930i Communications Test Set

Operating Manual

9100-2930-02 Rev. 3.00 71098

Table of Contents

Contents ***Page***

Contents *Page*

Contents ***Page***

Contents **Page**

Contents ***Page***

Contents **Page**

Contents ***Page***

SECTION I

GENERAL INFORMATION

1-1 INTRODUCTION

The Sage **930i** communications test set is designed to perform voiceband tests on analogue and digital trunks, as well as cellular test lines.

This manual is divided into seven sections: **Section I** provides general reference information on the **930i**; **Section II** describes preparations for operation; **Section III** describes the operation of the front panel, including the main test functions; **Section IV** describes the operation of the PCM functions; **Section V** describes the Option Menu functions; **Section VI** describes remote control operation; and **Section VII** lists the specifications for the **930i**.

1-1.1 Contacting Sage Instruments

To contact Sage Instruments in writing, send correspondence to:

Sage Instruments, Inc.
240 Airport Blvd.
Freedom, CA 95019-2614

or send email to:

sales@sageinst.com or support@sageinst.com

or fax inquiries to:

(831) 761-2452

To reach our Technical Support and Customer Service Departments by phone, call:

(831) 761-1000, M-F, 9 a.m. to 5 p.m., Pacific Time.

or fax our Technical Support and Customer Service Departments any time at:

(831) 761-9246

To receive company and product information via the World Wide Web, visit our home page at:

http://www.sageinst.com

Be sure to specify **Model 930i** when asking for technical support. Customers located outside of the U.S. may also contact their nearest Sage distributor for assistance.

1-2 INITIAL INSPECTION

Check the shipping carton for any visible signs of damage. Carefully unpack and remove the **930i** from the shipping container. If the **930i** is received in damaged condition, file a claim with the carrier and mail a copy of the claim to Sage Instruments.

The following items should be included in the shipping container:

- **930i** Communications Test Set.
- **930i** Operating Manual.
- **AC** power cord. (if AC system has been purchased.)

Accessories may be shipped separately from the **930i**, depending on their size. Check the shipping invoice against the contents of the received boxes.

1-3 TYPOGRAPHICAL CONVENTIONS

In this manual, text appearing in **bold COURIER** typeface denotes information appearing on the **930i** display panel.

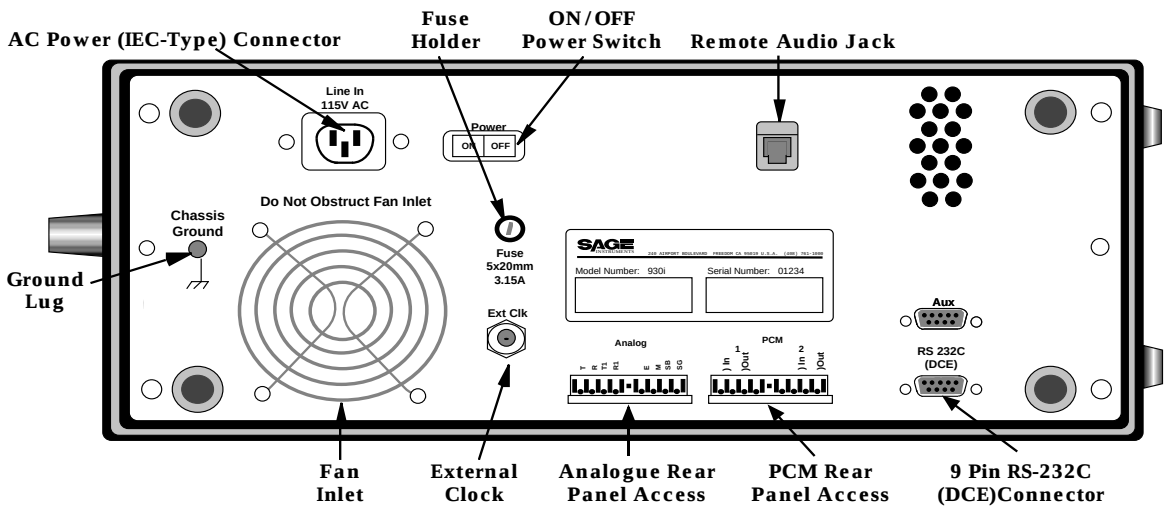
SECTION II

PREPARING FOR OPERATION/POWER-UP

2-1 AC POWER VERSION

The table shown below describes the components of the **930i** (AC power version) rear panel.

Table 2-1 Rear Panel (AC Power Supply)

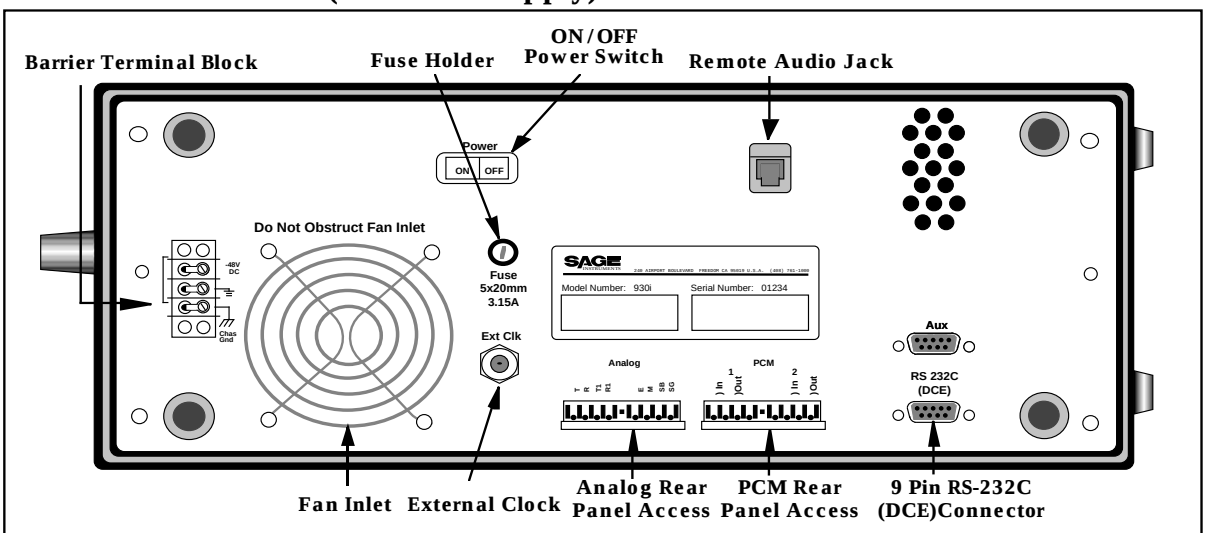


Ground Lug	Grounds the **930i** chassis.
Fan Inlet	Provides ventilation to the **930i**. **Do not** obscure fan inlet.(or outlet holes at the top right).
RS-232C Connector	Enables connection to Data Terminal Equipment (DTE).
AC Power Connector	Connects the **930i** to a 115VAC power supply (depending on power supply type purchased) via an IEC type connector.
ON/OFF Power Switch	Turns the **930i** on and off.
Fuse Holder	Holds a 2-amp Slo-Blo fuse. Turn 1/4 turn counterclockwise to open.
Analogue Rear Panel Access	Enables connection to a Jack Field from the rear panel.
PCM Rear Panel Access	Enables connection to a Jack Field from the rear panel .
Remote Audio Jack	Enables remote audio connection to a trunk under test via a separate dial-up line. (Requires Purchased Option 930i-47, Remote Audio Monitor)
External Clock	The BNC jack enables the **930i** to connect to an external clock source via a coaxial cable.

2-2 DC POWER VERSION

The table shown below describes the components of the **930i** (DC power version) rear panel.

Table 2-2 Rear Panel (DC Power Supply)



Barrier Terminal Block	Connects **930i** to a -48V DC power supply
Fan Inlet	Provides ventilation to the **930i**. Do not obscure fan inlet (or outlet holes at the top right).
RS-232C Connector	Enables connection to Data Terminal Equipment (DTE).
ON/OFF Power Switch	Turns the **930i** on and off.
Fuse Holder	Holds a 2-amp Slo-Blo fuse. Turn 1/4 turn counterclockwise to open.
Analogue Rear Panel Access	Enables connection to a Jack Field from the rear panel.
PCM Rear Panel Access	Enables connection to a Jack Field from the rear panel.
Remote Audio Jack	Enables remote audio connection to a trunk under test via a separate dial-up line.
External Clock	The BNC jack enables the **930i** to connect to an external clock source via a coaxial cable.

2-3 SUPPLYING POWER AC/DC

1. **AC version** (if your back panel looks like the one on the previous page)
   Connect the **930i** to a **115/220 V AC** power source via a **3-prong power cord.** The power connector is located next to the **red ON/OFF rocker switch** at the rear of the **930i**.

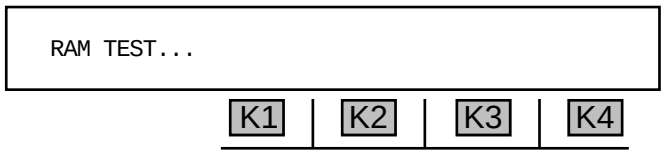
Warning! If the rear panel of your **AC unit does not** look like the one on the previous page, you could seriously damage your unit if you do not connect it to the proper power source. Older units, which have a different rear panel and power supply, **do not** automatically switch between **115 V AC** and **220 V AC** operation but are equipped to operate only at a single voltage. You must check your unit's power requirements before plugging it in and turning it on.

In addition, older units have a different rear panel configuration. If you are unsure of your unit's power requirements, contact the Sage Customer Service Department for assistance.

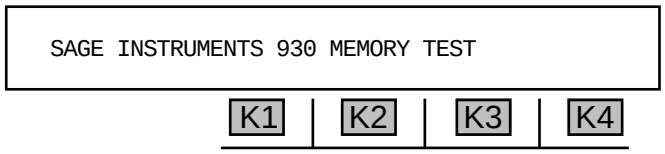
DC version

Connect the **930i** to a **-48 V DC** power source via 16 gauge wire. The wires connect at the two phillips head screws on the barrier terminal block.

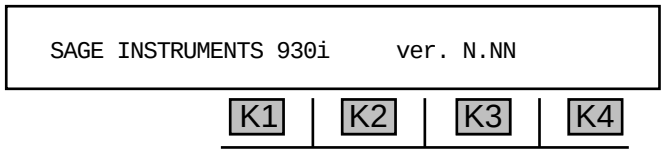
2. Toggle the red **ON/OFF rocker switch** at the rear of the **930i** to **ON**. The **930i** will run through a ram test:



After a moment the display will change to read:



If the memory check is successful the message: **MEMORY TEST** will change to **MEMORY OK!** If the memory test is successful, the display will change to read:



N.NN is the version of software installed in the unit. Note the status of the LEDs on the front panel. If an error has been detected, all of the LEDs will be lit. Turn the **930i** off and perform a cold boot.

After a brief pause, the **930i** will then advance to the last **Trunk Type** setup displayed when the unit was last powered-up.

To ensure optimal performance, do not store the **930i** adjacent to other equipment that produced a lot of heat, dust, static, ozone, sparks, or strong magnetic fields.

2-4 COLD BOOTING

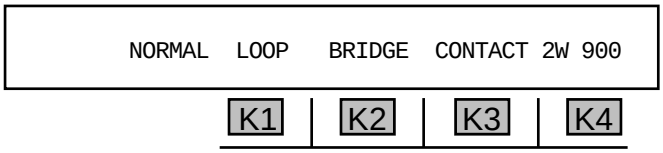
You can perform either a hardware or a software cold boot. A **hardware cold boot** clears all memory registers and resets the **930i** to its default parameters. A **software cold boot** retains all serial I/O settings but resets everything else to the factory default parameters. The procedure for performing a hardware cold boot is described below.

The software cold-boot function has been added for the convenience of persons writing remote control software, and can be performed by using **OPTION MENU #: 92 RESET 930**. (Refer to **Section 5-92, OPTION MENU #: 92 RESET 930** for a complete description of this function) This function also describes the procedure for performing a **warm boot** from the **Option Menu**, which is the equivalent of turning the **930i** off and on.

2-4.1 Hardware Cold-Boot

To perform a hardware cold-boot:

1. Turn the **930i** off.
2. Hold down the **Trunk Type** function key located on the left side of the front panel.
3. Turn the **930i** on. Do not release the **Trunk Type** function key until the display has scrolled all the way across the screen. The display reads:



A successful cold boot will return the **930i** to its default settings and erase all stored items.

2-5 VENTILATION

The **930i** is cooled by air drawn into the fan inlet on the lower left-hand side of the rear panel and expelled through the ventilation holes at the top right-hand corner.

To insure proper ventilation:

1. Check that the vents are not obstructed during operation.
2. Do not place the **930i** rear-panel-down on thick carpeting during operation.
3. Make sure that the operating environment is free of dust.
4. Inspect the vents periodically for dust buildup.

2-6 INTERIOR ACCESS

Access to the interior of the **930i** is obtained by removing the four phillips head screws (two on each side of the unit) that hold the top cover in place, and then lifting off the top panel. **DO NOT** attempt to gain access by removing the rear panel.

Since the **930i** contains no user serviceable parts, interior access is not normally necessary unless you are performing a factory authorized field upgrade.

2-7 SERIAL NUMBER

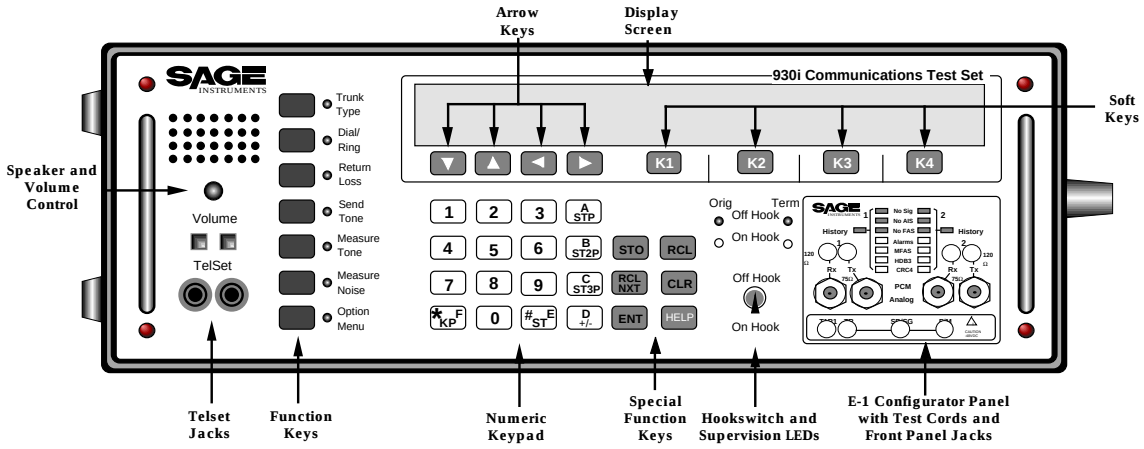
The product serial and model numbers are located on a serial tag on the rear panel.

SECTION III

FRONT PANEL OPERATION

This section provides information regarding operation of the front panel keys, configurator panels, switches and test cord connections. The table below provides an overview of each of the front panel functions.

Table 3-1 Front Panel Configuration



Speaker and Volume Control		Controls speaker volume.
Telset Jacks		Allows for an external telephone monitor. The "cufflinks" are for use with a telephone lineman's test set (external butt-in set) 48 V battery is supplied in Dial/Ring. The telset is 4-wire.
Function Keys		The 7 black keys control the main test functions of the **930i**. (see **Section 3-7** for a description of each function)
Numeric Keypad		The 16 white keys operate like a telephone keypad. They allow you to enter numerical data. Any leading blanks are treated as zeroes. The sign of a number can be changed by pressing the D+/- key.
Special Function Keys	**STO Key**	Allows you to store data that has been input using the softkeys or numeric keypad. (see **Section 3-6.1**)
	RCL Key	Allows you to recall a test setup or other parameters that have been stored in memory. (see **Section 3-6.2**)
	RCL NXT Key	Advances to the storage location following the last location recalled. (see **Section 3-6.3**)
	ENT Key	Allows you to enter information once numeric data has been selected. (see **Section 3-6.4**)
	CLR Key	Clears or initializes sequences allowing new entries to be made. **DOES NOT** clear to zero. (see **Section 3-6.5**)
	HELP Key	Displays a series of screens leading you step-by-step through the function selected. (see **Section 3-6.6**)
Hookswitch and Supervision LEDs		The chrome switch allows you to toggle on/off hook.The LEDs show the status at the originate (ORIG) and terminate (TERM) ends.
Test Cords and Front Panel Jacks		The jacks are used with the following configurations: **TR** -used on 2-wire loop start, ground start, or reverse battery trunks **TR&T1R1**-used on 4 wire trunks **E/M**-used on E&M types I-V **SB/SG**-used on signal battery/signal ground leads for E&M type II-IV **PCM IN 1/PCM OUT 1**-used on single direction EI carrier circuits **PCM IN 2/PCM OUT 2**-used in dual direction monitor or drop and insert
Configurator Panels		Contains optional interface jacks and/or LED status lights depending on whether analog or PCM functions have been purchased. (see **Section 3-8**)
Soft Keys		The four keys labelled **K1-K4** allow you to select from menu items that appear above each key on the display panel.
Arrow Keys		Allow you to scroll through items listed on the display panel.

3-1 SPECIAL FUNCTION KEYS

The **Special Function** keys are the six light gray keys located to the right of the **numeric keypad.**

Special Function Keys

3-1.1 STO Key

The **STO** key is used to store a particular test setup, outpulse sequence, digit string, or any **Option Menu** setup. Note that this function does not store current measurement results.

To store a setup:

1. Press the **STO** key. The display reads:

```
STORE TEST#      NNN   [999 TO ESC]
```

K1 | K2 | K3 | K4

2. Use the **numeric keypad** to enter the number corresponding to the register location desired. **NNN** in the display above is the number of the storage location. This may be any number between **1** and **998**.

3. Press the **ENT** key. The **930i** automatically increments the storage location after each entry.

The **930i** will retain what has been stored in its memory until the lithium battery on its CPU runs down, you overwrite that memory location, or you perform a cold-boot.

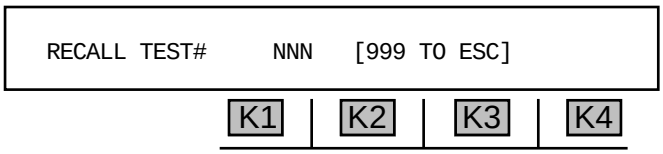
Storing something new in a memory location automatically replaces the previous contents. A general description of the stored parameters for various test situations follows:

In **Trunk Type**:	All of the Trunk Type parameters are saved exactly as they appear on the display.
In **Dial/Ring**:	The digit records and the protocol setup.
In **Return Loss**:	All of the displayed parameters, including signal type, echo-suppress tone, and transhybrid loss are saved.
In **Send Tone**:	The level, frequency, and Tone On/Tone Off are saved.
In **Measure Tone**:	The relative zero level is saved.
In **Measure Noise**:	The filter type, NTG or BAL setting, and relative zero are saved.
In **Option Menu:**	Use the **STO** key to save all parameters specified within that option.

3-1.2 RCL Key

To recall a test setup or other parameters which have been stored in a particular register:

1. Press the **RCL** key. The display reads:



2. Use the **numeric keypad** to input the storage location number (between **0** and **998**) of the desired test setup.

3. Press **ENT** or any softkey (**K1-K4**) to recall the setup stored in that location.

3-1.3 RCL NXT Key

To display the setup in the storage location following the currently displayed location:

1. Hold down the **RCL NXT** key. While you hold the key, the register location is displayed.

2. Release the key to display the stored information.

Each time **RCL NXT** is selected, the storage location increments by one. If a storage location has no information, the display reads: **`LOCATION [NN] IS EMPTY`**.

3-1.4 ENT Key

To accept data entered into the **930i:**

1. Enter the data using the **numeric keypad** **OR** make a selection from the display using the softkeys. Your entry options will vary depending on the function.

2. Press the **ENT** key. In some cases, you cannot advance to the next operation until you have completed your data entry and pressed the **ENT** key.

If the **930i** is in **`PRINTER`** Remote mode or **`COMPUTER`** Remote mode with the proper connections to a printer, pressing **ENT** will print out the current display with the time and date stamp.

3-1.5 CLR Key

The **CLR** key is used to clear or initialize sequences and allow new entries to be made. It is not used to clear a numeric value to zero. This is done by entering a zero. Press the **CLR** key to clear sequences of variable length, and to clear the **history LED** on the **E1 configurator**.

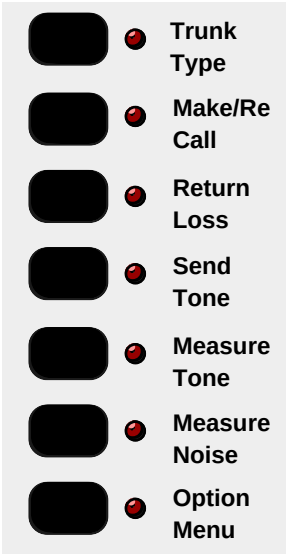
3-1.6 HELP Key

Pressing the **HELP** key allows you to view and set each step in a procedure separately and systematically. Selecting a parameter is done by pressing the softkey (**K1-K4**) directly under the desired value appearing in the display. A cursor will appear above your selection.

Note: HELP is not available for all menus. It is most useful in navigating the remote control option.

3-2 MAIN FUNCTION KEYS

This section provides information on the operation of each function key, located on the left of the front panel. (For information on the **Option Menu** function key, refer to **Section 5, Option Menu Numbers**.)



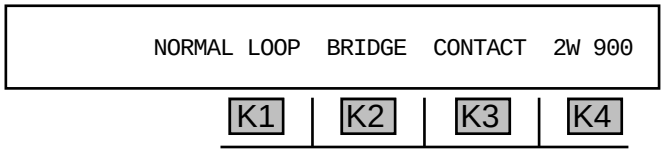
Main Function Keys

3-2.1 Trunk Type Function Key

The **Trunk Type** function key is used to select and set up a trunk type. This procedure should be done before accessing any other function, and before performing any test or measurement.

To select a **trunk type**:

1. Press the **Trunk Type** function key. When power is first applied to the **930i** it will default to the last-used configuration. The factory default display is shown below:



2. Use the **Up/Down Arrow** keys or **K1** to scroll through the available trunk types:

```
NORMAL LOOP
REVERSE LOOP
NORMAL GND-ST
REVERSE GND-ST
E&M (Types) I-V
(OPTIONAL TYPES) PCM SF WIDEBAND
```

For information on using the **PCM trunk type** , refer to **Section 4, PCM Operation**. **SF** and **Wideband** are not currently available.

3-2.1.1 Setup for Analogue Trunk Types

To set up an **analogue** trunk type:

1. Press **K4** to select **`2W 135-1200 Ohm`** or **`4W 135-1200 Ohm`** impedance.

Note: If ***Purchased Option 930i-70, Complex Impedance*** is installed in your unit, additional impedance types will be available under 2W trunk type. Complex impedance is identified by its nominal impedance at 1000Hz, and replaces the standard 135 Ohms impedance. Since there is a different value complex termination for every country, a hardware modification ismade to the unit in production. (Currently, only the **Russian** and **BABT** complex impedances are available.

Return Loss measurements can be made on a 2W circuit when a complex impedance has been selected. (The return loss function is not available with standard impedance types.) Refer to **Section 3-2.3** For more information on performing 2W return loss measurements.

2. Press **K3** to toggle between **BATTERY** or **CONTACT** if you selected a **LOOP** or **GND-ST** trunk type, **OR** between **SEND-E** or **SEND-M** if you selected an **E&M** trunk type. In **4W**, this affects the **TLP** settings. Refer to **Section 5-30, OPTION MENU # 30 SET TLP**.

3. Press **K2** to toggle between **BRIDGE** or **TERM** (terminate) mode.

Changing trunk types or from **2W** to **4W** operation automatically places the **930i** in **BRIDGE** mode. In this mode, the **930i** does not send anything. The supervision lamp marked **Orig** shows the end of the circuit which the **930i** would emulate if it were in **TERM** mode.

3-2.1.2 Setup for SF (Single Frequency) Supervision

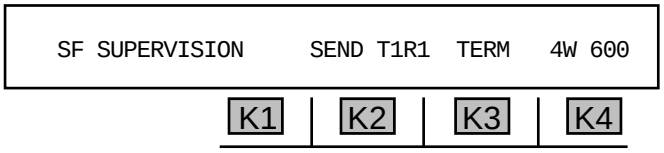
SF is inherently a 4-wire trunk type and is now mainly used on special service trunks in the U.S. It has been largely displaced in the network by digital *CCIS and SS-7 signalling types.*

To setup **SF supervision**:

1. Press the **Trunk Type** function key.

2. Press **K1** or use the **Up/Down Arrow** keys to scroll to the **OPTIONAL TYPES** display.

3. Press **K3** under **SF** to enter the **SF SUPERVISION** trunk type.



4. Press **K2** allows you to send on Tip/Ring (**SEND TR**) or Tip1/Ring1 (**SEND T1R1**).

5. Press **K4** to select the impedance (**2W 135-1200 Ohm** or **4W 135-1200 Ohm**). The **930i** presently does not support 2-wire **SF** systems which use 2 tones (2404 and 2604 Hz, for example), nor can it be used to provide **SF SUPERVISION** in **PCM**.

6. Press **K3** to toggle between **BRIDGE** and **TERM** operation.

7. Place the front panel **hookswitch** in the **Off Hook** position.

3-2.2 Dial/Ring Function Key

The **Dial/Ring** function can be used tor make and receive calls if you are in a **teminate mode**. In monitor mode, it allows you to non-intrusively monitor calls.

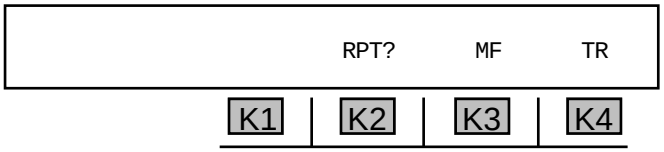
All calls can be analyzed under **Option Menu #4 Digit Receiver (Analogue Only)** or **Option Menu #4 Call Analyzer(PCM Only)**.

To make/ receive a call, or to monitor a phone line:

1. Connect the **930i** to the trunk on which you will make the call, or the line to be monitored.
2. Connect the **lineman's butt in set** to the **TelSet** jacks on the **930i** front panel.
3. Set up a trunk under the **Trunk Type** function key. Refer to **Section 3-2.1**.
4. Place the front panel **hookswitch** in the **On Hook** position.
5. Press the **Dial/Ring** function key. The next display will differ depending on whether you selected an **Analogue** or **PCM** trunk type under the **Trunk Type** function key. If you are in **Analogue**, proceed to **Section 3-2.2.1**. If you are in **PCM**, go to **Section 3-2.2.2**.

3-2.2.1 Dial/Ring in Analogue Mode

In **Analogue** mode, a display similar to the following appears when you press **the Dial/Ring function key**:



1. Use the **numeric keypad** to enter the digits to be dialed. The **Left Arrow** key is used to insert a one second pause into a digit sequence and appears on the display as a "**-**" between digits.
2. Press **K3** repeatedly to scroll through the outpulsing modes. The available modes are:

- **MF** (multi-frequency).*****
- **DTMF** (dual tone multifrequency).†
- **DP** (dial pulse). This mode is valid only in **CONTACT** mode or **PCM**; it is not available when simulating a Central Office (supplying battery).
- **RING** This mode is valid only when supplying **BATTERY** or in **PCM** ring types.
- **R2** This mode is available only if you selected **R2** under **PCM** in the **Trunk Type** function.

1209 Hz	1336 Hz	1477 Hz	1633 Hz	
1	ABC 2	DEF 3	A STP	697 Hz
GHI 4	JKL 5	MNO 6	B ST2P	770Hz
PRS 7	TUV 8	WXY 9	C ST3P	852 Hz
*	Oper 0	#	D	941 Hz

†DTMF Tone Pairs

1100 Hz	1100 Hz	1300 Hz	1500 Hz	1700 Hz	
1	2	4	7	ST3P	700 Hz
	3	5	8	STP	900Hz
		6	9	KP	1100 Hz
			0	ST2P	1300 Hz
				ST	1500 Hz

***MF tone pairs**

Changing the mode clears all digit sequences and resets all parameters to their default values.

3. Toggle the **hookswitch** to the **Off Hook** position. If you go off-hook before entering the digits to be dialed, the digits are outpulsed as you dial.

4. Press **K2** under **RPT?** to have the **930i** send the digits. The display changes to: **RPT!**

When sending **MF** digits, first enter a **KP** (key pulse), enter the numbers, and end with an **ST** (stop pulse). *For example, an MF digit string could be **KP004155551212ST**.*

5. Press **K1** under **MANUAL** to send if you are in **RING** mode. Ringing will continue as long as you press the button.

   K4 is inactive. Here, the **930i** indicates which leads are used for outpulsing: (**TR, T1R1, SEND-E, SEND-M, SEND AB, PCM 1** or **PCM 2**).

6. Use the **CLR** key to clear the display.

3-2.2.1.1 Storing and Recalling Phone Numbers in Dial/Ring

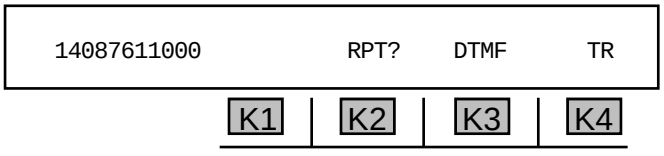
To store frequently used phone numbers for future recall and outpulsing, you must press the **STO** key to save the currently displayed digit sequence, its outpulsing mode (**MF**, **DTMF**, **DP**), and any modifications which may have been made. The parameters may be stored in any of the 998 register locations (numbered from **1** to **998**). Refer to **Section 5-2, OPTION MENU #: 2 SEND DIGIT SEQUENCES.**

for example:

To **store a digit sequence** in register location **17**:

1. Press the **Dial Ring** function key.

2. Use the **numeric keypad** to input a dial sequence (e.g., 14087611000). The display reads:



3. Press the **STO** key.

4. Select **17** using the **numeric keypad** and press **ENT**.

To **recall the digit sequence**:

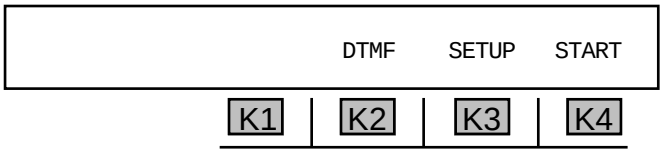
1. Press the **RCL** key.

2. Select **17** using the **numeric keypad** and press **ENT**.

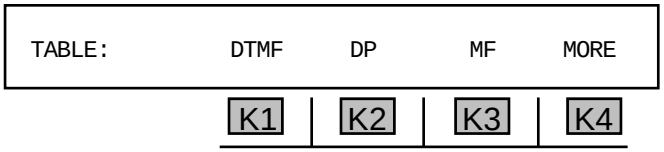
For **IDDD** applications in which a **CCITT No. 5 MF** sequence is being outpulsed, the required **KP2** pulse is equivalent to the **ST2P** pulse located on the **B ST2P** key on the **numeric keypad**. Such an **IDDD MF** sequence would appear as **ST2P11071738945ST**.

3-2.2.2 Dial/Ring in PCM Mode

In **PCM** mode, the following display appears when you press the **Dial/Ring** function key:



1. Press **K2** under **DTMF** to select your digit type. The display reads:



2. Press **K1** to select **MF** digits, **K2** for **DTMF** digits, or **K3** for **R2 FORWARD** digits. By pressing **K4** under more, you will advance to another display where you can select between **R2 BACKWARD** digits or **DP** digits. After making your selection, you will return to the dialling display.

3. Use the **Numeric Keypad** to enter your dialling digits.

Note: Although you can press **K4** under **START** after entering the digits to be dialed and immediately start sending and receiving digits, you should first select and set up a protocol and set up a span by pressing **K3** under **SETUP**. If you will be monitoring a call, you will only be required to select and set up a protocol.

3-2.2.2.1 Setting up a Call/Selecting a Protocol

The **930i** user interface has been designed to allow customers to download their own protocols to the **930i,** as well as use the pre-installed protocols.

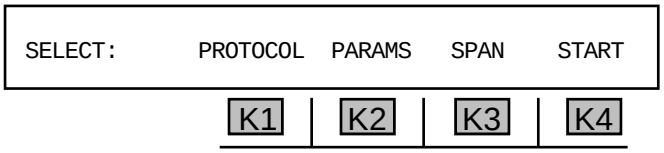
A protocol is an algorithm or set of cooperating algorithms capable of making, receiving, or monitoring the setup of a telephone call on a particular type of telephone trunk connected to the **930i**. The **930i** has been shipped with a limited number of pre-installed protocols which can be selected and set up under the **Dial/Ring** function key. (Refer to **Section 3-2.1.**)

In addition to these pre-installed protocols, custom-designed protocols can be added for almost any conceivable combination or permutation of protocol requirements. This flexability is indispensable in a global market where telephone systems and protocols differ from country to country or even from region to region within a country.

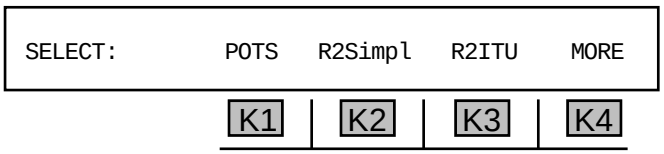
From the **930i** user's standpoint, the unit is easy to use, where calls are made or monitored through the **Dial/Ring** function key and protocols are selected and set up from there using the setup menu.

Before making or receiving a call:

1. Press the **K3** under **SETUP** from the main display. The new display reads:



2. Press **K1** under **PROTOCOL**. The display will look similar to the following:



The **930i** is shipped with several pre-installed protocols:

POTS

POTS Allows you to make a standard call on a **POTS** trunk. MF, DTMF and DP digits can be selected.

Parameter	Default	Description
N DIGITS	0	The **930i** will automatically answer after N Digits have been received. If N=0, the user must go off hook to manually answer or wait for the Digit Timout.
DIGIT TIMOUT	5000 ms	If N Digits have not been received, the unit will answer after this amount of time has elapsed.
HANGUP DELAY	1000 ms	When the unit at the user end hangs up, the near end will wait for this amount of time before going on hook.
ABORT TIME	100 ms	After a call has fbeen aborted by going on hook, the unit will wait this amount of time before sending an on hook signal.

POTS (cont...)

Parameter	Default	Description
MIN SEIZURE	100 ms	Any seizure signal that has a shorter duration than this will be ignored.
MIN ANSWER	100 ms	Any answer signal that has a shorter duration than this will be ignored.
MIN CLEAR	100 ms	Any clear signal that has a shorter duration than this will be ignored.
MAX CLEAR	500 ms	The maximum amount of time that the unit will wait before clearing a call.

R2 Simple

R2 Simple allows you to make an R2 call using generic setup parameters (e.g., tail, and script).

Parameter	Default	Description
TAIL	2	Additional digits appended to the end of the forward digits. (i.e., origin request)
BACK DIGITS	11131	Backward digits that tell the forward end which type of forward digits to send.
N DIGITS	0	The number of destination digits that will be expected at the answering end before pausing and then sending a pulsed backward digit (if applicable)
DIGIT TIMOUT	5000 ms	If N Digits have not been received, the unit will answer after this amount of time has elapsed.
PULSE DELAY	3000 ms	The delay between the receipt of the last forward digit at the answering end and the time that the answering end sends a pulsed backwards digit.
PULSE DURATION	150 ms	The length of the pulsed backward digit sent from the answering end.
SZ ACK DELAY	100 ms	After the line is seized, thebackward end waits for this amount of time before sending a Seizure Acknowledgement.
ANSWER DELAY	1000 ms	After the last digit was received, the backward unit will wait this amount of time before answering.
HANGUP DELAY	1000 ms	When the unit at the other end hangs up, the near end will wait this amount of time before going on hook.
ABORT TIME	100 ms	After a call fails, the unit will wait this amount of time before aborting.
MIN SEIZURE	100 ms	Any seizure signal that has a shorter duration than this will be ignored.
MIN ACKNOWLEDGE	100 ms	Any seizure acknowledgement signal that has a shorter duration than this will be ignored.
MIN ANSWER	100 ms	Any answer signal that has a shorter duration than this will be ignored.

R2 Simple (cont...)

Parameter	Default	Description
MIN CLEARFORWARD	100 ms	At the forward end, any clear signal that has a shorter duration than this will be ignored.
MAX CLEARFORWARD	3000 ms	After call completion, this is the maximum amount of time the forward end unit will wait before clearing.
MIN CLEARBACKWARD	100 ms	At the backward end, any clear signal that has a shorter duration than this will be ignored.
MIN IDLE	100 ms	After call completion, this is the minimum amount of time that the unit will remain idle before it can initiate or receive calls.
MIN BLOCK	500 ms	The interval during which the line will be blocked to incoming calls.

R2ITU

R2ITU allows you to make multi-frequency compelled **R2** calls. This is a signalling method where, after a signal has been sent from the **930i** at the originating end, the **930i** at the terminating end must send a signal back acknowledging the receipt of the forward digits before another signal can be sent in the forward direction.

Parameter	Default	Description
ORIGIN	7611000	The phone number of the calling party.
CATEGORY	1	The country dependent code. Always a single digit.
BACK DIGITS	11131	The backward digits that tell the forward end which type of forward digits to send.
N DIGITS	0	The number of destination digits that will be expected at the answering end before pausing and then sending a pulsed backward digit (if applicable)
DIGIT TIMOUT	15000 ms	If N Digits have not been received, the unit will answer after this amount of time has elapsed.
PULSE DELAY	3000 ms	The delay between the receipt of the last forward digit at the answering end and the time that the answering end sends a pulsed backwards digit.
PULSE DURATION	300 ms	The length of the pulsed backward digit sent from the answering end.
SZ ACK DELAY	100 ms	After the line is seized, the backward end waits for this amount of time before sending a Seizure Acknowledgement.
ANSWER DELAY	100 ms	After the last digit was received, the backward unit will wait this amount of time before answering.
HANGUP DELAY	1000 ms	When the unit at the other end hangs up, the near end will wait this amount of time before going on hook.
ABORT TIME	100 ms	After a call fails, the unit will wait this amount of time before aborting.
MIN SEIZURE	20 ms	Any seizure signal that has a shorter duration than this will be ignored.
MIN ACKNOWLEDGE	100 ms	Any seizure acknowledgement signal that has a shorter duration than this will be ignored.

R2 CCITT (cont...)

Parameter	Default	Description
MIN ANSWER	100 ms	Any answer signal that has a shorter duration than this will be ignored.
MIN CLEARFORWARD	100 ms	At the forward end, any clear signal that has a shorter duration than this will be ignored.
MAX CLEARFORWARD	3000 ms	After call completion, this is the maximum amount of time the forward end unit will wait before clearing.
MIN CLEARBACKWARD	100 ms	At the backward end, any clear signal that has a shorter duration than this will be ignored.
MIN IDLE	100 ms	After call completion, this is the minimum amount of time that the unit will remain idle before it can initiate or receive calls.
MIN BLOCK	500 ms	The interval during which the line will be blocked to incoming calls.

Digit	Description
Backwards 1	Sends the next digit or waits for a pulsed backward digit.
Backwards 2	Repeats the next to last destination digit.
Backwards 3	Send a category digit then expect s a group B digit.
Backwards 4	Signals congestion, stops more digits from being sent, and aborts call.
Backwards 5	1st instance: sends a category digit. Subsequent instances: sends con nect origin digit.
Backwards 6	End. Conect call.
Backwards 7	Send the last digit sent minus 2.
Backwards 8	Send the last digit sent minus 3.
Backwards 9-14	Abort errors.
Backwards 15	Congestion. Abort call.

R1

R1 is like POTS except:

- The backwards end sends a dial delay pulse before sending digits.
- The unit sends a KP at the beginning of a digit string and a ST at the end.

Parameter	Default	Description
N DIGITS	0	The number of destination digits that will be expected at the answering end.
DIGIT TIMOUT	3000 ms	If N Digits have not been received, the unit will answer after this amount of time has elapsed.
HANGUP DELAY	100 ms	When the unit at the other end hangs up, the near end will wait for the duration of the specified hangup delay before going on hook.
ABORT TIME	100 ms	After a call has failed, the unit will wait this amount of time before aborting the call.
MIN SEIZURE	100 ms	Any seizure signal that has a shorter duration than this will be ignored.
DELAY DIAL	200 ms	The receiving end tells the sending unit to wait this amount of time before dialling.
MIN DELAY DIAL	140 ms	Any delay dial signal that has a shorter duration than this will be ignored.
MAX DELAY DIAL	5000 ms	At the receive end, this is the maximum duration of the delay dial signal. If the delay dial signal is longer than this, the call will be aborted.
MIN ANSWER	100 ms	Any answer signal that has a shorter duration than this will be ignored.
MIN CLEAR	100 ms	Any clear signal that has a shorter duration than this will be ignored.
MAX CLEAR	300 ms	The maximum amount of time that the unit will wait before clearing a call.
MIN IDLE	100 ms	After call completion, this is the minimum amount of time the unit remains idle before it can initiate or receive calls.

In addition, other custom-made protocols may be available on your unit. Refer to **Section 3-1**.

3. Press the softkey (**K1-K3**) under the desired protocol, or press **K4** for additional protocols. After making your selection, you will be returned to the previous display.

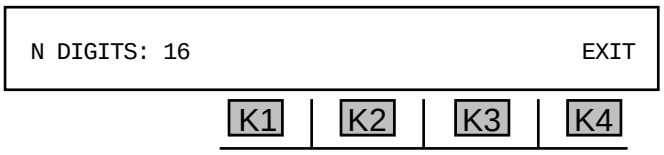
3-2.2.2.2 Setting up Protocol Parameters

To set up the protocol parameters:

1. Press **K2** under **PARAMS.** You will advance to the first of a series of screens that allow you to set up the parameters for the selected protocol. These screens will vary, depending on the protocol selected.

   for example:

   The display below shows the first set up parameter that would appear if you selected the **POTS** protocol:



   You can use the **numeric keypad** to enter a new number of digits to be dialed and then press the **Up Arrow** key to advance to the next setup parameter.

2. Use the **numeric keypad** to enter a new parameter.

3. After selecting each parameter, use the **Up/Down Arrow** keys to advance to the next parameters to be modified.

4. Press **K4** under **EXIT**. You will be returned to the **SELECT** display.

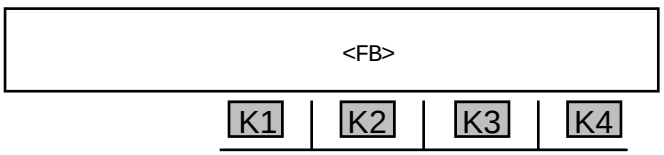
5. Press **K4** under **START** to begin sending or receiving digits.

3-2.2.2.3 Making a Call

To make a call:

1. At the **930i** originating the call, select and set up a a protocol, and enter a phone number. Refer to **Section 3-2.2.1**

2. Enter the main dialing menu:



   If you entered phone numbers into any of the 5 storage registers (refer to **Section 3-2.2.1**) the phone number in the last register entered now appears to the left of the **<FB>** label.

Note: **<F** refers to **forward digits**. These are the digits that are sent from the **originating end.** At the **originating end**, they appear to the left of the **<F** label when entered. They also appear to the left of the **<F** label at the **terminating end** when received.

B> refers to **backward digits**. These are the digits that are sent from the **terminating end** in response to forward digits received from the **originating end** when using an **R2 compelled signalling** or **call progress** protocol. At the **terminating end**, they appear to the right of the **<B** label when entered. They also appear to the left of the **<F** label at the **originating end** when received.

3. Use the **numeric keypad** to enter a new phone number or modify the number shown.

   You can go back and modify digits without reentering the whole phone number by using the **Left/ Right Arrow** keys. The cursor will appear over the selected digit and you can use the **numeric keypad** to change it.

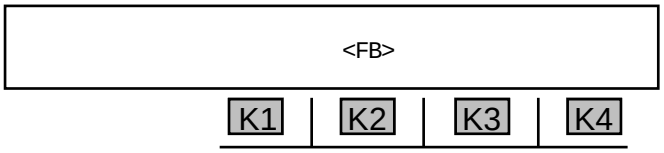
4. Toggle the **front panel hookswitch** to the **Off Hook** position. The call will be initiated.

3-2.2.2.4 Receiving a Call

To receive a call:

1. At the **930i** terminating the call, select and set up a a protocol. Refer to **Section 3-2.2.1.**

2. Enter the main dialing menu:



3. Wait for the originating end to initiate the call. Wnen the call is connected, the digits received will appear to the left of the **<F** label.

3-2.3 Return Loss Function Key

The **Return Loss** function is used to measure return loss on **4W** trunks.

To measure **return loss**:

1. Complete the initial trunk type setup.

2. Make sure the **930i** is off-hook on the contact end of a loop trunk.

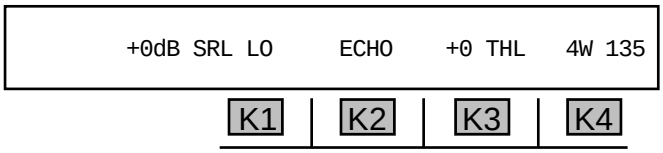
3. Press the **Return Loss** function key.

If you are in **2W** with a standard impedance selected, a display similar to the following appears:

No 2W RETURN LOSS AVAILABLE IN: 2W 600

If you are in **2W** with a **complex impedance** selected, a display similar to the following appears.

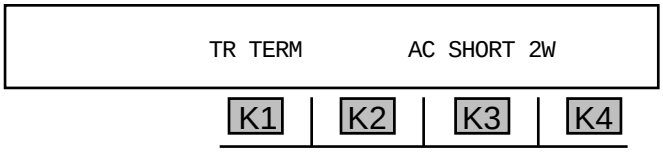
If you are in **4W**, a display similar to the following appears:



Entering the Return Loss function automatically sets the metallic trunk type to **TERM**. Check or change the **TERM/BRIDGE** setting under the **Trunk Type** function key. (Refer to **Section 3-7.1**.)

4. Press **K1** to cycle between **Echo Return Loss** (**ERL**), **Singing Return Loss Low** (**SRL-LO**), **Singing Return Loss High** (**SRL-HI**), and **Structural Return Loss** measurements. If you are in 2W with a complex impedance selected, **TR TERM** and **AC SHORT 2W** are also available.

   If you are in **2W**, the **TR TERM** display reads:



   Pressing **K3** allows you to cycle the termination between **AC SHORT 2W, 600+2uF 2W, 900+2uF 2W,** and **AC OPEN 2W**.

5. When measuring **structural return loss**, use the **numeric keypad** to enter the frequency of interest.

• A valid **tone** is between **20** and **5000 Hz**. The reading you get will not be valid unless echo suppressors/cancellers are disabled; these may be present on long distance circuits.

6. Press **K2** to toggle the echo canceller on and off.

7. Press the **Return Loss** function key to send the selected return loss signal, and receive and display measurements.

3-2.3.1 Transhybrid Loss Measurements

The amount of loss across a hybrid which may be on a **4W** circuit is used as a correction factor to the return loss measurement. The loss may be known from previous measurements (in which case it can simply be entered), or it may be measured by the **930i**. In either case, the **930i** will use this value to correct its return loss readings. Pressing **K3** allows you to measure and enter the **THL** (transhybrid loss) correction.

To measure **Trans hybrid loss**:

1. Connect the **930i** to the 4-wire side of the hybrid and set the trunk type to dry circuit.

2. Short the 2-wire side of the hybrid using a jumper cable. (If you cannot access the Hybrid, leave the **THL** at the default of **`0 dB`** in step 4.)

3. Press the **Return Loss** function key on the **930i**. Use **ERL** or **OSC** with a frequency of **1020 Hz**. This is mid-band for the measurement.

4. Press **K3** to measure the **THL.** The value will appear over **K3**.

5. Press **K3** again and the **930i** will prepare to set the measured value as the **THL** correction **OR** use the **numeric keypad** to enter the desired number when the cursor is flashing over the measured value.

If your return loss reading is unusually low, check the THL value entered to make sure you do not have a measured value entered as the THL.

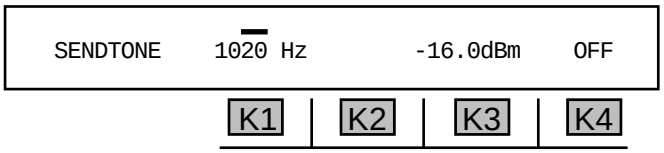
6. Press **K3** again and the measured value will be accepted. The display reads: **`MEAS THL`**.

3-2.4 Send Tone Function Key

To **send a tone**:

1. Press the **Send Tone** function key.

   The display reads:



2. Press **K1** to change the frequency, **OR K3** to change the level.

3. Use the **numeric keypad** to enter the desired frequency or level and press **ENT**.

   - A valid **frequency** is between **`20 Hz`** and **`5000 Hz`**.
   - A valid **level** is between **`-60.0 dBm`** and **`+12 dBm`**.

4. Press **K4** to toggle between tone **`ON`** and tone **`OFF`**. If the tone is **`ON`**, the display reads: **`TR`** (Tip/Ring), **`T1R1`** (Tip1/Ring1), **`PCM1`** or **`PCM2`,** depending upon the trunk type and direction. If **`OFF`** is selected, no tone is sent.

   When a tone is being sent with the **930i** performing a different function, the LED beside the **Send Tone** function key will flash to alert you to the fact that tone is being sent.

   If no tone is desired, return to the **Send Tone** function and press **K4** . The display reads: **`OFF`**.

The tone selected in **Send Tone** is not sent in the **Dial/Ring** or **Return Loss** functions.

The **hookswitch** must be in the **Off Hook** position to send tones in the contact end of loop and ground start trunks.

5. Use the **Left/Right Arrow** keys to move the cursor from digit to digit.

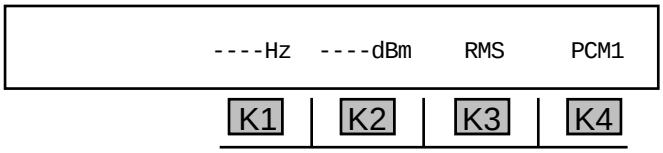
6. Use the **Up/Down Arrow** keys to increment or decrement the digit beneath the cursor, or use the **numeric keypad** to enter the new frequency or level directly.

Entering the **Send Tone** function automatically sets the trunk type to **TERM**. Check or change the **TERM/BRIDGE** setting under the **Trunk Type** function key. (Refer to **Section 3-7.1**.)

3-2.5 Measure Tone Function Key

To measure a **received tone**:

1. Press the **Measure Tone** function key. The display reads:



2. Press **K2** once to lock in the current measured value as the **0 dB** reference point. (Pressing **K2** again enables you to input a relative **0** using the **numeric keypad**.)

3. Press **K2** again to return the **930i** to **dBm** measurement. The **930i** displays measurements in **dBm** (absolute relative to 1 milliwatt), **dB** (relative to a measured 0), or **dBm0** (relative to a specified 0 or transmission level point).

4. Press **K3** to toggle between the **AVERAGE** and **RMS** detectors. **AVERAGE** is typically used when measuring tone only. Use **RMS** when measuring distorted tone or tone with noise.

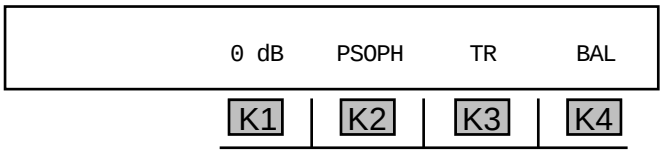
   K4 is inactive. The display above it shows the input from which the measurements are being taken, for example, **TR** (Tip/Ring), **T1R1** (Tip1/Ring1), and optionally, **PCM1** or **PCM2**, depending on which trunk type has been chosen.

Initially, the **930i** displays the measurement in **dBm** and always returns to **dBm** when cold booted. If the reading seems too high or low, make sure the reading is in dBm and not dB or dBm0. In **Loop** and **Ground Start Contact** modes, the position of the hookswitch will affect the AC Termination, and therefore, the measured level.

3-2.6 Measure Noise Function Key

To measure **Noise**:

1. Press the **Measure Noise** function key. The display reads:



2. Press **K2** to scroll through the weighting filters: **3K FLT** (3 kHz Flat), **PSOPHOMETRIC**, **P-NOTCH**, or **S/N** (Signal-to-Noise).

   K3 is inactive, displaying the input signal source (**TR, T1R1, PCM1,** or **PCM2**).

3. Press **K1** to scroll through and select a relative **dBm, dB** or **dBm0** reference point, or to enter a **TLP** correction factor.

4. If you selected a **dBm0** reference point, scroll through the reference points until a flashing cursor is displayed, and use the **numeric keypad** to enter the level.

   • A valid **reference point** is between **-999** and **+999 dB**.

5. **K4** toggles between **BAL** (balanced) or **N TO G** (Noise-to-Ground) measurements or analogue trunks. On **PCM** trunks, the displays shows the **CHANNEL**. **K4** is inactive on **PCM** trunks and during Signal-to-Noise measurements.

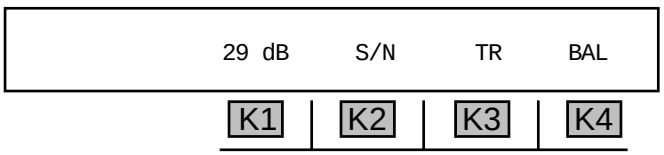
6. To measure noise other than **C-Notch**, use **Dial/Ring** mode to call the far-end Type-100 test line. This will place a quiet termination on the line.

To measure **Signal-to-Noise**:

1. Call the local milliwatt number to get a **1004 Hz** tone sent back. Alternately, contact someone at the other end of the circuit and have them send **1004 Hz** back.

2. Press the **Measure Noise** function key.

3. Press **K2** repeatedly to select **S/N**. The display reads:



If the holding tone is not present instead of the level, the display reads: **NO TONE**.

The **S/N** ratio measurement requires that a holding tone be present at the measuring end of the circuit.

On 2-wire trunks this usually means making an end-to-end measurement with one test set supplying **1020 Hz** from one end and the other test set measuring the **S/N** at the other end. On a 4-wire trunk, the far-end can be looped back. In this case the **930i** can generate a **1020 Hz** tone at the appropriate level and then measure the **S/N** ratio for the loop.

It is possible to set the relative zero for measurements in dB, using one weighting filter and then change to another filter. The display will then show the measurement in one filter relative to the other. This feature is particularly useful for measuring the quantization noise in **PCM**.

3-3 CONFIGURATOR PANEL

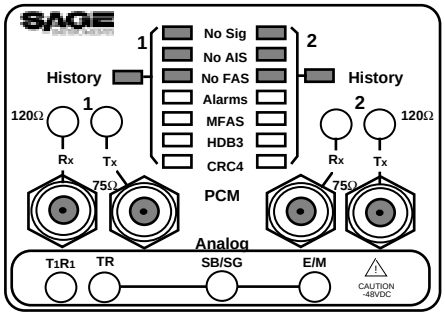


Figure 3-1
E1 Configurator Panel

The **E1 Configurator** is the standard configurator for **930i** units. LEDs indicate status and errors on the **E1** lines. These errors are: No signal, AIS, No FAS, Alarms, MFAS HDB3, and CRC4.

The 4 bantam jacks labelled 1 and 2 are the Tx (Transmit) and Rx (Receive) jacks for connection to PCM1 and PCM2 at 120 Ohms. The 4 BNC jacks are the corresponding jacks for connection at 75 Ohms via coaxial cables.

The four bantam jacks located at the bottom of the configurator are used for connection to metallic trunks. The analogue jacks are: TR (Tip/Ring), T1R1(Tip1/Ring1), SB/SG, and E/M.

3-3.1 TEST CORD CONNECTIONS

You can connect the **930i** to trunks under test in one of 2 ways: through test cords plugged in to the front panel jacks, or through wire wrap connectors attached at the **Analogue** and **PCM** rear panel access ports located at the back of the test set.

Test Cord Connections for a 2-Wire Loop Start Trunks

Connect a 2-wire loop start, ground start, or reverse battery trunk to the **930i** at the **Bantam jack** labeled **TR** (located on the bottom left of the configurator)

Test Cord Connections for 4-Wire Trunks

Connect a 4-wire trunk to the **930i** at the **Bantam jacks** labeled **TR** and **T1R1**. (located on the bottom left of the configurator)

If the trunk is an **E&M** trunk, the **E&M** test cord must be connected at the **Bantam jack** labeled **E/M** for **Type I**. (located on the bottom left of the configurator)

If **E&M Types II** through **IV** are being tested, the signal battery/signal ground leads must be connected at the **Bantam jack** labeled **SB/SG.** (located in the bottom center of the configurator)

Test Cord Connections for PCM Trunks

Connect an **E1** carrier circuit to the **930i** at the **PCM** jacks located on either side of the error LEDs. The **Bantam jacks** allow for connection at **120 Ohms,** and the **BNC** (a coaxial cable connector with a half-twist locking shell) at **75 Ohms**. The jacks are labeled **Rx** (receive) and **Tx** (transmit).

Use the **PCM1** jacks (located to the left of the error LEDs) for single-direction testing. For dual-direction drop and insert testing, use **PCM1** and **PCM2** (located to the left of the error LEDs).

SECTION IV

PCM OPERATION

This section of the manual describes the operation of the **930i** when set for **PCM** operation.

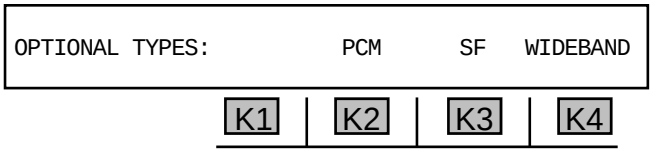
If ***Purchased Option 17, Remove 2W/4W Analogue Interface*** has been ordered, **PCM** is the only available trunk type.

The factory **E1 defaults** are:

Impedance:	**120/75 OHMS**
Line Coding:	**HDB3**
Framing:	**PCM30**
Line Signalling:	**NORMAL**

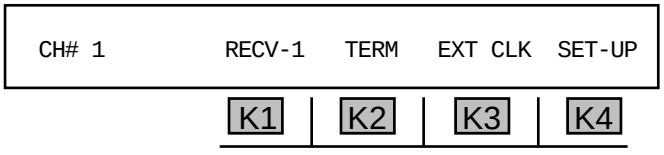
To select **E1 PCM** trunk type:

1. Press the **Trunk Type** function key.
2. Press **K1** or the **Up/Down Arrow** keys until you reach the **OPTIONAL TYPES** display:



SF and **wideband** are not currently available. If you press **K3** or **K4**, you will see one of the following messages: **SF NOT INSTALLED** or **WIDEBAND NOT INSTALLED.**

3. Press **K2** under **PCM**. The display below shows the factory default **PCM** display:



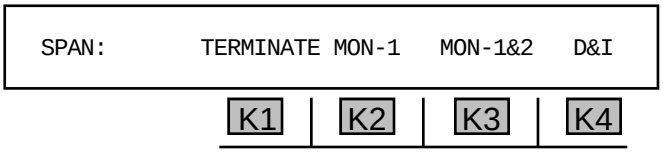
4-1 CHANNELS AND TEST DIRECTION

To change the **PCM** channel, use the **Up/Down Arrow** keys, or enter the number of the channel (1 to 30) from the **numeric keypad**. The **PCM** channel number to be tested is displayed on the far left of the display. The factory default is **CH# 1**.

4-1.1 Test Mode

To select the **span test mode**:

1. Press **K2** under **TERM**. from the main **PCM** display. The display advances to read:



2. Press the appropriate soft key (**K1-K4**) under the desired span type.

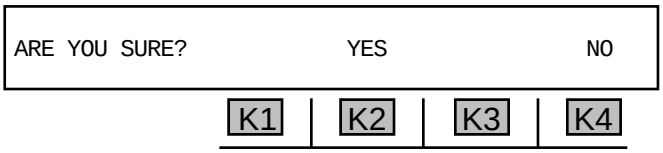
TERMINATE mode enables the **930i** to act as a channel bank or switch terminating one end of the span.

MON-1 is used for monitoring one direction of transmission.

MON-1&2 is used to monitor traffic in both directions simultaneously by activating both of the **930i's** receivers.

D&I mode, or Drop & Insert, is used on live spans between two switches or multiplexers, etc. One of the channels is dropped-out for testing while the rest pass through undisturbed.

If the **930i** is in **MON-1&2** or **D&I** mode and **TERMINATE** or **MON-1** mode is selected, the display reads:



3. Press **K4** under **NO** to return to the current mode **OR** press **K2** under **YES** to activate **MON-1**.

4-1.2 Test Direction

To select **test direction**:

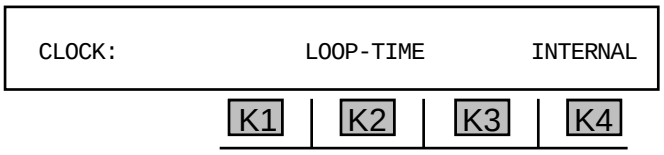
Press **K1** under **RECV-1** from the main **PCM** display to toggle between side 1 and side 2 in the **MON-1&2** or **D&I** mode without having to swap test cords around. If the **930i** is in **TERMINATE** or **MON-1** mode, the key is inactive because only side 1 is receiving.

4-1.3 Clock

When the **930i** is in **TERMINATE** mode, a transmit clock source may be chosen. The **930i** can be loop-timed (**LOOP-TIME**) to the span clock, or it can supply the clock (**INTERNAL**).

To select the **external clock**:

1. Press **K3** under **EXT CLK** in the main **PCM** display (when in **TERMINATE** mode only). The **CLOCK** display reads:



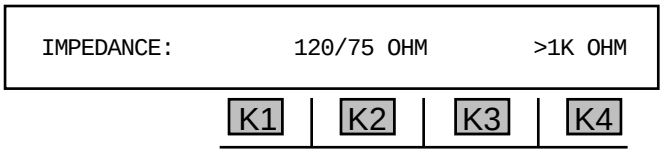
In **TERMINATE** mode, it is assumed that the **E1** span you are terminating has been taken out of service for test purposes. With the other three modes it is assumed that live traffic may be on the span.

2. Press **K2** under **LOOP-TIME** **OR** **K4** under **INTERNAL** for a clock source.

4-1.4 Setup

To change the default setups or the setup you have previously entered:

1. Press **K4** under **SET-UP** from the main **PCM** display. The **SPAN** display reads:

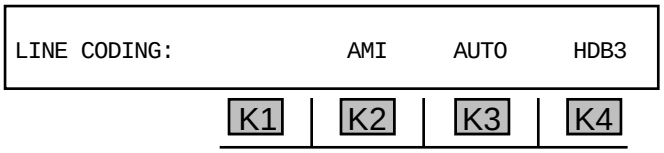


The cursor appears above the current selection.

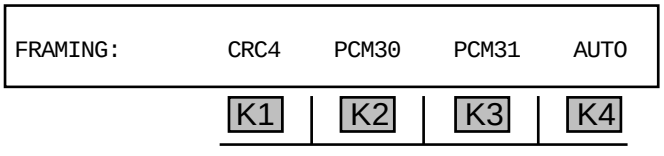
2. Use the **120/75 OHM** default at the **Jack Field** or at the **CSU** or **Office Repeater** jacks. Use **>1K OHM** only in cases where your **Jack Field** does not supply isolation resistors.

If you leave the **930i** in the **>1K OHM** position and connect it to the **Jack Field** monitor jacks (which already have 1000 Ohms of isolation), the signal will be distorted and cause error indications.

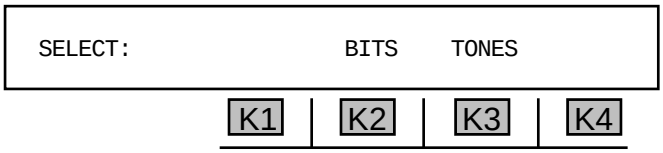
The display reads:



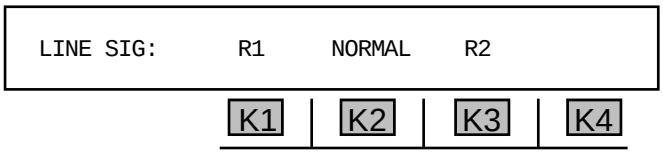
3. Press **K2** or **K4** to select a line coding type, and press **K3** to toggle **AUTO** on and off. Pressing **K2** or **K4** will advance you to the following display:



4. Press **K2** or **K3** to select a **PCM30** or **PCM31** span. **K1** toggles **CRC4** on/off and **K4** toggles **AUTO** on/off. Pressing **K2** or **K3** advances you to the following display:



5. Press **K2** to select **BIT** type signalling type, or **K3** to select **TONE** signalling.



5. Press **K2**, **K3,** or **K4** to select a line signalling type. You will return to the main display.

SECTION V

OPTION MENU NUMBERS

The following chart lists each Option Menu number with its description and the purchased option necessary to receive that function if it is not a standard feature of the **930i**.

Option Menu #	Description	Purchased Option Required
1	MODIFY DIAL/RING	STANDARD (analog only)
2	SEND DIGIT SEQUENCES	STANDARD (analog only)
3	REMOTE CONTROL	STANDARD
4	DIGIT ANALYZER	STANDARD (analog only)
4	CALL ANALYZER	STANDARD (PCM only)
5	RING LOAD	PURCHASED OPTION 930i-13 Ring Generator
6	DC VOLT/AMP METER	STANDARD (analog only)
7	SUPERVISION THRESHOLDS	STANDARD (analog only)
9	WINK TIMING	STANDARD (analog only)
10	FREQUENCY SWEEP	STANDARD
11	IMPULSE NOISE & HITS	PURCHASED OPTION 930i-100, Data Test Package
12	WINK MARGINING	STANDARD (analog only)
13	PHASE/AMPLITUDE JITTER	PURCHASED OPTION 930i-100, Data Test Package
14	SET TIME AND DATE	STANDARD
15	BEEP ON ERR?	STANDARD
16	DIGIT RECEIVER TIMEOUT	STANDARD (analog only)
17	ENVELOPE DELAY DISTORTION	PURCHASED OPTION 930i-100, Data Test Package
18	P/AR RATIO	PURCHASED OPTION 930i-100, Data Test Package
19	4-TONE INTERMODULATION	PURCHASED OPTION 930i-100, Data Test Package
20	30 BIT DISPLAY	STANDARD
21	TOGGLE ABCD BITS	STANDARD
22	ABSOLUTE DELAY	PURCHASED OPTION 930i-21, Absolute Delay
24	POST TPT DELAY	PURCHASED OPTION 930i-12 ROTL Responder, 105E
25	FAR END RESPONDER	PURCHASED OPTION 930i-12 ROTL Responder, 105E
26	ROTL/RESPONDER	PURCHASED OPTION 930i-12 ROTL Responder, 105E
27	ROTL/INTERROGATOR	PURCHASED OPTION 930i-12 ROTL Responder, 105E
29	CALL 102 LINE	STANDARD
30	ADJUST TLP	STANDARD (analog only)
31	SEND HOOK FLASH	STANDARD (analog only)
32	DIAL-UP TESTLINE	STANDARD
33	DIAL-UP SWEEP	STANDARD
34	SELECT REPORTS	STANDARD
35	DUAL TONE SENDER	STANDARD
37	LINE STATUS	STANDARD (analog only)
39	REMOTE AUDIO	PURCHASED OPTION 930i-47 REMOTE AUDIO
40	SEND PCM ALARMS	STANDARD
41	READ E-1 VOLTAGE	STANDARD
43	E-1 ERROR COUNTERS	STANDARD
44	E-1 ERROR HISTORY	STANDARD
45	E-1 ERROR INJECT	STANDARD
46	E-1 BIT ERROR RATE	STANDARD
55	FRACTIONAL E-1 BERT	PURCHASED OPTION 930i-51, Fractional E-1 BERT
56	64-KBIT E-1 BERT	PURCHASED OPTION 930i-23, Extended Bit Error Rate
59	ECHO CANCELLER DISABLE	STANDARD

Option Menu #	Description	Purchased Option Number
60	HUM FILTER	STANDARD (analog only)
62	GROUP DELAY	STANDARD
63	PCM ERROR HISTORY	STANDARD
65	ATME FAR END RESPONDER	PURCHASED OPTION 930i-11, ROTL Responder, ATME
66	ATME DIRECTOR	PURCHASED OPTION 930i-11, ROTL Responder, ATME
69	FAR 23 TONE RESPONDER	PURCHASED OPTION 930i-154, 23 Tones
70	23 TONES DIRECTOR	PURCHASED OPTION 930i-154, 23 Tones
71	23 TONES TEST	PURCHASED OPTION 930i-154, 23 Tones
75	REMOTE UPGRADE	STANDARD
80	KEYBOARD LOCKOUT	STANDARD
87	TPT BURST LENGTH	PURCHASED OPTION 930i-12 ROTL Responder, 105E
89	PRINTER HAND SHAKE	STANDARD
91	SOFTWARE VERSION	STANDARD
92	RESET 930	STANDARD
93	TEST DISPLAY	STANDARD
94	LIST OPTIONS	STANDARD
95	DRY CIRCUIT	STANDARD
97	HOLD CONTROL	STANDARD

Using Option Menu Functions

You can access the **Option Menu** functions in two ways:

- Select the desired **Option Menu** number using the **numeric keypad**, and then press any soft key (**K1-K4**) **OR ENT** to enter the **SETUP** display for that option.

- Use the **Up/Down Arrow** keys to scroll up to **OPTION MENU #:99** or down to **OPTION MENU #:1** (the **Arrow keys** do not "wrap" from 99 to 1), and then press any soft key (**K1-K4**) **or ENT** to enter the **SETUP** display for that option.

You can exit the **Option Menu** function by pressing the **Option Menu** function key **or** any of the other 6 function keys. In many cases, one of the selections in the display will be labeled **EXIT**; pressing the soft key below it also exits the option.

5-1 OPTION MENU #:1 MODIFY DIAL/RING

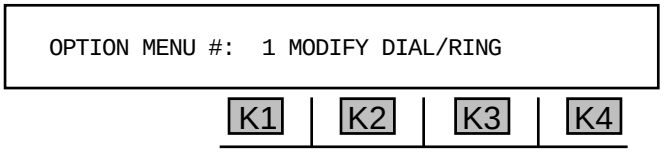
OPTION MENU #:1, MODIFY DIAL/RING, is a standard feature that enables you to modify the **Dial/Ring** parameters.

To modify the **Dial/Ring** parameters:

1. Select the type of signalling to be sent (**MF, DP, DTMF, R2,** or **RING**) from the **Dial/Ring** function.

2. Press the **Option Menu** function key.

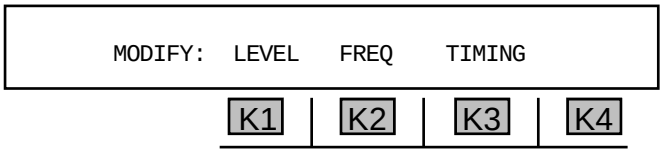
3. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **1** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT or** any soft key. The resulting **MODIFY** display will vary depending on whether you selected **MF**, **DTMF**, **DP**, **R2**, or **Ring.** Each of these types are discussed below.

5-1.1 MF, DTMF, or R2 Digits

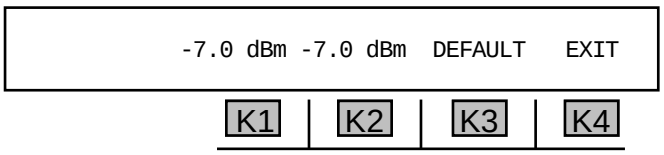
If you selected **MF**, **DTMF**, or **R2** mode under the **Dial/Ring** function key, the **MODIFY** display reads:



5-1.1.1 Level

To change the output level:

1. Press **K1** under **LEVEL**. The display reads:



2. Press **K1** to change the low frequency tone level **OR K2** to change the high frequency tone level.

3. Use the **numeric keypad** to enter a new level.

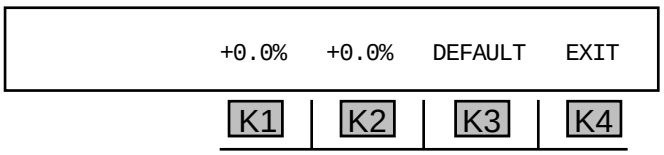
> • A valid **LEVEL** in **MF** and **DTMF** is between **–99.9** and **+12.0**, and between **-99.0** and **+3.0** in **R2.**

4. Press **K4** to exit to the **MODIFY** display.

5-1.1.2 Frequency

To change the output **frequency**:

1. Press **K2** under **FREQ**. The display reads:



2. Press **K1** to change the low tone percentage **or K2** to change the high tone percentage.

3. Use the **numeric keypad** to enter a new frequency.

> • A valid **frequency** is between -**99.9%** and **+99.9%.**

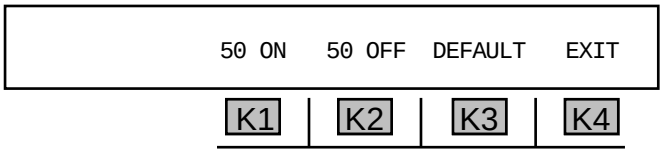
4. Press **K4** to exit to the **MODIFY** display.

Option Menu #: 1

5-1.1.3 Timing

To change the **timing interva**l:

1. Press **K3** under **TIMING**. The display reads:



2. Press **K1** to change the **ON** time **or K2** to change the **OFF** time.

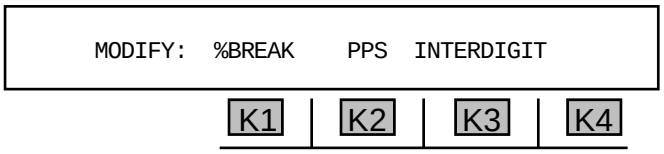
3. Use the **numeric keypad** to enter a new interval.

> • A valid **timing interval** is between **10 ms** and **9999 ms**. In the **TIMING** display, in **MF and R2**, the default is **70 ON 70 OFF**. In **DTMF**, the default is **50 ON 50 OFF**. If using a **KP, the 930i** automatically adds **30 ms** to its **ON** time.

4. Press **K4** to exit to the **MODIFY** display.

5-1.2 DP Digits

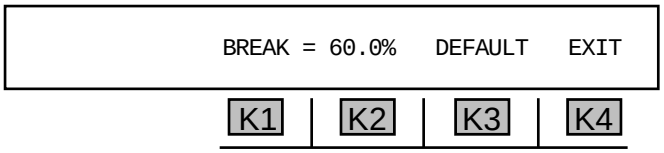
If you selected **DP** mode under the **Dial/Ring** function key, the **MODIFY** display reads:



5-1.2.1 % Break

To change the **% break:**

1. Press **K1** under **% BREAK**. The display reads:



2. Use the **numeric keypad** to enter a new **% break**.

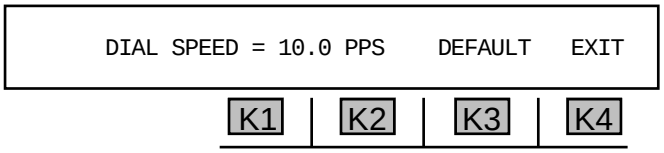
   • A valid **%BREAK** is between **25.0%** and **80.0%** with a default percentage of **60.0%.**

3. Press **K4** to exit to the **MODIFY** display.

5-1.2.2 Pulses Per Second

To change the **PPS**:

1. Press **K2** under **PPS**. The display reads:



2. Use the **numeric keypad** to enter a new number of **pulses per second**.

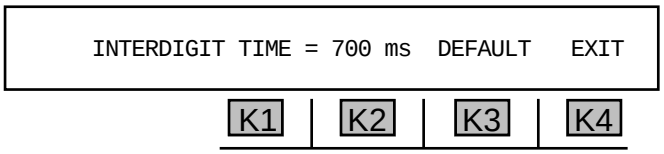
   • A valid **PPS** is between **2.0 PPS** and **35.0 PPS** with a default of **10.0 PPS.**

3. Press **K4** to exit to the **MODIFY** display.

5-1.2.3 Interdigit Time

To change the **time interval between digits**:

1. Press **K3** under **`INTERDIGIT`**. The display reads:



2. Use the **numeric keypad** to enter a new **interdigit time**.

   - A valid **interdigit time** is between **`100 ms`** and **`990 ms`** with a default of **`700 ms.`**

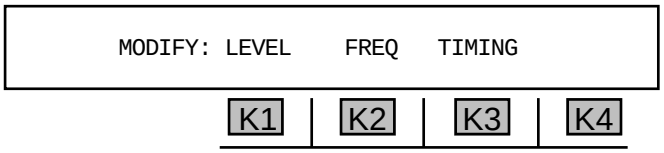
3. Press **K4** to exit to the **`MODIFY`** display.

5-1.3 Ring Generator

Option Menu #: 1

For the ring generator (**`RING`**) to be valid, the **930i** must be supplying **`BATTERY`** in an analog trunk type in **`TERMINATE`** mode **or** be in a **PCM** ringing type. (In **PCM**, the **930i** does not supply the ringing voltage, but provides a **PCM** ring signal state.)

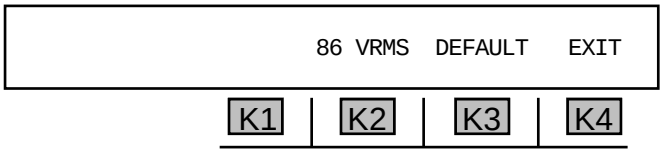
If you selected **`BATTERY`** under the **Trunk Type** function key and **`RING`** under the **Dial/Ring** function key, the **`MODIFY`** display reads:



5-1.3.1 Level

To change the **output level**:

1. Press **K1** under **`LEVEL`**. The display reads:



2. Use the **numeric keypad** to enter a new level.

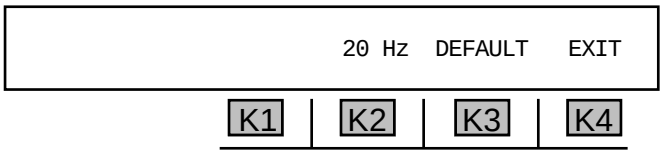
   - A valid **level** is between **`15 VRMS`** and **`99 VRMS`** with a default of **`86 VRMS`**.

3. Press **K4** to exit to the **`MODIFY`** display.

5-1.3.2 Frequency

To change the **output frequency**:

1. Press **K2** under **FREQ**. The display reads:



2. Use the **numeric keypad** to enter a new **frequency**.

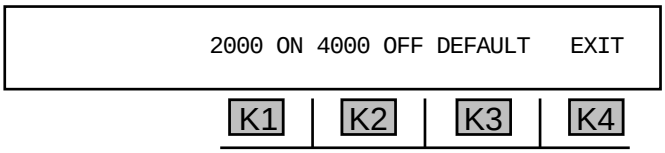
   • A valid **frequency** is between **15 Hz** and **65 Hz** with a default of **20 Hz**.

3. Press **K4** to exit to the **MODIFY** display.

5-1.3.3 Timing

To change the **timing interval**:

1. Press **K3** under **TIMING**. The display reads:



2. Press **K1** to change the **ON** time **or** **K2** to change the **OFF** time.

3. Use the **numeric keypad** to enter a new **interval**.

   • A valid **timing interval** is between **150 ms** and **9999 ms**, with a default of **2000 ms** for **ON** and **4000 ms** for **OFF**.

4. Press **K4** to exit to the **MODIFY** display.

5-2 OPTION MENU #:2 SEND DIGIT SEQUENCES

OPTION MENU #:2, SEND DIGIT SEQUENCES, is a standard feature that facilitates multistage outpulsing of stored phone numbers where one or more phone numbers are outpulsed in sequence, possibly separated by line signalling or call progress events and terminated by a testline.

This option operates in conjunction with the **Dial/Ring** function, **OPTION MENU #:1, MODIFY DIAL RING, OPTION MENU #:3, REMOTE CONTROL,** AND **OPTION MENU #:66, ATME FAR END RESPONDER.**

To set up and send a **digit sequence**:

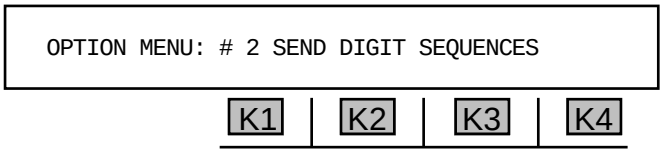
1. Press the **Trunk Type** function key to set up a trunk. If you are testing between two **930i**s in a 2W trunk type, you should set one end to **`CONTACT`** (usually the send unit), and one end to **`Battery`** (usually the receive unit, which is set up in **OPTION MENU #:4, DIGIT RECEIVER**).

2. Use the **numeric keypad** to enter the telephone numbers you want to send, one at a time, under **Dial/Ring**. (Refer to **Section 3, Front Panel Operation,** for a description of the dial/ring function.)

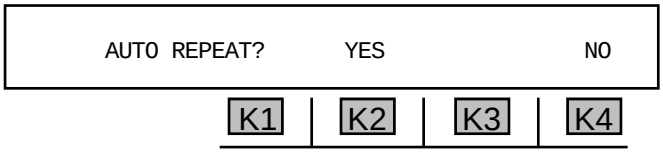
3. Use the **STO** key to store each number to be outpulsed (for example **4087611000**, **5551212**, etc.) in any of the **998** registers (**01** to **998**). (Refer to **Section 3-6.1** for a description of the **STO** key function.)

4. Press the **Option Menu** function key.

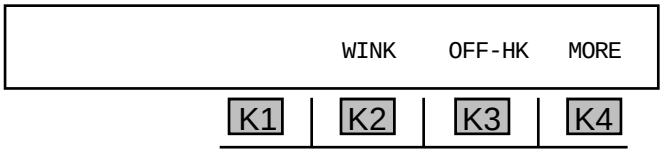
5. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **2** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



6. Press **ENT or** any soft key (**K1-K4**). The display reads:



7. Press **K2** under **YES** if you want to repeat the sequence indefinitely, **OR** press **K4** under **`NO`** to send the sequence once. The display reads:



8. Use the **numeric keypad** to enter the stored memory location of the numbers to be outpulsed.

Option Menu #: 2

Press **K2 t**o tell the **930i** to wait for a **WINK** from the terminating end, **or** press **K3** to wait for an **OFF-HK**. (The sequence at the terminating end is set in **OPTION MENU #:4, DIGIT RECEIVER**.)

At the **originating end**, the sequence consists of the record storage location of the digits to be outpulsed and the supervision events expected from the terminating end. (The table below shows the most common call sequence types.) The supervision events are:

WINK A single line signalling pulse. A **W** is added to the sequence at the originating end to wait for a wink. A wink must be less than **600 msecs** or the event will fail.

OFF-HOOK The condition where the receiver or handset is off the switch. An **H** is added to the sequence at the originating end to wait for an off-hook signal from the terminating end. An off-hook must be more than **200 msecs** in duration or the event will fail.

Sequence Type	Typical Sequence
Immediate Dial	**1**
Sequence Progress Originating end goes off hook and sends digits in record location # **1**.	
Wink Start	**W1**
Sequence Progress 1. Originating end seizes the line. 2. Terminating end provides a wink (**W**). 3. Originating end sends digits in record location # **1** after receiving the wink.	
Ground Start	**H1**
Sequence Progress 1. Originating end seizes the line. (provides ring ground) 2. Terminating end goes off hook. (provides tip ground) (**H**) 3. Originating end switches to loop and sends digits in record location # **1** after receiving the off hook signal.	

PAUSE A delay of one second before proceeding.

D-DIAL (Delay Dial) A signalling event that responds to a request for service and indicates a start dial to the sending switch. A **D** is added to the sequence to tell the originating end to wait for the terminating end to return an off-hook signal in response to the incoming request for service and waits to receive an on-hook signal when the receiving end is prepared to receive the incoming digits. It is used on delay dial lines.

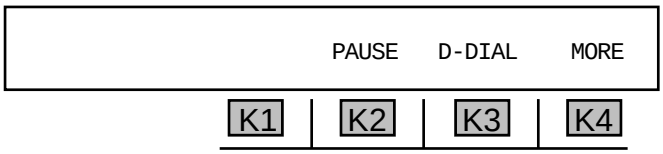
You can view the timing of supervision events in **OPTION MENU #:9, Wink Timing**.

After the originating end sends a digit sequence and connects to the testline that will undergo testing, you should select a testline type.

TESTLINE- Tells the **930i** to go off-hook at the end of a call and simulate a test line. Available testlines are:

CPROG-the **930i** goes off-hook and sends call progress tones.
102-the **930i** goes off-hook and sends 1020 Hz at -16 dBm.
105-the **930i** goes off hook and acts as a type 105 responder.
ATME-the **930i** goes off-hook and performs an ATME test.

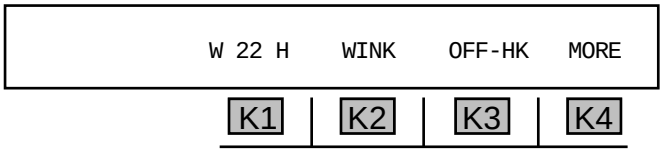
9. Press **K4** under **MORE**. The display reads:



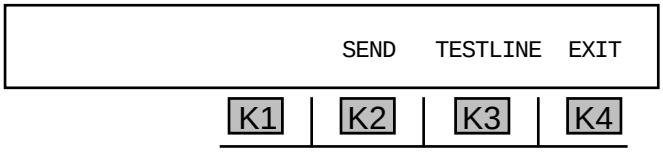
10. Press **K1** to add a **PAUSE** (**-**), **OR** press **K3** to add a **D-DIAL** (**D**).

    for example:

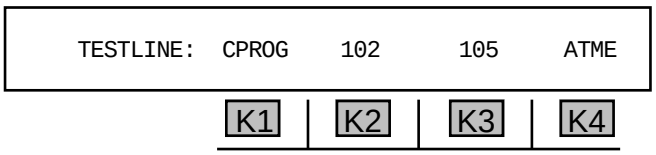
    A sequence that includes a **WINK**, followed by the number in stored memory location **22**, and ending with an **OFF-HK** reads:



11. Press **K4** under **MORE** again. The display reads:



12. Press **K3** under **TESTLINE** to select the type of test line. The display reads:



Selecting a type **102** testline adds a **T2** to the sequence, a **105** testline adds a **T5**, **CPROG** call progress adds a **CP**, and **ATME** adds a **TA**. (Tests to a 102 testline are set up in **OPTION MENU #:29, CALL 102 TESTLINE**. Tests to an **ATME** testline are set up in **OPTION MENU #:66, ATME DIRECTOR**.)

13. Press the soft key (**K1-K4**) below the desired testline. You will be returned to the last display.

14. Press **K2** under **SEND** to begin a sequence without going off hook.

Option Menu #: 2

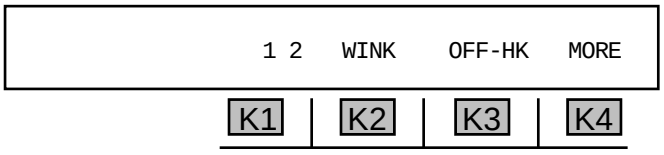
5-2.1 Sending a Call More Than 18 Digits Long

To send calling numbers that are more than **18 digits** long, you must enter the numbers in **18** digit blocks (the maximum number allowed) from the storage register.

for example:

To send a string of **30 DTMF digits**:

1. Select the **Dial/Ring** function key.
2. Press **K3** to select **DTMF** mode.
3. Use the **numeric keypad** to enter the first eighteen digits and store the string in **memory location 1**.
4. Clear the display and enter the last twelve digits and store them in **memory location 2**.
5. Press the **Option Menu** function key.
6. Enter **OPTION MENU #:2**.
7. Select **YES** or **NO** from the **AUTO REPEAT?** display.
8. Use the **numeric keypad** to enter the number **1** and press **ENT**.
9. Enter the number **2** and press **ENT** again. The display reads:



10. Go **off-hook**. The numbers stored in the two registers will be automatically outpulsed as a single digit string with a pause between the two records (approx. 1 sec).

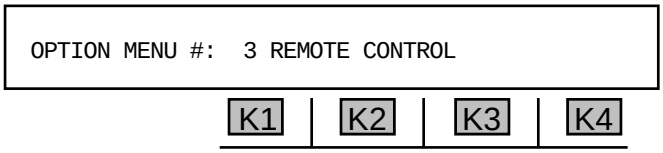
5-3 OPTION MENU #:3 REMOTE CONTROL

OPTION MENU #:3, REMOTE CONTROL, is a standard feature that allows you to set up the **930i** for remote control operation. Refer to **Section 5-75, OPTION MENU #:75, REMOTE UPGRADE,** and **Section 6, Remote Control Operation,** for additional information on the remote control function.

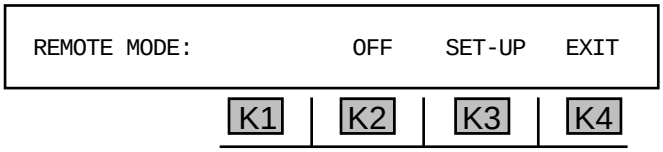
To set up the **930i** for remote control operation:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **3** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K2** to scroll through the different remote modes. The available modes are:

OFF	Manual control (no remote control)
TERMINAL	places **930i** under dumb terminal control
COMPUTER	places **930i** under computer control through the RS-232 serial port directly or via a modem attached to the port.
PRINTER	Used to drive a printer connected to the RS-232 serial port.

MASTER, SLAVE, and **ATR** are reserved for future use

The above modes are explained in detail in **Section 6, Remote Control Operation.**

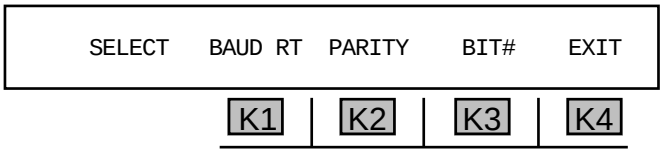
5. Press **K1** to put the **930i** into **STANDBY MODE.** The **930i** remains in **STANDBY MODE** until **K1** is pressed again.

5-3.1 Setup

To setup the **930i** for remote control operation:

Press **K3** under **SET-UP.**

The display reads:

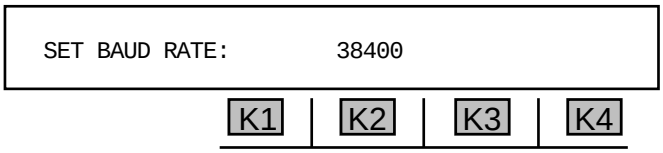


5-3.1.1 Baud Rate

Baud rate is the number of bits of data transmitted per second in a data signal.

To change the **baud rate**:

1. Press **K1** under **`BAUD RT.`** The display reads:



2. Use the **numeric keypad** to change the **baud rate**.

   • A valid **baud rate** is between **`300`** and **`38400`**. The default value is **`38400 baud`**.

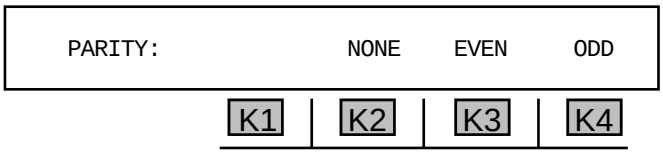
3. Press **ENT or** any soft key (**K1-K4**) to exit this display. You will be returned to the **`SELECT`** display.

5-3.1.2 Parity

Parity is a method of minimizing errors in data transmissions by adding an extra binary signal to each character to make the total number of 1s or 0s either odd or even for each character.

To change the **parity**:

1. Press **K2**. The display reads:



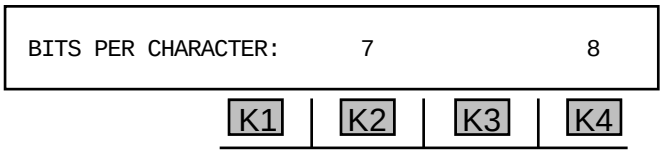
2. Press **K2** under **`NONE`** for no parity, **K3** for **`EVEN`** parity, **OR K4** for **`ODD`** parity. The default is **`NONE`**. You will be returned to the **`SELECT`** display.

5-3.1.3 Bit Number

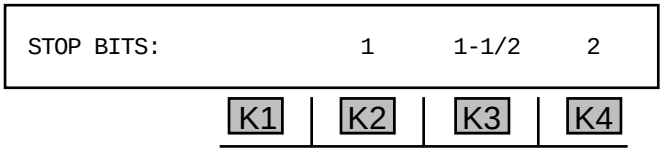
The **bit number** is the number of bits that make up a character. 7 bits are used to produce standard ASCII characters.
Stop bits are the bit or bits following character code in start stop transmissions.

To change the **data format**:

1. Press **K3** under **BIT#** from the **SELECT** display. The display reads:



2. Press **K2** to select **7** bits **OR K4** to select **8** bits. (The default format is **8** bits per character.) The display reads:



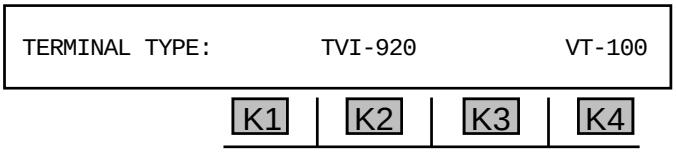
3. Press **K2** to select **1** stop bit, **K3** to select **1-1/2** stop bits, **OR K4** to select **2** stop bits. The default stop bit value is **1**. You will be returned to the **REMOTE MODE** display.

5-3.2 Terminal Selection and Reporting

To set up this feature for remote control operation:

1. Press **K4** under **EXIT** from the **REMOTE MODE** display.

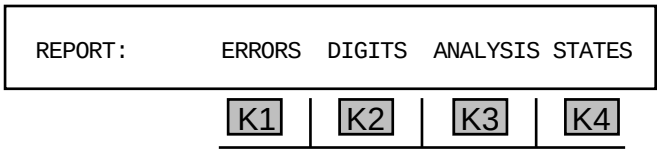
   If you selected **TERMINAL** mode, the display reads:



Pressing **K2** enables you to connect the **930i** to a **TVI-920** type terminal; pressing **K4** enables you to connect to a **VT-100** terminal. You will be returned to the **REMOTE MODE** display after making your selection.

If you selected **COMPUTER** or **PRINTER** mode, you will enter a setup display identical to the one in **OPTION MENU #:34, SELECT REPORTS**.

The report setup display reads:



If you selected **TERMINAL** or **PRINTER** mode, the message **REPORT:** is replaced by **PRINT:**

2. Press **K1** to report or print **ERRORS, or** press **K2** to print or report **DIGITS**. A cursor appears above each of your selections. (You can select more than one.)

   If you select **DIGITS**, an **ANALYSIS** field appears over **K3**, which can be selected. Selecting **ANALYSIS** prints an analysis of the results.

3. Press **K4** under **STATES** to scroll through and select from the following supervision report types:

   - **STATES**
   - **BITS**
   - **TOKENS**

4. Press the **Option Menu** function key to exit this function.

NOTE: In clear channel and dry circuit modes, no supervision report is generated.

5-4 OPTION MENU #:4 DIGIT RECEIVER (Analog Only)

OPTION MENU #:4, DIGIT RECEIVER, is a standard feature used in **BRIDGE** mode on analog trunks. In **TERM** mode, the **930i** emulates terminating equipment and records the digits it receives. In **TERM** mode the **930i** supplies line signalling. In the **BRIDGE** or **MON-1&2** modes, it looks for, and times, line signalling events (winks, off-hooks, etc.). The **930i** breaks an outpulsing sequence into groups of digits and line signalling events. **MF**, **DTMF**, or **DP** sequences are called **RECORDS**.

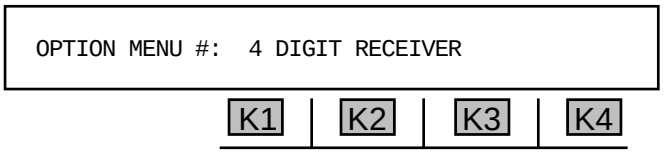
The **930i** records the outpulsed digits it receives. In **TERM** mode, the **930i** supplies supervision. In the **BRIDGE** or **MON-1&2** modes, it looks for, and times, supervision events (Winks, off-hooks, etc.). The **930i** breaks an outpulsing sequence into groups of digits and supervision events. The digit groups, which can be **MF**, **DTMF**, or **DP**, are called **RECORDS**.

To use the **digit receiver**:

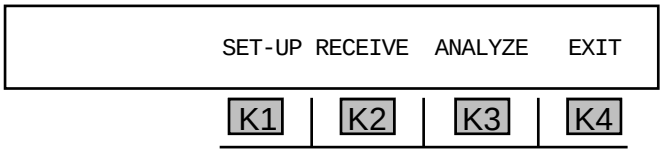
1. Press the **Trunk Type** function key to set up a trunk. If you are testing between two **930i**s in a 2W trunk type, you should set one end to **CONTACT** (usually the send unit, which is set up in **OPTION MENU #:2, SEND DIGIT SEQUENCES**), and one end to **BATTERY** (usually the receive unit).

2. Press the **Option Menu** function key.

3. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **4** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

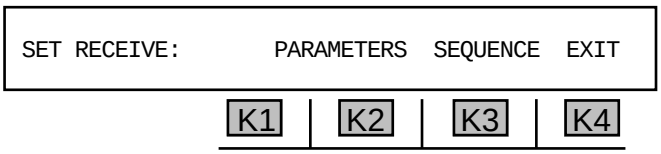


4. Press **ENT or** any soft key (**K1-K4**) to enter the **SET-UP** display. The display reads:



5-4.1 Setup

Press **K1** under **SET-UP**. The display reads:

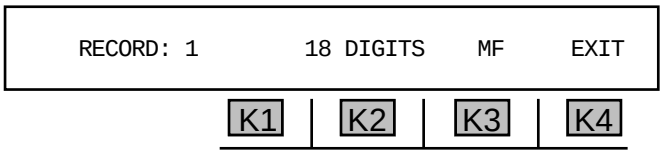


Option Menu #: 4

5-4.1.1 Parameters

To set the **parameters:**

1. Press **K1 or K2** under **PARAMETERS**. The display reads:



2. Press **K3** to select the signalling type. The display cycles between **MF**, **DTMF**, and **DP**.

3. Use the **numeric keypad** to enter the length of the number to be received.

   - A valid **number** is between **1** and **18** digits long.

Note: If a call is **MF**, you do not need to tell the **930i** the length of each number because it recognizes the **KP** and **ST**.

4. Use the **Up/Down Arrow** keys to scroll through records 1-4.

5. Press **K4** under **EXIT** to return to the main **SET-UP** display.

5-4.1.2 Sequence

At the **terminating end**, the **sequence** consists of the record storage location in which the **930i** will store digits received from the originating end, and the supervision events sent from the terminating end to the originating end.

The table to the right shows the progress of the four most common sequence types and the sequence that should be entered into the **930i** at the terminating end to set it up to receive digits from the originating end.

Sequence Type	Typical Sequence
Immediate Dial	**1**
Sequence Progress 1. Originating end goes off hook and sends digits. 2. Terminating end stores received digits in record (**1**).	
Wink Start	**W1**
Sequence Progress 1. Originating end seizes the line. 2. Terminating end provides a wink (**W**). 3. Originating end sends digits. 4. Terminating end stores received digits in record (**1**).	
Ground Start	**H1**
Sequence Progress 1. Originating end seizes the line .(provides ring ground) 2. Terminating end goes off hook. (provides tip ground) (**H**) 3. Originating end switches to loop and sends digits. 4. Terminating end stores received digits in record (**1**).	

You can add line signalling events to your sequence as well as digit records. Of these events, the **930i** can send them in **TERMINATE** mode or recognize and measure them in **BRIDGE** mode (**Mon1&2** and **PCM**). These events are:

WINK A single line signalling pulse. A **W** is added to the sequence at the receiving end to send a wink when it is ready to receive a digit record from the originating end. A wink must be less than **600 msecs** or the event will fail. (Refer to **OPTION MENU #:9, Wink Timing**.)

OFF-HOOK The condition where the receiver or handset is off the switch. An **H** is added to the sequence at the receiving end to send an off-hook signal to the originating end. An off-hook must be more than **200 msecs** in duration or the event will fail. (Refer to **OPTION MENU #:9, Wink Timing**.)

PAUSE A pause of one second before proceeding. Use this when terminating a call, never when monitoring. A **PAUSE** appears as a **-** in the sequence.

D-DIAL A signalling event that tells the terminating end to go on-hook when ready to receive digits. It is used for delay dial lines, and appears in the sequence as a **D**.

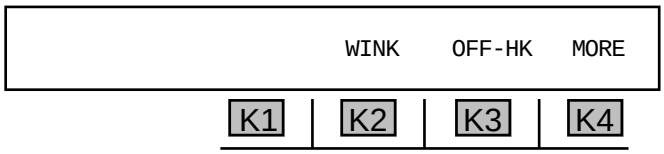
TESTLINE Tells the **930i** to go off-hook at the end of a call and simulate a test line. Available testlines are:

100-the **930i** goes off-hook and provides quiet termination.
102-the **930i** goes off-hook and sends 1020 Hz at -16 dBm.
105-the **930i** goes off hook and acts as a type 105 responder.
LOOPBACK-the **930i** goes off-hook and acts as a loopback testline.

Option Menu #: 4

To set the **sequence** at the **930i** operating as a **digit receiver**:

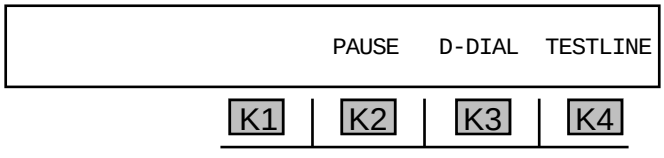
1. Press **K3** under **SEQUENCE**. The default display reads:



2. Use the **numeric keypad** to enter the number of the registers (1-4) where you want to store the incoming records received from the send end. Pressing **K2** under **WINK** tells the **930i** to send a wink (**W**) to the send end; pressing **K3** under **OFF-HK** tells it to send an off-hook (**H**).

For the Immediate Start trunk or a Ground Start trunk not in **TERM** mode, a wink is not necessary.

3. Press **K4** under **MORE**. The display reads:



4. Press **K2** to add a one-second pause, **K3** to add a dial delay, **OR** **K4** to select a testline. (**Testline** allows you to select **`100, 102, 105,`** or **`LOOPBACK`** in **PCM** mode.)

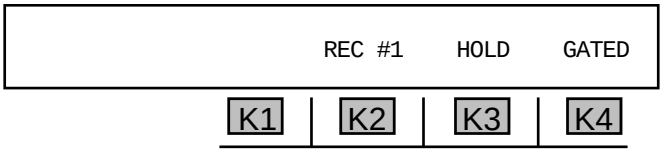
5. Press the **Option Menu** function key to return to the main **`SET RECEIVE`** display, **OR** press **K4** under **`EXIT`** to back out another step to the main selection display.

5-4.2 Receive

To activate the **digit receiver**:

1. Press **K2** under **`RECEIVE`** from the **`SET-UP`** display.

   for example:

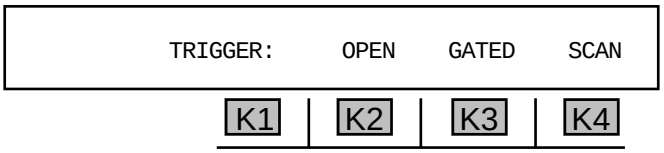
   

   When the trunk is seized and digits are sent, the digits appear on the left side of the display.

2. Press **K2** under **`REC #1`** to scroll through the available records.

3. Press **K3** to toggle **`HOLD`** on/off. In the on position, the captured digits are held until **K3** is pressed a second time. The factory default is **on**.

4. Press **K4** under **`GATED`** to select a trigger. The display reads:

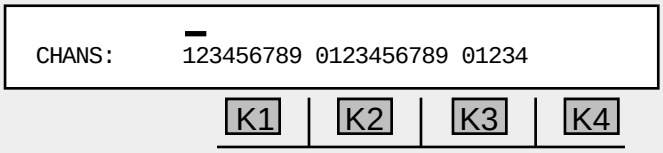
   

5. Press **K2** to activate **`OPEN`** mode, **K3** to activate **`GATED`** mode, **or** **K4** under **`SCAN`** (when in **PCM** mode only) to scan all **PCM** channels.

OPEN	receives digits regardless of the supervision state.
GATED	waits for an on–to–off-hook transition before the digit receiver is activated.
SCAN	scans all PCM channels until it sees one channel go off-hook and collects digits from that channel. The **930i** continues to monitor the active channel until it goes back on-hook or until the requested digit records are full. It automatically scans the next call until **K4** is pressed again, discontinuing the function.

In **GATED mode**, the digit receiver waits indefinitely unless the correct signalling is received before digits are sent. If digits can be heard with the speaker volume turned up but do not appear immediately on the display, check your trunk type settings and sequence. Or use **OPEN mode**.

If you select **SCAN,** the display reads:



The first nine digits are channels 1-9, the second are channels 10-19, and the third set of 5 digits are channels 20-24.

6. Use the **numeric keypad** to enter each channel to be scanned (the display will briefly read **ENTER CHANNEL #:**) and press **ENT**.

   • A valid number of **channels to be scanned** is between 1 and 24.

If you enter the number of a channel that has already been selected, that channel will then be deselected.

Alternatively, press **K1** to select **ALL** channels **or** the **CLR** key to clear all channels. You can then use the **Left/Right Arrow** keys to place the cursor over a channel to be added or deleted, then change it using the **numeric keypad**.

7. Press the **Option Menu** function key to return to the main display once the digits have been received.

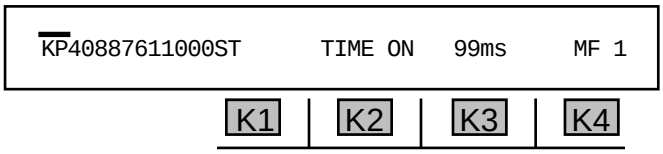
Option Menu #: 4

5-4.3 Analyze

Digit analysis results are not retained when the **930i** is switched off.

To **analyze** the characteristics of each digit in the received string:

1. Press **K3** under **ANALYZE** from the **MAIN** display. A sample display appears below:



2. Use the **Left/Right Arrow** keys to move the cursor (shown over the **KP**) from digit to digit.

3. Press **K2** to page through the amplitudes and frequencies of the two tones that make up the **KP** as well as their **ON** and **OFF** times.

4. Press **K4** to scroll through each record if multiple records have been stored.

5. Press the **Option Menu** function key to back out of the **ANALYZE** display to the main display. (Refer to **Section 6, Remote Control Operation,** for sending results to a computer or printer.)

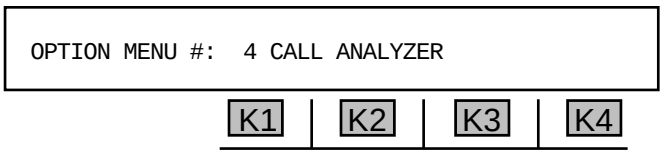
5-4 OPTION MENU #:4 CALL ANALYZER (PCM ONLY)

OPTION MENU #:4, Call Analyzer, is a standard feature that allows you to analyze a call in both directions. You can view the time and duration for each digit or line signalling event, as well as the content of the supervision.

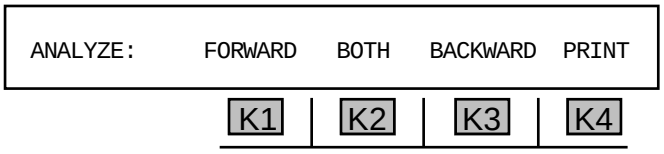
To set up the **930i** to analyze a call:

1. Press the **Option Menu** function key.

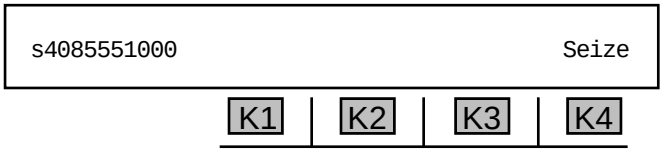
2. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **4** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K1** under **FORWARD** to analyze forward digits, **K2 under BOTH** to analyze both forward and backward digits, **K3** under **BACKWARD** to analyze only backward digits, **or K4** under **PRINT** to print results. If you pressed **K1-K4**, the display will look similar to the following:

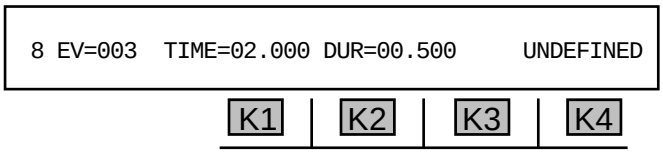


The left side of the display shows the digit sequence. A flashing cursor appears above the first digit or supervision event in the sequence. The right side of the display shows a message that describes the digit or supervision event that has a cursor above it.

5. Use the arrow keys to move the cursor from digit to digit. The message on the right side of the display will change as you move from digit (or supervision event) to digit.

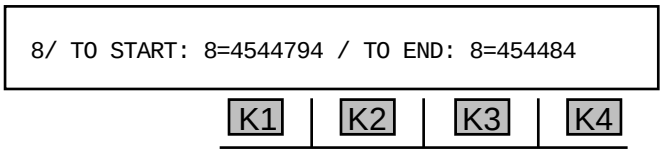
6. Press any of the soft keys (**K1-K4**) to analyze the digit or supervision event that has the flashing cursor displayed above it.

The display will appear similar to the following:



In this example, the **8** refers to the line seizure event, which is currently being analyzed. **EV** refers to the number of the event, (#s begin with) beginning with **000**. In this case, it is the third event. **TIME** refers to the time (in seconds) that 8 was sent after the call was initiated. **DUR** refers to the duration of the analyzed event (in seconds). The message above **K4** (in this case, **UNDEFINED**), is the name of the current event.

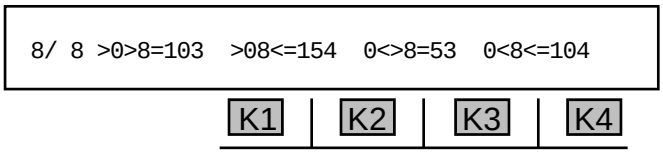
7. Press any soft key (**K1-K4**). The display looks similar to the following:



This display describes the duration between the start of the call and the event being analyzed (in this case, the digit **8**) as well as the duration from the event to the end of the call.

Option Menu #: 4

8. Press any soft key (**K1-K4**). The display looks similar to the following:

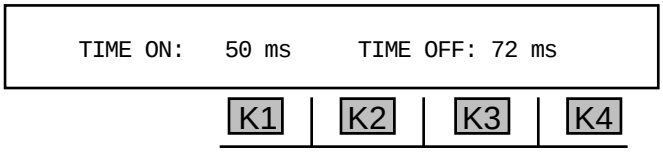


This display describes the intervals between the start and the end of the specified event and the digit preceding it. This display only appears for undefined events, and does not appear for the first undefined event.

In the display above, the digit being analyzed is **8** in the phone number **408-761-1000**.

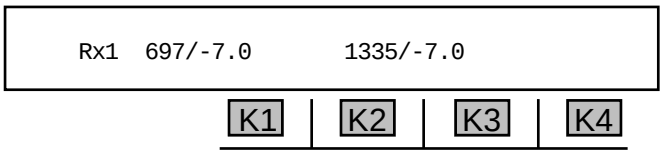
0>8 =103 is the duration (in ms) from the start of the **0** to the start of the **8**.
>08< =154 is the duration (in ms) from the start of the **0** to the end of the **8**.
0<>8 =53 is the duration (in ms) from the end of the **0** to the start of the **8**.
0<8< =104 is the duration (in ms) from the end of the **0** to the end of the **8**.

9. Press any soft key (**K1-K4**). The display reads:



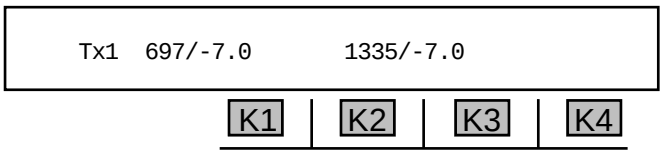
This display shows the duration of the on and off times (ms).

10. Press and soft key **(K1-K4)**. The display will appear similar to the following:



The display shows the frequency (in Hz) and amplitude (in dBm) of the two tones that make up the receive signal.

11. Press and soft key **(K1-K4)**. The display will appear similar to the following:



The display shows the frequency (in Hz) and amplitude (in dBm) of the two tones that make up the transmit signal.

12. Press any soft key (**K1-K4**) to return to the main display, **or** press the **Option Menu** function key to exit this function.

5-5 OPTION MENU #:5 MEASURE RING VOLTAGE

OPTION MENU #:5, Measure Ring Voltage, is available when *Purchased Option 930i-13 Ring Generator,* is purchased. This feature provides a true Ringer Equivalent Number 3 (REN-3) load to terminate ringing supplies. The ring generator and ring load are intended for operation on 2- and 4-wire Loop and Ground Start trunks.

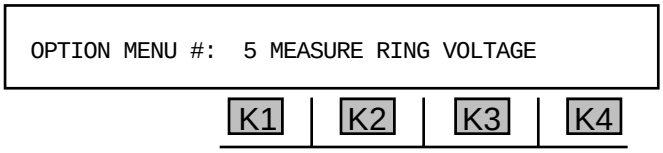
***WARNING!** The ring generator can produce potentially dangerous voltage levels. **DO NOT** touch the test leads while the generator is operating.*

5-5.1 Setup

To set up the **930i** to measure ring voltage:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **5** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

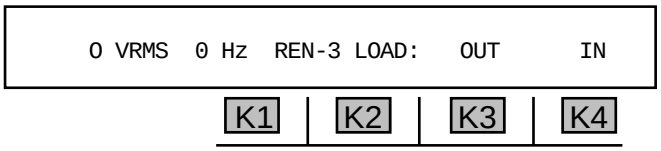


3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The **930i** must be set to **CONTACT** mode in the **Trunk Type** setup. (Refer to **Section 3-2.1, Trunk Type Function Key,** for trunk type setup.)

   If you are in **BATTERY,** the display reads: **NOT APPLICABLE.**

   If you are in **4W LOOP** or **4W GROUND START**, there is no display of the ring level and frequency.

   If you are in **2W LOOP** or **2W GROUND START**, the display reads:



4. Press **K3** under **OUT** to place the **REN-3** Load off-line (as shown above), **OR** press **K4** under **IN** to have the **930i** act as a true **REN-3** Load at its **TR** jacks if you are in 2W or **T1R1 jacks** if you are in 4W.

5. Toggle the **hookswitch** to the **On Hook** position. When ringing is introduced on a 2-wire trunk, the display will show the voltage level in RMS volts (**VRMS**) and the frequency in Hertz (**Hz**).

6. Toggle the **hookswitch** to the **Off Hook** position to trip ringing.

7. Press **K2 or K3** to move the cursor back to **OUT**.

5-6 OPTION MENU #:6 DC VOLT/AMP METER

OPTION MENU #:6, DC VOLT/AMP METER, is a standard feature that provides DC voltage and current measuring capability on metallic (analog) trunks. It allows you to:

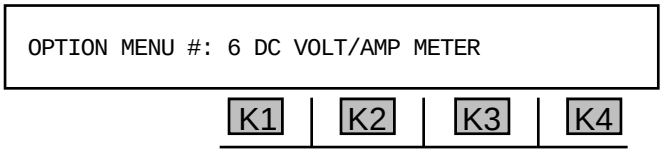
- determine the levels of line signalling voltages and applying the information towards setting thresholds in **OPTION MENU #:7, SUPERVISION THRESHOLDS**.
- measure the DC voltage from Tip-to-Ground, Ring-to-Ground, and Ring-to-Tip on 2-wire Loop and 2-wire Ground-Start trunks.
- measure the DC voltage from TR-to-Ground, T1R1-to-Ground and TR-to-T1R1 on 4-wire Loop and 4-wire Ground-Start trunks.
- measure the DC voltage from E-to-Ground and M-to-Ground on E&M trunks. All voltage readings are printed as signed values to the nearest volt. This feature may be used in either **TERM** or **BRIDGE** mode.
- measure loop current to a **930i** closed contact of a loop start trunk.

5-6.1 Loop and Ground Start Measurements

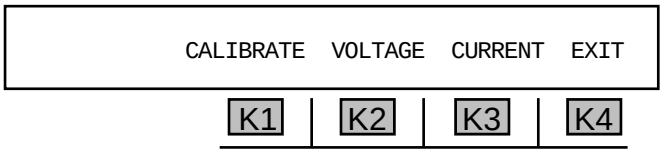
To enter the **loop and ground start measurements** function:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **6** using the **numeric keypad** and then press the **Option Menu** key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



5-6.1.1 Calibrate

To **calibrate** the **930i** prior to testing:

1. Press **K1** under **CALIBRATE** to force the **930i** to calibrate itself prior to making a measurement. You will see the message: **PLEASE UNPLUG CABLES FOR CALIBRATION.** This message will change to: **PRESS ANY SOFT KEY TO CALIBRATE.**

2. Remove any cables connected to the **930i** front panel.

3. Press any soft key (**K1-K4**) to continue.

If calibration is not successful, the display reads: **`CAL FAILED -- CHECK FOR VOLTAGE ON LINE.`**

5-6.1.2 Current

To measure the **office battery current** (available only when the **930i** is emulating the contact end of a normal loop trunk):

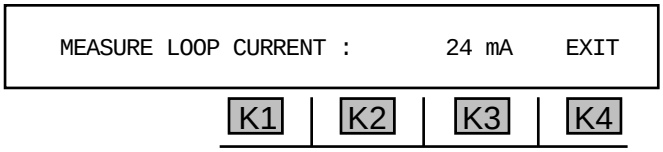
1. Calibrate the **930i**.

2. Plug the test cords back in.

3. Toggle the **hookswitch** to the **OFF HOOK** position.

4. Press **K3** under **`CURRENT`** in the main display. The loop current measurement is displayed.

   for example:



Error messages are provided if you try to measure a parameter with an incorrectly setup trunk.

5. Press **K4** under **`EXIT`** to return to the main **`SET-UP DISPLAY`**.

5-6.1.3 Voltage

To measure **DC office battery voltage** or **930i voltage:**

1. Press **K2** under **`VOLTAGE`** from the main **`SET-UP`** display. A new display measuring Tip-to-Ground (**`TIP TO GND`**) appears.

2. Press **K1** to cycle between Tip-to-Ground (**`TIP TO GND`**), Ring-to-Ground (**`RING TO GND`**), and Tip-to-Ring (**`TIP TO RNG`**) under on- and off-hook states.

   The following table lists the range and accuracy of the various 2-wire and 4-wire DC voltage measurements the **930i** can make:

	Range	Accuracy
Tip-to-Ring and TR-to-T1R1:	+60.0 to -60.0	+/- 3 volt
Tip-to-Ground and Ring-to-Ground:	+0.0 to -60.0	+/- 3 volt
TR-to-Ground and T1R1-to-Ground:	+0.0 to -60.0	+/- 3 volt

Ring to Tip
A typical Ring-to-Tip measurement when on-hook might be **-48 V DC**. If the contact side goes off-hook, a lower reading (less than **-45 V DC**) will be expected as current is drawn through the loop and voltage drops occur.

Tip-to-Ground
In the Tip-to-Ground voltage measurement, an idle state (both sides on-hook) should give a **0 V DC** measurement. This is the proper indication for a Loop Start trunk in the idle state.

When the battery side goes off-hook, a typical measurement of Tip-to-Ground voltage would be **-48 V DC**. This indicates a battery reversal. If these or similar readings are not obtained, this indicates trouble in the loop line signalling circuitry.

3. Press **K4** under **EXIT** to return to the main display.

5-6.2 E&M Measurements

To conduct **E&M measurements**:

1. Select **E&M** in the Trunk Type setup. (Refer to **Section 3-1.2, Trunk Type Operation,** for setup.)

2. Calibrate the **930i** (Refer to **Section 5-6.1.1**.)

3. Conduct a voltage test. (Refer to **Section 5-6.1.3.**)

   The following table shows the range and accuracy of the E&M 2-wire and 4-wire DC voltage measurements:

	Range	Accuracy
M-to-Ground and E-to-Ground:	+0.0 to -100.0	±3 volt

5-7 OPTION MENU #:7 SUPERVISION THRESHOLDS

OPTION MENU #:7, SUPERVISION THRESHOLDS is a standard feature that allows you to set the line signalling thresholds for the off-hook/on-hook LEDs. If expected voltages are not present and the line signalling LEDs flicker or do not light, the threshold needs to be changed.

You cannot change the level of the line signalling voltage, which the **930i** supplies as an output. This is fixed at **48 V** and **ground**. Voltage levels are printed as absolute values: **< 45 V** does not mean "more negative" than **-45 V**. It means less than **45 V** of potential. Values can be set to the nearest volt with an accuracy of ±**0.5 V**. Use **OPTION MENU #:6, DC VOLT/AMP METER,** to examine the current and voltage levels.

Supervision Threshold Ranges for 48 V DC

Normal Loop Start Supervision

Voltages above **39 V** will cause an **On Hook** indication from the line signalling lamps. Voltages above **3 V** and below **39 V** will cause an **Off Hook** indication. A reversal of **-48 V** and ground indicates the battery side **Off Hook**. (Refer to **Section 5-7.2** for detailed setup information.)

Ground Start Supervision

Voltages on Ring above **33 V** indicate **On Hook** at the contact side. Voltages on **Tip** in excess of **33 V** indicate **On Hook** on the battery side.

E&M Supervision

Originating End (SEND-M) Indications

The **ORIG LED** shows the status of the **'M'** lead. An **Off Hook** indication is provided if the voltage is above **39 volts**. The LEDs will not be lit for voltages above **11 V** but below **39 V**. The LEDs indicate **On Hook** if the voltage is less than **11 V**. (Refer to **Section 5-7.3** for detailed setup information.)

The **TERM LED**s show the status of the **'E'** lead. An **Off Hook** indication is provided if the voltage is below **11 V**. The **LED**s will not be lit for voltages above **11 V** but below **39 V**. The **LED**s show an **On Hook** if the voltage is above **39 V**. (Refer to **Section 5-7.3** for detailed setup information.)

Terminating End (SEND-E) Indications

In this case, the **ORIG LED** shows the status of the **'E'** lead. The LEDs will indicate an **Off Hook** status if the voltage is below **11 V** and **On Hook** if the voltage is above **39 V**. The **LED**s will not be lit for voltages above **11 V** but below **39 V**. (Refer to **Section 5-7.3** for detailed setup information.)

The **TERM LED**s show the status of the **'M'** lead. The LEDs will indicate an **Off Hook** status if the voltage is above **39 V** and **On Hook** if the voltage is less than **11 V**. The **LED**s will not be lit for voltages above **11 V** but below **39 V**. (Refer to **Section 5-7.3** for detailed setup information.)

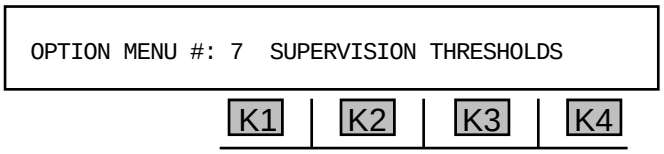
The following sections provide examples for setting Loop Start and E&M trunk line signalling thresholds to accommodate **24 V** line signalling instead of the normal **48 V**.

5-7.1 Loop Supervision Thresholds Other Than 48 V DC

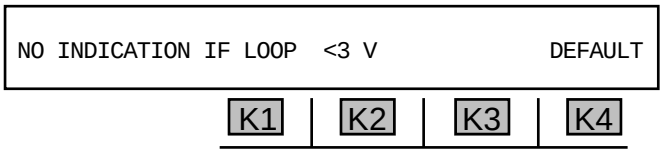
To set the **loop line signalling threshold**:

1. Set the **930i** to **NORMAL LOOP CONTACT 2W 600** or **900** under the **Trunk Type** function key. (Refer to **Section 3-2.1, Trunk Type Function Key,** for setup information.)

2. Press the **Up/Down Arrow** keys to scroll through the option menus, **or** select **7** using the **numeric keypad** and then press the **Option Menu** key. The display reads:

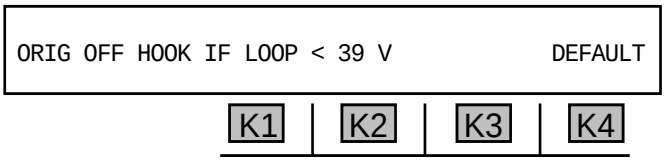


3. Press **ENT or** any soft key **(K1-K4)** to activate your selection. The display reads:



The display above shows that if there is no talk battery present ("dry" loop), there will be no voltage across the loop, and the **930i** will turn off all line signalling **LED**s. This threshold is preset at **3 V**. For this example, this value will be adequate.

4. Press **K1, K2,** or **K3** to advance the display to the next choice. The display reads:



When the originate, or **CONTACT**, side of the circuit goes off-hook, it closes the loop between **Tip and Ring** (2-wire) or **TR** and **T1R1** (4-wire). This lowers the voltage difference across the loop. On a short loop, or near the contact end of the circuit, this voltage will be very small. Near the battery (Central Office) end on a long loop, this voltage can remain fairly large. The **930i** sees the **CONTACT** end as being off-hook when the voltage across the loop falls below **39 V**. If a PBX is being tested and it is powered from **-24 V** instead of **-48 V**, the threshold of the **930i** should be set to about **20 V**.

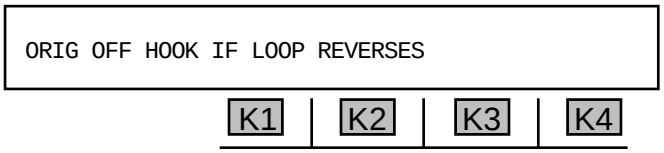
To set the **threshold** to **20 volts**:

1. Use the **numeric keypad** to enter the number **20**.

2. Press the **ENT** key. This value will now be remembered by the **930i**.

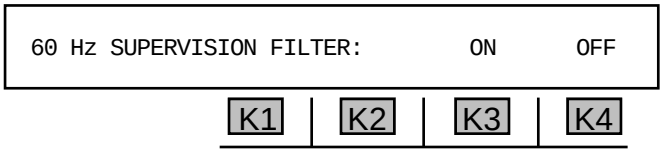
3. Press **K4** under **DEFAULT** when you have finished testing or the readings will be incorrect when you return to normal **48 V** trunks. The default value is **39 V**.

If you set the trunk type to emulate the Central Office, or **Battery** end of the circuit, the display below appears as a reminder:



The display above explains that the **930i** expects the battery (Central Office) side of a loop start circuit to provide **-48 V** on **Ring** (2-wire) or **T1R1** (4-wire) in **Normal** mode. In **Loop Reverse**, the **930i** expects to see **-48 V DC** on **Tip** (2-wire) or **TR** (4-wire). It interprets this as the normal on-hook condition. A reversal from **–** to **+** is interpreted as the battery side of the circuit being off-hook. There is no voltage threshold.

4. Press **K1, K2,** or **K3**. The **930i** prompts you to turn the **60 Hz** filter on or off:



5. If you are receiving **DP** digits, press **K4** to turn this filter **0FF**. Otherwise, press **K3**.

6. Press the **Option Menu** function key to exit from this display.

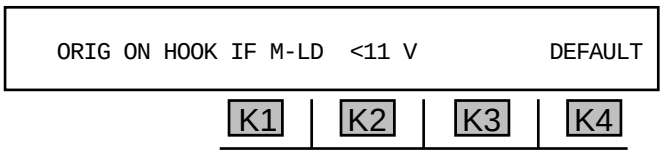
5-7.2 24 VDC: E&M Supervision Thresholds

The various **E&M Types** (1 through 5) have different means of providing line signalling battery to the **'E'** and **'M'** leads, but the end result is the same. In one line signalling state the lead is held at **-48 V**. In the other state it is held close to ground. The intermediate voltages are interpreted as “no indication” and the **930i** turns off the appropriate **LED**s.

for example:

The **930i** is assumed to be set to **`E&M I SEND-M 4W`** operation with a **24 V** supervised trunk instead of the normal **48 V**.

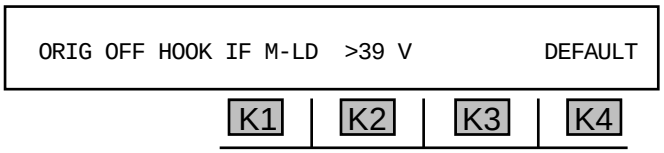
1. Enter **OPTION MENU #:7**. The display reads:



Since **24 V** is half of **48 V**, a good guess is to reduce everything displayed by half.

2. Use the **numeric keypad** to enter **6** (which is roughly half of **11**) and press **ENT**.

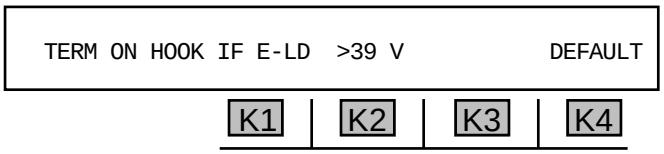
3. Press either **K1, K2,** or **K3**. The display reads:



In this case the **930i** provides an **Off Hook** indication on the **ORIG LED**s if the voltage on the **'M'** lead exceeds the **39 V** threshold. This value has to be changed to **20 V** (roughly half of **39**).

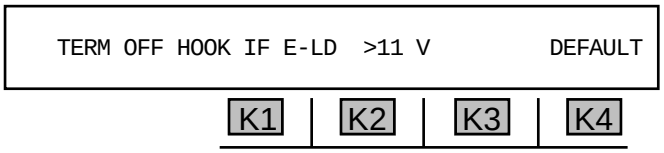
4. Enter **20** from the **numeric keypad** and press **ENT**.

5. Press **K1, K2,** or **K3**. The display reads:



The **930i** provides no line signalling indication if the voltage on the **'E'** lead is below the high threshold of **39 V** but above the low threshold of **11 V**. The high threshold can be changed to **20 V** as before.

6. Press **K1, K2,** or **K3**. The display reads:



An **Off Hook** indication on the front panel LEDs will be provided if the voltage on the **'E'** lead is below the **11 V** low threshold.

7. Change the voltage to **6 V** (roughly half of **11**).

8. Press the **Option Menu** function key to exit when the thresholds have all been set.

9. Return to each of the displays after you are finished testing and reset them to their default values to avoid problems on normal circuits.

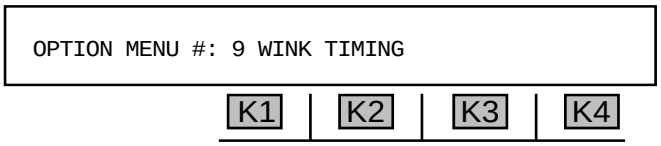
5-9 OPTION MENU #:9 WINK TIMING

OPTION MENU #:9, WINK TIMING is a standard feature that enables timing of wink, pre-wink, and off-hook supervision events. It is used with **OPTION MENU #:2, SEND DIGIT SEQUENCES, OPTION MENU #:4, DIGIT RECEIVER (Analog only)**, or **OPTION MENU #:4, DIGIT Analyzer (PCM only).** To set **wink timing**:

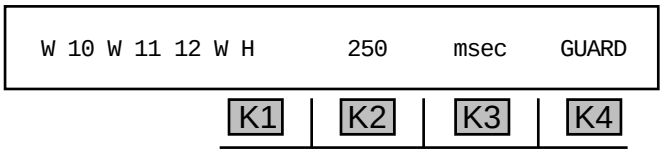
1. Set up a digit sequence in **OPTION MENU #:2, <u>or</u>** set up the sequence to be received in **OPTION MENU #:4** and then outpulse the call.

3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **<u>OR</u>** select **9** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display below shows a sequence that was keyed-in under **OPTION MENU #:2, SEND DIGIT SEQUENCES**.



A flashing cursor appears over the last completed wink (**W**), off-hook (**H**), or failed event in the sequence. If the sequence has not yet been outpulsed, all measurements will be zero.

There will be a measurement (**NNNN msec**) where **NNNN** is the length of time in milliseconds spent waiting for the event (the guard time). The word **GUARD** is displayed to label the measurement. This is the time from the previous event to the beginning of the wink. If the guard time exceeds 16 seconds, the event "fails." In such a case the **GUARD** display reads **>16000 msec**, and the wink or off-hook measurement reads **FAILED**.

6. Use the **Left/Right Arrow** keys to move the cursor within the sequence to examine any supervision event.

7. Use **K4** to toggle between **GUARD** and **WINK** timing measurement (if the event is a Wink), or **GUARD** and **OFF HOOK** time measurement (if the event is an off-hook). The actual off-hook time is not measured but merely a message that it exceeded the >2 sec threshold.

A wink fails if its duration is greater than **600 msecs**. An off-hook fails if its duration is less than **200 msecs**. You can also use **Wink Timing** to measure Delay Dial events as set up in **OPTION MENU #:2** or **OPTION MENU #:4**. A Delay Dial event fails if the Guard period exceeds **16 seconds**, or if the off-hook period exceeds **16 seconds**.

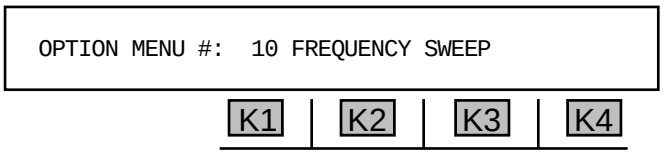
5-10 OPTION MENU #:10 FREQUENCY SWEEP

OPTION MENU #:10, FREQUENCY SWEEP is a standard feature that allows the **930i** to sweep up or sweep down in frequency, either one time or continuously.

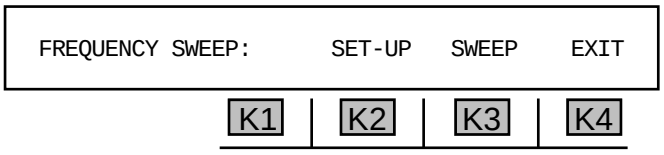
To **sweep up or down in frequency**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **10** using the **numeric keypad** and them press the **Option Menu** function key. The display reads:



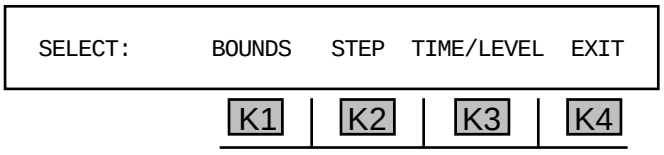
3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



5-10.1 Setup

To change the default parameters of the frequency sweep:

Press **K2** under **SET-UP.** The **SELECT** display reads:

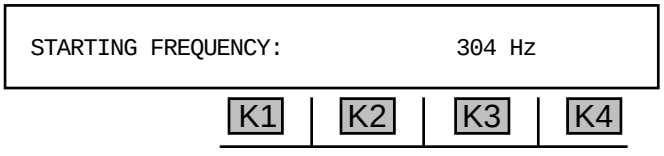


5-10.1.1 Bounds

BOUNDS are the beginning and ending frequencies between which the **930i** conducts its sweep.

To change the starting or ending **frequency parameters**:

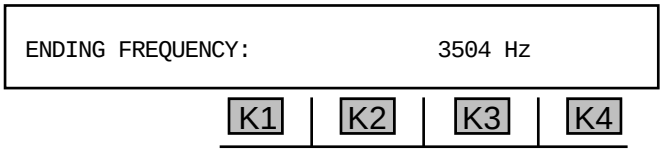
1. Press **K1** under **BOUNDS.** The display reads:



2. Use the **numeric keypad** to enter a new frequency.

   • A valid **starting frequency** is between **304** and **3504 Hz**.

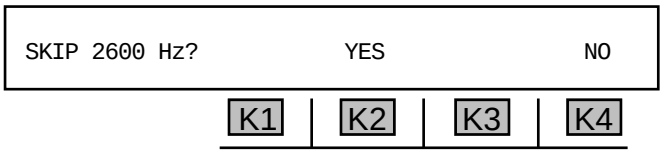
3. Press any soft key (**K1-K2**) **or ENT**. The display reads:



4. Use the **numeric keypad** to enter a new **frequency**.

   • A valid **ending frequency** is between **304** and **3504 Hz**.

5. Press any soft key (**K1-K4**) **or ENT**. The display reads:



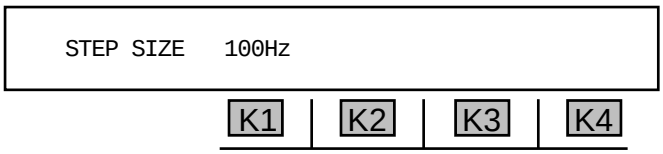
6. Press **K2** under **YES** to skip **SF** (**2600 Hz**) and **Loop Frequency (2713 HZ) OR K4** under **NO**. You will be returned to the **SELECT** display.

5-10.1.2 Step

The **STEP** denotes the frequency intervals through which the **930i** will sweep (e.g., every 100 Hz).

To change the **step size**:

1. Press **K2** under **STEP** from the **SELECT** display. The new display reads:



2. Use the **numeric keypad** to enter a new **step size** and press any soft key (**K1-K4**) **or ENT.** You will be returned to the **SELECT** display.

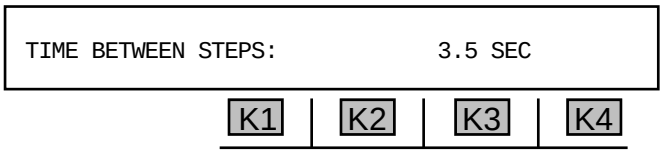
   • A valid **step size** is between **1** and **999 Hz.**

5-10.1.3 Time/Level

TIME refers to the time interval that the **930i** pauses at each frequency step.
LEVEL is the level of the send tone.

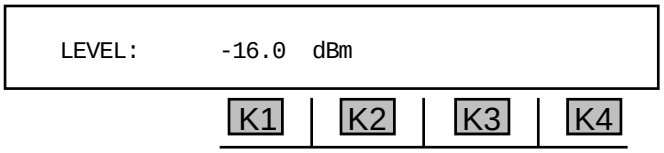
To change the step **time and level**:

1. Press **K3** under **`TIME/LEVEL`**. The display reads:



2. Use the **numeric keypad** to enter a new **pause between steps**.

3. Press **ENT**. The display will advance to the **Level** field. The display reads:

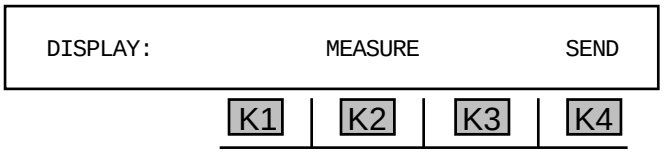


4. Use the **numeric keypad** to enter a new **level** and press **K4** under **`EXIT`** to return to the main sweep select display.

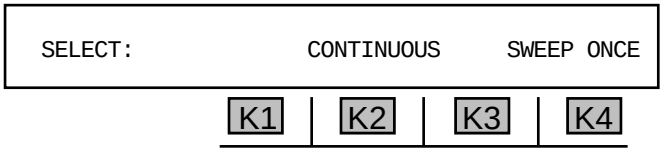
5-10.2 Sweep

To **sweep** a frequency range:

1. Press **K3** from the **`FREQUENCY SWEEP`** display. The new display reads:



2. Press **K4** under **`SEND`** if you want to display what you are sending, **OR** press **K2** under **`MEASURE`** if you require a measurement. The measure function displays the measured frequency as you sweep on the transmit. The display reads:



3. Press **K2** under **`CONTINUOUS`** to continuously repeat the sweep, **OR** press **K4** under **`SWEEP ONCE`** to sweep only one time. You will immediately hear the sweep tone, and the **930i** will display the selected transmitted or received frequency as the sweep continues. In the **Measure** mode, this is the received level and frequency. The **930i** will display the outgoing frequency and level if it is not in the **Measure** mode.

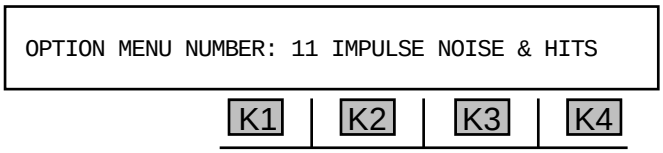
5-11 OPTION MENU #:11 IMPULSE NOISE & HITS

OPTION MENU #:11, IMPULSE NOISE & HITS is only available when *Purchased Option 930i-100 Data Test Package,* has been installed. It is used in conjunction with **OPTION MENU #:18, PHASE AND AMPLITUDE JITTER**. This option enables you to access the impulse noise and hits function and measure of the transients known as phase hits, gain hits, and dropouts.

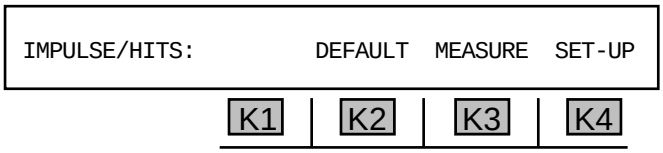
To access the **impulse noise and hits** function:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **11** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



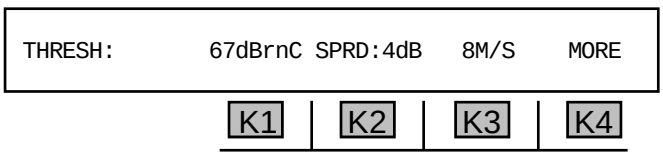
4. Press **K2** under **DEFAULT** to set the **930i** to **4 dB** spread and **7** measurements per second**.** The **930i** will display **DEFAULTS SET** momentarily. The default threshold for **PCM** is **67 dBm** and for **Analog** is **54 dBm**.

5. Press **K3** under **MEASURE** if you want to measure with the default settings. The display will advance to the first measurement display shown in **Section 5-11.2**.

5-11.1 Setup

For a setup other than the default specifications shown above:

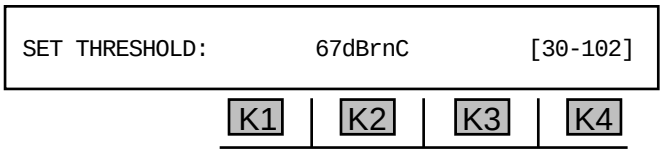
Press **K4** under **SET-UP**. The **SET-UP** display reads:



5-11.1.1 Noise Threshold

To change the **noise threshold**:

1. Press **K1**. The display reads:



2. Use the **numeric keypad** to enter a new **threshold**.

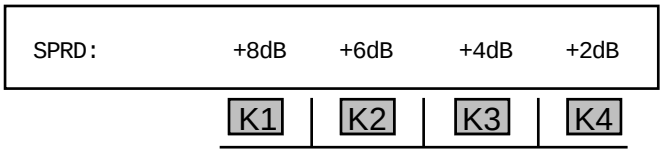
   • A valid **threshold** is between **30** and **102 dBrnC.**

3. Press any soft key (**K1-K4**) to return to the second **SET-UP** display.

5-11.1.2 Spread

To change the **spread**:

1. Press **K2** under **SPRD: N dB** from the **THRESH** display. The display reads:



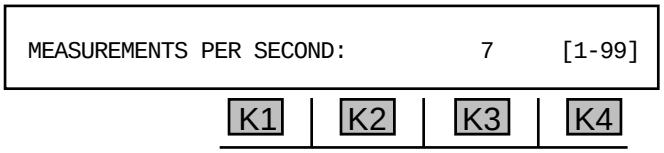
   ***8 dB** spread is not available with thresholds above **96 dBm**.*

2. Press the appropriate soft key (**K1-K4**). You will be returned to the second Set-Up display.

5-11.1.3 Measurements Per Second

To enter the desired **measurements per second:**

1. Press **K3** under **8 M/S**. The display reads:



2. Use the **numeric keypad** to enter a new number of **measurements per second**.

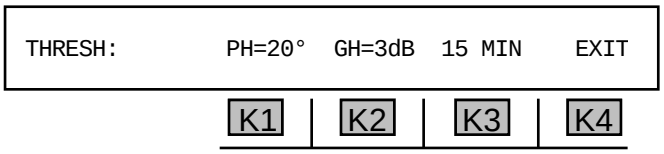
   • A valid number of **measurements per second** is between **1** and **99.**

3. Press **ENT or** any soft key (**K1-K4**) to return to the **SET-UP** display.

5-11.1.4 PH/GH Thresholds and Test Length

To select the appropriate **phase hit** and **gain hit thresholds** and **test length**:

1. Press **K4** under **MORE.** The display reads:



2. Press **K1** to change the phase hit (**PH**) threshold **OR K2** to change the gain hit (**GH**) threshold. The display reads either **ENTER PHASE HIT THRESHOLD** or **ENTER GAIN HIT THRESHOLD**.

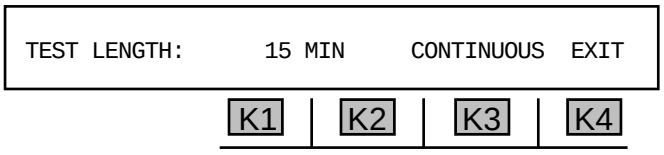
3. Use the **numeric keypad** to enter new **thresholds**.

- A valid **phase hit threshold** is between **1**° and **45**°.
- A valid **gain hit threshold** is between **1 dB** and **10 dB**.

Option Menu #: 11

4. Press **ENT**. You will be returned to the **THRESH** display.

5. Press **K3** under **15MIN**. The display reads:



6. Press **K1 or K2** to select a **measurement interval, OR** enter a value from the **numeric keypad**.

- A valid **interval** is between **1** and **99** minutes. The default is 15 minutes (**15 MIN**).

7. Press **K3** to select **CONTINUOUS** measurement. You will be returned to the threshold selection display.

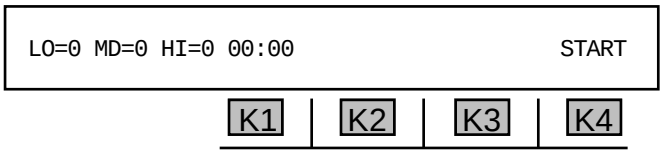
8. Press **K4** under **EXIT**. The **930i** will proceed to the start display below. (You will also reach this display by pressing **K3** under **MEASURE** in the main **Impulse/Hits** display.)

5-11.2 Measure

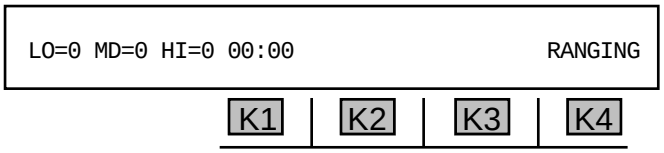
To begin **measuring:**

1. Press **K3** under **MEASURE** from the **Impulse/Hits** display. If you have completed the previous setup instructions for non-default parameters.

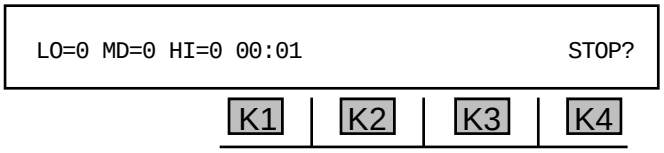
The display reads:



2. Press **K4** under **START** when you are ready to start testing. The display reads:



This display is only momentary and is replaced by the measurement display:

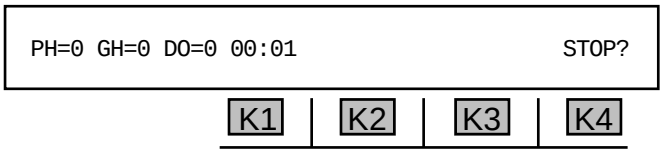


The **LO** value is the threshold setting, the **MED** setting is threshold + spread, and **HI** is threshold +2X spread.

If you need to stop the test, press **K4** under **STOP**. Otherwise the test will accumulate impulse noise as selected under the **TEST LENGTH** display.

If the test is to be performed with holding tone over a loopback circuit, the **930i** should be set to send **1020 Hz** at **-13.0 dBm** using the **Send Tone** function. If the received holding tone drops below **-40.0 dBm** during the test, the words **NO TONE!** appear above **K4**.

3. Press any soft key (**K1-K4**) to display the **Phase Hits**, **Gain Hits**, and **Dropouts**. The display reads:



4. Press the **Option Menu** function key to exit.

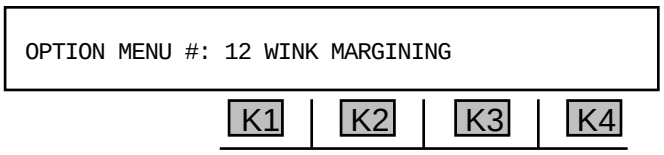
5-12 OPTION MENU #:12 WINK MARGINING

OPTION MENU #:12, WINK MARGINING, is a standard feature that lets you change the length of time the **930i** will wait (**200 milliseconds**) after it sees a seizure before it gives back a wink. This is called the pre-wink time or guard time.

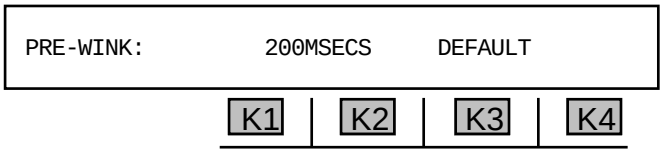
To change the **default margining**:

1. Press the **Option Menu** function key.

2. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **12** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



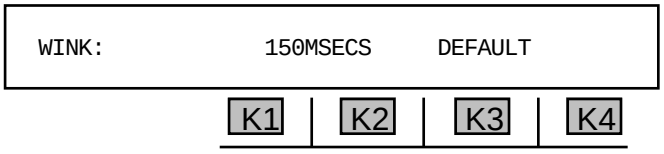
3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Use the **numeric keypad** to change the displayed pre-wink time, **OR** press **K3** under **DEFAULT** to accept it.

   • A valid **pre-wink time** is between **75** and **999 MSECS**. The default value is **200 MSECS** with an accuracy of ±**10 MSECS**.

5. Press **ENT**. The display reads:



6. Use the **numeric keypad** to change the displayed wink time, **OR** press **K3** under **DEFAULT** to accept the default value. The wink time is the number of milliseconds the **930i** will remain off-hook during a wink.

   • A valid **wink time** is between **35 MSECS** and **999 MSECS**. The default value is **150 MSECS** with an accuracy of ±**10 MSECS**.

7. Press **Option Menu** function key to exit the display.

5-13 OPTION MENU #:13 PHASE & AMPLITUDE JITTER

OPTION MENU #:13, PHASE & AMPLITUDE JITTER, is only available when *Purchased Option 930i-100, Data Tests,* is installed. This feature provides the capability to measure phase and amplitude jitter on voice frequency channels as well as transient phenomena such as phase hits, gain hits, and dropouts.

The phase and amplitude jitter measurements are displayed under **OPTION MENU #:13** and the hits are counted with impulse noise under **OPTION MENU #:11**.

Phase/Amplitude jitter is a dithering of the phase which appears as phase or frequency modulation. It is measured by sending a test tone of **1020 Hz**. At the receive end, a phase locked loop establishes a phase reference and jitter is measured relative to this reference. Phase jitter measurements are made over a **4 Hz** to **300 Hz** range in two bands: **20 Hz** to **300 Hz** and the entire **4 Hz** to **300 Hz** band. Jitter standards for data transmission are no more than **10˚** between **20 Hz** and **300 Hz** and **15˚** between **4 Hz** and **300 Hz**.

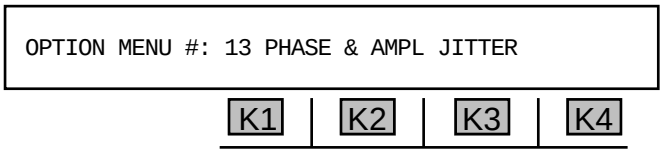
To measure **phase and amplitude jitter**:

1. Connect the **930i** to the trunk under test.

2. Perform a **Psophometric Noise** measurement prior to measuring phase jitter. Excess noise can cause what appears to be significant amounts of jitter (readings should be less than **20 dBm** for quiet terminated line).

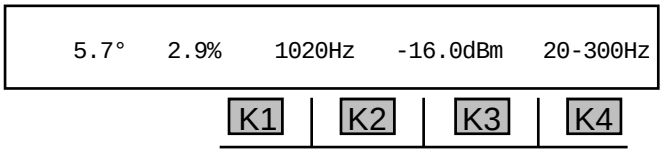
3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **13** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The **930i** begins measuring phase and amplitude jitter over the filter bandwidth of **20 Hz** to **300 Hz** and displays the level and frequency of the received holding tone (usually **1004 Hz**).

   for example:



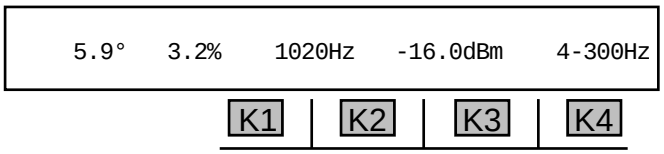
Phase jitter requires a test signal of **1004 Hz**. If the actual frequency of the test tone differs by more than ±**20 Hz** from the nominal value, or is below **-40 dBm** in level, the **930i** will indicate **`INVALID TONE`**:

The **930i** begins measuring phase and amplitude jitter over the filter bandwidth of **20 Hz** to **300 Hz** and displays the level and frequency of the received holding tone (usually **1020 Hz**).

If you receive an invalid tone, you should press the **Option Menu** key to stop testing and return to the main display to check your setup and connections. If a tone is valid, the display will show the measurements.

6. Press **K4** under **`20-300 Hz`** to change the filter bandwidth selection from **`20–300 Hz`** to **`4–300 Hz`**.

   for example:



If the readings are relatively the same in the **20-300Hz** test and the **4-300Hz** test, then the source of the excess jitter probably has a fundamental frequency above **20 Hz** because there are no significant contributions to the levels from below **20 Hz**.

Between **20 Hz** and **300 Hz** the most significant source of jitter is the **60 Hz** AC power line frequency and its 2nd through 5th harmonics (**120 Hz, 180 Hz, 240 Hz, 300 Hz**).

7. Press the **Option Menu** function key to exit this function.

Option Menu #: 13

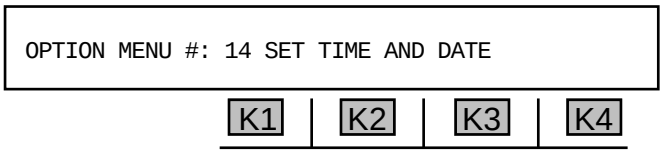
5-14 OPTION MENU #:14 SET TIME AND DATE

OPTION MENU #:14, SET TIME AND DATE, is a standard feature that allows you to set the time and date on the **930i** internal clock.

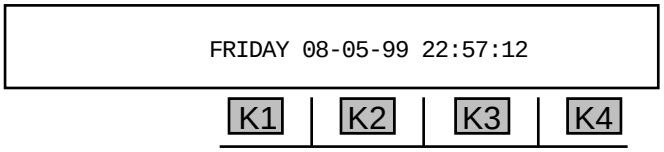
To set the **time and date**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **14** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT** or any soft key (**K1-K4**) and the currently stored time and date will appear. The cursor is over the day of the week.



4. Use the **Left/Right Arrow** keys to position the cursor over the day, date, or time parameter.

5. Use the **Up/Down Arrow** keys to change the parameter under the cursor **or**, for the date and time, you can also use the **numeric keypad** to enter the number directly.

6. Press the **Option Menu** function key to exit.

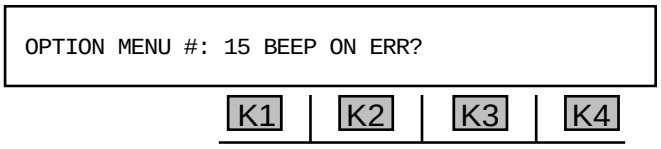
5-15 OPTION MENU #:15 BEEP ON ERR?

OPTION MENU #:15, BEEP ON ERR?, is a standard feature that provides you with the ability to turn on and off the audible beep that indicates various types of errors, generally **PCM**. Disabling the beep does not prevent the **930i** from sending the "Bell" character (ASCII 07) to a remote printer, terminal, or computer. (Refer to **Section 6, Remote Control Operation** for more information.)

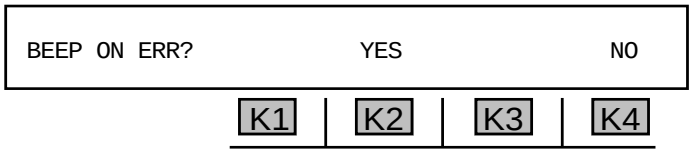
To turn the **beep on/off**:

1. Press the **Option Menu** function key.

2. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **15** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K4** under **NO** to turn the beep **OFF**, **OR** press **K2** under **YES** to turn the beep **on**.

5. Press the **Option Menu** function key to exit this function.

Option Menu #: 15

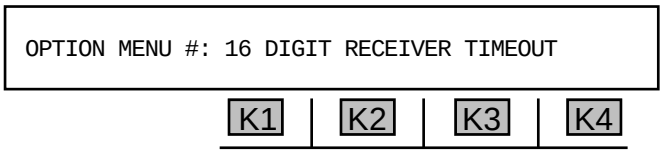
5-16 OPTION MENU #:16 DIGIT RECEIVER TIMEOUT

OPTION MENU #:16, DIGIT RECEIVER TIMEOUT, is a standard feature that allows the **930i** to set a timeout for the digit receiver. If the timeout elapses while the digit receiver is expecting a digit, the **930i** closes the digit record. This allows the digit receiver to be used more easily when an unknown number of **DTMF** or dial pulse digits are expected.

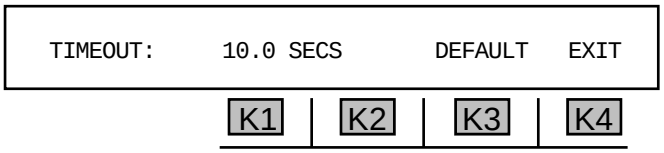
To set the **digit receiver timeout**:

1. Press the **Option Menu** function key.

2. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **16** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT** or any soft key (**K1-K4**) to activate the selection. The display reads:



4. Use the **numeric keypad** to enter a new **timeout**.

   - A valid **timeout** is between **0.1** and **99999.9 SECS**.
   - If you are in **OPEN** mode in the dry circuit trunk type, set the timeout to **99999.9 SECS**.
   - The **default** is **10.0 SECS**. (Pressing **K3** sets the timeout to the default.)

If you do not set the timeout to **99999.9 SECS**, the **930i** may shift to hold to turn off the Digit Receiver after the time out. (After the first record is complete, it may take longer than 10 seconds to receive the digits for the second, third, and consecutive records.) When in **OPTION MENU #:4, DIGIT RECEIVER,** press **K3** under **HOLD** to release the **930i** from this condition. Return to **OPTION MENU #:16, DIGIT RECEIVER TIMEOUT,** to reset the timer to **99999.9 SECS** again.

5. Press **K4** under **EXIT** when complete.

6. Select **OPTION MENU #:4, DIGIT RECEIVER,** to complete the procedure. (Refer to **Section 5-4, OPTION MENU #:4, Digit Receiver,** for more information on receiving digits.)

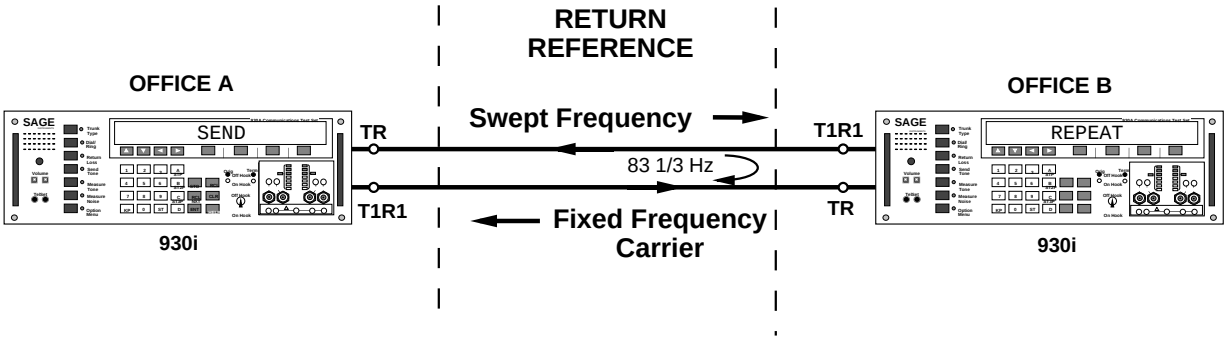
5-17 OPTION MENU #:17 ENVELOPE DELAY

OPTION MENU #:17, ENVELOPE DELAY, is available only when *Purchased Option 930i-100, Data Test Package,* is installed. Envelope Delay Distortion (EDD) is always an end-to-end test. It requires test sets at both ends of the circuit and a 4-wire transmission path. One end is set up in the **REPEAT** (or Slave) mode, and the other end is set up in **SEND** (or Master) mode. The **SEND** unit transmits a single frequency (usually **1804 Hz**) to establish a reference delay. This delay is "zeroed out," and the **SEND** unit sends a frequency sweep while the **REPEAT** unit continues sending reference. The **SEND** unit measures delay in microseconds relative to the reference. The **SEND** end then transmits the reference frequency while the **REPEAT** end sweeps the returned carrier. All delay measurements are made at the **SEND** end. These tests are commonly referred to as Return Reference and Forward Reference measurements.

Envelope Delay Distortion (EDD) results when different frequencies travelling along a circuit arrive at different times, even though the frequencies were transmitted together. This occurs when the rate of change of phase shift with frequency over the bandwidth of interest is not constant. **EDD** measurements are usually stated as one-half the difference between the delays of the two frequency extremes of the band of interest.

Option Menu #: 17

An **envelope delay distortion** measurement proceeds as shown below:



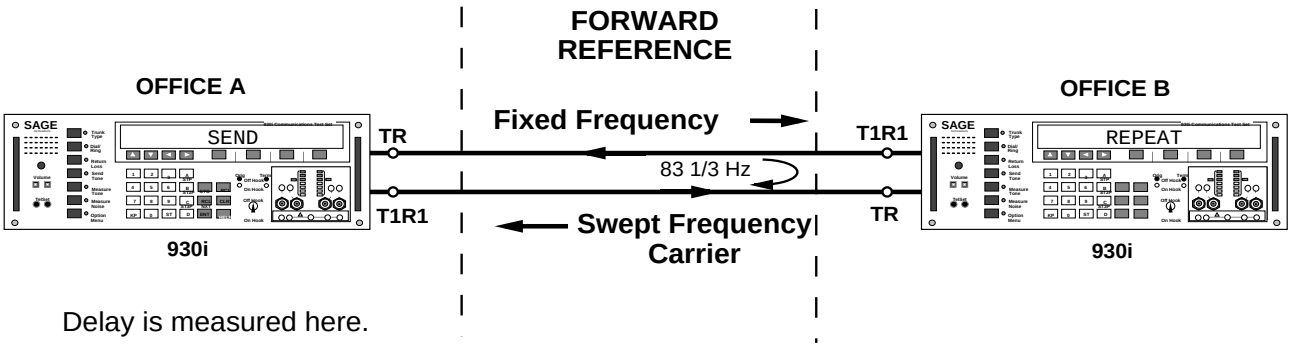
1. **Office A** sends an amplitude-modulated signal over the trunk under test.

2. **Office B** strips off the modulation and applies it to a carrier.

3. **Office A** recovers the returned modulation and compares it to that being sent. The difference in phase is proportional to the envelope delay.

4. The delay at a reference frequency is used as a zero reference, and a frequency sweep is then performed by the **SEND** unit. The delay at the other frequencies is measured in microseconds relative to the reference.

5. The **SEND** unit sends the reference frequency while the **REPEAT** unit sweeps the returned carrier. This allows the **SEND** unit to measure the delay on the return path.



Delay is measured here.

To use the **envelope delay distortion measurement** function:

1. Decide at this point which unit will be the **SEND** end and which will be the **REPEAT** end. **Envelope Delay** operates on any 4-wire trunk type that does not have DC supervision on **T/R** and **T1/R1** connections. Operation in other trunk types will result in degraded accuracy.

2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **17** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:


```
OPTION MENU #: 17 ENVELOPE DELAY
```

K1 | K2 | K3 | K4

4. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:

```
SELECT:      SET-UP   SEND   REPEAT   EXIT
```

K1 | K2 | K3 | K4

5-17.1 Setup

To select the envelope delay distortion measurement **parameters**:

Press **K1** under **SET-UP.** The display reads:

```
SELECT:      BOUNDS   STEP  TIME/LEVEL EXIT
```

K1 | K2 | K3 | K4

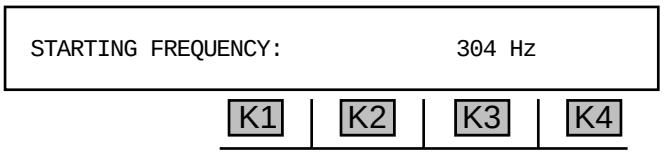
The **930i** default parameters have been preset to sweep from **304 Hz** to **3504 Hz** in **100 Hz** steps at a level of **-16 dBm** and a time between steps of **3.5** seconds with the **SF** frequency (**2600 Hz**) skipped.

5-17.1.1 Bounds

BOUNDS are the beginning and ending frequencies between which the **930i** will conduct its sweep.

To change the starting or ending **frequency parameters**:

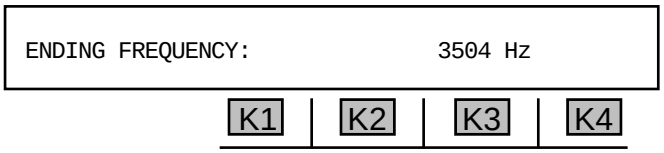
1. Press **K1** under **BOUNDS.** The display reads:



2. Use the **numeric keypad** to enter a new **starting frequency**.

   • A valid **starting frequency** is between **304 Hz** and **3504 Hz.**

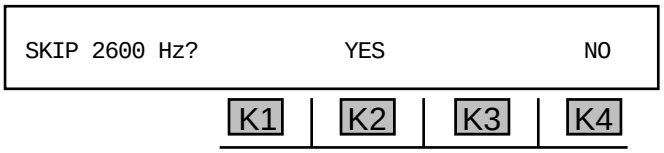
3. Press any soft key (**K1-K4**) or **ENT**. The display reads:



4. Use the **numeric keypad** to enter an **ending frequency**.

   • A valid **ending frequency** is between **304 Hz** and **3504 Hz**. If your starting frequency is less than your ending frequency, the frequency will increment according to the **Step** and **Time/Level** you've indicated until it reaches **3500 Hz** and will then stop.

5. Press any soft key (**K1-K4**) **or** the **ENT** key. The display reads:



6. Press **K2** under **YES** to skip **SF** (**2600 Hz**) and **Loop Frequency (2713 HZ) OR** press **K4** under **NO**. You will be returned to the **SELECT** display.

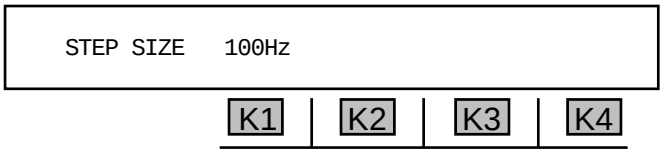
5-17.1.2 Step

The **STEP** denotes the frequency intervals at which the **930i** will take its measurements. (e.g., every 100 Hz).

Option Menu #: 17

To change the **step size**:

1. Press **K2** under **`STEP`** from the **`SELECT`** display. The new display reads:



2. Use the **numeric keypad** to enter a new **step size** and press **ENT** to return to the **`SELECT`** display.

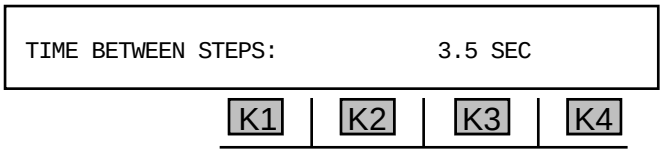
   • A valid **step size** is between **`1`** and **`999 Hz.`**

5-17.1.3 Time/Level

TIME refers to the time interval that the **930i** pauses at each frequency step.
LEVEL is the level of the send tone.

To change the **step time** and **level**:

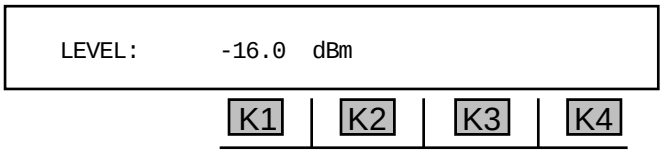
1. Press **K3** under **`TIME/LEVEL`**. The display reads:



2. Use the **numeric keypad** to enter a new **interval between steps**.

   • A valid **interval between steps** is between **`0.1 SEC`** and **`9.9 SEC`**.

3. Press **ENT**. The display will advance to the **Level** field. The display reads:



4. Use the **numeric keypad** to enter a new **level** and then press **K4** under **`EXIT`** to return to the main **EDD** selection display.

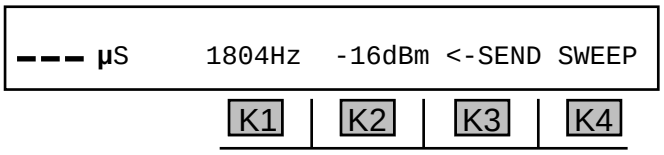
   • A valid **level** is between **`-40 dBm`** and **`0 dBm.`**

Since this display is taken directly from **OPTION MENU #:10, FREQUENCY SWEEP,** levels may be entered from **`+12.0 dBm`** to **`-60.0 dBm`** and they will appear to be accepted. However, the **930i** will only transmit over the **`0 dBm`** to **`-40.0 dBm`** range allowed in EDD measurements.

5-17.2 Send

To send a signal in **EDD** mode:

1. Press **K2** under **SEND** from the **EDD SELECTION** display. The display reads:



This display shows the calculated phase delay in microseconds for the return reference signal from the **REPEAT**, or slave unit, and the level and frequency of the signal being sent from the **SEND**, or Master unit. All measurements of **EDD** are made at the **SEND** end of the circuit. **EDD** is also a referenced measurement.

2. Use the **numeric keypad** to enter a new **frequency** and press **ENT**, **OR** use the **Up/Down Arrow** keys to scroll through the possible selections.

   • A valid **frequency** is between **304 Hz** and **3504 Hz.**

3. Press **K2** under the desired level. The cursor will move to the last digit of the level.

4. Use the **numeric keypad** to enter a new **level**, **OR** use the **Up/Down Arrow** keys to scroll through the possible selections and press **ENT**.

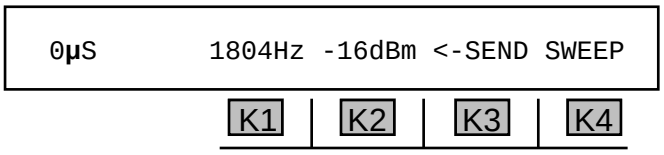
   • A valid **level** is between **-40 dBm** and **0 dBm.**

5. Allow the reading (at the far left of the display) to stabilize before setting the reference delay; wait approximately **15-20** seconds.

6. Press **K4** under **SETREF**.

The current delay reading will become the reference and all subsequent measurements will be relative to this reference. This effectively "zeros out" the current measurement. Once a reference has been established, the frequency or level of the outgoing reference signal can be changed or the frequency sweep can be generated. You will hear a high pitch tone.

The display should resemble the one shown below:



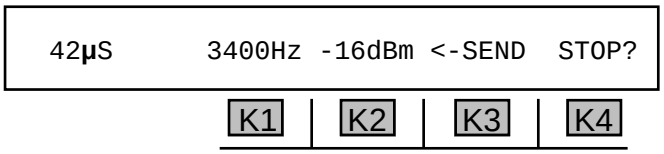
Notice the **SETREF** display has changed to **SWEEP**.

7. Press **K4** under **SWEEP** to send a sweep and perform a return reference measurement after setting the reference delay.

Option Menu #: 17

The delay is measured and displayed for each frequency in the sweep. If the **930i** is in **PRINTER** remote mode the **930i** will automatically print the delays. (Refer to **Section 5-3, OPTION MENU #:3, Remote Control,** or **Section 6, Remote Control Operation**.)

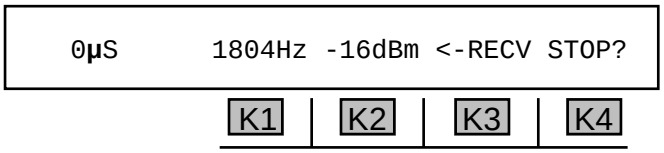
8. Press **K4** under **STOP?** to interrupt the sweep, without leaving the **SEND** mode.



When the sweep completes or is interrupted, the **930i** will revert to sending the reference frequency and **K4** will again be labeled **SWEEP**. The sweep can be repeated or the frequency of the signal can be manually set to examine the delay at frequencies of interest.

9. Press **K3** under **<-SEND** to examine the level and frequency of the returned carrier. The received level and frequency is displayed and the label above **K3** changes to: **<-RECV**.

10. Press **K3** under **<-RECV** to toggle between viewing the outgoing signal and the returned carrier at any time. An example display of the returned reference carrier while sweeping from the **Send** unit is shown below:



The carrier level should be within the **0 dBm** to **-40 dBm** range and steady for the test to be valid.

When the measurements are complete, the operator at the send end can alert the operator at the repeat end to sweep the return carrier. This will allow a forward reference measurement to be made of the return path delay. The **Send** unit transmits the fixed reference signal toward the **Repeat** unit, (Slave unit) at the far-end.

11. Press **K3** on the **SEND** unit to display the received frequency for the delay.

5-17.3 Repeat

To place the **930i** at the far end of the circuit in **Repeat** mode:

1. Press **K3** under **REPEAT** from the main **SELECT** display. A high pitched tone sounds and the display reads:

This display shows the level and frequency of the carrier tone that is being used to return the amplitude modulation to the **Send** unit. The default value is **`1804 Hz`** at **`-16 dBm`**.

2. Use the **numeric keypad** to enter a new **frequency** and press **ENT**.

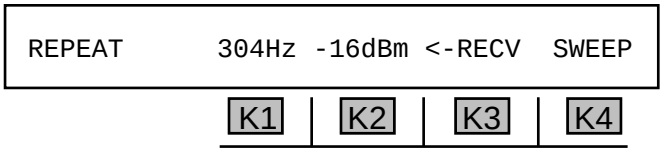
   • A valid **frequency** is between **`304 Hz`** and **`3504 Hz`**.

3. Press **K2** under the level. The cursor will move to the last digit of the level.

4. Use the **numeric keypad** to enter a new **level** and press **ENT**.

   • A valid **level** is between **`0 dBm`** and **`-40 dBm`**.

5. Press **K3** under **`<-SEND`** to examine the level and frequency of the signal being received. The display reads:

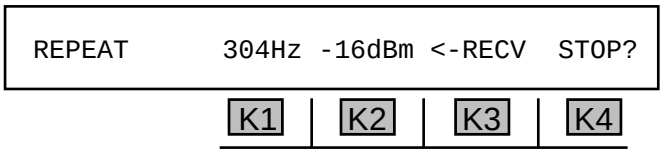


Option Menu #: 17

This display shows the level and frequency of the signal being sent to the **Repeat** unit from the **Send** unit. When the sweep completes, the return reference part of the measurement is over. It is then followed by the **Repeat** unit sweeping for the forward reference test.

6. Press **K3** to toggle between the received signal and the returned carrier.

7. Press **K4** under **`SWEEP`** to sweep the returned carrier for a forward reference measurement. The display reads:



The **930i** will begin to sweep the returned carrier through the frequencies that were selected previously.

8. Press **K4** under **`STOP?`** to interrupt the sweep without leaving the **Repeat** mode. When the sweep completes or is interrupted, the **930i** will revert to sending the reference frequency. **K4** will once again be labeled **`SWEEP`**.

9. Press the **Option Menu** key to exit this display.

10. Press the **Option Menu** key again or **K4** under **`EXIT`** to return to the main display.

5-18 OPTION MENU #:18 PEAK TO AVERAGE RATIO (P/AR)

OPTION MENU #:18, PEAK TO AVERAGE RATIO (P/AR), is available only when *Purchased Option 930i-100, Data Test Package,* is installed. This feature allows you to measure P/AR values over a 0 to 200 P/AR unit range.

P/AR measurements are end-to-end measurements. On 2-wire circuits, one end transmits while the other receives, then the sender and receiver switch places. One of the test sets must have its transmitter turned off and act as a receiver only. To accomplish this you should press **K3** under **MEASURE** immediately after entering **OPTION MENU #:18**. Pressing **K2** under **SEND** like you do with a 4-wire circuit would keep the **P/AR** transmitter turned on.

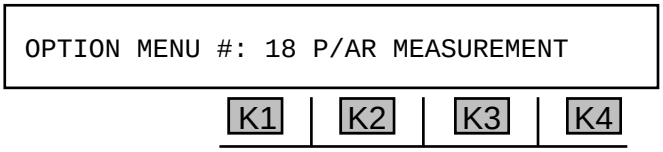
On 4-wire circuits, simultaneous transmitting and receiving is possible. When entering **OPTION MENU #:18, P/AR MEASUREMENT,** you should press **K2** under **SEND** first to check or adjust the transmit level before measuring.

To measure **P/AR** values:

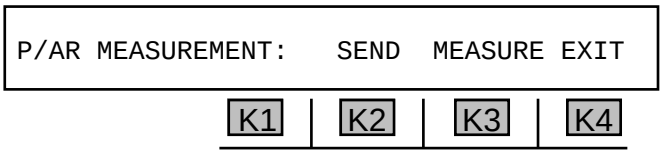
1. Connect the **930i** to the circuit under test at the 2- or 4-wire analog trunk access point or at the **DEMARC**. It can also be used on a **E1 PCM** trunk at the **Jack Field**. Before conducting a **P/AR** test, set the **930i** trunk type to the correct settings. (Refer to **Section 3, Front Panel Operation,** or **Section 4, PCM Operation,** for setup information.)

2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **18** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:

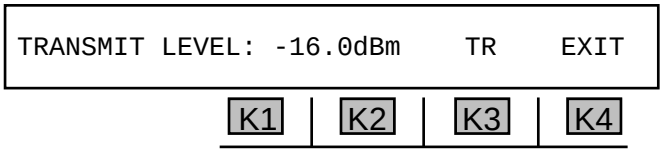


   K2 under **SEND** controls the setup of the **P/AR** transmitter level and also sends the **P/AR** signal on 2- and 4-wire circuits. The setups are retained in nonvolatile memory and need not be accessed every time a measurement is made, unless the level is to be changed.

5. Press **K2** under **SEND** to display the **P/AR** transmit level display if you are testing a 4-wire circuit. (If you are testing a 2-wire circuit, skip to step #9.)

for example:

A **4-wire E&M** trunk is shown below:



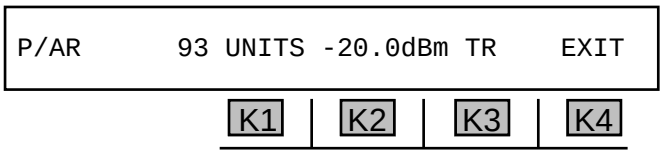
The test set at the far end of the circuit receives and displays the **P/AR** measurement.

6. Use the **numeric keypad** to enter a new **transmit level** and press **ENT**.

- A valid **transmit level** in **analog** trunk types is between **`-60.0 dBm`** and **`0 dBm`**.
- A valid **transmit level** in **PCM** trunk types is between **`-60.0 dBm`** and **`-13.0 dBm`**.

7. Press **K4** under **`EXIT`** to return to the main **P/AR** display.

8. Press **K3** under **`MEASURE`** to send and receive the **P/AR** waveform on a 4-wire circuit, or receive **P/AR** on a 2-wire circuit. A **P/AR** measurement display is shown below:



9. Press **K4** to exit to the main display.

Option Menu #: 18

5-19 OPTION MENU #:19 4-TONE INTERMODULATION DISTORTION

OPTION MENU #:19, 4-TONE INTERMODULATION DISTORTION, is available only when *Purchased Option 930i-100, Data Test Package,* is installed. Intermodulation Distortion (IMD) measures the 2nd and 3rd order distortion products created in a nonlinear circuit in the presence of a 4-tone signal.

Inter Modulation Distortion, sometimes referred to as Non-Linear Distortion or 4-Tone Intermod, is an end-to-end measurement. That is, one test set sends the tone pairs at **857 Hz**, **863 Hz** and **1372 Hz**, **1388 Hz** while the other set has its receiver looking at a band of frequencies centered around **520 Hz**, **2240 Hz**, and **1900 Hz**. The energy received in these filters constitutes the energy in the 2nd and 3rd order **IMD** products.

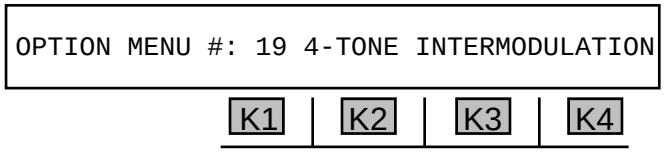
On 4-wire circuits, a loopback can be inserted at the distant end so that one set may send and receive. On a 2-wire circuit, two sets are required, with one set either sending, or receiving, in turn.

To test for **intermodulation distortion**:

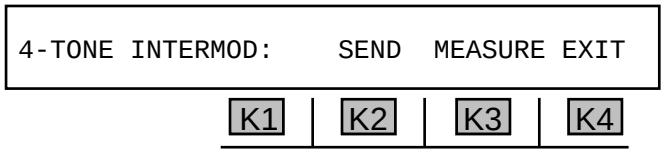
1. Connect the **930i** to the circuit.

2. Press the **Option Menu** function key.

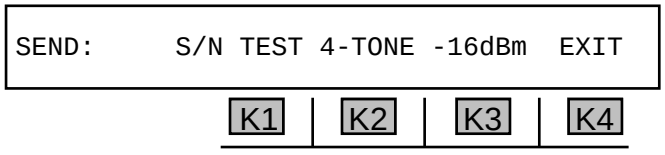
3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **19** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



5. Press **K2** under **SEND** to transmit and adjust the **IMD** tones being sent, to select the signal-to-noise test tones, or to send the Intermod tones over a 2-wire circuit. The display reads:



6. Press **K1** under **S/N TEST** to send the signal-to-noise test tones. This will suppress one tone pair while amplifying the other pair to maintain the same average level. This measurement is usually performed before **IMD** testing; the **930i** uses the **S/N** value to automatically correct the **IMD** measurement results for the noise in the same bands.

7. Press **K2** under **`4-TONE`** to send the four intermodulation distortion test tones at the level displayed. On a 2-wire circuit, another **930i** or a test set with intermodulation distortion measuring capability must be at the distant end.

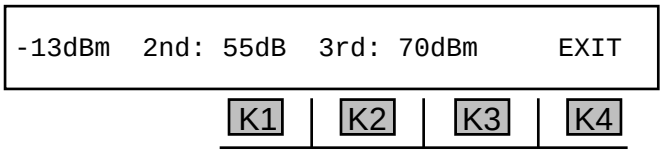
8. Use the **numeric keypad** to change the transmit level and press the **ENT** key.

   - A valid **send level** in **analog** is between **`-40 dBm`** and **`0 dBm.`**
   - A valid **send level** in **PCM** is between **`-40 dBm`** and **`-6 dBm.`**

9. Press **K4** to **`EXIT`** to the main display. This will not interrupt the tones being sent. From the main display, the test can be terminated, or the **Measure** mode can be selected to test on a 4-wire looped-back circuit.

10. Press the **Option Menu** function key **or K4** under **`EXIT`** again to terminate testing.

11. Press **K3** under **`MEASURE`** to measure the **IMD** present on the trunk under test. A typical display is shown below:



Option Menu #: 19

The first field in the above example is labeled **-13 dBm**. This field shows the composite received level of the four **IMD** tones. If no signal is present this field will be blank. The second field is labeled **2nd: 55 dB** and is the level at which the 2nd order intermodulation products are being received below the level of the four **IMD** tones. In this example, the 2nd order products are **55 dB** below the **IMD** tone level of **-13 dBm** for a total of **-68 dBm**. Similarly, the third field is labeled **3rd: 70 dB** and is the level at which the 3rd order products are received below the **-13 dBm** signal level.

The following messages appear above **K3** indicating conditions of the measured signal:

- **`INVALID`** indicates an invalid signal; i.e., the **IMD** signal is absent, the level is below **-40 dBm**, or the level is too high for the circuit (**>0 dBm** in analog, **>-6 dBm** in **PCM**).

- **`TWIST`** indicates that the **IMD** tones are being received at unequal levels (i.e., they differ by more than **6 dB** from each other).

- **`SPURIOUS`** indicates the presence of a spurious tone (any tone other than the four test tones).

- **`S/N TEST`** shows that the **930i** is receiving the signal-to-noise test tones. The **2nd** and **3rd** fields contain noise measurements where the distortion products used to be. The measurements are in **dB** below the received signal as a **S/N** ratio.

- **`ADJUSTED`** indicates that the distortion measurements are being corrected automatically for signal-to-noise ratio.

5-20 OPTION MENU #:20 30 BIT DISPLAY

OPTION MENU #:20, 30 BIT DISPLAY, is a standard feature that allows you to see the state of the A, B, C, and D bits on all 30 channels of a **E1** span.

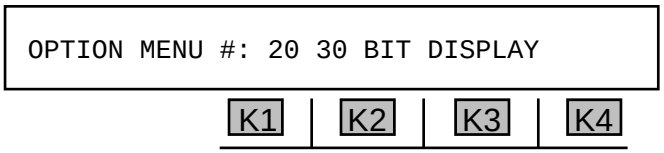
To view the **supervision states**:

1. Connect your **930i** to the **Jack Field**.

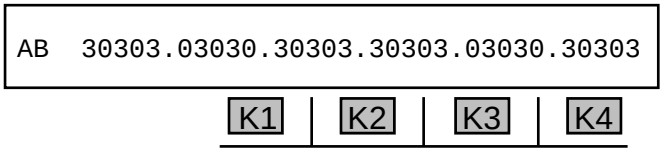
2. Make sure the **930i** is set to the **PCM** trunk type and that default settings are correct. If it is set to the **`MON-1`** mode, you will be able to look at the supervision bits on one side at a time. If you are in the **`MON-1&2`** mode, you can switch from **`RECV-1`** (by pressing **K1**) to **`RECV-2`** (by pressing **K2**), and look at the supervision bits in each direction.

3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **20** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The first display shows the **`AB bits.`**



   The channels are numbered from **1** to **30**, left to right. On a working span, you will see calls completing and terminating, so the display will change constantly.

6. Use the **Up Arrow** key to scroll through the **`AB bits, ABCD bits, A bit, B bit, C bit,`** and **`D bit`** displays respectively. The following tables explain the bit information.

	bit value	binary equivalent
`AB bits`	0	00
Display	1	01
	2	10
	3	11

	bit value	binary equivalent
`ABCD bits`	1	0001
Display	5	0101
	9	1001
	D	1101

7. Press the **Option Menu** function key to leave this display.

5-21 OPTION MENU #:21 TOGGLE A\B BITS

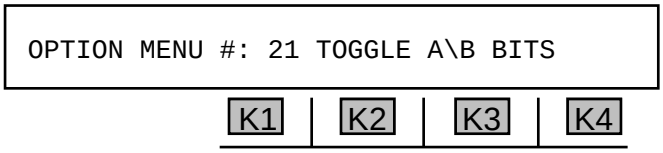
OPTION MENU #:21, TOGGLE A\B BITS, is available when *Purchased Option 930i-21, Absolute Delay,* is purchased. This feature that gives you complete control over A/B/C/D bit states and lets you view their status on the selected channel in both directions while in **MON 1&2** mode.

ABC & D Bits are the bits used to convey signalling information in digital transmissions.

To toggle **A, B, C, and D bits**:

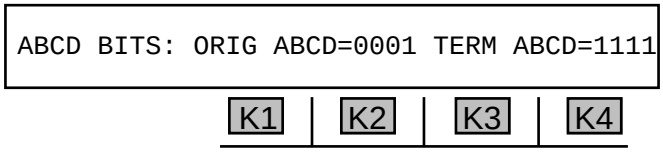
1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **21** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



Option Menu #: 21

3. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



In each of these **E1** span types, the originating end is on-hook. If the **930i** is in **MON1** mode, blanks will be displayed for the **ORIG** side.

4. Press **1** or **0** on the **numeric keypad** to change the **A bit**. The cursor moves to the next digit.

The **TERM** bits come from the **PCM IN** jack in the **RECV** direction. In **TERMINATE, D&I** or **MON-1** modes, the **ORIG** bits come from the **930i**. The **TERM** bits come from opposite the **RECV** side. In **MON-1&2**, the **ORIG** is the other **PCM** direction.

5. Repeat **step 4** for all bits.

6. Press the **Option Menu** function key to exit.

5-22 OPTION MENU #:22 ABSOLUTE DELAY

OPTION MENU #:22, ABSOLUTE DELAY, is available only when *Purchased Option 930i-21, Absolute Delay,* is installed. Absolute Delay provides a round trip delay measurement in milliseconds of the total delay for a given circuit. Some specifications for Absolute Delay as compared to Envelope Delay are the following:

- Forward frequency for absolute delay is 1020 Hz.
- Return frequency for both is 1804 Hz.
- Modulation frequency for both is 83.333 Hz.
- Level of signal is measured for absolute delay.
- Absolute delay may require an echo canceller disable tone of 2100 Hz.
- Absolute delay measurements are to 1 millisecond resolution.

Absolute delay is the time interval between transmission and reception of a signal. It is dependent on the length, frequency, and the transmission medium.

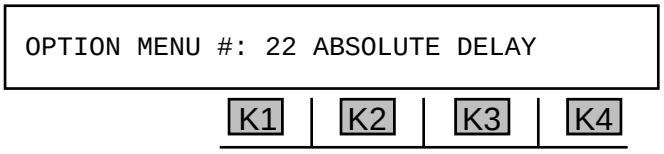
5-22.1 Setup and Testing (Send Unit)

On 4-wire circuits, a loopback can be inserted at the far end so that one set may send and receive. On a 2-wire circuit, two sets are used, with one set sending and receiving, and the other operating as a repeater. Refer to **Section 5-22.2** for information on setting up the repeating unit.

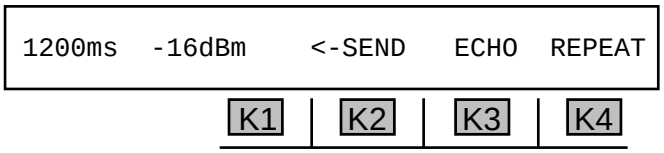
To provide a **round trip delay measurement**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **22** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:

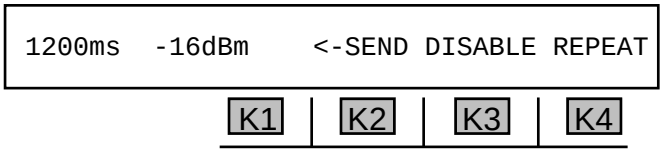


   The **930i** is now in send mode.

Note: The initial measurement is normally in microseconds and is considered preliminary. The level measurement refers to the level of the signal being sent. The measurement in ms is the round trip delay.

4. Press **K3** under **ECHO** to send the **2100 Hz** disabling tone to disable the echo canceller.

   The display reads:



   After a short delay, during which the echo canceller is disabled, the message above **K3** again reads: **ECHO.**

5. Press **K2** to toggle between viewing the level of the **SEND** tone and the **RECEIVE** tone. Note that the round trip delay reading remains the same.

6. If you are in **<-SEND** mode, use the **numeric keypad** to center a new **send tone level** and then press **ENT** or any soft key.

   - A valid **send tone level** is between **0 dBm** and **-40 dBm**

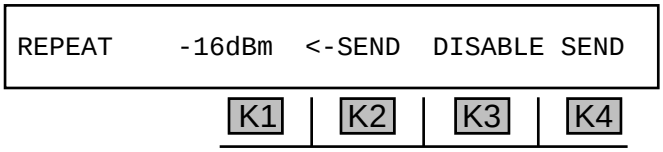
7. Press the **Option Menu** function key to leave this display.

Option Menu #: 22

5-22.2 Setup and Testing (Repeater)

To place the **930i** at the far end of the circuit in **Repeat** mode (usually in 2W):

1. Press **K4** under **REPEAT** on the **930i** at the far end. The display reads:



2. Press **K3** under **ECHO** to send the **2100 Hz** disabling tone to disable the echo canceller.

3. Press **soft key 2** to toggle between viewing the level of the **SEND** tone and the **RECEIVE** tone. The send level refers to the repeat tone being sent to the near end, and the receive level refers to the tone being received from the near end.

4. If you are in **<-SEND** mode, use the **numeric keypad** to enter a new repeat tone level and then press **ENT** or any soft key.

   - A valid **repeat tone level** is between **0 dBm** and **-40 dBm**

5. Press the **Option Menu** function key to leave this display.

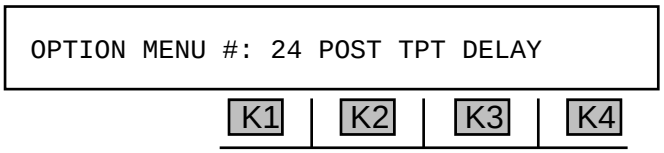
5-24 OPTION MENU #:24 POST TPT DELAY

OPTION MENU #:24, POST TPT DELAY, is available only when *Purchased Option 930i-12 ROTL Interrogator, Responder,* is installed. This option allows specification of the amount of time the **930i** pauses between detecting the TPT from a 105-type responder and sending command MF digits. The time setting affects **OPTION MENU #:26, ROTL RESPONDER, OPTION MENU #:2, SEND DIGITS**.

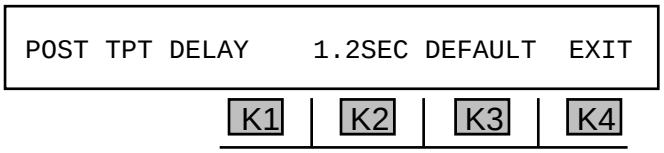
To set the **TPT delay**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **24** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



4. Use the **numeric keypad** to change the delay.

   - A valid **delay** is between **0.1 SEC** and **99.9 SEC**. The default is **1.2 SEC**. (Pressing **K3** accepts the default value.)

5. Press **ENT** to accept the value.

6. Press **K4** under **EXIT** to return to the main display.

5-25 OPTION MENU #:25 FAR END RESPONDER

OPTION MENU #:25, FAR END RESPONDER, is available only when *Purchased Option 930i-12, ROTL Interrogator, Responder,* is installed. It enables the **930i** to be configured as a Type 105 Far End Responder and controlled by any CAROT-compatible ROTL. The **930i** can also provide this function directly on a T1 PCM channel. The **930i** can measure loss, noise, noise with tone, gain-slope, and return loss.

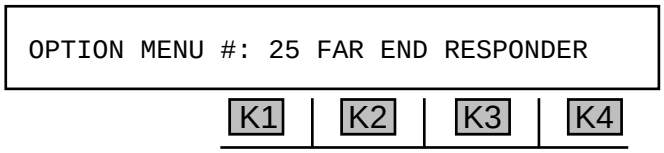
To use the **930i** as a **far-end responder**:

1. Select a trunk type. (Refer to **Section 3-2.1, Trunk Type Function Key,** and **Section 4, PCM Operation,** for the correct Trunk Type setup in Responder mode.)

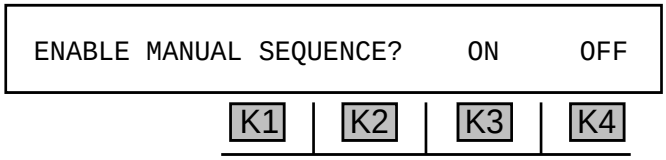
2. Connect the **930i** to the circuit.

3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **25** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



   Press **K3** to turn the manual sequence on, but generally the manual sequence is normally **OFF**.

6. Press **K4** to continue with the setup. The **930i** always functions in the automatic sequence mode. Manual sequence provides a means for performing single direction tests and is most useful for **PBX** testing.

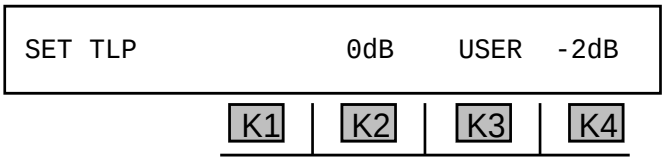
5-25.1 Setting the TLP and Enabling Manual Sequence

TLP is a point on a circuit where the transmission level has been specified, providing a reference point to compare the transmission levels at other points on the circuit. A **0 dB TLP** is standard.

To set the **TLP** and enable **manual sequence**:

1. Press **K3** under **ON or K4** under **OFF** from the **ENABLE MANUAL SEQUENCE** display.

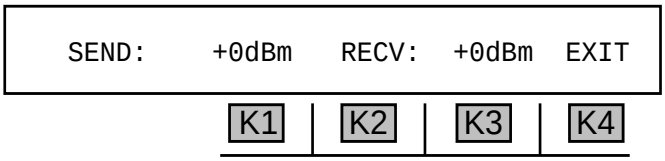
The display reads:



2. Press **K1** to advance to the next display without changing any parameters, **or** press **K2** to select **`0 dB`**, **or** press **K3** under **`USER`** (in **analog** mode) if you need to set a Send or Receive TLP value other than the standard **`0 dB`** or **`-2 dB`** values, **or** press **K4** to select **`-2 dB TLP`**.

   If you select a **`0 dB`** or **`-2 dB TLP,`** you will be advanced to step **5**.

   If you press **K3** to select a nonstandard **TLP**, the display reads:



3. Press **K1** to change the **`SEND TLP`** **OR** **K3** to change the **`RECV TLP`**.

4. Use the **numeric keypad** to enter the desired **TLP**.

   - A valid **`SEND TLP`** is between **`-16 dBm`** and **`+3 dBm`**.
   - A valid **`RECV TLP`** is between **`-16 dBm`** and **`+3 dBm`**.

5. Press **K4** under **`EXIT`**. You will then advance to the initial **Dial/Ring** display to set up and make your call. This display will differ depending on whether you are in **analog** or **PCM** mode. Refer to **Section 3-2.2.1** for a description of **the Dial/Ring** function in **analog**, and **Section 3-2.2.2** for a description of **Dial/Ring** in **PCM.**

Note: Before the **930i** can operate as a far end responder in PCM, you must select and set up a protocol (if one has not already been selected under the **Dial/Ring** function key), and set up your dial digits. Refer to **Section 3-2.2** for a complete description of this procedure.

When accessed by ringing or far-end seizure, the **930i** goes off-hook and responds with a **2225 Hz** test progress tone (TPT). The **930i** then waits for **MF** commands and performs the corresponding Type 105 tests. The **930i** will continue in this mode until one of the following occurs:

- It is released by the calling party via an **MF** “release” command.
- The calling party goes on-hook (see following notes).
- No **MF** command is received for **20** seconds (**930A** defaults to Manual mode if selected).
- The operator selects **OFF** or discontinues testing in any way.

When the **930i** is released, or the calling party goes on-hook, the **930i** goes on-hook for one second and then awaits seizure or ringing. If the **930i** is allowed to time out (**20** seconds without an **MF** command), it will either go on-hook, or initiate the manual test sequence (if selected).

If the **930i** is on a loop trunk simulating the subscriber (providing **CONTACT** rather than **BATTERY**), it will expect the far end to remain on-hook and will not treat this as a release condition.

For **PBX** testing, the manual mode sequence is most useful. If the manual mode has been selected, the responder is allowed to time out (no **MF** command is sent) for **20** seconds or more. The **930i** then provides the manual trunk test tone sequence shown below:

1. 9 seconds of 1004 Hz tone at -16 dBm0.
2. 1 second of quiet termination.
3. 9 seconds of 404 Hz tone at -16 dBm0.
4. 1 second of quiet termination.
5. 9 seconds of 2804 Hz tone at -16 dBm0.
6. 30 seconds of quiet termination.
7. Short burst of TPT (2225 Hz) signaling end of sequence.
8. On-hook.

Option Menu #: 25

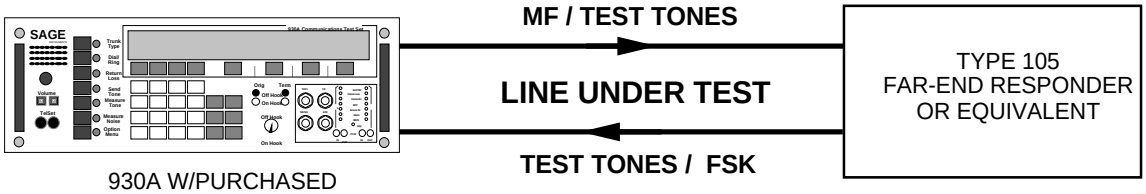
If the manual test sequence is not enabled, the **930i** will return to the on-hook state after a **20** second time out.

If the **930i** is in dry circuit (no signaling), it will answer the **DTMF** string **7243**.

6. Press the **Option Menu** function key to exit this option.

5-26 OPTION MENU #:26 ROTL/RESPONDER

OPTION MENU #:26, ROTL/RESPONDER, is available only when *Purchased Option 930i-12, ROTL/Responder Interrogator,* is installed. This feature enables the **930i** to perform the functions of a ROTL/near-end responder, access a 105 far-end responder, and supply the MF signalling necessary to initiate loss, gain/slope, C-message noise, noise with tone, and return loss measurements. A typical connection is shown below:

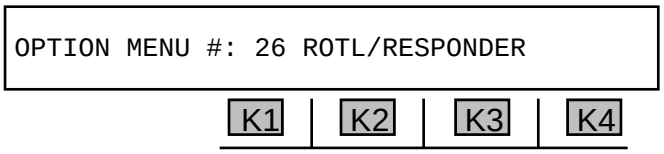


930A W/PURCHASED
OPTION 930A-12
OPTION NUMBER: 26
ROTL/RESPONDER

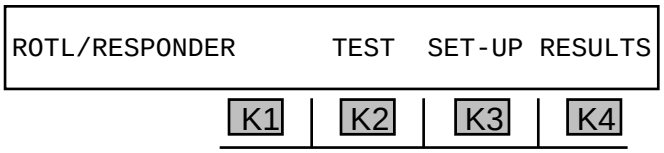
To set up the **930i** as a **ROTL/near-end responder:**

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **26** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



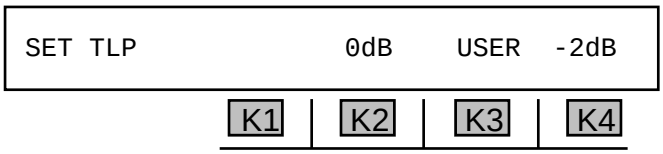
5-26.1 Setting the TLP

TLP is a point on a circuit where the transmission level has been specified, providing a reference point to compare the transmission levels at other points on the circuit. A **0 dB TLP** is standard.

To set the **TLP**:

1. Press **K3** under **SET-UP.**

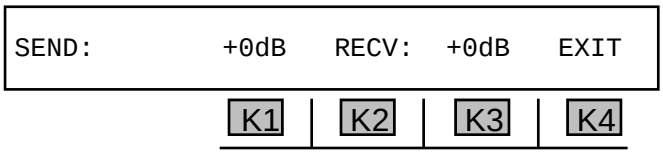
The display reads:



2. Press **K1** to advance to the next display without changing any parameters., **or** press **K2** to select **0 dB**, **or** press **K3** under **USER** if you need to set a Send or Receive TLP value other than the standard **0 dB** or **-2 dB** values, **or** press **K4** to select **-2 dB TLP**.

   If you select a **0 dB** or **-2 dB TLP,** you will be advanced to the **TESTS** display.

   If you press **K3** to select a nonstandard **TLP**, the display reads:



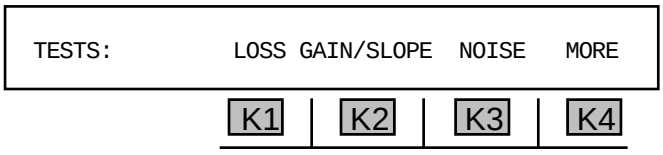
3. Press **K1** to change the **SEND TLP OR K3** to change the **RECV TLP**.

4. Use the **numeric keypad** to enter a new **TLP**.

   - A valid **SEND TLP** is between **-25 dBm** and **+7 dBm** in analog, and between **-16 dBm** and **+7 dBm** in PCM.

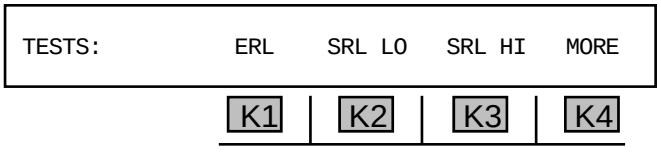
   - A valid **RECV TLP** is between **-16 dBm** and **+7 dBm** and between **-16 dBm** and **+7 dBm** in PCM.

5. Press **ENT** or any soft key (**K1-K2**) to complete the selection. The display reads:



6. Press **K1** to measure **LOSS**, **or K2** to measure **GAIN/SLOPE**, **or K3** to measure **NOISE**. A cursor will appear over each of your selections.

7. Press **K4** under **MORE** to advance to the next series of tests:



8. Press **K1** under **ERL** for Echo Return Loss, **or K2** under **SRL LO** for Singing Return Loss-Low, **or K3** under **SRL HI** for Singing Return Loss-High. A cursor appears over each selection.

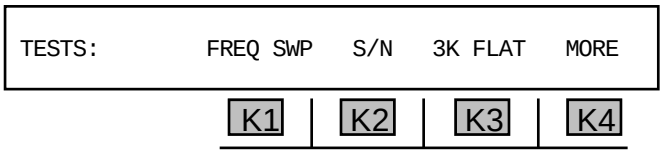
Option Menu #: 26

5-26.2 Extended 105 Responder Tests

The following tests are available only if the far-end is an Extended 105 (105E) Responder or another **930i**.

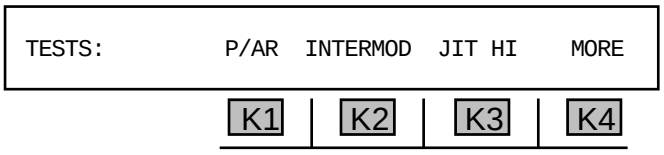
To select **extended responder tests**:

1. Press **K4** under **MORE** from the **TESTS** display. The new display reads:



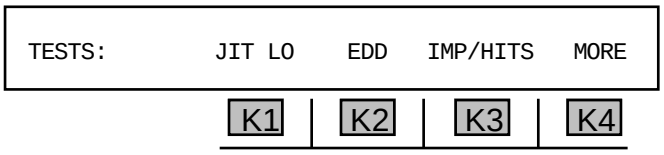
2. Press **K1** under **FREQ SWP** Frequency Sweep, **or K2** under **S/N** for Signal to Noise Ratio, **or K3** under **3K FLAT** for Singing Return Loss-High. A cursor appears over each selection.

3. Press **K4** under **MORE** to advance to the next display:



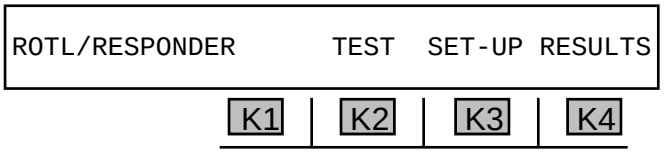
4. Press **K1** under **P/AR** for Peak to Average Ratio, **or K2** under **INTERMOD** for Intermodulation Distortion, **or K3** under **JIT HI** for Jitter High. A cursor appears over each selection.

5. Press **K4** under **MORE.** The display reads:



6. Press **K1** under **JIT LO** for Jitter Low, **or K2** under **EDD** for Envelope Delay Distortion, **or K3** under **IMP/HITS** for Impulse Noise and Hits. A cursor appears over each selection.

7. Press **K4** under **MORE** to return to the main **SET-UP** display.



8. Place the hookswitch in the **On Hook** position.

5-26.3 Test

To begin a test:

1. Place the hookswitch in **the On H**ook position.

2. Press **K2** under **TEST**. You will then advance to the initial **Dial/Ring** display to set up and make your call. This display will differ depending on whether you are in **analog** or **PCM** mode. Refer to **Section 3-2.2.1** for a description of **the Dial/Ring** function in **analog** and **Section 3-2.2.2** for a description of **Dial/Ring** in **PCM.**

NOTE: Before testing in PCM, you must select and set up a protocol if one has not already been selected under the **Dial/Ring** function key, and enter a phone number. Refer to **Section 3-2.2** for a complete description of this procedure.

3. Place the hookswitch in the **Off Hook** position. Your call will be outpulsed.

5-26.4 Results

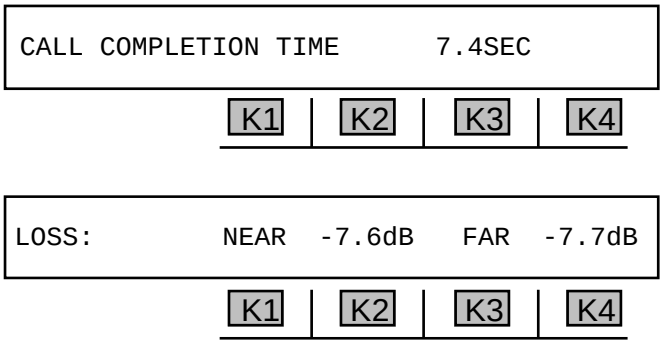
Option Menu #: 26

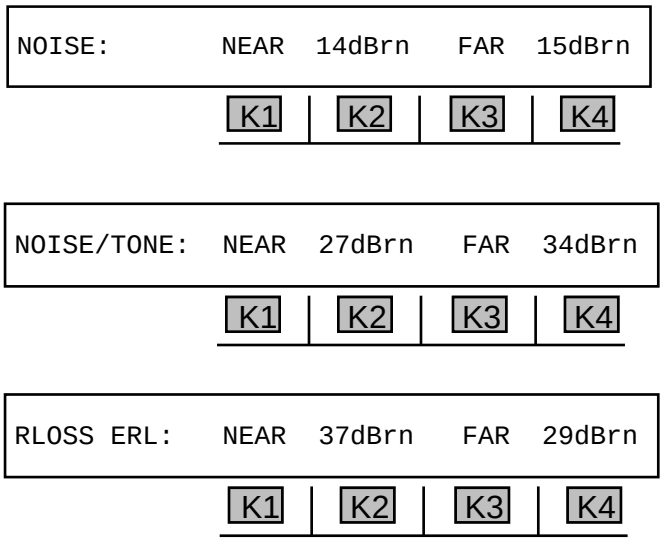
To quickly **scan test results**:

1. Press **K4** under **RESULTS** from the **ROTL/RESPONDER** display.

   If no tests are made before selecting **RESULTS**, the display reads: **NO RESULTS 00:00**.

   If tests were made, the test results, test duration, and time will be displayed briefly. The **930i** sequences through 5 different results displays and shows them briefly. The results are also stored in battery-backed CMOS RAM. If a printer is connected, the test results will be printed as they occur. (Refer to **Section 6, Remote Control Operation,** for more information).
   for example:





The **NEAR** results equate to Far-to-Near results given by CAROT. Similarly, the **FAR** results equate to the near-to-far results.

Once the sequence of tests has been completed the **930i** releases the far-end responder. When complete, the **930i** returns to the main display.

2. Press any soft key (**K1-K4**) to return to the previous display.

To **recall and review the results** of the tests more slowly:

1. Press **K4** under **RESULTS**. The **930i** will recall the stored results of the previous test sequence.
2. Use the **Up Arrow** key or any soft key (**K1-K4**) to scroll up through the various test results.
3. Use the **Down Arrow** key to go backwards through the results.
4. Press the **Right/Left Arrow** keys to return to the beginning of the test results. You will be taken to the first test result after **CALL COMPLETION TIME**.
5. Press the **Option Menu** function key to exit from the results option.

Return Loss testing is not standard in all far-end responders. A “failed” response from the **930i** means the far-end does not have Return Loss capability. Press the **Option Menu** function key to return to the main menu and begin testing toward standard responders. If you are testing toward a Sage Instruments **356E** Far End Responder or another **930i**, press **K4** under **MORE** to select additional tests in the **SET-UP** display.

The standard code 105 transmission tests which can be performed by the **930i** are briefly described below:

1. **LOSS** tests the two-way loss at 1004 Hz, 0 dBm.

2. **GAIN/SLOPE** tests the two-way loss at 404 Hz, 1004 Hz, and 2804 Hz. All tone levels are at -16 dBm.
3. **NOISE** tests C-Message noise in both directions and tests two-way C-Notch noise using a -16 dBm, 1004 Hz holding tone.
4. **ERL, SRL-LO,** and **SRL-HI** tests the two-way return loss for each of the three types.

The enhanced responder transmission tests also include the following:

5. **FREQ SWP** tests two-way attenuation distortion. (Set in **OPTION MENU #:10**)
6. **S/N** (signal to noise ratio) tests two-way signal-to-noise ratio.
7. **3K FLAT** tests 3 kHz flat-weighted noise in both directions.
8. **P/AR** tests peak-to-average ratio in both directions.
9. **INTERMOD** tests two-way 4-tone intermodulation distortion.
10. **JIT HI** tests phase and amplitude jitter in 20-300 Hz band in both directions.
11. **JIT LO** tests phase and amplitude jitter in 4-300 Hz band in both directions.
12. **EDD** tests forward and return reference envelope delay. (Set in **OPTION MENU #:19**)
13. **IMP/HITS** tests three-level impulse noise, phase hits, gain hits, and dropouts in both directions. Test length and other parameters are user selectable. (Set in **OPTION MENU #:11**.)

Option Menu #: 26

5-27 OPTION MENU #:27 ROTL INTERROGATOR

OPTION MENU #:27, ROTL INTERROGATOR, is available only when *Purchased Option 930i-12, ROTL Interrogator, Responder,* is installed. This option lets the **930i** command a **ROTL** from a **ROTL** access port or over a dial-up line. The **930i** supports two-way transmission testing to type 105 test lines and one-way transmission testing to type 100 and 102 test lines. Operational Balance and Long Term (**BALT**) tests can also be performed, but support for these tests is limited to the return of audible tones to the operator. A typical test line arrangement showing the **930i** connected to the near end switch **ROTL** access port is shown below.

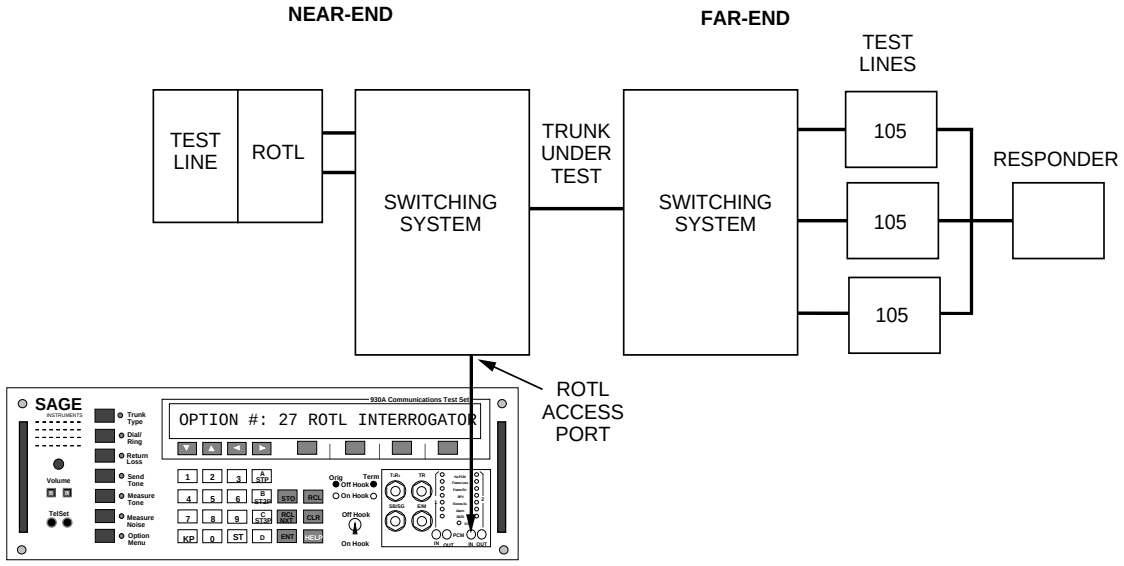


Figure 5-27.1
Interrogator Connected at ROTL Access Port

Since the **ROTL** access port is usually tied up by the **CAROT** controller, the **930i** can gain test access over any dial-up line, or **T1 PCM** channel at the **Jack Field** and interrogate the **ROTL** from there.

To set up the **930i** to command a **ROTL**:

1. Set the **930i** to the correct trunk type. (The trunk type the **930i** is using to connect to the **ROTL**, not the type that the **ROTL** will be testing.) Connect the **930i** to either the **ROTL** access port, the dial-up line, or the **Jack Field** (select the trunk type for the connection between the **930i** and the ROTL, not the line under test).

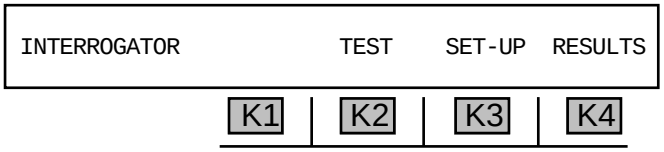
2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **27** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

```
OPTION MENU #: 27 ROTL INTERROGATOR
```

K1	K2	K3	K4

4. Press **ENT** or any soft key (**K1-K4**) to activate your selection. The display reads:



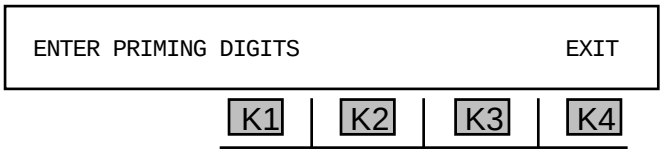
5. Place the **hookswitch** in the **On Hook** position.

5-27.1 Setup

To enter the priming digits and select the test types to be performed:

1. Press **K3** under **SET-UP**.

   If no priming digits have been entered, the display reads:



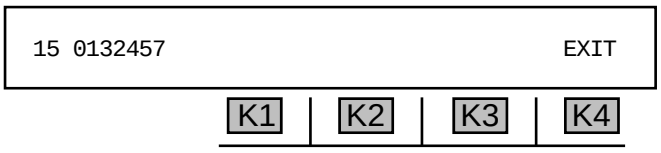
   If priming digits had previously been entered, the last string of priming digits will be displayed. If an unwanted string of digits is present, they can be removed by pressing the **CLR** key.

2. Use the **numeric keypad** to enter new **ROTL** priming digits. **ROTL** priming digits are always **MF** digits. The **930i** has been set to automatically insert the **KP** and **ST** delimiters. You only have to enter the numerical digits. This is a deviation from the way in which the Dial/Ring function operates.

   You can enter up to **30** digits in the **ROTL** priming digits field. These digits consist of the test type (up to **3** digits long), the trunk identification number (up to **7** digits long) and the far-end test line number (up to **11** digits long). The **930i** lets you enter blank characters between the groups for readability. These blank characters are inserted by the **Up Arrow** key and have no affect on outpulsing.

   for example:

   A typical **930i** display of **ROTL** priming digits, with blank spaces inserted to separate the groups, might appear as shown below:

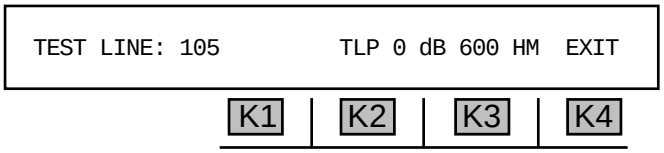


   ROTL priming digit sequences vary in accordance with the type and vintage of switching equipment, the type of testing to be performed, the test lines available and their manufacturer.

Option Menu #: 27

You can edit the string of priming digits to insert or delete individual characters, rather than re-entering the entire string if a mistake or an omission has occurred. The **Left/Right Arrow** keys move the cursor. The **Up Arrow** key inserts a blank space. The **Down Arrow** key deletes an unwanted digit.

3. Press **K4** under **`EXIT`** when your entry is complete. The display reads:

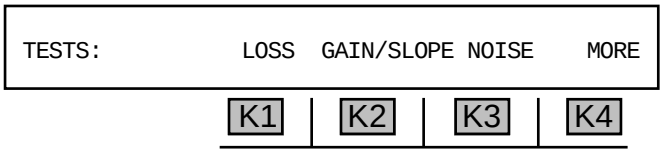


4. Press **K1** to scroll through the **`TEST LINE`** options of **`100`**, **`102`**, and **`105`**. **`105`** is the default.

5. Press **K2** to choose between **`0 dB`** and **`-2 dB TLP`**. **`0 dB`** is the default.

6. Press **K3** to choose between **`600`** and **`900 Ohms`**. **`600 Ohms`** is the default.

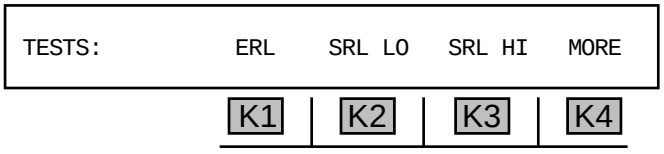
7. Press **K4** under **`EXIT`** when your selection is complete. You will advance to the first of two **TESTS** displays:



The default parameters show all tests selected.

8. Press the soft key (**K1-K4**) directly beneath a test to select or deselect it.

9. Press **K4** under **`MORE`** to advance to the next series of tests. The display reads:



10. Press the soft key (**K1-K4**) directly beneath a return loss measurement to select or deselect it.
11. Press **K4** under **`MORE`** to return to the main display.

5-27.2 Test

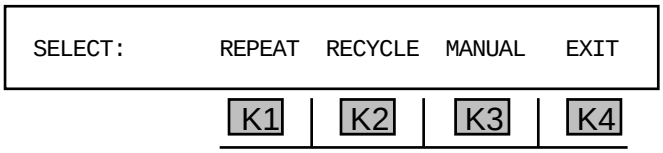
To perform a test:

1. Press **K2** under **TEST** in the **INTERROGATOR** display. You will then advance to the initial **Dial/Ring** display to set up and make your call. This display will differ depending on whether you are in **analog** or **PCM** mode. Refer to **Section 3-2.2.1** for a description of **the Dial/Ring** function in **analog**, and **Section 3-2.2.2** for a description of **Dial/Ring** in **PCM.**

NOTE: Before testing in PCM, you must select and set up a protocol if one has not already been selected under the **Dial/Ring** function key, and enter a phone number. Refer to **Section 3-2.2** for a complete description of this procedure.

2. Put the **hookswitch** in the **Off Hook** position. The **930i** calls the **ROTL**.

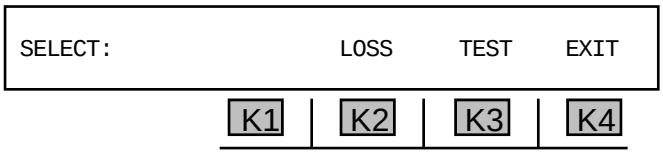
3. When all the tests are complete press the **Option Menu** function key. The display reads:



4. To repeat the tests, press **K1** under **REPEAT.**

5. Press **K2** under **RECYCLE** to return to the priming digits display. At this point you may enter new priming digits.

6. Press **K3** under **MANUAL** to perform each test one at a time. The display reads:



7. Press **K2** under **LOSS** to scroll through the different tests available.

8. Press **K3** under **TEST** when you are ready to perform that individual test.

9. Press **K4** under **EXIT** when testing is complete.

Option Menu #: 27

5-27.3 Results

To view test results:

1. Press **K4** under **RESULTS** in the **INTERROGATOR display.** In **PRINTER** remote mode, the results of each test will be sent to the printer as they occur. In **COMPUTER** remote mode, a bell will be sent to the computer at the conclusion of each test. The test results can be read from the display at that time. (Refer to **Section 6, Remote Control Operation,** for more information.)

   OPTION MENU #:3 REMOTE CONTROL, will tell you what mode you are in: **TERMINAL, MASTER, SLAVE, ATR, COMPUTER, PRINTER,** or **OFF** (not in remote control).

   The format of the possible results is:

```
LOSS:          NEAR   +nn.n    dB     FAR +nn.n      dB
SLOPE  404:    NEAR   +nn.n    dB     FAR +nn.n      dB
SLOPE 1004:    NEAR   +nn.n    dB     FAR +nn.n      dB
SLOPE 2804:    NEAR   +nn.n    dB     FAR +nn.n      dB
NOISE:         NEAR   nn       dBrn   FAR nn         dBrn
NOISE/TONE:    NEAR   nn       dBrn   FAR nn         dBrn
RLOSS ERL:     NEAR   nn       dB     FAR nn         dB
RLOSS SRL:     NEAR   nn       dB     FAR nn         dB
RLOSS SRH:     NEAR   nn       dB     FAR nn         dB
```

   The **NEAR** measurement is the far-to-near measurement and the **FAR** measurement is the near-to-far measurement.

2. Press the **Option Menu** function key to exit this option.

5-29 OPTION MENU #:29 CALL 102 LINE

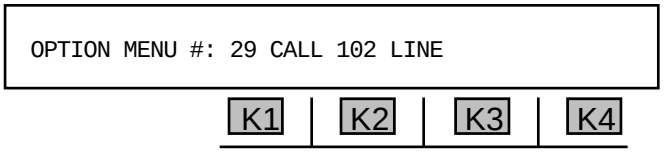
OPTION MENU #:29, CALL 102 LINE, is a standard feature that provides easy access to type 102 test lines, commonly known as milliwatt lines. These are dial-up test lines that return a nominal 1020 Hz signal at 0 dBm.

To gain access to **type 102 test lines**:

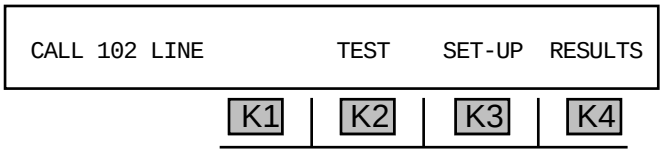
1. Connect the **930i** to the trunk under test and select the correct trunk type using the **Trunk Type** function key.

2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **29** using the **numeric keypad** and then press **Option Menu** funtion key. The display reads:



4. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:

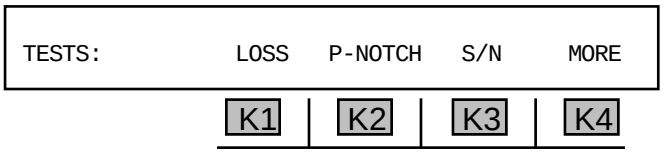


Option Menu #: 29

5-29.1 Setup

To set up a 102 test line:

1. Press **K3** under **SET-UP** if you have not previously setup a test. The display reads:



2. Press the softkey (**K1-K4**) beneath a test to select or deselect it. A cursor above it indicates that it has been selected. **LOSS** tests are performed at **1020 Hz**. **P-NOTCH** measures P-Notch noise. **S/N** measures a **1020 Hz** signal-to-noise ratio. The default parameters show all tests to be selected.

3. Press **K4** under **MORE** to return to the main display.

In **COMPUTER** remote mode (as setup in **OPTION MENU #:3, REMOTE CONTROL**), all previous selections will be cleared when **K3** under **SET-UP** is pressed. Send an **ASCII J** to select **LOSS**, an **ASCII K** to select **P-NOTCH**, and an **ASCII L** to select **S/N**. When all the selections are made, press **K4** under **EXIT**. Your setup will be retained in battery-backed **CMOS RAM**. You will not need to use the setup function again unless you wish to change the setup.

5-29.2 Test

To begin a test:

1. Press **K2** under **TEST**. You will advance to the initial **Dial/Ring** display to set up and make your call. This display will differ depending on whether you are in **analog** or **PCM** mode. Refer to **Section 3-2.2.1** for a description of **the Dial/Ring** function in **analog**, and **Section 3-2.2.2** for a description of **Dial/Ring** in **PCM.**

NOTE: Before you can make your connection to the 102 testline in **PCM** mode, you must select and set up a protocol (if one has not already been selected under the **Dial/Ring**function key), and enter a phone number. Refer to **Section 3-2.2** for a complete description of this procedure.

2. Place the **hookswitch** in the **Off Hook** position to make the call. The **930i** will seize the line, send any digits you have entered in the window, and expect the 102 test line at the far-end to answer the call. If no number has been entered in the window, no digits will be sent.

Printer Remote Mode

If you are in **PRINTER** remote mode (as setup in **OPTION MENU #:3, REMOTE CONTROL**), the **930i** will send a time and date stamp and the current access number to the printer to identify the test. (Refer to **Section 6, Remote Control Operation,** for more information.)

After it has sent the displayed digits, the **930i** will look for a **1020 Hz** tone from the transponder. If it does not receive the tone within **60** seconds, or if it detects busy, reorder, dial tone, or a tone other than **1020 Hz** (less than **950 Hz** or greater than **1050 Hz**), it will abort the test and send an **ABORT** message to the printer. If the **930i** successfully detects **a 1020 Hz tone**, the results will be sent to the printer.

Computer Remote Mode

If you are in **COMPUTER** remote mode, the **930i** will send a prompt **'>'** and a bell when it detects **1020 Hz** or when it aborts a test. It will send an **ABORT** message if unsuccessful, or the **CALL COMPLETION TIME** if successful. It will send another prompt when testing is complete and results can be read on the computer display.

The format of the test results is:

```
LOSS:       +nn.n dB
P-NOTCH NOISE:   nn    dBm
SIGNAL/NOISE:    nn    dB
```

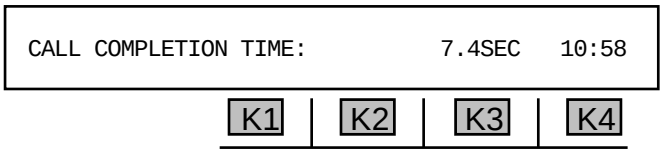
5-29.3 Results

1. Return the **hookswitch** to the **On Hook** position and release the phone line when you finish testing.

2. Press **K4** under **RESULTS** to examine the test results.

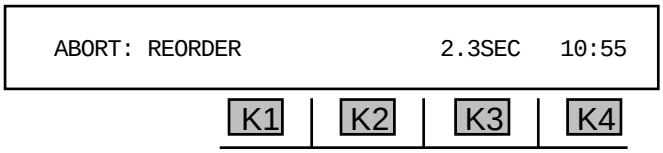
   If a **1020 Hz** signal is received from the transponder within **60** seconds, the display shows the call completion time.

   for example:



   If a **1020 Hz** signal is not received, the display shows an **ABORT** message.

   for example:



The following is a list of possible **ABORT** messages:

```
ABORT: BUSY          xx.x SEC
ABORT: REORDER       xx.x SEC
ABORT: DIALTONE      xx.x SEC
ABORT: TONE          xx.x SEC
ABORT: DEAD LINE     xx.x SEC
ABORT: RINGING       xx.x SEC
ABORT: SPEECH?       xx.x SEC
```

3. Press the **Option Menu** function key to return to the main display.

   If the call completion time is displayed, you are seeing the time elapsed from the last outpulsed digit in the 102 access number to the receipt of the **1020 Hz** envelope.

4. Press **K1 or** the **Up/Down Arrow** keys to scroll through the remaining test results.

5. Press the **Option Menu** function key to exit this option.

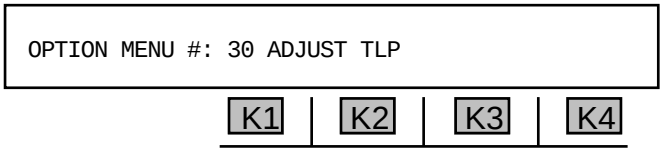
5-30 OPTION MENU #:30 ADJUST TLP

OPTION MENU #:30, ADJUST TLP, is a standard feature that allows the manual adjustment of the transmission level point (**TLP**) compensation of the **930i**. The Transmit **TLP** affects the level the **930i** sends. For **MF** and **DTMF** dialling formats, the Receive **TLP** affects the level sensitivity of the **930i** receiver. This function is normally not used when testing 2-wire analog or **PCM** (T-Carrier) trunks since these are usually a **0 dB TLP**. (Refer to **Section 3-2, Main Function Keys,** for information on 4-wire setup.)

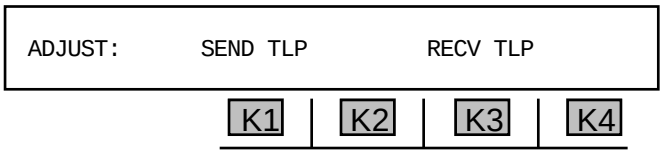
To adjust the **Transmission Level Point**:

1. Press the **Option Menu** function key.

2. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **30** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

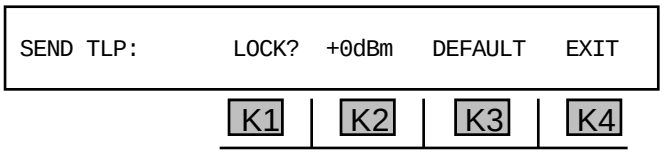


3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K1** under **SEND TLP** to set the send **TLP or K3** under **RECV TLP** to set the receive **TLP**. The display shows the current **TLP** setting.

   If you press **K1**, the display reads:



   If you press **K3**, the message: **SEND TLP** is replaced by **RECV TLP**.

5. Use the **numeric keypad** to change the **TLP** (the **D** key will change the value from **+** to **-**).

   • A valid **TLP** is **-20 dBm** to **+12 dBm**. The default is **+0 dB** for **PCM** and **Loop/Ground Start**.
   If you want the displayed value to remain as the start-up value, press **K1** under **LOCK?** The display will change to **LOCKED**.

6. Press **ENT** to accept the value.

7. Press **K4** under **EXIT** to return the **ADJUST** display.

5-32 OPTION MENU #:32 DIAL-UP TESTLINE

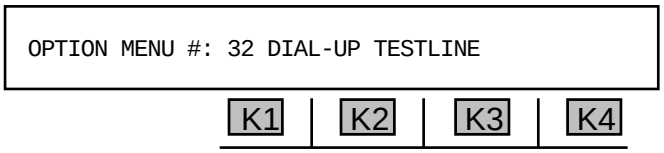
OPTION MENU #:32, DIAL-UP TESTLINE, is a standard feature that enables the **930i** to provide Quiet Termination or send a tone in response to ringing or seizure. That is, the **930i** can act as a Type 100 or a Type 102 testline. Note that, since the tone will not turn off, it is not a true 102 testline (i.e., a noise reading without tone cannot be made).

To set up the **930i** as a **Type 100** or **102 testline**:

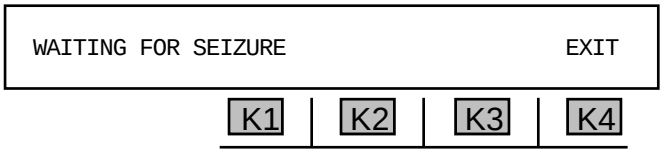
1. Use the **Send Tone** function to setup the tone to be sent. If the **Send Tone** function is turned off, the **930i** will supply Quiet Termination.

2. Press the **Option Menu** function key.

3. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **32** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display briefly reads:



You will then advance to the initial **Dial/Ring** display to set up and make your call. This display will differ depending on whether you are in **analog** or **PCM** mode. Refer to **Section 3-2.2.1** for a description of **the Dial/Ring** function in **analog**, and **Section 3-2.2.2** for a description of **Dial/Ring** in **PCM.**

Note: Before receiving a call in PCM, you must select and set up a protocol if one has not already been selected under the **Dial/Ring** function key. Refer to **Section 3-2.2** for a complete description of this procedure. After setup is completed, you will be ready to receive a call.

Entering this **Option Menu** places the **930i** on-hook where it will remain waiting for line seizure before going off-hook.

If the **930i** tone generator has been turned **OFF**, the **930i** will provide **Quiet Termination** when ringing or seizure is detected.

If you have selected a tone, for example, **1020 Hz** at **0 dBm**, and left the tone generator turned on prior to entering **OPTION MENU #:32**, then the **930i** will respond with the **1020 Hz** at **0 dBm** when ringing or seizure is detected. It will remain until seizure is dropped (on-hook), the **Option Menu** function key is pressed, or a 3 minute time out has occurred.

This option has a **3 minute** time out if forward disconnect is not available.

Option Menu #: 32

5-33 OPTION MENU #:33 DIAL-UP SWEEP

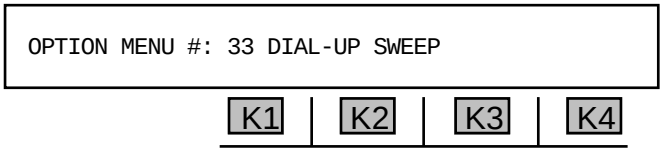
OPTION MENU #:33, DIAL-UP SWEEP, is a standard feature that operates exactly like **OPTION MENU #:32, DIAL-UP TESTLINE,** except that it sends back whatever sweep parameters have been set in **OPTION MENU #:10, FREQUENCY SWEEP**.

To conduct a **frequency sweep** that sends back the sweep parameters:

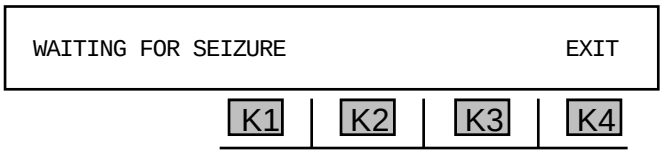
1. Set the sweep up using **OPTION MENU #:10, FREQUENCY SWEEP**. (Refer to **Section 5-10, OPTION MENU #:10 Frequency Sweep,** for information on this function.)

2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **33** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display briefly reads:



   You will then advance to the initial **Dial/Ring** display to set up and make your call. This display will differ depending on whether you are in **analog** or **PCM** mode. Refer to **Section 3-2.2.1** for a description of the **Dial/Ring** function in **analog**, and **Section 3-2.2.2** for a description of **Dial/Ring** in **PCM.**

Note: Before receiving a call, you must select and set up a protocol (if one has not already been selected under the **Dial/Ring** function key). Refer to **Section 3-2.2.2** for a complete description of this procedure. After setup is completed, you will be ready to receive a call.

When the **930i** receives ringing or seizure it will send the sweep frequencies back. This will continue until the trunk is disconnected (goes back **On Hook**), you exit the display, or after 5 minutes if no off-hook supervision is supplied.

5. Press **K4** to **EXIT** from this menu and stop any sweep in progress.

6. Press **K4** to **EXIT** from this menu and stop any sweep in progress.

This option has a **5 minute** time out if forward disconnect is not available.

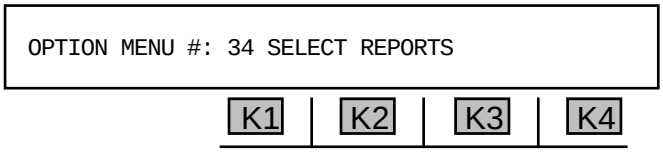
5-34 OPTION MENU #:34 SELECT REPORTS

OPTION MENU #:34, SELECT REPORTS, is a standard feature that allows you to select reports for printing, or for review on a computer or terminal. (Refer to **Section 5, Remote Control Operation,** and **Section 5-3, OPTION MENU #:3, REMOTE CONTROL,** for remote control setup.)

To select reports for printing or review:

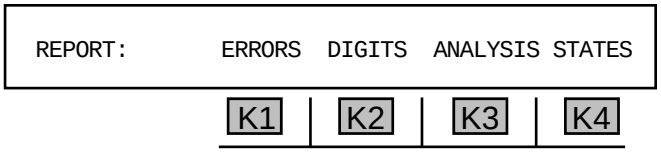
1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **34** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection.

   If you selected **COMPUTER** mode in **OPTION MENU #:3, Remote Control,** the display reads:



   If you selected **TERMINAL** or **PRINTER** mode, the message **REPORT:** is replaced by **PRINT:**

4. Press the **K1** to report or print **ERRORS**, **OR** press **K2** to print or report **DIGITS**. A cursor will appear above each of your selections. (You can select more than one.)

   If you select **DIGITS**, an **ANALYSIS** field appears over **K3** which can be selected. Selecting **ANALYSIS** will print an analysis of the results.

5. Press **K4** under **STATES** to scroll through and select from the following supervision report types:

   - **STATES**
   - **BITS**
   - **TOKENS**

6. Press the **Option Menu** function key to exit this function.

NOTE: In clear channel and dry circuit modes, no supervision report is generated.

5-35 OPTION MENU #:35 DUAL TONE SENDER

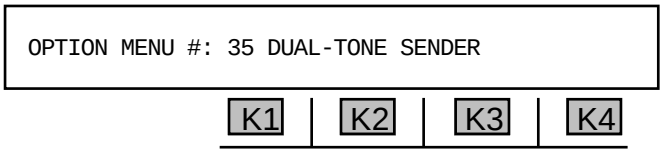
OPTION MENU #:35, DUAL TONE SENDER, is a standard feature that enables the **930i** to send any dual tone signal if the two tones fall within the **930i** frequency range. The **930i** has three preset signals: **Dial Tone**, **Busy** and **Reorder**.

In **Loop Start** or **Ground Start** contact end trunks, the **930i** must be off hook to send.

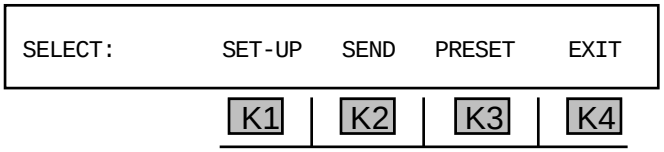
To use the **dual tone sender** feature:

1. Press the **Option Menu** function key.

2. Press the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **35** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



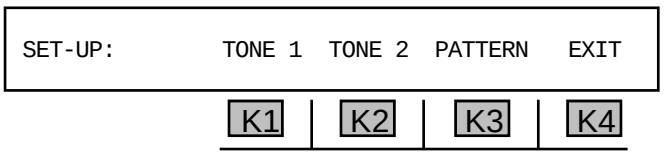
5-35.1 Setup

The setup function is used to select a pair of tones that is different from the factory preset tone pairs.

5-35.1.1 Frequency and Level

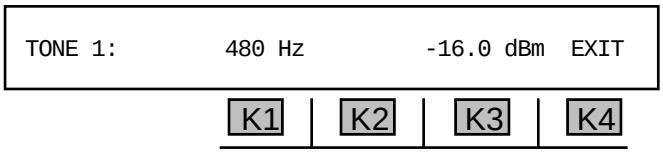
To change the **frequency** and **level** of the signal:

1. Press **K1** to enter the **SET-UP** display:



2. Press **K1** to set the level and frequency of **TONE 1, OR** press **K2** to set **TONE 2**.

For **TONE 1**, the display reads:



The display for **TONE 1** is the same as for **TONE 1.**

3. Press **K1** to change the frequency of the tone, **OR** press **K3** to change the level.

4. Use the **numeric keypad** to enter the desired frequency and level.

- A valid **frequency** is between **20 Hz** and **5000 Hz**. In **DIALTONE**, the default values are **350 Hz** and for **TONE 1** and **440 Hz** for **TONE 2**. In **BUSY** or **REORDER**, the default values are **480 Hz** and for **TONE 1** and **620 Hz** for **TONE 2**.
- A valid **level** is between **+12.0 dBm** and **-99.9 dBm**. In **DIALTONE BUSY** or **REORDER**, the default value is **-16.0 dBm** for **TONE 1&2**.

5. Press **ENT or** any soft key (**K1-K4**) to complete the selection.

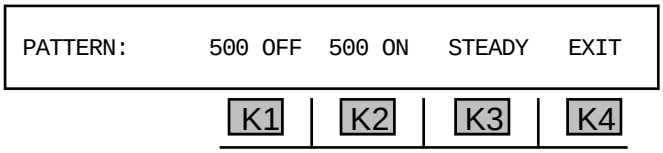
6. Press **K4** to exit back one display.

Option Menu #: 35

5-35.1.2 Pattern

To view the pattern setup in **DIALTONE**:

Press **K3** under **PATTERN.** The display reads:



The default (preset) value for **DIALTONE** is a steady tone. This default can not be changed.

To change the **timing** or **pattern** in any other setup:

1. Press **K1** under **OFF** to change the **OFF** signal, **OR K2** to change the **ON** signal.

You can change the interval for the tones or send a continuous tone. For example, **BUSY** is sent at **500** milliseconds **OFF** and **500** milliseconds **ON** as shown above. **REORDER** is sent at **250** milliseconds **OFF** and **250** milliseconds **ON**.

2. Use the **numeric keypad** to enter a new **time interval**.

- A valid **time interval** is between **1** millisecond and **9999 MSEC**.

3. Press **ENT or** any soft key (**K1-K4**) to accept the values.

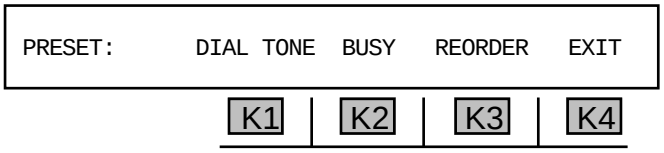
4. To send a signal continuously, press **K3** under **STEADY**. In this case the **OFF** and **ON** times are blank.

5. Press **K4** twice to exit back to the main display to perform the test.

5-35.2 Preset

To select and send one of the **930i**'s standard **preset signals**:

1. Press **K3** under **PRESET.** The display reads:



2. Press the soft key directly below the tones you want to send. You will be returned to the **SELECT** display.

3. Press **K2** under **SEND**. A flashing cursor will appear over **SEND** while you are transmitting. The tones will be audible through the front panel speaker.

In Loop Start or Ground Start contact end trunks, the **930i** must be off-hook to send.

4. Press **K2** under **SEND** again, **or** go **On Hook** to stop sending. If testing is complete, press **K4** under **EXIT**.

5-35.3 Send

To send a **dual-tone signal**:

1. Press **K2** under **SEND**. A flashing cursor will appear over **SEND** while you are transmitting. The tones will be audible through the front panel speaker.

2. Press **K2** under **SEND** again, **or** go **On Hook** to stop sending.

3. Press **K4** under **EXIT** when testing is complete.

5-37 OPTION MENU #: 37 LINE STATUS

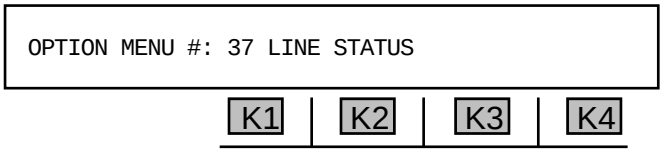
OPTION MENU #: 37 LINE STATUS is a standard feature that enables the **930i** to bridge or terminate on an analog facility (2W/4W) Loop or a **PCM** Channel, and monitor the status of the line in one direction. Typically, the **930i** analyzes the received audible tones on the line and displays the condition. The following audible tones are analyzed: **Dial tone, Busy, Reorder, Dead Line, Ringing, Talking** or **Speech,** and **Tone.**

When a tone is analyzed, the display will be in real time. If the condition changes, it will clear after a timeout and indicate the new condition. This information can be printed or sent to a computer as it occurs. (Refer to **Section 6, Remote Control Operation,** and **Section 5-3, OPTION MENU #:3, REMOTE CONTROL,** for more information.)

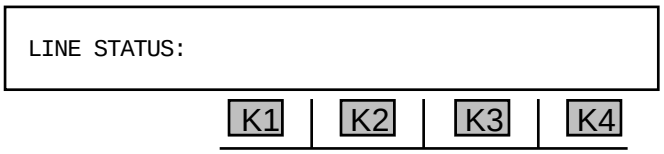
To view the **line status**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **37** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



   As conditions change on the line, the display status will update.

4. Press the **Option Menu** function key to exit when testing is complete.

5-39 OPTION MENU #:39 REMOTE AUDIO

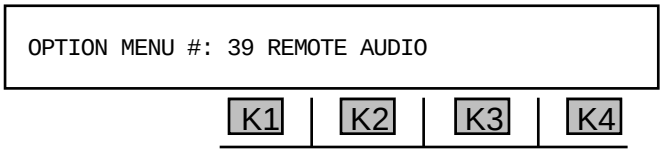
OPTION MENU #:39, REMOTE AUDIO, is only available when *Purchased Option 930i-47*, *Remote Audio,* is installed. The Remote Audio option provides remote access to the trunk under test. This is accomplished via a separate dial-up line. This enables troubleshooting and verification from a remote location.

Remote audio access is through a standard modular telephone jack (RJ-11) located on the **930i** rear panel. Refer to **Section 1-7, DC Rear Panel,** for location. The modular jack provides a loop appearance. When the **930i** is turned on, the remote audio line is placed on-hook. The monitor can be set to answer automatically when it detects ringing.

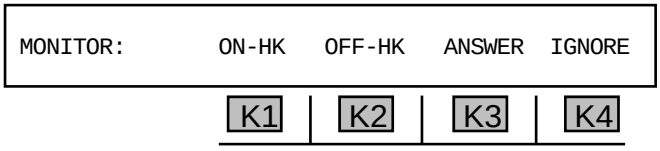
To gain **remote access** to the trunk under test:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **39** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



   Flashing cursors indicate whether the audio monitor is currently on- or off-hook, and whether it has been programmed to answer or ignore incoming calls.

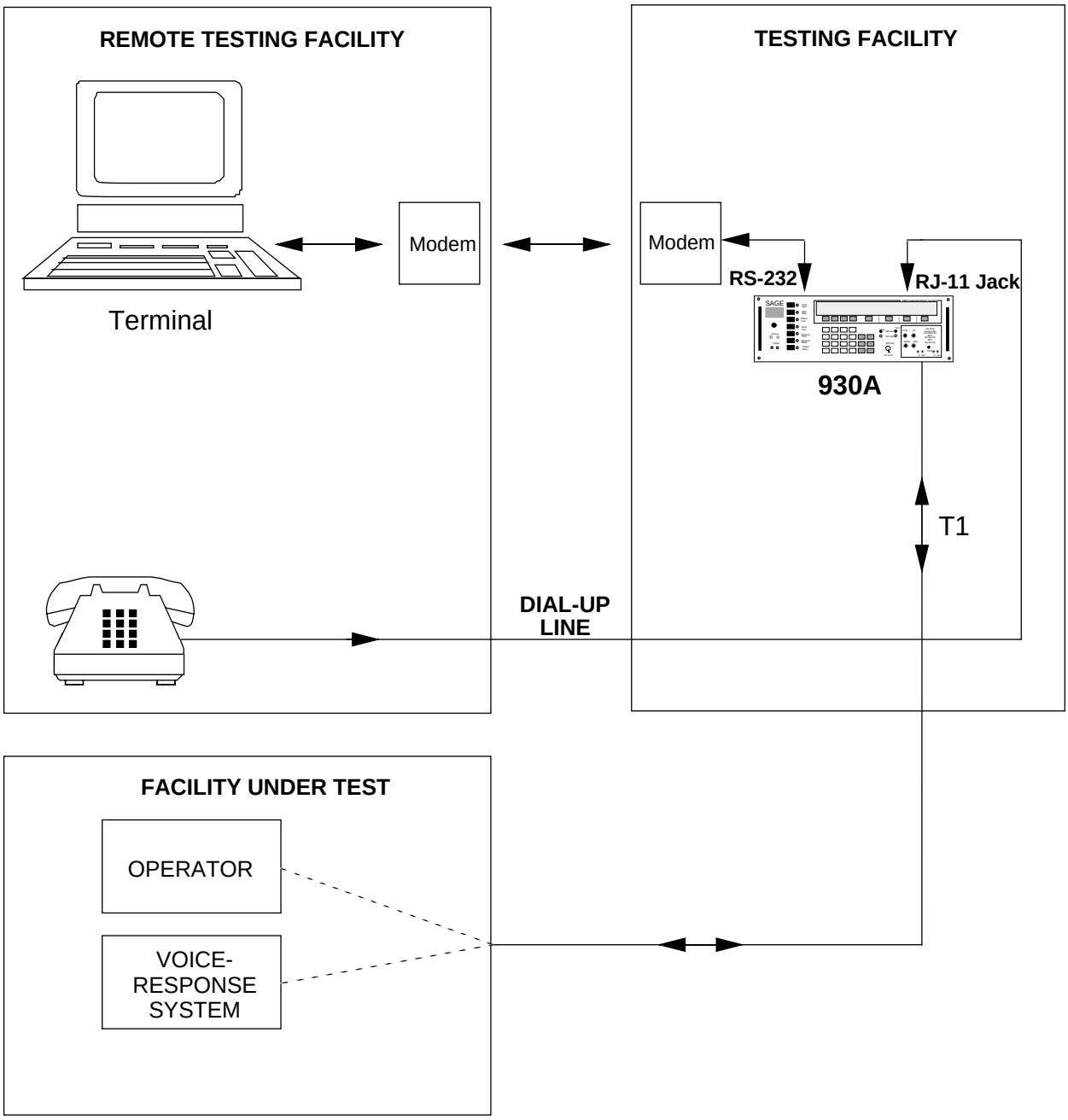
   If the remote line has been set to answer incoming calls, it will respond to and trip ringing by going off-hook.

4. Press **K1** to place the remote line on-hook, **or K2** to place the Remote Line off-hook, **or K3** to answer incoming calls, **or K4** to ignore incoming calls.

5. Press the **Option Menu** function key to exit.

Remote Audio may be operated remotely by establishing a modem call connection from the control site. (Refer to **Section 5-3, OPTION MENU #:3, Remote Control,** and **Section 6, Remote Control Operation,** for setup information.)

The connection of the **930i** for remote audio operation appears below:



Option Menu #: 39

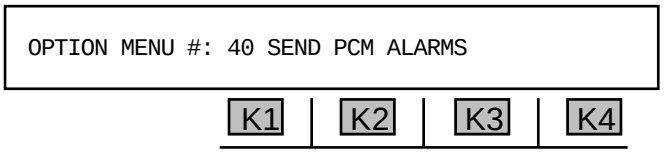
5-40 OPTION MENU #:40 SEND PCM ALARMS

OPTION MENU #:40, SEND PCM ALARMS, is a standard feature that allows you to send PCM alarms on spans that have been busied out. Sending Alarms or forcing a Frame Slip is not intended to be done on spans carrying service. They are tests usually performed prior to turning up service on a channel bank or switch to see that their alarm indicators are working.

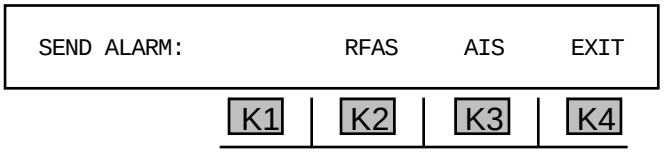
To send **PCM** alarms:

1. Set the **930i** to **PCM TERM** mode under the **Trunk Type** function key.
2. Connect the **930is** test cords as shown in **Figure 5-40.1.**

   If your circuit is loop-timed, you will not be able to force a frame slip toward the distant end of your circuit.
3. Press the **Option Menu** function key.
4. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **40** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



6. Press **K2** to send the Remote (**RFAS**) Alarm, **OR** press **K3** to send the unframed All 1s (**AIS**) Alarm. When you select an alarm, a cursor appears over your selection.
7. Press **K4** to exit from this display and turn the alarm off.

5-41 OPTION MENU #:41 READ E1 VOLTAGE

OPTION MENU #:41, READ E1 VOLTAGE, is a standard feature that enables you to measure and read the voltage on an E1 span.

To measure the positive and negative **base-to-peak voltages**:

1. Set a **PCM** trunk type.

2. Connect one, or both, of the **PCM** receivers to the **Jack Field**.

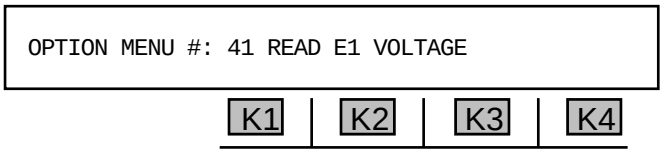
   for example:

   Figure 5-41.1 shows a **930i** in the **MON-1** mode connected to the **Jack Field**.

   At the **Jack Field** output jacks, expect to see about ±**3.0** volts base-to-peak. At the monitor jacks, however, expect to see about one tenth the voltage, or roughly ±**0.3** volts base-to-peak. The reading should not be less than ±**0.2** volts base-to-peak at the **Jack Field** Monitor jack. If so, this indicates a possible problem in the office. It could be a problem with a **CSU**, a defective cable, poor LBO equalization, or too long a cable run from the equipment to the **Jack Field**.

3. Press the **Option Menu** function key.

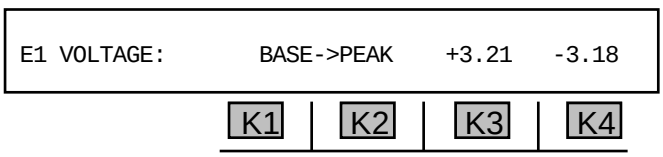
4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **41** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The **930i** will display its readings as Base-to-Peak voltage.

   for example:

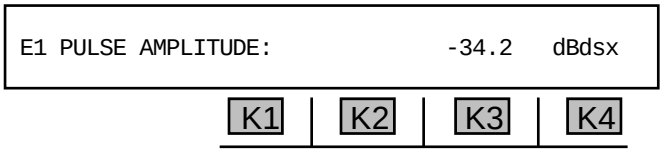
   A typical reading at the **Jack Field** output jack might be:



The positive and negative going peaks are close to each other in terms of absolute value. If they were very different from each other (more than **0.5 V**), or if they were much higher or lower than the nominal **3 V (±6.0 V**), problems may occur.

6. Press any soft key (**K1-K4**) to read the **E1** pulse amplitude in **dB** instead of **voltage**.

for example:



3.0 volts base-to-peak is equal to **0.0 dB**. Readings between **-1.0** and **1.0 dB** would be expected at the **Jack Field** output jacks. Readings of about **-20 dB** would be expected at the **Jack Field** monitor jacks.

5-43 OPTION MENU #:43 E1 ERROR COUNTERS

OPTION MENU #:43, E1 ERROR COUNTERS, is a standard feature that enables the **930i** to automatically monitor and count the following error types: **CODE, CER, FAS ERR, CRCRS, BIT SLIP, FR SLIP, FAS LOSS, EFS, %EFS, ES, %ES, SES, %SES, FAILED, %FAILED, AVAIL, %AVAIL, UNAVAIL,** and **%UNAVAIL**. All measurements are in accordance with **CCITT G.821**. (Refer to **Section 4, PCM Operation,** for setup information.)

If the **930i** is not in **OPTION MENU #:43**, the **930i** display will momentarily interrupt what it is showing you to flash an error messages on its display. If you are in a dual direction mode such as **MON-1&2** or **D&I**, the **930i** will also show you from which direction the error came.

5-43.1 Example: MON 1&2 Mode

To set up the **E1 Error Counter** function and view errors in **MON-1&2** mode:

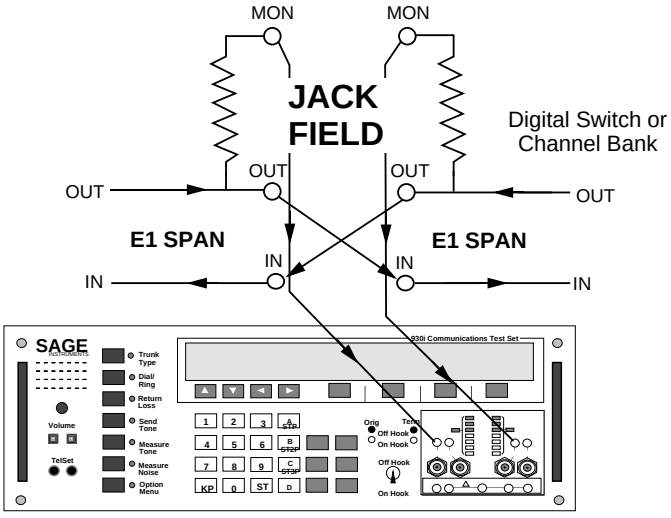
1. Connect the **930i's test cords** as shown in **Figure 5-43.1**

   When the **930i** is in the **MON-1&2** mode, and connected to the **Jack Field**, it will accumulate errors as they occur.

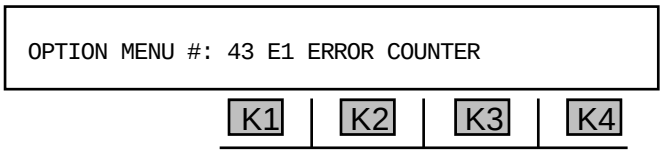
2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **43** using the **numeric keypad** and then press the **Option Menu** function key.

   The display reads:



PCM Mode: MON -1

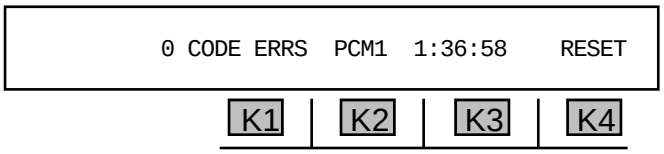


4. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display show the error counts. In order of display, the tests are:

CODE ERR	**CER**	**FAS ERR**	**CRCRS**
BIT SLIP	**FR SLIP**	**FAS LOSS**	**NO PCM**
EFS	**%EFS**	**ES**	**%ES**
SES	**%SES**	**FAILED**	**%FAILED**
AVAIL	**%AVAIL**	**UNAVAIL**	**%UNAVAIL**

for example:

The first display reads:



5. Press **K1 or** the **Up/Down Arrow** keys to page through the tests described above.

6. Press **K2** to toggle between **PCM1** and **PCM2**.

   If the **930i** is in the **MON-1&2** or **D&I** modes, press **K2** to toggle between side **1** and side **2**. The **930i** has independent counters on each side.

Errors for **ES** and **SES** are based on **line CODE, FAS**, and **CRC errors,** depending on the frame type used.

7. Press **K3** to change the elapsed time format from **24 hour clock** to **elapsed sec display**.

8. Press **ENT** if you are in **COMPUTER** or **PRINTER** mode to print out the current totals.

9. Press the **CLR** key or **K4** under **RESET** to clear all counters.

10. Press the **Option Menu** function key to exit.

5-44 OPTION MENU #:44 E1 ERROR HISTORY

OPTION MENU #:44, E1 ERROR HISTORY, is a standard feature that gives you up to 24 hours of history on the span under test. The tests are **CODE ERR, CER, FAS ERR, CRCS, BIT SLIP, FR SLIP, FAS LOSS, NO PCM, EFS, %EFS, ES, %ES, SES, %SES, FAILED, %FAILED, AVAIL, %AVAIL,** and **UNAVAIL.** Counts are displayed in 15-minute blocks for up to 24 hours at a time. If the **930i** is connected to a printer (or a computer), the information is not limited to the last 24 hours.

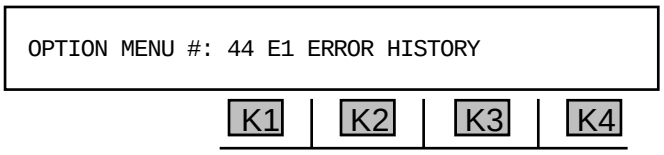
5-44.1 Example: MON 1&2 Mode

To obtain an **E1 error history** in **MON 1&2** mode:

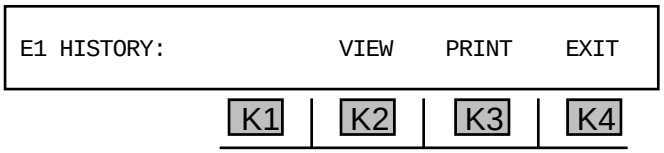
1. Connect your **930i's** test cords to the **Jack Field** as shown in **Figure 5-44.1** to monitor both directions of transmission.

2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **44** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:

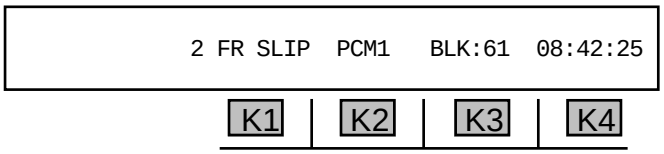


5-44.2 View

To **review errors** that have occurred over the past **24** hours:

1. Press **K2** under **VIEW** and the history display will come up showing the latest block in which error data has accumulated.

   for example:

   The above display shows the 61st 15-minute block of time since the test began (@ 15 hours)

2. Press **K1 or** the **Up/Down Arrow** keys to scroll through the remaining tests:

CODE ERR	**CER**	**FAS ERR**	**CRCRS**
BIT SLIP	**FR SLIP**	**FAS LOSS**	**NO PCM**
EFS	**%EFS**	**ES**	**%ES**
SES	**%SES**	**FAILED**	**%FAILED**
AVAIL	**%AVAIL**	**UNAVAIL**	**%UNAVAIL**

3. If the **930i** is monitoring both sides of the line, press **K2** to toggle to **PCM2**. The same results apply as for **PCM1**.

4. Press **K3** under **BLK:** to scroll through the remaining blocks, **or** enter a number from the **numeric keypad** to enter a specific block.

5-44.3 Print

You may connect a printer or computer to the **930i** and view the results via terminal or printout. (Refer to **Section 6, Remote Control Operation,** for instructions on connecting a printer or computer and **Section 6-4.4, Printing Test Results,** for instructions on the print function.)

5-45 OPTION MENU #:45 E1 ERROR INJECT

OPTION MENU #:45, E1 ERROR INJECT, is a standard feature that enables you to inject a single **CRC, Code,** or **FAS Error**. This feature is only active when the trunk type has been set to **TERMINATE** mode. Errors cannot be injected when the **930i** is monitoring the **E1** facility.

To inject a single **CRC, CODE** or **FAS** error:

1. Connect the **930i** when operating in the **TERMINATE** mode (simulating a channel bank) as shown in **Figure 5-45.1**.

2. Press the **Option Menu** function key.

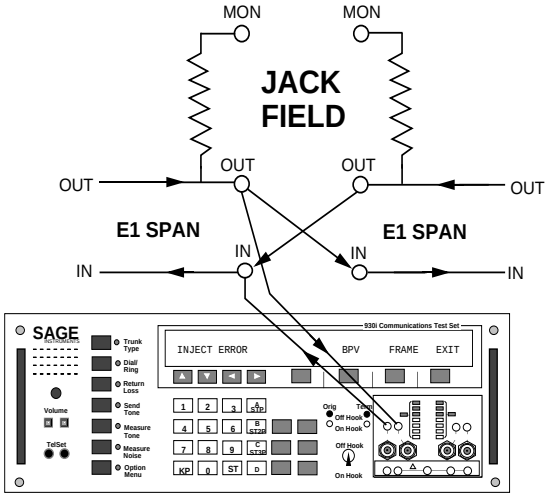


Figure 5-45.1
Injecting Bit Errors with the 930i

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **45** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

```
OPTION MENU #: E1 ERROR INJECT
```

K1 | K2 | K3 | K4

4. Press **ENT or** any soft key (**K1-K4**) to enter the option.

5-45.1 Error Type Selection

If you did not chose **CRC4** framing under the **Trunk Type** function key, the display reads:

```
INJ ERR:      SETUP              CODE     FAS
```

K1 | K2 | K3 | K4

If you chose **CRC4** framing under the **Trunk Type** function key, the display reads:

```
INJ ERR:      SETUP     CRC      CODE     FAS
```

K1 | K2 | K3 | K4

Option Menu #: 45

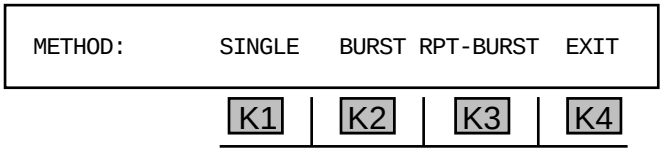
Press the soft key (**K2-K4**) beneath the type of error you want the **930i** to send. Press **K2** to inject a **CRC** error, **or K3** to inject a **CODE** error, **OR K4** to inject a **FAS** error.

The display will momentarily flash a cursor over the error being injected. If you are testing on a looped back facility, the **930i** will record the error coming back. The display will flash the appropriate error and the error counter in **OPTION MENU #:43, E1 ERROR HISTORY,** will increment. (Refer to **Section 5-43, OPTION MENU #:43, E1 ERROR COUNTERS,** for instructions on how to use Error History.)

5-45.2 Setup

To setup an error **injection method**:

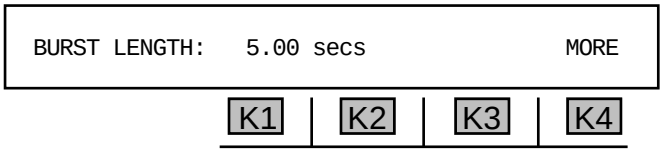
1. Press **K1** under **SETUP** from the **INJ ERR** display. The new display reads:



2. Press **K1** to send a **single error**, **K2** to send a **burst or K3** to send **multiple bursts**.

If you selected **SINGLE** as an injection method, you will be returned to the **INJ ERR** display.

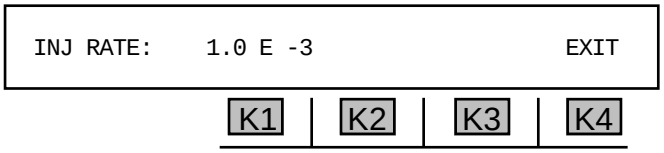
If you selected **BURST** as an injection method, the display reads:



1. Use the **numeric keypad** to enter a new **burst length**.

   • A valid **burst length** is between **0.02** and **15.00 secs**.

2. Press **K4** under **MORE**. The display reads:



3. Press **K1** to set the **mantissa of the rate**.

4. Use the **numeric keypad** to enter a new **mantissa**.

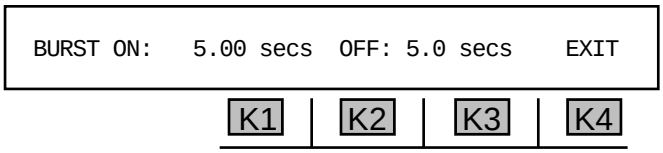
   • A valid **mantissa of the rate** is between **0.1 secs** and **2.0 secs**.

5. Press **K2** to change the **exponent of the rate**.

6. Use the **numeric keypad** to enter a new **exponent**.

- A valid **exponent** of the rate is between **-2** and **-9.**

If you selected **RPT-BURST** as an injection method, the display reads:

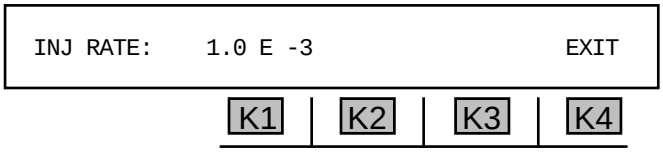


1. Press **K1** to change the burst on time **or K3** to change the burst off time.

2. Use the **numeric keypad** to enter a new **burst on** or **off time**.

- A valid **burst on time** is between **0.02 secs** and **15.0 secs**.
- A valid **burst off time** is between **0.1 secs** and **15.0 secs**.

3. Press **K4** under **MORE**. The display reads:



4. Press **K1** to set the **mantissa of the rate**.

5. Use the **numeric keypad** to enter a new **mantissa**.

- A valid **mantissa of the rate** is between **0.1 secs** and **2.0 secs**.

6. Press **K2** to change the **exponent of the rate**.

7. Use the **numeric keypad** to enter a new **exponent**.

- A valid **exponent** of the rate is between **-2** and **-9.**

8. Press **the Option Menu key** to exit.

Option Menu #: 45

5-46 OPTION MENU #:46 E-1 BIT ERROR RATE

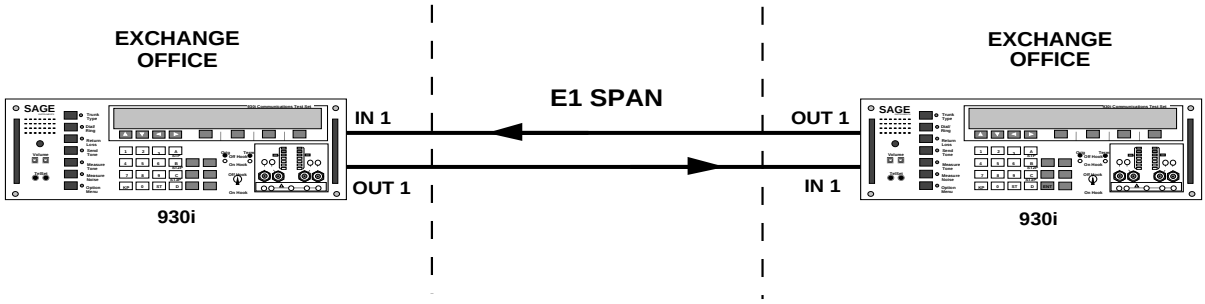
OPTION MENU #:46, E-1 BIT ERROR RATE, is a standard feature that allows you to perform either single direction or dual direction BER tests:

- between two EOs on a E1 span.
- between two EOs on a E1 span with the far-end looped back.
- between a EO and a customer CSU.
- on two E1 spans simultaneously.

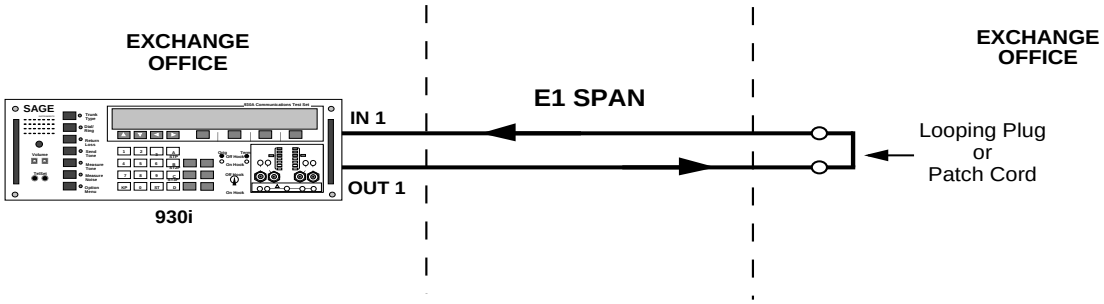
The following subsections discuss each of these configurations.

5-46.1 Testing between two EOs

Test setup between two EOs



Test setup between two EOs with far end looped back



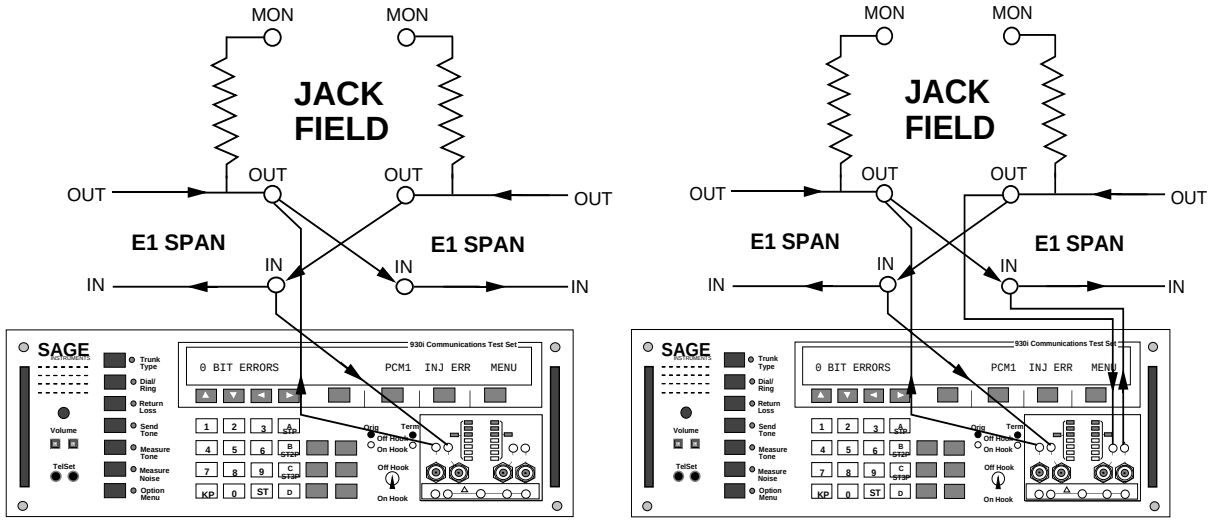
Use the factory defaults for testing if the far-end is looped back.

Both side 1 and side 2 of the **930i** are always activated upon entering **OPTION MENU #:46**. Either side may be viewed during a test.

To set up either a **single** or a **dual direction test**:

1. Make sure that the E1 span you are connecting to is out of service.

2. Connect the test cords from the **930i** to the E1 under tests according to **Figure 5-46.1.**



Single Direction BERT
Single Span

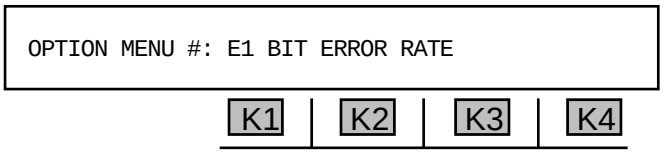
Dual Direction BERT
Single Span

Figure 5-46.1
Test Cord Connections

Upon entering **OPTION MENU #:46, E1 BIT ERROR RATE,** the **930i** automatically sets to **E1** operation. The factory default parameter settings have been implemented to allow testing in most instances without changing any setups. Both units must be set to the same patterns and parameters to achieve sync.

3. Press the **Option Menu** function key.

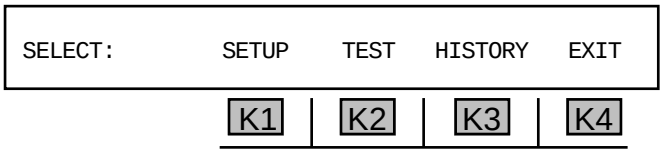
4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **46** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



5. Press any soft key (**K1-K4**) to activate your selection. If the **930i** is not in **PCM** mode, the display will momentarily read **SETTING E-1 MODE...STAND BY**. (Refer to **Section 4, PCM Operation,** for more information.)

Option Menu #: 46

Once the **930i** is in **PCM** mode, the display reads:



The following are the default parameters for testing in this option:

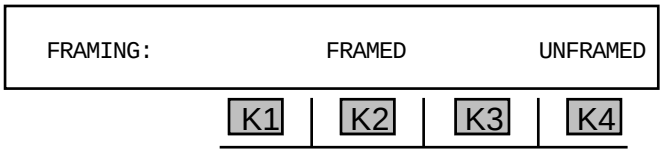
PATTERN:	**QRSS**
FRAME:	**PCM30**
CLOCK:	**INTERNAL 2.048 MBPS ±30 BPS**
IMPEDANCE:	**120/75 OHMS**
LINE CODING:	**AMI**
TEST LENGTH:	**CONTINUOUS**

6. To test using the default parameters, skip to **Section 5-46.3, Test Mode**. The following sections describe the **setup** procedure for parameters other than the default parameters shown above.

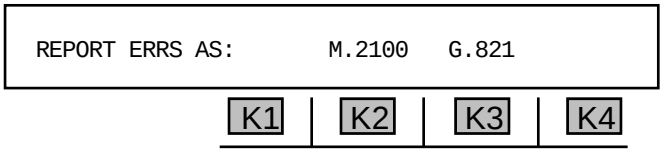
5-46.1.1 Customizing Parameters

To check or change the **testing parameters:**

1. Press **K1** under **SET-UP** in the **SELECT** display. The new display reads:



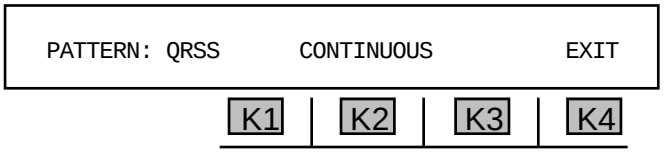
2. Press **K2** to select **FRAMED** testing **OR K4** to select **UNFRAMED** operation. The display reads:



3. Press **K2** under **M.2100 OR K3** under **G.821** to select a reporting format.

Note that **M.2100** and **G.821** differ in that **M.2100** includes line errors in calculating errored seconds and severely errored seconds, while **G.821** does not.

The display reads:



The default **pattern** is **QRRS**, and the default **test length** is **CONTINUOUS.**

4. Use the **Up/Down Arrow** keys **or** press **K2** to scroll through the valid patterns. The parameters

QRSS (default)	**2↑11-1**
2↑23-1	**2↑9-1**
2↑20-1	**USER** (inputs any 8 bit pattern) refer to **Section 5-46.1.2**.
2↑15-1	

5. Press **K2** to change the **test length.** Available test lengths are:

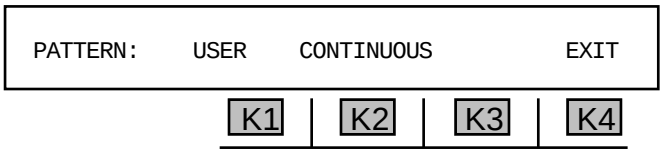
CONTINUOUS, 15 MINUTES, 1 HOUR, and **24 HOURS**.

6. Press **K4** to return to the main display.

5-46.1.2 The USER Pattern

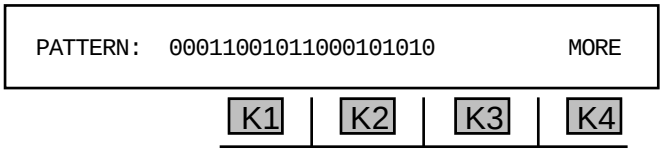
To setup a customized pattern:

1. Press the **Up Arrow or K1** from the **PATTERN** display until the display reads:



2. Press **K4** under **EXIT** to display the **USER** pattern.

   for example:



3. Press the **CLR** key to delete any existing pattern.

4. Use the **Left/Right Arrow** keys to position the cursor over the digit you want to change.

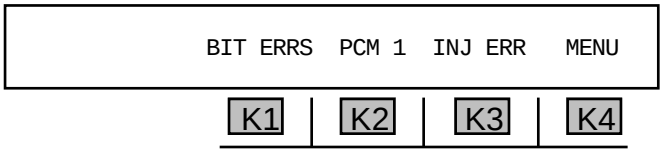
5. Use the **numeric keypad** to enter a **1** or **0**. (the pattern can be up to 30 bits in length) The default loop-down code is **100**.

Use the **numeric keypad** only if you wish to type over the digit under the cursor. Use the **Up Arrow** key to insert a **0** digit under the cursor and move all digits to the right. Use the **Down Arrow** key to delete the digit under the cursor.

The pattern entered becomes the test pattern the **930i** will use in the **TEST** display. By using the **930i**'s **STO** (store) and **RCL** (recall) functions the **930i** can store up to **39** different **USER** patterns.

5-46.2 Test

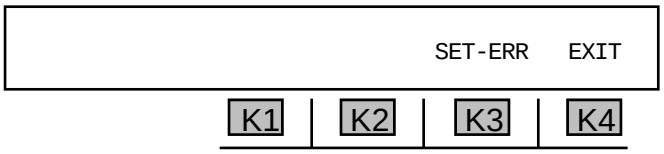
1. After completing the setup procedure, press **K2** under **TEST** from the **SELECT** display. If you have not made any connections or your test cords are not connected correctly, you will see the message: **NO PATTERN SYNC**. Otherwise, the test results will be displayed above **K1** in the following display:



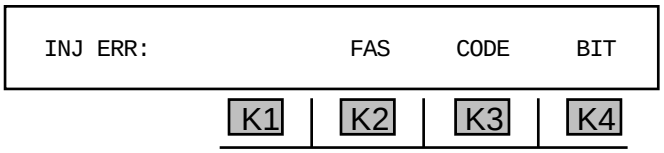
2. Press **K1 or** use the **Up/Down Arrow** keys to scroll through the following test results:

BIT ERRS	(BIT ERRORS)	**%EFS**	
BER	(BIT ERROR RATE)	**ES**	(ERRORED SECONDS)
CODE ERR		**%ES**	
CER		**SES**	(SEVERELY ERRORED SECONDS)
FAS ERRS		**%SES**	
FAS LOSS		**FAILED**	
BIT SLIP		**%FAILED**	
FR SLIP	(FRAME SLIP)	**AVAIL**	
FAS LOSS		**%AVAIL**	
SLS		**UNAVAIL**	
EFS		**%UNAVAIL**	
		ELAPSED	

3. Press **K4** under **MENU** to change the type of errors being injected:



4. Press **K3** under **SET-ERR.** The display reads:



5. Press the soft key (**K1-K4**) directly beneath the type of error you want to send. You will be returned to the main **BERT** display.

   If you do not interrupt the test, the message **TEST COMPLETED** will display if a finite parameter was selected under the **Test Length** display (**15 MINUTES, 1 HOUR, 24 HOURS**).

5-46.2.1 BER Testing Two E1 Spans Simultaneously

Your **930i** has the functionality of two **BERT** sets if it is equipped with *Purchased Option 9301-100.*

To test **two E1 spans** simultaneously:

1. Connect the jacks according to **Figure 5-46.4**.
2. Press **K2** under **`TEST`** from the **`SELECT`** display.
3. Press **K2** under **`PCM1`** to toggle between looking at the errors on **Side 1** and those on **Side 2**. (Refer to **Figure 5-18** for the connection setup.)

   The **`HISTORY`** for both sides is accumulated.
4. Press **K2** to toggle between **Side 1** and **Side 2** results.

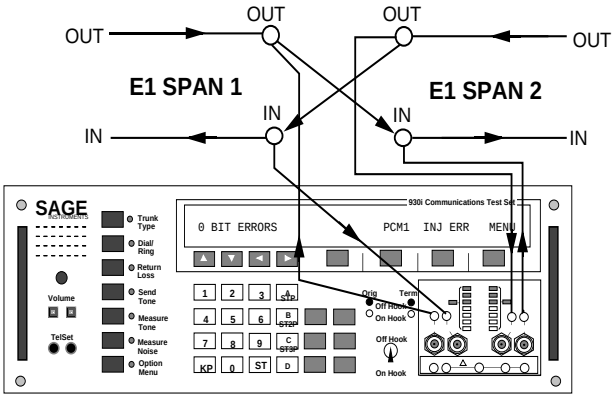


Figure 5-46.4
BER Testing Two E1 Spans Simultaneously

Option Menu #: 46

5-46.3 History

To review the errors which have been recorded:

Press **K3** under **`HISTORY`** in the **`SELECT`** display. If no tests have been made, you will see the message: **`NO BERT HISTORY AVAILABLE`**. Otherwise, the display reads:

```
DS1 BERT HISTORY:      VIEW    PRINT    EXIT
```

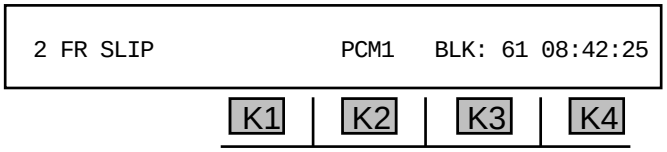
K1 | K2 | K3 | K4

5-46.3.1 View

To view **error data**:

1. Press **K2** under **`VIEW`** and the history display will come up showing the latest block in which error data has accumulated.

   for example:

   The above display shows the 61st 15-minute block of time since the test began (@15 hours).

2. Press **K3** under **`BLK: 61`** to find out what has gone on prior to this this time period or enter the number of the block of interest. The display will begin at **`BLOCK: 1`**. Continue pressing **K3** to scroll through the remaining 60 blocks. (Note that the time above **K4** changes with each block.)

3. If you are monitoring both sides of the line, press **K2** to toggle to **`PCM2`**. The same results apply as for **`PCM1`**.

4. Press **K1 or** the **Up/Down Arrow** keys to scroll through the remaining tests.

5. Press the **Option Menu** function key to return to the **`SELECT`** display.

5-46.3.2 Print

You may connect a printer or computer to the **930i** and view the results via terminal or printout. (Refer to **Section 6, Remote Control Operation,** for instructions on connecting a printer or computer and **Section 6-4.4, Printing Test Results,** for instructions on the print function.)

5-55 OPTION MENU #:55 FRACTIONAL E1 BERT

OPTION MENU #:55, FRACTIONAL E1 BERT, is available only when *Purchased Option 930i-51, Fractional E1 BERT,* is installed. **OPTION MENU #:55, FRACTIONAL E1 BERT,** provides the capability to group contiguous, noncontiguous, and true-noncontiguous **DS-0** circuits into a single wideband Data Circuit (**fractional E1**) that can be **BERT** tested and verified for operation.

Contiguous fractional E1 allows testing of a group of channels on a single **DS-0** that are sequential.

Noncontiguous fractional E1 allows testing of a group of channels on a single **DS-0** that are not sequential.

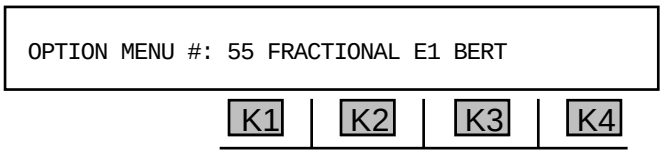
True-noncontiguous fractional E1 allows testing of a group of channels located on multiple **DS-0**s that must be inverse-multiplexed. These **fractional E1** types are used primarily for transmission of data and video signals.

To test both **PCM1** and **PCM2**, set your Trunk Type to **PCM, D&I**. For **PCM1** only, the **930i** must be in **TERMINATE** mode. Refer to **Section 4, PCM Operation,** for setup information.

To use **fractional E1 BERT**:

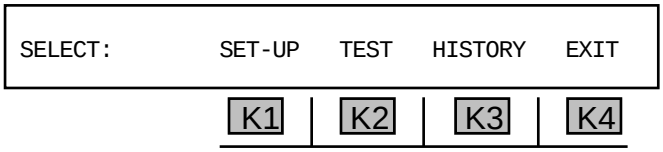
1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **55** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. If you are not in **PCM**, you will see the message: **NOT IN PCM!** Use the **Trunk Type** function key to select **PCM**. (Refer to **Section 4, PCM Operation,** for more details.)

   If you are in **PCM**, the main **SELECT** display reads:

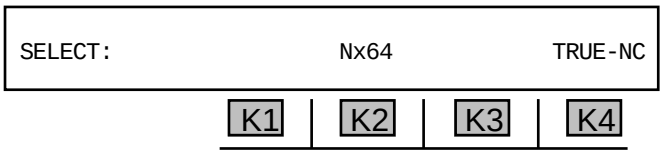


5-55.1 Setup

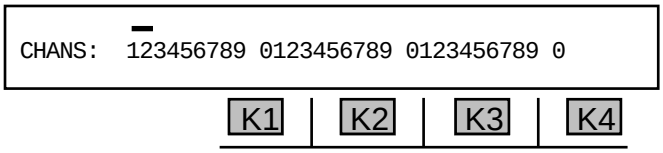
To set up a **fractional E1 BERT**:

1. Press **K1** under **SET-UP**.

The display reads:



2. Press **K2** under **Nx64** to select a contiguous or noncontiguous **DS-0** channels, **OR** press **K4** under **TRUE-NC** to select true noncontiguous **DS-0** channels for the Data Circuit under test. The display reads:



1-9 are channels 1-9. 0-9 are channels 10-19, 0-4 are channels 20-24.

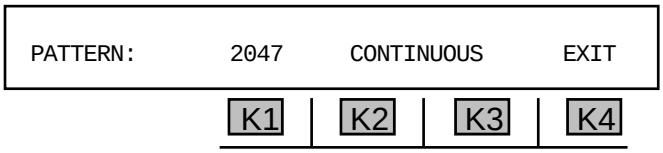
3. Use the **numeric keypad** to enter each channel to be tested (the display will briefly read **ENTER CHANNEL #:**) and press **ENT**.

   • A valid **channel number** is between **1** and **30**.

If you enter the number of a channel that has already been selected, that channel will then be deselected.

Alternately, you can press **K1** to select **ALL** channels **or** the **CLR** key to clear all channels. You can then use the **Left/Right Arrow** keys to place the cursor over the desired number, then change it, or enter the channel to be added/deleted using the **numeric keypad**.

4. Press the **Option Menu** function key when your channel selection is complete. The display reads:



5. Press **K1** to scroll through the available patterns:

2047
2^{15}
2^{20}
USER
511

6. Press **K2** or **K3** to scroll through the time parameters:

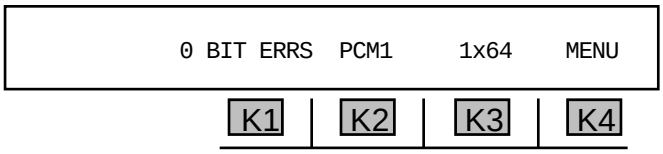
CONTINUOUS 1 HOUR
15 MINUTES 24 HOURS

5-55.2 Test

To begin testing **contiguous**, **noncontiguous** and **true-noncontiguous** channels for synchronization and transmission errors:

1. Press **K2** under **TEST** from the main **SET-UP** display.

   If you selected **Nx56** the new display reads:



   If **Nx64** was selected, the message **Nx56 KBIT** is replaced with **Nx64**.
   If you selected **true noncontiguous**, the message above **K3** reads: **TRUE-NC**.

2. Press **K1 or** the **Up/Down Arrow** keys to scroll through the tests and their results.

   The available tests are:

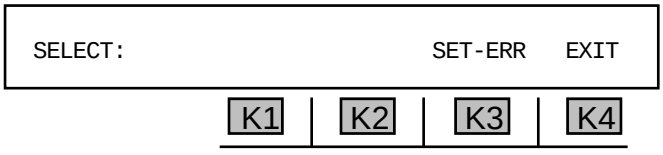
Option Menu #: 55

BIT ERRS	(BIT ERRORS)	**%EFS**
BER	(BIT ERROR RATE)	**ES** (ERRORED SECONDS)
BPV ERRS	(BIPOLAR VIOLATION ERRORS)	**%ES**
BPVR	(BIPOLAR VIOLATION RATE)	**SES** (SERIOUSLY ERRORED SECONDS)
FR ERRS	(FRAME ERRORS)	**%SES**
FR LOSS	(FRAME LOSS)	**FAILED**
BIT SLIP		**%FAILED**
FR SLIP	(FRAME SLIP)	**AVAIL**
SLS	(SYNC LOSS SECONDS)	**%AVAIL**
EFS	(ERROR FREE SECONDS)	**UNAVAIL**
		ELAPSED (TIME OF TEST)

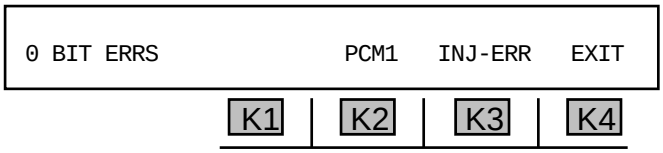
5-55.2.1 Testing Contiguous and Noncontiguous Channels

To continue testing **contiguous** and **noncontiguous** channels:

1. Press **K4** under **MENU**. The display reads:



2. Press **K3** under **SET ERR** once and you will see a display similar to:



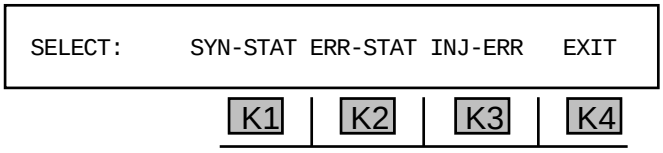
3. Press **K3** under **INJ-ERR** to inject an error.

4. Press **K4** to exit this display.

5-55.2.2 Testing True-Noncontiguous Channels

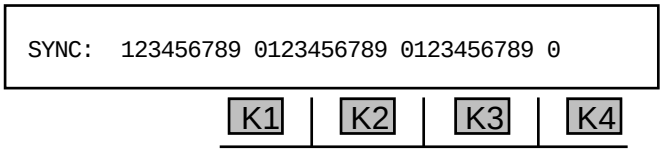
To continue testing **true**-**noncontiguous** channels:

1. Press **K4** under **MENU**. The display reads:



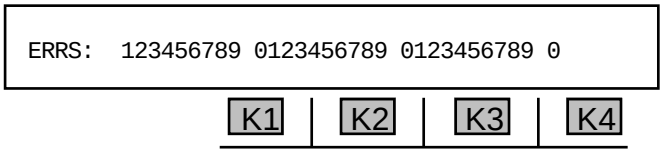
2. Press **K1** under **SYN-STAT** to view the synchronization status, **OR** press **K2** under **ERR-STAT** to view the error results.

   If you selected **SYN-STAT**, the display reads:



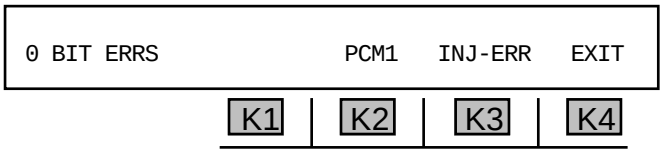
The display shows the synchronization status for up to 30 channels on the E1 under test. A **0** indicates that the indicated channel is synchronized, while a **1** indicates that the channel is not synchronized. A **-** indicated that the channel is not enabled.

   If you selected **ERR-STAT,** the display reads:



The display shows the error status for up to 30 channels on the E1 under test. A **0** indicates the absence of an error or errors on the indicated channel, while a **1** indicates the presence of an error. A **-** indicated that the channel is not enabled.

If you selected **INJ-ERR**, the display reads:



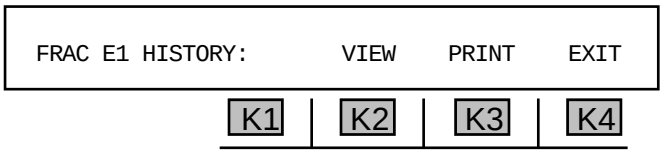
3. Press **K3** under **INJ-ERR** to inject an error.

4. Press **K4** to exit this display.

5-55.3 History

To **review errors** that have been recorded:

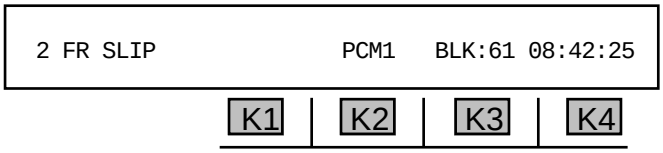
Press **K3** under **HISTORY**. If no tests have been made, you will see the message: **NO BERT HISTORY AVAILABLE**. Otherwise, the display reads:



5-55.3.1 View

To view **test results:**

1. Press **K2** under **VIEW**. The display reads:



The previous display shows the 61st 15-minute block of time since the test began.

2. Press **K3** under **BLK: 61** to find out what has gone on prior to this time period. The display will begin at Block 1. Continue pressing **K3** to scroll through the remaining 60 blocks. Note that the time above **K4** changes with each block. You can also use the **numeric keypad** to enter the number of the block of interest directly.

3. If you are monitoring both sides of the line, press **K2** to toggle to **PCM2**.

4. Press **K1** or the **Up/Down Arrow** keys to scroll through the remaining tests.

5. Press the **Option Menu** function key to return to the main **SELECT** display.

5-55.3.2 Print

You may connect a printer or computer to the **930i** and view the results via terminal or printout. (Refer to **Section 6, Remote Control Operation,** for instructions on connecting a printer or computer and **Section 6-4.4, Printing Test Results,** for instructions on the print function.)

5-56 OPTION MENU #:56 64-KBIT E1 BERT

OPTION MENU #:56, 64-KBIT E1 BERT, is available only when *Purchased Option 930i-23, Extended Bit Error Rate (BERT),* has been installed. This feature enables you to test an E-1 span at the **64 KBps** rates. It does not test individual sub-rates such as **9.6 KBps**.

To measure the **64-KBit E-1 bit error rate**:

1. Press the **Trunk Type** function key. Select **PCM** and **TERMINATE** or **D&I** mode. (Refer to **Section 3, PCM Operation,** for setup information in the **PCM** trunk type.)

   You cannot pass **64 KBit E-1 BERT** successfully unless you selected a **CLEAR-CHANNEL**.

2. Connect the **930i** test cords for terminated testing as shown in **Figure 5-56.1.**

   In the above example the **930i** has been connected at the Equipment side of the customer's E1 Channel Service Unit (**CSU**). The testing is toward the Channel Bank. There is an Office Channel Unit (**OCU**) data port plugged into time slot **7** or channel **7** on the bank. The **64 KBps** output from the **OCU** is fed to a combination Channel Service Unit/Data Service Unit (**DSU**) which interfaces to the Data Terminal Equipment (**DTE**). To test the path successively, loopback the devices on the path and run a BER test until errors are found. Start by looping the **OCU**, then the **64 KBps CSU**, and finally the **DSU**.

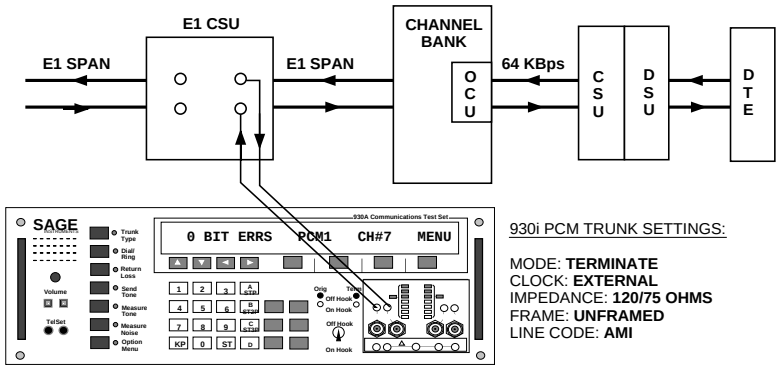


Figure 5-56.1
E-1 BERT Configuration

Option Menu #: 56

A **930i** set up for Drop /Insert testing should be connected as shown in **Figure 56-2.**

To test in either direction on any channel without disturbing the other channels on the E1 span, connect the test cords as shown in **Figure 5-56.2.**

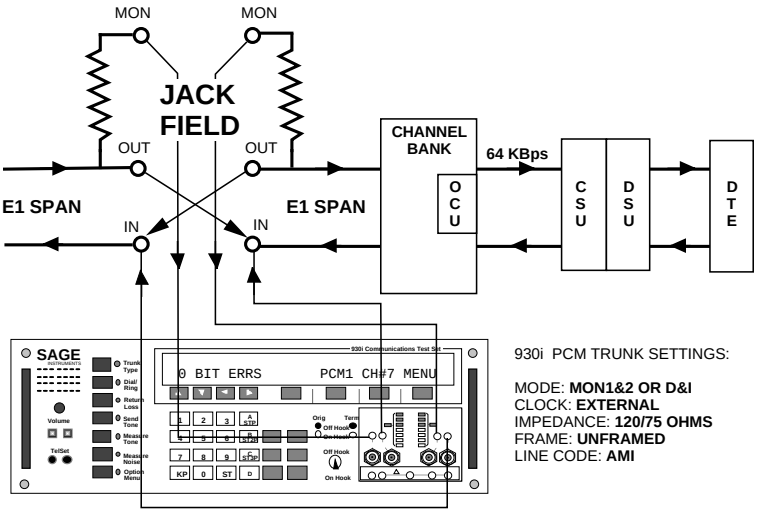


Figure 56-2
64-KBIT E1 BERT Drop and

3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **56** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

```
OPTION MENU #: 56 64-KBIT E1 BERT
```

K1 | K2 | K3 | K4

5. Press any soft key (**K1-K4**). The **SELECT** display reads:

```
SELECT:      SET-UP   TEST    HISTORY  EXIT
```

K1 | K2 | K3 | K4

5-56.1 Setup

To set up the **E-1** test parameters:

1. Press **K1** under **SET-UP** in the **SELECT** display. The new display reads:

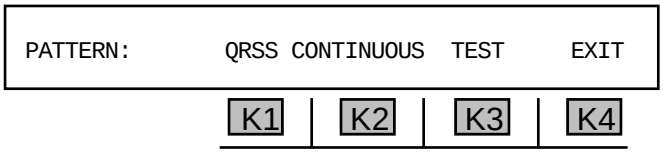
```
REPORT ERRS AS:       M.2100   G.821
```

K1 | K2 | K3 | K4

2. Press **K2** under **M.2100, OR** press **K3** under **G.821** to select a reporting format.

Note that **M.2100** and **G.821** differ in that **M.2100** includes line errors in calculating errored seconds and severely errored seconds, while **G.821** does not.

3. Press **K1** under **SET-UP**. The display reads:



The default pattern is a **QRSS** pseudorandom sequence in **CONTINUOUS TEST** mode.

4. Press **K1 or** the **Up/Down Arrow** keys to scroll through the following pattern choices:

2↑9-1 (default)	**2↑23-1**
2↑11-1	**USER (inputs any 8 bit pattern)**
2↑15-1	
2↑20-1	

Option Menu #: 56

5. Press **K2 or K3** to scroll through the test durations.

The following test durations are available:

CONTINUOUS TEST	**1 HOUR TEST**
15 MINUTE TEST	**24 HOUR TEST**

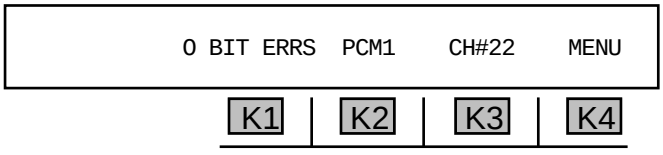
6. Press **K4** under **EXIT** when your pattern and test duration parameters have been chosen. If you selected any pattern except **USER**, you will be returned to the main **SELECT** display. If you selected the **USER** pattern, the next display allows you to use the **numeric keypad** to enter any 8 bit pattern of 1s and 0s.

7. Press **K4** under **MORE** when complete. You will be returned to the main **SELECT** display.

5-56.2 Test

To begin **64 KBIT E1 testing**:

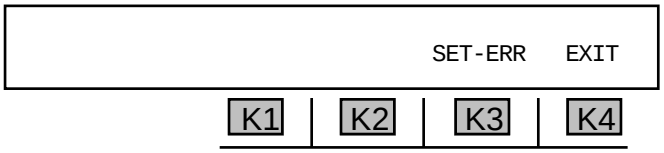
1. Press **K2** under **TEST** from the **SELECT** display. The test display reads:



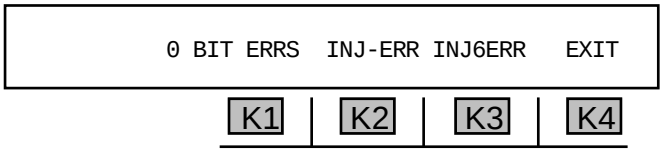
2. Press **K1 or** use the **Up/Down Arrow** keys to scroll through the following tests/ results:

BIT ERRS	**BIT SLIP**	**%ES**	**%AVAIL**
BER	**FR SLIP**	**SES**	**UNAVAIL**
CODE ERR	**SLS**	**%SES**	**%UNAVAIL**
CER	**EFS**	**FAILED**	**ELAPSED**
FAS ERRS	**%EFS**	**%FAILED**	
FAS LOSS	**ES**	**AVAIL**	

3. Press **K4** under **MENU** to test the integrity of the connection by injecting errors:



4. Press **K3** under **INJ-ERR.** The display reads:



5. Press **K1** under **0 BIT ERRS** to inject 0 bit errors, **or** press **K2** under **INJ-ERR** to inject a single error, **or** press **K3** under **INJ6ERR** to inject six bit errors at a time.

6. Press **K4** to return to the test display.

If you are in **D&I** mode, you may monitor both **PCM1** and **PCM2**.

7. Press **K2** under **PCM1**. The display reads: **WILL RESTART TEST - CONT? YES NO.**

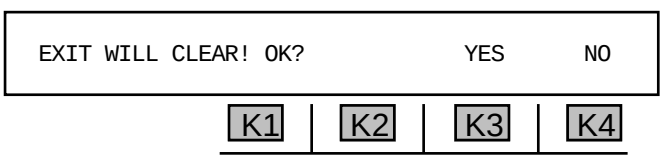
8. Press **K3** under **YES** to toggle to **PCM2**, **OR** press **K4** under **NO** to continue monitoring in **PCM1**. The previous error injection procedures apply when monitoring in **PCM2**.

Each time you toggle between **PCM1** and **PCM2**, the **RESTART** prompt appears.

If you did not select **CONTINUOUS** testing, the display reads: **TEST COMPLETED** at the end of the designated test duration.

9. Press the **Option Menu** function key to exit this display.

10. Press **K4** under **EXIT** or the **Option Menu** function key to stop testing and exit this function. The display reads:

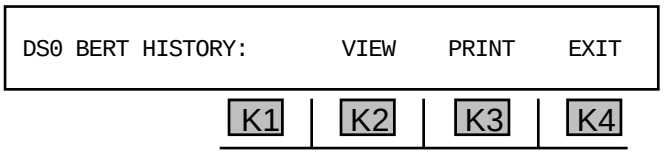


11. Press **K4** under **NO** to resume testing, **or** press K3 under **YES** to end (interrupt). You will be returned to the main display.

5-56.3 History

To review the errors which have been recorded:

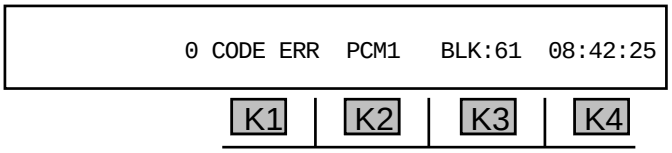
Press **K3** under **HISTORY** from the main **SELECT** display. If no tests have been made, the message: **NO BERT HISTORY AVAILABLE** appears. Otherwise, the display reads:



5-56.3.1 View

To view **test results**:

1. Press **K2** under **VIEW**. You will see a display similar to:



   The above display shows the 61st 15-minute block of time since the test began.

2. Press **K1 or** the **Up/Down Arrow** keys to scroll through the remaining tests listed in **Section 5-56.2**.

3. If you are monitoring both sides of the line, press **K2** to toggle between **PCM2** and **PCM2**.

4. To find out what has gone on prior to this time period, press **K3** under **BLK: 61**. The **930i** display will begin at Block 1. Continue pressing **K3** to scroll through the remaining 60 blocks. Note that the time above **K4** changes with each block. You can also use the numeric keypad to enter the block number of interest directly.

5. Press the **Option Menu** function key to return to the main **SELECT** display.

5-56.3.2 Print

You may connect a printer or computer to the **930i** and view the results via terminal or printout. (Refer to **Section 6, Remote Control Operation,** for instructions on connecting a printer or computer and **Section 6-4.4, Printing Test Results,** for instructions on the print function.)

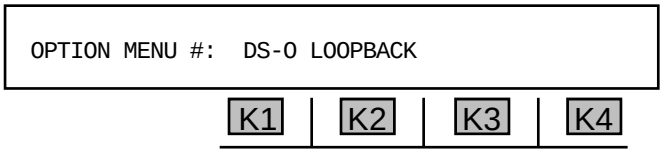
5-57 OPTION MENU #:57 DS-0 LOOPBACK

OPTION MENU #:57, DS-0 LOOPBACK, is available only when *Purchased Option 930i-22 , DS1 and DSO BERT,* is installed. This feature enables the **930i** to loopback the selected **PCM** channel in **TERMINATE** or drop/insert (**D&I**) modes. This is similar to a hard loopback in operation because no codes are involved. The number of bits looped depends on the signalling option selected in trunk type set up. Robbed bit is 7 bits looped, clear channel is 8 bits looped.

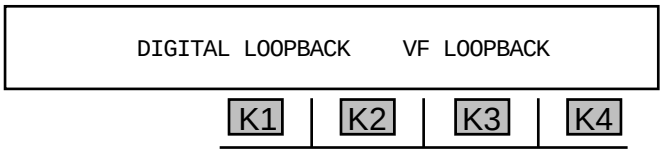
To put the **930i** in **loopback mode**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **57** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The **LOOPBACK** display reads:

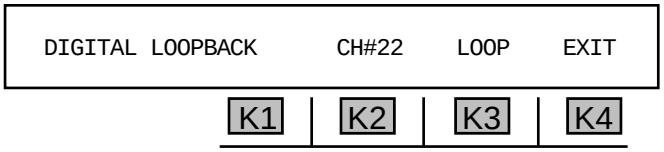


   The default selection is **DIGITAL LOOPBACK**.

4. Press **K1** to loopback digital patterns (**511** or **2047** bit long patterns), **OR** press **K3** under **VF LOOPBACK** if tones (**1004 Hz**) are being sent.

5-57.1 Digital Loopback

If you selected **DIGITAL LOOPBACK**, the display reads:



In the above example, Channel 22 (**CH# 22**) has been looped back. You can select a channel between **1** and **24** under **PCM** trunk type. (Refer to **Section 4, PCM Operation,** for setup information.)

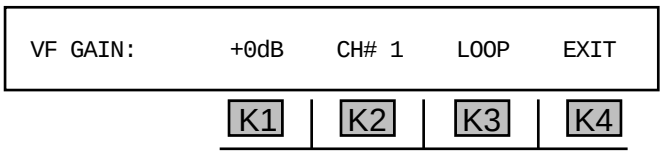
To setup a **digital loopback**:

1. Press **K3** under **LOOP**. A cursor will appear over **LOOP** indicating that the selected channel has been looped back.

2. Press **K3** under **LOOP** to discontinue the loop, **OR** press **K4** under **EXIT** to take down the loop and return to the main display. Note that only the selected channel is looped. The other **23** channels pass through unimpaired.

5-57.2 VF Loopback

If you select **VF LOOPBACK**, the display reads:



1. Press **K1** to insert **gain** or **attenuation**.

   • A valid **gain** or **attenuation** value is between **-40 dB** and **+2 dB**. The default is **0 dB.**

2. Use the **numeric keypad** to enter the value.

   • A valid **channel** is between **1** and **24** under **PCM** trunk type. (Refer to **Section 4, PCM Operation,** for setup information.)

3. Press **K3** under **LOOP**. A cursor will appear over **LOOP** indicating that the selected channel has been looped back. The **VF loopback** also retains the companding algorithm which is suspended during a **digital loopback**.

4. Press **K3** under **LOOP** to discontinue the loop.

5. Press **K4** under **EXIT** to take down the loop and return to the main display. Note that only the selected channel is looped. The other **23** channels pass through unimpaired.

Option Menu #: 57

5-59 OPTION MENU #:59 ECHO CANCELLER DISABLE

OPTION MENU #:59, ECHO CANCELLER DISABLE, is a standard feature that enables you to disable the echo canceller.

G.165 echo cancellers are used to suppress unwanted echoes from the transmitted signal on a circuit. These are the most common type of echo canceller, and react to phase reversal.

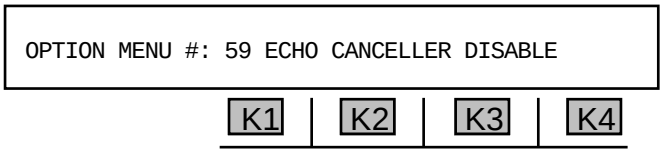
Some circuits may also have older **G.164 echo cancellers (echo suppressors)**, which do not react to phase reversal. These echo suppressors turn off transmission in the reverse direction while a person is talking in order to suppress echoes. Such suppression, however, impedes fully duplexed data, such as the bidirectional flow of data between two modems and bidirectional BERT tests.

The **echo canceller disabler** on the **930i** sends a tone (**2100Hz** with phase reversal) for **1500ms**, which is **ITU** compliant with **G.165 echo cancellers**. This tone is designed to disable all **G.165 echo cancellers,** although it also disables all **G.164 echo cancellers** on a circuit.

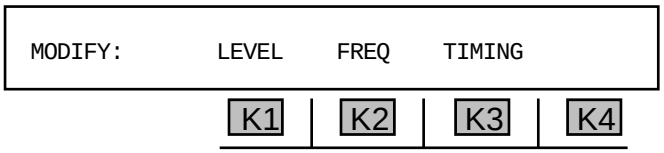
To **disable the echo canceller**:

1. Press the **Option Menu** function key.

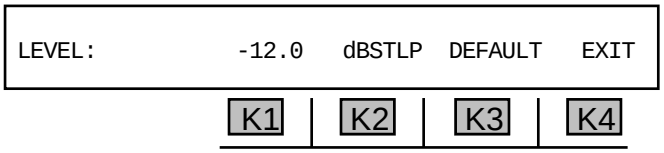
2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **59** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



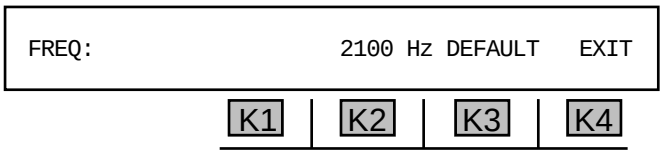
4. Press **K1** under **LEVEL**. The display reads:



5. Use the **numeric keypad** to enter a new **level**, and then press **K4** to exit to the **MODIFY** display.

   • A valid **level** is between **-99.9 dBSTLP** and **99.9 dBSTLP** or **-99.9 dBm** and **99.9 dBm**. The default is **-12.0 dBSTLP.** Press **K2** to toggle between **dBSTLP** and **dBm.**

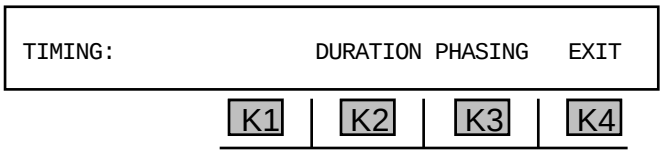
6. Press **K2** under **FREQ**. The display reads:



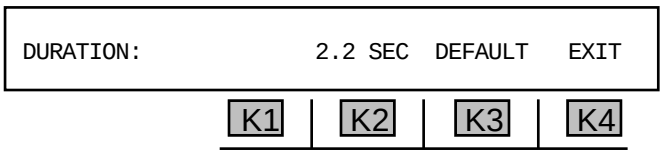
7. Use the **numeric keypad** to enter a new **frequency,** and then press **K4** to exit to the **MODIFY** display.

- A valid **frequency** is between **20 Hz** and **5000 Hz**. The default is **2100 Hz**.

8. Press **K3** under **TIMING** to change the timing and phasing. The display reads:



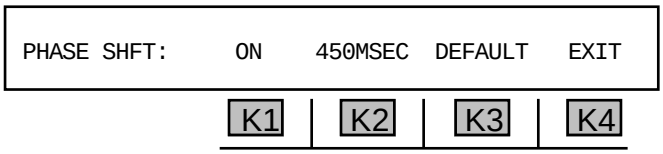
9. Press **K2** under **DURATION.** The display reads:



10. Use the **numeric keypad** to enter a new **duration** and then press **K4** to exit to the previous display.

- A valid **duration** is between **0 SEC** and **99.9 SEC**. The default is **2.2 SEC.**

11. Press **K3** under **PHASING**. The display reads:



12. Press **K1** under **ON** to toggle the phase shift on and off.

13. Use the **numeric keypad** to enter a new **phase shift duration** displayed above **K2**.

- A valid **phase shift duration** is between **10 MSEC** and **9999 MSEC**. The default is **450 MSEC**.

14. Press **K3** under **DEFAULT** to set the phase shift duration to its default setting.

15. Press **K4** to exit to the main display.

Option Menu #: 59

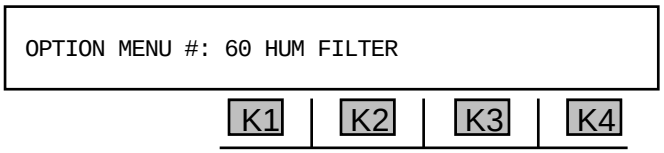
5-60 OPTION MENU #:60 HUM FILTER

OPTION MENU #:60, HUM FILTER, is a standard feature that enables you to engage a **60Hz** HUM filter.

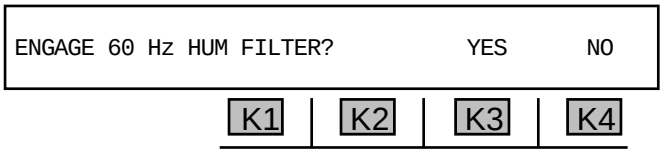
To engage a **HUM filter**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **60** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K3** under **YES** to engage a **HUM** filter **OR K4** under **NO** to disengage the filter.

5. Press the **Option Menu** function key to exit this option.

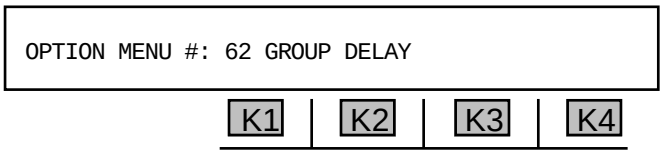
5-62 OPTION MENU #:62 GROUP DELAY

5-62 OPTION MENU #:62, GROUP DELAY, is a standard feature that enables you to conduct envelope delay distortion measurements "straight away" without a repeater set or a return path.

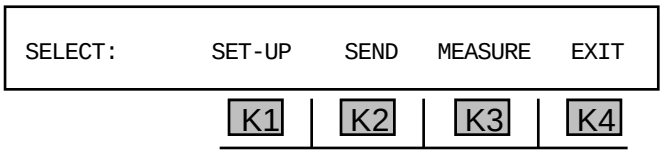
To use the **group delay measurement** feature:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **62** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



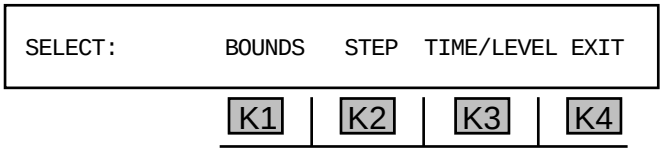
Option Menu #: 62

If you wish to use a previously saved test setup or accept the default setup, it is not necessary to reenter the setup mode. The **930i** default has been preset to sweep from **304 Hz** to **3504 Hz** (excluding SF frequency **2600 Hz**) in **100 Hz** steps at a level of **-16 dBm** and a time between steps of **3.5** seconds.

5-62.1 Setup

To select the **group delay parameters**:

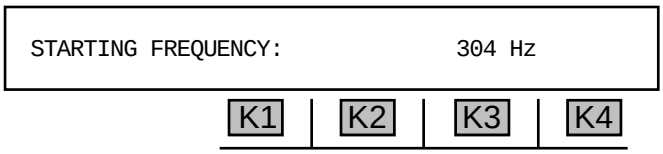
Press **K1** under **SET-UP.** The display reads:



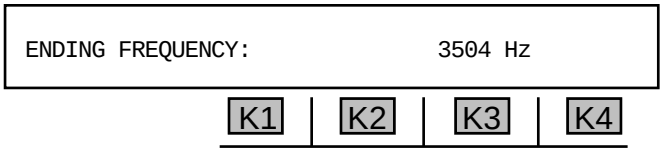
5-62.1.1 Bounds

To change the starting or ending **frequency parameters**:

1. Press **K1** under **BOUNDS.** The display reads:

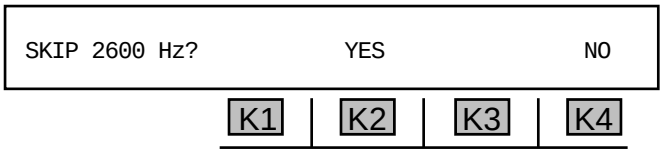


2. Use the **numeric keypad** to enter a new **starting frequency** and press **ENT**. The display reads:



- A valid **starting** or **ending frequency** is between **`304 Hz`** and **`3504 Hz`**.

3. Use the **numeric keypad** to enter a new **ending frequency** and press **ENT**. The display reads:



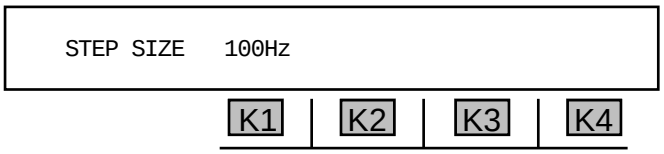
If your starting frequency is greater than your ending frequency, the frequency will decrement according to the **Step** and **Time/Level** you've indicated until it reaches the **ending frequency** and stops.

4. Press **K2** under **YES** to skip **SF** (**2600 Hz**) **OR K4** under **`NO`** if you do not want to skip **SF**. The display will return to the **SELECT** display.

5-62.1.2 Step

To change the **step size**:

1. Press **K2** under **`STEP`** from the **`SELECT`** display. The new display reads:



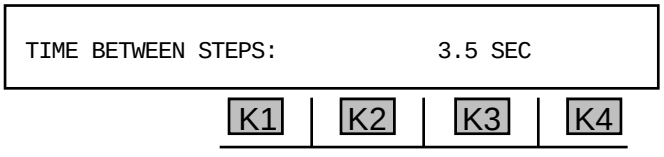
2. Use the **numeric keypad** to enter a new **step size** and press **ENT.**

- A valid **step size** is between **`1 Hz`** and **`999 Hz`**

5-62.1.3 Time/Level

To change the **time** between steps and the **signal level**:

1. Press **K3** under **`TIME/LEVEL`**. The display reads:



2. Use the **numeric keypad** to change the pause between steps.

   • A valid **step size** is between **`0.1 SEC`** and **`9.9 SEC`**.

3. Press **ENT**. You will advance to the **Level** display.

4. Use the **numeric keypad** to change the level.

   • A valid **level** is between **`-40 dBm`** and **`+12 dBm`**. The default level is **`-16.0 dBm.`**

Since the **LEVEL** display is taken directly from **OPTION MENU #:10, FREQUENCY SWEEP,** levels may be entered from **`+12.0 dBm`** to **`-60.0 dBm`** and they will appear to be accepted. However, the **930i** will only transmit over the **`0 dBm`** to **`-40.0 dBm`** range allowed in Envelope Delay Distortion measurements.

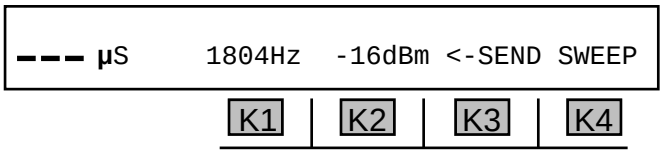
5. Press **K4** under **`EXIT`** to return to the main display. Once the **930i** has been setup, it is not necessary to enter the **`SET-UP`** display to start testing.

5-62.2 Send

Option Menu #: 62

To send a signal in **Group Delay** mode:

1. Press **K2** under **`SEND`** from the main display. The display advances to:



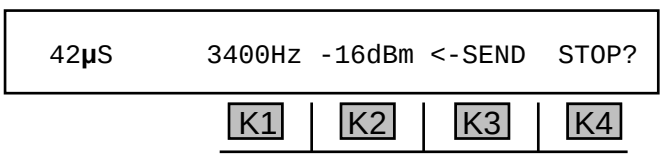
2. Press **K1** to change the frequency, **OR** press **K2** to change the level.

3. Use the **numeric keypad** to change the value and press **ENT, OR** use the **Up/Down Arrow** keys to scroll through the possible selections.

   • A valid **frequency** is between **`304 Hz`** and **`3504 Hz.`**
   • A valid **level** is between **`0 dBm`** and **`-40 dBm.`**

4. If you are looped-back, press **K3** under **`<-SEND`** to examine the level and frequency of the returned carrier, The received level and frequency will be displayed and the label above **K3** will change to read **`<-RECV`**. (If you are not looped-back, the **`RECV`** values are not valid.)

5. Press **K4** under **`SWEEP`** to begin a frequency sweep. (You can press **K4** again to interrupt the sweep at any time, without leaving the **`SEND`** mode.)



When the sweep completes or is interrupted, the **930i** will revert to sending the reference frequency. **K4** will again be labeled **SWEEP**.

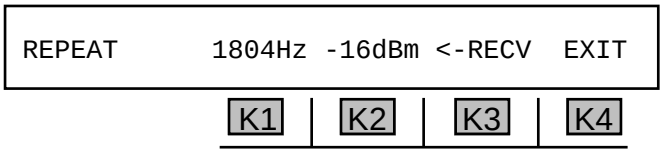
The sweep can be repeated or the frequency of the signal can be manually set to examine the delay at frequencies of interest.

6. Press the **Option Menu** function key to exit this display.

5-62.3 Measure

To place the **930i** at the far end of the circuit in **Measurement** mode:

1. Press **K3** under **MEASURE** from the main **SELECT** display. A high pitch tone sounds and the display reads:



   This display shows the level and frequency of the carrier tone that is being received from the send unit.

2. Press **K4** to exit this display.

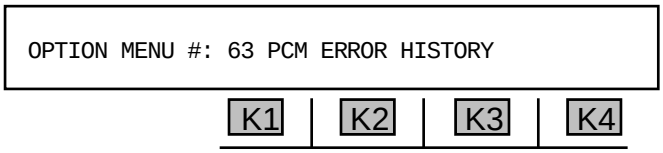
5-63 OPTION MENU #:63 PCM ERROR HISTORY

OPTION MENU #:63, PCM ERROR HISTORY, is a standard feature that enables you to view the error history for **signal loss**, **alarm indication system, frame alignment system, multi-frame alignment system, remote alarm,** and **remote multi-frame alignment system**.

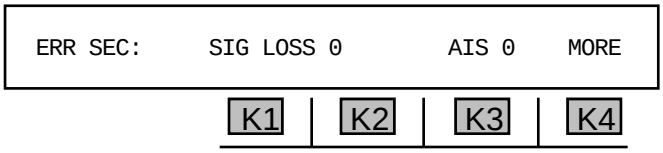
To display the **PCM error history:**

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **63** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

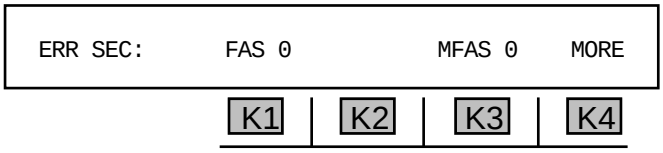


3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



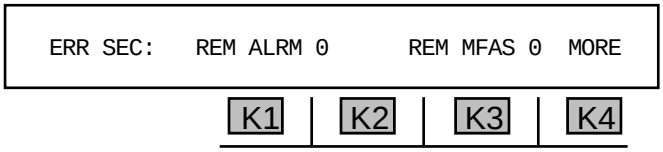
The signal loss history is displayed above **K1** and the alarm Indication system (**AIS**) history is displayed above **K3.**

4. Press **K4** under **MORE**. The display reads:



The frame alignment system (**FAS**) history is displayed above **K1**, and the multi-frame alignment system (**MFAS**) history is displayed above **K3**.

5. Press **K4** under **MORE**. The display reads:



The remote alarm (**REM ALRM**) history is displayed under **K1** and the remote multi-frame alignment system (**REM MFAS**) history is displayed above **K3**.

5-65 OPTION MENU #:65 ATME FAR END RESPONDER

OPTION MENU #:65, ATME FAR END RESPONDER, is available only when *Purchased Option 930i-11, ROTL Responder, ATME Format,* is installed. This feature enables you to configure the **930i** as an ATME Far End Responder. The **930i** can also provide this function directly on a **E1 PCM** channel. The **930i** can measure **loss, noise, noise with tone, gain-slope**, and **return loss**.

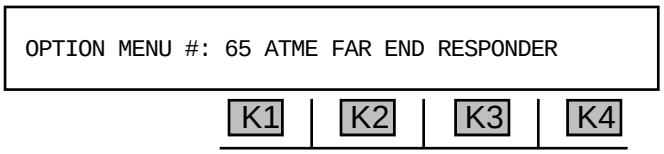
To use the **930i** as a **far-end responder**:

1. Use the **Trunk Type** function key to set up the **930i** to operate on a **PCM** trunk . (Refer to **Section 3-2.1, Trunk Type Function Key,** and **Section 4, PCM Operation,** for the correct trunk type setup in Responder mode.)

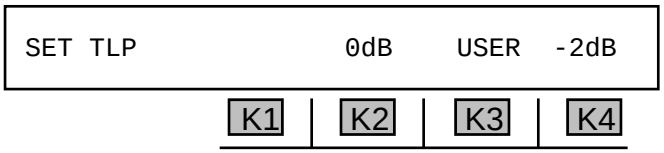
2. Connect the **930i** to the circuit.

3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **65** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

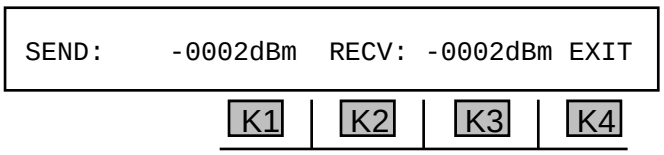


5. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



6. Press **K1** to advance to the next display without changing any parameters, **or** press **K2** to select **0 dB**, **or** press **K3** under **USER** if you need to set a Send or Receive **TLP** value other than the standard **0** or **-2 dB** values, **OR** press **K4** to select **-2 dB TLP**.

   If you press **K3** under **USER**, the display reads:



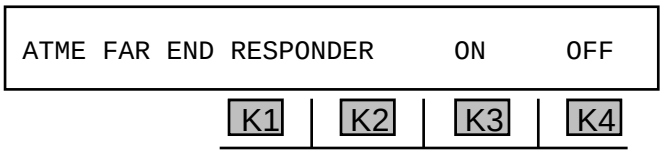
7. Press **K1** to change the **SEND TLP** or **K3** to change the **RECV TLP**.

8. Use the **numeric keypad** to enter the desired **TLP**.

   - A valid **SEND TLP** is between **-25 dBm** and **+7 dBm.**
   - A valid **RECV TLP** is between **-16 dBm** and **+7 dBm**.

9. Press **ENT or** any soft key (**K1-K4**) to complete the selection.

10. Press **K4** to **EXIT.** The display reads:



11. Press **K3** to enable the Far End Responder. A cursor will appear over the **ON** indication. The **930i** is now acting as an ATME Responder waiting to be accessed. The above display appears regardless of whether or not the **930i** is in manual sequence mode.

12. Press **K3** to enable the responder function.

    When accessed by ringing or far-end seizure, the **930i** goes off-hook and responds with a **2225 Hz** test progress tone (TPT). The **930i** then waits for **MF** commands and performs the corresponding. The **930i** will continue in this mode until:

1. It is released by the calling party via an **MF** "release" command.
2. The calling party goes on-hook (see following notes).
3. No **MF** command is received for **20** seconds (**930i** defaults to Manual mode if selected).
4. The operator selects **OFF** or discontinues testing in any way.

Option Menu #: 65

When the **930i** is released, or the calling party goes on-hook, the **930i** goes on-hook for one second and then awaits seizure or ringing. If the **930i** is allowed to time out (**20** seconds without an **MF** command), it will either go on-hook, or initiate the manual test sequence (if selected).

If the **930i** is on a loop trunk simulating the subscriber (providing **CONTACT** rather than **BATTERY**), it will expect the far end to remain on-hook, and will not treat this as a release condition.

For PBX testing, the manual mode sequence is most useful. If the manual mode has been selected, the responder is allowed to time out (no **MF** command is sent) for **20** seconds or more. The **930i** then provides the manual trunk test tone sequence shown below:

1. 9 seconds of 1020 Hz tone at -16 dBm0.
2. 1 second of quiet termination.
3. 9 seconds of 404 Hz tone at -16 dBm0.
4. 1 second of quiet termination.
5. 9 seconds of 2804 Hz tone at -16 dBm0.
6. 30 seconds of quiet termination.
7. Short burst of TPT (2225 Hz) signaling end of sequence.
8. On-hook.

If the manual test sequence is not enabled, the **930i** will return to the on-hook state after a **20** second time out.

13. Press the **Option Menu** function key to exit this option.

5-66 OPTION MENU #:66 ATME DIRECTOR

OPTION MENU #:66, ATME DIRECTOR, is available only when *Purchased Option 930i-11 ROTL Responder, ATME Format,* is installed. This feature enables you to set up the **930i** as an **ATME** near end responder that controls the **ATME** far end responder featured in **OPTION MENU #:65, ATME FAR END RESPONDER**. This feature enables you to conduct impedance, BERT and echo canceller tests, including:

- 1020 Hz @ 0 dBm
- 400 Hz @ 0 dBm
- 2800 Hz @ 0 dBm
- 1020 Hz @ -10 dBm
- 400 Hz @ -10 dBm
- 2800 Hz @ -10 dBm
- Noise/CMS
- S/TDHz with -10 dBm tone
- S/TD with -25 dBm tone
- EC LEVEL
- Far to Near Noise
- Near to Far noise
- Bypass Loss
- BER test (in PCM only)

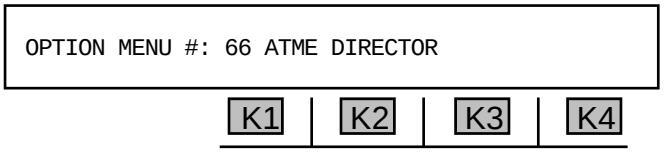
To use the **ATME Director** feature:

1. Select a trunk type. (Refer to **Section 3, Function Key Operation,** and **Section 4, PCM Operation,** for the correct trunk type setup in Responder mode.)

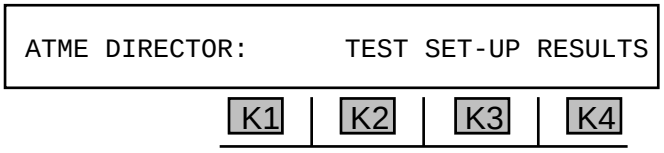
2. Connect the **930i** to the circuit.

3. Press the **Option Menu** function key.

4. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **66** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



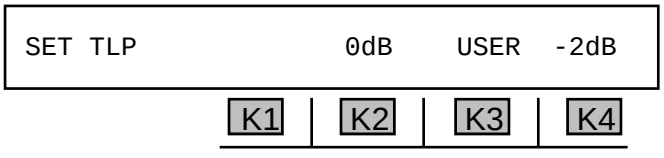
5. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



5-66.1 Setup

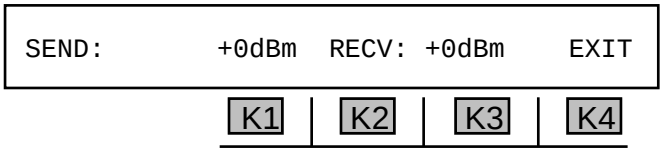
To set up the **ATME director**:

1. Press **K3** under **SET-UP**. The **SET TLP** display reads:



2. Press **K1** to advance to the next display without changing any parameters, **or** press **K2** to select **0 dB**, **or** press **K3** under **USER** if you need to set a Send or Receive **TLP** value other than the standard **0 dB** or **-2 dB** values, **or** press **K4** to select **-2 dB TLP**.

   If you press **K3** under **USER** , the display reads:

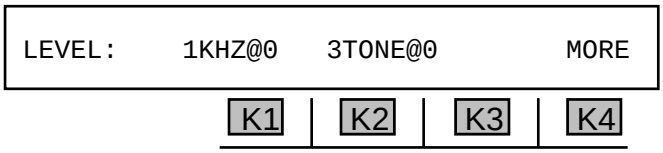


3. Press **K1** to change the **SEND TLP** or **K3** to change the **RECV TLP**.

4. Use the **numeric keypad** to enter the desired **TLP**.

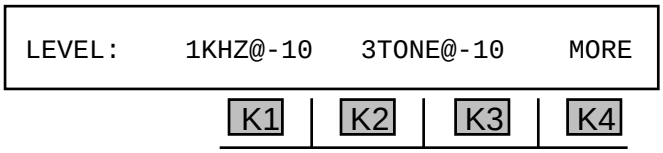
   - A valid **SEND TLP** is between **-25 dBm** and **+7 dBm**.
   - A valid **RECV TLP** is between **-16 dBm** and **+7 dBm**.

5. Press **K4** under **EXIT** to advance to the **LEVEL** displays. The first display reads:



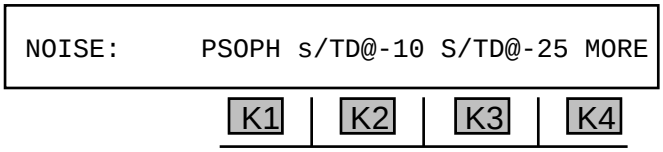
6. Press the soft key (**K1-K4**) under a level to select or deselect it (levels are in **kHz @ dBm0**). A cursor appears above your selections.

7. Press **K4** under **MORE**. The next **LEVEL** display reads:



8. Press the soft key (**K1-K4**) under a level to select or deselect it (levels are in **kHz @ dBm0**). A cursor appears above your selections.

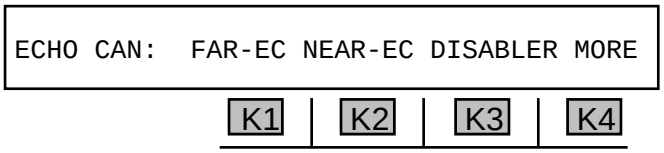
9. Press **K4** under **MORE** to advance to the **NOISE** display:



10. Press the soft key (**K1-K4**) under a filter to select or deselect it. You can choose between a **Psophormetric** filter, or an **S/TD** filter at at **10 dBm0** or **25 dBm0**. A cursor appears above your selections.

Option Menu #: 66

11. Press **k4** under **MORE** to advance to the **ECHO CANCELLER** display:



12. Press the soft key (**K1-K4**) under an echo canceller to select or deselect it. You may choose a Far End Echo Canceller (**FAR-EC**), Near End Echo Canceller (**NEAR-EC**), or an **echo canceller disabler test**.

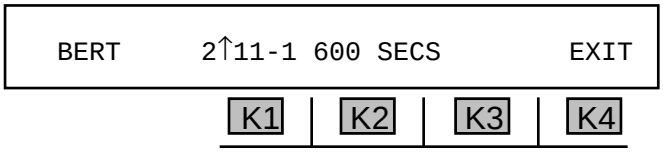
Note: G.165 echo cancellers are used to suppress unwanted echoes from the transmitted signal on a circuit. These are the most common type of echo canceller, and react to phase reversal.

Some circuits may also have older **G.164 echo cancellers (echo suppressors)**, which do not react to phase reversal. These echo suppressors turn off tranmission in the reverse direction while a person is talking in order to suppress echoes. Such suppression, however, impedes fully duplexed data, such as the bidirectional flow of data between two modems and bidirectional BERT tests.

The **echo canceller disabler** on the **930i** send a tone (**2100 Hz** with phase reversal) for **1500 ms**, which is **ITU** compliant with **G.165 echo cancellers**. This tone is designed to disable all **G.165 echo cancellers**, although it also disables all **G1.64 echo cancellers** on a circuit.

During an **echo canceller test**, the **930i** sends a **500 ms** pause just before the test, which re-enables both the **G.165** and **G.164 echo cancellers**. It then sends another **2100 Hz** signal (no phase reversal) for **800 ms**, which disables only the **G.164 echo cancellers**, thereby allowing the **G.165 echo cancellers** to be tested independently.

13. Press **K4** under **MORE**. If you selected a **PCM** trunk, you will advance to the following **BERT** display. (If you are in an **analog** trunk type, you will skip to the **CMS TONE LOCKING** display.)

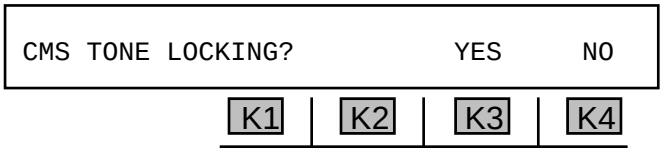


14. Press **K2** to modify the **BERT** test duration.

15. Use the **numeric keypad** to enter a new test duration.

- A valid test **duration** is between **10 SECS** and **600 SECS**.

16. Press **K4** under **EXIT** to advance to the **CMS TONE LOCKING** display:



Note: CMS tone locking is tied to **G.164 echo canceller** suppression on the **930i**. By deselecting **CMS tone locking**, the **2100 Hz** tone (no phase reversal) that is normally sent to disable **G.164 echo cancellers** during a **G.165 echo canceller test** will not be sent. This will prevent the **930i** from isolating the **G.165 echo cancellers** from the **G.164 echo cancellers** during testing.

17. Press **K3** under **YES** to turn tone locking on, **or K4** under **NO** to turn it off.

18. Press the **Option Menu** function key to exit this option.

19. Press **K2** to select **0 dB**, **or K4** to select **-2 dB TLP, OR K1** to advance to the next display without changing any parameters.

    If you did not select an echo canceller, you will be returned to the main display.

    If you selected an echo canceller, you will advance to the following display:

```
DELAYS:     ----   ----   ----   EXIT
            K1  |  K2  |  K3  |  K4
```

20. Press **K1, K2,** or **K3** to set a delay. You can insert from one to three delays.

21. Use the **numeric keypad** to enter up to three delay durations.

    - A valid **delay** is between **0 ms** and **75 ms.**

22. Press **K4** under exit to return to the main display.

Option Menu #: 66

5-66.2 Test

To begin **ATME** testing:

1. Press **K2** under **TEST**. If you have connected the **930i** to a testline and set up the test parameters correctly, the **TEST** display reads:

```
 CALL COMPLETION TIME:  3.5 SEC  11:45
            K1  |  K2  |  K3  |  K4
```

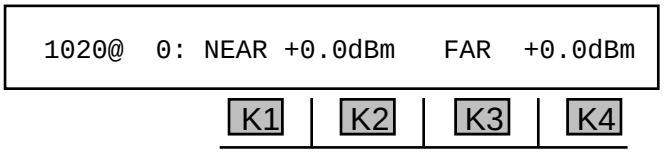
   The **930i** automatically conducts the test. The time for the call to be completed is displayed above **K3**. The current time is displayed above **K4**.

2. Press any soft key (**K1-K4**) to exit to the main display.

5-66.3 View

To view the results of the test:

1. Press **K3** under **RESULTS**. The first result display reads:



2. Use the **Arrow** keys **OR** press any soft key (**K1-K4**) to cycle through the test results. The types results are:

- 1020 Hz @ 0 dBm
- 400 Hz @ 0 dBm
- 2800 Hz @ 0 dBm
- 1020 Hz @ -10 dBm
- 400 Hz @ -10 dBm
- 2800 Hz @ -10 dBm
- Noise/CMS
- S/TDHz with -10 dBm tone
- S/TD with -25 dBm tone
- EC LEVEL
- Far loss
- Near loss
- Bypass Loss
- BER test (in PCM only)

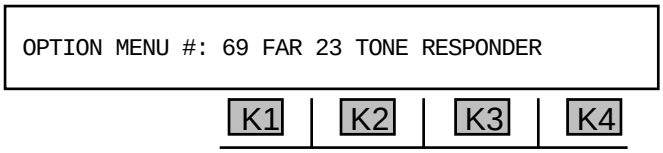
3. Press the **Option Menu** function key to exit to the main display.

5-69 OPTION MENU #:69 FAR 23 TONE RESPONDER

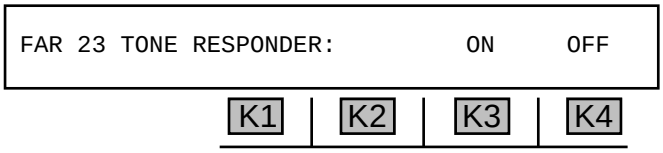
OPTION MENU #:69, FAR 23 TONE RESPONDER, is available only when *Purchased Option 930i-154 23 Tones,* is installed. This feature enables you to set up the **930i** as a **23 tone far end responder** which is controlled by another **930i** set up at the near-end as a **23 Tone Director.** (The **23 Tone Director** feature is described in **OPTION MENU #:64, 23 TONE DIRECTOR**.)

To use the **930i** as a **23 tones far end responder**:

1. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **69** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



2. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



3. Press **K1** to use the **930i** as a far end responder **or K4** to turn the far end responder function off.

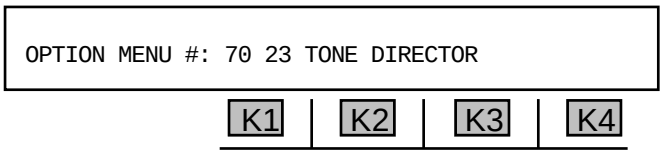
NOTE: Before testing, you must select and set up a protocol if one has not already been selected under the **Dial/Ring** function key, and enter a phone number. Refer to **Section 3-2.2** for a complete description of this procedure. Once the setup is complete, you will be ready to perform a 23 tone test.

5-70 OPTION MENU #:70 23 TONE DIRECTOR

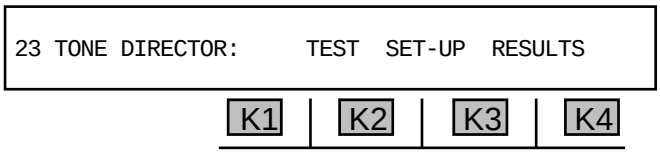
OPTION MENU #:70, 23 TONE DIRECTOR, is available only when *Purchased Option 930i-154 23 Tones,* is installed. This feature enables you to set up the **930i** as a **23 tone director** that controls another **930i** set up as a **23 tones far end responder**. (The **23 tone far end responder** feature is described in **OPTION MENU #:69, FAR 23 TONE RESPONDER**.)

To use the **23 tone director**:

1. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **70** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



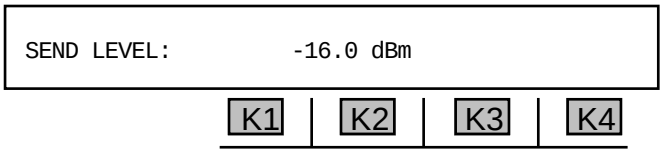
2. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



5-70.1 Setup

To set up the **23 tone director**:

1. Press **K3** under **SET-UP**. The display reads:



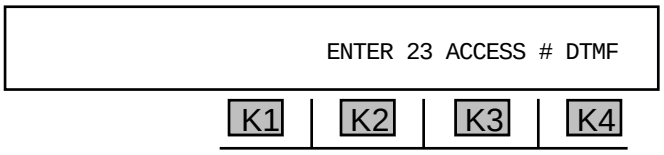
2. Use the **numeric keypad** to enter a new **send tone level**.

   • A valid **send tone level** is between **-60.0 dBm** and **0.0 dBm.**

5-70.2 Test

To begin testing:

1. Press **K2** under **TEST** when you are ready to begin testing. You will see a display similar to:



   The number most recently entered in the **DIAL/RING** mode will usually be displayed in place of the word **ENTER**.

2. Press the **CLR** key to remove any previous entry and return to a display similar to the one above.

3. Press **K4** under **MF**, **DTMF**, or **DP**, depending on the mode selected, to change the outpulsing format to the type required for your circuit. This will also clear any old numbers.

4. Use the **numeric keypad** to enter the access number of the far-end transponder.

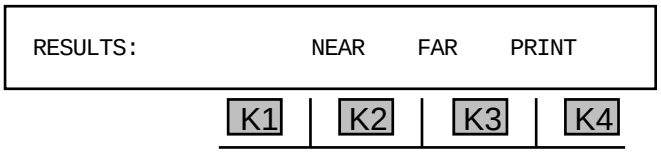
5. Go **off-hook** with the front panel hookswitch to begin testing. The **930i** will seize the line, send any digits you have entered in the window, and expect the responder at the far-end to answer the call. If no number has been entered in the window, no digits will be sent.

Option Menu #: 70

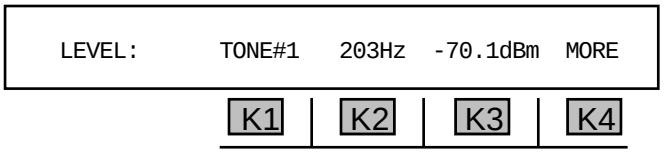
5-70.3 Results

To view the **23 tones test results**:

1. Press **K4** under **RESULTS** from the main display. The new display reads:

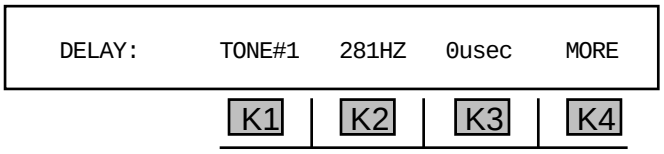


2. Press **K2** under **NEAR** to view the near end results, **or** press **K3** under **FAR** to view the far end results. The first results display reads:



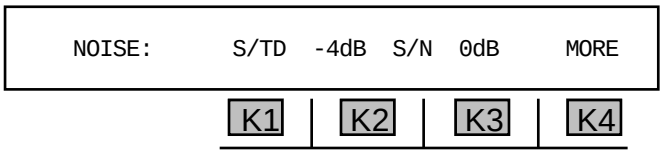
3. Press **K1 or** use the **Up Arrow** key to increment the tone number. Press **K2 or** use the **Down Arrow** key to decrement the tone number.

4. Press **K4** under **MORE** to advance to the **DELAY** display and view the results of the **Envelope Delay Distortion** measurement. The display reads:



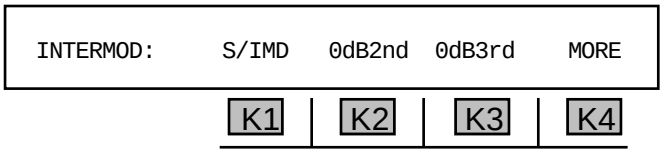
5. Press **K1 or** use the **Up Arrow** key to increment the tone number. Press **K2 or** use the **Down Arrow** key to decrement the tone number.

6. Press **K4** under **MORE** to advance to the **NOISE** display and view the results of the **Signal to Noise Ratio (S/N)** and **Signal to Total Distortion (S/TD)** measurements. The display reads:



   The **S/TD** is displayed above **K2**, and the **S/N** is displayed above **K3**.

7. Press **K4** to advance to the **INTERMOD** display and view the results of the **Intermodulation Distortion** measurement. The display reads:



   The second order **IMD** product is displayed above **K2**, and the third order product is displayed above **K3**.

8. Press the **Option Menu** function key to return to the main display.

5-70.3.1 Print

You may connect a printer or computer to the **930i** and view the results via terminal or printout. (Refer to **Section 6, Remote Control Operation,** for instructions on connecting a printer or computer and **Section 6-4.4, Printing Test Results,** for instructions on the print function.)

To print **23 tones test results**:

Press **K4** under **PRINT**. The message **--PRINTING--** will appear on the display as the **930i** sends the results to be printed.

5-71 OPTION MENU #:71 23 TONES TEST

OPTION MENU #:71, 23 TONES TEST, is available only when *Purchased Option 930i-154, 23 Tones,* is installed. This feature enables you to make a variety of transmission impairment measurements across the full channel spectrum in a short period of time.

The test signal consists of 23 equally spaced, phase coherent tones ranging from **203 Hz** to **3228 Hz**. The phase relationships of the tones create a signal that simulates the probability density of high speed modems such as **V.29**, **V.32**, and **V.34**. A single burst of 23 tones lasting only three seconds can yield multiple measurements:

- **Attenuation Distortion** at 23 frequencies
- **Envelope Delay Distortion (EDD)** at 22 frequencies
- **Signal to Total Distortion Ratio (S/TD)**
- Second and Third Order **Intermodulation Distortion (IMD)**

In addition to the measurements that correspond to conventional impairments test, 23 tones has capabilities not available with traditional techniques:

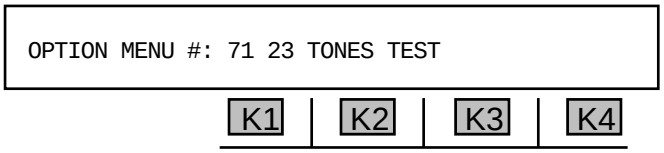
- **Two wire EDD** is measured straight away without a repeater set or a return path.
- The **23-Tone S/TD** measurement uses a complex signal that stresses the channel much better than a single tone and intermodulation products are included in the reading.
- **ADPCM detection**: the complexity of the **23-Tone** signal causes channels that use signal compression to exhibit a characteristically high **S/TD** ratio.

Option Menu #: 71

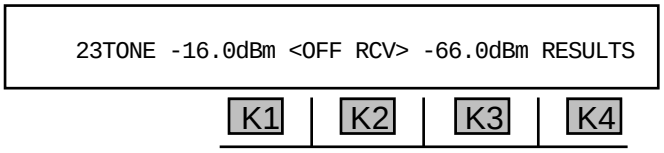
To use the **23 tones** test feature:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **71** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



5-71.1 Setup

To set up a **23 tones** test:

1. Use the **numeric keypad** to change the level of the send tone.

   • A valid **send tone level** is between **`-60.0 dBm`** and **`0.0 dBm`**.

2. Press **K2** to toggle **`SND`** 23-tone on/off. The send 23-tone level is displayed above **K1**.

The **930i** automatically performs the 23 tones test when you finish selecting your test parameters.

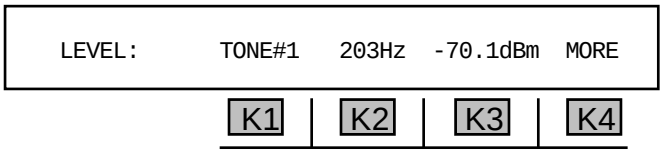
5-71.2 View

To view the **23 tones** test results:

1. Press **K4** under **`RESULTS`** to advance to the results of the measurement.

Attenuation Distortion is caused by a reduction in power level due to line resistance, leakages, induction, etc., resulting in the received signal being lower in volume than the original signal.

The **LEVEL** display reads:

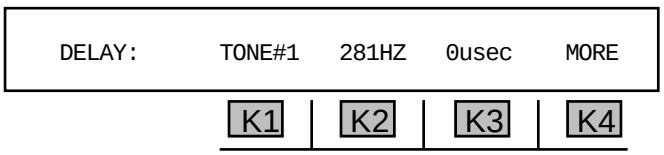


2. Press **K1 or** use the **Up Arrow** key to increment the tone number. Press **K2 or** use the **Down Arrow** key to decrement the tone number.

3. Press **K4** under **`MORE`** to advance to the **`DELAY`** display and view the results of the **Envelope Delay Distortion** measurement.

Envelope Delay Distortion (EDD) results when different frequencies travelling along a circuit arrive at different times, even though the frequencies were transmitted together. This occurs when the rate of change of phase shift with frequency over the bandwidth of interest is not constant. **EDD** measurements are usually stated as one-half the difference between the delays of the two frequency extremes of the band of interest.

The **`DELAY`** display reads:



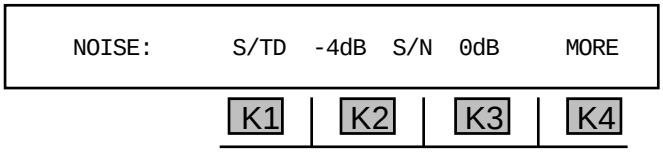
4. Press **K1 or** use the **Up Arrow** key to increment the tone number. Press **K2 or** use the **Down Arrow** key to decrement the tone number.

5. Press **K4** under **MORE** to advance to the **NOISE** display and view the results of the **Signal to Noise Ratio** and **Signal to Total Distortion** measurements.

Signal to Noise Ratio (S/N) is the ratio of the amplitude of the desired signal to the amplitude of noise at a single point in time.

Signal to Total Distortion (S/TD) is the ratio of the amplitude of the desired signal to the amplitude of all forms of distortion, including noise, at a single point in time.

The **NOISE** display reads:

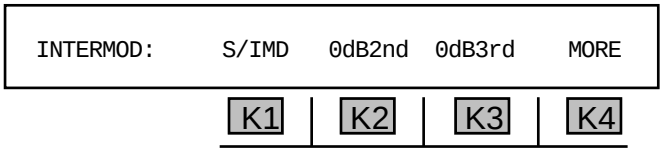


The Signal to Total Distortion Ratio (**S/TD**) is displayed above **K2** and the Signal to Noise Ratio (**S/N**) is displayed above **K3**.

6. Press **K4** to advance to the **INTERMOD** display and view the results of the **Intermodulation Distortion** measurement.

Intermodulation Distortion (IMD) is a form of nonlinear distortion caused by two or more waves passing through a nonlinear device such as and amplifier, modulator, demodulator, or switch. The frequencies produced are the sum and difference products of the input frequencies and their harmonics. In **PCM**, this distortion is caused by the quantizing process, which uses the logarithmic compression law to provide more steps per volt for small speech signals than for large samples.

The **INTERMOD** display reads:



The second order **IMD** product is displayed above **K2**, and the third order product is displayed above **K3**.

7. Press the **Option Menu** function key to return to the main display.

Option Menu #: 71

5-75 OPTION MENU #:75 REMOTE UPGRADE

OPTION MENU #:75, REMOTE UPGRADE, is a standard feature that you can use to download software to the **930i**. You can download software in one of two ways:

- From a computer connected directly to the **RS-232** port on the **930i**.
- From Sage instruments or a remote terminal using a modem.

Note: The **930i** must be in **`COMPUTER`** or **`TERMINAL`** remote mode to use this option. (Refer to **SECTION 5-3, OPTION MENU #:3, REMOTE CONTROL,** for setup information.)

5-75.1 Installing Sage Software Upgrade Files on a Hard Disk

This procedure enables you to copy the Sage software upgrade files from the diskette to the hard disk of the computer that will be used to perform the upgrade.

To install the software upgrade to your hard drive:

1. Exit from any applications you may have been running at the computer.
2. Go to the **`C:`** prompt.
3. Type **`md tempy.`** This will create a temporary subdirectory so you can copy the files from the upgrade diskette to the computer's hard disk.
4. Type **`cd tempy`**
5. Insert the software upgrade diskette into the PC's floppy disk drive.
6. Type **`copy a:*.* c:\tempy.`** This will copy all the files on the diskette to the **`tempy`** directory.
7. Type **`c:install`** and press the **RETURN** key. You will be prompted for the PC "COM" port (serial port) number with a display similar to the following: **`Select COM: port # [1,2,3,4]?`**
8. Type the computer's **COM** port number (typically **1** or **2**) that is connected to the **930i RS-232**
9. The installation program prompts you to select the data transmission baud rate:

   `Select BAUD rate: 1=38400 2=19200 3=9600 4=2400 5=1200`

   Type the number corresponding to the baud rate you want to use.

Hint: With the typical dial-up connection, 9600 baud tends to provide the fastest reliable transmission. Some connections will support 19200. Sage Instruments does not currently support modem download at 38400. When the computer is connected directly to the RS 232 port on the **930i**, use 38400.

10. You are now prompted to confirm your selections, and given a chance to change them.

11. Finish the downloading procedure.

    If you are downloading directly from a computer, refer to steps 4-10 in **Section 5-75.2, Downloading Software to the 930i from a Computer**.

    If you are downloading to the **930i** remotely using a modem, refer to **Section 5-75.3, Downloading Software to the 930i Remotely Using a Modem**.

5-75.2 Downloading Software to the 930i from a Computer

This procedure allows you to download new software to the **930i** from a computer via the RS-232 port located on the rear panel of the **930i** test set. To use this upgrade method, your personal computer (PC) must be equipped with a 3.5" floppy disk drive and a hard disk with 2 Mb (megabytes) of free disk space

To download software to the **930i** from a computer connected directly to the **RS-232** port:

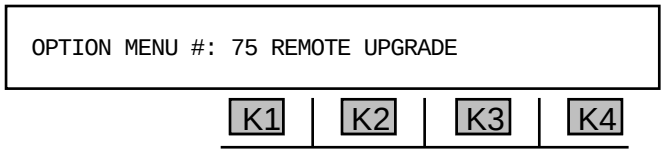
1. Connect an **RS-232** cable from the **COM1** port on your **PC** to the **RS-232C** port on the rear of the **930i**. (Refer to **Section 6, Remote Control Operation,** for further information.)

2. Use **OPTION MENU #:3, REMOTE CONTROL,** to setup the **930i** for **COMPUTER** mode.

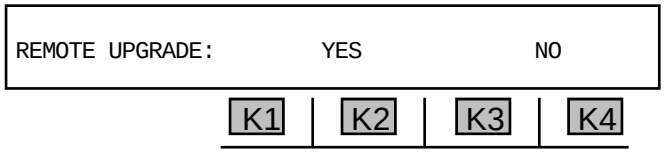
3. Follow the procedure in **Section 5-75.1, Installing Sage Software Upgrade Files on a Hard Disk**. When you finish step 11 of the procedure, you will continue the software download to the **930i** starting on step 4 below.

4. Press the **Option Menu** function key on the **930i**.

5. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **75** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

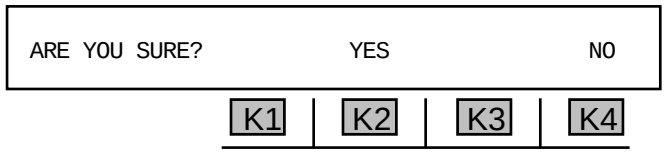


6. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



7. Press **K4** under **NO** to discontinue the upgrade process, **or** press **K2** under **YES** to proceed.

When you select **YES**, the display reads:



8. Press **K4** under **NO** to stop the upgrade process, **OR** press **K2** under **YES** to proceed. The **930i** display reads: **FIRMWARE UPDATE -- WAITING FOR CONNECT**.

The **930i** will cold-boot if it does not receive any communication within one minute.

If the downloading procedure is interrupted, turn off the **930i**, hold down the **ENT** and **HELP** keys and turn the **930i** on again. The **930i** returns to the **FIRMWARE UPDATE -- WAITING FOR CONNECT** display.

9. The install program on the computer asks you if you will be using a modem:

   Dialing the 930 through a modem? (y/n)

   Type the letter **n**.

10. The installation program runs automatically from here. The PC downloads the software to the **930i**. If any questions arise during the installation, they appear on the display.

5-75.3 Downloading Software to the 930i Remotely Using a Modem

Follow this procedure to download a software upgrade remotely after completing step 12 of **Section 5-75.1, Installing Sage Software Upgrade Files on a Hard Disk**.

5-75.3.1 Preparing the Equipment

Prerequisites

- Personal computer (PC) equipped with a 3.5" floppy disk drive and a hard disk with 2 Mb (megabytes) of free disk space
- Internal or external **US Robotics Sportster Modem**[1] for the PC
- Telephone line for the modem at the PC
- Sage Instruments Model **930i** Telecommunications Test Set
- US Robotics Sportster Modem[1] for the **930i**
- Null modem cable to connect the modem to the **930i**'s rear panel **DB25** serial port connector
- Telephone line for the modem at the **930i**

Note : Other manufacturers' modems may be used but, due to command variations between modem brands, these instructions only assume use of a **US Robotics Sportster** Modem. If you use another manufacturer's modem, refer to your modem manual and *Tables 1 & 2* of these instructions for setup of your modem.

5-75.3.1.1 PC Cable Connections

For PC's using an internal modem

Plug the telephone cord into the phone line connector on the modem.

For PC's using an external modem

1. Connect a standard **RS-232** serial cable between the PC's **COM** port and the **DB25** connector located on the modem's rear panel.

2. Plug the phone line into the phone line connector on the modem.

930i Cable Connections

Connect a null modem **RS-232** serial cable between the modem and the **DB25** connector located on the **930i**'s rear panel.

5-75.3.1.2 Modem Configurations

Setting Up the 930i

Use **Option Menu#: 3 Remote Control**, to set the **930i** with the following settings:

- Computer Mode
- Baud Rate = 1200, 2400, 9600, or 19200 (depending on the speed of the modem used—19200 or 9600 is recommended for minimum download time.)
- Data Bits = 8
- Parity = None
- Stop Bits = 1

Setting Up the Modem at the PC End

If you are using a modem other than the **US Robotics Sportster**, you must consult the modem manufacturer's instructions and interpret the settings according to **Table 75-1**.

Note: Carefully refer to the section of your modem manual covering DIP switch settings to ensure you know which way is "on" and "off".

Set the **DIP** switches on the **US Robotics Sportster Modem** connected to your PC according to the specifications in **Table 75-1**.

Table 75-1 — PC End: External US Robotics Sportster DIP Switch Settings

Switch	Factory Default	930i Download Setting	Function
1	**OFF**	**ON**	**Data Terminal Ready (DTR) Override** OFF = Normal DTR operations: computer must provide DTR signal for modem to accept commands; dropping DTR terminates a call ON = Modem ignores DTR (Override)
2	**OFF**	**OFF**	**Verbal/Numeric Result Codes** OFF = Verbal (word) results ON = Numeric results
3	**ON**	**OFF**	**Result Code Display** OFF = Suppresses result codes ON = Enables result codes
4	**OFF**	**ON**	**Command Mode Local Echo Suppression** OFF = Displays keyboard commands ON = Suppresses echo
5	**ON**	**ON (PC)**	**Auto Answer Suppression** OFF = Modem answers on first ring, or higher if specified in NVRAM (Non-Volatile Random Access Memory) ON = Disables auto answer
6	**OFF**	**OFF**	**Carrier Detect (CD) Override** OFF = Modem sends CD signal when it connects with another modem, drops CD on disconnect ON = CD always ON (Override)
7	**OFF**	**ON**	**Power-on and ATZ Reset Software Defaults** OFF = Loads Y or Y1 configuration from user-defined nonvolatile memory (NVRAM) ON = Loads &F0 — Generic template from read only memory (ROM)
8	**ON**	**ON**	**AT Command Set Recognition** OFF = Disables command recognition (Dumb Mode)

5-75.3.2 Performing a Remote Download

Be sure your modems are connected and configured at the **930i** and at the downloading computer before proceeding with this part of the software download.

To download software to the **930i** remotely:

1. The install program will ask you if you will be using a modem:

   `Dialing the 930 through a modem? (y/n)`

   Answer by typing the letter **`y`**.

2. You will then be prompted for the dial-up string with a display similar to the following:

   `Enter the dial-up string (Example: dt555-1122) followed by Ctrl-Z ENTER:`

   Type the dial-up string as instructed (Example: **`dt555-1122`**), followed by a **`CTRL-Z,`** then press **RETURN**.

Option Menu #: 75

- Dashes in the dial-up string are allowed, but not necessary.

- To cause a 2-second pause between dialed digits, type a comma "," between those digits. (Example: **`dt9,5551212`**)

- **CTRL-Z** is a two-key sequence: Hold down the **Ctrl** key and type the letter "**Z**".

- For transmission baud rates greater than 9600 baud, prefix the dial-up string with "**`&h1&b1&k2&a3`**" (Example: **`&h1&b1&k2&a3dt5551212`**). Do ***not*** insert spaces between any characters preceding the "**`dt`**".

3. The installation program runs automatically from here. The PC dials the phone number for the **930i**, downloads the software update and disconnects the phone call. If any questions need to be answered during the installation, they will appear on the display.

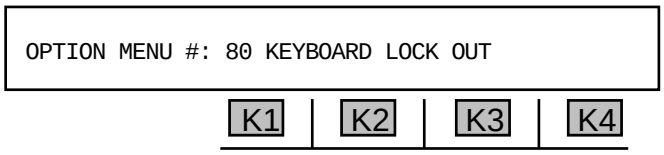
5-80 OPTION MENU #:80 KEYBOARD LOCK OUT

OPTION MENU #:80, KEYBOARD LOCK OUT, is a standard feature that enables you to lock out all keys on the **930i** front panel. This allows only **REMOTE** mode to affect the **930i**.

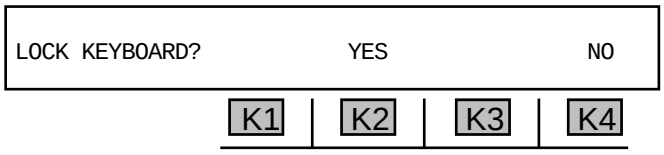
To **lock out** the **930i** front panel:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **80** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K4** under **NO** to discontinue this procedure, **OR** press **K2** under **YES** to lock out all keys on the **930i** front panel.

If any key is pressed while in the lockout state, the display reads: **KEYBOARD LOCKED! 9999 TO UNLOCK**.

5. To return the **930i** to normal functionality, type **9999** using the **numeric keypad**.

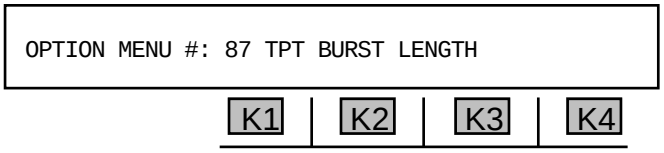
5-87 OPTION MENU #:87 TPT BURST LENGTH

OPTION MENU #:87, TPT BURST LENGTH, is a standard feature that enables you to set the length of the TPT tone sent from the **930i** when acting as a Type 105 responder. This affects **OPTION MENU #:25, FAR END RESPONDER,** and **OPTION MENU #:4, DIGIT RECEIVER**. This feature allows the **930i** to be compatible with most near-end responders.

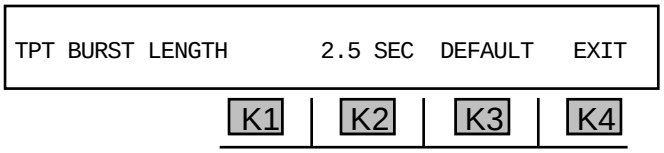
To set the **length of the TPT tone sent**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **87** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Use the **numeric keypad** to enter the burst length.

   • A valid **burst length** is between **`.01 sec`** and **`99.9 sec`**. The default parameter is **`2.5 sec`**.

5. Press **K4** under **`EXIT`** or the **Option Menu** function key to exit this display.

Option Menu #: 87

5-89 OPTION MENU #:89 PRINTER HAND SHAKE

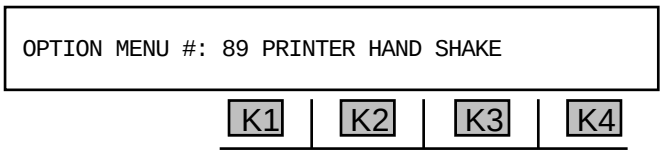
OPTION MENU #:89, PRINTER HAND SHAKE, is a standard feature that enables you to select a form of flow control when the **930i** sends data to the printer. This allows the printer to tell the **930i** to stop sending when the printer's buffer is full or the printer is off-line.

If your printer misses characters sent by the **930i**, especially during long printouts such as digit analysis or **E1 BERT** history, select a lower baud rate or use **OPTION MENU #:89, PRINTER HAND SHAKE,** to output data at the greatest efficiency. The **930i** supports **DTR** and **XON/XOFF** protocols.

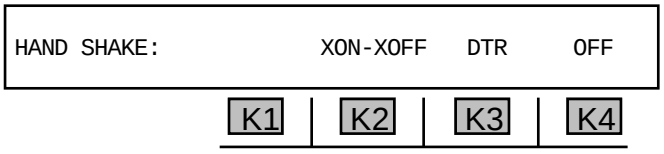
To select a form of **flow control** when data is sent to a printer:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **89** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



   The factory default is **0FF** (no hand shake).

4. Press **K2** under **XON-X0FF** to tell the **930i** to wait for a n **X0FF** character. A cursor will appear over your selection.

XON-XOFF enables the **930i** to stop sending characters to the printer when it receives the **XOFF** character (**CNTL-S**) from the printer. It will resume sending characters when it receives the **XON** character (**CNTL-Q**). **XON-XOFF** protocol is useful when communicating over modems or other media which do not allow a separate hardware hand shake, such as the **DTR** line.

5. Press **K3** to enable **DTR** handshaking. A cursor will appear over your selection.

DTR handshaking allows the **930i** to send characters to the printer only when it sees positive voltage on **DTR** (pin 20). If your printer is off-line, powered down, or has a full buffer, it will not provide this voltage and the **930i** will "hang" when attempting to print. **DTR** handshaking allows the printer to "catch up" by printing the contents of its buffer while the **930i** waits. (The printers supplied by Sage Instruments are shipped with **DTR handshaking** enabled.)

6. Press **K4** under **0FF** to allow the **930i** to send to any serial device.

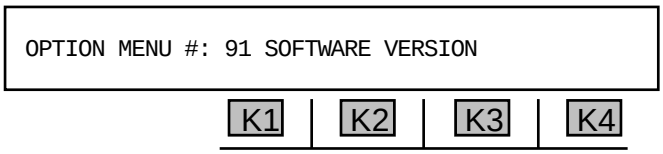
5-91 OPTION MENU #:91 SOFTWARE VERSION

OPTION MENU #:91, SOFTWARE VERSION, is a standard function that enables you to view the version of software that is currently installed on your **930i.**

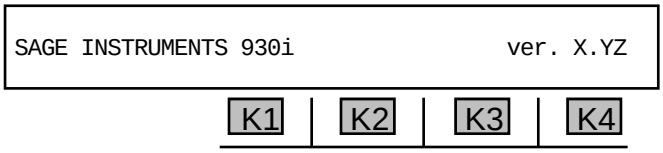
To display the **current software version**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **91** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The **930i** will display the software version installed:



4. Press the **Option Menu** function key to exit this display.

5-92 OPTION MENU #:92 RESET 930

OPTION MENU #:92, RESET 930, is a standard feature that restores the **930i** to its factory default settings though either a **cold** or a **warm boot**.

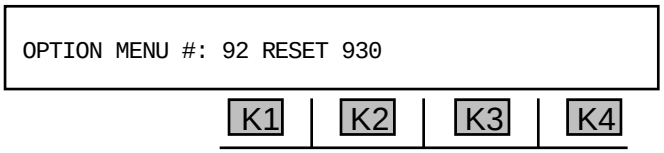
- A **cold boot** retains all serial I/O settings but resets everything else to the factory default parameters.
- A **warm boot** is the equivalent of turning the **930i** off and on. It does not default the parameters.

Selecting this option does not affect the Remote Control settings.

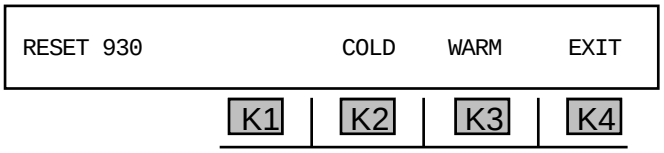
To perform a **cold or warm boot**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **92** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:

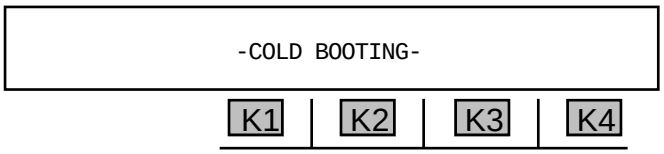


3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



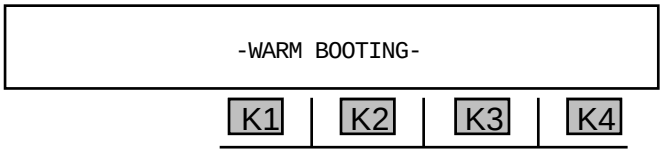
4. Press **K2** under **COLD** to cold-boot the **930i, OR** press **K3** under **WARM** to warm boot.

   If you select **cold boot**, the display reads:



   The display will then run through the initial **930i** start-up sequence.

   If you select **warm boot** the display reads:



The display will then run through the initial **930i** start-up sequence.

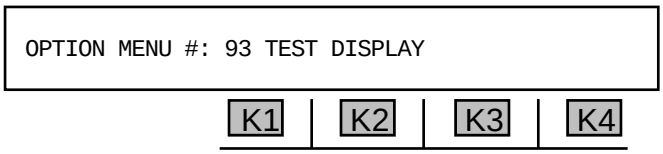
5-93 OPTION MENU #:93 TEST DISPLAY

OPTION MENU #:93, TEST DISPLAY, is a standard feature that enables you to test the display and the **LED**s by turning everything on.

To **test the display**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **93** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) and all lights and **LED**s will go on.

4. Press the **Option Menu** function key to exit this test.

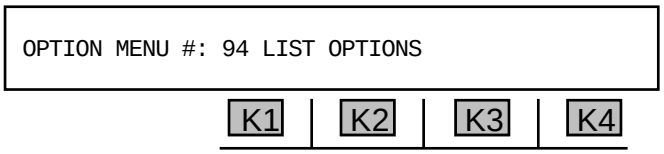
5-94 OPTION MENU #:94 LIST OPTIONS

OPTION MENU #:94, LIST OPTIONS, is a standard feature that lists the **Purchased Options** installed on your **930i**.

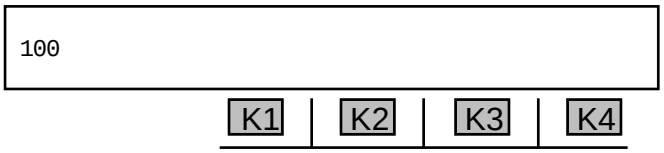
To list the **Purchased Options** installed on your **930i**:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **94** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to see a display similar to:



4. Press the **Option Menu** function key to exit to the main display.

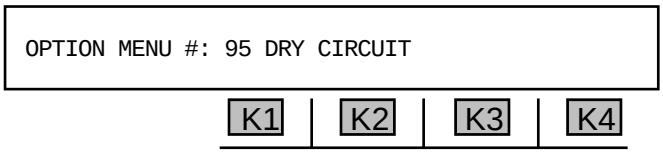
5-95 OPTION MENU #:95 DRY CIRCUIT

OPTION MENU #:95, DRY CIRCUIT, is a standard feature that puts the **930i** in the mode that tests these circuits. The **930i** normally expects to see supervision on the trunks it is testing. Dry circuits are trunks that have no supervision. These are usually dedicated lines found in special services point-to-point applications.

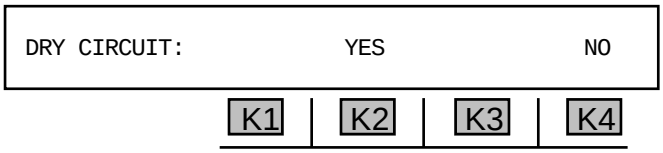
To bring the **930i** to **dry circuit**:

1. Press the **Option Menu** function key.

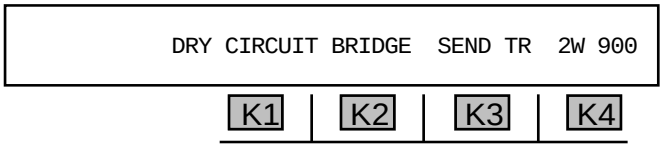
2. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **95** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



4. Press **K2** under **YES** to bring **930i** to **DRY CIRCUIT** mode in the **SETUP** display:



   The default parameters are shown above.

5. Press **K2** to toggle **BRIDGE** to **TERM** (terminate).

6. Press **K4** to scroll through the available impedances.

   • Available impedances are **2W** or **4W** at **135, 600, 900,** or **1200 Ohms**.

   After setting the correct operating conditions, the **930i** functions as it would in any other trunk type.

7. Press **K1** to exit this trunk type and remain in trunk type selection mode. Once the trunk type is changed, **DRY CIRCUIT** mode is disabled. You must reenter this option to enable **DRY CIRCUIT** mode again. If the trunk type selection does not change, the **930i** remains in **DRY CIRCUIT** mode until this option is reentered and **K4** under **NO** (disable) is selected.

5-97 OPTION MENU #:97 HOLD CONTROL

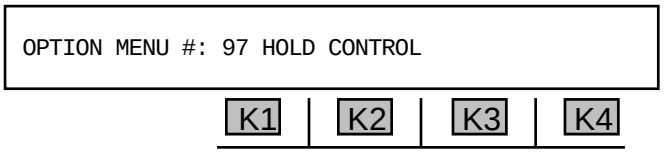
OPTION MENU #:97, HOLD CONTROL, is a standard feature that provides a path for DC current and allows the **930i** to control one or both hold coils, or "hold the Central Office equipment up". This may be accomplished in 4-wire normal loop, 4-wire E&M, or dry circuit Trunk Types.

To control one or both **hold coils**:

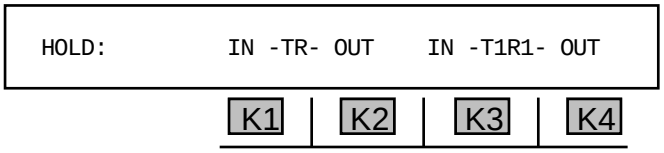
1. Set up a dry circuit. (Refer to **Section 5-95, OPTION MENU #:95, DRY CIRCUIT**.)

2. Press the **Option Menu** function key.

3. Use the **Up/Down Arrow** keys to scroll through the option menus, **OR** select **97** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



4. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



   The default setting is **OUT**.

5. Press **K1** or **3** under **IN** to enable the hold coils. Testing may be performed with either **TR IN** or **OUT, T1R1 IN** or **OUT**, both **IN** or both **OUT**.

6. Press the **Option Menu** function key to exit this display.

SECTION VI

REMOTE CONTROL OPERATION

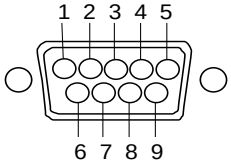
6-1 INTRODUCTION

The remote control feature enables the **930i** to be remotely controlled by a computer or terminal, or to remotely control a printer, through the RS-232C serial port located on the rear panel.

6-2 CONNECTIONS

The **930i** works with most printers and terminals without modification to cables or reconfiguration of pins. The **930i** serial interface is configured as Data Communication Equipment (DCE) and wants to "see" a Data Terminal Equipment (DTE) connection If your printer or computer has the capability of being either a DTE or a DCE, make sure that it is set to DTE emulation **before** connecting it to the **930i**. If the equipment cannot be configured as DTE, it will be necessary to use a special cable known as a null modem cable, or to use a breakout box.

Installation requires a standard female 9-pin miniature "D" type connector (DB-9). (Refer to **Section 3** for the location of the serial port on the rear panel.) The pinouts for the **930i** connector are shown in **Figure 6-1**.



TO DCE	NAME	FUNCTION
	DCD	DATA CARRIER DETECT
	RD	RECEIVED DATA
	SD	TRANSMITTED DATA
→	DTR	DATA TERMINAL READY
	SG	SIGNAL GROUND
	DSR	DATA SET READY
→	RTS	REQUEST TO SEND
	CTS	CLEAR TO SEND
	RI	RING INDICATOR

Figure 6-1
RS-232 (DB-9) Connector Pinouts

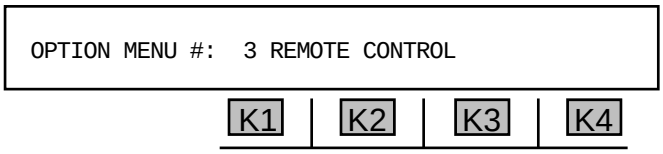
Note: Older units have a 25 pin RS-232C connector in place of the DB-9 connector.

6.3 930i REMOTE CONTROL SETUP

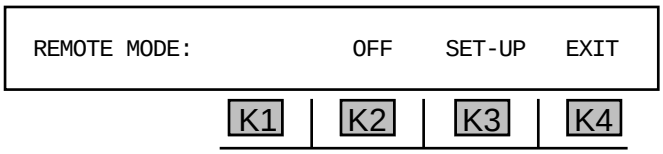
To set up the **930i** for remote control operation:

1. Press the **Option Menu** function key.

2. Use the **Up/Down Arrow** keys to scroll through the option menus, **or** select **3** using the **numeric keypad** and then press the **Option Menu** function key. The display reads:



3. Press **ENT or** any soft key (**K1-K4**) to activate your selection. The display reads:



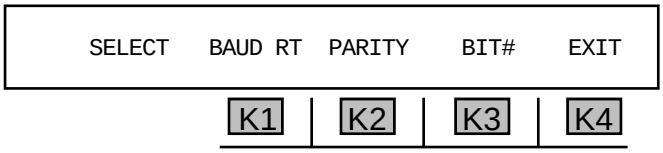
4. Press **K2** to scroll through the different remote modes. The available modes are:

OFF	Manual control (no remote control)
TERMINAL	For use with dumb terminals
MASTER	For future use
SLAVE	For future use
ATR	For future use
COMPUTER	For use under computer control
PRINTER	Used to drive a printer connected to the RS-232 serial port.

The above modes are explained in detail in **Section 6, Remote Control Operation.**

5. Press **K1** to put the **930i** into **STANDBY MODE.** The messages **REMOTE MODE** and **STANDBY MODE** will alternately flash on the display until **K1** is pressed again, releasing **STANDBY MODE.** Use **STANDBY MODE** to operate the **930i** manually without losing remote access capability.

6. Press **K3** under **SETUP.** The display reads:

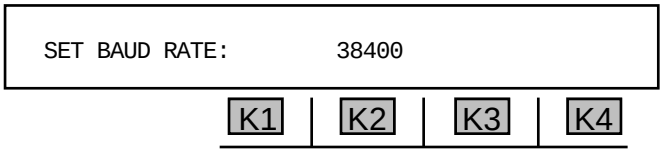


6-3.1 Baud Rate

Baud rate is the number of bits of data transmitted per second in data transmissions.

To change the **baud rate**:

1. Press **K1.** The display reads:



2. Use the **numeric keypad** to enter a new baud rate.

   • A valid baud rate is between **300** and **38400**. The default value is **38400 baud**.

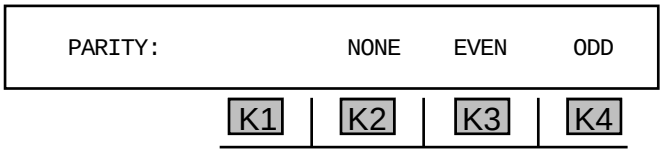
3. Press **ENT or** any soft key (**K1-K4**) to exit this display. You will be returned to the **SELECT** display.

6-3.2 Parity

Parity is a method of minimizing errors in data transmissions by adding an extra binary signal to each character to make the total number of 1s or 0s either odd or even for each character.

To change the **parity**:

1. Press **K2**. The display reads:



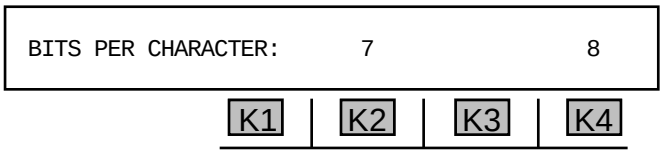
2. Press **K2** under **OFF** for no parity, **K3** for **EVEN** parity, **OR** press **K4** for **ODD** parity. The default is **NONE**. You will be returned to the **SELECT** display.

6-3.3 Bit Number

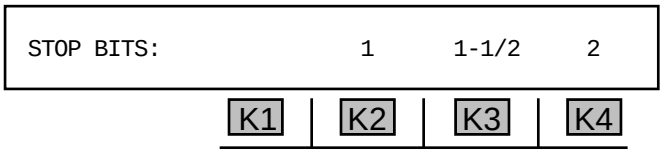
The **bit number** is the number of bits that make up a character. 7 bits are used to produce standard ASCII characters.
Stop bits are the bit or bits following character code in start stop transmissions.

To change the **data format**:

1. Press **K3** under **BIT#** from the **SELECT** display. The new display reads:



2. Press **K2** to select **7** bits **OR K4** to select **8** bits. (The default is **8** bits per character.) The display reads:



3. Press **K2** to select **1** stop bit, **or** press **K3** to select **1-1/2** stop bits, **OR** press **K4** to select **2** stop bits. The default stop bit value is **1**. You will be returned to the main display.

6-4 PRINTER MODE

6-4.1 Supported Printer Configurations

The **930i** will work with most printers provided that the printer:

- has an asynchronous RS-232C serial input port
- print s both upper and lower case
- is ASCII compatible
- has a carriage width of at least 50 characters (preferably 80 characters)
- accepts input at 9600 baud
- has at least a 2K buffer
- accepts continuous feed paper.

Sage Instruments currently recommends the **Okidata 182 with Super Speed Serial Interface**. You may obtain this printer from Sage Instruments by purchasing accessory number ***9400-0001-01, 80 Column Printer with Cable***.

Use care with printers that do not have buffers. These printers must be run at a speed at, or below their print speeds multiplied by a factor of 10. That is, an unbuffered printer with a print speed of 30 cps must be run at or below 300 baud, and an unbuffered 120 cps printer would have to be run at or below 1200 baud. If your printer cannot keep up with the **930i**, switch to a lower baud rate or use one of the printer flow control hand shakes described in **Section 6-4.5**. Hard copy terminals, such as Teletypes and DECwriters, may also be used as printers, but their low speed tends to degrade **930i** performance.

While the **930i** can be connected to most serial printers without modification or special cables, printers vary widely in terms of interface requirements. Some may require special cables or an adaptor. Refer to **Figure 6-1** for the pinouts of the **930i** serial interface.

6-4.2 Printer Applications

ERRORS, RECEIVED DIGITS, DIGIT ANALYSIS, and **WINK TIMING** may be printed. The results of ROTL/Responder tests, frequency sweep, and envelope delay measurements will be printed out automatically as they occur if the **930i** is in **PRINTER** remote mode. The **930i** will also automatically print out results every 4 hours or whenever its buffer is full when it is in **OPTION MENU #:8, SUPERVISION MONITOR**.

If **ERROR** reporting is selected, all detected **PCM** errors will be time stamped and printed out as they occur.

If **RECEIVED DIGITS** reporting is selected, received calls will be printed out whenever a digit receiver sequence is completed or whenever the originating end abandons the call (goes on-hook) in mid-sequence. The number of calls, frequency of inter-LATA vs. intra-LATA calls, the number of incomplete ANI sequences and abandoned calls can all be determined from the **930i**'s reports. All reports include a time and date stamp. If **DIGIT ANALYSIS** has also been selected, the frequency and amplitude of each MF or DTMF tone is displayed together with the Interdigit time, as well as any spurious tones. Dial Pulse digits are analyzed in terms of % Break, Pulses per second and Interdigit time.

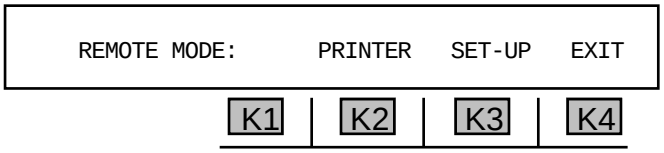
WINK TIMING information will be printed out whenever a record sequence is complete, a call is abandoned, or a wink fails. The **930i** times supervision events such as winks when it sends digits or when it receives digits in **MONITOR** mode. When the **930i** acts as a terminating digit receiver, it provides the winks rather than timing them. **WINK TIMING** printouts can show the time between line seizure and the first wink, the length of all winks, the time between the end of a digit sequence and a wink, and the time between call completion and answer supervision.

6-4.3 Setting Printer Mode Parameters

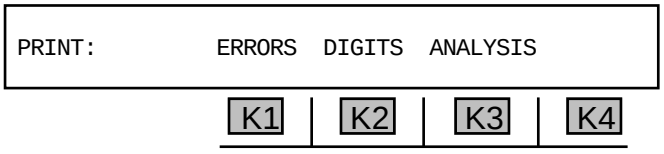
To set the **printing parameters**:

1. Follow the remote control setup procedure described in **Section 6-3** **EXCEPT** select **PRINTER** mode instead of **OFF**.

   The display reads:



2. Press **K4** under **EXIT** after completing the setup. The display reads:



3. Press the soft key (**K1-K4**) beneath each desired print parameter. A cursor will appear above your selections.

4. Press the **Option Menu** function key to exit to the main display.

Taking the printer off-line instead of turning off the power may not have the desired effect. The printer buffer may fill up with unwanted material which will be printed out when the printer is placed back on-line.

6-4.4 Printing Test Results

Test results are printed from within the option menu functions. The option menu functions that support printing are:

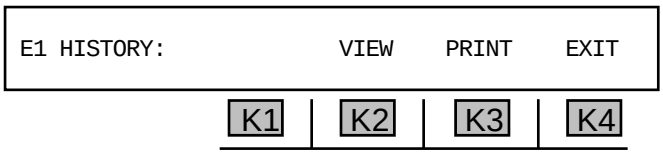
- Option Menu #:44, E1 Error History
- Option Menu #:46, E1 Bit Error Rate
- Option Menu #:55, Fractional E1-BERT
- Option Menu #:56, 64-KBit E1 BERT

To **print** test results when in printer mode:

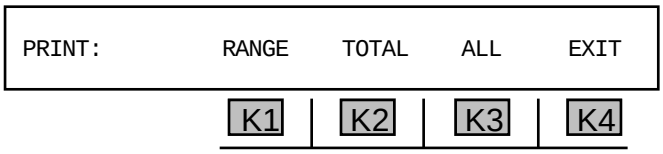
1. Set the **930i** to **PRINTER** mode in **OPTION MENU #:3, REMOTE CONTROL**.

2. Enter the option menu function in which you will be testing**.**

3. Go to the **E1 HISTORY** display in the desired **option menu** function. The display reads:

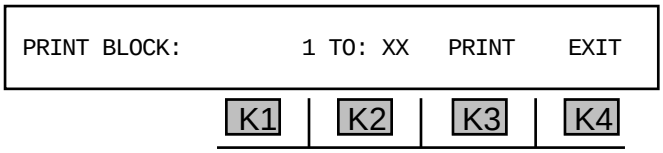


4. Press **K3** under **PRINT** to send the results to a printer or terminal**.** The display reads:



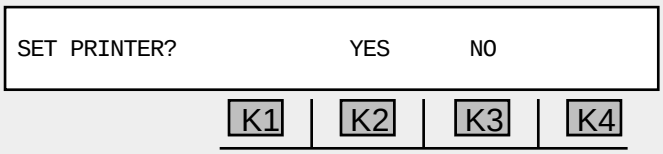
5. Press **K2** under **TOTAL** to send the accumulated total of errors in each block, **or** press **K3** under **ALL** to send every test in every block, **OR** press **K1** under **RANGE** to specify the number of blocks to print.

If you are in printer mode and select **RANGE**, the display reads:



If you have not set the **930i** to **PRINTER** mode, the display reads: **NOT IN PRINTER MODE!**

The display then advances to:



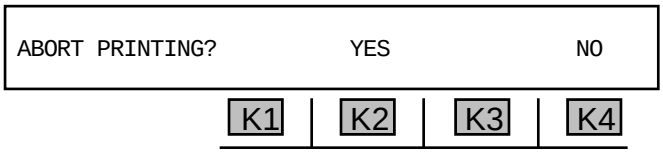
Press **K2** under **YES** to advance to the **REMOTE MODE** display. This lets you set the parameters for your printer. (Refer to **Section 6-4.1, Setting Printer Mode Parameters**.)

6. Press **K1** to change the beginning block number **OR K2** to change the ending block number.

7. Use the **numeric keypad** to enter the valid parameters. The default will show **1 TO <largest block number>.** Up to 96 15-minute blocks may be printed.

8. Press **K3** under **PRINT** when complete.

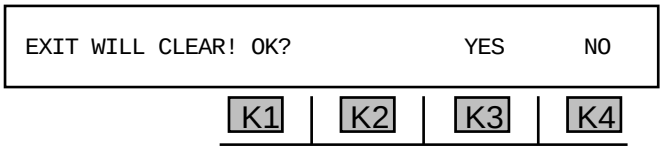
9. Press any soft key (**K1-K4**) or the **Option Menu** function key to abort printing. The display reads:



10. Press **K1 or K2** under **YES** to abort printing**.** You will see the message **FINISHING CURRENT BLOCK BEFORE ABORT**. Otherwise, press **K3 or K4** under **NO** to resume printing.

    If you select nothing, you will be returned to the **PRINT** display.

11. Press **K4** to exit this display, **OR** press the **Option Menu** function key to return to the top level display. Before exiting, the display reads:



12. Press **K4** under **NO** to continue within this option **OR K3** under **YES** to end (interrupt). You will return to the main display.

6-4.5 Printer Handshake

OPTION MENU #:89, PRINTER HAND SHAKE, allows you to select a form of flow control when the **930i** sends data to the printer. This allows the printer to tell the **930i** to stop sending when the printer's buffer is full or the printer is off-line. The factory default setting for the **930i** is hand shake **OFF**.

If your printer misses characters sent by the **930i**, especially during long printouts such as digit analysis or **E1 BERT** history, select a lower baud rate or use **OPTION MENU #:89, PRINTER HAND SHAKE,** to select a form of flow control.

6-4.6 Print Formats

This section provides report format details and examples of **930i** printouts for the various types of information.

PCM Error Reports

Description: The label **PCM1:** followed by one blank and the error detected on **PCM1** (if any). The label **PCM2:** followed by one blank and the error detected on **PCM2** (if any). An error report is a 40 character string terminated by a line feed and carriage return. The error report will have the following form:

```
PCM1: NO PCM!          PCM2: NO PCM!
FAS LOSS               FAS LOSS
FAS ERROR              FAS ERROR
SLIP                   SLIP
CODE ERROR             CODE ERROR
REMOTE ALARM           REMOTE ALARM
AIS                    AIS
CRC ERROR              CRC ERROR
>15 ZEROS              >15 ZEROS
```


Received Record Reports

A report may consist of up to four received records. Each record is a string of 40 characters terminated by a line and feed carriage return. The final record is followed by an additional carriage return and line feed.

Each record takes the form:

```
0123456789#*ABCD REC#N  HOLD  DTMF
```

Description: There is a 17 character record field, followed by the label "REC#", the record number (1-4), three blanks, the word "HOLD", three blanks, and the label "MF", "DTMF" or "DP". Dial Pulse records can be digits from 0 to 9. DTMF records can be all digits from 0 to 9 plus the characters "A", "B", "C", "D", "*", and "#". MF records may additionally include the characters "KP", "ST", "STP", "ST2P", and "ST3P". There are no spaces between characters, and records containing less than 17 characters are preceded by blanks.

Wink Timing Reports

Wink timing reports include all completed or interrupted supervision events from the last record sequence received. Each supervision event is sent as three strings. Each string is terminated by a line feed and carriage return. The first string takes the form: EVENT #N.

The string is six characters in length and all supervision events (winks, off-hooks, and delays) are preceded by this string. The second string takes the form:

```
W 01 W 02 03 W H  NNNN  MSEC  GUARD (any sequence)
>16,000                MSEC
>60,000                MSEC
```

The record sequence is printed first and may be up to 17 characters long (shorter sequences are preceded by blanks). The length of the Guard period in milliseconds, or a time-out indicator, followed by the word "GUARD" is printed out next. This string is 40 characters long.

The third string takes the form:

```
W 01 W 02 03 W H  NNNN  MSEC  WINK (any sequence)
      >200                   MSEC
OFF-HOOK                FAILED      DELAY
```

The record sequence is printed first, and may be up to 17 characters long (shorter sequences will be preceded by blanks). Next, the length of the event in milliseconds, or a time-out or failure indicator, followed by an event type label is printed out. This string is also 40 characters long. The final supervision event in the report is followed by an additional line feed and carriage return.

6-5 TERMINAL MODE

The **930i** supports **Televideo** terminals (the Televideo 910, 910+, 912, and 925), terminals that emulate **Televideo** (ADM, WYSE, and Hazeltine), and **VT-100** type terminals.

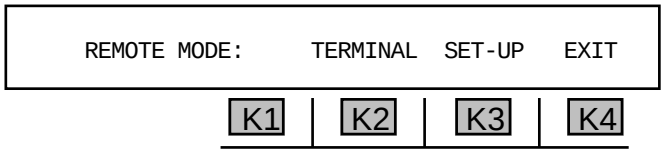
Terminal mode should be used when writing or debugging programs intended for use in the Computer mode. Terminal mode is fully interactive and comes with on-screen **HELP**. Terminal emulation programs such as **CROSSTALK®** and **PROCOMM®** allow a PC to operate the **930i** in terminal mode. Sage Instruments' **STARMAC®** Macro language program also support the **930is** terminal mode. Contact Sage Instruments for more information on **STARMAC**.

The **930i** currently does not support Teletypes or other "hard copy only" terminals such as DECwriters, except in **PRINTER** remote mode (refer to **Section 6-2** for details).

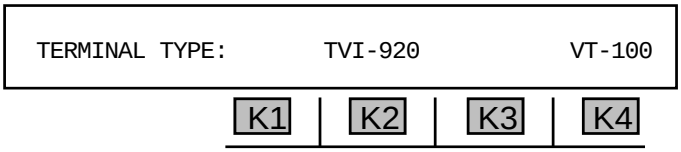
6-5.1 Setting Terminal Mode Parameters

To set the **terminal mode parameters:**

1. Complete the setup procedure outlined in **Section 6-3 EXCEPT** select **TERMINAL** mode rather than **OFF**. The display reads:



2. Press **K4** under **EXIT** after completing the setup procedure. The display reads:



3. Press **K2** to use Televideo 920 (or similar terminal), **OR** press **K4** for a **DEC VT-100** terminal. You will return to the previous display.

The terminal's display will be somewhat like that shown in **Figure 6-3** below.

```
NORMAL LOOP  TERM  CONTACT 2W  900  o   t  (Current Trunk Type)
       [ J ]  [ K ] [ L ] [; ] ORIG  TERM

A) TRUNK TYPE
B) DIAL/RING
C) RETURN LOSS
D) SEND TONE
E) MEAS TONE
F) MEAS NOISE
G) OPTIONS

UPPERCASE  O)   GO OFF HOOK     ?) HELP    CR) ENTER  SP)  CLEAR
Lowercase  o)   GO ON HOOK S) STO      R) RCL     N)  RCL NEXT

When sending digits:
To send:   0 1 2 3 4 5 6 7 8 9 - KP ST STP ST2P ST3P +/-
  Type:    0 1 2 3 4 5 6 7 8 9 -  *  #  a  b   c  d
```

Figure 6-3
Computer Display in Terminal Mode

6-5.2 Terminal Keyboard Equivalents to the 930i Keypad

Each key on the **930i**'s front panel is mapped to a key on your terminal keyboard. All commands given to the **930i** manually can also be done remotely. The terminal keyboard equivalents are the same as the computer keyboard equivalents listed in **Section 6-6.1, Computer Keyboard Equivalents to the 930i Keypad**.

6-5.3 Troubleshooting

Symptom:	Terminal CRT remains blank.
Probable Cause:	Faulty or improper RS-232 cable connection.
Solution:	Check cables, power to the terminal and RS-232 pinouts.
Symptom:	Terminal prints “gibberish”.
Probable Cause:	Incorrect data format.
Solution:	Turn terminal off. Set **930i** Remote Mode to **OFF**. Check **930i** baud rate, parity, character size, and stop bits. Check terminal DIP switches to be sure of their data format. Turn terminal on. Set the **930i** remote mode to **TERMINAL** and press **K4** to **EXIT**. Select a terminal type.
Symptom:	The **930i** does not respond to terminal commands.
Probable Cause:	Bad mechanical connection or **CAPS LOCK** not down.
Solution:	For mechanical condition, check the cables and connectors (broken pins), power, and **RS-232** pinouts. Be sure that uppercase commands are being sent when intended. The **930i** uses only a few lowercase commands so the **CAPS LOCK** key on the terminal should generally be down.
Symptom:	**930i** responds to some commands but not others.
Probable Cause:	Broken lead in **RS-232** cable or wrong data format.
Solution:	For data format, refer back to the "gibberish" symptom. Be sure parity and number of bits are correct. Test the **RS-232** cable with an ohmmeter or by replacing with another cable.

6-6 COMPUTER MODE

The **930i** can be operated under the control of any computer capable of sending and receiving serial ASCII characters over an **RS-232** link. Each key on the **930i**'s front panel is mapped to an ASCII character on the computer keyboard. Refer to **Table 6-2** for ASCII-to-Front Panel conversions as well as HEX and Decimal equivalents.

6-6.1 Computer Keyboard Equivalents to the 930i Keypad

Each key on the **930i**'s front panel is mapped to a key on your computer keyboard. All commands given to the **930i** manually can also be done remotely. All legal commands are listed on the screen and all measurements are returned immediately and updated continuously.

Table 6-1 ASCII to Front Panel Key Conversion

ASCII CHARACTER	FUNCTION	930i HEX	DECIMAL
[0]	0	30	48
[1]	1	31	49
[2]	2	32	50
[3]	3	33	51
[4]	4	34	52
[5]	5	35	53
[6]	6	36	54
[7]	7	37	55
[8]	8	38	56
[9]	9	39	57
[*]	*	2A	42
[#]	#	23	35
[a]	A	61	97
[b]	B	62	98
[c]	C	63	99
[d]	D	64	100
[*]	KP	2A	42
[#]	ST	23	35
[a]	STP	61	97
[b]	ST2P	62	98
[c]	ST3P	63	99
[A]	Trunk Type	41	65
[B]	Dial/Ring	42	66
[C]	Return Loss	43	67
[D]	Send Tone	44	68
[E]	Measure Tone	45	69
[F]	Measure Noise	46	70
[G]	Option Menu	47	71
[ENTER]	Enter (ENT)	0D	13
[SPACE]	Clear (CLR)	20	32
[?]	Help (HELP)	3F	63
[S]	Store (STO)	53	83
[R]	Recall (RCL)	52	82
[N]	Recall Next (RCL NXT))	4E	78
[d]	Change Sign (+/-)	64	100
[–]	Pause (Left Arrow)	2D	45
[O]	Go Off Hook	4F	79
[o]	Go On Hook	6F	111
[J]	K1	4A	74
[K]	K2	4B	75
[L]	K3	4C	76
[;]	K4	3B	59
[^H]	(← Cursor) Left Arrow	08	8
[^L]	(→ Cursor) Right Arrow	0C	12
[^K]	(↑ Cursor) Up Arrow	0B	11
[^J]	(↓ Cursor) Down Arrow	0A	10

Note: When monitoring the **930i**'s supervision lamps, a lowercase **[o]** and **[t]** in the display indicate that both the originating and terminating ends are **On Hook**. An uppercase **[O]** and **[T]** indicates an **Off Hook** condition at the originating or terminating end. A **[–]** in either location means no indication and generally signifies an incomplete or faulty circuit.

Table 6-2 Special ASCII Characters for Remote Control

ASCII CHARACTER	930i FUNCTION	HEX	DECIMAL
[H]	Causes the **930i** to send a copy of its terminal HELP screen (see **Figure 7-3**) to the remote computer or terminal.	48	72
[m]	Causes **930i** to send Hang-Up string to a Hayes compatible MODEM.	6D	109
[s]	Places **930i** in **STANDBY MODE**.	73	115
[W]	Causes the **930i** to report all pending PCM errors, received records, wink timing information or 105 test results to the host computer. Information is “pending” when an ALERT has been sent but no REPORT has been requested.	57	87
[X]	Interrupts the **930i** and causes it to send an immediate copy of its current display line to the host computer. This command is not buffered and executed in turn. It is executed at once.	58	88
[Y]	Causes the **930i** to send a copy of its current display line to the host computer. This command is buffered and executes after all previous commands have been completed.	59	89
[Z]	Causes the **930i** to send a copy of its current display line after it determines that a valid measurement has been made. A series of consecutive **[Z]** commands will cause the **930i** to send consecutive measurements to the host computer.	5A	90

NOTES:

The **[X]**, **[Y]**, and **[Z]** commands all cause the **930i** to send a copy of its display line to the host computer.

The **[X]** command executes immediately and can be used to find the current status of the **930i**. This allows "spot checking" progress through a command sequence at any time.

The **[Y]** command tells the **930i** to send a copy of its display line when it reaches a certain point in the command sequence. This can be used to obtain a measurement or start a timer in the host.

The **[Z]** command is like the **[Y]** command, except that successive **[X]** commands will each be delayed by one measurement period.

6-6.2 Setting Computer Mode Parameters

To set the **computer mode parameters**:

1. Complete the setup procedure outlined in **Section 6-3** **EXCEPT** select **COMPUTER mode**.

2. Complete the setup procedure in **OPTION MENU #:34, SELECT REPORTS**. (Refer to **Section 5-34, OPTION MENU #:34, SELECT REPORTS,** for a complete description.)

6-6.3 Input to the 930i

Input to the **930i** is in the form of "command strings." These are strings of ASCII characters that the **930i** recognizes as commands. A command string may be from 1 to 40 characters in length. The **930i** has a 40-character input buffer. **Tables 6-1** and **6-2** contain summaries of these commands.

The **930i** will echo each character back to the computer as it is received and placed in the buffer. **DO NOT SEND THE NEXT CHARACTER UNTIL THE ECHO HAS BEEN RECEIVED**. This is the **930i** input protocol (actually a hand shake). The **930i** executes the commands in the order they are received, with the exception of the **[X]** command which executes immediately. When all
received commands have been executed and the input buffer is empty, the **930i** will signal the host computer with a ">" prompt.

The **930i** will echo and ignore any characters it does not recognize as commands.

6-6.4 Output from the 930i

Output from the **930i** consists of the following:

Echoes	The **930i** echoes all received characters to the host computer.
Prompts	When the **930i** has executed all received commands and its command buffer is empty, it sends a prompt consisting of a line feed, carriage return, and a **[>]** character. The ASCII sequence in Hexadecimal code is 0A 0D 3E. Some data strings include the **[>]** character, but the 0D 3E sequence is unique.
Alerts	Under certain circumstances, the **930i** will send a "bell" character (ASCII 07) to alert the host computer that it has something to report. Any programs the user writes should screen all **930i** output carefully for this character. If the **OPTION MENU #:15, BEEP ON ERROR,** is set to **OFF**, the bell character will not be sent.
Data	When the **930i** executes an **[X]**, **[Y]**, or **[Z]** command, it sends a copy of its current display line and supervision status. This is a 50-character line terminated by a line feed and carriage return. **Section 6-4.4** contains details of display line formats.

Reports If the **930i** has sent the host computer an ALERT, it will respond to the **[W]** command with a report concerning what caused the ALERT. This could be a PCM error, a completed Receive Record sequence, Wink Timing information, 105 test results, or some combination of the four. **Section 6-4.4** contains further details of Report Formats. When used as a near-end responder (**OPTION MENU #:26, ROTL RESPONDER**), the **930i** will send an alert (bell) at the completion of each test.

6-6.5 Display Line Formats

A Display Line is always 50 characters long, terminated by a carriage return and line feed. The first 40 characters of a Display Line mirror the display on the front panel of the **930i**. The next 4 characters are ASCII blanks. The next character shows originating supervision. The next 4 characters are ASCII blanks. The last character shows terminating end supervision.

In the following examples of typical PC screen displays, numbers are denoted by a single **[N]** for each possible digit. Each **[N]** may stand for any number. Signed numbers are shown preceded by a **[+]** or **[–]** character.

Leading zeros are printed as blanks and trailing zeros are printed as zeros. The digit to the left of the decimal point will always be printed, including leading zeros. The sign of the number will always be printed to the left of the first non-blank digit. Uppercase **[O]** or **[T]** indicates an off-hook condition; lowercase **[o]** or **[t]** represent an on-hook condition. These symbols are not seen on the **930i** display.

Typical example displays of the computer's CRT are below:

In Measure Tone:

NNNN Hz	**+NN.N dBm0**	**AVERAGE**	**PCM1**	**O**	**T**
----	**OVER dBm**	**RMS**	**PCM2**	**o**	**t**
----	**dB**		**T1R1**	**-**	**-**
----	**dB**		**TR**	**-**	**-**

Description -- Seven leading blanks, followed by the frequency in Hz or four dashes, the label **Hz**, a signed level or the over or under indication (**OVER** or **----**), the relative zero label, the **AVERAGE** or **RMS** label, and the signal source label.

In Measure Noise:

+NNN dBrn0	**P-NOTCH**	**PCM1**	**CHANNEL**		**O**	**T**
dBrn	**3K FLT**	**PCM2**	**N-TO-G**		**o**	**t**
dB	**PSOPHOMETRIC**	**T1R1**		**BAL**	**-**	**-**
dB	**S/N**	**TR**				

Description --- Three leading blanks, followed by a signed level measurement, the relative zero label, the filter type, the signal source label, and the type of measurement.

In 4W Return Loss:

```
+NNNdB   SRL LO     NNNN Hz    +NN THL    4W 1200    O    T
         SRL HI                         4W 900     o    t
         ERL                            4W 600     -    -
         OSC                            PCM1
                                        PCM2
```

Description --- Two leading blanks, followed by a signed level measurement and the label **dB**, the signal type, the frequency of the echo suppress tone or the oscillator tone, and the label **Hz**, a signed transhybrid loss level and the label **THL**, and a Trunk Type label.

In 2W, Normal Return Loss:

```
+NNNdB   SRL LO     NNNNHz                 2W 1200    O    T
         SRL HI                         2W 900     o    t
         ERL   2W 600                               -    -
         OSC   2W 150
```

Description --- Two leading blanks, followed by a signed level measurement and the label **dB**, the signal type, the frequency of the echo suppress tone or oscillator tone, and the label **Hz**, 10 blanks, and a Trunk Type label.

6-7 PROGRAMMERS NOTES

6-7.1 Initializing the 930i

Send the command string **[AAA]** when you first access the **930i** remotely. This ensures that you have exited from any tests or submenus the **930i** may have been left in. You may use any of the function key commands (**[A]**, **[B]**, **[C]**, **[D]**, **[E]**, **[F]**, or **[G]**), but three repetitions is the minimum necessary to bring the **930i** to a known state before testing. By sending **[AAA]** you take the **930i** to the Trunk Type menu, no matter where it was previously. Sending **[GGG]** would take the **930i** to the Option Menu instead.

After this initial string has been sent, send a Trunk Type initialization string to ensure that the **930i** is properly terminated or bridged, looking at the correct signaling leads, etc. Use the **HELP** menu in Trunk Type to accomplish this (see the following pages for details). Two examples would be:

```
NORMAL          LOOP       TERM          CONTACT    2W 900:    [A?J;;LKK]
E&M TYPE II                TERM          SEND-E     4W 600:    [A?L2JK;K;]
```

Append a lowercase **[o]** to your initialization string to ensure that the **930i** is on hook.

To ensure that the **930i** is in quiet termination (sending no tone), send a Send Tone initialization string such as **[?;1004J160J]**. This sequence sets the frequency to 1020 Hz, the level to -16.0 dBm, and the output to **OFF**. The numeric input for frequency and level were terminated by the **[J]** character. Numeric input may be terminated by a carriage return or any K(**[J], [K], [L], [;]**). The **[J]** character has been used in all the examples contained in this document.

You may now use the **930i** to send or receive calls, send and measure tones and other VF signals, and perform automated tests to remote testlines and responders. The following section on **HELP** menus will get you started. There are separate sections on placing multistage calls using the digit receiver/ analyzer, and placing calls to remote testlines and responders.

For the convenience of programmers, the **930i** may be commanded remotely to dump its buffers and restore itself to the factory defaults. **OPTION MENU #:92, RESET 930,** is used for this purpose.

To remotely cold-boot the **930i**, perform the following sequence: **GGG92|K**

This command does not affect the RS-232 remote port settings nor does it affect the time/date settings.

A hardware cold-boot (recycling power while holding down a function key) will restore the RS-232 port settings to their factory default values.

6-8 HELP MENU IN REMOTE CONTROL

Pressing the **HELP** key on the **930i** brings up a series of menus for the user. The menu presented will depend on the function the **930i** is executing. Transmitting the ASCII **[?]** character remotely has the same effect as pressing the **HELP** key on the **930i** front panel.

Many of the **930i**'s features are controlled using soft keys (the four unlabeled keys directly beneath the display). The current setting is usually displayed above the soft key. If the **930i** displayed your parameter, continue to the next display, otherwise press the soft key until the **930i** displayed the setting you wanted.

Using the **HELP** menus allows the computer to avoid this procedure. Once you have used a **HELP** menu to put the **930i** in a known state, it may be more efficient to use the soft keys in the usual way. You would always use the **HELP** menus when your program begins: this provides a simple and foolproof initialization. After using a **HELP** menu once to put the **930i** in a known state, you may continue to use the **HELP** menus throughout your program.

The following section gives a brief overview of the **HELP** menus and includes some sample command strings.

Trunk Type function key (Analog circuits)

Trunk Type	Help	Type/Sense	Direction	Bridge/Term	Ohms	2W/4W
Trunk Type	**[A] =**	**Trunk Type**				
Help	**[?] =**	**Help**				
Type	**[J] =**	**Loop**	**[K] = Ground-Start**	**[L]=**	**{1-5}**	**[J] = E&M Type I-5**
Sense*	**[K] =**	**Normal**	**[;] =**	**Reverse**		
Direction	**[K] =**	**Battery**	**[;] =**	**Contact**	**[K] = SEND-E**	**[;] = SEND-M**
Bridge/Term	**[K] =**	**Bridge**	**[;] =**	**Terminate**		
Ohms	**[J] =**	**150Ω**	**[K] =**	**600Ω**	**[L] = 900Ω**	**[;] = 1200Ω**
2W/4W	**[K] =**	**2 Wire**	**[;] =**	**4 Wire**		

* (Loop and Gnd-Start only)

Examples:

```
E&M TYPE I      TERM      SEND-E     4W 600     [A?L1JK;K;]
E&M TYPE II     TERM      SEND-M     2W 900     [A?L2J;;LK]
LOOP NORMAL     TERM      CONTACT    2W 900     [A?JK;;LK]

Toggle Bridge/Term        [K]
Toggle Direction          [L]
```

Remote Control Operation

Dial/Ring function key

Dial/Ring Help Pulsing Digits

Dial/Ring	**B =**	**Dial/Ring**
Help	**? =**	**Help**
Pulsing	**K =**	**Dial Pulse L = MF ; = DTMF**

Number up to 17 digits

All pulsing types: 0-9, [–] for 1 sec. pause
DTMF: a,b,c,d,*,#
MF: *=KP, #=ST, a=STP, b=ST2P, c=ST3P

If you are already off-hook, the digits will be sent immediately. If you are on-hook, the digits will be stored in **Dial/Ring**. Go off-hook and send ASCII **[K]** to send stored digits.

Sending an ASCII blank (space bar) **[ ]** clears any existing digits. Using the **HELP** key also clears any previous digits.

Examples:

Go to **Dial/Ring**. Go off-hook. Select DTMF. Dial (408) 761-1000:
[BO?;4087611000]

Go to **Dial/Ring**. Go on-hook. Select MF. Store KP007ST to be dialed later:
[Bo?L*007#]

Go to **Dial/Ring**. Go off-hook. Select Dial Pulse. Pause 1 second and dial 9:
[BO?K-9]

Go to **Dial/Ring**. Go off-hook and send the most recently entered digit string:
[BOK]

Go to **Dial/Ring**, clear any old digits, and dial 411 in the current pulse mode:
[B 411]

Return Loss function key

4W:
Return Loss Help Band Frequency Acknowledge Set THL

Return Loss	**[C] = Return Loss**
Help	**[?] = Help**
Band	**[J] = SRL-LO [K] = SRL-HI [L] = ERL [;] = OSC (sine wave)**
Frequency	**[nnnnJ] =** freq. of nnnn Hz for echo suppress tone and/or sine wave return loss
Acknowledge	**[J],[K],[L] or [;]** =acknowledges message
Set THL	**[L] =** Current measurement is THL **[;nnJ] =** THL is -nn dB

2W:
Return Loss Help Mode [Band Frequency] or [Termination]

Return Loss	**[C] = Return Loss**
Help	**[?] = Help**
Mode	**[K] = Return Loss [;] = TR Termination**

Return Loss:

Band	**[J] = SRL-LO [K] = SRL-HI [L] = ERL [;] = OSC (sine wave)**
Frequency	**[nnnnJ] =** freq. of nnnn Hz for echo suppress tone and/or sinewave

TR Termination:
Termination: **[J] = AC Short [K] = 600Ω+2.14μF [L] = 900Ω+2.14μF [;] = AC Open**

Examples:

4W:

Go to Return Loss. Select ERL, 2225 Hz Echo Suppress, no THL compensation: **[C?L2225JJ0J]**

Go to Return Loss. Select SRL-LO, 2225 Hz Echo Suppress, measure THL: **[C?J2225JJK]**

2W:

Go to Return Loss. Select SRL-LO, 2225 Hz Echo Suppress tone: **[C?KJ2225J]**

Go to Return Loss. Select 900Ω with 2.14µF quiet termination: **[C?;L]**

All types:

Send echo suppress tone: **[K]**

Send Tone function key

Send Tone Help Output Frequency Level

Send Tone	**[D =]**	**Send Tone**
Help	**[? =]**	**Help**
Output	**[K =]**	**ON** **[;] = OFF**
Frequency	**[nnnnJ] =** frequency of nnnn Hz	
Level	**[nnnJ] =** level of -nn.n dBm (for level of +nn.n dBm, send **[nnndJ]**)	

Examples:

Send 1020 Hz at 0.0 dBm: **[D?K1004J0J]**

Send 1020 Hz at -16.0 dBm: **[D?K1004J160J]**

Send 2804 Hz at -13.0 dBm: **[D?K2804J130J]**

Send 404 Hz at +3.2 dBm: **[D?K0404J32dJ]**

Set frequency and level to 1020 Hz at -10.0 dBm, do not send tone: **[D?;0104J100J]**

Toggle tone on/off: **[D;]**

Set frequency to 1010 Hz: **[DJ1010J]**

Set level to -16.0 dBm: **[DK160J]**

Measure Tone function key

Measure Tone Help Reference Mode*

Measure Tone	**[E] = Measure Tone**	
Help	**[?] = Help**	
Reference	**[K] = Absolute (dBm)**	**[L] = Set 0** (dB relative to current level)
	[;nnnJ] = dBm0 (dB relative to -nn.n dBm)	
Mode*	**[K] = Average**[1]	**[;] = RMS**[2]

* Software Rev. 3.17 and later.
1 Use **AVERAGE** to measure sine waves.
2 Use **RMS** to measure the level of non-sinewave tones and digital milliwatt.

Examples:

Measure in dBm: **[E?KK]**

Make future measurements in dB relative to -16.0 dBm: **[E?;160JK]**

Make future measurements in dB relative to current measured level: **[E?LK]**

Make **RMS** measurements in dBm: **[E?K;]**

Toggle **RMS**/**AVERAGE**: **[L]**

Measure tone: **[E] [Z]** (Wait 1 sec. between sending **[E]** and **[Z]** or **[EZZ]**. Disregard first measurement.

*If a tone has been selected in **Send Tone** and the output is **ON**,* the tone will also be sent in **Measure Tone**. To measure far-to-near tone on a 2-wire circuit, be sure **Send Tone's** output is set to **OFF**.

Measure Noise function key

Measure Noise Help Filter Mode* Reference

Measure Noise	**[F] = Measure Noise**	
Help	**[?] = Help**	
Filter	**[J] = 3 KHz flat**	**[K] = Psophometric** **[L] = P-Notch** **[;] = Signal/Noise**
Mode* †	**[K] = Balanced**	**[;] = Noise/Ground**
Reference †	**[K] = Absolute** (dBrn)	**[L] = Set 0** (dB relative to current level)
	[;nnndJ] = dBrn0 (dB relative to nnn dBrn)	

* Not available in PCM. In PCM the **930i** measures channel noise only.
† Not available when making signal/noise measurement.

Examples:

Measure balanced noise in dBm using the P-Notch filter: **[F?LKK]**

Measure signal/noise: **[F?;]**

Measure noise-to-ground relative to 90 dBrn using the 3 KHz flat filter: **[F?J;090dJ]**

Measure noise: **[F] [Z]** Wait 1 sec. between sending **[F]** and **[Z]** or **[FZZ].** Disregard first measurement

*If a tone has been selected in **Send Tone** and the output is **ON**,* the tone will also be sent in **Measure Noise**. To measure far-to-near noise on a 2-wire circuit, be sure **Send Tone's** output is set to **OFF**.

6-9 BELL CHARACTER

The **930i** can be set to wait for or detect a variety of events. The **930i** sends the bell character to report these events. Some events are reported only if the user selects them; other events are reported only if the **930i** is performing a certain function. Select the events to be reported from **OPTION MENU #:34, SELECT REPORTS**. The following lists the events and conditions for a bell to be sent.

EVENT	REPORTED WHEN 930i IN:
PCM ERROR--An error on the E1 span such as a slip, bipolar violation, remote alarm, etc., has been detected.	PCM Trunk Type. REPORT PCM ERRORS selected.
INCOMING CALL COMPLETE--The **930i** has received a call.	Option Menu #:4, Digit Receiver REPORT RECEIVED RECORDS selected.
WINK TIMING AVAILABLE--A call has completed or abandoned, and a wink, off-hook, delay dial event, dial tone or credit card “bong” was expected.	Option Menu #:2, Send Digit Sequences. Option Menu #:4, Digit Receiver. REPORT WINK TIMING selected.
WINK FAILURE--An expected wink, off-hook, delay dial event, dial tone or “bong” failed to appear or was not recognizable.	Option Menu #:2, Send Digit Sequences. Option Menu #:4, Digit Receiver.
SIGNALING BIT CHANGE--An A, B, C, or D bit has changed state on one of the PCM Channels.	PCM Trunk Type. Option Menu #:20, 30 Bit Display.

EVENT	REPORTED WHEN 930i IN:
RINGING or LINE SEIZURE--The **930i** detects ringing or seizure and goes off-hook.	Option Menu #:32, Dial-Up Testline. Option Menu #:33, Dial-Up Sweep.
IMPULSE or HIT--An impulse, gain hit, phase hit or dropout has occurred.	Option Menu #:11, Impulse and Hits.
CALL PROGRESS FAILURE--The **930i** detects Busy, Reorder, Dead Line or any other call progress failure when it attempts to access a testline.	Calling to a testline from: Option Menu #:2, Send Digit Sequences. Option Menu #:66, ATME Director. Option Menu #:29, Call 102 Line.
TEST DATA AVAILABLE--A test to a far-end testline has completed, or has a screen full of results available. LOSS has one screen of data (one bell), GAIN SLOPE has three screens of data (one bell each), etc.	Calling to a testline from: Option Menu #:2, Send Digit Sequences. Option Menu #:65, ATME Far End Responder. Option Menu #:66. ATME Director. Option Menu #:29, Call 102 Line.

SECTION VII

SPECIFICATIONS

7-1 Measurement Standards

Analogue measurements may be made on either metallic or digital interfaces. Except as otherwise noted, specifications are in accordance with ITU-T, 0.41, 0.42, 0.81, 0.91, 0.95, 0.132, and North American IEEE 743-01.

7-2 Level/Frequency Measurements

Transmitter

Frequency Range	50 Hz to 5.0 kHz (0.131)
Resolution	1 Hz
Accuracy	±1 Hz
Step Size	1, 10, 100, or 1000 Hz steps
Level Range	60 dBm to +12 dBm
Resolution	0.1 dB
Accuracy	±0.1 dB at 1020 Hz (0 to -19 dBm), ±0.2 dB at all other frequencies
Flatness	±0.2 dB (200 Hz to 5 kHz, referenced to level at 1 kHz)
Distortion	-70 dB at 1020 Hz, 0 dBm

Receiver

Frequency Range	50 Hz to 5.0 kHz
Resolution	1 Hz
Accuracy	±1.0 Hz
Level Range	-50 dBm to +12 dBm
Resolution	0.1 dB
Accuracy	±0.1 dB at 1020 Hz (0 to -19 dBm), ±0.2 dB at 200 Hz to 5 kHz RMS or average

7-3 Noise Measurements

Input	Balanced or noise-to-ground
Weighting Filters	Psophometric, P-notch, 3K-flat, 15 K, PROG, 50 kbit
Notch Filter	995–1025 Hz, > 60 dB
Range	-80 dBm to +10 dBm balanced, -40 dBm to +40 dBm noise-to-ground
Resolution	1.0 dB
Accuracy	±1.0 dB

7-4 3-Level Impulse Noise

Weighting Filters	Psophometric, P-notch
Threshold Range	30–106 dBrnC
Accuracy	±1.0 dB
Threshold Spread	2, 4, 6, or 8 dB steps
Timer	1 minute to 99 minutes, or continuous
Counter Capacity	0–9999 for low (LO), mid (MD) and high (HI)
Measurement Range	7–99 measurements per second

7-5 Return Loss Measurement

General

Modes	ERL, SRL-Low, SRL-High, or Sine wave

2-Wire Return Loss

Transmitter Level	-10 dBm0
Receiver Range	0–40 dB
Resolution	1.0 dB
Accuracy	±0.5 dB
Internal Hybrid Impedance	600 or 900 Ohms ±0.1% in series with 2.16 µF ±1%

4-Wire Return Loss

Impedance	135, 600, 900, or 1200 Ohms
Transhybrid Loss Compensation	-30 dB to +30 dB
Transmitter Level	-10 dBm0 relative to TLP
Receiver Range	-10 dB to +50 dB
Resolution	1.0 dB
Accuracy	±0.5 dB

7-6 Peak to Average Ratio (P/AR)

Transmit Level Range	0 dBm to -40 dBm
Resolution	0.1 dB
Receive Level Range	-40 dBm to +12 dBm
Resolution	0.1 dB
P/AR Measurement Range	0 to 120 P/AR units
Resolution	1 P/AR unit
Accuracy	±1 P/AR unit

7-7 Phase and Amplitude Jitter Measurements

Received Holding Tone	Metallic:	+10 dBm to -40 dBm
	PCM:	0.0 dBm to -40 dBm
Holding Tone Frequency Range		990–1030 Hz

Phase Jitter Measurement	0.0° to 30.0° peak-to-peak
Accuracy	±5%, ±0.2°
Amplitude Jitter Measurement	0.0–30.0% peak
Accuracy	±5%, ±2%
Weighting Filter Bandpass	4–300 Hz and 20–300 Hz
Phase Hits	5.0° to 50.0° peak in 1° steps

7-8 Transient (Hits) Measurements

Gain Hits	1–10 dB in 2 dB steps
Dropouts	Tone level drops below 12 dB. ±1 dB
Timer	1–99 minutes, or continuous
Counter Capacity	0–9999 for low (LO), mid (MD) and high (HI)
Measurement Range	7–99 measurements per second

7-9 Envelope Delay Distortion Measurements

Modes	Send and repeat (master and slave)	
Transmitter	50% AM signal at modulation frequency of $83^{1}/_{3}$ Hz carrier	
Frequency:	304–3504 Hz	
Level	Metallic:	0.0 dBm to -40.0 dBm
	PCM:	0.0 dBm to -40.0 dBm
Flatness	0.2 dB (304–3504 Hz)	
Receiver Input Level	Metallic:	+10.0 dBm to -40.0 dBm
	PCM:	0.0 dBm to -40.0 dBm
Distortion Measurement Range	+9000, -3000 µ secs	
Accuracy	10 µsecs, 604–3504 Hz	
	30 µsecs, 304–603 Hz	

7-10 Group Delay Distortion Measurements

Transmitter	40% AM signal with a modulation frequency of $41^{2}/_{3}$ Hz
Frequency	200–3800 Hz
Level	0.0 dBm to -40.0 dBm
Flatness	±0.2 dB
Delay Range	0 to ±10,000 µsecs
Accuracy	200–400 Hz, ±100 µsecs
	400–600 Hz, ±30 µsecs
	600 Hz to 1 kHz, ±10 µsecs
	1–3800 kHz, ±5 µsecs

7-11 Absolute Delay Measurements

Modes	Send and Rrepeat
Transmitter	50% AM signal with a modulation frequency of $83^{1}/_{3}$ Hz
Frequency	1020 Hz send; 1800/1850 Hz repeat
Level	0.0 dBm to -40.0 dBm
Flatness	±0.2 dB
Delay Range	0–1.2 sec
Accuracy	±0.1 µsec
Harmonic Distortion	>35 dB below tone level

7-12 23 Tone Test

Transmitter

Composite Level	-40 dBm to -6 dBm
Individual Tones	
Level	-13.6 dB below composite level
Flatness	±0.1 dB
Frequencies	203.125–3640.625 Hz in 156.25 Hz steps ±10 ppm
Phase	per IEEE 743 ±0.25
Peak to RMS Ratio	8.79

Receiver

Range	-40 dBm to -6 dBm
Level	±0.2 dB
Attenuation	±0.2 dB
Envelope Delay Distortion	
Accuracy	±10µsecs
Range	
Frequencies	281.15–3562.5 Hz in 156.25 Hz steps
Signal-to-Noise	±2 dB from 10–24 dB
	±2 dB from 25–40 dB
	±2 dB from 41 –45 dB
Signal-to-Total Distortion	±2 dB from 10–24 dB
	±2 dB from 25–40 dB
	±2 dB from 41–45 dB
Intermodulation Distortion	±2 dB from 20–29 dB
(2nd and 3rd Order)	±2 dB from 30–46 dB
	±2 dB from 47–55 dB
	±2 dB from 56–60 dB

7-13 Intermodulation Distortion

Transmitter Level Range	Metallic:	0.0 dBm to -40.0 dBm RMS
	PCM:	-6.9 dBm to -40.0 dBm RMS
Accuracy	±1 dB	
Receiver Input Level	Metallic:	0.0 dBm to -40.0 dBm RMS
	PCM:	-6.0 dBm to -40.0 dBm RMS
Distortion Products	2nd order centered at 520 Hz and 2240 Hz 3rd order centered at 1900 Hz	
Distortion Range	2nd order:	10–70 dB below signal
	3rd order:	10–70 dB below signal
Resolution	1 dB	
Accuracy	±1 dB	
Signal-to-Noise Test	Removes low tone pair and increases level of remaining tone Pair by 3 dB.	

7-14 Supervision and Signalling

Wink Timing

Resolution	5 ms	
Accuracy	±5 ms	
Wink Fail Event	Fails for wink period >600 ms	
Off-Hook Fail Event	Fails for off-hook period <600 ms	

E&M Supervision

Types	I, II, III, IV, V	
Battery	-48 V DC current limited to 200 mA	
Threshold Voltages	On-hook	< -39 Volt on E Lead > -11 Volt M Lead
	Off-hook	> -11 Volt on E Lead < -39 Volt M Lead

Loop Supervision

Types	2- and 4-wire loop start, ground start, loop reverse and SX supervision
Battery	-48 V DC series limited to 120 mA
Metering Pulses	12 and 16 kHz, detect and send

MFC R1/R2, DTMF Senders

DTMF/MFCR1/R2	±0.1% of ITU-T Standard Frequencies
Adjustment Range	Tone frequencies adjustable in 0.1% steps to ±10% of standard frequencies for margining tests
Level	-7 dBm0 per tone in MFCR1 and DTMF -8 dBm0 per tone in MFCR2.
Level Adjustment Range	Tone level adjustable in 0.1 dB steps from -60.0 dBm to +6.0 dBm
Resolution	0.1 dB
Accuracy	±0.2 dB

Timing	DTMF:	50 ms tone on and tone off
	MFC-R1:	70 ms tone on and tone off (KP is 100 ms tone on)
	MFC-R2:	compelled
	Conditions:	idle seized seized acknowledgement answered clear-back clear-forward blocked release andelease guard

Timing Adjustment Range	Tone on and tone off times adjustable in 1 ms steps from 13–267 ms (KP adjustable from 45–300 ms)
Resolution	1 ms
Accuracy	±1.0% at 10.0 PPS

Dial Pulse Sender

PPS:	
Range	2–50 PPS (PCM interface); 2–35 PPS (Metallic interface)
Resolution	0.1 PPS
Accuracy	±1.0% at 10.0 PPS
% Break	
Range	5–95% (PCM interface); 25–80% (Metallic interface)
Resolution	0.1%
Accuracy	±1.0%for 25–75% break at 10 PPS
Interdigit Timing	
Range	40–990 ms
Resolution	10 ms
Accuracy	±5.0 ms

7-15 E-1 PCM Channel Access

General G.736	2.048 Mbs per ITU-T G.703, G.704, G.706, G.711, G.732 and	
	PCM 30:	30 channels with CAS in timeslot 16
	PCM 31:	31 channels without CAS
	PCM 30C:	30 channels with CAS in timeslot 16 and CRC4
	PCM 31C:	31 channels without CAS and with CRC4

Framing

Encoding/Decoding	HDB3, AMI
Multiplexing	
Receiver	Monitor N X 64 kbs channel or voice channel
Transmitter	Transmit N X 64 kbs channel or voice channel
Selection	Manual/Automatic selection of framing format

Transmitter

Clock Sources	Internal/External or recovered from received signal
Internal Frequencies	2.048 Mbs, ±5 ppm
Output Signal	Compliant with G.703, Standard A-LAW (G.711)

Receiver

Input Sensitivity	Bridge and Terminate: -25 to +6 db at 2.048 Mbs (balanced) -25 to +6 db at 2.048 Mbs (unbalanced) Monitor: Up to 30 db of flat gain
Impedance (unbalanced)	Monitor and Terminate: 75 Ohms
Impedance (balanced)	Monitor and Terminate: 120 Ohms Bridged: > 1,000 Ohms
Bit Rate	2 Mbs channel access 64 kbs channel access N X 64 kbs channel access

Channel Associated

Signalling

Analysis	A, B, C, D signalling Display A, B, C, D bits Control A, B, C, D bits
Connectors	Metallic and E&M: Bantam Connectors PCM Balanced: Bantam Connectors PCM Unbalanced: BNC Connectors
Indicators	No Signal (loss of signal indication) AIS (alarm indication signal) No FAS (no frame alignment Sequence, Near) MFAS (multiframe alignment sequence, near) CRC4 (present) HDB3 coding History (previous indication)

Data Generator and Receiver

Bit Error Rate Frequencies	2.048 Mbs, 64 kbs, N X 64 kbs
Bit Error Rate Access within the received signal	BER testing may be done at the received rate or on any tributary

Patterns	USER (3 to 24 bits). The user defined pattern can be used to produce common patterns such as: All 1s All 0s 1:1. 1:3, 1:4, 1:7, 1:8
Pseudorandom	Pattern — Recommendation 2^{11} - 1 (O.151) 2^{15} - 1 (V.52) 2^{20} - 1 (V.57) 2^{23} - 1 (O.151) QRSS (2^{20} - 1 with 14 zero suppression)
Error Insertion	Bit, Code (AMI/HDB3), FAS
Performance Measurements	G.821 M.550

Printer/RemoteControl

Standard V.24/RS232-C	Word Length:	7 or 8 bits
	Parity:	Odd, Even, or None
	Line Term:	Carriage return, line feed, carriage return and line feed
	Results Printing:	Time, date, results, test configuration

General

Impedance	135, 600, 900, 1200 Ohms
Store and Recall	99 or more programs or setup information
Non-Volatile Memory settings	Stores front panel setting, keypad entries and auxiliary function
FLASH Memory	Provides capability for remote download of applications programs
Maximum DC Blocking	160 V DC
Audio Volume	Adjustable at front panel
Display	40 character vacuum fluorescent
AC Power Supply	240 V AC ±10%, 50 Hz: 110 V AC ±10%, 60 Hz
Operating Temperature	0° C to 50° C
Storage Temperature	-40° C to +70° C
Dimensions	5.79" H x 14.33" W x 14.25" D
Weight	16 lbs to 19 lbs, depending upon options