

Helping Customers Innovate, Improve & Grow



## Features

- Long-term-stability: 5E-11/month
- 2E-12 frequency accuracy & 100nSec 1PPS accuracy relative to 1PPS input when disciplined
- Short term stability: 5E-12 @100s
- Phase noise: -150dBc/Hz @10kHz
- Outputs: 10 MHz and 1PPS
- Supply voltage: 15 VDC / 12 VDC (option)
- Steady state power < 8.25W
- Power-saving mode < 1.8W Steady State (option)
- Size: 77 x 77 x 25.4 mm (3" x 3" x 1")

## Applications

- Secure Communication
- Telecommunication
- Software Radio
- Test Equipment
- Cellular Base Stations
- TV Stations, HDTV
- Scientific Equipment
- Calibration

## Description

The AR-133 is a 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 AR-133 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.

*AR-133 special modes of operation:*

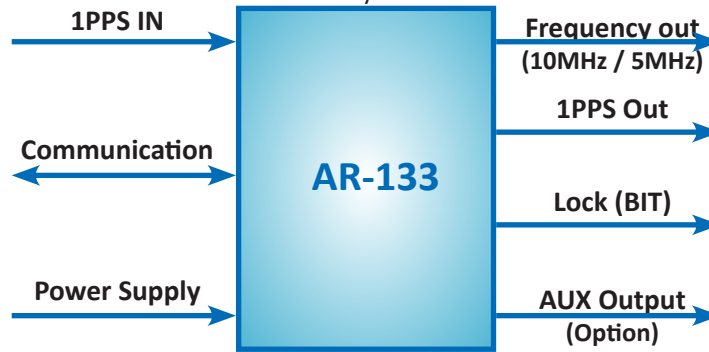
- Disciplined to an external 1PPS: this improves the long-term-stability, the accuracy, and synchronizes the phase of the 1PPS output to the 1PPS input.
- Power-saving modes (options): for applications where power is limited, the AR133A offers several power saving modes to be selected by the user.
  - 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

# Performance Specifications

All specifications are at room temperature, quiescent conditions, sea level ambient unless otherwise specified

Input & Outputs		
	Standard	Option
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	
	RS-232	CMOS level
Monitor & Control	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 contact factory



		Performance (Rubidium Mode)	
Parameter and Conditions		Standard	Option
Frequency	Short Term Stability	< 3E-11 @ 1s < 5E-12 @ 100s	< 1.5E-11 @ 1s < 5E-12 @ 100s
	Phase Noise	<-102 dBc/Hz @ 10Hz <-135 dBc/Hz @ 100Hz <-145 dBc/Hz @ 1kHz <-150 dBc/Hz @ 10kHz	<-116 dBc/Hz @ 10Hz <-1345 dBc/Hz @ 100Hz <-155 dBc/Hz @ 1kHz <-158 dBc/Hz @ 10kHz (Typical)
	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 month operation)	<±5E-11 / month (at shipment)
	Long Term Stability (Disciplined to external 1 pps)	<±2E-12 (24 hour average)	
Temperature Stability and Range	±3E-10 over -20°C to +65°C	±3E-10 -40°C to +74°C (base plate)	
Time Accuracy (1PPS)	1μs / 24 hours (after disciplining/calibration)		
	Long Term Accuracy	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.

## Performance Specifications (continued)

AR133-20 (All other parameters similar to AR133-00)

Modes of Operation	Phase Noise	<-95 dBc/Hz @ 1 Hz <-128 dBc/Hz @ 10 Hz <-140 dBc/Hz @ 100 Hz <-146dBc/Hz @ 1k Hz <-147 dBc/Hz @ 10 kHz
	Harmonics	<-48 dBc/Hz (up to 70 MHz)
	Spurious	<-120 dBc (10Hz -100Hz from carrier) <-110 dBc (100Hz -1kHz from carrier) <-100 dBc (1kHz -100kHz from carrier)
g-sensitivity for internal OCXO		±2E-10/g

## Power Supply, Dimensions & Weight

	Standard	Option
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. BIT result receives also by serial communication.
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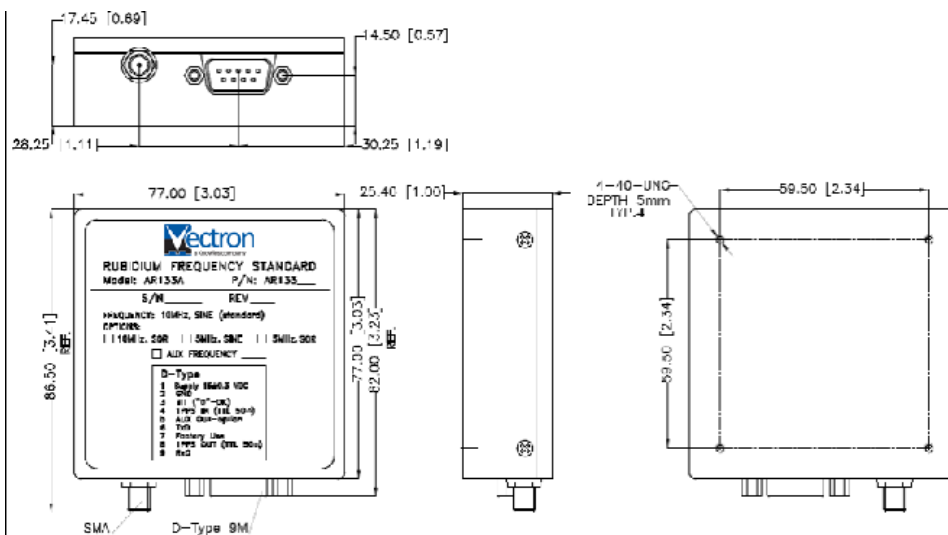
## Mode of Operation

Modes of Operation	Standard Rubidium Free-run	Standard
	Rubidium disciplining to Ext. 1PPS - Option	Excellent performance in Holdover
	OCXO disciplining to Ext. 1PPS - Option (*)	Medium performance in Holdover
	Mixed mode - option (*)	Low average power consumption, good performance

## Environmental

	Standard	Option
Operating Temperature	-20°C to +65 °C	-40°C to +74°C (base plate) Plate with 1.2°C/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**

## How To Order

Vectron P/N	Options Descriptions				
	Output Frequency	Wave Form	1PPS Input & Output	Operating Voltage	Special Features
AR133-00	10MHz	Sine	√	15V	Standard
AR133-02	10MHz	Sine	√	12V	10MHz Sive 12VDC
AR133-03-02	10 MHz	Sine	√	15V	Vibration Ruggedized (see separate data sheet)
AR133-04-02	10MHz	Sine	√	15V	Wide operating temperature rage
AR133-05	1MHz	SQR	√	15V	1MHz SQR
AR133-06	2.048MHz	SQR	√	15V	2.048MHz OUTPUT (different mechanical dimensions - see separate datasheet)
AR133-07	10MHz	Sine	-	12V	Improved EMI protection (different mechanical dimensions - see separate datasheet)
AR133-09	5MHz	Sine	√	15V	5MHz OUTPUT
AR133-10	10MHz	SQR	√	15V	10MHz SQR
AR133-11	10MHz	SQR	√	12V	10MHz SQR Temperature range: -30°C to +65°C
AR133-12	10MHz	Sine	-	15V	CLI COM format: CMOS Protocol: AR60A format
AR133-13	10MHz	Sine	√	15V	Improved Phase Noise
AR133-14	10MHz	Sine	√	15V	Improved Phase Noise, Improved Aging
AR133-17	10MHz	Sine	√	15V	Improved Phase Noise, Wide Operating Temperature Range
AR133-18	10MHz	Sine	√	15V	1pps high input impedance
AR133-19	10MHz	Sine	√	12V	High Resolution * Redundant 1PPS input (Refer to separate datasheet)
AR133-20	10MHz	Sine	√	15V	High Resolution * Low phase noise, low g sensitivity
AR133-23	10MHz	Sine	√	15V	High Resolution *
AR133-26	10MHz	Sine	√	12V	Improved phase noise, Wide operating temperature range
AR133-27	10MHz	Sine	√	12V	Improved phase noise, Wide operating temperature range, Improved Aging
AR133-28	10MHz	Sine	√	12V	Wide operating temperature range CLI com format: CMOS

**For other customized configuration - please contact the factory**

\*Improved ADEV: 1.5E-11 @ 1sec, Time Interval counter resolution: 3 ns

Accessories		
Name	Part Number	Description
GUI	SW50029	GUI for AR133
Interface cable	AC50549	Operational cable for AR133 with RS232 Com

## Revision History

Revision	Change Summary	Date
1.0	Product Release	October 2014
1.1	Added new part number AR133-21	March 2016
1.2	Added new part number AR-133-22	March 2016
1.3	Add multiple new part numbers, accessories	November 2016
1.4	Improved spurious responses, and pps precision	April 2017

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