

## Accurate Time & Frequency Ruggedized System

GPS - Disciplined Rubidium Clock  
Ruggedized, Rack mounted

The **AR78** is ruggedized, multi-function GPS Disciplined Rubidium Atomic Clock, which provides accurate time & frequency. The AR78 incorporates numerous features into a single box, including a Rubidium Frequency Standard, an internal C/A code 12 channels GPS receiver, and an input from external 1PPS / frequency.

The various options of the unit include a variety of different frequencies and several Time Codes outputs. The Rubidium Standard functions as a local oscillator and is phase-locked to the GPS / GLONASS or to external inputs. All outputs are derived from the Rubidium Clock, which maintains accurate time and frequency when GPS or other inputs are interrupted.



### Key Features

- Frequency Accuracy : 1E-12
- 1PPS Accuracy: 20ns RMS
- Holdover: 1 $\mu$ s/24 hours, 5E-11/month
- Multiple outputs (10MHz, 1PPS, TOD)
- LAN IPV4 (NTP V3, Monitor & Control, DHCP)
- External 1PPS / Frequency input for disciplining
- 12 channel C(A) code GPS receiver
- Front Panel Display (Time, Date, BIT and more)
- Monitor & control: RS232, UDP
- SNMP Monitor & Control (Custom MIB)
- Supply Voltage: 90/260 VAC
- Delay Correction for Input & Output
- Graphic User Interface (GUI) Software for PC

### Options

- Up to 2 channels LAN interface
- IEEE 1588 / PTP Grandmaster
- DDS - Up to 30MHz, 32 bit resolution
- Supply Voltage: 28VDC
- TOD Format: IRIG-B, NMEA, Have Quick

### Description

The **AR78** includes up to two physical LAN interface boards, which support UDP / SNMP for management and for NTP (Network Time Protocol). A Precision-Time Protocol (PTP) is available with one of the LAN board. The AR78 provides multiple outputs: 10 coax outputs, two fixed (10MHz and 1PPS) and 8 configurable outputs which can be selected from 1PPS, 10MHz, and more.

Additional outputs are available on the D-Type connector including differential RS422 outputs, TOD (Time Of Day) outputs with several standard protocol like NMEA, IRIG B etc' and more. The unit is 19" x 1U rack-mountable encasement.

### Applications

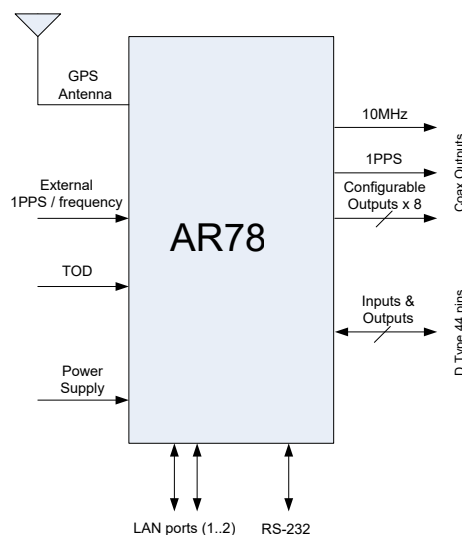
- Test Equipment
- Telecommunication
- Cellular Base Stations
- Scientific Equipment
- Secure Communication
- Mobile Radio Base Stations

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

## Specifications

		Basic Configuration	Options (*)
Outputs	TNC Connectors	<ul style="list-style-type: none"> <li>• 5 x Sine Wave (10±2 dBm) (*)</li> <li>• 5 x 1PPS (TTL/50Ω)</li> </ul> <p>The user can set other outputs configurations (see S/W ICD)</p>	<p>Other combinations of the following signals are available upon request:</p> <p><b>Frequency:</b> 1MHz, 5MHz, 2.048MHz (sine or square) and others</p> <p><b>DDS frequency:</b> 1KHz – 30MHz</p> <p><b>TOD:</b> IRIG B, Have Quick</p>
	44 pins D Type Connector		<p>Other combinations of the following signals are available upon request :</p> <ul style="list-style-type: none"> <li>• 4 x 1PPS (RS-422)</li> <li>• 4 x 1PPS (ICD-GPS-060)</li> <li>• 2 x 10MHz (RS-422)</li> <li>• 5 x TOD ICD-GPS-060 -Have Quick</li> <li>• 1 x NMEA</li> <li>• H/W BIT (open collector)</li> </ul>
Inputs	TNC Connector	<p>For Time and Frequency Disciplining:</p> <ul style="list-style-type: none"> <li>• 1PPS (TTL/50Ω or ICD-GPS-060)</li> <li>• 10MHz</li> </ul>	<b>TOD:</b> IRIG B, Have Quick
	44 pin D Type Connector		Contact factory
LAN	<ul style="list-style-type: none"> <li>• IPV4</li> <li>• NTP server V3 per RFC1305 ≤ 1ms, each LAN board can support up to 1100 NTP requests per second</li> <li>• DHCP</li> <li>• Control &amp; Monitoring (UDP)</li> </ul>		<ul style="list-style-type: none"> <li>• IEEE 1588 / PTP – Grandmaster / slave (one output)</li> <li>• Up to 2 independent LAN ports (2 NTP servers or 1 NTP servers and one PTP) Each one has a different IP address serving separates networks</li> <li>• SNMP V3 (Custom MIB)</li> </ul>
CLI	RS-232 port (single ended or RS-422 ) remote control		

(\*) The output power for the low phase noise version is different from the standard AR78 version. For more details, contact factory.



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Performance (with Rubidium Frequency Standard as the local oscillator)				
Mode of work		Disciplined to GPS or to external 1PPS	Free running Rubidium	
Time (1PPS)		±20ns RMS relative input (*)	1 µs/ 24 hours (typical) After 24 hours of disciplining	
Frequency	Frequency Accuracy	≤ 1E-12		
	Long Term Stability (Free running Rubidium)	≤1E-10 / month ( ≤5E-11 / month as an option)		
	Short Term Stability (ADEV)	3E-11 @ 1s 5E-12 @ 100s		
	Temperature Stability	±3E-10 over -20°C to +65°C		
	Phase Noise (*) (@ 10MHz)	Standard	Improved	
			≤-80dBc/Hz @ 1Hz ≤-114dBc/Hz @ 10Hz ≤-140dBc/Hz @ 100Hz ≤-146dBc/Hz @ 1KHz ≤-147dBc/Hz @ 10KHz	≤-125dBc/Hz @ 10Hz ≤-150dBc/Hz @ 100Hz ≤-155dBc/Hz @ 1KHz ≤-160dBc/Hz @ 10KHz
	Spurious (**) (10MHz)	≤ -100dBc @±100KHz		
	Harmonics (**) (10MHz)	≤ -48dBc		
Warm-up time	Rubidium Lock < 4 minutes 5E-11 within < 60 minutes 1E-11 within < 4 hrs 1E-12 within < 24 hrs			

(\*) improved 1PPS accuracy available (≤ 10ns RMS). Contact factory for more details.

(\*\*) The above figures are given for the J14 output. Some degradation may occur for other outputs.

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GPS C(A) Code Receiver	
GPS Tracking	L1 frequency 1575 MHz C/A code (SPS), 12 parallel tracking channels
Ephemeris & Almanac	Available on 44 pin D Type connector (option)
Position Accuracy	Latitude, Longitude: < 6m (CEP 50%), Altitude: < 11m (CEP 50%)
GPS signal gain at antenna input (*)	23dB-35dB
GPS Antenna DC Voltage	5VDC (up to 100 mA)

(\*) The gain at antenna input with respect to open sky reception.

Environmental	
Operating Temperature	-20°C to +55°C (up to 65°C as an option)
Storage Temperature	-20°C to +70°C
Humidity	MIL STD 810G, Method 507.5 (Figure 507.5-7 Aggravated temperature humidity cycle), 99% RH
Random Vibration (transportation)	MIL-STD-810F, Method 514.5, CAT. 4, figure 514.5C-3
Mechanical shock	MIL-STD-810F, Method 516.5, Proc. I 11 ms, saw tooth, 20g
Drip	MIL-STD-810F, Method 506.4, Proc III
Salt	MIL-STD-810F, Method 509.4, 5% NaCl (35°C)
Dust	MIL-STD-810F, Method 510.4, Proc. III (settling dust)

Power Supply	
Power Supply	90-260 VAC 47/63 Hz 18-32V DC (28VDC typical) - option
Power Consumption (for standard unit)	< 35W Warm-up , < 20W Steady state

Front panel display & indications and GUI	
Display	The LCD front panel display and buttons enable the user to view and configure most parameters. The displayed information includes the Time, Date, BIT, GPS parameters (antenna current, satellite status) and more. Configured parameters include time synchronizations source, 1PPS delay, outputs configuration and more. For details see user manual or contact factory.  Florescent display is available as an option (instead of the LCD display).
LED Indications	4 LEDs on the front panel: Power, Overall BOT, TOD Source, 1PPS / FREQ Source
Graphic User Interface (GUI) – option  (The GUI is software for PC used for maintenance and as a starter kit)	<ul style="list-style-type: none"> <li>○ Time / date display</li> <li>○ Satellites in view</li> <li>○ Navigation data from GPS</li> <li>○ BIT (Built In Test)</li> <li>○ Time source &amp; Time zone</li> <li>○ Leap seconds (from UTC to GPS)</li> <li>○ IP address configuration</li> <li>○ Antenna cable delay</li> <li>○ External input and 1PPS output delay</li> <li>○ Matrix configuration</li> <li>○ Time setting GPS / UTC</li> <li>○ Additional parameters</li> </ul>

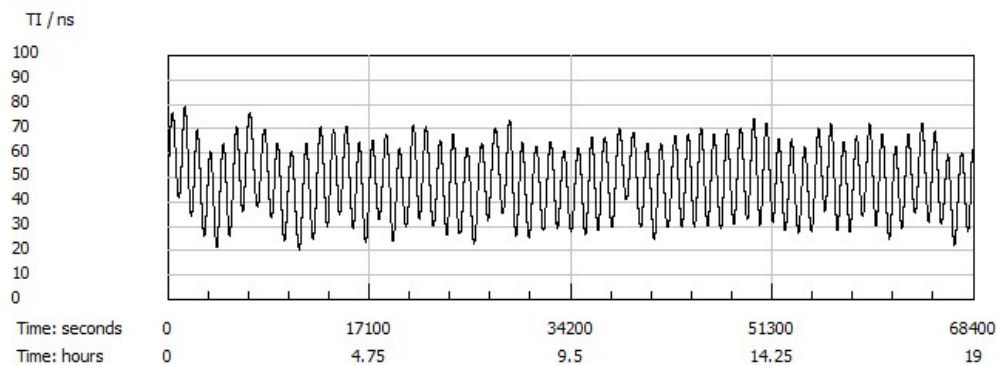
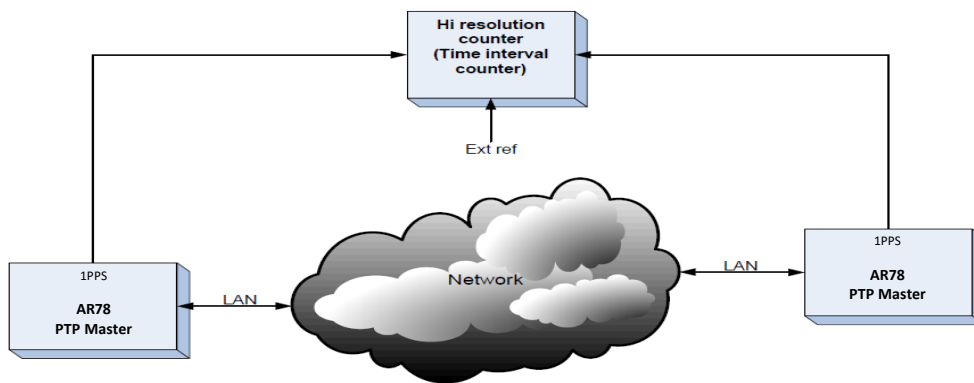
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**Precision Time Protocol – PTP (option)**

- IEEE-1588-2008 V2 PTP Grandmaster/Slave
- Multicast / Unicast modes of operation
- UDP/IPv4 (L2 or L3)
- Design to handle up to 200 slaves simultaneously
- Accuracy:  $\leq 1\mu\text{s}$  (network dependency)

In the following figure, two AR78 units are interconnected via a network (one as a master and one as a slave). The time interval between the two 1PPS outputs was measured over time and the results are shown in the plot below.

***PTP performance measurement setup***

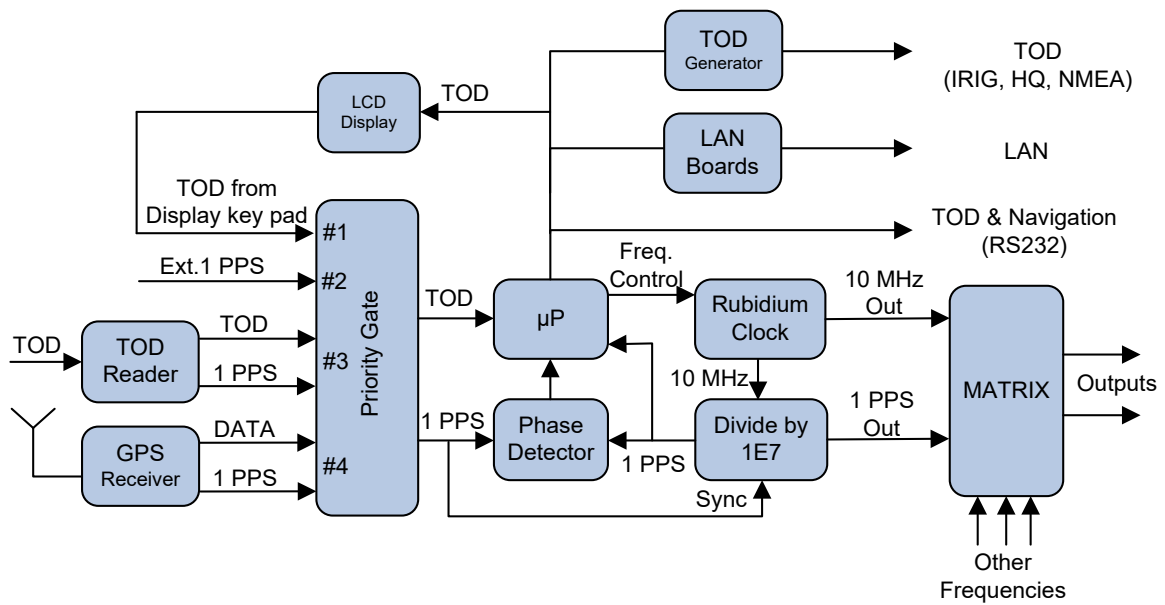


Time accuracy < 50ns RMS

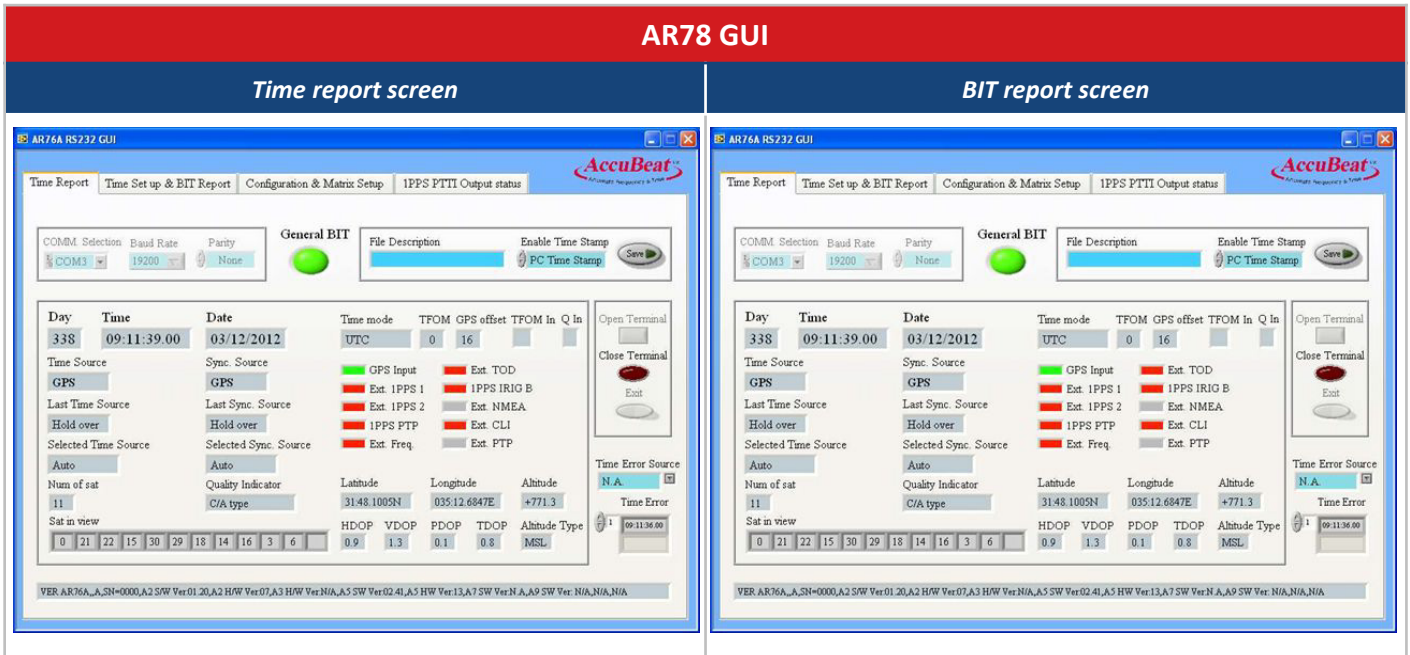
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**Principles of Operation**

The following block diagram describes the operation of the AR78. The unit includes Rubidium Clock and accepts inputs from either internal GPS receiver or external 1PPS & TOD sources. All outputs are derived from the internal Rubidium Clock, which is phase-locked via a digital PLL to the internal GPS receiver or to one of the external inputs. This way, the Rubidium Clock follows the GPS long term accuracy and cleans the jitter and the noise on the short and medium terms. When the GPS reception is lost, for short or long periods of time, the Rubidium continues to maintain accurate time and frequency.



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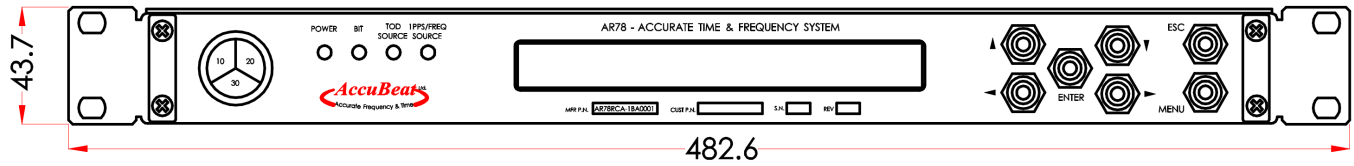
Electrical ICD			
Connector	Description	Standard Type	Options
J1	Power supply	Circular connector D38999	
J2	GPS antenna	TNC, Female	
J3	CLI	D9 (sealed), D Type connector, Female	
J4	Signals, LAN	D44 (sealed), D Type connector, Male	
J5 – J14	Coax outputs	TNC, Female	
J15 - J16	Coax inputs	TNC, Female	

J4 – Auxiliary Time, Frequency, communication, LAN and miscellaneous - 44 pin D type connector signals:

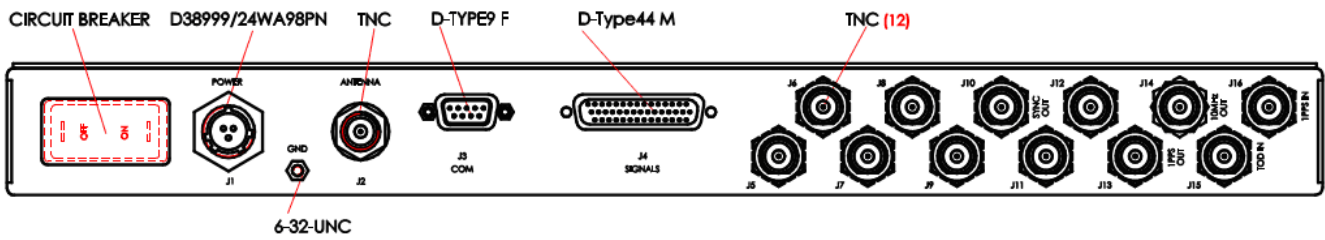
For more details contact factory

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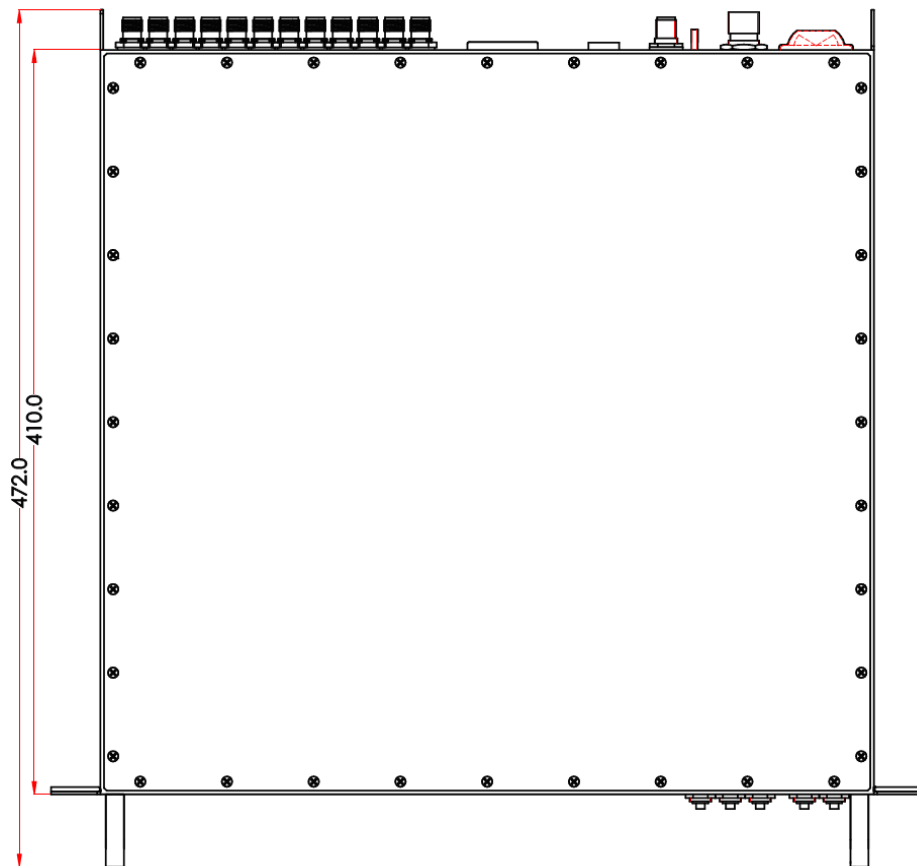
**Mechanical ICD**



Front panel



Rear panel



Upper View



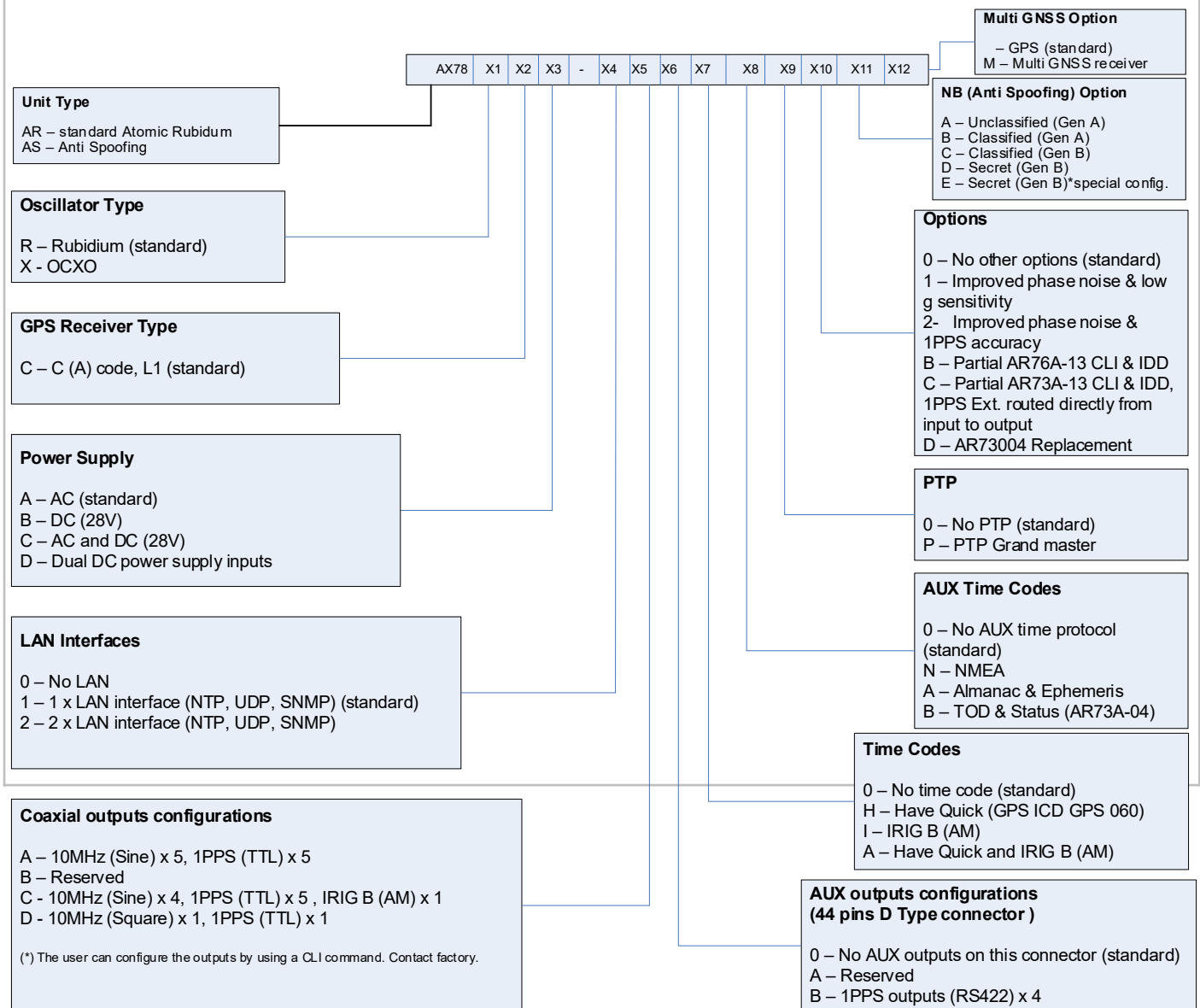
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**HOW TO ORDER:**

**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.



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AR78 DATA SHEET- REVISION 5/23  
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