

PCIe Card

“Peripheral Component Interconnect (Express)”

User Manual

The **Masterclock PCIe Card** provides more accurate time referred to PCs.

PCIe-OSC - basic unit: includes an onboard oscillator

PCIe-TCR - adds a Time Code connector and reader

PCIe-GPS - adds a GPS connector and reader

PCIe-HSO - adds an onboard high-stability oscillator

Table of Contents

The **PCIe** is a circuit board (card) that provides very stable (one minute/year), accurate time and date information for a Windows PC. Software runs under 32-bit Windows XP, 7, and Server 2003/2008 SP1 and 2019 versions, all in both 32- and 64-bit.

Models include:

PCIeTCR – Time Code Reader

PCIeGPS – GPS Reader

PCIeOSC – Oscillator Only

Thank you for your purchase of a PCIe circuit board from Masterclock.

Here you'll find instructions for unpacking and installing your circuit board, including suggestions for proper care and configuration.

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We are here to help.

You can reach us using various contact methods (phone, email, etc.) found at our website: www.masterclock.com and on page 22 of this manual.

Before calling us to rectify a problem, please attempt to find the answer to your situation here. You'll find this user manual will handle virtually all of your questions.

Disclaimer

The information contained in this document is subject to change without notice. Masterclock®, Inc. (hereinafter Masterclock) makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Masterclock shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material. See important limited warranty information starting on page 19.

Introduction



PCIe-OSC card shown with standard-sized bracket

APPLICATION

The **PCIe-OSC** is a circuit board (card) that provides very stable, accurate time and date information for a Windows PC. After the initial setup, the card generates reference time from an internal oscillator. During the initial setup the PCIe card takes time from the PC.

The **PCIe-OSC** basic card generates time information to your PC that is synchronized to within 2 milliseconds/day (one minute/year) from the initial time lock and so long as power is present. Daylight savings time adjustments are automatic.

Software runs under Windows XP, 7, and Server 2003/2008 SP1 and 2019 versions, all in both 32- and 64-bit.

Each PCIe is thoroughly tested prior to shipment.

OPTIONAL UPGRADES

The **PCIe-TCR** version references time from Time Code generators.

The **PCIe-GPS** version references time from GPS satellites.

The **HSO** option increases the accuracy of unreferenced time for the standard oscillator or the two options listed above.

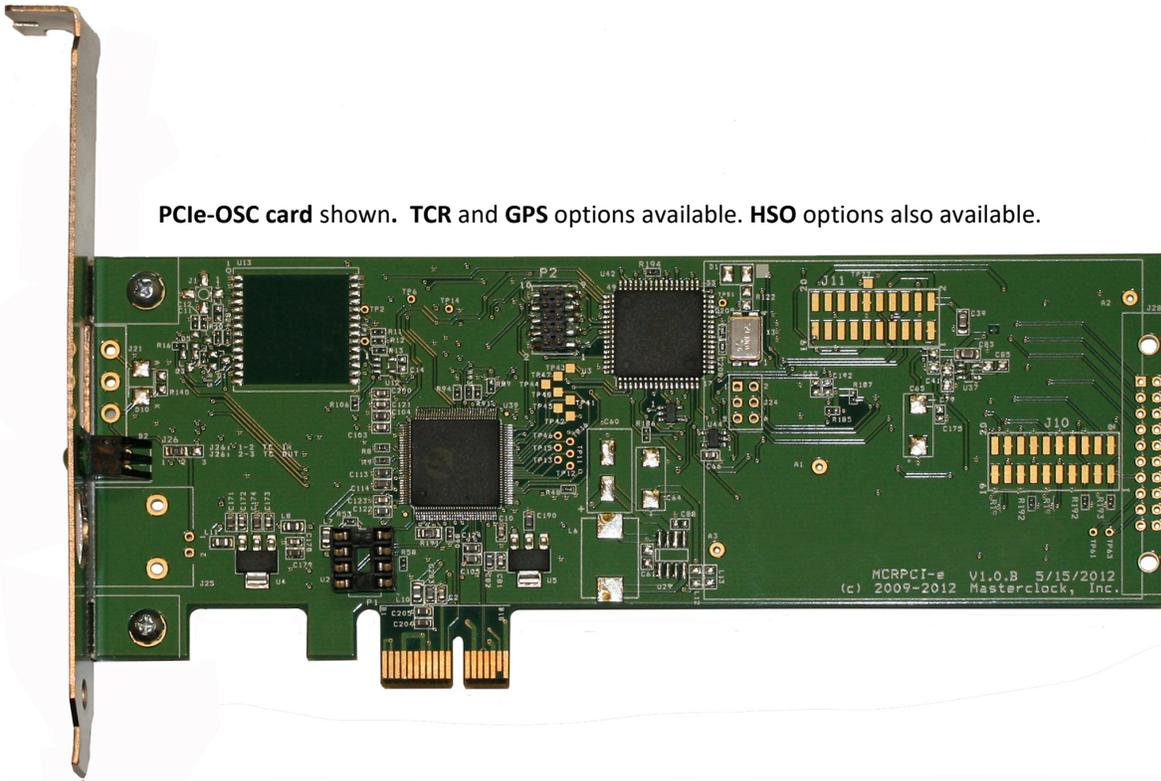
DAYLIGHT SAVINGS TIME

The PCIe provides UTC to the PC's operating system. Time zone offsets (depending on your place on the globe) and daylight savings time are handled as a standard feature of the Windows operating system to provide you with your correct local time, whether or not daylight savings time is in effect.

OPERATING ENVIRONMENT

The PCIe card is not water- or moisture-proof. Treat it as you would any other delicate electronic device and do not expose it to high humidity, excessive heat or physical abuse.

Specifications



PCIe-OSC card shown. TCR and GPS options available. HSO options also available.

SPECIFICATIONS

TIMING CHARACTERISTICS

Reference: PC (default)
Short term accuracy $\pm 10 \mu\text{s/day}$

OPERATING PARAMETERS

Temperature 0 to +60 °C

OPTIONAL TC INPUT CONNECTORS

BNC connector for unbalanced input
Three pin positive locking, right angle pin header
0.2 in (5.8mm) pin spacing for balanced input

OPTIONAL GPS INPUT CONNECTOR

SMA connector

OPTIONS

(TCR)SYNC-NTP Software
NTP Time Server Software
for use with PCIe-GPS and PCIe-TCR cards

POWER SUPPLY REQUIREMENTS

Contains its own CPU and requires only DC power from the PCIe slot.

PHYSICAL

PCIe card 1/3 slot AT/PCI card, +5VDC
Low profile card and bracket standard (full height bracket also available)
Length/height: 6.6" x 2.712" (167.6mm x 68.8mm)

FEATURES

LED status indicator
PCIe x1 Lane
Software runs as a service under 32-bit Windows XP/7/Server 2003, 2008-SP1, and 2012 versions

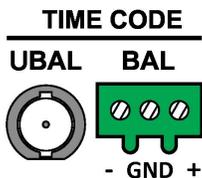
COAXIAL CABLE

Type 50 Ω low loss - RG-58A/U
(Belden 8219 or equivalent)
SMA-male connectors up to 75'/23m
50 Ω low loss –
Belden 9913 or equivalent up to 500'/152m

TCR Option



PCIe card with TCR option.
Unbalanced input.(BNC connector) on left.
Balanced input (three-pin header) on right.



Balanced input (three-pin header)

APPLICATION

The PCIe-TCR card references Time Code sources, including SMPTE: 24fps (film), EBU: 25fps, video, non-drop frame: 30fps IRIG-B0 – unmodulated/ pulse width modulated IRIG-B1 – am 1kHz . This improves the accuracy of the internal oscillator. Time Code is most often used in the broadcast and filmmaking industry.

BALANCED INPUT

Connect the Time Code input to the three-pin input connector on the rear of the card. The input is balanced, isolated from chassis ground and has an input impedance of >100K ohm.

UNBALANCED INPUT

Connect the Time Code input to the BNC coaxial connector.

INSTALLATION

Install the PCIe-TCR card into a PCe slot. The detection of Time Code, no matter the type, should be automatic. The Time Code gain level is also set automatically.

NORMAL OPERATION WITH TIME CODE

After acquisition of an incoming Time Code reference signal your PCIe will flash once per second while communicating time information to your PC.

ACCEPTED TIME CODE FORMATS

SMPTE: 24fps (film), EBU: 25fps, Video, Non-Drop Frame: 30fps

IRIG-B0 – unmodulated/pulse width modulated

IRIG-B1 – amplitude modulated 1kHz

GPS Option



APPLICATION

The PCIe-GPS card receives reference time from atomic clocks orbiting in GPS (Global Positioning System) satellites. This greatly improves the accuracy of the PCIe card and your PC. This unit requires a pre-amplified GPS antenna (included) that must be connected to the antenna coaxial cable and to the PC card bracket. Each PCIe-GPS is thoroughly tested with its external antenna prior to shipment.

NORMAL OPERATION WITH GPS

After acquisition of an incoming GPS reference signal your PCIe will flash once per second while communicating time information to your PC.

ANTENNA LOCATION

The GPS antenna needs to be located where it has a 180° unobstructed view of the southern sky (in northern areas and vice versa south of the equator). If placing the antenna next to a window doesn't work, the best antenna placement is on the roof or elsewhere on the outside of the building. With some applications mounting may work, but is not recommended.

If a longer cable is required, lengths up to 500 feet with pre-amplified antennas are available from Masterclock.

INITIAL OPERATIONS AND I/O CONNECTIONS

1. Do not move the antenna until after the PCIe-GPS has initiated operation (explained below).
2. As the unit acquires the GPS satellites the LED near the connector will freewheel until the GPS signal is locked.
3. When the **PCIe-GPS** is initially powered up, the time to “first fix” (to acquire at least three GPS satellites and extract correct time) typically runs from five to fifteen minutes, but could take up to 25 minutes. Atmospheric conditions, antenna type, antenna location and antenna cable length may affect reception.
4. After satellite acquisition the PCIe-GPS will begin generating time information and the card LED will flash once per second.



PCIe card with GPS option



Above: Basic Antenna
Included with GPS option.
Below: Standard antenna and
PVC pole.



PRE-AMPLIFIED ANTENNA

The PCIe-GPS card requires a pre-amplified antenna. The antenna provides 5 VDC via the center pin of the coaxial for remote power.

Warning: Attaching a passive (non pre-amplified) antenna to the PCIe-GPS could destroy the GPS receiver module. This is a major repair cost, which is not covered by warranty.

The unit is tested and shipped with the appropriate cable for the antenna that was ordered. Should you require a longer antenna cable we recommend that you contact Masterclock so that a properly matched cable and antenna can be supplied.

Although changing the GPS antenna or coaxial cable is not technically difficult, these changes are strictly the user's responsibility. We neither warrant nor support operation with any hardware not supplied by us.

ANTENNA COAXIAL CABLE CARE

The coaxial cable should not be crushed, crimped or bent at a sharp angle nor should it be strained by pulling. Any damage to the cable could result in the PCIe-GPS not functioning properly. If ¼" cable is to be coiled for storage, the coil diameter should be at least 6". Coil ½" cable with a diameter of 12."

WHENEVER GPS TIME IS NOT AVAILABLE

The PCIe-GPS will generate its own time from an on-board oscillator that runs on a backup battery in the absence of power. Loss of signal may occur during heavy cloud formations that occur during storms. Loss of power often coincides with large storms due to wind damage.

The PCIe-GPS navigation module maintains startup data whenever the PC is powered down. If the number of GPS satellites has not changed significantly while powered down, the PCIe-GPS tends to start up much faster as the sky clears.

The HSO Option



Masterclock's **PCIe-HSO (High Stability Oscillator)** is an add-on module option for master clock reference devices. It provides precision time and frequency for a wide range of applications. Affordable price and flexible order options make this a popular add-on for meeting critical time keeping during holdover (loss of primary reference such as GPS). It is ideal for specialized applications requiring a precise frequency reference.

This crystal oscillator option maintains excellent holdover stability up to **1 microsecond/day** using an OCVCXO.

Left: The HSO unit installed on a PCIe card.

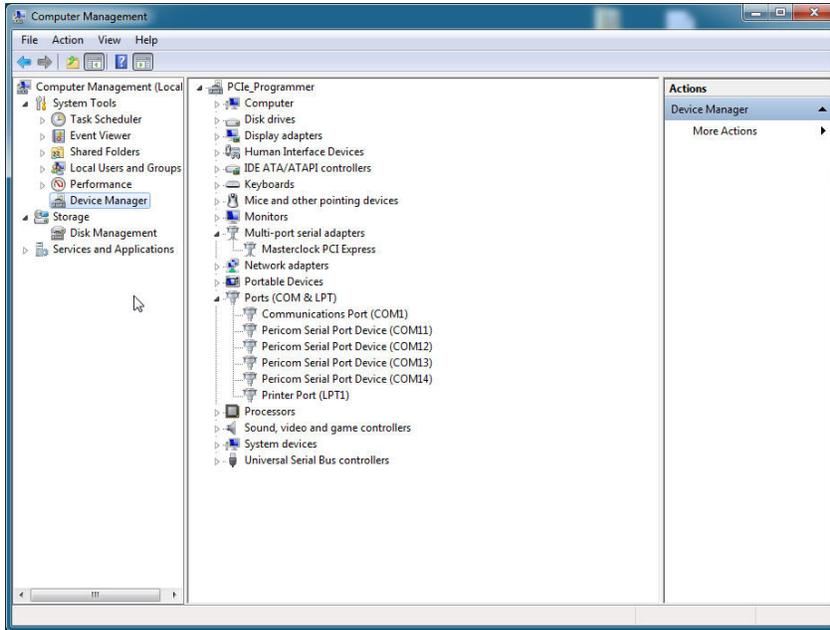
Freq = 10.000000 Mhz	1	2
Oscillator Type	TCXO	OCXO
Level (dBm) @ 50Ohms	7dBm ±2dBm	7dBm ±1dBm
Freq Stability - Aging /day	TBD	(1x10E-9)
Freq Stability - Aging/year	±1 ppm/year (1x10E-6)	±0.3 ppm/year (3x10E-7)
Short Term Stability (Allan Variance) 1 sec gate	TBD	≤ 1.0 e ⁻¹⁰
Time Drift per Year (max)	±3 sec	±0.3 sec
Optional Outputs – (10 MHz Output Option)	1 (clipped sine wave)	1 Sine wave
Phase Noise (dBc/Hz) @ 10MHz	1Hz	NA
	10Hz	NA
	100Hz	NA
	1kHz	NA
	10kHz	NA
		<-85dBc/Hz
		<-115dBc/Hz
		<-140dBc/Hz
		<-150dBc/Hz
		<-155dBc/Hz

Note 1 – Frequency and time stability are quoted for wide range of ambient temp. With constant temp the time stability will be better than 1 ms per year.

Installation and Configuration

INSTALL THE CARD

Install the PCIe card into a PCIe slot. Choose the size of bracket (standard or low profile) that fits your PC.



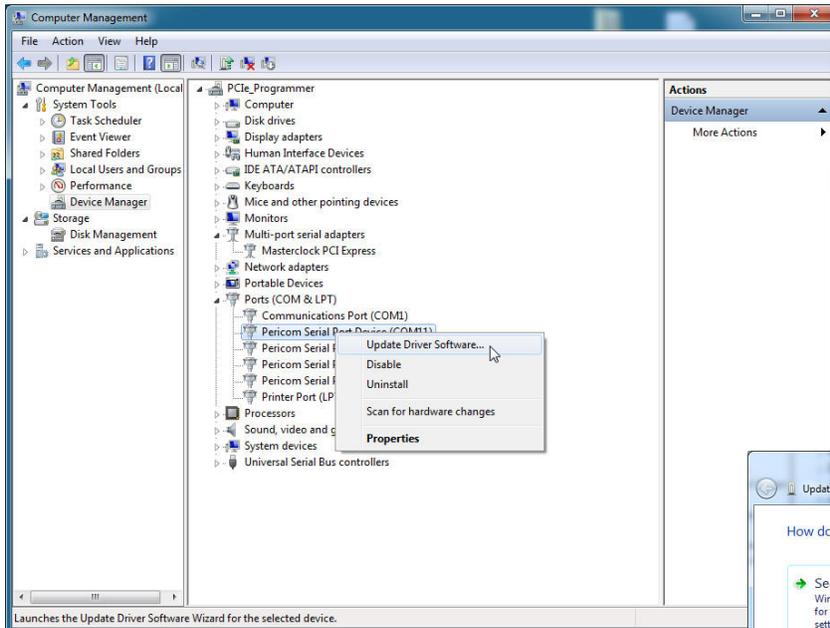
INSERT THE CD

Insert the included CD.

OPEN DEVICE MANAGER

Verify the PCIe card is showing up in two locations:

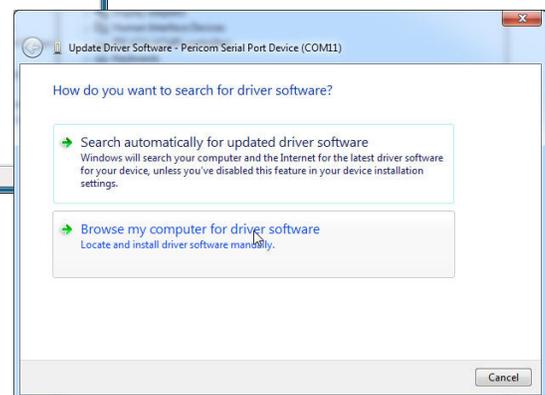
- Multi-port Serial Adapters
- Ports (COM & LPT)

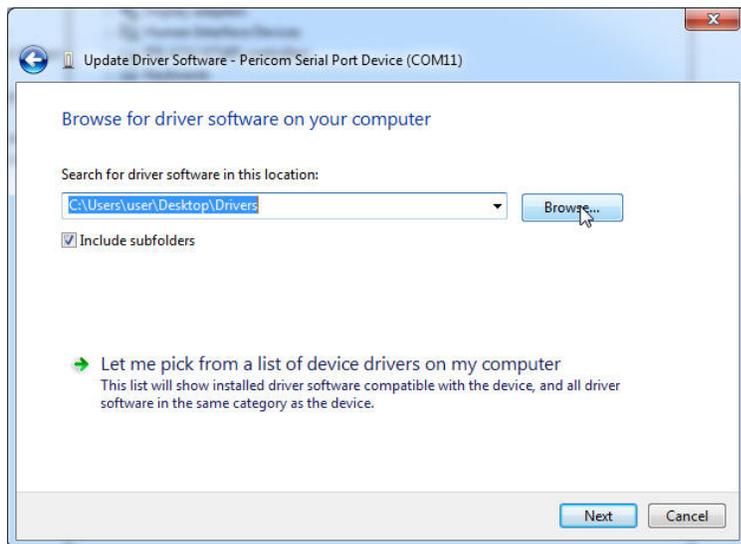


UPDATE DRIVERS

Right click on Pericom Serial Port Device and click [Update Driver Software]

Select either manually search or automatically search for correct drivers via Windows pop-up.

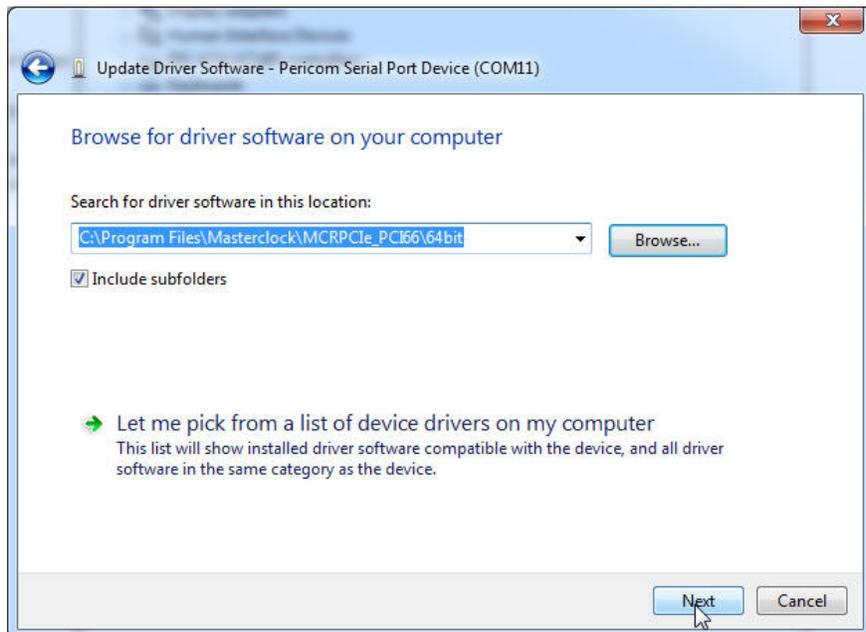
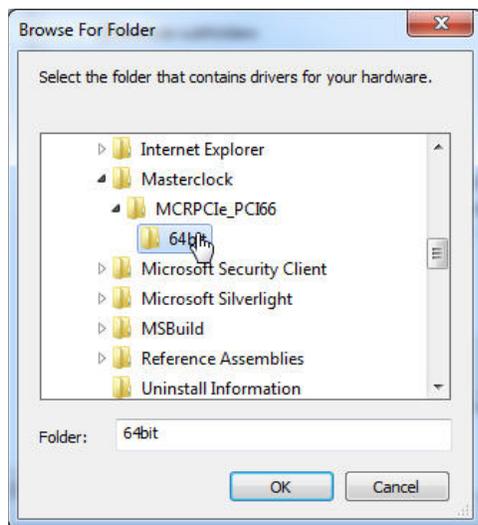


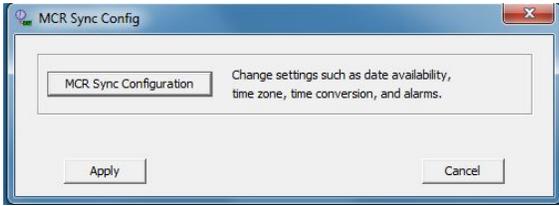


SEARCH FOR DRIVERS MANUALLY

If manually searching for drivers, click on "Browse" and select MCRPCIe_PCI66, 32 bit or 64 bit, depending on your operating system.

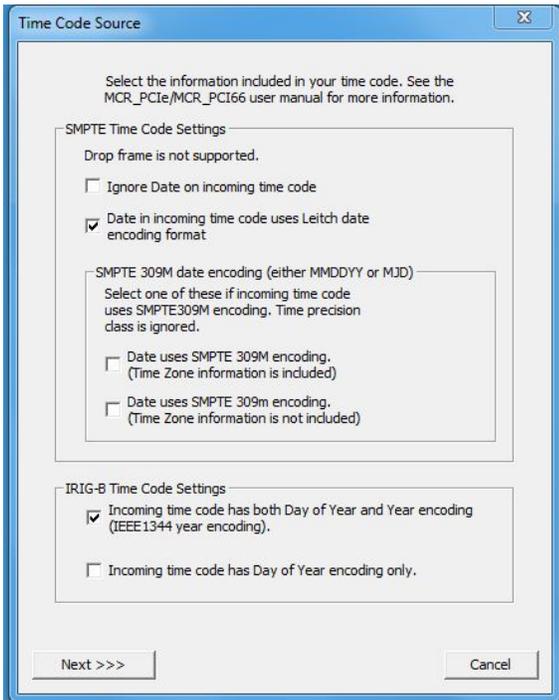
Once correct file is selected click [OK] and select [Next].





THE MCR SYNC CONFIG WINDOW

Once the drivers are updated, click on the MCRSync executable file and follow the directions to download the MCRSync software. Click the [MCR Sync Configuration] button to initiate the process. This can be found in the Masterclock folder created by the installer.

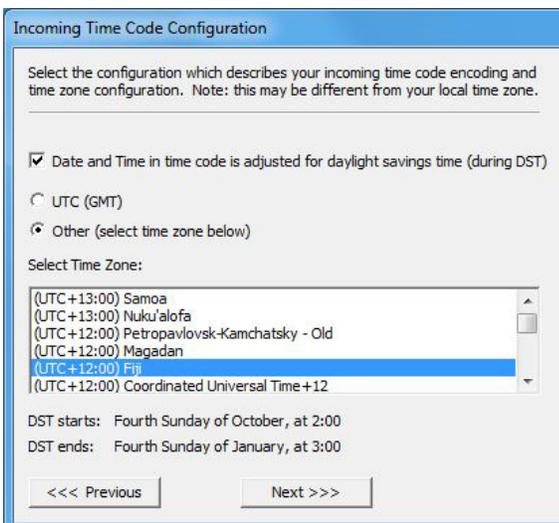


TIME CODE SOURCE WINDOW

In the SMPTE Time Code Settings box select your choice of options, following the onscreen instructions. Do the same with the IRIG-B Time Code Settings Box.

Then click [Next]

(SMPTE and IRIG adjustments apply only to the PCIe TCR Time Code Reader.)



INCOMING TIME CODE CONFIGURATION WINDOW

Select "UTC" or "Other" to manually set the time zone.

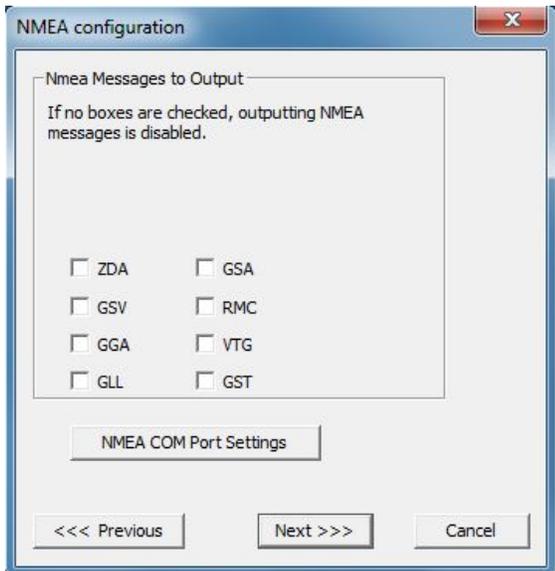
Then click [Next]



ADDITIONAL TIME CODE OPTIONS

Decide whether or not to allow Pop-up notifications.

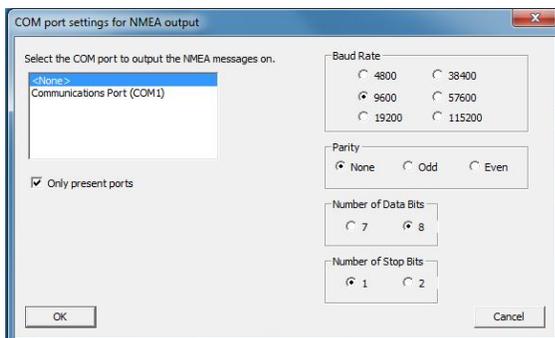
Then click [Next].



NMEA CONFIGURATION WINDOW

Decide which NMEA messages you will enable, if any and adjust your [NMEA COM Port Settings] by clicking the [NMEA COM Port Settings] button.

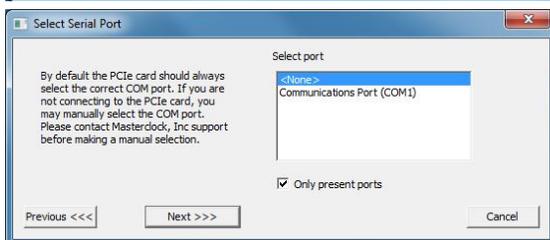
*NMEA messages are available only through a GPS receiver using the PCIE-GPS model.



COM PORT SETTINGS FOR NMEA OUTPUT WINDOW

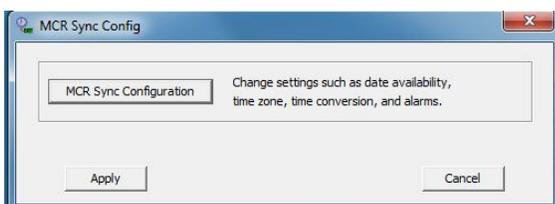
Select your COM ports, Baud rates and other details. When satisfied, click [OK].

Then, back on the NMEA configuration window click [Next].



SELECT SERIAL PORT WINDOW

Follow the onscreen instructions, then click [Next].



This window disappears and you are reverted back to the main MCRSync configuration window. Click [APPLY] to save all changes.

INITIAL TIME SET

When the PCIe is initially powered up, the time to acquire local time from your PC is typically just a few seconds. This all occurs during initial bootup of the operating system.

Whenever the PC is powered down the PCIe maintains time data. An onboard battery powers the oscillator for correct time, but only for the lifetime of the battery, typically 2-4 weeks. During that time the installed oscillator retains a one minute/year accuracy rate.

NORMAL OPERATION

For an oscillator-only card, the PCI card will flash twice/second while generating time information to your PC.

NORMAL OPERATION WITH OPTIONAL UPGRADES

After acquisition of an incoming time reference signal (GPS or TC) your PCIe will flash once per second while generating time information to your PC. Often the back of the computer tower is not visible to the operator. If so check this before putting the computer tower into its place or refer to the MCR monitor software.

POWER OUTAGE AND FREEWHEELING

During continuous operation it is likely that your PCIe will experience unavoidable power outages that can last from a few seconds to several hours. When the power reappears the unit will automatically recover.

Freewheeling is an operational state in which there is no syncing source (i.e. GPS or Time Code). Any time a GPS or Time Code reference is dropped or lost timing is maintained by an oscillator.

The transition to and from freewheeling mode is seamless - it does not interrupt time information output.

EXTERNAL INTERNAL API/DLL FOR NMEA

Unlike the earlier GPSPCI card, the PCIe card does not have an onboard DB9. Most PCs today don't have an output serial port.

The monitoring port requires a null modem RS-232 [or RS-485] cable along with the following externally or internally configurable COMport settings:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

This function allows external devices connected via the DB9 connector to operate in a listen only mode to broadcast NMEA messages from the GPS receiver.

This monitor function is always enabled at 9600 Baud

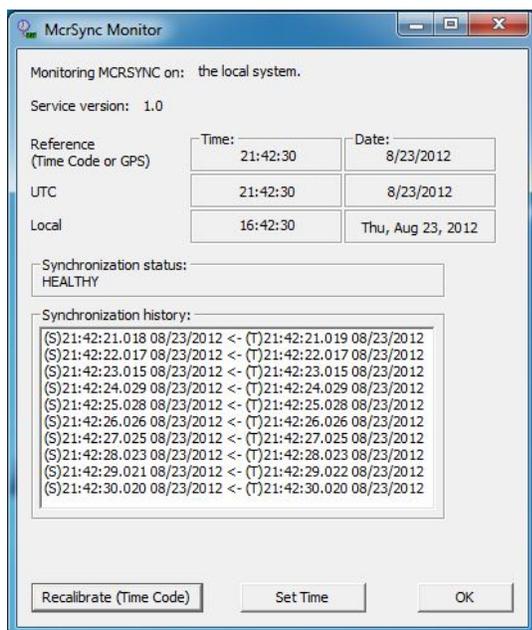
(Note: most GPS receivers support a native Baud rate of 4800).

Monitoring uses a simple terminal monitor application such as Windows *Hyperterminal* or by writing a custom serial port monitoring application. See *Hyperterminal* sample below.

In addition, the GPS receiver PPS (pulse per second) is available on pin 1 of the DB9 for synchronizing the data.

- **Note:** This version of the PCB, V1.2, no longer supports full RS232 communications, or the PCIe-GPS RS-232 protocol specification. Only native NMEA output messages from the GPS receiver are available. GPS module configuration can no longer be performed via the RS232 interface.

Monitoring Input



MCRSYNC MONITOR ACCESS

When you want to access your MCRSync Monitor, you'll find it on the ALL PROGRAMS menu in the Masterclock folder.

MCRSYNC MONITOR WINDOW

Here you'll find streaming data on reference, UTC, local time and date. You'll be alerted to any synchronization problems. The status window at left indicates "HEALTHY." A synchronization history includes streaming updates. The reference blocks shown (at left) will have active information when locked to a time source, either GPS or Time Code.

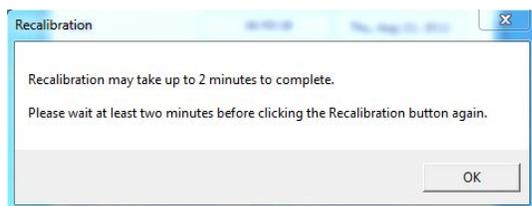
At the bottom buttons allow you to recalibrate the window by clicking the [Recalibrate (Time Code)] button.

You may manually set time by clicking [Set Time].

When finished, click [OK].

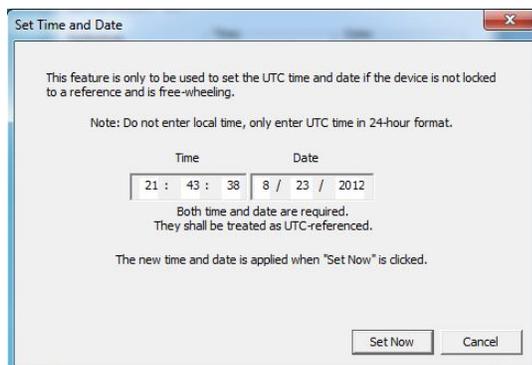
PCIE-OSC USERS:

The OSC card is not synced to TCR or GPS, therefore the synchronization status will always appear: "UNHEALTHY." That is perfectly normal.



RECALIBRATION WINDOW

When you click the [Recalibrate (Time Code)] button on the MCRSync Monitor window, the window at left will appear. Recalibration is automatic, but please be patient and wait the entire two minutes before hitting the recalibration button again. You may click the [OK] button immediately. While the unit is recalibrating and waiting for new sync data, the status may momentarily indicate "UNHEALTHY" until sync is reestablished. This is perfectly normal.



SET TIME AND DATE WINDOW FOR PCIE-OSC USERS

If you clicked the [Set Time] button on the MCRSync Monitor window (above), then the window at left will appear. This window is for owners of the PCIe-OSC card, who need to manually set their initial UTC time using this window. Thereafter the internal oscillating crystal to maintain correct time.

Troubleshooting Tips

GPS LOCK ISSUES

- Wait at least 20-30 minutes if installing the GPS receiver device in a new location. The GPS receiver must find and acquire the signal from at least 4 GPS satellites simultaneously, and will continue to acquire up to the eight satellites. When placed in a new location, time to first lock will vary, but can be quite lengthy since the GPS receiver must update its internal almanac and ephemeris data from the GPS satellites.
- Check the GPS antenna, antenna cable, and connectors. Make sure the cables and connectors are not damaged and the threaded connectors are tightly coupled.
- If you have not already done so, install or locate the GPS antenna outdoors with a clear/unobstructed view of the sky. Preferably on a rooftop or similar location such as a large open field or parking lot with an unobstructed view. While the unit may lock to GPS on some occasions with the antenna located indoors in a window, such use is not recommended.
- Locate your GPS antenna away from satellite dishes or sources of RF interference such as transmitters or other antennas. Try relocating your GPS antenna if you are experiencing problems.
- Your antenna/antenna cable installation may be faulty. Your antenna cable or connectors may be shorted or open.
- You may be using too long have an antenna cable or improper impedance cable.
- You may have damaged the cable(s) or connector(s) during installation. If your cables have been damaged during installation, please order an additional cable set or contact technical support at Masterclock to have the cable(s) repaired.
- The GPS antenna cables may be damaged by pulling/twisting of the connectors or by pinching/over bending the cables, such as while pulling the cables with a cable puller or other method. Pull and route the antenna cables carefully. Ensure that you do not pull directly on the connectors during the installation. Ensure that you do not twist the connector at the location where the connector meets the cable, as this can damage the braid. If the GPS antenna cables are damaged please contact Masterclock, Inc. to order a replacement.

Masterclock highly recommends using only the pre-made/pre-tested antenna cables provided by Masterclock, Inc. The use of customized/altered or customer provided cables are not covered under warranty or under the free limited technical support by Masterclock.

TIME CODE DECODING ISSUES

The easiest way to verify that the TCR is decoding time code is to observe the status of the LED on the card itself. The LED will blink once per second when the TCR is properly decoding time code. If the LED is not lit, or is flashing intermittently, then there is a problem with the time code signal.

Alternately, if drivers and software are installed, the MCRSync utility is a useful diagnostic tool for observing the status of time code calibration and decoding. The MCRSync utility will indicate “Calibration in progress” when the card has not received a valid time code signal since the last reboot/power cycle. “Unhealthy signal” is indicated when the card was able detect time code, but has since lost the signal.

Time code decoding problems can include any of the following:

- no time code present
- ground loops or other interference
- bad/intermittent cables, wiring, or connectors
- a signal level that is out of range (too high or too low)
- a signal level that is fluctuating
- a time code type that the PCIe-TCR does not support

Before concluding that there is a physical problem with time code decoding on the TCR, please rule out all of the above possibilities.

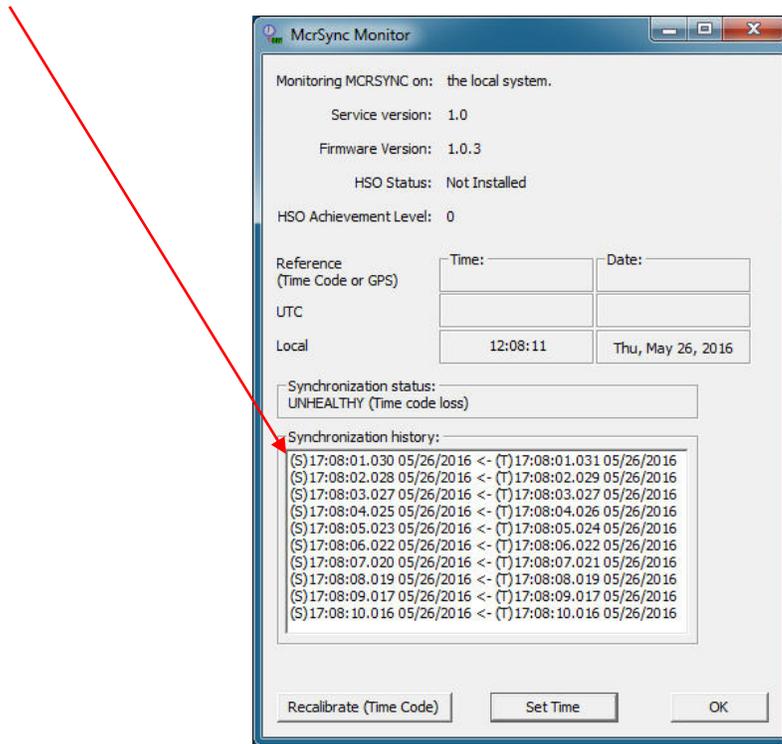
MCRSYNC CONFIGURATION TOOL ISSUES

In the dialog box where we need to select the COM port, how do we know which COM port is the right one?
The computer scans the COM ports and determines which ports will be used. There is no way to predict which port will be assigned.

What is the meaning of S and T in the Synchronization history?

S stands for “system time”

T stands for “time from PCIe card”



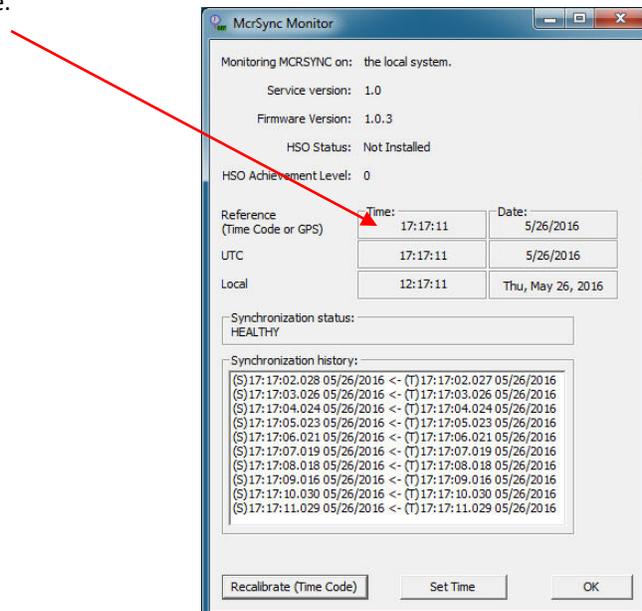
17

We see a large difference between S and T. Is this normal?

No. With the service running correctly, the S & T time should be very close to each other.

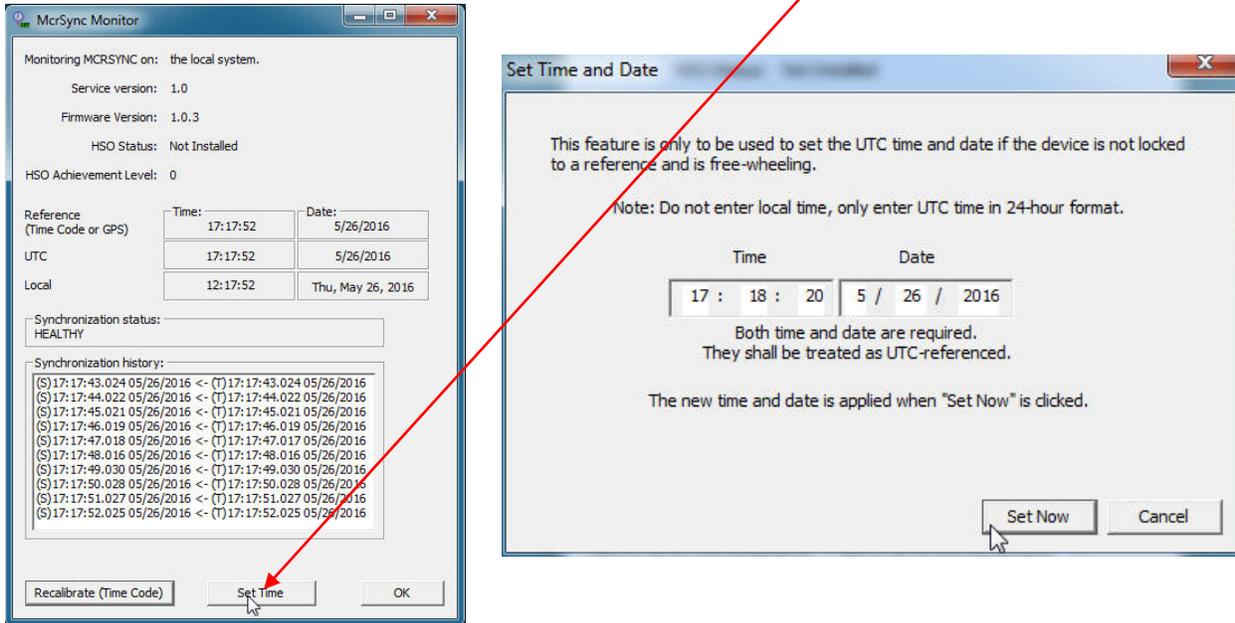
Where can we find the current time of the clock card?

The current time will be displayed in the window stating Local on MCRSync Monitor software, along with the date.



How can we set the time of the clock card?

To set the card time, click on the button at the bottom of the McrSync Monitor software.



Does the tool log any changes to the system time caused by the clock card? If so, where can we find these logs?

There are no logs the PCIe cards keep. Logs will only be available if there is an error in the service. This information will be located in the Event Viewer.

Note:

- PCIe cards will not operate properly in Sleep or Hibernation mode.
- If the PCIe card is not seated properly, an incorrect Firmware Version may be displayed.

FACTORY TESTING

All PCIe units are checked for proper operation before shipment. The unit was proven to be functional at the factory. Please check for damage incurred during shipping if you believe the unit is malfunctioning.

FACTORY SUPPORT

Often an installation problem can be resolved over the telephone. Feel free to call us during office hours in the central US (see back page).

30 DAY WARRANTY

For thirty (30) days after date of delivery of the product to you, if you are dissatisfied for any reason you may return the complete product - including the software, with your receipt, to Masterclock, postage prepaid, during the thirty (30) day period for a full refund. Note that software cannot be returned without the associated hardware.

LIMITED WARRANTY

Masterclock warrants this PCIe against defects in materials and workmanship for a period of five years from the date of invoice. If Masterclock receives notice of such defects during the warranty period, Masterclock will, at its option, either repair or replace products that prove to be defective.

Should Masterclock be unable to repair or replace the product within a reasonable amount of time, the customer's alternate remedy shall be a refund of the purchase price upon return of the product to Masterclock. This warranty gives the customer specific legal rights. Other rights, which vary from state to state or province to province, may be available.

EXCLUSIONS

The above warranty shall not apply to defects resulting from improper or inadequate maintenance by the customer, customer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product or improper site preparation and maintenance (if applicable).

WARRANTY LIMITATIONS

MASTERCLOCK MAKES NO OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS PRODUCT. MASTERCLOCK SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In any state or province which does not allow the foregoing disclaimer, any implied warranty of merchantability or fitness for a particular purpose imposed by law in those states or provinces is limited to the five-year duration of the written warranty.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL MASTERCLOCK BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

In any state or province that does not allow the foregoing exclusion or limitation of incidental or consequential damages, the customer may have other remedies.

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HARDWARE SERVICE

You may return your PCIe card to Masterclock for repair service. Please contact the factory for **RETURN AUTHORIZATION** before returning the unit.



Declaration of Conformity

DoC#: PCIe-201208

Masterclock, Inc.
2484 West Clay St.
Saint Charles, MO 63301

PCIe Time Reference PC Interface Card

PCIe-xxxx

where alphanumeric xxxx indicates time reference input options,
is compliant with the CE directives and standards listed below.

Directives:

Electromagnetic Compatibility (2004/108/EC)
RoHS 2 (2011/65/EC)

Standards:

CENELEC EN 55022:2010 Class B
CENELEC EN 55024:2010 Immunity
IEC 61000-4-2:2008
IEC 61000-4-3:2006 +A1:2007, +A2:2010
IEC 61000-4-4:2004 +A1:2010
IEC 61000-4-6:2008
CENELEC EN 60950-1:2006 +A11:2009

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