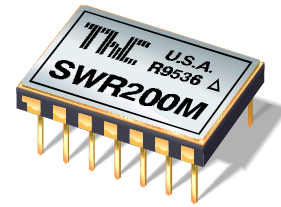




# SWR200 Precision Sine Wave Reference



THALER CORPORATION • 2015 N. FORBES BOULEVARD • TUCSON, AZ. 85745 • (520) 882-4000

## FEATURES

- **VERY HIGH ACCURACY:** 7.071 Vrms  $\pm 0.05\%$
- **EXTREMELY LOW DRIFT:**  
3 ppm/°C (-55°C to +125°C)
- **EXCELLENT STABILITY:** 10 ppm/1000 Hrs. Typ.
- **LOW DISTORTION:**  
0.1% THD @ f = 3300 Hz
- **HERMETIC 14-PIN CERAMIC DIP**
- **MILITARY PROCESSING OPTION**

## DESCRIPTION

SWR200 is a Precision Sine Wave Reference providing an ultra stable sine wave output of 7.071V at  $\pm 0.05\%$  initial accuracy and temperature coefficient as low as 3 ppm/°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 LVDT or RVDT position sensors. A programmable AC reference can be constructed using the SWR200 as a reference for a high accuracy multiplying Digital to Analog Converter.

## APPLICATIONS

- **TRANSDUCER EXCITATION**
- **HIGH RESOLUTION SERVO SYSTEMS**
- **HIGH PRECISION TEST and MEASUREMENT INSTRUMENTS**
- **AC VOLTAGE STANDARD**
- **LVDT OR RVDT REFERENCE**
- **MULTIPLYING D/A REFERENCE**

## 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

# ELECTRICAL SPECIFICATIONS

# SWR200

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

MODEL	C						M						
PARAMETERS	MIN	TYP	MAX	MIN	TYP	MAX	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		150				*		*				°C
Short Circuit Protection	Continuous							*					
<b>OUTPUT VOLTAGE</b>		7.071						*					Vrms
<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
Tmin - Tmax		1	2.0					1	3.0				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) $f = \frac{10^{-5}}{\sqrt{C1 C2}}$	.98	1	1.02				*	*	*				Hz
$\frac{\Delta f}{f}$ vs. Temperature	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.

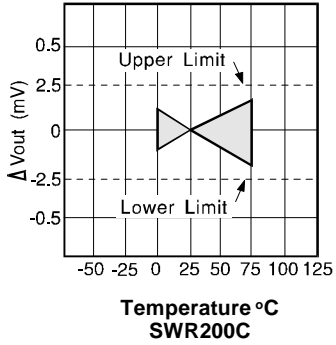
3. Pin 8 is internally connected to Pin 7 and can be used as Ref. GND.

4. The frequency range can be extended to any desired lower value by using 2 external AGC capacitors (see AN-3).

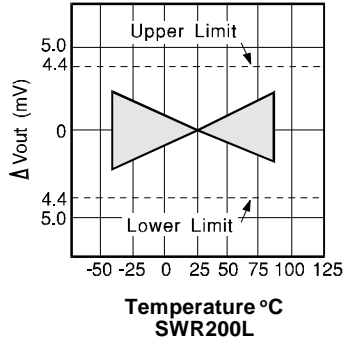
5. The increase in distortion at lower frequencies can be eliminated by using external AGC capacitors (see AN-3).

# TYPICAL PERFORMANCE CURVES

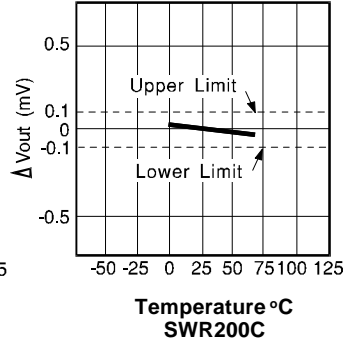
**V<sub>OUT</sub> vs. TEMPERATURE**



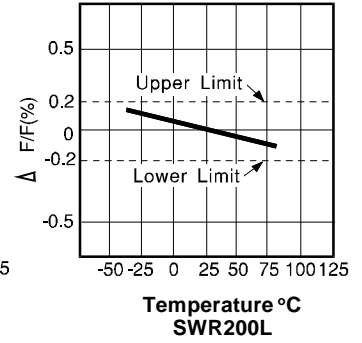
**V<sub>OUT</sub> vs. TEMPERATURE**



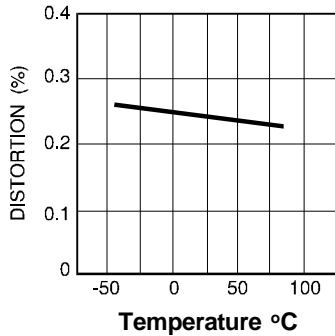
**% Δ FREQ. vs. TEMP.**



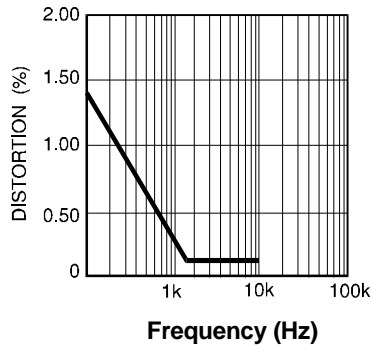
**% Δ FREQ. vs. TEMP.**



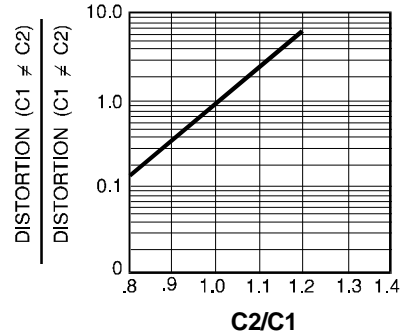
**DISTORTION vs. TEMP**



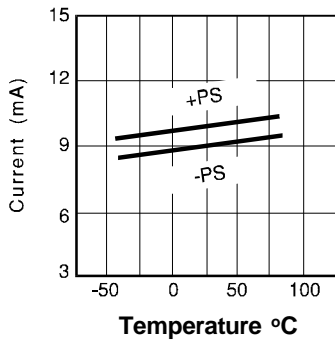
**DISTORTION vs. FREQUENCY**



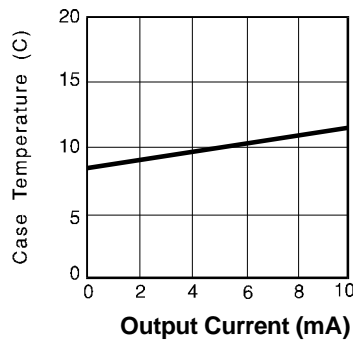
**NORMALIZED DISTORTION vs. C2/C1**



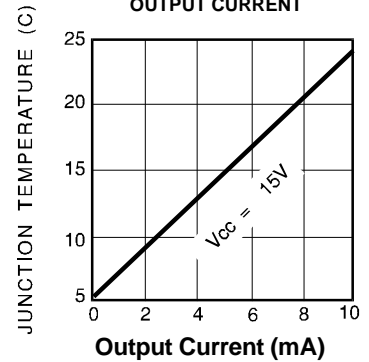
**POWER SUPPLY CURRENT vs. TEMP.**



**CASE TEMP. RISE ABOVE AMBIENT vs. OUTPUT CURRENT**



**JUNCTION TEMP. RISE ABOVE CASE TEMP. vs. OUTPUT CURRENT**



# DISCUSSION OF PERFORMANCE

## 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.

## 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.

## SCHEMATIC

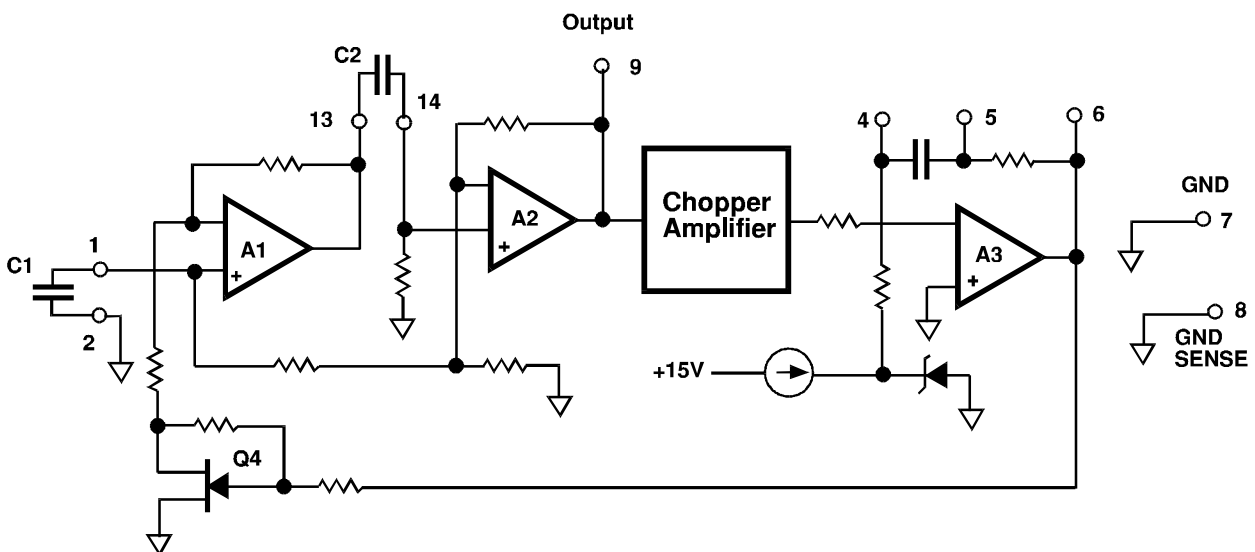


FIGURE 1

# EXTERNAL CONNECTIONS

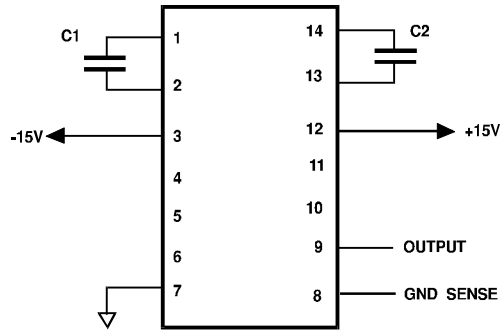
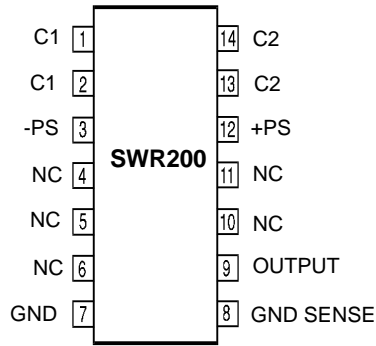


FIGURE 2

## PIN CONFIGURATION

### TOP VIEW



## 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					

