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16 December 2015
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GPS FOR SCHOLARS PROGRAM

Synergy has supported educational use of GPS products by delivering miscellaneous GPS related items either free of charge, or at a greatly reduced cost, since 1989. From time to time, various GPS parts become available for a "second use." These products usually come from excess inventory or from customers who have upgraded their products to newer versions. Rather than dispose of these re-usable items, Synergy makes them available for educational use.

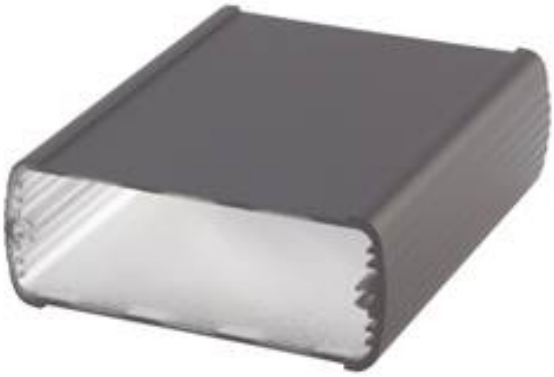
The **"TAPR GPS Timing Kit"** described below is available exclusively, without warranty, through the Tapper Amateur Packet Radio club: http://www.tapr.org for Hams, students, Time-Nuts, experimenters, etc. Click on: "M12+ Based GPS Timing Kit for Amateurs, Experimenters, Students, Scholars Available" for more information.

Originally introduced in 2001, and shipped through 2006, the Motorola M12+ GPS timing receiver remains one of the most accurate fixed position timing receivers available today. The M12+ Timing Oncore can also be used for Mobile timing, positioning and navigation applications. The GPS Kit items are:

SynPaQ/E Motherboard with Motorola M12+ Oncore timing receiver mounted. Motherboard to DB-9 cable assembly included.

The motherboard operates from 9 – 32 VDC and provides conversion from 3 V logic levels to RS-232. Function of LED indicators outlined in the attached SynPaQ/E User's Guide.

SynPaQ/E Housing assembly, black powder coating with mounting flange (No front or rear panels



The Motherboard shown at the left slides into the housing's internal grooves (user supplies front and rear panels).

An MMCX to panel-mount BNC Coax Cable – 6 inches end-to-end - is included for connection to a GPS antenna

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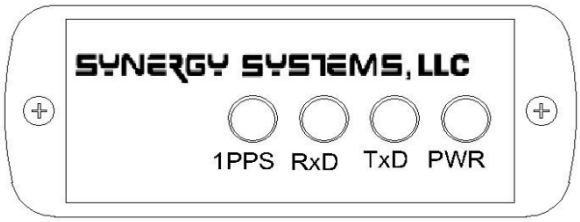
THE TAPR GPS KIT INCLUDES THE FOLLOWING ITEMS:

A. SynPaQ/E motherboard supplying reverse polarity and over-voltage protection, power regulation and 3 Volt logic level to RS-232 level conversion. Includes the Motorola M12+ Oncore GPS timing receiver (installed on motherboard).
B. DB-9 to motherboard cable assembly
C. SynPaQ/E Housing, black powder coat with mounting flange
D. Panel mount BNC to MMCX coax cable assembly
(User supplies the PC cable assembly, front and rear panels, 9 - 32 VDC power supply, GPS antenna and PC computer.)

GENERAL DESCRIPTION

Even without the optional front and rear panels installed (see below) the TAPR GPS Kit provides an accurate, nano-second level GPS timing source. See "M12+ Testing at USNO" available on this page:
http://www.synergy-gps.com/index.php?option=com_content&task=view&id=42&Itemid=89
The GPS Kit's Motorola M12+ Timing Oncore, including the full set of binary commands, is described in detail here:
http://www.synergy-gps.com/index.php?option=com_content&task=view&id=35&Itemid=60.

FRONT PANEL INDICATORS



The front end of the GPS Kit Motherboard contains four LEDs for status display. Details are as follows:

PWR—This LED should always be GREEN when power is applied to the GPS Kit.

TxD—The ***TxD*** indicator provides the user with visual feedback concerning data output from the receiver. The ***TxD*** LED will momentarily flash RED whenever the GPS Kit is sending GPS data to the host.

RxD—The ***RxD*** indicator will flash RED whenever commands are received from the host computer.

1PPS—The ***1PPS*** indicator will flash RED whenever a ***1PPS*** pulse is output from the GPS receiver. There are 2 user defined Modes of operation for the ***1PPS*** LED indicator:

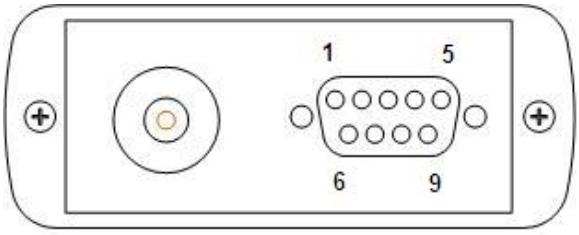
In Mode-1, the default mode, the ***1PPS*** indicator will start to flash **whether** satellites are being actively tracked and the receiver has developed a position fix or not.

In Mode-2 the ***1PPS*** indicator will only flash if satellites **are** being actively tracked and the receiver has developed a position fix. Using the **1PPS CONTROL MESSAGE (@@Gc)** the Mode is determined by the user as shown on pages 144 and 145 of the M12+ User's Guide here: http://www.synergy-gps.com/images/stories/guides/m12+userguide.pdf

In default mode, the PPS indicator also serves as a "heart-beat" giving the user visual feedback that the receiver's processor is powered up and accomplishing normal housekeeping routines (unless the user has previously disabled the ***1PPS*** output through software control of the receiver).

TYPICAL REAR PANEL CONNECTORS

(Emulating the original Motorola XT Oncore™)



Pin functions are as follows:

PIN	FUNCTION
1	RTCM In - RS-232 levels (M12+ Navigation receiver only)
2	Commands In - RS-232 levels
3	Data Out - RS-232 levels
4	N/C
5	Common (1PPS)
6	Power In (+5V regulated)
7	Common (power and data)
8	Power In (9-30 VDC)
9	1PPS Out (TTL levels)

Note: Only one power source may be connected at a time. This is NOT a standard DB-9 serial interface (Don't use port isolators)

POWER

An unregulated 8-32 VDC can be applied through pin 8 ***OR*** a regulated 5 VDC through pin 6 of the DB-9 connector (*but not at the same time*!). Power/Data common is on pin 7. Reverse voltage and over-voltage protection is included. Resettable fuses are installed on the GPS Kit motherboard assembly. Since a resettable fuse is a thermally activated device, if it opens due to application of excessive input voltage, the unit should be allowed to cool for several minutes before power is re-applied.

The short I/O cable assembly provided with the GPS Kit was first shipped in 2002 and emulates the non-standard DB-9 electrical interface design of the original Motorola "XT" Oncore™ and Synergy's "XTS/II" OEM GPS Sensors. The special SynPaQ/E DB-9 I/O wiring was retained for backward compatibility for Motorola's Land Mobile Product Sector (LMPS) and many other customers, who required a single connector for data I/O and power (see cable section below for standard RS-232 wiring suggestion).

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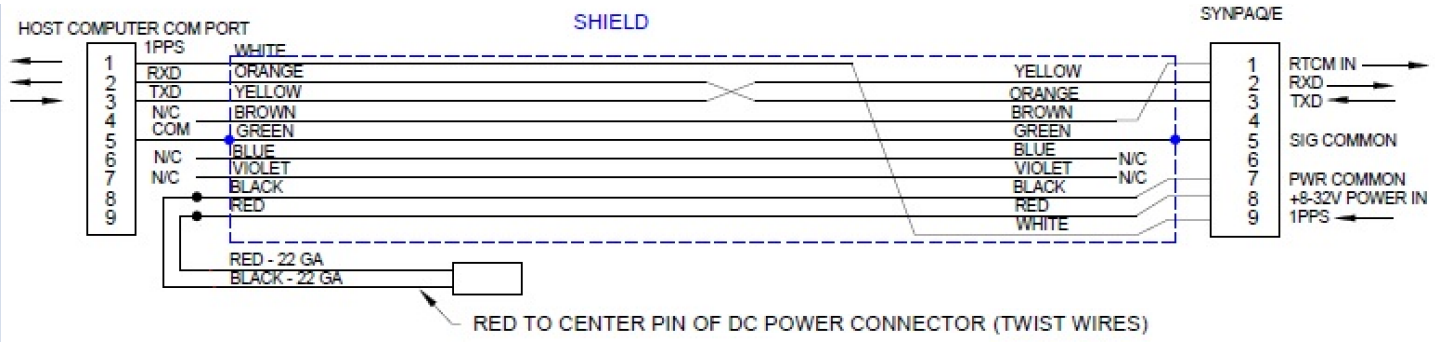
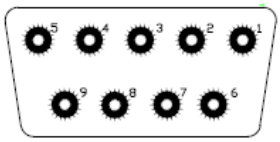
INTERCONNECTING CABLE WIRING INSTRUCTIONS

(Cable not included in the kit)

The following drawing illustrates how to connect the SynPaQ/E motherboard to a PC compatible computer with special DB-9 serial port wiring. Serial to USB converters can be used on the PC end of this cable, for newer computers that only offer USB ports. Care should be taken in the selection of Serial to USB adaptors to avoid data translation errors and to insure the integrity of the 1PPS signal (wired to the DCD line pin 1 of the DB-9).



Note: The DB-9 connector included in the kit contains two conductors for power; One conductor for 5 VDC regulated power and the other for unregulated 8 to 32 VDC power. The cable drawing above does not include a wire for operation from 5 VDC. Note that this is a ***Non-Standard*** serial connection:



DB-9 Female mating connector on cable - FRONT VIEW

CONVERTING THE DB-9 CONNECTOR WIRING TO A STANDARD RS-232 SERIAL PORT

It is an easy task to convert the motherboard DB-9 connector to a standard RS-232 port. Simply **remove** the unregulated + power conductor from pin 8 and route that wire, along with a ground wire connected to pin 7, to a separate panel-mounted connector or external power source (a small 2.1 mm diameter panel mount connector can be used). Also, **remove** the regulated 5 VDC power wire from pin 6 (Not included in the above cable drawing). With these DB-9 connector wiring modifications, a standard RS-232 cable can be used for connection to a PC computer or laptop.

GPS KIT OPERATION

With power applied, the GPS Kit is ready for immediate operation. Communications with the unit may be established with windows based GPS programs, or a host device using a different operating system. For direct control via microprocessor, the "Oncore Serial Communications" App-Note is located on this page (scroll down):

http://www.synergy-gps.com/index.php?option=com_content&task=view&id=42&Itemid=89.

Windows based WinOncore12 and SiRF Oncore software is available at no charge here (Scroll down):

http://www.synergy-gps.com/index.php?option=com_content&task=view&id=185&Itemid=196

As an alternate, Synergy's $59 SynTAC test and diagnostic software is available at the same location. It is a fully functioning application during a 30-day trial period and will automatically initialize the M12+ and fill the display with relevant data. Tac32 is a more robust version of SynTAC and is available from CNS Systems, Inc. here: http://www.cnssys.com.

The motherboard mounted LiOn battery powers the Real -Time Clock (RTC) when the GPS Kit is powered down. Receiver parameters, such as user selected messages, message output rate, antenna mask angle, etc. are saved in battery backed RAM. The motherboard needs to be powered on for 24 hours to charge the on-board backup battery. A full charge should keep receiver setup data saved in RAM for 60-90 days depending on age, battery condition, temperature, number of charge cycles, etc.

ANTENNA CONNECTION

An MMCX to panel mount BNC cable assembly is supplied with the GPS kit. Other, panel mount RF connectors, including SMA, SMB, TNC, etc., can be mounted to the user supplied rear end plate. The choice is up to the user. As stated in the Motorola M12+ User's Guide:

"The antenna sense circuit was designed to operate with the Motorola Hawk and Timing 2000 GPS antennas [25 dB to 30 dB] therefore non-Motorola antennas may exceed the threshold limits as listed below:

Under current detect @ 25°C:
Good indication: greater than 15 mA
Undercurrent indication: less than 15 mA
Over current detect @ 25°C: 80 mA maximum for normal operation"

An acceptable gain range is 18 dB – 36 dB at the receiver's MMCX connector. The M12+ GPS receiver will continue to function with an Under Current or Over Current indication (but not an "open").

HELPFUL ITEMS TO COMPLETE THE GPS KIT

1. Front and Rear Panel Source - The Cast Aluminum P/N ABD-800 end plates are described here and can be purchased here: https://www.bopla.de/en/enclosure-technology/product/alubos/alubos-accessories/abd-800.html.

The end plates are available either alone or with a gasket, assuring a dust-resistant final assembly, and mounting screws.

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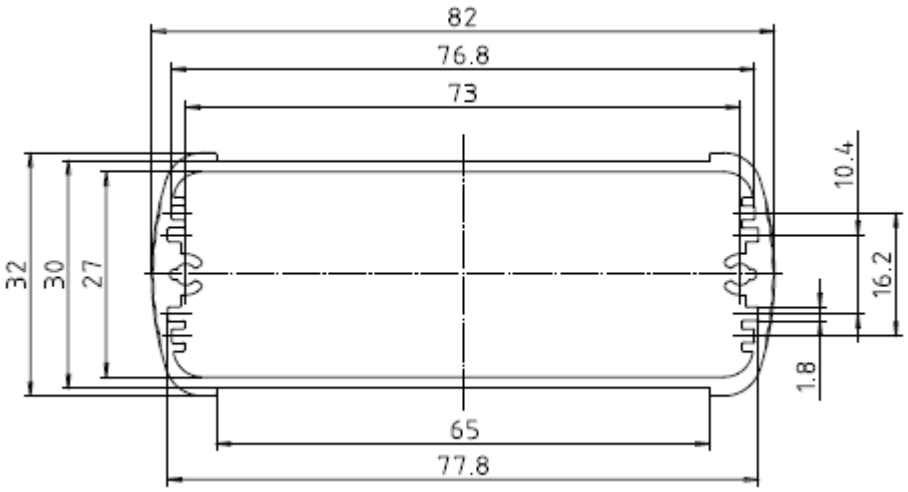
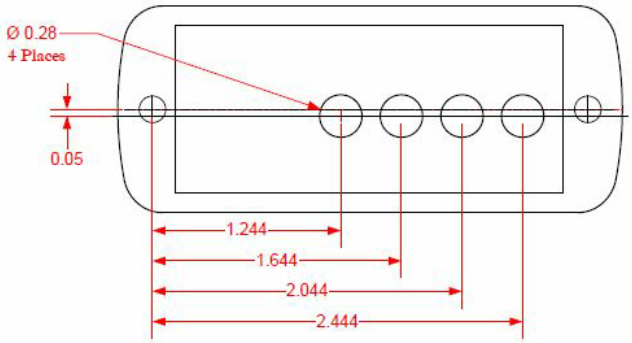
There are several choices available for end plates to covert the Rose+Bopla Aluminum housing extrusion into a complete enclosure. Part Number 84081000 includes the end plate with a sealing gasket, retaining screws and screw covers. See Distributor's Phoenix Mecano web site at http://phoenixmecano.com/wp-content/uploads/2014/08/Alubos-Catalog.pdf And scroll down for descriptions of the ALUBOS 800 series end plates. Users can call (301) 228-3111 to confirm end plate and gasket part numbers and obtain pricing.

2. Front and Rear End Plate Dimensions - As an alternate to the casketed end plates, the end plates can be fabricated from a flat piece of Aluminum plate referring to these dimensions:



In either case, the following dimensions can be used to accommodate the front panel LED status indicators:

Front End Plate



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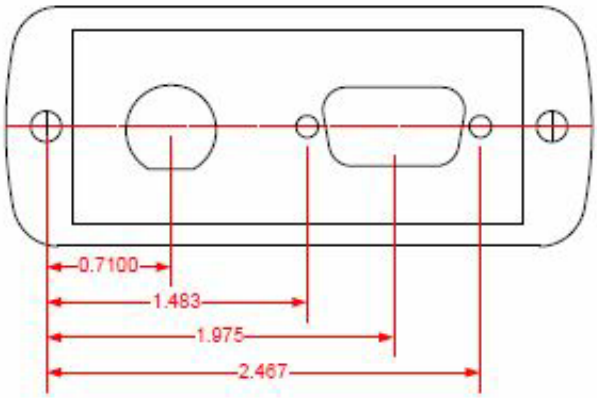
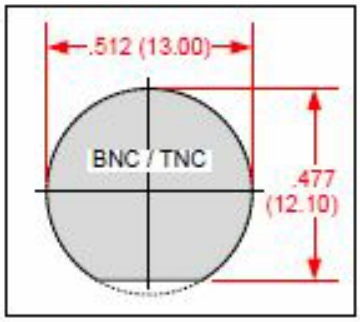
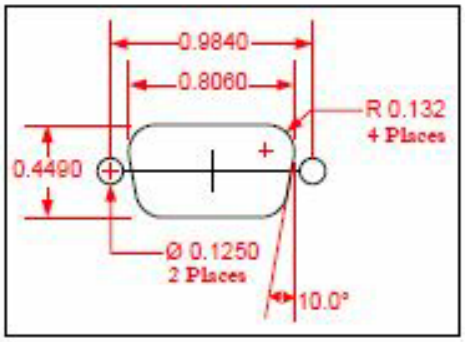
The following dimensions accommodate standard BNC\TNC RF connectors and standard DB-9 I/O connectors

Rear End Plate



Dimensions shown for standard BNC\TNC RF and DB-9 connectors





4. Fooling Around – The Motherboard Schematic is available here and is supplied as a reference only – no warranty extended or implied: http://www.synergy-gps.com/index.php?option=com_content&task=view&id=54&Itemid=73

5. The original SynPaQ/E motherboards supplied with the Motorola M12+ based TAPR GPS Kit were designed to accept the larger form factor Motorola VP, GT+ and UT+ Oncore Series GPS receivers. The mounting holes for the VP, GT+ and UT+ receivers, and the required 5 VDC supply, are already part of the motherboard. Simply add the larger 10 pin header and supply the slightly longer 440 x 0.250 receiver mounting standoffs. According to Motorola GT+\UT+ TRM0003 User's Guide, the mating Power/Data Connector is a 10 pin (2x5) on 2.54 Centers - AMP #104326-06 (Samtec has equivalent).

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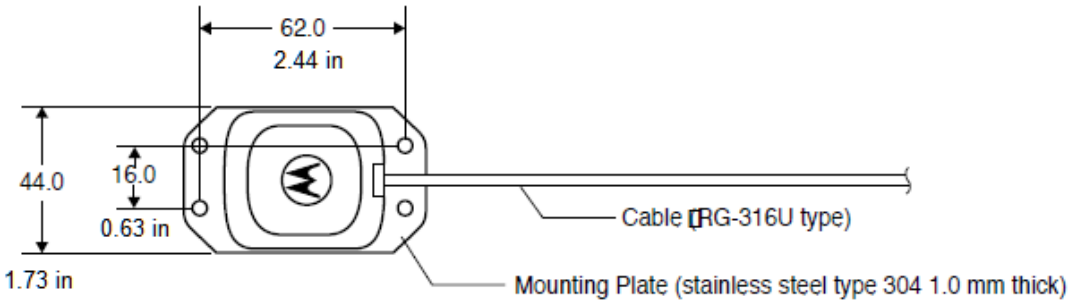
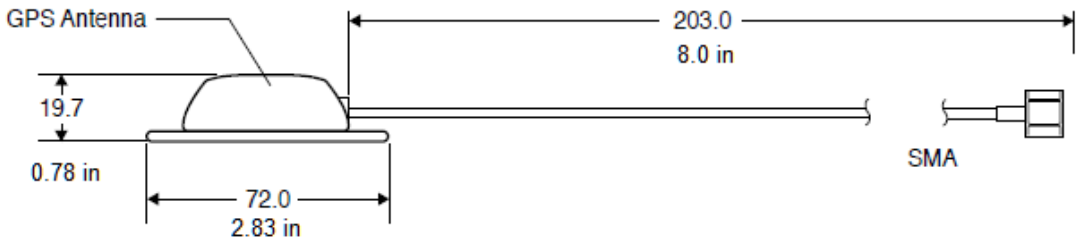
Optional - Motorola Antenna97 available from TAPR.ORG

Includes a Stainless Steel mounting plate, 8 inch coax cable terminated n a male SMA connector





Other GPS antennas are available from Synergy's web site here or many locations on the Internet:
http://www.synergy-gps.com/index.php?option=com_content&task=blogcategory&id=41&Itemid=124

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