



# GMR1000, GMR5000 USER MANUAL



## GMR1000

Multi-functional master clock  
Optional features shown



## GMR5000

Multi-functional master clock with rack mount  
Optional features shown

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# Table of Contents

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The **GMR1000** and **GMR5000** are high-precision time and frequency reference devices. They serve the needs of commercial establishments, industry, military and laboratory environments. NTP, GPS, NMEA, NENA, Time Code, 10 MHZ, IEEE 1588 PTP, PPS, PPO, and high-stability oscillator options are available.

**Thank you** for your purchase of a GMR precision time and frequency reference system from Masterclock.

**Here you'll find instructions** for unpacking and installing your GMR, proper care and configuration.

**We are here to help.** You can reach us using various contact methods (phone, email, etc.) found at our website: [www.masterclock.com](http://www.masterclock.com)

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

**Caution: No user-serviceable parts are inside the GMR. Please contact the factory if you require service or repair.**

|  |           |
|--|-----------|
| <b>DISCLAIMER</b> .....  | <b>3</b>  |
| <b>DATA SHEETS</b> .....                                       | <b>4</b>  |
| <b>INTRODUCTION</b> .....                                      | <b>10</b> |
| <b>STANDARD FEATURES</b> .....                                 | <b>11</b> |
| <b>OPTIONAL FEATURES</b> .....                                 | <b>12</b> |
| <b>BACK PANEL INTERFACES</b> .....                             | <b>15</b> |
| <b>CONFIGURATION OPTIONS</b> .....                             | <b>16</b> |
| <b>PASSWORD PROTECTION</b> .....                               | <b>16</b> |
| <b>UTC TIME REFERENCE</b> .....                                | <b>16</b> |
| <b>DHCP AUTO-CONFIGURATION</b> .....                           | <b>17</b> |
| <b>FACTORY DEFAULTS</b> .....                                  | <b>18</b> |
| <b>DRIVER INSTALLATION</b> .....                               | <b>19</b> |
| <b>QUICK START INSTRUCTIONS</b> .....                          | <b>20</b> |
| <b>FRONT PANEL 'LED' STATUS</b> .....                          | <b>21</b> |
| <b>WINDISCOVERY INSTALLATION AND STANDARD OPERATIONS</b> ..... | <b>22</b> |
| DEVICE SETTINGS.....   | 23        |
| NETWORK CONFIGURATION.....                                     | 24        |
| INPUT CONTROL.....   | 24        |
| OUTPUT CONTROL.....  | 29        |
| DEVICE SETTINGS > DISPLAY PROPERTIES.....                      | 33        |
| COMMUNICATIONS CONTROL.....                                    | 33        |
| DAYLIGHT SAVING TIME.....                                      | 34        |
| TIME ZONE/TIME OFFSET.....                                     | 34        |
| RELAY CONTROL.....   | 34        |
| ADMINISTRATIVE FUNCTIONS.....                                  | 35        |
| SET TIME/DATE.....   | 35        |
| SET PASSWORD.....  | 35        |
| GLOBAL PASSWORD.....   | 36        |
| RESET DEVICE.....  | 36        |
| INSTALL NEW OPTION.....  | 36        |
| LEAP SECOND DATE.....  | 36        |
| EMAIL CONFIGURATION (SMTP).....                                | 36        |
| SET TO DEFAULT CONFIGURATION.....                              | 36        |
| STATUS.....  | 37        |
| PROPERTIES.....  | 38        |
| <b>USING TELNET</b> .....                                      | <b>39</b> |
| <b>USING SSH – SECURE SHELL</b> .....                          | <b>40</b> |
| <b>TELNET AND SSH DEFAULTS</b> .....                           | <b>41</b> |
| <b>SNMP – SIMPLE NETWORK MANAGEMENT PROTOCOL</b> .....         | <b>46</b> |

|   |           |
|---|-----------|
| <b>GPS OPTION.....</b>                                | <b>47</b> |
| GPS ANTENNA LOCATION AND INSTALLATION .....           | 48        |
| GPS LOCK ISSUES AND TROUBLESHOOTING TIPS.....         | 51        |
| STREAMING GPS DATA USING PUTTY .....                  | 53        |
| <b>NMEA AND THE RS-232 INTERFACE .....</b>            | <b>54</b> |
| <b>PRECISION TIME PROTOCOL (PTP – IEEE 1588).....</b> | <b>56</b> |
| <b>TROUBLESHOOTING TIPS .....</b>                     | <b>63</b> |
| <b>WARRANTY.....</b>                                  | <b>68</b> |
| <b>DECLARATIONS OF CONFORMITY .....</b>               | <b>69</b> |
| <b>CERTIFICATES OF VOLATILITY .....</b>               | <b>71</b> |
| <b>CONTACT US .....</b>                               | <b>73</b> |

## Disclaimer

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### GPS/GLONASS SATELLITE SYSTEMS

Depending on many factors beyond the control of Masterclock, the signals that are received from the GPS satellites are subject to interference, fading, satellite failure and other influences that could cause the device to provide erroneous time and/or date information and, under some conditions, could prevent it from providing time/date information.

It is the responsibility of the user to determine the adequacy and suitability of this device for the intended use.

### TIME CODE INPUT

Depending on many factors beyond the control of Masterclock, the signals that are received from the Time Code Input Source are subject to interference, noise, loading effects and other influences such as time code format that could cause the Time Code Reader to provide erroneous time and/or date information and, under some conditions, could prevent it from providing time/date information.

It is the responsibility of the user to determine the adequacy and suitability of this device for the intended use.

### OPERATING ENVIRONMENT

#### Moisture

The GMR is not moisture-proof. It is designed for indoor use only. Treat it as you would any other delicate electronic device and do not expose it to water, high humidity excessive heat or physical abuse.

#### Static

Do not subject the unit, particularly the antenna input connector, to electrostatic discharge (ESD) during handling. Discharge yourself to a ground before handling the unit. Preferably, use a static discharge wrist strap connected to earth ground when installing or configuring the device.

**Caution: No user-serviceable parts are inside the GMR. Please contact Masterclock Support if you require service or repair by emailing [support@masterclock.com](mailto:support@masterclock.com) or calling (636) 724-3666.**



# GMR1000

Multi-Functional Master Clock

The **GMR1000** is an enterprise-grade time and frequency generator/server built into a robust and compact design. This Mission-critical Stratum 1 timing solution synchronizes to GPS, GNSS, IRIG-B, or PTP reference and is backward compatible with legacy signals. Internal-disciplined high-stability oscillator options allow for critical holdover resiliency.



## Standard Features

- Standard Inputs/Reference Sources
- NTP client via RJ45 10/100 Mb Ethernet
- NMEA 0183 via RS232/422, Serial, or IP
- NENA format 0, 1, 8 via RS232/422
- Internal high-stability TCXO oscillator  $\pm 3$  sec. /year
- Configuration via USB or Ethernet
- Mount multiple units in a single rack

## Specifications

### INPUT OPTIONS

- GPS Receiver – 12 channels
- GNSS Receiver - 72-channels - GPS/QZSS L1 C/A, GLONASS L10F, BeiDou B1 SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN Galileo E1B/C
- IRIG-B0 (DCLS), IRIG-B1 (AM), IRIG-A0 (DCLS), IRIG-A1 (AM), IRIG-E0 (DCLS), IRIG-E1 (AM), SMPTE 12M, 309M, 24/25/30 fps and 29.97 drop frame
- Internal high-stability OCXO oscillator  $\pm 0.25$  sec/year
- Synchronizing signals: PPS, PPM, PPH
- IEEE 1588 Precision Time Protocol

### STANDARD OUTPUTS

- NTP server with 10/100 Mb Ethernet
- NMEA 0183 via RS232/422 or USB
- NENA format 0, 1, 8 via RS232/422 or USB

### OUTPUT OPTIONS

- IRIG-H, IRIG-B0 (DCLS), IRIG-B1 (AM), IRIG-A0 (DCLS), IRIG-A1 (AM), IRIG-H0 (DCLS), HAVE QUICK II non-NATO, IRIG-E0 (DCLS), IRIG-E1 (AM), SMPTE 12M, 309M, 24/25/30 fps, 29.97 drop frame
- 5V at 20mA Pulse Per Second (PPS)
- Programmable Pulse Output (PPO)
- 10MHz sine wave

- IEEE 1588v2 Precision Time Protocol (1 MHz & 5 MHz requires Rb (HSO-3) option)
- IEEE 1588v2 Precision Time Protocol

### ADDITIONAL FEATURES

- Internal TXCO maintains time during loss of external sync within  $\pm 3$  seconds/year
- WinDiscovery configuration software included
- Fully configurable offsets for time zone and DST
- Programmable relay closure - with NO/NC dry contact relay
- Relay alerts loss of sync by default
- Secure configuration and monitoring with SSH SHA2 AES256 encryption
- SNMPv3 with custom MIB
- IPv4/IPv6 compatible

### POWER

- DC input (9-28 VDC)
- Includes external 24VDC wall mount power supply with locking DC plug
- Power consumption: < 7.5W steady state

### OPERATING PARAMETERS

- Temperature: 0 to 60°C
- Humidity: Up to 90% (non-condensing)
- MTBF: 625,979 hours  
(Calculated using Fixed/Ground Mil HDBK 217F assumptions)

### PHYSICAL

- Size: 6.45 x 4.17 x 1.52 in (16.38 x 10.59 x 3.86 cm)
- Weight: 16 oz (453.6 g)

### COMPLIANCE

- FCC, ROHS, CE Marked, ANSI

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## AVAILABLE OPTIONS

| Part #        | Description   |
|---------------|---|
| GMR-10 MHz-IN | 10 MHz Input, SMA Cntr  |
| GMR-DIN       | DIN Rail Bracket  |
| GMR-DS6       | 6-digit front panel display   |
| GMR-GNSS      | GNSS Receiver, SMA Connector  |
| GMR-GPS       | GPS Receiver, SMA Connector   |
| GMR-HSO-2     | OCXO High Stability Oscillator  |
| GMR-PPO       | Programmable Pulse Output, SMA Cntr   |
| GMR-PPS-OUT   | PPS Output, SMA Cntr  |
| GMR-PTP       | PTP IEEE 1588 Server / Client, 10/100 MB, RJ45  |
| GMR-SYNC-IN   | PPS, PPM, PPH, Input, SMA Cntr  |
| GMR-TCG       | Time Code Generator (IRIG B, IRIG A, IRIG E, SMPTE 12M, 309M, 24/25/30 ND fps - 29.97 Drop Frame). DB9 connector (Includes DB9FTBA DB9 Female to Terminal Block Breakout Adapter) |
| GMR-TCR       | Time Code Reader (IRIG B, IRIG A, IRIG E, SMPTE 12M, 309M, 24/25/30 ND fps - 29.97 Drop Frame). DB9 connector (Includes DB9FTBA DB9 Female to Terminal Block Breakout Adapter)    |

## GPS / GNSS ANTENNAS (KITS)

|                    |  |
|--------------------|--|
| GPSANT-Basic       | 28dB Magnetic/Adhesive Mount GPS Antenna with 16'/5m antenna cable and SMA male connector  |
| GPS-KIT-Standard   | 28dB GPS antenna, with SMA female pigtail connector, threaded pipe/mast mount kit  |
| GNSS-KIT-High Gain | 38dB High Gain GNSS antenna, N Female connector with N male to SMA female adapter, metal L mounting bracket, optional ground plate |
| GNSS-KIT-Anti Jam  | 38dB Anti-Jam High Gain GNSS antenna, TNC Female connector with TNC male to SMA female adapter, metal L mounting bracket           |
| PKG-Standard       | Standard Antenna Cable: 50'/15m antenna cable with SMA male connectors. Additional cable length options available                  |
|                    | Additional cable length options available  |

Rack Mount available with RM4

**Power Type:** DC

**Plug Types Available:** North American, Euro Plug, U.K. Style, and Australia/New Zealand (Equipment side: Locking Plug , 24VDC Center Pin Positive)

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# GMR5000

Multi-Functional Master Clock

The **GMR5000** is a 1U rack mount time and frequency generator/server that can reference a variety of timing sources and provide a range of outputs. Using standard NTP polling rates, the device can support and synchronize thousands of simultaneous NTP clients. Base model includes both NTP client and server functionality compatible with IPv4/IPv6 networks and SSH encryption for secure communications.



## Standard Features

- 13-digit display (Date/Time or Day of year/Time)
- Programmable relay closure - NO/NC dry contact relay
- Relay alerts loss of sync by default
- Fully configurable offsets for time zone and DST
- Secure configuration and monitoring with SSH SHA2 AES256 encryption
- SNMPv3 with custom MIB
- IPv4/IPv6 compatible
- WinDiscovery configuration software included

## Specifications

### STANDARD INPUTS

- NTP client via RJ45 10/100 Mb Ethernet (dual-port)
- NMEA 0183 via RS232/422
- NENA format 0,1,8 via RS232/422
- Internal high-stability TCXO oscillator  $\pm 3$  sec./year
- Configuration via USB or Ethernet

### INPUT OPTIONS

- GPS Receiver – 12 channels
- GNSS Receiver - 72-channels - GPS/QZSS L1 C/A, GLONASS L10F, BeiDou B1 SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN Galileo E1B/C
- Time codes: IRIG-B0 (DCLS), IRIG-B1 (AM)  
(See TCR Options Data Sheet for additional IRIG options)
- SMPTE 12M, 309M, 24/25/30 fps, 29.97 drop frame
- High-Stability Oscillator options:
  - a. Internal high-stability OCXO oscillator  $\pm 0.25$  sec/year
  - b. Rubidium Oscillator  $\pm 1$  mS/year
- Synchronizing pulses: PPS, PPM, PPH
- 10 MHZ Input (CMOS or Sinusoidal)
- Optical Fiber LAN (1 or both ports)
- IEEE 1588v2 Precision Time Protocol

### STANDARD OUTPUTS

- NTP server via RJ45 10/100 Mb Ethernet (dual-port)
- NMEA 0183 via RS232/422 serial, or via IP
- NENA format 0, 1, 8 via RS232/422 serial, or via IP
- RS-232/422
- Kinematics/Truetime serial protocol RS232/RS422
- 5V at 100mA Pulse Per Second (1PPS)

### OUTPUT OPTIONS

- Time codes: IRIG-B0 (DCLS), IRIG-B1 (AM), IRIG-A0 (DCLS), IRIG-A1 (AM), IRIG-E0 (DCLS), IRIG-E1 (AM), IRIG-H0 (DCLS), HAVE QUICK II NON-NATO, SMPTE 12M, 309M, 24/25/30 fps and 29.97 drop frame
- 5V at 100mA Programmable Pulse Output (PPO)
- Optical Fiber LAN (1 or both ports)
- 10 MHZ Output (Sinusoidal)  
(1 MHz & 5 MHz requires Rb (HSO-3) option)
- IEEE 1588v2 Precision Time Protocol

### COMPLIANCE

- FCC, ROHS, CE Marked, ANSI

### OPERATING PARAMETERS

- Temperature: 0 to 60°C
- Humidity: Up to 90% (non-condensing)
- MTBF: 625,979 hours  
(Calculated using Fixed/Ground Mil HDBK 217F assumptions)

### POWER AND DIMENSIONS

- Universal IEC C14 AC input connector
- AC Input 100-240 VAC, 50/60 Hz
- POWER <15W (<20 with Rb option)
- Size: 16.90w x 1.750h x 5.174d in  
(42.92w x 4.445h x 13.14d cm)
- Weight: 2.6 lbs. (1.2 kg)

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## AVAILABLE OPTIONS

| Part #         | Description   |
|----------------|---|
| GMR-10 MHz-IN  | 10 MHz Input, SMA Cntr  |
| GMR-10 MHz-OUT | 10 MHz Output, SMA Cntr   |
| GMR-FO-1       | 1 Fiber Optic (SC Single Mode) & 1 Ethernet Output (RJ45)   |
| GMR-FO-2       | 2 Fiber Optic Outputs (SC Single Mode) & No Ethernet  |
| GMR-GNSS       | GNSS Receiver, SMA Connector  |
| GMR-GPS        | GPS Receiver, SMA Connector   |
| GMR-HSO-2      | OCXO High Stability Oscillator  |
| GMR-HSO-3      | Rubidium Ultra High Stability Oscillator  |
| GMR-PPO        | Programmable Pulse Output, SMA Cntr   |
| GMR-PTP        | PTP IEEE 1588 Server / Client, 10/100 MB, RJ45  |
| GMR-SYNC-IN    | PPS, PPM, PPH, Input, SMA Cntr  |
| GMR-TCG        | Time Code Generator (IRIG B, IRIG A, IRIG E, SMPTE 12M, 309M, 24/25/30 ND fps - 29.97 Drop Frame). BNC/3Pin Terminal Block Connector            |
| GMR-TCR        | Time Code Reader (IRIG B, IRIG A, IRIG E, SMPTE 12M, 309M, 24/25/30 ND fps - 29.97 Drop Frame). DB9 connector BNC/3Pin Terminal Block Connector |

## GPS / GNSS ANTENNAS (KITS)

|                    |   |
|--------------------|---|
| GPSANT-Basic       | 28dB Magnetic/Adhesive Mount GPS Antenna with 16'/5m antenna cable and SMA male connector   |
| GPS-KIT-Standard   | 28dB GPS antenna, with SMA female pigtail connector, threaded pipe/mast mount kit   |
| GNSS-KIT-High Gain | 38dB High Gain GNSS antenna, N Female connector with N male to SMA female adapter, metal L mounting bracket, Optional ground plate. |
| GNSS-KIT-Anti Jam  | 38dB Anti-Jam High Gain GNSS antenna, TNC Female connector with TNC male to SMA female adapter, metal L mounting bracket            |
| PKG-Standard       | Standard Antenna Cable: 50'/15m antenna cable with SMA male connectors. Additional cable length options available                   |
|                    | Additional cable length options available   |

## AC Cord Types Available

IEC C13 to North American (NEMA 5-15, Type B), Euro Plug (CEE 7/7, Type F), U.K. Style (Type D), or Australia/New Zealand (Type I)

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# GPS/GNSS Antenna Options

Masterclock offers several antenna options for GPS/GNSS-enabled devices, available for both standard and mobile applications. Our GNSS (global navigation satellite system) antennas comprise all common global satellite services such as GPS, GLONASS, GALILEO and BeiDou.



|                            | Basic                                | Standard   | High-Gain  | Anti-Jam High-Gain   |
|----------------------------|--------------------------------------|--|--|--|
| <b>Type</b>                | Active, External                     | Active, External   | Active, External   | Active, External   |
|                            | GPS                                  | GPS  | GNSS   | GNSS   |
| <b>Band</b>                | GPS/QZSS-L1                          | GPS/QZSS-L1  | GPS/QZSS-L1, GLONASS-G1, Galileo-E1, and BeiDou-B1                   | GPS/QZSS-L1, GLONASS-G1, Galileo-E1, and BeiDou-B1                   |
| <b>(SBAS) Augmentation</b> | WAAS (North America)                 | WAAS (North America)   | WAAS (North America), EGNOS (Europe), MSAS (Japan), or GAGAN (India) | WAAS (North America), EGNOS (Europe), MSAS (Japan), or GAGAN (India) |
| <b>Gain</b>                | 28 ± 2 dB                            | 28 ± 2 dB  | 38 dB min  | 38 dB min  |
| <b>Mount</b>               | Magnet/Adhesive                      | Outdoor, threaded pipe/mast. M24 x 1.5 internal thread - Mounting kit provided | Metal mounting kit provided, Ground plate optional                   | Metal mounting kit provided  |
| <b>IP Rating</b>           | IP67 weather-proof enclosure         | IP67 weather-proof enclosure   | IP67 weather-proof enclosure   | IP67 weather-proof enclosure   |
| <b>Operating Temp.</b>     | -40° to 85°C (up to 95% humidity)    | -40° to 85°C (up to 95% humidity)  | -40° to 85°C (up to 95% humidity)                                    | -40° to 85°C (up to 95% humidity)                                    |
| <b>Voltage</b>             | 2.2-5 VDC                            | 3-5 VDC  | 2.5-12 VDC   | 2.5-12 VDC   |
| <b>Polarization</b>        | Right hand circular                  | Right hand circular  | Right hand circular  | Right hand circular  |
| <b>Impedence</b>           | 50 Ω                                 | 50 Ω   | 50 Ω   | 50 Ω   |
| <b>Connector</b>           | SMA Male                             | SMA Female   | N Female (Supplied with N to SMA-F Adapter)                          | TNC Female (Supplied with TNC to SMA-F Adapter)                      |
| <b>Antenna Cable Pkg</b>   | Belden 8219 or equivalent            | Belden 8219 or equivalent  | Belden 8219 or equivalent  | Belden 8219 or equivalent  |
| <b>Weight</b>              | 0.9 oz (26 g)                        | 6.7 oz (190 g)   | 5.3 oz (150 g)   | 13.0 oz (370 g)  |
| <b>Dimensions</b>          | 1.5 x 1.9 x .59 in (39 x 49 x 15 mm) | 3.7dia x 5.5h in (9.3dia x 14h cm)   | 2.6dia x 1.9h in (6.7dia x 4.8h cm)                                  | 4.0dia x 4.0h in (10.0dia x 10.2h cm)                                |

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### High Stability Oscillators

Masterclock offers three high-stability oscillator options for the GMR Series. When locked to GPS, the OCXO 10 MHz sine wave frequency will have the same long-term stability as an atomic clock. When not tied to GPS, a precision frequency 10 MHz reference output is available as a source for laboratory use or for an RF reference, including cellular applications. The HSO option is required for all 10 MHz signal outputs.

| <i>Freq. = 10 MHz</i>                                      |               | <b>HSO-1</b><br>Standard                 | <b>HSO-2</b>                                       | <b>HSO-3</b><br>Available only in GMR5000       |
|--|---------------|--|--|---|
| <b>Oscillator Type</b>                                     |               | TCXO                                     | OCXO   | Rubidium  |
| <b>Freq. Stability - Aging/Day</b>                         |               | $\leq \pm 0.0027$ ppm<br>(or 2.7E-9/day) | $\leq \pm 1E-9$ /day                               | $\pm 4E-11$ /day                                |
| <b>Freq. Stability - Aging/Year</b>                        |               | $\leq \pm 1.0$ ppm<br>(or 1E-6 /year)    | $\leq \pm 1E-7$ /year                              | $\pm 1.5E-9$ /year                              |
| <b>Power Consumption</b>                                   |               | $\leq 0.021$ W                           | $\leq 3.5$ W warm up,<br>$\leq 1.5$ W steady state | $\leq 14$ W warm up,<br>$\leq 8$ W steady state |
| <b>ROHS Compliant</b>                                      |               | Yes                                      | Yes  | Yes   |
| <b>Short Term Stability<br/>(Allan Variance), t =1sec.</b> |               | -  | -  | $\leq 5E-11$                                    |
| <b>Time Drift per Year (max)</b>                           |               | $\pm 3$ sec./year                        | $\pm 0.25$ sec./year                               | $\pm .001$ sec. / year                          |
| <b>Phase Noise<br/>(dBc/Hz) @ 10<br/>MHz</b>               | <b>1 Hz</b>   | -  | -  | $\leq -65$ dBc/Hz                               |
|  | <b>10 Hz</b>  | -  | $\leq -110$ dBc/Hz                                 | $\leq -85$ dBc/Hz                               |
|  | <b>100 Hz</b> | $\leq -135$ dBc/Hz                       | $\leq -130$ dBc/Hz                                 | $\leq -112$ dBc/Hz                              |
|  | <b>1k Hz</b>  | $\leq -135$ dBc/Hz                       | $\leq -145$ dBc/Hz                                 | $\leq -130$ dBc/Hz                              |
|  | <b>10k Hz</b> | $\leq -148$ dBc/Hz                       | $\leq -155$ dBc/Hz                                 | $\leq -140$ dBc/Hz                              |

**MASTERCLOCK, INC.**

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### Time Code Reader

The **Time Code Reader** option for the GMR Series automatically detects and locks to incoming time code using an automatic gain control circuit, reading and synchronizing to SMPTE or IRIG-B time code, as well as IRIG-A and IRIG-E waveforms.

|  | SMPTE 12M  | IRIG-B0<br>(DCLS, PWM)                    | IRIG-B1 (AM)                         | IRIG-A (DCLS)                       | IRIG-A (AM)                          | IRIG-E (DCLS)                       | IRIG-E (AM)                          |      |
|--|--|---|--------------------------------------|-------------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|------|
| <b>Rate</b>  | 24, 25, 30 fps NDF<br>and 29.97 DF   | 1kHz, 1mS                                 | 1kHz, 1mS                            | 10kHz, 0.1mS                        | 10kHz, 0.1mS                         | 100Hz, 10mS                         | 100Hz, 10mS                          |      |
| <b>Input Level Range</b>   | 0.2-18 Vpp<br>(2 Vpp <sub>nom</sub> )  | 0.5-12 Vp<br>(5Vpp <sub>nom</sub> )       | 0.5-8 Vpp<br>(5 Vpp <sub>nom</sub> ) | 0.5-12 Vp<br>(5 Vp <sub>nom</sub> ) | 0.5-8 Vpp<br>(5 Vpp <sub>nom</sub> ) | 0.5-12 Vp<br>(5 Vp <sub>nom</sub> ) | 0.5-8 Vpp<br>(5 Vpp <sub>nom</sub> ) |      |
| <b>Input Impedance kΩ</b>  | >10 kΩ   |   |                                      | >10 kΩ                              |                                      |                                     |                                      |      |
| <b>Mark to Space Ratio</b>   | N/A  | N/A                                       | 3.3:1                                | N/A                                 | 3.3:1                                | N/A                                 | 3.3:1                                |      |
| <b>Automatic Gain Adjust</b>   | Over input level range   |   |                                      |                                     |                                      |                                     |                                      |      |
| <b>Number of Inputs<br/>(SE: Single Ended - Unbalanced,<br/>Differential - Balanced)</b> | 1 SE, 1 DIFF   | 1 SE, 1 DIFF                              | 1 SE, 1 DIFF                         | 1 SE, 1 DIFF                        | 1 SE, 1 DIFF                         | 1 SE, 1 DIFF                        | 1 SE, 1 DIFF                         |      |
| <b>Type</b>  | NDF  | DCLS                                      | AM 1kHz                              | DCLS                                | AM 10kHz                             | DCLS                                | AM 100Hz                             |      |
| <b>Encoding</b>  | None,<br>Leitch Date,<br>SMPTE 309M  | None or IEEE 1344 year or IRIG STD 200-04 |                                      |                                     |                                      |                                     |                                      |      |
| <b>IRIG Coded<br/>Expression<br/>IRIG STD<br/>200-04</b>                                 | 0 BCD <sub>TOY</sub> , CF, SBS   | N/A                                       | B000                                 | B120                                | A000                                 | A130                                | E000                                 | E110 |
|  | 1 BCD <sub>TOY</sub> , CF  | N/A                                       | B001                                 | B121                                | A001                                 | A131                                | E001                                 | E111 |
|  | 2 BCD <sub>TOY</sub>   | N/A                                       | B002                                 | B122                                | A002                                 | A132                                | E002                                 | E112 |
|  | 3 BCD <sub>TOY</sub> , SBS   | N/A                                       | B003                                 | B123                                | A003                                 | A133                                | E003                                 | E113 |
|  | 4 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , CF,<br>SBS (IEEE-1344 -<br>1995 Encoding) | N/A                                       | B004                                 | B124                                | A004                                 | A134                                | E004                                 | E114 |
|  | 5 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , CF  | N/A                                       | B005                                 | B125                                | A005                                 | A135                                | E005                                 | E115 |
|  | 6 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub>   | N/A                                       | B006                                 | B126                                | A006                                 | A136                                | E006                                 | E116 |
|  | 7 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , SBS                                       | N/A                                       | B007                                 | B127                                | A007                                 | A137                                | E007                                 | E117 |

**MASTERCLOCK, INC.**

**5-YEAR LIMITED PARTS & LABOR WARRANTY**

**MADE IN THE USA**

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1-800-940-2248

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### Time Code Generator

The **Time Code Generator** option for the GMR Series generates SMPTE or IRIG-B time codes, as well as IRIG-A and IRIG-E waveforms. The TCG option is software controlled and locks to GPS satellites, Time Code Reader, NTP Client, and/or High-Stability Oscillator.

|  | SMPTE 12M  | IRIG-B0<br>(DCLS, PWM)                    | IRIG-B1 (AM)      | IRIG-A (DCLS)    | IRIG-A (AM)       | IRIG-E (DCLS)    | IRIG-E (AM)        |      |
|--|--|---|-------------------|------------------|-------------------|------------------|--------------------|------|
| <b>Rate</b>  | 24, 25, 30 fps NDF<br>and 29.97 DF   | 1kHz, 1mS                                 | 1kHz, 1mS         | 10kHz, 0.1mS     | 10kHz, 0.1mS      | 100Hz, 10mS      | 100Hz, 10mS        |      |
| <b>Output Level @ 50 Ω</b>   | 4 Vpp<br>(16 dBm)  | 5 Vp<br>(25 dBm)                          | 5 Vpp<br>(18 dBm) | 5 Vp<br>(25 dBm) | 5 Vpp<br>(18 dBm) | 5 Vp<br>(25 dBm) | 5 Vpp<br>(18 dBm5) |      |
| <b>Mark to Space Ratio</b>   | N/A  | N/A                                       | 3.3:1             | N/A              | 3.3:1             | N/A              | 3.3:1              |      |
| <b>Gain</b>  | 1  | 1   | 1                 | 1                | 1                 | 1                | 1                  |      |
| <b>Number of Inputs<br/>(SE: Single Ended - Unbalanced,<br/>Differential - Balanced)</b> | 1 SE, 1 DIFF   | 1 SE, 1 DIFF                              | 1 SE, 1 DIFF      | 1 SE, 1 DIFF     | 1 SE, 1 DIFF      | 1 SE, 1 DIFF     | 1 SE, 1 DIFF       |      |
| <b>Type</b>  | NDF  | DCLS                                      | AM 1kHz           | DCLS             | AM 10kHz          | DCLS             | AM 100Hz           |      |
| <b>Encoding</b>  | None,<br>Leitch Date,<br>SMPTE 309M  | None or IEEE 1344 year or IRIG STD 200-04 |                   |                  |                   |                  |                    |      |
| <b>IRIG Coded<br/>Expression<br/>IRIG STD<br/>200-04</b>                                 | 0 BCD <sub>TOY</sub> , CF, SBS   | N/A                                       | B000              | B120             | A000              | A130             | E000               | E110 |
|  | 1 BCD <sub>TOY</sub> , CF  | N/A                                       | B001              | B121             | A001              | A131             | E001               | E111 |
|  | 2 BCD <sub>TOY</sub>   | N/A                                       | B002              | B122             | A002              | A132             | E002               | E112 |
|  | 3 BCD <sub>TOY</sub> , SBS   | N/A                                       | B003              | B123             | A003              | A133             | E003               | E113 |
|  | 4 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , CF,<br>SBS (IEEE-1344 -<br>1995 Encoding) | N/A                                       | B004              | B124             | A004              | A134             | E004               | E114 |
|  | 5 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , CF  | N/A                                       | B005              | B125             | A005              | A135             | E005               | E115 |
|  | 6 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub>   | N/A                                       | B006              | B126             | A006              | A136             | E006               | E116 |
|  | 7 BCD <sub>TOY</sub> , BCD <sub>YEAR</sub> , SBS                                       | N/A                                       | B007              | B127             | A007              | A137             | E007               | E117 |

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# Introduction

**GMR1000 (OPTIONAL FEATURES SHOWN)**



**GMR5000 (OPTIONAL FEATURES SHOWN)**



The GMR1000 and GMR5000 are high-precision, small profile, multi-function reference generators that can operate on an Ethernet or Time Code network, or as a standalone master clock reference. On an Ethernet network, the built-in Network Time Protocol (NTP) client accurately sets system time from one or two NTP servers. For a time code system, a time code reader sets system time from a time code generator.

When equipped with a GPS or GNSS receiver the GMR can lock to GPS and/or GNSS satellite constellations, providing near-atomic clock precision. The GMR can also read NMEA and NENA messages to set its system time, or time can be set manually, and it can generate NMEA, NENA or Truetime/Kinematics. Holdover accuracy and stability is maintained with a high-stability TCXO oscillator that can be upgraded to an OCXO or Rubidium oscillator option.

Optional outputs include Time Code (SMPTE, IRIG-A, IRIG-B, IRIG-E), PPO (Programmable Pulse Output), PPS (Pulse Per Second), 10 MHz sine wave, and IEEE 1588 Precise Time Protocol.

## Standard Features

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- Custom configurations to meet application requirements (see Optional Features)
- NTP server/client functionality with selectable Stratum identification levels (1-15)
- NTP server accuracy:  $\pm 2$  milliseconds
- Serve thousands of NTP clients on a network
- Supports NTP broadcast, multicast, and/or unicast (query) modes of operation
- UTC time internal reference
- -11.5 to +12 hour time zone offsets in 30-minute increments
- Automatic daylight saving (US & Canada time standard)
- High Stability Temperature Controlled Crystal Oscillator (TCXO) maintains time during loss of external sync within  $\pm 3$  seconds/year
- Non-volatile memory configuration
- Internal Real Time Clock (RTC) backed by a maintenance-free rechargeable battery retains time during loss of power or loss of active reference(s) for up to 9 months with holdover stability of  $< 165$  ms/day
- Front panel LED status indicators
- R232 (and RS422 on GMR5000) serial port interface
- Kinematics/Truetime output
- NENA 911 PSAP master clock input/output
- NMEA 0183 ASCII serial input/output
- Configuration and monitoring via WinDiscovery software or Telnet/SSH
- USB serial port configuration interface
- Telnet/SSH interface for alternate configuration and maintenance
- Fully configurable network settings via DHCP or Static IP addressing
- IPv4/IPv6 compatible
- Password protection and authenticated communications
- MD5 authentication
- SNMP (Simple Network Management Protocol) with custom MIB
- SMTP (Simple Mail Transfer Protocol)
- Firmware upgradeability

## Optional Features

---

Your GMR can have hardware module accessories and multiple advanced function options, installed upon manufacture. These make the GMR an extremely versatile network device suitable for a large variety of applications.

### GPS/GLONASS

- GPS or GPS/GLONASS receiver option with up to 32-channel receiver, up to 24 satellites
- GPS Receiver accuracy:  $\pm 60$  nanosecond
- GPS/GLONASS Receiver:  $\pm 25$  nanosecond
- PPS on-time output is locked to the top of each second (standard on GMR5000, optional on GMR1000)
- NMEA-0183 messages on serial port output

### HSO: HIGH STABILITY OSCILLATORS

- Standard Temperature Controlled Crystal Oscillator (TCXO)
- Optional Oven Controlled Crystal Oscillator (OCXO) provides high stability time reference of  $\pm 0.25$  sec/year drift while freewheeling after disciplining from a GPS or other accurate reference
- Optional Rubidium oscillator provides high stability time reference  $\pm 1$  mS/year drift while freewheeling after disciplining from a GPS or other accurate reference
- Calibrates to best “active” time source (use GPS or GPS/GLONASS option for maximum holdover stability)

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12

### IEEE 1588V2 PRECISION TIME PROTOCOL

- Default Profile PTP grandmaster, slave, or transparent clock
- Peer-to-peer or end-to-end configuration
- Grand Master Clock accuracy compared to top of second of GPS reference:  $\pm 100$  nanoseconds
- Slave clock accuracy compared to top of second Grand Master Clock reference:  $\pm 200$  nanoseconds

### TCR: TIME CODE READER MODULE

- Reads SMPTE 24, 25, 30-fps non-drop frame and SMPTE 29.97 drop frame, IRIG-B (A and E optional) amplitude modulated and pulse width coded (un-modulated)
- Automatic time code detection circuit with automatic gain adjust
- Single-ended unbalanced or differential balanced inputs
- DB9 breakout adapter available for differential balanced input (GMR1000 only, not needed on GMR5000)
- Programmable delay offset with 1  $\mu$ S resolution

## **TCG: TIME CODE GENERATOR MODULE**

- Reads SMPTE 24, 25, 30-fps non-drop frame and SMPTE 29.97 drop frame, IRIG-B (A and E optional), amplitude modulated and pulse width coded (un-modulated)
- Time code signal accuracy: 200 nanosecond
- Single-ended unbalanced or differential balanced outputs
- DB9 breakout adapter available for differential balanced output (GMR1000 only, not needed on GMR5000)
- Programmable delay offset with 1  $\mu$ S resolution

## **PPS (PULSE PER SECOND) OUTPUT**

- 5V TTL (Transistor-Transistor Logic) level signal locked to the most accurate time reference
- Accuracy compared to top of second of GPS reference:  $\pm$  70 nanoseconds
- Rising edge of the PPS signal provides the “on time” mark
- Standard on GMR5000

## **PPO: PROGRAMMABLE PULSE OUTPUT**

- Pulse interval and duration can be selected via software from 100  $\mu$ s to 3 days
- Pulse output is 5Vpp from a low impedance source
- Pulse width selectable from 10  $\mu$  seconds to 100 m sec
- Accuracy is same as the current reference source (i.e. GPS, time code, NTP, etc.)

## **10 MHZ SINE WAVE FREQUENCY INPUT AND OUPUT**

- 9V Peak to Peak unloaded at 50 Ohm, 6V Peak to Peak with high impedance load at 50 Ohm

## **SYNC-IN**

- Sync to PPS, PPM or PPH input

## **PROGRAMMABLE DRY CONTACT RELAY (24VDC, 250MA)**

- Single event (daily) programmable relay schedule
- Standard on GMR5000

## **DRY CONTACT RELAY AND PROGRAMMABLE RELAY EVENT**

- AC or DC relay that can be used in either NO (normally open) mode by connecting to pins 2 and 3 of J9 or NC (normally closed) mode by connecting to pins 1 and 2 of J9 on the rear of the unit.
- **By default:** The relay will actuate to indicate when the unit has lost synchronization (lock) with the external time reference.
- The relay can be programmed to actuate at a single time (defined as HH:MM:SS start time) for a specified duration (in seconds) once per day.
- Standard on GMR5000

## **FRONT PANEL DISPLAY**

- Six-digit front panel LED display may be ordered with your GMR1000 to provide the time/date display.
- A thirteen-digit LED display is standard on the GMR5000.

**Caution: No user-serviceable parts are inside the GMR. Please contact Masterclock Support if you require service or repair by emailing [support@masterclock.com](mailto:support@masterclock.com) or calling (636) 724-3666.**



# Back Panel Interfaces

## ETHERNET RJ45 10/100 MB PORT

The GMR1000 includes 1 Ethernet RJ45 10/100 MB port; the GMR5000 includes 2 ports. These ports are used for NTP, IEEE 1588 PTP, and/or configuration over a network.

## SMA CONNECTORS

Depending on ordered configuration, the GMR 1000 and 5000 will have one or more SMA connectors. These include:

- 10 MHz Input
- 10 MHz Output
- GPS Antenna
- PPO (Programmable Pulse Output)
- Sync-In (PPS, PPM, or PPH)
- PPS Out

## BNC CONNECTOR AND 3-PIN TERMINAL BLOCK

With each of the Time Code Generator and Time Code Reader options, a BNC connector and a 3-pin terminal block is included:

- BNC Connector for balanced time code
- 3-Pin Terminal Block for single-ended unbalanced time code

## USB PORT

The GMR1000 and GMR5000 both include a USB type B port for serial communications and configuration.

## RS232 SERIAL PORT INTERFACE

The GMR1000 provides a DCE RS-232 for serial communications and configuration.

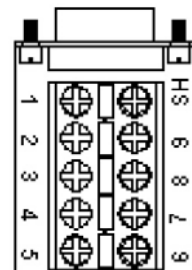
The GMR5000 provides a DTE RS-232 and RS-422, for serial communications and configuration. These communications include NENA 911, NMEA 0183 and Kinemetrics/Truetime.

On the GMR5000 both the RS-232 and the RS-422 can be used for output simultaneously.

For input, only one port can be used at a time.

### Standard I/O connections using optional DB9 Breakout Adapter (GMR1000 only)

- 1 - TC-OUT (NEG)\*
- 2 - RS232 RX(DTE) TX(DCE)\*\*
- 3 - RS232 TX(DTE) RX(DCE)\*\*
- 4 - RELAY COMMON\*
- 5 - GND
- 6 - TC-OUT (POS)\*
- 7 - TC-IN (POS)\*
- 8 - TC-IN (NEG)\*
- 9 - RELAY IN/OUT\*



\*if installed

\*\*based on internal jumper setting

# Configuration Options

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## WINDISCOVERY

Included with your GMR is the WinDiscovery GUI application. WinDiscovery is a detection, configuration and management software application which works with all Masterclock brand network devices. It operates under most Windows-based operating systems.

## TELNET AND SECURE SHELL (SSH) INTERFACES

Telnet, a terminal-style command line interface, is used on networks that are not Windows-based (i.e. Linux and UNIX). The Telnet interface may be disabled. Secure Shell (SSH) is a command line interface that encrypts data.

## CONFIGURATION SAVED VIA BATTERY-BACKED RTC

The GMR maintains its internal time settings in battery-backed memory located on an RTC (Real Time Clock) chip, which provides freewheeling accuracy (maximum drift) down to  $\pm 165$  ms/day. A built-in battery supplies power, for 6-9 months, to the RTC when the unit is powered off. This allows the internal time to be maintained and the time and date to increment whenever power is removed.

The battery is a rechargeable manganese lithium type. A built-in battery charging circuit is used when the unit is normally powered, eliminating the need for maintenance.

## PASSWORD PROTECTION

The GMR is provided with a password for security. Each Masterclock network device requires a password that must be entered before the device will accept configuration changes. Each device, or set of devices, can have a unique password or they can all share the same one. The password can be changed and retained to permit access only to authorized users.

A password can be a maximum of 11 characters and may contain any sequence of letters, numbers, and common punctuation. Passwords are case-sensitive.

## DEFAULT PASSWORD

The factory default password is “**public**”

## UTC TIME REFERENCE

The GMR's reference time is based on UTC (Coordinated Universal Time). UTC is a time standard which is the basis for the worldwide system of civil time. This time scale is kept by time laboratories around the world, including the U.S. Naval Observatory, and is determined using highly precise atomic clocks. The UTC scale is coordinated in Paris by the International Bureau of Weights and Measures (BIPM).

UTC runs at the rate of the atomic clocks, but when the difference between this atomic time and one based on the Earth approaches one second, a one second adjustment (a "leap second") is made in UTC.

UTC is the local time at the prime reference meridian at Greenwich, England. At a given location on the planet, local time can be displaced (referenced to UTC) by -11 to +12 hours. North and South America are from -3 to -11 hours delayed; most of Europe and Africa and all of Asia and Australia are advanced by +1 to +12 hours. Because the NTP time distribution standard operates with UTC-reference time only, time zone and/or daylight savings (summer) time are not used. UTC is sometimes colloquially referred to as "Greenwich Mean Time" (abbreviated GMT).

# DHCP Auto-Configuration

---

**DHCP (Dynamic Host Configuration Protocol)** is a mechanism for automating the configuration of networked devices that use TCP/IP. When DHCP is enabled, DHCP configuration acquisition will overwrite any manual configuration items.

The GMR can obtain its network configuration automatically from DHCP, when one or the other is available on the network. Utilizing DHCP, the GMR will automatically be assigned its network configuration. This includes an IP address and additional functions, such as DNS server and Router/Gateway settings. This feature is enabled by default. A GMR network device will not function properly if configured to use DHCP services when no DHCP server is present on the network. If no DHCP server is present, the device will use a fallback IP address: 169.254.xxx.yyy where xxx and yyy are the last two bytes of the MAC address.

The GMR can automatically obtain **Time Zone Offset** configuration and the NTP server addresses (primary and secondary). To utilize these features the DHCP server of the network must be pre-configured with the appropriate checklist items. **Factory default: DHCP enabled.**

Long DHCP names are not supported. Only the first 14 characters of the device name will be registered by the DHCP server.

The IP address of the unit is required to configure the GMR with SSH or Telnet. The DHCP server can be utilized to provide the IP address of the associated device name that is registered.

The following RFC2132-defined optional configuration items are, when available, used by the GMR for configuration:

| Option             | No. | Comments  |
|--------------------|-----|---|
| Router             | 3   | The first IP address provided will be used for router/gateway configuration.  |
| Domain Name Server | 6   | Up to two server IP addresses may be specified. GMR device will treat addresses as primary and secondary DNS servers. |
| NTP Server         | 42  | Specifies an NTP server available to the client. If more than one is listed, only the first will be used.             |

# Factory Defaults

## FACTORY-DEFAULT CONFIGURATION

The GMR is fully tested with factory defaults prior to shipping. This factory default configuration is defined as:

- UTC reference time (no local time zone offset and daylight saving auto adjustment is disabled)
- DHCP configuration mode – enabled for network address and NTP Server addresses
- NTP server enabled, NTP client disabled
- PTP (if installed), End-To-End default profile
- Time dissemination via Real-Time Clock (RTC) during reference outages enabled for 24 hours
- Device name set to GMR1000-XX:XX or GMR5000- XX:XX (where XX:XX are the last two bits of the MAC address of the unit)
- Relay Schedule – disabled. The default relay action is to close upon loss of external time reference (loss of lock).
- Password for WinDiscovery– **public**
- Password for Telnet – **public** (Telnet is disabled by default.)
- SSH Credentials – user: public password: **publicpass**

## RESET TO FACTORY DEFAULTS

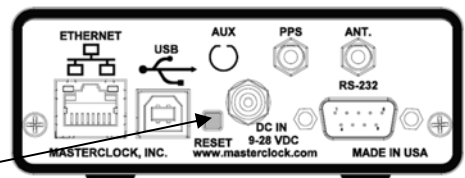
In some situations, (such as a lost password or removal of confidential information, perhaps prior to sending the unit in for repair service), it may be necessary to return the GMR to its factory default configuration. The factory defaults may be restored by using software (WinDiscovery, SSH or Telnet) or by holding down the reset button on the back panel of a GMR1000 or the front of a GMR5000 (see illustration at left). Maintain pressure for at least 5 seconds to reset the unit to factory defaults.

### Set to Factory Default Button

On the GMR1000, a recessed button labeled “RESET”, located on the back of the unit performs this function.

On the GMR5000, the reset button is located behind the pinhole to the right of the USB port on the front of the unit.  
To reset configuration to factory default:

1. **Press and hold the “RESET” button.**
2. **Continue to press the “RESET” button until the unit reboots.**



# Driver Installation

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The GMR is available in multiple configurations to fit almost any need with configurable modules and software options.

A **USB type B port** has been included on the rear of the GMR1000 and the front of the GMR5000 to provide a means of configuring the operation via WinDiscovery. To use it, connect a USB type A/B cable from the host computer to the GMR.

**Before the unit can be configured, the device drivers must be loaded.** The software configuration program WinDiscovery and USB drivers have been provided on a CD with the device.

**Installing USB drivers:** Power up the GMR, insert the WinDiscovery CD in to the PC, and complete its installation. Connect the GMR to the PC with a USB cable. The Windows **Plug and Play Manager** will detect the GMR and request drivers. Select the option to **“Install from a list or specific location [Advanced]”** then browse to the Drivers folder as detailed on the left. The wizard will install them and then the GMR can be accessed via WinDiscovery. The next time you connect a Masterclock device via USB you will NOT have to install the drivers again.

## QUICK DRIVER INSTALLATION

To control a GMR via USB cable, a driver must be installed on the PC.

1. **Plug** in your GMR to initiate start-up.
2. **Insert** WinDiscovery CD that shipped with your GMR.
3. **When prompted**, choose to “Run Setup\_WinDiscovery.exe”.
4. **If not prompted**, right-click the CD drive and choose Open or Explore, then double-click Setup\_WinDiscovery.exe.
5. **Finish** the installation.
6. **Connect** a USB cable between the PC and the GMR.
7. **If prompted** for a driver, navigate to Masterclock\WinDiscovery 4x\Drivers in C:\Program Files or C:\Program Files (x86)
8. **Open WinDiscovery** by double-clicking the shortcut on the desktop.
9. **Click the Discover button.**
10. **Expand the “Known Devices” tree** on the left.
11. **The GMR’s name appears in blue**, indicating that the connection is via USB.
12. **The GMR’s name appears in green**, indicating that the GMR has the IP address of 192.168.x.x
13. **The GMR’s name appears in red**, indicating that the GMR has the fallback IP address of 169.254.x.x where x.x are the last two octets of the MAC address.

# Quick Start Instructions

---

## PRE-INSTALLATION CHECKLIST

The GMR is available as a network device with an NTP client enabled and configured for DHCP provided network settings and NTP server addresses (by default). Of course, the user can change and elaborate these settings.

Before installing a GMR on a network one should be prepared with basic configuration information (see box at left). You may need to ask your network administrator for this.

| CHECKLIST   |  |
|---|--|
| <b>Dynamic Networking Configuration</b> (default for all GMR devices) |  |
| <input type="checkbox"/>  | Confirm that a DHCP service is accessible on the local network |
| <input type="checkbox"/>  | Determine if DHCP server will provide NTP server configuration |
| <input type="checkbox"/>  | Determine if DHCP server will provide time zone configuration  |
| -- OR --  |  |
| <b>Static Networking Configuration</b>                                |  |
| <input type="checkbox"/>  | IP address and netmask designation for device                  |
| <input type="checkbox"/>  | Primary and secondary DNS (domain name) servers                |
| <input type="checkbox"/>  | Gateway/router   |
| <input type="checkbox"/>  | Primary and secondary NTP time sources                         |

## QUICK START INSTRUCTIONS

- Make all connections at the rear of the unit, but keep the power disconnected until the last step.
- Connect the GMR device to your LAN (Local Area Network) hub/router/switch using Cat5 cable making the connection to the RJ45 connector labeled **ETHERNET**
- Make any additional desired input and output connections to the DB9 connector labeled **RS-232** using either your own cable or an optional DB9 breakout adapter (on the GMR1000 only).
- Insert the WinDiscovery CD into a computer running Windows XP, 7, 8, or 10 (Vista supported only in XP compatibility mode). The **InstallShield** application will begin automatically if AutoRun is enabled on your system. Otherwise, browse to the CD root directly and click the file **Setup\_WinDiscovery.exe** to begin the installer.
- Apply power. For a GMR5000 connect the supplied AC power cord between an AC power source and the IEC jack on the back of the device. For a GMR1000 insert the supplied AC/DC power supply module into an appropriate AC power source and the DC power connector into the male Switchcraft-style locking power socket on the rear of the unit labeled **DC IN 9-28 VDC**.
- If desired the GMR1000 can be operated from a nominal 12- VDC supply such as a battery (9-28 VDC range).

**Caution: Observe voltage polarity as indicated on the rear panel. The center pin is positive +VDC.**

- Monitor the front panel for power up status.
- When power is first applied the initial sequence of the front panel LEDs are:
- Front panel **LOCK** indicator will come on for 1 second, go out, come on for 1 second, and go out.

- Units with 6-digit LEDs will show all 8s, then will display time and/or date according to the settings the user has made.
- Yellow **NTP** LED signifying NTP status: Off
- Yellow **PTP** LED (if present): Off
- Green **LOCK** LED: Blinks twice per second, with time incrementing each second. This indicates lock to internal OCXO oscillator and acquiring lock to an external source, if applicable.
- Green **LOCK** LED: Blinks twice per second. This indicates synchronization to an external reference

## CONFIGURE THE GMR USING YOUR PREFERRED METHOD

At this time, the GMR can communicate with WinDiscovery, which can detect and identify the GMR through the exchange of broadcast messages, even when TCP/IP networking parameters are not configured on the same network.

Once the GMR has a valid network configuration and the IP address of the unit is known, it can also be accessed and configured via SSH or Telnet by computers in the same network.

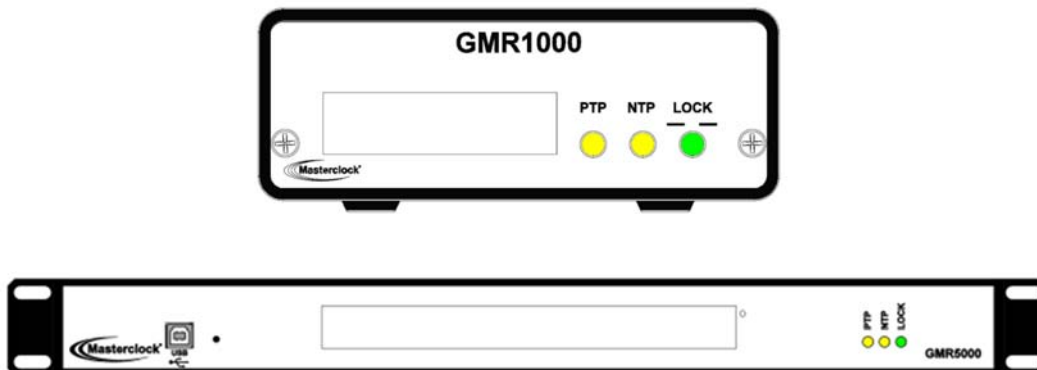
## FRONT PANEL 'LED' STATUS

GMR models have LEDs on the front panel to show status.

The left-most yellow LED (labeled **PTP** for **Precision Time Protocol, IEEE 1588**) flashes briefly with every PTP delay request (PTP is an optional feature).

The center yellow LED (labeled: **NTP** for **Network Time Protocol**) flashes briefly with every NTP request.

The right-most green LED (labeled: **Lock** or **Sync**) blinks twice per second when the device is not locked to a reference, and once per second when synced to an external reference such as GPS, PTP, Time Code, as NTP.



# WinDiscovery Installation and Standard Operations

Included on CD with your GMR is the WinDiscovery software application for detection, configuration and management of all Masterclock network devices. The application runs on Microsoft Windows.

## INSTALLING WINDISCOVERY

If you haven't already done so, insert the CD that shipped with your GMR to automatically install WinDiscovery. If AutoRun is not enabled on your computer:

1. Run the **Setup\_WinDiscovery.exe** application from the CD.
2. After a short "Preparing" step, you will be prompted to begin the install by clicking **Next**, accept the license agreement to proceed, fill in any user name and organization, click **Install**, which takes a minute or less, then click **Finish**.
3. By default the installation is in **C:\Program Files\Masterclock\WinDiscovery** or **C:\Program Files (x86)\Masterclock\WinDiscovery**

## Potential Communication Problems

Networks separated by physical routers will often block UDP broadcasts preventing WinDiscovery from locating devices on a remote network. Under such circumstances, WinDiscovery must be operated from a computer within the remote network or routers separating the networks must be configured to pass through (both directions) UDP traffic (including broadcasts) on ports 6163, 6263, 6170, 6171, 6172, 6173 and multicast addresses 224.0.1.254, 224.0.0.255.

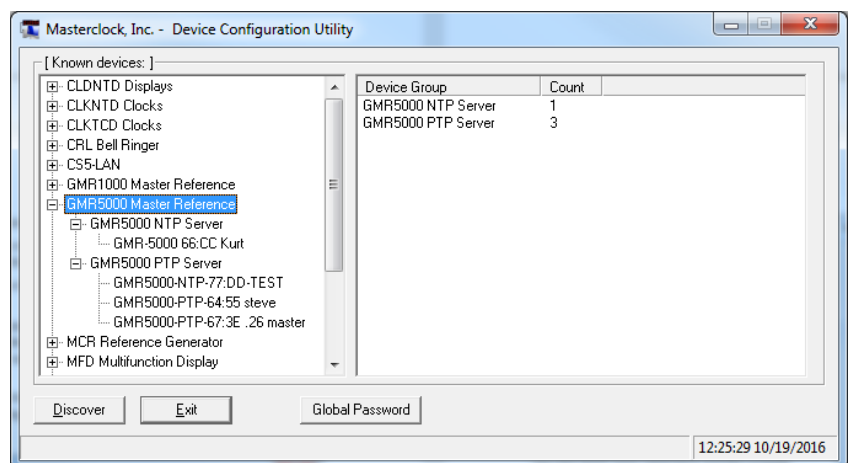
Personal computer firewall applications may also prevent WinDiscovery from operating correctly. Configure the firewall to allow bi-direction UDP traffic on port 6163 or temporarily disable the firewall while using the WinDiscovery application. Contact your IT department for proper switch configuration.

## USING WINDISCOVERY

Open **WinDiscovery** from the Windows Start Menu or by double-clicking the shortcut icon on the desktop.

Click the **Discover** button to reveal all the devices accessible on the network. The status bar will display the count of devices found. When complete (please wait until "100%" appears then disappears), a list of **device families and groups** will be displayed in the **left pane** of the WinDiscovery window. Click the **[+]** buttons to reveal the individual devices. Click the **[-]** buttons to hide them.

It is highly recommended that only one user opens **WinDiscovery** at a time. Other methods should not be used to manage the network devices while using this app.





## DEVICE SETTINGS

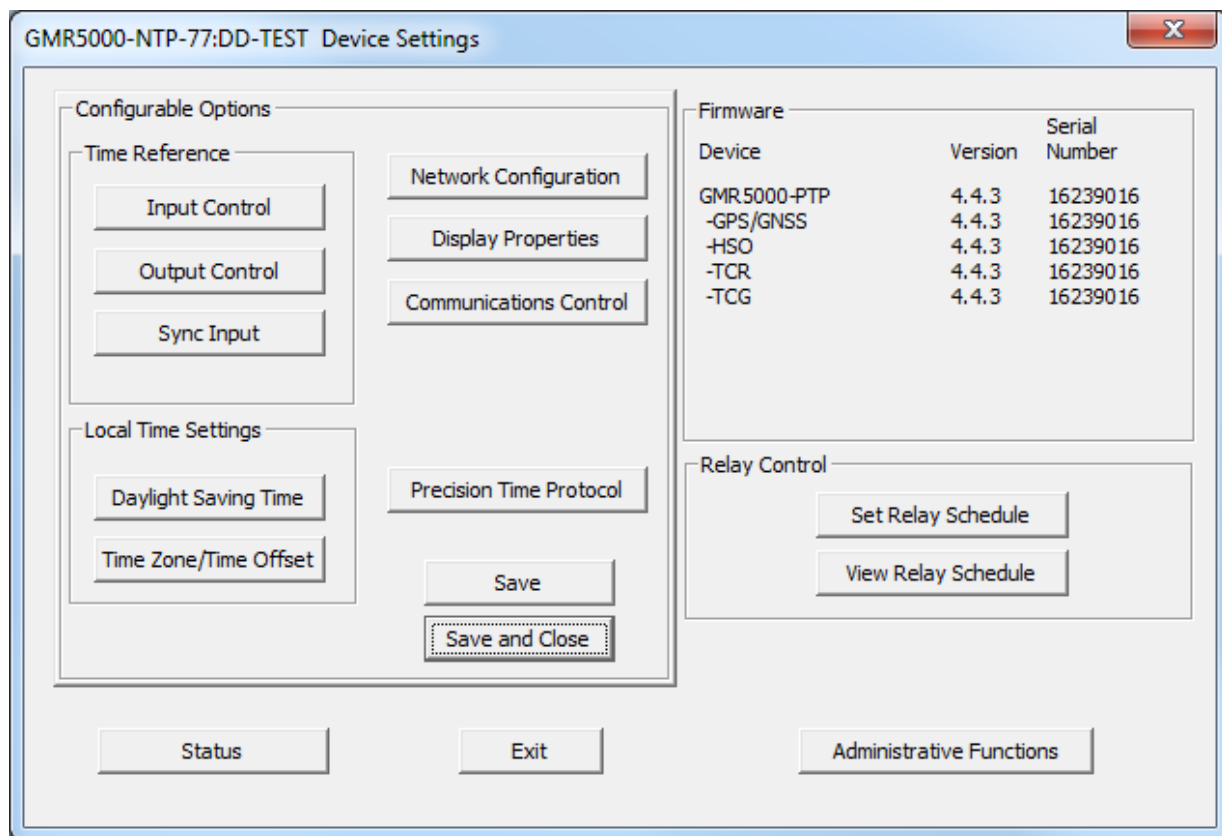
To open the Device Settings pane, click on the device name.

The Device Settings window configures the GMR to receive and display in the format that you prefer, using Time Zone offsets and DST settings to completely customize it relative to UTC time.

The top right section of the Device Settings window shows a list of the firmware and options associated with your GMR.

The rest of the Device Settings window includes access to all configuration options for the network. These include time reference inputs and outputs, display properties, relay control and administrative functions, such as password. There is also a status display to monitor remote clocks and devices from your computer screen using the free, included WinDiscovery software application.

*Any changes made in this window, including all the buttons thereon, will not be applied until you click the **Save** button, or the **Save and Close** button, prior to clicking the **Exit** button.*



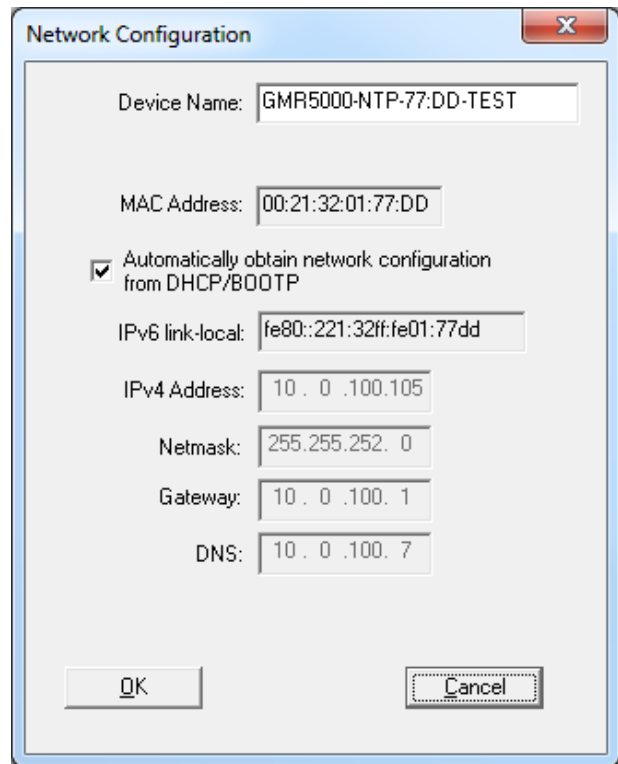
## NETWORK CONFIGURATION

The network configuration may be viewed in summary by clicking the **Network Configuration** button.

Each device is configured with a **device name** from the factory. Each device name includes the model name and a MAC address extension. You should change the device name to one that can identify the location of the device. By default, device names are the product name abbreviation followed by the last bit of the device's Ethernet address (MAC address). The device name may be changed from the factory default name by entering a unique name of up to 32 characters.

If a DHCP server is available on the network when the GMR is installed, the unit will be auto-registered with the DHCP server. The network system administrator can then view this DHCP name registration and the currently assigned IP address at the DHCP server.

The GMR allows for Static IP address, Gateway and DNS, network configuration entries to be made manually if no DHCP server is available. In addition, the NTP server addresses can be adjusted manually. Manual configuration requires disabling the DHCP defaults.



The screenshot shows a 'Network Configuration' dialog box with the following fields and values:

- Device Name: GMR5000-NTP-77:DD-TEST
- MAC Address: 00:21:32:01:77:DD
- Automatically obtain network configuration from DHCP/BOOTP
- IPv6 link-local: fe80::221:32ff:fe01:77dd
- IPv4 Address: 10.0.100.105
- Netmask: 255.255.252.0
- Gateway: 10.0.100.1
- DNS: 10.0.100.7

Buttons: OK, Cancel

To use a 3<sup>rd</sup> party NTP server, the DHCP box needs to be unchecked.

## INPUT CONTROL

The **Input Control** button provides access to the Input Control window, which provides buttons for NTP Client, Time Code Reader, NMEA Client, NENA Client, and GPS/GNSS.

### INPUT CONTROL > NTP CLIENT

NTP is an open-standard time synchronization protocol designed for precision synchronization and maintenance of time/date on computers and other devices attached to TCP/IP networks. NTP itself is transported with the UDP/IP (User Datagram Protocol), and is usually served on port 123. NTP time/date is UTC-referenced, as the protocol has no provisions for representing Time Zones or Daylight Savings Time ("Summer Time" in Europe).

A wealth of useful NTP information and resources can be found at <http://www.ntp.org>

The GMR acquires its internal UTC time reference from an NTP timeserver by using a built-in NTP client. The NTP client is fully configurable and can operate in several NTP modes to reference both a primary and a secondary NTP server. The NTP client can be disabled to allow operation as a stand-alone unit without a network connection.

If you want to synchronize PCs, workstations and servers to your GMR you must run an NTP/SNTP client on the PC that receives NTP time from the GMR. This client is responsible for asking the NTP server for time/date information. In some cases, it simply listens on the network for NTP time broadcasts, then sets the internal time of the computer or device

Masterclock provides a free Simple Network Time Protocol (SNTP) client for use to synchronize PCs, workstations and servers. This client app is called MasterSyncPC Freeware and it can be downloaded from the Masterclock website. The software is provided as-is, as a courtesy to our customers, with no technical support provided.

## NTP CLIENT SETTINGS

From the **Input Control** window, click the **NTP Client** button to access settings for the NTP client.

The NTP client is enabled by default. To disable the NTP client for certain applications, deselect **Enable NTP client** if desired.

The network client can be configured to either query the NTP time server at a selected interval, to listen to NTP broadcasts only, or to listen to multicast broadcasts.

**QUERY NTP SERVER FOR TIME** – is enabled by default. This is the **unicast** mode. The default configuration is to query the NTP server at 10-second intervals.

**LISTEN FOR NTP VIA BROADCAST ADDRESS** – The GMR can be configured to listen to NTP broadcasts by selecting the **Listen for NTP via broadcast address [255,255,255,255]** checkbox. When this is selected, the broadcast timeout period (in seconds) is adjustable. To configure the device to only listen to NTP broadcasts, click the checkbox **Listen for NTP broadcasts only** and enter a **Broadcast/Multicast Timeout** in seconds. The default timeout is 3600 seconds (1 hour).

**LISTEN FOR NTP VIA MULTICAST ADDRESS** – The GMR can be set up to listen to NTP using multicast addressing by selecting the **Listen for NTP via multicast address** checkbox. When multicast mode is selected, the client will also listen to broadcast messages.

When enabled, the **Multicast Class D/Group Address** may be specified as well as the frequency that multicast broadcasts will be issued. This can be changed as desired. The NTP client can listen for NTP multicast broadcasts using the full Class D/Group Address range. The NTP client does not restrict the use of the multicast address assignment and supports the full range of Class D multicast addresses or groups from 224.0.0.0 to 239.255.255.255.

These group addresses are defined and governed by **RFC3171, IANA IPv4Multicast Guidelines**.

Typically, the multicast address range 224.0.1.0 to 224.0.1.255 is utilized for NTP traffic. Please refer to the **RFC3171** for your specific application. <http://www.rfc-editor.org/rfc/rfc3171.txt>

**NTP SERVER NAMES**– By default the **Use NTP server provided by the DHCP server** box is checked and a primary NTP server address is displayed. If you wish to uncheck the box and provide your own server addresses for both primary and secondary servers, do so here.

**NTP CLIENT AUTHENTICATION SETTINGS** – This window permits the entering of up to 32 MD5 key values to be trusted or allowed. Primary client settings permit the entry of a primary server key number, a secondary server key number and a broadcast key number.

**NTP ADVANCED SETTINGS** – Advanced settings allow for the adjustment of additional network communication settings. Under most typical operating circumstances, it is not necessary, nor is it suggested, to change the advanced settings options.

## INPUT CONTROL > TIME CODE READER

The **Time Code Reader** button opens the Time Code Reader window and will only operate when a Time Code Reader is installed. installed auto-detects and decodes the date encoded incoming time code signal as UTC referenced time and treats the incoming time code signal as UTC referenced.

Choose from the selections offered and click the **OK** button when complete. Be sure to save configuration changes in the Device Settings window.

**Time Code Reader**

**SMPTE Time Code Settings**

- Ignore date on incoming time code.
- Date uses Leitch date encoding format.

**SMPTE 309M date encoding (either MMDDYY or MJD)**

Time precision class is ignored. Jam syncs to incoming time code occur as needed.

- Date uses SMPTE 309M encoding. (Time Zone information is included).
- Date uses SMPTE 309M encoding. (Time Zone information is not included.)

**IRIG Time Code Settings**

- Ignore Day of Year and Year on incoming time code. (Time Code is IRIG-A, B or E with no Day Of Year and/or no IEEE 1344 year encoding)

**Incoming Time Code Reference**

- UTC  
Incoming Time Code is UTC time.
- Local  
Incoming time code is Local Time. Make sure Daylight Saving Time and Time Zone/Time Offset parameters have been set in the Main Dialog box.
- Custom  
Incoming Time Code is offset from UTC by a custom value.  
**Custom Settings**

**Calibration for SMPTE or IRIG**

**Auto** - In this mode the device calibrates (finds the best gain) whenever locking to incoming time code. This can take from zero to 40 seconds, depending on type of time code.

**Saved** - The device re-uses the gain found at previous calibration. This shortens the time to lock to 2 seconds, if successful. If the device is not locked when the timeout expires then it re-calibrates.

**Manual** - In this mode the user enters a gain level for the device to use when locking. This shortens the time to lock to < 2 seconds, if successful. If that gain cannot achieve lock then the device will remain unlocked.

**Mode**

- Auto
- Saved
- Manual

**86400** Seconds to wait before re-calibrating when lock lost in Saved mode. 1 to 86400 allowed.

**Calibrate Now** Calibrate immediately in any mode.

**88** Current Gain

**255** Enter Manual Gain, 1 to 255, where 255 is maximum gain

**Fractional second time code offset**

Nanosecond offset: **0**

**OK** **Cancel**

## INPUT CONTROL > NMEA CLIENT

Click the **Enable NMEA Client** button and adjust the **Port**, **Baud rate**, **Data bits**, **Stop bits**, and **Parity** selections.

All GMR models have a client that can be enabled to decode NMEA 0183 messages coming from marine electronic devices such as an echo sounder, sonar, gyrocompass, autopilot and GPS.

Any one of the following NEMA messages can be used for time synchronization.

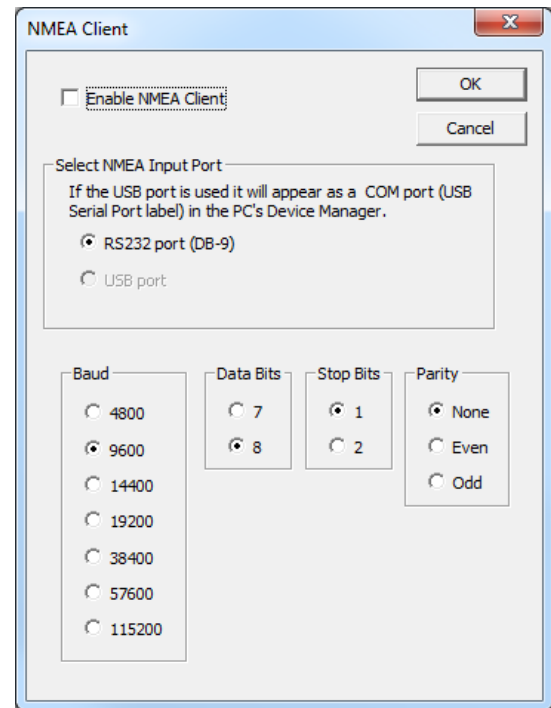
**\$GP ZDA**

**\$GP RMC**

**\$GP GGA**

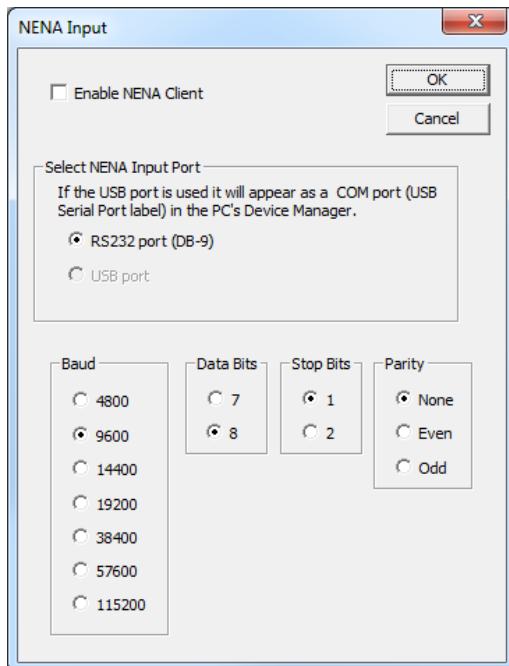
**\$GP GLL**

Before showing how to enable NMEA, keep in mind that NMEA, NENA and Truetime/Kinometrics use the same port, (the RS-232 port) so only one can be enabled at a time. This is true for their input as well as output, so only one client of any kind can be enabled, or one generator of any kind.



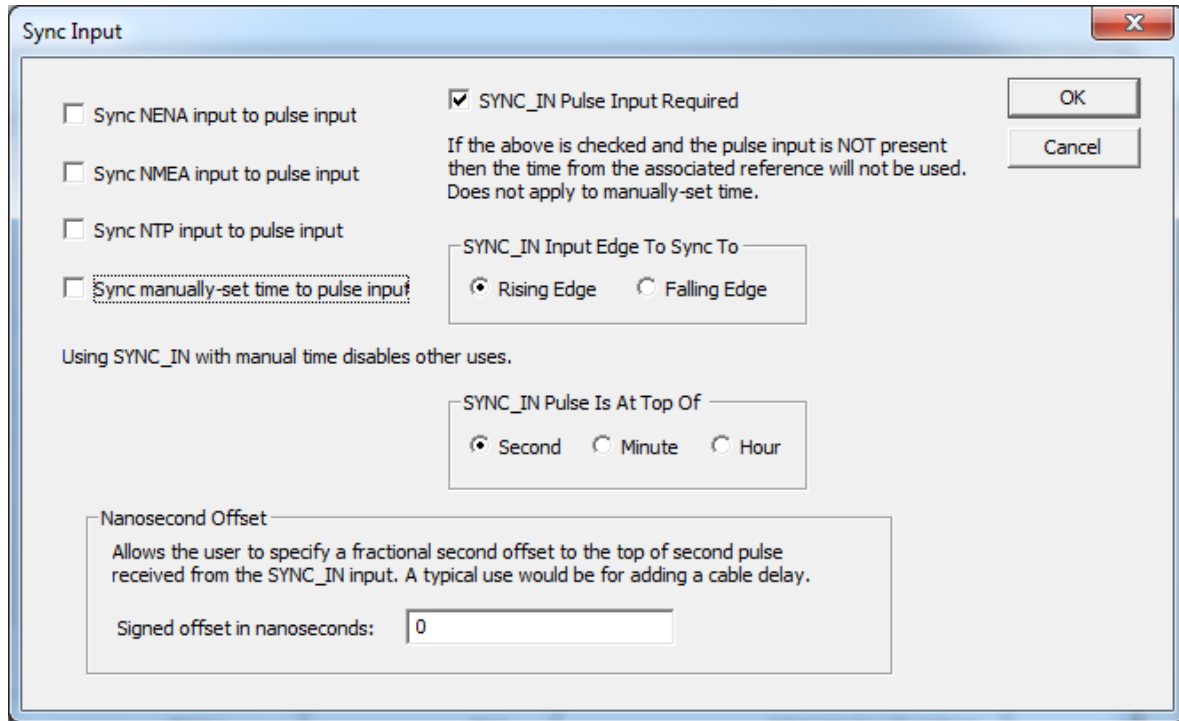
## INPUT CONTROL > NENA CLIENT

Click the **Enable NENA Client** button and adjust the **Port**, **Baud rate**, **Data bits**, **Stop bits** and **Parity** selections. The NENA client can synchronize to Format "0", Format "1", and Format "8".



## INPUT CONTROL > SYNC INPUT

If the **Sync Input** option is installed, you can sync the device to a pulse input. Several sync options are available.



The image shows a software dialog box titled "Sync Input" with a close button (X) in the top right corner. The dialog contains several configuration options:

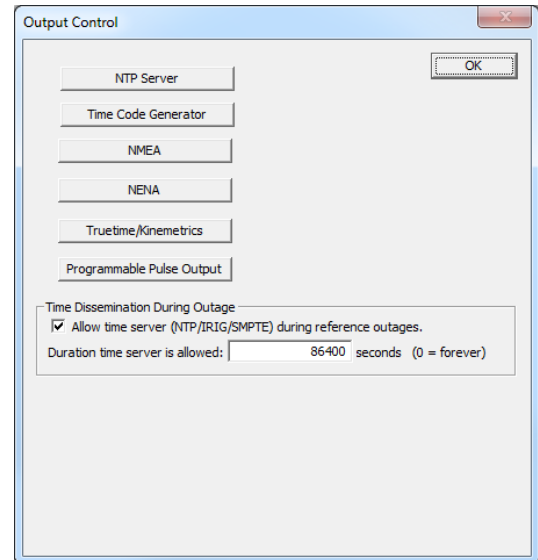
- Four unchecked checkboxes on the left: "Sync NENA input to pulse input", "Sync NMEA input to pulse input", "Sync NTP input to pulse input", and "Sync manually-set time to pulse input".
- A checked checkbox: "SYNC\_IN Pulse Input Required".
- Below the checked checkbox, a text block: "If the above is checked and the pulse input is NOT present then the time from the associated reference will not be used. Does not apply to manually-set time."
- A group box titled "SYNC\_IN Input Edge To Sync To" containing two radio buttons: "Rising Edge" (selected) and "Falling Edge".
- A group box titled "SYNC\_IN Pulse Is At Top Of" containing three radio buttons: "Second" (selected), "Minute", and "Hour".
- A group box titled "Nanosecond Offset" containing a text description: "Allows the user to specify a fractional second offset to the top of second pulse received from the SYNC\_IN input. A typical use would be for adding a cable delay." Below this is a text input field labeled "Signed offset in nanoseconds:" with the value "0" entered.
- Two buttons in the top right: "OK" and "Cancel".

## OUTPUT CONTROL

From the **Device Settings** window click the **Output Control** button to access the GMR output options.

*Any changes made in this window will not be applied until you click the **Save** button, or the **Save and Close** button on the **Device Settings** window.*

The **Time Dissemination During Outage** option is enable by default. If the device loses connection to its reference source (GPS, Time Code, NTP, etc.), it will continue to provide for the specified number of seconds.



## OUTPUT CONTROL > NTP SERVER

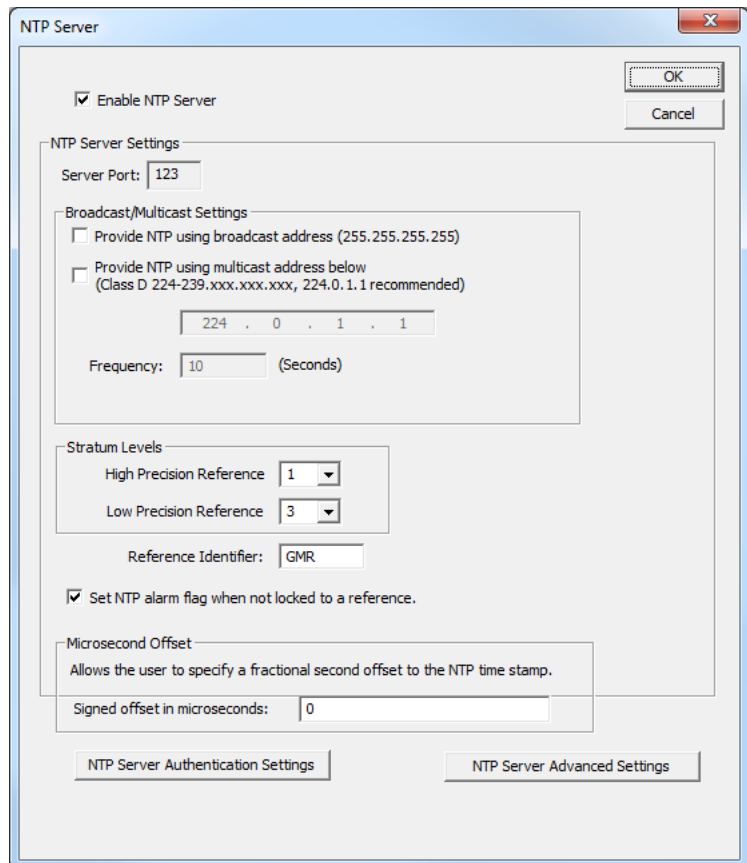
By default, the **Enable NTP Server** option is checked with all appropriate settings filled in. If you want to change these settings, the box must be checked.

**Stratum Levels** are user assignable from 0-15, for both the external high precision reference (primary – GPS or Time Code Reader) and the internal clock low precision reference (secondary– TCXO and or OCXO). A stratum reference level of “0” is defined to be “disabled”. A stratum reference level of “1” may be used for trusted time sources such as models with GPS receiver option or a Time Code Reader Option, or for units with an OCXO installed.

**Microsecond Offset** allows for the NTP time stamp to be adjusted.

By clicking the **NTP Server Authentication Settings** button you can set MD5 key settings for both Client and Server, plus enable authentication for client request, broadcast, and multicast packets.

The **NTP Server Advanced Settings** button allows you to change NTP time served from UTC to local time or modify it with custom offsets.



## OUTPUT CONTROL > TIME CODE GENERATOR

If you have the Time Code Generator Option installed, you control it by opening **Device Settings**, then clicking the **Output Control** button, then clicking the **Time Code Generator** button.

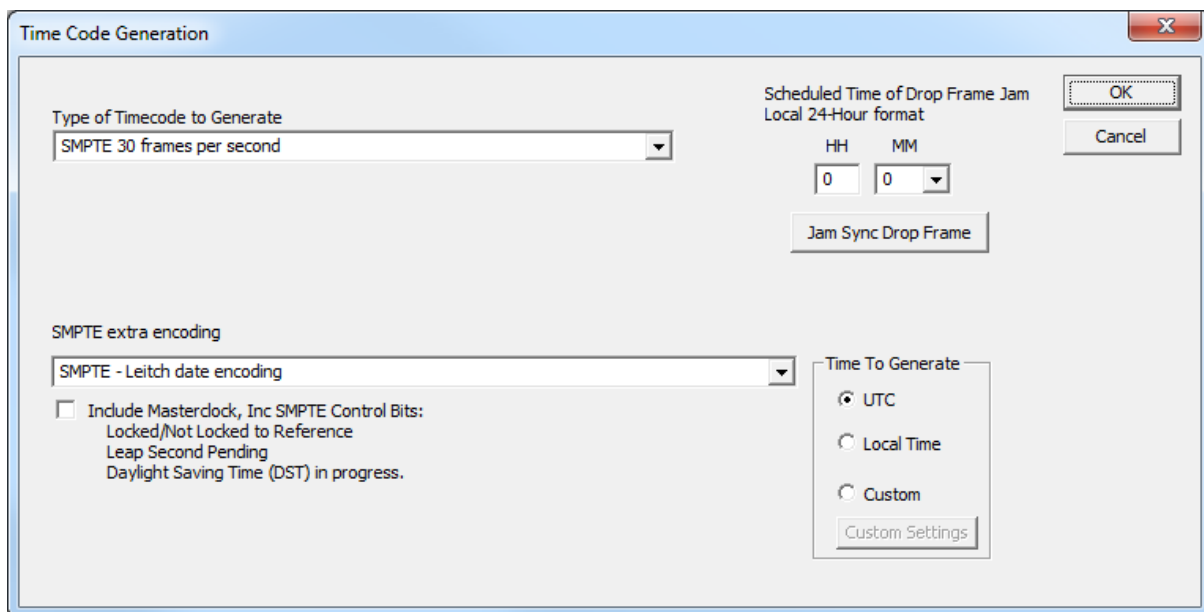
The **Time Code Generation** window allows you to choose the **Type of Time Code to Generate** and other information available for the type selected. Modify these options to suit your need.

Then, in the **Time To Generate** box, select **UTC**, **Local Time** or **Custom Time**. This sets the time that is encoded into the time code packet.

**IMPORTANT:** Your choice of **Time To Generate** influences what is displayed on the devices that receive the time code. UTC is the standard, so you may have to use it if the receiving devices do not know how to handle Local or Custom time.

Depending on your options, other drop down menus will appear in this **Time Code Generation** window.

Click the **OK** button when all your choices have been made, then click **OK** again on the **Output Control** pane, then **Save or Save and Close**.



The screenshot shows the "Time Code Generation" dialog box. It has a title bar with a close button (X). The main area contains several controls:

- Type of Timecode to Generate:** A dropdown menu currently showing "SMPTE 30 frames per second".
- Scheduled Time of Drop Frame Jam:** A section with the text "Local 24-Hour format". It includes two spinners for "HH" (Hours) and "MM" (Minutes), both currently set to "0". Below these is a "Jam Sync Drop Frame" button.
- Buttons:** "OK" and "Cancel" buttons are located in the top right corner.
- SMPTE extra encoding:** A dropdown menu currently showing "SMPTE - Leitch date encoding".
- Include Masterclock, Inc SMPTE Control Bits:** A checkbox that is currently unchecked. Below it, the text reads: "Locked/Not Locked to Reference", "Leap Second Pending", and "Daylight Saving Time (DST) in progress."
- Time To Generate:** A section with three radio buttons: "UTC" (which is selected), "Local Time", and "Custom". Below these is a "Custom Settings" button.



## OUTPUT CONTROL > NMEA

The GMR provides an **NMEA (National Marine Electronics Association) 0183** message output on the RS-232 serial port. All GMR units can transmit the ZDA format or RMC (with no position information) NMEA message.

**NMEA Message Output** – is disabled by default.

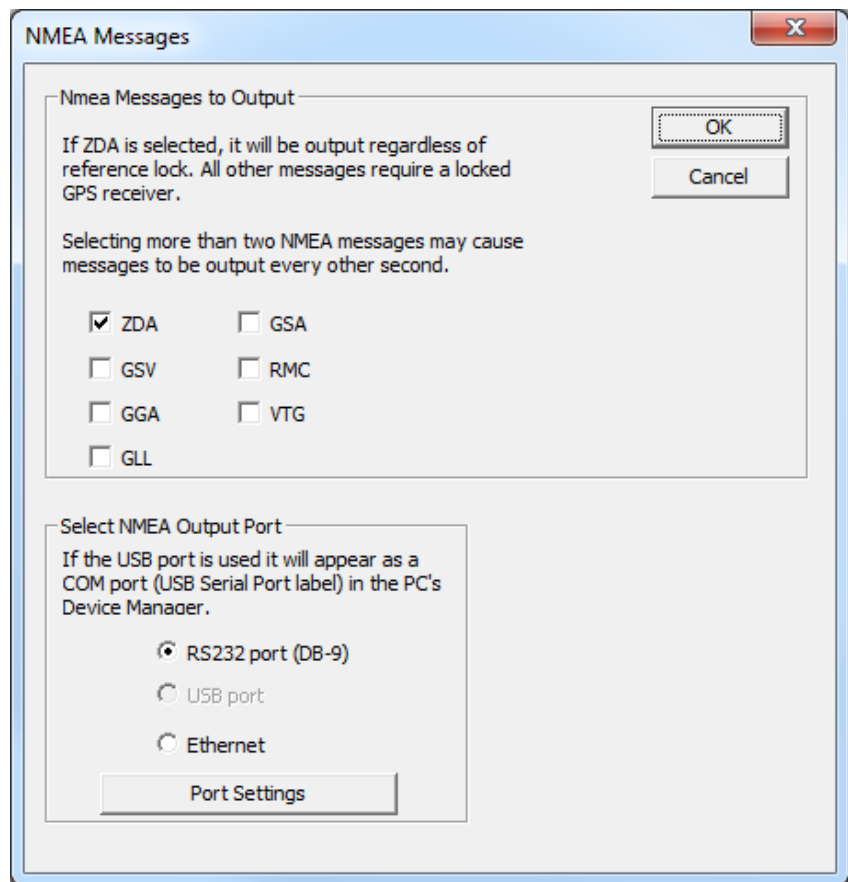
Select the RS-232 settings button to adjust the baud rate and communications settings for the GMR window. The RS-232 port can be configured for baud rates of 4800, 9600, 19200, 38400, 57600, and 115200; along with 7 or 8 data bits, 1 or 2 stop bits, and the parity bits can be selected as None, Odd, and Even. The default settings will be 4800 baud, 8 data bits, no parity, 1 stop bit.

The NMEA messages may be monitored on a computer using **HyperTerminal** or **PuTTY** or the output may be connected to other devices or apps that accept NMEA 0183 messages.

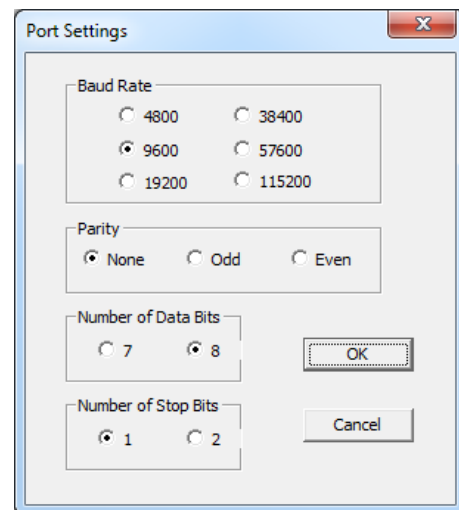
### Ethernet Settings

NMEA messages can be sent via LAN to a device with an Ethernet adapter. Select **Ethernet** as the port and click on **Port Settings**. The **Ethernet Settings** pane appears. Here you must enter the **IP Address** and **Port Number** of the device that will receive the messages.

You may also select to output an **Extra Identifier** to precede every NMEA message by clicking the **Yes** button.



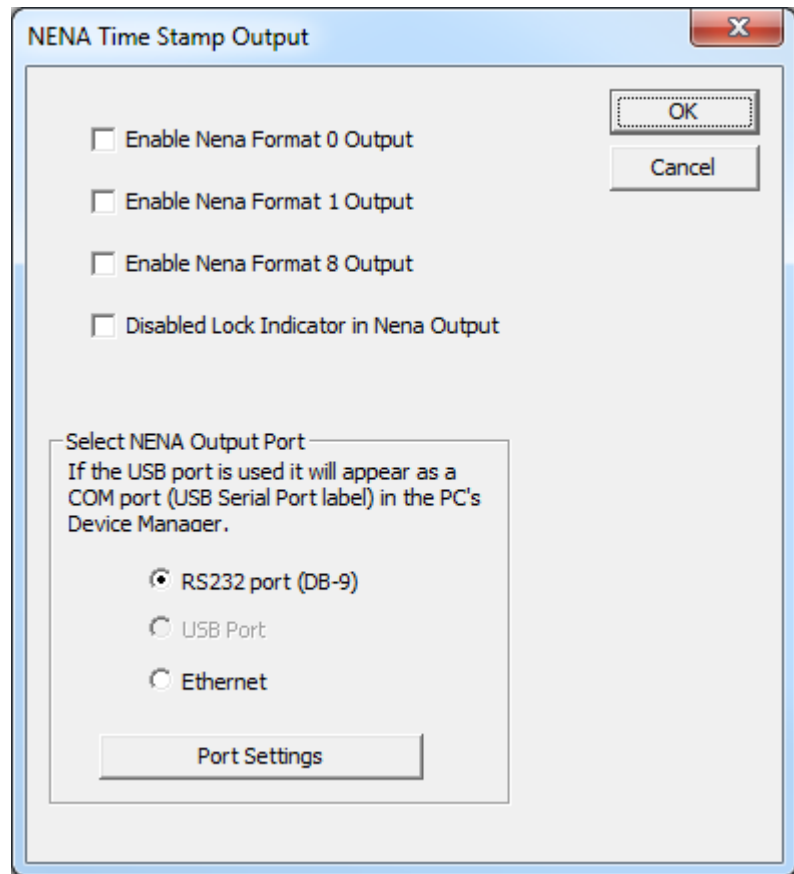
31



## OUTPUT CONTROL > NENA

The ability to decode and generate NENA (National Emergency Number Association, otherwise known as the 911 system) messages is standard on GMR models. To configure the **NENA** input, mimic the **NEMA Input** instructions. To configure the **NENA** output settings, follow these instructions:

1. On Device Settings click the **Output Control** button.
2. Click on the **NENA** button to show the **NENA Time Stamp Output** window. Select your preferred format from the four choices.
3. Select the output port for the messages.
4. Click on Port Settings to configure the port. The settings you make here must be put into every client that the messages go to.
5. When done click on every **OK** button until you get to the Device Settings window, then click **Save**.



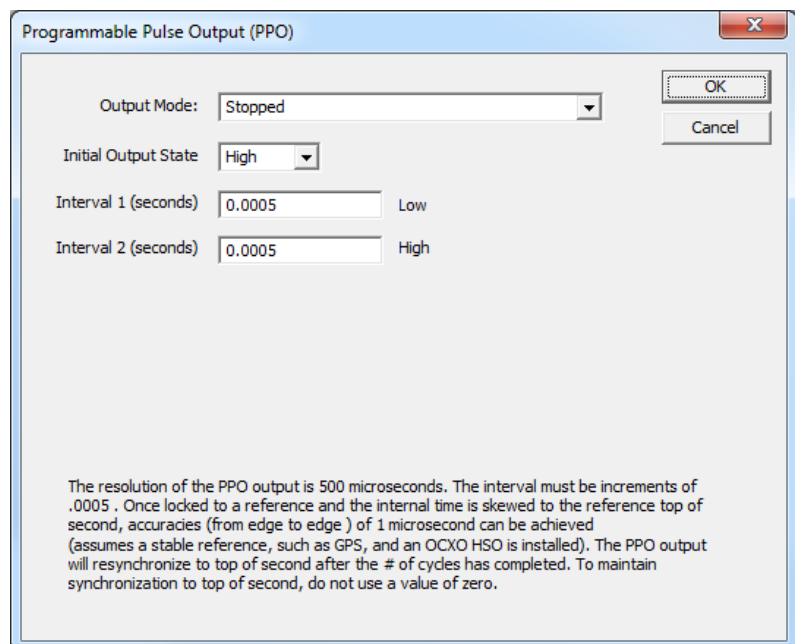
32

## OUTPUT CONTROL > TRUETIME/KINEMATICS

This is standard on GMR models. There is no provision for input. This output and others share a port, so only one can be enabled at once.

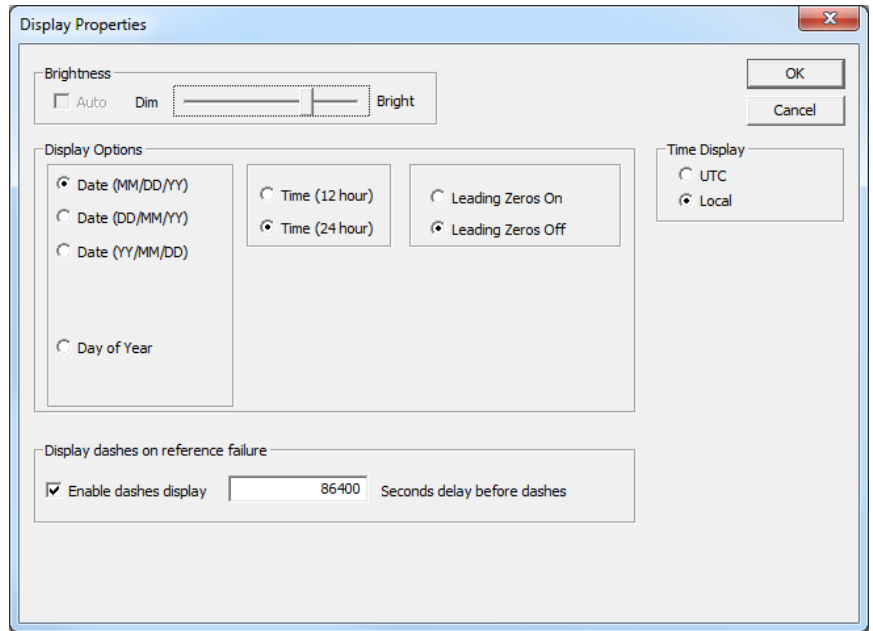
## OUTPUT CONTROL > PROGRAMMABLE PULSE OUTPUT

This button is visible or enabled only if a PPO module is installed. When a PPO is present, the GMR can provide an accurate pulse for specialized applications. A programmable pulse output option is available for separate purchase. This pulse output can be programmed with a pulse interval to occur from every 100  $\mu$ s to up to 3 days. Pulse width is programmable from 500 microseconds to 100 milliseconds (intervals of 500 microseconds). By default, the GMR5000 timing interval will be a 1 pulse per minute (1PPM), rising edge, 50mS [typical] wide (active high) 5V TTL pulse.



## DEVICE SETTINGS > DISPLAY PROPERTIES

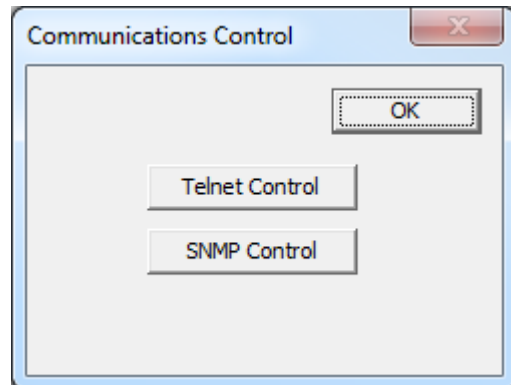
Here you can change the brightness of the display or modify the presentation of the date and time. You can change the display from UTC to local time and you can alternate times with dates and set the rate at which they change.



## COMMUNICATIONS CONTROL

**Telnet** and **SNMP** are configured using the **Communications Control** button. Telnet is a TCP/IP protocol through which the GMR can be configured via a command line. Almost all of the settings available in WinDiscovery are also available via Telnet. The default port number **23** cannot be changed.

**SNMP** stands for Simple Network Management Protocol. This protocol enables a PC application (called an SNMP Manager or MIB Browser) to get information from the SNMP Agent in the GMR. That information conveys the network identity and status of the GMR, like the number of packets transmitted or received, the number of communication errors, etc.



In addition to that standard SNMP data, Masterclock has created a custom set, called a custom MIB, which can be imported into a MIB Browser. It is available for download from our website. It conveys data such as this:

- NTP leap second setting, stratum level, precision, reference delay, poll interval, source and offset.
- Device description, processor, firmware version, serial number and model.
- GPS receiver health, latitude, longitude and number of satellites visible.
- The lock status of NTP, Time Code, GPS, PTP, NMEA and NENA.

## DAYLIGHT SAVING TIME

Daylight savings time (aka: “Summer Time” in Europe) adjustments can be configured separately and in addition to a Time Zone offset. Daylight time standards vary widely throughout the world. Traditional daylight/summer time is configured as a one-hour positive bias. The US/Canada DST standard is: one-hour positive bias, starting at 2:00 am on the second Sunday in March, and ending at 2:00 am on the first Sunday in November. In the European Union, time changes are defined relative to the UTC time of day instead of local time of day (as in US).

To ensure proper hands-free year-around operation, the automatic daylight time adjustments must be configured using the Daylight Savings Time Option and not with the Time Zone offset option. **Factory default: Daylight Savings time is not set.**

Click **Daylight Saving Time** to open this window. The clock has complete flexibility to display any Time Zone and DST combination.

For setting the DST rules, use one of the following options.

1. Manually enter the Daylight Saving Time rules; or
2. Click the **US/Canada Standard** button; or
3. Click the **EU Standard** (European Union) button; or
4. Click **Current Windows Setting** to apply the current configuration for your Windows OS.
5. Click **OK** to close the Window.

The DST rules will be saved when you click either the **Save** or **Save and Close** button on the Device Settings window.

The screenshot shows the 'Daylight Saving Time Configuration' dialog box. At the top, there's a 'Daylight Bias' field with a spinner set to '00:00:00' and a 'Disable daylight time' checkbox. Below that is a 'Time reference for daylight saving time shift' section with a 'Use UTC instead of local time' checkbox. The main area is split into two columns: 'Daylight saving time start' and 'Daylight saving time end'. Each column has radio buttons for 'First', 'Second', 'Third', 'Fourth', 'Last', and 'Absolute'. Below the radio buttons are dropdown menus for 'Day of week' (set to 'Sunday'), 'Month', and 'Day of month', and a 'Time' field with a spinner set to '00:00:00'. At the bottom, there are buttons for 'US/Canada Standard', 'EU standard', 'Current Windows Setting', 'OK', and 'Cancel'.

## TIME ZONE/TIME OFFSET

A time zone offset (or bias) can be provided to adjust the time for display or time output purposes. A bias can be set as a positive (+) or negative (-) value with a resolution of one second. **Factory default: No offset = UTC time.**

Click the **Time Zone/Time Offset** button to open the “**Time Zone Configuration**” window. Here you’ll find a list of Time Zones, including city and area descriptions to help with the selection. Select the offset that fits your location and click **OK** to close the window. Click the **Save** or **Save and Close** button on the Device Settings window.

## RELAY CONTROL

Set a schedule of relay switch events with the **Set Relay Schedule** button. Once a schedule has been applied to the GMR, the current relay schedule information can be retrieved to validate the entry was made correctly and the schedule is active by using the **View Relay Schedule** button. Click the **Save** or **Save and Close** button on the **Device Settings** window.

## ADMINISTRATIVE FUNCTIONS

Click the **Administrative Functions** button to open a menu that is rarely accessed. These include:

1. **Set Time/Date** for custom time, not UTC or local time
2. **Set Password**
3. **Reset Device**
4. **Install New Option**
5. **Leap Second Date**
6. **Email Configuration (SNMP)**

### SET TIME/DATE

There may be situations where you do not want to display UTC or local time. This feature may be most useful for demonstrations, in lab situations or in environments where an external reference time signal is not available. Use this when the built-in NTP client is disabled or when a network connection to an NTP server is not available.

Click the **Set Time/Date** button to reset the time to your preference. You will be prompted with some additional instructions then offered the choice to continue. Click **Yes**.

In the **Set Time and Date** window (left) click the **Custom** button to enter your new time and date. Click the **Set Now** button to activate your custom time. To return to UTC time, choose **UTC Time and Date button from the PC clock** then click **Set Now**.

### SET PASSWORD

Each Masterclock device in your network may have its own password (see the **Properties** window to **Set Password**), or you may create a **Global Password** on the **Discover** window (see below). The default password is **“public”**.

Your custom password should be one to eleven characters and is case sensitive. For added password strength, you should use both alphanumeric and special ASCII characters.

**The password must be entered twice to confirm the entry.** Click **Change Password** to save it.

When a password is set for a device, each time you click **OK**, **Save** or **Save and Close** for that device you will be asked for the password. You can select the **Remember this password for the session** button and you will not be prompted for the password, until you restart WinDiscovery, or you can use the **Global Password** feature (see below).

If you enter the wrong password and selected the **Remember this password for the session** checkbox, you will receive an error upon clicking **OK**, **Save** or **Save and Close** to any configuration changes. You can close the WinDiscovery session to forget the wrong password(s). However, this will require entering the password(s) again for each device.

You can also remove the incorrect password entry during a WinDiscovery session by going to the drop-down menu for the device (right click to see this) and selecting the **Forget memorized password** button.

## GLOBAL PASSWORD

The **Global Password** feature allows the user to enter a single password once for all Masterclock devices. During subsequent sessions, you will not have to reenter the password.

### ENABLING / DISABLING GLOBAL PASSWORD

To enable the Global Password:

1. Check **Enable Global Password**
2. Type your password.
3. Click **OK**

To disable the Global Password:

1. De-select the **Enable Global Password** checkbox
2. Click **OK**.

## RESET DEVICE

Click **Reset Device** to induce a soft reset. This procedure allows the GMR to clear its current communications buffer and re-initialize its processing, which includes another software request for a DHCP address. All settings will be reset except for Network Settings. (Only a hard reset will clear all settings including network setting.)

Alternatively, if you are not in the **Administrative Functions** window, but are viewing the list of devices after pressing the **Discover** button, simply right click on the device you are interested in and select the **Reset Device** button.

## INSTALL NEW OPTION

Click the **Install New Option** button to install any new option key you requested and received here. This will install the new option into the software.

## LEAP SECOND DATE

UTC runs at the rate of atomic clocks. When the difference between this official time and one based on the rotation of the Earth approaches one second, a "leap second" is added to UTC. It is to be applied at UTC midnight on the day which an international organization schedules it. This day is scheduled a few months in advance, but happens only when observation of Earth's rotation proves it is necessary. The user of a Masterclock device must keep himself aware of the schedule and manually enter into the device the date that the leap second is to be applied, in advance.

Click the **Leap Second Date** button to enable a future leap second to occur on any specific date that you manually enter.

## EMAIL CONFIGURATION (SMTP)

Click the **Email Configuration** button to generate email alerts when certain conditions are met.

## SET TO DEFAULT CONFIGURATION

Click the **Set to Default Configuration** button to reset all of your previously entered options and customs settings back to the original factory settings. You will get the "Are you sure?" window. Click the **Yes** button if you are sure you want to return to the default configuration with the default password: "**public**".

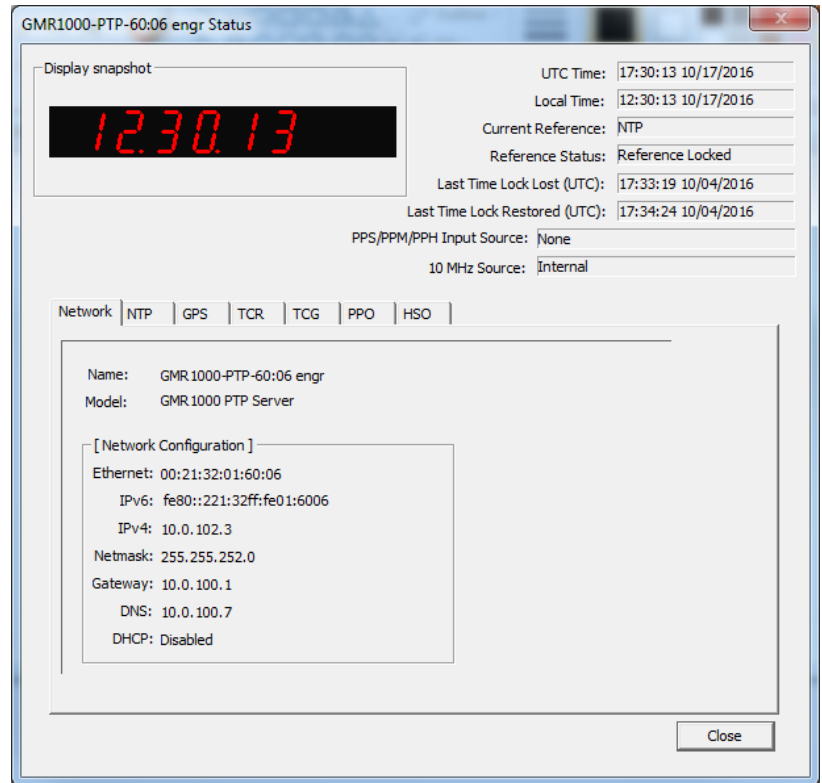
## STATUS

At the bottom left of the **Device Settings** window is the **Status** button. Clicking it shows the window showing the dynamic qualities and quantities of the device.

The **Status** window includes a **Display Snapshot** of a graphic digital clock representing the face of the actual GMR in real time.

On the top right appear the UTC Time and date, Local Time and date, the Current Reference (in this case GPS), the Reference Status (in this case Locked) and two fields listing **Last Time Lock Lost** and **Restored**. Those GMRs with the Sync Input option will show the origin of the sync in the **PPS Input Source** field. Those with the option of a 10 MHz input will show the source, either internal or external.

The bottom of the **Status** window has tabs for every major function of the device. A tab will display only if that function is installed and working.



### Network Tab

Includes the name of the device, the model of the device and a summary of the network configuration, much of this data is repeated from the network configuration window described earlier (page 20).

### NTP Tab

Shows if the NTP server is enabled, plus the number of NTP requests service and the server stratum. Also shows if the NTP client is enabled, including indications for the active server, the NTP status, the last NTP time stamp, the largest time adjustment, and the average time adjustment.

### GPS Tab

Includes time and date for Lock Lost (UTC), Lock Restored (UTC), your geographical position, receiver details and a list of the satellites the GPS antenna is listening to (in this case nine) and their individual SNR (signal-to-noise ratio, with 41.0 as the highest quality). This tab appears only if a GPS receiver is installed.

### TCG Tab

Includes the **Type of Code Being Generated**, the **Raw Time Code** and the **Time to Generate**, which is what you chose of **UTC**, **Local** or **Custom**.

### TCR Tab

Includes the **Type of Code** the device is locked, the last time lock was lost, the last time lock was restored, and the **Raw Time Code**.

### PPO Tab

Includes the **Output Mode**, the **Output State**, and the **Output Level**.

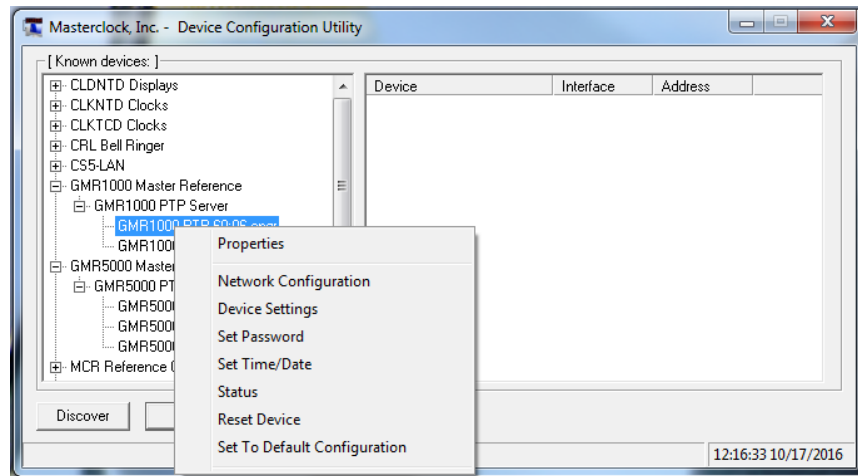
### HSO Tab

Includes the **Current Calibration Level** of the high-stability oscillator and the **Oscillator Voltage Level**.

## QUICK START MENU

By right-clicking on the device from the main WinDiscovery window, you can access several commands including:

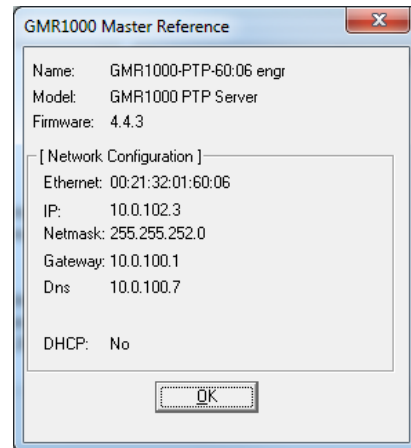
- Properties
- Network Configuration
- Device Settings
- Set Password
- Set Time/Date
- Status
- Reset Device
- Set To Default Configurations



## PROPERTIES

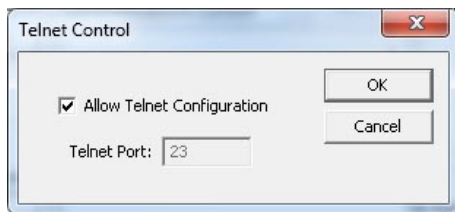
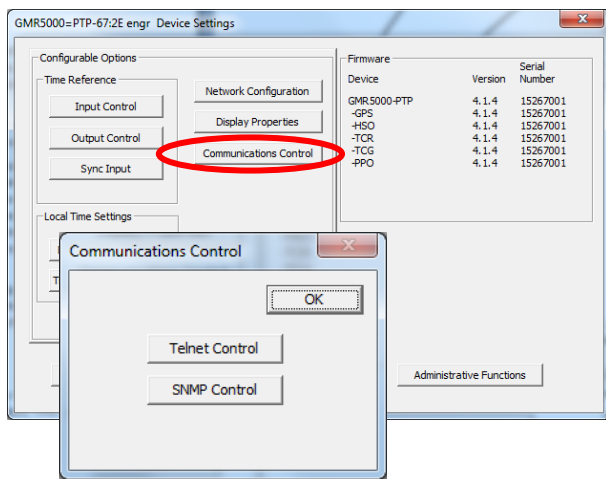
The device properties may be viewed in summary by clicking the **Properties** button. These include:

- Name
- Model
- Firmware Version
- Network Configuration





# Using Telnet



## TELNET

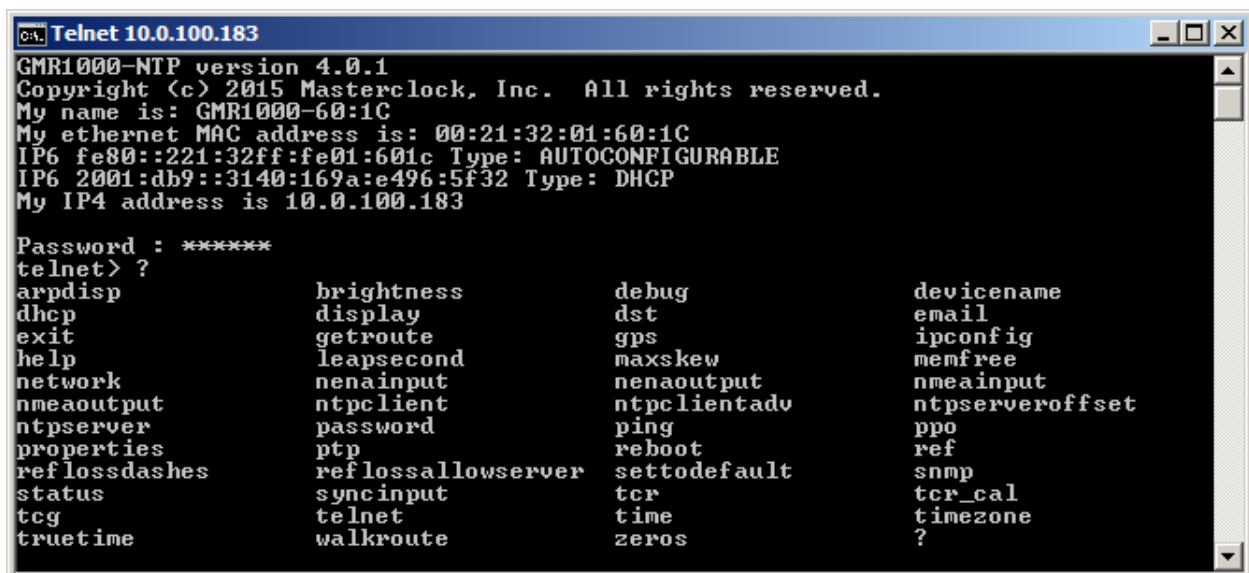
Typically, in Windows OS you use the free WinDiscovery app to establish first-time networking configuration. However, in Windows, Linux, UNIX, Macintosh and other operating systems you may use **Telnet** to configure the GMR, as a standard feature. Telnet is a communication protocol in the TCP/IP suite that uses typed-in commands to make settings.

To be sure Telnet is enabled, go to **Device Settings** and click the **Communications Control** button. In that window, click the **Telnet Control** button and then checkmark **Allow Telnet Configuration**. By default the Telnet Port is set to **23** and cannot be changed. Click **OK**, then **Save** or **Save and Close**.

**IP ADDRESS** – You must know the IP address of the GMR to begin a Telnet session. Click the **Network Configuration** button to view the IP address. Alternative, you can quickly push the reset button to display the IP address on the device.

Let's say the IP address of the GMR is 123.123.123.123. In Windows a Telnet session to this device is done by doing Run and entering "telnet 123.123.123.123" or by entering "cmd" and then entering "telnet 123.123.123.123" in the window that appears, called a command window. A banner of information appears, listing the GMR's name and essential network attributes. You are prompted to enter the password. It is "**public**" by default. The same password is used by telnet and WinDiscovery.

After logging in one controls the GMR by issuing commands. A list of them is displayed by entering "?". The commands available depend on what is installed in the device. Each command has options, which are described by entering the command followed by "?".



# Using SSH – Secure Shell

## SSH – SECURE SHELL

SSH is a secure command line way to control a GMR, as a standard feature. It is intended for users who cannot access WinDiscovery for network security reasons, or for users with Linux, UNIX or Macintosh PCs. The commands available are the same as those for Telnet. Data exchanged is encrypted by both 3DES and 128-bit AES methods, which is a very high level of security. SSH has no settings via WinDiscovery—only via Telnet and SSH itself.

To run an SSH session, a special client is needed to run on the user's PC. The client will connect with the SSH server running in the Masterclock device. TeraTerm is such a client (free for download: <http://ttssh2.sourceforge.jp/>).

**Note:** Masterclock does **NOT** make such a client.

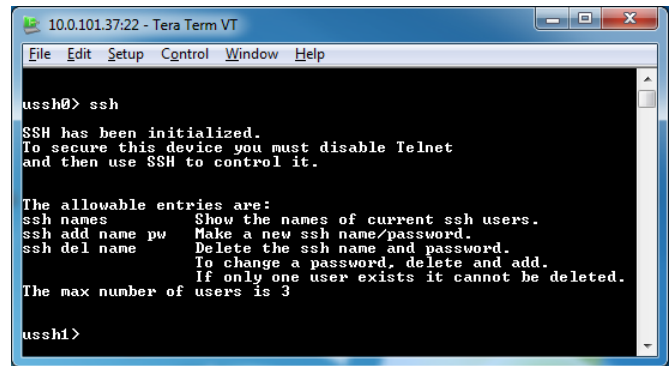
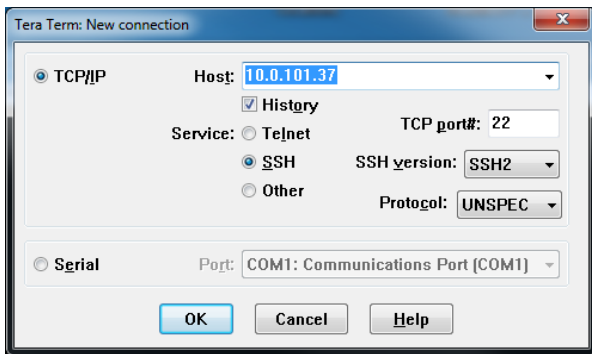
Typically, when using such a client, one states the IP address of the device and standard SSH settings, as at left.

Default **user name:** **public**  
Default **Passphrase:** **publicpass**

The first time you connect to a device, a security warning window will appear showing this host has never been seen before and ask if you want to add it to the list of known hosts.

To get commands to display as you enter them, you may need to turn on “local echo” for the session, and other settings may need to be made to make the text easily readable.

If you decide to rely on SSH then you **MUST DISABLE TELNET** for the device to be truly secure. The GMR allows only one SSH session at a time.



# Telnet and SSH Defaults

---

Firmware version 4.5.0

## **DISPLAY:**

Brightness = 12 out of 15  
Date format = MM/DD/YY  
Time format = 24 hour, Local  
Leading zeros = OFF  
Day of Year = OFF  
Dashes enabled, appear after device is unlocked for 86400 seconds

## **NETWORK CONFIGURATION:**

DHCP = on  
IPV4 address, IPV6 address, Netmask, Gateway and DNS set by DHCP server.

## **COMMUNICATIONS CONTROL:**

Telnet:  
Telnet = OFF

## **SNMP:**

Agent state = RUNNING  
Contact = BLANK  
Location = BLANK  
Name = BLANK  
Community 2 = BLANK  
Current Community = 0  
Trap Receivers 0 through 5 = BLANK

## **INPUT CONTROL:**

NTP Client:

State = NOT ENABLED  
Query NTP Server For Time = ON  
Listen For NTP via Broadcast Address = OFF  
Listen For NTP via Multicast Address = OFF  
Use NTP server provided by the DHCP server = OFF  
Primary NTP server = BLANK  
Secondary NTP server = OFF  
Ignore NTP response when the alarm flag is set = OFF  
Microsecond Offset = 0

Time Code Reader:

SMPTE:  
Ignore date on incoming time code = OFF  
Date uses Leitch date encoding format = ON  
Date uses SMPTE 309M encoding. = OFF  
Date uses SMPTE 309M encoding. = OFF  
IRIG Time Code Settings:  
Ignore Day of Year and Year on incoming time code. = OFF  
Incoming Time Code Reference:  
UTC = OFF  
Local = OFF  
Custom = OFF

Calibration for SMPTE or IRIG:  
Mode = Auto  
Seconds before recalibrating = 86400  
Fractional second time code offset:  
Nanosecond offset = 0

**NMEA Client:**

State = NOT ENABLED  
NMEA input port = RS232 port (DB-9)  
Baud = 9600  
Data Bits = 8  
Stop Bits = 1  
Parity = None

**NENA Client:**

State = NOT ENABLED  
NMEA input port = RS232 port (DB-9)  
Baud = 9600  
Data Bits = 8  
Stop Bits = 1  
Parity = None

**GPS/GNSS:**

Nanosecond offset = 0

**OUTPUT CONTROL:**

**NTP Server:**

State = ON  
Settings:  
Port = 123 (not editable)  
Provide NTP using broadcast address (255.255.255.255) = OFF  
Provide NTP using multicast address = OFF  
Frequency = 10

**Stratum Levels:**

High Precision Reference = 1  
Low Precision Reference = 3

Reference Identifier = GMR  
Set NTP alarm flag when not locked to a reference = OFF  
Microsecond Offset in microseconds = 0

**NTP Server Authentication:**

Keys 1 through 15:  
Trusted = OFF  
MD5 Key Value = BLANK  
Enable MD5 Authentication for client request = OFF  
Ignore Request if not authenticated = OFF  
Enable MD5 Authentication for broadcast = OFF  
Key # to use in broadcast packet = BLANK  
Enable MD5 Authentication for multicast = OFF  
Key # to use in multicast packet = BLANK

**NTP Server Advanced Settings:**

Time To Serve = UTC

Custom Settings:

Daylight Saving Time: Disable daylight time = ON  
Time Zone/Time Offset: Bias = 00:00:00

Time Code Generator:

Type of Timecode to Generate = SMPTE 30 frames per second  
SMPTE extra encoding = SMPTE Leitch date encoding  
Time To Generate = UTC  
Scheduled Time of Drop Frame Jam = 00:00

NMEA:

Messages = NONE  
Output Port = RS232 (DB-9)  
Port Settings:  
    Baud = 9600  
    Data Bits = 8  
    Stop Bits = 1  
    Parity = None

NENA:

Enable Nena Format 0 Output = OFF  
Enable Nena Format 1 Output = OFF  
Enable Nena Format 8 Output = OFF  
Disabled Lock Indicator in Nena Output = OFF  
Output Port = RS232 (DB-9)  
Port Settings:  
    Baud = 9600  
    Data Bits = 8  
    Stop Bits = 1  
    Parity = None

Truetime/Kinematics:

Enable = OFF  
Disabled Lock Indicator in Truetime/Kinematics Output = OFF  
Time Output = Local  
Port Settings:  
    Baud = 9600  
    Data Bits = 8  
    Stop Bits = 1  
    Parity = None

Programmable Pulse Output:

Output Mode = Stopped  
Initial Output State = High  
Interval 1 = .0005 seconds  
Interval 2 = .0005 seconds

Allow time server (NTP/IRIG/SMPTE) during reference outages = ON

Duration time server is allowed = 86400 seconds

Sync Input:

Sync NENA input to pulse input = OFF  
Sync NMEA input to pulse input = OFF  
Sync NTP input to pulse input = OFF  
Sync manually-set time to pulse input = OFF  
SYNC\_IN Pulse Input Required = ON

SYNC\_IN Input Edge To Sync To = Rising Edge  
SYNC\_IN Pulse Is At Top Of = Second  
Nanosecond offset in microseconds = 0

**DAYLIGHT SAVING TIME:**

Status = Disabled

US/Canada Standard:

Daylight Bias = 01:00:00

Use UTC instead of local time = OFF

Start:

Daylight saving time start = Second (occurrence of day)

Day of week = Sunday

Month = March

Day of month = BLANK

Time = 02:00:00

End:

Daylight saving time start = First (occurrence of day)

Day of week = Sunday

Month = November

Day of month = BLANK

Time = 02:00:00

EU Standard:

Daylight Bias = 01:00:00

Use UTC instead of local time = ON

Start:

Daylight saving time start = Last (occurrence of day)

Day of week = Sunday

Month = March

Day of month = BLANK

Time = 01:00:00

End:

Daylight saving time start = Last (occurrence of day)

Day of week = Sunday

Month = October

Day of month = BLANK

Time = 01:00:00

**TIME ZONE/TIME OFFSET:**

Bias = 00:00:00

Bias is negative = OFF

**SET RELAY SCHEDULE:**

Active = OFF

Name = BLANK

Time Format = 12 Hour

HH:MM:SS = 00:00:00

AM = ON

Duration in Seconds = 3

**ADMINISTRATIVE FUNCTIONS:**

Leap Second Date:

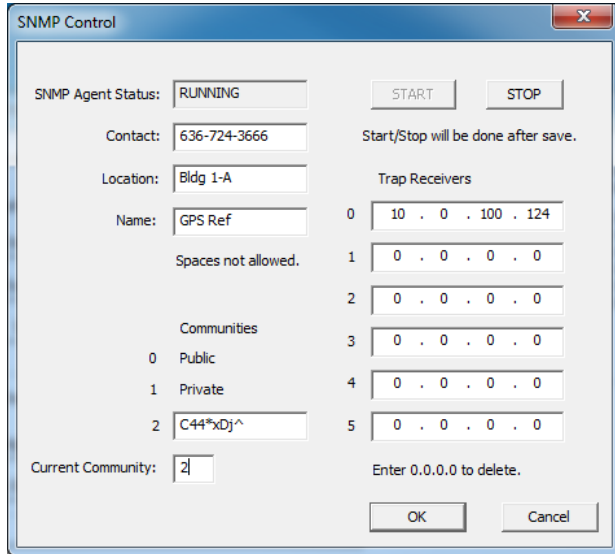
Enable Leap Second = OFF  
Leap Second Polarity = Positive  
Date = 0/0/0

Email Configuration:

Global Email Enable = OFF  
Server Name = BLANK  
Port = 25  
From = BLANK  
User Name = BLANK  
Password = BLANK  
Email Messages Allowed = NONE  
Delays = 0

# SNMP – Simple Network Management Protocol

## SNMP



SNMP is a standard way to monitor a device on an Ethernet network. It is used to monitor the health and network status of a device on an Ethernet LAN. SNMP's purpose is only to convey status, not for controlling the device.

The GMR runs firmware called the SNMP Agent. The user runs software called an SNMP Manager (or MIB Browser) on a PC. **THE USER MUST ACQUIRE THE MANAGER SOFTWARE;** Masterclock does not offer one.

Our Agent supports versions 1 and 2 of SNMP. The PC on which the Manager is running must also have SNMP abilities for Manager and Agent to communicate. Windows 7 and XP support SNMP v1 and 2. The user runs the Manager to get the data, issuing requests to the Agent. If some security tests are passed, then the Agent responds with the data.

The **SNMP Control** window in WinDiscovery provides START and STOP buttons for the user to turn the SNMP Agent on and off, and offers a few options, like **Name, Location** and **Contact**.

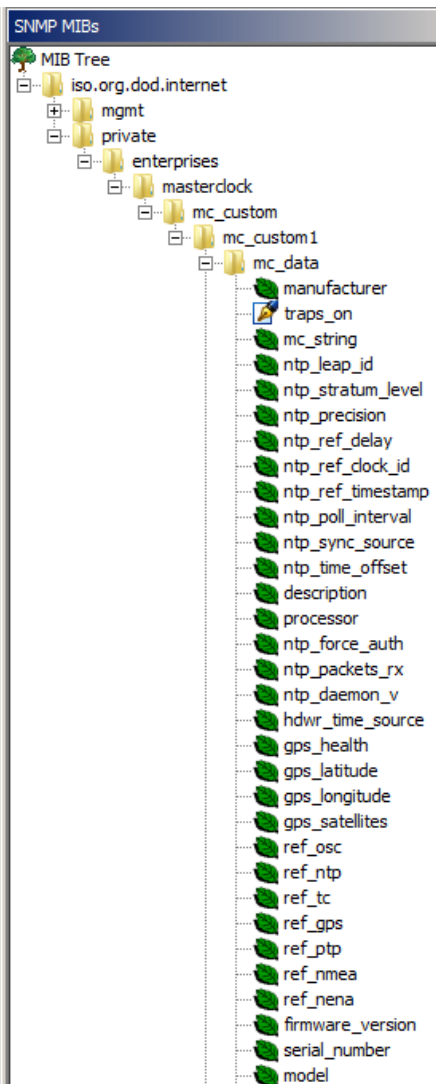
Thus a device could be named "GPS Ref", with the location "Bldg 1-A", and the contact "636-724-3666".

A **Custom Community** name can be created (community #2) and put to use by making it the **Current Community**, providing some security if the name is kept secret.

**Trap Receivers** are the IP addresses of PCs to which traps are sent. Traps are messages that the Agent can send to the Manager without being asked. They tell of events like:

1. Device Restart
2. Ethernet Link Up
3. Authentication Failure (Community mismatch)

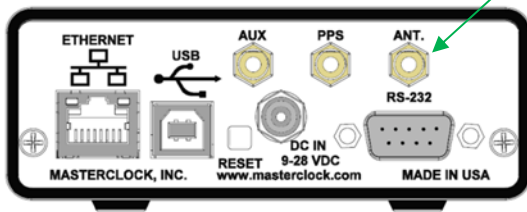
In addition to that standard SNMP data, Masterclock has created a custom set, called a custom MIB, which can be imported into an MIB Browser (Manager). It is available for download from our site. To the left is a display from a MIB Browser of the type of data this MIB enables the user to receive from the GMR. When the user double-clicks on an entry the Agent is asked for the data, and if returned it is displayed, along with descriptive text from the imported MIB.





# GPS Option

GPS ANTENNA – SMA FEMALE



**Note:** All components of the GPS system (including the GMR unit with GPS receiver, power supply, GPS antenna and antenna cable) are tested as a system at the factory before shipment.

**Be sure:**

- 1) The GPS antenna, the GMR and the supplied coaxial antenna cable have not been damaged;
- 2) The GPS antenna has an unobstructed view of the sky;
- 3) The power connector is properly installed;
- 4) The front panel LED follows the startup sequence described earlier (on, off and then on).

With the GPS option the GMR derives precision UTC time from satellites. The GMR includes an internal receiver that requires a pre-amplified GPS antenna.

## GPS ANTENNA CONNECTIONS

1. **Disconnect** power from the unit.
2. **Provide** the antenna with a clear view of the sky. Do not move it again until after the GMR has achieved satellite lock (explained below). Route the antenna cable to the back of the GMR.
3. **Connect** the antenna cable coaxial connector to the gold SMA female connector on the rear of the unit (labeled ANT in image at left).
4. **Reapply** power to the GMR.

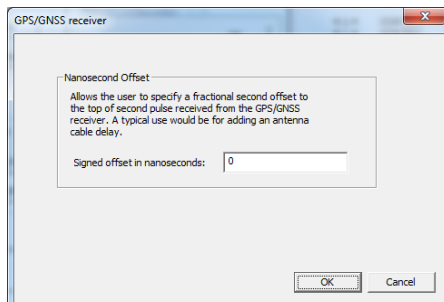
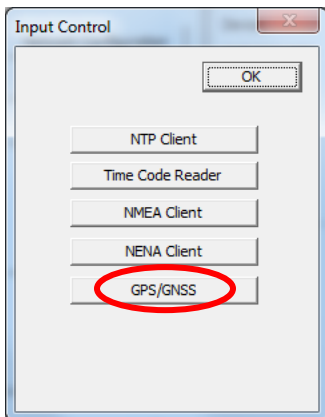
## START-UP AND GPS SATELLITE ACQUISITION

When the GMR is initially powered up the time to acquire satellites and extract correct time is typically 5 to 15 minutes. In less than optimal conditions this could extend to 25 minutes. Atmospheric conditions, type of antenna, antenna location and antenna cable length will affect acquisition time.

When restarting, if the location, time and number of satellites have not significantly changed since last power down, the GPS should lock much faster. The green lock LED on the front of the GMR will blink once per second when locked to a reference, twice per second when not locked. Verify the active reference using device status available with WinDiscovery, SSH, or telnet.

## ANTENNA CABLE LENGTH COMPENSATION

Nanosecond offsets can be added to compensate for cable length under **Input Control - GPS/GNSS**.



# GPS Antenna Location and Installation

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## GLOBAL POSITIONING SYSTEM AND PRECISE TIME AND FREQUENCY

The Global Positioning System (GPS) is a worldwide radio-navigation system formed from a constellation of 24 satellites that continuously orbit the earth. Each GPS satellite has on board several atomic clocks that are precisely synchronized to Universal Time Coordinated (UTC) provided by the U.S. Naval Observatory (USNO). Coded signals are broadcast by each of the satellites with the exact time and position of the satellite. All GPS receivers use an antenna to receive these signals. By using a GPS receiver optimized for time and not position it is possible to get extremely precise time synchronization with the satellite's atomic clocks.

### GPS ANTENNAS AND CABLES

The signals from the GPS satellites operate in the "semi-visible" spectrum of the L1 band (1575.42 MHz) with a minimum signal level of -162.0 dBW. With this very low signal strength the GPS antenna must be able to "see" the sky to acquire the signals. Practically speaking the antenna must have a clear view of the sky and thus be mounted on a roof, or in some cases in a window. The antennas are relatively small, coffee cup size or smaller, and are connected to the GPS receiver typically via coaxial cable.

Since the GPS signal is very weak the antenna usually amplifies the signal to drive it through the cable to the receiver. Antenna cable however offers some resistance and the GPS signal strength will attenuate as it travels down the cable. GPS receiver sensitivity is finite so if the cable length is too long the signal will be too weak for the receiver to detect it. Consequently, it is very important to know the distance in advance between the antenna and the receiver so that the proper cable solution can be installed.

### ANTENNA TYPES

There are two basic antenna types used with GPS timing receivers; roof mounted and window mounted. The roof mounted antenna is required for the more accurate GPS clocks since at least three satellites are required to be in view at all times to maintain timing accuracy, typically nanoseconds to UTC. The window mounted antenna is applicable for the network time servers which operate with a lesser degree of accuracy, typically microseconds or in some cases low milliseconds to UTC, and can function with as few as one intermittent satellite in view. The roof mounted antenna is always preferable since by nature of its location has the best view of the sky. A variation on the roof antenna is the GPS Down/Up converter used for very long cable runs. This is a special GPS antenna that receives the GPS signal and down converts it to a lower frequency that is then sent down the cable. Next to the GPS receiver is an up converter that converts the signal back to the original frequency and delivers it to the GPS receiver. This process is transparent to the GPS receiver.

### ANTENNA PLACEMENT AND MOUNTING

Roof Antenna Placement: When selecting a site for the roof antenna, find an outdoor location that provides full 360-degree visibility of the horizon. In most cases, this means locating the antenna as high as possible, such as on the roof. Any obstructions may degrade unit performance by blocking the satellite signals. Blocked signals can increase the time for satellite acquisition, or prevent acquisition altogether.

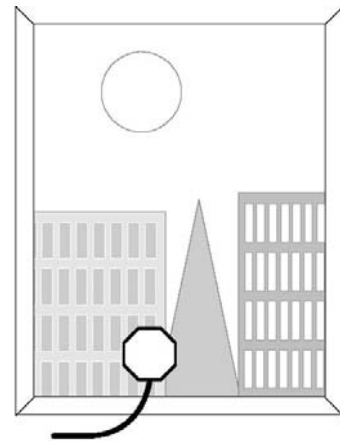
A short mounting mast and hose clamps are provided with the roof antenna to mount the antenna to a pole or the peak of a building. The antenna mounting mast and clamps are well suited to attach the antenna to a vent pipe or mast affixed to the roof. The pipe must be rigid and able to withstand high winds without flexing.

### TYPICAL ROOF ANTENNA MOUNTING

GPS Receivers can be susceptible to reflected GPS signals called multipath. MultiPath interference is caused by reflected signals that arrive at the antenna out of phase with the direct signal. This interference is most pronounced at low elevation angles from 10 to 20 degrees above the horizon. The height of the mast/antenna may be extended upward to prevent multipath interference. The antenna should also be at least three to six feet (1-2 m) from a reflecting surface.

## WINDOW ANTENNA PLACEMENT

The window mount antenna is suitable for use only with the network time server products with appropriate versions of firmware. For window mounted antenna installations, it is best to use a window with the best view of the sky. For windows with equivalent views, orientations that face the equator are preferred. Generally, more satellites will be in view toward the equator than away from it, east or west facing windows will also work. Polar facing windows will also work but in general are not preferred. Windows that have the best view of the sky are always preferred regardless of orientation. Attach the antenna above the window sill versus at the top of the window. This will improve the upward visibility from the antenna to the sky. Note that some window glazing treatments may reduce or block the GPS signals, preventing the time server from acquiring the time.

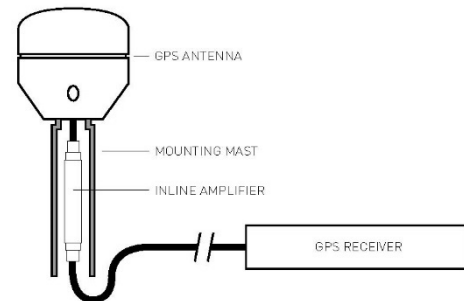


## ANTENNA CABLE CONFIGURATIONS/OPTIONS

Antenna cabling solutions typically vary depending on how far the antenna is installed from the GPS receiver. 150 feet (45 m) is the unaided cable length limit for many GPS timing receivers. Adding a GPS inline amplifier extends the cable length an additional 150 feet (45 m). Beyond 300 feet (90 m) alternative methods may be used. Figure 3 highlights the cable lengths and the antenna solutions that enable them.

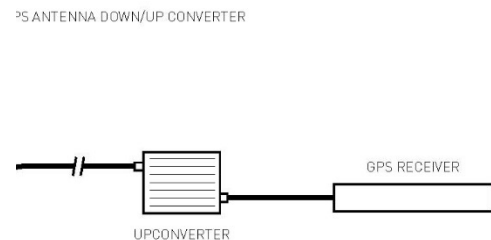
### IN-LINE AMPLIFIER

In-line amplifiers overcome signal attenuation in by amplifying the GPS signal, adding an additional 150 feet (45 m) in cable length. The inline amplifier attaches directly in line with the antenna cable and uses the same power as the antenna; no extra wiring is required. See Figure 4 for a typical mast mount application.



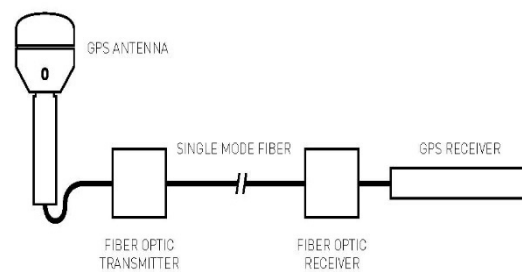
### GPS DOWN/UP CONVERTER

The GPS Down/Up converter makes cable runs of 250 to 1500 feet (75 m to 457 m) possible. GPS signal down conversion requires a special GPS antenna and corresponding signal up-converter. The antenna module converts the signal down to a lower frequency that is less susceptible to attenuation, and transmits it the length of the cable to the up-converter. The up converter restores the signal to the normal GPS signal frequency for the receiver. The down/up conversion process is transparent to the GPS receiver. As with any precision GPS timing receiver, only cable delay and down conversion delays need to be entered into the receiver. Power is supplied by the GPS receiver. In the case of Bus level GPS receivers an external power supply is used. It is important to note that the cable used in GPS down/up conversion is different than the standard cable.



### FIBER OPTIC LINKS

Fiber-optic connections function as a transparent link between the antenna and GPS receiver equipment. These links eliminate the limitations of copper systems by enabling longer transmission distances while retaining the highest level of signal quality. In addition, fiber optics provide several other significant network advantages, including simplified network design, ease of installation, and immunity from EMI/RFI and lightning.



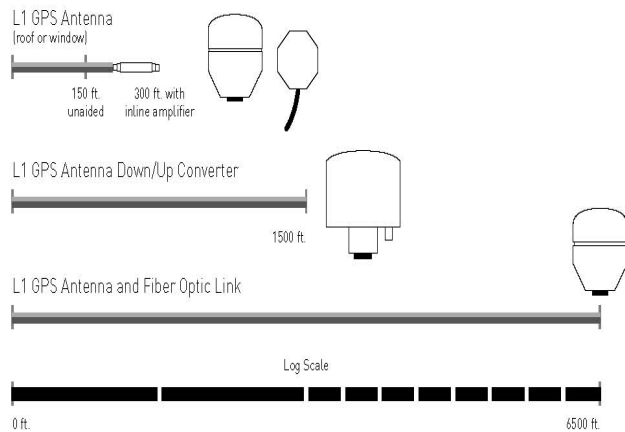
## LIGHTNING ARRESTOR

In-line lightning arrestors are mounted on a low impedance ground between the antenna and the point where the cable enters the building. They require no additional power or wiring except the ground lead.

## CABLE DELAY

GPS position as well as precise UTC time is determined at the point the GPS signals are received at the antenna. Since the antenna is typically attached to the GPS timing receiver via a cable, signal propagation delays through the cable cause the time calculated by the receiver to be slightly behind UTC. In GPS clocks with nanosecond and microsecond accuracies this is a critical factor. In products such as network time servers cable delay is not important because time transfer over IP networks degrades the time to the millisecond level.

Cable delay is a function of the cable type. RG-59 cable for example typically delays the signal 1.24 ns/ft. For 50 feet of cable (15 m) the delay would be 62 nanoseconds. Cable delay is removed by advancing the antenna signal inside the GPS receiver. In this example, advancing the signal +62 nanoseconds removes all cable latency. Solutions such as the GPS Down/up converter also introduce signal latency but this latency can also be removed by adjusting the signal. All precision GPS timing receivers with nanosecond or microsecond timing accuracy have the ability to compensate for cable delay.



## ADVANCED PLANNING

It is time well spent to estimate in advance the cable length from the GPS antenna to the receiver for any planned installation. Cable lengths that are too short or too long can each introduce problems. In some cases, adding an inline amplifier and some extra cable may be a quick and economical solution. In other instances, retrofitting for a GPS down/up converter may be necessary which will require installing a different cable type. Keep in mind that some extra cable coiled in a ceiling leftover from over estimating the cable length is not necessarily negative. Provided you know the length of the total cable, the cable delay can be accounted for and the timing accuracy maintained.

# GPS Lock Issues and Troubleshooting Tips

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Masterclock highly recommends using only the pre-made/pre-tested antenna cables provided by Masterclock, Inc. For best performance, it is best to order these cables at the same time that you order your GMR with GPS option installed as this means the unit has been factory tested as a system with the antenna cables and antenna before shipment.

The GMR with a GPS module installed requires a pre-amplified antenna. The GMR provides +5 VDC via the center pin of the SMA coaxial cable/connector for remote power to the antenna.

## GPS LOCK RELATED ISSUES AND TROUBLESHOOTING TIPS

The following problems are specific to the GMR with GPS option installed. These should be considered only after the 25-minute satellite acquisition time has elapsed.

### PROBLEMS:

- Unit is not locking to GPS
- The LED on the front panel is blinking twice per second
- Unit is not serving time
- WinDiscovery displays no GPS satellite information

### SYMPTOMS, REASONS AND SOLUTIONS

**FLASH ONCE PER SECOND:** The reference lock LED (green = **locked**) will flash once per second when locked to GPS. Verify the active reference using device status available with WinDiscovery, SSH, or telnet.

**FLASH TWICE PER SECOND:** The reference lock LED (green) will flash twice per second when freewheeling (running without external lock, reference from internal oscillator).

The GMR must first acquire an initial lock to GPS before it will serve accurate time. Once locked, the unit can continue to serve time (either while locked to GPS or while freewheeling) as long as the DC input power is not interrupted.

### Some procedures to consider:

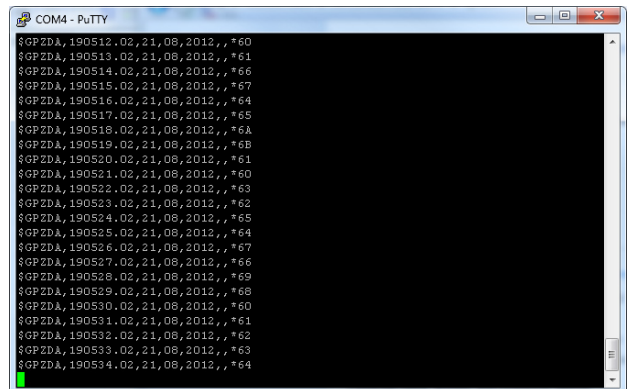
1. **Wait** at least 20 to 30 minutes if installing the GPS receiver device in a new location. The GPS receiver must find and acquire the signal from at least four GPS satellites simultaneously and will continue to acquire up to the eight satellites. When placed in a new location, time to first lock can be quite lengthy since the receiver must update its internal almanac and ephemeris data from the satellite signals.
2. **Make sure** the GPS cables and connectors are not damaged and the threaded connectors are tightly coupled.
3. **Relocate and reinstall** the GPS antenna outdoors with a clear/unobstructed view of the sky. Find a rooftop or similar location such as a large open field or parking lot with an unobstructed view. While the GMR may lock to GPS on some occasions with the antenna located indoors near a window, such use is not recommended. Your GPS antenna must not be near satellite dishes or sources of RF interference, such as transmitters or other antennas.
4. **Replace your cable and connectors.** Your antenna cable or connectors may be shorted or open.
5. **Check your cable length.** You may be using too long of an antenna cable or using an improper impedance cable. If necessary, remove the long antenna cable and connect the GMR directly to the short cable on the GPS antenna using the short SMA male to SMA male adapter provided with your antenna package. Preferred and tested GPS antenna cable is available from Masterclock in lengths up to 500 feet (152m).

6. **Internal damage:** The GPS receiver located within the unit may have been damaged during the installation or handling. Handle the GMR as you would any electronic device. Do not subject the assembly (particularly the antenna input connector) to electrostatic discharge (ESD) during handling. When handling or installing the device, observe proper ESD protection methods. At a minimum, discharge yourself to a convenient ground before handling the GMR. Preferably, use a static discharge wrist strap connected to Earth ground when handling, installing and/or configuring the device.
7. **Inappropriate power application:** The GPS option provides power to the pre-amplified GPS antenna using low voltage supplied on the center pin of the antenna cable. To avoid damage to the GPS receiver (and/or antenna) caused by a short circuit, make all antenna connections only after all power is removed from the unit.
8. **Incompatible antenna:** Do not use antennas provided by others. They may not be compatible with the GPS antenna supplied with your system and may damage the GPS receiver unit.
9. **Damage during installation:** The GPS antenna cables can be damaged by pulling and twisting the connectors. You should also avoid pinching and over-bending the cables. Such abuse may occur while using a cable puller. 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. The coaxial cable should not be crushed, crimped or bent at a sharp angle nor should it be strained by pulling.
10. **Coiling** If the cable is to be coiled for storage, the coil diameter should be at least six inches for quarter-inch cable, twice that for larger cable diameters.

# Streaming GPS Data Using PuTTY

For those of you with a more recent PC OS you may access several sentences of GPS data by using **PuTTY.exe**.

1. Assuming all electronic connections have been made...
2. **Open** WinDiscovery.
3. **Click** on the **Discover** button.
4. **Right click** on your GMR to reveal the **GMR Device Settings** window.
5. **Click** on the **Output Control** button.
6. **Click** on the **NMEA** button.
7. That reveals the **NMEA Messages** window. In the upper box, **select ZDA** or any other NMEA sentence.
8. In the **Select NMEA Output Port** box select the **RS-232** button and click on **Port Settings**.
9. Enter the Baud, Parity, Number of Data Bits and Number of Stop Bits that you intend to set into PuTTY. Click **OK**.
10. In the **NMEA Message** window click **OK**.
11. On the **Output Control** window click **OK**.
12. On the Device Settings window click **Save** or **Save and Close**.
13. **Open PuTTY.exe**.
14. If prompted with the “Are you sure you want to run this software?” message, click the **Run** button.
15. The **PuTTY Configuration** window should appear. On the left expand the tree and click on the **Serial** entry. Enter settings that match the output of the GMR. The entry “Serial line to connect to” must be set to the port on the PC that the serial cable to the GMR is attached to. Set “Flow control” to None.
16. On the left click on **Session**. For “Connection Type” select the **Serial** button.
17. The **Serial Line** and **Speed** entries that appear should be those you just entered. Click the **Open** button.
18. This reveals another PuTTY window displaying streaming NMEA messages (at left) incrementally delivered onscreen once per second. ZDA delivers UTC time and date. Other sentences deliver geographical coordinates.



NMEA data on PuTTY

# NMEA and the RS-232 Interface

| DB-9 Pin | Signal | GMR1000 signal name (DCE) |
|----------|--------|---------------------------|
| 2        | TxD    | Transmit Data             |
| 3        | RxD    | Receive Data              |
| 5        | SG     | Signal/System Ground      |

| DB-9 Pin | Signal | GMR5000 signal name (DTE) |
|----------|--------|---------------------------|
| 2        | RxD    | Receive Data              |
| 3        | TxD    | Transmit Data             |
| 5        | SG     | Signal/System Ground      |

## NMEA

In order to receive NMEA (National Marine Electronics Association) 0183 sentences (messages), the RS-232 interface (DB-9 male connector) may be used to connect your PC with your GMR. Unless the GPS option is included, only ZDA sentences will be outputted as they contain only UTC time and date signals. These are created by the GMR. Other sentences with latitude and longitude data are only available with the GPS option

Note: The device system cannot receive 2 NMEA message per second when locked to 1 PPS pulse input.

## SERIAL PINOUT FOR RS-232

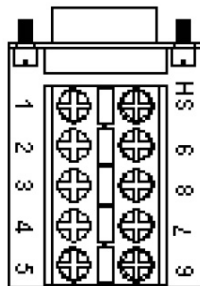
The GMR serial port pinouts are defined at left. For a GMR1000, RS-232 communications from a standard IBM PC or compatible host computer can use a straight-thru cable (3 wires only: pins 2, 3 and 5). For a GMR5000 a null modem cable must be used.

The default communication settings for the RS-232 port are: **9600 baud, 8 data bits, 1 stop bit, no parity.**

The RS-232 port can be configured for baud rates of 4800, 9600, 19200, 38400, 57600 and 115200, along with 7 or 8 data bits, 1 or 2 stop bit. The parity bits can be selected as None, Odd, and Even.

### Standard I/O connections using optional DB9 Breakout Adapter (GMR1000 only)

- 1 - TC-OUT (NEG)\*
- 2 - RS232 RX(DTE) TX(DCE)\*\*
- 3 - RS232 TX(DTE) RX(DCE)\*\*
- 4 - RELAY COMMON\*
- 5 - GND
- 6 - TC-OUT (POS)\*
- 7 - TC-IN (POS)\*
- 8 - TC-IN (NEG)\*
- 9 - RELAY IN/OUT\*



\*if installed  
\*\*based on internal jumper setting

## FOR OTHER TYPES OF RS-232 RECEIVERS

it may or may not be necessary to using a null modem cable. Remember, on a GMR1000, only a three wire null modem cable may be used.

- Ensure the host system can communicate via standard RS-232 at 4800 baud, 8 data bits, 1 stop bit, no parity.
- Pins 2 and 3 must use RS-232 voltage levels. The GMR cannot decode TTL-level serial communications at pin 2 and 3 of the DB-9 connector.
- Ensure that any cable you are using for communication with the GMR is within the RS-232 standard length and is a working cable.
- The interface may require a null modem cable.
- A “null modem” 3-wire serial cable or simple RS-232 cable utilizing pins 2,3 and 5 only should be used





# Precision Time Protocol (PTP – IEEE 1588)

IEEE 1588-2008 defines the Precision Time Protocol (PTP) with a goal of achieving very high precision for time-synchronization over a packet-based network such as Ethernet. The most important innovation of 1588 is the introduction of “hardware-assisted time stamping:” time-stamping embedded in the PTP messages using special 1588 Ethernet hardware. This is the key difference from NTP. All GMR1000/GMR5000’s that have PTP available use this hardware assisted time-stamping. In networks which have a PTP infrastructure, sub-microsecond accuracy is possible. If the network does not have a PTP infrastructure (standard switches which do not have PTP time-stamping), accuracies of better than 100 microseconds can be achieved (assumes the PTP endpoints support PTP hardware time-stamping, i.e. the grandmaster and the slave).

On the GMR5000, PTP can be ordered at the time of purchase or as a field upgrade software option. For a GMR1000, PTP must be ordered at the time of purchase. The GMR1000 cannot be field upgraded.

By default, a GMR1000/GMR5000 is an ordinary clock (i.e. it can be a master, slave, or transparent). The two ports on a GMR5000 are also a transparent clock.

## CONFIGURATION METHODS

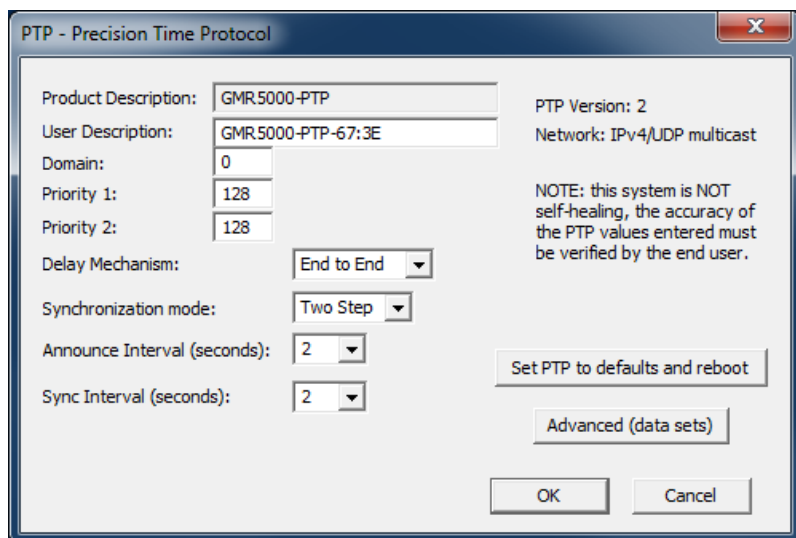
PTP configuration can be done using either WinDiscovery, SSH, or telnet. WinDiscovery offers basic and advanced configuration options. SSH and telnet allow the user to set one of the default profiles described Annex J of the IEEE Std 1588-2008. Individual settings of the various PTP parameters is also available via telnet/SSH.

## WINDISCOVERY PTP CONFIGURATION

To configure using WinDiscovery, follow the standard steps to discover a PTP capable device. Then select the device and open the Device Settings dialog. If PTP is available, the “Precision Time Protocol” button will be available. Click the button to open the PTP configuration dialog.

The dialog allows you to enter the basic PTP settings.

The network protocol used is UDP (Layer 3). A future release is planned which will support 802.3 (Layer 2) and PTP profiles (such as E2E default profile, P2P default profile, and others).



### Default Domain

A domain consists of one or more PTP devices communicating with each other. The default domain for PTP devices is domain “0”. Multiple domains are allowed and the input range is 0 to 127. All devices will receive all PTP packets but they will only process and respond to packets within their configured domain number.

### Priority #1 and #2

Priority is one of several parameters used to determine which device on the network will be the grandmaster. The lower the number, the higher the priority with priority 0 being the highest. The range of values is 0-255. Priority #1 is used early in the grandmaster selection process. Priority #2 occurs late in the selection process.

## Delay Mechanism

Delay Mechanism is the method used to calculate the network path delays. All devices on the network must use the same delay mechanism (even if they are in different PTP domains). End To End (E2E) only requires the master and slave to support PTP. It does not require the network infrastructure to support PTP. If the intervening infrastructure of the local network does not support PTP, accuracies of 20-100 microseconds can typically be achieved. If the intervening network devices does support E2E PTP (i.e. a transparent clock) sub-microsecond accuracies can be achieved. Peer To Peer (P2P) reduces the overall network traffic and can improve the accuracy compared the E2E, but all of the network infrastructure must support the P2P delay mechanism.

## Synchronization mode

Two methods are available for sending time stamps across the network, One Step and Two Step. Assuming all network devices do their time stamping in hardware (in general this should be true, and is true for all Masterclock equipment) both methods will give an accurate time. If there are a large number of PTP devices, One Step is preferred because it requires fewer packets.

## Announce Interval

Announce interval specifies the time interval between successive Announce messages. The Announce message is used by the devices on the network to determine which device should be the grandmaster. Typically, a value of 1 or 2 seconds is recommended.

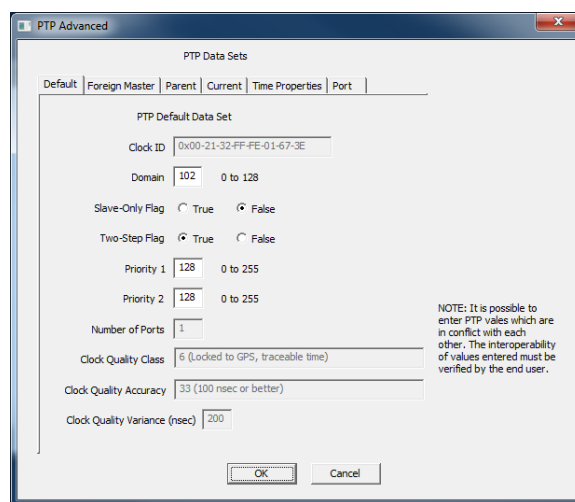
## Sync Interval

Sync Interval specifies how often the grandmaster sends a Sync message which starts the process of updating the time in a PTP slave. Typically, a value of 1 or 2 seconds is recommended.

To set PTP back to defaults, click the “Set PTP to defaults and reboot button”. Answering ‘yes’ will perform the action and the GMR1000/GMR5000 will automatically reboot. After rebooting, it will take approximately 30 seconds before the reboot process is completed. If this device is the grandmaster, it will typically another 30 seconds before devices on the network will synchronize to it. After 30 seconds, close the “Device Settings” dialog and re-open it to refresh the PTP settings.

If needed, the user can select the “Advanced (data sets)” button. This gives the user access to the low level PTP data sets defined in the PTP – IEEE 1588 standard.

It is beyond the scope of this document to discuss the PTP data sets. Please refer to online sources for help with these values. See the detailed description of the telnet/SSH PTP interface to get additional information for settings in the data sets.



## **PTP CONFIGURATION USING TELNET/SSH**

To login via telnet or SSH, first determine the IP address of the device. This can be accomplished by using WinDiscovery or momentarily pressing the Reset button. When the reset button is pressed for a moment the IPv4 and IPv6 address will be shown on the front panel display. NOTE: pressing the Reset button for more than one second will cause the device to set itself back to defaults.

The default telnet password is “public”. There is no user name.

The default user name for SSH is “public” and the password is “publicpass”. Example SSH settings for Teraterm are shown to the left.

Once the telnet/SSH session is established, type in “?” to see a list of commands. Type in “help” for a more detailed explanation of each command.

To view and/or change PTP settings, enter “ptp”. This will start an interactive session with PTP. “Foreign data set 0” are the values for this device. The next data set listed contains the values for the current grandmaster. If this device is the grandmaster only one foreign data set will be shown.

Select the dataset to view/modify, or action you wish to perform. The PTP standard defines five data sets. The defaultDS (default data set) and currentDS (current data set) are per-clock. The parentDS (parent data set), timepropertiesDS (time properties data set), and portDS (port data set) are per-port. Each data set member is static, dynamic, or configurable. Detailed documentation of the PTP data sets is available in the PTP standard, IEEE Std 1588-2008.

```
10.0.102.3:22 - Tera Term VT
File Edit Setup Control Window Help
ussht24> ptp
Foreign data set 0 <this device>
port id          = 0x00-0x21-0x32-0xFF-0xFE-0x01-0x60-0x06
port number     = 0
number of messages = 10
GM priority1    = 128
GM class       = 248
GM accuracy    = 254
GM offscaledLogVariance = 200
GM priority2   = 128
GM identity    = 0x00-0x21-0x32-0xFF-0xFE-0x01-0x60-0x06

Foreign data set 1
port id          = 0x00-0x21-0x32-0xFF-0xFE-0x01-0x67-0x2E
port number     = 0
number of messages = 5
GM priority1    = 128
GM class       = 6
GM accuracy    = 33
GM offscaledLogVariance = 200
GM priority2   = 128
GM identity    = 0x00-0x21-0x32-0xFF-0xFE-0x01-0x67-0x2E

Active Profile: 00-00-00-00-00-00
                No PTP profile active

Please select the data set or action.
All PTP changes are saved to non-volatile memory
 1) defaultDS
 2) currentDS
 3) parentDS
 4) timepropertiestDS
 5) portDS
 6) Disable any active PTP profile <does not change any other PTP setting?>
 7) Set PTP to defaults<disables any active PTP profile?>
 8) Set PTP to default profile Delay Request-Response <E2E?>
 9) Set PTP to default profile Peer-to-Peer <P2P?>
 x) exit
 ?) help

dataset/action:
```

After entering “ptp”, enter the number for one of the available data sets or actions. Options include:

- 1) defaultDS
- 2) currentDS
- 3) parentDS
- 4) timepropertiestDS
- 5) portDS
- 6) Disable any active PTP profile (does not change any other PTP setting)?
- 7) Set PTP to defaults (disables any active PTP profile)?
- 8) Set PTP to default profile Delay Request-Response (E2E)?
- 9) Set PTP to default profile Peer-to-Peer (P2P)?
- x) exit
- ?) help

#### 1) defaultDS, Default Data Set

Select which member to modify (1-5), ‘x’ to go back up a level, ‘?’ for help

The following cannot be modified:

clockIdentity – PTP clock identity

Number of ports – GMR1000 devices have one RJ45. Even though GMR5000 devices have two RJ45's, they are considered to be a single logical PTP port.

clockQuality.clockClass – The GMR product line can have the following clock classes. Non-GMR products may have additional values.

6 – locked to GPS

7 – previously locked to GPS

13 – locked to time code, NTP, etc.

14 – previously locked to time code, NTP, etc.

52 – out of holdover spec. for class 7, degradation A

58 – out of holdover spec. for class 14, degradation A

187 – out of holdover spec. for class 7, degradation B

193 – out of holdover spec. for class 14, degradation B

248 – default if none of the above

clockQuality.clockAccuracy – The GMR product line can have the following accuracies. Non-GMR products may have additional values.

32 – accurate to 25ns

33 – accurate to 100ns

34 – accurate to 250ns

35 – accurate to 1us

36 – accurate to 2.5us

37 – accurate to 10us

38 – accurate to 25us

39 – accurate to 100us

40 – accurate to 250us

41 – accurate to 1ms

42 – accurate to 2.5ms

43 – accurate to 10ms

44 – accurate to 25ms

45 – accurate to 100ms

46 – accurate to 250us

47 – accurate to 1s

48 – accurate to 10s

49 – accurate to >10s

254 – accuracy unknown

clockQuality.offsetScaledLogVariance – precalculated value set at factory, 200 ns

The following can be modified:

twoStepFlag – if true, two step is enabled, if false, one step is used.

priority1 and priority2 - Priority is one of several parameters used to determine which device on the network will be the grandmaster. The lower the number, the higher the priority with priority 0 being the highest. The range of values is 0-255. Priority #1 is used early in the grandmaster selection process. Priority #2 occurs late in the selection process.

domain number - A domain consists of one or more PTP devices communicating with each other. The default domain for PTP devices is domain "0". Multiple domains are allowed and the input range is 0 to 127. All devices will receive all PTP packets but they will only process and respond to packets within their configured domain number.

slave only – false, this device can become the grandmaster (based on the Best Master Clock (BMC) algorithm. True, this device can only be a slave.

## 2) currentDS, Current Data Set

No members can be modified. Select 'x' to go back up a level, '?' for help

The following cannot be modified:

stepsRemoved – the number of devices between this device and the master starting with the value of 1 (this device).

offsetFromMaster – calculated time difference between this device and the master.

meanPathDelay – calculation of the network path delay between this device and the master

60

## 3) parentDS, Parent Data Set

No members can be modified. Select 'x' to go back up a level, '?' for help

The following cannot be modified:

parentPortIdentity – identity of the current parent

parentStats – not used

observedParentOffsetScaledLogVariance – not used

observedParentClockPhaseChangeRate – not used

grandmasterIdentity – identity of the current grandmaster

grandmasterClockQuality - For GMR products, see previous definition in the default data set. Non-GMR products may have additional values.

grandmasterPriority1 and grandmasterPriority2 – see previous definition in the default data set.

## 4) timepropertiesDS, Time Properties Data Set

Select which member to modify (1-4), 'x' to go back up a level, '?' for help

The following cannot be modified:

timeTraceable – true, the current time is traceable. False, the current time is not traceable.

frequencyTraceable – true, the current frequency is traceable. False, the current frequency is not traceable.

ptpTimescale – true, the current timescale is the PTP default, TAI time. false, another timescale is being used (such as UTC).

timeSource – the GMR products support the following time source values. Non-GMR products may have additional values.

GPS – GPS/GNSS satellite time

PTP – Precision Time Protocol

NTP – Network Time Protocol

OTHER – time code reader, NMEA, NENA, etc.

INTERNAL\_OSCILLATOR – internal oscillator

The following can be modified:

currentUtcOffset – offset in seconds to UTS time.

currentUtcOffsetValid – true, currentUtcOffset offset value is valid and can be used. false, currentUtcOffset is invalid and cannot be used.

leap59 – true, a leap second is pending. false, no leap second is pending.

leap61 - true, a leap second is pending. false, no leap second is pending.

#### 5) portDS, Port Data Set

Select which member to modify (1-6), 'x' to go back up a level, '?' for help

The following cannot be modified:

portIdentity – port identity

portState – master (device is the grandmaster), slave (device is a slave to the grandmaster), passive (device is not synchronizing to the grandmaster and can become the grandmaster).

peerMeanPathDelay – only used when P2P is enabled.

versionNumber – PTP version number, always 2 for GMR products.

The following can be modified:

logAnnounceInterval – mean time interval between Announce messages. Used in the selection of the grandmaster. The value is logarithm to the base 2. A negative value is a fractional second. Recommended value is 1, range 0 to 4.

announceReceiptTimeout – timeout in seconds for the receipt of the announce message. Must be greater than the logAnnounceInterval (in seconds).

logSyncInterval – interval used to send Sync messages from the grandmaster. The value is logarithm to the base 2. A negative value is a fractional second. Recommended value is 1, range 0 to 4.

delayMechanism - Delay Mechanism is the method used to calculate the network path delays. All devices on the network must use the same delay mechanism (even if they are in different PTP domains). End To End (E2E) only requires the master and slave to support PTP. It does not require the network infrastructure to support PTP. If the intervening infrastructure of the local network does not support PTP, accuracies of 20-100 microseconds can typically be achieved. If the intervening network devices does support E2E PTP (ie. a transparent clock) sub-microsecond accuracies can be achieved. Peer To Peer (P2P) reduces the overall network traffic and can

improve the accuracy compared the E2E, but all of the network infrastructure must support the P2P delay mechanism.

logMinPdelayReqInterval – Used when the P2P delay mechanism is selected. The value is logarithm to the base 2. A negative value is a fractional second. Recommended value is 1, range 0 to 4.

6) Disable any active profile

Disables any active profile. Does not change any of the PTP settings.

7) Set PTP to defaults

Sets all of the PTP settings to their defaults.

8) Set PTP to default profile Delay Request-Response (E2E)

Sets PTP to the default Delay Request-Response (E2E) profile as define in Annex J of the IEEE Std 1588-2008.

9) Set PTP to default profile Peer-to-Peer (P2P)

Sets PTP to the default Peer-to-Peer (P2P) profile as define in Annex J of the IEEE Std 1588-2008.



# Troubleshooting Tips

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All GMR units are fully checked and system tested at the factory for proper operation before shipment. Unless physical damage is found, the unit is probably functional.

The following problems can probably be readily solved by the customer/user.

**Software Tip:** WinDiscovery uses bi-directional UDP messaging on port **6163** for both the discovery process and to communicate configuration. It also sends status packets to and from all Masterclock network devices on this port.

Delivery of UDP messages (packets) is NOT guaranteed.

**Intermittent problems with WinDiscovery?** Try closing the current session and restarting the application. If this does not resolve the issue, try some of the trouble shooting tips listed here. If this fails, switch to an alternate method of configuration, such as SSH or Telnet.

A **"soft" restart** may be performed once per hour by the GMR to automatically if the GMR is set to use DHCP and cannot find it. You will recognize a soft restart when the GMR green PWR LED begins to blink twice per second for a short time. You may even hear a quiet relay click.

## PROBLEM:

- Unable to find (discover) the new GMR in WinDiscovery.

## POSSIBLE REASONS/SOLUTIONS:

1. Verify that you have supplied power to the GMR.
2. Verify that all the network cables, hubs, etc. are in proper working order.
3. Be sure that no Ethernet crossover cables are being used where inappropriate.
4. After clicking the **Discover** button, wait until the status indicates 100% completion.
5. Verify that the GMR is a Masterclock brand device. WinDiscovery is not designed to work with products from other vendors.
6. Verify that the GMR is on the same physical network as the computer from which you are running WinDiscovery.
7. If the computer is separated from the GMR by a router (on a remote network) or a firewall it is likely that the router/firewall is blocking communication with the device. Run WinDiscovery from a computer within the remote network, or ask a network system administrator to configure the router/firewall in question to pass through (in both directions) UDP broadcasts on port **6163**. If this does not resolve the detection problems you may additionally configure to pass through both directions UDP broadcasts on ports **6165**, **6166**, and **6264**.

### Potential Network Topology Communication Problems

Networks separated by physical routers will often block UDP broadcasts preventing WinDiscovery from locating devices on a remote network.

Under such circumstances, WinDiscovery must be operated from a computer within the remote network. Or the routers separating the networks must be configured to pass bidirectional UDP traffic (including broadcasts) on port **6163**.

Consult your network administrator for additional information.

Personal or network computer firewall applications, or the Windows OS firewall may also prevent WinDiscovery from operating correctly. Configure the firewall to allow bidirectional UDP traffic on port 6163 or temporarily disable the firewall while using WinDiscovery.

8. Unfortunately, some routers will not forward UDP broadcasts across networks, but WinDiscovery requires this. If you are running a personal firewall product, or the built-in Windows firewall, you may need to adjust their configurations to pass through (in both directions) UDP traffic on port **6163**.
9. Verify that the hub/router/switch is capable of supporting the 10/100MB speed the GMR requires.
10. Verify that a DHCP server is present on the network. If the GMR has been configured to use DHCP for network configuration, but none is present, the GMR may not respond to discovery requests for up to twenty seconds after power-on.
11. Reset the GMR to initiate a new DHCP IP address request, or use the static IP address mode.
12. Consult your network system administrator to obtain a list or range of available IP addresses.

*Note: DHCP configuration is enabled as a factory-default. In addition, the clock will reset its address (during fallback) to a default address within the link-local address space (169.254.xxx.xxx) when no DHCP server is present or is not able to be reached.*

### **PROBLEMS:**

- WinDiscovery finds the GMR, but the status display is intermittent or not updating.
- The GMR clock is not responding to configuration changes made in WinDiscovery.
- Now that the GMR is hooked up other device(s) do not appear in WinDiscovery.
- The status or settings characters are garbled.

### **POSSIBLE REASONS/SOLUTIONS:**

1. WinDiscovery may have been left open too long and the GMR's configuration may have changed during the session. This can occur if the DHCP server has issued new or refreshed addresses without alerting you. Remedy: close and restart WinDiscovery.
2. The discovery process was not complete before selecting your device. After clicking the **Discover** button, please wait until the status indicates 100% completion.
3. Verify that the physical network cables and equipment and configuration for UDP have not changed.
4. Verify that you are currently the only user accessing the device via WinDiscovery, SSH or Telnet.
5. Heavy network traffic reduces the bandwidth and/or causes collisions with the UDP messages/packets. Heavy traffic can cause WinDiscovery to show outdated or garbled information. Remedy: Press the **Discover** button again and wait until the process completes to refresh WinDiscovery.
6. Take steps to increase the bandwidth and/or reduce network traffic. If this is an ongoing problem, consider the SSH or Telnet method or move the GMR to an isolated LAN.

### **PROBLEMS:**

- GMR name appears in RED in the WinDiscovery.
- GMR assigned an IP address of 169.254.xxx.xxx.
- GMR is not maintaining its assigned IP address.
- Function is erratic. Appears to periodically reset.

## POSSIBLE REASONS/SOLUTIONS:

1. Incorrect network configuration may cause the GMR to receive a fallback IP address or perform soft restarts. Verify that the IP address is correct. If you manually enter (or DHCP assigns) an IP address that already exists on the network, this will create a conflict. The GMR will reset its address (fallback) to one within the link-local address space. Determine the cause of the fallback IP address and resolve the issue.
2. View the error status field at the bottom of the **GMR Status** window for messages.
3. When the Ethernet interface is initialized the network device will verify that the IP address (either static or assigned by DHCP) is not being used by another device on the network. If a conflict is found the NTD clock will default to a 169.254.xxx.xxx address. The IP address that caused the error is saved and returned as an error to WinDiscovery. This error status is available to the user via the Status window on WinDiscovery.
4. If static IP addressing is being used the original conflicting static IP address can be restored by doing a soft restart of the device using either WinDiscovery, SSH or Telnet prior to changing any other configuration parameters.
5. *Note: Devices which have been assigned a fallback IP address of 169.254.xxx.xxx will be displayed in the main WinDiscovery window with RED text, indicating a problem with the configuration.*

**IMPORTANT NOTE:** *if the configuration of the network device is changed while a 169.254.xxx.xxx is being use, then the current 169.254.xxx.xxx address will become the permanent static address and the original conflicting static address is lost. At this point, it is necessary to manually change the static IP address to a one that will not conflict, or you may have to do a "Set To Default Configuration" to restore the system to factory default settings.*

## PROBLEM:

- GMR appears to 'reset' periodically.

## POSSIBLE REASONS/SOLUTIONS:

1. Check the network connection and setup. If DHCP is enabled and a DHCP server is not active on the network the will reboot once per hour while attempting to resolve DHCP configuration. To correct the problem, switch to manual networking configuration (set a Static IP address) or determine why the local DHCP server is not operating.
2. If the GMR has not been configured with at least one valid DNS server (or that DNS server is down) hesitations similar to those described in #1 will occur. At least one valid DNS server is required for operation.

## PROBLEM:

- GMR Unable to communicate via Telnet.

## POSSIBLE REASONS/SOLUTIONS:

1. Verify that you have the correct IP address for the unit and the IP address did not change. If using DHCP to provide the IP address, this address may change periodically, you must know the IP address of the unit to use the TELNET interface.
2. Verify that the GMR does not have the Telnet interface disabled.

*Note: For security purposes, the Telnet interface is disabled. To re-enable the Telnet feature, one of the other configuration methods must be used, or the unit must be reset to factory default configuration. Pressing the reset button will not enable Telnet.*

**PROBLEM:**

- NTP/SNTP client is unable to communicate with the GMR.

**POSSIBLE REASONS/SOLUTIONS:**

1. Verify that the GMR is attached to the network.
2. Verify that all network cables, hubs, etc. are in proper working order. Be sure that Ethernet crossover cables are not being used where inappropriate.
3. Verify that the GMR is actually reachable from the client. Try “pinging” the IP address of the GMR. If this fails, it is possible that it has an invalid network configuration or that the network is down. Consult your network administrator for assistance.
4. Verify that the GMR is set to output if operating in internal oscillator/real time clock mode and that the maximum time difference has not been exceeded.
5. Verify that the client is not using “Symmetric Active” mode. The GMR does not use Authentication and will not work with NTP/SNTP clients in a “Symmetric Active” mode.

**PROBLEM:**

- The NTP client indicates that the GMR is providing invalid time, or has flagged time as invalid.

**POSSIBLE REASONS/SOLUTIONS:**

1. The GMR will always answer NTP requests (unless the client is set to use symmetric active mode). The GMR will flag time as invalid if it does not have trusted time to distribute. This may occur temporarily during GPS navigation state changes or before the first GPS acquisition during power up following a long period without power.
2. By default, the GMR will begin flagging time invalid after 24 hours of consecutive GPS acquisition failure or non-operation (i.e. power off). This is a protective feature. It can be adjusted or disabled if desired.

**PROBLEM:**

- The UTC date and time are incorrect and the GMR does not retain time settings when powered down or up.

**POSSIBLE REASONS/SOLUTIONS:**

The GMR maintains its internal time in battery-backed memory located using a Real-Time Clock (RTC). The battery supplies power, up to 24 hours, to the TCXO 32kHz oscillator and RTC when the unit is powered off. This allows the internal configuration to be maintained and the time and date to continue to increment. So, if there is a problem here, the internal battery likely needs replacement.

The battery type is a “maintenance free” 3V rechargeable magnesium lithium battery. It can be replaced by a qualified technician. Or the unit can be sent to technical support at Masterclock.

**PROBLEM:**

- Lost password.

**POSSIBLE REASONS/SOLUTIONS:**

Your custom password cannot be recovered if it is lost. Reset the GMR to the factory default configuration. Under factory defaults the GMR will need to be reconfigured to your custom settings.

The factory - default password for WinDiscovery and telnet is “**public**”. For SSH the default user is “**public**” and the default password is “**publicpass**”.

**PROBLEM:**

- Multiple error windows titled, **Bad Password** continue to pop-up each time a configuration setting is applied.

**POSSIBLE REASONS/SOLUTIONS:**

1. You have entered and “remembered” an incorrect password in the password windows. You must clear the memorized password using one of the two options below.
2. WinDiscovery only remembers the password for the current session, so close the WinDiscovery session and reopen it. All passwords will be forgotten and you can start anew.
3. As an alternative to closing your WinDiscovery session, right click on the device in the left WinDiscovery window. The last entry in the pop-up menu lists **Forget Memorized Password**. Select this option.
4. You are using a global password that is different from the password of the GMR you are trying to administer. Change the global password to match that of the GMR, or change the unit password to the global password.

**PROBLEM:**

- The UTC time (and/or date) is incorrect

**POSSIBLE REASONS/SOLUTIONS:**

There are several potential failure points:

- invalid, intermittent, or missing time code source
  - date/year overwrite function for non-date encoded time code may be enabled improperly
  - battery may need replacement (see the previous problem item)
  - an NTP/SNTP client or Windows local time zone configuration
1. Verify that your time code source is generating the UTC referenced time and date that you expect, and that this time code format is at an acceptable signal level and quality that can be detected at the receiver (input to the GMR connector).
  2. If you have a time code source from an alternate vendor, be sure that your time code actually contains encoded date /year information to the SMPTE or IEEE 1344 [IRIG-B] time code formats. SMPTE-type time codes must have the date be encoded to the Leitch specification in the user bits. IRIG-B(0)/B(1) time code format, must have the year/date encoded to the IEEE 1344 specification in the CF (Control Functions). Verify through your master clock’s documentation that date encoding is both supported and enabled.
  3. If you are using an acceptable UTC time code source with date encoded time code, ensure that the time/date overwrite function of the MCR5000 TCR option is not enabled.
  4. If your time code source is providing daylight savings time adjustments (during DST) or time zone offsets these must be functions must be disabled or you must configure the GMR TCR time code offset options to remove the DST and Time Zone offsets to compensate.
  5. If you are using an NTP client or the date/time display such as on a Windows system, this may provide misleading information as these may be configured to display local time zone and daylight saving time information. This is configured through the Date/Time applet in the Control Panel. Use the WinDiscovery or Telnet interface or a system with the time zone and DST disabled.

# Warranty

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This Masterclock product warranty extends to the original purchaser.

Masterclock warrants this device against defects in materials and workmanship for a period of five years from the date of sale. 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 one-year duration of the written warranty.

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68

## 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.

## HARDWARE SERVICE

You may return your device to Masterclock for repair service. Please contact the factory for **RETURN AUTHORIZATION** before returning the unit. When you return your device for service, you must prepay all shipping charges, international duty, and taxes.



## Declaration of Conformity

**DoC#:** GMR1000-201509

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

Multi-protocol Time Generator / Server

**GMR1000**

is compliant with the CE directives and standards listed below.

**Directives:**

Electromagnetic Compatibility (2014/30/EC)  
RoHS 2 (2011/65/EC)

**Standards:**

CENELEC EN 55022: 2010/AC:2011, Class A  
CENELEC EN 55024: 2010 +A1:2015  
IEC 61000-4-2: 2008  
IEC 61000-4-3: 2006 +A1:2007, +A2:2010  
IEC 61000-4-4: 2012  
IEC 61000-4-5: 2005  
IEC 61000-4-6: 2013  
IEC 61000-4-11: 2004  
CENELEC EN 60950-1:2006 +A11:2009

**By:**

A handwritten signature in blue ink that reads "John Clark". The signature is fluid and cursive, with the first name "John" and the last name "Clark" clearly distinguishable.

John Clark,  
President  
Masterclock, Inc. USA

**September 21, 2015**



## Declaration of Conformity

**DoC#:** GMR5000-201510

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

Multi-protocol Time Generator / Server

**GMR5000**

is compliant with the CE directives and standards listed below.

### Directives:

Electromagnetic Compatibility (2014/30/EC)  
Low Voltage (2006/95/EC)  
RoHS 2 (2011/65/EC)

### Standards:

CENELEC EN 55022: 2010/AC:2011, Class B  
CENELEC EN 55024: 2010 +A1:2015  
IEC 61000-4-2: 2008  
IEC 61000-4-3: 2006 +A1:2007, +A2:2010  
IEC 61000-4-4: 2012  
IEC 61000-4-5: 2005  
IEC 61000-4-6: 2013  
IEC 61000-4-11: 2004  
CENELEC EN 60950-1:2006 +A11:2009

**By:**

A handwritten signature in blue ink that reads "John Clark". The signature is fluid and cursive, with the first name "John" and the last name "Clark" clearly distinguishable.

John Clark,  
President  
Masterclock, Inc. USA

**October 12, 2015**



# Certificate of Volatility

**Manufacturer:** Masterclock, Inc.

**Equipment Name:** Grand Master Reference (GMR1000)

**Model:** GMR1000

**Description:** Compact unit can generate and read NTP, time code, high stability oscillator, and 10 MHz sinewave all locked to the Atomic Clocks in the GPS satellites

## I. Type of memory

Non-volatile memory. MC Utility

## II. Accessibility

No. User data is never accessible.

## III. Required Memory

All memory listed is required for normal operation.

## IV. Removal Consequences

EPROM: The system initializing will not finish.

## V. Method of Access

There is no user access to the memory device, except as provided programmatically to control device behavior.

## VI. Warranty

Yes, memory removal will void the warranty.

## VII. Size and Spacing

EPROM is <1024kB (System application and set up data. No user configuration data)

## VIII. Addressability

Not Applicable. No external access to memory allowed.

Thank you,

Michael Smith

  
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10/19/2015 (Date)



# Certificate of Volatility

**Manufacturer:** Masterclock, Inc.

**Equipment Name:** Grand Master Reference (GMR5000)

**Model:** GMR5000

**Description:** Compact unit can generate and read NTP, time code, high stability oscillator, and 10 MHz sinewave all locked to the Atomic Clocks in the GPS satellites

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Thank you,

Michael Smith

  
\_\_\_\_\_

10/19/2015 (Date)



## Contact Us

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