



## **SGM9133**

### **4-Channel, Video Filter Driver for SD/HD (1080i)/HD (1080p)**

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#### **PRODUCT DESCRIPTION**

The SGM9133 video filter is intended to replace passive LC filters and drivers with an integrated device. One 6th-order channel offers SD filter while the other three HD filters are configurable between HDi and HDp filters. The SGM9133 may be directly driven by a DC-coupled DAC output or an AC-coupled signal. Internal clamp and bias circuitry may be used if AC-coupled inputs are required.

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

The SGM9133 is available in Green TSSOP-14 package. It operates over an ambient temperature range of -40°C to +85°C.

#### **FEATURES**

- **Three Configurable 6th-Order Filters for**
  - 1080i High Definition Mode**
  - 1080p High Definition Mode**
- **One 6th-Order Standard Definition Filter**
- **Shutdown Control to Save Power**
- **Clamp or Bias Mode Active with AC-Coupled Inputs**
- **Clamp or Bias Mode Inactive with DC-Coupled Inputs**
- **AC- or DC-Coupled Outputs**
- **DC-Coupled Output Eliminates AC Coupling Capacitor**
- **Available in Green TSSOP-14 Package**
- **-40°C to +85°C Operating Temperature Range**

#### **APPLICATIONS**

Set-Top Boxes  
Communication Devices  
Portable and Handheld Products  
Personal Video Recorders  
Video on Demand  
DVD Players  
HDTVs

**PACKAGE/ORDERING INFORMATION**

ORDER NUMBER	PACKAGE DESCRIPTION	TEMPERATURE RANGE	MARKING INFORMATION	PACKAGE OPTION
SGM9133YTS14G/TR	TSSOP-14	-40°C to +85°C	SGM9133YTS14	Tape and Reel, 3000

**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage, GND to $V_{CC}$ .....	6V
Input Voltage.....	GND - 0.3V to $V_{CC}$ + 0.3V
Storage Temperature Range .....	-65°C to +150°C
Junction Temperature .....	150°C
Operating Temperature Range .....	-40°C to +85°C
Lead Temperature (Soldering 10s).....	260°C
ESD Susceptibility	
HBM.....	8000V
MM.....	400V

**NOTE:**

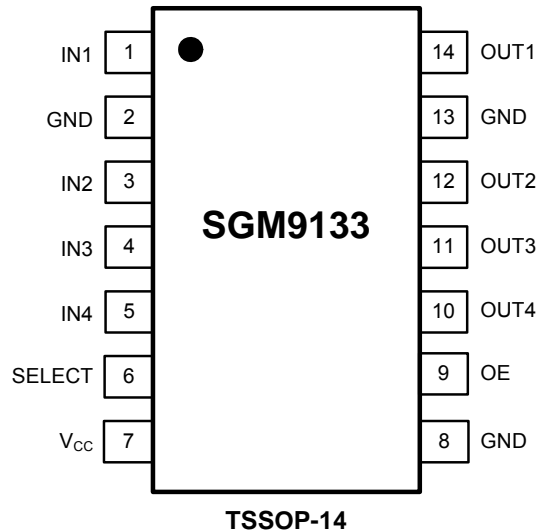
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

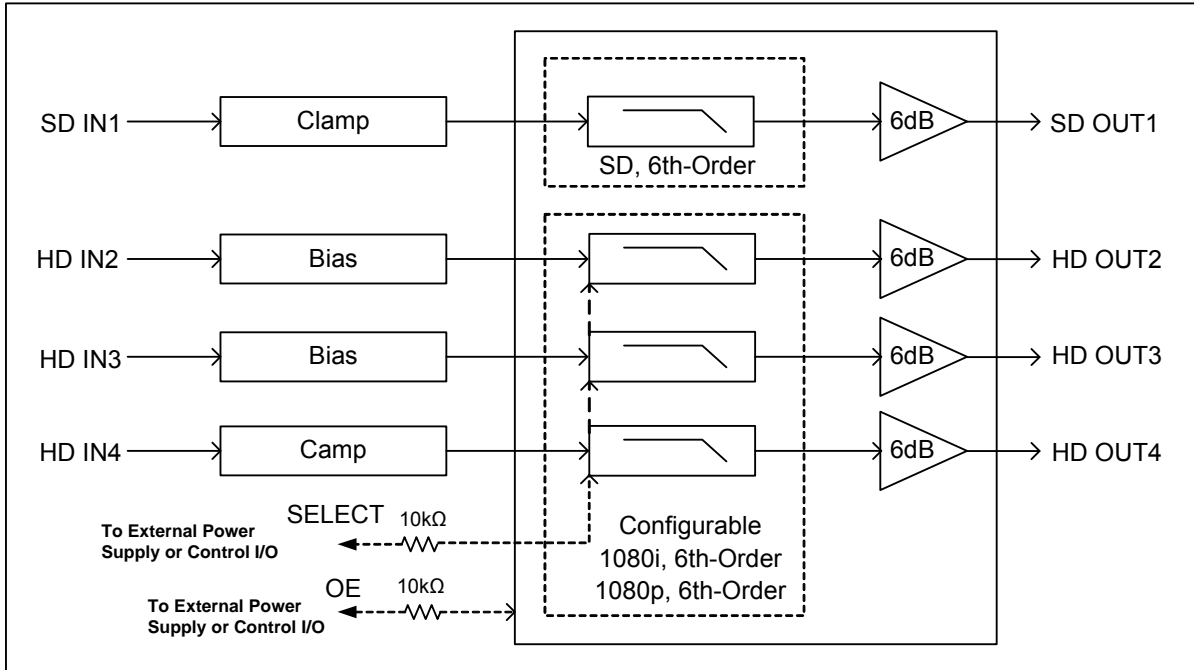
## PIN CONFIGURATION (TOP VIEW)



## PIN DESCRIPTION

PIN	NAME	FUNCTION
1	IN1	Video Input Channel SD. Input is clamp mode.
2, 8, 13	GND	Ground.
3	IN2	Video Input Channel HD (Pb). Input is bias mode.
4	IN3	Video Input Channel HD (Pr). Input is bias mode.
5	IN4	Video Input Channel HD (Y). Input is clamp mode.
6	SELECT	1080i and 1080p Select. SELECT = "low": 1080i mode is selected. SELECT = "high": 1080p mode is selected.
7	V <sub>CC</sub>	Power Supply.
9	OE	Output Enable Pin. When OE = "low", channel outputs are disabled, and chip is in shutdown mode. When OE = "high", channel outputs are enabled, and chip is in active mode. When OE pin is left floating, channel outputs are enabled.
10	OUT4	Filtered Output Channel HD (Y).
11	OUT3	Filtered Output Channel HD (Pr).
12	OUT2	Filtered Output Channel HD (Pb).
14	OUT1	Filtered Output Channel SD.

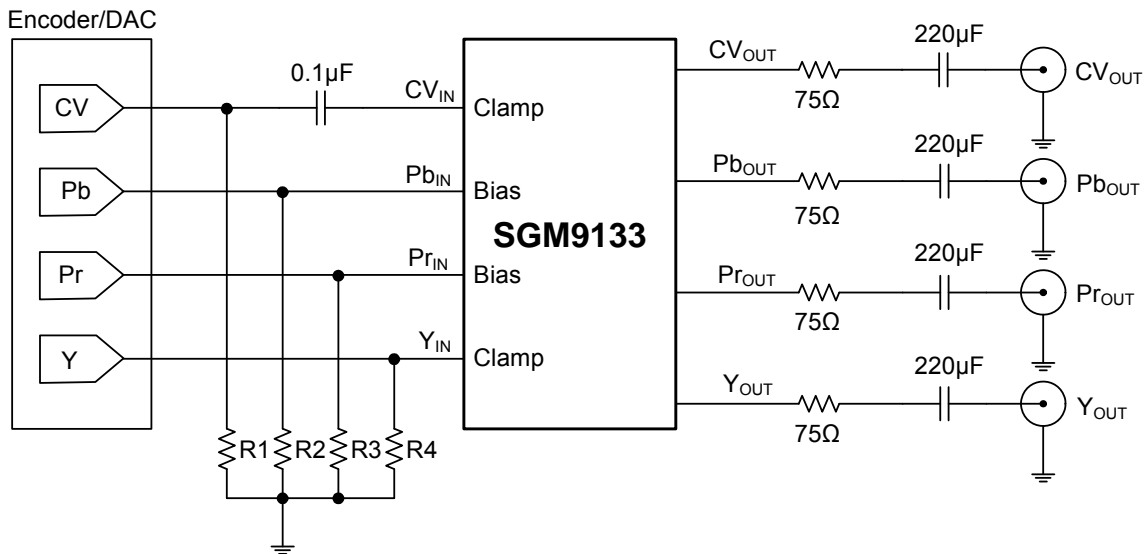
**BLOCK DIAGRAM**



NOTES:

1. A 10kΩ resistor must be serially connected to Select or OE pin.
2. Power supply V<sub>CC</sub> must be sequenced on first before input video signals.

**TYPICAL APPLICATION CIRCUIT**



**ELECTRICAL CHARACTERISTICS**

( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 1V_{PP}$ ,  $V_{CC} = 5V$ ,  $R_{SOURCE} = 37.5\Omega$ ; all inputs are AC-coupled with  $0.1\mu\text{F}$ ; all outputs are AC-coupled with  $220\mu\text{F}$  into  $150\Omega$ , referenced to  $400\text{kHz}$ , unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC ELECTRICAL CHARACTERISTICS</b>					
Operating Voltage Range ( $V_{CC}$ )		3.1	5	5.5	V
Quiescent Current ( $I_Q$ )	$V_{CC} = 5.0V$ , No load	1080i	58	73	mA
		1080p	75	95	
Output Level Shift Voltage ( $V_{OLS}$ )	$V_{IN} = 0V$ , No load	SD channel	420	600	mV
		1080i channel	550	700	
Voltage Gain ( $A_V$ )	$R_L = 150\Omega$	5.8	6.1	6.35	dB
Output Voltage High Swing	$V_{IN} = 3V$ , $R_L = 150\Omega$ to GND		4.8		V
Shutdown Current	OE = "Low"		2.5	15	$\mu\text{A}$
Video Input Voltage Range	Referenced to GND if DC-coupled		1.4		$V_{PP}$
Power Supply Rejection Ratio (PSRR)	DC (All channels)		50		dB
$V_{IH}$ of SELECT and OE Pin	$V_{CC} = 5.0V$	2.4			V
$V_{IL}$ of SELECT and OE Pin	$V_{CC} = 5.0V$			0.8	V
<b>STANDARD DEFINITION MODE ELECTRICAL CHARACTERISTICS</b>					
-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, $f_{IN} = 400\text{kHz}$ to $27\text{MHz}$		50		dB
Slew Rate	2V Output step, 80% to 20%		34		$V/\mu\text{s}$
Differential Gain (DG)	AC-AC coupled, PAL		0.5		%
	AC-DC coupled, PAL		0.4		
Differential Phase (DP)	AC-AC coupled, PAL		1.0		deg
	AC-DC coupled, PAL		1.0		
Group Delay Variation (D/DT)	Difference between $400\text{kHz}$ and $6.5\text{MHz}$		35		ns
Crosstalk (channel-to-channel)	$V_{OUT} = 1.4V_{PP}$ , $f = 1\text{MHz}$		-63		dB
Signal-to-Noise Ratio (SNR)	$100\text{kHz}$ to $5\text{MHz}$		-66		dB
Fall Time	2V Output step, 80% to 20%		34		ns
Rise Time	2V Output step, 80% to 20%		34		ns
Chroma Luma Gain ( $CLG_{SD}$ )	$f = 3.58\text{MHz}$ (Referenced to $SD_{IN}$ at $400\text{kHz}$ )		102		%
Chroma Luma Delay ( $CLD_{SD}$ )	$f = 3.58\text{MHz}$ (Referenced to $SD_{IN}$ at $400\text{kHz}$ )		8		ns
Enable Time ( $t_{ON}$ )			1.5		$\mu\text{s}$
Disable Time ( $t_{OFF}$ )			0.5		$\mu\text{s}$

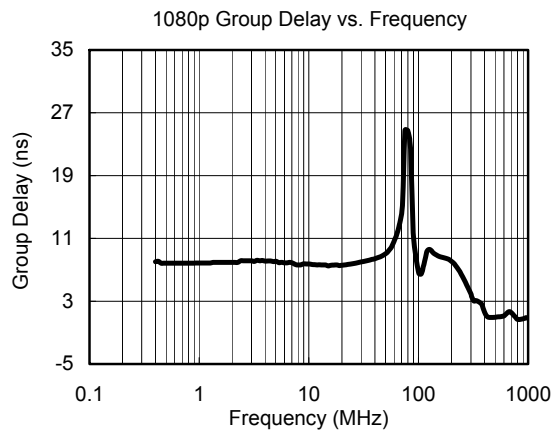
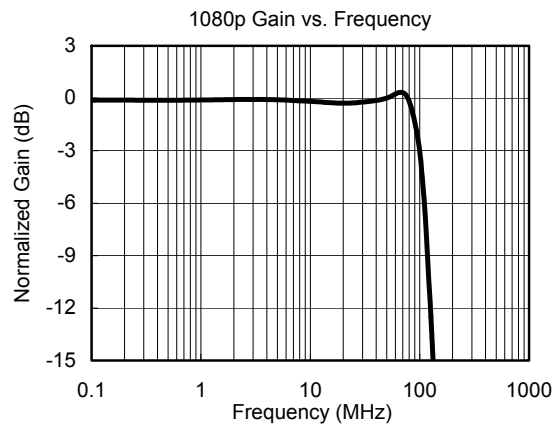
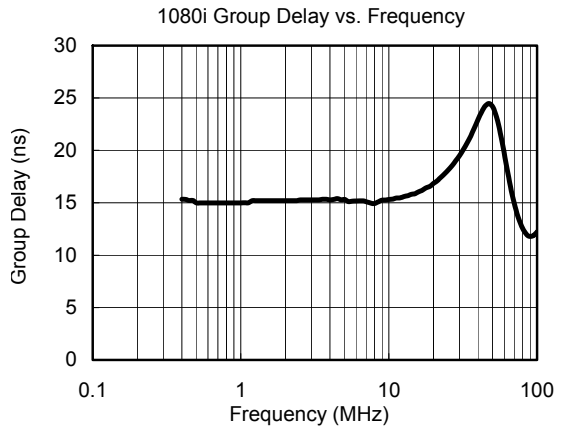
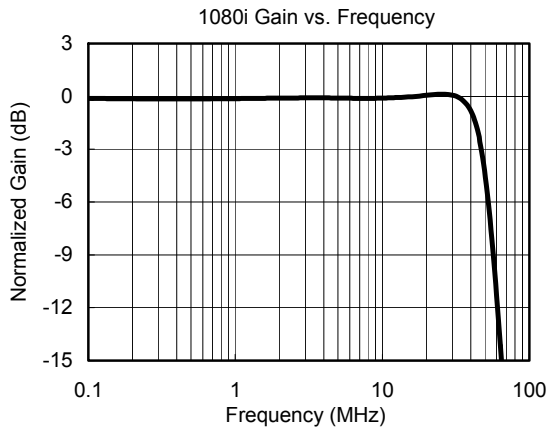
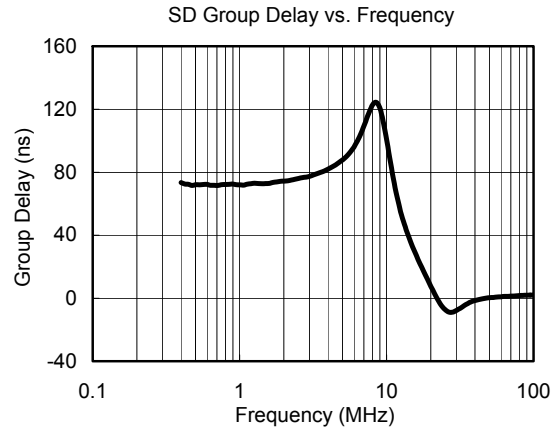
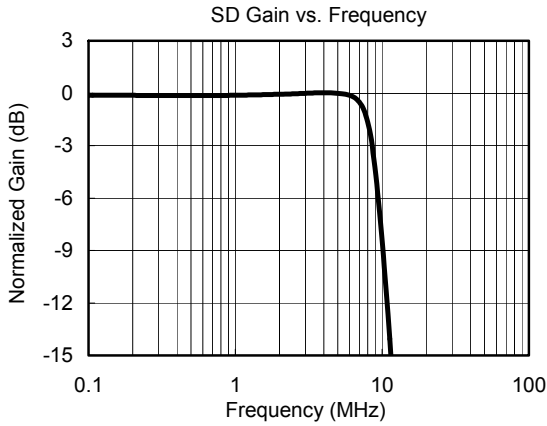
**ELECTRICAL CHARACTERISTICS**

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PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>1080i HIGH DEFINITION MODE ELECTRICAL CHARACTERISTICS</b>					
-0.1dB Bandwidth	$R_L = 150\Omega$		32		MHz
-1dB Bandwidth	$R_L = 150\Omega$		39		MHz
-3dB Bandwidth	$R_L = 150\Omega$		46		MHz
Filter Response (Normalized Gain)	$f_{IN} = 400\text{kHz}$ to $74.25\text{MHz}$		25		dB
Slew Rate	2V Output step, 80% to 20%		190		V/ $\mu\text{s}$
Group Delay Variation (D/DT)	Difference between $400\text{kHz}$ and $26\text{MHz}$		3.5		ns
Crosstalk (channel-to-channel)	$V_{OUT} = 1.4V_{PP}$ , $f = 1\text{MHz}$		-63		dB
Fall Time	2V Output step, 80% to 20%		6.2		ns
Rise Time	2V Output step, 80% to 20%		6.2		ns
<b>1080p HIGH DEFINITION MODE ELECTRICAL CHARACTERISTICS</b>					
-0.1dB Bandwidth	$R_L = 150\Omega$		78		MHz
-1dB Bandwidth	$R_L = 150\Omega$		86		MHz
-3dB Bandwidth	$R_L = 150\Omega$		98		MHz
Filter Response (Normalized Gain)	$f_{IN} = 400\text{kHz}$ to $148\text{MHz}$		22		dB
Slew Rate	2V Output step, 80% to 20%		340		V/ $\mu\text{s}$
Group Delay Variation (D/DT)	Difference between $400\text{kHz}$ and $70\text{MHz}$		7		ns
Crosstalk (channel-to-channel)	$V_{OUT} = 1.4V_{PP}$ , $f = 1\text{MHz}$		-64		dB
Fall Time	2V Output step, 80% to 20%		3.3		ns
Rise Time	2V Output step, 80% to 20%		3.6		ns

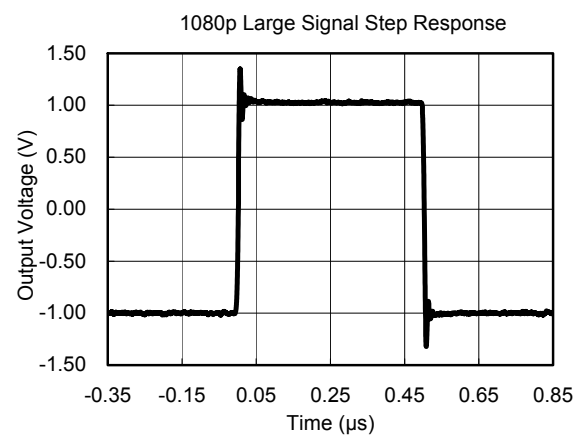
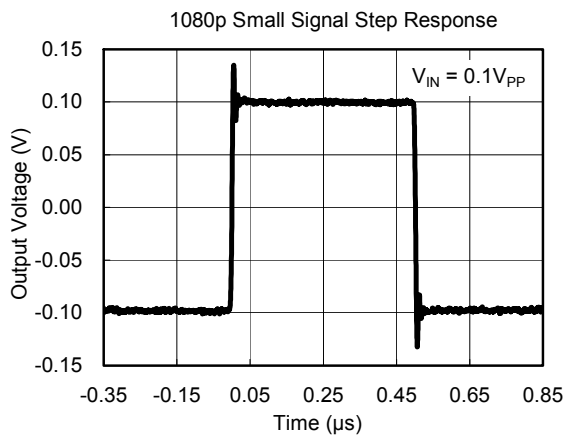
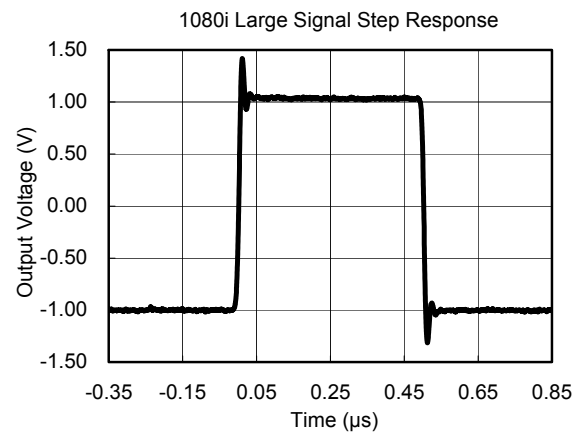
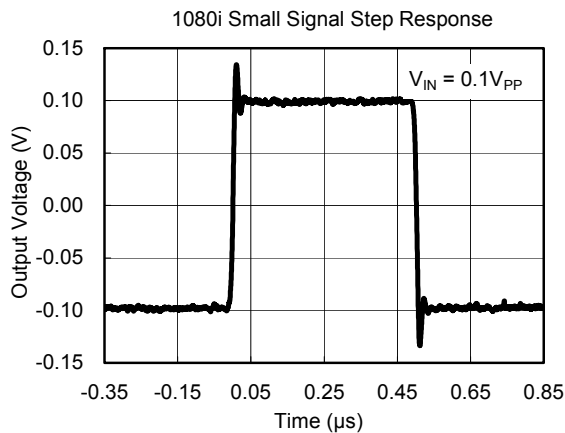
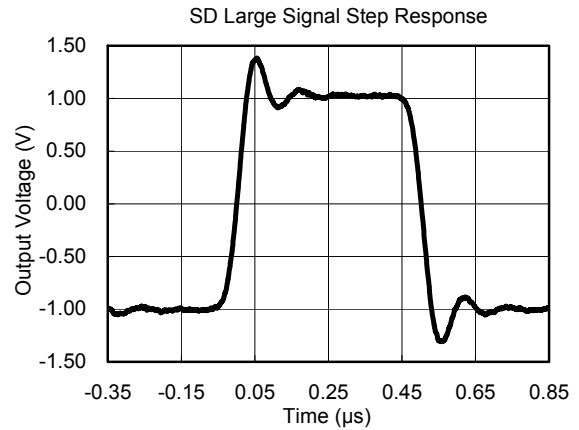
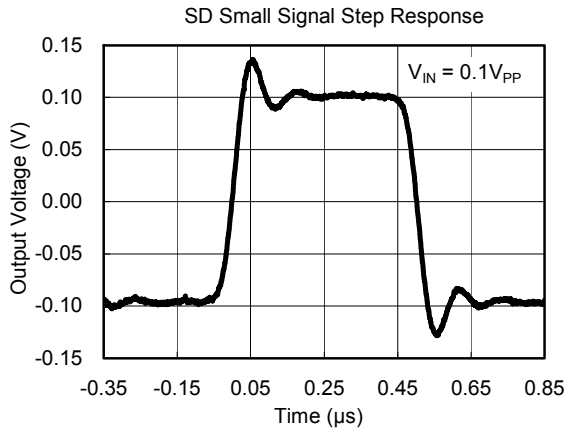
**TYPICAL PERFORMANCE CHARACTERISTICS**

$T_A = +25^\circ\text{C}$ ,  $V_{IN} = 1V_{PP}$ ,  $V_{CC} = 5V$ ,  $R_{SOURCE} = 37.5\Omega$ ; all inputs are AC-coupled with  $0.1\mu\text{F}$ ; all outputs are AC-coupled with  $220\mu\text{F}$  into  $150\Omega$ , referenced to  $400\text{kHz}$ , unless otherwise noted.



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APPLICATION INFORMATION

Application Circuits

The SGM9133 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 SGM9133 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 SGM9133 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.

For symmetric signals like Chroma, U, V, Pb and Pr, the average DC bias is fairly constant and the inputs can be AC-coupled. DAC outputs can also drive these same signals without the AC coupling capacitor.

I/O Configurations

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

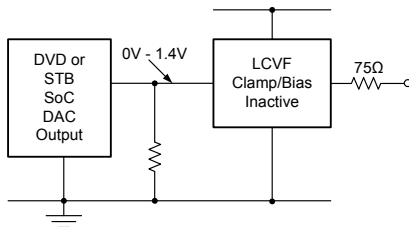


Figure 1. DC-Coupled Inputs and Outputs

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.

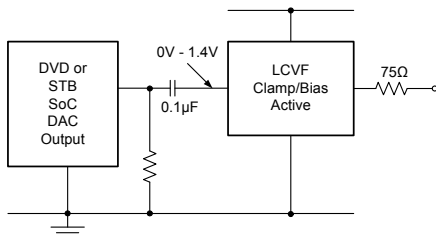


Figure 2. AC-Coupled Inputs, DC-Coupled Outputs

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

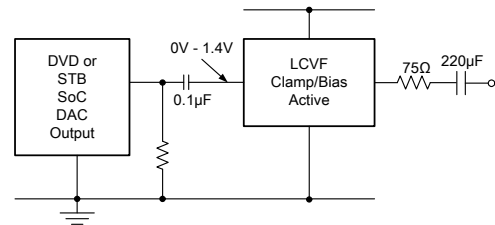


Figure 3. AC-Coupled Inputs and Outputs

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 SGM9133 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.

$$T_J = T_A + P_D \cdot \theta_{JA} \tag{1}$$

where:

$$P_D = P_{CH1} + P_{CH2} + P_{CH3} \tag{2}$$

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

where:

$$V_O = 2V_{IN} + 0.55V \tag{4}$$

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

$V_{IN}$  = RMS value of input signal

$I_{CC}$  = 58mA (1080i)

$V_{CC}$  = 5.0V

$R_L$  = channel load resistance

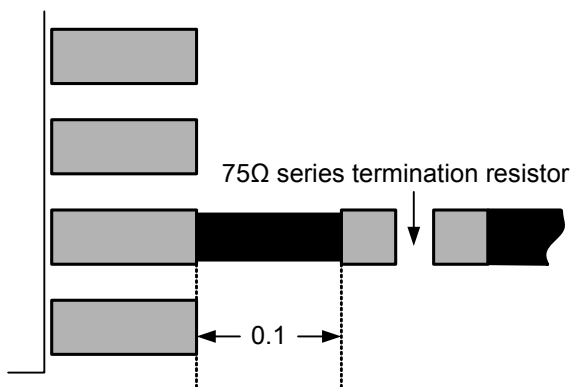
Board layout can also affect thermal characteristics. Refer to the Layout Considerations section for details.

The SGM9133 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

### Output Considerations

The selection of the coupling capacitor is a function of the subsequent circuit input impedance and the leakage current of the input being driven. In order to obtain the highest quality output video signal the series termination resistor must be placed as close to the device output pin as possible. This greatly reduces the parasitic capacitance and inductance effect on the SGM9133 output driver. Recommended distance from device pin to series termination resistor should be no greater than 0.1 inches.



**Figure 4. Distance from Device Pin to Series Termination Resistor**

### Thermal Considerations

Since the interior of systems such as set-top boxes, TVs and DVD players are at +70°C, 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.

### Layout Considerations

General layout and supply bypassing play a major role in high-frequency performance and thermal characteristics. We offer a demonstration board to guide layout and aid device evaluation. The demo board is a four-layer board with full power and ground planes. Following this layout configuration provides optimum performance and thermal characteristics for the device. For the best results, follow the steps and recommended routing rules listed below.

### Recommended Routing/Layout Rules

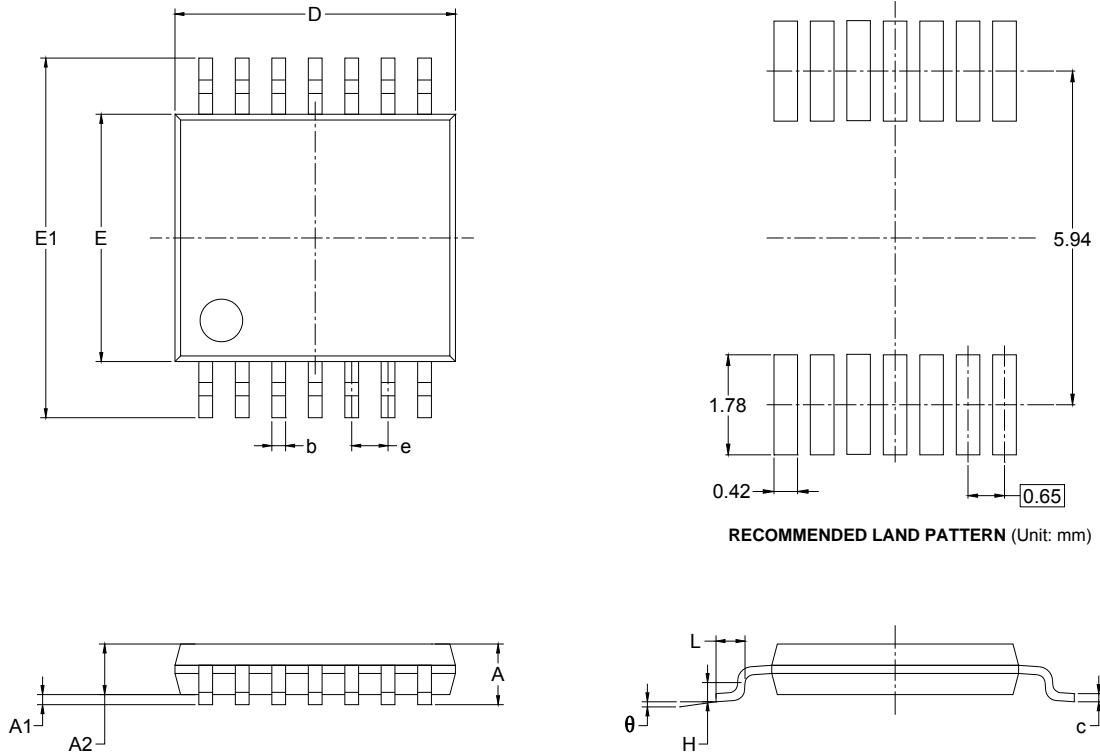
- Do not run analog and digital signals in parallel.
- Use separate analog and digital power planes to supply power.
- Do not run traces on top of the ground plane.
- Run no traces over ground/power splits.
- Avoid routing at 90-degree angles.
- Minimize clock and video data trace length differences.
- 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.

### 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

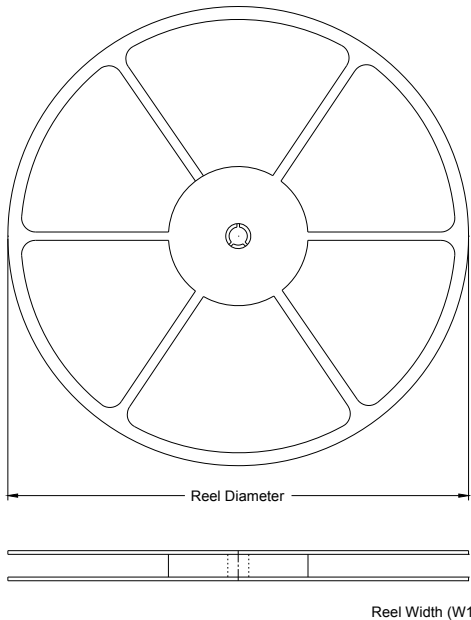
TSSOP-14



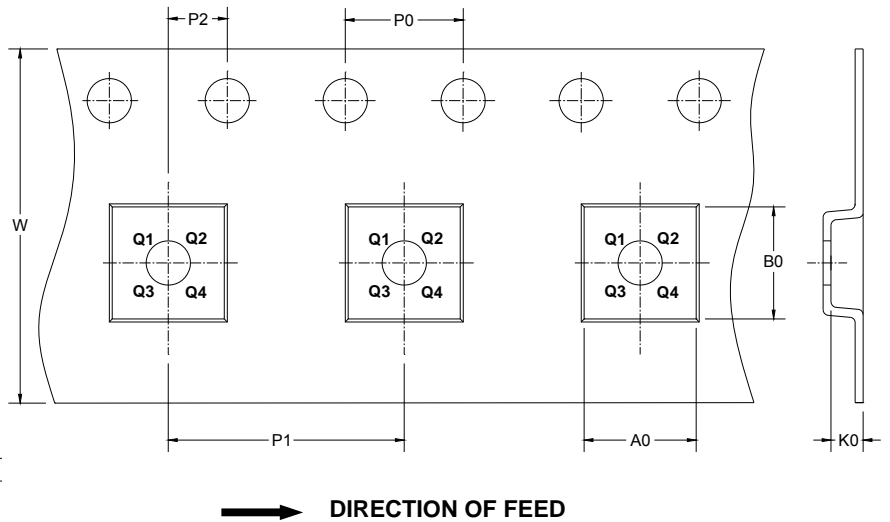
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
$\theta$	1°	7°	1°	7°

**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**



**TAPE DIMENSIONS**



NOTE: The picture is only for reference. Please make the object as the standard.

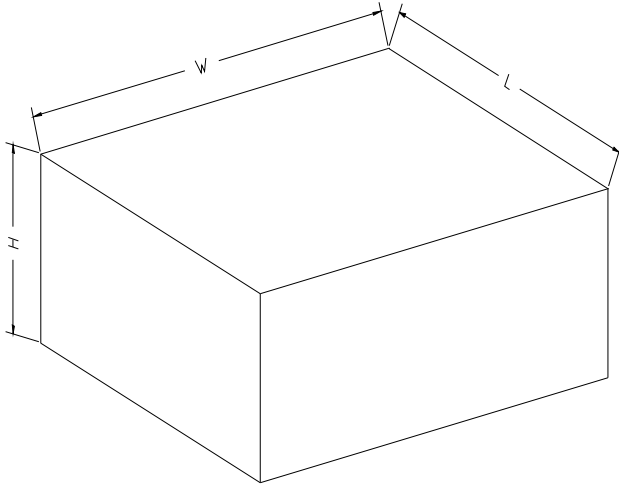
**KEY PARAMETER LIST OF TAPE AND REEL**

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TSSOP-14	13"	12.4	6.95	5.6	1.2	4.0	8.0	2.0	12.0	Q1

# SGM9133

# 4-Channel, Video Filter Driver for SD/HD (1080i)/HD (1080p)

## CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13"	386	280	370	5

