![AccuBeat Ltd. Accurate Frequency & Time]

GPS-Disciplined Rubidium Clock

AR51A-07

Industrial/ Military Compact Low Profile

Key Features

- ❖ GPS disciplined Rubidium clock
- ❖ Outputs: 10MHz, 1PPS (TTL & RS-422), TOD (Have Quick), 2PPS (opt.)
- ❖ Input: GPS antenna, 1PPS, TOD (Have Quick)
- ❖ Frequency Accuracy : 2E-12
- ❖ 1PPS Accuracy: Typ. 20ns (RMS)
- ❖ NTP Server. Time Accuracy <300µs (opt)
- ❖ Holdover (no GPS): Typ. 1µs/24 hours, 5E-11/month
- ❖ Operating Temperature: -25℃ to +65℃ (71℃ Emergency). -40℃ (opt.)
- ❖ Control and monitoring : RS-232 (input & output), RS-422 (output), MIL-STD-1553 (opt.)
- ❖ Ephemeris, Almanac & Ionosphere Data
- ❖ Supply Voltage: 22-32 VDC per MIL-STD-704D
- ❖ External battery input for power back-up

Low Profile!

- ❖ P(Y) code GPS (SAASM) receiver (Option)
- ❖ Full MIL-STD qualification for military Airborne Applications
- ❖ Graphic User Interface (GUI) Software for PC

Description

The **AR51A-07** unit is an industrial low profile GPS-Disciplined Rubidium Clock which offers an excellent stability and accuracy. The unit includes a Rubidium-Atomic-Standard which is phase-locked to the 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 is interrupted. When disciplined to GPS the unit provides time accuracy of < 20ns RMS and frequency accuracy better than 2E-12.

The AR51A-07 includes Have Quick (ICD-GPS-060) input and output which is essential for secure radio communication applications. The unit can be remote controlled via MIL-STD-1553RT channel which is required in airborne applications.

The unit includes internal GPS receiver (C/A code) and have option to install P(Y) code SAASM GPS receiver (For more information contact factory).

The AR51A-07 is designed for demanding platforms such as airborne, helicopters, UAV's, shipboard and ground mobile.

Applications

- ❖ Communication
- ❖ Telemetry test fields
- ❖ Field calibration

SPECIFICATIONS

All specs are at room temperature, quiescent conditions and sea level ambient, unless otherwise specified.

Input & Outputs

Outputs	1 x 10MHz, Sine wave (8±3) dBm SMA / 50Ω	
	2 X 1PPS TTL/50Ω	
	5 x 1PPS ICD-GPS-060/ 50Ω (10V, 20μs)	
	4 x 1PPS RS-422	
	AUX: 1PPS TTL/50Ω or other signal (opt.)	
	5 X TOD ICD-GPS-060 / 100KΩ	
Input	TOD ICD-GPS-060 TTL/100K Ω	
	GPS Antenna	
	External 1 PPS ICD-GPS-060/ 50Ω or TTL/50Ω (see option 4)	
Communication	CLI RS232 (input/output) for control and monitoring: setting time/date, delay correction for 1PPS 10ns steps, mode of operation; disciplining to GPS/Ext 1PPS, holdover, UTC time, GPS Time, Local Time, Day Light Saving etc. (see CLI document for more information). Baud rate: 19,200, Control: 1, N, 8	
	CLI RS422 (the Input (RXD) can not be connected simultaneously with the RS232).	
	Option: LAN – NTP / MIL- STD-1553RT (MUX-BUS)	
	GUI for PC is available :Time, Date, Position, Status, BIT (Built in test) etc.	

Diagram labels: GPS Ant. — J4, 1PPS PTTI, TOD H.Q, CLI RS-232, GPS Crypto Keys, MUX-BUS Address (opt.) — J2, NTP / MUX-BUS (opt.) — J3, 22-32 VDC — J1. AR51A-07. Outputs: 5x TOD H.Q, 5x 1PPS PTTI, 4x 1PPS RS-422, 1x 1PPS TTL/50Ω, CLI RS-422, Overall BIT — J2, AUX OUT:1PPS RAW — J5, 10MHz/ 50Ω — J6, 1PPS TTL/ 50Ω — J7.

Performance

Time (1PPS)	Long- term Accuracy	Disciplined to GPS or to an External synchronization source	50ns RMS (typ. 20ns RMS) @ 25℃, relative to an external ref.		
		Time Drift without GPS (Hold-Over)	< 1μs/24hr (Typ.)		
Frequency (10MHz)	Long Term Stability	Disciplined to GPS or to Ext. 1PPS	< 2E-12 (24 hour average, const temp.)		
		Free running Rubidium-Standard	5E-11 / month drift in holdover		
	Short Term Stability	≤ 4E-11 @ 1s (≤3E-11 Typ.)			
	Temperature Stability	±3E-10 over -25℃ to +65℃ (-40℃ opt.)			
	Phase Noise	Frequency	Standard (spec)	Standard (typical)	Improved (typical)
		1Hz			-96/Hz
		10Hz	≤-100dBc/Hz	-101dBc/Hz	-128/Hz
		100Hz	≤-134dBc/Hz	-137dBc/Hz	-148/Hz
		1KHz	≤-143dBc/Hz	-144dBc/Hz	-150/Hz
		10KHz	≤-145dBc/Hz	-149dBc/Hz	-153/Hz
	Harmonics	≤-45 dBc (-58 dBc typ.)			
	Spurious	<-75 dBc @ ± 100KHz from carrier			
	Warm-up	Rb Lock < 4 min 5E-10 within < 7 min 5E-11 within < 60 min, 1E-11 within < 4hrs 2E-12 within < 24 hrs.			
	Retrace	± 4E-11			

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SPECIFICATIONS *(continue)*

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Power Supply	
Input Voltage	22-32 VDC (28 VDC Typ.) per MIL-STD-704D
Power	< 30 Watt @ 28 VDC (warm-up) < 14 Watt @ 28 VDC @ 25℃ (steady-state)
Battery Back-Up	External power input for battery back-up via the main power inlet Automatically operated when the main power reduces to 24 VDC

Industrial GPS Receiver (MIL-P (Y) code as an option)	
Tracking	L1 frequency (1575 MHz), C/A code 12 parallel tracking channels L1/L2 frequency P(Y) code SAASM 12 parallel tracking channels as an option (For more information contact factory)
Position	Lat., long., alt.
Position Accuracy (Lat long)	6m CEP (50%) w/o SA
Position Accuracy (Alt)	11m CEP (50%) w/o SA
GPS Antenna DC Voltage	5V
Acquisition Time	Warm start 45 second, Cold start < 50 second (worst case)

Dimensions & Weight	
Dimensions	245 mm (w) x 166 mm (h) x 56 mm (d)
weight	1.5 Kg

| Environmental	
Temperature	Operating:-25℃ to +65℃ (-40℃ to +65℃ Opt.) Emergency: +71℃ for 60 minutes Storage: -40℃ to +71℃
Temperature Altitude	-40℃ to +65℃ (+71℃ for 60 minutes) 0 to 60,000 ft
Humidity	95% non condensing
Random Vibration (Without vibration absorbers. For more details on the vibration absorbers option – please see the Accessories chapter below)	2.45gRMS as per the following profile:
Mechanical Shock - Operation	MIL-STD-810C/E, Method 516.2, Proc. 1 (15g / 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-810C/E, Method 516.2, Procedure V
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)

| Reliability, Maintainability, Testability	
MTBF	> 20,000 hours @ 30℃, ARW, MIL-HBK-217F
MTTR – O Level	12 min. to replace failed unit (including warm-up time)
MTTR – I Level	34 min. to replace failed module (including warm-up time)
BIT (Built In Test)	On-line BIT – Automatic, Covers 90% of all failures

SPECIFICATIONS *(continue)*
All specs are at room temperature, quiescent conditions, sea level ambient unless otherwise specified.

Principles of Operation

The following block diagrams depict the operation of the AR51A-07. 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.
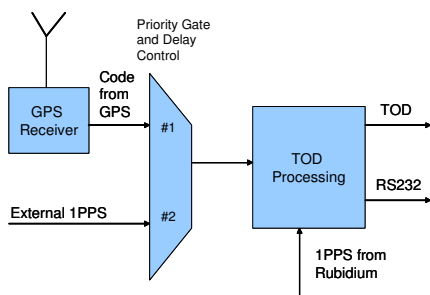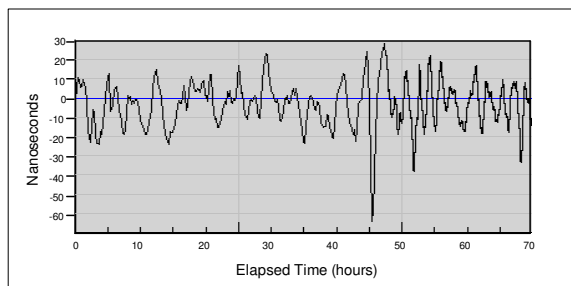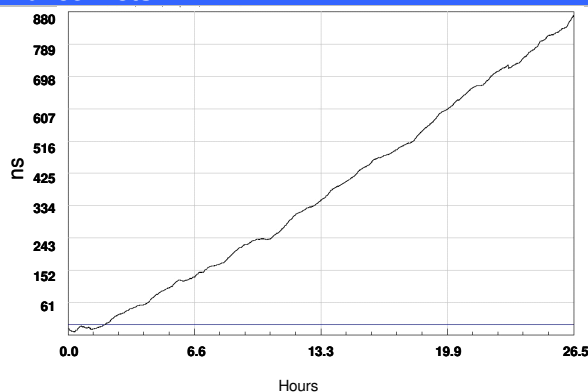

Data flow & Inputs Selection
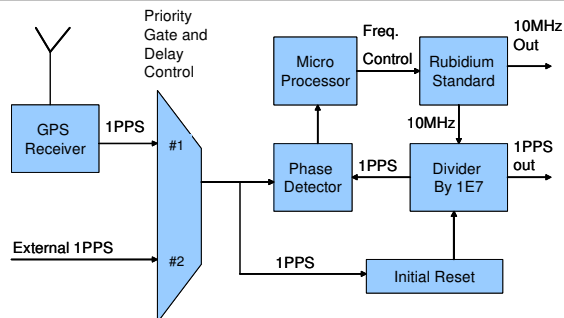
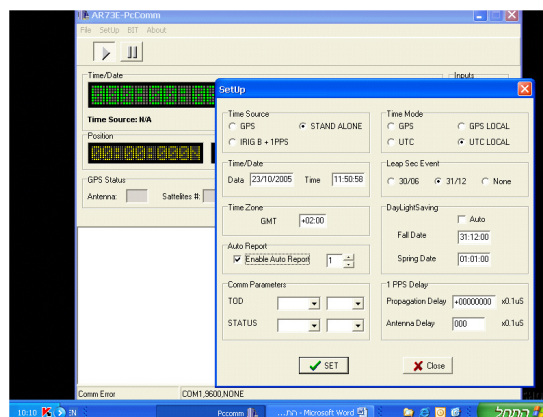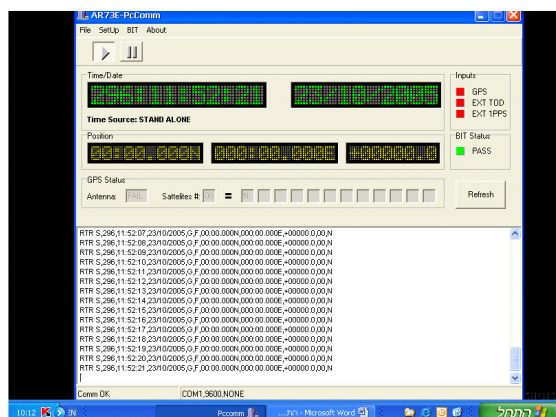Rubidium-GPS D-PLL and Inputs

Typical Performance Plots

Typical time error fluctuations when disciplined to GPS
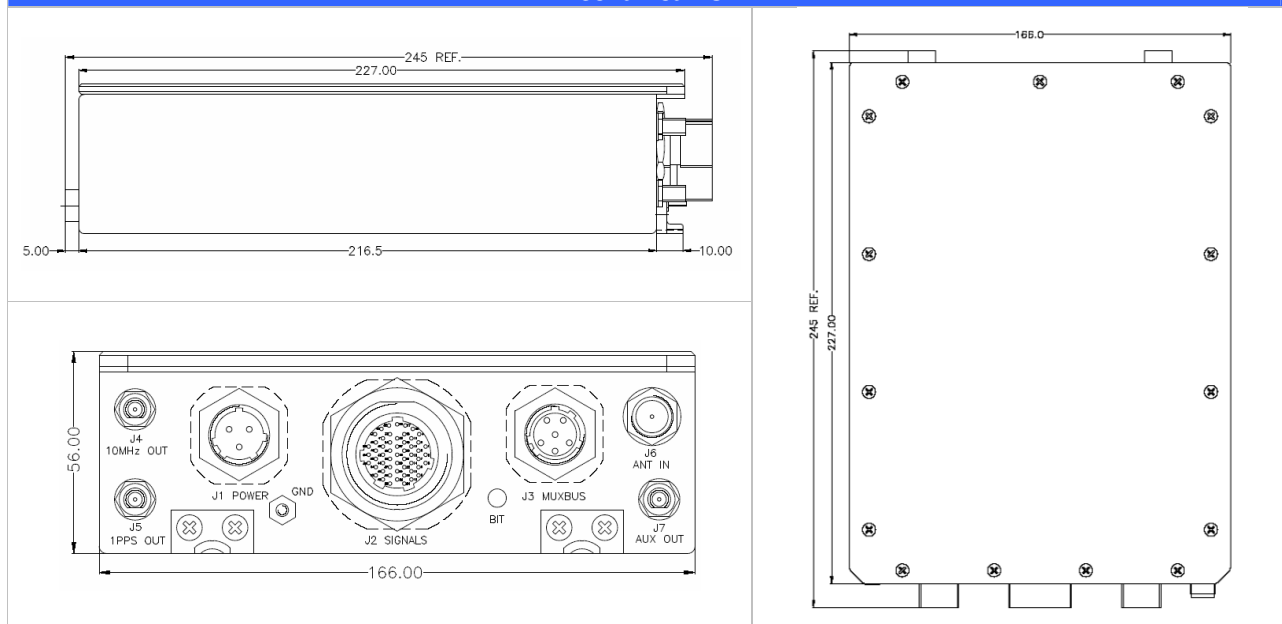

Typical time error in Holdover (without GPS)

Graphic User Interface (GUI) Software for PC (Opt.)

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SPECIFICATIONS *(continue)*

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Mechanical ICD

Electrical ICD

Connector		I/O
J1 - Supply		OUT
J2 - Signals	TOD TTL/100K ohm x 5	OUT
	1 PPS PTTI x 5	OUT
	1 PPS RS-422 x 4	OUT
	1 PPS TTL/50 ohm x 1	OUT
	Aux RS-422 x 1	IN/OUT
	CLI RS-232 x 1	IN/OUT
	1PPS ICD-GPS-060 x 1	IN
	TOD TTL/100K ohm x 1	IN
	MUX-Bus Address	IN
	Overall BIT	OUT
	GPS crypto keys	IN/OUT
J3 - MUXBUS	MIL-STD-1553RT, Female	IN/OUT
J4 - 10MHz OUT	Sine-wave, 8 ±3dBm, 50Ω, SMA, Female	OUT
J5 - 1PPS OUT	TTL/50 ohm, SMA, Female	OUT
J6 - ANT IN	L1/L2, TNC, 50Ω, Female	IN
J7 - AUX OUT	1PPS TTL/50 ohm (RAW), SMA, Female,	OUT

ACCESSORIES (OPTION)
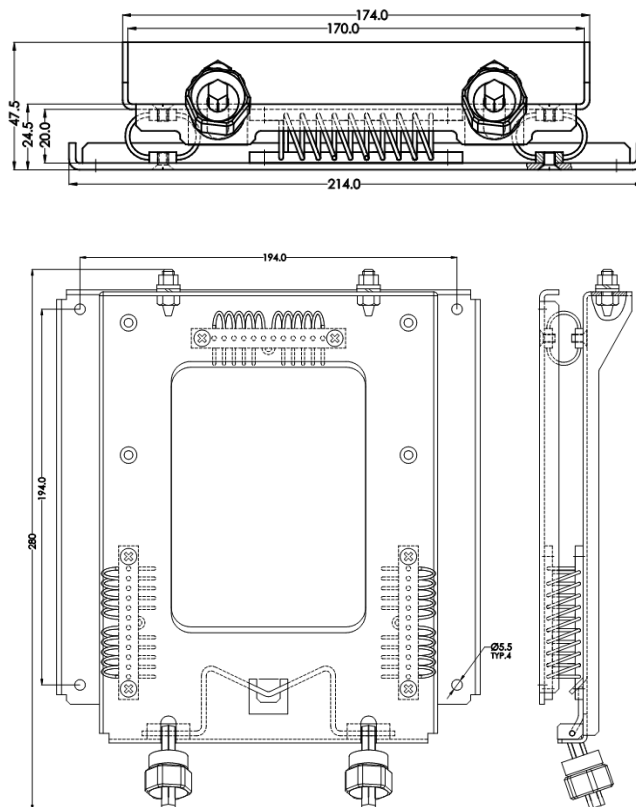
Vibration absorber tray:

The tray should be use in harsh environmental where **high vibration level** is applied, the absorber dramatically decrease the vibration level, so the clock obtain lower vibration level. The mechanical design of the tray, allows **rapid connection and disconnection** of the clock from the try, without use of any working tools.

For more details – contact factory.

Mechanical ICD

Weight: < 700g

AccuBeat P/N	Options description							
	C(A) code GPS	P(Y) code GPS (*)	LAN channel (NTP & UDP)	Temperature Range (**)	RS422 COM. (CLI)	Ephemeris & Almanac data (RS422)	Humidity (RH)	Improved Phase-noise & ADEV
AR51007-02	√	--	--	-25℃ to +65℃	√	--	95%	--
AR51007-04	√	--	--		√	--		√
AR51007-08	√	√	√	-40℃ to 65℃	√	--		√
AR51007-09	--	--	√	-25℃ to +65℃	√	--	98% Condensing	--
AR51007-10	√	--	--	-40℃ to 65℃	√	--	95%	--
AR51007-xx	--	--	GPS-Rb with P(Y) code SAASM GPS - For more information contact factory.					
Vibration absorber	AccuBeat part number: MU50015							
* For other customized configuration, 1553 MUX BUS protocol, and for more options - please contact factory.								

(*) GPS-Rb with P(Y) code SAASM GPS receiver. For more details contact factory.
(**) Emergency: up to +71℃ for 60 minutes.