低成本 单声道 1W 音频功率放大器

■ 产品概述

LN4890 是差分输入音频功率放大电路，适用于移动电话和其他内置扬声器的便携式音频设备。它能够为 8Ω 负载提供 1W 功率的稳定输出，5V 电源供电的条件下其总谐波失真和噪声不超过 1%。LN4890 采用桥接负载结构在提供高品质音频功率放大的同时，大大减少了外部元件数，无需外接输出耦合电容和自举电容。

LN4890 内置待机电路，当 $\overline{\text{SHUTDOWN}}$ 管脚接低电平时，整个电路工作在待机模式，待机电流不超过 100nA。LN4890 内置了杂音消除电路，可以消除芯片启动和关断过程中的咔嗒声或噼噗声。还可以通过外接电阻来调节增益。

■ 关键指标

- PSRR @f_{IN}=217HZ，VDD=5V　62dB(typ.)
- 功率输出@VDD=5V &1% THD　1W(typ.)
- 功率输出@VDD=3V &1% THD　400mW(typ.)
- 关断电流　0.1uA(typ.)

■ 用途

- 移动电话
- PDA
- 便携电子设备

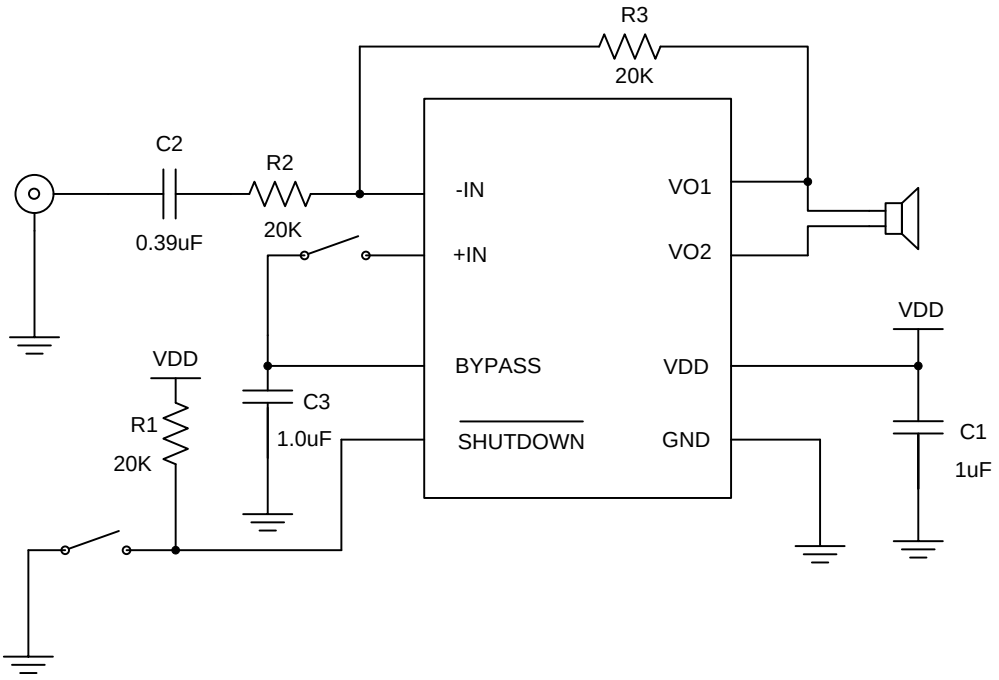
■ 产品特点

- 工作电压范围宽：2.2—5.0V
- 无需输出耦合电容、缓冲网络或自举电容
- 热保护功能
- 内部增益固定，外部增益可调
- 超小型封装
- 100nA 的低功耗关断模式
- BTL 输出可以驱动容性负载
- 上电/断电时无咔嗒声或噼噗声

■ 封装

- MSOP8
- SOP8

■ 典型应用电路图

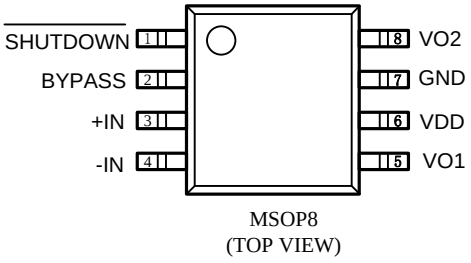


■ 订购信息

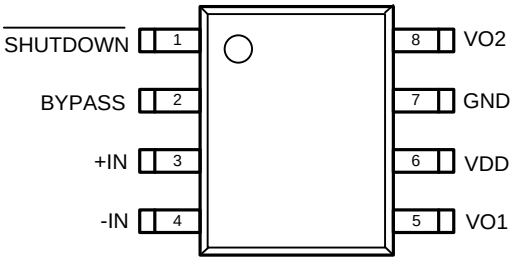
LN4890①②③-④

项目	符号	描述
①②		封装类型
	MM	MSOP8
	SR	SOP8
③	A	输入大于 5.2V 时自动关闭
	C	没有高压自动关闭功能
	D	没有高压自动关闭功能，且高温保护情况下增益自动降低至 1 倍
	E	没有高压自动关闭功能，且高温保护情况下增益自动降低至 1 倍，启动时间为 D 版本的 1/4。
④	G	绿料

■ 引脚配置



MSOP8
(TOP VIEW)



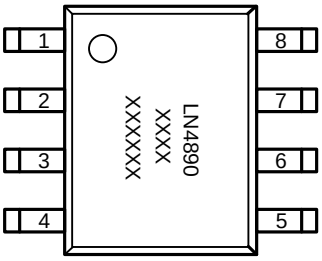
SOP8
(TOP VIEW)

■ 引脚功能描述

引脚号	引脚名称	功能描述
1	$\overline{\text{SHUTDOWN}}$	芯片使能端（低有效）
2	BYPASS	旁路电容输入端
3	+IN	正输入端（差分+）
4	-IN	负输入端（差分-）
5	VO1	负输出端（差分-）
6	VDD	电源输入端
7	GND	接地端
8	VO2	正输出端（差分+）

■ 打印信息

- MSOP8、SOP8



SOP8
(TOP VIEW)

第二行 XXXX: 晶圆版本号；

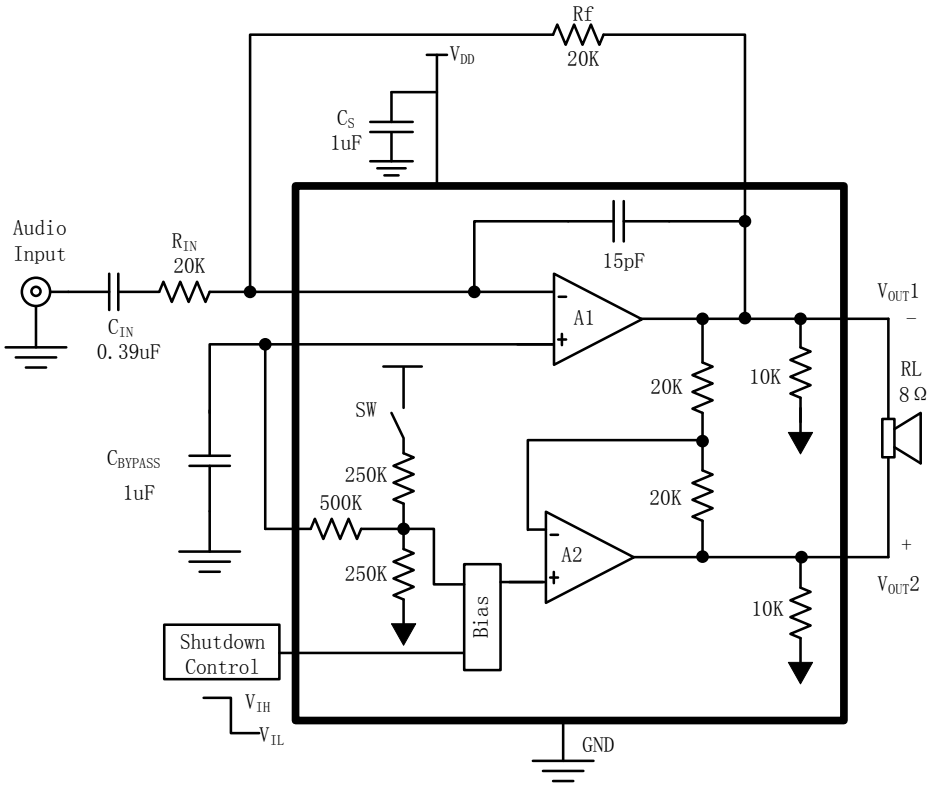
第三行 XXXXXX: 封装批号。

■ 绝对最大额定值

项目	符号	值	单位
工作电压	VDD	-0.3—5.2	V
输入电压	-IN	-0.3—VDD+0.3	V
工作温度	Topr	-40—85	℃
贮存温度	Tstg	-65—150	℃
ESD 参数	-	2000	V

注：LN4890*A 版本的工作电压最大值是 5.2V，其他版本稍有差异

■ 功能框图



■ 电学特性参数

VDD=5V　　（除非特别说明，T_a=25℃）

符号	参数	测试条件	最小	典型	最大	单位
I_{DD}	静态电流	-IN = 0V, Io = 0A, No Load	-	4	8	mA
		-IN = 0V, Io = 0A, 8Ω Load	-	5	10	mA
I_{SD}	关断电流	$V_{\overline{SHUTDOWN}}$ = 0V	-	0.1	2	μA
V_{SDIH}	关断电压 输入高电平	-	1.6	-	-	V
V_{SDIL}	关断电压 输入低电平	-	-	-	0.4	V
V_{OS}	输出失调电压	-	-	7	50	mV
$R_{OUT-GND}$	输出电阻	-	7.0	8.5	9.7	kΩ
P_O	输出功率	THD = 2% (max); f = 1 kHz 8Ω Load	0.8	1.0	-	W
T_{WU}	启动时间	-	-	50	-	ms
T_{SD}	热关断温度	-	150	170	190	℃
THD+N	总谐波失真 +噪声	Po = 0.4 Wrms; f = 1kHz	-	0.1	-	%
PSRR	电源抑制比	V_{ripple} = 200mV $_{sine\ p-p}$ f=217Hz	55	62	-	dB
		V_{ripple} = 200mV $_{sine\ p-p}$ f=1kHz		66		
T_{SDT}	关断时间	8Ω Load	-	70	-	ms

VDD=3V　　（除非特别说明，T_a=25℃）

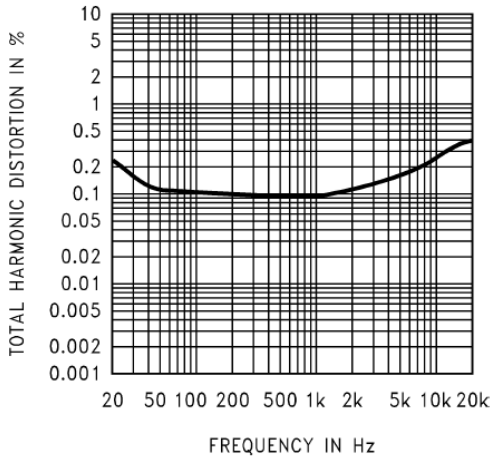
符号	参数	测试条件	最小	典型	最大	单位
I_{DD}	静态电流	-IN = 0V, Io = 0A, No Load	-	3.5	7	mA
		-IN = 0V, Io = 0A, 8Ω Load	-	4.5	9	mA
I_{SD}	关断电流	$V_{\overline{SHUTDOWN}}$ = 0V	-	0.1	2	μA
V_{SDIH}	关断电压 输入高电平	-	1.3	-	-	V
V_{SDIL}	关断电压 输入低电平	-	-	-	0.4	V
V_{OS}	输出失调电压	-	-	7	50	mV
$R_{OUT-GND}$	输出电阻	-	7.0	8.5	9.7	kΩ
P_O	输出功率	THD = 2% (max); f = 1 kHz 8Ω Load	0.28	0.31	-	W
T_{WU}	启动时间	-	-	50	-	ms
T_{SD}	热关断温度	-	150	170	190	℃
THD+N	总谐波失真 +噪声	Po = 0.4 Wrms; f = 1kHz	-	0.1	-	%
PSRR	电源抑制比	V_{ripple} = 200mV $_{sine\ p-p}$ f=217Hz	45	56	-	dB
		V_{ripple} = 200mV $_{sine\ p-p}$ f=1kHz		62		

VDD=2.6V　　（除非特别说明，T_a=25℃）

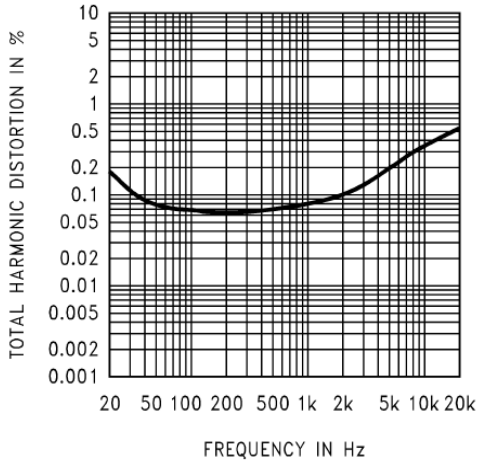
符号	参数	测试条件		最小	典型	最大	单位
I_{DD}	静态电流	-IN = 0V, Io = 0A, No Load		-	2.6	5.5	mA
I_{SD}	关断电流	$V_{\overline{SHUTDOWN}}$ = 0V		-	0.1	2	μA
V_{SDIH}	关断电压 输入高电平	-		1.2	-	-	V
V_{SDIL}	关断电压 输入低电平	-		-	-	0.4	V
P_O	输出功率	THD = 1% (max); f = 1 kHz	8Ω Load	-	0.2	-	W
			4Ω Load		0.22		
THD+N	总谐波失真 +噪声	Po = 0.1 Wrms; f = 1kHz		-	0.08	-	%
PSRR	电源抑制比	V_{ripple} = 200mV $_{sine\ p-p}$ f=217Hz		-	44	-	dB
		V_{ripple} = 200mV $_{sine\ p-p}$ f=1kHz			44		

■ 特性曲线

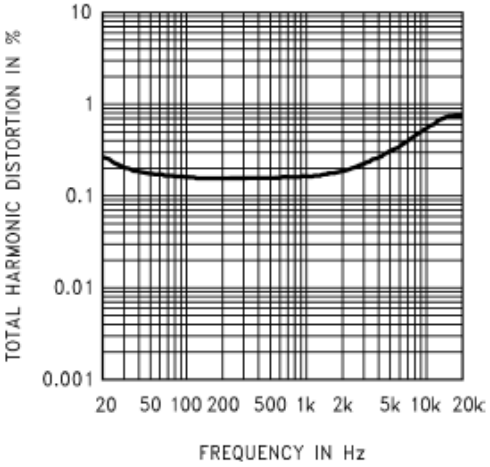
THD+N vs Frequency
at V_{DD} = 5V, 8Ω R_L, and PWR = 250mW, A_V = 2



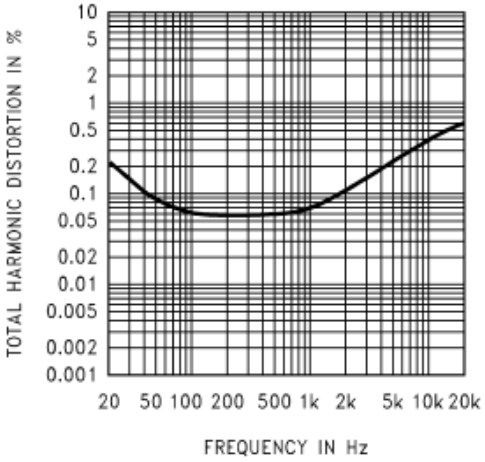
THD+N vs Frequency
at V_{DD} = 3.3V, 8Ω R_L, and PWR = 150mW, A_V = 2



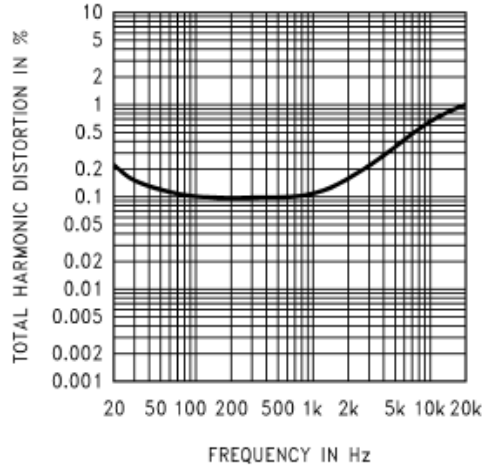
THD+N vs Frequency
at V_{DD} = 3V, R_L = 8Ω, PWR = 250mW, A_V = 2



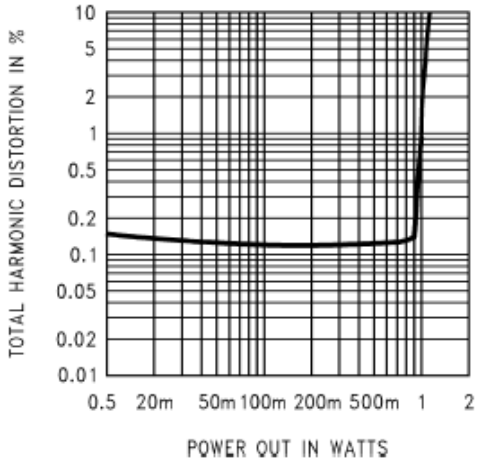
THD+N vs Frequency
@ V_{DD} = 2.6V, R_L = 8Ω, PWR = 100mW, A_V = 2



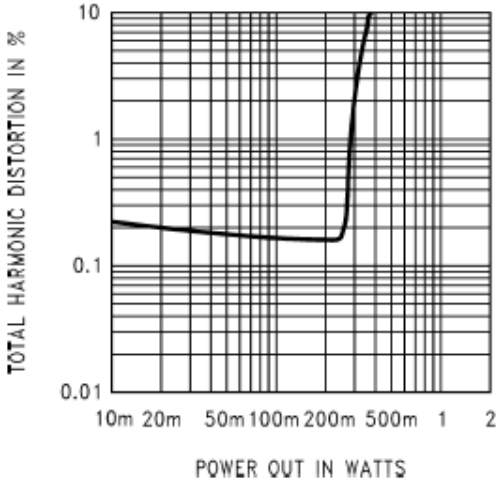
THD+N vs Frequency
@ V_{DD} = 2.6V, R_L = 4Ω, PWR = 100mW, A_V = 2



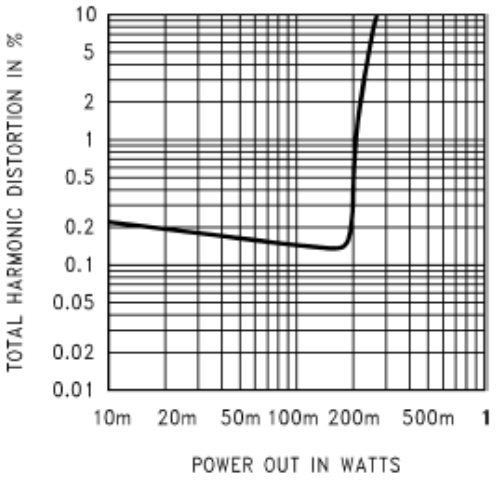
THD+N vs Power Out
@ V_{DD} = 5V, R_L = 8Ω, 1kHz, A_V = 2



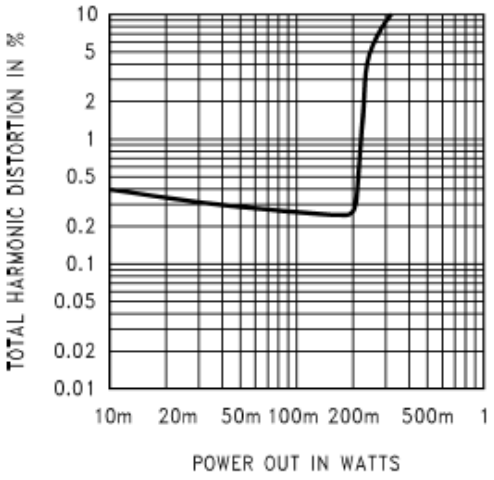
THD+N vs Power Out
@ V_{DD} = 3V, R_L = 8Ω, 1kHz, A_V = 2



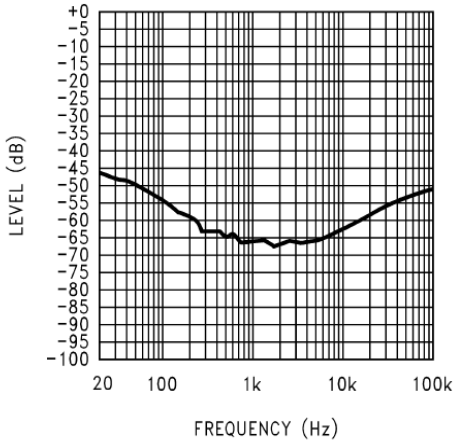
THD+N vs Power Out
@ V_{DD} = 2.6V, R_L = 8Ω, 1kHz, A_V = 2



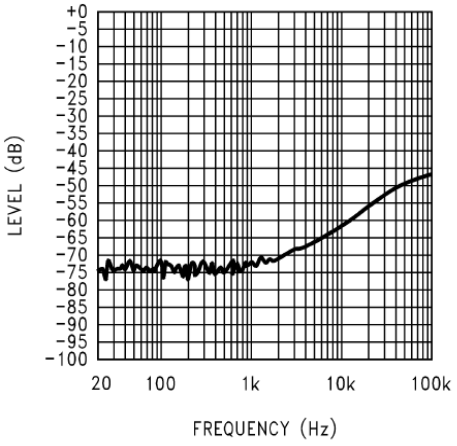
THD+N vs Power Out
@ V_{DD} = 2.6V, R_L = 4Ω, 1kHz, A_V = 2



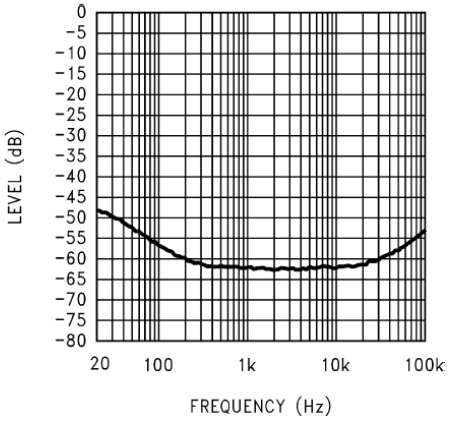
Power Supply Rejection Ratio (PSRR) @ A_V = 2
V_{DD} = 5V, V_{ripple} = 200mvp-p
R_L = 8Ω, R_{IN} = 10Ω



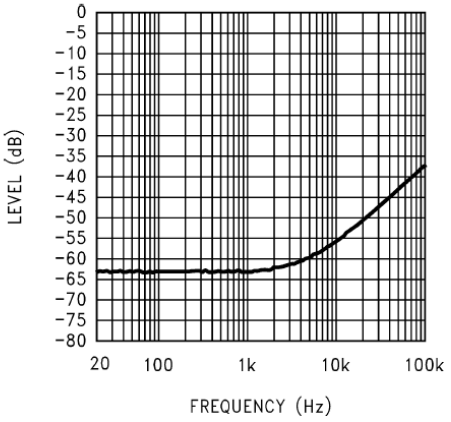
Power Supply Rejection Ratio (PSRR) @ A_V = 2
V_{DD} = 5V, V_{ripple} = 200mvp-p
R_L = 8Ω, R_{IN} = Float



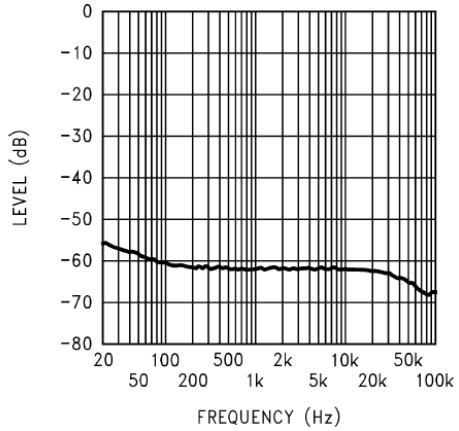
Power Supply Rejection Ratio (PSRR) @ A_V = 4
V_{DD} = 5V, V_{ripple} = 200mvp-p
R_L = 8Ω, R_{IN} = 10Ω



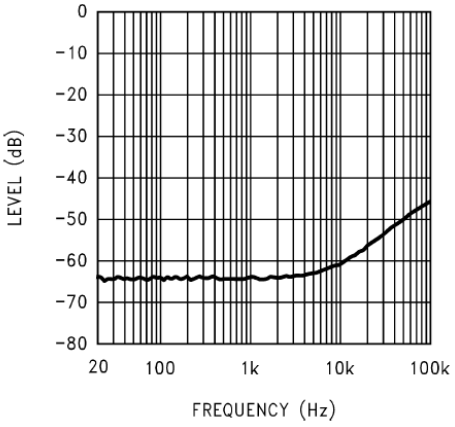
Power Supply Rejection Ratio (PSRR) @ A_V = 4
V_{DD} = 5V, V_{ripple} = 200mvp-p
R_L = 8Ω, R_{IN} = Float



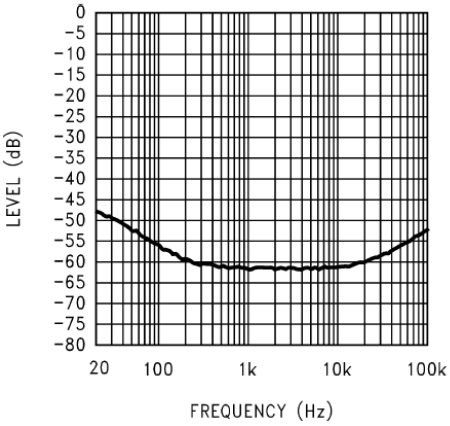
Power Supply Rejection Ratio (PSRR) @ A_V = 2
V_{DD} = 3V, V_{ripple} = 200mvp-p,
R_L = 8Ω, R_{IN} = 10Ω



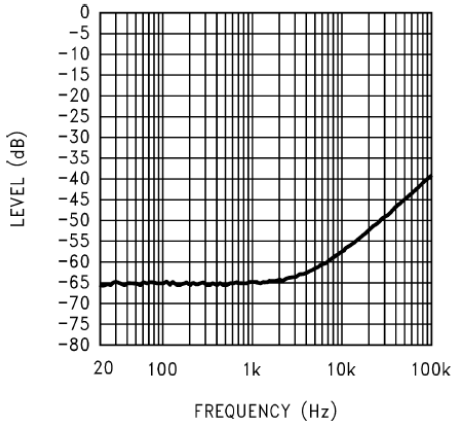
Power Supply Rejection Ratio (PSRR) @ A_V = 2
V_{DD} = 3V, V_{ripple} = 200mvp-p,
R_L = 8Ω, R_{IN} = Float



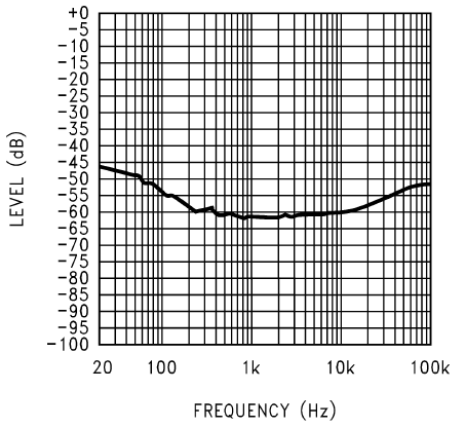
Power Supply Rejection Ratio (PSRR) @ A_V = 4
V_{DD} = 3V, V_{ripple} = 200mvp-p,
R_L = 8Ω, R_{IN} = 10Ω



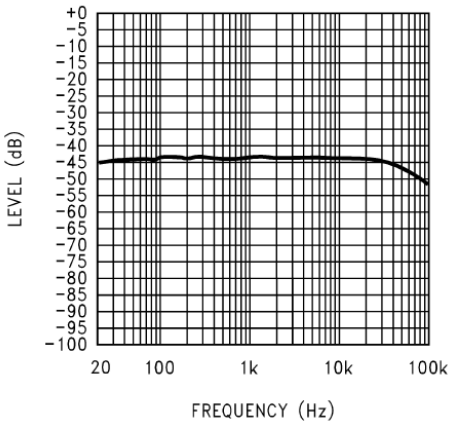
Power Supply Rejection Ratio (PSRR) @ A_V = 4
V_{DD} = 3V, V_{ripple} = 200mvp-p,
R_L = 8Ω, R_{IN} = Float



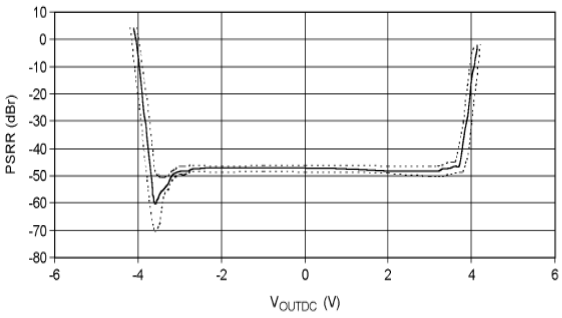
Power Supply Rejection Ratio (PSRR) @ A_V = 2
V_{DD} = 3.3V, V_{ripple} = 200mvp-p,
R_L = 8Ω, R_{IN} = 10Ω



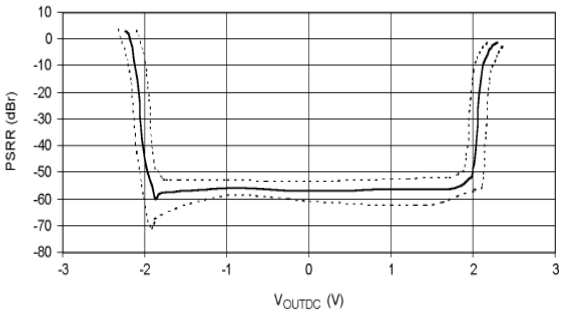
Power Supply Rejection Ratio (PSRR) @ A_V = 2
V_{DD} = 2.6V, V_{ripple} = 200mvp-p,
R_L = 8Ω, R_{IN} = 10Ω



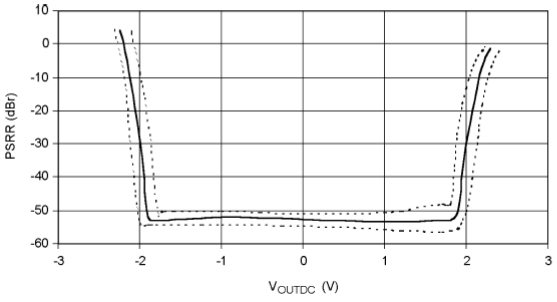
PSRR vs DC Output Voltage
V_{DD} = 5V, A_V = 10



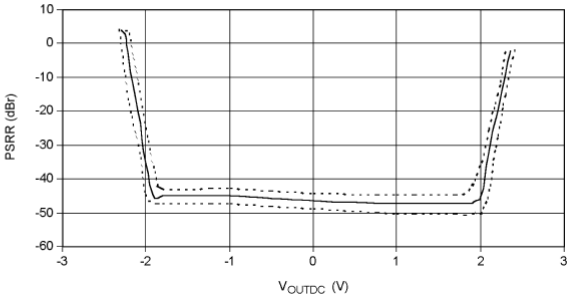
PSRR vs DC Output Voltage
V_{DD} = 3V, A_V = 2



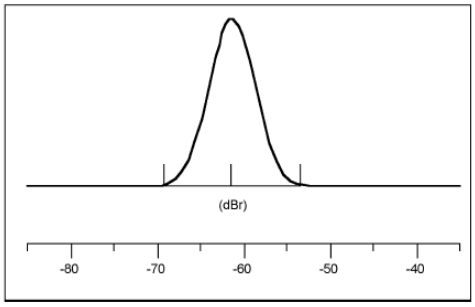
PSRR vs DC Output Voltage
V_{DD} = 3V, A_V = 4



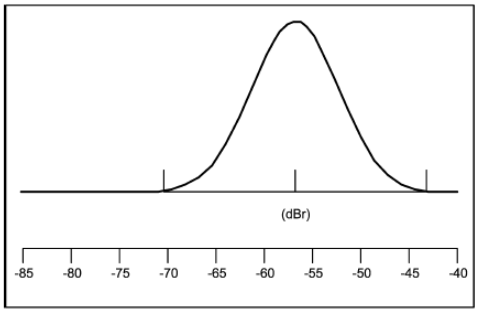
PSRR vs DC Output Voltage
V_{DD} = 3V, A_V = 10



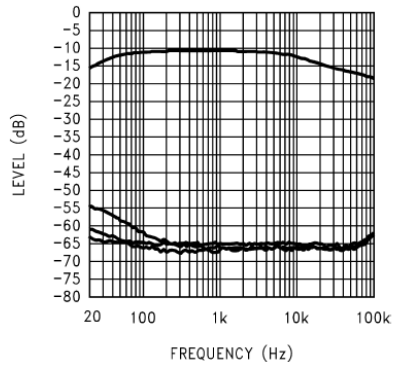
PSRR Distribution V_{DD} = 5V
217Hz, 200mvp-p,
-30, +25, and +80˚C



PSRR Distribution V_{DD} = 3V
217Hz, 200mvp-p,
-30, +25, and +80˚C

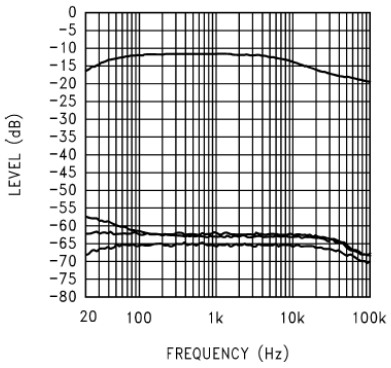


Power Supply Rejection Ration vs Bypass Capacitor Size
V_{DD} = 5V, Input Grounded = 10Ω, Output Load = 8Ω



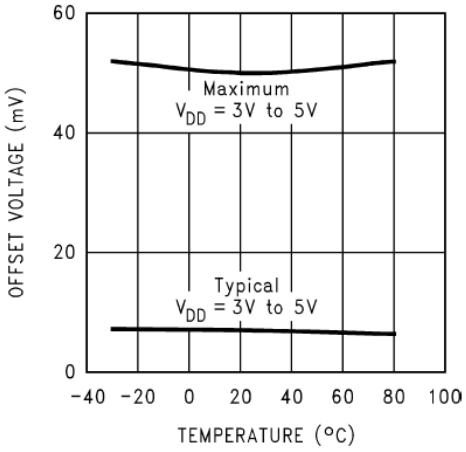
Top Trace = No Cap, Next Trace Down = 1µf
Next Trace Down = 2µf, Bottom Trace = 4.7µf

Power Supply Rejection Ration vs Bypass Capacitor Size
V_{DD} = 3V, Input Grounded = 10Ω, Output Load = 8Ω

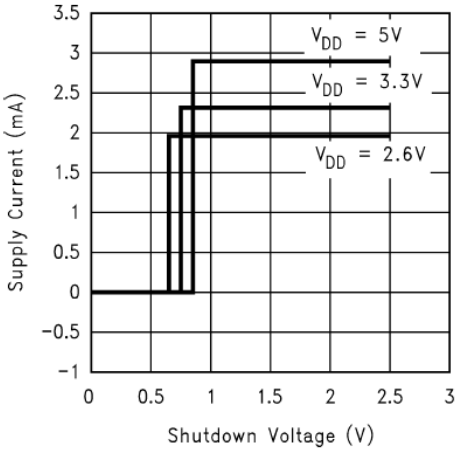


Top Trace = No Cap, Next Trace Down = 1µf
Next Trace Down = 2µf, Bottom Trace = 4.7µf

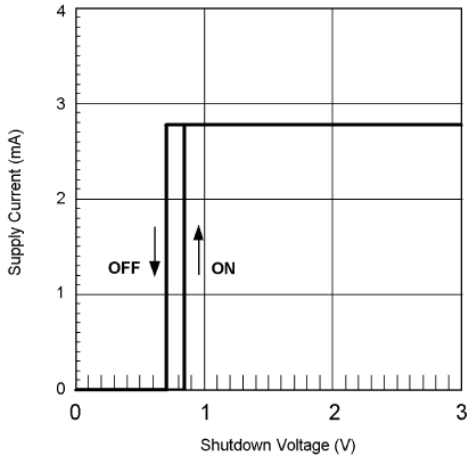
Output Offset Voltage



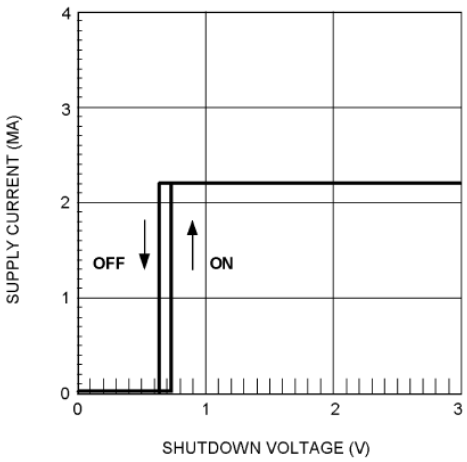
Supply Current vs Shutdown Voltage



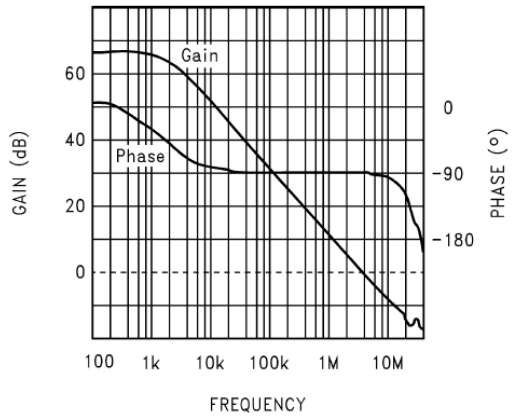
Shutdown Hysterisis Voltage
V_{DD} = 5V



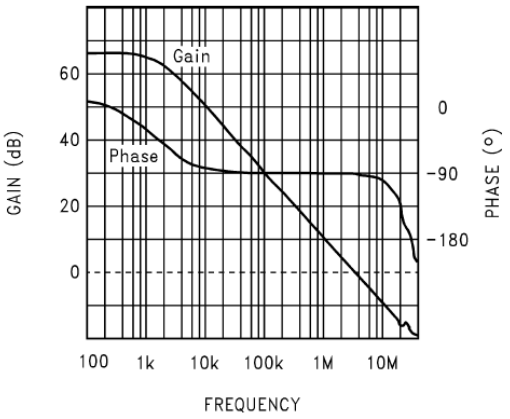
Shutdown Hysterisis Voltage
V_{DD} = 3V



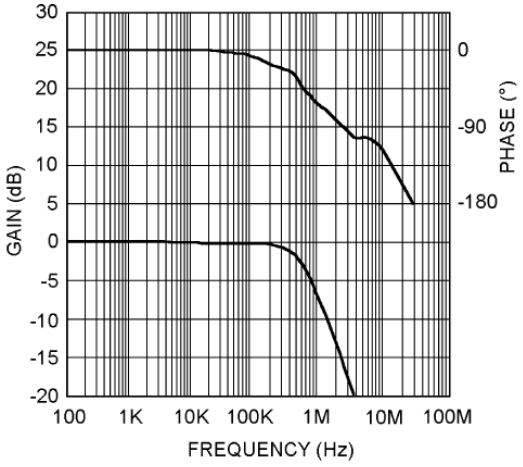
Open Loop Frequency Response
V_{DD} = 5V, No Load



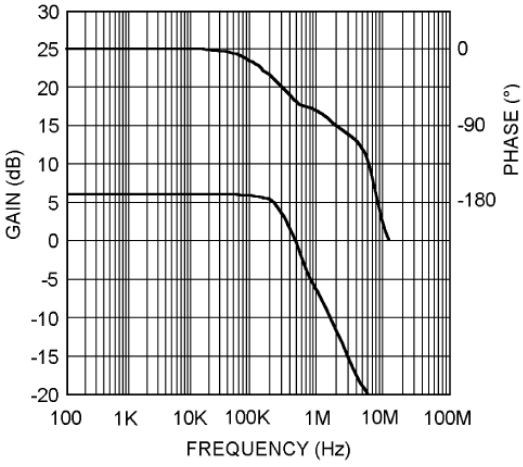
Open Loop Frequency Response
V_{DD} = 3V, No Load



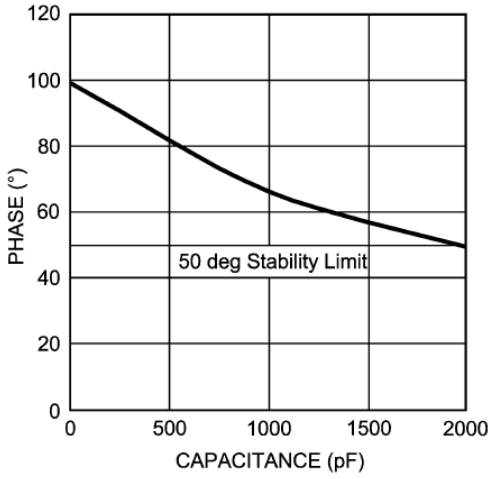
Gain / Phase Response, A_V = 2
V_{DD} = 5V, 8Ω Load, C_{LOAD} = 500pF



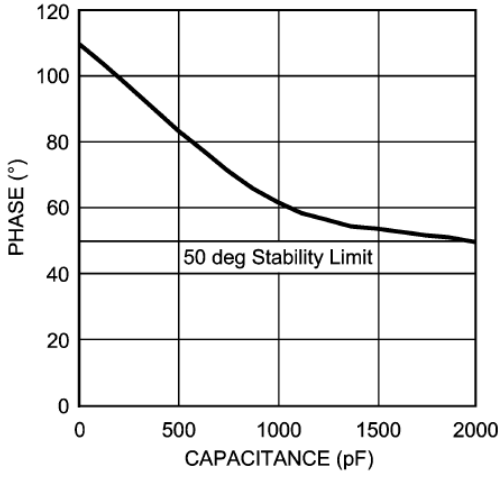
Gain / Phase Response, A_V = 4
V_{DD} = 5V, 8Ω Load, C_{LOAD} = 500pF



Phase Margin vs C_{LOAD}, A_V = 2
V_{DD} = 5V, 8Ω Load
Capacitance to gnd on each output

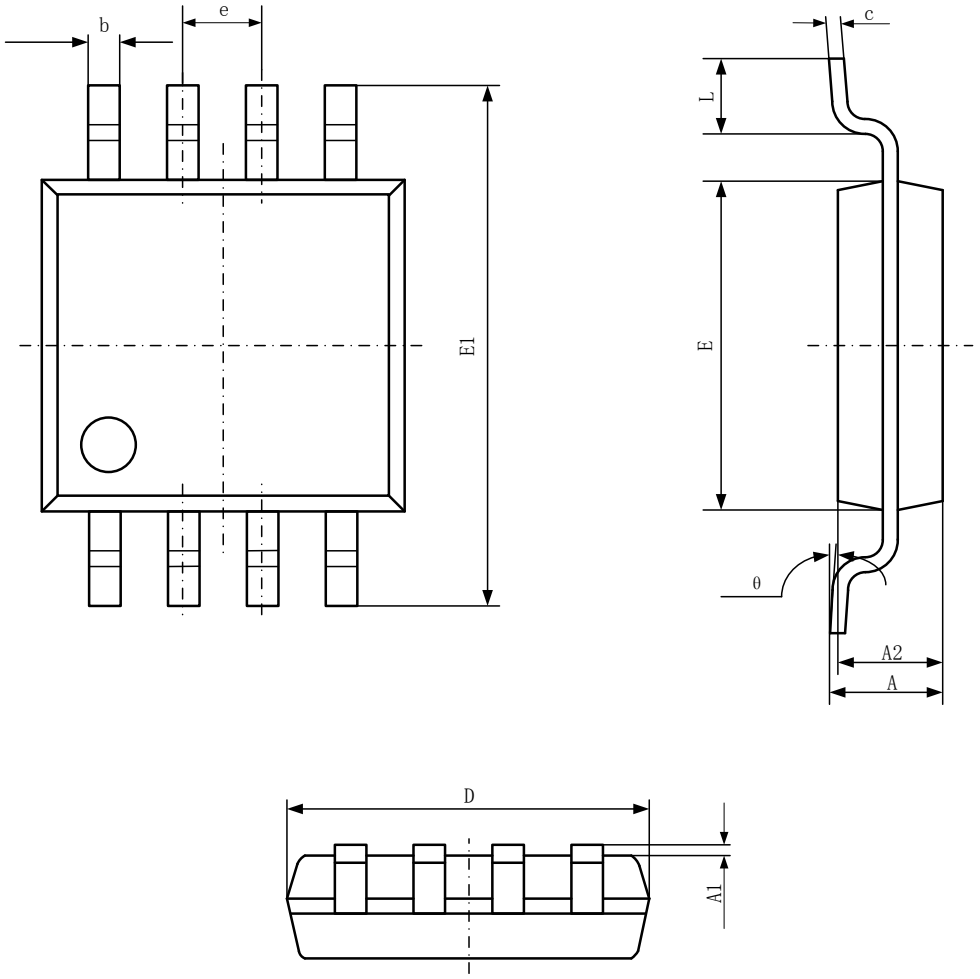


Phase Margin vs C_{LOAD}, A_V = 4
V_{DD} = 5V, 8Ω Load
Capacitance to gnd on each output



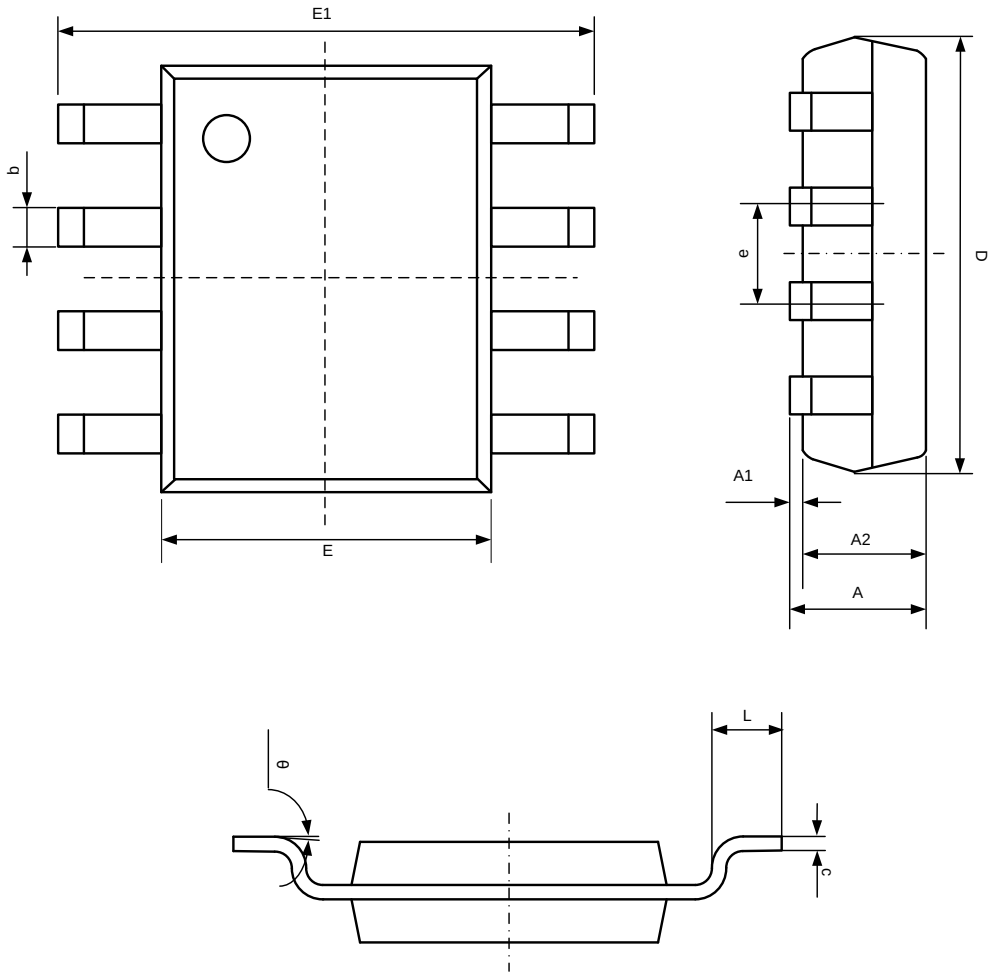
■ 封装信息

- **MSOP8**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.144	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

- **SOP8**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°