Accurate Time & Frequency system for military applications

Model AR51A-09

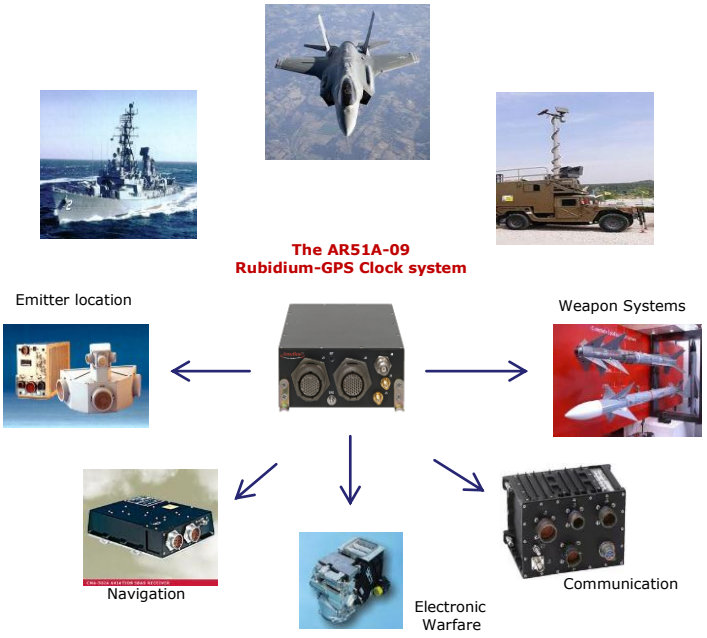
Use as an accurate Time & Frequency center for military platforms

Key features:

- *GPS disciplined Rubidium clock*
- *Frequency Accuracy : 1E-12*
- *1PPS Accuracy: 30ns (RMS)*
- *Multiple outputs: 10MHz, 1PPS, TOD (Time of Day)*
- *TOD protocols: Have Quick, CLI*
- *Inputs: GPS antenna, 1PPS, TOD*
- *Holdover (no GPS): 1µs/24 hrs (typ.), 5E-11/month*
- *Monitor & Control: RS232 / RS422*
- *C/A code GPS receiver*
- *MIL-STD qualification for airborne applications*
- *Compact: 175 mm (d) x 132 mm (w) x 56 mm (h)*

Options:

- *P(Y) code GPS (SAASM) receiver*
- *TOD : NMEA, NTP / PTP, IRIG B*
- *Monitor & Control: LAN (UDP, SNMP)*



For Airborne, Ship borne & Land platforms

The AR51A-09 unit is a compact GPS-Disciplined Rubidium Clock, which offers an excellent stability and accuracy. The unit includes a Rubidium-Atomic-Standard, which is phase-locked to the disciplining source (like GPS or other external inputs).
All outputs are derived from the Rubidium-Atomic-Standard and maintain highly accurate time and frequency even when GPS reception interrupted.

The AR51A-09 includes Time of Day (TOD) inputs and outputs. The standard unit include several Have Quick (ICD-GPS-060) Time Code outputs, followed by several (more than 20) 1PPS outputs (PTTI ICD-GPS-060, TTL and RS-422 formats) for accurate timing which is essential for secure radio communication applications. The standard unit includes also Have Quick (ICD-GPS-060) Time Code input for initial time loading followed by 1PPS input for the 1PPS timing synchronization, when the GPS signal is not available.
The communication with the unit is the CLI (Command Line Interface) by RS-232 or RS-422. The CLI outputs provides Time, Navigation and status data. The unit can be configured by CLI input channel.

Other Time of Day formats are available as an option like NMEA, IRIG B, NTP or PTP.

The AR51A-09 can be synchronized from 3 independent inputs: internal GPS, external GPS and other external independent accurate timing systems. The input synchronization source is selected manually by user or automatically.

Standard option of the unit is LAN interface, which include NTP (Network Time Protocol), and Monitor & Control by UDP or by SNMP.

The AR51A-09 is designed for demanding military platforms such as fighter aircraft, helicopters, UAV's, ship borne, submarine and mobile land platforms. The unit is designed for quick installation on a tray or hard mount installation with screws.

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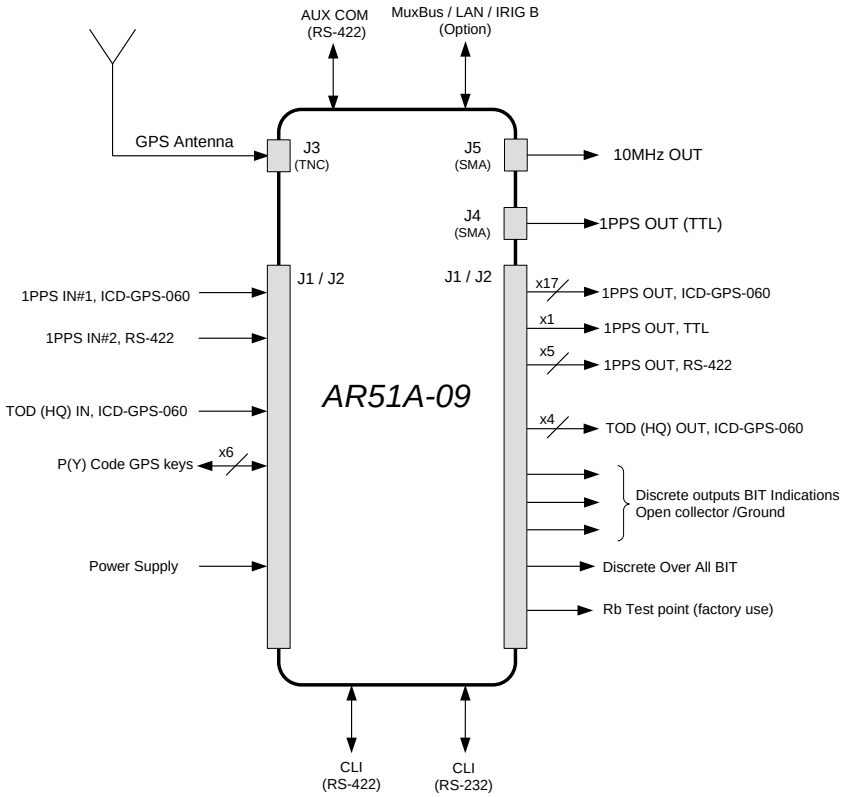
Input & Outputs

Outputs (*)	10MHz, Sine wave (8±3) dBm / 50Ω (x 1)	
	1PPS TTL/50Ω (x 2)	
	1PPS RS-422 (x 5)	
	1PPS PTTI (ICD-GPS-060)/ 50Ω (x 17)	
	TOD Have Quick (ICD-GPS-060) / TTL 100KΩ (x 4)	Options: NMEA, NTP server V3 per RFC1305 ≤ 1ms, IEEE 1588 (PTP) – Grandmaster, IRIG B
	H/W BIT (open collector) (x 1)	
Inputs	TOD Have Quick (ICD-GPS-060) / TTL 100K Ω (x 1)	Options: NMEA, IEEE 1588 (PTP) – Slave, IRIG B
	1PPS TTL/50Ω or PTTI, ICD-GPS-060/ 50Ω (x 1)	
	1PPS RS-422 (x 1)	
	GPS Antenna	
CLI Communication	CLI – Command Line Interface, RS232 or RS422 for status monitoring and control for unit configuration Baud rate: 19,200, Control: 1, N, 8	Options: LAN – UDP & SNMP, MIL- STD-1553RT (Mux-Bus)
MIL-GPS keys		Option: P (Y) code GPS receiver crypto keys

(*) For other outputs contact factory.



Electrical Interface

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Performance

Time (1PPS)	**Long- term Accuracy**	**Disciplined to GPS or to an external synchronization source**	50ns RMS @ 25°C (Typical: 30ns RMS)
		Time drift without GPS (Hold-Over)	< ±1µs/24hr (typical)
Frequency (10MHz)	**Long Term Stability**	**Disciplined to GPS or to external 1PPS**	< ±1E-12 (24 hours average)
		Frequency drift without GPS (Hold-Over / Aging)	±5E-11 / month
	Short Term Stability (ADEV)	≤ 3E-11 @ 1s	
	Temperature Stability	≤ ±3E-10 over -25°C to +65°C (relative to +25°C) (-40°C to +71°C available as an option)	
	Phase Noise	**Offset frequency [Hz]**	**Phase noise [dBc / Hz]**
		10Hz	≤-114 dBc/Hz
		100Hz	≤-140 dBc/Hz
		1KHz	≤-146 dBc/Hz
		10KHz	≤-150 dBc/Hz
	Harmonics	≤-53 dBc (up to 90MHz)	
	Spurious	≤-110 dBc @ ± 100KHz from carrier	
	Warm-up (accuracy vs. time)	Rb Lock (< 1E-9) < 5 min ±5E-10 within < 7 min ±5E-11 within < 60 min ±1E-11 within < 4hrs ±1E-12 within < 24 hrs	
	Retrace (without GPS or other disciplining input)	± 5E-11	

GPS Receiver

GPS Type	C (A) Code GPS receiver	P (Y) Code GPS receiver (option)
GPS Tracking	L1 frequency 1575 MHz C/A code (SPS) 12 parallel tracking channels.	L1/L2 frequency P(Y) code SAASM 12 parallel tracking channels
Ephemeris & Almanac	Available (Option)	---
Position Accuracy	Latitude, Longitude: < 6m (CEP 50%) Altitude: < 11m (CEP 50%)	PPS: < 12 m CEP
Acquisition Time (Typical) (*)	Warm start ≤ 45 second Cold start ≤ 50 second (worst case)	Warm start ≤ 1 min (worst case) Cold start ≤ 12.5 minutes (worst case) ≤ 30 seconds when receiving the same satellites constellation (warm or cold start)
Internal backup battery	N / A	Keeping Ephemeris & Almanac. The receiver uses the battery for saving the data for non-operating accumulative duration of about 2 years.
GPS Antenna DC Voltage	5VDC (up to 100 mA)	

The P (Y) code GPS receiver must be supplied by user.

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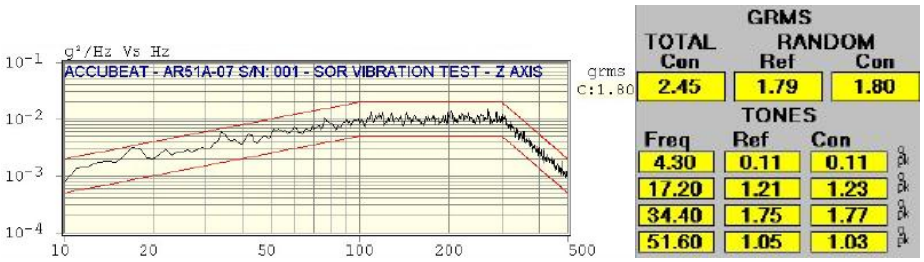
Environmental

Temperature	Operating :-25°C to +65°C (option for -40°C to +65°C) Emergency: +71°C for 30 minutes Storage : -40°C to +85°C
Temperature Altitude	0 to 50,000 ft
Humidity	95% non condensing
Random Vibration	2.45gRMS as per the following profile: 
Mechanical Shock - Operation	MIL-STD-810C/E, Method 516.2, Proc. 1 (30g / Half sine / 3 axis / 6 shocks per axis)
Mechanical Shock - Crash	X-40G, Y-15G, Z-20G, 11ms, Half Sine, Total 12 shocks
Bench Handling Shock	MIL-STD-810F, Method 516.5, Procedure VI
Rain	MIL-STD-810E Method 506.3 procedure I
Dust	MIL-STD-810E Method 510.3
Salt Atmosphere	MIL-STD-810E, Method 509.3, Procedure I
Bonding	≤2.5 mΩ
EMI / RFI	MIL-STD-461B/C Part: 5 (CE01, CE03, CE07, RE02, CS01, CS02, CS06, RS02, RS03)

Power Supply

Input Voltage	22-32 VDC (28 VDC Typ.) per MIL-STD-704D
Power consumption	< 30 W @ 28 VDC (warm-up) < 16 W @ 28 VDC @ 25°C (steady-state) < 20 W @ 28 VDC @ -25°C (steady-state)

Reliability, Maintainability, Testability

MTBF	> 16,000 hours @ 30°C, ARW, MIL-HBK-217F (for C/A GPS receiver) > 3,700 hours @ 30°C, ARW, MIL-HBK-217F (for P/Y GB-GRAM)
MTTR – O Level	12 minutes to replace failed unit (including warm-up time)
BIT (Built In Test)	On-line BIT – Automatic, Covers > 90% of all failures

Dimensions & Weight

Dimensions	175 mm (d) x 132 mm (w) x 56 mm (h)	
Weight	C / A code GPS receiver	≤ 1.2 Kg
	C / A code GPS receiver and LAN / 1553 board:	≤ 1.3 Kg
	P / Y code GPS receiver, back up battery and LAN / 1553 board	≤ 1.5 Kg

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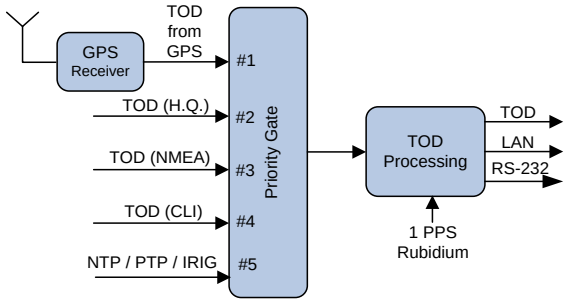
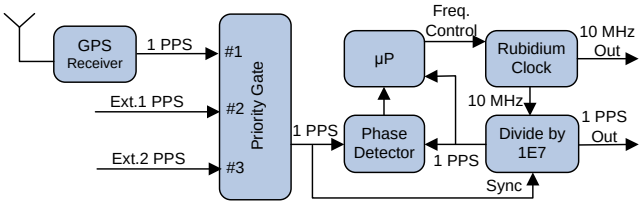
Principles of Operation

The following block diagrams depict the operation of the AR51A-09. The unit includes Rubidium Standard and accepts Input from internal GPS receiver, external 1PPS or external TOD (H.Q). All outputs are derived from the internal Rubidium Clock, which is phase locked by a digital PLL to the selected input. Thus, the Rubidium Clock - frequency and time - follows the GPS on the long term average. If GPS reception is lost for short or long periods of time the Rubidium Clock shall maintain accurate time and frequency with no phase interruption.

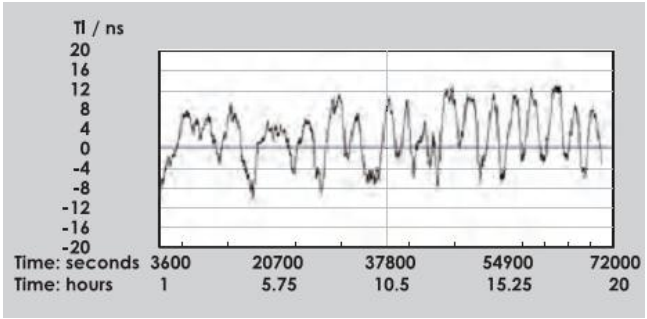


Data flow & Inputs Selection

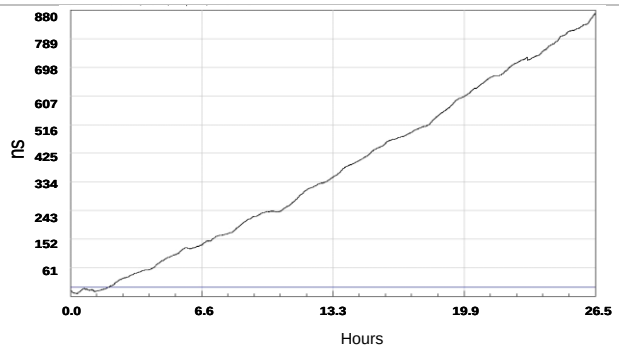


Rubidium-GPS DPLL and Inputs

Typical Performance Plots



Typical time error fluctuations when disciplined to GPS



Typical time error in Holdover (without GPS)

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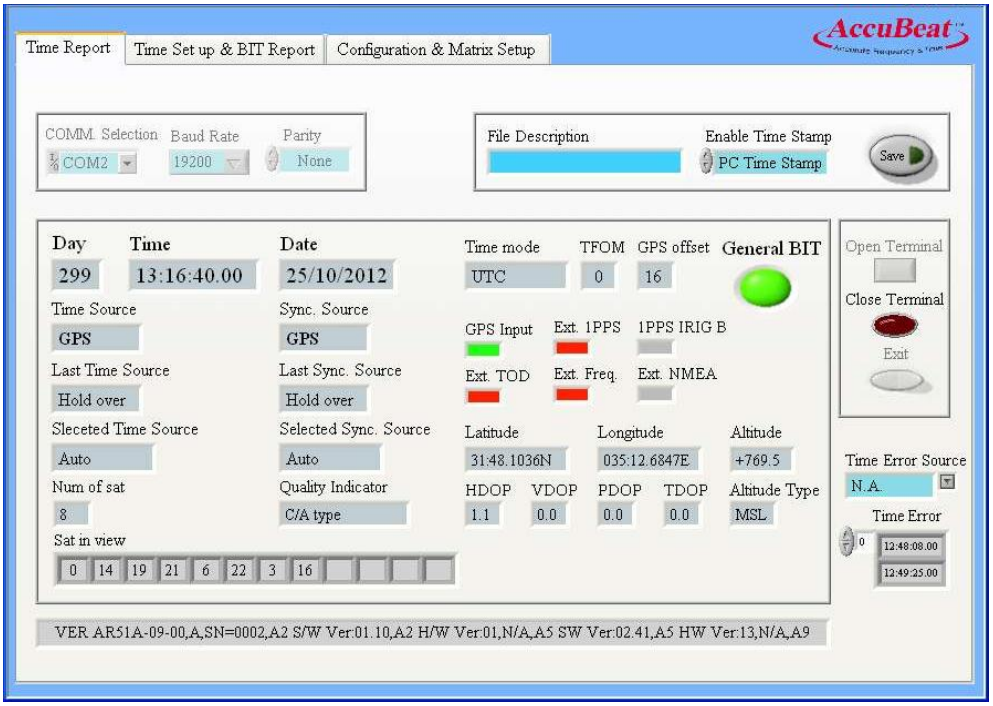
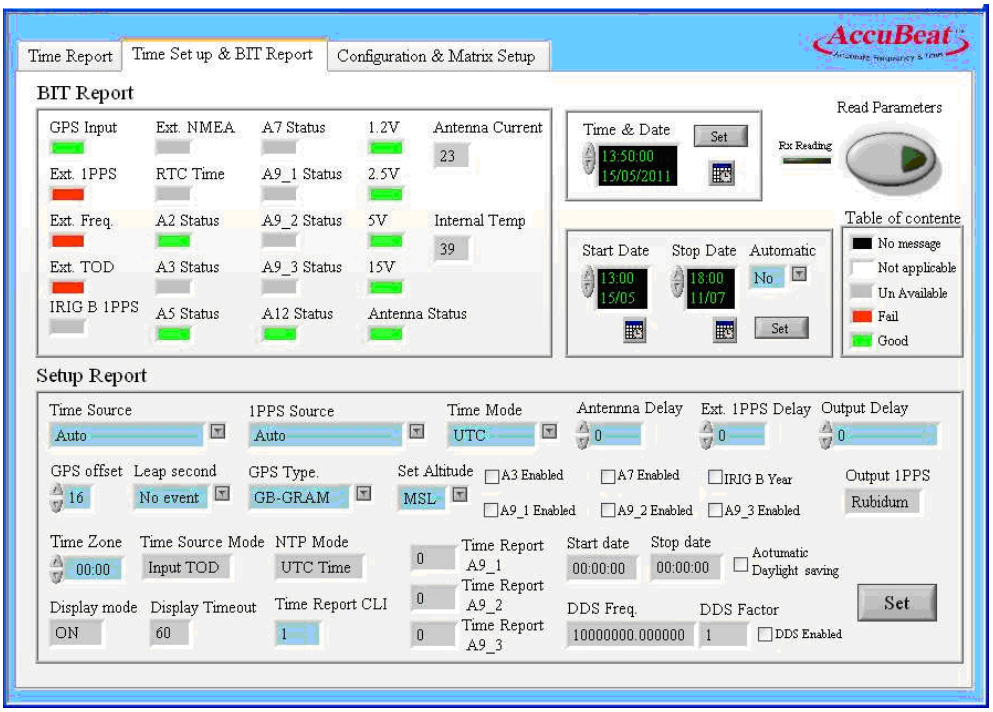
Graphic User Interface (GUI) Software for PC (Option)

GUI for PC is available: parameters settings (like: time, date, unit configuration etc'), monitoring (like: BIT status) and data presentation (like: time, date, position etc')





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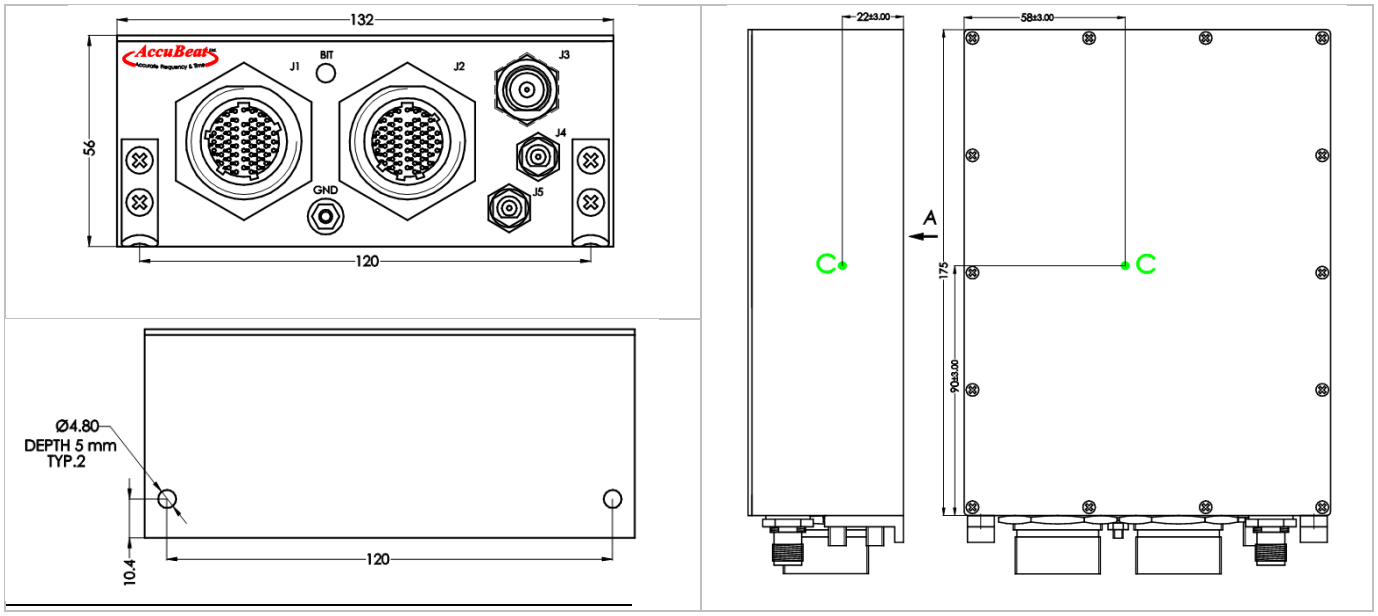
Mechanical ICD



Electrical ICD

Connector	Description	I/O
J1	1PPS RS422 outputs x 4 1PPS RS422 Input x 1 1PPS TTL output x 1 Have Quick outputs x 2 Have Quick input x 1 CLI RS-232 (Rx, Tx) LAN / MuxBus Over all BIT indication x 1 P (Y) code GPS receiver crypto keys Power supply	In / Out
J2	1PPS RS422 output x 1 1PPS PTTI input x 1 1PPS PTTI outputs x 17 Have Quick output x 2 CLI RS422 x 1	In / Out
J3	GPS antenna input 1.5GHz, TNC, Female 5V DC – out for active antenna	In / Out
J4	1PPS , TTL / 50Ω, SMA, Female	Out
J5	10MHz, Sine-wave, 8 ± 2dBm, 50Ω, SMA, Female	Out

(*) For more details on the electrical ICD contact factory

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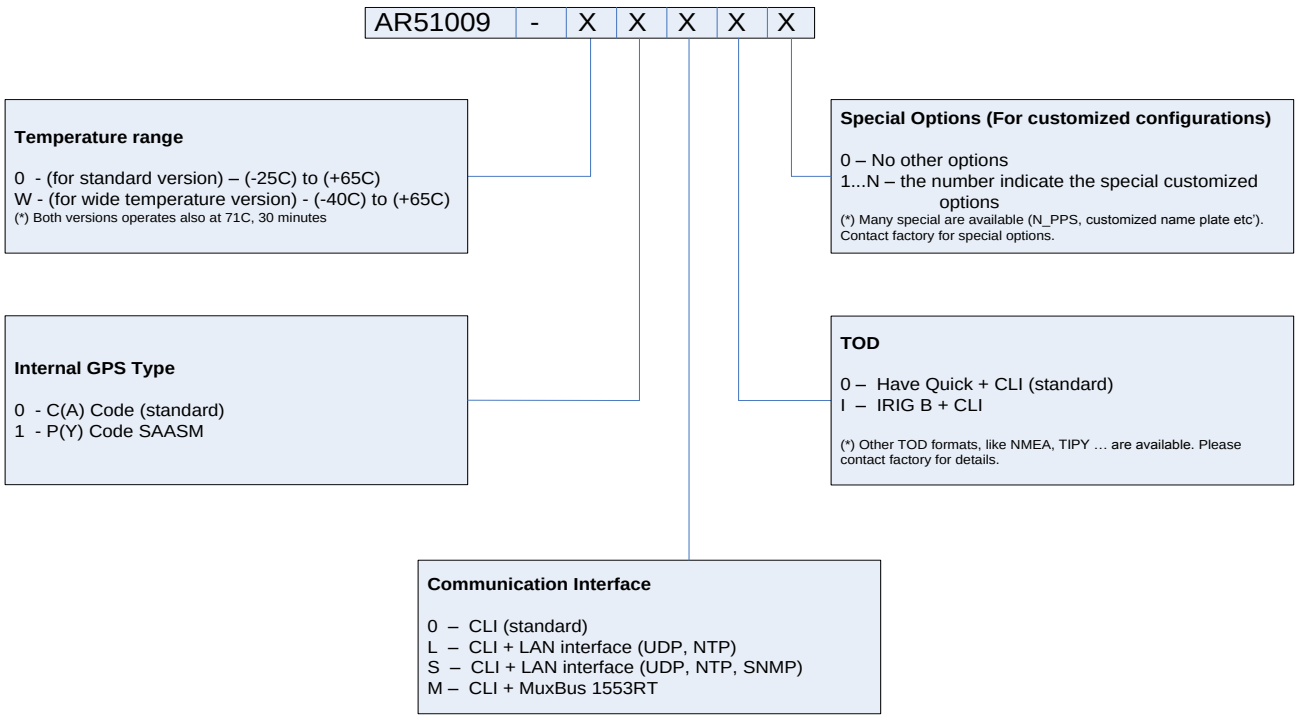
HOW TO ORDER

AccuBeat P/N	Description				
	Temperature Range	GPS Type	Communication Interface	TOD	Special Options
Standard AR51009-00000	-25°C to +65°C (71°C, 30 minutes – emergency)	C (A)	CLI	Have Quick + CLI	---
AR51009-xxxxx					



** Please note that not all combinations may be possible. Please contact AccuBeat for further information

ACCESSORIES

For Accessories like GPS antenna, antenna cable, tray with vibration isolator, GUI etc. contact factory.

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