



704 Universal Data Test Set Operations Manual

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This manual covers all Halycon models, including: 704A-400, 704A-410, 704A-430, 704A-460, 764A-024, 756A-00, 756A-01, 756A-02, 756A-07, 704A-PKG2, 704A-PKG3, 704A-NTS1, and 704A-NTS2

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INTRODUCTION TO THE 704 SERIES

The CXR Halcyon 704A Universal Test Set Series is a complete analog and digital transmission tester in a single, ruggedized, hand-held package. It includes integrated analog, DSL, Signaling, DDS, T1, BRI-ISDN, and T1/FT1 test functions.

Halcyon is a modular test set. The modules--TIMS, DDS, and T1--can be purchased separately or as a package.

- **TIMS:** The TIMS 704A-400 Wideband TIMS/Signaling Test Set is designed to accommodate complete analog and digital transmission testing functions in a single hand-held, light weight test set package. The basic 704A-400 chassis provides analog transmission test functions through 25KHz, which can be expanded to 1.5MHz frequency. Metallic Signaling functions and Class service testing are also offered.
- **DDS:** The DDS 756A Integrated Digital Data Test Set is designed to accommodate complete 4-Wire DEMARC and DS0/DDS testing functions in a single hand-held, light weight test set package. The unit provides DDS BERT, DSU/CSU simulation functions, latching and alternating loop code commands, control codes at 4W DEMARC as well as DS0 and OCU data-port plug-in modules, and load coil detection.
- **T1:** The T1 764A T1 and Fractional T1 Test Set is designed to accommodate complete T1 testing functions in a single hand-held, light weight test set package. The functions include a library of BERT test patterns and comprehensive loopback controls. Complete CSU/DSU functionality with an integral DCE interface, including comprehensive fractional T1 testing is included.
- **Packages:** The architecture of the Halcyon product line is modular. The different test functions- TIMS, T1, and DDS, can be easily combined into a single, hand-held package depending on the customer's test requirements. The packaged unit has the same dimensions, as the individual modules, but with greater depth.

General Operation

Upon power up, the LCD Screen label presents functional group testing choices selected by pressing one of the function keys F1 through F4. These functional groups are F1-DDS, F2-TIMS, F3-ISDN and F4-T1. When an equipped functional group is selected, the tester is prompted via a

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screen message to insert the corresponding template into the keypad template holder. Functional group templates are available for TIMS, DDS, T1 and BRI ISDN. The DDS functional group may include additional templates to accommodate the Northern Telecom 2-Wire SW 56K bps tests and/or the DDS network element Remote Provisioning and Remote control port option. The two additional templates are designated NT2W and REM respectively.

Selecting TIMS

Functional group TIMS (Function key F2)

Functional power up, pressing F2 causes the 704 to enter the TIMS test mode and the tester is prompted by a momentary LCD message to insert the TIMS template. The LCD next displays a message, READY. The tester can now select any of the TIMS tests/measurements as described in the section titled TIMS TESTING FEATURES.

Selecting DDS

Functional group DDS (Function key F1)

Functional power up, pressing F1 causes the 704 to enter the DDS test mode and the tester is prompted by a momentary LCD message to insert the DDS template. The DDS function initializes in the DS0 test mode and if the channel bank clock cable has not been connected, will present a screen message advising that BIT and BYTE clocks are not present. Pressing the keypad INTERFACE key rotates the test set interface through the selections DS0 Near, Far and Bipolar; 4-wire PRI SEC, SW56 and if equipped, the DTE test mode. The selection and setup of these interfaces is detailed in the section titled DDS TEST FEATURES.

Selecting ISDN

Functional group ISDN (Function key F3)

Functional power up, pressing F3 causes the 704 to enter the ISDN test mode and the tester is prompted by a momentary LCD message to insert the ISDN template. Upon successful establishment of the link between the 704 test set and the ISDN switch, the LCD will display a message: "ISDN READY". An unsuccessful link setup attempt will be flagged by one of the failure cause messages as detailed in the section titled BASIC RATE ISDN FEATURES.

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Selecting T1

Functional group T1 (Function key F4)

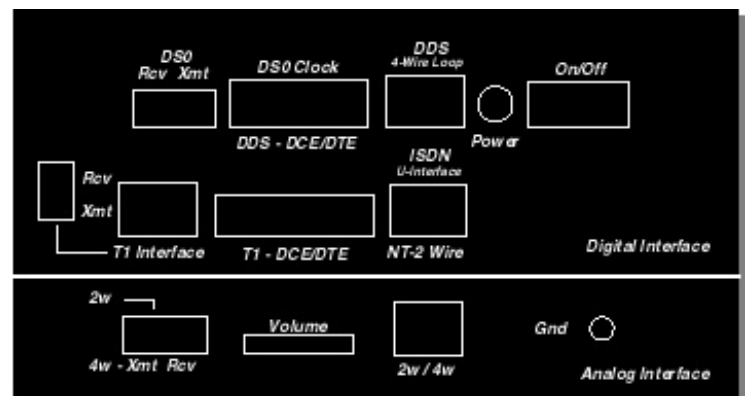
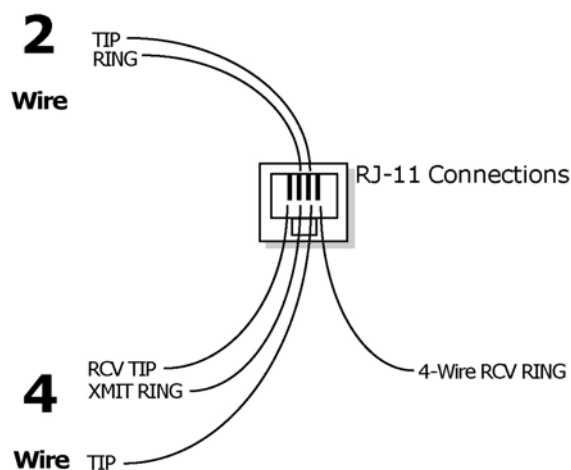
Functional power up, pressing F4 causes the 704 to enter the T1 test mode and the tester is prompted by a momentary LCD message to insert the T1 template. The tester can now select the desired configuration and test mode as described in the section title T1 TESTING FEATURES.

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Interface Connections

Connecting the CXR Halcyon 704 to the circuit under test is accomplished through two interface ports on the end panel of the unit. The primary interface is a six pin RJ-11C modular jack. The modular jack serves as both a 2-Wire and a 4-Wire interface, depending on the termination mode selected. When using the modular jack, the two inner most pins are used as the TIP and Ring connections of a 2-Wire line. Connection to a 4-Wire circuit utilizes



Connector Panel View (not to scale)

the four inner most pins, the inner two pins are the transmit pair, and the outer pins are the receive pair.

Connections can also be made through a pair of type 210 (bantam style) jacks. In 2-Wire applications, the single jack labeled "2W" is used alone. Both bantam jacks are used in 4-Wire applications. The bantam jacks and the modular jack are electrically connected in parallel. Either interface can be used depending on the type of cables available to make the connection. Both jacks can be used together in situations where another test set (such as a butt-set) is to be connected to the line.

The CXR Halcyon 704 can terminate the line in 135, 600, 900 or 1200 ohms, or operate in a bridged mode. A DC blocking capacitor is switched in when configured for 600, 900 or 1200 ohms (2W or 4W) termination. No DC

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blocking is provided in the 100 or 135 ohm terminated mode. In the bridged mode, the test set presents high impedance to the circuit under test, allowing tests to be run with the end terminating equipment connected.

Note: The internal transmitter circuit is disabled while in the 2-wire bridged mode, disabling features such as DTMF tone generation, return loss, 3-tone slope, 23-tone sequences, and loopback tone generation.

Battery & Audio Operation

The internal NiCad battery pack provides 4 hours of continuous operating time from a full charge. The CXR Halcyon 704 Series will trickle charge the battery pack any time the external 110V power adapter is plugged in. Normal charge time is 14 hours for a fully discharged pack. The front panel LED labeled Low Battery will illuminate indicating a low charge state of the internal battery. The user can expect about 30 minutes of operation after this LED has illuminated.

An automatic power down feature is incorporated into the CXR Halcyon 704 Series which will automatically shut the unit down completely after 20 minutes of inactivity has been detected. The auto-shut off is enabled only when the 704 Series is not running any test, as indicated by the "704A Ready" prompt. In this way, extended (overnight) tests can be performed. Make certain external power is connected before attempting extended testing, as the nominal 4-6 hour battery life may be exceeded.

The CXR Halcyon 704 Series test set has a built in speaker useful for monitoring the circuit under test. The pick off point of the audio monitor is after the internal filter networks, such that the effects of the filter can be heard. This becomes very evident during test such as notched noise, when the holding tone is notched out and only the distortion products of the signal are audible through the speaker. During the signal to noise testing the alternating signal and notched measurement can be heard. Use the slide control located on the top panel of the CXR Halcyon 704A-756 Series to adjust the volume to a comfortable level. Avoid overdriving the speaker whenever possible to avoid damaging the speaker and to conserve battery life.

An internal beeper has been incorporated into the test set to provide an audible feedback of each key press. The tone duration is longer during a DTMF dialing event indicating a valid digit has been sent. A tone is also sounded upon power up to indicate that the unit has successfully powered

up and the microcontroller is running properly.

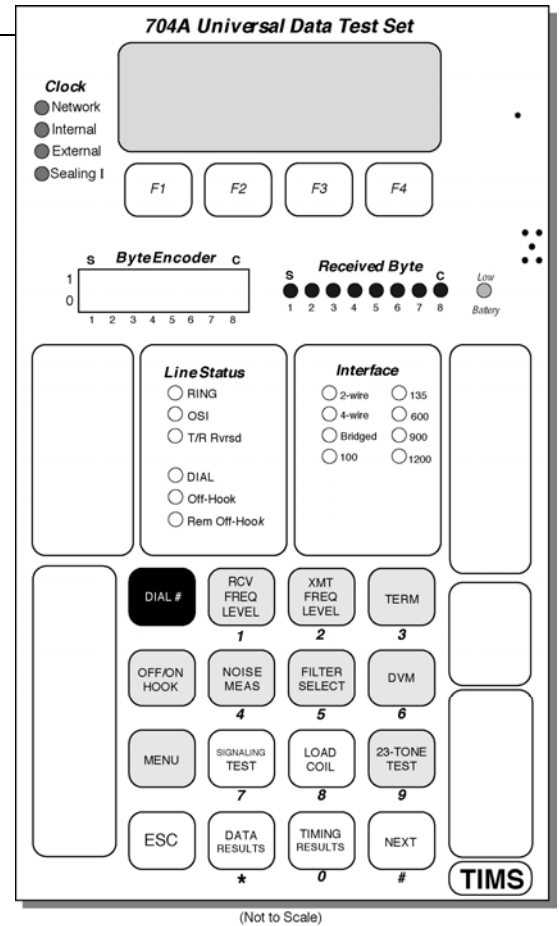
TIMS TEST FEATURES

The connector panel identifies the location of the test jacks utilized to access the circuit from both the central office and customer premise locations. The "receive" and "transmit" bantam jacks are utilized for 2-wire and 4-wire access. The speaker volume is controlled via a slide potentiometer. Customer access is provided via the 2-wire or modular RJ-11 jack. Whenever possible, the power jack should be utilized when testing from the CPE locations to ensure that the internal NiCad battery pack remains fully charged.

The 704 front panel provides access to the test functions used for analog circuit installation, analysis and repair. The comprehensive user interface provides easy test selection with all results displayed on the 4-line LCD and status LED. The interface is sectionalized into individual functions accessed by pressing the appropriate key. Test calls are placed by accessing SIGNALING mode and entering the number via the keypad keys. Optional Called ID/NAME (CID) and 105 Near End and 110 Far End responder features are activated by selections via the MENU keys.

Test results are displayed as they occur and stored for comparative analysis with previous messages (CID) or digits (DTMF). Noise measurements are made by first selecting the appropriate filter by pressing the FILTER key and then pressing the NOISE key until the desired noise measurement is displayed. The filter choices are:

- C-Message.....Typical voice grade noise test (600-3KHz)



(Not to Scale)

- C-Notch.....Noise with (1KHz) tone testing (600-3KHz)
- D-Filter/3KHz Flat.....Low frequency noise analysis (10-3KHz)
- E-Filter.....Measure BRI ISDN LVL and noise (1KHz-50KHz)
- E-Filter.....Measure HDSL LVL and noise (4.9KHz-245KHz)
- G-Filter.....Measure ADSL LVL and noise (20KHz-1100KHz)
- Program.....Weighted noise test for broadcast industry (500-10KHz)
- 15 KHz Flat.....Weighted noise test for program channels (10-15KHz)

When the desired noise filter has been selected the following noise measurements as appropriate to the filter choice may be made:

- Noise.....Noise measurements
- Notched Noise.....Noise with tone present measurement
- Signal/Noise.....Signal to Noise measurement
- Impulse Noise.....Transient Phenomena

Press a test key on the keypad and the corresponding test is activated. The test is terminated by pressing the ESC key.

Termination: 100, 135, 600, 900, 1200 Ohm and Bridged

704A-400 will automatically select the 2-wire 900 ohm TERM interface when the test set is first turned on. The TERM key is used to select the active interface (either 2W, 4W) and its impedance. Wideband operation is only available in the 100 ohm and the 135 ohm 4-wire modes.

To select a different interface:

Press the TERM key until the desired interface and impedance is selected as indicated by the LED.

Each press of the TERM key cycles to the next available interface/termination impedance option. For example:

To select the 4-Wire 600 ohm TERM interface from the 2-Wire 900 ohm interface:

Press the TERM key a total of five times.

To verify 4-wire 600 ohm mode, note the following LED states:

The 4-wire LED is ON.

The 600 ohm TERM LED is ON.

Note: Wideband operation is only available as terminated 100 or 135 ohm 4-Wire interface.

Install the Modular demarc cable or the Bantam cables to the appropriate test interface on the 704A-400. You have successfully selected the desired interface; continue to the desired test section as identified by the keypad labels.

DVM: Voltage and Current

The DVM (Digital Voltmeter) will monitor the status of the line for battery voltage, polarity, and current. Line status can be monitored while either on-hook or off-hook.

To select the DVM function:

Press the DVM key. The LCD indicates that Line Voltage/Current has been selected.

The T/R Rvrsd LED will illuminate if TIP and RING are reversed. (Normally, TIP is more positive than Ring). The LCD will also indicate a '+' voltage when the leads are reversed. The measured DC voltage and current will be displayed on the LCD:

```
"LINE VOLTAGE / CURRENT      "
"-10.7 Volts   24.6mA        "
"Last Ring: 62.3Vrms         "
"Press ESC to exit          "
```

The current reading should exceed 20mA when the 704A-400 is OFF-HOOK. This is an indication that sufficient loop current is available for proper telnet operation at the point of termination.

The RING function monitors the line (2-wire only) for incoming 20Hz ringing and will Display and hold the measured value of the last ring detected. You have successfully measured the line status using the DVM function. Press ESC to continue to the RCV – XMT Freq and Level section for single tone or frequency sweep send and receive measurements, or to the NOISE MEAS section for noise analysis.

RCV (Receive) Frequency and Level-Measure

The RCV Frequency and Level function allows the user to test the circuit for frequency shift or attenuation distortion as caused by carrier facilities. Point circuit loss (or gain) can be measured by having the distant end send a 1004Hz tone and measuring the received level in dBm. The circuit's usable bandwidth can then be defined by taking level measurements at different frequencies and comparing them to the reference reading made at 1004. If testing a 2-wire circuit and using a bantam cable, verify that it is inserted into the top panel 2W jack; if testing a 4-wire circuit verify that the bantam cable is inserted into the top panel 4W RCV jack. The modular RJ-11 jack (in parallel with the bantam jacks) can also be used for a 2-wire or 4-wire interface connection.

To select the RCV Freq and Level test:

Press the RCV Freq Level key

The measured signal will be displayed on the LCD:

```
"RX: 1004Hz   -0.1dB      "
"TX: ---OFF---          "
"                      "
"Press 2 to Select TX   "
```

To select or modify the Transmitter:

Press the XMT Freq Level key.

The LCD will display a simple menu allowing the frequency, level and the frequency step to be modified. Press the appropriate numeric key, enter the desired value, and press the '#' key to complete.

XMT (Transmit) Frequency and Level

The transmit frequency and level function of the 704A-00 allows the user to send tones with user selectable level and frequency on the desired 2-wire or 4-wire (RJ-11 or bantam jacks) interface. Tones are sent continuously (until interrupted) and can be manually stepped up or down in frequency using the * (steps down) or # (steps up) key. The step size of the frequency increment can also be defined by the user.

To select XMT Freq and Level:

Press the XMT Freq Level key.

The 704 enters the transmit frequency mode, tone generation begins immediately and the LCD displays:

(2-Wire mode)		(4-wire mode)	
" 2 FREQ: 1004Hz	"	" 2 FREQ: 1004Hz	"
" 3 at 0.0dBrn	"	" 3 at 0.0dBrn	"
" 4 STEP: 100Hz	"	" 4 STEP: 100Hz	"
" *=dwn, #=up 1 RX	"	" 5 TxOFF 1.. Return	"

The first line shows the selected frequency, the second line displays the current send level selected and the third line displays the frequency step size in Hertz. The fourth line provides the up/down step key designation and the message to use the 1 key to return to the 2-wire receive measure mode or the combined RX and TX display in the 4-wire mode.

To change the selected frequency.

Press the numeric '2' key.

Use the numeric keys to enter the desired frequency.

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Press the '#' key to begin transmitting at the new frequency.

When the '2' key is pressed, the displayed frequency changes to '0 Hz' indicating a numeric entry is needed. Using the numeric keypad keys, enter a number between 50Hz and 25KHz.

Note: Frequencies above 25KHz and up to 1.5MHz are only available with the Wideband option installed and the terminating impedance set to 100 or 135 ohms. The default signal level is 0.00dBrn; it can be changed to any level from -50dBrn to +7.0dBrn, with 0.1dB resolution.

To change the transmitted tone level:

Press the '3' key.

Use the numeric keys to enter the desired level.

Press the '#' key to begin transmitting at the new level.

As an example: to set the level to -6.5dBrn, just press '6', '5' then '#'. To enter -30.5dBrn, the keystrokes are 3, 0, 5 and #. While entering level, the '*' key can be used to toggle between positive and negative values. For example, a level of +3.8dBrn would be set by the keystrokes: 3, 8 and the '*', followed by '#' to enter.

Note: When not entering either a frequency or level, the '#' and '*' keys are used to raise and lower the frequency of the generated tone by the amount indicated in the STEP: display. If the step frequency displays 100Hz, then pressing the '#' or '*' will increase or decrease the tone frequency by 100Hz each time the button is pressed.

To change the step size of the tones:

Press the '4' key.

Use the numeric keys to enter the desired step size. Use the '*' key to lower the transmitted frequency one step each press. Use the '#' key to raise the transmitted frequency one step each press.

In the 2-wire terminated mode of operation, tone is transmitted only while in the XMT Freq and Level mode. Pressing the '1' key toggles to the

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RCV Level and Freq mode and turns off the transmitter. In the 4-wire terminated mode, tone generation continues after exiting the menu, allowing receiving measurements to be performed (such as frequency and level, noise, noise with tone, etc.) while transmitting a signal.

The following tests will terminate tone generation:

- 23-Tone Test
- Return Loss
- Caller ID analysis
- DVM function.

Use the ESC key to exit the tone generation mode.

To exit the tone generation menu:

Press the ESC or the Menu key.

Noise Measurements

The 704A-400 Series will monitor the circuit for excessive noise levels. The noise measurements available are:

- Weighted Noise
- Signal to Noise
- Noise with Tone (1010Hz Notch)
- Impulse Noise

To measure the circuit Noise Level:

Press the FILTER SELECT key until the desired filter is selected.

A comprehensive set of weighting filters are available for all noise measurements. The filters listed below are selected by pressing the FILTER SELECT key:

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- C-Message Noise
- 3 KHz
- 15 KHz Flat
- Prog-Weighted Noise
- 50 KHz Noise

To select another filter:

Press the FILTER SELECT key until the desired filter is displayed.

To measure noise, press the NOISE MEAS key repeatedly to step through the related noise measurements. For example, with the C-Message Noise filter selected, pressing the NOISE MEASURE key will step through C-Message Noise, C-Message Notched Noise, C-Message Signal to Noise and C-Notch Impulse Noise measurements. The measurement results are displayed on the LCD, for example:

```
"C-Message Noise    "
" 29.8 dBmC        "
"Press ESC to exit  "
```

Refer to the IMPULSE NOISE section for additional information on impulse noise measurements.

Impulse Noise – C-Notch and 50KHz

The three-level impulse noise test measures the occurrence of transient phenomena on the circuit under test. Transients of excessive level typically lead to data transmission errors. Impulse noise is a measurement of the component of the received noise which is much greater in amplitude than the normal peaks of the circuit noise. Typically, it is seen as short spikes or bursts of energy.

To select impulse noise testing:

Press the NOISE MEAS key until C-Notch Impulse Noise or 50KHz Impulse Noise is displayed.

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Next, to select the appropriate weighting filter:

Press the FILTER SELECT key until the desired filter is displayed. For 50KHz Impulse Noise, 50kHz should be displayed.

Impulse noise is measured by setting the lower threshold in dBm. The 704A-400 Series will set mid and high thresholds at +4 and +8 dB greater than the low level set. (The default low threshold is +68dBm). C and D message and 3 kHz impulse noise are generally measured with a 1KHz holding tone (set to data level) transmitted from the far end. For 50KHz Impulse Noise, set the threshold to 50.

To set the low threshold:

Press the '*' key to decrease the lower threshold.

Press the '#' key to increase the lower threshold.

Note: The level must be in the range of +30 to +90dBm at 600 ohms. For 50KHz Impulse Noise, set the threshold to 50.

To begin measuring impulse noise:

Press the '0' key to clear the elapsed timer and begin counting impulse events.

Testing begins immediately and continues until the ESC key is pressed.

C-Notch Impulse Noise results are displayed on the LCD as follows:

```
" 0 C-Notch Impulse Noise  "
" 0 HI 76 00:00:00      "
" 0 MID 72dBm 0=CLR    "
" 0 LOW 68 *=up, #=dwn  "
```

The numbers to the left indicate the Impulse counts for each of the three levels, and the numbers in the middle indicate the programmed thresholds. The display will be similar for the 50kHz Impulse Noise Test.

The Elapsed Time (ET) display is useful for keeping track of the length of time the test has been in progress.

Note: The auto power shut off is disabled during impulse noise testing. This is done to enable long term testing. It is recommended that external power be applied to avoid running the battery down completely and possibly losing test data.

To stop impulse noise testing:

Press the ESC key to stop testing.

The 704A-400 will return to the idle mode.

Peak/Average Ratio (PAR)

The Peak-to-Average (P/AR) test provides a quick measure of a circuit's data transmission capability. The P/AR test measures the effects of envelope delay distortion, bandwidth reduction, clipping, compression, and poor return loss (gain and/or phase ripples) on the data signal. P/AR is easier to interpret than envelope delay because the result is a single number rather than a curve.

The Transmitted P/AR test signal has a peak to average ratio and spectral content similar to a data signal. It is a complex waveform consisting of the sum of 16 non-harmonically related tones from 140 to 3890 Hz with a known envelope shape. The receiver filters the signal and measures the absolute peak and the full-wave rectified average value and displays the ratio of the two.

A P/AR value of 100 +/- 2 indicates that the signal has been received without distortion. Because the measurement reveals very little about the nature of the fault on the channel, the P/AR reading should be used as a relative indication of a circuit's performance. If poor circuit quality is indicated by a P/AR test, a more specific test such as envelope delay or inter-modulation distortion should be performed to isolate the cause.

To perform a P/AR test, the distant end must be sending the P/AR test signal at the circuit data level. Install the modular demarc cable or the Bantam cables to the appropriate test interface on the 704A-456.

To select Peak/Average Ratio testing:

Press the PAR key.

The received P/AR reading can be in the range of 30 to 140. If the received level is less than -45dBm, then the units display is blanked, indicating that the signal is out of the acceptable range of the detector.

The measured ratio and the received level will be displayed on the LCD:

```
"PAR: Peak/Avg Ratio    "
"      100 units        "
"rcvd level: -20dBm    "
"Press ESC to exit     "
```

The 704A-456 can also be used to transmit the P/AR test signal. It is transmitted at the fixed level of -6dBm. The signal is transmitted on either the 2W or the 4W interface as selected by the TERM key.

Note: The test set must be in a terminated configuration (135, 600, 900 or 1200 ohms) to enable the signal transmitter.

To begin transmitting the P/AR test signal in the 2-Wire mode:

Press the PAR key until TRASMIT PAR is displayed on the LCD.

The P/AR Select key will toggle between transmitting and receiving the P/AR test signal. In the 4-Wire mode, the P/AR signal generator and P/AR receiver are enabled simultaneously.

To end P/AR testing:

Press the ESC key.

Menu Operations

The menu key is used to access one of nine features of the 704A series:

- Programmed Tones
- Digit Analysis
- Caller ID
- Return Loss

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- Ring Generator
- Toggle LCD light
- Select Notch
- Responder Mode
- DTMF digits ABCD

To select the Menu function:

Press the MENU key once.

Verify the menu mode has been selected: the MENU LED is illuminated and the LCD displays:

```
"1 Programmed Tones    "
"2 Digit Analysis      "
"3 Caller ID Mode      "
"ESC=exit NEXT=more   "
```

The numeric keys 1, 2, and 3 are used to access the first three functions. The NEXT key displays functions 4, 5, and 6, and then 7, 8, and 9:

4. Return Loss: ERL, SRL-HI, SRL-LO
5. Ring Generator
6. Toggle LCD Back-light
7. Select Notch
8. Responder Mode
9. Generate DTMF Digits (A, B, C, D)

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Note: The test set must be in a terminated mode for proper operation of the signal generator circuitry.

To exit the Menu function:

Press the MENU key once,

or

Press the ESC key.

Menu: Programmed Tones

The Programmed Tones menu provides easy selection of preprogrammed tone sequences consisting of the following:

- Program Loop: test frequencies of 50 Hz, 100 Hz, 1 KHz, 5 KHz, 8 KHz, and 15 KHz.
- xDSL loop test frequencies of 28, 48, 82, 196, and 392KHz. (requires 100 or 135 ohms interface setting).
- 400Hz to 82 kHz sweep (requires 100 or 135 ohm interface setting).
- Three Tone Slopes of 404, 1004 and 2804Hz.

To select Programmed Tones:

Press the MENU key once.

Press the numeric '1' key.

The MENU LED will illuminate and the LCD will display the following choices:

```
"Programmed Tones.      "
"1 Program Loop         "
"2 xDSL tones           "
"ESC=exit NEXT=more    "
```

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Pressing the NEXT=more key advances to the additional choices of:

```
"Programmed Tones ..... "
"3 400Hz to 82 KHz ..... "
"4 3-Tone Slope .....   "
"ESC=exit NEXT=more ...  "
```

Press the numeric '1' key for Program Loop tones or numeric '2' key for xDSL tones.

Note: Frequencies above 25 KHz only available in 100 or 135 ohm interface.

The LCD displays the frequency and level being transmitted and the frequency choices.

To change the selected frequency:

Press the NEXT key.

Changing Level

The output level of Program Loop tones is fixed at 0dBm.

The output level of the xDSL tones tracks the level of the variable frequency generator. See the section on XMT Frequency and Level for setting the transmit xDSL levels.

To access the 400Hz to 82 kHz sweep:

Verify that the terminating impedance is set to 100 or 135 ohms. If not, press the ESC key to exit the MENU mode then press the TERM key repeatedly until the 4-wire 100 or 135 ohm LED is illuminated.

Select in sequence the MENU key, numeric key '1' – Programmed Tone, NEXT key and the numeric key '3' – 400Hz to 82KHz.

The LCD displays the following screen:

```
" 400Hz to 82KHz      "
"TX: 400Hz   +0.0dB   "
```

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```
" 400Hz to 82KHz      "
"ESC=exit  NEXT=more  "
```

Note 1: Repeatedly pressing the NEXT key will cause the transmitter to step through in sequence the following frequencies:

400Hz to 3200Hz in 200Hz steps; 4800Hz, 8000Hz, 28KHz, 32KHz, 36KHz, 48KHz, 80KHz and 82KHz.

Note 2: The output level of the transmitted frequency tracks the level of the variable frequency generator. See the section on XMT Frequency and Level for setting the transmit levels.

To stop Programmed Tones testing:

Press the ESC key to stop the testing.

The 704A-400 will return to the idle mode.

To access the Three-Tone Slope frequencies:

Select in sequence the MENU key, numeric key '1', the NEXT key and the numeric key '4'.

The LCD displays the following screen:

```
"3-TONE SLOPE      "
"1 404   3. *2804  "
"2 1004  4. 0dBm   "
"Press ESC to exit "
```

Note 1: Press the numeric key '1', '2' or '3' to select 404Hz, 1004Hz or 2804Hz respectively. The asterisk indicates the active tone 2804Hz in this case.

Note 2: Repeated presses of the numeric '4' key changes the transmitted level from 0, -10, -13 or -16dBm and QUIET (term).

To stop Programmed Tones testing:

Press the ESC key to stop the testing.

The 704A-400 will return to the idle mode.

The menu selection Digit Analysis provides a means to capture DTMF or MF digits when the 704A-400 is connected to a dry loop or when connected as a terminating device and the test set is in an off-hook condition. By capturing digits in an off-hook condition, the test set could be used to check a trouble report of a device such as an answering machine failing to respond to incoming digits. In this case, the answering machine goes off-hook and subsequently receives digits for functions such as playback, rewind, etc. DTMF, MF and Dial Pulse digits can also be similarly analyzed as part of the Signaling Test function when testing loop start, ground start and DID signaling arrangements.

The DTMF and MF analysis capability of the 704A-400 allows the user to capture digits as they are sent and perform detailed analysis on each tone of the tone pair. The 704A-400 captures digits with a duration as short as 35mSec, and has the capability of reporting the frequency and level of each tone of the captured digit. It measures the twist of the two tones, the time duration of the tone and the time interval between digits. Twist is defined as the level of the higher frequency tone relative to the lower frequency tone, expressed in dB. Twist is negative if the higher frequency tone level is below the lower frequency tone level.

Menu: Digit Analysis

To capture digits:

Connect the 2-wire line to the 2-wire input or the receive side of a 4-wire facility to the 4-wire receive jack.

Use the TERM key to select the correct interface setting of 2-wire or 4-wire and impedance.

Press the MENU key.

Press the numeric '2' key labeled XMT Freq Level.

The 704A-400 is in the DTMF tone capture mode as indicated on the LCD:

```
" DTMF MODE: Active  "
```

```
" Waiting for Tones...  "
"                        "
" ESC=exit. NEXT=more  "
```

Pressing the ESC key exits the Digit Analysis and Menu mode.

Pressing NEXT transfers to a similar screen for MF digit capture.

In this mode, each incoming digit is instantly tested for acceptance to within 3% of the standard DTMF or MF frequencies. If the digit's high and low tones are compliant, the LCD will display the received digit. Otherwise the LCD will display a question mark indicating that a digit was received, but either level, frequency or timing was out of spec. The faulty parameter can be viewed by using the DATA RESULTS or the TIMING RESULTS key. After receiving sixteen consecutive digits, the 704A-400 is no longer in the tone capture mode, and the DTMF test must be restarted in order to capture new digits.

See DATA RESULTS and TIMING RESULTS for more information.

Menu: Caller ID Analysis – On-Hook

The 704A-400 can be configured to perform advanced Caller Name & Number analysis for both On-hook and Off-Hook (CID-CW-Call Waiting) with Option 704A-OPTA1. In Caller ID mode, the user can analyze both the transmission and timing characteristics of incoming message deliveries.

Testing of the incoming call begins when the Caller ID mode is selected. In the On-hook Caller-ID mode, the 704A-400 monitors the line for RINGING. When RINGING is detected, the corresponding LED on the front panel illuminates providing a visual indication of the event. The RING signal is measured for time duration. Next, the 704A-400 monitors the line for CARRIER between the first and second RING. Subsequent data, including message type, length and checksum is measured and stored. The silent interval between the first and second ring is also measured and stored. C-MESSAGE noise is measured between the second and third rings. RING voltage is also measured and recorded.

The measured parameters of up to ten calls can be stored in the CXR-Halcyon 704A-400 memory and individually displayed for review. Processing begins when RINGING is detected.

To select the Caller ID function:

Press the MENU key.

Press the numeric '3' key.

The LCD will display: "CID On-hook: Active; Waiting for call", indicating that the test set is monitoring for RINGING event. Refer to the subsequent pages for information on Caller ID Off-hook and Caller ID analysis.

When a call is received with Caller ID information, the 704A-400 automatically stores the parameters of the On-hook transmission signal. The Call Progress states are displayed on the LCD as they occur. These states and the associated measurements are:

<u>DELIVERY STATE</u>	<u>MEASUREMENT</u>	<u>SPECIFICATION</u>
1st RING.....	ring duration.....	0.2 to 2.2 seconds
WAITING FOR CARRIER.....	ring to carrier interval.....	0.5 to 2.9 seconds
CARRIER DETECTED.....	measure carrier level.....	-12 to -36 dBm
MESSAGE RECEIVED.....	carrier to data interval.....	390 to 409 mSeconds
2nd RING.....	1st silent interval.....	3.6 to 4.4 seconds
MEASURING C-MSG NOISE.....	noise (2nd silent interval).....	< 45 dBmnc
3rd RING.....	measure ringing voltage.....	40 to 140 Vrms

After the 3rd ring the 704A-400 will briefly display the received NUMBER (or number & name) and determine whether the delivery parameters and timing were within spec. If one or more of the parameters was found to be out of spec, the LCD will display the first bad parameter encountered. After this brief summary, the unit will return to the "ready to receive a call" mode of operation. If the user wishes to review or compare the

parameters, the DATA RESULTS and TIMING RESULTS keys can be used to step through the results.

Note: If calls are received on lines which do not support Caller ID, then the 704A-400 will not detect carrier and the LCD will display: "TRANSMISSION INCOMPLETE" followed by "NO CARRIER DETECTED".

Continue to the subsequent pages for information on using the DATA RESULTS and TIMING RESULTS keys.

Menu: Caller ID Analysis – On-Hook (Call Waiting)

The 704A-400 can be configured with an option to perform advanced Caller Name & Number analysis for both On-hook and Off-hook (CID-CW-Call Waiting). In CALLER ID mode, the user can analyze both the transmission and timing characteristics of incoming message deliveries.

Note 1: For reception of Caller ID Off-hook/Call Waiting, the circuit must be configured for Caller ID, Call-Waiting and Caller-ID with Call Waiting services.

Note 2: To test Caller-ID Off-hook (or Call Waiting) the 704A-400 TIMS set must be terminating the line and in the Off-hook state (from a previously established call). When the TIMS is OFF-hook the ON/OFF-HOOK LED is illuminated.

To ensure proper operation the 704A-400 must be the only Caller ID-Call Waiting unit on the circuit.

Testing of the incoming call begins when the unit is Off-hook and the Caller ID mode is selected. In this mode, the 704A-400 monitors the line for the Subscriber Alerting Sequence (SAS) or the CPE Alerting Sequence (CAS). When CAS is detected, the Caller ID Off-hook message delivery is processed, stored and analyzed. The measured parameters for up to ten calls can be stored in the 704A-400 memory and individually displayed for review.

TO select the Caller ID Off-hook function:

Press the MENU key.

Press the numeric '3' key.

The LCD will display: "CIDCW Off-hk: Active; Waiting for Call.." indicating the test set is monitoring for the SAS or CAS. The Caller ID OFF-hook Analysis is displayed on the next page.

Menu: Caller ID Analysis – Off-Hook

When a call is received with the Caller ID information, The 704A-400 automatically stores the parameters of the OFF-hook transmission signal.

The Call progress states are displayed on the LCD as they occur. These states and the associated measurements are:

<u>DELIVERY STATE</u>	<u>MEASUREMENT</u>	<u>SPECIFICATION</u>
SAS (if provided)	SAS Frequency	440Hz
CAS	CAS duration	250 to 400 mSeconds
ACK (Generated by 704A-400)	CAS to ACK interval	< 100 mSeconds
Waiting for Data	ACK to MARK interval	0 to 500 mSeconds
MARK DETECTED	measure FSK level	-12 to 36 dBm
MESSAGE RECEIVED	carrier to data interval	390 to 409 mSeconds

After the message is received the 704A-400 will briefly display the received Number (or number and name) and determine whether the delivery parameters and timing were within spec. If one or more of the parameters was found to be out of spec, the LCD will display the first bad parameter encountered. After this brief summary, the unit will return to the "ready to receive a call" mode of operation. If the user wishes to review or compare the parameters, the DATA RESULTS and TIMING RESULTS keys can be used to step through the results.

Note: If calls are received on lines which do not support Caller ID, Call Waiting and Caller ID with Call Waiting, then the 704A-400 will not detect CAS and the LCD will display: "TRANSMISSION INCOMPLETE" followed by "CAS: Cust Alert Seq", "OUT of SPEC" (invalid or no CAS transmitted by switch and detected by the 704A-400 TIMS).

Continue to the subsequent pages for information on using the DATA RESULTS and TIMING RESULTS keys.

Menu: CID Data Results

The DATA RESULTS key is used to display the data parameters of any received CND/CNAM message. There are three data result screens for Caller Number and Caller Name deliveries. Caller Name deliveries provide an additional result screen consisting of the received Parameters

details. The DATA RESULTS available are:

- Message Details.....Message Type, Length and Checksum
- Message Contents.....Date and Time, Number and Name
- Parameter Details.....Parameter Types and Sequence
- RAW Data.....Received Raw Message in Hex format

The 704A-400 must first be in the Caller ID mode for the results to be displayed.

To review the CID Message Details:

Press the DATA RESULTS key.

The most recent call data is displayed on the LCD:

```
" Message: 3 of 3      "
" MSG TYPE: 04H (CND)  "
" MSG LEN: 18 chars    "
" CHECKSUM PASS: 37 hex "
```

Note: If the received checksum does not match the calculated, the last line will be displayed as: "CKSUM RCV:XX CALC:XX"

Caller ID utilizes single message format which is message type 04H (Hex), while CNAME utilizes multiple data message format, type 08H.

To review the CID Message Contents:

Press the DATA RESULTS key again.

The LCD will display the caller number, date, time, and caller name (if applicable) of the most recent call.

To review the CID-NAME Parameter Types and Sequence:

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Press the DATA RESULTS key again.

The most recent call parameter data is displayed on the LCD:

```
" PARAMETER TYPES:    "
" RCVD: 01, 02, 07    "
" SPED: 01, 02/04, 07/08 "
```

To review the CID RAW Data:

Press the DATA RESULTS key again.

The RAW data for the selected message is displayed on the LCD:

```
" Message: 3 of 3      "
" [ 001 ] 80 37 01 08 30 "
" 37 35 34 32 30 31 36  "
" '8' = MORE ESC=exit  "
```

The starting data number is displayed in the brackets (e.g. 1=80, 2=37).

To step through the CID RAW Data:

Press the numeric '8' key.

To review or compare data results of stored calls:

Press the NEXT key.

Each key press displays the previous stored message (up to 10 stored messages and results)

The TIMING RESULTS key is used to review the time interval of each of the states of a received CID event. Ring duration, ring to carrier, carrier to data, and ringing silent interval are the four timing intervals measured. Carrier level (in dBm), ring voltage (3rd ring), and the silent interval C-Message noise (during the second silent interval) are also measured. Data for up to ten calls is available for comparative analysis.

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To review the CID timing parameters:

Press the TIMING RESULTS key until the desired parameter is displayed.

The first measured parameter, RING DURATION, is displayed along with its specification. Each subsequent press of the TIMING RESULTS key displays the measured values of the remaining six parameters. The associated specification and a PASS/FAIL indicator is also included.

To review the timing information of a previous call:

Press the NEXT key until the desired message # is displayed.

Each time the NEXT key is pressed, the unit displays the previous call, and the LCD indicates the message number accessed. To exit the data of timing results menu, press the ESC key.

To exit the Caller ID function:

Press the ESC key.

The 704A-400 will now be in the idle condition. Continue on to other transmission tests, or to the Advanced DTMF analysis section.

Menu: Return Loss: ERL, SRL-Hi, SRL-LO

The return loss test is used to measure the impedance match between the circuit under test and a standard termination. It is the ratio of the transmitted power to the reflected power expressed in decibels. If the impedance mismatch of the circuit is high, as indicated by a low return loss reading, the excessive reflected power could lead to undesirable echoes and a "tunnel-like" sound to the listener. Poor return loss can also lead to distortion of data signals resulting in bit errors on data channels.

Return Loss is divided into three bands: Echo Return Loss (ERL), and Singing Return Loss High (SRL-HI) and Low (SRL-LO). The frequency range of the transmitted ERL signal covers the mid-range voice frequencies (560-1965Hz) while the LO and HI SRL signals allow return loss to be assessed on the upper and lower portion of the voice band.

To select 2-wire return loss testing:

Press the MENU key

Press the NEXT key

Press the numeric '4' key labeled NOISE MEAS

Note: The unit must be terminated in the correct circuit 2-wire impedance of 600, 900 or 1200 ohms for proper 2-wire Return Loss operation.

The 704A-400 Series responds by displaying the return loss results screen on the LCD and begins transmitting the ERL band signals on the selected interface port. The LCD will show the following received levels:

```
" * ERL: -0.1 dB      "
" SRL -HI: --- dB    "
"SRL -LO: --- dB     "
" ESC=exit '#=next  "
```

The asterisk (*) next to ERL indicates that the 704A-400 series is currently transmitting the ERL band of frequencies.

Note: A reading of nearly 0dB indicates either a shorted or open condition on the line.

The ERL reading is continuously updated until one of the SRL bands are selected.

Each press of the NEXT key will cycle through the three return loss readings.

When testing 4-wire loss, it is often desirable to zero the initial return loss reading with the circuit unterminated. A relative return loss test can then be performed which will subtract the effects of insertion loss or hybrid losses. The '#' key can be used (only during 4-wire ERL testing) to zero out the display and make relative return loss measurements.

To select the SRL-HI or SRL-LO band:

Press the '#' key until the asterisk (*) is next to the SRL-HI or SRL-LO line on the LCD.

Note: The previous reading is now frozen on the display, and the SRL-HI reading is being updated. This will continue until another key is pressed.

To end RETURN LOSS testing:

Press the ESC key to stop testing.

Note: It is imperative when testing 4-Wire Loss that the 704A-400 be both the signal source and the receiver, as the technique uses a unique filtered signal source applied to the line for testing each of the three return loss bands.

Menu: Ring Generator

The 704A-400 when equipped with the Ring Generator option provides a REN 3 equivalent ringing output. The ring generator function is used when emulating a Loop Start CO or Ground Start CO to signal (ring) the terminal end. Follow the steps outlined in the SIGNALING TEST section for setting up these interfaces. An Off-Premise Extension can also be signaled by selecting the CO emulation mode and ringing the station end (OPX/OPS).

To access the ring generator function:

Press the MENU key.

Press the numeric '5' key labeled FILTER SELECT.

The LCD screen displays the following:

```
" RING GENERATOR  "  
" 1 Auto Ring      "  
" 2 Manual Ring    "  
" ESC = exit       "
```

The Auto Ring selection provides an automatic four seconds of ring followed by two seconds of quiet. The ringing output will be terminated by the called end going off-hook and tripping the ring or by pressing the ESC key.

To send an Auto Ring:

Press the numeric '1' key labeled RCV Freq Level.

The Manual Ring selection provides a continuous ring which persists until the called end goes off-hook or until terminated by pressing the ESC key.

To send a Manual Ring:

Press the numeric '2' key labeled MANUAL RING.

To stop Manual Ring:

Press the ESC key.

Menu: Toggle LCD BACK-Light

To toggle the LCD back-light On or Off:

Press the MENU key.

Press the NEXT key.

Repeated presses of the '6' key will toggle the back-light between on and off states.

Press the ESC key to exit the Menu mode.

Menu: Select Notch

Measurement of noise with tone present requires that the tone be "notched" out by a notch filter. Two filters are provided, a 1010 Hz and an 825 Hz filter (CCITT version only). The 1010 Hz notch filter is the default.

To select a default notch filter:

Press the MENU key.

Press the numeric '7' key.

The LCD displays:

```
" Select NOTCH Filter      "
"1 1010 Hz*                "
"2 825 Hz (CCITT version ONLY) "
```

The asterisk (*) indicates that the 1010 Hz notch filter is selected.

Pressing the '2' key selects the 825 Hz notch filter (CCITT version only).

Menu: Responder Mode

The 704A-400 can be configured to perform as a Code 105 Near End Responder or as a 110 Far End Responder test line.

105 Near End Responder:

Operating as the 105 Near End Responder device, the 704A-400 is connected to a 2-wire dial tone line and user-programmed to dial a 105 Far End Responder device. The 105 Far End device may be installed at a tandem, end-office switch or as a station off of a PBX and serves as an automatic, unattended test termination for incoming calls from the 704A-400 setup as the 105 Near End Responder. The combination of the 105 Near and Far devices typically provides the following 2-way testing sequence displayed as Near (near to far measurement) and Far (far to near measurement):

- Loss @ 1004 Hz using a 0dBm test tone
- Loss @ 1004 Hz using a - 16dBm test tone
- Slope @ 404 Hz using a - 16dBm test tone
- Slope @ 2804 Hz using a - 16dBm test tone
- C-Message Idle Noise
- C-Notched Noise with a 1004Hz holding tone

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- Echo Return Loss
- Singing Return Loss Hi
- Singing Return Loss Lo

Note: Some 105 Far End Responders measure ERL, SRL-HI and SRL-LO in the Near direction only. If so, the 704A-400 can only measure the Near direction and will display a -40 dB ERL in the non-measured direction.

To operate the 704A-400 as the 105 Near End Responder:

Press the MENU key.

Press the numeric '8' key labeled LOAD COIL.

The LCD will display

```
" Responder Mode  "
" 1 105 NER Mode  "
" 2 110 FER Mode  "
```

Pressing the numeric key '1' displays the next LCD screen:

```
" CIRCUIT - 105 TEST  "
" Generate: DTMF      "
" PH#                 "
" OffHk = send  ESC=exit  "
```

Using the keypad, enter the telephone number assigned to the 105 far end responder and press the OFF/ON HOOK key to dial out (pressing the ESC key will clear any digits entered). The 704A-400 will dial the far end device and display a message Wait for DIAL-TONE: 0. If TPT is not received in 20 seconds or less, the test will be suspended. Upon receipt of the 2225 Hz TPT tone, the 704A-400 begins the two-way measuring

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sequence. The Near and Far data as listed above will be displayed in five screens observed by pressing the NEXT key.

To exit the 105 Near End Mode, press the ESC key.

110 Far End Responder Mode

When configured as a 110 Far End Test line, the 704A-400 provides a remote DTMF controlled transmission impairment tone source. The 704A-400 is connected to a 2-wire dial tone line and configured as a 110 Far End Test Line device. The 704A-400 will answer an incoming call and respond with the Code 102 sequence: a 1004Hz test tone at 0dBm, on for 10 seconds and quiet for 5 seconds until changed or the call is terminated. The output of the 704A-400 110 Far End Test Line can be changed by sending one of the following DTMF commands during the quiet interval:

Digit	Signal	Description
1	Code 100	Quiet Termination for 20 seconds
2	Code 102	Interrupted milliwatt for 5 min. @ 0dBm
3	Slope	404, 1004, 2804 for 5 sec. each; up/down twice
4	Slope/4	404, 1004, 2504, 3204 for 5 sec. each; up/down twice
5	Sweep	18 tones for 5 sec. each; up/down twice
6	1004Hz	Continuous tone for 17 minutes
7	Loopback	2713Hz analog loopback tone for 5 seconds
8	Tone	2863 Hz for 5 seconds
9	Tone	2913 Hz for 5 seconds
0	Set Lvl	Sets tone transmit level to 0dBm
*	Set Lvl	Sets tone transmit level to 16dBm
#	On-Hook	Disconnects the 704A-400

To operate the 704A-400 in the 110 Far End Responder mode:

Connect the 2-wire dial tone line to the modular or 2-wire bantam connector

Press the MENU key.

Press the numeric '8' key to advance to the RESPONDER menu.

Press the numeric '2' key to select 110 FER Mode.

The 704A-400 is now set up and waiting for an incoming ring and will respond by displaying the following message on the LCD:

```
"110 FER Mode:  "
"Waiting for RING  "
"Press ESC to exit  "
```

To exit the 110 Far End Responder mode:

Press the ESC key.

Menu: Generate DTMF Digits (A, B, C, D)

The DTMF characters A, B, C and D are accessible through the use of the DTMF menu function.

To select the DTMF digits: ABCD

Press the MENU key once.

Press NEXT key twice.

Press the numeric '9' key

The 704A-400 will respond by displaying the following message on the LCD:

```
" GENERATE DTMF DIGITS  "
" 1...'A'    3 'C'      "
" 2...'B'    4 'D'      "
" Press ESC to exit      "
```

Pressing one of the four numeric keys (1-4) will cause the 704A-400 to immediately transmit the desired DTMF character to the selected interface. There is no limit on how many characters can be sent in the DTMF character mode.

Note: The test set must be in terminated mode (600, 900 or 1200 ohms) for the transmitter to be enabled.

To exit the DTMF Generation function (or any other MENU function):

Press the ESC key

Load Coil Detect

DSL – Digital Subscriber Line services such as DDS, BRI ISDN, HDSL and ADSL require copper facilities free of load coils. The 704A-400 tests for the presence of load coils by sweeping the 2-wire pair and indicating how many load coils were detected. When the LOAD COIL test key is pressed, the 704A-400 will automatically switch to a 2-wire, 900 ohm interface and sweep the tip/ring conductors connected to the 2-wire interface. To test both pairs of a 4-wire facility simply connect one of the pairs to the 2-wire interface and test, then connect and test the other pair. The 704A-400 can identify the presence of a total of five load coils.

To test for Load Coils:

Press the LOAD COIL key.

The CXR Halcyon will automatically switch to the 2-wire, 900 ohm interface and sweep the pair connected to this interface. The LCD will display:

```
" Load Coil Detection  "
" Coils Detected:      "
" Press ESC to exit   "
```

The LCD screen will indicate '0', '1', '2' etc. load coils.

To repeat the test press the ESC key and press the LOAD COIL test key again.

Press the ESC key to exit the Load Coil test. The CXR Halcyon will automatically return to the originally selected interface termination.

Phase Jitter

This test measures the cumulative effect of phase modulation by repeaters or other active equipment and additive tones or noise on the phase oscillations of a 1004kHz pure tone.

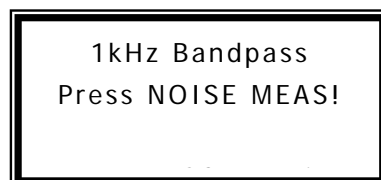
Jitter is the difference between the smallest to the largest peak-to-peak measurement on the normal curve. This value tends to increase with the number of samples taken. Phase jitter is only meaningful when accompanied by frequency and signal to noise ratio measurements, and only applicable on a 2- or 4-wire 600 ohm termination. To recover only the meaningful sinusoidal phase modulation produced by induced 20- or 60Hz, and strip away other interference, a 700Hz highpass 1300Hz lowpass filter is employed.

IEEE Std 743-1995 specifies that phase jitter is expressed in degrees, where 360 degrees is a full cycle of the 1004Hz tone. A measurement is taken of the longest cycle and the shortest cycle (peak-to-peak) during each 1-second display update interval. It is then a simple matter to divide the time difference between the two measurements by the average cycle time (based on frequency measured) and multiply the result by 360 to obtain the display value for phase jitter.

The set will display phase jitter from 0 degrees to 25 degrees. However, if the input signal level falls outside the range of -40dBm to +10dBm then the message *Tone Loss* replaces the jitter measurement on the screen.

To navigate to perform the phase jitter measurement, first select a termination of 600 ohms, 2- or 4-wire.

Assuming you are using the test set to produce the 1004Hz tone needed to test the phase jitter, press the *XMT Freq Level* button and choose 1004Hz, +0.0dBm. Press the *FILTER SELECT* button to cycle until the display shows as follows. Note that this selection only appears in the case



of 600 ohm, 2- or 4-wire. The 700Hz-1300Hz filter is engaged.

Press the **NOISE MEAS** button to view the measurement screen. This applies the standard (STD) frequency weighting band of 20Hz to 300Hz.

```

Phase Jitter STD
0.5° S/TD +47.5dB
TONE 1004Hz -0.8dBm
  
```

Press the **NOISE MEAS** button again change the measurement screen. This applies the low frequency (LF) weighting band of 4Hz to 300Hz.

```

Phase Jitter STD+LF
0.7° S/TD +47.5dB
TONE 1004Hz -0.8dBm
  
```

Note that from these Phase Jitter measurement screens you can press the **XMT Freq Level** button and change the frequency or level of the transmitted signal then return (Button 1) to view the results.

Transient Counts – Hits, Drops, and Impulse Counts

This screen counts phase hits, gain hits, and dropouts on an applied 1004kHz pure tone. Testing is made on a 2- or 4-wire 600 ohm termination. To ensure that hit counters have protection against low-frequency noise and noise at the upper end of the voice band, the C-Message filter is employed.

Phase Hits are counted every time three peak-to-peak intervals in a row (or two 15 degrees or more above the threshold) are off by a configurable

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5 to 45 degree threshold and do not return inside the limits for four cycles. Maximum 1 count every 125mS, with the timer starting when threshold first crossed.

Gain Hits are counted every time received tone levels are off by a configurable 2 to 10 dB threshold from the average level for 3.5mS (or 2.5mS if 4dB or more above the threshold) and return back inside the limits after 4.5mS. Loop recovery: If after 4.5mS the level does not return inside the limits, and if a net 4dB or more in either direction is measured 200mS after the level first went out of range, a 2dB hit is counted. If the threshold level was triggered but the level never dropped back within limits for 600mS, the potential hit is cleared and the new base level is established. Maximum 1 count every 125mS.

Dropouts are counted when the level falls 12dB for more than 4.5 mS. Maximum 1 count every second.

Three Impulse Noise Counts are specified at 4dB separation. The lowest threshold defaults to 68dBm, and is configurable in 1dB steps. Maximum 1 count every 125mS. If the input signal level falls outside the range of -40dBm to +10dBm then the message *Tone Loss* replaces the measurements on the screen.

To navigate to the tests, first select a termination of 600 ohms, 2- or 4-wire.

Assuming you are using the test set to produce the 1004Hz tone, press the **XMT Freq Level** button and choose 1004Hz, and the desired amplitude. Press the **FILTER SELECT** button to cycle until the display shows as follows.

```

C-Message Noise
Press NOISE MEAS!

Press ESC to exit
  
```

```

Impulse Nse 00:06:57
0 HI 76 * =EDIT
45 MID 72dBm 0 =CLR
123 LO 68 # =NEXT
  
```

Press the **NOISE MEAS** button three times to cycle to view the Impulse Noise panel. The zero button clears the counts and resets the timer, the **# NEXT** button switches to view the Transient Counts, and the *** DATA** button takes you to a screen to edit the Impulse thresholds and test duration.

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Transient counts panel. The **# NEXT** button switches back to view the Impulse Counts, and the *** DATA** button takes you to a screen to edit the threshold levels for phase and gain hits.

```

Transients 00:06:59
456 Phase Hits 10° *
123 Gain Hits 4dB 0=C
098 Dropouts # =NEXT
  
```

```

Transients EDIT
1..Phase Hits 15°
2..Gain Hits 4dB # =
3..Fast Count No OK
  
```

Pressing the *** DATA** button enables editing of the threshold levels for phase and gain hits. Fast Count can be enabled to bypass 125mS or 1second limits on counters. Simply press 1, 2 or 3 to cycle each setting to the desired value.

Pressing the **# NEXT** button exits editing of the threshold levels. After exiting the edit mode, the counts return to zero and the timer is reset.

```

Transients 00:00:00
0 Phase Hits 15° *
0 Gain Hits 4dB 0=C
0 Dropouts # =NEXT
  
```

```

Impulse Nse 00:00:04
0 HI 76 * =EDIT
0 MID 72dBn 0=CLR
2 LO 68 # =NEXT
  
```

To switch to Impulse Noise panel, press the **# NEXT** button .

Pressing the *** DATA** button enables editing of the Impulse Noise threshold. Press 1 or 2 to specify a value to change.

Pressing the '1' key changes the display context to edit the leastmost threshold level. Type in desired value in decibels using numeric keypad, then the **# NEXT** button to continue.

```

Impulse EDIT
1..Lo Thresh 68dBn
2..Test Len 0h 15m
# =OK
  
```

```

Impulse EDIT
1..Lo Thresh 0dBn

Press # to Enter
  
```

Pressing the '2' key changes the display context to edit the duration of the timed test. Type in desired value in hours and minutes using numeric keypad, then the **# NEXT** button to continue. If 0h 0m is specified, the test will run continuously, instead of suspending when the entered time is reached.

```

Impulse EDIT

2..Test Len 0h 0m
Press # to Enter
  
```

SIGNALING TEST FEATURES (OPTION A)

The SIGNALING TEST key is used to access the Loop Start, Ground Start, Direct Inward Dial (DID) and E&M metallic signaling test features of a 704A-400 equipped with the corresponding Signaling Option (Option A). The 704A-400 signaling option (Option A) provides the ability to emulate the network or terminal interface of these signaling types:

- LOOP START – Emulate a Station
- LOOP START – Emulate a Central Office
- GROUND START – Emulate a Station
- GROUND START – Emulate a Central Office
- DIRECT INWARD DIAL – Emulate a PBX
- DIRECT INWARD DIAL – Emulate a Central Office
- E&M Types I – V – Emulate a Trunk Circuit
- E&M Types I – V – Emulate a Signaling Circuit

The operation of the 704A-400 for each of these signaling interface types is described on the following pages.

Signaling Test: Loop Start

Signaling Test: Loop Start – Emulate a Station

In the station emulation mode the 704A-400 will:

- Terminate a 2-wire loop in 600, 900, or 1200 ohms via the modular or 2-wire bantam jack. (These connections are in parallel)
- Generate an audible incoming ring signal.

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- Answer an incoming call by going Off-Hook.
- Originate a call by going Off-Hook and dialing out.
- Provide DTMF, MF or Dial Pulse out-dial capability.
- Indicate Tip/Ring battery reversal.

To operate the 704A-400 in the Station Emulation mode:

Press the Signaling TEST key.

Press the numeric '2' key to select LS (Local Station) mode.

Press the numeric '1' key to select EMULATE: Station.

Press the NEXT key

Press the numeric '1', '2' or '3' key to select the digit type (MF, DTMF, or DIAL-PULSE).

Press the ESC key

The CXR HALCYON 704A-400 LCD screen will display:

```
" LS – STA: DTMF – IMM      "
" 'DIAL' to enter ph#      "
```

Note: On an incoming call, the ringing signal will be heard in the 704A-400 speaker and the RING LED will flash on when the ringing voltage is present and off during the ringing quiet period. The typical ring is 4 seconds of ringing followed by two seconds of quiet.

To answer an incoming call:

Go Off-Hook by pressing the OFF/ON HOOK key.

Going off-hook closes the loop and trips (stops) the ringing. To talk over the 2-wire circuit connect a butt-set to the parallel modular jack.

Note: Since the bantam and modular jacks are in parallel, if both are off-hook at the same time the circuit will be double terminated.

To place an out-going call:

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Press the DIAL key.

The 704A-400 LCD screen will display:

```
" GENERATE:  DTMF      "
" ph#>          "
"Off-Hook = send  ESC=exit  "
```

Enter the telephone number to be dialed using the keypad keys.

Press the OFF/ON HOOK key to send the displayed digits.

Once the call is established the transmission characteristics of the circuit can be tested by selecting the level and frequency, noise, 23 tone, etc. tests. Typically, from the station test mode, calls are placed to a QUIET TERM or Milliwatt test line available in most switches.

To perform transmission tests once the call is established:

Press the ESC key.

Press the key corresponding to the desired test

Note: To exit the signaling test function it is necessary to return to the SIGNALING TESTS selection menu and select EXIT SIGNALING.

Press the Signaling TEST key

Press the numeric '5' key

Signaling Test: Loop Start – Emulate a Central Office (CO)

In the Central Office emulation mode the 704A-400 provides the following:

- Applies negative battery on the Ring and positive on the Tip conductor.
- Displays Received Digits.

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- Analyzes Received Digit parameters.
- Provides Ringing generator.

To operate the 704A-400 in the CO emulation mode:

Press the Signaling TEST key.

Press the numeric '2' key to select LS mode.

Press the numeric '2' key to enter EMULATE CO mode.

Press the NEXT key.

Press the numeric '2' key to select DTMF (or 1 for MF, or 3 for DIAL-PULSE).

Press the ESC key.

The 704A-400 LCD screen will display:

```
" LS – CO: DTMF – IMM  "
" STATION: ON-HOOK    "
" Waiting for OFF-HOOK  "
```

When the station goes off-hook, the Remote Off-hook LED will illuminate and the screen will display:

```
" DTMF MODE: Active    "
"Waiting for Tones     "
" ESC=exit Next = more "
```

Upon receipt of the dialed digits the screen will display:

```
" DTMF Mode: Active    "
" 123456789           "
```

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" Press ESC to exit "

Press the OFF/ON HOOK key to simulate a far-end answer.

Note: Up to 15 received digits can be displayed. The DTMF receiver will remain active for 65 seconds following receipt of the first digit. This allows trapping extra digits dialed after the address such as extension numbers., pager numbers., etc. The parameters of the received digits can be analyzed by selecting the DATA RESULTS and the TIMING RESULTS keys. (Refer to DIGIT ANALYSIS: DATA and TIMING RESULTS section.)

To exit the signaling test function it is necessary to return to the SIGNALING TESTS selection menu and select 5 (EXIT SIGNALING).

Press the Signaling TEST key.

Press the numeric '5' key

Signaling Test: Ground Start

Signaling Test: Ground Start – Emulate a Station

Ground start signaling is typically used on 1 or 2 way PBX to Central Office facilities with Direct Outward Dialing (DOD) and attendant handling of incoming calls. A call originating from a Ground Start Station starts by the Station first checking to see that the tip conductor is not grounded. A grounded tip would indicate an incoming call from the CO and blocks an outgoing call attempt by the station. If the tip is not grounded, the station grounds the ring conductor. Since the CO typically provides negative battery on the ring-to-ground (conventional battery), current will flow in the ring conductor. The CO detects the ring conductor current flow and grounds the tip toward the station (conventional battery) or connects office battery across the tip (+) and ring (-) for floating battery. The station detects the tip ground or battery across the tip and ring, removes its ring ground, closes the loop and sends the digits. A ground start circuit is only a ground start during the call setup process, and operates as a loop start circuit when the station removes the ring ground.

Note: The 704A-400 must be grounded by connecting a ground to the top panel ground post to assure an adequate ground exists when the ring conductor is grounded.

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To operate the 704A-400 as a GROUND START STATION:

Press the Signaling TEST key.

Press the numeric '3' key to select Ground Start (GS) mode.

Press the numeric '1' key to select EMULATE Station mode.

Press the NEXT key.

Press the numeric '1', '2', or '3' to select the digit type.

Press the ESC key

The CXR HALCYON 704A-400 LCD screen will display:

" GS – STA: DTMF – IMM "

" DIAL' to enter ph# "

Note: On a ground start circuit, the CO signals the station by grounding the tip and may or may not also apply ringing voltage. On an incoming call, the ringing signal, if present, will be heard in the 704A-400 speaker and the RING-indicating LED will flash on when the ringing voltage is present and off during the ringing quiet period. The typical ring is 4 seconds of ringing followed by two seconds of quiet.

On an incoming call the CXR Halcyon LCD will display:

" GS – STA: DTMF – IMM "

" CO: TIP – GRD DETECTED "

The Remote off-hook LED will light indicating an off-hook from the Central Office.

To answer an incoming call:

Go Off-Hook by pressing the OFF/ON HOOK key.

Going off-hook closes the loop and provides answer supervision to the far end and trips (stops) the ringing (if present).

To talk over the 2-wire circuit, connect a butt-set to the parallel modular jack.

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Note: Since the bantam and modular jacks are in parallel, if both are off-hook at the same time the circuit will be double terminated.

To place an out-going call:

The 704A-400 LCD screen will display:

```
" GS – STA: DTMF – IMM  "
" Dial' to enter ph#    "
```

Press the DIAL key.

The 704A-400 LCD display:

```
" GENERATE: DTMF      "
"ph#>                "
" Off-Hook = send ESC=exit  "
```

Enter the telephone number to be dialed (max 15 digits) using the keypad keys Press the OFF/ON HOOK key to send the displayed digits.

The 704A-400 also measures the transition time from the application of ring ground to the detection of tip ground.

Press the TIMING RESULTS key to obtain this measurement.

Note: To exit the signaling test function it is necessary to return to the SIGNALING TESTS selection menu and select EXIT SIGNALING.

Press the SIGNALING TEST key.

Press the numeric '5' key to exit the Signaling Test mode.

Signaling Test: Ground Start – Emulate a Central Office (CO)

In the Central Office emulation mode the 704A-400 provides the following:

- Negative battery on the Ring conductor.
- Ground on the Tip conductor to originate a call.

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- Display of Received Digits.
- Analysis parameters of Received Digits.
- Ringing generator.

To operate the 704A-400 in the CO emulation mode:

Press the Signaling TEST key.

Press the numeric '3' key to select Ground Start (GS) test mode.

Press the numeric '2' key to select CO emulation.

Press the NEXT key.

Press the numeric '1', '2', or '3' key to select the desired digit type

Press the ESC key.

The 704A-400 LCD screen will display:

```
" GS – CO DTMF – IMM  "
" STATION: ON-HOOK    "
"Waiting for OFF-HOOK  "
```

When the station goes off-hook, the Remote Off-hook LED will light and the screen will display:

```
"DTMF MODE: Active  "
"Waiting for Tones   "
"ESC=exit Next=more  "
```

Upon receipt of the dialed digits the screen will display:

```
" DTMF Mode: Active  "
" 123456789         "
```

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" Press ESC to exit "

Note: The parameters of the received digits can be analyzed by selecting the DATA RESULTS and the TIMING RESULTS key. (Refer to the section "DIGIT ANALYSIS: DATA and TIMING RESULTS.")

Note: To exit the signaling test function it is necessary to return to the SIGNALING TESTS selection menu and select EXIT SIGNALING.

Press the Signaling TEST key.

Press the numeric '5' key.

Signaling Test: Direct Inward Dial – (DID)

DID trunks provide direct dial-in access to PBX stations on calls originated from the public switched network. The 704A-400 equipped with the Network Analysis & Signaling Option (Option A) can be used to test and evaluate the timing and signaling of circuits employing this technique of trunk access. DID trunks are used for one-way incoming service, allowing a caller in the public switched telephone network to directly dial a particular PBX extension without operator intervention. E911 service is an example of a widely deployed DID application.

Direct inward dialing requires transmission of address signals from the network (CO) to the station equipment (PBX). Either immediate or wink start supervisory control of address signals can be utilized depending on the serving switching office. In addition, loop reverse battery signaling is used to indicate station side on-hook or off-hook status. The addressing is typically sent by either DIAL PULSING, DTMF or by MF tone transmission.

In a typical DID line, the PBX supplies the loop current, with tip at ground and ring at negative battery indicating an idle or on-hook condition. When the switching office desires to access the DID line it goes off-hook by drawing loop current from the PBX's battery supply. In circuits employing wink start supervision, the CO waits for a "wink" signal from the station equipment before sending the addressing digits. The wink is provided by the PBX by momentarily reversing the polarity of the battery feed. In a valid wink, ring is at ground and tip is at negative battery for 250 milliseconds +/- 50 milliseconds. The time between the CO going off-hook and the wink is known as the pre-wink time. In immediate dial

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supervision, the central office begins its transmission of addressing after a brief delay, without any PBX side acknowledgement. Completion of the call is made when the PBX goes OFF-HOOK by reversing its battery feed.

The 704A-400 can be used to emulate either end (CO or PBX) of a DID circuit. CO emulation (also known as Direct Outward Dialing – or DOD) can accommodate both wink start and immediate dial circuits. When the PBX emulation mode is selected an on board battery feed is switched onto the 2-wire line. This battery feed is current limited to 24Ma and can accommodate loops up to 3600 ohms, including the station equipment. A comprehensive evaluation of the supervisory signals (PREWINK, WINK, POSTWINK and ANSWER DELAY) as well as the addressing (dial pulse, DTMF or MF) is captured and displayed as an aid to troubleshooting DID circuits

Signaling Test: Direct Inward Dial (DID) Setup.

To enter the DID mode setup:

Press the Signaling TEST key.

Press the numeric '1' key.

The 704A-400 will display the following:

```
"EMULATION MODE – "
" 1 Emulate: CO      "
" 2 Emulate: PBX    "
" ESC=start Next=more "
```

The arrow to the right of the display indicates the currently selected option.

Press 1 (emulate CO)

or

Press 2 (emulate PBX).

Press the NEXT key to continue.

The 704A-400 will display the following:

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```

" --- DIGIT TYPE --- "
" 1 MF      2 DTMF   "
" 3 DIAL-PULSE      "
"ESC=start NEXT=more "

```

The arrow to the right of the display indicates the currently selected option.

Press 1 for MF, 2 for DTMF, or 3 for DIAL-PULSE

Press the NEXT key to continue.

The 704A-400 will display the following.

```

" --- CALL TYPE --- "
" 1 Wink-Start      "
" 2 Immediate-Start "
"ESC=start NEXT=more "

```

Press 1 for Wink-Start or 2 for Immediate-Start.

To exit the setup screen and begin testing of a DID circuit:

Press the ESC key.

The 704A-400 will now be in the DID operating mode. The LCD will display the selected mode of emulation. For instance, if the PBX mode with DTMF and wink supervision was selected, the screen will display:

```

" DID – PBX: DTMF – WINK "
"CO: ON-HOOK             "
" Waiting for OFF-HOOK   "

```

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Note: In the PBX mode the 704A-400 provides battery feed to the circuit.

The test set is waiting for the other end (the CO) to go off-hook by drawing loop current.

When the office equipment seizes the line (by going off-hook), the 704A-400 will generate the wink pulse (if set-up for wink-start lines), and the display will show:

```

" DID – PBX: DTMF-WINK "
"CO: OFF-HOOK          "
" WINKING               "

```

The 704A-400 will then monitor for incoming digits as selected in the setup. In this example, the DTMF receiver is enabled. This is evident by the display:

```

" DTMF MODE: ACTIVE "
" Waiting for Tones  "
" Press ESC to exit  "

```

As the digits are received they appear on line two of the display. Up to 16 digits can be received. The LCD displays:

```

" DTMF MODE: ACTIVE "
" 1234 ..... 15    "
" Press ESC to exit  "

```

To analyze the received digits:

Press the TIMING RESULTS key

or

Press the DATA RESULTS key (MF or DTMF only).

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Turn to the section in this manual on Data and Timing analysis for details on analyzing tone digits. An example of received dial pulses as displayed in the Dial Pulse mode is as follows:

```
" PULSE MODE: ACTIVE  "
" DP: 1234             "
" POSTWINK: 0.796 Sec  "
" Press ESC to exit   "
```

To analyze the dial pulse timing parameters:

Press the TIMING RESULTS key.

An example of the TIMING RESULTS as displayed in the Dial Pulse mode is as shown:

```
" 1234 ... 15         "
" 10PPS 64% I = 286 Ms  "
" Make = 36 Break = 64 Ms "
" Press ESC to exit   "
```

Note: PPS = Pulses per Second, % = Percent Break, I = Interdigit time. The digit under analysis is indicated by the cursor.

To select the next digit to analyze:

Press the NEXT key.

Note: When analyzing dial pulse digits, no PPS, make/break percentage or make interval can be calculated on the digit '1'. Also, no interdigit timing will be displayed on the last digit received.

To complete the call and make the PBX go Off-Hook:

Press the OFF/ON HOOK key

The LED in the OFF/ON HOOK key will illuminate indicating the OFF-HOOK status.

Additional testing of the line can be performed once an end-to-end call has been established.

In the CO emulation mode, the test set becomes the digit sender instead of the digit receiver. Using the DIAL key the user can go OFF-HOOK, wait for a wink (if applicable), and begin transmitting either tone or pulse digits. The user has correctly entered the CO emulation (with wink supervision) mode when the display shows:

```
" DID-CO: DTMF-WINK  "
" DIAL' to enter ph#  "
```

Signaling Test: Direct Inward Dialing – CO Emulation

To enter the number to be dialed:

Press the DIAL # key.

Enter the numeric digits to be sent

Note: In MF dialing, use the '*' key to send KP and the '#' key to send ST

Note: The digits will not be transmitted as they are pressed, as in normal dialing. If an error was made during the entering of the digits, press the DIAL key once to clear the digits, and re-enter the digits.

The display will indicate:

```
"GENERATE: DTMF      "
"ph # > 1234        "
"OffHk = send ESC = exit  "
```

To go OFF-HOOK and begin the transmission of digits:

Press the OFF/ON Hook key.

The 704A-400 will then go OFF-HOOK (by drawing loop current) and will, if configured for wink start supervision, wait for the PBX to generate a

wink. The display indicates:

```
" GENERATE: DTMF  "
" ph # > 1234 567  "
" Waiting for wink  "
" PBX ON-HOOK      "
```

Note: If the loop current detected by the test set while OFF-HOOK is less than 20mA, line three will display the message, "No Loop Current". Verify connections and PBX battery supply or loop resistance.

The 704A-400 measures the time from when it went OFF-HOOK to the received wink, known as 'pre-wink' (PW) time. If a valid wink is received, the test set will begin sending digits in the format selected in the setup menu. DTMF and MF digits are sent at 75 mS and 65 mS respectively, while Dial pulses are sent at 10PPS with 60% break. Wink pulse timing is momentarily displayed on line three of the display and retained during the duration of the call and can be observed by pressing the TIMING RESULTS key.

```
" GENERATE: DTMF      "
" ph # > 1234567      "
" WINK: 200 mS PW: 0.243S  "
" Press ESC to exit    "
```

Note: In the Immediate Start mode, digits are sent after a 2.0 second delay. No wink analysis is done and line three will be blank.

The 704A-400 uses a reverse battery detector to determine the hook status of the station-side equipment under test. An off-hook status at the PBX is indicated on the last line of the display:

```
" GENERATE: DTMF  "
" ph # > 1234567  "
"                  "
```

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```
" PBX: OFF-HOOK  "
```

To view the timing parameters of the call setup:

Press the TIMING RESULTS key.

The LCD displays the received WINK duration, the Pre-WINK time, and the answer delay (time between the end of the last digit and the PBX providing an OFF-HOOK) as follows:

```
" DID: CO-MODE TIMING  "
" WINK: 250 mS PW: 1.253S  "
" ANSWER DELAY: 2.248S  "
" Press ESC to exit    "
```

Press the key corresponding to the desired test.

To perform transmission tests once the call has been established:

Press the ESC key.

With the call established, FREQUENCY RESPONSE, CHANNEL NOISE, or other tests can be performed at this time.

In the Immediate Supervision mode, the LCD displays the answer delay only:

```
" DID: CO-MODE TIMING  "
"                      "
" ANSWER DELAY: 1.234S  "
" Press ESC to exit    "
```

Note: If the other end is not answering, verify that the supervision and the digit format is matched to that of PBX. The test set will dial digits only in the format as selected in the setup mode. If the digits type is mismatched, (i.e. MF instead of DTMF) simply return to the DID option menu and re-configure the generator for the proper format.

To exit the DID mode:

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Press the Signaling TEST key.

Press the numeric '5' key to select EXIT SIGNALING.

This completes the section on DID testing.

Signaling Test: E&M Signaling/Ring Generation

The requirements for E&M signaling has declined significantly in the last two decades due to the industry's massive transition to modern integrated signaling systems, which combine the trunk/signaling circuits and the digital carrier terminal equipment into a single package. However, many outlying central offices (for example trunk groups from electromechanical offices, CENTREX Tie Lines and numerous private line applications) still require E&M signaling and the ever present requirement for maintenance testing.

Unlike the more contemporary signaling techniques, E&M signaling requires either 2 or 4 additional leads for application, depending upon the E&M type signaling configuration. For example, TYPE I and TYPE V require the addition of the E&M leads only, while the TYPE II, III, and IV require the additional SB and SG leads. It is also very important to note that while DTMF digits are transmitted and received on the conventional T and R leads for a two-wire facility, dial pulse (DP) digits in the E&M signaling mode are actually transmitted and received on the E&M leads.

The 704A-400 E&M Signaling Option enables emulation of either the E&M Signaling Set or the Trunk Circuit equipment and facilities testing of the 5 distinct E&M signaling configuration as indicated:

E&M Configuration	704A Test Lead Connections
TYPE I	E-M (Ground lug on the 704A-400 should be grounded)
TYPE II	E-M and SB-SG
TYPE III	E-M and SB-SG
TYPE IV	E-M and SB-SG
TYPE V	E-M (Ground lug on the 704A-400 should be grounded)

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Signaling Test: E&M Set-up

It is important to note that the test set-up configuration for Types II, III, and IV, the signal battery and the signal trunk leads under test must be connected to the SB/SG jack on the 704A-400. On the SB/SG jack, "SG" is tip and "SB" is ground. The SB and SG connections are not required when testing Types I and V interfaces.

E is the TIP and M is the RING on the E&M jack.

TYPE	Trunk to Signaling Circuit			Signaling to Trunk Circuit		
	LEAD	ON-HOOK	OFF-HOOK	LEAD	ON-HOOK	OFF-HOOK
I	M	Ground	Battery	E	Open	Ground
II	M	Open	Battery	E	Open	Ground
III	M	Ground	Battery	E	Open	Ground
IV	M	Open	Battery	E	Open	Ground
V	M	Open	Battery	E	Open	Ground

To enter the E&M mode setup, press the Signaling Test key and then the numeric 4 key. The unit will display the following:

```

"--EMULATION MODE --  "
"1 Send - M: TRK CKT  "
"2 Send - E: SIG Set   "
"ESC = Start Next = More  "

```

The arrow to the right of the display indicates the currently selected options.

Press "1" for Send-M-TRK CKT or "2" for Send -E SIG-set. To continue, press the NEXT key..

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The unit will display the following:

```
"E&M Signaling      "
"1.I 2.II 3.III 4.IV 5.V  "
"ESC=Start NEXT=More  "
```

The arrow to the right of the display indicates the currently selected options.

Press numeric keys "1" to "5" for the TYPE desired or NEXT to continue to advance to the next screen.

The unit will display the following:

```
Press "1" for MF
Press "2" for DTMF
Press "3" for Dial-Pulse
Press the next key to continue.
```

The unit will display the following:

```
"CALL TYPE          "
"1. Wink Start      "
"2. Immediate Start "
"ESC=Start NEXT=More  "
```

The arrow to the right of the display indicates the currently selected option.

Press numeric key 1 for WINK START or 2 for IMMEDIATE DIAL or NEXT to continue to advance to the next screen.

The unit will display the following:

```
"DIAL: SEND/REC      "
```

```
"1. SEND DIGITS     "
"2. RECEIVE DIGITS  "
"ESC=Start NEXT=More  "
```

The arrow to the right of the display indicates the currently selection option.

Press numeric key "1" for Send Digits or "2" for Receive Digits or NEXT to advance to the next screen.

To exit the setup screen and to start the testing of the E&M trunk, press the ESC key. The unit will now be in the E&M operating mode.

If an E&M TYPE II Trunk was selected and the SEND DIGIT (Signaling Circuit Mode) was selected, the unit will display the following:

```
"E&M 2 TRK DTMF-WINK  "
"DIAL TO ENTER PH#    "
```

Signaling Test: E&M Receive Digit

If an E&M 2 trunk was selected and RECEIVE DIGITS (Trunk Circuit Mode) was selected, the unit will display the following:

```
"E&M 2 - SIG DTMF-WINK  "
"TRK CKT ON HOOK       "
"WAITING FOR OFF HOOK   "
```

When the Signaling Set equipment at the other end of the circuit seizes the line by going off-hook, the unit will generate the wink pulse (if set-up for wink-start) and the display will momentarily show the following message:

```
"E&M TRK: DTMF-WINK  "
"SIG-SET: OFF HOOK   "
"WAITING FOR DIGITS  "
```

The unit will then monitor for incoming digits as selected in the setup. In this example, the DTMF receiver is enabled. This is evident by the

following display:

```
"DTMF MODE: ACTIVE      "
"WAITING FOR TONES      "
"PRESS ESC TO EXIT      "
```

As the digits are received, they appear on line two of the display. Up to 16 digits can be received. The unit will display:

```
"DTMF MODE: ACTIVE      "
"1234.....15           "
"Press ESC to EXIT      "
```

To analyze the received digits, press the TIMING RESULTS and DATA RESULTS keys (for MF or DTMF only). An example of received dial pulses as displayed in the Dial Pulse Mode is as follows:

```
"Pulse Mode: Active     "
"DP: 1234               "
"Press ESC to exit     "
```

To analyze the dial pulse timing parameters, press the TIMING RESULTS key. An example of the TIMING RESULTS as displayed in the Dial Pulse mode is as follows:

```
"1234.....15           "
"10PPS 64% I=286 mS    "
"Make = 36 Break = 64 mS "
"Press ESC to exit     "
```

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Note that PPS=Pulses Per Second, %=Percent Break, I=Interdigit time. The digit under analysis is indicated by the cursor.

To select the next digit to analyze

Press the NEXT key.

Note that when analyzing dial pulse digits, no PPS, make/break percentage, or make interval can be calculated on the digit "1". Also, no interdigit timing will be displayed on the last digit received.

Signaling Test: E&M Send Digit

In the signaling set emulation mode, the test set becomes the digit sender instead of the digit receiver. Using the DIAL key, the user can go OFF-HOOK, wait for a wink (if applicable), and begin transmitting either tone or pulse digits. The user has correctly entered the signaling set emulation (with wink supervision) mode when the display shows:

```
"E&M 2 SIG DTMF-WINK   "
"Dial To Enter PH #     "
```

To initiate the emulation of the signaling set, press dial, enter the required digit sequence from 1 to 16, and then press off/on hook to send the digits. The unit will momentarily flash the following message on Line 3 of the display:

```
"WAITING FOR WINK"
```

and then the wink-timing message

```
"WINK 203 MS PW 1061 MS"
```

The test set measures the time from when it was OFF HOOK to the received wink, known as "pre-wink" (PW) time. If a valid wink is received, the unit will begin sending digits in the format selected in the user set-up menu. DTMF and MF digits are sent at 75mS and 65mS, respectively, while Dial Pulses are sent at 10 PPS with a 60% break. Wink pulse timing is monetarily displayed and retained during the duration of the call and can be observed by pressing the TIMING RESULTS key.

```
"GENERATE: DTMF       "
```

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```

"ph#>6578810      "
"WINK: 201MS PW: 243 MS "
"Press EXC to exit  "

```

Note that in the immediate start mode, digits are sent after a 2 second delay. No wink analysis is done and line 3 will be blank.

The test set uses a reverse battery detector to determine the hook status of the receive-digit side equipment under test. An offhook status at the PBX is indicated on the last line of the display:

```

"GENERATE: DTMF    "
"ph#>2683397      "
"OFF HOOK=SEND     "

```

To view the timing parameters of the call setup, press the TIMING RESULTS key.

The LCD displays the received WINK duration and the PRE_WINK time as follows:

```

"GENERATE: DTMF    "
"WINK: 203 mS PW: 1074 mS "
"PRESS ESC to exit "

```

To perform the transmission tests once the call has been established, press the ESC key. With the call established, frequency response, noise, and other transmission tests may be performed. Note that if the distant end of the circuit under test is not answering, verify that the supervision and the digit format and other set-up parameters is matched to that of the RECEIVE DIGIT END. The test set will dial digits only in the format as selected in the setup mode. If the digit type, E&M circuit type is incorrect: return to the Signaling-E&M set-up menu and reconfigure the generator for the proper format.

To exit the E&M signaling mode, press ESC, then the Signaling TEST key, and the numeric "5" key.

Signaling Test: E&M Ring Generation

The test set provides ring generation function, both manually and automatically. From the Main TMS menu, press MENU and then NEXT. The unit will display the following:

```

"4.... Return Loss  "
"5.... Ring Generator "
"6.... Toggle LCD Light "

```

Select the numeric "5" key and to select the Ring Generator. The options will be 1 for automatic and 2 for manual.

For automatic ring function, press the numeric "1" key (Auto Ring) and ring generation will occur repeatedly without user intervention. To stop automatic ring generation, press ESC. While in automatic mode, the unit will display the following:

```

"Automatic Ringing  "
"Ringer ON          " (OFF in the off state time period)
"Remote: ON HOOK    "

```

For manual ring function, press the numeric "2" key (Manual Ring). To stop manual ring generation, press ESC. While in manual mode, the unit will display the following:

```

"Manual Ringing     "
"Ringer ON          "
"Remote: ON HOOK    "

```

Note that while in manual ring, the ring generation will be continuous until ESC is pressed. The same menu as above will reappear on the display and the user can again select Manual by pressing "2" or Automatic by pressing "1".

Data Results: digit Analysis

When the 704A-400 is operated in Menu – Digit Analysis mode or the circuit signaling mode configured to emulate a Loop Start CO, Ground Start CO, DID PBX or E&M mode, pressing the DATA RESULTS key provides the following measurements of captured MF or DTMF digits:

- Individual frequencies of each Dual Tone Multi-Frequency (DTMF) tone
- Individual frequencies of each Multi-Frequency (MF) tone
- Calculate the TWIST of the tones in Db.

Twist is defined as the difference in level between the two tones expressed as Db. TWIST is positive if the higher frequency tone is of higher level than the lower frequency tone; TWIST is negative if the higher frequency tone level is below the lower frequency tone level.

The DTMF and MF frequencies pairs (codes) are listed in the following chart:

Dual-Tone Multi Frequency Codes (DTMF):

		High Group Frequencies (Hz)			
		1209	1336	1477	1633
Low Group Frequencies (Hz)	697	1	2	3	A
	770	4	5	6	B
	852	7	8	9	C
	941	*	0	#	D

Each captured MF or DTMF digit is instantly tested for acceptance to within 3% of the standard frequency for that tone. If the digit's high and low tones are compliant, the LCD will display the received digit. Otherwise the LCD will display a question mark, indicating that a digit was received but either level, frequency or timing was out of spec. The faulty parameter can be viewed by using the DATA RESULTS or the TIMING RESULTS key.

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After receiving sixteen consecutive digits, the 704A-400 is no longer in the tone capture mode and the digit capture test must be restarted in order to capture new digits.

The LCD displays the MF or DTMF digits in the order they were received. The user can view the frequency/level and the timing parameters of each tone of the pair.

To display the frequency, level and twist of the tone pair:

Press the DATA RESULTS key.

The LCD displays:

```
"1234567890...15      "
"LOW 770Hz -21.0dBm    "
"HIGH 1209 Hz - 22.6dBm "
"TWIST: -1.6dBm       "
```

The first line indicates the received digits with the cursor under the digit '4' indicating that this is the digit being analyzed. The second and third lines display the high and low frequency and level component of the digit under analysis. The last line shows the twist (difference in level) of the two tones. Use the NEXT key to view another digit or go on to the timing parameters by using the TIMING RESULTS key. To move the cursor to the next digit: Press the NEXT key.

A cursor is used to select the digit analyzed. Use the NEXT key to move the cursor to the right one digit. When the cursor is positioned at the last digit, pressing the NEXT key one more time returns the cursor to the first digit. Position the cursor under the digit to be analyzed and then press DATA RESULTS or TIMING RESULTS key to display the measured values.

To exit DATA RESULTS: Press the ESC key.

Timing Results: Digit Analysis

Each of the captured MF or DTMF digits can be analyzed for tone duration as well as interdigit timing. The interdigit time measurement is the time interval preceding the digit under analysis. Therefore, the posted interdigit time of the first received digit is zero and is displayed as such. All

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measurements are displayed in milliseconds.

To display the MF or DTMF timing parameters:

Press the TIMING RESULTS key.

The test set immediately displays the timing measurements of the current digit under analysis, as identified by the cursor. The timing display shows both the digit duration and the time between digits.

```
" 123456789...15      "
" DURATION: 73mSec   "
" INTERVAL: 76mSec   "
" Press ESC to exit  "
```

Use the NEXT key to examine the next received digit, or press ESC to return the 704A-400 to the idle condition. After sixteen digits have been captured, the 704A-400 stops capturing digits.

To restart the digit capture mode:

Press the ESC key.

23-Tone Test

Previous generations of transmission impairment measuring test sets analyzed the parameters of a 4kHz analog facility by performing a frequency sweep (loss vs frequency), measuring Intermodulation distortion (IMD) using a four tone technique, Envelope Delay Distortion by comparing the propagation delay of various frequencies and signal to noise ratio. These tests were difficult and time consuming and often incorrectly done because of the complex setup requirements.

A new tone measuring technique made possible by the advances in digital signal processing and processor power permits these test to be performed with one operation. Simply explained, 23 tones are simultaneously generated and transmitted with a known frequency and phase relationship. The 23 frequencies are derived by dividing 8000Hz into 512 bins of 15.625Hz each. The 23 tones used are the 13th, 23rd, 33rd, 43rd,

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etc. up to the 233rd bin. For example, bin 13 (tone #1) equals $15.625\text{Hz} \times 13 = 203.125\text{ Hz}$ while bin 233 (tone #23) equals $15.625\text{Hz} \times 233 = 3640.625$. The phase of each of the 23 tones is similarly established by $(360i/23 = 15.652)$ with tone 12 at phase 0, tone 4 at $15.652i$, tone 5 at $31.30i$, tone 23 at $328.7i$.

By simultaneously transmitting these 23 tones with a known level, frequency and phase, the following measurements can be made directly with one set-up:

- Measure level of the composite 23-tone signal
- Measure level of the individual tones
- Measure Envelope Delay Distortion (EDD)
- Measure Intermodulation Distortion (IMD)
- Measure Signal to Total Distortion (S/TD)
- Measure Signal to Noise Ratio (SNR)

23-Tone Test Setup

To setup the 704A-400 for the 23-TONE test:

Press the TERM key to set the appropriate interface impedance (100Ω, 135Ω, 600Ω, 900Ω, op1200Ω).

Press the 23-Tone key.

The LCD screen displays the following:

```
" --- 23 Tone Test --- "
" 1. Receive 23 Tone   "
" 2. Transmit 23 Tone  "
" Press ESC to exit   "
```

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To set the 23-Tone composite transmit level:

Press numeric key '2' key.

The LCD screen displays the following:

```
" XMT 23TONE – 15.0dBm  "
" 2. Transmit 23 Tone    "
" 3. Change Level       "
" Press ESC to exit     "
```

The 23-Tone composite level default setting is –15.0dBm. The transmit level can be set in a range of –6.0dBm to –40.0dBm. Levels higher than –6.0dBm cause clipping and would provide erroneous readings.

Press the numeric '3' key to select the change level command.

The LCD screen displays the following:

```
" XMIT 23Tone –15.0dBm  "
" Enter New Level       "
" *=+/- (change sign)  "
"ESC = clear #=XMT     "
```

Insert the new transmit level value using the keypad and press the '#' (NEXT) key to send.

The LCD screen displays the following:

```
" XMIT 23 Tone –6.0dBm  "
" Sending 23 Tone       "
```

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```
"
" Press ESC to exit     "
```

The 704A-400 is now transmitting the 23-Tone sequence.

Press ESC to return to the 23-Tone setup menu.

Press ESC again to exit the 23-Tone test.

23-Tone Test: Receive Level Measurements

To measure the level of the composite 23-Tones:

Press the 23-Tone TEST key.

The LCD screen displays the following:

```
" --- 23 Tone Test ---  "
" 1. Receive 23 Tone    "
" 2. Transmit 23 Tone   "
" Press ESC to exit     "
```

Press the numeric '1' key to select Receive 23 Tone test.

The LCD screen displays the following:

```
" --- 23 Tone Test ---  "
" 1. Level  2. EDD       "
" 3. IMDs  4. S/TD SNR  "
" Press ESC to exit     "
```

To measure level of the composite 23-Tones and the individual tones:

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Press the numeric '1' key.

The LCD screen displays the following:

```
" RCV Level    -6.0dBm  "
"
" NEXT = 1 to 23 Levels  "
" ESC = exit      "
```

Subsequent presses of the NEXT key toggles thru the following tone level readings: 203 & 359 Hz, 516 & 672 Hz, 828 & 984 Hz, 1141 & 1297 Hz, 1453 & 1609 Hz, 1766 & 1922 Hz, 2078 & 2234 Hz, 2391 & 2547 Hz, 2703 & 2859 Hz, 3016 & 3172 Hz, 3328 & 3484 Hz, 3641 Hz

Pressing the NEXT key once more returns to the first screen.

Press the ESC key to exit the level tests.

Press the ESC key to exit the 23-Tone TEST.

23-Tone Test: Receive EDD Measurement

Envelope Delay Distortion (EDD) is a measurement of the difference in the transit time (delay) of a sequence of frequencies sent over the transmission facility and is measured in microseconds (μ s). Since the 23-Tone sequence is sent with a known phase relationship, EDD can be made on a straight away basis.

To measure Envelop Delay Distortion using the 23-Tone sequence:

Press the 23-Tone TEST key.

Press the numeric '1' key to select Receive 23-Tone test.

Press the numeric '2' key to select EDD measurement.

The LCD screen displays the following:

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```
" PAIR FREQ  EDD    "
" TESTING LINE      "
"
" ESC=exit NEXT=more "
```

Once the 704A-400 has acquired the EDD measurement data the LCD displays:

```
" Pair Freq  EDD    "
" 1  281Hz  +33us   "
" 2  438Hz  +10us   "
" ESC=exit  NEXT=More "
```

Note: The EDD measurements are based upon frequencies of 281, 438, 594, 750, 906, 1063, 1219, 1375, 1531, 1688, 1845, 2000, 2156, 2313, 2469, 2625, 2781, 2938, 3094, 3250, 3406 and 3563 Hz. The displayed frequencies are derived and are displayed as tone pair 4 in the EDD measurement screen.

Press the NEXT key to step thru the EDD frequency pairs/measurements.

Press the ESC key to exit the EDD measurements.

Press the ESC key to exit the 23-Tone TEST.

23-Tone Test: Receive IMD Measurement

Intermodulation Distortion (IMD) is the measurement of nonlinear distortion of a system characterized by the appearance of frequencies at the output equal to the sums and differences of integral multiples of two or more of the input frequencies. IMD is the ratio of the test signal to specific spurious output signals generated by the non-linearity. The 23-TONE test sequence uses the 23 tones generated to measure any 2nd or 3rd order harmonic distortion products.

To measure IMD:

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Press the 23-TONE TEST key.

Press the numeric '1' key labeled RECEIVE 23 TONE

Press the numeric '3' key to select IMD testing.

The LCD screen displays the following:

```
"IMD Measurements  "
"2nd IMD    +1.6dB  "
"3rd IMD    1.4dB   "
"ESC=exit    "

```

Once the 704A-400 acquires the measurement data the screen indicates:

```
" IMD MEASUREMENTS  "
" 2nd IMD    +1.6dB  "
" 3rd IMD    +1.4dB  "
" ESC= exit    "

```

To exit the 23-TONE IMD test, press the ESC key.

Press the ESC key to exit the 23- Tone TEST.

23-Tone Test: Receive S/TD and SNR

The Signal-to-Total-Distortion ratio (S/TD) is the ratio of the power in dB of a single or multiple tone test signal to the power of all spurious signals (including IMD products) resulting from the application of the test signal plus the power from background noise. The Signal-to-Noise Ratio (SNR) is

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the ratio of the power in dB of a single or multiple-tone test signal to the power of the background noise not related to the application of the test signal, plus all spurious signals resulting from the application of the test signal, except for 2nd order and 3rd order intermodulation (IMD) distortion.

To measure S/TD and SNR:

Press the 23-TONE TEST key.

Press the numeric '1' key to select 23 Tone Test mode.

Press the numeric '4' key to select S/TD SNR test.

Once the 704A-400 acquires the measurement data the screen indicates:

```
" NOISE MEASUREMENTS "
" S/TD    -7.3 dB    "
" SNR     -7.7 dB    "
" ESC = exit    "

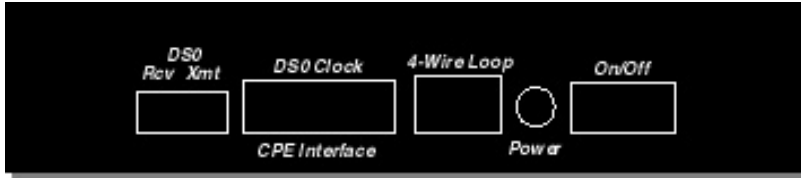
```

Press the ESC key to exit the 23-Tone test.

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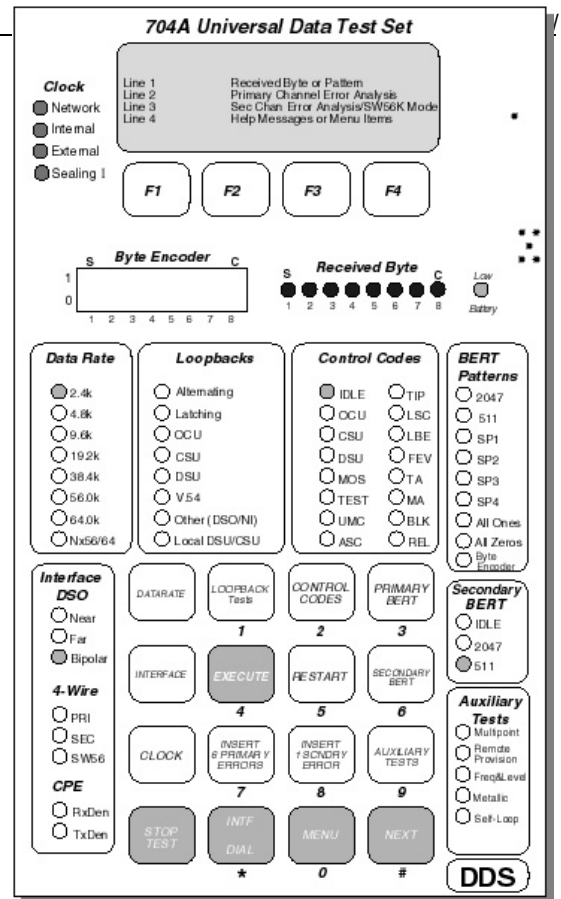
DDS TEST FEATURES

The connector panel identifies the location of the test jacks utilized to access the DDS circuit from both central office and customer premise locations. The receive and transmit bantam jacks are utilized for DS0 logic and bipolar access. The clock D-sub connector accesses the bit and byte clocks supplied from the channel bank or provides the DCE/DTE interface. Local loop testing utilizes the 4-wire modular



RJ48S jack. Whenever possible, the power jack should be utilized when testing from CPE locations to ensure that the internal NiCad battery pack is fully charged.

The 704A-756A front panel provides access to the test functions necessary for DDS circuit installation, analysis and repair. The comprehensive user interface provides immediate circuit status and test set configuration via the 4 line LCD and 69 LEDs. This interface is sectionalized into seven individual groups: Interface, Data Rate, Loopbacks, Control Codes, Primary and Secondary Patterns and Auxiliary tests. Configuration and testing is simplified by stepping through these basic functional groups: Interface (Setup for the type of interface: DS0, Bipolar, or 4-wire), Data Rate (Select the circuit data rate (including 38.4K)), Loopbacks (Loopback a circuit

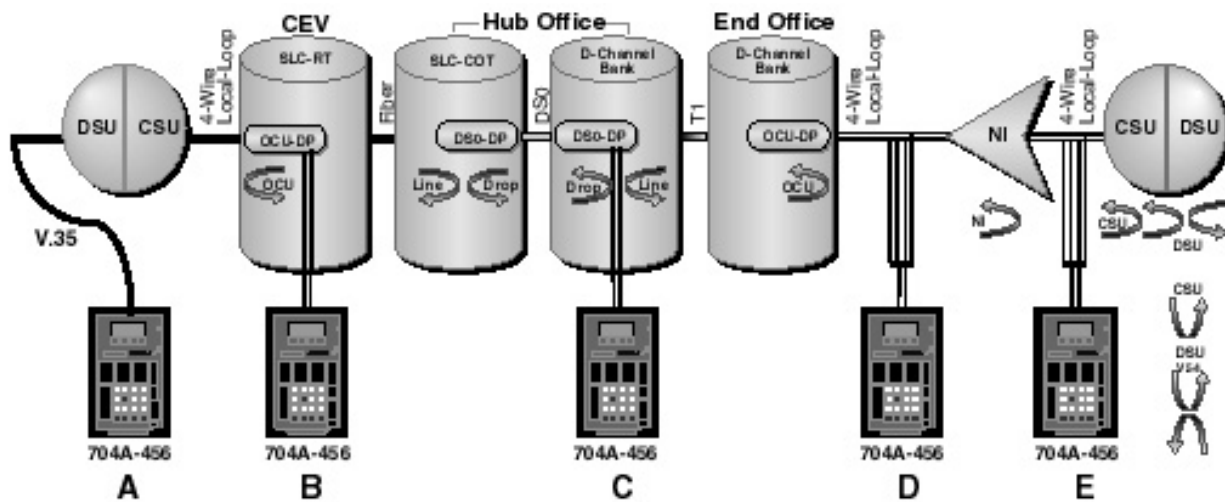


(Not to Scale)

element, if desired), Primary BERT (Analyze circuit data with a 2047 or DDS stress pattern), and Control Codes (Transmit a control code for element reset or release). Press a corresponding key on the keypad and press EXECUTE. The selected function is immediately performed and complete circuit status and test results are displayed on the LCD.

The received byte (visible on the received byte LEDs) is decoded and displayed on the LCD (line 1). When pattern analysis is performed, the error results are displayed on line 2 (line 3 for secondary patterns). Line 4 of the LCD provides soft-key functions (F1-F4), help messages and menu prompts for enhanced testing. This operation manual is partitioned into the functional groups described above. This format allows users not familiar with DDS testing to quickly access and test DDS circuits. Review the circuit diagrams for the access location, then start at the interface section and continue through the user guide performing the desired test functions.

DDS Circuit Testing



DDS Access Locations:

- A: Access and TEST from the DTE
- B: Access and TEST from the OCU
- C: Access and TEST from the DS0
- D: Access and TEST from the NI/Repeater
- E: Access and TEST from the CSU/DSU

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Access and Test from DTE

DTE Interface at CPE:

Access at V.35 Interface on installed CSU/DSU

Typical Tests:

- Loopback and straight-away testing
- Respond to or generate latching V.54 Loopback
- Pseudorandom data patterns (2047 , 511 , ALL 1s)
- DDS-specific stress patterns (SP 1 , 2 , 3 , and 4)
- Error analysis (BE, %EFS, ES, dribbling, streaming or bursty)

Results:

- Faulty DTE to DCE connection?
- Faulty transmit or receive path?
- Data sensitivity?
- Faulty element (CSU/DSU) or circuit cable?

Refer to the Interface: DTE section to initiate testing from the DTE interface.

Access and Test from OCU

OCU-UP:

- TTL-unipolar access to DS0 signal
- TTL bit and byte clock supplied from the Channel bank (OIU on AT&T compatible d4)

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- Logic NEARaccess and test DDS circuit toward local 4-Wire loop
- Logic FARaccess and test DDS circuit into the Network and toward remote CPE

Typical Tests:

- Looped-back and straight-away testing
- Alternating DSU, CSU, OCU Loopbacks
- Latching DSC, CSU, OCU Loopbacks (plus DS0-Line, DS0-Drop, OCU, NI in Far)
- Pseudorandom data patterns (2047 , 511 , ALL 1s)
- DDS-specific stress patterns (SP1 , 2 , 3 , and 4)
- Secondary channel data patterns (2047 , 511)
- Error analysis (BE, %EFS, ES, dribbling, streaming or bursty)

Results:

- Faulty circuit in direction toward local or remote CPE?
- Faulty transmit or receive path?
- Data sensitivity?
- Faulty element (OCU, CSU/DSU) or circuit cables?

Refer to the Interface: DS0-Near or Far section to initiate testing from a DS0 Logic interface.

Access and Test in OCU mode

4-Wire Interface:

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- Remove the 4-Wire local-loop from the OCU-DP and Channel Bank.
- Access at the 4-Wire local-loop toward the CSU/DSU or the NI (network interface/repeater) if installed.
- Enter OCU Mode via the AUSILIARY TEST key to provide sealing current to the local-loop.
- Set the 704A-756A to INTERNAL (MASTER) clock, to provide a clock source to the loop elements.

Note: Transmission of CSU control code, Alternating or Latching CSU loopback reverses the sealing current.

Typical Tests:

- Looped-back and straight-away testing
- Alternating DSU and CSU Loopbacks
- Latching DSU and CSU Loopbacks (and NI if installed)
- Pseudorandom data patterns (2047, 511, ALL 1s)
- DDS-specific stress patterns (SP 1, 2, 3, and 4)
- Secondary channel data patterns (2047, 511)
- Error analysis (BE, %EFS, ES, dribbling, streaming or bursts)

Results:

- Faulty Network access equipment (OCU-DP, Channel bank-clocking)
- Faulty circuit in direction toward local CPE?
- Faulty transmit or receive path?
- Data sensitivity?
- Faulty element (NI, CSU/DSU) or circuit cables?

Refer to the OCU Emulation Mode section for additional information on OCU Mode.

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Access and Test from DS0

DS0-DP:

- Bipolar access to DS0 signal
- TTL bit and byte clock supplied from the Channel bank (OIU on AT&T compatible D4)

Typical Tests:

- Loopback and straight-away testing
- Alternating DSU, CSU, OCU Loopbacks
- Latching DSU, DSU, CSU, OCU Loopbacks
- Pseudorandom data patterns (2047 , 511 , ALL 1s)
- DDS-specific stress patterns (SP1, 2, 3, and 4)
- Secondary channel data patterns (2047 , 511)
- Error analysis (BE, %EFS, ES, dribbling, streaming or bursty)

Results:

- Faulty circuit in direction toward local or remote CPE?
- Faulty transmit or receive path?
- Data sensitivity?
- Faulty element (OCU, CSU/DSU) or circuit cables?

Refer to the Interface: DS0-Bipolar section to initiate testing for a DS0 Bipolar interface.

Access and Test from NI/Repeater

Repeater or Network Interface:

- Access on 4-Wire Local-loop toward OCU-DP
- Access on 4-Wire Local-loop toward CSU/DSU (Note- dry loop toward CPE)
- Set the 704A-756A to INTERNAL (MASTER) clock, to provide a clock source to the loop elements

Typical Tests:

- Metallic testing
- Signal Level and frequency
- Loopback and straight-away testing
- Respond to Alternating or Latching CSU Loopback
- Respond to or generate Alternating DSU Loopback
- Respond to or generate Latching DSU and V.54 Loopbacks
- Pseudorandom data patterns (2047 , 511 , ALL 1s)
- DDS-specific stress patterns (SP 1 , 2 , 3 , and 4)
- Secondary channel data patterns (2047 , 511)
- Error analysis (BE, %EFS, ES, dribbling, streaming or bursty)

Results:

- Excessive signal attenuation?
- Faulty circuit in direction toward local or remote CPE?
- Faulty transmit or receive path?

- Data sensitivity?
- Faulty element (OCU, CSU/DSU) or circuit cables?

Refer to the Interface: 4-Wire Primary, Secondary & Switched 56K sections to initiate testing from a Local Loop interface.

Access and TEST from CSU/DSU

On CPE at CSU/DSU:

Access on 4-Wire Local –loop toward OCU-DP

Access on 4-Wire Local –loop toward CSU/DSU (Note: dry loop)

Set the 704A-756A to INTERNAL (MASTER) clock, to provide a clock source to the loop elements

Typical Tests:

- Metallic testing
- Signal Level and frequency
- Loopback and straight-away testing
- Respond to Alternating or Latching CSU Loopback
- Respond to or generate Alternating DSU Loopback
- Respond to or generate Latching DSU and V.54 Loopbacks
- Pseudorandom data patterns (2047 , 511 , ALL 1s)
- DDS-specific stress patterns (SP 1 , 2 , 3 , and 4)
- Secondary channel data patterns (2047 , 511)
- Error analysis (BE, %EFS, ES, dribbling, streaming or bursty)

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Results:

- Excessive signal attenuation?
- Faulty circuit in direction toward local or remote CPE?
- Faulty transmit or receive path?
- Data sensitivity?
- Faulty element (OCU, CSU/DSU) or circuit cables?

Refer to the Interface: 4-Wire Primary, Secondary & Switched 56K sections to initiate testing from a Local Loop interface.

Interface: DS0-Near

The 704A-756A will automatically select the DS0-NEAR interface when the test set is switched on.

To select the DS0-NEAR interface from another interface:

Press the INTERFACE key until the DS0-Near LED is ON

To verify DS0-NEAR mode, note the following LED states.

The DS0-Near LED is ON

The Network Clock LED is ON

Connect the OCU-DP Tx/Rx jacks to the DS0 Tx/Rx interface on the top-end of the 704A-756A with a pair of Bantam cables.

Install the Clock cable to the interface on the channel-bank, (OIU for AT&T and compatible D4).

"No Clocks Received", Message removed from LCD

If a fixed byte is received by the OCU, the LCD will display the received byte on line 1. The red Received Byte LEDs will display the format of this

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byte. If random data is detected the LEDs will all appear to be on and the LCD will indicate:

"NO PATTERN DETECTED"

You have successfully selected the DS0-NEAR interface. Continue to the Data rate section to select the circuit data rate.

Interface: DS0-Far

The 704A-756A will automatically select the DS0-NEAR interface when the test set is switched on.

To select the DS0-FAR interface:

Press the INTERFACE key until the DS0-Far LED is ON

To verify DS0-FAR mode, note the following LED states:

The DS0-Near and Bipolar LEDs are OFF.

The Network Clock LED is ON.

Connect the OCU-DP Tx/Rx jacks to the DS0 Tx/Rx interface on the top-end of the 704A-756A with a pair of Bantam cables.

Install the Clock cable to the clock interface on the channel-bank (OIU for AT&T compatible D4).

" No Clocks Received", Message removed from LCD

If a fixed byte is received by the OCU, the LCD will display the received byte on line 1. The red Received Byte LEDs will display the format of this byte. If random data is detected the LEDs will all appear to be on and the LCD will indicate:

" NO PATTERN DETECTED ".

You have successfully selected the DS0-FAR interface. Continue to the Data rate section to select the circuit data rate.

Interface: DS0-Bipolar

The 704A-756A will automatically select the DS0-NEAR interface when the test set is switched on.

To select the DS0-BIPOLAR interface:

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Press the INTERFACE key until the DS0-Bipolar LED is ON.

To verify DS0-BIPOLAR mode, note the following LED states:

The DS0-Bipolar LED is ON

The Network Clock LED is ON

Connect the DS0-DP Tx/Rx jacks to the DS0 Tx/Rx interface on the top-end of the 704A-756A with a pair of Bantam cables.

Install the Clock cable to the clock interface on the channel-bank, (OIU for AT&T compatible D4).

" No Clocks Received ", Message removed from LCD

If a fixed byte is received by the OCU, the LCD will display the received byte on line 1. The red Received Byte LEDs will display the format of this byte. If random data is detected the LEDs will all appear to be on and the LCD will indicate:

" NO PATTERN DETECTED "

You have successfully selected the DS0-BIPOLAR interface. Continue to the Data rate section to select the circuit data rate.

Interface: 4-Wire Primary

The 4-Wire loop interface provides three modes of operation:

- PRIMARY mode (2.4 , 4.8 , 9.6 , 19.2 , 38.4 , 56K bps)
- SECONDARY Channel mode (3.2 to 72 (64)K bps)
- Switched-56K mode

To select the 4-Wire Primary interface:

Press the INTERFACE key until the 4-Wire Loop Primary (PRI) LED is ON

To verify 4-Wire Loop mode, note the following LED states:

The 4-Wire PRI (primary) and DCE LEDs are ON

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Install the Local Loop cable into the 4-Wire Loop interface (RJ48S) located on the top-end of the 704A-756A.

Note: If the loop cable is not installed or no signal is received, the LCD will indicate, "Loop: LOSS of SIGNAL".

If a fixed byte is received by the 704A-756A, the LCD will display the received byte on line 1. The red Received Byte LEDs will display the format of this byte. If random data is detected the LEDs will all appear to be on and the LCD will indicate.

" NO PATTERN DETECTED "

You have successfully selected the 4-Wire Loop interface. Continue to the Data rate section to select the circuit data rate.

Interface: 4-Wire Secondary

The 4-Wire loop interface provides three modes of operation:

- PRIMARY mode (2.4 , 4.8 , 9.6 , 19.2 , 38.4 and 56K bps)
- SECONDARY Channel mode (3.2 to 72 (64)K bps)
- Switched-56K mode

To select the 4-Wire Secondary interface:

Press the INTERFACE key until the 4-Wire Loop Secondary (SEC) LED is ON

To verify 4-Wire Loop SEC mode, note the following displays:

The 4-Wire SEC (secondary) and DCE LEDs are ON.

The Secondary BERT IDLE LED is ON.

Install the Local Loop cable into the 4-Wire Loop interface on the top-end of the 704A-756A.

Note: If the loop cable is not installed or no signal is received, the LCD will indicate: "Loop: LOSS of SIGNAL".

If a fixed byte is received by the 704A-756A, the LCD will display the received byte on line 1. The red Received Byte LEDs will display the format

of this byte. If random data is detected the LEDs will all appear to be on and the LCD will indicate:

"NO PATTERN DETECTED"

You have successfully selected the 4-Wire Loop interface (SEC mode). Continue to the data rate section to select the circuit data rate.

Interface: 4-Wire Switched-56K

The 4-Wire loop interface provides three modes of operation:

- PRIMARY mode (2.4 , 4.8 , 9.6 , 19.2 , 38.4 and 56K bps)
- SECONDARY Channel mode (3.2 to 72 (64)K bps)
- Switched-56K mode

To select the 4-Wire Switched-56K interface:

Press the INTERFACE key until the 4-Wire Loop SW56k LED is ON.

To verify 4-Wire Loop mode, note the following LED states:

The 4-Wire SW56 (Switched-56) and DCE LEDs are ON.

Install the Local Loop cable into the 4-Wire Loop interface (RJ48S) located on the top-end of the 704A-756A.

Note: If the loop cable is not installed or no signal is received, the LCD will indicate, "Loop: LOSS of SIGNAL".

If a fixed byte is received by the 704A-756A, the LCD will display the received byte on line 1. The red Received Byte LEDs will display the format of this byte. If random data is detected the LEDs will all appear to be on and the LCD will indicate:

" NO PATTERN DETECTED "

You have successfully selected the 4-Wire Switched-56K interface; in this mode the Data rate is automatically set to 56K bps.

SW56: Calling station

To Dial a Switched-56K circuit the 704A-756A must be set to the 4 wire Switched-56K Interface (see the Interface section). To access a remote station on the Switched-56K circuit: call the desired station by dialing the number.

Note: "Code: IDLE " will typically be received upon installation of local loop.

To dial the number:

Press INTF DIAL key and note the LCD:

```
"ENTER SW56k NUMBER  "
"ph#:                  "
"press 'F1' to SEND   "
```

Press the number keys (Note that F3 is BACKSPACE).

To initiate the call, press SEND (F1) and note the LCD:

```
" Waiting for WINK...  "
```

When WINK is detected, the LCD will indicate:

```
" Dialing. . .        " and then
" Waiting for ANSWER... "
```

When ANSWER is detected, the LCD will indicate:

```
" CALL ESTABLISHED   "
"                    "
"                    "
" HANGUP              "
```

For circuits without WINK supervision, wait for time-out and then press YES to continue to transmit digits (see top of next page).

If WINK is not detected within a 10 second time-out period, the 704A-756A will beep and the LCD will display:

```
" --NO WINK RECEIVED-- "
```

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```
"
"   Select Option Below  "
" EXIT  CONTINUE        "
```

Press CONTINUE (F3) to transmit the dialing sequence or press EXIT (F1) to terminate the call.

When dialing a call to a remote station the following procedure is initiated:

- 1) SEIZURE (Tx).....The calling station sends data mode to the network, indicating the desire to place a call.
- 2) WINK.....The network responds with data mode, indicating it is ready to receive the dialing pulses.
- 3) DIALING.....The calling station pulses out the numbers, (alternating data and control mode idle).
- 4) SEIZURE (Rx).....The network sends data mode to the receiving station, indicating an incoming call.
- 5) ANSWER.....The receiving station responds with data mode, indicating acceptance of the incoming call. The network transmits the ANSWER to the calling station (>2 Sec), indicating call established.

When the 704A-756A is transmitting the dialing sequence the IDLE and All Ones LEDs will toggle as the digits are being transmitted.

When transmission of the digits is complete, the 704A-756A will monitor for ANSWER (see above).

Note: HITS or GLARE conditions occurring during WINK or ANSWER indicate a handshake of invalid duration; a HIT when the duration is too short (WINK<70mS, ANSWER<600mS) and GLARE for durations that are too long (WINK>350).

Note: Transmission of CONTROL CODES will indicate 'hang-up' to the Network and the established call will terminate.

To terminate the call (HANGUP):

Press the HANGUP (F2) key and at the prompt press YES (F1).

The call will be terminated; note on the LCD:

```
" DISCONNECTING CALL from LOCAL STATION "
```

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If a call is terminated by the remote station, the LCD will indicate

"CALL DISCONNECTED by REMOTE STATION".

The 704A-756A will return to a monitor mode (transmitting IDLE code), waiting for incoming calls from the remote station.

SW56: Receiving Station

When the 704A-756A is operating in a Switched-56K mode, the unit will monitor for incoming SEIZURE. A SEIZURE (data mode) is generated by the network when the remote station is attempting to establish a 56k link.

When a valid SEIZURE is detected the LCD will display:

```
" --REMOTE SEIZURE -- "
```

```
" CALL ESTABLISHED   "
```

```
"                   "
```

```
"   HANGUP           "
```

The call has been established and testing can be initiated.

A HIT that occurs prior to valid SEIZURE indicates that an interval of data mode of insufficient duration has occurred. (VALID SEIZURE: >90mSec, SEIZURE HIT: <35mSec).

To terminate the call (HANGUP):

Press the HANGUP (F2) key and at the prompt Press YES (F1).

The call will be terminated; note on the LCD:

"DISCONNECTING CALL from LOCAL STATION".

If a call is terminated by the remote station the LCD will indicate:

"CALL DISCONNECTED by REMOTE STATION"

The 704A-756A will return to a monitor mode: transmitting IDLE code and waiting for incoming calls from the remote station.

Interface: DTE

The CPE interface operates in two modes:

- DCE Mode – CSU/DSU emulation (Loop data sent to DTE)
- DTE Mode – Emulate DTE (test into DSUs RS232/V.35)

To select the DTE interface and test mode:

Press the INTERFACE key until the CPE–DTE LED is ON

To verify DTE mode, note the following LED states:

The CPE–DTE LED is ON

The CLOCK – EXTERNAL LED is ON

Install the RS232 or V.35 DTE adapter cable into the Clock interface (DB-15) located on the top-end of the 704A-756A.

The test set is now configured to act as the CPE and can be connected into an existing CSU/DSU. The DTE adapter cable will automatically select the RS232 or V.35 interface when connected to the test set and to the DSU (CTS must be active from the DSU for proper operation). In this mode the test set can generate data patterns or V.54 loopback into the CSU/DSU (and thus into the network).

Note: Transmission of a Data pattern activates RTS to the DSU and transmission of a Control Code deactivates RTS.

CSU/DSU Emulation

When configured for the 4-Wire local loop interface, the 704A-756A will function as a CSU/DSU. The 704A-756A will respond to the following loopbacks typically performed by dedicated and switched CSU/DSUs:

- Alternating CSU and DSU Loopbacks
- Latching CSU and DSU Loopbacks
- CCITT compatible V.54 Loopback (latching at DSU)

When a streamed or Alternating CSU Loopback is detected the 704A-756A will display, "REMOTE CSU LOOPBACK", on line 1 of the LCD. At subrates when the test set is configured for 2047 PRIMARY PATTERN and pattern sync is obtained, the test set identifies the loopback is streamed or alternating. If an alternating loopback is detected the LCD will display, "REMOTE: ALT CSU LPBK".

When a Latching CSU Loopback is detected the 704A-756A will display, "REMOTE CSU LOOPBACK", on line 1 of the LCD. When the test set is configured for the transmitted PRIMARY PATTERN and pattern sync is obtained, the test set identifies whether the loopback is latching. If a latching loopback is detected the LCD will display, "REMOTE CSU LatchLPBK".

When a streamed or Alternating DSU Loopback is detected the 704A-756A will display, "REMOTE DSU LOOPBACK", on line 1 of the LCD. At subrates when the test set is configured for 2047 PRIMARY PATTERN and pattern sync is obtained, the test set identifies whether the loopback is streamed or alternating. If an alternating loopback is detected the LCD will display, "REMOTE: ALT DSU LPBK".

When a Latching DSU OR V.54 Loopback is detected the 704A-756A will display, "REMOTE DSU LOOPBACK", on line 1 of the LCD. When the test set is configured for the transmitted PRIMARY PATTERN and pattern sync is obtained, the test set identifies whether the loopback is latching. If a latching loopback is detected the LCD will display, "REMOTE DSU LatchLPBK".

When alternating, latching or V.54 loopback has been identified, the 704A-756A will monitor for errors in the receive from the network direction.

For proper operation of the automatic DCE adapter cable, the RTS from the CPE must be active.

LOOPBACK	LOOP-UP MECHANISM	CSU/DSU RESPONSE
Streamed CSU	Current reversal by OCU in response to the CSU control bytes	Loopback toward the Network at the 4-Wire transceiver
Streamed DSU	Continuous DSU control code bytes	Loopback toward the NW and CPE at the DCE interface
Alternating CSU	Current reversal by OCU in response to CSU alternated with 2047	Loopback toward the Network at the 4-Wire transceiver
Alternating DSU	DSU control code bytes alternated with the 2047 QRW pattern	Loopback toward the NW and CPE at the DCE interface
Latching CSU	Current reversal by OCU in response to TIP, CSU-LSC, LBE and FEV bytes	Loopback toward the Network at the 4-Wire transceiver
Latching DSU	Control code sequence of TIP, DSU-LSC, LBE and FEV	Loopback toward the NW and CPE at the DCE interface
V.54 (latching)	CCITT recommendation V.54 data sequence	Loopback toward the NW and CPE at the DCE interface

LOOPBACK	LOOP-DOWN MECHANISM
Streamed CSU	Removal of CSU control code transmission
Streamed DSU	Removal of DSU control code transmission
Alternating CSU	Removal of CSU control code transmission
Alternating DSU	Removal of DSU control code transmission
Latching CSU	Transmission of TIP control code bytes
Latching DSU	Transmission of TIP control code bytes
V.54 (latching)	Transmission of CCITT recommendation V.54 Release data sequence

To perform a local CSU/DSU loopback, refer to the Loopbacks: Self-Loop section. To transmit a loopback to an existing CSU/DSU, the test set must be located upstream from the CSU/DSU. Refer to the Access & Test section to select the desired access location. Then continue with the Interface, Data rate and Loopback sections.

Data rate: 2.4 to 56K bps

The 704A-756A will automatically select 9.6K bps when the test set is switched on.

To select another data rate:

Press the DATA RATE key until the desired rate LED is ON.

Note: Switched-56K mode is accessed via the INTERFACE key, refer to the Interface Switched-56K section for additional information.

Note: If the INTERFACE is set to 4-Wire secondary channel mode, the actual loop bit rate is 3.2, 6.4, 12.8, 25.6 or 72K bps for 2.4, 4.8, 9.6, 19.2, and 56K bps, respectively.

You have successfully selected the DATA RATE. Continue to the Loopbacks or Primary Patterns sections to perform circuit diagnosis.

Data rate: 64K bps

The 704A-756A will automatically select 9.6K bps when the test set is switched on.

To select another data rate:

Press the DATA RATE key until the 64k LED is ON

Note: 64K bps (Clear Channel) is a secondary channel mode of operation, i.e. the loop is operating with framing at 72K bps. All bits are data bits with the exception of the framing bit, (See section on byte format for more information).

You have successfully selected 64K DATA RATE; continue to the Loopbacks or Primary Patterns sections to perform circuit diagnosis.

Loopbacks: Alternating

Alternating loopbacks are typically performed from a DS0 interface. DSU loopbacks can also be performed from the 704A-756A to a CSU/DSU in a back-to-back application using OCU Mode (see Auxiliary Tests section). Note that one of the units must be configured for internal or master clock.

To perform an ALTERNATING OCU LOOPBACK:

Press the LOOPBACK Tests key until the Alternating and OCU LEDs are ON.

Press the EXECUTE key.

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If ALTERNATING CSU or ALTERNATING DSU loopback is desired:

Press the LOOPBACK Tests key until the Alternating LED and the CSU or DSU LED is ON.

Press the EXECUTE key.

The LCD will briefly display, "Undefined DATA byte", or "Data: OCU/DSU MAP", while the 704A-756A is transmitting a minimum of one second of the streamed loopback code. After completion of this interval the 704A-756A will start transmitting Alternating QRW bytes with the loopback code.

When loopback has been successfully activated and pattern sync has been obtained, the LCD will display:

```
" ALTERNATING OCU LPBK  "
" PRI BE:0000   ES:000   "
" ELAPSED TIME 00:00:05  "
```

If "ALT LPBK: SYNC LOST" is displayed in place of "ELAPSED TIME 00:00:05", pattern sync was briefly obtained and lost. Clear any errors and reset the elapsed timer by pressing RESTART (see below).

To restart (clear) the error display:

Press the RESTART key

To verify that the error analysis has been restarted and that pattern is in sync, you will note that:

The Primary Bit Errors (PRI BE) is 0000

The Errored Seconds (ES) is also 000

The "SYNC LOST" message is replaced with "ELAPSED TIME 00:00:02"

You have successfully activated an Alternating Loopback. Continue to the Error Analysis section for enhanced error interpretation or to the Insert

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Primary Errors section for error insertion.

Loopbacks: Terminating Alternating Loopback

To STOP alternating loopback and return to IDLE:

Press the STOP TEST key.

To exit alternating loopback with another alternating loopback:

Press the LOOPBACK Tests key until the Alternating and the OCU, CSU or DSU LED is ON

Press the EXECUTE key

To exit the alternating loopback test with a CONTROL CODE (such as IDLE CODE):

Press the CONTROL CODES key; note that the CMI LED is ON.

Press the EXECUTE key.

To exit the alternating loopback test with data (a primary pattern):

Press the PRIMARY BERT (PATTERNS) key until the desired PATTERN LED is ON.

Press the EXECUTE key.

To exit the alternating loopback test with a latching loopback test:

Press the LOOPBACK Tests key until the LATCHING and the OCU, CSU or DSU LED is ON.

Press the EXECUTE key.

The latching loopback sequence will be transmitted, releasing the alternating loopback and activating the latching loopback.

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For additional information on transmitting Latching Loopbacks, Control Codes or Primary Patterns, refer to their respective sections in the following pages.

Loopback: Latching OCU, CSU, DSU

Latching loopbacks are typically performed from a DS0 interface. Latching DSU loopback can also be performed from the 704A-756A to a CSU/DSU in a back-to-back application using OCU Mode (see Auxiliary Tests section). Note that one of the units must be configured for internal or master clock.

To perform a LATCHING OCU LOOPBACK:

Press the LOOPBACK Tests key until the Latching and OCU LEDs are ON.

If LATCHING CSU or LATCHING DSU loopback is desired:

Press the LOOPBACK Tests key until the Latching LED and the CSU or DSU LED is ON.

To initiate the Latching loopback test:

Press the EXECUTE key.

The LCD will briefly display, "SENDING: LATCH LPBK", followed by, "Code: FEV", or "Code: FEV MAP". The 704A-756A transmits the latching loopback sequence consisting of TIP, LSC, LBE, and FEV codes. The 704A-756A transmits up to two seconds of FEV code. When loopback is activated these FEV bytes are returned to the 704A-756A, and "LOOPBACK ACTIVATED" is displayed on the LCD.

The 704A-756A will transmit LBE code and monitor for the LBE map bytes. The received MAP byte will be displayed on the LCD:

" LBE REMAP: MAP0 " or, " MAP1 "

Note: Latching loopback may be activated without reception of valid LBE REMAP bytes. For example, a latching CSU loopback may be activated by the OCU, but may not be looped at the CSU.

When loopback has been successfully activated the 704A-756A will automatically transmit the 2047 QRW pattern on the primary channel. When pattern sync has been obtained, the LCD will display:

" Data: 2047 ET 00:00:05 "

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```
" PRI BE: 0000 ES:000      "
" STOP TEST to Release     "
```

If "Data: 2047 SYNC LOST" is displayed in place of "Data: 2047 ET 00:00:09", pattern sync was briefly obtained and lost. Clear the errors and reset the elapsed timer by pressing RESTART (see below).

To restart the error display:

Press the RESTART key.

To verify that the error analysis has been restarted and that pattern is in sync, you will note that:

The Primary Bit Errors (PRI BE) is 0000.

The Errored Seconds (ES) is also 000.

The "SYNC LOST" message is replaced with "ET 00:00:02".

If an audible beep is heard and the LCD display indicates, "LPBK DID NOT LATCH", the streamed FEV bytes were not detected, indicating that the loopback was not activated. It is recommended that TIP code is transmitted for several seconds to ensure that all elements have released loopback (e.g. Latching CSU loopback can be activated by the OCU and not detected by the test set if the CSU is not present or does not activate a loopback!). For help on transmitting TIP code, refer to the section on CONTROL CODES.

You have successfully activated a Latching Loopback. Continue to the Primary Patterns, Control Codes, or Error Analysis sections for additional circuit diagnosis or to the Insert Primary Errors section for error insertion.

Loopbacks: Releasing Latching Loopback

The Latching Loopback is automatically terminated:

Press the STOP TEST or the LOOPBACK Tests key.

The LCD will briefly display:

"SENDING LPBK RELEASE"

To verify that the loopback has been released select a PRIMARY PATTERN and monitor for sync. If pattern sync occurs on several patterns, the loopback has not released. It is recommended that TIP code be transmitted for several seconds to ensure loopback release. If the loopback is still in effect a possible metallic (hard) loopback is indicated.

To exit the latching loopback test with streamed TIP CODE:

Press the CONTROL CODE key; note that the TIP LED is ON.

Press the EXECUTE key.

To exit the latching loopback with another latching loopback:

Press the LOOPBACK Tests key until the Latching and the OCU, CSU or DSU LED is ON.

Press the EXECUTE key.

The latching loopback sequence will be transmitted, releasing the original loopback and activating the new latching loopback.

Note: When latching loopback has been automatically released via the LOOPBACK TESTS key, the 704A-756A will transmit IDLE code (ALL1's in Switched-56K mode - to prevent call disconnect).

For additional information on transmitting Latching Loopbacks, Control Codes or Primary Patterns, refer to their respective sections in the following pages.

Loopbacks: V.54 & Other Latching Loopback

V.54 and Other Latching loopbacks are typically performed from a DS0 interface. Latching NI and V.54 loopback can be performed from the 704A-756A to an NI or remote DSU in a back-to-back application. Note that the test set must be configured for internal or master clock.

To perform a V.54 LATCHING LOOPBACK:

Press the LOOPBACK Tests key until the Latching and the V.54 LEDs are ON.

To perform a LATCHING OTHER LOOPBACK:

Press the LOOPBACK Tests key until the Latching and OTHER LEDs are ON.

The LCD (line 4), will display, "LPBK: Network Interface". With each additional press of the LOOPBACK TESTS key, the LCD will display – in order:

```
" LPBK: NI           "
" LPBK: DS0 # 1     "
" LPBK: DS0 # 2     "
" LPBK: DS0 # 3     "
" LPBK: DS0 # 4     "
" LPBK: DS0 # 5     "
" LPBK: DS0 # 6     "
" LPBK: LSI (HL-222) "
```

To initiate the Latching loopback test:

Press the EXECUTE key.

The sequence of these loopbacks is similar to those for OCU, CSU, and DSU with the exception that for DS0 #2 through DS0 #6 an ALL 1s and LBE intervals are transmitted to release the preceding DS0 element from activating the latching loopback.

Release of these latching loopbacks is identical to those for Latching OCU, CSU and DSU. Refer to the previous section for additional information on releasing latching loopbacks.

The V.54 Latching Loopback:

The Latching V.54 loopback is a CCITT recommended latching loopback (similar to latching DSU loopback) consisting of a pseudorandom data sequence. A data-only pattern allows activation of a latching loopback from the local CPE to the remote CPE. This loopback is typically used in Switched-56K applications.

Release of a V.54 Loopback is identical to a latching loopback:

Press the STOP TEST or the LOOPBACK Tests key.

The LCD will briefly display, "SENDING LPBK RELEASE".

As an additional method of releasing a V.54 latching loopback, the Latching Other loopbacks includes a, "RELEASE V.54 LPBK" option, providing a continuously streamed V.54 release pattern.

Loopback: local CSU or DSU

Local CSU and DSU loopbacks are performed from the 4-Wire interface. These loopbacks allow local activation of the CSU and DSU loopbacks to assist in circuit diagnosis.

To perform a LOCAL CSU LOOPBACK:

Press the LOOPBACK Tests key until the LOCAL CSU/DSU LED and the CSU LED is ON.

Press the EXECUTE key.

To activate a LOCAL DSU loopback:

Press the LOOPBACK Tests key once more until the LOCAL CSU/DSU and the DSU LED is ON.

Press the EXECUTE key.

Termination of Local CSU or DSU Loopback

To STOP alternating loopback and return to IDLE:

Press the STOP TEST key.

To terminate a local loopback with another function:

Select a CONTROL CODE, PRIMARY PATTERN or another LOOPBACK.

Press the EXECUTE key.

For additional information on any of the above functions, refer to the appropriate section in this manual.

Loopbacks: Self-Loop

The Self-Loop can be activated in any interface mode. It is used primarily as a verification of 704A-756A operation. Note that in a DS0 Interface mode the Clock Cable must be installed to provide clocking to the unit.

Note: In 4-Wire modes if a test is in progress (unit not in IDLE) the unit will prompt you to continue. If you continue the test will be terminated, the unit will return to IDLE and Auxiliary tests will be activated.

To perform a SELF-LOOPBACK:

Press the AUXILIARY TESTS key until the Self-Termination of Self-Loop LED is ON.

To STOP self loopback and return to IDLE:

Press the STOP TEST key.

For additional information on any of the above functions, refer to the appropriate section in this manual.

Primary BERT Testing

The PRIMARY BERTs are performed from the DS0 interface during latching loopbacks to identify ONES density or pattern sensitivities. The PRIMARY BERTs are also performed at the DS0 and 4-Wire interface for straight-away testing to isolate a faulty pair (transmit or receive direction).

To perform a PRIMARY BERT test:

Press the PRIMARY BERT key until the desired pattern LED is ON.

Press the EXECUTE key.

Until Pattern SYNC is obtained, the LCD will briefly display:

" NO PATTERN DETECTED "

" ** SYNC LOSS ** "

When Pattern SYNC is obtained, the LCD will display:

" Data: 2047 ET 00:00:05 "

" PRI BE: 0000 ES: 000 "

If Pattern SYNC was obtained and then lost, the LCD will display:

" Data: 2047 SYNC LOST "

" PRI BE: 0000 ES: 000 "

To clear any accumulated errors (or to restart the elapsed timer):

Press the RESTART key; note that the errors are cleared.

To insert errors, refer to the Insert Errors section.

For error display options, refer to the Restart: Error Analysis section.

Primary BERTs: 2047/511 & DDS Stress Patterns

The patterns provide circuit performance analysis and identify element sensitivities. Sensitivity to data content, to ones or zeros density or to specific data bytes can indicate clock recovery or synchronization problems, framing difficulties, or incorrect data or code mapping. The quasi-random or pseudorandom patterns and stress pattern content is described below.

511..... Simulation of live data. Maximum of 8 Zero's and 9 One's (29-1).

2047..... A better simulation of live data. Maximum of 10 Zero's and 11 One's (211-1).

Special Pattern 1..... Stress the signal and clock recovery circuits with minimum and maximum ones density. 100 bytes of 0xFF and 100 bytes of 0x00 (800 One's and 800 Zero's).

Special Pattern 2.....	Simulate the HDLC/SDLC (X.25) packet framing protocol with minimum ones density. 100 bytes of 0x7E Hex followed with 100 bytes of 0x00
Special Pattern 3.....	Continuous bytes of 0x32 Hex (Bisync EBCIDIC), typical data transmitted by IBM and compatible equipment. Test for false S-bit framing on DS0-B circuits.
Special Pattern 4.....	Continuous bytes of 0x40 Hex (0100000), typically transmitted by VT100 and compatible terminals. Minimum ones density (1 in 8)
Composite (SP5).....	All 4 (SP1-SP4) LEDs ON. Automatically cycle through each stress pattern, verify sync and no errors for one-minute each. On failure, abort test and report the failing pattern.
All Ones.....	Maximum ones density (all data bits are ones).
All Zeros.....	Minimum ones density. Identify element handling/mapping of an All Zero byte.
Byte Encoder.....	User defined data or code. Note; format is Sddd,dddC, see section on BYTE ENCODER.

For additional information on clearing or inserting errors or on error analysis, refer to their respective sections in the following pages.

Packet Mode BERT Testing

Packet Mode is designed to emulate switched data applications or in modes where RTS is active, when the DTE is transmitting data. In WAN, Frame-Relay and other packetized applications (i.e.HDLC/X.25) or in applications utilizing async to sync conversions, the DTE may transmit data in a bursty, noncontinuous fashion.

In these bursty applications, the data transmitted to the network is interspersed with Control Mode Idle (CMI). These transitions from Data to IDLE (CMI) to Data may not be processed properly by all the circuit elements resulting in data errors. The typical 2047 and 511 test patterns do not provide the same bursty stress characteristics as the PACKET MODE test feature. Packet Mode permits varying the Control Mode Idle, and allows Circuit Elements susceptible to bursty data problems to be exposed. CMI can be set from 0 to 150 msec in 10 msec steps while Data interval can

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be set from 100 to 1000 msec in 100 msec steps.

Improper processing can result in lost data, data which is overwritten with invalid data or the insertion of additional data. Data corruption can occur on a bit, byte or on an entire packet basis. To identify whether data corruption occurs, the 704A-756A Packet Mode packetizes the standard 511 or 2047 BERT test patterns at data rates of 56K bps or 64K bps. Resultant errors are Identified as Bit Errors with Errored Seconds and Bit Error Rate calculations.

The Packet Mode test can be performed with any interface available with the 704A Universal Data Test Set. Packet analysis can be performed in both looped-back and in straight-away testing with another 704A or 704A-756A Integrated Digital Data Test Set.

Setup and Test Procedure

Note: Data Rate must be 56 or 64K bps

Set up the test set for the access and interface configuration (See Table of Contents) arrangement.

Execute the desired 511 or 2047 BERT test and verify that SYNC is obtained.

Press RESTART if any errors or SYNC LOST is indicated.

When in sync, again press RESTART and the LCD will display PACKET MODE setup menu.

Adjust the CMI and Data timing interval using the F1 and F2 control keys.

- F1: changes the IDLE interval from 0 to 150msec in 10msec steps.
- F2: changes the Data interval from 100 to 1000msec in 100msec steps.
- F3: turns the PACKET MODE ON and OFF
- F4: Escapes or exits the PACKET setup menu.

PACKET MODE will remain ON until terminated with the STOP TEST key or by deactivating the test from the PACKET MODE setup menu.

Byte Encoder

The BYTE ENCODER allows transmission of specific data or code patterns which can be used for circuit verification and identify proper mapping

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of circuit elements. The Byte Encoder dip switches are located on the top left of the unit, below the LCD. Note that the byte format is Sddd,dddC. Setting C to 0 will transmit control codes, (which may be remapped by circuit elements). The Byte Encoder can also be utilized to verify the clock recovery circuits. When transmitting an encoded byte during a latching loopback, the Received Byte (red LEDs, located to the right of the DIP switches), will display a fixed pattern. Note that the LEDs do not walk or shift (however the pattern may be rotated during some loopbacks – such as DSU).

To transmit an encoded byte:

Press the PRIMARY BERT (PATTERNS) key until the red Byte Encoder LED is ON.

Press the EXECUTE key.

If the received byte is defined DDS data or control byte the LCD will display the decoded byte on Line 1, see examples below:

" Code: UMC ", or

" Data: ALL ONES "

If the received byte is an undefined code or data byte, the LCD will display one of the following:

" Undefined CODE byte ", or

" Undefined DATA byte "

Control Codes

The CONTROL CODES function allows selection and transmission of the DDS control codes.

To select and activate a CONTROL CODE:

Press the CONTROL CODES key until the desired CODE LED is ON.

Press EXECUTE.

The CONTROL CODES can be utilized to:

- Perform streamed loopbacks
- Activate or release latching loopbacks
- Simulate circuit trouble conditions
- Test and verify Control Code remaps
- Identity any Control Code interactions or deficiencies
- Select, Block and Release MJU branches
- Determine MJUHUB-ID (Office location)

Note: The location and direction of test access and the circuit configuration will impact the response to and the translation or remap of the transmitted control code.

Note: The Latching Select Code (LSC) has been included for user selection of new or custom LSC bytes. The red Byte Encoder LED illuminates when LSC is selected – enter the desired LSC on the byte encoder dip switches.

Control Codes: Descriptions

The control codes provide a means of access and control of the various transmission elements of the DDS circuit. In addition, some codes provide status and diagnostic information. Below, is a brief description of the DDS control codes.

CPE status..... IDLE, CMI..... Control mode Idle: idle circuit – CPE inactive, (RTS low)

Loopbacks..... OCU..... Office Channel Unit: Loopback at OCU, (toward network)

(alternating, streamed).... CSU..... Channel Service Unit: Loopback at DDS repeater, NI or CSU, (toward network)

DSU..... Data Service Unit: Loopback at DSU, (toward network)

Circuit Status.....	MOS.....	Mux Out of Sync: Carrier System Failure, (generated by F1 or DLC)
	TEST.....	Text (code): Test in progress, (generated by test equipment)
	UMC.....	Unassigned Mux Code: X-conn. Problem, (generated by F1 or DS0-DO)
	ASC.....	Abnormal Station Code: loop down or no DSU, (generated by the OCU-DP)
Latching Loopbacks.....	TIP.....	Transition In Progress: latching loopback start/release
	LSC.....	Latching Select Code: Select loopback element (actually a data byte)
	LBE.....	Loopback Enable: Enable latching loopback (and query for MAP byte)
	FEV.....	Far End Voice: Activate Latching Loopback
MJU control.....	TA.....	Test Alert: Alert MJU of imminent loopback
	MA.....	MJU Alert: Query the MJU for the HUB ID (location of Office)
	BLK.....	Block (branch): Block (pre-selected) MJU branch
	REL.....	Release all blocked (downstream) MJU branches
		(Note: Use CMI to restore selected or blocked branches)

For additional information on specific groups of control codes, refer to the appropriate section in the manual.

Secondary Channel BERT

Secondary BERT (PATTERNS) are performed from the DS0 interface during latching loopbacks to verify circuit support for secondary channel data transmission. Secondary BERT (PATTERNS) also perform straightaway testing at the DS0 and 4-Wire interface for transmit/receive direction

isolation, and verification of Control code handling on secondary channel circuits.

Note: To enter the secondary channel mode of operation see the Interface 4-Wire Secondary mode section.

To perform a Secondary Pattern test:

Press the SECONDARY BERT (PATTERNS) key until the desired pattern LED is ON.

Press the EXECUTE key.

Until Pattern SYNC is obtained, the LCD will briefly display on line 3:

*** SYNC LOSS ***

When Pattern SYNC is obtained, the LCD will display on line 3:

" SEC BE:0000 ES:000 "

To clear any accumulated errors (or to restart the elapsed timer):

Press the RESTART key, and note that the errors are cleared.

Note: RESTART clears secondary and primary channel errors simultaneously.

To insert errors, refer to the Insert Secondary Errors section.

For error display options, refer to the Error Analysis section.

Insert Errors: PRI & SEC

The insertion of errors during loopbacks or straight-away testing aids in the verification of the pattern source. Two keys on the 704A-756A provide this capability:

The INSERT 6 PRIMARY ERRORS key inserts 6 bit-errors (BE) in the primary data stream on each press.

The INSERT 1 SCNDRY ERROR key inserts one (1) bit-error (BE) in the secondary channel data stream (if activated) on each press.

To insert errors into the transmit data stream:

Press the desired INSERT ERRORS key

If a loopback test is in progress, each press of the ERROR INSERT key will result in a proportional increase in the Bit errors (BE) displayed on the LCD.

To clear any accumulated errors or to restart the elapsed timer, press the RESTART button.

For information on the error display and on optional error analysis displays, refer to the Error Analysis section later in this manual.

Restart

The RESTART key restarts the elapsed timer and clears all the accumulated errors. In addition, when the errors are zero(0), the RESTART key will cycle the display through various error analysis options. Refer to the section on Error Analysis for additional information on this feature.

To restart the elapsed timer and clear all errors:

Press the RESTART key

The following examples are displays which may be visible on the LCD:

```
" PRI BE:0014  ES:003  "
" SEC BE:0004  ES:001  "

" Data 2047  SYNC LOST  "
" ELAPSED TIME 07:51:47  "
```

These will be replaced by:

```
" PRI BE:0000  ES:000  "
" SEC BE:0000  ES:000  "
```

```
" Data:2047  ET 00:00:00  "
" ELAPSED TIME 00:00:00  "
```

Error Analysis

The default error analysis display is Bit Errors (BE) and Errored Seconds (ES). Optional error displays are available by clearing any existing errors (with RESTART) and then pressing the RESTART key again. In primary mode the following displays are available with each additional press of the RESTART key (with no errors):

```
" PRI BE:0000  ES:000 " (default)
---- line 3 blank ----

" BE:0000  BER:0.00e+00 " (1st press)
" ES:000  %EFS: 100.00% "
" BE:0000  ES:000 " (2nd press)
"  %EFS: 100.00%  "

" BE:0000  ES:000 " (3rd press)
" SES:000 %  SES: 0.00% "
```

The error display will return to the default on the 4th press and then begin again. If you are in secondary channel mode and a secondary pattern test is in progress or in an alternating loopback, only line 2 (primary errors) will display the optional errors.

Refer to the next page for additional information on the available error displays.

Below is a brief description of the error analysis functions available on the 704A-756A.

BE	BIT ERRORS	The number of individual errors that have occurred in the data content of the received pattern.
----	------------	---

ES	ERRORED SECONDS	The total number of seconds in which one or more bit errors occurred.
BER	BIT ERROR RATE	The number of bits in error versus the total number of bits transmitted.
EFS	ERROR FREE SECONDS	The total number of seconds without a single bit error.
%EFS	PERCENT ERROR FREE SECONDS	The number of seconds without a single bit error versus the total number of seconds the test has been in progress.
SES	SEVERELY ERRORED SECONDS	The number of seconds in which the Bit Error Rate was equal or greater than 1x10 ⁻³ .
%SES	PERCENT SEVERELY ERRORED SECONDS	The number of Severely Errored Seconds versus the total number of seconds the test has been in progress.

Internal/Network Clock

The 704A-756A will automatically select the NETWORK (SLAVE) clock mode when the DS0 or 4-Wire interface is selected. In the 4-Wire Interface mode, operation in a Limited Distance Modem (LDM) application or operation in the OCU MODE may require that the test set provide INTERNAL (MASTER) clock. You must be in the 4-Wire interface mode to select this option.

To select INTERNAL clock:

Press the CLOCK key.

To verify INTERNAL CLOCK mode, note the following LED state:

The CLOCK – INTERNAL LED is ON.

The 704A-756A is now the MASTER and is the clock source.

To select NETWORK clock:

Press the CLOCK key.

To verify NETWORK CLOCK mode, note the following LED state:

The CLOCK – NETWORK LED is ON.

The 704A-756A is now the SLAVE and is deriving clock from the external interface.

Note: EXTERNAL clock is only utilized in DTE mode testing. Refer to the Interface: DTE section for additional information.

External Clock

The 704A-756A will automatically select the EXTERNAL clock mode when the DTE interface is selected. In the DTE Interface mode, testing is performed on the RS232 or V.35 interface of an existing DCE (CSU/DSU or T1/FT1 CSU). In this mode the DCE is typically deriving clock from the network and providing this clock to the DTE. The 704A-756A will derive clocking from the RS232 or V.35 interface.

Note: The DTE adapter cable will automatically select the RS232 or V.35 interface when connected to the test set and to the DCE (CTS must be active from the DCE for proper operation). In this mode the test set can generate data patterns or v.54 loopback into the CPE (and thus into the network).

Load Coil Detect

The Load Coil Detect Function tests the metallic DDS Loop for Installed Load Coils and provides a count of none, one, two or three. The test performs a frequency sweep of the selected pair and analyzes for Load Coil presence. The Loop can be open or terminated at the far end.

The Load Coil Detect Test Feature is accessed via the MENU key according to the following steps.

Following power up:

Press F1 to place the 704A-756A in the DDS test mode.

Press the INTERFACE key until the 4-Wire Primary LED is on.

Press the MENU key.

Press F2 – COIL DET.

Note: The status display on the LCD:

Press F1 to initiate a load coil test on the R-T pair or press F2 to test the R1-T1 pair

Note: The asterisk symbol indicates the pair being tested and the LCD displays the message – SWEEPING RX or TX. At the completion of the load coil detect test the LCD will display one of the following messages:

NO COILS DETECTED

ONE, TWO, or THREE COILS DETECTED

Press F4 to exit the load coil detect mode

Store Configuration

STORE CONFIGURATION provides the capability of saving the existing 704A-756A configuration into non-volatile memory. The stored configuration can be recalled at a later time. Memory is retained during power down or battery pack replacement.

To STORE the existing configuration:

Press the MENU key.

Press F3 MEM-CON FIG.

The DTS LCD display will indicate:

```
" CONFIGURATION MEMORY  "
"                          "
"                          "
" STORE   RECALL        "
```

Press STORE (F1) to Save the existing configuration.

Press RECALL (F3) to recover a saved configuration.

The 704A-756A verifies the storage of all configuration parameters. In addition, all parameters are verified prior to execution of the recalled configuration. The LCD will display any non-volatile memory failures. The non-volatile memory is guaranteed for over 100,000 writes. If a failure

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occurs, re-try the storage/recall process. Should non-volatile memory failures persist, memory failure may be indicated. A non-volatile memory failure will only affect the configuration storage and recall feature. Note that the 704A-756A and all the test features will remain fully operational.

SW56K CO Emulation

The Switched-56K CO Emulation mode provides the 704A-756A with the capability of operating as the Switch toward the local CSU/DSU.

Note: The 704A-756A must be configured for a data rate of 56K.

To STORE the existing configuration:

Press the MENU key.

Press F1 SW56-CO.

The DTS LCD display will indicate:

```
" SW56 OFFICE EMULATION  "
"                          "
"                          "
" WAITING FOR SEIZURE    "
```

The following call progress occurs:

Wait for SEIZURE from the local station.

Provide WINK toward the local station to initiate Dialing.

Monitor, measure and display incoming DIGITS.

Provide ANSWER toward the local station to complete the call.

Valid SEIZURE is DATA MODE for >290mS.

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Transmitted WINK is 200mS of DATA MODE, (spec. 140-290mS).

Hangup occurs upon CONTROL MODE IDLE for >300mS.

Switched-56K CO Emulation mode can be performed from either a DS0 access point or at the 4-Wire local loop. See SW56K CO Mode: Digit Analysis for additional information (the DIGIT key).

SW56K CO Mode: Digit Analysis

When the 704A-756A is in a Switched-56K CO Emulation mode, received digits can be analyzed to identify incorrect digit transmission from the CSU/DSU or identify possible transmission impairments corrupting digits received at the CO.

To analyze received DIGITS from CALL reception mode:

Press the DIGITS key (F3).

Note the analysis display on the LCD:

```
" ph# 6578810      "
" 10PPS 60% I=248 mS  "
" Make=40 Break=60 mS  "
```

PPS	Pulses Per Second	the digit out-pulsing rate
60%	Percent Break	the percentage Break of the pulse
I	Interdigit Interval	the delay between this Digit and the next
Make	Make duration	the avg duration of the MAKE period
Break	Break duration	.the avg duration of the BREAK period

Note: A '1' digit has no discernible Percent Break or Make duration. The last digit has no interdigit interval.

To view the NEXT digit:

Press the NEXT (F1) key.

To EXIT digit analysis mode:

Press the EXIT (F2) key.

To HANGUP a CALL (if in progress):

Press the HANGUP (F3) key.

Auxiliary Tests

The Auxiliary tests consist of a set of test functions which are useful to further define and isolate failures from the basic loopback tests or which are used less often but necessary for complete circuit diagnosis. These functions are sectionalized into six areas;

- Multipoint testing
- Remote DS0/OCU
- Frequency and Level measurement
- Metallic testing aids
- OCU Emulation Mode
- Self-Loop

To select an AUXILIARY test:

Press the AUXILIARY TESTS key.

If a test is in progress the DTS will prompt:

```
" Auxiliary Tests:  "
"                  "
" INTERRUPT TEST?  "
```


" YES NO "

Press YES (F1) to STOP the test and enter the AUX Test.

Press NO (F3) to EXIT the AUX Test functions.

The AUXILIARY TESTS LED indicates the test in progress, and the function (F1-F4) keys define any softkey options.

To terminate an AUXILIARY Test:

Press the STOP TEST key (twice if loopback in progress).

Multipoint - MJU

The MJU testing functions allow access and testing of multipoint circuits. The multipoint tests provided are MJU loopback, branch select, branch block, restore branch, release all branches and MJU secondary channel compatibility test.

To initiate a multipoint test, access the master dataport and select the desired function. Note the LCD display for the specific test selected.

To initiate a multipoint test:

Press the AUXILIARY TEST key until Multipoint LED is ON.

Press SELECT, BLOCK, LPBK or SEC (see below).

Press EXECUTE and monitor LCD for status messages.

Branch SELECT by pressing SELECT (F1). The LCD will display:

" Select Branch: 1 "
 " Select Branch: 2 "
 " Select Branch: 3 "
 " Select Branch: 4 "

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BLOCK, RESTORE or RELEASE by pressing BLOCK (F2). The LCD will display:

" Block Branch "
 " Release Branch "
 " Release ALL Branches "

Loopback MJU by pressing LPBK (F3). The LCD will display:

" Loop-back MJU "

MJU Secondary compatibility test by pressing SEC (F3). The LCD will display:

" SEC Channel MJU test "

MJU Testing

Typical multipoint testing consists of looping at the MJU, selecting branches and looping the dataport or blocking suspected streaming branches. A brief example of access and test of a multipoint circuit follows:

Loopback at MJU #A to verify the circuit setup. Note that the 704A-756A responds with the HUB ID of the accessed MJU, (in this case #A).

Release the MJU loopback and then Select Branch #4. Perform a dataport (OCU or DS0) loopback.

If tests pass, one can continue and Select Branch #1 and continue to MJU at HUB ID #C.

Otherwise a series of loopbacks at the intermediate dataports can isolate the trouble further.

If troubles persist, streaming CSU/DSUs may be indicated. Select the branches where streaming DSUs may be suspected and block those branches, then resume testing. (Note: Blocked branches loopback toward the CPE).

Frequency & Level

To monitor the received signal on the 4-Wire local loop for frequency and level you must be in the 4-Wire interface mode (not Switched-56K).

To activate FREQUENCY and LEVEL measurement:

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Press the AUXILIARY TEST key

Note that the FREQ & LEVEL LED is ON.

Note the status display on the LCD:

```
" Tx: 28000Hz +0.0dBm   "
" Rx: 28000Hz -32.4dBm  "
" Tx FREQ               "
```

When frequency and level measurements are complete:

Press the STOP TEST key to exit.

To select another transmit frequency, refer to Frequency Generation section, below.

Frequency Generation

To generate a test tone (sine wave at 0 + 0.5dBm at 135Ω) on the 4-Wire local loop you must be in the 4-Wire interface mode (not Switched-56K).

To activate FREQUENCY GENERATION:

Press the AUXILIARY TEST key

Note that the FREQ & LEVEL LED is ON.

Note the status display on the LCD:

```
" Tx: 28000Hz +0.0dBm   "
" Rx: 28000Hz -32.4dBm  "
"                       "
" Tx FREQ               "
```

To enter a new TRANSMIT FREQUENCY:

Press the Tx FREQ (F1) key.

Enter the desired frequency: Press the DIGIT (0-9) keys (90,000 max).

To transmit the new frequency:

Press the SEND (F1) key.

When frequency generation is complete:

Press the STOP TEST key to exit.

Metallic Testing Aids

The metallic test functions allow pair and pair-to-pair isolation and testing . The quiet term facilitates return loss and noise measurements. You must be in the 4-Wire interface mode (and not Switched 56K) to select this option.

To select a METALLIC TEST:

Press the AUXILIARY TEST key, twice.

Note that the METALLIC LED is ON.

Note the status display on the LCD:

```
"METALLIC TEST AIDS   "
"RCV XMT R-R1 135Ω   "
"R-T R1-T1 T-T1 TERM  "
```

Press the F1, F2, F3 or F4 key, to select the desired SHORT.

Note the status display on the LCD (F1 pressed):

```
" METALLIC TEST AIDS  "
"                       "
" RCV XMT R-R1 135Ω   "
```

" R-T R1-T1 T-T1 TERM "

Note: R-R1 and T-T1 (F3) is a metallic loopback toward the network (no regeneration).

When metallic testing is complete:

Press the STOP TEST key to exit.

OCU Emulation Mode

In OCU emulation mode the 704A-756A operates as a Channel bank and an OCU-DP providing clocking, sealing current and current reversal to the 4-Wire local-loop. Complete testing toward the NI and CSU/DSU can be performed without the channel access equipment, thus sectionalizing the customer loop from the network access equipment.

Note: The 704A-756A is internally current limited to 20mA maximum in normal and reversed sealing current.

To enter the OCU MODE:

Press the AUXILIARY TEST key, until the OCU Mode LED is ON.

The LCD will display:

```
" OCU EMULATION MODE  "
  "Tx: Sealing Current  "
  "Press   Yes to Verify "
  " YES                  "
```

Press the YES (F1) key to enter OCU Mode.

Note: When the OCU Mode has been entered, normal testing functions (loop-backs and BERT) can be performed. Note that execution of any CSU loopback or CSU control code results in sealing current reversal.

When OCU Mode testing is complete:

Press the STOP TEST key to exit

Self-Loop

The Self-Loop can be activated in any interface mode. It is used primarily as a verification of 704A-756A operation. Note that in a DS0 Interface mode the Clock Cable must be installed to provide clocking to the unit.

Note: In 4-Wire modes if a test is in progress (unit not in IDLE) the unit will prompt you to continue. If you continue the test will be terminated, the unit will return to IDLE and Auxiliary tests will be activated.

To perform a SELF-LOOPBACK:

Press the AUXILIARY TESTS key until the Self-Loop LED is ON.

To STOP self loopback and return to IDLE:

Press the STOP TEST key.

For additional information on any of the above functions, refer to the appropriate section in this manual.

Interface: 2-Wire Datapath

The 2-Wire Datapath interface provides Switched-56K access to Northern Telecom Datapath circuits at the 2-Wire local loop. This interface provides:

- Switched-56K CSU/DSU emulation (56K bps).
- Support for 56K connection with 4-Wire SW56K DDS CSU/DSUs.
- DTE data rates of 2.4, 4.8, 9.6, 19.2, 38.4 and 57.6K with T-Link.

To select the 2-Wire Datapath interface:

Power-Cycle the 704A-756A and note the LCD.

Press the F2 key to select the NT-2W interface.

The LCD will display a reminder to insert the NT-2W template into the 704A-756A overlay assembly.

Note: If the loop cable is not installed or no signal is received, the LCD will indicate, "NW: LOSS of SIGNAL".

Install the 2-Wire modular cable into the 2-Wire interface at the top panel of the 704A-756A. If a valid Datapath 2-Wire signal is detected the ALARM LED will extinguish and the LCD will indicate:

" LOOP NORMAL :56s "

Note: The READY LED is illuminated when the LOOP is NORMAL.

The NT-2W interface defaults to the 56K Synchronous DCE data rate as indicated by the "56s" in the upper right-hand corner of the LCD.

The 704A-756A is now ready to place or receive Switched-56K calls.

Datapath: Miscellaneous Setup

Note: THIS AND THE NEXT THREE SECTIONS ARE FOR THOSE WITH OPTION H2 (NT2W)

Options to the basic setup include Echo canceller options;

- AT&T.....Off – Disable Echo Canceller
- SPRINT-normal.....Originate
- SPRINT-auxiliary.....Answer
- SPRINT-auxiliary.....Both

To check or change the ECHO cancellation mode:

Press ECHO Select and note the LCD.

Press the numeric key corresponding to the desired mode.

Press the '2' KEY to Enable Originate (for SPRINT-normal).

To exit the ECHO select mode:

Press ESC, and wait while carrier is removed.

The OPTIONAL – DCE interface provides:

- DTE Interface RS232, RS530 and V.35.
- DTE Protocol Synchronous and Asynchronous operation
- DTE Data rates 2.4, 4.8, 9.6, 19.2, 38.4, 57.6K with T-Link.

To select a DCE interface:

Press the DTE Interface key, and the desired numeric key.

To select Asynchronous or Synchronous DCE Protocol:

Press the DTE Protocol key, and note the LCD (upper-right).

To select the DCE Data rate:

Press the DTE Data rate key, and note the LCD (upper-right).

Datapath: Loopbacks & BERT

All loopbacks (with the exception of DTE) must be performed after a call is established. The DTE loopback cannot be performed when a call is connected. The following Local and NW activated loopbacks are available in the NT 2-Wire Datapath interface:

- LL loops the unit to the Network and DTE.
- RT loops the unit toward the network.
- DTE loops the unit at the 2-Wire interface back toward the DTE.
- REM loops the Far-End unit back toward the Network and the DTE.
- REM w/BERT loops the Far-End unit and then initiates a 2047 BERT.

To perform a LOOPBACK:

Press the LOOPBACK Tests key and note the LCD.

Press the numeric key corresponding to the desired loopback.

Press the '5' key for REM loopback with BERT; the REM and BERT LEDs will illuminate.

A Bit Error Rate Test (BERT) can also be performed in a straight-away mode. A call must be established to execute a BERT test.

To perform a 2047 BERT:

Press the BERT Tests key; note the LCD.

Press CLEAR Errors to clear errors and the Elapsed Timer.

To terminate a loopback for BERT test:

Press the ESC key; the LCD will return to "CONNECTED".

SW56K Datapath: Calling Station

To Dial a Switched-56K Datapath circuit the 704A-756A must be set to the Northern Telecom 2-Wire Datapath Interface (see the Interface section).

To access a remote station on the Switched-56K circuit, call the desired station by dialing the number.

To dial the number:

Press DIAL # and note the LCD:

```
" ph#>          "
"  press 'DIAL' to SEND  "
```

Press the number keys to enter the desired phone number.

To initiate the call, press DIAL # and note the LCD.

```
" NO DIAL TONE  "
```

When DIAL TONE is detected, the LCD will indicate:

```
" Dialing...      " and then
" Waiting for ANSWER  "
```

When ANSWER is detected, the LCD will indicate:

```
" CALL CONNECTED:  "
"                  "
" Press '*' to Hangup  "
```

Note: If CARRIER is dropped or a LOSS of SIGNAL occurs the CALL will terminate and the unit will return to "LOOP NORMAL".

End-to-end BERT or loopback testing can now be performed.

To HANGUP the CALL:

Press HANGUP, and wait while carrier is removed.

SW56K Datapath: Receiving Station

When the 704A-756A is operating in a Datapath Switched-56K mode, the unit will monitor for incoming RINGING. RINGING is generated by the network when the remote station is attempting to establish a connection to this station. The 704A-756A NT-2W Datapath interface automatically answers all incoming calls.

When RINGING is detected the LCD will display:

```
" ** RINGING **  " and then
" ANSWERING...  "
```

When the ANSWER is received at the far-end unit, the LCD will indicate:

```
" CALL CONNECTED:  "
```

" " " "
 " " " "
 " Press "*" to Hangup " "

Note: If CARRIER is dropped or a LOSS of SIGNAL occurs the CALL will terminate and the unit will return "LOOP NORMAL".

End-to-end loopback or BERT testing can now be performed.

To HANGUP the CALL:

Press HANGUP, and wait while carrier is removed.

T1 TEST FEATURES (OPTION C)

The 704A-756A is a versatile and complete T1 and Fractional T1 test set. This feature was carefully selected to include those tests typically essential for the vast majority of facility turn-up and conformance test requirements, and provides a simple user-friendly interface to assist the rapid restoration of the user's network.

The 704A-756A T1/FT1 test functions include a rich library of BERT test patterns and comprehensive loopback controls. Automatic configuration provides one-keystroke setup resulting in error-free setup, reduced service clearing time, minimal training and improved tester moral. In addition, the 704A-756A provides complete CSU/DSU functionality with an integral DCE interface, and includes comprehensive Fractional T1 test functions.

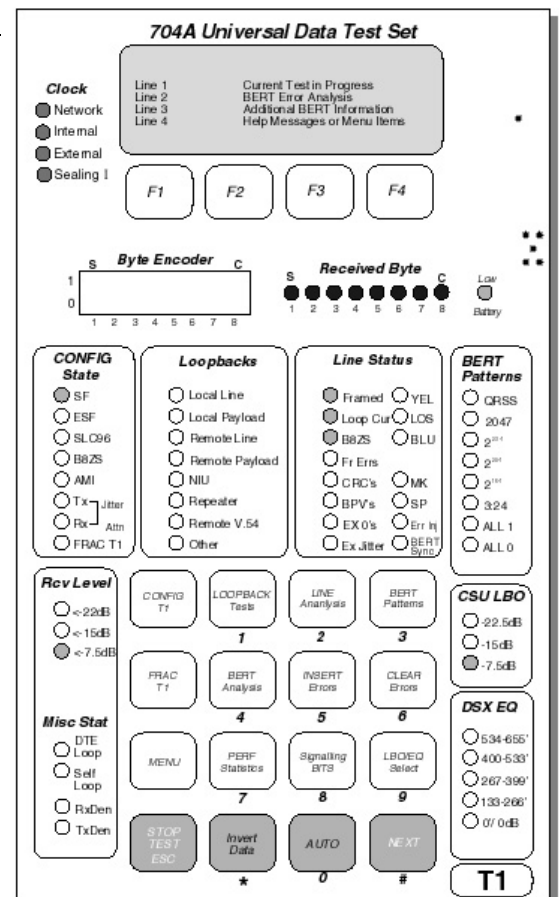
Overview: Refer to the front panel call-outs and the following descriptions for an understanding of the front panel controls and LEDs. The page number of the related test procedures is provided.

T1 test interface

The 704A-756A DDS interface allows access and test of T1, fractional-T1 and individual DS0 channels. The user interface can be switched between the DDS test set and the T1 test set (See below to return to the DDS interface from the T1 interface).

To select the T1 interface after power-up:

Press the F4 function key.



Note: the LCD display prompts you to insert the T1 test template.

To select the T1 interface from DDS testing:

Press the MENU key.

Note: the LCD displays the various options and NEXT displays more options.

Press the NEXT key twice.

Note the LCD display:

```
" Select Interface:  "
"                   "
" DDS  T1          "
```

Finally, press the F4 function key.

Note: The LCD display prompts you to insert the T1 test template.

To exit or re-select the DDS interface while in the DDS interface:

Press the F1 function key, or press the STOP TEST key

The test set will return to the DDS test interface.

T1 Test Interface: DS0 Drop

The 704A-756A DDS test set can perform all normal DDS tests on a single DS0 provided by the T1 interface. Note that if multiple DS0s are selected on the T1 interface, the DDS unit will not accept T1 DS0 drop.

To drop a DS0 from the T1 interface:

Press the MENU key, then Press the NEXT key.

The LCD will display the DS0 source options:

```
" Access DS0 from 1  "
```

```
" DDS *  T1          "
```

Note: The asterisk indicates the current source of the DS0 under test.

Finally, press the F4 function key.

Note: after changing the DS0 channel on the T1 interface you must re-select the T1 DS0 drop mode (e.g. first testing channel 4 and then switching to channel 12).

To return to the DDS interface from the T1 interface:

Press the STOP-TEST key twice.

The LCD will display on line 4 the DDS interface selection:

```
"          DDS "
```

Press the F4 function key.

Note: The LCD display will prompt you to insert the DDS template.

Front panel Descriptions

CLOCK: The illuminated LED indicates whether Network Clock (loop timed) or internal Clock is selected. Selection is made via the CONFIG T1 keypad. See

Configuration Timing.LCD: 4 line X 20 character liquid crystal display. LCD Backlight is controlled by pressing the MENU key and selecting backlight toggle.

F1 to F4 (Functions Keys): The function of these keys is identified by the LCD screen label above the key. **BYTE ENCODER:** Sets the 1/0 state of transmitted DDS byte when 704A-756A is equipped with DDS option. **REC BYTE:** Displays 1/0 status of the received DDS byte when the 704A-756A is equipped with the DDS option. **CONFIG STATE:** Configure State selections are made via the Config T1 keypad key. A lighted LED indicates the active state for configuration selections below.

SF / D4: Sets the 704A-756A transmitter and receiver to the T1/D4 superframe mode.

ESF: Sets the 704A-756A transmitter and receiver to the T1 ESF Mode.

SLC 96: Sets the 704A-756A transmitter and receiver to the SLC 96 Subscriber Loop Carrier Framing Mode.

B8ZS: Indicates the Bipolar Eight Zero Substitution zero suppression mode is active.

AMI: Alternate Mark Inversion. The T1 signal is transmitted with each subsequent mark of opposite polarity to the previous mark.

Tx/Rx Jitter Atten: A lighted TX or RX LED indicates that jitter attenuation is on.

Fract T1: The 704A-756A is configured as a Fractional T1 tester.

LOOPBACKS: A lighted LED indicates the loopback choice selected via the LOOPBACK TESTS keypad key.

LOCAL PAYLOAD: In the Local Payload mode, only the 1.536 payload data bits are looped back and retransmitted. New framing bit pattern and CRC6 error check word are generated.

REMOTE LINE (CSU): When selected via the Loopback Test keypad key, the menu prompts the tester to select either the Inband (SF or ESF) or Facility Data Link (ESF only) loopback.

REMOTE PAYLOAD: Applies only to ESF framed T1 facility. Transmits in the ESF facility data link the Payload loopback command.

NIU: Loops the Telco Demarc NIU Network Interface Unit (NIU) by sending the inband NIU Facility II code of 11000 (loop up) and 11100 (loop down) or the ESF facility data link NIU 16 bit code of 1111 1111 0100 1000 (loop up) and 1111 1111 0010 0100 (loop down).

REPEATER OPTIONAL CODE: When installed, provides codes to loop the Smart Office or Line Repeaters. Selection is by manufacturer's type.

REMOTE V.54: Transmits the V.54 FT1 loopback command.

LINE STATUS:

HISTORY: LED will light to notify that an error or alarm condition was detected.

FRAMED: Lights to indicate that the received signal framing matches the framing state selected via the Config T1 keypad key in the Manual Mode or Auto Framing achieved in the AUTO mode.

B8ZS: Lights to indicate receipt of the B8ZS pattern.

FR ERRS: When lighted indicates errors in the received framing bit pattern.

CRCs: Indicates the computed value of the received CRC word does not match the transmitted value for the extended superframe checked.

BPVs: Lighted LED indicates receipt of bipolar violations not part of a valid B8ZS word.

EX Os: Lights when the received signal contains greater than 15 consecutive zeros (AMI mode) or 8 consecutive zeros in the B8ZS mode.

EX JITTER: Lights when the jitter attenuator reaches its tolerance limit.

YEL: Yellow Alarm. Lights in SF mode when bit 2 of every byte is set to zero or in ESF when 16 consecutive patterns of 00FF appear in the ESF FDL.

LOS: Loss of Signal. Lights when 192 consecutive zeros are received.

AIS: Alarm Indicating Signal. Indicates receipt of an unframed All 1s signal. Also called Keep Alive signal.

MK: Mark. Lights to indicate an all-ones condition within the selected bandwidth.

ERR INJ: Error Inject. Lights when bit errors are being transmitted continuously.

BERT SYNC: Lights indicate pattern sync.

BERT PATTERNS: The patterns provide circuit performance analysis and identify element sensitivities. Sensitivity to data content, to ones or zeros density or to specific data bytes can indicate clock recovery or synchronization problems, framing difficulties, or incorrect data or code mapping. The quasi-random or pseudorandom patterns and stress pattern content is described below:

QRSS	Similar to 220-1 except it meets the ANSI requirement for minimum ones density.
2047	Simulation of live data. Maximum of 10 Zero's and 11 One's (211-1).
223-1	Quasi-random stress pattern with a maximum of 22 consecutive zeros and 23 ones.
220-1	Quasi-random stress pattern with a maximum of 19 consecutive zeros and 20 ones.
215-1	Quasi-random stress pattern with a maximum of 14 consecutive zeros and 15 ones.
3:24	Repetitive stress pattern: FR 01000100 00000000 00000100 (FR = Framing Bits) which contain 15 consecutive zeros and is used to stress repeater clock recovery circuits.
All Ones	Maximum ones density (all data bits are ones).
All Zeros	Minimum ones density. Should be used with B8ZS zero code suppression.

The following patterns are part of "Other" Selection:

2:8	8 bit repeated code, with 2 ones and 6 zeros: 0100 0100
1:7	8 bit repeated code, with 1 ones and 7 zeros: 0100 0000
ALT	An alternating 1/0 test pattern.
63	Simulation of live data. Maximum of 5 Zeros and 9 Ones (26-1).
511	Simulation of live data. Maximum of 8 Zeros and 9 Ones (29-1).
Bridged Tap	Pattern sequence designed to identify possible bridged taps on the circuit.

LEDs: RCV Level & Misc Stat

The seven LEDs on the lower left side of the test set provide a means of measuring the level of the T-carrier as well as miscellaneous status.

Below is a brief description of the LED functions:

RCV Level < -22dB	Lights when the signal at the receive interface is below -22dBdsx
< -15dB	Lights when the signal at the receive interface is below -15dBdsx, but greater than -22dBdsx
< -7.5dB	Lights when the signal at the receive interface is below -7.5dBdsx, but greater than -15dBdsx

Note: If none of the LEDs are lit then the level is between +2 and -7.5 dBdsx

MISC	DTE Lpbk	This LED lights to indicate to the user that a DTE loopback is in effect. This loopback loops stats from the DTE equipment back to the DTE interface. Transmit side data continues to be sent toward the T1 facility in this mode
	Self Loop	This LED lights when the test set has been placed into a self loop mode. Data from the DTE equipment is looped back and an AIS signal is sent onto the T1 line to put the far end equipment into an alarm state.
	Rx Den	Receive Density: This LED lights when the received bit stream does not meet the requirements outlined in ANSI

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	T1.403 for minimum pulse density of 1 of 8 bits a mark.
Tx Den	Transmit Density: This LED lights when the transmitted bit stream does not meet the requirements outlined in ANSI T1.403 for minimum pulse density of 1 of 8 bits a mark.

CSU LBO: Used to attenuate the transmit T1 signal. Pressing the LBO/EQ keypad key steps the selection thru a 7.5, 15 and 22.5 dBdsx pad.

DSX EQ: Pressing the LBO/EQ keypad key steps the selection thru five equalizer steps from 0 to 655 feet. Used to simulate cable lengths so that T1 pulse can be shaped as needed.

KEYPAD SELECTIONS:

Config T1: Selecting Config 1 reveals the following setup choices: T1 Framing, Zero Coding, T1 Timing Mode and Jitter Attenuation.

Loopback Test: Provides menu selections for Local Loopbacks, Remote Loopback, NIU, Repeater and V.54.

Line Analysis: Displays count of Frame Slips, Frame Errors, BPVs and CRCs (ESF mode only).

BERT Patterns: Repeated presses step thru BERT Pattern selections. Lighted LED indicates current pattern.

FRACT T1: Permits selecting any combination of DS0 time slots as the bandwidth to be tested.

BERT Analysis: This key when pressed displays bit error counts related to the received BERT pattern. BERT analysis screen also displays error insert setup when the insert Errors keypad key is pressed.

Restart: Pressing the restart key clears the History LED and all error counters. It does not reinitiate the pattern search.

Menu: Pressing the MENU key displays a selection of additional test choices and default settings. Selection includes T1 Frequency and Level, PCM Analysis, PCM Performance Statistics, Invert Data Function, set Equalizer Gain, Backlight ON/OFF and set loopback default code.

Auto: Automatically determines framing, line coding and pattern type.

Signaling Bits: Displays the A/B signaling bit state for each of the 24 DSO channels.

LBO/EQ Select: Repeated presses of this key step through the CSU LBO and DSX EQ selections. See callout #11 and #12.

Stop TEST / ESC: The first press of this key executes the Escape function and returns the 704A-756A to the History screen. The second press of this key stops the test in progress.

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Loop Up/Loop Down: Transmits the loop code selected via the Loopback Test Key or the Menu key default selection.

Next: Advances to display subsequent screens if any.

LOW BATTERY: Illuminates to indicate low battery charge state. Approx. 30 minutes of battery operation remain when LED lights.

Power-Up Automatic Operation

Upon power-up, the 704A-756A defaults to the Auto mode with the impedance set to Terminated and the clock in the Network (Loop) timed test mode. The set will automatically determine the received Framing format, Line Coding and test pattern. The auto search process will make one pass through the BERT library and display the detected BERT pattern or Alarm pattern. If no test pattern or alarm pattern is detected, the 704A-756A will declare LIVE DATA and display the History screen.

The Auto search process can be terminated by pressing the STOP TEST – ESC keypad key.

Softkeys:

F1: Pressing F1 selects the test set interface impedance of TERM, MON or BRDG.

F2: Pressing F2 - Hist will display additional screens of history events.

F3: Pressing F3 - Clear will clear the History display and extinguish the History LED. Error Counts are retained under the associated analysis section and can be observed by pressing keypad key #2 – Line Analysis or keypad #4 – BERT Analysis.

Power-Up Manual Configuration

Upon power up the 704A-756A defaults to the Auto mode with the transmitting framing, line coding and pattern automatically set to match the received signal. To abort the auto process and access the manual 704A-756A setup menus perform the following steps:

Press the keypad STOP TEST / ESC key.

Press the keypad CONFIG T1 key.

Select the desired setup parameters as listed in the screen sequence. Press the F4 NEXT key to step through the manual setup screen sequence shown below.

The T1 framing screen permits selecting the displayed modes by pressing the associated numeric key.

The asterisk indicates that ESF is the current mode.

The ZERO Coding screen permits selecting the line coding format by pressing the associated numeric key.

The asterisk indicates that B8ZS zero suppression code is the current selection.

The Timing Mode screen permits selecting the displayed modes by pressing the associated numeric key.

The asterisk indicates that Loop Timed is the current mode.

The Jitter Attenuation screen permits selecting the receive or transmit jitter attenuation modes by pressing the associated numeric key.

The asterisk indicates that OFF is the current mode.

When parameter selections are complete, press the STOP / ESC key to exit to the History screen.

Configuration: Framing

To select the desired framing format:

Press the CONFIG T1 key.

Press either 1, 2, or 3 to select the desired framing.

Note: The LED in the CONFIG area lights corresponding to selected framing format. This gives the user a quick indication of the current framing format.

Connect the T1 line to the RJ-45 jack or the Rec and XMT bantam jacks on the end panel of the test set. These jacks are labeled "T1 Interface".

Use the LEDs in the Line Status area of the test set to determine if proper framing has been selected. The Framed LED will light indicating proper frame synchronization has been achieved. If the red LOS (Loss Of Signal) LED is lit, check for proper connection of the test interface. In many cases the receive and transmit lines may be swapped.

To continue with configuration (zero code suppression):

Press the NEXT key.

Or press STOP TEST / ESC key if configuration is complete.

Configuration: Zero Code Suppression

To select the zero code options:

Press the CONFIG T1 key.

Press the NEXT key once.

The LCD will show:

```
"  ZERO CODING      "
" 1 .. B8ZS  3 .. * AMI  "
" 2 ... B7S          "
" < ESC or NEXT = more  "
```

Use the 1, 2, or 3 keys to select the required Zero code suppression. B8ZS is the most common zero code suppression technique. If "3" is selected, the test set is operating in what is known as "AMI" mode, short for Alternate Mark Inversion. AMI refers to the type of line coding used on T1 lines, but is also used as a term to describe T1 running without zero code suppression.

To continue with configuration (timing mode):

Press the NEXT key once

Or press the STOP TEST / ESC key if configuration is complete.

Configuration: Timing

To change the timing mode:

Press the CONFIG T1 key.

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Press the NEXT key twice.

The LCD will display:

```
" 1 .. * Loop Timed      "
" 2 .. Internal Timing   "
"                          "
" <ESC or NEXT = more>  "
```

Note: The LEDs at the top left corner of the test set indicate the current timing mode selected (Network Clock = Loop Timed).

For most applications, especially when emulating customer equipment, looped timing is the proper choice. When in looped timing the recovered network clock is used to transmit T1 data onto the line. In contrast, while in internal timing, the transmit clock is generated within the test set and is independent of the recovered (rcv) clock. Internal timing would be used when the test set is used as a replacement for network side equipment.

To continue with configuration (jitter attenuation):

Press the NEXT key.

Or pres STOP TEST / ESC key if configuration is complete.

Configuration: Jitter Attenuation

To select the jitter attenuation options:

Press the CONFIG T1 key.

Press the NEXT key three times.

The LCD will show:

```
" JITTER ATTENUATION  "
```

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```
" 1.. *ON_Rx  4.. 32bit  "
" 2... ON_Tx  5.*128bit  "
" 3.. OFF <ESC, NEXT>  "
```

Use the 1, 2, or 3 keys to select which path the attenuator is to be placed, or to disable it entirely. Normally, the jitter attenuator is placed in the receive path so a stable recovered clock is maintained. Sometimes, while troubleshooting a signal in the transmit path, it can be beneficial to move the jitter attenuator to the transmit side.

The 128 bit mode is used in applications where a wide tolerance to clock wander is needed. The 32 bit mode is more appropriate in delay sensitive applications.

To quit the configuration mode:

Press the STOP TEST / ESC key once.

Or you may press the NEXT key to return to framing configuration.

Configuration: CSU LBO/DSX Pre-EQ

The test set initially powers up with no LBO or Pre-EQ enabled and transmits a signal at 0 dBdsx.

The LBO/EQ Select key is used to set up the transmitter section to provide the optimum DS-1 wave shape needed by the equipment at the other end of the transmission line. Each time this key is pressed, the test set steps to the next LBO/EQ setting.

When connected to a DSX patch panel (generally on network side equipment) the DSX Pre-EQ is used to pre-emphasize the signal to compensate for line losses in cabling and is set based on the length of the cable rather than the dB attenuation.

The CSU LBO is used to attenuate the outgoing signal to prevent the test set from overdriving the far end receiver. It has three attenuation settings which simulate the effects of cable on the DS-1 signal.

To select the DSX Pre-EQ or the CSU LBO:

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Press the LBO/EQ Select key until the desired setting is achieved.

The eight LEDs in the lower right area of the test set indicate the currently selected LBO/EQ setting. Each time the key is pressed, the test set steps to the next setting and will cycle through back to 0/0 dB. Always start with 0/0 dB and add LBO or EQ as needed.

Line Analysis - SF

The Line analysis key on the 704A-756A is used to assess the 'quality' of the transmission path by showing the number of Bipolar Violations (BPVs) and Framing bit errors seen in the received T1 data stream. When in the SF (D4) framing format, BPVs and the Framing bits are about the only way to non-intrusively assess the circuit quality.

To enter the line analysis mode:

Press the LINE Analysis key.

The LCD will show:

```
" LINE ERRORS 00:28:15  "
" Frame Slip: 000000  "
" Frame Errors: 000000  "
"                   <F4 NEXT>"
```

The first line shows the elapsed time on which the count is based. Press the F4 NEXT Key or the Line Analysis Key to cycle the display to the BPV Error Screen.

Use the RESTART key to reset all of the counters to zero.

To exit the line analysis display:

Press the STOP TEST / ESC key once.

Line Analysis – ESF

When running ESF formatted T1, a method of determining errors in the payload is accomplished through the facility data link (FDL). A checksum based on the payload data, called the Cyclic Redundancy Check (CRC), is sent to aid the distant end in determining when errors have occurred.

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By counting the CRC errors, a good estimate of line quality can be made.

To enter the line analysis mode:

Press the LINE Analysis key.

The LCD will show:

```
" LINE ERRORS 00:28:15  "
" BPV Errors: 000389    "
" CRC Errors 000015    "
```

The first line shows the elapsed time on which the count is based. Violations are displayed on line two. Line three shows the current count of CRCs received in error. Press the F4 NEXT Key or the Line Analysis Key to cycle the display to the Frame Slip and Errors Screen.

Use the RESTART key to reset all of the counters to zero.

To exit the line analysis display:

Press the STOP TEST / ESC key once.

BERT Testing

Bit Error Rate Tests (BERT) are primarily performed on the entire DS1 bit stream in either a straight-away fashion or from one end with the distant end in a loopback mode. Straight-away testing is useful when testing to isolate a faulty transmission path, but requires a signal source/receiver at each end of the circuit. A looped test can be run from one end of the circuit, but path isolation is difficult.

The 704A-756A will also allow a BERT test to be performed on either full or fractional T1 circuits. In the fractional mode, the user can select single or multiple DS0s. Refer to the section on DS0 selection if BERT tests on fractional T1 are required.

To perform a BERT test:

Press the BERT Patterns key until the desired pattern LED is ON.

Until Pattern Sync is obtained, the LCD will display:

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```
" QRSS          "
" *** SYNC LOSS *** "
```

When Pattern Sync is obtained, the status LED Bert Sync will light and the LCD will display:

```
" RCV: QRSS      "
" **** NO       **** "
" **** ERRORS   **** "
" TERM          INTF "
```

BE = Bit Errors, ES = Errored Seconds, and BER = Bit Error Rate.

The (F1) TERM Key when pressed selects the MONitor, TERMinated or BRDG – Bridged Test Set Interface.

The (F2) HIST Key when pressed displays the screen showing the cause of the History Event. Pressing the NEXT Key displays additional screens as appropriate.

The (F3) CLEAR Key when pressed clears the History counters and resets the History LED. When the History LED is off, the F2 and F3 Keys are not labeled.

The (F4) Key when pressed returns Main Menu.

BERT Analysis

If Pattern SYNC was obtained, and then lost, the LCD will display:

```
" RCV: QRSS      "
" HISTORY: SIGNL LOSS "
" TERM hist clear INTF "
```

To display Bit Errors and Errored seconds:

Press the BERT Analysis key once

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The LCD will display:

```
" QRSS      00:00:25  "
" BE: 0000    ES: 100.00  "
" BER:0.00e+00          "
```

Note: ES = Errored Seconds, %EFS = Percent Error Free Seconds, SES = Severely Errored Seconds, and %SES = Percent Severely Errored Seconds.

To observe Errored Seconds and Error Free Seconds (Shown Above, Right):

Press the BERT Analysis key once.

Use the BERT Analysis key to toggle between these two screens.

To clear any accumulated errors (or to restart the elapsed timer):

Press the RESTART key.

To insert errors, refer to the Insert Errors section.

BERT Pattern Selection

On power up, the 704A-756A defaults to the Auto Mode. To suspend the Auto Search sequence, press the STOP TEST / ESC keypad key. A test pattern of choice can now be selected as follows:

To select a BERT pattern:

Press the BERT Patterns key until the desired pattern LED is ON.

Note: Seven additional patterns are available to the user when the LED marked 'other' is lit.

When the pattern marked 'other' is selected the LCD will show:

```
" SELECT DESIRED BERT "
"                      "
```

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```
"
" 2:8 1:7 NEXT      "
```

To select one of the two indicated patterns, use F2 or F3. Select F4 to call up three additional patterns: ALT, 63, 511, and F4 again to select Bridged TAP.

To turn off the BERT pattern:

Press the STOP TEST key twice.

All of the BERT Patterns LEDs will be off

Insert Error

The insertion of errors during loopbacks or straight-away testing aids in the verification of the pattern source. The INSERT Errors key on the 704A-756A provides the capability of either sending single bit errors or sending a stream of errors at a choice of 6 bit error rates.

Note: Bit errors can only be inserted while running a BERT test. If a pattern has not been selected, the Insert Errors key is disabled.

To insert single bit errors into the transmit data stream:

Press the BERT Analysis Key.

Press the INSERT Errors key to enable the error screen.

The LCD will display:

```
" QRSS 00:00:25  "
" BE:000000 ES: 0000  "
" BER: 0.00e+00  "
" 1 bit INSRT CLEAR ESC  "
```

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" (F1) (F2) (F3) (F4) "

With the above display, a single bit error will be sent with each press of the F2 Key or the INSERT Errors key. If a far end loop has been established, each press of the INSERT Errors key will result in a proportional increase in the Bit Errors displayed on the 704A-756A screen.

For information on the error display and the optional error analysis display, refer to the BERT Testing section in this manual.

Bit errors can also be streamed at one of six user selectable bit error rates. These Bit Error Rates (BER) are 1 E-2, 1 E-3, 1 E-4, 1 E-5, 1 E-6, and 1 E-7.

Note: Bit errors can only be inserted while running a BERT test. If a pattern has not been selected, the Insert Errors key is disabled.

To select the rate at which bit errors will be streamed:

Press the INSERT Errors key.

Press the F1 key until the desired rate is displayed.

Once the rate has been selected, use the insert errors key or the (F2) key to turn the bit error rate generator on and off:

To start or stop the bit error generator:

Press the INSERT Errors key or (F2) now labeled STOP

An LED in the Line Status section of the display labeled Err Inj will light when the generator is streaming bit errors.

To exit from the Bit Error Rate generation mode:

Press the F2 STOP key.

Press the F4 key.

To clear any accumulated errors or to restart the elapsed timer, press the RESTART key.

Restart

The RESTART key restarts the elapsed timer and clears all the accumulated errors.

To restart the elapsed timer and clear all errors:

Press the RESTART key.

The following examples are displays which may be visible on the LCD:

```
" RCV:   3n24   "
" **** NO **** "
" **** ERRORS **** "
" TERM   INTF   "
```

These will be replaced by:

```
" RCV:   3n24   "
" HISTY: CRC EVENT "
" PATTERN BIT ERRORS "
" TERM  Clear INTF   "
```

Invert Data

The Invert Data function is accessed from the Menu keypad and is used to invert the BERT data in both the transmitted and received directions. This can be useful, especially since some vendors' test equipment has unconventional patterns which are inverted versions of the more standard test patterns.

The Invert Data function can also be used when troubleshooting a circuit with a suspected ones density problem. A pattern with a low ones density can be inverted to provide a pattern with a high ones density. If a big difference is found in the performance, suspect a clock recovery problem, perhaps in a T1 repeater.

To invert the transmitted and received data pattern:

Press the MENU key.

Press keypad #4 to select Invert Data.
Press STOP/ESC to exit to History Screen.

The pattern type displayed on the first line of the LCD includes the word Inv to indicate an inverted pattern is being run:

" QRSS – INV 00:00:25 "

To return the BERT pattern to normal:

Press the MENU key again.

Deselect Invert Data by Pressing keypad # 4.

Auto Remote loopbacks

The 704A-756A permits assigning a default remote loop up and loop down code to the front panel keypad LOOP UP and LOOP DOWN keys. To assign a default value follow these steps:

Press STOP TEST / ESC to normalize the test set.

Press the MENU key to display the menu screen.

Press NEXT until screen item #7 – Default Loop back is displayed.

Press keypad numeric #7 key to display the following remote loopback default choices:

```
"1.. *REM-INBAND NIU  "
"2... REM-INBAND LINE  "
"3... REM-FDL NIU      "
"                          next"
```

The screen choice permit selecting the displayed remote loop back default code by pressing the associated numeric key.

The asterisk indicates that REMOTE INBAND NIU is the current default mode assigned to the loop up and down keys.

The additional remote default loopback codes are provided as choices 4 and 5.

The following chart provides the bit sequence associated with each of these codes:

LOOP CO	LOOP UP	LOOP DOWN
IN-BAND		
CSU	10000	100
NIU FACILITY 2	11000	11100
OUT OF BAND (ESF FACILITY DATA LINK)		
CSU LINE	1111 1111 0111 0000	1111 1111 0001 0000
CSU PAYLOAD	1111 1111 0010 1000	1111 1111 0100 1100
NIU	1111 1111 0100 1000	1111 1111 0010 0100

Local Loopbacks

Local Loopbacks are used to manually put the test set into a looped mode. In this way, circuit path continuity can be checked.

To access the LOCAL loopback options:

Press the LOOPBACK Tests key.

The 704A-756A will check for a pre-existing loop. If one is detected, the screen will display the message:

```
" PREEXISTING LOOPBACK  "
" CONTINUE LOOPBACK?    "
"  YES  NO                "
" (F1) (F2) (F3) (F4)   "
```

Select (F1) Yes to Continue.

Press the numeric '1' key.

Three loopback choices are available, and one selection to turn off any local loopbacks. The first choice is line loopback. In this loopback, data received from the T1 line will be transmitted back onto the T1 line, including any Bi-Polar Violations (BPVs) received. This loopback is also known as 'CSU' Loopback.

To initiate a LINE (CSU) Loopback:

Press the numeric '1' key.

Note: An asterisk will appear next to the word Line on the LCD and the Local Line LED will be lit.

The second type of loopback is known as 'payload' loopback and is similar to line loopback. Data within all 24 DS0 channels is looped back to the source, but any BPVs will be corrected. A new CRC6 (error checking) word is calculated, a new framing pattern is generated, and the Facility Data Link (ESF only) is re-generated.

To initiate a PAYLOAD loopback test:

Press the numeric '2' key.

Local Payload loopback will be indicated on the LCD by the asterisk next to the word Payload and also by the LED labeled Local Payload in the loopback section of the front panel display.

Note: In each of these loopbacks, received data from the T1 stream continues to pass through the test set while being looped to the transmit side. Because of this, the BERT receiver can still synchronize with the incoming data, and by using the BERT Patterns key, a one-way (RCV) BERT can be done.

The third type of Local loopback is self loopback. The test set will replace the normally transmitted T1 data with an unframed all ones (AIS) signal, to alert the distant end that a test is being run. In this mode, the test set will loop data internally back to itself. Self loop is useful in verifying proper operation of the test set. Bert patterns can be run while in self loop.

To initiate a self loop:

Press the numeric '3' key.

The LCD will display an asterisk next to the word SELF while this loopback is enabled. Also, the LED in the lower left corner of the test set will light.

To shut off any of the Local Loopbacks:

Press the numeric '4' key.

Press STOP TEST / ESC to return to the main testing screen.

Manual Remote Loopbacks

Manual Remote Loopbacks are used to place the far end equipment into a looped mode. Circuit quality and continuity can be checked.

To access the REMOTE loopback options:

Press the LOOPBACK Tests key.

The 704A-756A will check for a pre-existing loop. If one is detected, the screen will display the message:

Press the numeric '2' key.

```
" REMOTE LOOPBACKS:  "
" 1.. Line   4.. RPTR  "
" 2.. Payload 5.. V.54 "
"3.. NIU           "
```

To initiate a LINE (CSU) Loopback:

Press the numeric '1' key.

The LCD will prompt the user for either INBAND (SF) or Facility Data Link (ESF) code:

```
" REMOTE LINE LOOPBACK  "
" 1.. In-Band           "
" 2.. FDL, ESF – Datalink "
```

Caution: Facility Data link transmission is only available when the interface is configured for ESF framing. The 704A-756A will prompt the user if FDL transmission is selected while in the SF format.

Upon selecting the type of code to be sent, the 704A-756A will prompt the user to begin loop-up code transmission. For example, when INBAND LINE Loopback is selected the LCD shows:

```
" REM – INBAND LINE LPBK  "
" 1 .. Loop-Up           "
" 2 .. Loop-Down        "
```

Note: Use the STOP TEST / ESC key to exit at any time.

To transmit the loop-up code:

Press the numeric '1' key.

The test set immediately begins transmission of the loop up code. Loop up code transmission will continue until the receiver sees the loop up code coming back, or until the STOP TEST / ESC key is pressed. If loopback was successfully enacted the LCD will show:

```
" LOOPBACK ACTIVATED "
```

Typically the user would then run BERT patterns or do a line analysis. When finished, the procedure to loop down the circuit is the same, only press the numeric '2' key when prompted to loop down.

To loop down the circuit:

Press the numeric '2' key.

Manual Remote Payload Loopback is used to loop the payload data at the distant end of an ESF formatted line. This loopback will not work on SF formatted lines and the user will be prompted so. Because of this, the user is not prompted for INBAND or FDL transmission. Payload loopback is not always supported by end equipment, so be cautious when using it.

To access remote payload loopback options:

Press the LOOPBACK Tests key.

Press the numeric '2' key TWICE.

The test set prompts the user to begin transmission of loop code:

```
" REMOTE PAYLOAD LPBK  "
" 1.. LOOP-Up          "
" 2.. Loop-Down       "
" Press No# ESC=exit   "
```

Ten repetitions of loop-up code are sent and the fourth line of the LCD momentarily displays:

```
" Sending Loop-up Code  "
" LOOPBACK ACTIVATED   "
```

To loopdown a Payload LOOPBACK:

Press the LOOPBACK Tests key.

Press the numeric '2' key twice.

The test set will prompt the user to send loop down code with the following display:

```
" REM PAYLOAD LPB      "
" 1.. Loop-Up         "
" 2.. Loop-Down       "
" Press No# ESC=exit   "
```

Pressing the number 2 key will cause the unit to send ten repetitions of loop down code in the Facility Data Link. The LCD will momentarily show:

" Sending Loop-Down "

Note: Payload Loop-up or Loop-down code can only be sent while configured for ESF format. If an attempt is made to send one of these codes while in SF format, an error message and tone will be generated, and the loop up/down code will not be sent.

The user should verify that the distant end is out of loopback by sending a BERT pattern.

Manual Remote NIU Loopback

Manual Remote NIU Loopback is used to put the distant end Network Interface Unit (sometimes referred to as 'smartjack') into a line loopback mode. It is very similar to a CSU loopback, but because it uses a different loop code, a different element is put into loopback. The NIU is usually placed right at the customer demarc, so loopback at this point is useful in determining the status of the telco owned lines.

To perform an NIU Loopback:

- Press the LOOPBACK Tests key, then select key 2.
- Select the NIU option (numeric key 3).

The 704A-756A will prompt the user for either Inband or ESF Facility Data Link code transmission. Press the numeric '1' key for Inband, and the '2' key for FDL. The user is then prompted to begin transmission of either loop-up or loop-down code:

```
" REM – INBAND NIU LPBK  "
" 1.. Loop-Up           "
" 2.. Loop-Down        "
" Press No# ESC=exit    "
```

Upon pressing the numeric 1 or 2 key, code transmission begins immediately. Inband loopback will be sent continuously and it will cease if it is seen coming back. ESF Data link code will be repeated ten times regardless of the status of the loop. The Loopback LEDs on the face of the unit display the current loopback status.

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Manual Remote repeater loopback

Manual Remote repeater loopback is used to access and initiate loopbacks in intelligent line and office T1 repeaters. Because of differences between vendors and their operation codes, the user is prompted to select one of three vendors as well as the address of the repeater to be looped. These repeaters require an 'arming' code before they will respond to any loopcodes. The arming sequence is the same code as Inband NIU loopback.

To begin testing office and line repeaters:

- Press the LOOPBACK Tests key, & select REMOTE with key '2'.
- Select RPTR option by pressing the numeric '4' key.

The 704A-756A will prompt the user to choose either an office or a line repeater:

```
" REMOTE REPEATER LPBK  "
" 1.. OFFICE           "
" 2.. LINE             "
```

Select either numeric key '1' or '2' and the test set will prompt the user to select one of three vendor types:

```
" REMOTE REPEATER LPBK  "
" 1. Teltrend 3. Wescom "
" 2. Westell           "
```

Upon making the selection, the 704A-756A will prompt the user to select the address of the repeater being accessed.

The 704A-756A will prompt the user to select the address of the device to be looped up. Use the numeric keys to enter a number from 1 to 20, then press the NEXT key. The test set will then prompt the user to begin transmission of loop codes:

```
" REM – REPEATER LPBK  "
```

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```
" 1.. Loop-Up          "
" 2.. Loop-Down       "
" Press No# ESC=exit  "

```

Upon pressing the numeric 1 or 2 key, code transmission begins immediately. All repeater loop codes are sent In-band and the arming sequence is sent before any loop-up command. Circuit verification can then be made by running a standard BERT test.

The Loopback LEDs on the face of the unit display the current loopback status.

Fractional T1

The Fractional T1 mode of operation allows the user to break up the bandwidth of the T1 stream and run either data traffic or BERT tests in the selected DS0s. A full T1 contains 24 DS0s, with each DS0 using up 64kb of the bandwidth. With fractional T1, the band width is selectable in N x 64 increments, with N being any number from one to 24. DS0s do not have to be contiguous, and any imaginable combination can be programmed. By using fractional T1 the tester can access one DS0 and perform maintenance testing on that channel and its associated line equipment.

To select the active FRACTIONAL T1 channels:

Press the FRAC T1 key.

The LCD will show:

```
" SELECT DS0(s):      1536K  "
" Channel  □□□□□□□□□□□□  "
"   2    □□□□□□□□□□□□  "
" CLEAR  <<          >>  OFF  "

```

When the test set is first turned on, all of the DS0s are enabled (full T1). The number in the upper right corner of the display shows the total

aggregate bandwidth enabled. In the case of full T1 this number is 1536kb/s. The user will notice that this number will change as the DS0s are selected or de-selected. The 24 small boxes on LCD lines 2 and 3 represent the 24 DS0s in the T1 signal.

```
" SELECT DS0(s):      1280K  "
" Channel  □□□□□□□□□□□□  "
"   2    □□□□□□□□□□□□  "
" CLEAR  <<          >>  OFF  "

```

The display shows DS0 5 thru 8 being off, with the rest on. The blinking cursor shows which channel is being acted on, and its numerical equivalent is displayed to the left. The function keys F1 thru F4 are used to set up the fractional T1 channels. F1 is used to either turn all of the channels on or all off. Initially, since the unit comes up in full T1, the key shows 'clear' and if pressed, will turn off all of the DS0s, for a total bandwidth of 0kb. F2 and F3 are used to position the cursor to the channel to be changed. F4 then toggles the state of the channel pointed to by the cursor. If the channel is on, then F4 will show 'off' meaning that pressing the F4 key will turn off the channel. Conversely, if the channel is off, the F4 key will show 'ON', indicating that a key press will turn that channel on. Each time F4 is pressed, the cursor automatically moves to the next channel.

Use the F1 key to select FULL T1, or to start over by clearing all channels.

To select the active DS0(s):

Use the F2 and F3 keys to position the cursor, then use the F4 key to select or de-select the channel.

To exit from programming fractional T1 channels:

Press the FRAC T1 key or the STOP TEST / ESC key.

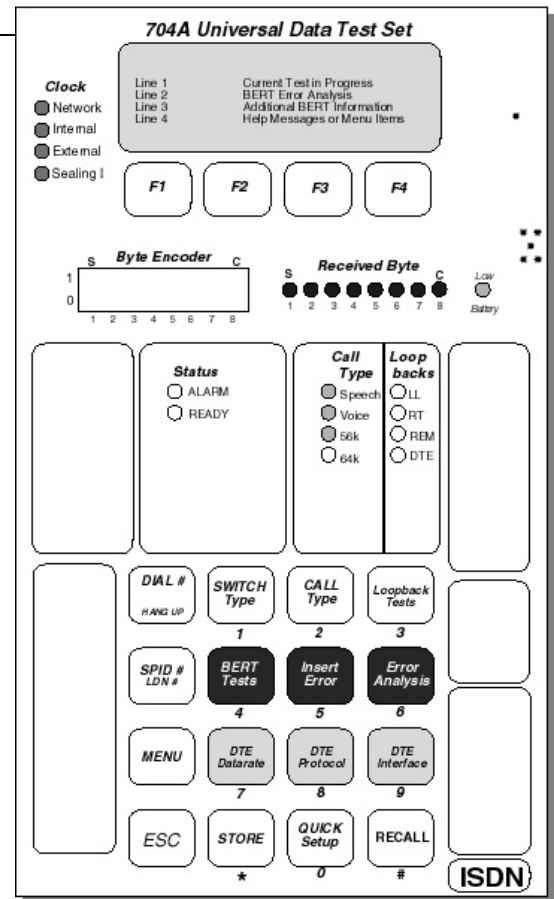
BASIC RATE ISDN FEATURES (OPTION N)

The 704A-756A Option N provides a versatile and complete BRI ISDN test function optimized for data and internet applications. The Option N ISDN test capabilities include BRI ISDN configuration, loopback and BERT testing capabilities from 2B1Q U interface. The Basic Rate Interface provides NT1 or combined NT1 + T1 functionality and supports both asynchronous and synchronous operation. The implicit user interface allows quick user configuration and call set-up. Comprehensive loopbacks and BERT capabilities ensure proper circuit operation. The NT1 + TA emulation mode simulates the actual operation of the end-user equipment to insure circuit compatibility. The Option N interface supports the industry standard BONDING protocol which allows the B1 and B2 channels to be combined to provide an aggregate 112K or 128K BPS synchronous or 115.2K asynchronous data channel.

The BRI ISDN test functions per Option N may be ordered as an option on either the Integrated Digital Data Test Set package per the 704A-756A-00 or 704A-756A-01 nomenclature or alternately ordered as Option C as part of the 704A Universal Data Test Set Chassis

Typical Service Problems

ISDN service troubles consist primarily of the four (4) basic configuration mismatches shown below. The 704A-756A Option N is designed to assist in identification and verification of the circuit and TA configuration required to provide the end-to-end data



connections commonly utilized by ISDN service customers.

TYPICAL SERVICE PROBLEMS

- 1) Invalid SWITCH-TYPE
- 2) Incorrect SPID numbers
- 3) Mismatched CALL-TYPE
- 4) Mismatched DTE Protocol

1) and 2) prevent Link Activation identified by the "ISDN READY" display. When the "ISDN READY" message is displayed on the LCD the NT1 + TA configuration to the network (switch) is correct. 3) and 4) prevent successful connection to remote TA's (Terminal Adapters). Calls can be made but connection failures, connection drops or connection at undesired data rates occur.

1) Invalid Switch type prevents successful layer-1 link activation. The most common switch type is National ISDN-1. Other switch types supported by the 704A-756A/704A-756A Option N is NEC, AT&T and NT (DMS 100). The National ISDN-1 switch type is a vendor-independent switch protocol, (i.e. the ISDN-1 switch type will function with any switch configured with generic software supporting ISDN-1).

If an incorrect switch type is selected, the LCD will indicate one of the following messages: "LINK DOWN", "Waiting for TEI#1" or "Sending SPID1". After a timeout interval the LCD will display, "Check Switch type and SPID numbers".

2) Incorrect SPID (Service Profile ID) number will prevent successful layer-2 link activation. The SPID is a 14 digit number consisting of the area-code (3 digits), phone number (7 digits), Suffix (2-digit Terminal ID) of the ISDN line. If the line is configured for two B channels (2B+D), two SPID numbers will be required.

If an incorrect SPID1 number has been entered, the LCD will indicate one of the following messages: "Waiting for TEI#1" or "Sending SPID1". If an incorrect SPID2 number has been entered, the LCD will indicate one of the following messages: "Waiting for TEI#2" or "Sending SPID2". After a timeout interval the LCD will display, "Check Switch type and SPID numbers".

3) Mismatched Call-Type results in connection failures or connection at reduced data rates. If a serious mismatch occurs the LCD will display, "N CARRIER" or "CONNECTION" briefly and then, "CALL DISCONNECTED". Some call type mismatches will connect if the protocol is set to CLEAR. In these cases, the connection may be at a reduced data rate, such as 56k when making a 64k call.

4) Mismatched DTE Protocol results in connection failures or connection at reduced data rates. If a serious mismatch (e.g. V.120-BOND or PPP-TLINK) occurs the LCD will display, "NO CARRIER" or "CONNECTION" briefly and then, "CALL DISCONNECTED". Some protocol mismatches will connect with a varied success depending on the protocols in question. In some cases, the connection may be at a reduced data rate.

While connections may occur at mismatched DTE data rates, only rate adapting protocols (such as V.120 or T-LINK) allow end to-end data flow.

Switch Types

The 704A-756A Option N ISDN test set supports all common switch types providing ISDN services. These switch types are National ISDN-1, AT&T 5ESS, Northern Telecom DMS 100 and the NEC. Note that National ISDN-1 is a switch independent protocol and most switches listed above among others, like the SEIMENS EWSD, also support National ISDN-1.

Incorrect or mis-matched Switch Types (and SPID) can prevent successful layer-1 link activation, indicated by the ALARM LED and "LINK DOWN", "Waiting for TEI#1" or "Sending SPID#1". Successful link activation is identified by illumination of the READY LED and the "ISDN READY" display on line 1 of the LCD.

The current Switch-type selected is displayed on line 1 of the LCD.

To change the SWITCH TYPE:

Press the SWITCH Type key.

The available Switch Types will be displayed on the LCD:

```
" SWITCHTYPE: ISDN-1  "
" 1.. 5ESS   3.. 1SDN-1  "
```

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```
" 2.. DMS100  4.. NEC    "
" Press No# for Switch  "
```

To select a new Switch Type:

Press the Numeric key associated with the desired Switch Type.

You have successfully selected a Switch Type; continue to the section on SPID# entry.

SPID & LDN Numbers

The SPID (Service Profile ID) Number accesses the service configuration for the circuit. For 2B+D service two SPID numbers will be required. The LDN number(s) is generally the phone number of the B1/B2 line(s) and is usually not required (except for BONDing B1 and B2 for 112K calls).

Incorrect SPID Numbers (and Switch Types) can prevent successful layer-1 link activation, indicated by "Waiting for TEI#1" or "Sending SPID#1". "Waiting for TEI#2" or "Sending SPID#2" indicates an incorrect or mis-matched SPID 2.

To change the SPID or LDN numbers:

Press the SPID# LDN # key.

The LCD displays the current SPID number and displays a prompt for entering a new SPID (or LDN).

```
"  ENTER SPID1          "
" SPID 1:51065788100111 "
" Enter New # or ESC    "
" Press SPID when done  "
```

To enter a new SPID or LDN number:

Press the Numeric keys for the new number.

Press the SPID key to continue to the next SPID or LDN.

Press the ESC key to exit SPID/LDN number entry.

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Special care should be taken when entering the SPID. Incorrect SPID numbers are the most common fault in Link failures. The SPID is a 14 digit number consisting of the area code (3), the phone number (7), the Suffix (2) and the TID (2).

Call Type

The Call Type defines the call connection type. The type of calls supported by the 704A-756A/704A-756A Option N consists of Speech, Voice (or audio), 56K or 64K. The call type defines the method by which the data is configured onto the B channels.

The 704A-756A/756A Option N is a data test set; the speech and voice call types allow placement or reception of a data call (to compatible TA's – Terminal Adapters) over a speech or voice circuit. The 56K call type is designed to format the data for transmission over or terminating into DDS circuits.

To change the CALL TYPE:

Press the CALL Type key.

The LCD display is:

```
" SELECT CALL TYPE      "
" 1.. Speech  3.. 56k    "
" 2.. Voice   4.. 64k    "
" Press No# to select    "
```

To select a new CALL TYPE:

Press the Numeric key associated with the desired CALL Type.

You have successfully selected a Call Type; continue to the section on DTE Protocol.

DTE Protocol

The 704A-756A/756A Option N support a complete set of DTE protocols designed to allow call connection with industry standard Terminal Adapters. The DTE protocols supported by the 704A-756A/756A Option N are:

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- Clear.....Clear channel – no protocol, raw data
- Bonded.....Mode 1 Bonding of B1 to B2 for 112K or 128K bps
- V.120.....CCITT Rate adaption protocol
- T-Link.....Northern Telecom Rate adaption protocol
- SAP.....Simple Async to Sync conversion protocol
- DSU 57.6....Async 57.6 protocol for 56k DDS DSU/CSUs
- PPP.....Async to Sync conversion (subset of MLPP)

Mis-matched DTE Protocols can prevent call connection or result in premature call termination, (brief connection and then the call is dropped).

Press the DTE Protocol key

The LCD display is:

```
" Select DTE Protocol:  "
" 1.. *Clear  2.. BONDED  "
" 3.. V.120   4.. T-LINK  "
" ESC=exit   #=more      "
```

An asterisk (*) appears next to the current Protocol.

To select a new DTE Protocol:

Press the Numeric key associated with the desired Protocol.

Refer to the DTE Data rate section to configure the desired data rate of the connection.

DTE Data rate

The 704A-756A/704A-756A Option N provides all the data rates utilized by Basic-Rate ISDN Terminal Adapters. The rates available are;

ASYNCHRONOUS SYNCHRONOUS

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300	19.2K	1200	48K
120	38.4K	2400	56K
2400	57.6K	4800	64K
4800	115.2K	9600	112K
9600		19.2K	128K
		38.4K	

Note: The data rate available is dependent on the CALL Type and the DTE Protocol selected. See the Sync and Async Data rate tables for the available DTE Data rates vs. Call type vs. DTE Protocol.

To change or view the DTE Data rate:

Press the DTE Data rate key.

The LCD display is

```
" DTE RATE:64k SYNC  "
"                               "
" 1... Down  3... Up  "
" 2... Select  ESC=exit  "
```

To select a new DTE Data rate

Press the '1' or '3' key to view the next lower or higher data rate.

Press the '2' key to select the new data rate.

For ASYNC or SYNC selection (for supported data rates – e.a. 9.6K):

Press the '0' key to toggle between ASYNC and SYNC.

Asynchronous data rate format options are available via the MENU. Refer to the Menu section for additional details.

DTE Interface

The DTE Interface function allows selection of the optional RS232 or V.35/RS530 DCE interface. The 704A-756A/756A Option N can be optioned with a V.35 or RS530 and an RS232 DCE interface. The DCE interface allows the 704A-756A Option N to replace the customer NT1 and TA including the connection to the terminating equipment (DTE). Replacement of the CPE TA allows qualification and verification of the TA and identification of any TA incompatibilities with the Network (TA faults or mis-configuration).

The DCE Interface option (DCE) provides appropriate adapter cables for connection to the DTE.

To change the DTE Interface:

Press the DTE Interface key.

The LCD will display:

```
" Select DTE Interface:  "
" 1.. *RS232  2... V.35  "
" 3... RS530              "
" Press No#  ESC=exit    "
```

An asterisk (*) appears next to the current Interface.

To select a new DTE Interface:

Press the Numeric key associated with the desired Interface.

Note: At data rates above 38.4K bps a balanced interface such as V.35 or RS232 is recommended, (especially for long cable runs).

Refer to the DTE Data rate section to configure the desired data rate of the connection.

Sync DTE Data rate Table

Call-Type	Protocol	Synchronous DTE Data rates Available												
		1200	2400	4800	9600	19.2k	38.4k	48k	56k	57.6k	64k	112k	115.2k	128k
Dial 64k	BONDING								56k		64k			
	CLEAR							48k	56k		64k			

CALL (1B)	V.120				9600	19.2k	38.4k	48k						
	T-LINK		2400	4800	9600	19.2k			56k			64		
	SAP						38.4k							
Dial 56k CALL (1B)	BONDING									56k				
	CLEAR									56k				
	V.120				9600	19.2k	38.4k	48k						
	T-LINK		2400	4800	9600	19.2k			56k					
64k(2B)	BONDING												128k	
56k(2B)											112k			
Leased64k	CLEAR							48k	56k		64k			
	SAP		2400	4800	9600	19.2k	38.4k							
Leased128k	CLEAR												128k	

Async DTE Data rate Table

Call-Type	Protocol	Asynchronous DTE Data rates Available												
		1200	2400	4800	9600	19.2k	38.4k	48k	56k	57.6k	64k	112k	115.2k	128k
DIAL 64k CALL (1B)	PPP Async-Sync	1200	2400	4800	9600	19.2k	38.4k			57.6k			115.2k	
	CLEAR		2400	4800	9600	19.2k	38.4k			57.6k				
	V.120	1200	2400	4800	9600	19.2k	38.4k			57.6k			115.2k	
	T-LINK	1200	2400	4800	9600	19.2k								
	SAP							38.4k			57.6k			115.2k
DIAL 64k CALL (1B)	PPP Async-Sync	1200	2400	4800	9600	19.2k	38.4k			57.6k			115.2k	
	BONDING		2400	4800	9600	19.2k	38.4k			57.6k				
	DSU57.6k									57.6k				
	V.120	1200	2400	4800	9600	19.2k	38.4k			57.6k			115.2k	
	T-LINK	1200	2400	4800	9600	19.2k								
64k(2B)	BONDING												115.2k	
56k(2B)													115.2k	
Leased64k	DSU 57.6k									57.6k				
	SAP	1200	2400	4800	9600	19.2k	38.4k			57.6k			115.2k	
Leased128k	CLEAR									57.6k			115.2k	

Placing Calls

Placing Calls with the 704A-756A/756A Option N is essentially as easy as dialing a handset. Call progress such as "DIALING", "BUSY", "NO ANSWER" is displayed as the call procedure is executed. Call connection, Protocol and Data rate is indicated on the LCD.

Note: Mis-matched CALL TYPEs, DTE Protocol, or DTE data rate can prevent CALL connection or can cause connection and drop of the call. To ensure call connection verify that the CALL Type, DTE Protocol and DTE Data rate match me remote station or TA that you are dialing.

To DIAL a Call:

Press the DIAL# HANG UP key.

The LCD display is:

```
" Ph # > 5106578810  "
" Press DIAL          "
" to Place CALL       "
```

The last phone number dialed will be recalled for quick re-dial.

To enter a new Phone Number:

Press the Numeric keys, or

To DIAL the number:

Press the DIAL# HANG UP key.

To HANG-UP or terminate the Call (after the call is connected):

Press the DIAL# HANG UP key, twice.

To STORE or RECALL stored numbers, refer to the Store/Recall section. Refer to the Loopbacks or BERT section for testing functions.

Answering a Call

The 704A-756A/756A Option N has been designed to auto answer all incoming calls. If the CALL TYPE, DTE Protocol and the DTE Data rate is compatible to the remote TA the incoming CALL will be answered and CONNECTION will be established. When an incoming Call connects the DTE Protocol and the DTE Data rate will be displayed on line (1) one of the LCD.

Note: Mis-matched CALL TYPEs, DTE Protocol, or DTE data rate can prevent CALL connection or can cause connection and drop of the call. To

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ensure Call connection verify that the CALL Type, DTE Protocol and DTE Data rate match the remote station or TA that is placing the call.

To HANG-UP or terminate the Call (after the call is connected):

Press the DIAL# HANG UP key, twice.

To STORE or RECALL stored numbers, refer to the Store/Recall section. Refer to the Loopbacks or BERT section for testing functions.

Loopback Tests

The 704A-756A/704A-756A Option N responds to the Network B1, B2 and 2B+D Loopbacks. In addition, several locally generated loopbacks are available to diagnose circuit faults. The local loopbacks are:

- LL.....Loopback B1 and B2 toward Network at the NT1
- RT.....Loopback toward Network after the TA Protocol Conversion
- Remote...Loopback Remote TA toward the local unit with V.54 Loopback
- DTE.....Loopback toward the DTE data at the DTE Interface

Note: The RT loopbacks will not operate properly if the local and remote TA are not configured for compatible DTE Protocols.

The Remote V.54 loopback requires CLEAR channel DTE protocol. The remote unit must support the V.54 loopback.

DTE Loopback cannot be executed when a Call is Connected.

To Select a LOOPBACK test:

Press the Loopback Tests key.

The LCD display is:

```
" LOOPBACK TESTS      "
" 1.. LL  2.. RT  3.. DTE  "
" 4.. Remote V.54      "
" Press No#  ESC=exit  "
```

To Execute a Loopback:

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Press the Numeric keys corresponding to the desired Loopback.

To Terminate a Loopback:

Press the ESC key.

For Bit Error testing, refer to the section on BERT Tests.

BERT Tests

The 704A-756A/756A Option N provides the basic BERT tests of 2047 and 511. BERT tests provide a means to identify the quality of the line. The BERT patterns simulate live data and individual bit errors and the bit error rate (BER) indicate various impairments on the circuit. Activate a remote loopback (locally or remotely) and initiate a BERT test to qualify the end-to-end transmit and receive circuits. If SYNC LOSS occurs verify the loopback and retest. Then, if possible run an end-to-end BERT to isolate the specific circuit path failure.

Note: BERTs can only be performed in SYNC modes.

To initiate a BERT Test:

Press the BERT Tests key, then a Numeric key for the BERT.

The LCD will display:

```
"  BERT Tests:      "
" 1... 511    4... ALL0  "
" 2... 2047   5... ALL1  "
" 3... OFF    ESC=exit  "
```

To change the BERT Test results:

Press the Error Analysis key, until the desired Error results are displayed.

To Insert a Bit Error (verify the BERT source):

Press the Insert Error key.

To Terminate a BERT Test:

Press the ESC key.

Refer to the Loopbacks section for loopback tests.

REMOTE CONTROL

For the NTS packages only, the unit may be controlled remotely via a Personal Computer. The unit must have special hardware.

Scope

This chapter is intended to explain the use of the Halcyon Universal Data Test Set Remote Control, including:

1. How to connect the unit.
2. How the Halcyon Universal Data Test Set interface will be displayed on the PC.
3. How the PC interface can be used to manipulate the Halcyon unit.
4. How to use the Scripting capabilities of the remote control software.
5. How to use the Logging feature of the remote control software.

Communication

The remote control software interfaces with the Halcyon Universal Data Test Set using the 704A-480 serial cable provided by CXR Telcom.

The remote control software communicates with the Halcyon via simple ASCII strings. There are two types of strings used in the communication with the Halcyon. Command strings are used by the controller to control Halcyon functions. LED status packets are used by the Halcyon to indicate the state of the LEDs.

Installation

The Halcyon Universal Data Test Set Remote Control can be installed on a standard PC running the Windows XP operating system.

On an XP system:

1. Insert the CD in the CD Drive. If CD does not automatically start initiating setup, execute:
 RUN d:setup.exe (assuming d: is your CD drive)

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2. The setup program will load files to your system, then begin asking questions. Simply follow the prompts to complete the installation.

Notation

In this chapter, a special notation will be used to describe the selection of options from the toolbar and submenus. The following notation will be used:

<Toolbar selection>/<submenu selection>[/submenu selection]

This means that the first field will define the tool bar selection that must be pressed first, then the submenu item will be identified and if further submenu selections are required, they will be listed. All selections will be separated by a “/”. The following example states that the users should select the MACRO option of the toolbar followed by the START option of the macro submenu:

MACRO/START

Remote Control Display

The Remote Control unit opens with two windows. One window displays the LCD and LED interfaces in a manner similar to the LCD and LED on the test set. The second window displays the input keys in a manner similar to the keys on the test set. As on the standard interface for the Universal Data Test Set, the options, LED, LCD, and Keys on the two windows will be context-dependent on the mode in which the test set is operating. That is, the specific labels will depend on whether the remote is attached to a unit configured for DDS, TIMS, ISDN or T1 operation. Once attached, the LEDs which are in use will be labeled appropriately to match the actual hardware. Similarly, keys on the key pad map will be labeled appropriately.

The content of the Status and Results window will mirror the content of LCD and LEDs on the Universal Data Test Set. Fundamentally, the keypad mirrors the keypad of the Test Set. The keys of the keypad will mirror (with minor variations of abbreviation) the keypad of the Test Set. However, there is an added tool bar attached to the top of the window. The options of the tool bar, submenus and the descriptions are displayed in the following table.

Toolbar	Submenu	Sub option	Description
---------	---------	------------	-------------

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Macro			
	Create		
		Start	– Start the saving of keypresses.
		Save	– Save the keypress sequence as a macro. Selection of Save results in the opening of a save file window, permitting selection or specification of a target file.
		Quit	– Quit saving macro keypresses without storing the macro.
	Control		
		Delay	– Insert a delay of a specified number of seconds in a macro. Selecting Delay results in a pop-up window requiring entry of a number of seconds to delay.
		Pause	– Insert a pause that requires human intervention in a macro.
		Delete	– Delete a selected macro. Selection of delete results in the opening of a delete file window permitting selection of a file to delete.
		Run	– Run a selected macro.
		Cancel	– Cancel the execution of an executing macro.
Log			
	Off		– Turn off logging to an active file or printer.
	File		– Start file logging. Selection of file logging results in the opening of an open file window permitting selection or specification of a target log file.
	Printer		– Start logging to printer.
Comm			
	Select Com Port		
		Com 1	- Option to select the PC serial interface connecting to the Halcyon unit.
		Com 2	
		Com 3	
		Com 4	
	Data Rate		
		9.6K	- Option to select the baud rate by which the comm. port connects to the Halcyon unit.

		19.2K	Default is 9.6K
		38.4K	
		57.6K	
		115.2K	
	Format		
		Data	Access to configuration of data bits, default 8 bit.
		Stop	Access to configuration of stop bits, default 1 bit.
		Parity	Access to configuration of parity, default none.
Close status			– Closes the Status and Results window.
Dial			– Always remains gray. Dial out is not implemented at this time.

Remote Control Keys

The remote control key labels are populated in a context-sensitive manner according to the selection of DDS, TIMS, ISDN or T1 via the selection of the F1, F2, F3 or F4 keys.

Using the mouse, the user of the remote control may press any key on the remote control keypad or the associated character below the keys (ie. 1,2,3,4,5,6,7,8,9,0,*, or #). Labeled keys frequently have dual functions, the function on the label or the value under the key, therefore, it is permissible to press either. Regardless of the location pressed (the key or the character below the key) the program will correctly interpret the press to match the context. That is, if the key TERM is press and a number is expected, the TERM key will be used as a 3. If the 3 is pressed and the context expects a key press, TERM will be used as the selection.

The remote control keypad should be used with the same expectations as directly pressing the keypad on the Test Set.

Macros

Macro Creation

The remote control is able to create macros. By selection of toolbar MACRO/START, the remote control will begin to record all following key

presses. This permits the creation of a file that may be executed again in the future. After desired key presses have been completed, select MACRO/SAVE. This will result in the opening of the save window, permitting the specification of a file to save and the storage of the macro.

Should you create a macro and decide that it is not correct, you need not save the macro. By selecting MACRO/QUIT, the recording of key presses will stop and previous key presses will not be saved to any file.

As a precaution against several problems, it is necessary for the first key press in any macro to be the key press of a F1, F2, F3 or F4 key to assure the hardware is correctly configured to accept the following commands of the macro.

During the creation of a macro file, special handling may be added to the macro file.

In the event that a user of the macro would like to cause the macro to hold the state for examination, the user may press MACRO/PAUSE. On replay of the macro, this will cause execution of the macro to halt until human intervention gives the macro permission to continue. On execution of a macro, as it passes the point containing the pause request, a dialog box will pop-up asking the user to select OK when they have completed their examination of the Status and Results screen.

Macros are executed quite rapidly, so a problem may occur if a macro executes two key presses before the action of the first key press is complete. This is resolved by insertion of a delay. Should you perform an operation that requires the system to delay before continuing on to the next activity, press MACRO/DELAY at the location where you would like the delay. This will result in the display of a screen permitting the insertion of a delay time in seconds. Then enter the keypress for the next function that is desired. Thus, when the macro is played again later, the program will delay long enough to permit the first key press to be effective before the following key press is executed.

Note 1: During replay, a keypress causes about a 4 second delay before the next key press is executed. Numerics presses cause about a 2 second delay in execution before the next key press is executed by the macro. (Remember: you may press the keys or the labels under the keys ... the numbers, #, or *.)

Note 2: If the "&" is pressed during the creation of a macro, the contents of the LCD will be dumped to the log device and the command to dump to the log device will be added to the macro.

Macro Run

To run a macro, go to MACRO/RUN. This will result in the opening of the open file window, permitting the selection of a file to run. Selection of a file will result in the execution of the macro. Failure to select a macro file will result in the display of a message indicating that no macro will be run. While a macro is executing, it may be aborted by entering MACRO/CANCEL. This will result in the termination of the executing macro.

Note: As the macro executes, two new display areas open in the Status and Results window. In the upper right corner, an area displays the time left in a delay. That is, in the event that a macro requests a delay of 15 seconds, this area will count down from 15 to 0. On reaching 0, the delay is over and execution will continue. In the lower right corner, an area displays the executing command. On completion of the macro, these two added display areas will vanish from the Status and Results window.

Note: Logging can not be turned on by a macro. If you desire logging during the running of a macro, turn it on before starting the macro.

Macro Delete

For completeness of file maintenance, an option is provided to delete macros. Should the user select MACRO/DELETE, a delete file window is opened. The user may browse directories and select the macro file that should be deleted from the system.

It is not necessary to use this feature. It is acceptable for the users to use the standard windows browser to locate macro files and delete them from the system.

Scripting

The remote control permits the creation of a script file that may be run as a macro. To create a script file, create a file with one key press per line. Each line should have the label of the key to be executed, a number from 0 through 9, #, *, &, Pause or Delay.

Additionally, scripts may contain comments. Comments are delineated by the insertion of a single quote mark ('). All characters in a line following the single quote mark are ignored, permitting the insertion of comments.

As a precaution against several problems, it is necessary for the first key press in any script to be the label F1, F2, F3 or F4 to assure the hardware is correctly configured to accept the following commands of the script.

The reading of labels is case sensitive so be careful to enter the commands correctly.

The following is an example of a script with comments.

```

F2          'TIMS
RCV FREQ
XMT FREQ
2          ' Change frequency
3          ' Entering 356
5
6
#          ' Entering number 356
RCV FREQ
&          ' Log the Receive Frequency LCD if a log file is open
Delay
40         ' 40 second delay. Note, Delay is the only script command
          ' that permits/demands the full number to be placed on one line.

Pause
ESC

```

Once a script has been created, it may be executed as any macro. (See section on Macro Run).

Note: Logging may not be turned on from a script. If you desire logging during a script, turn it on before executing the script.

Logging

Logging is permitted in two forms, file and printer logging.

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File Logging

In the event that the user desires a file containing a record of the sequence of command execution, logging to a file may be activated by the command LOG/FILE. This will result in the opening of a open file window, permitting the selection or specification of a file that may be used as the logging target. Once the file logging is complete, selection of LOG/OFF will terminate the logging of commands to the file.

Note: any requests to dump (&) LCD data will go to the file while logging is on.

Printer Logging

In the event that the user desires a printed record of the sequence of command execution, printer logging may be activated by the command LOG/PRINTER. This will result in subsequent commands being recorded to the printer. Once the logging is complete, selection of LOG/OFF will terminate the logging of commands to the printer.

Note: any requests to dump (&) LCD data will go to the printer while logging is on.

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SPECIFICATIONS

Specifications (TIMS)

Physical	9.5" L x 6.33" W x 3.50" H (Equipped with all options – Weight less than 4 lbs.) 9.5" L x 6.33" W x 2.63" H (Basic 704A-400 Series – Weight approximately 3 lbs.)
Operating Environment:	0 to 50 C, 0 to 95% R.H.
Power Requirements:	5 Watts at 115 VAC, 60 Hz nominal for 9VDC external DC power supply.
CLEI Codes:	TETMAAE7AA, TETMAAF7AA.
Battery:	4 Hours continuous operation from the internal 7.2VDC NiCad pack. Charge time: 14 hours.
2W/4W Interface:	RJ-11 C or Dual Bantam (210) connector.
Impedance:	100/135/600/900/1200 ohms in terminated mode; >30K Ohms in bridged mode.
Longitudinal Balance:	Better than 60 dB from 200 to 1.5MHz.
Audio & Display:	Built in speaker with volume control. Display is LCD, 4 line x 20 character
Line Hold:	Electronic, internally current limited to 24mA on either the 2W or 4W-XMT port when Off-Hook.
Dial:	16 Character DTMF generation, 12 character MF generation, 10 digit Dial Pulse generation.
Measurements:	Level (dBm), Frequency, Weighted Noise, Notch Noise, Signal to noise ratio, Impulse Noise, Return Loss, 23-Tone Sequence (RMS level/frequency, individual level/frequency, IMD, EDD, S/TD, SNR), Advanced Caller ID CND/CNAM (optional), Line voltage, current and ring voltage, Load Coil Detect, MF/DTMF/Dial Pulse analysis.
SIGNALING	
Signaling Interfaces:	Emulate network and terminal end of Loop Start, Ground Start, Direct Inward Dial, E&M I-IV: Originate or terminate calls, Analyze digits, perform transmission tests,
GENERATOR	
Variable Tone:	Frequency adjustable from 50 Hz to 1.5Mhz in 1Hz steps: accurate to within -0.5Hz
Fixed Tones:	Program 50 Hz, 100 Hz, 1 kHz, 5 kHz, 8 kHz, and 15 kHz. (transmit level fixed at 0.0dBm).
ADSL Tones:	28 kHz, 40 kHz, 48 kHz, 82 kHz, 196 kHz, 392 kHz (level adj. +7dBm to -40dBm).
Wideband Sweep	400Hz to 3200 Hz in 200 Hz steps, 4800 Hz, 8000 Hz, 28kHz, 32kHz, 36kHz, 48kHz, 80kHz, 82kHz. Level

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	adjustable from +7dBm to -40dBm.
3-Tone Slope	404 Hz, 1004 Hz, 2804 Hz, each at -0.5Hz. Level adjustable in 4 steps of 0, -10, -13 and -16dBm -0.2dBm.
2713Hz Loop Back	Generated at at -0.5Hz. Level adjustable as in 3-Tone Slope.
Level Accuracy:	600/900/1200 ohm mode -0.1 dB from 400 to 10,000 Hz; -0.5dB from 220 to 30,000 Hz.
100/135 Ohm 4W Mode	-0.2 dB from 400 to 30,000. Optional wideband 135 ohm; -0.5 dB from 250 to 1.5mHz. Level adjustable from +7dBm to -40dBm in 0.1 dB steps.
23-Tone Test:	Generate 23-Tone sequence per IEEE-1995 at -6dBm to -40dBm. Measures individual frequencies and level, RMS composite tone, IMD, EDD, S/TD and S/NR.
Return Loss:	Continuous generation of band limited noise signal sent at -6 -1.0dBm in each of three bands
DTMF Generation	XMT level of -7 -0.2dBm, w/1.5 dB twist: freq. Accurate to -0.5 Hz, 75 mS on, 75mS off.
RECEIVER	
Level:	+7 dBm to -72 dBm, 0.1dBm resolution, 100/135/600/900/1200 ohm 4W mode: -0.2 dB from 400 to 25,00 Hz, -0.5 dB from 250 to 35,000 Hz. Wideband 100 and 135 ohm 4-wire mode: -0.2 dB form 450 to 100 kHz, -0.5dB from 250 to 1.5 mHz.
Frequency:	30 to 1.5 mHz with 1 Hz resolution and 0.1% accuracy at levels down to -50 dBm.
Noise:	15 to 95 dBm with 1 dB resolution and -1 dB accuracy from 20 to 90 dBm.
Notched Noise:	1010 Hz notch, with a minimum of 50 dB attenuation in the band of 995 to 1025 Hz.
Signal to Noise Ratio:	Holding tone (1004 Hz) must be in the range of +6 to -45 dB: measured S/N ratio range from from 10 to 55 dB with 1 dB resolution and -2 dB accuracy.
3-Level Impulse Noise:	Threshold can be set from 30 to 90 dBm: 3 level difference fixed at 4 dB with a measurement accuracy of +1 Db. Blanking interval fixed at 125; with 3 independent counters.
Return Loss:	Three bands: ERL, SRL-HI, SRL-LO; range of 0 to -30 dB with 1 dB resolution and -1 dB accuracy.
Line Voltage Measurement	2 to 85 V DC : 0.1 Volt resolution and -1 Volt accuracy.
Line Current Measurement	10 to 80mA; 0.1 mA resolution and -1 mA accuracy.

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Specifications (DDS)

Power Requirements:	4 Watts at 115 VAC, 60 Hz nominal; Output 9VDC external Power supply. Internal 7.2VDC NiCad pack.
CLEI Codes:	TETMAAG7AA, DDETEAFFJAA
DS0 and Bipolar Interface:	Dual "Bantam".
DS0 and Bipolar Clock Interface:	15-pin HD D-sub
Operating Modes:	DS0A, SW56K, 64K Clear, Primary and Secondary channels (fully independent).
DS0 Rates:	2.4, 4.8, 9.6, 19.2, 38.4, 56.0, 64K bps.
DS0 Transmit Signal:	'0': 0.7 Vmax, '1': 3.5Vmin.
DS0 Receive Signal: " Select DTE Interface: "	'0': 0.9 Vmax, '1': 1.6Vmin.
Bipolar Rate:	64K bps.
Bipolar RCV & XMT Signals:	'0': 0.9 Vmax, '1': +3.5 to +5.5V.
Termination:	Bellcore TA-TSY-000077 135Ω resistive.
Cable Gauge:	24 AWG, standard Office cable.
Cable Lengths:	0 to 1500 feet.
Pulse Width:	15.6 microseconds nominal.
Pulse Amplitude and Wide Rations:	+5%.
OCU Emulation Mode:	4 Wire Loop 8 pin modular RJ48S
Sealing Current Supply:	-24 VDC, limited to 20mA max.
4-Wire Interface:	DDS standard 8-pin modular RJ48S
Operating Modes:	CSU/DSU emulation, SW56K, 64K Clear, Primary and Secondary channels (fully independent).
Primary Channel:	Compatible with AT&T PUB 62310.
Secondary Channel:	Bellcore TR-NPL-000157.

Loop Rates:	2.4, 3.2, 4.8, 6.4, 9.6, 12.8, 19.2, 25.6, 56.0 and 72 (64)K bps.
Termination:	AT&T PUB 62310 135Ω impedance.
Cable Gauge:	19 to 26 AWG.
Receiver Sensitivity:	Subrates: -34, -40 dB, 56.0 and 72 (64) K bps: -48 dB.
Signal Amplitude:	9.6 and 12.8K bps: 1.66 Vmax, All other rates: 3.32 Vmax.
Band Rejection:	AT&T PUB 62310 C-message filter.
Frequency Jitter Tolerance:	+5%.
RS232 Interface:	Compatible with EIA RS232D.
V.35 Interface:	Compatible with CCITT V.35.
Clock Modes:	Network (slave), Internal (master) and External (DTE).
Frequency Generator:	10 to 91k Hz +0.5%.
Frequency Measurement:	0 to 90k Hz +0.25%.
Level Measurement Range:	0 to -40 dBm
Metallic Test Aids:	Short, R-R1 and T-T1, R-T, R1-T1 and 135Ω quiet termination.
Load Coil Detect:	Auto Detect up to 3 Load Coils, Range: Facility Loss < 45 dB

Specification (T1 – Option C)

Power Requirements:	4 Watts at 115 VAC, 60 Hz nominal; Output 9VDC external Power supply. Internal 7.2VDC NiCad pack.
T1 Interface:	RJ-48 Modular and Bantam Transmit and Receive Jacks.
Transmitter	
T1 Signal Format:	DS-1 PCM, 1.544 MHz +/- 50Hz.
Operating Modes:	Full T1 or Fractional N x 64 DS0
DS-1 Signal Waveshape:	Meets T1.403 specifications.
DS-1 Line Level:	0 +/- 0.2dBdsx (6.0 V p-p).

Line Codes:	AMI, B8ZS, or B7S.
Clocksource:	Recovered from RCV or internally generated 1.544MHz +/- 30 Hz.
Framing:	D3/D4 (SF), ESF, and SLC-96.
FT1 Fill Data:	Idle code (7F) sent in unused channels.
Test Patterns:	QRSS, 2047, 215-1, 220-1, 223-1, 3 in 24, All 1s, All zeros, Alt 1/0, 1 in 16, 2 in 8, 1:7, 63, and 511.
Error Injection:	Single bit, or streamed BER at 1e-3, 1e-4, 1e-5, 1e-6, or 1e-7.
Line Build Out:	0, -7.5, -15dB.
DSX Pre-Equalizer:	5 steps for cable lengths to 655 feet.
Receiver	100 Ohms.
Input Impedance:	+6 to -30 dBdsx.
Input Signal Level Range:	3 steps: 0 to -7.5, -15, and -22 dB
DS1 Level Measure:	Recovered from received signal. (From 0 to 6000 ft.)
Clock Source:	Yellow, (AIS)
DS1 Alarm Reporting:	Frame Sync, Loop Current, B8ZS, Framing Errors, CRC Errors, BPV Errors, Excess Jitter, Excess zeros.
DS1 Status Reporting:	Terminates 60mA nominal. Loop current indicator lights at 55 +/- 2mA or higher.
Simplex Current:	16 volts nominal.
Simplex Voltage Drop:	Activates and responds to Inband Line and unscheduled, Bit oriented FDL messages for Line, Payload, and NIU loopbacks.
Loopbacks:	

Analysis Modes	
BERT Analysis:	Bit Errors (BE), Errored Seconds (ES), Bit Error Rate (BER), %Error Free Seconds (%EFS), Severely Errored Seconds (SES), %Severely Errored Seconds (%SES), Elapsed Time.
LINE Analysis:	Ft Framing Errors, Fs Framing Bit errors, Bi-Polar Violations (BPV), CRC Bit Errors, FPS Bit Errors.

Specifications (Basic Rate ISDN – Option N)

Physical:	2B1Q per ANSI T1.601
U Interface:	Modular 8 pin connector
Power:	120VAC or Internal NiCad Rechargeable Battery. Operate Time > 4Hrs.
Battery Charger/AC Adapter:	Input 120VAC, Output 9VDC, 1A, Power connector negative shell, positive center conductor.
Modes:	NT1, NT1/TA
Call Control:	5ESS per AT&T 5D5-900-321, DMS-100, Siemens, NEC, ISDN N1
Call Type:	Speech, Voice, 56k, 64k
Loopbacks:	LL-Loopback B1 and B2 towards network at NT1, RT – Loopback toward network after the TA protocol conversion, Rem – Loopback Remote TA toward the local unit with V.54 loopback, DTE – Loopback toward the DTE data at the DTE interface.
DTE Data Rates:	0.3, 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, 115.2K bps ASYNC 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 48, 64, 112, & 128K bps SYNC.
BERT Test Patterns:	511, 2047, All 0s, All 1s
TA Protocols:	Clear Channel, V-120 Bonding (Sync & Async), ML PPP (Sync & Async)
Receiver Sensitivity:	-42 dB at 40 KHz, Maximum Loop Resistance of 1,300Ω

Maintenance, Service, Warranty

The 704A-400 test unit does not require periodic maintenance for normal operation. In excessively dirty environments the unit may be wiped clean with a damp cloth. The padded carrying case should be used to provide additional protection when operating in harsh environments, for storage, and transportation.

In case of difficulty or for technical assistance contact CXR Telcom Technical Support at: (510) 657-8810 Monday through Friday between the hours of 8:00 AM and 5:00 PM Pacific Coast Time; or via fax at (510) 657-1158. Contact your local representative or CXR Telcom Corporation directly for additional information. Should your 704A-400 ever require repairs contact CXR Telcom Sales at (510) 657-8810 to obtain the required RMA number and shipping instructions. Units received without an RMA will not be serviced.

All equipment manufactured by CXR Telcom Corporation is warranted for a period of two years from the date of shipment against defects in material and workmanship. This warranty applies to the original equipment purchaser and is non-transferable without the express written authorization from CXR Telcom Corporation. Liability under this warranty extends only to the replacement value of the equipment. The warranty is void if: The equipment has been altered or repaired without specific authorization from CXR Telcom Corporation. The equipment is installed or operated in any manner other than those specifically described in the instructions and operating literature. No other warranty is expressed or implied. CXR Telcom is not liable for consequential damages.