

LOW-NOISE, HIGH-SPEED CURRENT FEEDBACK AMPLIFIERS

FEATURES

- **Low Noise**
 - 2.9 pA/√Hz Noninverting Current Noise
 - 10.8 pA/√Hz Inverting Current Noise
 - 2.2 nV/√Hz Voltage Noise
- **Wide Supply Voltage Range** ±5 V to ±15 V
- **Wide Output Swing**
 - 25 V_{PP} Output Voltage, R_L = 100 Ω, ±15-V Supply
- **High Output Current, 150 mA (Min)**
- **High Speed**
 - 110 MHz (–3 dB, G=1, ±15 V)
 - 1550 V/μs Slew Rate (G = 2, ±15 V)
- **Low Distortion, G = 2**
 - –78 dBc (1 MHz, 2 V_{PP}, 100-Ω load)
- **Low Power Shutdown (THS3115)**
 - 300-μA Shutdown Quiescent Current Per Channel
- **Thermal Shutdown and Short Circuit Protection**
- **Standard SOIC, SOIC PowerPAD™, and TSSOP PowerPAD™ Package**
- **Evaluation Module Available**

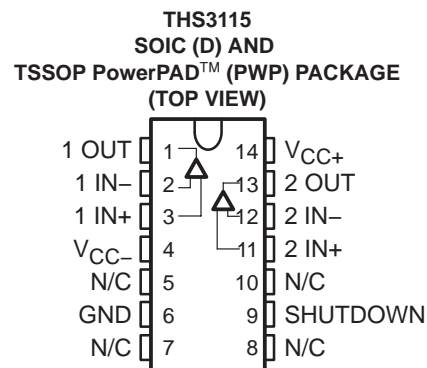
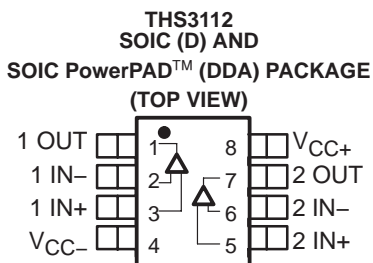
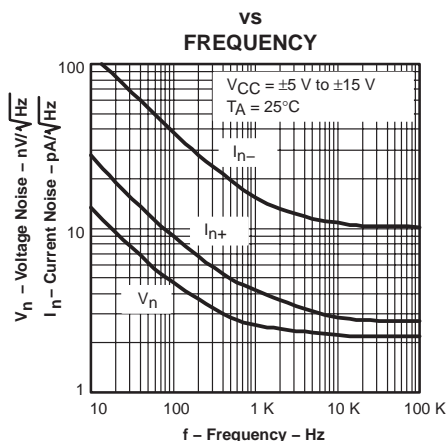
APPLICATIONS

- **Communication Equipment**
- **Video Distribution**
- **Motor Drivers**
- **Piezo Drivers**

DESCRIPTION

The THS3112/5 are low-noise, high-speed current feedback amplifiers, ideal for any application requiring high output current. The low noninverting current noise of 2.9 pA/√Hz and the low inverting current noise of 10.8 pA/√Hz increase signal to noise ratios for enhanced signal resolution. The THS3112/5 can operate from ±5-V to ±15-V supply voltages, while drawing as little as 4.5 mA of supply current per channel. It offers low –78-dBc total harmonic distortion driving 2 V_{PP} into a 100-Ω load. The THS3115 features a low power shutdown mode, consuming only 300-μA shutdown quiescent current per channel. The THS3112/5 is packaged in a standard SOIC, SOIC PowerPAD™, and TSSOP PowerPAD packages.

VOLTAGE NOISE AND CURRENT NOISE



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PowerPAD is a trademark of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

AVAILABLE OPTIONS

T _A	PACKAGED DEVICE				EVALUATION MODULES
	SOIC-8 (D)	SOIC-8 PowerPAD (DDA)	SOIC-14 (D)	TSSOP-14 (PWP)	
0°C to 70°C	THS3112CD	THS3112CDDA	THS3115CD	THS3115CPWP	THS3112EVM
–40°C to 85°C	THS3112ID	THS3112IDDA	THS3115ID	THS3115IPWP	THS3115EVM

absolute maximum ratings over operating free-air temperature (unless otherwise noted)†

Supply voltage, V _{CC+} to V _{CC–}	33 V
Input voltage	± V _{CC}
Output current (see Note 1)	275 mA
Differential input voltage	± 4 V
Maximum junction temperature	150°C
Total power dissipation at (or below) 25°C free-air temperature	See Dissipation Ratings Table
Operating free-air temperature, T _A : Commercial	0°C to 70°C
Industrial	–40°C to 85°C
Storage temperature, T _{stg} : Commercial	–65°C to 125°C
Industrial	–65°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	300°C

† 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.

NOTE 1: The THS3112 and THS3115 may incorporate a PowerPAD™ on the underside of the chip. This acts as a heatsink and must be connected to a thermally dissipating plane for proper power dissipation. Failure to do so may result in exceeding the maximum junction temperature which could permanently damage the device. See TI Technical Brief SLMA002 for more information about utilizing the PowerPAD™ thermally enhanced package.

DISSIPATION RATING TABLE

PACKAGE	θ _{JA}	T _A = 25°C POWER RATING
D-8	95°C/W‡	1.32 W
DDA	67°C/W	1.87 W
D-14	66.6°C/W‡	1.88 W
PWP	37.5°C/W	3.3 W

‡ This data was taken using the JEDEC proposed high-K test PCB. For the JEDEC low-K test PCB, the θ_{JA} is 168°C/W for the D-8 package and 122.3°C/W for the D-14 package.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V _{CC+} to V _{CC–}	Dual supply	±5		±15	V
	Single supply	10		30	
Operating free-air temperature, T _A	C-suffix	0		70	°C
	I-suffix	–40		85	
Shutdown pin input levels, relative to the GND pin	High level (device shutdown)	2			V
	Low level (device active)			0.8	

electrical characteristics over recommended operating free-air temperature range, $T_A = 25^\circ\text{C}$, $V_{CC} = \pm 15\text{ V}$, $R_F = 750\ \Omega$, $R_L = 100\ \Omega$ (unless otherwise noted)

dynamic performance

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
BW	Small-signal bandwidth (–3 dB)	$R_L = 100\ \Omega$	$R_F = 1\ \text{k}\Omega$, $G = 1$	$V_{CC} = \pm 5\ \text{V}$		95	MHz	
				$V_{CC} = \pm 15\ \text{V}$		110		
		$R_L = 100\ \Omega$	$R_F = 750\ \Omega$, $G = 2$	$V_{CC} = \pm 5\ \text{V}$		103		
				$V_{CC} = \pm 15\ \text{V}$		110		
	Bandwidth (0.1 dB)	$R_F = 750\ \Omega$, $G = 2$	$V_{CC} = \pm 5\ \text{V}$		25			
			$V_{CC} = \pm 15\ \text{V}$		48			
SR	Slew rate (see Note 2), $G=8$	$G = 2$ $R_F = 680\ \Omega$	$V_O = 10\ \text{V}_{PP}$	$V_{CC} = \pm 15\ \text{V}$		1550	$\text{V}/\mu\text{s}$	
			$V_O = 5\ \text{V}_{PP}$	$V_{CC} = \pm 5\ \text{V}$		820		
				$V_{CC} = \pm 15\ \text{V}$		1300		
t_s	Settling time to 0.1%	$G = -1$	$V_O = 2\ \text{V}_{PP}$	$V_{CC} = \pm 5\ \text{V}$		50	ns	
			$V_O = 5\ \text{V}_{PP}$	$V_{CC} = \pm 15\ \text{V}$		63		

NOTE 2: Slew rate is defined from the 25% to the 75% output levels.

noise/distortion performance

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
THD	Total harmonic distortion		G = 2, V _{CC} = ±15 V, f = 1 MHz	R _F = 680 Ω, V _O (PP) = 2 V		–78		dBc
				V _O (PP) = 8 V		–75		
			G = 2, V _{CC} = ±5 V, f = 1 MHz	R _F = 680 Ω, V _O (PP) = 2 V		–76		
				V _O (PP) = 6 V		–74		
V _n	Input voltage noise		V _{CC} = ±5 V, ±15 V	f = 10 kHz		2.2		nV/√Hz
I _n	Input current noise	Noninverting Input	V _{CC} = ±5 V, ±15 V	f = 10 kHz		2.9		pA/√Hz
		Inverting Input				10.8		
Crosstalk			G = 2, f = 1 MHz, V _O = 2 V _{pp}	V _{CC} = ±5 V		–67		dBc
				V _{CC} = ±15 V		–67		
Differential gain error			G = 2, R _L = 150 Ω 40 IRE modulation	V _{CC} = ±5 V		0.01%		
				V _{CC} = ±15 V		0.01%		
Differential phase error			±100 IRE Ramp NTSC and PAL	V _{CC} = ±5 V		0.011°		
				V _{CC} = ±15 V		0.011°		

electrical characteristics over recommended operating free-air temperature range, $T_A = 25^\circ\text{C}$, $V_{CC} = \pm 15\text{ V}$, $R_F = 750\ \Omega$, $R_L = 100\ \Omega$ (unless otherwise noted) (continued)

dc performance

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_{CC} = \pm 5\text{ V}$, $V_{CC} = \pm 15\text{ V}$	$T_A = 25^\circ\text{C}$		3	8	mV
			$T_A = \text{full range}$			13	
	Channel offset voltage matching		$T_A = 25^\circ\text{C}$		1	3	
	Offset drift		$T_A = \text{full range}$			4	$\mu\text{V}/^\circ\text{C}$
I_{IB}	– Input bias current	$V_{CC} = \pm 5\text{ V}$, $V_{CC} = \pm 15\text{ V}$	$T_A = 25^\circ\text{C}$			23	μA
			$T_A = \text{full range}$			30	
	+ Input bias current		$T_A = 25^\circ\text{C}$		0.33	2	
			$T_A = \text{full range}$			3	
	Input offset current		$T_A = 25^\circ\text{C}$		4	22	
			$T_A = \text{full range}$			30	
Z_{OL}	Open loop transimpedance	$V_{CC} = \pm 5\text{ V}$, $V_{CC} = \pm 15\text{ V}$	$R_L = 1\text{ k}\Omega$		1		$\text{M}\Omega$

input characteristics

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{ICR}	Input common-mode voltage range	$V_{CC} = \pm 5\text{ V}$	$T_A = \text{full range}$	± 2.5	± 2.7		V
		$V_{CC} = \pm 15\text{ V}$		± 12.5	± 12.7		
CMRR	Common-mode rejection ratio	$V_{CC} = \pm 5\text{ V}$, $V_I = -2.5\text{ V to } 2.5\text{ V}$	$T_A = 25^\circ\text{C}$	56	62		dB
			$T_A = \text{full range}$	54			
		$V_{CC} = \pm 15\text{ V}$, $V_I = -12.5\text{ V to } 12.5\text{ V}$	$T_A = 25^\circ\text{C}$	63	67		
			$T_A = \text{full range}$	60			
R_I	Input resistance	+ Input			1.5		$\text{M}\Omega$
		– Input			15		Ω
C_i	Input capacitance				2		pF

output characteristics

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage swing	$G = 4$, $V_I = 1\text{ V}$, $V_{CC} = \pm 5\text{ V}$	$R_L = 1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$		3.9		V
			$R_L = 100\ \Omega$, $T_A = 25^\circ\text{C}$		3.6	3.8	
			$T_A = \text{full range}$		3.4		
		$G = 4$, $V_I = 3.4\text{ V}$, $V_{CC} = \pm 15\text{ V}$	$R_L = 1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$		13.5		
			$R_L = 100\ \Omega$, $T_A = 25^\circ\text{C}$		12.2	13.3	
			$T_A = \text{full range}$		12		
I_O	Output current drive	$G = 4$, $V_I = 0.9\text{ V}$, $V_{CC} = \pm 5\text{ V}$	$R_L = 25\ \Omega$, $T_A = 25^\circ\text{C}$	100	130		mA
		$G = 4$, $V_I = 1.7\text{ V}$, $V_{CC} = \pm 15\text{ V}$	$R_L = 25\ \Omega$, $T_A = 25^\circ\text{C}$	175	270		
r_o	Output resistance	open loop			14		Ω

electrical characteristics over recommended operating free-air temperature range, $T_A = 25^\circ\text{C}$, $V_{CC} = \pm 15\text{ V}$, $R_F = 750\ \Omega$, $R_L = 100\ \Omega$, $GND = 0\text{ V}$ (unless otherwise noted) (continued)

power supply

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{CC}	Quiescent current (per amplifier)	$V_{CC} = \pm 5\text{ V}$	$T_A = 25^\circ\text{C}$		4.4	5.5	mA
			$T_A = \text{full range}$			6	
		$V_{CC} = \pm 15\text{ V}$	$T_A = 25^\circ\text{C}$		4.9	6.5	
			$T_A = \text{full range}$			7.5	
PSRR	Power supply rejection ratio	$V_{CC} = \pm 5\text{ V}$	$T_A = 25^\circ\text{C}$	53	60		dB
			$T_A = \text{full range}$	50			
		$V_{CC} = \pm 15\text{ V}$	$T_A = 25^\circ\text{C}$	68	74		
			$T_A = \text{full range}$	66			

shutdown characteristics (THS3115 only)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$I_{CC}(\text{SHDN})$	Shutdown quiescent current (per channel)	$V_{GND} = 0\text{ V}$, $V_{CC} = \pm 5\text{ V}$, $\pm 15\text{ V}$			0.3	0.45	mA
t_{DIS}	Disable time (see Note 3)	$V_{CC} = \pm 15\text{ V}$			200		ns
t_{EN}	Enable time (see Note 3)	$V_{CC} = \pm 15\text{ V}$			300		ns
$I_{IL}(\text{SHDN})$	Shutdown pin input bias current for power up	$V_{CC} = \pm 5\text{ V}$, $\pm 15\text{ V}$, $V(\text{SHDN}) = 0\text{ V}$			18	25	μA
$I_{IH}(\text{SHDN})$	Shutdown pin input bias current for power down	$V_{CC} = \pm 5\text{ V}$, $\pm 15\text{ V}$, $V(\text{SHDN}) = 3.3\text{ V}$			110	130	μA

NOTE 3: Disable/enable time is defined as the time from when the shutdown signal is applied to the SHDN pin to when the supply current has reached half of its final value.

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
Small signal closed loop gain	vs Frequency		1 – 11, 13, 14
Gain and phase	vs Frequency		12
Small signal closed loop noninverting gain	vs Frequency		15, 16
Small signal closed loop inverting gain	vs Frequency		17, 18
Small and large signal output	vs Frequency		19, 20
Harmonic distortion	vs Frequency		21, 22
	vs Peak-to-peak output voltage		23, 24
V_n , I_n	Voltage noise and current noise	vs Frequency	25
CMRR	Common-mode rejection ratio	vs Frequency	26
PSRR	Power supply rejection ratio	vs Frequency	27
Crosstalk	vs Frequency		28
Z_o	Output impedance	vs Frequency	29
SR	Slew rate	vs Output voltage step	30
V_{IO}	Input offset voltage	vs Free-air temperature	31
		vs Common-mode input voltage	32
I_B	Input bias current	vs Free-air temperature	33
V_O	Output voltage	vs Output current	34, 35
	Output voltage headroom	vs Output current	36
I_{CC}	Supply current (per channel)	vs Supply voltage	37
	Shutdown response		38

TYPICAL CHARACTERISTICS

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

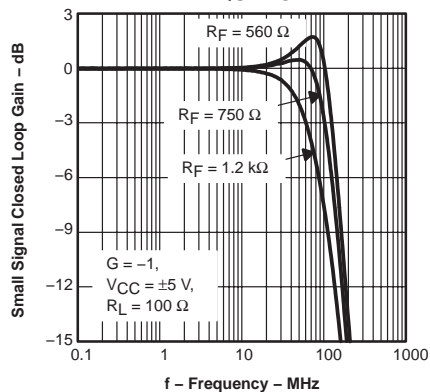


Figure 1

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

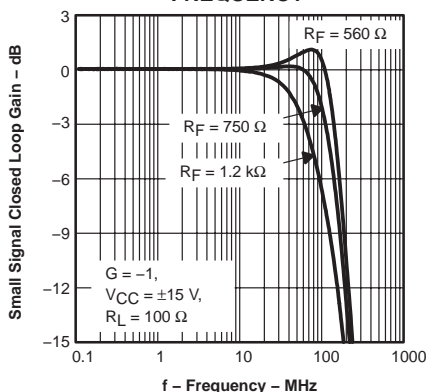


Figure 2

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

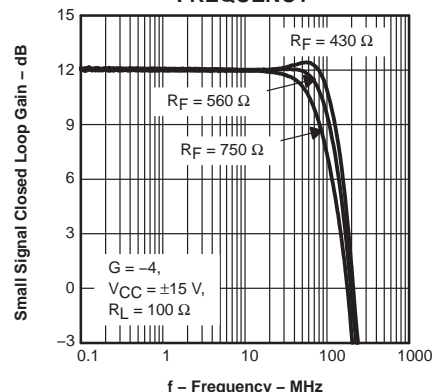


Figure 3

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

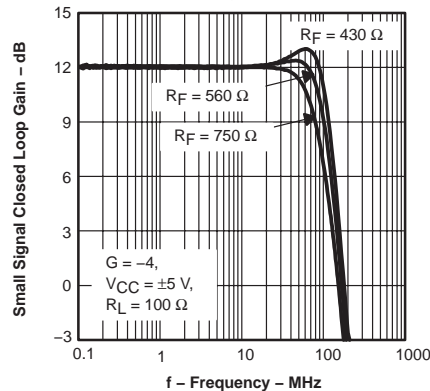


Figure 4

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

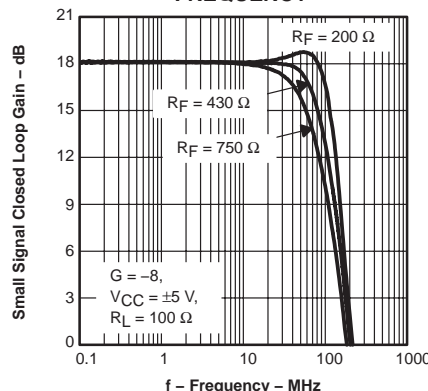


Figure 5

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

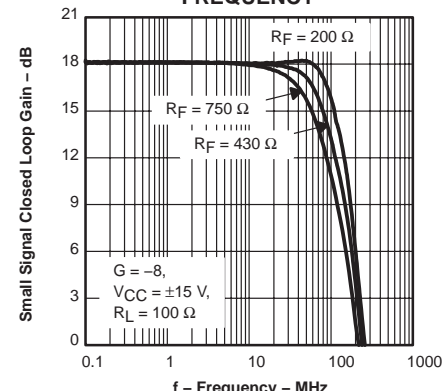


Figure 6

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

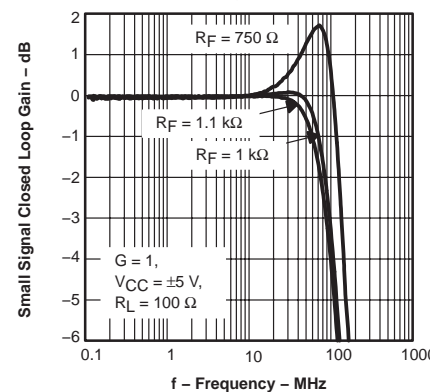


Figure 7

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

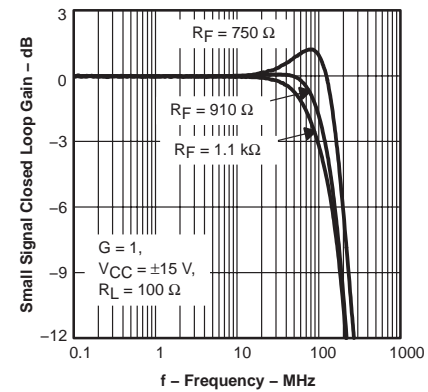


Figure 8

SMALL SIGNAL CLOSED LOOP GAIN
VS
FREQUENCY

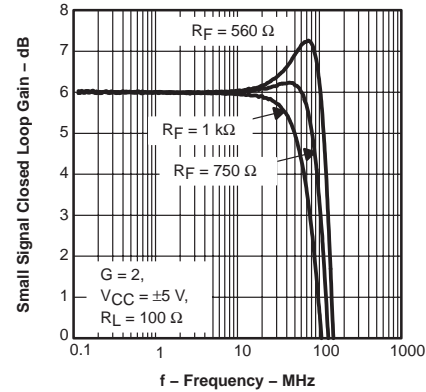


Figure 9

TYPICAL CHARACTERISTICS

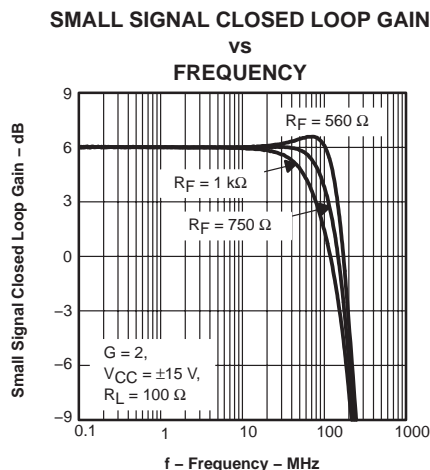


Figure 10

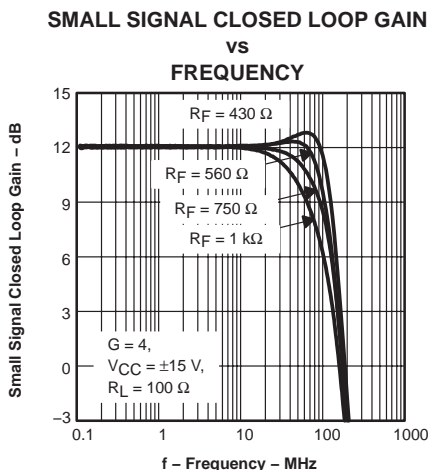


Figure 11

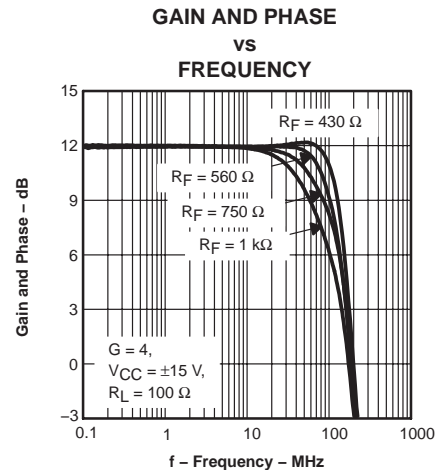


Figure 12

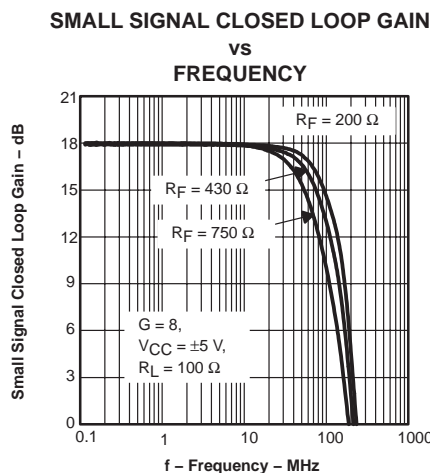


Figure 13

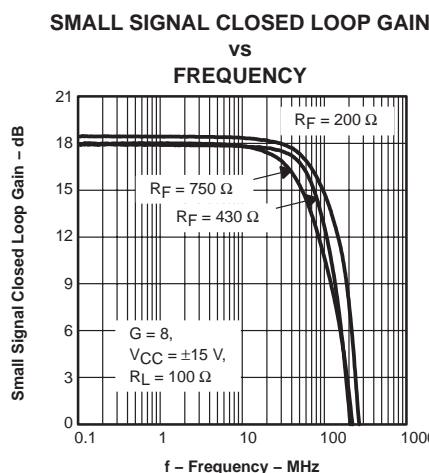


Figure 14

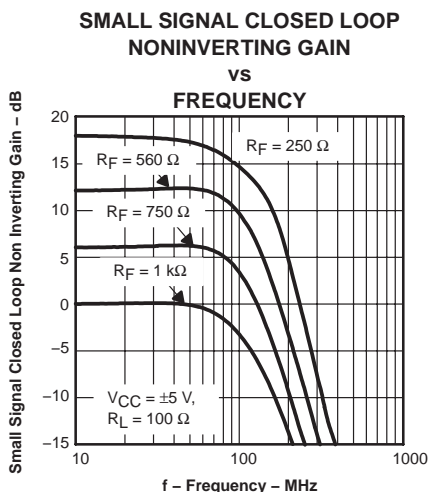


Figure 15

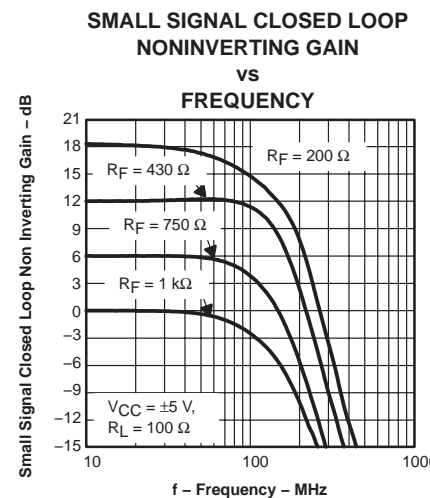


Figure 16

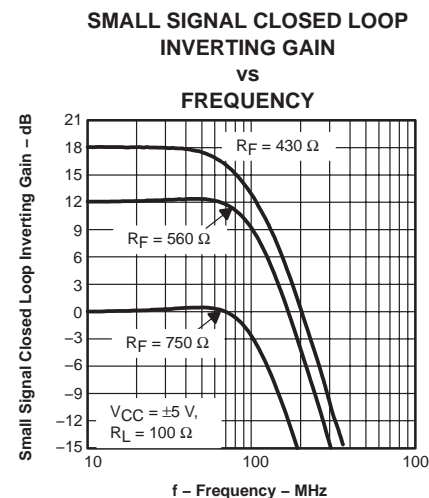


Figure 17

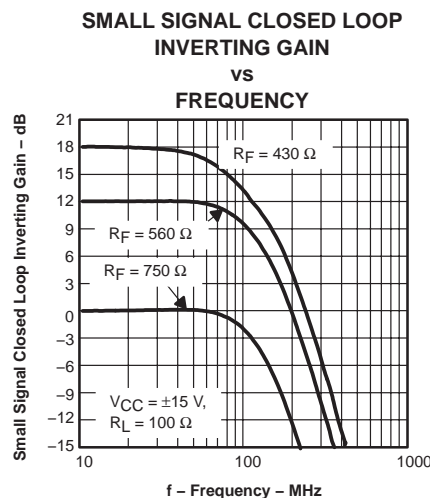


Figure 18

TYPICAL CHARACTERISTICS

**SMALL AND LARGE SIGNAL OUTPUT
VS
FREQUENCY**

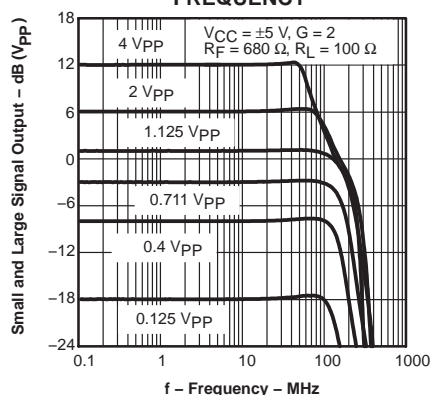


Figure 19

**SMALL AND LARGE SIGNAL OUTPUT
VS
FREQUENCY**

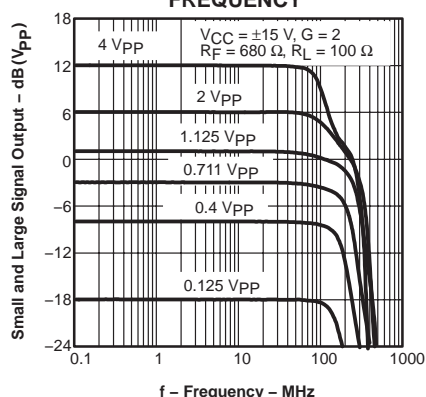


Figure 20

**HARMONIC DISTORTION
VS
FREQUENCY**

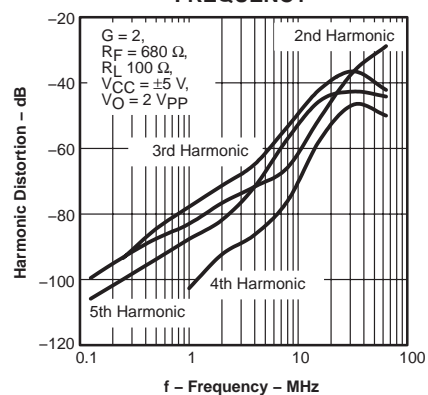


Figure 21

**HARMONIC DISTORTION
VS
FREQUENCY**

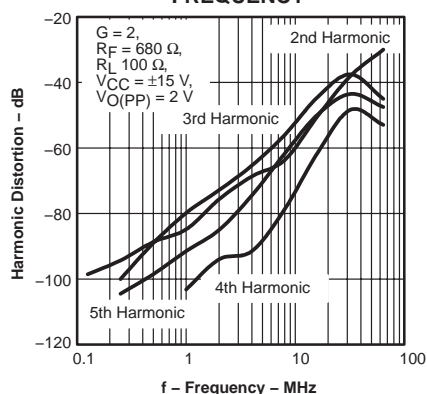


Figure 22

**HARMONIC DISTORTION
VS
PEAK-TO-PEAK OUTPUT VOLTAGE**

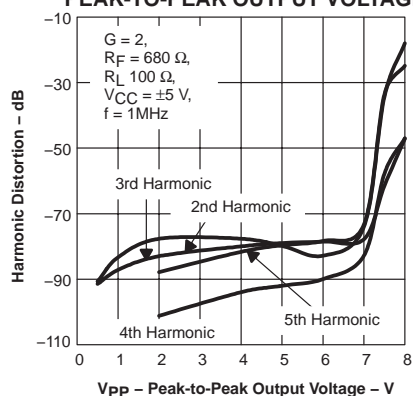


Figure 23

**HARMONIC DISTORTION
VS
PEAK-TO-PEAK OUTPUT VOLTAGE**

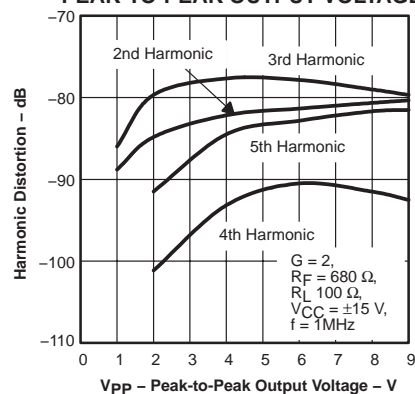


Figure 24

**VOLTAGE NOISE AND CURRENT NOISE
VS
FREQUENCY**

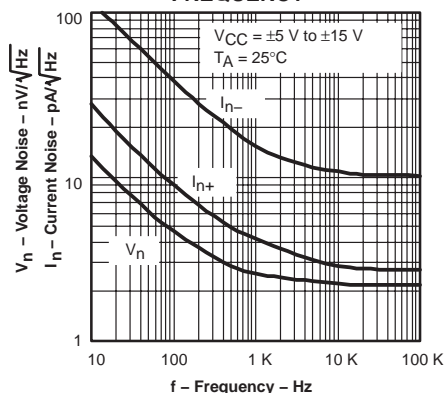


Figure 25

**COMMON-MODE REJECTION RATIO
VS
FREQUENCY**

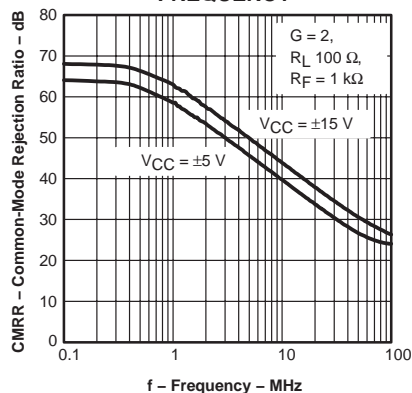


Figure 26

**POWER SUPPLY REJECTION RATIO
VS
FREQUENCY**

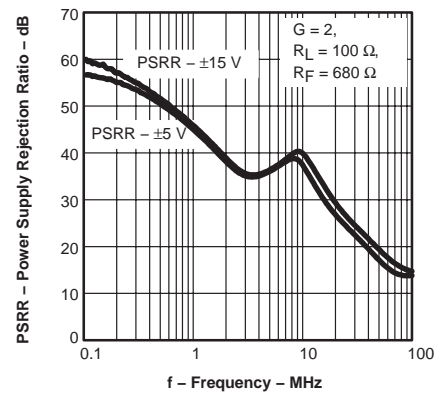


Figure 27

TYPICAL CHARACTERISTICS

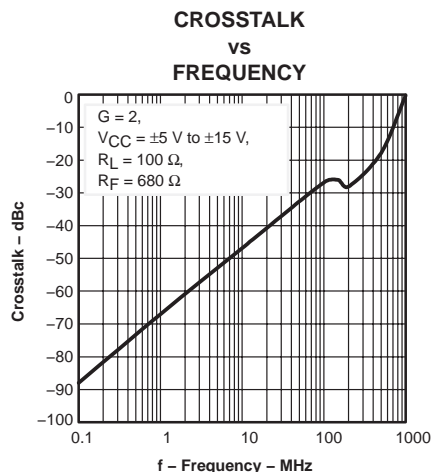


Figure 28

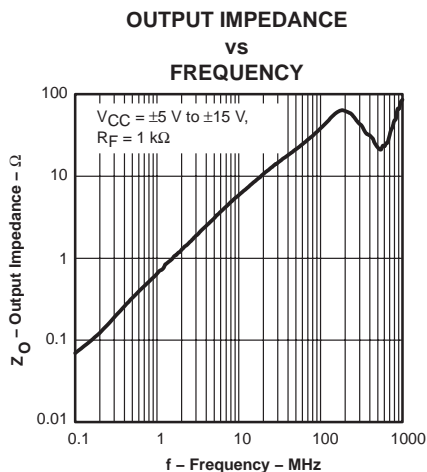


Figure 29

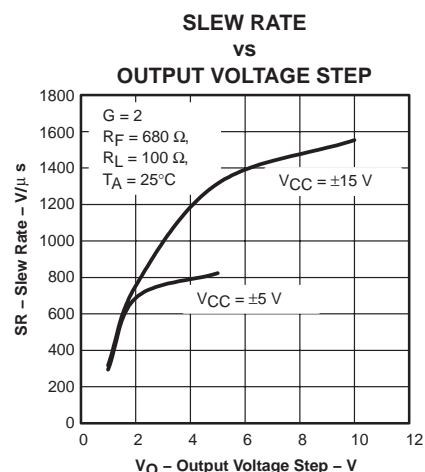


Figure 30

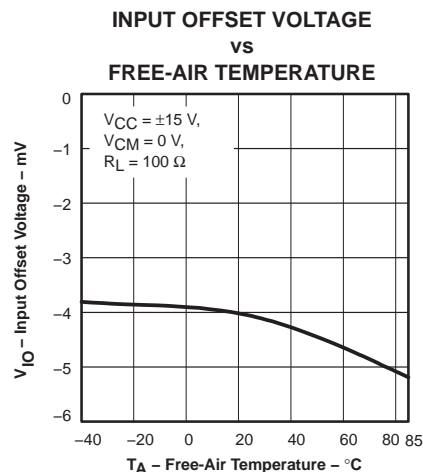


Figure 31

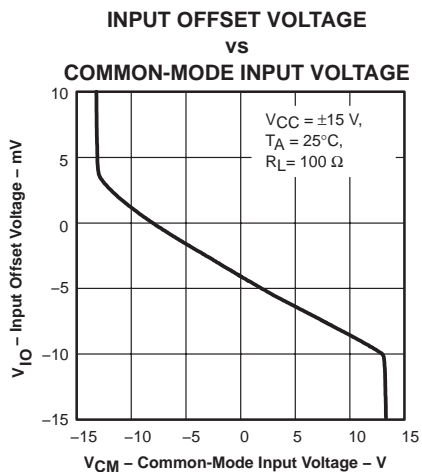


Figure 32

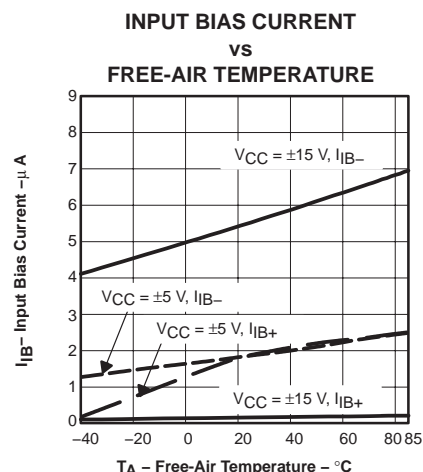


Figure 33

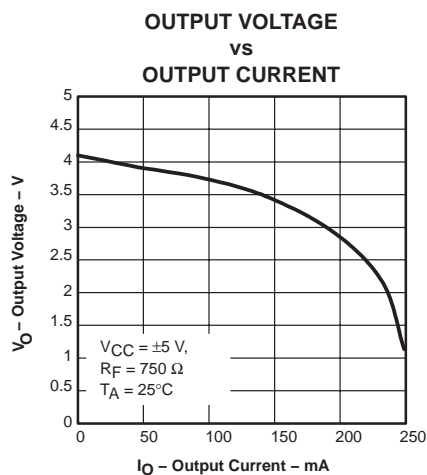


Figure 34

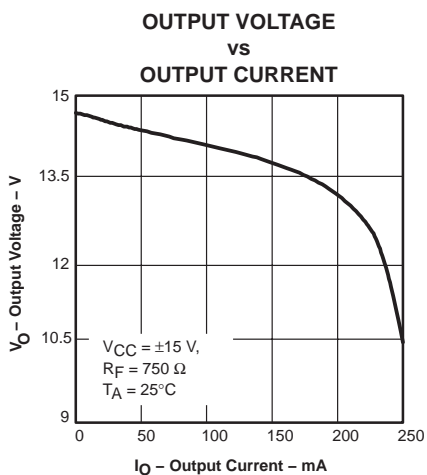


Figure 35

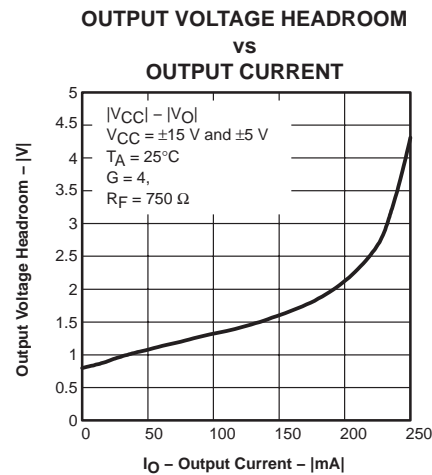


Figure 36

TYPICAL CHARACTERISTICS

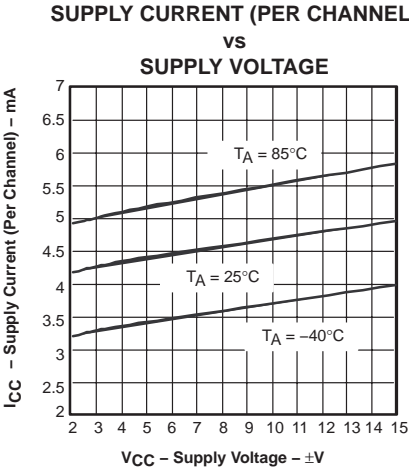


Figure 37

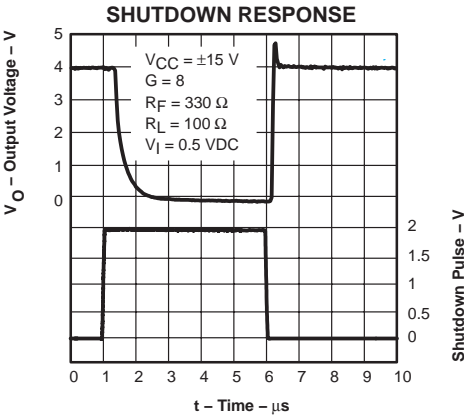


Figure 38

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
THS3112CD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3112CDDA	ACTIVE	SO Power PAD	DDA	8	75	None	CU SNPB	Level-1-235C-UNLIM
THS3112CDDAR	ACTIVE	SO Power PAD	DDA	8	2500	None	CU SNPB	Level-1-235C-UNLIM
THS3112CDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3112ID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3112IDDA	ACTIVE	SO Power PAD	DDA	8	75	None	CU SNPB	Level-1-235C-UNLIM
THS3112IDДАР	ACTIVE	SO Power PAD	DDA	8	2500	None	CU SNPB	Level-1-235C-UNLIM
THS3112IDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3115CD	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3115CDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3115CPWP	ACTIVE	HTSSOP	PWP	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
THS3115CPWPR	ACTIVE	HTSSOP	PWP	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
THS3115ID	ACTIVE	SOIC	D	14	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3115IDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
THS3115IPWP	ACTIVE	HTSSOP	PWP	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
THS3115IPWPR	ACTIVE	HTSSOP	PWP	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR

⁽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.

OBSELETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

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

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