SGM9128YP
4-Channel, 6th-Order Video Filter Driver for SD/HD (1080i)

PRODUCT DESCRIPTION

The SGM9128YP video filter is intended to replace passive LC filters and drivers with an integrated device. Four 6th-order Butterworth filters provide improved image quality compared to typical passive solutions. One channel offers Standard Definition (SD) filter while the other three channels are High Definition (HDi) filters.

The SGM9128YP offers a fixed gain of 6dB. It may be directly driven by a DC-coupled DAC output or an AC-coupled signal. Internal clamp circuitry may be used if AC-coupled inputs are required.

The outputs can be AC- or DC-coupled. DC coupling the output removes the need for output coupling capacitors.

SGM9128YP is available in Green MSOP-10 (Exposed Pad) package. It operates over an ambient temperature range of -40℃ to +85℃.

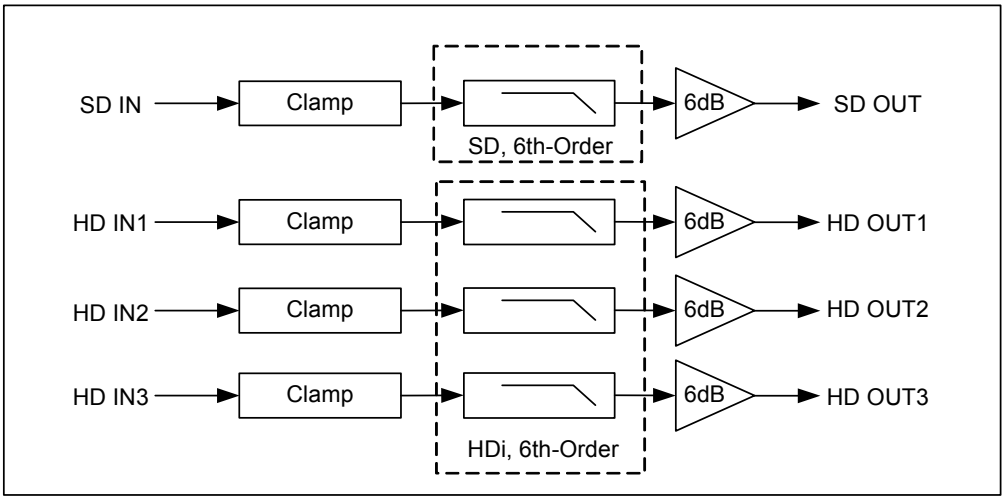
FEATURES

- **Three 6th-Order High Definition Filters**
- **One 6th-Order Standard Definition Filter**
- **Clamp Mode Active with AC-Coupled Inputs**
- **Clamp Mode Inactive with DC-Coupled Inputs**
- **AC- or DC-Coupled Outputs**
- **DC-Coupled Outputs Eliminate AC Coupling Capacitors**
- **Single Supply: 3.1V to 5.5V**
- **Available in Green MSOP-10 (Exposed Pad) Package**
- **-40°C to +85°C Operating Temperature Range**

APPLICATIONS

Set-Top Boxes
DVD Players
HDTV
Personal Video Recorders (PVR)
Video on Demand

BLOCK DIAGRAM



PACKAGE/ORDERING INFORMATION

ORDER NUMBER	PACKAGE DESCRIPTION	TEMPERATURE RANGE	MARKING INFORMATION	PACKAGE OPTION
SGM9128YPMS10G/TR	MSOP-10 (Exposed Pad)	-40℃ to +85℃	SGM9128YPMS10	Tape and Reel, 3000

ABSOLUTE MAXIMUM RATINGS

DC Supply Voltage 6V
Analog and Digital Input/Output Voltage
..... GND - 0.3V to V_{CC} + 0.3V
Storage Temperature Range.....-65℃ to +150℃
Junction Temperature ..... 150℃
Operating Temperature Range .....-40℃ to +85℃
Lead Temperature Range (Soldering 10 sec)..... 260℃
ESD Susceptibility
HBM.....8000V
MM.....400V

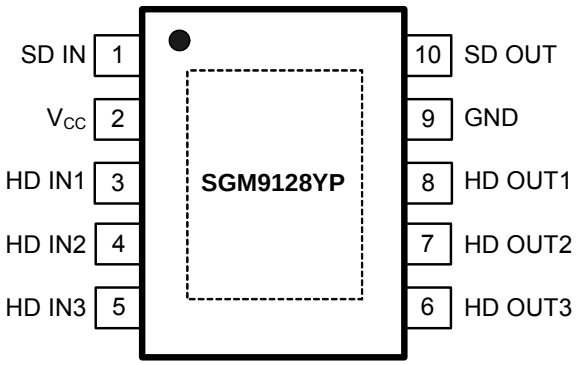
NOTE:
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

CAUTION

This integrated circuit can be damaged by ESD if you don’t pay attention to ESD protection. SGMICRO 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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

PIN CONFIGURATION (TOP VIEW)



MSOP-10 (Exposed Pad)

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	SD IN	SD Video Input.
2	V_{CC}	Power Supply.
3	HD IN1	HD Video Input. Channel 1.
4	HD IN2	HD Video Input. Channel 2.
5	HD IN3	HD Video Input. Channel 3.
6	HD OUT3	Filtered HD Video Output. Channel 3.
7	HD OUT2	Filtered HD Video Output. Channel 2.
8	HD OUT1	Filtered HD Video Output. Channel 1.
9	GND	Ground.
10	SD OUT	Filtered SD Video Output.
Exposed Paddle	—	Exposed Paddle. Can only be connected to GND or left floating.

ELECTRICAL CHARACTERISTICS

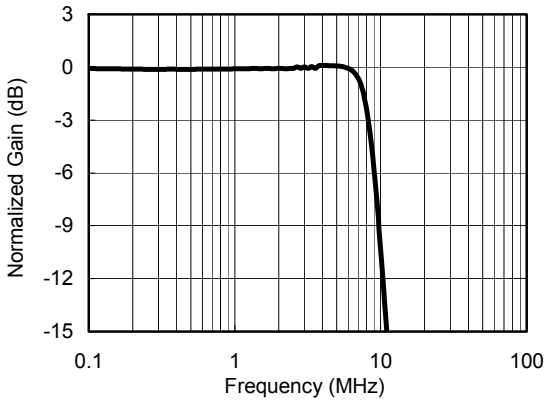
(T_A = +25℃, V_{IN} = 1V_{PP}, V_{CC} = 5V, R_{SOURCE} = 37.5Ω; all inputs are AC-coupled with 0.1μF; all outputs are AC-coupled with 220μF into 150Ω, referenced to 400kHz, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
DC ELECTRICAL CHARACTERISTICS					
Operating Voltage Range (V_{CC})		3.1	5	5.5	V
Quiescent Current (I_Q)	V_{CC} = 5.0V, No load		65	84	mA
Output Level Shift Voltage (V_{OLS})	V_{IN} = 0V, No load		550	760	mV
Voltage Gain (A_V)	R_L = 150Ω	5.8	6.1	6.35	dB
Output Voltage High Swing	V_{IN} = 3V, R_L = 150Ω to GND		4.8		V
Video Input Voltage Range	Referenced to GND if DC-coupled		1.4		V_{PP}
Power Supply Rejection Ratio (PSRR)	DC (All channels)		50		dB
STANDARD DEFINITION ELECTRICAL CHARACTERISTICS					
-0.1dB Bandwidth	SD channel		6.4		MHz
-1dB Bandwidth	SD channel		7.6		MHz
-3dB Bandwidth	SD channel		8.5		MHz
Filter Response (Normalized Gain)	SD channel, f_{IN} = 400kHz to 27MHz		50		dB
Slew Rate	2V Output step, 80% to 20%		34		V/μs
Differential Gain (DG)	AC-AC coupled, PAL/NTSC		0.9/0.5		%
	AC-DC coupled, PAL/NTSC		0.5/0.35		
Differential Phase (DP)	AC-AC coupled, PAL/NTSC		1/0.7		deg
	AC-DC coupled, PAL/NTSC		0.7/0.6		
Group Delay Variation (D/DT)	Difference between 400kHz and 6.5MHz		30		ns
Crosstalk (channel-to-channel)	V_{OUT} = 1.4V_{PP}, f = 1MHz		-61		dB
Signal-to-Noise Ratio (SNR)	NTC-7 weighting, 100kHz to 5MHz		75		dB
Fall Time	2V Output step, 80% to 20%		34		ns
Rise Time	2V Output step, 80% to 20%		36		ns
Chroma Luma Gain (CLG_{SD})	f = 3.58MHz (Referenced to SD_{IN} at 400kHz)		102		%
Chroma Luma Delay (CLD_{SD})	f = 3.58MHz (Referenced to SD_{IN} at 400kHz)		8		ns
1080i HIGH DEFINITION ELECTRICAL CHARACTERISTICS					
-0.1dB Bandwidth	R_L = 150Ω		32		MHz
-1dB Bandwidth	R_L = 150Ω		39		MHz
-3dB Bandwidth	R_L = 150Ω		46		MHz
Filter Response (Normalized Gain)	f_{IN} = 400kHz to 74.25MHz		23		dB
Slew Rate	2V Output step, 80% to 20%		190		V/μs
Group Delay Variation (D/DT)	Difference between 400kHz and 26MHz		2.5		ns
Crosstalk (channel-to-channel)	V_{OUT} = 1.4V_{PP}, f = 1MHz		-60		dB
Fall Time	2V Output step, 80% to 20%		6.2		ns
Rise Time	2V Output step, 80% to 20%		6.2		ns

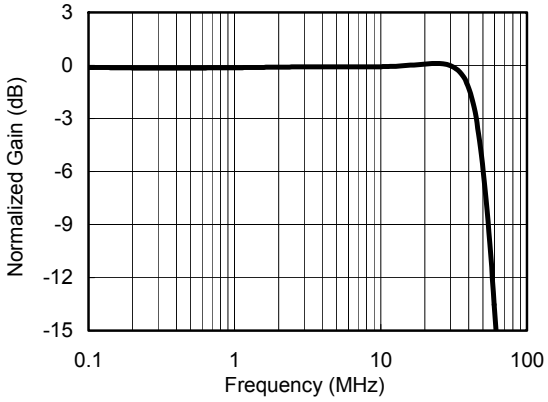
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25℃, V_{IN} = 1V_{PP}, V_{CC} = 5V, R_{SOURCE} = 37.5Ω; all inputs are AC-coupled with 0.1μF; all outputs are AC-coupled with 220μF into 150Ω, referenced to 400kHz, unless otherwise noted.

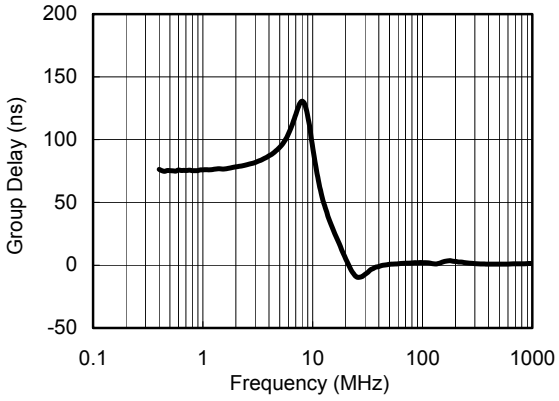
SD Gain vs. Frequency



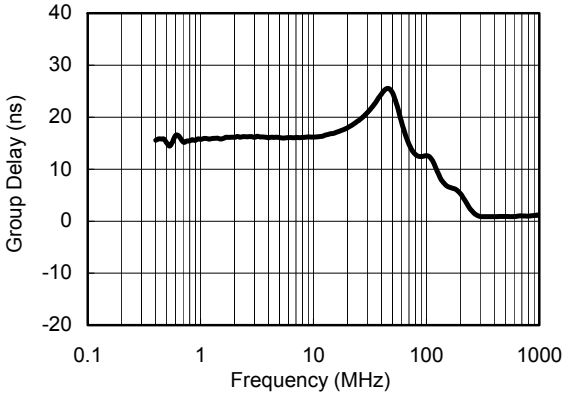
HD Gain vs. Frequency



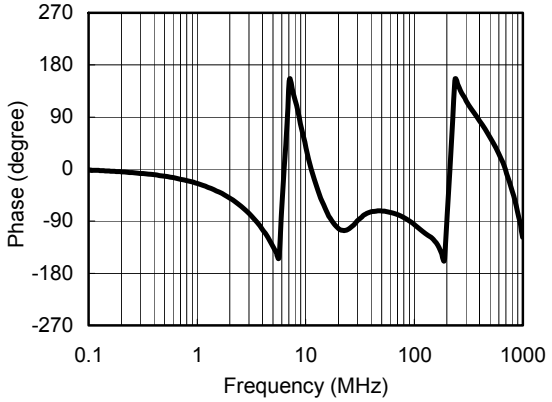
SD Group Delay vs. Frequency



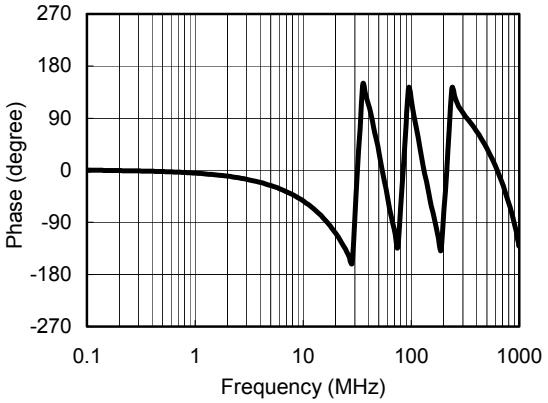
HD Group Delay vs. Frequency



SD Phase vs. Frequency



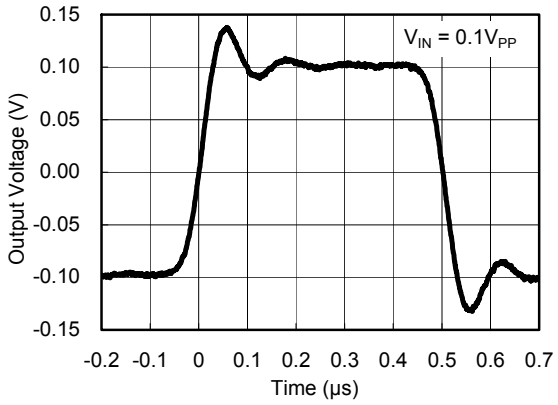
HD Phase vs. Frequency



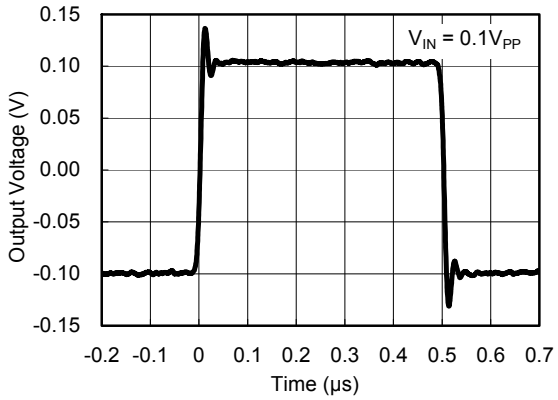
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25℃, V_{IN} = 1V_{PP}, V_{CC} = 5V, R_{SOURCE} = 37.5Ω; all inputs are AC-coupled with 0.1μF; all outputs are AC-coupled with 220μF into 150Ω, referenced to 400kHz, unless otherwise noted.

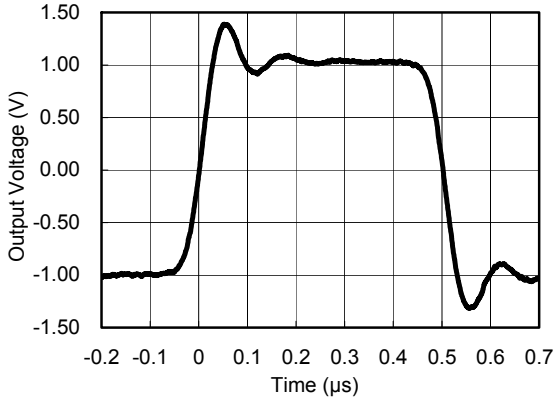
SD Small Signal Step Response



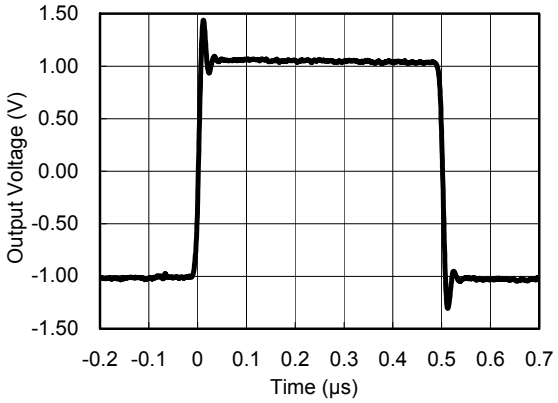
HD Small Signal Step Response



SD Large Signal Step Response

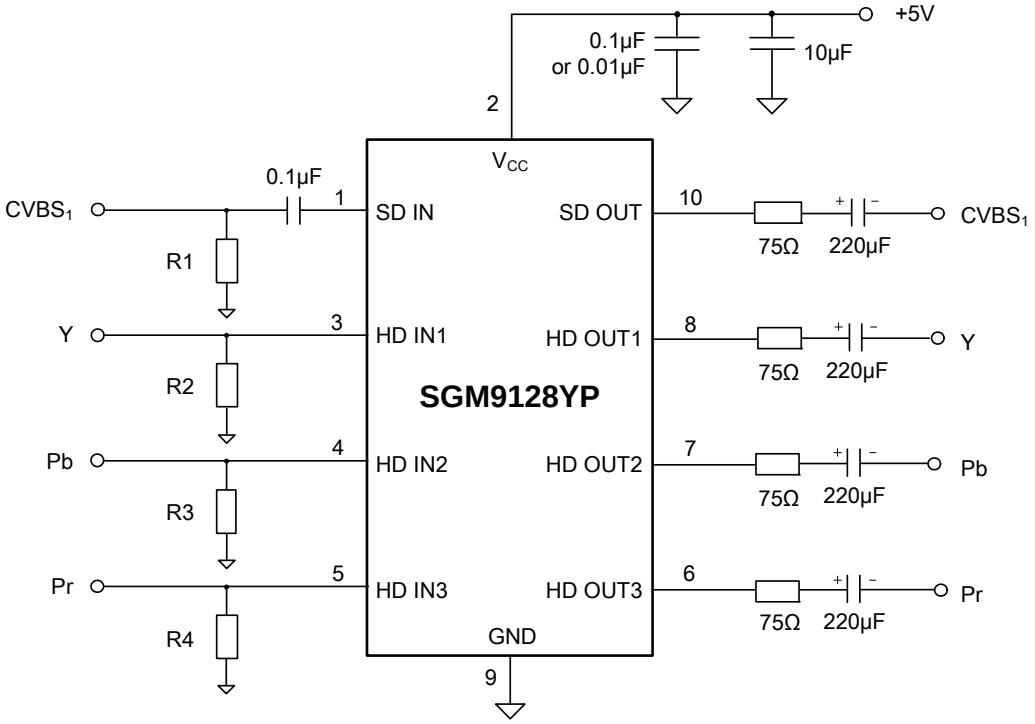


HD Large Signal Step Response



TYPICAL APPLICATION DIAGRAM

The following circuit may be used for direct DC-coupled drive by DACs with an output voltage range from 0V to 1.4V. AC-coupled or DC-coupled outputs may be used with AC-coupled outputs offering slightly lower power dissipation.



APPLICATION INFORMATION

Application Circuits

The SGM9128YP video filter provides 6dB gain from input to output. In addition, the input is slightly offset to optimize the output driver performance. The offset is held to the minimum required value to decrease the standing DC current into the load.

The SGM9128YP provides an internal clamp to support AC-coupled input signals. If the input signal does not go below ground, the input clamp does not operate. This allows DAC outputs to directly drive the SGM9128YP without an AC coupling capacitor. When the input is AC-coupled, the clamp sets the sync tip (or lowest voltage) just below ground. The worst-case sync tip compression due to the clamp cannot exceed 7mV. The input level set by the clamp, combined with the internal DC offset, keeps the output within its acceptable range.

I/O Configurations

For a DC-coupled DAC drive with DC-coupled outputs, use the configuration in Figure 1.

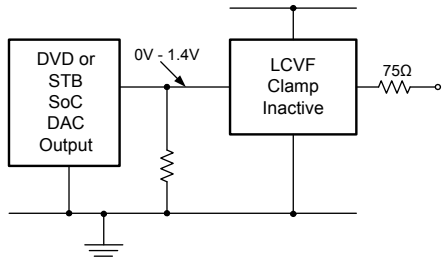


Figure 1. DC-Coupled Inputs and Outputs

Alternatively, if the DAC's average DC output level causes the signal to exceed the range from 0V to 1.4V, it can be AC-coupled as shown in Figure 2.

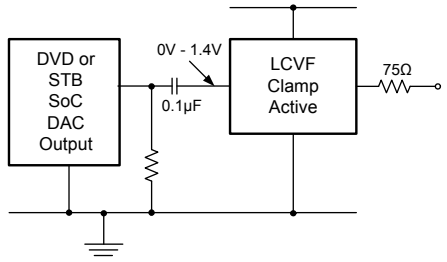


Figure 2. AC-Coupled Inputs, DC-Coupled Outputs

The same circuits can be used with AC-coupled outputs if desired.

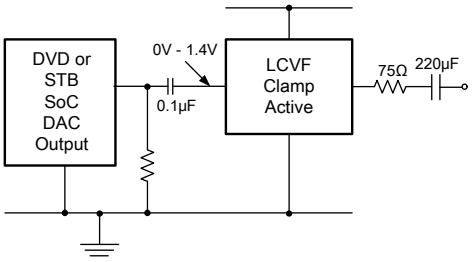


Figure 3. AC-Coupled Inputs and Outputs

NOTE: The video tilt or line time distortion is dominated by the AC coupling capacitor. The value may need to be increased beyond 220μF to obtain satisfactory operation in some applications.

Power Dissipation

The SGM9128YP output drive configuration must be considered when calculating overall power dissipation. Care must be taken not to exceed the maximum die junction temperature. The following equations can be used to calculate the power dissipation and internal temperature rise.

$$T_J = T_A + P_D \bullet \theta_{JA} \quad (1)$$

where:

$$P_D = P_{CH1} + P_{CH2} + P_{CH3} \quad (2)$$

$$P_{CHX} = V_{CC} \bullet I_{CH} - (V_O^2/R_L) \quad (3)$$

where:

$$V_O = 2V_{IN} + 0.55V \quad (4)$$

$$I_{CH} = (I_{CC}/3) + (V_O/R_L) \quad (5)$$

V_{IN} = RMS value of input signal

I_{CC} = 65mA

V_{CC} = 5.0V

R_L = channel load resistance

Board layout can also affect thermal characteristics. Refer to the Layout Considerations section for details.

The SGM9128YP is specified to operate with output currents typically less than 50mA, more than sufficient for a dual (75Ω) video load. Internal amplifiers are current limited to a maximum of 80mA and should withstand brief-duration short-circuit conditions. This capability is not guaranteed.

APPLICATION INFORMATION

Recommended Routing/Layout Rules

- Do not run analog and digital signals in parallel.
- Use separate analog and digital power planes to supply power.
- Do not run traces on top of the ground plane.
- Run no traces over ground/power splits.
- Avoid routing at 90-degree angles.
- Minimize clock and video data trace length differences.
- Include 0.01μF and 0.1μF ceramic power supply bypass capacitors.
- Place the 0.1μF capacitor within 0.1 inches of the device power pin.
- Place the 0.01μF capacitor within 0.75 inches of the device power pin.
- For multi-layer boards, use a large ground plane to help dissipate heat.
- For two-layer boards, use a ground plane that extends beyond the device body at least 0.5 inches on all sides. Include a metal paddle under the device on the top layer.
- Minimize all trace lengths to reduce series inductance.
- Place a 75Ω series resistor within 0.5 inches of the output pin to isolate the output driver from board parasitics.

Thermal Considerations

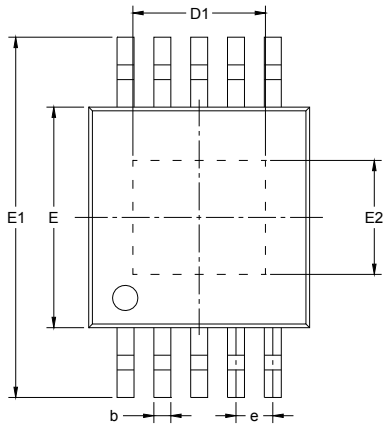
Since the interior of systems such as set-top boxes, TVs and DVD players are at +70℃, consideration must be given to providing an adequate heat sink for the device package for maximum heat dissipation. When designing a system board, determine how much power each device dissipates. Ensure that devices of high power are not placed in the same location, such as directly above (top plane) or below (bottom plane) each other on the PCB.

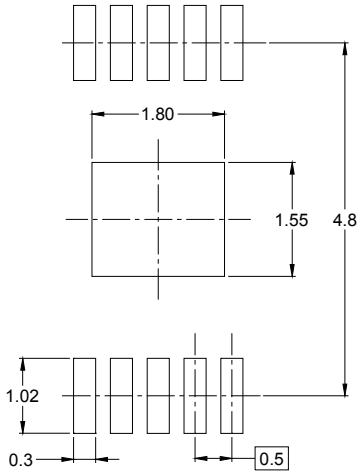
PCB Thermal Layout Considerations

- Understand the system power requirements and environmental conditions.
- Maximize thermal performance of the PCB.
- Consider using 70μm of copper for high-power designs.
- Make the PCB as thin as possible by reducing FR4 thickness.
- Use vias in the power pad to tie adjacent layers together.
- Remember that baseline temperature is a function of board area, not copper thickness.
- Consider modeling techniques a first-order approximation.

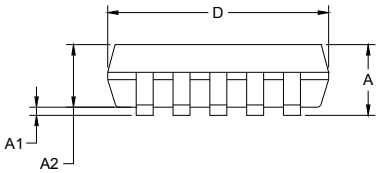
PACKAGE OUTLINE DIMENSIONS

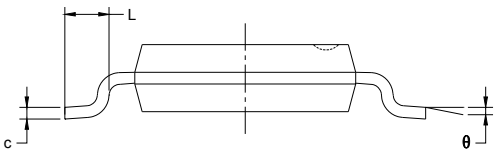
MSOP-10 (Exposed Pad)





RECOMMENDED LAND PATTERN (Unit: mm)





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	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
D1	1.700	1.900	0.067	0.075
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
E2	1.450	1.650	0.057	0.065
e	0.500 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°