IMX-4T1

T1 Inverse Multiplexer
Installation and Operation Manual

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Telecommunication Safety

The safety status of each of the ports on the IMX-4T1 is declared according to EN 41003 and is detailed in the table below:

Ports	**Safety Status**	
V.24, V.35, V.36, X.21, RS-530, HSSI, Ethernet	SELV	Circuit operating with Safety Extra-Low Voltage
T1, Sub T1	TNV-1	Circuit whose normal operating voltage is within the limits of SELV, on which overvoltages from Telecommunications Networks *are* possible.

Regulatory Information

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Warning per EN 55022

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

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IMX-4E1/IMX-4T1

E1/T1 Link Limit when using Extension Cables

The number of E1/T1 links (and thus the data rate) that can be used is limited by the data port interface type, clock mode selected and actual length of the extension cable used.

In the table below, the number of E1/T1 links that can be used are listed according to data port interface, clock mode used and cable length tested. Corresponding data rates (shown in parenthesis) are in Mbps.

Interface	Clock Mode	**IMX-4E1** Number of E1 Links		**IMX-4T1** Number of T1 Links	
X.21		1m Cable	2m Cable	1m Cable	2m Cable
	DCE Normal	up to 3 (5.76)	up to 3 (5.76)	up to 4 (5.888)	up to 4 (5.888)
	DCE Invert	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	up to 4 (5.888)
	EDCE Normal	N/A	N/A	N/A	N/A
	EDCE Invert	N/A	N/A	N/A	N/A
V.35		1m Cable	2m Cable	1m Cable	2m Cable
	DCE Normal	up to 2 (3.84)	up to 2 (3.84)	up to 3 (4.416)	up to 3 (4.416)
	DCE Invert	up to 4 (7.68)	up to 4 (7.68)	1 (1.472), 3 (4.416) or 4 (5.888)	up to 4 (5.888)
	DCE Normal	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	up to 4 (5.888)
	EDCE Invert	–	–	up to 4 (5.888)	up to 4 (5.888)
RS-530, V.36/RS-449		1m Cable	2m Cable	1m Cable	2m Cable
	DCE Normal	up to 3 (5.76)	up to 3 (5.76)	up to 4 (5.888)	up to 4 (5.888)
	DCE Invert	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	1 (1.472), 3 (4.416) or 4 (5.888)
	EDCE Normal	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	up to 4 (5.888)
	EDCE Invert	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	up to 4 (5.888)
HSSI		2m Cable	15m Cable	2m Cable	15m Cable
	DCE Normal	up to 4 (7.68)	1 (1.92) only	up to 4 (5.888)	1 (1.472) only
	DCE Invert	up to 4 (7.68)	up to 2 (3.84)	up to 4 (5.888)	up to 3 (4.416)
	EDCE Normal	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	up to 4 (5.888)
	EDCE Invert	up to 4 (7.68)	up to 4 (7.68)	up to 4 (5.888)	up to 4 (5.888)

Note: all tests were carried out using Fireberd 6000A equipment (S/W ver. M)

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IMX-4E1/IMX-4T1 with V.35 Ports

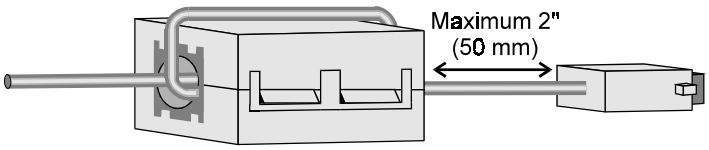
Installation Instructions for Compliance with EMC Requirements

To comply with electromagnetic compatibility requirements, a ferrite core (such as FAIR-RITE Catalog number 0443164151 or equivalent) should be installed on any unshielded data cable connected to a V.35 port.

This limits the electromagnetic energy emitted from the unshielded cables.

Alternatively, replace unshielded data cable with shielded data cable. (Note: If using a shielded data cable, the cable shield should be connected to the metallic hood.)

To install the ferrite core:



- Run the cable through the open core.
- If cable thickness allows, wrap it around the core and run it through again. Allow no more than 2 inches (50 mm) between the core and the connector to the unit.
- Snap the core shut.

Note: to protect against electro-static discharge (ESD) into the V.35 port, use a connector with a hood which completely covers the pin connection.

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Chapter 1
Introduction

This chapter:

- Provides a Functional Description of the IMX-4T1
- Describes the operating environment
- Describes system application considerations
- Provides technical specifications.

1.1 Functional Description

Purpose and Main Features

The IMX-4T1 is an inverse multiplexer that allows transparent transmission of high-speed synchronous data at rates up to a maximum of 5.888 Mbps, using up to four standard T1 lines. This provides a cost-effective, high-speed transmission medium for the interconnection of bridges, routers, etc.

Figure 1-1 shows a basic application for the IMX-4T1, in which the IMX-4T1 is used to provide a high-speed data link for interconnecting two bridges or routers via standard T1 lines.

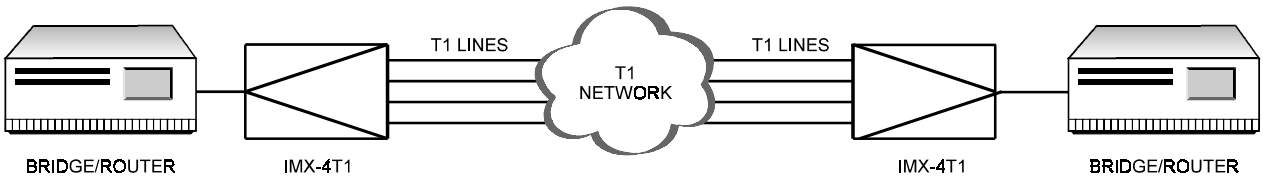


Figure 1-1 Basic IMX-4T1 Application

Figure 1-2 shows another typical application for the IMX-4T1. In the application shown in Figure 1-2, IMX-4T1 units are used to provide routers equipped with ATM-DXI interfaces access to the ATM network using fractional T3 services, e.g., the Accunet Fractional T45 (FT45) service offered by AT&T. Using the FT45 service significantly increases the rate of transfer of inter-LAN traffic, and provides the other advantages of connecting routers via an ATM network.

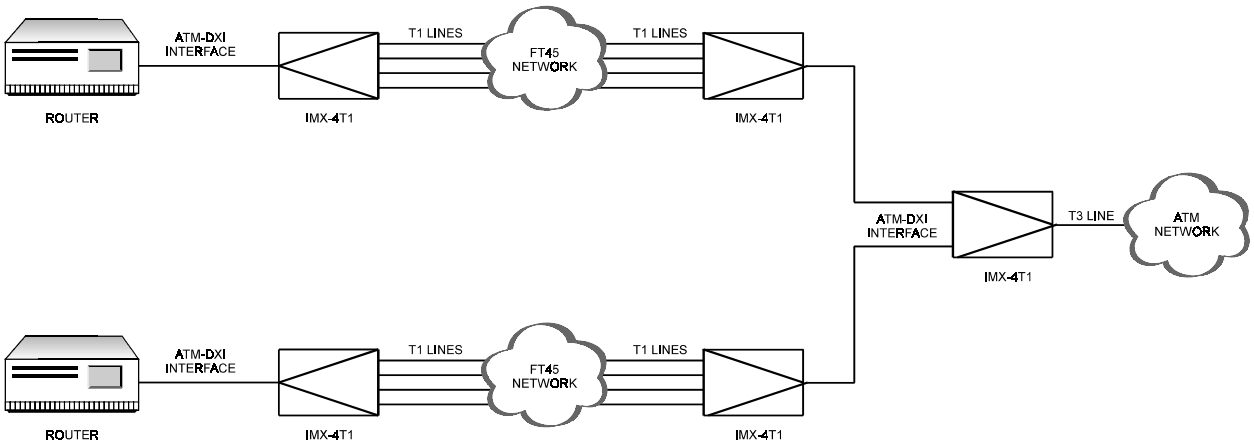


Figure 1-2 Typical IMX-4T1 Application for Fractional T3 Access to the ATM Network

Inverse Multiplexing

Inverse multiplexing is a technique that splits a high-speed data stream for parallel transmission over several lower-speed transmission lines. The IMX-4T1 uses T1 lines for data transmission. The number of T1 link interfaces of the IMX-4T1 is four, therefore it can transmit data at rates which are a multiple of 1.472 Mbps, i.e., 2.944, 4.416, and 5.888 Mbps, respectively, in accordance with the number of T1 lines that is being used. The number of T1 lines is user-selectable: when the number of T1 lines is less than four, the user can specify the link interfaces to be used.

The IMX-4T1 supports an automatic rate fallback feature: if one of the T1 links fails, the IMX-4T1 will automatically select the next lower rate available and continue providing service at the fallback rate. When the failed link recovers, the IMX-4T1 automatically returns to the original, user-selected rate. To make use of the fallback feature, the user's equipment must be able to tolerate changes in the data rate.

The data rates supported by the IMX-4T1 are similar to the data rates offered by the AT&T ACCUNET™ Fractional T45 service, however the IMX-4T1 can tolerate differential delays between any two lines up to 64 msec, and in addition it can automatically detect interchanging of T1 lines. These capabilities allow routing of the T1 lines used by a given IMX-4T1 over different paths or different facilities for increased flexibility and reliability. Note that although the IMX-4T1 can tolerate differential delays up to 64 msec, the actual latency of an IMX-4T1 link is similar to the maximum differential delay encountered on the T1 lines being used.

T1 Link Interface Characteristics

The IMX-4T1 is available with up to four T1 link interfaces. The link interfaces can also be ordered with a built-in CSU.

The IMX-4T1 T1 link interfaces are compatible with virtually all carrier-provided T1 services. The link interfaces support both the D4 (SF) and ESF framing formats, in accordance with user's selection. Zero suppression over the line is user-selectable (transparent [AMI] coding, or B8ZS).

The T1 line interfaces meet the requirements of AT&T TR-62411, ANSI T1.403, and ITU-T Rec. G.703, G.704. Each interface has a 100Ω balanced line interface, terminated in an RJ-48C connector. The nominal transmit

level is 3V, and the line signal is software-adjustable for line lengths of 0 to 655 feet in accordance with AT&T CB-119. The maximum line attenuation, without CSU, is up to 10dB; when the integral CSU option is used, the maximum line attenuation is up to 34 dB. For shorter lines, the CSU transmit level can be set to -7.5, -15, or -22.5 dB.

User Data Port Sync Interface Characteristics

The IMX-4T1 can be ordered with one of several synchronous data interfaces for the DCE user Port. The sync data interfaces available are V.35, X.21, RS-530, V.36/RS-449 and HSSI (high-speed serial interface).

The user sync data port connector depends on the interface type:

- V.35 interface: 34-pin female connector.
- X.21 interface: 15-pin D-type female connector.
- RS-530 interface: 25-pin D-type female connector.
- V.36/RS-449 interface: a supplied adapter cable converts between the 25-pin D-type female connector of the RS-530 interface to a 37-pin D-type male connector.
- HSSI interface: 50-pin SCSI-2 female connector.

Ethernet Interface Characteristics

An Ethernet Bridge port can be ordered instead of a sync data port interface. The Ethernet interface has a 10BaseT interface complying with the IEEE 802.3 standard, and is terminated in an 8-pin RJ-45 shielded connector, which can operate over UTP and STP media.

The interface includes a full-feature remote bridge, that operates at the physical and data link layers of the OSI model, and is therefore completely transparent to higher level protocols, such as TCP/IP, DEC net, XNS, ISO, and to operating systems such as NetWare, VINES, and 3COM+.

The bridge operates as a media access (MAC) layer remote bridge with self-learning capabilities: it learns and automatically recognized the address of the nodes attached to the local LAN (the LAN directly attached to the IMX-4T1 interface), and uses this information to filter the LAN traffic. The address information is stored in table, which can store up to 10,000 addresses. The address information is automatically updated (aging time is 5 minutes, that is, if no frames are received from a node for 5 minutes, the node address is automatically removed from the tables to ensuring that only fresh addresses are used).

Therefore the bridge block the packets addressed to local nodes, and forwards through the IMX-4T1 link only multicasts, broadcasts, and packets addressed to nodes attached to the remote LAN. To increase transmission efficiency, the bridge compresses short packets by automatically recognizing the padding bits in 64-bit frames, transmitting only the payload, and reconstructing the packets at the remote end.

The filtering and forwarding can be performed at a rate of up to 15,000 packets per second (provided the bandwidth selected on the T1 link is sufficient to carry the resulting payload rate). When bridging is not necessary,

e.g., for LAN extender applications, the user can disable the bridge: in this case the IMX-4T1 operates as a repeater that transfers transparently all the traffic to the remote end.

Notes

1. *The factory setting of the clock is DCE mode*
2. *It is not recommended to perform loops when this interface is used.*

System Timing

The IMX-4T1 has several timing modes that confer maximum flexibility in system integration.

The IMX-4T1 system timing reference can be locked to the desired user-selected clock source:

- The receive clock of each T1 link is always derived from the incoming line signal.
- The system clock, which also serves as the transmit clock source common to all the T1 links, is derived from a user-selected timing source:
  - An internal crystal oscillator with an accuracy of ±32 ppm.
  - An external (station) clock signal, having a nominal rate of 1.544 Mbps, connected to a separate RJ-48C connector via a balanced T1-type interface.
  - The recovered receive clock signal of a user-selectable T1 link.

In addition to a main system clock source, the user can specify a fallback source, which is automatically selected in case the main source fails, e.g., because of a loss of synchronization condition on the link selected as the main source.

User Data Channel Timing

The IMX-4T1 user data channel interface has two timing modes. In both modes, the clock signals are derived from the internal IMX-4T1 system timing reference:

- DCE mode: the IMX-4T1 provides transmit and receive clock signals to the user's data terminal equipment. The user's DTE must read the data sent by the IMX-4T1 at the rate of the receive clock signal, and the IMX-4T1 samples the transmit data arriving from the user's DTE in accordance with the transmit signal provided to the user's DTE.
- E-DCE mode: this mode is similar to the DCE mode, except that the IMX-4T1 samples the transmit data arriving from the user's DTE in accordance with an external transmit signal returned by the user's DTE. This clock signal must be derived from the transmit signal provided to the user's DTE.

Note *E-DCE timing mode is not available for X.21 or Ethernet interfaces.*

Statistics Collection

When operating with the ESF frame format, the IMX-4T1 stores T1 line statistics in compliance with the ANSI T1.403-1989 requirements. IMX-4T1 also provides local statistics support that meets the requirements of AT&T Pub. 54016.

Test and Diagnostics Capabilities

The IMX-4T1 has comprehensive diagnostics capabilities that include local and remote loopbacks on the links and on the user's data channel, and bit error rate (BER) testing. The IMX-4T1 also supports the in-band code-activated network payload loopback. When the T1 links are equipped with CSU interfaces, the IMX-4T1 also supports the in-band code-activated network line loopback.

Maintenance is further enhanced by advanced self-test capabilities, and by an automatically performed power-up self-test that provides circuit-level diagnostics data.

Alarms

The IMX-4T1 stores alarms detected during its operation in a buffer that can hold up to 100 alarms. During regular operation, the front panel LCD display shows if there are any alarms in the alarm buffer, to notify the local operator that alarm conditions have been detected. The local operator can then review the contents of the alarm buffer on the front panel display, and can delete old alarms.

In addition to the alarm buffer, the front-panel LED indicators display in real time the status of the IMX-4T1 links and the activity of the user's data channel, and alert when test loops are present in the system.

The IMX-4T1 can provide an alarm indication by means of an alarm relay. The alarm relay is energized when the IMX-4T1 is powered and operating normally and is de-energized when a major alarm condition is present, or the IMX-4T1 power is off.

Control of IMX-4T1 Operation

The IMX-4T1 system is designed for unattended operation. The configuration of the IMX-4T1, that is, a complete collection of operating parameters, is determined by a data base stored in non-volatile memory.

The IMX-4T1 can be controlled by means of a simple menu, operated by push-buttons located on the front panel. During set-up, an LCD display guides the operator in the execution of the desired operations. The display provides information concerning the current system configuration and operating mode, and the available values of each programmable parameter. In case of operator errors, the IMX-4T1 displays a message that explains the error and helps the operator take the correct action.

Remote Supervision and Monitoring

In addition to the front panel control, the IMX-4T1 also includes an RS-232 supervisory port. The supervisory port allows full control over IMX-4T1 operation, remote reading of alarm messages, and remote monitoring of IMX-4T1 operation from a standard ASCII data terminal, using either point-to-point or polling communications.

For polling purposes, each IMX-4T1 can be assigned an eight-bit address, for a maximum of 255 nodes (the zero address is reserved).

In addition, it is possible to connect a Hayes™ compatible dial-up modem to the supervisory port, to provide call-in and call-out capabilities.

Physical Characteristics

The IMX-4T1 is a compact unit, intended for installation on desk tops or shelves. Unit height is only 1U (1.75"). An optional rack-mount adapter kit enables the installation of the IMX-4T1 units in a 19" rack.

Power Requirements

The IMX-4T1 can be powered by 115 VAC and 230 VAC, 47 to 63 Hz.

1.2 Operating Environment

This section describes the T1 environment, to provide the background information required for the understanding of the IMX-4T1 configuration parameters.

The T1 line interfaces of the IMX-4T1 comply with the applicable requirements of AT&T Pub. 62411, and ITU-T Rec. G.703, G.704, G.711, G.733, and G.824.

The T1 Signal Structure

The T1 line operates at a nominal rate of 1.544 Mbps. The data transferred over the T1 line is organized in frames. Each T1 frame includes 193 bits. The 193 bits consist of 24 time slots of eight bits each, that carry the data payload. An additional time slot, including one bit (the F bit) carries framing and supervision information. As a result, the data rate supported by each payload time slot is 64 kbps. The data rate of the framing slot is 8 kbps. The T1 frame format is shown in Figure 1-3.

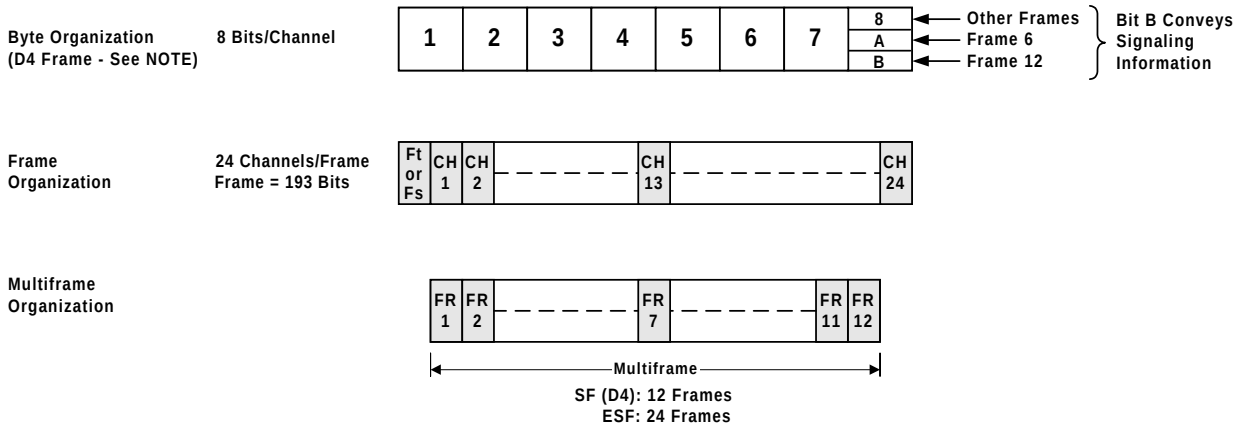


Figure 1-3 T1 Frame Format

In order to enhance link/system supervision capabilities, the frames are organized in larger patterns, called super-frames. Two types of super-frames are used:

- SF (also called D4), consists of 12 T1 frames.
- Extended SF (ESF), consists of 24 T1 frames.

The SF format provides limited supervision capabilities such as end-to-end reporting of local loss-of-signal (yellow alarm).

The ESF format provides much improved supervision capabilities, and allows better utilization of the 8 kbps framing time slots. The major advantage of the ESF format is that it supports on-line link performance monitoring (by means of a 2 kbps Cyclic Redundancy Check (CRC) channel) and in addition provides a 4 kbps end-to-end supervision and control data link.

The implementation of the multiframing format is based on the use of various F-bit patterns. The F-bit pattern is used to perform three functions:

- Framing Pattern Sequence (FPS), defines frame and multiframe boundaries.
- Facility Data Link (FDL), allows transfer of supervisory data, e.g., alarms, error performance, test loop commands, etc., to be passed through the T1 link.
- Cyclic Redundancy Check (CRC), allows the measurement of the bit error rate and enhances the reliability of the framing algorithm.

The F-bit pattern defines the structure of frames and multiframes. In the D4 (SF) frame format, the F-bit of consecutive frames is alternately interpreted as an $F_t$bit (terminal framing bit) or $F_s$bit (frame signaling bit).

- F_t pattern: alternating 0's and 1's, defines the frame boundaries.
- F_s pattern: fixed 001110 pattern, defines the multiframe boundaries, so that one frame may be distinguished from another. In particular, the F_s pattern is needed so that frames 6 and 12 may be identified for the recovery of signaling bits.

In the ESF frame format, the multiframe structure is extended to 24 frames, but the frame and channel structure are the same as in the D4 (SF) format.

T1 Line Signal

The basic T1 line signal is coded using the alternate mark inversion (AMI) rules. In the AMI format, ones are alternately transmitted as positive and negative pulses, whereas zeros are transmitted as a zero voltage level. The AMI format cannot transmit long strings of zeros, because such strings do not carry timing information. Therefore, the AMI signal source must generate a signal with guaranteed minimum “ones” density.

The minimum average “ones” density is 1:8, so when a T1 signal is transmitted over an AMI line each frame time slot must include at least one "1" bit. In certain applications, this would effectively reduce the data rate available to the user to only 56 kbps per time slot, and would preclude the provision of clear channel capability (CCC). To circumvent this problem, modified line codes, which perform zero suppression by substituting special codes for long strings of "zeros", are used.

A widely used zero suppression method is B8ZS. The B8ZS zero suppression method provides clear channel capability, and the ones density requirement no longer restricts user data characteristics. This means that each T1 frame time slot can support the full 64 kbps.

T1 Alarm Conditions

The basic alarm conditions are the red alarm and the yellow alarm.

- **Red Alarm.** A red alarm is generated when the local unit has lost frame synchronization for more than 2.5 consecutive seconds. Loss of frame synchronization may be caused by F_s or F_t errors, by the reception of an AIS signal, or by the loss of the input signal.

  In accordance with AT&T TR-62411, a system automatically recovers synchronization when there has been a period of 10 to 20 consecutive seconds free of the loss of sync condition. Since in many system applications this is a overly conservative specification, the IMX-4T1 allows the user to select a “fast” mode, which reduces the time necessary to declare synchronization to approximately one second free of the loss of sync condition.

- **Yellow Alarm.** A yellow alarm is sent from the remote unit to inform the local unit that a red alarm exists at the remote end.

- **Alarm Indication Signal (AIS).** The AIS signal is an unframed all-ones signal, and is used to maintain line signal synchronization when an alarm condition occurs in the equipment that supplies the line signal.
- **Excessive Bit Error Rate.** The bit error rate is measured on the framing bits. An excessive error rate condition is declared when the measured bit error rate exceeds 10^{-3}.

1.3 System Application Considerations

This section presents typical IMX-4T1 applications and explains special application considerations.

Clock Waveforms

The IMX-4T1 distributes the incoming user's data bits among the active T1 links on a bit-by-bit basis. The number of active T1 links is selected by the user (up to the maximum of four available on a given IMX-4T1).

The number of active T1 links determines the user's data rate: the IMX-4T1 utilizes 23 time slots of each frame transmitted on a T1 link for the transmission of user's data, therefore the user's data rate is 1.472 Mbps times the number of active links. The remaining bits of each T1 frame (these are the eight bits of time slot 1 and the 193-th bit of the frame) are used to transmit the overhead data. The overhead data includes the standard T1 frame synchronization and housekeeping data (see Figure 1-3), and information generated by the IMX-4T1. The information generated by the IMX-4T1 is used for the following main purposes:

- Determining the differential delays among the active T1 links.
- Reassembling the bits in the correct order, to restore the original user's data stream at the remote end of the IMX-4T1 link.

The receive path of the IMX-4T1 provides the original user's data stream and a clock signal that is synchronized with the individual data bits. As a result, the receive clock supplied to the user's DTE consists of bursts separated by gaps that appear during the transmission of overhead data. The basic frequency of the clock bursts is 1.544 Mbps, and gap duration depends on the number of active links, n.

The gap duration is an integer multiple of the bit interval at the 1.544 Mbps clock burst rate. The gap duration is n x 9 bits, followed by a clock burst of n x 184 bits. For example, at a user's data rate of 5.888 Mbps (four active links), the gap has a duration of 36 bit intervals (4 x 9 bits) and appears after every group of 736 user's data bits (4 x 184 bits).

System Timing Considerations

This section describes the timing modes offered by the IMX-4T1. The IMX-4T1 allows the selection of a timing mode for the user's data channel, and the selection of a system timing mode.

User's Data Channel Timing Modes

The IMX-4T1 user's data channel timing is always locked to the system clock. For flexibility, the flow of user's data channel timing signals can be configured to use either the DCE timing mode, or the E-DCE timing mode.

The basic user's data channel timing mode is called the DCE mode: in this mode, the user's data channel interface operates as a DCE interface, that is, the IMX-4T1 provides transmit and receive clock signals to the user's data terminal equipment. These signals are derived from the IMX-4T1 system clock. The user's DTE must read the data sent by the IMX-4T1 at the rate of the receive clock signal, the IMX-4T1 samples the transmit data arriving from the user's DTE in accordance with the transmit signal provided to the user's DTE. The flow of timing signals in the user's data channel interface, in the DCE mode, is shown in Figure 1-4.

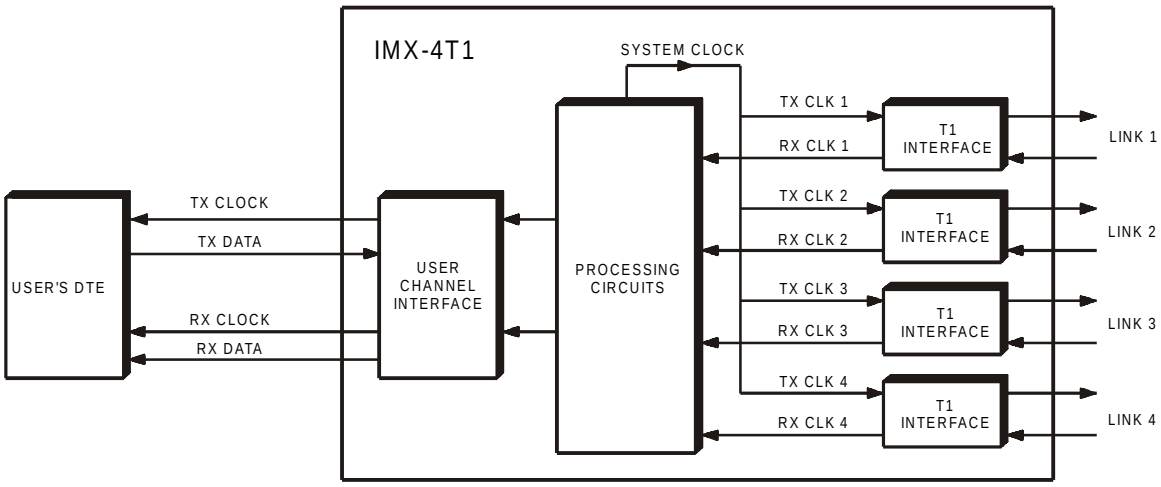


Figure 1-4 Flow of Timing Signals in User's Data Channel Interface in the DCE Mode

The second timing mode is the E-DCE mode: this mode is similar to the DCE mode, except that the IMX-4T1 samples the transmit data arriving from the user's DTE in accordance with an external transmit signal returned by the user's DTE. This clock signal must be derived from the transmit signal provided to the user's DTE. The flow of timing signals in the user's data channel interface, in the E-DCE mode, is shown in Figure 1-5.

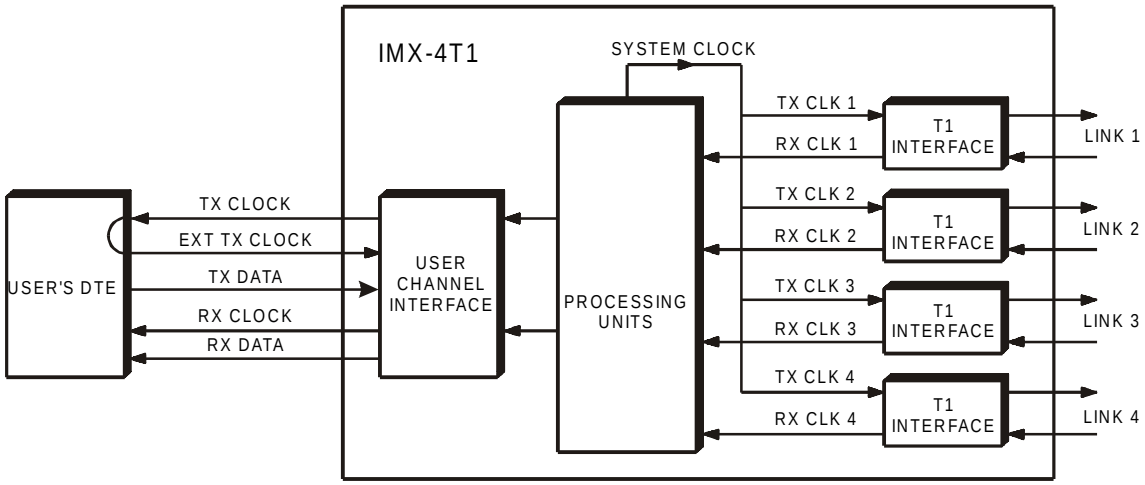


Figure 1-5 Flow of Timing Signals In User's Data Channel Interface in the E-DCE Mode

System Timing Modes

The IMX-4T1 system clock serves as the reference source for the transmit clocks of all the link interfaces, and for the user's data channel interface clock signals. The IMX-4T1 has three system timing modes:

- Internal timing
- External timing
- Loopback timing.

Internal Timing

With internal timing, the system clock of the IMX-4T1 is derived from a free-running internal crystal oscillator with an accuracy of ±32 ppm. Figure 1-6.A shows the flow of timing signals in an IMX-4T1 using the internal timing mode. When internal clocking is used by an IMX-4T1, the IMX-4T1 at the remote end of the link must use loopback timing, as shown in Figure 1-6.B.

Note that the receive paths of the T1 link interfaces work with their own recovered clocks. These clock signals must be derived from the same source.

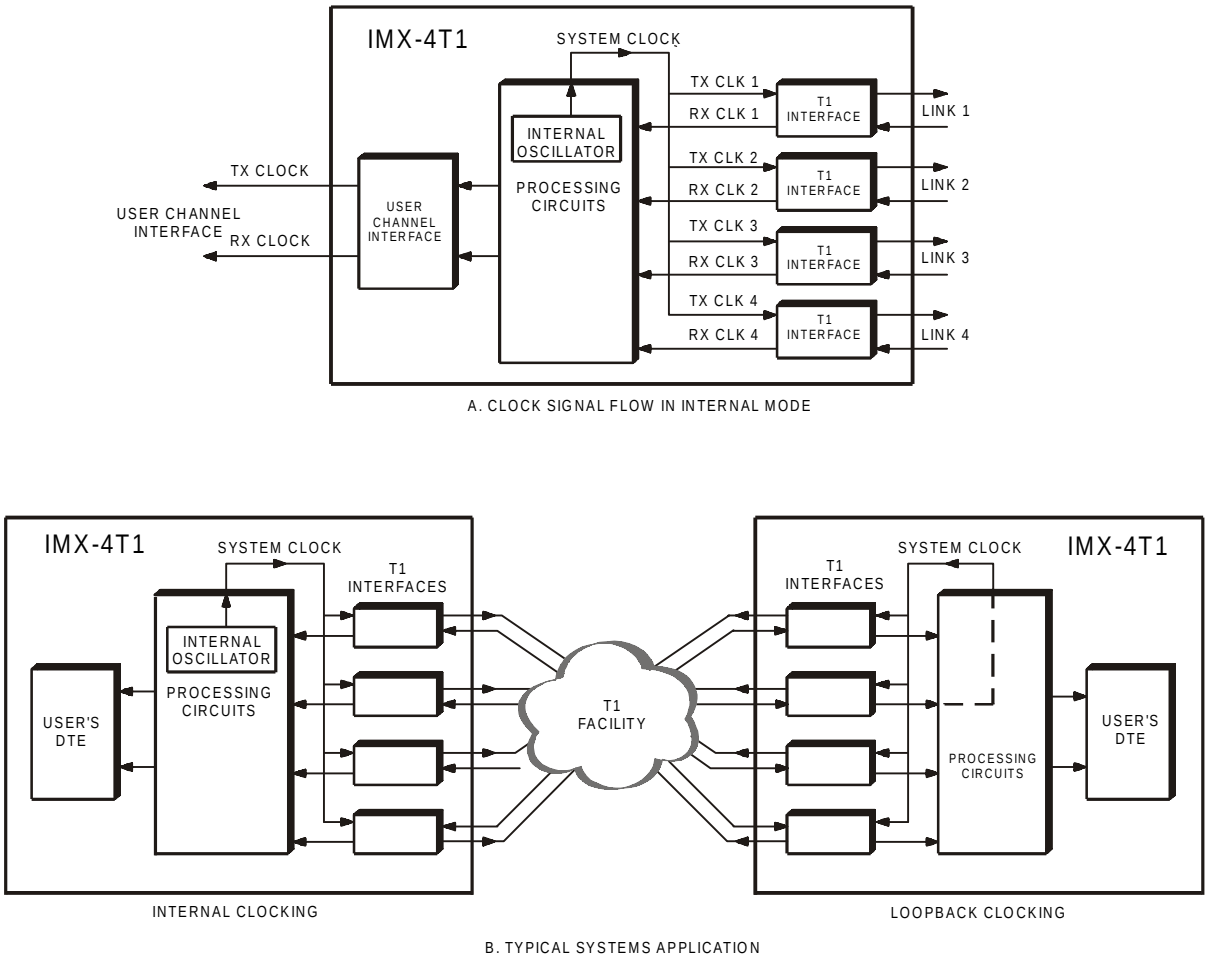
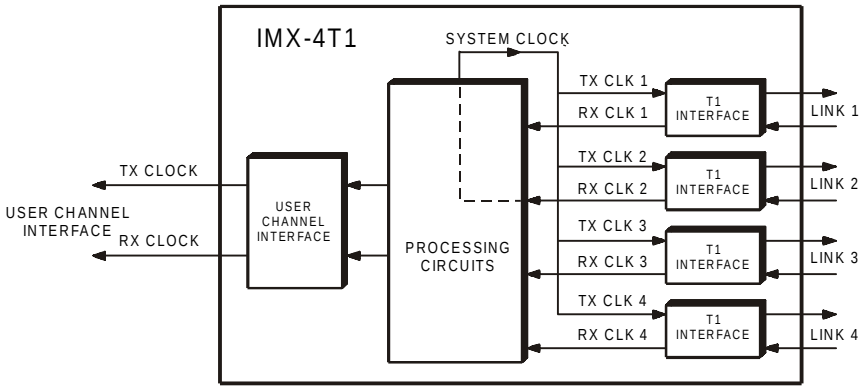


Figure 1-6 Flow of Timing Signals in Internal Timing Mode

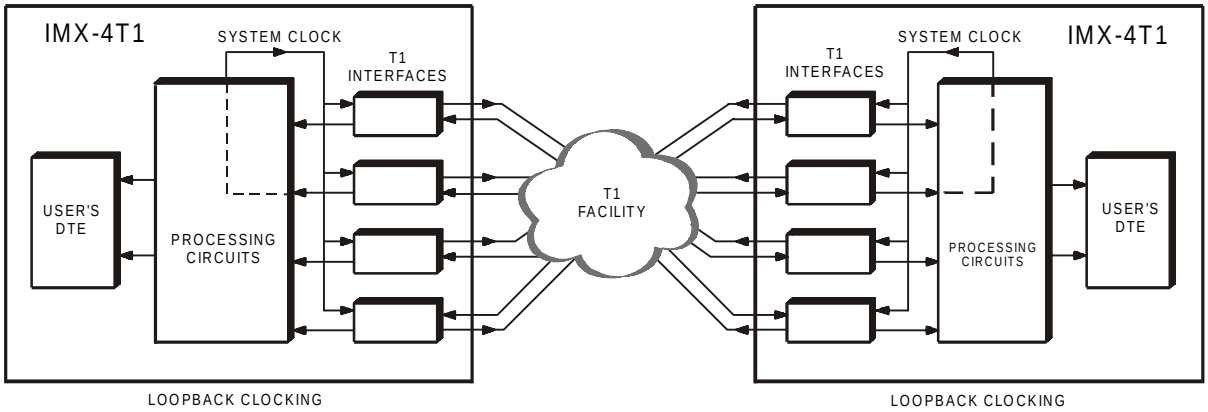
Loopback Timing

With loopback timing, the system clock is locked to the recovered receive clock signal of a user-selectable T1 link. Figure 1-7.A shows the flow of timing signals in an IMX-4T1 using the loopback timing mode, when the timing source is the recovered clock signal of T1 link interface 2.

Since the network reference clock of most T1 carriers is locked to a master clock with very high accuracy and stability, the use of loopback timing at both ends of a link is a simple and effective means for locking the system clocks of the two IMX-4T1 units to the T1 network clock. This application is illustrated in Figure 1-7.B.



A. CLOCK SIGNAL FLOW IN LOOPBACK MODE



B. TYPICAL SYSTEMS APPLICATION

Figure 1-7 Flow of Timing Signals In Loopback Timing Mode

External (Station) Timing

With external timing, the system clock is locked to an external (station) clock signal. The external clock interface is available in a separate RJ-48C connector, designated STATION CLOCK. The external clock interface accepts a balanced unframed all-ones AMI or B8ZS signal having a nominal rate of 1.544 Mbps, and the maximum acceptable tolerance is 130 ppm.

Figure 1-8.A shows the flow of timing signals in an IMX-4T1 using the external timing mode.

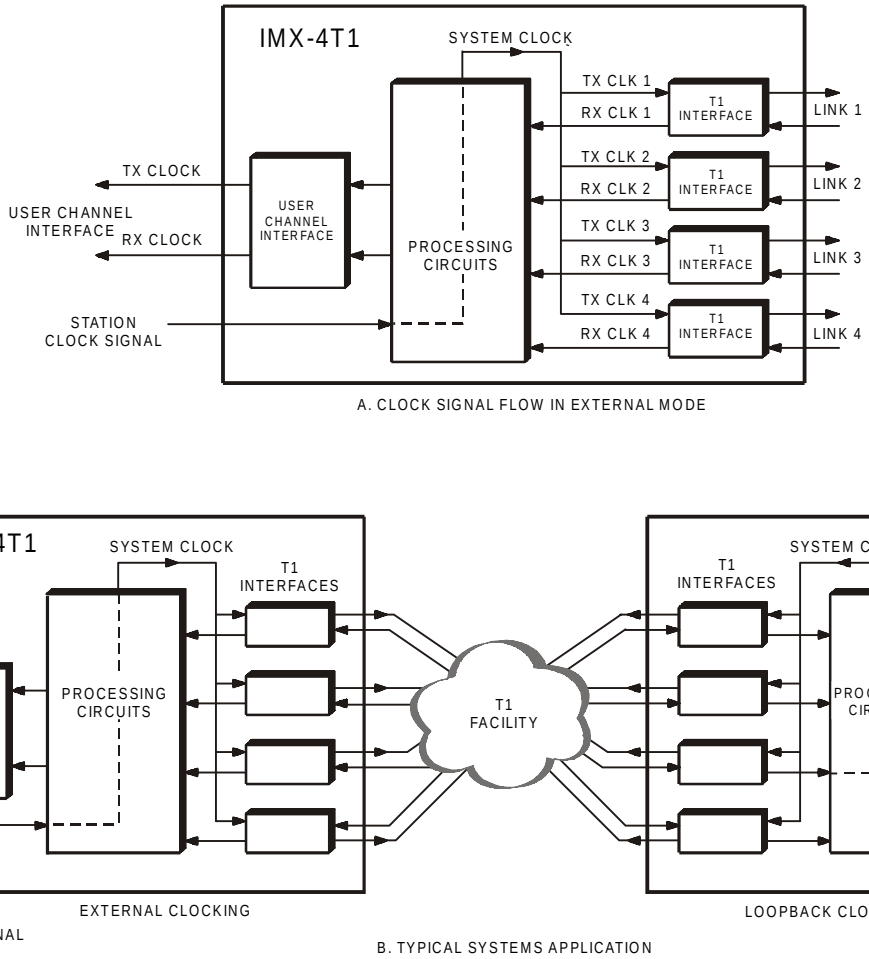


Figure 1-8 Flow of Timing Signals in External (Station) Timing Mode

Note that the receive paths of the T1 link interfaces work with their own recovered clocks. These clock signals must be derived from the same source.

When external clocking is used by an IMX-4T1, the IMX-4T1 at the remote end of the link must use either loopback timing, or external timing derived from the same timing source that provides the timing signal for the other IMX-4T1. An external (station) clock signal is usually available in locations that include higher level multiplexers, e.g., T3 multiplexers. Figure 1-8.B shows a system that uses station timing at one end of the link, and loopback timing at the other end.

Main/Fallback Timing Sources

To prevent the loss of system timing in case the selected timing source fails, the IMX-4T1 will automatically switch to internal timing in case the selected timing source fails, e.g., because of a red alarm (loss of signal) condition on the link selected as the main source.

To ensure that the system timing integrity is not lost in case the main timing source fails, the user can specify an additional timing source as a fallback source. The source selected as a fallback source is automatically selected in case the main source fails (if the fallback source fails, the IMX-4T1 will nevertheless switch automatically to internal timing).

When the main timing source returns to normal operation, the IMX-4T1 will automatically switch back to the main source.

1.4 Technical Specifications

General

Number of Links	4 or 2 (according to order)
Maximum Differential Delay between Links	64 msec (complies with AT&T TR 54019)
Latency	Equal to the highest actual differential delay between links

T1 Link Interfaces Characteristics

Applicable Standards	– AT&T TR-62411, AT&T Pub. 54016, ANSI T1.403 – ITU-T Rec. G.703, G.704
Framing	D4 (SF), ESF
Nominal Line Data Rate	1.544 Mbps
Line Code	AMI
Line Impedance	100 Ω, balanced
Zero Suppression	– Transparent (no zero suppression) – B8ZS The desired mode is software-selectable
Signal Levels	
Transmit Levels	
Nominal Level	±3V ±10%
Levels with CSU	0 dB, -7.5 dB, -15 dB, -22.5 dB
Levels without CSU	Software adjustable to be measured at 0 to 655 ft

Receive Levels	– 0 to -34 dB with CSU – 0 to -10 dB without CSU
Connectors	RJ-48C
Timing Modes	
Main Source	– Loopback timing (locked to a selected link), acceptable tolerance ±130 ppm – External (station) timing, acceptable tolerance ±130 ppm – Internal timing (accuracy: ±32 ppm)
Fallback Source	– Loopback timing (locked to another selected link) – External (station) timing Fallback source is software-selectable, independently of the main source

Station Clock Interface

Nominal Rate	1.544 Mbps
Line Code	AMI or B8ZS
Impedance	100Ω, balanced
Format	Unframed or framed “all-ones” signal
Connector	RJ-48C

User Data Port Interface

Data Rate	– 1.472, 2.944, 4.416 or 5.888 Mbps, in accordance with number of T1 links being used – Automatic fallback to next lower rate when a T1 link fails
Timing Modes	– DCE (supplies transmit and receive clocks to user) – E-DCE (supplies receive and transmit clocks to user and accepts an external transmit clock from user)

Interface (*according to order*)

V.35 Interface	34-pin female connector
X.21 Interface	15-pin D-type female connector
RS-530 Interface	25-pin D-type female connector
V.36/RS-449 Interface	Adapter cable, converts 25-pin D-type female connector of the RS-530 interface to a 37-pin D-type male connector
HSSI Interface	50-pin SCSI-2 female connector
Ethernet 10BaseT	Shielded RJ-45 connector

Diagnostics

- Local and remote T1 loopbacks
- Local or remote user's channel loopbacks
- Code-activated network loopback per ANSI T1.403
- BER testing

Statistics

- Full support of ANSI T1.403 statistics
- Local support of AT&T Pub. 54016 statistics

Front Panel Controls

LCD	Two rows of 16 characters
Push-buttons	CURSOR, SCROLL, ENTER

Indicators

- Red alarm for each T1 link
- Yellow alarm for each T1 link
- User's data channel transmit and receive activity
- Test active

10BaseT port only:

- Ethernet port link status
- Ethernet port collision indicator
- Ethernet port transmit and receive data activity

Supervisory Port

Interface	V.24/RS-232, asynchronous
Connector	9-pin D-type female connector
Data Rate	300, 1200, 2400, 4800 and 9600 bps, or automatic detection of data rate (Autobaud)

Alarm Relay

Via the STATION CLOCK RJ-48C connector

Normally closed	On pin 7 and 8
Normally open	On pin 6 and 8

Physical Characteristics

Height	4.4 cm/1.7 in (1U)
Width	43.2 cm/17 in
Depth	24.2 cm/9.5 in
Weight	2.3 kg/5.0 lb

Power Requirements

Supply Voltage	115 VAC (±10%) and 230 VAC (±10%), 47 to 63 Hz
Power Consumption	18.5 Watts

Environment

Operating Temperature	0 to +45°C (32 to 113°F)
Relative Humidity	Up to 90%, non-condensing

Chapter 2
Installation

This chapter:

- Describes the site requirements for installing the IMX-4T1
- Provides configuration information
- Describes the connections made during installation.

2.1 General

The IMX-4T1 is delivered completely assembled. It is designed for installation as a desk-top unit or for mounting in a 19" rack.

Mechanical and electrical installation procedures for the IMX-4T1 are provided in the following paragraphs.

After installing the unit, refer to Chapter 3 for system configuration information and procedures using the front panel controls, or to Chapter 4 for system configuration procedures using an ASCII terminal connected to the IMX-4T1 supervisory port.

If a problem is encountered, refer to Chapter 5 for test and diagnostics instructions.

2.2 Unpacking

A preliminary inspection of the equipment container should be made before unpacking. Evidence of damage should be noted and reported immediately.

Unpack the equipment as follows:

- Place container on a clean flat surface, cut all straps, and open or remove top.
- Take out the IMX-4T1 carefully and place it securely on a clean surface.
- Inspect the product for damage. Report immediately any damage found.

2.3 Site Requirements

Power

AC-powered IMX-4T1 units should be installed within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing the nominal supply voltage (115 or 230 VAC).

Link and Station Clock Connections

The IMX-4T1 has one RJ-48C connector for each link interface, and one for the external (station) clock interface. Appendix A provides the pin allocation for the RJ-48C connectors.

The maximum allowable line attenuation between the IMX-4T1 port and the network interface depends on the IMX-4T1 interface:

- For the station clock interface, and for link interfaces without CSU, the maximum range is 10 dB.
- For link interfaces with CSU, the maximum range is 34 dB.

User's Data Port Connections

The IMX-4T1 user's data port connector depends on the interface type installed on the unit:

- V.35 interface: 34-pin female connector.
- X.21 interface: 15-pin D-type female connector.
- RS-530 interface: 25-pin D-type female connector.
- V.36/RS-449 interface: a 37-pin D-type male connector is provided by means of an adapter cable that connects to the RS-530 port connector.
- HSSI interface: 50-pin SCSI-2 female connector
- Ethernet 10BaseT: 8-pin RJ-45 female connector.

Front and Rear Panel Clearance

Allow at least 90 cm (36 inches) of frontal clearance for operator access. Allow at least 10 cm (4 inches) clearance at the rear of the unit for interface cable connections.

Ambient Requirements

The ambient operating temperature of the IMX-4T1 should be 32°F to 113°F (0°C to 45°C), at a relative humidity of up to 90%, non-condensing.

2.4 IMX-4T1 Configuration Information

General

This paragraph provides information on the functions of the internal jumpers, to help you select the correct setting for your particular application, and gives you step-by-step instructions for setting these jumpers. The default settings for each jumper are also listed.

All the other configuration actions can be performed from the front panel or from a supervision terminal, after the installation is completed. Information and detailed instructions for these operations appear in Chapters 3 and 4, respectively.

Prior to IMX-4T1 installation, it is necessary to check the positions of its internal jumpers and switches. If necessary, change the settings in accordance with the specific requirements of your application.

Warning

Disconnect the unit from the power line and from all the cables before removing cover.
Dangerous high voltages are present inside the IMX-4T1 when it is connected to power and/or to the links. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, would be carried out only by a skilled person who is aware of the hazard involved. Capacitors inside the instrument may still be charged even after the instrument has been disconnected form its source of supply.

Caution

The IMX-4T1 contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components, and before moving jumpers, touch the IMX-4T1 frame.

Opening IMX-4T1 Case

To reach the internal jumpers and switches of the IMX-4T1, use the following procedure:

1. Disconnect all the cables connected to the IMX-4T1.
2. Unscrew the large captive screws fastening the top cover to the rear panel.
3. Remove IMX-4T1 top cover.

IMX-4T1 Construction

Figure 2-1 shows IMX-4T1 construction. The main components of the IMX-4T1 are the motherboard, four link interface boards, and a DCE interface board.

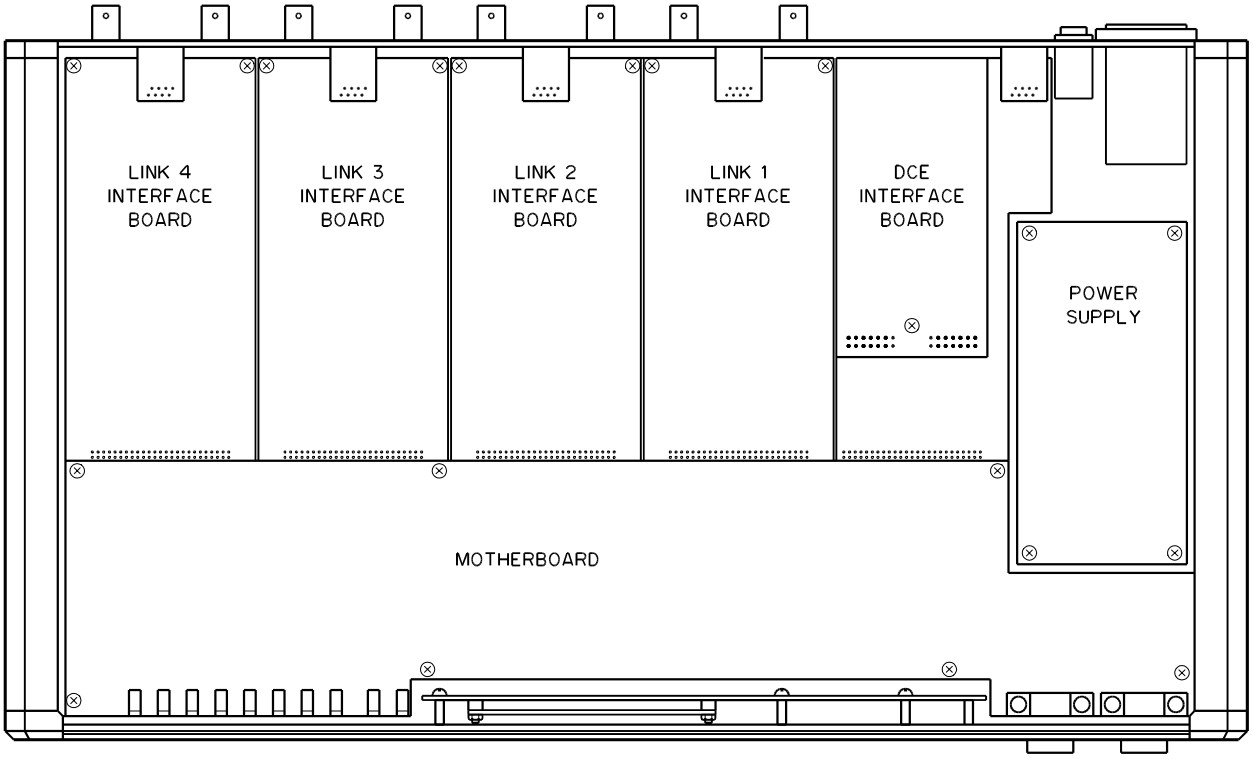


Figure 2-1 IMX-4T1 Construction

Motherboard Jumpers and Switch, Location and Functions

The jumpers and switches located on the IMX-4T1 motherboard are identified in Figure 2-2. Their functions are described below.

In addition to the jumpers listed below, the IMX-4T1 has additional jumpers, that are set by the manufacturer and must not be changed by the user.

WD Selection, Jumper JP5

The WD (watchdog) jumper is used to disable the internal watchdog function during maintenance. The WD jumper, JP5, has two positions:

- ON : watchdog enabled.
- OFF : watchdog disabled.

The IMX-4T1 is shipped with the jumper set at ON.

FGND=SGND Jumper JP22

The jumper JP22 controls the connection between the IMX-4T1 signal ground and the frame (chassis) ground.

- YES : signal ground is connected to the frame (chassis) ground.
- NO : signal ground is not connected to the frame ground.

The IMX-4T1 is shipped with the jumper set at YES (connected).

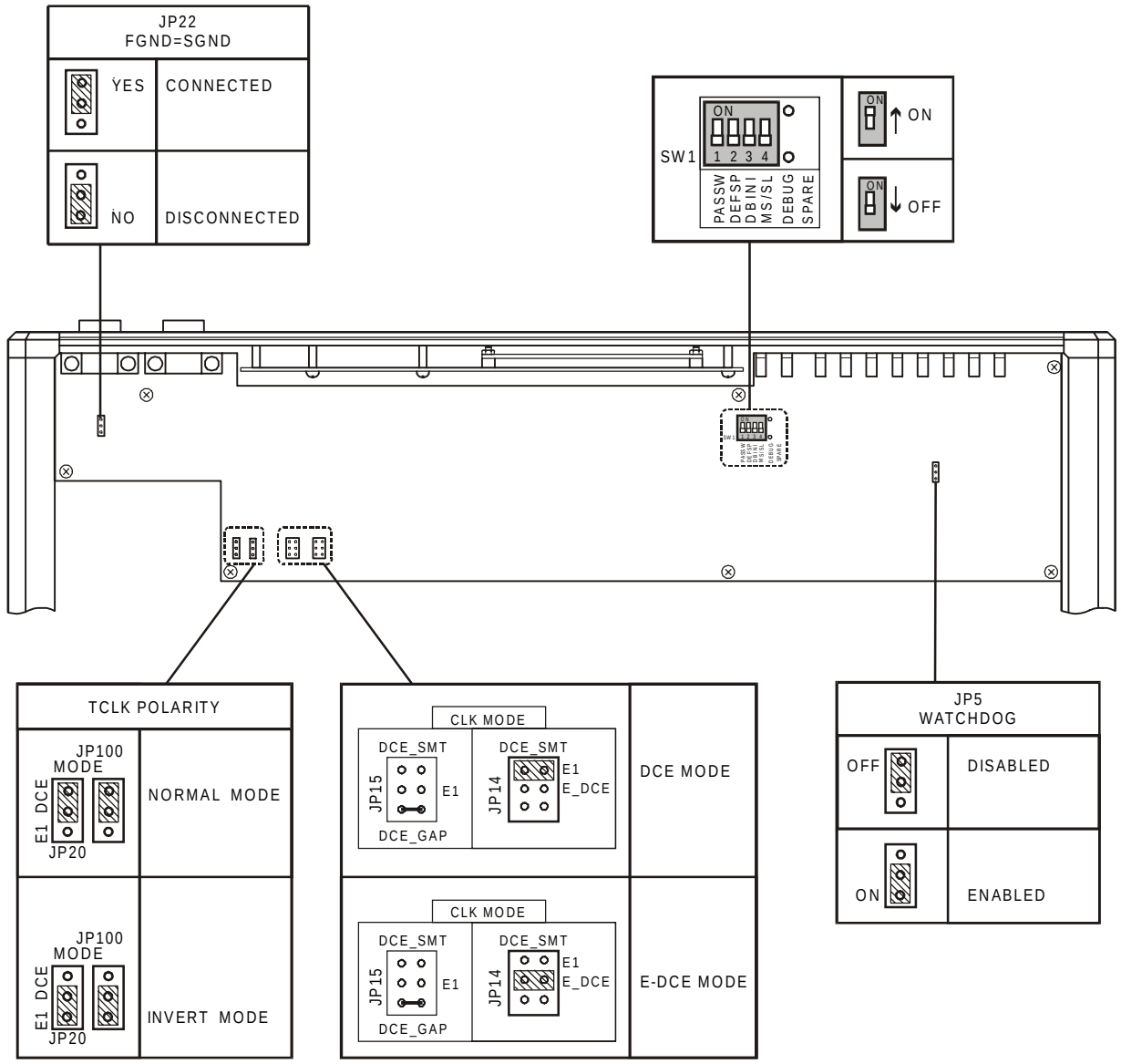


Figure 2-2 IMX-4T1 Motherboard, Internal Settings

Switch SW1

The IMX-4T1 is delivered with a set of default parameters that allow the user to start the configuration activities from a known state. These parameters are stored in its program EPROM, and therefore cannot be modified. By configuring the IMX-4T1, the user specifies custom parameter values; these parameter values are stored in the IMX-4T1 data base (located in non-volatile memory), and are automatically loaded each time the IMX-4T1 is powered up.

Note *If during the power-up self-test, it is found that the user's configuration has been corrupted, the IMX-4T1 will automatically reload the default parameters from its EPROM.*

Switch SW1 allows the user to control the reloading of the desired group of default parameters. The functions of the user-selectable sections are as follows:

- **Section 1 PASSW**. A password, consisting of four to eight alphanumeric characters, can be used to prevent unauthorized personnel from changing IMX-4T1 parameters from the front panel, and from using the IMX-4T1 supervision program. Note that the personnel can read the configuration parameters of the IMX-4T1 from its front panel even when the password is used.

  The IMX-4T1 is delivered with a default password **IMX**, but normally the password is selected by the user.

  Section 1 of SW1 is used to select between the default IMX-4T1 password (the ON position) and the user-selected password (the OFF position). The IMX-4T1 address (node number) is also affected by section 1: with the section set at ON, the node number is set to 0.

  Upon first-time operation, you should use the ON position to start the configuration. You can select this position again to restart with the default password and node address 0 in case the current user password was lost.

  The IMX-4T1 is shipped with section 1 set at OFF.

- **Section 2 DEFSP**. This section selects the source of the supervisory port parameters:

  – ON IMX-4T1 uses the default parameters stored in its program EPROM. The default values are Autobaud, eight data bits, and no parity.

  – OFF IMX-4T1 uses the user-selected parameters.

  Upon first-time operation, you should use the ON position to start the configuration. You can select this position again to restart with the default parameters in case the current values are not known, and it is not possible to communicate with the IMX-4T1 through its supervisory port.

The IMX-4T1 is shipped with section 2 set at OFF.

- **Section 3 DBINI**. This section selects the source of the data base configuration parameters:

  – ON IMX-4T1 uses the default parameters stored in its program EPROM.

  – OFF IMX-4T1 uses the user-selected parameters.

  The IMX-4T1 is delivered with the data base loaded with the default parameters. You can select the ON position again to restart with the default parameters in case the current values are not known.

The IMX-4T1 is shipped with section 3 set at OFF.

Note *User-selected parameter values are not erased by setting one or more of SW1 sections 1, 2, or 3 to ON: this action merely causes the IMX-4T1 to use the default values. However, if the IMX-4T1 is turned off and then powered up again, the default values replace the user values.*

- **Section 4 - MS/SL.** This section selects the maximum differential delay between links. Relevant for models with Ethernet interface only.
  - ON IMX-4T1 uses differential delay of 64 msec.
  - OFF IMX-4T1 uses differential delay of 16 msec (for compatibility with older versions of the IMX-4T1).

Note *IMX-4T1 models with sync data interfaces always operate with a differential delay of 64 msec. For these models, changing this section setting has no effect.*

IMX-4T1 models with Ethernet interface are shipped with section 4 set at ON (other models are shipped set at OFF).

DEBUG Jumper

On certain IMX-4T1 models, this jumper is factory installed. **Do not** change the factory setting.

Clock Mode Selection Jumper JP14

The jumper designated JP14 is used to determine the clocking mode. The two settings of this jumper currently available to the user, shown in Figure 2-2, are as follows:

- DCE – the IMX-4T1 user's data channel operates in the DCE mode, explained in section 1.3.
- E-DCE – the IMX-4T1 user's data channel operates in the E-DCE mode, explained in section 1.3. Note that this mode can be selected only when the user's equipment can provide an external transmit clock.

In both settings, the clock waveform is gapped.

Note *E-DCE timing mode is not available for X.21 or Ethernet interfaces.*

The IMX-4T1 is shipped with the jumper set for the E-DCE mode (models with X.21 or Ethernet interfaces are set for DCE mode).

Polarity Selection, Jumpers JP20 and JP100

These jumpers determine the polarity clock of TCLK that sample the incoming data:

- DCE (Normal): the incoming data sample with the rising edge of TCLK.
- E1 (Invert): the incoming data sample with the falling edge of TCLK.

Note *Variation in cable length, round trip delay and other factors can cause the clock and the data to shift out of phase. Inverting the polarity of TCLK by using the E1 (Invert) mode, may often correct this shift. See the E1/T1 Link Limit Supplement at the beginning of this manual for more information.*

These jumpers are factory set according to the data port interface ordered, for optimal performance.

T1 Link Interface Boards

The four T1 link interface boards do not include user-selectable jumpers.

Note *Each CSU interface board has protection fuses for the surge protection circuits located on the line side of the line isolation transformers.*

DCE Interface Boards

The DCE interface boards include a single user-selectable jumper (JP-2).

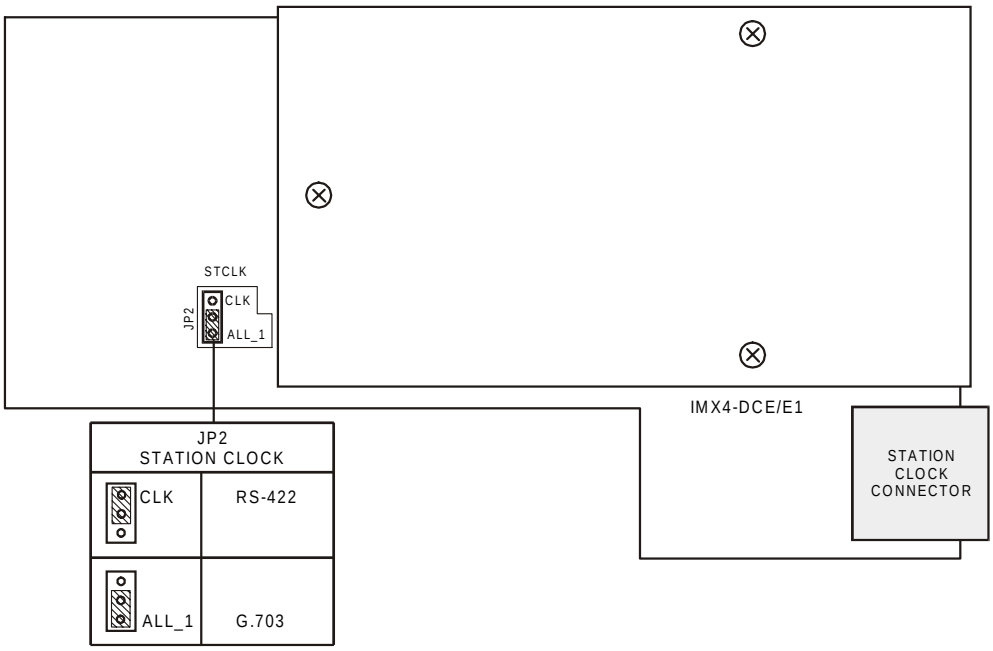


Figure 2-3 DCE Interface Board

Station Clock Source Selection Jumper JP2

The jumper designated JP2 on the DCE interface board is used to select the station clock interface type. The two settings of this jumper, shown in Figure 2-3, are as follows:

- CLK – for RS-422 type station clock interface.
- ALL_1 – for G.703 type station clock interface.

The IMX-4T1 is shipped with the jumpers set for the ALL_1 source.

Internal Settings Procedure

Refer to Figures 2-2 and 2-3, and identify jumper and switch locations and settings. Change settings as required.

After completing the internal settings, reinstall the top cover of the IMX-4T1 and fasten it to the rear panel by fully screwing in the large rear panel screws.

2.5 Installation In 19" Racks

General

The IMX-4T1 can be installed in 19" racks. Unit height corresponds to 1U (1.75"). The hardware necessary for rack installation is available as a kit, **RM-7/NEW**. Below are instructions for rack installation of a unit.

Warning

Disconnect all the cables, including the power cables, from the unit while performing the following procedure.

Installation Procedure

The rack adapter kit includes two brackets. The brackets are fastened by means of screws to the two side walls of the case, as shown in Figure 2-4.

To prepare the unit for rack installation, attach the two brackets to the side walls of the unit. Each bracket is fastened by means of two screws (with flatwashers), which are inserted into the two front holes on the wide wall (nuts are already in place, on the inner side of the wall).

After attaching the brackets, the unit is ready for installation in the 19" rack. Fasten the brackets to the side rails of the 19" rack by means of four screws (not included in the kit), two on each side.

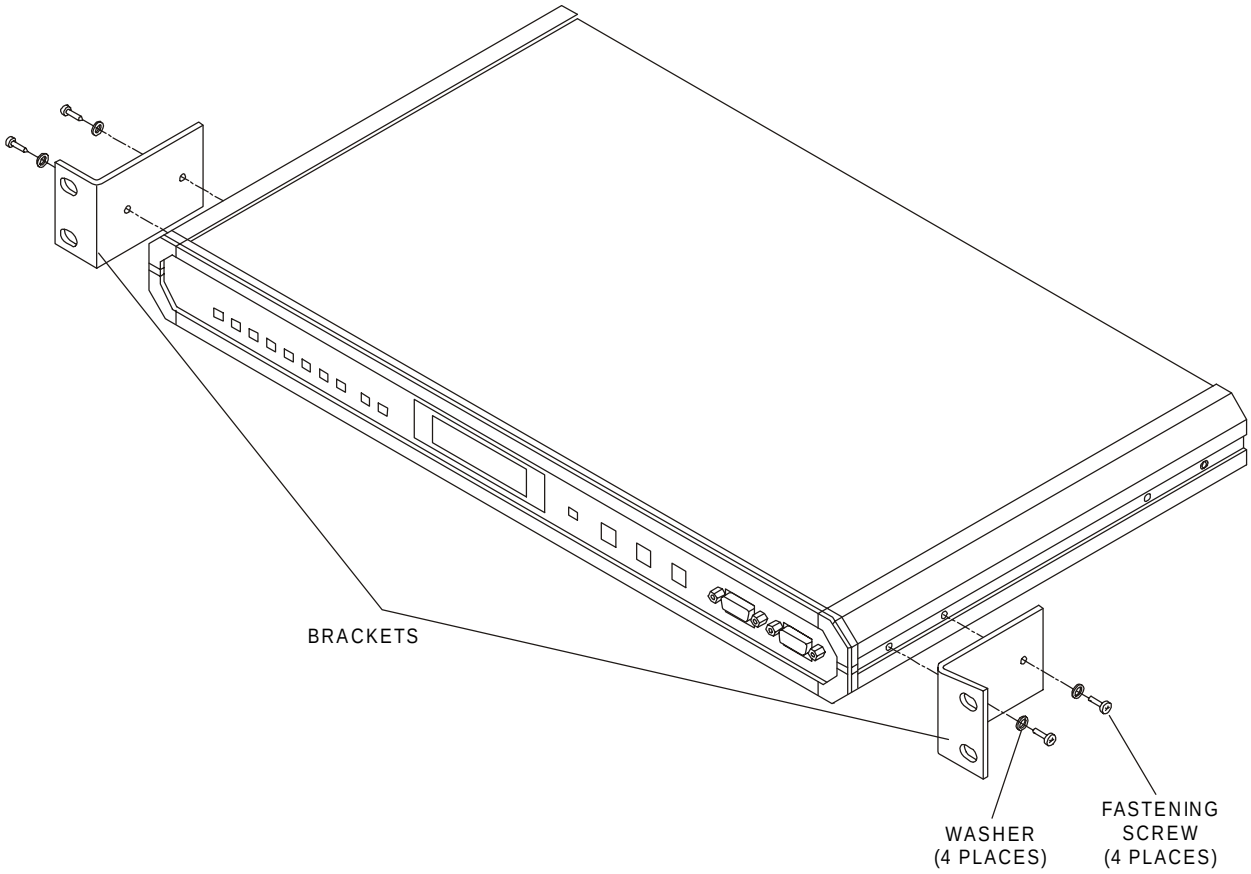


Figure 2-4 Installation of IMX-4T1 in 19″ Rack

2.6 Connections

Connector Locations

Figure 2-5 shows the rear panel of an IMX-4T1 unit and identifies connector locations.

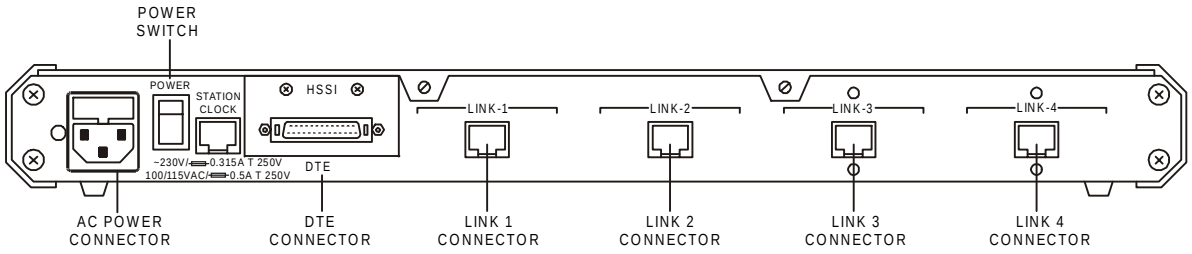


Figure 2-5 IMX-4T1 Rear Panel

Grounding

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

Warning

Before switching on this instrument and before connecting any other cable, the protective earth terminals of this instrument must be connected to the protective ground conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. To preserve this protection, use only extension cords (power cables) with protective grounding.

Make sure that only fuses with the required rated current, as marked on the IMX-4T1 rear panel, are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

AC Power Connections

AC power should be supplied to the IMX-4T1 through a 5-feet (1.5 m) standard power cable terminated by a standard 3-prong plug.

- Check that the ON/OFF switch on the IMX-4T1 rear panel is set to OFF.
- Connect the power cable first to the connector on the IMX-4T1 rear panel, then to the mains outlet.

Link Connections

Connect each of the link cables to the connector corresponding to the link interface to be used, LINK-1, LINK-2, LINK-3, or LINK-4.

Station Clock Connection

If an external clock signal will be used, connect the external clock cable to the STATION CLOCK connector.

User's Data Port Connection

The connection of the user's data terminal equipment is made to the rear panel connector marked DTE. The interface type installed in the IMX-4T1 is indicated by the label displayed above the connector (for example, Figure 2-5 shows an IMX-4T1 with HSSI interface). Connector pin allocations and adapter cable wiring data appear in Appendix A.

V.35 Interface The V.35 interface has a 34-pin female connector, wired for direct connection to V.35 DTE interfaces.

X.21 Interface The X.21 interface has a 15-pin D-type female connector, wired for direct connection to X.21 DTE interfaces.

HSSI Interface The HSSI interface has a 50-pin SCSI-2 female connector wired for direct connection to HSSI DTE interfaces.

RS-530 Interface The RS-530 interface has a 25-pin D-type female connector wired for direct connection to RS-530 DTE interfaces.

V.36/RS-449 Interface If the required interface is V.36/RS-449, connect first the interface adapter cable to the RS-530 connector, then connect the user's data cable to the 37-pin D-type male connector at the other end of the adapter cable.

Ethernet 10BaseT The Ethernet port has a shielded RJ-45 Connector, wired for direct connection to 10BaseT interfaces.

Ethernet Interface Indicators

Figure 2-6 shows the indicators located on the rear panel of the IMX-4T1, also described in Table 2-1 .

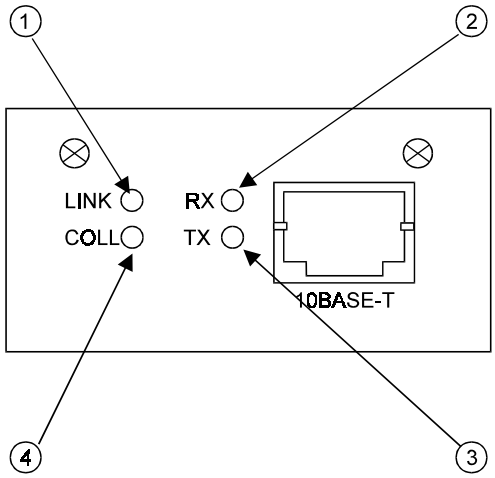


Figure 2-6 Ethernet 10BaseT Interface

Table 2-1 Ethernet 10BaseT Interface Indicators

No.	Indicator	Function
1	LINK indicator	Lights when the Ethernet interface is connected to an active LAN (i.e., a LAN with at least one active stations)
2	RX indicator	Lights when receive activity is present on the Ethernet interface
3	TX indicator	Lights when transmit activity is present on the Ethernet interface
4	COLL indicator	Lights temporarily for each collision

Supervisory Port Connection

Connect a cable prepared in accordance with Appendix A between the supervisory port connector marked DCE, located on the front panel of the IMX-4T1, and the supervision terminal. If the supervision terminal is connected via modems, use a cross-over cable.

To enable communication with the IMX-4T1, the supervisory terminal should be set to the same data rate, data word format and parity type as the IMX-4T1, before you start operations.

Chapter 3

Front-Panel Operating Instructions

This chapter:

- Describes the IMX-4T1 front panel
- Provides a general description of IMX-4T1 control, display and push-button functions, and menu organization
- Explains IMX-4T1 configuration parameters
- Provides IMX-4T1 operating procedures (turn-on, front-panel indications, performance monitoring and turn-off)
- Details IMX-4T1 local configuration set-up
- Explains IMX-4T1 configuration error messages.

Refer to Chapter 4 for instructions on the use of a supervision terminal to remotely control and monitor IMX-4T1 operation.

3.1 Front Panel Controls, Connectors and Indicators

Figure 3-1 shows the front panel of the IMX-4T1. Table 3-1 lists the functions of the IMX-4T1 controls, connectors and indicators, located on the IMX-4T1 front panel. The index numbers in Table 3-1 correspond to the item numbers in Figure 3-1.

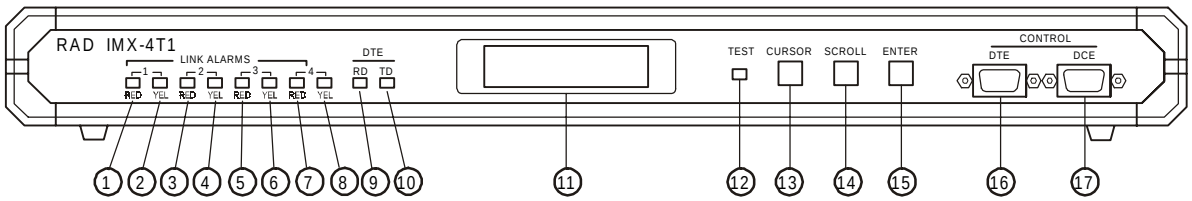


Figure 3-1 IMX-4T1 Front Panel

Table 3-1 IMX-4T1 Controls, Connectors and Indicators

No	Control or Indicator	Function
1	LINK 1 RED indicator	Lights when a red alarm is detected on link 1
2	LINK 1 YEL indicator	Lights when a yellow alarm is detected on link 1
3	LINK 2 RED indicator	Lights when a red alarm is detected on link 2
4	LINK 2 YEL indicator	Lights when a yellow alarm is detected on link 2
5	LINK 3 RED indicator	Lights when a red alarm is detected on link 3
6	LINK 3 YEL indicator	Lights when a yellow alarm is detected on link 3
7	LINK 4 RED indicator	Lights when a red alarm is detected on link 4
8	LINK 4 YEL indicator	Lights when a yellow alarm is detected on link 4
9	DTE RD indicator	Lights when data is present on the receive line of the user's interface
10	DTE TD indicator	Lights when data is present on the transmit line of the user's interface
11	Alphanumeric display	Liquid Crystal Display (LCD) used to display messages and status information. The display contains 2 rows of 16 characters each
12	TEST indicator	Lights when a test is active
13	CURSOR push-button	Used to move among the information fields
14	SCROLL push-button	Used to scroll among the available options of the displayed functions
15	ENTER push button	Used to enter the changes made in the IMX-4T1 operation, and initiate operation under the new set-up
16	DTE connector	Reserved for future use
17	DCE connector	Connection to supervision terminal

3.2 Control of IMX-4T1 Operation, General

General

IMX-4T1 operating mode is determined by a set of parameters stored in an internal non-volatile memory. These parameters are selected by the user, using the IMX-4T1 front panel push-buttons, or a supervision terminal. After the operating parameters are loaded, the configuration set-up process begins and no further operator attendance is required.

The configuration stored in the IMX-4T1 memory is not affected when power is turned off. Upon turn-on, the IMX-4T1 checks the validity of the stored configuration data, and if everything is OK, it assumes the last selected configuration. If the configuration does not require modification, the IMX-4T1 is then ready for operation immediately after power is applied. However, if the configuration data is not valid, the IMX-4T1 lets you load instead a default configuration. The default configuration, prepared by the manufacturer, is stored in the program EPROM.

General Operating Instructions

All operations are performed using an interactive, menu-driven user-friendly interface. The interface is controlled by means of the display and three push-buttons. The IMX-4T1 guides you in the execution of the required task by means of simple and clear messages, presents the range of available parameter values and checks your inputs.

Moreover, the IMX-4T1 will present to you only those parameter values available on your IMX-4T1 model in the selected operating mode.

If you make a configuration error, e.g., you select a parameter value that conflicts with the current operating mode, the IMX-4T1 rejects the erroneous selection and displays an error message that identifies the error.

You will find detailed instructions for operating the IMX-4T1 in sections 3.7 and 3.8. Section 3.9 explains the configuration error messages, and presents instructions for correcting the problem.

Display Functions

The IMX-4T1 display has four functions:

- Display of status messages
- Display of diagnostics performance data
- Display of test functions
- Display of configuration parameters.

Status Messages

When the IMX-4T1 is not being configured and no test is active, its display shows status messages. The alarm buffer can store up to 100 alarms. The status messages appear under the header ALARM BUFFER. The status messages are described in Chapter 5.

Diagnostic Functions

The IMX-4T1 displays the traffic performance parameters gathered when operating with ESF framing. The IMX-4T1 can also display BPV statistics when operating with SF (D4) framing. The diagnostics data appears under the header DIAGNOSTICS. Chapter 5 explains the diagnostics data displayed by the IMX-4T1.

Test Functions

The test functions include:

- Local and remote loopbacks, for rapid isolation of faults.
- BER test
- For T1 links with CSU interface, network line loopback and network payload loopback, controlled by the network. These loopbacks have the highest priority and will override any other loop request..

The test function messages appear under the header TEST OPTIONS. Chapter 5 describes the available test functions.

Configuration Parameters

The IMX-4T1 has three groups of configuration parameters:

- System parameters
- Link parameters
- Channel parameters
- Supervisory port parameters.

The configuration parameter groups are detailed in the following table.

Table 3-2 Configuration Parameter Groups

Display	Description	See...
SYSTEM PARAMETER	Display and selection of system parameters: - Master clock source - Fallback clock source - Ethernet transmission mode - Bridging control of Ethernet traffic	Section 3.3
LINK PARAMETER	Display and selection of link parameters: - Framing - Synchronization time - Link interface function - Idle time slot fill-up code - Zero compression coding - Transmission signal masking/attenuation - Link connection	Section 3.4
CH MAP	Display and selection of IMX-4T1 links to be used	Section 3.5
SP PARAMETER	Display and selection of IMX-4T1 supervisory port parameters: - Data rate - Number of data bits - Parity - Interface type	Section 3.6

In addition to the parameters configured from the front panel, there are parameters that can be controlled only from the supervision terminal. These are presented in Chapter 4.

After configuration, if alarm messages are stored in its ALARM BUFFER, the IMX-4T1 automatically returns to the display of status messages.

Organization of IMX-4T1 Display

The IMX-4T1 display has two rows:

- **Upper row**. Shows the name of the displayed function, group of configuration parameters, or test option.
- **Lower row**. The lower row displays:
  - Parameter name and value.
  - Status messages.
  - Loopback status.
  - Error messages.
  - Diagnostics messages.

Using Front-Panel Push-buttons

IMX-4T1 operation is controlled by means of the display and the three push-buttons designated CURSOR, SCROLL and ENTER. The same control actions are consistently used for all the activities:

CURSOR Use this push-button to indicate what you want to change. Pressing the CURSOR push-button moves the cursor among the fields in the current display. The cursor is a bar that underlines the selected field.

Some fields list several different items. To select an item, place the cursor under the desired item. The item displayed above the cursor can be changed (scrolled) by pressing SCROLL.

SCROLL Press repeatedly to display the alternatives for the current field/item indicated by the cursor. Holding the push-button depressed causes automatic scrolling of the available alternatives.

ENTER Press it once to select the value displayed in the field/item indicated by the cursor. If the selected value is valid, it replaces the old value and the change takes effect immediately. The ENTER key has two additional functions:

- When the alarm buffer is displayed, the ENTER key can be used to delete all the alarms in the buffer.
- When DIAGNOSTICS is displayed, the ENTER key can be used to reset the following error counters: ERROR CRC, AV ERROR CRC, CURR ES, CURR SES, CURR BES, CURR UAS, CURR LOFC, CURR CSS, CURR SECS, BPV COUNT, L. TERM ES, L. TERM SES, L. TERM BES, L. TERM UAS, L. TERM LOFC, L. TERM CSS, L. TERM INT, CUR DEG MIN, BPV WORST, LST DEG MIN.

If you make an incorrect selection, the selection is not accepted. In this case, you see a **CONFIG ERROR** message with a two-digit code in the second display row. The code indicates what is wrong. Section 3.10 explains the codes and what to do to correct the error.

After a short time, the error message disappears and the original display returns. At this time, you can correct the error.

3.3 System Configuration Parameters

Table 3-3 lists the available system configuration parameters and their functions. The table also lists the parameter values included in the IMX-4T1 default configuration.

Table 3-3 System Parameters

Designation	Function	Values
CLK_MASTER	Selects the master timing	LNK 1 - Locked to the recovered receive clock of link 1 LNK 2 - Locked to the recovered receive clock of link 2 LNK 3 - Locked to the recovered receive clock of link 3 LNK 4 - Locked to the recovered receive clock of link 4 ST - External clock signal connected to the STATION CLOCK connector INT - Internal oscillator Default: **INT**
CLK_FBACK	Selects the alternate (fallback) timing reference for use in case the master reference fails	NONE - No fallback source is used LNK1 - Locked to the recovered receive clock of link 1 LNK2 - Locked to the recovered receive clock of link 2 LNK3 - Locked to the recovered receive clock of link 3 LNK4 - Locked to the recovered receive clock of link 4 ST - External clock signal connected to the STATION CLOCK connector Default: **NONE**
BRODCAST_TX	Selects the data transmission function	YES - Data transmitted to every link regardless of whether the link is operational NO - Data transmitted to a link only when the link is operational Default: **NO**
ETRNET	Selects the Ethernet LAN traffic transfer mode	HALF - Half duplex operation FULL - Full duplex operation Default: **HALF**
BRIDGING	Select the Ethernet traffic control function	FILTER - The internal bridge of the IMX-4T1 is enabled, and filters the traffic transferred to the remote end TRANS - The internal bridge of the IMX-4T1 disabled, and the Ethernet traffic is transparently transferred (LAN extender function) Default: **FILTERED**

3.4 Link Configuration Parameters

Table 3-4 lists the available link configuration parameters and their functions. The table also lists the parameter values included in the IMX-4T1 default configuration.

Parameter values can be independently selected for each link.

Table 3-4 Link Parameters

Designation	Function	Values
CON	Used to control the use of the selected link To actually use a given link, first it must be assigned to the data channel (section 3.5)	NO - Link is not used YES - Link is used to carry user's data Default: **YES** (provided the link is installed)
FRAME	Selects the multiframing mode for the selected link	SF - 12 frames per multiframe. ESF - 24 frames per multiframe Default: **ESF**
CODE	Selects the line coding method used for zero suppression	TRAN - Transparent (AMI) coding, no processing for zero suppression B8ZS - B8ZS coding Note: Clear channel capability is available only with B8ZS coding. Default: **B8ZS**

Table 3-4 Link Parameters (Cont.)

Designation	Function	Values
MASK	Controls the link transmit signal characteristics. The displayed options depend on the link interface hardware (with or without CSU): • When the link interface does not include a CSU, the transmit signal mask can be selected in accordance with the transmit line length, to meet DSX-1 requirements, as specified by AT&T CB-119, or operation in accordance with FCC Rules Part 68. • When the link interface includes a CSU, the transmit signal can be attenuated by 7.5, 15, or 22.5 dB, to meet the requirements of FCC Rules Part 68.	**For links without CSU:** 1. DSX-1 operation: The following selections, indicating the line length in feet, are available: Length (ft) Display 0-133 000- 133-266 133- 266-399 266- 399-533 399- 533-655 533- 2. An additional selection, FCC68, provides compliance with the FCC Rule 68.308 Option A output pulse mask. Default for links without CSU: **0-133** **For links with CSU:** 0 No attenuation 7.5 Attenuation of 7.5 dB relative to the nominal transmit level 15 Attenuation of 15 dB relative to the nominal transmit level 22.5 Attenuation of 22.5 dB relative to the nominal transmit level Default for links with CSU: **0**
SYNC	Permits to reduce the time required for the selected link to return to normal operation after local loss of synchronization	62411 -Complies with the requirements of AT&T TR-62411 (after 10 seconds) FAST - After 1 second Default: **FAST**
I_TS_CODE	Selects the code transmitted to fill idle (unused) time slots in the frames transmitted on the selected link, when it is not used (not mapped)	The available selections are 00 to FF (hexa). Default: **3F**
FUNCTION	Indicates the type of interface installed on the selected link. The value appearing in this field is automatically displayed in accordance with the hardware installed on the selected link, and cannot be changed	CSU - The link interface includes a CSU DSU - The link interface does not include a CSU

3.5 Channel Map Configuration Parameters

Table 3-5 lists the channel map configuration parameters. The table also lists the parameter values included in the IMX-4T1 default configuration.

Table 3-5 Channel Map Parameters

Designation	Function	Values
LINK X	Controls the connection of each individual link to the user's data channel X designated the link number, 1 through 4	YES - Link can be used by the user's data channel NO - Link cannot be used to carry user data, even if it is installed on the IMX-4T1 channel Default: **YES** (provided the link is installed on the IMX-4T1)

3.6 Supervisory Port Configuration Parameters

Table 3-6 lists the available supervisory port configuration parameters and their functions. The table also lists the parameter values included in the IMX-4T1 default configuration.

In addition to the parameters listed below, the IMX-4T1 supports additional parameters, which can be modified only via the supervisory port. These parameters are explained in Chapter 4.

Table 3-6 Supervisory Port Parameters

Designation	Function	Values
SPEED	Selects supervisory port data rate (bps)	300, 1200, 2400, 4800, 9600 AUTO — Autobaud operation. The IMX-4T1 automatically identifies the supervisory port data rate. Default: **AUTO**
DATA	Selects the number of data bits in the word format	7 or 8 data bits. Default: **8**
PARITY	Controls the use of parity	ODD — Odd parity EVEN — Even Parity NONE — Parity disabled (only available with 8 data bits) Default: **NONE**
INTERFACE	Selects supervisory port interface type	DCE — The IMX-4T1 functions as a DCE for the supervision terminal. DTE — The IMX-4T1 functions as a DTE, for connection via modem to the supervision terminal. Note: for either setting, use the DCE supervisory port connector. Default: **DCE**

3.7 Operating Instructions

This paragraph covers the following activities:

- Turn-on
- Checking IMX-4T1 configuration
- Normal IMX-4T1 operating indications
- Monitoring IMX-4T1 performance
- IMX-4T1 turn-off.

Refer to section 3.8 for local configuration set-up instructions.

Turn-on

To turn the IMX-4T1 on, set the rear POWER switch to ON. Upon turn-on, the IMX-4T1 performs self-test; observe the front-panel indications.

During the self-test, the IMX-4T1 displays the software version in the X.Y format:

```
IMX-4T1 REV: X.Y
SELF TEST
```

After successfully completing the self-test procedure, the IMX-4T1 will switch to the default display - the ALARM BUFFER.

Note

1. *If the IMX-4T1 fails the self-test, you will see a description of the fault in the second row. In this case, the IMX-4T1 must be repaired before it can be used again. Refer to Chapter 5 for instructions.*
2. *If the configuration data stored by the IMX-4T1 is corrupted, the DATABASE CKS ERR alarm message is generated. In this case, it is necessary to initialize the data base (after initialization, you can select again the desired parameters). To initialize the data base, set section 3 of the internal switch SW1 to ON, turn the IMX-4T1 on, and then turn it off and return section 3 to OFF (refer to Chapter 2 for detailed procedures).*

   The parameter values included in the default configuration are listed in sections 3.3 through 3.6.

You can verify the IMX-4T1 configuration as explained below. If the configuration does not require modification, the IMX-4T1 is ready for operation immediately after self-test is completed. To change the configuration, refer to section 3.8.

Checking Current Operating Configuration

Review section 3.3 through 3.6 for an explanation of the IMX-4T1 configuration parameters.

Note *During the following procedure, do not press the ENTER push-button, to prevent accidental change of parameters.*

1. Bring the cursor under the top row (if not already there).
2. Scroll to display SYSTEM PARAMETER in the top row.
   Second row shows the first system parameter, CLK MASTER, and its current selections
3. Bring the cursor under the left-hand field in the second row.
4. Scroll to see the other system parameters.
   After each pressing of the SCROLL button, the second display row shows the current value of the next system parameter. Continue until CLK MASTER appears again
5. Bring the cursor under the right-hand field in the top row.
6. Bring to display the next group of configuration parameters (the link parameters of link 1).
   LINK PARAMETER LINK1
   The second row shows the first parameter of link 1, CON, and its current value.
7. Bring the cursor under the left hand field in the second row.
8. Scroll to see the other parameters of link 1.
   Each time SCROLL is pressed, the second display row shows the current value of the next parameters. Continue until CON appears again.
9. Bring the cursor under the right-hand field in the top row.
10. Scroll to display LNK2 in the top row.
    The second row shows the first parameter of link 2, CON, and its current value.
11. Bring the cursor under the left-hand field in the second row.
12. Scroll to see the other parameters of link 2.
    Each time SCROLL is pressed, the second display row shows the current value of the next parameters. Continue until CON appears again.
13. Repeat steps 9 through 12 for link 3.
14. Repeat steps 9 through 12 for link 4.
15. Bring the cursor under the left-hand field in the top row.
16. Bring the cursor under the left-hand field in the top row.
17. Bring to display the next group of configuration parameters, CH MAP.
    Second row shows the first channel parameter, LINK 1, and its current selection

18. Scroll to see the other channel parameters.
    Each time SCROLL is pressed, the second display row shows the current value of the next parameters. Continue until LINK 1 appears again.
19. Bring the cursor under the left-hand field in the top row.
20. Bring the cursor under the left-hand field in the top row.
21. Repeat steps 1 through 4 to display the supervisory port parameters - SP PARAMETER.

Normal Indications

Display

The normal message displayed in the top row is ALARM BUFFER. However, if no alarm is stored in the alarm buffer, the IMX-4T1 will continue displaying the last user-selected display.

In addition, the IMX-4T1 will automatically abort the current activity and will redisplay the ALARM BUFFER message if no front-panel button is pressed for 1 minute, thereby ensuring that it will not remain in an indeterminate state even if the operator does not complete a configuration activity. This, however, does not apply to the DIAGNOSTICS display.

When the top row shows ALARM BUFFER, the second row displays the following information:

- During normal operation, the second row should show EMPTY (no alarm messages).
- If the alarm buffers contains alarms, you will see SCROLL in the left-hand field of the second row, and CLEAR in the right-hand field.

The alarms can be displayed by bringing the cursor under SCROLL, and then pressing ENTER: you can now scroll between the alarms stored in the alarm buffer. To interpret the alarm messages displayed in the second row, refer to Table 5-1. In Table 5-1, you will find two types of alarms, designated as ON/OFF and ON:

- A message indicating an ON/OFF alarm is displayed only when the alarm condition is present, and is automatically removed when the condition is cleared (if the alarm is being displayed, it will disappear only when the display is refreshed by scrolling).
- A message indicating an ON alarm persists even after the event that caused the alarm condition is cleared.

If the IMX-4T1 operates normally, but an alarm message of the ON type is displayed, you can clear the event alarm message from the display by the following procedure:

1. Bring the cursor in the second row, under CLEAR.
2. Press ENTER to clear the event messages in the alarm buffer.
   If no state alarms are present, the second row should show EMPTY

Normal Front-Panel Indications

During normal operation, all the IMX-4T1 front-panel indicators located in the LINK ALARMS area, and the TEST indicator are off. Only the DTE RD and TD indicators should light to indicate data transmission on the user's data channel interface.

Fault Indications

If any of the LINK ALARMS indicators and/or the TEST indicator lights, data transfer is interrupted.

- The TEST indicator lights when a test is active. If the test is activated from the local IMX-4T1, you can see the test type by entering the TEST OPTIONS (Chapter 5). You can disconnect a local or remote loop as explained in Chapter 5.
- The RED indicator of a link lights when a RED alarm (local unit loss of synchronization) condition is present on the corresponding link.
- The YEL indicator of a link lights when a YELLOW alarm (remote unit loss of synchronization) condition is present on the corresponding link.

Monitoring IMX-4T1 Performance

The IMX-4T1 continuously measures diagnostics performance data. The diagnostics data is available under DIAGNOSTICS. The measured parameters are explained in Chapter 4 and 5.

Turn-off

Set the IMX-4T1 rear power switch to OFF.

3.8 Local Configuration Set-Up Procedure

Before starting any configuration action:

- Review the relevant configuration parameters given in sections 3.3 through 3.5.
- Obtain a list of the required parameters from your network subscription data, and/or from your system administrator.

IMX-4T1 configuration is set-up by a simple three-step procedure:

1. Select the system parameters.
2. Select the link parameters.
3. Select the channel parameters.

When a supervision terminal will be used to control the IMX-4T1, you should also select the parameters of the supervisory port.

The general configuration procedure is explained on the following page. The general procedure is followed by special considerations for each group of parameters.

The IMX-4T1 presents only those parameters available in the selected mode, therefore it is important to perform the configuration according to the order specified above.

Password Protection

The IMX-4T1 is intended for configuration via the supervision port, using a supervision terminal. If you cannot use a terminal for performing the configuration procedures, it is necessary to configure the IMX-4T1 from the front panel. This, however, is possible only when the use of the password is disabled: if the password is enabled, you can use the IMX-4T1 front panel to display the current parameter values, but cannot modify them. If you try to modify a parameter, or to perform a test function, from the front panel when the password is enabled, you will see CONFIG ERROR 11.

When the IMX-4T1 uses the default parameters values, the use of the password is disabled (to load the default parameters, use the DBINI section of the internal switch SW1, as explained in section 2.4). The use of the password can be enabled or disabled by means of the supervision terminal, by entering the DEF SP command (refer to Chapter 4 for detailed instructions).

General Configuration Procedure

The following steps are used to perform any configuration activity:

Notes

- *Before starting the configuration procedure, always disconnect all the user-initiated loopbacks (select OFF on TEST OPTIONS).*
- *Refer to section 3.9 for an explanation of the configuration error messages the IMX-4T1 displays when you make an error.*

1. Bring the cursor under the top row (if not already there).
2. Scroll to display the desired group of parameters in the top row. Second row shows the first parameter in the selected group and its current value

Note

When the desired group of parameters must be independently selected for each link, the top row includes and additional field (at the rightmost side of the top row): this field is used to select the desired link number. In this case, use the CURSOR key to bring the cursor to the rightmost field, then SCROLL to show the desired link number.

3. When the second row has more than one field, bring the cursor under the left-hand field (parameter name) in the second row, and then scroll to display the desired parameter in the selected group. The second row shows the parameter name and its current value.
4. Bring the cursor under the right-hand filed (the parameter value) in the second row.
5. Scroll to set the required value for the displayed parameter. The second row shows the available values

6. When the desired parameter value is displayed, select the new parameter value.
   The cursor returns to the first field in the top row. The second row displays shortly CONFIG ENTER, then returns to the normal display

Note *You must press ENTER after changing parameters of a certain group, e.g., SYSTEM, LINK, etc. If you change parameter values, but return the cursor to the first field and scroll to another group without pressing ENTER, the changes are discarded and you will see the message CONFIG LOST.*

7. Repeat steps 3 through 6 until values are assigned to all the parameters in the group.
   The second row shows the current selection.
8. Repeat steps 1 through 7 until values are assigned to all the parameters in the desired groups.
   The second row shows the current selection.
9. After completing the configuration actions, you can use steps 1, 2 or return to the ALARM BUFFER.
   If alarm messages are stored in the ALARM BUFFER, ALARM BUFFER is automatically displayed if no push button is pressed for one minute.
   The top row shows:
   ALARM BUFFER

Specific Configuration Guidelines

This section presents specific configuration guidelines for the selection of parameter values. You may also wish to refer to section 1.2, that provides a concise description of the IMX-4T1 operating environment, including explanations for many of the relevant terms.

System Parameter

For the definitions of parameters, see section 3.3.

CLK MASTER For connection to carrier lines, select any one of the connected links: LNK1, LNK2, LNK3, or LNK4. If a station clock is available, you may also select ST.

For a point-to-point application with stand-alone equipment at both link ends, you can also select INT (or ST, if available) at one end and LNK1, LNK2, LNK3, or LNK4 at the other end.

CLK FBACK Select a source different from that selected as master. To disable switching to the fallback source, select NONE. In this case, the default fallback clock source is the IMX-4T1 internal clock oscillator.

BRODCAST TX For data transmitted over the link.

- **Yes** - the data is transmitted to all the links, regardless of whether the link is operational or not
- **No** - the data is transmitted to a link only when it is operational.

ETRNET Select the method used to handle the LAN traffic, half-duplex (HALF_DUP) or full-duplex (FULL_DUP). This parameter is relevant only for the Ethernet interface: for other interfaces, it always shows N/A

BRIDGING Select FILTERED if you want to operate the T1 link as a remote bridge (the recommended method). To operate the link as a LAN extender (or repeater), select TRAN.

This parameter is relevant only for the Ethernet interface: for other interfaces, it always shows N/A.

Link Parameter

For each link, select the following parameters. See parameter definitions in section 3.4.

CON For an active link, select YES. The number of active links determines the user's channel data rate (the user's channel data rate is n x 1.472 Mbps, where n is the total number of active links).

Make sure you connect the required number of links using the CH MAP function.

FRAME Select the framing mode specified for use in your network.

In general, always select ESF unless the T1 equipment connected to the IMX-4T1 does not support this mode.

CODE Select the framing mode specified for use in your network. For point-to-point applications, B8ZS should be used whenever supported by the carrier.

MASK Select in accordance with the required link operating mode, and the hardware installed on the link interface.

If the link interface does not include a CSU:

- For compliance with DSX-1 specifications per AT&T CB-119 and ANSI T1.102-1987, select the value corresponding to the length of the cable (in feet) connected between the T1 LINK connector and network entry point.
- For compliance with FCC Rules Part 68, select FCC68.

If the link interface includes a CSU, it is necessary to adjust the T1 output transmit level, for reliable operation of the network, and for compliance with FCC Rules Part 68. This adjustment is used to minimize the interference caused by your transmit signal to other users that transmit their signals on other pairs of the same cable.

The required setting depends mainly on the length of the cable that connects your IMX-4T1 to the first repeater down the link. Repeaters are usually located every mile, and therefore, they are designed to optimally handle signals attenuated by one mile length of cable. If your

IMX-4T1 is closer, the repeater would receive your signal at a higher level. This will not significantly improve the handling of your signal, but will certainly increase the interference coupled from your pair to repeaters that serve other pairs in the cable.

To prevent this, you can select an attenuation value that will bring your signal level closer to the expected repeater signal level. This is achieved by connecting, as required, one, two, or three artificial line sections in series with your T1 transmit signal. Each line section introduces a nominal attenuation of 7.5 dB (equivalent to the attenuation of approximately 1000 feet of cable). Your system administrator or data carrier will tell you what is the proper setting for your IMX-4T1.

SYNC Select FAST, unless your application requires exact conformance with AT&T TR-62411 requirements.

I_TS_CODE Select the value specified for your network.

CH Map

For each link, select YES if you want to enable its use. See parameter definitions in section 3.5.

SP Parameters

See parameter definitions in section 3.6.

SPEED Select the supervisory port data rate (in bps). It is recommended to select AUTO whenever feasible (except when connected to a modem).

DATA Select the required number of data bits (same as on the terminal).

PARITY Select the required parity (same as on the terminal).

INTERFACE Select DCE when directly connected to the supervision terminal.
Select DTE when connected to a modem.

Note *The INTERFACE parameter only changes the direction of the interface control (handshaking) signals, but not the functions of the interface pins. Therefore, when connecting to a modem, it is necessary to use a cross cable.*

For either setting, use the DCE supervisory port connector.

3.9 LCD Configuration Error Messages

The IMX-4T1 detects configuration errors and displays a CONFIG ERROR XY message. The code XY identifies the error. You will find below the list of error messages and instructions that will help you correct the problem.

CONFIG ERROR 1 You are trying to select the same source as both master and fallback clock source. Check and change as required.

CONFIG ERROR 2 You are trying to select as clock source a link that is not connected to the IMX-4T1. Check and change as required.

CONFIG ERROR 3 Illegal combination of loopbacks: you are trying to activate simultaneously local and remote loopbacks on links and on the data channel, or a network-activated loopback may already be activated. Only one loopback can be connected at a time.

CONFIG ERROR 4 Reserved.

CONFIG ERROR 5 You are trying to map a link that is not active.

CONFIG ERROR 6 You are trying to activate a link which is not connected to the IMX-4T1. Check and change as required.

CONFIG ERROR 7 You are trying to disconnect a link that has been selected as clock source, or a link that is mapped to the user's data channel. Check and change as required.

CONFIG ERROR 8 You are trying to disconnect a loopback that is not active.

CONFIG ERROR 11 You are trying to change a parameter from the front panel when the password is enabled.

CONFIG ERROR 23 You are trying to activate a loopback that is already running.

Chapter 4

Control via the Supervisory Port

This chapter:

- Describes the supervision terminal hardware requirements, communication and handshaking
- Explains how to prepare for use of supervision terminal
- Describes of supervision terminal set of commands and command syntax
- Provides general operating instructions, including start-up, routine operations, and stopping of remote control
- Explains configuration error messages and provides corrective procedures.

4.1 Hardware Requirements

Terminal Characteristics

Any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface can be used to control IMX-4T1 operation. The software necessary to run the IMX-4T1 supervision program is contained in the IMX-4T1.

Communication Requirements

The supervision terminal can be connected either directly to the IMX-4T1 supervisory port, or through a modem or any other type of full-duplex data link. The IMX-4T1 supervisory port interface type must be set in accordance with the connection method (see section 3.6):

- DCE - for direct connection to a supervision terminal, or for connection through a modem or data link (cross cables must then be connected at the DCE front-panel connector).
- DTE - future option that will allow connection through a modem or data link without requiring the use of cross cables at the DTE front-panel connector.

The IMX-4T1 can communicate with the supervision terminal at rates of 300, 1200, 2400, 4800 or 9600 bps. The word format consists of one stop bit and 7 or 8 data bits. Parity can be odd, even or disabled.

The communication interface of the terminal and the IMX-4T1 must be configured for operation with the same parameters.

The IMX-4T1 supports two types of modems:

- Dial-up Hayes™ compatible modems, e.g., RAD's miniature DLM/AT modem. The IMX-4T1 features call-in/call-out capability.
- Multidrop modems, e.g. RAD's SRM-6 miniature multidrop modem.

For multidrop operation, each IMX-4T1 can be assigned a node address in the range of 1 through 255. Assigning address 0 to the IMX-4T1 means that it will accept and answer any message: this is not permitted in multidrop operation. Address 0 is however recommended for use with both point-to-point and dial-up modes.

Each IMX-4T1 can be assigned a logical name of up to eight characters. The logical name is sent in each transmission of alarm messages. The name helps the operator to identify the source of messages that are received by the supervision terminal.

The relevant IMX-4T1 configuration parameters are described in sections 3.6 and 4.4. Instructions for configuring the IMX-4T1 supervisory port appear in section 3.8.

Handshaking Protocol

The handshaking between the IMX-4T1 and the supervision terminal uses the control lines in the DCE connector located on the front panel of the IMX-4T1.

The control lines being used in each mode and the direction of the control signals is detailed in the following table.

Table 4-1 Handshaking Protocol Lines

Interface Type	DCE	DTE
CTS	Out	Not used
DCD	Out	Out
DSR	Out	Out
DTR	In	In
RI	Not Used	In
RTS	In	In

Data Terminal Ready (DTR)

The terminal sets the DTR line ON (active) to gain control over the IMX-4T1 and start a configuration/monitoring session.

When the DTR is ON, the front panel controls are disabled, and the LCD shows: **TERMINAL ON LINE.**

The DTR line is OFF (inactive) when terminal control is not required. This ends the terminal control connection, and returns the control to the IMX-4T1 front panel. If password protection is used, the password must be entered again the next time the DTR line is set ON to start a new session.

Request to Send (RTS)

The RTS line is normally ON (active) when the supervision terminal is in session.

When the RTS line is OFF (inactive), the IMX-4T1 interprets any data received from the terminal on the TD line as MARK.

Clear to Send (CTS)

The state of the CTS line is determined by the CTS parameter:

ON The CTS line is always ON (active).

=RTS The CTS line follows the RTS line.

Data Carrier Detect (DCD)

The state of the DCD line depends on the communication address (node number):

- When the node address is 0, the DCD line is always ON (active).
- When a non-zero node address is used, the DCD line becomes ON (active) when data is detected on the RD line, provided the IMX-4T1 recognizes its own address in the data stream.

To simulate DTE operation, the delay between these events can be set by the used (by means of the DCD-Delay parameter).

Ring Indications (RI)

The RI line is used only with dial-up modems (INT=DTE).
The RI line is normally OFF (inactive), and switches to the ON (active) state when the modem attached to the IMX-4T1 front-panel DCE connector detects an incoming call. See also the DSR line.

Data Set Ready (DSR)

- Usually, the DSR line is configured to track the DTR line. In this case, if the supervisory port interface is DTE, the DSR line will be set to ON for 5 seconds when the RI line is ON while the DTR line is OFF.
- If the supervisory port interface is DCE, the DSR line can also be configured to be continuously ON. However, if the DTR line switches to OFF, the DSR line will also switch to OFF for 5 seconds.

In addition, the IMX-4T1 always sets DSR OFF (inactive) for 5 seconds when the EXIT command is executed, or the disconnect time-out expires.

AUTOBAUD Function

When the AUTOBAUD function is enabled, the IMX-4T1 can identify the operating data rate of the terminal by analyzing the timing of three consecutive Carriage Return + Line Feed characters (generated by pressing three times the carriage return key). The detected data rate is then used for the current communication session.

The automatic baud rate identification procedure is performed (or repeated) whenever three consecutive carriage returns are received after one of the following events occurs:

- The DTR line has been switched OFF.
- The EXIT command has been executed.
- The idle disconnect time-out expired because no data has been exchanged with the supervision terminal.

In case one of these events occurred, the IMX-4T1 assumes that the current communication session has been terminated. Therefore, when the password protection is enabled, the password must be entered again before the supervision terminal can resume communication with the IMX-4T1.

4.2 Preparation for Use of Supervision Terminal

IMX-4T1 Preparations

Internal Settings

See section 2.4 for detailed information.

Note that in general you must enter a password when you start a control session. If the password is incorrect, the IMX-4T1 will not respond. This can be corrected by appropriate setting of the PASSW section of SW1. Set the PASSW section of SW1 as follows:

OFF In this position, you can define your own password and node address.

ON Set the switch section to ON to restore the default IMX-4T1 password (IMX), and change the node address to the default value of 0. The change will be made after you turn the IMX-4T1 off for a short time, and then turn it back on.

Supervisory Port Configuration

Configure the IMX-4T1 supervisory port as required. See sections 3.5 through 3.8.

If the supervisory port parameters are not correct, the IMX-4T1 will not respond. This can be corrected by appropriate setting of the DEFSP section of SW1. Set the DEFSP section of SW1 as follows:

OFF In this position, you can define the desired supervisory port parameters.

ON Set the switch section to ON to restore the default supervisory port parameters. The change will be made after you turn the IMX-4T1 off for a short time, and then turn it back on.

Supervision Terminal

Configure the terminal for the same communication parameters you selected for the IMX-4T1 supervisory port.

Connections

Connect the supervision cable (coming directly from the terminal, or from the modem used to connect the terminal) to the front-panel DCE connector of the IMX-4T1. See Appendix A for cable wiring information.

Turn the supervision terminal on and when applicable, turn on the modems and the other communication equipment used to connect the terminal to the IMX-4T1.

4.3 IMX-4T1 Supervision Language

This paragraph presents the IMX-4T1 supervision language syntax, usage, and set of commands.

Command Language Syntax

- Commands can only be entered when the IMX-4T1 supervisory port prompt is displayed. The prompt is **IMX-4T1**>, and it always appears at the beginning of a new line. The cursor appears to the right of the prompt.
- Commands are case-insensitive, e.g. you can type commands in either lower case and/or upper case letters.
- To correct typing errors, backspace by pressing the BACKSPACE key until the error is cleared, and then type again the correct command.
- Use space as a separator between command fields and/or parameters. Commands must end with a carriage return <CR>.
- To cancel the current command, press BREAK or type CTRL-C. You will obtain again the IMX-4T1 prompt.

Command Options

The following general types of options are available with some commands. See details in the command set index, Table 4-2.

Table 4-2 Option Commands

Option	Meaning	Example of Usage
/A	All	CLR ALM/A Clear all the alarms stored by the alarms buffer
/C	Clear	DSP ALM/C Displays all the alarms stored by the alarm buffer, and then clears all the alarms in the ON state stored by the alarm buffer
/CA	Clear all	DSP ALM/CA Displays all the alarms stored by the alarm buffer, and then clears all the alarms stored by the alarm buffer
/R	Repeat automatically command execution. Available only when node address is 0	DSP ST LINK/R Enable you to monitor the status of link 1

Command Protocol

- If AUTOBAUD is on, start any session by pressing the <CR> key three times in sequence. This will ensure identification of terminal data rate.
- When the IMX-4T1 uses a non-zero node address, it expects an address before responding to the terminal commands. No response will occur until the node number is received and acknowledged by the addressed IMX-4T1.

  Acknowledgment is indicated by the echoing of the node address part, i.e. Node<SP>nnn<SP>, where <SP> stands for space.
- The address is in the range of 1 through 255 (0 indicates that the selective addressing function is disabled). The address is a prefix sent in the following format: Node<SP>nnn<SP>.
- When password protection is on, the addressed IMX-4T1 waits for the password before continuing. After the correct password is received, the IMX-4T1 sends the working prompt, IMX-4T1>.

  If password protection is off, this step is omitted and the working prompt appears after the node address conditions are fulfilled.
- After the working prompt is displayed, every character typed on the terminal keyboard is immediately evaluated by the IMX-4T1 and echoed to the terminal screen. Full duplex communication with the terminal is therefore necessary, to provide on-line feedback to the terminal operator.
- Command evaluation starts only when the <CR> key is pressed.
- In case an error is detected during command evaluation, the command is not executed. Instead, the IMX-4T1 will send the erroneous command back to the terminal, and you will see BAD COMMAND OR

PARAMETER. TYPE 'H' FOR HELP in the next row. The correct command must then be sent again.

- The command is executed only after it is validated.
- Command execution can be interrupted by pressing BREAK or CTRL-C. This will result in the display of the IMX-4T1 prompt, and a new command can be entered.

  Use the BREAK key (or CTRL-C) to stop the automatic repetition of commands (/R option).
- If an idle disconnect time-out is specified, the IMX-4T1 will automatically disconnect the ongoing session if no command is received from the terminal for the specified time-out interval.

Index of Commands

Table 4-1 lists the IMX-4T1 commands in alphabetical order.

Table 4-3 IMX-4T1 Command Set Index

Command	Purpose	Options
BERT OFF	Deactivate the BER test on the IMX-4T1	
BERT ON	Activate the BER test on the IMX-4T1	
CLR ALM	Clear the alarms stored in the IMX-4T1 alarm buffer	/A
CLR LOOP L CH CLR LP L CH CLR LOOP R CH CLR LP R CH	Clear user initiated loopbacks on the user's data channel	
CLR LOOP L LINK CLR LP L LINK CLR LOOP R LINK CLR LP R LINK	Clear user-initiated loopbacks on the IMX-4T1 links	
CLR TST	Clear all the user-initiated tests and loopbacks	
DATE	Set the date for the IMX-4T1 internal clock	
DEF CALL	Define the call-out parameters	
DEF CH	Define the link connections	
DEF LINK X	Define the link parameters. The parameters can be defined for a specified link, or simultaneously for all the links. X stand for the link identification, 1 through 4	/A
DEF NAME	Define the logical name of the IMX-4T1	
DEF NODE	Define the node number of the IMX-4T1	
DEF PWD	Define new password	
DEF SP	Define supervisory port parameters	

Table 4-3 IMX-4T1 Command Set Index (Cont.)

Command	Purpose	Options
DEF SYS	Define system parameters	
DSP ALM	Display the contents of the alarm buffer and optionally clear the buffer	/C /CA
DSP BERT	Display the last results (errors seconds) of the on-going BER tests	/R /C
DSP CH	Displays current IMX-4T1 link utilization, the user's data channel interface type, and the state of the loops on the user's data channel	
DSP HDR TST	Display hardware faults (detected during the power-on self-test, and during normal operation)	
DSP PM X	Display the contents of the performance monitoring registers, and optionally clear these registers. X stands for the link identifications, 1 through 4	/C /CA
DSP ST LINK X	Display status information on the selected link (link interface type and function, and link error events counters), and optionally clear the link error event counters. X stands for the link identification, 1 through 4	/R /C
DSP ST SYS	Display system status information (node name and number, software and hardware versions, and clock source)	
EXIT	End the current control session	
F	Select the codes for the "clear the screen", "cursor right", and "cursor home" commands sent to the supervisory terminal	
HELP	Displays a concise index of commands and option switches	
INIT DB	Load the default configuration instead of the user configuration, Table 4-5 lists default parameter values	
INIT F	Reset the codes for "clear the screen", "cursor right", and "cursor home" to 0	
LOOP L LINK LP L LINK LOOP R LIN LP R LINK	Activate a specified user-controlled loopback on the IMX-4T1 links	
LOOP L CH LP L CH LOOP R CH LP R CH	Activate a specified user-controlled loopback on the user's data channel	
NODE	Send the node address to the IMX-4T1; followed by the node address itself	
RESET	Reset the IMX-4T1 system	
TIME	Set the time of the IMX-4T1 internal clock	

4.4 IMX-4T1 Command Set Description

This section describes the IMX-4T1 commands. The commands are listed in alphabetical order. The description includes command format, use, and options.

The following notation conventions are used below:

[ ] square brackets indicate optional entry/parameter

' ' single quotes delimit user entry

<CR> indicates the pressing of the carriage return key

X identifies the link (1 for link 1, 2 for link 2, 3 for link 3, 4 for link 4)

BERT OFF

Purpose Deactivate (stop) the BER test.

Format BERT OFF

Use

1. To deactivate the BER test, type:

   BERT OFF <CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.

BERT ON

Purpose Activate the BER test.

To perform the BER test, it is necessary to activate a loopback at the appropriate location along the signal paths, or to activate the BER test at both ends of the link.

Format BERT ON

Use

1. To activate the BER test, type:

   BERT ON <CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.

CLR ALM

Purpose Clear the alarm buffer.

Format CLR ALM [/A]

Use

1. To clear only alarms of the ON type stored in the alarm buffer (see Table 5-1):

   CLR ALM <CR>

2. To clear all the alarms stored in the alarm buffer (including ON/OFF alarms):

   CLR ALM /A <CR>

3. You will see the time and date, followed by the IMX-4T1 prompt.

CLR LOOP CH

Purpose Deactivate the specified user-initiated loopback on the user's data channel.

Format CLR LOOP [looptype] CH or CLR LP [looptype] CH Use

1. To deactivate a local (L) or a remote (R) loopback on the IMX-4T1 user's data channel:

   CLR LOOP L CH <CR>

   CLR LOOP R CH <CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.
3. If no loopback of the specified type is now activated, you will receive ERROR 8.

CLR LOOP LINK

Purpose Deactivate the specified user-initiated loopback on the IMX-4T1 links.

Format CLR LOOP [looptype] LINK or CLR LP [looptype] LINK

Use

1. To deactivate a local (L) or a remote (R) loopback on the IMX-4T1 links, type:

   CLR LOOP L LINK <CR>

   CLR LOOP R LINK <CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.
3. If no loopback of the specified type is now activated, you will receive ERROR 8.

CLR TST

Purpose Deactivate all the user-initiated tests and loopbacks on the IMX-4T1.

Format CLR TST

Use

1. To deactivate all the user-initiated tests and loopbacks, type:

   CLR TST <CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.

DATE

Purpose Set the date for the IMX-4T1 internal real-time clock.

Format DATE

Use

1. Type

   DATE <CR>

2. The IMX-4T1 sends the date entry form:

   DAY = 06

   MONTH = 09

   YEAR = 1994

3. Bring the cursor to the first field to be changed by pressing <CR>.
4. To change the selected field, press F to increase and B to decrease the displayed values. When done, press <CR> to move to the next field.
5. To end, press <CR> after the YEAR field. The IMX-4T1 will display the TIME and DATE fields (note that DATE has changed), followed by the IMX-4T1 prompt.

DEF CALL

Purpose Define the call-out parameters for the IMX-4T1 supervisory port (connector CONTROL DCE).

Note *For call-in/call-out applications, a cross cable must be used for connection to the CONTROL DCE connector.*

The specified call-out parameters are used by the IMX-4T1 to build the call command that is sent to the dial-out modem. The modem connected to the CONTROL DCE connector must be set up as follows (for convenience, the Hayes™ commands required to select the specified parameters are listed in brackets):

- Auto-answer mode (AT S0=1)
- Call set up in response to the CONNECT string (AT X0)
- No echo (AT E0)
- Verbose mode (no codes, e.g., CONNECT string instead of 0) (AT V1)

Format DEF CALL

Use

1. To define the supervisory port call-out parameters, type:
   DEF CALL<CR>
2. You will see the first page of the call-out parameters data form. A typical display is shown below.

NUM_OF_RETRIES	WAIT_FOR_CONNECT	DIAL_MODE	ALT_NUM_MODE
0	60SEC	TONE	NO

3. Change the parameter values as follows:
   - Bring the cursor to the beginning of the first field to be changed by pressing the space bar.
   - To change the selected field, press F or B to scroll among the available selections.
   - When the desired selection is displayed, press the space bar to move to the next field.
4. The call-out parameters displayed on the first page of the data form, and their range of values, are as follows:

NUM_OF_RETRIES This parameter is used to control the number of dialing retries.

- 0 - no redialing attempts are made in case the call is not established on the first attempt.
- 1 through 8 - in case the call is not established on the first attempt, the IMX-4T1 will redial the specified number of times.

The NUM_OF_RETRIES parameter applies to both the primary and the alternate numbers:

- If the call is not established after dialing the primary directory number the specified number of times, the IMX-4T1 attempts to establish the call by dialing the alternate directory number (provided the use of an alternate number is enabled by means of the ALT_NUM_MODE parameter).
- If the call cannot be established within the specified number of redialing attempts on neither of the two directory numbers, the IMX-4T1 stops the call attempts. When a new alarm report must be sent, the call attempts are started again.

The user is notified that the call attempts failed by a message recorded in the alarm buffer (separate messages are provided for each directory number).

WAIT FOR CONNECT This parameter specifies the time the IMX-4T1 will wait for an answer after each dialing attempt. If the called station does not answer within the specified time, the IMX-4T1 disconnects. If additional call attempts are allowed, the IMX-4T1 will redial immediately after disconnecting.

The available selections are 30, 45, or 60 seconds.

DIAL_MODE This parameter is used to select the dialing mode:

- TONE - the modem is instructed to use DTMF dialing.
- PULSE - the modem is instructed to use pulse dialing.

The appropriate dialing mode depends on the dialing mode supported by the telephone network.

ALT_NUM_MODE This parameter is used to control the use of an alternate number. The alternate number is dialed used after the specified number of call attempts on the primary number failed:

- NO - no alternate number. In this case, the IMX-4T1 stops the call attempts after the specified number of call attempts on the primary number failed.
- YES - the use of an alternate number is enabled.

5. When done, press <CR> to display the second page of the call-out parameters data form. A typical display is shown below.

   NEW PRIMARY NUMBER [MAX 20 CHARS] =
   CURRENT PRIMARY NUMBER = 'primary number'

   The second page is used to enter a new primary directory number, and the second row displays the current primary directory number. The directory number can include up to 20 digits, including the * and # symbols.

6. After entering the desired directory number, press <CR>:

- If the ALT_NUM_MODE parameter is NO (no alternate number), the IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.
- If the ALT_NUM_MODE parameter is YES, you will see the third page of the call-out parameters data form, used to enter a new alternate directory number. A typical display is shown below.

  NEW ALTERNATE NUMBER [MAX 20 CHARS] =
  CURRENT ALTERNATE NUMBER = 'alternate number'

- After entering the desired directory number, press <CR> to end.

DEF CH

Purpose Define the IMX-4T1 link connections. See section 3.8 for practical selection recommendations.

Format DEF CH

Use

1. To define the link connectivity data form, type:

   DEF CH <CR>

2. You will see the link connectivity data form. A typical display is shown below.

   LNK-1 LNK-2 LNK-3 LNK-4

   YES YES YES YES

3. The data form includes one field for each link. The field shows the current connection status:

   - NO link is not used.
   - YES link is used.

4. To change the link status, use the following procedure:

   - Bring the cursor to the beginning of the desired field by pressing the space bar.
   - Select between NO and YES by pressing F or B.

5. After updating the link status, press <CR> to end. The IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

DEF LINK

Purpose Assign values to the link parameters for a selected IMX-4T1 link.

See section 3.4 for parameter description and allowable ranges, and section 3.7 for practical selection recommendations.

Format DEF LINK [link]

Use

1. To define the parameters of each link, type:

   DEF LINK X <CR>

   where X stands for the link identification (1,2, 3, or 4).

2. To define the parameters of all the installed links, type:

   DEF LINK /A <CR>

3. The link parameters data form for the selected link is displayed. A typical display is shown below.

CON	FRAME	CODE	MASK	SYNC	IDLE_TS_CODE
YES	ESF	B87S	000	FAST	3F

4. Change the parameter values as follows:
   - Bring the cursor to the beginning of the first field to be changed by pressing the space bar.
   - To change the selected field, press F or B to scroll among the available selections. When the desired selection is displayed, press the space bar to move to the next field.
5. After the desired parameter values are selected, press <CR> to display the second page of the link parameters data form. Change the parameter values as explained above.
6. After the desired parameter values are selected, press <CR> to end. The IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

DEF NAME

Purpose Define the node name (up to eight alphanumeric characters).

Format DEF NAME

Use

1. To define the IMX-4T1 node name, type:

   DEF NAME <CR>

2. The IMX-4T1 displays the node name entry form:

   ENTER NODE NAME (MAX 8 CHARACTERS) =

   CURRENT NODE NAME = 'name'
   where 'name' is the node name the IMX-4T1 is currently assigned.

3. Type the desired name, and then press <CR>. The IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

Note *Before entering a node name, make sure that section 1, PASSW, of the IMX-4T1 internal switch SW1 is not set to ON, because in such a case the default name (blank) is enforced.*

DEF NODE

Purpose Define the node number, or address, of the IMX-4T1. The allowed range is 0 to 255.

Format DEF NODE

Use

1. To define the IMX-4T1 node number, type:

   DEF NODE <CR>

2. The IMX-4T1 displays the node entry form:

   NODE (0 to 255) = 0

3. Type the desired number in the range of 0 to 255, and then press <CR>. The IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

Note *Before entering a node name, make sure that section 1, PASSW, of the IMX-4T1 internal switch SW1 is not set to ON, because in such a case the default number (0) is enforced.*

DEF PWD

Purpose Define a new user password for the IMX-4T1. The password must have 4 to 8 characters.

Format DEF PWD

Use

1. Type

   DEF PWD <CR>

2. The password entry screen appears, e.g.:

   NEW PASSWORD (4 to 8 CHARS) =

   CURRENT PASSWORD = 'password'

   where 'password' is the current password.

3. Type the required password. Carefully check that the specified password has been indeed typed in, and then press <CR>. The IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

Note *Before entering a node name, make sure that section 1, PASSW, of the IMX-4T1 internal switch SW1 is not set to ON, because in such a case the default password (IMX) is enforced*

DEF SP

Purpose Assign values to supervisory port parameters. See section 3.6 for parameter description and allowable ranges, and section 3.8 for practical selection recommendations.

Format DEF SP

Use

1. Type

   DEF SP<CR>

2. The first page of the supervisory port parameters data form is displayed. A typical form is shown below. The form presents the current parameter values as defaults.

SPEED	DATA	PARITY	INTERFACE	CTS	DCD_DEL	DSR
AUTO	8	NO	DCE	=RTS	0 MS	ON

3. Change the parameter values as follows:

   - Bring the cursor to the beginning of the first field to be changed by pressing the space bar.
   - To change the selected field, press F or B to scroll among the available selections.
   - When the desired selection is displayed, press the space bar to move to the next field.

4. When done, press <CR> to display the next page of supervisory port parameters. A typical form is shown below.

POP_ALM	PWD	LOG_OFF	CALL_OUT_MODE
NO	NO	NO	NONE

5. Repeat the procedure given in section 3 above to select new parameter values.

SPEED Selects supervisory port data rate (in bps):

300, 1200, 2400, 4800, 9600, or AUTO (Autobaud - in this mode the IMX-4T1 automatically identifies the supervisory port data rate)

Note: Select AUTO whenever feasible. In this case, start the communication with three Carriage Returns, to ensure positive identification of terminal data rate.

However, If a modem is to be connected to the supervisory port for call-in/call-out function, the speed selected for the port must match the data rate of the modem (do not use AUTO).

Default: AUTO

DATA Selects the number of data bits in the word format:

7 or 8 data bits.

Default: 8

PARITY Controls the use of parity:

ODD Odd parity

EVEN Even Parity

NONE Parity disabled (only available with 8 data bits)

Default: NONE

INTERFACE Selects supervisory port interface function:

DCE The IMX-4T1 functions as a DCE for the supervision terminal.

DTE The IMX-4T1 functions as a DTE, for connection via modem to the supervision terminal.

Note: for either setting, use the DCE supervisory port connector.

Default: DCE

Note *The following parameters can be programmed only from the terminal (they are not available via the front panel controls):*

CTS Determines CTS state:

ON The CTS line is always ON (active).

=RTS The CTS line follows the RTS line.

Default: =RTS

DCD_DEL With IMX-4T1 supervisory port INTERFACE parameter set for DTE operation, this parameter indicates delay (in msec) between DCD=ON and the sending of data.

If the INTERFACE parameter is set for DCE, you must leave the default value of 0 msec.

Values: 0, 10, 50, 100, 200, 300 msec.

Default: 0 MS

DSR Determines the DSR state:

ON The DSR line is continuously ON. It will switch to OFF for five seconds after the DTR line is switched OFF.

=DTR The DSR line tracks the DTR line.

If the supervisory port INTERFACE parameter is set for DTE, the DSR parameter must be set to =DTR (the DSR line will switch to ON for five seconds when the RI line is ON while the DTR line is OFF).

Default: ON

POP_ALM Controls the automatic display of alarms in the terminal

YES The terminal automatically displays every 10 minutes the alarm status (or whenever an alarm changes state to ON)

NO The automatic display feature is disabled

Default: NO

PWD Password protection: select YES or NO

Default: NO

LOG_OFF Idle disconnect time:

NO automatic session disconnection disabled.

10_MIN automatic disconnection after ten minutes

if no input data is received by the IMX-4T1.

Default: NO

CALL_OUT_MODE This parameter controls the use of the call-out function

NONE the call-out function is disabled

ALL the IMX-4T1 will initiate a call after each new alarm

Default: NONE

6. After the desired parameter values are selected, press <CR> to end. IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

DEF SYS

Purpose Assign values to system parameters. See section 3.4 for parameter description and allowable ranges, and section 3.9 for practical selection recommendations.

Format DEF SYS

Use

1. Type

   DEF SYS <CR>

2. The system parameters data form is displayed. A typical form is shown below. The form presents the current parameter values as defaults.

CLK_MASTER	CLK_FBACK	BROADCAST	ETHERNET_MODE	BRIDGING
INT	NONE	N/A	N/A	N/A

3. Change the parameter values as follows:
   - Bring the cursor to the beginning of the first field to be changed by pressing the space bar.
   - To change the selected field, press F or B to scroll among the available selections.
   - When the desired selection is displayed, press the space bar to move to the next field.
4. After the desired parameter values are selected, press <CR> to end. The IMX-4T1 will display the TIME and DATE fields, followed by the IMX-4T1 prompt.

DSP ALM

Purpose Display the contents of the alarm buffer. This buffer can contain up to 100 alarms.

Format DSP ALM <CR>

Use

1. To display the complete contents of the buffer, type:

   DSP ALM <CR>

2. To display the complete buffer contents and then clear the type-ON alarms, type:

   DSP ALM /C <CR>

3. To display the complete buffer and then clear all the stored alarms, type:

   DSP ALM /CA <CR>

Display Format

The contents of the alarm buffer are displayed as a table with four columns: the alarm record number, the alarm number and alarm syntax (description), alarm status and time of occurrence. Each block of alarms received from a IMX-4T1 is preceded by a header. The header lists the assigned node name and the node number of the IMX-4T1 unit which sent the alarm block, and thus it serves as an easily-identified separator between alarms transmitted by different IMX-4T1 units.

Table 4-2 lists all the alarm messages that can be displayed by the terminal. X stands for the link identification, 1, 2, 3 or 4.

Table 4-4 Supervision Terminal Alarm Messages

Alarm No.	Alarm Syntax	Meaning	Status	Time
01	SIGNAL LOSS, LNK:X	Loss of input signal on link X	[ON]	hh:mm:ss
02	BPV ERROR, LNK:X	A bipolar violation error has been detected on link X	[ON]	hh:mm:ss
03	FRAME SLIP, LNK:X	A frame slip occurred on link X	[ON]	hh:mm:ss
04	NETWORK LLB, LNK:X	A network-activated line loopback is currently activated on link X	[ON] [OFF]	hh:mm:ss
05	NETWORK PLB, LNK:X	A network-activated payback loopback is currently activated on link X	[ON] [OFF]	hh:mm:ss
06	EXCESSIVE BPV, LNK:X	The rate of bipolar violation errors on link X is too high	[ON] [OFF]	hh:mm:ss
07, 08	Reserved for future use			
09	AIS OCCURRED, LNK:X	AIS is being detected on link X	[ON] [OFF]	hh:mm:ss
10	AIS RED ALARM, LNK:X	AIS and loss of frame alignments on link X	[ON] [OFF]	hh:mm:ss
11	RED ALARM LOSS	Local loss of frame alignment on link X	[ON] [OFF]	hh:mm:ss
12	DB CHECKSUM ERROR	The data base currently stored in the non-volatile memory of IMX-4T1 is corrupted. Message can appear only upon power-up	[ON]	hh:mm:ss
13	ALARM BUFFER OVERFLOW	The IMX-4T1 alarm buffer is full, and new alarms overwrite the older alarms	[ON] [OFF]	hh:mm:ss
14	CLOCK WAS CHANGED TO FALLBACK	The main clock source of the IMX-4T1 failed, and the IMX-4T1 switched to the clock source selected as fallback	[ON]	hh:mm:ss
15	CLOCK WAS CHANGED TO INTERNAL	The current clock source of the IMX-4T1 failed, and the IMX-4T1 switched to the internal oscillator	[ON]	hh:mm:ss

Table 4-4 Supervision Terminal Alarm Messages (Cont.)

Alarm No.	Alarm Syntax	Meaning	Status	Time
16	SELF TEST ERROR	A fault has been detected during the power-up self-test	[ON]	hh:mm:ss
17	HARDWARE FAILURE	A hardware fault has been detected	[ON]	hh:mm:ss
18	PSWRD SWITCH IS ON	Section 1, PASSW, of switch SW1 is set to ON	[ON]	hh:mm:ss
19	SP-PAR SWITCH IS ON	Section 2, DEFSP, of switch SW1 is set to ON	[ON]	hh:mm:ss
20	SB-INIT SWITCH IS ON	Section 3, DMINI, of switch SW1 is set to ON	[ON]	hh:mm:ss
21	REAL TIME CLOCK BATTERY FAILURE	The battery that power the IMX-4T1 internal real-time clock when IMX-4T1 is not powered has failed	[ON]	hh:mm:ss
22	YELLOW ALARM LNK:X	The remote unit connected to the other end of link X reports loss of frame alignment	[ON] [OFF]	hh:mm:ss
38	RECEIVE OOS CODE, LNK:X	The out-of-service (OOS) code is being received from the equipment connected to the other end of link X	[ON] [OFF]	hh:mm:ss
39	LAN NOT CONNECTED	The Ethernet interface is not connected to an operating LAN (i.e., at least one station must be active ion the LAN)	[ON] [OFF]	hh:mm:ss
40	DP DIAL CYCLE FAILED	The dial-out cycle failed, and the IMX-4T1 stopped the redial attempts until a new alarm must be reported	[ON]	hh:mm:ss
41	DP PRIMARY CALL FAILED	The call setup attempts to the primary directory number failed	[ON]	hh:mm:ss
42	DP ALTERNATE CALL FAILED	The call setup attempts to the alternate directory number failed	[ON]	hh:mm:ss

DSP BERT

Purpose Display the BER test results while a BER test is being performed. The BER test results are given as the number of errors seconds detected since the BER test has been started, or since the results have been last cleared (the latter of the two events). The errors seconds counter range is 0 through 63555. If the count exceeds the maximum count, the counter continues showing 65535 (an overflow message will be displayed).

Format DSP BERT [Option]

Use

1. To display the current BER test results, type:

   DSP BERT <CR>

2. To monitor continuously the BER test results, type:

   DSP BERT /R <CR>

   The display will be continuously updated. To stop the monitoring, press the BREAK key (or CTRL+C).

3. To display the current BER test results and then clear the counter, type:

   DSP BERT /C <CR>

DSP CH

Purpose Display the current IMX-4T1 link connections, the data channel interface type, and the state of the loops on the user's data channel.

Format DSP CH

Use

1. To display the link connectivity data form, type:

   DSP CH <CR>

2. You will see the link connectivity data form. A typical display is shown below.

   STATUS OF CHANNEL

   LNK-1 LNK-2 LNK-3 LNK-4 INTERFACE

   YES YES YES YES V.35

   CH LOOPS: LOCAL REMOTE
   NO NO

3. The data form includes one field for each link. The field shows the link connection status:

   - NO link is not used.
   - YES link is used.

4. For the user's data channel, the form lists the data channel interface type, and the state of the loops:

   - NO loop not connected.
   - YES loop connected.

DSP HDR TST

Purpose Display the results of the last hardware test (made during power-on self-test and during regular operation).

Format DSP HDR TST

Use To display the hardware test report, type:
DSP HDR TST <CR>

Display Format The display has one field that shows NO HARDWARE FAILURE if everything checks good, or lists the detected problem:

- DATABASE FAILURE
- EPROM FAILURE
- I/O EXPANDER ERROR
- COUNTER ERROR

DSP PM

Purpose Display the contents of the performance monitoring registers specified by AT&T Pub. 54016. This option is available only on T1 links with ESF framing. For an explanation of the performance monitoring registers, refer to section 5.3.

Format DSP PM X [Option]

Use 1. To display the performance monitoring registers of any link, type:

DSP PM X <CR>

where X stands for the link identification, L1, L2, L3, or L4.

To display the performance monitoring registers of any link, and clear only the event register of another link, type:

DSP PM X /C <CR>

where X stands for the link identification, L1, L2, L3, or L4.

To display the performance monitoring registers of any link, clear all the performance monitoring registers of another link, and restart the count intervals, type:

DSP PM X /CA <CR>

where X stands for the link identification, L1, L2, L3, or L4.

2. In case the current framing mode is SF (D4), you will receive an error message (illegal command for current link mode).

Display Format The performance monitoring registers displayed for a T1 link with ESF framing are listed in the following order:

```
ESF ERROR EVENTS          = [0] ..... [65535]
CURRENT ES                = [0] ..... [900]
CURRENT UAS               = [0] ..... [900]
CURRENT SES               = [0] ..... [900]
CURRENT BES               = [0] ..... [900]
CURRENT LOFC              = [0] ..... [255]
CURRENT CSS               = [0] ..... [255]
CURRENT TIMER             = [0] ..... [900]
INTERVAL mm ES=nnn UAS=nnn BES=nnn SES=nnn LOFC=nnn CS=nnn
24 HOUR ES                = [0] ..... [65535]
24 HOUR UAS               = [0] ..... [65535]
24 HOUR SES               = [0] ..... [65535]
24 HOUR BES               = [0] ..... [65535]
24 HOUR LOFC              = [0] ..... [255]
24 HOUR CSS               = [0] ..... [255]
LAST 24 DEGRADE MIN       = [0] ..... [1440]
24 HOUR INTERVAL          = [0] ..... [96]
```

The numbers in brackets indicate the range of values for each register.

DSP ST LINK

Purpose Display status information on a selected link, and optionally clear the event registers.

Format DSP ST LINK X [Option]

Use To display the current status information for any link, type:

DSP ST LINK X<CR>

where X stands for the link identification, L1, L2, L3, or L4.

To display status information for any link, and then clear all the event registers of another link, type:

DSP ST LINK X /C<CR>

where X stands for the link identification, L1, L2, L3, or L4.

To monitor continuously the status information of any link, type:

DSP ST LINK X /R<CR>

where X stands for the link identification, L1, L2, L3, or L4.

The display will be automatically updated. To stop the monitoring, press BREAK (or CTRL+C).

Display Format

A typical link status display for a T1 link is shown below. X stands for the link identification: L1 for link 1, L2 for link 2, L3 for link 3, L4 for link 4.

```
STATUS OF LINK X
TYPE                = T1
FUNCTION            = CSU
ALARM               = RED       YELLOW
                      NO        NO
LNK LOOPS           = LOCAL     REMOTE    PLB     LLB
                      NO        NO        NO      NO
BPV LAST MINUT      = 0
BPV WORST MINUT     = 1
```

The fields included in the status information display are listed below:

TYPE Displays the type of the selected link, T1.

FUNCTION Displays the type of interface hardware installed on the selected link: CSU or DSU.

ALARM Indicates the status of the link alarms.

LNK LOOPS Displays the state of each type of loopback, including network-initiated loopbacks, that can be activated on the selected link.

BPV LAST MINUT Displays the number of BPV events detected during the worst minute since the last time the counters were cleared. This counter is displayed only when the link framing mode is SF (D4).

BPV WORST MINUT Displays the number of BPV events detected in the worst minute. This counter is displayed only when the link framing mode is SF (D4).

DSP ST SYS

Purpose Display system status information.

Format DSP ST SYS [option]

Use To view the current system status, type:

DSP ST SYS <CR>

Display Format A typical status information display is shown below.

```
NODE            = 0
NAME            = 'IMX-4T1 name'
NODAL CLOCK     = INT
BERT STATE      = OFF
SOFTWARE REV    = X.Y
HARDWARE REV    = X.Y
```

The system status fields are described below (from top to bottom)

NODE The node number of the IMX-4T1.

NAME The node name of the IMX-4T1.

NODAL CLOCK Indicates the current source for the IMX-4T1 system clock:

INT, ST, LNK-1, LNK-2, LNK-3, LNK-4 (see section 3.3).

BERT STATE Indicates the current state of the BER test: ON or OFF.

SOFTWARE REV IMX-4T1 software version.

HARDWARE REV IMX-4T1 hardware version.

EXIT

Purpose End the current session and return control to the IMX-4T1 front panel.

Format EXIT

Use Type:

EXIT <CR>

F

Purpose Define the codes used to be sent to the supervision terminal to perform the following terminal control functions:

- Clear screen
- Move cursor to screen home position.
- Move cursor to the right by one position.

The codes used by typical terminals are listed in the following table:

Table 4-5 Terminal Codes

Function	Terminal Type				
	TV920	VT52	VT100	Freedom 100/110	Freedom 220
Clear Screen	1B2A0000	N/A	1B5B325A	1B2A0000	1B5B325A
Cursor Home	1E000000	1B480000	1B5B4800	1E000000	1B5B4800
Cursor Right	0C00000	1B430000	1B5B3143	0C00000	1B5B3143

Format F

Use

1. To display the current codes, type:

   F <CR>

2. The terminal function entry screen is displayed. The screen includes three separate lines, displayed one after the other. A typical screen, showing all the three lines, is shown below:

   CLEAR SCREEN = hhhhhhhh (clear screen code)

   CURSOR HOME =hhhhhhhh (cursor home code)

   CURSOR RIGHT =hhhhhhhh (cursor right code)

   where h indicates hexadecimal digits.

3. To change a code, bring the cursor under the first digit of the code to be changed, by pressing <CR>, then enter the appropriate hexadecimal digit.

4. Repeat the procedure until all the necessary digits are changed.

HELP

Purpose Display an index of the supervisory port commands and the options available for each command.

Format H <CR>

& Use

When this option is selected, the first HELP page is displayed. Press any key to advance to the next page.

INIT DB

Purpose Load a specified set of default parameters values instead of the user configuration (Table 4-5).

Format INIT DB <CR>

Use 1. Type

INIT DB <CR>

2. The IMX-4T1 will display the TIME and DATE fields followed by the IMX-4T1 prompt.

Table 4-6 IMX-4T1 Default Configuration Used with Supervision Terminal

Parameter Type	Parameter Designation	Default Value	
General	PASSWORD	IMX	
	NODE (node number)	0	
	CLEAR SCREEN	00000000	
	CURSOR HOME	00000000	
	CURSOR RIGHT	00000000	
System	CLK_MASTER	INT	
	CLK_FBACK	NONE	
		For units w/o Ethernet port:	*For units with Ethernet port:*
	BROADCAST	N/A	NO
	ETHERNET_MODE	N/A	HALF_DUP
	BRIDGING	N/A	FILTER
CHANNEL	LNK-1	YES	
	LNK-2	YES	
	LNK-3	YES	
	LNK-4	YES	
LINK	CON	YES (provided the link is installed)	
	FRAME	ESF	
	CODE	B8ZS	
	MASK	000	
	SYNC	FAST	
	I_TS_CODE	3F	
SP (Supervisory Port)	SPEED	AUTO	
	DATA	8	
	PARITY	NONE	
	INTERFACE	DCE	
	CTS	=RTS	
	DCD_DEL	0 MS	
	DSR	ON	
	POP_ALM	NO	
	PWD	NO	
	LOG_OFF	NO	
	CALL_OUT_MODE	NONE	

INIT F

Purpose Resets the terminal control codes used to clear the terminal screen, to move the cursor to the right, and to return the cursor to the home position to 0.

Format & Use INIT F <CR>

LOOP CH

Purpose Activate a user-controlled loopback on the IMX-4T1 user's data channel (see section 5.2 for loopback description).

Format LOOP [looptype] CH or LP [looptype] CH

Use

1. To activate a local (L) or remote (R) loopback on the user's data channel, type:

   LOOP L CH <CR> or LP L CH <CR>

   LOOP R CH <CR> or LP R CH <CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.

At any time, you can activate only one loopback on the IMX-4T1 user's data channel. If you try to activate a second loopback on the user's data channel, you will see an error message (illegal link loop combination). You must deactivate the other loopback before you can activate the new one.

LOOP LINK

Purpose Activate a user-controlled loopback on the IMX-4T1 links (see section 5.2 for loopback description).

Format LOOP [looptype] LINK or LP [looptype] LINK Use

1. To activate a local (L) or remote (R) loopback on the IMX-4T1 links, type:

   LOOP L LINK<CR> or LP L LINK<CR>

   LOOP R LINK 1<CR> or LP R LINK<CR>

2. You will see the time and date, followed by the IMX-4T1 prompt.

At any time, you can activate only one loopback on the IMX-4T1 links. If you try to activate a second loopback on the IMX-4T1 links, you will see an error message (illegal link loop combination). You must deactivate the other loopback before you can activate the new one.

NODE

Purpose Select an IMX-4T1 for establishing a control session.

Format NODE 'node number'

Use

1. To connect to the desired IMX-4T1, type:

   NODE 'node number' <CR>

   where 'node number' is the three-digit node number, in the range of 1 through 255.

2. When the addressed IMX-4T1 is on-line, it will echo the complete string: NODE<SP>nnn<SP>. After you see the echo, type the desired command.

PASSWORD

Purpose Enter the password when prompted to type the password upon the start of a control session.

Format PWD<SP> 'password'

Use

1. When you see the prompt

   PASSWORD>

   type:

   'password' <CR>

   where 'password' is the string of four to eight alphanumeric characters that has been defined by the user (or the default, IMX, as appropriate).

2. The IMX-4T1 sends the current time and date, and then the prompt IMX-4T1> is displayed on the next line.

RESET

Purpose Reset the IMX-4T1. This will cause the IMX-4T1 to initialize, therefore the traffic through the IMX-4T1 will be disrupted until the IMX-4T1 returns to normal operation.

Format RESET

Use

1. To reset the IMX-4T1, type:

   RESET <CR>

TIME

Purpose Set the time for the IMX-4T1 internal real-time clock.

Format TIME

Use

1. Type

   TIME <CR>

2. The IMX-4T1 sends the time entry form:

   HOUR = 12

   MINUTE = 25

   SECOND = 16

3. If necessary, change the time as follows:.

   - Bring the cursor to the beginning of the first field to be changed by pressing the space bar.
   - To change the selected field, press F or B to scroll among the available selections.
   - When the desired selection is displayed, press the space bar to move to the next field.

4. Set the time about one minute beyond the current time, and then press <CR> at the correct instant.

   The IMX-4T1 will display the TIME and DATE fields (note that TIME has changed), followed by the IMX-4T1 prompt.

4.5 Supervision Terminal Operating Instructions

Before using the supervision terminal, make sure the preparations listed in section 4.2 were completed and all the relevant equipment has been turned on.

Starting a Session - Single IMX-4T1

When the terminal is used to control a single IMX-4T1, always assign node address 0 to the IMX-4T1. Use the following start-up sequence to connect to a IMX-4T1 that has been assigned node number 0.

1. If you use the AUTO (Autobaud) mode, press the <CR> key three times. This allows the IMX-4T1 to identify the terminal data rate.
2. Assuming that the IMX-4T1 successfully identified the data rate of the supervision terminal, you will be notified if the IMX-4T1 failed the power-up self-test:
   - If you see IMX-4T1 SELFTEST FAILED, the IMX-4T1 must be repaired before you can continue using it.
   - If the IMX-4T1 successfully passed the power-up self-test (IMX-4T1 SELFTEST OK), it sends the following message:

   IMX SUPERVISORY PORT ON LINE. TYPE H FOR HELP
3. By now, the IMX-4T1 prompt should already be displayed on the terminal screen, after the ON-LINE announcement.

   If you see

   PASSWORD

   this indicates that password protection is enabled. In this case, type the password:

   'password'<CR>

   where 'password' stands for the current password (four to eight characters). For each password character typed by you, the terminal displays an asterisk *.

   The default password is IMX.

   If your password is accepted, you will see the prompt IMX-4T1>.
4. The IMX-4T1 is now in session, under your control:
   - The following prompt is displayed:

     IMX-4T1>
   - On the IMX-4T1 front panel, you will see the message:

     TERMINAL ON LINE

   The front panel controls are disabled as long as the IMX-4T1 is under remote control.

Note *While the supervision terminal is in session with the IMX-4T1, the IMX-4T1 local operator can regain control by disconnecting the cable from the IMX-4T1 front-panel DTE connector, or by sending the EXIT command from the supervision terminal.*

The IMX-4T1 will automatically return to front panel control if no commands are received for a certain period of time (controlled by the LOG_OFF parameter). This time-out can however be disabled.

Starting a Session - Multiple IMX-4T1

When one terminal is used to control several IMX-4T1 connected via modems, non-zero node addresses are assigned to each IMX-4T1. The node addresses, in the range of 1 through 255, are assigned during the first session, by means of the command DEF NODE. Use the following procedure to establish a session with a specific IMX-4T1.

IMPORTANT If you are using a multidrop configuration, do not assign address 0 to any of the IMX-4T1 connected to a given terminal. Make sure the interface type is set as DTE, and select the appropriate DCD_DEL parameter.

1. Press the <CR> key three times.
2. Type NODE, space, the desired IMX-4T1 node address and another space, and then type the desired command and press <CR>. For example, with node address 234, type:

   NODE<SP>234<SP> 'command' <CR>
3. If the addressed IMX-4T1 does not use password protection, it will immediately execute the command.
4. If the addressed IMX-4T1 is password protected, you will see the prompt:

   PASSWORD>

   Type again the node address and then the password. For example, for node address 234, type :

   NODE<SP>234<SP>'password'<CR>
5. If the password is correct, the IMX-4T1 will execute the command. Otherwise, you will see ENTER PASSWORD.

Control Session

1. During the control session, type the desired commands at the terminal keyboard. You must see the IMX-4T1 echo character by character.

   If a bad command appears, backspace to clear the error, and then type again the correct character.

   - When you see the correct and complete command in the echo line, press <CR> to execute the command. The IMX-4T1 will process the command and display the appropriate response. At the end of the command execution, the IMX-4T1 displays the current time and date, and then provides a new prompt for the next command line.

- If you changed your mind, and want to abort the command, press BREAK or CTRL-C. You will again receive the prompt, allowing you to enter another command.

Note *You can also use BREAK or CTRL+C to stop automatic repetition of commands sent with the /R option.*

2. If your command is not correct, the IMX-4T1 will not execute it, but will echo again the command, with a bad command message in the following line. Type again the correct command.
3. If the terminal screen fills up during the exchange with the IMX-4T1, you will see the message:

   HIT ANY KEY TO CONTINUE

   After pressing any key except BREAK, the terminal scrolls to the next page.

Ending a Control Session

1. To end the control session, type:

   EXIT

2. The IMX-4T1 prompt will disappear. Now you can control the IMX-4T1 from its front panel.

Note A control session may also be terminated by the IMX-4T1 if the idle disconnect time-out is enabled, or when the DTR line switches to the inactive (OFF) state.

4.6 Configuration Error Messages

The IMX-4T1 provides configuration error messages for the supervision terminal user. The configuration messages have the format ERROR, followed by a two-digit code. The IMX-4T1 will display a short description of the error message after the ERROR code.

The error messages are explained below.

ERROR 01 MASTER AND FALLBACK CLOCKS ARE SAME

You are trying to select the same source as both master and fallback clock source. Check and change as required.

ERROR 02 CLOCK SOURCE FROM NOT VALID LINK

You are trying to select as clock source a link that is not connected to the IMX-4T1. Check and change as required.

ERROR 03 ILLEGAL LOOP COMBINATION

Illegal combination of loopbacks: you are trying to activate simultaneously local and remote loopbacks on links or on the data channel (it is not allowed to connect a local channel loopback and a remote link loopback at the same time).

ERROR 04 Reserved.

ERROR 05 MAPPING UNCONNECTED LINK

You are trying to map a link that is not active.

ERROR 06 CONNECTING TO UNEXISTING LINK

You are trying to activate a link which is not connected to the IMX-4T1. Check and change as required.

ERROR 07 UNCONNECTING LINK THAT SUPPLIES CLOCK OR MAPPED TO CHANNEL

You are trying to disconnect a link that has been selected as clock source, or a link that is mapped to the user's data channel. Check and change as required.

ERROR 08 LOOP IS NOT ACTIVE

You are trying to disconnect a loopback that is not active.

ERROR 09 LINK IS NOT ACTIVE

You are trying to display the status of a link which is not active. Check and change as required.

ERROR 10 ILLEGAL COMMAND FOR CURRENT LINK MODE

You are trying to select a parameter value which is not supported under the current link framing mode. Check and change as required.

ERROR 11 ILLEGAL DCD_DEL AND INTERFACE COMBINATION

There is a conflict caused using DEF SP command via the supervision terminal: the INTERFACE parameter is set for **DCE** and the DCD_DEL parameter is set for a value other than **0 MS**. (Must be set for 0 msec when supervisory port interface functions as DCE)

ERROR 12 CONFLICT IN INTERFACE AND DSR PARAMETERS

There is a conflict caused using DEF SP command via the supervision terminal: the INTERFACE parameter is set for **DTE** and the DSR parameter is set to **ON**. (DSR parameter needs to be set to **=DTR**)

ERROR 23 LOOP ALREADY ACTIVE

You are trying to activate a loopback that is already running.

Chapter 5
Diagnostics

This chapter:

- Explains status indications and messages
- Explains how to perform performance diagnostics
- Describes the test functions
- Describes the power-up self-test
- Provides troubleshooting procedures.

5.1 Status Indications and Messages

Indicators

IMX-4T1 status is indicated by the RED and YEL alarm indicators of its links, and by the DTE RD and TD indicators of the user's data channel. Indicator functions are listed in Table 3-1.

Display

The IMX-4T1 maintains an alarm buffer. The buffer can store one alarm event of each type. Up to 100 alarms can be displayed on the supervision terminal.

The IMX-4T1 operator can view the contents of the alarm buffer on the front panel LCD display, and can delete the event alarms from the buffer when no longer needed. This procedure is explained in section 3.8.

Table 5-1 presents the alarm messages displayed on the IMX-4T1 display in alphabetical order, and lists the actions required to correct the alarm condition (the messages displayed on the supervision terminal have a similar syntax). In these messages, X identifies the link, 1, 2, 3 or 4.

To correct the reported problem, perform the corrective actions in the given order, until the problem is corrected. If the problem cannot be corrected by carrying out the listed actions, have the IMX-4T1 checked by the technical support personnel.

Table 5-1 IMX-4T1 Alarm Buffer Messages

Message	Description	Corrective Actions	Alarm Type
ALARM BUFFER OVERFLOW	More than 100 alarms entries have been written in the alarm buffer since the last clear command	Read the messages. If you are using the front panel, delete all the event alarms by selecting CLEAR. From the supervision terminal, send the CLR ALM command	ON/OFF
AIS OCCURRED, LNK:X	Unframed "all ones" sequence is received in the link data stream	Problem at the remote equipment	ON/OFF
AIS RED ALM, LNK:X	Local loss of frame synchronization alarm on the specified link caused by AIS condition	Problem at the remote equipment	ON/OFF
BPV ERROR, LNK:X	Bipolar violations in the link receive signal. Updated once per second	Have the link checked	ON
CLOCK WAS CHANGED TO FALLBACK	The IMX-4T1 switch to the fallback clock source, because the master clock source failed	Check the link providing the master clock source. The IMX-4T1 replaces a recovered link clock when the corresponding link loses frame synchronization or its input signal is missing.	ON/OFF
CLOCK WAS CHANGED TO INTERNAL	The IMX-4T1 switched to the internal clock source, because both the master and the fall back clock sources failed	Check the link providing the master and/or fallback clock source. The IMX-4T1 replaces a recovered link clock with the internal clock when the corresponding link loses frame synchronization or its input signal is missing, and also when no fallback clock source is defined.	ON/OFF
DATABASE CKS ERR	IMX-4T1 technical failure (internal data base error)	1. Load the default configuration instead of the current data base (from the supervision terminal, enter the INIT DB command) 2. Replace the IMX-4T1	ON/OFF
DB-INIT SW IS ON	Section 3, DBINI, of switch SW1 is set to ON	If it is no longer necessary to enforce the default data base parameter values, change setting to OFF	ON
EXCESSIVE BPV, LNK:X	The rate of bipolar violations in the link receive signal exceeds $1x10^{-6}$ during a measurements interval of 1000 seconds	Problem in network facilities	ON/OFF
FRAME SLIP, LNK:X	Frame slips are detected (not displayed during local loss of frame synchronization). Updated once per second	1. Incorrect selection of clock source 2. Problem at far end (unstable clock source) 3. Replace the IMX-4T1 only if no problem has been detected in steps 1 and 2	ON

Table 5-1 IMX-4T1 Alarm Buffer Messages (Cont.)

Message	Description	Corrective Actions	Alarm Type
HARDWARE FAILURE	IMX-4T1 technical failure (one of the internal programmable components)	Replace the IMX-4T1	ON/OFF
NETWORK LLB, LNK:X	Line loopback command received from the network	Wait until the loopback condition is removed	ON/OFF
NETWORK PLB, LNK:X	Payload loopback command received from the network	Wait until the loopback condition is removed	ON/OFF
PSWRD SW IS ON	Section 1, PASSW, of switch SW1 is set to ON	If it is no longer necessary to enforce the default password and node number, change setting to OFF	ON
REAL TIME CLOCK BATTERY FAILURE	The battery that powers the IMX-4T1 internal real-time clock when IMX-4T1 is not powered has failed	Have the IMX-4T1 repaired	ON
RECEIVE OOS CODE, LNK:X	The IMX-4T1 detects the OOS (out-of-service) code on the specified link	Problem at the remote equipment. Perform the following check on the remote equipment. 1. Check cable connections to the link connector 2. Check line and/or other communication equipment providing the link to the remote equipment	ON/OFF
RED ALARM, LNK:X	Local loss of frame synchronization alarm on the specified link	1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote IMX-4T1 3. Replace the IMX-4T1	ON/OFF
YELLOW ALARM, LNK:X	Remote loss of frame synchronization alarm on the specified link (only on T1 links)	Problem at the remote equipment. Perform the following checks on the remote equipment: 1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote IMX-4T1 3. Replace the IMX-4T1	ON/OFF

Table 5-1 IMX-4T1 Alarm Buffer Messages (Cont.)

Message	Description	Corrective Actions	Alarm Type
SELF TEST ERROR	A problem has been detected during IMX-4T1 self-test	Replace the IMX-4T1	ON
SIGNAL LOSS, LNK:X	Loss of link receive signal	1. Check cable connections to the link connector 2. Check line and/or other communication equipment providing the link to the remote IMX-4T1	ON/OFF
SP-PAR SW IS ON	Section 2, DEFSP, of switch SW1 is set to ON	If it is no longer necessary to enforce the default supervisory port parameters, change setting to OFF	ON
DP ALTERNATE CALL FAILED	The call attempts to the alternate dial-out number failed	If the number is not busy, check the modem connected to the CONTROL DCE connector. If the called number is often busy, you may also increase the number of call retries	ON
DP DIAL CYCLE FAILED	The current cycle of call attempts failed	Check the modem connected to the CONTROL DCE connector. If the called number is often busy, you may also increase the number of call retries	ON
DP PRIMARY CALL FAILED	The call attempts to the primary dial-out number failed	If the number is not busy, check the modem connected to the CONTROL DCE connector. If the called number is often busy, you may also increase the number of call retries	ON
LAN NOT CONNECTED	The Ehternet interface is not connected to an operating LAN	Check the cable connecting to the LAN, the LAN media, and check that at least one station is active on the LAN	

5.2 Performance Diagnostics Data

This section describes the performance evaluation and monitoring functions provided by the IMX-4T1. The functions actually available depend on the framing in use, ESF or SF (D4):

- **ESF Framing:** when ESF framing is used, it is possible to monitor end-to-end data transmission performance. With this type of framing (see section 1.2), the data stream transmitted end-to-end includes supervision and error detection information.

  The error detection information is derived from the data payload included in each extended super-frame, by performing a cyclic redundancy check (CRC). The resulting CRC checksum is transmitted in addition to the raw data bits.

  The receiving end recalculates the checksum and compares the results with the received checksum: any difference between the two checksums indicates that one or more bit errors are contained in the current data block (ESF) being evaluated.

- **SF Framing:** the SF-framed signal does not support the capabilities listed above. However, the IMX-4T1 is capable of gathering the number of bipolar violations measured during the last minute.

ANSI T1.403-1989 ESF Statistics

When using ESF framing, the IMX-4T1 stores T1 line statistics for each T1 link interface in compliance with the ANSI T1.403-1989 requirements. The statistic data is gathered once per second. The statistics are collected over the last four seconds, and then transmitted via the 4 kbps control and supervision data link (FDL) of the ESF frames. This permits real-time monitoring of data transmission performance.

The performance parameters defined for AT&T Pub. 54016 statistics are listed below:

- Current ESF error events (ERROR EV)

  An ESF error event is any extended super-frame containing a CRC error and/or OOF event. The number of events is collected in a current ESF error events register.

Note *Register contents can be displayed at any time. When the ESF error events are displayed on the front-panel LCD, the register can be reset by pressing ENTER.*

- Current seconds (SECS)

  The number of seconds in the current measurement interval. A measurement interval has 900 seconds (15 minutes).

- Current errored seconds (ES)

  An errored second is any second containing one or more CRC error events, or one or more OOF events, or one or more controlled slip events. The data is collected for the current 15-minute interval.

- Current unavailable seconds (UAS)

  An unavailable second is any second in which a failed signal state exists. A failed signal state is declared when 10 consecutive severely errored seconds (SES) occur, and is cleared after 10 consecutive seconds of data are processed without a SES.

- Current severely errored seconds (SES)

  A SES is a second with 320 or more CRC error events, or one or more OOF events. The data is collected for the current 15-minute interval.

- Current bursty errored seconds (BES)

  A BES is a second with 2 to 319 CRC error events. The data is collected for the current 15-minute interval.

- Current loss of frame counter (LOFC)

  The loss of frame (LOF) counter counts the loss of frame alignment events. The data is collected for the current 15-minute interval.

- Current slip second counter (CSS)

  A CSS is a second with one or more controlled slip events. The data is collected for the current 15-minute interval.

IMX-4T1 also provides local statistics support that meets the requirements of AT&T Pub. 54016. These are long-term statistics gathered over the long-term interval (96 intervals of 15 minutes, i.e., a total of 24 hours) for each T1 link interface. The additional parameters included in this class are:

- Long-term errored seconds (ES)

  The total number of ES in the current 24-hour interval.

- Long-term fail seconds (UAS)

  The total number of UAS in the current 24-hour interval.

- Long-term severely errored seconds (SES)

  The total number of SES in the current 24-hour interval.

- Long-term loss of frame counter (LOFC)

  The total number of LOF events in the current 24-hour interval.

- Long-term slip second counter (CSS)

  The total number of CSS in the current 24-hour interval.

- Long-term (BES)

  The total number of BES in the current 24-hour interval.

- Long-term interval

  The number of valid 15-minute intervals in the previous 24 hour period.

- Current degraded minutes

  The total number of degraded minutes in the current 24-hour interval. A degraded minute is a minute in which the bit error rate (BER) exceeded $1x10^{-6}$. This number is updated every minute.

- Last degraded minutes

  The total number of degraded minutes in the last 24-hour interval. This number is updated every 24 hours.

SF Statistics

The performance evaluation and monitoring parameters collected by the IMX-4T1 for SF framing are listed below:

- Bipolar violations (BPV) count (BPV last minute)

  The total number of bipolar violations counted in the last minute. This number is updated every minute.

- Bipolar violations worst count

  The number of bipolar violations counted in the worst minute since the last resetting of the BPV count. This number is updated every minute.

Summary of Performance Monitoring from the Front Panel

A summary of the performance diagnostics data displayed on the IMX-4T1 front panel, under DIAGNOSTICS, is given in Table 5-2.
The IMX-4T1 allows the user to reset the performance diagnostics by pressing the ENTER button.

Table 5-2 Summary of Performance Monitoring from the Front Panel

Display	Description	Range
CURR ES	Number of ES measured during the current 15-minute interval. The display is updated every second	0 - 900
CURR UAS	Number of UAS measured during the current 15-minute interval. The display is updated every second	0-900
CURR SECS	The time in seconds that expired from the start of the current 15-minute interval. The display is updated every second	0-900
CURR SES	Number of SES measured during the current 15-minute interval. The display is updated every second	0-900
CURR BES	Number of BES measured during the current 15-minute interval. The display is updated every second.	0-900
CURR LOFC	Number of loss of frame synchronization event measured during the current 15-minute interval. The display is updated ever second	0-255
CURR CSS	Number of CSS synchronization event measured during the current 15-minute interval. The display is updated ever second	0-255
L. TERM ES	Number of ES measured during the current 24-hour interval. The display is updated every 15 minutes.	0-900
L. TERM UAS	Number of UAS measured during the current 24-hour interval. The display is updated every 15 minutes.	0-65535
L. TERM SES	Number of SES measured during the current 24-hour interval. The display is updated every 15 minutes	0-65535
L.TERM BES	Number of BES measured during the current 24-hour interval. The display is updated every 15 minutes	0-65535
L. TERM LOFC	Number of loss of frame synchronization events measured during the current 24-hour interval. The display is updated every 15 minutes	0-255
L.TERM CSS	Number of CSS measured during the current 24-hour interval. The display is updated every 15 minutes	0-255
L. TERM INT	The number of 15-minute intervals that expired from the start of the current 24-hour interval. The display is updated every 15 minutes	0-96
ERROR EV	The number of ESF error events recorded since the last time the register was cleared. The display is updated every second	0-1000

Table 5-2 Summary of Performance Monitoring from the Front Panel (Cont.)

Display	Description	Range
BPV COUNT	The total number of BPV error during the last minute the display is updated every minute	0-9999
CUR DEG MIN	Number of degraded minutes measured during the last 24 hours. The display is updated every minute	0-1440
BPV WORST	The number of BPV error measured during the worst minute. The display is updated every minute.	0-9999
LST DEG MIN	Last 24-hour count of degraded minutes. The display is updated every 24 hours	0-1440

Displaying the Performance Data on the Front Panel

Use the following procedure to display the performance diagnostics data on the IMX-4T1 front-panel LCD:

1. Bring the cursor under the left-hand field of the top row (if not already there).
2. Scroll to display DIAGNOSTICS in the top row.
   The right-hand field of the top row indicates LNK1, meaning that the displayed diagnostics data pertains to link 1.
   Second row shows the first performance item for link 1, and its current value. The displayed item depends on the framing mode used on this link.
3. Bring the cursor under the left-hand field in the second row.
4. Scroll to see the other statistics
   After each SCROLL pressing, the second row shows the current value of the next item.
   Continue until the first item appears again.
5. Bring the cursor under the right-hand field of the top row (if not already there.
6. Scroll to display LNK2.
   Second row shows the first performance item for link 2, and its current value. The displayed item depends on the link type and framing mode
7. Repeat steps 3, 4 above to see the other statistics of link 2.
   After each SCROLL pressing, the second row shows the current value of the next item. Continue until the first item appears again.
8. Repeat steps 6, 7 above to see the statistics of link 3, and then for those of link 4.

Resetting the Performance Data Registers

The registers storing diagnostics data can be reset. To reset a register, bring the register to display and press ENTER.

To ensure that the collected data remains meaningful and correlated after a specific register is reset, the IMX-4T1 will automatically perform the following actions:

- Since the data collected on a given link for the current interval and for the current 24-hour interval is correlated, pressing ENTER while any of the following CURR or L.TERM data items is displayed clears all the performance diagnostics registers, not only that appearing on the display: ES, UAS, SES, BES, LOFC, CSS, and the registers for CURR SECS, CURR DEG MIN, LST DEG MIN, and L.TERM INT.
- In case the BPV COUNT register of a given link is reset, the BPV WORST register of that link is also reset, and vice versa.

The only register that can be reset independently of the other registers is the ERROR EV register (available for T1 links using ESF framing).

Displaying the Performance Data on a Supervision Terminal

The performance data can be displayed on the supervision terminal by means of the DSP PM command, as explained in Chapter 4. By adding the /CA switch to the command, you can reset all the performance diagnostics registers.

5.3 Test Functions

Test Functions

The IMX-4T1 supports five types of test functions:

- Local channel loopback (LOOP L CH)
- Remote channel loopback (LOOP R CH)
- Local link loopback (LOOP L LINK)
- Remote link loopback (LOOP R LINK)
- BER testing on the data channel.

The user-controlled test functions are accessed from the TEST OPTIONS menu.

The available test functions are described in the following paragraphs. The test functions are identified by the designation displayed by the IMX-4T1.

Loop L CH

When activated, the local channel loopback returns the signal received from the user's DTE, after passing through the user channel interface of the IMX-4T1. The local loopback is obtained by connecting the transmit signal to the input of the receive path of the user channel interface. The test signal is provided by the DTE connected to the IMX-4T1, that must receive its own transmission without errors while the loopback is activated. During the loopback, the local IMX-4T1 continues sending the user's data to the link.

Figure 5-1 shows a typical local channel loopback.

This test is generally used to check the connections to the DTE to the IMX-4T1.

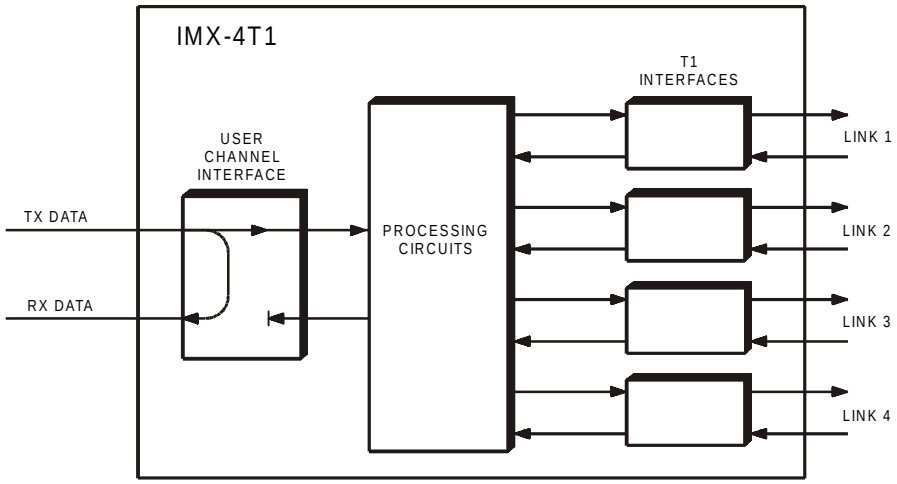


Figure 5-1 LOOP L CH Loopback

Loop R CH

When activated, the remote channel loopback returns the received data channel signal toward the remote user DTE. The remote loopback is performed by internally connecting the data channel receive signal, to the input of the transmit path. The received data channel signal remains connected to the local user's DTE. The test signal is provided by the user DTE connected to the remote end of the link, that must receive its own transmission without errors while the loopback is activated.

For this test, the IMX-4T1 must be configured to use the DCE timing mode.

Figure 5-2 shows a typical remote channel loopback.

This test fully checks the data link, including the cables connecting the two IMX-4T1 to the links, the transmission plant connecting the two IMX-4T1, and the cable connecting the remote user DTE to the remote IMX-4T1.

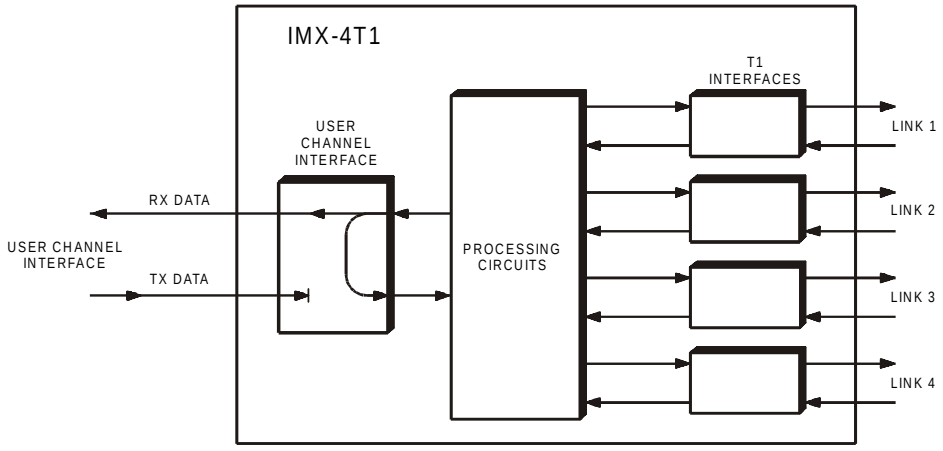


Figure 5-2 LOOP R CH Loopback

Loop L Link

When activated, the local link loopback returns the signals transmitted by each T1 link interface of the local IMX-4T1 to the receive input of the same interface. Therefore, this loop tests all the local IMX-4T1 circuits.

The local loop is obtained by connecting the link transmit signal to the input of the receive path. The test signal is provided by the local DTE, that must receive its own transmission without errors while the loopback is activated. During the loopback, the local IMX-4T1 sends an unframed “all-ones” signal to the links.

Figure 5-3 shows a typical local link loopback.

This test fully checks local IMX-4T1 operation, and the connections to the local user's DTE.

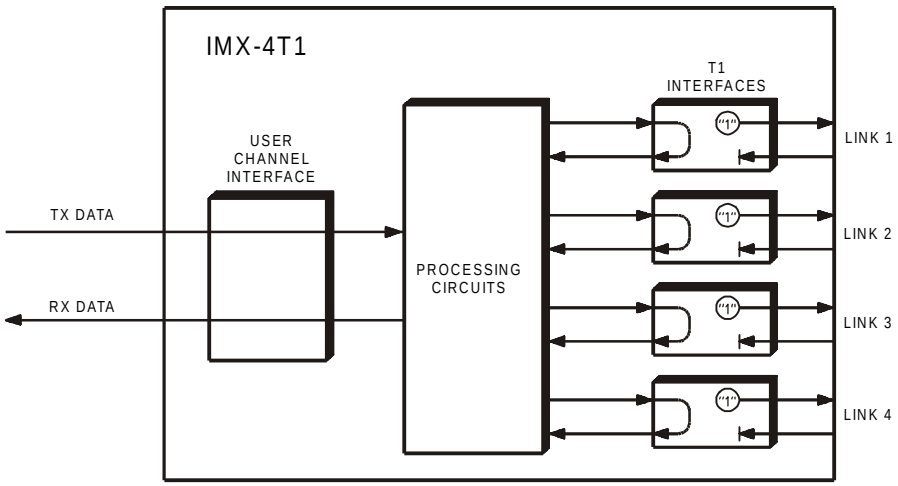


Figure 5-3 LOOP L LINK Loopback

LOOP R LINK

When activated, the remote link loopback returns the signals received by each IMX-4T1 link interface toward the remote user DTE, on the same link. The loopback is performed by connecting the link receive signal, after regeneration, to the input of the transmit path. The test signal is provided by the user DTE connected to the remote end of the link, that must receive its own transmission. Figure 5-4 shows a typical remote link loopback.

This test fully checks the data link, including the cables connecting the two IMX-4T1 to the links, the transmission plant connecting the two IMX-4T1, and the cable connecting the remote user DTE to the remote IMX-4T1.

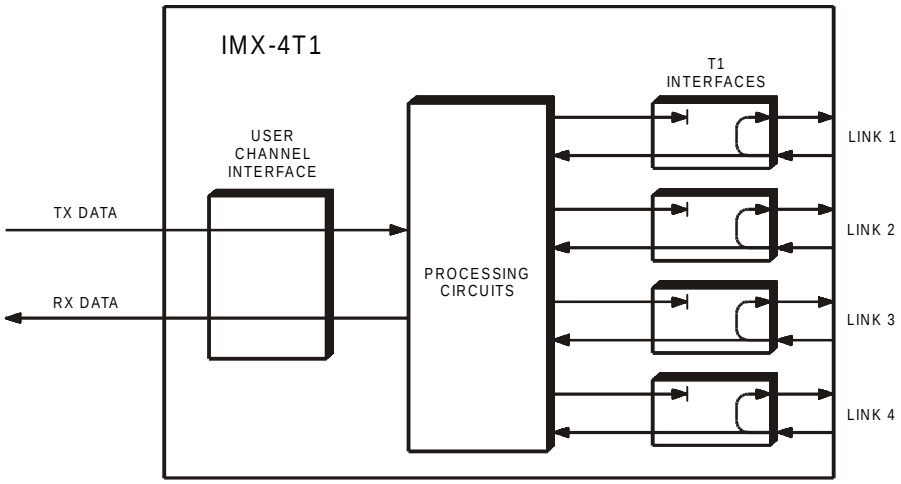


Figure 5-4 LOOP R LINK Loopback

BER Testing

The BER testing is performed by replacing the transmit user's data with a pseudo-random sequence having a length of 2^{11}-1 (2047 bits) provided by a test sequence generator. The test sequence is returned to an error detector by means of a loopback connection, at the desired location along the signal path: for example, for testing the local IMX-4T1, a local link loopback should be used. However, you can also perform BERT testing by activating this test on both IMX-4T1 units connected in a link.

The error detector compares the received sequence with a copy of the transmitted sequence, and counts the errored seconds detected during the test.

For the BERT test, the IMX-4T1 must be configured to use the DCE timing mode.

Test Options Operating Instructions

Before starting the execution of a test, note that in general you should activate only one loopback at a time. However, the IMX-4T1 will allow you to activate remote loopback on links, and local loopback on the data port.

To activate or deactivate a specific test, use the following procedure:

1. Bring the cursor under the left-hand field of the top row (if not already there).
2. Scroll to display TEST OPTIONS in the top row.
   The right-hand field of the top row indicates OFF, to indicate that no test is active. The second row is empty.
3. To select the type of test, bring the cursor under the right-hand field in the top row, and scroll to display the desired type. (for BERT test refer to note 1.)
   The right-hand field of the top row indicated LNKS when the test is to be activated on the links, or CH when the test is to be activated on the data channel.
4. After the desired type is selected, bring the cursor under the left-hand field in the second row, and scroll to display the desired type of loopback or BERT testing: LOCAL LOOP or REMOTE LOOP or BERT testing. (for BERT test refer to note 2.)
   The second row shows the current state of the selected test, OFF or ON.
5. To change the test state, bring the cursor under the right-hand field in the second row and scroll to display the desired state.
   The second row shows the new state of the selected test, e.g., OFF
6. Press ENTER to activate the displayed test. (for BERT test refer to note 3.)
   The TEST indicator turns on if the test is activated, or turns off if no test is activated

To deactivate all the tests, perform steps 1, 2, 3 above and press ENTER. The TEST indicator will turn off.

Notes

1. *Choose LNKS*
2. *Before activating the BERT test, the local link loopback must be activated, or the BERT test must be activated at both ends of the link.*
3. *Once the BERT test is activated, the E symbol in the second row will display the error per second of the current BERT test.*
4. *Before activating the BERT test, make sure that the timing mode is set for DCE.*

Network-Controlled T1 Loopback Functions

The IMX-4T1 supports two types of network-controlled loopbacks: network latching loopback (LLB) and network payload loopback (PLB). Note that these loopbacks are not initiated from the IMX-4T1.

The available network-controlled loopback functions are described below. The loopbacks are identified by the designation displayed by the IMX-4T1.

Network LLB

The latching network line loopback is connected upon the reception of the appropriate code from the network. The loopback connections are shown in Figure 5-5.

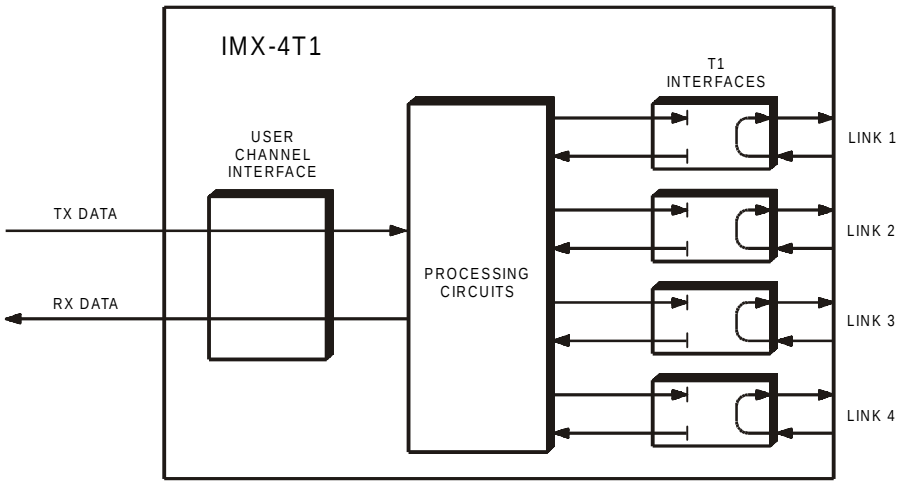


Figure 5-5 Latching Network Line Loopback

The activation/deactivation code depends on the main link framing mode:

SF (D4) The network line loopback is activated when the IMX-4T1 detects the continuous transmission of the repeating sequence 10000..... for at least 5 seconds, and is deactivated by the transmission of the sequence 100..... for at least 5 seconds.

ESF The network line loopback is activated when the IMX-4T1 detects the pattern 00001110 11111111 on the FDL, and is disconnected by the reception of the pattern 00111000 11111111 (rightmost bit transmitted first). Alternately, the network line loopback is also activated by the pattern listed above for SF (D4) framing.

The latching network line loopback has priority over all the user-controlled loopbacks, therefore, when a network loopback command is received, the user-controlled loopbacks are disconnected; they are automatically reconnected upon the reception of the network loopback disconnection command.

While the network line loopback is connected, the IMX-4T1 displays NETWORK LLB.

Network PLB

The latching network payload loopback is connected upon the reception of the appropriate code from the network. The loopback connections are shown in Figure 5-6.

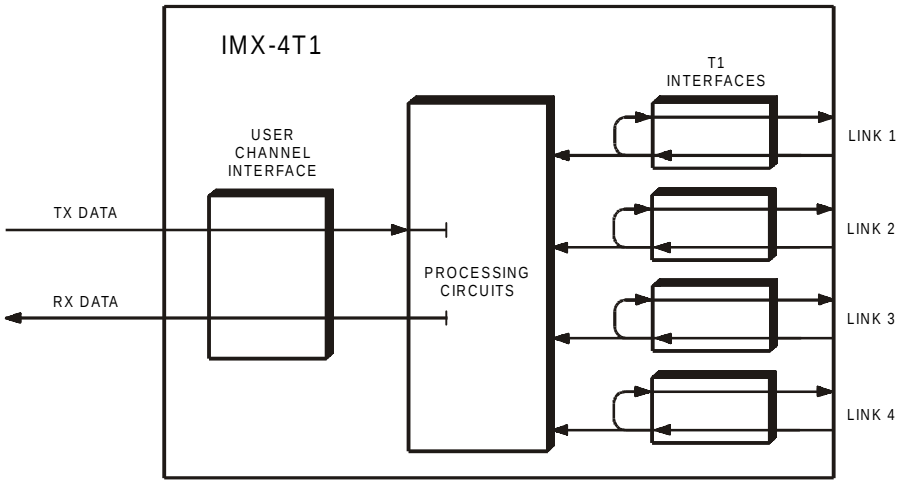


Figure 5-6 Latching Network Payload Loopback

The loopback can only be connected when ESF main link framing is used. The connection is performed by means of commands transmitted through the FDL link:

- The network payload loopback is activated when the IMX-4T1 detects the pattern 00010100 11111111 on the FDL.
- The network payload loopback is disconnected by the reception of the pattern 00110010 11111111 (rightmost bit transmitted first).

The latching network payload loopback has priority over all the user-controlled loopbacks. Therefore, when a network loopback command is received, the user-controlled loopbacks are disconnected; they are automatically reconnected upon the reception of the network loopback disconnection command.

While the network line loopback is connected, the IMX-4T1 displays NETWORK PLB.

5.4 Power-Up Self-Test

The IMX-4T1 performs a power-up self-test upon turn-on. The self-test sequence, described in section 3.6, tests the critical circuit functions and the display.

In case of failure, the IMX-4T1 displays an alarm message in the second row.

5.5 Troubleshooting Instructions

In case a problem occurs, check the displayed alarm messages and refer to section 5.1 and Table 5-1 for their interpretation.

If the trouble cannot be corrected by performing the actions listed in Table 5-1, use Table 5-2: identify the trouble symptoms and perform the actions listed under Corrective Measures in the order given in Table 5-3, until the problem is corrected.

Table 5-3 Troubleshooting Chart

No	Trouble Symptoms	Probable Cause	Corrective Measures
1	The IMX-4T1 is "dead"	1. No Power	Check that both ends of the power cable are properly connected
		2. Blown Fuse	Disconnect power cable from both ends and replace the fuse with another fuse of proper rating
		3. Defective IMX-4T1	Replace the IMX-4T1
2	IMX-4T1 reports red alarm	1. External problem	Activate the local link loopback. Check that the previously lit RED indicator turns OFF. If the indicator turns OFF, the problem is external.
		2. Defective IMX-4T1	Perform power-up self-test and replace the IMX-4T1 if defective.
3	IMX-4T1 reports yellow alarm	1. Problem at remote end	Activate the local link loopback on the remote IMX-4T1. Check that all the RED indicators turn OFF. If a RED indicator remains ON, replace the remote IMX-4T1.
		2. Defective IMX-4T1	Perform power-up self-test and replace the IMX-4T1 if defective.
4	Local user's DTE does not receive data	1. Incorrect timing mode	Select the timing mode (DCE or E-DCE) in accordance with the type and characteristics of the equipment connected to the IMX-4T1
		2. Cable problem	Activate the local data channel loopback. If the local DTE does not receive its own transmission, check the cable connecting it to the IMX-4T1 DTE connector
		3. Defective DTE	Perform self-test on the DTE
		4. Defective IMX-4T1	Perform power-up self-test and replace the IMX-4T1

Table 5-3 Troubleshooting Chart (Cont'd)

No	Trouble Symptoms	Probable Cause	Corrective Measures
5	Remote unite does not receive data when the LOOP R CH is activated, or when performing the BERT Test	1. Incorrect timing mode	Select the DCE timing mode during the test
6	Local IMX-4T1 reports the reception of the OOS code	1. Problem at the remote equipment	1. Check the cable connections at the remote equipment 2. Check the line and/or the communication equipment providing the link to the remote equipment
7	Ethernet interface COLL indicator lights most of the time, and LAN cannot operate	1. Loopback connected on the IMX-4T1	If the TST indicator lights, check and disconnect the loopback
		2. Cable problem	Check and replace if necessary the cable that connects the IMX-4T1 10BaseT connector to the LAN
		3. Problem on the LAN	Disconnect the IMX-4T1 from the LAN; if problem persists, troubleshoot the LAN
		4. Defective IMX-4T1	Perform power-up self-test and replace the IMX-4T1 if defective
8	Ethernet interface LINK indicator not lit	1. No active station on the LAN	Check that at least one station is active on the LAN
		2. Cable problem	Check and replace if necessary the cable that connects the IMX-4T1 10BaseTconnector to the LAN
		3. Problem on the LAN	Check LAN media
		4. Defective IMX-4T1	Perform power-up self-test and replace the IMX-4T1 if defective

Appendix A
Connector Wiring

A.1 T1 Link Connectors

The T1 LINK connectors have eight-pin RJ-48C connectors, wired in accordance with Table A-1.

Table A-1 LINK Connectors, Pin Allocation

Pin	Line Connector Pin Function
1	Receive Data (A wire)
2	Receive Date (B wire)
3	Frame Ground
4	Transmit Data (A wire)
5	Transmit Date (B wire)
6	Frame Ground
7, 8	Not Connected

A.2 RS-530 User Data Channel Connector and V.36/RS-449 Adapter Cable

When the IMX-4T1 is ordered with a RS-530 interface, the physical interface is a 25-pin female connector wired in accordance with Table A-2.

Table A-2 RS-530 Channel Connector Pinout

Pin	Direction	Designation	Function	RS-530
1	↔	FG	Frame Ground	AA
2	To IMX-4T1	SDA	Send Data A	BA(A)
3	From IMX-4T1	RDA	Receive Data A	BB(A)
4	To IMX-4T1	RTSA	RTS A	CA(A)
5	From IMX-4T1	CTSA	CTS A	CB(A)
6	From IMX-4T1	DSRA	DSR A	CC(A)
7	↔	SG	Signal Ground	AB
8	From IMX-4T1	DCDA	DCD A	CF(A)
9	From IMX-4T1	RCB	Receive Clock B	DD(B)
10	From IMX-4T1	DCDB	DCD B	CF(B)
11	To IMX-4T1	SCEB	Send External Clock B	DA(B)
12	From IMX-4T1	SCB	Send Clock B	DB(B)
13	From IMX-4T1	CTSB	CTS B	CB(B)
14	To IMX-4T1	SDB	Send Data B	BA(B)
15	From IMX-4T1	SCA	Send Clock A	DB(B)
16	From IMX-4T1	RDB	Receive Data B	BB(B)
17	From IMX-4T1	RCA	Receive Clock A	DD(A)
18	N/A	-	Not Connected	-
19	To IMX-4T1	RTSB	RTS B	CA(B)
20	To IMX-4T1	DTRA/RCEA	DTRA/Receive External Clock A	CD(A)
21	N/A	-	Not Connected	-
22	From IMX-4T1	DSRB	DSR B	CC(B)
23	To IMX-4T1	DTRB/RCEB	DTRB/Receive External Clock B	CD(B)
24	To IMX-4T1	SCEA	Send External Clock A	DA(A)
25	N/A	-	Not Connected	-

Table A-3 V.36/RS-449 Channel Interface Adapter Cable (CBL-HS2/R1) - DCE Timing Mode

Pin	Direction	Designation	Function	V.36/RS-449
1	↔	FG	Frame Ground	1
2	To IMX-4T1	SDA	Send Data A	4
3	From IMX-4T1	RDA	Receive Data A	6
4	To IMX-4T1	RTSA	RTS A	7
5	From IMX-4T1	CTSA	CTS A	9
6	From IMX-4T1	DSRA	DSR A	11
7	↔	SG	Signal Ground	19
8	From IMX-4T1	DCDA	DCD A	13
9	From IMX-4T1	RCB	Receive Clock B	26
10	From IMX-4T1	DCDB	DCD B	31
11	To IMX-4T1	SCEB	Send External Clock B	35
12	From IMX-4T1	SCB	Send Clock B	23
13	From IMX-4T1	CTSB	CTS B	27
14	To IMX-4T1	SDB	Send Data B	22
15	From IMX-4T1	SCA	Send Clock A	5
16	From IMX-4T1	RDB	Receive Data B	24
17	From IMX-4T1	RCA	Receive Clock A	8
18	N/A	-	Not Connected	-
19	To IMX-4T1	RTSB	RTS B	25
20	To IMX-4T1	RCEA	Receive External Clock A	-
21	N/A	-	Not Connected	-
22	From IMX-4T1	DSRB	DSR B	29
23	To IMX-4T1	RCEB	Receive External Clock B	-
24	To IMX-4T1	SCEA	Send External Clock A	17
25	N/A	-	Not Connected	-

Note *The V.36/RS-449 connector is a 37-pin D-type male connector.*

A.3 V.35 User Data Channel Connector

When the IMX-4T1 is ordered with a V.35 interface, the physical interface is a 34-pin female connector wired in accordance with Table A-4.

Table A-4 V.35 User Data Channel Connector, Pin Allocation

Pin	Designation	Direction	Function
A	PG	↔	Protective Ground
B	SG	↔	Signal Ground
C	RTS	To IMX-4T1	Request to Send
D	CTS	From IMX-4T1	Clear to Send
E	DSR	From IMX-4T1	Data Set Ready
F	DCD	From IMX-4T1	Data Carrier Detect
P	TDA	To IMX-4T1	Transmit Data (A wire)
R	RDA	From IMX-4T1	Receive Data (A wire)
S	TDB	To IMX-4T1	Transmit Data (B wire)
T	RDB	From IMX-4T1	Receive Data (B wire)
U	ETCA	To IMX-4T1	External Transmit Clock (A wire)
V	RCA	From IMX-4T1	Receive Clock (A wire)
W	ETCB	To IMX-4T1	External Transmit Clock (B wire)
X	RCB	From IMX-4T1	Receive Clock (B wire)
Y	TCA	From IMX-4T1	Transmit Clock (A wire)
Z	ERCB	To IMX-4T1	External Receive Clock (B wire)
AA	TCB	From IMX-4T1	Transmit Clock (B wire)
BB	ERCA	To IMX-4T1	External Receive Clock (A wire)

A.4 X.21 User Data Channel Connector

When the IMX-4T1 is ordered with an X.21 interface, the physical interface is a 15-pin female D-type connector wired in accordance with Table A-5.

Table A-5 X.21 User Data Channel Connector, Pin Allocation

Pin	Designation	Direction	Function
1	FG	↔	Frame Ground
2	TA	To IMX-4T1	Transmit Data (A wire)
3	CA	To IMX-4T1	Control (A wire)
4	RA	From IMX-4T1	Receive Data (A wire)
5	IA	From IMX-4T1	Indication Data (A wire)
6	SA	From IMX-4T1	Signal Timing (A wire)
7	BA	To IMX-4T1	External Timing (A wire)
8	G	↔	Signal Ground
9	TB	To IMX-4T1	Transmit Data (B wire)
10	CB	To IMX-4T1	Control (B wire)
11	RB	From IMX-4T1	Receive Data (B wire)
12	IB	From IMX-4T1	Indication Data (B wire)
13	SB	From IMX-4T1	Signal Timing (B wire)
14	BB	To IMX-4T1	External Timing (B wire)
15	-	N/A	Not Connected

A.5 HSSI User Data Channel Connector

When the IMX-4T1 is ordered with an HSSI interface, the physical interface is a 50-pin female D-type connector wired in accordance with Table A-6.

Table A-6 HSSI User Data Channel Connector, Pin Allocation

Pin	Designation	Direction	Function
1	SG	↔	Signal Ground
2	RT	From IMX-4T1	Receive Timing (+ wire)
3	CA	From IMX-4T1	DCE Available (+ wire)
4	RD	From IMX-4T1	Receive Data (+ wire)
5	LC	From IMX-4T1	Loopback Circuit C (+ wire) - optional
6	ST	From IMX-4T1	Send Timing (+ wire)
7	SG	↔	Signal Ground
8	TA	To IMX-4T1	DTE Available (+ wire)
9	TT	To IMX-4T1	Terminal Timing (+ wire)
10	LA	To IMX-4T1	Loopback Circuit A (+ wire)
11	SD	To IMX-4T1	Send Data (+ wire)
12	LB	To IMX-4T1	Loopback Circuit B (+ wire)
13	SG	↔	Signal Ground
14 - 18	-	To IMX-4T1	Ancillary to DCE (reserved) (+ wire) -optional
19	SG	↔	Signal Ground
20 - 23	-	From IMX-4T1	Ancillary to DCE (reserved) (+ wire) -optional
24	TM	From IMX-4T1	Test Mode (+ wire)
25	SG	↔	Signal Ground
26	SG	↔	Signal Ground
27	RT	From IMX-4T1	Receive Timing (-wire)
28	CA	From IMX-4T1	DCE Available (-wire)
29	RD	From IMX-4T1	Receive Data (-wire)
30	LC	From IMX-4T1	Loopback Circuit C (-wire) - optional
31	ST	From IMX-4T1	Send Timing (-wire)
32	SG	↔	Signal Ground
33	TA	To IMX-4T1	DTE Available (-wire)

Table A-6 HSSI User Data Channel Connector, Pin Allocation (Cont.)

Pin	Designation	Direction	Function
34	TT	To IMX-4T1	Terminal Timing (-wire)
35	LA	To IMX-4T1	Loopback Circuit A (-wire)
36	SD	To IMX-4T1	Send Data (-wire)
37	LB	To IMX-4T1	Loopback Circuit B (-wire)
38	SG	↔	Signal Ground
39 - 43	-	To IMX-4T1	Ancillary to DCE (reserved) (-wire)
44	SG	↔	Signal Ground (- wire)
45-48	-	From IMX-4T1	Ancillary to DCE (reserved) (-wire)
49	TM	From IMX-4T1	Test Mode (-wire)
50	SG	↔	Signal Ground

A.6 10BaseT User Data Channel Connector

The IMX-4T1 has an Ethernet interface, terminated in an eight-pin RJ-45 connector wired in accordance with Table A-7.

Table A-7 Ethernet Interface Connector

Pin	Designation	Direction	Function
1	TxD+	To IMX-4T1	Transmit Data - wire +
2	TxD-	To IMX-4T1	Transmit Data - wire -
3	RxD+	From IMX-4T1	Receive Data +
4	-	N/A	Not connected
5	-	N/A	Not connected
6	RxD-	From IMX-4T1	Receive Data -
7, 8	-	N/A	Not connected

A.7 RS-232 (V.24) Supervisory Port Connector

The IMX-4T1 supervisory port has a standard RS-232 interface. The physical interface is a 9-pin female connector wired in accordance with Table A-8.

Table A-8 Supervisory Port Interface Signals (ITU-T V.24/EIA RS-232 Interface)

Pin	Line	Notes	Connected to Terminal	Connected to Dial-Out Modem
1	Data Carrier Detect (DCD)	From IMX-4T1	8	4
2	Receive Data (RD)	From IMX-4T1	3	2
3	Transmit Data (TD)	To IMX-4T1	2	3
4	Data Terminal Ready (DTR)	To IMX-4T1	20	6
5	Signal Ground (SIG)	Common reference and DC power supply ground. Can be isolated from chassis ground (AA) (Strap-selectable)	7	7
6	Data Set Ready	From IMX-4T1	6	20
7	Request to Send (RTS)	To IMX-4T1	4	8
8	Clear to Send (CTS)	From IMX-4T1	5	-
9	Ring indicator (RI)	To IMX-4T1	-	22

A.8 Station Clock Connector

The station clock port physical interface is an eight-pin RJ-48C connector, wired in accordance with Table A-9.

Table A-9 Station Clock Connector, Pin Allocation

Pin	Designation	Function	Direction
1	CLK (T)	Station Clock (Tip)	To IMX-4T1
2	CLK (R)	Station Clock (Ring)	To IMX-4T1
3	N/A	N/A	N/A
4	N/A	N/A	N/A
5	N/A	N/A	N/A
6	RELAY	Normally open (connects to pin 8)	
7	RELAY	Normally closed (connects to pin 8)	
8	RELAY COMMON	Common alarm relay contact	