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August 2009

FMS6203
Low-Cost, 3-Channel, Video Filter Driver for SD/PS/HD

Features

- Three 6th-Order Video Anti-Aliasing or Reconstruction Filters
- Supports Component YPrPb or RGB Video
- Three Channels: Selectable to 8MHz, 16MHz, or 32MHz for SD/PS/HD Applications
- Includes Wide Bandwidth Bypass Mode
- 6dB Gain Option Available for 150Ω Double Terminated Video Load
- 0dB Gain Option Available for High-Impedance Loading
- Selectable Clamp or Bias Mode on Pb/B, Pr / B,R Inputs
- Inputs and Outputs can be AC- or DC-Coupled
- DC-Coupled Outputs Eliminate Coupling Capacitors
- Output Disable
- Single 5V Supply
- 2kV CDM / 8kV HBM ESD Protection

Applications

- Cable and Satellite Set-Top Boxes
- DVD Players
- HDTV
- Personal Video Recorders (PVR)
- Video On Demand (VOD)

Description

FMS6203 offers comprehensive filtering for set-top box or DVD applications. It is intended to replace passive LC filters and drivers with a low-cost integrated device.

Filter channels are specialized for either component (YPbPr) or RGB video signals. These channels offer a selectable frequency response of 8, 16, or 32MHz. The filters can also be bypassed for high-frequency operation. Additional functionality of these channels includes input biasing mode and output disable.

The FMS6203 may be driven directly by a DC-coupled DAC output or an AC-coupled signal. All inputs accept standard $1V_{pp}$ video signals.

Each channel includes an output amplifier capable of driving a single (150Ω) AC- or DC-coupled video load. All outputs can be disabled to save power in DC-coupled applications.

The device is available in two factory-set options, a 0dB gain option and a 6dB gain option.

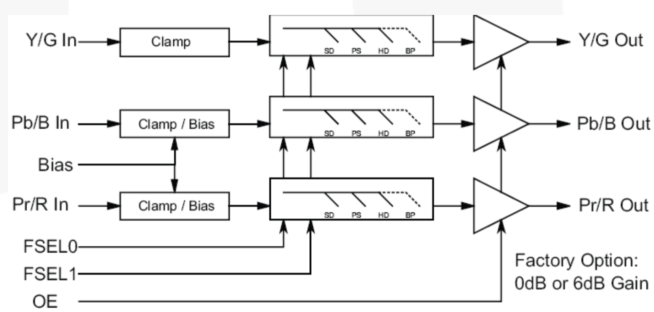


Figure 1. Block Diagram

Ordering Information

Part Number	Operating Temperature Range	Gain Setting	Eco Status	Package	Packing Method
FMS6203MTC1400X	-40°C to +85°C	0dB	RoHS	TSSOP-14	Tape and Reel
FMS6203MTC1406X	-40°C to +85°C	6dB	RoHS	TSSOP-14	Tape and Reel

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Note:
1. Moisture sensitivity level is MSL-1.

Pin Configuration

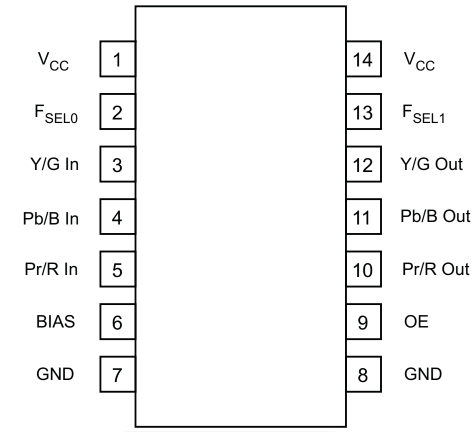


Figure 2. Pin Configuration

Pin Definitions

Pin #	Name	Type	Description
1	V_{CC}	Input	+5V supply
2	F_{SEL0}	Input	Selects filter corner frequency
3	Y/G In	Input	Selectable video input
4	Pb/B In	Input	Selectable video input
5	Pr/R In	Input	Selectable video input
6	BIAS	Input	Input bias on Pb/B Pr/R: 0=Bias 1=Clamp
7	GND	Input	Must be tied to ground. Do not float.
8	GND	Input	Must be tied to ground. Do not float.
9	OE	Input	Output disable control: 0=Disable, 1=Enable
10	Pr/R Out	Output	Filtered SD, PS, HD, BP video output
11	Pb/B Out	Output	Filtered SD, PS, HD, BP video output
12	Y/G Out	Output	Filtered SD, PS, HD, BP video output
13	F_{SEL1}	Input	Selects filter corner frequency
14	V_{CC}	Input	+5V supply

Frequency Select Truth Table

F_{SEL1}	F_{SEL0}	Filter Frequency	Video Format	Sync Format
0	0	8MHz	SD, 480i	Bi-level, 4.70µs Pulsewidth
0	1	16MHz	PS, 480p	Bi-level, 2.35µs Pulsewidth
1	0	32MHz	HD,1080i, 720p	Tri-level, 589ns Pulsewidth
1	1	Bypass		

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	DC Supply Voltage	-0.3	6.0	V
V_{IO}	Analog and Digital I/O	-0.3	V_{CC}+0.3	V
I_{OUT}	Output Current, Any One Channel, Do Not Exceed		50	mA

Reliability Information

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_J	Junction Temperature			+150	°C
T_{STG}	Storage Temperature Range	-65		+150	°C
T_L	Lead Temperature, Soldering 10 Seconds			+300	°C
Θ_{JA}	Thermal Resistance, JEDEC Standard Multi-Layer Test Boards, Still Air		97		°C/W

Electrostatic Discharge Information

Symbol	Parameter	Max.	Unit
ESD	Human Body Model, JESD22-A114	8	kV
	Charged Device Model, JESD22-C101	2	

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_A	Operating Temperature Range	-40		+85	°C
V_{CC}	Supply Voltage Range	4.75	5.00	5.25	V

DC Electrical Characteristics

Unless otherwise noted, T_A=25°C, V_{CC}=5V, R_{SOURCE}=37.5Ω, inputs AC coupled with 0.1μF, all outputs AC coupled with 220μF into 150Ω loads, referenced to 400kHz, all gain options.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
I_{CC}	Supply Current[(2)]	No Load		36	75	mA
I_{CC1}	Supply Current[(2)]	No Load, Output Disabled		15	35	mA
V_{IN}	Video Input Voltage Range	Referenced to GND if DC Coupled		1.0		V_{PP}
V_{IL}	Digital Input Low[(2)]	F_{SEL0}, F_{SEL1}	0		0.8	V
V_{IH}	Digital Input High[(2)]	F_{SEL0}, F_{SEL1}	2.4		V_{CC}	V
t_{ENABLE}	Output Enable Time	150Ω DC Load		300		ns

Note:
2. 100% tested at 25°C

Standard Definition Electrical Characteristics

Unless otherwise noted, T_A=25°C, V_{IN}=1V_{PP}, V_{CC}=5V, R_{SOURCE}=37.5Ω, all inputs AC coupled with 0.1μF, all outputs AC coupled with 220μF into 150Ω loads, referenced to 400kHz, all gain options.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
AV_{SD}	Channel Gain Error[(3)]		-0.4	0	0.4	dB
f_{1dBSD}	-1dB Bandwidth[(3)]		5.20	7.15		MHz
f_{cSD}	-3dB Bandwidth			8		MHz
f_{SBSD}	Attenuation (Stopband Reject)[(3)]	f=27MHz	40	50		dB
DG	Differential Gain			0.3		%
DP	Differential Phase			1.0		°
THD	Total Harmonic Distortion, Output	V_{OUT}=1.4V_{PP}, 3.58MHz		0.6		%
X_{TALKSD}	Crosstalk (Channel-to-Channel)	1MHz		-70		dB
SNR	Signal-to-Noise Ratio[(4)]	NTC-7 Weighting, 100kHz to 4.2MHz		75		dB
t_{pdSD}	Propagation Delay	Delay from Input to Output, 4.5MHz		85		ns

Notes:
3. 100% tested at 25°C.
4. SNR=20 • log (714mV/rms noise).

Progressive Scan Electrical Characteristics

Unless otherwise noted, T_A=25°C, V_{IN}=1V_{PP}, V_{CC}=5V, R_{SOURCE}=37.5Ω, inputs AC coupled with 0.1μF, all outputs AC coupled with 220μF into 150Ω loads, referenced to 400kHz, all gain options.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
AV_{PS}	Channel Gain Error[(5)]		-0.4	0	0.4	dB
f_{1dBSPS}	-1dB Bandwidth[(5)]		10.0	13.5		MHz
f_{cPS}	-3dB Bandwidth			16		MHz
f_{SBPS}	Attenuation (Stopband Reject)[(5)]	f=54MHz	37	44		dB
THD	Total Harmonic Distortion, Output	V_{OUT}=1.4V_{PP}, 7MHz		0.55		%
X_{TALKPS}	Crosstalk (Channel-to-Channel)	1MHz		-75		dB
SNR	Signal-to-Noise Ratio[(6)]	Unweighted; 100kHz to 15MHz		66		dB
t_{pdPS}	Propagation Delay	Delay from Input to Output, 10MHz		47		ns

Notes:
5. 100% tested at 25°C.
6. SNR=20 • log (714mV/rms noise).

High-Definition Electrical Characteristic

Unless otherwise noted, T_A=25°C, V_{IN}=1V_{PP}, V_{CC}=5V, R_{SOURCE}=37.5Ω, inputs AC coupled with 0.1µF, all outputs AC coupled with 220µF into 150Ω loads, referenced to 400kHz, all gain options.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
AV_{HD}	Channel Gain Error[7]		-0.4	0	0.4	dB
f_{1dBHD}	-1dB Bandwidth[7]		28	31		MHz
f_{cHD}	-3dB Bandwidth			32		MHz
f_{SBHD}	Attenuation (Stopband Reject)[7]	f=74.25MHz	30	40		dB
THD	Total Harmonic Distortion, Output	V_{OUT}=0.7V_{PP}, 22MHz, 0dB, 10kΩ Load		0.5		%
		V_{OUT}=1.4V_{PP}, 22MHz, 6dB, 150Ω Load		0.5		
X_{TALKHD}	Crosstalk (Channel-to-Channel)	1MHz		-75		dB
		30MHz		-57		dB
SNR	Signal-to-Noise Ratio[8]	Unweighted, 100kHz to 30MHz		66		dB
t_{pdHD}	Propagation Delay	Delay from Input to Output, 20MHz		25		ns

Notes:
7. 100% tested at 25°C.
8. SNR=20 • log (714mV/rms noise).

Bypass Mode Electrical Characteristics

Unless otherwise noted, T_A=25°C, V_{IN}=1V_{PP}, V_{CC}=5V, R_{SOURCE}=37.5Ω, inputs AC coupled with 0.1µF, all outputs AC coupled with 220µF into 150Ω loads, referenced to 400kHz, all gain options.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
AV_{BP}	Channel Gain Error[9]	DC	-0.4	0	0.4	dB
f_{1dBBP}	-1dB Bandwidth			90		MHz
f_{cBP}	-3dB Bandwidth			115		MHz
THD	Total Harmonic Distortion, Output	V_{OUT}=0.7V_{PP}, 22MHz, 0dB, 10kΩ Load		0.3		%
		V_{OUT}=1.4V_{PP}, 22MHz, 6dB, 150Ω Load		0.25		
X_{TALKBP}	Crosstalk (Channel-to-Channel)	1MHz		-74		dB
		30MHz		-64		dB
SNR	Signal-to-Noise Ratio[10]	Unweighted, 100kHz to 30MHz		70		dB

Notes:
9. 100% tested at 25°C.
10. SNR=20 • log (714mV/rms noise).

Layout Considerations

General layout and supply bypassing play a major role in high-frequency performance and thermal characteristics. Fairchild offers an evaluation board to guide layout and aid device evaluation. The evaluation 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.
- Run traces on top of the ground plane at all times.
- Do not run traces over ground/power splits.
- Avoid routing at 90-degree angles.
- Minimize clock and video data trace length differences.
- Include 10µF and 0.1µF ceramic power supply bypass capacitors.
- Place the 0.1µF capacitor within 0.1 inches of the device power pin.
- Place the 10µF 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 by 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.

Thermal Considerations

Since the interior of most systems, such as set-top boxes, TVs, and DVD players, are at +70ºC; 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) and 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 70µm 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.
- Use modeling techniques for first-order approximation.

Output Considerations

The FMS6203 outputs are DC offset from the input by 150mV; therefore, $V_{OUT} = 2 \cdot V_{IN}$ DC+150mV. This offset is required to obtain optimal performance from the output driver and is held at the minimum value to decrease the standing DC current into the load. Since the FMS6203 has a 2x (6dB) gain, the output is typically connected via a 75Ω-series back-matching resistor followed by the 75Ω video cable. Because of the inherent divide by two of this configuration, the blanking level at the load of the video signal is always less than 1V. When AC-coupling the output, ensure that the coupling capacitor of choice passes the lowest frequency content in the video signal and that line time distortion (video tilt) is kept as low as possible.

The selection of the coupling capacitor is a function of the subsequent circuit input impedance and the leakage current of the input being driven. 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 FMS6203 output driver. Recommended distance from device pin to place series termination resistor is no greater than 0.1 inches.

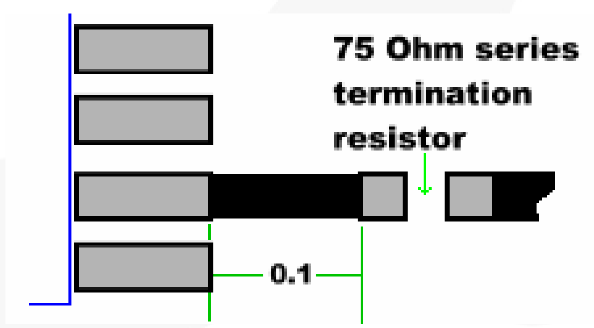
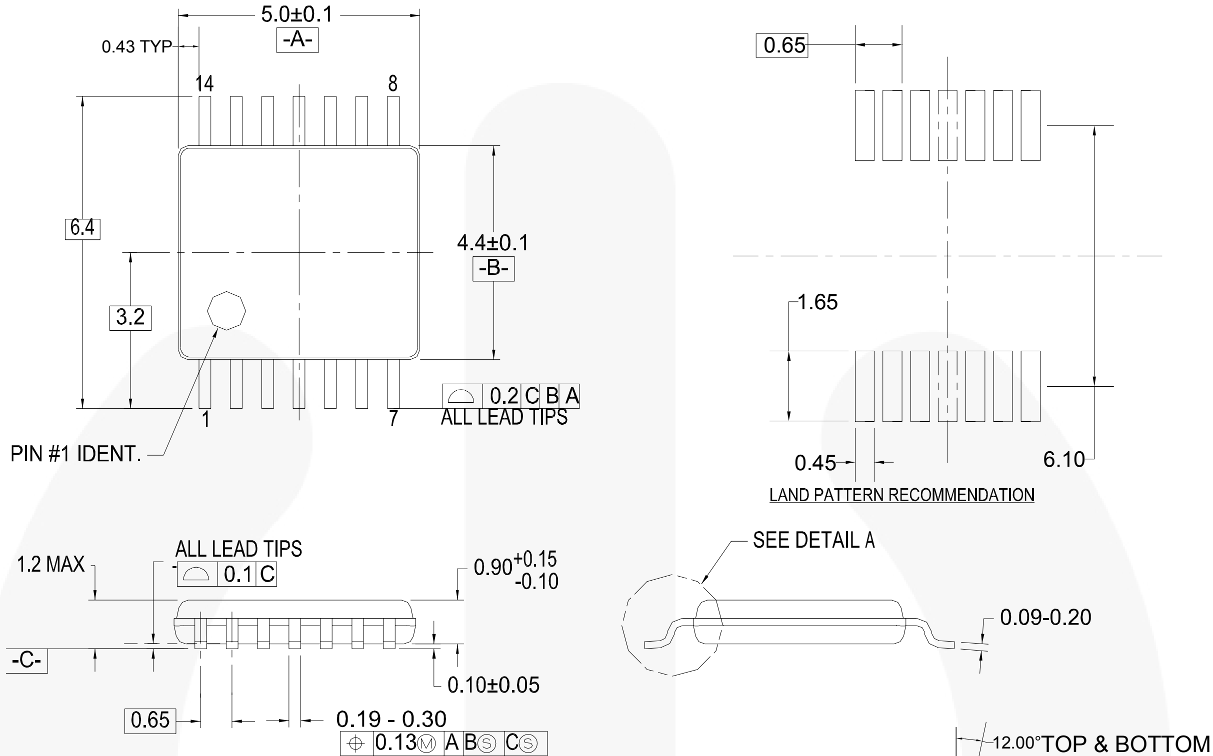
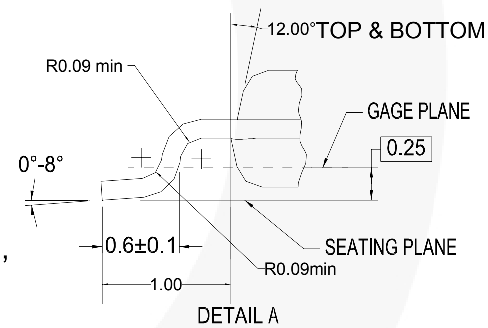


Figure 3. Distance from Device Pin to Series Termination Resistor

Physical Dimensions





NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6
B. DIMENSIONS ARE IN MILLIMETERS
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982
E. LANDPATTERN STANDARD: SOP65P640X110-14M
F. DRAWING FILE NAME: MTC14REV6

Figure 4. 14-Lead Thin Shrink Small Outline Package (TSSOP)

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No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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