TTM 01-E

USER MANUAL

TEKRON

Table of Contents

1 Introduction

The TTM 01-E – Tekron's powerful and cost effective synchronization solution for RTUs, Protection Relays and other Intelligent Electronic Devices (IEDs) used in electrical sub-stations and industrial control installations.

Utilizing state of the art technology and a timing optimized snow-resistant antenna, this compact unit locks onto atomic clock references from the GPS satellite constellation and produces time codes and pulses with sub-microsecond accuracy and precision.

TTM 01-E clips onto a standard DIN rail. Its 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.

It comes complete with Ethernet cables to allow for customization and easy setup from the Windows™ Configuration software which is available to download from www.tekron.com. Optional accessories include antenna, low loss antenna cable, antenna pipe mounting components and lightning protection kit.

2 LED Indicators

The top of the TTM 01-E features two LED indicators. The GPS LED shows the status of the internal GPS receiver, while the SYN LED shows sync status of the unit.

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

The table below provides information regarding the interpretation of the LEDs.

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, TTM 01-E is searching the sky for satellites; but is not in sync to UTC time.
•••••••••••••••••• •••••••••••••••• 1 flash /sec (long on)	On	TTM 01-E outputs are accurate to within 200 ns of UTC time, and therefore useable for sync purposes.

See section 3.2 for information regarding the interpretation of the LNK LED.

3 Inputs and Outputs

Antenna connector (SMA connector)

The “ant” antenna input provides an interface for an external active antenna via low-loss coaxial cable, 50Ω impedance. 5V DC @ 50mA max is supplied to power an active antenna. The total combined gain of the antenna system (antenna plus cable and connectors) should fall in the range of 10 to 35dB, the optimum being 22dB.

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.

A Lightning Protection device should be inserted into the antenna lead. A suitable device complete with additional cable connectors, a connector crimping tool and mounting hardware is available as an option. Use of a Lightning Protector does not degrade the performance of the antenna system.

Ethernet Port (RJ45 connector)

TTM 01-E units are fitted with an RJ45 Ethernet interface. This allows the unit to be configured over a LAN (Local Area Network) switch or by direct connection using an Ethernet cross over cable. The TTM 01-E can be ordered with, or upgraded to, output NTP/SNTP and also PTP via the Ethernet interface. The interface supports 100 Mbps connectivity.

To the left of the antenna SMA connector is a green LED labeled “LNK” which provides information on the status of the Ethernet port.

The table below provides information regarding the interpretation of the LEDs.

LNK LED	Description
OFF	Ethernet cable is not connected or a fault has been detected
••••• •••••••••••••••••••••	Ethernet cable is connected
_ _ _ _ (Rapid Flashing)	Ethernet connectivity – Packets are being detected

Sync Indication Output

The sync indication output reflects the state of sync. Sync indication, is via an opto-isolator switch, rated at 200V and 100 mA. When the unit is in sync with UTC time, the opto-isolator switch is on. See figure 1 & 2 below for wiring examples.

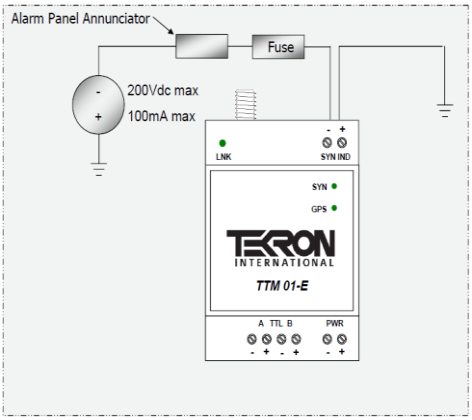


Figure 1 – Positive earth connection diagram

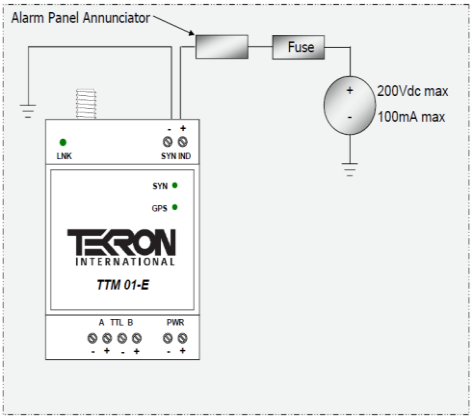


Figure 2 – Negative earth connection diagram

Output options

TTM 01-E has three main variants: TTL, Serial and AM IRIG-B. In addition to the outputs available on these variants, the TTM 01-E can be ordered with NTP/SNTP or with NTP/SNTP and PTP output options.

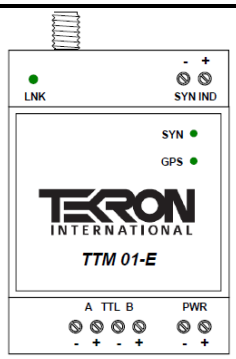
The table below shows the main variants and orderable options:

Version	Number of serial output strings 9600 bd.	No. of user defined/digital pulses or time codes (DCF-77, DC IRIG-B00x, DC IRIG-B22x)	Number of AM IRIG-B (B12x) outputs:	NTP/SNTP and PTP
TTL (T2-Txxx)	none	2	none	1 (Optional)
Serial (T2-Sxxx)	1	1	none	1 (Optional)
AM IRIG-B (T2-Axxx)	none	none	1	1 (Optional)

TTL (order code: T2-T*)

CMOS/TTL (5 V) driven (150 mA push-pull). Each port is fully floating and isolated.

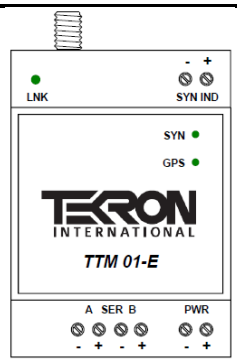
	Output Type
TTL A	User defined/Digital pulses or Time codes: IRIG-B (B00x, B22x), DCF-77
TTL B	User defined/Digital pulses or Time codes: IRIG-B (B00x, B22x), DCF-77



Serial (order code: T2-S*)

Signals A and B (+/-9V) are not isolated from each other in that they share the signal ground, but the port as a whole is isolated.

	Output Type
SER A	User defined/Digital pulses or Time codes: IRIG-B (B00x, B22x), DCF-77
SER B	Serial time messages at 9600 baud, 8 bit, no parity
Both	Each output is user programmable. A typical application has String-C on “SER B” output and 1PPS on “SER A” (See section 8) describes the message strings programmable for output on “SER B”.



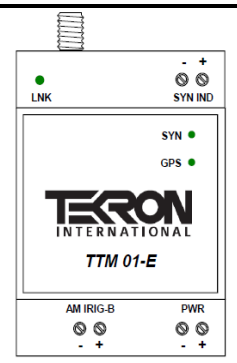
AM IRIG-B (order code: T2-A*)

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.

	Output Type
AM IRIG-B	Amplitude modulated IRIG-B Output Impedance 120Ω
	The output is user programmable for: IRIG-B12x.The AM IRIG-B 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 100Ω (few loads) to 180Ω (many loads). 1W resistors are recommended.



4 Installation

Identification

Each TTM 01-E unit is shipped with an identification label on the side of the case. The label provides details of the particular options fitted to the unit, the power supply requirement, the serial number and firmware revision.

Check the identification label on the side of the unit to ensure that the correct model has been supplied before proceeding to install

Product Registration

Register your TTM 01-E at www.tekron.com/register to receive firmware upgrade notifications, customer resources access, and more.

Packing list

Each TTM 01-E kit is shipped with the following:

- TTM 01-E Time Code Generator
- CAT5e Ethernet cable

Mounting the TTM 01-E

The clock is designed to be mounted to a standard din rail mount using the supplied clips on the base (See figure 3). The clips can also be used to screw mount the unit.

Figure 3 – Base of TTM 01-E

Operation

The label on the side of TTM 01-E contains the voltage rating: Do not apply power outside of this rating

Connect the antenna lead and the antenna (with a good view of the sky). Then connect the power source to the power input terminals on the base of the unit. The polarity of the power connection is unimportant.

The time required to obtain tracking and synchronization (given a good view of the sky) is typically within a minute. Reactivating a unit that previously has been synchronized thousands of kilometers away from the present position will take longer, but not more than 45 minutes.

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

5 Configuration of Software

Introduction

Configuration software is available to download from Tekron.com. This software is compatible with all versions of the Windows operating system from Windows 2000 through to Windows 7. The software uses the PC's Ethernet port to communicate with the clock. Each clock ships with a straight-wired Ethernet cable (for connection to a LAN switch) and a cross-over Ethernet cable (for direct connection to a PC).

Connection via LAN

Apply power to TTM 01-E and connect the unit to a network switch located on the LAN using a CAT5e straight-wired Ethernet cable (2m cable supplied with clock). Using a PC connected to the LAN, run the configuration software program "TekronConfigTool-x.x.x.x.exe".

Preset IP addresses are NOT required if PC and clock(s) are on the same IP sub-net.

Discovery Window

The window shown in Figure 5 will appear. Click the 'Discover' button the configuration software will automatically locate and identify all Tekron "E" level clocks that are connected to the LAN on the same sub-net as the PC. The clocks serial number, IP address and status will be displayed in the discovery window. Select the type of unit you would like to configure and click "Open".

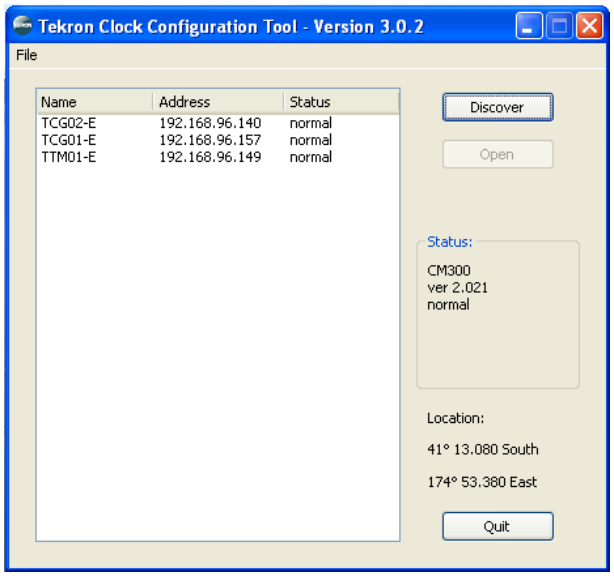


Figure 5 – Unit selection

If no units are found on the network and you are confident that the TTM 01-E is connected properly, check the Windows firewall settings on your PC to ensure that the program is not being blocked.

Add Clock

Tekron clocks that have already been configured with an IP address also support remote configuration over one or more network routers (WAN). The user can communicate with the target clock by selecting "Add Clock" under the File menu and entering the clock's IP address in the field provided. The "Add Clock" feature can also be accessed by right clicking on the clock list. The availability of the remote configuration feature over a WAN is dependent on the WAN configuration. Please refer to your WAN support personnel for further information.

Where clocks have been configured not to respond to incoming broadcasts (Refer 5.9.2), they can be accessed via the Configuration tool by manually entering their IP address as described above.

Open Saved Configuration

General clock configuration data that was saved on your PC as a ".tcf" file" (See section 5.6.2) can be previewed by selecting the "Open Saved Config" from the File menu.

Save & Open Clock Lists

The units that are being displayed inside the discovery window can be saved to a text file by selecting the "Save Clock List" from the File menu. These units can then be loaded back into the discovery window by selecting "Load Clock List" from the File menu. Note that the default file ("clock_ip.txt") if saved in the same directory as the configuration tool will be loaded into the discovery window automatically once the executable is run again. Please ensure that the files are named accordingly when saving.

After successful connection, the configuration tool opens with the "Time" tab active (See figure 6).

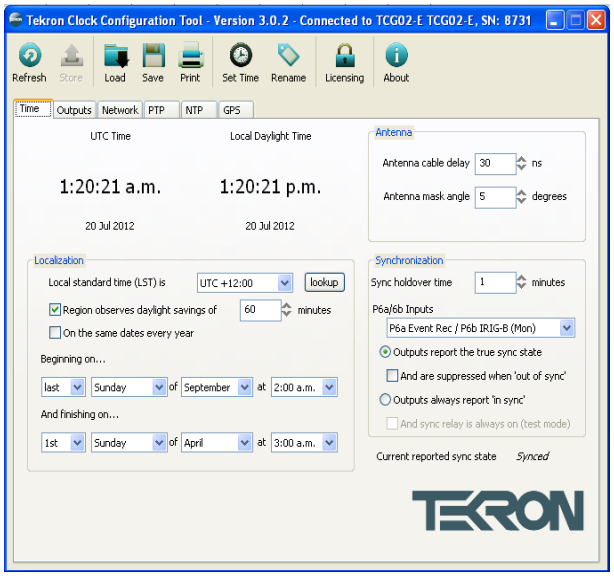


Figure 6 – Time configuration tab

Direct connection method

Run the configuration software.

Apply power to TTM 01-E, connect the unit via an Ethernet crossover cable to a PC and run the configuration software program "TerkonConfigTool-x.x.x.x.exe". As in the case of connection via a LAN, a window will appear showing the serial number of the TTM 01-E unit connected. Select the serial no of the unit and click "open" to see the "Time" tab as per figure 6.

If the TTM 01-E unit is not found and you are confident that the units are connected properly, check the Windows firewall settings on your PC to ensure that the program is not being blocked.

Firmware Upgrade

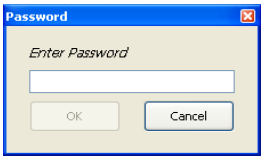
For instructions on how to upgrade the firmware of your clock, please refer to the upgrade procedures as detailed on our website – www.tekron.com .

Toolbar

Refresh and Store

Changes made in the configuration tool can be applied to the TTM 01-E using the “Store” button. Note that the “Store” button can only be selected when the configuration displayed does not match what is actually stored in the clock. After storing the configuration changes, the TTM 01-E may reset, registering a loss of sync for a brief period.

If password protection is enabled on the clock (0) an authentication window will appear when the “Store” button is pressed. Enter your password and click “OK” to proceed. If the correct password has been entered and the write is successful, this window will disappear. Otherwise, it will indicate failure and prompt for a retry.



If password protection is disabled on the clock, the configuration tool will immediately attempt to write its changes to the device. The Write window that appears will prompt for a retry on failure, and close on success.

The “Refresh” button can be used to undo any changes that have been made to the configuration options on screen that have not yet been stored using the “Store” button.

Load, Save and Print

General clock configuration data can be saved on your PC as a “.tcf” files using the “Save” button, and loaded using the “Load” button. Note that configuration options are not applied to the TTM 01-E until the “Store” button is pressed.

The “Print” button prints a text document listing all currently stored configuration data.

Set Time

When the true time is unknown and the antenna is disconnected, the time can be arbitrarily set using the “Set Time” button. This function allows the TTM 01-E to be used as a signal source for testing the ability of externally attached equipment to correctly process received time codes through unusual time transitions such as the 28/29 February rollover during leap years, or daylight savings transitions.

The TTM 01-E would normally be configured with “Outputs report “in sync” always” and “And sync relay is always on” settings activated when arbitrarily setting the time.

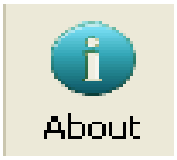
Rename

The TTM 01-E clocks can be configured using the "Rename" button with a name up to 16 alpha numeric characters long to differentiate each unit from others on the same network.

Licensing

The “Licensing” button opens a window in which new license keys can be entered to enable additional functionality. Currently NTP Server and/or PTP functions are controlled in this way. A license may be purchased at any time to activate these features. A License can also be used to reset the security password.

About

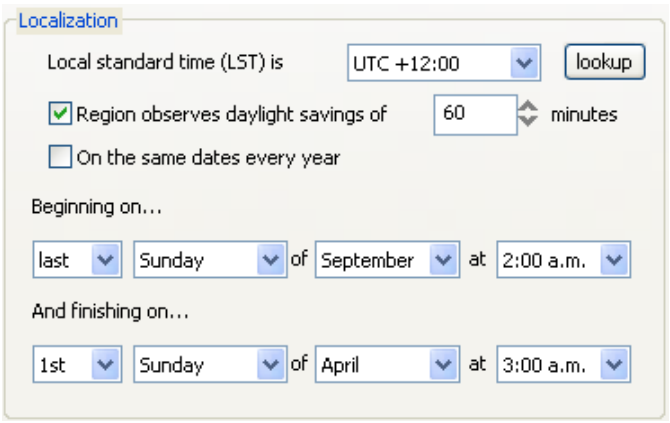


The “About” button displays copyright information, website link, and firmware / software version information.

Time Tab

The “Time” tab (See figure 6) displays the current time and contains regional, antenna and synchronization settings.

Localization



Local Standard Time (LST)
The time offsets define the number of hours (and, in rare cases, minutes) that the local time differs from UTC time. A positive offset means that the local time is ahead of UTC.

Lookup…
The “Lookup…” button provides a convenient way to automatically set time offset and daylight savings parameters simply by selecting a geographical location. Note: this information is derived from Windows™ Date and Time settings, so should be verified as correct before use.

Region observes daylight savings

Selecting this option allows the TTM 01-E to be configured to make daylight savings changes automatically.

Further options are then made available including:

- DST (Daylight Savings Time) offset in reference to LST (Local Standard Time).
- Fixed date or fixed rule for calculating a date method.

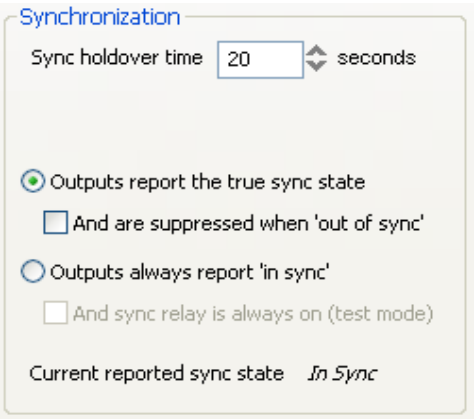
Antenna

Antenna Cable Delay
All antenna systems introduce signal delay (depending on the cable length). To optimize the precision of the output signals enter a value in this field corresponding to 4ns per meter of antenna cable. For example, if the antenna cable has a length of 30 meters, enter “120”.

Antenna Mask Angle
This is the elevation above the horizon below which satellites will not be used in time and position calculations. A good starting value is 5°, but this may need to be increased in areas with land based obstacles to prevent time quality loss due to multi-pathing effects. Increasing this value reduces the field of sky view so may reduce the number of satellites in view at any given time.

The mask angle will only take effect when the clock is in “Position Lock” (displays P as the receiver status)

Synchronization



Sync Holdover Time

This parameter is used to control the period after loss of satellite sync that will be tolerated before TTM 01-E will show the "loss of sync" status, and release the "sync" relay. Correct installation will make the "loss of sync" event rare; although in areas with poor GPS coverage there can be occasions where satellite tracking is momentarily lost. The "sync holdover" feature is used to mask these effects.

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

In typical SCADA operations, time syncing to within 0.5ms is considered adequate. Setting Sync Hold to the maximum (42 minutes) will prevent "loss of sync" alarms in the event that satellites are temporarily obstructed.

Outputs report the true sync state

Under normal conditions this option should be selected. The clock reports the true state of synchronization to the connected IEDs.

And are suppressed when "out of sync"

This option suppresses TTM 01-E outputs when it goes out of sync. The sync relay operation is unaffected by this option and will still indicate the true sync state of TTM 01-E

Outputs report "in sync" always ****

The clock will output time sync signals as if it were synced to GPS, even if this is not true (e.g. there is no antenna attached). In this mode the sync relay always reports the true sync status

And sync relay is always on ****

Enabling this option forces TTM 01-E to output time sync signals as if it were synced to GPS, even if this is not true (e.g. there is no antenna attached). In this mode the sync relay will be on at all times.

When the TTM 01-E is in this mode, the time can be arbitrarily set. This function allows the TTM 01-E to be used as a signal source for testing the ability of externally attached equipment to correctly process received time codes through unusual time transitions such as the 28 /2 9 Feb rollover during leap years, or daylight savings transitions.

The latter two options (marked **) are typically used only for testing. They should never be used in applications where a true UTC time reference is required.**

Outputs Tab

The “Outputs” tab (See figure 7) enables the selection and configuration of TTM 01-E output ports.

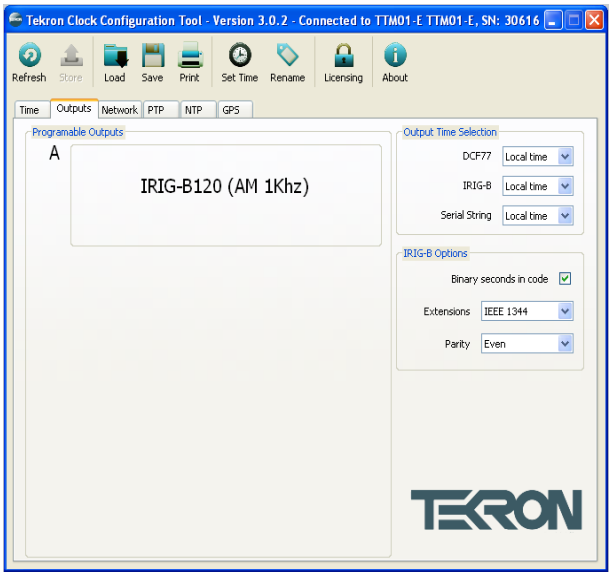


Figure 7 – Outputs configuration tab

Programmable Outputs

TTM 01-E GPS Clocks with order codes beginning with T2-Sxxx or T2-Txxx; can be configured to output one of four different output waveforms. Selection between the four options is done via a drop-down menu. The options available for each output are:

- DCF-77 simulation
- IRIG-B000 (standard DCLS)
- IRIG-B200 (Modified Manchester)
- User defined pulse

Each of the programmable outputs can also be inverted in its operation.

TTM 01-E GPS Clocks beginning with T2-Axxx only output modulated IRIG-B (B120) time codes.

In the case of the User-Defined Pulse option being selected for any outputs, further parameters are entered to define the pulse sequence. The parameters are as follows:

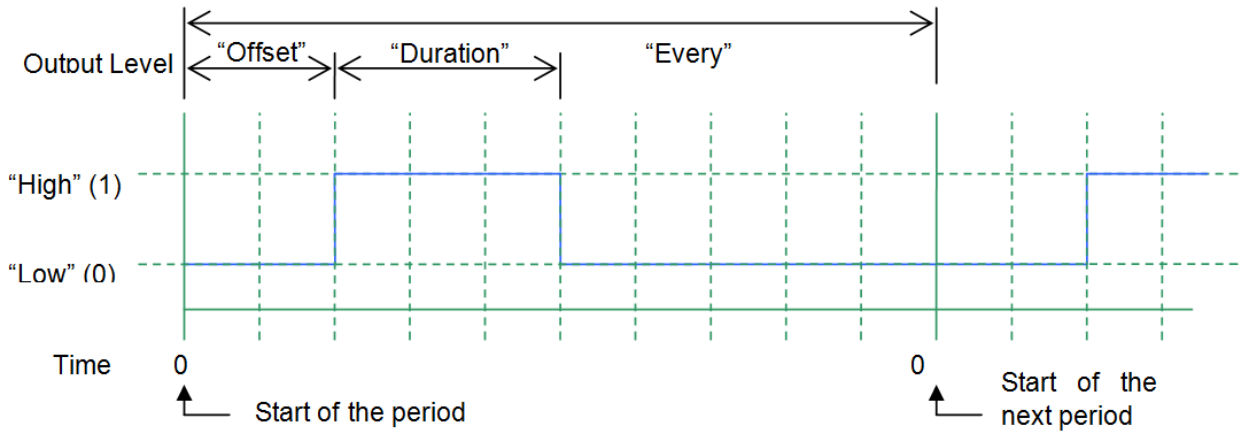
1 A drop-down menu allows the user to choose to have pulses output every “second”, “minute”, “hour”, or “day”. Specify the frequency of pulses under the “Every” and “Pulses” fields: The table below shows what number of pulses per second are valid:

Period “Every”	Number of “Pulses”
Second	1, 2, 4, 5, 10, 20, 25, 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

2 Specify the “Offset” this is the interval from the start of the day, hour, minute, or second to the start of the pulse.

3 Specify the “Duration”; this is the time the pulse stays asserted.

4 Check “inverted” to swap the polarity of the pulse – that is “High” and “Low” levels are swapped.



Serial Strings

On serial equipped units (T1-Sxxx), serial strings are selected by using a single drop down list in the "Outputs" Tab.

See section 7.2 for definitions of all the serial strings supported.

Output time selection

This option allows the user to output local time or UTC time over the IRIG-B outputs.

IRIG-B Options

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.

IEEE 1344 and AFNOR Extensions

The IRIG-B time code provides time of day and day of year data. The latest version of the standard "IRIG 200-04" also includes year information. The IEEE 1344 extensions add data relating to local time and the quality of the time signal.

Extension name	Extra information contained	Origin
IEEE 1344	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 IEEE 1344 or AFNOR NFS 87-500 may be on at any time. Most equipment that comes from the US will use the IEEE 1344 extensions.

Network Tab

This tab contains network addresses and options such as SNMP and Syslog (See figure 8).

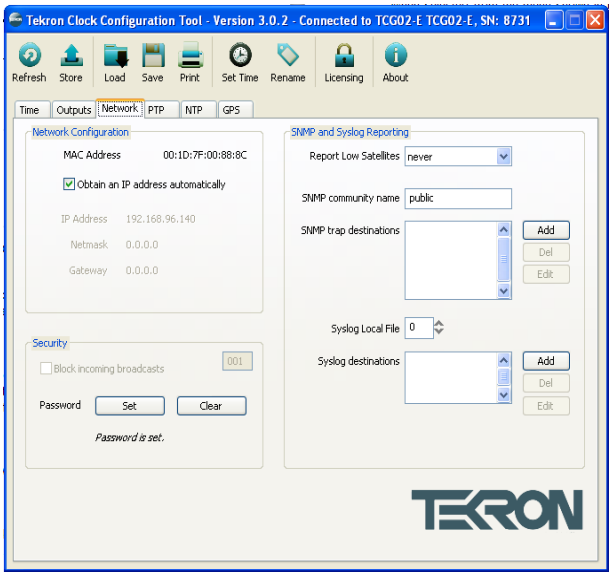


Figure 8 – Network configuration tab

Network configuration

MAC Address
Shows the MAC address assigned to the unit. This field cannot be modified.

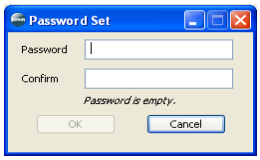
IP Configuration
Selecting "Obtain an IP address automatically" will invoke DHCP operation. Networks that include a DHCP server offer automatic address allocation via Dynamic Host Configuration Protocol (DHCP). In such a network, the unit will automatically use DHCP to fetch a dynamic address if it does not already have a fixed address configured.

IP Address
If a DHCP server is unavailable, or if fixed addressing is preferred, an IP address can be entered manually

Netmask
Defaults to 255.255.255.0

Gateway
Please refer to your network administrator for the correct setting in this field.

Security



Enabling Password Protection
Click on the "Set" button. A window prompt will appear to enter and confirm your new password. Note that the password will only be stored inside the unit once the "Store" button has been clicked New Password

When entering a new password it should contain at least 1 character. Underneath the entry field an indicator will display the 'strength' of the password chosen. If the device already contains a password, you will be prompted for the previous password when this change is stored.

When the password is set, no configuration changes can be made to the clock. The user can still open the configuration tool, and look at the settings, however no changes can be stored to the clock without the entry of the password. This password protection applies to all of the tabs.

Confirm Password
Retype the new password. A warning message will be displayed if the two password fields do not match.

Clear Password
The password protection can be removed by clicking on the “Clear” button. Underneath the button a text indicator will display “Password is not set” label. Note that the password will only be removed once the “Store” button has been clicked and a correct password has been entered. Resetting Password

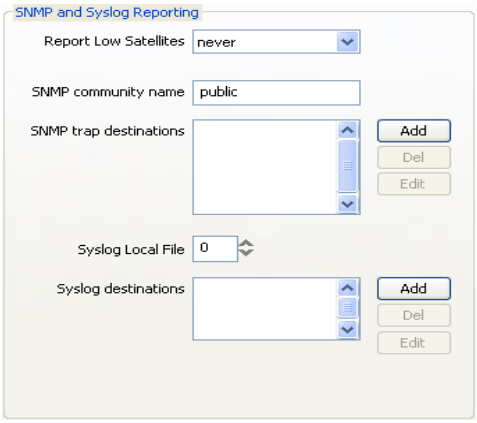
Resetting Password
To reset your password you will need to contact Tekron and provide the MAC address and security code (located in the top right hand corner) numbers of your unit. You will then be issued a license key which will allow you to set a new password (See section 5.5.4).

Block Incoming Broadcasts
Enabling “Block incoming broadcasts” will cause the clock to ignore all broadcast messages, including DHCP and configuration discovery messages. This option can only be implemented when fixed IP address is assigned to the unit.

When this option is enabled, the clock will not respond to the configuration tools discovery requests. To access the clock, the user must manually add the IP address in the discovery window (refer to 5.3.1).

This option is generally used to reduce the amount of traffic on the network.

Simple Network Management Protocol (SNMP) and Syslog reporting



Report low satellites
If the number of GPS Satellites drops below this threshold, an SNMP message “low satellites” is generated. After the unit has been operating with four satellites or more, the clock is tuned such that it can maintain full specified accuracy even if satellite visibility drops to just one satellite. For this reason, the default value for this parameter is “1”. This prevents the transmission of numerous unnecessary “low satellites” messages.

SNMP community name
The default value is “public”. This may be changed to suit the specific SNMP architecture on the network if required. If SNMP is not implemented for other purposes on the network, then the “public” setting allows the use of a simple SNMP trap display utility running on a remote monitoring PC to display the status messages sent from the unit.

SNMP trap destination
This parameter allows for up to five destination IP addresses to be entered. Machines on any or all of these IP addresses can then receive the status messages from the unit. Even if there is no formal SNMP system running on the network, the messages can be received and displayed on the destination machines running “Windows NT” or higher using the freeware utility “SNMPTRAP.EXE”, which is on the CD supplied with the TTM 01-E kit.

SNMP walk
Please use Tekron’s MIB file which can be found on the provided software CD.

Syslog local file
Normally you would set to zero unless further categorizations of the Syslog messages are required.

Syslog destination
One or two IP addresses may be entered to define destination machines running system logs.

PTP & NTP Tabs

A TTM 01-E unit licensed for NTP/SNTP operation provides a complete Stratum-1 time-server function while still retaining all other output services. A further license option is also available that enables support for PTP v2 time synchronization.

The features on this tab (See figure 9) are inactive and invisible unless NTP/SNTP or PTP options are ordered (See section 5.5.4) for instructions on enabling an NTP or PTP license).

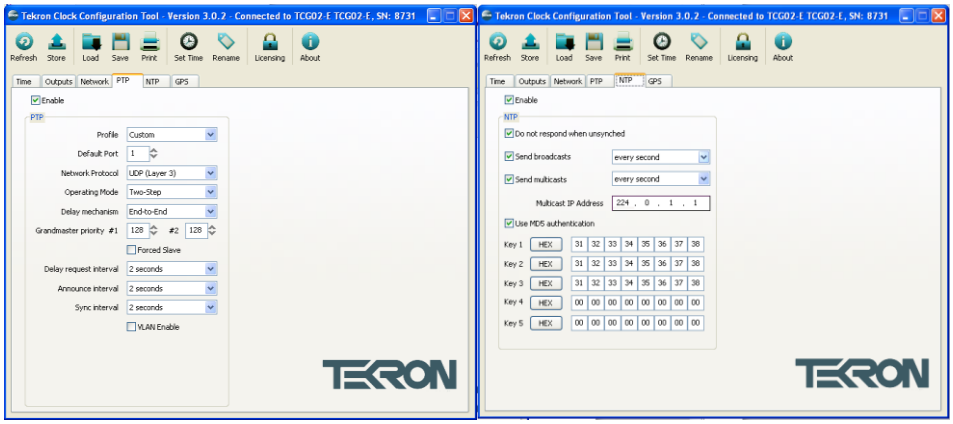


Figure 9 – NTP/PTP configuration tab

PTP

Profile

This drop down list provides a quick way to configure PTP parameters based on industry recognized profiles. Once these changes are applied (or if any parameters are altered) this option will revert to "custom".

- Default
- Custom

Default Port

Select the default PTP port.

Network Protocol

The network protocol must be consistent across the entire subnet.

- UDP (Layer 3)
- ETH (Layer 2)

UDP is the most common PTP network protocol in use.

Operation Mode

Operation mode is a network wide parameter. In any given network, only one mode of operation will be present.

- One-Step
- Two-Step

Select Two-Step operation if the mode is unknown.

Delay Mechanism

Delay mechanism is a network wide parameter. The delay selected must be consistent across the network.

- End-to-End
- Peer-to-Peer

The Peer-to-Peer option requires the network to use PTP v2 transparent switches. Use End-to-End if standard switches are employed in the network.

Grandmaster Priority
These parameters modify the automatic selection of master clocks in PTP networks. Lower values indicate higher probability that the unit will be selected as master clock. The first value overrides all other selection criteria, whereas the second value gives a finer-grained priority used for selection between otherwise-equal clocks.

The input range is 0 to 255, where 0 is the highest priority. The default setting is 128.

Force Slave
Tick this box to force the unit to become a PTP slave. In this mode, the GPS time is ignored and the unit will never allow itself to become a master clock.

Delay Request Interval
Delay request interval specifies the time interval between successive Delay Request messages being sent to other PTP devices on the network.

Announce Interval
Announce interval specifies the time interval between successive Announce messages.

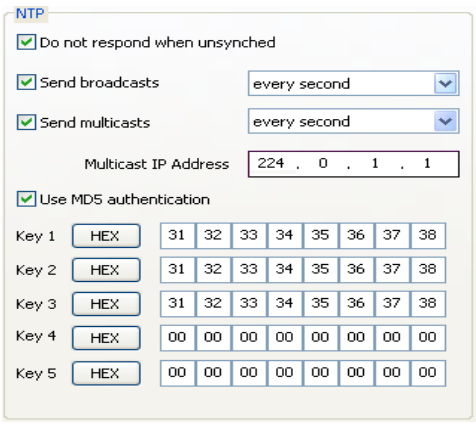
Sync Interval
The sync interval specifies the time interval between successive Sync messages.

VLAN Enable
Tick this box to enable VLAN tagging of PTP packets. Enabling VLAN changes the network packet structure to include VLAN ID and Priority fields.

VLAN ID
This parameter sets the ID field inside the VLAN tag. PTP time synchronization is only allowed between clocks with the same VLAN ID, unless one (or both) has the default value of 0. The allowable input range is 0 to 4094.

VLAN Priority
This parameter sets the Priority field inside the VLAN tag. The allowable input range is 0 to 7.

NTP



NTP Enable
Select this box to enable the clock to function as a Network Time Protocol (NTP/SNTP) server (NTP license must be procured).

Compatibility: Do not respond when unsynchronized
Selecting this option causes the time server not to respond to NTP time sync requests unless it is itself synced to UTC time.

Broadcasts: Send broadcasts
If this option is selected, the unit prompts for a poll interval. The unit will then broadcast time packets at the interval specified.

Send multicasts
If this option is selected, the unit prompts for a poll interval and Multicast Group IP. The unit will then broadcast time packets at the interval specified to the multicast group specified.

Security: Use MD5 authentication
The TTM 01-E supports fully encrypted requests. If this option is selected, the unit then prompts for five ASCII or Hex keys.

The length of the MD5 keys is limited to 8 characters; longer keys will be clipped.

GPS Tab

The information in the “GPS” tab helps with troubleshooting and optimizing an antenna installation.

Satellite Visibility

Visible satellites are shown on a polar-display. The rings mark the 'elevation' and the sectors mark 'azimuth'. The center 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 green bar on the Satellite Signal Strength Indicator, otherwise it is grey on both.

Satellite trails and a minimum elevation plot (the blue area) are also shown in the polar display. Over time this minimum elevation plot will show the viewable horizon. An example of a minimum elevation plot obtained from Wellington, New Zealand is shown in figure 10.

To ensure reliable performance, when operating TTM 01-E at extreme southern latitudes, position the antenna with a clear view of the northern sky. Similarly, when operating in extreme northern latitudes, the antenna must be able to “see” the southern sky.

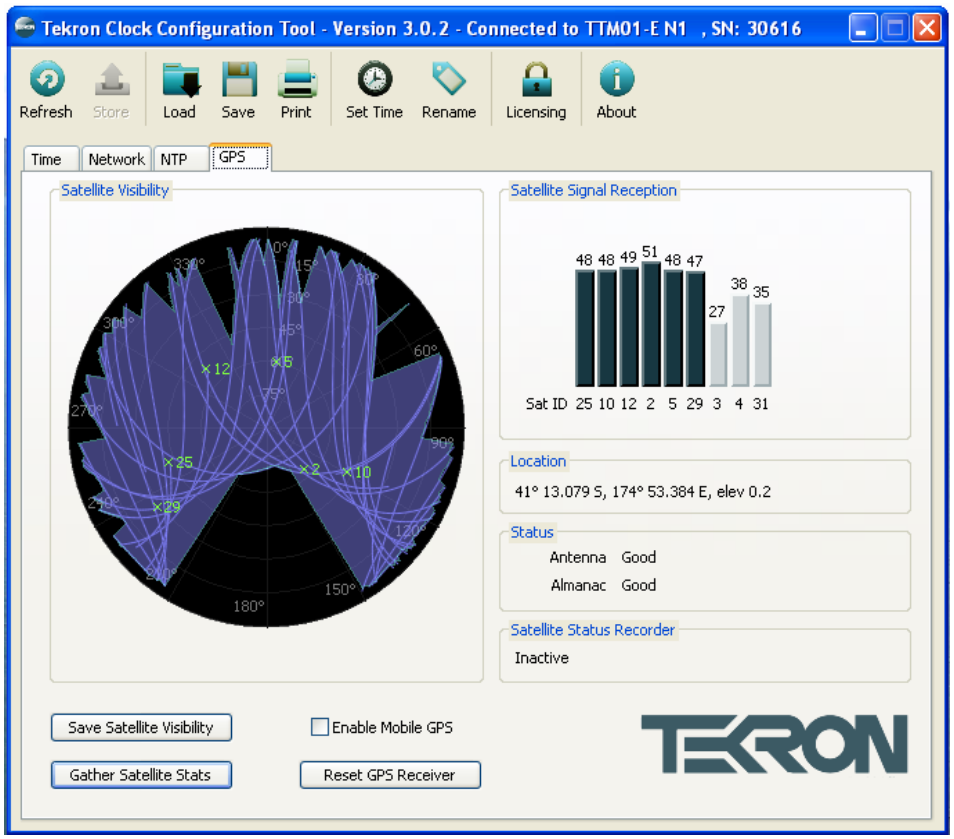


Figure 10 – GPS configuration tab showing trails and minimum elevations

Satellite Signal Reception

The satellite signal strength indicator gives real-time information regarding the signal reception from GPS satellites.

- Dark blue bars indicate satellites are being used for timing.
- Grey bars indicate poor reception.

Location

This shows the latitude, longitude and elevation of the installation.

Status

This shows the Antenna and Almanac status.

Reset GPS Receiver

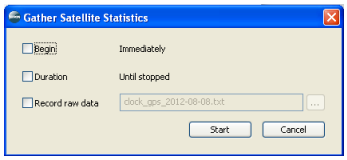
This forces the GPS receiver to hard reset. This also wipes the GPS receiver's memory, by doing this the receiver loses track of all previously tracked satellites (resets the Almanac).

Save Satellite Visibility

By clicking on this button the current satellite visibility image can be saved as a .BMP image inside a specified location.

Gather Satellite Stats

This feature enables satellite statistics to be gathered for the purpose of commissioning and evaluating the antenna position and GPS reception. The "Gather Satellite Stats" button opens a separate window giving recording options for the information.

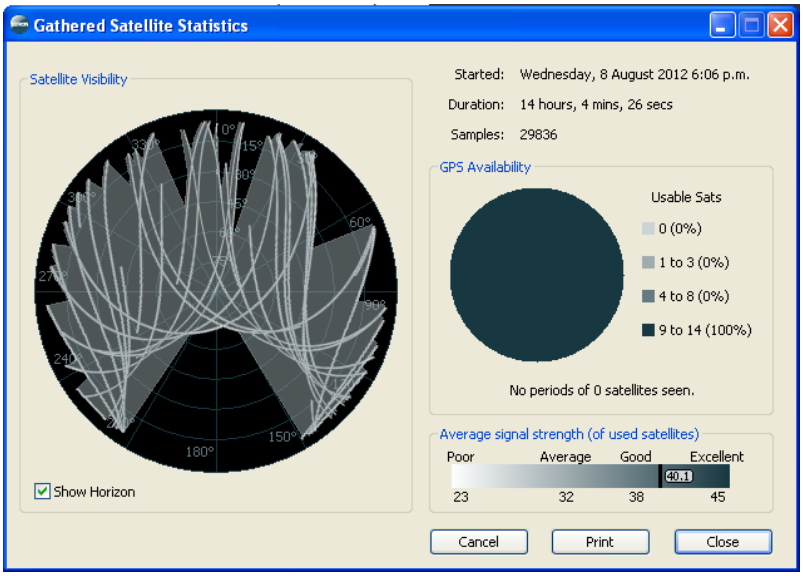


Begin
This feature gives the user the option to commence recording the satellite statistics at a defined time and date. If not selected, the recording will commence immediately.

Duration
Select the length of time for satellite recording to last. If not selected the data recording will continue until the user selects the "Stop" button.

Record Raw Data
Selecting this option will enable you to save to a .txt file the raw satellite data. If you choose not to use this option, the raw data will be deleted once the configuration tool is closed.

View Gathered Stats
Clicking on this button will open a window which displays a summary of the recorded satellite information. This information can either be disregarded or printed as a 'Commissioning Report' along with clock information (Including clock type, firmware revision(s) etc.) and configuration settings of the clock.



Inside the "Gathered Satellite Statistics" window select the 'Cancel' button to close the window and abandon all current saved data. The 'Close' button will close the current window without affecting the saved results and the 'Print' button will print the commissioning report to a user selectable printer.

6 Factory Hardware Options

Power Supply Options

This table shows the three different power supply configurations that may be ordered with TTM 01-E.

Designator	DC Input Range
L (Low)	14-36Vdc
M (Medium)	20-75Vdc
H (High)	90-300Vdc

Lightning Protection Option

A lightning Protection kit may be fitted into the antenna lead-in cable. The kit contains a protection device, two coaxial cable connectors, a connector crimp tool, and mounting hardware.

7 Appendix

TTM 01-E Specification

Physical Specifications		
UL94-V0 polycarbonate flame retardant DIN rail enclosure with IP40 (Ingress Protection rating).		
Performance Property		**Metric**
Dimensions	Width Depth Height	55 mm 60 mm 90 mm
Weight		0.15 kg
GPS Receiver		
L1 (1575.42 MHz) Frequency, C/A Code, 12-Channel, parallel-tracking receiver		
Performance Property		**Metric**
Position Accuracy	Horizontal	< 9 m (90%)
	Altitude	< 18 m (90%)
Timing Accuracy		< 15 ns to UTC
Acquisition	Reacquisition	< 2 s (90%)
	Hot Start	< 3 s (90%)
	Warm Start	< 35 s (90%)
	Cold Start	< 38 s (90%)
Sensitivity	Acquisition	-146 dBm
	Tracking	-160 dBm

Input and Output Specifications			
Type	**Electrical**	**Physical**	**Accuracy at the port**
AM IRIG-B (modulated)	8 V	2 Pin	≤2 µs of UTC
TTL	5 V	2 Pin	≤200 ns of UTC
Ser A (Pulse)	-9 V to + 9 V	DB9 male	≤1.5 µs of UTC
Ser B (String)	-9 V to + 9 V	DB9 male	≤ 100 µs of UTC
NTP/ SNTP		RJ 45	≤200 ns of UTC

Environmental Specifications	
Performance Property	**°C**
Operating Temperature Range	-10 to +65 °C

Electrical Specifications		
Performance Property		**Metric**
Power Supply	Low Voltage	14 to 36 Vdc
	Medium Voltage	20 to 75 Vdc
	High Voltage	90 to 300 Vdc
Power drain		4 W max

8 Serial Output String

NGTS Time Code O/P

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

Timing	Transmitted once per minute. Sent during the last second before the minute rollover to which the data in the string refers.
Comms	9600 bps, 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 0D
<LF>	Line Feed: HEX 0A

Example Interpretation:

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

IRIG J-17 Time Code O/P

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	9600 bps, 7-bit ASCII, odd parity
Definition	<SOH>ddd:hh:mm:ss<CR><LF>
Placeholder	**Content**
<SOH>	HEX 01
ddd	Day of year: range “001” – “366”
:	HEX 3A
hh	hour: “00” – ”23”
mm	minute: “00” – “2
ss	Seconds: “00” – “59”
<CR>	HEX 0D
<LF>	HEX 0A

Example Interpretation:

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

String-A Time Code O/P

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	9600 bps, 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” – “366”
:	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 0D
<LF>	HEX 0A

Example Interpretation:

<SOH>112:12:34:36:10<CR><LF> day 112, time 12:34:36, year (20)10

String-B Time Code O/P

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	9600 bps, 8-bit ASCII, no parity	
Definition	<SOH> DDD:hh:mm:ssQ<CR><LF>	
“Quality” Character (Q)		**Content**
HEX	ASCII	
20	‘ ’ (space)	Clock in sync, timing accuracy is better than 60 ns
2E	‘.’ (full stop)	Clock is accurate to 1 µs
2A	‘*’	Clock is accurate to 10 µs
23	‘#’	Clock is accurate to 100 µs
3F	‘?’	Clock accuracy may be worse than 100 µs

*Refer to String-A table (above) for the definitions of the common digits

Example Interpretation:

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

String-C Time Code O/P

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	9600 bps, 8-bit ASCII, no parity
Definition	<CR><LF>Q␣yy␣ddd␣hh␣mm␣ss.000␣␣␣
Placeholder	**Content**
<CR>	HEX 0D
<LF>	HEX 0A
Q	Quality indicator: “ “ = in-sync, “?” = out-of-sync
␣	HEX 20 (space)
yy	Year: “00” – “99” representing the last two digits of the year
ddd	Day of year: range “001” – “366”
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

String-D Time Code O/P

String-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, >100 µs sync error

String-E Time Code O/P

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	9600 bps, 8-bit ASCII, no parity
Definition	<SOH>YYYY:ddd:hh:mm:ssQ<CR><LF>
Placeholder	**Content**
<SOH>	HEX 01
YYYY	4-digit year
:	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)
<CR>	HEX 0D
<LF>	HEX 0A

Example Interpretation:

<SOH>2004:112:12:34:36?<CR><LF> 2004, day 112, 12:34:36pm, >100us sync error

String-F Time Code O/P

About	This string complies with the protocol required to drive Vorne type Time Displays.
Timing	The string is transmitted once every second, with the leading edge of the “start” bit of the last <BEL> exactly on the second.
Comms	9600 bps, 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>	HEX 0D
<LF>	HEX 0A
1100	ASCII “1100”
44	ASCII “44” (means local time follows)
hh	Local hour of day: “00” – ”23”
mm	Local minute of day: “00” – “60”
ss	seconds: “00” – “59”
54	ASCII “54” (means local day of year follows)
ddd	Local day of year: “001” – “365”
45	ASCII “45” (means UTC time follows)
HH	UTC hour: “00” – ”23”
MM	UTC minute: “00” – “59”
55	ASCII “55” (means UTC day of year follows)
DDD	UTC Day of year: “001” – “365”
<BEL>	HEX 07

String-G Time Code O/P

About	This general time string is used predominantly in Europe.
Timing	The string is transmitted once every second, with the leading edge of the “start” bit of the last <ETX> exactly on the second.
Comms	9600 bps, 8-bit ASCII, no parity
Definition	<STX>swhhmmssddMMyy<LF><CR> <ETX>
Placeholder	**Content**
<STX>	HEX 02
s	Clock Status (see below)
w	Day of Week (see below)
hh	hour of day: “00” – ”23”
mm	minute of day: “00” – “60”
ss	seconds: “00” – “59”
dd	day of month: “01” – “31”
MM	month of year: “01” – ”12”
yy	year: “10” – “99”
<LF>	HEX 0A
<CR>	HEX 0D
<ETX>	HEX 03

Clock Status					
The s “Clock Status” is an ASCII character in the range 0-9, A-F representing a single hex digit (nibble)					
Bits	3	2	1	0	
				0	No announcement for time change
				1	Announcement for time change – active for an hour before
			0		Local Standard Time (LST)
			1		Daylight Saving Time (DST)
	0	0			Time/date invalid – clock is out of sync
	0	1			Hold-over mode – running on local Oscillator
	1	0			GPS / IRIGB controlled mode
	1	1			GPS / IRIGB controlled mode (high accuracy)

Day of Week					
The w “Day of Week” is an ASCII character in the range 1-7, 9, A-F representing a single hex digit (nibble)					
Bits	3	2	1	0	
	0				Local Time
	1				UTC time
		0	0	1	Monday
		0	1	0	Tuesday
		0	1	1	Wednesday
		1	0	0	Thursday
		1	0	1	Friday
		1	1	0	Saturday
		1	1	1	Sunday

Example Interpretation:

<STX>E3123456170410<LF><CR><ETX> High Accuracy Mode, DST, Wed, 12:34:56, 17/4/2010

NMEA ZDA Time Code O/P

About	This string is in accordance with the NMEA-0183 standard in content, but is transmitted at 9600bps.
Timing	Transmission is once every second. The leading edge of the “start” bit of the “$” is exactly on the second.
Comms	9600 bps, 8-bit ASCII, no parity
Definition	$GPZDA,hhmmss.00,dd,MM,YYYY,s,xx,yy*CC<CR><LF>
Placeholder	**Content**
$GPZDA	ASCII “$GPZDA”
,	ASCII “,” (comma)
hhmmss.00	UTC hour of day, minute, seconds (millisecond = 0) (0 – 23 hour, 0 – 59)
dd	UTC day of month: “01” – “31” depending on which month
MM	UTC month: “01” – “12”, “01” = January
YYYY	UTC year, 4 digits.
s	Local time zone offset sign (positive means local time leads UTC)
xx	Local time zone offset from UTC in hours
yy	Local time zone offset from UTC in minutes
*	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>	HEX 0D
<LF>	HEX 0A

Example Interpretation:

$GPZDA,123456.0023042010+1200* UTC time is 12:34:56, 23 April 2010, the local time offset is +12:00

NMEA RMC Time Code O/P

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	9600 bps, 8-bit ASCII, no parity
Definition	$GPRMC,hhmmss.00,a,tttt.tttt,N,ggggg.gggg,W,0.0,0.0,DDMMYY,0.0,E*CC<CR><LF >
Placeholder	**Content**
$ GPRMC	ASCII “$GPRMC”
,	ASCII “,” (comma)
Hhmmss.00	UTC hour of day, minute, seconds (millisecond = 0) (0 – 23 hour, 0 – 59)
a	Status: “A” = valid, “V” = invalid
tttt.tttt	Latitude (degrees, minutes): “00” – “89” degrees; “00.0000” – “59.9999” minutes
N	Latitude (north/south): “N” = north, “S” = south
ggggg,gggg	Longitude (degrees, minutes): “000” – “180” degrees; “00.0000” – “59.9999” minutes
W	Longitude (east/west): “E” = east, “W” = west
ddmmyy	UTC day of month, month, 2-digit year
0.0	ASCII “0.0”
E*	ASCII “E*”
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including the "$" and "*".
<CR>	HEX 0D
<LF>	HEX 0A

9 Warranty Statement

Tekron International Ltd (Tekron) warrants for a period of TEN years from the date of shipment that each Product supplied shall be free of defects in material and workmanship. During this period, if the customer experiences difficulty with a product and is unable to resolve the problem by phone with Tekron Technical Support, a Return Material Authorization (RMA) will be issued. Following receipt of an RMA number, the customer is responsible for returning the product to Tekron, freight prepaid. Tekron, upon verification of warranty will, at its option, repair or replace the product in question and return it to the customer, freight prepaid. No services are handled at the customer's site under this warranty.

Tekron shall have no obligation to make repairs, or to cause replacement required through normal wear and tear or necessitated in whole or in part by catastrophe, fault or negligence of the user, improper or unauthorized use of the Product, or use of the Product in such a manner for which it was not designed, or by causes external to the Product, such as, but not limited to, power or failure of building services.

A product will not be warranted if it is an accessory not carrying the Tekron brand name. In this case, warranties are limited to the warranty provided by the original manufacturer of the accessory. Examples of such products and accessories are antennas, cables, etc.

There are no understandings, agreements, representations or warranties, express or implied, including warranties of merchantability or fitness for a particular purpose, other than those specifically set out above or by any existing contract between the parties. Any such contract states the entire obligation of Tekron. The contents of this document shall not become part of or modify any prior or existing agreement, commitment or relationship.

The information, recommendation, description and safety notations in this or other documents supplied by Tekron are based on general industry experience and judgment with respect to such hardware and software. This information should not be considered to be all inclusive or covering all contingencies. No other warranties, expressed or implied, including warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade are made regarding this information, recommendations, descriptions and safety notifications contained hereby, in hardware and software specification documentation or instructions supplied by Tekron. In no event will Tekron be responsible to the user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss of equipment, plant or power system, cost of capital, loss of profits or revenues, cost of replacement power, additional expenses in the use of existing software, hardware, equipment or facilities, or claims against the user by its employees or customers resulting from the use of the information, recommendations, descriptions and safety notations supplied by Tekron. Tekron liability is limited (at its election) to (1) refund of buyer's purchase price for such affected products (without interest); (2) repair of such products, or (3) replacement of such products, provided however, that the buyer follows the procedures set forth herein.

Warranty claims must be received by Tekron within the applicable warranty period. A replaced product, or part thereof, shall become the property of Tekron and shall be returned to Tekron at the Purchaser's expense.

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

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.

Notes
The information in this manual may change without notice. The manufacturer assumes no responsibility for any errors that may appear in this manual.

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