VRE100/102

Precision Voltage Reference

FEATURES

- Very High Accuracy: ±10 V Output, ±1.0 mV
- Extremely Low Drift: 1.09 ppm/ºC (-55ºC to +125ºC)
- Low Warm-up Drift: 1.0 ppm Typical
- Excellent Stability: 6 ppm/1000 Hrs. Typical
- Excellent Line Regulation: 3 ppm/V Typical
- 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

VRE100 Series Precision Voltage References provide ultrastable +10 V (VRE100) and ±10 V (VRE102) outputs with ±1.0 mV initial accuracy and temperature coefficient as low as 1.09 ppm/°C over the full military temperature range. This improvement in accuracy is made possible by a unique, proprietary multipoint laser compensation technique.

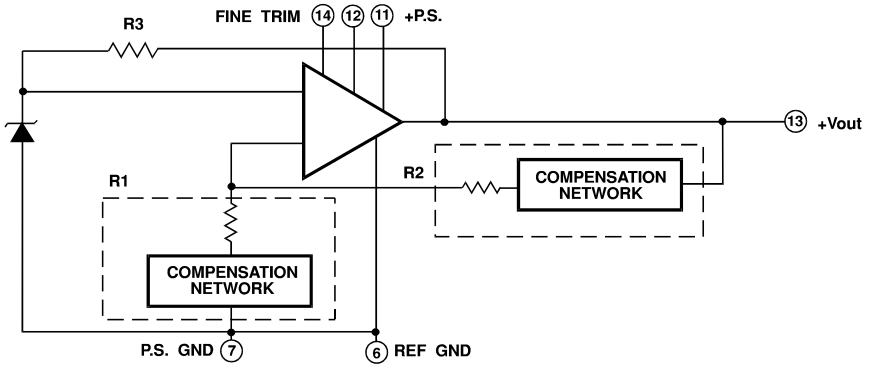
Significant improvements have been made in other performance parameters as well, including initial accuracy, warm-up drift, line regulation, and long-term stability, making the VRE100 series the most accurate and stable 10 V reference available.

VRE100/102 devices are available in two operating temperature ranges, -25°C to +85°C and -55°C to +125°C, and 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.

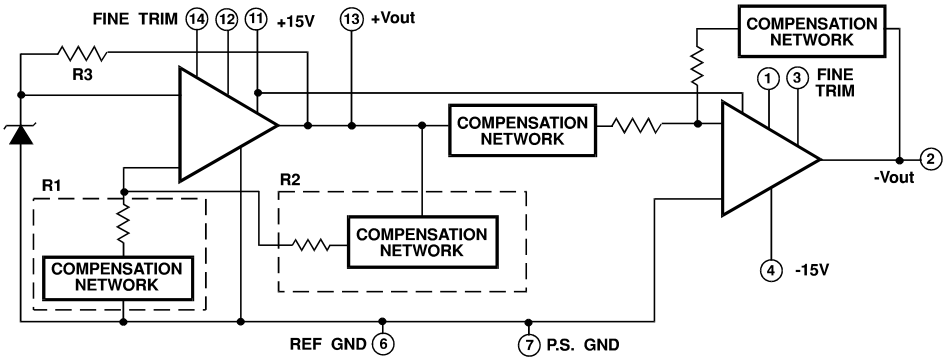
Superior stability, accuracy, and quality make these references ideal for precision applications such as A/D and D/A converters, high-accuracy test and measurement instrumentation, and transducer excitation.

Figure 1. BLOCK DIAGRAMS

VRE100



VRE102



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1. CHARACTERISTICS AND SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

V_{PS} =±15V, T = +25°C, R_L = 10K UNLESS OTHERWISE NOTED.

Grade	C			CA			M			
Parameter	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Units**
ABSOLUTE MAXIMUM RATINGS										
Power Supply	±13.5		±22	*		*	*		*	V
Operating Temperature	-25		+85	*		*	-55		+125	ºC
Storage Temperature	-65		+150	*		*	*		*	ºC
Short Circuit Protection	Continuous			*			*			
OUTPUT VOLTAGE										
VRE100		+10			*			*		V
VRE102		±10			*			*		V
OUTPUT VOLTAGE ERRORS										
Initial Error			±1.2			±1.0			±1.7	mV
Warmup Drift		2			1			2		ppm
T_{MIN} - T_{MAX} (Note1)			0.8			0.6			1.2	mV
Long-Term Stability		6			*			*		ppm/1000hrs
Noise (0.1 - 10Hz)		6			*			*		µVpp
OUTPUT CURRENT										
Range	±10			*			*			mA
REGULATION										
Line		3	10		*	*		*	*	ppm/V
Load		3			*			*		ppm/mA
OUTPUT ADJUSTMENT										
Range		20			*			*		mV
Temperature Coefficient		4			*			*		µV/ºC/mV
POWER SUPPLY CURRENT (Note 2)										
VRE100 +PS		5	7		*	*		*	*	mA
VRE102 +PS		7	9		*	*		*	*	mA
VRE102 -PS		4	6		*	*		*	*	mA

NOTES:

* Same as C Models.

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.

SELECTIONGUIDE

Model	Output (V)	Temperature Operating Range	Volt Deviation (MAX)
VRE102C	±10	-25°C to +85°C	±0.8mV
VRE102CA	±10	-25°C to +85°C	±0.6mV
VRE102M	±10	-55°C to +125°C	±1.2mV

Hermetic 14-pin Ceramic DIP
Package Style HC

2. THEORY OF OPERATION

The following discussion refers to the block diagrams in Figure 1. In operation, approximately 6.3 volts is applied to the noninverting input of the op amp. The voltage is amplified by the op amp to produce a 10.000 V output. The gain is determined by the networks R1 and R2: G=1 + R2/R1. The 6.3 V zener diode is used because it is the most stable diode over time and temperature.

The zener operating current is derived from the regulated output voltage through R3. This feedback arrangement provides a closely regulated zener current. This current determines the slope of the references' 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 compensation technique is not well suited for wide temperature ranges.

A nonlinear compensation network of thermistors and resistors is used in the VRE series voltage references. This proprietary network eliminates most of the nonlinearity in the voltage vs. temperature function. By then adjusting the slope, this 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. By using highly stable resistors in our network, we produce a voltage reference that also has very good long term stability.

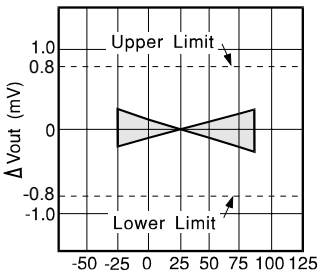
3. APPLICATION INFORMATION

Page 5 shows the proper connection of the VRE100 series voltage reference with the optional trim resistors. When trimming the VRE102, 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 VRE100 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. The VRE series voltage references can be connected with or without the use of pin 6 and still provide superior performance.

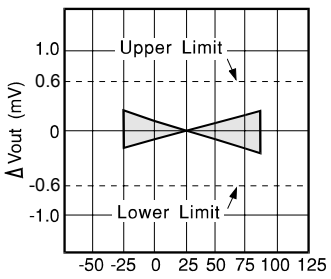
4. TYPICAL PERFORMANCE CURVES

V_{OUT} vs. TEMPERATURE



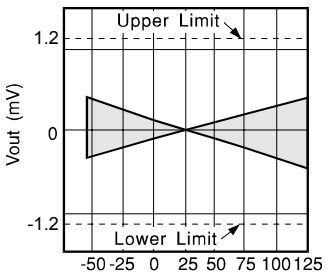
Temperature °C
VRE102C

V_{OUT} vs. TEMPERATURE



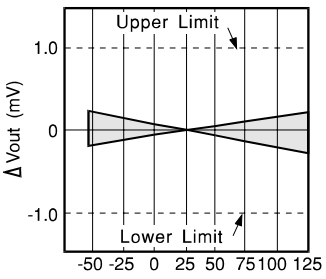
Temperature °C
VRE102CA

V_{OUT} vs. TEMPERATURE



Temperature °C
VRE102M

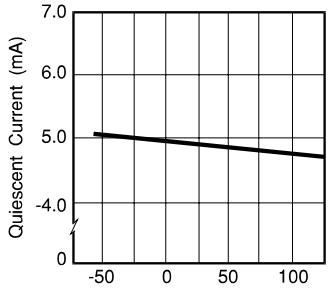
V_{OUT} vs. TEMPERATURE



Temperature °C
VRE100MA

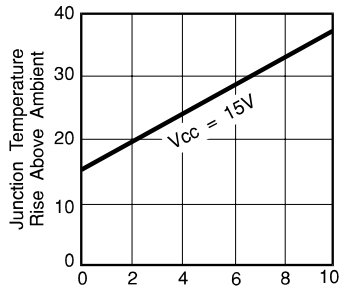
VRE100

QUIESCENT CURRENT VS. TEMP



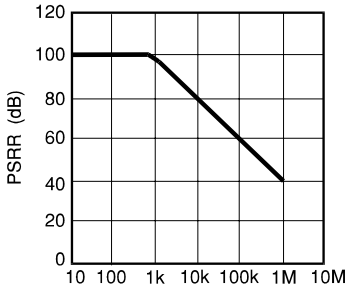
Temperature °C

JUNCTION TEMP. RISE VS. OUTPUT CURRENT



Output Current (mA)

PSRR VS. FREQUENCY

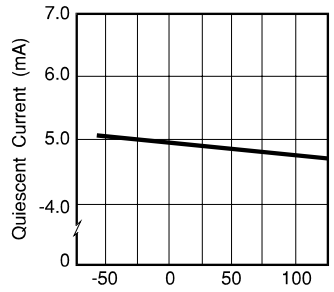


Frequency (Hz)

VRE102

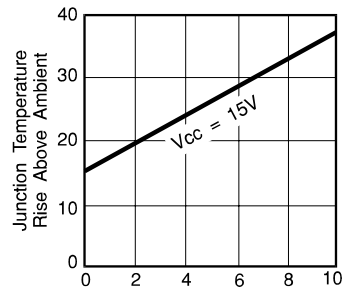
POSITIVE OUTPUT

QUIESCENT CURRENT VS. TEMP



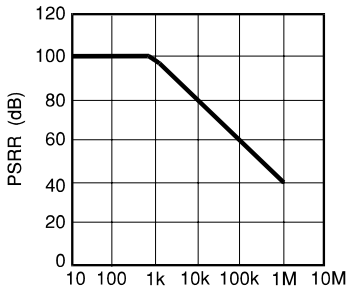
Temperature °C

JUNCTION TEMP. RISE VS. OUTPUT CURRENT



Output Current (mA)

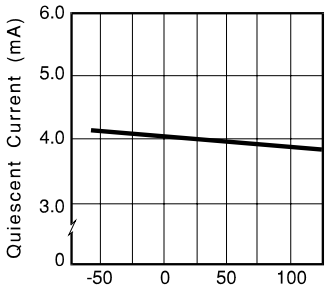
PSRR VS. FREQUENCY



Frequency (Hz)

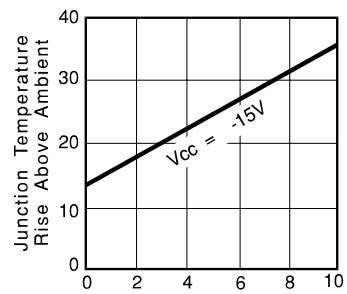
NEGATIVE OUTPUT

QUIESCENT CURRENT VS. TEMP



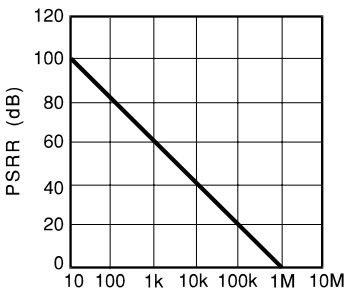
Temperature °C

JUNCTION TEMP. RISE VS. OUTPUT CURRENT



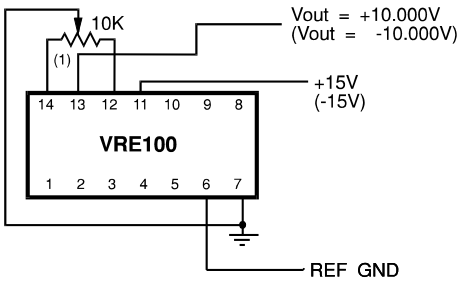
Output Current (mA)

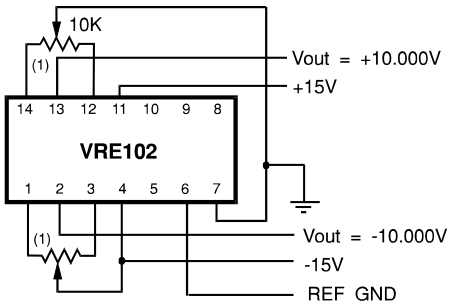
PSRR VS. FREQUENCY



Frequency (Hz)

EXTERNAL CONNECTIONS

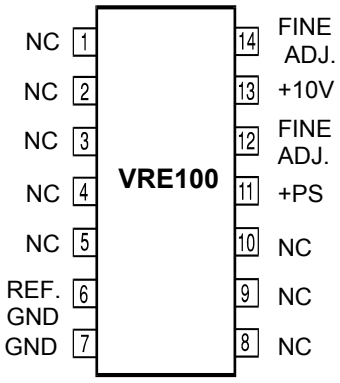




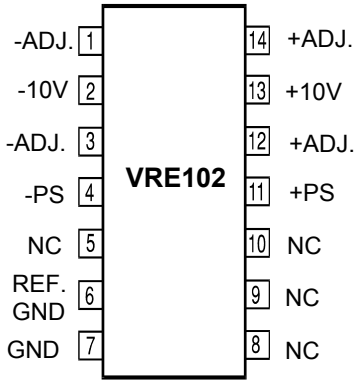
1. Optional Fine Adjust for approximately ±20mV.

PIN CONFIGURATION

TOP VIEW



TOP VIEW



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