Titan CPX Expander

User Manual

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Proprietary Notice

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Titan CPX Expander User Manual v1.5
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Introduction

The Titan CPX Expander allows you to connect up to three Titan CPUs to configure large channel-count test systems of up to 384 analog channels, plus digital channels.

Device connections to the Titan CPX Expander are made using industry-standard Ethernet cables, which provide communication and synchronization on a single cable. Data can be recorded directly to an SD memory card or to a host PC, and network operation is possible via TCP/IP or UDP.

This manual is intended to provide the user with an overview of the Titan CPX Expander, with complete features, specifications, set up procedures and operation. It contains important safety information as well.

Support

Support for this product is available by contacting the factory during regular business hours (9am – 6pm EST) at 301-470-3278. Additional information can be found on our web site: http://www.marslabs.com

General Guidelines and Warnings

Electrostatic Discharge

Electrostatic Discharge (ESD) occurs when a static charge builds up on either yourself or the Titan hardware, and then you touch the Titan hardware, which rapidly dissipates the status charge. The spark of the discharge can be so small that you don't feel it, however, it can flaw a semiconductor. These flaws may generate an immediate failure, or, in most cases, cause a slight reduction in performance which will continue to degrade, eventually leading to failure of the hardware. When you feel a static shock, you are experiencing a minimum of 3,000 volts of electricity.

Even though the input connectors have protection to prevent ESD damage, it is good practice to always ground yourself and the Titan hardware while connecting and removing sensors.

Always use approved ESD handling procedures to prevent ESD damage.

Grounding Titans

In general, grounding the Titan hardware to the test vehicle or test structure will usually reduce noise pickup.

All of the analog inputs of the Titan hardware have a return path to ground. However, it is very important that each sensor have only one return path to avoid ground loops. When testing a vehicle, often the vehicle chassis and Titan can have very large ground imbalances of one or two volts. In such situations, ground the sensors to Titan and use differential inputs across the sensor. A totally floating input (like a 9-Volt battery) must have one side grounded at the point where used, either grounded to Titan or connected to the vehicle chassis ground via a resistor (e.g. 10K ohm).

If there is a possibility that a floating sensor may be occasionally grounded, install a 10K ohm resistor from the minus input to Titan ground. When the sensor is floating, the 10K ohm resistance will reference it to Titan ground, and when it is grounded, the resistor will allow the direct minus input wire to reference the remote chassis ground.

Specific Warnings

When using a power adapter with the Titan, always connect the adapter to the Titan before applying power. Never hot plug a Titan device under any circumstances - hot plugging may damage the device!
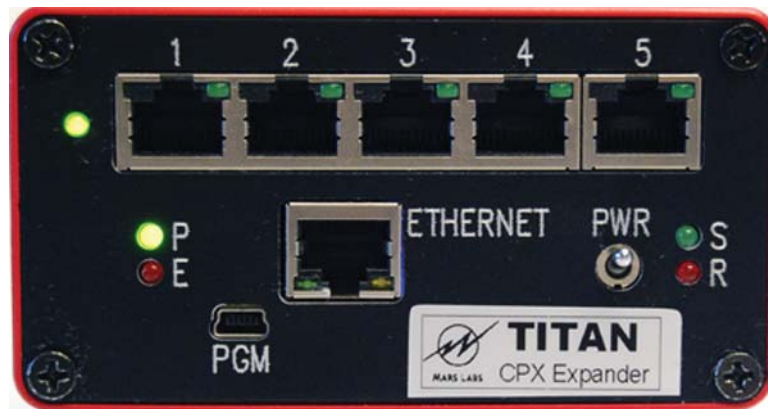
Guidelines for Wiring Sensors

Observe the following guidelines when wiring and connecting sensors to the Titan hardware:

1. Observe polarity of sensor wires
2. Strain relieve all connections
3. Secure cables with wire ties and bundle cables where possible
4. Secure connectors by fastening to the Titan chassis
5. For Thermocouples, apply heat shrink to exposed wires
6. Double check all connections prior to connecting the cables to the Titan
7. Use only heavy gauge straight-through CAT-6 Ethernet cables with locking tabs when connecting Titan CPUs to the CPX Expander.
8. When routing cables, be aware of sharp edges and pinch points where cables can bind or be cut, introducing shorts in the wiring

Operation

Front Panel

The Titan CPX Expander front panel incorporates an Ethernet port, Mini-USB port, five RJ45 connection ports, status indicators, and a power switch

Ethernet

An RJ-45 port that provides an Ethernet Local Area Network (LAN) connection to the Expander microprocessor.

PGM

A Mini-USB port that provides communication with the Expander microprocessor via a terminal emulator program.

RJ45 Connection Ports

Five RJ45 ports provide connections for the Expander, the Ethernet LAN, and up to three Titan CPUs.

Status Indicators

P – A green LED indicating that the CPX Expander is ON.
E – A red LED indicating an error condition when lit.
S – A green LED indicating that the device is scanning when lit
R – A red LED indicating that the device is recording when lit.

An unlabeled indicator on the upper left of the CPX Expander indicates Ethernet hub power and is illuminated when power is applied.
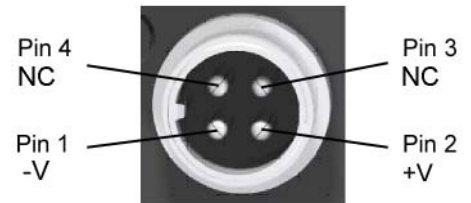
Rear Panel

The Titan CPX Expander rear panel has a 4-pin power connector that accepts a standard Titan Power Adapter (Mars Labs PS12V3A-SM or equivalent).

Power Connector

The CPX Expander power connector accepts power from a standard Titan Power Adapter. Should you need to power the Titan CPX Expander using your own source, connect using the power connections shown.

NOTES:

1. *The Expander does not provide power to Titan CPU devices. Titan CPU devices require their own power.*

2. *The mating connector for 4-pin Auxiliary Power input is available from the following sources:*

   Mars Labs - P/N MLCON10227
   Description: 4-Pin Female CB and HAM Radio Microphone Plug

   Radio Shack - P/N 274-001
   Description: 4-Pin Female CB and HAM Radio Microphone Plug
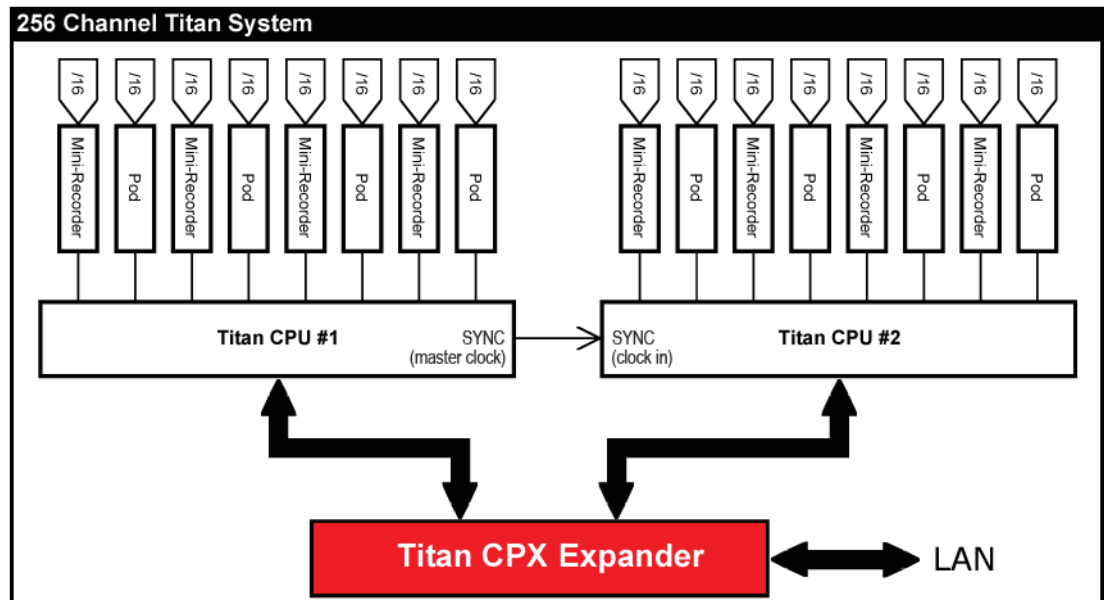
   Westlake Electrical Supply - P/N T609B
   Description: 4-Pin Inline Female Mobile Connector

⚠ **WARNING:** *When using a power adapter with any Titan device, always connect the adapter before applying power. Never hot plug a device under any circumstances - hot plugging may damage the device!*

Functional Diagram

The diagram below depicts a 256 channel data acquisition system using two Titan CPUs and sixteen Titan Input Modules (a combination of Pods and Mini-Recorders). A common clock establishes and maintains synchronicity between the CPUs (see note 2 below). The Titan CPX Expander acts as a command and control hub, directing commands between the control software (TCS) and the appropriate CPU, and relaying responses back. While running, the data received from the CPUs is stitched together and passed upstream.
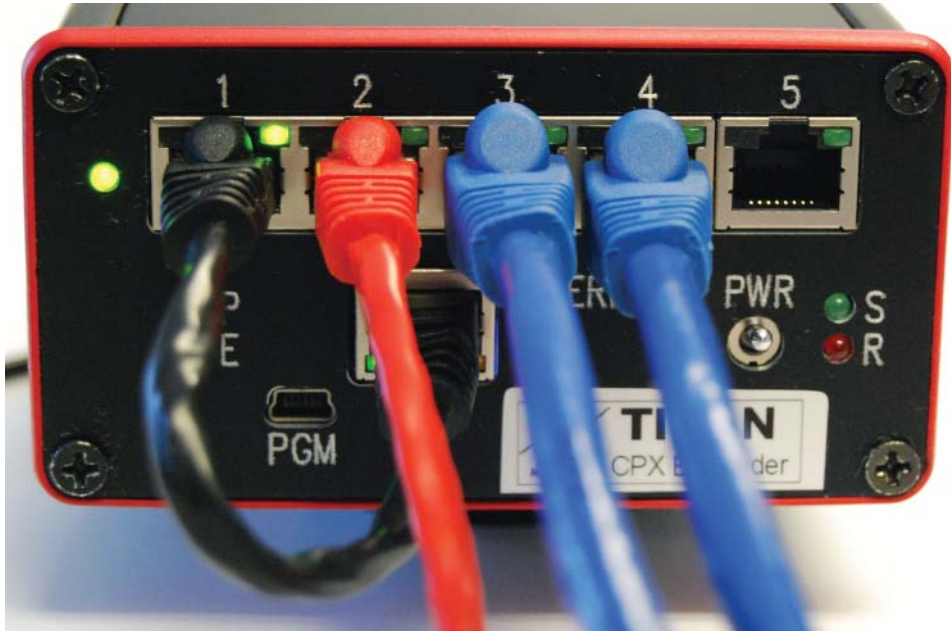

NOTES:

1. The CPX Expander automatically selects the CPU that provides the Master Clock by choosing the CPU with the lowest numerical IP address.

2. The clock connection is made using an 1/8" Tip-Ring-Sleeve (TRS) cable between the SYNC jacks on the CPUs. Note that when three CPUs are used, the clock signal from the master clock must be split and connected to the remaining two CPUs.

Configuration

The Titan CPX Expander can be operated directly from a host PC or over a network connection (see 'Connections' section).

For operation using either method, make the connections to the CPX Expander as shown:

1. With power removed from all devices to be connected, use a short length of Ethernet cable (shown in black) to connect the CPX Expander's 'Ethernet' port to Port 1.

2. Connect the LAN cable (shown in red) to Port 2.

3. Connect up to three Titan CPUs to Ports 3-5 (shown in blue).

4. Make the SYNC clock connections between the CPUs (illustrated in the functional diagram on page 9).

5. Make all sensor connections to the connected Titan Input Modules before continuing.

Connections

1. If your CPX Expander is configured with a unique IP address on the same subnet as your local network, you can simply connect it to your network. To make sure there are no IP address conflicts, you should ping the address before connecting the CPX Expander (open a command prompt [Start Menu -> Run: cmd] and enter "ping <ip address>").

2. Make all connections as described the 'Configuration' section (page 10). Connect the Titan CPX Expander to the network, but *do not* apply power.

3. With the CPX Expander power OFF, begin by applying power to the connected Titan CPU's and allow the devices to complete their initialization before continuing.

4. Apply power to the CPX Expander and allow the device to initialize (approx. 45 seconds).

5. If you have not already done so, install the TCS software according to the installation instructions in the TCS User Manual, and then follow the procedure in the manual to configure the Titan CPX Expander, Titan CPUs and Titan Input Modules for your setup.

Remote Switch Operation

A remote recording switch can be plugged into any one of the connected Titan CPU's and used to control the CPX Expander. The switch will work only if the CPX Expander has first been configured and started scanning using TCS. After configuring and running the system with TCS, turning on the record switch will cause the CPX Expander to send a run startup sequence to all of the Titan CPU's (if the CPX Expander is not already in run mode). It then starts recording into a file on the CPX Expander's "/data" directory, and a command is sent to connected CPU's to instruct them to flash their RECORD LED's. When the record switch is turned OFF, the CPX Expander stops recording, sends a command to the connected CPU's to turn off their remote LED's, and then sends a sequence of commands to the CPU's to stop.

In order to minimize potential synchronization problems, the CPU's will stop scanning for a few seconds when the Remote Switch is turned off, and then resume scanning.

Standalone Mode and Auto Start/Auto Record Mode

The CPX Expander can operate in Standalone Mode; it is able to power-on and then beginning scanning and recording immediately when the Auto Start or Auto Record modes are enabled in TCS, or under user control when the Remote Record Switch is turned on. In order for standalone mode to work, the CPX Expander must have first been configured and started scanning using TCS. After a successful "RUN" using TCS, the CPX Expander will store the IP addresses of the connected CPU's in order to use them in standalone mode. When the CPX Expander is subsequently power cycled, it will attempt to connect to the stored IP addresses and put the connected Titan CPUs in slave mode. If Auto Start or Auto Record mode is turned on, or when the Remote Record Switch is turned on, the CPX Expander will initiate a RUN sequence and, for Auto Record mode or the Remote switch, will then start recording.

The LED lights on the remote record switch and connected Titan CPUs are designed to assist the user in recognizing and troubleshooting problems. A slow blinking error LED (1 second period, 50% duty cycle) with a solidly lit remote record LED indicates no connection to the CPX Expander. When a CPU is first powered on after last being used in slave mode, it will slow blink its error LED and solidly light the remote record LED. As soon as the CPX Expander connects to it, or as soon as the user connects directly to it using TCS (v3.0.5 or higher), the error LED is turned off and the remote record LED begins flashing (0.75 second period, with a brief flash). When operating in slave mode, if the CPU does not receive a "keep-alive" packet from the CPX Expander every 10 seconds, it will again slow blink its error LED and solid light the remote record LED. This can happen, for example, if an Ethernet cable is disconnected or the CPX Expander is powered off. When the connection is restored, the error light turns off and the remote record LED resumes flashing.

When the CPX Expander is recording, it instructs all connected CPU's to blink their record LEDs (approx. 0.75 second period, mostly on with a brief flash off).

Changing the IP Address

If the IP address of the Titan CPX Expander is known, it can be changed using the Titan IP Address Programmer. The Titan IP Address Programmer is part of the Titan Service Pack, available from the Mars Labs Knowledge Base.

If the address is unknown or uncertain, it can be changed via the PGM port as described on the following page.

Using the Titan IP Address Programmer -

NOTE: *The Titan IP Address Programmer changes configuration settings that are critical to the operation of the CPX. Incorrect or incompatible network settings can potentially cause the device to become unresponsive on the network. If you are uncertain about any of the network settings, leave them as default.*

Before running the Address Programmer:

- Connect the CPX to your Ethernet network.

- Set your computer to a static IP address that uses the same subnet as the CPX IP address.

- Power on the CPX and verify that you can connect to it [F1] using TCS.

- Make a note of the IP address for use in the next section.

PROCEDURE

- Launch the Titan II IP Address Programmer:

- Enter the current IP address of the CPU in the 'IP Address' field, and then click 'Connect'

- Enter the new IP address in the field in the lower half of the window, and verify that it is correct. Click 'Program Settings' to program the new settings, and then wait for the CPX to reboot.

- After the CPX reboots, verify the new settings by clicking 'Connect' to re-populate the programmer fields.
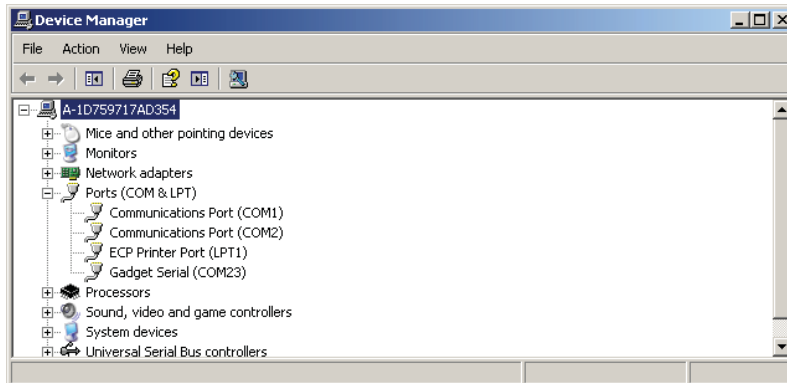
- When finished, click 'Disconnect' and close out of the Programmer window.

- Record the new IP Address for future reference.
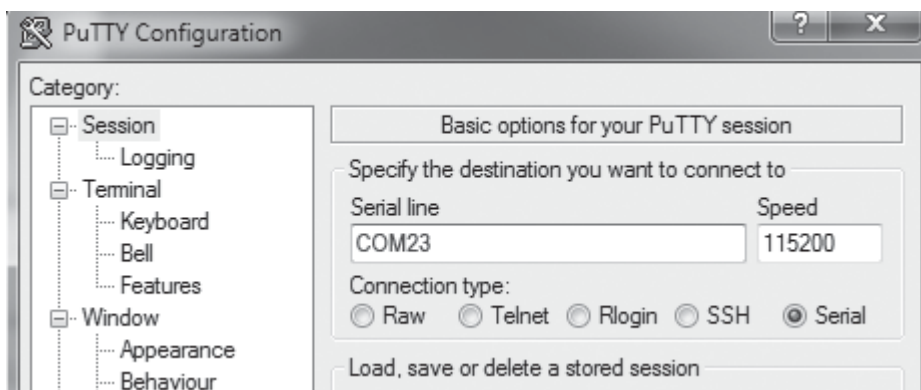
Via the PGM port -

Remove power to the Titan CPX and disconnect any connected Titan devices. Connect the PC to the CPX's PGM port using a mini-USB cable (this connection will provide power to the CPX; the device will take approximately one minute to initialize before you can continue). Note that you may also need to install a driver if the 'Found New Hardware ' window appears. The driver is located in C:\Program Files\MarsLabs\TCS3\Drivers\Gadget Driver, and is also found on the TCS installation CD-ROM. You can also obtain the driver online:

<div align="center">http://www.kernel.org/doc/Documentation/usb/linux-cdc-acm.inf</div>

Follow the Windows prompts to install the driver. With the Gadget Driver installed and the CPX connected, open the Windows Device Manager, select 'Ports (COM & LPT)' and make note of the Gadget Serial port connection (COMxx):

Close the Device Manager window and open a terminal emulator program (PuTTY is the preferred terminal emulator program - a copy can be found on the installation disc). Connect to the CPX PGM port using a Serial connection. Enter the Gadget Serial port number (COMxx) in the 'Serial Line' field:

Click 'Open' and a blank terminal window will appear. In the terminal window, enter the command "RESET_IP" <ENTER>. This command will reset the IP address to a default value of 192.168.10.50.

NOTE: *In it's default state, PuTTY will not echo back the characters entered in the terminal window. To turn local echo on, select 'Terminal' in the PuTTY Configuration window and then set both Line discipline options to 'Force On'.*

You can also use the terminal emulator change the IP address. In the terminal window, enter the command:

CHANGE_IP xxx.xxx.xxx.xxx/yy <ENTER>

This command will reset the IP address to the entered value "xxx.xxx.xxx.xxx". The value "/yy" corresponds to the desired subnet mask (see note 1 below). Note that there is no error checking using this command - the string of characters that appears after the 'CHANGE_IP and up to the carriage return <ENTER> simply becomes the new IP address. After changing or resetting the IP address, power cycle the CPX to have the change take effect. To confirm the change, reconnect in TCS using an Ethernet connection.

In the event that an invalid IP address entry is made, recovery is done by reconnecting to the device using PuTTY and using either the RESET_IP or CHANGE_IP command as described above. You could also reset the address by first using the RESET_IP command to restore the address to a known state, and then use the IP Address Programmer to program a new address; the difference being that the IP Address Programmer takes the subnet mask value into account, whereas the CHANGE_IP command requires you to enter the correct value.

NOTES:
1. The range of valid entries for "/yy" is 0-31. For example, a value of '/24' corresponds to a subnet mask of 255.255.255.0. For the value that corresponds to your company/organization, consult with your IT department.

2. After changing the IP address you should make note of it for future use.

3. USB Power is not sufficient to operate the CPX with Titan devices connected. For normal operation, connect to a Titan Power Adapter or other external power source.

Features and Specifications

Key Features

- Supports up to 3 Titan CPUs
- Wide ranging, isolated power supply accepts voltages of 11–32 VDC.
- Provides communication and synchronization via CAT5/6 Ethernet cable
- Records directly to SD card (internal) or to a host PC
- Network interface allows remote operation via TCP/IP
- Auto Start / Auto Record modes
- CPUs may be linked together for expanded configuration up to 384 analog channels, plus digital channels

Specifications

Number of Titan Modules supported:	Up to three Titan 8-port Titan CPUs; 384 analog channels total, plus digital channels.

Sample Rate:	Recording to device:
	    Up to 2000 samples/second (256 channels) for Titan CPU08
	    Up to 5000 samples/second (256 channels) for Titan CPU08V

Recording Media:	32 GB SD Memory Card (non-removable)
PC Operation :	Via network
Power Requirements:	11–32 VDC
Dimensions / Weight:	13.3 cm x 10.6 cm x 5.6 cm (L x W x H) / 500g

Warranty

Mars Labs warrants all their manufactured equipment to be free from defects in material and workmanship. **Mars Labs** liability under this warranty is limited to servicing or adjusting any equipment returned to the factory for that purpose, and to replace any defective parts thereof. The warranty remains effective for 365 days following delivery to the original purchaser. During this time, equipment will only receive repair when the original purchaser prepays all return transportation charges, and **Mars Labs** finds to its satisfaction that the equipment is indeed defective.

If the fault has been caused by misuse or abnormal conditions of operation, normal service charges will prevail. In this case, an estimate will be submitted before work is started. **Mars Labs** must authorize any warranty returns.

Mars Labs reserves the right to make changes in the design of its instruments without incurring any obligation to make the same changes on equipment previously purchased.

This warranty will be void if unauthorized alterations or modifications are found which impede the repair or testing of the equipment.

Receipt of Equipment

The equipment should be tested as soon as it is received. If the equipment is damaged in any way, a claim should be obtained by the claim agent, and this report should be forwarded to **Mars Labs**.

Mars Labs will then advise the customer of the disposition to be made of the equipment and arrange for repair or replacement. When referring to this equipment for any reason, the model number, serial number and purchase order number should be included.

Malfunction

If the unit fails to operate, or any fault develops, **Mars Labs** should be notified, giving full details of the difficulty, including model number and serial number. Upon receipt of this information, **Mars Labs** will provide service data and shipping instructions.

This warranty is expressly in lieu of all other obligations or liabilities on the part of **Mars Labs**, which neither assumes nor authorizes any person to assume for it any other liability in connection with the sale of its equipment. Contact:

> Mars Labs
> 29 C Street
> Laurel, MD
> 20707
> (301) 470-3278
> email: Support@MarsLabs.com

Notes & Known Issues

Digital Pod and CPX Expander

If your test setup does not include a Digital Pod, make sure that the Digital Pod is not enabled in TCS. If enabled without a Digital Pod in the system, TCS will not connect to the CPX Expander and time out.

MONITOR MODE not supported

The CPX Expander does not support monitor mode. Issuing the command "SET_MONITOR_MODE 1" will return an ERROR.

CPU Scan Rate Limitation

When using a CPX Expander, the maximum recommended CPU scan rate should not exceed 2000 s/s for CPU08 devices, and 5000 s/s for CPU08V devices.

Connectivity interruption using a Remote Switch:

If a Remote Switch is connected to a CPU and scanning, and then you attempt to connect [F1] to TCS, engaging the remote switch will cause TCS to interrupt the scan and query the ports.

CPU Power Loss/Data Loss

If a CPU loses power while scanning, all independently-powered Titan Input Devices (Mini-Recorders or Pods) must be power-cycled in order to re-synchronize the system.

Sync Cable

If running a single CPU with the Expander, the sync cable must be disconnected from the SYNC jack. Failure to observe this can result in issues.