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TW5343
Integrated GPS/ GLONASS Receiver/Antenna User Manual

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1 Introduction

The TW5382 is a multi-band, multi-constellation integrated GNSS receiver and precision timing reference antenna. The TW5382 is capable of providing nanosecond-level timing accuracy to support the most demanding infrastructure and timing applications.

The TW5382 incorporates a latest generation multi-band (L1/ L2) GNSS receiver with a Tallysman Accutenna™ multi-band (L1/L2) dual feed patch. The dual feed Accutenna element maintains circular polarization over a broad operating frequency range offering superior rejection of destructive multi-path signal interference.

The TW5382 RF signal chain employs precise Pre and Post LNA signal filtering offering low noise figure with strong rejection of proximity out-of-band jamming signals.

The TW5382 GNSS receiver/antenna employs a state of the art 184-channel receiver offering concurrent tracking of four GNSS constellations (GPS, Galileo, GLONASS and BeiDou) in two separate frequency bands (L1/L2). The multi-band (L1/L2) architecture is the most effective method for the removal of ionospheric error.

The concurrent multi-band (L1/L2) access to all four satellite constellations improves the receiver's capability to deliver a precise and reliable solution which is unaffected by ionospheric errors, and provides resilience to jamming.

Colocation of the antenna receiver offers superior C/No performance with precise replication of the RF path. Eliminate the requirement for the system architect to capture RF signal propagation delay and employ expensive RF cabling.

The TW5382 outputs standard NMEA 0183 output with navigation updates rates up to 20 Hz supported. Active NMEA output messages are configurable.

The TW5382 supports an input voltage range of 5V to 36V.The TW5382 employs RS485/RS422 half-duplex signaling for both TX, RX and 1PPS. Receiver timing may be synchronized to UTC or a selected constellation reference.

Figure 1 TW5382

The TW5382 is housed in an industrial grade weatherproof IP69K enclosure for 19mm diameter (¾”) thru-hole mount or mast mount installations. For timing applications, the standard configuration is a conical radome, however the option is available to request a low profile radome.

2 Ordering Information

Part Numbering:
33-5343-x-yy-zzzz GPS/GLONASS /QZSS Timing Smart Antenna

33-0095-0 TW5343 SDK Test Adaptor

Where
x= interface/voltage
(8 = RS422 12V to 36V)
yy= Radome
(00= grey conical, 10=grey low profile, 01=white conical, 11=white low profile)
zzzz= cable length in mm
Standard is 5m, (15m and 20m special order only).

3 GNSS Systems

Tallysman TW5343 family of GNSS Receiver/Antennas are multi-GNSS receivers that receive and track GPS, and GLONASS, signals simultaneously.

3.1 GPS

The US Global Position System (GPS) uses L1C/A signals at 1575.42 MHz to determine position.

3.2 GLONASS

The Russian GLONASS satellite system is an alternative system to the US-based Global Positioning System (GPS).

4 NMEA Packet Format

The TW5343 serial interface is based on the NMEA-0183 protocol standard.
The NMEA -0183 protocol starts with a “$” character followed by a NMEA Talker ID.

“GP” indicates Talker ID for the GPS constellation

“GL” indicates Talker ID the GLONASS constellation

“GN” indicates Talker ID for all constellations

5 Software Utilities

5.1 Open Source GPS Software Utilities

The following open source GPS utility can be used to display the GPS and GLONASS GGA and GSV messages with Talker ID's GP and GL.

http://www.visualgps.net/VisualGPSView/

Note: "GN" Talker ID's are not currently supported by this application.

This VisualGPS application can log data which can subsequently be imported into the following data conversion application for easy display tracking data on Goggle maps:

http://www.gpsbabel.org/

6 Hardware Interface

The TW5343 is provided with a 5 m cable terminated in a RJ45 connector.

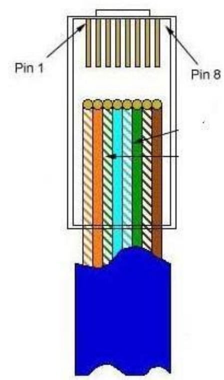

Figure 2

Wire Color	Signal	Comments	Pin #
Brown	Power	12V to 36V	8
Brown/White	Ground	0V	7
Orange	Differential TX 422 output or D+	TX422_A (0 to 2.0V levels).	6
Blue/White	RX into the TW5343	RS232 level Min +/- 5.0V, Max +/-5.7V)	5
Blue	Wake up Input	Wake Up -input Low '"not supported on Rev 1_0 release"	4
Orange/White	Differential TX 422 output or D-	TX422_B (0 to 2.0V levels).	3
Green	Differential 1PPS output or D+	1PPS_A (0 to 2.0V levels).	2
Green/White	Differential 1PPS output or D- or Standby status	1PPS_B (0 to 2.0V levels).	1

Table 1

6.1 TW5343 Installation

For best results the TW5343 GPS Receiver/Antenna should installed with a clear view of the sky. The GPS Receiver/Antenna will obtain a 3D fix GPS fix with a minimum of 4 satellites.

7 Testing

Tallysman TW5343 SDK Test adaptor (part # 33-0095-0) connects to the RJ45 connector on the TW5433 and provides a COM port connection to a PC vis USB bridge for testing purposes.

7.1 Baud Rate

The default output from the TW5343 is 5 digit resolution GGA, GSV and Usage messages at 115,200 baud. See section 11 for message format information. Minimum recommended baud rate is 4800 baud.

7.2 NMEA Output test

Run the VisualGPS application (see section 5.1), select the NMEA tab to display message output.
Set COM Port: Select Tools/Connect to GPS

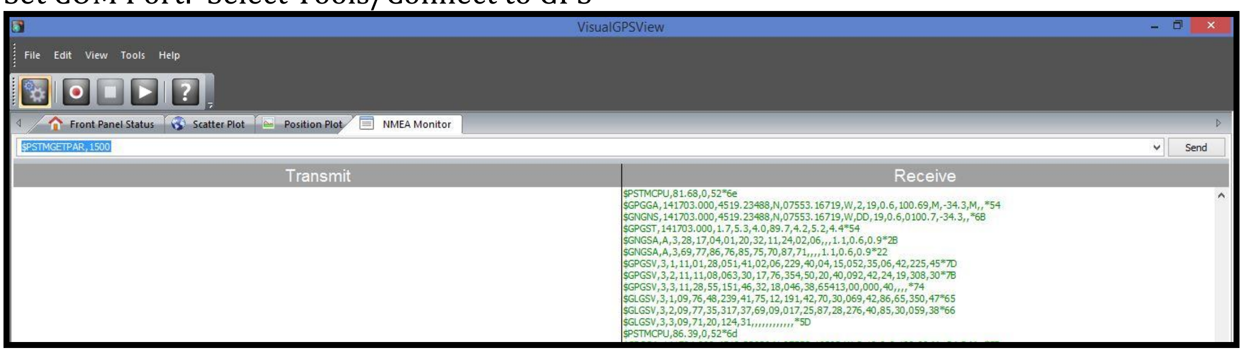

Figure 3

7.3 Satellite Output Test

To display GPS/GLONASS satellite outputs the TW5343 must be configured to output a GSV and GGA messages (default configuration). Run the VisualGPS application (see section 5.1), select the Front Panel Status tab to display:

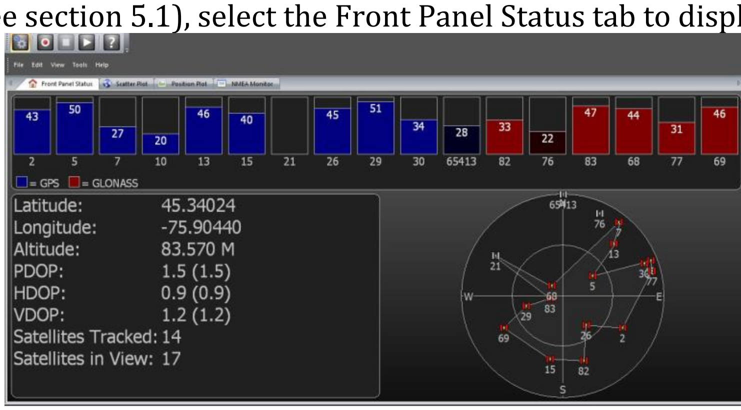

Figure 4

To read and write the TW5343 configuration parameters the same hardware test configuration is can be used while running the Tallysman Windows based Configurator application on the PC. See section 10 for configuration details.

The SBAS satellite is indicated by its NMEA ID and not the PRN #. For details see Table 3

7.4 Power

The TW5343 operates 12 to 36 volts. Overvoltage and transient protection is provided making it suitable for installation in the harshest of vehicle installations. On the RJ45 connector shown in Figure 2:

- Connect the BROWN wire on the TW5343 to Positive supply
- Connect the BROWN/WHITE wire on the TW5343 to Gnd

7.5 1PPS

The TW5343 provides a one (1) pulse-per second output signal for timing purposes. Differential 1PSS outputs are provided at RS422 levels.
The 1PPS signal can be synchronized to GPS or GLONASS reference times to an accuracy within 50 nanoseconds.

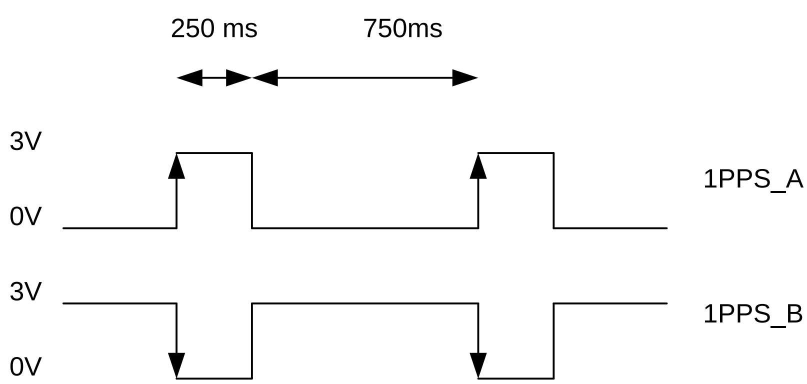

Figure 5

The default pulse width is 250 ms, and is configurable from 100 ms to 500 ms. Typical jitter is 20ns. Signal levels are differential, 0.V to 2.03V.
After obtaining a GPS fix, the 1PPS output will be accurately maintained even when tracking only one satellite. Once synchronized the 1PPS maintains synchronization accuracy with no GPS reception by fly-wheeling for a period.

The following examples are provided for termination of the 1PPS signals.

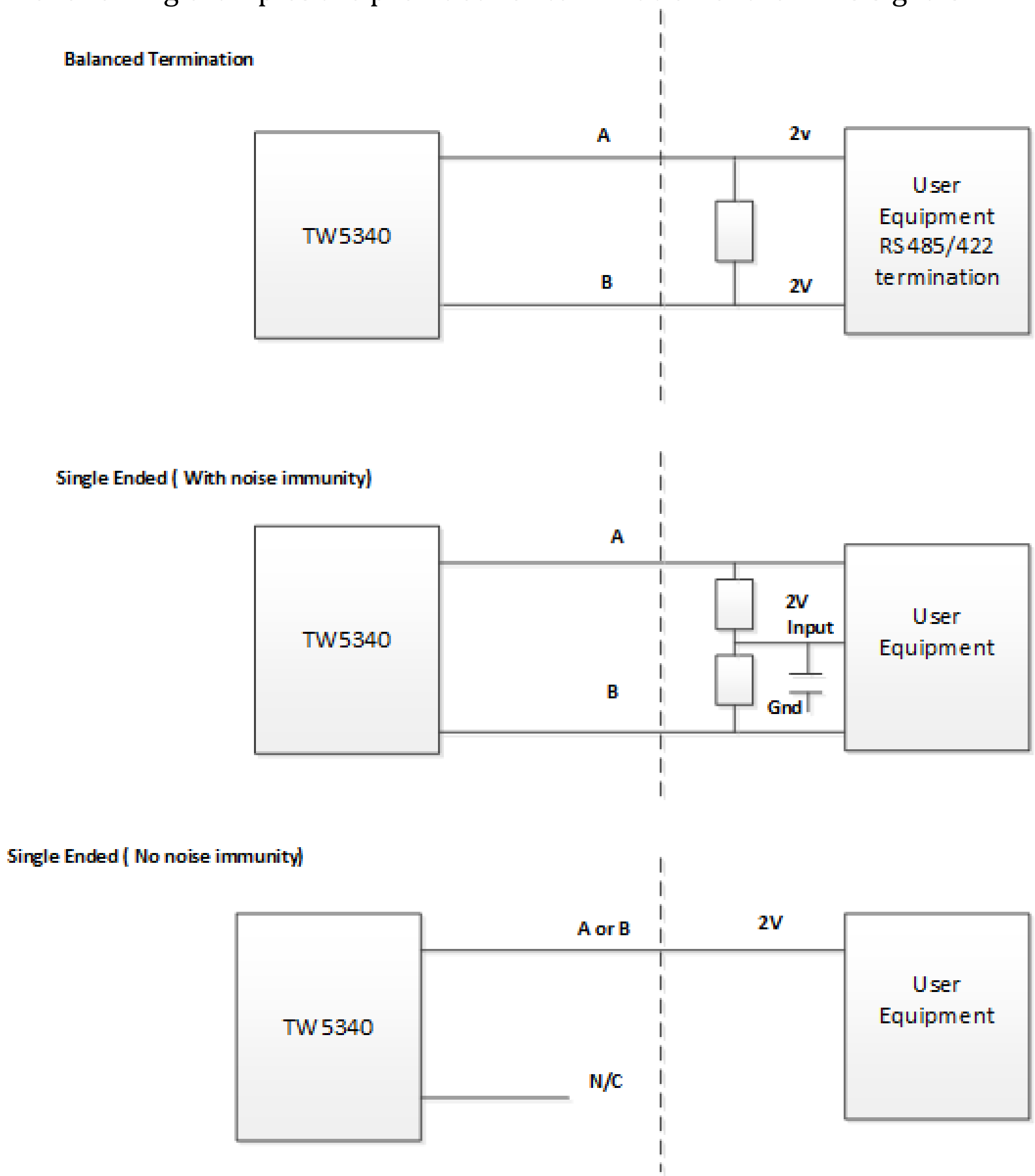

Figure 6

The balanced driver in the TW5343 is an Intersil 3179E. Please check the data sheet for additional information.

Note: 1 : To reduce jitter on the balanced line ensure that RS422 is the only selection, see section 10.1

Note 2: A alternative termination to the shunt resistors is to install 120 ohm resistors at the source end in series with the A & B outputs.

7.5.1.1 Cable Delays:

The timing of the 1PPS pulse depends on the length of both antenna and interface cables, to account for cable delays subtract 3 ns for each meter of cable (see 1PPS correction parameter)

7.6 Wake Up Input

The Wakeup input is pulled high by the TW5343. It must be left in this state to enter standby mode. When in standby, the wakeup input must be pulled to ground to cause the TW5343 to exit Standby mode and return to Navigation mode.

8 Operating Modes

The TW5343 has three operating modes:

8.1 Navigation Mode

The TW5343 uses the acquisition engine continually resulting in the shortest time to first fix. It searches all possible satellites until the almanac is completely downloaded, the receiver then switches to the tracking engine to lower power consumption.

8.2 Standby Mode

Standby mode stops the navigation operation, and all supply inputs are powered down and power drain is reduced. Standby mode is entered by External control (see below)
In Navigation mode the current consumption is approximately 70 mA, and in Standby mode is approximately 1 mA,

The Standby status output pin provides a positive feedback that the device has entered Standby mode. When Not In standby the output is pulled high, when in standby the output is floating.

External control
The TW5343 can enter Standby mode by issuing a “$PSTMGOTOSTANDBY” command.
$PSTMGOTOSTANDBY,1,<sleep time>,0,<sleep time>
<Sleep time> is the number of seconds to remain in standby mode. Note the two sleep times in the command must be identical.
The TW5343 can be woken from standby state by the wakeup pin.
Pin 3 on the TW5343 can be used to wake the device up. To exit Standby mode the Wake-Up pin must be pulsed low for approximately 1 ms by an open collector output.
Note: If the TW5343 is in Standby mode for greater 30 minutes the ephemeris data may old and have to be re-acquired before a GNSS position can be resolved resulting in a cold start of approximately 50 to 90 seconds.

As a rule of thumb the TW5343 should be on for 30 seconds every 30 minutes to guarantee a hot start of less than 10seconds.

Note: For applications that need to conserve power by waking up quickly from standby mode and getting a fix as quickly as possible it is recommended that both GPS & GLONASS constellations are enabled

8.2.1 **Initialize GPS time**

Acquisition of a position fix can be sped up by initializing the TW5433 with the GPS time. The following NMEA command can be used **$PSTMINITTIME**

$PSTMINITTIME,<Day>,<Month>,<Year>,<Hour>,<Minute>,<Second><cr><lf>

Parameter	Format	Description
Day	dd - decimal, 2 digits	Day of month (01 to 31)
Month	mm – decimal, 2 digits	Month (01 to 12)
Year	YYYY – decimal, 4 digits	Year (194 - ….)
Hour	HH – decimal, 2 digits	Hour (00 to 23)
Minute	MM _ decimal, 2 digits	Minute (00 to 59)
Second	SS – decimal, 2 digits	Second (00 to 59

Table 2

The following message will be output on the NMEA communications channel
$PSTMINITTIMEOK<cr><lf> If success
$PSTMINITTIMEERROR<cr><lf> If no success

9 Satellite Based Augmentation System (SBAS)

The TW5343 can be configured to use satellite corrections transmitted by SBAS satellites to provide greater positioning accuracy. There are three compatible SBAS systems which are integrated to provide a seamless worldwide navigation system. Configure the SBAS satellite ID closest to your Location.

Service	Satellite Name	NMEA	Satellite ID (PRN)	Location (longitude)
WAAS	Inmarsat 4-F3	46	133	98^0 W
WAAS	Galaxy 15	48	135	133^0 W
WAAS	Anik F1R	51	138	107.3^0 W
EGNOS	Inmarsat 3-F2	33	120	15.5^0 W
EGNOS	ASTRA-5B	36	123	31.5^0 E
EGNOS	Inmarsat 4-F2	39	126	25^0 E
MSAS	MTSAT-1R	42	129	140^0 E
MSAS	MTSAT-2	50	137	145^0 E
GAGAN	GSAT-8	40	127	55^0 E
GAGAN	GSAT-10	41	128	83^0 E

Table 3

The default satellite ID is 133 (Suitable for longitudes of those of the Eastern US). The TW5343 configurator supports the addition of two future SBAS satellite ID's.

Four SBAS are already operational (WAAS, MSAS, EGNOS, & GAGAN), two are under development (SDCM, SNAS) while others are under feasibility studies, as is the case of SACCSA.

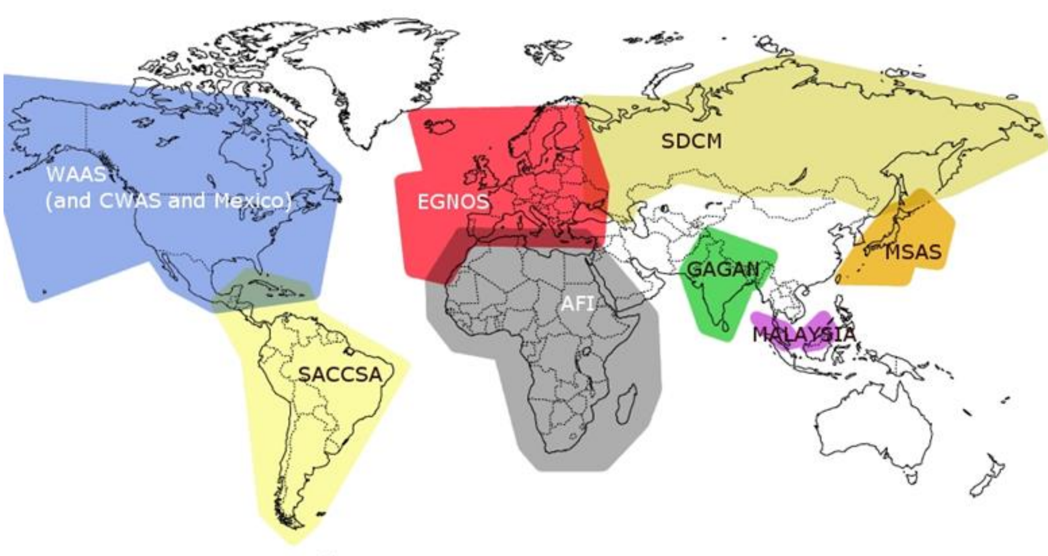

Figure 7

More information can be found by clicking on the following link:

http://www.navipedia.net/index.php/SBAS_Systems

An example of SBAS use in the GAGAN region (India).
To use this system the following configuration is required on the 'Constellation' tab.

Enable SBAS (WAAS) [x]
SBAS Auto-search [x]
SBAS PRN 127
SBAS-1 Parameter: PRN [x] 127
SBAS-1 Parameter: Longitude 55.0
SBAS-1 Parameter: Service GAGAN
SBAS-2 Parameter: PRN [x] 128
SBAS-2 Parameter: Longitude 83.0
SBAS-2 Parameter: Service GAGAN

10 TW5343 Configuration

Tallysman provides downloadable software package which includes a Windows based “Configurator” for reading and writing of operating parameters and a user manual.

Please request application download link:

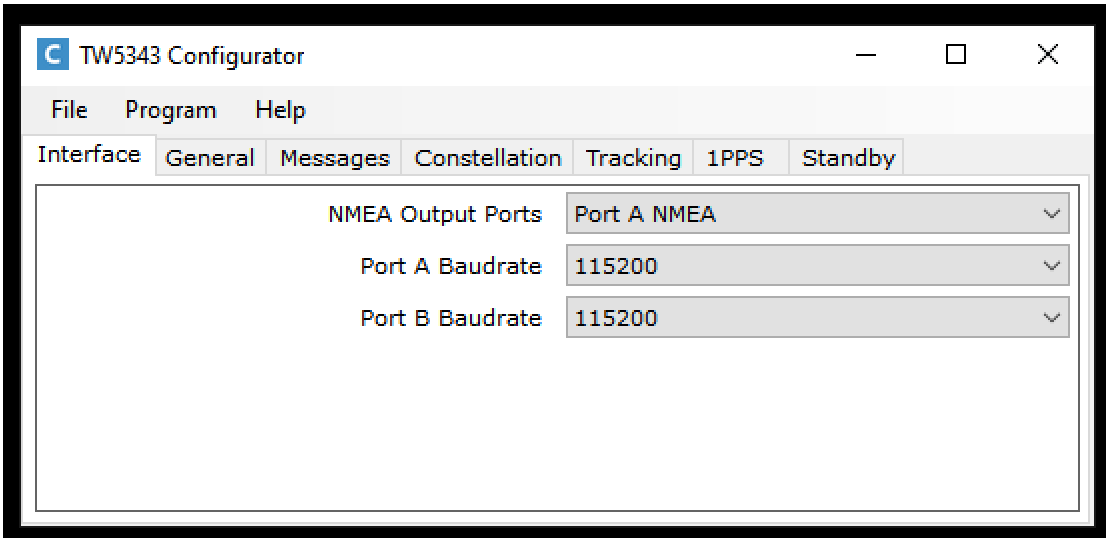

Figure 8

Connect the PC to the TW5343 using the SDK Test Adaptor (33-0095-0)
Set the TW5343 Configurator to the COM port speed of the TW5343 (115200 baud is default).

- Select **Program/Read** to read the parameters in the TW5343.
  (*Note: It is recommended that the default parameters are saved, so that you can always retrieve and Write them back if required).*
- To write a new set of parameters to the TW5343 select **Program/Write**
- The configuration file can be save by selecting **File/Save.**

Note: Most configuration parameter changes do not take effect until the TW5343 is reset i.e. power cycled.

The configurator provides configuration of the “general” parameters of the TW5343. Contact Tallysman Wireless to discuss specific parameters that may not be listed.

10.1 INTERFACE TAB

NMEA RS422 Baudrate: (default 115200)
Sets the operating baud rate of the TW5343 on the RS422 port. If the baud rate is changed and written to the TW5343 remember to change the Configurator baud rate to **match.**

10.2 GENERAL TAB

Enable watchdog:
Enable to set the internal watchdog. TW5343 resets when watchdog times out.

FIX Rate (sec): (default 1)
Defines the time in seconds between fixes. E.g., if a Message list output rate of 10 Hz is required, then the Fix Rate per second should be set to 0.1 sec, or (1 / 10 Hz). With a fix rate > 5 Hz, ensure that High Dynamics is enabled (See Tracking tab)
Text Message: (default is the current firmware revision)
The user modifiable text message which is output on reset.

CPU Clock Speed:
Sets the CPU clock rate to support the required fix rate.
The lower the speed, the less current draw. 52 MHz (Osc) provides the lowest operating power. Higher speeds (104 MHz minimum) will be required to support higher fix rates, accurate 1PPS timing, or reliable NMEA output time relative to a fix. The proprietary NMEA "Usage" message provides information on % of CPU usage, see section 11 for Usage message format.

10.3 MESSAGES TAB

SBAS Satellite on GSV Message:
The SBAS satellite information is output in a GSV message.

NMEA 3.01 Mode field on RMC, VTG, and GLL messages:
Setting this option will enable a "mode" field to be appended to the RMC, VTG and GLL sentences, as required by the NMEA 3.01 specification. (See the "mode indicator" in the GNGNS NMEA message, section 11.7 under GNGNS).

Start Up header message:
Outputs device information on reset, including version, model, ESN, and user text message.

Current Configuration message on startup:
Outputs the configuration parameters of the TW5343 on startup.

Use GNGSV in place of GLGSV or GPGSV:
The GSV message can be configured to be output with GN talker ID.

Use GNGSA in place of GLGSA or GPGSA:
The GSA message are be configured to be output with GN talker ID.

Decimal digits in GGA:
Sets the number of decimal digits in GGA output.

Decimal Digits in RMC and GLL
Sets the number of decimal digits in RMC and GLL output.

NMEA Talker ID: (Default is "P")
Assign a unique talker ID to these non-constellation message types. This NMEA talker ID relates to the following message types; RMC, GGA, VTG, GST, GLL, and ZDA.
Note: Constellation related messages are automatically assigned on selection of constellation type.

- *"GP" indicates the GPS constellation*
- *"GL" indicates the GLONASS constellation*
- *"GN" indicates satellites for all constellations*

Delay from Fix to Start of Output:
If the start of a NMEA out message is being used for timing purposes the "fix rate" should be set to 1 second and message list 3 used.
For >5Hz fix rate operation this parameter should be set to zero.

GLONASS satellite Format: (default ID is based on slot)
Selects satellite ID based on "frequency" or "slot" (as reported in almanac and ephemeris data).

10.3.1 NMEA MESSAGE LISTS

The TW5343 will output messages that are specified in two sets of 3 lists. Messages from each list will output at different rates.

Message List #1 rate:
Sets message list #1 output rate. The rate is specified as the number of fixes between message outputs. The fix rate interval is specified by the **FIX Rate** parameter found on the General Tab.

Message List #2 rate:
Sets message list #2 output rate.

There is No Message List 3 rate
Messages from list 3 are always output at the fix rate.

Figure 9

NMEA Message List 1
The basic output message list is shown in Figure 9. Additional outputs are available in expert mode, contact Tallysman for details.
Message list 1 is the standard message list. Use message list 1 if the NMEA multiple output rate feature is not required.
NMEA Message List 2
Use to output messages at a different rate. For example GSV and GSA can be output at a much lower rate than RMC or GGA.
NMEA Message List 3
Message list 3 is reserved for those messages which need to be sent at a high rate (10 Hz) and /or require accurate message output timing (low jitter). If high rate messages or low jitter messages are not required, this message list should not be used.
If you are outputting message list 3 at 10 Hz, message list 1 & 2 should be disabled. If additional lists outputs are required the output message rate of list 1 will need to be reduced e.g. if you configure message list 3 to output GGA at 8 Hz then message list 1 can be configure to output once per second (by setting the Message List 1 Rate to 8).
Note: When configuring additional NMEA lists, check that the baud rate is high enough to ensure there is enough time to output all messages.

10.3.2 10 Hz. Operation

For 10 Hz operation the following configuration settings are required:
[1] In the “Interface” tab: set:
    [a] the “NMEA Baudrate” to at least 115200.
    The next time the configurator is run be sure to set the “COM Port Baudrate” in the “Program” Menu “COM Port…” tab to the same value.
[2] In the “General” tab set:
    [a] “Fix Rate (sec)” option to “.1”
    [b] “CPU Clock Speed” option to “208 MHz (PLL)”
[3] In the “Message” tab set:
    [a] “Delay from Fix to Start of Output (ms)” option to 0
    [b] Uncheck all items from List #1 and List #2 (*)
    [c] Check just one item for List #3
    (*) If more NMEA sentence outputs are required, then set the “Message List #1 Rate” option to 10, so the selected sentences in List #1 are output at most once per second.

[4] If fix rate is > 5Hz.
    [a] In the “Tracking” tab check “High Dynamics”.
    This enables a higher DSP sample rate.

10.4 CONSTELLATIONS

Enable GPS Constellation and fix
Enables GPS constellation. (Note for GNS messages the talker ID is "GP" unless GLONASS is also selected, in which case, the talker ID will be "GN").
Enable GLONASS Constellation and Fix:
Enables GLONASS constellation. (Note for GNS messages the talker ID is "GL" unless GPS is also selected, in which case, the talker ID will be "GN").
Enable SBAS (WAAS):
When set and if data is currently received from an SBAS satellite, then the TW5343 includes the SBAS corrections in the calculated position.

SBAS Auto-Search: (default ON)
The TW5343 will automatically search for an appropriate satellite in view.
SBAS PRN
Set the SBAS satellite number to track.

SBAS -1 Parameter: PRN
Two additional SBAS satellites can be added to the SBAS search list. Enter PRN, Longitude, and Service for each SBAS satellite.

SBAS -1 Parameter: Longitude
See Table 3 column 5

SBAS -1 Parameter: Service
See Table 3, column 1

SBAS -2 Parameter: PRN
See Table 3 column 4.

SBAS -2 Parameter: Longitude
See Table 3 column 5

SBAS -2 Parameter: Service
See Table 3 column 1

10.5 TRACKING

2 D Fix: (default off)
Enables a two-dimensional GPS position fix that includes only horizontal coordinates (no GPS elevation). It requires a minimum of three visible satellites.

Walking mode: (default off)
The receiver engine uses different filters in walking mode i.e. does not include velocity in position calculations or accelerations that are not feasible by a pedestrian, and maintain accurate position in urban environments during lower operating speeds (0.5 to 3 m/sec) such as walking or even running.

Stop Detection: (default on)

This enables "pining" the position while stopped to minimize "wandering" such as in an automotive application at a stop light. It also has protection to prevent it from getting stuck in an undesirable mode when the user dynamics change.
This feature should be disabled when doing 'wander' testing or when walking mode is enabled.

High Dynamics: (default off**)**
The receiver engine uses different filters for high acceleration applications.
High dynamics increases the sample rate of the DSP and must be enabled when the fix rate is >5Hz.

Acquisition Mask Angle (degrees):
The elevation angle of a GNSS satellite below which data will be ignored when acquiring a fix. A lower mask angle may lead to faster acquisition.

Positioning Mask Angle:
The elevation angle of a GNSS satellite below which data will be ignored once a fix has been acquired. Once a fix has been acquired the mask angle can be increased so that only high satellites are tracked. By setting this parameter to a value less than the acquisition mask angle the satellite will always be used in a fix once it is acquired.
Having larger values helps reduce multipath errors.

Tracking Threshold (SNR):
This parameter sets the minimum C/N0 threshold to track a satellite. Any GNSS satellite, with C/N0 less than the threshold value is dropped and the engine searches for another satellite with a stronger signal level. Increasing the tracking threshold decreases the GNSS sensitivity, but helps prevent errors due to multipath. The value must be in the range 10 to 40. The default is 10.

Positioning Threshold (SNR):

A satellite must have a signal strength above this threshold to be included in a fix calculation. The default is 15, which helps reduce multi-path errors.

Default 2D DOPS
A low DOP value represents a better positional precision due to the wider angular separation between the satellites used to calculate a unit's position.

These are the maximum allowable values for calculating a 2D fix.

Default 3D DOPS:
These are the maximum allowable values for calculating a 3D fix.

Startup 2D DOPS
Set these values the same as the default 2D DOPS.

Startup 3D DOP:
Set these values the same as the default 3D DOPS.

10.6 1 PPS TAB

1PPS Enable:
1PPS is output when set.

Invert 1PPS Polarity:
The polarity of the 1PPS output is inverted.

1 PPS Hold Position:
The configured Hold Position is used in Timing application as the current position. The accuracy and integrity of the timing solution is highly dependent on the accuracy of the reference position. Position can be set and held but should be generated from a highly accurate survey grade receiver. If this is not available, the reference position may be determined automatically by position hold auto-survey command to self-survey over an extended period (at the very least, 1 hour). See # Auto survey samples below.

TRAIM Enable:
Enable/disable the TRAIM algorithm
Timing Receiver Autonomous Integrity Monitoring allows the receiver to remove satellites with timing errors in excess of a given timing threshold.

1PPS Clock (Mhz)
Set to 64 Mhz for highest accuracy

1PPS pulse Duration (ms):
Duration of 1 PPS pulse, the default configuration is 250ms.

1PPS Correction (Delay in ns):
This is a time correction to compensate for any 1PPS delays due to cable length or the RF chain.

Hold Position Latitude (degrees):
Sets the latitude for the position hold mode.

Hold Position Longitude (degrees):
Set the longitude of the position hold mode.

Hold Position Height (meters):
Set altitude for the position hold mode.

 # Auto-survey samples
When setting the reference 1 PPS hold position, the reference position may be determined automatically by position hold auto-survey command to self-survey

over an extended period (at the very least, 1 hour). Remember to scale this value by number of fixes per second.

1PPS Elevation Mask (degrees):
Sets the elevation mask angle of 1PPS.

1PPS Satellite Threshold (snr):
Fix quality evaluation only uses satellites above SNR threshold.

1PPS Fix condition:
GNSS fix condition for PPS generation.

NO FIX: PPS signal is present even in GNSS NO fix conditions.
2D FIX: the PPS is present if the GNSS is at least in 2D fix condition
3D FIX: the PPS is present only if the GNSS is in 3D fix conditions.

1PPS reference time:
Sets the 1PPS time reference.

1PPS Output:
1PPS output enabled base on selection.

1PPS Constellations:
This parameter enables the usage of mixed constellations in the 1pps timing filter. If "Use GPS…" is enabled GPS satellites are used to correct the GLONASS reference time together with GLONASS satellites. If "Use GLONASS…" is enabled, GLONASS satellites are used to correct the GPS reference time together with the GPS satellites. When constellation mask is zero (default) only GPS satellites are used to correct the GPS reference time and only GLONASS satellites are used to correct the GLONASS reference time.

10.7 STANDBY TAB

Enable Periodic Standby:
Enables the Standby mode low current consumption feature.

Sleep Time (seconds)
Sets the sleep time in seconds.

Fix Time (seconds)
Sets the navigation wake time to acquire a fix.
In order to refresh satellite ephemeris data the receiver should be configured to transitions to full power every 30 minutes and can remain awake for up to 3 minutes.

Maximum Awake Time (Fix count)
The maximum number of attempts to get a fix before resuming standby mode.

11 NMEA Message Reference

NMEA 0183 sentences are all ASCII. Each sentence begins with a dollar sign “$”. The first two letters following the “$” are the talker identifier. The next three characters are the sentence identifier, followed by a number of data fields separated by commas, followed by an optional checksum, and terminated by carriage return/line feed. The data fields are uniquely defined for each sentence type.

11.1 RMC

Recommended Minimum Navigation Information

Fields:

UTC Time
Status, V=Navigation receiver warning A=Valid
Latitude
N or S
Longitude
E or W
Speed over ground, knots
Track made good, degrees true
Date, ddmmyy
Magnetic Variation, degrees
E or W
FAA mode indicator (NMEA 2.3 and later)
Checksum

A status of V means the GPS has a valid fix that is below an internal quality threshold, e.g. because the dilution of precision is too high or an elevation mask test failed.

11.2 GGA

Global Positioning System Fix Data
Time, Position and fix related data for a GPS receiver.

Fields :

Universal Time Coordinated (UTC)
Latitude
Direction of latitude N or S (North or South)
Longitude
Direction of Longitude E or W (East or West)
GPS Quality Indicator,
0 - fix not available,
1 - GPS fix,
2 - Differential GPS fix (values above 2 are 2.3 features)
3 = PPS fix
4 = Real Time Kinematic
5 = Float RTK
6 = estimated (dead reckoning)
7 = Manual input mode
8 = Simulation mode
Number of satellites in view, 00 - 12
Horizontal Dilution of precision (meters)
Antenna Altitude above/below mean-sea-level (geoid) (in meters)
Units of antenna altitude, meters
Geoidal separation, the difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" means mean-sea-level below ellipsoid
Units of geoidal separation, meters
Age of differential GPS data, time in seconds since last SC104 type 1 or 9 update, null field when DGPS is not used
Differential reference station ID, 0000-1023
Checksum

11.3 GSA

GPS DOP and active satellites

Fields :

Selection mode: M=Manual, forced to operate in 2D or 3D, A=Automatic, 3D/2D
Mode (1 = no fix, 2 = 2D fix, 3 = 3D fix)
PRN number, 01 through 32 for GPS, 33 through 64 for SBAS, 64+ for GLONASS
  ID of 1st satellite used for fix
  ID of 2nd satellite used for fix
  ID of 3rd satellite used for fix
  ID of 4th satellite used for fix
  ID of 5th satellite used for fix
  ID of 6th satellite used for fix
  ID of 7th satellite used for fix
  ID of 8th satellite used for fix
  ID of 9th satellite used for fix
  ID of 10th satellite used for fix
  ID of 11th satellite used for fix
  ID of 12th satellite used for fix
PDOP
HDOP
VDOP
Checksum

11.4 GSV

GSV - Satellites in view

These sentences describe the sky position of a UPS satellite in view. Typically they’re shipped in a group of 2 or 3.

Fields:

Total number of GSV messages to be transmitted in this group
Origin number of this GSV message within current group
Total number of satellites in view (leading zeros sent)
Satellite PRN number (leading zeros sent)
Elevation in degrees (00-90) (leading zeros sent)
Azimuth in degrees to true north (000-359) (leading zeros sent)
SNR in dB (00-99) (leading zeros sent) more satellite info quadruples like 4-7 n) checksum

Example:

```
$GPGSV,3,1,11,03,03,111,00,04,15,270,00,06,01,010,00,13,06,292,00*74
$GPGSV,3,2,11,14,25,170,00,16,57,208,39,18,67,296,40,19,40,246,00*74
$GPGSV,3,3,11,22,42,067,42,24,14,311,43,27,05,244,00,,,,*4D
```

Some GPS receivers may emit more than 12 quadruples of {PRN,elevation,azimuth,SNR} in more than three GPGSV sentences, even though NMEA-0813 doesn’t allow this. The extras might provide for WAAS satellites, for example. Receivers may also report quadruples for satellites they aren’t tracking, in which case the SNR field will be null.

11.5 VTG

VTG - Track made good and Ground speed

Fields :

Track Degrees
T = True relative to true North
Track Degrees
M = Magnetic
Speed Knots
N = Knots
Speed Kilometers per Hour over ground
K = Kilometers per Hour
FAA mode indicator (NMEA 2.3 and later)
Checksum

11.6 GLL

Geographic Position - Latitude/Longitude
Fields :
Latitude
N or S (North or South)
Longitude
E or W (East or West)
Universal Time Coordinated (UTC)
Status A - Data Valid, V - Data Invalid
FAA mode indicator (NMEA 2.3 and later)
Checksum

11.7 GNGNS

Outputs GPS and Glonass information in the same message list
GNSS capable receivers will also output this message with the GP and/or GL talker ID when using more than one constellation for the position fix.
An example of the GNS message output from a GNSS capable receiver is:
$GNGNS,014035.00,4332.69262,S,17235.48549,E,RR,13,0.9,25.63,11.24,,*70<CR><LF>
$GPGNS,014035.00,,,,,,8,,,,1.0,23*76<CR><LF>
$GLGNS,014035.00,,,,,,5,,,,1.0,23*67<CR><LF>

Fields:

1 = Message ID $GNS
2 = UTC of position fix
3 = Latitude
4 = Direction of latitude, N: North, S: South
5 = Longitude
6 = Direction of longitude, E: East, W: West
7 = Mode indicator:

Variable character field with one character for each supported constellation.
First character is for GPS
Second character is for GLONASS
Subsequent characters will be added for new constellation
Each character will be one of the following:
N = No fix. Satellite system not used in position fix, or fix not valid
A = Autonomous. Satellite system used in non-differential mode in position fix
D = Differential (including all OmniSTAR services). Satellite system used in differential mode in position fix
P = Precise. Satellite system used in precision mode. Precision mode is defined as: no deliberate degradation (such as Selective Availability) and higher resolution code (P-code) is used to compute position fix
R = Real Time Kinematic. Satellite system used in RTK mode with fixed integers
F = Float RTK. Satellite system used in real time kinematic mode with floating integers
E = Estimated (dead reckoning) Mode
M = Manual Input Mode
S = Simulator Mode

8= Number of SVs in use, range 00–99
9=HDOP calculated using all the satellites (GPS, GLONASS, and any future satellites) used in computing the solution reported in each GNS sentence.
10= Orthometric height in meters (MSL reference)
11= Geoidal separation in meters - the difference between the earth ellipsoid surface and mean-sea-level (geoid) surface defined by the reference datum used in the position solution
“-” = mean-sea-level surface below ellipsoid.
12= Age of differential data - Null if talker ID is GN, additional GNS messages follow with GP and/or GL Age of differential data
13= Reference station ID1, range 0000-4095
- Null if talker ID is GN, additional GNS messages follow with GP and/or GL Reference station ID
14= The checksum data, always begins with *

11.8 ZDA

ZDA - Time & Date - UTC, day, month, year and local time zone

Fields:

UTC time (hours, minutes, seconds, may have fractional subsecond)
Day, 01 to 31
Month, 01 to 12
Year (4 digits)
Local zone description, 00 to +- 13 hours
Local zone minutes description, apply same sign as local hours
Checksum

Example: $GPZDA,160012.71,11,03,2004,-1,00*7D

11.9 USAGE

Output CPU loading and clock setting.

$PSTMCPU, 53.13,0,52*6d

Fields:

% of CPU usage
Clock Source
Clock Speed

11.10 WAAS

Example:

$PSTMSBAS,1,2,133,,,43*2C

Fields:

Status (1= WAAS ON)
Acquire flag
PRN
Elevation
Azimuth

Example:

$PSTMSBASCH,0,133,,,26*76
$PSTMSBASCH,1,0,0,,,,*42

Fields:

Channel # (up to two SBAS channels tracked)
PRN
Elevation
Azimuth