PMX04

PORTABLE 4-SLOT 3U PXI HYBRID INSTRUMENTATION SYSTEM

USER'S MANUAL

P/N: 82-0150-000
Released November 3rd, 2014

VTI Instruments Corp.

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CERTIFICATION

VTI Instruments Corp. (VTI) certifies that this product met its published specifications at the time of shipment from the factory. Note that the contents of this document are subject to change without notice.

WARRANTY

The product referred to herein is warranted against defects in material and workmanship for a period of one year from the receipt date of the product at customer's facility. The sole and exclusive remedy for breach of any warranty concerning these goods shall be repair or replacement of defective parts, or a refund of the purchase price, to be determined at the option of VTI. Note that specifications are subject to change without notice.

For warranty service or repair, this product must be returned to a VTI Instruments authorized service center. The product shall be shipped prepaid to VTI and VTI shall prepay all returns of the product to the buyer. However, the buyer shall pay all shipping charges, duties, and taxes for products returned to VTI from another country.

VTI warrants that its software and firmware designated by VTI for use with a product will execute its programming when properly installed on that product. VTI does not however warrant that the operation of the product, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The warranty shall not apply to defects resulting from improper or inadequate maintenance by the buyer, buyer-supplied products or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

VTI Instruments Corp. shall not be liable for injury to property other than the goods themselves. Other than the limited warranty stated above, VTI Instruments Corp. makes no other warranties, express or implied, with respect to the quality of product beyond the description of the goods on the face of the contract. VTI specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

RESTRICTED RIGHTS LEGEND

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VTI Instruments Corp.
2031 Main Street
Irvine, CA 92614-6509 U.S.A

GENERAL SAFETY INSTRUCTIONS

Review the following safety precautions to avoid bodily injury and/or damage to the product. These precautions must be observed during all phases of operation or service of this product. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of the product. Note that this product contains no user serviceable parts or spare parts.

Service should only be performed by qualified personnel. Disconnect all power before servicing.

TERMS AND SYMBOLS

These terms may appear in this manual:

WARNING Indicates that a procedure or condition may cause bodily injury or death.

CAUTION Indicates that a procedure or condition could possibly cause damage to equipment or loss of data.

These symbols may appear on the product or in the manual:

ATTENTION - Important instructions

Indicates hazardous voltage.

Frame or chassis ground

Indicates that the product was manufactured after August 13, 2005. This mark is placed in accordance with *EN 50419, Marking of electrical and electronic equipment in accordance with Article 11(2) of Directive 2002/96/EC (WEEE)*. End-of-life product can be returned to VTI by obtaining an RMA number. Fees for take-back and recycling will apply if not prohibited by national law.

WARNINGS

Follow these precautions to avoid injury or damage to the product:

Use proper Power Cord To avoid hazard, only use the power cord specified for this product.

Use proper Power Source To avoid electrical overload, electric shock, or fire hazard, do not use a power source that applies other than the specified voltage. The mains outlet that is used to power the equipment must be within 3 meters of the device and shall be easily accessible.

Use proper Power Source	To avoid electrical overload, electric shock, or fire hazard, do not use a power source that applies other than the specified voltage. The mains outlet that is used to power the equipment must be within 3 meters of the device and shall be easily accessible.
Use proper Fuse	To avoid fire hazard, only use the type and rating fuse specified for this product.
Power Consumption	Prior to plugging-in PXI modules, it is imperative that the power consumption of all modules that will be installed in the mainframe be calculated for all power supply rails. The required information is available in detailed specifications of this chassis, and respective I/O card user manuals. *Failure to do so may result in damaging the switch card and the mainframe.*
Avoid Electric Shock	To avoid electric shock or fire hazard, do not operate this product with the covers removed. Do not connect or disconnect any cable, probes, test leads, etc. while they are connected to a voltage source. Remove all power and unplug unit before performing any service. ***Service should only be performed by qualified personnel.***
Ground the Product	This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground.
Operating Conditions	To avoid injury, electric shock or fire hazard: - Do not operate in wet or damp conditions. - Do not operate in an explosive atmosphere. - Operate or store only in specified temperature range. - Provide proper clearance for product ventilation to prevent overheating. - When selecting the installation location, be certain that there is enough space around the power plug and the outlet so that they are readily accessible. Do not insert the power cord into an outlet where accessibility to the plug cord is poor. - All unused slots should be closed with the dummy filler panels to ensure a proper air circulation. This is critical to avoid overheating of the cards. - DO NOT operate if any damage to this product is suspected. ***Product should be inspected or serviced only by qualified personnel.***

IMPROPER USE

The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

Conformity is checked by inspection.

SUPPORT RESOURCES

Support resources for this product are available on the Internet and at VTI Instruments customer support centers.

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Visit http://www.vtiinstruments.com for worldwide support sites and service plan information

SECTION 1

INTRODUCTION

OVERVIEW

The PMX04 is a new generation of innovative instrumental products from VTI Instruments Corporation. It integrates an embedded controller, PXI/PXIe hybrid slots, a multipoint capacitive touch screen, LCD, and a 256 GB internal hard drive. The compact design of the PMX04 offers users a brand-new experience in portable testing.

UNPACKING

Upon arrival, the shipping carton should be inspected for damage. If the carton or any of its contents are damaged please contact VTI Instruments immediately for a replacement. Do not dispose of the carton or any of its contents; VTI Instruments will not replace the damaged product if these materials are not returned.

Please check that the following materials are in the carton. If any of these materials are missing please contact VTI Instruments immediately.

- PMX04 - Portable 4-Slot 3U PXI Express “Tablet” with Integrated Display
- User’s Manual
- Power Cord

SECTION 2

FEATURES

FEATURES

The PMX04 includes the following features:

- Intel i7 dual-core processor
- 14-inch multipoint capacitive touch screen
- Windows 8 operating system
- Hybrid mixed PXI/PXIe slots
- Durable design for construction or industrial environments
- QM67 PCH Chipset equipped with 4GB DDR3 DRAM
- Internal 256GB HDD Drive standard with SATA 3.0 Interface

Figure 2-1: PMX04 Front View

1. Air Out/Fan Heatsink
2. Power Button
3. Stereo Speakers
4. Handle
5. Mic
6. Touch Screen

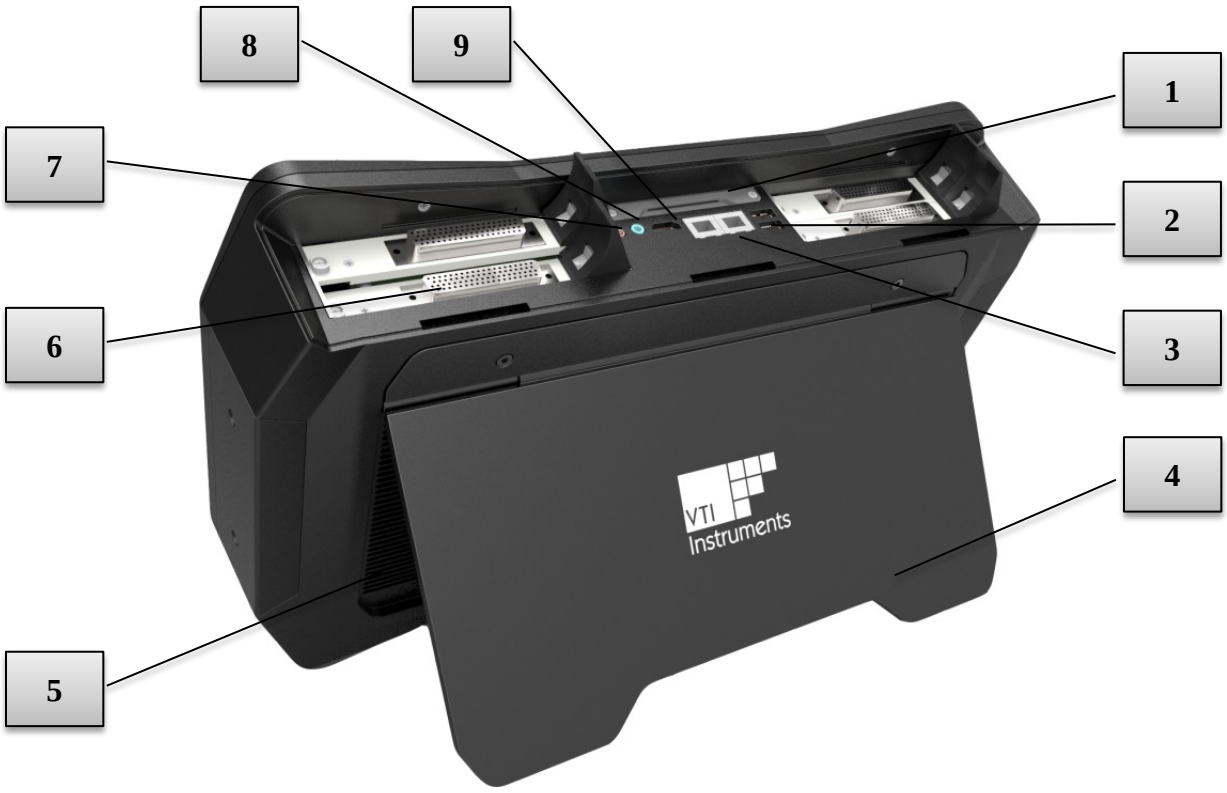

Figure 2-2: PMX04 Rear View

1. SATA 3.0 Hard Disk
2. Dual USB 2.0 Parts
3. Dual Gigabit Ethernet Ports
4. Metal Kickstand
5. Reserved for Battery (Optional)
6. 4x PXI-H Slots
7. Headset Jack
8. GPS Antenna
9. HDMI

SLOT CONFIGURATION

The PMX04 is a 4-slot PXI Express mainframe with an embedded controller, and 4 peripheral slots capable of accepting PXI Express or PXI Hybrid plug-in modules.

The PXI Express hybrid slot delivers connectivity to either an x4 PCI Express link or to the 32-bit, 33 MHz PCI bus on the backplane. This allows PXI Express hybrid-compatible, or 32-bit cPCI/PXI-1 modules (without J2 connector), to be used in this slot.

The PXIe timing slot accepts either a PXI Express module or a PXI Express system timing controller for advanced timing and synchronization.

The system controller slot has configurable 4x4, 2x8 and 1x8 links, which allows all PXIe controllers to be supported per spec.

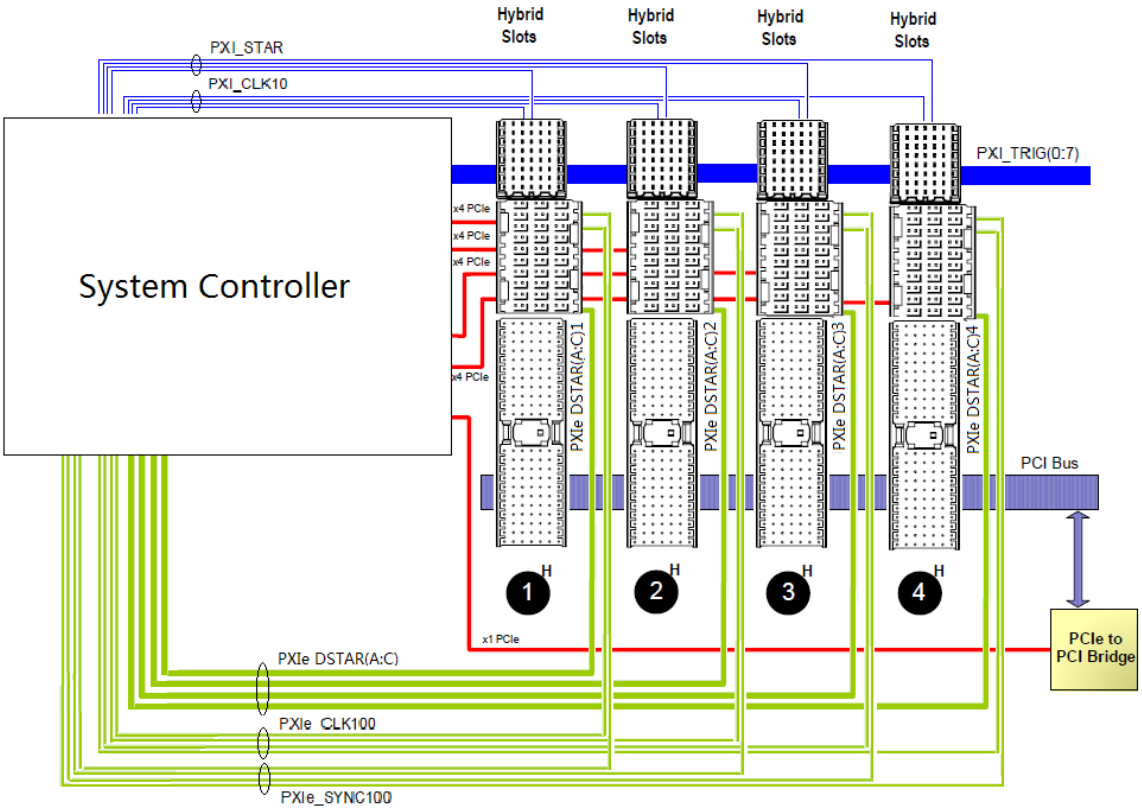

Figure 2-3: Backplane Architecture

DETAILED SPECIFICATIONS

GENERAL SPECIFICATIONS	
Total Slots	4 slots
Module Size	3U
Standards Compliance	PXI-1 hardware specification Rev 2.2
Processor	Intel Core i7-3517UE processor/1.7GHz/dual-core/Intel QM77 PCH Chipset
	Intel Core i7-3612QE processor/2.1GHz/quad-core/Intel QM77 PCH Chipset (optional)
Memory	Double data rate 3 (DDR3) synchronous dynamic random access memory
	Standard equipped 4GB/1333MHz/DDR3 memory sticks, with 4GB memory capacity
Hard Disk	SATA 3.0 standard interface, access speed up to 6GB/s
	Compatible with 2.5-inch SSD solid-state hard disk or HDD mechanical hard disk
	Standard equipped with 7200 rpm mechanical hard disk, with a capacity of 500GB
	Knock-down
Display Screen	Thin-film Transistor Liquid-crystal Display (TFT LCD) technology
	14.9-inch (13.97”), 16:9 wide screen
	1366x768 pixel resolution
	LED backlight design, automatic brightness adjustment
Peripheral Interfaces	2 Gigabit Ethernet port
	2 USB 2.0 interfaces
	HDMI high-definition interface
	GPS Antenna interfaces
	Standard 3.5 mm headset jack
Audio devices	Multiple built-in stereo speakers
	Built-in dual digital array microphone
Size	16.5” W x 2.6” D x 11.2”H
Weight	15 Lbs.

ELECTRICAL

Power Supply	AC/DC Power Adapter
AC Input	100 to 240 V AC, input current 2 A
Input Frequency	50 to 60 Hz
DC Input	19 V DC
Battery (Optional)	Optional Lithium Ion Battery pack for up to 2 hours of back up capacity

OPERATING ENVIRONMENT

Max DC Power Output	150 W
Operating Temperature	0 ° C to 50 ° C
Storage Temperature	-20 ° C to 70 ° C
Operating Humidity	8% - 80%, 95% RH@30 ° C, <65% (0 ° C to 50 ° ° C), no condensation
Storage Humidity	5% - 95%, <65% (0 ° C to 50 °), no condensation

RANDOM VIBRATION

Operating	5Hz – 500Hz, 2Grms, three-axis

RELATED PRODUCTS

PMX09	Portable 9 Slot PXI Express System
PMX04-AVI	Portable 9 Slot PXI Express System for Avionics Test Applications
PMX04-VID	Portable 9 Slot PXI Express System for Video & Graphics Applications
CMX09	9 Slot PXI Express Chassis
CMX18	18 Slot PXI Express Chassis

SECTION 3

PREPARATION FOR USE

The Windows 8 operating system has been installed in the PMX04 before leaving the factory. It is necessary to read this section carefully only when the self-contained operating system fails or when you are installing a new operating system.

SETTING BIOS

The Basic Input Output System (BIOS) is a program providing communication at the bottom layer between the processor and peripheral devices. The BIOS setup utility contains the operation menu used for enabling characteristics of the tablet device. To enter the BIOS setup screen, perform the following steps:

1. Insert USB keyboard device;
2. Reboot PXI smart tablet;
3. Once the standby screen appears press the <**Delete**> key to enter the BIOS setup screen.

Note: Changing BIOS setup may cause unexpected behavior or create boot up problems. For satisfying the requirements of most customers, settings are optimized for PXI applications by default. Changing the BIOS setup should only be done by well-qualified personnel.

INSTALLING OPERATING SYSTEM

The PMX04 is delivered with a factory-installed operating system. The PMX04 can be optionally set as booting from a USB CD-ROM or USB flash disk. Specific settings are as follows:

Reboot the device and enter the BIOS setup screen, then go to Boot→Hard Drive BBS Priorities→Boot Option #1 […] to select the device that you want to boot from with priority. After that, press <F10> to save the changes that you made and reboot the device.

INSTALLING THE OPERATING SYSTEM FROM USB FLASH DISK

To install operating system from USB flash disk, perform the following steps:

1. Make sure there is Windows PE system in the USB flash disk as the boot system;
2. Insert the USB flash disk within which the OS installation file is placed;
3. Insert a USB keyboard device;
4. Reboot the PMX04, press <**Delete**> to enter the BIOS setup screen;
5. Go to **Boot→Hard Drive BBS Priorities→ Boot Option #1 […]** successively and select USB flash disk as the first boot device;
6. Press <**F10**> to save the change that you made, PMX04 will reboot automatically.
7. Log on the Windows PE system, open the OS installation package and select the .exe file to execute it.

INSTALLING THE OPERATING SYSTEM FROM USB CD-ROM

To install the operating system from a USB CD-ROM, perform the following steps:

1. Insert the USB CD-ROM drive and put the OS installation CD onto the CD-ROM drive;
2. Insert a USB keyboard device;
3. Reboot the PMX04, press <**Delete**> to enter the BIOS setup screen;
4. Go to **Boot→Hard Drive BBS Priorities→Boot Option #1 […]** successively and select USB CD-ROM as the first boot device;
5. Press <**F10**> to save the changes that you made, the PMX04 will reboot automatically.
6. Enter the system installation screen and execute OS installation.

For more detailed information about OS, refer to related documents of the OS manufacturer. The following operating systems are recommended for and supported by the PMX04:

- Windows 8 Pro (32-bit/64-bit)
- Windows 7 Pro (32-bit/64-bit)

INSTALLING DRIVERS

After the operating system is installed, you need to install some necessary drivers to make the system run efficiently. You can find the necessary drivers in the included CD-ROM.

Note: You may also contact VTI Instruments directly to receive supplemental files, device drivers, or application software.

MAIN CHIPSET DRIVER

The main chipset driver for the PMX04 is Intel CEQM77. Before installation, please make sure that the operating system has been installed properly. The main chipset driver is in the folder **DRIVER\Chipset** under the root directory of the supplied CD. Please select the proper driver for 32-bit or 64-bit operating system depending on the OS installed on your device.

GRAPHICS DRIVER

The PMX04 uses an Intel Graphics Media Accelerator 5.0 on the Intel CEQM77 chipset for video graphic display. Before installation, please ensure that the operating system has been installed properly. The VGA driver is in the folder **DRIVER\Graphics** under the root directory of the supplied CD. Please select the proper driver for 32-bit or 64-bit operating system depending on the OS installed on your device.

AUDIO DRIVER

The PMX04 device uses Hi-Fi audio part and IDT STAC9200 sound chip. It supports a built-in dual-track speaker, built-in digital mic, and headset. The audio driver is in the folder **DRIVER\Audio** under the root directory of the supplied CD. Please select the proper driver for 32-bit or 64-bit operating system depending on the OS installed on your device.

ETHERNET DRIVER

A 10/100/1000 Mbps Ethernet port is integrated on the main board of the PMX04 and uses an Intel Gigabit Ethernet Controller as the primary chip. The Ethernet card driver can be found in the folder **DRIVER\Ethernet** under the root directory of the supplied CD. Please select the proper driver for 32-bit or 64-bit operating system depending on the OS installed on your device.

ETHERNET DRIVER

A 10/100/1000 Mbps Ethernet port is integrated on the main board of the PMX04 and uses an Intel Gigabit Ethernet Controller as the primary chip. The Ethernet card driver can be found in the folder **DRIVER\Ethernet** under the root directory of the supplied CD. Please select the proper driver for 32-bit or 64-bit operating system depending on the OS installed on your device.

OTHER DRIVERS

If other drivers are needed, please contact VTI Instruments directly.

SECTION 4

PRE-INSTALLED APPLICATION SOFTWARE

The PMX04 can be pre-configured at the factory with several application specific modules. The PMX04-VID is configured with any two of the following video formats; NTSC, VGA, DVI, SMPTE*, RS-422*, and Gigabit Video*. Each of these formats will have dual channel capabilities for signal generation on one channel and capture on the other. The installed EX Video Software package provides the user with the ability of configuring the signal generation and doing advanced analysis of the video captured. All of the captured data can be stored on the local HDD.

The PMX04-AVI is integrated with advanced MIL-STD-1553B and ARINC-429 protocol interface cards, including an easy to use Protocol Analyzer package from Alta Data.

TABLET SYSTEM CONTROL SOFTWARE

The PMX04 system control software has the functions of temperature monitoring, trigger routing settings, and fan control. For instruction about specific configuration, please refer to *Instruction on Control Program of the PMX04 Instrument System.*

Four temperature sensors inside the PMX04 monitor temperature and can be set to alarm based on user defined threshold values.

Trigger routing can route a trigger source to peripherals as a form of hardware handshaking. For example, you may pass a software trigger source to an external trigger terminal. This function allows for tight synchronization among multiple modules. A powerful system timer and trigger logic control function are incorporated inside the PMX04, with which routing among multiple trigger modes such as software trigger, external trigger, TTL trigger, differential trigger, star trigger, and others can be realized.

Four fans are equipped at the PMX04 slots for dissipating heat. Through the fan control software, each fan can be controlled separately, including displaying current rotation speed, setting minimum speed, automatic speed regulation, and full-speed operation.

SECTION 5

INSTALLING PXI/PXIE MODULES

The PMX04 is equipped with four PXI/PXIe hybrid slots with standard PXI/PXIe bus interface support. PXI, CPCI, PXIe, CPCIe functional modules such as oscilloscopes, digital multimeters, arbitrary waveform generators, communication modules and RF microwave modules, from a variety of manufacturers are compatible with plug-and-play support.

To install PXI/PXIe Modules, perform the following steps:

1. Turn off power to the PMX04 system;

2. Confirm that the module to be installed PXI-Hybrid or PXIe module. Commonly used modules are shown in the images below.

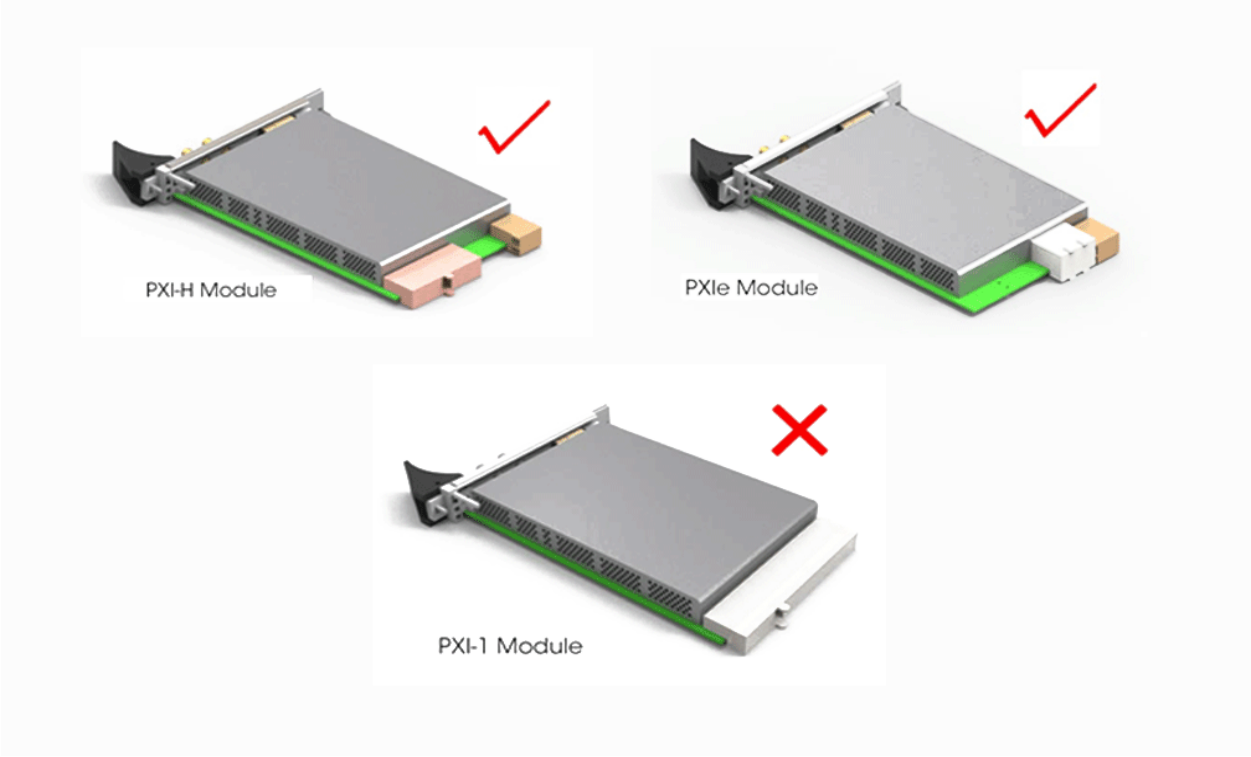

Figure 5-1: Acceptable PXI Modules

Note: This tablet device supports 32-bit bus modules only. Do not insert 64-bit modules into the PMX04.

3. Insert the module into any one of the slots of the PMX04.

4. After the module is installed, you can select and insert modular instruments depending on requirements to quickly form a small comprehensive instrument system. For example, by inserting a VTI EMX-4350 and EMX-1434 the PMX04 will have the necessary functions to perform modal analysis tests. Quick and free switching between instruments is available, turning the PMX04 into an all-in-one solution.

Note: The PMX04 has an isolated ground. If a source instrument such as a function generator is connected to a digitizer on the PMX04, the ground on each side must be connected together in order to see the clean source signal.

SECTION 6

GPS FUNCTION

The PMX04 includes a GPS module which communicates with the motherboard through a synchronous serial interface. The GPS function can be accessed via the following steps:

1. Open **Device Manager**, and check whether the **Ports(COM&LPT)** includes ***CP2102 USB to UART Bridge controller.***

Note: If it appears as shown in Figure 6-1, the driver was not installed or was installed incorrectly.

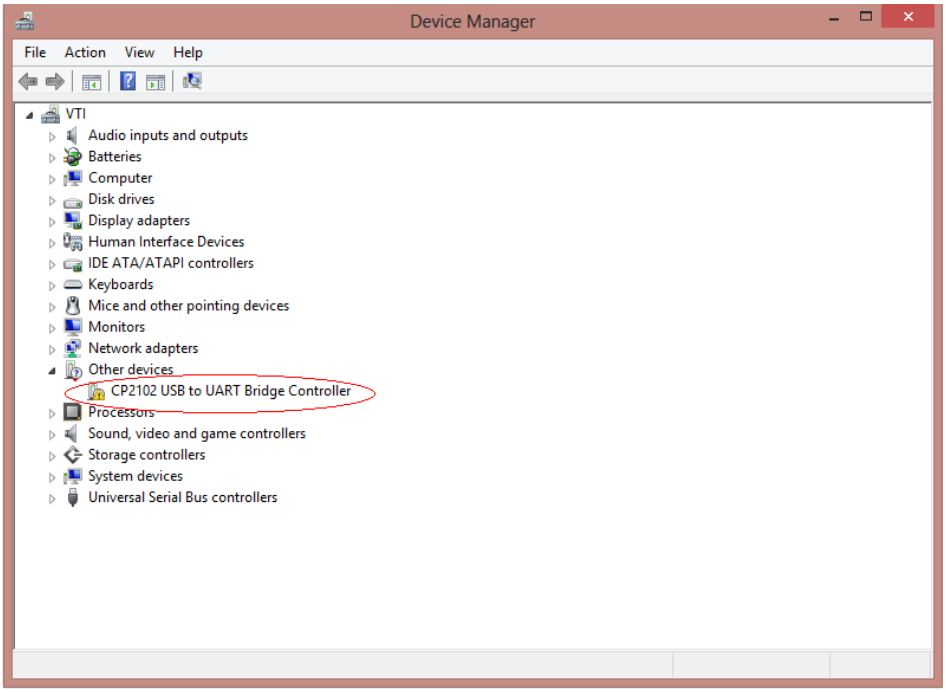

Figure 6-1: Driver Not Installed or Installed Incorrectly

If so, please use the Driver CD-ROM/**DRIVER/USB to RS232** to re-install the driver and check device manager again.

If it appears as shown in Figure 6-2, it means the driver is already installed.

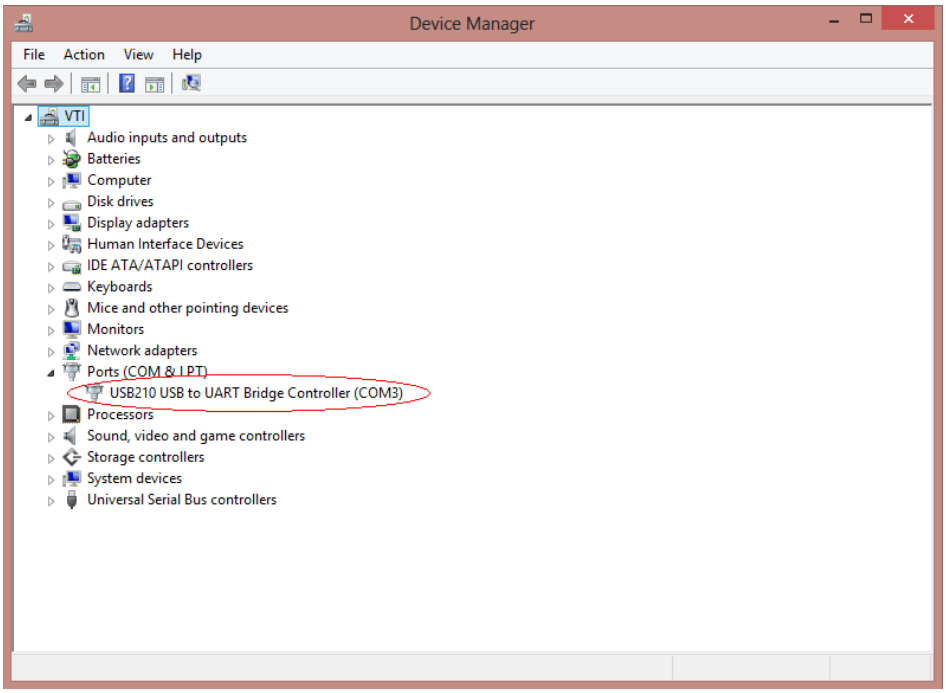

Figure 6-2: Driver is Already Installed

Attention: The COM port is a virtual port, which allows you to choose the COM port number, such as COM1 & COM2.

2. Open the **System Control of PXI Pad.** Choose the **WirelessControl** panel, as shown in Figure 6-3. The default status is **OFF**. Switch the GPS function to **ON** to begin using it.

Figure 6-3: System Control of PXI Pad

Note: System Control of PXI Pad is installed in the default path:
C:/ProgramFiles/PI/xPad.exe

3. The PMX04 uses an external GPS antenna. The GPS antenna interface is shown in Figure 6-4. The antenna uses an MCX socket. Please select the corresponding antenna plug.

Figure 6-4: GPS Antenna Interface

4. Open the GPS application software and choose the COM port number through the **Device Manager**. Other parameters are chosen as follows: ***9600 bps, 8 data bits, no parity, 1 stop bits.*** The GPS module supports **NMEA 0183 V3.0 protocol, which GGA, GLL, GSA, RMC, VTG** are refreshed by 1Hz, and GSV by 0.2Hz. To get more information regarding the GPS data, please refer to the **GP5MX1513F1 GPS Receiver Module Specification** in section 10.

SECTION 7

EMX-4X50 DISCOVERY

In order to discover the VTI EMX-4x50 series card(s) with the VTI PMX04 on Windows 8, follow these steps:

1. Download and install the VTI PCIe System Software Package (VTI P/N: 72-0380-000) from www.vtiinstruments.com.

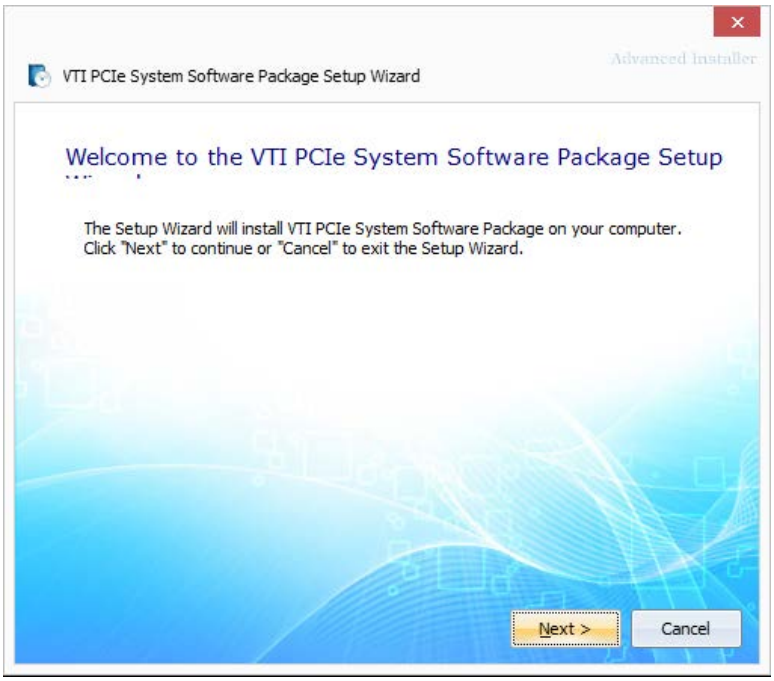

Figure 7-1: VTI PCIe System Software Package Setup Wizard

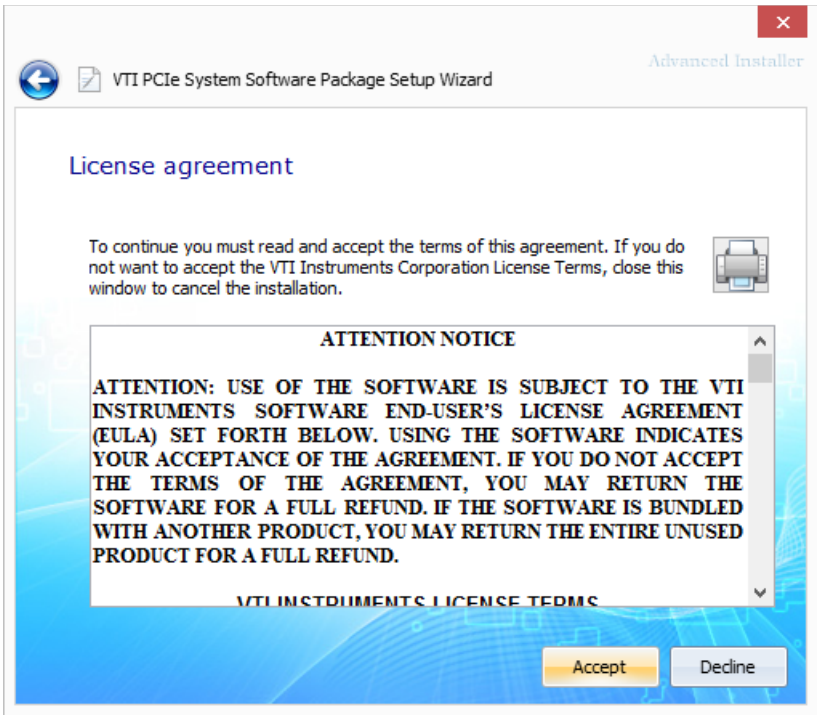

Figure 7-2: VTI PCIe System Software Package License Agreement

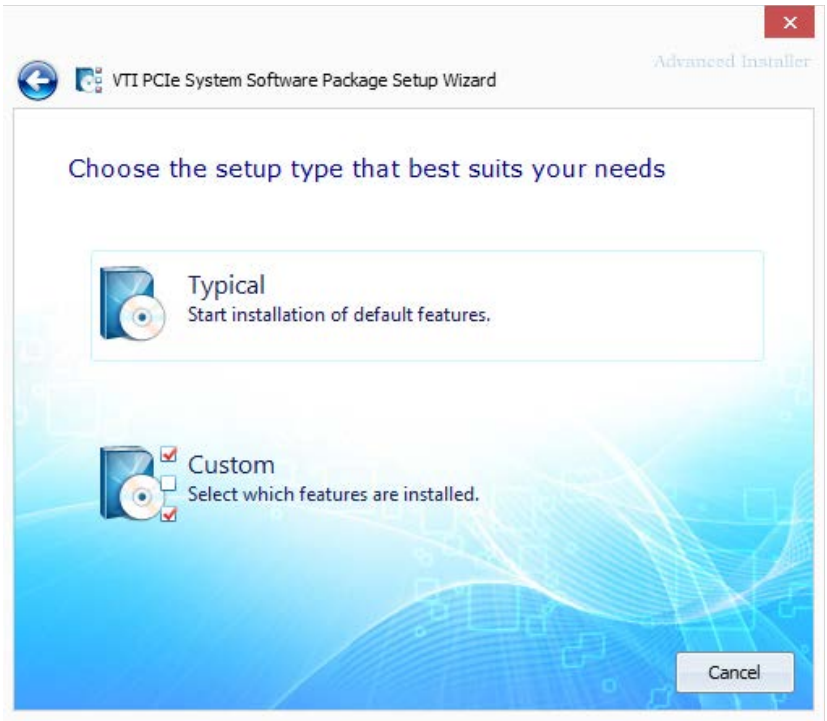

Figure 7-3: Select Setup Type Selection

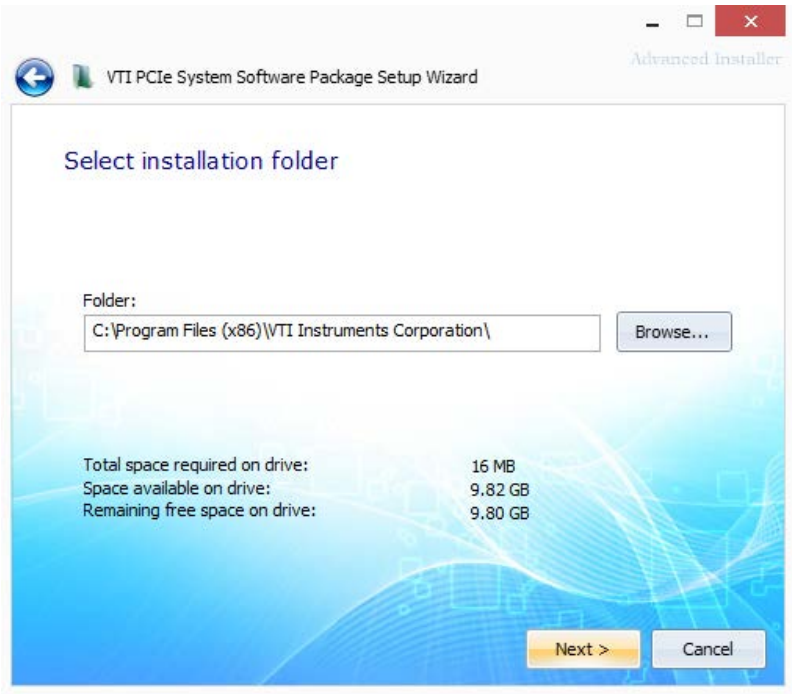

Figure 7-4: Installation Folder

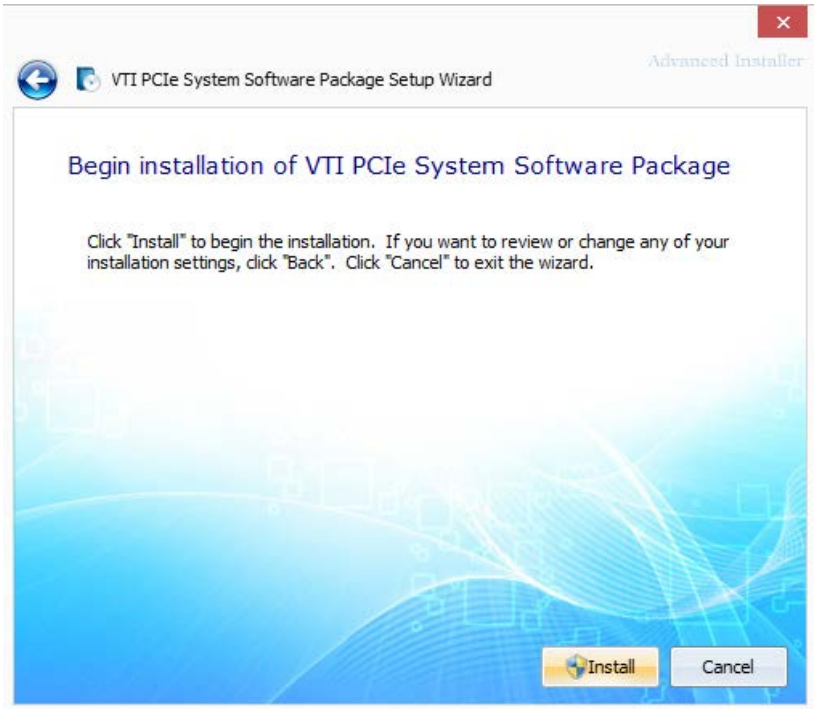

Figure 7-5: Begin Installation

2. After the installation is complete, right-click on the start button and select device manager.

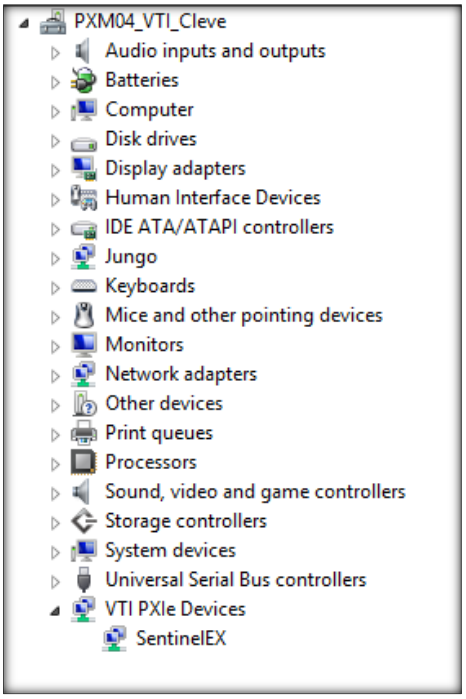

Figure 7-6: Select Device Manager

3. Check that “SentinelEX” shows up under VTI PXIe Devices.

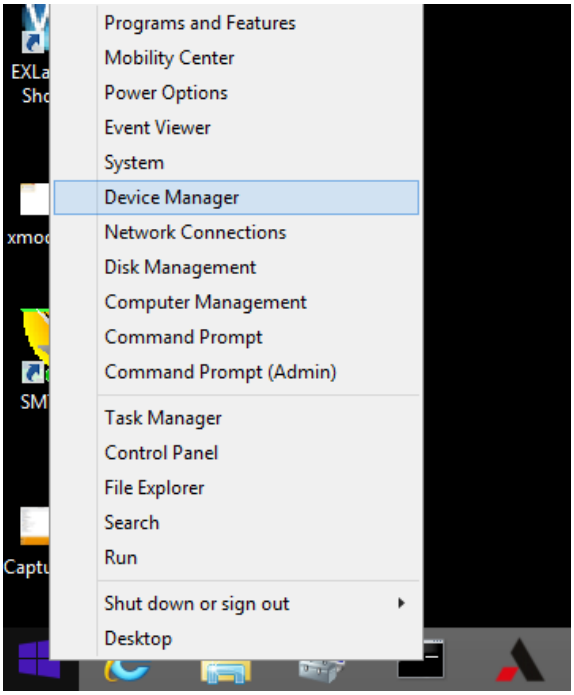

Figure 7-7: Confirm SentinelEX Under VTI PXIe Devices

4. Open a browser such a Mozilla Firefox or Google Chrome and enter “127.0.0.1” to see the list of VTI Instrument EMX-4x50 card(s) plugged into the PMX04.

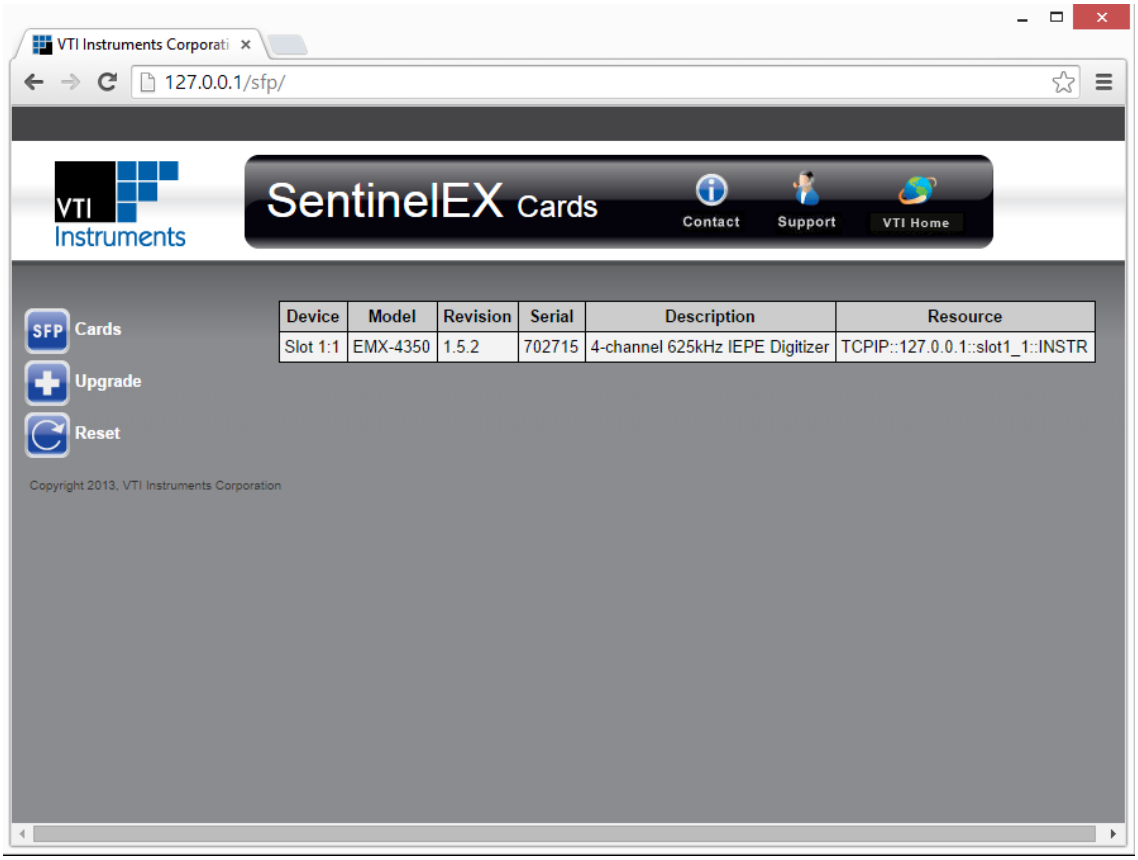

Figure 7-8: Access the Soft Front Panel via Browser

SECTION 8

MAINTENANCE AND TROUBLESHOOTING

If unexpected failures occur while operating the PMX04, please refer to table 8-1 below for possible corrective actions. If the problem persists, please contact VTI technical support for assistance.

No.	Problem	Cause	Action
1	No display or abnormal display on LCD screen	Wrong LVDS port setting in BIOS setup	Reboot the PMX04 and enter BIOS setup screen, then select **Configuration→Intergrated Video Configuration→Active Local Flat Panel [Integrated LVDS]** and **IGD-LVDS Color Depth[18 bit]** successively.
		Too high resolution or refresh rate setting	Adjust resolution to **1366×768** and refresh rate to **60**Hz.
2	Network port unable to communicate normally	Wrong LAN port setting in BIOS setup	Reboot the PMX04 and enter BIOS setup screen, then select **Configuration→LAN Configuration→Onboard LAN [Enabled]** successively.
		Network cable damaged	Replace network cable
		IP address setting incorrect	Adjust to correct IP address according to the actual condition
3	USB port not recognized	Wrong USB port setting in BIOS setup	Reboot the PMX04 and enter BIOS setup screen, then select **Configuration→USB Configuration→USB Port 0~7 [Enabled]** successively.

4	Device will turn on upon power is connected.	Wrong parameter setting in BIOS setup	Reboot the PMX04 and enter BIOS setup screen, then select **Configuration→Power Control Configuration→After Power Failure [Remain off]** successively.
5	System time unable to be saved, always restore factory time	Lithium battery runs out	Contact qualified technician for replacing BIOS battery.
6	Module not recognized	PCIe link not enabled in BIOS setup	Reboot the PMX04 and enter BIOS setup screen, then select **Configuration→PCIe Expansion Slot Configuration→PCI Express Port [Enabled]** successively.
		Driver not installed	Install the driver of the corresponding module correctly.
7	Module cannot be inserted into the corresponding slot successfully.	Non-standard PXI-H or PXIe module is used.	Only 32-bit, instead of 64-bit, PXI bus module and PXIe bus module are supported.
		The pins on the rear panel inside the tablet device are bent.	Contact VTI for repair information.

Figure 8-1: Maintenance and Trouble Shooting

ITEMS AND CONTENTS FOR MAINTENANCE

- Peripheral slots of the PMX04 are only applicable for 3U sized PXI-H/PXIe modules;
- **None of the slots in the PMX04 support hot swapping. Be sure not to unplug or plug modules with the power on.**

MAINTENANCE PERIOD

When the device will not be used for a long period of time, it should be powered on and checked every 6 months to prevent dry failure of components like the electrolytic capacitor. To do so, insert a functional PXI module into a slot. With power on, open up the module soft front panel and confirm that the instrument is operating as expected.

PRECAUTIONS

If any circuit failure occurs during the process of using the PMX04, do not repair on your own, instead, contact VTI Instruments for repair.

SECTION 9

TRANSPORTATION AND STORAGE

TRANSPORTATION

- Transportation condition:
  - Environment temperature: -20°C ~ +70°C
  - Relative humidity: 10% ~ 90%

STORAGE

- The device should be used and stored under the environment specified in chapter 1 of this user manual.
- Heavy pressure or violent vibration should be avoided during storage or transportation.
- The device should be handled with care to avoid mechanical damage caused by impact.

SECTION 10

GP5MX1513F1 GPS RECEIVER MODULE

ABOUT THE MODULE

The GP5MX1513F1 Module features a high sensitivity, low power, fast capturing satellite. The GPS module is powered by a Sony 800 SM chipset which provides greater sensitivity and performance. This module is capable of receiving GPS signals in environments such as canyons and dense forests.

FEATURES

- Support for 64-channel GPS.
- Ultra low power consumption 45mW
- Ultra high sensitivity to -170dBm
- 1uA backup current
- Fast TTFF at low signal levels
- Capable of SBAS (WAAS, EGNOS, MSAS)
- 3 GPIO available
- Built-in LNA and SAW filter
- Small form factor – 15 x 13 x 2.4 mm
- SMD type with stamp holes; RoHS compliant

APPLICATIONS

- Personal positioning and navigation
- Automotive navigation
- Marine navigation
- Geography measure
- Speed measure
- Logistics management

GPS RECEIVER KEY PARAMETERS

GP5MX1513F1 Key Parameters		
Chip Module		Sony chipset 800SM
Frequency		L1 1575.42MHz, C/A code
Channels		64
Update rate		1Hz
Sensitivity		Tracking -170dBm
		Capture -152dBm
Acquisition Time		Hot start (Open Sky) < 1s
		Hot start (Indoor) < 15s
		Cold Start (Open Sky) 32s (static)
Position Accuracy		Autonomous < 2m (2D RMS)
		SBAS < 1m (2D RMS)
Max. Altitude		< 18,000 m
Max. Velocity		< 1,800 km/h
Protocol Support	NMEA 0183 V3. 0	NMEA 0183 V3.0, 4800 bps, 8 data bits, no parity, 1 stop bits (default), 1Hz: GGA, GLL, GSA, RMC, VTG 0.2Hz: GSV (1Hz GSV at 9600bps)

Figure 10-1: GPS Receiver Parameters

NMEA OUTPUT MESSAGE

GP5MX1513F1 supported NMEA format data output. NOTE: For more information on the NMEA Standard please refer to the **NMEA0183 Standard For Interfacing Marine Electronic Devices.**

NMEA PROTOCOL FRAME

$	<Address>	{,<value>}	*<checksum>	<CR><LF>

Figure 10-2: Protocol Frame

NMEA PROTOCOL RECORD

NMEA Record	Description
GGA	GPS fix data
GLL	Geographic
GSA	GNSS DOP and active satellite
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed
GRS	GNSS range residuals
GST	GNSS range residuals
ZDA	Time & Data
TXT	Text Transmission

Figure 10-3: NMEA Protocol Record

NOTE: The GP5MX1513F1 receiving module supports all NMEA data formats including: GGA, GLL, GSA, GSV, RMC, and VTG. For details about these data formats please refer to Appendix I.

PROPRIETARY NMEA INPUT MESSAGE

MESSAGE PARAMETERS

Start Sequence	Payload	Checksum	End Sequence
$PSRF<MID>	Data	*CKSUM	<CR><LF>

Figure 10-4: Message Parameters

- Message Identifier consisting of three numeric characters. Input messages begin at MID 100.
- Message specific data.
- CKSUM is a two-hex character checksum as defined in the NMEA specification **NMEA-0183 Standard for Interfacing Marine Electronic Devices.** Use of checksums is required on all input messages.
- Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings but must be sent to terminate the message and cause the receiver to process that input message.

Note: All fields in all proprietary NMEA messages are required, none are optional. All NMEA message are comma delimited.

Proprietary NMEA Input Messages

Message	MID1	Description
Set SerialPort	100	Set PORT A parameters and protocol
Navigation Initialization	101	Parameters required for start using X/Y/Z2
SetDGPSPort	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt3
Development Data On/Off	105	Development Data messages On/Off
Select Datum	106	Selection of datum to be used for coordinate transformations

Figure 10-5: NMEA Input Messages

Table 10-5 – Proprietary NMEA Input Messages

- MID: Message Identification
- 101: Input coordinates must be WGS84
- 104: Input coordinates must be WGS84

Note: The details about Proprietary NMEA input messages can be found in the GP5MX1513F1 Appendix II.

SECTION 11

GP5MX1513F1 APPENDIX I: DETAILS OF NMEA OUTPUT MESSAGES

CGA-GLOBAL POSITIONING SYSTEM FIXED DATA

Table 11-1 contains the values for the following example:
$GPGGA,053740.000,2503.6319,N,12136.0099,E,1,08,1.1,63.8,M,15.2,M,0000*64

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	53740		Hhmmss.sss
Latitude	2503.6319		Ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12136.01		Dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table I-1-2
Satellites Used	08		Range 0 to 12
HDOP	1,1		Horizontal Dilution of Precision
MSL Altitude	63.8	mters	
Units	M	mters	
Geoid Separation	15.2	mters	
Units	M	mters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0		
Checksum	*64		
<CR><LF>			End of message termination

Figure 11-1: Global Positioning System Fixed Data

POSITION FIX INDICATORS

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3 5	Not Supported
6	Dead Reckoning Mode, fix valid

Figure 11-2: Position Fixed Indicators

GLL - GEOGRAPHIC POSITION – LATITUDE/LONGITUDE

Table 11-3 contains the values for the following example:
$GPGLL,2503.6319,N,12136.0099,E,053740.000,A,A*52

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	2503.6319		Ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12136.01		Dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	53740		Hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*52		
<CR><LF>			End of message termination

Figure 11-3: Geographic Position – Latitude/Longitude

GSA-GNSS DOP AND ACTIVE SATELLITES

Table 11-4 contains the values for the following example:
$GPGSA,A,3,24,07,17,11,28,08,20,04,,,,,2.0,1.1,1.7*35

Name	Example	Description
Message ID	$GPGSA	GSA protocol header
Mode 1	A	See Table 11.d
Mode 2	3	See Table 11.e
ID of satellite used	24	Sv on Channel 1
ID of satellite used	07	Sv on Channel 2

…..		…..
ID of satellite used		Sv on Channel 12
PDOP	2	Position Dilution of Precision
HDOP	1.1	Horizontal Dilution of Precision
VDOP	1.7	Vertical Dilution of Precision
Checksum	*35	
<CR><LF>		End of message termination

Figure 11-4: GNSS DOP And Active Satellite Examples

Value	Description
M	Manual – forced to operate in 2D or 3D mode
A	Automatic – allowed to automatically switch 2D/3D

Figure 11-5

Value	Description
1	Fix not available
2	2D
3	3D

Figure 11-6

GSV-GNSS SATELLITES IN VIEW

Table 11-7 contains the values for the following example:

$GPGSV,3,1,12,28,81,285,42,24,67,302,46,31,54,354,,20,51,077,46*73

$GPGSV,3,2,12,17,41,328,45,07,32,315,45,04,31,250,40,11,25,046,41*75

$GPGSV,3,3,12,08,22,214,38,27,08,190,16,19,05,092,33,23,04,127,*7B

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Total number of messages	3		Range 1 to 3
Message number	1		Range 1 to 3
Satellites in view	12		
Satellite ID	28		Channel 1 (Range 01 to 32)

Elevation	81	degrees	Channel 1 (range 00 to 90)
Azimuth	285	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	42	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
Satellite ID	20		Channel 4 (Range 01 to 32)
Elevation	51	degrees	Channel 4 (Range 00 to 90)
Azimuth	77	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	46	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*73		
<CR> <LF>			End of message termination

Figure 11-7: GNSS Satellites in View Examples

RMC – RECOMMENDED MINIMUM SPECIFIC GNSS DATA

Table 11-8 contains the values for the following example:

$GPRMC,053740.000,A,2503.6319,N,12136.0099,E,2.69,79.65,100106,,,A*53

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	53740		RMC protocol header
Status	A		A=data valid or V=data not valid
Latitude	2503.6319		Ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12136.01		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed over ground	2.69	knots	True
Course over ground	79.65	degrees	
Date	100106		Ddmmyy

Magnetic variation		degrees	
Variation sense			E=east or W=west (Not shown)
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*53		
<CR> <LF>			End of message termination

Figure 11-8: Recommended Minimum Specific GNSS Data Example

VTG – COURSE OVER GROUND AND GROUND SPEED

Table 11-9 contains the value for the following example:

$GPVTG,79.65,T,,M,2.69,N,5.0,K,A*38

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course over ground	79.65	degrees	Measured heading
Reference	T		True
Course over ground		Degrees	Measured heading
Reference	M		Magnetic
Speed over ground	2.69	Knots	Measured speed
Units	N		Knots
Speed over ground	5.0	Km/hr	Measured speed
Units	K		Kilometer per hour
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*38		
<CR> <LF>			End of message termination

Figure 11-9: VTG Data Format Example

SECTION 12

APPENDIX II: PROPRIETARY NMEA INPUT MESSAGE

100 – SETSERIALPORT

This command message is used to set the protocol (Sony binary or NMEA) and/or the communication parameters (Baud, data bits, stop bits, and parity). Generally, this command is used to switch the module back to Sony binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and the Evaluation Receiver restarts using the saved parameters.

Table 12-1 contains the input values for the following example:

Switch to Sony binary protocol at 9600, 8, N, 1 $PSRF100,0,9600,8,1,0*0C

Name	Example	Units	Description
Message ID	$PSRF100		PSRF100 protocol header
Protocol	0		0=Sony binary, 1=NMEA
Baud	9600		4800, 9600, 19200, 38400, 57600
DataBits	8		8,71
StopBits	1		0, 1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*0C		
<CR> <LF>			End of message termination

Figure 12-1: Set Serial Port Data Format

101 – NAVIGATIONINITIALIZATION

This command is used to initialize the Evaluation Receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the Evaluation Receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the Evaluation Receiver to acquire signals quickly.

Table 12-2 contains the input values for the following example:

Start using known position and time

$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*1C

Name	Example	Units	Description
Message ID	$PSRF101		PSRF101 protocol header
ECEF X	-2686700	Meters	X coordinate position
ECEF Y	-4304200	Meters	Y coordinate position
ECEF Z	3851624	Meters	Z coordinate position
ClkOffset	96000	Hz	Clock Offset of the Evaluation Receiver
TimeOfWeek	497260	Seconds	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See table 12-3
Checksum	*1C		
<CR> <LF>			End of message termination

Figure 12-2: Navigation Initialization Data Format

Note: Use 0 for last saved value if available. If this is unavailable, a default value of 96000 is used.

Hex	Example
0x01	Hot Start – All data valid
0x02	Warm Start – Ephemeris cleared
0x03	Warm Start (with Init) – Ephemeris cleared, initialization data loaded

0x04	Cold Start – Clears all data in memory
0x08	Clear Memory – Clears all data in memory and resets the receiver back to factory defaults

Figure 12-3: Reset Configuration

102 – SETDGPSPORT

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used that has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and the receiver restarts using the saved parameters.

Table 12-4 contains the input values for the following example:

Set DGPS Port to be 9600,8,N,1. $PSRF102,9600,8,1,0*12

Name	Example	Units	Description
Message ID	$PSRF102		PSRF102 protocol header
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8, 7
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*12		
<CR> <LF>			End of message termination

Figure 12-4: Set GPS Port Data Format

Note: RTCM is not supported.

103 – QUERY/RATE CONTROL

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

Table 12-5 contains the input values for the following example:

1. Query the GGA message with checksum enabled $PSRF103,00,01,00,01*25

2. Enable VTG message for a 1 Hz constant output with checksum enabled $PSRF103,05,00,01,01*20

3. Disable VTG message $PSRF103,05,00,00,01*21

Name	Example	Units	Description
Message ID	$PSRF103		PSRF103 protocl header
Msg	0		See Table 12-6
Mode	1		0=SetRate, 1=Query
Rate	0	Seconds	Output – off=0, max=255
CksumEnable	1		0=Disable Checksum, 1=Enable Checksum
Checksum	*25		
<CR> <LF>			End of message termination

Figure 12-5: Query/Rate Control Data Format

Value	Descriptions
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG
6	MSS (If internal beacon is supported)
7	Not Defined
8	ZDA (if 1PPS output is supported)
9	Not Defined

Figure 12-6

104 – LLANAVIGATIONINITIALIZATION

This command is used to initialize the Evaluation Receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

Table 12-7 contains the input values for the following example:

Start using known position and time.

$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1*07

Name	Example	Units	Description
Message ID	$PSRF104		PSRF104 protocol header
Lat	37.387511	Degrees	Latitude position (range 90 to -90)
Lon	-121.97232	Degrees	Longitude position (Range 180 to -180)
Alt	0	Meters	Altitude position
ClkOffset	96000	Hz	Clock Offset of the evaluation receiver
TimeOfWeek	237759	Seconds	GPS Time of Week
WeekNo	1946		Extended GPS Week Number (1024 added)
ChannelCount	12		Range 1 to 12
ResetCfg	1		See table 12-8
Checksum	*07		
<CR> <LF>			End of message termination

Figure 12-7: LLA Navigation Initialization Data Format

Note: Use 0 for last saved value if available. If this is unavailable, a default value of 96000 is used.

Hex	Example
0x01	Hot Start – All data valid

0x02	Warm Start – Ephemeris cleared
0x03	Warm Start (with Init) – Ephemeris cleared, initialization data loaded
0x04	Cold Start – Clears all data in memory
0x08	Clear Memory – Clears all data in memory and resets the receiver back to factory defaults

Figure 12-8

105 – DEVELOPMENT DATA ON/OFF

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables you to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

Table 12-9 contains the input values for the following example:

1. Debug On
   $PSRF105,1*3E
2. Debug Off
   $PSRF105,0*3F

Name	Example	Units	Description
Message ID	$PSRF105		PSRF105 protocol header
Debug	1		0=Off, 1=On
Checksum	*3E		
<CR><LF			End of message termination

Figure 12-9: Development Data On/Off Data Format

106 – SELECT DATUM

$PSGPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. The default datum is WGS 84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. (Local map datums are a best fit to the local shape of the earth and not valid worldwide.)

Table 12-10 Contains the input values for the following example:

Datum select TOKYO_MEAN

$PSRF106,178*32

Name	Example	Units	Description
Message ID	$PSRF106		PSRF106 Protocol header
Datum	178		21=WGS84
			178=TOKYO_MEAN
			179=TOKYO_JAPAN
			180=TOKYO_KOREA
			181=TOKYO_OKINAWA
Checksum	*32		
<CR> <LF>			End of message termination

Figure 12-10: Development Data On/Off Format