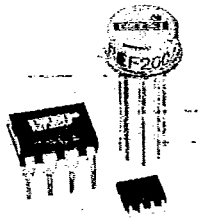
T-58-07

BURR-BROWN®



REF200

DUAL CURRENT SOURCE

FEATURES

- COMPLETELY FLOATING: No Common Connection
- HIGH ACCURACY: 100µA ±0.5%
- LOW TEMPERATURE COEFFICIENT: ±25ppm/°C
- WIDE VOLTAGE COMPLIANCE: 2.5V TO 40V
- ALSO INCLUDES CURRENT MIRROR

APPLICATIONS

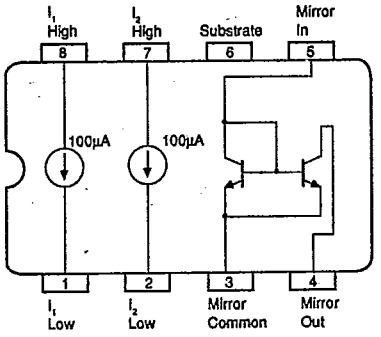
- SENSOR EXCITATION
- BIASING CIRCUITRY
- OFFSETTING CURRENT LOOPS
- LOW VOLTAGE REFERENCES
- CHARGE-PUMP CIRCUITRY
- HYBRID MICROCIRCUITS

DESCRIPTION

The REF200 combines three circuit building-blocks on a single monolithic chip—two 100µA current sources and a current mirror. The sections are dielectrically isolated, making them completely independent. The performance of each section is individually measured and laser-trimmed to achieve high accuracy with low cost.

The sections can be pin-strapped for currents of 50µA, 100µA, 200µA, 300µA or 400µA. External circuitry can be used to obtain virtually any current. These and many other circuit techniques are shown in the Applications section of this Data Sheet.

The REF200 is available in plastic 8-pin mini-DIP, TO-99, and SOIC packages. Die are also available.



International Airport Industrial Park • Mailing Address: PO Box 11400 • Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd. • Tucson, AZ 85706
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PDS-851

SPECIFICATIONS

ELECTRICAL

T_A = 25°C, V_s = 15V unless otherwise noted.

		REF200AM, AP, AU			
PARAMETER	**CONDITION**	**MIN**	**TYP**	**MAX**	**UNITS**
CURRENT SOURCES					
Current Accuracy			±0.1	±0.5	%
Current Match			±0.05	±0.5	%
Temperature Drift	Specified Temp Range		25		ppm/°C
Output Impedance	2.5V to 40V	20	100		MΩ
	3.5V to 30V	200	500		MΩ
Noise	BW = 0.1Hz to 10Hz		1		nA p-p
	f = 10kHz		20		pA/√Hz
Voltage Compliance (1%)	T_{MIN} to T_{MAX}		See Curves		
Capacitance			10		pF
CURRENT MIRROR	I = 100µA unless otherwise noted.				
Gain		0.995	1	1.005	
Temperature Drift			25		ppm/°C
Impedance (output)	2V to 40V	40	100		MΩ
Nonlinearity	I = 0µA to 250µA		0.05		%
Input Voltage			1.4		V
Output Compliance Voltage			See Curves		
Frequency Response (–3dB)	Transfer		5		MHz
TEMPERATURE RANGE					
Specification					
AP, AU, AM		–25		+85	°C
Operating					
AP, AU		–40		+85	°C
AM		–55		+125	°C
Storage					
AP, AU,		–40		+125	°C
AM		–60		+150	°C

AP AND AU SPECIFICATIONS ARE PRELIMINARY AND SUBJECT TO CHANGE

ORDERING INFORMATION

Model [1]	Package	Temperature Range
REF200AM	TO-99	–25°C to +85°C
REF200AP	Plastic DIP	–25°C to +85°C
REF200AU	Plastic SOIC	–25°C to +85°C
BURN-IN SCREENING OPTION See text for details.		
Model [1]	**Package**	**Burn-In Temp (160h) [2]**
REF200AM-BI	TO-99	+125°C
REF200AP-BI	Plastic DIP	+85°C
REF200AU-BI	Plastic SOIC	+85°C

NOTE: (1) Grade designation "A" may not be marked. Absence of grade designation indicates A grade. (2) Or equivalent combination of time and temperature. See text.

ABSOLUTE MAXIMUM RATINGS

Applied Voltage	–6V to +40V
Reverse Current	–350µA
Voltage between any two sections	±80V
Operating Temperature	
M Package	–65°C to +150°C
P and U Packages	–40°C to +85°C
Storage Temperature	
M Package	–65°C to +150°C
P and U Packages	–40°C to +125°C

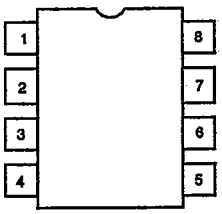
BURN-IN SCREENING

Burn-in screening is available on the REF200. Burn-in duration is 160 hours at +85°C (+125°C for M package), or at an equivalent combination of time and temperature according to the Arrhenius equation using 1eV activation energy.

All units are tested after burn-in to ensure that grade specifications are met. To order burn-in, add "-BI" to the base model number.

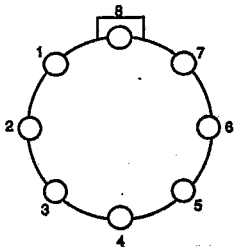
PIN CONFIGURATION

Top View — P, U Packages



1) I_1 Low
2) I_2 Low
3) Mirror Common
4) Mirror Output
5) Mirror Input
6) Substrate
7) I_2 High
8) I_1 High

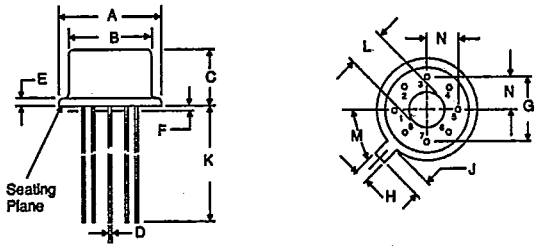
Top View — M Package



1) I_1 Low
2) I_2 Low
3) Mirror Common
4) Mirror Output
5) Mirror Input
6) Substrate
7) I_2 High
8) I_1 High

MECHANICAL

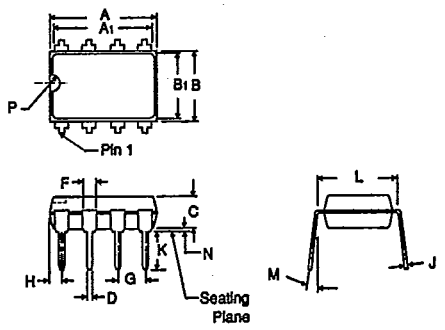
M Package — Metal TO-99



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.335	.370	8.51	9.40
B	.305	.335	7.75	8.51
C	.165	.185	4.19	4.70
D	.016	.021	0.41	0.53
E	.010	.040	0.25	1.02
F	.010	.040	0.25	1.02
G	.200 BASIC		5.08 BASIC	
H	.028	.034	0.71	0.86
J	.029	.045	0.74	1.14
K	.500	—	12.7	—
L	.110	.160	2.79	4.06
M	45° BASIC		45° BASIC	
N	.095	.105	2.41	2.67

NOTE: Leads in true position within 0.01" (0.25mm) R at MMC at seating plane. Pin numbers shown for reference only. Numbers may not be marked on package.

P Package — 8-Pin Plastic DIP

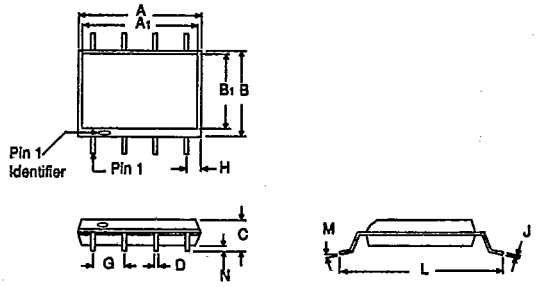


DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.355	.400	9.03	10.16
A1	.340	.385	8.65	9.80
B	.230	.290	5.85	7.38
B1	.200	.250	5.09	6.36
C	.120	.200	3.05	5.09
D	.015	.023	0.38	0.59
F	.030	.070	0.76	1.78
G	.100 BASIC		2.54 BASIC	
H	.025	.050	0.64	1.27
J	.008	.015	0.20	0.38
K	.070	.150	1.78	3.82
L	.300 BASIC		7.63 BASIC	
M	0°	15°	0°	15°
N	.010	.030	0.25	0.76
P	.025	.050	0.64	1.27

NOTE: Leads in true position within 0.01" (0.25mm) R at MMC at seating plane. Pin numbers shown for reference only. Numbers may not be marked on package.

MECHANICAL

U Package — 8-Pin SOIC



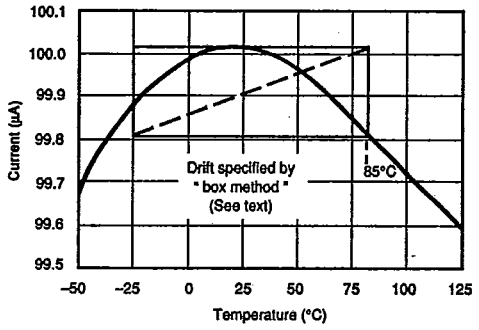
DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.185	.201	4.70	5.11
A1	.178	.201	4.52	5.11
B	.146	.162	3.71	4.11
B1	.130	.149	3.30	3.78
C	.054	.145	1.37	3.69
D	.015	.019	0.38	0.48
G	.050 BASIC		1.27 BASIC	
H	.018	.026	0.46	0.66
J	.008	.012	0.20	0.30
L	.220	.252	5.59	6.40
M	0°	10°	0°	10°
N	.000	.012	0.00	0.30

NOTE: Leads in true position within 0.01" (0.25mm) R at MMC at seating plane. Pin numbers shown for reference only. Numbers may not be marked on package.

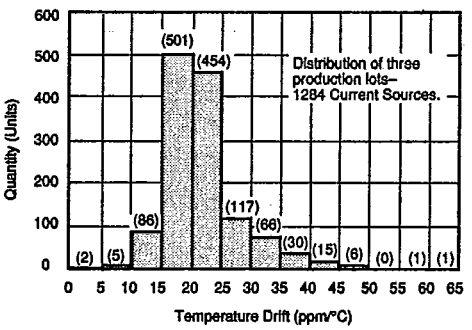
TYPICAL PERFORMANCE CURVES

T_A = +25°C, V_S = +15V unless otherwise noted.

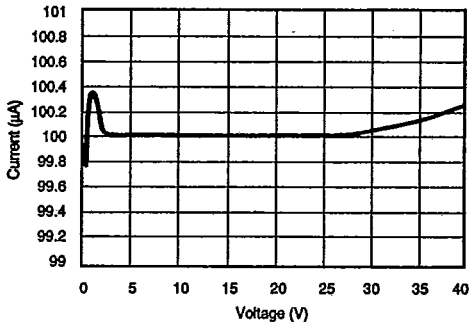
CURRENT SOURCE
TYPICAL DRIFT vs TEMPERATURE



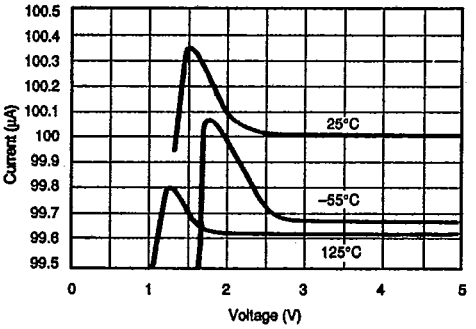
CURRENT SOURCE
TEMPERATURE DRIFT DISTRIBUTION



CURRENT SOURCE
OUTPUT CURRENT vs VOLTAGE



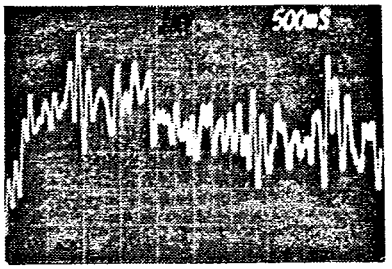
CURRENT SOURCE
OUTPUT CURRENT vs VOLTAGE



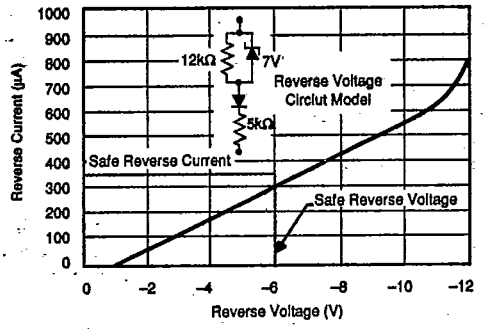
TYPICAL PERFORMANCE CURVES

T_A = +25°C, V_S = +15V unless otherwise noted.

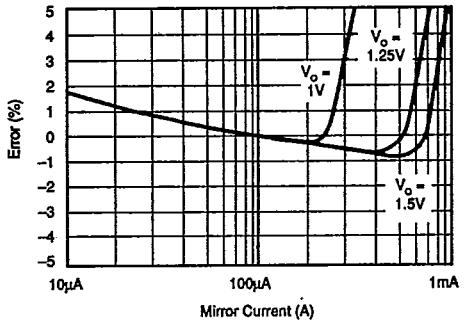
CURRENT SOURCE
CURRENT NOISE (0.1Hz to 10Hz)



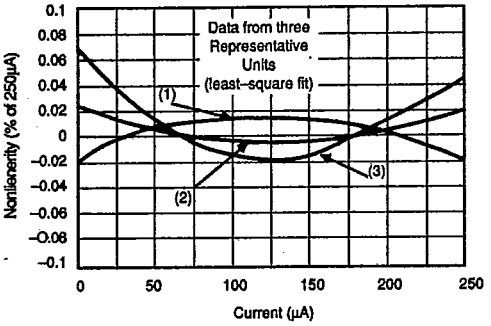
CURRENT SOURCE
REVERSE CURRENT vs REVERSE VOLTAGE



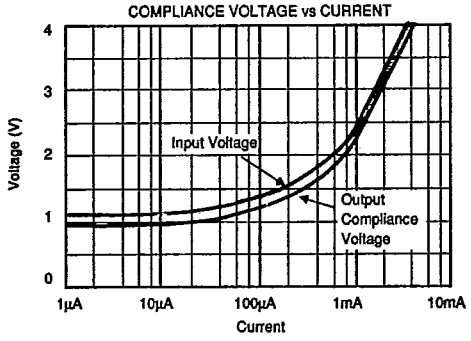
MIRROR GAIN ERROR vs CURRENT



MIRROR TRANSFER NONLINEARITY



MIRROR INPUT VOLTAGE/OUTPUT
COMPLIANCE VOLTAGE vs CURRENT



APPLICATIONS INFORMATION

The three circuit sections of the REF200 are electrically isolated from one another using a dielectrically isolated fabrication process. A substrate connection is provided (pin 6), which is isolated from all circuitry. Still, this pin should be connected to a defined circuit potential to assure that rated performance is achieved. The preferred connection is to the most positive constant potential in your system. In most analog systems this would be $+V_S$.

Although sections of the REF200 may be left unconnected, they should preferably be connected to ground or the positive power supply. Connect one or all terminals of an unused section to an appropriate node.

Drift performance is specified by the "box method," as illustrated in the Current vs Temperature plot of the typical performance curves. The upper and lower current extremes measured over temperature define the top and bottom of the box. The sides are determined by the specified temperature range of the device. The drift of the unit is the slope of the diagonal—typically 25ppm/°C from –25°C to +85°C.

If the current sources are subjected to reverse voltage, a protection diode may be required. A reverse voltage circuit model of the REF200 is shown in the Reverse Current vs Reverse Voltage Curve. If reverse voltage is limited to less than 6V *or* reverse current is limited to less than 350µA, no protection circuitry is required. A parallel diode (Figure 2a) will protect the device by limiting the reverse voltage across the current source to approximately 0.7V. In some applications, a series diode may be preferable (Figure 2b) because it allows no reverse current. This will, however, reduce the compliance voltage range by one diode drop.

Applications for the REF200 are limitless. A collection of circuits is shown to illustrate some techniques.

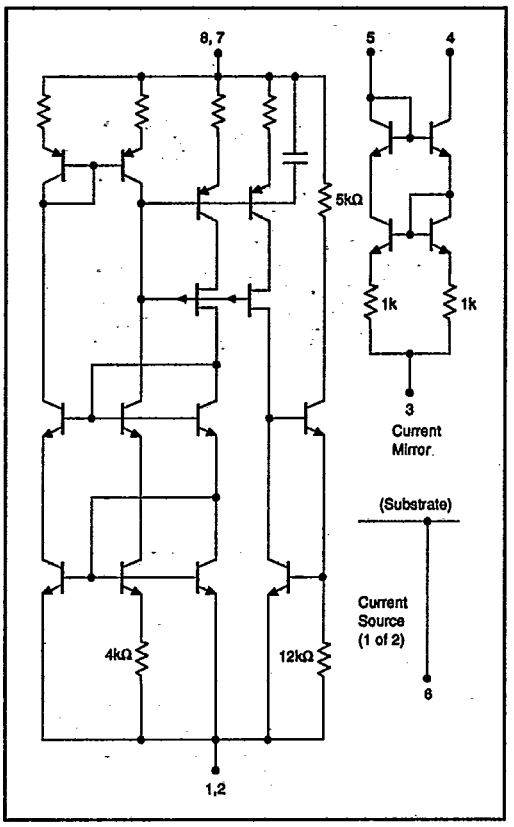


FIGURE 1. Simplified Circuit Diagram.

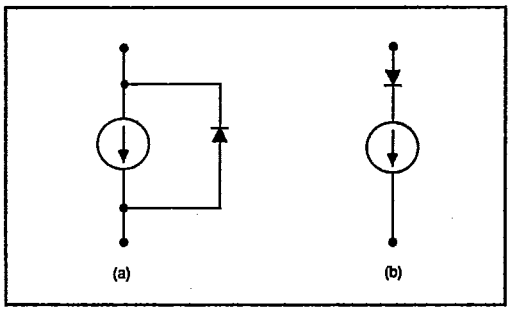


FIGURE 2. Reverse Voltage Protection.

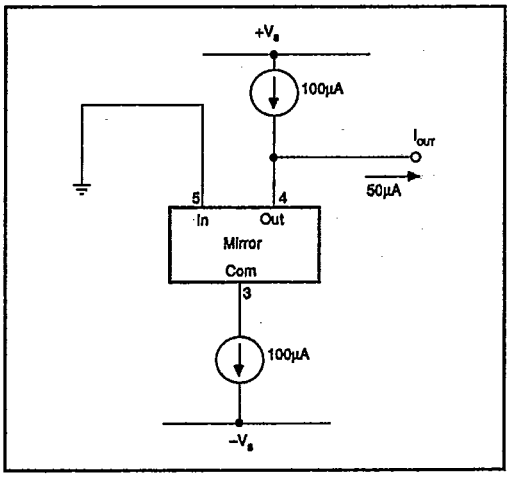


FIGURE 3. 50µA Current Source.

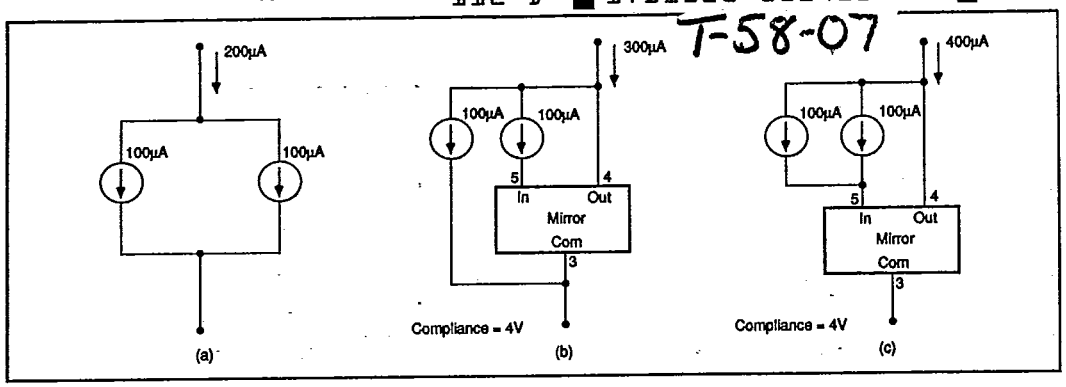


FIGURE 4. 200µA, 300µA, and 400µA Floating Current Sources.

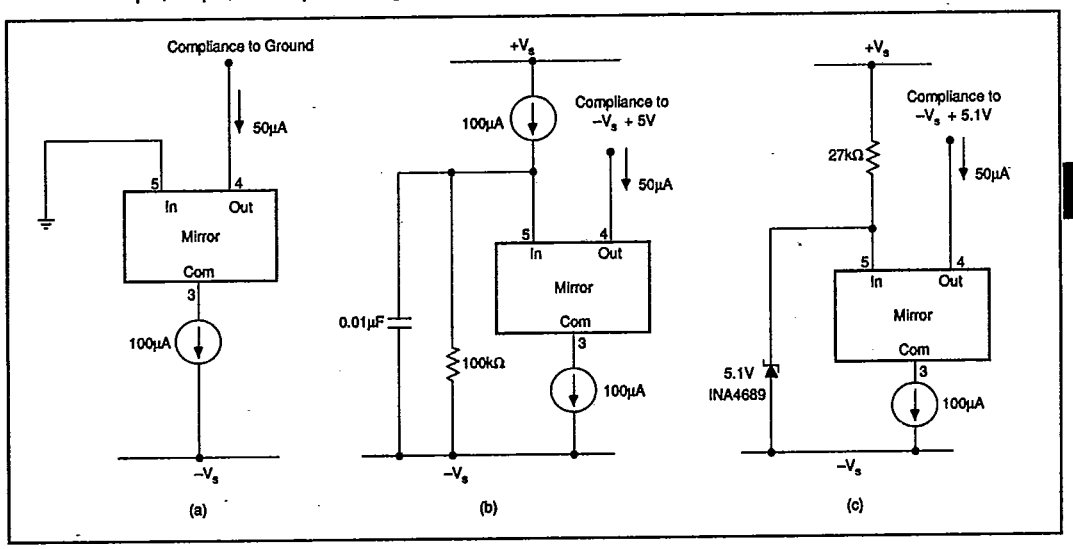


FIGURE 5. 50µA Current Sinks.

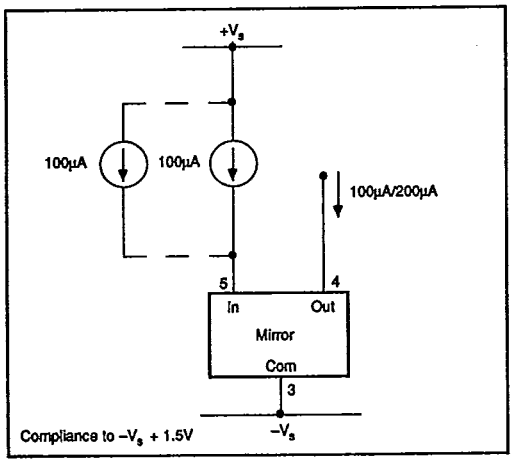


FIGURE 6. Improved Low-Voltage Compliance.

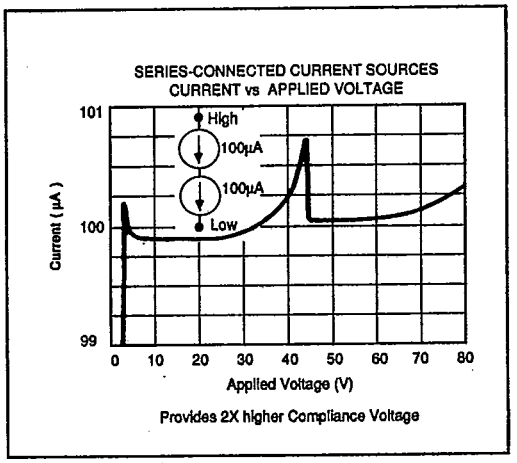


FIGURE 7. 100µA Current Source—80V Compliance.

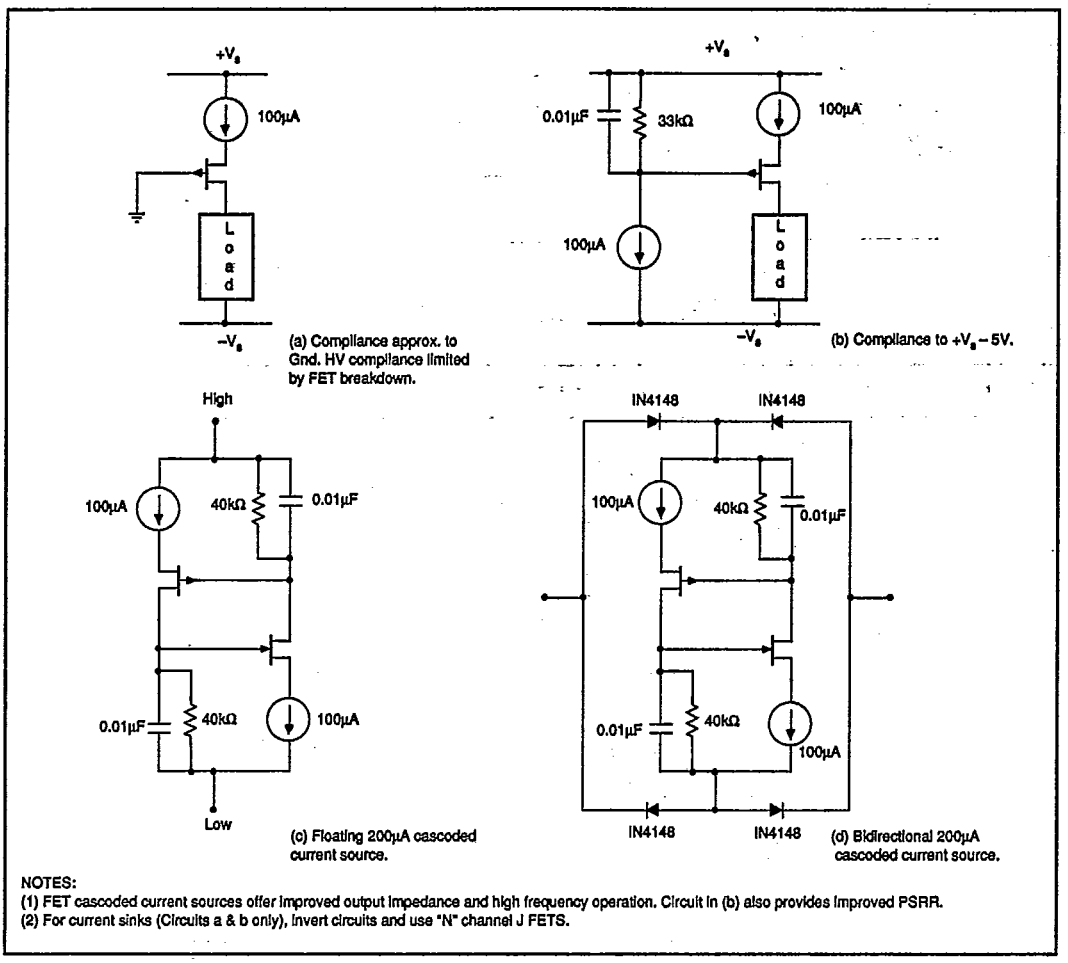


FIGURE 8. FET Cascode Circuits.

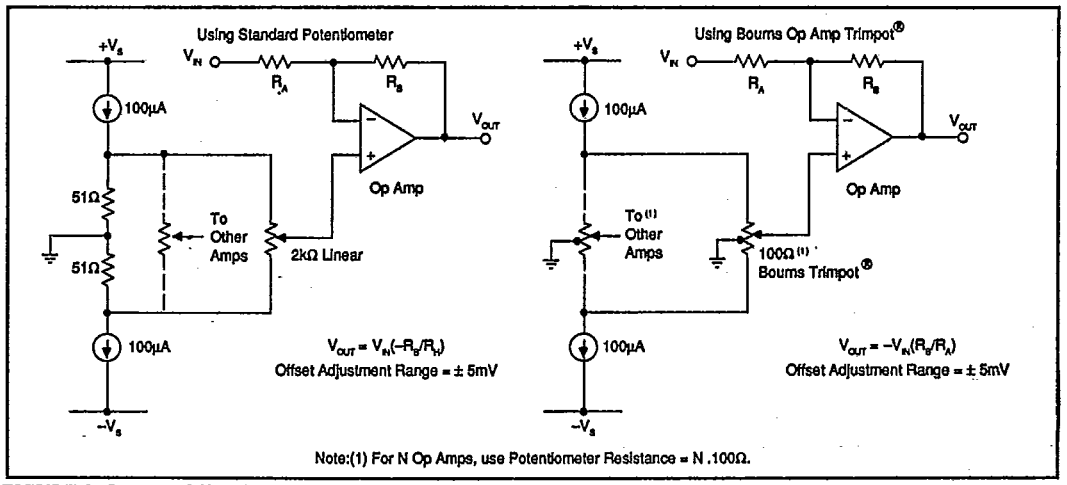


FIGURE 9. Op Amp Offset Adjustment Circuits.

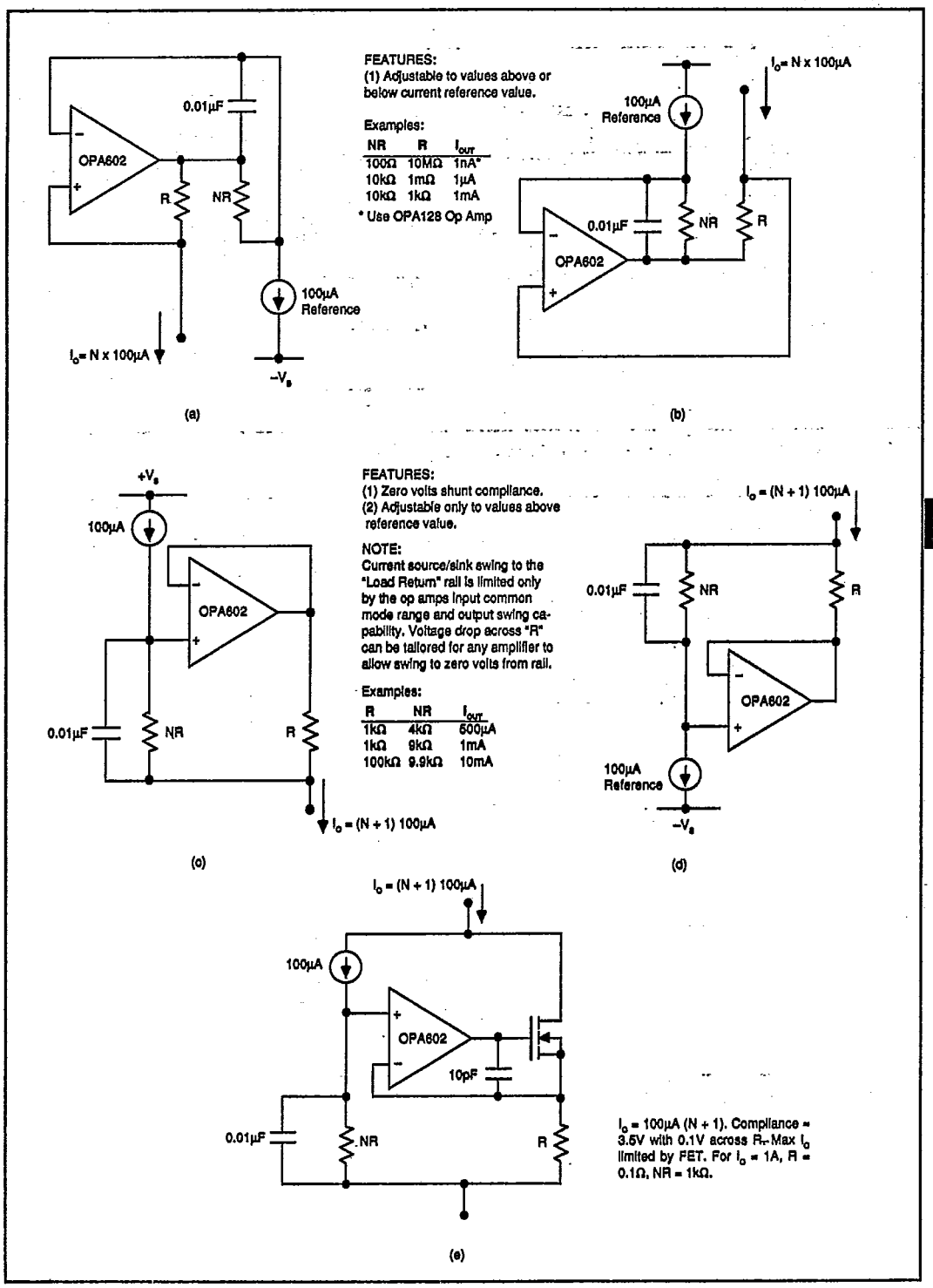


FIGURE 10. Adjustable Current Sources.

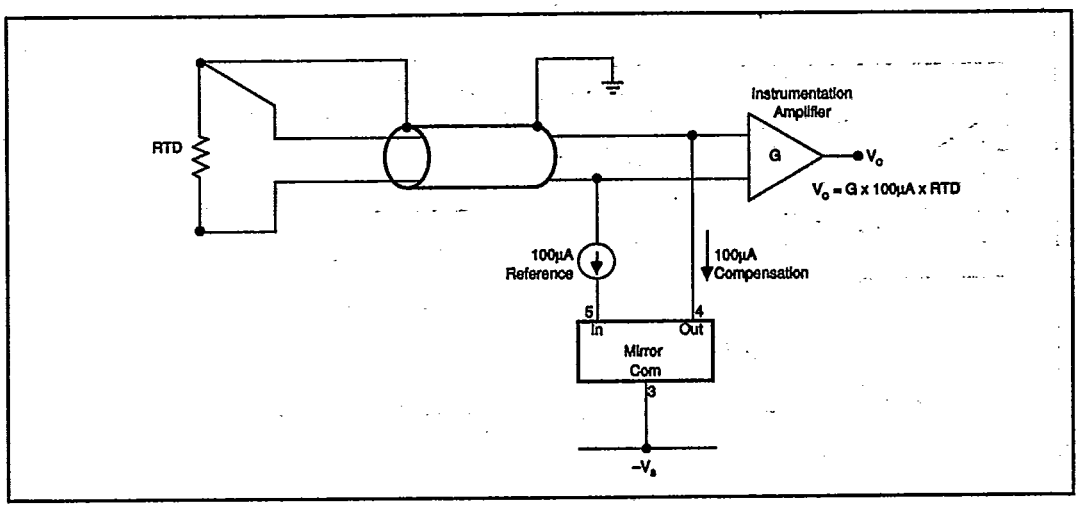


FIGURE 11. RTD Excitation With Three Wire Lead Resistance Compensation.

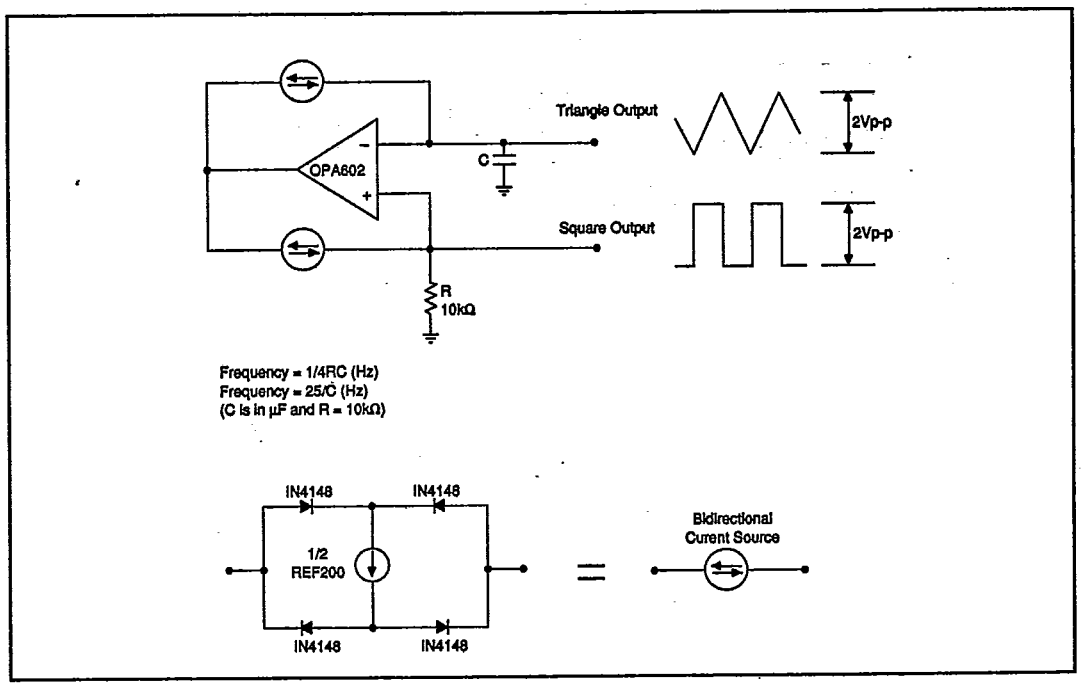


FIGURE 12. Precision Triangle Waveform Generator.

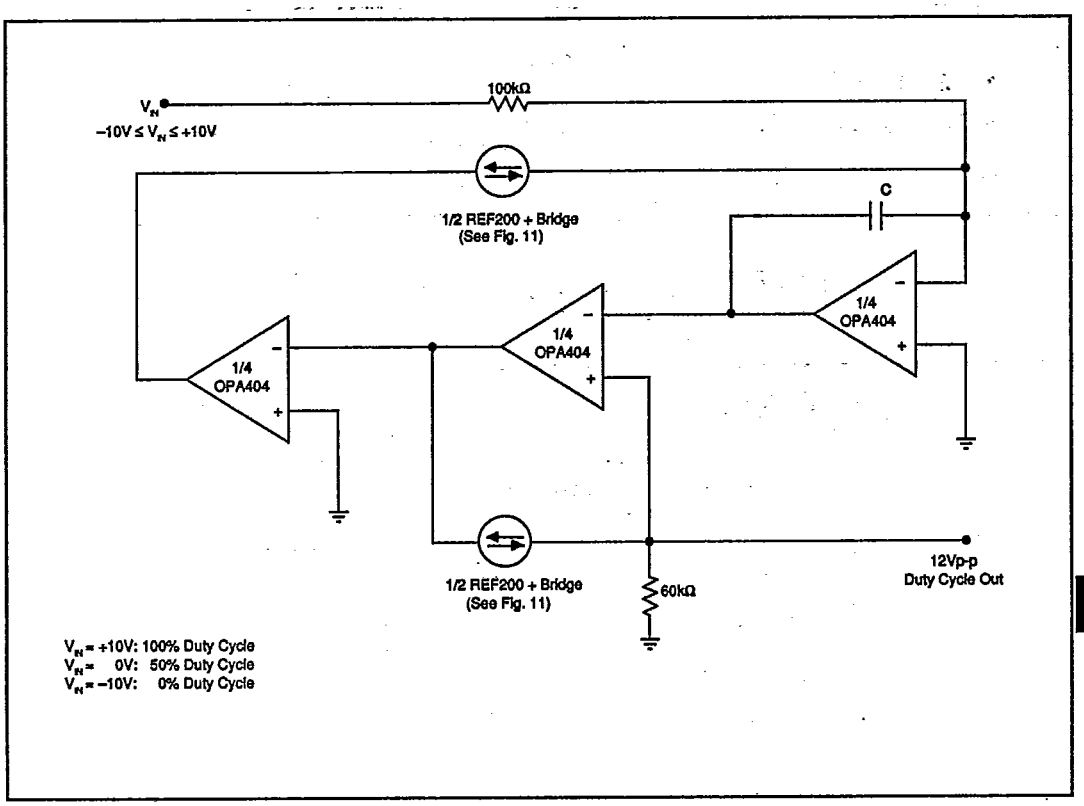


FIGURE 13. Precision Duty-Cycle Modulator.

For More Applications, Request Product Data Sheet PDS-851.