

12-Slot Shelf Installation Practice

Model 77020

Document 650-00210-00



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Revision History

Part #	Date	Description
65-77020003	1993	Issue 3
5000182	December, 2001	Issue 4
650-00210-00	April, 2004	Issue 5

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REGULATORY INFORMATION

NRTL Listing and cNRTL Certification

This equipment meets OSHA Nationally Recognized Testing Laboratory (NRTL) and Canadian NRTL listing requirements for information technology equipment.

Canadian Telecommunications

This equipment does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the Radio Interference Regulations of Canada.
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1. GENERAL

This Manual describes the mechanical installation of Kentrox 12-Slot Shelf, Model 77020.

Instructions for installing shelf plug-in units are given in the following Kentrox documents:

- T-SMART Shelf Interface Unit (SIU) Installation Manual
- T-SMART Diagnostic T1 CSU (Plug-in module) Installation Manuals
- T-SERV II T1 Channel Service Unit (CSU) Operator Manual
- T-SMART FRAME CONVERTER (Plug-in module) Installation Manual

For operation and installation information on the Group Controller Unit (GCU) see:

- T-SMART Group Controller Unit Operator Manual

For operational information on the T-SMART Frame Converter see:

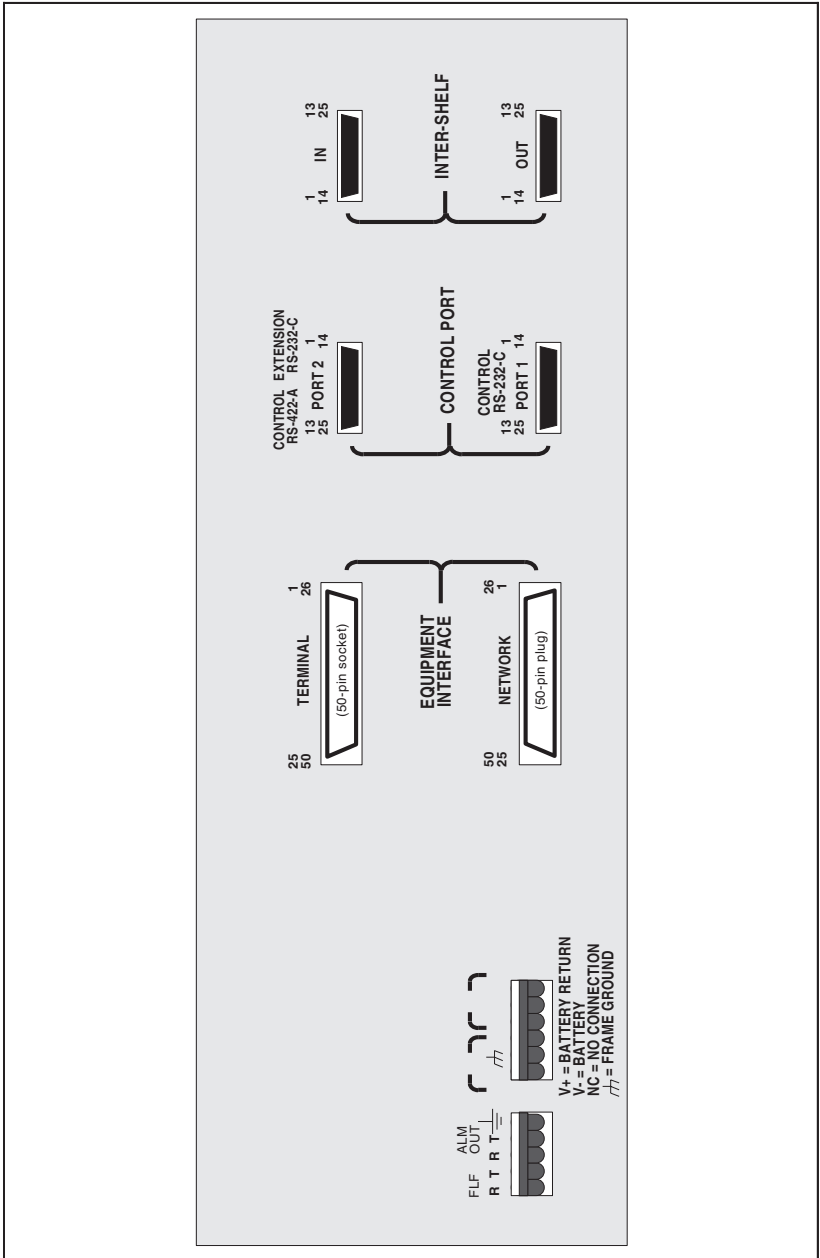
- T-SMART FRAME CONVERTER Operator Manual

Function

The 12-Slot Shelf provides mounting for up to twelve plug-ins (T-SMART Intelligent CSUs, T-SERV II CSUs, or T-SMART Frame Converters) in seven vertical inches of a 19-inch or 23-inch equipment rack. The depth is approximately twelve inches.

NOTE: A mixture of T-SMART Intelligent CSUs and T-SERV II CSUs can be installed in the same 12-Slot shelf. However, T-SMART Frame Converters **cannot** be mixed in the same shelf with CSUs.

Figure 1. Model 77020 Shelf Backplane



Materials

The shelf package contains:

- 1 — 12-Slot Shelf, Model #77020
- 1 — Mounting hardware packet
- 1 — Shorting plug (Type DB-25S) for T-SERV II CSU installation only
- 1 — 12-Slot Shelf Manual
- 1 — *T-SMART Channel Service Unit (CSU) Operator Manual*
- 1 — *T-SERV II T1 Channel Service Unit (CSU) Operator Manual*

To install the shelf you'll also need:

- 1 — Cable, to terminal equipment
- 1 — Cable, to network termination
- 1 — Cable, to control terminal*
- 1 — Cable, for control chaining of multiple shelves*
- 1/8" screwdriver; Wire strippers
- 20 AWG and 14 AWG wire or larger
- Cable tie

* *Not required for T-SERV II Basic CSUs.*

Connections

Signal, power, output, and control connections to the shelf are made through standard connectors on the shelf backplane, shown in *Figure 1*.

- a) The signal connections use 50-pin connectors, FCC Part 68 USOC Type RJ-48H, for both network interface (NI) and terminal equipment interface (TI). The NI connector is a male, and the TI connector is a female.
- b) Power attaches to a connectorized screw terminal block at the lower left of the backplane.
- c) Alarm outputs use a similar connectorized screw terminal, located next to the power block.
- d) Connection to the controlling terminal uses one of two female connectors, Type DB-25S, labeled PORT 1 and PORT 2. If the shelf contains only T-SERV II Basic CSUs, a controlling terminal will not be used.
- e) The backplane also provides a pair of male 25-pin connectors, Type DB-25P, for shelf-to-shelf control chaining.
- f) Kentrox offers cables for each of these connectors. Kentrox cables and their functions are described in *Table A*.

2. INSTALLATION

Rack Mounting

The shelf can be mounted in a computer cabinet or in an equipment rack. The mounting ears are multi-purpose to allow front or mid-mounting in a 19-inch or 23-inch rack. *Figure 2* shows the various mounting arrangements.

Prepare cables to reach from the shelf to the terminal equipment and from the shelf to the network interface termination. Cable requirements are given in *Table A*; pre-assembled Kentrox cables are also listed in the table.

Figure 2. Mounting Arrangements

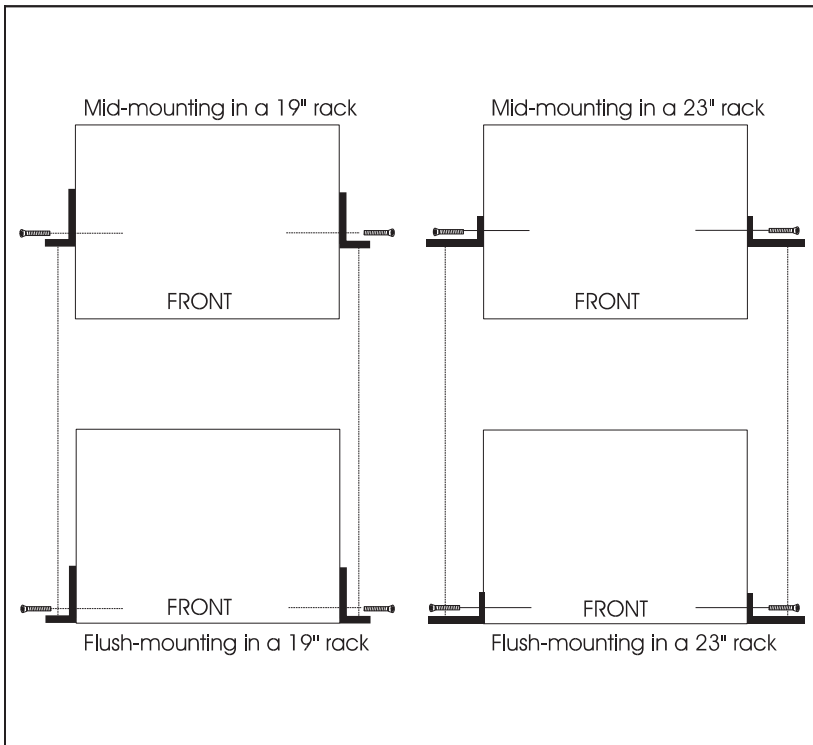
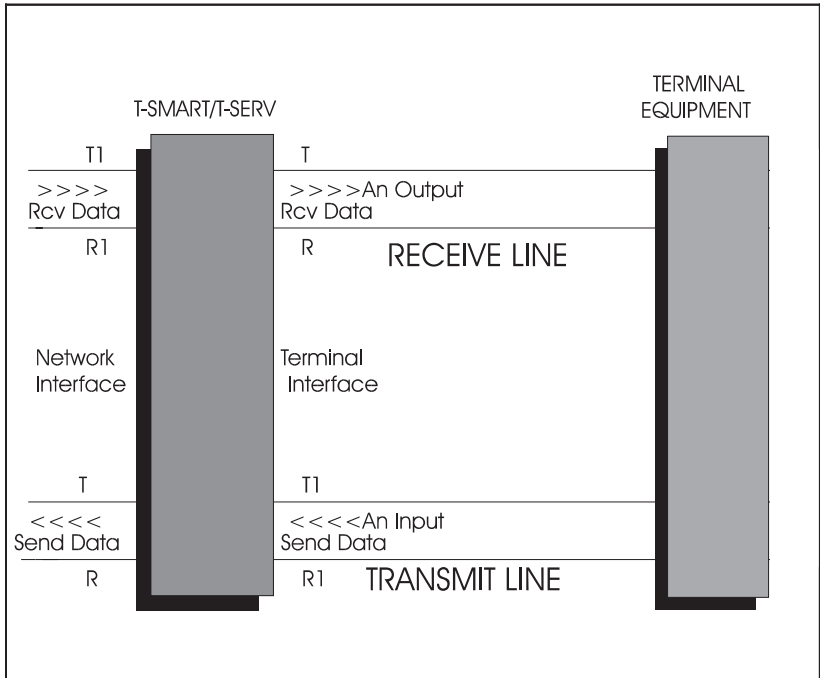


TABLE A. Cable Specifications and Model Numbers

CABLE FUNCTION	CONNECTORS	CABLE	SHIELDING	KENTROX MODEL*
Shelf to T1	50-pin male/pigtail	25-pair	Tx and Rx	930xx-071
	50-pin male/female	25-pair	Tx and Rx	930xx-061
Shelf to NI	50-pin female/male	25-pair	Tx and Rx	930xx-061
	50-pin male/pigtail	25-pair	Tx and Rx	930xx-081
	50-pin female/two males (RJ-48H)/(two RJ-48Ms)	25-pair	Tx and Rx	930xx-161
Shelf to Control	DB-25 male/DB-25 male	7-pair	Common	950xx-021
Shelf to Shelf	DB-25 female/DB-25 female	12-pair	Common	93301-001
*xx = denotes cable length. Contact factory for available lengths.				

Figure 3. Tx and Rx Nomenclature



Network Interface

**WARNING:**

Do not connect the cable shield across the network interface. See the Applications section for shielding requirements.

Connect the shelf to its network interface through the “NETWORK” connector on the rear of the shelf. The connector is a 50-pin male, Type RJ-48H.

CAUTION: T-SMART Frame Converters are not intended to connect directly to public Network metallic lines. They should be isolated from the Network by either multiplexer/fiber systems or CSUs. Refer to *Section 3, Applications*, for a typical Frame Converter application.

- a) To prevent cross-talk between signals and minimize the electromagnetic interference (EMI), the Transmit and Receive lines must be separated and shielded separately, as Kentrox cables are. See also *Figure 3, Tx and Rx Nomenclature*.

NOTE: NI RCV signals should be engineered to have no more than a 7.5 db variation in signal level.

- b) The network cable will need a 50-pin female RJ-48H connector, wired with the pin assignments as given in *Table B*.
- c) The network cable attaches to the shelf by a mounting screw at the toe and a cable tie at the heel (a bracket is provided on the backplane).

TABLE B. NI Connector Pin Assignments

Kentrox Cable #930xx-061, #930xx-081, or #930xx-161							
Cables use Type RJ-48H female connector.							
Send Data Shielding: CLEAR mylar/foil.							
Receive Data Shielding: BLUE mylar/foil.							
Slot #	Pair	Fcn.	Wire	Pin	Fcn.	Wire	Pin
Slot 00*	Rcv Data R1, T1	R1	Wht/Blu	1*	T1	Blu/Wht	26*
Slot 01	Rcv Data R1, T1	R1	Wht/Orn	2	T1	Orn/Wht	27
Slot 02	Rcv Data R1, T1	R1	Wht/Grn	3	T1	Grn/Wht	28
Slot 03	Rcv Data R1, T1	R1	Wht/Brn	4	T1	Brn/Wht	29
Slot 04	Rcv Data R1, T1	R1	Wht/Sl't	5	T1	Sl't/Wht	30
Slot 05	Rcv Data R1, T1	R1	Red/Blu	6	T1	Blu/Red	31
Slot 06	Rcv Data R1, T1	R1	Red/Orn	7	T1	Orn/Red	32
Slot 07	Rcv Data R1, T1	R1	Red/Grn	8	T1	Grn/Red	33
Slot 08	Rcv Data R1, T1	R1	Red/Brn	9	T1	Brn/Red	34
Slot 09	Rcv Data R1, T1	R1	Red/Sl't	10	T1	Sl't/Red	35
Slot 10	Rcv Data R1, T1	R1	Blk/Blu	11	T1	Blu/Blk	36
Slot 11	Rcv Data R1, T1	R1	Blk/Orn	12	T1	Orn/Blk	37
All Slots	Shield	Send Data	Shield	13	Rcv Data	Shield	38
Slot 00*	Send Data R,T	R	Wht/Blu	14*	T	Blu/Wht	39*
Slot 01	Send Data R,T	R	Wht/Orn	15	T	Orn/Wht	40
Slot 02	Send Data R,T	R	Wht/Grn	16	T	Grn/Wht	41
Slot 03	Send Data R,T	R	Wht/Brn	17	T	Brn/Wht	42
Slot 04	Send Data R,T	R	Wht/Sl't	18	T	Sl't/Wht	43
Slot 05	Send Data R,T	R	Red/Blu	19	T	Blu/Red	44
Slot 06	Send Data R,T	R	Red/Orn	20	T	Orn/Red	45
Slot 07	Send Data R,T	R	Red/Grn	21	T	Grn/Red	46
Slot 08	Send Data R,T	R	Red/Brn	22	T	Brn/Red	47
Slot 09	Send Data R,T	R	Red/Sl't	23	T	Sl't/Red	48
Slot 10	Send Data R,T	R	Blk/Blu	24	T	Blu/Blk	49
Slot 11	Send Data R,T	R	Blk/Orn	25	T	Orn/Blk	50
* No connection if SIU or GCU is in Slot 00							

Terminal Interface

Connect the shelf to its terminal equipment interface through the “TERMINAL” connector on the backplane. The connector is a 50-pin female, Type RJ-48H.

- a) To prevent cross-talk between signals and minimize the electromagnetic interference (EMI), the Transmit and Receive lines must be separated and shielded separately, as they are in Kentrox cables. See also *Figure 3, Tx and Rx Nomenclature*.
- b) The terminal cable will need a 50-pin male RJ-48H connector, wired with the pin assignments as given in *Table C*.
- c) The terminal cable attaches to the shelf by a mounting screw at the toe and a cable tie at the heel (a bracket is provided on the backplane).

TABLE C. TI Connector Pin Assignments

Kentrox Cable #930xx-061 or #930xx-071							
Cables use Type RJ-48H male connector.							
Send Data Shielding: CLEAR mylar/foil.							
Receive Data Shielding: BLUE mylar/foil.							
Slot #	Pair	Fcn.	Wire	Pin	Fcn.	Wire	Pin
Slot 00*	Rcv Data R, T	R	Wht/Blu	1*	T	Blu/Wht	26*
Slot 01	Rcv Data R, T	R	Wht/Orn	2	T	Orn/Wht	27
Slot 02	Rcv Data R, T	R	Wht/Grn	3	T	Grn/Wht	28
Slot 03	Rcv Data R, T	R	Wht/Brn	4	T	Brn/Wht	29
Slot 04	Rcv Data R, T	R	Wht/Sl't	5	T	Sl't/Wht	30
Slot 05	Rcv Data R, T	R	Red/Blu	6	T	Blu/Red	31
Slot 06	Rcv Data R, T	R	Red/Orn	7	T	Orn/Red	32
Slot 07	Rcv Data R, T	R	Red/Grn	8	T	Grn/Red	33
Slot 08	Rcv Data R, T	R	Red/Brn	9	T	Brn/Red	34
Slot 09	Rcv Data R, R	R	Red/Sl't	10	T	Sl't/Red	35
Slot 10	Rcv Data R, T	R	Blk/Blu	11	T	Blu/Blk	36
Slot 11	Rcv Data R, T	R	Blk/Orn	12	T	Orn/Blk	37
All Slots	Shield	Send Data	Shield	13	Rcv Data	Shield	38
Slot 00*	Send Data R1,T1	R1	Wht/Blu	14*	T1	Blu/Wht	39*
Slot 01	Send Data R1,T1	R1	Wht/Orn	15	T1	Orn/Wht	40
Slot 02	Send Data R1,T1	R1	Wht/Grn	16	T1	Grn/Wht	41
Slot 03	Send Data R1,T1	R1	Wht/Brn	17	T1	Brn/Wht	42
Slot 04	Send Data R1,T1	R1	Wht/Sl't	18	T1	Sl't/Wht	43
Slot 05	Send Data R1,T1	R1	Red/Blu	19	T1	Blu/Red	44
Slot 06	Send Data R1,T1	R1	Red/Orn	20	T1	Orn/Red	45
Slot 07	Send Data R1,T1	R1	Red/Grn	21	T1	Grn/Red	46
Slot 08	Send Data R1,T1	R1	Red/Brn	22	T1	Brn/Red	47
Slot 09	Send Data R1,T1	R1	Red/Sl't	23	T1	Sl't/Red	48
Slot 10	Send Data R1,T1	R1	Blk/Blu	24	T1	Blu/Blk	49
Slot 11	Send Data R1,T1	R1	Blk/Orn	25	T1	Orn/Blk	50
* No connection if SIU or GCU is in Slot 00							

Power Connections

The shelf is locally powered from a 20 to 56 Vdc supply, using one power feed or two power feeds for greater reliability. Power requirements for the CSU/Frame Converter equipment are listed in *Table D*. Use 20 gauge leads or larger to wire local power to the six-post terminal plug. Install the plug onto the shelf backplane at the lower left as shown in *Figures 4 & 5*.

NOTE: Power wires must never be larger than ground wires.

- a) Posts 4 and 6 of the terminal plug accept the “A” power leads. “A” power supplies the shelf slots numbered 00, 02, 04, 06, 08, and 10.
- b) Post 2 of the plug is Frame ground. Use 14 gauge wire or larger to ground the plug to earth ground.
- c) Posts 1 and 3 of the terminal plug accept the “B” power leads. “B” power supplies shelf Slots 01, 03, 05, 07, 09, and 11.
- d) Post 5 of the plug is not connected (NC).

TABLE D. Power Requirements

Equipment	Current	DC Voltage
Each T-SERV II, Line powered	57 - 150 mA	@ 32V ± 2V
Each T-SERV II, Local powered	30 mA	@ 50V ± 6V
	60 mA	@ 24V ± 4V
Each T-SMART CSU, Line powered	57 - 85 mA	@ 53V ± 3V
Each T-SMART CSU or Frame Converter, Local powered	70 mA	@ 50V ± 6V
	140mA	@ 24V ± 4V
Model 77101 SIU	25 mA	@ 50V ± 6V
	50 mA	@ 24V ± 4V
GCU Model 77102	45 mA	@ 50V ± 6V
	125 mA	@ 24V ± 4V
12-Slot Shelf “A” or “B” feed with up to 6 CSUs or Frame Converters installed	420 mA	@ 50V ± 6V
	840 mA	@ 24V ± 4V
12-Slot Shelf “A” feed with up to 5 CSUs or Frame Converters + Model 77101 SIU installed	375 mA	@ 50V ± 6V
	750 mA	@ 24V ± 4V
12-Slot Shelf “A” feed with up to 5 CSUs or Frame Converters + Model 77102 GCU installed	395 mA	@ 50V ± 6V
	825 mA	@ 24V ± 4V

Figure 4. Power Plug/Two Power Feeds

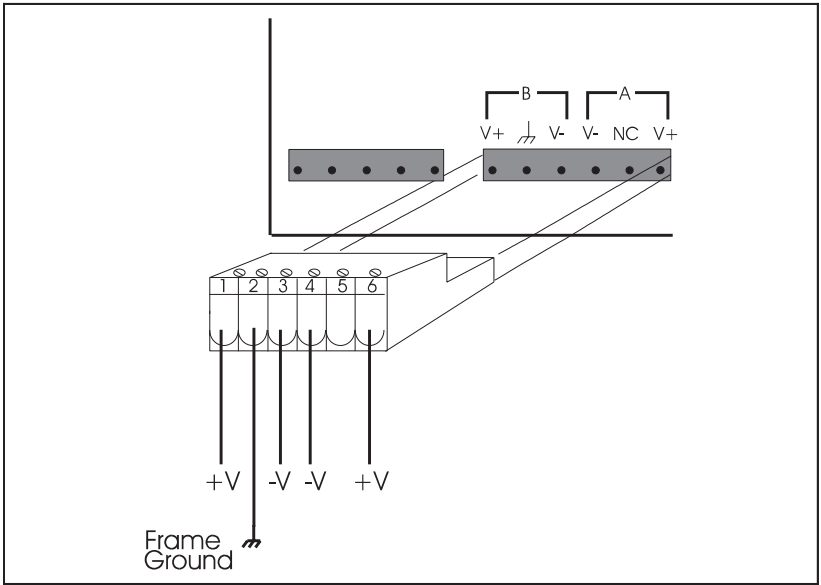
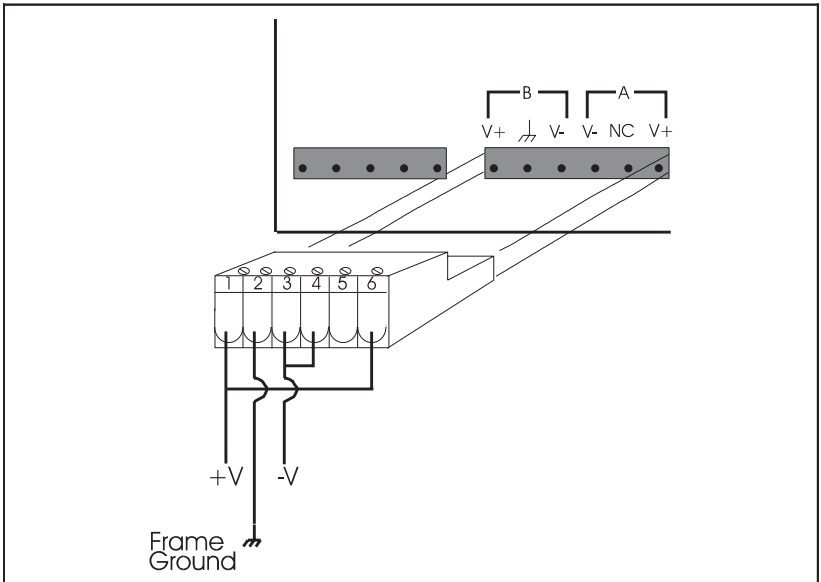


Figure 5. Power Plug/One Power Feed



Controlling Terminal

Connections to the controlling terminal use two female connectors, Type DB-25S, labeled PORT 1 and PORT 2. If the shelf contains only T-SERV II Basic CSUs, a controlling terminal will not be used.

Pin-outs for the control ports are given in *Table E*.

- a) The lower connector, PORT 1, provides connection to a local controlling terminal, Network Management System (NMS), modem or printer via an RS-232-C interface. Applications differ, depending on whether the controller is a GCU or SIU.
- b) The upper connector, PORT 2, provides an RS-232-C or RS-485 port for control of another shelf, group of shelves, controlling terminal, Network Management System (NMS), or printer, depending on whether the controller is a GCU or SIU.

TABLE E. Control Port Pin Assignments

Kentrox Cable #950xx-021		
Cable uses Type DB-25 Male connector		
Overall shielding, common for all leads		
A. Pin-outs for RS-232C Interface, CONTROL or EXTENSION		
Function	Pin	Circuit
TRANSMIT Data to Control	2	BA
RECEIVE Data from Control	3	BB
Signal Ground	7	AB
B. Pin-outs for RS-485 interface		
Function	Pin	Circuit
SEND Data to Control	3, 16	Tx+, Tx-
RECEIVE Data from Control	2, 14	Rx+, Rx-

T-SERV II CSU Shorting Plug

If the shelf will contain only T-SERV II Basic CSUs, install the supplied shorting plug (Type DB-25S) onto the “IN” connector.

Shelf-to-Shelf Connections

If the system includes multiple shelves with T-SMART Diagnostic CSUs or Frame Converters to be controlled from one terminal, chain the shelves together with the Shelf-to-Shelf Cable, Model #93301. This short cable is available from Kentrox. Install the cables at the right of the shelf backplanes, between the “OUT” connector of each shelf and the “IN” connector of the shelf immediately below it. The shelf interconnection feature allows one VDT to have access to all T-SMARTs at one location (a group of up to 16 shelves). If you have a GCU, you can connect a cable from PORT 2 to another group of shelves and increase the number of units one VDT can access from one group of 16 shelves to 255 groups of 16 shelves.

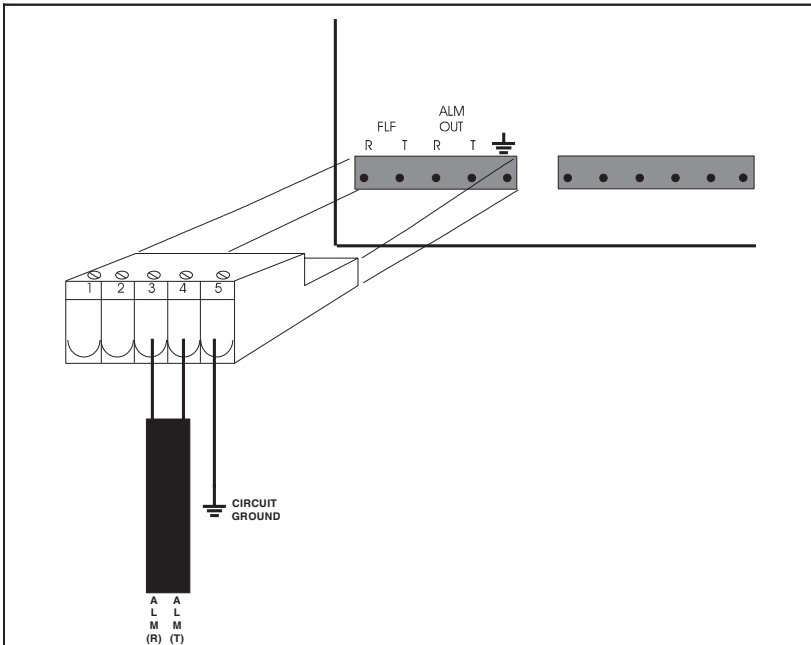
NOTE: Run a common ground between all shelves chained together at one site; see the *Applications* section.

Alarm Outputs

A five-post terminal connector at the lower left of the backplane provides outputs for external alarms. If this optional feature is used, wire the supplied five-post terminal plug and attach it to the backplane (see *Figure 6*).

- a) The alarm outputs, if used, are wired to Posts 3 (Ring) and 4 (Tip) of the terminal plug. Circuit or signal failure in the CSU shelf causes a contact closure between the internal alarm connections. This triggers the alarm outputs and activates your external alarm.
- b) Post 5 of the terminal is a Circuit Ground. This post may be connected to either ALM-T or ALM-R so that an alarm will provide a circuit ground to the customer upon contact closure. Use 20 AWG wire or larger.

Figure 6. Alarm Output Plug Assembly



3. APPLICATIONS

This section provides explanations of the options available in configuring the 12-Slot Shelf for your specific application.

Cabling

Kentrox offers pre-assembled cables for the signal connectors, as listed in *Table A* earlier.

- a) To break out to RJ-48M 50-pin connectors at the NI, use Kentrox cable #930xx-161 (xx represents the cable length in feet). This cable converts the shelf's RJ-48H wiring to the RJ-48M convention, and splits the leads into two 50-pin male connectors for use with a modular 66 block at the NI. One connector terminates shelf Slots 00 through 07; the other terminates Slots 08 through 11.
- b) To preserve the RJ-48H wiring at the NI, use Kentrox cable #930xx-061. This cable is also intended for connection to a modular 66 block.
- c) For the TI, use Kentrox cables #930xx-071 (terminates in pigtail stubs for your own wiring choice) or #930xx-061 (terminates in a female 50-pin Type RJ-48H connector for use with a modular 66 block). In addition, Kentrox offers a cable, Model #91059-xxx, that terminates in a male 50-pin connector (xxx represents the cable's length in feet).
- d) Both the network and terminal cables attach to the shelf by a mounting screw at the toe and a cable tie at the heel (a bracket is provided on the backplane). Kentrox strongly recommends that the cable tie be used.

Shielding

To minimize cross-talk and EMI, the signal cables must provide separate shields for the Transmit and Receive leads. Do not depend on the shields to properly ground T-SMART equipment. T-SMART equipment must be grounded separately from the network line's shield ground.

- a) If you run Kentrox cable #930xx-081 to your NI, do not connect either shield lead (Wire 13 or Wire 38) across the network interface. Isolate Wire 13 with the Receive Data Shield and Wire 38 with the Send Data Shield from the hood.
- b) If you run Kentrox cable #930xx-061 or #930xx-161, the shield leads are pre-wired.
- c) If the network line has its shield brought out to the NI, both leads must be cut back from the connector. Remove the connector hood and isolate Wire 13 with the Receive Data Shield and Wire 38 with the Send Data Shield from the hood.
- d) To avoid cross-talk, NI RCV signals should be engineered to have no more than a 7.5 db variation in signal level.

Grounding

The shelf accepts Signal Grounds on its control, and output connectors as described in the Installation section. In addition, the power terminal plug accepts a Frame Ground.

CAUTION: Frame Ground must be connected to earth ground to provide protection from excessive line voltages such as lightning or power line crossings.

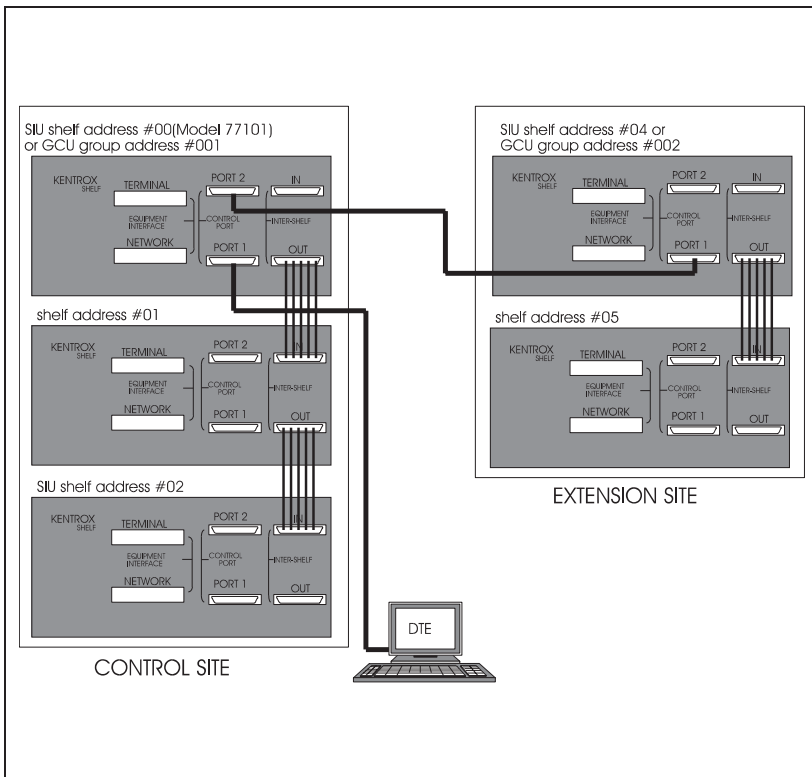
- a) Frame Ground is isolated internally from Signal Ground by a 100 ohm resistor in accordance with the RS-232-C specification.
- b) If multiple shelves are chained together for common control, they must be grounded in common. Jumper Pins 2 of the power terminal plugs together for all shelves under common control.
- c) The signal ground pins of Control PORT 1 and Control PORT 2 are internally bused to the power terminal plug, and no external connection is required. In all cases, this ground is on Pin 7 of the control port connector.
- d) Pin 5 of the Alarm/FLF terminal provides a Circuit Ground. This can be connected to an alarm lead to provide a circuit ground for the customer upon contact closure.

Shelf Interface Units

T-SMART Intelligent CSUs and Frame Converters are controlled through a Shelf Interface Unit (SIU), model #77101, mounted in Slot 00 of the shelf. Two shelves in the same location can share one SIU if they are connected by the Shelf-to-Shelf cable. As shown in *Figures 7 and 8*, the SIU mounts in Slot 00 of the shelf.

The SIU provides an RS-232-C interface for local control of Intelligent CSUs or Frame Converters through the PORT 1 connector. PORT 2 provides an Extension RS-232-C interface for remote control. See *Figure 7*.

Figure 7. Use of RS-232 Extension Port (SIU or GCU)



Group Controller Units

The GCU Model #77102 can replace the SIU in the shelf. The GCU provides an RS-232-C interface for an operator's control terminal, Network Management System (NMS), modem or a printer through the PORT 1 connector.

The PORT 2 connector provides an RS-232-C or RS-485 interface for an operator's control terminal, Network Management System (NMS), control of another shelf, control of another group or connection to a printer.

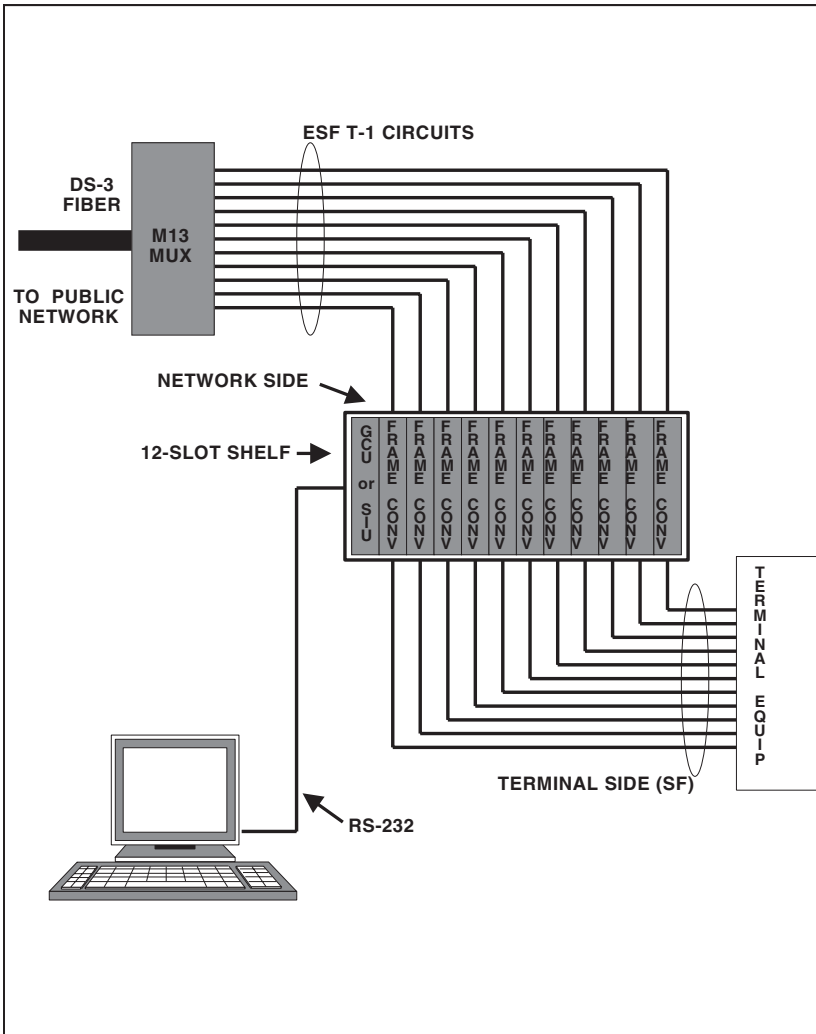
A CRAFT port on the GCU allows an on site terminal interface.

The GCU expands the number of addresses accessible to a single control terminal, stores up to 50 alarms and can be configured to automatically forward alarms through a modem to a terminal or to a remote Network Control Center. The GCU is hard wired for slot 00 and shelf 00. See *Figures 7 & 8*.

T-SMART Frame Converters

T-SMART Frame Converters operate in a 12-Slot shelf with an SIU or GCU in the same manner as T-SMART CSUs. *Figure 8* shows a typical Frame Converter application.

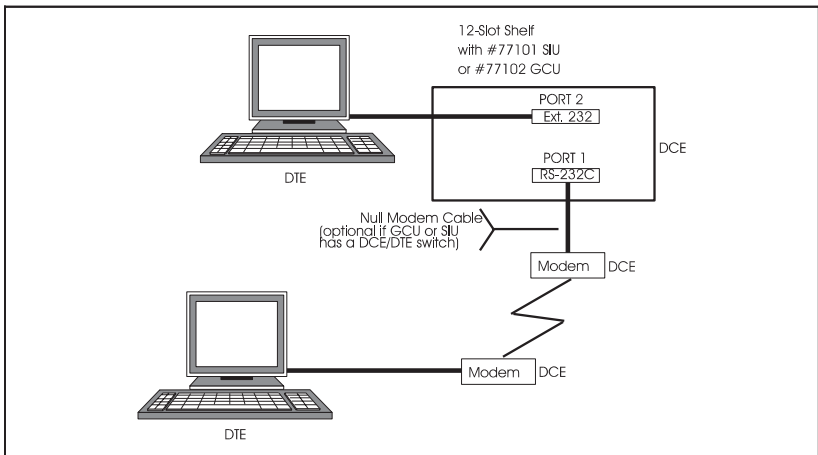
Figure 8. Shelf Mounted Frame Converter Application



Modem Control, Null Modem Cable

When T-SMART Intelligent CSUs or Frame Converters are used, the control connection may be via modem, as shown in *Figure 9*. Since the modem and the shelf are both configured as DCE (Data Communication Equipment), a null modem connection is required between them. This can be accomplished by using the DCE/DTE switch on the GCU or SIU, or using a null cable. The purpose of the null cable is to invert Pins 2 and 3 of the RS-232-C connector as shown in *Figure 10*. Note that the T-SMART system is using only Pins 2, 3, and 7 in this configuration. If the modem expects a handshake, strap the pins together as shown in *Figure 10*. At the modem end, strap Pin 4 with Pin 5; and strap together Pins 6, 8, and 20.

Figure 9. Typical Modem Application



Modem Control, DCE/DTE Switch

A GCU or an SIU with a DCE/DTE switch eliminates the need for using a null modem cable with PORT 1. The DCE/DTE switch configures the unit as DCE or DTE. See *Table G* for switch settings.

Smart Modems

If a smart modem is used for the control connection, it must be enabled to the quiet mode (command **ATQ1** in the “AT” command set), Autoanswer and Echo enabled. Otherwise, the smart modem will not “CONNECT” to the busy data port. Refer to your modem manual.

Figure 10. Null Modem Cable Wiring

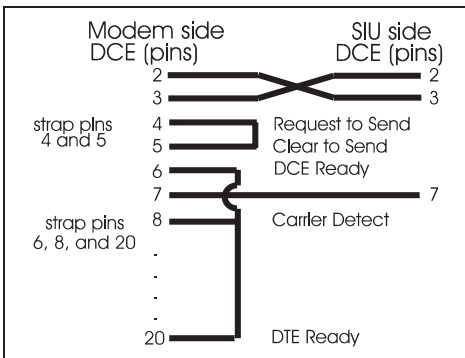


TABLE F. DCE/DTE Switch Settings

<i>From SIU or GCU (Port 1) to:</i>	<i>Straight Through Cable</i>	<i>Null Modem Cable</i>
Terminal (DTE)	DCE	DTE
Modem (DCE)	DTE	DCE
Another shelf (DCE)	DTE	DCE
PC* (DTE)	DCE	DTE
PC* (DCE)	DTE	DCE

****If you are using a PC which does not have switchable control over its COM ports, then the COM port is a DTE port. Some PCs do allow these ports to be switchable to DTE or DCE.***

Shelf Accessories

Three converter panels are available to simplify the wiring from the 12-Slot shelf to your network and terminal interfaces.

- a) **RJ-48H to RJ-48C Converter Panel.** A converter panel, Model #77830, is available as an accessory for use at the network interface. It breaks out the shelf's 50-pin RJ-48H connector leads into twelve 8-pin RJ-48C jacks, one for each T1 line. This panel mounts in a 19-inch equipment rack, and requires one mounting space (1-3/4 vertical inches). It is designed for use at the NI with the #930xx-061 cable; it can also be used at the TI with a male/male RJ-48H cable to connect to the shelf.
- b) **RJ-48H to DA-15S Converter Panel.** A converter panel, Model #77840, is available as an accessory for use at the TI. It breaks out the shelf's 50-pin RJ-48H connector leads into twelve 15-pin female DA-15S connectors, one for each T1 line. The panel mounts in a 19-inch equipment rack, and requires one vertical mounting space (1-3/4"). It is designed for use with the #930xx-061 cable at the TI; it can also be used at the NI with a female/female RJ-48H cable to connect to the shelf.
- c) **RJ-48H to DA-15P Converter Panel.** A converter panel, Model #77850, is available as an accessory for use at the NI. It breaks out the shelf's 50-pin RJ-48H connector leads into twelve 15-pin male DA-15P connectors, one for each T1 line. The panel mounts in a 19-inch equipment rack, and requires one vertical mounting space (1-3/4"). It is designed for use with the #930xx-061 cable at the NI; it can also be used at the TI with a male/male RJ-48H cable to connect to the shelf.

