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# FMS6501A

## 12x9 Video Switch Matrix with Input Clamp, Input Bias Circuitry, and Output Drivers

### Features

- 12 x 9 Crosspoint Matrix
- Supports SD, ED, HD (1080i, 1080p Video)
- Input Clamp / Bias Circuitry
- Dual-Load Output Drivers with Disable
- AC- or DC-Coupled Inputs
- AC- or DC-Coupled Outputs
- 1-to-1 or 1-to-Many Input-to-Output Connections
- Programmable Gain: +6, +7, +8, or +9 dB
- I<sup>2</sup>C Compatible Digital Interface, Standard Mode
- 9 kV ESD Protection
- Supply Voltage Range: 3.3 V to 5 V
- Lead-Free 28-Lead TSSOP Package

### Applications

- Cable and Satellite Set-Top Boxes
- TV and HDTV Sets
- A/V Switchers
- Personal Video Recorder (PVR)
- Security and Surveillance
- Video Distribution
- Automotive (In-Cabin Entertainment)

### Description

The FMS6501A switch matrix provides flexible options for today's video applications. The device has twelve (12) inputs that can be routed to any of the nine (9) outputs. Each input can be routed to one or more outputs, but only one input may be routed to any one output. The input-to-output routing is controlled via an I<sup>2</sup>C-compatible digital interface.

Each input supports an integrated clamp option to set the output sync-tip level of video with sync to approximately 300 mV. Alternatively, the input may be internally biased to center signals without sync (Chroma, Pb, Pr) at approximately 1.25 V. These DC output levels are for the 6 dB gain setting. Higher gain settings increase the DC output levels accordingly. The input clamp/bias mode is selected via I<sup>2</sup>C control.

Unused outputs may be powered down to reduce power dissipation.

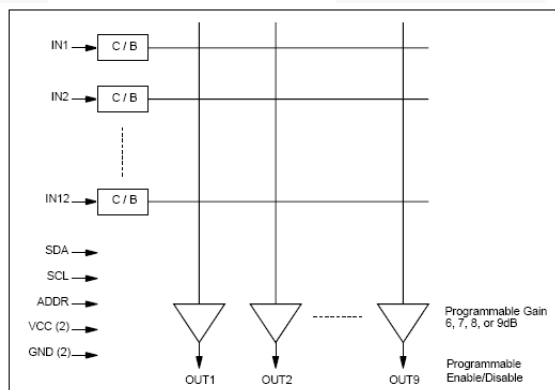


Figure 1. Block Diagram

### Ordering Information

| Part Number    | Operating Temperature Range | Package   | Packing Method | Quantity |
|----------------|-----------------------------|---|----------------|----------|
| FMS6501AMTC28X | -40°C to +85°C              | 28-Lead, Thin-Shrink Small-Outline Package (TSSOP), JEDEC MO-153, 4.4 mm Wide | Reel           | 2500     |

## Pin Configuration

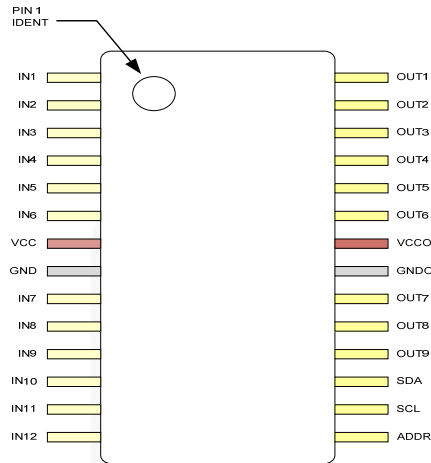


Figure 2. Pin Assignments

## Pin Definitions

| Pin # | Name | Type   | Description  |
|-------|------|--------|--|
| 1     | IN1  | Input  | Input, channel 1   |
| 2     | IN2  | Input  | Input, channel 1   |
| 3     | IN3  | Input  | Input, channel 1   |
| 4     | IN4  | Input  | Input, channel 1   |
| 5     | IN5  | Input  | Input, channel 1   |
| 6     | IN6  | Input  | Input, channel 1   |
| 7     | VCC  | Power  | Core power, must be tied to positive power supply                        |
| 8     | GND  | Power  | Core ground, must be tied to ground                                      |
| 9     | IN7  | Input  | Input, channel 7   |
| 10    | IN8  | Input  | Input, channel 8   |
| 11    | IN9  | Input  | Input, channel 9   |
| 12    | IN10 | Input  | Input, channel 10  |
| 13    | IN11 | Input  | Input, channel 11  |
| 14    | IN12 | Input  | Input, Channel 12  |
| 15    | ADDR | Input  | Selects I <sup>2</sup> C address; 0=0x06 (0000 0110), 1=0x86 (1000 0110) |
| 16    | SCL  | Input  | Serial clock for I <sup>2</sup> C port                                   |
| 17    | SDA  | Input  | Serial data for I <sup>2</sup> C port                                    |
| 18    | OUT9 | Output | Output, channel 9  |
| 19    | OUT8 | Output | Output, channel 8  |
| 20    | OUT7 | Output | Output, Channel 7  |
| 21    | GND0 | Power  | Output ground, must be tied to ground                                    |
| 22    | VCCO | Power  | Output power, must be tied to positive power supply                      |
| 23    | OUT6 | Output | Output, channel 6  |
| 24    | OUT5 | Output | Output, channel 5  |
| 25    | OUT4 | Output | Output, channel 4  |
| 26    | OUT3 | Output | Output, channel 3  |
| 27    | OUT2 | Output | Output, channel 2  |
| 28    | OUT1 | Output | Output, channel 1  |

## 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 |
|-----------|---|------|--------------|------|
| $V_S$     | DC Supply Voltage                                 | -0.3 | 6.0          | V    |
| $V_{IO}$  | Analog and Digital I/O                            | -0.3 | $V_{CC}+0.3$ | V    |
| $V_{OUT}$ | Maximum Output Current Per Channel, Do Not Exceed |      | 40           | mA   |

## Electrostatic Discharge Information

| Symbol | Parameter  | Min. | Unit |
|--------|--|------|------|
| ESD    | Human Body Model (HBM), JESD22-A114, Pins 18,19,20,23,24,25,26,27,28 | 12   | kV   |
|        | Human Body Model (HBM), JESD22-A114, All Input Pins and VCC          | 9    |      |
|        | Charged Device Model(CDM), JESD22-C101, All Pins                     | 2    |      |

## 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   |
| $\Theta_{JA}$ | Thermal Resistance, JEDEC Standard, Multilayer Test Boards, Still Air |      | 50   |      | °C/W |

## 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        | 3.135 | 5.00 | 5.25 | V    |

## DC Electrical Characteristics

$T_A=25^\circ\text{C}$ ,  $V_{CC}$  5 V,  $V_{IN} = 1 V_{PP}$ , input bias mode, one-to-one routing, 6 dB gain, all inputs AC coupled with 0.1  $\mu\text{F}$ , unused inputs AC-terminated through 75  $\Omega$  to GND, all outputs AC coupled with 220  $\Omega$  into 150  $\Omega$  loads, referenced to 400 kHz, unless otherwise noted.

| Symbol      | Parameter                      | Conditions                   | Min. | Typ. | Max. | Unit       |
|-------------|--------------------------------|------------------------------|------|------|------|------------|
| $I_{CC}$    | Supply Current <sup>(1)</sup>  | No Load, All Outputs Enabled |      | 80   | 100  | mA         |
| $V_{OUT}$   | Video Output Range             |                              |      | 2.8  |      | $V_{PP}$   |
| $R_{OFF}$   | Off Channel Output Impedance   | Output Disabled              |      | 3.0  |      | k $\Omega$ |
| $V_{CLAMP}$ | DC Output Level <sup>(1)</sup> | Clamp Mode                   |      | 0.3  | 0.4  | V          |
| $V_{BIAS}$  | DC Output Level <sup>(1)</sup> | Bias Mode                    | 1.15 | 1.25 | 1.35 | V          |
| PSRR        | Power Supply Rejection Ratio   | DC (All Channels)            |      | 50   |      | dB         |

### Note:

- 100% tested at  $T_A=25^\circ\text{C}$ .

## AC Electrical Characteristics

$T_A=25^\circ\text{C}$ ,  $V_{CC}$  5 V,  $V_{IN} = 1 V_{PP}$ , input bias mode, one-to-one routing, 6 dB gain, all inputs AC coupled with 0.1  $\mu\text{F}$ , unused inputs AC-terminated through 75  $\Omega$  to GND, all outputs AC coupled with 220  $\Omega$  into 150  $\Omega$  loads, referenced to 400 kHz, unless otherwise noted.

| Symbol            | Parameter                            | Conditions   | Min. | Typ. | Max. | Unit    |
|-------------------|--------------------------------------|--|------|------|------|---------|
| $AV_{SD}$         | Channel Gain Error <sup>(2)</sup>    | All Channels, All Gain Settings, DC                      | -0.2 | 0    | +0.2 | dB      |
| $AV_{STEP}$       | Gain Step <sup>(2)</sup>             | All Channels, DC   | 0.9  | 1.0  | 1.1  | dB      |
| $f_{+1dB}$        | 1dB Peaking Bandwidth                | $V_{OUT} = 1.4 V_{PP}$                                   |      | 65   |      | MHz     |
| $f_{-1dB}$        | -1dB Bandwidth                       | $V_{OUT} = 1.4 V_{PP}$                                   |      | 90   |      | MHz     |
| $f_C$             | -3dB Bandwidth                       | $V_{OUT} = 1.4 V_{PP}$                                   |      | 115  |      | MHz     |
| dG                | Differential Gain                    | Standard SD Signal 3.58 MHz                              |      | 0.1  |      | %       |
| dP                | Differential Phase                   | Standard SD Signal 3.58 MHz                              |      | 0.2  |      | °       |
| THD <sub>SD</sub> | SD Output Distortion                 | $V_{OUT} = 1.4 V_{PP}$ 5 MHz                             |      | 0.05 |      | %       |
| THD <sub>HD</sub> | HD Output Distortion                 | $V_{OUT} = 1.4 V_{PP}$ 22 MHz                            |      | 0.6  |      | %       |
| $X_{TALK1}$       | Input Crosstalk                      | 1 MHz, $V_{OUT} = 2.0 V_{PP}$ <sup>(3)</sup>             |      | -72  |      | dB      |
| $X_{TALK2}$       | Input Crosstalk                      | 15 MHz, $V_{OUT} = 2.0 V_{PP}$ <sup>(3)</sup>            |      | -50  |      | dB      |
| $X_{TALK3}$       | Output Crosstalk                     | 1 MHz, $V_{OUT} = 2.0 V_{PP}$ <sup>(3)</sup>             |      | -68  |      | dB      |
| $X_{TALK4}$       | Output Crosstalk                     | 15 MHz, $V_{OUT} = 2.0 V_{PP}$ <sup>(3)</sup>            |      | -61  |      | dB      |
| $X_{TALK5}$       | Multi-Channel Crosstalk              | Standard SD Video, $V_{OUT} = 2.0 V_{PP}$ <sup>(4)</sup> |      | -45  |      | dB      |
| SNR <sub>SD</sub> | Signal-to-Noise Ratio <sup>(5)</sup> | NTC-7 Weighting, 4.2 MHz Low Pass, 100 kHz High Pass     |      | 73   |      | dB      |
| $V_{NOISE}$       | Channel Noise                        | 400 kHz to 100 MHz, Input Referred                       |      | 20   |      | nV/rtHz |
| AMP <sub>ON</sub> | Amplifier Recovery Time              | Post I <sup>2</sup> C Programming                        |      | 300  |      | ns      |

### Notes:

- 100% tested at  $T_A=25^\circ\text{C}$ .
- Adjacent input pair to adjacent output pair. Interfering input is through an open switch.
- Crosstalk of eight synchronous switching outputs into single, asynchronous switching output.
- Signal-to-Noise Ratio (SNR) =  $20 \times \log(714 \text{ mV/rms noise})$ .

## Applications Information

### Digital Interface

The I<sup>2</sup>C-compatible interface is used to program output enables, input-to-output routing, input clamp / bias, and output gain. The I<sup>2</sup>C address is 0x06 (0000 0110) with the ability to offset it to 0x86 (1000 0110) by tying the ADDR pin HIGH.

Both data and address data, of eight bits each, are written to the I<sup>2</sup>C address to access control functions.

There are separate internal addresses for each output. Each output's address includes bits to select an input channel, adjust the output gain, and enable or disable

the output amplifier. More than one output can select the same input channel for one-to-many routing. When the outputs are disabled, they are placed in a high-impedance state. This allows multiple FMS6501A devices to be paralleled to create a larger switch matrix. Typical output power-up time is less than 500 ns.

The clamp / bias control bits are written to their own internal addresses, since they should always remain the same regardless of signal routing. They are set based on the input signal connected to the FMS6501A.

All undefined addresses may be written without effect.

**Table 1. Output Control Register Contents and Defaults**

| Control Name | Width  | Type  | Default | Bit(s) | Description  |
|--------------|--------|-------|---------|--------|--|
| Enable       | 1 Bit  | Write | 0       | 7      | Channel Enable: 1=Enable, 0=Power Down <sup>(6)</sup>  |
| Gain         | 2 Bits | Write | 0       | 6:5    | Channel Gain: 00=6dB, 01=7dB, 10=8dB, 11=9dB   |
| Inx          | 5 Bits | Write | 0       | 4:0    | Input Selected to Drive this Output: 00000=OFF <sup>(7)</sup> , 00001=IN1, 00010=IN2... 01100=IN12 |

**Notes:**

- Power down places the output in a high-impedance state so multiple FMS6501 devices may be paralleled. Power down also de-selects any input routed to the specified output.
- When all inputs are OFF, the amplifier input is tied to approximately 150 mV and the output goes to approximately 300 mV with the 6 dB gain setting.

**Table 2. Output Control Register MAP**

| Register Name | Register Address | Bit 7  | Bit 6 | Bit5  | Bit4 <sup>(8)</sup> | Bit3 | Bit2 | Bit1 | Bit0 |
|---------------|------------------|--------|-------|-------|---------------------|------|------|------|------|
| OUT1          | 0x01             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT2          | 0x02             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT3          | 0x03             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT4          | 0x04             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT5          | 0x05             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT6          | 0x06             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT7          | 0x07             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT8          | 0x08             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |
| OUT9          | 0x09             | Enable | Gain1 | Gain0 | IN4                 | IN3  | IN2  | IN1  | IN0  |

**Notes:**

- IN4 is provided for forward compatibility and should always be written as 0.

**Table 3. Clamp Control Register Contents and Defaults**

| Control Name | Width | Type  | Default | Bit(s) | Description                                 |
|--------------|-------|-------|---------|--------|---|
| CLAMP        | 1 bit | Write | 0       | 7:0    | Clamp / Bias selection: 1 = Clamp, 0 = Bias |

**Table 4. Clamp Control Register Map**

| Register Name | Register Address | Bit 7  | Bit 6  | Bit5   | Bit4   | Bit3   | Bit2   | Bit1   | Bit0  |
|---------------|------------------|--------|--------|--------|--------|--------|--------|--------|-------|
| CLAMP1        | 0x1D             | Clmp8  | Clmp7  | Clmp6  | Clmp5  | Clmp4  | Clmp3  | Clmp2  | Clmp1 |
| CLAMP2        | 0x1E             | Resv'd | Resv'd | Resv'd | Resv'd | Clmp12 | Clmp11 | Clmp10 | Clmp9 |

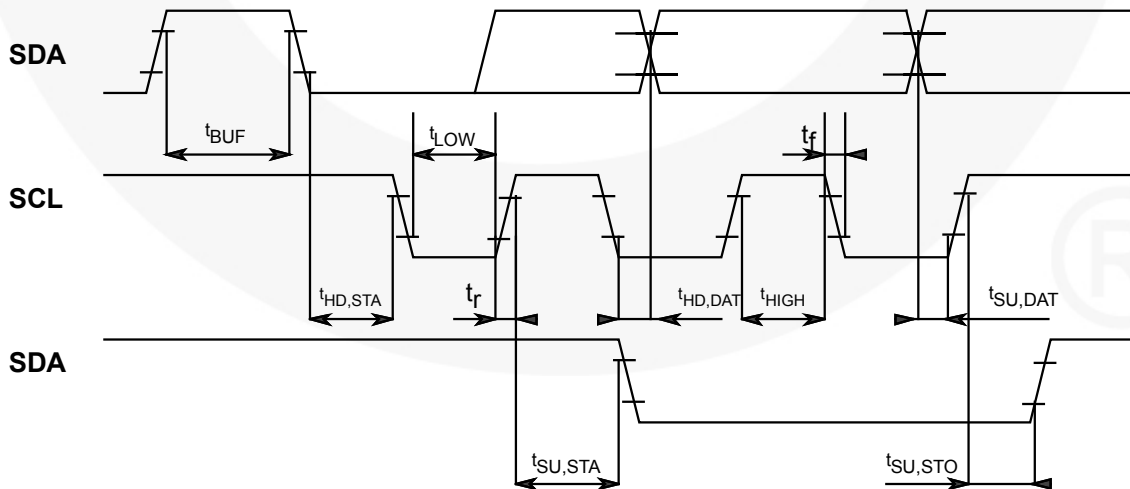
## I<sup>2</sup>C BUS Characteristics

T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5 V unless otherwise noted.

| Symbol              | Parameter                                     | Conditions     | Min. | Typ. | Max.            | Unit |
|---------------------|---|----------------|------|------|-----------------|------|
| V <sub>IL</sub>     | Digital Input Low <sup>(9)</sup>              | SDA, SCL, ADDR | 0    |      | 1.5             | V    |
| V <sub>IH</sub>     | Digital Input High <sup>(9)</sup>             | SDA, SCL, ADDR | 3.0  |      | V <sub>CC</sub> | V    |
| f <sub>scl</sub>    | Clock Frequency                               | SCK            |      | 100  |                 | kHz  |
| t <sub>R</sub>      | Input Rise Time                               | 1.5 V to 3 V   |      | 1000 |                 | ns   |
| t <sub>F</sub>      | Input Fall Time                               | 1.5 V to 3 V   |      | 300  |                 | ns   |
| t <sub>LOW</sub>    | Clock Low Period                              |                |      | 4.7  |                 | µs   |
| t <sub>HIGH</sub>   | Clock High Period                             |                |      | 4.0  |                 | µs   |
| t <sub>SU,DAT</sub> | Data Set-up Time                              |                |      | 300  |                 | ns   |
| t <sub>HD,DAT</sub> | Data Hold Time                                |                |      | 0    |                 | ns   |
| t <sub>SU,STO</sub> | Set-up Time from Clock HIGH to Stop           |                |      | 4    |                 | µs   |
| t <sub>BUF</sub>    | Start Set-up Time Following a Stop            |                |      | 4.7  |                 | µs   |
| t <sub>HD,STA</sub> | Start Hold Time                               |                |      | 4    |                 | µs   |
| t <sub>SU,STA</sub> | Start Set-up Time Following Clock LOW to HIGH |                |      | 4.7  |                 | µs   |

**Notes:**

- 100% tested at T<sub>A</sub>=25°C.



**Figure 3. I<sup>2</sup>C Bus Timing**

## I<sup>2</sup>C Interface

### Operation

The I<sup>2</sup>C-compatible interface conforms to the I<sup>2</sup>C specification for Standard Mode. Individual addresses may be written. There is no read capability. The interface consists of two lines. These are a serial data line (SDA) and a serial clock line (SCL), both of which must be connected to a positive supply through an external resistor. Data transfer may be initiated only when the bus is not busy.

### Bit Transfer

One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse. Changes in the line during this time are interpreted as a control signal.

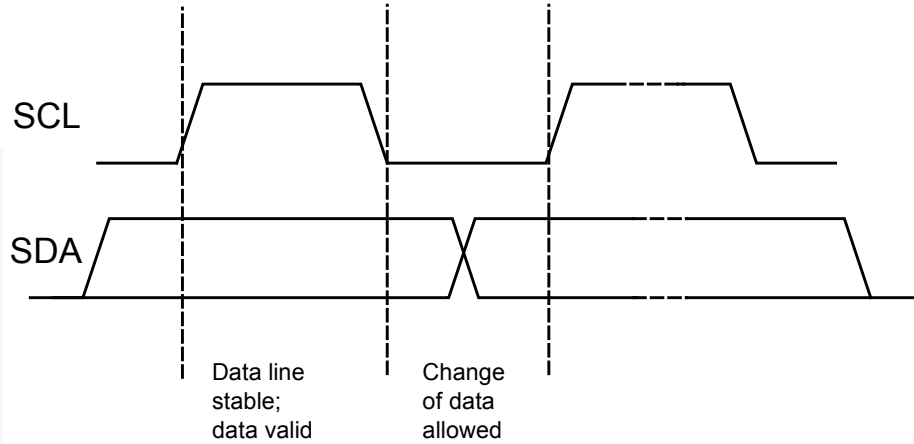


Figure 4. Bit Transfer

### Start and Stop Conditions

The data and clock lines remain HIGH when the bus is not busy. A HIGH-to-LOW transition of the data line, while the clock is HIGH, is defined as START condition

(S). A LOW-to-HIGH transition of the data line, while the clock is HIGH, is defined as STOP condition (P).

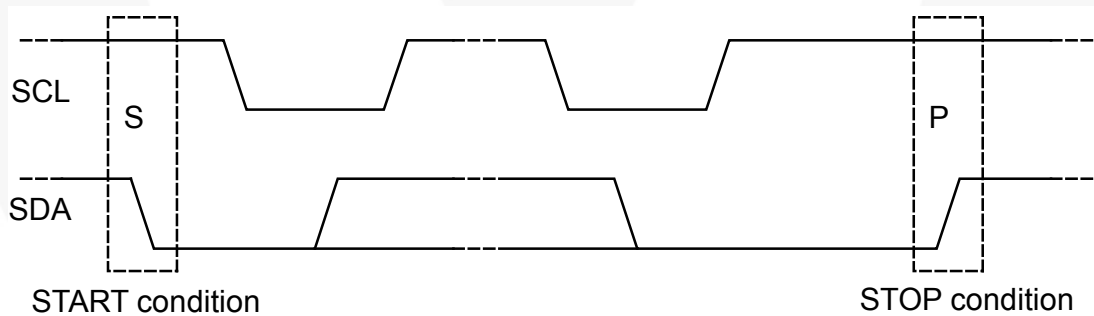


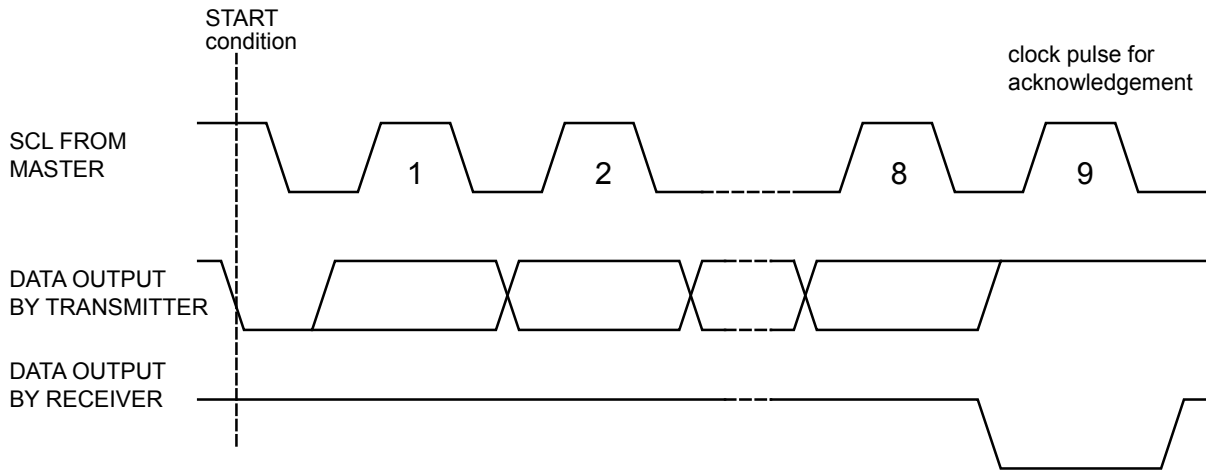
Figure 5. Definition of START and STOP conditions

### Acknowledge

The number of data bytes transferred between the START and STOP conditions from transmitter to receiver is unlimited. Each byte of eight bits is followed by an acknowledge bit. The acknowledge bit is a high-level signal put on the bus by the transmitter, during which the master generates an extra acknowledge-related clock pulse. A slave receiver must generate an acknowledge (ACK) after the reception of each byte. A master receiver must generate an acknowledge after the reception of each byte that has been clocked out of the slave transmitter.

The device that acknowledges must pull down the SDA line during the acknowledge clock pulse so the SDA line is stable LOW during the HIGH period of the acknowledge-related clock pulse (set-up and hold times must be taken into consideration). A master receiver must signal an end of data to the transmitter by not generating an acknowledge on the last byte clocked out of the slave. In this event, the transmitter must leave the data line HIGH to enable the master to generate a STOP condition.



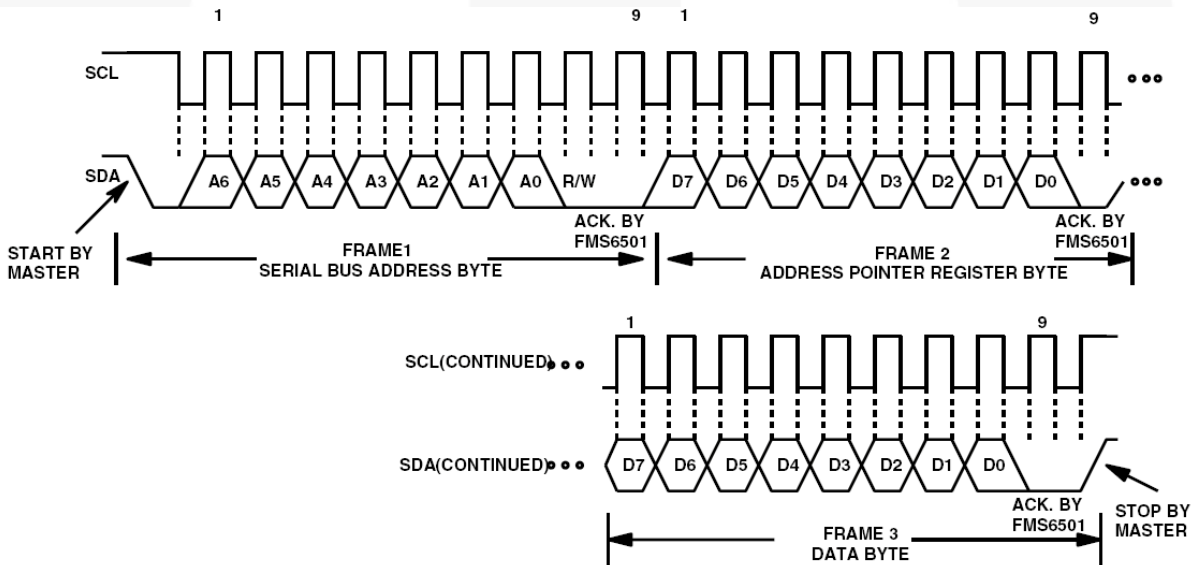


**Figure 6. Acknowledgement on the I<sup>2</sup>C Bus®**

### I<sup>2</sup>C Bus Protocol

Before any data is transmitted on the I<sup>2</sup>C Bus, the device that should respond is addressed first. The addressing is always carried out with the first byte

transmitted after the START procedure. The I<sup>2</sup>C bus configuration for a data write to the FMS6501 is shown in Figure 7.



**Figure 7. Write a Register Address to the Pointer Register, Then Write Data to the Selected Register**

## Applications Information

### Input Clamp / Bias Circuitry

The FMS6501A accommodates AC- or DC-coupled inputs. Internal clamping and bias circuitry are provided to support AC-coupled inputs. These are selectable through the CLMP bits via the I<sup>2</sup>C compatible interface.

For DC-coupled inputs, the device should be programmed to use the bias input configuration. In this configuration, the input is internally biased to 625 mV through a 100 kΩ resistor. Distortion is optimized with the output levels set between 250 mV above ground and 500 mV below the power supply. These constraints, along with the desired channel gain, need to be considered when configuring the input signal levels for input DC coupling.

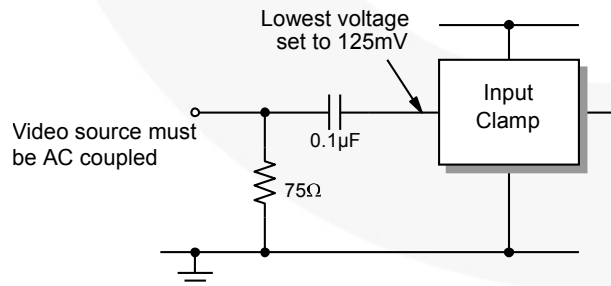
With AC-coupled inputs, the FMS6501A uses a simple clamp rather than a full DC-restore circuit. For video signals with and without sync (Y, CV, R, G, B); the lowest voltage at the output pins is clamped to ~300 mV above ground when the 6dB gain setting is selected.

If symmetric AC-coupled input signals are used (Chroma, Pb, Pr, Cb, Cr), the bias circuit described above can be used to center them within the input common range. The average DC value at the output is approximately 1.27 V with a 6 dB gain setting. This value changes, depending upon the selected gain setting, as shown in Table 5.

**Table 5. Common Mode Voltage**

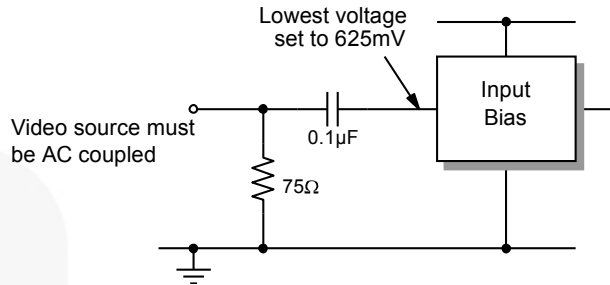
| Gain Setting | Clamp Voltage | Bias Voltage |
|--------------|---------------|--------------|
| 6dB          | 300 mV        | 1.27 V       |
| 7dB          | 330 mV        | 1.43 V       |
| 8dB          | 370 mV        | 1.60 V       |
| 9dB          | 420 mV        | 1.80 V       |

Figure 8 shows the clamp-mode input circuit and the internally controlled voltage at the input pin for AC-coupled inputs.



**Figure 8. Clamp Mode Input Circuit**

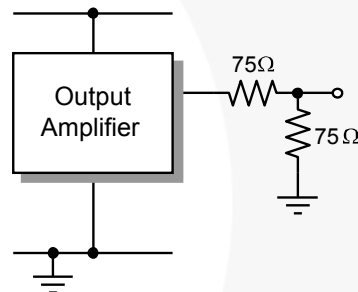
Figure 9 shows the bias mode input circuit and internally controlled voltage at the input pin for AC-coupled inputs.



**Figure 9. Bias Mode Input Circuit**

### Output Configuration

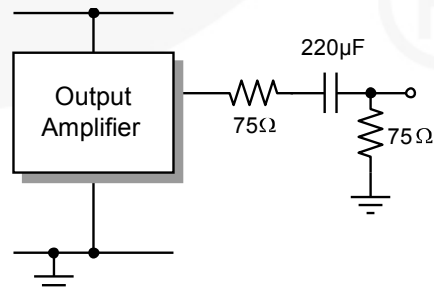
The FMS6501A outputs may be either AC or DC coupled. Resistive output loads can be as low as 75 Ω, representing a dual doubly terminated video load. High impedance capacitive loads of up to 20 pF can be driven without loss of signal integrity. For standard 75 Ω video loads, a 75 Ω matching resistor should be placed in series to allow for a doubly terminated load. DC-coupled outputs should be connected as shown in Figure 10.



**Figure 10. DC-Coupled Load Connection**

If multiple low-impedance loads are DC coupled, increased power and thermal issues need to be addressed. In this case, the use of a multilayer board with a large ground plane is recommended to help dissipate heat. If a two-layer board is used under these conditions, an extended ground plane directly under the device is recommended. This plane should extend at least 12.7 mm (0.5 inches) beyond the device. PC board layout issues are discussed in the Layout Considerations section.

AC-coupled loads should be configured as in shown in Figure 11.



**Figure 11. AC-Coupled Load Connection**

Thermal issues are reduced with AC-coupled outputs, eliminating special PC layout requirements.

Each of the outputs can be independently powered down and placed in a high-impedance state with the ENABLE bit. This function can be used to mute video signals, to parallel multiple FMS6501A outputs, or to save power. When the output amplifier is disabled, the high-impedance output presents a 3 kΩ load to ground. The output amplifier typically enters and recovers from the power-down state in less than 300 ns after being programmed.

When an output channel is not connected to an input, the input to that channel's amplifier is forced to ~150mV. The output amplifier is active unless specifically disabled by the I<sup>2</sup>C interface. Voltage output levels depend on the programmed gain for the channel.

### Crosstalk

Crosstalk is an important consideration: input and output crosstalk represent the two major coupling modes in a typical application. Input crosstalk is crosstalk in the input pins and switches when the interfering signal drives an open switch. It is dominated by inductive coupling in the package lead frame between adjacent leads. It decreases rapidly as the interfering signal moves farther away from the pin adjacent to the input signal selected. Output crosstalk is coupling from one driven output to another active output. It decreases with increasing load impedance, as it is caused mainly by ground and power coupling between output amplifiers. If a signal is driving an open switch, its crosstalk is mainly input crosstalk. If it is driving a load through an active output, its crosstalk is mainly output crosstalk.

Input and output crosstalk measurements are performed with the test configuration shown in Figure 12.

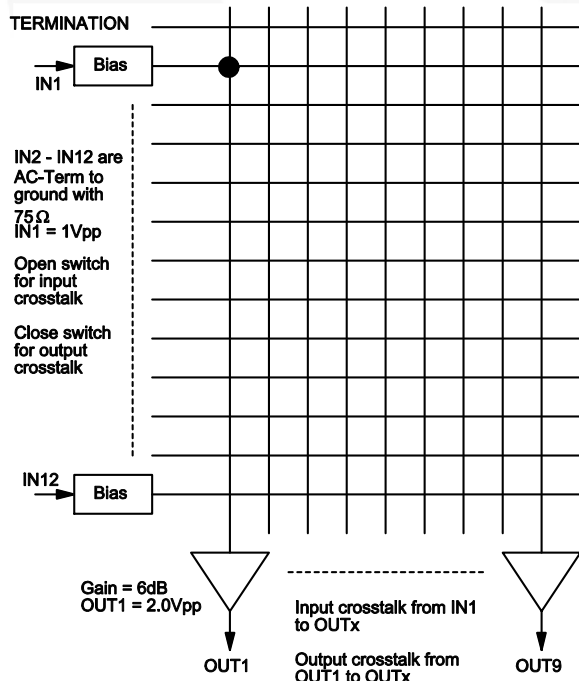


Figure 12. Test Configuration for Crosstalk

For input crosstalk, the switch is open. All inputs are in bias mode. Channel 1 input is driven with a 1 V<sub>PP</sub> signal, while all other inputs are AC terminated with 75 Ω. All outputs are enabled and crosstalk is measured from IN1 to any output. For output crosstalk, the switch is closed. Crosstalk from OUT1 to any output is measured.

Crosstalk from multiple sources into a given channel has been measured with the setup shown in Figure 13. Input IN1 is driven with a 1 V<sub>PP</sub> pulse source and is connected to outputs Out1 to Out8. Input In9 is driven with a secondary, asynchronous, gray-field video signal, and is connected to Out9. All other inputs are AC terminated with 75 Ω. Crosstalk effects on the gray field are measured and calculated with respect to a standard 1 V<sub>PP</sub> output measured at the load.

If not all inputs and outputs are needed, avoid using adjacent channels, where possible, to reduce crosstalk. Disable all unused channels to further reduce crosstalk and power dissipation.

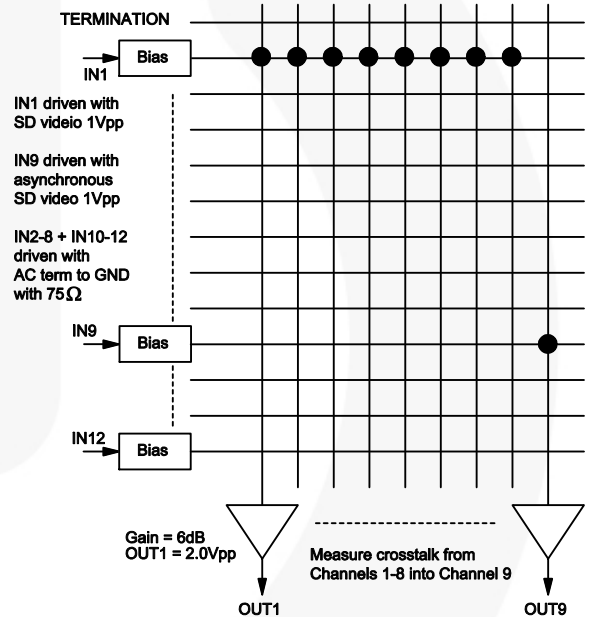


Figure 13. Test Configuration for Multi-Channel Crosstalk

## Layout Considerations

General layout and supply bypassing play major roles in high-frequency performance and thermal characteristics. Fairchild offers a demonstration board, FMS6501ADEMO, to use as a guide for layout and to aid in device testing and characterization. The FMS6501ADEMO is a four-layer board with a full power and ground plane. For optimum results, follow the steps below as a basis for high frequency layout.

- Include 10  $\mu\text{F}$  and 0.1  $\mu\text{F}$  bypass capacitors.
- Place the 10  $\mu\text{F}$  capacitor within 19.05 mm (0.75 inches) of the power pin.
- Place the 0.1  $\mu\text{F}$  capacitor within 2.7 mm (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.
- Place 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  $(V_{CC2}/4R_L)$  per output channel. This assumes a constant DC output voltage of  $V_{CC}/2$ . For 5 V  $V_{CC}$  with a dual-DC video load, add  $25 / (4 \times 75) = 83 \text{ mW}$ , per channel.

## Video Switch Matrix Applications

The increased demand for consumer multimedia systems has created a challenge for system designers to provide cost-effective solutions to capitalize on the growth potential in graphics display technologies. These applications require cost-effective video switching and filtering solutions to deploy high-quality display technologies rapidly and effectively to the target audience. Areas of specific interest include HDTV, media centers, and automotive “infotainment” (includes navigation, in-cabin entertainment, and back-up camera). In all cases, the advantages an integrated video switch matrix provides are high-quality video switching specific to the application as well as video input clamps and on-chip low-impedance output cable drivers with switchable gain.

Generally the largest application for a video switch is for the front end of an HDTV, where it takes multiple inputs and routes them to appropriate signal paths (main picture and Picture-in-Picture (PiP)). These are normally routed into ADCs followed by decoders. There are many different technologies for HDTV; including LCD, plasma, and CRT, with similar analog switching circuitry.

An example of a HDTV application is shown in Figure 14. This system combines a video switch matrix and two three-channel switchable anti-aliasing filters. There are two three-channel signal paths in the system; one for the main picture, the other for PiP.

## VIPDEMO™ Control Software

The FMS6501A is configured via an  $I^2C$ -compatible digital interface. To facilitate demonstration, Fairchild Semiconductor had developed the VIPDEMO™ GUI-based control software to write to the register map. This software is included in the FMS6501ADEMO kit. A parallel port  $I^2C$  adapter and an interface cable to connect to the board are also included. Besides using the full interface, the VIPDEMO can also be used to control single-register read and writes for  $I^2C$ .

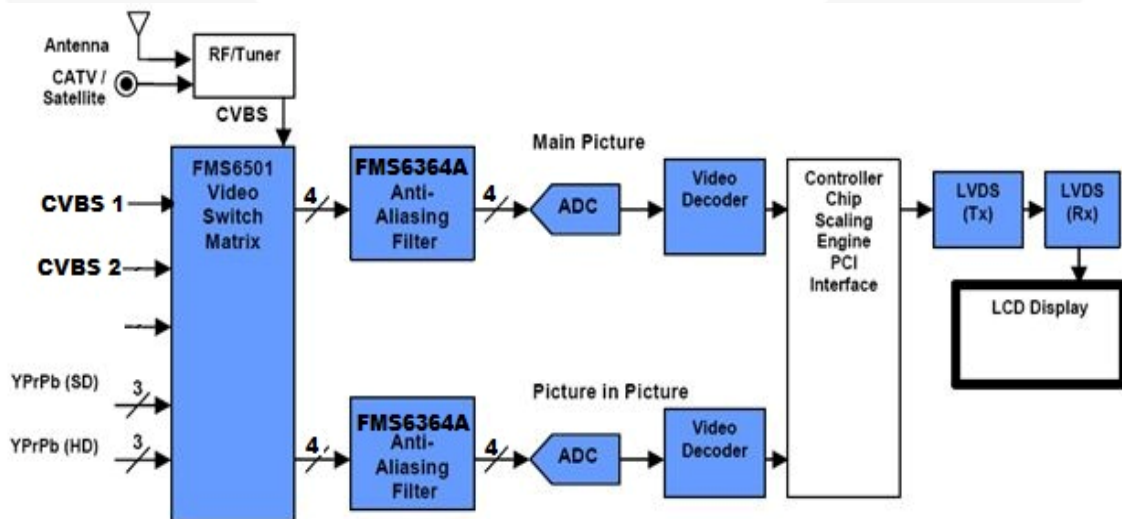


Figure 14. HDTV Application Using the FMS6501A Video Switch Matrix

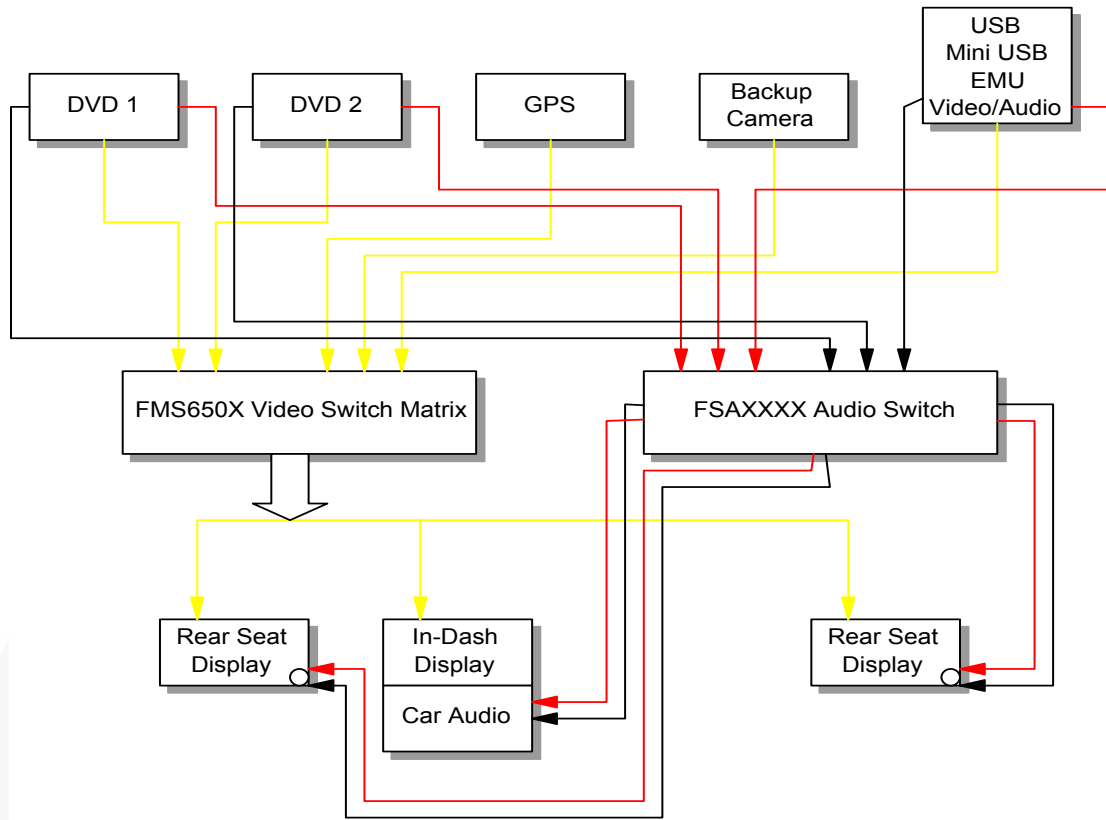


Figure 15. Example of an In-Cabin System

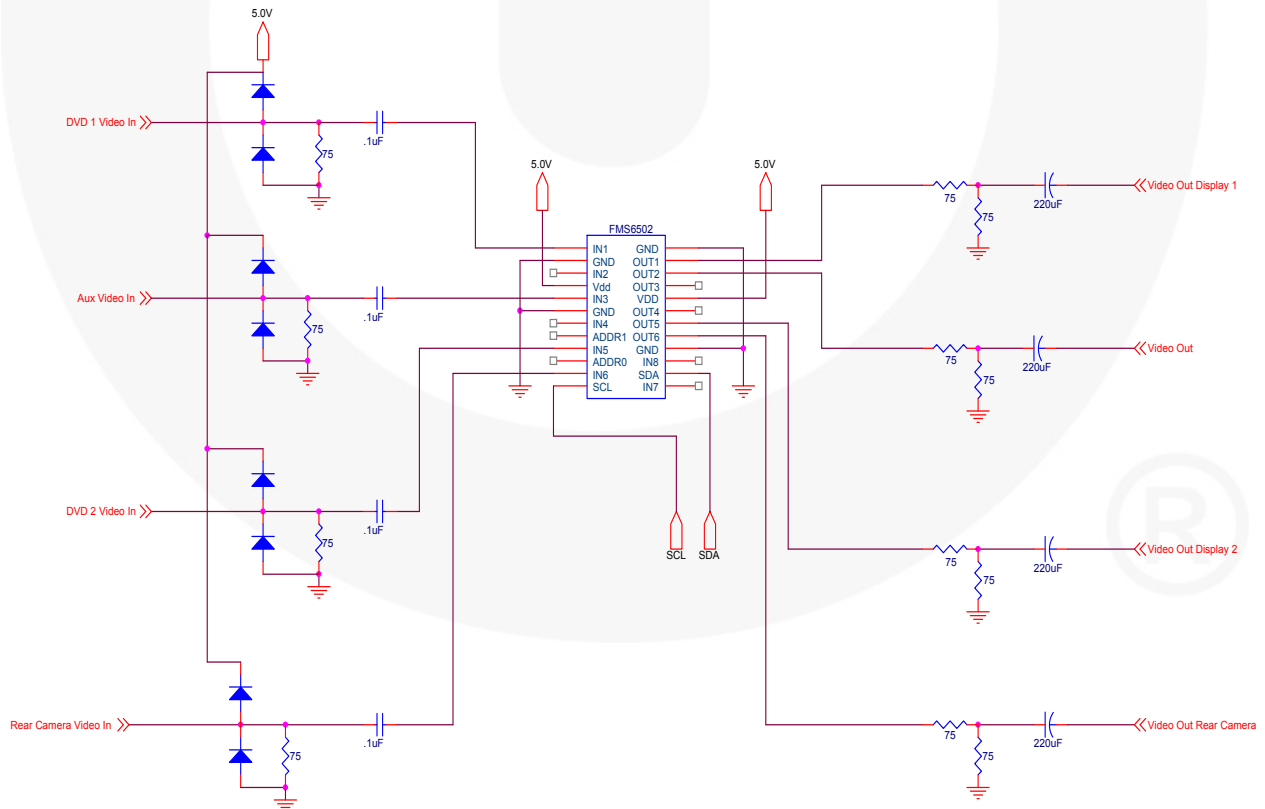
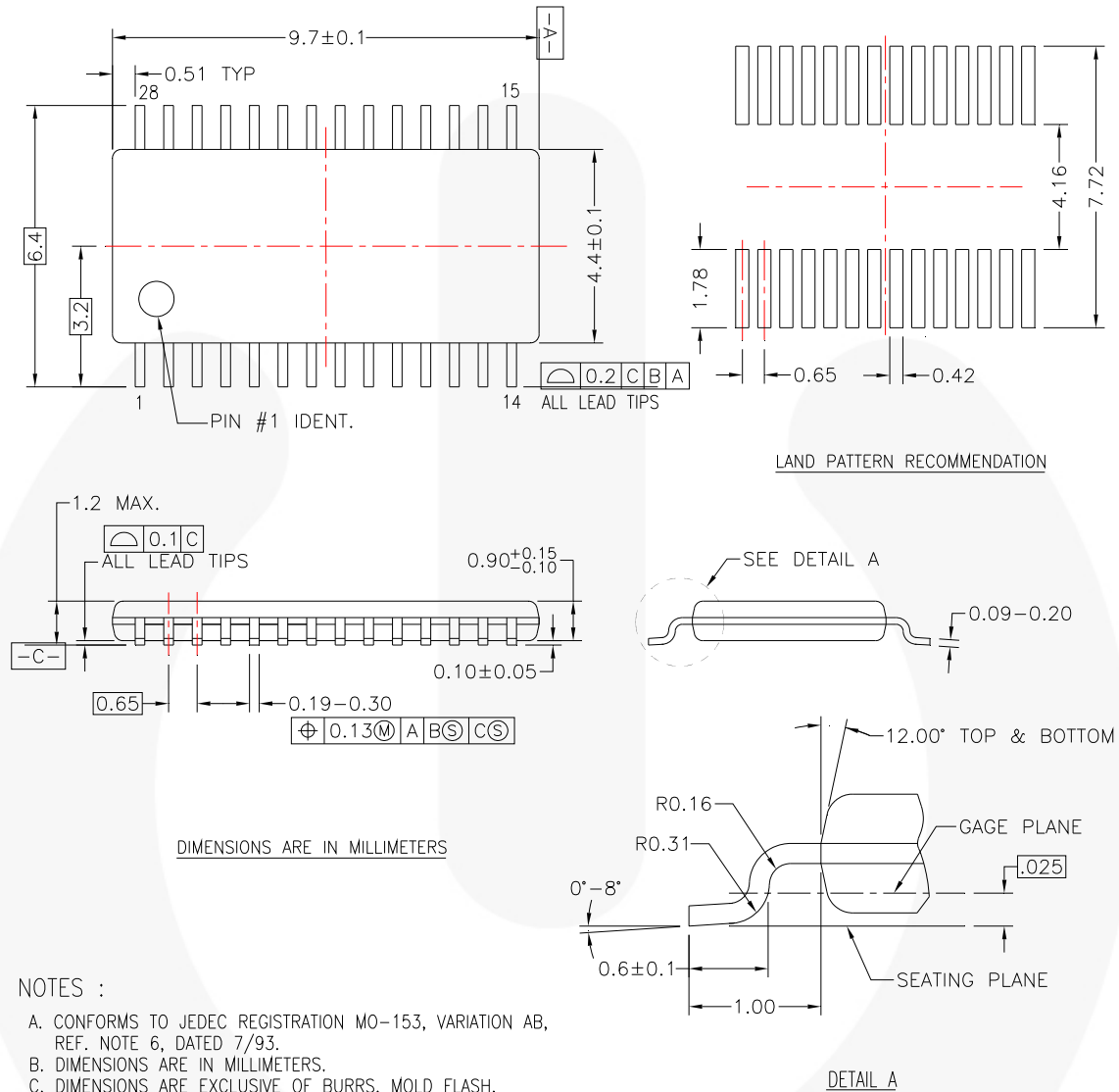


Figure 16. Schematic of an In-Cabin System

### Physical Dimensions



**NOTES :**

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF. NOTE 6, DATED 7/93.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTC28REVA

**Figure 17. 28-Lead, Thin-Shrink Small-Outline Package (TSSOP), JEDEC MO-153, 4.4 mm Wide**





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