



# Audio/Video Switch for Dual SCART Connector

MAX9595

## General Description

The MAX9595 dual SCART switch matrix routes audio and video signals between an MPEG encoder and two external SCART connectors under I<sup>2</sup>C<sup>†</sup> control, and meets the requirements of EN50049-1, IEC 933-1, Canal+, and BSkyB standards.

The video and audio channels feature input source selection multiplexers, input buffers, and output buffers for routing all inputs to selected outputs.

The MAX9595 provides programmable gain control from +5dB to +7dB in 1dB steps for red, green, and blue component video signals. All other video outputs have a fixed +6dB gain. Additional features include an internal luma and chroma (Y/C) mixer that generates a composite video signal (CVBS) to supply an RF modulator output, and internal video reconstruction lowpass filters with a cutoff frequency of 6MHz. The MAX9595 TV audio channel features clickless switching and programmable volume control from -56dB to +6dB in 2dB steps. The VCR audio output also has programmable gain for -6dB, 0dB, or +6dB. The device also generates monaural audio from left and right stereo inputs. All audio drivers deliver a 3.0VRMS minimum output.

The MAX9595 operates with standard 5V and 12V power supplies and supports slow-switching and fast-switching signals. The I<sup>2</sup>C interface programs the gain and volume control, and selects the input source for routing.

The MAX9595 is available in a compact 48-pin thin QFN package and is specified over the 0°C to +70°C commercial temperature range.

## Applications

Satellite Set-Top Boxes  
Cable Set-Top Boxes  
TVs  
VCRs  
DVDs

<sup>†</sup>Purchase of I<sup>2</sup>C components from Maxim Integrated Products, Inc. or one of its sublicensed Associated Companies, conveys a license under the Philips I<sup>2</sup>C Patent Rights to use these components in an I<sup>2</sup>C system, provided that the system conforms to the I<sup>2</sup>C Standard Specification as defined by Philips.

## Features

- ◆ Video Outputs Drive 2Vp-p into 150Ω
- ◆ Audio Outputs Drive 3VRMS into 10kΩ
- ◆ Clickless, Popless Audio Gain Control and Switching
- ◆ Interrupt Output Detects Changes on Slow Switching Input
- ◆ AC-Coupled Video Inputs with Internal Clamp and Bias
- ◆ DC-Coupled Video Outputs
- ◆ Composite Video Signal Created Internally from Y/C Inputs
- ◆ Internal Video Reconstruction Filters Provide -50dB at 27MHz
- ◆ Single-Ended Audio Input
- ◆ Red/Chroma Switch for Bidirectional I/O
- ◆ I<sup>2</sup>C-Programmable RGB Gain from +5dB to +7dB
- ◆ I<sup>2</sup>C-Programmable Audio Gain Control from +6dB to -56dB
- ◆ Meets EN50049-1, IEC 933-1, Canal+, and BSkyB Requirements

## Ordering Information

| PART        | TEMP RANGE   | PIN-PACKAGE                    | PKG CODE |
|-------------|--------------|--------------------------------|----------|
| MAX9595CTM+ | 0°C to +70°C | 48 Thin QFN-EP*<br>(7mm x 7mm) | T4877-6  |

\*EP = Exposed paddle.

+Denotes lead-free package.

**Pin Configuration and Typical Application Circuit appear at end of data sheet.**

**System Block Diagram appears at end of data sheet.**

# Audio/Video Switch for Dual SCART Connector

## ABSOLUTE MAXIMUM RATINGS

V<sub>VID</sub> to GNDVID ..... -0.3V to +6V  
 V<sub>12</sub> to GNDAUD ..... -0.3V to +14V  
 V<sub>AUD</sub> to GNDAUD ..... -0.3V to +6V  
 GNDAUD to GNDVID ..... -0.1V to +0.1V  
 All Video Inputs, ENCIN\_FS, VCRIN\_FS,  
 SET to GNDVID ..... -0.3V to (V<sub>VID</sub> + 0.3V)  
 All Audio Inputs,  
 AUDBIAS to GNDAUD ..... -0.3V to (V<sub>AUD</sub> + 0.3V)  
 SDA, SCL, DEV\_ADDR,  
 INTERRUPT\_OUT to GNDVID ..... -0.3V to +6V  
 All Audio Outputs, TV\_SS,  
 VCR\_SS to GNDAUD ..... -0.3V to (V<sub>12</sub> + 0.3V)

INTERRUPT\_OUT Current ..... +50mA  
 All Video Outputs, TVOUT\_FS to V<sub>VID</sub>, V<sub>AUD</sub>,  
 GNDAUD, GNDVID ..... Continuous  
 All Audio Outputs to V<sub>VID</sub>, V<sub>AUD</sub>, V<sub>12</sub>,  
 GNDVID, GNDAUD ..... Continuous  
 Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 48-Pin Thin QFN (derate 27mW/°C above +70°C) ..... 2105.3mW  
 Operating Temperature Range ..... 0°C to +70°C  
 Junction Temperature ..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature (soldering, 10s) ..... +300°C

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.

## ELECTRICAL CHARACTERISTICS

(V<sub>12</sub> = 12V, V<sub>VID</sub> = V<sub>AUD</sub> = 5V; 0.1μF X5R capacitor in parallel with a 10μF aluminum electrolytic capacitor from V<sub>AUD</sub> to GNDAUD, V<sub>12</sub> to GNDAUD, and V<sub>VID</sub> to GNDVID; SET = 100kΩ nominal, R<sub>LOAD</sub> = 150Ω, T<sub>A</sub> = 0°C to +70°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER                                 | SYMBOL             | CONDITIONS                                                                                | MIN  | TYP  | MAX  | UNITS   |
|-------------------------------------------|--------------------|-------------------------------------------------------------------------------------------|------|------|------|---------|
| V <sub>VID</sub> Supply Voltage Range     | V <sub>VID</sub>   | Inferred from video gain test                                                             | 4.75 | 5.0  | 5.25 | V       |
| V <sub>AUD</sub> Supply Voltage Range     | V <sub>AUD</sub>   | Inferred from audio gain test                                                             | 4.75 | 5.0  | 5.25 |         |
| V <sub>12</sub> Supply Voltage Range      | V <sub>12</sub>    | Inferred from slow switching levels                                                       | 11.4 | 12.0 | 12.6 |         |
| V <sub>VID</sub> Quiescent Supply Current | I <sub>VID_Q</sub> | All video output amplifiers are enabled, no load                                          |      | 69   | 100  | mA      |
| V <sub>VID</sub> Standby Supply Current   | I <sub>VID_Q</sub> | All video output amplifiers are in shutdown, and TV_FS_OUT driver is in shutdown, no load |      | 40   | 60   | mA      |
| V <sub>AUD</sub> Quiescent Supply Current | I <sub>AUD_Q</sub> | No load                                                                                   |      | 2.4  | 6    | mA      |
| V <sub>12</sub> Quiescent Supply Current  | I <sub>12_Q</sub>  | No load                                                                                   |      | 3.6  | 6    | mA      |
| <b>VIDEO CHARACTERISTICS</b>              |                    |                                                                                           |      |      |      |         |
| Voltage Gain                              | G <sub>V</sub>     | CVBS and Y-C, 1V <sub>P-P</sub> input                                                     | +5.5 | +6.0 | +6.5 | dB      |
|                                           |                    | RGB, 1V <sub>P-P</sub> input, (programmable gain control)                                 | +4.5 | +5.0 | +5.5 |         |
|                                           |                    |                                                                                           | +5.5 | +6.0 | +6.5 |         |
|                                           |                    |                                                                                           | +6.5 | +7.0 | +7.5 |         |
| LP Filter Attenuation                     | ATTN               | T <sub>A</sub> = +25°C, f = 6MHz, V <sub>IN</sub> = 1V <sub>P-P</sub>                     |      | 1.2  | 3.3  | dB      |
| LP Filter Suppression                     | SPPR               | T <sub>A</sub> = +25°C, f = 27MHz, V <sub>IN</sub> = 1V <sub>P-P</sub>                    | 35   | 50   |      | dB      |
| Slew Rate                                 | SR                 | V <sub>OUT</sub> = 2V <sub>P-P</sub>                                                      |      | 8    |      | V/μs    |
| Settling Time                             | t <sub>S</sub>     | V <sub>OUT</sub> = 2V <sub>P-P</sub> , settle to 0.1% (Note 2)                            |      | 380  |      | ns      |
| Gain Matching                             | AG                 | 1V <sub>P-P</sub> input, between RGB or Y-C                                               | -0.5 |      | +0.5 | dB      |
| Differential Gain                         | DG                 | 5-step modulated staircase                                                                |      | 0.4  |      | %       |
| Differential Phase                        | DP                 | 5-step modulated staircase                                                                |      | 0.2  |      | degrees |

# Audio/Video Switch for Dual SCART Connector

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{12} = 12V$ ,  $V_{VID} = V_{AUD} = 5V$ ; 0.1 $\mu F$  X5R capacitor in parallel with a 10 $\mu F$  aluminum electrolytic capacitor from  $V_{AUD}$  to GND<sub>AUD</sub>,  $V_{12}$  to GND<sub>AUD</sub>, and  $V_{VID}$  to GND<sub>VID</sub>; SET = 100k $\Omega$  nominal,  $R_{LOAD} = 150\Omega$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 1)

| PARAMETER                                                | SYMBOL       | CONDITIONS                                                                                                                | MIN  | TYP                       | MAX  | UNITS      |
|----------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------|------|---------------------------|------|------------|
| Signal-to-RMS Noise                                      | SNR_V        | $V_{IN} = 1V_{P-P}$                                                                                                       |      | 65                        |      | dB         |
| Group Delay Variation                                    | $\Delta GD$  | $f = 0.1MHz$ to $4.43MHz$                                                                                                 |      | 14                        |      | ns         |
| Sync-Tip Clamp Level                                     | $V_{CLMP}$   | RGB, composite, and luma input, no signal, no load                                                                        |      | 1.21                      |      | V          |
| Chroma Bias                                              | $V_{BIAS}$   | Chroma input only, no signal, no load                                                                                     |      | 1.9                       |      | V          |
| Droop                                                    | D            | Set by input current                                                                                                      | -2   |                           | +2   | %          |
| Power-Supply Rejection Ratio                             | PSRR_V       | DC, 0.5V <sub>P-P</sub>                                                                                                   |      | 48                        |      | dB         |
| Input Impedance                                          | $Z_{IN}$     | CVBS or RGB video inputs, $V_{IN} > V_{CLMP}$                                                                             |      | 4                         |      | M $\Omega$ |
|                                                          |              | Chroma video input. $V_{IN} = V_{BIAS}$                                                                                   |      | 11                        |      | k $\Omega$ |
| Input Clamp Current                                      | $I_{CLMP}$   | $V_{IN} = 1.75V$                                                                                                          | 2.5  | 5                         | 8.0  | $\mu A$    |
| Pulldown Resistance                                      | $R_P$        | Enable VCR_R/C_OUT and TV_R/C_OUT pulldown through I <sup>2</sup> C, (see registers 7 and 9 for loading register details) |      | 10                        |      | $\Omega$   |
| Output Pin Bias Voltage                                  | $V_{OUT}$    | RGB, composite, and luma, no signal, no load                                                                              |      | 1.08                      |      | V          |
|                                                          |              | Chroma, no signal, no load                                                                                                |      | 2.27                      |      |            |
| Crosstalk                                                | XTLK         | Between any two active inputs, $f = 4.43MHz$ , $V_{IN} = 1V_{P-P}$                                                        |      | -50                       |      | dB         |
| Mute Suppression                                         | $M_{SPR\_V}$ | $f = 4.43MHz$ , $V_{IN} = 1V_{P-P}$ , on one input only                                                                   |      | -50                       |      | dB         |
| <b>AUDIO CHARACTERISTICS (Note 3)</b>                    |              |                                                                                                                           |      |                           |      |            |
| Voltage Gain (Measured From Application Input)           | $G_A$        | TV or VCR to stereo, gain = 0dB, $V_{IN} = 1V_{P-P}$                                                                      | -0.5 | 0                         | +0.5 | dB         |
|                                                          |              | TV or VCR to mono, gain = 0dB, $V_{IN} = 1V_{P-P}$                                                                        | 2.5  | 3.0                       | 3.5  |            |
|                                                          |              | ENC to stereo, gain = 0dB, $V_{IN} = 1V_{P-P}$                                                                            | 3.02 | 3.52                      | 4.02 |            |
|                                                          |              | ENC to mono, gain = 0dB, $V_{IN} = 1V_{P-P}$                                                                              | 6.02 | 6.52                      | 7.02 |            |
| Gain Matching Between Channels                           | $\Delta G_A$ | Gain = 0dB, $V_{IN} = 1V_{P-P}$                                                                                           | -0.5 | 0                         | +0.5 | dB         |
| Flatness                                                 | $\Delta A$   | $f = 20Hz$ to $20kHz$ , 0.5V <sub>RMS</sub> input, gain = 0dB                                                             |      | 0.01                      |      | dB         |
| Frequency Bandwidth                                      | BW           | 0.5V <sub>RMS</sub> input, frequency where output is -3dB referenced to 1kHz                                              |      | 230                       |      | kHz        |
| Input DC Level (Excluding Encoder Inputs which are Hi-Z) | $V_{IN}$     | Gain = 0dB                                                                                                                |      | 0.2308<br>$\times V_{12}$ |      | V          |

# Audio/Video Switch for Dual SCART Connector

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{12} = 12V$ ,  $V_{VID} = V_{AUD} = 5V$ ; 0.1 $\mu F$  X5R capacitor in parallel with a 10 $\mu F$  aluminum electrolytic capacitor from  $V_{AUD}$  to  $GND_{AUD}$ ,  $V_{12}$  to  $GND_{AUD}$ , and  $V_{VID}$  to  $GND_{VID}$ ; SET = 100k $\Omega$  nominal,  $R_{LOAD} = 150\Omega$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 1)

| PARAMETER                                                   | SYMBOL        | CONDITIONS                                                                                                  | MIN | TYP            | MAX | UNIT      |
|-------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------|-----|----------------|-----|-----------|
| Input Signal Amplitude<br>(Measured from Application Input) | $V_{IN\_AC}$  | Single-ended inputs, $f = 1kHz$ , THD < 1%                                                                  |     | 3              |     | $V_{RMS}$ |
|                                                             |               | ENC inputs single-ended, $f = 1kHz$ , THD < 1%                                                              |     | 1.31           |     |           |
| Input Resistance (Measured at Parts Input)                  | $R_{IN}$      | Single ended: VCR_INR, VCR_INL, TV_INR, TV_INL                                                              |     | 0.1            |     | $M\Omega$ |
|                                                             |               | Encoder, ENC_INL, ENC_INR                                                                                   |     | 0.1            |     |           |
| Output DC Level                                             | $V_{OUT\_DC}$ | $V_{IN} = 0V$                                                                                               |     | 0.5 x $V_{12}$ |     | V         |
| Signal-to-Noise Ratio (Measured from Application Input)     | $SNR_A$       | $f = 1.0kHz$ , 1 $V_{RMS}$ application input, gain = 0dB, 20Hz to 20kHz                                     |     | 95             |     | dB        |
| Total Harmonic Distortion Plus Noise                        | THD+N         | $R_{LOAD} = 10k\Omega$ , $f = 1.0kHz$ , 0.5 $V_{RMS}$ output                                                |     | 0.004          |     | %         |
|                                                             |               | $R_{LOAD} = 10k\Omega$ , $f = 1.0kHz$ , 2 $V_{RMS}$ output                                                  |     | 0.004          |     |           |
| Output Impedance                                            | $Z_O$         | $f = 1kHz$                                                                                                  |     | 1              |     | $\Omega$  |
| Volume Attenuation Step                                     | ASTEP         | 1.414 $V_{P-P}$ input, programmable gain to TV SCART volume control range extends from -56dB to +6dB        | 1.5 | 2              | 2.5 | dB        |
|                                                             |               | 1.414 $V_{P-P}$ input, programmable gain to VCR audio extends from -6dB to +6dB                             | 5.5 | 6              | 6.5 |           |
| Power-Supply Rejection Ratio                                | PSRR_A        | From $V_{12}$ , $f = 1kHz$ , 0.5 $V_{P-P}$ , ( $C_{AUD\_BIAS} = 47\mu F$ ), gain = 0dB                      |     | 75             |     | dB        |
|                                                             |               | From $V_{AUD}$ , $f = 1kHz$ , 0.5 $V_{P-P}$ , $V_{AUD} \geq +4.75V$ , $V_{AUD} \leq +5.25V$ , gain = 0dB    |     | 75             |     |           |
| Mute Suppression                                            | $M\_SPR\_A$   | $f = 1kHz$ , 0.5 $V_{RMS}$ input, set through I <sup>2</sup> C, see register 1 for loading register details |     | 90             |     | dB        |
| Audio Clipping Level                                        | VCLIP         | $f = 1kHz$ , 2.5 $V_{RMS}$ input, gain = 6dB, THD < 1%                                                      |     | 3.6            |     | $V_{RMS}$ |
| Left-to-Right Crosstalk                                     | XTLK_LR       | $f = 1kHz$ , 0.5 $V_{RMS}$ input, gain = 0dB                                                                |     | 80             |     | dB        |
| Crosstalk                                                   | XTLK_CC       | TV SCART to VCR SCART or VCR SCART to TV SCART, $f = 1kHz$ , 0.5 $V_{RMS}$ input, gain = 0dB                |     | 90             |     | dB        |

# Audio/Video Switch for Dual SCART Connector

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{12} = 12V$ ,  $V_{VID} = V_{AUD} = 5V$ ; 0.1 $\mu F$  X5R capacitor in parallel with a 10 $\mu F$  aluminum electrolytic capacitor from  $V_{AUD}$  to  $GND_{AUD}$ ,  $V_{12}$  to  $GND_{AUD}$ , and  $V_{VID}$  to  $GND_{VID}$ ; SET = 100k $\Omega$  nominal,  $R_{LOAD} = 150\Omega$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 1)

| PARAMETER                                      | SYMBOL       | CONDITIONS                | MIN | TYP  | MAX      | UNIT    |
|------------------------------------------------|--------------|---------------------------|-----|------|----------|---------|
| <b>DIGITAL INTERFACE: SDA and SCL (Note 4)</b> |              |                           |     |      |          |         |
| Low-Level Input Voltage                        | $V_{IL}$     |                           | 0   |      | 0.8      | V       |
| High-Level Input Voltage                       | $V_{IH}$     |                           | 2.6 |      |          | V       |
| Hysteresis of Schmitt Trigger Input            |              |                           |     | 0.2  |          | V       |
| SDA Low-Level Output Voltage                   | $V_{OL}$     | $I_{SINK} = 3mA$          |     |      | 0.4      | V       |
|                                                |              | $I_{SINK} = 6mA$          |     |      | 0.6      |         |
| Output Fall Time for SDA Line                  |              | 400pF bus load            |     |      | 250      | ns      |
| Spike Suppression                              |              |                           |     | 50   |          | ns      |
| Input Current                                  |              |                           | -10 |      | +10      | $\mu A$ |
| Input Capacitance                              |              |                           |     | 5    |          | pF      |
| SCL Clock Frequency                            |              |                           | 0   |      | 400      | kHz     |
| Hold Time                                      | $t_{HD,STA}$ |                           | 0.6 |      |          | $\mu s$ |
| Low Period of SCL Clock                        | $t_{Low}$    |                           | 1.3 |      |          | $\mu s$ |
| High Period of SCL Clock                       | $t_{HIGH}$   |                           | 0.6 |      |          | $\mu s$ |
| Setup Time for a Repeated Start Condition      | $t_{SU,STA}$ |                           | 0.6 |      |          | $\mu s$ |
| Data Hold Time                                 | $t_{HD,DAT}$ |                           | 0   |      | 0.9      | $\mu s$ |
| Data Setup Time                                | $t_{SU,DAT}$ |                           | 100 |      |          | ns      |
| Setup Time for Stop Condition                  | $t_{SU,STO}$ |                           | 0.6 |      |          | $\mu s$ |
| Bus Free Time Between a Stop and Start         | $t_{BUF}$    |                           | 1.3 |      |          | $\mu s$ |
| <b>OTHER DIGITAL PINS (Note 4)</b>             |              |                           |     |      |          |         |
| DEV_ADDR Low Level                             |              |                           |     |      | 0.8      | V       |
| DEV_ADDR High Level                            |              |                           | 2.6 |      |          | V       |
| INTERRUPT_OUT Low Voltage                      |              | INTERRUPT_OUT sinking 1mA |     | 0.15 | 0.4      | V       |
| INTERRUPT_OUT High Leakage Current             |              | $V_{INTERRUPT\_OUT} = 5V$ |     | 1    | 10       | $\mu A$ |
| <b>SLOW SWITCHING SECTION (Note 4)</b>         |              |                           |     |      |          |         |
| Input Low Level                                |              |                           | 0   |      | 2        | V       |
| Input Medium Level                             |              |                           | 4.5 |      | 7.0      | V       |
| Input High Level                               |              |                           | 9.5 |      | $V_{12}$ | V       |
| Input Current                                  |              |                           |     | 50   | 100      | $\mu A$ |

# Audio/Video Switch for Dual SCART Connector

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{12} = 12V$ ,  $V_{VID} = V_{AUD} = 5V$ ; 0.1 $\mu F$  X5R capacitor in parallel with a 10 $\mu F$  aluminum electrolytic capacitor from  $V_{AUD}$  to GND<sub>AUD</sub>,  $V_{12}$  to GND<sub>AUD</sub>, and  $V_{VID}$  to GND<sub>VID</sub>; SET = 100k $\Omega$  nominal,  $R_{LOAD} = 150\Omega$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 1)

| PARAMETER                              | SYMBOL | CONDITIONS                                                       | MIN | TYP  | MAX      | UNIT    |
|----------------------------------------|--------|------------------------------------------------------------------|-----|------|----------|---------|
| Output Low Level                       |        | 10k $\Omega$ to ground, internal TV,<br>$11.4 < V_{12} < 12.6$   | 0   |      | 1.5      | V       |
| Output Medium Level                    |        | 10k $\Omega$ to ground, external 16/9,<br>$11.4 < V_{12} < 12.6$ | 5   |      | 6.5      | V       |
| Output High Level                      |        | 10k $\Omega$ to ground, external 4/3,<br>$11.4 < V_{12} < 12.6$  | 10  |      | $V_{12}$ | V       |
| <b>FAST SWITCHING SECTION (Note 4)</b> |        |                                                                  |     |      |          |         |
| Input Low Level                        |        |                                                                  | 0   |      | 0.4      | V       |
| Input High Level                       |        |                                                                  | 1   |      | 3        | V       |
| Input Current                          |        |                                                                  |     | 1    | 10       | $\mu A$ |
| Output Low Level                       |        | $I_{SINK} = 0.5mA$                                               | 0   | 0.01 | 0.2      | V       |
| Output High Level                      |        | $I_{SOURCE} = 20mA$ , $V_{VID} - V_{OH}$                         |     | 0.75 | 2        | V       |
| Fast Switching Output to RGB Skew      |        | (Note 5)                                                         |     | 30   |          | ns      |
| Fast Switching Output Rise Time        |        | 150 $\Omega$ to ground                                           |     | 30   |          | ns      |
| Fast Switching Output Fall Time        |        | 150 $\Omega$ to ground                                           |     | 30   |          | ns      |

**Note 1:** All devices are 100% tested at  $T_A = +25^\circ C$ . All temperature limits are guaranteed by design.

**Note 2:** The settling time is measured from the 50% of the input swing to the 0.1% of the final value of the output.

**Note 3:** Maximum load capacitance is 200pF. All the listed parameters are measured at application's inputs, unless otherwise noted. See the *Typical Application Circuits*.

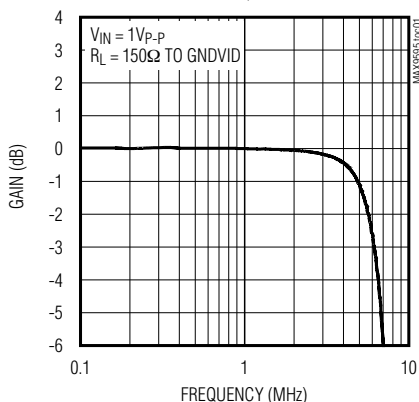
**Note 4:** Guaranteed by design.

**Note 5:** Difference in propagation delays of fast-blanking signal and RGB signals. Measured from 50% input transition to 50% output transition. Signal levels to be determined.

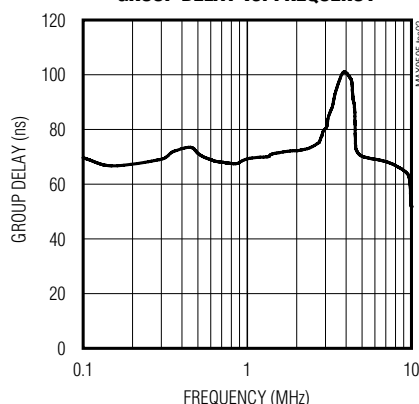
## Typical Operating Characteristics

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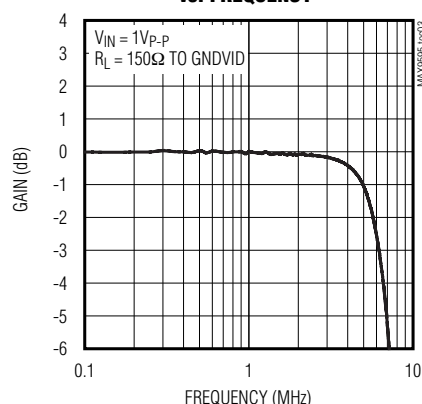
**R/G/B VIDEO LARGE-SIGNAL BANDWIDTH vs. FREQUENCY**



**GROUP DELAY vs. FREQUENCY**



**Y VIDEO LARGE-SIGNAL BANDWIDTH vs. FREQUENCY**

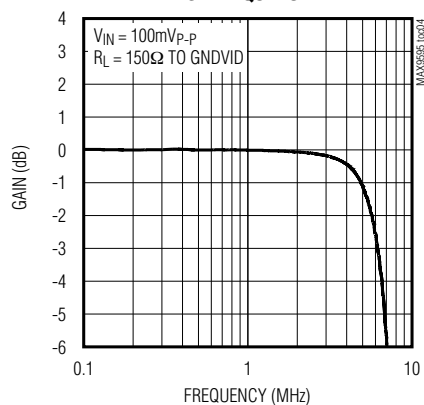


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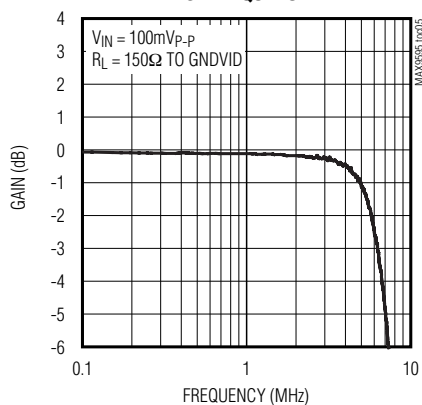
## Typical Operating Characteristics (continued)

( $V_{I2} = 12V$ ,  $V_{VID} = V_{AUD} = 5V$ ,  $0.1\mu F$  X5R capacitor in parallel with a  $10\mu F$  aluminum electrolytic capacitor from  $V_{AUD}$  to  $GND_{AUD}$ ,  $V_{I2}$  to  $GND_{AUD}$ ,  $V_{VID}$  to  $GND_{VID}$  no load,  $T_A = 0^\circ C$  to  $+70^\circ C$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

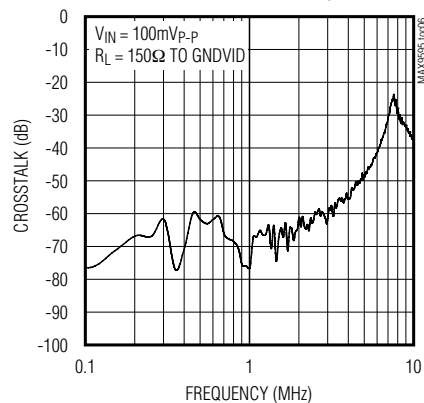
**R/G/B VIDEO SMALL-SIGNAL BANDWIDTH  
vs. FREQUENCY**



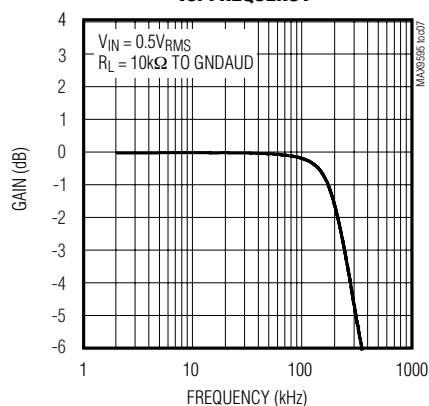
**Y VIDEO SMALL-SIGNAL BANDWIDTH  
vs. FREQUENCY**



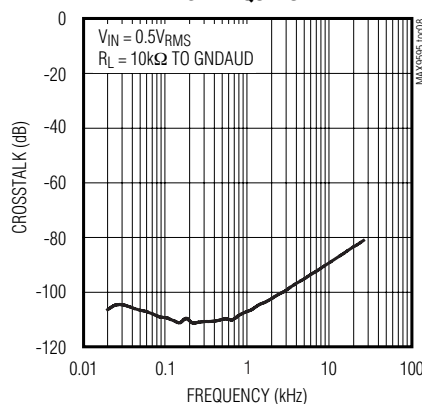
**VIDEO CROSSTALK vs. FREQUENCY**



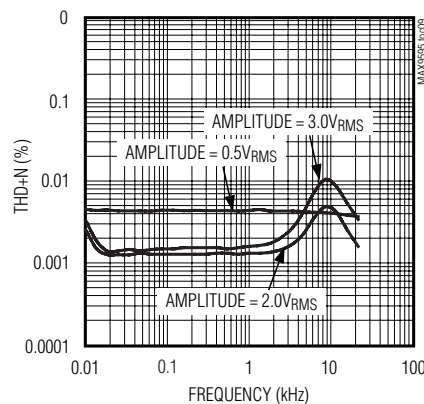
**AUDIO LARGE-SIGNAL BANDWIDTH  
vs. FREQUENCY**



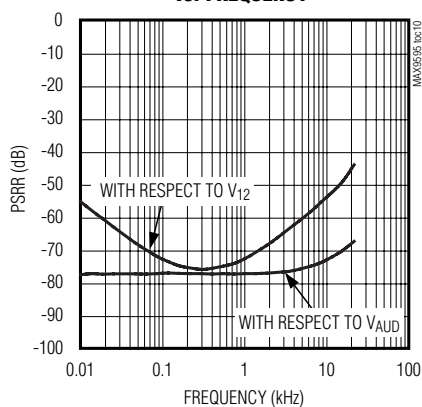
**AUDIO CROSSTALK  
vs. FREQUENCY**



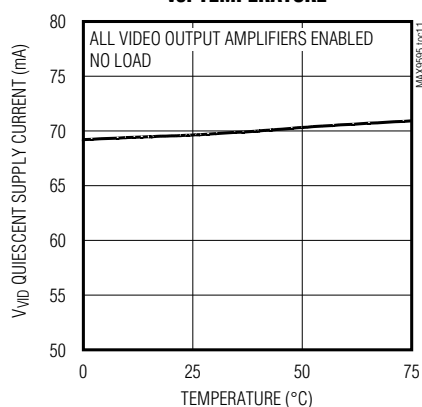
**AUDIO TOTAL HARMONIC DISTORTION  
PLUS NOISE vs. FREQUENCY**



**POWER-SUPPLY REJECTION RATIO  
vs. FREQUENCY**



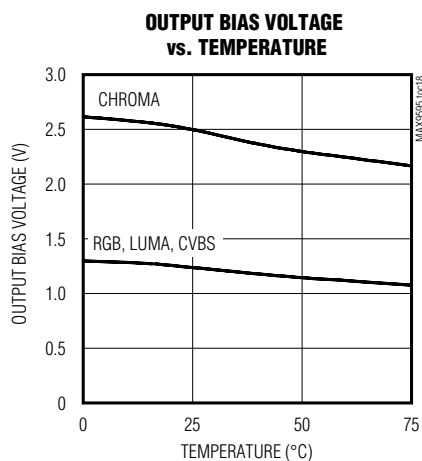
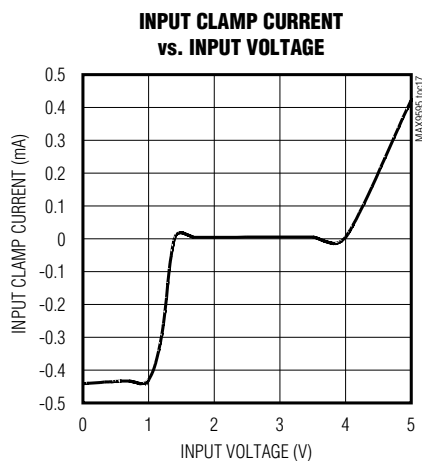
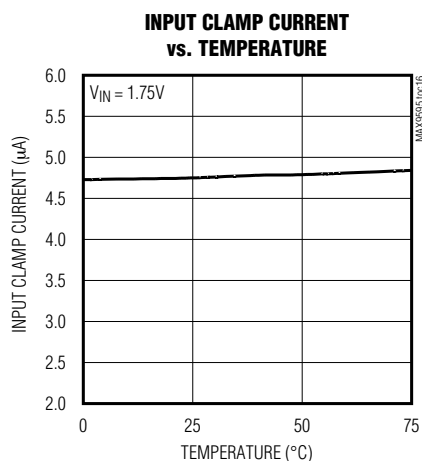
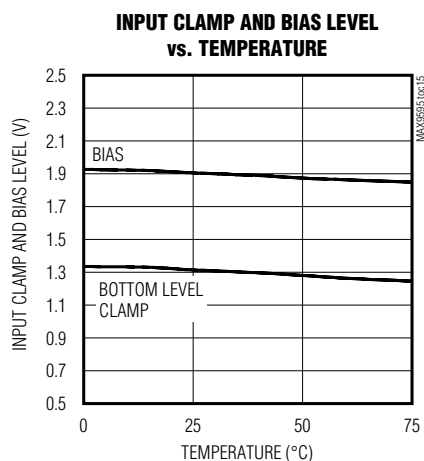
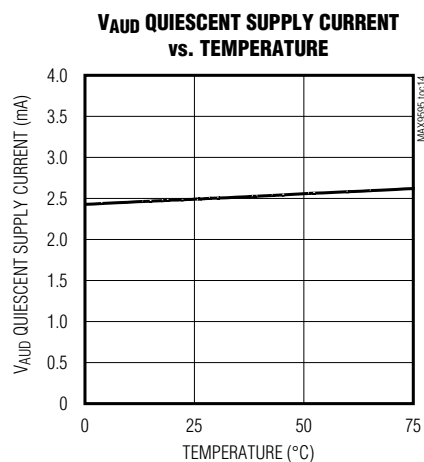
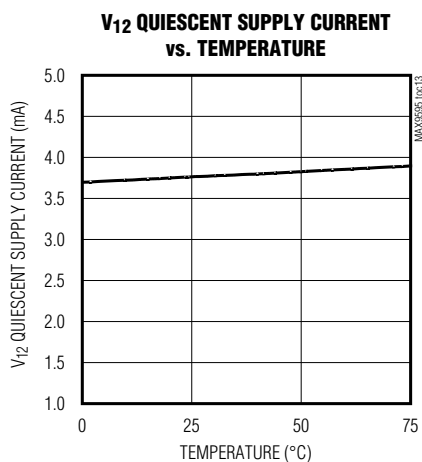
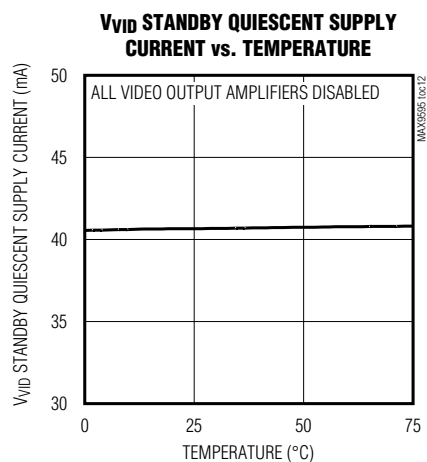
**V<sub>VID</sub> QUIESCENT SUPPLY CURRENT  
vs. TEMPERATURE**



# Audio/Video Switch for Dual SCART Connector

## Typical Operating Characteristics (continued)

( $V_{12} = 12\text{V}$ ,  $V_{VID} = V_{AUD} = 5\text{V}$ ,  $0.1\mu\text{F}$  X5R capacitor in parallel with a  $10\mu\text{F}$  aluminum electrolytic capacitor from  $V_{AUD}$  to  $\text{GND}_{AUD}$ ,  $V_{12}$  to  $\text{GND}_{AUD}$ ,  $V_{VID}$  to  $\text{GND}_{VID}$  no load,  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ\text{C}$ .)





# Audio/Video Switch for Dual SCART Connector

## Pin Description

**MAX9595**

| PIN    | NAME             | FUNCTION                                                                                                                                                                                        |
|--------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | SDA              | Bidirectional Data I/O. I <sup>2</sup> C -compatible, 2-wire interface data input/output. Output is open drain.                                                                                 |
| 2      | SCL              | Serial Clock Input. I <sup>2</sup> C -compatible, 2-wire clock interface.                                                                                                                       |
| 3      | DEV_ADDR         | Device Address Set Input. Connect to GNDVID to set write and read addresses of 94h or 95h, respectively. Connect to V <sub>VID</sub> to set write and read address of 96h or 97h, respectively. |
| 4      | ENC_INL          | Digital Encoder Left-Channel Audio Input                                                                                                                                                        |
| 5      | INTERRUPT_OUT    | Interrupt Output. INTERRUPT_OUT is an open-drain output that goes high impedance to indicate a change in the slow switch lines, TV_SS or VCR_SS.                                                |
| 6      | ENC_INR          | Digital Encoder Right-Channel Audio Input                                                                                                                                                       |
| 7      | N.C.             | No Connection. Not internally connected.                                                                                                                                                        |
| 8      | VCR_INR          | VCR SCART Right-Channel Audio Input                                                                                                                                                             |
| 9      | VCR_INL          | VCR SCART Left-Channel Audio Input                                                                                                                                                              |
| 10     | TV_INR           | TV SCART Right-Channel Audio Input                                                                                                                                                              |
| 11     | TV_INL           | TV SCART Right-Channel Audio Input                                                                                                                                                              |
| 12     | GNDAUD           | Audio Ground                                                                                                                                                                                    |
| 13     | AUD_BIAS         | Audio Input Bias Voltage. Bypass AUD_BIAS with a 47μF capacitor and a 0.1μF capacitor to AUDGND.                                                                                                |
| 14     | V <sub>AUD</sub> | Audio Supply. Connect to a +5V supply. Bypass with a 10μF aluminum electrolytic capacitor in parallel with a 0.47μF low-ESR ceramic capacitor to GNDAUD.                                        |
| 15     | VCR_OUTR         | VCR SCART Right-Channel Audio Output                                                                                                                                                            |
| 16     | VCR_OUTL         | VCR SCART Left-Channel Audio Output                                                                                                                                                             |
| 17     | RF_MONO_OUT      | RF Modulator Mono Audio Output                                                                                                                                                                  |
| 18     | TV_OUTL          | TV SCART Left-Channel Audio Output                                                                                                                                                              |
| 19     | TV_OUTR          | TV SCART Right-Channel Audio Output                                                                                                                                                             |
| 20     | V <sub>12</sub>  | +12V Supply. Bypass V <sub>12</sub> with a 10μF capacitor in parallel with a 0.1μF capacitor to ground.                                                                                         |
| 21     | TV_SS            | TV SCART Bidirectional Slow-Switch Signal                                                                                                                                                       |
| 22     | VCR_SS           | VCR SCART Bidirectional Slow-Switch Signal                                                                                                                                                      |
| 23     | SET              | Filter Cutoff Frequency Set Input. Connect 100kΩ resistor from SET to ground.                                                                                                                   |
| 24, 36 | V <sub>VID</sub> | Video and Digital Supply. Connect to a +5V supply. Bypass with a 0.01μF capacitor to GNDVID. V <sub>VID</sub> also serves as a digital supply for the I <sup>2</sup> C interface.               |
| 25     | VCRIN_FS         | VCR SCART Fast-Switching Input                                                                                                                                                                  |
| 26     | ENCIN_FS         | Digital Encoder Fast-Switching Input                                                                                                                                                            |
| 27     | TVOUT_FS         | TV SCART Fast-Switching Output. This signal is used to switch the TV to its RGB inputs for on-screen display purposes.                                                                          |
| 28     | GNDVID           | Video Ground                                                                                                                                                                                    |
| 29     | RF_CVBS_OUT      | RF Modulator Composite Video Output. Internally biased at 1V.                                                                                                                                   |
| 30     | TV_Y/CVBS_OUT    | TV SCART Luma/Composite Video Output. Internally biased at 1V.                                                                                                                                  |
| 31     | TV_R/C_OUT       | TV SCART Red/Chroma Video Output. Internally biased at 1V for red video signal and 2.2V for chroma video signal.                                                                                |

# Audio/Video Switch for Dual SCART Connector

## Pin Description (continued)

| PIN | NAME           | FUNCTION                                                                                                                   |
|-----|----------------|----------------------------------------------------------------------------------------------------------------------------|
| 32  | TV_G_OUT       | TV SCART Green Video Output. Internally biased at 1V.                                                                      |
| 33  | TV_B_OUT       | TV SCART Blue Video Output. Internally biased at 1V.                                                                       |
| 34  | VCR_Y/CVBS_OUT | VCR SCART Luma/Composite Video Output. Internally biased at 1V.                                                            |
| 35  | VCR_R/C_OUT    | VCR SCART Red/Chroma Video Output. Internally biased at 1V for red video signals and 2.2V for chroma video signal.         |
| 37  | TV_R/C_IN      | TV SCART Red/Chroma Video Input. Internally biased at 1V for red video signals, or 2.2V for chroma video signals.          |
| 38  | TV_Y/CVBS_IN   | TV SCART Luma/Composite Video Input. Internally biased at 1.2V.                                                            |
| 39  | VCR_Y/CVBS_IN  | VCR SCART Luma/Composite Video Input. Internally biased at 1.2V.                                                           |
| 40  | VCR_R/C_IN     | VCR SCART Red/Chroma Video Input. Internally biased at 1.2V for red video signals and 1.9V for chroma video signals.       |
| 41  | VCR_G_IN       | VCR SCART Green Video Input. Internally biased at 1.2V.                                                                    |
| 42  | VCR_B_IN       | VCR SCART Blue Video Input. Internally biased at 1.2V.                                                                     |
| 43  | ENC_Y/CVBS_IN  | Digital Encoder Luma/Composite Video Input. Internally biased at 1.2V.                                                     |
| 44  | ENC_R/C_IN     | Digital Encoder Red/Chroma Video Input. Internally biased at 1.2V for red video signals, or 1.9V for chroma video signals. |
| 45  | ENC_G_IN       | Digital Encoder Green Video Input. Internally biased at 1.2V.                                                              |
| 46  | ENC_B_IN       | Digital Encoder Blue Video Input. Internally biased at 1.2V.                                                               |
| 47  | ENC_Y_IN       | Digital Encoder Luma Video Input. Internally biased at 1.2V.                                                               |
| 48  | ENC_C_IN       | Digital Encoder Chroma Video Input. Internally biased at 1.9V.                                                             |
| EP  | GNDAUD         | Exposed Paddle. Solder to the circuit board ground (GNDAUD) for proper thermal and electrical performance.                 |

## Detailed Description

The MAX9595 is a switch matrix that routes audio and video signals between different ports using the I<sup>2</sup>C interface. The ports consist of the MPEG decoder output, and two SCART connectors for the TV and VCR. Per EN50049 and IEC 933, the encoder can only input a signal to the SCART connector, while TV and VCR SCART connectors are bidirectional.

The MAX9595 circuitry consists of four major sections: the video section, the audio section, the slow- and fast-switching section, and the digital interface.

The video section consists of clamp and bias circuitry, input buffers, reconstruction filters, a switch matrix, a Y/C mixer, and output buffers. All video inputs are AC-coupled through a 0.1μF capacitor to set an acceptable DC level using clamp or bias networks. The bidirectional red/chroma outputs can be connected to ground

using I<sup>2</sup>C control to make them terminations when red/chroma is an input (see the *Video Inputs* section).

The audio section features an input buffer, a switching matrix, volume- or gain-control circuitry, and output drivers. The audio inputs are AC-coupled through a 0.1μF capacitor. The TV output audio path has volume control from -56dB to +6dB in 2dB steps, while the VCR output audio path has volume control from -6dB to +6dB in 6dB steps. The MAX9595 can be configured to switch inputs during a zero-crossing function to reduce clicks.

The slow-switching feature allows for bidirectional, tri-level, slow-switching input and output signals at pin VCR\_SS and TV\_SS, respectively. The slow-switching signals from the VCR set the aspect ratio or video source of the TV screen. If INTERRUPT\_OUT is enabled, then INTERRUPT\_OUT changes to a high-impedance state if any of the slow-switching inputs change logic levels. See the *Slow Switching* section.

# Audio/Video Switch for Dual SCART Connector

Fast switching consists of two inputs from the encoder and VCR, and one output to the TV to insert an on-screen display (OSD). Fast switching is used to route video signals from the VCR or from the encoder to the TV. In addition, the fast-switching output can be configured to a high or low voltage. Fast switching is controlled through the I<sup>2</sup>C interface.

The digital block contains the 2-wire interface circuitry, control, and status registers. The MAX9595 can be configured through an I<sup>2</sup>C-compatible interface. DEV\_ADDR sets the I<sup>2</sup>C-compatible address.

## SCART Video Switching

The MAX9595 switches video signals between an MPEG decoder, TV SCART, and VCR SCART. The video switch includes reconstruction filters, multiplexed video amplifiers, and a Y-C mixer driver for an RF modulator. See Figure 1 for the functional diagram of the video section. While the SCART connector supports RGB, S-video, and composite video formats, RGB and S-video typically share a bidirectional set of SCART connector pins.

**MAX9595**

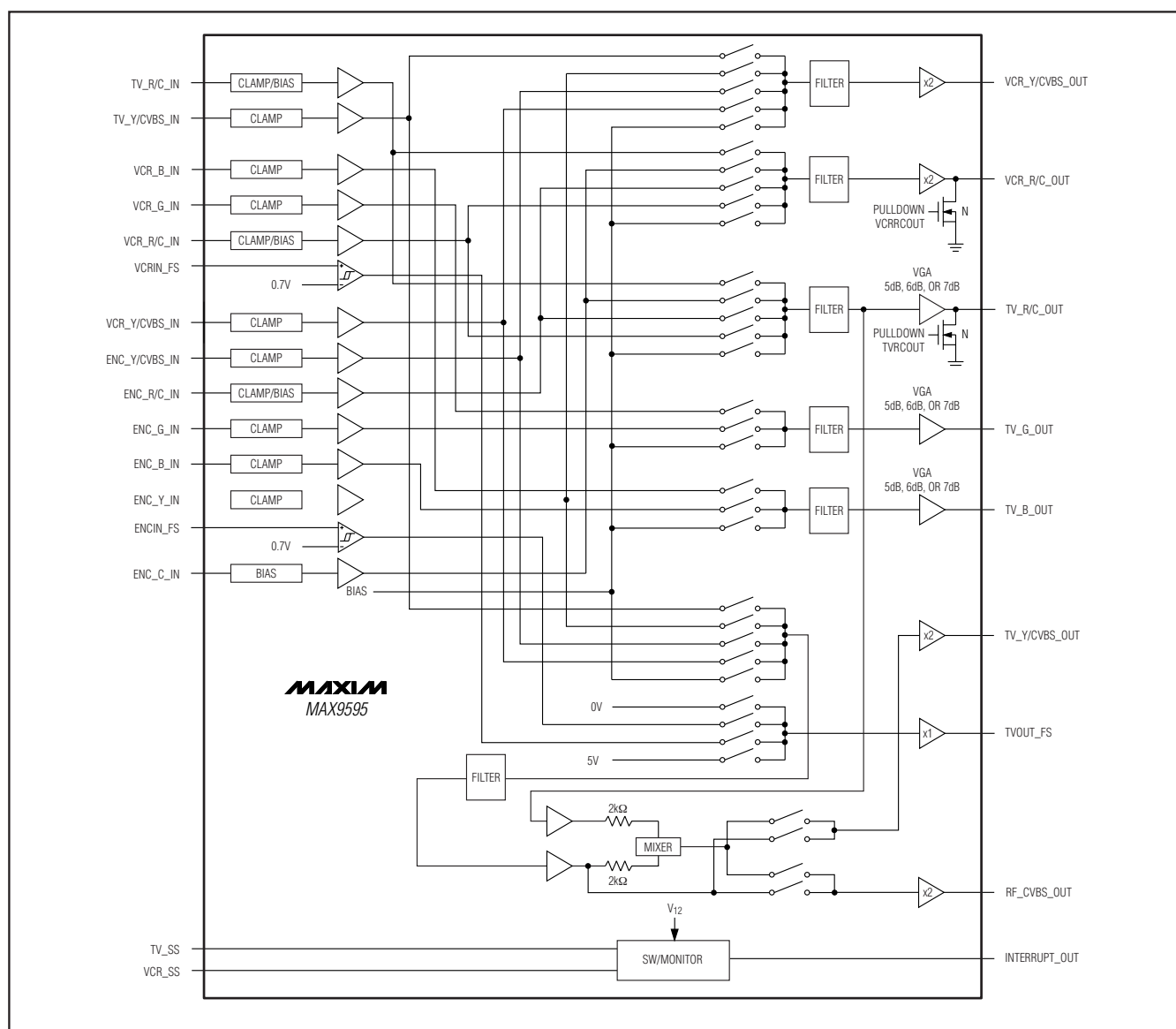


Figure 1. MAX9595 Video Section Functional Diagram

## Audio/Video Switch for Dual SCART Connector

### Video Inputs

All video inputs are AC-coupled with an external  $0.1\mu\text{F}$  capacitor. Either a clamp or bias circuit sets the DC input level of the video signals. The clamp circuit positions the sync tip of the composite (CVBS), the component RGB, or the S-video luma signal. If the signal does not have a sync tip, then the clamp positions the minimum of the signal at the clamp voltage. The bias circuitry is used to position the S-video chroma signal at midlevel of the luma (Y) signal. On the video inputs that can receive either a chroma or a red video signal, the bias or clamp circuit is selected through I<sup>2</sup>C. See Tables 3–12 for loading register details.

The MPEG decoder and VCR uses the RGB format and fast switching to insert an on-screen display (OSD), usually text, onto the TV. The MAX9595 supports RGB as an input from either the VCR or the MPEG decoder and as an output only to the TV. The red video signal of the RGB format and the chroma video signal of the S-VHS format share the same SCART connector pin. Therefore, RGB and S-video signals cannot be present at the same time. Loop-through is possible with a composite video signal but not with RGB signals because the RGB SCART pins are used for both input and output.

In SCART, there is the possibility of a bidirectional use of the red/chroma pin. When using the red/chroma pin as an input port, terminate the red/chroma output with a

$75\Omega$  resistor to ground. Thus, a ground state is provided by an active pulldown to GNDVID on the red/chroma output to support the bidirectional chroma or red I/O, turning the output source resistors into terminations (see Figure 2). The active pulldown also provides the “Mute Output” function, and disables the deselected video outputs. The “Mute Output” state is the default power-on state for video.

For high-quality home video, the MPEG decoder, VCR, and TV use the S-video format. The MAX9595 supports S-video signals as an input from the VCR, the MPEG decoder, and the TV, and also as a separately switchable output to the TV and VCR. Because S-video support was not included in the original specifications of the SCART connector, the luma (Y) signal of S-video and the CVBS signal share the same SCART connector pins. If S-video is present, then a composite signal must be created from the Y and C signals to drive the RF\_CVBS\_OUT pin. For S-video, loop-through is not possible since the chroma SCART port is used for both input and output.

The MAX9595 supports composite video (CVBS) format, with inputs from the VCR, MPEG decoder, and TV. Full loop-through is possible to the TV and VCR only, since the MPEG decoder SCART connector has separate input and output pins for the CVBS format.

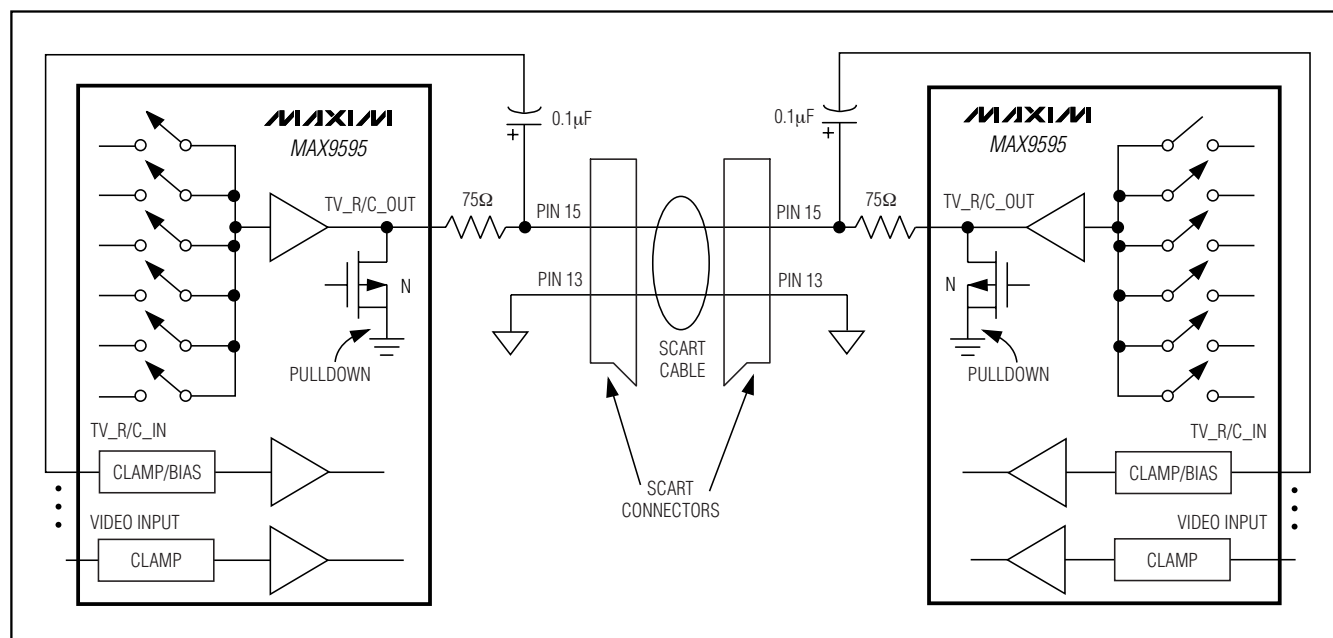


Figure 2. Bidirectional SCART Pins

# Audio/Video Switch for Dual SCART Connector

## Video Outputs

The DC level at the video outputs is controlled so that coupling capacitors are not required, and all of the video outputs are capable of driving a DC-coupled, 150Ω, back-terminated coax load with respect to ground. Since some televisions and VCRs use the horizontal sync height for automatic gain control, the MAX9595 accurately reproduces the sync height to within ±2%.

## Slow Switching

The MAX9595 supports the IEC 933-1, Amendment 1, tri-level slow switching that selects the aspect ratio for the display (TV). Under I<sup>2</sup>C-compatible control, the MAX9595 sets the slow-switching output voltage level. Table 1 shows the valid input levels of the slow-switching signal and the corresponding operating modes of the display device.

Two bidirectional ports are available for slow-switching signals for the TV and VCR. The slow-switching input status is continuously read and stored in register 0Eh. The slow-switching outputs can be set to a logic level or high impedance by writing to registers 07h and 09h. See Tables 8 and 10 for details. When enabled, INTERRUPT\_OUT becomes high impedance if the voltage level changes on TV\_SS or VCR\_SS.

**Table 1. Slow-Switching Modes**

| SLOW-SWITCHING<br>SIGNAL VOLTAGE<br>(V) | MODE                                                                                                  |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------|
| 0 to 2                                  | Display device uses an internal source such as a built-in tuner to provide a video signal             |
| 4.5 to 7.0                              | Display device uses a video signal from the SCART connector and sets the display to 16:9 aspect ratio |
| 9.5 to 12.6                             | Display device uses a signal from the SCART connector and sets the display to 4:3 aspect ratio        |

## Fast Switching

The VCR or MPEG decoder outputs a fast-switching signal to the display device or TV to insert on-screen display (OSD). The fast-switching signal can also be set to a constant high or low output signal through the I<sup>2</sup>C interface. The fast-switching output can be set through writing to register 07h.

## Y/C Mixer

The MAX9595 includes an on-chip mixer to produce composite video (CVBS) when S-video (Y and C) is present. The composite video drives the RF\_CVBS\_OUT output pin. The circuit sums Y and C signals to obtain the CVBS component. A +6dB output buffer drives RF\_CVBS\_OUT.

## Video Reconstruction Filter

The encoder DAC outputs need to be lowpass-filtered to reject the out-of-band noise. The MAX9595 integrates the reconstruction filter. The filter is fourth order, which is composed of two Sallen-Key biquad in cascade, implementing a Butterworth-type transfer function. The internal reconstruction filters feature a 6MHz cutoff frequency, and -35dB minimum attenuation at 27MHz. Note that the SET pin is used to set the accuracy of the filter cutoff frequency. Connect a 100kΩ resistor from SET to ground.

## SCART Audio Switching

### Audio Inputs

The audio block has three stereo audio inputs from the TV, the VCR, and the MPEG decoder SCART. Each input has a 100kΩ resistor connected to an internally generated voltage equal to 0.23 x V<sub>12</sub>, and is AC-coupled.

# Audio/Video Switch for Dual SCART Connector

## Audio Outputs

Both right and left channels have a stereo output for the TV and VCR SCART. The monaural output, which is a mix of the TV right and left channels, drives the RF modulator, RF\_MONO\_OUT. The monaural mixer, a resistor summer, attenuates the amplitude of each of the two signals by 6dB. A 12.54dB gain block follows the monaural mixer. If the left and right audio channels

were completely uncorrelated, then a 9.54dB gain block is used. See Figure 3 for the functional diagram of the audio section.

## Clickless Switching

The TV channel incorporates a zero-crossing detect (ZCD) circuit that minimizes click noise due to abrupt signal level changes that occur when switching between audio signals at an arbitrary moment.

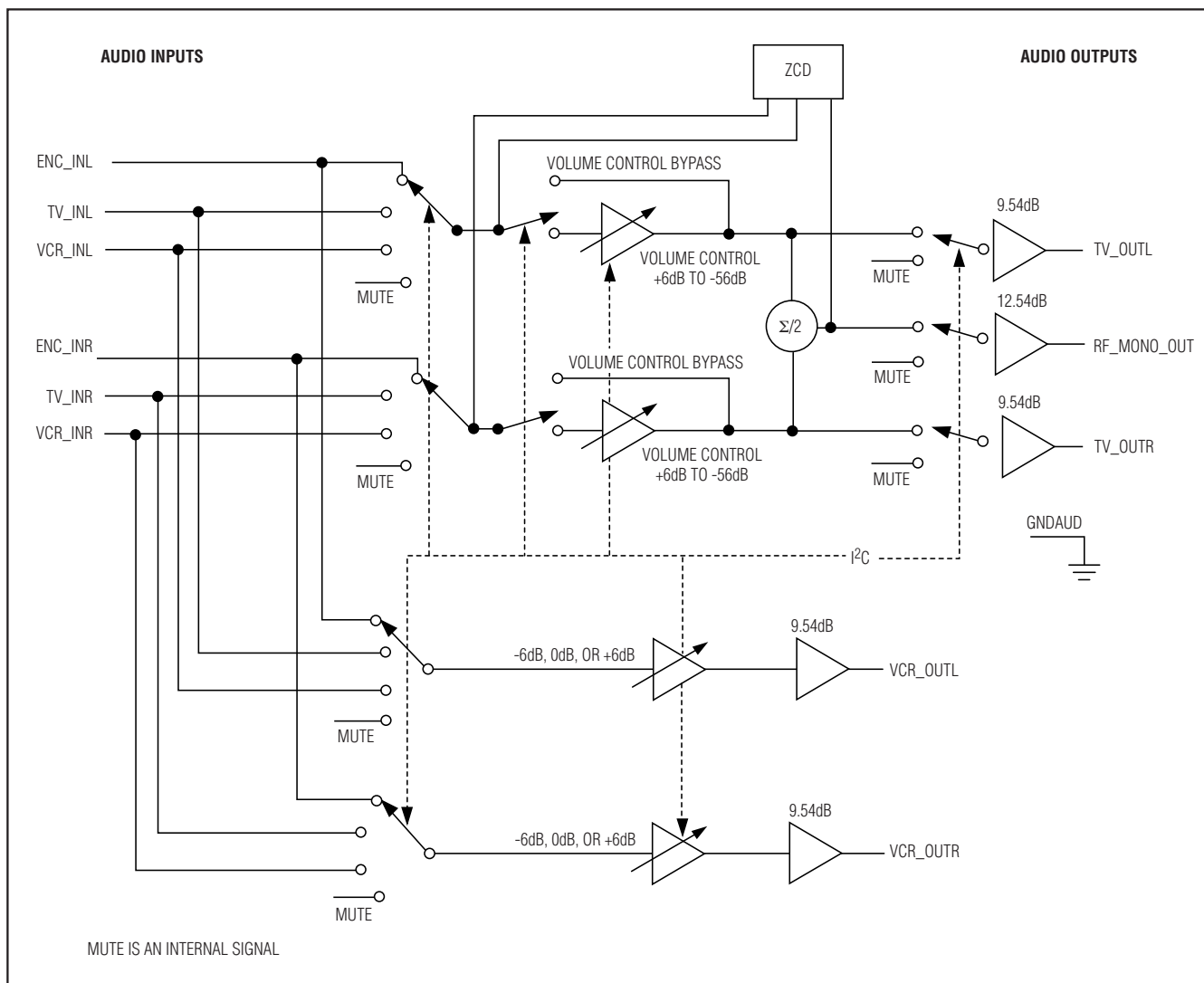


Figure 3. MAX9595 Audio Section Functional Diagram

# Audio/Video Switch for Dual SCART Connector

To implement the zero-crossing function when switching audio signals, set the ZCD bit by loading register 00h through the I<sup>2</sup>C-compatible interface (if the ZCD bit is not already set). Then set the mute bit low by loading register 00h. Next, wait for a sufficient period of time for the audio signal to cross zero. This period is a function of the audio signal path's low-frequency 3dB corner ( $f_{L3dB}$ ). Thus, if  $f_{L3dB} = 1\text{kHz}$ , the time period to wait for a zero-crossing detect is 0.5kHz or 0.5ms.

Next, set the appropriate TV switches using register 01h. Finally, clear the mute bit (while leaving the ZCD bit high) using register 00h. The MAX9595 switches the signal out of mute at the next zero crossing.

To implement the zero-cross function for TV volume changes, or for TV and phono volume bypass switching, simply ensure the ZCD bit in register 00h is set.

## Volume Control

The TV channel volume control ranges from -56dB to +6dB in 2dB steps. The VCR volume control settings are programmable for -6dB, 0dB, and +6dB. These gain levels are referenced to the application inputs, where some dividers are present. With the ZCD bit set, the TV volume control switches only at zero-crossings, thus minimizing click noise. The TV outputs can bypass the volume control. Likewise, the monaural output signal can be processed by the TV volume control or it can bypass the volume control.

## Digital Section

### Serial Interface

The MAX9595 uses a simple 2-wire serial interface requiring only two standard microprocessor port I/O lines. The fast-mode I<sup>2</sup>C-compatible serial interface allows communication at data rates up to 400kbps or 400kHz. Figure 4 shows the timing diagram of the signals on the 2-wire interface.

The two bus lines (SDA and SCL) must be at logic-high when the bus is not in use. The MAX9595 is a slave device and must be controlled by a master device. Pullup resistors from the bus lines to the supply are required when push-pull circuitry is not driving the lines.

The logic level on the SDA line can only change when the SCL line is low. The start and stop conditions occur when SDA toggles low/high while the SCL line is high (see Figure 5). Data on SDA must be stable for the duration of the setup time ( $t_{SU,DAT}$ ) before SCL goes high. Data on SDA is sampled when SCL toggles high with data on SDA stable for the duration of the hold time ( $t_{HD,DAT}$ ). Note that data is transmitted in an 8-bit byte. A total of nine clock cycles are required to transfer a byte to the MAX9595. The device acknowledges the successful receipt of the byte by pulling the SDA line low during the 9th clock cycle.

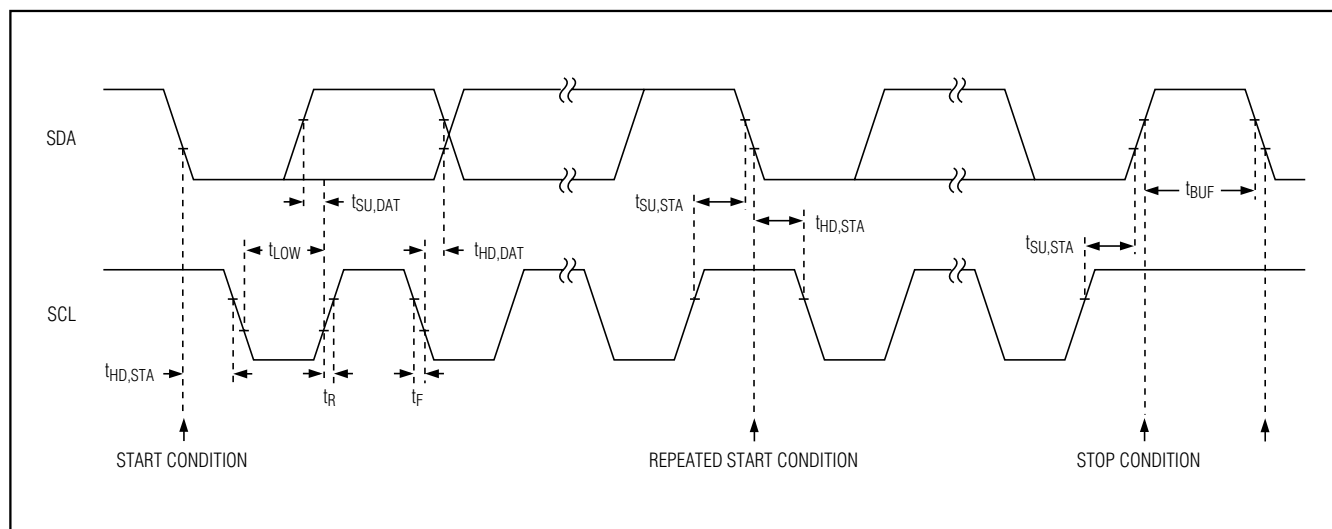


Figure 4. SDA and SCL Signal Timing Diagram

# Audio/Video Switch for Dual SCART Connector

## 2-Wire Interface Data Format

### Write and Read Mode

| S | Slave Address | A | Register Address | A | Data2 | A | P |
|---|---------------|---|------------------|---|-------|---|---|
|---|---------------|---|------------------|---|-------|---|---|

S = Start Condition, A = Acknowledge, P = Stop Condition

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

The MAX9595 is compatible with existing I<sup>2</sup>C systems. SCL and SDA are high-impedance inputs. SDA has an open drain that pulls the bus line to a logic-low during the 9th clock pulse. Figure 5 shows a typical I<sup>2</sup>C interface application. The communication protocol supports the standard I<sup>2</sup>C 8-bit communications. The MAX9595 address is compatible with the 7-bit I<sup>2</sup>C addressing protocol only; 10-bit format is not supported.

### Digital Inputs and Interface Logic

The I<sup>2</sup>C-compatible, 2-wire interface has logic levels defined as  $V_{IL} = 0.8V$  and  $V_{IH} = 2.0V$ . All of the inputs include Schmitt-trigger buffers to accept low-transition interfaces. The digital inputs are compatible with 3V CMOS logic levels.

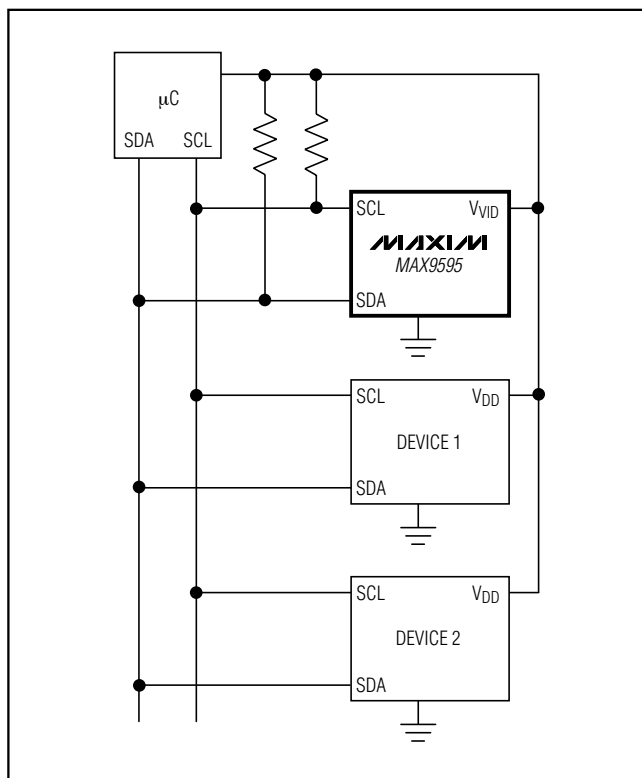


Figure 5. Typical I<sup>2</sup>C Interface Application

## Programming

Connect DEV\_ADDR to ground to set the MAX9595 write and read address as shown in Table 2.

Table 2. Slave Address Programming

| ADDRESS PIN STATE | WRITE ADDRESS | READ ADDRESS |
|-------------------|---------------|--------------|
| V <sub>VID</sub>  | 96h           | 97h          |
| GNDVID            | 94h           | 95h          |

### Data Register Writing and Reading

Program the SCART video and audio switches by writing to registers 00h through 0Dh. Registers 00h through 0Eh can also be read, allowing read-back of data after programming and facilitating system debugging. The status register is read-only and can be read from address 0Eh. See Tables 3–12 for register programming information.

### INTERRUPT\_OUT Signal

INTERRUPT\_OUT is an open-drain output that becomes high impedance when a change in any of the slow-switch signals occurs. Clear INTERRUPT\_OUT by setting bit 4 of register 01h low.

## Applications Information

### Hot-Plug of SCART Connectors

The MAX9595 features high-ESD protection on all SCART inputs and outputs, and requires no external transient-voltage suppressor (TVS) devices to protect against floating chassis discharge. Some set-top boxes have a floating chassis problem in which the chassis is not connected to earth ground. As a result, the chassis can charge up to 500V. When a SCART cable is connected to the SCART connector, the charged chassis can discharge through a signal pin. The equivalent circuit is a 2200pF capacitor charged to 311V connected through less than 0.1Ω to a signal pin. The MAX9595 is soldered on the PC board when it experiences such a discharge. Therefore, the current spike flows through the ESD protection diodes and is absorbed by the supply bypass capacitors, which have high capacitance and low ESR.

To better protect the MAX9595 against excess voltages during the cable discharge condition, place an additional 75Ω resistor in series with all inputs and outputs to the SCART connector. For harsh environments where ±15kV protection is needed, the MAX4385E and MAX4386E single and quad high-speed op amps feature the industry's first integrated ±15kV ESD protection on video inputs and outputs.



# Audio/Video Switch for Dual SCART Connector

## Power Supplies and Bypassing

The MAX9595 features single 5V and 12V supply operation and requires no negative supply. The +12V supply V<sub>12</sub> is for the SCART switching function. For pin V<sub>12</sub>, place all bypass capacitors as close as possible with a 10µF capacitor in parallel with a 0.1µF ceramic capacitor. Connect all V<sub>AUD</sub> pins together to +5V and bypass with a 10µF electrolytic capacitor in parallel with a 0.47µF low-ESR ceramic capacitor to audio ground. Bypass V<sub>AUD</sub> pins with a 0.1µF capacitor to audio ground. Bypass AUD\_BIAS to audio ground with a 10µF electrolytic in parallel with a 0.1µF ceramic capacitor.

Bypass V<sub>DIG</sub> with a 0.1µF ceramic capacitor to digital ground. Bypass each V<sub>VID</sub> to video ground with a 0.1µF ceramic capacitor. Connect V<sub>VID</sub> in series with a 200nH ferrite bead to the +5V supply.

## Layout and Grounding

For optimal performance, use controlled-impedance traces for video signal paths and place input termination resistors and output back-termination resistors close to the MAX9595. Avoid routing video traces parallel to high-speed data lines.

The MAX9595 provides separate ground connections for video, audio, and digital supplies. For best performance, use separate ground planes for each of the ground returns and connect all three ground planes together at a single point. Refer to the MAX9595 evaluation kit for a proven circuit board layout example.

**Table 3. Data Format for Write Mode**

| REGISTER ADDRESS<br>(HEXADECIMAL) | BIT 7                  | BIT 6               | BIT 5                 | BIT 4                          | BIT 3               | BIT 2                 | BIT 1              | BIT 0                |
|-----------------------------------|------------------------|---------------------|-----------------------|--------------------------------|---------------------|-----------------------|--------------------|----------------------|
| 00h                               | TV volume bypass       | ZCD                 | TV volume control     |                                |                     |                       |                    | TV audio output mute |
| 01h                               | VCR volume control     |                     | Not used              | Interrupt enable               | VCR audio selection |                       | TV audio selection |                      |
| 02h                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 03h                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 04h                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 05h                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 06h                               | TV_R/C_IN clamp        | RGB gain            |                       | TV G and B video switch        |                     | TV video switch       |                    |                      |
| 07h                               | Not used               | RF_CVBS_OUT switch  | TV_Y/ CVBS_OUT switch | TV fast blank (fast switching) |                     | TV_R/C_OUT ground     | Set function TV    |                      |
| 08h                               | VCR_R/ C_IN clamp      | Not used            | Not used              | Not used                       | ENC_R/ C_IN clamp   | VCR video switch      |                    |                      |
| 09h                               | Not used               | Not used            | Not used              | Not used                       | Not used            | VCR_R/C_OUT ground    | Set function VCR   |                      |
| 0Ah                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 0Bh                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 0Ch                               | Not used               |                     |                       |                                |                     |                       |                    |                      |
| 0Dh                               | VCR_Y/ CVBS_OUT enable | VCR_R/ C_OUT enable | TV_R/C_OUT enable     | TV_G_OUT enable                | TV_B_OUT enable     | TV_Y/ CVBS_OUT enable | TVOUT_ FS enable   | RF_CVBS_OUT enable   |

# Audio/Video Switch for Dual SCART Connector

Table 4. Data Format for Read Mode

| REGISTER ADDRESS (HEXADECIMAL) | BIT 7        | BIT 6          | BIT 5    | BIT 4 | BIT 3                 | BIT 2 | BIT 1                | BIT 0 |
|--------------------------------|--------------|----------------|----------|-------|-----------------------|-------|----------------------|-------|
| 0Eh                            | Thermal SHDN | Power-on reset | Not used |       | VCR slow switch input |       | TV slow switch input |       |

Table 5. Register 00h: TV Audio Control

| DESCRIPTION               | BIT |   |   |   |   |   |   |   | COMMENTS                                                  |
|---------------------------|-----|---|---|---|---|---|---|---|-----------------------------------------------------------|
|                           | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                                           |
| TV Audio Mute             |     |   |   |   |   |   |   | 0 | Off                                                       |
|                           |     |   |   |   |   |   |   | 1 | On (power-on default)                                     |
| TV Volume Control         |     |   | 0 | 0 | 0 | 0 | 0 |   | +6dB gain                                                 |
|                           |     |   | 0 | 0 | 0 | 0 | 1 |   | +4dB gain                                                 |
|                           |     |   | 0 | 0 | 0 | 1 | 0 |   | +2dB gain                                                 |
|                           |     |   | 0 | 0 | 0 | 1 | 1 |   | 0dB gain (power-on default)                               |
|                           |     |   | 0 | 0 | 1 | 0 | 0 |   | -2dB gain                                                 |
|                           |     |   | 0 | 0 | 1 | 0 | 1 |   | -4dB gain                                                 |
|                           |     |   | 1 | 1 | 1 | 1 | 0 |   | -54dB gain                                                |
|                           |     |   | 1 | 1 | 1 | 1 | 1 |   | -56dB gain                                                |
| TV Zero-Crossing Detector |     | 0 |   |   |   |   |   |   | Off                                                       |
|                           |     | 1 |   |   |   |   |   |   | On (power-on default)                                     |
| TV Volume Bypass          | 0   |   |   |   |   |   |   |   | TV audio passes through volume control (power-on default) |
|                           | 1   |   |   |   |   |   |   |   | TV audio bypasses volume control                          |

## Audio/Video Switch for Dual SCART Connector

Table 6. Register 01h: TV/VCR Audio Control

| DESCRIPTION                | BIT |   |   |   |   |   |   |   | COMMENTS                               |
|----------------------------|-----|---|---|---|---|---|---|---|----------------------------------------|
|                            | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                        |
| Input Source for TV Audio  |     |   |   |   |   |   | 0 | 0 | Encoder audio                          |
|                            |     |   |   |   |   |   | 0 | 1 | VCR audio                              |
|                            |     |   |   |   |   |   | 1 | 0 | TV audio                               |
|                            |     |   |   |   |   |   | 1 | 1 | Mute (power-on default)                |
| Input Source for VCR Audio |     |   |   |   | 0 | 0 |   |   | Encoder audio                          |
|                            |     |   |   |   | 0 | 1 |   |   | VCR audio                              |
|                            |     |   |   |   | 1 | 0 |   |   | TV audio                               |
|                            |     |   |   |   | 1 | 1 |   |   | Mute (power-on default)                |
| Interrupt Enable           |     |   |   | 0 |   |   |   |   | Clear INTERRUPT_OUT (power-on default) |
|                            |     |   |   | 1 |   |   |   |   | Enable INTERRUPT_OUT                   |
| VCR Volume Control         | 0   | 0 |   |   |   |   |   |   | 0dB gain (power-on default)            |
|                            | 0   | 1 |   |   |   |   |   |   | +6dB gain                              |
|                            | 1   | 0 |   |   |   |   |   |   | -6dB gain                              |
|                            | 1   | 1 |   |   |   |   |   |   | 0dB gain                               |

# Audio/Video Switch for Dual SCART Connector

Table 7. Register 06h: TV Video Input Control

| DESCRIPTION                             | BIT |   |   |   |   |   |   |   | COMMENTS                                            |                         |
|-----------------------------------------|-----|---|---|---|---|---|---|---|-----------------------------------------------------|-------------------------|
|                                         | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                                     |                         |
| Input Sources for TV Video              |     |   |   |   |   |   |   |   | TV_Y/CVBS_OUT                                       | TV_R/C_OUT              |
|                                         |     |   |   |   |   | 0 | 0 | 0 | ENC_Y/CVBS_IN                                       | ENC_R/C_IN              |
|                                         |     |   |   |   |   | 0 | 0 | 1 | ENC_Y_IN                                            | ENC_C_IN                |
|                                         |     |   |   |   |   | 0 | 1 | 0 | VCR_Y/CVBS_IN                                       | VCR_R/C_IN              |
|                                         |     |   |   |   |   | 0 | 1 | 1 | TV_Y/CVBS_IN                                        | TV_R/C_IN               |
|                                         |     |   |   |   |   | 1 | 0 | 0 | Not used                                            | Not used                |
|                                         |     |   |   |   |   | 1 | 0 | 1 | Mute                                                | Mute                    |
|                                         |     |   |   |   |   | 1 | 1 | 0 | Mute                                                | Mute                    |
|                                         |     |   |   |   |   | 1 | 1 | 1 | Mute (power-on default)                             | Mute (power-on default) |
|                                         |     |   |   |   |   |   |   |   | TV_G_OUT                                            | TV_B_OUT                |
| Input Sources for TV_G_OUT and TV_B_OUT |     |   |   | 0 | 0 |   |   |   | ENC_G_IN                                            | ENC_B_IN                |
|                                         |     |   |   | 0 | 1 |   |   |   | VCR_G_IN                                            | VCR_B_IN                |
|                                         |     |   |   | 1 | 0 |   |   |   | Mute                                                | Mute                    |
|                                         |     |   |   | 1 | 1 |   |   |   | Mute (power-on default)                             | Mute (power-on default) |
| RGB Gain                                |     | 0 | 0 |   |   |   |   |   | 6dB (power-on default)                              |                         |
|                                         |     | 0 | 1 |   |   |   |   |   | 7dB                                                 |                         |
|                                         |     | 1 | 0 |   |   |   |   |   | 5dB                                                 |                         |
|                                         |     | 1 | 1 |   |   |   |   |   | 5dB                                                 |                         |
| TV_R/C_IN Clamp/Bias                    | 0   |   |   |   |   |   |   |   | DC restore clamp active at input (power-on default) |                         |
|                                         | 1   |   |   |   |   |   |   |   | Chrominance bias applied at input                   |                         |

# Audio/Video Switch for Dual SCART Connector

**Table 8. Register 07h: TV Video Output Control**

| DESCRIPTION                 | BIT |   |   |   |   |   |   |   | COMMENTS                                                                                    |
|-----------------------------|-----|---|---|---|---|---|---|---|---------------------------------------------------------------------------------------------|
|                             | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                                                                             |
| Set TV Function Switching   |     |   |   |   |   |   | 0 | 0 | Low (< 2V), internal source (power-on default)                                              |
|                             |     |   |   |   |   |   | 0 | 1 | Medium (4.5V to 7V), external SCART source with 16:9 aspect ratio                           |
|                             |     |   |   |   |   |   | 1 | 0 | High impedance                                                                              |
|                             |     |   |   |   |   |   | 1 | 1 | High (> 9.5V), external SCART source with 4:3 aspect ratio                                  |
| TV_R/C_OUT Ground           |     |   |   |   |   | 0 |   |   | Normal operation, pulldown on TV_R/C_OUT is off (power-on default)                          |
|                             |     |   |   |   |   | 1 |   |   | Ground, pulldown on TV_R/C_OUT is on, the output amplifier driving TV_R/C_OUT is turned off |
| Fast Blank (Fast Switching) |     |   |   | 0 | 0 |   |   |   | 0V (power-on default)                                                                       |
|                             |     |   |   | 0 | 1 |   |   |   | Same level as ENC_FB_IN                                                                     |
|                             |     |   |   | 1 | 0 |   |   |   | Same level as VCR_FB_IN                                                                     |
|                             |     |   |   | 1 | 1 |   |   |   | VVID                                                                                        |
| TV_Y/CVBS_OUT Switch        |     |   | 0 |   |   |   |   |   | Composite video from the Y/C mixer is output                                                |
|                             |     |   | 1 |   |   |   |   |   | The TV_Y/CVBS_OUT signal selected in register 06h is output (power-on default)              |
| RF_CVBS_OUT Switch          |     | 0 |   |   |   |   |   |   | Composite video from the Y/C mixer is output (power-on default)                             |
|                             |     | 1 |   |   |   |   |   |   | The TV_Y/CVBS_OUT signal selected in register 06h is output                                 |

**Table 9. Register 08h: VCR Video Input Control**

| DESCRIPTION                 | BIT |   |   |   |   |   |   |   | COMMENTS                                            |                         |
|-----------------------------|-----|---|---|---|---|---|---|---|-----------------------------------------------------|-------------------------|
|                             | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                                     |                         |
| Input Sources for VCR Video |     |   |   |   |   |   |   |   | VCR_Y/CVBS_OUT                                      | VCR_R/C_OUT             |
|                             |     |   |   |   |   | 0 | 0 | 0 | ENC_Y/CVBS_IN                                       | ENC_R/C_IN              |
|                             |     |   |   |   |   | 0 | 0 | 1 | ENC_Y_IN                                            | ENC_C_IN                |
|                             |     |   |   |   |   | 0 | 1 | 0 | VCR_Y/CVBS_IN                                       | VCR_R/C_IN              |
|                             |     |   |   |   |   | 0 | 1 | 1 | TV_Y/CVBS_IN                                        | TV_R/C_IN               |
|                             |     |   |   |   |   | 1 | 0 | 0 | Not used                                            | Not used                |
|                             |     |   |   |   |   | 1 | 0 | 1 | Mute                                                | Mute                    |
|                             |     |   |   |   |   | 1 | 1 | 0 | Mute                                                | Mute                    |
| VCR_R/C_IN Clamp/Bias       |     |   |   |   |   | 1 | 1 | 1 | Mute (power-on default)                             | Mute (power-on default) |
|                             | 0   |   |   |   |   |   |   |   | DC restore clamp active at input (power-on default) |                         |
| ENC_R/C_IN Clamp/Bias       | 1   |   |   |   |   |   |   |   | Chrominance bias applied at input                   |                         |
|                             |     |   |   |   | 0 |   |   |   | DC restore clamp active at input (power-on default) |                         |
|                             |     |   |   |   | 1 |   |   |   | Chrominance bias applied at input                   |                         |

# Audio/Video Switch for Dual SCART Connector

**Table 10. Register 09h: VCR Video Output Control**

| DESCRIPTION                | BIT |   |   |   |   |   |   |   | COMMENTS                                                                                      |
|----------------------------|-----|---|---|---|---|---|---|---|-----------------------------------------------------------------------------------------------|
|                            | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                                                                               |
| Set VCR Function Switching |     |   |   |   |   |   | 0 | 0 | Low (< 2V), internal source (power-on default)                                                |
|                            |     |   |   |   |   |   | 0 | 1 | Medium (4.5V to 7V), external SCART source with 16:9 aspect ratio                             |
|                            |     |   |   |   |   |   | 1 | 0 | High impedance                                                                                |
|                            |     |   |   |   |   |   | 1 | 1 | High (> 9.5V), external SCART source with 4:3 aspect ratio                                    |
| VCR_R/C_OUT Ground         |     |   |   |   |   | 0 |   |   | Normal operation, pulldown on VCR_R/C_OUT is off (power-on default)                           |
|                            |     |   |   |   |   | 1 |   |   | Ground, pulldown on VCR_R/C_OUT is on, the output amplifier driving VCR_R/C_OUT is turned off |

**Table 11. Register 0DH: Output Enable**

| DESCRIPTION    | BIT |   |   |   |   |   |   |   | COMMENTS               |
|----------------|-----|---|---|---|---|---|---|---|------------------------|
|                | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                        |
| RF_CVBS_OUT    |     |   |   |   |   |   |   | 0 | Off (power-on default) |
|                |     |   |   |   |   |   |   | 1 | On                     |
| TVOUT_FS       |     |   |   |   |   |   | 0 |   | Off (power-on default) |
|                |     |   |   |   |   |   | 1 |   | On                     |
| TV_Y/CVBS_OUT  |     |   |   |   |   | 0 |   |   | Off (power-on default) |
|                |     |   |   |   |   | 1 |   |   | On                     |
| TV_B_OUT       |     |   |   |   | 0 |   |   |   | Off (power-on default) |
|                |     |   |   |   | 1 |   |   |   | On                     |
| TV_G_OUT       |     |   |   | 0 |   |   |   |   | Off (power-on default) |
|                |     |   |   | 1 |   |   |   |   | On                     |
| TV_R/C_OUT     |     |   | 0 |   |   |   |   |   | Off (power-on default) |
|                |     |   | 1 |   |   |   |   |   | On                     |
| VCR_R/C_OUT    |     | 0 |   |   |   |   |   |   | Off (power-on default) |
|                |     | 1 |   |   |   |   |   |   | On                     |
| VCR_Y/CVBS_OUT | 0   |   |   |   |   |   |   |   | Off (power-on default) |
|                | 1   |   |   |   |   |   |   |   | On                     |

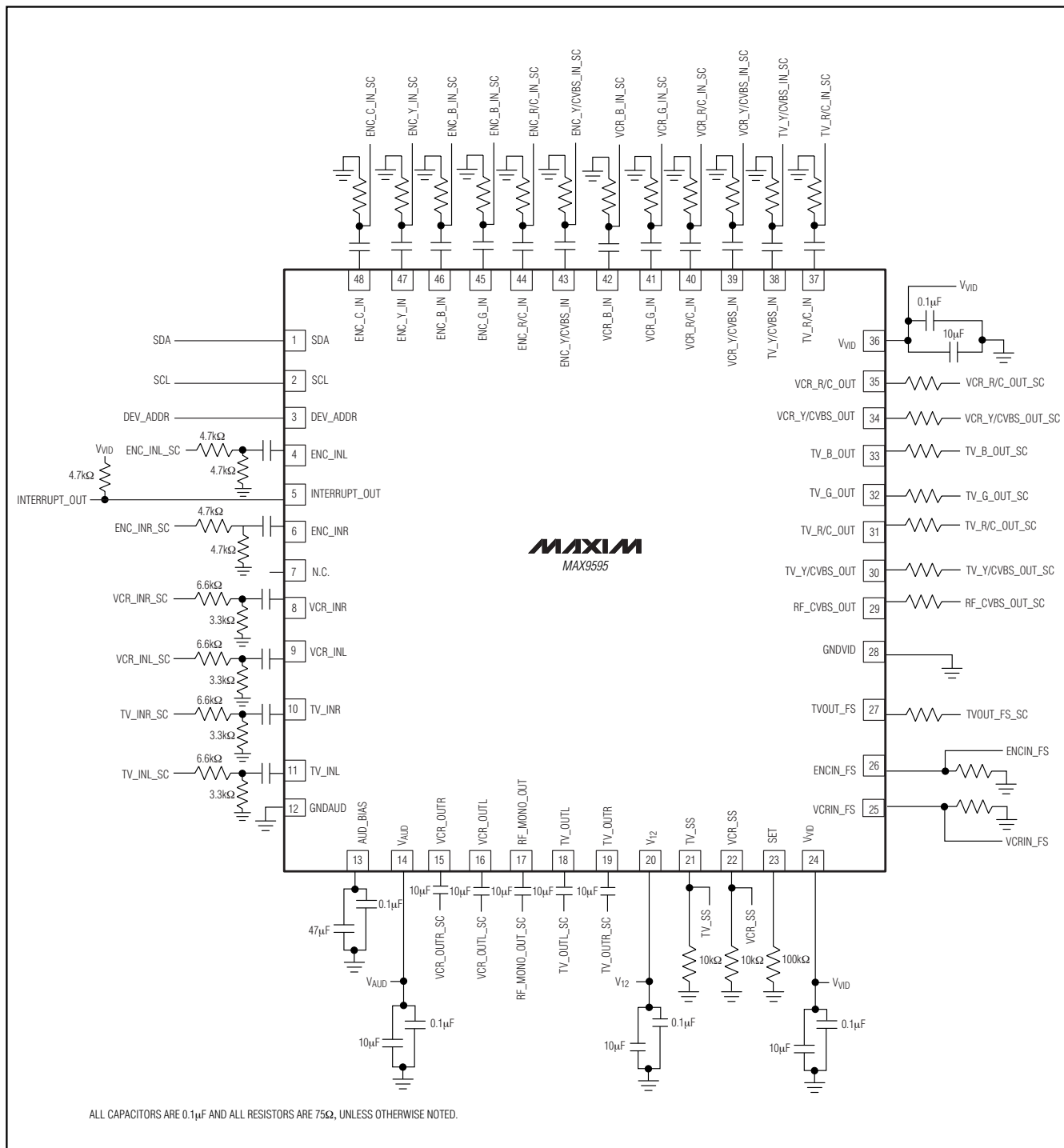
# Audio/Video Switch for Dual SCART Connector

**Table 12. Register 0Eh Status**

| DESCRIPTION           | BIT |   |   |   |   |   |   |   | COMMENTS                                                     |
|-----------------------|-----|---|---|---|---|---|---|---|--------------------------------------------------------------|
|                       | 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 |                                                              |
| TV Slow Switch Input  |     |   |   |   |   |   | 0 | 0 | 0 to 2V, internal source                                     |
|                       |     |   |   |   |   |   | 0 | 1 | 4.5V to 7V, external source with 16:9 aspect ratio           |
|                       |     |   |   |   |   |   | 1 | 0 | Not used                                                     |
|                       |     |   |   |   |   |   | 1 | 1 | 9.5V to 12.6V, external source with 4:3 aspect ratio         |
| VCR Slow Switch Input |     |   |   |   | 0 | 0 |   |   | 0 to 2V, internal source                                     |
|                       |     |   |   |   | 0 | 1 |   |   | 4.5V to 7V, external source with 16:9 aspect ratio           |
|                       |     |   |   |   | 1 | 0 |   |   | Not used                                                     |
|                       |     |   |   |   | 1 | 1 |   |   | 9.5V to 12.6V, external source with 4:3 aspect ratio         |
| Power-On Reset        |     | 0 |   |   |   |   |   |   | V <sub>VID</sub> is too low for digital logic to operate     |
|                       |     | 1 |   |   |   |   |   |   | V <sub>VID</sub> is high enough for digital logic to operate |
| Thermal Shutdown      | 0   |   |   |   |   |   |   |   | The part is in thermal shutdown                              |
|                       | 1   |   |   |   |   |   |   |   | The temperature is below the TSHD limit                      |

# Audio/Video Switch for Dual SCART Connector

## Typical Application Circuit

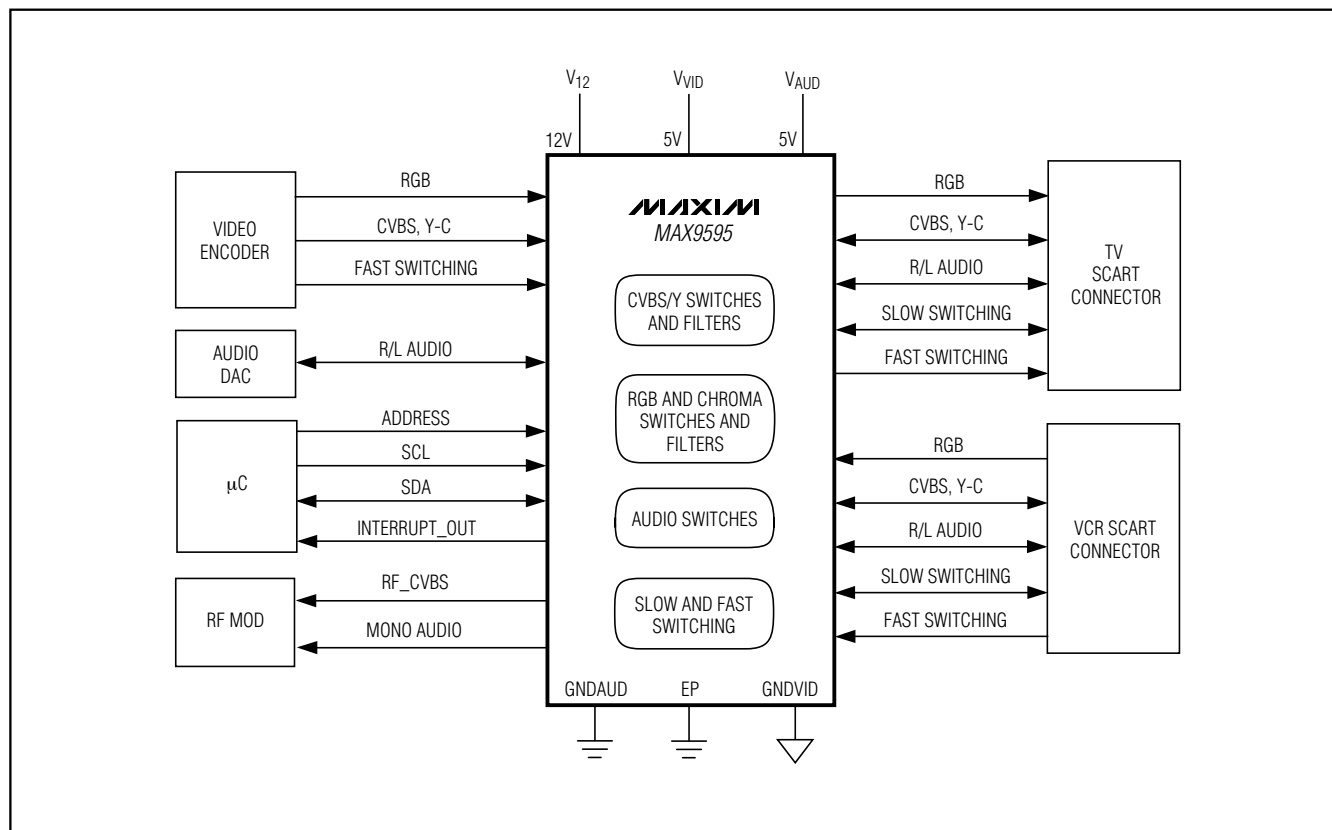




# Audio/Video Switch for Dual SCART Connector

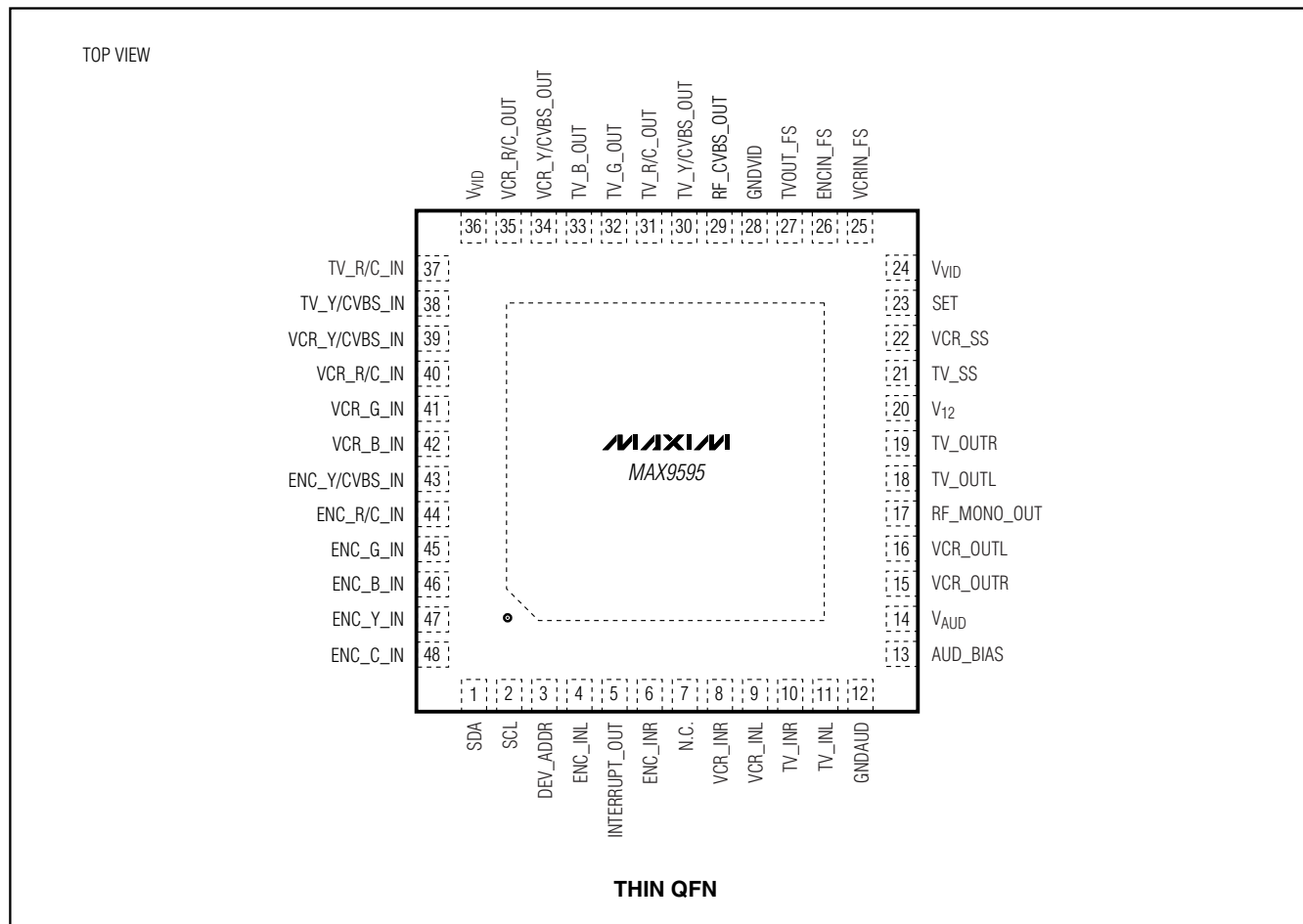
## System Block Diagram

**MAX9595**



# Audio/Video Switch for Dual SCART Connector

## Pin Configuration



## Chip Information

TRANSISTOR COUNT: 13,265

PROCESS: BiCMOS

# MAX9595

## 32, 44, 48L QFN.EPS

**TOP VIEW**

2X  $\Delta$  0.15 C B

E

E/2

D/2

D

1 2 3

A

B

MARKING

PIN # 1 I.D.

**DETAIL B**

e

L

L1

PKG. CORNERS ONLY (4x)

APPLICABLE TO .4mm PITCH PKG. ONLY

**BOTTOM VIEW**

DETAIL A

(NE-1) X E

k

D2

D2/2

E2/2

E2

3 2 1

b

B

$\Delta$  0.10 C A B

PIN # 1 I.D. 0.35x45°

**DETAIL A**

(R IS OPTIONAL)

TERMINAL TIP

EVEN TERMINAL

ODD TERMINAL

**SIDE VIEW**

C

SEATING PLANE

A1 A2 A

$\Delta$  0.10 C

$\Delta$  0.08 C

$\Delta$

**DALLAS SEMICONDUCTOR**

**MAXIM**

TITLE: PACKAGE OUTLINE  
32, 44, 48, 56L THIN QFN, 7x7x0.8mm

APPROVAL: \_\_\_\_\_

DOCUMENT CONTROL NO. 21-0144

REV. E 1/

**-DRAWING NOT TO SCALE-**

# Audio/Video Switch for Dual SCART Connector

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

| COMMON DIMENSIONS |           |      |      |           |      |      |           |      |      |                                     |      |      |           |      |      |
|-------------------|-----------|------|------|-----------|------|------|-----------|------|------|-------------------------------------|------|------|-----------|------|------|
| PKG               | 32L 7x7   |      |      | 44L 7x7   |      |      | 48L 7x7   |      |      | CUSTOM PKG.<br>(T4877-1)<br>48L 7x7 |      |      | 56L 7x7   |      |      |
| SYMBOL            | MIN.      | NOM. | MAX. | MIN.      | NOM. | MAX. | MIN.      | NOM. | MAX. | MIN.                                | NOM. | MAX. | MIN.      | NOM. | MAX. |
| A                 | 0.70      | 0.75 | 0.80 | 0.70      | 0.75 | 0.80 | 0.70      | 0.75 | 0.80 | 0.70                                | 0.75 | 0.80 | 0.70      | 0.75 | 0.80 |
| A1                | 0         | 0.02 | 0.05 | 0         | 0.02 | 0.05 | 0         | 0.02 | 0.05 | 0                                   | 0.02 | 0.05 | 0         | —    | 0.05 |
| A2                | 0.20 REF. |      |      | 0.20 REF. |      |      | 0.20 REF. |      |      | 0.20 REF.                           |      |      | 0.20 REF. |      |      |
| b                 | 0.25      | 0.30 | 0.35 | 0.20      | 0.25 | 0.30 | 0.20      | 0.25 | 0.30 | 0.20                                | 0.25 | 0.30 | 0.15      | 0.20 | 0.25 |
| D                 | 6.90      | 7.00 | 7.10 | 6.90      | 7.00 | 7.10 | 6.90      | 7.00 | 7.10 | 6.90                                | 7.00 | 7.10 | 6.90      | 7.00 | 7.10 |
| E                 | 6.90      | 7.00 | 7.10 | 6.90      | 7.00 | 7.10 | 6.90      | 7.00 | 7.10 | 6.90                                | 7.00 | 7.10 | 6.90      | 7.00 | 7.10 |
| e                 | 0.65 BSC. |      |      | 0.50 BSC. |      |      | 0.50 BSC. |      |      | 0.50 BSC.                           |      |      | 0.40 BSC. |      |      |
| k                 | 0.25      | —    | —    | 0.25      | —    | —    | 0.25      | —    | —    | 0.25                                | —    | —    | 0.25      | 0.35 | 0.45 |
| L                 | 0.45      | 0.55 | 0.65 | 0.45      | 0.55 | 0.65 | 0.30      | 0.40 | 0.50 | 0.45                                | 0.55 | 0.65 | 0.40      | 0.50 | 0.60 |
| L1                | —         | —    | —    | —         | —    | —    | —         | —    | —    | —                                   | —    | —    | 0.30      | 0.40 | 0.50 |
| N                 | 32        |      |      | 44        |      |      | 48        |      |      | 44                                  |      |      | 56        |      |      |
| ND                | 8         |      |      | 11        |      |      | 12        |      |      | 10                                  |      |      | 14        |      |      |
| NE                | 8         |      |      | 11        |      |      | 12        |      |      | 12                                  |      |      | 14        |      |      |

NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.

2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

3. N IS THE TOTAL NUMBER OF TERMINALS.

4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JEDEC 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.

5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.

6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.

7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.

8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

9. DRAWING CONFORMS TO JEDEC MO220 EXCEPT THE EXPOSED PAD DIMENSIONS OF T4877-1/-3/-4/-5/-6 & T5677-1.

10. WARPAGE SHALL NOT EXCEED 0.10 mm.

11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY

12. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY

-DRAWING NOT TO SCALE-

| EXPOSED PAD VARIATIONS |                   |      |      |      |      |      |      |                    |                    |
|------------------------|-------------------|------|------|------|------|------|------|--------------------|--------------------|
| PKG. CODES             | DEPOPULATED LEADS | D2   |      |      | E2   |      |      | JEDEC MO220 REV. C | DOWN BONDS ALLOWED |
|                        |                   | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |                    |                    |
| T3277-2                | —                 | 4.55 | 4.70 | 4.85 | 4.55 | 4.70 | 4.85 | —                  | YES                |
| T3277-3                | —                 | 4.55 | 4.70 | 4.85 | 4.55 | 4.70 | 4.85 | —                  | NO                 |
| T4477-2                | —                 | 4.55 | 4.70 | 4.85 | 4.55 | 4.70 | 4.85 | WKKD-1             | YES                |
| T4477-3                | —                 | 4.55 | 4.70 | 4.85 | 4.55 | 4.70 | 4.85 | WKKD-1             | YES                |
| T4877-1**              | 13,24,37,48       | 4.20 | 4.30 | 4.40 | 4.20 | 4.30 | 4.40 | —                  | NO                 |
| T4877-3                | —                 | 4.95 | 5.10 | 5.25 | 4.95 | 5.10 | 5.25 | —                  | YES                |
| T4877-4                | —                 | 5.45 | 5.60 | 5.63 | 5.45 | 5.60 | 5.63 | —                  | YES                |
| T4877-5                | —                 | 2.40 | 2.50 | 2.60 | 2.40 | 2.50 | 2.60 | —                  | NO                 |
| T4877-6                | —                 | 5.45 | 5.60 | 5.63 | 5.45 | 5.60 | 5.63 | —                  | NO                 |
| T4877-7                | —                 | 4.95 | 5.10 | 5.25 | 4.95 | 5.10 | 5.25 | —                  | YES                |
| T5677-1                | —                 | 5.20 | 5.30 | 5.40 | 5.20 | 5.30 | 5.40 | —                  | YES                |

\*\* NOTE: T4877-1 IS A CUSTOM 48L PKG. WITH 4 LEADS DEPOPULATED. TOTAL NUMBER OF LEADS ARE 44.

NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.

2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

3. N IS THE TOTAL NUMBER OF TERMINALS.

4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JEDEC 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.

5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.

6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.

7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.

8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

9. DRAWING CONFORMS TO JEDEC MO220 EXCEPT THE EXPOSED PAD DIMENSIONS OF T4877-1/-3/-4/-5/-6 & T5677-1.

10. WARPAGE SHALL NOT EXCEED 0.10 mm.

11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY

12. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY

-DRAWING NOT TO SCALE-

|                                                                                       |                                 |
|---------------------------------------------------------------------------------------|---------------------------------|
|  |                                 |
| TITLE: PACKAGE OUTLINE<br>32, 44, 48, 56L THIN QFN, 7x7x0.8mm                         |                                 |
| APPROVAL                                                                              | DOCUMENT CONTROL NO.<br>21-0144 |
| REV.<br>E                                                                             | 2/2                             |

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