19-4431; Rev 2; 11/11

EVALUATION KIT AVAILABLE

DirectDrive Video Amplifier with Short-to-Battery Protection

MAX9532

General Description

The MAX9532 DirectDrive® video filter amplifier is specifically designed to work in harsh environments such as automobiles. The MAX9532 provides integrated short-to-battery protection, allowing the output of the device to survive shorts up to 18V.

Maxim's DirectDrive technology eliminates large output coupling capacitors and sets the output video black level near ground. DirectDrive requires an integrated charge pump and an internal linear regulator to create a clean negative power supply so that the amplifier can pull the sync below ground. The charge pump injects so little noise into the video output that the picture is visibly flawless.

The MAX9532 features an internal reconstruction filter that smoothes the steps and reduces the spikes on the video signal from the video digital-to-analog converter (DAC). The reconstruction filter typically provides ±1dB passband flatness of 9.5MHz and 42dB attenuation at 27MHz.

The input of the MAX9532 can be directly connected to the output of a video DAC. The MAX9532 also features a transparent input sync-tip clamp, allowing AC-coupling of input signals with different DC biases.

The MAX9532 features an internal fixed gain of 4V/V. The input full-scale video signal is nominally $0.5V_{P-P}$, and the output full-scale video signal is nominally $2V_{P-P}$.

The short-to-battery protection utilizes an internal switch in series with the amplifier output. When the MAX9532 detects that the output is short circuited to the battery voltage, the internal switch is disabled, protecting the MAX9532 from voltages up to 18V.

The MAX9532 is available in a 3mm x 3mm, 10-pin µMAX® package and is specified over the -40°C to +125°C automotive operating temperature range.

Features

- **Short-to-Battery Protection on Video Output (Up to 18V)**
- **DirectDrive Sets Video Output Black Level Near Ground**
- **DirectDrive Eliminates DC-Blocking Capacitors at the Output**
- **3.3V Single-Supply Operation**
- **Reconstruction Filter with 9.5MHz Passband and 42dB Attenuation at 27MHz**
- **DC-Coupled Input/Output**
- **Transparent Input Sync-Tip Clamp**
- **4V/V Internal Fixed Gain**

Applications

Automotive Infotainment Systems

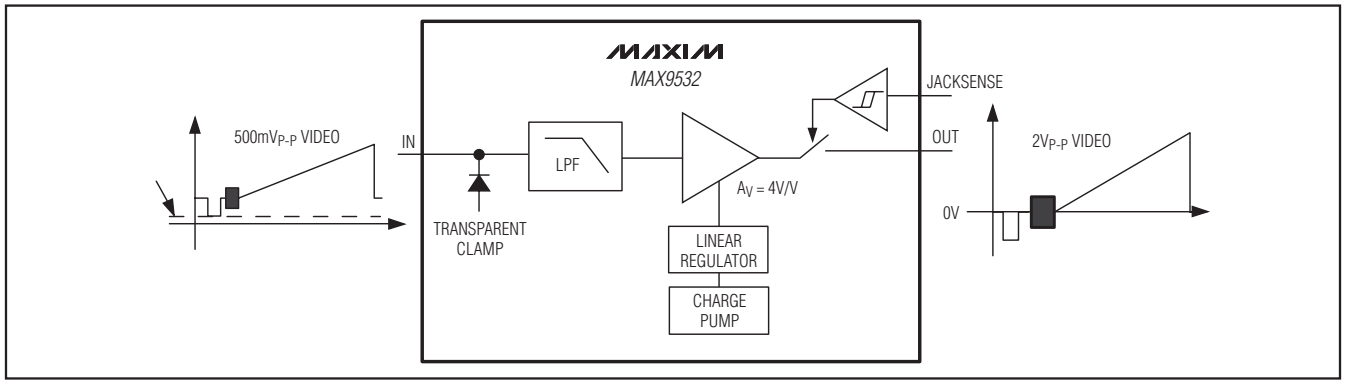
Ordering Information

PART	PIN-PACKAGE	TEMP RANGE
MAX9532AUB/V+T	10 µMAX	-40°C to +125°C
MAX9532AUB+	10 µMAX	-40°C to +125°C

+Denotes a lead(Pb)-free/RoHS-compliant package.
/V denotes an automotive qualified part.
T = *Tape and reel.*

Pin Configuration and Functional Diagram/Typical Application Circuits appear at end of data sheet.

Simplified Block Diagram



DirectDrive is a registered trademark of Maxim Integrated Products, Inc.

µMAX is a registered trademark of Maxim Integrated Prodcuts, Inc.

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

DirectDrive Video Amplifier with Short-to-Battery Protection

ABSOLUTE MAXIMUM RATINGS

V_{DD} to GND .....-0.3V to +4V
V_{DD} to CPGND .....-0.3V to +4V
CPGND to GND .....-0.1V to +0.1V
IN to GND .....-0.3V to +4V
JACKSENSE to GND .....The higher of V_{SS} and -2V to (V_{SS} + 22V)
OUT to GND .....The higher of V_{SS} and -1.5V to (V_{SS} + 22V)
V_{SS} to CPVSS .....-0.1V to +0.1V
Continuous Current
  IN, JACKSENSE.....±20mA
  C1P, C1N, CPVSS .....±50mA
  OUT .....±50mA

Continuous Power Dissipation (T_A = +70°C)
  10-Pin µMAX (derate 8.8mW/°C above +70°C) 707.3mW
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
Soldering Temperature (reflow) .....+260°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} = 3.3V, V_{GND} = V_{CPGND} = 0V, R_L = 100Ω to GND, C_1 = C_2 = C_3 = 1µF, 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
DC-COUPLED INPUT						
Input Voltage Range	V_{IN}	Guaranteed by output voltage swing 3V < V_{DD} < 3.135V	0		0.5	V
		Guaranteed by output voltage swing 3.135V < V_{DD} < 3.6V	0		0.7	
Input Current	I_{IN}	V_{IN} = 0.5V		2	3.3	µA
Input Resistance	R_{IN}	0.1V ≤ V_{IN} ≤ 0.5V		5		MΩ
SYNC-TIP CLAMP INPUT						
Sync-Tip Clamp Level	V_{CLP}	Sync-tip clamp	-6.2	-1.63	+3.5	mV
Input Voltage Range		Guaranteed by output voltage swing 3V < V_{DD} < 3.135V	0		0.5	V_{P-P}
		Guaranteed by output voltage swing V_{DD} > 3.135V	0		0.7	
Sync Crush		Sync-tip clamp; percentage reduction in sync pulse (0.15V_{P-P}, 75Ω source impedance), guaranteed by input clamping current measurement			2.3	%
Input Clamping Current		Sync-tip clamp		2	3.3	µA
Max Input Source Resistance				300		Ω
GENERAL						
Supply Voltage Range	V_{DD}	Guaranteed by PSRR	3.0	3.3	3.6	V
Quiescent Supply Current				15	23	mA
DC Voltage Gain	A_V	Guaranteed by output voltage swing	3.92	4	4.08	V/V
Output Level		V_{IN} = 150mV	-0.120		+0.150	V

ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = 3.3V, V_{GND} = V_{CPGND} = 0V, R_L = 100Ω to GND, C_1 = C_2 = C_3 = 1µF, 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
Output Voltage Swing		Measured at output, V_{DD} = 3.135V, V_{IN} = V_{CLP} to (V_{CLP} + 0.7V), R_L = 100Ω to -2V and +2V		2.744	2.8	2.856	V_{P-P}
		Measured at output, V_{DD} = 3V, V_{IN} = V_{CLP} to (V_{CLP} + 0.5V), R_L = 100Ω to -2V and +2V		1.96	2	2.04	
Output Short-Circuit Current					90		mA
Output Resistance	R_{OUT}				0.1		Ω
Short Circuit to Battery Current		Short-to-battery, V_{OUT} = 9V to 16V				3	mA
Power-Supply Rejection Ratio		3.0V ≤ V_{DD} ≤ 3.6V		46	78		dB
Filter		V_{IN} = 0.5V_{P-P}, reference frequency is 100kHz	Attenuation at 5.5MHz	-1.29		+1	dB
			Attenuation at f = 27MHz	20	42		
Differential Gain	DG	5-step modulated staircase, f = 4.43MHz, R_L = 100Ω to -2V and +2V			0.7		%
Differential Phase	DP	5-step modulated staircase, f = 4.43MHz, R_L = 100Ω to -2V and +2V			0.5		deg
2T Pulse-to-Bar K Rating		2T = 200ns; bar time is 18µs; the beginning 2.5% and the ending 2.5% of the bar time is ignored; R_L = 100Ω to -2V and +2V			0.5		K%
2T Pulse Response		2T = 200ns, R_L = 100Ω to -2V and +2V			0.4		K%
2T Bar Response		2T = 200ns; bar time is 18µs; the beginning 2.5% and the ending 2.5% of the bar time is ignored; R_L = 100Ω to -2V and +2V			0.1		K%
Nonlinearity		5-step staircase; R_L = 100Ω to -2V and +2V			0.1		%
Group Delay Distortion		100kHz ≤ f ≤ 5MHz, outputs are 2V_{P-P}; R_L = 100Ω to -2V and +2V			13		ns
Glitch Impulse Caused by Charge Pump Switching		Measured at outputs, R_L = 100Ω to -2V and +2V			40		pVs
Peak Signal to RMS Noise		100kHz ≤ f ≤ 5MHz, R_L = 100Ω to -2V and +2V			64		dB
Power-Supply Rejection Ratio		f = 100kHz, 100mV_{P-P}; R_L = 100Ω to -2V and +2V			47		dB
Output Impedance		f = 5MHz			2		Ω
JACKSENSE Input Resistance				120	250		kΩ
BATTERY DETECTION							
Threshold Accuracy		Referred to GND		7.3	8	8.7	V
Video Output Disconnect Time		After detection of short-to-battery			20		µs
Video Output Connect Time		After short-to-battery has been removed		4.9	10	20	ms

DirectDrive Video Amplifier with Short-to-Battery Protection

ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = 3.3V, V_{GND} = V_{CPGND} = 0V, R_L = 100Ω to GND, C_1 = C_2 = C_3 = 1µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

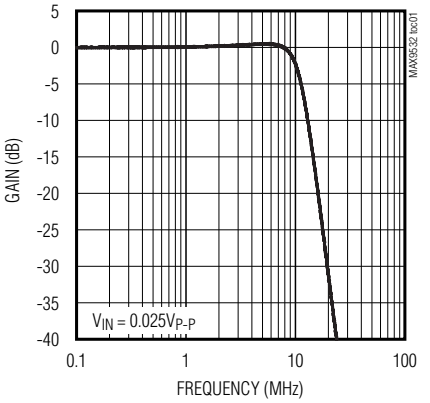
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
CHARGE PUMP						
Switching Frequency	f_{CP}		220	440	660	kHz

Note 1: All devices are 100% production tested at T_A = +25°C. Specifications over temperature limits are guaranteed by design.

Typical Operating Characteristics

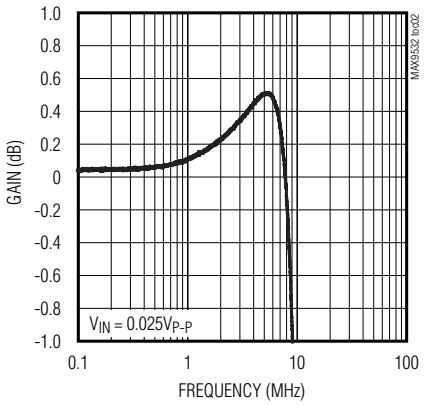
(V_{DD} = 3.3V, V_{GND} = V_{CPGND} = 0V, video output has R_L = 100Ω to GND, C_1 = C_2 = C_3 = 1µF, T_A = +25°C, unless otherwise noted.)

SMALL-SIGNAL GAIN vs. FREQUENCY



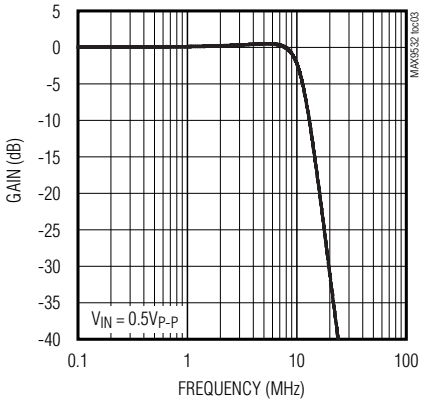
NOTE: GAIN VALUES (PLOTTED IN dB) ARE NORMALIZED VALUES RELATIVE TO THE EXPECTED VALUE OF 4V/V.

SMALL-SIGNAL GAIN FLATNESS vs. FREQUENCY



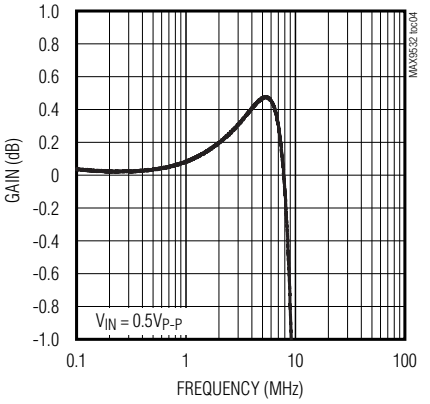
NOTE: GAIN VALUES (PLOTTED IN dB) ARE NORMALIZED VALUES RELATIVE TO THE EXPECTED VALUE OF 4V/V.

LARGE-SIGNAL GAIN vs. FREQUENCY



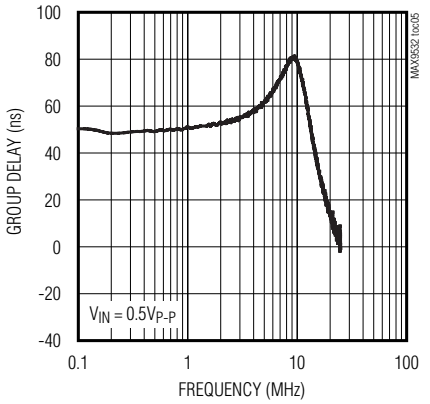
NOTE: GAIN VALUES (PLOTTED IN dB) ARE NORMALIZED VALUES RELATIVE TO THE EXPECTED VALUE OF 4V/V.

LARGE-SIGNAL GAIN FLATNESS vs. FREQUENCY

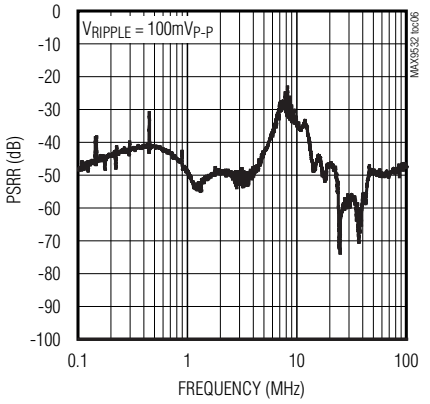


NOTE: GAIN VALUES (PLOTTED IN dB) ARE NORMALIZED VALUES RELATIVE TO THE EXPECTED VALUE OF 4V/V.

GROUP DELAY vs. FREQUENCY



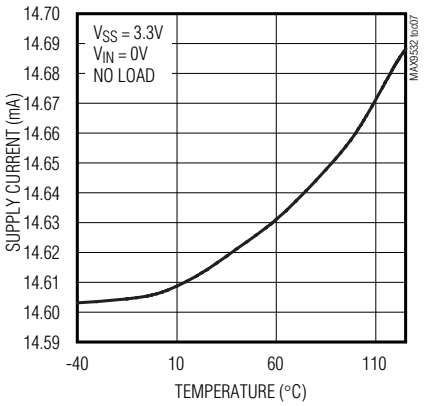
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



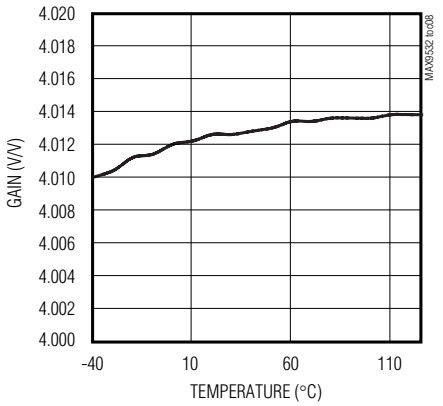
Typical Operating Characteristics (continued)

(V_{DD} = 3.3V, V_{GND} = V_{CPGND} = 0V, video output has R_L = 100Ω to GND, C_1 = C_2 = C_3 = 1µF, T_A = +25°C, unless otherwise noted.)

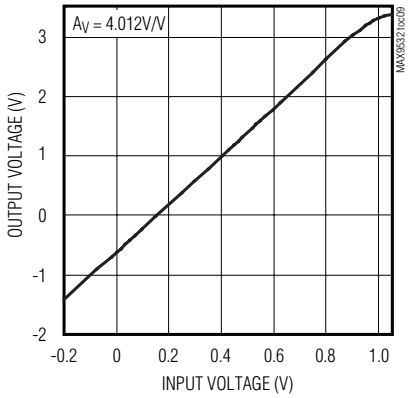
QUIESCENT CURRENT vs. TEMPERATURE



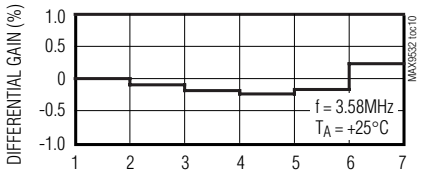
DC GAIN vs. TEMPERATURE



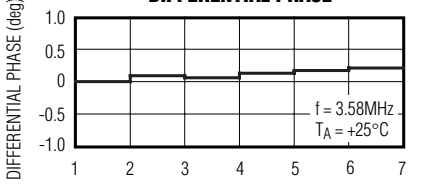
OUTPUT VOLTAGE vs. INPUT VOLTAGE



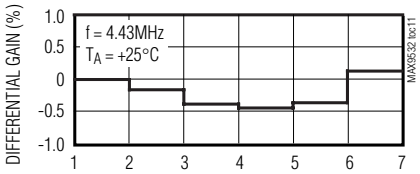
DIFFERENTIAL GAIN AND PHASE



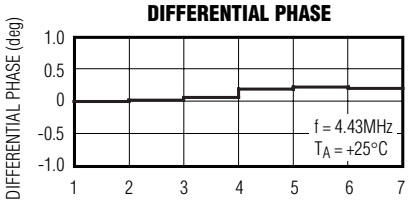
DIFFERENTIAL PHASE



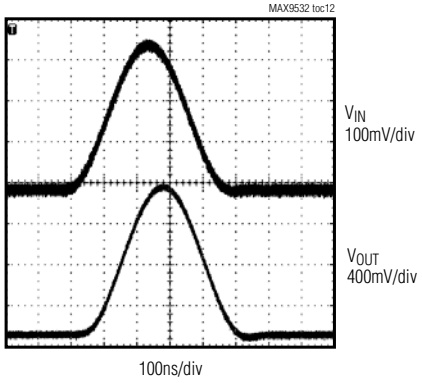
DIFFERENTIAL GAIN AND PHASE



DIFFERENTIAL PHASE



2T RESPONSE

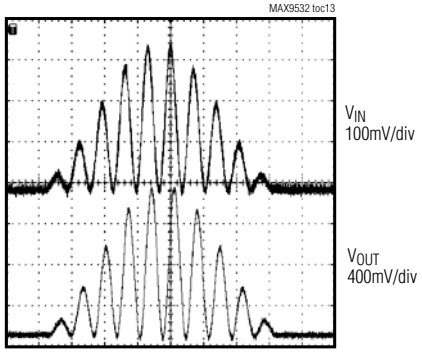


DirectDrive Video Amplifier with Short-to-Battery Protection

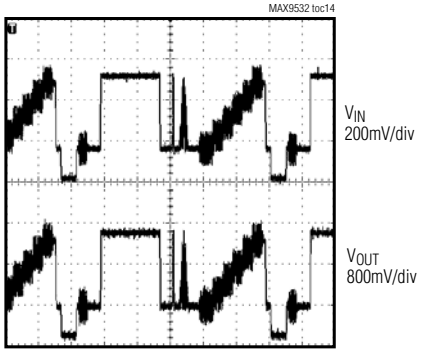
Typical Operating Characteristics (continued)

(V_{DD} = 3.3V, V_{GND} = V_{CPGND} = 0V, video output has R_L = 100Ω to GND, C_1 = C_2 = C_3 = 1µF, T_A = +25°C, unless otherwise noted.)

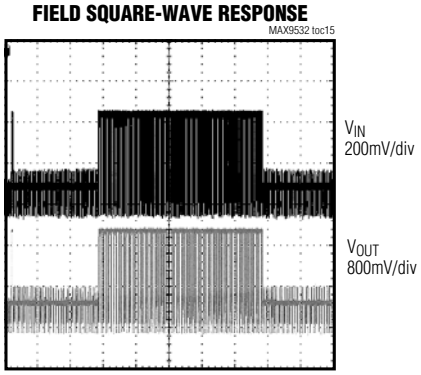
2T RESPONSE



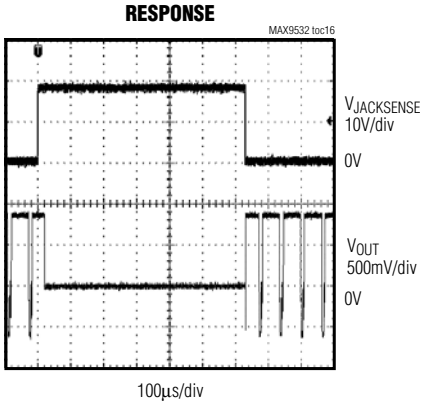
VIDEO TEST SIGNAL



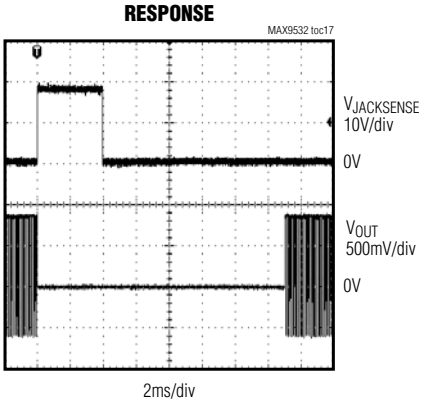
FIELD SQUARE-WAVE RESPONSE



OUTPUT SHORT-TO-BATTERY RESPONSE



OUTPUT SHORT-TO-BATTERY RESPONSE



Pin Description

PIN	NAME	FUNCTION
1	V_{DD}	Positive Power Supply. Bypass V_{DD} with a 1µF capacitor to GND.
2	C1P	Charge-Pump Flying Capacitor Positive Terminal. Connect a 1µF ceramic capacitor from C1P to C1N.
3	CPGND	Charge-Pump Ground. Connect to GND.
4	C1N	Charge-Pump Flying Capacitor Negative Terminal. Connect a 1µF ceramic capacitor from C1P to C1N.
5	CPVSS	Charge-Pump Negative Power Supply. Bypass CPVSS with a 1µF ceramic capacitor in parallel with a 10nF low ESL capacitor to GND.
6	V_{SS}	Negative Power Supply. Connect V_{SS} to CPVSS.
7	OUT	Video Output
8	JACKSENSE	Jack-Sense Input. Connect to the video output connector after the back-termination resistor.
9	GND	Ground
10	IN	Video Input

Detailed Description

The MAX9532 DirectDrive video amplifier with short-to-battery protection features an internal 5-pole Butterworth lowpass filter with the amplifier configured with a gain of 4. The MAX9532 accepts DC-coupled or AC-coupled full-scale input signals of $0.5V_{P-P}$. Integrated short-to-battery protection prevents the MAX9532 from being damaged when the output is short circuited to the battery in automotive applications.

DirectDrive

Background

Integrated video filter amplifier circuits operate from a single supply. The positive power supply usually creates video output signals that are level-shifted above ground to keep the signal within the linear range of the output amplifier. For applications where the positive DC level is not acceptable, a series capacitor can be inserted in the output connection to eliminate the positive DC level shift. The series capacitor cannot truly level shift a video signal because the average level of the video varies with picture content. The series capacitor biases the video output signal around ground, but the actual level of the video signal can vary significantly depending upon the RC time constant and the picture content.

The series capacitor creates a highpass filter. Since the lowest frequency in video is the frame rate, which is between 24Hz and 30Hz, the pole of the highpass filter is ideally an order of magnitude lower in frequency than the frame rate. Therefore, the series capacitor must be very large, typically from 220µF to 3000µF. For space-constrained equipment, the series capacitor is unacceptable. Changing from a single series capacitor to a SAG network that requires two smaller capacitors can only reduce space and cost slightly.

Video Amplifier

When the full-scale video signal from a video DAC is 500mV, the black level of the video signal created by the video DAC is around 150mV. The MAX9532 shifts the black level to near ground at the output so that the active video is above ground and the sync is below ground. The amplifier needs a negative supply for the output stage to remain in the linear region when driving sync below ground.

The MAX9532 includes an integrated charge pump and linear regulator to create a low-noise negative supply from the positive supply voltage. The charge pump inverts the positive supply to create a raw negative voltage that is then fed into the linear regulator filtering out the charge-pump noise.

Comparison Between DirectDrive Output and AC-Coupled Output

The actual level of the video signal varies less with a DirectDrive output than with an AC-coupled output. The average video signal level changes depending upon the picture content. With an AC-coupled output, the average level changes according to the time constant formed by the series capacitor and series resistance (usually 150Ω). For example, Figure 1 shows an AC-coupled video signal alternating between a completely black screen and a completely white screen. Notice the excursion of the video signal as the screen changes.

DirectDrive Video Amplifier with Short-to-Battery Protection

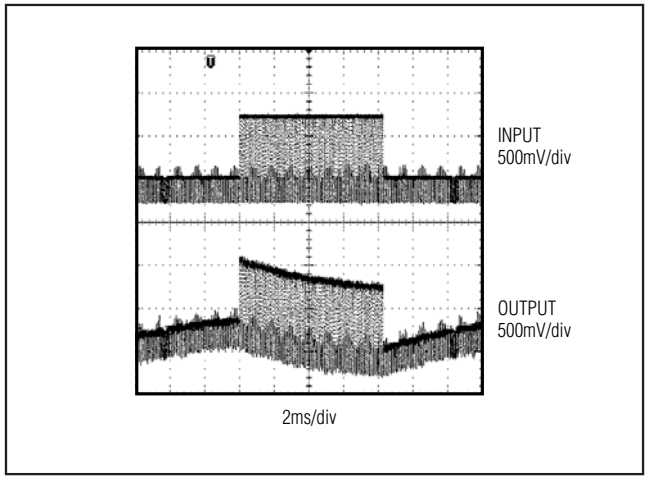


Figure 1. AC-Coupled Output

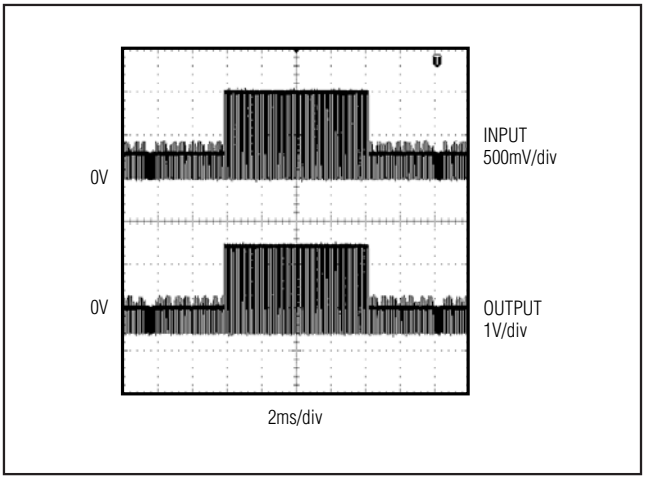


Figure 2. DirectDrive Output

With the DirectDrive amplifier, the black level is held at ground. The video signal is constrained between -0.3V to +0.7V. Figure 2 shows the video signal from a DirectDrive amplifier with the same input signal as the AC-coupled system.

Video Reconstruction Filter

The MAX9532 features an internal five-pole, Butterworth lowpass filter to condition the video signal. The reconstruction filter smoothes the steps and reduces the spikes created whenever the DAC output changes value. In the frequency domain, the steps and spikes cause images of the video signal to appear at multiples of the sampling clock frequency. The reconstruction filter typically provides ±1dB passband flatness of 9.5MHz and 42dB attenuation at 27MHz.

Transparent Sync-Tip Clamp

The MAX9532 contains an integrated, transparent sync-tip clamp. When using a DC-coupled input, the sync-tip clamp does not affect the input signal as long as the input signal remains above ground. When using an AC-coupled input, the sync-tip clamp automatically clamps the input signal to ground, preventing the input signal from going lower. A low current of 2µA pulls down on the input to prevent an AC-coupled signal from drifting outside the input range of the device.

Short-Circuit and Short-to-Battery Protection

The MAX9532 typical operating circuit includes a 50Ω or 75Ω back-termination resistor that limits short-circuit current when an external short is applied to the video output. The MAX9532 also features an internal output short-circuit protection to prevent device damage in prototyping and applications where the amplifier output can be directly shorted to ground.

To protect the device from output short circuits to voltages higher than the supply voltage V_{DD}, the MAX9532 utilizes an internal switch in series with the amplifier output. When the JACKSENSE input detects that the output connector of the circuit is shorted to the battery voltage (up to 18V) higher than the internal 8V threshold, an internal comparator disables the switch in 10µs (typ) preventing the MAX9532 from being damaged.

After the output is shorted to a battery, the output immediately resumes normal operation when the short is removed within 1ms. When the output is shorted to the battery for longer than 1ms, the output resumes normal operation 10ms after the short is removed.

Applications

Power Consumption

Quiescent power consumption is defined when the MAX9532 is operating without load. In this case, the MAX9532 consumes about 47.355mW. Average power consumption, when the MAX9532 drives a 100Ω and 150Ω load to ground with a 50% flat field, is about 51.596mW and 49.513mW, respectively. Table 1 shows the power consumption with different video signals.

Notice that the two extremes in power consumption occur with a video signal that is all black and a video signal that is all white. The power consumption with 75% color bars and 50% flat field lies in between the extremes.

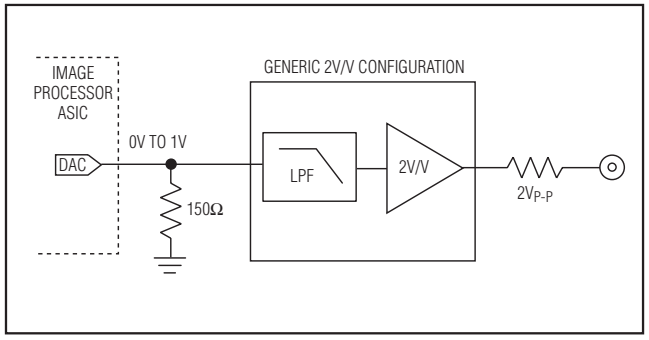


Figure 3. Typically, a Video DAC Generates a 1VP-P Signal Across a 150Ω Resistor Connected to Ground

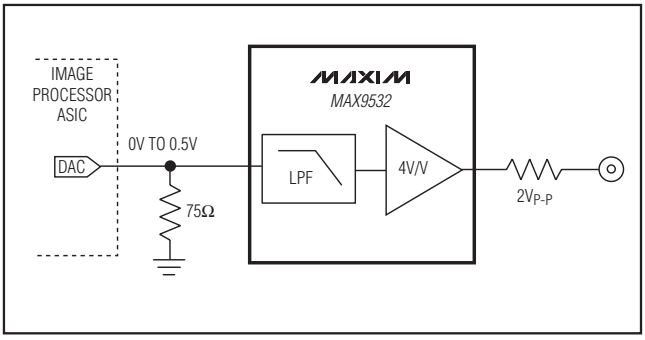


Figure 4. Video DAC Generates a 0.5VP-P Signal Across a 75Ω Resistor Connected to Ground

Table 1. Power Consumption of the MAX9532 with Different Video Signals

VIDEO SIGNAL	MAX9532 POWER CONSUMPTION (mW) WITH 150Ω LOAD	MAX9532 POWER CONSUMPTION (mW) WITH 100Ω LOAD
All Black Screen	51.236	53.978
All White Screen	57.077	65.399
75% Color Bars	53.074	57.486
50% Flat Field	49.513	51.596

Note: *The supply voltage is 3.3V.*

Interfacing to Video DACs that Produce Video Signals Higher than 0.5VP-P

Devices designed to generate 1VP-P video signals at the output of the video DAC can work with the MAX9532. Most video DACs source current into a ground-referenced resistor, which converts the current into a voltage. Figure 3 shows a video DAC that creates a video signal from 0V to 1V across a 150Ω resistor. With a gain of 2V/V, the following video filter produces a 2VP-P output.

The MAX9532 accepts input signals that are 0.5VP-P nominally. The video DAC in Figure 3 can be made to work with the MAX9532 by scaling down the 150Ω resistor to a 75Ω resistor, as shown in Figure 4. The 75Ω resistor is one-half the size of the 150Ω resistor, resulting in a video signal that is one-half the amplitude.

Video Source with a Positive DC Bias

In some applications, the video source generates a signal with a positive DC voltage bias, i.e., the sync tip of the signal is well above ground. Figure 5 shows an example in which the outputs of the luma (Y) DAC and the chroma (C) DAC are connected together. Since the DACs are current-mode, the output currents sum together into the resistor, which converts the resulting current into a voltage representing a composite video signal.

When the chroma DAC is connected to an independent output resistor to ground, the chroma signal, which is a carrier at 3.58MHz for NTSC or at 4.43MHz for PAL, generates a positive DC bias to keep the signal above ground at all times. When the luma DAC is connected to an independent output resistor to ground, the luma signal usually does not have a positive DC bias, and the sync tip is at approximately ground. When the chroma and luma signals are added together, the resulting composite video signal generates a positive DC bias. Therefore, the signal must be AC-coupled into the MAX9532 because the composite video signal is above the nominal 0V to 0.7V DC-coupled input range.

Video Signal Routing

Minimize the length of the PCB trace between the output of the video DAC and the input of the MAX9532 to reduce coupling of external noise into the video signal. If possible, shield the PCB trace.

DirectDrive Video Amplifier with Short-to-Battery Protection

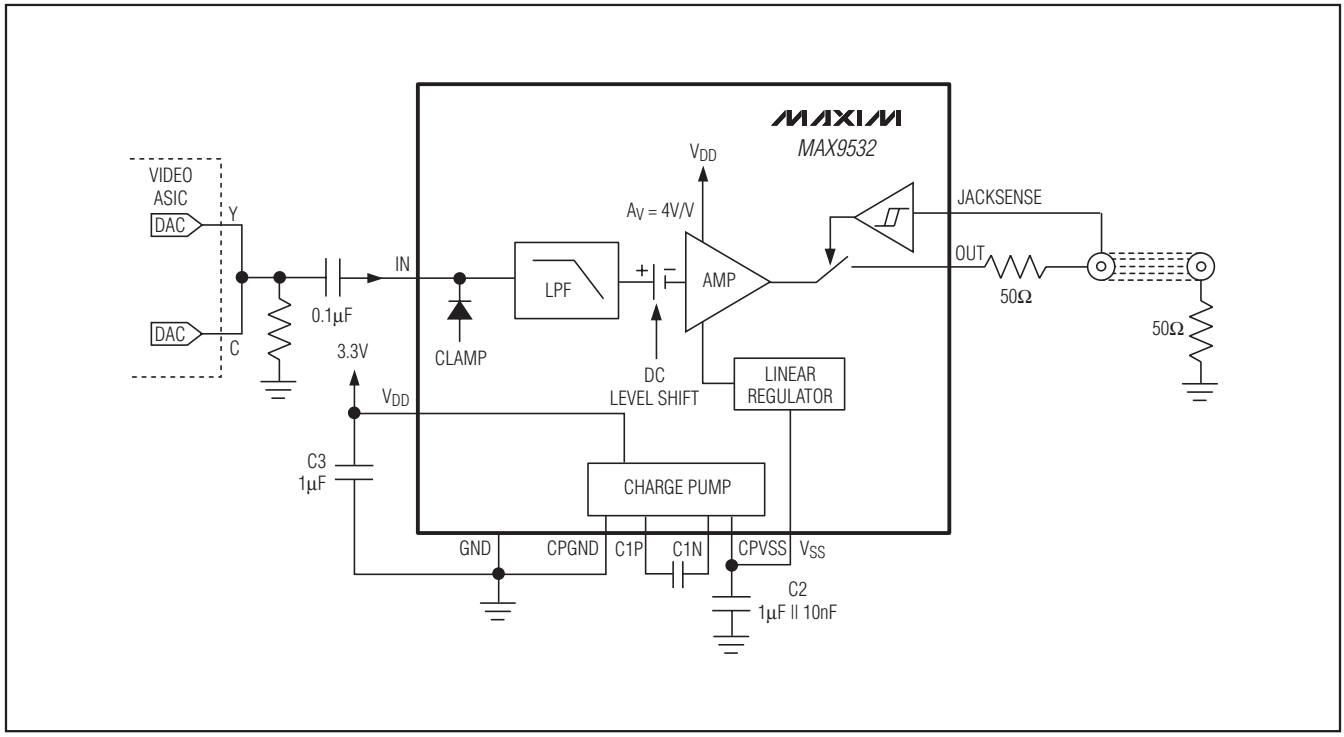


Figure 5. Luma (Y) and Chroma (C) Signals are Added Together to Create a Composite Video Signal, Which is AC-Coupled into the MAX9532

Power-Supply Bypassing and Ground Management

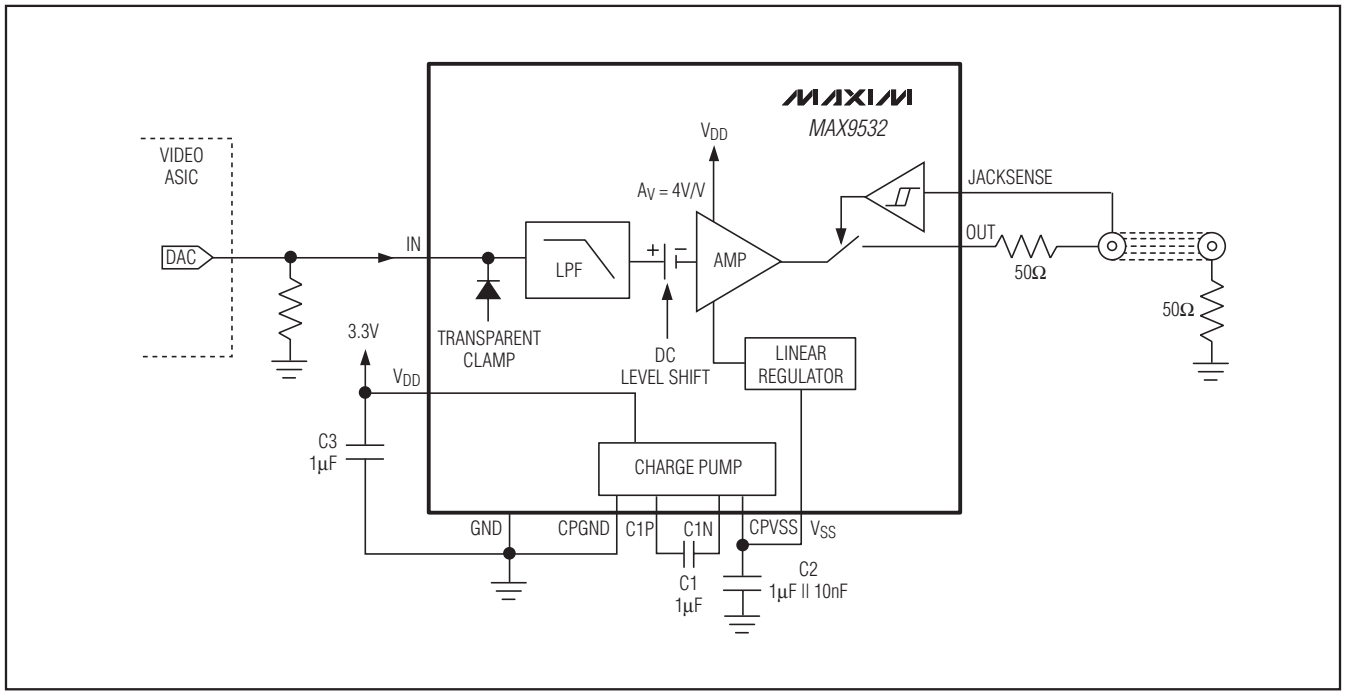
The MAX9532 operates from a 3V to 3.6V single supply and requires proper layout and bypassing. For the best performance, place the components as close as possible to the device.

Proper grounding improves performance and prevents any switching noise from coupling into the video signal.

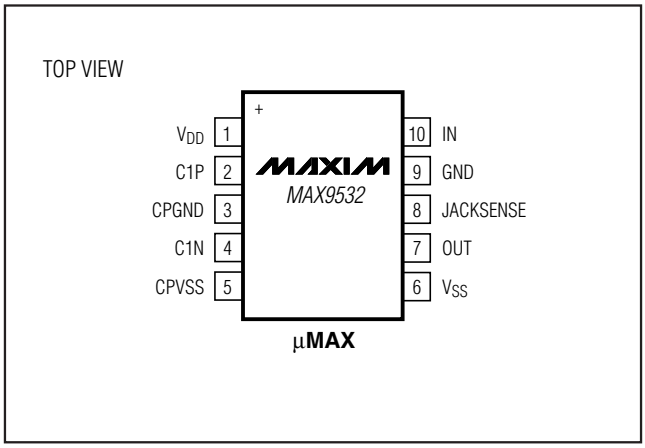
Bypass the analog supply (V_{DD}) with a 1µF capacitor to GND, placed as close as possible to the device. Bypass CPVSS to GND with a 1µF ceramic capacitor in parallel with a 10nF low-ESR capacitor. The bypass capacitors should be placed as close as possible to the device.

DirectDrive Video Amplifier with Short-to-Battery Protection

Functional Diagram/Typical Application Circuits (DC-Coupled Input/Inactive Input Clamp)



Pin Configuration



Chip Information

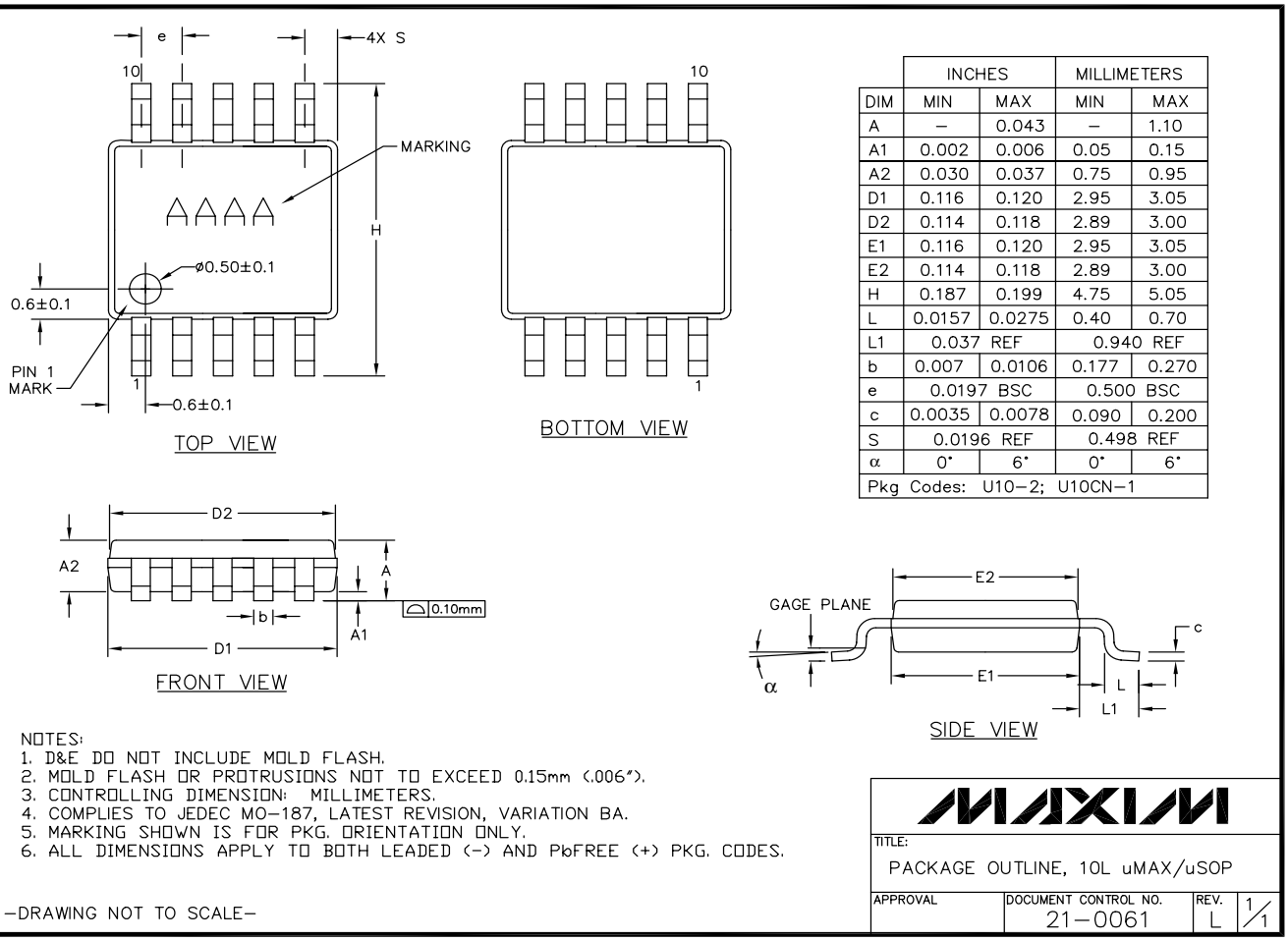
PROCESS: BiCMOS

DirectDrive Video Amplifier with Short-to-Battery Protection

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
10 µMAX	U10+2	21-0061	90-0330



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	–	0.043	–	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
D1	0.116	0.120	2.95	3.05
D2	0.114	0.118	2.89	3.00
E1	0.116	0.120	2.95	3.05
E2	0.114	0.118	2.89	3.00
H	0.187	0.199	4.75	5.05
L	0.0157	0.0275	0.40	0.70
L1	0.037 REF		0.940 REF	
b	0.007	0.0106	0.177	0.270
e	0.0197 BSC		0.500 BSC	
c	0.0035	0.0078	0.090	0.200
S	0.0196 REF		0.498 REF	
α	0°	6°	0°	6°
Pkg Codes: U10-2; U10CN-1				

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. COMPLIES TO JEDEC MO-187, LATEST REVISION, VARIATION BA.
5. MARKING SHOWN IS FOR PKG. ORIENTATION ONLY.
6. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PbFREE (+) PKG. CODES.

-DRAWING NOT TO SCALE-

MAXIM

TITLE: PACKAGE OUTLINE, 10L uMAX/uSOP

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0061	L	1/1

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/09	Initial release	—
1	8/11	Added automotive qualified part	1
2	11/11	Updated part number to show tape and reel designation	1

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