Technical Bulletin for ICM and Res SMT 360 receiver modules.

Overview

This document discusses the TSIP protocol differences between a Res SMT GG and Res/ICM SMT 360 modules. Note that some changes are for the ICM SMT 360 only.

This bulletin covers the following products.

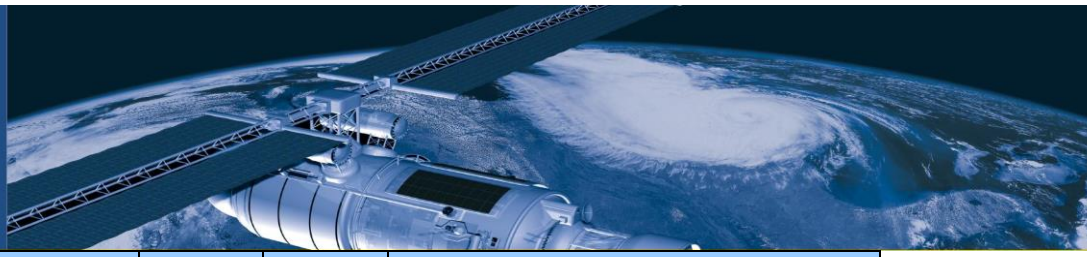
Part number	Description	Firmware version
94471-05	ICM SMT 360 GPS receiver starter kit	1.00.0
96975-00	ICM SMT 360 GPS receiver	1.00.0
67974-11	ICM SMT 360 on Carrier Board	1.00.0
96960-05	Res SMT 360 GPS receiver starter kit	1.00.0
97975-00	Res SMT 360 GPS receiver	1.00.0
97779-00	Res SMT 360 on Carrier Board	1.00.0

Firmware changes introduced between Res SMT GG and SMT 360 variants

1. Report packet 0x5D: GNSS Satellite Tracking Status

This message replaces 0x5C that was output on the Res SMT GG. The Res SMT 360 and ICM SMT 360 receivers send this packet in response to command packet 0x3C.

Byte	Bit	Item	Type	Value	Description
0		Packet ID	UINT8	0x5D	
1		SV PRN #	UINT8		
2		Channel number	UINT8		Channel number minus 1
3		acquisition flag	UINT8	0 1 2	Never acquired Acquired Re-opened search
4		ephemeris flag	UINT8	0 >0	Flag not set Good ephemeris
5-8		signal level	SINGLE		dB-Hz
9-12		time of last measurement	SINGLE	seconds	GPS time of week

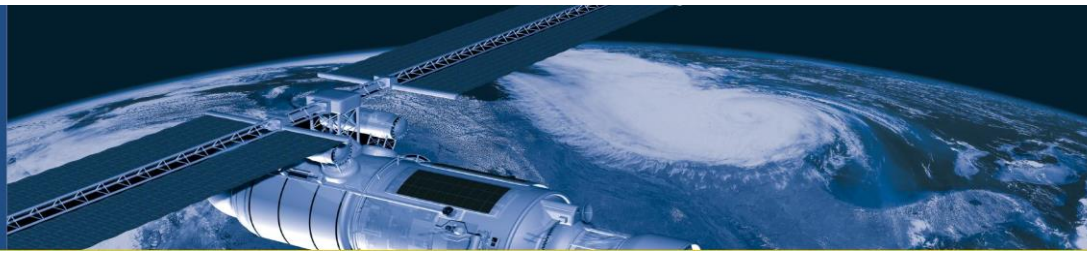


Byte	Bit	Item	Type	Value	Description
13-16		elevation angle	SINGLE	radians	
17-20		azimuth angle	SINGLE	radians	
21		old measurement flag	UINT8	0 >0	Flag not set Measurement old
22		integer msec flag	UINT8	0 1 2 3 4	Don't know msec Known from subframe Verified by bit crossing verified by good fix Suspect msec error
23		bad data flag	UINT8	0 1 2	Flag not set Bad parity Bad ephemeris health
24		data collection flag	UINT8	0 >0	Flag not set Collection in progress
25		Used flags	Bit field	Bit 0 Bit 1 Bit 2-7	Satellite used in timing fix Satellite used in position fix reserved
26		SV Type	UINT8	0 1 2 3 4 5 6 7	GPS GLONASS Reserved Reserved SBAS (WAAS) QZSS Reserved Reserved

2. Command Packet 0x8E-A0: Set DAC Value *(ICM SMT 360 only)*

Additional command packet 0x8E-A0 to set the DAC output voltage or to request the current DAC output voltage plus the parameters describing the DAC. The DAC output voltage is used to control the frequency of the OCXO. Send this packet with no data to request the DAC voltage. ICM responds with packet 0x8F-A0.

Byte	Item	Type	Value/Unit	Description
0	Packet ID	UINT8	0x8E	
1	Subpacket ID	UINT8	0xA0	
2	Voltage/Value Flag	UINT8	0 1	Set DAC voltage Set DAC value
3-6	DAC Voltage Value	SINGLE/ UINT32		DAC voltage/Value



Field	Description	Setting
Voltage/ Value flag	Use this field to specify that the DAC is to be Set either by value or by voltage	0: Set DAC by voltage 1: Set DAC by value
DAC Voltage Value	When the Voltage/Value Flag is set to voltage, use this field to specify the numeric value of the DAC as the 32-bit unsigned number	

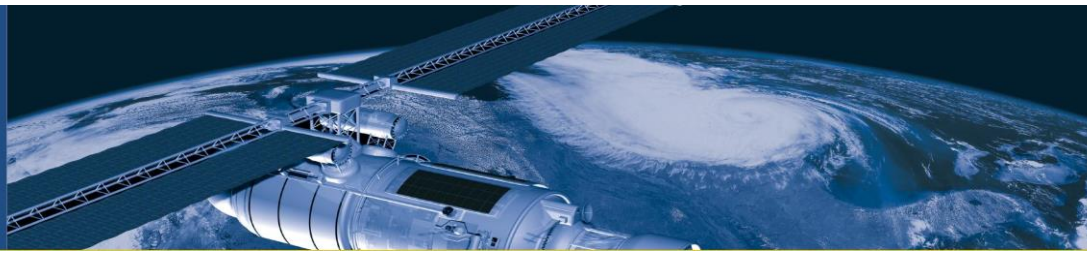
3. Report packet 0x8F-A0: DAC Value *(ICM SMT 360 only)*

This packet is sent in response to packet 0x8E-A0.

Data Field	Description
DAC Value	The current numeric value of the DAC.
DAC Voltage	The current output voltage of the DAC in Volts
DAC Resolution	The number of bits used in the DAC
DAC Data Format	The format of the DAC value
Min. DAC Voltage	The minimum (most negative) voltage that the DAC can produce
Max. DAC Voltage	The maximum (most positive) voltage that the DAC can produce

Report Packet 0x8F-A0 Data Format

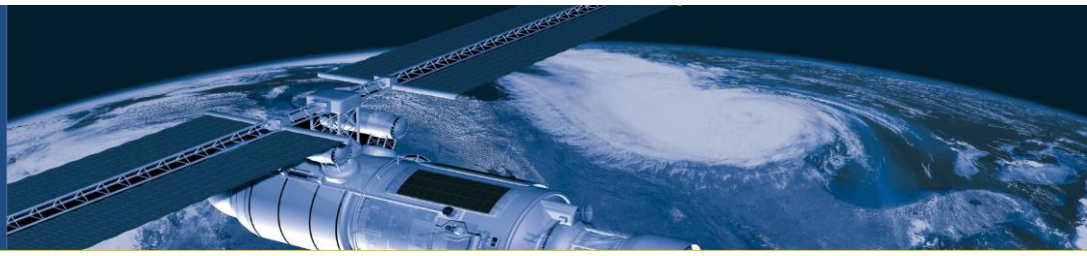
Byte	Item	Type	Value/Unit	Description
0	Packet ID	UINT8	0x8F	
1	Subpacket ID	UINT8	0xA0	
2-5	DAC Value	UINT32		Value
6-9	DAC Voltage	SINGLE		Volts
10	DAC Resolution	UINT8		Number of bits
11	DAC Data Format	UINT8	0 1	Offset binary 2's complement
12-15	Min. DAC Voltage	SINGLE		Volts
16-19	Max. DAC Voltage	SINGLE		Volts



4. Command packet 0x8E-A2: UTC/GPS Timing

This packet is modified for use of all the SMT 360 constellations.

Byte	Item	Type	Bit	Value	Description
0	Packet ID	UINT8		0x8E	
1	Subpacket ID	UINT8		0xA2	Subpacket ID
2	Time Flag	Bit Field	0	0	GPS time (Default)
				1	UTC or GNSS time
			1	0	GPS PPS (Default)
				1	UTC or GNSS PPS
			2	0	Time is set
				1	Time is not set
			3	0	Have UTC info
				1	No UTC info
			4-5	0	UTC (USNO) time
				1	GLONASS time
				2	Beidou time
				3	Galileo time
			6-7	0	UTC (USNO) PPS
				1	GLONASS PPS
				2	Beidou PPS
				3	Galileo PPS



5. Command packet 0x8E-A3: Issue Oscillator Disciplining Command *(ICM SMT 360 only)*

Added new command packet 0x8E-A3 to issue an oscillator disciplining command. ICM responds with Packet 0x8F-A3 in the same format as packet 0x8E-A3.

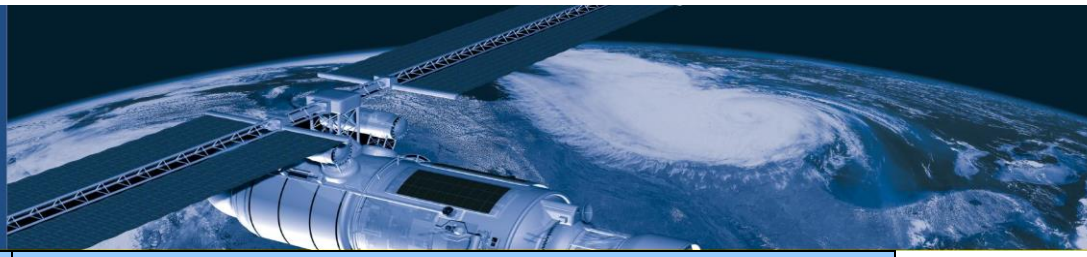
Byte	Item	Type	Value	Description
0	Packet ID	UINT8	0x8E	
1	Subpacket ID	UINT8	0xA3	
2	Disciplining Command	UINT8	0 1 2 3 4 5	Place PPS on time (jam sync) Transition to recovery state Transition to manual holdover Transition from manual holdover Disable oscillator disciplining Enable oscillator disciplining

6. Command packet 0x8E-A8: Set or Request Disciplining Parameters *(ICM SMT 360 only)*

Note *– This packet allows the user to change key disciplining parameters in the ICM.*

This packet is usually intended to be used only when instructed by the factory. Incorrect use of this packet will most likely cause ICM timing outputs to be degraded severely. However, the “Type 2” (Recovery Mode) parameters are intended to be set by the user to suit the application. Send this packet with the type field only to request the current setting. ICM replies to sets and requests with the packet 0x8F-A8.

Type	Data field	Description
0	Type	A “0” in this field indicates that the packet contains loop dynamics information.
	Time Constant	This field carries the time constant of the disciplining control loop
	Damping Factor	This field carries the damping of the disciplining control loop.
1	Type	A “1” in this field indicates that the packet contains 10MHz oscillator parameters.
	OCXO Constant	This field carries the OCXO constant into Hz/Volt.
	OCXO Min. Control Voltage	This field carries the minimum (most negative) control voltage that can be applied to the 10MHz oscillator’s control voltage input.
	OCXO Max. Control Voltage	This field carries the maximum (most positive) control voltage that can be applied to the 10MHz oscillator’s control voltage input.



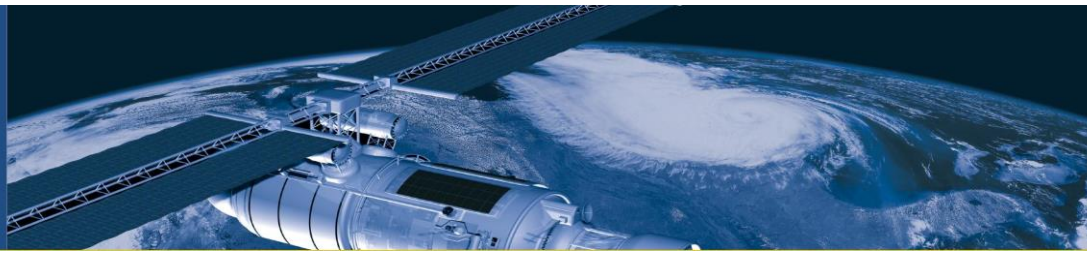
Type	Data field	Description
2	Type	A "2" in this field indicates that the packet contains Recovery Mode parameters. These parameters allow the user to control the recovery process. During Recovery, ICM will remove any PPS offset accumulated during period of Holdover by either shifting the PPS into alignment or by shifting the frequency of the 10MHz oscillator by a specified amount until the PPS has slewed back into alignment or by using both methods. The following tow parameters control these methods: - If a fast recovery is desired, allow jam syncs to be used - If it is important to maintain 10 million clock cycles per PPS pulse, then disable jam syncs and set the maximum frequency offset to a tolerable value.
	Jam Sync Threshold	This field carries the jam sync threshold in nanoseconds used during Recovery mode. While in Recovery Mode, if the PPS offset is above this threshold, ICM will automatically perform a jam sync to shift the PPS into alignment with GPS. The minimum allowed value is 50 ns. Setting a value less than or equal to 0ns will disable automatic jam syncs during Recovery (though the user can still issue a jam sync command with packet 0x8E-A3).
	Max. Frequency Offset	This field carries the maximum allowable frequency offset in ppb (parts per billion or 1E-09) of the 10MHz oscillator during Recovery Mode. While in Recovery Mode, ICM will remove any PPS offset accumulated during periods of Holdover by shifting the frequency of the oscillator by an amount up to the value specified. The minimum allowed value is 5ppb.
3	Type	A "3" in this field indicates that the packet contains the initial DAC voltage parameter.
	Initial DAC Voltage	At reset, the oscillator's frequency control voltage is set to this value.

Command Packet 0x8E-A8 Type 0 Data Format

Byte	Item	Type	Value	Description
0	Packet ID	UINT8	0x8E	
1	Subpacket ID	UINT8	0xA8	
2	Type	UINT8		0 = Loop dynamics
3-6	Time Constant	SINGLE		Seconds
7-10	Damping Factor	SINGLE		Dimensionless

Command Packet 0x8E-A8 Type 1 Data Format

Byte	Item	Type	Value	Description
0	Packet ID	UINT8	0x8E	
1	Subpacket ID	UINT8	0xA8	
2	Type	UINT8		1 = Oscillator parameters
3-6	Oscillator Gain Constant	SINGLE		Hz/Volt
7-10	Min. Control Voltage	SINGLE		Volts
11-14	Max. Control Voltage	SINGLE		Volts



Command Packet 0x8E-A8 Type 2 Data Format

Byte	Item	Type	Value	Description
0	Packet ID	UINT8	0x8E	
1	Subpacket ID	UINT8	0xA8	
2	Type	UINT8		2 = Recovery mode parameters
3-6	Jam sync threshold	SINGLE		nanosecond
7-10	Max. Frequency Offset	SINGLE		ppb

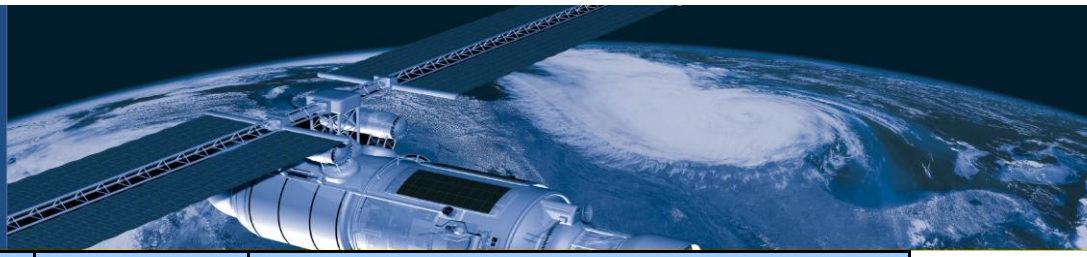
Command Packet 0x8E-A8 Type 3 Data Format

Byte	Item	Type	Value	Description
0	Packet ID	UINT8	0x8E	
1	Subpacket ID	UINT8	0xA8	
2	Type	UINT8		3 = Initial DAC voltage
3-6	Initial DAC Voltage	SINGLE		Volts

7. Report packet 0x8F-AB: Primary Timing Packet

1) Byte 10 – Timing Flag is now used for all the SMT 360 constellations.

Byte	Item	Type	Value	Description		
0	Packet ID	UINT8	0x8F			
1	Subpacket ID	UINT8	0xAB			
2-5	Time of week	UINT32		GPS seconds of week		
6-7	Week Number	UINT16		GPS Week Number		
8-9	UTC Offset	SINT16		UTC Offset (seconds)		
10	Time Flag	Bit Field		**Bit**	**Value**	**Description**
				0	0	GPS time (Default)
					1	UTC or GNSS time
				1	0	GPS PPS (Default)
					1	UTC or GNSS PPS
				2	0	Time is set
					1	Time is not set



Byte	Item	Type	Value	Description		
				3	0	Have UTC info
					1	No UTC info
				4-5	0	UTC (USNO) time
					1	GLONASS time
					2	Beidou time
					3	Galileo time
				6-7	0	UTC (USNO) PPS
					1	GLONASS PPS
					2	Beidou PPS
					3	Galileo PPS
11	Seconds	UINT8	0-59	Seconds		
12	Minutes	UINT8	0-59	Minutes		
13	Hours	UINT8	0-23	Hours		
14	Day of Month	UINT8	1-31	Day of Month		
15	Month	UINT8	1-12	Month of Year		
16-17	Year	UINT16		Four digits of Year		

8. Report packet 0x8F-AC: Supplemental Timing Packet

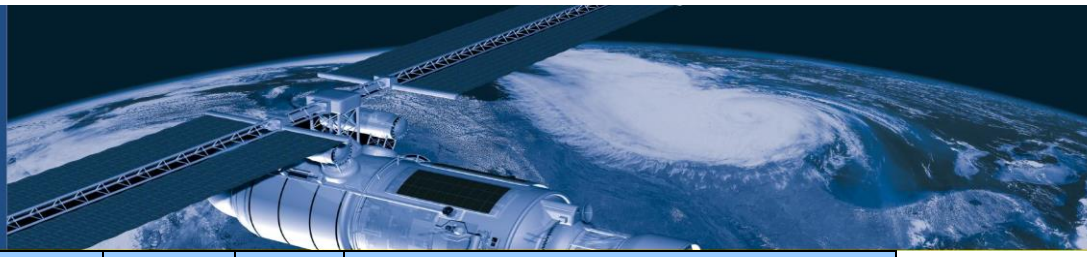
1) Byte 3 - Disciplining Mode was reserved for the GG and is now used for the ICM SMT 360. It is still reserved for the Res SMT 360

2) Bytes 5 to 8 - Holdover Status were reserved on the GG and is now used for the ICM SMT 360. It is still reserved for the Res SMT 360

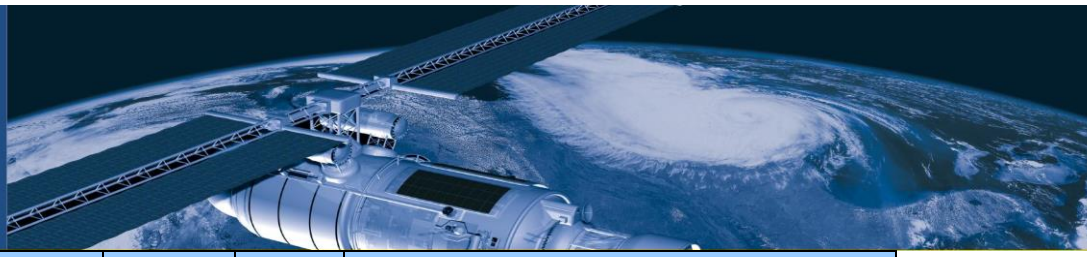
3) Bytes 9 to 10 - Critical Alarms were reserved on the GG and is now used for the ICM SMT 360. It is still reserved for the Res SMT 360

4) Byte 14 - Disciplining Mode was reserved for the GG and is now used for the ICM SMT 360. It is still reserved for the Res SMT 360

5) Byte 15 – PPS Indication was used for the GG and is now used for the Res SMT 360. It is reserved for the ICM SMT 360



Byte	Item	Type	Value	Description
0	Packet ID	UINT8	0x8F	
1	Subpacket ID	UINT8	0xAC	
2	Receiver Mode	UINT8	0 1 3 4 7	Automatic (2D/3D) Single Satellite (Time) Horizontal (2D) Full Position (3D) Over-determined Clock
3	Disciplining Mode (Available only in ICM SMT 360. Mark as Reserved in RES SMT 360)	UINT8	0 1 2 3 4 5 6	Normal (Locked to GPS) Power Up Auto Holdover Manual Holdover Recovery Not used Disciplining Disabled
4	Self-Survey Progress	UNIN8		0-100%
5-8	Holdover Duration	UINT32		Seconds
9-10	Critical Alarms	UINT16	Bit Field	Bit 4 : DAC at rail
11-12	Minor Alarms	UINT16	Bit Field	Bit 0 : DAC near rail Bit 1 : Antenna Open Bit 2 : Antenna shorted Bit 3 : Not tracking satellites Bit 4 : Not disciplining oscillator Bit 5 : Survey-in progress Bit 6 : No stored position Bit 7 : Leap second pending Bit 8 : In test mode Bit 9 : Position is questionable Bit 10 : Not used Bit 11 : Almanac not complete Bit 12 : PPS not generated
13	GPS Decoding Status	UINT8	0x00 0x01 0x03 0x08 0x09 0x0A 0x0B 0x0C 0x10	Doing fixes Don't have GPS time PDOP is too high No usable satellites Only 1 usable sat Only 2 usable sats Only 3 usable sats The chosen sat is unusable TRAIM rejected the fix
14	Disciplining Activity (Only available in ICM SMT 360)	UINT8	0x00 0x01 0x02 0x03 0x04 0x05 0x06 0x07	Phase Locking Oscillator warm-up Frequency locking Placing PPS Initializing loop filter Compensating OCXO (Holdover) Inactive Not used



Byte	Item	Type	Value	Description
			0x08 0x09	Recovery mode Calibration/control voltage
15	PPS indication (Available only in RES SMT 360 – Reserved for ICM SMT 360)	UINT8	0	PPS Good indication
			1	PPS Not Good indication
16	Spare Status 2	UINT8		0x00
17-20	PPS Offset	Single		ns
21-24	Clock Offset	Single		ppb
25-28	DAC Value	UINT32		
29-32	DAC Voltage	Single		Volts
33-36	Temperature	Single		Degrees C
37-44	Latitude	Double		Radians
45-52	Longitude	Double		Radians
53-60	Altitude	Double		Meters
61-64	PPS Quantization Error	Single		ns
65-68	Spare			Future expansion

Commands in the Res SMT GG that are not in SMT 360 modules

Command Packet 0x22: Request GPS Satellite Selection
Command Packet 0x23: Request Initial Position (XYZ)
Command Packet 0x25: Soft Reset / Self-Test
Command Packet 0x29: Almanac Health Page Request
Command Packet 0x2D: Oscillator Offset Request
Command Packet 0x3B: Satellite Ephemeris Status Request

If you have any further questions please call your local Trimble sales representative.

Trimble