TDC

Theater Deployable Communications

Baseline Requirements Document

FCC-100 Tactical Module

(v1)

Nov 2003

ESC/NI4T
5 Eglin Street
Hanscom AFB, MA 01731

Table of Contents

1.0 SCOPE - 6
2.0 APPLICABLE DOCUMENTS - 7
3.0 REQUIREMENTS - 8
3.1 Module Definition - 8
3.2 Performance Requirements - 9
3.2.1 Electrical Interface Requirements (External) - 9
3.2.1.1 Prime Power - 11
3.2.1.2 Dual Port Carrier Module - 11
3.2.1.3 Dual Port Tactical CDI Module - 13
3.2.1.4 Dual Port Tactical CDI Low Speed Module with Phantom Power - 14
3.2.1.5 Dual Voice 2 Wire FXS Module - 14
3.2.1.6 E&M Voice Module - 15
3.2.1.7 Aggregate Module - 15
3.2.1.8 Alarm and External Input - 17
3.2.1.9 Control Terminal - 17
3.2.2 Electrical Interface (Internal) - 18
3.2.3 Functional Requirements - 18
3.2.3.1 FCC-100 Tactical Configuration - 18
3.2.3.2 Module Equipment Details - 18
3.2.3.2.1 Multiplexer - 18
3.2.3.2.2 Timing - 20
3.2.3.2.3 Crypto Ancillary Unit (CAU) Function - 20
3.2.3.2.4 Built-In Test - 20
3.2.3.3 Configuration Options - 20
3.2.4 Physical Characteristics - 21
3.2.4.1 Transit Case - 21
3.2.4.2 Weight - 21
3.2.4.3 Storage Space - 21
3.2.4.4 Marking - 21
3.2.5 Cables and Adapters - 21
3.2.6 Reliability - 22
3.2.7 Maintainability - 22
3.2.7.1 Mean Time Between Preventive Maintenance - 22
3.2.8 Environmental Conditions - 22
3.2.8.1 Temperature - 22
3.2.8.2 Relative Humidity - 23
3.2.8.3 Altitude - 23
3.2.8.4 Sand and Dust - 23
3.2.8.5 Shock - 23
3.2.8.6 Vibration - 23
3.3 Design and Construction - 24
3.3.1 Material Parts and Processes - 24
3.3.2 Safety - 24

3.3.2.1 Electrical Safety - 24
3.3.2.2 Mechanical Safety - 24
3.4 Logistics - 24
4.0 QUALITY ASSURANCE PROVISIONS - 25
4.1 General - 25
4.2 Responsibility for Inspection - 25
4.3 Product Qualification Test (PQT) - 25
4.4 Production Acceptance Test (PAT) - 25
4.5 Verification Cross Reference Matrix (VCRM) - 25
4.5.1 Not Required (N/R) - 25
4.5.2 Inspection - 25
4.5.3 Analysis - 26
4.5.4 Demonstration - 26
4.5.5 Test - 26
5.0 PREPARATION FOR DELIVERY - 28
6.0 BASELINE CONFIGURATION - 29
6.1 Equipment - 29
6.2 Elevation Drawings - 31
6.3 Cable Diagrams - 32
6.4 Interconnection Diagrams - 33

List of Tables

Table 1 - Standards and Applicable Documents - 7
Table 2 - FCC-100 Tactical Module External Interface Characteristics - - - - - - - - - - - 9
Table 3 - FCC-100 Tactical Mux Port Connections - 10
Table 4 - Conditioned Diphase Port Connector - 12
Table 5 - Synchronous Port Connector - 12
Table 6 - Asynchronous Port Connector - 12
Table 7 - Tactical CDI High Speed Port Connector - 13
Table 8 - Tactical CDI Low Speed Port Connector - 14
Table 9 - Dual Voice FXS and FXO Port Connector - - - - - - - - - - - - - - - - - - - 14
Table 10 - 4-Wire Voice Port Connector - 15
Table 11 - NRZ Aggregate Module Connector - 16
Table 12 - Tactical Conditioned Diphase Aggregate Module Connector - - - - - - - - - 16
Table 13 - Alarm and External Input Connector - 17
Table 14 - Control Terminal Connector Wiring - 17
Table 15 - FCC-100 Tactical Mux Card Complement - - - - - - - - - - - - - - - - - - 19
Table 16 - Cables and Adapters included with FCC-100 Module - - - - - - - - - - - - 22
Table 17 - MTBF of Major Components - 22
Table 18 - Module Temperature Characteristics - 22
Table 19 - Module Humidity Characteristics - 23
Table 20 - Module Altitude Characteristics - 23
Table 21 - Verification Cross Reference Matrix - 26
Table 22 - Equipment Listing - 29
Table 23 - Cable Diagrams - 32

List of Figures

Figure 1 - FCC-100 Mux Module Application in TDC ICAP - - - - - - - - - - - - - - - - - 8
Figure 2 - FCC-100 Mux Module Context Diagram - 9
Figure 3 - AN/FCC-100 Application in the TDC ICAP Network - - - - - - - - - - - - - 18
Figure 4 - FCC-100 Multiplexer Card Layout - 19
Figure 5 - Front Elevation - 31
Figure 6 - Rear Elevation - 32

1.0 SCOPE

This requirements document establishes the performance, manufacture and test requirements for the TDC ICAP FCC-100 Tactical Module v1.

2.0 APPLICABLE DOCUMENTS

To the extent specified herein, the following documents of latest current issue on the date of this Baseline Requirements Document form part of this BRD.

Table 1 - Standards and Applicable Documents

Document Number	Title
DNE Technologies, Inc 24000991*	AN/FCC-100 (V9) Installation, Setup, Configuration, Operation, and Maintenance Manual.
IEEE 802.3	Ethernet Standard.
TIA/EIA–422–B	Electrical Characteristics of Balanced Voltage Digital Interface Circuits (ANSI/TIA/EIA–422–B–94) (May, 1994)
EIA–530	High Speed 25 — Position Interface for Data Terminal Equipment and Data Circuit — Terminating Equipment, (June 1992)
EIA/TIA–232–E	Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment employing serial binary data interchange (rates to 20 Kbps) (July 1991).
MIL-STD-810E	Environmental Test Methods
	TDC Standards Document

3.0 REQUIREMENTS

3.1 Module Definition

The AN/FCC-100 (V) 9 is a 7" high (4U) tactical multiplexer which supports a mix of up to sixteen user port interfaces and mounts in a 19" EIA rack or transit case. The multiplexer supports analog (voice frequency) and digital data user interfaces that may be mixed as required to meet specific system requirements.

User interface modules include two and four wire analog port devices that support a wide range of POTS (Plain Old Telephone System) equipment, including standard and STU-III telephones, fax machines, and modems. An optional voice compression module compresses the digitized voice signal from 64 kbps to user-selectable rates of 2.4, 4.8, 9.6, 12.8, 14.4 and 16 kbps. DSVT interfaces provide phantom power and transformer-coupled interfaces to phones up to 3.2 km away from the multiplexer, eliminating the need for a separate power supply.

The multiplexed signal (aggregate) is user-specified as either synchronous RS422/423 or TRI-TAC Conditioned Diphase (CDI) at data rates from 1200 bps to 2048 kbps. The synchronous interfaces support automatic crypto resynchronization capability for circuits that require bulk encryption of the user data.

In the ICAP network, the FCC-100 Tactical Mux Module provides multiplexing and demultiplexing of voice, data and message traffic. This multiplexing function creates bandwidth efficient connectivity between the deployed base and off-base locations. The FCC-100 Tactical Mux Module is generally located at the primary hub of the deployed base. Figure 1 shows the FCC-100 Tactical Mux Module connections for interfacing voice and data traffic from local equipment to off-base locations as seen in the Context Diagram Figure 2.

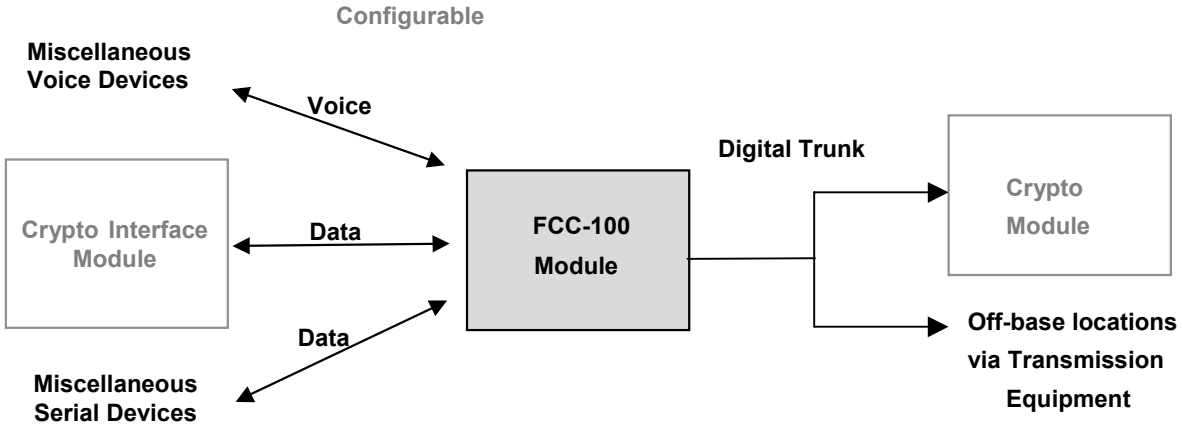

Figure 1 - FCC-100 Mux Module Application in TDC ICAP

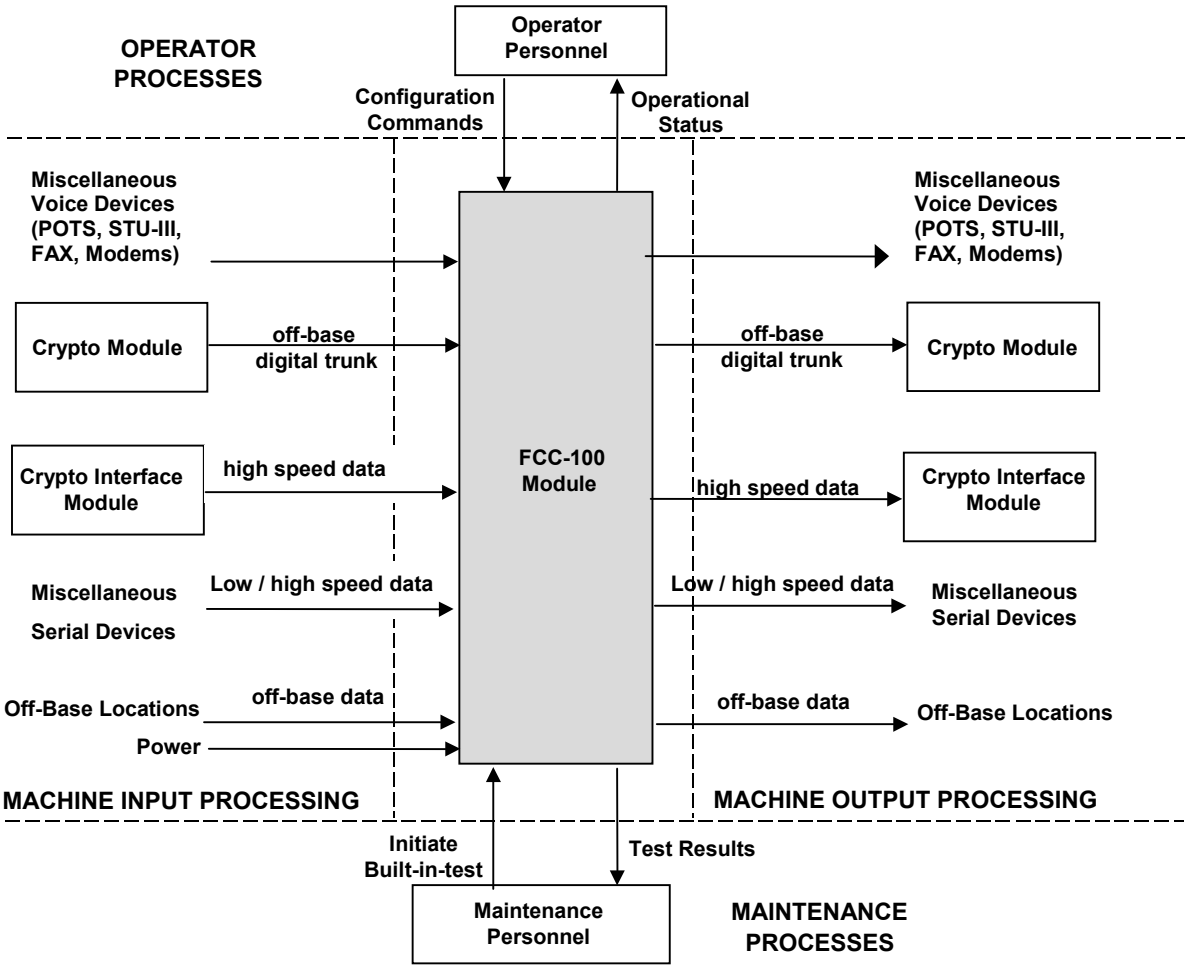

Figure 2 - FCC-100 Mux Module Context Diagram

3.2 Performance Requirements

3.2.1 Electrical Interface Requirements (External)

The FCC-100 Tactical Mux Module (V1) includes the number and type of active external interfaces presented in Table 2.

Table 2 - FCC-100 Tactical Module External Interface Characteristics

Signal Name	Quantity	Connector	Primary Interface	Electrical Characteristics
Prime Power	1	N/A	IEC 320 C-20 Receptacle	AC Power

Table 2 - FCC-100 Tactical Module External Interface Characteristics

Signal Name	Quantity	Connector	Primary Interface	Electrical Characteristics
E&M Voice Module	2	1-2	DB-25F	Miscellaneous Voice Devices
Dual Port Carrier Module	2	7-8	DB-25F	Misc Serial Devices & CIM
Dual Port Carrier Module	4	3-6	DB-25F	Misc Serial Devices & CIM
Dual Port Tactical CDI	2	16	DB-25F or UG-1837/U[3]	CIM
Module		15	DB-25F	
Dual Port Tactical CDI Module	2	13-14	DB-25F	CIM
Dual Voice 2 Wire FXS Module	4	9-12	DB-25F	Miscellaneous Voice Devices
Aggregate Module	1	17	DB-25F or UG-1837/U[3]	Crypto Module/ Off-Base Locations
Alarm and External Input	1	18	DB-25F	Processor Module
Control Terminal	1	19	DB-25F	Dumb Terminal/PC

Note 1 Interface quantities are configurable using modules, sub modules and terminators in the Tactical Accessory Kit.

Note 2 When using EIA 530 Interface Adapter [P/N64025043] to change pin assignments from DNE standard to EIA-530.

Note 3 Connectors J16 and J17 only.

System interconnection is through the tactical backplane assembly at the rear of the FCC-100. The backplane assembly has seventeen DB-25 and two DB25 or UG-1837/U (CDI) connectors plus the power connector. J1 through J16 service ports 1 through 16 each of which can interface with one TDM data channel on one TDM voice channel. J17 connects the aggregate data (trunk) to the crypto module or off-base transmission equipment, and J18 provides remote alarm monitoring. Connector J19 accommodates a control terminal. A CDI connector option is also provided for J16 and J17. The specific port configurations that are provided for the FCC-100 Tactical Mux Module are presented in Table 3.

Table 3 - FCC-100 Tactical Mux Port Connections

Port	Connector	Connector Type	Module
Port 1	J1	DB-25F	4-Wire E&M Voice
Port 2	J2	DB-25F	4-Wire E&M Voice
Port 3	J3	DB-25F	Dual Port Carrier: with NRZ Serial Card

Table 3 - FCC-100 Tactical Mux Port Connections

Port	Connector	Connector Type	Module
Port 4	J4	DB-25F	Dual Port Carrier: with NRZ Serial Card
Port 5	J5	DB-25F	Dual Port Carrier: with NRZ Serial Card
Port 6	J6	DB-25F	Dual Port Carrier: with NRZ Serial Card
Port 7	J7	DB-25F	Dual Port Carrier: with Conditioned Diphase Card
Port 8	J8	DB-25F	Dual Port Carrier: with Conditioned Diphase Card
Port 9	J9	DB-25F	Dual Voice 2 Wire FXS w CELP Compression Card
Port 10	J10	DB-25F	Dual Voice 2 Wire FXS w CELP Compression Card
Port 11	J11	DB-25F	Dual Voice 2 Wire FXS w CELP Compression Card
Port 12	J12	DB-25F	Dual Voice 2 Wire FXS w CELP Compression Card
Port 13	J13	DB-25F	Dual Tactical CDI: Low Speed w Phantom Power
Port 14	J14	DB-25F	Dual Tactical CDI: Low Speed w Phantom Power
Port 15	J15	DB-25F	Dual Tactical CDI: High Speed
Port 16	J16	DB-25F or UG-1837/U	Dual Tactical CDI: High Speed
Aggregate	J17	DB-25F or UG-1837/U	Aggregate Carrier w NRZ and CDI Drivers
Alarms	J18	DB-25F	Interface [Alarms]
Control	J19	DB-25F	Interface [Terminal Control]

3.2.1.1 Prime Power

The FCC-100 Mux Module is designed to operate from 120/240 VAC ± 10%, 47/63 Hz., single phase, three-wire power. The maximum power consumption does not exceed 250 watts.

3.2.1.2 Dual Port Carrier Module

The FCC-100 Dual Port Carrier Module provides interfacing between two external voice/data devices and the FCC-100 internal high-speed data bus. It requires installation of four plug-in type sub modules for operation: two interfaces and two corresponding terminators. The interface sub modules convert data from the user's port to synchronous NRZ data for transmission, and from synchronous NRZ to the format used by the external voice or data devices for receive operation. The terminator modules are used to match the electrical characteristics of the port carrier between the FCC-100 Mux module and the external devices.

The port carrier modules require installation of two plug –in interface sub modules, one for each port, for proper operation. There are three digital interface sub modules: synchronous, asynchronous and conditioned diphase.

The connector wiring diagrams (pinouts) for the Dual Port Carrier Module configured with the synchronous data sub modules, asynchronous data sub modules, and conditioned diphase sub modules are presented in Table 4, Table 5, and Table 6 respectively.

Table 4 - Conditioned Diphase Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Clear To Send (-)	19	Receive Data (-)
2	Transmit Data (+)	11	Request To Send (-)	20	Data Terminal Ready (+)
3	Receive Data (+)	12	Not Connected	21	Data Terminal Ready (-)
4	Request To Send (+)	13	Not Connected	22	Data Set Ready (-)
5	Clear To Send (+)	14	Transmit Data (-)	23	Not Connected
6	Data Set Ready (+)	15	Not Connected	24	Not Connected
7	Signal Return	16	Not Connected	25	Not Connected
8	Data Carrier Detect (+)	17	Not Connected		
9	Data Carrier Detect (-)	18	Not Connected		

Table 5 - Synchronous Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Clear To Send (-)	19	Receive Data (-)
2	Transmit Data (+)	11	Request To Send (-)	20	Data Terminal Ready (+)
3	Receive Data (+)	12	Receive Clock In (+)	21	Data Terminal Ready (-)
4	Request To Send (+)	13	Receive Clock In (-)	22	Data Set Ready (-)
5	Clear To Send (+)	14	Transmit Data (-)	23	Transmit Clock In (-)
6	Data Set Ready (+)	15	Transmit Clock Out (+)	24	Transmit Clock In (+)
7	Signal Ground	16	Transmit Clock Out (-)	25	Not Connected
8	Data Carrier Detect (+)	17	Receive Clock Out (+)		
9	Data Carrier Detect (-)	18	Receive Clock Out (-)		

Note: For high speed (above 64 kbps) unbalanced operation – connect pins 14 and 19 to pin 1 (chassis ground).

Table 6 - Asynchronous Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Clear To Send (-)	19	Receive Data (-)
2	Transmit Data (+)	11	Request To Send (-)	20	Data Terminal Ready (+)

Table 6 - Asynchronous Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
3	Receive Data (+)	12	Not Connected	21	Data Terminal Ready (-)
4	Request To Send (+)	13	Not Connected	22	Data Set Ready (-)
5	Clear To Send (+)	14	Transmit Data (-)	23	Not Connected
6	Data Set Ready (+)	15	Not Connected	24	Not Connected
7	Signal Return	16	Not Connected	25	Not Connected
8	Data Carrier Detect (+)	17	Not Connected		
9	Data Carrier Detect (-)	18	Not Connected		

3.2.1.3 Dual Port Tactical CDI Module

The FCC-100 Dual Port Tactical CDI Module provides interfacing between two external data devices and the FCC-100 internal high-speed data bus. Each module has two complete CDI data channels. There are two CDI port versions:

- 58 ohm high speed version without phantom power
- 128 ohm low speed version with and without phantom power

The 58 ohm version is optimized for data rates less than or equal to 576 kbps, and line lengths less than or equal to 3.2 km. The 128 ohm version is optimized for data rates less than or equal to 56 kbps, and line lengths equal to less than 3.2 km. Phantom power is only available on the 125 ohm CDI port version and is a 50 VDC nominal voltage that is present between the receive and transmit wire pairs. The transmit (i.e. input) wire pairs are at –50 VDC with respect to the receive (i.e. output) wire pairs.

Two different versions of Dual Port Tactical CDI Module, the T-CDI high speed module and T-CDI low speed module with phantom power, are provided with the FCC-100 Tactical Mux Module configuration.

The connector wiring diagrams (pinouts) for the two versions are presented in Table 7 and Table 8 respectively.

Table 7 - Tactical CDI High Speed Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Not Connected	19	Receive Data (-)
2	Transmit Data (+)	11	Not Connected	20	Not Connected
3	Receive Data (+)	12	Not Connected	21	Not Connected
4	Not Connected	13	Not Connected	22	Not Connected
5	Not Connected	14	Transmit Data (-)	23	Not Connected
6	Not Connected	15	Not Connected	24	Not Connected

Table 7 - Tactical CDI High Speed Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
7	Signal Ground	16	Not Connected	25	Not Connected
8	Not Connected	17	Rx Recovered Clock (+)		
9	Not Connected	18	Rx Recovered Clock (-)		

Note: For high speed (above 64 kbps) unbalanced operation – connect pins 14 and 19 to pin 1 (chassis ground).

3.2.1.4 Dual Port Tactical CDI Low Speed Module with Phantom Power

Table 8 - Tactical CDI Low Speed Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Not Connected	19	Receive Data (-)
2	Transmit Data (+)	11	Not Connected	20	Not Connected
3	Receive Data (+)	12	Not Connected	21	Not Connected
4	Not Connected	13	Not Connected	22	Not Connected
5	Not Connected	14	Transmit Data (-)	23	Not Connected
6	Not Connected	15	Not Connected	24	Not Connected
7	Signal Ground	16	Not Connected	25	Not Connected
8	Not Connected	17	Rx Recovered Clock (+)		
9	Not Connected	18	Rx Recovered Clock (-)		

3.2.1.5 Dual Voice 2 Wire FXS Module

The FCC-100 Dual Voice Port (DVP) 2 – Wire FXS Module provides interfacing between an analog (VF) subscriber line interface and the FCC-100 internal high-speed data bus. It provides pulse code modulation (PCM) encoding which can be further encoded by the voice compression module (VCM) for increased bandwidth efficiency.

The connector-wiring diagram (pinout) for the Dual 2 – Wire FXS Module configured with two (CELP)/ secure voice compression sub modules is presented in Table 9.

Table 9 - Dual Voice FXS and FXO Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Not Connected	19	Chassis Ground
2	Ring (R)	11	Not Connected	20	Not Connected
3	Not Connected	12	Not Connected	21	Not Connected

Table 9 - Dual Voice FXS and FXO Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
4	Not Connected	13	Not Connected	22	Not Connected
5	Not Connected	14	Tip (T)	23	Not Connected
6	Not Connected	15	Not Connected	24	Chassis Ground
7	Signal Ground	16	Not Connected	25	Chassis Ground
8	Not Connected	17	Not Connected		
9	Not Connected	18	Chassis Ground		

Note: Pins 1, 18, 19, 24 & 25 must be connected at the connector.

3.2.1.6 E&M Voice Module

The FCC-100(v)9 E&M Dual Port Voice Card provides 4-wire E&M interfacing between external voice devices and the FCC-100(V)9 internal high-speed data bus. The connector-wiring diagram (pinout) for the 4-wire Voice Module is presented in Table 10.

Table 10 - 4-Wire Voice Port Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Not Connected	19	Chassis Ground*
2	Ring (R)	11	Not Connected	20	Not Connected
3	Ring 1 (R1)	12	Not Connected	21	Not Connected
4	Signal Ground Set	13	Not Connected	22	Not Connected
5	-48VDC Signal Battery (SB)	14	Tip (T)	23	Not Connected
6	Not Connected	15	Tip 1 (T1)	24	Chassis Ground*
7	Not Connected	16	E Lead	25	Chassis Ground*
8	Not Connected	17	M Lead		
9	Not Connected	18	Chassis Ground*		

* Pins 1, 18, 19, 24, 25 must be connected at the connector.

3.2.1.7 Aggregate Module

The aggregate module transfers data between the local FCC-100 internal high-speed data bus and the transmission path to the remote FCC-100. The aggregate module requires selection of appropriate strapping options and installation of the user-specified driver interface sub module prior to operation. The aggregate module provided with the FCC-100 Tactical Mux module configuration (P/N 85970030) is designed to accept one of four different driver interface sub modules: NRZ (RS-422/423) interface driver, low-speed (MIL-188-114) interface driver, T-CDI high speed interface driver, and T-CDI low speed interface driver. Both the NRZ and the T-CDI high-speed interface drivers are provided with the FCC-100 Tactical Mux module.

The connector wiring diagrams (pinouts) for the Aggregate Module when configured with the RS-422/423 interface driver sub module and with the T-CDI high-speed interface driver submodule is presented in Tables X and Y respectively.

Table 11 - NRZ Aggregate Module Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Aux Clock (-) *	19	Receive Data (-) *
2	Transmit Data (+)	11	KG Resync (+)	20	Data Terminal Ready
3	Receive Data (+)	12	Recovered Rx Clock Out(+)	21	Not Connected
4	Request To Send	13	Recovered Rx Clock Out(-) *	22	Not Connected
5	Not Connected	14	Transmit Data (-) *	23	Transmit Clock Out (-) *
6	Data Set Ready	15	Transmit Clock In (+)	24	Transmit Clock Out (+)
7	Signal Return	16	Transmit Clock In (-) *	25	KG Resync (-) *
8	Not Connected	17	Receive Clock In (+)		
9	Aux Clock (+)	18	Receive Clock In (-) *		

Note: No connection necessary for unbalanced operation.

Table 12 - Tactical Conditioned Diphase Aggregate Module Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Aux Clock (-)	19	Receive Data (-)
2	Transmit Data (+)	11	Not Connected	20	Data Terminal Ready
3	Receive Data (+)	12	Recovered Rx Clock Out(+)	21	+ 5 VDC
4	Request To Send	13	Recovered Rx Clock Out(-)	22	- 5 VDC
5	Not Connected	14	Transmit Data (-)	23	Transmit Clock Out (-)
6	Data Set Ready	15	Transmit Clock In (+)	24	Transmit Clock Out (+)
7	Signal Return	16	Transmit Clock In (-) *	25	Not Connected
8	Not Connected	17	Receive Clock In (+)		
9	Aux Clock (+)	18	Receive Clock In (-) *		

3.2.1.8 Alarm and External Input

The Interface Module is the communications link between the FCC-100 processor module and the front panel assembly or an external control terminal. The processor module provides input signals used to control illumination of the six LEDs on the front panel assembly. Front panel keypad inputs are converted in the interface module to control FCC-100 operation and the front panel display. Alarms register outputs control relay drivers and alarm relays K1 through K6. The relay driver outputs are used to illuminate the LEDs in the front panel assembly and the relay contacts are routed to the backplane external alarm connector. The connector-wiring diagram (pinout) for the Alarm and External Input Connector is presented in Table 13.

Table 13 - Alarm and External Input Connector

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Fault Relay -NO	19	Alarm A- Com
2	Not Connected	11	Port Loopback - NC	20	Alarm A- NO
3	Not Connected	12	Port Loopback - C	21	Alarm B- NC
4	Remote Loopback-NC	13	Port Loopback - NO	22	Alarm B- NO
5	Remote Loopback-C	14	Local Loopback NC	23	Loss of Frame- NC
6	Remote Loopback-NO	15	Local Loopback C	24	Loss of Frame- C
7	Signal Return	16	Local Loopback NO	25	Loss of Frame- NO
8	Fault Relay -NC	17	Syn Inhibit		
9	Fault Relay- C	18	Alarm A- NC		

3.2.1.9 Control Terminal

The Interface Module contains an internal MPU/ UART that is used to receive data from and transmit data to an external control terminal. Data in and out to the control terminal is in serial asynchronous form, routed in through a receiver, and sent out through mark sense logic and a line driver to the terminal. The MPU outputs the data set ready (DSR) and the clear-to-send (CTS) control leads to the control terminal for operation. The connector-wiring diagram (pinout) for the Control Terminal Connector is presented in Table 14.

Table 14 - Control Terminal Connector Wiring

Pin	Signal	Pin	Signal	Pin	Signal
1	Chassis Ground	10	Not Connected	19	Not Connected
2	Transmit Data	11	Not Connected	20	Not Connected
3	Receive Data	12	Not Connected	21	Not Connected
4	Not Connected	13	Not Connected	22	Not Connected
5	Clear To Send	14	Not Connected	23	Not Connected
6	Not Connected	15	Not Connected	24	Not Connected

Table 14 - Control Terminal Connector Wiring

Pin	Signal	Pin	Signal	Pin	Signal
7	Signal Return	16	Not Connected	25	Not Connected
8	Not Connected	17	Not Connected		
9	Not Connected	18	Not Connected		

3.2.2 Electrical Interface (Internal)

Not used.

3.2.3 Functional Requirements

3.2.3.1 FCC-100 Tactical Configuration

A block diagram of the FCC-100 Mux Module functional architecture within the TDC ICAP Network is provided in Figure 3. The heart of the module is the FCC-100 digital multiplexer. The multiplexer accepts voice and data traffic from the other ICAP modules and multiplexes it for link encryption and transmission to off-base locations. Conversely, the multiplexer demultiplexes off-base traffic onto digital voice and data lines.

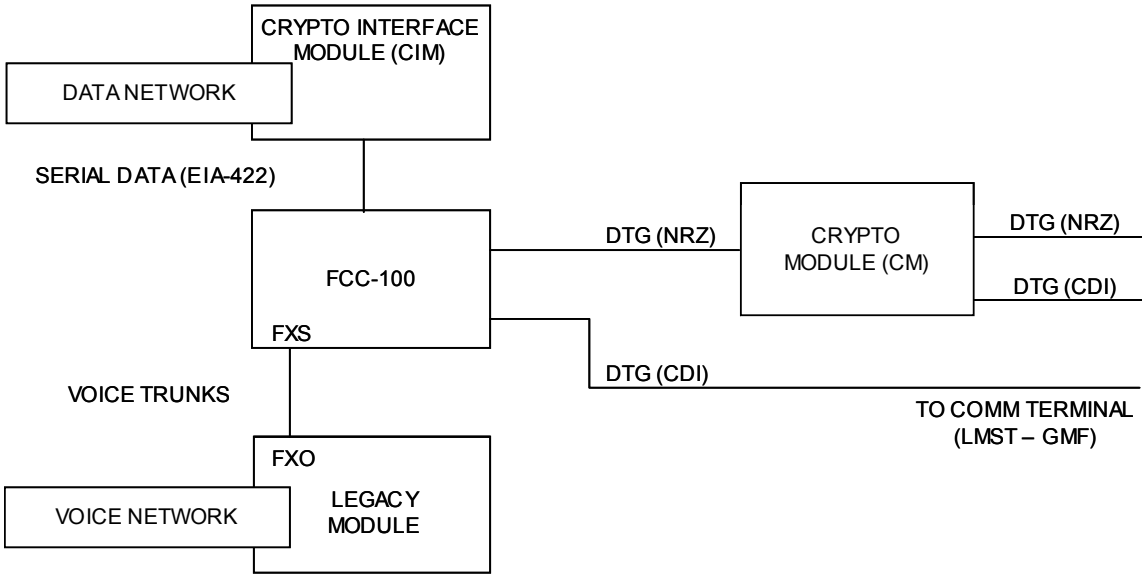

Figure 3 - AN/FCC-100 Application in the TDC ICAP Network

3.2.3.2 Module Equipment Details

3.2.3.2.1 Multiplexer

The FCC-100 Tactical Mux Module includes a DNE Technologies FCC-100 16 port multiplexer as shown in Figure 4. The specific card complement for the tactical mux module configuration is presented in Table 15 which lists the card type, quantity and reference describing each card's capabilities and features. The references come from the DNE Technologies AN/FCC-100 (V) 9 Time Division Multiplexer Installation, Setup, Configuration, Operation and Maintenance Manual in Chapter 5 Theory of Operation.

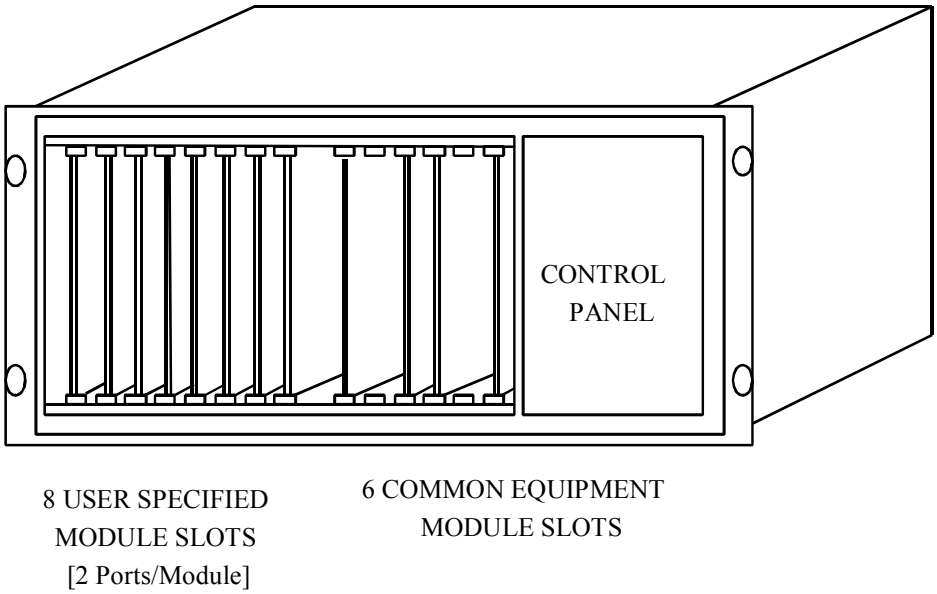

Figure 4 - FCC-100 Multiplexer Card Layout

Table 15 - FCC-100 Tactical Mux Card Complement

Module	Position	Quantity	Reference
Empty	Slot 1	1	
Dual Port Carrier (NRZ)	Slot 2	1	Port Carrier Module
Dual Port Carrier (NRZ)	Slot 3	1	Port Carrier Module
Dual Port Carrier (CDI)	Slot 4	1	Port Carrier Module
Dual 2 Wire FXS	Slot 5	1	Dual Voice 2 Wire FXS Card
Dual 2 Wire FXS	Slot 6	1	Dual Voice 2 Wire FXS Card
Dual T-CDI (Low Speed)	Slot 7	1	CDI Interface Module
Dual T-CDI (High Speed)	Slot 8	1	CDI Interface Module
Aggregate	Slot 9	1	Aggregate Module
Empty	Slot 10		Aggregate Module
Mux / Demux	Slot 11	1	Mux / Demux Module
Processor	Slot 12	1	Processor Module

Table 15 - FCC-100 Tactical Mux Card Complement

Module	Position	Quantity	Reference
Empty	Slot 13		
Interface	Slot 14	1	Interface Module

3.2.3.2.2 Timing

Because the FCC-100 Mux Module operates in widely diverse networks, a number of clock options are available.

- The FCC-100 Mux Module is capable of deriving or accepting external timing.
- The FCC-100 Mux Module can provide internal timing via the timing signals generated by the on-board oscillator (accurate to 25 parts per million over operating temperature range).
- The FCC-100 Mux Module can accept an external clock at any aggregate rate, 1 MHz or 5 MHz and slave all of its transmit timing to this external source.

3.2.3.2.3 Crypto Ancillary Unit (CAU) Function

The FCC-100 Mux Module has a crypto ancillary unit (CAU) function that allows the multiplexer to be directly connected to a key generator (KG), and to reset the KG when it loses synchronization. This function can be enabled or disabled during FCC-100 Mux configuration. The FCC-100 Mux has operating parameters stored in internal memory for operation with the KG-34, KG-81, KG-84 (KIV-7HS), and KG-94 (KIV-19).

3.2.3.2.4 Built-In Test

The FCC-100 includes continuously running diagnostics to detect and report major faults via the configuration and status ports. The FCC-100 includes supplementary built-in diagnostics, which may be run off-line, to aid the operator in isolating faults to the LRU level. The multiplexer includes a local loopback function, which may be enabled by the operator. Six alarm outputs are provided at connector J18: remote aggregate loopback relay, fault relay, port loopback relay, local aggregate loopback relay, power on relay, and loss of frame relay.

3.2.3.3 Configuration Options

In addition to the basic functions and features provided with the FCC-100 Tactical Mux Module, the installer may customize the FCC-100 by modifying the card complement to provide additional functions and features listed below:

FCC-100 Tactical Accessory Kit – Contains two (2) Dual Port Carrier Modules, four (4) Synchronous NRZ Port Sub modules & Terminators, two (2) Asynchronous Port Sub modules & Terminators, two (2) Dual FXO Modules each configured with two CELP/secure vice compression sub modules, and one (1) Tactical CDI Aggregate Driver Sub module.

3.2.4 Physical Characteristics

The module is a 7" high (4U) tactical multiplexer which supports a mix of up to sixteen user port interfaces and mounts in a 19" EIA rack or transit case. The rack or transit case must be capable of supporting 65 pounds, plus the weight of cabling connected to the backplane assembly.

All input/output connections are made on the rear backplane assembly. The backplane has nineteen DB-25 connectors. J1 through J16 service ports 1 through16, each of which can interface one TDM data channel or one TDM voice channel. J17 connects the aggregate, and J18 provides remote alarm monitoring. Connector J19 accommodates a control terminal.

3.2.4.1 Transit Case

The module is housed in an 8 U transportable container (transit case), approximately 22.5”W. x 34.5”D. x 18.1”H. The transit cases are designed to stack on top of and mechanically interlock to like cases. The transit cases with their covers in place are designed to protect the electronic equipment inside from direct exposure to environmental conditions; e.g., rain, snow, ice, dust, etc., likely to be encountered during world wide military transit.

3.2.4.2 Weight

The module, including all internally carried cables, does not exceed 68kg/150lb.

3.2.4.3 Storage Space

The module transit case includes a storage drawer for the tactical accessory kit as well as storage pouches within its covers to contain cables, manuals, etc. that must be transported and used with the module.

3.2.4.4 Marking

The module is visually identified by color code, having two inch wide White and Orange diagonally striped tape surrounding the case. A nameplate is permanently affixed to the module body (not its covers) listing the module’s stock number, name, supplier code and serial number. Each removable cover and cable are suitably marked identifying it as part of a specific module.

A warning or information label is prominently affixed to the module body that informs the installer of the module’s power requirements.

Permanent marking is prominently placed on the module body to indicate fully loaded weight, center of gravity and top of case.

3.2.5 Cables and Adapters

In addition to the tactical accessory kit detailed in Paragraph 3.2.3.3, the FCC-100 Tactical Multiplexer Module includes the cables and adapters listed in Table 16, stored within the covers. Strain relief and cable management hardware are provided with the module.

Table 16 - Cables and Adapters included with FCC-100 Module

Function	Color Code	Quantity	Description
Power Cord	N/R	1	IEC-320 C20 Jack to NEMA 5-15P
Adapter	N/R	4	EIA 530 Interface Adapter
Adapter	N/R	1	DB-25Quick Release Adapter

3.2.6 Reliability

The module with its standard complement of LRUs, have a mean time between failure (MTBF) commensurate with similar commercial equipment in its class. The actual MTBF for the major system components are shown in Table 17. Where reliability data is not readily available from the vendor, this is indicated.

Table 17 - MTBF of Major Components

Component	MTBF
FCC-100 (V9)	5000 hours

3.2.7 Maintainability

Maintainability characteristics will be part of the selection criteria for all hardware. Ease of maintenance, such as accessibility to Line Replaceable Units, fault detection/isolation software capability, and fault annunciation will be considered.

3.2.7.1 Mean Time Between Preventive Maintenance

The Mean Time Between Preventive Maintenance, during operation, is 30 days. The duration of preventive maintenance actions such as corrosion control, cleaning filters, etc., does not exceed 30 minutes.

3.2.8 Environmental Conditions

During storage, transport and operation the modules can withstand exposure to temperatures as shown in Table 18.

3.2.8.1 Temperature

Temperature characteristics for the major equipment components are shown in Table 18.

Table 18 - Module Temperature Characteristics

	Temperature (degrees C)	
Equipment	Operating	Non-Operating
FCC-100 (V9)	0 to 50	-21 to 63

3.2.8.2 Relative Humidity

Relative humidity characteristics for the major equipment components are shown in Table 19.

Table 19 - Module Humidity Characteristics

Equipment	Humidity
	Non-condensing
FCC-100 (V9)	0 to 90%

3.2.8.3 Altitude

Altitude characteristics for the major equipment components are shown in Table 20.

Table 20 - Module Altitude Characteristics

Equipment	Altitude (feet)	
	Operating	Non-Operating
FCC-100 (V9)	Up to 15,000 feet	Up to 15,000 feet

3.2.8.4 Sand and Dust

During storage and transport, the modules are protected when exposed to sand and dust in accordance with the best commercial practices for close proximity to operating aircraft. During operation with covers removed, the modules can withstand sand and dust in accordance with the best commercial practices for natural conditions.

3.2.8.5 Shock

Module equipment racks are equipped with rubber shock isolation mounts and is protected from shocks induced during handling, setup and tear down. Modules and components can operate without degradation following exposure to the non-operating shock environment described by Method 516.4, Procedure VI (Bench Handling) of MIL STD 810F.

3.2.8.6 Vibration

The modules are equipped with rubber shock isolation mounts so that the modules can withstand the vibration encountered while being transported by commercial and military airlift, sealift and vehicular (over unimproved roads) systems. MIL-STD-810F, Method 514.5, Procedure I, Categories 4, 7 and 8. applies; alternative procedures may be substituted after TDC Program Office approval.

3.3 Design and Construction

3.3.1 Material Parts and Processes

This module is built to good commercial practices. Mechanical and electrical interchangeability exists between like systems, subsystems, assemblies, subassemblies and replaceable parts.

3.3.2 Safety

This module shall not present a safety, fire or health hazard to personnel.

3.3.2.1 Electrical Safety

This module is designed to eliminate the hazard to personnel of inadvertent lethal voltage contact. All electrical conductors carrying voltages in excess of 70 volts shall be insulated to prevent contact or covered by a protective barrier. All removable protective barriers shall be interlocked to automatically disconnect power behind the barrier upon removal or clearly marked with a warning label that indicates the voltage potential that will be encountered behind the barrier. All warning labels shall remain visible after the cover has been removed.

3.3.2.2 Mechanical Safety

Sharp surfaces shall have protective covers or other suitable features to minimize injury where personnel are likely to be exposed to such surfaces.

3.4 Logistics

This module accommodates a two level maintenance concept: organizational (Air Force personnel) and depot (contractor personnel). Removal and replacement of an LRU is defined at the organizational level and any needed repair of the LRU is defined at the depot level. Any special test or support equipment required to effect removal or replacement of an LRU at the organizational level can be provided as part of the module. No more than two persons shall be required to remove or replace an LRU.

An LRU is defined as the lowest element of the module which can be isolated to be faulty through inspection; built-in test; technical manuals; TDC-ICAP system performance; spares substitution; or other diagnostic aid approved by the Government for organizational level maintenance, exclusive of expendables such as fuses, lamps and LEDs. An LRU is defined at the card/module level or higher.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

The quality assurance program includes tests and other evaluations to the extent specified herein. The quality assurance program is designed to verify the electrical, mechanical and functional characteristics of each module. The purpose is to ensure that each module complies with or performs better than the requirements specified herein.

4.2 Responsibility for Inspection

Unless otherwise specified in the contract, the contractor shall be responsible for the performance of all inspection requirements and may use his own or any other facilities suitable for the performance of the inspection requirements. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.3 Product Qualification Test (PQT)

Inspections, analyses, demonstrations and tests verify compliance of Section 3 of this specification on the first production unit.

4.4 Production Acceptance Test (PAT)

Each module delivered to the Government undergoes an Acceptance Test Process as identified in Table 21. The acceptance test verifies that the module interfaces are operating properly prior to delivery to the Government.

4.5 Verification Cross Reference Matrix (VCRM)

Table 21 provides a list of each Section 3 requirement and the verification method to be used. The following paragraphs define the codes employed in the VCRM. Unless otherwise noted, where more than more one verification method is shown, one method or a combination of methods may be used to show compliance.

4.5.1 Not Required (N/R)

This method indicates that verification is not required because the paragraph is a title, heading, general introductory paragraph or statement of a goal and contains no “shall” or “must” statements.

4.5.2 Inspection

Inspection is a method of verification of the module performance or characteristics by examination of the equipment or associated documentation. Inspections are conducted with the use of inspection tools, measurement devices, visual means and comparison. Most inspections apply to verification of requirements associated with physical characteristics such as size, weight,

appearance, adherence to specified standards and engineering practices, quality design, and construction supported with quality documentation. Inspections also include the auditing of manufacturer's data that verifies the performance of non-developmental items that comprise the TDC ICAP module. Inspections may occur during any assembly stage of the unit under test.

4.5.3 Analysis

Analysis is a method of verification through technical evaluation of calculations, computations, models, analytical solutions, use of studies, reduced data, and/or representative data to determine that the item conforms to the specified requirements.

4.5.4 Demonstration

Demonstration is a method of verification whereby the properties, characteristics and parameters of the item are determined by observation alone and without the use of instrumentation for quantitative measurements. This method is used when a requirement does not contain a specific numerical parameter that must be measured. Demonstrations may occur during verification of a unit under test at any assembly stage. Pass/fail criteria are simple yes/no indications of functional performance since no quantitative values are specified.

4.5.5 Test

Test is a method to verify that a specified requirement is met by thoroughly exercising the applicable item under specified conditions and by using the appropriate instrumentation in accordance with test procedures. This method requires the use of laboratory equipment, simulators, or services to verify compliance to the specified requirements. This method is used when it is practicable to make direct or indirect measurement of a specified numerical parameter to verify compliance with a requirement. Tests may occur during verification of a unit at any assembly stage. Actual measured values are recorded, and pass/fail is determined by comparing the measured value with the specified value. Measurement accuracy is precise enough to ensure that the measured value is within the specified tolerance.

Table 21 - Verification Cross Reference Matrix

		Verification Method					
			PQT				
Paragraph	Title	N/R	Inspect	Analysis	Demo	Test	ATP
3.0	Requirements	X					
3.1	Module Definition	X					
3.2	Performance Requirements	X					
3.2.1	Electrical Interface Requirements (External)	X					
3.2.1.1	Prime Power		X			X	X
3.2.1.2 – 8	Modules/Connectors		X			X	X
3.2.2	Electrical Interface (Internal)	X					

Table 21 - Verification Cross Reference Matrix

Paragraph	Title	Verification Method					
			PQT				
		N/R	Inspect	Analysis	Demo	Test	ATP
3.2.3	Functional Requirements	X					
3.2.3.1	FCC-100 Tactical Configuration	X					
3.2.3.2	Module Equipment Details	X					
3.2.3.2.1	Multiplexer		X			X	X
3.2.3.2.2	Timing		X			X	X
3.2.3.2.3	CAU Function		X			X	
3.2.3.2.4	Built-In-Test		X			X	X
3.2.3.3	Configuration Options	X					
3.2.4	Physical Characteristics	X					
3.2.4.1	Transit Case		X				
3.2.4.2	Weight		X				
3.2.4.3	Storage Space		X				
3.2.4.4	Marking		X				
3.2.5	Cables		X			X	X
3.2.6	Reliability			X			
3.2.7	Maintainability			X			
3.2.7.1	Mean Time Between Preventive Maintenance [MTBPM]			X			
3.2.8	Environmental Conditions	X					
3.2.8.1	Temperature			X			
3.2.8.2	Relative Humidity			X			
3.2.8.3	Altitude			X			
3.2.8.4	Sand and Dust			X			
3.2.8.5	Shock			X			
3.2.8.6	Vibration			X			
3.3	Design and Construction	X					
3.3.1	Materials Parts and Processes			X			
3.3.2	Safety	X					
3.3.2.1	Electrical Safety			X	X		
3.2.2.2	Mechanical Safety				X		
3.4	Logistics			X			

5.0 PREPARATION FOR DELIVERY

Each module is packaged for shipment and the package marked in accordance with the requirements of the contract under which the module is ordered.

6.0 BASELINE CONFIGURATION

6.1 Equipment

Table 22 - Equipment Listing

Device	Manufacturer	Part Number	Descritpion	Quantity
FCC-100 TACTICAL MULTIPLEXER MODULE	DNE Technologies	21001087	Tactical Multiplexer Module	1
AN/FCC-100(V)9	DNE Technologies	97010109	FCC-100 Chassis & Common Modules	1
Aggregate Carrier, Combined NRZ/CDI	DNE Technologies	85970030	Aggregate Carrier Module	1
Aggregate Driver, RS422/423	DNE Technologies	85090180	Aggregate NRZ Driver Submodule	1
Port Carrier	DNE Technologies	84890730	Dual Port Carrier Module	3
Port Card, Sync NRZ	DNE Technologies	84890540	Synchronous NRZ Port Submodule	4
Port Card, Diphase	DNE Technologies	84890090	Diphase Port Submodule	2
Terminator Balanced	DNE Technologies	84890630	Balanced Terminator	4
Terminator Diphase	DNE Technologies	84890660	Conditioned Diphase Terminator	2
Dual Port, T-CDI Low Speed with Phantom Power	DNE Technologies	85974125	Dual Port, T-CDI Low Speed Module with Phantom Power	1
Dual Port, T-CDI High Speed	DNE Technologies	85970070	Dual Port, T-CDI High Speed Module	1
4-Wire Voice Module	DNE Technologies	21000823	E&M Voice Module	1
Dual port 2/W FXS Voice	DNE Technologies	21000821	Dual-2 Wire FXS Voice Module	2
Tactical Backplane	DNE Technologies	21000937	Backplane/Lightning Protection Assembly	1
LD-CELP/ Secure	DNE Technologies	21001011	Voice Compression Submodule	4
LD-CELP/ Secure	DNE Technologies	21001011	E&M Voice Compression Submodule	2
FCC-100 Mux Module Transit Cases	ECS Composites	64030246	TDC ICAP 8U Transit Case	1
4U Drawer	ECS Composites	64020287	4U Military Style Drawer, On Slides	1

Table 22 - Equipment Listing

Device	Manufacturer	Part Number	Descritpion	Quantity
FCC-100 Tactical Accessory Kit (In Drawer)			Tactical Accessory Kit containing:	1
Port Carrier	DNE Technologies	84890730	Dual Port Carrier Module	2
Port Card, Sync NRZ	DNE Technologies	84890540	Synchronous NRZ Port Submodule	4
Terminator Balanced	DNE Technologies	84890630	Balanced Terminator	4
Port Card, Async	DNE Technologies	84890210	Asynchronous Port Submodule	2
Terminator Unbalanced	DNE Technologies	84890670	Unbalanced Terminator	2
Dual Port 2/W FXO Voice	DNE Technologies	21000822	Dual 2-Wire FXO Voice Module	2
LD-CELP/ Secure	DNE Technologies	21001011	FXO Voice Compression Submodule	4
Quick release to DB-25 Adapter	DNE Technologies	21000943	Connector Adapter	1
Connector Adapter EIA 530 Port	DNE Technologies	64025043	Connector Adapter	4
Aggregate Driver, High Speed CDI	DNE Technologies	85970130-058	Aggregate High Speed CDI Driver Submodule	1

NOTE: All parts shown in the equipment list are ordered under the single part number 21001087 from DNE. T his includes the transit case and drawer which are both manufactured by ECS Composites. This also includes all items comprising the FCC-100 Tactical Accessory Kit which are stored in the drawer of the transit case when delivered.

6.2 Elevation Drawings

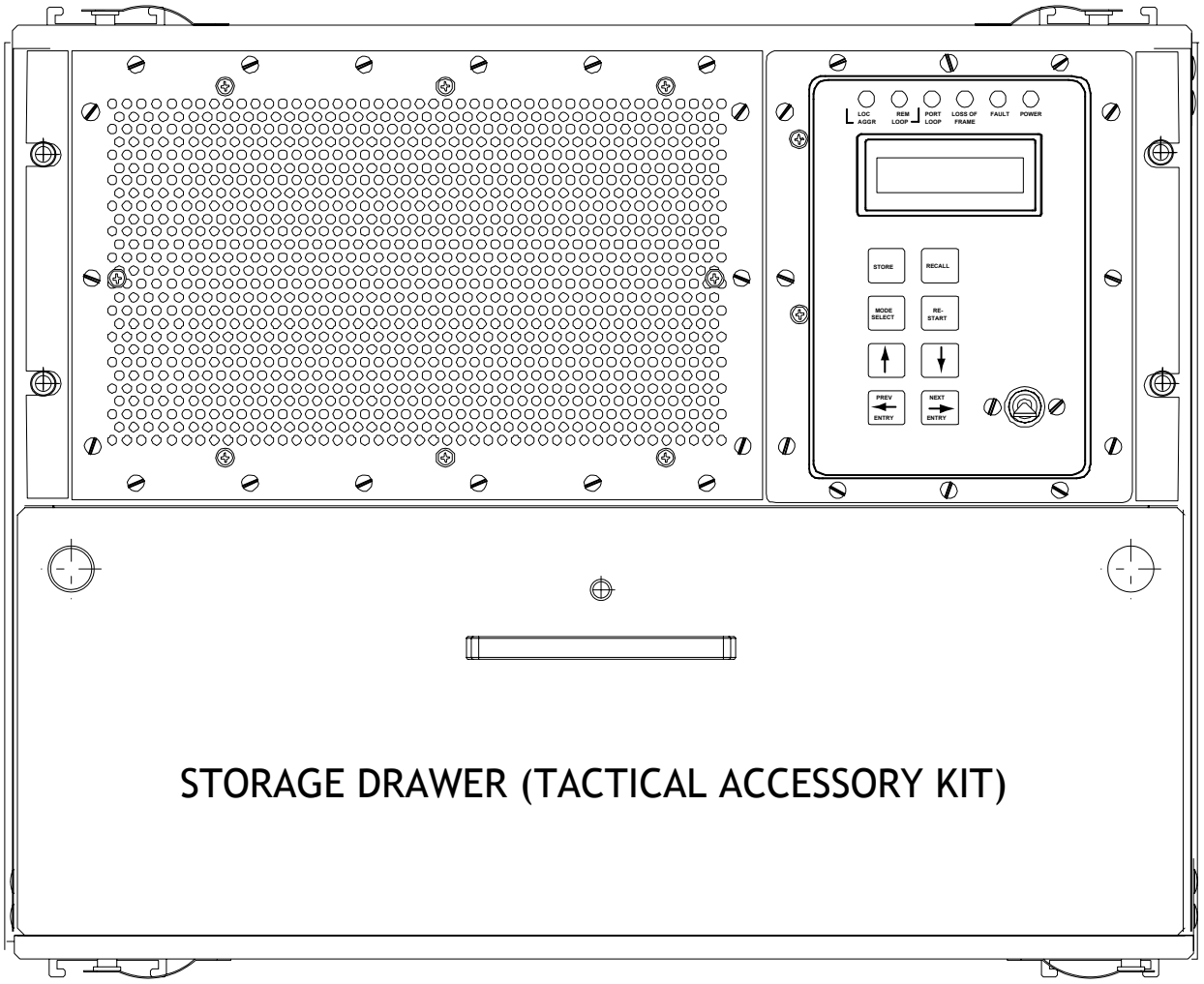

Figure 5 - Front Elevation

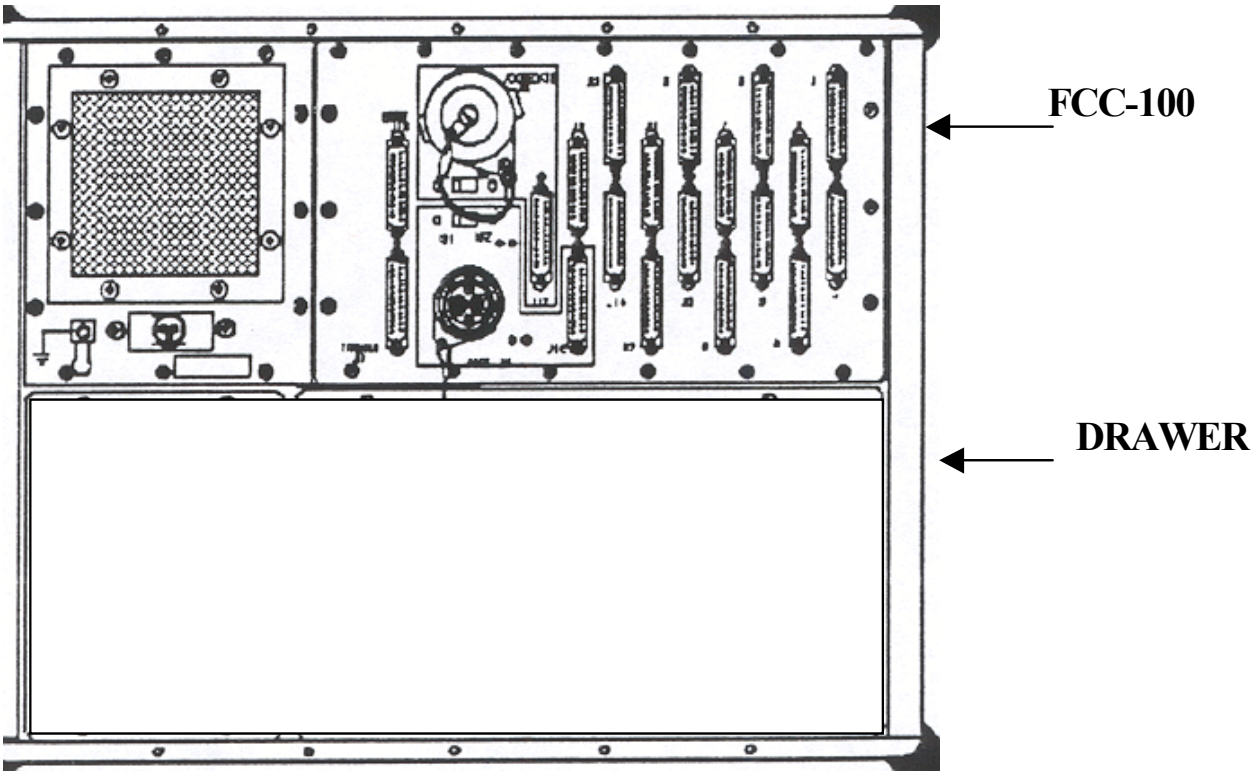

Figure 6 - Rear Elevation

6.3 Cable Diagrams

Table 23 - Cable Diagrams

Wire Number	Manufacturer	Part Number	Description
W001		DNE Technologies	AC Power Cable

	Cable W001 Pin Assignments						
		AC Power Cable					
	IEC-320				IEC-320		
	RECEPTACLE				PLUG		
			Signal	Direction			
		1	Line	----	1		
		2	Neutral	----	2		
		3	GND	----	3		

6.4 Interconnection Diagrams

Not available.