Accurate Time & Frequency system for military applications
Use as an accurate Time & Frequency center for military 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.

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)

The AR51A-09 Rubidium-GPS Clock system

Emitter location

Weapon Systems

Navigation

Communication

Electronic Warfare

For Airborne, Ship borne & Land platforms

Options

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

Description

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.

All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

Specifications

Input & Outputs		
Outputs (*)	10MHz, Sine wave (8±3) dBm / 50W (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 cryptokeys

(*) For other outputs contact factory.
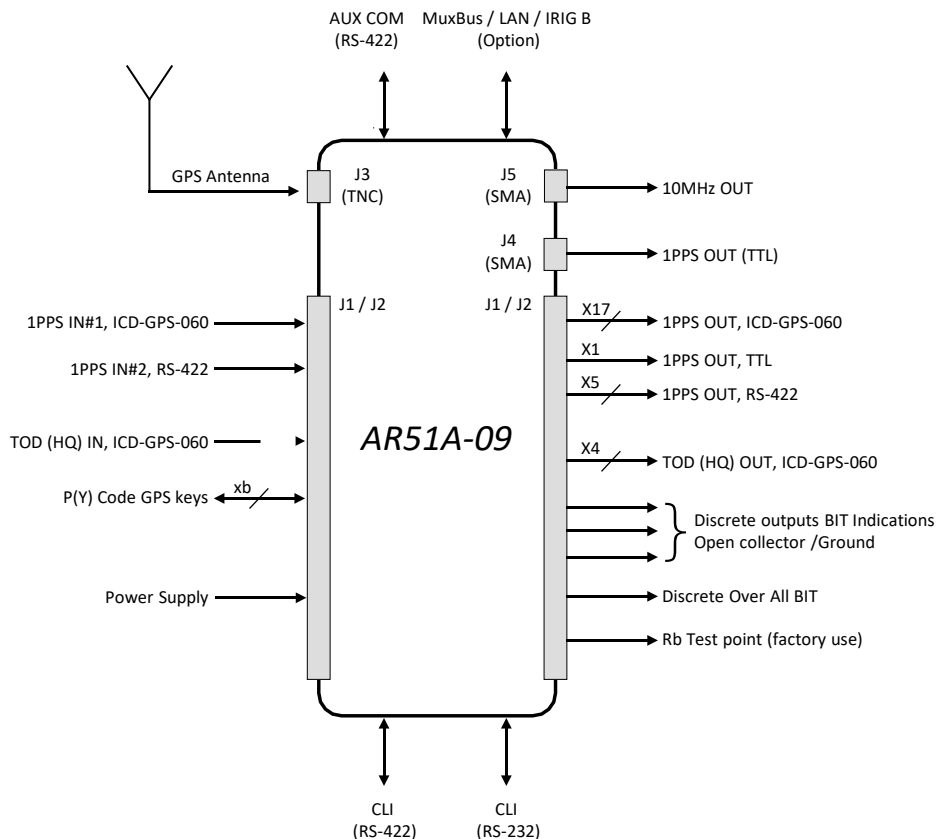
All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified
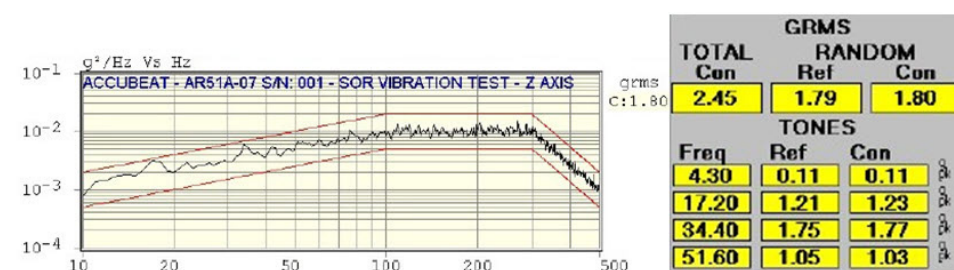
Electrical Interface

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)	Frequency Accuracy	Disciplined to GPS or to external 1PPS	< ±1E-12 (24 hours average)
	Long Term stability	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	≤-140 dBc/Hz
		10KHz	≤-150 dBc/Hz
	Harmonics	≤-53 dBc (up to 90MHz)	
	Spurious	≤-100 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 receiveruses the battery for saving the data for non-operating accumulative duration of about 2years.
GPS Antenna DC Voltage	5VDC (up to 100 mA)	

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

All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

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 (option: lower storage temperature of -46°C. Been tested in modelAR51A009-W0L00)
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

All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

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
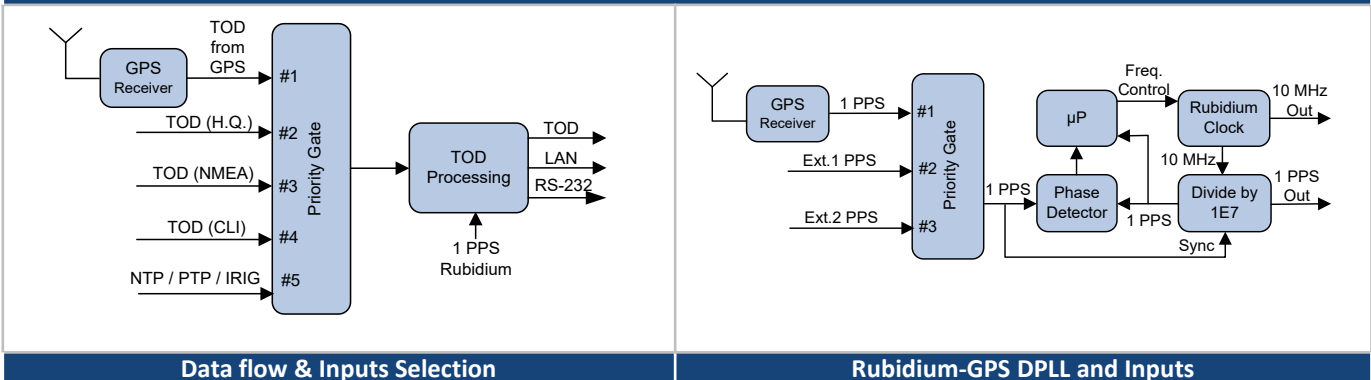
Typical Performance Plots
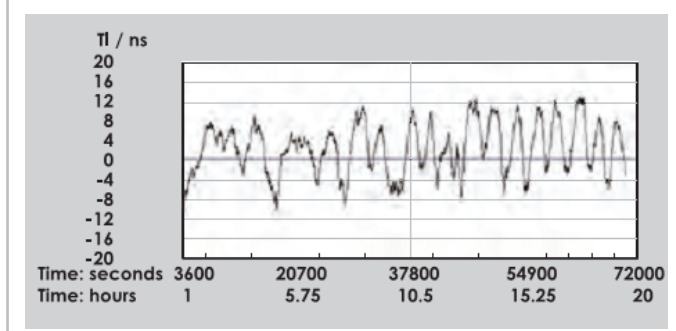
Typical time error fluctuations when disciplined to GPS
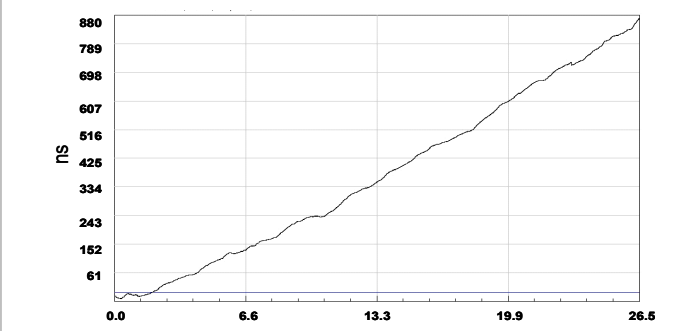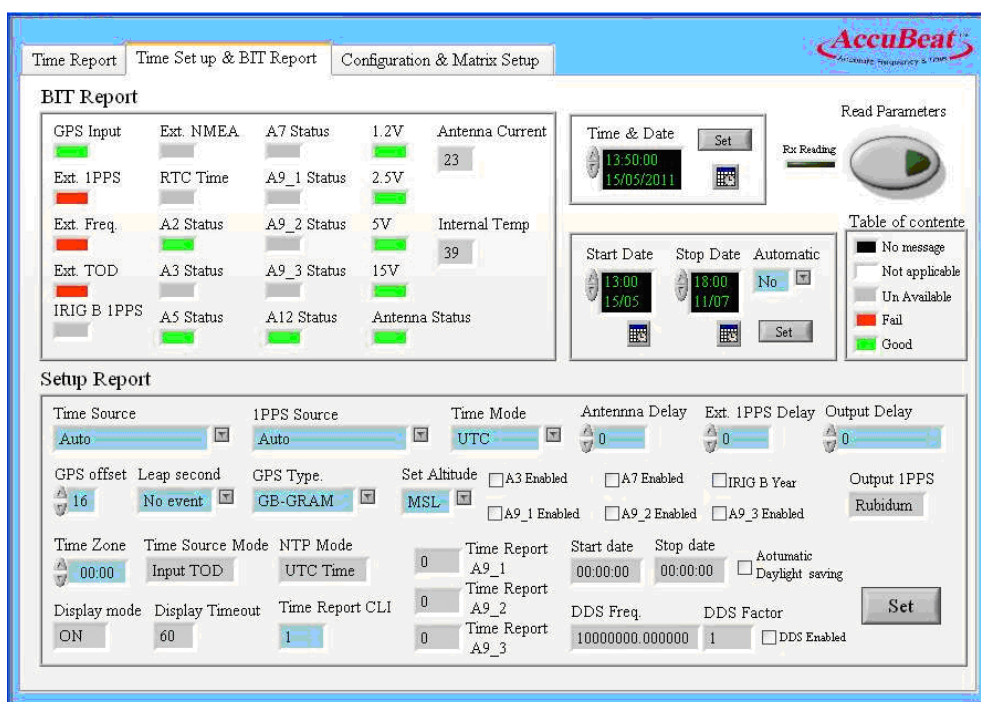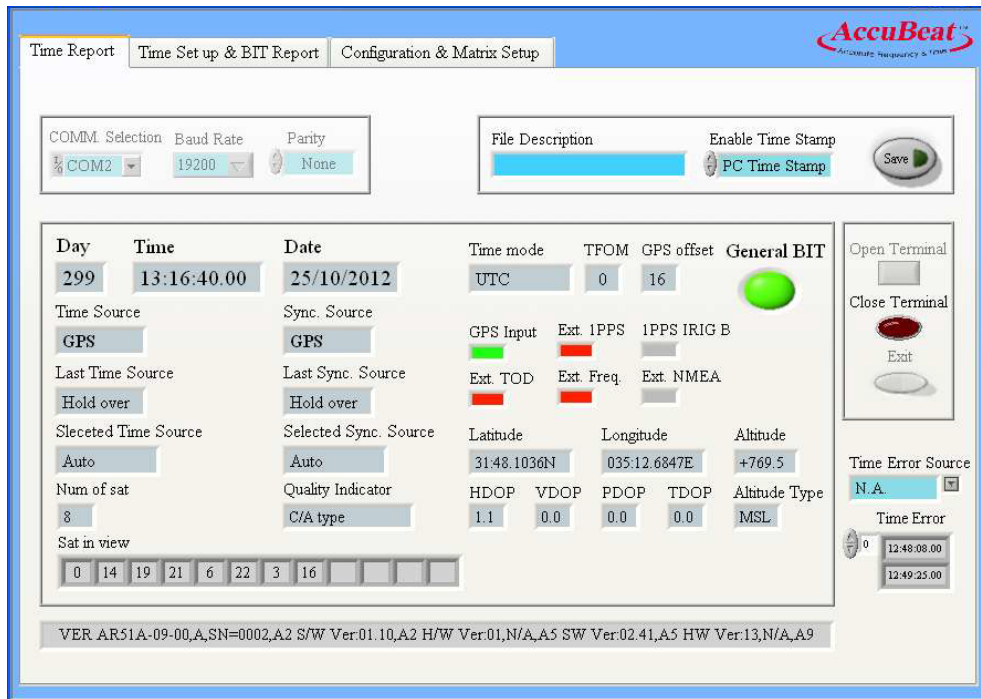

Typical time error in Holdover (without GPS)

All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified
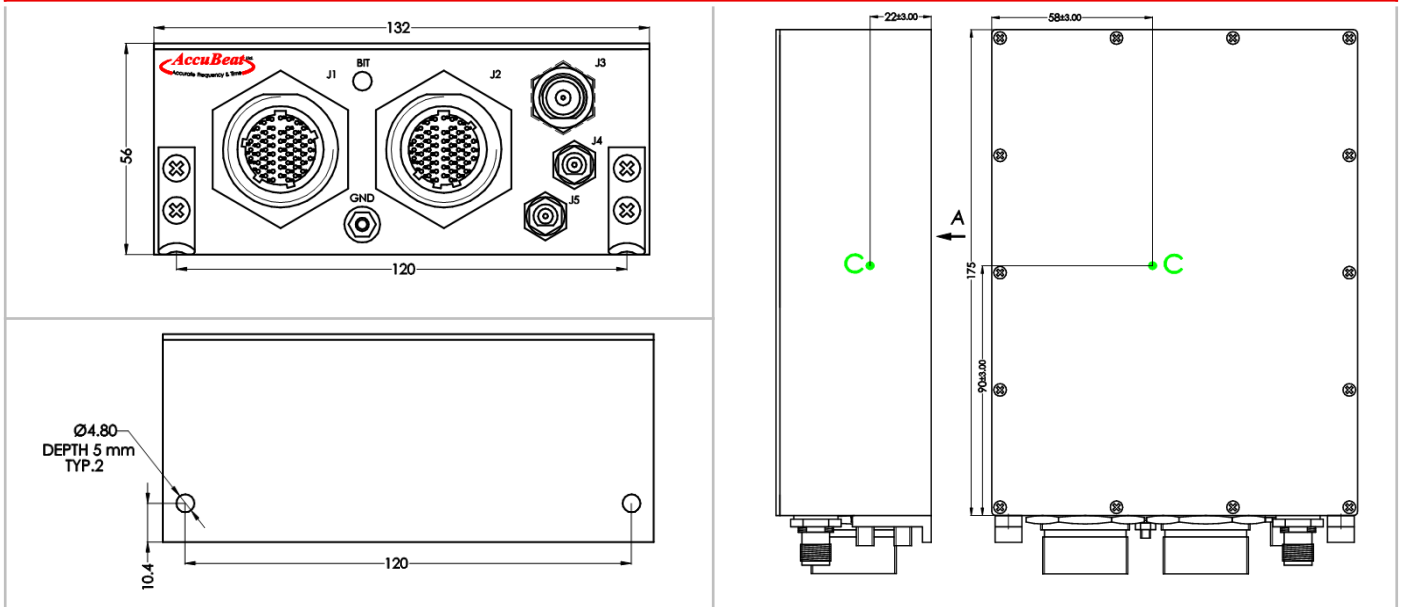
Graphic User Interface (GUI) Software for PC (Option)

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')

All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

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

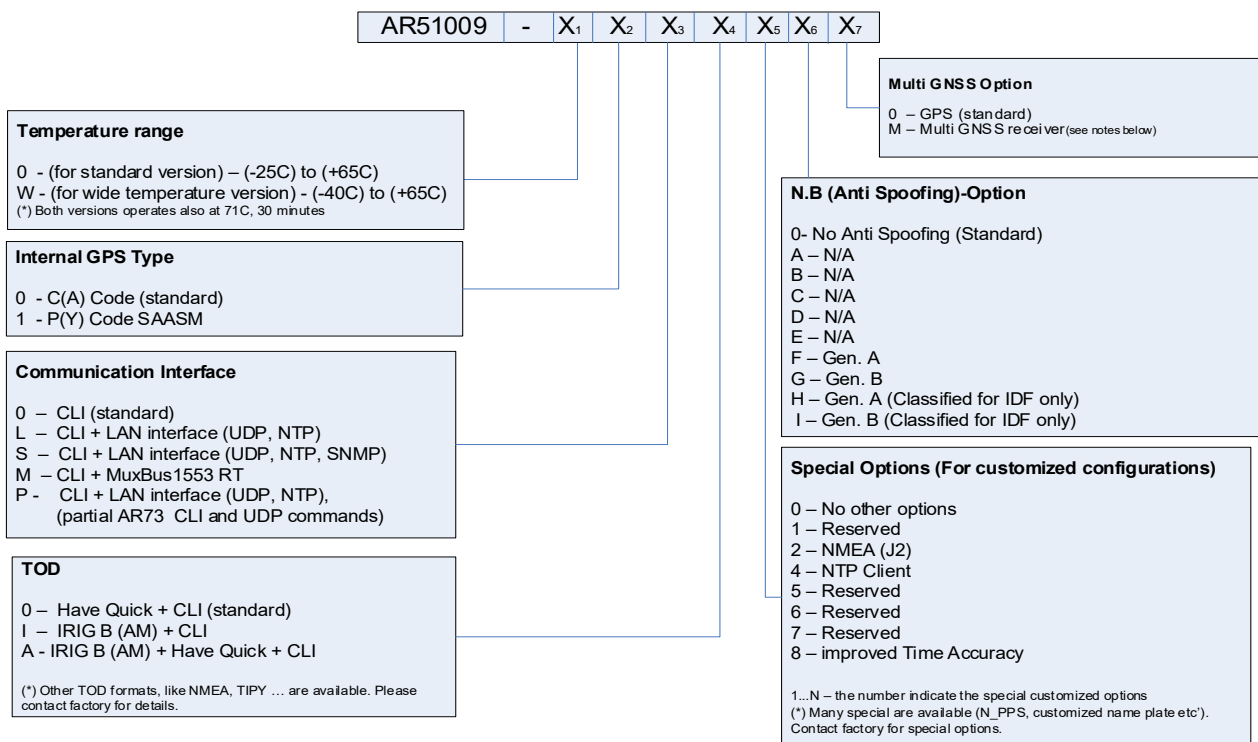| Electrical ICD		
Connector	**Description**	**I/O**
J1	1PPS RS422 outputs x 4 1PPS RS422 Input x 1 1PPS TTL output x 1 Have Quick outputs x 2 Have Quick input x 1 CLI RS-232 (Rx, Tx) LAN / MuxBus Over all BIT indication x 1 P (Y) code GPS receiver crypto keys Power supply	In / Out
J2	1PPS RS422 output 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

All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

HOW TO ORDER

AccuBeat recommends the following operation configuration:

1. Time & Sync. source : GPS (See *'STS' & 'SPS'* CLI commands).
2. AccuBeat GPS anti-spoofing suit ("Narrow Bell").
3. AccuBeat calibration suitcase for GPS denied environment.

For other operation configurations please contact factory in order to verify proper operation.

AR51009 - X_1 X_2 X_3 X_4 X_5 X_6 X_7

Temperature range

0 - (for standard version) – (-25C) to (+65C)
W - (for wide temperature version) - (-40C) to (+65C)
(*) Both versions operates also at 71C, 30 minutes

Internal GPS Type

0 - C(A) Code (standard)
1 - P(Y) Code SAASM

Communication Interface

0 – CLI (standard)
L – CLI + LAN interface (UDP, NTP)
S – CLI + LAN interface (UDP, NTP, SNMP)
M – CLI + MuxBus1553 RT
P - CLI + LAN interface (UDP, NTP),
  (partial AR73 CLI and UDP commands)

TOD

0 – Have Quick + CLI (standard)
I – IRIG B (AM) + CLI
A - IRIG B (AM) + Have Quick + CLI

(*) Other TOD formats, like NMEA, TIPY … are available. Please contact factory for details.

Multi GNSS Option

0 – GPS (standard)
M – Multi GNSS receiver(see notes below)

N.B (Anti Spoofing)-Option

0- No Anti Spoofing (Standard)
A – N/A
B – N/A
C – N/A
D – N/A
E – N/A
F – Gen. A
G – Gen. B
H – Gen. A (Classified for IDF only)
I – Gen. B (Classified for IDF only)

Special Options (For customized configurations)

0 – No other options
1 – Reserved
2 – NMEA (J2)
4 – NTP Client
5 – Reserved
6 – Reserved
7 – Reserved
8 – improved Time Accuracy

1...N – the number indicate the special customized options
(*) Many special are available (N_PPS, customized name plate etc').
Contact factory for special options.

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

Notes:
1. Multi GNSS supports GPS, GLONAS, GALILEO and BEIDU constellation.

ACCESSORIES

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