

Helping Customers Innovate, Improve & Grow



**AR-133**

## 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:*

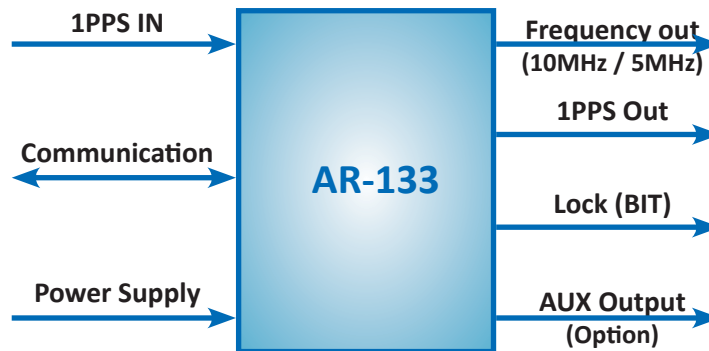
- Disciplined to an external 1PPS: this improves the long-term-stability, the accuracy, and synchronizes the phase of the 1PPS output to the 1PPS input.
- Power-saving modes (options): for applications where power is limited, the AR133A offers several power saving modes to be selected by the user.
  - 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 - (*) In AR133A-01 output level is +7±2 dBm	- 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	
	Phase Noise	<-102 dBc/Hz @ 10Hz <-135 dBc/Hz @ 100Hz <-145 dBc/Hz @ 1kHz <-150 dBc/Hz @ 10kHz	<-118 dBc/Hz @ 10Hz <-135 dBc/Hz @ 100Hz <-155 dBc/Hz @ 1kHz <-159 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	<±1E-9 / year (after 3 month operation)	<±5E-10 / year (at shipment) Disciplined to external 1PPS - <±2E-12 (24 hrs average)
Temperature Stability and Range	±3E-10 over -20°C to +65°C	-40°C to +70°C	
Time Accuracy (1PPS)	Long Term Accuracy	1µs / 24 hours (after disciplining/calibration)	Disciplined to external 1PPS - 100ns (50ns 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)

### Power Supply, Dimensions & Weight

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.

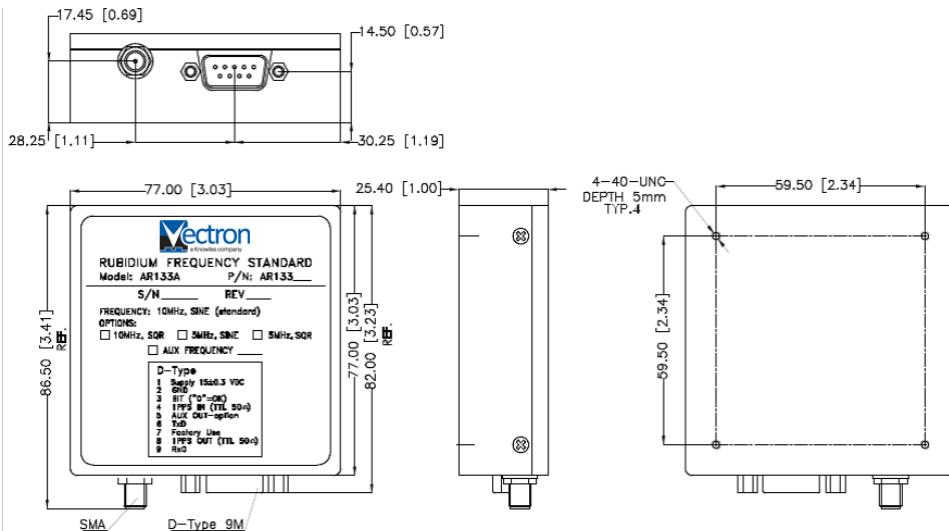
### Mode of Operation

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

Operating Temperature	-20°C to +65 °C (for wider temperature range contact factory)
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
AR-133	10MHz	Sine	√	15V	Standard
AR-133-02	10MHz	Sine	√	12V	10MHz Sine 12VDC
AR-133-04-02	10MHz	Sine	√	15V	Wide operating temperature range (-40°C TO +74°C BASE PLATE)
AR-133-05	1MHz	SQR	√	15V	1MHz SQR
AR-133-06	2.048MHz	SQR	√	15V	2.048MHz OUTPUT
AR-133-07	10MHz	Sine	-	12V	Improved EMI protection
AR-133-09	5MHz	Sine	√	15V	5MHz OUTPUT
AR-133-10	10MHz	SQR	√	15V	10MHz SQR
AR-133-11	10MHz	SQR	√	12V	10MHz SQR 12VDC
AR-133-13	10MHz	Sine	√	15V	Improved Phase Noise
AR-133-14	10MHz	Sine	√	15V	High Stability, Low Phase Noise
AR-133-21	10MHz	Sine with digital SQR	√	15V	Digital square wave output on dB9
AR-133-22	10MHz	Sine	√	15V	100% start time screening

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

## Revision History

Revision	Change Summary	Date
1.0	Product Release	October 2014
1.1	Added new part number AR-133-21 option in the how to order table	March 2016
1.2	Added new part number AR-133-22 option in the how to order table	March 2016

### For Additional Information, Please Contact

#### **USA:**

Vectron International  
267 Lowell Road, Suite 102  
Hudson, NH 03051  
Tel: 1.888.328.7661  
Fax: 1.888.329.8328

#### **Europe:**

Vectron International  
Landstrasse, D-74924  
Neckarbischofsheim, Germany  
Tel: +49 (0) 7268.801.100  
Fax: +49 (0) 7268.801.282

#### **Asia:**

68 Yin Cheng Road(C), 22nd Floor  
One Lu Jia Zui  
Pudong, Shanghai 200120, China  
Tel: +86 21 6194 6886  
Fax: +86 21 6194 6699

#### **Disclaimer**

Vectron International reserves the right to make changes to the product(s) and or information contained herein without notice. No liability is assumed as a result of their use or application. No rights under any patent accompany the sale of any such product(s) or information.