

**CTU - CENTRAL TERMINAL UNIT
DESCRIPTION AND OPERATIONS GUIDE**

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SECTION 1.0 CTU FUNCTIONAL DESCRIPTION

The Central Terminal Unit (CTU) is a card frame with up to four analog output cards (64 local analog channels) and up to eight 16 channel local digital cards (128 local digital channels). The CTU will transmit and receive over a high speed serial data link from the TC-560 Data Transmitter Interface in the Show Control Computer, and drive up to eight other Remote Terminal Units (RTU's) or Servo Terminal Units (STU's) using discrete full duplex high speed RS-422 serial data links.

As there is a great deal of traffic through the CTU, no analog ramping or servo loop closure functions are possible. Diagnostics are limited to local analog and digital channel control/status display and blinding operations, as well as terminal (serial port) diagnostics. In future releases, routines will exist for forward and reverse handling of block data, such as configuration, presets, and unit ID's between the SCU and CTU, as well as external RTU's or STU's.

NOTE: The slots within a CTU are dependent on the card type. Please reference the installation section of this manual for slot configurations.

Cards that are associated with a CTU are as follows:

TC-3550 (Data Processor/Receiver Card) Communicates/controls other serial, analog, and digital I/O modules within a CTU card frame.

TC-3518 (8 Channel Serial Card) Communicates with up to eight other card frames i.e. as Remote Terminal Units (RTU's), Data Terminal Units (DTU's), or Servo Terminal Units (STU's) through a TC-644 RS-422 Level Translator/Termination Interface card.

TC-336 (16 Channel D/A Card) A maximum of four TC-336 Digital to Analog Output Modules are available per CTU for a total of 64 analog output channels.

TC-316 (16 Channel Digital Logic Output Card) A maximum of eight TC-316 cards per CTU, for a total of 128 total isolated digital outputs are available in a single CTU frame.

TC-644 (4 Channel RS-422 to TTL Level Translator Card) This card is mounted on the back panel of the CTU and is used to interface RTU, DTU, and STU card frames. A maximum of 2: TC-644 strip cards are used per CTU.

TC-636 (Active Card Frame Backplane) This is the backplane in which the TC-3550 Processor, TC-3518 Serial Interface, and TC-336 Analog Modules plug into and interconnect with the back panel using IDC header connectors.

TC-616 (Passive Card Frame Backplane) This is the backplane in which the TC-316 Digital Output cards plug into and interconnect with the back panel terminations using IDC header connectors.

Power required is +5VDC for all digital logic, +/- 15VDC for analog I/O cards (if used), +/- 12VDC for RS-232/serial communications (if used), as well as +24VDC for digital output modules.

SECTION 2.0 INSTALLATION

The CTU is designed as a three rack unit (5.25") x 19" rack mount card frame that will accept the processor and I/O modules as required for the specific system configuration.

*Always ensure that power to the CTU is **OFF** when inserting or removing cards in the CTU card frame.*

The slots within the CTU card frame are not keyed and it is possible to insert a card into a wrong slot or in the wrong orientation. All cards should be installed with the component side facing to the left. If incorrect orientation or the wrong slot is used, severe damage to some or all of the CTU electronics will result!

When installing a CTU follow the chart below for proper card placement. Slots are referenced left to right and 1 through 10 when facing the front of the CTU card frame. When facing the front of a CTU the solder side of all cards is on the right and the components are located on the left.

SLOT	ID	DESCRIPTION	NOTES
1	TC-3550	Processor/Receiver CPU Card	Left-most Card
2	TC-3518	8 Channel Serial Interface Adapter	
3	TC-336	16 Channel Analog Output Module	As Configured/Required
4	TC-336	16 Channel Analog Output Module	As Configured/Required
5	TC-336	16 Channel Analog Output Module	As Configured/Required
6	TC-336	16 Channel Analog Output Module	As Configured/Required
7	TC-316	16 Channel Digital Output Interface	As Configured
8	TC-316	16 Channel Digital Output Interface	As Configured
9	TC-316	16 Channel Digital Output Interface	As Configured
10	TC-316	16 Channel Digital Output Interface	As Configured
N/A	TC-644	RS-422/TTL Level Translator Interface	These cards are mounted on the back panel of the CTU card frame.
	TC-644	RS-422/TTL Level Translator Interface	

SECTION 3.0 I/O PORTS

Data termination to and from the CTU is normally accomplished through DB-style connectors located on the rear panel, with appropriate connectors installed for the specific CTU configuration or application. The following describes the type and function of each connector. Detailed pin assignment information can be found in drawings SC-7.12 and SC-7.13. Custom configurations are available with ELCO or other style terminations.

TERMINAL This is a DB-9F connector that requires a mating DB-9M connector on the cable end. It provides full duplex RS-232 serial communication to the host or programming computer or a terminal for setup and diagnostic operations. It is normally connected to the front panel modular terminal connector on the TC-3550 Processor/Receiver card.

PIN	DESIGNATION	NOTES
1	Frame Ground	Use for Shield
2	RxD	Received data from terminal/host
3	TxD	Transmit data to terminal/host
7	COM	Signal Ground/Common

MX1-MX8 These are DB-9F serial RS-232 connectors used for serial communication with other card frames, including Data Terminal Units (DTU's) within the equipment rack, or Remote Terminal Units (RTU's) or Servo Terminal Units (STU's) located within the facility.

PIN	DESIGNATION	NOTES
1	COM	Use for Shield
2	Rx+	Received data + from external device
3	Tx+	Transmit data + to external device
6	Rx-	Received data - from external device
7	Tx-	Transmit data - to external device
9	COM	Signal common

DATA This DB-9M port is designed for RS-422 communication with the host system and contains additional digital I/O points for special applications.

PIN	DESIGNATION	NOTES
1	COM	Use for Shield
2	Rx+	Received data + from external device
3	Tx+	Transmit data + to external device
4	INP1	External input 1 - Show Stop (active low)
5	INP2	External input 2 - Show Start (active low)
6	Rx-	Received data - from external device
7	Tx-	Transmit data - to external device
8	OUT1	External output 1 - active low, 100MA maximum
9	COM	Signal common

AO1-AO4 These are discrete analog output channels, normally terminated at a DB-25F connector requiring a mating DB-25M connector on the cable end. Analog outputs appear on pins 1-16, and the commons are returned on pins 17-24 with an overall shield on pin 25. Some configurations may not require analog outputs and these connectors may not apply.

DO1-DO4 These are digital outputs terminated at DB-37F connectors requiring a DB-37M on the cable end. Emitters (commons) are on pins 1-16, collectors on pins 20-35. For most applications, the collectors are used as the outputs, sinking to ground. +24VDC is available on pins 36 and 37, and ground or common is on pins 17, 18, and 19. Some

configurations may have additional DOx connectors. Refer to the TC-316 documentation for further information and applications.

POWER

This is an AMP CPC-16 style connector which supplies power to the CTU I/O card frame. Triad has a standard power cable pin assignment defined for the AMP connector, but not all voltages may be required by the CTU configured for this installation.

PIN	DESIGNATION	NOTES	
1	Digital Ground	Isolated from other grounds	
2	+5 V	Regulated	
3	+10 V	Unregulated logic	Not Used in CTU
4	Analog Ground		
5	+12 V	Regulated	RS-232 levels
6	-12 V @	Regulated	(optional for RS-232)
7	Analog Ground	Same as pin 4	
8	+15 V	Regulated	Analog Output Modules
9	-15 V @	Regulated	(if used)
13	Control Ground	Isolated	
14	+24 VDC	Relay/tally power	
15	N/C		
16	Frame Ground	Chassis ground	

The 24VDC power is provided to operate tally lamps, small relays, or for inputs to the TC-326 digital input module only. Systems requiring higher current at 24VDC should use an external fuse panel/power supply.

SECTION 4.0 TERMINAL OPERATION

A "dumb" terminal or terminal emulator (i.e. within the Synthesis system) may be connected to the upper modular port of the TC-3550 to access diagnostics, configuration, and other options directly. Please refer to the reference section for information on the TechTerm terminal.

Configuration parameters, initial defaults, and other operating parameters are stored in battery-backed RAM memory when the interface is not powered up. The communications parameters for the terminal are as follows:

9600 baud, No parity, 8 data bits, 1 stop bit
(2 stop bits may be required for upload/download procedures)

There is normally a "sign-on" message displayed whenever the CTU is reset; otherwise, the display is quiet until a specific request is entered from the terminal.

To get the CTU's attention, press the ESC (escape) key on the terminal. The CTU should respond with a menu roughly as follows:

```
CTU:  C.fig D.iag R.un
```

Options are normally selected by pressing the letter key corresponding to the desired operation, i.e. "C" for configure, "D" for diagnostics, etc. Although the interface will continue to transmit TRX data to the remote devices and communication is maintained with the host computer, several tasks are not possible while the menu functions are being used. Therefore, it is essential that the interface be placed into the "R"un mode (or reset) when all terminal operations are complete.

The **Escape** key is generally used to terminate any operation, and to return to the next higher selection or menu level. Pressing ESC from the (main) menu will also cause the system to restart similar to R.un. If ESC is pressed two (2) times within a second at the main: menu, the system will drop into the Triad/65 monitor and debugger, and all functions will cease. The only known exception is when it is necessary to 'exit' the terminal mode. In this case CTRL-A is used to exit terminal operation and return to the Diagnostic menu. To restart the system from the monitor either do a hardware reset or type in the following command from the system monitor:

```
C000G (that's zero, not "o"!)
```

*Improper operation or damage could be caused by changing **any** parameters stored in the RAM memory using debugger commands, and this should only be performed if directed by Triad!*

Refer to the section "TechTerm" operation for more information regarding the handheld terminal used for diagnostics, maintenance, and focus operations.

SECTION 5.0 SETUP AND CONFIGURATION

The CONFIG: menu is used to display and set characteristics of the CTU card frame. It is accessed by selecting "C" from the Main menu.

The terminal will display a line similar to the following:

CONFIG:A.na D.ip L.oc P.rt R.em Upld Z.ap

A.na: Name Mode Trim Prst Analog configuration menu

Name Allows entry of a 16 character function name for each analog channel.

Mode Used to set the mode of the local analog output channels. The possible modes are 8 bit mono-polar (0-10), 8 bit bi-polar (-10 to + 10), 12 bit bi-polar (-10 to +10) and Off.

Note: When in 12 bit mode, two adjacent logical channels are required for each physical output channel. Thus a maximum of 32: 12 bit channels are possible per CTU card frame.

Trim Used to set the fine trim for 8 bit analog output channels. The number is from 0-16, but only the 4 MSB's have an effect.

Prst Displays analog value of current channel's preset.

D.ip A soft-switch used to emulate the eight position hardware dip switch used on older Triad cards. It is used to set variables or options. Most of these are being phased into menu options. The value is entered in HEX and should normally be set to 10h. *The "Dip switch" will be phased out in favor of menu driven configuration and options.*

L.oc Used to select the analog and digital channels that will be decoded **locally** within the CTU frame.

NAME:
Allows entry of a 16 character name for each frame.

FRAME: F0
Selects the CTU unit frame ID used for requesting upload, download, or special requests to the CTU. The default frame ID for the first CTU in any system is F0, the second unit is F1, etc.

ABNK1:
One bank of 32 analog channels may be selected. Twelve bit analog outputs require two logical adjacent 8 bit channels per output!

Bank offsets are:

A0: 1-32	A4: 129-160	A8: 257-288	AC: 385-416
A1: 33-64	A5: 161-192	A9: 289-320	AD: 417-448
A2: 65-96	A6: 193-224	AA: 321-352	AE: 449-480
A3: 97-128	A7: 225-256	AB: 353-384	AF: 481-512

DBANK:

For digitals, there are two banks (D1 or D2) that select which group of digital channels is to be used by local digital cards in the CTU.

D0: 1-256

D1: 257-512

DCHAN:

Selects the number of strobe pulses to generate for local digital I/O card subchannels, and should normally be set to 16 or 32 based on the cards and configuration being used. The default/standard configuration is for 32 digital outputs per (digital) channel.

DSHFT:

It is possible to offset the logical card/channel number without rewiring the data and strobe signals to the decoder/driver cards within the I/O frame by using the DSHFT parameter. A DSHFT of 0 maps logical card 1 to physical card #1, 2 to 2, etc. By using a DSHFT of 1, physical card 1 will receive data from logical card 2, 2 from 3, etc. The maximum DSHFT value is 7 for each digital GROUP (currently D0 or D1).

The DSHFT option has been implemented in firmware release 92.12.

- P.rt Will print (display) the software revision and configuration settings. A communications program (such as ProComm) may be used to capture this information for future reference. (We also suggest that the analog and digital presets be logged, which are not part of the current P.rt output dialogue.)
- R.em Used to setup a bit-map of remote I/O frames (STU/RTU/DTU) for the analog and digital channels to be repeated. The bitmap is entered in hex values, and controls which MX ports will receive selected banks of data. A sample configuration might look like this:

	8	7	6	5	4	3	2	1	
A0	0	0	0	0	0	0	0	1 = 01h	MX1 SET TO BANK A0 (1-32)
A1	0	0	0	0	0	0	1	0 = 02h	MX2 SET TO BANK A1 (33-64)
A2	0	0	0	0	0	1	0	0 = 04h	MX3 SET TO BANK A2
A3									
A4									
A5									
A6									
A7									
A8									
A9									
AA									
AB									
AC									
AD									
AE	1	0	0	0	0	0	0	0	
AF	1	0	0	0	0	0	0	0	

	8	7	6	5	4	3	2	1	
D0	0	0	0	0	1	1	1	1 = 0Fh	MX1-4 SET TO DIGITAL GROUP D0
D1	1	1	1	1	0	0	0	0 = F0h	MX5-8 SET TO DIGITAL GROUP D1
D2	0	0	0	0	0	0	0	0 = 00h	(NOT USED!)
D3	0	0	0	0	0	0	0	0 = 00h	(NOT USED!)

- Upld Will request the CTU configuration information to be uploaded to the terminal port and may be saved on disk using the Triad "Rombake" or other communications program.

- Z.ap Performs a "cold" start of the system and resets all configuration parameters to the defaults setup in the ROM firmware. Caution: This operation will destroy the current local, remote, and all other setup parameters! A prompt of "Are You Sure?" is presented; respond with "Y" to confirm clearing of all parameters. Ensure that you restore all parameters to the values defined in the installation.

SECTION 6.0 DIAGNOSTICS SYSTEM

DIAG MENU

D.iag is the Diagnostics menu, and is used to exercise analog and digital channels, test serial communications, etc.

*** NOTE ***

When any digital or analog channel is selected in the D.iagnostics system, it is automatically "blinded" from any data from a higher source, such as the TC-560 Transmitter Interface in the Show Control Unit computer. Otherwise, new data from the SCU would "wipe out" any local settings. The channel WILL REMAIN BLIND until explicitly reset by using the R.estimate command which is independent for analog or digital channels, or by a system "reset."

DIAG: A.na D.ig S.ts T.rm Esc

ANA: C.hn P.re R.st S.ts U.nbl Z.ap

- C.hn (Channel) Selects an analog channel to exercise, and allows setting or ramping the current level. Any channel that is actually changed is blinded until R.reset. Channels that are configured for 12 bit operation require two adjacent logical channels, with the high 4 bits of the lower channel becoming the LSB of the 12 bit value, and the next sequential channel being the MSB.
- P.re (Preset) Makes the current analog settings the default preset when the CTU card is reset or restarted. If the value for an analog channel is P.reset to 255, then when the system is R.reset, the analog channel will remain at the last value set (from 0 to 255) and will not be cleared or set to a default value.
- R.st (Reset/Restore) Clears the blind status bits for all channels, and restores the internal preset values for analog channels (unless new data from the SCU is being received).
- S.ts (Status) Shows the current value for each of the analog channels. Any channel that is in local "blind" mode will have a 'b' next to the value. This display requires a full 24x80 screen display format to be meaningful.
- U.nbl Unblinds analog channels.
- Z.ap Forces all analog channels to a value of 0. Use extreme caution that no animation or show action equipment is active as there is no ease-in or ramping if a Zap is performed!

DIG: C.hn P.re R.st S.ts U.nb Z.ap

These are the digital diagnostics options, used to set/clear any or all of the digital channels in the local or downstream remote card frame(s) such as a STU, DTU, or RTU.

C.hn (Channel) Allows selection of an output channel/subchannel and shows the current status (on/off). Pressing the ENTER key will toggle the status of the channel on->off->on, and automatically "blind" the output from data received from Show Control. As a shortcut, the letters A-P may be used to directly toggle the first 16 subchannels of a digital channel.

Note that if a DSHFT digital offset is in effect, then the "local" channel numbers must be entered as the actual offset into the configured system. For example, if the DSHFT for this frame is 3, the channel should be entered as 4 (4-DSHFT) to access the first local channel, followed by the card(s) subchannels to toggle/test. This is because the CTU is assumed to be a "global" frame, communicating to other frames "downstream".

P.re (Preset) Makes the current digital settings the default preset for when the transmitter card is reset or restarted.

R.st (Reset) Restores all digital channels to an UNBLINDED condition, and sets the values to the default (preset) value.

S.ts (Status) Displays the current status of all of the digital channels in process by the card frame. Note that this display will 'overload' the focus/remote terminal, and will only be meaningful on a 24x80 display screen.

U.nb (Unblind) Unblinds digital channels.

Z.ap Resets all digital channels to clear or off. Unless this is also made a P.reset (see above), the channels will revert to their preset values when the channels are R.reset or the system is restarted. A prompt of "Are You Sure?" is presented; respond with "Y" to confirm clearing of all digital channels.

S.ts (Status) Displays the current status of all of the analog and digital channels being received by the card frame.

T.rm (Terminal) Allows communication between the terminal port and serial devices connected to one of the auxiliary comm ports on the CTU card frame. No buffering of data is performed in this mode, so the maximum communications speed is limited to the SLOWEST of the device baud rates. In a CTU, there are eight additional serial ports used to talk to other I/O frames. When T.rm is selected, it will prompt for the comm port to "talk" to. '0' is the host (SCU) port on the TC-3550 Processor Interface, 1-8 are the serial ports on the TC-3518 Serial Communications Adapter card. Control-A is used to break from the terminal mode back to the main menu.

Data received from any comm port will be echoed on the terminal port, even if it is not the currently selected comm port.