

## Precision Sine Wave Reference

### FEATURES

- ◆ Very High Accuracy:  $+7.071 \text{ Vrms} \pm 0.05\%$
- ◆ Extremely Low Drift:  $30 \text{ ppm}/^\circ\text{C}$   
( $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ )
- ◆ Excellent Stability:  $10 \text{ ppm}/1000 \text{ Hrs. Typical}$
- ◆ Low Distortion:  $0.1\% \text{ Thd @ } f = 3300 \text{ Hz}$
- ◆ Hermetic 14-pin Ceramic DIP
- ◆ Military Processing Option

### APPLICATIONS

- ◆ Transducer Excitation
- ◆ High Resolution Servo Systems
- ◆ High Precision Test and Measurement Instruments
- ◆ AC Voltage Standard
- ◆  $L_{\text{VDT}}$  Or  $R_{\text{VDT}}$  Reference
- ◆ Multiplying D/A Reference

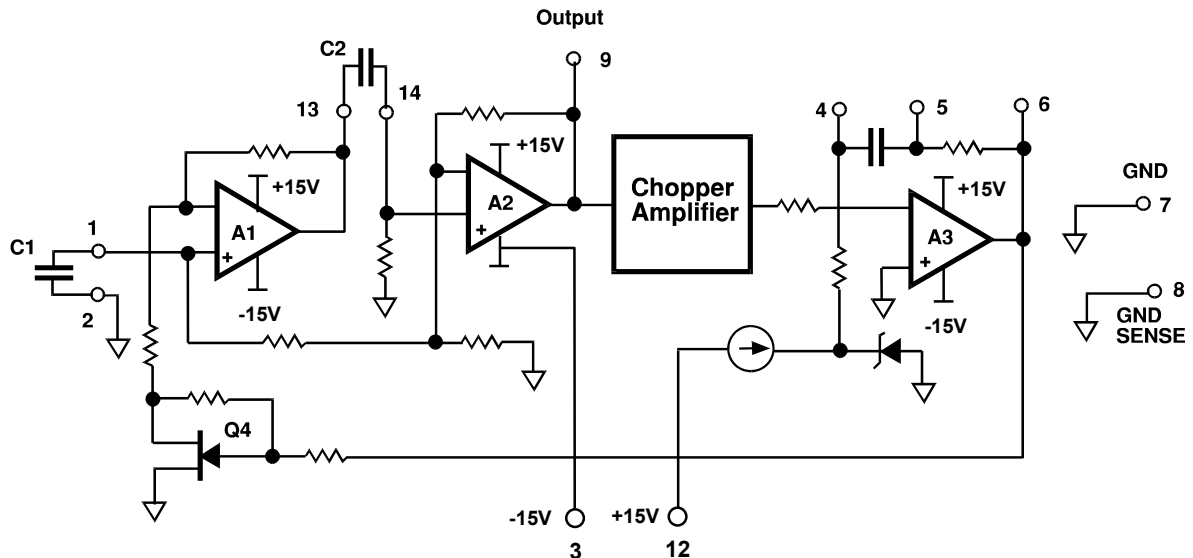
### DESCRIPTION

SWR200 is a Precision Sine Wave Reference providing an ultra stable sine wave output of  $+7.071 \text{ V}$  at  $\pm 0.05\%$  initial accuracy and temperature coefficient as low as  $30 \text{ ppm}/^\circ\text{C}$  over the full military temperature range. The extreme accuracy is made possible by a chopper-based AGC circuit. The temperature characteristic of the chopper circuit compensates the typical nonlinearity of the internal DC zener reference, resulting in a nearly linear amplitude-temperature characteristic. Frequency of the SWR200 is programmable with two external capacitors.

The SWR200 is available in a 14-pin bottom braze package. They are hermetically sealed and "M" versions are screened for high reliability and quality.

SWR200 is well suited for any application requiring a stable sine wave source. The SWR200 can be used as a reference source in precision sensing systems based on  $L_{\text{VDT}}$  or  $R_{\text{VDT}}$  position sensors. A programmable AC reference can be constructed using the SWR200 as a reference for a high accuracy multiplying Digital to Analog Converter.

**Figure 1. BLOCK DIAGRAM**



**SELECTION GUIDE**

Type	Output (Typ.)	Temperature Operating Range	Package
SWR200C	+7.071V	-25°C to +85°C	DIP
SWR200M	+7.071V	-55°C to +125°C	DIP



Hermetic 14-pin Ceramic DIP  
Package Style HC

**1. CHARACTERISTICS AND SPECIFICATIONS**

**ELECTRICAL SPECIFICATIONS**

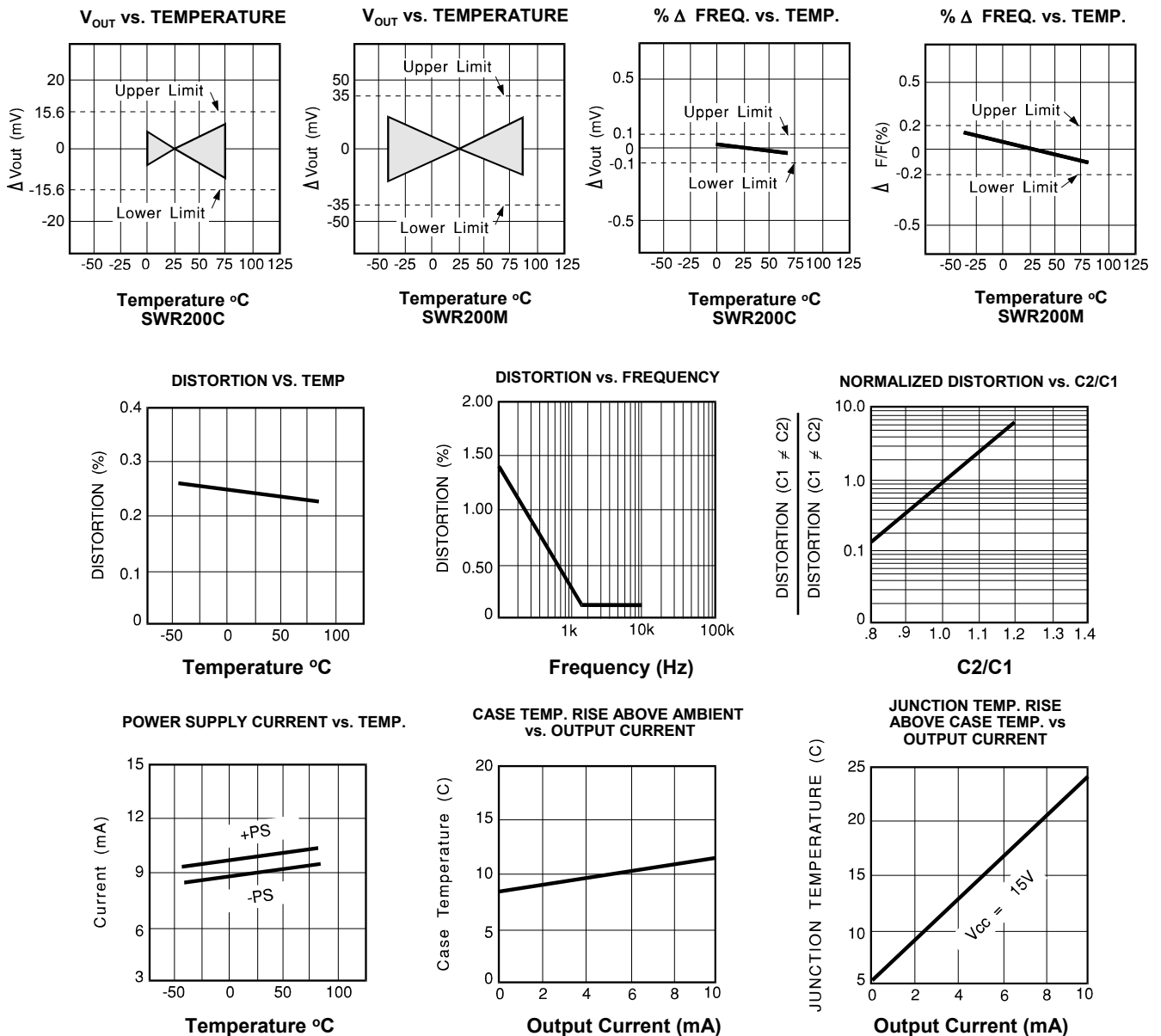
V<sub>PS</sub> = ±15V, T = +25°C, R<sub>L</sub> = 10KΩ UNLESS OTHERWISE NOTED.

Model	SWR200C			SWR200M			
Parameter	Min	Typ	Max	Min	Typ	Max	Units
<b>ABSOLUTE MAXIMUM RATINGS</b>							
Power Supply	±13.5	±15	±22	*	*	*	V
Operating Temperature	-25		+85	-55		+125	°C
Storage Temperature	-65		+85	*		*	°C
Short Circuit Protection	Continuous			*			Vrms
<b>OUTPUT VOLTAGE</b>		7.071			*		V
<b>OUTPUT VOLTAGE ERRORS</b>							
Initial Error			±0.05			*	%
Warmup Drift		100			*		µV
DC Offset			3			*	mV
DC Offset Over Temp.		3	18		*	*	µV/ °C
T <sub>MIN</sub> - T <sub>MAX</sub>		1	20.0		1	30.0	ppm/ °C
Long-Term Stability		10			*		ppm/ °C
<b>OUTPUT CURRENT</b>							
Range	±10			*			mA
<b>REGULATION</b>							
Line		10			*		ppm/V
Load		3			*		ppm/mA
<b>POWER SUPPLY CURRENTS</b>							
+PS		10.5	13		*	*	mA
-PS		9.5	13		*	*	mA
<b>DISTORTION</b>			0.5			*	%
<b>FREQUENCY</b>							
Range (f) $f = \frac{10^{-5}}{\sqrt{C_1 C_2}}$ $\frac{\Delta f}{f}$ vs. temperature	.98	1	1.02	*	*	*	Hz
	400		10K	*		*	Hz
			15			*	ppm/°C

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. Pin 8 is internally connected to Pin 7 and can be used as Ref. GND.
- 4. The frequency range can be extended to any desired lower value by using 2 external AGC capacitors (see AN-3).
- 5. The increase in distortion at lower frequencies can be eliminated by using external AGC capacitors (see AN-3).

2. TYPICAL PERFORMANCE GRAPHS



### 3. THEORY OF OPERATION

The following refers to the schematic in Figure 1. A1 and A2 are connected as a phase-shift oscillator circuit with the frequency set by the external capacitors C1 and C2. Q4 is included in the feedback loop of A1 as a gain control element.

The oscillator output is fed to the chopper amplifier which develops an absolute value representation of the oscillator output. The chopper output is compared to a precision DC reference in integrator amplifier A3. This DC error signal is used to control the gain setting FET Q4.

As in all precision zener based DC references, the drift of the zener becomes nonlinear at temperature extremes. The chopper amplifier drift characteristic is complementary to this nonlinearity and compensates for the reference drift.

### 4. APPLICATION INFORMATION

Figure 1 shows the connections for the SWR200 including the two frequency setting capacitors. The frequency is:

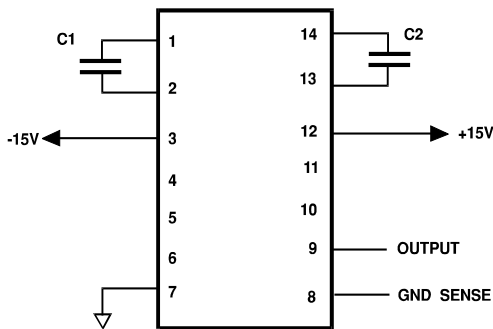
$$f = \frac{10^{-5}}{\sqrt{C_1 C_2}}$$

The frequency stability is directly related to the stability of the capacitors, therefore stable capacitors like NPO ceramic, or polycarbonate or polystyrene film should be used.

Two separate ground pins are provided for accurate ground sensing. This minimizes errors due to drops in the ground pin which can become a significant source of error in sockets.

The offset of the SWR200 is fully specified for initial offset and drift and is low enough that it can normally be neglected. In applications which are especially sensitive to offset the output can be AC coupled. Proper capacitor sizing and high impedance sensing will minimize errors due to capacitive coupling.

### EXTERNAL CONNECTIONS



### PIN CONFIGURATION

TOP VIEW

