VRE107

Precision Voltage Reference

FEATURES

- Very High Accuracy: ±5 V, ±0.8 mV
- Extremely Low Drift: 1.33 ppm/°C (-55°C to +125°C)
- Excellent Stability: 6 ppm/1000 Hrs. Typical
- Excellent Line Regulation: 6 ppm/V Typical
- Wide Supply Range: ±13.5 V to ±22 V
- Hermetic 14-pin Ceramic DIP
- Military Processing Option

APPLICATIONS

- Precision A/D and D/A Converters
- Transducer Excitation
- Accurate Comparator Threshold Reference
- High Resolution Servo Systems
- Digital Voltmeters
- High Precision Test and Measurement Instruments

DESCRIPTION

VRE107 Series Precision Voltage References provide ultrastable ±5 V outputs with ±0.8 mV initial accuracy and temperature coefficient as low as 1.33 ppm/°C over the full military temperature range. This improvement in accuracy is made possible by a unique, proprietary multipoint laser compensation technique.

Significant improvements have been made in other performance parameters as well, including initial accuracy, warm-up drift, line regulation, and long-term stability, making the VRE107 series the most accurate and stable 5 V references available.

VRE107 series devices are available in two performance grades. All devices are packaged in 14-pin hermetic ceramic packages for maximum long-term stability. “M” versions are screened for high reliability and quality.

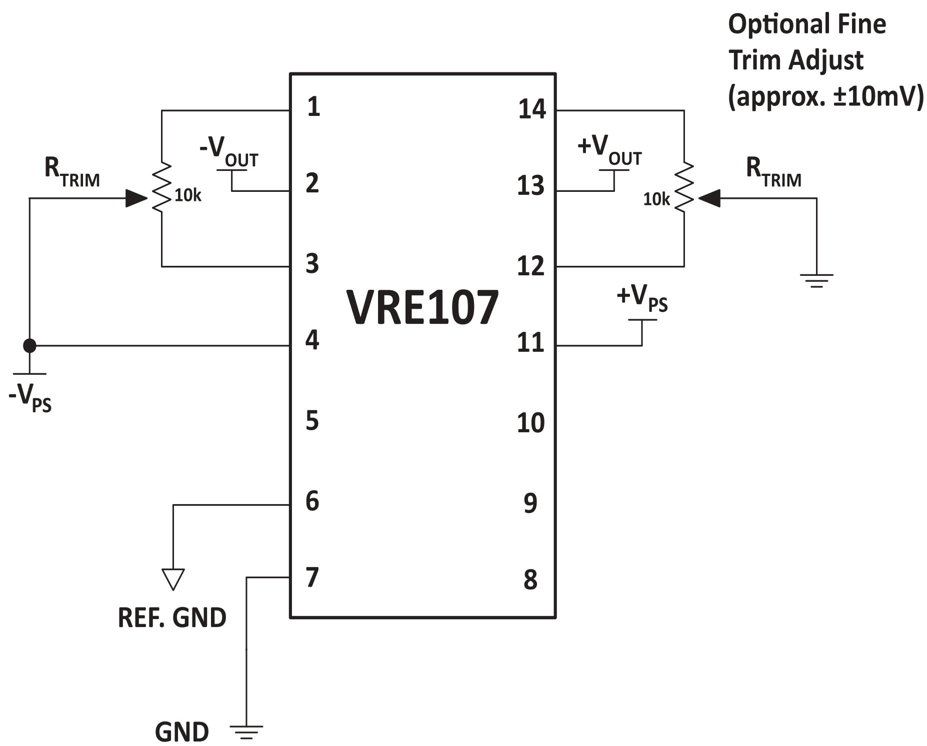
Superior stability, accuracy, and quality make these references ideal for precision applications such as A/D and D/A converters, high accuracy test and measurement instrumentation, and tranducer excitation.

SELECTION GUIDE

Model	Output (V)	Temperature Operating Range	Volt Deviation (Max)
VRE107M	±5	-55°C to +125°C	±0.7mV
VRE107MA	±5	-55°C to +125°C	±0.6mV

TYPICAL CONNECTION

Figure 1: Typical Connection



PIN DESCRIPTIONS

Pin Number	Name	Description
1, 3	-ADJ	Optional fine adjustment for approximately ±10 mV on -OUT.
2	-OUT	-5 V output.
4	$-V_{PS}$	The negative supply voltage connection.
6	REF_GND	Provided for accurate ground sensing. Internally connected to GND.
7	GND	Ground.
11	$+V_{PS}$	The positive supply voltage connection.
12, 14	+ADJ	Optional fine adjustment for approximately ±10 mV on +OUT.
13	+OUT	+5 V output.
5, 8, 9, 10	NC	No connection.

SPECIFICATIONS

V_{PS} = ±15 V, T = 25ºC, R_L = 10 kΩ unless otherwise noted.

ABSOLUTE MAXIMUM RATINGS

Parameter	VRE107M			VRE107MA			Units
	Min	Typ	Max	Min	Typ	Max	
Power Supply	±13.5		±22	*		*	V
Operating Temperature	-55		+125	*		*	ºC
Storage Temperature	-65		+150	*		*	ºC
Short Circuit Protection	Continuous			*			

ELECTRICAL SPECIFICATIONS

Parameter	VRE107M			VRE107MA			Units
	Min	Typ	Max	Min	Typ	Max	
Output Voltage		±5			*		V
Initial Error			±900			±800	µV
Warmup Drift		2			1		ppm
T_{MIN} - T_{MAX} [1]			700			600	µV
Long-Term Stability		6			*		ppm/1000hrs.
Noise (0.1 - 10 Hz)		3			*		µVpp
Output Current	±10			*			mA
Line Regulation		6	10		*	*	ppm/V
Load Regulation		3			*		ppm/mA
Output Adjustment		10			*		mV
Temperature Coefficient		4			*		µV/ºC/mV
Power Supply Current, +PS [2]		7	9		*	*	mA
Power Supply Current, -PS [2]		4	6		*	*	mA

1. Using the Box Method, the specified value is the maximum deviation from the output voltage at 25°C over the specified operating temperature range.
2. The specified values are unloaded.

Note: * Same as M Model.

TYPICAL PERFORMANCE GRAPHS

Figure 2: V_{OUT} vs. Temperature (VRE107M)

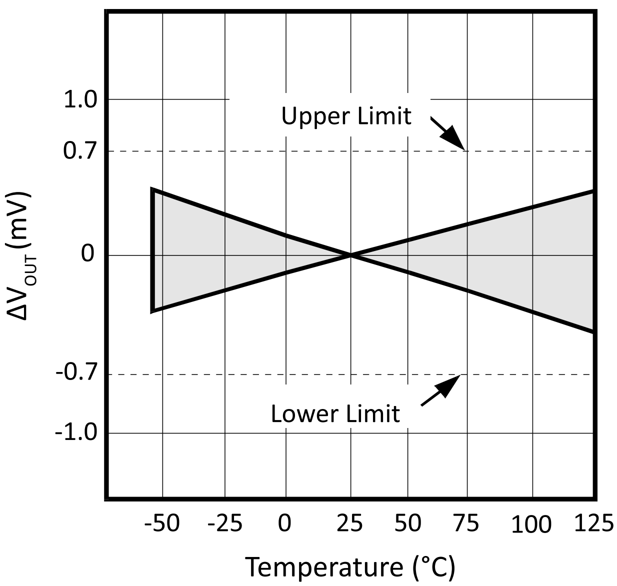
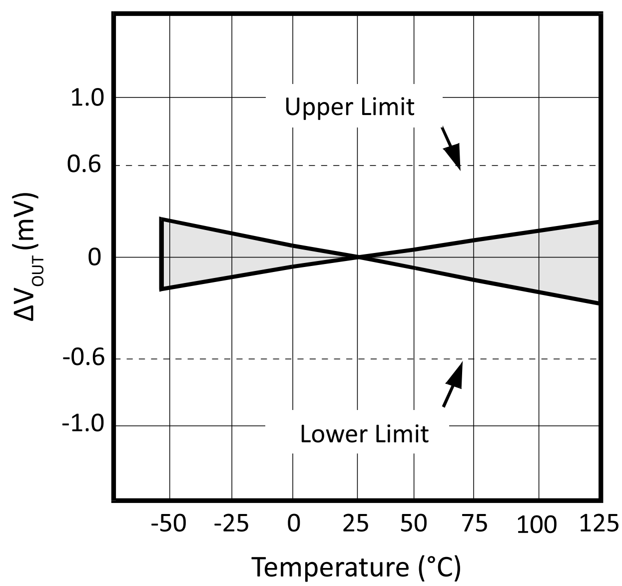


Figure 3: V_{OUT} vs. Temperature (VRE107MA)



POSITIVE OUTPUT

Figure 4: Power Supply Current vs. Temperature

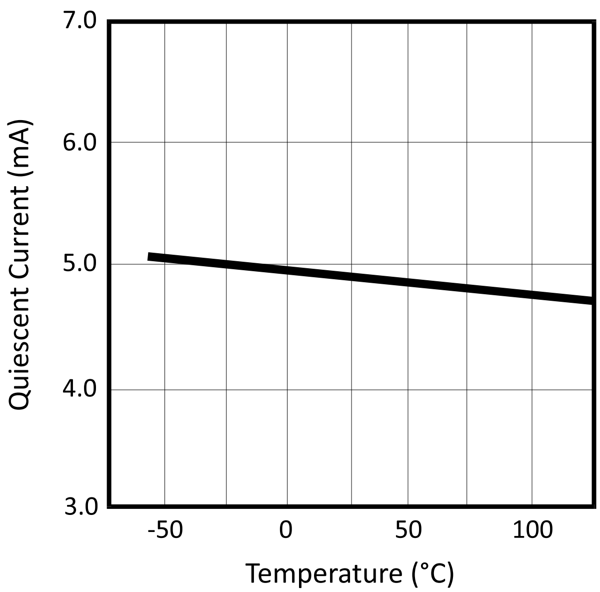


Figure 5: Junction Temp. Rise vs. Output Current

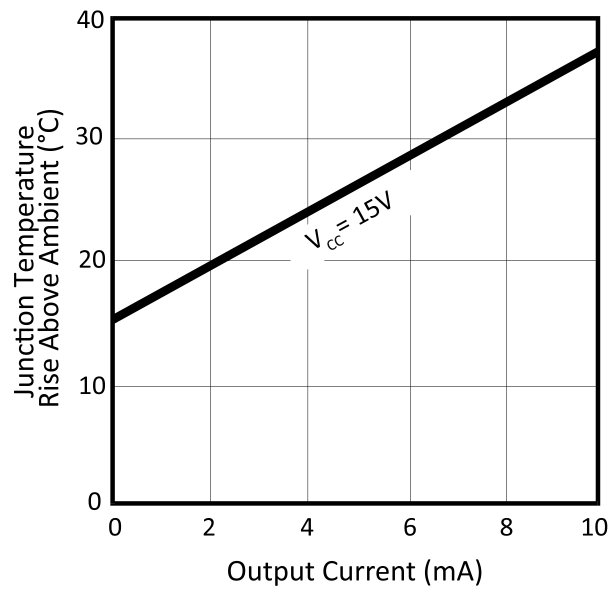
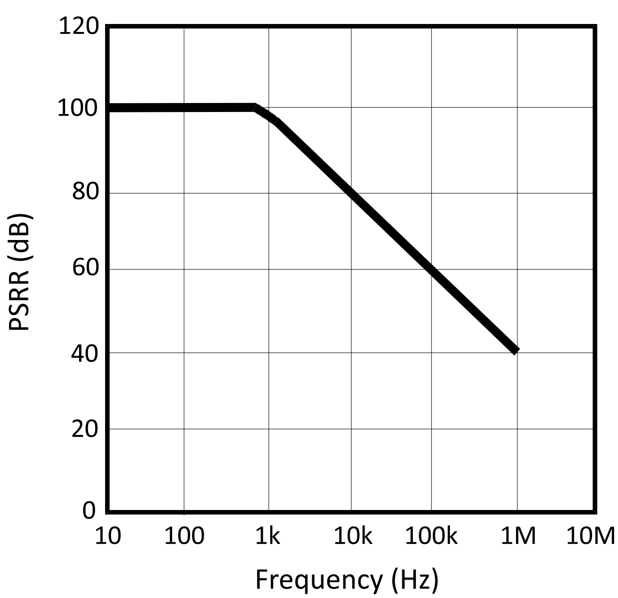


Figure 6: PSRR vs. Frequency



NEGATIVE OUTPUT

Figure 7: Power Supply Current vs. Temperature

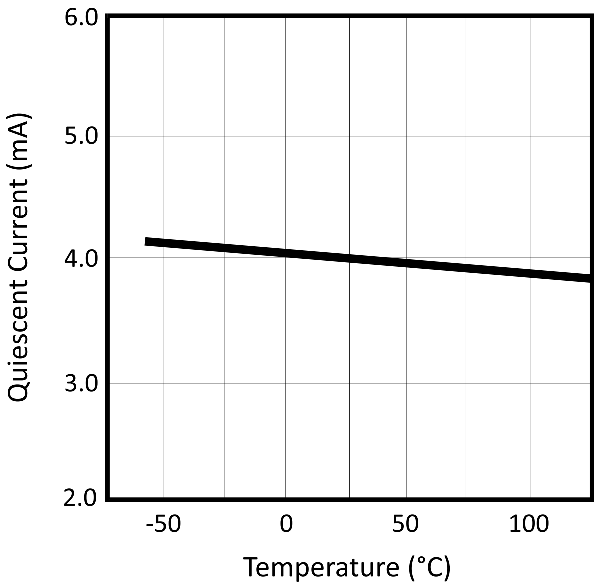


Figure 8: Junction Temp. Rise vs. Output Current

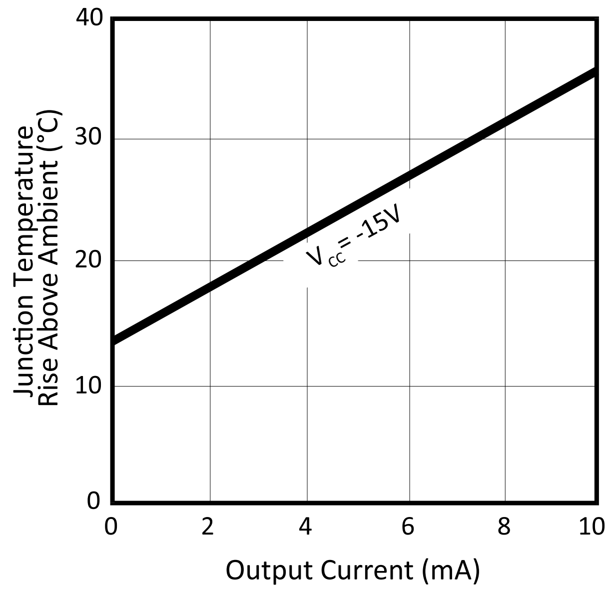
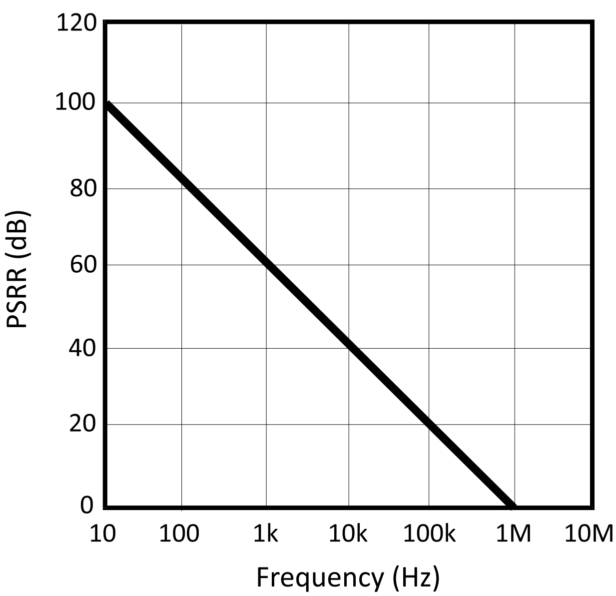
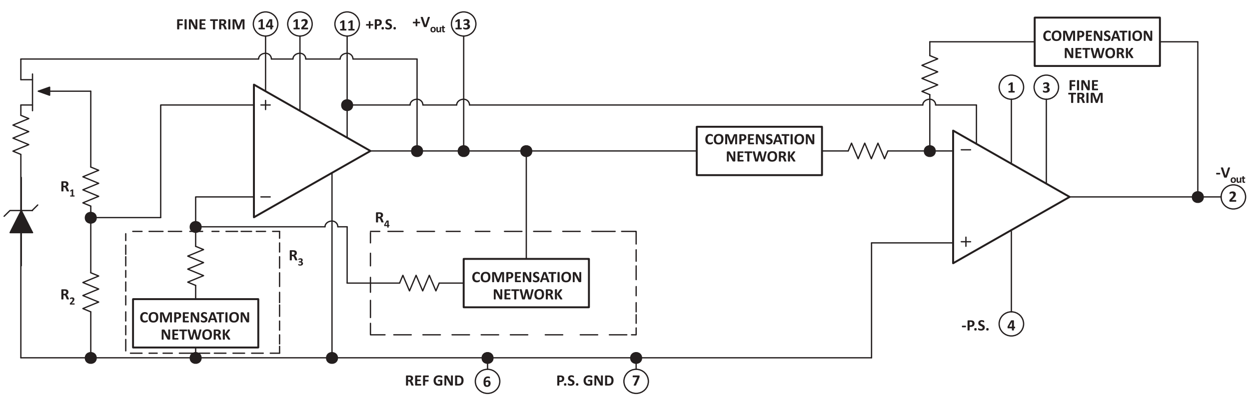


Figure 9: PSRR vs. Frequency



BLOCK DIAGRAM

Figure 10: Block Diagram



THEORY OF OPERATION

The following discussion refers to the block diagram in Figure 10. A FET current source is used to bias a 6.3 V zener diode. The zener voltage is divided by the resistor network R1 and R2. This voltage is then applied to the noninverting input of the operational amplifier which amplifies the voltage to produce a 5 V output. The gain is determined by the resistor networks R3 and R4: G=1 + R4/R3. The 6.3 V zener diode is used because it is the most stable diode over time and temperature.

The current source provides a closely regulated zener current, which determines the slope of the reference's voltage vs. temperature function. By trimming the zener current, a lower drift over temperature can be achieved. But since the voltage vs. temperature function is nonlinear, this method leaves a residual error over wide temperature ranges.

To remove this residual error, a nonlinear compensation network of thermistors and resistors is used in the VRE107 series references. This proprietary network eliminates most of the nonlinearity in the voltage vs. temperature function. By then adjusting the slope, The VRE107 series produces a very stable voltage over wide temperature ranges. This network is less than 2% of the overall network resistance so it has a negligible effect on long term stability.

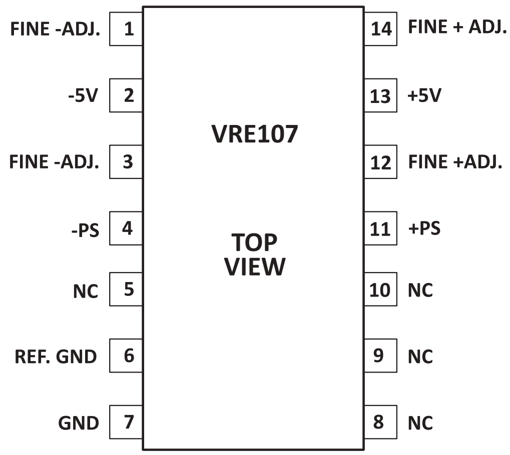
APPLICATION INFORMATION

The proper connection of the VRE107 series voltage reference is shown in figure 1 with the optional trim resistors. When trimming the VRE107, the positive voltage should be trimmed first since the negative voltage tracks the positive side. Pay careful attention to the circuit layout to avoid noise pickup and voltage drops in the lines.

The VRE107 series voltage references have the ground terminal brought out on two pins (pin 6 and pin 7) which are connected together internally. This allows the user to achieve greater accuracy when using a socket. Voltage references have a voltage drop across their power supply ground pin due to quiescent current flowing through the contact resistance. If the contact resistance was constant with time and temperature, this voltage drop could be trimmed out. When the reference is plugged into a socket, this source of error can be as high as 20 ppm. By connecting pin 7 to the power supply ground and pin 6 to a high impedance ground point in the measurement circuit, the error due to the contact resistance can be eliminated. If the unit is soldered into place the contact resistance is sufficiently small that it doesn't effect performance.

PIN CONFIGURATION

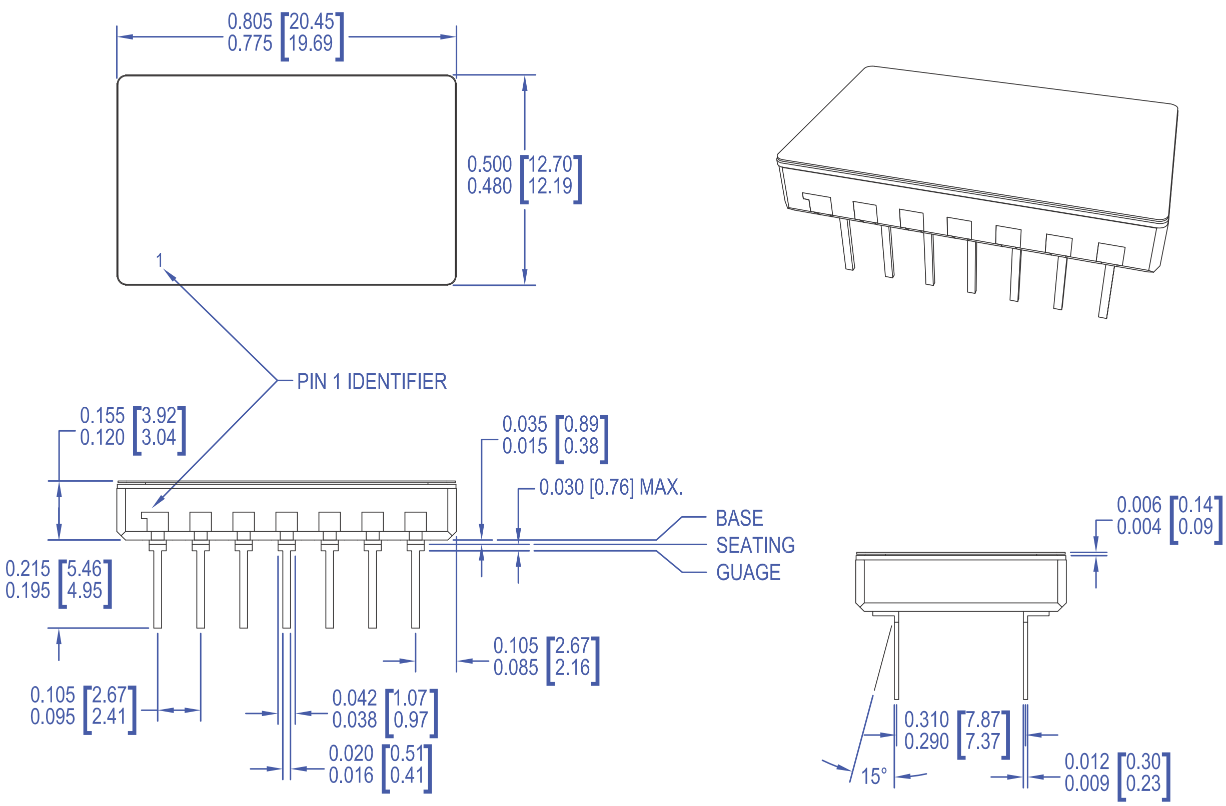
Figure 11: Pin Configuration



PACKAGE OPTIONS

Part Number	Apex Package Style	Description
VRE107M	HC	Hermetic 14-pin Ceramic DIP
VRE107MA	HC	Hermetic 14-pin Ceramic DIP

PACKAGE STYLE HC



NOTES:
1. Dimensions are inches & [millimeters].
2. Bracketed alternate units are for reference only.
3. Pins: Phosphor bronze, Gold over Nickel plated.
4. Material: Alumina Ceramic substrate and cover.
5. Cover: Electroless Nickel plated.
6. Package weight: 0.092 oz. [2.605 g].

NEED TECHNICAL HELP? CONTACT APEX SUPPORT!

For all Apex Microtechnology product questions and inquiries, call toll free 800-546-2739 in North America. For inquiries via email, please contact apex.support@apexanalog.com. International customers can also request support by contacting their local Apex Microtechnology Sales Representative. To find the one nearest to you, go to www.apexanalog.com