GPS92 User Guide
USER INSTRUCTIONS

HYTEC GPS92 PRECISION TIME-STAMP MODULE

Preliminary version Oct. 1997

1. Introduction.

These user instructions are prepared in advance of a full user manual which will be produced once more evaluation of the user environment has been carried out. The firmware in the GPS92 is, at the date of writing, in an early form which will be updated by later releases sent out to each customer in the form of a set of four replacement EPROMs.

2. Preparation

Before installing the module in the CAMAC crate, make sure the internal settings are as required. These are as follows:-

Note: Exercise extreme care when removing the left-hand side cover since the GPS engine is mounted here and cabled to the rest of the module. You can remove the antenna cable without any effect, but if you remove the 20-way ribbon cable then stored information on the GPS engine will be lost from the non-volatile RAM. This will affect start-up time!

On the right-hand card, there is only a four-pole DIL switch, which sets the baud rate for *both* serial ports, that is the front panel RS232 port and the serial data connection to the GPS engine. Since the baud rate to the GPS engine is fixed at 4800 baud, these switches must be left as delivered:

SW1-1 = OFF SW1-2 = ON SW1-3 = ON SW1-4 = OFF

The front panel RS232 port must always, therefore, be connected at 4800 baud. The data format is 8 data bits, no parity, 1 stop bit. The pinout of the connector is as follows:-

Pin 1 GND Pin 2 TX DATA Pin 3 RX DATA [Data IN to GPS module]

On the **left-hand card**, there are a number of jumpers and adjustments:-

2.1 Active Edge Selection JP1, JP2 select the active edge of the EVENT and FAST CLEAR inputs respectively. Each jumper consists of three pins, pin 1 identified by a square PCB pad, nearest the back of the module, pin 2 in the centre and pin 3 nearest the front of the module. Joining pins 1 and 2 of the relevant jumper selects the rising edge of the input, joining pins 2 and 3 selects the falling edge. The selected edge sets an interrupt flag for the processor and, in the case of the event input, stores the state of the internal counter for event timing purposes. 'Rising' and 'Falling' refer to the input in TTL level terms, where 'rising' means going from a TTL low to a TTL high. It is possible to select NIM input signal levels by adjusting potentiometers (see below) but the direction of signal movement remains the same; so selecting the rising edge with a NIM input would mean looking for a transition **to** a less negative voltage, e.g. from -0.8 volts to 0 volts.

At manufacture, both JP1 and JP2 are fitted 1-2 rising edge.

2.2 Signal level selection. VR1 and VR2 adjust the threshold for high speed comparators which condition the FAST CLEAR and EVENT inputs respectively. The range of adjustment is from -1V to +1V. At manufacture, both are set to +1V, for TTL signals.

To Adjust, proceed as follows:-

Event Input: monitor IC 21 pin 8 and adjust with VR2 to the desired value.
Fast Clear Input: monitor IC 22 pin 8 and adjust with VR1 to the desired value.

2.3 Latch Clock Delay. Jumpers JP3, JP4, JP5, JP6 and JP7 (select one only) select between one and five delay steps in the clock for the latches with respect to the clock for the counter. Each delay step is 2 nanoseconds and at manufacture, this is set at 1 step - JP3 in, all others out.

JP8 and JP9 select the power source for a special oscillator which is not used in the commercial version - so these should not be fitted.

Having adjusted and set up the module, it can be CAREFULLY reassembled and installed in the crate.

3. Connecting Up.

The CAMAC GPS92 module can now be connected up to its antenna [BNC connector] and any signal inputs. The antenna should be connected and, if necessary, disconnected with the power switched off to avoid any damage to the unit. The antenna supplied, if any, will normally be an active 26dB patch antenna for surface mounting, together with the necessary cable. Excessive cable length should be avoided and the antenna position is quite important:

3.1 Antenna Position. The antenna should be mounted 'on its back', that is facing the sky [the surface opposite the mounting face is the active face] and with a clear view of the sky in all directions. Trees and buildings are barriers to the signal and should be avoided. A clear view right down to 40 degrees above the horizon in all directions is ideal.

4. Setting to Work.

With the antenna in position and connected up, the power can be switched on.

When the unit is first switched on, it is advisable to have a diagnostic terminal connected to the front panel port so that operation of the unit can be observed.

The front panel LEDs should show "TRACKING" ON and all the others OFF. The message "Looking for a satellite......." should be displayed on the terminal, followed at regular intervals by further messages saying that it is still looking.

This goes on until the GPS engine has established where in the world it is, what the time is, and which satellites it can track. When the unit is first switched on, the unit will obviously need to do a full survey and this can take up to 30 minutes. Once the GPS engine has acquired a satellite, this is reported on the screen, together with some time and position information and the firmware version number. Further satellites will then be acquired.

At this point you can press <RETURN> on the terminal and the unit will respond with time information and details of satellites being tracked. In this initial version of the firmware, that is all you can do from the terminal, although other commands will be added later.

5. Problems Getting Started

If the unit fails to see a satellite within 30 minutes or so, then there is probably a problem with the antenna. Check the cable connections and the antenna position, make sure there is no water in any of the connectors.

6. Using the Module

The primary purpose of this module is to provide accurate time stamp values for external events. The Event input on the front panel stores a 50MHz count value in an internal latch and interrupts the processor. From this value and the value of a similar latch which stored the count on the last 1PPS (Pulse-Per-Second) pulse from the GPS engine, the processor works out the exact UTC (Universal Co-ordinated Time) time of the event. This is then stored in the Dual-Ported Memory, accessible via CAMAC.

The Event Input - size 00 LEMO socket - is terminated in 50 ohms and, as we have seen above, can be a TTL signal or a negative signal such as NIM.

The other input on the front panel is Fast Clear, which is the same type as Event, i.e. TTL or NIM into 50 ohms- size 00 LEMO socket - , which causes the processor to abort the last event calculation and prepare for the next.

There is one size 00 LEMO socket output on the front panel and this is called 1PPS. This is a high-powered TTL signal 2 microseconds wide whose leading edge is derived from the GPS engine 1PPS output, which is normally within 100 nanoseconds of UTC 1PPS. An LED next to this shows a stretched version of this pulse.

In a typical application, the event input will be connected to some external trigger signal, which will cause the time to be stored. The maximum rate at which this input can pulse has been found by experiment to be approximately 3KHz.

When an Event pulse has been received and the calculated time put in the Dual-Ported RAM, the processor will attempt to set the GPS module's LAM signal. It will succeed if the Enable LAM command has been sent to the module.

REMEMBER that this module will evaluate the time of an event pulse at the front panel and put the data into the dual-ported memory, but the firmware is not designed to operate this unit as a "Real-Time Clock", that is it won't keep an updated time in the memory for you. If that is the intended application, you will need to put pulses into the event input in order to get it to update the time. You can use the 1PPS output for this if you wish, or supply an external 1-2KHz signal for the purpose. Don't forget that the input is 50 ohms to ground so you will need a line-driving type TTL signal.

7. CAMAC Commands.

All CAMAC Commands are received by the **RIGHT-HAND station**

Command	Function	Data valid	Q	X
F(0) A(0)	Read Dual-Ported RAM Word 1 in current page	16 bits	1	1
F(0) A(1)	Read Dual-Ported RAM Word 2 in current page	16 bits	1	1
F(0) A(2)	Read Dual-Ported RAM Word 3 in current page	16 bits	1	1
F(0) A(3)	Read Dual-Ported RAM Word 4 in current page	16 bits	1	1
F(0) A(4)	Read Dual-Ported RAM Word 5 in current page	16 bits	1	1
F(0) A(5)	Read Dual-Ported RAM Word 6 in current page	16 bits	1	1
F(0) A(6)	Read Dual-Ported RAM Word 7 in current page	16 bits	1	1
F(0) A(7)	Read Dual-Ported RAM Word 8 in current page	16 bits	1	1
F(0) A(8)	Read Dual-Ported RAM Word 9 in current page	16 bits	1	1
F(0) A(9)	Read Dual-Ported RAM Word 10 in current page	16 bits	1	1
F(0) A(10)	Read Dual-Ported RAM Word 11 in current page	16 bits	1	1
F(0) A(11)	Read Dual-Ported RAM Word 12 in current page	16 bits	1	1
F(0) A(12)	Read Dual-Ported RAM Word 13 in current page	16 bits	1	1
F(0) A(13)	Read Dual-Ported RAM Word 14 in current page	16 bits	1	1
F(0) A(14)	Read Dual-Ported RAM Word 15 in current page	16 bits	1	1
F(0) A(15)	Read Dual-Ported RAM Word 16 in current page	16 bits	1	1
F(1) A(0)	Read Dual-Ported RAM Word 17 in current page	16 bits	1	1
F(1) A(1)	Read Dual-Ported RAM Word 18 in current page	16 bits	1	1
F(1) A(2)	Read Dual-Ported RAM Word 19 in current page	16 bits	1	1
F(1) A(3)	Read Dual-Ported RAM Word 20 in current page	16 bits	1	1
F(1) A(4)	Read Dual-Ported RAM Word 21 in current page	16 bits	1	1
F(1) A(5)	Read Dual-Ported RAM Word 22 in current page	16 bits	1	1
F(1) A(6)	Read Dual-Ported RAM Word 23 in current page	16 bits	1	1
F(1) A(7)	Read Dual-Ported RAM Word 24 in current page	16 bits	1	1
F(1) A(8)	Read Dual-Ported RAM Word 25 in current page	16 bits	1	1
F(1) A(9)	Read Dual-Ported RAM Word 26 in current page	16 bits	1	1
F(1) A(10)	Read Dual-Ported RAM Word 27 in current page	16 bits	1	1

F(1) A(11) 1	Read Dual-Ported RAM Word 28 in current page	16 bits		1
F(1) A(12) 1	Read Dual-Ported RAM Word 29 in current page	16 bits		1
F(1) A(13) 1	Read Dual-Ported RAM Word 30 in current page	16 bits		1
F(1) A(14) 1	Read Dual-Ported RAM Word 31 in current page	16 bits		1
F(1) A(15) 1	Read Dual-Ported RAM Word 32 in current page	16 bits		1
F(2) A(0)	Read Dual-Port RAM Page Select Register	5 bits	0	1
F(18) A(0)	Write Dual-Port RAM Page Select Register	5 bits	0	1
F(10) A(0)	Clear Module LAM	-	0	1
F(24) A(0)	Disable Module LAM	-	0	1
F(26) A(0)	Enable Module LAM	-	0	1
F(27) A(0)	Test Module LAM	-	True	1

Dual-Ported RAM Page 0 DATA FORMAT:-

WORD	NAME	BIT(s)	CONTENTS
1	Time_1	0-15	Low 16 bits of 10 nanosecond increments into second.
2	Time_2	0-10	High 11 bits of 10 nanosecond increments [27 bits total]
		11-15	Low 5 bits of seconds into day.
3	Time_3	0-11	High 12 bits of seconds into day [17 bits total]
		12-15	Low 4 bits of day into year.
4	Time_4	0-4	High 5 bits of day into year [9 bits total]
		5-9	5 bits of year starting from 1996 (0=1996)
		10	1 bit status = scheduled satellite visible?
		11-13	3 bits of number of satellites visible
		14-15	2 bits of navigation mode:- 0=normal precision, 1=high precision, 2=determining position, 3=no satellites visible.
5	Status_1	0-15	Low 16 bits of next satellite changeover time in seconds
6	Status_2	0	High bit of changeover time [17 bits total]
		1-5	5 bits of PRN (satellite number) of currently viewed satellite
		6-9	4 bits of current schedule entry number
		10	1 bit of "Position Known?" '1' = 'yes'.
7	PRN_1	0-4	PRN of first visible satellite,
		5-9	PRN of second visible satellite
		10-14	PRN of third visible satellite.
8	PRN_2	0-4	PRN of fourth visible satellite,
		5-9	PRN of fifth visible satellite
		10-14	PRN of sixth visible satellite.
9	Position_1	0-6	7 bits of Latitude degrees
		7-12	6 bits of Latitude minutes
		13-15	Low 3 bits of fraction of a minute of Latitude.
10	Position_2	0-6	High 7 bits of fraction of a minute of Latitude,
		7	North/South flag bit,
		8-15	8 bits of Longitude in degrees.
11	Position_3	0-5	6 bits of Longitude minutes,
		6-15	10 bits of fraction of a minute of Longitude.
12	Position_4	0	One bit East/West flag,
		1-12	12 bits of Altitude in metres,
		13	One bit flag for above/below sea level.

8. Suggested Operating Sequence

The only page of Dual-Ported RAM data of any interest is page 0, so first we write zero to the page select register with F(18) A(0), data 0.

As long as we are prepared to accept LAMs from the module, we can now enable LAM with F(26) A(0).

Then, when an event trigger is received by the module, the host computer will be interrupted.

Normally this will direct the host application to service this module's LAM by clearing it with F(10) A(0), and then reading out the necessary data.

For time information only this will be words 1 to 4 and the data within will then be extracted and formatted.