



Accurate Time & Frequency System Model AR77A

GPS-Disciplined Rubidium/OCXO Clock

Key features:

- ❖ Frequency Accuracy : 1E-12
- ❖ 1PPS Accuracy: 20ns RMS
- ❖ Holdover: 1µs/24 hours, 5E-11/month
- ❖ 20 outputs (10MHz, 1PPS, TOD)
- ❖ LAN (NTP, Monitor & Control)
- ❖ External 1PPS / Frequency input for disciplining
- ❖ C(A) code GPS receiver
- ❖ Front Panel Display (Time, Date, BIT and more)
- ❖ Monitor & control: RS232, UDP
- ❖ Supply Voltage: 90/260 VAC
- ❖ Delay Correction for Input & Output

Options:

- ❖ P (Y) code GPS receiver
- ❖ Up to 3 channels LAN interface
- ❖ SNMP Monitor & Control
- ❖ IEEE 1588 / PTP Grandmaster
- ❖ DDS - Up to 30MHz, 32 bit resolution
- ❖ Supply Voltage: DC or DC&AC
- ❖ TOD Format: IRIG-B,NMEA,IRIG-A, NASA-36
- ❖ External frequency and TOD distributor
- ❖ Graphic User Interface (GUI) Software for PC

Description

The AR77A is a multi-function GPS Disciplined Rubidium Atomic Clock, which provides accurate time & frequency. The AR77A incorporates numerous features into a single box, including a Rubidium Frequency Standard, an internal C/A code 12 channels GPS receiver (or P(Y) code GPS receiver. The GPS receiver must be supplied by user) 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 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. For low cost applications an Oven Control Crystal Oscillator (OCXO) is offered instead of Rubidium Frequency Standard.

The unit includes up to three physical LAN interfaces boards, which support UDP / SNMP for management and for NTP (Network Time Protocol). The three LAN boards can be used for three different networks (with three different IP network addresses), or for two networks where the 3rd LAN board is reserved as a redundant back-up. A Precision-Time Protocol (PTP) is available with one of the LAN board. The AR77A 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 and Have Quick. The unit is 19" x 1U rack-mountable encasement.

Applications

Test Equipment
Scientific Equipment

Telecommunication
Secure Communication

Cellular Base Stations
Mobile Radio Base Stations

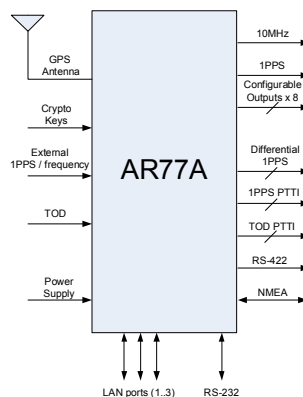
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All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

		Basic Configuration	Options (*)
Outputs	BNC Connectors	<ul style="list-style-type: none"> * 5 x Sine Wave (10±2 dBm) * 5 x 1PPS (TTL/50Ω) <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>Frequency: 1MHz, 5MHz, 2.048MHz (sine or square) and others</p> <p>DDS frequency: 1KHz – 30MHz</p> <p>TOD: IRIG B (additional formats are also available) , Have Quick, NMEA</p>
	44 pins D Type Connector		<p>Other combinations of the following signals are available upon request :</p> <p>Frequency: 1MHz, 5MHz, 2.048MHz (sine or square) and more other frequencies</p> <p>DDS frequency: 1KHz – 30MHz</p> <p>TOD: NMEA, Have Quick</p> <ul style="list-style-type: none"> * 4 x 1PPS (RS-422) * 2 x 10MHz (RS-422) * 4 x 1PPS (ICD-GPS-060) * 5 x TOD ICD-GPS-060 -Have Quick * H/W BIT (open collector)
Inputs	BNC Connector	<p>For Time and Frequency Disciplining:</p> <ul style="list-style-type: none"> • 1PPS (TTL/50Ω or ICD-GPS-060) • 10MHz 	<p>Frequency: 1MHz, 2.048MHz, 5MHz and more</p> <p>TOD: IRIG B (more formats are available as well)</p>
	44 pin D Type Connector	Crypto keys & ZEROIZE CVS	TOD: NMEA
	Front panel	Crypto keys	
LAN	<ul style="list-style-type: none"> • NTP server V3 per RFC1305 ≤ 1ms, each LAN board can support up to 1100 NTP requests per second • Control & Monitoring (UDP) 	<ul style="list-style-type: none"> • IEEE 1588 / PTP – Grandmaster / slave (one output) • Up to 3 independent LAN ports (3 NTP servers or 2 NTP servers and one PTP) Each one has a different IP address serving three separates networks • SNMP V3 	
CLI	RS-232 port (single ended or RS-422) remote control		

(*) Contact factory for detail





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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	Long Term Stability	≤ 1E-12	≤ 5E-11 / month
	Short Term Stability (ADEV)	Standard	Improved (option)
		3E-11 @ 1s 5E-12 @ 100s	Contact factory for information
	Temperature Stability	±3E-10 over -20°C to +65°C	
	Phase Noise (*) (@ 10MHz)	Standard (typical)	Improved (option)
		≤-85dBc/Hz @ 1Hz ≤-118dBc/Hz @ 10Hz ≤-140dBc/Hz @ 100Hz ≤-144dBc/Hz @ 1KHz ≤-147dBc/Hz @ 10KHz	≤-125dBc/Hz @ 10Hz ≤-150dBc/Hz @ 100Hz ≤-155dBc/Hz @ 1KHz ≤-160dBc/Hz @ 10KHz
	Harmonics (*) (10MHz)	≤ -48dBc	
		Standard (typical)	Improved (option)
Spurious (*) (10MHz)	≤ -100dBc @±100KHz	≤-110dBc@±100KHz	
Warm-up time	Rubidium Lock < 4 minutes 5E-11 within < 60 minutes 1E-11 within < 4 hrs 1E-12 within < 24 hrs		

(*) The above figures are given for the J17 output. Some degradation may occur for other outputs.

For the low phase noise option, the unit distributes the low phase noise signal for two outputs and will maintain the performance under 1g@5-200Hz sine wave vibrations.

The spurious level under 1g@5-200Hz sine wave vibrations can degrade to -58dBc for the vibration frequency only.



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<u>GPS C(A) Code Receiver</u>	
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%)
Acquisition Time (Typical) (*)	Warm start ≤ 45 second, Cold start ≤ 50 second (worst case)
GPS Antenna DC Voltage	5VDC (up to 100 mA)

(*) The acquisition time refers to the GPS receiver output. For frequency stabilization during Warm-up – see above.

<u>GPS P(Y) Code Receiver GB-GRAM (option) The GPS receiver must be supplied by user</u>	
GPS Tracking	L1/L2 frequency P(Y) code SAASM 12 parallel tracking channels
Position Accuracy	PPS: <12m CEP
Acquisition Time (Typical) (*)	Cold start < 12.5 min Warm Start <1 min
GPS Antenna DC Voltage	5VDC (up to 100 mA)

<u>Environmental</u>	
Operating Temperature	-20°C to +65 °C
Storage Temperature	-20°C to +70 °C
Humidity	Up to 95% at 35°C, non-condensing
Vibration	2.5g RMS

<u>Safety</u>	
Safety Standard	CE (safety)

<u>Power Supply</u>	
Power Supply	90-260 VAC 47/63 Hz (Option: DC power supply 28VDC± 4V, -48VDC)
Power Consumption	< 37W Warm-up , < 25W Steady state
Power Supply Redundancy (option)	Options for power supply redundancy: <ol style="list-style-type: none"> 1. Two power supply inputs – one for AC and the other for DC 2. Two DC power supply inputs

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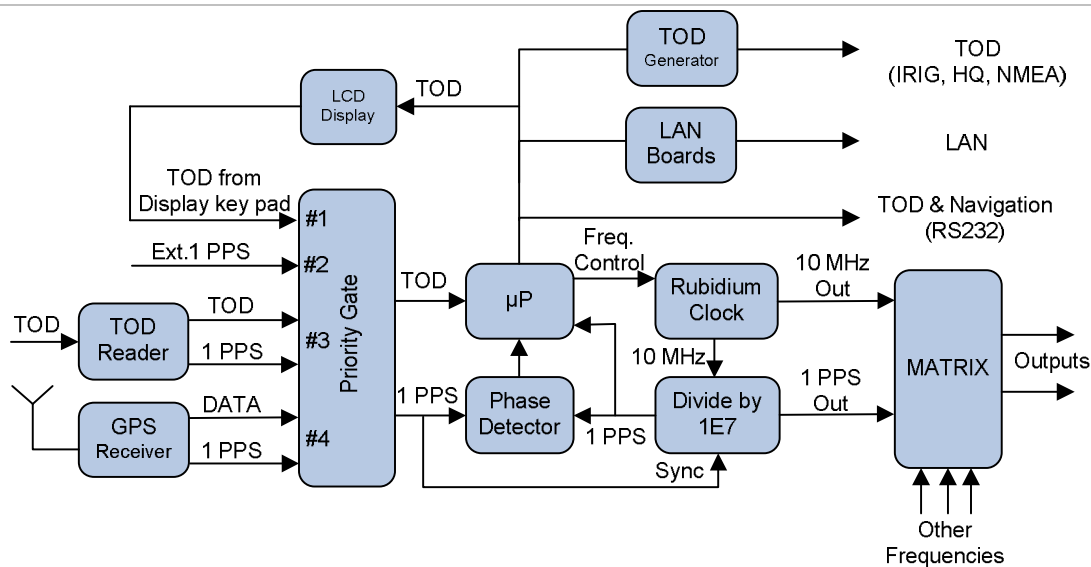
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Front panel display & indications and GUI

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 <small>(The GUI is software for PC used for maintenance and as a starter kit)</small>	<ul style="list-style-type: none"> ○ Time / date display ○ Satellites in view ○ Navigation data from GPS and ○ BIT (Built In Test) ○ Time source & Time zone ○ Leap seconds (from UTC to GPS) 	<ul style="list-style-type: none"> ○ IP address configuration ○ Antenna cable delay ○ External input and 1PPS output delay ○ Matrix configuration ○ Time setting GPS / UTC ○ Additional parameters

Principles of Operation

The following block diagram describes the operation of the **AR77A**. 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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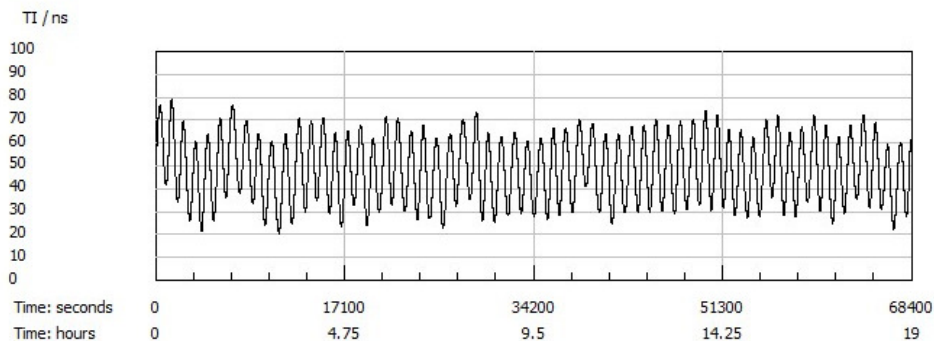
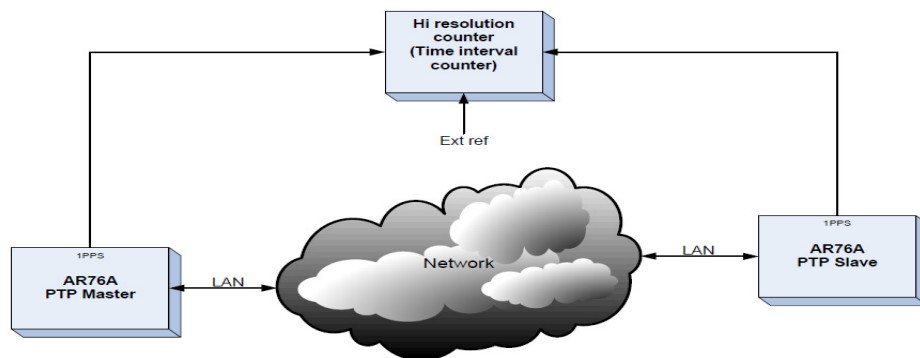
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Precision Time Protocol – PTP (option)

- 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 AR77A 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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Performance (with OCXO as local oscillator instead of Rubidium) (option)

Mode of work		Disciplined to GPS or to external 1PPS	Free running Rubidium
Time (1PPS)		100ns RMS relative input @ 25°C	1 ms/ 24 hours (typical) After 24 hours of disciplining.
Frequency	Accuracy	$\leq 1E-11$	$\leq 2E-8$ / month (after 30 days of operation)
	Short Term Stability (ADEV)	$3E-11$ @ 1s	
	Temperature Stability	± 200 ppb over -20°C to +70°C	
	Phase Noise (10MHz) (*)	≤ -85 dBc/Hz @ 1Hz ≤ -115 dBc/Hz @ 10Hz ≤ -130 dBc/Hz @ 100Hz ≤ -135 dBc/Hz @ 1KHz	
	Harmonics (10MHz) (*)	≤ -48 dBc	
	Spurious (10MHz) (*)	≤ -100 dBc @ ± 100 KHz	
	Warm-up time	1E-11 within < 24 hrs	

(*) The above figures are given for the J17 output. Some degradation may occur for other outputs.

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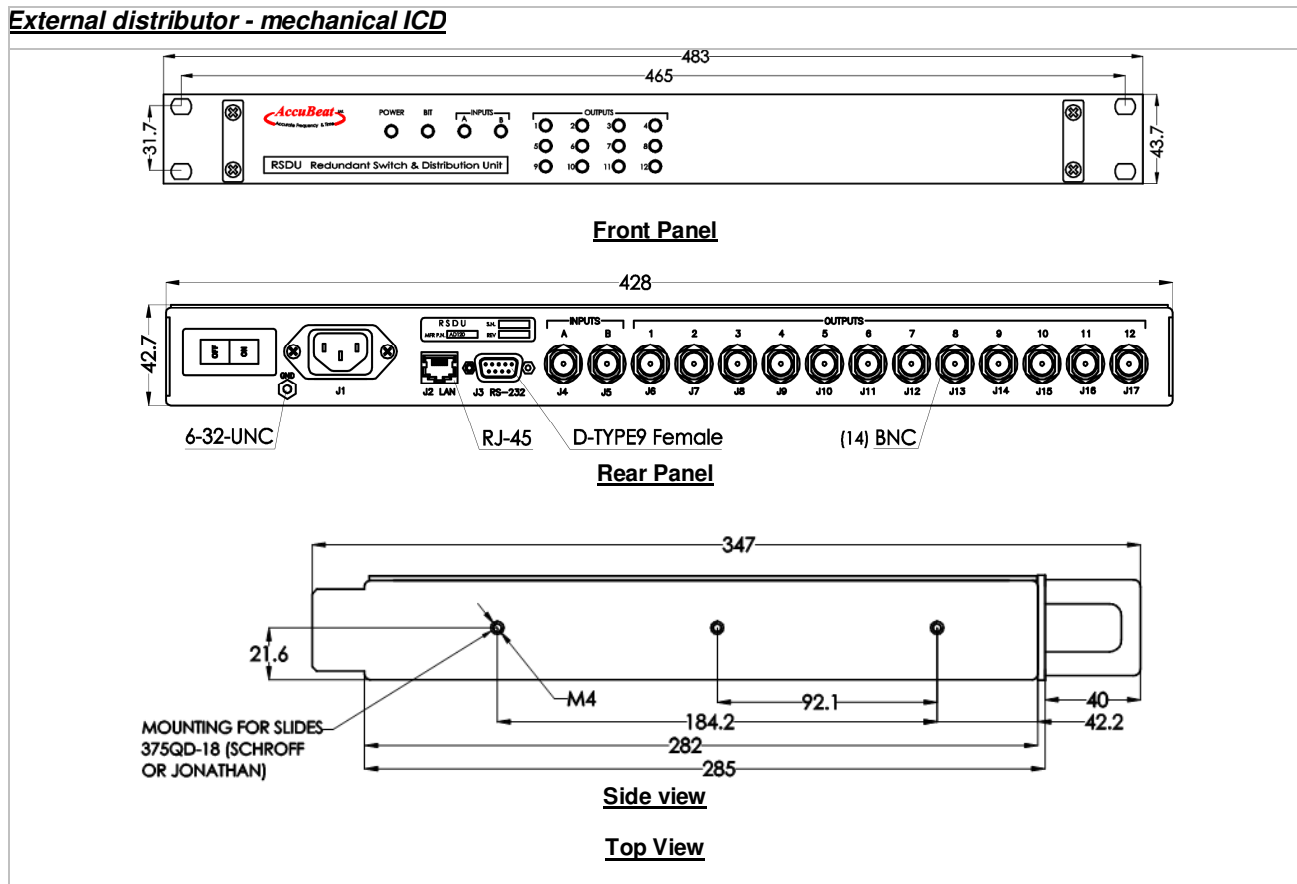
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External distributor (option)

The AR77A can be connected to an external distributor (AccuBeat's model: AD12A-03) comprising of two redundant inputs and 12 outputs. The signal from the first input is distributed to all the outputs and in case of failure from the first input the unit automatically switches to the second input.

For more details contact factory.

External distributor - mechanical ICD





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Model AR77A

AR77A GUI

Time report screen

BIT Report screen



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Electrical ICD

Connector	Description	Standard Type	Options
J1	Power supply	AC, Standard Inlet (IEC320)	28VDC / -48VDC
J2	GPS antenna	TNC, Female	---
J3 – J5	LAN	RJ-45	---
J6	CLI	D9, Female	---
J7	Additional I/O	D type, 44 pin, Female	---
J8 – J17	Coax outputs	BNC, Female	TNC, Female
J18 - J19	Inputs	BNC, Female	TNC, Female
Front panel	Crypto keys	TBD	---

J6 – RS-232 communication to PC - 9 pin D type connector signals:

Pin Number	Function
2	CLI-Tx (to PC)
3	CLI-Rx (from PC)
5	GND
1, 4, 6, 7, 8, 9	Not used

RS-232, 19,200 baud rate, 1,8,1 no parity (default)

J7 – Auxiliary Time, Frequency, communication and miscellaneous - 44 pin D type connector signals (Standard configuration):

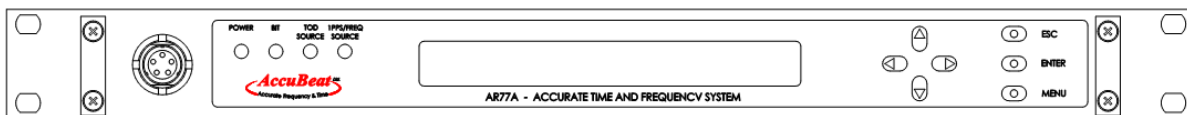
With this connector the customer can get additional outputs such as: 1PPS, 10PPS (and more, TTL or RS-422), additional square-wave frequencies (TTL or RS-422), TOD (Time of Day) in NMEA / IRIG B (DC) / Have-Quick, CLI communication in RS-422 and Overall BIT indication.

Please note that in the table below, outputs of pins 6 – 13, 16 – 19, 26 – 30 and 32 – 35 are offered as an option.

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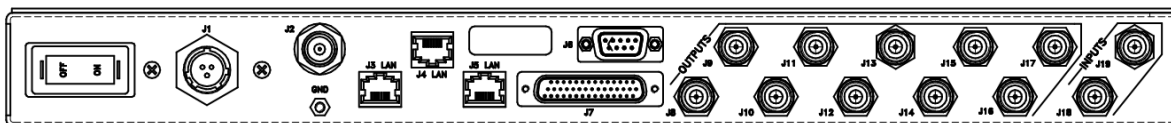
Pin #	Function	Pin #	Function	
1	CLI_IN RS422+	23	GND	
2	CLI_IN RS422-	24	FACTORY USE (Lock signal)	
3	CLI_OUT RS422+	25	GND	
4	CLI_OUT RS422-	26	TOD #1 (TTL / 100kohm)	
5	GND	27	TOD #2 (TTL / 100kohm)	
6	X_PPS_RS422+ output (#1)	28	TOD #3 (TTL / 100kohm)	
7	X_PPS_RS422- output (#1)	29	TOD #4 (TTL / 100kohm)	
8	Y_PPS_RS422+ output (#2)	30	TOD #5 (TTL / 100kohm)	
9	Y_PPS_RS422- output (#2)	31	GND	
10	Z_PPS_RS422+ output (#3)	32	1PPS #1 (TTL / 50ohm) output	
11	Z_PPS_RS422- output (#3)	33	1PPS #2 (TTL / 50ohm) output	
12	W_PPS_RS422+ output (#4)	34	1PPS #3 (TTL / 50ohm) output	
13	W_PPS_RS422- output (#4)	35	1PPS #4 (TTL / 50ohm) output	
14	GND	36	Over all BIT (open collector), < 100mA Low = OK, High impedance = fail	
15	5.5V (internal 300Ω series resistor)	37	GND	
16	AUX Frequency RS422 OUT+ (#1) Default: 10MHz	38	MIL GPS Crypto Keys	KYK-13/KOI-18 CLOCK
17	AUX Frequency RS422 OUT - (#1) Default: 10MHz	39		KYK-13/KOI-18 DATA
18	AUX Frequency RS422 OUT + (#2) Default: 10MHz	40		KYK-13/KOI-18 CTS
19	AUX Frequency RS422 OUT - (#2) Default: 10MHz	41		KYK-13/KOI-18 SENSE
20	GND	42		KYK-13/KOI-18 LOGIC REF
21	NMEA_RxD_RS-232	43		KEY_LOAD_EN_FALSE
22	NMEA_TxD_RS-232	44		ZEROIZE_CVS

AR77 - Mechanical ICD

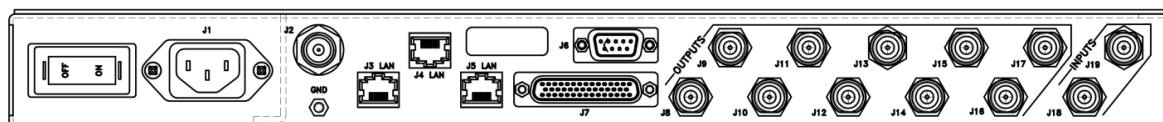


Front panel

Dimensions: 19" (482.6 mm), 1U (43.7mm)

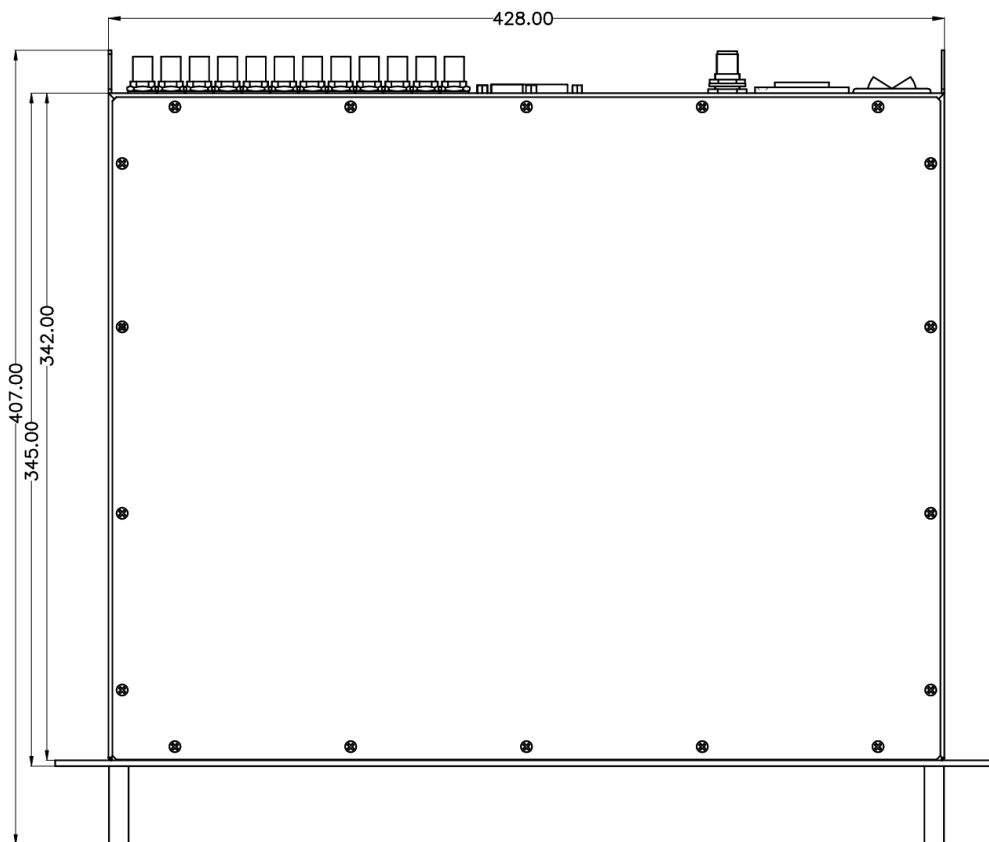


Rear panel – DC power input configuration



Rear panel – AC power input configuration

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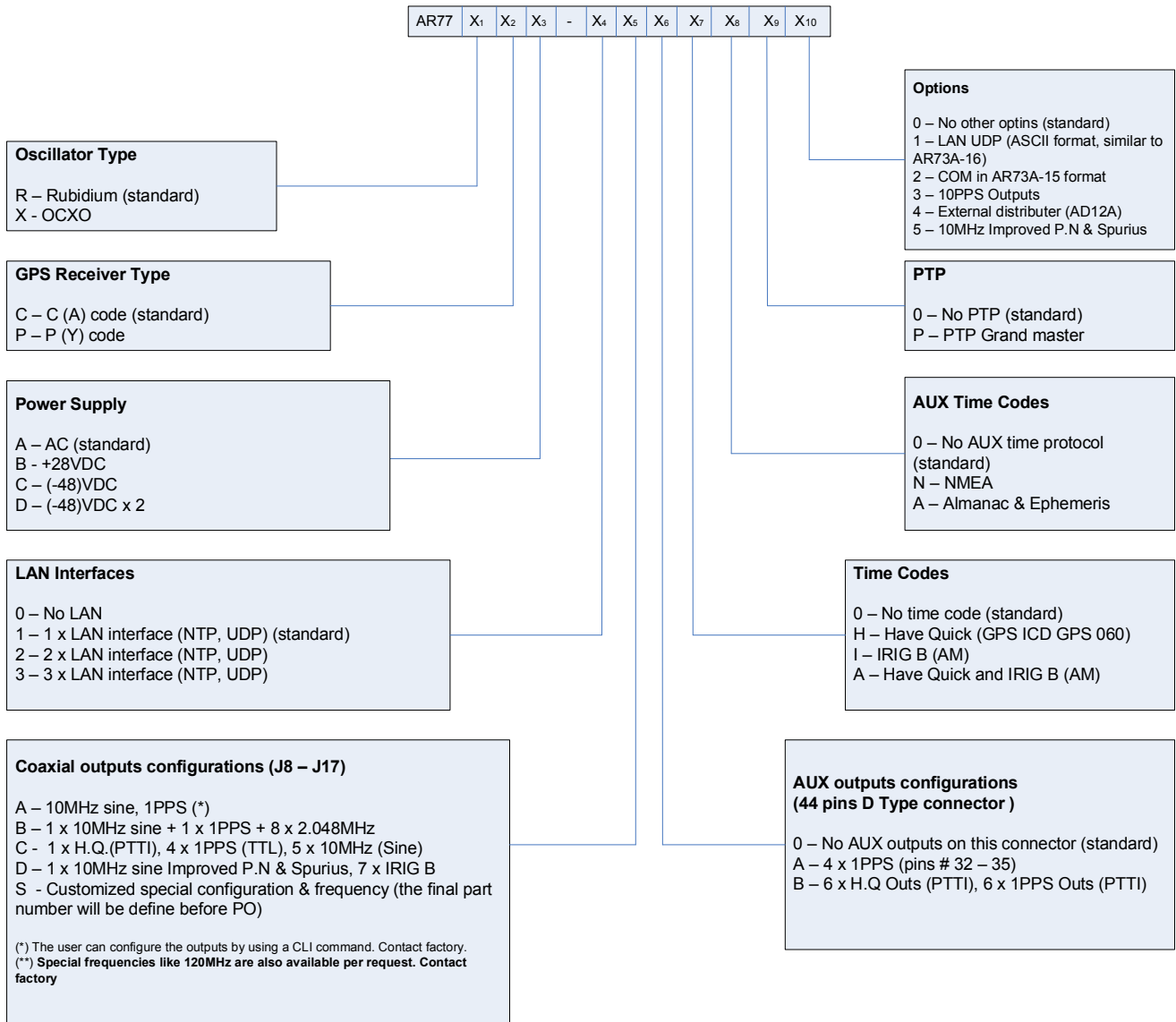


Weight: ≤ 5 kg

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HOW TO ORDER:



Note: the P (Y) code GPS receiver must be supplied by user