

GPS-Disciplined Rubidium Clock

Industrial/ Military Compact Low Profile

The **AR51-07** unit is an industrial low profile GPS-Disciplined Rubidium Clock which offers an excellent stability and accuracy.

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 $<300\mu\text{s}$ (opt)
- Holdover (no GPS): Typ. $1\mu\text{s}/24$ hours, $5E-11$ /month
- Operating Temperature: -25°C to $+65^{\circ}\text{C}$ (71°C Emergency). -40°C (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 AR51-07 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 $< 20\text{ns}$ RMS and frequency accuracy better than $2E-12$.

The AR51-07 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 AR51-07 is designed for demanding platforms such as airborne, helicopters, UAV's, shipboard and ground mobile.

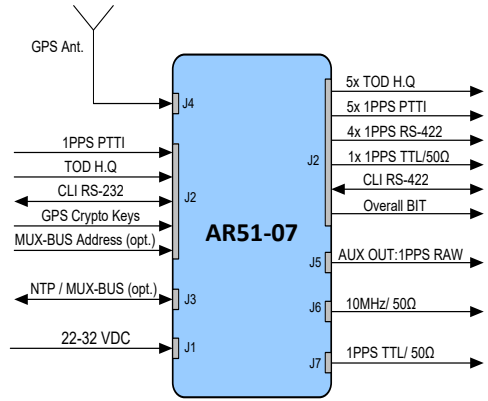
Applications

- Communication
- Telemetry test fields
- Field calibration

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

Specifications

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 (-80dBm --100dBm)
	External 1 PPS ICD-GPS-060/ 50Ω (or TTL/50Ω as an option)
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.



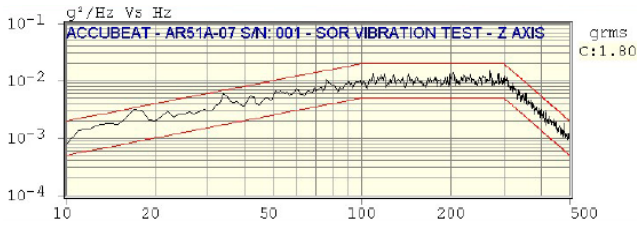
Performance					
Time (1PPS)	Long- term Accuracy	Disciplined to GPS or to an External synchronization source		50ns RMS (typ. 20ns RMS) @ 25°C, relative to an external ref.	
		Time Drift without GPS (Hold-Over)		< 1μs/24hr (Typ.)	
Frequency (10MHz)	Frequency Accuracy	Disciplined to GPS or to Ext. 1PPS		< 2E-12 (24 hour average, const temp.)	
	Long Term stability	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°C to +65°C (-40°C 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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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°C (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
Input power	(-100dBm) ÷ (-80dBm)

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

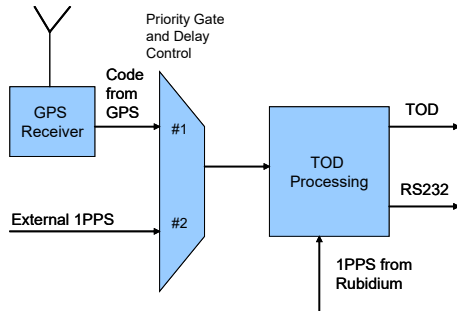
Environmental																												
Temperature	Operating: -25°C to +65°C (-40°C to +65°C Opt.) Emergency: +71°C for 60 minutes Storage: -40°C to +71°C																											
Temperature Altitude	-40°C to +65°C (+71°C for 60 minutes) 0 to 60,000 ft																											
Humidity	95% non 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:  <table border="1"> <thead> <tr> <th colspan="3">GRMS</th> </tr> <tr> <th>TOTAL Con</th> <th>Ref</th> <th>RANDOM Con</th> </tr> </thead> <tbody> <tr> <td>2.45</td> <td>1.79</td> <td>1.80</td> </tr> <tr> <th colspan="3">TONES</th> </tr> <tr> <th>Freq</th> <th>Ref</th> <th>Con</th> </tr> <tr> <td>4.30</td> <td>0.11</td> <td>0.11</td> </tr> <tr> <td>17.20</td> <td>1.21</td> <td>1.23</td> </tr> <tr> <td>34.40</td> <td>1.75</td> <td>1.77</td> </tr> <tr> <td>51.60</td> <td>1.05</td> <td>1.03</td> </tr> </tbody> </table>	GRMS			TOTAL Con	Ref	RANDOM Con	2.45	1.79	1.80	TONES			Freq	Ref	Con	4.30	0.11	0.11	17.20	1.21	1.23	34.40	1.75	1.77	51.60	1.05	1.03
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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°C, 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

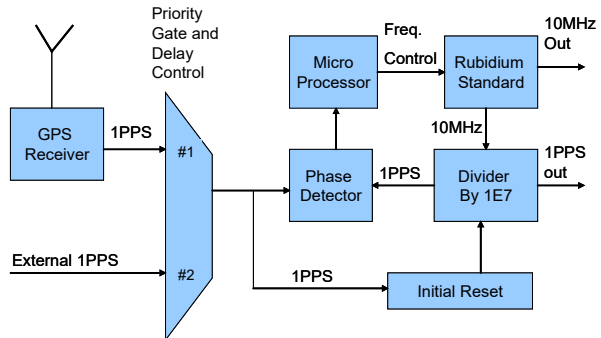
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Principles of Operation

The following block diagrams depict the operation of the AR51-07. 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.

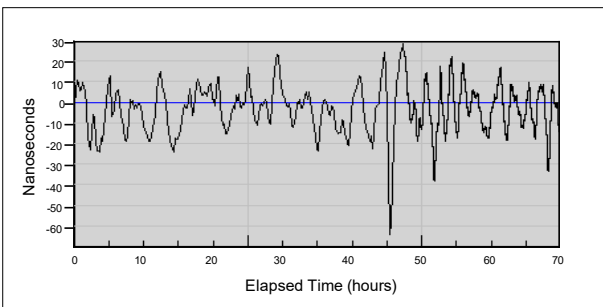


Data flow & Inputs Selection

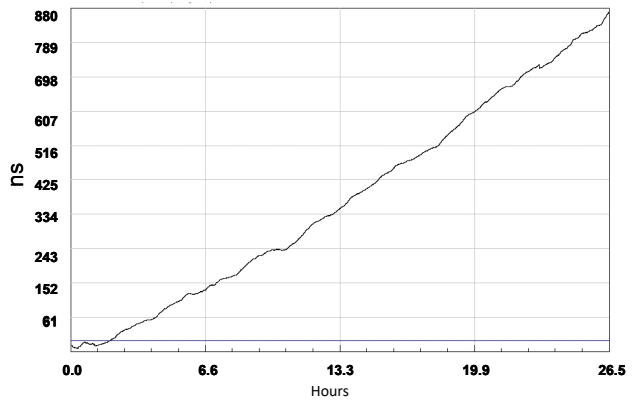


Rubidium-GPS D-PLL and Inputs

Typical Performance Plots

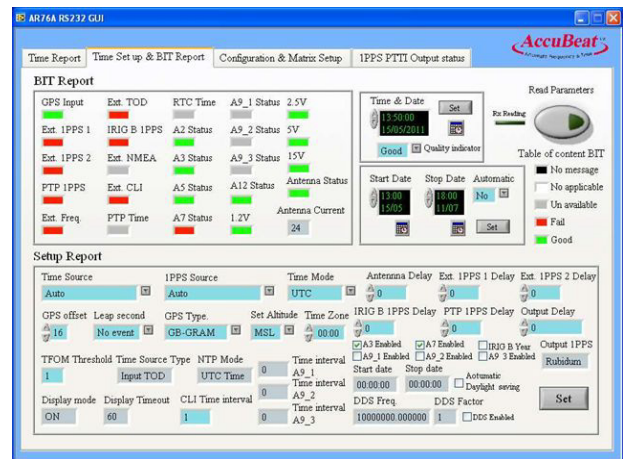
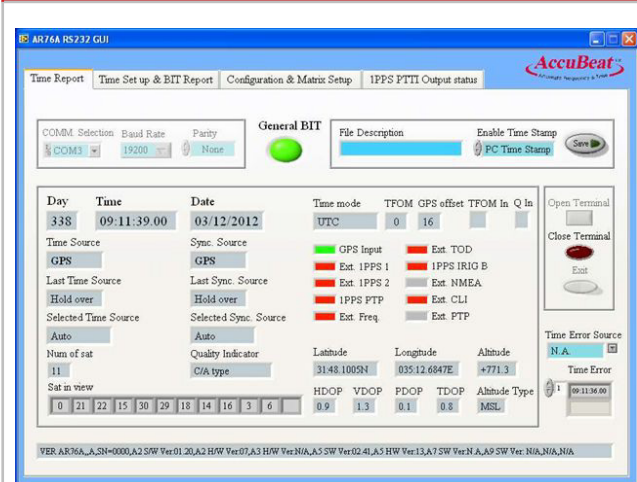


Typical time error fluctuations when disciplined to GPS

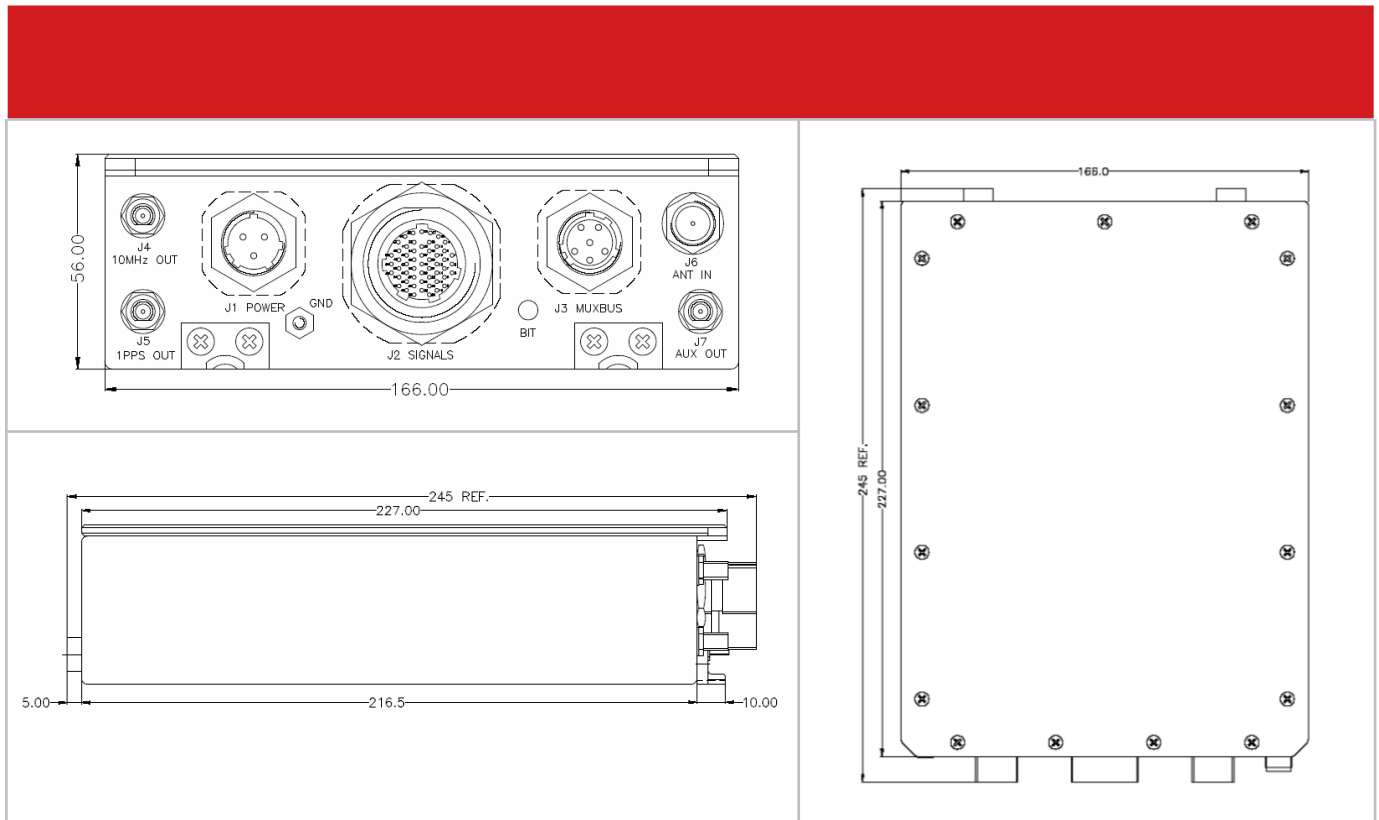


Typical time error in Holdover (without GPS)

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



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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
J3 - MUXBUS	GPS crypto keys	IN/OUT
J4 - 10MHz OUT	MIL-STD-1553RT, Female	IN/OUT
J5 - 1PPS OUT	Sine-wave, 8 ±3dBm, 50Ω, SMA, Female	OUT
J6 - ANT IN	TTL/50 ohm, SMA, Female	OUT
J7 - AUX OUT	L1/L2, TNC, 50Ω, Female	IN
	1PPS TTL/50 ohm (RAW), SMA, Female,	OUT

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ACCESSORIES (OPTION)

Vibration Absorber Tray:

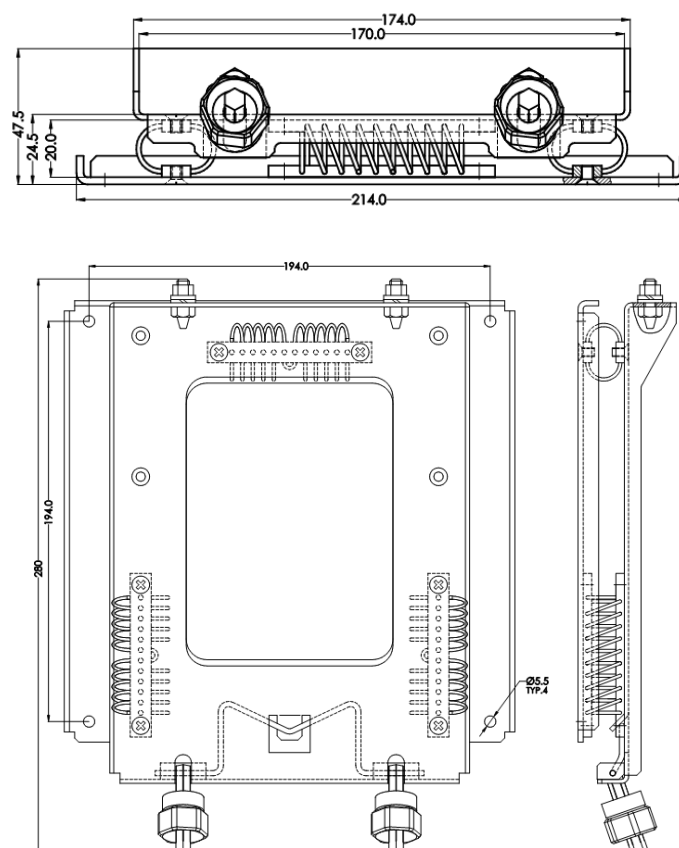


The tray should be used in harsh environments where **high vibration level** is applied, the absorber dramatically decreases the vibration level, so the clock obtains a lower vibration level.

The mechanical design of the tray allows **rapid connection and disconnection** of the clock from the tray, without the use of any working tools.

For more details – contact factory.

Mechanical ICD



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HOW TO ORDER:

AccuBeat P/N	Options description								High Resolution	
	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°C to +65°C	√	--	95%	--	--	
AR51007-04	√	--	--		√	--		√	--	
AR51007-08	√	√	√	-40°C to 65°C	√	--		√	--	
AR51007-09	√	--	√	-25°C to +65°C	√	--	98% Condensing	--	--	
AR51007-10	√	--	--	-40°C to 65°C	√	--	95%	--	--	
AR51007-11-03	√	--	--	-25°C to 65°C	√	--	95%	--	√	
AR51007-12	√	--	√	-25°C to +65°C	√	--	98% Condensing	--	√	
AR51007-xx	--	--	GPS-Rb with P(Y) code SAASM GPS - For more information contact factory.							
Vibration absorber	AccuBeat part number: TBD									
* 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°C for 60 minutes.