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DELORME GPS2058-10 GPS Receiver Module Specification

June 2008

General Description

The DeLorme GPS2058 module combines the STMicroelectronics high sensitivity STA2058 (Teseo) GPS baseband chip with the STA5620 Low Power GPS RF front end to form a complete high performance GPS receiver module. The GPS2058 is an ideal solution for consumer, Handheld, PND (Portable Navigation), in-vehicle Navigation and Telematics systems. The GPS2058 is offered with a complete GPS firmware which performs all basic GPS operations including tracking, acquisition, navigation and data output with no need of external memories. SBAS (WAAS and EGNOS) features are also supported.



Features

- Compact 16mm x 16mm footprint minimizes board space
- Very high sensitivity and fast time to fix for very accurate position fixes in all environments
- Fully Integrated RF Section for direct Interface to Active or Passive Antenna Systems
- GPS Firmware embedded in FLASH eliminates programming
- Standard NMEA0183 output message structure for easy interfacing
- Evaluation kit and Reference Design Available
- Low Power and standby modes for battery powered applications
- PPS Output Synchronized to UTC for Time Synchronization Applications
- Superior Multi-path Error rejection algorithm for optimum performance in urban canyons
- RoHS Compliant

Performance Specifications

16-channel, L1 (1575.42 MHz) GPS receiver		Time (PPS)	+/-62ns Accuracy synchronized to UTC time
Reacquisition time	0.1 seconds average	DGPS (Optional)	<0.5m (depending on correction technique)
Position Accuracy	2 meters, CEP 50%	Acquisition Sensitivity	-146dBm (warm)
Acquisition Time		Tracking Sensitivity	-159dBm
• Hot Start	2.5 seconds	Velocity	<515 m/s (~1,000 knots) Max
• Warm Start	34 seconds	Acceleration	4g Max
• Cold Start	39 seconds	Altitude	<18,000 m (~60,000 ft)
Reacquisition Time	<1 second	Jerk	20 m/s ³
Altitude	<+/-35 m vertical in term of 95%		
Velocity	0.1 m/s		

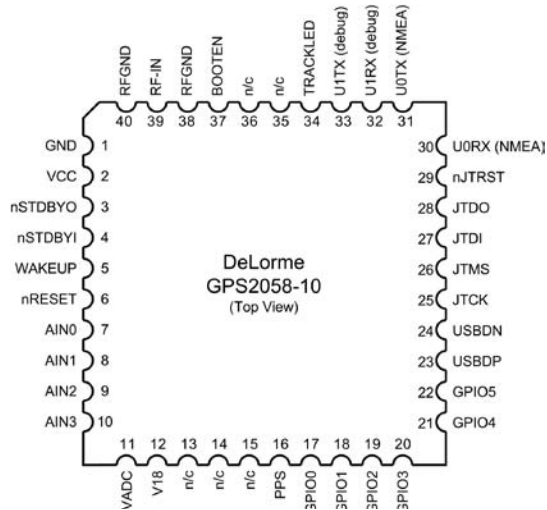
Functional Description

The DeLorme GPS2058-10 module simplifies embedded applications of GPS-based information systems. The important components of a basic GPS receiver subsystem are LNA, SAW Filter, RF front end, power conditioning, and the GPS baseband receiver itself. All these subsystems have been built into the DeLorme GPS module to eliminate the cost and time needed for the user to develop them independently. In simple terms, the user must connect an active or passive antenna, provide a power source, and connect the module to a host system via a serial port (or USB) to produce GPS positional data and enable a complete GPS receiver system. Designed for PCB mounted application, the module has a tiny 16x16mm footprint for use in small form-factor end applications such as portable systems.

For fast startup times, the Teseo baseband features an onboard 16KB of FLASH memory for storing the satellite almanac and ephemeris data, and this data is saved and restored automatically as a background process. This eliminates the need for additional external memory and eliminates any programming to save and recover this data.

The Pulse-Per-Second (PPS) output provides an accurate timestamp, synchronized to Universal Coordinated Time (UTC). The time is established via communication with one satellite and verified with a second satellite. If a fix is obtained and lost the PPS will continue to run as long as the time is valid. No PPS pulse indicates the time is not valid.

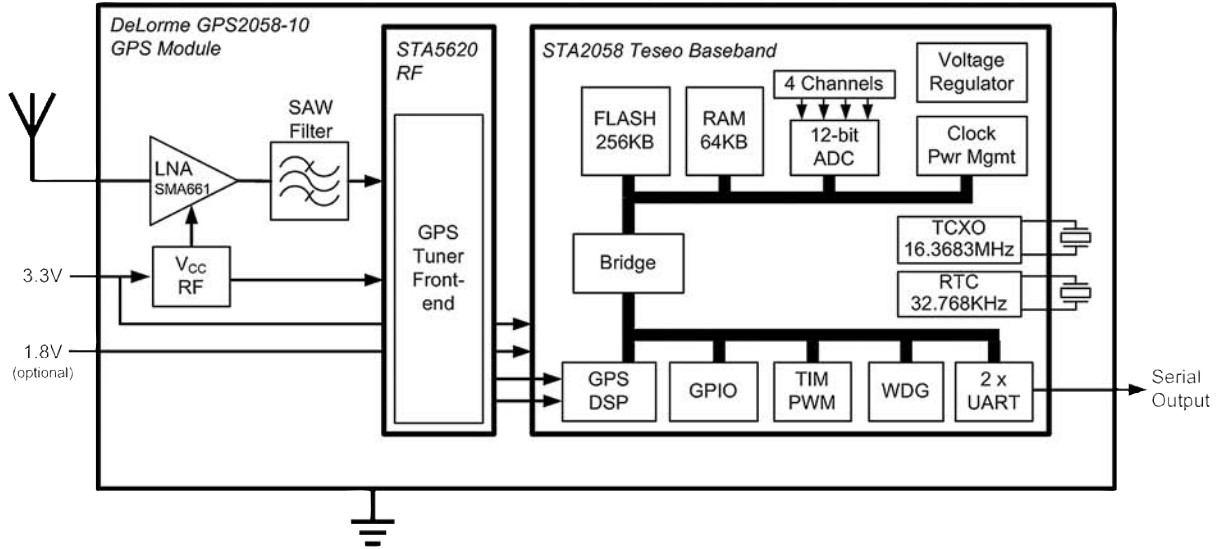
Module Pinout



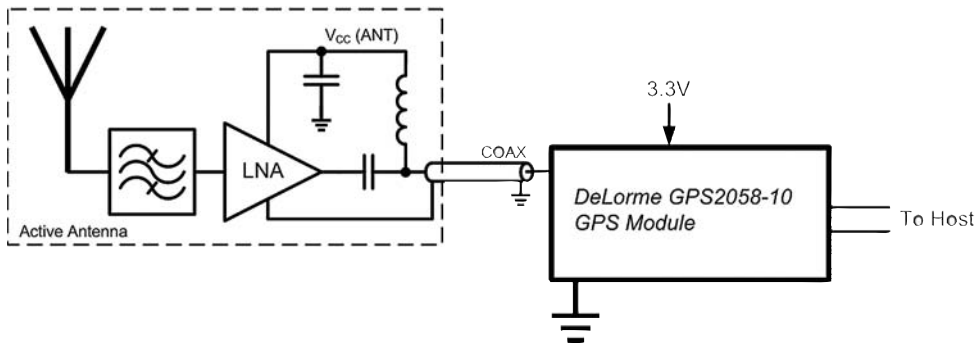
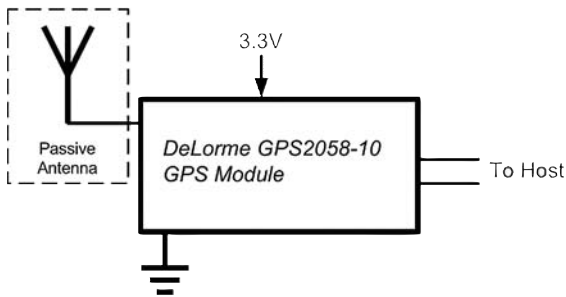
Pin Descriptions

Pin	Name	Function	Description	Secondary Function
1	Ground	Power	Digital Ground	N/A
2	VCC	Power	Digital 3.3v +/- 5% supply	N/A
3	nSTDBYO	Output	Low indicates Module is in standby mode	N/A
4	nSTDBYI	Input	Low input forces Module into standby mode	N/A
5	WAKEUP	Input	Wakeup from standby mode	N/A
6	nRESET	Input	Module reset active Low	N/A
7	AIN0	I/O	Analog Input 0 (Future)	N/A
8	AIN1	I/O	Analog Input 1(Future)	N/A
9	AIN2	I/O	Analog input 2 (Future)	N/A
10	AIN3	I/O	Analog Input 3 (Future)	N/A
11	VADC	Power	External ADC Power (tie to VCC if ADC's are not used)	N/A
12	V18	Power	Optional 1.8V core supply to reduce power	N/A
13	n/c	I/O	N/A	N/A
14	n/c	I/O	N/A	N/A
15	n/c	I/O	N/A	N/A
16	PPS	I/O	Pulse Per Second Output	N/A
17	GPIO0	I/O	GPIO0	SPI0MISO (Future)
18	GPIO1	I/O	GPIO1	SPI0MOSI (Future)
19	GPIO2	I/O	GPIO2	12C_CK (Future)
20	GPIO3	I/O	GPIO3	12C_D (Future)
21	GPIO4	I/O	GPIO4	CANRX (Future)
22	GPIO5	I/O	GPIO5	CANTX (Future)
23	USBDP	I/O	USB Data Line Positive	N/A
24	USBDN	I/O	USB Data Line Negative	N/A
25	JTCK	Input	JTAG Clock (Factory Test Only)	N/A
26	JTMS	Input	JTAG Mode Select (Factory Test Only)	N/A
27	JTDI	Input	JTAG Data Input (to module) (Factory Test Only)	N/A
28	JTDO	Output	JTAG Data Output (from module) (Factory Test Only)	N/A
29	nJTRST	Input	JTAG Reset (active low) (Factory Test Only)	N/A
30	U0RX	I/O	NMEA UART0 Receive Data Input (to module)	N/A
31	U0TX	I/O	NMEA UART0 Transmit Data Output (from module)	BOOT0
32	U1RX	I/O	DEBUG UART1 Receive Data Input (to module)	BOOTRX
33	U1TX	I/O	DEBUG UART1 Transmit Data Output (from module)	BOOTTX
34	TRACKLED	I/O	3D Fix Indicator	N/A
35	n/c	I/O	N/A	N/A
36	n/c	I/O	N/A	N/A
37	BOOTEN	Input	Enable sampling of BOOT[0:1] pins on exit from external reset	N/A
38	RFGND	Ground	RF Ground, connect only to RF	N/A
39	RF-IN	Input	GPS signal in from antenna	N/A
40	RFGND	Ground	RF Ground, connect only to RF	N/A

Block Diagram



Typical Applications



Absolute Maximum Ratings

Symbol	Parameter	Value		Unit
		Min	Max	
VDD	Voltage on VDD with respect to ground (VSS)	-0.3	+4.0	V
V18	Voltage on optional 1.8V core supply input	-0.3	+2.0	V
VADC	Voltage on VADC pin with respect to ground (VSS)	-0.3	+3.6	V
VIN	Voltage on any pin with respect to ground (VSS)	-0.3	+4.0	V
IOV	Input Current on any pin during overload condition	-10	+10	mA
ITDV	Absolute sum of all input currents during overload conditions		200	mA
TST	Storage Temperature	-55	+150	°C
ESD	ESD Susceptibility (Human Body Model)	2000		V

NOTE: Stresses exceeding above listed recommended "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Value		Unit
		Min	Max	
VDD	Digital Supply Voltage for I/O Circuitry	3.0	3.6	V
VADC	Analog Supply Voltage for the A/D Converter	VDD	VDD	V
V18	Voltage on optional 1.8V core supply input	1.7	1.9	V
TA	Ambient Temperature under bias	-40	+85	°C
TJ	Junction Temperature under bias	-40	+105	°C

DC Electrical Characteristics

Symbol	Parameter	Conditions	Value			Unit
			Min	Typ	Max	
VIH	Input High Level CMOS	With or w/o Hysteresis	0.7*VDD			V
VIL	Input Low Level CMOS	With or w/o Hysteresis			0.3*VDD	V
VHYS	Input Hysteresis CMOS Schmitt Trigger		0.4	0.8	1.2	V
	Input Hysteresis Schmitt Trigger	WAKEUP pin only	0.3	0.5		V
VOH	Output High Level High Current Pins (GPIO)	IOH = 8mA	VDD - 0.8			V
	Output High Level Standard Current Pins	IOH = 4mA	VDD - 0.8			V
VOL	Output Low Level High Current Pins (GPIO)	IOL = 8mA			0.4	V
	Output Low Level Standard Current Pins	IOL = 4mA			0.4	V
RWPU	Weak Pull-up Resistor	Measured at 0.5 VDD		100		KΩ
RWPD	Weak Pull-down Resistor	Measured at 0.5 VDD		100		KΩ

AC Electrical Characteristics

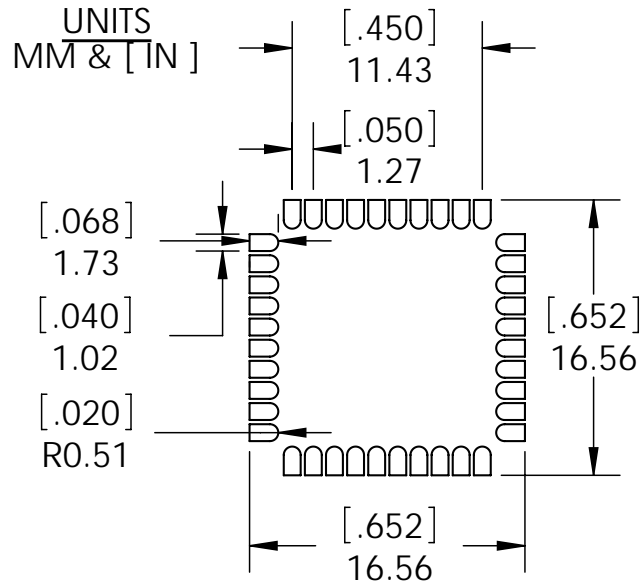
Symbol	Parameter	Conditions	Value			Unit
			Min	Typ	Max	
IDDRUN	RUN mode current	VDD=3.3V, 33MHz		85		mA
IDDRUN18	Run mode current using both 3.3V 1.8V supplies (internal regulator powered off)	3.3V supply current		35		mA
		1.8V supply current		50		mA
IDDSB1	STANDBY mode current	LP Vreg and 32kHz OSC on		90		uA
IDDRESET0	RESET mode current	Active but held in Reset		8		mA

Environmental Specifications

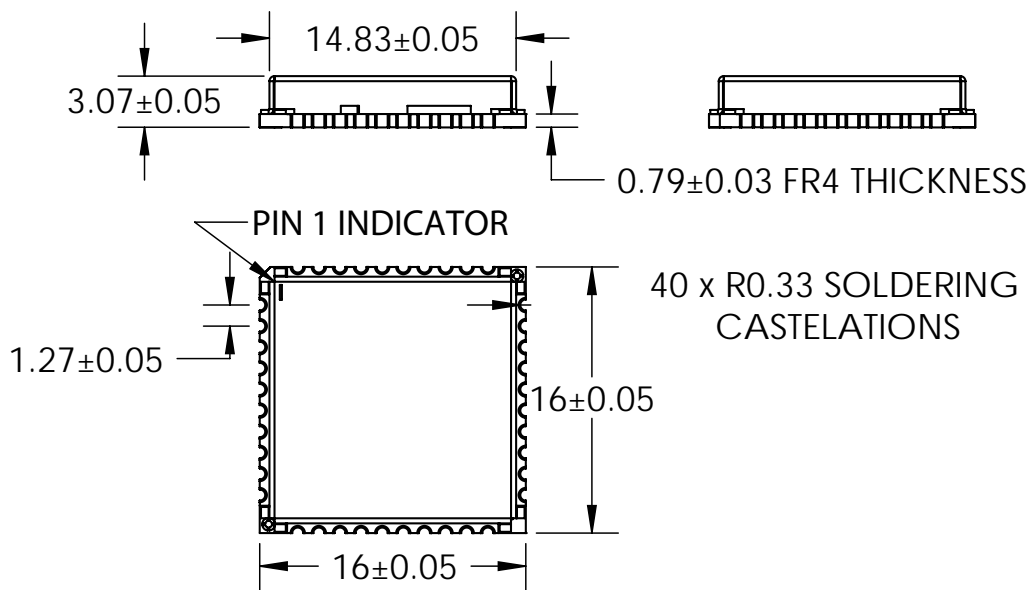
Operating Temperature -40 °C to +85 °C
 Storage Temperature -55 °C to +100 °C
 Relative Humidity 5% to 95%, non-condensing

Mechanical Diagram

GPS2058
RECOMMENDED PC BOARD LAYOUT



GPS2058
PACKAGE OUTLINE

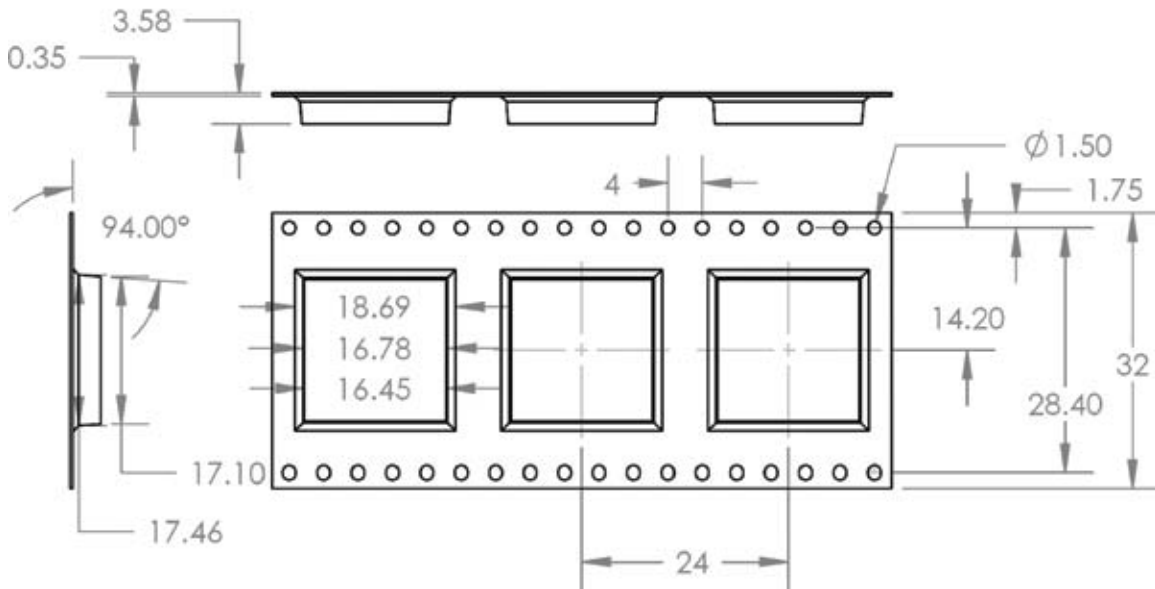


UNITS: MM

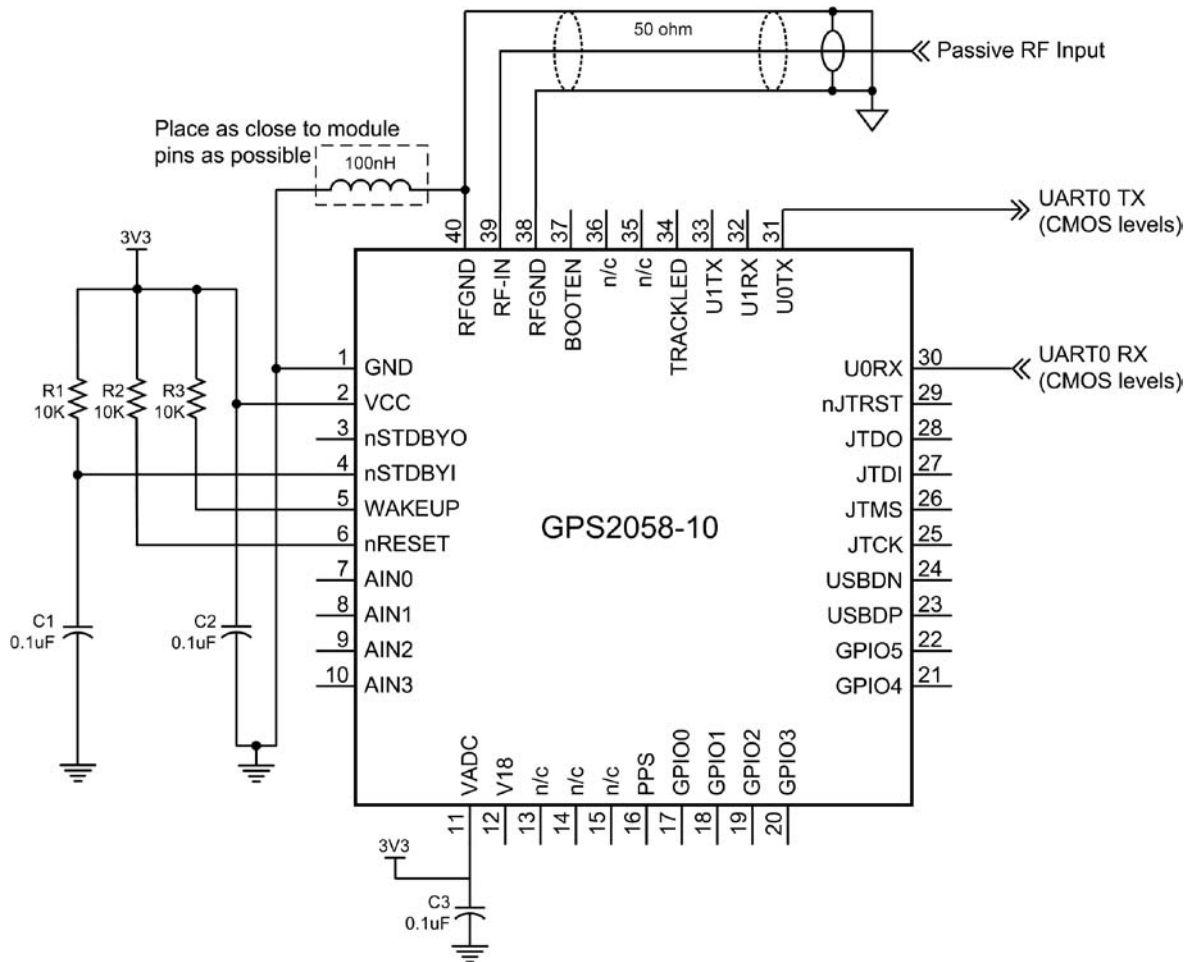
Ordering Information

Ordering Code: GM-205810-000
 Tape And Reel minimum order quantity: 500 units

Tape Dimensions



Minimum Application Connectivity



The following describes the minimum GPS2058 GPS receiver module connectivity necessary to obtain a position fix with passive antenna and host connection.

The Antenna connects to the module on the RF-input pin. It is very important that this connection maintains a 50 ohm impedance with minimal discontinuities to maximize the energy transfer from the antenna to the module RF input. Both RF ground pins (38 and 40) must be isolated from digital ground through a 100nH inductor to eliminate high frequency loop currents and preventing self jamming from digital noise injected into the RF section or RF noise from being introduced to the digital section. Refer to our application note titled 'GPS Module Antenna and RF Design Guidelines' for additional discussion and layout recommendations.

Power is supplied to the module by connecting a 3.3V digital supply to pin 2. Use 0.1uF decoupling cap as close to the module pin as possible. Pin 1 is digital ground, connect to ground plane as close to module as possible. For reducing the supply current when an additional 1.8V supply is available, refer to the section titled "Power Supply Options" in this document.

To ensure that module powers up in the correct state, nRESET (pin 6) must be tied to 3.3V thru a 10Kohm resistor to prevent accidental receiver reset. The WAKEUP input (pin 5) must be tied to 3.3V thru a 10Kohm resistor and the nSTDBYI input (pin 4) must also be tied to 3.3V thru a 10K ohm resistor to hold the receiver out of standby mode. A 0.1uF cap to ground is also tied to the nSTDBYI input to delay the ramp up to 3.3V, which brings the pin biasing up in the right sequence.

The UART0 NMEA connection is a CMOS level TTL signal level. Pin 31 is the transmit output pin for sending the NMEA data FROM the module TO the host, and pin 30 is the receive input for sending commands FROM the host TO the Module.

The VADC input (pin 11) should also be tied to the 3.3V supply to properly bias the device. A decoupling capacitor of 0.1uF is used as close to the pin as possible.

All other pins may remain unconnected.

Power Supply Options

The GPS2058 module can be powered by two different methods. The preferred method will depend on the supply voltages available on the PCB and the power consumption goals of the system.

A single external 3.3V supply can be used to power the entire module. When only the external 3.3V supply is used the voltage is down converted inside the module to supply the core 1.8V. Using an external 3.3V supply requires 85mA (typical) of total current for the entire module.

There is power loss associated with the internal regulator. If external 3.3V and 1.8V sources are both available to power the module the internal regulator can be shut off to eliminate its power loss. The external 3.3V supply is still needed to power the I/O and some other components in the module requiring 3.3V (i.e.; LNA).

When using the dual 3.3V and 1.8V supply rails approximately 50mA of current comes from the 1.8V rail while about 35mA will come from the 3.3V supply.

There is a NMEA command to turn off the internal regulator, \$PDME,12,2. When the GPS2058 is initially powered on (and not in STANDBY mode) the \$PDME,12,2 command can be issued to power off the internal regulator and reduce the total power consumption. When a hardware reset occurs the 1.8V regulator is powered on and the \$PDME,12,2 command must be re-issued to bypass the 1.8V regulator.

Note that the GPS2058 will still function properly using two supplies with the internal regulator still ON, providing the V18 never exceeds 2.0V (abs max).

When an external 1.8V supply is not used the V18 supply pin should be left floating.

In order to fully enter STANDBY mode you should disable the internal 1.8V regulator when using an external 1.8V supply. Coming out of STANDBY mode will require you to re-issue the command to disable the internal regulator if an external 1.8V supply is used.

STANDBY MODE

In Standby mode, the CPU core is switched off to reduce power consumption. The Real Time Clock and Wake-Up logic remains independently powered by an internal low-power voltage regulator for fast start-ups coming out of Standby mode.

The Standby mode power-down sequence may be initiated by either a software command, or by hardware control using the nSTDBYI and WAKEUP inputs. DO NOT tie the nSTDBYI and WAKEUP pins together if you are using STANDBY mode.

Coming out of Standby mode requires the nSTDBYI and WAKEUP inputs to be in the proper state even if Standby mode was initiated via software (see below).

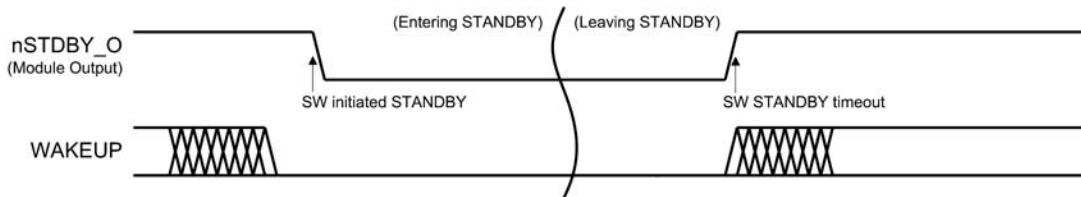
The WAKEUP input must be low to initiate Standby mode. If WAKEUP is high then Standby mode cannot be initiated by any event, software or hardware.

A Reset event (nRESET pin goes low) has priority over nSTDBYI. Therefore, reset activation will force an exit from the Standby mode. If nRESET is activated while nSTDBYI is logic high, the device exits from Standby mode. If a Reset pulse is given while nSTDBYI is kept at constant low level, the device will enter Standby mode again after nRESET rising edge.

The nSTDBYO output is useful as an indication of the module status – when this output is low the module is in Standby mode.

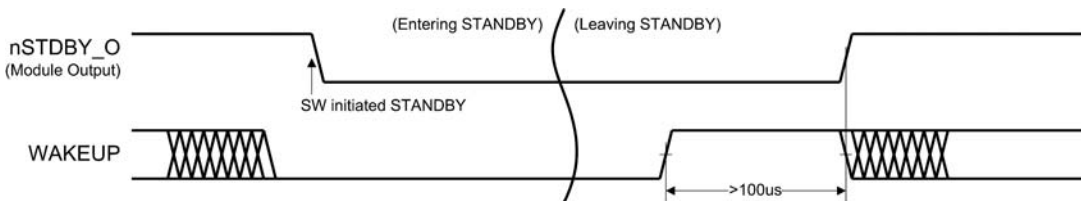
Software STANDBY

The following figure shows the sequence of events when entering Standby mode via software by sending a \$PDME,13,1,#seconds command to the GPS2058. When this command is executed the module will enter Standby mode if the WAKEUP input is low. After the #seconds has timed out the module wakes itself up and the CPU restarts. If the #seconds is zero the module remains in standby mode indefinitely, or until an external wake-up is initiated via the WAKEUP input or a reset event occurs.

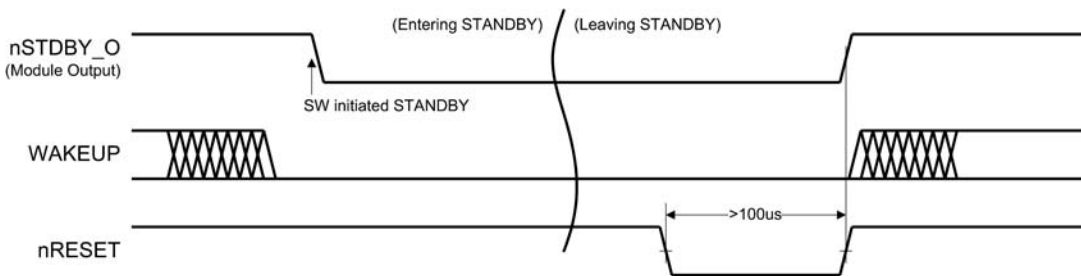


SW-Entered STANDBY Mode with timeout exit

Applying a positive pulse of 100us (minimum) on the WAKEUP pin switches the main internal voltage regulator back on and applies power to the core. The CPU core is kept in reset mode until the internal voltage is correctly regulated, then the CPU restarts itself.



SW-Entered STANDBY Mode with WAKEUP Exit



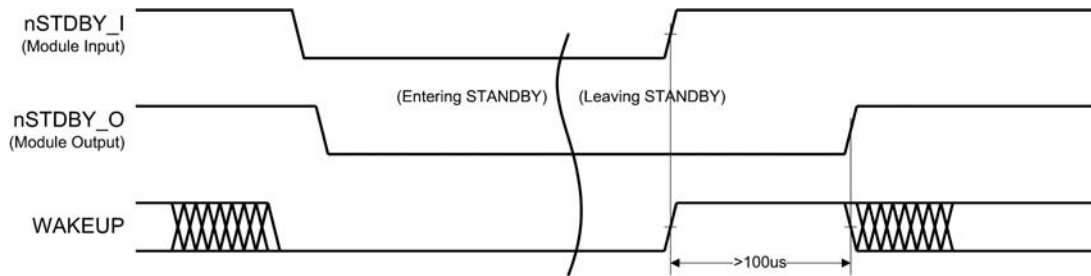
SW-Entered STANDBY Mode with nRESET Exit

If the nSTDBYI pin is low when the device wakes up, the module will re-enter Standby mode.

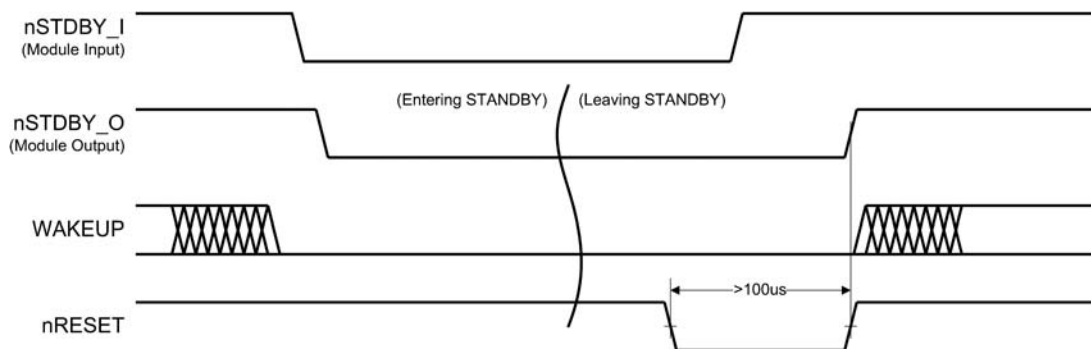
Hardware STANDBY

To enter Standby mode via hardware requires bringing the nSTDBYI pin to a logic low state while the WAKEUP input is low. If the WAKEUP pin is at a high logic level the GPS2058 will not enter Standby mode.

To exit standby mode via hardware both the WAKEUP and nSTDBYI pin must be high. The WAKEUP rising edge switches the Main Voltage Regulator back on, while nSTDBYI pin rising edge releases the internal Reset to the CPU core.



HW-Entered STANDBY Mode with WAKEUP Exit



HW-Entered STANDBY Mode with nRESET Exit

NMEA Output Messages

When the GPS receiver is running a set of messages is presented on the NMEA port. These output strings are compatible with the NMEA 0183 standard and provide all the information needed by a navigation system. At system run-time the current message list can be modified using the \$PDME,11 (see the NMEA software commands section). A description of the available (NMEA 0183) navigation messages is reported in the next pages.

\$GPGGA

GPS fix data, message available at startup in the default message list. It can be enabled/disabled with the \$PDME,11 command. GGA5 (default) provides latitude/longitude out to 5 decimal places. GGA provides latitude/longitude out to 2 decimal places.

Message rate: 1 Hz

Message: **\$GPGGA**,<PosUTC>,<Lat>,<LatRef>,<Lon>,<LonRef>,<Qual>,<NbSat>,<HDOP>,<AltMsl>,M,<GeoidSep>,M,<null>,<null>*checksum<cr><lf>

Field	Description	Format
PosUTC	Universal time coordinated	Hhmmss.sss
Lat	Latitude	ddmm.mmmmm
LatRef	Latitude direction	'N' or 'S'
Lon	Longitude	dddmm.mmmmm
LonRef	Longitude Direction	'E' or 'W'
Qual	Quality indicator 0 – no fix 1 – GPS fix 2 – Differential GPS fix	X
NbSat	Number of satellites in use	Xx
HDOP	Horizontal dilution of precision	x.x
AltMsl	Antenna altitude above/below main sea level	x.x
M	Meters	'M'
GeoidSep	Geoidal separation	x.x
M	Meters	'M'
Null	–	
Null	–	

\$GPGSA

DOP and active satellite list, available at startup in the default message list. It can be enabled/disabled with the \$PDME,11 command.

Message rate: 1 Hz

Message: **\$GPGSA**,<Opmode>,<FixMode>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<Sat>,<PDOP>,<HDOP>,<VDOP>*checksum<cr><lf>

Field	Description	Format
Opmode	Operating mode (A for automatic switch 2D/3D)	'A'
Fixmode	Fix mode 1 – no fix 2 – 2D fix 3 – 3D fix	X
Sat	ID of the satellite	Xx / null
PDOP	Position dilution of precision (PDOP) in meters	x.x
HDOP	Horizontal dilution of precision (HDOP) in meters	x.x
VDOP	Vertical dilution of precision (VDOP) in meters	x.x

\$GPGSV

Satellites in view, available as soon as the first satellite is acquired. It can be enabled/disabled with the \$PDME,11 command. Note that this message is repeated MaxMsg times to report the status of all satellites in view (up to 16 satellites).
 Message rate: 1 Hz

Message: **\$GPGSV**,<MaxMsg>,<NumMsg>,<NumSats>,<SatPrn>,<Elev>,<Az>,<SNR>,<SatPrn>,<Elev>,<Az>,<SNR>,<SatPrn>,<Elev>,<Az>,<SNR>*checksum<cr><lf>

Field	Description	Format
MaxMsg	Total number of messages	X
NumMsg	Message number	X
NumSats	Total number of satellites in view	Xx
SatPrn	Satellite PRN number	Xx
Elev	Elevation in degrees (90 maximum)	Xx
Az	Azimuth in true degrees (000 to 359)	Xxx
SNR	SNR (C/No) 00 to 99dB, null when tracking	Xx

\$GPVTG

Track made good and ground speed. It can be enabled/disabled with the \$PDME,11 command.

Message rate: 1 Hz

Message: **\$GPVTG**,<TrueCourse>,T,<MagneticCourse>,M,<SpeedKnots>,N,<SpeedKmh>,K*checksum<cr><lf>

Field	Description	Format
Course (True)	Measured reading (True)	
T	True	
Course (Magnetic)	Measured heading (magnetic)	
M	Magnetic	
Speed Knots	Measured horizontal speed (knots)	
N	Knots	
SpeedKmh	Measured horizontal speed (km/h)	
K	Kilometers per hour	

\$GPRMC

Recommended minimum specific data. Available at startup in the basic message list. It can be enabled/disabled with the \$PDME,11 command.

Message rate: 1 Hz

Message: **\$GPRMC**,<PosUTC>,<PosStat>,<Lat>,<LatRef>,<Lon>,<LonRef>,<Spd>,<Hdg>,<Date>,<MagVar>,<MagRef>*checksum<cr><lf>

Field	Description	Format
PosUTC	Universal time coordinated	Hhmmss.sss
PosStat	Position status (A=valid or V=invalid)	'A' or 'V'
Lat	Latitude	Ddmm.mmm
LatRef	Latitude direction	'N' or 'S'
Lon	Longitude	Dddmm.mmm
LonRef	Longitude Direction	'E' or 'W'
Spd	Speed over ground (knots)	x.x
Hdg	Heading track make good (degree true)	x.x
Date	Date	Ddmmyy
MagVar	Magnetic variation (degree) (Future)	Future
MagRef	Magnetic variation (Future)	Future

\$GPGLL

Geographic Position - Latitude/Longitude. It can be enabled/disabled with the \$PDME,11 command.

Message rate: 1 Hz

Message: **\$GPGLL**,<Lat>,<LatRef>,<Lon>,<LonRef>,<PosUTC>,<Status>*checksum<cr><lf>

Field	Description	Format
Lat	Latitude	Ddmm.mmm
LatRef	Latitude direction	'N' or 'S'
Lon	Longitude	Dddmm.mmm
LonRef	Longitude Direction	'E' or 'W'
PosUTC	Universal time coordinated	Hhmmss.sss
Status	Status A – Data valid, V – Data invalid	'A' or 'V'

NMEA Software Commands

Summary of Commands

\$PDME,0 Cold Start
 \$PDME,1 Warm Start
 \$PDME,2 Hot Start
 \$PDME,4,n Version information
 \$PDME,5 Get threshold DOPs
 \$PDME,6,n,f1,f2,f3 Set threshold DOPs
 \$PDME,7 Get sat. masking angle
 \$PDME,8,f Set sat. masking angle
 \$PDME,9,n1,n2,n3,n4,n5,n6,n7,n8,n9 Init GPS position & time
 \$PDME,10,n NMEA Port Msg control
 \$PDME,11,n1,h,n2 NMEA Message config
 \$PDME,12,n System control set A
 \$PDME,13,n1,n2 System control set B

Command: Cold Start**Format:** \$PDME,0<cr><lf>**Variables:** None**Return:** If monitoring NMEA, the module will issue power-on start-up message (Delorme F/W and H/W versions are displayed), satellite vehicle NMEA message should indicate only 1 satellite (i.e., \$GPGSV,1,1...) and the active satellite message will indicate no fix (\$GPGSA,A,1...).**Operation:** Suspends GPS operations, clears ephemeris and almanac, invalidates user position and RTC, then issues restart/reset**Application:** Diagnostic purposes – used to reproduce TTFF for an initial acquisition.**Command: Warm Start****Format:** \$PDME,1<cr><lf>**Variables:** None**Return:** If monitoring NMEA, the module will issue power-on start-up message (Delorme F/W and H/W versions are displayed), satellite vehicle NMEA message will maintain existing information but the active satellite message will indicate no fix (\$GPGSA,A,1...).**Operation:** Suspends GPS operations, clears ephemeris then issues restart/reset**Application:** Diagnostic purposes – used to reproduce TTFF for a device that had a previous fix and is downloading new ephemeris info.**Command: Hot Start****Format:** \$PDME,2<cr><lf>**Variables:** None**Return:** If monitoring NMEA, the module will issue power-on start-up message (Delorme F/W and H/W versions are displayed), satellite vehicle NMEA message will maintain existing information but the active satellite message will indicate no fix (\$GPGSA,A,1...).**Operation:** Suspends GPS operations, then issues restart/reset**Application:** Diagnostic purposes – used to reproduce TTFF for a device that had a previous fix and is downloading new ephemeris info.**Command: Get Version Information****Format:** \$PDME,4,n<cr><lf>**Variables:** n = 1, 2, 3 or 4**Return:**

If n=1, return is "\$PDME,4,1, GPS2058_FW_1.0.0";

if n=2, return is "\$PDME,4,2, GPS2058_HW_1.0.1";

if n=3, return is "\$PDME,4,3, GPS_LIBRARY_VERSION GPSLIB_5.4.1.5 GNU – Jun 11 2007 10:05:32";

if n=4, return is "\$PDME,4,4, WAAS_VERSION SBASLIB_01.08.03 – Jun 11 2007 10:05:42".

Operation: n=1 returns DeLorme firmware revision, n=2 returns DeLorme hardware revision, n=3 returns GPS library revision, n=4 returns SBAS/WAAS library revision**Application:** Informational; n=1 and n=2 are valuable for revision checking by systems integrators**Command: Get Dilution of Precision Threshold Values****Format:** \$PDME,5<cr><lf>**Variables:** None**Return:** "\$PDME,5,<pdop3>,<hdop3>,<vdop3>,<pdop2>,<hdop2>,<vdop2>"**Operation:** Returns the threshold values used for determining a fix; by default these are very large values. 3-D thresholds are sent first, followed by 2D.**Application:** Informational; used in conjunction with the Set DOP to restrict or loosen initial position calculation thresholds**Command: Set Dilution of Precision Threshold Values****Format:** \$PDME,6,n,f1,f2,f3<cr><lf>**Variables:** n=3 for 3D DOP thresholds, n=2 for 2D DOP thresholds, f1=positional DOP, f2=horizontal DOP, f3=vertical DOP**Return:** "\$PDME,6,OK" if the command is accepted**Operation:** Sets the thresholds used for initial positional accuracy calculations in either 3D or 2D fix types.**Application:** Used for restricting or loosening initial position calculations. Threshold DOPs may range from 1 (ideal) to 50 (poor), but tend to be set to large values, e.g., 30. Operational DOPs, which are different than the threshold DOPs, typically range from 1-2 (ideal to excellent)

Command: *Get Satellite Masking Angle***Format:** \$PDME,7,<cr><lf>**Variables:** None**Return:** "\$PDME,7,<maskang>"**Operation:** Returns the angle below which satellites are ignored; returned value is in whole degrees for the current GPS Library.**Application:** Informational; used with Set Mask Angle to establish and effective satellite horizon to eliminate multipath (reflected) signals**Command: *Set Satellite Masking Angle*****Format:** \$PDME,8,f,<cr><lf>**Variables:** f=0 to 90 degrees**Return:** "\$PDME,8,OK" if the command is accepted**Operation:** Sets the angle below which satellites are ignored; decimal values may be entered but the GPS Library only accepts whole numbers as of now.**Application:** Valuable tool for eliminating multipath signals typically found in environments with a limited sky view and a lot of reflected satellite signals, such as urban canyons.**Command: *Initialize GPS Position and Time*****Format:** \$PDME,9,n1,n2,n3,n4,n5,n6,n7,n8,n9,<cr><lf>**Variables:** n1=Latitude in (whole) degrees

n2=Longitude in (whole) degrees

n3=Altitude in (whole) meters

n4=Year (four digits)

n5=Month (1-12)

n6=Day(1-31)

n7=Hour(0-23)

n8=Min(0-59)

n9=Sec(0-59)

Return: "\$PDME,9,OK" if the command is accepted**Operation:** Sets the values used for the initial position calculations**Application:** Valuable for a unit that has been moved while off; a faster TTFF can be achieved by preloading the position and time information; must be issued immediately after a reset or startup to be most effective.**Command: *NMEA Port Messaging Controls*****Format:** \$PDME,10,n,<cr><lf>**Variables:** n = 0,1, 2, 3,4 or 5**Return:** "\$PDME,10,OK" if command is accepted.**Operation:** n=0,1 turns NMEA messages Off or On, respectively;

n=2,3 turns ECH messages Off or On, respectively, but if the NMEA messages are off, the n=2,3 has no effect.

n=3,4 turns Debug messages Off or On, respectively. When on, Debug info is directed to the NMEA port and regular NMEA messages are disabled; Debug information remains on the Debug port. Disabling the Debug message returns the NMEA port to normal messaging.

Application: Valuable for customizing the content selection on NMEA port.

Command: NMEA Messaging Configuration**Format:** \$PDME,11,n1,h,n2<cr><lf>**Variables:** All variables are independent of each other.

n1= Baud Rate, acceptable values

4800 (default)

9600

19200

38400

57600

115200

h = Hex value to enable the corresponding NMEA message

0x01 = GGA

0x02 = GGA5 (default; see note below)

0x04 = GSA (default)

0x08 = GSV (default)

0x10 = VTG

0x20 = GLL

0x40 = RMC (default)

0x80 = RF

0x40000 = RF Test, diagnostic

n2 = 0 (broadcast on UTC second, default)

1 (broadcast after fix)

Return: "\$PDME,11,OK" if the command is accepted**Operation:** Configures the communications parameters for the NMEA port (only).**Application:** Used for customizing the NMEA messages and changing communications rates. (All serial communications uses <Baud Rate>,8,N,1.) Care should be taken when using higher rates so as to avoid overloading the stream. For example, the GSV messaging will broadcast three lines of ASCII when a full contingent of satellites is available, so lower rates are recommended for GSV. The default message selection is given by 0x40+0x08+0x04+0x02 = 0x4E, so an equivalent default statement is "\$PDME,11,4800,0x4E,0".*Note: GGA5 is equivalent to GGA except that there are 5 decimal places of precision in the location values.***Command: System Control Set A, Bypass Internal 1.8V Regulator****Format:** \$PDME,12,n<cr><lf>**Variables:** n = 2**Return:** "\$PDME,12,OK" if the command is accepted**Operation:** Assumes an external 1.8V source is connected to pin 12 of the module. This command bypasses the internal regulator in favor of the external connection. The bypass is cleared through a hardware reset.**Application:** The primary purpose is to save on power. The internal regulator takes 3.3V as its source and the core of the device operates at 1.8V wasting significant power.**Command: System Control Set A, Invalidate RTC****Format:** \$PDME,12,n<cr><lf>**Variables:** n = 3**Return:** "\$PDME,12,OK" if the command is accepted**Operation:** This can be used to invalidate the RTC information obtained from the first satellite.**Application:** Diagnostic command; this is a key component in a Cold Start but rarely used alone. It is most effective in the early stages of establishing a fix because once communications from multiple satellites has been established the module will assume its RTC is valid.**Command: System Control Set A, Install SBAS Satellite List****Format:** \$PDME,12,n<cr><lf>**Variables:** n = 4**Return:** "\$PDME,12,OK" if the command is accepted**Operation:** This is an internal command that moves the SBAS list into the WAAS/SBAS operational code.**Application:** This is usually handled automatically but may be of value if WAAS communications is problematic.

Command: System Control Set A, Return Estimated Position Error**Format:** \$PDME,12,n<cr><lf>**Variables:** n = 5**Return:** "\$PDME,12,<horizontal error>,<vertical error>"**Operation:** Returns a running statistical estimate of horizontal and vertical positional errors in meters.**Application:** Useful for general evaluation of accuracy, particularly if a more elaborate data collection tool is not available to collect and analyze the data in more detail.**Command: System Control Set A, GPS Leap Seconds****Format:** \$PDME,12,n<cr><lf>**Variables:** n = 6**Return:** "\$PDME,12,<leap second value>"**Operation:** Returns the number of leap seconds added to UTC relative to maintain consistency with mean solar time (and GPS timing).**Application:** Valuable information for UTC synchronized GPS systems.**Command: System Control Set B, Software Standby Mode****Format:** \$PDME,13,n1,n2<cr><lf>**Variables:** n1 = 1, n2 = any integer**Return:** "\$PDME,13,OK" if the command is accepted**Operation:** This is used to put the module into standby mode; if n2=0, the module enters standby mode indefinitely and requires an external wakeup (pin 5 high) or reset (pin 6 low) to remove the standby; any other value of n2 is equivalent to the number of seconds the module remains in standby**Application:** This is valuable for power savings. The module drops to less than 100uA during standby, so it may be self timed off the RTC crystal or left in standby indefinitely until woken up by hardware.**Command: System Control Set B, WAAS Control****Format:** \$PDME,13,n1,n2<cr><lf>**Variables:** n1 = 2, n2 = 0 or 1**Return:** "\$PDME,13,OK" if the command is accepted**Operation:** If n2 = 0, WAAS can be disabled; if n2 = 1 (default), WAAS is (re)enabled;**Application:** In most cases, leaving WAAS enabled provides the better fix. If WAAS is disabled, the vacated processing channel can be used to capture information from another GPS satellite.**Command: System Control Set B, Set SBAS Satellite PRN Code****Format:** \$PDME,13,n1,n2<cr><lf>**Variables:** n1 = 3, n2 = valid SBAS PRN codes**Return:** "\$PDME,13,OK" if the command is accepted**Operation:** This is used to select a specific WAAS satellite by PRN code. As of this writing, valid WAAS PRNs are 122, 134, 135 and 138 (East Coast). Valid EGNOS satellites are 120, 124 and 126. Valid MSAS satellites are 129 and 137.**Application:** This can be used to improve the fix time for WAAS (by eliminating the need for hunting) or to improve a fix if the module is located on the boundary where two SBAS satellites are available and one is obscured.**Command: System Control Set B, Set RF Test Satellite PRN Code****Format:** \$PDME,13,n1,n2<cr><lf>**Variables:** n1 = 3, n2 = 0 – 11 (GPS correlator channel number)**Return:** "\$PDME,13,OK" if the command is accepted**Operation:** This is used to select a specific satellite for the RF Test (NMEA) Message (see section on "NMEA Messaging Configuration")**Application:** This is a diagnostic which will return the PRN, center frequency, phase error and CNO (gain) of the satellite in that GPS correlator channel.

Recommended Reflow Profile

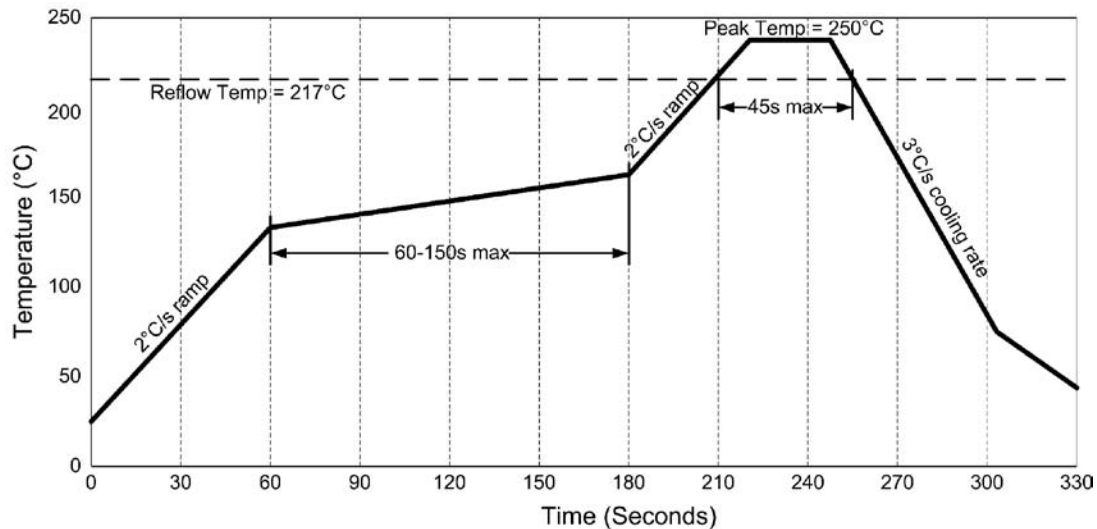
The following graph shows a suggested reflow profile for an automated surface mount assembly processes. This reflow profile follows the recommendations for the lead-free solder used in the module assembly. The reflow process follows 4 complete stages:

Pre-heat: Ramp to 130°C at a rate of 2°C/second

Soak: Ramp from 130 to 165°C over 60-150 seconds

Reflow: Ramp from 165°C to 217°C at a rate of 2°C/second. The peak reflow temperature should be 230-250°C, total time above 217°C should be less than 45 seconds

Cool-down: A cooling rate of 3°C/second is recommended



Ideally the module will only be subjected to a single reflow process with the module on the top side surface of the printed circuit board. Additional reflows may cause bridging between pads, or potential damage to the module.

If the PCB is a two-sided board the secondary reflow should be performed with the module on the top side of the board to avoid damage to the module. If a secondary reflow is performed with the module on the bottom side of the printed circuit board the weight of the shield can or entire module may exceed the adhesive properties of the solder menisci and the shield can or the entire module may fall off the board.