TTM 01-G

USER MANUAL

TEKRON

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1 Introduction

Welcome to the TTM 01-G user manual! This document contains everything you need to know about the key features, hardware, and installation process of the TTM 01-G.

Product Overview

The TTM 01-G is a powerful and cost-effective synchronization solution for Remote Terminal Units (RTUs), Protection Relays and other Intelligent Electronic Devices used in electrical sub-stations and industrial control installations.

Utilizing state of the art technology, this compact unit locks onto atomic clock references from the GPS and GLONASS satellite constellations and produces time codes and pulses with sub-microsecond accuracy and precision.

The TTM 01-G clips onto a standard DIN rail. Its rugged compact design is suitable for noisy electrical environments, while built in electrical isolation combined with strong push pull drives on outputs simplifying wiring schemes and enhancing reliability. Refer to Figure 1.

Figure 1 - TTM 01-G Front View

Accessories

The TTM 01-G comes complete with Ethernet cables to allow for customization and easy setup from the Windows™ Configuration software which is available to download from www.support.tekon.com

Optional accessories include antenna, low loss antenna cable, antenna pipe mounting components, lightning protection kit and BNC to 2-pin connector adaptor.

2 LED Indicators

The top of the TTM 01-G features two LED indicators. The **SYN LED** shows synchronization status, while the **ALM LED** shows the alarm status of the unit.

Outputs are synchronized to UTC time only when the SYN LED is fully illuminated.

Table 1, Table 2 and Table 3 below provide information regarding the interpretation of the LEDs.

SYN LED	Meaning
Off	The TTM 01-G has no power.
Slow Flash (1x flash per second)	The TTM 01-G is operating in the "holdover" state (holdover timer is running) or is operating in the "tuning" state (time server is gaining synchronization).
Fast Flash (5x flashes per second)	The TTM 01-G is not synchronized (out of sync and not in holdover).
On	The TTM 01-G is synchronized.

Table 1 - SYN LED Functionality

ALM LED	Meaning
Off	The TTM 01-G is operating normally and has no alarms.
Fast Flash (5x flashes per second)	At least one alarm is active. Refer to the alarm window in the Clock tab of the Configuration Tool to find the name of the active alarm(s). Refer to Table 3 below for the details on each alarm by name.

Table 2 - ALM LED Functionality

Alarm Name	Specification
Satellites Low	The number of satellites currently being used for time and position calculations is below the threshold.
No Sync	The TTM 01-G is not synchronised to any source, or holdover period has expired, or the timing output inaccuracy has been exceeded.
Holdover	The TTM 01-G has lost synchronization to any source and is now in holdover.
No Antenna	The antenna circuit current drain is low (typically under 3mA). This could be caused by poor connections, or if the connected antenna has a lower current drain specification or if a component in the antenna system is providing power to the antenna and therefore the TTM 01-G is not seeing a connected load, or if there is no antenna connected.
Antenna Short	The antenna circuit current drain is high (typically over 100 mA). This is caused by a short in the antenna circuit, or by moisture ingress in the circuit, or if the antenna connected has a higher current drain specification.
Antenna Fault	This alarm is generated if there is high current or low current detected on the antenna input.
Factory Reset Armed	This alarm is generated if the Forgotten Password Reset (Factory Reset Process) is enabled and has been initiated by the user.

ADMIN/ETH1 Address Fault	This alarm comes up when the DHCP server is unavailable or when the IP address is assigned to some other node in the network and cannot be assigned to the TTM 01-G Ethernet port. Under such situations the Ethernet port defaults to a link local address.
Sync Forced	This alarm is generated when the “Never leave Sync (Test Mode)” option has been selected.

Table 3 - Alarm Specification

3 Inputs and Outputs

ANT: Antenna Port (SMA connector)

The “ANT” antenna input provides an interface for an external active antenna. The antenna should be connected using a high quality, low loss 50 Ω low loss coaxial cable. The centre conductor can supply 5 Vdc (100 mA max.) to power an active antenna. The antenna voltage will automatically fold back to limit the output current under fault condition.

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! Ensure the antenna SMA male connector center pin is straight before plugging in.

Antenna Cable Considerations

The TTM 01-G antenna port expects a signal with a gain of at least 15 dB, and no more than 35 dB, with 20 – 35 dB being the optimal gain range.

All antenna cables will introduce some signal loss in the antenna installation system, which will be dependent on cable length. The total gain of the antenna installation should fall within the ranges specified below. The total gain is calculated by the gain of the antenna (Tekron supplied antenna provides 40 dB gain) minus the antenna cable loss.

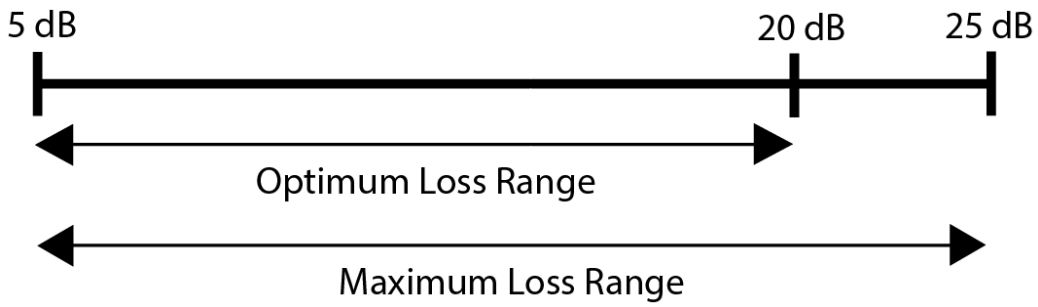

Figure 2 - Recommended antenna cable loss range

Note: The above figures are based on an average GNSS signal strength of -130 dBm at sea level and assumes that the Tekron supplied antenna is used.

CNT-240	32.8 dB/100 m (10dB/100ft). Plus 1 dB/connector
	Approximate optimum length range: 15m to 60m (50 ft – 197 ft)
	Approximate maximum length range: 15m to 76m (50 ft – 250 ft)
CNT-400	16.73 dB/100 m. Plus 1 dB/connector
	Approximate optimum length range: 30m to 120 m (99 ft – 394 ft)
	Approximate maximum length range: 30m to 150m (99 ft – 493 ft)

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. The introduction of the lightning protector introduces an additional loss of 0.1 dB and the loss of two connectors.

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 by hand only. DO NOT OVER-TIGHTEN!

ETH: Ethernet Interface (ST Fiber / RJ-45)

TTM 01-G units are fitted with either an RJ-45 10/100 Mbps Ethernet interface or an ST multi-mode Fiber 100BASE-FX Ethernet interface. The unit can be configured over the LAN (Local Area Network) and can be loaded with PTP or NTP / SNTP Licenses.

To the left of the Ethernet connector are two LEDs: The "**LNK**" LED (above) and the yellow "**ACT**" LED (below). The LNK LED will be on when the unit is connected to a valid Ethernet port whilst the ACT LED will be on when there is activity on either the transmit or receive pair on the Ethernet port.

TX: Fiber Output

This port transmits an IRIG-B (B00x or B22x), programmable pulse or DCF77 signal over fiber, that may be configured to output in either inverted or non-inverted polarity. The fiber transmitter is compatible with 50/125 µm, 62.5/125 µm and 100/140 µm multimode glass fiber.

TTL: TTL Output

The TTL output is a high drive, non-isolated TTL level driver which can be configured using Tekron's Configuration Tool. This port transmits an IRIG-B (B00x or B22x), programmable pulse, or DCF77 signal using 0 – 5 Vdc TTL level on pins "+" and "-" of the screw terminal connector. The default output is an un-modulated IRIG-B signal (IRIG-B004 with C37.118.1 extensions). It can be used as the master source signal to drive one or many slave devices. The IRIG-B timing pulses (both leading and trailing edges) from this port is typically to within 100 ns of UTC.

This port is a programmable TTL level output that may be configured to output in either inverted or non-inverted polarity:

- A configurable number of pulses per second, minute, hour, day with adjustable pulse-width and offset.
- IRIG-B time code (Un-modulated DCLS or Modified Manchester) with option C37.118.1 or AFNOR extensions.
- Simulated DCF77 receiver time code.

ALM: Alarm Output

The alarm output is a type “A” (normally open) dry contact type. Additionally, it is a high voltage isolated contact capable of switching up to 300 V at 100 mA.

Note: The “Normally-Open” (NO) descriptor refers to the de-energized state of the relay.

The TTM 01-G operates with the alarm relays energized during normal operation, and de-energized in the alarm state. It follows that, in the event of all power to the TTM 01-G being lost, the alarm relay defaults to the “alarm” state (open contact). The “+” and “-” symbols are included for reference purposes only, as the alarm contacts are not polarized.

The “ALM” output is a synchronization fail alarm. This alarm is active (contact open) when the unit is not synchronized and is not in the holdover state.

OPT: Optional Output

The TTM 01-G has a slot for one I/O card, to allow a variety of user interfaces. Each card is limited to one additional port with at least 3 kV isolation from the rest of the system to avoid current loops. Refer to Table 5 for the list of orderable options.

4 Software

Configuration Tool

The TTM 01-G can be configured via Ethernet. The configuration tool can be downloaded from the Tekron Support website: www.support.tekon.com. By default, the unit is shipped with DHCP enabled for automatic IP address assignment, with a fall back to link local addressing (169.254.xxx.xxx) if no DHCP server is present.

Default Username: admin

Default Password: Password

Note:
The user is required to change the default password on first login.

5 Installation

Identification

Each TTM 01-G unit is shipped with an identification label on the side of the case. The label provides details of the optional output (if any), the power supply fitted to the unit, and the unit's serial number.

Check the identification label on the side of the unit to ensure that the correct order code and voltage range has been supplied before proceeding with the installation.

The label on the side of the TTM 01-G contains the voltage range: Do not apply power outside of this range!

Location

WARNING

The unit is intended for installation in restricted access areas. A restricted access area can be accessed only using a lock and key or other means of security. Installation is to be done by suitably qualified personnel.

Power Supply

DC power should be applied to the '+' and '-' screw clamp terminals above the "PWR" input. The DC polarity is not critical. As shown in Figure 3, the input voltage range can be found on the side of the unit, above the power input screw clamp terminals.

***Note**: The Power supply has polarity protection built in to prevent damage.*

The input voltage range is marked on the product label on the side of the unit, and on a label above the "+' and '-" screw clamp terminals on the power input. Do not apply voltage outside the range noted.

The label on the side of TTM 01-G indicates the type of output Option Card fitted: Do not apply voltages to output only interfaces!

Figure 3 - Power supply voltage input label above PWR screw clamps

Hazardous Voltage

Figure 4 - PWR and ALM screw clamp terminals

Up to 300 V may be present at the power input port “PWR”. Up to 275 V may be present at the alarm relay port “ALM” (in Figure 4). These voltages are supplied to the unit only, and not generated by the unit. However, the installer must exercise care in wiring the screw clamps to ensure bare copper is not accessible.

Earthing

The GND connection is located next to the power supply input terminals (highlighted in Figure 5). This must be connected to earth for full protection of the TTM 01-G.

Figure 5 - GND screw clamp

The unit must be safety earthed whenever it is powered on, using the earth terminal as pictured in Figure 5. The cable cross section must be equal to or greater than 0.2 mm^2 (30 AWG).

Mounting the TTM 01-G

The TTM 01-G is designed to be mounted to a standard 'Top Hat' din rail mount using the supplied clips on the base (see Figure 6). The clips can also be used to screw mount the unit by extending them beyond the case edge.

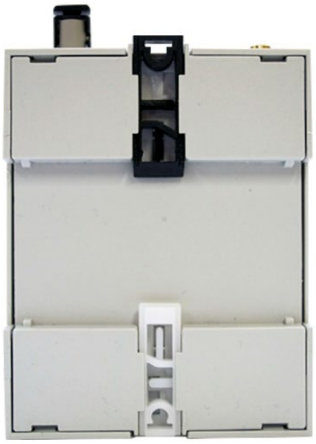

Figure 6 - Base of TTM 01-G

Connecting the TTM 01-G

The TTM 01-G has an SMA connector, RJ-45 / 100Base FX connector and ST Fiber output on the top, and a row of rising clamp screw terminals on the bottom. Any connection not required may be left unterminated. The screw terminals are designed for the following cables:

• 0.2 - 4.0mm² (30 – 12 AWG) solid cable

• 0.2 - 2.5mm² (30 - 14 AWG) stranded cable

The SMA **(ANT)** connector should be connected to the antenna lead-in cable. Care should be used to ensure that the cable bend radius is kept within the cable specification and the SMA connector is not placed under strain.

The Fiber TTM 01-G can be connected to an ST multimode Fiber cable for Ethernet and is labeled **ETH** on the case whereas the IRIG-B fiber out is simply labeled **TX**.

The connections from left to right along the bottom are:

- Optional output (**OPT**) '-' and '+'
- Alarm (**ALM**) '-' and '+'
- TTL '-' and '+'
- Ground
- Power Supply Negative
- Power Supply Positive

If the optional output isn't fitted, then the unused terminals are covered.

Figure 7 – TTM 01-G Top Connectors (left) and Bottom Connectors (right)

6 Factory Reset

The TTM 01-G features the ability to reset to factory default settings in the event that the administrator password is forgotten, or if the time server is rendered unreachable on the network due to incorrect settings, provided that physical access to the unit is available.

This feature is disabled by default in order to maximize security and must be enabled via the Tekron Configuration Tool before it can be used. When disabled, there is no method to gain full access to the unit without the administrator password, and if the administrator password is forgotten, the unit must be returned to Tekron for reprogramming at the customer's expense.

This feature may be permanently disabled by Tekron on request.

For further details on this feature, see the Configuration Tool Manual, which can be downloaded from the Tekron website at support.tekron.com

7 Factory Hardware Options

Power Supply Options

There are three different power supply options available for the TTM 01-G, detailed in Table 4. Low, medium, or high voltage power supplies are available and feature similar maximum output ratings but different levels of isolation.

Power Supply	Input Voltage Ratings	Maximum Power Rating	Isolation
Low	14 – 36 Vdc.	4 W	1.6 kV
Medium	20 – 75 Vdc.	4 W	1.6 kV
High	90 – 300 Vdc.	4 W	3.75 kV

Table 4 - TTM 01-G Orderable Power Supply Modules

Optional Output Cards

The TTM 01-G has a slot for one I/O card, to allow a variety of user interfaces. Each card is limited to one additional port with at least 3 kV isolation from the rest of the system to avoid current loops.

Table 5 below shows the orderable options:

Output Type	Features
None	No optional output. These screw clamps will be blanked off on units that have no optional output.
TTL	TTL (5 V, 150 mA) IRIG-B (B00x, B22x), DCF77 or user defined pulse output.
Serial	RS232 level (9 V, 10 mA) output supporting serial strings.
AM IRIG-B	Amplitude Modulated (AM) IRIG-B (B12x) signal, typically 8 V with 3:1 mark space ratio. Output Impedance 120 Ω. Requires a 100 – 180 Ω terminator.

Table 5 - TTM 01-G Orderable Interface Modules

8 Isolation and Protection

The GNSS Antenna input is earth referenced. Care should be used when installing to prevent earth currents circulating in the antenna cable. The TTL output features an earthed, non-isolated driver and is designed for connection within the same rack. Since it is the only output with an earth reference, it is isolated from the power supply via the power supply isolation, and from all other I/O by their isolation. All the other outputs are galvanically isolated (including the optional TTL output card) from the internal electronics and power supply.

The Alarm port has a UL and VDE approved 3.75 kV isolated contact and is protected by a 600 V, 175 mA self-resetting fuse and a 350 V transient suppressor diode.

The copper Ethernet port provides 1.5 kV isolation and includes Electro-Static Discharge (ESD) suppression on board.

All optional output cards feature at least 3 kV isolation from earth and have ESD suppression suitable for the interface type.

The power supply isolation varies from 1.6 kV for low and medium voltage power supplies to 3 kV for the high voltage power supply. In addition, isolation protects the internal electronics from longitudinal transient voltages and transient suppression devices protect from transverse transient voltages.

9 Lightning Protection

A lightning protection kit should be fitted into the antenna lead-in cable if lightning strikes are a risk in the location of installation. The Tekron supplied antenna kit can be ordered with a lightning arrestor, two coaxial cable connectors, a connector crimp tool, and mounting hardware.

General

The first line of protection against the effects of lightning-induced surge events involves positioning the antenna in a "lightning-protected zone" as far as is possible. In practice, this means ensuring that there is at least one other earth-bonded structure located in the same rooftop area (e.g., another antenna, or a lightning rod) that reaches significantly higher than the top of the GNSS antenna. The GNSS antenna should then be mounted so that it lies within a 45-degree angle from the top of the other earth-bonded structure. The GNSS antenna mount itself should also be securely bonded directly to the building protection earth – and *not* connected via any of the other earthed structures.

However, this will *not* provide immunity from damage caused by a direct lightning strike, or voltages induced in the antenna lead-in cable due to side flashes or induction.

All Tekron antenna installations should follow the guidelines above – regardless of whether a separate lightning protection device is to be fitted to the antenna lead-in cable.

In areas with a low incidence of electrical storms, careful attention to antenna positioning and earth connections may be all the protection deemed necessary. The antenna lightning protection kit provides additional security through the use of an impulse suppressor installed in the antenna lead-in coax cable. In the event of a lightning-derived high voltage surge occurring on the coaxial cable, the impulse suppressor activates, short-circuiting the cable directly to the protection ground.

While the Lightning Protector kit provides a high degree of protection, there is no guarantee of protection against ALL surge related events, including a direct lightning strike to the antenna. Careful antenna positioning is strongly advised!

The performance of the antenna system under normal (non-surge) conditions is unaffected by the introduction of a correctly installed Lightning Protector.

10 Appendix

TTM 01-G Specifications

Physical Specifications				
UL94-V0 polycarbonate flame retardant DIN rail enclosure with IP40 (Ingress Protection rating).				
Dimensions	Width	72 mm		
	Depth	60 mm		
	Height	90 mm		
Weight		0.15 kg		
GNSS Receiver				
L1/GLONASS (1575.42 / 1598-1606 MHz) Frequency. 32 Channel, parallel-tracking receiver				
Position Accuracy	Horizontal	<9 m (90%)		
	Altitude	<18 m (90%)		
Timing Accuracy		<15 ns (1 sigma) to UTC		
Sensitivity	Acquisition	-148 dBm		
	Tracking	-160 dBm		
Antenna output voltage		5 V		
Antenna output current		100 mA (max.)		
Input and Output Specifications				
TTL		5 V (4.5 V at 150 mA)	2 Pin	< 100 ns to UTC
Fiber (λ = 820 nm)[1]		-19 dB optical power	ST	< 100 ns to UTC
Alarm		275 Vac / 275 Vdc, 100 mA	2 Pin	
Ethernet (Copper)			RJ45	
Ethernet (Fiber)[2]		TX: -17 dB optical power RX: -33 dB sensitivity	Dual ST, ½ inch pitch	
Optional Output Specifications				
TTL		5 V (4.5 V at 150 mA)	2 Pin	< 100 ns to UTC
Serial		± 9 V	2 Pin	< 1 ms to UTC
AM IRIG-B		8 V	2 Pin	< 2 µs to UTC
Environmental Specifications				
Operating Temperature Range		-10 to 65 °C		
Electrical Specifications				
Power Supply	Low Voltage	14 - 36 Vdc	2 Pin + common earth	
	Medium Voltage	20 - 75 Vdc	2 Pin + common earth	
	High Voltage	90 - 300 Vdc	2 Pin + common earth	
Power drain		4 W max		

[1] Fiber transmitter is compatible with 50/125 µm, 62.5/125 µm and 100/140 µm multimode glass fiber.

[2] Fiber Ethernet is compatible with 50/125 µm and 62.5/125 µm multimode glass fiber.

11 Serial Output String (Serial Output Option)

General Key to Fields

Fields between brackets ('<' and '>') represent ASCII character codes. The used codes are in Table 6 below:

Placeholder	HEX	Content
<SOH>	01	ASCII Start of Header character
<STX>	02	ASCII Start of Text character
<ETX>	03	ASCII End of Text character
<BEL>	07	ASCII BEL character
<LF>	0A	ASCII Line Feed character
<CR>	0D	ASCII Carriage Return character
<SPACE>	20	ASCII Space character

Table 6 - ASCII character codes

NGTS Time Code O/P

The NGTS time code is normally used in conjunction with a 10 ms pulse that finishes precisely on the second. Timing Transmitted once per minute. Sent during the last second before the minute rollover to which the data in the string refers. Table 7 details the NGTS serial string format and fields.

Timing	Transmitted once per minute. Sent during the last second before the minute rollover to which the data in the string refers.
Default Comms	9600 bps, 8-bit ASCII, no parity
Definition	TyyMMDDWhhmmx<CR><LF>
Placeholder	**Content**
T	"T"
yy	Last two digits of the year: e.g., "21" = the year 2021
MM	Month: "00" = January … "12" = December
DD	Day of Month: 01…31
W	Day of week: "1"= Monday … "7"= 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

Table 7 - NGTS String Time Code Format Fields

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

IRIG J-17 Time Code O/P

Table 8 details the IRIG-J17 serial string format and fields.

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

Table 8 - IRIG-J17 String Time Code Format Fields

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

String-A Time Code O/P

Table 9 details the String A serial string format and fields.

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.
Default Comms	9600 bps, 8-bit ASCII, no parity
Definition	<SOH>ddd:hh:mm:ss:yy<CR><LF>
Placeholder	**Content**
<SOH>	Start Of Header: HEX 01
ddd	Day of Year: range “001” – “366”
:	HEX 3A
hh	hour: “00” – ”23”
:	HEX 3A
mm	minute: “00” – “59”
:	HEX 3A
ss	seconds: “00” – “59”
:	HEX 3A
yy	year: “00” – “99” representing the last two digits of the year since 2000
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A

Table 9 - String A Time Code Format Fields

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

Table 10 details the String B serial string format and fields.

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.
Default Comms	9600 bps, 8-bit ASCII, no parity
Definition	<SOH>ddd:hh:mm:ssQ<CR><LF>
Placeholder	**Content**
<SOH>	Start Of Header: HEX 01
ddd	Day of Year: range “001” – “366”
:	HEX 3A
hh	hour: “00” – ”23”
:	HEX 3A
mm	minute: “00” – “59”
:	HEX 3A
ss	seconds: “00” – “59”
Q	“Quality” Character (detailed in Table 11)
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A

Table 10 - String B Time Code Format Fields

“Quality” Character (Q)		Content
HEX	**ASCII**	
20	‘ ’ (space)	Clock is synchronized, 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

Table 11 - String B Quality Character 'Q' Indicators

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

Table 12 details the String C serial string format and fields.

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.
Default Comms	9600 bps, 8-bit ASCII, no parity
Definition	<CR><LF>Q<SPACE>yy<SPACE>ddd<SPACE>hh:mm:ss.000<SPACE><SPACE><SPACE>
Placeholder	**Content**
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A
Q	Quality indicator: ‘ ‘ = in-sync, ‘?’ = out-of-sync
<SPACE>	HEX 20 (space)
yy	Year: “00” – “99” representing the last two digits of the year
<SPACE>	HEX 20 (space)
ddd	Day of year: range “001” – “366”
<SPACE>	HEX 20 (space)
hh	hour: “00” – ”23”
:	HEX 3A
mm	minute: “00” – “59”
:	HEX 3A
ss	seconds: “00” – “59”
.000	ASCII “.000”
<SPACE>	HEX 20 (space)
<SPACE>	HEX 20 (space)
<SPACE>	HEX 20 (space)

Table 12 - String C Time Code Format Fields

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 (in Table 10), 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

Table 13 details the String E serial string format and fields.

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.
Default Comms	9600 bps, 8-bit ASCII, no parity
Definition	<SOH>YYYY:ddd:hh:mm:ssQ<CR><LF>
Placeholder	**Content**
YYYY	4-digit current year
:	HEX 3A
ddd	Day of year: range “001” – “365”
:	HEX 3A
hh	hour: “00” – ”23”
:	HEX 3A
mm	minute: “00” – “59”
:	HEX 3A
ss	seconds: “00” – “59”
Q	Quality character, as defined in String B (refer to Table 11)
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A

Table 13 - String-E Time Code Format Fields

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

Table 14 details the String F serial string format and fields.

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.
Default 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**
<BEL>	HEX 07
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A
1100	ASCII “1100”
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A
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”
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A
45	ASCII “45” (means UTC time follows)
HH	UTC hour: “00” – ”23”
MM	UTC minute: “00” – “59”
ss	UTC seconds: “00” – “59”
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A
55	ASCII “55” (means UTC Day of year follows)
DDD	UTC Day of year: “001” – “365”
<CR>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A
<BEL>	HEX 07

Table 14 - String-F Time Code Format Fields

Example:

<CR><LF>1100<CR><LF>44132530<CR><LF>54138<CR><LF><CR><LF>45012530<CR><LF>55138<CR><LF><BEL>

Interpretation:

Local time: 1:25:30pm, day 138.

UTC time: 1:25:30am, day 138.

String-G Time Code O/P

Table 15 details the String G serial string format and fields.

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.
Default Comms	9600 bps, 8-bit ASCII, no parity
Definition	<STX>swhhmmssDDMMyy<LF><CR> <ETX>
Placeholder	**Content**
<STX>	Start of Text: HEX 02
S	Clock Status (refer to Table 16)
W	Day of Week (refer to Table 17)
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>	Line Feed: HEX 0A
<CR>	Carriage Return: HEX 0D
<ETX>	End of Text: HEX 03

Table 15 - String-G Time Code Format Fields

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)

Table 16 - String-G Clock Status Indicators

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

Table 17 - String-G Day of Week Indicators

Example: Interpretation:

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

NMEA ZDA Time Code O/P

Table 19 details the NMEA ZDA serial string format and fields.

About	This string is defined by the NMEA-0183 standard and transmitted at 9600 bps.
Timing	Transmission is once every second. The leading edge of the “start” bit of the “$” is exactly on the second.
Default 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)
hh	UTC hour of day: “00” – “23”
mm	UTC minute of day: “00” – “60”
ss	UTC seconds: “00” – “59”
.00	ASCII “.00”
,	ASCII “,” (comma)
dd	UTC day of month: “01” – “31” depending on which month
,	ASCII “,” (comma)
MM	UTC month: “01” – “12”, “01” = January
,	ASCII “,” (comma)
YYYY	UTC year, 4 digits.
,	ASCII “,” (comma)
s	Local time zone offset sign (positive means local time leads UTC)
,	ASCII “,” (comma)
xx	Local time zone offset from UTC in hours
,	ASCII “,” (comma)
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>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A

Table 18 - NMEA-ZDA Time Code Format Fields

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

Table 20 details the NMEA ZDA serial string format and fields.

About	This string is defined by the NMEA-0183 standard and transmitted at 9600 bps.
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)
hh	UTC hour of day: “00” – “23”
mm	UTC minute of day: “00” – “60”
ss	UTC seconds: “00” – “59”
.00	ASCII “.00”
,	ASCII “,” (comma)
a	Status: “A” = valid, “V” = invalid
,	ASCII “,” (comma)
tttt.tttt	Latitude (degrees, minutes): “00” – “89” degrees; “00.0000” – “59.9999” minutes
,	ASCII “,” (comma)
N	Latitude (north/south): “N” = north, “S” = south
,	ASCII “,” (comma)
ggggg,gggg	Longitude (degrees, minutes): “000” – “180” degrees; “00.0000” – “59.9999” minutes
,	ASCII “,” (comma)
W	Longitude (east/west): “E” = east, “W” = west
,	ASCII “,” (comma)
0.0	ASCII “0.0”
,	ASCII “,” (comma)
0.0	ASCII “0.0”
,	ASCII “,” (comma)
dd	UTC day of month
mm	UTC month
yy	2-digit UTC year
,	ASCII “,” (comma)
0.0	ASCII “0.0”
,	ASCII “,” (comma)
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>	Carriage Return: HEX 0D
<LF>	Line Feed: HEX 0A

Table 19 - NMEA-RMC Time Code Format Fields

Example:

$GPRMC,102520.00,A,8530.1383,N,12847.8675,E,0.0,0.0,230223,0.0,E*01<CR><LF >

Interpretation:

UTC Time: 10:25:20. valid. Latitude: 85°, 39.1383 minutes, North. Longitude: 128°, 47.8675 minutes, East. Date: 23rd of February 2023.

12 Warranty

For terms and conditions of Tekron's Warranty see the website

http://tekron.com/about-tekron/warranty

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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