



**3580**  
**3581**  
**3582**

## High Voltage OPERATIONAL AMPLIFIERS

### FEATURES

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

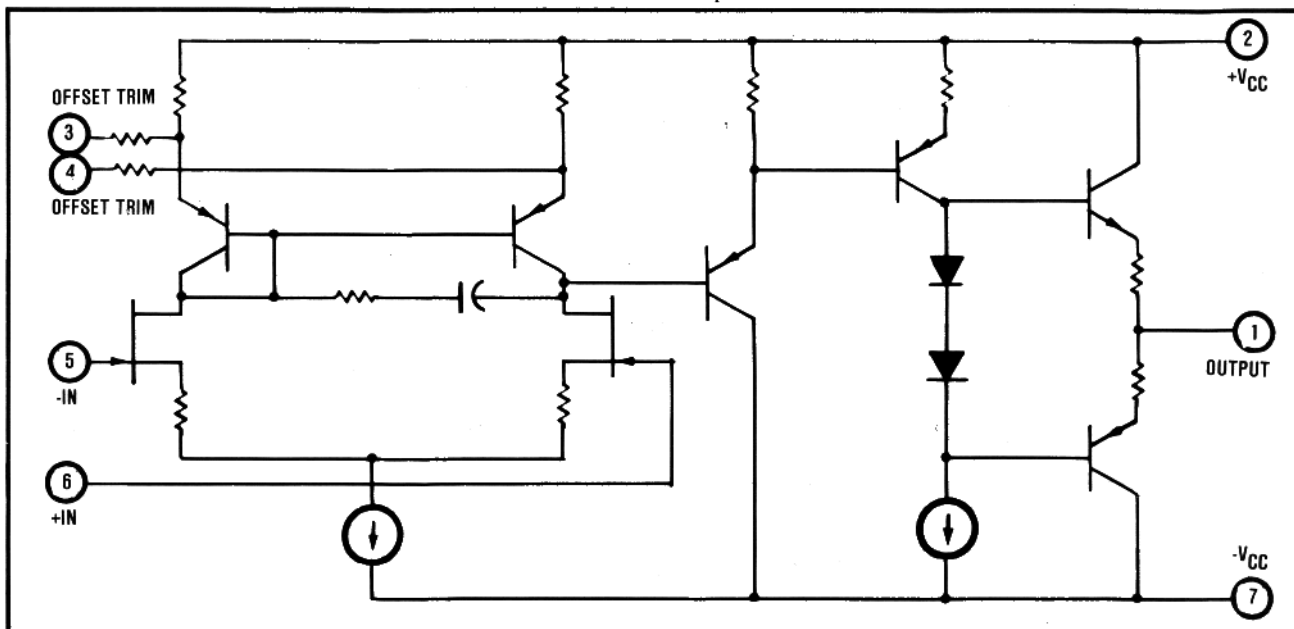
### DESCRIPTION

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

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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# THEORY OF OPERATION

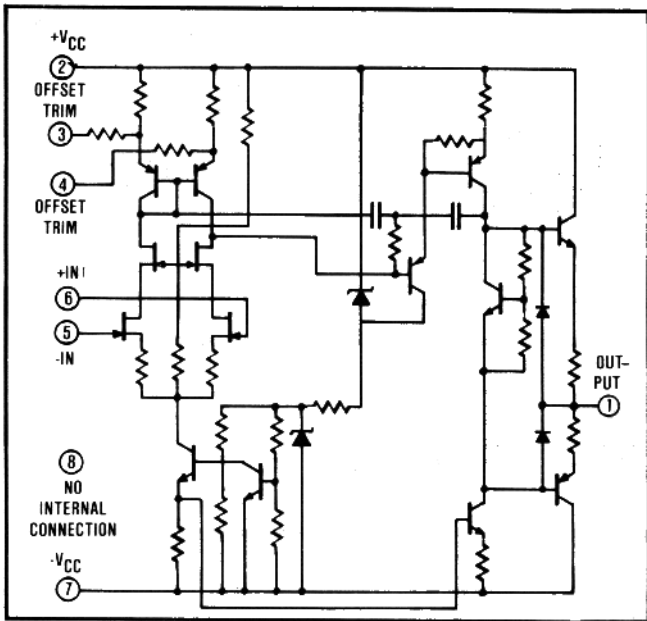


FIGURE 1. Simplifier Schematic of 3580.

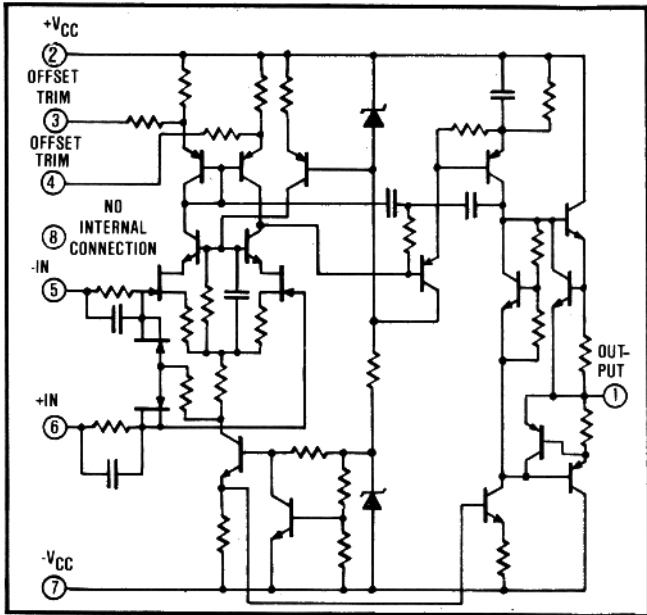


FIGURE 2. Simplified Schematic of 3581 and 3582.

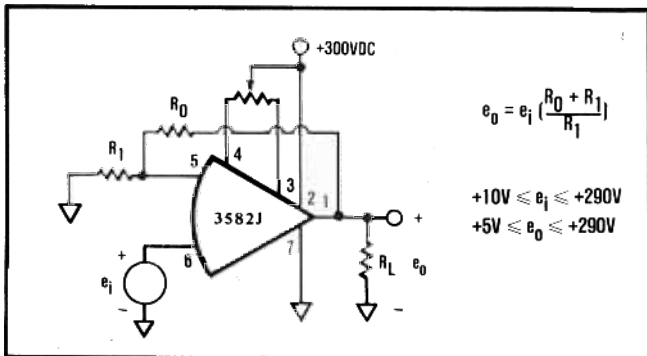


FIGURE 3. Operation from a Single Supply.

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<sub>CC</sub>-V<sub>CC</sub>). 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 <sub>CASE</sub> = +25°C max unless otherwise noted.			
<b>MODELS</b>	3580J	3581J	3582J
<b>POWER SUPPLY</b>			
Voltage, ±V <sub>CC</sub>	±15VDC to ±35VDC	±32VDC to ±75VDC	+70VDC to ±150VDC
Quiescent Current, max	±10mA	±8mA	±6.5mA
<b>RATED OUTPUT</b>			
Voltage, ±V <sub>CC</sub> -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	
<b>OPEN-LOOP GAIN</b>			
No Load, DC	106dB	112dB	118dB
Rated Load, DC, min	86dB	94dB	100dB
<b>FREQUENCY RESPONSE</b>			
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	
<b>INPUT OFFSET VOLTAGE</b>			
Initial at T <sub>CASE</sub> = +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
<b>INPUT BIAS CURRENT</b>			
Initial at T <sub>CASE</sub> = +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
<b>INPUT OFFSET CURRENT</b>			
Initial at T <sub>CASE</sub> = +25°C, max		±20pA	
Drift vs Temp		doubles every 10°C	
Drift vs Supply Voltage	0.5pA/V	0.2pA/V	0.2pA/V
<b>INPUT IMPEDANCE</b>			
Differential		10 <sup>11</sup> Ω	10pF
Common-mode		10 <sup>11</sup> Ω	
<b>INPUT NOISE</b>			
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
<b>INPUT VOLTAGE RANGE</b>			
Max Safe Differential Voltage <sup>(1)</sup>		+V <sub>CC</sub> - -V <sub>CC</sub>	
Max Safe Common-mode Voltage		+V <sub>CC</sub> to -V <sub>CC</sub>	
Common-mode Voltage, Linear Operation	± V <sub>CC</sub> -8 V	± V <sub>CC</sub> -10 V	± V <sub>CC</sub> -10 V
Common-mode Rejection	86dB	110dB	110dB
<b>TEMPERATURE Case</b>			
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  $dV/dt \geq 1V/ns$ . 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.

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## MECHANICAL

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	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	.583 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

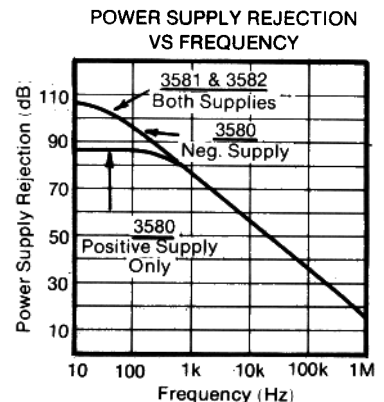
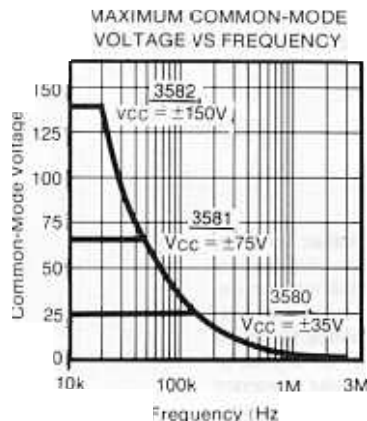
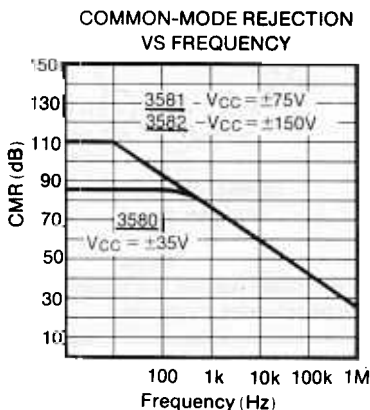
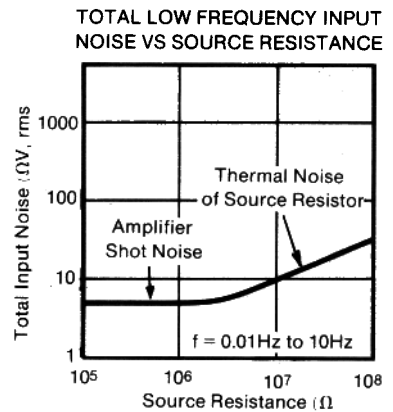
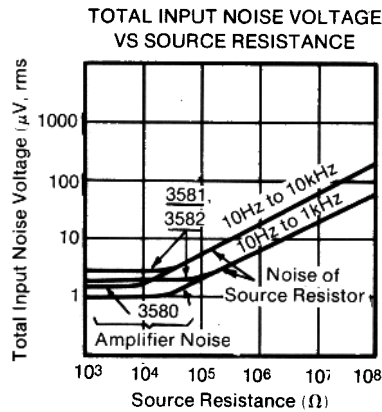
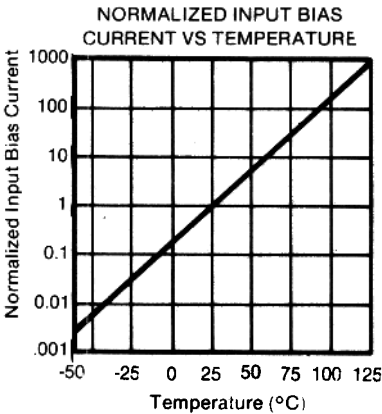
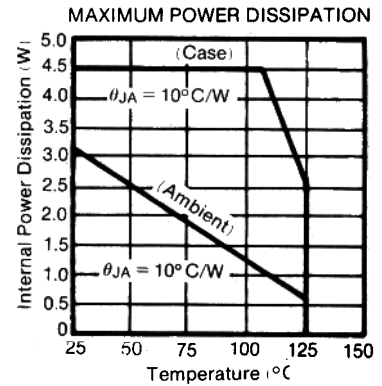
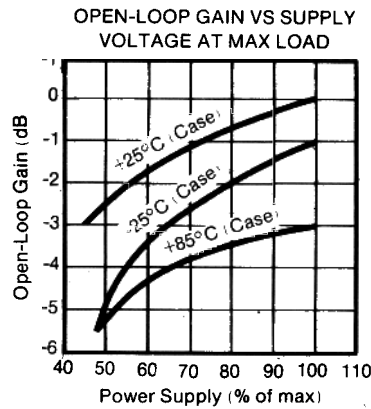
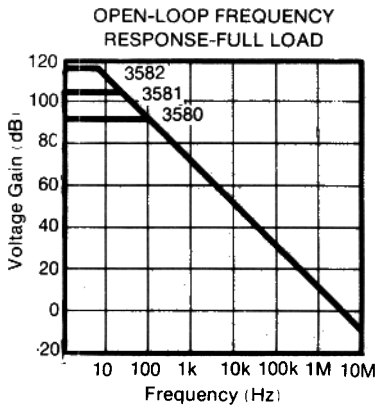
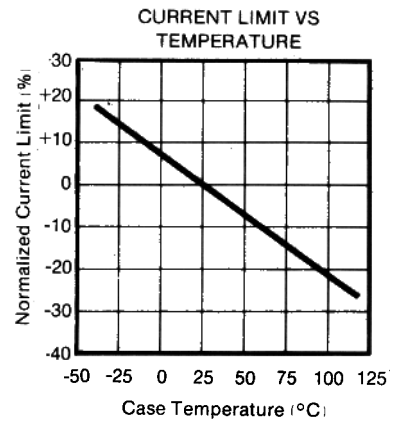
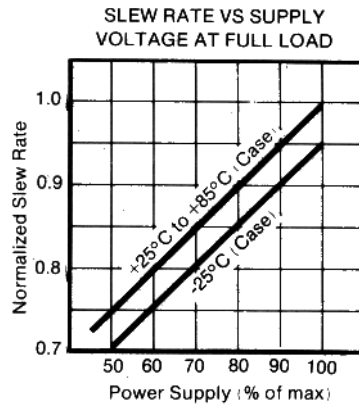
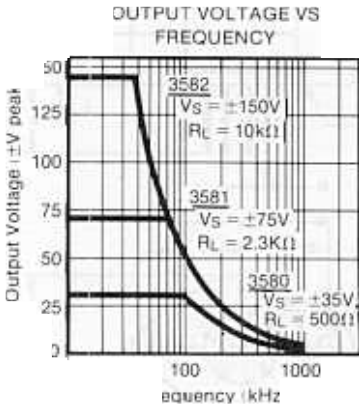
TOP VIEW

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<sub>CASE</sub> = +25°C and ±V<sub>CC</sub> max unless otherwise noted.



**PACKAGING INFORMATION**

ORDERABLE DEVICE	STATUS(1)	PACKAGE TYPE	PACKAGE DRAWING	PINS	PACKAGE QTY
3581J	NRND	TO/SOT	LMF	8	18

(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.

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**OBSOLETE:** TI has discontinued the production of the device.

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