

MODEL 6140
GPS/TRIG B VIDEO SYNCHRONIZER

Revised
January 30, 2004

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MODEL 6140
GPS/IRIG B VIDEO SYNCHRONIZER

1.0 GENERAL

The Model 6140 is a stand-alone unit designed to synchronize color and/or monochrome video cameras to GPS time or IRIG B serial time code. All cameras genlocked to like units will be precisely synchronized. It consists of a twelve channel GPS receiver, the output of which, when selected via the front panel IRIG/GPS switch, is used to synchronize an internal IRIG B time code generator. This IRIG B signal is then used to drive the color and monochrome video sync generators.

The 6140 provides a precise IRIG B serial time code output, an RS-170 composite video signal and an RS-170A (NTSC) composite signal with black burst. The unit automatically acquires all in-view satellites upon power up and locks the internal IRIG B time code generator to the GPS time reference. The Video Sync Generators then lock to the IRIG B. When IRIG is selected via the front panel switch, the 6140 uses the external IRIG B input signal to synchronize the internal IRIG generator/video timing logic. Lock status of GPS or IRIG and IRIG B to the Video Sync is displayed via LED indicators on the front panel. If the external GPS or IRIG lock is lost the 6140 will automatically switch to an internal clock and continue generating the output IRIG B signal. No discernible change in the IRIG B output or video sync will occur due to this transition.

The 6140 may also be used as a stand-alone unit to generate an IRIG B signal and video synchronization signals. The time-of-year may be set by the user via an included RS-232 port which may also be used to read the GPS/IRIG time. In the event of a power failure the 6140 will no longer output the serial time code or video sync however the time will continue to advance by automatically switching to a battery backed-up internal clock. The IRIG and video outputs will resume, without resetting, upon reapplication of power.

The 6140 is powered by 9 to 36 Volts DC and includes an active magnetic mount GPS antenna.

2.0 CHARACTERISTICS

2.1 TIME CODE SYNCHRONIZATION

The 6140 internal clock automatically synchronizes to either an external GPS or IRIG B input signal as selected by the front panel IRIG/GPS SYNC REF switch when that input is connected and a valid signal is received and verified. If the unit loses lock after initial synchronization, it will continue to operate on the internal clock which also generates a serial IRIG B signal output. No discernible change in the IRIG B output will occur when signal lock is lost after synchronization. The IRIG/GPS presence and lock status are displayed on front panel indicators. The "IRIG/GPS LOCKED" indicator is lit when the units internal time generator is synchronized with the selected source. The "TIME CODE SYNCHRONIZED" indicator is lit when the unit is locked and remains lit until either the time is changed via the RS-232 serial port after the input IRIG or GPS signal is removed, when the IRIG/GPS mode is changed, or until power to the unit is turned OFF. The synchronized IRIG B serial time is available at a rear panel connector for use by other instruments as well as used to internally synchronize the video sync generators. When the unit is powered up without an external time reference, it will initialize from the internal Time-of-Day clock. The TOD clock accuracy is 1 part in 10^4 with a ± 1 ms uncertainty error at turn-on. The TOD clock is re-synchronized each second while the 6140 is locked to an external time reference.

2.2 VIDEO SYNCHRONIZATION

The 6140 contains two independent Composite Video Sync generators, one for monochrome cameras (RS-170) and one for color cameras (RS-170A). Both lock to the internal IRIG B signal which in turn is locked to external IRIG or GPS time. The lock status of the generators is displayed by "RS-170 LOCKED" and "RS-170A LOCKED", LED indicators.

2.3 TIMING ACCURACY

The purpose of the Model 6140 is to provide a means to assure that cameras located at different sites, even over great distances, will be precisely synchronized. The 6140 is designed to be synchronized to an IRIG B time reference, a GPS time reference, or both, and provides both RS-170 and RS-170A synchronization signals.

If two or more 6140s are synchronized to a common time signal/reference the corresponding synchronization signals produced by the unit will be aligned regardless of location. This means

2.3 TIMING ACCURACY (continued)

that all RS-170 cameras are in sync with all other RS-170 cameras and all RS-170A in sync with all other RS-170A cameras. The two formats are **NOT** compatible with one another and as such will bear no apparent timing relationship to each other. RS-170 video has a 60 Hz vertical rate and the relationship to a 1 Hz time reference can be easily observed; the vertical sync will be coincident with the 1 Hz time mark every second. The RS-170A vertical rate is approximately 59.94 Hz and therefore appears to have no relationship to either the 60 Hz RS-170 or a 1 Hz reference. The only useful way to describe accuracy of the Model 6140 is by expressing the relative accuracy between units using like video formats.

The most accurate time reference is GPS. The video synchronization signal output will be accurate to within ± 250 nanoseconds from each unit giving a ± 500 nanoseconds relative accuracy between units using only GPS. IRIG B time reference is less accurate because it must be demodulated and decoded from a 1 KHz modulated carrier. Waveform distortion, carrier level variation, noise, and other analog errors cause timing uncertainties, which make it difficult or impossible to pin down absolute timing accuracy. In laboratory tests, with clean IRIG signals, an accuracy of better than ± 5 microseconds is normal per unit, giving a total ± 10 microseconds between units using only IRIG B as their time reference. The user must take care, when using a distributed IRIG B time signal to synchronize the 6140s, that propagation delays be considered when routing the signal throughout a facility or to other sites, since those delays may also contribute to a potential timing error.

2.4 USER PROGRAMMING

Programming of the "time-of-year" is performed via the RS-232C serial port. Additionally the time may be read via this port. If the 6140 is locked to IRIG or GPS time, the "time set" function is disabled. The native GPS time data format is in UTC. Internal 'TIME OFFSET' DIP switch S3 (LS 5 bits) is provided to allow the user to convert the UTC time to local time (see table 1). This switch affects only the GPS time.

2.4.1 RS-232C Command Format

The 6140 receives commands via the rear panel RS-232C port. The data format is 1 start bit, 1 stop bit, 8 data bits, and no parity. The factory configured data rate is 9600 baud; however, it may be changed by the user via the three MS bits of internal 'TIME OFFSET' switch S3 (see table 2). RTS/CTS handshake lines are provided, however, their statuses are ignored. There are three commands that are accepted by the 6140: Read Status, Read Time, and Set Time. The format for these commands are as follows:

2.4.1 RS-232C Command Format (continued)

Read Status: ^S (13H)

This single byte command invokes a single byte ASCII numeric response: '0' if the unit is not synchronized to external time signal, '1' if it is.

Read Time: ^T (14H)

This single byte command invokes a 10 byte ASCII numeric response string: LDDDDHHMMSS where L=lock status (see above), DDD=Julian day, HH=hours, MM=minutes, and SS=seconds. The response is delayed until the next second transition at which time the 1st byte is sent. This allows for an accurate time mark with which to reference the time that follows. As the system is defaulted to a data rate of 9600 baud, the error in the time from receipt of the 1st byte to the actual time is only about 1ms.

Set Time: ^R (12H) YYDDDDHHMMSS <CR>

This is a thirteen byte command where YYDDDDHHMMSS is an ASCII string of digits and: YY=LS year, DDD=Julian day, HH=hours, MM=minutes, and SS=seconds. The string is terminated by a CARRIAGE RETURN (0DH). The receipt of the terminator sets the time into the 6140 if it is not currently locked to an external source. If not locked, the unit responds with an ASCII '+' byte. If the unit is locked to an external time source, the entry is ignored and an ASCII BELL (07H) is sent in response. This command allows the 6140 internal IRIG B time generator to be set from the RS-232C port when an external time reference is not available. Although not an extremely accurate method of setting the time, this 'reference' unit can provide synchronization to other 'slave' units via the IRIG B output resulting in an accurately synchronized group with respect to one another.

TIME ZONE OFFSET
TABLE 1

<u>S3-4</u>	<u>S3-3</u>	<u>S3-2</u>	<u>S3-1</u>	<u>Offset</u>
On	On	On	On	None (UTC)
On	On	On	Off	1 hr
On	On	Off	On	2 hr
On	On	Off	Off	3 hr
On	Off	On	On	4 hr
On	Off	On	Off	5 hr
On	Off	Off	On	6 hr
On	Off	Off	Off	7 hr
Off	On	On	On	8 hr
Off	On	On	Off	9 hr
Off	On	Off	On	10 hr
Off	On	Off	Off	11 hr
Off	Off	On	On	12 hr

S3-5 ON is positive offset, S3-5 OFF is negative offset

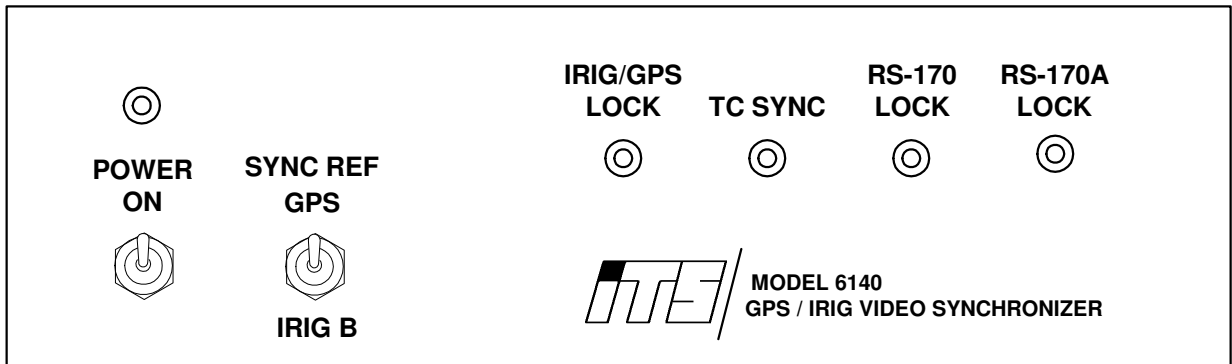
BAUD RATE SELECT
TABLE 2

<u>S3-8</u>	<u>S3-7</u>	<u>S3-6</u>	<u>Baud Rate</u>
On	On	On	300
On	On	Off	600
On	Off	On	1200
On	Off	Off	2400
Off	On	On	4800
Off	On	Off	9600 (default)
Off	Off	On	19200
Off	Off	Off	38400

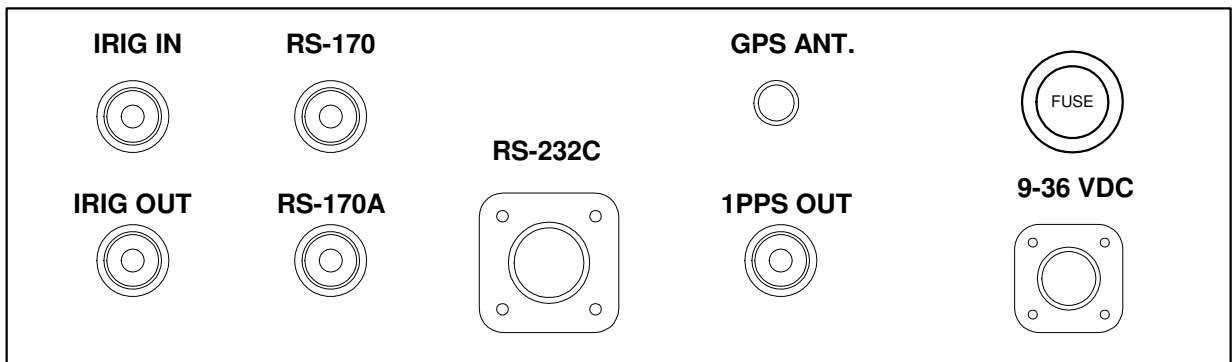
3.0 MECHANICAL CONFIGURATION

The 6140 is housed in a ruggedized aluminum case, 8.5" wide x 10" deep x 2.5" high. (See Fig. 1). All circuitry is on a two printed wiring boards. All internal connections are via mating connectors, no edge connectors are used. All connectors are on the rear of the enclosure and all controls and indicators are on the front panel.

FIGURE 1
MODEL 6140 ENCLOSURE



Front Panel



Rear Panel

4.0 CONTROLS AND INDICATORS (See Figure 1)

- 4.1 Power 2 Position Toggle Switch -
Selects power ON/OFF. LED illuminates when external power is applied.
- Toggle Switch -
Selects primary sync source of GPS or external IRIG B.
- 4.3 IRIG/GPS Lock Green LED Indicator -
Illuminates when IRIG/GPS switch has GPS selected and GPS signal is present and satellite acquisition is accomplished or if IRIG is selected, present, and locked.
- 4.4 TC Sync Yellow LED Indicator -
Illuminates when 6140 is or has been synchronized to the selected time source. Resets to off condition when power is turned off, time source is changed, or time is reset manually.
- 4.5 RS-170 Locked Green LED Indicator -
Illuminated when RS-170 composite sync is locked to internal IRIG B.
- 4.6 RS-170A Locked Green LED Indicator -
Illuminated when RS-170A composite sync is locked to internal IRIG B.
- 4.7 GPS Antenna SMA Connector -
Provides +5V power to and receives signal from GPS antenna.
NOTE: DO NOT connect passive antenna to this connector since it may damage the GPS antenna power regulator.
- 4.8 IRIG B Output BNC Connector -
Outputs serial IRIG B signal.
- 4.9 IRIG B Input BNC Connector -
Receives IRIG B signal which may be used as primary reference when GPS is not present.
- 4.10 RS170 Out BNC Connector -
Outputs Composite RS170 (525/60 monochrome) Video synchronization signal.

4.0 CONTROLS AND INDICATORS (cont'd)

4.11 RS170A BNC Connector -
Outputs Composite RS170A (Color NTSC) Video synchronization signal.

4.12 1 PPS Out BNC Connector -
Outputs 1PPS TTL signal, synchronized with GPS 1 second Time Mark. Reference time is on the Low-to-High transition and valid in GPS mode only.

4.13 RS-232 PTO2A10-6P Connector -
Provides serial interface to read or set time.

<u>Signal</u>	<u>Pin</u>	<u>Function</u>
TxD	A	Transmit Data (out)
RxD	B	Receive Data (in)
CTS	C	Clear to Send (in)
RTS	D	Request to Send (out)
GND	E	Signal ground
CHASS	F	Chassis

4.14 Power PT02A8-4P Connector -

<u>Pin</u>	<u>Function</u>
A	9 to 36 VDC
B	Return
C	Chassis
D	N/U

5.0 SPECIFICATIONS

5.1 Frequency Stability (when not locked to GPS)

When powered 1 part in 10^6 .

On Battery backup 1 part in 10^4 .

5.2 Clock backup life (un-powered) 1 year minimum

5.3 GPS Performance

Channels: 12 Parallel channels, tracks all satellites in view

Time-to-first-fix <15 seconds typical (warm start), <90 seconds typical (cold start)

UTC Time Mark Synchronized with Global Reference Standard

Reacquisition: 2 seconds typical

Antenna power: The system is provided with an active antenna which is supplied 5 volt power via the antenna cable from the 6140. The supply voltage is set internally via jumper J8 for 5 volts, 12 volts, or 0 volts (passive antenna). Other antenna types than that supplied may be used, however, the required antenna supply voltage **MUST** be set correctly or permanent damage may result in either or both the 6140 and/or the antenna!. A passive antenna can short out the cable and it's use requires that jumper J8 be removed. Care must be used if installing additional cable to prevent excessive loss, which will degrade performance, or shorts which may damage the system.

5.4 IRIG B Output Standard IRIG B serial time code IAW IRIG Standard 200-98.

5.5 RS-170 Output Composite Video Sync signal IAW EIA RS-170, 1V peak to peak, 60 Hz field rate. Vertical sync referenced to 1PPS time mark in GPS mode or the reference mark in IRIG mode.

5.0 SPECIFICATIONS (cont'd)

5.6	RS-170A Output	Composite Video Sync signal IAW EIA RS-170A (NTSC), 1V peak to peak, 59.94 Hz field rate, Black burst. Vertical sync is referenced to Jan 1 00:00:00.0000.
5.7	Power	9 to 36VDC, 2.75 Watts
5.8	Temperature	
	Operating	0°C to +55°C
	Nonoperating	-20 to +70
5.9	Humidity	95% non-condensing
5.10	Package	
	Size	8.5" wide x 10" deep x 2.5" high
	Weight	2.5 lbs.