

GPS200A

MASTER CLOCK

IRIG-B / SMPTE

TIME CODE GENERATOR



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TABLE OF CONTENTS

DISCLAIMER.....	c
ADVISORY NOTICE.....	c
INTRODUCTION.....	1
GPS Satellites.....	1
UTC/Greenwich Time.....	1
Time Zones & Daylight Saving Time.....	1
TIME CODES SUPPORTED.....	1
SMPTE.....	1
IRIG-B.....	1
INITIAL OPERATION.....	2
Operating The GPS200A For The First Time.....	2
Antenna Location.....	2
Time Code Interconnect Cable.....	2
Initial Operations and I/O Connections.....	2
NORMAL OPERATION.....	3
FREEWHEELING.....	3
Freewheeling/Non- Locked LED Indication.....	3
HARDWARE.....	3
Operating Environment.....	3
Access to PC Board.....	3
OPERATIONAL MODES.....	4
Configuring Operation Via On-Board Switches.....	4
Time Code routing Configuration.....	5
Relay Configuration.....	6
Dual Time Code Output Considerations.....	6
DB-9 CONNECTIONS.....	6
COMMUNICATING VIA RS-232.....	6
PRE-AMPLIFIED ANTENNA.....	7
Antenna Coaxial Cable.....	7
PROBLEMS - TROUBLE SHOOTING.....	7
PC BOARD LAYOUT.....	8
SPECIFICATIONS.....	8
Output – Time Code.....	8
Timing Characteristics.....	9
Power Supply Requirements.....	9
Physical.....	9
Environmental.....	9
Antenna Input.....	9
PRE-AMPLIFIED Antenna (Standard).....	9
Coaxial ANTENNA Cable (Standard Package).....	9
ANTENNA MOUNT KIT (Standard).....	9
OPTIONS.....	10
LIMITED WARRANTY.....	11
Exclusions.....	11
Warranty Limitations.....	11
Exclusive Remedies.....	11
HARDWARE SERVICE.....	11

DISCLAIMER

The information contained in this document is subject to change without notice.

Masterclock, Inc. (hereinafter MC) makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

MC shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

MC is not responsible for legislative changes to the Daylight Saving Time (DST) rules, nor to the systems relying on accurate time which may be affected by such changes. Issues related to legislative changes to the DST rules are not covered under the Masterclock, Inc. limited warranty.

See important *limited warranty* information starting on page 11.

ADVISORY NOTICE

CONCERNING GPS SATELLITE SYSTEM AND THE GPS200A TIME CODE GENERATOR

Depending on many factors beyond the control of MC, the signals that are received from the GPS Satellites **are subject to interference, fading, satellite failure and other influences that could cause** the GPS200A to generate erroneous time and/or date information and, under some conditions, **could prevent** it from generating a time code signal and or cause it to generate an erroneous time code signal.

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

INTRODUCTION

The GPS200A is a precision IRIG-B or SMPTE time code generator that provides a source of very stable time code (hereinafter TC) and accurate time and date information. It receives reference time information from Atomic Clocks in the GPS (Global Positioning System) satellites.

GPS SATELLITES

The GPS satellites are operated and maintained by the US Department of Defense and allow for the precise determination of local time and location at any point on (or above) the Earth. This is accomplished via the transmission of very accurate timing information from a series of satellites that provide coverage of the entire planet.

The GPS200A extracts timing reference from these signals and generates time code that is synchronized to within less than 10 microseconds of UTC (Universal Coordinated or Greenwich mean time).

UTC/GREENWICH TIME

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.

TIME ZONES & DAYLIGHT SAVING TIME

Local time in the US and some other countries can also be offset by Daylight Saving Time (DST) whereby the local time is advanced by 1 hour in the Spring of the year and set-back in the Fall. UTC is not affected or changed by any of these local variations.

The GPS200A can provide offset to local time. Hour offsets of -11 to +12 hours (including ½ hour offsets) can be configured via a switch bank on the GPS200A board. U.S. and Canadian daylight savings time adjustment can also be enabled. Other daylight savings offsets can be provided on special order. Additional time zone and daylight saving time configurations can be programmed via the GPS200A's RS-232 interface.

TIME CODES SUPPORTED

The GPS200A supports configurable output of three major TC formats. All of these TCs work well and all are in use in thousands of locations throughout the world. If your operation, installation, or facility is currently using a particular type of TC it is probably best to continue using the same TC.

SMPTE

Defined by the Society of Motion Picture and Television Engineers. It is available in frame rates of 30, 25, and 24 frames second. The GPS200A supports all three formats.* All formats of SMPTE time code generated by the GPS200A carry full date information in the user bits as defined by Leitch Inc.

** The GPS200A does not support generation of SMPTE drop-frame time code. Masterclock, Inc. does not provide products with, or support for, drop-frame capability.*

IRIG-B

Defined by the Range Commanders Council, U.S. Army White Sands Missile Range. The format is used by military, government, power industry, and many other commercial and industrial applications. The GPS200A generates IRIG-B in both a 1kHz modulated and unmodulated (pulse-width coded) format. All formats of IRIG-B time code generated by the GPS200A carry time of year information BCD (binary coded decimal). All formats of IRIG-B time code generated by the GPS200A also carry extended year/date and time zone information in the control functions (CF) as defined by the IEEE 1344 specification.

INITIAL OPERATION

The GPS200A was thoroughly tested with its external power supply (PS) and antenna prior to shipment. Installation and setup is simply a matter of connecting the antenna and PS.

OPERATING THE GPS200A FOR THE FIRST TIME

When the GPS200A is initially powered up, after having been shipped to a new location, the time to first fix (time the unit takes to acquire satellites and extract correct local time) could be up to 25 minutes although it is typically 5 - 15 minutes. Factors such as atmospheric conditions, type of antenna, antenna location, and antenna cable length will affect the time to first fix.

The GPS200A's GPS navigation module has a backup battery that maintains startup data when the unit is powered down. If, when starting up, the location, time and number of satellites that the unit can receive has not changed significantly since last power down then the unit will startup much faster.

ANTENNA LOCATION

Depending on the type of building where the GPS200A is located and obstructions that may block reception of signals from the GPS satellites, the antenna may have to be located where it has an unobstructed view of the sky. In some cases this can be accomplished by placing the antenna adjacent to a window. In most cases it will require mounting it outside of the building or on a roof. In the worse case, the basic requirement for assured system operation is that the antenna module have a clear and unobstructed view of the sky for initial satellite acquisition and lock (generation of time code by the GPS200A). It is possible that the system will operate indoors and under other obstructions however this can only be determined empirically; it is not guaranteed.

If a longer cable is required, cables of various lengths (up to 500 feet) with pre-amplified antennas are available from Masterclock. *Bringing the GPS200A up for the first time with an indoor antenna may prevent or significantly increase the time to first fix.*

TIME CODE INTERCONNECT CABLE

The time code signals are audio signals similar to that of a modem. This time code signal can be routed over unshielded wire like a telephone or, if desired, over a RG-58/59 coaxial cable. The GPS200A generates time code on pin 6 of the male DB-9 connector located on the rear of the unit. Pin 5 is the associated ground.

The necessary connectors and wire can be purchased at a Radio Shack or other electronic supply store or from MC. Check with factory for details.

INITIAL OPERATIONS AND I/O CONNECTIONS

1. Locate the antenna in a suitable area so that the top of the antenna module has a clear view of the sky. Do not move it until after the GPS200A has initiated TC generation (explained below).
2. Connect the antenna coax to the TNC connector on the rear of the unit.
3. Connect your time code reader system to the DB-9 connector on the rear of the GPS200A. (The SMPTE output of the GPS200A is approximately 2 volt PP., both the modulated and unmodulated IRIG-B outputs of the GPS200A are approximately 5 volt PP.)
4. Apply power by inserting the PS module into an appropriate AC power source and the power connector into the male power socket on the rear of the unit.
5. If desired the unit can be operated from a nominal 12 VDC battery (9-18 VDC range). Observe voltage polarity - printed on the rear panel.
6. When power is first applied the initial sequence of the front panel LED is:
 - LED on briefly

- LED off for one second
 - LED steady on.
7. The unit first calculates coordinates and distances for acquisition of GPS satellites. The LED will remain on until satellites are acquired and precise location and timing references are established.

NORMAL OPERATION

After acquisition of satellites the GPS200A will begin generating time code and the LED will blink on and off once each second; the start of each on period is in precise time alignment with UTC and with the “on-time mark” of the selected time code output.

FREEWHEELING

During continuous operation it is likely that the unit will experience outages and loss of satellite reference time. This can be caused by atmospheric and many other outside conditions which are essentially unavoidable with a simplex system. Such signal losses can last from a few minutes to hours. When the condition disappears and the unit re-acquires satellite timing reference it will automatically resync to the satellite time reference.

During such outages the GPS200A will continue to generate time code (TC) referenced to the last available satellite timing information. This mode is referred to as freewheeling. When the unit first acquires satellite time it calibrates an internal reference oscillator against the incoming atomic time. During freewheeling the generated time code will be referenced to this calibrated oscillator and will typically be accurate to within a few milliseconds over a 24 hour period (if the power is not disconnected). As is covered in other areas of this instruction book the freewheeling status is encoded/decoded by the TCRSYNC software supplied by MC and the operator is given the option of synchronizing to the TC during the freewheeling state.

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

FREEWHEELING/NON- LOCKED LED INDICATION

During a freewheeling period the front panel LED will flash twice each second.

HARDWARE

OPERATING ENVIRONMENT

The GPS200A is not water or moisture proof. Treat it as you would any other delicate electronic device and do not expose it to water, excessive heat or physical abuse, particularly when using the unit as a portable TC generator.

ACCESS TO PC BOARD

In order to gain access to the pin jumpers it is necessary to remove the case from the GPS200A. This is accomplished as follows:

First disconnect the DC power (if applied). Although the highest voltage inside the GPS200A is 12 to 28 VDC (which is generally not dangerous to touch), accidentally shorting a trace or wire inside the unit with power-on could destroy or damage any one of the extremely sensitive electronic modules. **Accidentally shorting a wire or trace or subjecting the unit to a static discharge, even for a very small fraction of a second, can destroy these modules. Such damage is not covered by the warranty.**

Remove the two outside Phillips screws in the rear panel (this is the end with the power, and antenna socket, and DB-9 connector). Holding the case of the unit in one hand, slide the rear panel assembly outward from the rear. The entire rear panel assembly and PC board will slide out.

As was mentioned above, the PC board is sensitive to any electrical signal including static discharge. Do not touch the PC board with any external wiring and, whenever possible, handle the unit by the rear panel or on the edge of the PC board as you would a Compact Disk. When not changing the jumpers always keep the PC board installed in the case.

When reassembling the unit take care that the PC board is properly fitted into the slots in the base of the chassis. When properly inserted, the PC board and rear panel assembly will slide easily into the case, no force is necessary. The warranty does not cover damage caused to the unit while removing or reassembling the PC board.

OPERATIONAL MODES

The operational modes for the GPS200A are:

- SMPTE (30 frames/second, non drop-frame)
- SMPTE (EBU - 25 frames/second)
- SMPTE (FILM - 24 frames/second)
- IRIG-B/B(1)

CONFIGURING OPERATION VIA ON-BOARD SWITCHES

The on-board 12 position switch bank (SW1) is used to configure the basic operation modes of the GPS200A. If switch settings are changed while the GPS200A is operating power must be cycled off/on the unit for the new settings to take affect.

Note: Some switch banks may refer to on as “closed” and off as “open”.

Switch positions 1 through 4 configure the hour offset the GPS200A will apply to generated time code. The offset is referenced to UTC (Greenwich Mean Time).

<u>Position</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>Hour offset</u>
	off	off	off	off	No offset
	on	off	off	off	1 hour
	off	on	off	off	2 hours
	on	on	off	off	3 hours
	off	off	on	off	4 hours
	on	off	on	off	5 hours
	off	on	on	off	6 hours
	on	on	on	off	7 hours
	off	off	off	on	8 hours
	on	off	off	on	9 hours
	off	on	off	on	10 hours
	on	on	off	on	11 hours
	off	off	on	on	12 hours

Switch 6 in the *ON* position applies an additional ½ hour offset to the offset specified by switches 1 - 4.

Switch 5 in the *ON* position indicates that the offset specified by switches 1 - 4 & 6 is negative.

Switch 7 in the *ON* position instructs the GPS200A to apply a daylight savings time adjustment to generated time code (when applicable). *(Note: The default daylight savings time definition is U.S./Canada . The GPS200A with firmware version 4.1 or later uses the 2007 US/Canada DST standard., where daylight time begins on the second Sunday of March, at 2:00AM and ends on the first Sunday of November at 2:00AM. Additional daylight savings time configurations can be provided(permanently programmed) by MC on special order.)*

Switch 8 is reserved.

Switches 9, 10, and 11 configure the time code output format of the GPS200A.

Position	9	10	11	Time code type
	off	off	off	SMPTE 30 frames/second
	on	off	off	SMPTE 25 frames/second
	off	on	off	SMPTE 24 frames/second
	on	on	off	IRIG-B/B(1)

Position	12	RS-232 Output Protocol
	off	default - native Masterclock® GPS200/200A serial port protocol
	on	special – Kinometrics/Truetime format (when configured for IRIG-B/B1)

Switch 12 configures RS-232 output format of the GPS200A. Switch 12 *OFF* (default) always specifies native RS-232 protocol. If you would like to utilize the native RS-232 serial port protocol, please see the support area of the MC website www.masterclock.com to download a copy of the serial port protocol specification.

Switch 12 *ON* specifies special RS-232 output mode. When configured as an IRIG-B/B(1) generator switch 12 on provides a 1Hz broadcast ASCII output string in a Kinometrics/Truetime format, as follows:

<SOH>DDD:HH:MM:SSQ<CR><LF>

<SOH> = ASCII 0x01
 <CR> = carriage return (ASCII 0x0d)
 <LF> = line feed (ASCII 0x0a)

DDD = day of year, HH = hours, MM = minutes, SS = seconds

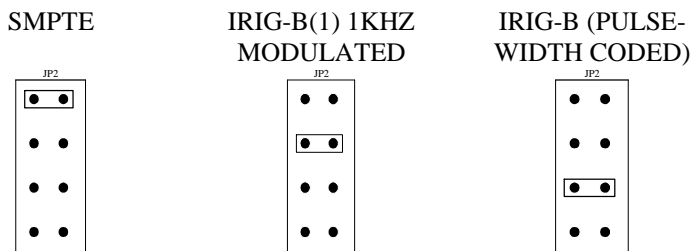
Q = lock quality where SPACE (ASCII 0x20) is normal and '?' (ASCII 0x3f) indicates not locked.

The “on-time” mark for the time encoded in the time string is the at the leading edge of the start bit for the <CR> character.

Switch 12 on for any other time code generator format is undefined and reserved.

TIME CODE ROUTING CONFIGURATION

Important note: Pin Jumper J2 must be configured, in addition to the SW1-9 - SW1-11 switches, to configure/route generated time code to pin 6 of the DB-9. See table below.



RELAY CONFIGURATION

The GPS200A incorporates a configurable relay closure to signal alarm conditions. There are two modes:

J3 – pins 1&2 closed – Relay N/O on valid time – Closes on alarm or power loss

J3 – pins 2&3 closed – Inverted operation

DUAL TIME CODE OUTPUT CONSIDERATIONS

Time code will always be simultaneously available on the unbalanced and balanced (RS-422 differential) time code outputs. When unbalanced time code output is jumpered for SMPTE or IRIG-B (unmodulated), the same signal will also be present on the balanced output.

As a special case, when the unbalanced output is jumpered for IRIG-B(1) (modulated) the IRIG-B (unmodulated) will still be available on the balanced output pins. This will be useful in situations which require both formats of IRIG-B output simultaneously.

DB-9 CONNECTIONS

Pin 1 - Pulse Out

TTL-level 100ms active low pulse generated once per second by the GPS receiver. The negative-going edge of the pulse is aligned with UTC (Greenwich Mean Time) when the receiver has a 3-dimensional GPS satellite fix. This pulse is not available when the GPS200A is first powered on. The pulse may become unavailable if the receiver loses GPS satellite fix for an extended period of time. Accuracy of this pulse (when synchronized to GPS satellite) is nominally +/- 1us.

Pin 2 - RS-232 RX

RS-232 receive line.

Pin 3 - RS-232 TX

RS-232 transmit line.

Pin 4 - Relay Common

Dry contact closure common.

Pin 5 - Ground

Connect this pin to the ground of any host communicating to the GPS200A via RS-232. Also connect this pin to the ground of any device decoding time code from the GPS200A's unbalanced time code out (pin 6).

Pin 6 - Unbalanced Time Code Out

Jumper J2 must be switched to properly route generated time code to this pin.

Pin 7 & 8 - Balanced Time Code Out

RS-422 balanced 5V differential time code output. SMPTE or IRIG-B unmodulated (pulse-width coded) time code is available here per time code output configuration.

Pin 9 - Relay N/C or N/O

Dry contact closure N/C or N/O, depending upon configuration. Shipped from factory configured as N/C.

COMMUNICATING VIA RS-232

The GPS200A supports a robust protocol for determining operation status. The following lists some of the information available to the user:

- GPS200A status bits
- GPS receiver diagnostics
- GPS fix status and type
- UTC and generate time (including frame rate output)
- Enhanced time zone and daylight savings time configuration capability

The full GPS200A RS-232 protocol specification is available for download at the Masterclock home page on World Wide Web (<http://www.masterclock.com>). See the GPS200A folder in the Downloadable Files area.

PRE-AMPLIFIED ANTENNA

The GPS200A requires a pre-amplified antenna. It provides 5 VDC via the center pin of the coaxial for remote power. ***Warning: Attaching a passive (non pre-amplified) antenna to the GPS200A could destroy the GPS receiver module. This is a major repair cost which is not covered by warranty.***

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

Although changing the GPS antenna or coaxial cable is not technically difficult, you are on your own should you decide to make such changes. We do not warrant or support operation with any hardware not installed or supplied by us.

ANTENNA COAXIAL CABLE

The coaxial cable should not be crushed, crimped or bent at a sharp angle nor should it be strained by pulling. Any damage to the cable could result in the GPS200A not functioning properly. If the cable is to be coiled for storage, the coil diameter should be at least 6".

PROBLEMS - TROUBLE SHOOTING

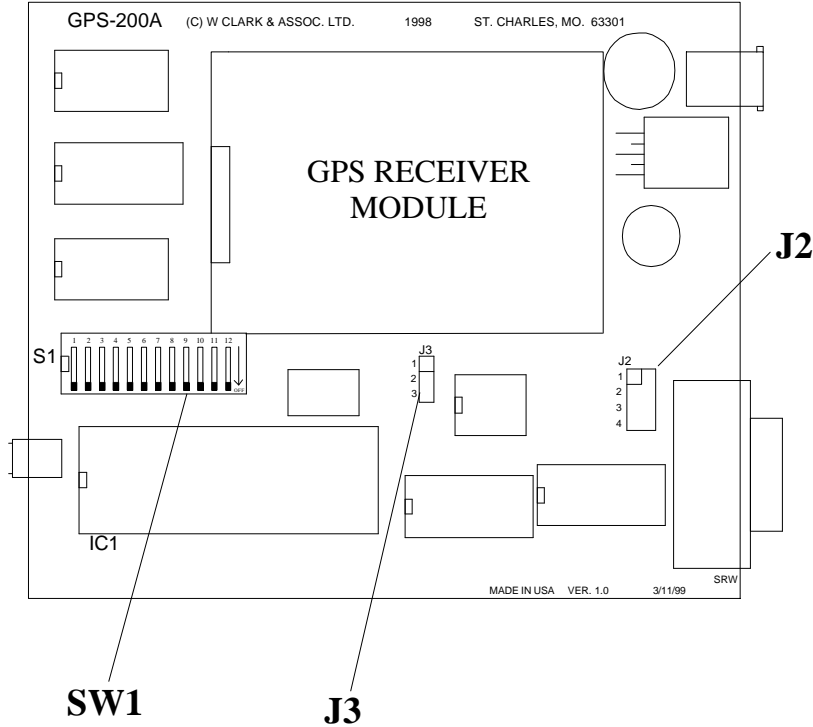
All GPS200A units are checked for proper operation before shipment and unless physical damage is found, the unit is probably functional.

Please remember for an initial startup at a new location the unit could take up to 30 minutes. After the unit has acquired satellites at the new location the startup time is greatly reduced to anywhere from a few seconds to several minutes.

If the antenna (and coaxial cable) has not been damaged and has an unobstructed view of the sky, the power connector is properly installed and the front panel LED follows the startup sequence described earlier (on, off & then on) the unit will probably work.

If you continue to have problems even after the above precautions have been noted please contact the factory.

PC BOARD LAYOUT



SPECIFICATIONS

OUTPUT – TIME CODE

Type:..... LTC (Longitudinal/Linear Time Code), forward running

Format: SMPTE - 24, 25 or 30 fps NDF (Non Drop-Frame)

Level: Approx. - 2 Vpp

Connector: DB-9 pin 6 (Single Ended, Unbalanced, pin 5 associated return/signal ground)

Format: IRIG-B(1) 1kHz, amplitude modulated

Level: Approx. - 5V Vpp

Connector: DB-9 pin 6 (Single Ended, Unbalanced, pin 5 associated return/signal ground)

Format: IRIG-B pulse-width coded

Level: Approx. - 5V Vp

Connector: DB-9 pin 6 (Single Ended, Unbalanced, pin 5 associated return/signal ground)

Format: SMPTE - 24, 25 or 30 fps NDF (Non Drop-Frame)

Level: RS-422 balanced - 5V differential

Connector: DB-9 pin 7 and 8

Format: IRIG-B pulse-width coded

Level: RS-422 balanced - 5V differential

Connector: DB-9 pin 7 and 8

TIMING CHARACTERISTICS

Reference:..... UTC/GMT (default)
Date (SMPTE):..... Included in user bits per Leitch specification
Date/Year (IRIG-B):..... Included in control functions (CF) per IEEE 1344 specification
Short term accuracy +/- 10 µs (when locked)
Long term stability..... Same as GPS atomic clock (when locked)
PPS (pulse per second) 100mS pulse width, TTL level, negative edge going with +/- 1 uS accuracy, relative to GPS time, available on Pin 1 of DB-9 connector (pin 5, associated ground/signal return)

POWER SUPPLY REQUIREMENTS

Input Voltage +12 to +28 VDC
Input Power Connector 2 mm male power jack, center pin +
Power Consumption - @ 12V .. @ 220 ma (2.64W)

PHYSICAL

Size: 1.5 x 4.1 x 5.5 in. (3.8 x 10.4 x 14 cm)
Weight 17 oz. (480 g)

ENVIRONMENTAL

Temperature (operating) 0 to +70 °C
Temperature (storage)..... - 40°C to + 85°C
Humidity Up to 90% Non-Condensing @ +25 °C

ANTENNA INPUT

Connector SMA Female
Center Pin +5 VDC power for external pre-amplified antenna

PRE-AMPLIFIED ANTENNA (STANDARD)

Frequency 1575 MHz ± 10 MHz
Polarization..... Right Hand Circular
Impedance..... 50 Ohm
Weight 8.3 Oz (235 gr.)
Voltage +5 VDC , center pin/conductor
Power Consumption..... @ 20 ma (.24W)
Gain 32 DB Standard
Temperature..... -40 to +70°
Connector SMA female
Mount Internal Thread - M24x1.5

COAXIAL ANTENNA CABLE (STANDARD PACKAGE)

Type..... 51 Ohm low low –RG-58A/U (Belden 8219 or equivalent)
Connectors..... SMA male
Length..... 50 ft / 15m

ANTENNA MOUNT KIT (STANDARD)

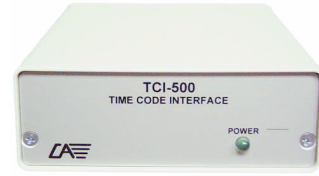
Type..... PVC pipe , with 2 mounting clamps
Mount External Thread - M24x1.5
Diameter ¾ “ / 1.9 cm
Length..... 12” / 30 cm

OPTIONS

RACK MOUNT



TIME CODE
CONVERTER/INTERFACE



LARGE CHARACTER CLOCK
DISPLAYS



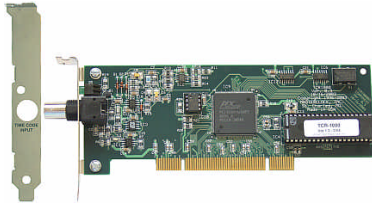
SMALL CHARACTER CLOCK
DISPLAYS



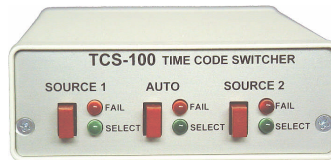
TIME CODE ANALOG CLOCK



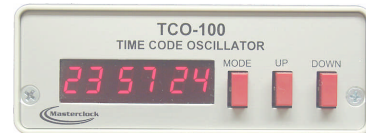
TIME CODE READER CARD



TIME CODE SWITCHER



TIME CODE OSCILLATOR
[REDUNDANT BACKUP]



LIMITED WARRANTY

This Masterclock, Inc. (hereinafter MC) product warranty extends to the original purchaser.

MC warrants the GPS200A against defects in materials and workmanship for a period of one year from date of sale. If MC receives notice of such defects during the warranty period, MC will, at its option, either repair or replace products which prove to be defective.

Should MC 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 MC. 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

MC MAKES NO OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS PRODUCT. MC 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.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL MC 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 which 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 GPS-200A to MC for repair service. Please contact the factory for return authorization before returning the unit.