TELEDYNE PHILBRICK

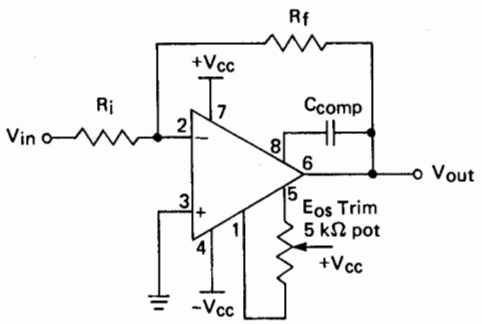
Wideband Fast-Settling Operational Amplifiers

1437
1438

The 1437 and 1438 are designed to offer versatility in wideband steady state and fast transient applications. The absence of large transients and oscillations in the settling waveform makes these op amps dependable system elements that help solve settling problems associated with A/D's, D/A's, and sampling circuits. Among their competitors, the 1437 and 1438 stand out for their speed and predictability, exemplified by their fast and smooth settling.

The 1437 and 1438 have excellent DC characteristics with ± 200pA input bias currents, 95dB open loop gains, and ± 0.5mV input offset voltages. The choice of a single external compensation capacitor allows for maintenance of a 40MHz bandwidth over a variety of gains, with slew rates up to 400V/μsec. A true differential input ensures equally superior performance in all system configurations whether they are inverting, noninverting, or differential. With their attractive price/performance ratios, the 1437 and 1438 should prove to be new industry workhorses in the fields of data acquisition and high-speed, high-accuracy signal processing.

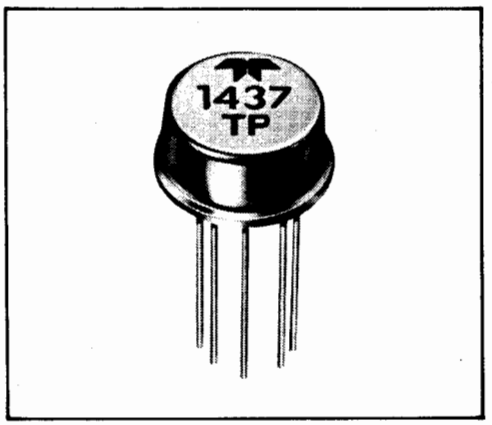
The 1437 is packaged in a TO-99 can and has a guaranteed ± 20mA output. The 1438 is packaged in a TO-8 can and has a guaranteed ± 50mA output. Standard devices are fully specified for 0°C to + 70°C operation. Add "-83" to part number for − 55°C to + 125 °C operation and MIL-STD-883, Method 5008 screening.



An E_{OS} trim pot is optional.
Power supplies should be bypassed with 1 μF tantalum and 0.01 μF ceramic capacitors.

The use of a finned heat sink is recommended.

Figure 1. Normal Inverting Operation



FEATURES

- 350MHz Gain-Bandwidth Product
- FET Input
- 40MHz Operating Bandwidth
- 110ns Settling Time to 0.1%
- ± 20mA and ± 50mA Outputs
- Small TO-99 and TO-8 Packages
- Single External Compensation Capacitor

APPLICATIONS

- Current to Voltage DAC's
- Pulse Amplifiers
- Radar and Sonar Signal Processing
- Graphic CRT Displays
- Video A/D, D/A, and S/H's

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SPECIFICATIONS (+25°C; V_{CC} = ±15V; R_L = 500Ω; R_f, R_i = 2k, unless otherwise indicated). ⑦

	Typical	Guaranteed
OUTPUT RANGE		
Voltage (peak) ①	±12V	±10V
Current ① ②	±24mA	±20mA
VOLTAGE GAIN (open loop @ f = 10Hz) ④ ⑤		
Rated Load	95dB	88dB
FREQUENCY RESPONSE		
Gain-Bandwidth Product ①	350MHz	---
Unity-Gain Bandwidth	40MHz	---
Full Power Bandwidth		
C_C = 0pF	6.0MHz	---
C_C = 15pF	3.1MHz	---
TIME RESPONSE		
Settling Time ③		
10V Step to 1%	85ns	---
10V Step to 0.1% ③	110ns	140ns
10V Step to 0.025%	150ns	---
Small Signal Rise Time C_C = 15pF	9ns	---
Slew Rate		
C_C = 0	400V/μsec	---
C_C = 15pF	225V/μsec	---
INPUT VOLTAGE RANGE/CMRR/IMPEDANCE		
Common Mode for DC Linear Operation ③	±12V	±10V
Absolute Max. Differential Between Inputs	---	±20V
CMRR @ DC ③ ⑤	78dB	60dB
PSRR @ DC	76dB	---
Input Impedance @ DC (differential)	10MΩ ‖ 3pF	---
Output Impedance (open loop)	90Ω	---
INPUT OFFSET VOLTAGE		
Initial (without external trim) ⑤	±0.5mV	±2mV
Vs. Temperature (R_L = ∞) ⑤	±15μV/°C	±50μV/°C
INPUT BIAS CURRENT		
Initial (without external trim)	±200pA	---
Bias Current over Rated Temperature	Doubles every 10°C	---
Offset Currant	±20pA	---
NOISE (referred to input)		
0.1Hz to 100Hz	4μV (p-p)	---
	0.5μV RMS	---
100Hz to 10kHz	5μV (p-p)	---
	1μV RMS	---
10kHz to 1MHz	50μV (p-p)	---
	6μV RMS	---
POWER REQUIREMENTS		
Nominal Power Supply Voltage	±15V	---
Supply Voltage Range	---	±12V to ±20V
Quiescent Current @ V_{CC} = ±15V ④ ⑤	±12mA	±15mA
Short Circuit Current ④ ⑤ ⑥	50mA	---
TEMPERATURE RANGE		
Operating		
1437	---	0°C to +70°C
1437-83	---	−55°C to +125°C
Thermal Resistance (θ_{JA})	150°C/Watt	---
(θ_{JC})	70°C/Watt	---
Storage		
All Units	---	−65°C to +150°C

① Measured at 10MHz. C_C = 0.
③ Settling time measured in circuit of Figure 7.
③ See Figure 13 for plot of CMRR vs. frequency.
④ 100% interim tested for "-83" version.
⑤ 100% final electrical tested for "-83" version.
⑥ Finned heat sink use recommended if long term short circuits can occur. Without finned heat sink, short-circuited duration should be limited to < 10s.
⑦ Specifications listed are for the 1437 only. At the time of this printing, the 1438 (±50mA guaranteed output), was still being characterized. Its DC characteristics (offset, bias, CMRR, etc.) will be the same as the 1437's. Its time and frequency response characteristics (slew rate, settling time, etc.) will be different. If a 1438 data sheet is not attached, please contact the factory for a complete specification.

Applications

Its fast settling characteristics make the 1437 an excellent buffer for successive approximation A/D converters. See Figure 2.

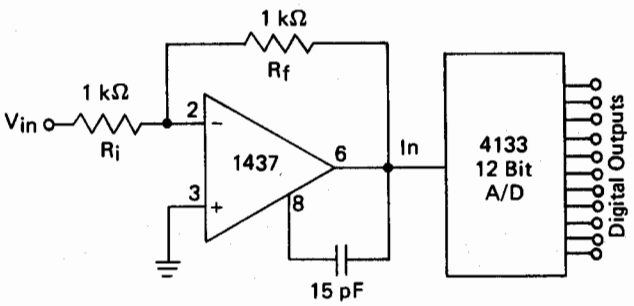


Figure 2. Fast-Settling Buffer

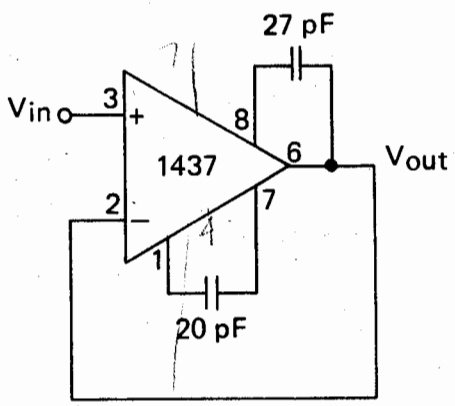


Figure 3. 40MHz Unity Gain Buffer

There is no need for a compensation capacitor for gains over 30. See Figure 4 where gain is 70 and bandwidth is 5 MHz.

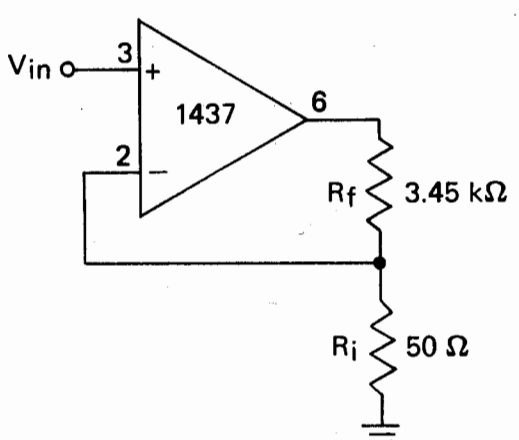


Figure 4. Video Amplifier

With an inverting gain of 10, bandwidth is 30 MHz. See Figure 5.

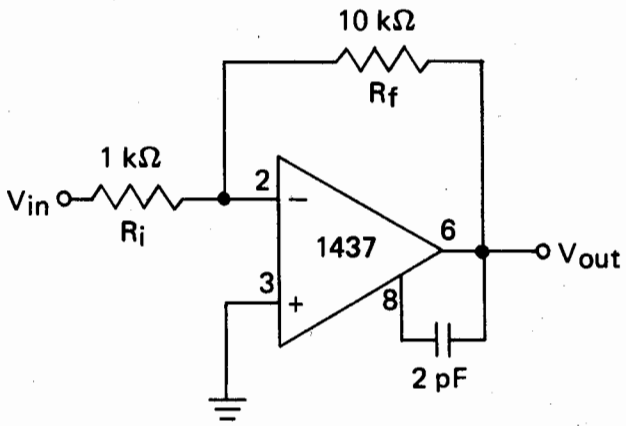


Figure 5. Inverting Gain of 10

This current to voltage converter settles in less than 400 ns to 0.025%. See Figure 6.

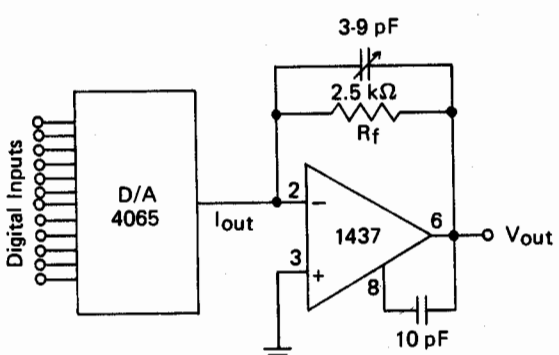
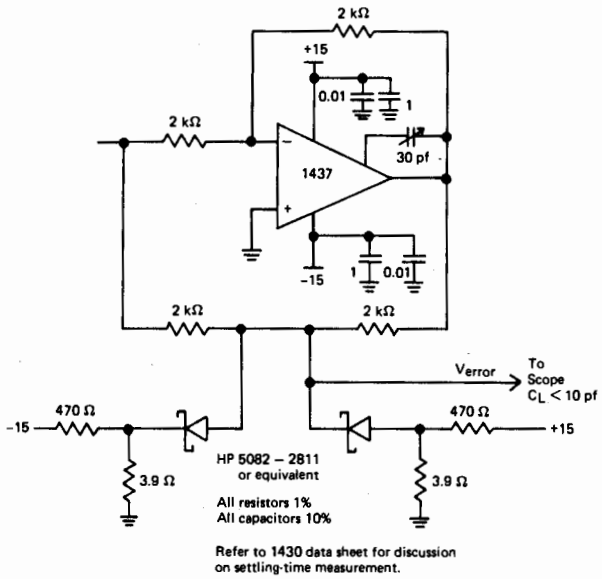


Figure 6. Current to Voltage Converter

Typical Performance Curves



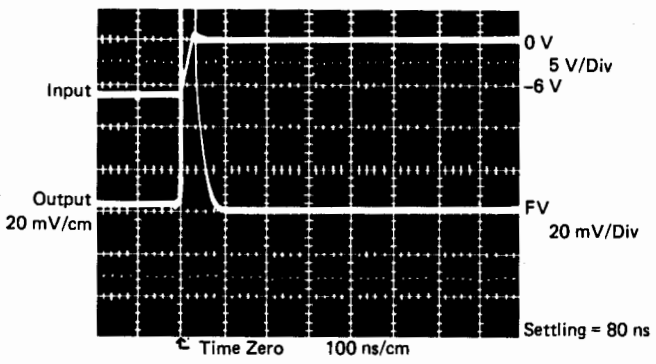


Figure 7. Settling Time Test Circuit and Graph

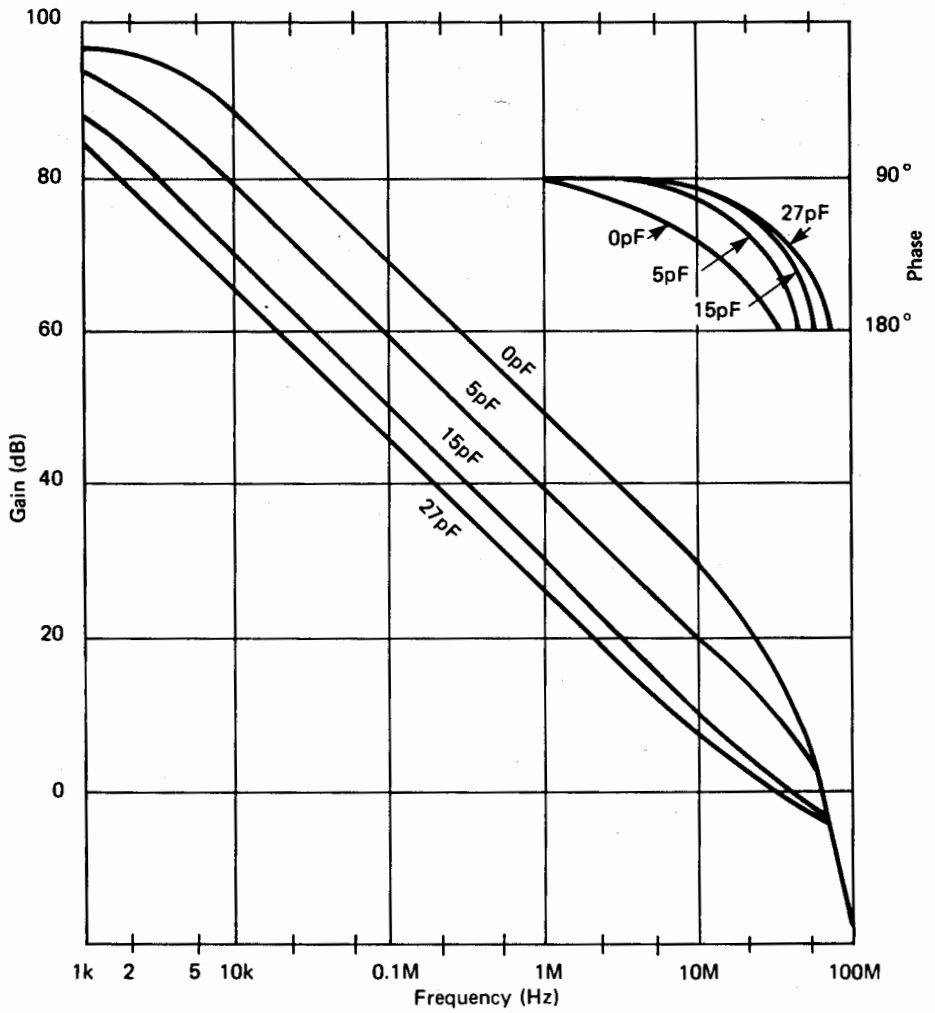


Figure 8. Open Loop Gain and Phase vs. Frequency

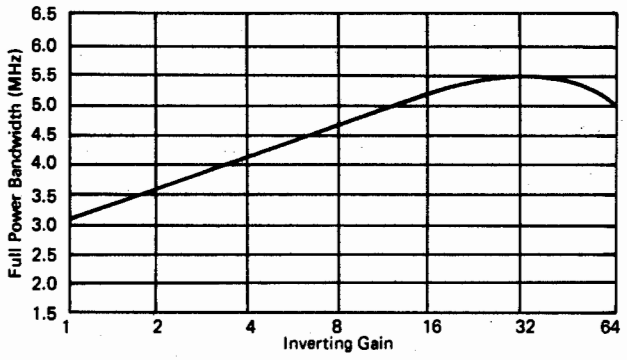


Figure 9. Full Power Bandwidth vs. Inverting Gain

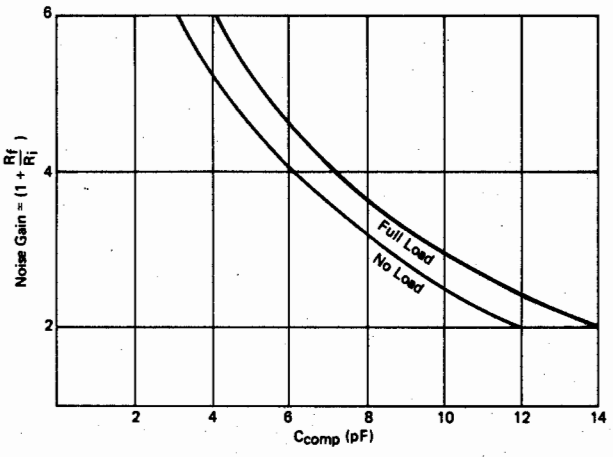


Figure 12. Noise Gain vs. C_{comp} for 16% Overshoot

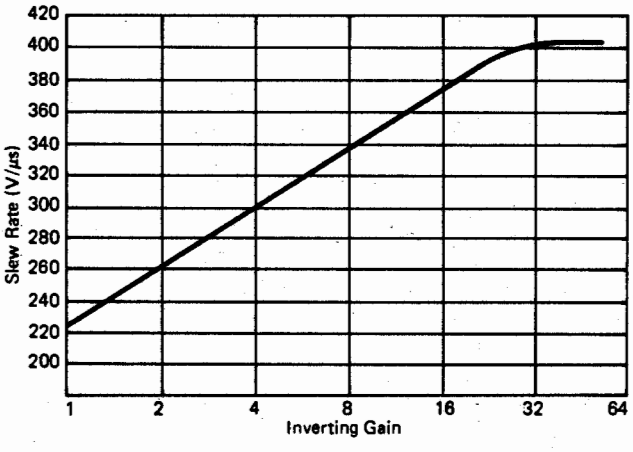


Figure 10. Slew Rate vs. Inverting Gain

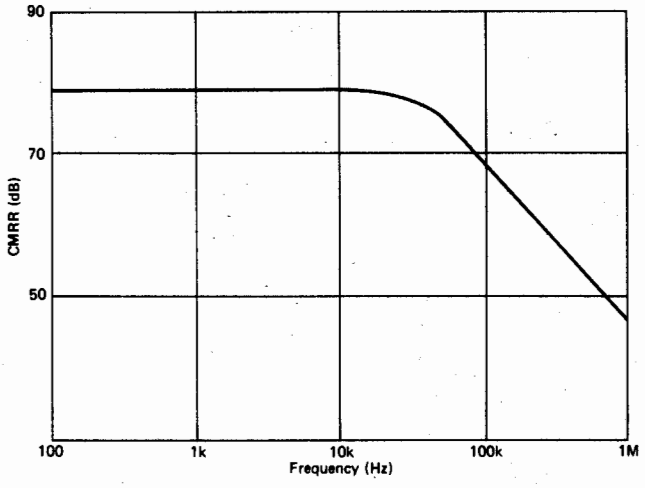


Figure 13. CMRR vs. Frequency

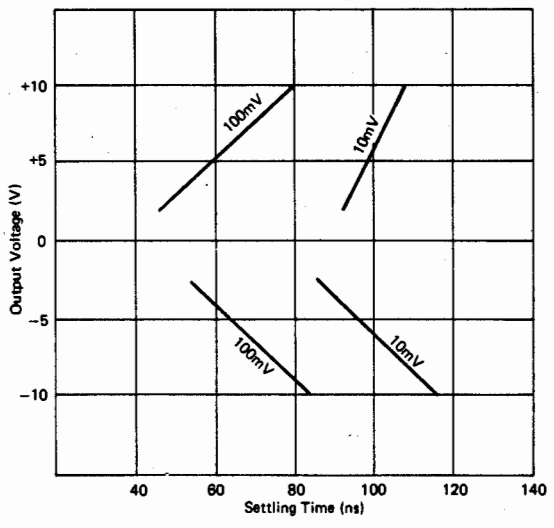


Figure 11. Settling Time vs. Output Voltage Change

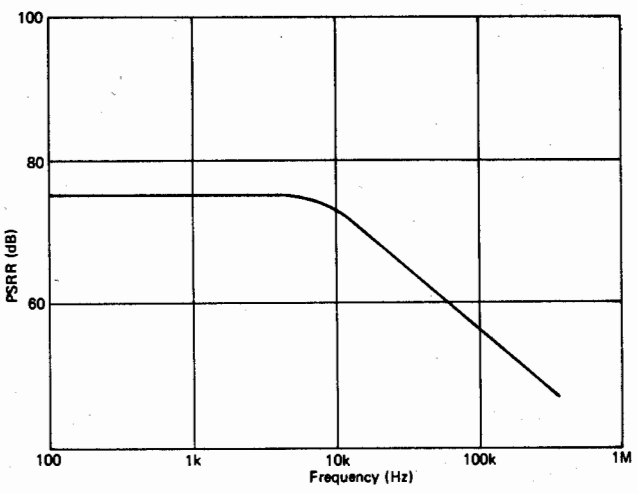


Figure 14. PSRR vs. Frequency, $\Delta PS = 1\%$

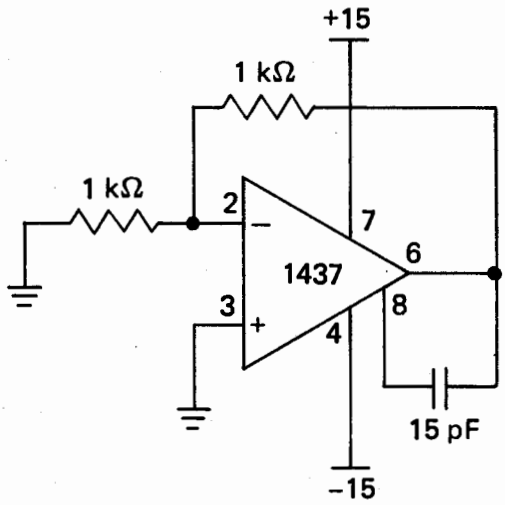
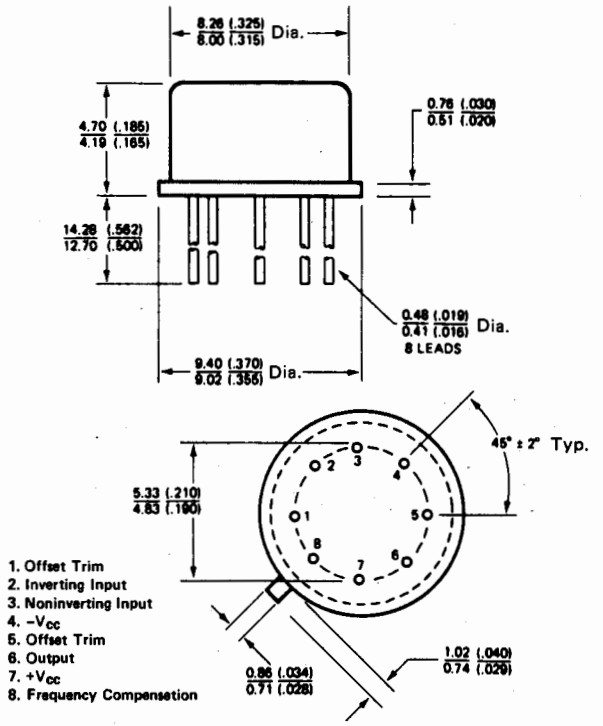


Figure 15. Burn-In Test Circuit



View Towards Pins

TO-99

Dimensions are in millimeters and those in parentheses in inches.

Not shown actual size.

Figure 16. Pinouts

SCREENING ACCORDING TO MIL-STD-883 METHOD 5008		
Test	**Methods and Conditions**	**Purpose**
① Internal Visual	Method 2017	Removes potentially defective units with respect to materials, construction, and workmanship.
① Stabilization Bake	Method 1008, Condition C 24 hours at 150 °C	Stabilizes circuit components, with a preconditioning treatment, prior to conducting further testing and trimming.
① Constant Acceleration	Method 2001, Condition B Y_1 Axis, 10,000 g	Removes potential failures due to weak wire or chip bonding.
① Seal, Fine and Gross	Method 1014, Fine Leak Condition A and C	Verifies Integrity of hermetic package.
Interim Electrical	---	---
② Burn In	Method 1015, Condition C 160 hours at 125 °C	Reduces infant mortality rate.
Temperature Cycling	Method 1010, Condition B 10 cycles from $-65\,^{+0}_{-5}\,°C$ to $+150\,^{+3}_{-0}\,°C$	Removes potential failures due to weak wire or chip bonding.
Final Electrical	---	---
① External Visual	Method 2009	Removes defective units with respect to materials, construction, and workmanship.

① Standard tests for all 1437 units.

② See Figure 16 for burn-in circuit used.

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