V-data Timecode Generator Model TCG
OPERATION MANUAL

Introduction

The V-data Timecode Generator Model TCG is a crystal controlled IRIG-B timecode source which will synchronize with 1 microsecond accuracy to GPS receiver outputs when available, otherwise reverting to coast or fail-safe mode.

The Model TCG is a replacement for the Model GTP, with the following improvements:

- smaller and lighter, 4 x 4 x 1.5 inches and 7 ounces
- uses less power, 8-16VDC at 40 ma (or typically 100ma with GPS receiver)
- more weather resistant gasketed enclosure
- available with or without an internal GPS receiver
- enhanced LED status indicator (indicates tracking, acquisition, and fault conditions)

Note: The TCG is weather resistant but recurring precipitation or condensation can damage the external connectors. It should be covered when left outdoors. A plastic bag or pail covering will generally not impair the operation of the internal receiver antenna.

GPS Receiver

Recommended external GPS receivers for use with the TCG are the GARMIN GPS-18 or the GARMIN GPS-17HVS, with a DB9M connector wired as follows:

Pin 1	+5V power to GPS-18	Red (heavier gauge)
Pin 2	Serial track data from receiver	White
Pin 3	Serial setup data to receiver	Green
Pin 4	Pulse-Per-Second (PPS) from receiver	Yellow
Pin 5	Ground	Black (heavier gauge)
Pin 6	12V power to GPS-17HVS	Red
Pin 9	Shield/Drain	Black

(Caution: The GPS-18 operates on 5V and can be destroyed by connection to 12V)

The GPS receiver used with the TCG must supply a $GPRMC message at 4800 baud and a +5V pulse-per-second signal. It is recommended that unused messages be turned off. Software to configure the GPS-18 receiver can be downloaded from the GARMIN.com website. The GPS-18 is available from V-data with the proper connector and configuration. The GPS-18 has a 3 meter cable which, if required, can be extended several hundred feet using a 6 conductor cable (only 4 conductors needed without setup and shield wires).

The TCG is also available with an internal GPS receiver, but in this configuration it must be used outdoors. To use the TCG with an external GPS receiver the internal GPS receiver can be simply unplugged and left in place.

Power and Startup

The GTP is powered by the supplied 9VDC, 200ma wall transformer or by any source of 8-16 VDC at 100 milliamps to the standard 2.1mm power jack, with center pin positive. Reverse polarity protection and a 500ma self-resetting polycrystalline fuse are built-in. On power-up the TCG immediately begins to generate IRIG-B timecode starting at the first second of the century, and it will take several seconds for an internal or external GPS receiver to acquire and provide current UTC time. Acquisition time depends on how long power has been off and how far the unit has been moved while the power has been off.

LED Status Indicator

If no internal or external GPS receiver is detected, or if no PPS is detected when a receiver is tracking, the LED status indicator will repetitively **flash one second on and four seconds off to signal a fault condition**. If the TCG detects a GPS receiver that is not tracking, the status indicator will **flash one second on and one second off to signal acquisition condition**. When the receiver is tracking and PPS is present the status indicator will stay **continuously on to signal track condition**. If GPS signals or track is lost for any reason, the status indicator will return to flashing, but the timecode output will continue to update without discontinuity in coast or fail-safe mode subject to the 30 ppm accuracy of the internal oscillator.

IRIG-B Output

Standard 3V p-p, 1KHz IRIG-B timecode is output on the BNC connector. The output can drive four 600 ohm loads, and is compatible with all V-data VED video time inserters. Full date has been added to the IRIG-B format in fields 5,6, and 7. Time of day in binary seconds is in fields 8 and 9.

GPS and COM Connectors

The two DB9F connectors are designated GPS and COM. Pins 1-5 are the same on both connectors, so an external GPS-18 receiver can be plugged into either connector. Only the GPS connector supplies 12V power on Pin 6 for the GPS-17HVS. It is recommended that the GPS connector be used for the receiver, leaving the COM connector free. The COM connector can then be used as needed for the following supplemental functions:

(Note: Serial connection is 4800 baud, 8 data bits, 1 stop bit, no parity. Ground on Pin 5 or Pin 9)

- Monitor and configure the internal or external GPS receiver
  Pin 2—data output from receiver, Pin 3—setup input to receiver
- Set the time and date for test applications (must first disconnect external and internal receiver)
  Pin 2—time and date from computer, Pin 6—acknowledge from TCG
  Time and Date input format: **$GPRMC,HHMMSS,T,,,,,,ddmmyy,<CR>** (<LF> optional)
- Capture event time from a computer interrogation
  Pin 8—null, @, or space character from computer, Pin 6—captured time from TCG
  Captured time output format: **ddmmyy,HHMMSS.SSS,R<CR>** (R is receiver status)
- Capture event time from an external pulse
  Pin 8—5 to 15V positive pulse>1ms from user, Pin 6—captured time from TCG
  Captured time output format: **ddmmyy,HHMMSS.SSS,R<CR>** (R is receiver status)
- Output unmodulated IRIG-B timecode
  Pin 7—unmodulated IRIG-B from TCG
  Current source output will drive cine film-plane LED or fiber-optic transmitter LED.

Receiver Status Character

Additional receiver status information is contained in a receiver status character that occupies the four unused bits in the IRIG-B timecode after Julian date. The status character is encoded in BCD format like the other timecode characters and is read as a 0-9 number. The 2, 4, and 8 bits are used to encode the current receiver status. The 1 bit is used for receiver track history and is set the first time track is achieved, to remain on as long as the TCG is powered. Track history is useful in determining if the receiver has never acquired or if it is just experiencing a temporary track loss. With the history bit off, the 2, 4, and 8 bits will be set or cleared to encode receiver status conditions as follows:

Status 0—This is the track condition with receiver tracking and PPS present
Status 2—This is an acquisition condition with receiver not tracking but PPS present
Status 4—This is an acquisition condition with receiver not tracking and PPS absent
Status 6—This is a fault condition with receiver tracking and PPS absent
Status 8—This is a fault condition with no internal or external receiver detected

When set, the history bit will add one to each of these numbers to signify that at some point after power-up the receiver was tracking. For example, a Status 3 would indicate that that the receiver is not currently tracking but has been in the past, and that the PPS is still present. This is a normal temporary track-loss condition. The normal track condition will almost always be Status 1, because Status 0 can only persist at most for one second when track is acquired before the history bit is set. In summation, Status 0-1 indicates track, Status 2-5 indicates acquisition, and Status 6-9 indicates a fault condition, with the odd numbers indicating that the receiver has been tracking at some point regardless of the present condition.

The receiver status character, designated by **R** is read out along with the time information in an event time capture operation on the COM connector as previously described.

Test Time Input

As previously described, using the COM connector the TCG can be loaded with a test time from an external computer if there is no external or internal GPS receiver connected. Unlike GPS input, this is normally a one-time operation and the TCG will continue to update the test time once it is initially loaded. The LED status indicator and the receiver status indicator are not affected by a test time input and will continue to indicate presence or absence of GPS input. A valid GPS input will over-ride a previous test time input. In the test time input format, HHMMSS represents the hour, minute, and second, ddmmyy represents the day, month, and year, and the T character tells the TCG that the input is a test input rather than a similar GPS input. The TCG adds 38 milliseconds to allow for transmission time, setting the time with an accuracy of one millisecond referenced to the beginning of the transmission.

Event Time Capture

As previously described, using the COM connector, the TCG can capture an event time from an input pulse or a computer generated null, space, or @ character. The captured time is accurate to one millisecond referenced to the beginning of the pulse or character. The receiver status character, designated by **R**, is read out along with the time and date. Further event inputs are ignored until the current event capture has been read out.

Unmodulated IRIB-B Output

As previously described, using the COM connector the TCG can output unmodulated IRIG-B time. The output is a current source derived from 5VDC with an internal 100 ohm series resistor. The output will drive a typical LED with a peak current of 30 ma, or an average current of about 15 ma based on a 50% duty cycle IRIG-B signal. The current can be reduced using additional external series resistance. If not driving an LED, the output can be monitored at an external terminating resistor of about 1k ohms. The output will appear as a sequence of 5V pulses at a 100 Hz rate. The pulses are 2ms, 5ms, or 8ms in duration representing one, zero, or marker bits.

Trouble-Shooting

The NMEA communications protocol used by most GPS receivers is standardized, but there is still room for variation. For this reason, satisfactory operation of the TCG with GPS receivers other than the GPS-18, GPS-17HVS (or previous GARMIN models) is likely but not guaranteed. Most GPS receivers will require a one-time setup to set the baud rate, disable unneeded messages, and enable the $GPRMC message and the Pulse-Per-Second (PPS). Software for setting up the GARMIN receivers is available for download from the GARMIN website.

The length of time it takes a GPS receiver to acquire depends on several factors including how recently it was last tracking, how far it has been moved since last tracking, and how much the view of the sky is obstructed. If a receiver has been tracking recently, has not moved far from that position, and has a good view of sky, it should re-acquire in less than 30 seconds. Under less favorable conditions it may take up to ten minutes to acquire.

A common problem is a missing PPS signal, due to it not being enabled in the receiver, or due to a broken wire or connection. A missing PPS is normal for a receiver that is acquiring, so it is not recognized as a fault until the receiver begins tracking. The typical indication of a missing PPS would be the normal acquisition indication of the LED flashing at one second on and one second off after the receiver is powered-up. Then after some time, when the receiver begins tracking, the missing PPS would then be seen as a fault and the LED would begin flashing at one second on and four seconds off. This is in contrast to the situation where no internal or external GPS receiver is connected or the $GPRMC message is missing, which results in an immediate fault condition at power-up.

A fault condition at power-up is the best way to tell that no internal receiver is installed, and that an external receiver is needed. If an immediate fault condition at power-up occurs even with internal or external receiver installed, then it is likely that the $GPRMC message has not been enabled in setting up the receiver or that the baud rate is not set to 4800.

When using an internal receiver the TCG must be positioned with the antenna facing up, as noted by text on the TCG board. An internal receiver limits the TCG to outdoor use. An advantage of the external receiver is that it can be remoted hundreds of feet so that the TCG can be located indoors. The internal receiver can be unplugged and left in place to convert the TCG for use with an external receiver. To unplug the internal receiver, remove the four screws securing the top cover and pull the connector out of the receiver board. The connector has no locking mechanism so can be pulled out easily by grasping all the wires to distribute the load.

The TCG covers are made of rugged polycarbonate plastic. If replacements are needed, they are available at CircuitShell.com.