

Audio/Video Switch Matrix

Main Features

■ I²C Bus Control

■ Standby Mode with Interrupt Signal Output

■ Video Section

- 3 CVBS Inputs, 2 CVBS Outputs
- 3 Y/C Inputs, 2 Y/C Outputs
- 6 dB Gain on all CVBS/Y and C Outputs
- Integrated 150 Ω Buffers
- 2 RGB/FB Inputs, 1 Tri-state RGB/FB Output with 6 dB Adjustable Gain (from +3 dB to +9 dB)
- Video Muting on all Outputs
- 2 Slow Blanking Inputs/Outputs
- Sync Bottom Clamp on all CVBS/Y and RGB Inputs, Average Clamp on C Inputs
- Bandwidth: 15 MHz
- Crosstalk: 50 dB Minimum

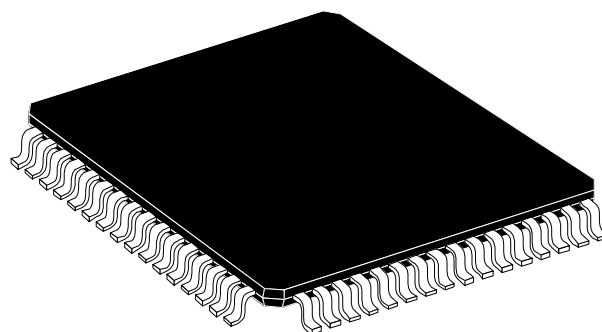
■ Audio Section

- 3 Stereo Inputs, 3 Stereo Outputs
- Stereo-to-Mono Sound Capability
- 0/6/9 dB Selectable Gain on one Stereo Input
- Full Range Volume Control with Soft Control
- Audio Muting on all Outputs

Description

The STV6413 is a highly integrated I²C bus-controlled audio and video switch matrix, optimized for use in digital set-top box applications. It provides the audio and video routings required in a two SCART set-top box design.

In a TQFP64 (10 x 10 mm) package, the STV6413 is compatible with the STV6412A (TQFP64 14 x 14 mm) used for designing boards with two levels of integration.



TQFP64

(10 x 10 x 1.40 mm)
(Thin Full Plastic Quad Flat Pack)

Order Codes:

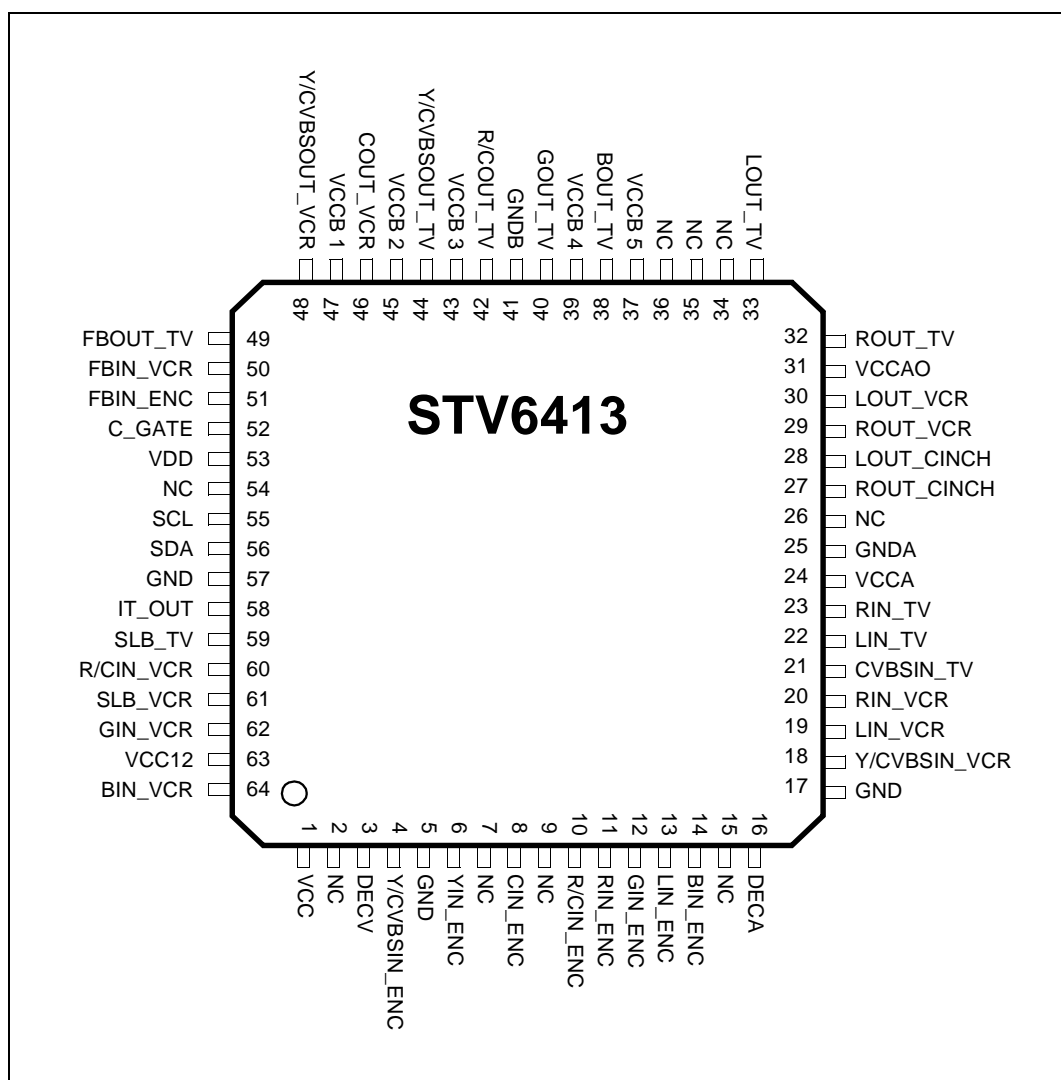
STV6413D (Tray)
STV6413DT (Tape and Reel)

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1 General Information

Figure 1: STV6413 Pinout Diagram



1.1 I/O Pin Description

Table 1: Pin Description (Sheet 1 of 3)

| Pin No. | Name | Function |
|---------|--------------|----------------------------|
| 1 | VCC | +5 V Supply |
| 2 | NC | Not connected |
| 3 | DECV | Video Decoupling Capacitor |
| 4 | Y/CVBSIN_ENC | Y/CVBS Input from Encoder |
| 5 | GND | Ground |
| 6 | YIN_ENC | Y Input from Encoder |
| 7 | NC | Not connected |

Table 1: Pin Description (Sheet 2 of 3)

| Pin No. | Name | Function |
|---------|--------------|--|
| 8 | CIN_ENC | Chroma Input from Encoder |
| 9 | NC | Not connected |
| 10 | R/CIN_ENC | Red/Chroma Input from Encoder |
| 11 | RIN_ENC | Audio Right, Input from Encoder |
| 12 | GIN_ENC | Green Input from Encoder |
| 13 | LIN_ENC | Audio Left, Input from Encoder |
| 14 | BIN_ENC | Blue Input from Encoder |
| 15 | NC | Not Connected |
| 16 | DECA | Audio Decoupling Capacitor |
| 17 | GND | Ground |
| 18 | Y/CVBSIN_VCR | Y/CVBS Input from VCR SCART |
| 19 | LIN_VCR | Audio Left, Input from VCR SCART |
| 20 | RIN_VCR | Audio Right, Input from VCR SCART |
| 21 | CVBSIN_TV | CVBS Input from TV SCART |
| 22 | LIN_TV | Audio Left, Input from TV SCART |
| 23 | RIN_TV | Audio Right, Input from TV SCART |
| 24 | VCCA | Audio Supply Voltage - or - Audio Supply Decoupling |
| 25 | GNDA | Audio Ground |
| 26 | NC | Not Connected |
| 27 | ROUT_CINCH | Audio Right Output to Cinch |
| 28 | LOUT_CINCH | Audio Left Output to Cinch |
| 29 | ROUT_VCR | Audio Right Output to VCR SCART |
| 30 | LOUT_VCR | Audio Left Output to VCR SCART |
| 31 | VCCAO | Audio Output Supply Voltage - or - Main Audio Supply Voltage |
| 32 | ROUT_TV | Audio Right Output to TV SCART |
| 33 | LOUT_TV | Audio Left Output to TV SCART |
| 34 | NC | Not connected |
| 35 | NC | Not connected |
| 36 | NC | Not connected |
| 37 | VCCB5 | Video Output Buffer Supply Pin |
| 38 | BOUT_TV | Blue Output to TV SCART |
| 39 | VCCB4 | Video Output Buffer Supply Pin |
| 40 | GOUT_TV | Green Output to TV SCART |
| 41 | GNDB | Video Buffer Ground |
| 42 | R/COUT_TV | Red/Chroma Output to TV SCART |

Table 1: Pin Description (Sheet 3 of 3)

| Pin No. | Name | Function |
|---------|---------------|---|
| 43 | VCCB3 | Video Output Buffer Supply Pin |
| 44 | Y/CVBSOUT_TV | Y/CVBS Output to TV SCART |
| 45 | VCCB2 | Video Output Buffer Supply Pin |
| 46 | COUT_VCR | Chroma Output to VCR SCART |
| 47 | VCCB1 | Video Output Buffer Supply Pin |
| 48 | Y/CVBSOUT_VCR | Y/CVBS Output to VCR SCART |
| 49 | FBOUT_TV | Fast Blanking Output to TV SCART |
| 50 | FBIN_VCR | Fast Blanking Input from VCR SCART |
| 51 | FBIN_ENC | Fast Blanking Input from Encoder |
| 52 | C_GATE | External MOS Command for C_VCR bidirectional mode |
| 53 | VDD | +5 V I ² C Supply |
| 54 | NC | Not connected |
| 55 | SCL | I ² C Bus Clock |
| 56 | SDA | I ² C Bus Data |
| 57 | GND | Ground Digital |
| 58 | IT_OUT | Interrupt Output |
| 59 | SLB_TV | Slow Blanking Input/Output from TV SCART |
| 60 | R/CIN_VCR | Red Input (or C Input) from VCR SCART |
| 61 | SLB_VCR | Slow Blanking Input/Output from VCR SCART |
| 62 | GIN_VCR | Green Input from VCR SCART |
| 63 | VCC12 | +12 V Supply |
| 64 | BIN_VCR | Blue Input from VCR SCART |

Figure 2: STV6413 Block Diagram

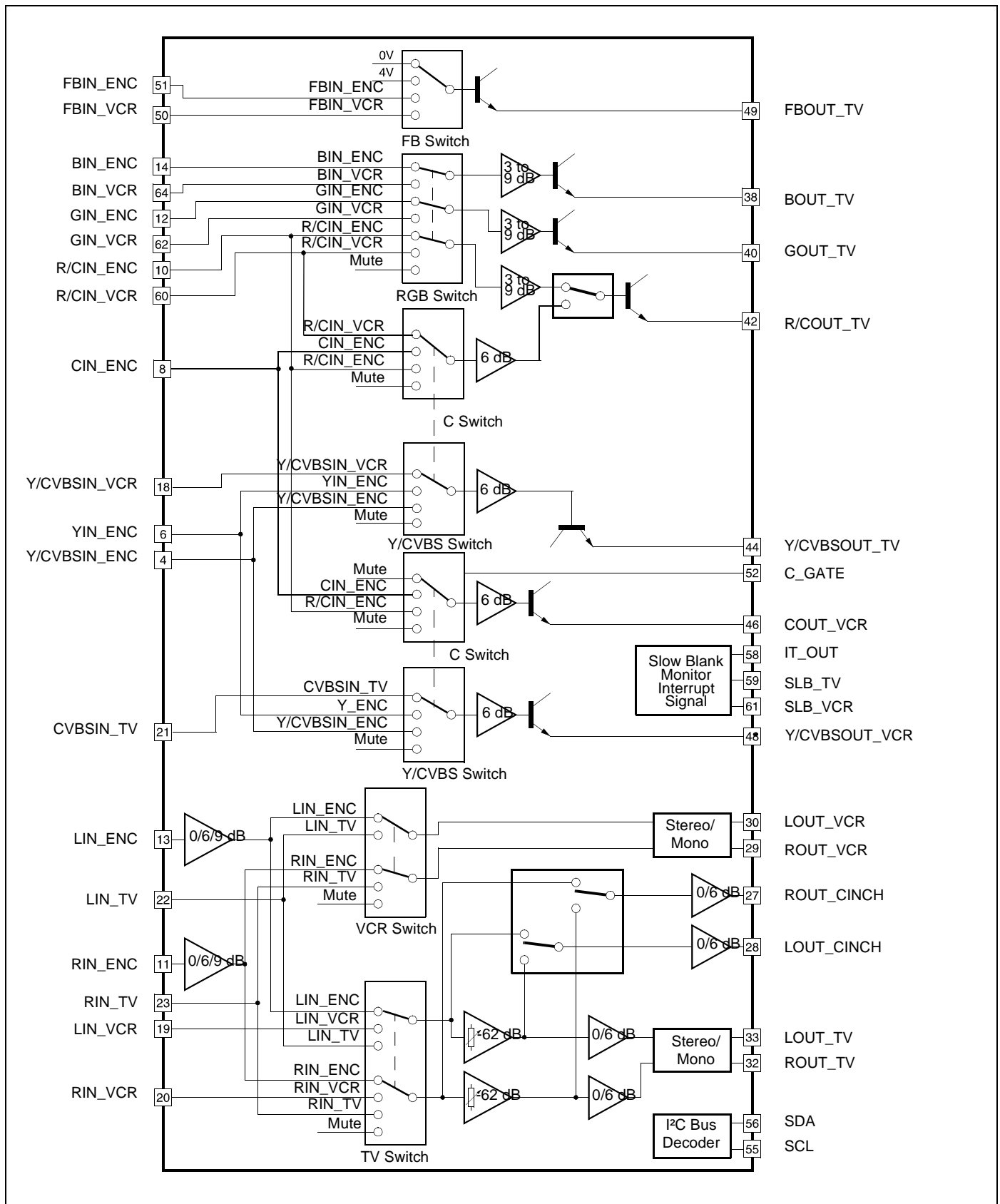
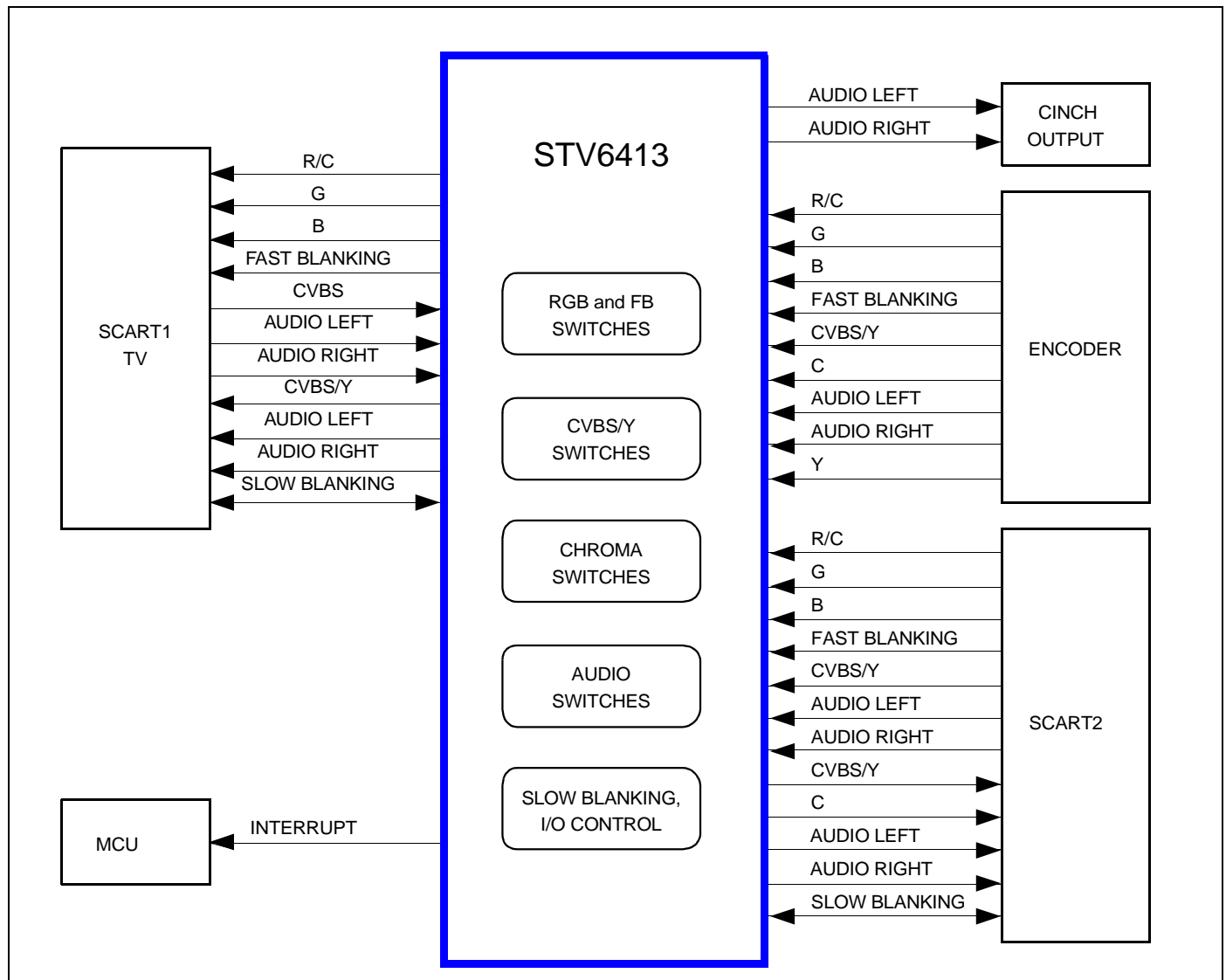


Figure 3: STV6413 Functional Diagram



2 Electrical Characteristics

2.1 Absolute Maximum Ratings

| Symbol | Parameter | | Value | Unit |
|--------------------------|--|--|--|------|
| V_{CC12} | Supply voltage for Slow Blanking sections | | 13.2 | V |
| V_{CCAO} | Supply voltage for Audio Drivers | | 13.2 | V |
| V_{CCA} | Supply voltage for Digital Audio sections | | 10 | V |
| V_{DD} | Supply voltage for Digital sections | | 6 | V |
| V_{CC} , V_{CCBI} | Supply voltage for Video sections | | 6 | V |
| V_{IN} | Input Voltage at Pin (in reference to GND) | Audio pins Video pins Bus pins Slow Blanking pins | 0, V_{CCA} 0, V_{CC} or V_{CCBI} 0, 5.5 0, V_{CC12} | V |
| V_{ESD} | Maximum ESD Voltage allowed. (Human Body Model: 100 pF capacitor discharged through 1.5 kOhm serial resistor) | | ±4 | kV |
| T_{OPER} | Ambient Operating Temperature | | 0 to +70 | °C |
| T_{STG} | Storage Temperature | | -20 to +150 | °C |

2.2 Thermal Data

| Symbol | Parameter | | Value | Unit |
|------------|---|--|-------|------|
| R_{thJC} | Junction-to-Case Thermal Resistance | | | °C/W |
| R_{thJA} | Junction-to-Ambient Thermal Resistance ¹ | | 48 | °C/W |
| T_J | Maximum Recommended Junction Temperature | | | °C |

1. Measured on 4-layer application board.

2.3 Latch-up Data

At an ambient temperature of 25 °C, all pins meet the following specifications:

- $I_{trigger} = 200 \text{ mA}$ or $I_{trigger} = -200 \text{ mA}$.
- Pin 58 (IT_OUT) does not meet this specification and the trigger current must be limited to 100 mA.

2.4 Electrical Characteristics

$T_{AMB} = 25^{\circ}C$, $V_{CCAO} = 12V$, $V_{CC} = 5V$, $V_{CC12} = 12V$, $V_{DD} = 5V$

$R_{GA} = 600\Omega$, $R_{GV} = 50\Omega$, $R_{LOUTA} = 10k\Omega$, $R_{LOUTV} = 150\Omega$ (unless otherwise specified).

Supply Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|------------|--------------------------------------|---|-------------|---------|-------------|------|
| V_{DD} | Digital Supply Voltage | | 4.75 | 5 | 5.25 | V |
| V_{CCAO} | Audio Operating Supply Voltage | - Decoupling capacitor on V_{CCA} - Connected to V_{CCA} | 11.2 8.5 | 12 9 | 12.8 9.5 | V |
| V_{CC} | Video Operating Supply Voltage | | 4.75 | 5 | 5.25 | V |
| V_{CC12} | Slow Blanking Control Supply Voltage | | 11.2 | 12 | 12.8 | V |

Active Mode (All channels ON)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|------------|---|--|------|----------|--------|------|
| I_{DD} | Digital Supply Current | $V_{DD} = 5V$ | | 4.5 | 10 | mA |
| I_{CCA} | Audio Supply Current | $V_{CCAO} = 12V$, No Load | | 9 | 15 | mA |
| I_{CCV} | Total Video Supply Current ($V_{CC} + V_{CCB1} + V_{CCB2} + V_{CCB3} + V_{CCB4} + V_{CCB5}$) | $V_{CC} = 5V$, No Load | | 43 | 60 | mA |
| I_{CC12} | 12 V Supply Current | $V_{CC12} = 12V$ SLB input mode SLB output mode, No Load | | 0 2.5 | 1 4 | mA |

Standby Mode (All channels OFF)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|----------------------------|----------------------------|------|------|------|------|
| I_{DD} | Digital Supply Current | $V_{DD} = 5V$ | | 4.5 | 10 | mA |
| I_{CCASTD} | Audio Supply Current | $V_{CCAO} = 12V$, No Load | | 3 | | mA |
| I_{CCVSTD} | Total Video Supply Current | $V_{CC} = 5V$, No Load | | 1 | | mA |

Audio Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------|--------------------------|---|------|----------|------|------|
| SVR100 | Supply Voltage Rejection | $V_{RIPPLE} = 500mV_{RMS}$ at 100 Hz, Gain = 0 dB DECA filter cap = 47 μF DECA filter cap = 220 μF | 60 | 70 80 | | dB |
| SVR1K | Supply Voltage Rejection | $V_{RIPPLE} = 500mV_{RMS}$ at 1 kHz, Gain = 0 dB | 70 | 80 | | dB |

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|--|---|----------|----------------------|----------------------|-----------------|
| V_{INDC} | Input DC Level | $V_{CCA} = 9\text{ V}$ | | $V_{CCA}/2$ | | V |
| V_{INAC} | Input Signal Amplitude | | | | 2 | V_{RMS} |
| R_{IN} | Input Resistance | | 30 | 50 | | $k\Omega$ |
| $R_{INmatch}$ | Input Resistance Matching | | | ± 2 | ± 10 | % |
| F_{RANGE} | Bandwidth | -3 dB, 0.5 V_{RMS} , $R_{LOAD} = 10\text{ k}\Omega$, Gain = 0 dB | 50 | | | kHz |
| Flatness | Spread of Gain in Audio Band | -0.5 V_{RMS} , 20 Hz to 20 kHz, Gain = 0 dB | | | 0.5 | dB |
| CS | Channel Separation, from audio inputs Between L & R of TV outputs | $V_{IN} = 0.5\text{ V}_{RMS}$ at 1 kHz on one input, $R_{LOAD} = 10\text{ k}\Omega$, Gain = 0 dB | 80 70 | 90 74 | | dB dB |
| Ci | Channel Isolation from video inputs | $V_{IN} = 1\text{ V}_{PP}$ at 15 kHz on one point | | 85 | | dB |
| V_{OUT} | Output DC Level | $V_{CCA} = 9\text{ V}$ | | $V_{CCA}/2$ | | V |
| V_{OFF} | DC Offset Change | Switching between inputs | | 1 | ± 15 | mV |
| R_{OUT} | Output Resistance | | | 60 | 120 | Ω |
| PHD | Phase Difference | 1 V_{RMS} input on each input channel at 1 kHz | | | 3 | $^{\circ}$ deg. |
| ASN | S/N Ratio | $V_{IN} = 1\text{ V}_{RMS}$ at 1 kHz input weighted CCIR 468-4 quasi peak, Gain = 0 dB | 80 | 90 | | dB |
| eNI | Equivalent RMS Input Voltage Noise | BW = 20 Hz, 20 kHz Flat, Gain = 0 dB | | 5 | | μV |
| G0 | 0 dB Gain | 0.5 V_{RMS} , $R_{LOAD} = 10\text{ k}\Omega$, Gain = 0 dB | -0.5 | | +0.5 | dB |
| G_{STEP} | Gain Step | -62 dB to +6 dB (see Figure 2) | | 2 | | dB |
| G_{MATCH1} | Gain matching between different inputs of one output | $V_{IN} = 0.5\text{ V}_{RMS}$ at 1 kHz, Gain = 0 dB | -0.5 | | 0.5 | dB |
| G_{MATCH2} | Gain matching between Left/Right outputs of one input channel | $V_{IN} = 0.5\text{ V}_{RMS}$ at 1 kHz, Gain = 0 dB | -0.5 | | 0.5 | dB |
| THD0 THD6 THD9 | Total Harmonic Distortion ENC Input at 0 dB ENC Input at 6 dB ENC Input at 9 dB | $V_{OUT} = 0.5\text{ V}_{RMS}$ at 1 kHz, LPF at 80 kHz, Volume Level Adjustment = 0 dB | | 0.01 0.01 0.01 | 0.05 0.05 0.05 | % |
| V_{CL} | Output Clipping Level | THD = 0.2%, 1 kHz | 2.1 | 2.3 | | V_{RMS} |
| R_L | Output Load Resistance | $V_{IN} = 1\text{ V}_{RMS}$, THD = 0.3%, Gain = 0 dB | 2 | 2.25 | | $k\Omega$ |
| Mute | Mute Suppression | $V_{IN} = 0.5\text{ V}_{RMS}$, on one point | 90 | | | dB |

Video Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|---|---|----------|----------|------------------------|-----------------|
| V_{DCIN} | DC Input Level | Bottom Sync Pulse | | 2 | | V |
| I_{CLAMP} | Clamping Current | at $V_{DCIN} - 400$ mV | 1 | 2 | | mA |
| I_{LEAK} | Input Leakage Current | $V_{IN} = V_{DCIN} + 1$ V | | 1 | 10 | μ A |
| C_{IN} | Input Capacitance | | | 2 | | pF |
| V_{IN} | Max Input Signal | $V_{CC} = 5$ V | | 1.5 | | V_{PP} |
| DYN | Dynamic Output Signal | $V_{CC} = 5$ V | | 3 | | V_{PP} |
| BW | Bandwidth at -3 dB - Y/CVBS - RGB | $V_{IN} = 1 V_{PP}$ $V_{IN} = 1 V_{PP} V_{INC} = \text{muted}$ | 12 12 | 15 15 | | MHz |
| Flatness | Spread of Gain in Video Band (15 kHz - 5 MHz) - Y/CVBS - RGB | $V_{IN} = 1 V_{PP}$ $V_{IN} = 1 V_{PP} V_{INC} = \text{Muted}$ | | | ± 0.5 ± 0.5 | dB |
| CTi | Crosstalk Isolation between Input Channel | $V_{IN} = 1 V_{PP}$ at 4.43 MHz on one point | | 60 | | dB |
| CTo | Crosstalk Isolation between Output Channel | $V_{IN} = 1 V_{PP}$ at $f = 4.43$ MHz, on one point, $R_{LOAD} = 150\Omega$ | | 50 | | dB |
| R_{OUT} | Output Resistance | | | 5 | 10 | Ω |
| G_{RGB} | Gain at RGB outputs | $V_{IN} = 1 V_{PP}$, Gain = 6 dB | 5.5 | 6 | 6.5 | dB |
| G_{RGBM} | Gain matching between R, G, B | $V_{IN} = 1 V_{PP}$, Gain = 6 dB | -0.3 | 0 | 0.3 | dB |
| $G_{RGBSTEP}$ | Step of Gain | 3 dB to 6 dB | 0.75 | 1 | 1.25 | dB |
| G_{YCVBS} | Gain on Y, CVBS channels | $V_{IN} = 1 V_{PP}$ | 5.5 | 6 | 6.5 | dB |
| G_{YCVBSM} | Gain matching between Y, CVBS inputs | $V_{IN} = 1 V_{PP}$ | -0.5 | 0 | 0.5 | dB |
| DC_{OUT} | DC Output Voltage | Bottom sync pulse | | 0.6 | | V |
| DPHI | Differential Phase | $V_{IN} = 1 V_{PP}$ at 4.43 MHz | | 1 | 5 | $^{\circ}$ deg. |
| DG | Differential Gain | $V_{IN} = 1 V_{PP}$ at 4.43 MHz | | 1 | 5 | % |
| Mute | Mute Suppression | $V_{IN} = 1 V_{PP}$ at 5 MHz on one point | 55 | | | dB |
| LNL | Luminance non-linearity | | | 0.3 | 3 | % |
| VSN | Video S/N Ratio | Refer to Note 1 | 65 | | | dB |

Note: 1 $S/N = 20 \log (V_{OUT} \text{ Black to White} = 0.7 V_{PP} / V_{Noise} (mV_{RMS}) \text{ weighted CCIR 567})$.

Chroma Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------|--|---|------|------|------|-----------------|
| V_{DCIN} | DC Input Level | | | 3 | | V |
| R_{IN} | Input Resistance | | 30 | 50 | | k Ω |
| C_{IN} | Input Capacitance | | | 2 | | pF |
| V_{IN} | Max Input Signal | | | 1.5 | | V _{PP} |
| DYN | Dynamic Output Signal | | | 3 | | V _{PP} |
| DC _{OUT} | DC Output VCR Voltage | | | 2.2 | | V |
| CBW | Chroma Bandwidth | $C_{IN} = 1 V_{PP}$ at -3 db | 10 | | | MHz |
| CTi | Crosstalk Isolation between Input Channel | $V_{IN} = 1 V_{PP}$ at 4.43 MHz on one input | | 55 | | dB |
| CTo | Crosstalk Isolation between Output Channel | $V_{IN} = 1 V_{PP}$ at 4.43 MHz on one input, $R_{LOAD} = 150 \Omega$ | | 50 | | dB |
| R_{OUT} | Output Resistance | | | 5 | 10 | Ω |
| G _{OUTC} | Gain at OUTC | $V_{IN} = 1 V_{PP}$ | 5.5 | 6 | 6.5 | dB |
| G _{CM} | Gain Matching between C inputs | $V_{IN} = 1 V_{PP}$ | -0.5 | 0 | 0.5 | dB |
| Mute | Mute Suppression | $V_{IN} = 1 V_{PP}$ at 4.43 MHz on one input | 55 | | | dB |
| CToYdel | Chroma to Luma Delay, Source Y/C | V_{PP} at 4.43 MHz, | | | 20 | ns |
| CToYdel | Chroma to Luma Delay, Source Y/C | | | | 20 | ns |

Slow Blanking Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|---------------------------------|-----------------|------|------|------|---------|
| Input Mode | | | | | | |
| SLB _{low} | Input Low Level Threshold | | 2.5 | 3.25 | 4 | V |
| SLB _{high} | Input High Level Threshold | | 7.5 | 8.25 | 9 | V |
| I_{IN} | Input Current | | | 50 | 100 | μ A |
| Output Mode | | | | | | |
| SLB _{low} | Output Low Level (Int. TV) | | 0 | 0.02 | 1.5 | V |
| SLB _{med} | Output Medium Level (Ext. 16:9) | | 5 | 5.75 | 6.5 | V |
| SLB _{high} | Output High Level (Ext. 4:3) | | 10 | 11 | 12 | V |

Fast Blanking Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|---|---|------|----------|------|---------|
| Input Mode | | | | | | |
| FBlow/high | Input Low/High Level Threshold | | 0.4 | 0.7 | 0.9 | V |
| I_{IN} | Input Current | | | 2 | 10 | μA |
| Output Mode | | | | | | |
| FB _{LOW} | Output Low Level | $R_{LOAD} = 150 \Omega$ | | | 0.5 | V |
| FB _{HIGH} | Output High Level | | 3.0 | 3.4 | 3.8 | V |
| FB _{DEL} | Fast Blanking RGB delay | At 50% on digital RGB transients, at 2 V on FB rise transient, at 1 V on FB fall, $C_{LOAD} = 10pF$ maximum | | 15 | | ns |
| FB _{TRANS} | FB Transitions at FB output - Rise Time - Fall Time | $C_{LOAD} = 10 pF$ maximum between 10% and 90% between 90% and 10% | | 10 10 | | ns |

C_Gate Function Output Section

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------|--------------------------------------|------------------------------------|------|------|------------|------------|
| C_GATE-H | Pull-up Resistor Value to V_{CCB1} | | | 20 | | k Ω |
| C_GATE-L | Output Low Level | $I_{IN} = 0 mA$ $I_{IN} = 1 mA$ | | | 0.3 0.7 | V |

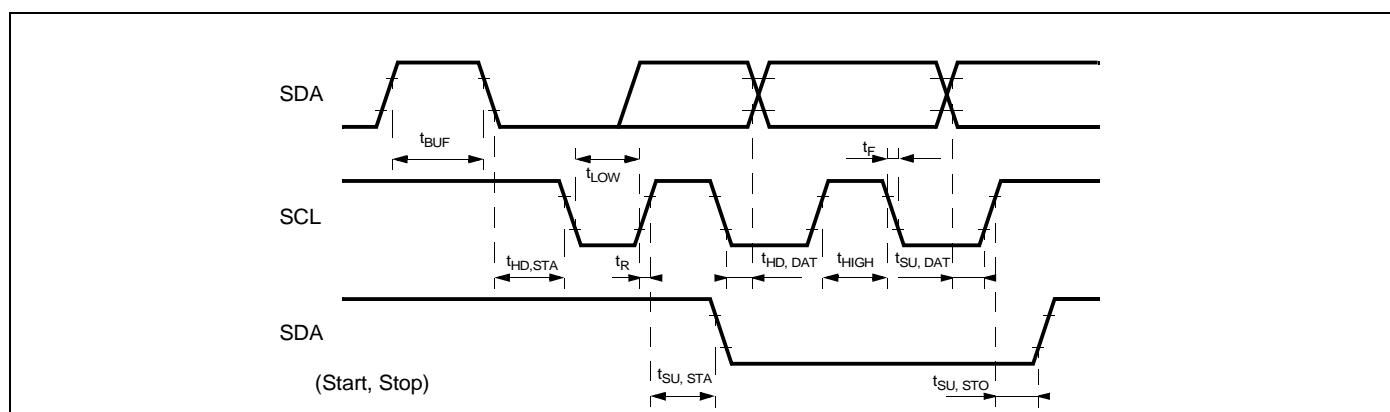
Interrupt Output Section¹

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------|---------------------------|------------------------------------|------|------|------------|---------|
| IT-Leak | High Level Leakage | External pull-up to 5 V | | | 10 | μA |
| IT-Low | Output Low Level (Active) | $I_{IN} = 0 mA$ $I_{IN} = 1 mA$ | | | 0.3 0.7 | V |

1. When bit IT Enable is set, the interrupt is forced to a low level when a change is detected on slow blanking inputs. It can be used in standby mode to wake up the microprocessor. It is released when the I²C bus register is read.

I²C Bus Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|---|-----------------------|------|------|------|---------|
| SCL | | | | | | |
| V_{IL} | Low Level Input Voltage | | -0.3 | | 1.5 | V |
| V_{IH} | High Level Input Voltage | | 2.3 | | 5.5 | V |
| I_{LI} | Input Leakage Current | $V_{IN} = 0$ to 5.5 V | -10 | 0 | 10 | μ A |
| SDA | | | | | | |
| V_{IL} | Low Level Input Voltage | | -0.3 | | 1.5 | V |
| V_{IH} | High Level Input Voltage | | 2.3 | | 5.5 | V |
| I_{LI} | Input Leakage Current | $V_{IN} = 0$ to 5.5 V | -10 | 0 | 10 | μ A |
| C_I | Input Capacitance | | | | 10 | pF |
| t_R | Input Rise Time | 1.5 V to 3 V | | | 1 | μ s |
| t_F | Input Fall Time | 3 V to 1.5 V | | | 300 | ns |
| V_{OL} | Low Level Output Voltage | $I_{OL} = 3$ mA | | | 0.4 | V |
| t_F | Output Fall Time | 3 V to 1.5 V | | | 250 | ns |
| C_L | Load Capacitance | | | | 400 | pF |
| Timing | | | | | | |
| t_{LOW} | Clock Low Period | | 4.7 | | | μ s |
| t_{HIGH} | Clock High Period | | 4 | | | μ s |
| $t_{SU,DAT}$ | Data Setup Time | | 250 | | | ns |
| $t_{HD,DAT}$ | Data Hold Time | | 0 | | 340 | ns |
| $t_{SU,STO}$ | Setup Time from Clock High to Stop | | 4 | | | μ s |
| t_{BUF} | Start Setup Time following a Stop | | 4.7 | | | μ s |
| $t_{HD,STA}$ | Start Hold Time | | 4 | | | μ s |
| $t_{SU,STA}$ | Start Setup Time following Clock Low to High Transition | | 4.7 | | | μ s |

Figure 4: I²C Bus Timing

3 I²C Bus Selection

Data transfers follow the usual I²C format; i.e. after the start condition (S), a 7-bit slave address is sent, followed by an eight-bit data direction bit (W). An 8-bit sub-address is sent to select a register, followed by an 8-bit data word to be included in the register. The IC's I²C bus decoder enables the automatic incrementation mode in write mode.

String Format

Write only mode (S = Start condition, P = Stop condition, A = Acknowledge)

| | | | | | | | | |
|---|---------------|---|---|-------------|---|------|---|---|
| S | Slave Address | 0 | A | Sub-address | A | Data | A | P |
|---|---------------|---|---|-------------|---|------|---|---|

Read only mode

| | | | | | | |
|---|---------------|---|---|------|---|---|
| S | Slave Address | 1 | A | Data | A | P |
|---|---------------|---|---|------|---|---|

Slave Address

| Address | A7 | A6 | A5 | A4 | A3 | A2 | A1 |
|---------|----|----|----|----|----|----|----|
| Value | 1 | 0 | 0 | 1 | 0 | 1 | 1 |

Auto Increment Mode

| | | | | | | | | | | | | | |
|---|---------------|---|---|-------------|---|-----------------|---|-----------------|---|-----|--------|---|---|
| S | Slave Address | 0 | A | Sub-address | A | Data0 | A | Data1 | A | ... | Data n | A | P |
| | | | | Sub-address | | Sub-address + 1 | | Sub-address + N | | | | | |

3.1 I²C Bus Addresses

Write Address: 1001 0110 = 96(hex), Read Address: 1001 0111 = 97(hex)

Table 2: Input Signal Summary (Write Mode)

| Reg. Add. | Data | | | | | | | |
|-----------|----------------------|--|--------------------------------------|----|--------------------|------------------------------------|------------------------------------|------------------|
| | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 |
| Audio | | | | | | | | |
| 00h | TV Stereo Mono | TV 0/6 dB | TV Volume-62 dB to 0 dB - 2 dB steps | | | | | Soft Volume Mode |
| 01h | VCR Stereo Mono | Not Used (See Note 1) | VCR Audio Switch Control | | CINCH Audio Gain | TV/CINCH Audio Switch Control | | |
| Video | | | | | | | | |
| 02h | VCR Chroma muted | VCR Video and Chroma Switch Control | | | TV Chroma muted | TV Video and Chroma Switch Control | | |
| 03h | RGB and FB Tri-state | RGB Gain | | | RGB Switch Control | | Fast Blanking Mode/Input Selection | |

Table 2: Input Signal Summary (Write Mode)

| Reg. Add. | Data | | | | | | | |
|---------------|---|------------|---|----------------------------|---|---|---|----------------------------------|
| | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 |
| Miscellaneous | | | | | | | | |
| 04h | IT Enable | SLB Mode | Not Used (See Note 1) | VCR-C Output Control | VCR-C Gate Control | Not Used (See Note 1) | Not Used (See Note 1) | TV R or C Output Selection |
| 05h | VCR Slow Blanking | | TV Slow Blanking | | ENC Audio Input Gain 0/6/9 dB | | VCR R/C sub Clamp | ENC R/C sub Clamp |
| Standby | | | | | | | | |
| 06h | Not Used (See Note 1) | TV Outputs | CINCH Outputs | VCR Outputs | Not Used (See Note 1) | TV Inputs | VCR Inputs | ENC Inputs |

Note: 1 At register address 06h, bits marked “Not Used” must be set to “1”. All other bits marked “Not Used” must be set “0”.

Table 3: TV Audio Output

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|------------------------|------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------------------|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 00h | Soft Volume Change | 1 | X X | X X | X X | X X | X X | X X | X X | 0 1 | Active Disabled |
| | Level Adjustment | 5 | X X | X X | 0 1 | 0 1 | 0 1 | 0 1 | 0 1 | X X | 0 dB -62 dB (-2 dB/step) |
| | 6 dB Extra Gain | 1 | X X | 0 1 | X X | X X | X X | X X | X X | X X | 0 dB +6 dB |
| | TV Stereo or Mono Mode | 1 | 0 1 | X X | X X | X X | X X | X X | X X | X X | 0 = Stereo 1 = Mono |

Table 4: Audio Selection & VCR Audio Output

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|-----------------------------------|------|------|----|----|----|----|----|----|----|----------------------|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 01h | TV & CINCH Audio Output Selection | 3 | X | X | X | X | X | 0 | 0 | 0 | Muted |
| | | | X | X | X | X | X | 0 | 0 | 1 | Encoder L/R selected |
| | | | X | X | X | X | X | 0 | 1 | 0 | VCR L/R selected |
| | | | X | X | X | X | X | 0 | 1 | 1 | Not allowed |
| | | | X | X | X | X | X | 1 | 0 | 0 | TV L/R selected |
| | | | X | X | X | X | X | 1 | 0 | 1 | Not allowed |
| | | | X | X | X | X | X | 1 | 1 | 0 | Not allowed |
| | | | X | X | X | X | X | 1 | 1 | 1 | Not allowed |
| | CINCH Audio Gain | 1 | X | X | X | X | 0 | X | X | X | 0 dB |
| | | | X | X | X | X | 1 | X | X | X | Follow TV Gain |
| | VCR Audio Output Selection | 2 | X | X | 0 | 0 | X | X | X | X | Muted |
| | | | X | X | 0 | 1 | X | X | X | X | Encoder L/R selected |
| | | | X | X | 1 | 0 | X | X | X | X | TV L/R selected |
| | | | X | X | 1 | 1 | X | X | X | X | Not allowed |
| | VCR Stereo or Mono Mode | 1 | 0 | X | X | X | X | X | X | X | 0 = Stereo |
| | | | 1 | X | X | X | X | X | X | X | 1 = Mono |

Table 5: TV & VCR Video Selection

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|----------------------------|------|------|----|----|----|----|----|----|----|-----------------------------|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 02h | TV Video Output Selection | 3 | X | X | X | X | X | 0 | 0 | 0 | Y/CVBS muted & Chroma muted |
| | | | X | X | X | X | X | 0 | 0 | 1 | Y/CVBS_ENC & R/C_ENC |
| | | | X | X | X | X | X | 0 | 1 | 0 | Y_ENC & C_ENC |
| | | | X | X | X | X | X | 0 | 1 | 1 | Y/CVBS_VCR & R/C_VCR |
| | | | X | X | X | X | X | 1 | 0 | 0 | Not allowed |
| | | | X | X | X | X | X | 1 | 0 | 1 | Not allowed |
| | | | X | X | X | X | X | 1 | 1 | 0 | Not allowed |
| | | | X | X | X | X | X | 1 | 1 | 1 | Not allowed |
| | TV Chroma Output Control | 1 | X | X | X | X | 0 | X | X | X | Chroma defined by d2d1d0 |
| | | | X | X | X | X | 1 | X | X | X | Chroma force to mute |
| | VCR Video Output Selection | 3 | X | 0 | 0 | 0 | X | X | X | X | Y/CVBS muted & Chroma muted |
| | | | X | 0 | 0 | 1 | X | X | X | X | Y/CVBS_ENC & R/C_ENC |
| | | | X | 0 | 1 | 0 | X | X | X | X | Y_ENC & C_ENC |
| | | | X | 0 | 1 | 1 | X | X | X | X | CVBS_TV & Chroma muted |
| | | | X | 1 | 0 | 0 | X | X | X | X | Not allowed |
| | | | X | 1 | 0 | 1 | X | X | X | X | Not allowed |
| | | | X | 1 | 1 | 0 | X | X | X | X | Not allowed |
| | | | X | 1 | 1 | 1 | X | X | X | X | Not allowed |
| | VCR Chroma Output Control | 1 | 0 | X | X | X | X | X | X | X | Chroma defined by d6d5d4 |
| | | | 1 | X | X | X | X | X | X | X | Chroma force to mute |

Table 6: RGB & Fast Blanking Outputs

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|-----------------------|------|------|----|----|----|----|----|----|----|------------------------------|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 03h | Fast Blanking Control | 2 | X | X | X | X | X | X | 0 | 0 | FB forced to low level |
| | | | X | X | X | X | X | X | 0 | 1 | FB forced to high level |
| | | | X | X | X | X | X | X | 1 | 0 | FB from Encoder |
| | | | X | X | X | X | X | X | 1 | 1 | FB from VCR |
| | RGB Selection | 2 | X | X | X | X | 0 | 0 | X | X | Muted |
| | | | X | X | X | X | 0 | 1 | X | X | RGB_ENC selected |
| | | | X | X | X | X | 1 | 0 | X | X | RGB_VCR selected |
| | | | X | X | X | X | 1 | 1 | X | X | Not allowed |
| | RGB Gain | 2 | X | X | 0 | 0 | X | X | X | X | +6 dB gain |
| | | | X | X | 0 | 1 | X | X | X | X | +5 dB gain |
| | | | X | X | 1 | 0 | X | X | X | X | +4 dB gain |
| | | | X | X | 1 | 1 | X | X | X | X | +3 dB gain |
| | RGB and FB Control | 1 | X | 0 | X | X | X | X | X | X | +0 dB extra gain |
| | | | X | 1 | X | X | X | X | X | X | +3 dB for weak input signals |

Table 7: Miscellaneous Control

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|-------------------------|------|------|----|----|----|----|----|----|----|---------------------------------|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 04h | R/C TV Output Selection | 1 | X | X | X | X | X | 0 | 0 | 0 | Red signal selected |
| | | | X | X | X | X | X | 0 | 0 | 1 | Chroma signal selected |
| | C_Gate Output Control | 1 | X | X | X | X | 0 | 0 | 0 | X | High level |
| | | | X | X | X | X | 1 | 0 | 0 | X | Low level |
| | C_VCR Output Control | 1 | X | X | X | 0 | X | 0 | 0 | X | Tri-state mode (high impedance) |
| | | | X | X | X | 1 | X | 0 | 0 | X | Active |
| | Slow Blanking Mode | 1 | X | 0 | X | X | X | 0 | 0 | X | Normal Mode |
| | | | X | 1 | X | X | X | 0 | 0 | X | SLB TV is driven by SLB VCR |
| | IT Enable | 1 | 0 | X | X | X | X | 0 | 0 | X | No interrupt flag |
| | | | 1 | X | X | X | X | 0 | 0 | X | IT enable |

Table 8: Slow Blanking & Inputs Control

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|--------------------------------|------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|--|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 05h | Encoder R/Csub Clamp | 1 | X X | X X | X X | X X | X X | X X | X X | 0 1 | Bottom level clamp Average level clamp |
| | VCR R/Csub Clamp | 1 | X X | X X | X X | X X | X X | X X | 0 1 | X X | Bottom level clamp Average level clamp |
| | Encoder Input Level Adjustment | 2 | X X X | X X X | X X X | X X X | 0 0 1 | 0 1 0 | X X X | X X X | 0 dB for normal audio inputs +6 dB for weak audio inputs +9 dB for weak audio inputs |
| | Slow Blanking TV SCART | 2 | X X X X | X X X X | 0 0 1 1 | 0 1 0 1 | X X X X | X X X X | X X X X | X X X X | Input mode only Output < 2 V Output 16/9 format Output 4/3 format |
| | Slow Blanking VCR SCART | 2 | 0 0 1 1 | 0 1 0 1 | X X X X | X X X X | X X X X | X X X X | X X X X | X X X X | Input mode only Output < 2 V Output 16/9 format Output 4/3 format |

Table 9: Standby Modes

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|---------------|------|--------|--------|--------|--------|--------|--------|--------|--------|---|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 06h | ENC Inputs | 1 | 1 1 | X X | X X | X X | 1 1 | X X | X X | 0 1 | Inputs active Inputs disabled |
| | VCR Inputs | 1 | 1 1 | X X | X X | X X | 1 1 | X X | 0 1 | X X | Inputs active Inputs disabled |
| | TV Inputs | 1 | 1 1 | X X | X X | X X | 1 1 | 0 1 | X X | X X | Inputs active Inputs disabled |
| | VCR Outputs | 1 | 1 1 | X X | X X | 0 1 | 1 1 | X X | X X | X X | Audio & Video Outputs ON Audio & Video Outputs OFF |
| | CINCH Outputs | 1 | 1 1 | X X | 0 1 | X X | 1 1 | X X | X X | X X | Audio & Video Outputs ON Audio & Video Outputs OFF |
| | TV Outputs | 1 | 1 1 | 0 1 | X X | X X | 1 1 | X X | X X | X X | Audio & Video Outputs ON Audio & Video Outputs OFF |
| | Full Stop | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Only I ² C bus and slow blanking detection parts are supplied. |

Table 10: Output Signals (Read Mode)

| Reg. Add. | Description | Bits | Data | | | | | | | | Comments |
|-----------|-------------------------|------|------|----|----|----|----|----|----|----|---|
| | | | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | Slow Blanking TV SCART | 2 | X | X | X | X | X | X | 0 | 1 | Input < 2 V Input 16/9 format Input 4/3 format |
| | Slow Blanking VCR SCART | 2 | X | X | X | X | 0 | 1 | X | X | Input < 2 V Input 16/9 format Input 4/3 format |
| | Interrupt Flag | 1 | X | X | X | 0 | X | X | X | X | No change since read One change has been detected (refer to Note 1) |

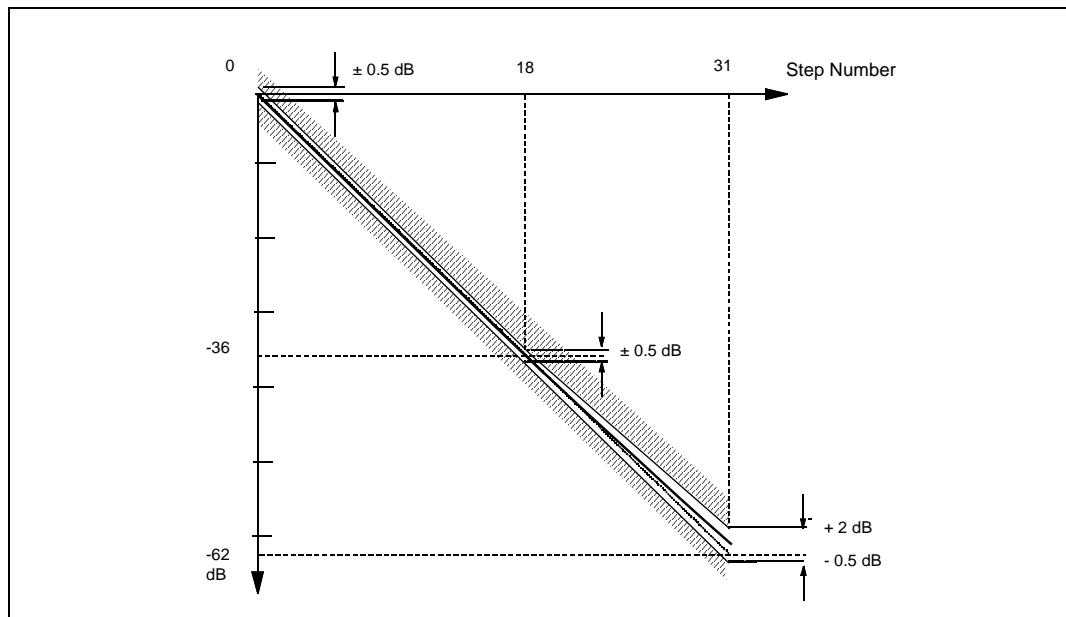
Note: 1 The Interrupt Flag will be cleared when this register is read. To prepare for a new interrupt, a “1” must be re-written in the IT Enable bit (Reg. 04, d7).

3.2 Power-on Reset — Bus Register Initial Conditions

Power-on Reset is active when the supply V_{DD} is less than 3.5 volts.
Non-significant bits (X) are pre-set to “0”.

| Reg. Add. | Data | | | | | | | | Comments |
|-----------|------|----|----|----|----|----|----|----|---|
| | d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 00h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Audio TV and Cinch outputs are in Stereo Mode, 0 dB Gain Adjustment. |
| 01h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | TV, Cinch and VCR audio outputs are muted. VCR output is in Stereo Mode. |
| 02h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | VCR, TV video outputs are muted. |
| 03h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Fast Blanking is forced to '0'. RGB outputs are muted and in high impedance. |
| 04h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | C_GATE is high. C_VCR is high impedance. |
| 05h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Encoder and VCR R/Csub Bottom Level Clamp, RGB outputs 6 dB Gain, and Slow Blanking parts are in read mode. |
| 06h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | All internal blocks are ON. |

Figure 5: Volume Control Characteristics



4 Input/Output Groups

Figure 6: Bottom Clamped Video Inputs
(Pins 4, 6, 12, 14, 18, 21, 62 and 64)

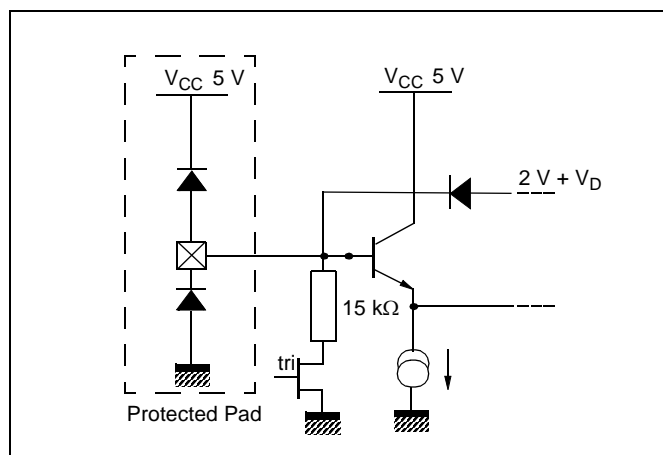


Figure 7: R/C Clamped Video Inputs (Pins 10 and 60)

R/C inputs may be configured either as a bottom clamped input or as an average clamped input. In either case, the simplified input schematic is very close to one of the graphics shown above.

Figure 9: Fast Blanking Inputs
(Pins 50 and 51)

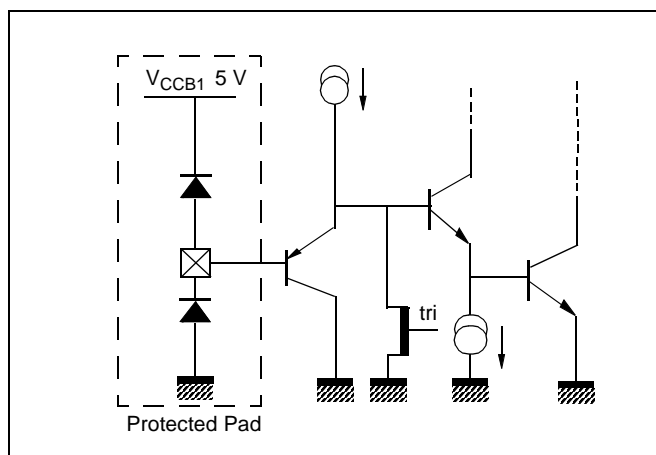


Figure 10: Average Clamped Video Inputs (Pin 8)

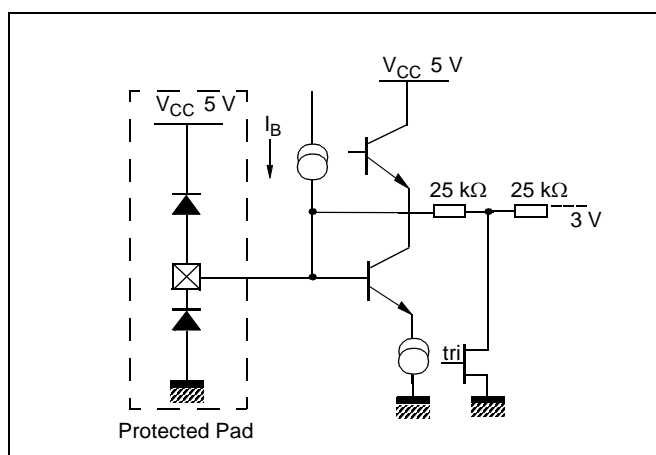


Figure 8: Fast Blanking Output (Pin 49)

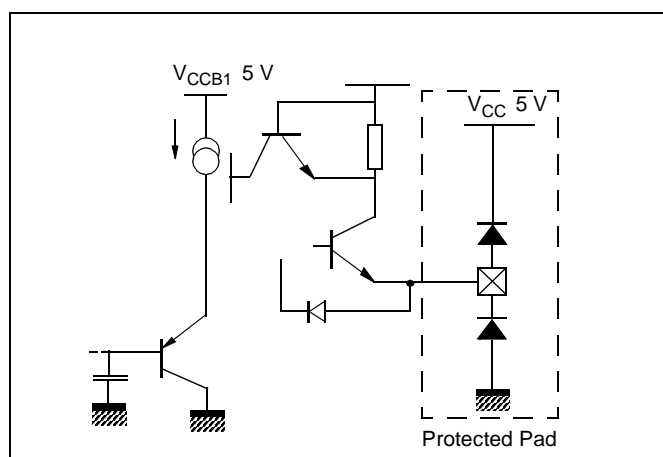


Figure 11: Cgate Logical Output (Pin 52)

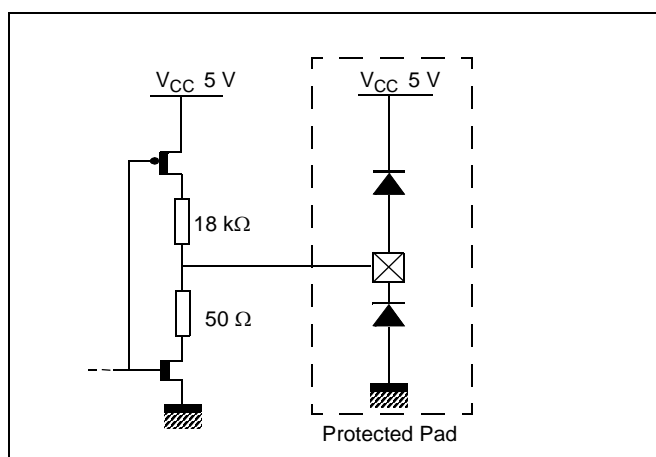


Figure 12: Video Outputs
(Pins 38, 40, 42, 44, 46 and 48)

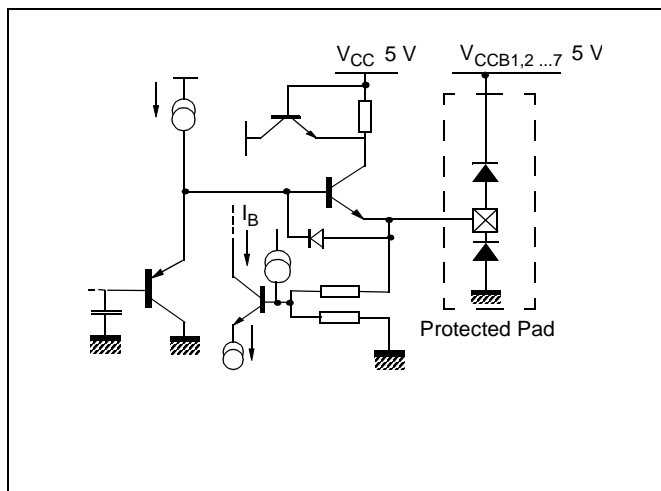


Figure 15: Audio Outputs
(Pins 27, 28, 29, 30, 32 and 33)

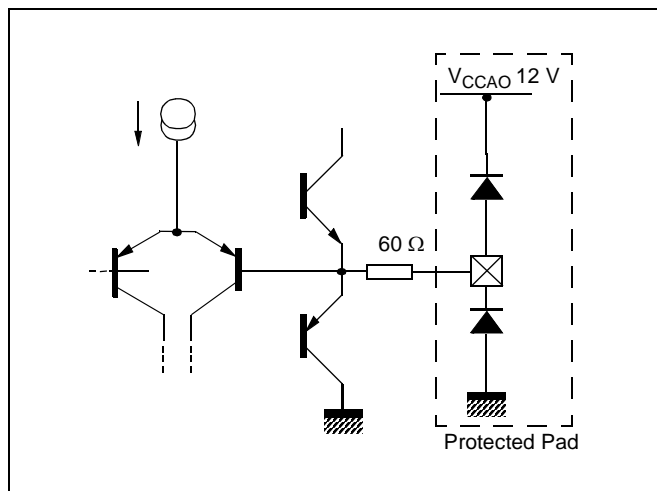


Figure 13: Audio Inputs
(Pins 11, 13, 19, 20, 22 and 23)

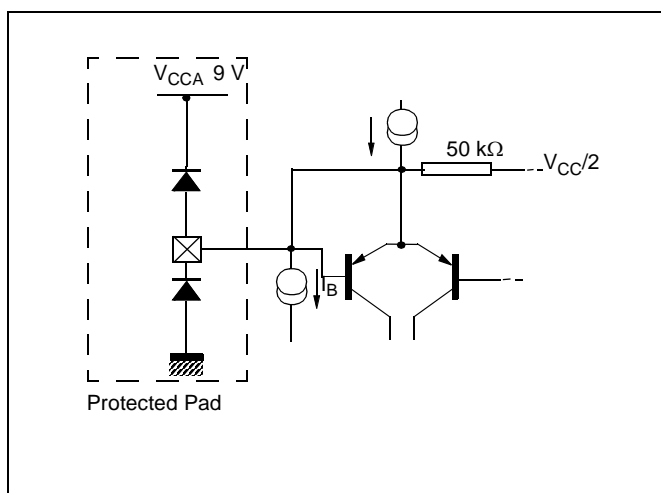


Figure 16: Interrupt Output
(Pin 58)

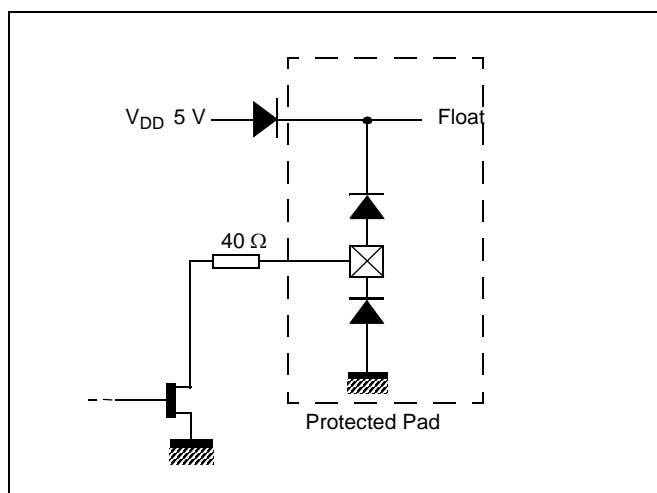


Figure 14: Slow Blanking I/O (Pins 59 and 61)

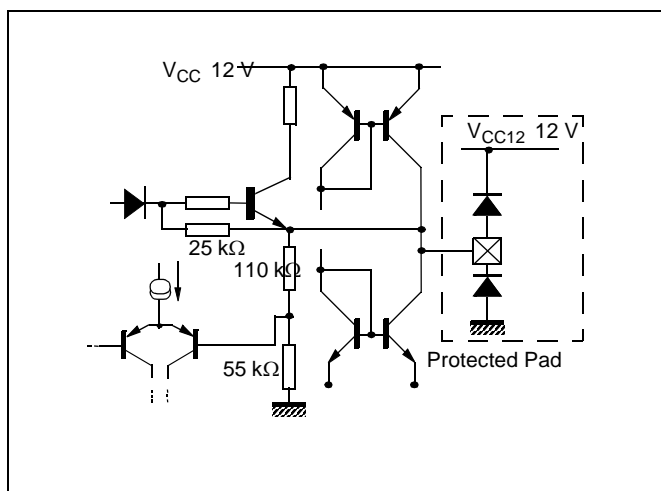


Figure 17: I²C Bus (SDA) (Pin 56)

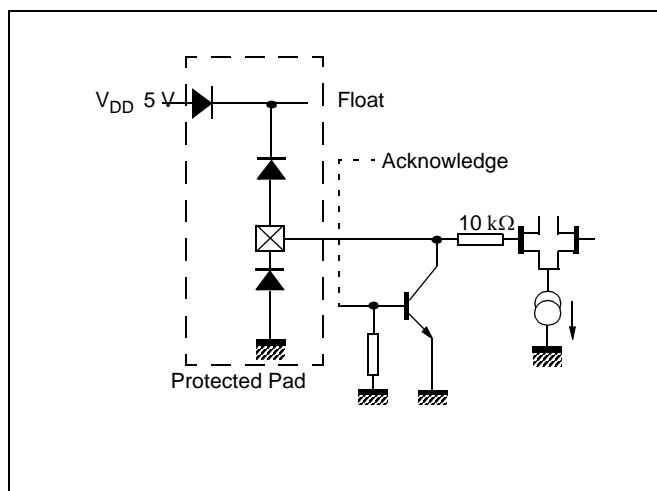


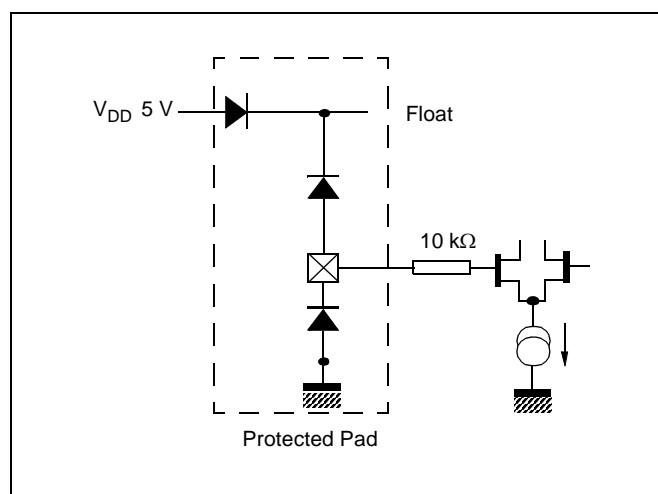
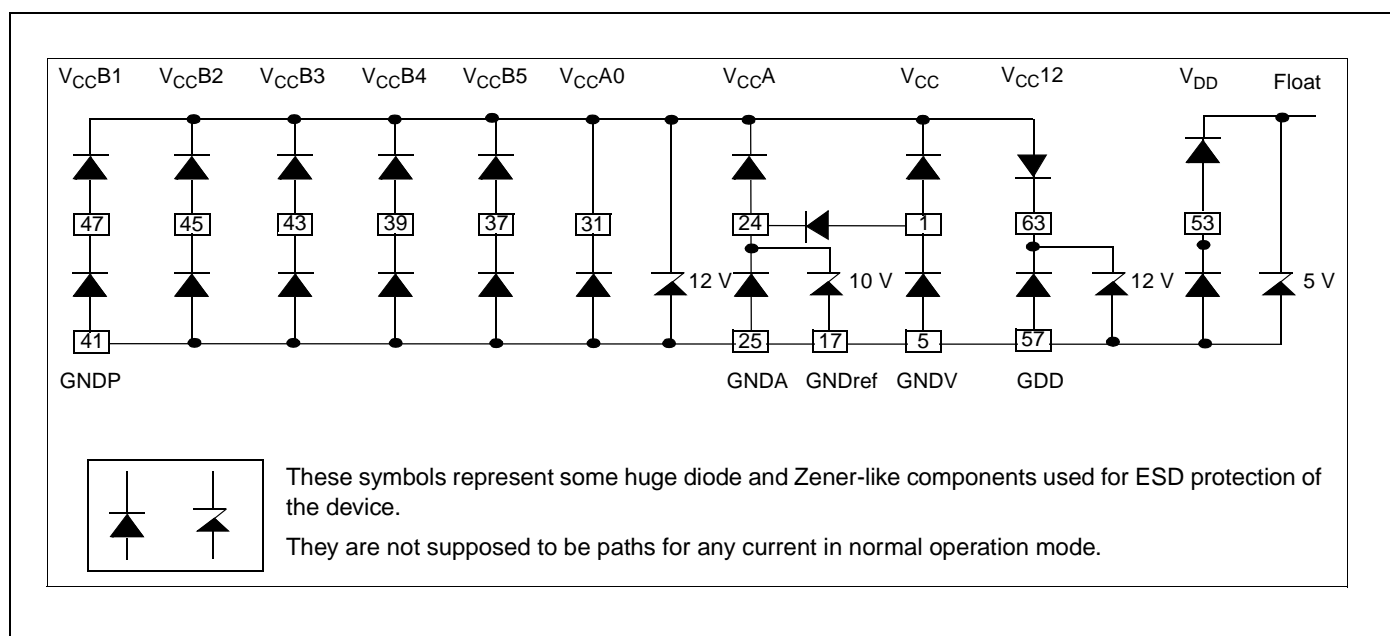
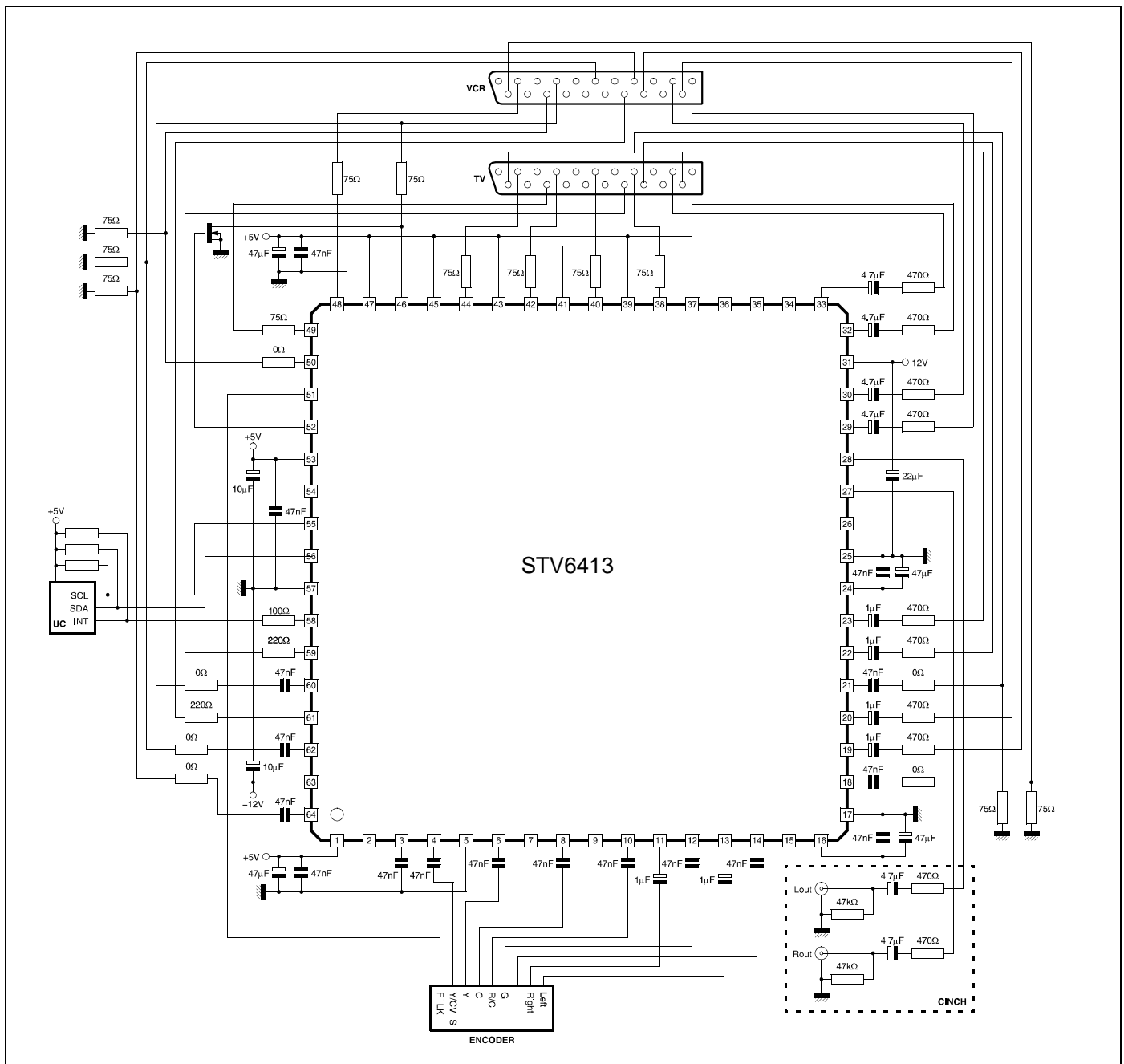
Figure 18: I²C Bus (SCL) (Pin 55)

Figure 19: Power Supply Connection



5 Application Diagram

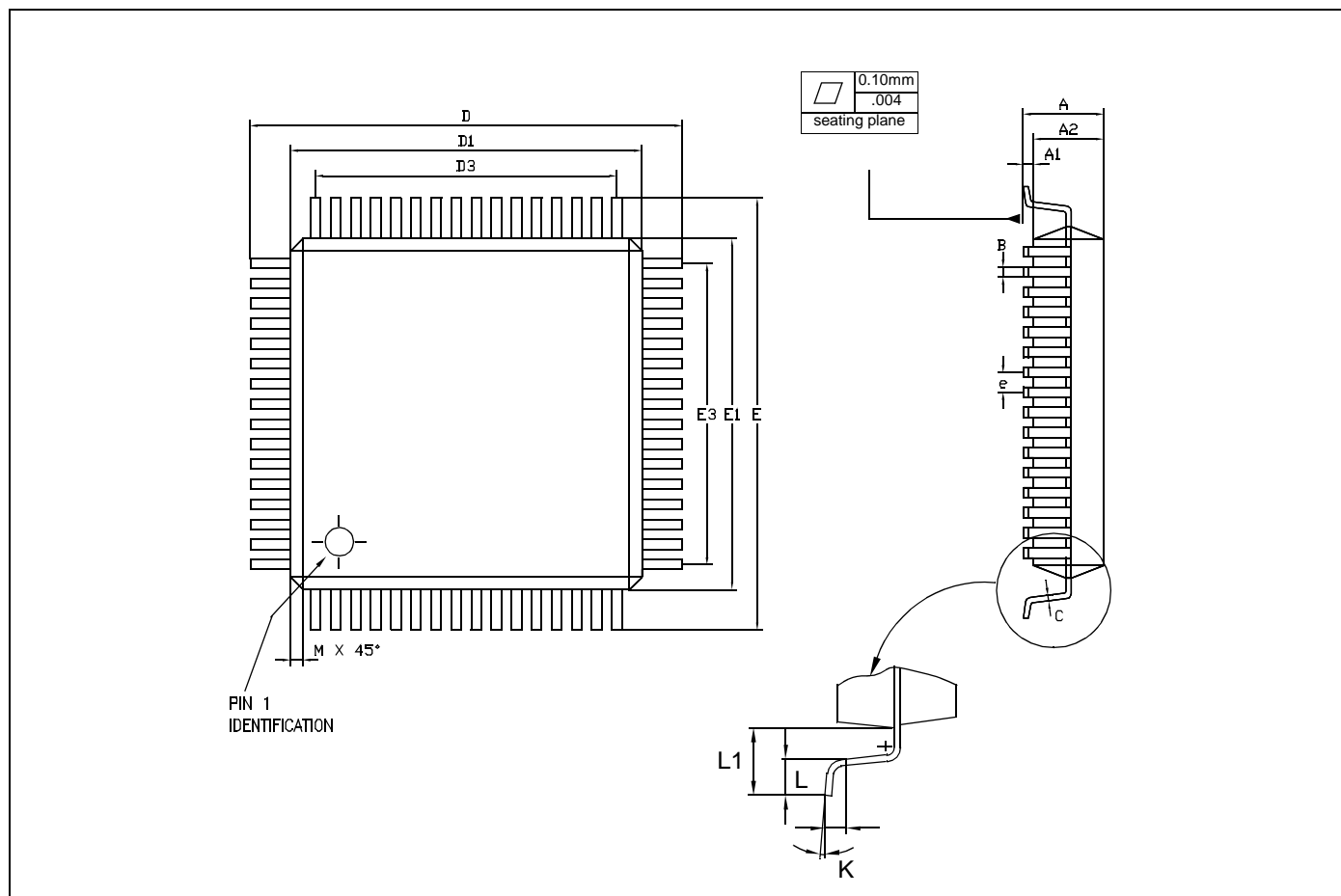
Figure 20: STV6413 Application Diagram



Note: For more details refer to STV6412A Application Note.

6 Package Mechanical Data

Figure 21: 64 Pin, Thin Full Plastic Quad Flat Pack (TQFP)



| Dim. | mm | | | Inches | | |
|------|----------------|-------|------|--------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.60 | | | 0.063 |
| A1 | 0.05 | | 0.15 | 0.002 | | 0.006 |
| A2 | 1.35 | 1.40 | 1.45 | 0.053 | 0.055 | 0.057 |
| b | 0.17 | 0.22 | 0.27 | 0.007 | 0.009 | 0.011 |
| C | 0.09 | | 0.20 | 0.004 | | 0.008 |
| D | | 12.00 | | | 0.472 | |
| D1 | | 10.00 | | | 0.394 | |
| E | | 12.00 | | | 0.472 | |
| E1 | | 10.00 | | | 0.394 | |
| e | | 0.50 | | | 0.020 | |
| K | 0° | 3.5° | 7° | 0° | 3.5° | 7° |
| L | 0.45 | 0.60 | 0.75 | 0.018 | 0.024 | 0.030 |
| L1 | | 1.00 | | | 0.039 | |
| | Number of Pins | | | | | |
| N | 64 | | ND | 16 | NE | 16 |

7 Revision History

| Revision | Main Changes | Date |
|----------|--|------------|
| 1.0 | First Issue | Sept. 2001 |
| 1.1 | Pin List updated. | Dec. 2001 |
| 1.2 | STV6413 Product Preview updated to Datasheet. Order codes updated. Note added to Section 2.2: Thermal Data on page 8 . Test Conditions updated for Total Harmonic Distortion values in Section : Audio Section on page 9 . | March 2002 |
| 1.3 | Modification of Note 1 on page 16 . | July 2002 |

