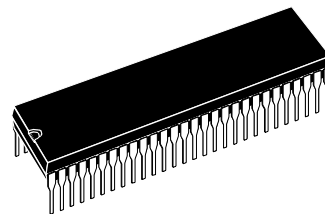




## STV223XD/224XC

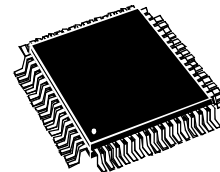
### I<sup>2</sup>C BUS-CONTROLLED MULTISTANDARD SINGLE CHIP TV PROCESSOR

- I<sup>2</sup>C Bus Control
- PIF Circuit with PLL Demodulation (Positive and Negative Video)
- SIF Circuit with QSS Structure, FM Demodulation and AM Demodulation for France
- Intercarrier Capability
- Built-in Sound Bandpass
- Sound Subcarrier Output for Stereo Chassis (FM, NICAM)
- Audio Switch and Volume Control (Mono Chassis)
- AVL (Automatic Volume Levelling)
- Integrated Chroma Filters and Luma Delay Line
- Integrated Chroma Delay Line
- Video Switch (3 CVBS In, 1 or 2 CVBS Out)
- SVHS Switch (Y Combined with CVBS3 Input)
- OSD RGB Inputs
- External RGB/YCrCb Inputs or YUV Interface
- PAL / SECAM / NTSC Chroma Demodulators
- Auto Flesh Control Capability in NTSC mode
- South America Capability (PAL-M / PAL-N / NTSC)
- Chroma Subcarrier Output
- Black Stretch Circuit
- Peaking Circuit
- Automatic Cut-off Current Loop
- Manual Cut-off possible for low-cost applications
- Two Horizontal Deflection PLLs
- Vertical Countdown
- Half Contrast
- APR (Automatic RGB Peak Regulation) Function
- SAW Filter Switch Control (Optional)
- Very Few External Components



**SHRINK56**  
(Plastic Package)

**ORDER CODE:** STV224XC/8XC



**TQFP64** (14 x 14 x 1.4 mm)  
(Full Thin Plastic Quad Flat Pack)

**ORDER CODE:** STV223XD

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## 1 GENERAL DESCRIPTION

### 1.1 INTRODUCTION

The STV223XD/224X are fully bus-controlled ICs for TV that include PIF, SIF, Luma, Chroma and Deflection processing functions. Used with a vertical frame booster (TDA8174A for a 90° chassis,

STV9306 for a 110° chassis), they allow multistandard (BGDKIMNLL', PAL/SECAM/NTSC) sets to be designed with very few external components and no manual adjustments.

#### STV22XX Family Characteristics

Package	Application			
	PAL/NTSC Intercarrier	PAL/NTSC QSS/Intercarrier	PAL/SECAM/NTSC QSS/Intercarrier AM	PAL/SECAM/NTSC QSS/Intercarrier
SHRINK56	STV2246C/86C	STV2247C	STV2248C	STV2249C
TQFP64	STV2236D	STV2237D	STV2238D	STV2239D

#### STV22XX IC Versions

Function	IC Version								
	SHRINK56					TQFP64			
	2246C	2247C	2248C	2249C	2286C	2236D	2237D	2238D	2239D
PAL/SECAM/NTSC			X	X				X	X
PAL/NTSC	X	X			X	X	X		
QSS/Intercarrier		X	X	X			X	X	X
Intercarrier Only	X				X	X			
AM			X					X	
2 CVBS Outputs	X	X	X	X	X	X	X	X	X
1 EXT RGB Input (OSD)					X				
OSD RGB Inputs & RGBEXT/YCrCb Inputs	X	X	X	X		X	X	X	X
YUV Interface							X	X	X
APR	X	X	X	X	X	X	X	X	X
Half Contrast	X	X	X	X	X	X	X	X	X
SAW Filter Control						X	X	X	X

## STV223XD/224XC - GENERAL DESCRIPTION

### 1.2 PIN DESCRIPTION

Table 1. Pin Configuration

Pin N°		Symbol	Description
STV224XC/8XC	STV223XD		
SDIP56	TQFP64		
1	8	SIFIN1	SIF Input (Please refer to Note 1)
2	9	SIFIN2	SIF Input (Please refer to Note 1)
3	10	AGCSIFCAP	AGC SIF Capacitor (Please refer to Note 1)
4	11	V <sub>REFIF</sub>	Voltage Reference Filtering
5	12	AGCPIFCAP	AGC PIF Capacitor
6	13	PIFIN1	PIF Input
7	14	PIFIN2	PIF Input
8	16	TUNERAGCOUT	AGC Tuner Output
9	17	IFPLL	IF PLL Filter
10	18	GND <sub>IF</sub>	IF Ground
11	19	AM/FMOUT/SC	AM/FM Mono Sound or Stereo Carriers Output
12	20	V <sub>CCIF</sub>	5 V IF Supply
13	21	INTCVBSOUT	Internal CVBS Output
14	22	EXTAUDIOIN	External Audio Input
15	23	PIFLC1	LC Input
16	24	PIFLC2	LC Input
17	25	V <sub>CC2</sub>	Video/Luma Supply Voltage (8 V)
18	26	CVBSIN1	Internal Video Input
19	27	GND2	Video/Luma Ground
20	28	CVBSIN2	External Video Input
21	29	BS	Black Stretch Capacitor
22	34	Y/CVBSIN3	Y(SVHS) or CVBS3 External Input
23	35	CHR	Chroma (SVHS) Input
-	37	UIN	B-Y Input (Please refer to Note 1)
-	38	VIN	R-Y Input (Please refer to Note 1)
-	39	YIN	Y Input (Please refer to Note 1)
-	40	YOUT	Y Output (Please refer to Note 1)
-	41	VOUT	R-Y Output (Please refer to Note 1)
-	42	UOUT	B-Y Output (Please refer to Note 1)
30	43	BOUT	Blue Output
31	44	GOUT	Green Output
32	45	ROUT	Red Output
33	46	I <sub>CATH</sub>	Cathode Current Measurement Input
34	47	BOSD	OSD Blue Input
35	48	GOSD	OSD Green Input
36	49	ROS	OSD Red Input
37	50	FBOSD/HC	OSD Fast Blanking Input / Half Contrast on SDIP56 package
38	52	XTAL3/BTUN	3.5X MHz Crystal or Cloche Filter Tuning Capacitor
39	53	XTAL2	3.5X MHz Crystal
40	54	XTAL1	4.43/3.5X MHz Crystal
41	55	CLPF	Chroma PLL Filter
42	56	X1/VAMP/CHROUT	XTAL1 Control Pin, Vertical Amplitude DAC Output and Chroma Reference Signal Output

## STV223XD/224XC - GENERAL DESCRIPTION

Pin N°		Symbol	Description
STV224XC/8XC	STV223XD		
SDIP56	TQFP64		
43	57	GND1	Chroma/Scanning Ground
-	58	CVBSOUT1	Main Video Switch Output
45	59	V <sub>CC1</sub>	Chroma/Scanning Power Supply (8 V)
46	61	BCL/SAF	Beam Current Limiter Control Voltage and Safety Input (XRAY)
47	62	VERT	Vertical Output Pulse
48	63	HOUT	Horizontal Output Pulse
49	64	LFB/SSC	Line Flyback Input and Super-Sandcastle Output
50	1	SLPF	Scanning PLL Filter
51	2	SCL	I <sup>2</sup> C Bus Clock Input
52	3	SDA	I <sup>2</sup> C Bus Data Input
53	4	V <sub>CCD</sub>	Digital Supply Voltage (5 V)
54	5	GNDD	Digital Ground
55	6	AUDIOOUT	Main Audio Output
56	7	FMCAP	FM Demodulation Capacitor
-	15	SAW	Filter Switch Control
25	30	BEXT/Cb	External Blue Input or external Cb Input (Please refer to Note 2)
26	31	GEXT/Y	External Green Input or external Y Input (Please refer to Note 2)
27	32	REXT/Cr	External Red Input or external Cr Input (Please refer to Note 2)
28	33	FBEXT	External Fast Blanking Input (Please refer to Note 3)
24	36	APR	Automatic RGB Peak Regulation
-	51	HC	Half Contrast Input
44	60	CVBSOUT2	Second Video Switch Output
29	-	NTBC/CVBSOUT1	Not To Be Connected or CVBS Output 1 (Please refer to Note 4)

**Note 1:** Input/Output not available in STV2246C/86C and STV2236D versions. This pin must not be connected.

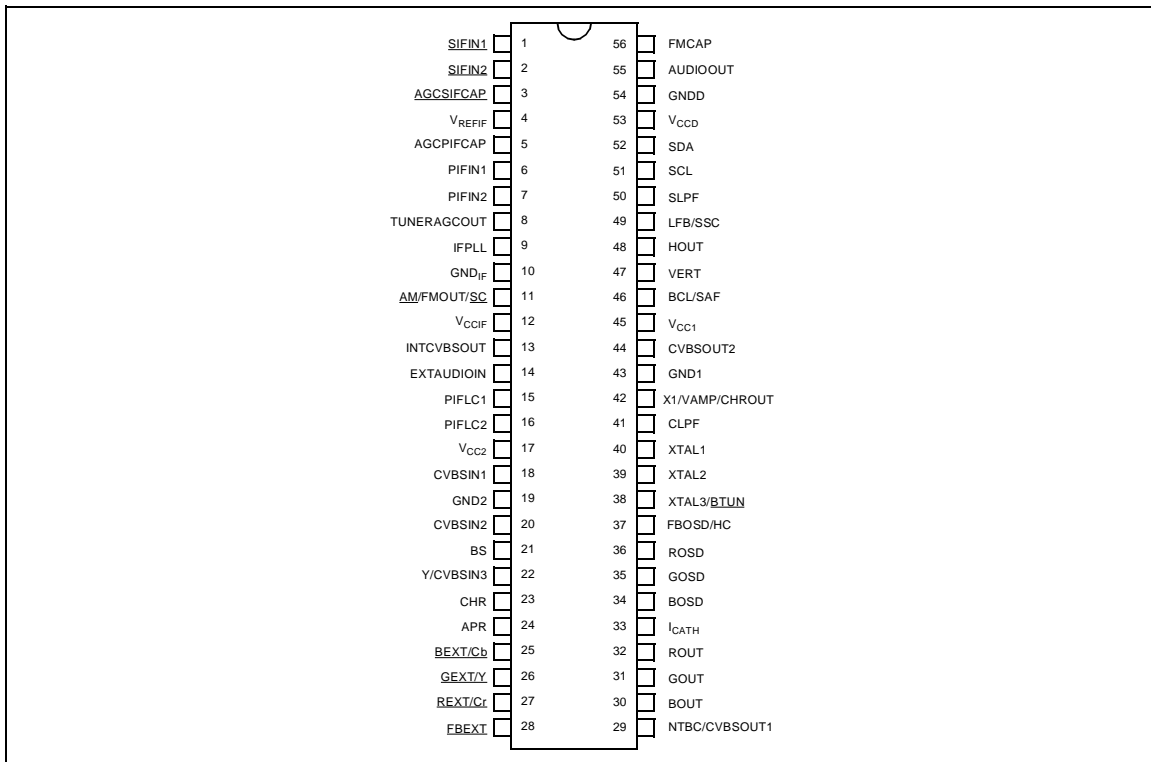
**Note 2:** When REXT, GEXT and BEXT pins are not used, they must not be connected. Register 0Ah must be set (d7 and d6 = 01). (RGB external inputs disabled.)

**Note 3:** FBEXT to be connected to ground when not used.

**Note 4:** CVBS output 1 on pin 29 (SDIP56), if register 1Dh = 07h.

## STV223XD/224XC - GENERAL DESCRIPTION

Figure 1. STV224XC/8XC Pinout (SDIP56)



**Note:** Underlined pin functions are optional.

Figure 2. STV223XD Pinout (TQFP64)

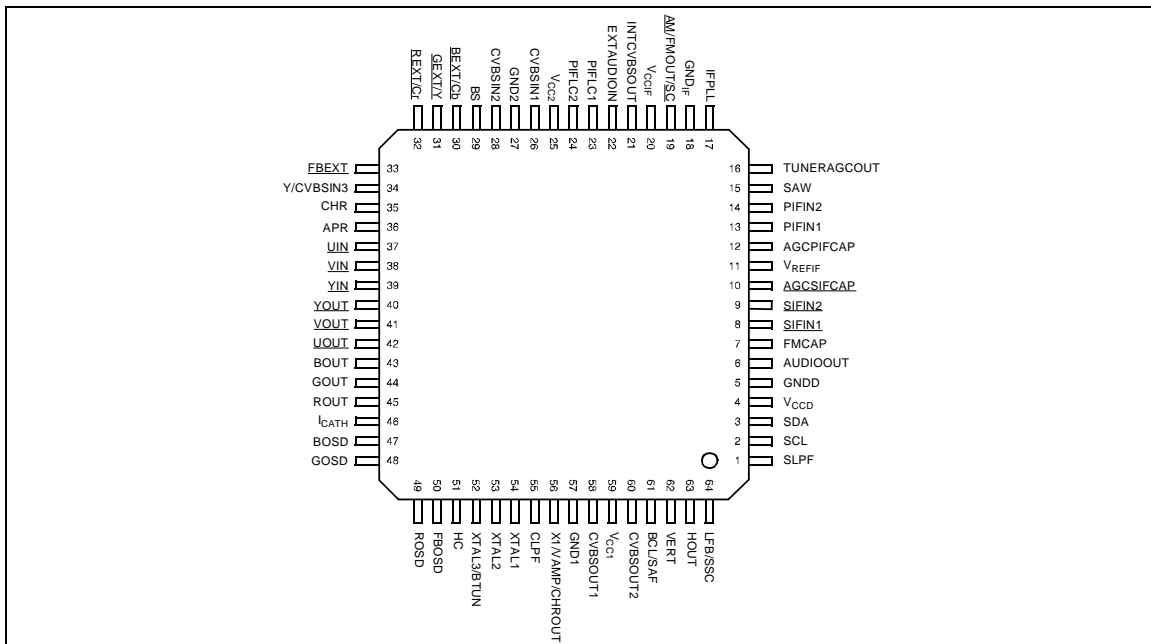
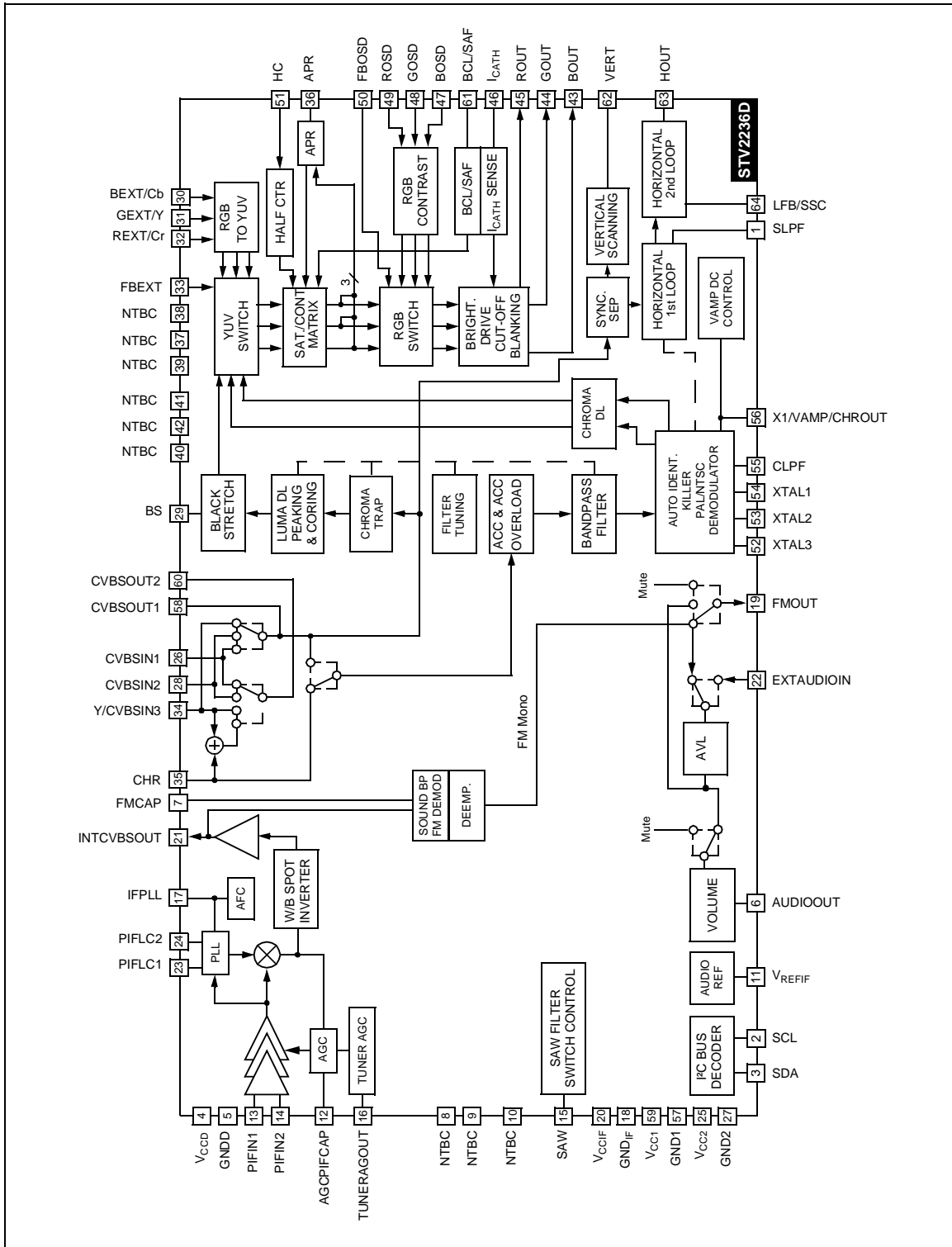
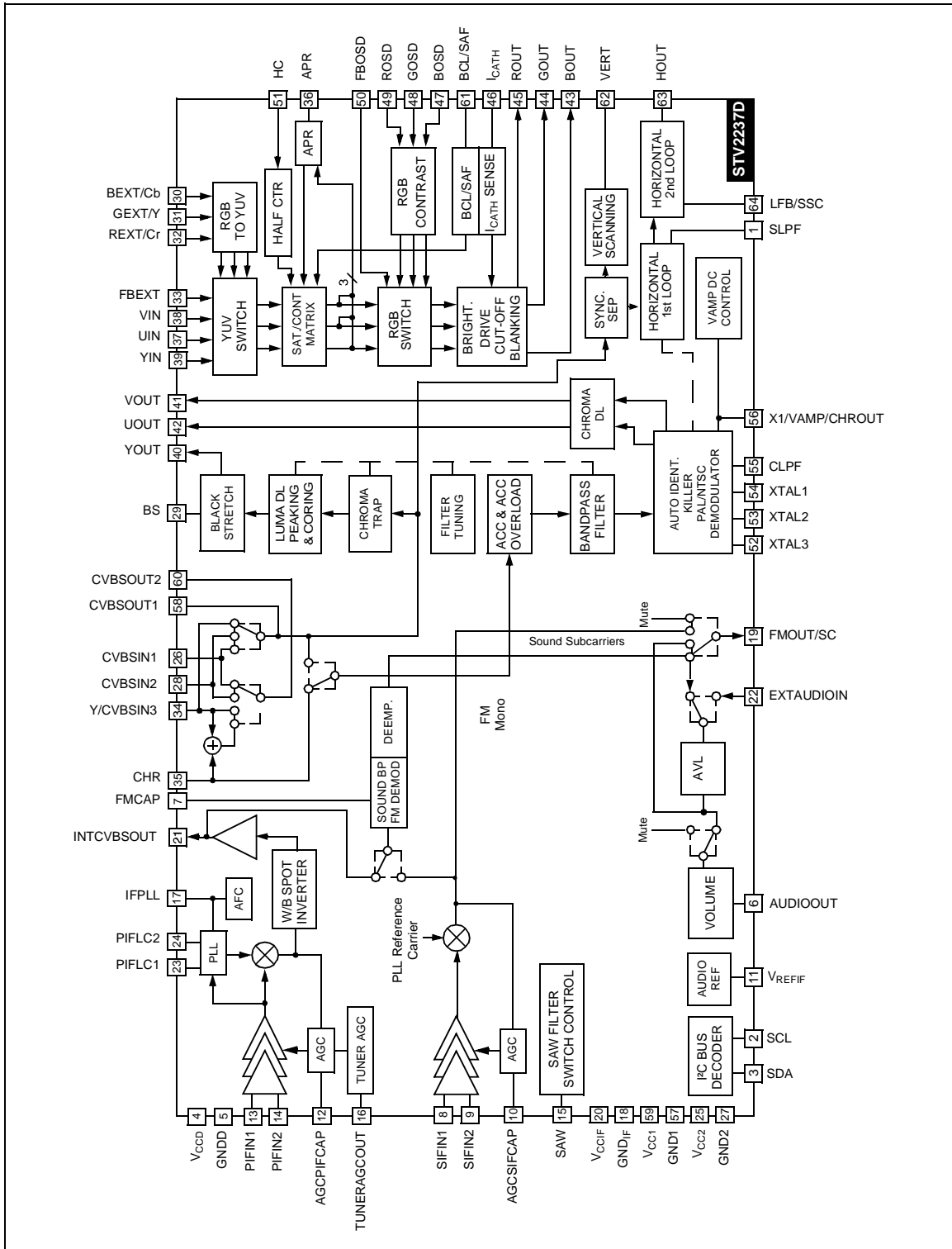


Figure 3. STV2236D (TQFP64) Block Diagram

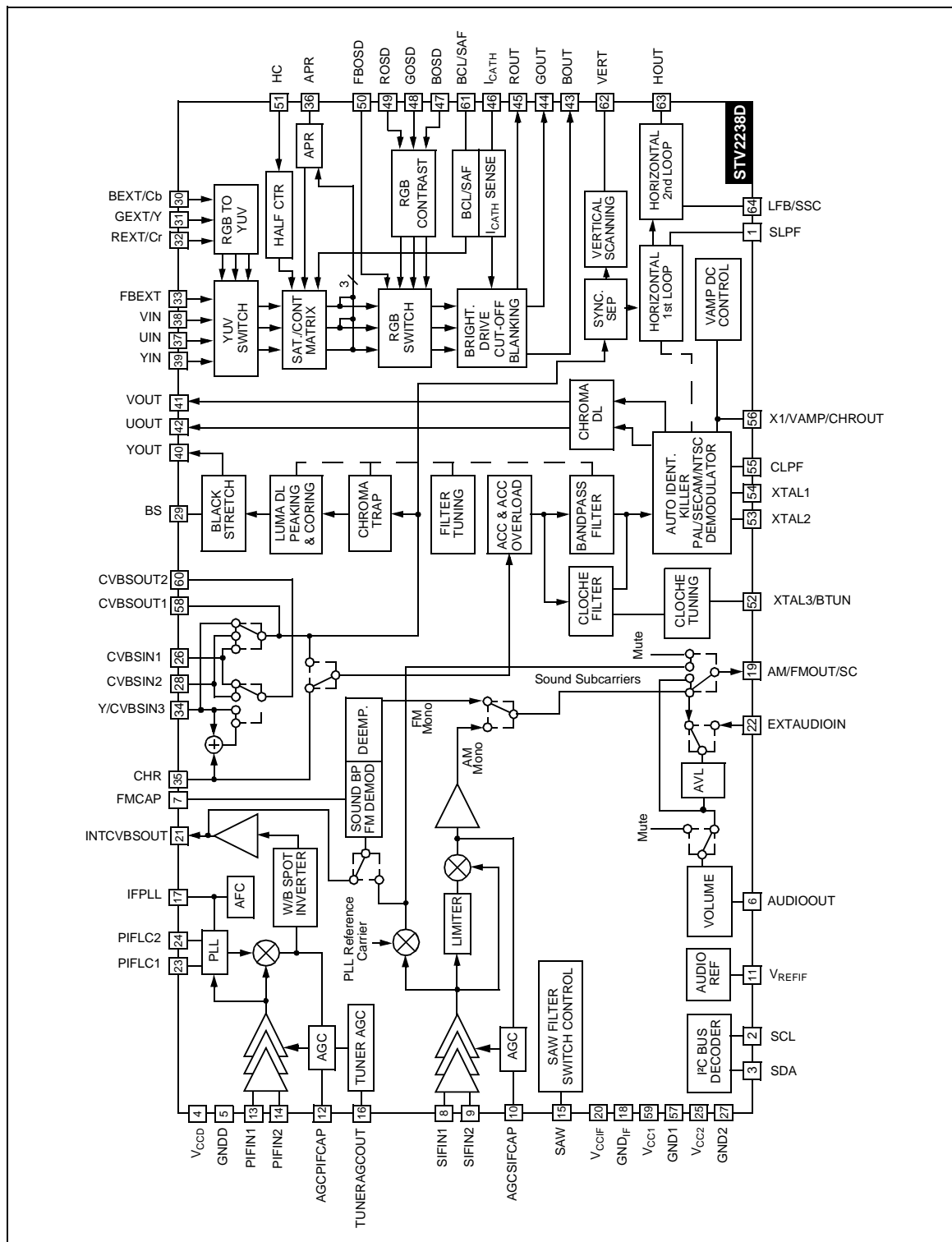


## STV223XD/224XC - GENERAL DESCRIPTION

Figure 4. STV2237D (TQFP64) Block Diagram

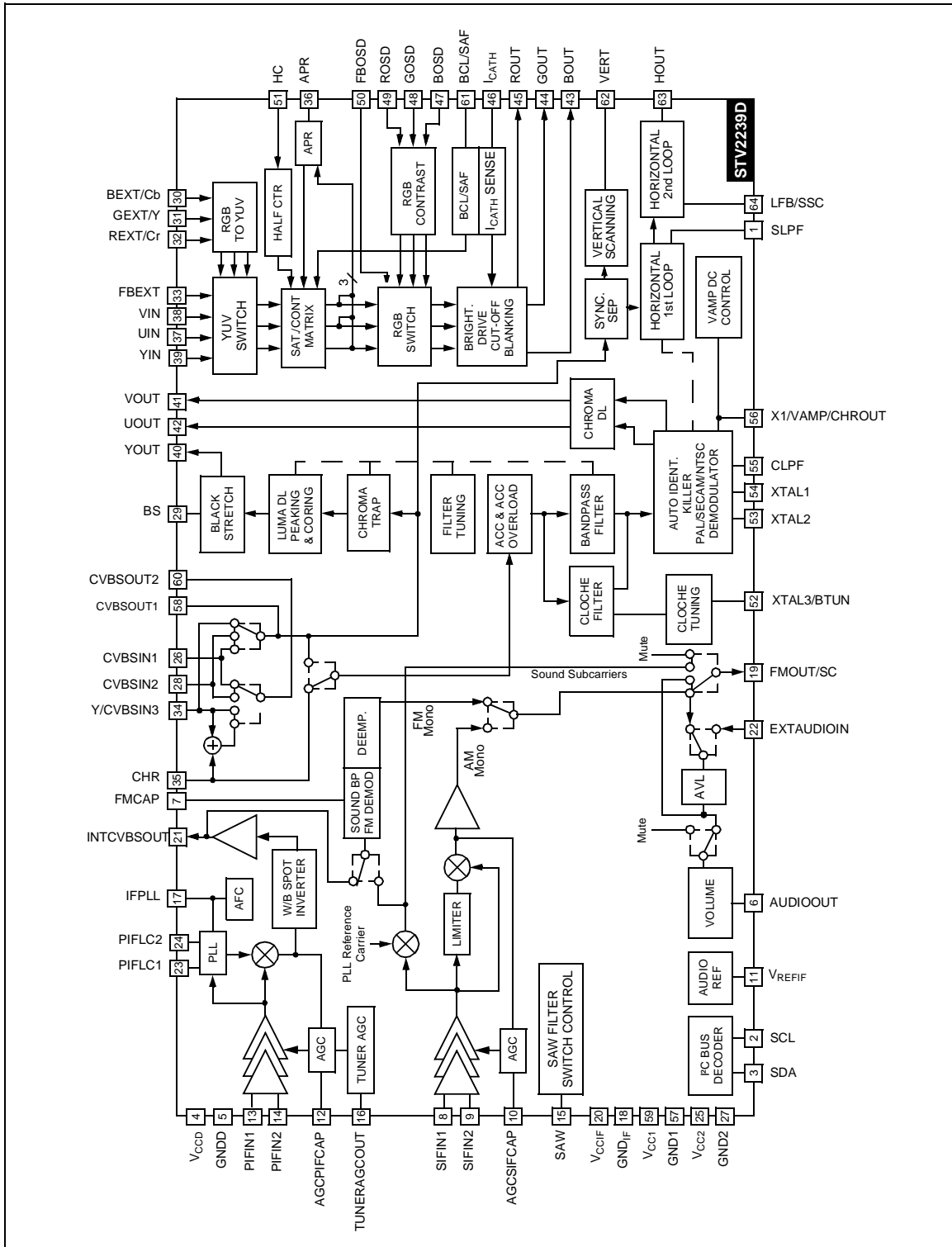


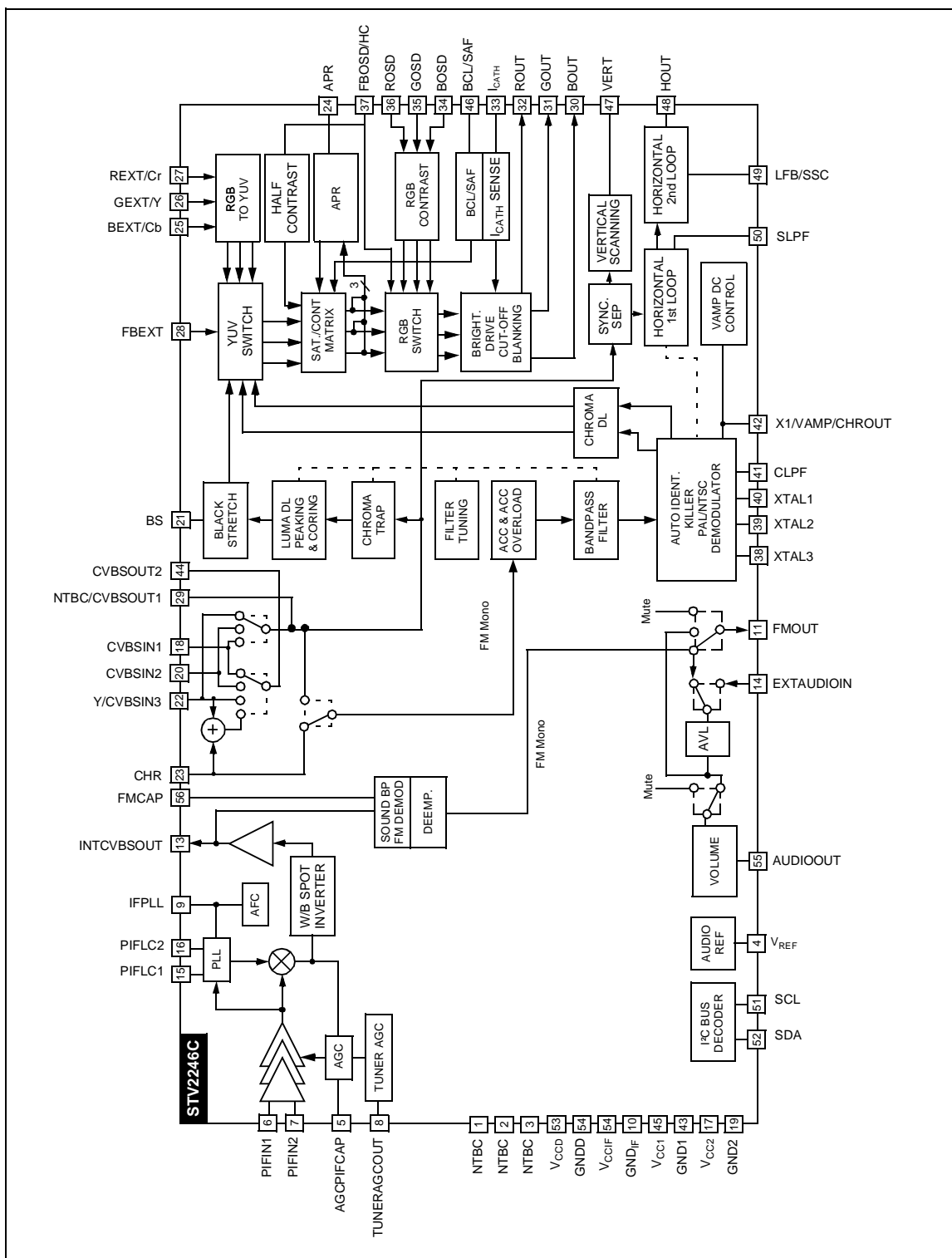




## STV223XD/224XC - GENERAL DESCRIPTION

Figure 6. STV2239D (TQFP64) Block Diagram





## STV223XD/224XC - GENERAL DESCRIPTION

Figure 8. STV2247C (SDIP56) Block Diagram

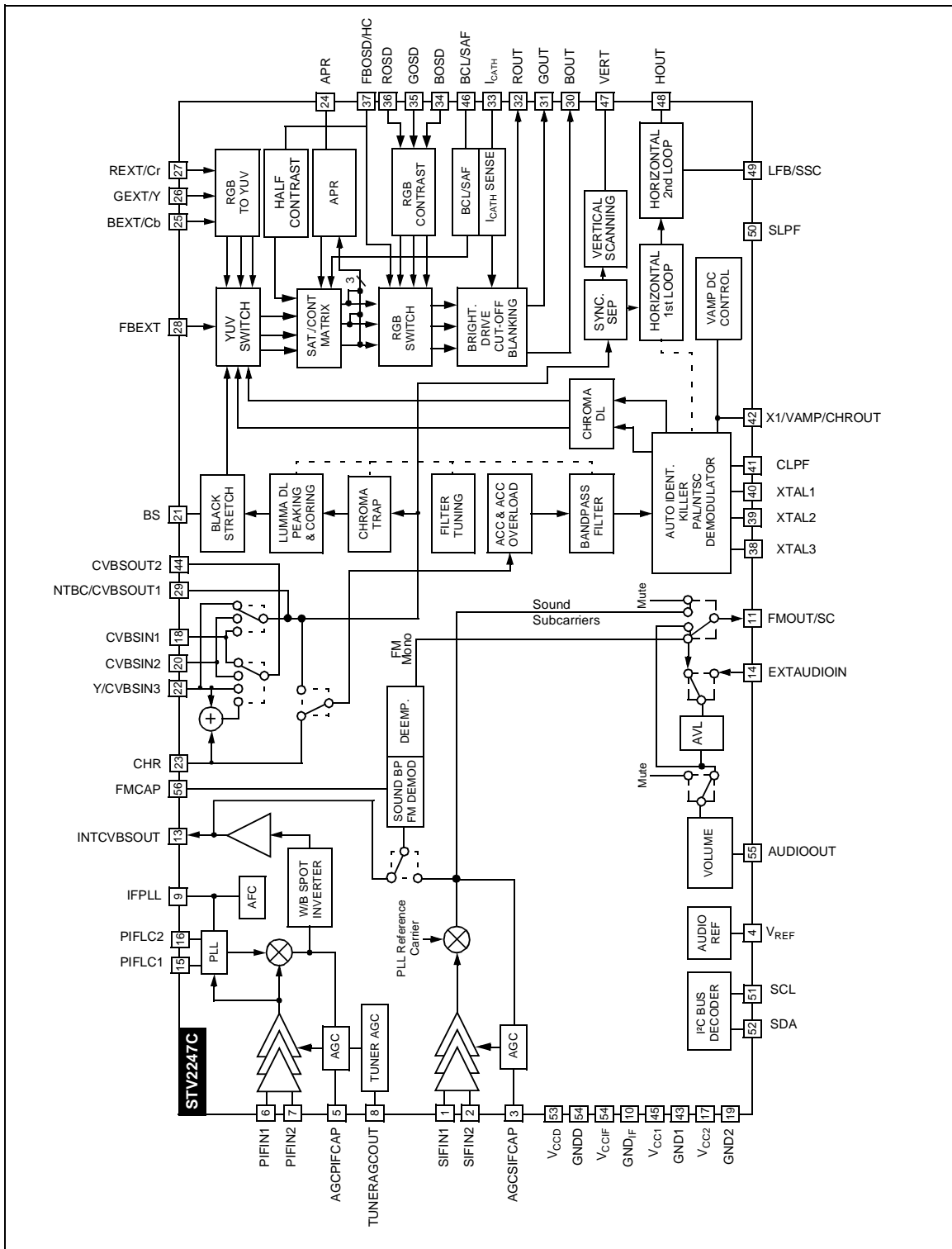
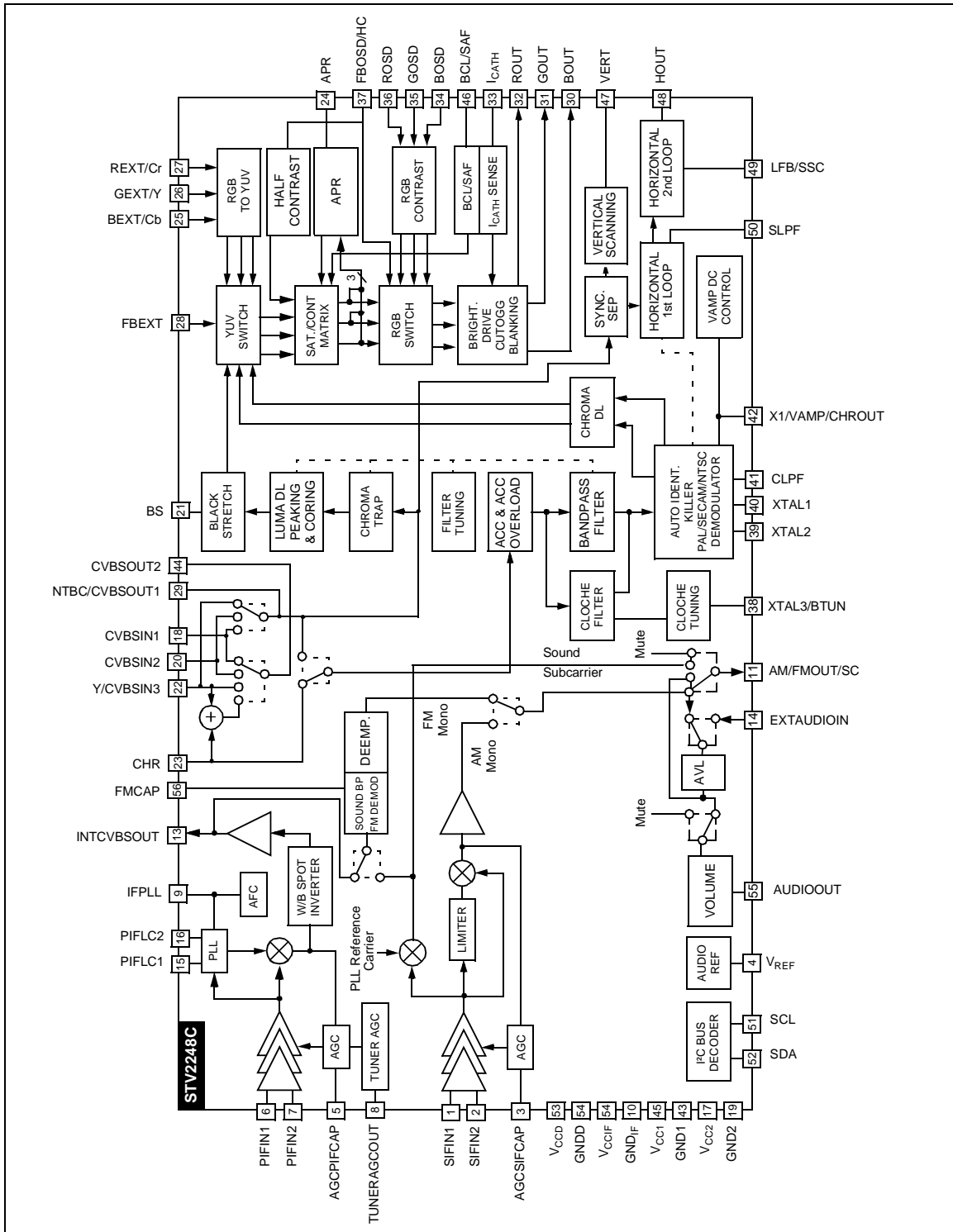


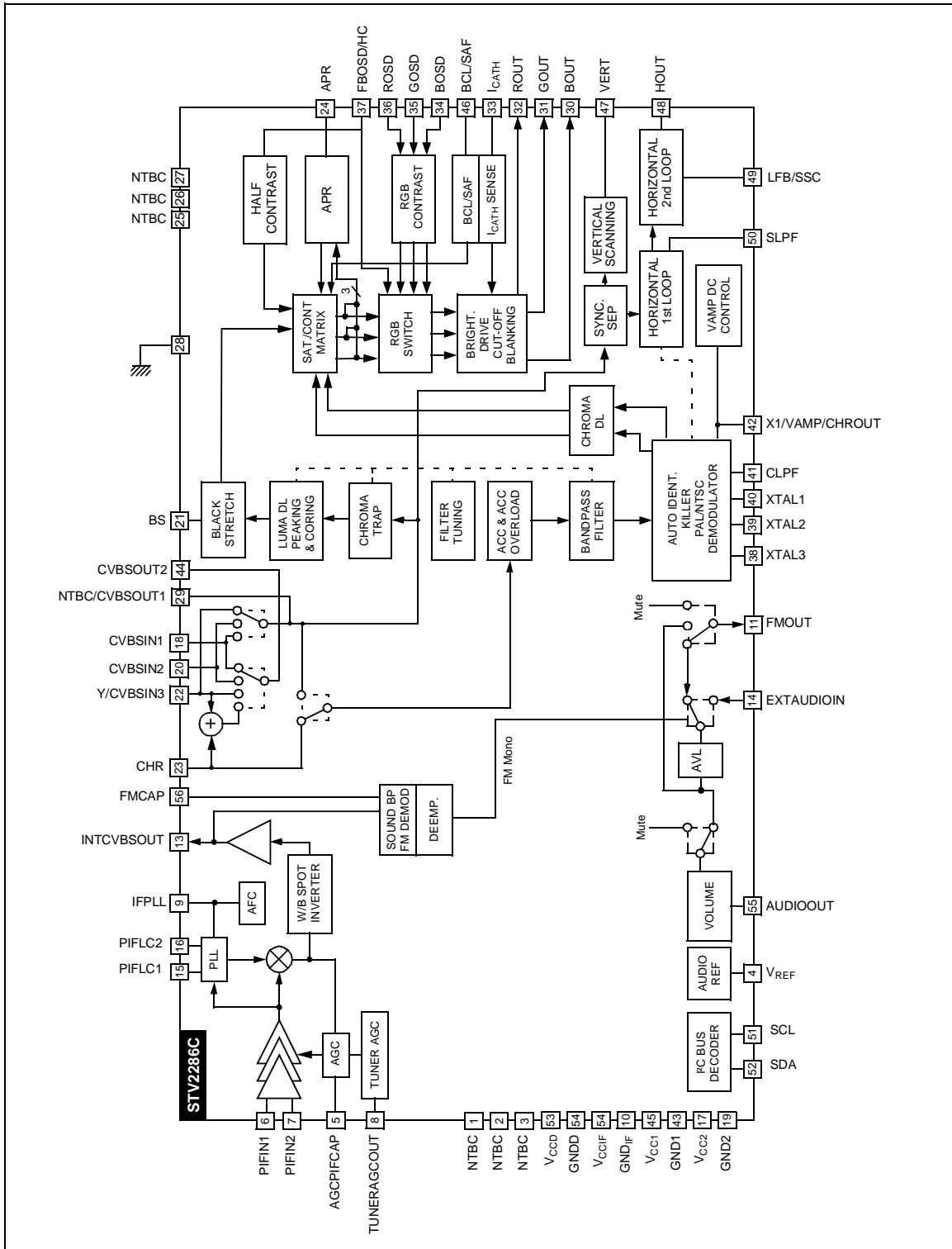
Figure 9. STV2248C (SDIP56) Block Diagram



### Figure 10. STV2249C (SDIP56) Block Diagram



Figure 11. STV2286C (SDIP56) Block Diagram



### 2 STV2238D MAIN FEATURES

- I<sup>2</sup>C Bus control (Read and Write modes).
- PLL PIF demodulator, bus-controlled VCO alignment.
- Positive and negative IF modulation.
- Digital AFC.
- Tuner-delayed AGC output.
- White and Black Spot cancellation.
- SIF with QSS structure.
- Inter-carrier capability.
- Built-in sound bandpass.
- Multistandard PLL FM Demodulator (4.5, 5.5, 6.0, 6.5 MHz).
- AM demodulator for France.
- Sound subcarrier output for Stereo chassis: FM and NICAM carriers.
- Audio switch for external audio input, Mono chassis.
- Digital volume control.
- Audio Mute.
- Automatic Volume Levelling (AVL) on audio signal (internal or external audio).
- Digital buffer for SAW filter switching.
- Video switch, three Composite Video Broadcasting Signal (CVBS) inputs and two CVBS outputs (which can be used to drive a teletext decoder).
- SVHS switch, Y input is combined with CVBS3 input.
- Capability to output Y+C signal on second CVBS output.
- OSD RGB analog inputs, fast blanking detection on fast blanking OSD pin, contrast control capability.
- Half-contrast control pin.
- External analog RGB inputs with contrast and saturation control (external RGB matrixed in YUV). External analog YCrCb inputs can be connected to the same inputs. In this case, the sync signal must be sent to the CVBS input, and External YCrCb mode must be selected through the I<sup>2</sup>C bus.
- Y,U,V inputs outputs: Y,U,V inputs/outputs for the use of enhanced picture ICs.
- Integrated chroma filters (trap, bandpass, cloche) with automatic alignment.
- Integrated luminance delay line.
- Adjustable peaking on the luminance signal with coring function.
- Black Stretch circuit.
- Automatic RGB peak regulation (APR).
- PAL/SECAM/NTSC color decoder with automatic identification of standards.
- Integrated chroma delay line.
- Full integrated SECAM decoder.
- Hue control, two selectable matrices in NTSC mode.
- Automatic Flesh Control circuit with two selectable characteristics (normal and wide).
- ACC overload circuit.
- Chroma subcarrier output which could be used to drive a comb filter circuit.
- Automatic digital cut-off current loop with warm-up detection circuit.
- White point (drive) and cut-off point adjustments.
- Manual cut-off capability.
- Beam current limiter control stage.
- High performance synchronization pulses separator.
- Horizontal synchronization with two phase-locked loops.
- Integrated VCO, auto-calibration using the chroma crystal reference frequency.
- Automatic time constant selection for the first PLL, three selectable time constants.
- Video identification circuit (independent from PLL1).
- Noise detector circuit.
- Vertical countdown circuit.
- Automatic 50/60 Hz selection circuit.
- Blanking and inserted cut-off pulses position adapted to standard (50 or 60 Hz).
- Long blanking mode capability in 60 Hz (same blanking as with 50 Hz standard).
- Possibility of inserting cut-off pulses after a vertical oversize blanking signal.
- De-interlace capability.
- Horizontal starting circuit with soft-start capability.
- Horizontal and vertical position adjustments, vertical amplitude control voltage (combined with chroma subcarrier output).
- 4/3, 16/9 selection voltage.
- Oversize Blanking capability on OSD Fast Blanking input.



### 3 FUNCTIONAL DESCRIPTION

The STV2238D is an integrated device that processes PIF, SIF, Video and Chroma signals while scanning for PAL, SECAM and NTSC standards. It includes a base band chroma delay line, Video, SVHS and audio switches.

#### 3.1 DETAILED FEATURES

##### 3.1.1 Power Supplies

$V_{CCIF}$ : 5 V power supply dedicated to IF processors.

$V_{CCD}$ : 5 V power supply dedicated to I<sup>2</sup>C bus and digital parts. GND1 is the ground reference of these parts.

$V_{CC1}$ : 8 V power supply for video switches, scanning part and the chroma decoder. GND 1 is the ground reference of all these functions.

$V_{CC2}$ : 8 V power supply for the luminance, RGB processing parts audio switch and internal CVBS output. GND2 is the ground reference of these parts.

##### 3.1.2 Picture Intermediate Frequency (PIF)

- AGC amplifier.
- PLL synchronous demodulator. Bus-controlled VCO for integrated tuning of the external LC resonator. For a 38.9 MHz VCO, the LC coil specification has to be:  
 $C = 39\text{pF}$ ,  $f = 44\text{ MHz} \pm 2\%$  (LC not connected).  
 For a 33.9 MHz VCO (L'), the VCO can be switched via the bus control.
- Digital AFC via bus.
- IF Automatic Gain Control (AGC)  
 Negative modulation: top sync regulation, regulation of overmodulated signals (overmodulation regulation circuit enabled through bus control).  
 Positive modulation: main regulation on white level with black level limitation.
- Tuner-delayed AGC with bus control for AGC gain and threshold. When tuner AGC output is active, read register 03hex, data D7 is set to "1".
- CVBS output with 2 bus-controlled amplitudes. CVBS output at  $2 V_{PP}$  if external sound trap is not connected (QSS mode). CVBS output at  $2.3 V_{PP}$  if external sound trap is connected (Intercarrier mode).

##### 3.1.3 Sound Intermediate Frequency (SIF) and Sound Demodulators

- QSS structure.
- SIF Automatic Gain Control (QSS mode).
- Built-in sound bandpass.

- PLL FM Demodulator for 4.5, 5.5, 6.0 or 6.5 MHz carriers. The Sound Standard is selected by the MCU. The FM demodulator VCO is automatically calibrated using the chroma crystal VCO reference frequency. The FM Demodulator VCO is automatically calibrated for all sound standards independently of the chroma crystal VCO frequency, which is either 4.4 MHz or 3.5 MHz. For each sound carrier frequency, the IC sends an indication of the sound subcarrier level to the MCU so that it can select the proper standard.
- The sound subcarrier level is valid when the FM Demodulation VCO is calibrated. This information can be read via the I<sup>2</sup>C Bus.
- Bus controls for FM de-emphasis (50 or 75  $\mu\text{s}$ ) and FM deviation  $\pm 25$  or  $\pm 50$  kHz).
- AM demodulator.
- Sound demodulator output: either an AM or FM signal can be the output for the Mono chassis
- Sound subcarriers for the Stereo chassis.

##### 3.1.4 Audio Switch

- One SCART switch.
- Bus-controlled volume and mute. Zero-crossing function on volume control.
- Automatic Volume Levelling (AVL) function can be enabled via the I<sup>2</sup>C bus. Two time constants (gain increase) can be selected via the I<sup>2</sup>C bus.
- The AM sound can be selected on the main audio output for the Stereo chassis.

##### 3.1.5 Surface Acoustic Wave (SAW) Filter Switch Control

- SAW filter switch control pin is available in the TQFP64 package. The SAW filter switch control pin is used to select the correct SAW filter characteristics (e.g.: M/N or BGDK characteristics). In a multi-standard chassis, two output voltages are selected via the I<sup>2</sup>C bus (low level voltage at 0.4 V Max., and high level voltage at 4 V Min.).

##### 3.1.6 Video Switches

- Video switch with three CVBS inputs and one CVBS output (CVBSOUT1) which may be used to drive a teletext decoder.
- A second CVBS output (CVBSOUT2) is able to output recombined Y+C signals.  
 All switches are independently controlled.
- SVHS switch, Y input is combined with CVBS 3 input. CVBS/SVHS modes can be selected either by bus control (software selection), or by sensing the DC voltage on the Chroma Input pin (hardware selection). If the Chroma Input is

## STV223XD/224XC - FUNCTIONAL DESCRIPTION

grounded, the CVBS mode is selected and the bus control is not active. If the DC level of the Chroma Input is higher than the SVHS threshold, then the bus control for the SVHS switch is active. Therefore, the SVHS mode can be selected by hardware using a special SVHS connector that includes a mechanical switch. In this type of application, the bus control is set to SVHS mode, and the CVBS mode is selected by grounding the Chroma Input pin.

### 3.2 DEFLECTION PART

- Fully-integrated synchronization separator with a low pass filter, black level alignment of the CVBS input, and a 50% slicing level for the synchronized pulse amplitude.
- Vertical output pulse is locked on a pulse that is twice the horizontal frequency to ensure perfect interlacing.
- Auto-calibrated VCO using the chroma crystal reference. Crystal control pin X1/VAMP/CHROUT indicates the crystal reference value on Pin XTAL1.  
When a 4.43 MHz crystal is connected to Pin XTAL1, the output load on Pin X1/VAMP/CHROUT must be greater than 80 k $\Omega$ . When a 3.58 MHz crystal is connected to Pin XTAL1, the output load must be less than 10 k $\Omega$ .

Two Phase-locked Loops (PLL):

- The first PLL locks the VCO to the video line frequency,
- The second PLL compensates the line transistor storage time.

Three time constants for the first PLL.

- [X,Y]: Line number referring to the internal line counter numbering system.

The long time constant is used for normal operation.

The short time constant is automatically used during the VCR search mode and frame retrace when the frame pulse is outside [258,264] and [309,314].

The very long time constant is used when there is no video recognition (very good OSD stability).

Time constants in normal operation (automatic selection of time constants):

- 50 Hz input signal:  
short time constant: [306,21],  
long time constant: the rest of the field.
- 60 Hz input signal:  
short time constant: [0,16],  
long time constant: the rest of the field.

Inhibition of the first PLL:

The first PLL is inhibited from line 309 to line 4.5 (or 314) in 50 Hz mode and from line 258 to line 5.5 (or 264) in 60 Hz mode. The time constant values are chosen by means of external components.

- Possibility of forcing the short time constant during the allframe via the bus.
- Possibility of forcing the long time constant during the allframe via the bus.
- Possibility of forcing a very long time constant during the allframe via the bus.

Video identification: independent from PLL1.

The video identification status is available in the output register of the I<sup>2</sup>C bus decoder.

Generation of burst gate pulses and line frequency signals from the first PLL to drive the Chroma and Video circuits. The burst gate pulse is also sent to the super-sandcastle generator.

Frame synchronized window:

- large window: [248,352] in AUTO mode, [248,284] in forced 60 Hz mode, [288,352] in forced 50 Hz mode.
- narrow window: [309,314] in 50 Hz mode, [258,264] in 60 Hz mode.

Field frequency selection windows:

- [248,286] 60 Hz mode selection window.
- [288,352] 50 Hz mode selection window.

Frame blanking pulse adapted to standard:

- from line 309 to line 21 in 50 Hz mode,
- from line 258 to line 16 in 60 Hz mode.

Long blanking mode: the end of frame blanking is line 21 both in 50 and 60 Hz modes. This mode is useful when the flyback time of the vertical output stage is longer than the 60 Hz blanking time. It is used to optimize the 50/60 Hz vertical amplifier application due to long frame blanking.

Vertical output pulse duration is 10.5 lines.

Horizontal output pulse: 28  $\mu$ s line pulse on an open collector output.

Start-up circuit: the horizontal output is at high level (disabled) when  $V_{CC1}$  increases from 0 to 6.0 V and when  $V_{CCD}$  has not reached 4 V.

Soft mode circuit: it provides a softer operating horizontal output with a 75% duty cycle [ $t_{HIGH} / (t_{HIGH} + t_{LOW})$ ]. This results in a smaller conducting time (16  $\mu$ s instead of 28  $\mu$ s).

This mode is active at start-up until two frames after the  $V_{CC2}$  reaches 75% of the  $V_{CC1}$ . It is also active at shutdown when the  $V_{CC1}$  floats between 6 V and 5.4 V. And finally, this mode is used if the  $V_{CC2}$  drops below 75% of the  $V_{CC1}$ .

At shutdown, horizontal pulses are disabled when  $V_{CC1}$  is less than 5.4 V or when  $V_{CCD}$  is less than 3.5 V.

The horizontal output pulse may be disabled via the bus (force a high level on HOUT).

Safety input on BCL Pin. When the BCL Pin is switched to ground, the horizontal output pulse is disabled and the inhibition of horizontal output pulse is maintained until  $V_{CC1}$  is less than 3 V ( $V_{CC1}$  power supply is switched off). The Safety function can be disabled via the I<sup>2</sup>C bus. When register 15hex data D7 is set to "1", the Safety function is reset and no longer active.

The horizontal position adjustment is controlled via the bus.

Bus-controlled DC output voltage for adjusting the vertical amplitude. This voltage supply is used to adjust the slope of the vertical sawtooth generated by the external vertical booster.

Bus-controlled vertical position. The high level of the vertical pulse is used to adjust the vertical position.

Bus-controlled 4/3-16/9 selection. 0.2 V is the low level of the vertical pulse when 16/9 is selected and 2 V when 4/3 is selected.

The Oversized Blanking function is controlled by the voltage on the FBOSD pin. When the FBOSD voltage is between the first and the second thresholds, the OSD RGB signals are selected. When the FBOSD voltage is greater than the second threshold (4 V blanking threshold), the RGB outputs are blanked during the whole field, but not during inserted cut-off lines (the cut-off loop is always active). The blanking feature, via the FBOSD input pin, enables Vertical Oversize Blanking when a 4/3 picture is displayed on a 16/9 screen in Zoom mode. The picture outside the screen is blanked by the Oversize Blanking pulse supplied by the external vertical IC (STV9306).

Combined Flyback input and Super-Sandcastle output: The line blanking level is clamped at 3 V, the burst key pulse voltage is 5 V and vertical pulse voltage is 2 V. The line pulse is extracted with a 2.5 V slicing level used for RGB line blanking and PLL2 control.

## 3.3 FILTERS

### Integrated Trap Filter

$Q = 1.5$  ( $f_{-3dB} = f_0 (1 - 1/2Q)$ ),

Center frequency:

- 4.43 MHz, 3.58 MHz for PAL and NTSC.
- 4.25 MHz, for SECAM  
(-20 dB rejection between 4.1 MHz and 4.4 MHz).

The chroma trap filter is switched off in SVHS mode, or in color standard search mode (standard not identified). The trap filter can be switched off via the bus.

### Integrated Chroma Bandpass

$Q = 3.5$ , Center frequency: 4.43 MHz, 3.58 MHz. The Bus Control Frequency Shift is used to optimize the chroma response for the video signal from the IF stage.

### Integrated Bell Filter for SECAM

$Q = 16$ , Center frequency: 4.286 MHz.

The Bus Control Frequency Shift is used to optimize the chroma response for the video signal from the IF stage.

### Integrated Luma Delay Line

Bandwidth: 8 MHz.

The Luma Delay Line is automatically adapted to the chroma standard. For PAL BG and applications without group delay compensation, a Luma Delay Shift of -140 ns can be selected via the I<sup>2</sup>C bus.

### Filter Tuning

All filters are tuned via a reference phase-locked loop. The PLL is based on a trap filter, a phase comparator and an internal loop filter (capacitor). The reference signal is the continuous carrier wave from the Chroma VCO (4.43 MHz or 3.58 MHz). The PLL adjusts the center frequency of the trap until it equals the reference signal. The PLL tuning voltage is used to adjust all other integrated filters. The Bell filter is fine-tuned with a second PLL during the frame retrace. The Bell filter tuning voltage is memorized on an external capacitor (BTUN Pin).

## STV223XD/224XC - FUNCTIONAL DESCRIPTION

### 3.4 VIDEO CIRCUIT

#### RGB Inputs

The RGB (OSD) input has priority over the external RGB input. The RGB (EXT) source is matrixed into YUV signals for color and contrast adjustments. The brightness is adjusted according to the internal and external RGB and OSD RGB signals. The Contrast Control regulates both external and internal RGB signals and has a maximum attenuation of -24 dB. It also regulates the OSD RGB signal and its maximum attenuation is limited to -12 dB. The Contrast Control for RGB (OSD) input can be disabled via the bus. The brightness of the RGB (OSD) input varies according to the main brightness level.

The RGB (EXT) insertion signal can be disabled or forced via the bus. A fast blanking detector on an external fast blanking input and OSD fast blanking input operate during frame retrace. The Fast Blanking detection status is sent to the I<sup>2</sup>C bus read register.

The OSD fast blanking input has several functions: OSD Insertion Control, RGB Output Blanking or Half Contrast Control.

#### Half-contrast Control Pin (TQFP64)

The 6 dB gain reduction will be applied to the internal YUV signals when the half-contrast function is turned ON, and the voltage of the half-contrast input exceeds the threshold (0.7 V Typ.).

The Half Contrast function is also available in the SDIP56 package. The Half Contrast input is combined with the FBOSD input.

#### Automatic Cut-off Current Loop

The Cut-off Loop range is 2 V (the cut-off level of the RGB outputs is between 1.5 V and 3.5 V, 2.5 V Typ.). The cut-off current is measured sequentially during the three lines after the internal frame blanking signal (the blue cathode current is measured first, then the green and red). The Leakage cathode current is measured during frame blanking and is memorized on an internal capacitor. Cut-off pulses can be inserted after the external vertical oversize blanking signal. The Cut-off loop can be frozen via the bus. To prevent cut-off lines from being visible in 16/9 mode, cut-off pulses are not inserted when the cut-off loop is frozen.

#### Warm-up Detector

At power on, the cut-off loop is not active and high DC levels are inserted during "cut-off" lines. The Cut-off loop will be active when the cathode current reaches the warm-up detection threshold. This causes the picture to be displayed from a dark screen. The RGB outputs are blanked until cut-off current is close to the reference voltage.

The manual cut-off mode can be selected via the I<sup>2</sup>C bus. In this mode, the I<sub>CATH</sub> input pin is inactive and cut-off pulses are not inserted. The RGB black levels are independently controlled by three I<sup>2</sup>C bus registers (8-bit resolution). The black level of each RGB output can be adjusted within a range of 2.5V typ.

#### Beam Current Limiter DC Voltage Input (BCL)

The BCL will first decrease the contrast and then the brightness when the contrast attenuation reaches -5 dB. The red, green, blue channel gain for white point adjustment takes place via the bus. The red and green DC levels for black point adjustment takes place via the bus.

The PAL/SECAM matrix is provided and a specific NTSC matrix is used when demodulation angles are (0°, 104°).

#### Bus-controlled Contrast and Saturation

The Contrast Control regulates internal RGB, external RGB and OSD RGB inputs. The maximum attenuation on internal and external RGB inputs is -24 dB and is limited to -12 dB for OSD RGB inputs. The bus-controlled saturation range is 50 dB.

#### Bus-controlled Brightness and Sharpness

The total brightness range is 60% of the black-to-white amplitude at maximum contrast. The brightness control regulates all RGB sources (internal, external and OSD). Bus-controlled Sharpness (peaking) is provided in PAL/SECAM/NTSC standards.

#### Bus-controlled Coring function on Sharpness

When the Coring-on-sharpness function is switched ON, the peaking function is not active on low amplitude signals (below 10 IRE).

The Black Stretch circuit can be disabled via the bus. Two modes are provided, one to be used when the video signal is transmitted with a set-up (7.5IRE set-up in NTSC), the other to be used when the video signal is transmitted without a set-up (PAL/SECAM).

The bus-controlled Blue Screen feature is used to insert a blue background on the screen when no video is available. The RGB OSD can be displayed when the blue screen is active.

The APR (Automatic RGB Peak Regulation) function is used to take advantage of the total RGB output range. APR circuits detect the peak level of the RGB outputs (before OSD insertion) and regulate the RGB gain (contrast) so that signals above the APR threshold are limited. For example, at maximum drive and contrast levels with the APR function switched OFF, the 100 IRE input signal gives 3 V(B/W) to the RGB outputs. With APR ON and the APR threshold at 70 IRE, the 70 IRE input signal gives 3 V (B/W) at RGB outputs. For input

signals above 70 IRE, the APR will decrease the RGB gain so that amplitude at the RGB output is always 3 V (B/W). The APR gain control voltage is memorized on an external capacitor where the gain decrease is very fast and the gain increase is very slow (several frames). The APR function can be enabled or disabled via the I<sup>2</sup>C bus.

### 3.5 CHROMA CIRCUIT

#### PAL/SECAM/NTSC Decoders

SVHS Chroma input; bus-controlled SVHS mode.

- 30 dB ACC range.
- Integrated chroma base band delay line and ON/OFF bus control.
- Automatic standard identification, with possibility of forcing the standard via the bus.
- 3-crystal application capability for the South American market:  
The first crystal on Pin XTAL1 (3.5X MHz only), the second crystal on Pin XTAL2 (3.5X MHz only), and the third crystal on Pin XTAL3/BTUN (3.5X MHz only, used for PAL/NTSC application only).

#### PAL/NTSC Decoder

ACC carried out by peak detector on synchronous demodulation of the burst.

Fully-integrated killer function.

VCO using two standard crystals: 4.43 MHz and 3.58 MHz. One crystal is internally selected depending on the standard selection. A third crystal can be used in PAL/NTSC applications only.

VCO reference signal is available on Pin X1.

- 4.433619 MHz XTAL specification.  
Mode of operation: serial resistance (without load capacity),  
Motional capacitance:  $C_M = 13\text{fF} \pm 3\text{fF}$ ,  
Shunt capacitance:  $C_P < 7\text{pF}$ ,  
Serial resistance:  $R_S < 70\Omega$ .
- 3.579545 MHz XTAL specification (NTSC M).  
Mode of operation: serial resistance (without load capacity),  
Motional capacitance:  $C_M = 11\text{fF} \pm 3\text{fF}$ ,  
Shunt capacitance:  $C_P < 7\text{pF}$ ,  
Serial resistance:  $R_S < 70\Omega$ .
- 3.575611 MHz XTAL specification (PAL M).  
Mode of operation: serial resistance (without

load capacity),

Motional capacitance:  $C_M = 12\text{fF} \pm 2\text{fF}$ ,

Shunt capacitance:  $C_P < 7\text{pF}$ ,

Serial resistance:  $R_S < 70\Omega$ .

- 3.582056 MHz XTAL specification (PAL N).  
Mode of operation: serial resistance (without load capacity),  
Motional capacitance:  $C_M = 12\text{fF} \pm 2\text{fF}$ ,  
Shunt capacitance:  $C_P < 7\text{pF}$ ,  
Serial resistance:  $R_S < 70\Omega$ .

0° and  $\pm 90^\circ$  demodulation angles for PAL.

Bus-controlled demodulation angles (0, 90) or (0, 104) are available in NTSC mode.

Bus-controlled Hue adjustment is available in NTSC mode.

#### NTSC Automatic Flesh Control

Two automatic flesh control characteristics are available via the bus. The normal flesh control with  $\pm 10^\circ$  correction and a total action range of  $\pm 60^\circ$  and the wide flesh control with  $\pm 20^\circ$  correction and a total action range of  $\pm 90^\circ$ .

#### SECAM Decoder

The following functions are fully-integrated: Killer, PLL demodulator and De-emphasis functions.

### 3.6 CHROMA STANDARD IDENTIFICATION

#### Sequential Identification

Three identification sequences:

- XTAL1 (4.43 MHz) mode to identify either PAL or NTSC.
- XTAL2 (3.58 MHz) mode to identify either PAL or NTSC.
- SECAM mode (XTAL1 selection).

In 3-crystal applications, the SECAM sequence is replaced by XTAL3 selection to identify either PAL or NTSC signals.

#### PAL/NTSC Priority

SECAM mode is locked after two identified SECAM sequences.

SECAM mode can be selected in 50 Hz mode only.

R-Y and B-Y outputs are blanked during Color Search mode.

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### 4 ELECTRICAL CHARACTERISTICS

#### 4.1 ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC-8V}$	8 V Supply Voltage	10	V
$V_{CC-5V}$	5 V Supply Voltage	7	V
$V_{ESD}$	Capacitor 100 pF discharged via 1.5 k $\Omega$ serial resistance (Human Body Model)	$\pm 2$	kV
$T_{oper}$	Operating Temperature	0, +70	°C
$T_{stg}$	Storage Temperature	-55, +150	°C

#### 4.2 THERMAL DATA

Symbol	Parameter		Typical Value	Unit
$R_{th(j-a)}$	Junction-ambient Thermal Resistance (measured at $P_D = 1$ W)	SDIP56 TQFP64	40 50	°C/W °C/W

#### 4.3 SUPPLY

(Supplies at Typical Values,  $T_{amb} = 25^\circ\text{C}$ , I<sup>2</sup>C bus register at power-on reset value, automatic cut-off mode, unless otherwise specified).

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$V_{CCIIF}$	IF Circuit Supply Voltage		4.75	5	5.25	V
$V_{CCD}$	Bus & Digital Supply Voltage		4.75	5	5.25	V
$V_{CC1}$	Chroma, Scanning Supply Voltage		7.6	8	8.4	V
$V_{CC2}$	Video Supply Voltage		7.6	8	8.4	V
$I_{CCIIF}$	$V_{CCIIF}$ Current Consumption	$V_{CCIIF} = 5$ V. No-load at RGB outputs.		58		mA
$I_{CC5F}$	$V_{CC5F}$ Current Consumption	$V_{CCD} = 5$ V. No-load at RGB outputs.		48		mA
$I_{CCI}$	$V_{CC1}$ Current Consumption	$V_{CC1} = 8$ V. No-load at RGB outputs.		40		mA
$I_{CC2}$	$V_{CC2}$ Current Consumption	$V_{CC2} = 8$ V. No-load at RGB outputs.		56		mA
$P_D$	Total Power Dissipation	$V_{CC1} = V_{CC2} = 8$ V, $V_{CCIIF} = V_{CC5V} = 5$ V No-load at RGB outputs.		1300		mW

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### 4.4 IF SECTION

Tamb = 25°C, V<sub>CCIF</sub> = 5 V, V<sub>CC2</sub> = 8 V, IF input = 10 mV<sub>RMS</sub> (at sync level for negative modulation, or at peak white level for positive modulation).

Video modulation DSB, D = 90% and f<sub>SC</sub> = 33.4 MHz in B/G, D = 95% in L, f<sub>PC</sub> = 38.9 MHz.

Video Bandwidth = 5 MHz, AF = 1 kHz, Audio Bandwidth = 20 kHz, FMdev = ±27 kHz.

Volume Attenuation = 0 dB, AM carrier input: 10 mV<sub>RMS</sub>, 54% modulated unless otherwise specified.

#### PIF AMPLIFIER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
VINPIF	Input Sensitivity	-1dB at Video Output (INTCVBSOUT)	75	85	95	μV <sub>RMS</sub>
RINPIF	Differential Input Resistance	PIF Inputs.	1.5	2	2.5	kΩ
CINPIF	Differential Input Capacitance	PIF Inputs.	1.5	2	2.5	pF
GR	Gain Control Range			65		dB
VMax.	Maximum Input Signal	+1dB at Video Output (INTCVBSOUT)	0.12	0.15		V <sub>RMS</sub>

#### PIFAGC NEGATIVE MODULATION

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
I <sub>C</sub>	Charging Current at AGCPIFCAP Pin		450	675	900	μA
I <sub>D</sub>	Discharging Current at AGCPIFCAP Pin		10	15	20	μA
I <sub>C</sub> /I <sub>D</sub>	Charging/Discharging Current Ratio		41	45	49	

#### PIFAGC POSITIVE MODULATION

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
I <sub>C</sub>	Charging Current at AGCPIFCAP Pin		1.75	2.5	3.25	mA
I <sub>D</sub>	Discharging Current at AGCPIFCAP Pin		0.15	0.25	0.35	μA
I <sub>CP</sub>	Additional Charging Current at AGCPIFCAP Pin	L mode in case of missing VITS pulses and no white in Video content	2.8	4	5.2	μA
THICP	Threshold for additional charging current	Referred to nominal black level 2.3 V <sub>PP</sub> at INTCVBSOUT Pin		160		mV
I <sub>DP</sub>	Additional Discharging Current		20	30	40	μA
THIDP	Threshold for additional discharging current	Referred to nominal black level 2.3 V <sub>PP</sub> at INTCVBSOUT Pin		-345		mV

#### TUNER AGC

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
IAGCT	Maximum Sunked Current		1.5	2	2.5	mA
SAGCT	Tuner AGC Slope (current)	Reg 03 (D7, D6) 00 01 10 11		50 95 170 270		μA/dB
I <sub>AGCP</sub>	Maximum Tuner plus Sunked Current	(See Note 1)		40		mA
AGCST	Tuner AGC Starting Point (IF input related signal)	Reg 03 (D5 to D0 = 10 0000) Reg 03 (D5 to D0 = 00 0000) Reg 03 (D5 to D0 = 11 1111)		12 2 80		mV <sub>RMS</sub>
STT	Variation of take over point with temperature			0.03	0.07	dB/K

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

**Note 1:** Additional sinked current for large increasing steps of input signal when:

- Voltage at PIFinput > Tuner AGC starting point adjustment given by the WR03(d5 to d0)
- Output Signal (IntCVBSout) saturated (VIntCBVSoutVwth) in positive modulation.

### SYNCHRONOUS VIDEO DEMODULATOR

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
DFPC	Vision Carrier Capture Range			±2		MHz
f <sub>VCO</sub>	Maximum VCO Frequency for PIF regeneration	With external LC network at 50 MHz (see Note 2)	50			MHz
V <sub>ILOCK</sub>	PIF Input Signal for PIF PLL locking			40	70	μV <sub>RMS</sub>
TVCO	PIFVCO Temperature Coefficient				±20	ppm/K

**Note 2:** This parameter is not tested during production, it is tested during the qualification phase.

### DEMODULATED VIDEO OUTPUT (INTCVBSOUT PIN)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
PIFOUT-Q PIFOUT-I	Video Amplitude at INTCVBSOUT Pin	Black-to-White Video amplitude: reg 02 data = 10h (INTCVBSOUT = 2 V <sub>PP</sub> ) reg 02 data = 90h (INTCVBSOUT = 2.3 V <sub>PP</sub> )	1.19 1.36	1.4 1.6	1.61 1.84	V
BG/L	BG to L Ratio	Video amplitude bus register Typ.: reg 02 data = 10 hex		5	8	%
DG	Differential Gain			3	5	%
DP	Differential Phase			3	5	deg
V <sub>PIF</sub>	Residual Carrier Signal			1	10	mV <sub>RMS</sub>
V <sub>R2IF</sub>	Residual 2nd Harmonic			1	10	mV <sub>RMS</sub>
S/N	Video Output S/N Ratio	See Note 3	55	60		dB
V <sub>WTH</sub>	White Noise Threshold Voltage	reg 02 data = 90h 2.3 V <sub>PP</sub> at INTCVBSOUT Pin		6.7		V
V <sub>WIL</sub>	White Noise Insertion Level	reg 02 data = 90h 2.3 V <sub>PP</sub> at INTCVBSOUT Pin		3.7		V
V <sub>BTH</sub>	Black Noise Threshold Voltage	reg 02 data = 90h 2.3 V <sub>PP</sub> at INTCVBSOUT Pin		1		V
V <sub>BIL</sub>	Black Noise Insertion Level	reg 02 data = 90h 2.3 V <sub>PP</sub> at INTCVBSOUT Pin		2.6		V
BW	Video Bandwidth		6	8	10	MHz
LUMLIN	Luminance Non Linearity				5	%
ROUT	Internal Output Resistance			50		Ω
RLOAD	Output Load Resistance	reg 02 data = 10hex (INTCVBSOUT = 2 V <sub>PP</sub> )	2	3		kΩ
IVID	Video Output Source Current	reg 02 data = 90hex (INTCVBSOUT = 2.3 V <sub>PP</sub> )	7	10	13	mA
DCOUT	DC Output Level	Top Sync Level		2		V
Inter Mod.	1.07 MHz Intermodulation	Intercarrier Mode		52		dB
PSRR	Power Supply Ripple Rejection	Video signal Grey level (see Note 4) BG standard L standard	35 30			dB
NH	Suppression of Video signals harmonics		35	40		dB

**Note 3:** S/N = 20 log [PIFOUT Black to White / V<sub>NOISE</sub>(mV<sub>RMS</sub>) weighted CCIR 567.

**Note 4:** Supply Voltage ripple rejection = 20log (V<sub>SUPPLY</sub>/V<sub>OUTPUT</sub>) measured at 100 Hz with V<sub>AC</sub> Max. = 100 mVpp applied to V<sub>CC IF</sub> = 5 V.



## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### SIF AMPLIFIER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
VINSIF	SIF Input Sensitivity	- 3dB at AM/FMOUT Pin (see Note 5) AM output amplitude, FM subcarrier amplitude		55 40		$\mu\text{V}_{\text{RMS}}$
GRSIF	Gain Control Range	- 3dB to +1dB at AM/FMOUT Pin		60		dB
C <sub>INSIF</sub>	Differential Input Capacitance	SIF Inputs (see Note 6)	1.5	2	2.5	pF
R <sub>INSIF</sub>	Differential Input Resistance	SIF Inputs	1.5	2	2.5	k $\Omega$

**Note 5:** L standard Sc/Pc = -10 dB, Nyquist Pc = -6 dB, SIF input -4 dB with PIF input = 84  $\mu\text{V}$ , BG standard Sc/Pc = -13 dB, Nyquist Pc = -6 dB, SIF input -7 dB with PIF input = 85  $\mu\text{V}$ .

**Note 6:** This parameter is not tested during production. It is tested on the validation bench during the qualification phase.

### SIF AGC (FM)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
I <sub>C</sub>	Charging Current			2.4		mA
I <sub>D</sub>	Discharging Current			100		$\mu\text{A}$

### SIF AGC (AM)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
I <sub>NORMAL</sub>	Charging/Discharging Current	Normal time constant		$\pm 6$		$\mu\text{A}$
I <sub>FAST</sub>	Charging/Discharging Current	Fast time constant		$\pm 2.4$		mA

### FM DEMODULATOR

Electrical parameter valid in both QSS and Inter-carrier modes, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
SIFMin	Min. Broadcast Sound/Video Carrier Ratio	Inter-carrier mode: SAW filter K2955M at SNR 35 dB		-30		dB
VOAF	FM Audio Output Amplitude at AM/FMOUT Pin	FM dev = $\pm 27\text{kHz}$ BGDKI FM dev = $\pm 13.5\text{kHz}$ MN	400	500	630	$\text{mV}_{\text{RMS}}$
DFMX	Maximum FM Deviation	THD < 10%		170		kHz
THD_FM	Total Harmonic Distortion	FM dev = $\pm 27\text{kHz}$ BGDKI		0.3	1	%
S/N	Audio S/N	Weighted according to CCIR468-4 Quasi-Peak		55		dB
AMR	Amplitude Modulation Rejection	m = 30%, AF = 1 kHz		32		dB
SVR	Supply Voltage Rejection	See Note 4		45		dB
S/N vs video	S/N versus picture content, Inter-carrier mode	Inter-carrier mode: SAW filter K2955M Black picture, White picture, 250 kHz squarewave		52 50 52		dB

### DEEMPHASIS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
deemp-T1	De-emphasis Time Constant	B, G, D, K, I standards		50		$\mu\text{s}$
deemp-T2	De-emphasis Time Constant	M, N, standards		75		$\mu\text{s}$

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### AM DEMODULATOR

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
AFOUT	AM Audio Output Amplitude at AM/FMOUT Pin	54% modulation	400	500	630	mV <sub>RMS</sub>
AMlowco	Low Cut-off Frequency	-3 dB compared AFout			40	Hz
AMhighco	High Cut-off Frequency	-3 dB compared AFout	30			kHz
AMthd	Total Harmonic Distortion	54% modulation			2	%
AMs/n	Signal/Noise Ratio	Weighted according to CCIR468-4 Quasi-Peak		55		dB
AMsvr	Supply Voltage Rejection	See Note 4		20		dB

### SIF OUTPUT (AM/FM OR SOUND SUBCARRIERS OUTPUT)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
SIFout	Output Level	Sound subcarriers		150		mV <sub>RMS</sub>
SIFbw	Bandwidth	Sound subcarriers	7.5			MHz
SIFdcout	DC Output Level			4		V
SIFres	Residual Carrier	Fundamental wave (38.9 MHz) and harmonics		0.4		mV <sub>RMS</sub>
SIFcur	Sink Output Current	AM or FM demod. output selected Sound subcarriers output selected		0.5 1.5		mA

### SAW FILTER SWITCH OUTPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
SAW low	Low Output Voltage	I <sub>SINK</sub> = 2 mA			0.4	V
SAWcur	Maximum allowed Current				2	mA
SAW high	High Output Voltage	I <sub>SOURCE</sub> = 2 mA	4			V

### EXTERNAL AUDIO INPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
R <sub>IN</sub>	Input Resistance		70	100	130	kΩ
V <sub>IDC</sub>	DC Input Voltage			2.4		V
AFIN	maximum Audio Input Signal		2			V <sub>RMS</sub>

### MAIN AUDIO OUTPUT

(See Figure 17 and Figure 18)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
AMax	Maximum Attenuation (Audio Out/AM-FM Out)	Register 05hex, data = 7Fhex		78		dB
AMin	Minimum Attenuation (Audio Out/AM-FM Out)	V <sub>IN</sub> = 1 V <sub>RMS</sub> , f = 1 kHz, Register 05hex, data = 00hex	-1	0	1	dB
ASTEP	Step Resolution	reg 05, d7 = 0		0.7		dB
DCSH	DC Output Shift	From max. volume to min. volume			50	mV
V <sub>ODC</sub>	DC Output Level			4		V
AFDIFF	Audio Amplitude difference between sources	f = 1 kHz, f <sub>M</sub> = ±27 kHz, Ext. Audio Input = 500 mV <sub>RMS</sub>			2	dB
R <sub>OUT</sub>	Output Resistance			110		Ω
BWO	Output Bandwidth		1			MHz
THD_AM	Total Harmonic Distortion	V <sub>IN</sub> = 1 V <sub>RMS</sub> , f = 1 kHz		0.1	0.3	%
S/N1	Signal to Noise Ratio from External Input	Measured at 0 dB attenuation, Ext. Audio Input at 500 mV <sub>RMS</sub> , CCIR 468-4 Weighted Quasi Peak		75		dB

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
S/N2	Signal to Noise Ratio from External Input	Measured at 20 dB attenuation, 0 dB reference Ext. Audio Input at 500 mV <sub>RMS</sub>	55	60		dB
S/N3	Signal to Noise Ratio from FM Demod	Measured at 20 dB attenuation, FM: $\pm 27$ kHz (Standards BGDKI)	52	55		dB
SVRV	Supply Voltage Rejection from External Input	Measured at f = 100 Hz from V <sub>CC</sub> = 5 V and V <sub>CC</sub> = 8 V	60			dB
XT	Crosstalk	See Note 7	70			dB
NOISE	Output Noise Level	CCIR 468-4 Weighted Quasi Peak Volume at minimum Volume at typical Volume at maximum		50 50 100	60 60 120	$\mu$ V
AFIN	Audio Input Level	Volume = -25 dB, THD < 1%	2			V <sub>RMS</sub>

**Note 7:** Measured from any input to output at f = 10 kHz with RL = 10k $\Omega$  and Rg = 600 $\Omega$ , Volume attenuation = 0dB.

### AVL

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
GAVL	AVL Gain Control Range (7-bit Resolution)			20		dB
AVL <sub>MAX</sub>	Maximum attenuation			-15		dB
Reg.AVL	Regulation amplitude	Measured at AUDIOOUT Volume Control at maximum		0.55		V <sub>RMS</sub>

## 4.5 CVBS, Y/C, RGB INPUTS AND CVBS OUTPUTS

### LUMINANCE AND CVBS INPUTS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
DC <sub>IN1</sub>	Black Level Voltage	Input selected on main CVBS output		3.3		V
V <sub>IN</sub>	CVBS or Y Input Voltage			1	1.41	V <sub>PP</sub>
-I	Negative Clamping Current	During SYNC pulse	20	27	35	$\mu$ A
I	Positive Clamping Current		2.5	4.5	7	$\mu$ A

### COMBINED CHROMINANCE AND SVHS SELECTION INPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V	Chrominance Input Voltage	Burst Amplitude, 100/75 Color Bar		0.3	0.6	V <sub>PP</sub>
V <sub>CLIP</sub>	Input Amplitude before Clipping		1			V <sub>PP</sub>
V <sub>DC</sub>	DC Voltage	SVHS Mode	1.55	1.70	1.85	V
V <sub>TH</sub>	SVHS Threshold Voltage		0.50	0.90	1.45	V
I <sub>LOW</sub>	Output Current	0V at CHR Pin			150	$\mu$ A

### CVBS1 OUTPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>OUT</sub>	Dynamic Output Amplitude				1.5	V <sub>PP</sub>
R <sub>OUT</sub>	Internal Output Resistance			50		$\Omega$
R <sub>LOAD</sub>	Output Load Resistance		1.5			k $\Omega$
BW	CVBS Bandwidth	V <sub>IN</sub> = 1V <sub>PP</sub>	10			MHz
Crosstalk	Deletion of non-selected signals	Up to 5 MHz	50			dB
MGAIN	Output Gain	From any CVBS/Y inputs	-0.5	0	0.5	dB
DCMAIN	DC Output Voltage	Black Level		3.5		V

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### CVBS1 OUTPUT (Pin 29 - SDIP56)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>OUT</sub>	Dynamic Output Amplitude	Register 1Dhex, data = 07hex			1.5	V <sub>PP</sub>
R <sub>LOAD</sub>	Output Load Resistance	Register 1Dhex, data = 07hex	3			kΩ
BW	CVBS Bandwidth	Register 1Dhex, data = 07hex V <sub>IN</sub> = 1 V <sub>PP</sub>		10		MHz
Crosstalk	Deletion of non-selected signals	Register 1Dhex, data = 07hex Up to 5 MHz	50			dB
MGAIN	Output Gain	Register 1Dhex, data = 07hex From any CVBS/Y inputs	-0.5	0	0.5	dB
DCMAIN	DC Output Voltage	Register 1Dhex, data = 07hex Black Level		4.2		V

### CVBS2 OUTPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>OUT2</sub>	Dynamic Output Amplitude				3	V <sub>PP</sub>
R <sub>OUT2</sub>	Internal Output Resistance			10		Ω
BW2	CVBS Bandwidth	V <sub>IN</sub> = 1 V <sub>PP</sub>	10			MHz
Crosstalk2	Deletion of non-selected signals	Up to 5 MHz	50			dB
SWI2gain	Output Gain	From any CVBS/Y inputs	5.5	6	6.5	dB
SWI2DC	DC Output Voltage	Black Level		3.8		V
R <sub>LOAD2</sub>	Output Load Resistance		1.5			kΩ

### OSD RGB INPUTS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>CLAMP</sub>	Clamp Level	Max. Contrast		4		V
V <sub>RGB</sub>	RGB Input Voltage			0.7	1	V <sub>PP</sub>
CRGB	RGB Gain	Max. Contrast, Max. Drive		4.28		-
Dblack	Difference of black level of internal and external signals at the RGB outputs	OSD signal versus internal signal			50	mV
I <sub>RGB</sub>	Clamping Current		60	100	140	μA
Crosstalk	Deletion of non-selected RGB source	From 0 to 5 MHz	50			dB

### OSD FAST BLANKING INPUT (TQFP64)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>THFB1</sub>	Insertion Threshold Voltage		0.5	0.7	0.85	V
V <sub>THFB2</sub>	Blanking Threshold Voltage,	Oversize Blanking active Register 08hex d7 = 1	3.2	4	4.8	V
t <sub>SWI1</sub>	Insertion Switching Delay			20	40	ns
t <sub>SWI2</sub>	Blanking Switching Delay	From FBOSD = 4V to starting of blanking falling edge at RGB out- puts		100		ns
I <sub>FB</sub>	Input current	0V at Pin FBOSD			10	μA

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### HALF CONTRAST INPUT (TQFP64)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>TH_HC</sub>	Half Contrast Threshold Voltage		0.5	0.7	0.85	V
tsWI_HC	Half Contrast Delay			20		ns
CTR_HC	Contrast Attenuation when half contrast active	At Max. Contrast		6		dB
I <sub>HC</sub>	Leakage Current	0V at Pin HC			10	μA

### FBOSD/HC INPUTS (SDIP56)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>THFB1A</sub>	OSD Insertion Threshold Voltage	Half Contrast disable Register 08hex d6 = 0	0.5	0.7	0.85	V
V <sub>THFB1B</sub>	OSD Insertion Threshold Voltage	Half Contrast enable Register 08hex d6 = 1	1.5	1.9	2.3	V
V <sub>TH-HC</sub>	Half Contrast Threshold Voltage	Half Contrast enable Register 08hex d6 = 1	0.5	0.7	0.85	V
V <sub>THFB2</sub>	Blanking Threshold Voltage,	Oversize Blanking active Register 08hex, d7 = 1	3.2	4	4.8	V
t <sub>SWI1</sub>	Insertion Switching Delay			20	40	ns
t <sub>SWI2</sub>	Blanking Switching Delay	From FBOSD = 4V to starting of blanking falling edge at R,G,B out- puts		100		ns
I <sub>FB</sub>	Input current	0V at Pin FBOSD			10	μA

### EXTERNAL RGB/YCrCb INPUTS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>CLAMP</sub>	Clamp Level	Max. Contrast		3.5		V
V <sub>RGB</sub>	RGB Input Voltage			0.7	1	V <sub>PP</sub>
V <sub>YCrCb</sub>	YCrCb Input Voltage	100% color bar register 0Ahex d7d6 = 11  Y Cr Cb		1 0.7 0.7		V <sub>PP</sub>
CRGB	RGB Gain	Max. Contrast, Max. Drive		4.28		-
Dblack	Difference of black level of internal and external signals at the RGB out- puts	OSD signal versus internal signal			50	mV
I <sub>RGB</sub>	Clamping Current		60	100	140	μA
Crosstalk	Deletion of non-selected RGB source	From 0 to 5 MHz	50			dB

### EXTERNAL FAST BLANKING INPUT (See Note 8)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
V <sub>THFB</sub>	Insertion Threshold Voltage		0.5	0.7	0.85	V
t <sub>SWI</sub>	Insertion Switching Delay			20	40	ns
I <sub>FB</sub>	Input Current	0V at Pin FBEXT			10	μA
V <sub>MAX</sub>	Max. voltage allowed at FBEXT input				5	V

**Note 8:** FBEXT input must be connected to ground if not used in the application.

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### 4.6 LUMA PART

#### Y DELAY LINE

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
t <sub>D1</sub>	Delay Time PAL/NTSC	SVHS mode, Register 1F d3 = 0		520		ns
t <sub>D2</sub>	Delay Time SECAM	SVHS mode, Register 1F d3 = 0		640		ns
t <sub>D3</sub>	Delay Time PAL/NTSC	CVBS mode, Register 1F d3 = 0		560		ns
t <sub>D4</sub>	Delay Time SECAM	CVBS mode, Register 1F d3 = 0		710		ns
t <sub>SHIFT</sub>	Delay Time (lumDel1 - lumDel2)	lumDel1 = reg 1F d3 = 0, standard luma delay lumDel2 = reg 1F d3 = 1, shifted luma delay		140		ns
Groupdel	Group Delay up to 3.5MHz	Trap-off		±30		ns

#### PEAKING CIRCUIT

Electrical parameter measured with color identified

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
f <sub>PEAK</sub>	Center Frequency	Trap-off, coring ON	2.5	3	3.5	MHz
G <sub>PEAK</sub>	Gain Variation from Min. to Max. peaking	At f <sub>PEAK</sub> , coring ON		9		dB
Overshoot	Amplitude Variation compared to B/W amplitude	2T pulse, Max. peaking, coring ON		55		%
Pre-shoot	Amplitude Variation compared to B/W amplitude	2T pulse, Max. peaking, coring ON		40		%
Aft-shoot	Amplitude Variation compared to B/W amplitude	2T pulse, Max. peaking, coring ON		40		%
Coring	Coring Range compared to B/W	Coring ON		10		%

#### BLACK STRETCH CONTROL (PIN BS) See Figure 12

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
BSth1	Black Stretch Threshold referred to B/W amplitude	Y/CVBS inputs: 0.7V B/W, No set-up		50		%
BSMax.	Maximum expansion referred to B/W amplitude	Y/CVBS inputs: 0.7V B/W, No set-up		-20		%
BSVMax.	Black Stretch Control Voltage	Max. black stretch		2.6		V
BSVMin.	Black Stretch Control Voltage	No black stretch		3.3		V
I100IRE	Discharging current	Y = 100IRE		8		μA
I0IRE	Charging Current	Y = 0IRE		35		μA

#### Y OUTPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
Yout-DC	Black level			3.7		VBW
Yout-amp	Black to White Amplitude			0.7	0.99	V
Yout-BW	Luma Path Bandwidth	Peaking nominal SVHS mode/Trap-off CVBS, PAL/NTSC 4.43MHz CVBS, SECAM CVBS, PAL/NTSC 3.58MHz	8 2.7 2.5 2.5	3.5 3.1 3.0		MHz
Yout S/N	Signal to Noise Ratio (V <sub>PP</sub> /V <sub>RMS</sub> )	Bandwidth 5MHz, Peaking Min.,coring ON	50			dB

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### 4.7 FILTERS

#### Y TRAP FILTER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$f_{\text{TRAP-PN}}$	Notch Frequency	PAL/NTSC		$f_{\text{OSC}}$		MHz
$f_{\text{TRAP-S}}$	Notch Frequencies	SECAM fnb SECAM fnr		4.2 4.5		MHz
$f_{\text{TRAP-ACC}}$	Notch Frequency Accuracy				3.5	%
$Q_{\text{TRAP}}$	Trap Quality Factor	$Q = 1 / (f_0/f - 3\text{dB} - f - 3\text{dB}/f_0)$ , Peaking Min.		1.5		-
CrejPN	Color Subcarrier Rejection	PAL/NTSC	20			dB
CrejS	Color Rejection in SECAM Mode	From 4.1 to 4.6 MHz At 3.9 MHz	10	20		dB

#### CHROMINANCE BANDPASS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$f_{\text{BP}}$	Center Frequency	Register 12h, d3-d0 = 0000	-5%	$f_{\text{OSC}}$	+5%	MHz
$Q_{\text{BP}}$	Bandpass Quality Factor		2.8	3.5	4.2	-

#### CLOCHE FILTER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$f_{\text{CLOCHE}}$	Center Frequency	Register 11h, d4-d0 = 00000	4.27	4.29	4.31	MHz
$Q_{\text{BP}}$	Cloche Quality Factor		14	16	18	-

### 4.8 CHROMA PART

#### ACC

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$G_{\text{ACC}}$	ACC Control Range	Change of burst overall ACC control range < 2dB		26		dB
$V_{\text{Min.}}$	Minimum Burst Signal Amplitude	Within the ACC control range		0.03		$V_{\text{PP}}$

#### ACC OVERLOAD

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$V_{\text{TH}}$	Chroma regulation Threshold	ACC overload ON, PAL/NTSC		3		dB

#### KILLER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
Ident-kill	Color on Threshold of ident. circuit	Burst amplitude on selected CVBS input		5		$\text{mV}_{\text{PP}}$
Kill-Hyst	Color off Killer Hysteresis	Strong signal condition, S/N > 40 dB		2		$\text{mV}_{\text{PP}}$

#### CHROMA PLL

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
CaptR	Catching Range	With recommended crystal and recommended CLPF filter value.	$\pm 300$			
HoldR	Holding Range		> or = to capture range			

## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### PLL LOOP FILTER (PAL/NTSC)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
$I_C$	Maximum Control Current	Color search mode (colour not ident.) Color identified		1000 350		$\mu A$
$I_L$	Leakage Current				5	$\mu A$
Frange-W	Auto Flesh Control	Register 14(HEX), d6 = 1, d7 = 1		$\pm 90$		Deg

### HUE CONTROL

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
Rhue	Hue Control Range		$\pm 35$	$\pm 45$	$\pm 55$	Deg

### AUTOMATIC FLESH CONTROL See Figure 13

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
FleshNom.	Nominal Flesh tint phase			118		Deg
Fcorr0	Phase Correction when auto flesh ON	At FleshNom		0		Deg
FMax.-N	Maximum Phase Correction	Register 14(HEX), d6 = 1, d7 = 0		$\pm 10$		Deg
Flesh-N	Chroma Input Phase at Max. correction	Register 14(HEX), d6 = 1, d7 = 0		$\pm 30$		Deg
Frange-N	Auto Flesh Control Range	Register 14(HEX), d6 = 1, d7 = 0		$\pm 60$		Deg
FMax.-W	Maximum Phase Correction	Register 14(HEX), d6 = 1, d7 = 1		$\pm 20$		Deg
Flesh-W	Chroma Input Phase at Max. correction	Register 14(HEX), d6 = 1, d7 = 1		$\pm 45$		Deg
Frange-W	Auto Flesh Control	Register 14(HEX), d6 = 1, d7 = 1		$\pm 90$		Deg

### COLOR DEMODULATORS

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
DoffsetP	Demodulator Offset	PAL/NTSC mode, 75% color bar			$\pm 2$	%
DoffsetS	Demodulator Offset	SECAM mode, 75% color bar			$\pm 2$	%
PhaseErr	Phase Error in demodulated signal	PAL/NTSC mode, 90% matrix			5	Deg
TransPal	Chroma Transient Time	PAL mode, 75% color bar green-magenta transient		700		ns
transSEC	Chroma Transient Time	SECAM mode, 75% color bar green-magenta transient		900		ns
Naxis	R-Y Demodulation Axis	NTSC mode, 104° matrix		104		Deg

### CHROMA DELAY LINE

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
Cdelay	Delay of delayed signals	Relative to non delayed signal	63.9	64	64.1	$\mu s$
Ctrans	Difference of transient times between delayed and non delayed signals	SECAM mode. $t_{RN} - t_{RN+1}$ $t_{RN}$ : rise time line N (direct) $t_{RN+1}$ : rise time line N +1 (delayed)			150	ns
Dgain	Differential Gain of delayed signals versus direct signals	SECAM mode. $G_{n+1}/G_n$ $G_n$ : direct channel gain $G_{n+1}$ : delayed channel gain	-0.5	0	0.5	dB



## STV223XD/224XC - ELECTRICAL CHARACTERISTICS

### U & V OUTPUTS (TQFP64)

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
UVout-dcc	Black Level			3.7		V
Uout-amp	B-Y Signal Amplitude	Chroma delay line ON, 75% color bar PAL/SECAM		1.33		V <sub>PP</sub>
Vout-amp	R-Y Signal Amplitude	Chroma delay line ON, 75% color bar PAL/SECAM		1.05		V <sub>PP</sub>
UVres	Internal Output Resistance			300		Ω
Uout-amp	B-Y Signal Amplitude	Chroma delay line OFF, 75% color bar PAL		0.66		V <sub>PP</sub>
Vout-amp	R-Y Signal Amplitude	Chroma delay line OFF, 75% color bar PAL		0.52		V <sub>PP</sub>
DemRatio	Ratio of B-Y/R-Y demodulators gain	75% color bar PAL/SECAM, measured on U, V outputs	1.14	1.27	1.4	-
RES	Residual Subcarrier at U, V outputs				45	mV <sub>PP</sub>
Lum/chr	Luma/Chroma Delay Difference at U, V outputs	External CVBS input signal, reg 1Fd3 = 0			±80	ns

### CHROMA REFERENCE OUTPUT

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
CHR-amp	Chroma VCO Reference Signal Amplitude			0.4		V <sub>PP</sub>
I <sub>SCHR</sub>	Sink Current			0.5		mA

## 4.9 SCANNING PART

### SYNC. SEPARATOR

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
Vsync	Synchronization Pulse Amplitude		50	300	450	mV

### HORIZONTAL OSCILLATOR

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
f <sub>H50</sub>	Horizontal Frequency	50 Hz mode		15.6		kHz
f <sub>H60</sub>	Horizontal Frequency	60 Hz mode		15.7		kHz
f <sub>RANGE</sub>	Frequency Control Range	Low Frequency High Frequency	14.7 15.9	15.0 16.3	15.3 —	kHz
f <sub>FREE</sub>	Free Frequency when PLL1 opened		15.3	15.6	15.9	kHz

### FIRST LOOP FILTER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
I <sub>LOW</sub>	Long Time Constant Output Current		0.10	0.13	0.16	mA
I <sub>HIGH</sub>	Short Time Constant Output Current		0.30	0.40	0.56	mA
I <sub>VLOW</sub>	Very Long Time Constant		0.03	0.05	0.07	mA

### SECOND LOOP FILTER

Symbol	Parameter	Test Conditions	Min.	Typ	Max.	Unit
CrangleP2	Control Range from start of horizontal output to flyback pulse	Centered horizontal position		0 to 12		μs
Hshift	Horizontal Position Control Range		5	5.25		μs
Hdrift	Horizontal Drift with temperature	From 0°C to 70°C (see Note 9)			200	ns