Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor’s system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.
FMS6363 — Low-Cost, Three-Channel, 6th-Order, High-Definition, Video Filter Driver

Features
- Three Sixth-order 30MHz (HD) Filters
- Transparent Input Clamping
- Single Video Drive Load (2Vpp, 150Ω = 6dB)
- AC or DC-coupled Inputs
- AC or DC-coupled Outputs
- DC-coupled Outputs Eliminate AC-coupling Capacitors
- 5V Only
- Robust 8kV ESD Protection
- Package SOIC-8

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

Description
The FMS6363 low-cost video filter (LCVF) is intended to replace passive LC filters and drivers with a low-cost integrated device. Three sixth-order filters provide improved image quality compared to typical lower-order passive solutions.

The FMS6363 may be directly driven by a DC-coupled DAC output or an AC-coupled signal. Internal diode clamps and bias circuitry may be used if AC-coupled inputs are required (see Applications section for details).

The outputs can drive AC-or DC-coupled single (150Ω) loads. DC-coupling the outputs removes the need for output coupling capacitors. The input DC levels are offset approximately +280mV at the output (see Applications section for details).

Block Diagram

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Operating Temperature Range</th>
<th>Eco Status</th>
<th>Package</th>
<th>Packing Method</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMS6363CS</td>
<td>0 to 70°C</td>
<td>RoHS</td>
<td>8-Lead, Small Outline Integrated Circuit (SOIC)</td>
<td>Rail</td>
<td>95</td>
</tr>
<tr>
<td>FMS6363CSX</td>
<td>0 to 70°C</td>
<td>RoHS</td>
<td>8-Lead, Small Outline Integrated Circuit (SOIC)</td>
<td>Reel</td>
<td>2500</td>
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</table>

For Fairchild's definition of Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html)
FMS6363 — Low-Cost, Three-Channel, 6th-Order, High-Definition, Video Filter Driver

Pin Configuration

Figure 2. 8-Pin SOIC

Pin Definitions

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IN1</td>
<td>Input</td>
<td>Video input, channel 1</td>
</tr>
<tr>
<td>2</td>
<td>IN2</td>
<td>Input</td>
<td>Video input, channel 2</td>
</tr>
<tr>
<td>3</td>
<td>IN3</td>
<td>Input</td>
<td>Video input, channel 3</td>
</tr>
<tr>
<td>4</td>
<td>VCC</td>
<td>Input</td>
<td>+5V Supply</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Input</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>OUT3</td>
<td>Output</td>
<td>Filtered output, channel 3</td>
</tr>
<tr>
<td>7</td>
<td>OUT2</td>
<td>Output</td>
<td>Filtered output, channel 2</td>
</tr>
<tr>
<td>8</td>
<td>OUT1</td>
<td>Output</td>
<td>Filtered output, channel 1</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>DC Supply Voltage</td>
<td>-0.3</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>VO</td>
<td>Analog Digital I/O</td>
<td>-0.3</td>
<td>VCC + 0.3</td>
<td>V</td>
</tr>
<tr>
<td>IOUT</td>
<td>Output Current, Any One Channel, Do Not Exceed</td>
<td>50</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>ESD</td>
<td>Human Body Model, JESD22-A114</td>
<td>8</td>
<td>kV</td>
<td></td>
</tr>
</tbody>
</table>

Reliability Information

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJ</td>
<td>Junction Temperature</td>
<td></td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>TSTG</td>
<td>Storage Temperature Range</td>
<td>-65</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>Lead Temperature, Soldering 10 Seconds</td>
<td></td>
<td>+300</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>JA</td>
<td>Thermal Resistance, JEDEC Standard, Multi-layer Test Board, Still Air</td>
<td>112.7</td>
<td>°C/W</td>
<td></td>
<td></td>
</tr>
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</table>

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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
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<td>TA</td>
<td>Operating Temperature Range</td>
<td>0</td>
<td>70</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>VCC</td>
<td>Supply Voltage Range</td>
<td>4.75</td>
<td>5.00</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>RSOURCE</td>
<td>Input Source Resistance</td>
<td></td>
<td>300</td>
<td>Ω</td>
<td></td>
</tr>
</tbody>
</table>
### DC Electrical Characteristics

$T_A=25^\circ C$, $V_{CC}=5V$, $R_{SOURCE}=37.5\Omega$, inputs AC coupled with 0.1µF, all outputs AC coupled with 220µF into 150Ω loads, referenced to 400kHz; unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{CC}$</td>
<td>Supply Current$^{(1)}$</td>
<td>No Load</td>
<td>22</td>
<td>30</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>$V_{IN}$</td>
<td>Video Input Voltage Range</td>
<td>Referenced to GND, if DC-coupled$^{(2)}$</td>
<td>1.4</td>
<td></td>
<td></td>
<td>V$_{pp}$</td>
</tr>
</tbody>
</table>

Note:
1. 100% tested at 25°C.

### AC Electrical Characteristics

$T_A=25^\circ C$, $V_{IN}=1V_{pp}$, $V_{CC}=5V$, $R_{SOURCE}=37.5\Omega$, inputs AC coupled with 0.1µF, all outputs AC coupled with 220µF into 150Ω loads, referenced to 400kHz; unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_V$</td>
<td>Channel Gain$^{(2)}$</td>
<td>All Channels</td>
<td>5.8</td>
<td>6.0</td>
<td>6.2</td>
<td>dB</td>
</tr>
<tr>
<td>$f_{1dB}$</td>
<td>-1dB Bandwidth$^{(2)}$</td>
<td>All Channels</td>
<td>23</td>
<td>30</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>$f_c$</td>
<td>-3dB Bandwidth</td>
<td>All Channels</td>
<td>30</td>
<td>33</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>$f_{SB1}$</td>
<td>Attenuation, Stopband Reject</td>
<td>All Channels at $f=37.125MHz$</td>
<td>6.5</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$f_{SB2}$</td>
<td></td>
<td>All Channels at $f=44.25MHz$</td>
<td>14.5</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$f_{SB3}$</td>
<td></td>
<td>All Channels at $f=74.25MHz^{(2)}$</td>
<td>32</td>
<td>36</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>THD1</td>
<td>Output Distortion, All Channels$^{(3)}$</td>
<td>$V_{OUT}=1.4V_{PP}$, 10MHz</td>
<td>0.2</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>THD2</td>
<td></td>
<td>$V_{OUT}=1.4V_{PP}$, 15MHz</td>
<td>0.4</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>THD3</td>
<td></td>
<td>$V_{OUT}=1.4V_{PP}$, 22MHz</td>
<td>1.2</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>$X_{TALK}$</td>
<td>Crosstalk Channel-to-Channel</td>
<td>At 1MHz</td>
<td>-60</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>SNR1</td>
<td>Signal-to-Noise Ratio, All Channels$^{(4)}$</td>
<td>Unweighed; 30MHz lowpass, 100KHz to 30KHz</td>
<td>65</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$t_{pd}$</td>
<td>Propagation Delay</td>
<td>Delay from input to output</td>
<td>20</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

Notes:
2. 100% tested at 25°C.
3. 1.4V$_{PP}$ active video.
4. SNR=$20 \cdot \log (714mV/\text{rms noise})$. 
Typical Performance Characteristics

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

Figure 3. Frequency Response

Figure 4. Group Delay vs. Frequency

Figure 5. PSRR vs. Frequency; No Bypass Caps

Figure 6. PSRR vs. Frequency; Bypass Caps

Figure 7. SYNC Tip Compression vs. $R_{SOURCE}$
Applications Information

Functional Description
The FMS6363 Low-Cost Video Filter (LCVF) 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. Typical voltage levels are shown in Figure 8.

I/O Configurations
For DC-coupled DAC drive with DC-coupled outputs, use the configuration in Figure 10.

Alternatively, if the DAC's average DC output level causes the signal to exceed the range of 0V to 1.4V, it can be AC-coupled, as shown in Figure 11.

When the FMS6363 is driven by an unknown external source or a SCART with its own clamping circuitry the inputs should be AC-coupled, shown in Figure 12.

Figure 8. Typical Voltage Levels
The FMS6363 provides an internal diode 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 FMS6363 without an AC coupling capacitor. The worst-case sync tip compression due to the clamp does not exceed 7mV. The input level set by the clamp, combined with the internal DC offset, keeps the output within its acceptable range. When the input is AC-coupled, the diode clamp sets the sync tip (or lowest voltage) just below ground.

For symmetric signals like C, U, V, Cb, Cr, Pb and Pr; the average DC bias is fairly constant and the inputs can be AC-coupled with the addition of a pull-up resistor to set the DC input voltage. DAC outputs can also drive these same signals without the AC coupling capacitor. A conceptual illustration of the input clamp circuit is shown in Figure 9.

Figure 9. Input Clamp Circuit

Figure 10. DC-coupled Inputs and Outputs

Figure 11. AC-coupled Inputs, DC-coupled Outputs

Figure 12. SCART with DC-coupled Outputs
The same method can be used for biased signals with the addition of a pull-up resistor to make sure the clamp never operates. The internal pull-down resistance is 800Ω ±20%, so the external resistance should be 7.5MΩ to set the DC level to 500mV. If a pull-up resistance of less than 7.5MΩ desired, add an external pull-down such that the DC input level is set to 500mV.

The FMS6363 is specified to operate with output currents typically less than 50mA, more than sufficient for a single (150Ω) video load. Internal amplifiers are current limited to a maximum of 100mA and should withstand brief duration, short-circuit conditions; however, this capability is not guaranteed.

**Output Considerations**

The FMS6363 outputs will be DC offset from the input by 150mv therefore \( V_{OUT} = 2 \times V_{IN} + 150 \text{mV} \). This offset is required to obtain optimal performance from the output driver and is held at the minimum value in order to decrease the standing DC current into the load. Since the FMS6363 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 will pass 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. 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 FMS6646 output driver. Recommend distance from device pin to place series termination resistor should be no greater than 0.1 inches.

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 FMS6363 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 example can be used to calculate the FMS6363’s power dissipation and internal temperature rise.

\[
T_J = T_A + P_e \cdot \Theta_{JA}
\]

where \( P_e = P_{CH1} + P_{CH2} + P_{CH3} \) and \( P_{CH} = V_s \times I_{CH} \times (V_D/RL) \) where

- \( V_D = 2 \times V_{IN} + 0.280V \)
- \( I_{CH} = (I_{CC}/3) + (V_D/RL) \)
- \( V_{IN} = \text{RMS value of input signal} \)
- \( I_{CC} = 24 \text{mA} \)
- \( V_s = 5V \)
- \( RL = \text{channel load resistance} \)

Board layout affects thermal characteristics. Refer to the Layout Considerations section for more information.
Layout Considerations

Layout and supply bypassing play major roles in high-frequency performance and thermal characteristics.

For optimum results, follow the steps below as a basis for high-frequency layout:

- Include 10µF and 0.1µF ceramic bypass capacitors
- Place the 10µF capacitor within 0.75 inches of the power pin.
- Place the 0.1µF capacitor within 0.1 inches of the power pin.
- Connect all external ground pins as tightly as possible, preferably with a large ground plane under the package.
- Layout channel connections to reduce mutual trace inductance.
- Minimize all trace lengths to reduce series inductances. If routing across a board, place device such that longer traces are at the inputs rather than the outputs. If using multiple, low-impedance DC-coupled outputs, special layout techniques may be employed to help dissipate heat.

If a multilayer board is used, a large ground plane directly under the device helps reduce package case temperature.

For dual-layer boards, an extended plane can be used.

Worst-case additional die power due to DC loading can be estimated at \((V_{CC}^2/4R_{load})\) per output channel. This assumes a constant DC output voltage of \(V_{CC}^2\). For 5V \(V_{CC}\) with a dual DC video load, add \(25/(4\times75) = 83\text{mW}\), per channel.
**Typical Application**

**Figure 17. Typical Application Diagram**

- **DVD Player or STB**
- **Video SoC**
- **R/Pr**
- **G/Y**
- **B/Pb**
- **DAC Load Resistors**
- **AC-Coupling Caps** are Optional

- **FMS6363**
- **BL SOIC**
- **IN1**
- **OUT1**
- **IN2**
- **OUT2**
- **IN3**
- **OUT3**
- **Vcc**
- **GND**

- **220µF**
- **75Ω**
- **10µF**
- **0.1µF**

- **+5V**

- **75Ω Video Cables**

- **R SOURCE** = DAC load resistor // video SoC output resistance

- **RSOURCE = DAC load resistor // video SoC output resistance**
Physical Dimensions

Figure 18. 8-Lead, Small Outline Integrated Circuit (SOIC) Package

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FMS6363 — Low-Cost, Three-Channel, 6th-Order High-Definition Video Filter Driver
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Grounded PSP™
Green FSP™
Green FSP™ e-Series
Grenz™
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Kable™
MicroCOUPLER™
MicroFET™
MicroFET®
MOSFET™
MOSFET®
MotionMax™
MotionSM™
OPTOLOGIC™
OPTOPLANAR™
POP™
Power-SM™
PowerTrench™
PowerTrench®
Programmable Active Droop™
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QFET®
Quiet Series™
RapidConfigure™
SILENCE™
SignalView™
SmartMax™
SMART-START™
SMPS™
STEALTH™
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SupreSOT™
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System™
SYSTEM™
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PRODUCT STATUS DEFINITIONS

**Definition of Terms**

**Datasheet Identification**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
</tr>
<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.</td>
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<tr>
<td>No Identification Needed</td>
<td>Full Production</td>
<td>Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.</td>
</tr>
<tr>
<td>Obsolete</td>
<td>Not In Production</td>
<td>Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.</td>
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**Revision Information**

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