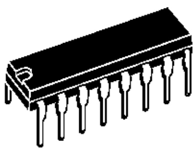
SGS-THOMSON MICROELECTRONICS

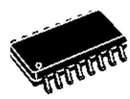
TSH94

HIGH SPEED LOW POWER QUAD OPERATIONAL AMPLIFIER (WITH **STANDBY** POSITION)

- **2 SEPARATE STANDBY** : REDUCED **CONSUMPTION** AND **HIGH IMPEDANCE OUTPUTS**
- LOW SUPPLY CURRENT : 4.5mA/amp. typ.
- HIGH SPEED : 150MHz - 110V/µs
- UNITY GAIN STABILITY
- LOW OFFSET VOLTAGE : 3mV
- LOW NOISE 4.2 nV/√Hz
- LOW COST
- SPECIFIED FOR **600Ω** AND **150Ω** LOADS
- HIGH VIDEO PERFORMANCES :
  Differential Gain : 0.03%
  Differential Phase : 0.07°
  Gain Flatness : 6MHz, 0.1dB max. @ 10dB gain
- HIGH AUDIO PERFORMANCES



N
DIP16
(Plastic Package)

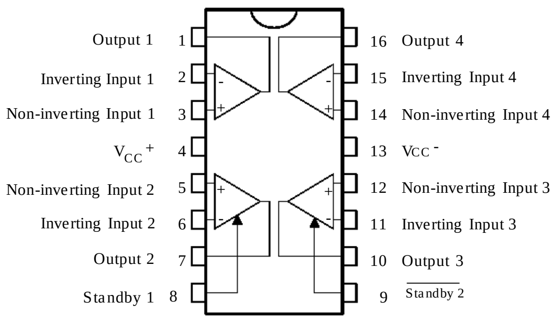


D
SO16
(Plastic Micropackage)

ORDER CODES

Part Number	Temperature Range	Package	
		N	D
TSH94I	-40, +125°C	•	•

PIN CONNECTIONS (top view)



DESCRIPTION

The TSH94 is a quad low power high frequency op-amp, designated for high quality video signal processing. The device offers an excellent speed consumption ratio with 4.5mA/amp. for 150MHz bandwidth.

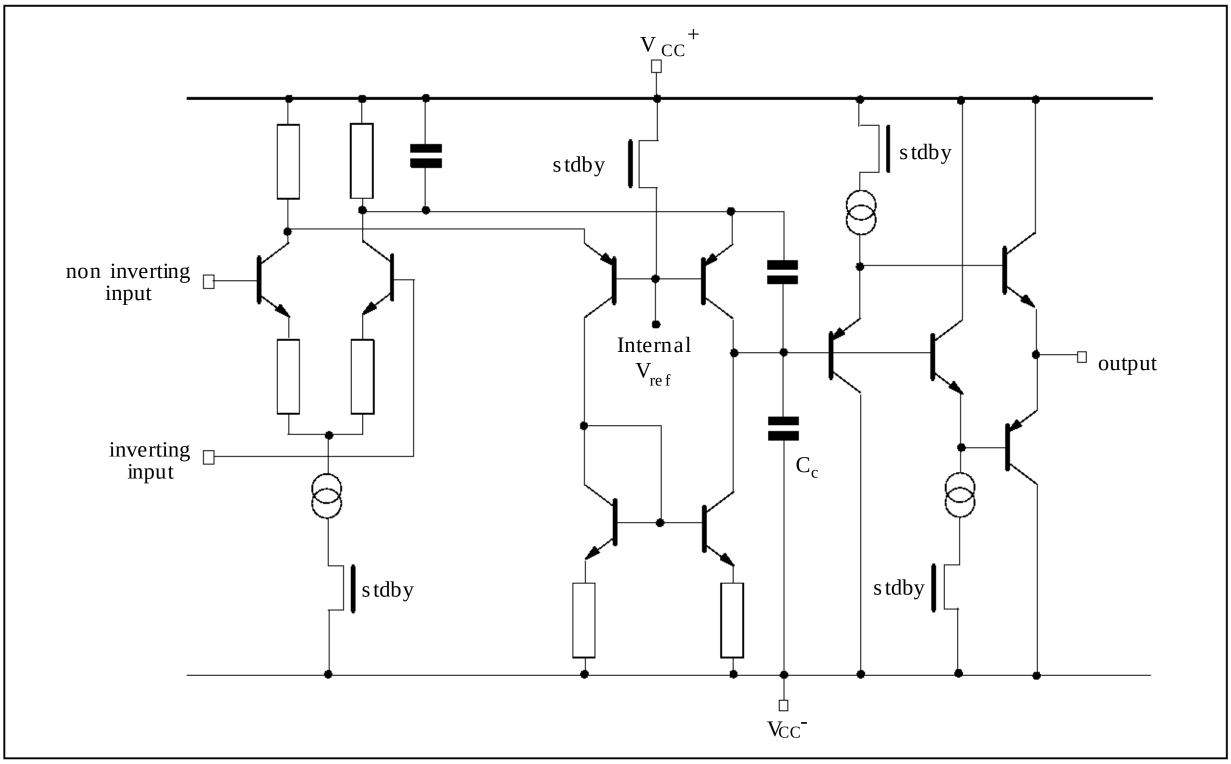
High slew rate and low noise make it also suitalbe for high quality audio applications.

The TSH94 offers 2 separate complementary **STANDBY pins** :

- STANDBY 1 acting on the n° 2 operator
- STANDBY 2 acting on the n° 3 operator

They reduce the consumption of the corresponding operator and put the output in a high impedance state.

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage - (note 1)	14	V
V_{id}	Differential Input Voltage - (note 2)	±5V	V
V_i	Input Voltage - (note 3)	-0.3 to 12	V
T_{oper}	Operating Free Air Temperature Range	-40 to +125	^oC
T_{stg}	Storage Temperature	-65 to +150	^oC

Notes :
1. All voltage values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed V_{CC}^+ +0.3V.

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	7 to 12	V
V_{icm}	Common Mode Input Voltage Range	V_{CC}^- +2V to V_{CC}^+ -1	V

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 5V, V_{CC}^- = -5V, pin 8 connected to 0V, pin 9 connected to V_{CC}^+, T_{amb} = 25°C
(unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage (V_{ic} = V_o = 0V) $T_{min.} \leq T_{amb.} \leq T_{max.}$			3 5	mV
I_{io}	Input Offset Current $T_{min.} \leq T_{amb.} \leq T_{max.}$		1	2 5	µA
I_{ib}	Input Bias Current $T_{min.} \leq T_{amb.} \leq T_{max.}$		5	15 20	µA
I_{CC}	Supply Current (per amplifier, no load) $T_{min.} \leq T_{amb.} \leq T_{max.}$		4.5	6 8	mA
CMR	Common Mode Rejection Ratio (V_{ic} = -3V to +4V, V_o = 0V) $T_{min.} \leq T_{amb.} \leq T_{max.}$	80 70	100		dB
SVR	Supply Voltage Rejection Ratio (V_{CC} = ±5V to ±3V) $T_{min.} \leq T_{amb.} \leq T_{max.}$	60 50	75		dB
A_{vd}	Large Signal Voltage Gain (R_L = 10kΩ, V_O = ±2.5V) $T_{min.} \leq T_{amb.} \leq T_{max.}$	57 54	70		dB
V_{OH}	High Level Output Voltage (V_{id} = 1V) R_L = 600Ω R_L = 150Ω $T_{min.} \leq T_{amb.} \leq T_{max.}$ R_L = 150Ω	 3 2.5 2.4	 3.5 3		V
V_{OL}	Low Level Output Voltage (V_{id} = -1V) R_L = 600Ω R_L = 150Ω $T_{min.} \leq T_{amb.} \leq T_{max.}$ R_L = 150Ω		 -3.5 -2.8	 -3 -2.5 -2.4	V
I_o	Output Short Circuit Current (V_{id} = ±1V) Source Sink $T_{min.} \leq T_{amb.} \leq T_{max.}$ Source Sink	20 20 15 15	36 40		mA
GBP	Gain Bandwidth Product (A_{VCL} = 100, R_L = 600Ω, C_L = 15pF, f =7.5MHz)	 90	 150		MHz
f_T	Transition Frequency		90		MHz
SR	Slew Rate (A_{VCL} = +1, R_L = 600Ω, C_L = 15pF, V_{in} = -2 to +2V)	70	110		V/µs
∅m	Phase Margin (A_{VM} = +1)		35		Degrees
e_n	Equivalent Input Noise Voltage (R_s = 50Ω, f = 1kHz)		4.2		$\frac{nV}{\sqrt{Hz}}$
V_{O1}/V_{O2}	Channel Separation (f = 1MHz to 10MHz)		65		dB
Gf	Gain Flatness (f = DC to 6MHz, A_{VCL} = 10dB)			0.1	dB
THD	Total Harmonic Distortion (f = 1kHz, V_o = ±2.5V, R_L = 600Ω)		0.01		%
ΔG	Differential Gain (f = 3.58MHz, A_{VCL} = +2, R_L = 150Ω)		0.03		%
Δφ	Differential Phase (f = 3.58MHz, A_{VCL} = +2, R_L = 150Ω)		0.07		Degree

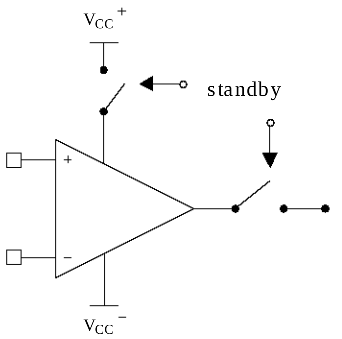
STANDBY MODE

$V_{CC}^+ = 5V$, $V_{CC}^- = -5V$, $T_{amb} = 25^oC$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{SBY}	Pin 8/9 Threshold Voltage for STANDBY Mode	V_{CC}^+ -2.2	V_{CC}^+ -1.6	V_{CC}^+ -1.0	V
$I_{CC\ SBY}$	Total Consumption Standby 1 & 2 = 0 Standby 1 & 2 = 1 Standby 1 = 1, Standby 2 = 0		 13.7 13.7 9.4		mA
I_{sol}	Input/Output Isolation (f = 1MHz to 10MHz)		70		dB
t_{ON}	Time from Standby Mode to Active Mode		200		ns
t_{OFF}	Time from Active Mode to Standby Mode		200		ns
I_D	Standby Driving Current		2		pA
I_{OL}	Output Leakage Current		20		pA
I_{IL}	Input Leakage Current		20		pA

LOGIC INPUT		STATUS		
Standby 1	Standby 2	Op-amp 2	Op-amp 3	Op-amp 1 & 4
0	0	Enable	Standby	Enable
0	1	Enable	Enable	Enable
1	0	Standby	Standby	Enable
1	1	Standby	Enable	Enable

STANDBY POSITION



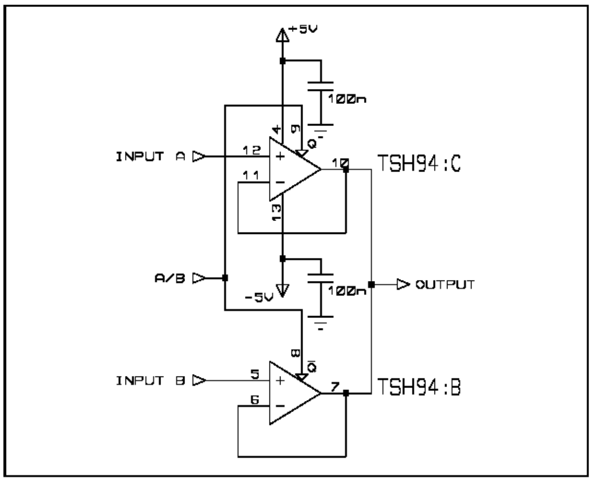
STANDBY MODE

To put the device in standby, just apply a logic level on the standby MOS input. As ground is a virtual level for the device, threshold voltage has been refered to V_{CC}^+ at V_{CC}^+ - 1.6V typ.

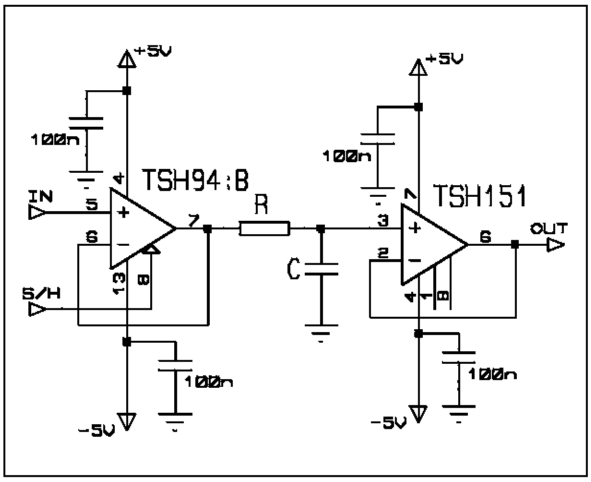
In standby mode, the output goes in high impedance in 200ns. Be aware that all maximum rating must still be followed in this mode. It leads to swing limitation while using the device in signal multiplexing configuration with followers, differential input voltage must not exceed ±5V limiting input swing to 2.5Vpp.

APPLICATIONS

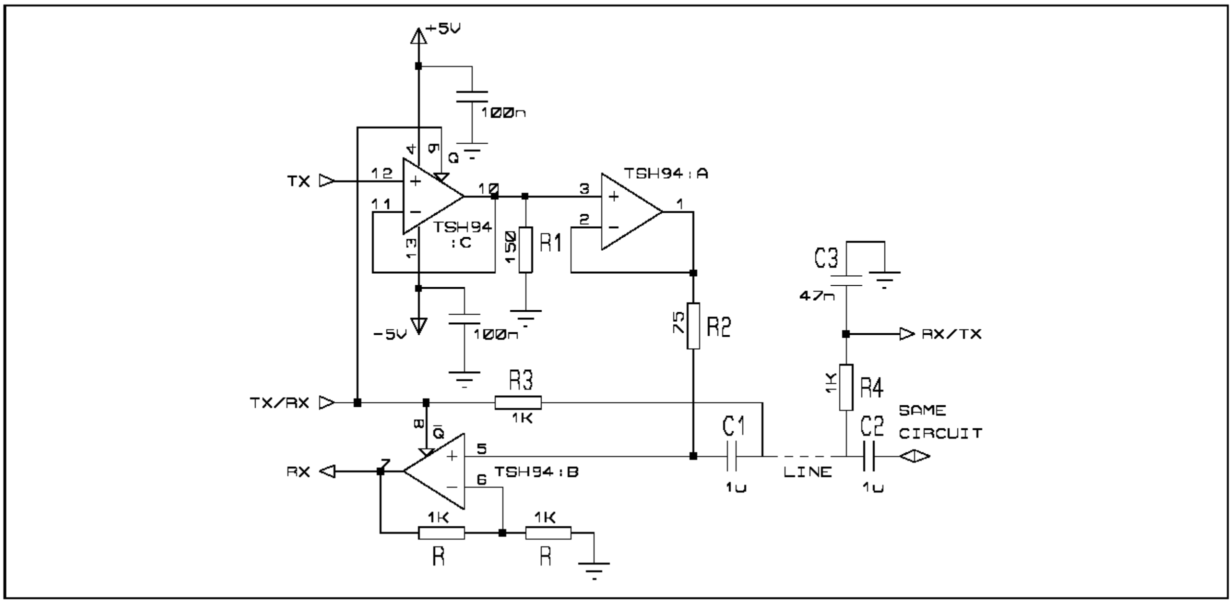
SIGNAL MULTIPLEXING



SAMPLE AND HOLD



VIDEO LINE TRANSCEIVER WITH REMOTE CONTROL

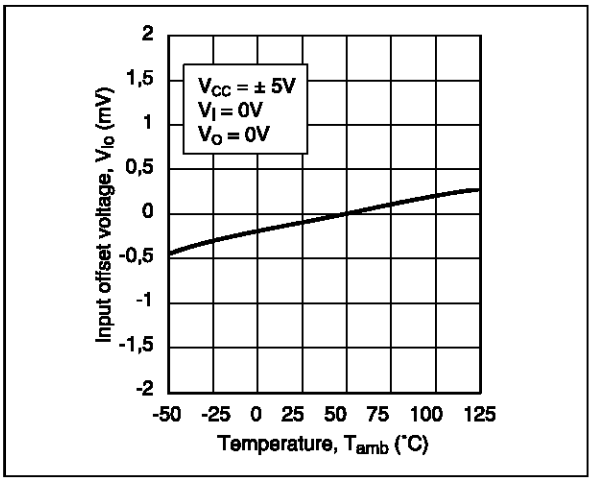


PRINTED CIRCUIT LAYOUT

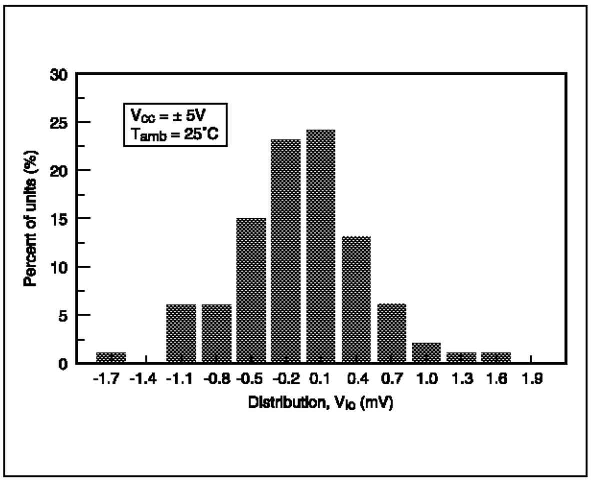
As for any high frequency device, a few rules must be observed when designing the PCB to get the best performances from this high speed op amp.
From the most to the least important points :

- Each power supply lead has to be by-passed to ground with a 10nF ceramic capacitor very close to the device and 10µF capacitor.
- To provide low inductance and low resistance common return, use a ground plane or common point return for power and signal.
- All leads must be wide and as short as possible especially for op amp inputs. This is in order to decrease parasitic capacitance and inductance.
- Use small resistor values to decrease time constant with parasitic capacitance.
- Choose componentsizes as small as possible (SMD).
- On output, decrease capacitor load so as to avoid circuit stability being degraded which may cause oscillation. You can also add a serial resistor in order to minimise its influence.

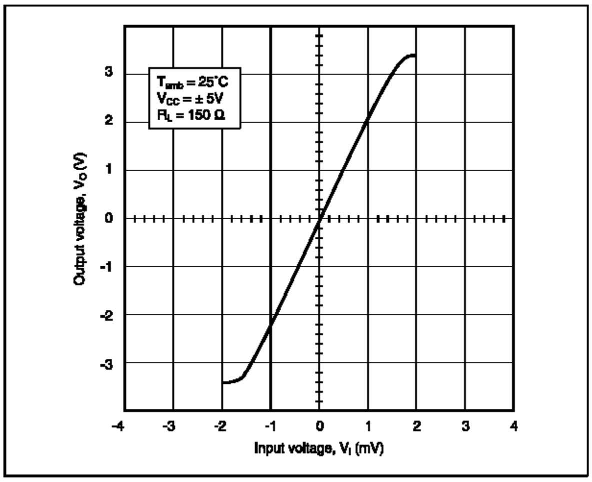
INPUT OFFSET VOLTAGE DRIFT VERSUS TEMPERATURE



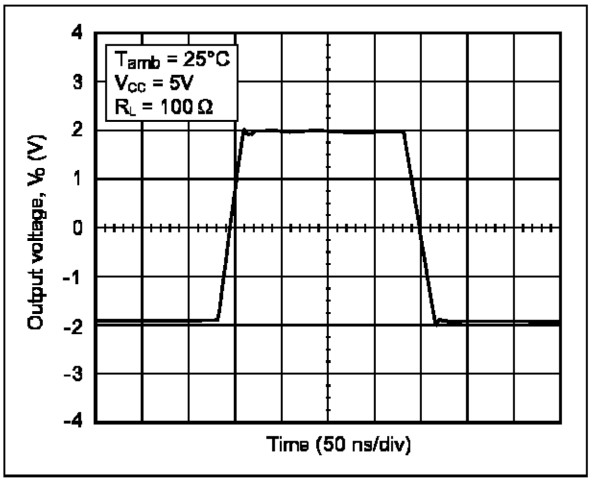
INPUT OFFSET VOLTAGE DISTRIBUTION



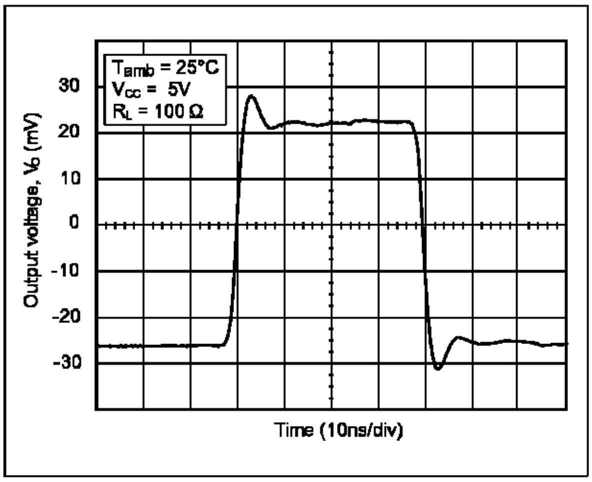
STATIC OPEN LOOP VOLTAGE GAIN



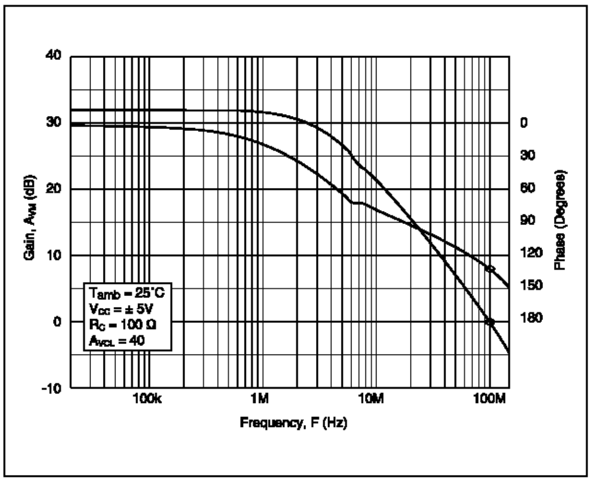
LARGE SIGNAL FOLLOWER RESPONSE



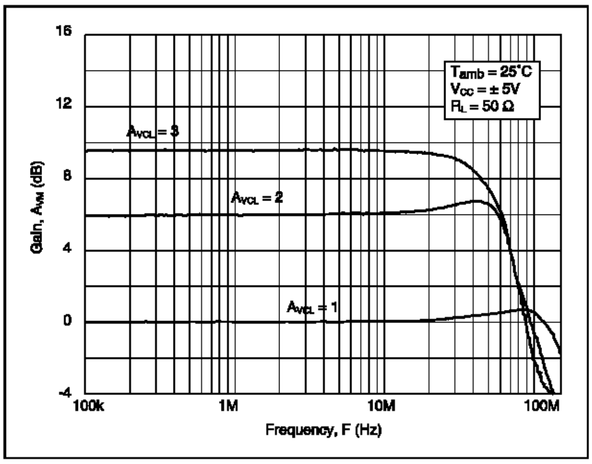
SMALL SIGNAL FOLLOWER RESPONSE



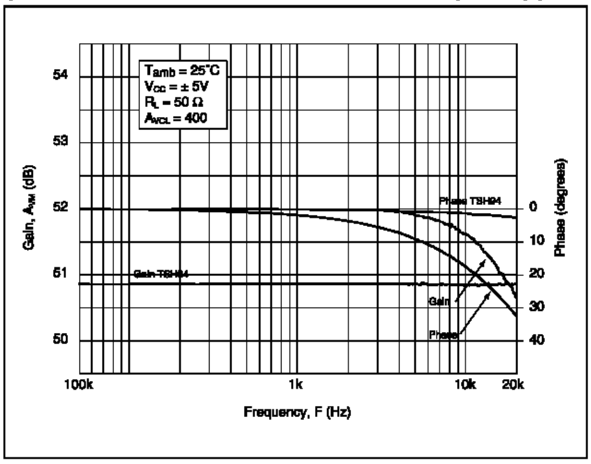
OPEN LOOP FREQUENCY RESPONSE AND PHASE SHIFT



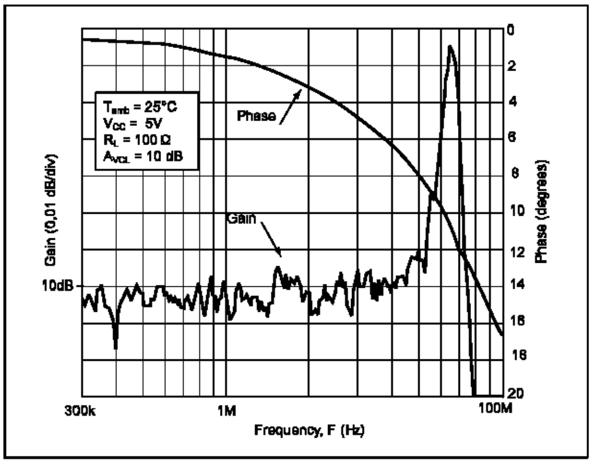
CLOSE LOOP FREQUENCY RESPONSE



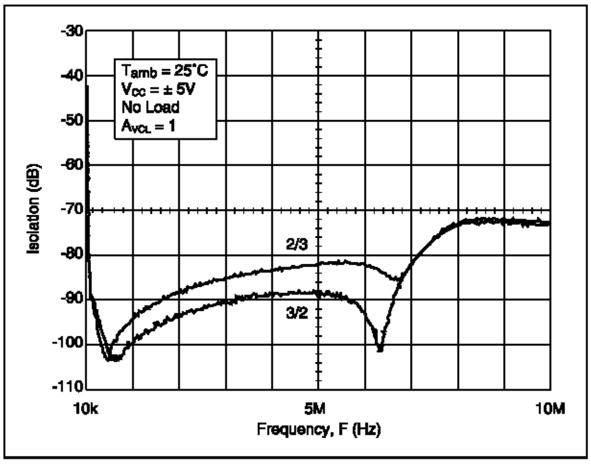
AUDIO BANDWIDTH FREQUENCY RESPONSE AND PHASE SHIFT (TSH94 vs Standard 15MHz Audio Op-Amp)



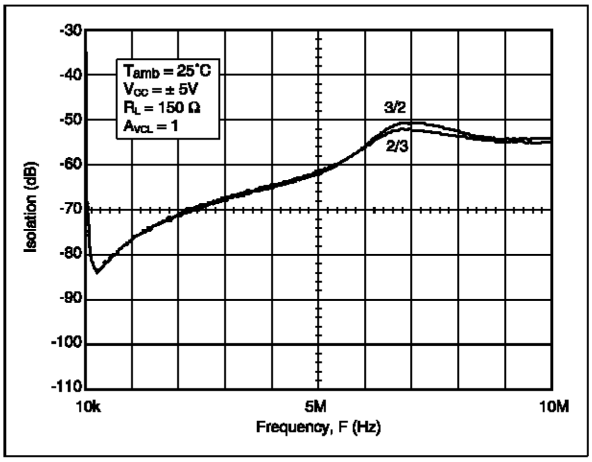
GAIN FLATNESS AND PHASE SHIFT VERSUS FREQUENCY



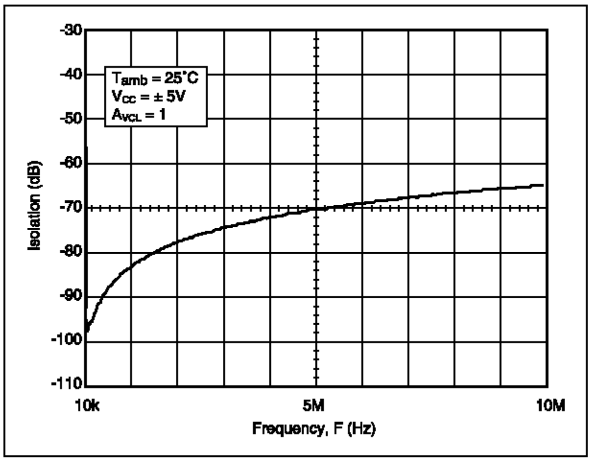
CROSS TALK ISOLATION VERSUS FREQUENCY (SO16 PACKAGE)



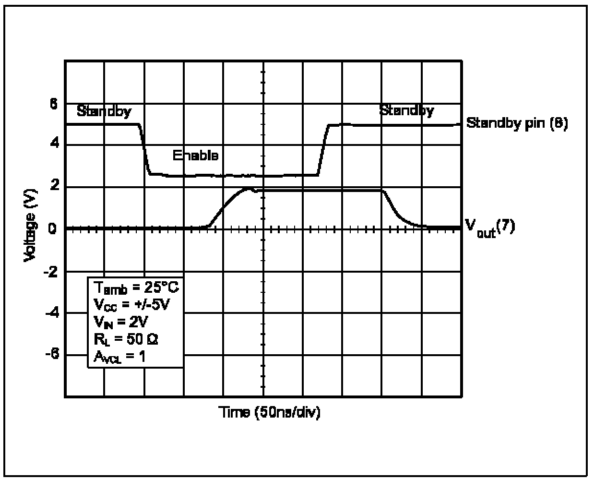
CROSS TALK ISOLATION VERSUS FREQUENCY (SO16 PACKAGE)



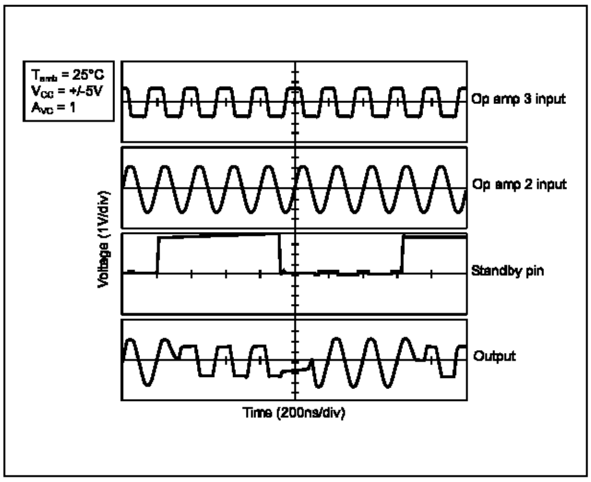
INPUT/OUTPUT ISOLATION IN STANDBY MODE (SO16 PACKAGE)



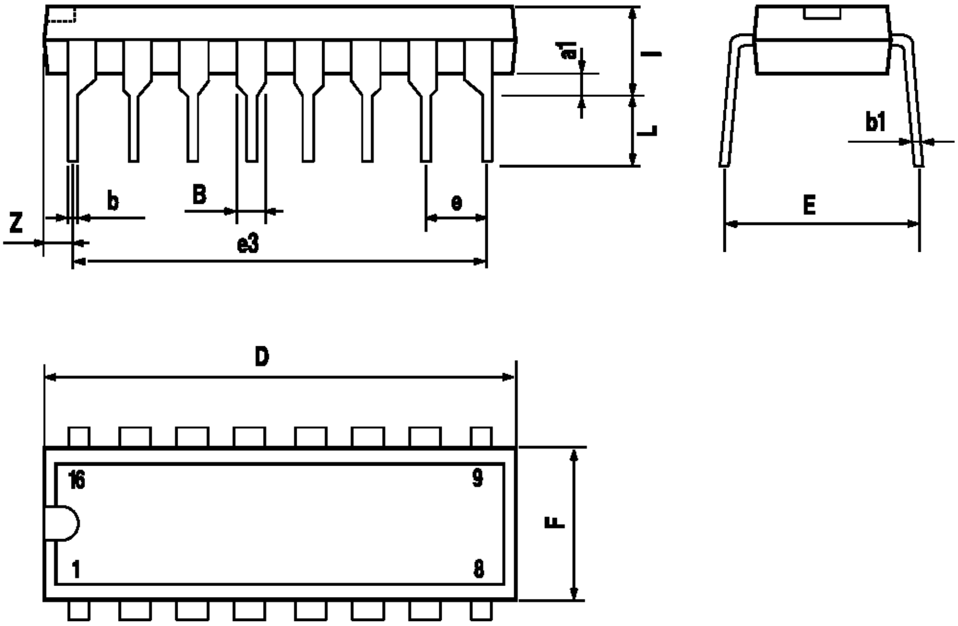
STANDBY SWITCHING



SIGNAL MULTIPLEXING (cf p. 5/10)



PACKAGE MECHANICAL DATA
16 PINS - PLASTIC DIP



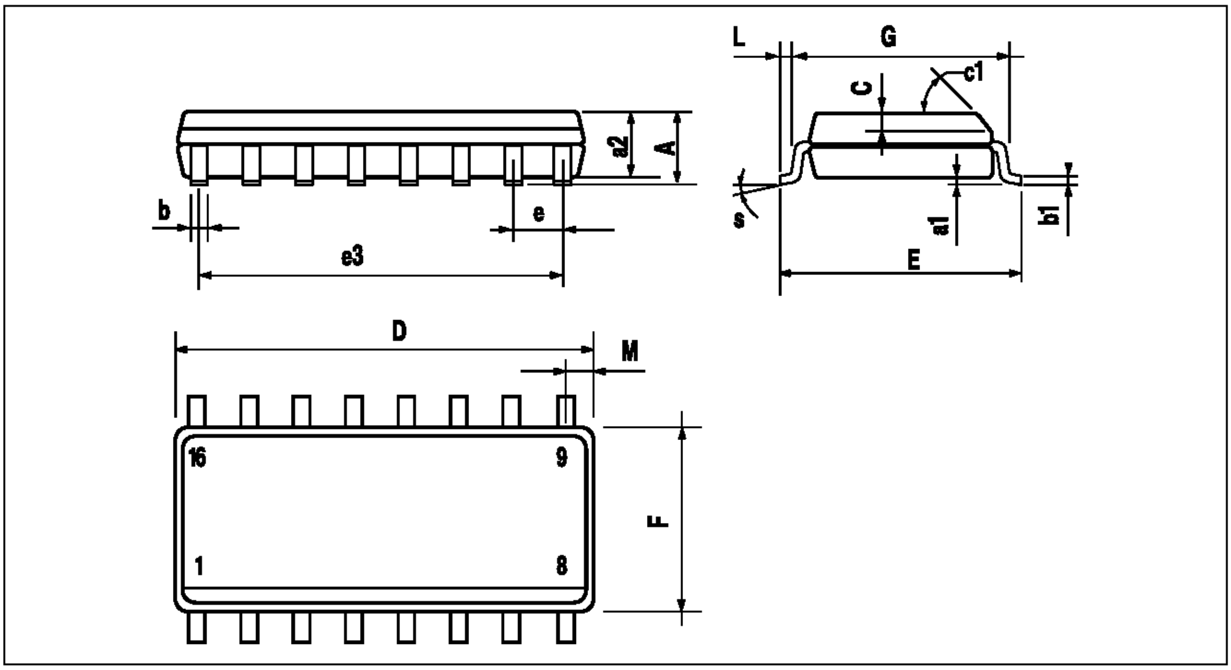
PM-DIP16.EPS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

DIP16.TBL

PACKAGE MECHANICAL DATA

16 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45^{o} (typ.)					
D	9.8		10	0.386		0.394
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.209
L	0.5		1.27	0.020		0.050
M			0.62			0.024
S	8^{o} (max.)					

SO16.TBL

ORDER CODE :