

# External Time Reference Interface

## GPS 100 00

## User's Guide

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## 1.0 EXTERNAL TIME REFERENCE OVERVIEW

The External Time Reference Interface (ETR) card provides a way to synchronize multiple Sequence of Events Recorder (SER) cards to an external time reference. The card also allows the time in the PLC's time of day clock to be synchronized with an external time reference. A time offset register is also provided to allow the ETR to adjust the time for the local time zone. When used with a Global Positioning Satellite (GPS) receiver, the ETR card provides both position and velocity information.

The ETR has two synchronizing inputs, a Global Position Satellite (GPS) receiver interface and a modulated IRIG-B interface. The GPS 300 00 GPS receiver that is supported by the ETR card is an integrated module containing a GPS receiver and antenna which are mounted in a weather proof plastic housing that can be located up to 250 feet from the ETR. The GPS receiver is powered by the Quantum PLC power supply through the ETR card. The GPS receiver communicates with the ETR through a five conductor twisted pair cable using RS 232 signal levels. The GPS 100 00 series ETR, which plugs into one of the I/O slots of a Quantum controller, comes with a Modsoft custom loadable function block and a Concept IEC function block which can be used to set the time in the PLC time of day clock.

When the ETR is first powered up it will try to synchronize with a GPS receiver and then the IRIG-B signal in that order. If neither signal is present the ETR will revert to its own crystal controlled clock. When the ETR has synchronized with a GPS receiver the current time and date will be correct. Since an IRIG-B time code signal does not contain year information, when the ETR has synchronized with an IRIG-B signal, the time, day and month will be updated from the IRIG-B signal, but the year will be obtained from the current PLC time of day clock setting.

Included in the time synchronization signal that is sent to the SER cards are a time quality indication. The time quality is calculated based on the synchronization mode of the ETR. When the ETR is first turned on, the time will be based on the time of day clock in the PLC. If the ETR is unable to read a valid time from the PLC, the time quality will be "BAD" indicating that no time reference is available. If a valid time is read, then the time quality will be set to "POOR" indicating an error of greater than 50 mS. If the ETR is synchronized with either a GPS receiver or an IRIG-B signal then the time quality will be "GOOD" indicating synchronization within 1 mS. If both of these signals are lost then the ETR will continue to maintain time based on the internal crystal oscillator. When a time period has elapsed sufficient for the crystal oscillator to have drifted more than 1 mS, the time quality will change to "FAIR" indicating an error of greater than 1 mS but less than 50 mS. When a time period has elapsed sufficient for the crystal oscillator to have drifted more than 50 mS, the time quality will change to "POOR" indicating an error of greater than 50 mS.

## 2.0 HARDWARE INSTALLATION

The GPS 100 00 ETR card plugs into an I/O slot of a Quantum controller. The card communicates with the controller through six 3X input registers and three 4X output registers.

The ETR card communicates with the SER cards through an RS-485 connection, which is made through a 4-pin connector on the front of the card.

The ETR card has two synchronization sources, which can provide a time reference. The interface for the Trimble Navigation Acutime II receiver is through a 9 pin D connector and the interface for a modulated IRIG-B signal is through a SMB connector, both of which are mounted on the front of the card.

## 2.1 MODSOFT

The GPS 100 00 card is supported under Modsoft version 2.6 and later, with no modifications. For earlier versions of Modsoft, a disk is provided with each card that contains the files:

QUANTUM.SYS  
GCNFTCOP.SYS

If this disk is not available, it can be downloaded from the Monaghan Engineering web site at [www.monaghan-engineering.com](http://www.monaghan-engineering.com).

The QUANTUM.SYS file contains the help screens for all of the Quantum modules. The version that is provided with the GPS card is the standard Modsoft version 2.51 QUANTUM.SYS, with support for the GPS 100 00 card added. This file should be copied to the C:\MODSOFT\RUNTIME subdirectory.

The GCNFTCOP.SYS file contains the I/O addressing information for all of the Modicon I/O modules. The version that is provided with the GPS card is the standard Modsoft version 2.51 GCNFTCOP.SYS, with support for the GPS 100 00 card added. This file should be copied to the C:\MODSOFT\RUNTIME subdirectory.

Under some circumstances it may be necessary to add support for the GPS 100 00 card to an existing GCNFTCOP.SYS file. This can be done by adding the following lines to the existing file, following the directions in the file header.

```
GPS 100 00,yyy,0,12,06,GPS/IRIG TIME SYNC,1,L0133,1,0000,0
```

where yyy is the module order number.

## 2.2 CONCEPT

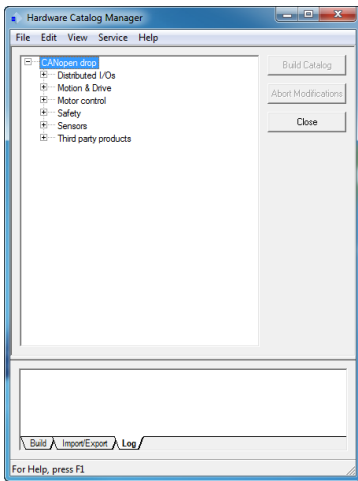
The GPS 100 00 card is supported under Concept version 2.1 and later. The GPS card configuration data must be added to the Concept database. This is done by running the MODCONN.EXE utility provided with Concept. Select the FILE command, then the Open Installation File command and then load the MNENG.MDC file that is provided on the disk supplied with the GPS card. Then exit the program, start Concept and the GPS card will be available in the module selection list.

## 2.3 UNITY

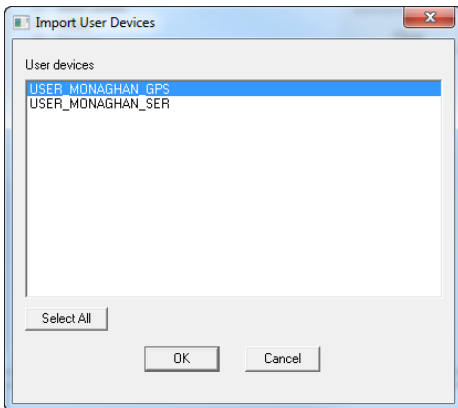
The GPS 100 00 card is supported under Unity version 2.1 and later. In Unity versions 4.0 and earlier the GPS 100 00 card is entered in the project configuration as a Generic Analog card. The following parameters should be entered into the card configuration screen.

Module Personality	307
Mapping	Word(%I-3X %M-4X)
Setting the Module	
Number of Inputs	12
984 Quantum Input Format (Simple Module)	0
984 Quantum Input Format (DPM Module)	0
Number of Outputs	6
984 Quantum Output Format (Simple Module)	0
984 Quantum Output Format (DPM Module)	0
Input Type	Binary
Input Starting Address	Enter the starting 4X address of the card. Example: 4X0001 = 1
Output Type	Binary
Output Starting Address	Enter the starting 3X address of the card. Example: 3X0001 = 1

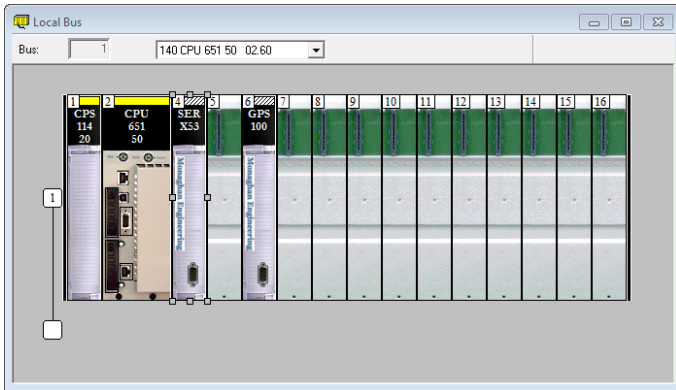
Starting with Unity 4.1, the GPS 100 00 card can be added to the Hardware Catalog. This is done by running the Hardware Catalog Manager.



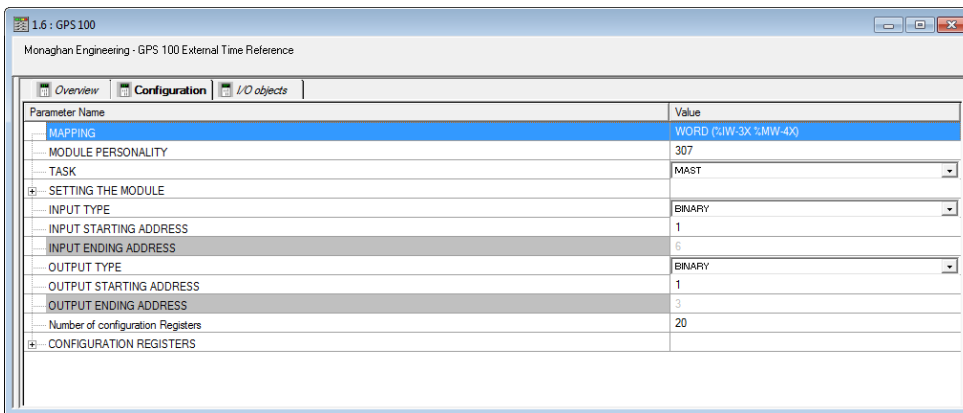
Select File and then Import User Devices. Open the USER\_MONAGHAN.cpx file.



Select USER\_MONAGHAN\_GPS and press OK. This will add the GPS 100 00 card to the Unity Hardware Catalog. When configuring the drop, the GPS 100 00 card will be shown in the rack.



Double clicking the GPS 100 00 card will bring up the configuration screen where you can enter the proper starting addresses for the card.



## 2.4 CARD OPERATION

After the card has been installed and the Traffic Cop information has been entered , the Active light should be on. The ETR has three other indicator lights, which are defined as follows:

**GPS** This light will flash when a GPS receiver is sending 1 pulse per second pulses to the ETR card and will be on steady when the GPS receiver has locked on to at least three satellites which are providing accurate time and position, and the ETR has selected the GPS signal as a time source.

**IRIG-B** This light will be on when the ETR has decoded a valid IRIG-B signal and has selected the IRIG-B signal as a time source.

**Internal** This light will be on when the ETR is using it's internal crystal as a time source.

## 2.5 SER CARD CONNECTION

In order to synchronize the time of multiple SER modules with an External Time Reference module, the RS-485 time synchronization bus must be connected between all of the modules. Wiring within a single I/O rack may be done with unshielded wire, but for long runs between I/O racks a twisted pair shielded cable must be used. The RS-485 bus connects to pins 38 - 40 of the front wiring connector on the 800 Series SER card, pin 2 - 4 of the Quantum SER card, and to pins 2 - 4 of the plug connector on the ETR card. On the GPS 100 00 card, pin 1 is located toward the bottom of the card. The wiring is as follows:

ETR	800 Series SER #1	800 Series SER #2	Quantum SER #3	Quantum SER #N	Signal Name
2	38	38	2	2	A
3	39	39	3	3	B
4	40	40	4	4	Ground

**2.6 REGISTER ASSIGNMENTS**

The GPS 100 00 contains six input registers and three output registers. The first 4 input registers and the first output register contain information that can be used directly by PLC logical functions. The last two input and output registers are used by the GPS loadable function to access internal information on the GPS 100 00 card.

**2.6.1 GPS INPUT REGISTER 1**

The first input register contains the Signal Source information from the GPS 100 00 card.

- Bit 1 – GPS receiver selected as source
- Bit 2 – IRIG-B selected as source
- Bit 3 – Reserved for future use
- Bit 4 – GPS receiver 1PPS signal present
- Bit 5 – GPS receiver time sync message present
- Bit 6 – Reserved for future use

**2.6.2 GPS INPUT REGISTER 2**

The second input register contains the current millisecond value.

**2.6.3 GPS INPUT REGISTERS 3 & 4**

The third and fourth input registers contain a 32 bit long integer, which represents the time of day in seconds since January 1, 1984.

**2.6.4 GPS INPUT REGISTERS 5 & 6**

The fifth and sixth input registers are used by the GPS loadable to access the internal registers on the GPS 100 00 card.

**2.6.5 GPS OUTPUT REGISTER 1**

The first output register is used to adjust the time to the local time zone. The output from the GPS receiver and the output from some IRIG-B time sources is set to Universal Coordinated Time (UCT). The value in this register is added to the time from either the GPS receiver or the IRIG-B signal to obtain the local time. The acceptable range of values is from -23 to +23 hours.

**2.6.6 GPS OUTPUT REGISTERS 2 & 3**

The second and third output registers are used by the GPS loadable to access the internal registers on the GPS 100 00 card.

**3.0 SOFTWARE**

Software support is provided for the GPS 100 00 card for 984 Ladder Logic programming in Modsoft, ProWORX NxT and Concept, and IEC Function Block programming in Concept. The following manuals provide detailed information on programming for the GPS 100 00:

984 Ladder Logic Function Block User's Guide  
IEC Function Block User's Guide

Publication 10011  
Publication 10012



**APPENDIX A**

**EXTERNAL TIME REFERENCE  
GPS 100 00  
I/O WIRING**

**Port 1** - 4 Position Phoenix connector - RS-485 Port

Pin	Description
1	Output driver enable (Open collector drive for fiber optic interface) (Bottom Pin)
2	RS-485 A terminal
3	RS-485 B terminal
4	RS-485 Ground (Top pin)

**Port 2** - SMB Connector for Modulated IRIG-B Time Code Signal

**Port 3** - 9 Pin D connector – GPS 300 00 Receiver

Pin	Description
1	Not Used
2	RS-232 TX Data
3	RS-232 RX Data
4	RS-232 1 Pulse per Second Input
5	Ground
6	GPS Receiver Shutdown
7	Ground
8	Not Used
9	+5 Volt - Power for receiver

**RS-485 Wiring**

In order to time sync multiple SER modules with a GPS 100 00 External Time Reference module, the RS-485 time synchronization bus must be connected between all of the modules. Wiring within a single I/O rack may be done with unshielded wire, but for long runs between I/O racks a twisted pair shielded cable must be used. The RS-485 bus connects to pins 38 - 40 of the front wiring connector on the M884/807 SER cards, pins 2, 3 & 4 of the front wiring connector on the Quantum SERx53 cards, and to pins 2, 3 & 4 of the plug connector on the GPS 100 00 card. On the GPS 100 00 card, pin 1 of the RS-485 connector is located toward the bottom of the card. The RS-485 wiring is as follows:

ETR	SER #1	SER #2	SER #3	SER #N	Signal Name
GPS 100	M884/807	M884/807	SERx53	SERx53	
2 -----	38 -----	38 -----	2 -----	2 -----	A
3 -----	39 -----	39 -----	3 -----	3 -----	B
4 -----	40 -----	40 -----	4 -----	4 -----	Ground

**APPENDIX B****EXTERNAL TIME REFERENCE  
GPS 100 00  
REGISTER ASSIGNMENTS****External Registers****3X+0 - Signal Source**

- Bit 0 – GPS receiver selected as source
- Bit 1 – IRIG-B selected as source
- Bit 2 – Reserved for future use
- Bit 3 – GPS receiver 1PPS signal present
- Bit 4 – GPS receiver time sync message present
- Bit 5 – Reserved for future use

**3X+1 - Milliseconds**

- 3X+2 – Least significant word of number of seconds since January 1, 1984
- 3X+3 – Most significant word of number of seconds since January 1, 1984
- 3X+4 – Command register for accessing internal registers
- 3X+5 – Data register for accessing internal registers

**4X+0 – Hour bias for local time zone**

- 4X+1 – Command register for accessing internal registers
- 4X+2 – Data register for accessing internal registers

**Internal Registers**

- 1 – Month
- 2 – Day
- 3 – Year
- 4 – Hour
- 5 – Minute
- 6 – Second
- 7 - GPS I/O Options
- 8 - Card Firmware Version
- 9 - GPS Status
- 10 – Number of Satellites
- 11 & 12 - Latitude Position (Single Precision)
- 13 & 14 - Longitude Position (Single Precision)
- 15 & 16 - Altitude Position (Single Precision)
- 17 & 18 – Velocity (Single Precision)
- 19 & 20 - Course (Single Precision)
- 21 & 22 – Not Used
- 23 – Time Quality
- 24 – Power On Reset Flag