

Single Port, VDSL2 Differential Line Driver

ISL1550

The ISL1550 is a dual operational amplifier intended to be used as a differential line driver. ISL1550's high bandwidth and low distortion performance enables the support of VDSL2 8b, 17a and 30a modem applications.

This device features a high current drive capability of $\pm 750\text{mA}$ required to drive large voltage peaks into heavy loads. In Central Office (CO) applications, the driver achieves a typical Missing Band Power Ratio (MBPR) of -66dBc in VDSL2 8b upstream (US) 1 band and MBPR's of -61dBc and -60dBc in VDSL2 17a US1 and US2 respectively.

The ISL1550 has two bias current control pins (C0, C1) to allow for four power settings (disable, low, medium, high). The VDSL modem DSP configures the line driver's power setting based on the desired mode of operation. The line driver operates on a nominal single $+12\text{V}$ or a dual $\pm 6\text{V}$ supplies with bias current in active mode between 15mA to 32mA , depending on its power setting. The ISL1550's gain setting is configurable at the application level by setting the R_f and R_g resistor values. The surge current handling of ISL1550 has been enhanced to allow ITU-T K.20 and GR1089 compliance with minimal external surge protection circuitry.

The ISL1550 is available in the thermally-enhanced, Pb-free RoHS compliant 16 Ld QFN package and is specified for operation over the full -40°C to $+85^\circ\text{C}$ temperature range.

Features

- 20dBm output power capability
- Drives up to $\pm 750\text{mA}$ from a $+12\text{V}$ supply
- $18\text{V}_{\text{P-P}}$ differential output drive into 20Ω
- -89dBc typical driver output distortion at full output at 200kHz , $12\text{V}_{\text{P-P}}$ differential
- -61dBc US1, -60dBc US2 avg. MBPR 17a
- Supply range: $\pm 4.0\text{V}$ to $\pm 6.6\text{V}$, $+8.0\text{V}$ to $+13.2\text{V}$
- Thermal shutdown
- K.20, GR-1089 Surge Robustness Validated

Applications

- VDSL2 Profiles: 8MHz, 17MHz, and 30MHz

Related Literature

- [AN1325](#) "Choosing and Using Bypass Capacitors"

TABLE 1. ALTERNATE SOLUTIONS

PART #	NOMINAL $\pm V_{\text{CC}}$ (V)	BANDWIDTH (MHz)	APPLICATIONS
ISL1557	$\pm 6, +12$	200	VDSL2
ISL1539A	$\pm 12, +24$	240	VDSL2

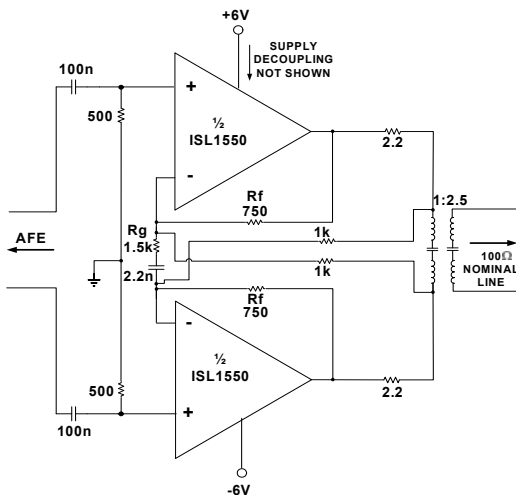


FIGURE 1. TYPICAL APPLICATION CIRCUIT

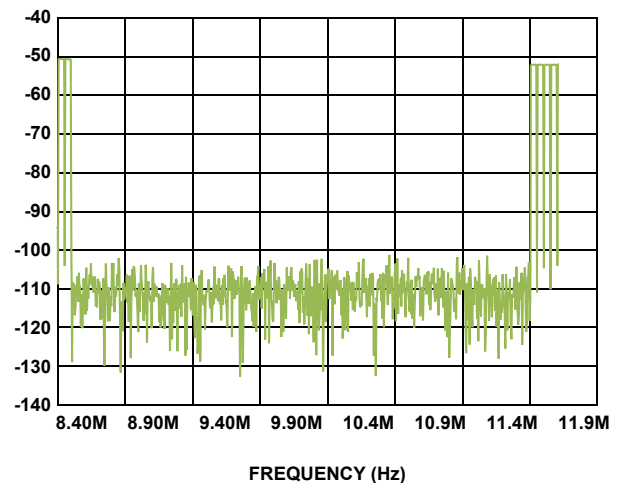


FIGURE 2. US2 MBPR 17a VDSL2 PERFORMANCE

ISL1550

Connection Diagram

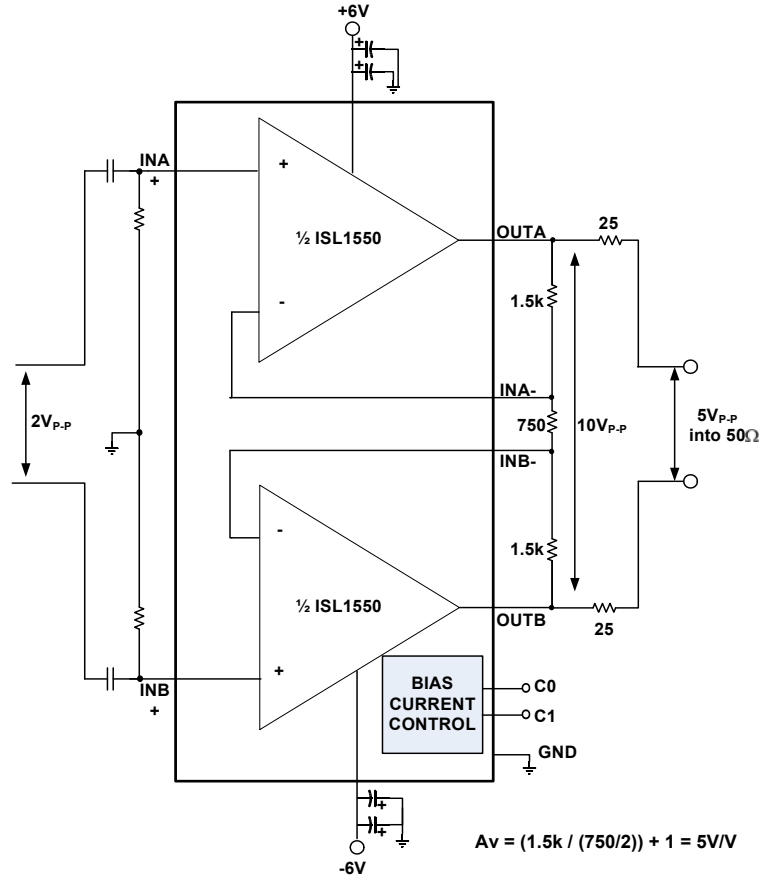
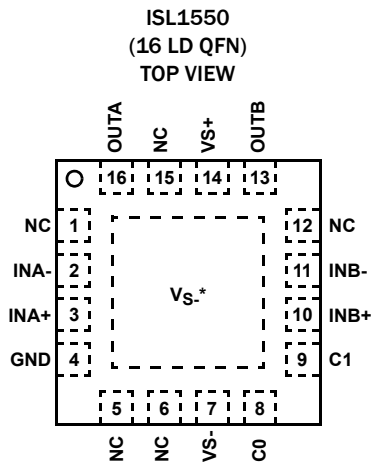


FIGURE 3. TYPICAL DIFFERENTIAL AMPLIFIER I/O

Pin Configuration



*THERMAL PAD CONNECTS TO MOST NEGATIVE SUPPLY

ISL1550

Pin Descriptions

PIN NUMBER	PIN NAME	FUNCTION
1	NC	No Connect
2	INA-	Amplifier A Inverting Input
3	INA+	Amplifier A Non-Inverting Input
4	GND	Ground
5	NC	No Connect
6	NC	No Connect
7	VS-	Negative Supply Voltage
8	CO	Digital Control Pin
9	C1	Digital Control Pin
10	INB+	Amplifier B Non-Inverting Input
11	INB-	Amplifier B Inverting Input
12	NC	No Connect
13	OUTB	Amplifier B Output
14	VS+	Positive Supply Voltage
15	NC	No Connect
16	OUTA	Amplifier A Output

Ordering Information

PART NUMBER (Notes 2, 3)	PART MARKING	TEMP RANGE (°C)	PACKAGE (Pb-free)	PKG. DWG. #
ISL1550IRZ	155 0IRZ	-40 to +85	16 Ld QFN	L16.4x4H
ISL1550IRZ-T7 (Note 1)	155 0IRZ	-40 to +85	16 Ld QFN	L16.4x4H
ISL1550IRZ-T13 (Note 1)	155 0IRZ	-40 to +85	16 Ld QFN	L16.4x4H
ISL1550IRZ-EVALZ	Evaluation Board			

NOTES:

1. Please refer to [TB347](#) for details on reel specifications.
2. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), please see device information page for [ISL1550](#). For more information on MSL please see tech brief [TB363](#).

ISL1550

Absolute Maximum Ratings (T_A = +25 °C)

V _S + Voltage to GND	-0.3V to +13.2V
Driver V _{IN} + Voltage	GND to +V _S
C ₀ , C ₁ Voltage to GND	-0.3V to +V _S
Current into any Input	8mA
Continuous Output Current for Long Term Reliability	50mA
ESD Rating	
Human Body Model (Tested per JESD22-A114F)	4kV
Machine Model (Tested per JESD22-A115C)	300V
Charge Device Model (Tested per JESD22-C101E)	1.5kV

Thermal Information

Thermal Resistance (Typical)	θ _{JA} (°C/W)	θ _{JC} (°C/W)
16 Ld QFN Package (Notes 4, 5)	53	16.5
Maximum Junction Temperature (Plastic Package)	+150 °C	
Storage Temperature Range	-40 °C to +150 °C	
Pb-Free Reflow Profile	see link below http://www.intersil.com/pbfree/Pb-FreeReflow.asp	

Operating Conditions

Ambient Temperature Range	-40 °C to +85 °C
Junction Temperature Range	-40 °C to +150 °C

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

- θ_{JA} is measured in free air with the component mounted on a high effective thermal conductivity test board with “direct attach” features. See Tech Brief [TB379](#).
- For θ_{JC}, the “case temp” location is the center of the exposed metal pad on the package underside.

Electrical Specifications V_S = ±6V, see Figure 1, T_A = +25 °C, unless otherwise specified.

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 6)	TYP	MAX (Note 6)	UNIT
AC PERFORMANCE						
BW	-3dB Bandwidth	See Figure 1		105		MHz
THD	Total Harmonic Distortion, Differential	f = 200kHz, V _O = 12V _{P-P} output, R _L = 20Ω		-89		dBc
		f = 4MHz, V _O = 12V _{P-P} output, R _L = 100Ω		-67		dBc
		f = 10MHz, V _O = 12V _{P-P} output, R _L = 100Ω		-61		dBc
SR	Slew Rate (20% to 80%)	V _{OUT} from -6V to +6V (differential)	1500	2400		V/μs
DC PERFORMANCE						
V _{OS_CM}	Input Offset Voltage Common Mode		-45		+45	mV
V _{OS_DM}	Input Offset Voltage Differential Mode		-7.5		+7.5	mV
INPUT CHARACTERISTICS						
I _{B+}	Non-Inverting Input Bias Current		-7.0	-3.0	+7.0	μA
I _{B-DM}	Inverting Input Bias Current Differential Mode		-45	±7	+45	μA
e _O	Differential Output Noise	See Figure 1 [at transformer input]		45		nV/√Hz
OUTPUT CHARACTERISTICS						
V _{OUT}	Loaded Output Swing (single-ended)	V _S = ±6V, R _{L DIFF} = 100Ω	±4.7	±5.0		V
		V _S = ±6V, R _{L DIFF} = 20Ω		±4.5		V
SUPPLY						
+V _S	Supply Voltage	Single supply (-V _S = GND)	8.0	12	13.2	V
I _{S+} (Full Bias)	Positive Supply Current	All outputs at 0V, C ₀ = C ₁ = 0V	27	32	37	mA
I _{S+} (Medium Bias)	Positive Supply Current	All outputs at 0V, C ₀ = 5V, C ₁ = 0V	19	23	26	mA
I _{S+} (Low Bias)	Positive Supply Current	All outputs at 0V, C ₀ = 0V, C ₁ = 5V	12	15	18	mA
I _{S+} (Power down)	Positive Supply Current	All outputs at 0V, C ₀ = C ₁ = 5V	1.3	1.6	2.5	mA
I _{INH} , C ₀ or C ₁	C ₀ , C ₁ Input Current, High	C ₀ , C ₁ = 6V	100	165	224	μA
I _{INL} , C ₀ or C ₁	C ₀ , C ₁ Input Current, Low	C ₀ , C ₁ = 0V	-1.5	-1.0	+1.5	μA
V _{INH} , C ₀ or C ₁	C ₀ , C ₁ Input Voltage, High		2.0			V
V _{INL} , C ₀ or C ₁	C ₀ , C ₁ Input Voltage, Low				0.8	V

NOTE:

- Compliance to datasheet limits is assured by one or more methods: production test, characterization and/or design.

Typical Performance Curves

$V_{CC} = \pm 6V$, See Figure 1, $T_A = +25^\circ C$, $C_0 = C_1 = 0V$ (Full power), Unless otherwise noted.

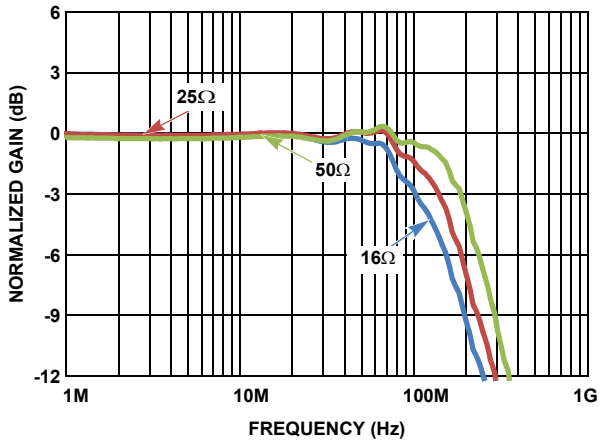


FIGURE 4. SMALL SIGNAL FREQUENCY RESPONSE vs R_{LOAD}

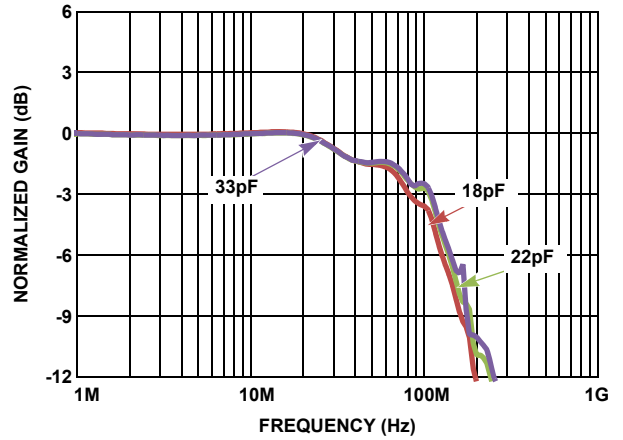


FIGURE 5. SMALL SIGNAL FREQUENCY RESPONSE vs C_{LOAD}

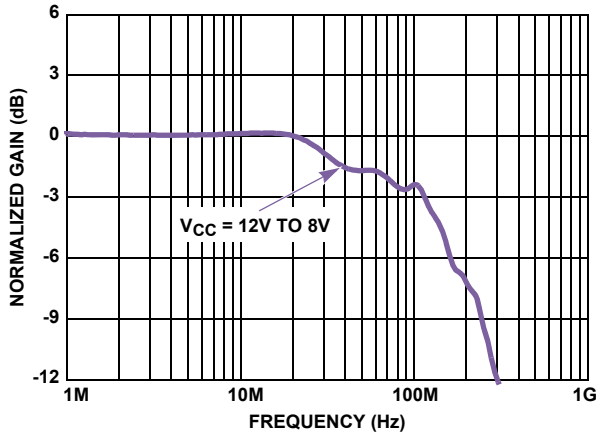


FIGURE 6. SMALL SIGNAL BANDWIDTH vs SUPPLY VOLTAGE

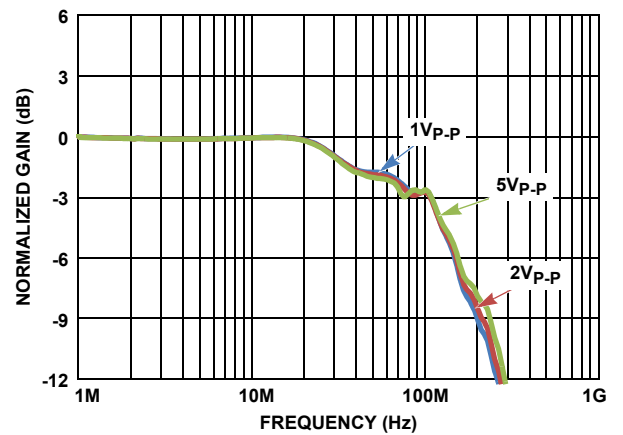


FIGURE 7. LARGE SIGNAL FREQUENCY RESPONSE

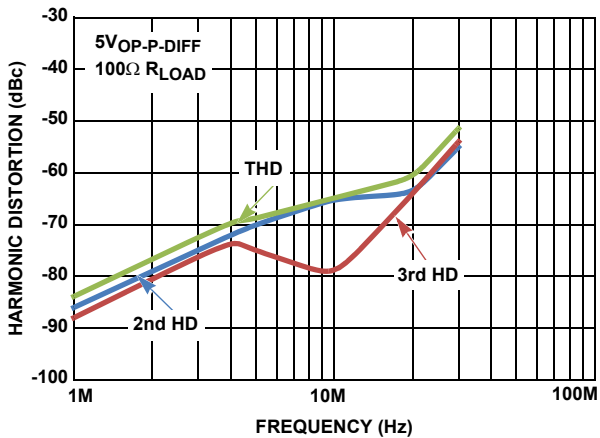


FIGURE 8. HARMONIC DISTORTION vs FREQUENCY

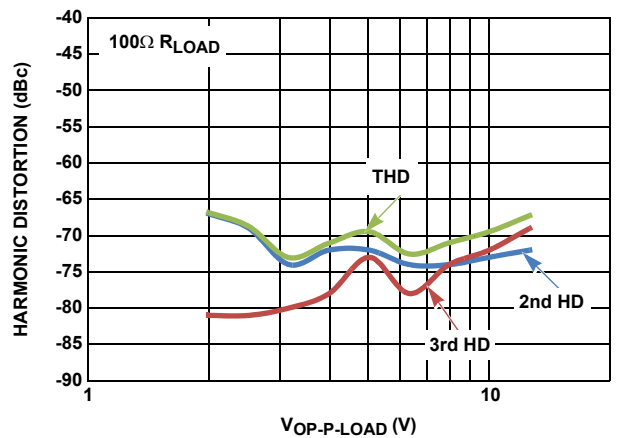


FIGURE 9. 4MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

Typical Performance Curves

noted. (Continued)

$V_{CC} = \pm 6V$, See Figure 1, $T_A = +25^\circ C$, $C_0 = C_1 = 0V$ (Full power), Unless otherwise noted.

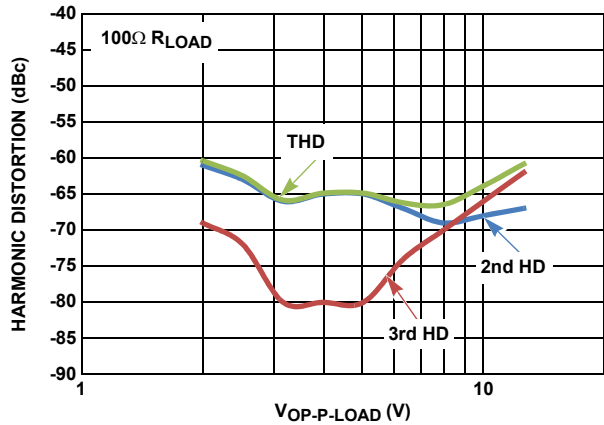


FIGURE 10. 10MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

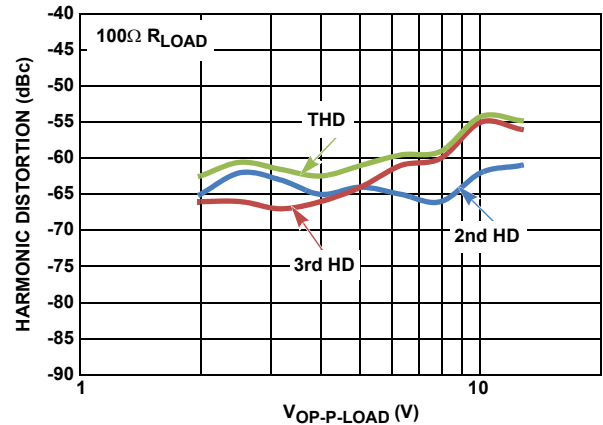


FIGURE 11. 20MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

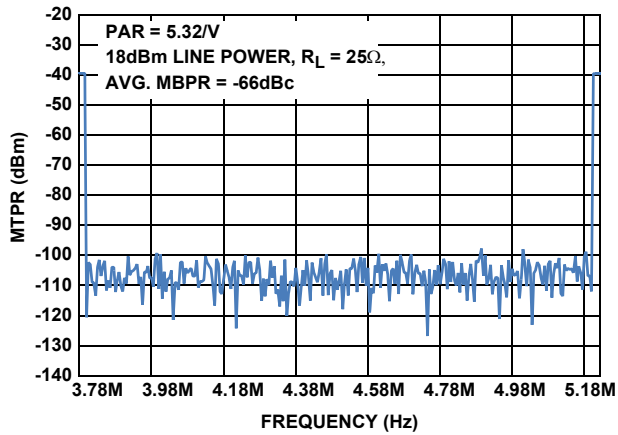


FIGURE 12. MBPR 8b US1

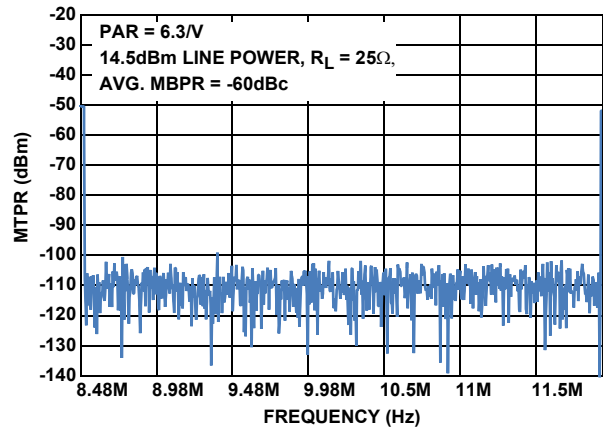


FIGURE 13. MBPR 17a US2

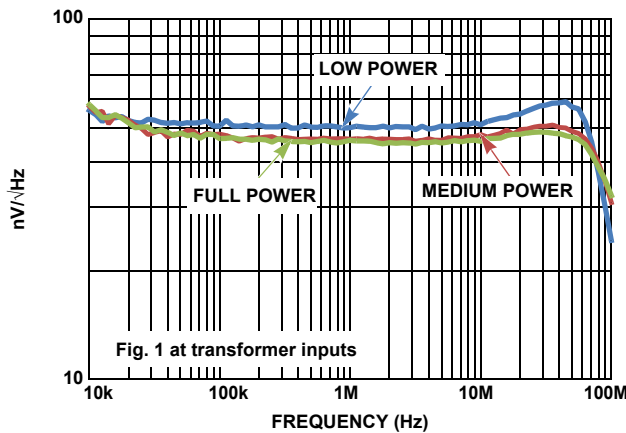


FIGURE 14. DIFFERENTIAL OUTPUT NOISE

Typical Performance Curves

$V_{CC} = \pm 6V$, See Figure 1, $T_A = +25^\circ C$, $C_0 = 3.3V$, $C_1 = 0V$ (Medium power), Unless otherwise noted.

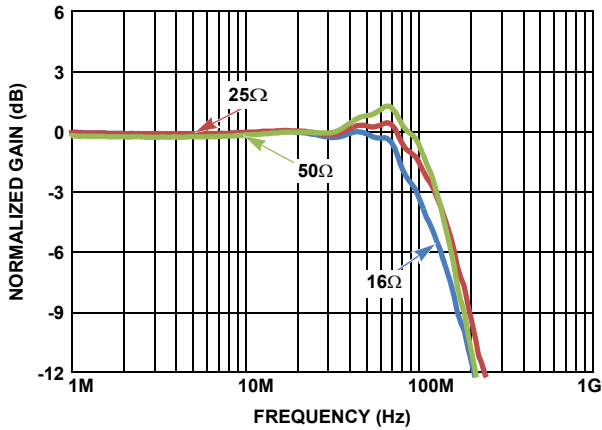


FIGURE 15. SMALL SIGNAL FREQUENCY RESPONSE vs R_{LOAD}

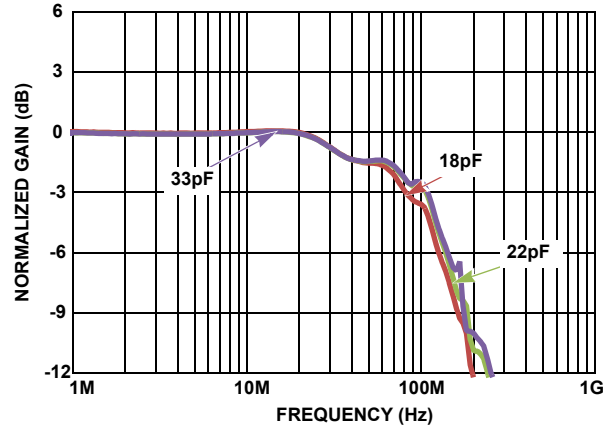


FIGURE 16. SMALL SIGNAL FREQUENCY RESPONSE vs C_{LOAD}

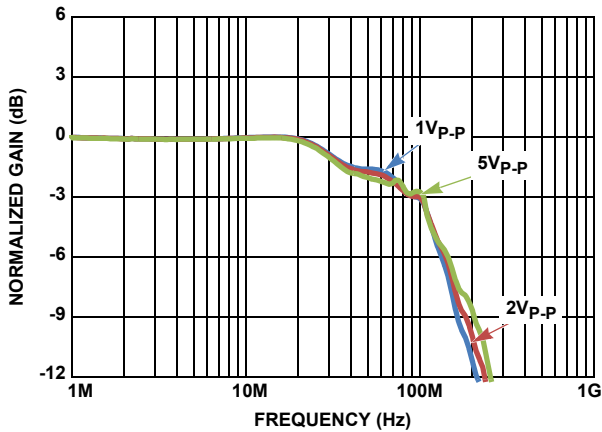


FIGURE 17. LARGE SIGNAL FREQUENCY RESPONSE

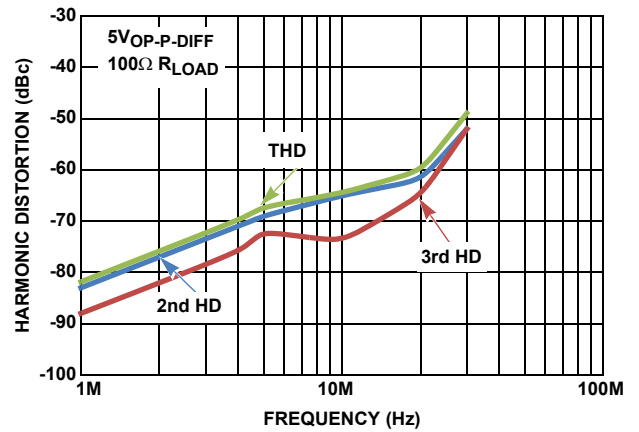


FIGURE 18. HARMONIC DISTORTION vs FREQUENCY

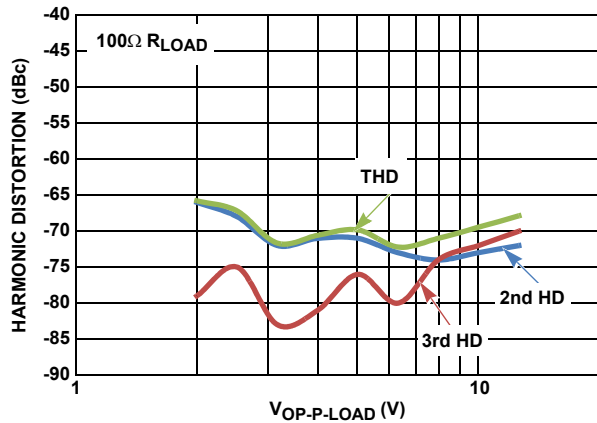


FIGURE 19. 4MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

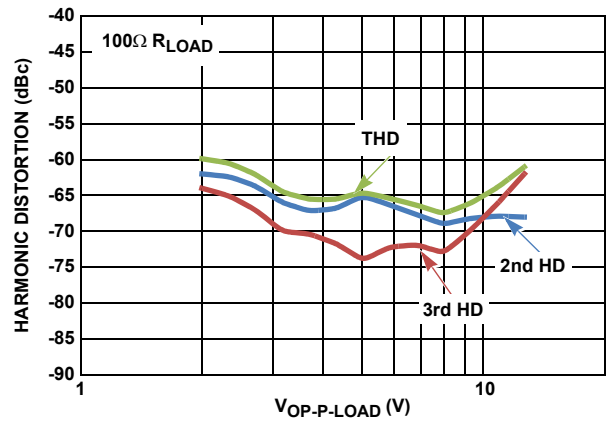


FIGURE 20. 10MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

Typical Performance Curves

otherwise noted.

$V_{CC} = \pm 6V$, See Figure 1, $T_A = +25^\circ C$, $C_0 = 0V$, $C_1 = 3.3V$ (Low power), unless

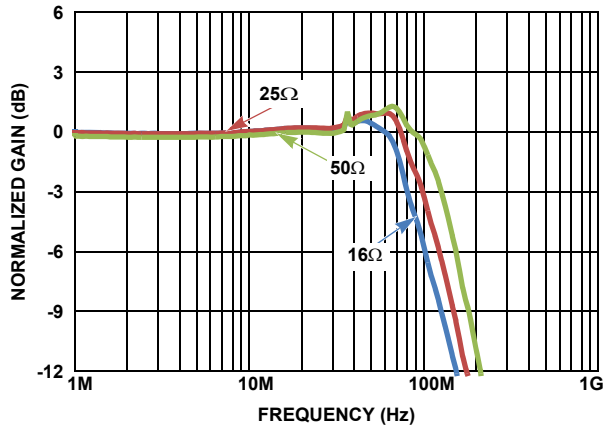


FIGURE 21. SMALL SIGNAL FREQUENCY vs R_{LOAD}

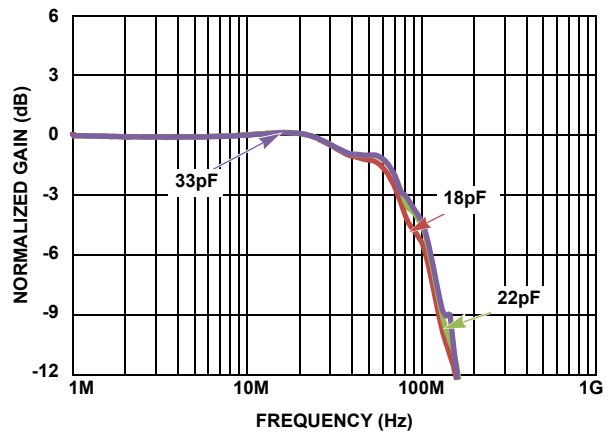


FIGURE 22. SMALL SIGNAL FREQUENCY RESPONSE vs C_{LOAD}

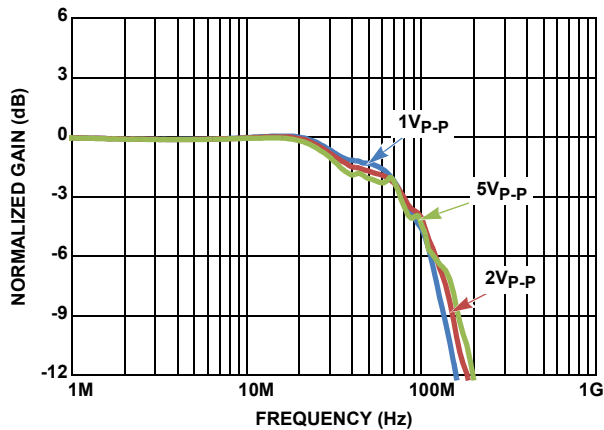


FIGURE 23. LARGE SIGNAL FREQUENCY RESPONSE

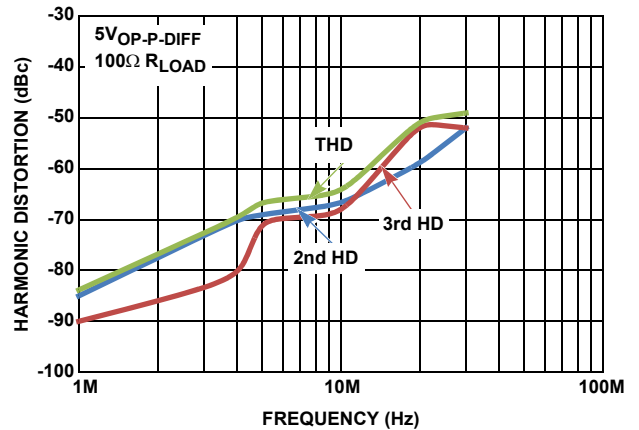


FIGURE 24. HARMONIC DISTORTION vs FREQUENCY

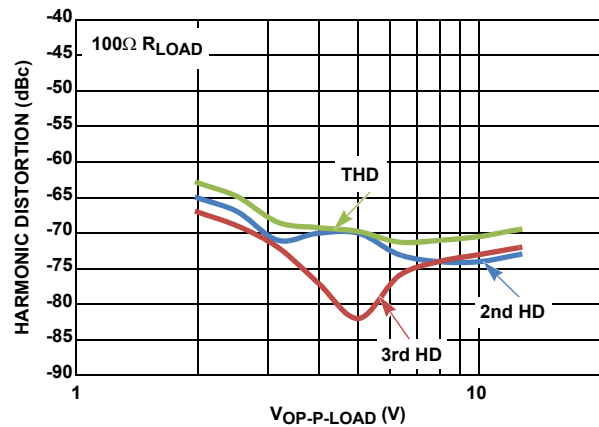


FIGURE 25. 4MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

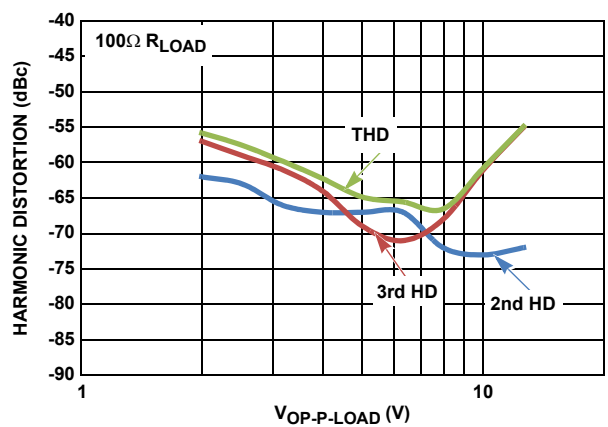


FIGURE 26. 10MHz HARMONIC DISTORTION vs OUTPUT VOLTAGE

Typical Performance Curves

$T_A = +25^\circ\text{C}$, C_0 and C_1 Varied, unless otherwise noted.

$V_{CC} = \pm 6\text{V}$, See Figure 3, Gain = 5V/V (Differential), $R_f = 1.5\text{k}\Omega$, $R_{LOAD} = 100\Omega$,

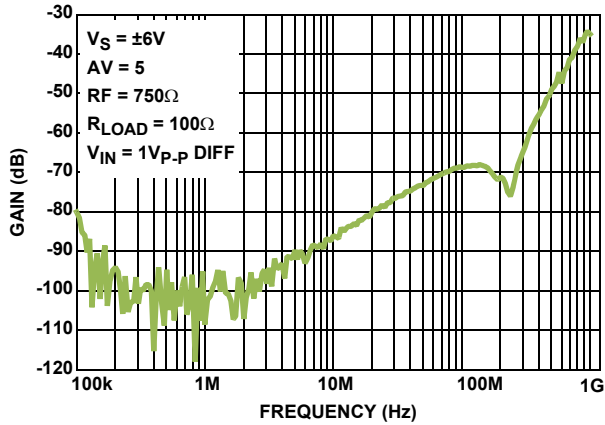


FIGURE 27. OFF-ISOLATION

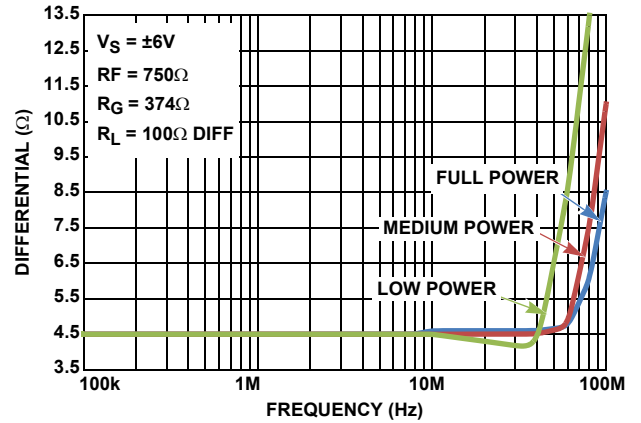


FIGURE 28. DIFFERENTIAL OUTPUT IMPEDANCE

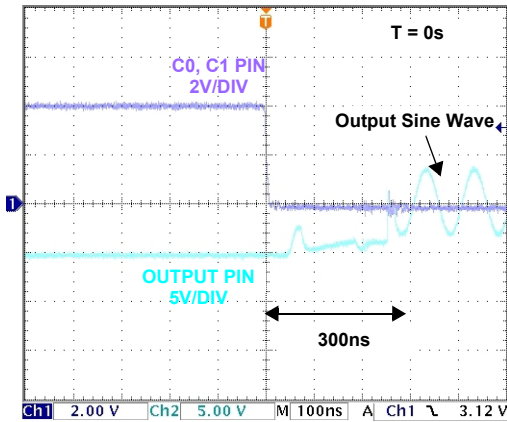


FIGURE 29. POWER ON

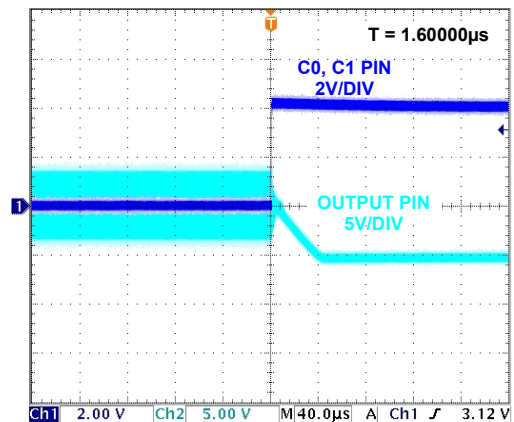


FIGURE 30. POWER OFF

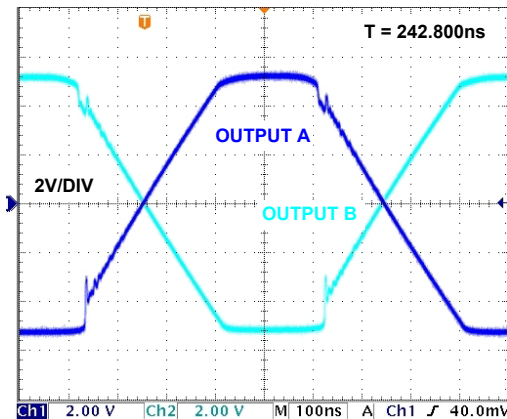


FIGURE 31. OVERDRIVE RECOVERY

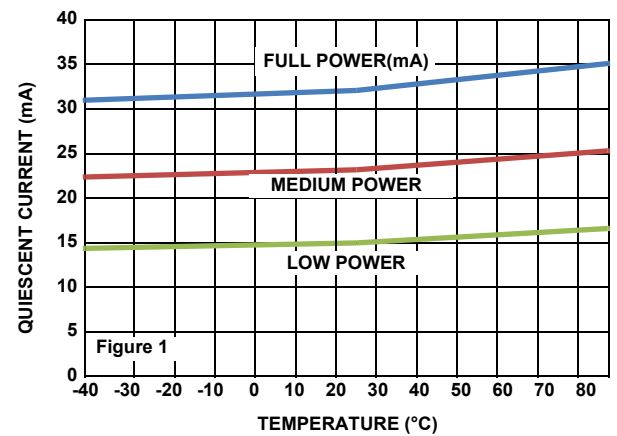


FIGURE 32. QUIESCENT CURRENT vs TEMPERATURE

Typical Performance Curves

$V_{CC} = \pm 6V$, See Figure 3, Gain = 5V/V (Differential), $R_f = 1.5k\Omega$, $R_{LOAD} = 100\Omega$, $T_A = +25^\circ C$, C_0 and C_1 Varied, unless otherwise noted. (Continued)

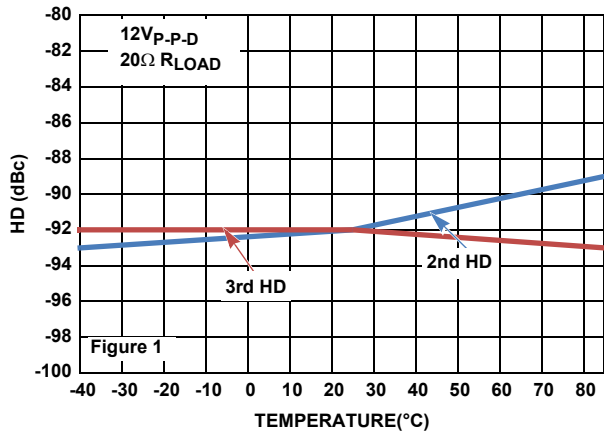


FIGURE 33. 200kHz DISTORTION vs TEMPERATURE

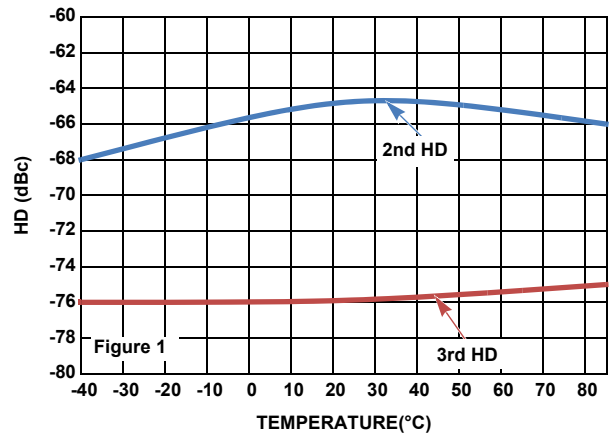


FIGURE 34. 4MHz DISTORTION vs TEMPERATURE

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to web to make sure you have the latest revision.

DATE	REVISION	CHANGE
March 16, 2012	FN6795.0	Initial release.

Products

Intersil Corporation is a leader in the design and manufacture of high-performance analog semiconductors. The Company's products address some of the industry's fastest growing markets, such as, flat panel displays, cell phones, handheld products, and notebooks. Intersil's product families address power management and analog signal processing functions. Go to www.intersil.com/products for a complete list of Intersil product families.

For a complete listing of Applications, Related Documentation and Related Parts, please see the respective device information page on intersil.com: ISL1550

To report errors or suggestions for this datasheet, please go to: www.intersil.com/askourstaff

For additional products, see www.intersil.com/product_tree

Intersil products are manufactured, assembled and tested utilizing ISO9000 quality systems as noted in the quality certifications found at www.intersil.com/design/quality

Intersil products are sold by description only. Intersil Corporation reserves the right to make changes in circuit design, software and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that data sheets are current before placing orders. Information furnished by Intersil is believed to be accurate and reliable. However, no responsibility is assumed by Intersil or its subsidiaries for its use; nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Intersil or its subsidiaries.

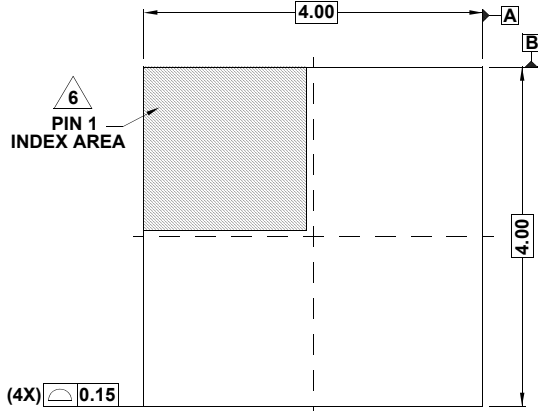
For information regarding Intersil Corporation and its products, see www.intersil.com

Package Outline Drawing

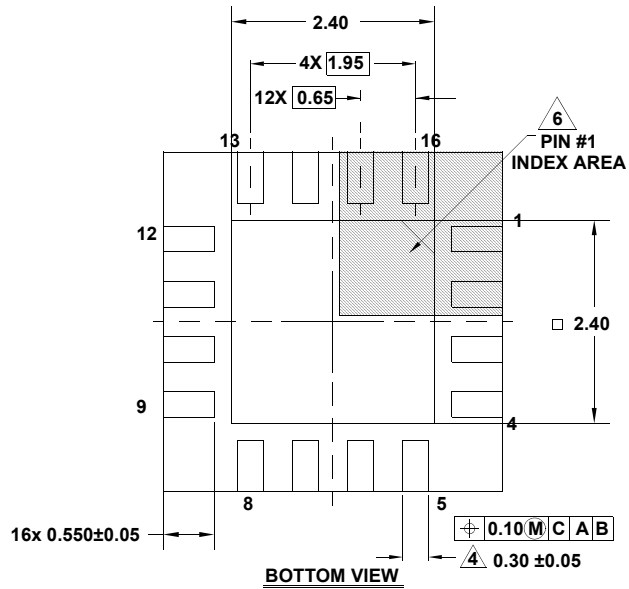
L16.4x4H

16 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE

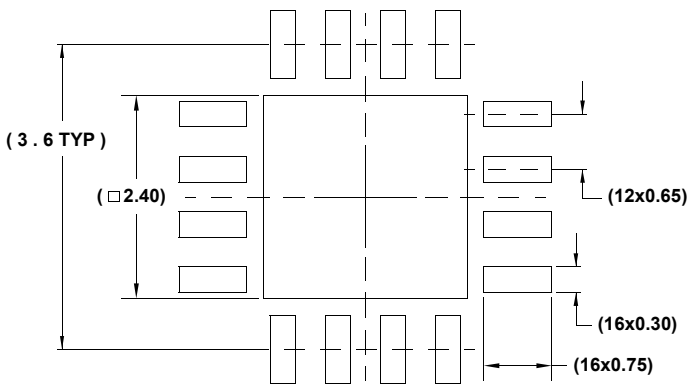
Rev 0, 1/12



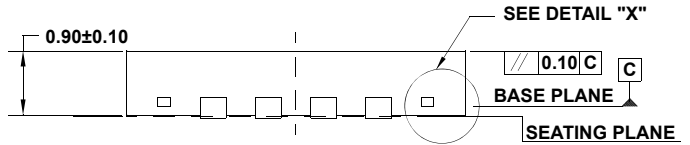
TOP VIEW



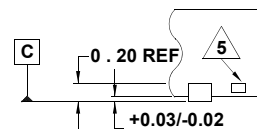
BOTTOM VIEW



TYPICAL RECOMMENDED LAND PATTERN



SIDE VIEW



DETAIL "X"

NOTES:

1. Dimensions are in millimeters.
Dimensions in () for Reference Only.
2. Dimensioning and tolerancing conform to ASME Y14.5m-1994.
3. Unless otherwise specified, tolerance : Decimal ± 0.05
4. Dimension applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
5. Tiebar shown (if present) is a non-functional feature.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.