TEKRON INTERNATIONAL

Tek Time

TTM 01

User Manual

1st Revision

When you need to be certain

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Revision History:

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1 INTRODUCTION

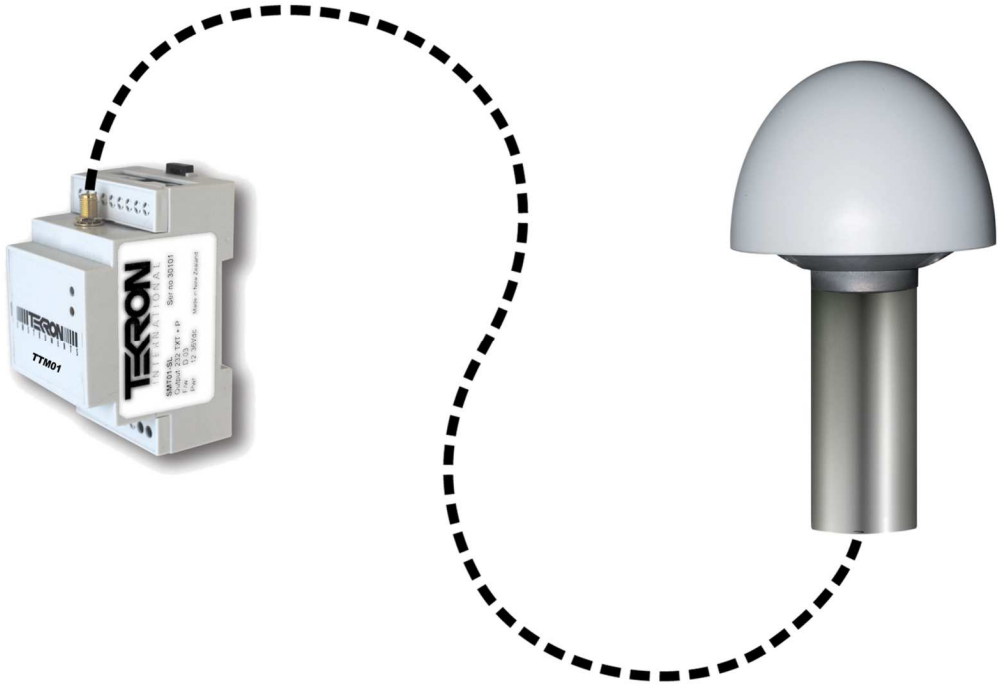
Congratulations on your purchase of Tek-Time! – Tekron's powerful and cost effective synchronization solution for RTU's, Protection Relays and other Intelligent Electronic Devices (IED's) used in electrical sub-stations and industrial control installations.

Utilizing state of the art technology and timing optimized snow-resistant antenna, these compact units lock onto atomic clock references from the GPS satellite constellation and produce time codes and pulses with sub-microsecond accuracy and precision.

Tek Time's rugged design is suitable for noisy electrical environments, while built in electrical isolation combined with strong push pull drives on all outputs simplify wiring schemes and enhance reliability.

Tek Time clips onto a standard DIN rail and Windows™ software and USB connectivity make customization and setup a breeze.

Tek Time comes complete with all components required for installation, including low loss antenna cable, antenna pipe mounting components, configuration software and cable, and optional lightning protection kit.



2 INSTALLATION

2.1 MOUNTING TEK TIME

Attach Tek Time to a standard din rail mount using the supplied clips on the base, or use the clips to panel mount Tek Time using self tapping screws.

2.2 ANTENNA INSTALLATION

Mount the antenna with a clear view of the sky and horizon in all directions, and in a "lightning-protected zone" (there should be at least one other earth-bonded structure such as another antenna, or a lightning rod, located in the same roof-top area that reaches significantly higher than the top of the GPS antenna).

☛ Additional protection from lightening induced voltages is available in the form of Lightning protection kits available an optional extra from Tekron.

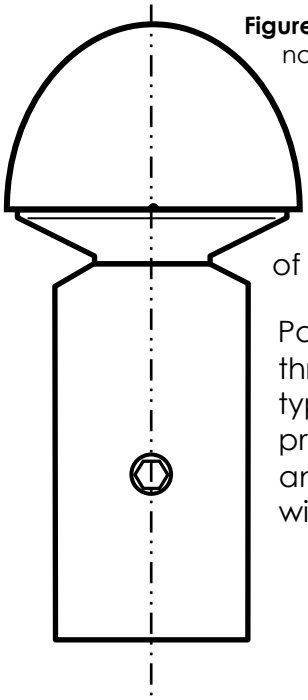
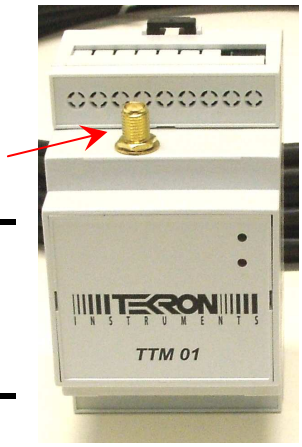


Figure 1: Trimble GPS antenna assembly for a 26mm max OD pipe (¾ inch / 20mm ID nominal galvanized pipe).

The antenna mount is designed to fit over the top of a user-supplied pipe like a capping. The mount has an internal diameter of 27.5mm, to fit a pipe with external diameter of between 25 and 27mm. For durability, the pipe should have walls of at least 2mm thickness, and be treated to resist corrosion.

Pass the antenna cable up through the pipe from the bottom end, through the antenna mount, and connect this directly to the TNC-type connector on the base of the antenna. If not already provided, apply "Lock-tite" onto the screw thread of the mount, and screw into the antenna base. Finally fix the mount to the pipe with the supplied stainless steel M6 grub screw.



Connect the antenna cable to Tek Time using the SMA socket.

☛ Care should be taken to ensure that the connector is not cross-threaded when attaching the antenna lead-in cable. The connector should be tightened firmly by hand only. Do NOT over-tighten!

2.3 Power Connection

Power is supplied to the unit via the terminals on the right hand side of the white din rail clip. The polarity of the power connection is unimportant.

☛ The label on the side of Tek Time contains the voltage rating: DO NOT apply power outside of this rating!

Within a few minutes after applying power, the SYN LED on the front of Tek Time should be illuminated. If *not* check the antenna connections and ensure that the antenna has an unobstructed view of the sky.

☛ By default, all outputs become active within a few seconds of initial power-up even when the unit is *not* synced to GPS satellite time! However output time codes are *not* precise until the SYN LED is illuminated.

3 INDICATORS

3.1 LED Indicators

Tek Time features two LED indicators. The **GPS** LED shows the status of the GPS receiver, while the **SYN** LED shows that the unit is synchronized to UTC reference time derived from the GPS satellites.

Outputs are synchronized to UTC time only when the SYN LED is illuminated (on).

GPS LED	SYN LED	Meaning
4 flashes /sec	OFF	Antenna fault; The antenna or antenna cable is either disconnected, or faulty, or there is a short circuit somewhere.
2 flashes /sec	OFF	The antenna is good, Tek Time is searching the sky for satellites; but is not in sync to UTC time.
1 flash /sec (long on)	ON	Tek Time outputs are accurate to within 200ns of UTC time, and therefore useable for sync purposes.

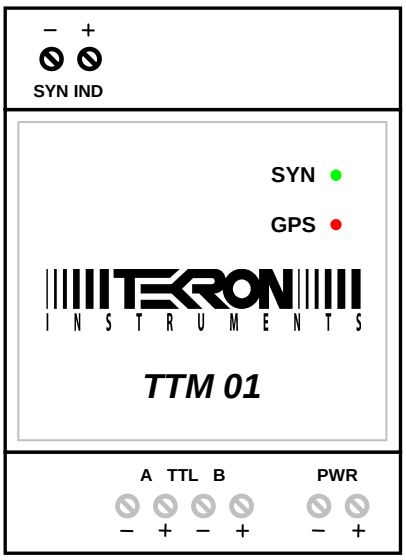
4 OUTPUT DESCRIPTION

4.1 SYNC INDICATION OUTPUT (OPTIONAL)

Where provided as an option, the sync indication reflects the state of the SYN LED. Sync indication, is via an opto-isolator switch, rated at 60V and 50mA.

N.B. Sync indication is an option that must be explicitly requested at the time of ordering, unless specifically requested TTM 01 do not include sync indication output.

SYN INDICATOR



4.2 OUTPUT OPTIONS

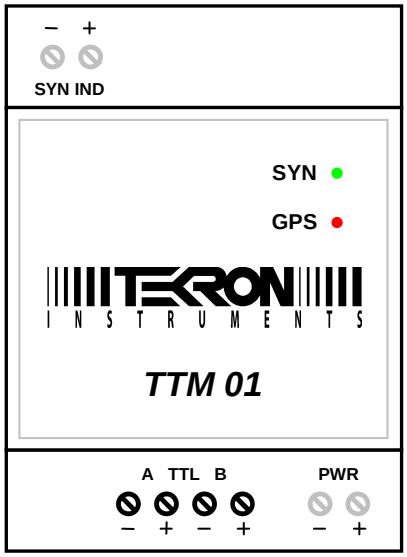
Tek Time may be ordered to have "TTL" (T1-Txxx), "Serial" (T1-Sxxx) or "AM IRIG" (T1-Axxx) outputs. Their different capabilities are summarized here:

	Number of serial output strings at 9600 bd.	Number of time codes or pulses:		Number of AM IRIG-B outputs:
		DCF-77,IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223)	Pulses up to 1 day in duration and offset. 1/100sec resolution.	IRIG-B type B120, B121, B122, B123
TTL (T1-Txxx)	none	2		none
Serial (T1-Sxxx)	1	1		none
AM IRIG (T1-Axxx)	none	none		1

4.2.1 TTL (order code: T1-Txxx)

- CMOS/TTL (5V) driven (100mA push-pull).
- Each is port fully floating and isolated.

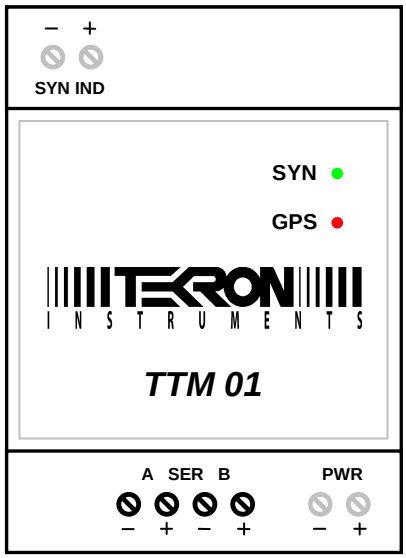
	Type of output
TTL A	Digital pulses or time codes: IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223), DCF-77
TTL B	Digital pulses or time codes: IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223), DCF-77
	Specific outputs are user programmable. A typical application will have one output programmed for IRIG-B and the other for 1 PPS



4.2.2 Serial (order code: T1-Sxxx)

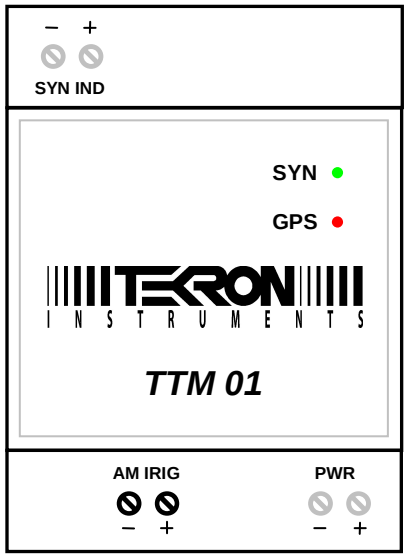
- RS232 level (+/-9V) signaling.
- The RS232 signals A and B are not HV-isolated from each other in that they share a common earth, but the port as a whole is isolated.

	Type of output
SER A	Serial time messages at 9600 baud
SER B	Digital pulses or time codes: IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223), DCF-77
	Specific outputs are user programmable. A typical application has String-C on "SER A" output and 1PPS on "SER B" Appendix A on page 26 describes the message strings programmable for output on "SER A".



4.2.3 AM IRIG (order code: T1-Axxx)

- Provides amplitude modulated IRIG-B output (B12x).
- Use either coaxial cable or shielded twisted pair, to feed this signal to any connected IED.
- The output is fully floating, and is transformer-isolated.

	Type of output	
AM IRIG	Amplitude modulated IRIG-B	
	The output is user programmable for: IRIG-B120, B121, B122 or B123. The AM IRIG output can drive many devices in parallel (multi-drop). In all cases a terminating resistor must be fitted at the far end of the cable. The terminating resistor value range is from 100 ohms (few loads) to 180 ohms (many loads). 1W resistors are recommended.	

5 PROGRAMMING

5.1 CONFIGURATION SOFTWARE

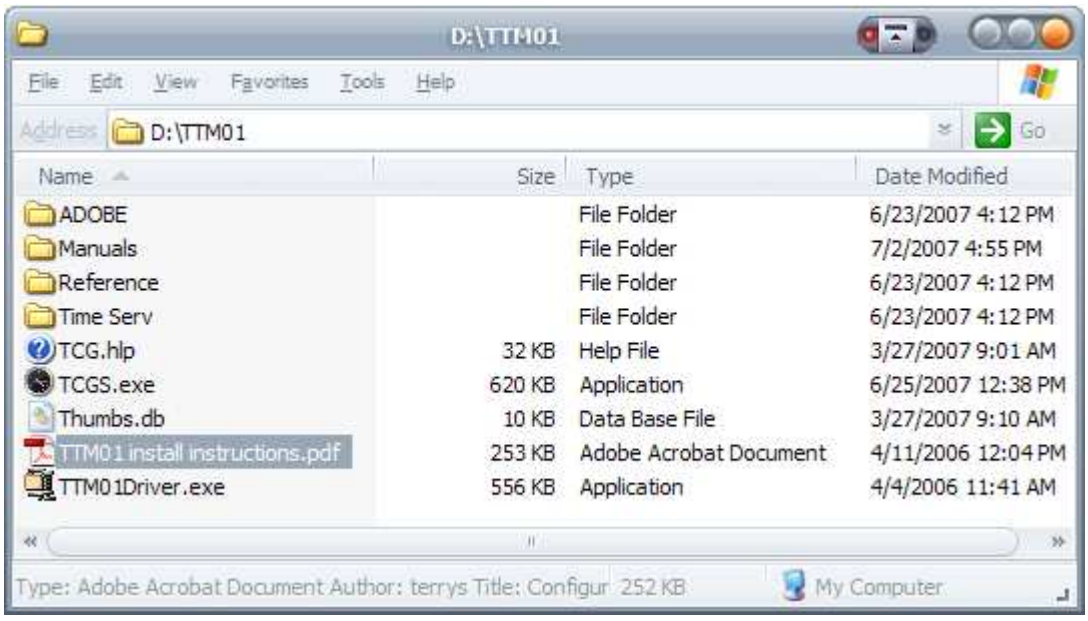
Configuration software is provided on a CD with all Tek Time units. This software is compatible with Windows 2000, XP, NT, and Vista PC's.

☛ WARNING! During the configuration process, outputs of TTM01 are not always correct – this is especially the case with T1-Sxxx (Serial) TTM01. It may therefore be a necessary precaution to disconnect external equipment from TTM01 outputs before programming.

5.1.1 Installation procedure

Browse to the Tek Time (TTM01) folder on the supplied CD (normally D:\TTM01\) and follow the instructions in the installation guide "TTM01 install instructions.pdf". Alternatively if you are confident with Windows hardware installation: simply run TTM01Driver.exe to pre-install drivers and then connect TTM01 to the USB port of the PC using the supplied cable to complete the installation.

It is not necessary to have Tek Time powered while doing this hardware installation; however power is required during programming.



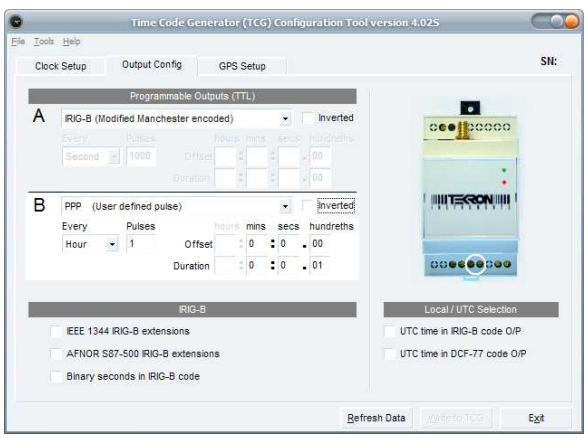
Locate the configuration software. It is normally found in "D:\TTM01\TCGS.exe". This software may be run directly from CD or copied to a local folder (if copying to a local folder, also copy "TCG.hlp" because this contains the on-line help information.)

5.1.2 Establishing a connection

Apply power to Tek Time and connect the PC to the unit using the supplied USB cable. Start the configuration tool TCGS.exe. The status window above will appear while the connection between the PC and Tek Time is being established.

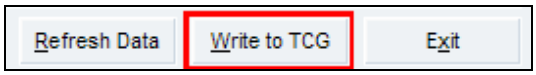
If the Tek Time is: un-powered, or disconnected, or the installation on the previous page was not successful; a message will pop up giving appropriate advice – simply disconnect and reconnect the USB cable between Tek Time and the PC and reapply power. If unsuccessful, repeat the installation procedure.

After a successful connection, a snapshot of the current clock settings is shown in the "Clock Setup" and "Output Config" pages along with the current time.



If the antenna is connected, information about the currently used satellites is shown in the "GPS Setup" Page.

5.1.3 Operation Summary



- "Refresh Data" re-connects Tek Time and retrieves its settings.
- "Write" programs any changes directly to Tek Time. Write is highlighted red and is active when changes have been made – it is otherwise grayed.
- "Exit" or, the close gadget on the top right hand corner of the window; will safely close the connection and then exit. The configuration tool may become unresponsive if the unit is unplugged before the configuration tool is shut down. It this happens, don't worry! Simply force shut the configuration tool from Windows™ (close it from the taskbar). To operate the configuration tool with Tek Time again, you will need to unplug and re-plug the USB cable.

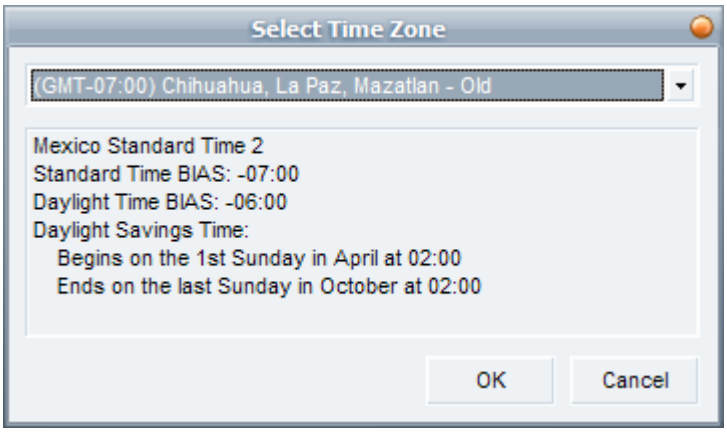
- "?" near the close gadget, actives online help, so does pressing 'F1'. When activated move the cursor over an option and click for information.
- Use File → Save As… to save a current configuration. View or restore by using File →Open… Use Print to obtain a Hard copy.

5.2 LOCAL TIME

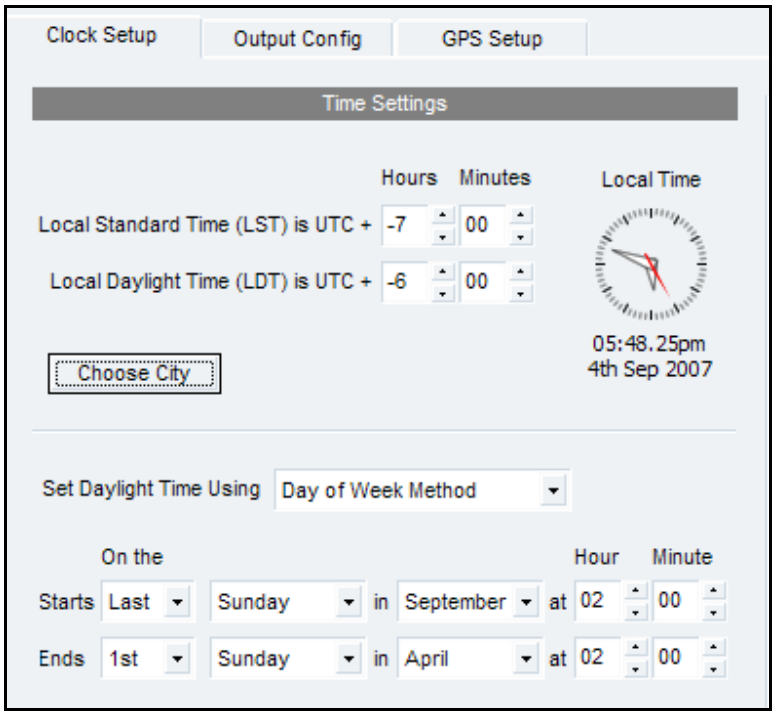
Tek Time may output either local or UTC time; there are two areas of the configuration tool that need to be set correctly before outputs will report the correct time:

5.2.1 Configuring Local Time

Provide the local time settings, which are the local UTC offsets, and daylight savings rules in the "Time Settings" area of the "Clock Setup" page.



The local time settings may be filled in by the configuration tool: Click the "Choose City" button, and then in the "Select Time Zone" dialogue, select the appropriate time-zone, and click "OK".



Notice how the settings now match what was described in the "Select Time Zone" dialogue. It is prudent to do a manual check that the settings are in fact right.

5.2.2 Daylight Savings Methods

There are two supported ways of specifying daylight savings, the most common in western countries is the "Day of Week Method" in which daylight savings begins and finishes on a certain weekday; the exact dates change every year.

In some regions daylight savings happens on a fixed date each year: choose the fixed date method to specify daylight savings for these locations.

5.2.3 Selecting Local or UTC time

In the "Output Config" page under "Local / UTC Selection"; select either UTC or Local time.

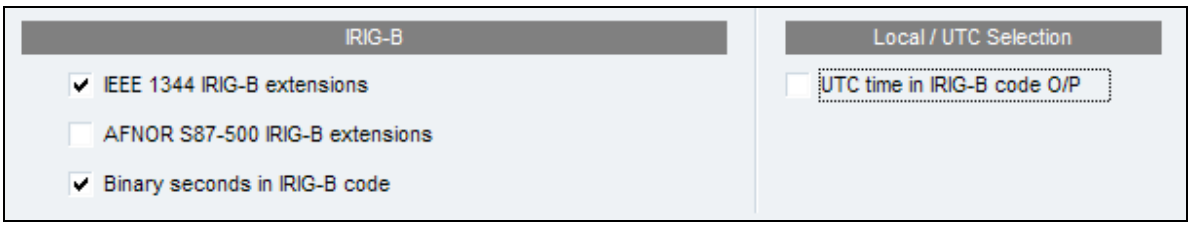
Depending on the Tek Time model, one or two of these options will be available:

- ❑ UTC time in IRIG-B code O/P
- ❑ UTC time in DCF-77 code O/P
- ❑ UTC time in ASCII STRING O/P

Check these to select UTC time for output, leave these unchecked to output local time.

5.3 PROGRAMMABLE OUTPUTS

5.3.1 Using IRIG-B (T1-Sxxx, T1-Txxx, T1-Axxx)



In the "Output Config" page:

- Checking the "Binary seconds in IRIG-B code" field adds binary encoded seconds of day information to the IRIG-B code.
- Checking the "IEEE 1344" or "AFNOR" extensions adds AFNOR S87-500 or IEEE 1344 extensions to the IRIG-B code.

5.3.2 IEEE1344 and AFNOR Extensions

A deficiency with IRIG-B (Standard 200-98) is that the code lacks year information AND it specifies the day of year only, not the date. During a leap year January has an extra day, so if the year is unknown (and therefore whether it is a leap year is unknown), after January 28 it is impossible to determine the date. The extensions make up for this and other omissions in the standard:

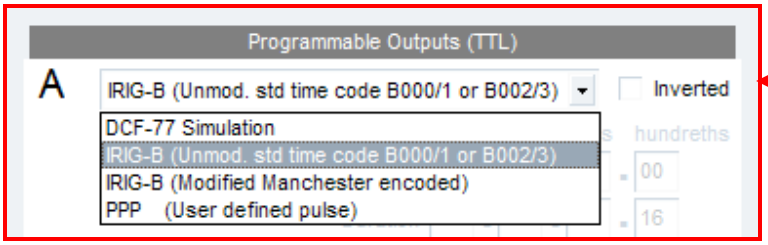
Extension name	Extra information contained:	Origin
IEEE1344	Year, impending leap second info, local time offset specification, impending daylight savings change, time-quality	US
AFNOR NFS 87-500	Year, day of year, day of week, month, day of month.	European

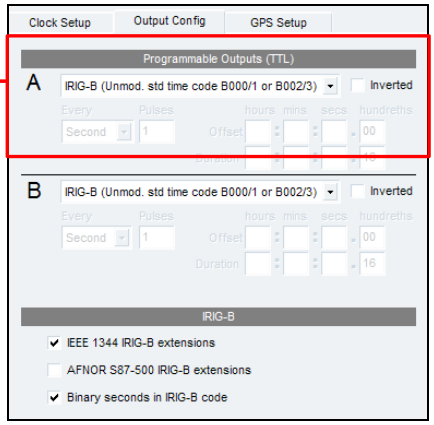
Only one of IEEE1344 or AFNOR NFS 87-500 may be on at any time, most equipment that comes from the US will use the IEEE1344 extensions.

5.3.3 Selecting IRIG-B

On Tek Time with code T1-Axxx, Amplitude Modulated (AM) IRIG-B is always output (B120—B123).

On Tek Time with code T1-Sxxx or T1-Txxx; Digital IRIG-B may be output in either standard or modified manchester encoding (B020—B023 or for modified manchester: B220—B223). A drop down list selects these codes for output:





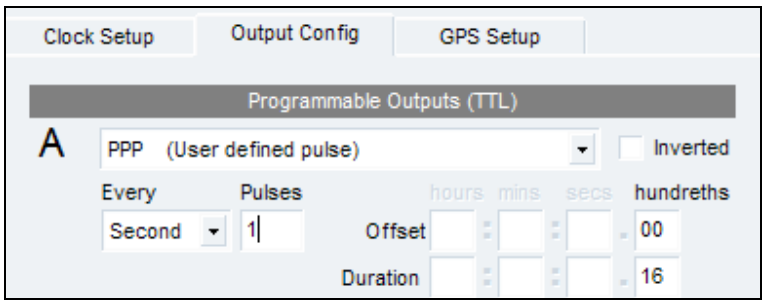
Under the "Programmable Outputs" section, select the form of IRIG-B (Either "Unmod. std…" Or modified manchester encoded). The majority of applications will use "Unmod. std time code".

5.3.4 IRIG-B code chart

Many manufacturers specify IRIG-B using a code, these codes directly map to the options of the configuration tool; the following chart provides conversion:

Code	AFNOR or IEE1344 Extensions	Binary seconds	Unmod. Std time code	Amplitude Modulated (AM)	Modified Manchester encoded
B020	✓	✓	✓		
B021	✓		✓		
B022			✓		
B023		✓	✓		
B120	✓	✓		✓	
B121	✓			✓	
B122				✓	
B123		✓		✓	
B220	✓	✓			✓
B221	✓				✓
B222					✓
B223		✓			✓

5.3.5 Defining Timed Pulses



To set an output for a timed pulse (all Tek Time except T1-Axxx):

(1) Select from the drop down list "PPP (user defined pulse)"

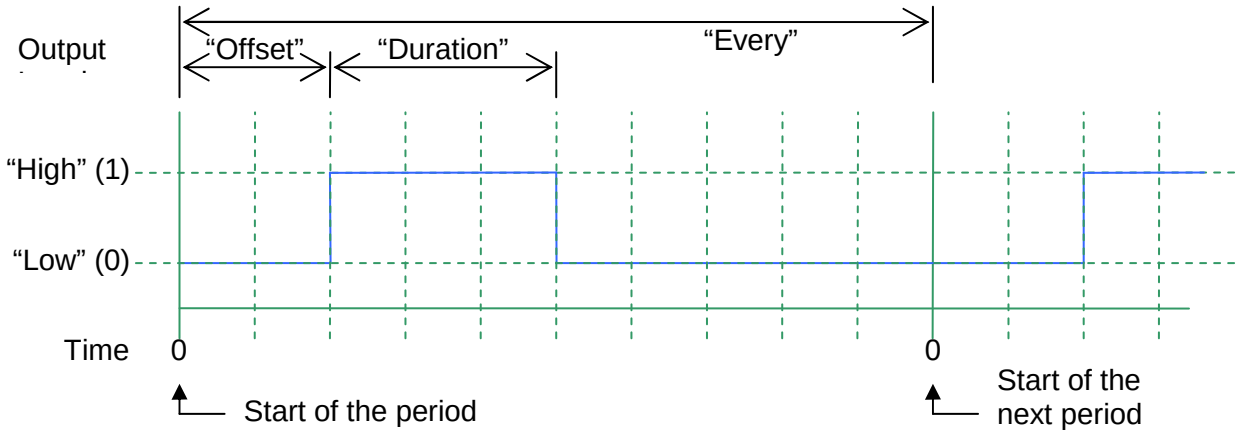
(2) Specify the frequency of pulses under the "Every" and "Pulses" fields: Use online help or press "F1" while over the pulses area to get a list of the available values that can be entered into the "Pulses" box. The table below shows what number of pulses per second are valid:

Period "Every"	Number of "Pulses"
Second	1, 2, 3, 4, 10, 20, 50, 1000
Minute	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Hour	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Day	1, 2, 3, 4, 6, 8, 12

(3) Specify the "Offset" this is the period after the start of a new day, hour, minute, or second to the start of the pulse.

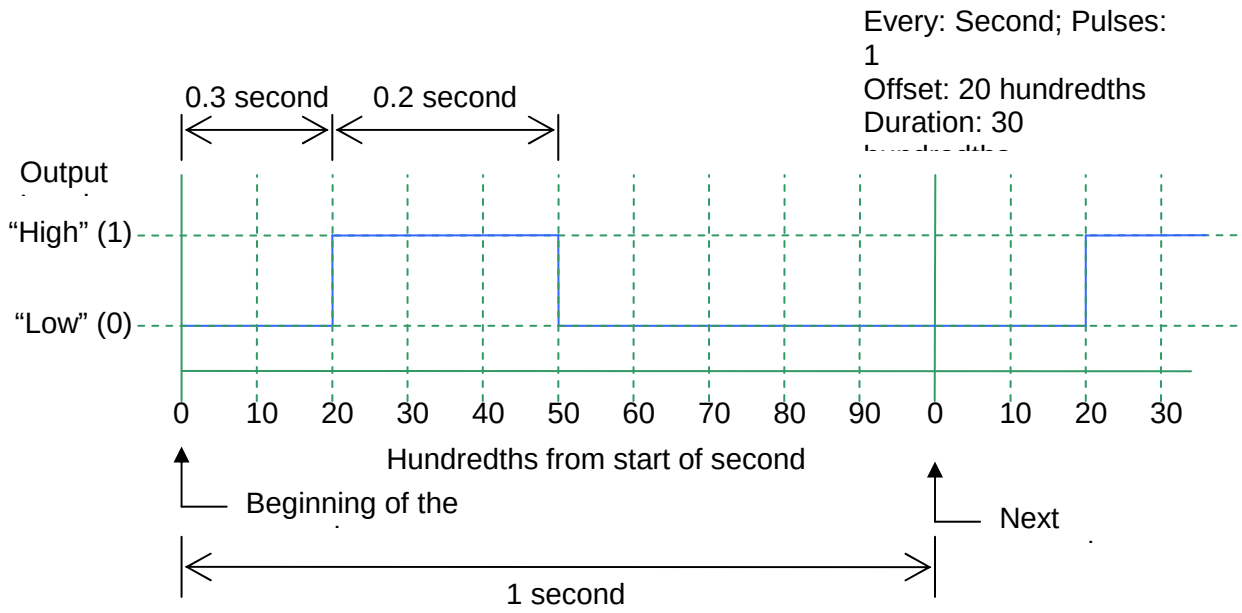
(4) Specify the "Duration"; this is the time the pulse stays asserted.

(5) Check "inverted" to swap the polarity of the pulse – that is "High" and "Low" levels are swapped.

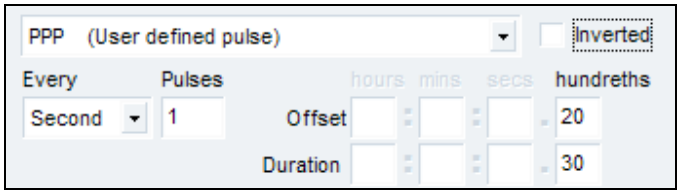


EXAMPLE:

A pulse per second, with duration 0.3 seconds and beginning 0.2 seconds after the start of the second has the following form:

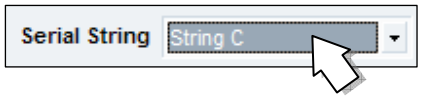


To generate this pulse, set the programmable output as follows:



5.3.6 Serial Strings (T1-Sxxx)

On serial equipped units, serial strings are selected for output by using a single drop down list in the "Output Config" page. A definition of each string is provided by on-line help. Activate on-line help by pressing the "F1" key while hovering over the string name.



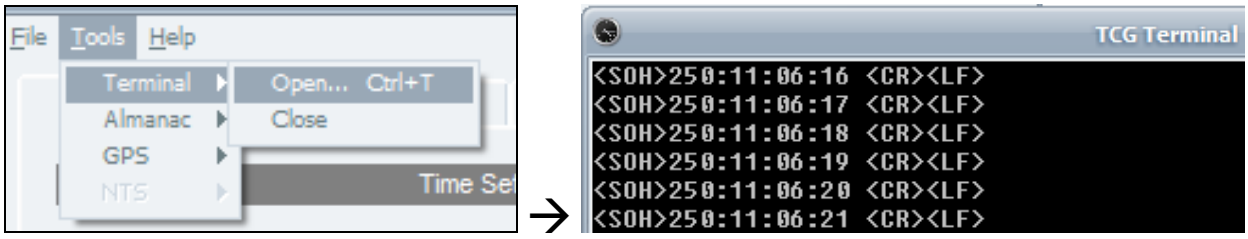
To bring up the definition of a particular serial string (right) move the mouse over the string name and then press "F1"

String C:
<CR><LF>Q_YY_DDD_HH:MM:SS.000<SPACE><SPACE><SPACE>
Q = time quality indicator ("?" = clock out of sync , <SPACE> = clock in sync), YY = 00 to 99 meaning year 2000 through 2099, HH:MM:SS is the current time.

Transmission is every second.
The start bit of the <SOH> is the on-time point.
Operation is 9600BD, 8 bit, no parity.

Refer to Appendix A on page 26 for definitions of all the serial strings supported.

The currently programmed serial string can be viewed in real time. Use the menus; Tools → Terminal → Open… to bring up a terminal, after a few seconds it will show the currently programmed serial string. Unprintable codes are shown according to their ASCII names in braces e.g. "<SOH>" which is ASCII#1 and <CR> which is ASCII#13.



Return to the configuration tool by closing the terminal.

5.4 Precision and Sync

Precision of GPS clocks are affected by external influences outside the control of the local GPS receiver. Settings that compensate for these external influences are found in the "General Options" area in the "Clock Setup" page. Of particular importance are compensations for antenna cable length, local obstructions that can cause multi-pathing and therefore loss of GPS timing precision, and installations that are in areas with poor GPS coverage.

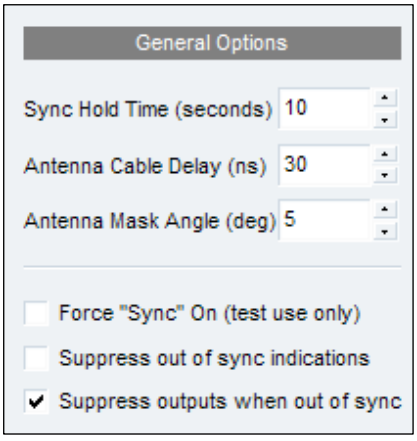
In most cases with good installation, the unit will stay in sync at all times, however there are situations and installation where sync can be lost.

Synchronization status is reported from Tek Time by;

- serial messages and time codes (IRIG-B)
- The green SYN LED on the front panel.
- The optional sync indicator; sometimes referred to as "sync relay" in the configuration tool on-line help.

When not synchronized it is possible to make Tek Time outputs automatically go quiet, or it is possible to change the behavior of the sync indications themselves to avoid tripping alarms or to assist in testing.

All the options that affect Precision and Sync status are found under "General Options" in the "Clock Setup" page (shown to the right).



5.4.1 Sync Hold Time

The "Sync Hold Time" parameter is used to control the period after loss of synchronization to GPS satellites that will be tolerated before Tek Time will report that it has lost sync. Correct antenna installation will make the loss of sync event rare, but in areas with poor GPS coverage there will be occasions where tracking is momentarily lost.

The accuracy of all outputs when there is a complete satellite "blackout" is maintained to within a few micro-seconds over short periods (a few minutes), and to within 200µs for up to 40 minutes. A single satellite signal sufficiently recovers accuracy to within 1µs.

☛ In typical SCADA operations, time syncing to within 0.5ms is considered adequate so it is good to set Sync Hold to the maximum (2550 seconds). This will prevent "loss of sync" alarms in the event that satellites are temporarily obstructed.

5.4.2 Antenna Cable Delay Compensation

All antenna systems introduce signal delay (depending on the cable length). To optimize the precision of the output signals enter for "Antenna Cable Delay" the length of the antenna cable × 20ns. E.g.: For a 30 meter antenna cable, enter "120".

5.4.3 Mask Angle

"Mask Angle" represents the elevation above the horizon below which satellites are excluded from time and position calculations. A good starting value is 5 degrees, and this *may need to be increased in areas with land based obstacles to prevent time quality loss due to multi-path effects*. Increasing this value will reduce the number of satellites in view.

5.4.4 Force "Sync" On

Checking "Force Sync On (test use only)" makes outputs report "in sync" at all times. This is convenient for testing when an antenna connection is unavailable. **THIS SHOULD NEVER BE CHECKED DURING NORMAL OPERATION.**

5.4.5 Suppress Out of Sync Indications

This makes outputs operate as if they are in sync at all times, even if there is no antenna attached. The sync indicator is unaffected and indicates the true sync state.

5.4.6 Suppress Outputs When Out of Sync

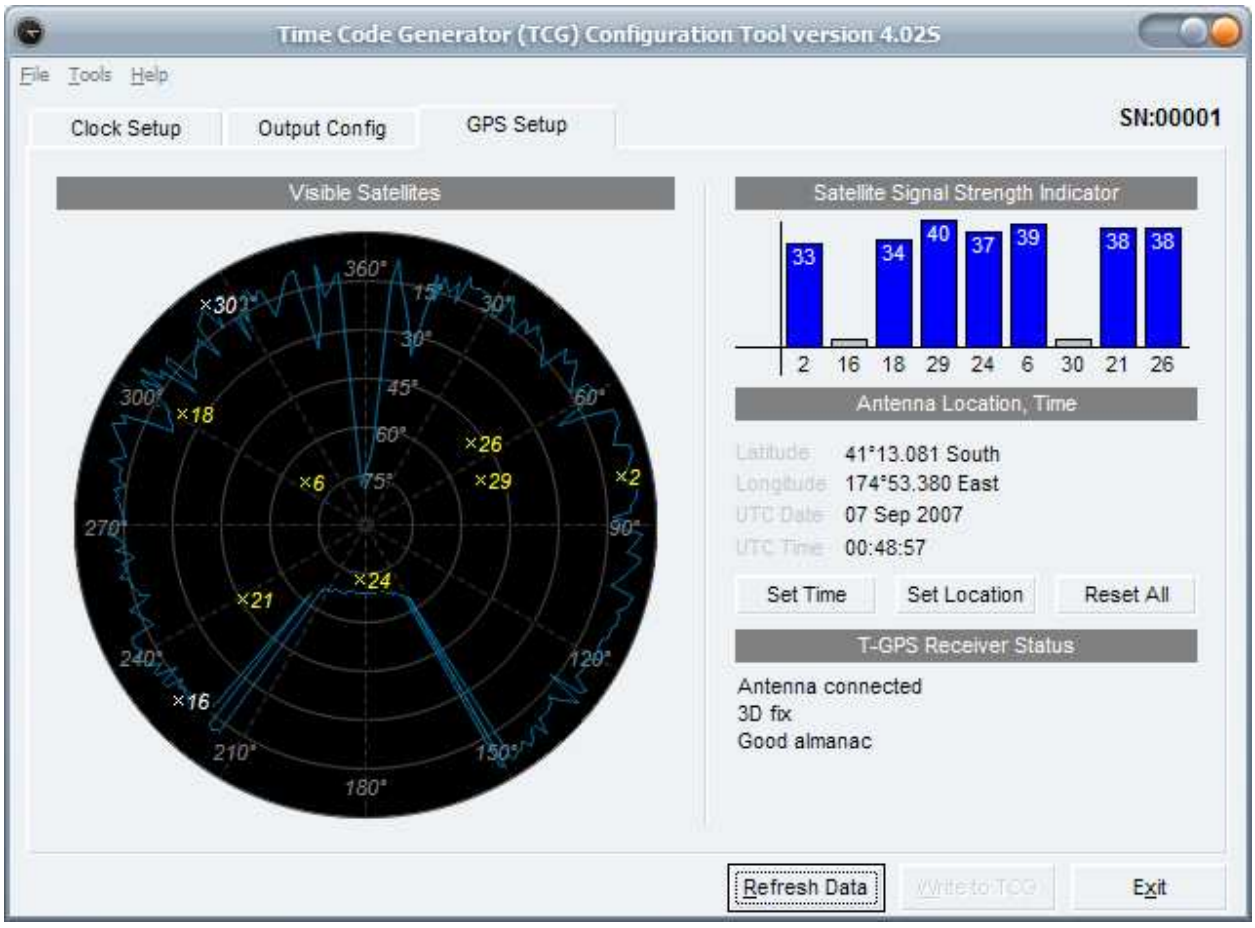
This option suppresses the outputs when out of sync. The sync indicator is unaffected, and indicates the true sync state.

5.5 EMBEDDED GPS

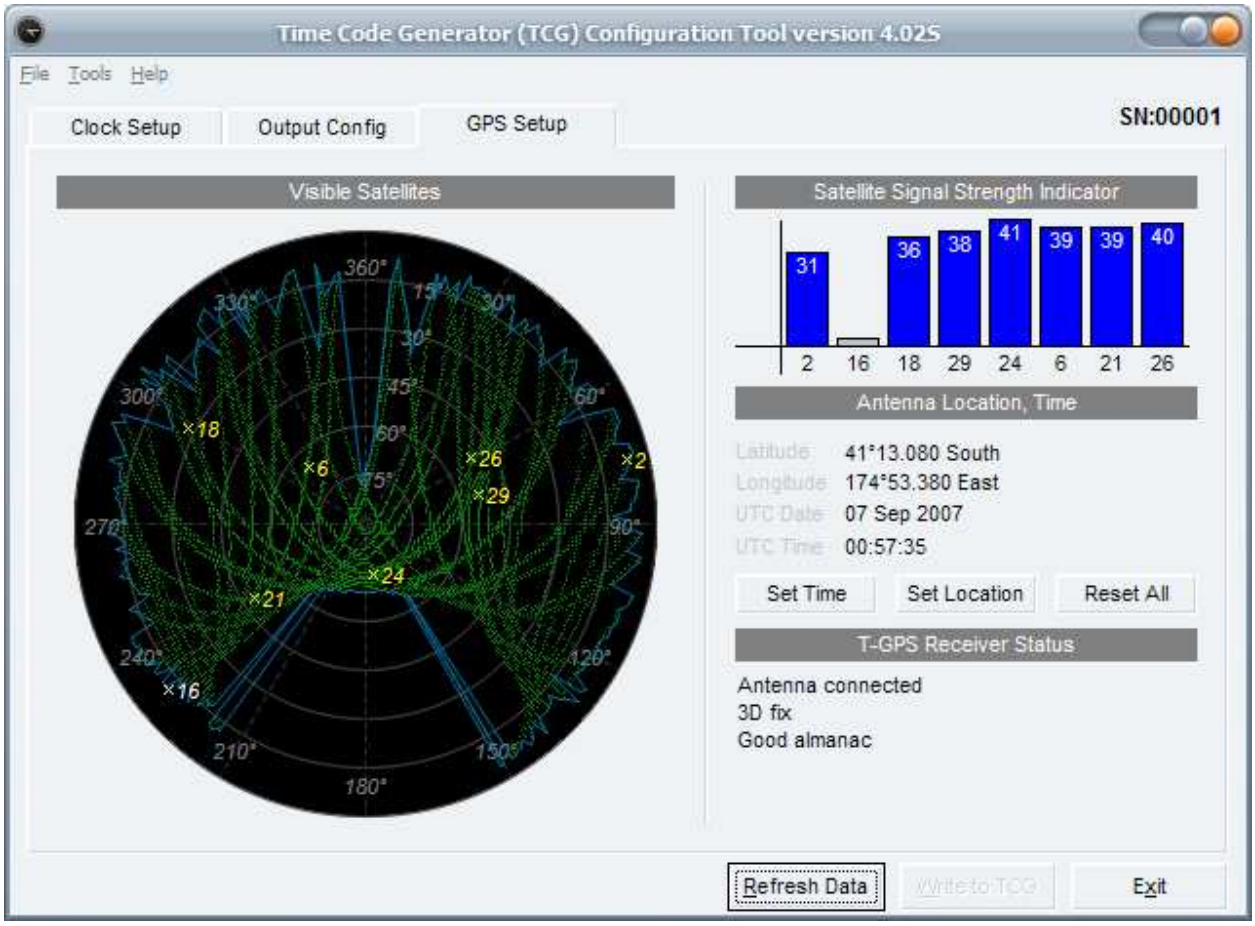
The information in the "GPS Setup" page helps with troubleshooting and optimizing an antenna installation.

5.5.1 Visible Satellites

Visible satellites are shown on a polar-display. The rings mark the 'elevation' and the sectors mark 'azimuth'. The centre of the display represents directly overhead and the elevation is 90° at this point. The edge of the display, elevation = 0°, represents the horizon. The 'azimuth' is a compass direction where 0° represents true north, 90° is east and 180° is south. Satellites being used are marked by a colored cross on the display, and a blue bar on the Satellite Signal Strength Indicator, otherwise it is gray on both.



Right clicking over the Visible Satellites area, brings up a menu where satellite trails (green lines), and a minimum elevation plot (the blue lines) can be turned on. Over time this minimum elevation plot will show the viewable horizon. An example of a minimum elevation plot is shown over the page. This example from Wellington, New Zealand, shows that there is poor satellite coverage in southern latitudes.



GPS Setup Page, showing a plot of GPS coverage in Wellington, New Zealand over a 24 hour period, satellite trails (the green lines) are turned on

☛ To ensure reliable operation when operating TTM 01 in extreme southern latitudes, locate the antenna where there is a clear view of the northern sky; conversely when in extreme northern latitudes, position the antenna with a clear view of the southern sky.

6 SPECIFICATIONS

6.1 TEK TIME TTM 01

Physical:

Dimensions (mm)	Height: 90 Width: 55: Depth: 60
Weight	150g
Mounting	Din Rail or Panel Mount

Electrical:

Low Supply Range	12–36Vdc (16-24Vac)
Medium Supply Range	20-72Vdc (24-48Vac)
High Supply Range	90-300Vdc (80-120Vac)
Power Draw (max):	4W

Timing and Isolation:

Isolation (Supply to Outputs)	3kV
Oscillator Holdover stability (Timing innacurracy when all satellites lost)	5 parts in 10^8 (<200µs over 40 minutes)
Antenna delay compensation granularity	nanosecond

AM IRIG (T1-Axxx)

Timing Precision of AM IRIG	± 1µs
Peak to peak amplitude (no Load)	9V
modulation ratio (modulated: unmodulated)	3:1
Output impedance	100Ω
Output Protection	Resettable fuse, and Varistor

TTL (T1-Txxx)

Timing precision of Pulses, IRIG-B, DCF-77	± 200ns
Output High voltage	5V
Output Low voltage	0V
Output Current (push-pull)	100mA
Output Protection	Resettable fuse, and Varistor

Serial (T1-Sxxx)

Timing precision of Serial Strings	±1 ms
Timing precision of Pulses, IRIG-B, DCF-77	± 1.5µs (slew rate limited to comply with RS232)
Output Protection	Resettable fuse, and Varistor

6.2 ANTENNA CABLE

Tek Time is supplied with high performance RF cable factory-fitted with a TNC-type male connector at one end, and a SMA male connector at the other. The TNC-type connector mates with the connector on the antenna and provides a robust and weather-resistant connection. The smaller SMA connector mates with the connector on the Tek Time and is only fractionally larger in diameter than the cable itself; this facilitates installation in conduit and through small apertures. The supplied cable has the following characteristics:

Centre conductor:		1.42mm diameter Solid bare copper
Dielectric:		3.81mm diameter Low loss, closed polyethylene foam (Cellular PE)
Shield:		3.94mm diameter Aluminum Laminated Tape bonded to the Dielectric, with a Tinned Copper Over braid – 4.52mm diameter
Jacket:		6.10mm Black Polyethylene
Bending Radius:		40mm (maintaining less than 1Ω impedance change at bend).
Weight:		0.051 kg/meter
Temperature Range:		-40°C to +85°C
Impedance:		50 Ω
Velocity:		84%
Capacitance		79.4pf/metre
DC Resistance	Centre conductor	10.5 Ω per 1000 meter
	Shield:	2.8 Ω per 1000 meter
Attenuation:		0.33dB per meter @ 1575.42MHz (L1)
Shielding:		> 90dB
Phase Stability:		+/- 10ppm/degree C

Care should be taken during installation to ensure that the minimum bending radius limit noted above is scrupulously maintained.

☞ While the cable shielding is excellent, the cable should not be routed in close proximity to power cables or other RF cables carrying transmitter signals – in particular, parallel runs are to be avoided if possible. If such runs are absolutely unavoidable, a minimum separation of 30cm may be used as a guideline.

The GPS receiver in Tek Time has excellent out-of-band rejection characteristics, as does the antenna. However, sound engineering practice should not rely on these factors alone to guarantee performance. Careful installation will enhance the long-term reliability and on-going stability of Tek Time.

APPENDIX A SERIAL STRINGS

A.1 NGTS

Timing: Transmitted once per minute. Sent during the last second before the minute rollover to which the data in the string refers

About: Normally used in conjunction with 10ms long pulse on P4 pin 1 that finishes precisely on the minute.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: TYYMMWhhmmx<CR><LF>

Placeholder	Content
T	"T"
YY	Last two digits of the year: e.g. "12" = the year 2012
MM	Month: "00" = January … "12" = December
W	Day of week: "01"=Monday … "07"=Sunday
hh	Two digit hour
mm	Two digit minute
x	Time mode: "0" = Local time, "1" = UTC time
<CR>	Carriage Return: HEX 0A
<LF>	Line Feed: HEX 0D

Example	Interpretation
T020422112340<CR><LF>	Monday 22 April 2002 – 12:34 local time

A.2 IRIG J-17

About: This code is compatible with IRIG Standard 212-00

Timing: Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.

Comms: 9600bd, 7-bit ASCII, odd parity

Definition: <SOH>DDD:hh:mm:ss<CR><LF>

Placeholder	Content
<SOH>	HEX 01
DDD	Day of year: range "001"—"365"
:	HEX 3A
hh	hour: "00"—"23"
mm	minute: "00"—"2
ss	Seconds: "00"—"59"
<CR>	HEX 0A
<LF>	HEX 0D

Example	Interpretation
<SOH>112:12:34:36<CR><LF>	day 112, time 12:34:36

A.3 String-A

About: This code is very similar in data content to the IRIG J-17 code, but adds a two-character field containing the year, and uses 8-bit ASCII, no parity data format

Timing: Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: <SOH>DDD:hh:mm:ss:YY<CR><LF>

Placeholder	Content
<SOH>	HEX 01
DDD	Day of year: range "001"—"365"
:	HEX 3A
hh	hour: "00"—"23"
mm	minute: "00"—"59"
ss	seconds: "00"—"59"
YY	year: "00"—"99" representing the last two digits of the year
<CR>	HEX 0A
<LF>	HEX 0D

Example	**Interpretation**
<SOH>112:12:34:36<CR><LF>	day 112, time 12:34:36

A.4 String-B

About: This code substitutes a "Quality" indicator byte for the year field, but otherwise is identical in form, function and timing to String-A.

Timing: Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: <SOH>DDD:hh:mm:ss:Q<CR><LF>

Refer to String-A table for the definitions of the common digits:

"Quality" Character (Q)		Meaning
HEX	ASCII	
20	<Space>	Clock in sync, accuracy is better than 200ns
2E	. (full stop)	Clock is accurate to 1µs
2A	*	Clock is accurate to 10µs
23	#	Clock is accurate to 100µs
3F	?	Clock accuracy may be worse than 100µs

Example	**Interpretation**
<SOH>112:12:34:36?<CR><LF>	day 112, time: 12:34:36, >100uS sync error

A.5 String-C

About: This code is effectively a combination of String-A and String B. It provides both year information and a sync indicator field.

Timing: Transmitted once every second. The leading edge of the "start" bit of the first character, <CR>, is exactly on the second to which the message data refers.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: <CR><LF>Q★YY★DDD★hh★mm★ss.000★★★

Placeholder	Content
<CR><LF>	HEX 0A,0D
Q	Quality indicator: " " = in-sync, "?" = out-of-sync
★	HEX 20 (ASCII " ")
YY	Year: "00"—"99" representing the last two digits of the year
DDD	Day of year: range "001"—"365"
hh	hour: "00"—"23"
mm	minute: "00"—"59"
ss	seconds: "00"—"59"
.000	ASCII ".000"

Example	Interpretation
<CR><LF>? 02 112 12:34:36.000	day 112 of year (20)02, time: 12:34:36, out-of-sync

N.B. in the above example the three trailing spaces as described in the definition are invisible.

A.6 String-D

Tekron-D is IDENTICAL in content to String-B, but the second mark is at the leading edge of the start-bit of the (<CR>).

Example	Interpretation
<SOH>112:12:34:36?<CR><LF>	day 112, time: 12:34:36, >100uS sync error

A.7 String-E

About: This provides time, year information, and a sync indicator field.

Timing: The string is transmitted once every second, with the leading edge of the "start" bit of the <CR> exactly on the second.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: <SOH>YYY:DDD:hh:mm:ssQ<CR><LF>

Placeholder	Content
<SOH>	HEX 01
YYY	3-digit year, e.g. "012" = 2012
:	HEX 3A
DDD	Day of year: range "001"—"365"
hh	hour: "00"—"23"
mm	minute: "00"—"59"
ss	seconds: "00"—"59"
Q	Quality character, as defined in String-B (above)

Example	**Interpretation**
<SOH>004:112:12:34:36?<CR><LF>	(2)004, day 112, 12:34:36pm, >100us sync error

A.8 String-F

Timing: The string is transmitted once every second, with the leading edge of the "start" bit of the first carriage return (<CR>) exactly on the second.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: <CR><LF>1100<CR><LF>44hhmmss<CR><LF>54ddd<CR><LF>
<CR><LF>45HHMMss<CR><LF>55DDD<CR><LF><BEL>

Placeholder	Content
<CR><LF>	HEX 0A, 0D
1100	ASCII "1100"
44	ASCII "44" (means local time follows)
54	ASCII "54" (means local day of year follows)
45	ASCII "45" (means UTC time follows)
55	ASCII "55" (means UTC day of year follows)
ddd	Local day of year: "001"—"365"
hh	Local hour of day: "00"—"23"
mm	Local minute of day: "00"—"60"
ss	seconds: "00"—"59"
DDD	UTC Day of year: "001"—"365"
HH	UTC hour: "00"—"23"
MM	UTC minute: "00"—"59"
<BEL>	HEX 07

A.9 NMEA ZDA

About This string is compatible with and defined by the NMEA-0183 standard
Timing Transmission is once every second. The leading edge of the "start" bit of the "$" is exactly on the second.
Comms 9600bd, 8-bit ASCII, no parity
Definition $GPZDA,hhmmss.00,DD,MM,YYYY,xx,yy*CC<CR><LF>

Placeholder	Content
$GPZDA	ASCII "$GPZDA"
,	ASCII "," (comma)
hh	UTC hour of day: "00"—"23"
mm	UTC minute of day: "00"—"60"
ss	UTC Seconds: "00"—"59"
.00	ASCII ".00"
DD	UTC day of month: "01"—"31" depending on which month
MM	UTC month: "01"—"12", "01" = January
YYYY	UTC year, 4 digit.
xx	Local time zone offset from UTC in hours[1]
yy	Local time zone offset from UTC in minutes[1]
*	ASCII "*"
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including the "$" and "*". (00-FF)
<CR><LF>	HEX 0A, 0D

[1]*set to zero when UTC time in ASCII string is selected*

A.10 NMEA RMC

About: This string is compatible with and defined by the NMEA-0183 standard

Timing: Transmission is once every second. The leading edge of the "start" bit of the "$" is exactly on the second.

Comms: 9600bd, 8-bit ASCII, no parity

Definition: $GPRMC,hhmmss.00,a,tt,tt.tttt,n,ggg,gg.gggg,w,0.0,0.0,DDMMYY,0.0,E*CC<CR><LF>

Placeholder	Content
$GPZDA	ASCII "$GPRMC"
,	ASCII "," (comma)
hhmmss	UTC hour of day, minute of day, seconds
.	ASCII "." (full stop)
0	ASCII "0"
a	Status: "A" = valid, "V" = invalid
tt,tt.tttt	Latitude (degrees, minutes): "00,00.0000"—"89,59.9999"
N	Latitude (north/south): "N" = north, "S" = south
ggg,gg,gggg	Longitude (degrees, minutes): "000,00.0000"—"359,59.9999"
W	Longitude (east/west): "E" = east, "W" = west
DDMMYY	UTC day of month, month, 2-digit year:
E*	ASCII "E*"
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including the "$" and "*".
<CR><LF>	HEX 0A, 0D

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returned to Tekron at the Purchaser's expense.

A return material authorization number issued by Tekron must accompany all return material.

NOTES

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WARNING

This product has been designed to comply with the limits for a Class A digital device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against such interference when operating in a commercial environment.