VRE410

Precision Dual Voltage Reference

FEATURES

- ♦ ±10 V Output, ± 1.6 mV
- ♦ Temperature Drift: 1.0 ppm/ºC
- ♦ Low Noise: 6 μV_{P-P} (0.1-10Hz)
- ♦ Tracking Error: 0.3 mV
- ♦ Excellent Line Regulation: 6 ppm/V Typical
- ♦ Surface Mount Package

APPLICATIONS

The VRE410 is recommended for use as a reference for high precision D/A and A/D converters which require an external precision reference. The device is also ideal for calibrating scale factor on high resolution A/D converters. The VRE410 offers superior performance over monolithic references.

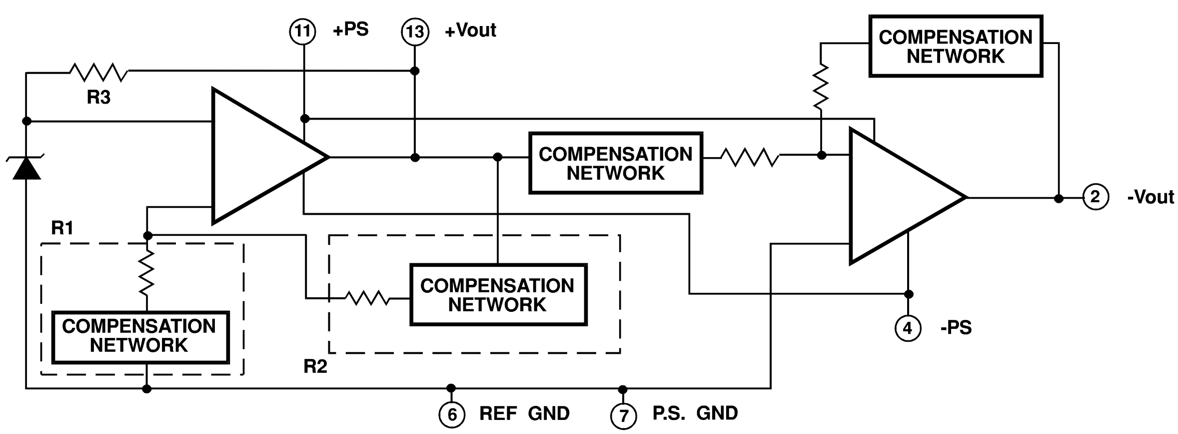
DESCRIPTION

The VRE410 is a low cost, high precision, ±10 V reference. Available in a 14-pin SMT package, the device is ideal for new designs that need a high performance reference.

The device provides ultrastable ±10 V output with ±1.6 mV initial accuracy and a temperature coefficient of 1.0 ppm/°C. This improvement in accuracy is made possible by a unique, patented multipoint laser compensation technique.

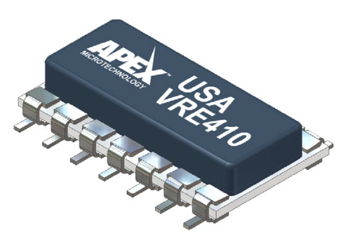
Another key feature of this reference is the 0.5 mV tracking error between the positive and negative output voltages over the full operating temperature range. This is extremely important in high performance systems for reducing overall system errors.

Figure 1. BLOCK DIAGRAM



SELECTION GUIDE

Model	Initial Error (mV)	Temp. Coeff. (ppm/ºC)	Temp. Range (ºC)
VRE410AS	±1.6	1.0	0ºC to +70ºC
VRE410BS	±2.0	2.0	0ºC to +70ºC
VRE410JS	±1.6	1.0	-40ºC to +85ºC
VRE410LS	±2.2	2.2	-40ºC to +85ºC



14-pin Surface Mount Package Style GE

1. CHARACTERISTICS AND SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

V_{PS} =±15V, T = +25ºC, R_L = 10KΩ Unless Otherwise Noted.

Model	A/J			B			L			
Parameter	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Units
ABSOLUTE RATINGS										
Power Supply	±13.5	±15	±22	*	*	*	*	*	*	V
Operating Temperature (A,B)	0		+70	*		*	*		*	ºC
Operating Temperature (J,L)	-40		+85	*		*	*		*	ºC
Storage Temperature	-65		+150	*		*	*		*	ºC
Short Circuit Protection		Continuous			*			*		
OUTPUT VOLTAGE										
VRE410		±10.0			*			*		V
OUTPUT VOLTAGE ERRORS										
Initial Error (Note 1)			±1.60			±2.00			±2.20	mV
Warmup Drift		1			2			3		ppm
T_{MIN} - T_{MAX} (Note 2)			1.0			2.0			2.2	ppm/ºC
Tracking Error (Note 3)		0.5			0.7			1.0		mV
Long-Term Stability		6			*			*		ppm/1000hrs.
Noise (0.1 - 10Hz)		6			*			*		µVpp
OUTPUT CURRENT										
Range	±10			*						mA
REGULATION										
Line		3			*			*		ppm/V
Load		3			*			*		ppm/mA
POWER SUPPLY CURRENT (Note 4)										
+PS		7			*			*		mA
-PS		4			*			*		mA

NOTES:

* Same as A/J Models.

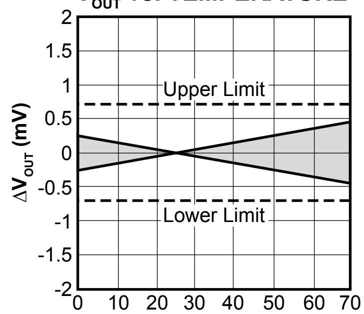
1. The specified values are without external trim.
2. The temperature coefficient (TC) is determined by the box method using the following formula:

$$T.C. = \frac{V_{MAX} - V_{MIN}}{V_{NOMINAL} \times (T_{MAX} - T_{MIN})} \times 10^6$$

3. The tracking error is the deviation between the positive and negative output over the operating temp. range.
4. The specified values are unloaded.

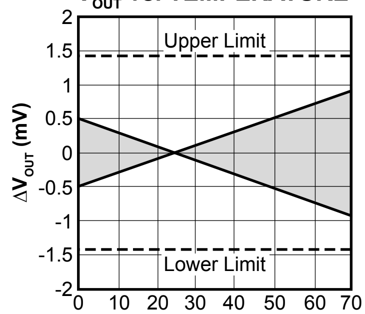
2. TYPICAL PERFORMANCE CURVES

V_{OUT} vs. TEMPERATURE



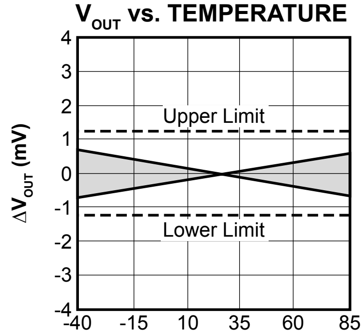
Temperature, °C
VRE410AS

V_{OUT} vs. TEMPERATURE



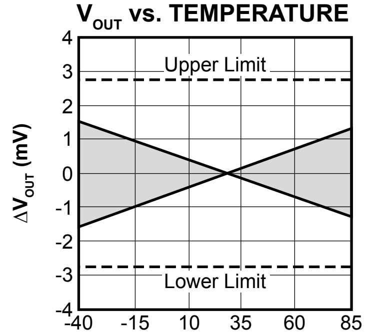
Temperature, °C
VRE410BS

V_{OUT} vs. TEMPERATURE



Temperature, °C
VRE410JS

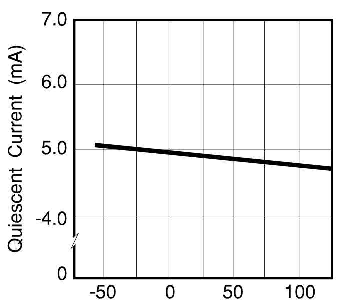
V_{OUT} vs. TEMPERATURE



Temperature, °C
VRE410LS

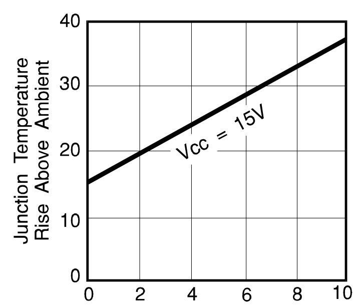
POSITIVE OUTPUT (TYP)

QUIESCENT CURRENT VS. TEMP



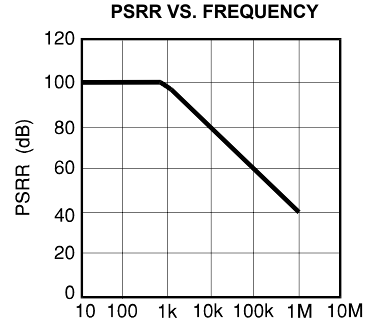
Temperature °C

JUNCTION TEMP. RISE VS. OUTPUT CURRENT



Output Current (mA)

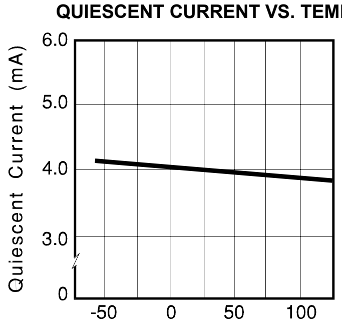
PSRR VS. FREQUENCY



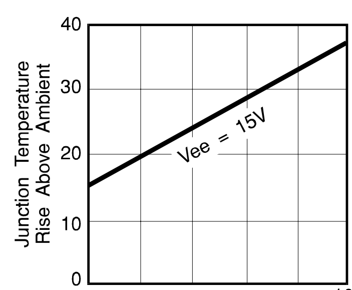
Frequency (Hz)

NEGATIVE OUTPUT (TYP)

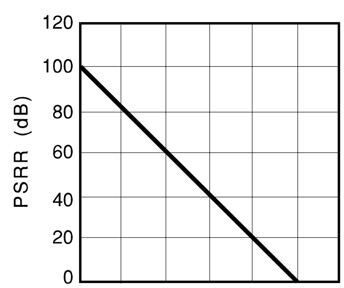
QUIESCENT CURRENT VS. TEMP



JUNCTION TEMP. RISE VS. OUTPUT CURRENT



PSRR VS. FREQUENCY



3. THEORY OF OPERATION

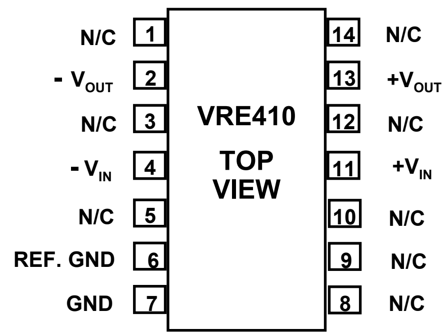
The following discussion refers to the block diagram in Figure 1. In operation, approximately 6.3 V is applied to the noninverting input of the op amp. The voltage is amplified by the op amp to produce a 10 V output. The gain is determined by the networks R1 and R2: G=1 + R2/R1. The 6.3 V zener diode 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, a very stable voltage is produced over wide temperature ranges.

The VRE400 series voltage references have the ground terminal brought out on two pins (pin 6 and 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



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