

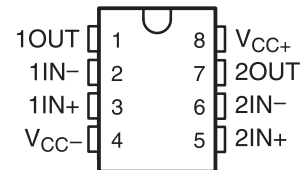
## DUAL AUDIO OPERATIONAL AMPLIFIER

Check for Samples: [RC4580-Q1](#)

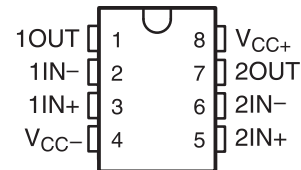
### FEATURES

- Qualified for Automotive Applications
- AEC-Q100 Qualified With the Following Results:
  - Device Temperature Grade 1:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  Ambient Operating Temperature Range
  - Device HBM ESD Classification Level H2
  - Device CDM ESD Classification Level C3B
- Operating Voltage . . .  $\pm 2\text{ V}$  to  $\pm 18\text{ V}$
- Low Noise Voltage . . .  $0.8\text{ }\mu\text{Vrms}$  (TYP)
- Wide GBW . . .  $12\text{ MHz}$  (TYP)
- Low THD . . .  $0.0005\%$  (TYP)
- Slew Rate . . .  $5\text{ V}/\mu\text{s}$  (TYP)
- Suitable for Automotive Applications Such As Audio Preamplifier, Active Filter, Headphone Amplifier, Industrial Measurement Equipment
- Drop-In Replacement for NJM4580
- Pin and Function Compatible With LM833, NE5532, NJM4558/9, and NJM4560/2/5

**D PACKAGE**  
**SOIC – 8**  
**(TOP VIEW)**



**PW PACKAGE**  
**TSSOP – 8**  
**(TOP VIEW)**



### DESCRIPTION

The RC4580-Q1 device is a dual operational amplifier that is designed optimally for audio applications, such as improving tone control. It offers low noise, high gain bandwidth, low harmonic distortion, and high output current. All of these features make the device ideally suited for audio electronics, such as audio preamplifiers and active filters, as well as industrial measurement equipment. When high output current is required, the RC4580-Q1 device can be used as a headphone amplifier. Due to its wide operating supply voltage, the RC4580-Q1 device can also be used in low-voltage applications.

### ORDERING INFORMATION<sup>(1)</sup>

$T_A$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
$-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$	SOIC – D	Reel of 2000	RC4580QDRQ1	R4580Q
$-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$	TSSOP - PW	Reel of 2000	RC4580QPWRQ1	R4580Q

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).

(2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).



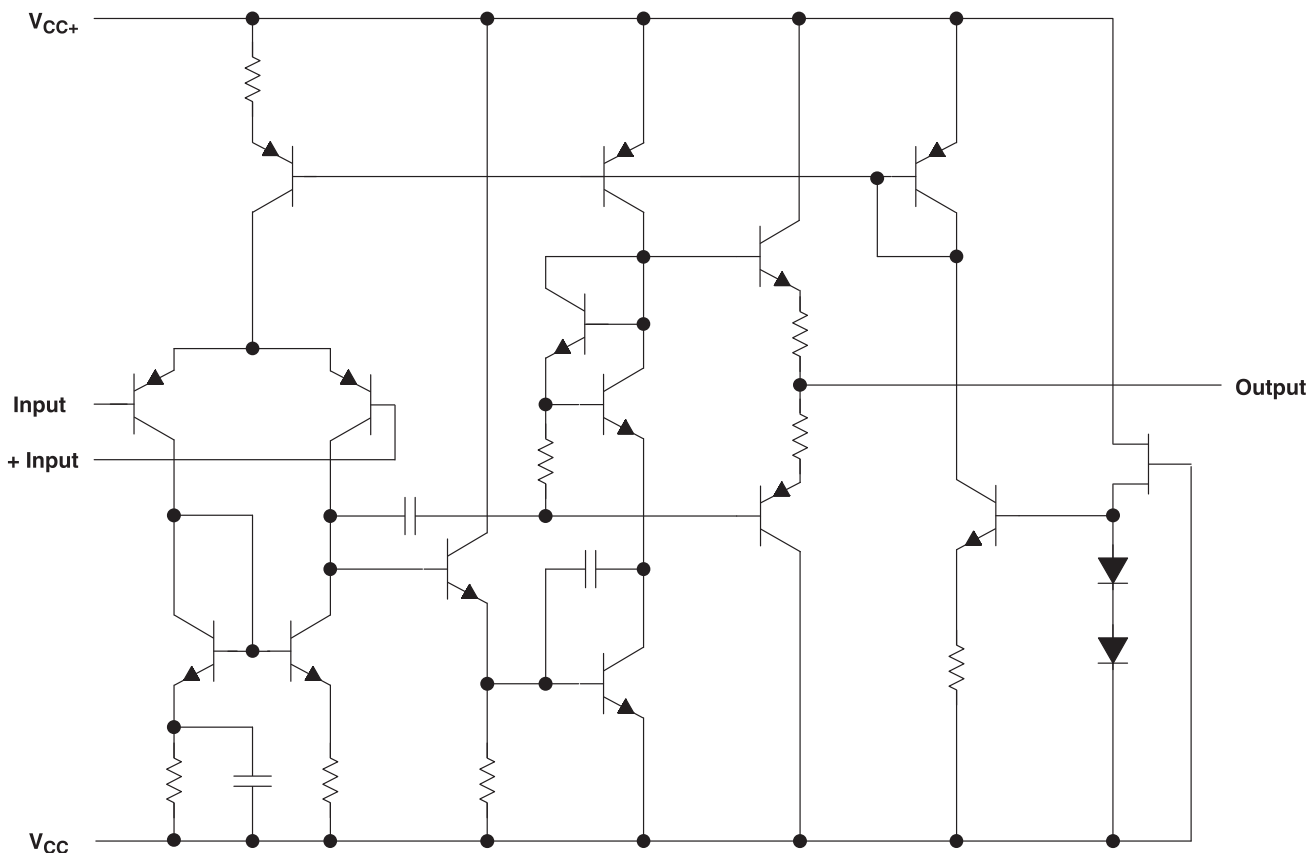
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

**Figure 1. EQUIVALENT SCHEMATIC**



## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage		±18	V
	Input voltage (any input)		±15	V
V <sub>ID</sub>	Differential input voltage		±30	V
	Output current		±50	mA
T <sub>A</sub>	Ambient temperature range	-40	125	°C
T <sub>stg</sub>	Storage temperature range	-60	125	°C
Electrostatic Discharge (ESD) Ratings	Human-body model (HBM) AEC-Q100 Classification Level H2		2	kV
	Charged-device model (CDM) AEC-Q100 Classification Level C3B		750	V

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## THERMAL INFORMATION

THERMAL METRIC <sup>(1)</sup>		RC4580-Q1		UNIT
		D (8 PINS)	PW (8 PINS)	
$\theta_{JA}$	Junction-to-ambient thermal resistance	109	163	°C/W
$\theta_{JCTop}$	Junction-to-case (top) thermal resistance	55.7	38	
$\theta_{JB}$	Junction-to-board thermal resistance	49	90.6	
$\psi_{JT}$	Junction-to-top characterization parameter	10.6	1.3	
$\psi_{JB}$	Junction-to-board characterization parameter	48.6	88.9	
$\theta_{JCbott}$	Junction-to-case (bottom) thermal resistance	n/a	n/a	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

## RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
$V_{CC+}$	Supply voltage	2	16	V
$V_{CC-}$		–2	–16	
$V_{ICR}$	Input common-mode voltage range	–13.5	13.5	V
$T_A$	Operating free-air temperature	–40	125	°C

## ELECTRICAL CHARACTERISTICS

$V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage		0.5	3	mV
$I_{IO}$	Input offset current		5	200	nA
$I_{IB}$	Input bias current		100	500	nA
$A_{VD}$	Large-signal differential voltage amplification	$R_L \geq 2\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$	90	110	dB
$V_{CM}$	Output voltage swing	$R_L \geq 2\text{ k}\Omega$	$\pm 12$	$\pm 13.5$	V
$V_{ICR}$	Common-mode input voltage		$\pm 12$	$\pm 13.5$	V
CMRR	Common-mode rejection ratio	$R_S \leq 10\text{ k}\Omega$	80	110	dB
$k_{SVR}$	Supply-voltage rejection ratio <sup>(1)</sup>	$R_S \leq 10\text{ k}\Omega$	80	110	dB
$I_{CC}$	Total supply current (all amplifiers)		6	9	mA

(1) Measured with  $V_{CC\pm}$  varied simultaneously

## OPERATING CHARACTERISTICS

$V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $125^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TYP	UNIT
SR	Slew rate at unity gain	5	V/ $\mu\text{s}$
GBW	Gain-bandwidth product	12	MHz
THD	Total harmonic distortion	0.0005%	
$V_n$	Equivalent input noise voltage	0.8	$\mu\text{Vrms}$

## TYPICAL CHARACTERISTICS

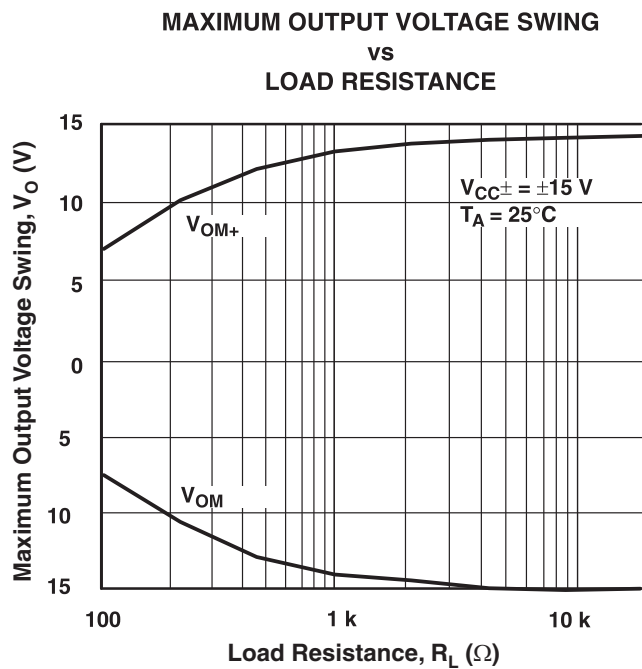


Figure 2.

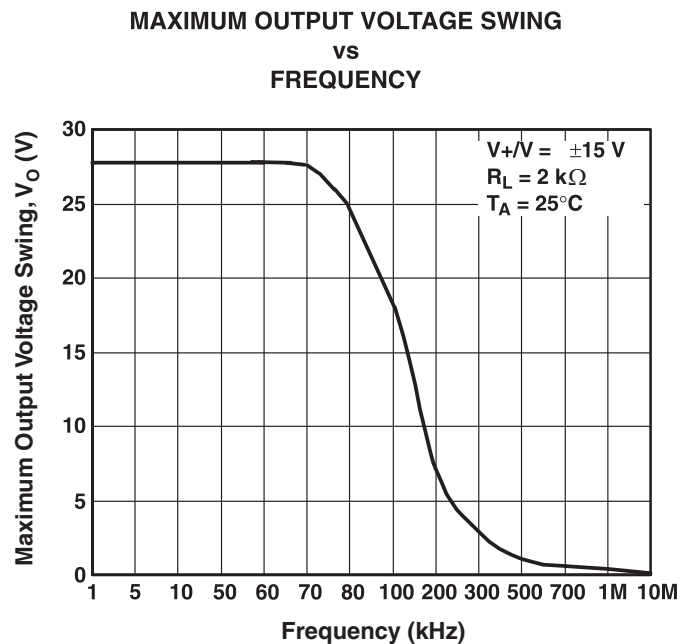


Figure 3.

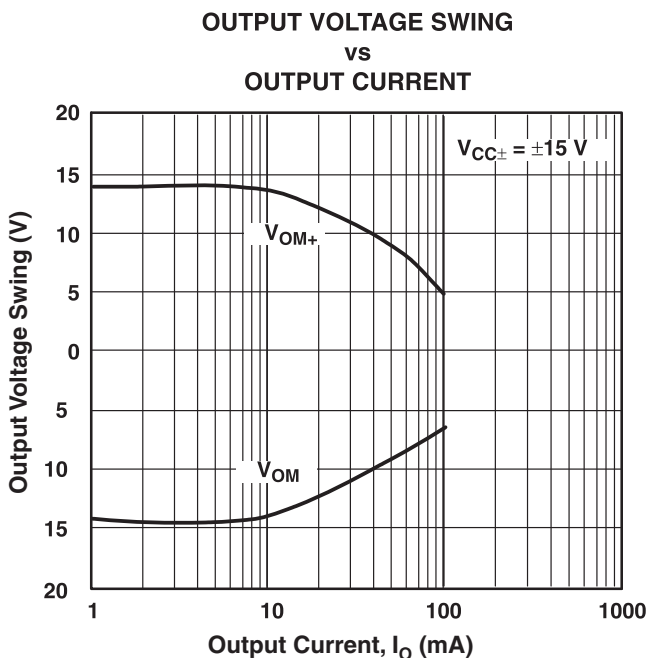


Figure 4.

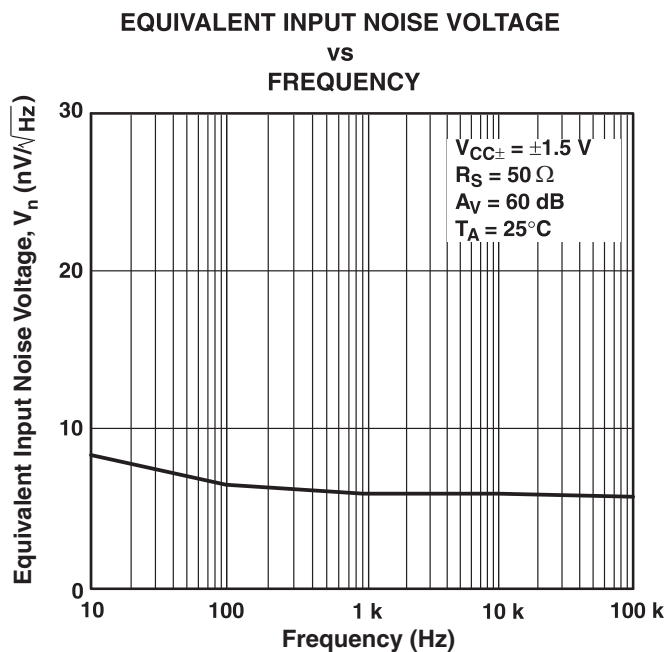


Figure 5.

## TYPICAL CHARACTERISTICS (continued)

### OPERATING CURRENT

vs

TEMPERATURE

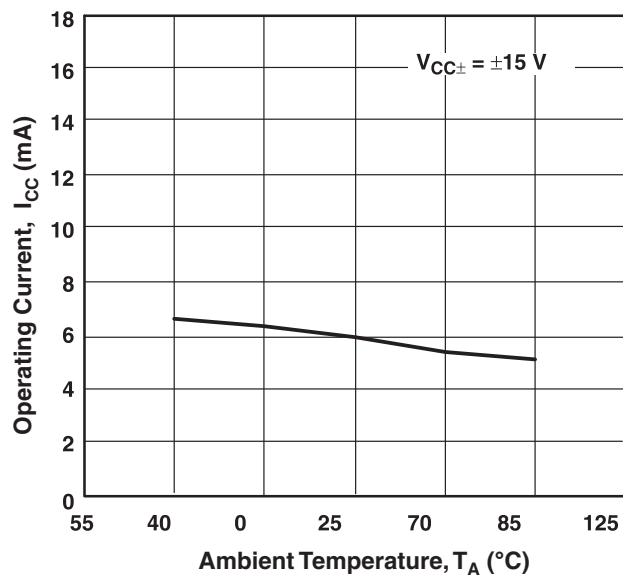


Figure 6.

### OUTPUT VOLTAGE SWING

vs

TEMPERATURE

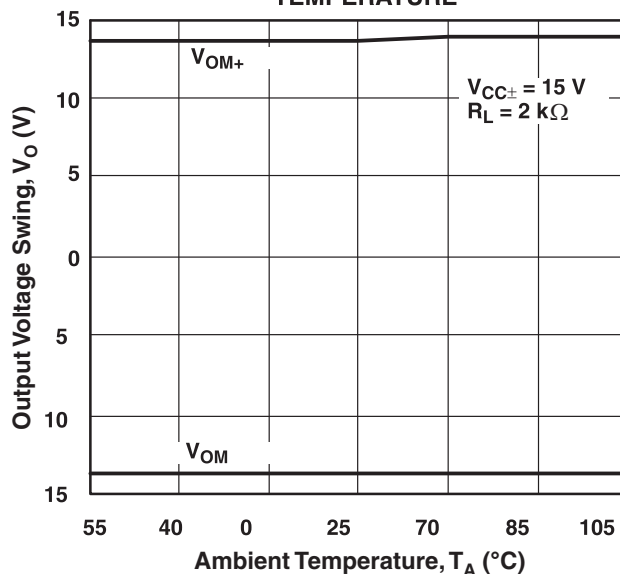


Figure 7.

### INPUT OFFSET VOLTAGE

vs

TEMPERATURE

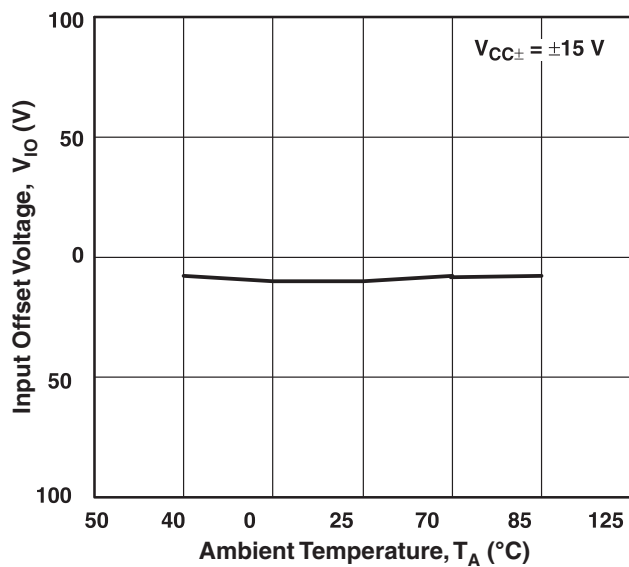


Figure 8.

### INPUT BIAS CURRENT

vs

TEMPERATURE

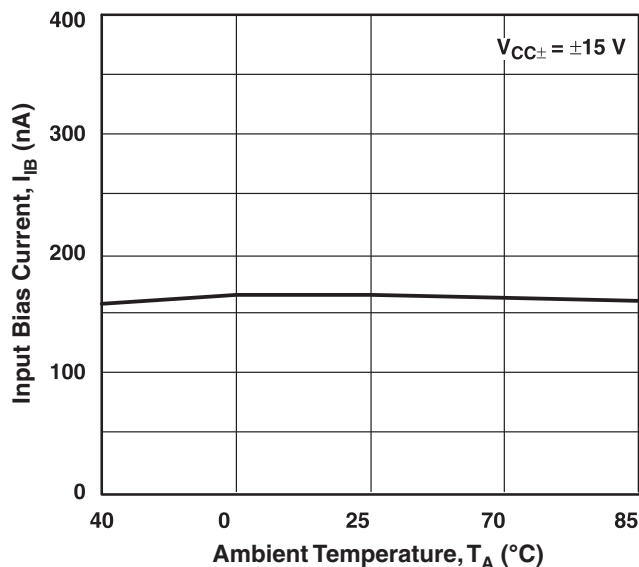


Figure 9.

**TYPICAL CHARACTERISTICS (continued)****MAXIMUM OUTPUT VOLTAGE SWING**

vs  
OPERATING VOLTAGE

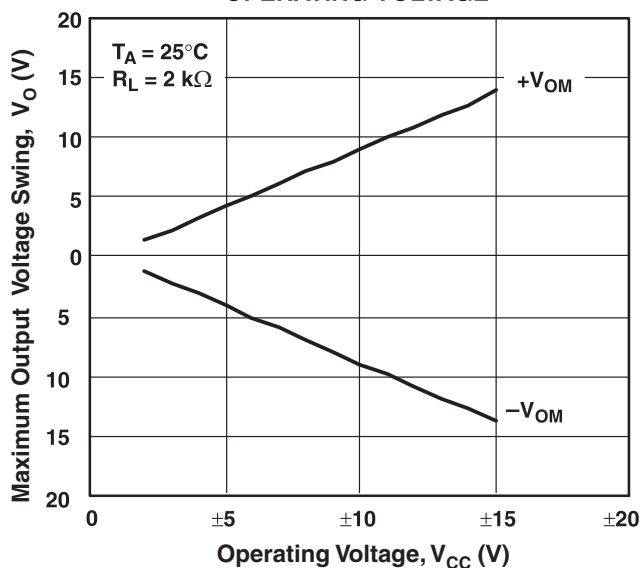


Figure 10.

**OPERATING CURRENT**

vs  
OPERATING VOLTAGE

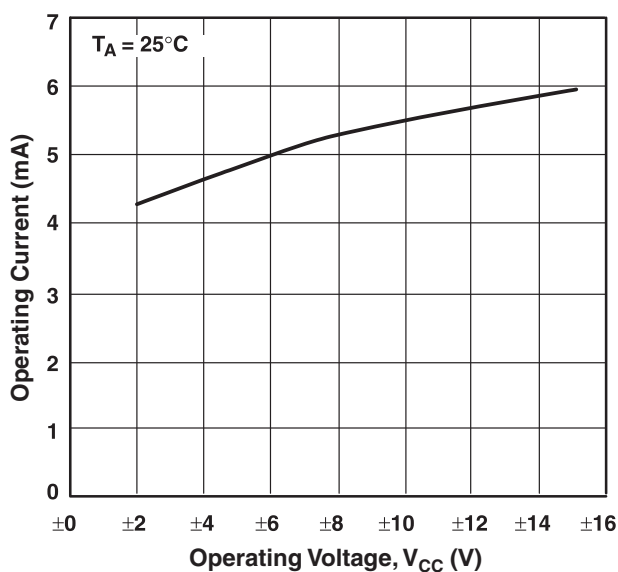


Figure 11.

**TOTAL HARMONIC DISTORTION**

vs  
OUTPUT VOLTAGE

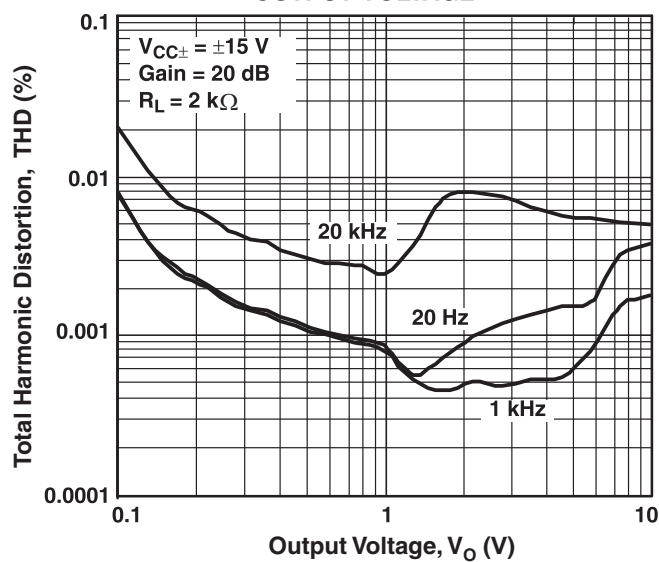


Figure 12.

**VOLTAGE GAIN, PHASE**

vs  
FREQUENCY

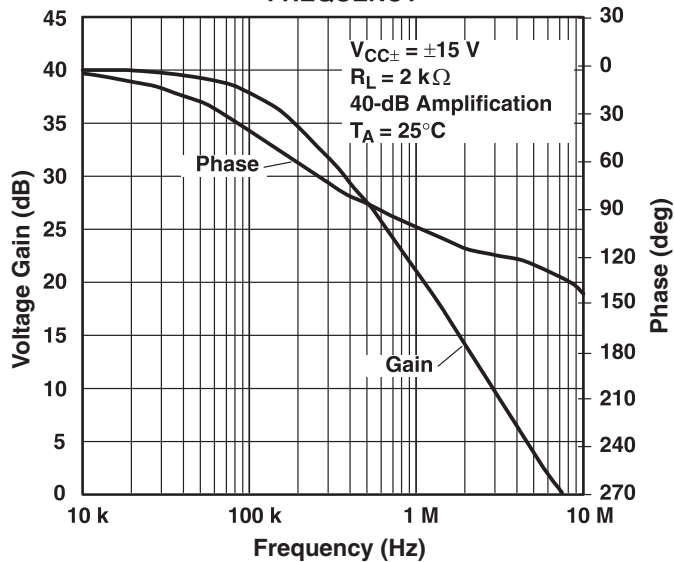


Figure 13.

## REVISION HISTORY

Changes from Original (December 2010) to Revision A	Page
• Added AEC-Q100 info to the features; changed Suitable for Applications to Suitable for Automotive Applications .....	1
• Added PW pinout drawing .....	1
• Added second row for PW package to Ordering Information table .....	1
• Added ESDS .....	2
• Changed $T_J$ to $T_A$ .....	2
• Removed $\theta_{JA}$ row from Abs Max table because it is also listed in the thermal table .....	2
• Added ESD ratings to Abs Max table .....	2
• Added thermal table .....	3
• Changed $T_A = 25^\circ\text{C}$ to $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ in condition statement for Elec Char table and Op Char table .....	3

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
RC4580QDRQ1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
RC4580QPWRQ1	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF RC4580-Q1 :**

- Catalog: [RC4580](#)

NOTE: Qualified Version Definitions:



- 
- Catalog - TI's standard catalog product

**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

**TAPE AND REEL INFORMATION**

\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
RC4580QDRQ1	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
RC4580QPWRQ1	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS

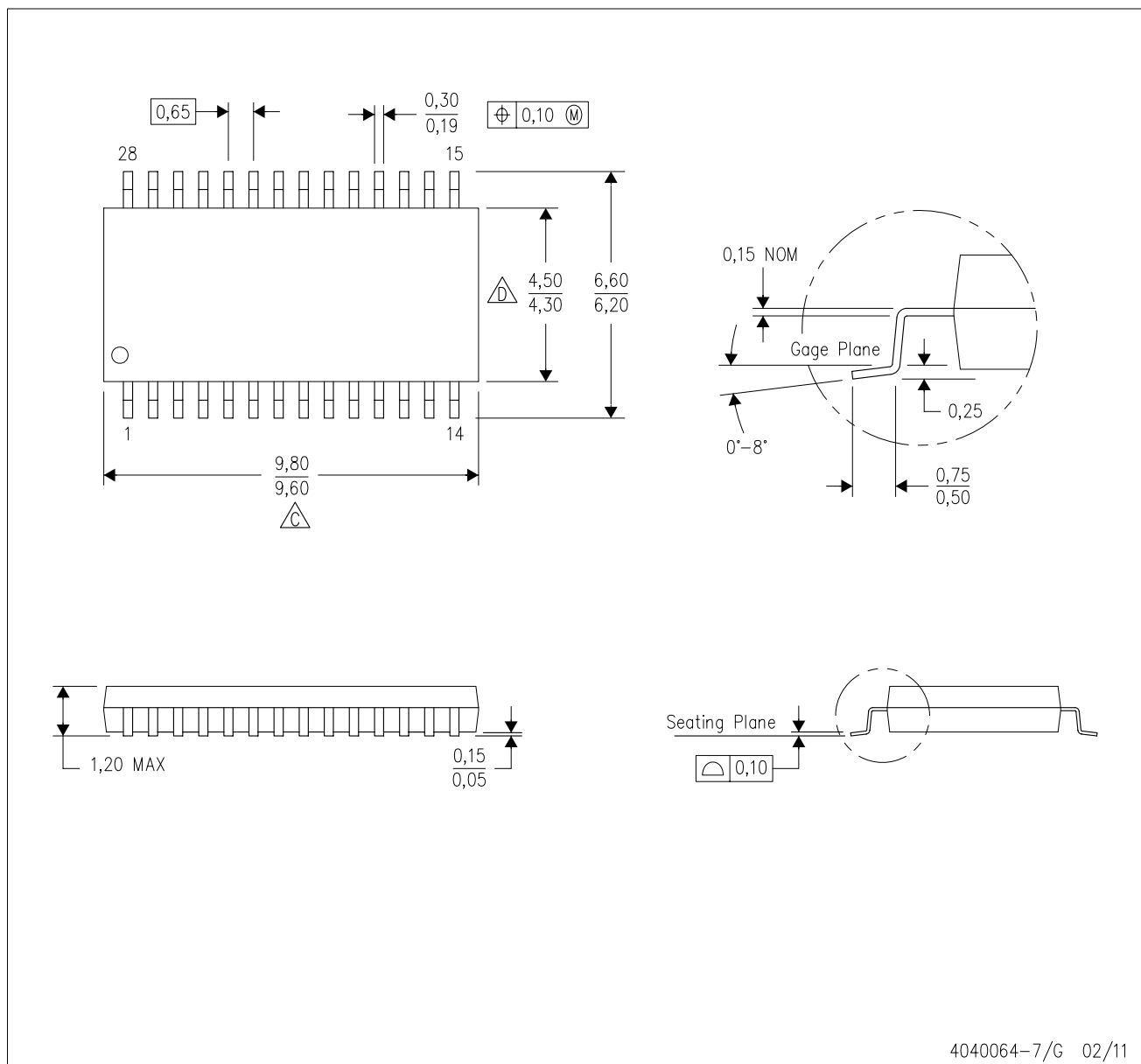


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
RC4580QDRQ1	SOIC	D	8	2500	340.5	338.1	20.6
RC4580QPWRQ1	TSSOP	PW	8	2000	367.0	367.0	35.0

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE

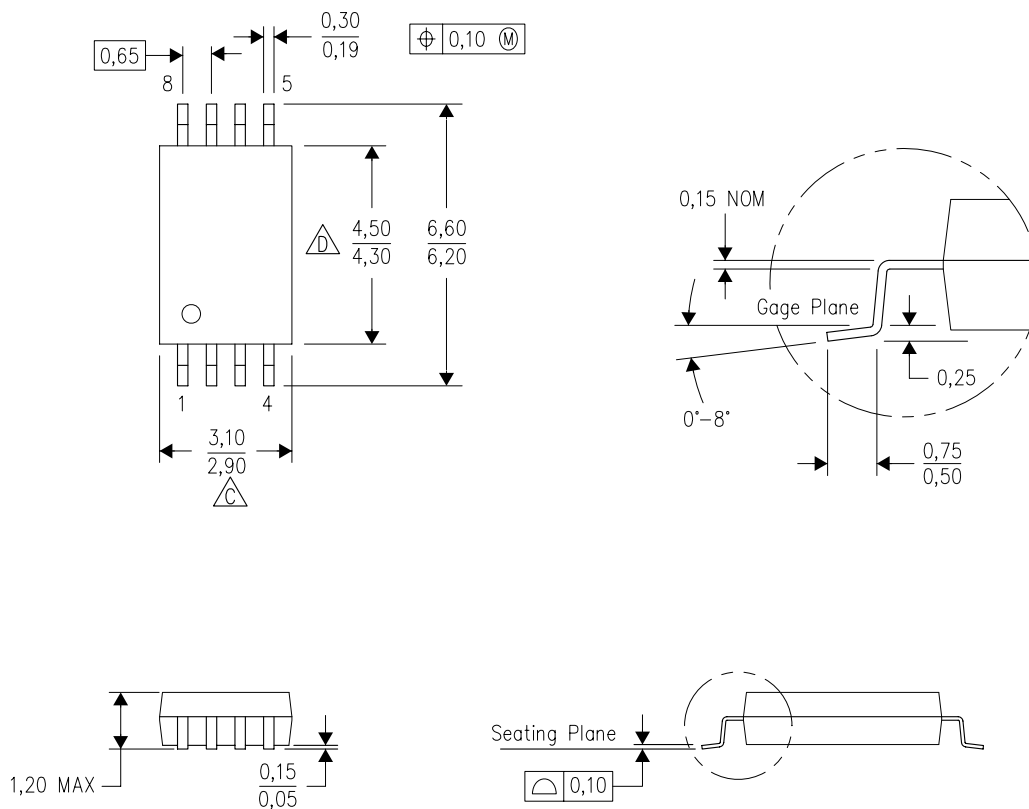


4211283-2/E 08/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4040064-2/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)