BURR-BROWN®

3580
3581
3582

High Voltage OPERATIONAL AMPLIFIERS

FEATURES

- HIGH OUTPUT SWINGS, up to ±145V (3582)
- LARGE LOAD CURRENTS, up to ±60mA (3580)
- DIFFICULT TO DAMAGE, automatic thermal shutoff
- REDUCES SOURCE LOADING, $10^{11}\Omega$ Input Z
- PRESERVES SYSTEM ACCURACY, 110dB CMR 20pA bias current

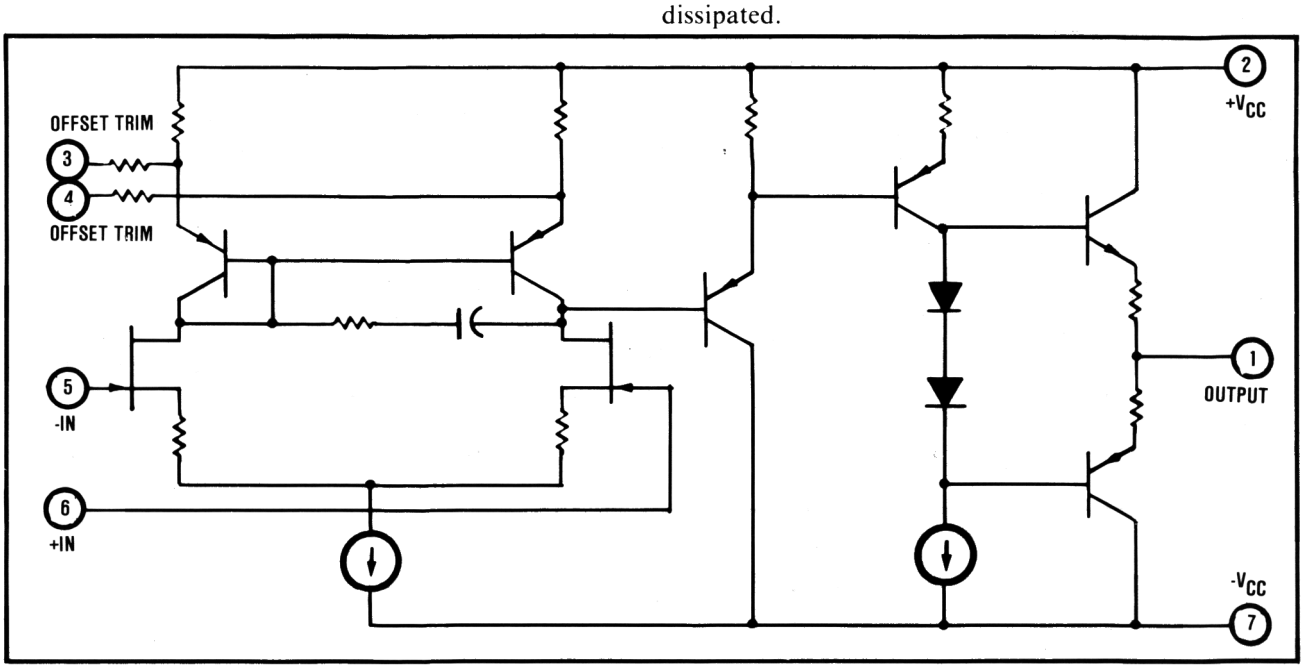
DESCRIPTION

The 3580 series is the first family of Integrated Circuit operational amplifiers which will provide output voltage swings of up to ±145V.

The monolithic FET input stage has low bias currents (20pA) which minimizes the offset voltages caused by the bias current and the large resistance normally associated with high voltage circuits.

The 3580 series is packaged in a TO-3 package which will dissipate over 3W of power without a heat sink and 4.5W with a suitable heat sink.

The input stage is protected against overvoltages and the output stage is protected against short-circuits-to-ground. A special thermal sensing circuit prevents damage to the amplifier by automatically shutting the amplifier down when too much power is being dissipated.



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SBOS166

THEORY OF OPERATION

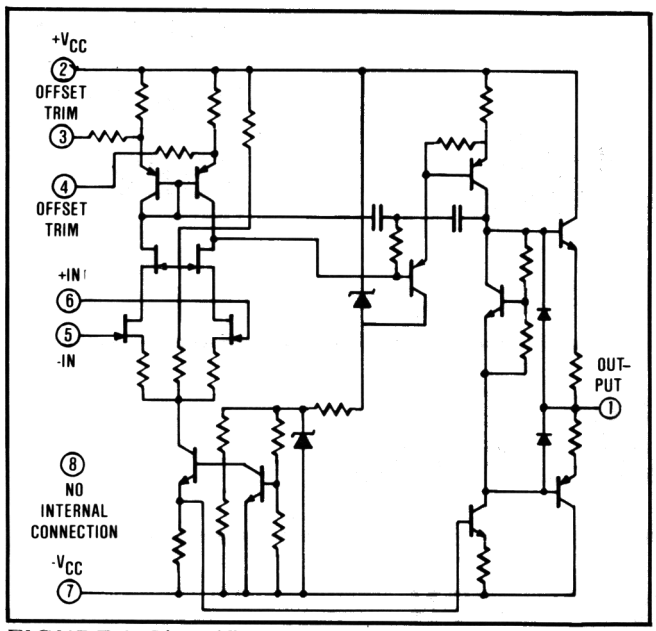


FIGURE 1. Simplifier Schematic of 3580.

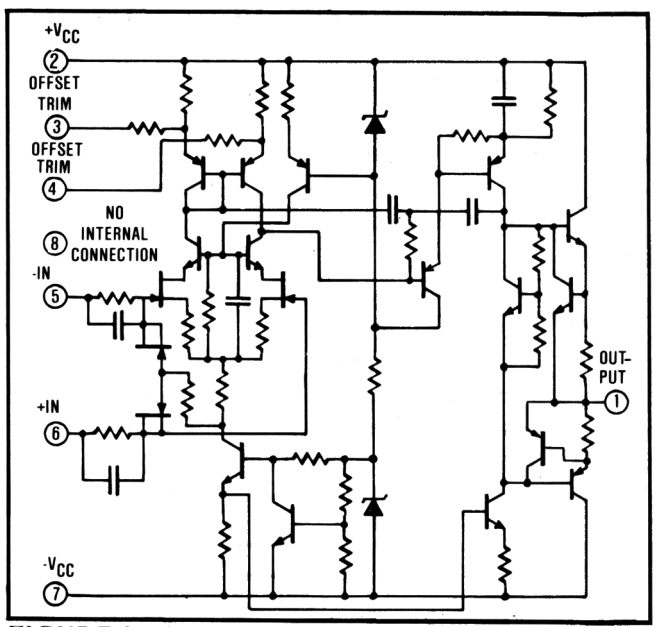


FIGURE 2. Simplified Schematic of 3581 and 3582.

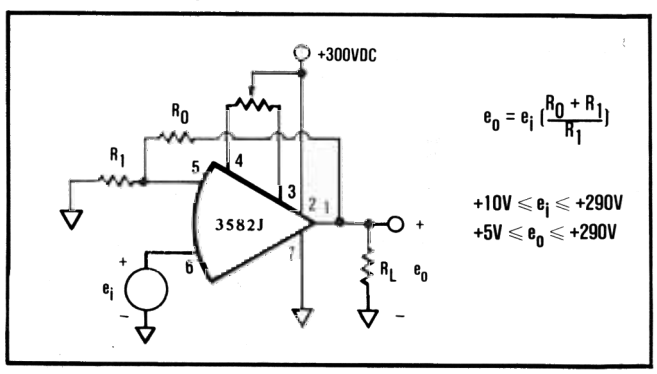


FIGURE 3. Operation from a Single Supply.

The 3580 family of integrated circuit high voltage amplifiers provides performance which previously was only available in bulky modular packages (see Figures 1 and 2). In addition to the smaller size and inherent reliability, the integrated circuit construction offers other advantages not normally available in modular or discrete component units. The amplifiers have thermal sensing and shut-off circuitry which automatically turns the amplifier off when the internal temperature reaches approximately 150°C. This is accomplished by sensing the substrate temperature and deactivating the input stage current source when the temperature reaches a critical level. As this happens, the output load current limits at a safe value and the amplifier's quiescent current decreases.

If the cause of the abnormal power dissipation is continuous (such as a short circuit across the load) the output current may remain at a low value or oscillate between two values depending on the amount of power being dissipated and the heat sink conditions seen by the amplifier. In either case, the amplifier will not sustain internal damage and will return to normal operation within a few seconds after the abnormal condition is removed.

The incorporation of thermal sensing and shut-off in the amplifier will allow the use of a smaller heat sink than would otherwise be required. This is due to the fact that the amplifier will protect itself and does not require a massive heat sink for protection under abnormal conditions.

Another unique feature of the 3580 family is the thorough testing of the unit receiver. In addition to the normal tests, all amplifiers are 100% tested for input protection at the full rated differential voltage ($+V_{CC}$ -V_{CC}). Each unit is also 100% tested for output short circuit to common at maximum supply voltage.

The 3581 and 3582 have a unique feature that is important in many high voltage applications. In these two models the input bias current is virtually independent of the applied common-mode voltage. This is accomplished by the true cascode input stage which keeps the drain-to-source voltage of the input transistors constant as the common-mode voltage changes.

OPERATION FROM A SINGLE SUPPLY

It may be desirable in some applications to operate the amplifiers from a single supply. The circuit in Figure 3 illustrates a typical application.

Note that there are restrictions on the input and output voltages (e_i and e_o) which are necessary in order to keep the amplifier circuits operating in a linear manner.

It should be noted that when the 3581 and 3582 amplifiers are operated from a single supply, the output stage, which is still short-circuit-current limited and thermally protected, is not protected against short circuits to ground (the 3580 will still be short circuit protected under these conditions). When the amplifiers are operated from a single supply, the voltage across one of the output transistors is high enough that secondary breakdown is a consideration. The output current must be limited in order to prevent damage. This can be done by keeping the load resistor larger than 5kΩ for the 3582 and greater than 1kΩ for the 3581.

SPECIFICATIONS

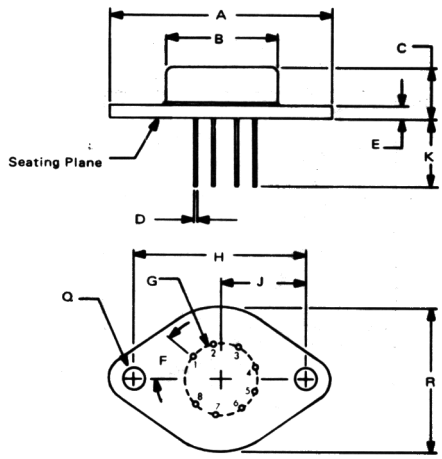
ELECTRICAL

Typical at T_{CASE} = +25°C max unless otherwise noted.

MODELS	3580J	3581J	3582J
POWER SUPPLY			
Voltage, $\pm V_{CC}$	±15VDC to ±35VDC	±32VDC to ±75VDC	±70VDC to ±150VDC
Quiescent Current, max	±10mA	±8mA	±6.5mA
RATED OUTPUT			
Voltage, $\pm V_{CC}$ -5 VDC, min	±10VDC to ±30VDC	±27VDC to ±70VDC	±65VDC to ±145VDC
Current, min	±60mA	±30mA	±15mA
Current, Short Circuit	±100mA	±50mA	±25mA
Load Capacitance, max		10nF	
OPEN-LOOP GAIN			
No Load, DC	106dB	112dB	118dB
Rated Load, DC, min	86dB	94dB	100dB
FREQUENCY RESPONSE			
Unity Gain Bandwidth, Small Signal		5MHz, min	
Full Power Bandwidth	100kHz	60kHz	30kHz
Slew Rate	15V/μs	20V/μs	20V/μs
Settling Time, 0.1%		12μs	
INPUT OFFSET VOLTAGE			
Initial at T_{CASE} = +25°C, max	±10mV	±3mV	±3mV
Drift vs Temp, max	±30μV/°C	±25μV/°C	±25μV/°C
Drift vs Supply Voltage	100μV/V	20μV/V	20μV/V
Drift vs Time	100μV/mo	50μV/mo	50μV/mo
INPUT BIAS CURRENT			
Initial at T_{CASE} = +25°C, max	-50pA	-20pA	-20pA
Drift vs Temp		doubles every 10°C	
Drift vs Supply Voltage	0.5pA/V	0.2pA/V	0.2pA/V
INPUT OFFSET CURRENT			
Initial at T_{CASE} = +25°C, max		±20pA	
Drift vs Temp		doubles every 10°C	
Drift vs Supply Voltage	0.5pA/V	0.2pA/V	0.2pA/V
INPUT IMPEDANCE			
Differential		$10^{11}\Omega$. 10pF	
Common-mode		$10^{11}\Omega$	
INPUT NOISE			
Voltage 0.01Hz to 10Hz, p-p		5μV	
10Hz to 1kHz, rms	1μV	1.7μV	1.7μV
Current 0.01Hz to 10Hz, p-p	1pA	0.3pA	0.3pA
INPUT VOLTAGE RANGE			
Max Safe Differential Voltage(1)		$+V_{CC}$ + $-V_{CC}$	
Max Safe Common-mode Voltage		$+V_{CC}$ to $-V_{CC}$	
Common-mode Voltage, Linear Operation	± V_{CC} -8 V	± V_{CC} -10 V	± V_{CC} -10 V
Common-mode Rejection	86dB	110dB	110dB
TEMPERATURE Case			
Specification		0°C to 70°C	
Operating		-55°C to +125°C	
Storage		-55°C to +150°C	

NOTE:
1. On Models 3581 and 3582 the inputs may be damaged by pulses at pins 5 or 6 with dV/dt≥1V/ns. Any possible damage can be eliminated by limiting the input current to 150mA with external resistors in series with those pins. No external protection is needed for slower voltage.

MECHANICAL



NOTE:
Leads in true position within .010" (.25mm) R @ MMC at seating plane.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	1.510	1.550	38.35	39.37
B	.745	.770	18.92	19.56
C	.240	.290	6.10	7.37
D	.038	.042	0.97	1.07
E	.080	.105	2.03	2.67
F	40° BASIC		40° BASIC	
G	.500 BASIC		12.7 BASIC	
H	1.186 BASIC		30.12 BASIC	
J	.593 BASIC		15.06 BASIC	
K	.400	.500	10.16	12.70
Q	.151	.161	3.84	4.09
R	.980	1.020	24.89	25.91

Pin material and plating composition conform to Method 2003 (solderability) of Mil-Std-883 [except paragraph 3.2].

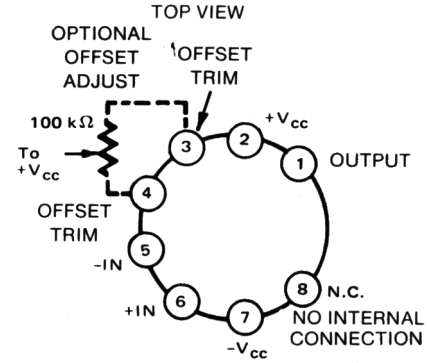
ORDER NUMBER: 3580J
3581J
3582J

WEIGHT: 15 GRAMS

CASE: METAL

PIN CONFIGURATION

TOP VIEW



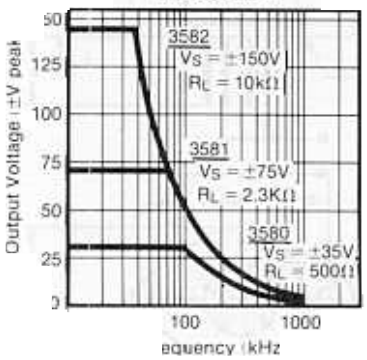
CONNECTOR: 0803MC
HEAT SINK: 0803HS
0804HS
0805HS

*The case is electrically isolated. It is recommended that the case be grounded during use.

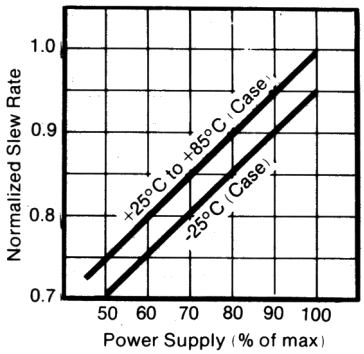
TYPICAL PERFORMANCE CURVES

T_{CASE} = +25°C and $\pm V_{CC}$ max unless otherwise noted.

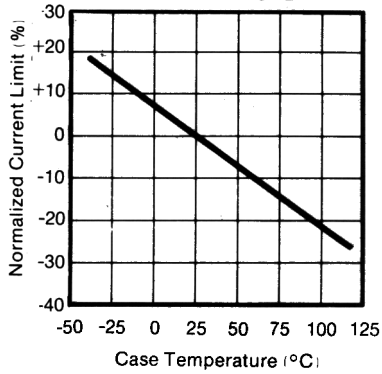
OUTPUT VOLTAGE VS FREQUENCY



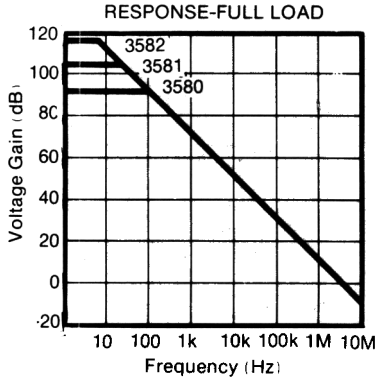
SLEW RATE VS SUPPLY VOLTAGE AT FULL LOAD



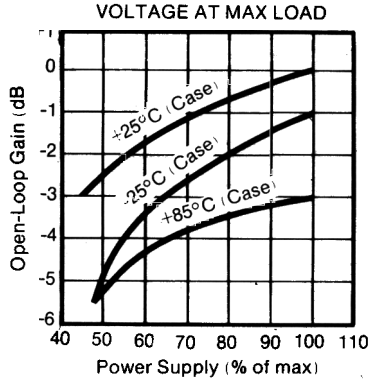
CURRENT LIMIT VS TEMPERATURE



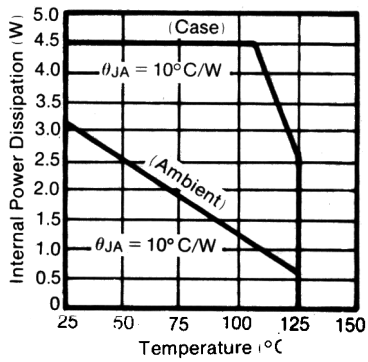
OPEN-LOOP FREQUENCY RESPONSE-FULL LOAD



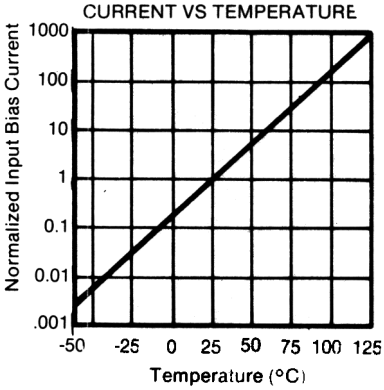
OPEN-LOOP GAIN VS SUPPLY VOLTAGE AT MAX LOAD



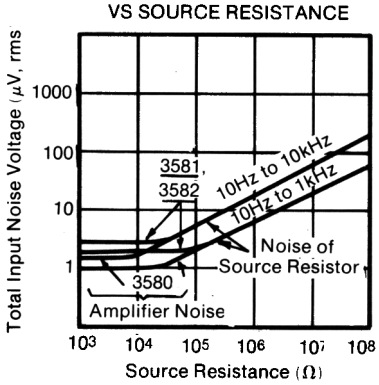
MAXIMUM POWER DISSIPATION



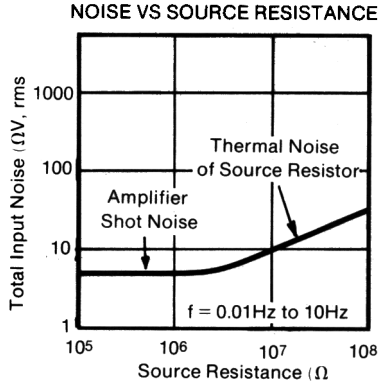
NORMALIZED INPUT BIAS CURRENT VS TEMPERATURE



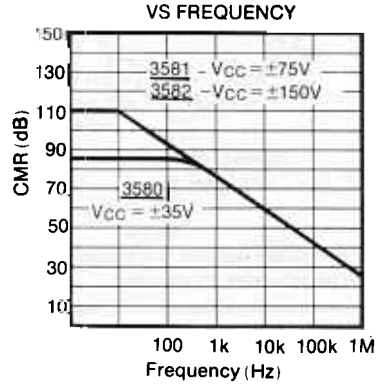
TOTAL INPUT NOISE VOLTAGE VS SOURCE RESISTANCE



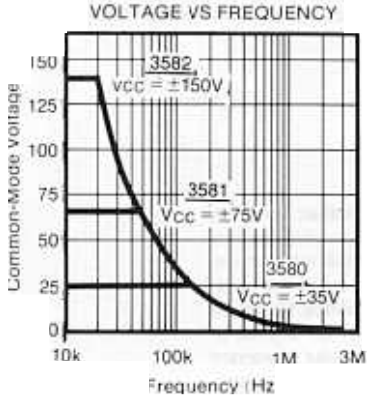
TOTAL LOW FREQUENCY INPUT NOISE VS SOURCE RESISTANCE



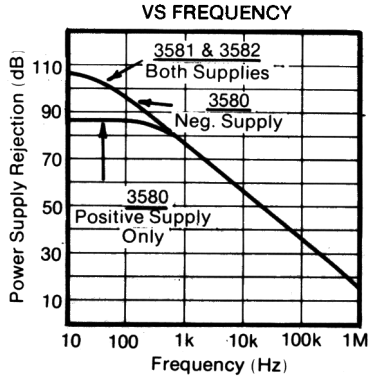
COMMON-MODE REJECTION VS FREQUENCY



MAXIMUM COMMON-MODE VOLTAGE VS FREQUENCY



POWER SUPPLY REJECTION VS FREQUENCY



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
3581J	NRND	TO-3	LMF	8	18	Pb-Free (RoHS Exempt)	Call TI	N / A for Pkg Type

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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