General Description

DACS II ISX is a software-controlled Digital Cross-Connect System which terminates T1 (1.544 Mbit/s) and E1 (2.048 Mbit/s) transmission lines. DACS II ISX provides cross-connections for 64 kbit/s and ranges of 64 kbit/s circuits (denoted as Nx64 kbit/s), 64 kbit/s test access for T1 and E1 transmission lines, Nx64 kbit/s test access for E1 transmission lines and cross-connections and test access capabilities for clear 1.5Mbit/s and clear 2Mbit/s signals.

It also performs transmission line and equipment maintenance and provides interfaces for remote operations systems.

A fully populated DACS II ISX Main Shelf supports up to 64 T1 or E1 transmission lines. The DACS II ISX Expansion Shelf can increase the transmission line capacity of the DACS II ISX. An additional 64 T1 or E1 transmission lines can be terminated on the DACS II ISX Expansion Shelf, increasing the total capacity of a DACS II ISX system to 128 T1 or E1 transmission lines.

DACS II ISX system timing can either be derived from an external 2.048 MHz sinusoidal synchronization source or from traffic-carrying E1 or T1 signals that terminate on the DACS II ISX.

The Timing Link Interface (TLI) timing signal, which is phase locked to the DACS II ISX system clock, can also be distributed to other on the network.

This document contains technical specifications for DACS II ISX features, performance information, external interfaces, environmental considerations, and system reliability. This information supplements the information contained in the Lucent Technologies DACS II ISX documentation listed in Table A on the next page.

TABLE 1 —Lucent Technologies DACS II ISX Documentation

Document Identifier	Document
365-359-050	DACS II ISX Release 2.0, PDS Operation and Maintenance Manual
365-359-051	DACS II ISX Release 2.0, PDS Command and Message Manual
365-359-052	DACS II ISX Release 2.0, PDS Quick Reference Guide
365-359-053	DACS II ISX Release 2.0, MML Operation and Maintenance Manual
365-359-054	DACS II ISX Release 2.0, MML Command and Message Manual
365-359-055	DACS II ISX Release 2.0, MML Quick Reference Guide
CIR 365-099-137TD	DACS II ISX Release 1.1 Technical Description
SD 99674-01	Application Schematic for DACS II ISX

CONTENTS

List of Figures

List of Tables

1. Synchronization and Timing

This section provides system level specifications for DACS II ISX synchronization. DACS II ISX was designed according to the following synchronization standards.

- "Digital Cross-Connect System Generic Requirements and Objectives", Bellcore TR-NWT-000170, Issue 2, January, 1993.
- "Clocks for the Synchronized Network: Common Generic Criteria", Bellcore TR-NWT-001244, Issue 1, June 1993.
- The Control of Jitter and Wander within Digital Networks which are Based on the 2.048 Mbit/s Hierarchy, ITU-T Recommendation G.823, 1989.

1.1 Clock Mode Operation

The DACS II ISX supports the following modes of operation:

- Fast lock
- Normal
- Holdover.

The fast lock mode is used to quickly lock internal oscillators to an external reference frequency. The normal mode is active during typical operation. The holdover mode is utilized when all external timing references are impaired. In the holdover mode, the DACS II ISX maintains the output frequency at the last known good value of the external reference and is subject to the stability of the DACS II ISX's internal oscillator.

1.2 Stratum 3/CEPT Local Clock

The DACS II ISX provides a fully duplicated clock which meets the following North American Stratum 3 and CEPT Local clock stability requirements.

Table A — Clock Specifications

Clock Stability	Minimum Accuracy	Minimum Stability	Minimum Pull-in Range
Stratum 3	+/- 4.6×10^{-6}	< 255 slips for the initial 24 hours of holdover, (+/- 0.37×10^{-6} average over first 24 hours)	Capable of synchronizing to clock with accuracy of +/- 4.6×10^{-6}
CEPT Local	Unspecified	+/- 2×10^{-8}/day	Unspecified

Minimum accuracy is the maximum long-term (20 years) deviation from nominal frequency with no external frequency reference (free run). Minimum stability is the maximum rate of change of clock frequency over time upon loss of all timing references (holdover). Pull-in range is the maximum input frequency difference from the nominal clock rate that can be overcome by a clock to pull itself into synchronization with a reference signal.

1.3 Timing Reference Types

As in previous releases, the DACS II ISX uses timing signals from traffic-carrying 1.544 Mbit/s and/or 2.048 Mbit/s signals terminated on the Enhanced Dual Digroup Circuit (EDDC) or Enhanced Dual Primary Circuit (EDPC) circuit packs.

In this release, the DACS II ISX can also use timing signals from an external 2.048MHz sinusoidal synchronization source.

Each of the two Timing Link Interface circuit packs on the DACS II ISX has the capability of terminating two 2.048MHz external timing sources (a total of four TLI ports) and outputting two separate distributions of 2.048MHz sinusoidal clock signals.

The DACS II ISX has the capability to assign up to 6 timing references (TREF1-TREF6). Any of the six possible timing references can be provisioned to either a NPC or a TLI synchronization port. The assignments can be in any combination from six NPCs and zero TLI ports to two NPCs and four TLI ports. Timing references must be provisioned on different EDDC/EDPC circuit packs.

1.4 Timing Reference Monitoring

A single timing reference is selected as active. All of the active and the non-active NPC timing references are monitored for availability. For 1.544 Mbit/s transmission line and 2.048 Mbit/s line timing references, the following signal impairments are detected:

- Loss of Signal
- Loss of Frame
- Alarm Indication Signal (AIS).

For 2.048 Mbit/s transmission line timing references, the following additional signal impairments are also detected:

- Excessive Error Rate
- TS0 Bit 5 Sync Failure Indication.

For the TLI timing references, the following signal impairment is detected:

- Loss of (Input) Signal

The DACS II ISX clock will not attempt to synchronize to a timing reference signal with any of the above impairments.

1.5 Automatic Reference Switching

The DACS II ISX supports the revertive and non-revertive timing reference modes:

- In the revertive mode, the number 1-6 will be interpreted as a priority. The highest priority, TREF1, will be the timing reference used by the synchronizer if it is available. If it fails or is put out of service, TREF2, if it is available, will be the timing reference used by the synchronizer. If the TREF2 fails or is not available, TREF3 is used, and so on. Whenever a higher priority timing reference becomes available, the system automatically switches back to it.

- In the non-revertive mode, there is no priority and all six timing references are equal. When the timing reference being used fails or is put out of service, the system automatically switches to the next available reference. The algorithm used is if TREF1 fails or is not available, TREF2 is used; if TREF2 fails or is not available, TREF3 is used, and so on. If TREF6 fails or is not available, TREF1 is used.

  When the original timing reference is made available, the system will not automatically switch back to it. An input command is required to switch back.

In both revertive and non-revertive modes, if no timing reference is available, the system will go into the holdover mode where timing is obtained from the internal timing base.

The DACS II ISX automatically switches back from holdover to the timing references when one becomes available.

Switching between timing references is non-revertive by default. However, revertive switching between timing references is provided as a user selectable option.

1.6 Synchronization Alarms

The following synchronization alarms are provided by the DACS II ISX:

- Minor Alarms
  - — Loss of a (but not all six) timing reference
  - — Active SXC in non-normal (fast or holdover) mode
  - — Frequency control exceeding 75% of pull-in range.
  - — TLI circuit failure
- Major Alarms
  - — Loss of all six timing references
  - — Failure of one of the two SXCs.
- Critical Alarms
  - — Failure of both of the redundant SXCs.

1.7 Jitter Performance

1.7.1 Input Jitter Tolerance

DACS II ISX meets the requirements for susceptibility to jitter on the incoming 1.544 Mbit/s signal in accordance with the following Bellcore requirement:

- "Clocks for the Synchronized Network: Common Generic Criteria", TA-NWT-001244, Issue B, July 1992.

Operation with larger jitter amplitudes may result in bit errors, reframes, and slips.

DACS II ISX is designed to operate error free when the 2.048 Mbit/s transmission line primary input signal contains jitter or wander within the bounds as specified in ITU-T Recommendation G.823; paragraph 3.1.1, Table 1/G.823.

1.7.2 Jitter Transfer

The DACS II ISX synchronizer meets the following Bellcore and ITU-T requirements for jitter transfer from the timing reference signal to any output signals:

- "Clocks for the Synchronized Network: Common Generic Criteria", Bellcore TA-NWT-001244, Issue B, July 1992.
- "Timing Requirements at the Outputs of Slave Clocks Suitable for Plesiochronous Operation of International Digital Links", ITU-T Fascicle III.5, Recommendation G.812, 1988.
- "The Control of Jitter and Wander within Digital Networks which are based on the 2.048 (&1.544) Mbit/s Hierarchy ", ITU-T Fascicle III.5, Recommendations G.823 and G.824, 1988.

1.7.3 Output Jitter

When synchronized to a jitter-free timing reference, the maximum jitter at a DACS II ISX output port does not exceed 0.05 Unit Interval peak to peak measured over a bandwidth of 10 – 100 KHz.

2. Transmission Characteristics

The DACS II ISX Main Shelf and the Expansion Shelf interface with digital transmission lines at the 1.544 Mbit/s and 2.048 Mbit/s signal levels. For 2.048 Mbit/s transmission lines, DACS II ISX supports either 100/120 Ohm twisted pair cabling or 75 Ohm coaxial cabling.

Both the DACS II ISX Main Shelf and the Expansion Shelf have two Network Processing Modules (NPMs) that contain the 1.544 Mbit/s and 2.048 Mbit/s transmission line terminating circuit packs. Each NPM contains 16 circuit pack slots which can be populated with Enhanced Dual Digroup Circuits (EDDCs) for 1.544 Mbit/s transmission line terminations or with Enhanced Dual Primary Circuits (EDPCs) for 2.048 Mbit/s transmission line terminations. Each EDDC or EDPC pack terminates and processes two transmission line interfaces (referred to as Network Processing Circuits (NPCs)). Therefore, a total of 32 NPCs can be supported in each NPM. For 2.048 Mbit/s transmission line interfaces, the EDPC pack is software programmable to support either 100/120 Ohm or 75 Ohm transmission lines.

Both 1.544 Mbit/s and 2.048 Mbit/s transmission line terminating circuit packs can be equipped in an NPM. However, to provide compact transmission line cabling into the DACS II ISX, each NPM is divided into two Network Processing Sub-Modules with eight circuit pack slots (16 transmission lines) per Sub-Module. Each Network Processing Sub-Module can be software provisioned to support 1.544 Mbit/s transmission line interfaces, 75 Ohm 2.048 Mbit/s transmission line interfaces or 100/120 Ohm 2.048 Mbit/s transmission line interfaces. Adapter panels are connected to the standard Line Interface Connectors for interfacing 75 Ohm 2.048 Mbit/s transmission lines. Fully connectorized cable interfaces are provided for both 1.544 Mbit/s and 2.048 Mbit/s transmission line terminations.

2.1 1.544 Mbit/s Transmission Line Interface

2.1.1 Interface Characteristics

The DACS II ISX 1.544 Mbit/s interface has a nominal termination impedance of 100Ω. The 1.544 Mbit/s signal meets the requirements specified in Lucent Technologies Compatibility Bulletin 119 (CB 119) for signals interfacing at the DSX-1 cross-connect frame.

The cable (100 ohm) and connector types recommended for the 1.544 Mbit/s transmission lines are:

— Lucent Technologies 255AS

This cable type provides 20 twisted pairs (of which 16 are used) and meets the requirements with up to 500 feet between the DACS II ISX system and the DSX-1.

— Connector type

Cinch 223-10-50-047.

Transmit and receive signals of the 1.544 Mbit/s transmission line interface are carried in separate cables, with 16 active pairs per cable. Five programmable equalizer settings are provided to maintain the pulse shape and amplitude within the template specified in CB 119 over the full range of cabling distance.

2.1.2 Framing Modes

DACS II ISX supports the following 1.544 Mbit/s transmission line framing modes:

- D4 Superframe (SF): in accordance with PUB 43801, "Digital Channel Bank Requirements and Objectives."
- Ericson Mobile Both-Way Line Terminal (MBLT): A derivative of standard D4 framing, this is a proprietary format used on older generation Ericson cellular switches.
- Extended Superframe (ESF): in accordance with Bellcore Technical Reference TR-TSY-000194, Extended Superframe Format, Issue 1, December 1987 and Lucent Technologies Compatibility Bulletin 142 (CB 142), "Extended Framing Format Interface Specification."
- DDS T1 Data Multiplexer (T1DM): in accordance with Bellcore Technical Advisory TA-TSY-000278, "Digital Data System (DDS) T1 Data Multiplexer (T1DM) Requirements," Issue 1, October 1985 and Bell System Technical Journal (BSTJ) Vol. 54 No. 5 May/June 1975, pages 893 – 918, "Digital Data System Digital Multiplexers."
- "Carrier-to-Customer Installation - T1 Metallic Interface", American National Standards Institute T1.403-1989.

2.1.3 Reframe Time

DACS II ISX meets the 50 millisecond maximum average reframe time requirement for 1.544 Mbit/s transmission lines in either D4 SF or ESF framing formats specified in Bellcore TR-TSY-000170 and T1DM specifications in accordance with Bellcore Technical Advisory TA-TSY-000278.

Note that this reframe time value is based upon the assumption that there are no false framing patterns.

The T1DM reframe time is in accordance with Bellcore Technical Advisory TA-TSY-000278, "Digital Data System (DDS) T1 Data Multiplexer (T1DM) Requirements," Issue 1, October 1985 and Bell System Technical Journal (BSTJ) Vol. 54 No. 5 May/June 1975, pages 893 – 918, "Digital Data System Digital Multiplexers."

2.1.4 False Framing Immunity and Rejection

The DACS II ISX provides 1.544 Mbit/s transmission line false framing protection. During a 1.544 Mbit/s transmission line out-of-frame condition, the framing circuitry will not lock onto an arbitrary candidate if more than one framing bit pattern is present. The 1.544 Mbit/s transmission line will remain in an out-of-frame condition until a unique framing bit pattern is identified. For the D4 framing mode, the DACS II ISX framing strategy uses both the terminal framing (Ft) and signaling framing (Fs) patterns. An in-frame condition is not declared unless both the Ft and Fs patterns are present. For the ESF mode, DACS II ISX uses both the ESF framing pattern and the Cyclic Redundancy Check (CRC6). An in-frame condition is not declared unless a good framing pattern is found with a good CRC6. For T1DM mode, the DACS II ISX framing strategy additionally uses the channel 24 framing pattern.

DACS II ISX provides a signaling fixing capability, described in *Section 2.1.7.3*, to avoid false framing pattern simulation by signaling bits on outgoing 1.544 Mbit/s signals.

2.1.4.1 Out-of-Frame (OOF); Loss of Frame (LOF) Detection Limits

The 1.544 Mbit/s transmission line interface OOF detection limits are mode dependent and are listed below:

- D4 SF and T1DM framing modes: 2 out of 4 framing bits in error
- ESF framing mode: 2 out of 4 framing bits in error or, if the facility is already out-of-frame, 32 out of 33 CRC-6 check bit errors.

2.1.5 Line Coding

DACS II ISX supports the following 1.544 Mbit/s transmission line codes:

- Zero Code Suppression (ZCS)
- No Zero Code Suppression (NZCS)
- Bipolar with 8 Zero Substitution (B8ZS).

2.1.6 Channel Sequencing Formats

DACS II ISX provides 1.544 Mbit/s transmission line interfaces having the following channel numbering formats in accordance with Lucent Technologies PUB 43801:

— D1D

— D2

— D4.

2.1.7 Signaling Characteristics

DACS II ISX channel-associated signaling has the following characteristics for the 1.544 Mbit/s transmission line interface.

2.1.7.1 Signaling Modes

DACS II ISX supports the following per channel signaling modes for 1.544 Mbit/s transmission lines:

— Robbed bit: The signaling bits are transmitted in the least significant bit of the data channel every sixth frame. The signaling frames and bits are identified by a superframe sequence (12 frames for the D4 mode; 24 frames for the ESF mode) in the 193rd bit.

— Digital Multiplexed Interface-Bit Oriented Signaling (DMI-BOS): It provides a signaling channel (in channel 24) without robbing bits from the data channel. The signaling bits are identified by a superframe sequence in channel 24.

— Transparent: No signaling bits are associated with the channel.

2.1.7.2 Signaling Formats

DACS II ISX supports the following 64 kbit/s signaling formats:

- 2-state signaling
- 4-state signaling
- 16-state signaling
- Transparent Signaling.

The application of the signaling formats is framing mode dependent, as follows:

- The 2-state and 4-state signaling and transparency are applicable for either the D4 SF or ESF framing mode.
- The 16-state signaling is only applicable for the ESF framing mode signals.

2.1.7.3 Signaling Fixing

For 64 kbit/s channels provisioned with the robbed bit signaling mode, DACS II ISX performs the following signaling fixing features:

- For 4-state signaling, if both A and B signaling bits are not equal to 0 (that is, 01,10,11), on a cross-connection with signaling, DACS II ISX forces the least significant bit of the outgoing channel to 1 in a nonsignaling frame when the incoming channel was in a signaling frame.
- For 16-state signaling, the least significant bit is forced to 1 if A,B,C, and D signaling bits are not equal to 0 (that is, 0001,0010,.....,1110,1111).

This algorithm prevents generation of false framing patterns when a circuit traverses multiple DACS II ISX systems.

2.1.7.4 Signaling Freezing

DACS II ISX enters the signaling freezing state when one of the following conditions occurs:

- An out of frame (OOF)
- A single framing bit error, or

- In the D4 with DMI-BOS mode when 2 frames contain Remote Frame Alarm (RFA) - yellow alarm.

The signaling freezing is done by maintaining the signaling state that existed before the detection of the failure condition. The signaling freezing state is released when the above conditions are not detected for two superframes or when a Carrier Failure Alarm (CFA) is entered.

2.1.7.5 Signal Distortion

DACS II ISX does not insert any envelope distortion in the line signal. The only noise contribution is associated with robbed bit signaling and the lack of superframe alignment.

2.1.7.6 Programmable Signaling Insertion Modes

DACS II ISX supports the following per channel signaling output insertion modes for 1.544 Mbit/s transmission lines:

- Pass-through (transparent)
- Robbed bit signaling
- Alternate Message Store (AMS): A predefined (per-channel programmable) 8-bit word is inserted when the circuit is not provisioned or, in the event of transmission line or equipment failure, when the circuit is provisioned.
- 1.544 Mbit/s transmission line interface level alarm code outputs (yellow alarm and AIS).

2.1.8 64 kbit/s Channel Capability

The DACS II ISX supports 64 kbit/s channel capability for the following modes:

- B8ZS provides a 64 kbit/s clear data channel. If signaling is required, it can be either robbed bit or DMI-BOS.
- No Zero Code Suppression (NZCS) prevents the normal overwriting of the second least significant bit (bit 7) of an all-zero word. This requires the source of the 64 kbit/s or 1.544 Mbit/s signal to ensure that 1.544 Mbit/s pulse density requirements are met. This option is normally used when DACS II ISX provides cross-connection of 1.544 Mbit/s (24 channel) services such as digitally encoded video signals for teleconferencing. If signaling is required, it can be either robbed bit or DMI-BOS.

  These two options are selected on a per-1.544 Mbit/s transmission line interface basis as part of the DACS II ISX equipment provisioning commands.

2.2 2.048 Mbit/s Transmission Line Interface

2.2.1 Interface Characteristics

The DACS II ISX 2.048 Mbit/s transmission line interface has nominal termination impedances of either 100/120 Ohms or 75 Ohms. The 2.048 Mbit/s signal meets the pulse shape and amplitude requirements specified in ITU-T Recommendation G.703 Interface at 2.048 Mbit/s.

The connector types recommended for 2.048 Mbit/s transmission lines are:

— 100/120 Ohm

Cinch 223-10-50-047

— 75 Ohm

BT43 or DIN/IEC 1.6/5.6.

2.2.2 Framing Modes

DACS II ISX supports the basic frame structure at 2.048 Mbit/s in accordance with the following:

- "Synchronous Frame Structures Used at Primary and Secondary Hierarchical Levels", ITU-T Recommendation G.704, 1991.
- "Frame Alignment and CRC Procedures Relating to Basic Frame Structures Defined in Recommendation G.704", ITU-T Recommendation G.706, 1991.

2.2.3 Reframe Time

The maximum average reframe time for 2.048 Mbit/s transmission lines is 3 milliseconds. Note that this reframe time value is based upon the assumption that there are no false framing patterns.

2.2.4 (64 kbit/s) Errors

The DACS II ISX introduces no errors on 2.048 Mbit/s signals cross-connected through it.

2.2.5 False Framing Immunity and Rejection

For 2.048 Mbit/s primary block transmission lines, the TS0 frame is used to maintain in-frame conditions in accordance with ITU-T Recommendation G.704. In addition, if the transmission line interface is also provisioned in the CRC-4 mode, an Out-of-Frame (OOF) condition is declared if CRC multiframe alignment cannot be achieved within 400 ms after the basic frame alignment has been achieved.

2.2.5.1 Out-of-Frame (OOF); Loss of Frame (LOF) Detection Limits

The 2.048 Mbit/s primary block LOF detection limits are three consecutive errored framing pattern errors (that is, the Frame Alignment Signal (FAS) in the TS0 frame word) or three consecutive errors of bit 2 of the Non Frame Word (NFW).

2.2.6 Line Coding

DACS II ISX supports the High Density Bipolar of order 3 (HDB3) 2.048 Mbit/s transmission line code.

2.2.7 Channel Sequencing Formats

DACS II ISX meets the telephone channel numbering and time slot channel numbering as specified in ITU-T Recommendation G.704 for cross-connecting time slots from 2.048 Mbit/s signals.

2.2.8 Signaling Characteristics

DACS II ISX channel-associated signaling has the following characteristics for 2.048 Mbit/s transmission line interfaces.

2.2.8.1 Signaling Modes

DACS II ISX supports two multiframe and signaling formats for 2.048 Mbit/s primary block transmission lines:

- Non-signaling Associated (NSA) format

  With this format, DACS II ISX does not process signaling; that is, it is transparent to signaling, but can carry signaling formats such as Common Channel Signaling (CCS), in-band signaling, or data channels with no signaling.

- Channel Associated Signaling (CAS)

  With this format, Time Slot 16 (TS16) of the 2.048 Mbit/s primary block transmission line is used to carry channel associated signaling information as specified in ITU-T Recommendation G.704.

2.2.8.2 Signaling Formats

DACS II ISX supports the following 64 kbit/s signaling formats:

- 2-state signaling
- 4-state signaling
- 16-state signaling
- Transparent Signaling.

When 2-state signaling or 4-state signaling is applied, the unused signaling bits can be set at fixed values.

2.2.8.3 Signaling Freezing

DACS II ISX enters the signaling freezing state when one of the following conditions occurs:

- An out of frame (OOF)
- A single framing bit error.

The signaling freezing is done by maintaining the signaling state that existed before the detection of the failure condition. The signaling freezing state is released when the above conditions are removed and two superframes have passed or when a Carrier Failure Alarm (CFA) is entered.

2.2.8.4 Signal Distortion

DACS II ISX does not insert any envelope distortion in the line signal.

2.2.8.5 Programmable Signaling Insertion Modes

DACS II ISX supports the following per channel signaling output insertion modes for 2.048 Mbit/s primary block transmission lines:

- AMS: A predefined (per-channel programmable) 8-bit word is inserted when the circuit is not provisioned or, in the event of transmission line or equipment failure, when the circuit is provisioned.
- 2.048 Mbit/s transmission line alarm code outputs [Remote Alarm Indication (RAI)].

2.3 Internal Transmission Characteristics

2.3.1 Loss and Delay Distortion

The DACS II ISX equipment does not introduce any loss or delay distortion in the transmission path.

2.3.2 Blocking

DACS II ISX is a fully nonblocking cross-connect system. That is, it allows absolute connectivity through the system.

2.3.3 Transmission Delay

The nominal absolute delay introduced by DACS II ISX for a 64 kbit/s channel passing through a DACS II ISX system is 293 microseconds. The minimum delay is 43 microseconds. The maximum delay is 544 microseconds.

3. Office Alarms

The DACS II ISX provides relay contact closures for interfacing with the central office alarm grid. The DACS II ISX Status and Alarm Panel is equipped with alarm indicators and an alarm cutoff (ACO) switch. The ACO switch is provided to silence local audible alarms. The ACO function can also be activated/deactivated from a local or remote terminal by entering the ACO command.

The classification (levels) and types of alarms are described in the sections below.

3.1 Alarm Classification

DACS II ISX provides four classifications (levels) of visual alarms. These have the following general definitions:

- Minor Alarm in 1.544 Mbit/s Applications; Deferred Maintenance Alarm (DMA) in 2.048 Mbit/s applications

  Minor alarms are generated for the following non-service-affecting failures: All 2.048 Mbit/s transmission line interface alarms or administrative link failures programmed by the user to generate minor alarms, failure of one but not all timing references, active synchronizer in non-normal (fast or holdover) mode, synchronizer frequency control exceeding 75% of pull-in range, failure or manual removal of one but not both Memory Cards when the Main Controller is In Service, system date or time not set.

- Major Alarm in 1.544 Mbit/s Applications; Prompt Maintenance Alarm (PMA) in 2.048 Mbit/s applications

  Major alarms are generated for all service-affecting failures which affect five or fewer transmission lines or the non-service affecting failure of a redundant Synchronizer Cross Connect (SXC). Specifically, major alarms are generated for the following failures: protected failures of power feeders, primary fuses or power units, at least one but not more than five transmission lines and/or facility equipment failures, non-service affecting failure of one of the duplicated SXC circuit packs, failure of the Main Controller, failure of the last In Service Memory Card, failure of both timing references, administrative link failures programmed by the user to generate major alarms.

- Main Controller Failure Alarm

  Any Main Controller failure

- Critical Alarm (PMA Critical in 2.048 Mbit/s application)

  Critical alarms are generated from all service affecting failures which affect more than five transmission lines. Specifically, critical alarms are generated for the following failures: unprotected failures of power feeders, primary fuses or power units causing a total loss of Main Shelf power, more than five transmission lines and/or facility equipment failures, failure of both of the duplicated SXC circuit packs.

DACS II ISX also provides Maintenance Information notifications to report non-alarmed changes in the system state and changes brought about by manual maintenance actions. Maintenance Information notifications are not displayed on the Status and Alarm Panel.

3.2 Alarm Types

DACS II ISX provides contact closures for the following alarm groups:

- Local Visual alarms: critical, major, minor, MC failure - major
- Local Audible alarms: critical, major, and minor
- Remote Alarms: critical, major, minor, and MC failure - major.

A "remote only" alarm mode can be set by software command which results in the generation of only remote alarms (local visual and audible alarms are suppressed) until the "remote only" mode is released by entry of another software command.

3.3 Alarm Interface Parameters

All central office alarm relay contact closures are rated as follows:

- Maximum instantaneous current: 2.5 ampere for 1 second
- Maximum steady state current: 1.0 ampere
- Maximum voltage: 30 V
- Maximum volt-ampere rating: 60 VA
- Transient noise suppression devices (diodes, networks, or other devices) must be used to protect terminations from inductive load transients.

A remote reset capability for DACS II ISX is provided.

The DACS II ISX interface to all alarm and remote reset leads is connectorized and is accessed at the rear of the DACS II ISX Main Shelf.

4. Facility Alarms and Performance Monitoring

DACS II ISX collects and reports 1.544 Mbit/s and 2.048 Mbit/s transmission line alarms and performance data and supports programmable thresholds. 2.048 Mbit/s transmission line performance monitoring allows for quality of service measurement as specified in ITU-T Recommendations G.821, G.784, and supports compliance with G.826. 1.544 Mbit/s transmission line performance monitoring is compliant with ANSI T1.403 and Bellcore TR-TSY-000820.

DACS II ISX reports whenever any of these transmission line degradations exceeds the user programmable maintenance and service limits. DACS II ISX also provides a 24-hour alarm summary report and autonomous daily audits.

4.1 1.544 Mbit/s Transmission Line Alarms and Performance Monitoring

4.1.1 1.544 Mbit/s Transmission Line Alarms

DACS II ISX continuously monitors 1.544 Mbit/s transmission lines and detects and reports the occurrence and retirement of Carrier Group Alarms (CGAs). The CGA is the combination of a Carrier Failure Alarm (CFA) plus suitable Trunk Conditioning (TC).

- Loss of Signal (LOS) Alarm

  The LOS alarm indicates that DACS II ISX is detecting no pulses of either positive or negative polarity at the 1.544 Mbit/s line interface. The LOS alarm is generated independent of any additional Red CGA alarm that may result from an accompanying failure of the 1.544 Mbit/s path. When a LOS alarm is declared, trunk conditioning is applied on a per-channel basis and a yellow alarm signal is transmitted back in the upstream direction. For the duration of a 1.544 Mbit/s transmission line LOS condition, the accumulation of all 1.544 Mbit/s line performance parameters is inhibited. A 1.544 Mbit/s line LOS condition is cleared when a 1.544 Mbit/s signal containing an average pulse density of at least 12.5% is persistently detected. When a 1.544 Mbit/s line LOS alarm clears, the yellow alarm signal is removed, trunk conditioning is removed and line performance monitoring is resumed.

- Red CGA Alarm

  The Red CGA alarm indicates that the DACS II ISX is detecting a continuous out-of-frame condition on an incoming 1.544 Mbit/s transmission line. It can also be generated by the integration of intermittent short out-of-frame conditions. A Red CGA may supersede either an Alarm Indication Signal (AIS) or a Yellow CGA. When a Red CGA is declared, trunk conditioning is applied on a per-channel basis and a yellow alarm signal is transmitted back in the upstream direction. For the duration of a Red CGA, the accumulation of all 1.544 Mbit/s path performance parameters except Path Unavailable Seconds is inhibited. A Red CGA condition is cleared when a continuous in-frame condition with no slips is detected. When a Red CGA condition clears, the yellow alarm signal is removed, trunk conditioning is removed and normal path performance monitoring is resumed.

- Yellow CGA Alarm

  The Yellow CGA alarm indicates that the remote terminal is detecting an out-of-frame condition on a 1.544 Mbit/s signal transmitted by the DACS II ISX. A Yellow CGA may supersede either an Alarm Indication Signal (AIS) or a Red CGA. When a Yellow CGA is declared, trunk conditioning is applied on a per-channel basis. The accumulation of near-end 1.544 Mbit/s transmission line performance parameters is unaffected by a Yellow CGA. A Yellow CGA is cleared when a received yellow alarm signal is no longer detected, causing trunk conditioning to be removed.

- Alarm Indication Signal (AIS) CGA Alarm

  The AIS CGA alarm indicates that the DACS II ISX is detecting an AIS signal on an incoming 1.544 Mbit/s transmission line. An AIS is a signal associated with a maintenance alarm that is transmitted in the direction of a failure as a substitute for

the normal signal. AIS CGAs may be programmed to generate either a major alarm or simply an informational message on a per transmission line basis. An AIS CGA may supersede either a Red or a Yellow CGA. When an AIS CGA is declared, trunk conditioning is applied on a per-channel basis and a yellow alarm signal is transmitted back in the upstream direction. For the duration of an AIS CGA, the accumulation of all 1.544 Mbit/s path performance parameters except Path Unavailable Seconds is inhibited. When an AIS CGA condition clears, the yellow alarm signal is removed, trunk conditioning is removed and normal path performance monitoring is resumed.

- Loss of Multiframe Alarm (LMA)

  The LMA is valid only in DMI-BOS signaling modes and indicates that DACS II ISX cannot frame on the word 24 multiframe pattern of the 1.544 Mbit/s signal.

- Remote Multiframe Alarm (RMA)

  The RMA is valid only in DMI-BOS signaling modes and indicates that the far end transmission line interface cannot frame on the word 24 multiframe pattern of the 1.544 Mbit/s signal transmitted by the DACS II ISX.

Table B summarizes the declaration, retirement, and action performed by DACS II ISX for the 1.544 Mbit/s transmission line alarms.

Table B — DACS II ISX 1.544 Mbit/s Transmission Line Carrier Group Alarms

Alarm	Mode	Detection		Retirement	
		Algorithm	Action	Algorithm	Action
RED (voice)	D4, ESF	OOF active for 2.5 seconds or hit integration 5/1	Transmit YELLOW upstream and Trunk Conditioning downstream	OOF inactive for 12.5 seconds	Remove YELLOW and Trunk Conditioning
RED (data)	ESF, T1DM	OOF active for 500 ms or hit integration 5/1	Same as above	OOF inactive for 2.5 ms	Same as above
LMA (voice)	D4 (DMI), ESF (DMI)	LMA active for 7.5 seconds or hit integration 5/1	Transmit RMA	LMA inactive for 17.5 seconds	Remove RMA
LMA (data)	ESF (DMI)	LMA active for 500 ms or hit integration 5/1	Same as above	LMA inactive for 100 ms	Same as above
YELLOW (voice)	D4, ESF	RFA active for 500 ms or hit integration 5/1 (facility is in-frame)	Transmit Trunk Conditioning downstream	RFA Inactive for 100 ms	Remove Trunk Conditioning
YELLOW (data)	ESF, T1DM	RFA active for 50 ms (facility is in-frame)	Same as above	RFA inactive for 50 ms	Same as above
RMA (voice)	D4 (DMI), ESF (DMI)	RMA active for 500 ms or hit integration 5/1 (facility is in-frame)	Transmit Trunk Conditioning downstream	RMA inactive for 100 ms	Remove Trunk Conditioning
RMA (data)	ESF (DMI)	RMA active for 50 ms (facility is in-frame)	Same as above	RMA inactive for 50 ms	Same as above

Table B — DACS II ISX 1.544 Mbit/s Transmission Line Carrier Group Alarms (Cont'd.)

Alarm	Mode	Detection		Retirement	
		Algorithm	Action	Algorithm	Action
AIS (voice)	D4, ESF	OOF active to declare RED and AIS active for 1 second or hit integration 6/1	Transmit YELLOW upstream and Trunk Conditioning downstream	OOF inactive and AIS inactive for 200 ms, if OOF active and AIS inactive hold AIS and restart RED algorithm	Remove YELLOW and Trunk Conditioning
AIS (data)	ESF, T1DM	OOF active to declare RED and AIS active for 300 ms or hit integration 3/1	Same as above	OOF inactive and AIS inactive for 100 milliseconds, if OOF active and AIS inactive hold AIS and restart RED algorithm	Same as above
LOS	D4, ESI, T1DM	LOS active for 2.5 seconds or hit integration 5/1	Same as above	LOS inactive for 12.5 seconds	Same as above

4.1.2 1.544 Mbit/s Transmission Line Performance Monitoring

Performance monitoring, data storage and retrieval on DACS II ISX is compliant with Bellcore TR-TSY-000820. This specification identifies the Near End and Far End 1.544 Mbit/s transmission line interface PM parameters to be monitored as well as the data collection intervals for these PM data. DACS II ISX also complies with ANSI T1.403, which defines the requirements for broadcast and receipt of PM data as well as the initiation of loopbacks.

DACS II ISX support of ANSI T1.403 includes:

- Generating/Terminating the ANSI T1.403 ESF data link 1.544 Mbit/s transmission line performance reports
- Calculation and storage of Far End performance data
- Initiation of ANSI T1.403 compliant Far End loopbacks.

DACS II ISX provides full time line and path performance monitoring on 1.544 Mbit/s transmission lines. The performance data are stored in 15 minute and 24 hour intervals, and may be retrieved for analysis by an external user or operations system. DACS II ISX monitors and stores the following performance parameters for each terminating 1.544 Mbit/s transmission line:

- Near End 1.544 Mbit/s Line Performance Parameters
  - — Coding Violations (CV)
    This parameter is a count of the line coding violations (e.g., bipolar violation) based on the DS1 line format.
  - — Errored Seconds (ES)
    This parameter is a count of seconds during which at least one line CV has occurred.
  - — Severely Errored Seconds (SES)
    This parameter is a count of seconds during which 1.544 or more line CVs have occurred. This number corresponds to an approximate BER of 10^{-3}.
- Far End 1.544 Mbit/s Line Performance Parameters[1]
  - — Errored Seconds (ES)
    This parameter is a count of seconds during which at least one far end line CV has occurred. The far end CV data are communicated to the near end via the Extended Superframe data link.
- Near End 1.544 Mbit/s Path Performance Parameters
  - — Coding (CRC-6) Violations (CV)
    For Extended Superframing format, this parameter is a count of detected CRC-6 CVs. For D4 Framing format, it is a count of detected framing bit errors.
  - — Errored Seconds (ES)
    This parameter is a count of seconds during which at least one of the following has occurred: a path CV, a controlled slip, or a severely errored framing event.
  - — Severely Errored Seconds (SES)
    For ESF format, this parameter is a count of seconds during which at least one of the following has occurred: 320 or more CRC-6 CVs or a severely errored framing event. For non-Extended Superframe formats, the occurrence of 8 or more framing errors may be substituted for the 320 CRC-6 CVs.
  - — Severely Errored Framing Seconds (SEFS)
    This parameter is a count of seconds during which at least one severely errored framing event has occurred. A severely errored framing event is defined as: 2 or more framing bit errors within a 3 millisecond period (often referred to as an out of frame condition).
  - — Controlled Slip Seconds (CSS)
    This parameter is a count of seconds during which a controlled slip has occurred.
  - — Unavailable Seconds (UAS)
    This parameter is a count of seconds from the onset of the condition that causes an Unavailable signal status to be declared to the onset of the condition that causes it to be cleared.

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1. The far end performance parameters are communicated to the near end via the Extended Superframe data link as defined in ANSI T1.403.

- Far End 1.544 Mbit/s Path Performance Parameters

  The far end path performance parameters are based on far end CRC-6 CV, SEF, and slip counts that are communicated to the near end via the Extended Superframe data link. The CVs are not communicated as exact counts but rather as a range of counts in compliance with ANSI T1.403. For example, if 40 far end CRC-6 errors were detected in a one second interval, the far end would indicate (via the data link) that between 11 and 100 CRC-6 errors were detected. The near end would, therefore, always have the worst case assessment of the far end performance (e.g., DACS II ISX would assume 100 CRC-6 errors in the above example). The following far end path performance parameters are monitored and stored by DACS II ISX.

  — Coding Violations (CV)
  This parameter is a count of detected far-end CRC-6 coding violations.

  — Errored Seconds (ES)
  This parameter is a count of seconds during which a far end path CV is reported.

  — Severely Errored Seconds (SES)
  This parameter is a count of seconds during which the far end reports 320 or more CRC-6 CVs.

  — Severely Errored Framing Seconds (SEFS)
  This parameter is a count of seconds during which at least one far end severely errored framing event is reported.

  — Controlled Slip Seconds (CSS)
  This parameter is a count of seconds during which a far end controlled slip is reported.

  — Unavailable Seconds (UAS)
  This parameter is a count of seconds during which the far end 1.544 Mbit/s signal is deemed unavailable.

Table C — DA Type NPCs Parameter Register Threshold Range and Default Values

Parameter	Threshold Value Range	Default Threshold Value
Daily Near-end Path Coding Violations	000000000–134217727	132960*
Daily Near-end Path Errored Seconds	00000–86400	648
Daily Near-end Path Severely Errored Seconds	00000–86400	100
Daily Near-end Severely Errored Framing Seconds	00000–86400	17
Daily Near-end Path Controlled Slip Seconds	00000–86400	4
Daily Near-end Path Unavailable Seconds	00000–86400	10
Daily Near-end Line Coding Violations	000000000–134217727	133400
Daily Near-end Line Errored Seconds	00000–86400	648
Daily Near-end Line Severely Errored Seconds	00000–86400	100
Daily Far-end Path Coding Violations	000000000–134217727	132960
Daily Far-end Path Errored Seconds	00000–86400	648
Daily Far-end Path Severely Errored Seconds	00000–86400	100
Daily Far-end Severely Errored Framing Seconds	00000–86400	17
Daily Far-end Path Controlled Slip Seconds	00000–86400	4
Daily Far-end Path Unavailable Seconds	00000–86400	10
Daily Far-end Line Errored Seconds	00000–86400	648
15-Minute Near-end Path Coding Violations	0000000–2097151	13296†
15-Minute Near-end Path Errored Seconds	000–900	65
15-Minute Near-end Path Severely Errored Seconds	000–900	10
15-Minute Near-end Severely Errored Framing Seconds	000–900	2
15-Minute Near-end Path Controlled Slip Seconds	000–900	1
15-Minute Near-end Path Unavailable Seconds	000–900	10
15-Minute Near-end Line Coding Violations	0000000–2097151	13340
15-Minute Near-end Line Errored Seconds	000–900	65
15-Minute Near-end Line Severely Errored Seconds	000–900	10
15-Minute Far-end Path Coding Violations	0000000–2097151	13296
15-Minute Far-end Path Errored Seconds	000–900	65
15-Minute Far-end Path Severely Errored Seconds	000–900	10
15-Minute Far-end Severely Errored Framing Seconds	000–900	2
15-Minute Far-end Path Controlled Slip Seconds	000–900	1
15-Minute Far-end Path Unavailable Seconds	000–900	10
15-Minute Far-end Line Errored Seconds	000–900	65

* The value shown applies to ESF framing and is a count of CRC errors. When the 1.544 Mbit/s transmission line has D4 or T1DM framing, framing errors are counted and the default Daily value is 691.

† The value shown applies to ESF framing and is a count of CRC errors. When the 1.544 Mbit/s transmission line has D4 or T1DM framing, framing errors are counted and the default 15-Minute value is 72.

4.1.3 1.544 Mbit/s Transmission Line Performance Data Storage

DACS II ISX monitors the above performance parameters and stores their counts for future retrieval as required by Bellcore TR-TSY-000820. These data storage intervals are listed below.

- 15 minute intervals:
  - — Current 15 minute interval
  - — Previous 15 minute interval
  - — Additional 95 most recent 15 minute intervals.
- 24 hour intervals:
  - — Current 24 hour interval
  - — Previous 24 hour interval
  - — Additional 6 most recent 24 hour intervals.

Each of the performance parameters has thresholds for the current 15 minute interval and the current 24 hour interval. When a threshold is exceeded, an autonomous message is broadcast over the DACS II ISX administrative link. Each performance parameter may be assigned one of four software settable threshold values for generating the autonomous message. When provisioning a 1.544 Mbit/s transmission line interface, the user can select one of the four threshold options for each performance parameter on that particular 1.544 Mbit/s transmission line interface.

4.1.4 1.544 Mbit/s Transmission Line Interface Loop Back

In compliance with ANSI T1.403, DACS II ISX provides the ability to initiate and terminate the following far end 1.544 Mbit/s transmission line interface loop backs:

- Line Loop Back (LLB)
- Network Loop Back (NLB)
- Payload Loop Back (PLB).

The far end loop back commands are initiated and terminated via the standard DACS II ISX administrative interface (i.e., PDS or MML commands). Upon receiving a request to initiate a far end loop back, DACS II ISX uses the Extended Superframe data link and/or inband signaling to direct the identified far end equipment to execute/terminate the loopback.

In addition to requesting far end loop backs, DACS II ISX can also perform a near end payload loop back in compliance with ANSI T1.403. That is, upon receiving a data link payload loop back command from the far end equipment or via a local administrative command, DACS II ISX will loop the received payload back onto the transmission line. When the loop back is terminated, DACS II ISX automatically returns the existing connections to their previous states.

4.1.5 1.544 Mbit/s Test Signal Injection

The DACS II ISX EDDC circuit pack provides the ability to inject 1.544 Mbit/s test signals onto existing, provisioned 1.544 Mbit/s transmission lines. The test signals may be used in conjunction with the far end loop back features to perform single ended transmission line maintenance.

The four 1.544 Mbit/s test signals that DACS II ISX can inject are:

- Yellow Signal:
  In ESF mode, the yellow signal is carried in the ESF data link. It is a continuously repeating 16-bit pattern of eight ones followed by eight zeros. Since the ESF yellow signal is carried in the data link, requested payload test signals can be applied in combination with the yellow signal.

  For the D4 and T1DM modes, payload test signals and the yellow signal cannot be applied in combination. In D4 mode, the yellow signal is transmitted by setting bit 2 of each DS0 channel to zero. In T1DM mode, the yellow signal is transmitted by setting a single bit in the channel 24 synchronization word.
- High Ones Density Test Signal:
  This signal consists of all ones in the payload bits with valid 1.544 Mbit/s framing.
- Low Ones Density Test Signal:
  This signal consists of a repeating eight bit pattern of (00000001) with valid 1.544 Mbit/s framing.
- Quasi-Random Test Signal:
  A 1,048,575 bit sequence generated by a 20 stage shift register as defined in ANSI T1.403, with valid 1.544 Mbit/s framing.

In addition to the test signals, the EDDC circuit pack enables DACS II ISX to send the following in-band signals to control far end loopbacks:

- In-band Loop Back Activate Signal:
  This signal consists of a repeating bit pattern of (00001) lasting for 5 to 8 seconds with valid 1.544 Mbit/s framing .
- In-band Loop Back Deactivate Signal:
  This signal consists of a repeating bit pattern of (001) lasting for 5 to 8 seconds with valid 1.544 Mbit/s framing.

Once the test signal activation command is received and executed by DACS II ISX, the test signal remains on the line until it is deactivated by a subsequent user command. The In-band Loopback Activate and In-band Loopback Deactivate signals are temporary test signals. These test signals are activated by a command, transmitted for a duration of 5 to 8 seconds, and then automatically deactivated. When these are deactivated, the facility returns to its previous state, transmitting either normal data or any previously active test signal.

DACS II ISX always applies downstream trunk conditioning before it begins transmitting the requested test signal.

For ANSI T1 NPCs using the ESF framing format, the DACS II ISX will also transmit a Loopback Retention signal on the ESF Data Link.

4.2 2.048 Mbit/s Primary Block Transmission Line Alarms and Performance Monitoring

DACS II ISX continuously monitors the 2.048 Mbit/s primary block transmission line for both Primary Block Alarms (PBAs) and transmission line performance parameters.

4.2.1 2.048 Mbit/s Primary Block Transmission Line Alarms

2.048 Mbit/s transmission lines terminating on DACS II ISX are monitored for three types of 2.048 Mbit/s transmission line alarms: signal alarms, Time Slot 0 (TS0) detected alarms and Time Slot 16 (TS16) detected alarms.

4.2.1.1 Signal Alarms

- Loss of Signal (LOS)
  The LOS condition is declared when more than 32 consecutive zeroes are detected.
- Alarm Indication Signal (AIS) Alarm
  The AIS alarm is declared when two consecutive 512 bit blocks with fewer than 3 zeroes are detected.
- Loss of Frame (LOF)
  The LOF condition is declared when three consecutive Frame Alignment Signals (FASs) have been received with an error or when TS0 bit 2 of the Non Frame Word (NFW) have been received with an error on 3 consecutive occasions. In addition, DACS II ISX will declare a LOF when 915 or more CRC-4 block errors are detected in a one second interval.
- Excessive Error Rate (EER)
  The EER alarm is declared when 8192 or more coding violations are detected in a four second interval, which is equivalent to a Bit Error Rate (BER) of $1X10^{-3}$. The EER alarm is also declared when four consecutive 1-second intervals each have 19 or more FAS+[2] errors.
- Bit Error Rate (BER)
  The BER alarm is declared when 1228 or more coding violations are detected in a 1 minute interval, which is equivalent to a BER of $1X10^{-5}$. The BER is also declared when 3 consecutive 2-second intervals each contain 2 or more CRC block errors (for transmission line interface provisioned with CRC-4), or 2 or more FAS+ block errors (for transmission line interface provisioned without CRC-4).
- Loss of CRC-4 Multiframe Alignment (LCMA)
  The LCMA alarm is declared when basic frame alignment is valid but CRC-4 multiframing is lost on the transmission line interface which is provisioned with automatic CRC mode.
- Far End LCMA (FLCMA)
  The FLCMA alarm is declared when more than 990 CRC-4 block errors are reported from the far end equipment (via E-Bits) in each second for five consecutive seconds.

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2. FAS+ is defined as the 8-bit total consisting of the Frame Alignment Signal (FAS) (0011011 pattern in the even frame of Time Slot 0) and bit 2 contained in the odd framing word of TS0.

4.2.1.2 TS0 Detected Alarms

- Remote Alarm Indication (RAI)
  The RAI alarm is declared when the remote alarm indication is received in TS0 Bit 3 of the NFW.
- Remote AIS (RAIS)
  The RAIS alarm is declared when the RAIS indication is detected in TS0 Bit 4 of the NFW on the transmission line interface which is provisioned with RAIS alarming capability enabled.
- Remote Bit Error Rate (RBER)
  The RBER alarm is declared when the RBER indication is detected in TS0 Bit 4 of the NFW on the transmission line interface which is provisioned with RBER alarming capability enabled.
- Synchronization Failure Indication (SFI)
  The SFI alarm is declared when SFI indication is detected in TS0 Bit 5 of the NFW. Detection of this alarm is software programmable on a per 2.048 Mbit/s transmission line interface basis.
- Pseudo Frame Word Out-of-Frame (PFWOOF)
  For timeslot zero to non-timeslot zero cross-connections using the Pseudo Frame Word (PFW) mode, the PFWOOF alarm will be declared if the PFW cannot be recognized.

4.2.1.3 TS16 Detected Alarms

- A16
  The A16 alarm is declared when "ALL-Ones" is received in TS16 of a transmission line interface using CAS.
- Loss of Multiframe Alignment (LMA)
  The LMA alarm is declared when LMA or loss of incoming signal is detected on TS16 of a transmission line interface using CAS.
- R16
  The R16 alarm is declared when the remote alarm indication is received in bit 6 of TS16 of Frame 0.

4.2.1.4 Alarm Maintenance Classification and Consequent Action

The alarm levels that can be raised include the following:

- PMA - Prompt Maintenance Alarm
- DMA - Deferred Maintenance Alarm
- MI - Maintenance Information.

Table D shows the alarm levels that are declared for each type of 2.048 Mbit/s failure, TS0 or TS16 failure indication. The "alarm type (k)" column represents the alarm type keyword that is output in the alarm message.

Table D — 2.048 Mbit/s Failures and Alarm Levels

Failure	Alarm Type (k)	Alarm Level
LOS	R	PMA
LOF	F	PMA
EER	X	PMA
LMA	L	PMA
AIS	A	PMA, DMA, MI
BER	B	DMA
SFI	S	MI
LCMA	C	MI
RAI	Y	MI
RAIS	I	MI
RBER	E	MI
FLCMA	G	MI
R16	M	MI
A16	V	MI
PFWOOF	P	MI

Figure 1 shows the alarm reporting priority and coexistence scheme in a tree type format. An offspring alarm on the tree has a lower priority than its root alarm and is not reported if there is an existing root alarm. Two alarms can coexist if they are not in each other's root path.

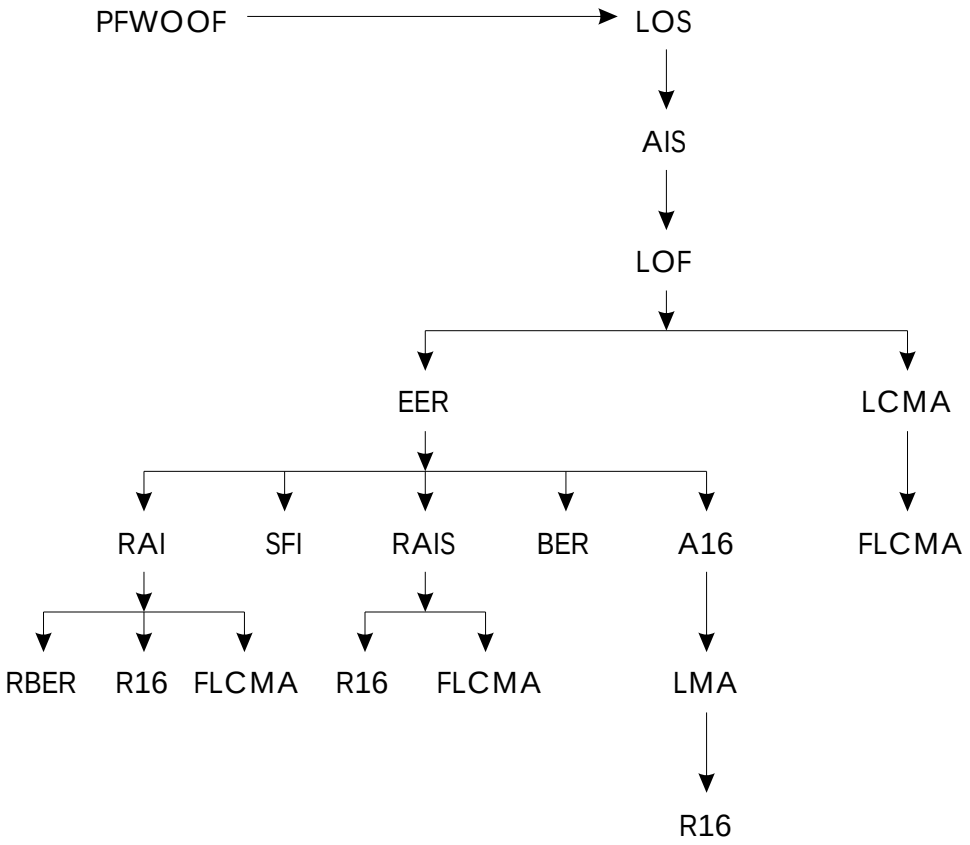

Figure 1 — DACS II ISX Facility Alarm Priority and Coexistence

Table E summarizes the consequent actions for detected alarms.

Table E — Consequent Actions for Detected Alarms

Detected Alarm	Consequent Action			
	Remote Alarm Indication Transmitted in TS0 Bits	**Remote Alarm Indication Transmitted in TS16, Bit 6, Frame 0**	**AIS Applied to All Received Timeslots**	**AIS Applied to Received Signaling Channels in TS16**
LOS/LOF	RAI	—	yes	yes
AIS	RAI,RAIS*	—	yes	yes
EER	RAI	—	yes	yes
BER	RBER*	—	—	—
RAI	—	—	—	yes*
RAIS	—	—	—	yes*
A16	—	R16	—	yes
LMA	—	R16	—	yes
R16	—	—	—	yes*
FLCMA	—	—	—	—
LCMA	Set E bits	—	yes†	yes†
SFI‡	—	—	—	—

* Dependent on the 2.048 Mbit/s transmission line provisioning.

† No consequent action if Automatic CRC-4 is enabled.

‡ Extracted line clock to synchronizer is squelched.

4.2.2 2.048 Mbit/s Transmission Line Performance Monitoring

DACS II ISX provides enhanced 2.048 Mbit/s transmission line performance monitoring similar to the 1.544 Mbit/s transmission line performance monitoring enhancements. DACS II ISX performance monitoring is based on ITU-T Recommendations G.784, G.821, and G.826. The following parameters are accumulated/calculated per 2.048 Mbit/s transmission line.

4.2.2.1 Error Count Parameters

- Code violations (CV)
  The CV count is incremented every time a code violation is detected. DACS II ISX monitors and accumulates the CV in addition to converting it into an error rate estimate for alarm reporting.
- Framing error count (FRER)
  The FRER count is incremented every time a framing error is detected. The FRER is also used to provide an error rate estimate for alarm reports.

- Unavailable time count (UATC)
  A period of unavailable time (UAT) begins when the bit error ratio in each second is worse than 10^{-3} for a period of ten consecutive seconds. These ten seconds are considered unavailable time. A new period of available time begins at the first second of a period of ten consecutive seconds each having an error rate better than 10^{-3}. The UATC count is incremented every time a period of unavailable time is entered.
- CRC4 block error count (CRC)
  The CRC count is incremented every time a CRC block error is detected.
- Multiframe alignment Error count (MER)
  The MER count is incremented when an error is detected in the Multiframe Alignment Signals (MASs).

4.2.2.2 Errored Interval Parameters

- Controlled slip seconds (CSS)
  The CSS is incremented for every 1-second interval with one or more slip defects.
- Out of frame seconds (OFS)
  The OFS is incremented for every 1-second interval with one or more Loss of frame defect. Continuous Loss of frame defects are counted as one defect.
- Errored seconds (ES)
  The ES is incremented for every 1-second interval with one or more of the following conditions: CV, slip, LOS, LOF, framing error, or CRC4 block error.
- Severely errored seconds (SES)
  The SES is incremented for every 1-second interval with one or more of the following conditions: slip, LOS, LOF, a percentage of FAS or CRC blocks received in error - programmable from 1% to 91% (default 81%).
- Unavailable seconds (UAS)
  The UAS count is incremented for every 1 second interval in an UAT period.

4.2.2.3 Remote (Far end) Performance Parameters

It is also possible to accumulate some far-end 2.048 Mbit/s transmission line performance parameters by using the received E-bits (or international bits) in the CRC-4 multiframe word as defined in ITU-T Recommendation G.706. The following parameters are stored.

- Far end block error count (FEBE)
  FEBE is equivalent to the local error count parameter.
- Far end errored seconds (FES)
  The FES count is incremented every time one or more FEBE occur in a one second interval.
- Far end severely errored seconds (FSES)
  The FSES count is incremented every time a percentage of far end blocks are in error in a one second interval, programmable from 1% to 91% (default 81%).
- Far end unavailable seconds (FUAS)
  FUAS is similar to UAS but it is calculated using FSES rather than SES.

Table F summarizes the various parameter accumulation for the PA-type framed 2.048 Mbit/s signal. All parameters are collected for 15-minute, previous 15-minute, 24-hour, and previous 24-hour intervals.

Table F — Parameter Accumulation During Failures or UAT

Termination Type	Parameters	Failures							
		LCMA	UAT	TS16	EER	LOF	AIS	LOS	FUAT
Framed 2Mb/s	CV	M	M	M	M	I	I	I	M
	FRER	M	M	M	I	I	I	I	M
	CRC	I	M	M	M	I	I	I	M
	CSS	M	M	M	M	I	I	I	M
	OFS	M	M	M	M	M	I	I	M
	ES	M	I	M	M	M	M	M	M
	SES	M	I	M	M	M	M	M	M
	UAS	M	M	M	M	M	M	M	M
	MER (MERS)	M	M	I	M	I	I	I	M
	UATC	M	M	M	M	M	M	M	M
	FEBE	I	M	M	M	I	I	I	M
	FES	I	M	M	M	I	I	I	I
	FSES	I	M	M	M	I	I	I	I
	FUAS	I	M	M	M	I	I	I	M
	TS0M	M	I	M	I	I	I	I	M

I - Inhibited
M - Monitored
NA - Not Applicable

TS16 is defined as A16 or LMA.

UAT is Unavailable Time (defined as the time when the Primary is unavailable).

FUAT is Far-End Unavailable Time.

TS0M (TS0 Monitoring) is an optional capability on all 2.048 Mbit/s ports which allows all incoming TS0 spare bits to be monitored for state changes with corresponding reports to the administrative links.

4.2.3 2.048 Mbit/s Transmission Line Performance Data Management

DACS II ISX collects and stores the performance parameters in 15 minute and daily intervals as required per ITU-T Recommendation G.784. For each collection interval, current and previous registers are kept to provide a history of the parameter. As an example, the following registers are kept for coding violations:

Current 15 minute interval, previous 15 minute interval, 95 most recent 15 minute intervals, current day and previous day.

All current parameters have associated thresholds that, when exceeded, result in an autonomous messages. These messages are user programmable as either informational (MI), minor alarms (DMA), or major alarms (PMA). The associated thresholds can be specified on a per-parameter per-2.048 Mbit/s link basis from one of four values, either locally or remotely over the administrative links. One of the four values is the system default value while the remaining three values are programmable by the user. The daily counts and alarm state of all transmission links are also displayed automatically as part of a daily report. By default the daily report is issued at midnight. The user can define any time of day for the daily report and the transmission line performance parameters to be included in the report.

Table G shows the 2.048 Mbit/s transmission line performance parameters, the threshold ranges, and the default thresholds.

Table G — 2.048 Mbit/s Transmission Line Performance Parameters Threshold Range and Default Values

Parameter	Interval	Threshold Value Range	Default Threshold Value
CRC Block Errors	Daily	1–79056000	176947
Framing Errors	Daily	1–345600000	176947
Out of Frame Seconds	Daily	1–86400	4
Errored Seconds	Daily	1–86400	4320
Severely Errored Seconds	Daily	1–86400	90
Controlled Slip Seconds	Daily	1–86400	4
Coding Violations	Daily	1–176947200	176947
Unavailable Seconds	Daily	1–86400	90
Unavailable Time Count	Daily	1–4320	9
Multiframe Errors	Daily	1–86400	4095
Far End Block Errors	Daily	1–79056000	176947
Far End Errored Seconds	Daily	1–86400	4320
Far End Severely Errored Seconds	Daily	1–86400	90
Far End Unavailable Seconds	Daily	1–86400	90
CRC Block Errors	15 Min.	1–823500	18432
Framing Errors	15 Min.	1–3600000	18432
Out of Frame Seconds	15 Min.	1–900	4
Errored Seconds	15 Min.	1–900	300
Severely Errored Seconds	15 Min.	1–900	30
Controlled Slip Seconds	15 Min.	1–900	1
Coding Violations	15 Min.	1–1843200	18432
Unavailable Seconds	15 Min.	1–900	30
Unavailable Time Count	15 Min.	1–45	3
Multiframe Errors	15 Min.	1–900	255
Far End Block Errors	15 Min.	1–823500	18432
Far End Errored Seconds	15 Min.	1–900	300
Far End Severely Errored Seconds	15 Min.	1–900	30
Far End Unavailable Seconds	15 Min.	1–900	30

The alarm state of a threshold crossing message is user programmable on a per parameter and per 2.048 Mbit/s basis as one of the following:

- Maintenance Information (MI)
- Deferred Maintenance Alarm (DMA)
- Prompt Maintenance Alarm (PMA)
- Inhibited (no threshold alarm).

4.2.4 2.048 Mbit/s Transmission Line Loopback

The DACS II ISX Enhanced Dual Primary Circuit (EDPC) packs support the following 2.048 Mbit/s transmission line loop backs:

- Facility Loop Back
- Equipment Loop Back.

The 2.048 Mbit/s transmission line loop backs are initiated and terminated by user commands entered via the DACS II ISX administrative links. The transmission line interface loop back loops the received 2.048 Mbit/s signal from the incoming transmission line back onto the transmission line. The received signal line coding and line timing are both preserved during the transmission line loop back.

The equipment loop back loops the transmitted 2.048 Mbit/s signal from the EDPC pack back into the EDPC pack (i.e., the EDPC receives its own transmitted 2.048 Mbit/s signal). This loop back includes the line coding and line timing produced by the EDPC.

For both loop backs, the user specifies whether the direction being looped should be transmitted through DACS II ISX (for transmission line loop back), transmitted onto the 2.048 Mbit/s transmission line (for equipment loop back) or be terminated, with AIS transmitted downstream (for both loop backs). Users also specify whether DACS II ISX is to provide 2.048 Mbit/s transmission line performance monitoring on the received signal.

5. Equipment and Facility Protection

5.1 Hardware Protection

The DACS II ISX architecture provides complete redundancy to equipment which carries or affects service for more than two 1.544 Mbit/s/2.048 Mbit/s transmission lines.

5.1.1 Duplicated Equipment and Protection Switching Performance

The duplicated equipment redundancy consists of two independent but fully duplicated sides (Side 0 and Side 1) for signal and clock distribution paths. This duplication is provided via the redundant SXC packs.

The protection switching of the duplicated SXC can be initiated autonomously or manually. The autonomous protection switching is performed when an entity on the active side fails, provided that the inactive side is in service. The manually initiated switching is performed when a valid protection switching command is entered while the inactive side is in service.

5.2 Software Protection and Data Transfer Performance

DACS II ISX provides protection for the executable software code and database by using hardware parity bits and software checksums. In addition, all data is duplicated in the system nonvolatile memory. The nonvolatile backup is on redundant Personal Computer Memory Card International Association (PCMCIA) memory cards (MEMA and MEMB). In the event of loss of data in the operating memories (RAM), the system is rebooted from the nonvolatile backup.

When the MC is restored to service, an attempt is made to duplicate and restore both Memory Cards to service. System executables and database are transferred from the Memory Cards to the MC's Random Access Memory (RAM). In addition, the system hardware is configured with the information transferred from the Memory Cards.

If the MC can access the cross-connect hardware, it performs a timeslot by timeslot comparison of the hardware configuration with the database. If no mismatches exist, the boot will proceed. Otherwise, if the MC determines that booting the hardware with

the database will disconnect existing circuits, a warning message is generated. The number of channels that will be disconnected is displayed in the message and the user is then asked if the boot should proceed.

When the MC is restored to service, existing test sessions are released. All alarms that exist on the system are cleared. Any transmission line alarms that still exist on the system will return once the MC is restored to service.

System reset, also known as cold boot, is defined as a manual reset of the DACS II ISX, which results in the Main Controller being reset, downloading of the system database and software executables from backup memory, and a rewrite of the hardware with the database information. Boot frame, also known as warm boot, is invoked by user command and involves only the database and does not require code downloading.

6. Cross-Connect Capability and Performance

DACS II ISX provides its cross-connect capability via the duplicated SXC. The SXC has a 4096×4096 switch matrix. The SXC is fully duplicated for reliability and is fully nonblocking for any equipment configuration or cross-connect type. The SXC and the digital signal terminating and processing circuitry maintain frame integrity for all 64 Mbit/s signals cross-connected. That is, each 64 Mbit/s signal experiences the same number of frame delays. DACS II ISX is compliant with the cross-connect standards specified in ETS 300-010-01 and ITU-T Recommendation G.796.

6.1 Supported Cross-Connect Types

DACS II ISX performs several types of 64 kbit/s and N×64 kbit/s cross-connections. The circuit types include:

- 2-way, 2-point cross-connections
- 1-way, 2-point cross-connections
- Multipoint broadcasts with selectable return path
- Multipoint, 1-way broadcast
- Timeslot zero to non-timeslot zero cross-connections.

Also, cross connections of clear 1.5Mbit/s and clear 2Mbit/s are supported. The types of cross-connections supported for clear 1.5Mbit/s and 2Mbit/s signals are:

- one-way, two-point cross-connections
- two-way, two-point cross-connections
- one-way broadcast cross-connections
- two-way broadcast cross-connections with switched or looped return.

All cross-connections can be in the normal transmitting mode, or terminated mode with Alarm Indication Signal transmission. The clear 2Mbit/s can be framed or unframed. Cross-connections between framed and unframed clear 2Mbit/s signals are supported. However, the clear 1.5Mbit/s supported in the DACS II ISX can only be framed. Unframed clear 1.5Mbit/s is not supported.

7. C-bit Monitoring and Modification for 2.048Mbit/s facilities

The DACS II ISX provides the capability to monitor and modify the

facility. This provides the network operator with a communication channel to and from remote equipment, for example, multiplexers.

The DACS II ISX can monitor the associated C-bit stream of any received timeslot in any 2.048Mbit/s facility that has been provisioned for C-bit monitoring. There are two C-bit streams associated with any network device, received and transmitted. Received C-bit streams may be monitored and transmitted C-bit streams may be modified. The monitoring and modification functions are independent of each other.

- C-bit Monitoring:

  The DACS II ISX supports C-bit monitoring by finding the Multiframe Alignment Signal in Timeslot 16, finding the C-bit framing pattern and reports state transitions of the C-bit pattern.

- C-bit Modification:

  The DACS II ISX can modify the C-bit stream of any transmitted timeslot in any 2.048Mbit/s facility that has been provisioned for C-bit modification. The remaining bits of timeslot 16 are not affected.

  When a circuit pack which is performing C-bit processing fails, the standby circuit pack will be automatically configured and activated to replace the failed circuit pack. When the failed circuit pack is replaced and restored, C-bit processing will not automatically revert back to the original circuit pack.

8. Test Access Capability and Performance

DACS II ISX provides two ways of obtaining digital test access to cross-connections:

- 64 kbit/s (single channel) test access for T1 and E1 signals
- Nx64 kbit/s (multiple channel) test access for E1 signals.
- Clear 1.5Mbit/s test access for T1 signals
- Clear 2Mbit/s test access for E1 signals

All methods provide full access to the circuit under test but do not interfere with any other cross-connections.

8.1 64 kbit/s Test Access (Single Channel)

DACS II ISX provides test access for 64 kbit/s circuits passing through the system. This access is provided via Test Access NPCs called NPCs for Test Ports (NPCTPs). An NPCTP has 12 64 kbit/s Test Ports (TPs), each consisting of a pair of 64 kbit/s channels. DACS II ISX supports up to eight NPCTPs for a total of 96 TPs. NPCTPs and TPs are predesignated via user commands.

8.2 Nx64 kbit/s Test Access (Multiple Channel)

The Nx64 kbit/s test access feature for 2.048 Mbit/s interfaces allows customers to designate up to 32 E1 Network Processing Circuits (NPCs) for use as NPCTGs and grow and reconfigure up to 100 Nx64 kbit/s Test Groups (TGs) on DACS II ISX. A TG is composed of two separate bundles of N 64 kbit/s channels. These bundles are referred to as the East bundle and the West bundle of the TG and allow an Nx64 kbit/s

circuit to be tested simultaneously in both directions of transmission. Customers will be able to gain Nx64 kbit/s test access regardless of the service channel arrangement within the circuit under test (i.e., the service channels may be contiguous, alternate, or random).

The Nx64 kbit/s test access feature allows customers to test Nx64 kbit/s services with value of N ranging between 1 and 31 for 2.048 Mbit/s interfaces.

8.3 Test Access Types

DACS II ISX provides the following test access modes:

- Monitor
- Split
- Hub
- Terminated
- Looped.

For details and allowed options, refer to the *DACS II ISX Command and Message Manuals*.

9. Digital Signal Processing (DSP) Platform

The Digital Signal Processing Platform will be an integrated part of the DACS II ISX generic software which will provide a set of platform service functions (PSF) in support of applications running on the Digital Signal Processing Platform (DSPP) circuit pack.

Note that the DSP Platform described here is the operating system like interface for applications that run on the TG193 circuit pack.

The primary benefit of this new architecture is the un-coupling of the application software from the ISX generic software. The reader should envision an operating system like interface that supports a multiplicity of applications much like Windows 95 supports a multiplicity of applications on a PC. The formal un-coupling of the application software enhances the robustness of the total system, because it uncouples any possible problems in the application software from the software that operates DACS II ISX. In addition, the new architecture makes it easier to develop additional applications, because the interface with the software that operates DACS II ISX is well defined.

This interface between DACS II ISX and one or more applications, which is called DSP Platform services, performs the following functions:

- There is a standard procedure to install the application software on DACS II ISX by copying the application software from a distribution flash card to the standard flash cards in memory slot MEMA and MEMB that are used on DACS II ISX for non-volatile memory.
- A particular application that is to run on the TG193 circuit pack is identified at the time the TG193 circuit pack is grown by the type field SDxyz. The "x" value in the type field identifies the application, the "y" and "z" values are additional initialization parameters that are provided to the application on that particular TG193 circuit pack. The application software is downloaded into the TG193 circuit pack at the time that circuit pack is restored.

- Input commands for the application are parsed by the application and not by the DACS II ISX parser. The DACS II ISX parser recognizes a particular prefix verb (DSPC) as an indication to send the command without the prefix to the application. The application then parses the command, performs the actions that the command requested and then sends a response message back to the user through DACS II ISX.
- An application may request information such as attributes of a particular NPC from DACS II ISX while processing a command. An application may request cross-connect services from DACS II ISX for any of its own channels.
- The TG193 circuit pack, and therefore any application that runs on it, has a maximum capacity of 64 channels that can be cross-connected to other channels, such as channels on facility terminating NPC. A particular application may have additional constraints on the number of channels. Refer to the manual of a particular application for details.
- An application normally requests DACS II ISX to backup its database after each transaction, in order to safeguard the information across frame resets.
- An application is able to send autonomous warning messages and/or ask DACS II ISX to generate an alarm in case of a failure.
- DACS II ISX is able to do error recovery if the TG193 circuit pack has a hardware failure. This feature is independent of any particular application.

Details about the functions and the specifications for a particular application are part of the documentation for that application and are not presented here.

The download performance time for an application at the time an application is restored should be 30 seconds or less.

10. Administrative Interfaces

10.1 Administrative Link Options

DACS II ISX provides one synchronous X.25 link and four asynchronous links for administrative interfaces. All links are EIA RS-232D compliant. The RS-232D synchronous link has a maximum transmission rate of 20K baud, and maximum cable length of 150 feet. The four RS-232D asynchronous links each have a maximum transmission rate of 9.6K baud, and maximum cable length of 150 feet.

10.2 Asynchronous Administrative Links

10.2.1 Physical and Electrical

DACS II ISX provides 4 Snider asynchronous administrative links designed with physical and electrical interfaces according to EIA Standard RS-232D.

10.2.2 Terminal Requirements

Any terminal having the following features is acceptable for communicating with the DACS II ISX equipment, either locally or remotely via suitable modems:

- EIA RS-232D interface with full duplex operation
- ASCII characters (10 bits) with even parity (7 data bits, 1 start bit, 1 stop bit, and 1 parity bit)

- 300, 1200, 2400, 4800, and 9600 baud asynchronous operation
- Responds with ASCII "ACK" when it receives an ASCII "ENQ" character. DACS II ISX asynchronous Snider links implement the ENQ/ACK communication protocol, provisionable on a per-link basis, with "disabled" as the default selection.

  If the connecting terminal does not respond to DACS II ISX "ENQ" characters, communication between DACS II ISX and the terminal is still possible. However, all DACS II ISX command responses, other than echoes and immediate responses to commands, will be delayed by 2 seconds after an initial delay of 24 seconds. This 2-second delay on the asynchronous links is caused by ENQ/ACK protocol requirements. The delay may cause the output buffer in the DACS II ISX to fill, slowing down responses on other DACS II ISX administrative links as well. These delays will not occur if the ENQ/ACK protocol is disabled.
- Employment of the XON/XOFF flow control protocols on terminals is optional on DACS II ISX asynchronous Snider links. The flow control is used to temporarily suspend DACS II ISX output messages. This option is provisionable on a per-link basis for Snider links, and the default selection is "enabled".

  The connection terminal may send DACS II ISX an XOFF, ASCII character "DC3", hexadecimal value 0x13, or CTRL-S, and DACS II ISX will suspend its output for up to 60 seconds. The terminal may send an XON, ASCII character "DC1", hexadecimal value 0x11, or CTRL-Q, prior to the 60-second time limit to resume transmission. If an XON is not received after 60 seconds, DACS II ISX will resume transmission automatically. Additional XOFF characters may be sent by the terminal to continue output control. XON/XOFF may only be used while a link is in output mode.

10.2.3 Modem Requirements

The recommended method for administering DACS II ISX frames remotely is via dedicated private line data circuits. For operation over 1200 b/s (asynchronous analog circuits), the recommended modem is an Lucent Technologies 202T type or equivalent with the following features:

- Asynchronous, binary, serial, full-duplex operation
- EIA RS-232D interface
- 4-wire private line operation
- 1200 b/s data rate without line conditioning
- Clear-to-send delay of 8 ± 0.3 ms
- Carrier detection:

  Operate = 6.9 ± 0.4 ms

  Release = 5.0 ± 0.5 ms
- Soft carrier turn-off: 8 ± 0.4 ms
- Received data is clamped when received line signal is off.

10.3 Synchronous Administrative Link

The DACS II ISX X.25 administrative link complies with ITU-T X.25, 1984. The X.25

administrative link supports up to 16 Virtual Circuits (VCs), which may be provisioned in any combination of Permanent VCs or Switched VCs.

10.3.1 Packet Assembler/Disassembler Requirements

Any packet assembler/disassembler (PAD) having the following features is acceptable for communicating with the DACS II ISX:

- EIA RS-232D interface
- Up to 20K baud operation.

Direct connection to a PAD is supported with a synchronous modem eliminator.

10.3.2 Packet Network Interface Requirements

The recommended method for administering DACS II ISX frames remotely is via dedicated private line circuits. The modem must have the following features:

- Synchronous, binary, serial, full-duplex operation
- EIA RS-232D interface
- 4-wire private line operation
- Received data is clamped when received line signal is off.

10.4 Access Security and Screening

DACS II ISX provides the following link/user access security and screening feature for applications where it is necessary to administer the system over a public network:

- Link Access Restriction

  DACS II ISX allows its administrative links or virtual circuits (VCs) to be provisioned individually with the access restriction. With the restriction, the link can be accessed only if valid user identification and password are entered.

- Input Command Restriction

  DACS II ISX input commands are categorized into six functional groups. Different privileges of entering commands of a particular group are assignable to each link, VC, or user. A command is denied if it is entered from a link/VC/user without the correct privilege.

- Output Message Screening

  DACS II ISX provides an output screening feature so that a message of a specific function group will only be generated to the links/VCs/users with the correct screening privilege. This feature can also be used to avoid the receipt of unwanted outputs.

11. Power and Battery

11.1 Primary Power Supply Limits

Redundant power feeds (Feeder A and Feeder B) are used to supply power to both the DACS II ISX Main Shelf and the Expansion Shelf. A failure of either one of these feeds will not affect DACS II ISX operation.

DACS II ISX Main Shelf and Expansion Shelf primary power supply limits are shown in Table H.

Table H — DACS II ISX Primary Power Supply Limits

Condition	Limits
Normal Operating Voltage	-36 V to -75 V
Transient Voltage	1 kV*
* According to IEC-801-4 1988 test method	

11.2 Total Power Consumption

The total power consumption for a fully equipped Main Shelf consisting of 3 PUs, 1 MC, 2 SXCs, 2 TLIs and a combination of up to 32 EDDC/EDPC circuit packs is less than 200 watts. The total power consumption for a fully equipped Expansion Shelf consisting of 2 PUs and a combination of up to 32 EDDC/EDPC circuit packs is less than 75 watts. The total power consumption for a fully equipped system consisting of a DACS II ISX Main Shelf and a DACS II ISX Expansion Shelf is less than 275 Watts.

With the addition of the TLI circuit packs, three Power Units will be used for the Main Shelf, two for usage and one for backup.

11.3 Manual Interface

DACS II ISX provides the following indicators and controls for local maintenance.

Main Shelf Status and Alarm Panel:

- Power On LED indicator
- Indicator fuses for input power supplies
- LEDs indicating the alarm state of the system
  - — System Minor
  - — System Major
  - — System Critical
  - — Main Controller Failure.

  The System Minor, System Major, and System Critical LEDs are labeled differently for the Bellcore compliant and ITU-T compliant versions of the Status and Alarm Panel as shown in Table I.

Table I — Status and Alarm Panel LED Indicators

Alarm	Status and Alarm Panel Type	
	Bellcore	ITU-T
Critical	CR	PMA CR
Major	MJ	PMA MJ
Minor	MN	DMA MN

- Alarm Cutoff (ACO) switch to silence local audible alarms, with LED display

- System reset switch and reset enable switch
- Front access to administrative link No. 1 for connecting a maintenance terminal
- LED test switch
- ESD wrist strap grounding jack.

Expansion Shelf Status Panel:

- Power On LED indicator
- Indicator fuses for input power supplies
- ESD wrist strap grounding jack.

Power Unit:

- LEDs on power units
  - — Green LED indicates good input power
  - — Red LED indicates unacceptable output power.
- Test lead access jacks for output voltage measurements.

Enhanced Dual Primary Circuit (EDPC) Packs - TG192

- Signal Monitor Points

  The TG192 circuit pack provides two software selectable 75 Ohm or 120 Ohm 2.048 Mbit/s transmission line terminations. The TG192 circuit pack provides monitor points for both the receive and transmit interfaces for both NPCs on the circuit pack. These monitor points are attenuated by slightly different levels depending on the line impedance selected. The attenuation values are shown in Table J.

Table J — TG192 Monitor Point Attenuation Values

Selected Impedance	Attenuation
75 Ohms	23.75 dB
120 Ohms	20 dB

The EDPC monitor jack layout is shown in Figure 2.

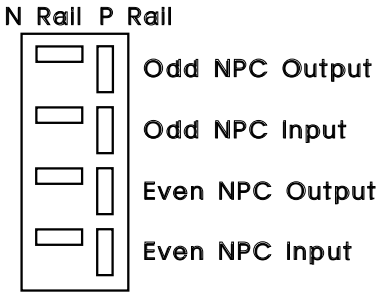

Figure 2 — TG192 EDPC Monitor Jack Layout

11.4 Power Failure Indicators

In the event of a failure in one of the Power Units, a light emitting diode (LED) is illuminated on the failed unit and an alarm message is transmitted over the administrative links. In addition, summary alarm indications are sent to the office audible and visual alarm systems and to remote systems (via telemetry).

11.5 Power Protection

Sufficient redundancy is provided in both the number of power units and in the power distribution scheme; therefore, transmission service will not be affected by a failure of any one of the two power feeds or by any one of the Power Units located on either the Main Shelf or on the Expansion Shelf.

12. Physical Specifications

12.1 DACS II ISX Main Shelf and Expansion Shelf Dimensions

Table K — DACS II ISX Main Shelf and Expansion Shelf Dimensions

Product	Dimension	Inches	Millimeters
Main Shelf	Height	15.75	400
Main Shelf	Width	17.5	445
Main Shelf	Depth	13.5	343
Expansion Shelf	Height	12.25	311
Expansion Shelf	Width	17.5	445
Expansion Shelf	Depth	13.5	343

The minimum front and rear aisle specifications are as follows:

- Minimum Front Aisle: 760mm (2’ 6’’)
- Minimum Rear Aisle: 570mm (1’ 10.5’’).

12.2 Shipping Dimensions

Table L — DACS II ISX Main Shelf and Expansion Shelf Shipping Dimensions

Product	Dimension	Inches	Millimeters
Main Shelf	Height	30	762
Main Shelf	Width	43	1092
Main Shelf	Depth	31	787
Expansion Shelf	Height	19	482
Expansion Shelf	Width	37	939
Expansion Shelf	Depth	26	660

12.3 Installed Weight and Shipping Weight

The following table specifies the maximum installed weight and shipping weight for a fully equipped DACS II ISX Main Shelf.

Table M — DACS II ISX Main Shelf Weight

Product	Pounds	Kilograms
Main Shelf Installed*	70 lbs	32 kg
Main Shelf Shipping	101 lbs	46 kg

* Installed weight is less external cables.

13. Environmental Specifications

13.1 Temperature and Humidity

DACS II ISX is compliant with Bellcore NEBS GR-63-CORE, Issue 1, October 1995 thermal requirements in accordance with the following tests.

- *Section 5.1.1 Transportation and Storage Test Methods.*
- *Operating Temperature and Relative Humidity.*

DACS II ISX is compliant with the following European Telecommunications Standards for storage, transportation and operation.

- ETS 300 019-1-1, Class 1.1 "Weather Protected, Partly Temperature Controlled Storage Locations"
- ETS 300 019-1-2, Class 2.3 "Public Transportation"
- ETS 300 019-1-3, Class 3.1 "Temperature Controlled Locations".

13.2 Handling, Transportation, and Office Vibration

DACS II ISX suffers no damage or degradation to performance when subjected to the transportation vibration test and drop-distance test specified in the following sections:

- *Section 5.3.1 of TR-NWT-000063* Test 1 - Handling Drop Tests - Packaged Equipments.
- *Section 5.4.1.3 of TR-NWT-000063* Test 3 - Installation Drop Tests - Shipping Packaging Removed. Equipment weighing less than 50 lbs.
- *Section 5.4.1.4 of TR-NWT-000063* Test 4 - Transportation Vibration - Packaged Equipment
- *Section 5.4.2.1 of TR-NWT-000063* Test 1 - High-Temperature Thermal Shock
- *Section 5.4.2.2 of TR-NWT-000063* Test 2 - Low-Temperature Thermal Shock
- *Section 5.4.2.3 of TR-NWT-000063* Test 3 - Cyclic Temperature - High Relative Humidity
- *Section 5.4.2.4 of TR-NWT-000063* Test 4 - Cyclic Temperature - Low Relative Humidity.

13.3 Electrostatic Discharge (ESD)

DACS II ISX suffers no equipment damage and no network service-affecting failures during contact discharge in accordance with TR-NWT-001089, Issue 1, October 1991 Section 2 *System Level Electrostatic Discharge* and IEC 801-2:1991 Severity Level 2, performance criteria B applies.

13.4 Electromagnetic Interference (EMI)

13.4.1 Radiated Field Emission

DACS II ISX is compliant with the limits specified in FCC Part 15B Class A and EN55022 Class A.

13.4.2 Conducted Emmisions

DACS II ISX is compliant with EN55022 Class A. Frequency range 150 kHz to 30 MHz.

13.4.3 Radiated Field Immunity

DACS II ISX is compliant with the tests specified in IEC801-3:1984 with a modified frequency range of 26 MHz to 1000 MHz. The applied carrier wave field strength was 3 V/m with amplitude modulation of 1 kHz at 80% mod depth, performance criteria A applies. In addition, DACS II ISX operates without malfunction when subjected to radiated field emission energy at 1.89 GHz with a field strength of 10 V/m.

13.4.4 Conducted Radio Frequency Immunity

DACS II ISX is compliant with IEC-801-6 in the frequency range 150 kHz to 80 MHz.

13.4.5 Surge Immunity

DACS II ISX is compliant with IEC-801-5, 1990 performance criteria B applies.

13.4.6 Transients Immunity

DACS II ISX is compliant with IEC-801-4, 1988 *Electrical Fast Transient Burst* requirements.

13.4.7 Voltage Dips, Interruptions, and Fluctuations

The equipment can be operated at the extreme values of permissable dc supply voltage without failure. The voltage may be varied if required. The range is specified from –36V to –75V. Failure criteria A applies.

13.5 Fire Resistance and Flammability

All components of DACS II ISX Release 2.0 have an oxygen index of 28% or greater as determined by the American Society for Testing and Materials (ASTM) Standard D2863-77, *Standard Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index)*, and a 94 V-1 or better rating as determined by Underwriters Laboratories (UL) Standard 94, *Test for Flammability of Plastic Materials for Parts in Devices and Appliances*, in the paragraph titled: "Vertical Burning Test for Classifying Material 94 V-0, 94 V-1, or 94 V-2.

13.6 Safety Listing

- UL1459, File E60667
- CSA, File LR 93283-X
- VDE, Registration Number 1634
- IEC (EN60) 950, File E121070.

14. Reliability

14.1 Circuit pack reliability

Table N provides a summary of the steady-state failure and Mean Time Between Failure (MTBF) predictions for the individual DACS II ISX circuit packs. Failures in 10^9 hours (FIT) rates are based on calculations based on Bellcore Technical Reference TR-NWT-000332, "Reliability Prediction Procedures for Electronic Equipment", Issue 4, September 1992.

Table N — Circuit Pack Reliability

Circuit Pack	FITs	Failure Rate (Failures/Hour)	MTBF (Years)
TG-191 (EDDC)	1201	0.000001322	86.35
TG-192 (EDPC)	2170	0.000002268	50.33
KER3 (SXC)	4799	0.000004799	23.79
KER4 (MC)	7403	0.000007403	15.42
424AA (PU) - Memory Card	2446 4000	0.000002446 0.000004	46.67 28.54

14.2 System Reliability

The yearly outage predictions shown in Table O for the DACS II ISX hardware were calculated based on the circuit pack failure rates listed previously in Table N.

Table O — DACS II ISX Outage Estimates

Parameter	DACS II ISX Estimate (Minutes/Year)
Unavailability per 1.544 Mbit/s Port	1.45
Unavailability per 2.048 Mbit/s Port	2.44
Total System Outage (64/128 ports)	0.057
Unavailability for Reconfiguration	7.84
Unavailability for Alarming	7.84

15. Terminology

This section contains a list of acronyms and abbreviations and their definitions.

TERM	DEFINITION
ACK	Acknowledge
ACO	Alarm Cutoff
AIS	Alarm Indication Signal (Also known as all 1s signal)
AMI	Alternate Mark Inversion
AMS	Alternate Message Store
ANSI	American National Standards Institute
B8ZS	Bipolar Eight Zero Substitution

TERM	DEFINITION
BER	Bit Error Rate
BES	Bursty Errored Second
BOS	Bit-Oriented Signaling
BPV	Bipolar Violation
CAS	Channel Associated Signaling
CCS	Common Channel Signaling
CEPT	Conference Europeene des Postes et Telecommunications
CFA	Carrier Failure Alarm
CGA	Carrier Group Alarm
CRC	Cyclic Redundancy Checking
CSA	Canadian Standards Association
CSS	Controlled Slip Seconds
DACS II ISX	Digital Access and Cross-Connect System II - Integral Shelf Cross-Connect
DCE	Data Circuit-terminating Equipment
DCS	Digital Cross-Connect System
DMA	Deferred Maintenance Alarm
DMI-BOS	Digital Multiplexed Interface-Bit Oriented Signaling
DS0	Digital Signal Level 0 (64 kbit/s)
DS1	Digital Signal Level 1 (1.544 Mbit/s)
DSX	Digital Signal Cross-Connect
DTE	Data Terminal Equipment
E1	2.048 Mbit/s Data Rate
EDDC	Enhanced Dual Digroup Circuit
EDPC	Enhanced Dual Primary Circuit
EER	Excessive Error Rate
EMI	Electromagnetic Interference
ENQ	Enquiry
ES	Errored Seconds
ESD	Electrostatic Discharge
ESF	Extended Superframe
ETSI	European Telecommunication Standardization Institute
FAS	Frame Alignment Signal
FBE	Framing Bit Error
FAD	Facility Access Digroup
FDL	Facility Data Link
FRER	Framing Error
HDB3	High Density Bipolar of order 3
IEC	International Electrotechnical Commission

TERM	DEFINITION
ISX	Integral Shelf Cross-Connect
ITU-TSS	International Telecommunication Union-Telecommunication Standardization Sector
LAN	Local Area Network
LBO	Line Build Out
LED	Light-Emitting Diode
LFER	Line Format Error Rate
LFV	Line Format Violation
LFVR	Line Format Violation Rate
LMA	Local Multiframe Alarm
LOF	Loss Of Frame
LOS	Loss of Signal
MBER	Minor Bit Error Rate
MER	Multiframe Alignment Errors
MC	Main Controller
MI	Maintenance Information
MJ	Major
MML	HuMan-Machine Language
MN	Minor
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NEBS	Network Equipment Building System
NFW	Non Frame Word
NPC	Network Processing Circuit
NPCTP	NPC Test Port
NSA	Non-signaling Associated
NZCS	No Zero Code Suppression
OA&M	Operation, Administration and Maintenance
OOF	Out-Of-Frame
OS	Operations System
PBA	Primary Block Alarms
PBF	Primary Block Failure
PCM	Pulse Code Modulation
PDS	Program Documentation Standards (Language)
PMA	Prompt Maintenance Alarm
PU	Power Unit
PVC	Permanent Virtual Circuit
RAI	Remote Alarm Indication
RAIS	Remote AIS

TERM	DEFINITION
RAM	Random Access Memory
RBER	Remote Bit Error Rate
RFA	Remote Frame Alarm
RMA	Remote Multiframe Alarm
RPP	Reliability Prediction Procedures
SES	Severely Errored Seconds
SF	Superframe
SFDT	Signaling Freeze Delay Time
SFI	Synchronization Failure Indication
SVC	Switched Virtual Circuit
SXC	Synchronizer Cross Connect
T1	1.544 Mbit/s Data Rate
T1DM	T1 Data Multiplexer
TAD	Test Access Digroup
TLI	Timing Link Interface
TC	Trunk Conditioning
TP	Test Port
TCON	Two-Way Cross-Connection
TM	Transparent Mode
TS0	Time Slot 0
TS16	Time Slot 16
UAS	Unavailable Seconds
UL	Underwriters Laboratories
US	Unavailable Seconds
VC	Virtual Circuit
VDE	Verband Deutscher Elektrotechniker
ZCS	Zero Code Suppression