ATME RESPONDER

The ITU-T Recommendation O.22 describes a type of ***Automatic Transmission Measuring Equipment (ATME No. 2)***. It is intended to perform transmission measurements (analog and digital), echo canceller tests and signaling system functional tests on 4-Wire International circuits.

ATME is similar to Type 105 responder systems - it uses automatic test lines that work with near-end equipment to automatically perform measurements in both directions and transmit the results back to the near-end. It is different in the type of tests and the method of encoding results.

The ATME system performs four basic types of test:

1. ***Signaling*** *- generates line-signals for various signaling types, i.e.: clear back, forward transfer*
2. ***Transmission*** *- power level at three frequencies, noise, level, signal-to-total-distortion.*
3. ***Echo-canceller*** *- tests near and far end G.165 echo cancellers at various delays and levels.*
4. ***Digital loop-back*** *- allows round trip BERT testing on digital circuits.*

THEORY OF OPERATION

The ATME test-line system consists of near end and far end equipment. The *directing equipment* (*director*) is what we call the near-end responder the *responding equipment (responder)* is the far-end. The director initiates the test by dialing the responder and waiting for an answer signal. The test sequence begins when the answer supervision is detected; there is no test progress tone, as in the Type 105 responder.

The ATME system uses MF digits for command sequences and for encoding measurement results. The layer one commands are single digit compelled MF codes. This means that the director sends a command digit until it receives an acknowledgment digit from the responder; the responder sends the ack digit until it detects the end of the command digit. Therefore there is no set digit length; the digit timing is dependent on the delay of the circuit and forms a timing reference for the measurement sequence that remains synchronized over variable circuit delays. The measurement data is sent as normal pulsed MF (i.e. no ack digit).

There are two command layers. Layer number one controls the transmission tests: ***level, noise and Signal to Total Distortion***. Level tests can be performed at three different frequencies (400, 1020, and 2800 Hz) and two different levels (0 and -10 dBm). The Total Distortion measurement can be performed at -10 and/or -25 dBm. The noise and S/TD measurements are Psophometric weighted but a C-Message weighted version is planned for North America.

Layer number two is entered when the director issues a code 9 command. This causes the far-end to map the 15 available MF codes to different functions. Layer Three commands are pulsed, not compelled. There are two test groups currently defined in layer three: Echo canceller tests and digital loop-back. Eleven codes are left undefined for future expansion. We plan to use these extra codes to extend the ATME functionality in the same way we did with the 105E series responders.

Echo Canceller Tests

After entering layer two the echo canceller tests are initiated by issuing a 500 ms pulse of MF code 3. The director and responder then perform a 2-way loss measurements, return loss measurement, far-end echo canceller tests, near-end echo canceller tests and echo canceller disable tests in both directions.

The echo canceller performance is tested by transmitting a shaped noise signal from one end of the circuit through a programmable loop-back at the other end. The loop-back simulates an echo source with +2 dB gain and -10 dB loss and delays variable from 0 to 70 ms. The effectiveness of the echo cancellers can be measured by comparing the level of the test signal on the transmit path to the signal on the return path. The Director and Responder take turns sending and looping to test both the near and far-end echo cancellers.

The ability of the echo cancellers to remove themselves from the circuit is tested by generating an echo canceller disable signal (a 2100 Hz tone with 180 deg phase reversals every 450 ms per G.165, V.25). The same shaped noise signal is then transmitted though a loop back at the far end of the circuit and measured at the return path. If the echo cancellers have removed themselves from the circuit then the round trip attenuation should be the same as was calculated from the two way loss test at the beginning of the echo canceller test sequence. First the far-end canceller is tested, then the director and responder swap directions to test the near-end echo canceller. At the end of the test the cancellers are allowed to re-enable and the director sends an MF code 5 to return the system to layer one.

64kbps BERT

The digital loop-back sequence is initiated from layer one by sending a code 9, which is acknowledged by the responder. The director then sends a pulsed code 3 to start the loop-back. If there is an end to end clear channel digital connection, a round-trip bit error rate test can be made. The 2^{11} pseudorandom pattern specified in O.152 is standard for ATME tests but other patterns can easily be substituted. The loop-back will terminate upon the receipt of an MF code 5 or after a 30-second time out. The time out can be extended in thirty second increments by sending an MF code 3.

MF Codes

Code No.	Frequencies (Hz)	Layer 1	Layer 2
1	700 + 900	1 kHzlevel @ 0dBm0	echo canceller test
2	700 + 1100	400 Hz level	reserved
3	900 + 1100	2800 Hz level	digital loop-back
4	700 + 1300	psoph-noise w/2800 Hz notch	return to layer 1
5	900 + 1300	psophometric noise	undefined
6	1100 + 1300	1kHz level @ -10dBm0	undefined
7	700 + 1500	distortion w/-10dBm0 signal	undefined
8	900 + 1500	distortion w/-25dBm0 signal	undefined
9	1100 + 1500	shift to layer 2	undefined
10	1300 + 1500	undefined	undefined
11	700 + 1700	forward transfer	undefined
12	900 + 1700	undefined	undefined
13	1100 + 1700	reverse direction	undefined
14	1300 + 1700	reserved for national use	undefined
15	1500 + 1700	end of program	undefined

Table 1. The frequency pairs and commands for the 15 MF codes.

Figure 1 illustrates a typical ATME signaling sequence for performing noise or level tests on circuits that have echo cancellers. There is also an option for circuits that do not have echo cancellers, which omits the echo canceller tone and the 2800 Hz locking tone.

- *The director initiates the sequence by sending a burst of echo canceller disable signal, followed by an MF command, followed by a 2800 Hz holding tone.*
- *The responder acknowledges the command with the digit 13 and sends a measurement signal.*
- *The director derives its timing from the ack digit and makes a measurement.*
- *The director then sends a forward MF code 13 followed by test tone.*
- *The responder returns an acknowledgment, makes a measurement and encodes it for the director as three pulsed MF digits one representing sign and two for magnitude.*
- *The director stops sending the measurement signal when the last measurement digit is received from the responder.*
- *A command is then issued to begin a new test or terminate the sequence*.

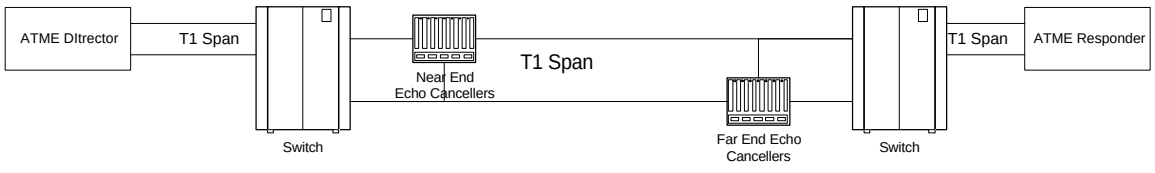

Figure 1. Typical ATME Sequence