Accurate Time & Frequency System

Model AR/AS77

GPS-Disciplined Rubidium Clock
With optional anti-spoofing and Jamming capabilities

Key features:

- *Frequency Accuracy : 1E-12*
- *1PPS Accuracy: 20ns RMS*
- *Holdover: 1µs/24 hours, 1E-10/month*
- *Multiple outputs (10MHz, 1PPS, TOD)*
- *LAN (NTP V3, Monitor & Control – UDP&SNMP)*
- *External 1PPS / Frequency input for disciplining*
- *C \ A code GPS receiver*
- *Front Panel Display (Time, Date, BIT and more)*
- *Monitor & control: RS232, UDP, SNMP*
- *Supply Voltage: 90/260 VAC*
- *Delay Correction for Input & Output*
- *Graphic User Interface (GUI) Software for PC*
- *Proprietary spoofing and jamming detection algorithm*

Description

The AR/AS77A is a multi-function GPS Disciplined Rubidium Atomic Clock, which provides accurate time & frequency. The AR/AS77A incorporates numerous features into a single box, including a Rubidium Frequency Standard, an internal C\A code GPS receiver (which should be supply by the customer) and an input from external 1PPS / frequency.

The AS77A receives a GNSS (GPS) signal from the antenna and performs an integrity test on the signal using a local Rubidium clock and other proprietary methods. If the AS77A determines that the GNSS signal is unreliable (due to jamming, spoofing or any other malicious attacking), it sends a warning alarm and use timing derived from the local Rubidium clock operating in "Holdover" mode. This action allows continuous and uninterrupted timing and synchronization signals even in a GNSS denied or spoofed environment.

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.

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 AR/AS77A 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 PTTI (ICD-GPS-060) outputs and Have Quick TOD (Time Of Day) protocol.

The unit is 19" x 1U rack-mountable encasement.

Applications

Telecommunication Secure Communication

ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

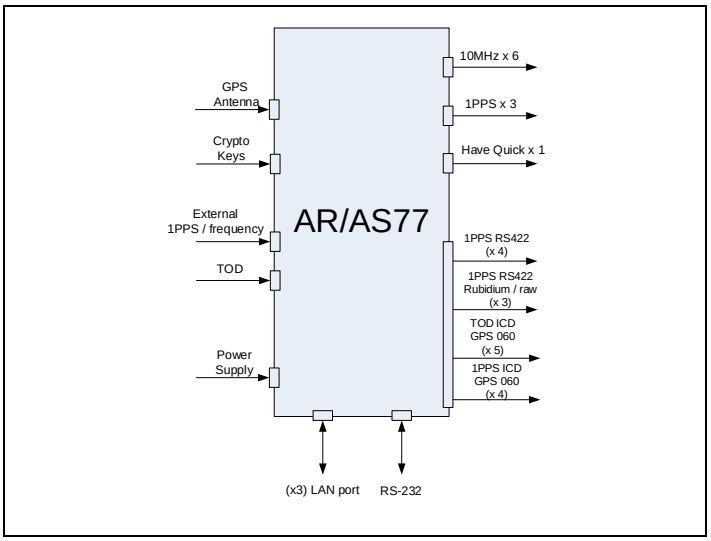
Accurate Time & Frequency System

Model AR/AS77

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

		Basic Configuration	
Outputs	TNC Connectors	6 x Sine Wave (10±2 dBm) 3 x 1PPS (TTL/50Ω) 1 x Have Quick (ICD GPS 060)	
	44 pins D Type Connector	4 x 1PPS (RS422) – Rubidium 1PPS 3 x 1PPS (RS422) – these outputs can be configure to be Rubidium backup 1PPS or raw 1PPS 5 x TOD ICD-GPS-060 -Have Quick 4 x 1PPS (ICD-GPS-060) H/W BIT (open collector)	
Inputs	TNC Connector	• Provision for Time / Frequency Disciplining: 1PPS (TTL/50Ω or ICD-GPS-060) or 10MHz • Provision for TOD synchronizing: Have Quick (ICD GPS 060)	
	Front panel	Crypto keys (Not used connector)	
LAN	• IPV4 • NTP server V3 per RFC1305 ≤ 1ms, each LAN board can support up to 1100 NTP requests per second • DHCP • Control & Monitoring (UDP)		• 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 (Custom MIB)
CLI	RS-232 port remote control		

(*) Contact factory for more details



Accurate Time & Frequency System

Model AR/AS77

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

Performance

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 @ 25°C
Frequency	**Long Term Stability**	≤ 1E-12	≤ 1E-10 / month
	Short Term Stability (ADEV)	3E-11 @ 1s 5E-12 @ 100s	
	Temperature Stability	±3E-10 over -20°C to +65°C	
	Phase Noise (*) (@ 10MHz)	≤- 113dBc/Hz @ 10Hz ≤- 140dBc/Hz @ 100Hz ≤- 144dBc/Hz @ 1KHz ≤- 147dBc/Hz @ 10KHz	
	Harmonics (*) (10MHz)	≤ -48dBc	
	Spurious (*) (10MHz)	≤ -100dBc @ ±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.

Accurate Time & Frequency System

Model AR/AS77

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

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%)
Acquisition Time (Typical) (*)	Warm start ≤ 45 second, Cold start ≤ 50 second (worst case)
GPS signal gain at antenna input (**)	23dB-35dB
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.
(**) The gain at antenna input with respect to open sky reception.

Environmental	
Operating Temperature	-20°C to +65 °C
Storage Temperature	-20°C to +70°C
Humidity	15 – 85 % @ 40°C (non condensing) under operation
Temperature Altitude	Operating: -10°C to +45°C @ 10k feet Non operating: -40°C to +71°C @ 40k feet
Transportation Vibration	MIL-STD-810E Method 514.4 Category 1 (basic transportation), figures 514.4-7 to 514.4-9 1.04g RMS, 60 minutes (for each axis)
Functional vibration	RTCA DO-160E, Section 8, figure 8-1, Curve B2 (0.74 gRMS) (The vibration can cause some degradation on the phase noise)
Robust vibration	RTCA DO-160E, Section 8, figure 8-4, Curve B12 (1.48 gRMS)
Operational Shock	Total 18 shocks, three (3) shocks in both directions of the three orthogonal axes 11 ms, half sine, 6g
Crash safety shock	Saw tooth, 20g, 11 ms (for each axis). Total shocks: 18 shocks.
Structural acceleration	Up to 9 g
Fungus	MIL-HDBK-454B

Power Supply	
Power Supply	28VDC± 4V
Power Consumption	< 37W Warm-up , < 25W Steady state

ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

Accurate Time & Frequency System

Model AR/AS77

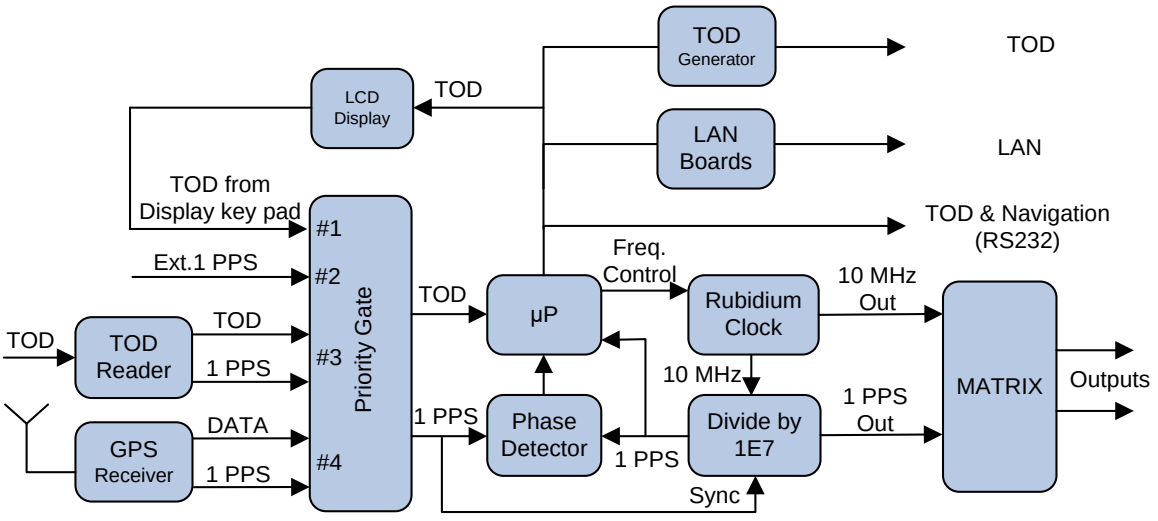
All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

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)	○ 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)	○ 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 **AR/AS77.** 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.



Accurate Time & Frequency System
Model AR/AS77

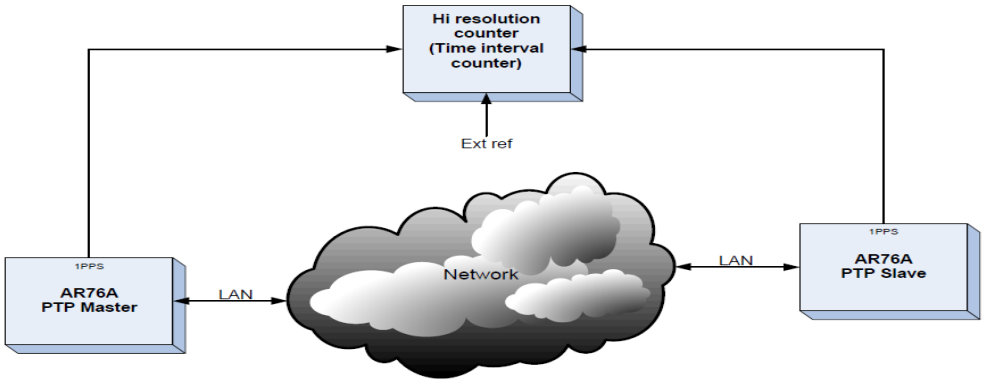
All specs are @ 25°C, quiescent conditions and sea level ambient unless otherwise specified

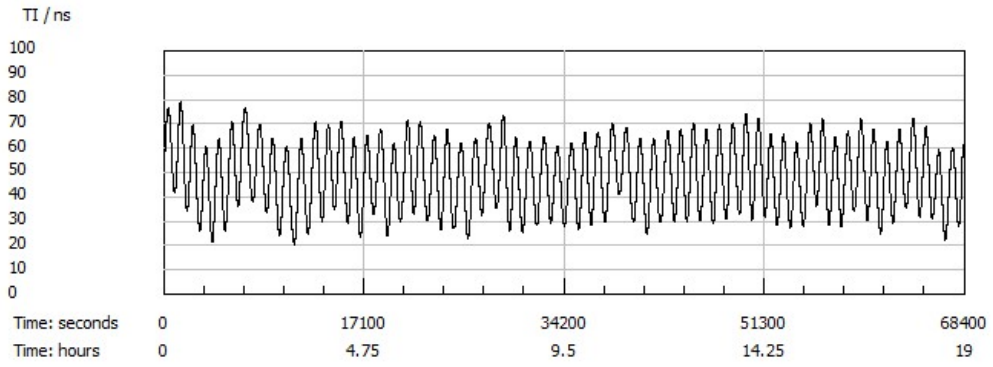
Precision Time Protocol – PTP (option)

- 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: ≤1µs (network dependency)

In the following figure, two AR/AS77A 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

(measured on low traffic, symmetrical path network and low number of users)

Accurate Time & Frequency System

Model AR/AS77

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

Electrical ICD

Connector	Description	Standard Type
J1	Power supply	28VDC
J2	GPS antenna	TNC, Female
J4	LAN	RJ-45
J6	CLI	D9, Female
J7	Additional I/O	D type, 44 pin, Female
J8 – J17	Coax outputs	TNC, Female
J18 - J19	Inputs	TNC, Female
Front panel	Crypto keys	Audio connector jack, 5 pins (Not used connector)

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

Pin Number	*Function*	
2	CLI-Tx (to PC)	RS-232, 19,200 baud rate, 1,8,1 no parity (default)
3	CLI-Rx (from PC)	
5	GND	
1, 4, 6, 7, 8	Factory use	
9	COM from CLDU / CDU	

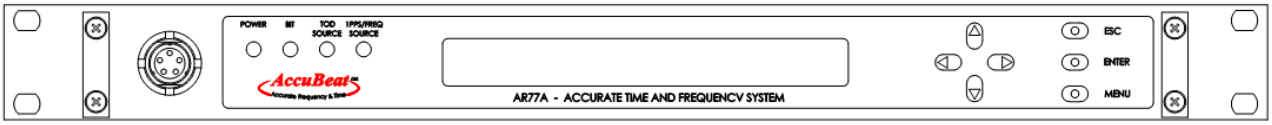
J7 – Auxiliary Time, Frequency, communication and miscellaneous - 44 pin D type connector signals:

Pin Number	*Function*		*Pin Number*	*Function*
1	FACTORY USE		23	GND
2	FACTORY USE		24	FACTORY USE (Lock signal)
3	1PPS_RS422_OUT+ (#1) (*)		25	GND
4	1PPS_RS422_OUT- (#1) (*)		26	TOD (H.Q.)_PTTI output (#1)
5	GND		27	TOD (H.Q.)_PTTI output (#2)
6	1PPS_RS422+ output (#1)		28	TOD (H.Q.)_PTTI output (#3)
7	1PPS_RS422- output (#1)		29	TOD (H.Q.)_PTTI output (#4)
8	1PPS_RS422+ output (#2)		30	TOD (H.Q.)_PTTI output (#5)
9	1PPS_RS422- output (#2)		31	GND
10	1PPS_RS422+ output (#3)		32	1PPS_PTTI output (#1)
11	1PPS_RS422- output (#3)		33	1PPS_PTTI output (#2)
12	1PPS_RS422+ output (#4)		34	1PPS_PTTI output (#3)
13	1PPS_RS422- output (#4)		35	1PPS_PTTI output (#4)
14	GND		36	Over all BIT (open collector) The maximum current through the open collector is 100mA. When the Overall BIT is OK, the output level is low.
15	5.5V (internal 300Ω series resistor)		37	GND
16	1PPS_RS422_OUT+ (#2) (*)		38	FACTORY USE
17	1PPS_RS422_OUT- (#2) (*)		39	FACTORY USE
18	1PPS_RS422_OUT+ (#3) (*)		40	FACTORY USE
19	1PPS_RS422_OUT- (#3) (*)		41	FACTORY USE
20	GND		42	FACTORY USE
21	FACTORY USE		43	FACTORY USE
22	FACTORY USE		44	FACTORY USE

ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

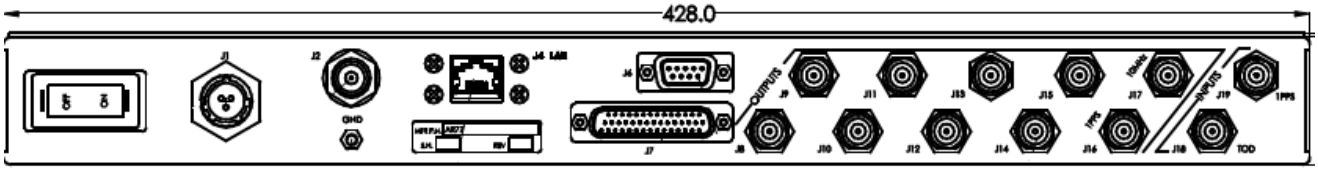
Accurate Time & Frequency System
Model AR/AS77

AR/AS77 - Mechanical ICD

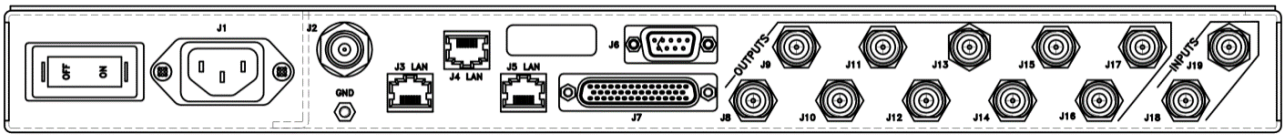


Front panel

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



Rear panel for 1 LAN with DC input



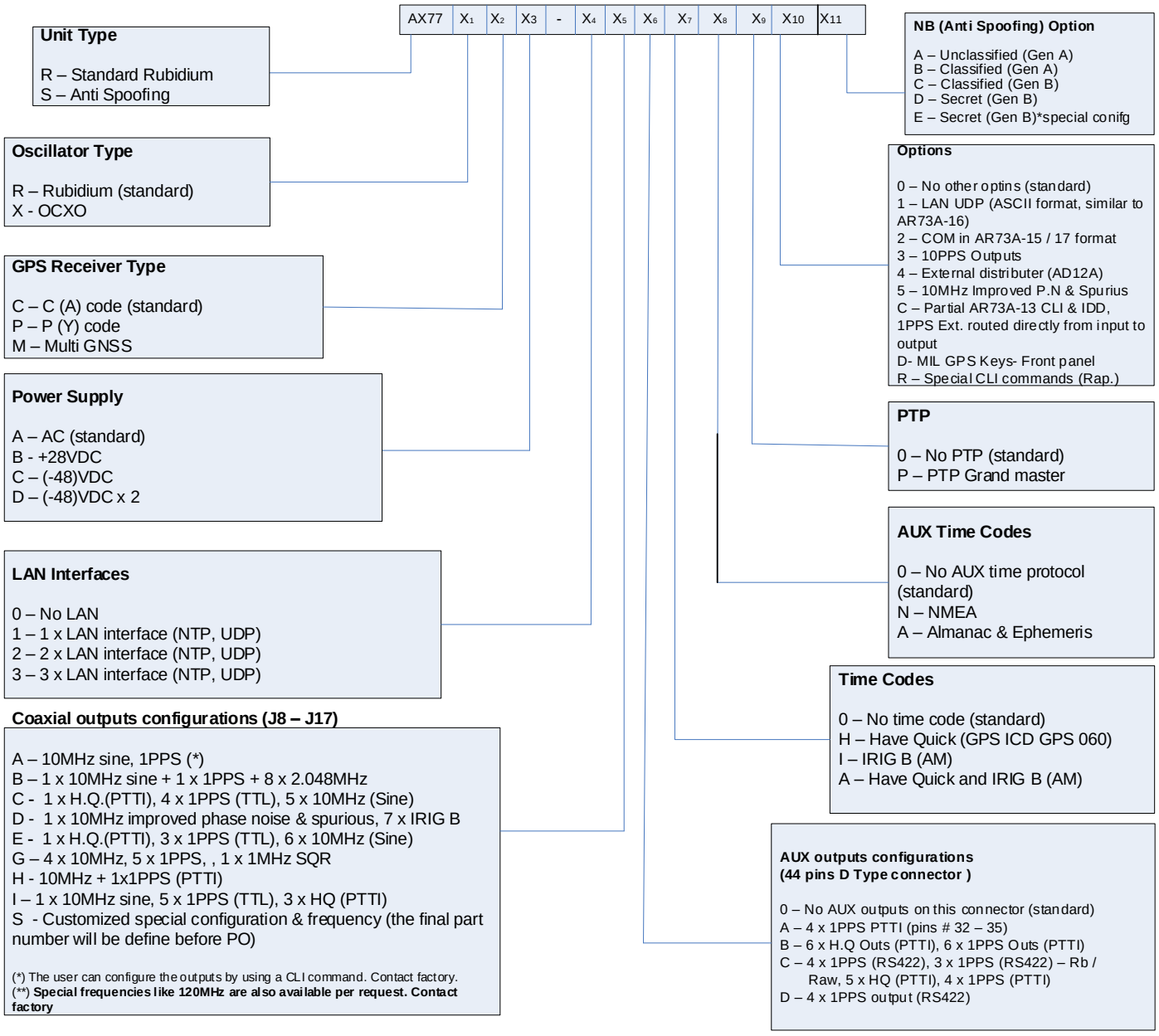
Rear panel for 2 or 3 LANs with AC input

Weight: ≤ 3.5 kg

Accurate Time & Frequency System

Model AR/AS77

HOW TO ORDER:



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

ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com