

# ENGINEERING INSTRUCTION

## TESTING OF DCME EQUIPMENT MODEL DTX 360 No. DCME/AT-001

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**TESTING OF DCME EQUIPMENT MODEL DTX 360****1. SCOPE:**

This engineering instruction describes the testing procedure of Digital Circuit Multiplication Equipment (DCME) model DTX 360.

**2. GENERAL:**

The Digital Circuit Multiplication Equipment model DTX-360 system handles traffic consisting of Speech, Voice-Band Data, Fax and Non-fax, High-speed Data and Inter exchange Information. The DTX-360 system provides both the highest Digital Circuit multiplication figures and the best transmission quality. Speech signals are low-rate encoded, using Adaptive Differential PCM (ADPCM) or Low Delay-Code Exited Prediction (LD-CELP) algorithms. Using ADPCM algorithm, speech signals are transmitted at a nominal total compression ratio 5:1. Using the LD-CELP algorithm, speech signals are transmitted at a nominal total compression ratio 10:1. When the LD-CELP algorithm is used, the performance of the LD-CELP encoder at 16 Kbits/s closely resembles the performance of the standard ADPCM at 32 Kbits/s. This inclusion of VBR process enables operation at any rate between 9.6 Kbits/s and 16 Kbits/s.

In addition, ITU Group 3 Fax calls using standard or non-standard protocols in accordance with ITU-REC.T.30, can be detected and demodulated with the aid of compression unit. The Fax demodulation process is implemented using waveform analysis techniques.

The Fax mode of operation permits two user selected features:

- Fax demodulation with Forward Error Correction (FEC enabled)
- Fax demodulation without Forward Error Correction. (FEC disabled)

When FEC is enabled, the DTX-360 can operate successfully over routes with poor Bit Error Rate performance. (BER between  $10^{-3}$  and  $10^{-5}$ ). Fax calls are transmitted with a compression ratio of up to 6:1 when the DTX-360 operates with FEC disabled and with a compression ratio of up to 4:1 when FEC is enabled. A maximum of 180 simultaneous fax calls can be recognized and demodulated by the DTX-360. If LD-CELP algorithms is used, 12 trunks can be connected to DTX-360 equipment.

The DTX-360 transmits digital signals, which are pre-assigned or dynamically assigned in the bearer bit stream. Intermediate trunks, carrying non- pre assigned signals are constantly scanned by the DTX-360 on a per time slot basis. When signal energy is detected then a classification process takes place to determine the appropriate process as given below.

SIGNAL TYPE	PROCESS
Voice	Digital Speech Interpolation + Low Rate Encoding + Variable Bit Rate
Voice Band Data Non Fax	Low Rate Encoding
Fax	Fax Demodulation + FEC (Optional)

Finally, the signals are compressed into a single bit stream (Bearer) where each signal occupies a bearer facility (Bearer Channel) assigned by the system.

In addition, pre-assigned signals are included in the bearer in previously system-defined bearer facilities.

**2.1 SPEECH TRAFFIC:**

Speech Traffic is compressed using Digital Speech Interpolation (DSI) and Low Rate Encoding (LRE) LD-CELP or ADPCM.

When LD-CELP mode is used, speech-type calls are encoded by the LD-CELP algorithm and transmitted through the bearer via bearer channels at bit rates of 16, 12.8 or 9.6 Kbits/s depending on the traffic load characteristics.

When speech calls are encoded by the ADPCM algorithm they are transmitted through the bearer via bearer channels at bit rates of 32, 24 and 16 Kbits/s depending on traffic load.

**2.2 VOICE BAND DATA TRAFFIC:**

Non-fax traffic is subjected to Low Rate Encoding Techniques. Using LD-CELP (upto 19.2 Kbits/s ) or ADPCM (upto 14.4 Kbits/s ) and transmitted via the bearer bit stream at 40 Kbits/s.

**2.3 FAX TRAFFIC:**

Standard and non-standard fax calls are recognized and demodulated by the fax compression unit. An optional forward error correction feature enables the DTX-360 to operate successfully over any route with poor Bit Error Performance (ie.) BER between  $10^{-3}$  and  $10^{-5}$  ). Fax demodulated calls are dynamically assigned to 32 Kbits/s bearer channels, called Fax banks.

**2.4 64 Kbits/s TRAFFIC:**

64 Kbits/s unrestricted traffic may be connected on demand .

**2.5 PRE-ASSIGNMENT**

The DTX-360 supports pre-assignment of N x 64 Kbits/s channels. 64 Kbits/s, 40 kbits/s, 32 kbits/s, 24 Kbits/s and 16 Kbits/s channels may be pre-assigned for leased line services which would not be subject to any compression. When ADPCM encoding is used, pre-assigned channels are transmitted at a fixed rate of 64, 40, 32, 24 or 16 Kbits/s. If LD-CELP encoding is used, pre-assigned channels are transmitted at a fixed rate of 64, 40, 16, 12.8 or 9.6 Kbits/s.

**2.6 INTER-EXCHANGE SIGNALLING:**

- a) ITU # 5 signals will be passed transparently through the DTX-360 using dynamically assigned channels.
- b) Signals corresponding to signaling systems ITU R1 and R2D can be transmitted within the control channel when optional signaling modules are included.
- c) ITU # 6 and ITU # 7 signals can be accommodated through 64 Kbits/s pre-assigned channels.

**2.7 NETWORK OPERATING MODES:**

The DTX-360 supports the following modes of operations.

- ❖ Point to Point (Single Destination) mode
- ❖ Multi-clique mode
- ❖ Multi-Destination mode
- ❖ Mixed mode

The various multiple destination capabilities of the DTX-360 for the modes listed above are summarized below:

**I. TRANSMIT:**

MODES	TOTAL NO. OF DESTINATION	POOLS IN THE BEARER	NO. OF DESTINATIONS IN THE POOL
Point to Point	1	1	1
Multi-Clique	2 ( ADPCM) 4 (LDCELP)	2 ( ADPCM) 4 (LDCELP)	1
Multi-Destination	4 max	1	1 to 4
Mixed-mode	4 max	2	1 to 3, 1

**II. RECEIVE:**

MODES	TOTAL NO. OF ORIGINS	NO. OF RECEIVED BEARERS	NO. OF POOLS IN EACH BEARER
Point to Point	1	1	1
Multi-Clique	2 ( ADPCM) 4 (LDCELP)	1 or 2 ( ADPCM) 2 or 4 (LDCELP)	2 or 1 ADPCM 2 to 4 LDCELP
Multi-Destination	4 max	4 max	1
Mixed-mode	4 max	4 max	2

**2.8 TRAFFIC OVERLOAD HANDLING:**

The DTX-360 system employs a variable Bit Rate encoding technique to reduce adverse effects on speech quality during traffic overload periods.

Moreover, at a specified traffic threshold, the system employs a Dynamic Load Control (DLC) process. The DLC activation and deactivation thresholds are user programmable.

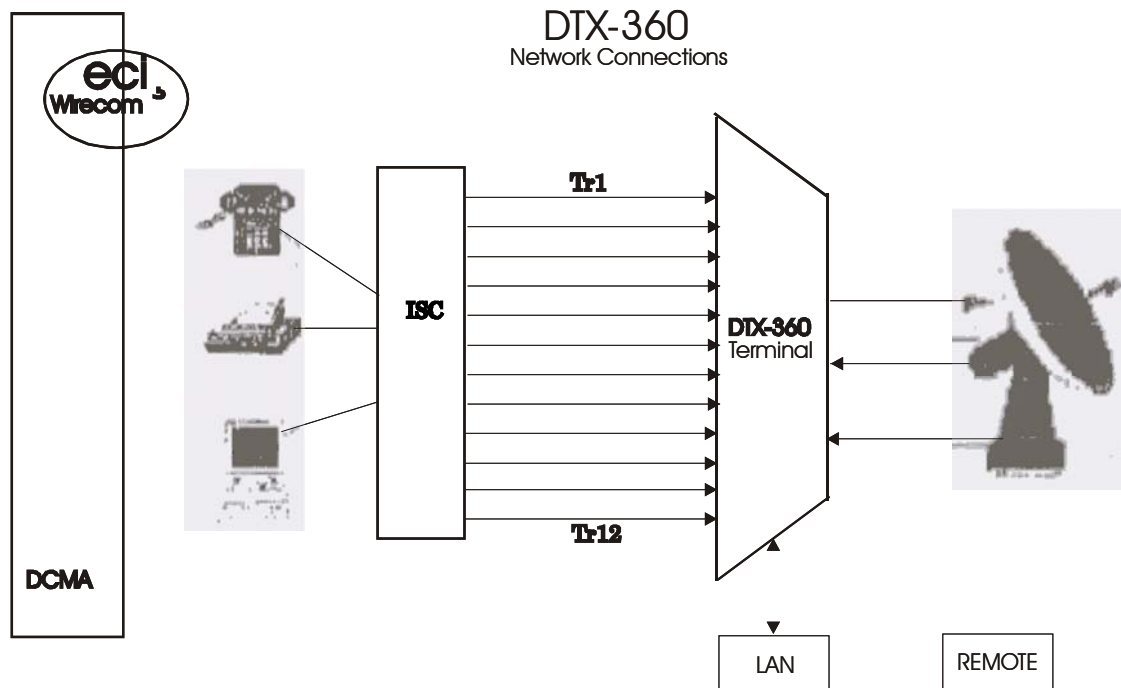
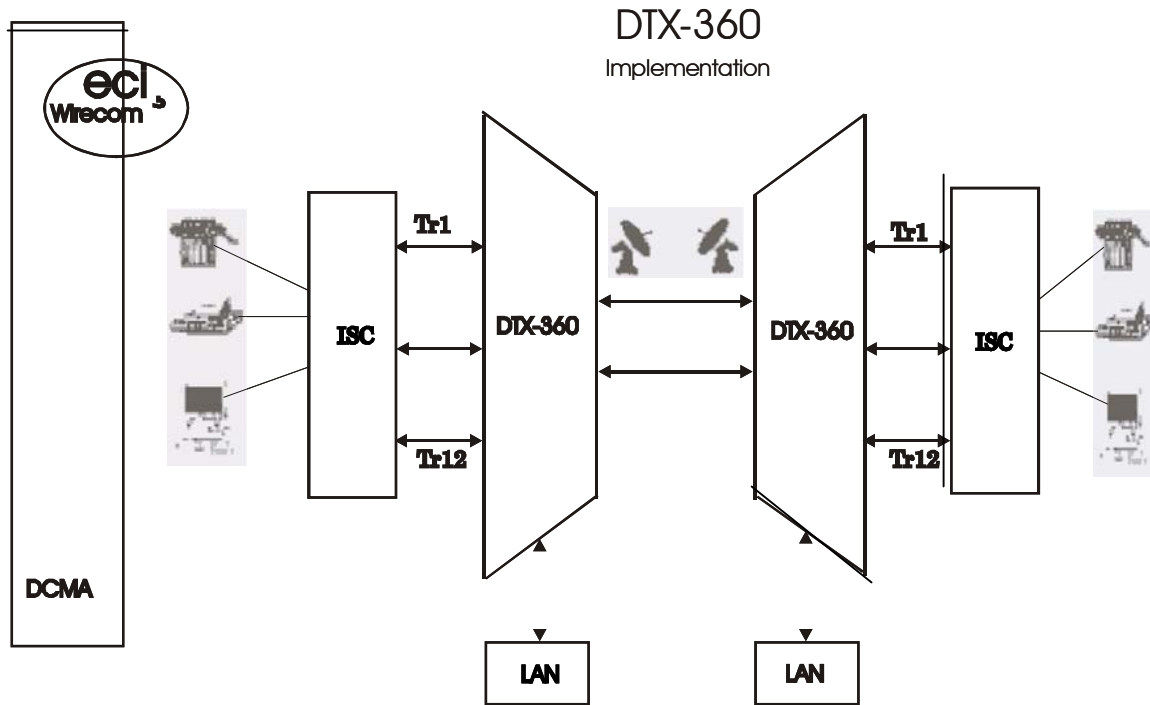
**2.9 OPERATOR STATION 360:**

The DTX-360 provides a complete packet of in-service functions in support of maintenance tasks that assure uninterrupted service.

**The following inservice functions are available.**

- **Local Built in test**
- **Terminal internal Redundancy**
- **System Clock Monitoring**
- **Control Channel BER Monitoring**
- **Trunk and Bearer Error Performance**
- **System Statistics**
- **System Anomaly Reports**
- **Terminals Alarm condition indication**
- **End to End tests**
- **Communication Link monitoring**
- **Stand-by terminal for cluster mode.**

**The figures 1 & 2 shows the implementation and network connections of DTX-360.**



**3.0 TESTING OF DCME DTX-360:**

The following tests are to be taken in DCME DTX-360 equipment.

I. **LOCAL TEST:**

- i. Voice Channel Test
- ii. Voice Band Data (VBD) test
- iii. Clear Channel test (pre-assigned 64 Kbits/s)

II. **THROUGH TEST:**

a) **BER TEST FOR BEARER CHANNEL:**

- i. Voice Channel test
- ii. Voice Band Data (VBD) test
- iii. Clear Channel test (pre-assigned 64 Kbits/s)
- iv. Fax Transmission test
- v. Orderwire test
- vi. Alarm test
- vii. Stability test for 48 hours

b) **TESTING INSTRUMENTS REQUIRED:**

- i. PFA-30 or PCM Analyser
- ii. Fax Machine

**LOCAL TEST:**

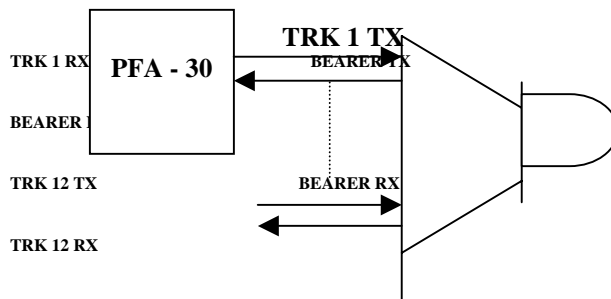


FIGURE:3

For all local test, test setup is shown in Figure.3.

**i.Voice Channel Test (Tone test):**

Send 610 Hz at -10 dbm in Channel 1 of Trunk 1 by PFA-30. Receive the same tone and tabulate the readings . Repeat the test for all channels in Trunk 1 to 12 except pre-assigned channels.

**LIMIT : - 10 ± 0.5 dbm OR SPECIFIED IN THE TECHNICAL MANUAL.**

TRUNK 1/CHL.NO	TRUNK 2/CHL.NO	---	---	---	---	---	---	---	---	---	TRUNK 12/CHL.NO

ii. **VOICE BAND DATA TEST (VBD TEST):**

Send 2000 Hz at – 10 dbm in channel 1 of Trunk 1 by PFA 30. Receive the same tone and tabulate the readings. Repeat the test for all channels in Trunk 1 to 12 except pre-assigned channels.

**LIMIT : - 10 ± 0.5 dbm OR SPECIFIED IN THE TECHNICAL MANUAL.**

TRUNK 1/CHL.NO	TRUNK 2/CHL.NO	---	---	---	---	---	---	---	---	---	TRUNK 12/CHL.NO

**iii. CLEAR CHANNEL TEST:**

Send 64 Kbits/s,  $2^{15}-1$  PRBS pattern in pre-assigned channel in Trunk 1. Receive the same data. Repeat the test for all pre-assigned 64 Kbits/s channels in Trunk 1 to 12. Observe for 5 minutes. Tabulate the readings.

**LIMIT : NO ERROR SHOULD BE OBSERVED.**

TRUNK 1/CHL.NO	TRUNK 2/CHL.NO	---	---	---	---	---	---	---	---	---	TRUNK 12/CHL.NO

**THROUGH TEST:**

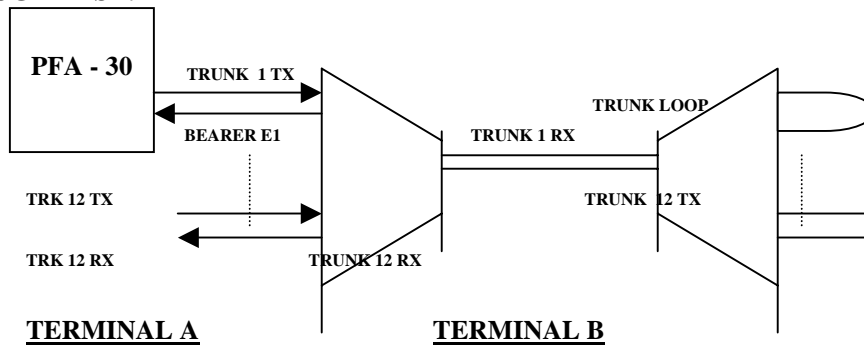


FIGURE – 4

**a. BEARER CHANNEL TEST:**

Send 2 Mb/s,  $2^{15}-1$  PRBS pattern in Bearer channel from Terminal A and loop the Bearer channel at Terminal B. Receive the same data at Terminal A. Observe BER for 1 hour. Repeat the test in all Bearers according to Network Operating modes.

**LIMIT : NO ERROR.**

**b) VOICE CHANNEL TEST:**

Test setup as per fig.4. Send 610 Hz at -10dbm in channel 1 of trunk 1 from Terminal A by PFA-30. Loop the corresponding Trunk at Terminal B or as per network operating modes. Receive the same tone and tabulate the readings. Repeat the test for all channels in Trunks 1 to 12 except pre-assigned channels.

**LIMIT : - 10 ± 0.5 dbm OR SPECIFIED IN THE TECHNICAL MANUAL**

TRUNK 1/CHL.NO	TRUNK 2/CHL.NO	---	---	---	---	---	---	---	---	---	TRUNK 12/CHL.NO

**c) VOICE BAND DATA TEST: (VBD)**

Test set up as per fig.4. Send 2000 Hz at -10dbm in Channel 1 of Trunk 1 from Terminal A by PFA-30. Loop the corresponding Trunk at Terminal B or as per network operating modes. Receive same tone and tabulate the readings. Repeat the test for all channels in Trunk 1 to 12 except pre-assigned channels.

**LIMIT : - 10 ± 0.5 dbm OR SPECIFIED IN THE TECHNICAL MANUAL**

TRUNK 1/CHL.NO	TRUNK 2/CHL.NO	---	---	---	---	---	---	---	---	---	TRUNK 12/CHL.NO

**d. CLEAR CHANNEL TEST(Pre-assigned 64 Kbits/s):**

Test set up as per Fig.2. Send 64 Kbits/s 2<sup>15</sup>-1 PRBS pattern in pre-assigned channel in Trunk 1. Loop the corresponding Trunk at Terminal B or as per network operating modes. Receive the same data at Terminal A. No error should be observed. Tabulate the readings. Repeat the test for all pre-assigned channel in Trunk 1 to 12.

**LIMIT: NO ERROR SHOULD BE OBSERVED.**

TRUNK 1/CHL.NO	TRUNK 2/CHL.NO	---	---	---	---	---	---	---	---	---	TRUNK 12/CHL.NO

**e. FAX TRANSMISSION TEST:**

The FAX machines are to be connected in TAX exchanges at both Terminals. FAX calls should be established in either direction. Repeat the test on all Trunks on sample basis as per the network operating modes.

**LIMIT: FAX MESSAGE SHOULD BE CLEAR LIKE THE TRANSMITTED COPY.**

**f. OPERATION STATION CHECK:**

The following inservice functions are to be monitored by the operation station computer in Local and Remote terminals.

- 1) Built-in test
- 2) Terminal redundancy
- 3) System Clock Monitoring
- 4) Control Channel BER monitoring
- 5) Trunk and Bearer Error-Performance
- 6) System Statistics
- 7) System Anamoly Reports
- 8) Alarm Monitoring

**g. ORDERWIRE CHECK:**

Calling and speech are to be tested for orderwire as per network operating modes i.e. Point-to-Point, Multi-destination, Multi-clique and Mixed Mode.

**LIMIT: OK/Not OK.**

**h. ALARM CHECK:**

The following alarms are to be checked.

3. LOS (Loss of incoming signal)
4. AIS (Alarm Indication Signal)
5. LOF ( Loss of Frame Alignment)
6. High CRC Error
7. High BER ( $10^{-3}$  or higher)
8. Low BER ( $10^{-3}$  ro  $10^{-6}$ )
9. RAI ( Remote Alarm Indication)
10. Loss of Multi Frame Alignment
11. Remote Multi Frame Alarm Indication
12. High Slip Rate/

**i) STABILITY TEST:**

Set up as per Fig.4. Send 64 Kbps,  $2^{15}-1$  PRBS pattern in Pre-assigned channel in any of the trunk by PFA-30 from Terminal A. Loop the corresponding trunk at the other Terminal. Receive the same data at Terminal A. Observe for 48 hours. Result should be in form G-821.

**LIMIT:**

**I. For satellite medium**

- a) SES % : 0.015
- b) ES % : 0.8

**II For OFC & M/W**

- a) SES % : 1. For OFC :  $-0.00023$   
2. For M/W :  $-0.003$
- b) ES % : For both : 0.018