19-0604; Rev 1; 2/09

EVALUATION KIT AVAILABLE

CVBS Video Filter Amplifier with SmartSleep and Bidirectional Video Support

General Description

The MAX9513 CVBS video filter amplifier with SmartSleep and bidirectional video support is ideal for portable DVD players and portable media players (PMPs). The input can be directly connected to the digital-to-analog converter (DAC) output. The reconstruction filter removes high-frequency signals above 6.75MHz. The amplifiers have 6dB of gain, and the outputs can be DC-coupled to a load of 75Ω, which is equivalent to two video loads, or can be AC-coupled to a load of 150Ω.

The SmartSleep circuitry intelligently reduces power consumption based on the presence of the input signal and the output loads. When the MAX9513 does not detect the presence of sync on the input video signal, the supply current is reduced to less than 7µA. The device only enables a video amplifier when there is an active video input signal and an attached load. The video amplifier remains on while a load is connected. If the load is disconnected, the video amplifier is turned off.

The MAX9513 contains one reconstruction filter, two video amplifiers, and a pulldown switch at one of the two CVBS outputs. The MAX9513 has the ability to control the bidirectional video signals at the CVBS video connections without the need for separate switches or relays. This feature is particularly useful for portable DVD players, which often use the same connector to drive a composite video output and to accept an external video signal to display on the LCD panel.

The MAX9513 operates from a 2.7V to 3.6V single supply and is offered in a small 16-pin TQFN (3mm x 3mm) package. The device is specified over the -40°C to +125°C automotive temperature range.

Applications

Portable DVD Players

Portable Set-Top Boxes

Personal Video Recorders (PVRs)

Portable Media Players (PMPs)

Portable Video

Features

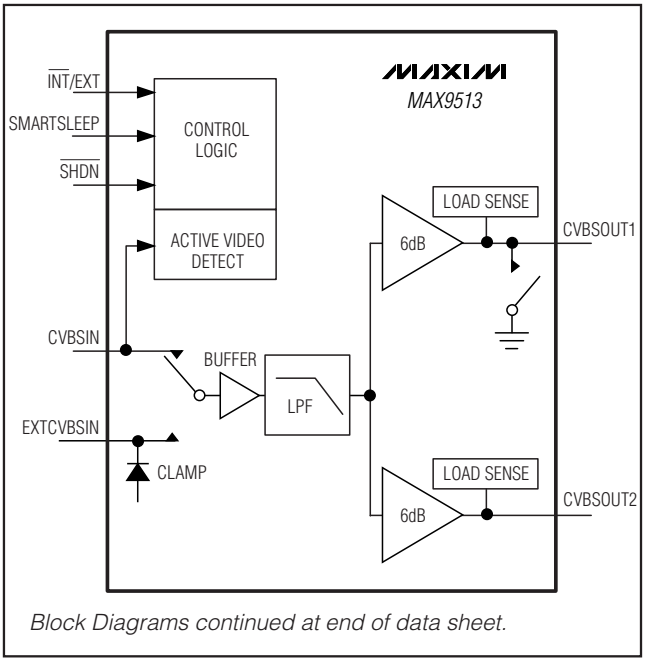
- **SmartSleep Feature Detects Input Signal and Output Load Status to Reduce Power Consumption**
- **Standard-Definition Video Reconstruction Filter with 6.75MHz Passband**
- **Two Composite Inputs and Outputs**
- **Integrated Support for a Bidirectional Composite Video Signal**
- **Supports Two Video Loads at Each Output (DC-Coupled)**
- **2.7V to 3.6V Single-Supply Operation**

Ordering Information

PART	PIN-PACKAGE	TOP MARK
MAX9513ATE+	16 TQFN-EP* (3mm x 3mm)	AFC

Note: *The device is specified over the -40°C to +125°C operating temperature range.*
+Denotes lead(Pb)-free/RoHS-compliant package.
**EP = Exposed pad.*

Block Diagrams



Block Diagrams continued at end of data sheet.

CVBS Video Filter Amplifier with SmartSleep and Bidirectional Video Support

ABSOLUTE MAXIMUM RATINGS

(Voltages with respect to GND.)
V_{DD} .....-0.3V to +4V
SMARTSLEEP, $\overline{SHDN}$, $\overline{INT}$/EXT, CVBSIN, EXTCVBSIN .....-0.3V to +4V
Duration of Short Circuit to V_{DD} or GND (CVBSOUT1, CVBSOUT2).....Continuous
Continuous Input Current
EXTCVBSIN, CVBSIN, SMARTSLEEP, $\overline{SHDN}$, $\overline{INT}$/EXT .....±20mA

Continuous Power Dissipation (T_A = +70°C)
16-Pin TQFN (derate 15.6mW/°C above +70°C).....1250mW
Operating Temperature Range .....-40°C to +125°C
Junction Temperature.....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{DD} = $V_{\overline{SHDN}}$ = 3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V, R_L = no load. T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{DD}	Guaranteed by PSRR		2.7		3.6	V
Supply Current	I_{DD}	$\overline{INT}$/EXT = GND, V_{CVBSIN} = 0.3V			13	16	mA
		$\overline{INT}$/EXT = V_{DD}, EXTCVBSIN is unconnected			4.3	6	
		SMARTSLEEP = V_{DD}, CVBSIN has no active video signal			7	14	µA
		SMARTSLEEP = V_{DD}, CVBSIN has a black-burst video signal with sync tip at GND (Note 2)			17		
Shutdown Supply Current	I_{SHDN}	$\overline{SHDN}$ = GND			0.01	10	µA
SMARTSLEEP CHARACTERISTICS							
Minimum Line Frequency		CVBSIN		14.3			kHz
Sync Slice Level		CVBSIN		4.1		5.2	% V_{DD}
Output Load Detect Threshold		Sync pulse present, R_L to GND				200	Ω
DC CHARACTERISTICS							
Input Voltage Range	V_{IN}	CVBSIN, guaranteed by output voltage swing	2.7V < V_{DD} < 3.6V	0		1.05	V
			3.0V < V_{DD} < 3.6V	0		1.2	
Input Current	I_{IN}	V_{CVBSIN} = 0V			2	5	µA
Input Resistance	R_{IN}	CVBSIN			20		MΩ

ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = $V_{\overline{SHDN}}$ = 3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V, R_L = no load. T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Sync-Tip Clamp Level	V_{CLP}	EXTCVBSIN		0.25		0.37	V
Input Clamping Current		EXTCVBSIN = 500mV + V_{CLP}		0.5	1	1.5	µA
EXTCVBSIN Input Voltage Range		Guaranteed by output voltage swing	2.7V < V_{DD} < 3.6V			1.05	V_{P-P}
			3.0V < V_{DD} < 3.6V			1.2	
Sync Crush		EXTCVBSIN, percentage reduction in sync pulse (0.3V_{P-P}), guaranteed by input clamping current measurement, measured at input				2	%
Maximum Input Source Resistance		EXTCVBSIN			300		Ω
DC Voltage Gain	A_V	R_L = 150Ω to V_{DD} / 2, 0V ≤ V_{IN} ≤ 1.05V, V_{DD} = 2.7V		5.7	6	6.3	dB
DC Gain Matching		R_L = 150Ω to V_{DD} / 2, 0V ≤ V_{IN} ≤ 1.05V, V_{DD} = 2.7V		-0.2	0	+0.2	dB
Output Level		V_{CVBSIN} = 0V, $\overline{INT}$/EXT = GND, R_L = 150Ω to GND		0.21	0.3	0.38	V
		$C_{EXTCVBSIN}$ = 0.1µF to GND, $\overline{INT}$/EXT = V_{DD}, R_L = 150Ω to GND		0.21	0.27	0.38	
Output Voltage Swing		Measured at output, V_{DD} = 2.7V, 0V ≤ V_{IN} ≤ 1.05V, R_L = 150Ω to -0.2V	T_A = -40°C to +85°C	2.027	2.1	2.163	V_{P-P}
			T_A = -40°C to +125°C	2.006		2.163	
		Measured at output, V_{DD} = 2.7V, 0V ≤ V_{IN} ≤ 1.05V, R_L = 150Ω to V_{DD} / 2		2.027	2.1	2.163	
		Measured at output, V_{DD} = 3V, 0V ≤ V_{IN} ≤ 1.2V, R_L = 150Ω to -0.2V	T_A = -40°C to +85°C	2.316	2.4	2.472	
			T_A = -40°C to +125°C	2.292		2.472	
		Measured at output, V_{DD} = 3V, 0V ≤ V_{IN} ≤ 1.2V, R_L = 150Ω to V_{DD} / 2		2.316	2.4	2.472	
		Measured at output, V_{DD} = 3.135V, 0V ≤ V_{IN} ≤ 1.05V, R_L = 75Ω to -0.2V		2.027	2.1	2.163	
Output Resistance	R_{OUT}	V_{OUT} = 1.3V, -5mA ≤ I_{LOAD} ≤ +5mA			0.47		Ω

CVBS Video Filter Amplifier with SmartSleep and Bidirectional Video Support

ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = $V_{\overline{SHDN}}$ = 3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V, R_L = no load. T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Power-Supply Rejection Ratio	PSRR	2.7V ≤ V_{DD} ≤ 3.6V, input referred, R_L = 150Ω to GND	48			dB
Output Pulldown Resistance	R_{PD}	$\overline{INT}$/EXT = V_{DD}, CVBSOUT1		3.7		Ω
Output Shutdown Impedance				28		kΩ
LOGIC INPUTS (SMARTSLEEP, $\overline{SHDN}$, $\overline{INT}$/EXT)						
Logic-Low Threshold	V_{IL}				0.3 x V_{DD}	V
Logic-High Threshold	V_{IH}		0.7 x V_{DD}			V
Logic Input Current	I_{IL} / I_{IH}	V_I = 0V or V_{DD}		0.01	10	µA

AC ELECTRICAL CHARACTERISTICS

(V_{DD} = $V_{\overline{SHDN}}$ = 3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V, R_L = 150Ω to GND. T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Standard-Definition Reconstruction Filter		Inputs are $1V_{P-P}$, reference frequency is 1MHz	f = 5.5MHz		-0.1		dB
			f = 6.75MHz	-1	-0.3	+1	
			f = 11MHz		-3		
			f = 27MHz	-33	-41		
Differential Gain	DG	DC-coupled output, 5-step modulated staircase	f = 3.58MHz or 4.43MHz		0.2		%
		AC-coupled output, 5-step modulated staircase	f = 3.58MHz or 4.43MHz		0.4		
Differential Phase	DP	DC-coupled output, 5-step modulated staircase	f = 3.58MHz		0.62		Degrees
			f = 4.43MHz		0.75		
		AC-coupled output, 5-step modulated staircase	f = 3.58MHz		0.78		
			f = 4.43MHz		1.01		
2T Pulse Response		2T = 200ns or 250ns			0.2		K%
2T Bar Response		Bar time is 18µs, the beginning 2.5% and the ending 2.5% of the bar time are ignored, 2T = 200ns or 250ns			0.2		K%
2T Pulse-to-Bar K Rating		Bar time is 18µs, the beginning 2.5% and the ending 2.5% of the bar time are ignored, 2T = 200ns or 250ns			0.3		K%

AC ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = $V_{\overline{SHDN}}$ = 3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V, R_L = 150Ω to GND. T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Nonlinearity		5-step staircase		0.1		%
Group Delay Distortion		100kHz ≤ f ≤ 5MHz, inputs are $1V_{P-P}$		10		ns
Peak Signal to RMS Noise		100kHz ≤ f ≤ 5MHz, inputs are $1V_{P-P}$		67		dB
Power-Supply Rejection Ratio		f = 100kHz, $200mV_{P-P}$, input referred		43		dB
Output Impedance		f = 5MHz		6		Ω
Enable Time		CVBSIN = 1V, output settled to within 1% of the final voltage, R_L = 150Ω to GND		13		µs
Disable Time		CVBSIN = 1V, output settled to within 1% of the final voltage, R_L = 150Ω to GND		1.1		µs
CROSSTALK						
All Hostile Output Crosstalk		f = 4.43MHz		-70		dB
All Hostile Input Crosstalk		f = 4.43MHz, $\overline{SHDN}$ = GND, input termination resistors are 75Ω		-69		dB

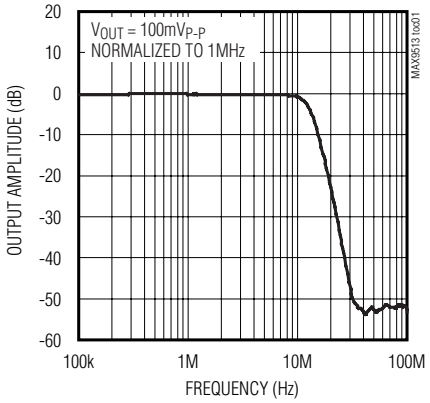
Note 1: All devices are 100% production tested at T_A = +25°C. Specifications over temperature limits are guaranteed by design.
Note 2: Specified current is an average over time.

CVBS Video Filter Amplifier with SmartSleep and Bidirectional Video Support

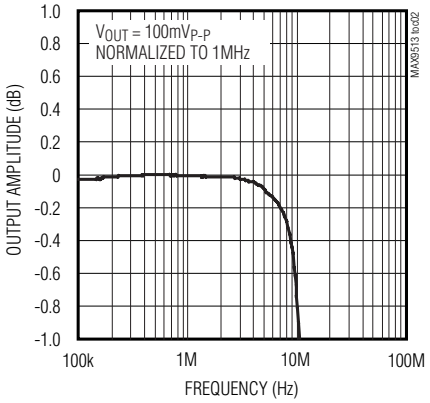
Typical Operating Characteristics

(V_{DD} = $V_{\overline{SHDN}}$ = +3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V. R_L = 150Ω to GND. T_A = +25°C, unless otherwise noted.)

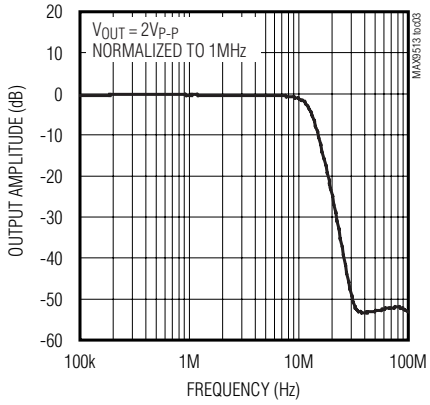
SMALL-SIGNAL GAIN vs. FREQUENCY



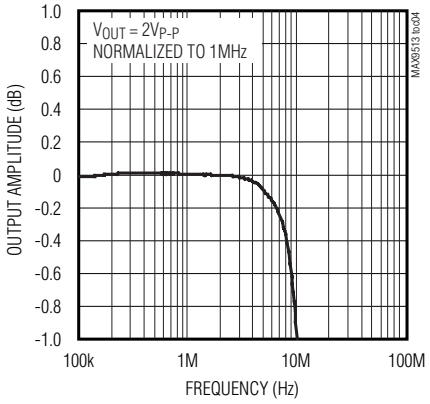
SMALL-SIGNAL GAIN FLATNESS vs. FREQUENCY



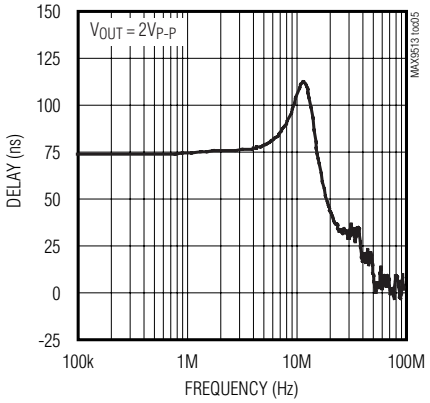
LARGE-SIGNAL GAIN vs. FREQUENCY



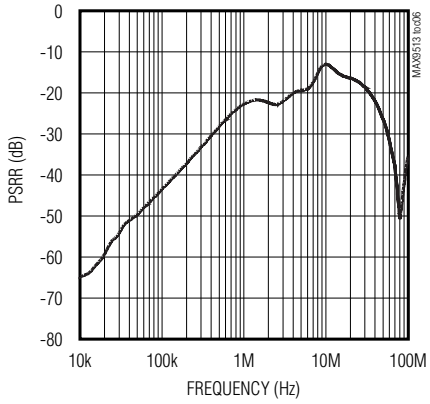
LARGE-SIGNAL GAIN FLATNESS vs. FREQUENCY



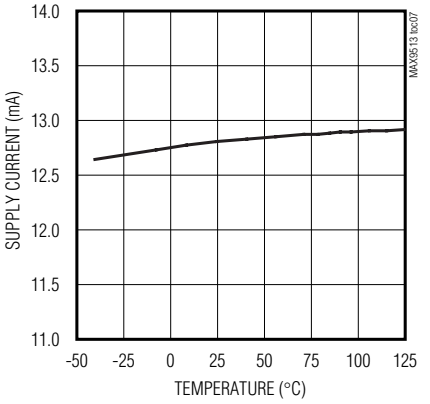
GROUP DELAY



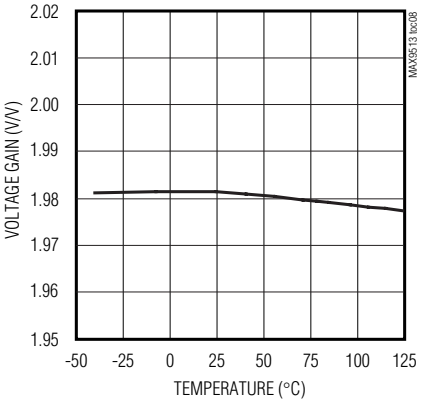
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



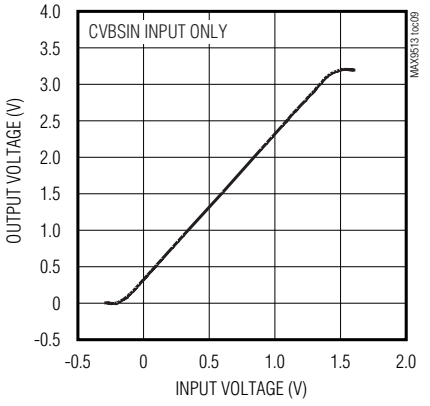
QUIESCENT SUPPLY CURRENT vs. TEMPERATURE



VOLTAGE GAIN vs. TEMPERATURE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

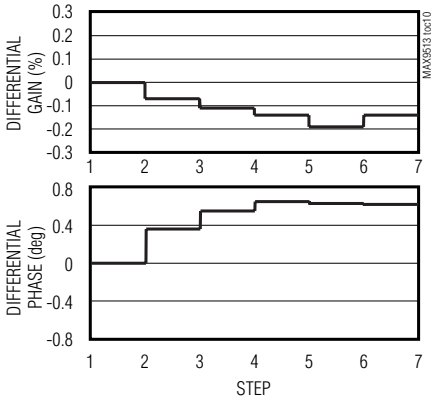


CVBS Video Filter Amplifier with SmartSleep and Bidirectional Video Support

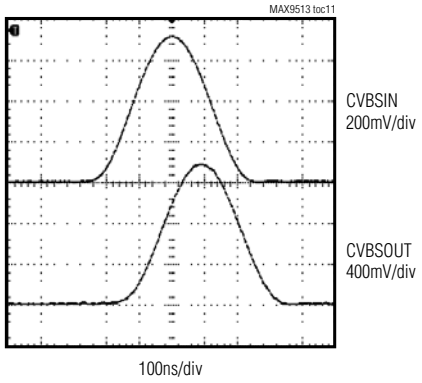
Typical Operating Characteristics (continued)

(V_{DD} = $V_{\overline{SHDN}}$ = +3.3V, $V_{SMARTSLEEP}$ = $V_{\overline{INT}/EXT}$ = V_{GND} = 0V. R_L = 150Ω to GND. T_A = +25°C, unless otherwise noted.)

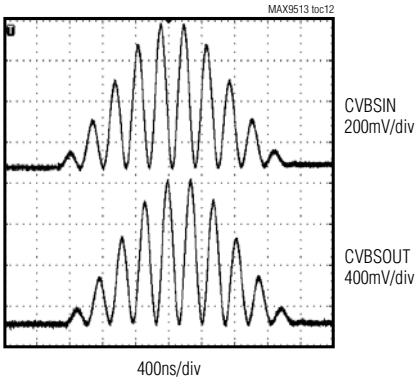
DIFFERENTIAL GAIN AND PHASE



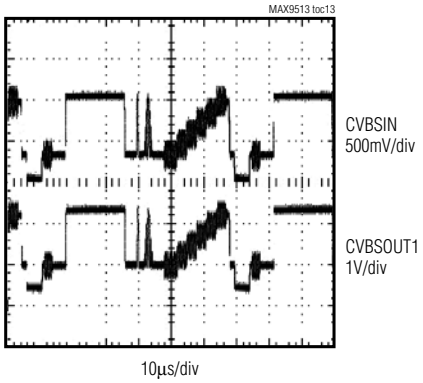
2T RESPONSE



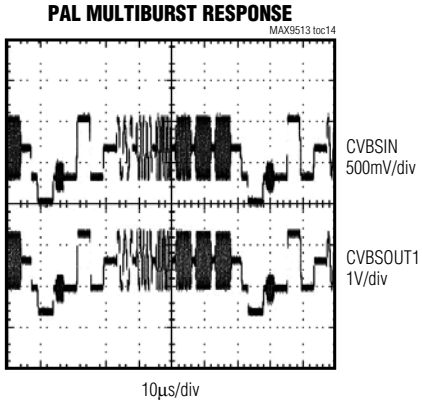
12.5T RESPONSE



NTC-7 VIDEO TEST SIGNAL ON CVBS OUTPUTS



PAL MULTIBURST RESPONSE



PAL COLOR BARS