AccuBeat Ltd.
Accurate Frequency & Time

Rubidium Frequency Standard
Model AR133A
Ruggedized Low Profile

Key Features

❖ *Long-term-stability: 1E-11/month*

❖ *Short term stability: 1E-12 @ 1000s (Typ.)*

❖ *Phase noise: -158 dBc/Hz @10kHz*

❖ *Spurious: < -110 dBc*

❖ *Time Accuracy (1PPS): 15ns (7ns typical) RMS*

❖ *Holdover – 1us / 24 Hours*

❖ *Outputs: 10 MHz and 1PPS*

❖ *Supply voltage: 15 VDC / 12 VDC (option)*

❖ *Steady state power < 7.5W*

❖ *Power-saving mode < 1.8W Steady State (option)*

❖ *Size: 77 x 77 x 25.4 mm (3" x 3" x 1")*

AR133 is available in various configurations – see table below

Description

The AR133A is AccuBeat's new generation *multifunctional Rubidium Frequency Standard*. It is one of the smallest atomic standards available today, where the accuracy and stability are derived from *a quantum transition* that occurs in a *free rubidium atom*. The unit utilizes a unique advanced technology, which allows reducing the unit's size without sacrificing performance.

The AR133A is comprised of a unique *DFLL (Digital Frequency Lock Loop)* where a high performance crystal oscillator is locked to the rubidium atomic line using an embedded microprocessor and a special patented algorithm.
The algorithm optimizes the performance vs. external disturbances, improves temperature stability, and enables very fine digital frequency control.

AR133A special modes of operation:

o **Disciplined to an external 1PPS**: this improves the long-term-stability, the accuracy, and synchronizes the phase of the 1PPS output to the 1PPS input.
o **Power-saving modes** (options): for applications where power is limited, the AR133A offers several power saving modes to be selected by the user.
  ▪ *Mixed Mode (Option)* - in this mode the physics package, which is the main power consumer, is turned on and off periodically, allowing lower average power consumption. In this mode the internal OCXO supplies accurate frequency calibrated to the atomic clock frequency. Although performance is slightly reduced, power consumption is significantly lower in this mode.
  ▪ *OCXO Disciplined Mode (Option)* – this mode implements an OCXO disciplining to external 1PPS (with Physics Package shut-down) and consumes even lower power of about 1.8 W

Applications

❖ Secure Communication
❖ Cellular Base Stations

❖ Telecommunication
❖ Software Radio
❖ Test Equipment

❖ TV Stations, HDTV
❖ Scientific Equipment
❖ Calibration

AR133A DATA SHEET 17/06/2020
SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE. THE BINDING SPECIFICATIONS ARE ONLY THOSE STATED IN OUR

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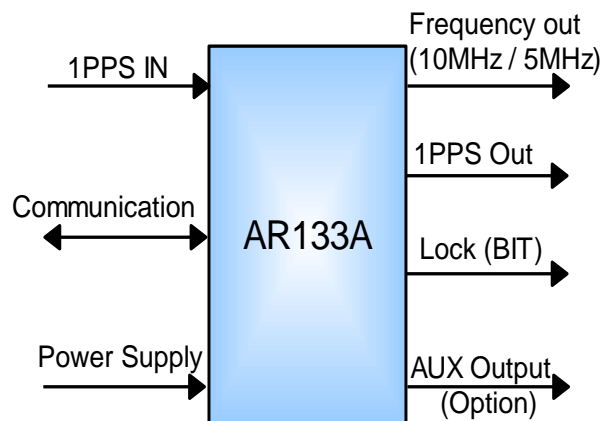Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

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Input & Outputs

	Standard	Option(s)
Outputs	10MHz sine wave +12 ± 2 dBm into 50Ω	- 5MHz - 1MHz, Square wave - 2.048MHz, Square wave - Other Frequencies (contact factory)
	1PPS, 3V TTL into 50Ω Rise time < 30nSec Pulse width <20uSec	
Input	1PPS TTL 50Ω	
Monitor & Control	RS-232	CMOS level
	Control and monitor interface provide: ID, Status, frequency adjustment. Protocol: 9600, 1, 8, 1, No parity	
	Digital frequency adjustment: 7.6E-13 steps over > 5E-7 range	

For more information about the communication channel, please contact AccuBeat.

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Performance (Rubidium Mode)

		Standard	Option(s)
Frequency	**Short Term Stability (ADEV)**	< 3E-11 @ 1s	<1.5E-11 @ 1s / <5E-12 @ 1s
		< 1E-11 @ 10s	
		< 5E-12 @ 100s	< 2.5E-12 @ 100s
		< 2E-12 @ 1000s (Typ.)	< 1.5E-12 @ 1000s (Typ.)
	Phase Noise	<-102 dBc/Hz @ 10Hz <-135 dBc/Hz @ 100Hz <-145 dBc/Hz @ 1kHz <-150 dBc/Hz @ 10kHz	<-116 dBc/Hz @ 10Hz (Typ.) < -142 dBc/Hz @ 100Hz (Typ.) < -154 dBc/Hz @ 1kHz (Typ.) < -158 dBc/Hz @ 10kHz (Typ.)
	Harmonics	< -44 dBc (up to 70MHz)	< -50 dBc (up to 70MHz)
	Spurious	< -80 dBc in the range 10Hz to 100kHz from carrier	< -110 dBc in the range 10Hz to 100kHz from carrier
	Warm-up	< 5E-8 (Lock) within 4 minutes @ 25°C ±5E-10 within 5 minutes @ 25°C	
	Retrace	< 5E-11 with on-off-on cycle: 24 hours, 48 hours, 12 hours	
	Accuracy @ Shipment	< 5E-11	
	Magnetic Field Sensitivity	< 8E-11 / gauss up to 3 gauss DC (worst direction)	
	Long Term Stability (Free run)	<±1E-10 / month (after 3 months of operation)	<±5E-11 / month (at shipment) <±1E-11 / month (at shipment)
	Long Term Stability (Disciplined to external 1PPS)	<±2E-12 (24 hrs average)	
	Temperature Stability and Range	±3E-10 over -20°C to +65°C	±3E-10 over -40°C to +74°C (Base Plate) ±5E-11 over -20°C to +65°C (Base Plate)
Time Accuracy (1PPS)	**Long- Term Accuracy**	1µs / 24 hours (after disciplining/calibration) typical @ 25ºC	
		Disciplined to external 1PPS - 40ns (20ns typical) RMS @ 25°C	Disciplined to external 1PPS - 15ns (7ns typical) RMS @ 25°C
Power Consumption *(standard Rubidium mode)*	@ Steady-state	< 8.25W @ 25°C	
	@ Warm-up	< 18W @ 25°C	< 16W @ 15VDC, room temp. (Time to Lock < 8 min) (**)

(*) Unless specified, all parameters relate to 10MHz main output.

(**) Low Power at Warm Up (option) - the internal ovens are activated in sequence thereby reducing the warm-up consumption.

_AR133A-20_ (all other parameters are as AR133A-00 specification)

Frequency	**Short Term Stability (ADEV)**	<5E-12 @ 1s
Spectral purity	**Phase Noise (Typical)**	< -95 dBc/Hz @ 1Hz < -128 dBc/Hz @ 10Hz < -143 dBc/Hz @ 100Hz < -152 dBc/Hz @ 1kHz < -157 dBc/Hz @ 10kHz
	Harmonics	< -48 dBc (up to 70MHz)
	Spurious	< -125 dBc (10Hz - 100Hz from carrier) < -120 dBc (100Hz – 1kHz from carrier) < -100 dBc (1kHz – 100kHz from carrier)
G sensitivity of the internal OCXO		±3E-10 / g

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Power Supply, Dimensions & Weight

	Standard	**Option(s)**
DC	15 ± 0.3 VDC	12 ± 0.3 VDC
Size	77 mm x 77mm x 25.4 mm (3" x 3" x 1")	
Weight	≤ 295 g	

BIT and Remote Control

Built In Test (BIT):	The built in test detects > 95% of all failures. Receive by hardware pin (number 3 in the D Type connector), open collector (10mA max). High impedance = BIT Fail; short to ground = BIT Pass & Lock. The BIT result is also reported via the serial communication channel.

Mode of Operation

Modes of Operation	Rubidium Free-run
	OCXO disciplining to Ext. 1PPS - Option (For more information contact factory)

Environmental

	Standard	**Option**
G sensitivity of the internal OCXO	±1E-9 / g	±3E-10 / g
Operating Temperature	-20°C to +65 °C	-40°C to +74°C (Base Plate) A plate with 1.2 ºC/W should be used
Storage Temperature	-40°C to +80°C	
Humidity	Up to 95% at 35°C, non-condensed	

Mechanical & Electrical ICD

D-Type subminiature 9 pins (male):
Pin 1 – Supply
Pin 2 – GND
Pin 3 – Lock (BIT)
Pin 4 – 1PPS IN
Pin 5 – AUX OUT - Option
Pin 6 – TxD
Pin 7 – Factory Use
Pin 8 – 1PPS OUT
Pin 9 – RxD

SMA: RF OUT

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HOW TO ORDER

AccuBeat P/N	Output Frequency	Wave Form	1PPS Input & Output	Operating Voltage	Special Features
AR13300	10MHz	Sine	√	15V	Standard
AR13302	10MHz	Sine	√	12V	Standard 12VDC
AR13303-01	10MHz	Sine	√	15V	Vibration Ruggedized (Refer to separate datasheet)
AR13304-02	10MHz	Sine	√	15V	Wide operating temperature range
AR13305	1MHz	SQR	√	15V	1MHz SQR Output
AR13306	2.048MHz	SQR	√	15V	2.048MHz Output (different mechanical dimensions)
AR13307	10MHz	Sine	---	12V	Improved EMI protection (different mechanical dimensions – refer to separate datasheet)
AR13309	5MHz	Sine	√	15V	5MHz output
AR13310	10MHz	SQR	√	15V	10MHz SQR Output
AR13311	10MHz	SQR	√	12V	10MHz SQR Output Temperature range: -30°C to 65°C
AR13312	10MHz	Sine	---	15V	CLI COM format: CMOS Protocol: AR60A format
AR13313	10MHz	Sine	√	15V	Improved phase noise
AR13314	10MHz	Sine	√	15V	Improved phase noise. Improved Aging
AR13317	10MHz	Sine	√	15V	Improved phase noise Wide operating temperature range
AR13318	10MHz	Sine	√	15V	1PPS input high impedance
AR13319	10MHz	Sine	√	12V	Redundant 1PPS input (Refer to separate datasheet)
AR13320	10MHz	Sine	√	15V	Ultra-High Stability (ADEV) Improved time accuracy (1PPS) Ultra-Low phase noise, low g sensitivity
AR13323	10MHz	Sine	√	15V	High Stability (ADEV) Improved time accuracy (1PPS)
AR13326	10MHz	Sine	√	12V	Improved phase noise Wide operating temperature range
AR13327	10MHz	Sine	√	12V	Improved phase noise. Improved Aging Wide operating temperature range
AR13328	10MHz	Sine	√	12V	Wide operating temperature range CLI com format: CMOS
AR13329	10MHz	Sine	√	15V	Operating temperature range: -20°C to +71°C
For other customized configurations - please contact factory					

Developer KIT

Name	AccuBeat P/N	Description
GUI	SW50029	GUI for AR133A
Interface cable	AC50549	OPERATIONAL CABLE FOR AR133A WITH RS232 COM