



T1-FT1

Aggregate Interface Card

Installation & Operation Manual

036R485-000

Issue 2

April 2002



General DataComm

Smart Solutions for Service Providers

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Documentation

Revision History: T1-FT1 Aggregate Interface Piggyback Card Manual 036R485-000

Issue Number	Date	Description of Change
1	March 1993	Initial Release
2	April 2002	Reformatted for electronic distribution, general updates

Related Publications

Description	Part Number
MEGAMUX TMS Operating and Installation Instruction Manual	036R302-000
MEGAMUX TMS User's Guide (Software Version 2.06 or later)	036R602-206
MEGAMUX TMS Compact Instruction Manual	036R320-000
MEGAMUX PLUS TDM Instruction Manual	036R360-000
MEGAMUX PLUS TDM Operator's Instruction Manual	036R660-000
TDM 1258 Instruction Manual	036R357-000
MINIMUX TDM Instruction Manual	036R333-000

-REV is the hardware revision (**-000**, **-001**, etc.)

-VREF is the most current software version (**-V400** is Version 4.0.0.)

In addition to the publications listed above, always read Release Notes supplied with your products.

Table of Contents

Preface

Safety and Precautions	v
Compliance	vi
Service Support and Training	x

Chapter 1: Introduction & Specifications

Associated Equipment	1-1
Typical Applications	1-2
Technical Specifications	1-2

Chapter 2: Installation

Unpacking and Handling	2-1
Installation Procedures	2-1
Pre-Operational Checks	2-1
Configuration Options Overview	2-2
N x 56/64 kHz RATES	2-10
CONNECTOR PIN ASSIGNMENTS	2-11
Installing the T1-FT1 Aggregate Piggyback Card	2-13
MEGAMUX TMS and MEGAMUX TMS Compact only	2-13

Chapter 3: Network Characteristics and Applications

Fractional T1 Service Overview	3-1
The Digital Access Cross-Connect Advantage	3-1
The T1 Frame	3-3
D4 Framing Format	3-3
Extended Superframe Format (ESF)	3-4
AMI Bipolar Signal	3-4
Pulse Density	3-5
Clear Channel Capability/B8ZS	3-5

Chapter 4: Principles of Operation

Overview	4-1
Transmit/Receive Section w/FIFO	4-1
T1 Interface	4-1
Software Interface	4-3
Tests	4-3

[Chapter 5: Glossary](#)

Preface

Scope of this Manual

This manual describes installing the T1-FT1 Aggregate Interface Piggyback Card and placing it into service. The information contained in this manual has been carefully checked and is believed to be entirely reliable. This information is intended for installers, service technicians and users and assumes a working knowledge of data interfaces and data transmission services.

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Safety and Precautions

The CAUTION, WARNING, and DANGER statements that appear throughout this manual are intended to provide critical information for the safety of both the service engineer and operator, and enhance equipment reliability. The definitions and symbols for such statements comply with ANSI Z535.2, American National Standard for Environmental and Facility Safety Signs, and ANSI Z535.4, Product Safety Signs and Labels, issued by the American National Standards Institute..

Note *Indicates a note. It is something you should be particularly aware of; something not readily apparent. A note is typically used as a suggestion.*

Important *Indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent. Important is typically used to prevent equipment damage.*



CAUTION *Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury. It may also be used to alert against unsafe practices.*



WARNING *indicates an imminently hazardous situation which, if not avoided, could result in death or serious injury.*



DANGER *indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*

Safety Guidelines

Under proper conditions, this unit will operate reliably and safely in your network. If any component is improperly handled or installed, equipment failure or personnel hazard may occur. Use caution and common sense when installing network wires. Use the following guidelines, especially when unsafe conditions exist or when potentially hazardous voltages are present:

- Repairs must be performed by qualified service personnel only.
- To reduce the risk of electrical shock, do not operate equipment with the cover removed.
- Never install network jacks in a wet location unless the jack is designed for that location.
- Never touch uninsulated network wires or terminals unless the network line is disconnected at the network interface.
- Never install network wiring during an electrical storm.

Antistatic Precautions

Electrostatic discharge (ESD) results from the buildup of static electricity and can cause computer components to fail. ESD occurs when a person whose body contains a static buildup touches a computer component. The SCM card may contain static-sensitive devices that are easily damaged. Proper handling, grounding and precautionary ESD measures are essential. Keep parts and cards in antistatic packaging during transport or when not in use. When handling always use antistatic floorpads, workbench pads and an antistatic wrist strap connected to a grounded equipment frame or chassis. *If a wrist strap is not available, periodically touch an unpainted metal surface on the equipment.* Never use a conductive tool, like a screw driver or paper clip to set switches.

Compliance

Part 15 Compliance

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference and
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC Part 68 Compliance

Connection of data communications equipment to the public telephone network is regulated by FCC Rules and Regulations. This equipment complies with Part 68 of these regulations which require all of the following:

For single or multi-line equipment that connects to the telephone network via a plug and jack, the plug and jack must comply with the FCC Part 68 rules. This device is designed to be connected to the telephone or premises wiring, using a compatible modular jack which is Part 68 compliant.

The telephone company may discontinue your service if the unit causes harm to the telephone network. If possible, you will be notified of such an action in advance. If advance notice is not practical, you will be notified as soon as possible and will be advised of your right to file a complaint with the FCC. The telephone company may change its communication facilities, equipment, operations and procedures where reasonably required for operation. If so, the telephone company will notify you in writing. All repairs or modifications to the equipment must be performed by General DataComm. Any other repair or modification by a user voids the FCC registration and the warranty.

To connect the product to the Public Telephone Network, you are required to give the following information to the telephone company:

- FCC Registration Number: AG697J-17897-XD-N
- Telephone Company jack type: N/A
(Device connects to customer/Telco-provided CSU)
- Facility Interface Codes: 04DU9-BN/DN/1KN, 1ZN
- Service Order Code: DDS- 6.0N

United Kingdom

This unit is approved for all Rx base level gain pad settings up to +2dB. This unit is not approved for Rx base level gain pad settings above +2dB; higher settings must not be selected for use within the United Kingdom.

Industry Canada Notification

The Industry Canada label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operation and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department 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. 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 coordinated by a representative 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.

Notice: The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

Electromagnetic Compatibility: Canada

This Class A digital apparatus complies with Canadian ICES-003.

Avis D'industrie Canada

L'étiquette d'Industrie Canada identifie le matériel homologué. Cette étiquette certifie que le matériel est conforme aux normes de protection, d'exploitation et de sécurité des réseaux de télécommunications, comme le prescrivent les documents concernant les exigences techniques relatives au matériel terminal. Le Ministère n'assure toutefois pas que le matériel fonctionnera à la satisfaction de l'utilisateur.

Avant d'installer ce matériel, l'utilisateur doit s'assurer qu'il est permis de le raccorder aux installations de l'entreprise locale de télécommunication. Le matériel doit également être installé en suivant une méthode acceptée de raccordement. L'abonné ne doit pas oublier qu'il est possible que la conformité aux conditions énoncées ci-dessus n'empêche pas la dégradation du service dans certaines situations.

Les réparations de matériel homologué doivent être coordonnées par un représentant désigné par le fournisseur. L'entreprise de télécommunications peut demander à l'utilisateur de débrancher un appareil à la suite de réparations ou de modifications effectuées par l'utilisateur ou à cause de mauvais fonctionnement.

Pour sa propre protection, l'utilisateur doit s'assurer que tous les fils de mise à la terre de la source d'énergie électrique, des lignes téléphoniques et des canalisations d'eau métalliques, s'il y en a, sont raccordés ensemble. Cette précaution est particulièrement importante dans les régions rurales.

Avertissement: L'utilisateur ne doit pas tenter de faire ces raccordements lui-même; il doit avoir recours à un service d'inspection des installations électriques, ou à un électricien, selon le cas.

Avis: L'indice d'équivalence de la sonnerie (IES) assigné à chaque dispositif terminal indique le nombre maximal de terminaux qui peuvent être raccordés à une interface. La terminaison d'une interface téléphonique peut consister en une combinaison de quelques dispositifs, à la seule condition que la somme d'indices d'équivalence de la sonnerie de tous les dispositifs n'excède pas 5.

La Compatibilité d'Électro-magnétique

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Electromagnetic Compatibility

EN 50082-1: 1992

- Generic immunity standard Part 1 Residential, Commercial, and Light Industry.

Deutschland

Überblick Sicherheit

Bitte lesen sie dieses Handbuch komplett durch und stellen sie sicher, daß sie alle Vorschriften verstehen, bevor sie das Gerät installieren oder betreiben. Die Hinweise in diesem Handbuch müssen vor Installation oder Betrieb gelesen werden. Beispiele für Hinweise sehen sie hier.

Hinweis

Ein Hinweis enthält wichtige Informationen zum Betrieb, die nicht auf den ersten Blick ersichtlich sind, und die zu beachten sind. Ein Hinweis dient als Vorschlag.

Wichtig

Bedeutet einen besonders wichtigen Hinweis. Darauf sollten sie besonders achten, da dies nicht offensichtlich ist. Wichtige Hinweise dienen im Allgemeinen dazu, Schäden am Gerät zu vermeiden.

Die Hinweise CAUTION (VORSICHT), WARNING (WARNUNG) und DANGER (GEFAHR), welche im Handbuch erscheinen, enthalten entscheidende Informationen für die Sicherheit sowohl des Servicepersonals als auch der Bediener. Diese Hinweise erhöhen die Zuverlässigkeit der Anlage. Die folgenden Definitionen und Symbole für VORSICHT, WARNUNG und GEFAHR, wie sie in diesem Handbuch auftreten, sind gemäß ANSI Z535.2, Amerikanischer Nationaler Standard für Sicherheitszeichen für Umwelt und Anlagen, und ANSI Z535.4, Produkt-Sicherheits-Zeichen und Beschriftungen, ausgegeben vom American National Standards Institute.



VORSICHT bedeutet eine potentiell gefährliche Situation, die wenn sie nicht vermieden wird, zu leichten oder mittelschweren Verletzungen führen kann.



WARNUNG bedeutet eine drohende gefährliche Situation, die wenn sie nicht vermieden wird, zu schweren Verletzungen oder zum Tode führen kann.



GEFAHR bedeutet eine drohende gefährliche Situation, die wenn sie nicht vermieden wird, zwangsläufig zu schweren Verletzungen oder zum Tode führt.

Sicherheitsrichtlinien

Unter normalen Umständen arbeitet die Anlage sicher und zuverlässig in ihrem Netzwerk. Falsche Handhabung oder Installation von Bestandteilen kann zu Ausfällen oder Gefahren für den Bediener führen. Seien sie vorsichtig und beachten sie die allgemeinen Regeln bei der Installation der Netzkabel. Beachten sie die folgenden Hinweise, besonders bei unsicheren Umständen oder potentiell gefährlichen Spannungen:

- Reparaturen dürfen nur von qualifiziertem Servicepersonal ausgeführt werden.
- Zur Vermeidung elektrischer Schläge darf die Anlage nicht mit geöffneter Abdeckung betrieben werden.
- Niemals Netzwerkstecker in feuchter Umgebung installieren, es sei denn der Stecker ist dafür ausgelegt.
- Niemals unisolierte Netzwerkdrähte oder Klemmen berühren, es sei denn das Netzwerk ist am Interface abgeschaltet.
- Niemals Netzwerk bei elektrischem Gewitter verdrahten.

Service Support and Training

VITAL Network Services is a leading single source, data communications organization which provides network service and support for General DataComm customers throughout the world. Vital Network Services provides the support and training required to install, manage and maintain your GDC equipment. Training courses are available at centers in the US, UK, France, Singapore and Mexico, as well as at a customer's site.

For more information on VITAL Network Services or for technical support assistance, contact VITAL Network Services.

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Chapter 1: Introduction & Specifications

Overview

The T1-FT1 Aggregate Interface Piggyback Card is designed to add a T1-FT1 interface capability on the high speed aggregate port of several existing GDC multiplexer products:

- TDM 1258
- MEGAMUX PLUS
- MEGAMUX TMS
- MEGAMUX TMS Compact
- MINIMUX TDM

With the T1/FT1 capability of this piggyback card the T1 serial bit stream (at the data rate of 1.544 Mbps) does not have to be fully utilized to carry voice and data information assembled by the associated multiplexer. Fractions of the T1 bit rate (in multiples of 56 or 64 kbps) can be used by the multiplexer.

This fractional T1 application permits the TDM equipment to be connected to a Digital Access Cross Connect Switch (DACCS), thereby providing routing of individual (56 or 64 kbps) DSO channels to various remote locations.

Associated Equipment

The T1-FT1 Aggregate Interface Piggyback Card is designed to plug in to the following GDC equipment:

- The Aggregate Interface Module (036P040-001) of the TDM 1258 multiplexer
- The Redundancy Control Module (036P040-021) of the MEGAMUX PLUS TDM
- The Aggregate Control Module (036P313-001, -002, -003) of the MEGAMUX TMS or MEGAMUX TMS Compact.
- The Aggregate Control Module of the MINIMUX TDM (G036P192-001)

Note *The T1-FT1 Aggregate Interface Piggyback Card is not intended for use on ASDS (Alt. DSO) facilities due to option selection restrictions.*

Typical Applications

The T1-FT1 Aggregate Interface Piggyback Card allows point-to-point fractional T1 access within the TDM 1258, MEGAMUX PLUS, MEGAMUX TMS MEGAMUX TMS Compact or MINIMUX TDM. In point-to-point applications, the T1-FT1 piggyback is a cost-effective alternative to the Combined Digital Aggregate (CDA) Module.

The MEGAMUX PLUS or MINIMUX TDM become low-cost fractional feeder multiplexers when used with a T1-FT1 Aggregate Interface Piggyback Card. Existing networks are easily updated to take advantage of fractional T1 services.

The principal application for the T1-FT1 Aggregate Interface Piggyback Card is to offer a T1 interface that takes advantage of fractional T1 services. Instead of paying for a full T1 line, you pay only for the bandwidth needed by selecting the number (N) of DSO channels (where $N = 1 - 24$). As bandwidth requirements change, you can change the number of DSOs. This is useful at feeder nodes which typically have smaller bandwidth requirements.

Technical Specifications

The following table describes the physical, operational, and environmental specifications for the T1-FT1 Interface Piggyback Card. Conforming to these specifications ensures maximum system performance and reduces the chances of mechanical breakdown and personnel hazard

Table 1-1 T1-FT1 Aggregate Interface Piggyback Card, GDC P/N 036P335-002

Specification	Description
T1-FT1 Aggregate Interface Piggyback Card	Physical Dimensions: 4.5 in x 5.5 in (11.43 cm x 13.97 cm)
Power Requirements	+5 V dc +/-5%, .256 A, typical, 1.28 W, typical
System Load Capacity	One T1 line
Number of DSOs per frame (max)	Switch or software selectable in integer multiples of either $N \times 56$ kHz or $N \times 64$ kHz (up to 1.536 MHz), where $N = 1$ to 24.
DSO Bandwidth	Switch or software selectable: $N \times 56$ kHz or 64 kHz DSO bandwidth
Framing	Switch selectable: Extended Superframe (ESF) or D4 framing
Line Encoding	Switch selectable: B8ZS or normal (AMI) encoding
Line Buildout	Switch selectable: 0 to 655 ft
Yellow Alarm Transmission	Switch selectable: Enable or Disable the sending yellow alarm
Receive FIFO Depth	Switch selectable: 2, 8 or 16 T1 frames. Used for terrestrial and satellite applications and to compensate from the effects of jitter and wander.
Non-operating Temperature	-40 to 85 degrees C (-40 to 186 degrees F)
Operating Temperature	0 to 50 degrees C (32 to 124 degrees F)
Humidity	95% Relative Humidity, non-condensing
Non-operating Altitude	0 m to 12,192 m (0 ft. to 40,000 ft.)
Operating Altitude	0 m to 3,048 m (0 ft. to 10,000 ft.) Derate by one degreeC/1000 feet above sea level.

Note Software selectable options are available only in the MEGAMUX TMS or MEGAMUX TMS Compact.

Chapter 2: Installation

Unpacking and Handling

Inspect the T1-FT1 Aggregate Interface Piggyback Card for damage. If any is found, notify the shipper immediately. Save the box and packing material for reshipping the unit, if necessary.

The TDM equipment should be located in a well ventilated area where the ambient temperature does not exceed 124 degrees F (50 degrees C). Do not install above equipment that generates a large amount of heat (such as power supplies).

Installation Procedures

In the MEGAMUX TMS, MEGAMUX TMS Compact and MINIMUX TDM, the T1-FT1 Aggregate Interface Piggyback Card mounts onto the Aggregate Control Module.

In the TDM 1258, the T1-FT1 Aggregate Interface Piggyback Card mounts onto the Aggregate Interface Card.

In the MEGAMUX PLUS, the T1-FT1 Aggregate Interface Piggyback Card mounts onto the Redundancy Control Module.

Pre-Operational Checks

To ensure your T1-FT1 Aggregate Interface Piggyback Card is properly installed and configured for use, perform all of the pre-operational checks and installation procedures in this chapter. Common installation errors that will affect card performance and operability are:

- Piggyback card dip switches have been improperly selected
- a fault exists elsewhere in the system
- improper configuration of the Piggyback card
- faulty communication line or remote installation
- fault in the Redundancy Control Module or the Aggregate Interface Module

No diagnostic tests are available for the T1-FT1 Aggregate Interface Piggyback Card. If the unit is not passing data, an error may have been made in the installation, configuration or in one or more of the above conditions. Recheck the cables, line connections, the option strapping, and soft option selection.

In the event the T1-FT1 Aggregate Interface Piggyback Card does not check out properly, replace it with a spare T1-FT1 Aggregate Interface Piggyback Card, if available. Do not attempt to repair the T1-FT1 Aggregate Interface Piggyback Card. For assistance, contact General DataComm.

Configuration Options Overview

Before installing the T1-FT1 Aggregate Interface Piggyback Card onto the multiplexer module (Aggregate Control, Redundancy Control, or Aggregate Interface module) check that all of the following configuration options have been properly set on the Piggyback card.

- Switches S1-1-3
Adjusts the Line Build Out (select from 0 to 655 feet on the transmit side only.)
- Switches S1-4-5
Adjusts the Receive FIFO buffer depth.
- Switches S1-6-7 are not used.
- Switch S1-8
Enables or disables the sending of a qualified yellow alarm.
- Switches S2-1-5
Adjust the maximum number of DSOs in a time frame.
- Switch S2-6
Selects the DSO Rate at either 56 or 64 kbps.
- Switch S2-7
Selects either D4 or ESF frame formatting. Switch
- S2-8
Selects either B8ZS or normal (AMI) line coding.

Option Selection

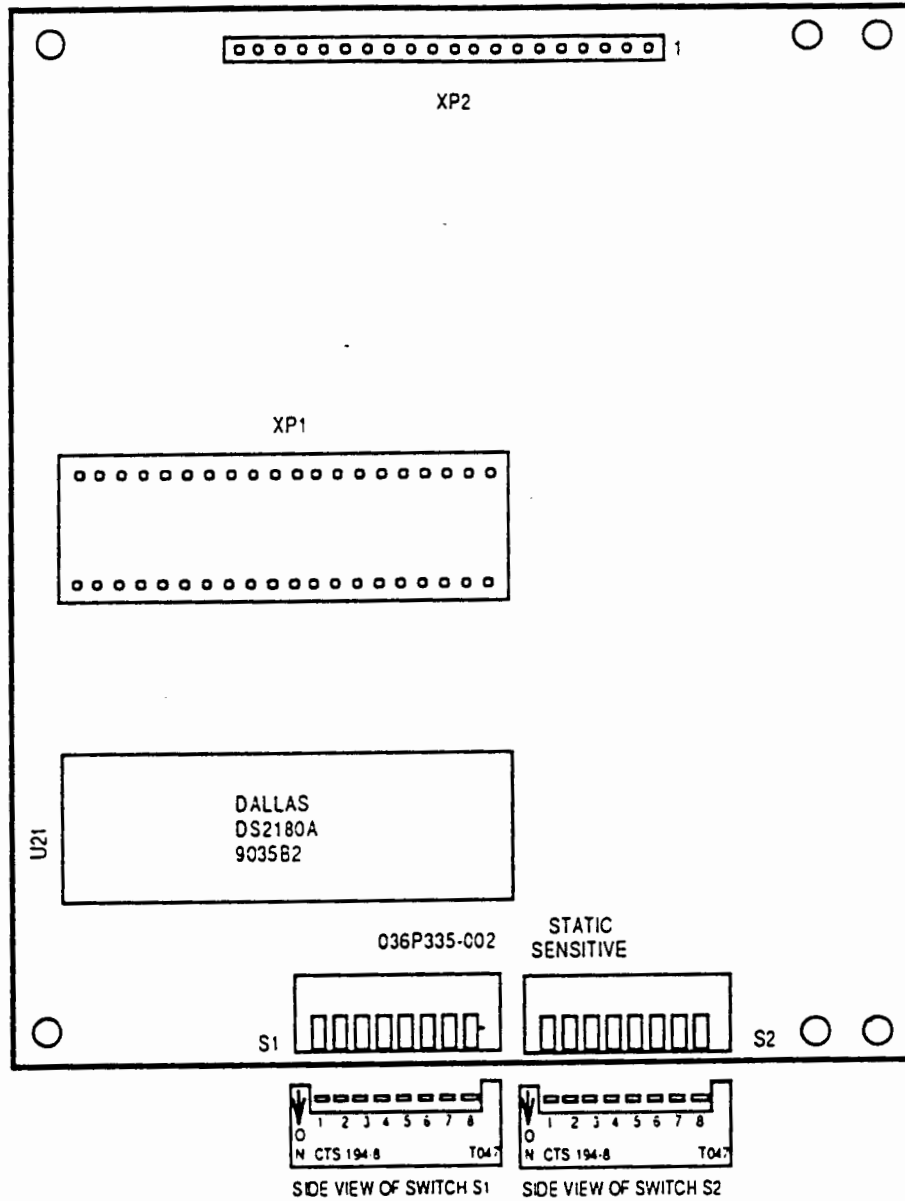
On the MEGAMUX TMS or MEGAMUX TMS Compact, you have the option of configuring the T1-FT1 Aggregate Interface Piggyback Card either through hardware or software (in MEGAMUX TMS controller software version 2.0.6 or later.) To configure software options on the T1-FT1 Aggregate Interface Piggyback Card installed in the MEGAMUX TMS or MEGAMUX TMS Compact, refer to MEGAMUX TMS/MEGAMUX TMS Compact Controller Configuration.

A T1-FT1 Aggregate Interface Piggyback Card installed in a TDM 1258, MEGAMUX PLUS or MINIMUX TDM can only be configured through hardware option switches.

Figure 2-1 shows the location of option switches S1 and S2 on the T1-FT1 Aggregate Interface Piggyback Card.

Figure 2-2 shows the silk-screen switch designations for option switches S1 and S2 that are located on the rear (pc side) of the T1-FT1 Aggregate Interface Piggyback Card.

Figure 2-3 and Figure 2-4 provide information on configuring option switches S1 and S2 on the T1-FT1 Aggregate Interface Piggyback Card.



NOTE
 SILK SCREEN DESIGNATIONS OF SWITCHES S1 AND S2 LOCATED ON PC (LAND) SIDE OF T1-FT1 AGGREGATE PIGGYBACK CARD.

Figure 2-1 T1-FT1 Aggregate Interface Piggyback Card (036P335-002) (Component Side)

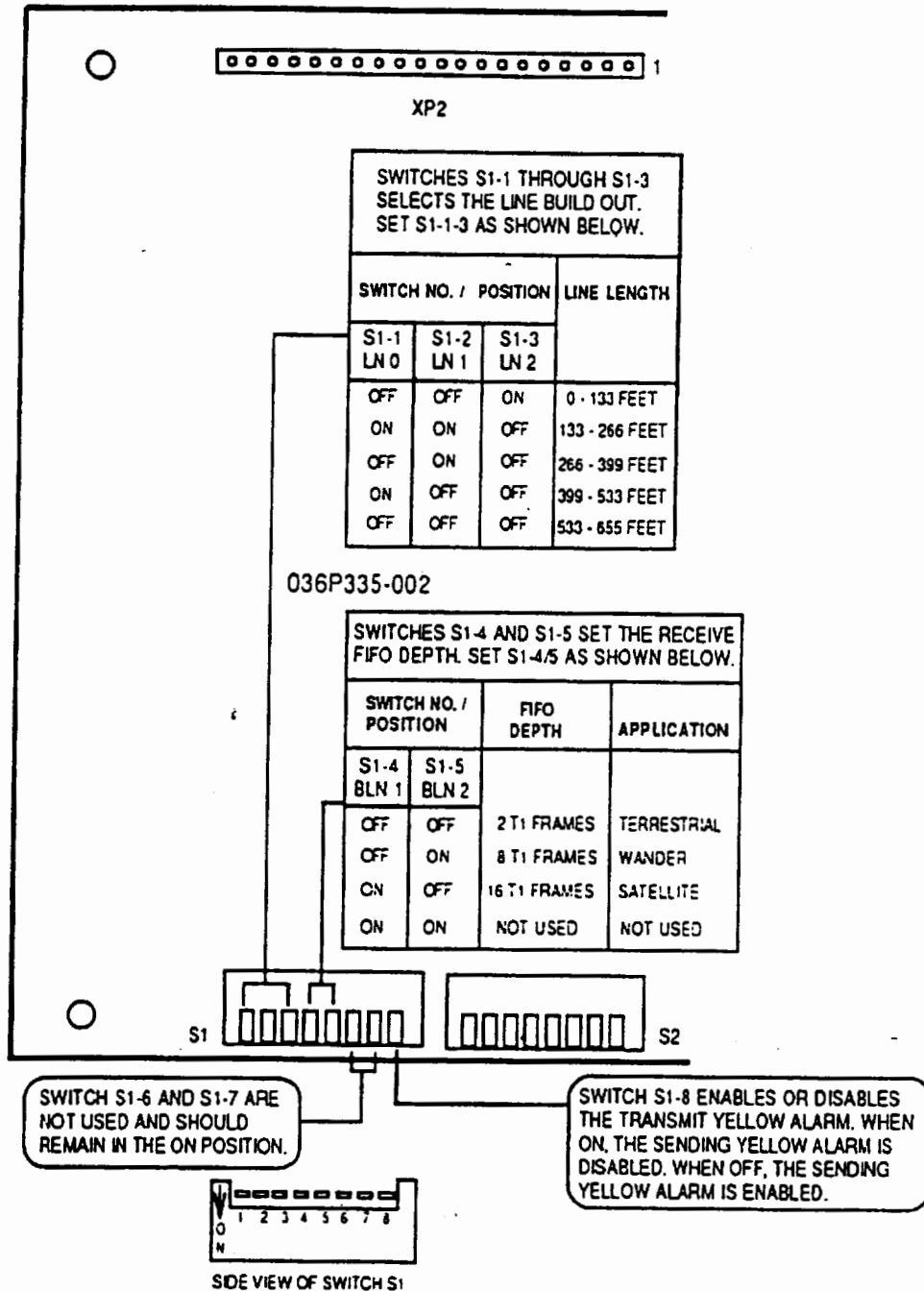


Figure 2-3 T1-FT1 Aggregate Interface Piggyback Card (036P335-002)
(Option Switch and jumper Selections - Sheet 1 of 2)

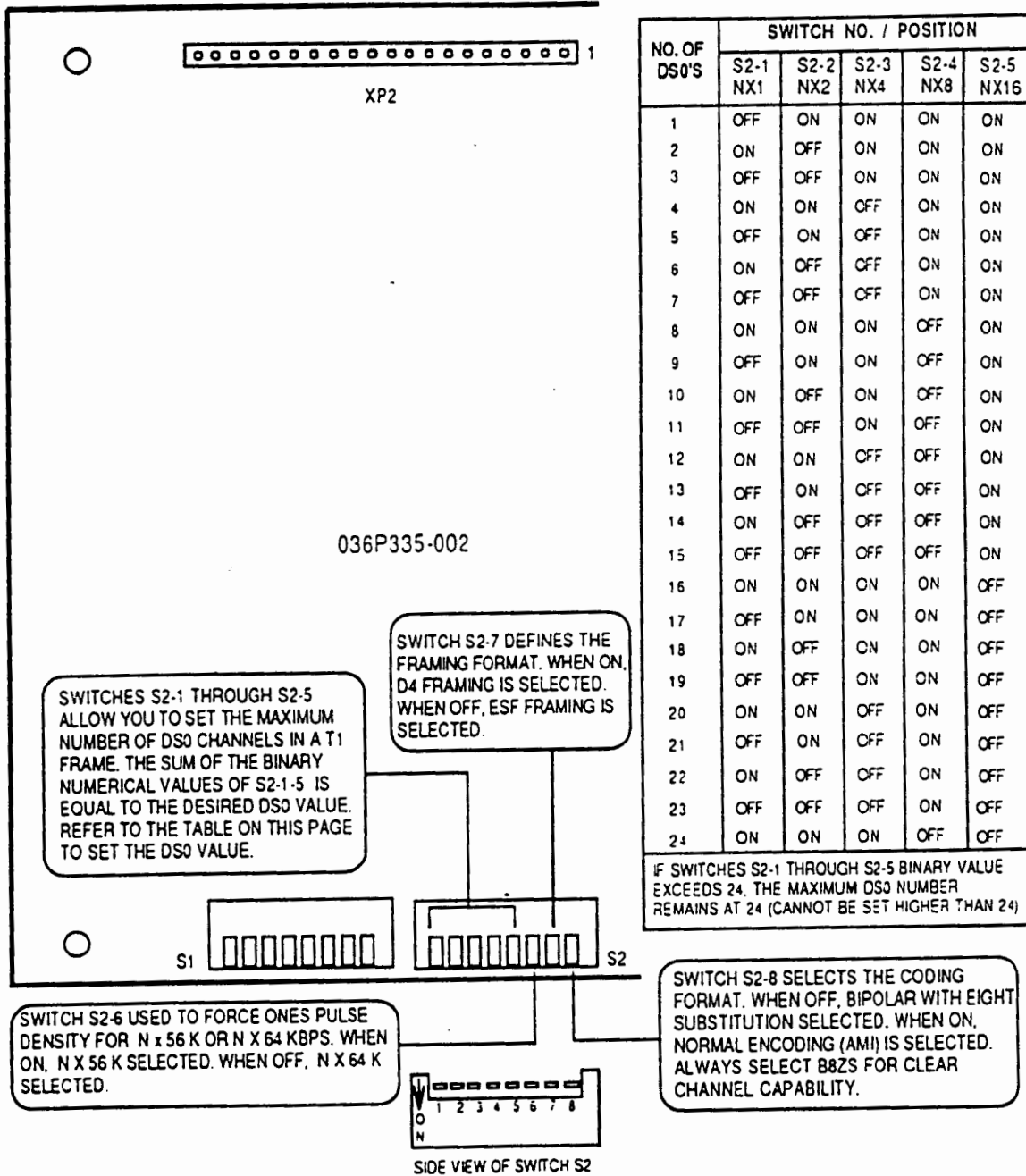


Figure 2-4 T1-FT1 Aggregate Interface Piggyback Card (036P335-002)
 (Option Switch and jumper Selections - Sheet 1 of 2)

Table 2-1 T1-FT1 Aggregate Interface Piggyback Card Option Application Notes

Switch or Jumper No.	Feature	Switch or Jumper Position	Selection	Application
S1-1 (LN 0) S1-2 (LN 1) S1-3 (LN 2)	Line Build Out (LBO)	S1-1 S1-2 S1-3		Clock and data extraction are improved by cable length transmit equalization. This feature accommodates line lengths up to 655 feet between the T1-FT1 aggregate interface and the receiving equipment to be used without the customary line build-out networks. With line transmit equalization, the pulse shape and amplitude at properly terminated receiving equipment will conform to the DSX-1 mask specified in ATT CB119. ABAM cable or equivalent must be used to connect the aggregate interface to the receiving equipment.
		Off Off On	0-133 feet	
		On On Off	133-266 feet	
		Off On Off	266-399 feet	
		On Off Off	399-533 feet	
Off Off Off	533-655 feet			
S1-4 (Bin 1) S1-5 (Bin 2)	Receive FIFO Depth	S1-4 S1-5	Rx FIFO Depth	Setting switches S1-4 and S1-5 changes the depth of the receive FIFO buffer. Set the switches as shown for the following applications: Two T1 frames for terrestrial applications. Eight T1 frames for wander. Sixteen T1 frames if used in satellite applications. Not used (set both switches on).
		Off Off	Two T1 Frames	
		Off On	Eight T1 Frames	
		On Off	Sixteen T1 Frames	
		On On	Not Used	
S1-6 S1-7	Not Used	On	—	Switches S1-6 and S1-7 are not used. Both switches should remain in the On position.
S1-8 (YAE/YAD)	Yellow Alarm	On	Disables the sending yellow alarm	This switch enables or disables the sending of a qualified yellow alarm.
		Off	Enables the sending yellow alarm.	

Table 2-2 T1-FT1 Aggregate Interface Piggyback Card Option Application Notes (Continued)

Switch or Jumper No.	Feature	Switch or Jumper Position		Selection	Application
S2-1-5	Maximum number of DS0 channels	Desig.	Position	The maximum number of DS0s in a time frame is obtained by selecting switches S2-1-5 so that the sum of their binary numerical values is equal to the desired DS0 value. The window of DS0s selected will always start with DS0-1. You cannot set the switches below DS0-1. All of the N DS0s selected for a T1 port into a DACS must connect to the same destination port.	Defines the maximum number of DS0 channels in the time frame. This parameter is either switch selectable or software selectable (in MEGAMUX TMS controller software version 2.0.6.) The user will select the number of DS0s (1-24) based on the bandwidth that the data requires in order to take advantage of fractional T1 services. Each DS0 timeslot is equivalent to 64 kbps of aggregate bandwidth. If N equals one, then aggregate data will only be sent in timeslot DS0-1. Several examples of setting switches S2-1-5 for the number of DS0s follows: If a maximum of two DS0s are in the time frame, set S2-2 off, S2-1, 3, 4 and 5 are on. If a maximum of three DS0s are in the time frame, set S2-1 and S2-2 off. S2-3, 4 and 5 are on. If a maximum of sixteen DS0s are in the time frame, set S2-5 off. Set S2-1, 2, 3 and 4 on. If switches S2-1-5 are set higher than a binary value of 24, the maximum DS0 setting remains at 24 DS0s.
		S2-1	On =0 Off =1		
		S2-2	On =0 Off =2		
		S2-3	On =0 Off =4		
		S2-4	On =0 Off =8		
		S2-5	On =0 Off =16		
S2-6	64k/56k	On		Selects N X 56 K	If 64 kHz DS0s are selected, then the full 64 kHz per DS0 of bandwidth can be used for clear channel capability. The user should select B8ZS coding or be sure that the data will meet ones density and consecutive zeroes constraints. If 56 kHz DS0s are selected, then only 56 kHz of bandwidth (per DS0) is available for data and bit 8 of each DS0 is forced to mark which will meet the average 1 of 8 one's density requirement. This option is hardware/software selectable, and may be used if clear channel capability is allowed by the TELCO. Refer to Tables 2-2 and 2-3 for the aggregate data bandwidth.
		Off		Selects N X 64 K	

Table 2-3 T1-FT1 Aggregate Interface Piggyback Card Option Application Notes (Continued)

Switch or Jumper No.	Feature	Switch or Jumper Position	Selection	Application
S2-7	ESF/D4	On	D4 framing	This selection defines the format of framing. The T1/D4 framing format is defined by a superframe which consists of 12 frames. Each of these 12 frames is made up of 193 bits. The first 192 bits are the 24 DSO's (24 X 8), and the last bit is for frame synchronization. The T1/ESF framing format is defined by an extended superframe which consists of 24 frames. Like D4, each of the 24 frames is made up of 193 bits. Twenty-four bits out of the 24 frames are used for frame synchronization (six bits are used for frame sync, six bits for CRC, and twelve bits for data link messages.)
		Off	Extended Superframe (ESF) framing	
S2-8	B8ZS /Norm	Off	Selects Bipolar with Eight Zero Substitution	B8ZS must be used for clear channel (N x 64 kHz) operation. The transmitter will replace a series of eight consecutive zeroes with a bipolar code sequence which violates the bipolar rule. The receiver will recognize this code and return the eight consecutive zeroes.
		On	Selects Normal encoding (Alternate Mark Inversion)	

N x 56/64 kHz RATES

The following table provides the effective aggregate data bandwidth rates based on N x 56 kHz or N x 64 kHz clock selection.

Table 2-4 T1-FT1 Aggregate Interface Piggyback Card Data Rates

N value	N X 56 kHz Aggregate Data Bandwidth	N x 64 kHz Aggregate Data Bandwidth
1	56 kHz	64 kHz
2	112 kHz	128 kHz
3	168 kHz	192 kHz
4	224 kHz	256 kHz
5	280 kHz	320 kHz
6	336 kHz	384 kHz
7	392 kHz	448 kHz
8	448 kHz	512 kHz
9	504 kHz	576 kHz
10	560 kHz	640 kHz
11	616 kHz	704 kHz
12	672 kHz	768 kHz
13	728 kHz	832 kHz
14	784 kHz	896 kHz
15	840 kHz	960 kHz
16	896 kHz	1024 kHz
17	952 kHz	1088 kHz
18	1008 kHz	1152 kHz
19	1064 kHz	1216 kHz
20	1120 kHz	1280 kHz
21	1176 kHz	1344 kHz
22	1232 kHz	1408 kHz
23	1288 kHz	1472 kHz
24	1344 kHz	1536 kHz

CONNECTOR PIN ASSIGNMENTS

Connector pin assignments for T1-FT1 Aggregate Interface Piggyback Card connectors XP1 and XP2 are provided below.

Table 2-5 T1-FT1 Aggregate Interface Piggyback Card Connector Pin Assignments - XP1

Pin No.	Signal Name	Description
1	CHASSIS GROUND	—
2	XMT DATA	Input. Transmit Data from Aggregate Control Module base card.
3	DATACLK	Output. Aggregate Clock to Aggregate Control Module base card — N x 56 k/ N x 64 k.
4	RCV DATA	Output. Receive Data to Aggregate Control Module base card.
5	D4RRLB -	Input. D4 receive remote loopback indication from ACC basecard.
6	DATACLK	Output. Aggregate Clock to Aggregate Control Module base card — N x 56 k/ N x 64 k.
7	—	Not Used
8	ROOS-	Output. Remote T1 out-of-sync. Receive yellow alarm.
9	SIG GND	Signal Ground
10-12	—	Not Used.
13	EXT TMG	Input. 1.544 MHz node clock for transmit timing.
14-17	—	Not Used.
18	+ 5 V	Positive 5-volt power supply.
19	SIG GND	Signal Ground.
20	LOOS-	Output. Local T1 out-of-sync.
21-30	—	Not Used.
31	RCV 1.544M-	Output. Receive 1.544 MHz clock for node clocking.
32-34	—	Not Used.
35	RCV DATA B	Input. Balanced Rx Data B input from interface.
36	RCV DATA A	Input. Balanced Rx Data A input from interface.
37	—	Not Used.
38	XMT DATA A	Output. Balanced Tx Data A to interface.
39	XMT DATA B	Output. Balanced Tx Data B to interface.
40	PROT GND	Protective Ground Output from T1-FT1 to interface.

Table 2-6 T1-FT1 Aggregate Interface Piggyback Card Connector Pin Assignments - XP2

Pin No.	Signal Name	Description
1	5 V	Positive 5-volt power supply (optional).
2	—	Not used.
3	SIG GND	Signal Ground.
4	BD 0	Microprocessor Data Bus.
5	BD 1	Microprocessor Data Bus.
6	BD 2	Microprocessor Data Bus.
7	BD 3	Microprocessor Data Bus.
8	BD 4	Microprocessor Data Bus.
9	BD 5	Microprocessor Data Bus.
10	BD 6	Microprocessor Data Bus.
11	BD 7	Microprocessor Data Bus.
12	WRSTB (L)	Write Strobe (low = true condition).
13	RDSTB (L)	Read Strobe (low = true condition).
14	CSN	Board Select (low = true condition).
15	BA 0	Microprocessor Address Bus.
16	BA 1	Microprocessor Address Bus.
17	BA 2	Microprocessor Address Bus.
18	BA 3	Microprocessor Address Bus.
19	POP -	Aggregate Control Module basecard with a power-on pulse signal.
20	—	Not used.

NOTE: Connector XP2 is used only on the MEGAMUX TMS and MEGAMUX TMS Compact.

Installing the T1-FT1 Aggregate Piggyback Card

MEGAMUX TMS and MEGAMUX TMS Compact only

The T1-FT1 Aggregate Interface Piggyback Card contains a 40-pin DIP socket (XP1) that mates with pins on the Aggregate Control Module, Aggregate Interface or Redundancy Control Module. The 20-pin male connector (XP2) plugs into a socket on the Aggregate Control Module's basecard on the MEGAMUX TMS and MEGAMUX TMS Compact only.

Line up the pins and gently press the T1-FT1 Aggregate Interface Piggyback Card onto the Aggregate Control or Redundancy Control Module. Secure the T1-FT1 Aggregate Interface Piggyback Card to the Aggregate Control or Redundancy Control Module using the screws and spacers provided.

Configuring the MEGAMUX TMS/MEGAMUX TMS Compact Controllers

Several software configurable parameters are available on the T1-FT1 Aggregate Interface Piggyback Card when used in conjunction with the MEGAMUX TMS/MEGAMUX TMS Compact Controller.

1. From the Aggregate Configuration screen on the MEGAMUX TMS controller, highlight the Interface Type field.
2. Press **Enter** until **T1-FT1** appears.
3. On the Aggregate Configuration screen, the Effective Data Rate field contains the rate table. The rate selected is based on the prior N x 56 kHz or N x 64 kHz selection. Select the data rate of the T1-FT1 Aggregate Interface Piggyback Card.
4. For more information on configuring the Aggregate Control Module and its piggyback interface cards, refer to the MEGAMUX TMS User's Guide, TMS controller software version 2.0.6 (or later), GDC Publication No. 036R602-206.

Chapter 3: Network Characteristics and Applications

Fractional T1 Service Overview

Fractional T1 (or Channelized T1) describes a service offered by the telephone company, whereby a portion of the T1 bandwidth can be made available to the user. Consequently, the user only pays proportionately to the amount of bandwidth utilized.

The user available bandwidth is in increments of 1/24th of the total aggregate bandwidth (increments of 64 kbps). These increments are typically referred to as DSO channels.

When actual requirements are much smaller than the full 1.544 Mbps bandwidth, fractional T1 offers attractive economics to both user and carrier. DACS equipment based in the carrier's central office consolidates partial-filled T1 lines from various users into full T1 bandwidth that is efficiently transmitted between central offices.

The Digital Access Cross-Connect Advantage

A Digital Access and Cross-Connect Switch (DACS) is a DSO switching device that divides T1 (1.544 Mbps) ports into DSO (64 kbps) channels. This switch is capable of cross connecting a DSO channel from any T1 port to any DSO channel of any other T1 port. A typical deployment of DACS equipment consists of an installation in the carrier's central office where its crossconnect capability may be used to consolidate partial-fill Fractional T1 customer lines into full inter-office T1 circuits.

Figure 3-1 demonstrates the use of DACS equipment to consolidate partially filled T1 customer lines into full inter-office T1 circuits.

Benefits of DACS Equipment

- Rapid re-routing of the customer DSO channels in the event of inter-office circuit failure to other circuits.
- Potential for dynamic bandwidth usage by requesting the telephone company to vary the number of DSO channels. This would satisfy a temporary requirement for higher bandwidth (i.e., video and teleconferencing.)
- Control of the actual routing of individual DSO channels to different destinations via user-provided access to the DACS equipment. This service is known as Customer Controlled Reconfiguration (CCR).
- Fractional T1 benefits for the TELCO - Previously unused DSO bandwidth that was dedicated to non-fractional T1 links can be used to provide bandwidth to new customers without installing additional equipment and new inter-office trunks.

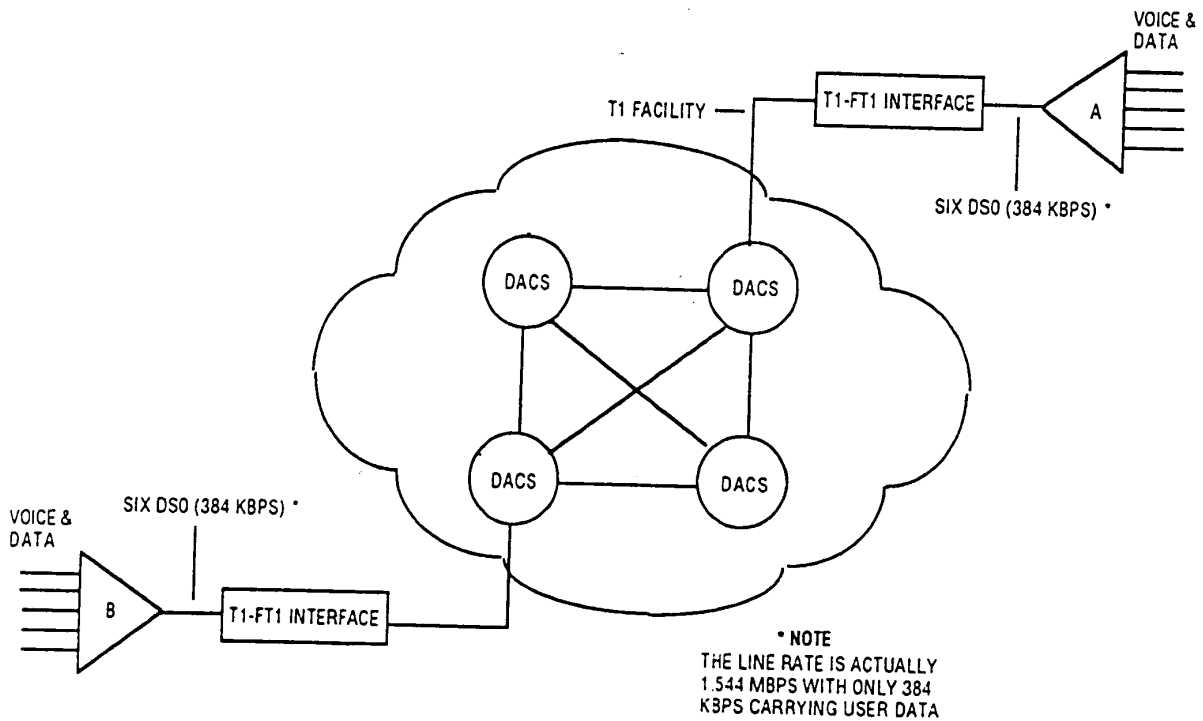


Figure 3-1 DACS Equipment Consolidates Partially Filled T1 Lines into Full T1 Circuits

The T1 Frame

The T1 serial bit stream is organized in repeating blocks of bits, called frames. Each frame contains 24 DSO channels (64 kbps) in the form of 8bits for each of the 24 channels. At the end of each frame, a bit is added for the purpose of frame recognition and synchronization. This bit varies each frame to create a specific bit pattern, that is recognized as the framing pattern. The frames are repeated 8000 times per second to yield a combined bit stream of 1.544 Mbps. (Refer to Figure 3-2.)

The mathematics of T1 framing can be summarized as follows:

- Number of bits per frame: $(24 \times 8) + 1 = 193$ bits/frame
- Number of frames per second: 8000 frames/sec
- Total number of bits per second: $193 \text{ bits/frame} \times 8000 \text{ frames/sec} = 1.544 \text{ Mbps}$

It is interesting to point out that there are 8000 bps dedicated to framing, hence:

- $1,544,000 - 8000 = 1,536,000$ bps
1,536,000 bps can be used within the 1,544,000 bps stream to carry voice/data information.

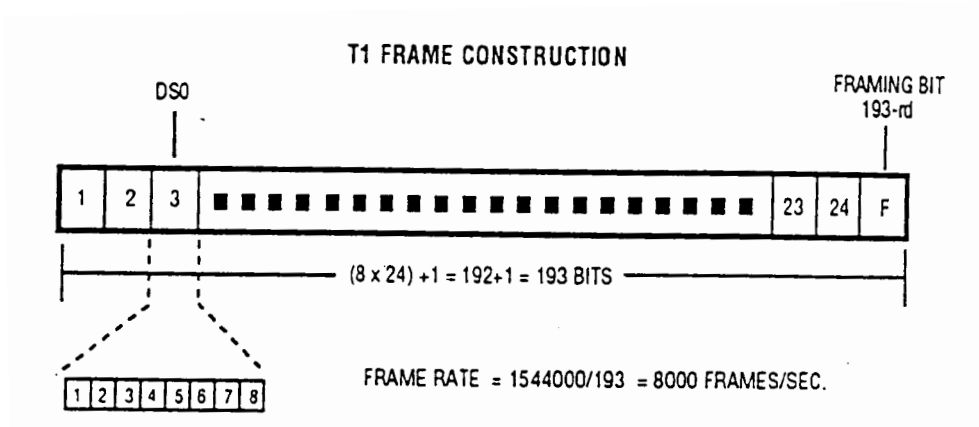


Figure 3-2 T1 Frame Construction

D4 Framing Format

The D4 superframe format consists of 12 frames of 193 bits each. The 193rd framing bit defines a repeating sequence of 12 bits as follows:

- 100011011100

Extended Superframe Format (ESF)

The Extended Superframe format extends the previously defined superframe structure from 12 frames to 24 frames. At the same time, the 8 kbps of bandwidth used for frame synchronization is redefined as follows:

The Extended Superframe format consists of 2 kbps for basic frame synchronization, 2 kbps for a CRC-6 (cyclical redundancy check) code and 4 kbps for a data link. In other words, six of the 24 bits are used for frame synchronization, 6 for CRC-6, and 12 for data link (DL). The CRC-6 and DL bits are added features of the ESF format that provide capabilities for network supervision and maintenance by the TELCO.

The CRC-6 code has the ability to detect most errors that occur on the T1 facility. The 4 kbps data link provides a communication channel in each direction of the T1 facility.

A synchronous data link protocol may be used by the TELCO for requesting and communicating ESF performance information from equipment at various points in the T1 facility and for sending control commands for various maintenance purposes.

AMI Bipolar Signal

Alternate Mark Inversion (AMI) with bipolar signal defines a digital "return to zero" signal, which indicates a binary "zero" (space) by zero voltage (no pulse), and a binary "one" (mark) by the presence of a pulse. The polarity of successive "ones" is alternated, hence the term bipolar signal with alternate mark inversion. The binary "one" condition lasts for a time interval corresponding to the duration of one-half of a bit and then returns to zero. Refer to Figure 3-3.

Bipolar violation means the condition which occurs when the alternate polarity is violated. Under alternate mark inversion encoding, a binary "one" is transmitted as either a positive or negative pulse, opposite in polarity to the previous pulse. For example, a bipolar violation occurs if the last "one" was transmitted as a positive going pulse, and the next "one" is also transmitted as a positive going pulse rather than as a negative going pulse (bipolar). Bipolar violations generally occur as a result of noise in circuit pairs.

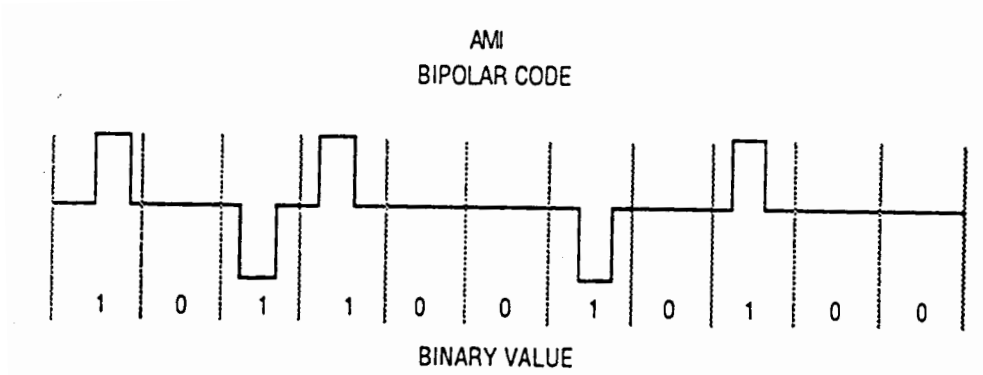


Figure 3-3 AMI BIPOLAR CODE

Pulse Density

Regenerative repeaters placed along a digital T1 transmission line at a distance of 6000 feet, perform a sequence of operations which result in an output signal that is a replica of that transmitted from the original equipment at the source of the line. The regenerative function of the repeater necessitates a certain pulse density defined as:

- Not more than 15 spaces (zeros) between successive marks (ones)
- An average mark (ones) density of at least 3 in 24.

These guidelines insure that clocking is maintained throughout the system and decreases the amount of jitter on the link.

For data or voice channels, where it is possible to transmit 8 zeroes, it is necessary (in order to guarantee the required pulse density), to dedicate one of the 8 bits of a DSO byte to a mark (one). This reduces the actual DSO bandwidth of 64 kbps, so only 56 kbps is available.

Clear Channel Capability/B8ZS

Clear Channel Capability (CCC) allows the network to transmit a T1 signal unconstrained by ones density, or number of sequential zeroes requirement. CCC utilizes a line coding scheme known as "Bipolar with 8 Zero Substitution" (B8ZS).

When B8ZS coding is used in terminal equipment, a BBZS code replaces any transmitted series of eight consecutive zeroes with a OOOVBOVB code, where the B represents a normal bipolar pulse and the V represents a pulse violating the bipolar rule (Figure 3-4). The receive circuitry in the terminal equipment at the far end of a circuit would recognize this B8ZS code and invert it to the original 8 consecutive zeroes. With CCC, the full 64 kbps of each DSO channel is available for transmission of user data.

When a DTE device transmits BBZS codes, a new clear channel CSU detects them as bipolar violation errors, and corrects the character so a bipolar violation error isn't transmitted to the TELCO. If this had occurred, incorrect user data would be received at the remote DTE device. In order for the DTE device to transmit B8ZS properly, the network and CSU must be designed to pass BBZS codes at either end. Some clear channel CSUs which pass B8ZS codes also show a bipolar violation alarm each time a B8ZS code is detected. This is a normal indication and doesn't affect the data.

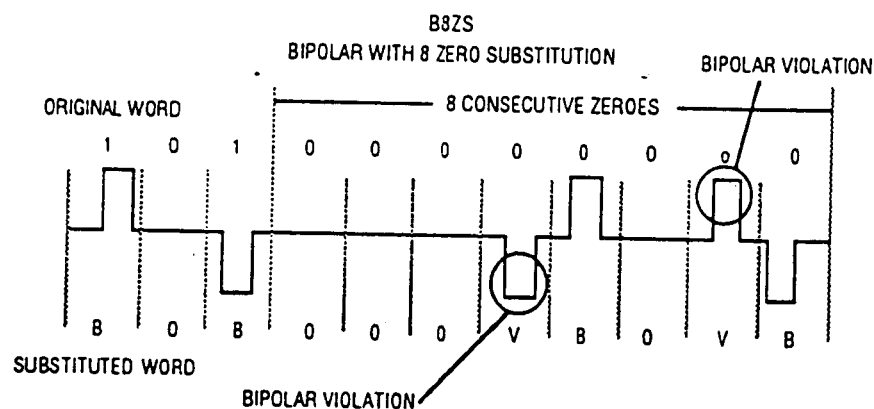


Figure 3-4 Bipolar with Eight Zero Suppression

Chapter 4: Principles of Operation

Overview

The operation of the T1-FT1 Aggregate Interface Piggyback card is similar to a rate converter, whereby the bit stream of the associated multiplexer at a rate of N times 64 or 56 kbps is converted into a bit stream at the T1 rate of 1.544 Mbps (N has a value between 1 and 24).

Note *The bit stream is $N \times 64$ or $N \times 56$ respectively depending upon whether Clear Channel capability is possible or not.*

The N times 64 or 56 kbps bit stream is actually bundled into N-consecutive DSO channels within the D4 frame. The N-consecutive 8-bit bytes may be positioned anywhere within the 24 DSO bytes, but they must always start at DSO channel number 1. The multiplexer data is actually bit-interleaved within the N times 64 or 56 kbps block of bandwidth. The following paragraphs describe circuit operation of the T1-FT1 Aggregate Interface Piggyback card. Figure 4-1 identifies major circuit functions.

Transmit/Receive Section w/FIFO

A FIFO buffer is used in the transmit and receive portions of the T1-FT1 Aggregate Interface Piggyback card to achieve the desired rate conversion between the bit stream from the associated multiplexer at a rate of N times 56 or N times 64 kbps and the aggregate I/O at a rate of 1.544 Mbps. The actual T1 bit stream is fractional, or channelized (only a portion or fraction of the bit stream contains customer data), however, it is not ASDS (Alt. DSO) compatible.

The transmit section receives a constant flow of data at N times 56 or N times 64 kbps which is temporarily stored (written) and then retrieved (read) at 1.544 Mbps, during a period of time that corresponds to the desired window within the T1 frame.

The receive section performs similarly, the only difference being data is written during the receive window at 1.544 Mbps and then read-out at N times 56 kbps or N times 64 kbps. There are no options to affect the data buffers. The receive section also has a provision to adjust the FIFO buffer capacity (through switches). This compensates for the effects of jitter and wander in the T1 frame.

T1 Interface

The T1 interface circuitry is responsible for all functions associated with interfacing to the T1 facility. These functions are:

- T1 frame formatting and coding of the bit stream into AMI bipolar format in the transmitter.
- T1 frame recognition and synchronization, 1.544 MHz clock recovery and conversion of AMI bipolar data in the receiver.

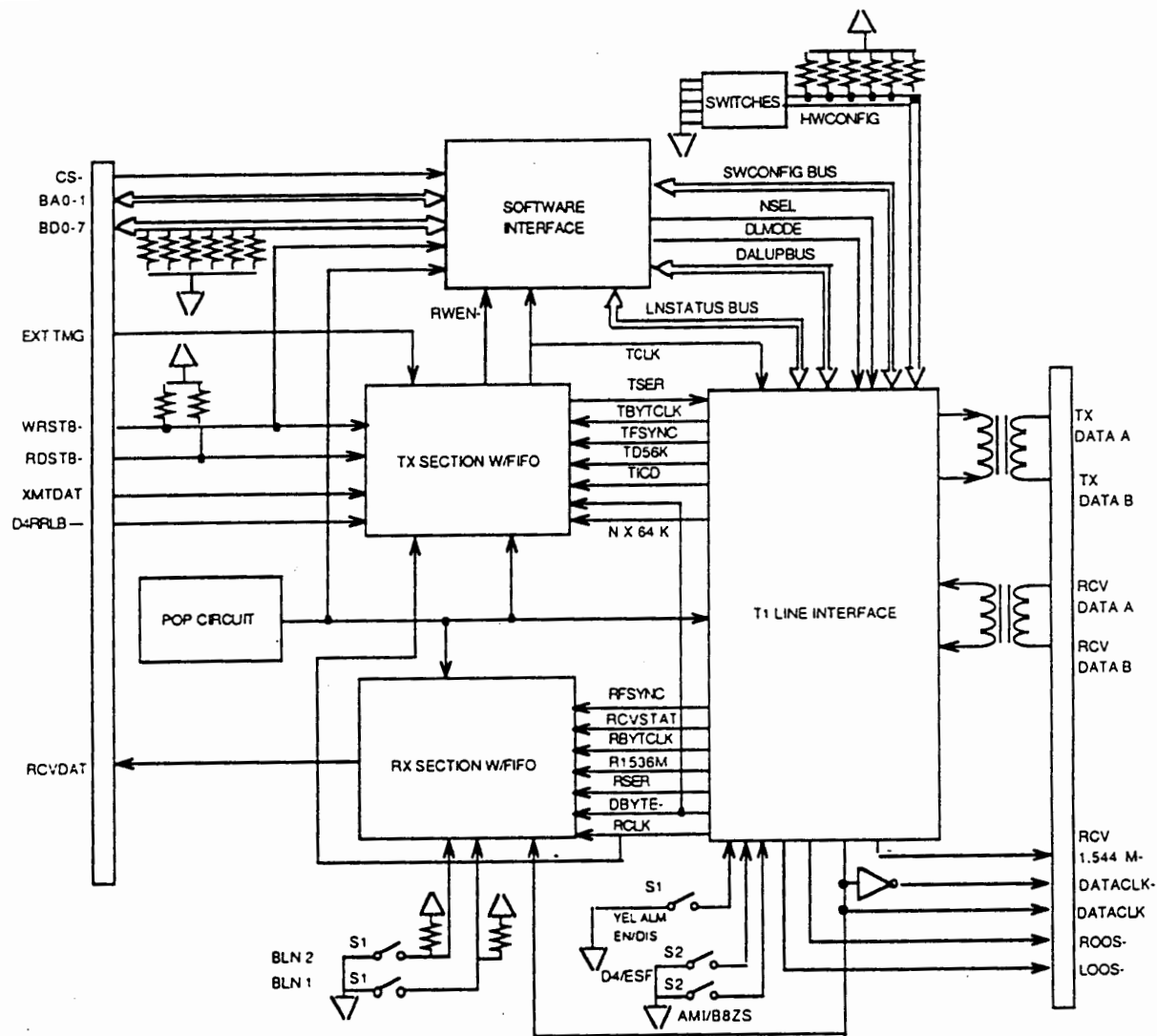


Figure 4-1 T1-FT1 Aggregate Piggyback Interface card Block Diagram

Software Interface

On the MEGAMUX THIS and MEGAMUX TMS Compact, a software interface is available. The software interface can provide the following information from/to the Aggregate Control Module:

- Card Identification
- Revision level of hardware
- Status (B8ZS/Norm switch, D4/ESF switch, driver performance monitor, receive loss-of-signal, and transmit yellow alarm.)
- Basic configuration (includes maximum number of DSOs/T1 frame and aggregate data rate.
- Optional access to the T1 transceiver chip for enhanced control and status.

Tests

No diagnostic tests are available for the T1-FT1 Aggregate Interface piggyback card.

Chapter 5: Glossary

Aggregate Control Module

This module interfaces the 16.896 MHz Fast Bus with a full duplex aggregate trunk connected to a remote node. It buffers data from the Fast Bus and reforms it according to the transmit frame by adding overhead and frame sync bits. Piggyback Cards on board the Aggregate Control Module then prepare the data to comply with transmission standards (EIA or CCITT). The receive section locates the frame sync bits in the receive aggregate data stream, and, using these bits as a reference, disassembles the remainder of the data stream into channel data, channel controls, and overhead bits.

Aggregate Trunk

A communication line, usually full duplex, which transports data between two nodes.

Alarms

These are raised when a malfunction is detected in the system. Major alarms need immediate attention. Minor alarms are not immediately detrimental to the working of the system. Major alarms indicate that hardware on a Common Module is malfunctioning. Minor alarms indicate that the malfunction is in one of the Data or Voice Channel Modules.

Base Card

A board that can have one or more cards called "piggybacks" plugged into it. It can be tested, removed, and replaced as a unit independent from the piggyback card(s).

B8ZS (Bipolar Eight Zero Substitution)

Timing is critical in a digital T1 network. If too many consecutive zeros are in the aggregate data stream, the system may lose synchronization. B8ZS is a method used to meet the "ones density" constraints by taking strings of zeros, converting them to ones and zeros, and placing them back into the aggregate bit stream.

bps

bits per second transmitted or received.

Buffer

A storage device used to streamline data transfer when there is a slight difference in data rates.

Card

An assembly of components that can be tested, removed, and replaced as a unit. A card usually refers to a single unit without piggybacks connected to it.

CCITT

International Telegraph and Telephone Consultative Committee. A committee that sets international communications standards.

Channel

Part of a circuit path through several entities in a communication system. A channel runs between two nodes.

Channel Module

A Voice II or Data Channel Module that plugs into an Expansion Shelf. It interfaces external equipment coming in via cables to a Channel Interface Module.

Channel Interface Module

This module interfaces Channel Modules and the 16.896 MHz Fast Bus. It contains all the circuitry necessary to control, frame, multiplex, and demultiplex up to 64 channels onto the Fast Bus. Channel Card connections to the Channel Interface Module are made via a pair of ribbon cables that run from the backplane of the Expansion shelf, holding the channel cards, to the Main Shelf Backplane where the Channel Interface Module is located.

Circuit

An end-to-end data path which can pass through several entities in a communication system. A circuit is described or referred to by the node/channel names which become connected by the existence of the circuit.

Common Module

A generic term for any module that, when removed, will cause a major alarm. This includes all modules housed in the main shelf plus the Expansion Modules located on each Expansion Shelf.

Communications Bus

See MP bus.

Control Data

Data characters that are sent serially along with data. These characters cause functions such as framing, addressing, synchronization, and error checking to be performed. Control data are also used to indicate handshaking protocol.

DACS Network

DACS (Digital Access Cross-connect System) is a byte oriented (DSO) digital T1 network service.

Dial Backup

A feature that provides a direct node to controller link if normal supervisory communication between the node and controller is disrupted. Dial Backup establishes the link using the Internal GDC 212A modem on the Redundancy Control Module or the use of an external modem.

Diversity

The term for two aggregate trunk lines between the same nodes if one trunk is operational and the other is in stand-by in case the first goes down. Both lines are monitored for serviceability by firmware on the Aggregate Control Module. Switching of the line is controlled independently at both ends by the Aggregate Control module.

DSO (Digital Signal Level 0)

A single 64 kbps channel. The data stream is divided into 8-bit bytes. DSO is a byte-oriented environment. An example of DSO is the DACS network.

DS1 (Digital Signal Level 1)

A combination of 24 DSO channels and 8000 framing bits into a 1.5-14 Mbps data stream.

DSX-1 Interface

Converts a formatted data signal into the proper signal levels for the digital T1 network. Also called a cross-connect.

ESF- ESF (Extended Superframe)

A modified D4 framing format. The basic D4 framing structure contains 1 frame bit followed by 24 eight-bit time slots or a 193 bit frame. An ESF contains (24) 193 bit frames. ESF allows a greater amount of access to digital network services.

Expansion Shelf

Shelf that holds up to 16 Channel Modules and 2 Expansion Modules (one primary, one redundant). Since one Channel Interface Module can interface up to 64 channels, at maximum a Channel Interface Module is connected to 4 Expansion Shelves.

Fast Bus

Also known as the 16.896 MHz, "Common equipment" Bus, it carries controls and data between the Channel Interface and the Aggregate Control Modules in the node. One bit of data is conveyed by every clock bit on this bus. Physically, it spans across the Main Harness Card.

Intelligent Automatic Rerouting

A system that automatically determines proper routing of circuits around any failed node or facility.

ISDN

Integrated Services Digital Network

Main Harness Card or Main Harness Backplane

This assembly is covered by the back panel of the Main Shelf. It is covered by the external connectors used by all the modules in the Main Shelf. Three buses on the Main Harness Card enable the modules to communicate with each other. These three buses are the Fast Bus, the MP Bus (or Communication Bus), and the Clock Bus.

Module

An assembly which has definable performance characteristics so that it can be tested, removed, and replaced as a unit. A module can have other cards called "piggybacks" plugged into it.

MP Bus

Also known as the Communications Bus, it is used to convey configuration, diagnostic, and alarm information between the System Control and all other modules in the system.

Network

Term used to refer to a group of three or more nodes connected together with aggregate trunks.

Node

Any addressable location within a network capable of carrying a MEGAMUX TMS, TMS Compact, MEGAMUX PLUS or MINIMUX TDM circuit. In a network, a MEGAMUX TMS in Philadelphia or a MEGAMUX PLUS in Boston are nodes.

Piggyback Card

A card that plugs into a base card. The piggyback is a separate assembly that can be tested, removed, and replaced as a unit.

Printed Circuit Board (pcb)

See "card".

Route

A logical path through a network from the transmitting equipment to the receiving equipment. The path can go through several nodes.

Station Clock

An external group of modules that connects into the External Timing socket on the Main Harness Card. It monitors two incoming master clock sources (such as DDS). One of the clock sources is kept on stand-by in case the other goes down. The incoming signal is used as the master clock for the network.

Superframe

A D4 frame consists of 1 frame bit followed by 24 eight-bit time slots. A D4 superframe contains 12 consecutive 193-bit frames.

Supervisory Data

Information which travels from the System Control Module via the MP Bus. It does not have any immediate bearing on the data being multiplexed. Instead, it keeps supervisory software in various parts of the system up to date.

System Communications Link

A link over each aggregate trunk. It is reserved for supervisory information originating at the System Control Module and takes up the bandwidth occupied for channel 0 on the aggregate.

T D M

A Time Division Multiplexer processes two or more channels of data for transmission over a shared trunk.

Trunk

See "Aggregate Trunk."

Universal Voice Card

Provides full duplex voice communication capabilities in a MEGAMUX TMS, TMS Compact, MEGAMUX PLUS or MINIMUX TDM Pulse Code Modulation (PCM), Adaptive Differential Pulse Code Modulation (ADPCM) and Advanced Speech Processing (ASP) card configurations are available. The card converts analog voice signals to a sync data rate of 64 kbps for PCM and 32 kbps for ADPCM.



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