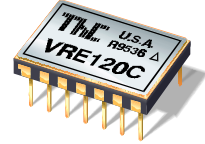


# VRE120/121/122

## Precision High Temperature Reference Supplies



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### FEATURES

- WIDE OPERATING RANGE: -55°C TO +180°C
- EXTREMELY LOW DRIFT: 1 ppm /°C -55°C to +150°C
- LOW WARM-UP DRIFT: 1 ppm Typ.
- EXCELLENT STABILITY: 6 ppm / 1000 Hrs. Typ.
- EXCELLENT LINE REGULATION: 3 ppm / V Typ.
- HERMETIC 14-PIN CERAMIC DIP
- PIN & FUNCTION COMPATIBLE WITH AD2700, AD2710, MAX 670/671 REFERENCES

### 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
- GEOLOGICAL EQUIPMENT

### DESCRIPTION

VRE120 series references are designed to operate over an extremely wide temperature range (-55°C to +180°C) and still provide excellent accuracy. The VRE120 provides a +10V output, the VRE121 provides a -10V and the VRE122 provides a ±10V output. All types are available in commercial (C suffix) and military (M suffix) models. The "M" models are screened for high reliability and quality. Two accuracy grades (standard and "A") are available for all models.

The adjacent selector guide shows the limits of the most important parameters of the VRE120 series voltage references. The maximum voltage deviation increases linearly with temperature from the 150°C specification to the 180°C specification. For example, the A grade maximum voltage deviation of 1mV increases to 2mV at 175°C and is 3mV at 180°C. This degree of accuracy over such a large temperature range has been achieved using the Thaler Corporation patented multipoint compensation technique.

All devices are packaged in 14-pin hermetic ceramic packages for maximum long term stability. They are pin and function compatible with other Thaler references and AD2700, AD2710 and MAX 670/671 References

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.

### SELECTION GUIDE

Type	Output	Max. Volt Deviation (-55°C to +150°C)	Max. Volt Deviation (150°C to +180°C)	Initial Accuracy (Max)
VRE120C	+10V	1.5mV	5.0mV	1.0mV
VRE120CA	+10V	1.0mV	3.0mV	0.5mV
VRE120M	+10V	1.5mV	5.0mV	1.5mV
VRE120MA	+10V	1.0mV	3.0mV	0.8mV
VRE121C	-10V	1.5mV	5.0mV	1.0mV
VRE121CA	-10V	1.0mV	3.0mV	0.5mV
VRE121M	-10V	1.5mV	5.0mV	1.5mV
VRE121MA	-10V	1.0mV	3.0mV	0.8mV
VRE122C	±10V	1.5mV	5.0mV	1.0mV
VRE122CA	±10V	1.0mV	3.0mV	0.5mV
VRE122M	±10V	1.5mV	5.0mV	1.5mV
VRE122MA	±10V	1.0mV	3.0mV	0.8mV

# ELECTRICAL SPECIFICATIONS

## VRE120/121/122

Vps = ±15V, T = 25°C, RL = 10KΩ unless otherwise noted.

MODEL	C			CA			M			MA			
PARAMETERS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
<b>ABSOLUTE MAXIMUM RATINGS</b>													
Power Supply	±13.5		±22	*		*	*		*	*		*	V
Operating Temperature	-55		180	*		*	*		*	*		*	°C
Storage Temperature	-65		150	*		*	*		*	*		*	°C
Short Circuit Protection	Continuous				*			*			*		
<b>OUTPUT VOLTAGE</b>													
VRE120		+10			*			*			*		V
VRE121		-10			*			*			*		V
VRE122		±10			*			*			*		V
<b>OUTPUT VOLTAGE ERRORS</b>													
Initial Error			1.0			0.5			1.5			0.8	mV
Warmup Drift <sup>(1)</sup>		2			1			2			1		ppm
-55°C to 150°C <sup>(3)</sup>			1.5			1.0			*			*	mV
150°C to 180°C			5.0			3.0			*			*	mV
Long-Term Stability		6			*			*			*		ppm/1000hr.
Noise (.1-10Hz)		6			*			*			*		μVpp
<b>OUTPUT CURRENT</b>													
Range	±10			*			*			*			mA
<b>REGULATION</b>													
Line		3	10		*	*		*	*		*	*	ppm/V
Load		3			*			*			*		ppm/mA
<b>OUTPUT ADJUSTMENT</b>													
Range		10			*			*			*		mV
Temperature Coefficient		4			*			*			*		μV/°C/mV
<b>POWER SUPPLY CURRENTS <sup>(2)</sup></b>													
VRE120 +PS		5	7		*	*		*	*		*	*	mA
VRE121 -PS		5	7		*	*		*	*		*	*	mA
VRE122 +PS		7	9		*	*		*	*		*	*	mA
VRE122 -PS		4	6		*	*		*	*		*	*	mA

NOTES: \*Same as C Models.

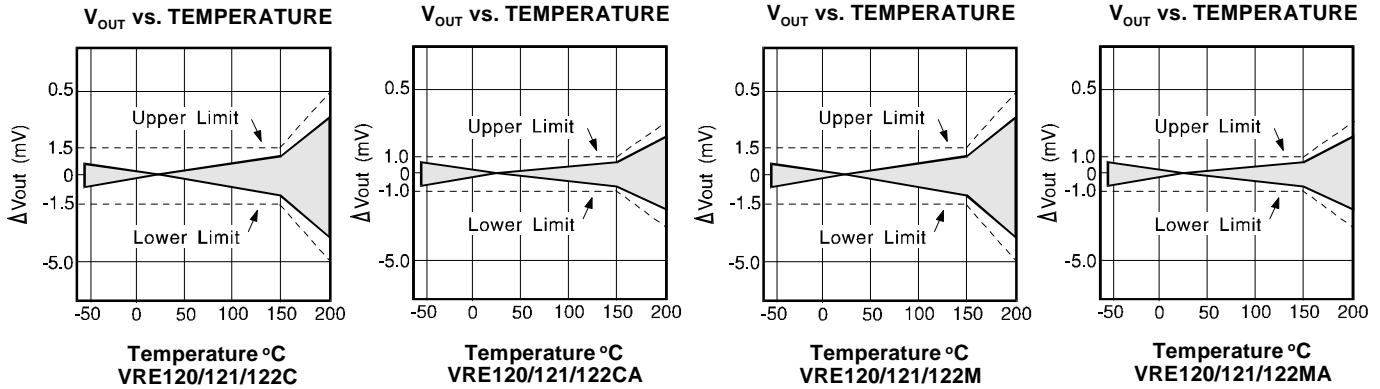
1. Using the box method, the specified value is the maximum deviation from the output voltage at 25°C over the specified operating temperature range.

2. The specified values are unloaded.

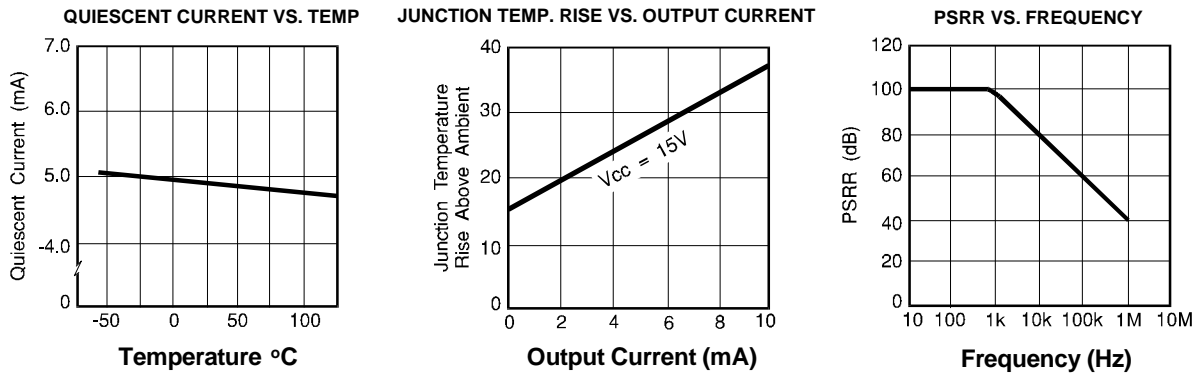
3. Cone widening from 150 °C value to specified value.

VRE120DS REV. C SEPT 1994

# TYPICAL PERFORMANCE CURVES

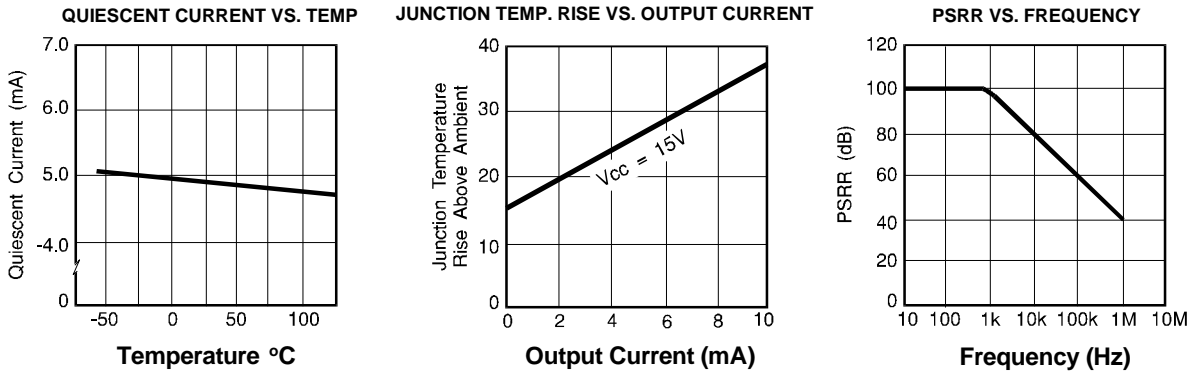


## VRE120/121

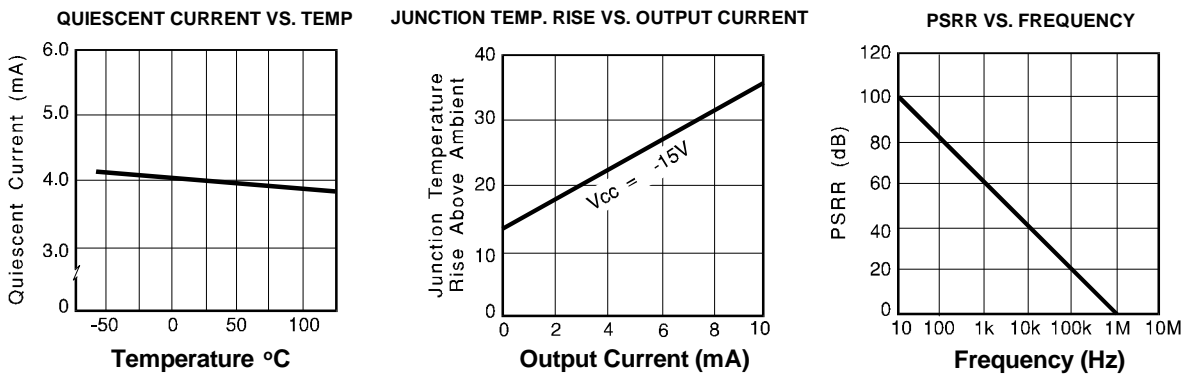


## VRE122

### POSITIVE OUTPUT



### NEGATIVE OUTPUT



# DISCUSSION OF PERFORMANCE

## THEORY OF OPERATION

The following discussion refers to the schematic below. 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 10.000V output. The gain is determined by the networks R1 and R2:  $G=1 + R2/R1$ . The 6.3V 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 reference's voltage vs. temperature function. By trimming the zener current 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.

Thaler Corporation has developed a nonlinear compensation network of thermistors and resistors that is used in the VRE120 series voltage references. This proprietary network eliminates most of the nonlinearity in the voltage vs. temperature function. By then adjusting the slope, Thaler Corporation 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.

## APPLICATION INFORMATION

Figure 1 shows the proper connection of the VRE120 series voltage reference with the optional trim resistors. When trimming the VRE122, 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.

When using the precision voltage references at high temperatures it is best to keep them powered up. If the zener diode isn't powered up at high temperatures the junction will collect ions, and then when power is applied, the voltage will drift until the charge build up is depleted.

The VRE120 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 20ppm. 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.

### VRE120

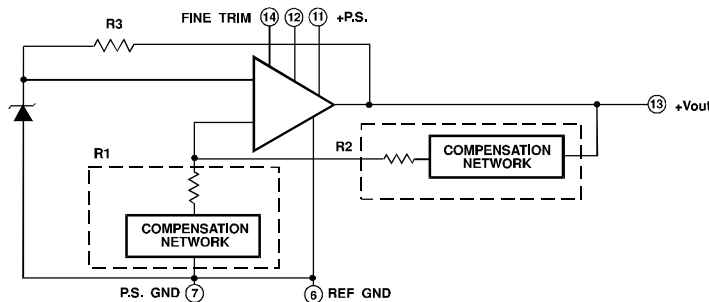


FIGURE 2

### VRE122

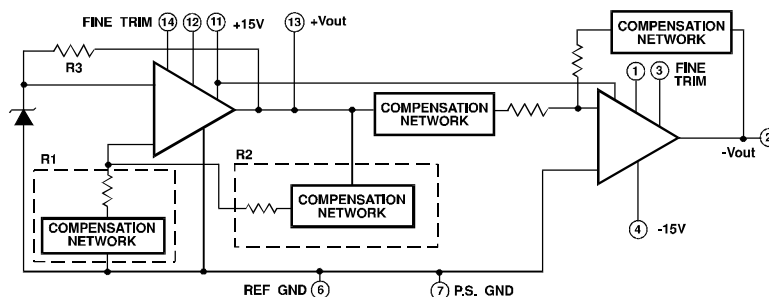
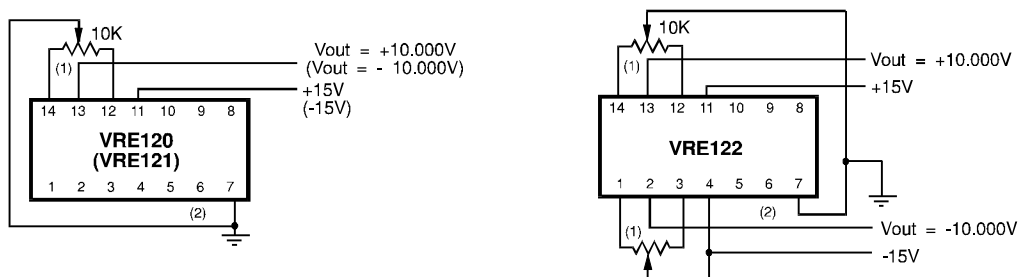


FIGURE 3

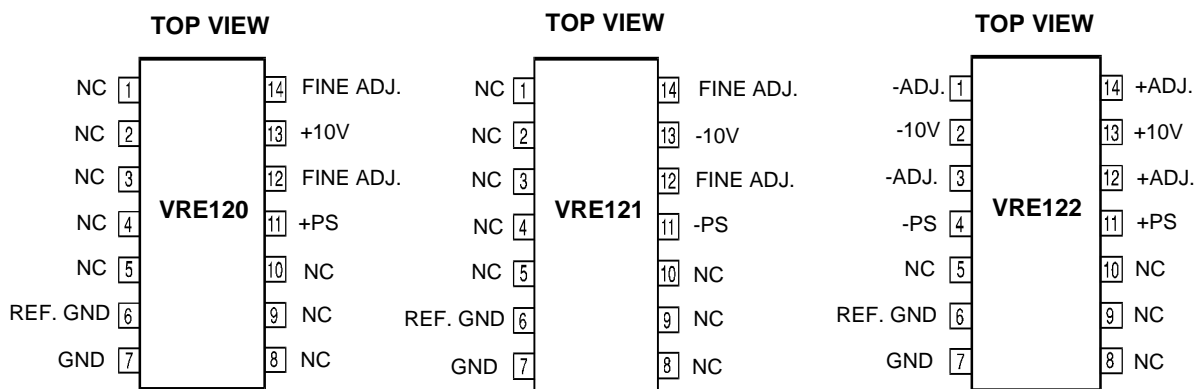
## EXTERNAL CONNECTIONS



**FIGURE 1**

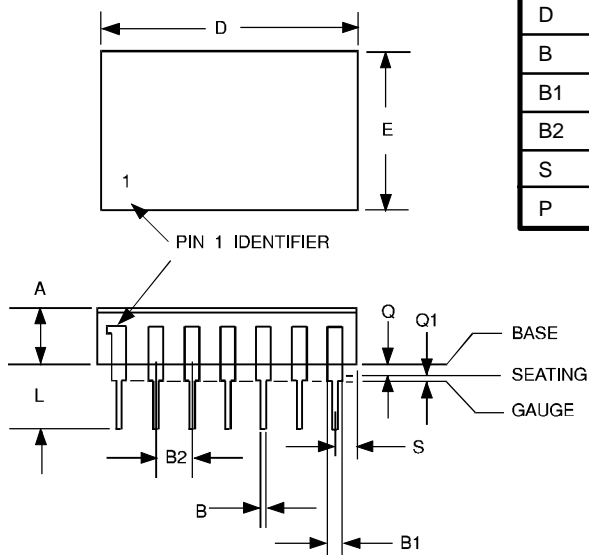
1. Optional Fine Adjust for approximately  $\pm 10\text{mV}$ . VRE122 center tap connects to -PS.
2. Pin 6 is internally connected to Pin 7 and can be used as Ref. GND.

## PIN CONFIGURATION



## MECHANICAL

### 14-PIN HYBRID PACKAGE



DIM	INCHES		MILLIMETER		DIM	INCHES		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
E	.480	.500	12.1	12.7	A	.120	.155	3.0	4.0
L	.195	.215	4.9	5.4	Q	.015	.035	0.4	0.9
D	.775	.805	19.7	20.4	Q1	N/A	.030	N/A	0.7
B	.016	.020	0.4	0.5	C	.009	.012	0.2	0.3
B1	.038	.042	0.9	1.0	G1	.290	.310	7.3	7.8
B2	.095	.105	2.4	2.6					
S	.085	.105	2.1	2.6					
P	.004	.006	0.10	0.15					