Verilink DIU 2130
User Manual

October 1999

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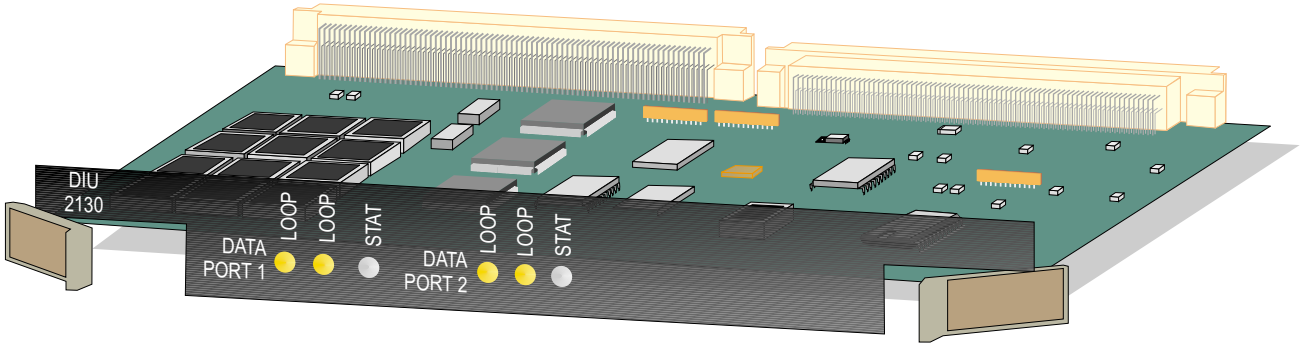

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FCC Requirements

This equipment has been tested and found to comply within the limits for a Class A digital device pursuant to Part 15 of the Federal Communications Commission (FCC) rules. These limits are designed to provide protection against harmful interference in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user manual, can cause harmful interference to radio communications.

There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception—which can be determined by turning the equipment off and on—try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with Part 68 of the FCC Rules. On the rear, side or bottom of the unit is a label that contains the FCC registration number and other information. If requested, provide this information to the telephone company.

- All direct connections to the network lines must be made using standard plugs and jacks (compliant with Part 68). The following tables list the applicable registration jack universal order codes (USOCs), facility interface codes (FICs), and service order codes (SOCs). These are required to order service from the telco.

For T1 interfaces:

Port ID	REN / SOC	FIC	USOC
1.544 Mbit/s SF 1.544 Mbit/s SF, B8ZS 1.544 Mbit/s ANSI ESF 1.544 Mbit/s ANSI ESF, B8ZS	6.0N	04DU9 -BN 04DU9 -DN 04DU9 -1KN 04DU9 -1SN	RJ-48C jack

For DDS interfaces:

Port ID	REN / SOC	FIC	USOC
56 kbit/s 64 kbit/s	6.0N	04DU5 -56 04DU5 - 64	RJ-48S jack

- If the unit appears to be malfunctioning, inform the telco and disconnect it from the network lines until the source of trouble is determined to be your equipment or the telephone line . If your equipment needs repair, it should not be reconnected until it is repaired.
- The unit has been designed to prevent harm to the network. If the telephone company finds that the equipment is exceeding tolerable parameters, it can temporarily disconnect service. In this case, the telephone company will provide you advance notice if possible.

- If the telephone company alters its equipment in a manner that can affect the use of this device, it must give you warning so that you have the opportunity to maintain uninterrupted service. You will be advised of your right to file a complaint with the FCC.
- No customer is authorized to repair this equipment, regardless of warranty status. All repairs must be performed by Verilink or an authorized agent. It is the responsibility of users requiring service to report the need for service to Verilink or to one of our authorized agents.

Lithium Battery

The lithium battery referred to in the following notices is contained inside the clock chip.

English

DANGER!

The battery can explode if incorrectly replaced! Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

DANGER!

To avoid electrical shock in case of failure, the power supply must be installed by a professional installer. The terminal labeled with the ground symbol (⏚) on the power supply must be connected to a permanent earth ground.

CAUTION!

Interconnecting circuits must comply with the requirements of EN60950:1992/A4:1997 Section 6.2 for telecommunications network voltages (TNV) circuits.

Français

ATTENTION!

Une explosion peut se produire si la batterie est remplacée d' une façon incorrecte! Remplacez-la seulement avec le même modêle de batterie ou un modèle équivalent selon les recommendations de manufacture. Disposez de les batteries usées selon les instructions de manufacture.

ATTENTION!

Pour éviter choc électrique en cas de insuccès, la provision de pouvoir doit êtré installé par un installeur professionnel. Le terminal de la provision de pouvoir, marqué du symbol de terre, (⏚) doit connecté à un circuit de terre permanent.

PRUDENT!

Les circuits doivent êtré interconnectés de manière à ce que l' équipement continue a êtré en agrément avec "EN60950:1992/A4:1997, Section 6.2, pour les circuits de voltage de liaisons d' échanges (réseau) par les télécommunications (TNV)," après les connections de circuits.

Española

ATTENCION!

La bateria puede explotar si se reemplaza incorrectamente. Reemplace la bateria con el mismo tipo de bateria ó una equivalente recomendada por el manufacturero. Disponga de las baterias de acuerdo con las instrucciones del manufacturero.

ATTENCION!

Para evitar contacto con circuitos que electrocutan, la fuente de alimentación debe ser instalada por un técnico profesional. La terminal de la fuente de alimentación marcada con el símbolo de tierra (⏚) debe ser conectada a un circuito de vuelta por tierra permanente.

PELIGRO!

Circuitos que se interconectan a la red de telecomunicaciones deben hacerse de tal manera que cumplan con los requisitos estipulados en las especificaciones "EN60950:1992/A4:1997, Sección 6.2, para los voltages de circuitos interconnectados a la Red de Telecomunicaciones (TNV)," despues de terminar las connecciones entre los circuitos.

Deutsch

VORSICHT!

Explosionsgefahr bei unsachgemäßem Ersetzen der Batterie! Batterie gleichen Typs und gleicher Qualität benutzen, wie vom Hersteller empfohlen. Entsorgung der Batterie nach Anweisung des Herstellers!

VORSICHT, GEFAHR!

Um keinen Schlag zu erhalten beim Versagen der electrischen Anlage, muss der Stromanschluss von einem Elektriker vorgenommen werden. Der elektrische Pol, versehen mit dem Erdsymbol (⏚) muss am Stromanschluss permanent geerdet sein.

VORSICHT!

Schaltungen, die in den Geräten zusammengeschaltet sind, müssen weiterhin den Vorschriften EN60950:1992/A4:1997, Absatz 6.2 für Telecommunications Netz Spannung (TNV) Schaltkreize entsprechen.

Canadian Requirements

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques (de la class A) prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

The Industry Canada label indentifies CS-03 certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. Industry Canada does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

Safety Precautions

This equipment is intended to be installed only in a Restricted Access Location that meets the following criteria:

- Access can only be gained by service personnel or users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that must be taken.
- Access can only be gained through the use of a lock and key or other means of security, and is controlled by the authority responsible for the location.

When handling this equipment, follow these basic safety precautions to reduce the risk of electric shock and injury:

- Follow all warnings and instructions marked on the product and in the manual.
- Unplug the hardware from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a cloth slightly dampened with water.
- Do not place this product on an unstable cart, stand, or table. It may fall, causing serious damage to the product.
- Slots and openings in the shelves are provided for ventilation to protect them from overheating. These openings must not be blocked or covered. Never place this product near a radiator or heat register.

- This product should be operated only from the type of power source indicated on the marking label and manual. If you are unsure of the type of power supply you are using, consult your dealer or local power company.
- Do not allow anything to rest on the power cord. Do not locate this product where the cord will interfere with the free movement of people.
- Do not overload wall outlets and extension cords, as this can result in fire or electric shock.
- Never push objects of any kind into the shelves. They may touch dangerous voltage points or short out parts that could result in fire or electric shock. Never spill liquid of any kind on this equipment.
- Unplug the equipment from the wall outlet and refer servicing to qualified service personnel under the following conditions:
    - When the power supply cord or plug is damaged or frayed.
    - If liquid has been spilled into the product.
    - If the product has been exposed to rain or water.
    - If the product has been dropped or if the cabinet has been damaged.

Product Warranty

Verilink's product warranty covers repair or replacement of all equipment under normal use for a five-year period from date of shipment. Replacement products may be new or reconditioned. Any replaced or repaired product or part has a ninety (90) day warranty or the remainder of the initial warranty period, whichever is longer. Our in-house Repair Center services returns within ten working days.

Customer Service

Verilink offers the following services:

- System Engineers at regional sales offices for network design and planning assistance (800) 837-4546
- Technical Assistance Center for free 24x7 telephone support during installation, maintenance, and troubleshooting (800) 285-2755 and support@verilink.com)
- To return a product, it must be assigned a Return Materials Authorization (RMA) number before sending it to Verilink for repair (800) 926-0085, ext. 2282
- Maintenance contracts and leasing plans (800) 837-4546
- Technical Training on network concepts and Verilink products (800) 282-2755 and training@verilink.com
- Web site (www.verilink.com)

Publications Staff

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DIU 2130

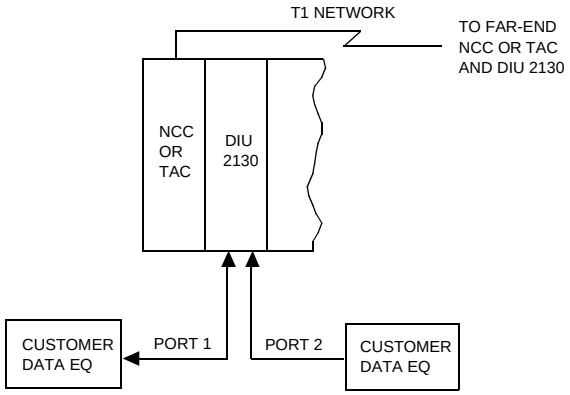
Chapter 1

DIU 2130 Overview

This manual describes the operations and functions of the DIU 2130 Data Service Unit and its associated rear connector modules (Data Interface Modules—DIMs) of the AS2000 system.

The DIU 2130 provides way to transmit high-speed data over the network. It interfaces with two data ports operating at rates of 56 kbit/s, 64 kbit/s, or any multiple of either rate up to 1.344 or 1.536 Mbit/s. The DIU places these signals on the user-assigned DS0 channel time slots of the DS1 signal. It then sends the channelized data to a CSU (NCC, SCC, TAC, or—with an NCM—a DIDCSU), where the data is multiplexed onto the T1 line for network transmission. In the opposite direction of transmission, the DIU 2130 receives the incoming network signal from the CSU and passes the data to the Data Terminating Equipment.

Figure 1-1 Typical DIU 2130 Application



Up to twelve DIUs and one NCC 2020, SCC 2020, or TAC 2010 provide carrier network access and T1 transmission for high-speed data applications. If using the DIU 2130 DBU option at one timeslot per Port 1, then it is possible to get up to 24 DIUs per CSU module. The DIU interfaces with the associated CSU through a data bus on the shelf backplane.

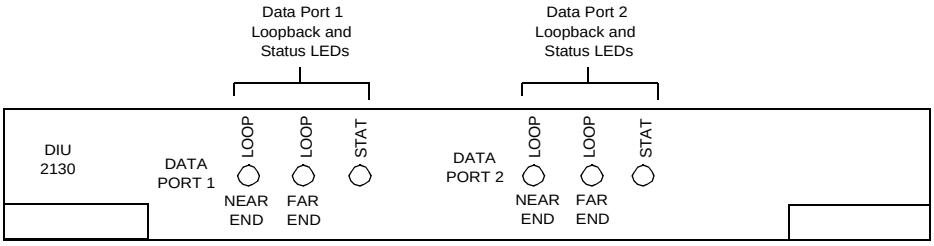
DIU 2130 T1 Dial Backup (DBU) Option

DIU 2130 56K Network Management System (NMS) Option (DDS)

DIU 2130 Front Module

The DIU 2130 front panel (Figure 1-2) has three LEDs for each customer data port.

Figure 1-2 DIU 2130 Front Panel



Data Interface Modules

One of four Data Interface Modules (DIM)—or rear connector modules—connects the DIU 2130 to the customer data equipment cables. Each DIM plugs into the rear of a multiline or dual-line shelf and mates with the associated DIU 2130.

DIM 2035

The Data Interface Module (DIM) 2035 provides:

- Dual (2) V.35 connectors (34-pin Winchester type) for connecting either Data Terminal Equipment (DTE) or Data Control Equipment (DCE)

Figure 1-3 DIM 2035, V.35

DIM 2449

The Data Interface Module (DIM) 2449 provides:

- Dual (2) RS-449/422 connectors (DB-37) for connecting either DTE or DCE

Figure 1-4 DIM 2449, RS-449/RS-422

DIM 2435

The Data Interface Module (DIM) 2435 provides:

- One (1) V.35 connector (34-pin Winchester type) for connecting either DTE or DCE to the DIU 2130
- One (1) RS-449/422 connector (DB-37) for connecting either DTE or DCE

Figure 1-5 DIM 2435, V.35/RS-449

DIM 2530

The Data Interface Module (DIM) 2530 provides:

- Dual (2) EIA 530 connectors (DB-25) for connecting either DTE or DCE

Figure 1-6 DIM 2530, EIA 530

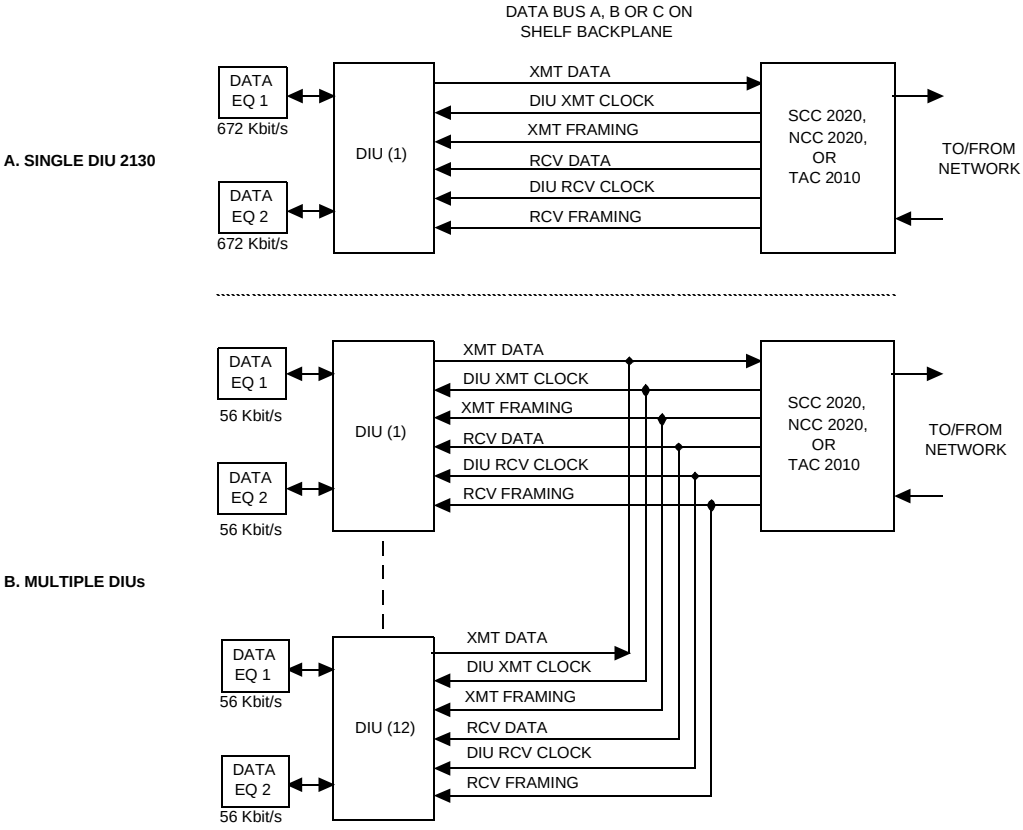
NOTE: *When connecting DCE to a DIU 2130, a cross-over cable must be used.*

CSU Interfaces

T1 Mux (CSU/DSU) Mode

In a typical single-DIU configuration (Fig 1-4, A), each data port operates at 672 kbit/s and therefore requires 12 channel time slots on the T1 network (672 kbit/s = 12 channels × 56 kbit/s each) for the proper transmission bandwidth. The sum total of the bandwidths of the two data equipment ports cannot exceed 24 channels (1.344 Mbit/s) in this example.

Figure 1-7 Typical DIU 2130 Configurations



For a typical CSU/DSU configuration with multiple DIUs, up to 12 DIU 2130s can be connected to an NCC, SCC, or TAC to accommodate up to 24 data ports (Section B of Figure 1-7). In this example, each port operates at 56 kbit/s and requires one DS0 channel on the T1 network.

Drop-and-Insert Mode

The DIU 2130 can also be used with an NCC, SCC, or TAC in drop-and-insert mode. This mode permits a combination of analog (VF) and high-speed data to be transmitted over a single T1 circuit on the network. Drop and insert is transparent to the DIU hardware and depends on the configuration of the CSU. Drop and insert can be provided toward either the DS1 equipment or the network.

DIU Data Buses

Three separate data buses (A, B, and C) convey data between the DIUs and the associated NCCs, SCCs, or TACs. These buses are located on the system shelf backplane, and can be extended from shelf to shelf through data-bus extension cables. In T1 multiplexer (CSU/DSU) mode, one data bus is assigned to each CSU-DIU array. In drop-and-insert, data bus “A” is typically assigned to each DIU-CSU array. A second bus is also needed if the DIUs and CSU are timed from an external clock source, or if they are timed from the data equipment connected to a DIU data port.

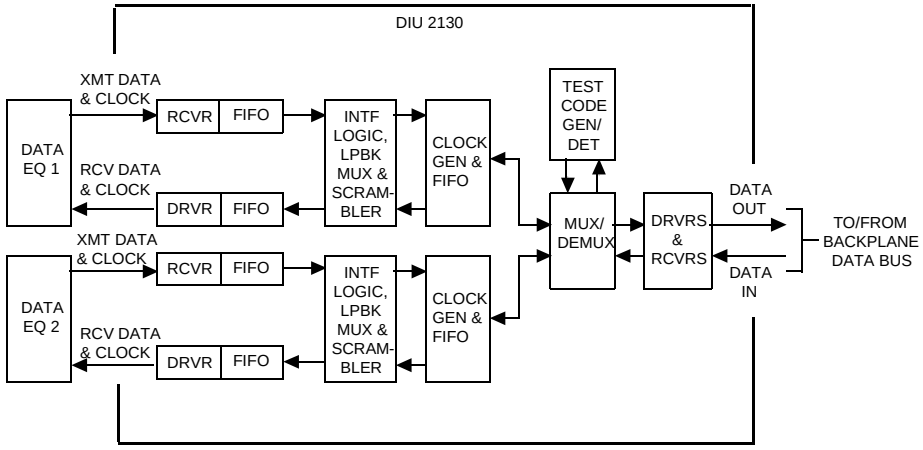
Figure 1-7 shows the signals conveyed between the DIUs and associated CSU on the assigned data bus. In the transmit direction toward the network, the data bus sends the output data from each DIU to the CSU of the NCC or TAC. It also sends clocking and framing information from the CSU to the DIUs. The transmit clock synchronizes the DIU transmit side circuits to the CSU.

In the incoming direction from the network, the data bus sends the data from the CSU to the DIU. It also furnishes receive clocking and framing information to the DIU for synchronization of the DIU's receiver to the CSU.

Transmit Side Functions

The DIU transmit data port accepts the data from the customer equipment for the designated DS0 channels. The data from both ports is multiplexed and sent to the associated CSU through the assigned data bus.

Figure 1-8 DIU 2130 Block Diagram



Data Receiver

The data receiver converts the V.35, RS-449, or EIA 530 data and control signals to a format suitable for internal DIU processing.

The data signals are in a balanced differential format. The control and timing signals are either balanced or unbalanced, depending on the interface used.

Serial FIFO Buffer

Each DIU input/output (I/O) port is equipped with a 256 × 1 bit first-in, first-out (FIFO) buffer at the data interface. The FIFO provides elastic buffering between the data equipment and the DIU to accommodate short-term timing differences between them without loss of data.

Interface Logic and Loopback Multiplexer

When handshaking is enabled on the DIU, the interface logic processes the handshaking control signals between the data port and the DIU. The loopback multiplexer provides a signal loopback on a selected data channel when commanded by the controller.

Pulse Stuffing

If the data port is configured for 56 kbit/s or a multiple of this rate, the DIU sends the data in the first seven bits of every 8-bit block and transmits a one as the eighth bit. This allows a network configured with AMI coding to meet minimum density requirements during normal operation.

If the data port is configured for 64 kbit/s clear-channel transmission, the data is sent in 8-bit blocks without pulse stuffing on a network configured for B8ZS coding.

Data Scrambler

The scrambler feature in the DIU 2130 is not a security feature, but rather it uses an algorithm (xOR*55h) to maximize the ones density in the data stream.

Data Bus Interface Multiplexer and Driver

The backplane data-bus interface multiplexer combines the channelized data from the two data ports into a composite data signal. It places the data on the operator-assigned shelf data-bus for T1 network transmission over the assigned channel time slots. The backplane interface driver converts the outgoing data to the RS-422 signal levels required by the assigned data bus.

Test Signal Generator

When activated, the test code generator substitutes a four-bit pseudorandom bit sequence (PRBS) signal with a pattern of varying ones and zeros for the normal data on the selected channel. This signal is used for end-to-end circuit bit error testing.

Receive Side Functions

The receive side extracts the incoming data from the associated CSU, demultiplexes the data, and sends it to the connecting customer data equipment.

Data Bus Interface Receiver and Demultiplexer

The backplane data bus interface receiver converts the incoming data and clock signals to the format required for data demultiplexing. The demultiplexer reads the framing data from the incoming DS1 signal and derives the channelized data signals for the customer equipment ports.

Interface Logic and Loopback Multiplexer

The interface logic and loopback multiplexers operate as previously described for the transmit side of the DIU. The clock and data outputs of the interface logic are applied to the interface driver in TTL format.

Descrambler

The DIU's receive-side logic multiplexer contains a descrambler. If the DS0 customer data is scrambled at the transmitting end, the descrambler restores the original data before sending it to the data equipment.

Table 1-1 Scramble Option Status

Point "A"	Point "B"	Validity
Off	Off	Valid
On	Off	Invalid
Off	On	Invalid
On	On	Valid

Serial FIFO Buffer

The receive-side FIFO buffer has the same function as the FIFO buffer on the transmit side.

Data Driver

The data driver converts the outgoing data and clock signals to the interface format required by each data port. Depending on the customer data equipment connected to the DIU, the following may be used:

- V.35
- RS-449
- EIA 530

Specifications

Electrical, environmental, and mechanical specifications of the DIU 2130 and associated DIMs are given below.

Table 1-2 DIU 2130 and DIM Specifications

Data Equipment Interface	• **I/O Ports:** Two synchronous $n \times 56$ kbit/s or $n \times 64$ kbit/s, where n is an integer from 1 to 24 (If using both ports, neither may be 24). • **Interfaces:** ITU-T V.35, RS-449, or EIA 530; DCE to DTE or DCE to DCE • **V.35 Signal Levels:** 0.55V ±20% (balanced signals) or +5V to +15V (unbalanced) • **RS449 Signal Levels:** 2V to 6V (balanced) per RS422; or 4V to 6V (unbalanced) per RS423 • **EIA 530 Signal Levels:** Same as RS449 • **Channelization:** D4, in accordance with AT&T TR-62411 • **Clock Signal:** Steady clock at fractional T1 rate ± 32 ppm, 40% to 60% duty cycle • **Clock Jitter:** ± 38 nanoseconds, maximum • **Loopbacks:** Local and far end on each data channel • **Backup Battery Life:** Battery has power for three months without external power.
Power Requirements	• **Current Drain:** 0.5A (nominal) at +5 V_{dc} • **Power Dissipation:** 2.5W (8.4 BTU), nominal
Environmental	• **Operating Temperature:** 32^{o} F (0^{o} C) to 122^{o} F (50^{o} C) • **Humidity:** 95%, non-condensing
Dimensions	• **Height:** 8.05 in. (20.45 cm) • **Depth:** 8.04 in. (20.42 cm) • **Width:** 0.96 in. (2.44 cm)

Table 1-3 Data Interface Modules (DIMs):

Rear Connector Module	Dimensions
DIM 2035	8.44 in (21.4 cm) high × 2.93 in (7.44 cm) deep × 0.96 in (2.5 cm) wide
DIM 2449	8.44 in (21.4 cm) high × 2.75 in (7.0 cm) deep × 0.96 in (2.5 cm) wide
DIM 2530	8.44 in (21.4 cm) high × 2.75 in (7 cm) deep × 0.96 in (2.5 cm) wide
DIM 2435	8.44 in (21.4 cm) high × 2.93 in (7.4 cm) deep × 0.96 in (2.5 cm) wide

Chapter 2

DIU 2130 Quick Set-up

Before installing each DIU 2130 and associated DIM, the shelves, power, controller cards (NCC, SCC, or NCM), and CSUs (NCC, SCC, DIDCSU, or TAC 2010s) must be installed.

The Access System 2000 allows installation of a DIU 2130 and DIM in any shelf/slot, except Slot 1 in Shelf 1 of each node—this slot is reserved for the node controller.

The DIU 2130 is always a DCE device. The external customer data equipment can be either DCE or DTE.

Installation

Do the following before installing the DIU:

- Install all associated Access System 2000 shelves and power supplies, as outlined in the *AS2000: The Basics* manual.
- Install and test the CSUs. Be sure all CSUs are configured properly for operation with the DIUs.

The following CSU configuration options must be set before use with DIUs:

- DIU Data Bus Assignment
- DIU Timing Mode

Configure the DIU module before connecting its DIM to the customer data equipment.

Cables

The cables required for DIU connection to the customer data equipment depend on the type of interface selected (RS-449, V.35 or EIA 530) and the data equipment configuration, which can be either DTE (data terminal equipment) or DCE (data communication equipment). The DIU 2130 is always in a DCE configuration.

Configuring the DIU 2130

For this example, an SCC 2020 is used with a DIU 2130 module in the right side (slot 2) of a Dual-Line Shelf. The SCC 2020 connects directly to the T1 circuit and provides CSU functionality. The DIU 2130 presents two synchronous serial interfaces for connecting the Data Terminal Equipment (DTE) and provides DSU functions.

Before any module may be configured, it must first be selected. When you first logged in, the default was that the controller module (in this case, the SCC) was selected. To configure the DIU 2130, first select it using the Shelf/Slot command, **S**, from the controller module's **Main Menu** (Figure 2-1).

Figure 2-1 SCC 2020 Main Menu

```
   -- VERILINK SCC NODE CONTROLLER at[1,1]: FW Rev 2.06, Jan 15, 1998. --
FLASH BANK: B    Serial Number: 00435509
Ethernet Address: A0:6A:00:06:A5:35:
Slip Local IP Address: 192.94.46.222, Subnet Mask: 255.255.255.0
Ethernet Local IP Address: 192.94.45.242, Subnet Mask: 255.255.255.0

SITE NAME: Tech Pubs SCC 2020    NODE ID: 12
                                 <- SLOT ->
 SHELF    1    2    3    4    5    6    7    8    9   10   11   12   13
 1 DL    [C]   D
 2
 3
 4
 KEY: C = CSU, D = DIU, F = DIU/DDS, R = SRD, I = IDCSU, T = TU, A = APS,
      B = DIU/DBU, S = SMDS, L = HLM


S) shelf/slot                    D) diagnostics
N) near element                  O) node administration
F) far element                   M) monitor alarms (OFF)
C) configuration                 A) view alarm buffer
P) performance                   X) log off

[1,1] NEAR TAC 2010 >
```

The **S) shelf/slot** command is used to navigate from one module to another. Type S and press ENTER. The prompt for selecting another module displays:

Enter shelf,slot >

For this example the node has only one shelf (shelf #1) and the DIU 2130 is in slot two of that shelf. Enter 1,2 and press ENTER.

The prompt line returns as:

[1,2] DIU 2130 (UPDATE) >

This indicates that the DIU 2130 has been selected. Type C and press ENTER to select the DIU 2130 configuration menu.

NOTE: *Whenever the word UPDATE appears in the command line prompt, it indicates that some information has changed since the screen was last refreshed. To refresh the screen with current information, press* **ENTER** *by itself.*

Configuration Menu

There is a brief delay as the SCC module tries to communicate with a CSU module in Shelf 0, Slot 0 since this is the default value for CSU assignment in a new DIU 2130 module. An address of Shelf 0, Slot 0 is not a valid address. Modules are shipped this way, however, so that they may be added to a shelf without interfering with any existing applications. An error message displays:

No response from csu[0,0]

The error message, in this case, means that the DIU 2130 is new and has never been assigned to any CSU module in any slot of any shelf. Ignore this error message.

Then the DIU 2130 **Configuration/Diagnostic** Menu displays.

Figure 2-2 DIU 2130 Configuration Menu

```
       --- DIU 2130  CONFIGURATION/DIAGNOSTIC MENU ---

C) CSU              [ 0,0 ]
T) timing source    CSU

   chnl 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Dp)port .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. ..

   Lead Toggles     DTR)   DSR)   RTS)   CTS)   DCD)
   Forced Ports     -/-    -/-    -/-    -/-    -/-

                    Port 1     Port 2        Statistics
Mp) mode            56K        56K           FW/HW Rev.............1.6/0.8
Sp) scram/hdlc inv  N/N        N/N           Battery...............OK
Kp) clocking        ST         ST            DTE Intf..............V.35/V.35
Gp) LOS lead        NONE       NONE          Data bus..............NONE

Ep) enable loop     YES        YES           Tp) test and monitor BEC
Np) near loopback   OFF        OFF           Pp) monitor leads and status
Fp) far loopback    ON         OFF           A)  Alarm Enable......YES

[1,2] DIU 2130 >
```

The CSU command assigns the DIU 2130 module to the CSU it will use. Since the SCC 2020 contains a TAC 2010 CSU module, it will be used for the CSU in this example.

Type C and press ENTER.

At the **enter shelf >** prompt type 1 and at the **enter slot >** prompt type 1 again.

This selects the SCC 2020 in slot 1 of shelf 1 as the CSU for this DIU 2130 module.

The Timing Source defaults to CSU, meaning that the DIU 2130 will derive its transmit clock from the source selected in the CSU configuration (recovered network clock in this example). This is correct for this example.

The DS0 (timeslot) selection prompt appears as an uppercase **D** with a lowercase **p**. The lowercase **p** is a variable. Instead of typing "**p**", use a port number, 1 or 2. For this example, timeslots 1 through 12 are to be used on Data Port 1 and timeslots 13 through 24 are to be assigned to Data Port 2.

Type D1 and press ENTER.

At the prompt **enter port 1 channels >** type 1-12 and press ENTER.

This assigns timeslots 1 through 12 to Data Port 1.

Now type D2 and press ENTER.

At the prompt **enter port 2 channels >** type 13-24 and press ENTER.

This assigns timeslots 13 through 24 to Data Port 2.

Press ENTER again to refresh the display with the timeslot (DS0) assignments.

Figure 2-3 DIU 2130 Configuration Menu

```
       --- DIU 2130  CONFIGURATION/DIAGNOSTIC MENU ---

C) CSU              [ 1,1 ]
T) timing source    CSU

   chnl 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Dp)port 01 01 01 01 01 01 01 01 01 01 01 01 02 02 02 02 02 02 02 02 02 02 02 02

   Lead Toggles     DTR)   DSR)   RTS)   CTS)   DCD)
   Forced Ports     -/-    -/-    -/-    -/-    -/-

                    Port 1     Port 2        Statistics
Mp) mode            56K        56K           FW/HW Rev.............1.6/0.8
Sp) scram/hdlc inv  N/N        N/N           Battery...............OK
Kp) clocking        ST         ST            DTE Intf..............V.35/V.35
Gp) LOS lead        NONE       NONE          Data bus..............A

Ep) enable loop     YES        YES           Tp) test and monitor BEC
Np) near loopback   OFF        OFF           Pp) monitor leads and status
Fp) far loopback    ON         OFF           A)  Alarm Enable......YES

[1,2] DIU 2130 >
```

Lead toggles are used to determine whether the control leads on the synchronous serial interface will function in the normal way or be forced on. When the DTE does not assert control leads they can

be forced on by typing the three letter abbreviation of the control lead. For this example, the DTE supports normal control lead operation and the default values are appropriate.

Mode is used to determine the data rate of each of the timeslots assigned to the port. For an AMI T1 circuit the mode must be 56K. For the B8ZS T1 used in this example, 64K provides greater throughput. Use the M1 and M2 commands (replacing the "**p**" with the appropriate port number) to set both data ports to 64K per DS0.

The remaining options are correct for this example. The T1 circuit and DTE should now be connected.

Once the CSU has been connected to the T1 circuit for at least fifteen minutes, meaningful performance statistics will be available under the controller module's **Performance Monitoring** Menu. See the appropriate controller module user manual for more information.

Within 15 seconds of connecting the T1 circuit, the NET LED on the front of the controller module should change from red to green. If it does not, the Diagnostics Menu of the controller module may be used for troubleshooting.

Chapter 3 DIU 2130 Configuration

Before configuring a DIU 2130, verify that:

- A data bus has been assigned to the CSU of the associated NCC, SCC, or TAC. This bus conveys customer data between the DIUs and the CSU during normal operation.
- The proper DIU timing mode has also been selected on the associated CSU.

Configuration Options and Default Settings

Table 1-1 provides the DIU 2130 configuration options and factory default settings. These settings allow the DIU to interface properly with the customer equipment and the associated CSU for T1 network transmission. The DIU 2130 is shipped with the default settings listed in the table.

Table 3-1 DIU 2130 Configuration Options and Default Setting

Description	Options	Default Setting
Data port speed	56 kbit/s to 1.536 Mbit/s in multiples of 56 or 64 kbit/s	--
Data mode = 64 kbit/s	Yes or No	No (56 kbit/s)
CA, RTS, or RS control lead	Yes = forced on, No = follow DTE input	No
CD, DTR, or TR control lead	Yes = forced on, No = follow DTE input	No
CB, CTS, or CS control lead	Yes = always on, No = follow CA, RTS, or RS; turned off during alarm	No
CC, DSR, or DM control lead	Yes = always on, No = follow CD, DTR, or TR; turned off during alarm	No
CF, RR, or RLSD control lead	Yes = always on, No = follow CD, DTR, or TR; turned off during alarm	No
Data channel loopback enable	Yes or No	No
Timing Unit enable	Yes or No	No
Data equipment clock	TT, ST, or inverted ST ($\overline{ST}$)	TT or ST

Description	Options	Default Setting
Data scrambler	Yes or No	No (disabled)
DS0 channel assignments	User defined	None
CSU shelf and slot number	User defined	0,0

Handshake Control Leads

Each DIU 2130 data port also supports handshaking operation. Table 3-2 lists the handshaking signal options available on the DIU for each data port.

Table 3-2 Handshaking Control Signal Options

Handshake Signals					Data Port Handshake Options	
V.35	RS-449	EIA 530	Signal Description	Signal Direction	Turned On (Set to YES)	Turned Off (Set to NO)
RTS	RS	RTS (CA)	Request to Send	To DIU	Forced On	Factory Default (normal mode of operation) follows input
CTS	CS	CTS (CB)	Clear to Send	From DIU	Forced On	Factory Default (follows conditioned RTS. See Note 1)
DTR	TR	DTR (CD)	Data Terminal Ready	To DIU	Forced On	Factory Default (normal mode of operation) follows input
DSR	DM	DSR (CC)	Data Set Ready	From DIU	Forced On	Factory Default (follows conditioned DTR. See Note 2)
RLSD	RR	DCD (CF)	Data Carrier Detect	From DIU	Forced On	Factory Default (normal mode of operation. See Note 3)

Note 1: If the CSU goes into an LOF or receives a yellow (RAI) alarm, CTS is turned off if this handshaking option is not forced on.

Note 2 If the CSU goes into an LOF or receives a yellow (RAI) alarm, DSR is turned off if this handshaking option is not forced on.

Note 3 If the CSU goes into an LOF alarm condition, DCD is turned off if this handshaking option is not forced on.

Verilink DIU 2130 Configuration/Diagnostics

The letter **D** is used on the Shelf/Slot map of the Top or **Main Menu** of the controller module to represent a DIU 2130 DSU. The DIU 2130 must be used in conjunction with a CSU module—NCC 2020, SCC 2020, TAC 2010; or, with an NCM 2000 a DIDCSU. Each DIU 2130 supports one or two data ports. By selecting from various rear interface cards, different synchronous serial interfaces may be supported. Up to 24 DIU 2130 modules may be associated with a single CSU, allowing the custom design of a data channel bank.

Configuring the DIU 2130

For this example, an SCC 2020 is used with a DIU 2130 module in the right side (slot 2) of a Dual-Line Shelf. The SCC 2020 connects directly to the T1 circuit and provides CSU functionality. The DIU 2130 presents two synchronous serial interfaces for connecting the Data Terminal Equipment (DTE) and provides DSU functions.

Before any module may be configured, it must first be selected. When you first logged in, the default was that the controller module (in this case, the SCC) was selected. To configure the DIU 2130, first select it using the Shelf/Slot command, **S**, from the controller module's **Main Menu** (Figure 3-1).

Figure 3-1 SCC 2020 Main Menu

```
   -- VERILINK SCC NODE CONTROLLER at[1,1]: FW Rev 2.06, Jan 15, 1998. --
FLASH BANK: B    Serial Number: 00435509
Ethernet Address: A0:6A:00:06:A5:35:
Slip Local IP Address: 192.94.46.222, Subnet Mask: 255.255.255.0
Ethernet Local IP Address: 192.94.45.242, Subnet Mask: 255.255.255.0

SITE NAME: Tech Pubs SCC 2020    NODE ID: 12
                                 <- SLOT ->
 SHELF    1    2    3    4    5    6    7    8    9   10   11   12   13
 1 DL    [C]   D
 2
 3
 4
 KEY: C = CSU, D = DIU, F = DIU/DDS, R = SRD, I = IDCSU, T = TU, A = APS,
      B = DIU/DBU, S = SMDS, L = HLM


S) shelf/slot                      D) diagnostics
N) near element                    O) node administration
F) far element                     M) monitor alarms (OFF)
C) configuration                   A) view alarm buffer
P) performance                     X) log off

[1,1] NEAR TAC 2010 >
```

The **S) shelf/slot** command is used to navigate from one module to another. Type S and press ENTER. The prompt for selecting another module displays:

Enter shelf,slot >

For this example the node has only one shelf (shelf #1) and the DIU 2130 is in slot two of that shelf. Enter 1,2 and press ENTER.

The prompt line returns as:

[1,2] DIU 2130 (UPDATE) >

This indicates that the DIU 2130 has been selected. Type C and press ENTER to select the DIU 2130 configuration menu.

NOTE: *Whenever the word UPDATE appears in the command line prompt, it indicates that some information has changed since the screen was last refreshed. To refresh the screen with current information, press* **ENTER** *by itself.*

Configuration Menu

There is a brief delay as the SCC module tries to communicate with a CSU module in Shelf 0, Slot 0 since this is the default value for CSU assignment in a new DIU 2130 module. An address of Shelf 0, Slot 0 is not a valid address. Modules are shipped this way, however, so that they may be added to a shelf without interfering with any existing applications. An error message displays:

No response from csu[0,0]

The error message, in this case, means that the DIU 2130 is new and has never been assigned to any CSU module in any slot of any shelf. Ignore this error message.

Then the DIU 2130 **Configuration/Diagnostic** Menu displays.

Figure 3-2 DIU 2130 Configuration Menu

```
       --- DIU 2130  CONFIGURATION/DIAGNOSTIC MENU ---

C) CSU              [ 0,0 ]
T) timing source    CSU

   chnl 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Dp)port .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. ..

   Lead Toggles     DTR)   DSR)   RTS)   CTS)   DCD)
   Forced Ports     -/-    -/-    -/-    -/-    -/-

                    Port 1     Port 2        Statistics
Mp) mode            56K        56K           FW/HW Rev.............1.6/0.8
Sp) scram/hdlc inv  N/N        N/N           Battery...............OK
Kp) clocking        ST         ST            DTE Intf..............V.35/V.35
Gp) LOS lead        NONE       NONE          Data bus..............NONE

Ep) enable loop     YES        YES           Tp) test and monitor BEC
Np) near loopback   OFF        OFF           Pp) monitor leads and status
Fp) far loopback    ON         OFF           A)  Alarm Enable......YES

[1,2] DIU 2130 >
```

The CSU command assigns the DIU 2130 module to the CSU it will use. Since the SCC 2020 contains a TAC 2010 CSU module, it will be used for the CSU in this example.

Type **C** and press ENTER.

At the **enter shelf >** prompt type 1 and at the **enter slot >** prompt type 1 again.

This selects the SCC 2020 in slot 1 of shelf 1 as the CSU for this DIU 2130 module.

The Timing Source defaults to CSU, meaning that the DIU 2130 will derive its transmit clock from the source selected in the CSU configuration (recovered network clock in this example). This is correct for this example.

The DS0 (timeslot) selection prompt appears as an uppercase **D** with a lowercase **p**. The lowercase **p** is a variable. Instead of typing "**p**", use a port number, 1 or 2. For this example, timeslots 1 through 12 are to be used on Data Port 1 and timeslots 13 through 24 are to be assigned to Data Port 2.

Type D1 and press ENTER.

At the prompt **enter port 1 channels >** type 1-12 and press ENTER.

This assigns timeslots 1 through 12 to Data Port 1.

Now type D2 and press ENTER.

At the prompt **enter port 2 channels >** type 13-24 and press ENTER.

This assigns timeslots 13 through 24 to Data Port 2.

Press ENTER again to refresh the display with the timeslot (DS0) assignments.

Figure 3-3 DIU 2130 Configuration Menu

```
       --- DIU 2130  CONFIGURATION/DIAGNOSTIC MENU ---

C) CSU              [ 1,1 ]
T) timing source    CSU

   chnl 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Dp)port 01 01 01 01 01 01 01 01 01 01 01 01 02 02 02 02 02 02 02 02 02 02 02 02

   Lead Toggles     DTR)   DSR)   RTS)   CTS)   DCD)
   Forced Ports     -/-    -/-    -/-    -/-    -/-

                    Port 1     Port 2        Statistics
Mp) mode            56K        56K           FW/HW Rev.............1.6/0.8
Sp) scram/hdlc inv  N/N        N/N           Battery...............OK
Kp) clocking        ST         ST            DTE Intf..............V.35/V.35
Gp) LOS lead        NONE       NONE          Data bus..............A

Ep) enable loop     YES        YES           Tp) test and monitor BEC
Np) near loopback   OFF        OFF           Pp) monitor leads and status
Fp) far loopback    ON         OFF           A)  Alarm Enable......YES

[1,2] DIU 2130 >
```

Lead toggles are used to determine whether the control leads on the synchronous serial interface will function in the normal way or be forced on. When the DTE does not assert control leads they can be forced on by typing the three letter abbreviation of the control lead. For this example, the DTE supports normal control lead operation and the default values are appropriate.

Mode is used to determine the data rate of each of the timeslots assigned to the port. For an AMI T1 circuit the mode must be 56K. For the B8ZS T1 used in this example, 64K provides greater throughput. Use the M1 and M2 commands (replacing the "**p**" with the appropriate port number) to set both data ports to 64K per DS0.

The remaining options are correct for this example. The T1 circuit and DTE should now be connected.

Once the CSU has been connected to the T1 circuit for at least fifteen minutes, meaningful performance statistics will be available under the controller module's **Performance Monitoring** Menu. See the appropriate controller module user manual for more information.

Within 15 seconds of connecting the T1 circuit, the NET LED on the front of the controller module should change from red to green. If it does not, the Diagnostics Menu of the controller module may be used for troubleshooting.

Configuration Menu Details

The lowercase **p** shown in some prompts is a variable representing the port number. Use the number 1 or the number 2 in place of the **p**, depending on which port you want to configure.

Table 3-3 Configuration Menu Commands

Command	Options
Save Configuration	If a DIU 2130 is controlled through an NCC, the **Save Configuration** option saves the DIU configuration to battery-protected NVRAM in the NCC module. If the DIU 2130 is controlled by an SCC, the Save Configuration option will return an error message. This function is not supported by the SCC.
Restore Config	If a DIU 2130 is controlled through an NCC, the **Restore Configuration** restores the original DIU configuration from the battery-protected NVRAM in the NCC. This works only if the configuration of the DIU has been previously saved to the NCC. If the DIU 2130 is controlled by an SCC, the Restore CSU Configuration option will return an error message. This function is not supported by the SCC.
CSU	The **C** command is used to assign the DIU 2130 to the CSU from which and to which it will be transferring user data. The selected CSU is then displayed inside brackets. The DIU 2130 will poll the CSU to get information such as which of the data busses in the shelf is to be used (A, B or C). During DIU 2130 installation, assign the CSU first. New DIU 2130s are shipped with a value of 0,0 for this option. Since there is no slot 0, shelf 0, this has the effect of insuring that the DIU 2130 may be added to a shelf with operating circuits and not bring down any existing applications. If you fail to change the CSU assignment from 0,0 to the desired value, the DCD lead to the DTE will remain in “low” (inactive) state and the card will appear to be defective.
Timing Source	The **T** command on the **DIU 2130 Configuration/Diagnostics** menu is used to set the master timing source for the DIU 2130. The submenu looks like: T1 timing source (1) port 1 (2) port 2 (3) csu > In most cases, the value CSU will be selected to let the timing source being used by the associated CSU also time the DIU 2130. In the less common case of tail circuit timing, where a dataport is being connected via a crossover cable to another DCE, a dataport may be selected as the input source for timing.

Command	Options
Timeslots	All timeslots from 1 to 24 are listed across the screen on the eighth line of the display. Below this line, beneath each timeslot, the dataport to which that timeslot is assigned is indicated. Thus, for each of the timeslots 1 through 24, either a 1, a 2, or a pair of dots indicating unassigned will be shown. For example: chnl 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Dp)port 01 01 01 01 .. .. 02 02 02 02 .. .. In this example, timeslots 1 through 4 are assigned to the first DIU 2130 dataport and timeslots 9 through 12 are assigned to dataport 2. To assign timeslots to the dataports, use the command **Dp**; however, do not use the lowercase **p**. Instead, use either a **1** or a **2** in place of the lowercase **p**. The lowercase **p** is used as a variable. Multiple timeslots are entered by separating the numeric values with a comma or a minus sign. In the example below, the first twelve timeslots are assigned to dataport 1: [1,2] DIU 2130 > d1 enter port 1 channels > 1-12 [1,2] DIU 2130 (UPDATE) >
DTR	Data Terminal Ready—a control lead presented by the DTE (Data Terminal Equipment). The Verilink DIU 2130 is DCE (Data Communications Equipment) which expects to receive DTR as an input from the DTE indicating it is present, powered up and prepared to operate. If the DTE does not assert DTR, this option allows the DIU 2130 to behave as it would if DTR were asserted by the DTE. This feature can be set independently for port 1 and/or port 2. The user types "DTR" and gets this response: force dtr handshake port(s) (1) 1 (2) 2 (3) both (4) none > The display as shown in our example reflects DTR forced on port 1 and not on port 2.
DSR	Data Set Ready—a control lead presented by the DCE (Data Communications Equipment). The Verilink DIU 2130 is DCE. The DIU expects to receive DTR as an input from the DTE indicating it is present, powered up and prepared to operate. This option allows the DIU 2130 to assert DSR regardless of any DTE leads. This feature can be set independently for port 1 and/or port 2. The user types "DSR" and gets this response: force dsr handshake port(s) (1) 1 (2) 2 (3) both (4) none > The display shown reflects DSR forced on port 1 and not on port 2.

Command	Options
RTS	Request To Send—a control lead presented by the DTE (Data Terminal Equipment) to indicate that it has data that it would like to transmit. The Verilink DIU 2130 is DCE (Data Communications Equipment) which expects to receive RTS as an input from the DTE (Data Terminal Equipment). Typically if RTS is not asserted by the DTE then no user data is conveyed end to end. If the DTE does not assert RTS this option allows the DIU 2130 to behave as it would if RTS were asserted by the DTE. The DIU 2130 will output CTS (Clear To Send) as a “high” or asserted value when RTS is on for that port. This feature can be set independently for port 1 and/or port 2. The user types "RTS" and gets this response: force rts handshake port(s) (1) 1 (2) 2 (3) both (4) none > The display as shown in our example reflects RTS forced on port 1 and not on port 2.
CTS	Clear To Send—a control lead presented by the DCE (Data Communications Equipment) to indicate that the DTE may now transmit. CTS is the logical result of RTS being on and no major alarm condition being present. The Verilink DIU 2130 is DCE (Data Communications Equipment) which expects to receive RTS as an input from the DTE (Data Terminal Equipment). Typically if RTS is not asserted by the DTE then no user data is conveyed end to end. If the DTE does not assert RTS this option allows the DIU 2130 to behave as it would if RTS were asserted by the DTE. The DIU 2130 will output CTS (Clear To Send) as a “high” or asserted value when CTS is on for that port. This feature can be set independently for port 1 and/or port 2. The user types "CTS" and gets this response: force cts handshake port(s) (1) 1 (2) 2 (3) both (4) none > The display shown reflects CTS forced on port 1 and not on port 2.
DCD	Data Carrier Detect—a control lead presented by the DCE (Data Communications Equipment) to indicate that it is receiving a valid, framed signal. The Verilink DIU 2130 is DCE (Data Communications Equipment) which outputs DCD. This option allows the DIU 2130 to output DCD as a HIGH or asserted value at all times for that port. This feature can be set independently for port 1 and/or port 2. The user types "DCD" and gets this response: force dcd handshake port(s) (1) 1 (2) 2 (3) both (4) none > The display shown reflects DCD forced on port 1 and not on port 2.
Mode	For each port, the Mode may be set to either 56K or 64K. This selection determines the bandwidth usage per DS0 (a DS0 is the same thing as a timeslot and is also sometimes called a channel). To set the mode for port 1, type M1; To set the mode for port 2, type M2. If the T1 circuit being used is AMI the mode must be 56K. If the T1 circuit being used is B8ZS the mode may be either 56K or 64K, as the user or application may require.

Command	Options
Scramble/HDLC	The **Sp** command is used to enable or disable two options, Scramble and HDLC Invert, which are related to ones density. Since there is no requirement for ones density on a B8ZS T1, there is never a reason to use scramble or HDLC inversion on a B8ZS T1. If asserting one of these functions appears to clear up a problem on a B8ZS T1 it would indicate there is a service problem on that span which is most likely caused by some device being set for AMI instead of B8ZS. On the other hand, an AMI T1 does impose certain requirements for ones density which must be met. If you have selected 56K mode for the DIU dataports on your AMI T1, then the density requirement has already been met and using either scramble or HDLC inversion is superfluous. If you are trying to bend the rules by selecting 64K mode for an AMI T1 and using the Scramble and/or HDLC options to minimize density violations then it should be understood that the data pattern may violate AMI standards for ones density and the CSU may occasionally enforce the density rules. If a CSU enforces density on a user datastream this will always cause data errors. Verilink Tech Support does not recommend use of Scramble or HDLC on AMI circuits. Use of Scramble or HDLC on B8ZS circuits is superfluous. Use of any of these options in a frame relay environment will always render the T1 inoperative. Scramble has nothing to do with encryption. Your data is no more or less secure if scramble is on or off. When scramble is selected the actual DTE data for that port is run through a mathematical algorithm (XOR by 55hex) which increases the probability that any particular bit will be a one (represented on a T1 as a pulse). Use of Scramble absolutely requires use of Scramble at the far end. HDLC inversion means that all data is inverted. When the DTE sends a one the CSU will send a zero, conversely if HDLC inversion is on all zeros are sent as ones. If HDLC Invert is On at one end of a circuit it must be On at the other end as well to avoid outputting inverted data to the far end DTE.

Clocking

Enter K1 to select the clocking option for port 1.

Enter K2 to select the clocking option for port 2.

There are three choices available for clocking a DIU 2130 port:

ST
INV_ST
TT

This option selection determines which clock signal, and/or which phase of that clock signal, will be used to control the sampling of the transmit data presented by the DTE. The best choice for this option is most often determined by factors outside the DIU 2130, therefore it may be necessary to try varying this option while monitoring the far end DTE device for reports of received errors.

In all cases, the DIU 2130 will present a clock signal to the DTE, the source of that transmit clock signal is determined by the timing source option, not by this option. No matter what selection is made here: ST, INV-ST or TT, it will not change the phase or the frequency of the Transmit Clock signal being sent to the DTE.

If ST is selected, the DIU 2130 will sample the transmit data lead, to determine if the DTE is sending a one or a zero, at the instant of the negative going transition of the transmit clock signal. This is the selection which is most often used. The lower the data rate of the port and the shorter the cable from the DTE to the DIU port; the greater the chance that ST will be the optimum setting.

If INV-ST is selected, the DIU 2130 will sample the transmit data lead during the positive going transition of the transmit clock signal. This is one-half of a clock cycle later than the negative going transition which is used for ST. The INV-ST option is used in order to compensate for delay in the DTE itself and/or especially delay caused by the length of the DTE to DIU cable. With higher data rates, longer cables, or the combination of high data rate and a long cable, the probability that INV-ST will be the best option to choose increases.

Factors such as cable capacitance per foot, inductive reactance in the cable, conductor thickness (gauge) and especially cable length will all factor in to the phase relationship between the transmit clock signal being sent by the DIU and the transmit data arriving at the DIU transmit data leads. There are too many variables and too many unknown factors to be able to make hard and fast rules for selecting the choice between ST and INV-ST.

If the ideal selection has been made, then the DIU 2130 will always be sampling the transmit data lead near the middle of each transmit data bit. This insures that the DIU 2130 will correctly sense whether the DTE has presented a one or a zero during that bit time and no sampling errors will occur.

If the value selected is other than ideal, the DIU 2130 may be sampling the transmit data lead at or near the transition between one bit and the next. This will cause errors because the DIU 2130 may sense what is actually a one as a zero or vice versa. Longer cables and higher data rates cause more rounding of the otherwise square transitions from one bit to the next. Poorer quality DTE cables have higher capacitance per foot which accelerates the rounding off effect on pulse edges. This means that even as the width of a data bit is decreasing, the portion of that data bit that may be used to reliably sample is also decreasing. Thus, the higher the data rate the more critical this selection becomes.

For receive data and the relationship to receive clock, long cables do not present problems of this sort. This is because both the receive data and the receive clock originate in the DCE, travel the same length of cable and are subjected to the same delay. They arrive at the DTE still in phase with each other. Transmit data presents a different case—the transmit clock signal is generated by the DCE. It must travel the (unknown) length of cable to reach the DTE being subject to (unknown) delay. The DTE does not react to transitions of transmit clock until they reach it—some delay will always be present. Once the DTE senses a clock transition it presents the next data bit which is to be transmitted. This data must now travel the length of cable in the opposite direction so that it will arrive at the DCE before it samples again.

Some manufacturers, among them Cisco Systems, take the transmit clock signal provided by the DCE and loop it back toward the DCE on an optional third pair of clock leads. In V.35 this pair is SCTE (Serial ClockTransmit External) plus and minus; in RS449 they are called TT (Terminal Timing). This is the actual clock signal which the DCE originally sent, so it is at the same frequency, but it is subjected to the same delay and waveshape distortion as the transmit data, since it travels the same length of cable.

When TT is selected the DIU 2130 looks to SCTE or TT for a clock signal and uses that clock to control when it samples transmit data. Since this clock is expected to be perfectly in phase with transmit data it solves the sampling issues described above. Therefore Verilink Tech Support recommends selecting this option whenever the DTE presents this optional third clock signal.

If the DTE is not actually presenting a clock signal on the SCTE or TT pair, selecting TT will cause a high error rate.

LOS Lead

If desired the DIU may be configured to monitor either one of two leads (RTS or DTR) which typically are asserted by the DTE. When this lead is not asserted an alarm is then reported. In this way the DIU can be relied upon to report if one of these conditions occurs:

DTE is powered down
DTE cable is disconnected
DTE goes offline

Use G1 to select the LOS lead for port 1.
Use G2 to select for port 2.

Statistics

On the right side of the screen some information appears:

```
Statistics
FW/HW Rev...1.2/0.8
Battery.....OK
DTE Intf....V.35/V.35
Data bus....A
```

Data Bus

The field under Statistics which shows the Data Bus is informational only, in the sense it is not directly a menu prompt, but it is critical.

This shows which of the three shelf backplane busses the CSU is using. One does not set this option in the DIU, instead the CSU is optioned for some data bus—if it is to be used with a DIU—and then the DIU is optioned for which CSU it is to operate with. Once the DIU is assigned to some CSU it polls the CSU to get the bus assignment.

Enable Loop

This option determines whether a local or remote user will be able to establish a loop on the given port of this DIU.

If loop is enabled, then when the DIU receives a loop-up code from a far end device it will go into the bidirectional DTE loop mode.

If loop is disabled, then when the DIU receives a loop-up code from a far end device it will not go into any loop mode.

In most cases, this should be enabled for any port being used.

Test/Monitor

The Test and Monitor Block Error Counter function is used after a loopback has already been established. The loop might be in the local CSU, the network itself, or the far end DIU. When T1 or T2 is selected a test pattern is sent from the port indicated and the receive data is monitored for errors. The pattern being sent should be received unaltered, indicating a good path to the point of loopback.

To run a test and monitor results on port 1, enter T1.

To run a test and monitor results on port 2, enter T2.

A display appears like:

```
Port 1, Block Error Count 0,  (STOP) >
```

If the data pattern being sent is received with no errors, the Block Error Count (BEC) will remain at zero. For any block in which a single bit error occurs the number will increment.

During a good test the STAT LED on the DIU for the port in test will be lit solid amber. If errors occur that LED will flash red to green.

To end the test just press the ENTER key. Be sure to also end whatever loop may have been used.

Near Loop

Use N1 to turn Near End loopback on or off for port 1.

Use N2 to turn Near End loopback on or off for port 2.

The Near End loop is also called a DTE loop, it is a loopback test that takes place in the DIU and is bidirectional. On the DIU the Near End Loop LED will come on for the port which is in loopback.

Monitor Leads

Selecting P1 for port 1 or P2 for port 2 produces output like:

```
          TXD RXD  DTR  DSR  RTS CTS DCD LL    RL    TM   LOS
Port 1: NO   YES  ON    ON   ON   ON   ON   OFF  OFF  OFF  NO  (STOP) >
```

This display continues to update until the user presses the Enter key. Shown are various interface leads and their current status. A series of snapshots are displayed, one after another, allowing the user to monitor activity. Leads are defined across the top line and their status is shown on the line below. NO = low = logical off while YES = high = logical on.

The abbreviations stand for:
TXD = Transmit Data
RXD = Receive Data
DTR = Data Terminal Ready
DSR = Data Set Ready
RTS = Request To Send
CTS = Clear To Send
DCD = Data Carrier Detect
LL = Local Loopback
RL = Remote Loopback
TM = Test Mode
LOS = Loss Of Signal

Far Loop

Use F1 to turn Far End loopback on or off for port 1.

Use F2 to turn Far End loopback on or off for port 2.

The Far End loop is also called a remote DTE loop, it is a loopback test that takes place in the DIU and is bidirectional. A loop-up or loop-down code is sent from the near site to the far site through the T1. On the DIU at this site the Far End Loop LED will come on for the port which is in loopback. On the DIU at the far site the Near End Loop LED will come on for the port that is in loopback.

Alarm Enable

If alarm reporting is enabled, messages will appear on the craft interface screen as alarms occur and clear. If disabled, this does not occur.

DIU Bus

The DIU Data Bus option looks like:

DSU Bus (1)NONE (2)A (3)B (4)C (5)B,D&I EQ (6)A,D&I NET >

This very critical option determines the mode in which the CSU will operate and which of the three busses in the shelf, if any, will be used to pass data back and forth to DIU cards.

1. NONE—The CSU is in CSU mode. This means that all 24 timeslots are being passed directly through the CSU to an attached DSX-1 T1 device, often used for PBX or telephone switch applications. Note that in CSU mode (only) the DIU clock option is not in effect, the actual behavior of the card is passive as regards timing when CSU mode is selected.
2. A—The CSU is in mux mode and it is using bus A to pass data back and forth to the associated DIU card(s). The equipment interface is not in use in mux mode.
3. B—The CSU is in mux mode and it is using bus B to pass data back and forth to the associated DIU card(s). The equipment interface is not in use in mux mode.
4. C—The CSU is in mux mode and it is using bus C to pass data back and forth to the associated DIU card(s). The equipment interface is not in use in mux mode.
5. B,D&I EQ—The CSU is in a very rarely used mode (Tech Support has never seen it used) in which the DIU data traffic is being routed out the DSX-1 T1 equipment port to the local T1 equipment instead of out the T1 network port. This is called the drop and insert toward the equipment. Unless your requirement is exceptionally unusual, do not select (5)B,D&I EQ.

6. A,D&I NET—The CSU is in drop and insert mode and both the T1 equipment port and a DIU are in use.

DIU Clock

These options determine the source for the TRANSMIT clock that is used by the CSU to send toward the T1 network. In all cases the RECEIVE clock is derived from the incoming T1 datastream received from the T1 network.

The DIU Clock submenu is:

(1)THRU (2)INT (3)EXT 422 (4)EXT TTL (5)NET (6)EQ (7)TIU (8)DIU >

1. THRU—Selects passive timing behavior. The CSU uses the clock provided by the connected local DSX-1 equipment to drive the network signal. THRU is recommended in many cases for drop and insert mode and it is the actual mode in which the CSU functions when it is in CSU mode. Even though some selection other than THRU may appear as the current value, if the CSU is in CSU mode it is actually operating with THRU timing.

2. INT—Selects the oscillator built in to the CSU card as the timing source. This is often used in mux mode. INT should only be selected at one end of a point to point T1 and only if the T1 does not have timing applied to it by the service provider (phone company).

3. EXT 422—Selects the balanced pair of input leads that are present in the DIN connector on the CIM behind the CSU. Use of this option requires that the external clock being provided must be at 1.544 MHz in a balanced signal which meets RS422 specifications. EXT 422 might be used in any CSU mode.

4. EXT TTL—Selects the unbalanced pair of input leads that are present in the DIN connector on the CIM behind the CSU. Use of this option requires that the external clock being provided must be at 1.544 MHz in a +5V to 0V signal level. EXT TTL might be used in any CSU mode.

5. NET—The most widely used value for this option. If it is known that the T1 passes through a DACS or if the far end CSU is set for INT clock, then always choose NET. NET is commonly used in mux mode and may occasionally be used in drop and insert mode for situations where the T1 equipment does not provide a reliable clock source. When connecting to a fractional T1 or frame relay T1 and operating in mux mode always select NET.

6. EQ—Similar to THRU. The clock signal derived from the DSX-1 T1 equipment is used as the transmit clock source for the CSU. This choice is invalid for mux mode, may be useful in drop and insert mode.

7. TIU—Used only if the shelf has a TIU 2850 timing circuit module installed. This is a special circuit card which takes a T1 signal in on one of several ports, recovers a clock signal from that input, then propagates that clock signal to all of the slots in the shelf using bus C. This option should not be selected unless a TIU 2850 is installed in the shelf.

8. DIU—Used for tail-circuit timing. A single port of a single DIU 2130 may be used to provide clock for that DIU and the CSU if necessary. Three options must be set for tail-circuit timing.

   a. In the DIU 2130, the port to be used to provide timing must be set to TT clocking.

   b. In the DIU 2130, the timing source must equal the port being used (port 1 or port 2) instead of the usual value of CSU.

   c. DIU may then be selected as the timing source for the CSU. This option is not recommended except when using mux mode.

Chapter 4

Troubleshooting

Controller card(s) poll the various modules for alarms. If alarm reporting is enabled for the node and for the module(s), the node controller card retrieves and sends the alarm to Access Manager 2000, Node Manager 2000, or an SNMP agent.

An alarm list is provided under the alarms displays of the various options of AM2000, NM2000, SNMP, or the Craft interface.

Alarms can also be automatically sent to a specified printer by setting up the printer address in the various management utilities menus.

Near End Loop LED

The Near End Loop LED lights amber when the associated data port is looped on the DIU.

Far End Loop LED

The Far End Loop LED lights amber when the associated data port is looped at the far-end DIU. This occurs only if the loop-up command was sent by the near-end DIU to the far-end DIU over the T1 circuit.

STAT LED

The STAT (DIU 2130 status) LED is a tri-color indicator which shows one of the following conditions for each data port:

- **Green for 6 Seconds, then 2 Flashes of Red (repeated)**—This indicates that there is a loss-of-signal on the data port.
- **Green for 6 Seconds, then 3 Flashes of Red (repeated)**—This indicates that the DIU 2130 has a low battery. This alarm will only be displayed both STAT LEDs.

NOTE: *If the STAT LED has a low battery alarm and a loss-of-signal alarm at the same time, the LED will flash in the following order:*

Solid Green (6 sec.), 2 Red Flashes, Out (2 sec.), 3 Red Flashes (repeated).

- **Green**—DIU is working properly (normal operation).
- **Flashing Green**—DIU is accessed by a master NCC or SCC thumbwheel switch. Both the PORT 1 and PORT 2 STAT LEDs flash green during this time.
- **Red**—DIU is faulty or problem in equipment connections. Replace the DIU.

- **Amber**—Associated data channel is under test by an operator (a test signal is being applied by the DIU).
- **Flashing Red**—Power-up self test failure.
- **Flashing Red and Amber**—DIU has failed an operator-initiated data channel test.
- **Not Lit**—DIU is not powered up (power is lost).

Loss of Clock Alarm Notification

If the DIU 2130 detects loss of clock, it will send an alarm to the management software and activate an LED indicator. The following loss of clock sources can be detected upon failure:

- **TIU 2850**—AMI, TTL, or RS-422
- **NCC 2020 orTAC 2010 External** —TTL and RS-422
- **DIU 2130**—Tail-circuit timing

Loss of Signal Alarm Notification

A loss of signal alarm will be sent to the management software when the DIU 2130 detects the loss of RTS or DTR handshake leads via the cable becoming disconnected or the DTE deactivating the leads. Access Manager and the ASCII Terminal Interface offer the following settings for this feature:

- **RTS**—Sends an alarm notification upon the loss of RTS on the DTE interface.
- **DTR**—Sends an alarm notification upon the loss of DTR on the DTE interface.
- **None**—Does not send any notification upon loss of RTS or DTR.

Test Signal Detector

If a test signal is applied by the DIU to the selected data channel and is looped back at the far-end DIU, the test signal detector looks for bit errors in the returned signal. If errors are detected, the STAT LED for that data port flashes red and yellow on the DIU front panel. If no errors are detected, this LED lights yellow.

Data Channel Loopbacks

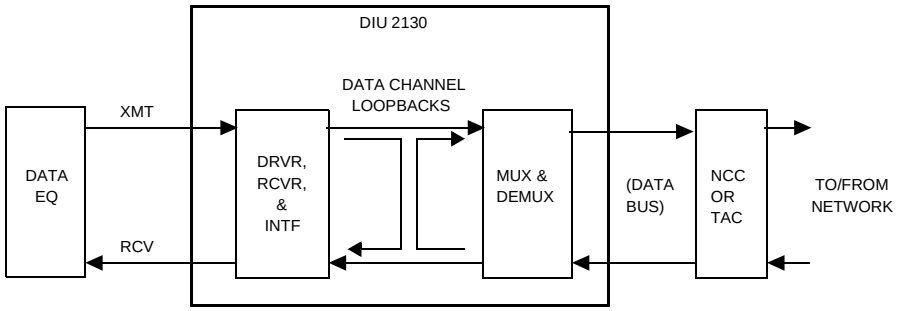
The DIU 2130 provides a data channel loopback to help isolate data channel failures. Figure 4-1 shows this loopback. When this loopback is activated by a test operator it provides two simultaneous connections:

- One toward the data equipment
- One toward the network

On the equipment side, the data equipment transmitter is connected to the receiver through the DIU interface driver and receiver circuits. This path allows the operator to verify operation of the customer data equipment and the associated interface cabling to the DIU.

When a data channel loopback is activated, the incoming channel data from the network is looped back toward the far-end. This path allows end-to-end channel testing of the data circuit through the network and associated DIU and CSU at each end.

Figure 4-1 DIU 2130 Data Channel Loopbacks



The DIU data channel loopback can be activated and deactivated on either data channel. When this loopback is activated, only the selected data channel is tested. The other data channel continues to operate normally and transmission service is not affected.

V.54 Data Channel Loopbacks

The V.54 data channel loopbacks are identical to the loopbacks shown in Figure 4-1 above; however, they can be activated by the Data Terminal Equipment connected to the DIU 2130's Data Interface Module (DIM). The three V.54 leads used to activate these loopbacks are:

- **LL**—activates the data channel loopbacks on the DIU 2130 at the local node (the node to which the DTE sending LL is connected).
- **RL**—activates the data channel loopbacks on the DIU 2130 on the far-end of the network connection.
- **TM**—is set high by the DIU 2130 upon successfully activating LL or RL to notify the DTE of its current state.

Once the DTE sets LL or RL low, the DIU 2130 will deactivate the data channel loopbacks and return to normal transmitting state.

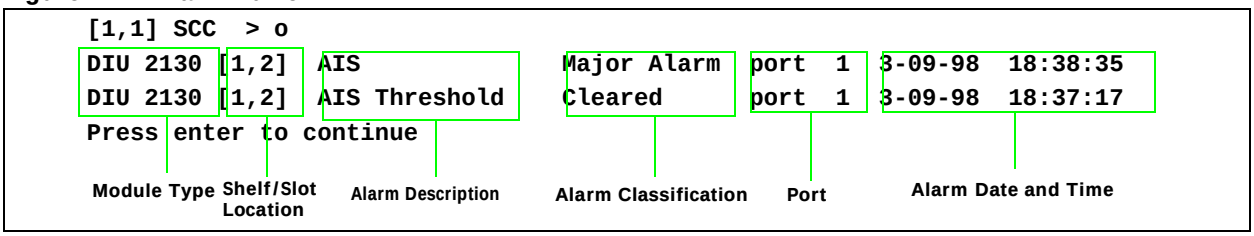
Interpreting Alarms

The alarm buffer displays the following information about alarms (This information may vary depending on the controller module and management method used):

- Whenever the system powers up and any module does a self-test
- Power is lost from one of the redundant power supplies
- A default or user-designated threshold is exceeded

- A Yellow Alarm is received from the network (DS1)
- An unframed all-ones or alarm indication signal (AIS) is reveived from the network
- There is a loss of signal (LOS) or loss of frame (LOF)
- A CSU or Data Port loopback is present
- A module fails
- A module is removed from the shelf

Figure 4-2 Alarm Buffer



Status Code

The status code column displays a decimal code when using an ASCII terminal. (Varies depending on the SNMP or ASCII terminal used.)

Alarm Description

The alarm description column lists the text which is:

- printed on the display
- sent to the alarm printer
- saved to the alarm buffer/database

Classifications

Verilink classifies alarms into the following severities:

- Critical
- Major
- Minor
- Warning
- Info
- Cleared

Problem Types

These classifications are further categorized into the following problem types:

- LOS
- LOF

- Error
- Call Setup

What To Do About Alarms

Some alarms clear after the user-configured timeout has expired. Other alarms require corrective action.

- If an alarm has been cleared, no other action is required.
- If there is a loopback present, unless you are intentionally testing, remove the loopback. (Only if the loopback is from your end. If the loop was initiated by your network service provider, check with their test facility before taking down the loop.)
- For an LOF, you may have a telco or module problem. To test, do an RLB. If there is no LOF indicated by the test, the problem is with the telco.
- For an LOS, check your router cables, power, and ports.
- For a power-up self-test failure, reseat the module a few times to see if it will power up and pass the self test. If it does not pass after repeated self tests, replace the module.

Alarm Records

Every alarm record that displays is “active” in the database until you do something about it. Do the following with the alarm records:

- Deactivating alarm records is a database management function. As long as an alarm is active, you can view it onscreen, using the one of the management options on the ASCII interface, AM2000, or Node Manager 2000. When you deactivate an alarm, it’s still in the database, but not viewable on screen. Deactivated alarms can be archived, printed, or deleted.
- Archiving an alarm record stores it to a disk file you specify.
- Printing an alarm record prints a copy of all active and deactivated alarms.
- Deleting an alarm record removes it from the database. To delete an alarm, first deactivate it.

Chapter 5

T1 Dial Backup Option Overview

The T1 Dial Backup Option automatically switches a failed T1 or fractional T1 (FT1) to a usage-measured dial-up circuit if a dedicated T1 circuit or dedicated 56K circuit becomes unusable. The dial backup circuit can be selected from the following alternatives:

- Switched 56 (SW56)

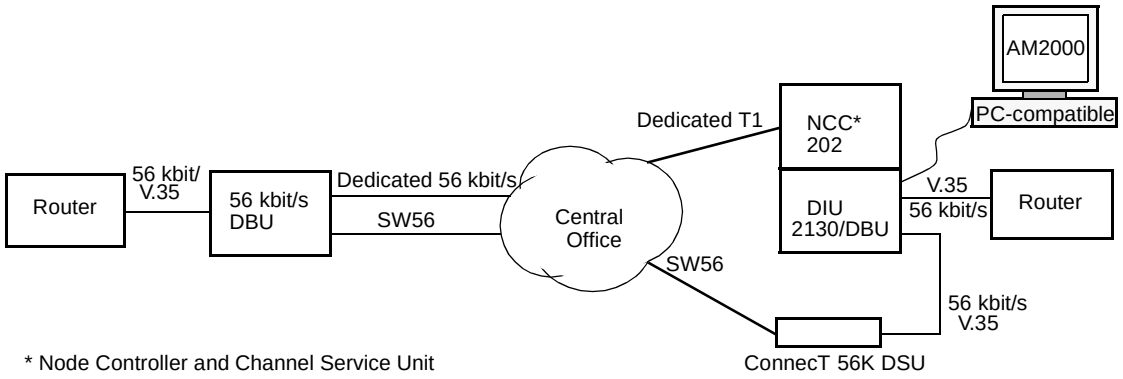
  SW56 is a switched carrier service providing 56 kbit/s dial-up lines. It charges customers for data connection only when the interface unit is active.

- Analog modem service
- Integrated Services Digital Network — Basic Rate Interface (ISDN BRI) service

The backed up circuit can be $n \times 56$ or $n \times 64$ kbit/s. The DIU 2130/DBU automatically reduces clock rates as necessary.

Figure 1 illustrates an application in which a circuit composed of a 56 kbit/s circuit and a T1 circuit. The circuit is backed up by a Verilink AS2000 at a central site and by a 56K Dial Backup Unit at the far-end.

Figure 1 Example Application of the T1 Dial Backup Option in an AS2000 Node



This T1 Dial Backup Option is an EPROM upgrade or download upgrade to the Verilink Data Interface Unit (DIU) 2130 plug-in module. The upgraded plug-in module is designated as the DIU 2130/DBU.

The option can use the Verilink ConnecT 56K Data Service Unit (DSU) as the interface to the backup circuit. Third party devices with Data Terminal Ready (DTR) dialing can also be used.

Features

The T1 Dial Backup Option offers the following features:

- Backs up $n \times 56$ or $n \times 64$ kbit/s T1 circuits
- Automatically dials and switches to the backup circuit on loss of frame or Dataphone Digital Service (DDS) Abnormal Station Code (ASC)
- Failed circuit remains accessible for troubleshooting
- Initiates the backup from either end in the event of a circuit failure
- Dial backup automatic mode can be controlled manually
- The Verilink Access Manager 2000 (AM2000) monitors the status of the switching and manages alarms and testing
- Available in pre-configured and field upgrade versions
- Downloads into existing DIU 2130 plug-in module using Verilink Advanced Programmable Architecture™ (APA)

Available configurations

The T1 Dial Backup Option is a factory-ordered item available in three forms:

- Plug-in module (DIU 2130/DBU)
- EPROM upgrade kit
- Download upgrade kit

You can download the software upgrade version of the T1 Dial Backup Option into the RAM of a standard DIU 2130.

Compatibility and requirements

The T1 Dial Backup Option is compatible with installed-base AS2000 hardware. The T1 Dial Backup Option requires the following:

- Verilink DIU2130/DBU at the central site
- Compatible DBU or another DIU 2130/DBU at the far-end
- A DCE to the dial backup circuit in the form of a dedicated Verilink ConnecT 56K DSU, user-supplied analog modem, or user-supplied ISDN BRI DSU device
- SW56, analog modem, or ISDN BRI circuit available at each end
- NCC plug-in module of Rev. 4.6 or higher
- AM2000 (Release 3.2A or higher) installed in a PC connected to the AS2000 Node Controller and Channel Service Unit (NCC) plug-in module.

  AM2000 is used for downloading the upgrade, and for configuring and testing of the backup circuit. Once the backup is operational, you can use the AM2000 for monitoring, managing, and testing.

How dial backup works

The T1 Dial Backup Option allows a Verilink DIU 2130/DBU to automatically connect both nodes of a circuit to a dial-up circuit and switch the Data Terminal Equipment (DTE) data to the dial-up circuit.

Events that indicate a circuit failure at the near-end are:

- Loss of frame (LOF) on the T1 signal
- DDS ASC within the channelized data

Either node can initiate dial backup mode. The far-end monitors the incoming calls and responds automatically to complete the circuit. When both sides are connected, the DIU 2130/DBU(s) switch the Data Terminal Equipment (DTE) data to the dial backup circuit.

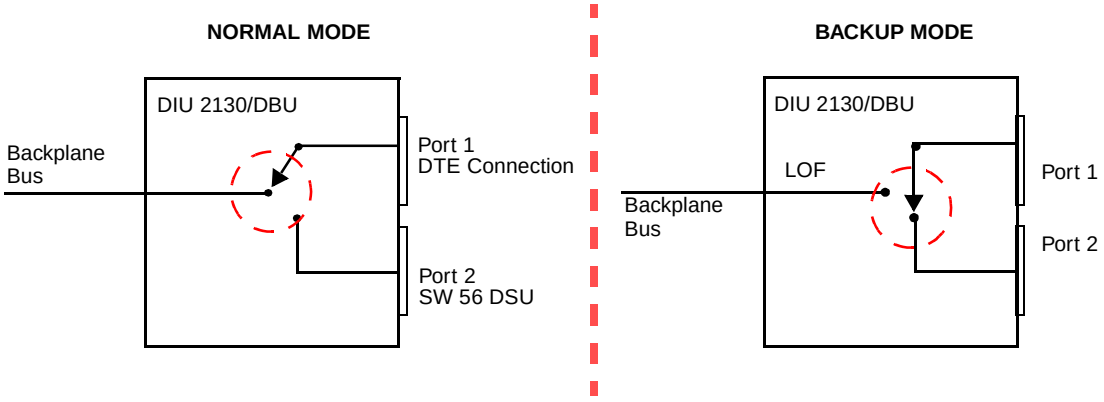
The dedicated T1 portion of the circuit remains intact for troubleshooting. The DIU 2130/DBUs route the DTE data over the backup circuit until the dedicated circuit can be restored.

When the T1 circuit comes back up, the system automatically switches back to the T1 circuit. (See the Caution in the section Managing Alarms and Testing, on page 510.) The operator can use AM2000 to manually override the automatic mode setting at any time.

AM2000 also tracks the status of the switching and the associated alarms and sends test patterns.

Each DIU 2130/DBU supports one dial backup circuit. (Both Port 1 and Port 2 are dedicated to the option.) Port 2 of the DIU 2130/DBU is always the backup circuit. Figure 2 diagrams the switched and unswitched modes internal to the DIU 2130/DBU.

Figure 2 Internal State of the DIU 2130/DBU in Normal and Backup Modes of Operation



The DTR control lead of the DCE attached to Port 2 of the DIU 2130/DBU is used to initiate the call to the dial backup circuit. The handshake lead Carrier Detect (CD) is monitored in the answer mode at the central site. Backup mode initiates when:

1. Loss of Frame is declared for the T1 line. LOF is defined as 2.5 seconds (± 0.5 seconds) of Out of Frame (OOF) integrated (therefore applying a leaky bucket algorithm for an intermittent T1 circuit).

OR:

2. ASC is received continuously for 5 seconds by the DIU 2130/DBU from the far-end Office Channel Unit-Data Processor (OCU-DP) when a far-end 56 kbit/s DSU circuit fails.

Upgrading to the T1 Dial Backup Option

This section describes how to install your option depending on which of the available configurations you have. This section also describes how you configure your T1 Dial Backup Option for operation and management.

NOTE: *To make use of the option, you need AM2000 Release 3.2A or higher. Preferably, you should have the current AM2000 installed before you begin a firmware download of the option. However, if you do not, you can still download the firmware upgrade using an earlier version of AM2000.*

Preconfigured Option

If you purchased a preconfigured DIU 2130/DBU, its EPROM already contains the T1 Dial Backup Option. All you need do is to install the plug-in module and ConnecT 56K DSU(s). Then configure the element as directed in the section, “Overview of Installation and Management Tasks”.

Download Upgrade

If you purchased the downloadable software, you can download the T1 Dial Backup Option into an existing DIU 2130 using AM2000. See “Configuring the ConnecT 56K DSU for Dial Backup”.

NOTE: *When you download a firmware upgrade to an existing module, the upgrade is loaded into the battery-backup RAM and not into the EPROM proper. If you disconnect the battery in such a module, the firmware reverts to the original firmware in the EPROM. Therefore, a module upgraded by a firmware download is different from a preconfigured module or one in which the EPROM has been replaced.*

EPROM Upgrade

If you purchased the EPROM upgrade, replace the existing EPROM in the appropriate DIU 2130 with the upgrade EPROM.

Installation and Management

NOTE: *Before installing or using the T1 Dial Backup Option, read the Verilink End-user Software License Agreement.*

You can use AM2000 for installing the download upgrade and managing the T1 Dial Backup Option. The AM2000 connects to the NCC plug-in module. Managing can include the following functions:

- Detecting the presence of a T1 Dial Backup Option plug-in module
- Configuring the T1 Dial Backup Option
- Selecting the appropriate dial backup automatic mode
- Tracking the status of the dial backup circuit
- Monitoring and setting dial backup alarm limits
- Testing the dial backup before or after a T1 circuit failure

For more information on AM2000, see the *Access Manager 2000 User Manual.*

Installation and management tasks are summarized as follows:

1. Install the release 3.2A of AM2000 if available and if you have not done so already.

   (If you do not have the current AM2000 software, you can still download the firmware with earlier versions.)

2. Identify the AS2000 DIU 2130 elements that require the T1 Dial Backup Option and upgrade them according to the appropriate download or EPROM replacement procedures found towards the back of this document.

3. Re-configure the DIU for T1 Dial Backup Option operation. (For new installations, create a node prior to this step.)

4. Assure that the cabling is properly terminated.

   For specifics on the interface connectors or shelf backplane, consult the DIU 2130 sections in the AS2000 manual set.

5. Begin initial testing by activating loop-backs and generating various test patterns onto the network. A counter maintained during the test indicates the number of bit errors occurring in the network.

6. When the tests have completed successfully, place the circuit in service.

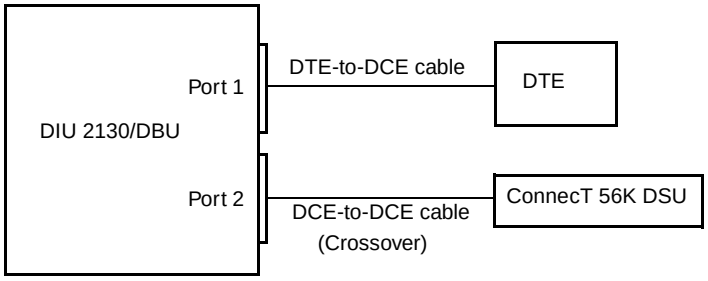
The following sections detail the various screens and steps involved in installing and managing the T1 Dial Backup Option.

NOTE: *If you are not already familiar with the ConnecT 56K DSU unit, you will need a copy of the ConnecT 56K DSU User Manual to configure your dial backup system.*

Connecting Cables for Dial Backup

Figure 3 shows the cable connections from the DTE to Port 1 of the DIU 2130/DBU and from Port 2 of the DIU 2130/DBU to the ConnecT 56K DSU.

Figure 3 Cabling for D I U2130/DBU and ConnecT 56K DSU



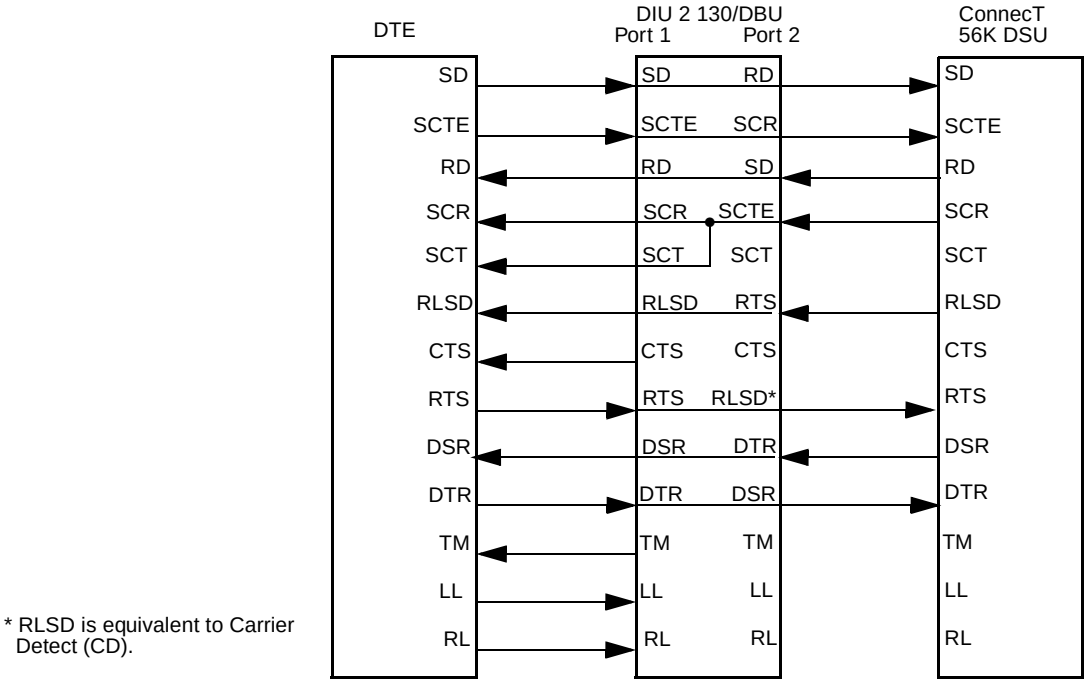
If the T1 Dial Backup Option is configured for V.35, refer to the cable part numbers in Table 5-1.

Table 5-1 V.35 Cable Interconnect Part Numbers

	15 Foot	50 Foot
DTE-to-DCE	458-501775-015	458-501775-050
DCE-to-DCE	458-501776-015	458-501776-050

Figure 4 shows the pin-to-pin diagram for the two cable connections.

Figure 4 Cable Interconnect Schematic when the Backup Circuit is Activated

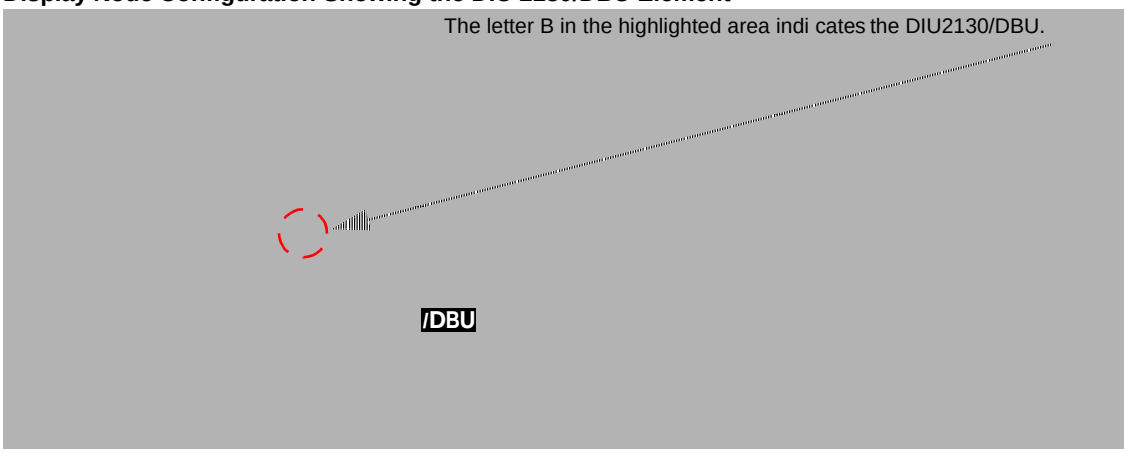


* RLSD is equivalent to Carrier Detect (CD).

Detecting a DIU 2130/DBU

Using the AM2000, you can detect the presence of a DIU 2130/DBU (DIU 2130 with the T1 Dial Backup Option) by displaying the node configuration from the **Online Access/Display** or the **AS2000 Configuration** menus.

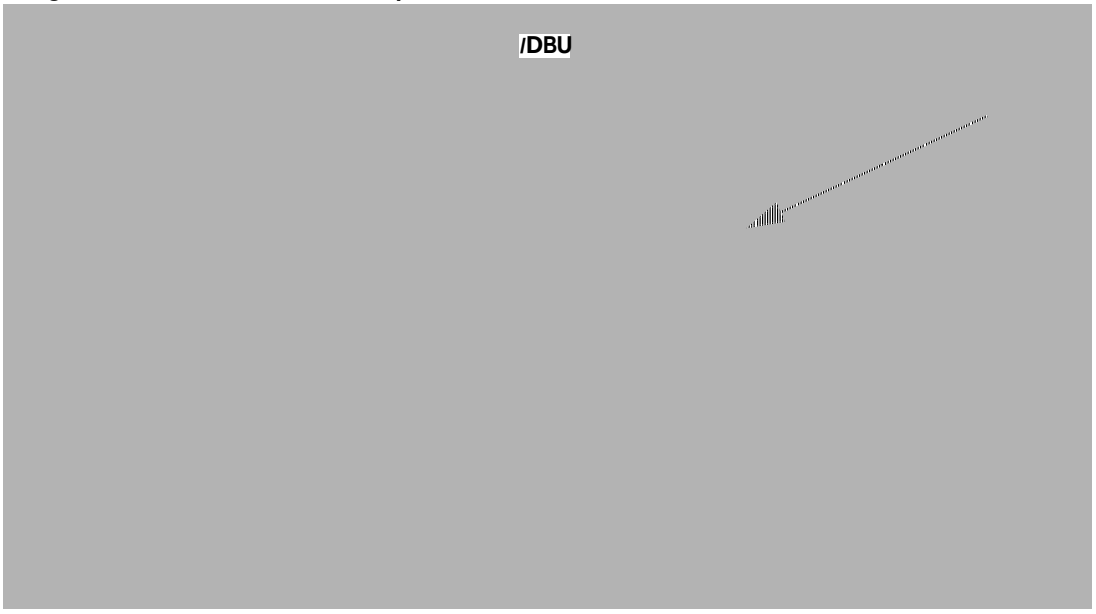
Figure 5 Display Node Configuration Showing the DIU 2130/DBU Element



Configuring Modes for Dial Backup

The AM2000 display for configuring the T1 Dial Backup Option operation is shown in Figure 6.

Figure 6 Configuration Screen for Dial Backup Mode



The **Port 1 Backup/Restore Mode** line selection allows you to select dial backup mode. (Port 2 is always the backup port.) Pressing **F8** steps through the available modes as follows:

AUTOMATIC/AUTOMATIC

Port 1 is connected to port 2 upon one of the following conditions:

1) Abnormal Station Code (ASC) is detected within the channel data.

2) Loss of Frame (LOF) occurs on the T1 Signal.

3) The handshake lead Carrier Detect (CD) on the Port 2 interface goes high.

Once the failed condition clears, port 1 drops the backup line and resume normal operation over the T1 line.

AUTOMATIC/MANUAL

Similar to **AUTOMATIC/AUTOMATIC** mode. Port 1 connects to port 2 upon any of the above conditions. However, it does not switch back when the condition clears. You must switch it back manually from the online **Test Activity menu** by selecting the **Deactivate backup connection** menu option. (See Figure 5-2.)

MANUAL/MANUAL The port does ***not*** switch when any of the above conditions occur.

Table 1 provides the default setting and range of parameter values for the user-programmable options.

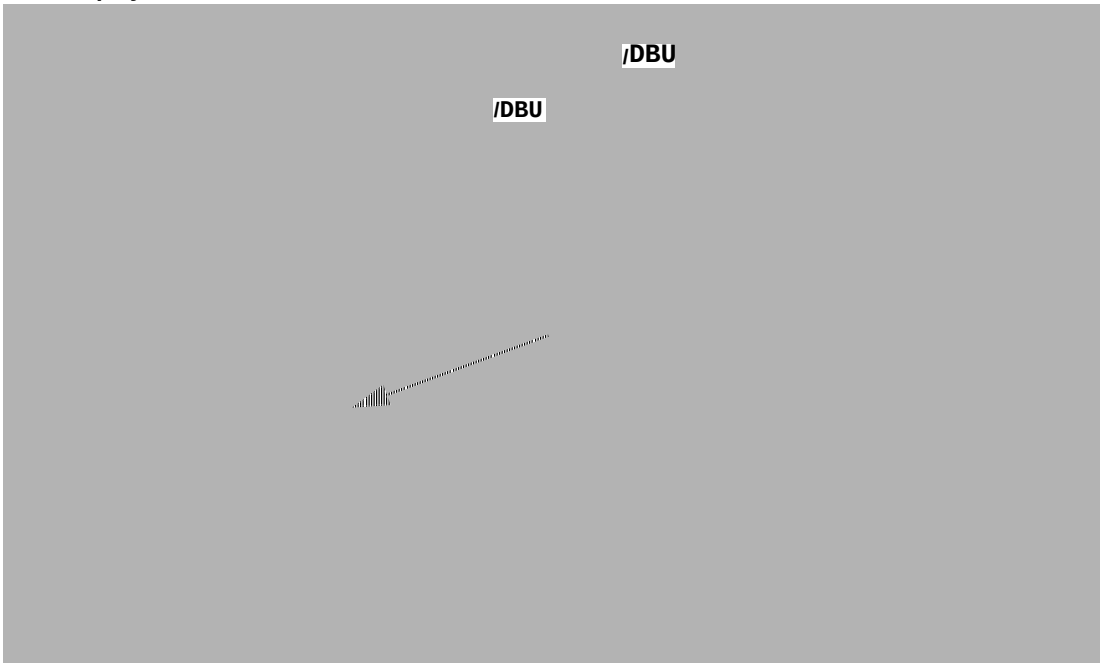
Table 1 DIU 2130/DBU Configuration Settings

Option	Default	Range of Values
Installed and operational?	No	Y, N
Save configuration to DIU?	No	Y, N
Enable alarm reporting?	No	Y, N
Connected CSU shelf #	0	1-4
Connected CSU plug #	0	1-13
Port 1 Channel Assignment	unassigned	1-24
Port 1 Backup Mode	Automatic	Manual, Automatic
Port 1 EQP Name	blank	16 characters
Port 1 EQP SER.	blank	16 characters
Port 1 EQP Interface	blank	16 characters
Port 1 EQP Speed	blank	16 characters
Port 1 DS0 mode	No	Y,N
Port 1 Enable Selected Loops?	Yes	Y, N
Port 1 Enable Scramble?	No	Y, N
Port 1 EQP-Clock	ST	ST, INV ST, TT
Port 1 Force DTR?	No	Y, N
Port 1 Force RTS?	No	Y, N
Port 1 Force DSR?	No	Y, N
Port 1 Force CTS?	No	Y, N
Port 1 Force DCD?	No	Y, N
Port 1 Detect DTE LOS?	No	No, RTS, DTR
Port 1 Enable as TIU?	No	Y, N

Monitoring Dial Backup Status

Using the AM2000, you can check in what state the DIU 2130/DBU element is currently operating by selecting DIU 2130/DBU from the **Online Access/Status Element** menu. The DIU 2130/DBU Status window shown in Figure 7 appears. Notice the option **Active Path,** which indicates whether Port 2 is currently active.

Figure 7 Status Display Screen for DIU213 0/DBU



Under Port 1, one of the following codes can result:

ACTIVE	No errors are detected and the port is operating normally.
ASC	The port switched due to an Abnormal Station Code on Port 1.
LOF	The port switched due to Loss Of Frame.
CD	The port switched due to Carrier Detect received from the backup circuit DCE.
USER	The port switched due to user command.

Under Port 2 one of the following codes may result:

STANDBY	The backup circuit is currently not being used.
ACTIVE	Errors detected on Port 1 (or by user command) caused the backup circuit to become active.
ERROR	The backup criteria was met but an attempt to establish the backup circuit failed.

Managing Alarms and Testing

Managing Dial Backup Alarms

Table 2 lists the possible alarms that can occur during the DIU 2130/DBU operation.

Table 2 Dial Backup Alarm Codes for DIU 2 130/DB

Alarm Code	Alarm Description
853	Backup connection activated alarm
854	Backup connection activated alarm cleared
855	Backup connection failed alarm

Manually Controlling Dial Backup

If you do not want the automatic backup feature to take effect, you can manually disable the automatic mode (see ***Configuring Modes for Dial Backup***). You can then manually force Port 1 to connect to Port 2 (dial backup mode), as shown in this section. You may want to do this for diagnostic purposes. (See ***Managing Alarms and Testing***.)

In the AM2000, these activities are located in the online **Test Activity** menu as shown in Figure 5-2.

Table 5-2 Test Activity Menu

The dial backup options include:

Activate backup connection

This breaks the connection to the T1 backplane bus and switches Port 1 to Port 2. (See Figure 2.)

Deactivate backup connection

This option breaks the connection to the backup port and re-establishes the connection to the T1 backplane. (See Figure 2.)

Testing Before or After a T1 Circuit Failure

When you have the backup circuit activated, you can test it by selecting items **A** and **B** on the **Select Test Activity** menu shown in Figure 5-2. **Send Test Pattern** sends a the loop code or test pattern to the far-end to verify that a dedicated circuit is operating satisfactorily.

CAUTION

If you are testing a failed T1 circuit after the T1 Dial Backup Option has switched the data to the backup circuit, you must first disable the automatic feature as described in Configuring Modes for Dial Backup, on page 58. Otherwise, the T1 Dial Backup Option can prematurely switch the data back to the failed line if it senses a continuously reliable test pattern. When the T1 circuit is reinstated, you can switch the T1 Dial Backup Option back to automatic.

Configuring the ConnecT 56K DSU for Dial Backup

If you are using a Verilink ConnecT 56K DSU in your dial backup system, you need to configure the ConnecT 56K DSU for use with the T1 Dial Backup Option. For specific instructions and details, see the *ConnecT 56K DSU User Manual*. Follow these basic steps.

1. Configure the unit for SW56 operation.

   Use the **3 = Config** menu as described in Chapter 3 of the *ConnecT 56K DSU User Manual*. See also Table A-1 Telephone company information in the aforementioned manual.

2. Configure the unit for DTR dialing.

   This is also described in Chapter 3 of the *ConnecT 56K DSU User Manual*. See especially the 4 = Dial Options section of that manual. See also Table A-3 Configuration Profiles in the aforementioned manual.

3. Program the unit with the number to dial if that dial backup mode is initiated.

Use the **4 = Dial Options** menu as described in Chapter 3 of the *ConnecT 56K DSU User Manual*.

Chapter 6

56K NMS Option Overview

Used with the Verilink ConnecT 56K Data Service Unit (DSU), the 56K NMS Option allows Access Manager 2000 (AM2000) to manage remote Dedicated 56K circuits. Management features include alarms based on DDS (Digital Dataphone Service) control codes, 56K circuit-compatible loopbacks, and monitoring of the circuit data.

With the 56K NMS Option you can manage remote Verilink ConnecT 56K DSUs including the following:

- Monitor DDS control code information per AT&T TR 62310
- Identify and manage alarms on DDS control codes
- Send 56K loopback signals and test patterns
- Monitor circuit data

The 56K NMS Option is available as an EPROM upgrade or Verilink download upgrade to an existing DIU 2130 plug-in module. The resulting plug-in module, designated DIU 2130/DDS, is also available from the factory.

You can also use AM2000 to install the APA download upgrade kit for an existing DIU 2130 if you have purchased that configuration of the 56K NMS Option.

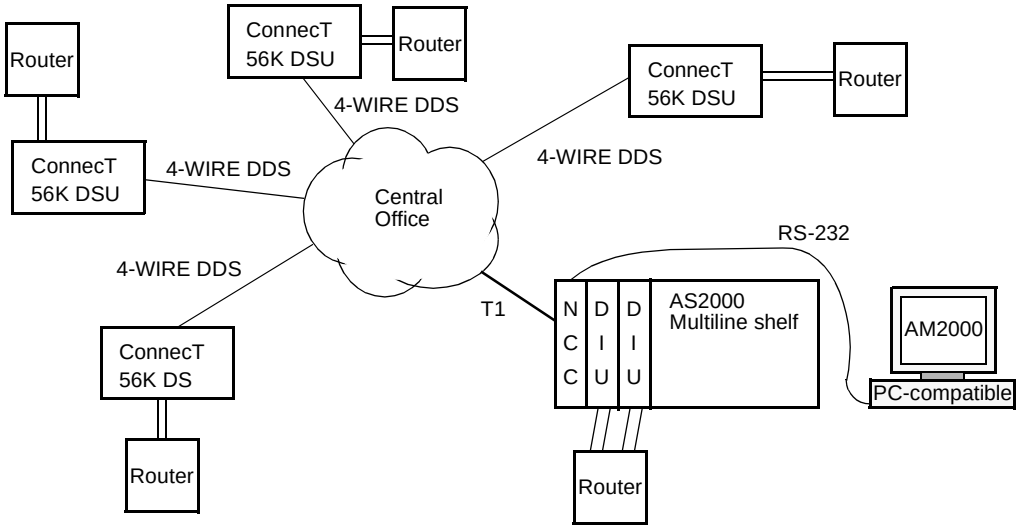
You can also do configuration and testing using a "dumb" terminal connected to the ASCII interface of the DIU 2130/DDS.

NOTE: *The 56K NMS Option is an enhancement to the existing functionality of the DIU* 2130. *You can configure each port of a DIU 2130/DDS for either 56K DDS service or standard FT1 service.*

Application Example

Figure 1 shows an application in which traffic from four remote routers is networked to a router at an AS2000 central site.

Figure 1 Example Configuration of the 56K NMS Option managing four remote DDS circuits



The routers are each connected to the network by ConnecT 56K DSUs. Each port of a DIU 2130/DDS supports one ConnecT 56K DSU.

The 56 kbit/s CSU/DSU circuits are multiplexed in the central office and passed on to the AS2000 node on a T1 or FT1 circuit. This is a common cost-effective approach for terminating 56K circuits in a central site.

The AM2000 accesses the DDS circuits through the Verilink Node Controller and Channel Service Unit (NCC 2020).

Features

In this section, the 56K NMS Option features are grouped as follows:

- status codes
- alarms
- loopback codes

Status/Control Codes

The 56K NMS Option allows the AM2000 to display the following DDS status/control codes received by the DIU 2130/DDS:

- Abnormal Station Code (ASC)
- Control Mode Idle (CMI)
- MJU Alert (MA)
- Test Alert (TA)
- MUX-Out-Of-Sync (MOS)
- Unassigned MUX Channel (UMC)
- Test Code (TC)
- Channel loopback (CHNL)
- DSU loopback (DSU)

- OCU loopback (OCU)
- Transition in Progress (TIP)
- Block Code (BLK)
- Release Code (RLS)

If no control code is being received, the raw data is displayed.

Alarms

The 56K NMS Option configures individual alarm thresholds in the DIU 2130 for each of the following DDS status codes:

- Abnormal Station Code (ASC)
- Control Mode Idle (CMI)
- MUX-Out-Of-Sync (MOS)
- Unassigned MUX Channel (UMC)

The following items are grouped together and associated with one common threshold setting. The AM2000 autonomously receives alarms whenever one of the configured DDS status code thresholds is crossed.

- MJU Alert (MA)
- Test Alert (TA)
- Test Code
- Block Code (BLK)
- Release Code (RLS)

For more information on alarms, see the section “Managing Alarms”, below.

Loopback Codes

Use the 56K NMS Option to send the following loopback codes to far-end DDS DSUs:

- ITU-T V.54 (most useful in DDS mode)
- DDS latching loopbacks (OCU, Channel, DSU)

When you have the loopbacks established, you can send 511 and 2047 test patterns over them.

Available DIU 2130/DDS Configurations

The 56K NMS Option is available as a factory-order in three configurations:

- Plug-in module designated DIU 2130/DDS
- EPROM upgrade kit to an existing DIU2130
- APA download upgrade kit for an existing DIU2130

  The software upgrade version is downloadable using the AM2000.

Compatibility and Requirements

The following revision and release levels are required to run the 56K NMS Option:

- NCC plug-in module of Rev. 4.6 or higher
- AM2000 Release 3.2A or higher

Upgrading to the 56K NMS Option

This section describes how to install your option depending on which of the available configurations you have.

NOTE: *To make use of the option, you need AM2000 Release 3.2A or higher. Preferably, you should have the current AM2000 installed before you begin a firmware download of the option. However, if you do not, you can still download the firmware upgrade using an earlier version of AM2000.*

Preconfigured Option

If you purchased a preconfigured DIU 2130/DDS, its EPROM already contains the 56K NMS Option. All you need do is to install the plug-in module and ConnecT 56K DSU(s). Then configure the element as directed in the subsection “Configuring a 56K DDS Module”.

Download Upgrade

If you purchased the downloadable software, you can download the 56K NMS Option into an existing DIU 2130 using AM2000.

The DIU 2130 56K NMS Option can be dynamically configured in the following formats:

- Both ports as standard $n \times 56$ or $n \times 64$ kbit/s (FTI)
- Both ports as 56K DDS
- Port 1 as 56K DDS and Port 2 as $n \times 56$ or $n \times 64$ kbit/s (FTI)
- Port 2 as 56K DDS and Port 1 as $n \times 56$ or $n \times 64$ kbit/s (FTI)

NOTE: *When you download a firmware upgrade to an existing module, the upgrade is loaded into the battery-backup RAM and not into the EPROM proper. If you disconnect the battery in such a module, the firmware reverts to the original firmware in the EPROM. Therefore, a module upgraded by a firmware download is different from a preconfigured module or one in which the EPROM has been replaced.*

EPROM Upgrade

If you purchased the EPROM upgrade, you need to replace the existing EPROM in the appropriate DIU 2130 with the DDS EPROM.

Installation

NOTE: *Before installing or using the 56K NMS Option, read the Verilink End-user Software License Agreement.*

Use AM2000 for installing and managing 56K circuits in a DDS network. The following steps ***summarize*** these tasks:

1. Install the release 3.2A of AM2000 if available and if you have not done so already.

   (If you do not have the current AM2000 software, you can still download the firmware with earlier versions.)

2. Identify the AS2000 DIU 2130 elements that require the 56K NMS Option (if any) and upgrade them according to the appropriate download or EPROM replacement procedures found towards the back of this document.

   For new installations with preconfigured DIU 2130/DDS elements that already contain the 56K NMS Option, skip to step 4.

3. Download the 56K NMS Option as instructed in the following sections.

4. Re-configure the existing node DIU for DDS operation.

   This includes modifying the DDS alarm thresholds for the site and configuring the loopback parameters for diagnostics.

   (For new installations, create the node before this step. See the *Access Manager 2000 User Manual*.)

5. Install the remote ConnecT 56K DSU(s).

6. Assure the system wiring is properly terminated, then begin initial testing by activating loop-backs and generating various test patterns onto the network. A counter maintained during the test, indicates the number of bit errors occurring in the network.

7. When the tests complete successfully, place the circuit in service.

The following sections describe the AM2000 screens and procedures for installing and managing the 56K NMS Option.

Configuring a 56K DDS Module

Configuration is similar to that of the standard DIU 2130, except for additional fields relating to alarm thresholds and DDS enable/disable. The configuration parameters are described below.

For the default parameter settings for the DIU 2130/DDS, see Table 1.

CAUTION

When you change to 56K DDS mode for a port that has previously been in *n* × 56/64K mode, be sure no more than one time slot is allocated to the port.

Figure 2 AM2000 Display of Options for DIU 2130/DDS Configuration Screen

Enable Alarm Reporting

Pressing F8 while the cursor is in this field displays the **Alarm Condition Options** screen shown in Figure 6-2.

DS0 Mode An F8 key is also associated with this field with the following options:

56K Select this mode for fractional T1.

56K DDS Select this mode to enable the 56K NMS Option mode. When you select this option, you can assign only one channel to the port.

See the Caution on the previous page.

64K This allows fullest use of the channelized data path, however, to ensure ones-density throughout the network, the CSU must be optioned for B8ZS. As with 56K mode, multiple channels of the T1 can be allocated to each DIU port at this rate.

Loop Pressing F8 while the cursor is in this field displays the **Loop Definition Options** screen described in ***Managing Loopbacks***.

Scramble This function is disabled in 56K DDS mode. The user interface will allow you to set it, but it is not supported.

Invert Tx HDLC Invert. This function is disabled in 56K DDS mode. (It inverts the user data to/from the DS1 connection and can be used to aid density enforcement with certain protocols.)

The default configuration parameter settings for the DIU 2130/DDS are listed in Table 1.

Table 1 DIU 2 130/DDS Configuration Default Settings

OPTION	DEFAULT
Installed and operational?	No
Save configuration to DIU?	No
Enable alarm reporting?	No
ASC Threshold	0 seconds
CMI Threshold	0 seconds
MOS Threshold	0 seconds
UMC Threshold	0 seconds
Group 1 DDS Codes Threshold	0 seconds
Alarm when looped?	Yes
Alarm when sending test pattern?	Yes
Alarm clear Delay time	15 seconds
Connected CSU shelf #	0
Connected CSU plug #	0
For each port:	
Channel Assignment	unassigned
EQP Name	blank
EQP SER.	blank
EQP Interface	blank
EQP Speed	blank
DS0 mode	64K
Enable Loops?	Y
Loop on received DDS code	DSU
Detect DTE LOS?	No

Table 1 DIU 2 130/DDS Configuration Default Settings

OPTION	DEFAULT
Select loop type on RL lead?	V.54
Enable Scramble?	No
Enable Invert? (Disabled in DDS mode)	No
EQP-Clock	ST
Force DTR?	No
Force RTS?	No
Force DSR?	No
Force CTS?	No
Force DCD?	No
Enable as TIU?	No

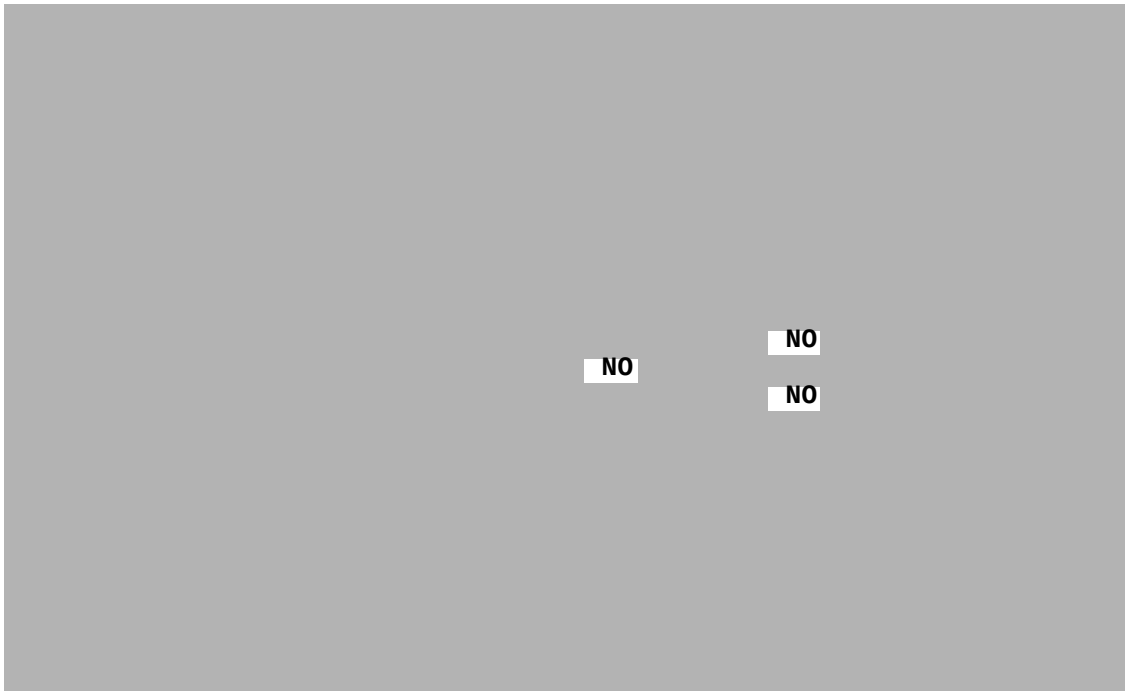
Status Monitoring

Monitor the 56K DDS circuit by either of the following alternatives:

- Await the autonomously generated alarms to arrive indicating a failure in the circuit.
- Periodically retrieve the element status to view the performance of the circuit.

Viewing the circuit status is available from the **On-line Access/Element Status** menu. When you select DIU 2130/DDS, the screen shown in Figure 3 is displayed.

Figure 3 AM2000 Display of DIU 2 130/DDS Status



The fields displayed in Figure 3 are described as follows:

Near End Looped Indicates whether a bidirectional loopback is activated for that port.

Far End Looped When set toYes, indicates that the far end device responded successfully to in-band loop-code transmission.

Sending Test Pattern Indicates that the port is sending a test pattern in the configured channel(s) of the T1 signal. Possible values for this field include:

- **NO** No test pattern is currently being generated
- **VERILINK** Indicates that theVerilink test pattern is being generated
- **511** Indicates that the 511 test pattern is being generated
- **2047** Indicates that the 2047 test pattern is being generated

Error Counter When the port is generating a test pattern, the received channelized data is verified against the data being transmitted. If a mismatch occurs, the data block is considered as having one or more bit errors and increments a counter. This field is the current count of block errors detected by the DIU for that port.

DTE LOS A value of YES or NO indicating the presence of a DTE device connected to the DIU port. The DIU uses the DTR or RTS signals found on the port connector to detect if a device

is present. The DIU must be configured properly in order to detect these signals. (See ***Upgrading to the 56K NMS Option***.)

ASC Exceeded Indicates that the configured threshold for Abnormal Station Code has been exceeded. This field is available for ports configured for 56K DDS mode only.

CMI Exceeded Indicates that the configured threshold for Control Mode Idle has been exceeded. This field is available for ports configured for 56K DDS mode only.

MOS Exceeded Indicates that the configured threshold for Mux-Out-Of-Sync has been exceeded. This field is available for ports configured for 56K DDS mode only.

UMC Exceeded Indicates that the configured threshold for Unassigned Mux Channel has been exceeded. This field is available for ports configured for 56K DDS mode only.

Received DDS Code Indicates the last received DDS code from the channelized data. The following abbreviations can appear in this field:

ASC	Abnormal Station Code
BLK	MJU Branch Block
CMI	Control Mode Idle
FEV	Far End Voice
LBE	Loop Back Enable
MA	MJU Alert
MOS	Mux-Out-Of-Sync
RLS	Release
TA	Test Alert
TC	Test Code
TIP	Transition In Progress
UMC	Unassigned Mux Channel
ZCS	Zero suppression

If an unknown code is detected, then the received data bits will be displayed in hexadecimal format, as shown in Figure 3.

The threshold exceeded fields and DDS status byte field are only available for ports configured for 56K DDS mode.

If the port is not configured for 56K DDS mode, then the fields for that port will be displayed with N/A.

Managing Alarms

The 56K NMS Option generates the following alarms:

ASC	Abnormal Station Code
CMI	Control Mode Idle
LB	Local Loopback Alert
MOS	Mux-Out-of-Sync
TM	Local Test Started
UMC	Unassigned Mux Channel

Group 1 DDS Codes

- BLK (Block Code)
- MA (MJU Alert)
- RLS (Release Code)
- TA (Test Alert)
- TC (Test Code)

Alarm Detection

Detection of alarms is based on exceeding the thresholds based on a "leaky bucket" algorithm. The thresholds are variable and can be set by the user in seconds from 1 to 255. Setting the alarm thresholds to 0 will disable the alarms (same options as CSU alarm configuration). If the DDS control code is received continuously for the specified period then the alarm is declared. If the circuit is intermittent, the integration process decays at the rate of 1/5 of the rise slope. Alarms clear when 15 seconds have elapsed without the DDS control code.

Alarm Parameters

The following DDS status codes have an associated alarm threshold which will cause an alarm to be generated when reached:

Abnormal Station Code (ASC)

This indicates that channelized data upstream is disrupted.

Control Mode Idle (CMI)

This is an idle pattern sent when no channelized data is present. This may be normal for some types of circuits.

MUX-Out-Of-Sync (MOS)

Indicates that a loop is established upstream or the DS-1 signal is in an out-of-frame condition.

Unassigned MUX Channel (UMC)

Similar to MOS, an upstream device has disrupted the transmission path.

Group 1 DDS Codes This threshold setting affects the following DDS codes:

- Block Code (BLK)
- MJU Alert (MA)
- Test Alert (TA)
- Test Code (TC)
- Release (RLS)

Individual counters are kept for each of the listed DDS codes and when the counter exceeds this value, an alarm specific to the exceeded counter will be generated.

Figure 6-2 AM2000 Display of Optionable Alarm Parameters for DIU 2130 (DDS)

Table 3, DIU 2130/DDS Alarm Codes, lists the alarm codes that can be sent by the DIU 2130 when configured for 56K DDS.

Table 3 DIU 2 130/DDS Alarm Codes

Alarm Code	Description
801	Port 1 Loss of Signal Alarm
802	Port 1 Loss of Signal Cleared
803	Port 2 Loss of Signal Alarm
804	Port 2 Loss of Signal Alarm Cleared
805	Port 1 Abnormal Station Code Exceeded Alarm
806	Port 1 Abnormal Station Code Exceeded Alarm Cleared
807	Port 1 Control Mode Idle Exceeded Alarm
808	Port 1 Control Mode Idle Exceeded Alarm Cleared
809	Port 1 Mux-Out-Of-Sync Exceeded Alarm
810	Port 1 Mux-Out-Of-Sync Exceeded Alarm Cleared
811	Port 1 Unassigned Mux Channel Exceeded Alarm
812	Port 1 Unassigned Mux Channel Alarm Cleared
813	Port 1 MJU Alert Exceeded Alarm
814	Port 1 MJU Alert Exceeded Alarm Cleared
815	Port 1 Test Code Exceeded Alarm
816	Port 1 Test Code Exceeded Alarm Cleared
817	Test Alert (TA) Port 1
818	Test Alert (TA) Port 1 Cleared (Table continued on the next page.)
819	Port 1 Block Exceeded Alarm
820	Port 1 Block Exceeded Alarm Cleared
821	Port 1 Release Exceeded Alarm
822	Port 1 Release Exceeded Alarm Cleared
823	Port 1 Looped Alarm
824	Port 1 Loop cleared
825	Far Port 1 looped Alarm
826	Far Port 1 loop cleared
827	Port 1 Test Signal Alarm
828	Port 1 Test Signal Cleared
829	Port 2 Abnormal Station Code Exceeded Alarm
830	Port 2 Abnormal Station Code Exceeded Alarm Cleared
831	Port 2 Control Mode Idle Exceeded Alarm
832	Port 2 Control Mode Idle Exceeded Alarm Cleared
833	Port 2 Mux-Out-Of-Sync Exceeded Alarm
834	Port 2 Mux-Out-Of-Sync Exceeded Alarm Cleared
835	Port 2 Unassigned Mux Channel Exceeded Alarm

Table 3 DIU 2 130/DDS Alarm Codes

Alarm Code	Description
836	Port 2 Unassigned Mux Channel Alarm Cleared
837	Port 2 MJU Alert Exceeded Alarm
838	Port 2 MJU Alert Exceeded Alarm Cleared
839	Port 2 Test Code Exceeded Alarm
840	Port 2 Test Code Exceeded Alarm Cleared
841	Test Alert (TA) Port 2
842	Test Alert (TA) Port 2 Cleared
843	Port 2 Block Exceeded Alarm
844	Port 2 Block Exceeded Alarm Cleared
845	Port 2 Release Exceeded Alarm
846	Port 2 Release Exceeded Alarm Cleared
847	Port 2 Looped Alarm
848	Port 2 Loop Cleared
849	Far Port 2 Looped Alarm
850	Far Port 2 Loop Cleared
851	Port 2 Test Signal Alarm
852	Port 2 Test Signal Cleared
1013	Low Battery Alarm

Managing Loopbacks

Loopbacks are used for sending and receiving test patterns on a circuit. The 56K NMS Option provides different types of loopbacks, loopback modes, and test patterns. Once the loopback is established, you can send the test pattern from the near end unit. This section describes how to select a loopback and configure its loopback mode.

Types of Loopbacks

The 56K NMS Option provides the following methods of activating the DIU 2130 bidirectional DTE loopback:

- DDS Latching Loopback (OCU, CSU, DSU)

  This loopback is discussed in a separate subsection below.

- ITU-T V.54 (useful in DDS mode)
- Local DTE loopback
- Remote RL lead loopback

V.54 Loopback

This loopback meets the T1.403 standard which is similar to the CCITT V.54 standard. It uses the same polynomial as the V.54 loopback to generate the loop-up and loop-down codes:

$$1 + x^{-4} + x^{-7}$$

Verilink Proprietary In-band Loopback

(Verilink proprietary in-band loopback is not useful in DDS mode.) This loopback includes the following:

loop-down Inverted 1-in-3

loop-up Inverted 1-in-5

Local DTE Loopback

The local DTE loopback is supported in ASCII user interface and AM2000. It can be activated/enabled by the ASCII user interface, AM2000, or the LL lead. This loopback is bidirectional.

Remote RL Lead Loopback

You can activate/enable a remote loopback by the ASCII user interface, AM2000, or the RL lead. This loopback is bidirectional.

Loop-back Mode Configuration Options

Several parameters can be specified for the operation of loop-backs. These parameters are located in the AM2000 **DDS Loop Options** screen. (See Figure 4.) You can display them by pressing the F8 key when the cursor is in the **Loop** field in the DIU 2130 configuration screen (See Figure 2). The **DDS Loop Options** screen is used to configure the loopback options. Each port can be configured independently.

The following fields are available:

Figure 4 AM2000 Example Display of Available DDS Loopback Definition Options

Loop on received DDS code

Selects the DDS code on which the DIU213 0 port will activate its bidirectional loopback. Choices include:

- DSU
- OCU
- V.54
- Channel

Select loop type on RL lead

This field selects which loop code to send in the channelized data to the remote end when the RL lead on the DTE connector interface module is forced high. Various loop code types include:

V.54	Most useful in DDS mode
FT1	Used for fractional T1
Verilink	Not useful in DDS mode

AM2000 Loopback Activity Menu

Figure 5 is a AM2000 screen display of the loopback selections available in AM2000.

Figure 5 AM2000 Display of the Select DIU 2130/DDS Loopback Activity

There are sub-menus for DDS latching loopback menu selections.

DDS Latching Loopbacks

Once this loopback is started, it remains in effect until released by another specific code sequence. This eliminates most restrictions on the test data that can be transmitted.

NOTE: *The DIU 2130 must be optioned for the 56K NMS Option for latching loopbacks to work.*

When you select the DDS latching loopback, the screen in Figure 6 appears. The possible choices are:

Figure 6 Choices for Latching loop backs

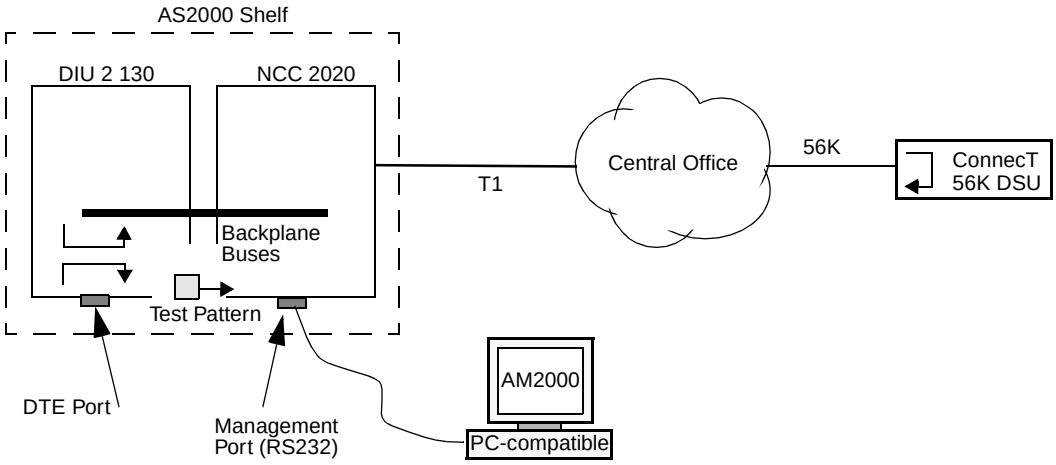
Channel	The DDS code S 0 1 0 1 0 0 0 is placed in the channelized data.
DSU	The DDS code S 0 1 0 1 1 0 0 is placed in the channelized data.
OCU	The DDS code S 0 1 0 1 0 1 0 is placed in the channelized data.

Sending Diagnostic Test Patterns

Once the loop is established, you can send the test pattern from the near end unit. The test pattern is placed only in the channel allocated to the port being tested.

The example circuit shown in Figure 7 illustrates the diagnostic capabilities provided by AS2000 within the DDS network that is accessible from AM2000.

Figure 7 DIU 2 130/DDS) Example Test Pattern Circuit



In this example, a DIU 2130 with DDS capability is connected to a ConnecT 56k DSU at the far end. To test the network circuit, a remote loop-back is first activated. In a DDS circuit to a ConnecT 56, either a DDS latching loop or a V.54 loopback option can be used to perform the remote loop-back.

You can send and monitor diagnostic test patterns from the AM2000 **Online Access/Loopbacks** and **Online Access/Select Test** menu items. The AM2000 displays the results of the test. The **Status** menu described in the section titled***Status Monitoring***, indicates when a test pattern is being sent.

The AM2000 menu shown in Figure 8 lists the available test patterns you can select.

Figure 8 AM2000 Screen display of the Select DIU2130/DDS Test Activity Menu

Verilink test pattern	is a 4-bit pseudo-random test pattern. It is not very useful in DDS mode.
511 and **2047**	These test patterns can be locally enabled on both ends simultaneously without enabling loops in order to independently test the transmit and receive lines. Both these test patterns are useful in DDS mode.

ASCII Interface

Figure 9 illustrates the ASCII (Craft) Interface Configuration Screen for a DIU 2130/DDS.

Figure 9 ASCII Interface Configuration Screen for the 56K NMS Option

```
              --- DIU 2130 CONFIGURATION/DIAGNOSTIC MENU ---

S) save config                  Q) restore config              X) exit menu

C) CSU                 [1,1]
T) timing source       CSU

chnl  01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Dp)   01 02.. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. ..

   Lead Toggles     DTR)   DSR)   RTS)   CTS)   DCD)
   Forced Ports     -/-    -/-    -/-    -/-    -/-

                       Port 1         Port 2      Statistics
Mp) mode               56K(DDS)       56K         FW/HW Rev...1.0/0.8
Sp) scram/HDLC Inv     OFF/OFF        ON/OFF      Battery.....OK
Kp) clocking           ST             ST          DTE Intf....--/--
Gp) LOS lead           NONE           NONE        Data bus....A

Ep) enable loop        YES            YES         Tp) test and monitor BEC
Np) near loopback      OFF            OFF         Pp) monitor leads and status
Fp) far loopback       OFF            OFF         A) enable alarm reporting
```

NOTE: *Any options on the Configuration Menu followed by a small* **p** *must be used in combination with the appropriate port number. For example, the* **Mp - mode** *command must be entered as either* **M1** *or* **M2** *depending on which port is to be configured.*

Supervisory Functions

S save config — Save current DI U2130 configuration settings into the master NCC node controller.

Q restore config — Restore the previously saved configuration.

X exit menu — Return to main menu.

A enable alarm reporting

Enables or disables alarm reporting for the plug. This includes the standard DIU 2130 alarms as well as the extended DDS alarms for both port 1 and port 2.

NOTE: *DDS alarm thresholds must be set using AM2000.*

DIU 2130 Configuration / Diagnostic Menu Options

C - csu Assigns a DIU 2 1 30 to a CSU in the node. (The CSU must have the A, B, or C bus enabled.)

T - timing source Selects the DIU data port that will provide a TT clock as the T1 timing source.

Dp - port Assigns channels to the port selected. In the DIU2130 mode any number of channels from 1 to 24 can be assigned. In the DDS 56K mode only ***one*** channel can be assigned from the 24 channels.

Mp - mode Establishes the data transmission mode (56Kbit/s, 64Kbit/s, 56K DDS) for the data port selected with the **Dp** command.

Sp - scramble data Scrambles and/or Inverts the data in DIU213 0 mode. In DDS 56K mode these options are always OFF.

Kp - clocking Selects the proper data input clock for each data port of the DIU.

Gp - LOS lead Detects the lead for Loss of Signal. The options are DTR, RTS and NONE.

DTR, DSR, RTS, CTS, DCD

(Handshake leads) Force handshake leads on.

Test Functions

Ep - enable loop Enable a response to loopbacks when any of the various loop codes are received.

Np - near loopback Activates and deactivates a near-end loopback.

Fp - far loopback Most useful for activating and deactivating V.54 a far-end loopback:

Verilink	Nx56K and Nx64K modes
V.54	56K DDS modes
T1E1.2	(FT1). Nx56K and Nx64K modes

Tp - test and monitor BEC

Initiates a 511, 2047, or Verilink test pattern and displays an error monitor.

Pp - monitor leads and status

Shows and updates the real-time handshake leads and status every two seconds. In 56K DDS mode the last received DDS control code or data will also be displayed.

Appendix 7

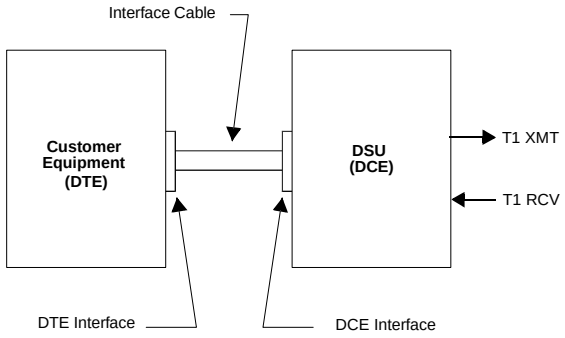
DIU/DIM Details

Verilink DSUs have two sides:

- A Network (T1) Side
- An Equipment Side

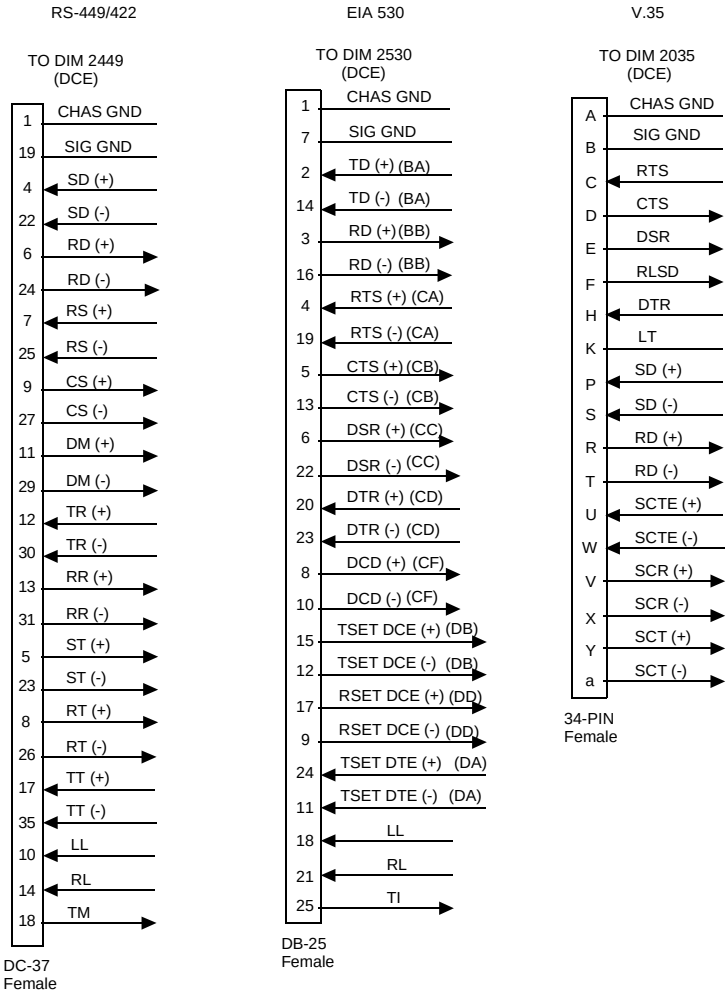
The equipment side of the DSU is a Data Communication Equipment (DCE) interface. In a standard configuration, the equipment connected to the DSU is the Data Terminal Equipment (DTE) (Figure 7-1).

Figure 7-1 Standard DCE-to-DTE Configuration



The DIU 2130 supports three types of (DTE) interfaces: ITU-T V.35, RS-449/422, and EIA 530. The RS-449/422, EIA 530, and V.35 interfaces are logically equivalent. The only difference between the three are their electrical interface characteristics (voltage levels) and connectors (Figure 7-2).

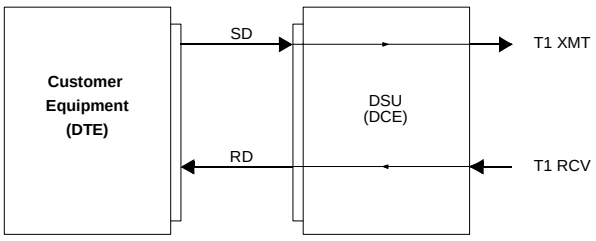
Figure 7-2 DIU 2130 Data Signal Connections



DCE to DSU Data and Clock/Timing Signals

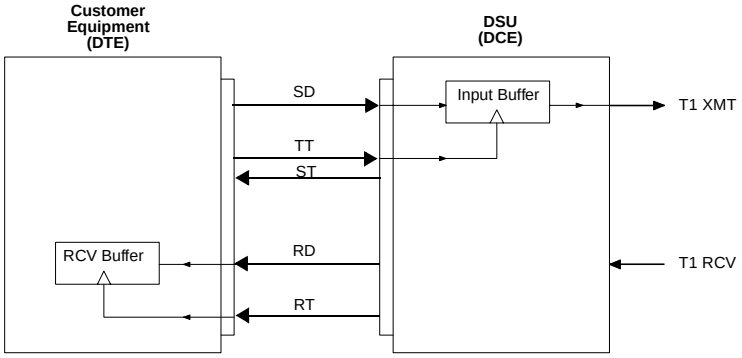
At the DCE interface on the DIU, data from the equipment being sent towards the network is referred to as Send Data (SD). Data from the network being sent towards the equipment is referred to as Receive Data (RD) (Figure 7-3).

Figure 7-3 Send Data (SD) and Receive Data (RD)



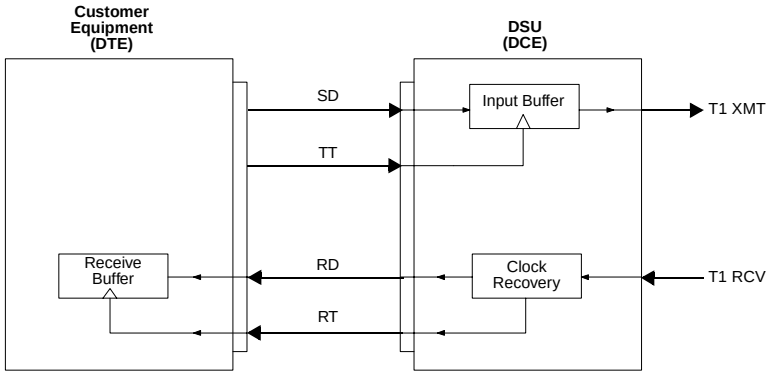
The SD and RD signals have associated clock signals called Terminal Timing (TT) and Receive Timing (RT). The DIU's input buffer may use the TT signal to clock in SD. The customer's DTE receive buffer uses the RT signal to clock in RD (Figure 7-4).

Figure 7-4 Terminal Timing (TT) and Receive Timing (RT)



The RT signal is derived by recovering the clock from the data stream coming from the network. Since the T1 data contains overhead bits that are removed before being sent to the DTE, the frequency of this data is different than the frequency of RD. In the receive direction, the frequency is decreased from 1.544 Mbit/s to the selected interface frequency. In the transmit direction, the frequency is increased from the selected interface frequency to 1.544 Mbit/s. (Figure 7-5)

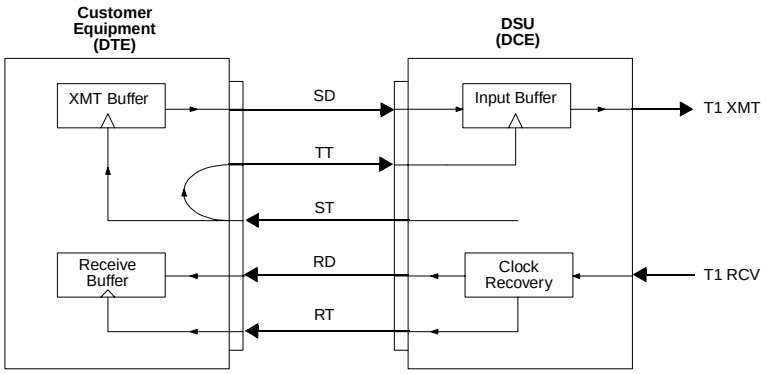
Figure 7-5 Receive Clock Recovery



Send Timing

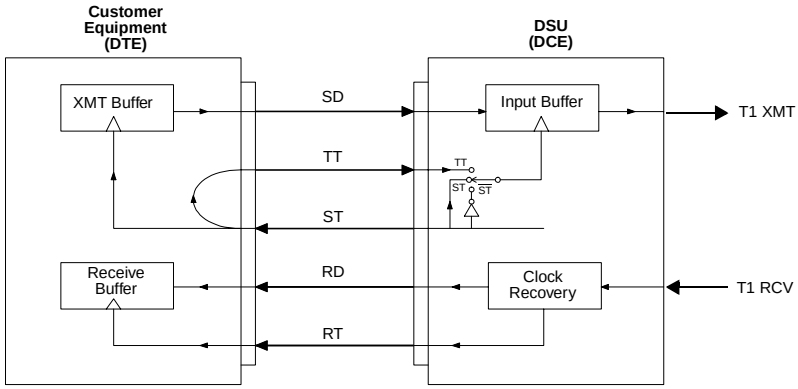
Send Timing (ST) is used to control the rate at which the DTE presents transmit data. Send Timing (ST) is also sent by the DIU to tell the DTE the exact frequency to transmit on the SD and TT leads. The DTE uses the ST signal to clock data onto the SD lead. (Figure 7-6)

Figure 7-6 Send Timing (ST)



Since TT must be locked to ST, most DTE manufacturers turn ST around on TT, and TT is usually an exact duplicate of ST. (Figure 7-7)

Figure 7-7 Interface Timing Options



Therefore, the DIU can be set to clock in SD using ST instead of TT. Consequently, some DTE manufacturers do not implement the TT signal. If the cable between the DIU and DTE is long enough, the DIU may require setting the clock for inverted ST rather than ST; this allows for a slight phase shift.

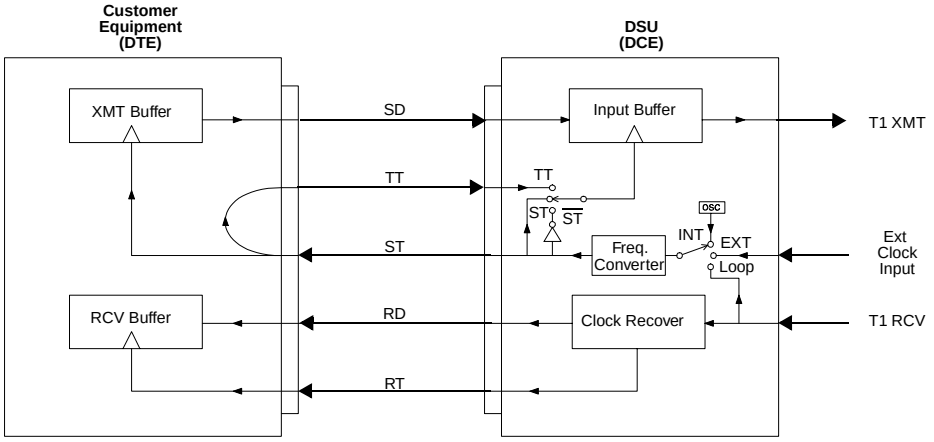
For the DCE-DTE interface to function properly, the data signals must be synchronized with the associated clock signals. Therefore, the following signals (if implemented) must be synchronized:

- RD with RT
- TT with ST with SD

In the T1 transmit direction, SD and TT (if implemented) must both be synchronized with ST. The ST is derived from the T1 transmit clock, and is generated using one of one the following timing methods (Figure 7-8):

- Network Loop Timing (T1 Bit Stream)
- Internal Timing (Master Clock)
- External Timing (Station Clock)

Figure 7-8 Source of Send Timing (ST)



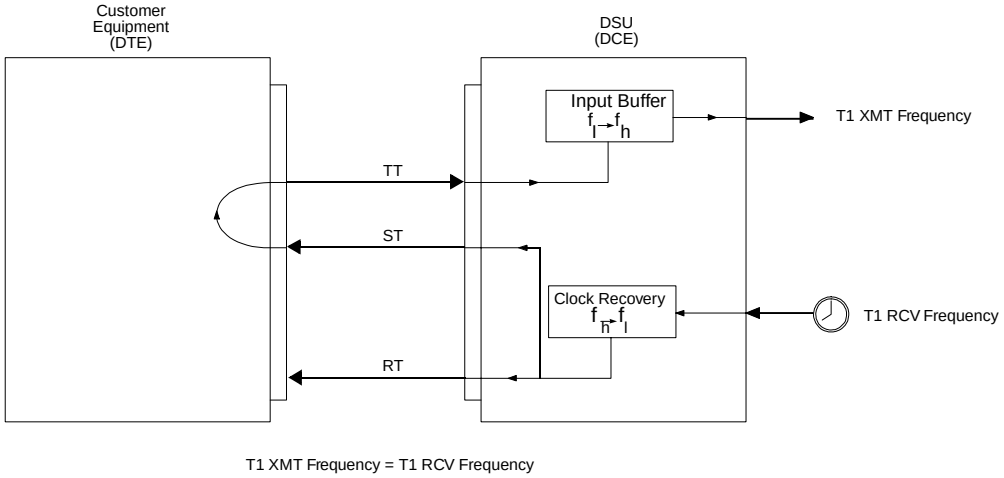
ST controls the exact bit rate at which data is transmitted toward the network on the DTE interface.

Network Loop Timing

In loop timing, the received T1 signal generates both the RT and ST signals. The receive T1 signal is the clock source. Figure 7-9 shows the timing signal paths as follows:

- The receive T1 signal clock is extracted in the CSU clock recovery circuit. The clock is converted from T1 frequency (1.544 Mbit/s) to the lower RT frequency in the DIU. This is shown in the clock recovery circuit as f_h (higher frequency) being converted to f_l (lower frequency).
- In loop timing, ST is synchronized with RT.
- The T1 transmit frequency is derived from the T1 receive signal; therefore, the T1 transmit frequency is identical to the T1 receive frequency.

Figure 7-9 Loop Timing



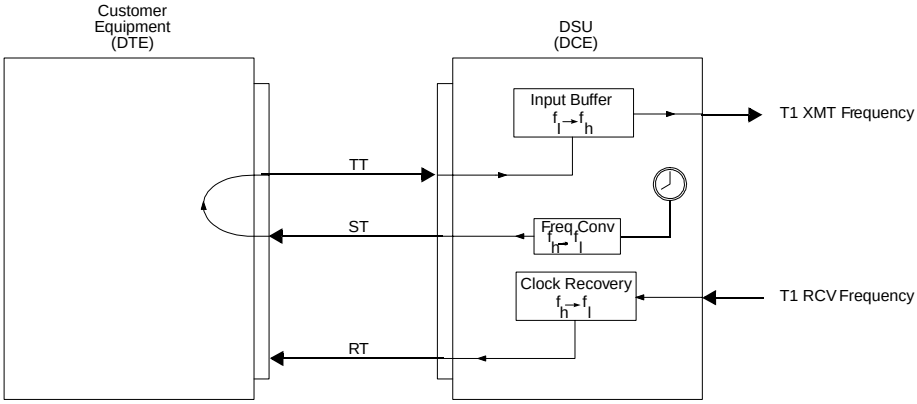
Internal Timing

In internal timing, the ST signal is generated from an internal oscillator, while the RT signal is generated from the recovered T1 signal clock. There is no connection between the two transmission directions; RT is generated separately from ST, and the T1 transmit frequency is not necessarily synchronized with the T1 receive frequency.

The T1 transmit and receive frequencies will be synchronized, if the far-end circuit is looped-timed. However, the T1 transmit and receive frequencies will be different if the far-end DIU is set for internal or external timing.

Figure 7-10 shows the timing signal paths for internal timing.

Figure 7-10 Internal Timing

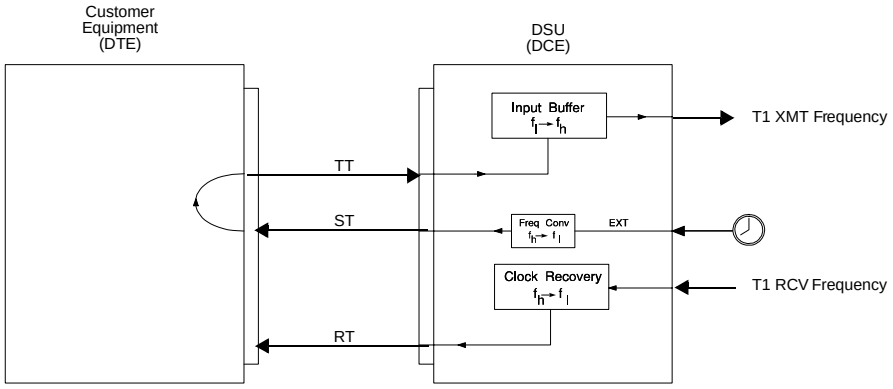


External Timing

In external timing, the ST signal is generated from an external oscillator, while the RT signal is generated from the recovered T1 signal clock. There is no connection between the two transmission directions; RT is generated separately from ST, and the T1 transmit frequency is not necessarily synchronized with the T1 receive frequency.

The T1 transmit and receive frequencies will be synchronized, if the far-end circuit is looped-timed. However, the T1 transmit and receive frequencies will be different if the far-end DIU is set for internal or external timing. SeeFigure 7-11.

Figure 7-11 External Timing



If the Far End is looped timed, then T1 XMT Frequency is = T1 RCV Frequency

If the Far End is not looped timed, then T1 XMT Frequency = T1 RCV Frequency

DIU 2130 Clear Channel Operation Requirements

This section contains information on the Data Service Unit (DIU 2130) clear-channel operation requirements for 64 kbit/s transmission.

On a normal T1 line, the following two requirements must be met before transmitting the data onto the public network (as requested by most tariffs):

1. Average ones density requirement—in general, 12.5% of transmitted data must be ones, or the transmitted data must have an average density of 12.5%.

2. Consecutive zeros requirement—transmitted data can have no more than 15 zeros in a row.

Clear-Channel T1 Line

On a clear-channel T1 line, the transmitted data can contain unrestricted zeros density (any number of ones and zeros) in any combination.

A clear-channel T1 line is achieved by using B8ZS (Binary Eight Zeros Substitution) before transmitting the data to the public telephone network and decoding it at the other end. The NCC 2020 or TAC 2010 CSU does this encoding and decoding. The option is set using Node Manager, Access Manager 2000, some other management software, the Craft interface, or the master NCC/SCC thumbwheel switch.

Carrier Requirements

Contact the T1 line provider (telco) and verify that the network will support the B8ZS encoding scheme.

Clear-channel operation and data equipment rates

When using a DIU 2130, the requirement for a clear-channel T1 line depends upon the data equipment transmission that will be used. The following guidelines apply:

1. If you have selected a data rate of 56 kbit/s or a multiple of 56 kbit/s, the DIU 2130 can operate at any data rate up to and including 1.344 Mbit/s without a clear-channel T1 line.

2. If you have selected a data rate that is a multiple of 64 kbit/s, the following guidelines apply:

   - If you assign alternate DS0 channels (i.e., odd-numbered or even-numbered channels only), the DIU 2130 can operate at any data rate up to and including 768 kbit/s. This mode is used when B8ZS is not available.
   - If you assign DS0 channels randomly such that two channels in a frame are never next to each other (i.e., 1, 4, 6, and 9), then a clear-channel T1 line is not required.
   - If you assign DS0 channels such that two channels in a frame are next to each other (i.e., 1, 2, 6, and 7), then a clear-channel T1 line is required.
   - If you assign DS0 channels contiguously (in numeric sequence), a clear-channel T1 line is required at all data rates at 128 kbit/s and above. Include 64 kbit/s if the adjacent channels are also used for 64 kbit/s or if rates higher than 64 kbit/s are required by the application.
   - Simply put, for rates = $n \times 64$, B8ZS is required.

Drop and Insert Mode

If you are connected to a DS1 channel bank using 64 kbit/s data and configured for drop and insert, all of the guidelines apply.

DIU Interface Operation

The CSU of the NCC or TAC can operate with DIU 2130s for high-speed customer data transmission over the T1 network. The CSU provides this data service in either a T1 multiplexer mode or a drop-and-insert mode.

T1 Mux Mode

Figure 7-12 shows how the CSU of an SCC, NCC, or TAC interfaces with one or more DIUs in a T1 multiplexer mode. In the transmit direction toward the network, each DIU multiplexes the incoming data from the customer data equipment. It places the data in the

appropriate DS0 channel time slots of the backplane DIU data bus assigned to the CSU. In the figure, four channels are assigned to each of the four DIU data ports for network transmission.

The composite data going to the CSU contains the multiplexed data from all associated DIUs. Upon receiving this data, the CSU multiplexes it into a DS1 signal for transmission over the T1 network. It also sends all-ones bytes on all unassigned channels.

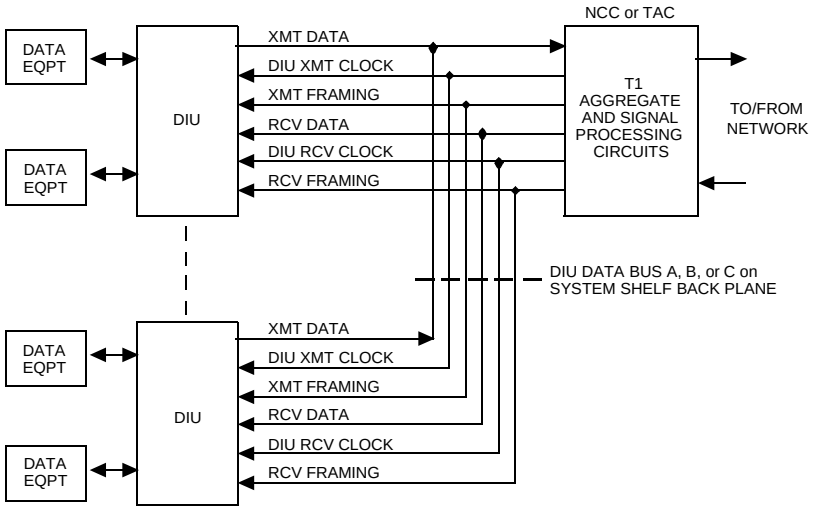
In the other direction of transmission, the CSU routes the incoming signal to all DIUs via the assigned data bus. Each DIU demultiplexes the incoming signal to derive the individual channel data.

The CSU also sends clock and framing signals to the DIUs over the assigned data bus. These signals synchronize the DIU transmit and receive side circuits to the CSU. The CSU derives the CSU and DIU transmit clocks and the DIU receive clock from one of the following reference clocks:

- The internal crystal oscillator clock generated in the CSU circuits.
- An external 1.544 MHz DS1/AMI
  - optional with a TIU 2850 timing coprocessor, or
  - RS-422 or TTL reference clock.
- External timing N × 56 or N × 64 kbit/s; optional through the TIU 2850 timing coprocessor.
- The incoming signal from the network or equipment interfaces (loop timing).
- Terminal Timing (TT) signal from a data terminal equipment (DTE) device connected to a DIU 2130.

The CSU accommodates up to 24 DIU 2130s over the selected data bus. It can also interface with any combination of DIUs whose aggregate capacity is 24 DS0 channel time slots.

Figure 7-12 T1 Multiplexer (CSU/DSU) Operation



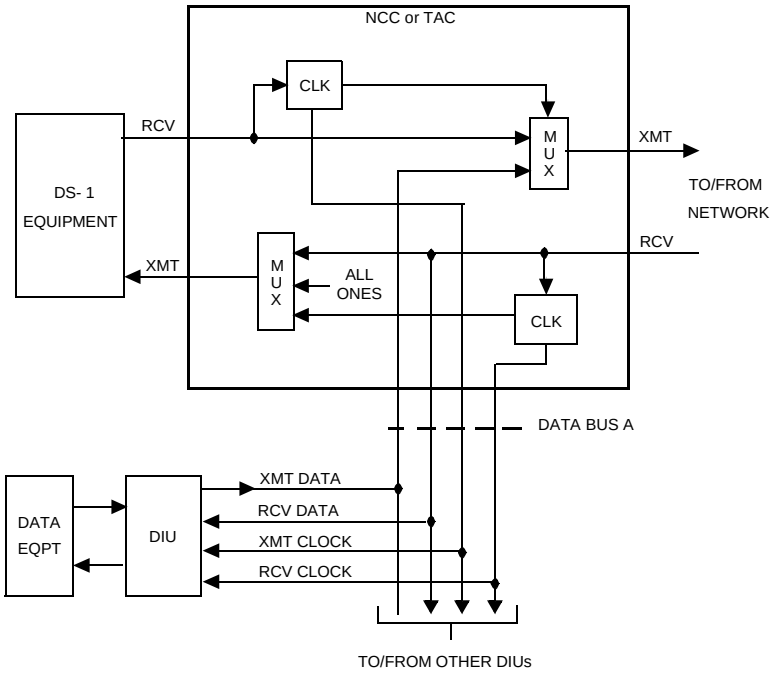
Drop-and-Insert Mode

The CSU of an SCC, NCC ,or TAC can also operate with DIUs in a drop-and-insert mode. This allows the CSU to transmit a combination of voice (VF) and high-speed data over the T1 network. The CSU provides drop-and-insert toward either the network or the equipment in a full-duplex, unidirectional transmission mode.

Toward Network

Figure 7-13 shows a CSU drop-and-insert configuration toward the network. The incoming signal from the customer's DS1 equipment is applied to a multiplexer in the CSU. The multiplexed data from the DIUs is also routed to this multiplexer over the data bus A on the shelf backplane. This data occupies the DS0 channel time slots assigned by the user to the DIUs. The T1 aggregate signal is then applied by the multiplexer to the network.

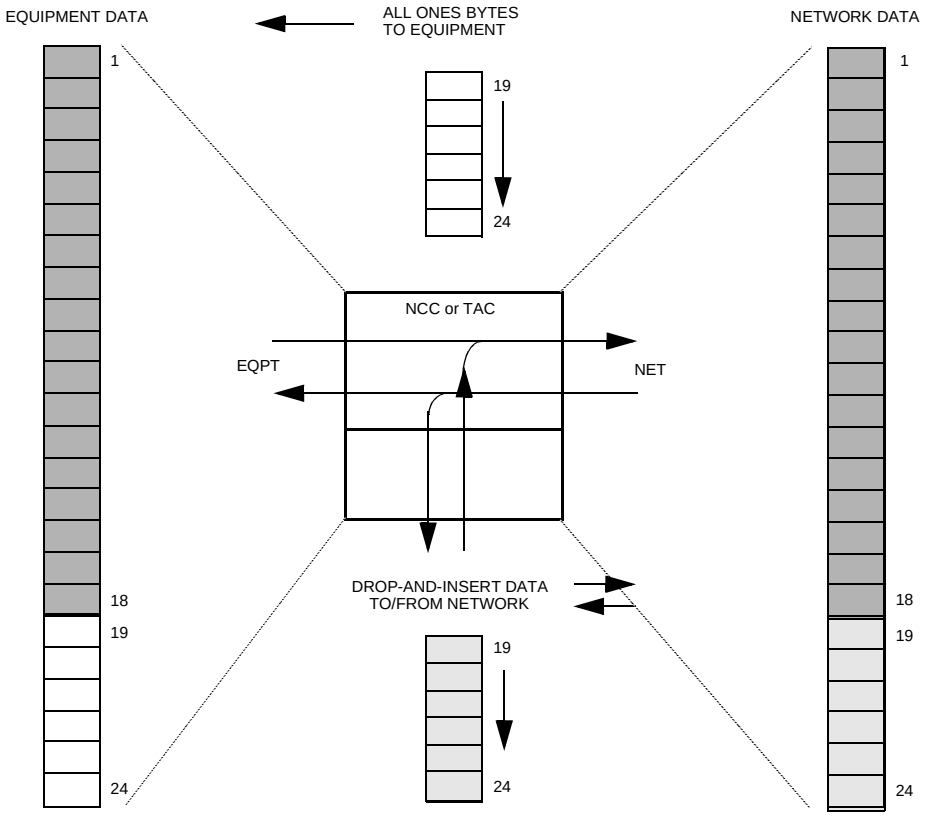
Figure 7-13 Drop-and-Insert Toward Network



In the opposite direction of transmission, the CSU passes the incoming T1 signal to the DIUs over data bus A. The equipment-side multiplexer of the CSU also routes the incoming network signal to the DS1 equipment. In addition, it inserts all-ones idle code bytes into the DS0 channel time slots assigned to the DIUs, and sends this data to the DS1 equipment.

Figure 7-14 shows how DS0 data is processed during drop-and-insert toward the network. In this example, channels 1 to 18 of the signal from the DS1 equipment convey voice channels from the channel bank or PBX.

Figure 7-14 Data Flow for Drop-and-Insert Toward Network



Channels 19 to 24 are available for high-speed data transmission over the network. These six channels are user-assigned to a data port of a DIU 2130 connected to the CSU. The CSU inserts the high-speed data onto channels 19 through 24 of the signal from the equipment, and then sends the composite signal to the network.

Incoming from the network, the CSU drops the incoming composite DS1 signal to the DIU 2130. The high-speed data on channels 19 to 24 is extracted by the DIU and routed to the customer data equipment. The data on channels 1 through 18 of the incoming network signal continues through the CSU to the DS1 equipment. The CSU also sends all-ones on channels 19 to 24 toward the equipment.

For through timing with drop-and-insert toward the network, the receive DIU clock is derived from the incoming network signal and applied to the DIUs via data bus A. (Figure 7-13.) The DIU transmit clock and the CSU transmit clock to the network are similarly derived from the incoming signal from the equipment. The transmit and receive clocks are applied to the DIUs via Data Bus A.

CSU Timing

When a CSU is used with DIUs, the associated DIUs must be timed from a reference clock source. The CSU synchronizes itself with the DIUs by deriving two separate timing signals (transmit and receive clocks) from the reference clock source. It sends these signals to the DIUs over the assigned data bus.

To support various T1 network applications, the Access System 2000 offers several operator-selectable system timing options. These options are:

- Through timing
- Internal timing
- Network timing
- Equipment timing
- External timing
- Data equipment timing (DTE)

In all of the above timing modes, the transmit and receive clocks sent by the CSU to the DIUs over the assigned data bus are 1.544 MHz clocks. The DIUs divide these clocks down to the proper rates before sending them to the customer data equipment.

Through Timing

Through timing is commonly used in drop-and-insert mode. Signal clocking through the CSU occurs as described above in each direction. Also, the CSU sends the transmit and receive clocks to the DIUs. These are used to clock data from the T1 multiplexers of the CSU to the associated DIUs, and from the DIUs to the CSU.

For through timing with drop-and-insert toward the network, the receive DIU clock is derived from the incoming network signal and applied to the DIUs via Data Bus A. (Figure 7-13). The DIU transmit clock and the CSU transmit clock to the network are similarly derived from the incoming signal from the equipment. The transmit and receive clocks are applied to the DIUs via Data Bus A.

Loop Timing

In loop timing, the reference clocks that synchronize the CSU with the associated DIUs are derived from a DS1 signal received by the CSU. These clocks can be derived from either the incoming network signal (network timing) or the equipment signal (equipment timing).

Network Timing

Typical applications of network timing in the T1 multiplexer and the drop-and-insert CSU modes are shown in these figures:

- Figure 7-15
- Figure 7-16

In network timing, DS1 data is timed through the CSU by a reference clock derived from the incoming signal from the network. The network-extracted transmit clocks also synchronize the DIUs to the CSU. These clocks are applied to the DIUs via the assigned data bus.

Figure 7-15 Network Timing (T1 Multiplexer Mode)

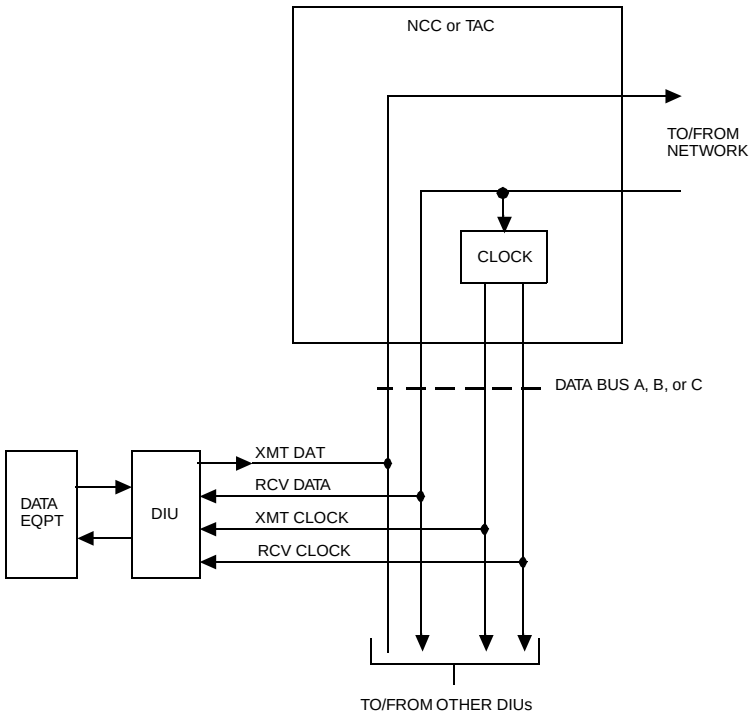
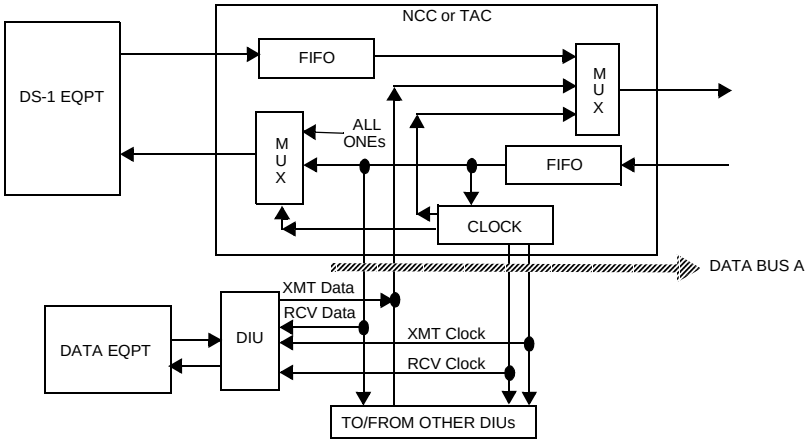


Figure 7-16 Network Timing (Drop and Insert Mode)



External Timing

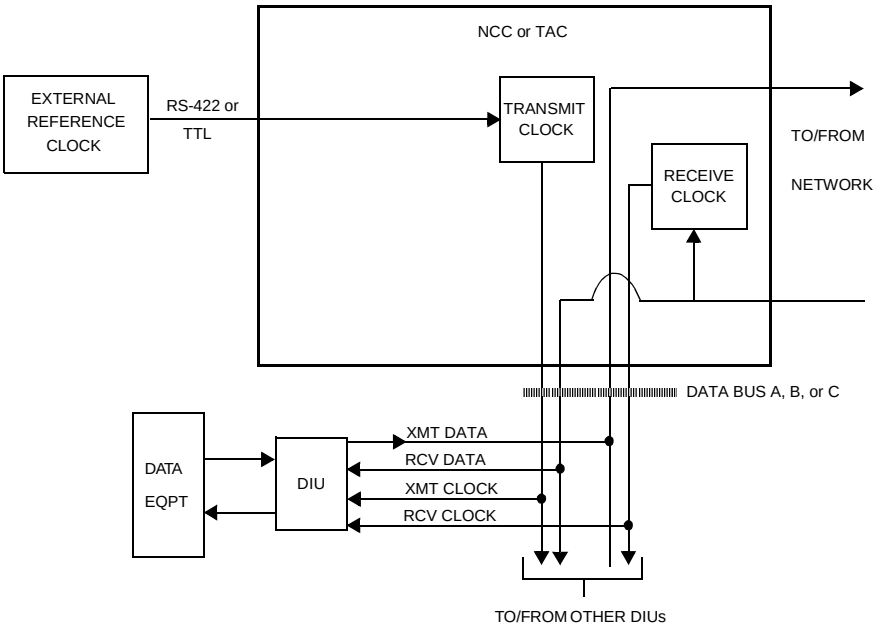
In external timing, the network and equipment signals are timed through the CSU of an NCC or TAC by a customer-furnished reference clock. External timing can be provided directly to the CSU as described below. In all external timing modes, the receive DIU clock is always derived from the T1 signal to the CSU.

T1 Multiplexer Mode

Figure 7-17 shows an external timing application when the CSU is in the T1 multiplexer mode. The external clock is applied directly to the NCC or TAC. This clock is a stable 1.544 MHz signal in an RS-422 or TTL format.

NOTE: *The external clock must meet the input frequency, jitter, and wander requirements of a DS1 signal as per AT&T PUB 62411.*

Figure 7-17 External Timing (T1 Multiplexer Mode)



Data Equipment Timing

In data equipment timing, the clock source is the TT (Terminal Timing) signal applied from a data equipment device in a DTE configuration to a DIU 2130. Figure 7-18 shows data equipment timing for the CSU T1 multiplexer mode of operation. Data Bus A or B conveys the data between the DIUs and CSU, and Data Bus C conveys the TT signal.

Figure 7-18 Data Equipment Timing (T1 Multiplexer Mode)

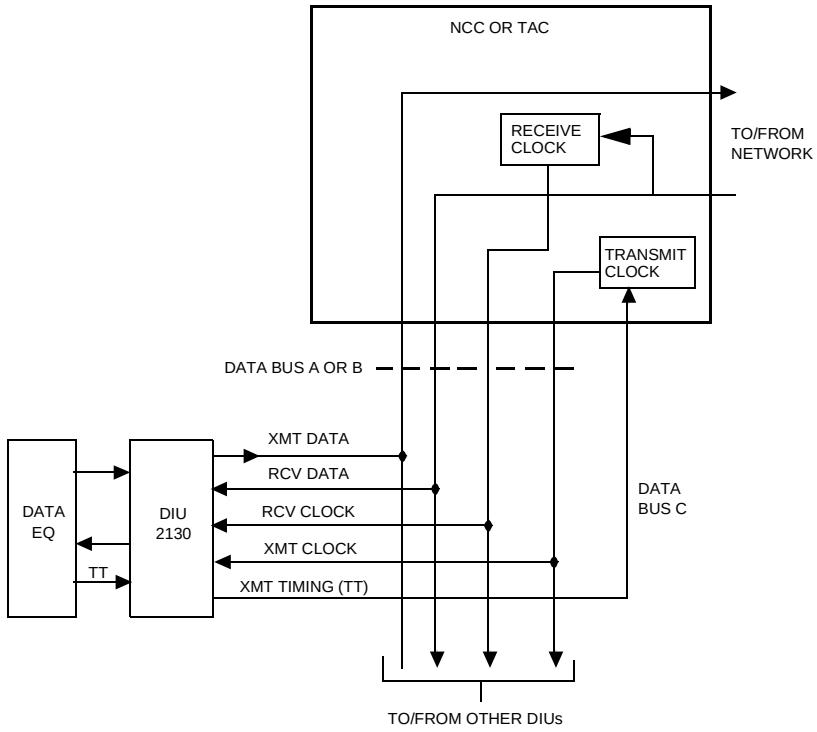
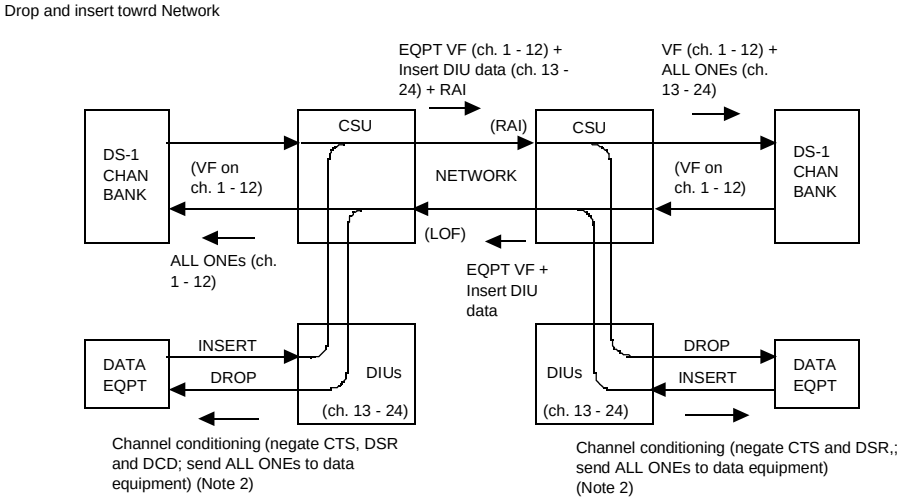


Figure 7-19 shows alarm processing when LOF is detected from the network and CSU drop-and-insert is toward the network. The LOF-detecting CSU sends all-ones on channels 1 through 12 toward the DS1 channel bank for channel conditioning.

Figure 7-19 Drop-and-Insert LOF/RAI Processing (Detection from the Network)



NOTES:
1. In the SF mode, the CSU neither generates nor responds to a received Yellow Alarm. Therefore, far-end channel conditioning does not occur with SF framing.

The associated DIUs also perform channel conditioning by sending all-ones idle bytes to the connecting customer data equipment. Each DIU also negates the CTS, DSR, and DCD signals to the data equipment as previously described for the CSU T1 multiplexer mode of operation.

In the opposite direction, the near-end CSU sends the incoming VF on channels 1 through 12 from the channel bank to the network. It also continues inserting normal DIU data into channels 13 through 24, and sends an RAI to the network if the network is ESF-framed.

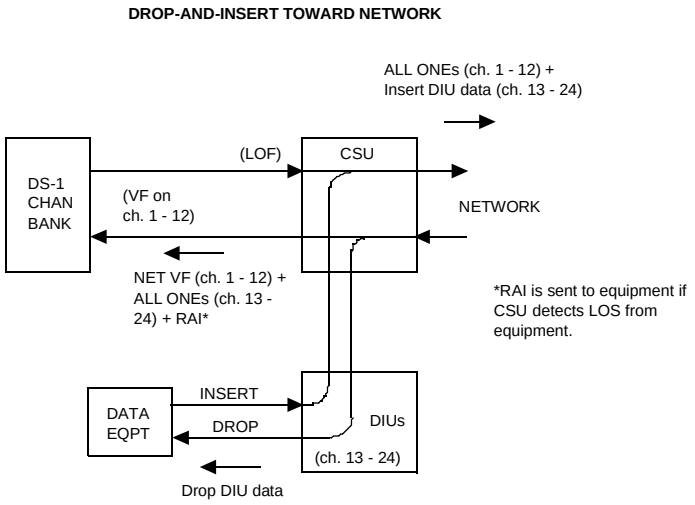
The far-end CSU responds by sending the incoming VF from the network to the channel bank via channels 1 through 12. It also sends all-ones idle bytes on the drop-and-insert channels (13 through 24) to the channel bank for channel conditioning. The far-end CSU also drops off the incoming data on channels 13 through 24 from the network to the DIUs. In addition, it continues sending VF from the channel bank to the network on channels 1 through 12, along with DIU data on the remaining channels. Each far-end DIU also performs the channel conditioning operations previously described for the CSU T1 multiplexer mode.

NOTE: *If the CSU is programmed for SF framing, it neither generates nor responds to a received RAI. Therefore, channel conditioning will not occur at the far-end CSU and DIUs.*

- **LOF Detection from the Equipment**—Figure 7-20 shows LOF processing when a CSU in the drop-and-insert mode detects an LOF from the equipment and is programmed for ESF framing on the network. If the drop-and-insert is toward the network (Figure 7-20), the CSU continues inserting DIU data into channels 13 through 24 toward the network. It also sends all-ones idle bytes to the network on channels 1 through 12 from the equipment for far-end DS-1 equipment channel conditioning.

  In the opposite direction, the CSU sends the VF on channels 1 through 12 of the incoming network signal to the channel bank. It also inserts all-ones on channels 13 through 24 and sends this data to the equipment. In addition, if the CSU detects an LOF from the equipment, it sends an RAI to the equipment. If the equipment uses SF framing, the RAI (all B2 bits = zeros) overwrites the data on all channels.

Figure 7-20 Drop-and-Insert LOF/RAI Processing (Detection from Equipment)



When the CSU detects an LOF from the equipment, the DIUs perform channel conditioning operations on the associated data equipment. Each DIU negates the CTS, DSR, and DCD handshaking signals to the associated customer data equipment (if not configured by the user to permanently assert these signals). It also sends all-ones idle bytes to the data equipment.

In the opposite direction, the CSU sends channels 1 through 12 of the incoming network signal to the equipment. It also continues inserting data from the DIUs into channels 13 through 24, and sends this data to the equipment.

NOTE: *In LOF and RAI processing with DIUs, if the CSU is programmed for SF framing, it neither generates nor responds to a received RAI. Therefore, channel conditioning will not occur at the far-end CSU and DIUs.*

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