

Precision Dual Voltage Reference

FEATURES

- ◆ ± 5 V Output, ± 0.5 mV (.01%)
- ◆ Temperature Drift: 0.6 ppm/°C
- ◆ Low Noise: 3 μ V_{P-P} (0.1-10Hz)
- ◆ Tracking Error: 0.3 mV Max.
- ◆ Excellent Line Regulation: 6 ppm/V Typical
- ◆ Surface Mount and DIP Package Options

APPLICATIONS

The VRE405 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 ideal for calibrating scale factor on high resolution A/D converters. The VRE405 offers superior performance over monolithic references.

DESCRIPTION

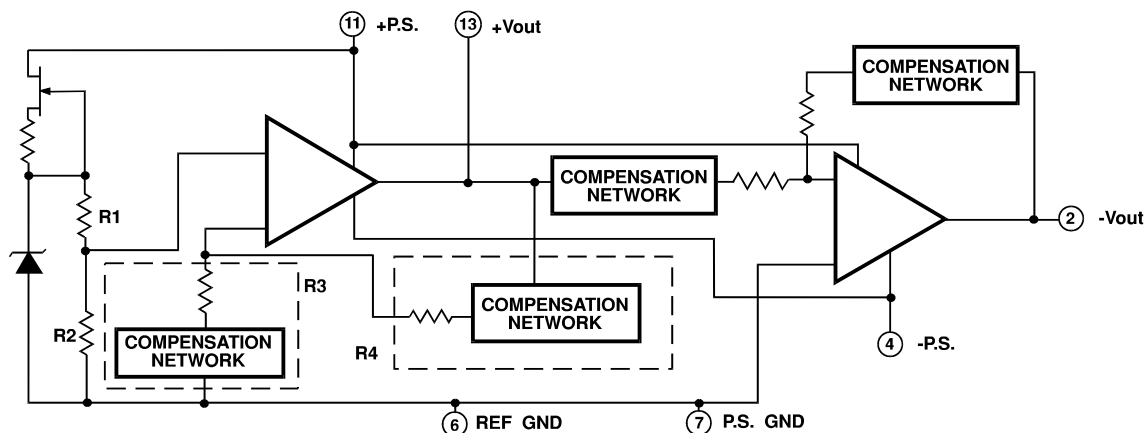
The VRE405 is a low cost, high precision, ± 5 V reference. Available in 14-pin DIP or SMT packages, the device is ideal for new designs that need a high performance reference.

The device provides ultrastable ± 5 V output with ± 0.5 mV (.01%) initial accuracy and a temperature coefficient of 0.6 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 0.3 mV maximum tracking error between the positive and negative output voltages over the operating temperature range. This is extremely important in high performance systems for reducing overall system errors.

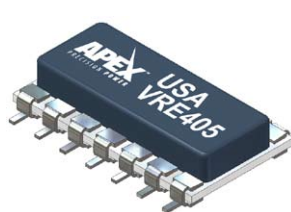
For designs which use the DIP package in a socket, there is a reference ground pin to eliminate the reference ground errors.

Figure 1. BLOCK DIAGRAM



SELECTION GUIDE

Model	Initial Error (mV)	Temp. Coeff. (ppm/°C)	Temp. Range (°C)	Package Options
VRE405AS	± 0.5	0.6	0°C to +70°C	SMT14 (GE)
VRE405AD	± 0.5	0.6	0°C to +70°C	DIP14 (KE)
VRE405BS	± 0.8	1.0	0°C to +70°C	SMT14 (GE)
VRE405BD	± 0.8	1.0	0°C to +70°C	DIP14 (KE)
VRE405CS	± 1.0	2.0	0°C to +70°C	SMT14 (GE)
VRE405CD	± 1.0	2.0	0°C to +70°C	DIP14 (KE)



**14-pin Surface Mount
Package Style GE**



**14-pin DIP
Package Style KE**

1. CHARACTERISTICS AND SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

$V_{PS} = \pm 15V$, $T = +25^{\circ}C$, $R_L = 10K\Omega$ Unless Otherwise Noted.

Model	VRE405A			VRE405B			VRE405C			
Parameter	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Units
ABSOLUTE RATINGS										
Power Supply	±13.5	±15	±22	*	*	*	*	*	*	V
Operating Temperature	0		+70	*		*	*		*	°C
Storage Temperature	-65		+150	*		*	*		*	°C
Short Circuit Protection	Continuous			*			*			
OUTPUT VOLTAGE										
VRE405		±5.0			*			*		V
OUTPUT VOLTAGE ERRORS										
Initial Error (Note 1)			±0.05			±0.80			±1.00	mV
Warmup Drift		1			2			3		ppm
T _{MIN} - T _{MAX} (Note2)			0.6			1.0			2.0	ppm/°C
Tracking Error			0.3			0.4			0.5	mV
Long-Term Stability		6			*			*		ppm/1000hrs.
Noise (0.1 - 10Hz) (Note 3)		3			*			*		µVpp
OUTPUT CURRENT										
Range	±10			*						mA
REGULATION										
Line		3	10		*	*		*	*	ppm/V
Load		3			*			*		ppm/mA
OUTPUT ADJUSTMENT										
Range		20			*			*		mV
POWER SUPPLY CURRENT (Note 4)										
+PS		7	9		*	*		*	*	mA
-PS		4	6		*	*		*	*	mA

NOTES:

* Same as A Models.

1. The specified values are without external trim.

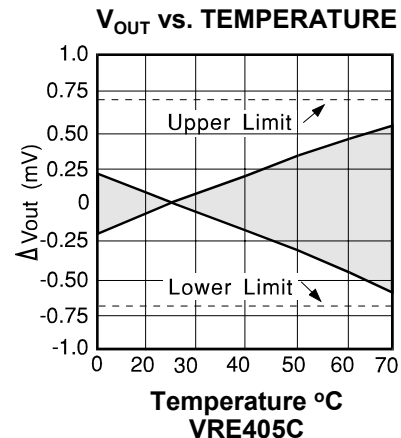
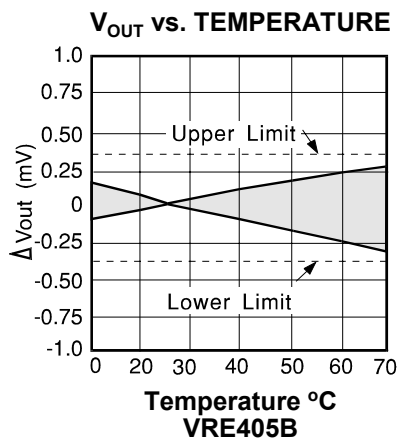
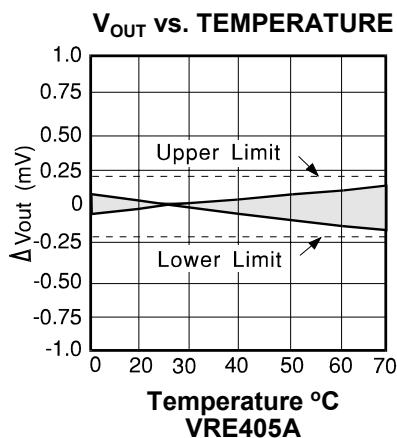
2. The temperature coefficient (TC) is determined by the box method using the following formula:

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

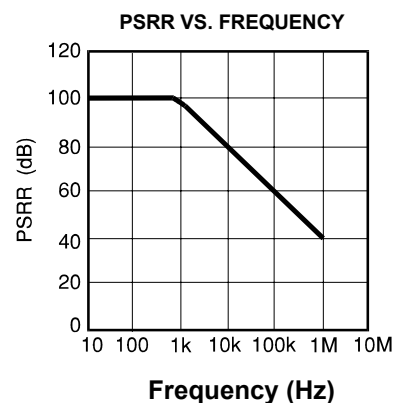
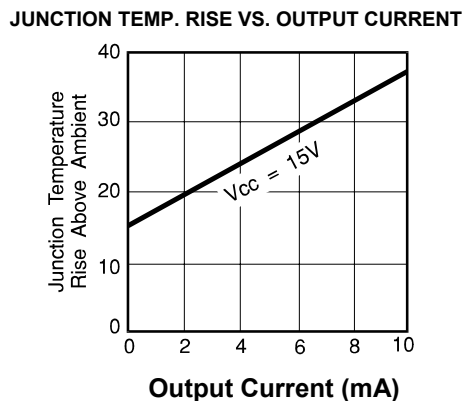
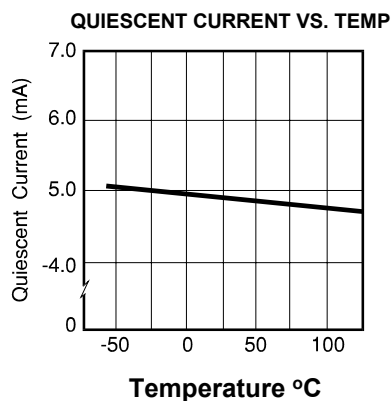
4. The tracking error is the deviation between the positive and negative output over the operating temp. range.

5. The specified values are unloaded.

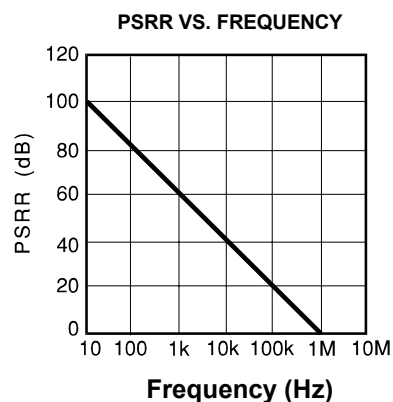
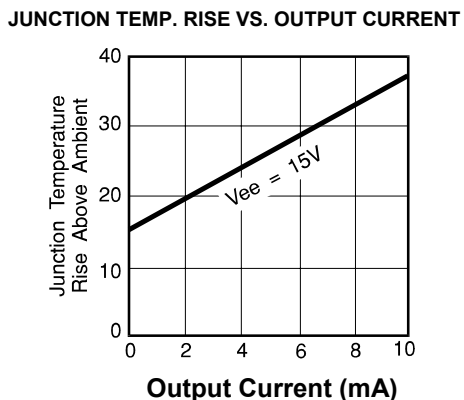
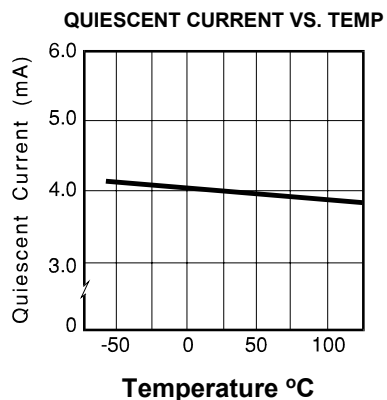
2. TYPICAL PERFORMANCE CURVES



----- POSITIVE OUTPUT (TYP) -----



----- NEGATIVE OUTPUT (TYP) -----



3. THEORY OF OPERATION

The following discussion refers to the block diagram in Figure 1. 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.

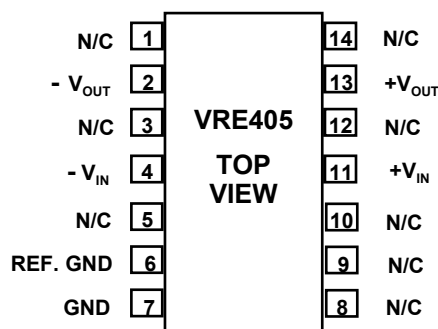
The current source provides a closely regulated zener current, which determines the slope of the references' voltage vs. temperature function. By trimming the zener current a lower drift over temperature can be achieved. But since the voltage vs. temperature function is nonlinear this compensation technique is not well suited for wide temperature ranges.

A nonlinear compensation network of thermistors and resistors that is used in the VRE series voltage references. This proprietary network eliminates most of the nonlinearity in the voltage vs. temperature function. By adjusting the slope, a very stable voltage is produced 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.

The VRE405 reference has its ground terminal brought out on two pins (pin 6 and 7) which are connected 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 does not effect performance.

PIN CONFIGURATION



CONTACTING CIRRUS LOGIC SUPPORT

For all Apex Precision Power product questions and inquiries, call toll free 800-546-2739 in North America.

For inquiries via email, please contact tucson.support@cirrus.com.

International customers can also request support by contacting their local Cirrus Logic Sales Representative.

To find the one nearest to you, go to www.cirrus.com

IMPORTANT NOTICE

Cirrus Logic, Inc. and its subsidiaries ("Cirrus") believe that the information contained in this document is accurate and reliable. However, the information is subject to change without notice and is provided "AS IS" without warranty of any kind (express or implied). Customers are advised to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, indemnification, and limitation of liability. No responsibility is assumed by Cirrus for the use of this information, including use of this information as the basis for manufacture or sale of any items, or for infringement of patents or other rights of third parties. This document is the property of Cirrus and by furnishing this information, Cirrus grants no license, express or implied under any patents, mask work rights, copyrights, trademarks, trade secrets or other intellectual property rights. Cirrus owns the copyrights associated with the information contained herein and gives consent for copies to be made of the information only for use within your organization with respect to Cirrus integrated circuits or other products of Cirrus. This consent does not extend to other copying such as copying for general distribution, advertising or promotional purposes, or for creating any work for resale.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). CIRRUS PRODUCTS ARE NOT DESIGNED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN PRODUCTS SURGICALLY IMPLANTED INTO THE BODY, AUTOMOTIVE SAFETY OR SECURITY DEVICES, LIFE SUPPORT PRODUCTS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF CIRRUS PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK AND CIRRUS DISCLAIMS AND MAKES NO WARRANTY, EXPRESS, STATUTORY OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, WITH REGARD TO ANY CIRRUS PRODUCT THAT IS USED IN SUCH A MANNER. IF THE CUSTOMER OR CUSTOMER'S CUSTOMER USES OR PERMITS THE USE OF CIRRUS PRODUCTS IN CRITICAL APPLICATIONS, CUSTOMER AGREES, BY SUCH USE, TO FULLY INDEMNIFY CIRRUS, ITS OFFICERS, DIRECTORS, EMPLOYEES, DISTRIBUTORS AND OTHER AGENTS FROM ANY AND ALL LIABILITY, INCLUDING ATTORNEYS' FEES AND COSTS, THAT MAY RESULT FROM OR ARISE IN CONNECTION WITH THESE USES.

Cirrus Logic, Cirrus, and the Cirrus Logic logo designs, Apex Precision Power, Apex and the Apex Precision Power logo designs are trademarks of Cirrus Logic, Inc. All other brand and product names in this document may be trademarks or service marks of their respective owners.