查询MAX7438供应商 捷多邦，专业PCB打样工厂，24小时加急出货

19-2857; Rev 0; 4/03

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MAXIM

# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND



## General Description

The MAX7438/MAX7439 three-channel standard definition video reconstruction filters include a back-porch clamp that sets the output blanking level of the video signal to ground. Each channel of the MAX7438/MAX7439 combines a lowpass filter with adjustable high-frequency boost levels and an output buffer capable of driving two standard 150Ω video loads. The blanking level of the output video signal on each channel is clamped to ground, eliminating the need for large AC-coupling output capacitors. Direct input coupling circuitry eliminates the need for AC-coupling input capacitors. This DC-in/DC-out architecture results in extremely low line-time distortion. The MAX7438/MAX7439 are ideal for antialiasing and DAC smoothing in digital video devices such as STBs, DVDs, PVRs, and hard disk recorders. The MAX7438/MAX7439 operate from ±5V dual supplies.

The three-channel MAX7438/MAX7439 are ideal for Y, $P_b$, $P_r$, and RGB component video signals, three composite video signals, and also Y/C plus CVBS video signals. Each filter channel achieves 60dB of attenuation at 27MHz and a maximally flat passband from DC to 5MHz.

The MAX7438 offers an internal gain of +2V/V, while the MAX7439 offers a gain of +3V/V.

## Applications

Set-Top Boxes/HDR/DVD
Game Consoles
Camcorders

Composite, Component, S-Video Output for NTSC, PAL, SDTV

## Features

- Back-Porch of Video Output Signal Clamped to Ground
- Eliminates Input/Output AC-Coupling Capacitors
- 0.1% Line-Time Distortion
- Stopband: 55dB at 27MHz
- Passband: ±0.8dB out to 5MHz
- Diff Gain = 0.05%, Diff Phase = 0.05 Degrees
- Output Clamped to Ground with Loss of Input
- Each Output Drives Two 150Ω Video Loads
- Up to 2dB of High-Frequency Boost Control
- Ideal for CVBS, Y/C (S-Video), and RGB (Y, $P_b$, $P_r$) Outputs for NTSC, PAL, and SDTV
- Filter Bypass Mode
- Small 20-Pin 5mm × 5mm Thin QFN Package

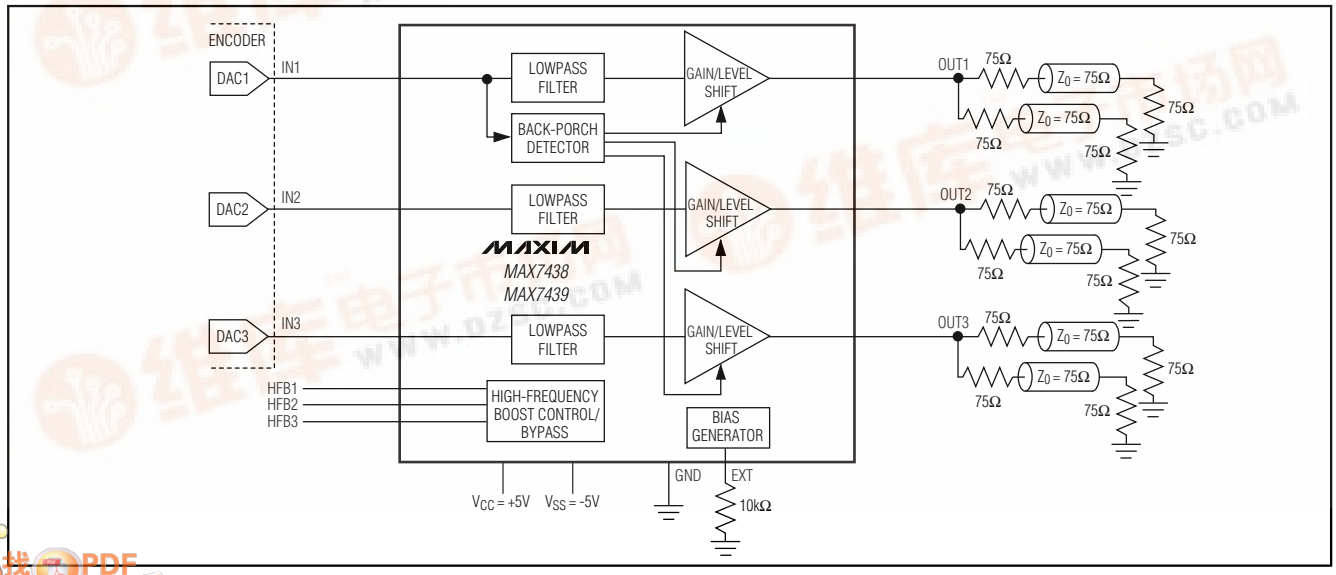
## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX7438**ETP | -40°C to +85°C | 20 Thin QFN-EP* |
| **MAX7439**ETP | -40°C to +85°C | 20 Thin QFN-EP* |

*EP = Exposed paddle

***Pin Configuration appears at end of data sheet.***

## Functional Diagram






For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at

# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

## ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ to GND .....-0.3V to +6V
$V_{SS}$ to GND.....-6V to +0.3V
OUT_ to GND .....-2.5V to +3.5V
All Other Pins to GND .....($V_{SS}$ - 0.3V) to ($V_{CC}$ + 0.3V)
Maximum Current into Any Pin .....±50mA
Continuous Power Dissipation ($T_A$ = +70°C)
20-Pin 5mm x 5mm Thin QFN (derate 20.8mW/°C above +70°C).....1666.7mW

Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature.....+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

($V_{CC}$ = +5V ±5%, $V_{SS}$ = -5V ±5%, $R_{EXT}$ = 10kΩ ±1%, $R_{HFB_-1}$ = 15kΩ ±1%, $R_{HFB_-2}$ = 1kΩ ±1%, no boost, $R_{OUT}$ = 75Ω, $C_{OUT}$ = 0 to 20pF, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values are at $T_A$ = +25°C.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Passband Response | | f = 100kHz to 4.2MHz, no HF boost | | -0.6 | | +0.6 | dB |
| | | f = 100kHz to 5MHz, no HF boost | | -0.8 | | +0.8 | |
| Stopband Attenuation | $A_{SB}$ | f = 27MHz, relative to 100kHz | | 40 | 60 | | dB |
| HF Boost Step Size | | f = 4.2MHz | | | 0.45 | | dB |
| HFB_ Voltage Range | $V_{HFB_}$ | Bypass | | 0 | | 50 | mV |
| | | No boost | | 280 | | 360 | |
| | | Boost 1 | | 670 | | 850 | |
| | | Boost 2 | | 1360 | | 1700 | |
| | | Boost 3 | | 2250 | | 2750 | |
| | | Boost 4 | | 3500 | | $V_{CC}$ | |
| Differential Gain | dG | 5-step modulated staircase | MAX7438, $V_{IN}$ = 1$V_{P-P}$ | | 0.05 | 0.5 | % |
| | | | MAX7439, $V_{IN}$ = 670m$V_{P-P}$ | | 0.05 | 0.5 | |
| Differential Phase | dθ | 5-step modulated staircase | MAX7438, $V_{IN}$ = 1$V_{P-P}$ | | 0.05 | 0.5 | Degrees |
| | | | MAX7439, $V_{IN}$ = 670m$V_{P-P}$ | | 0.05 | 0.5 | |
| Total Harmonic Distortion | THD | f = 100kHz to 5MHz, $V_{IN}$ = 0.7$V_{P-P}$ | MAX7438, $V_{IN}$ = 700m$V_{P-P}$ | | 0.2 | 0.5 | % |
| | | | MAX7439, $V_{IN}$ = 460m$V_{P-P}$ | | 0.2 | 0.5 | |
| Signal-to-Noise Ratio | SNR | Output signal (2$V_{P-P}$) to P-P noise, f = 100Hz to 5MHz | | 68 | 75 | | dB |
| Group Delay Deviation | $\Delta t_G$ | Deviation from 100kHz to 3.58(4.43)MHz | | | 12 | 30 | ns |
| Group Delay Matching | $t_{G(MATCH)}$ | f = 100kHz | | | 2 | | ns |
| Line-Time Distortion | $H_{DIST}$ | 18µs, 100 IRE bar | | | 0.1 | | % |
| Field-Time Distortion | $V_{DIST}$ | 130 lines, 18µs, 100 IRE bar | | | 0.2 | | % |

## ELECTRICAL CHARACTERISTICS (continued)

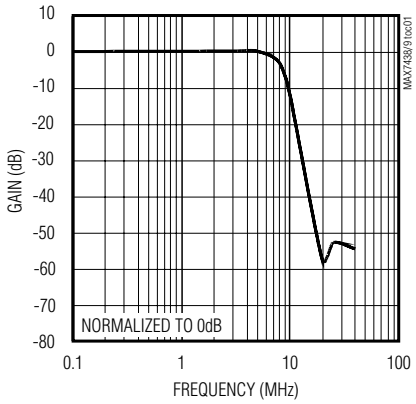
($V_{CC}$ = +5V ±5%, $V_{SS}$ = -5V ±5%, $R_{EXT}$ = 10kΩ ±1%, $R_{HFB_-1}$ = 15kΩ ±1%, $R_{HFB_-2}$ = 1kΩ ±1%, no boost, $R_{OUT}$ = 75Ω, $C_{OUT}$ = 0 to 20pF, $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values are at $T_A$ = +25°C.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Clamp Accuracy | | Output blanking level relative to GND | | -55 | | +55 | mV |
| Clamp Settling Time | | Back porch within the specified clamp accuracy | | | | 50 | Lines |
| Low-Frequency Gain | | Gain at 100kHz | MAX7438 | 5.5 | 6 | 6.5 | dB |
| | | | MAX7439 | 9 | 9.54 | 10 | |
| Low-Frequency Gain Matching | $t_G$ | Channel-to-channel gain matching, f = 100kHz | | | | +5 | % |
| Input Voltage Range | | THD < 0.5% | | -0.5 | | +1.8 | V |
| Output Voltage Range | $V_{OUT}$ | f = 5MHz | | -0.8 | | +1.8 | V |
| Channel-to-Channel Crosstalk | $X_{TALK}$ | Channel-to-channel crosstalk, f = 5MHz | | | -60 | | dB |
| Output Short-Circuit Current | $I_{SC}$ | OUT_ shorted to GND or $V_{CC}$ | | | 50 | | mA |
| Input Leakage Current at IN_ | $I_{IN_}$ | | | | ±1 | ±5 | µA |
| Input Leakage Current at HFB_ | $I_{HFB_}$ | Bypass mode, boost 1 to boost 3 | | | | 0.2 | µA |
| | | Boost 4 | | | | 30 | |
| Input Resistance | | | | 500 | | | kΩ |
| Supply Voltage Range | $V_{CC}$ | | | 4.75 | | 5.25 | V |
| | $V_{SS}$ | | | -4.75 | | -5.25 | |
| Supply Current | $I_{CC}$ | $V_{CC}$ = +5.25V, no load | | | 110 | 160 | mA |
| | $I_{SS}$ | $V_{SS}$ = -5.25V, no load | | | 110 | 160 | |
| Power-Supply Rejection Ratio | PSRR | $V_{IN}$ = 100m$V_{P-P}$, f = 0 to 3.5MHz | | | 30 | | dB |

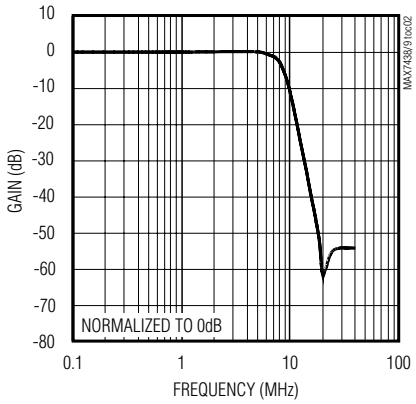
## Typical Operating Characteristics

($V_{CC}$ = +5V, $V_{SS}$ = -5V, $R_{OUT_}$ = 150Ω, $R_{EXT}$ = 10kΩ, no boost, $T_A$ = +25°C, unless otherwise noted.)

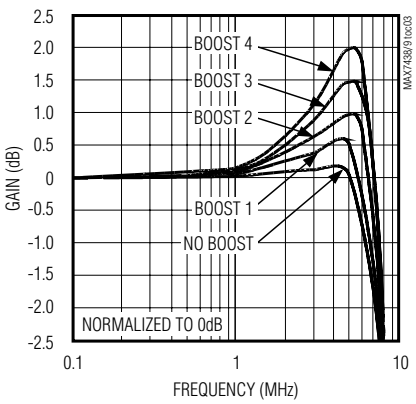
**MAX7438**
**AMPLITUDE vs. FREQUENCY**




**MAX7439**
**AMPLITUDE vs. FREQUENCY**




**MAX7438**
**PASSBAND AMPLITUDE vs. FREQUENCY**

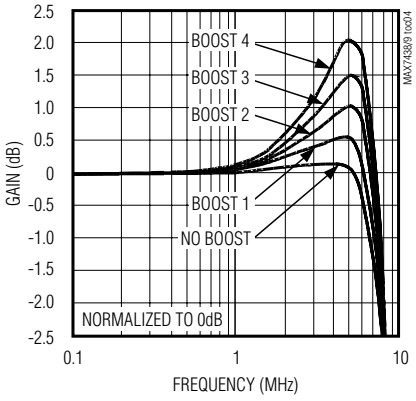


# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

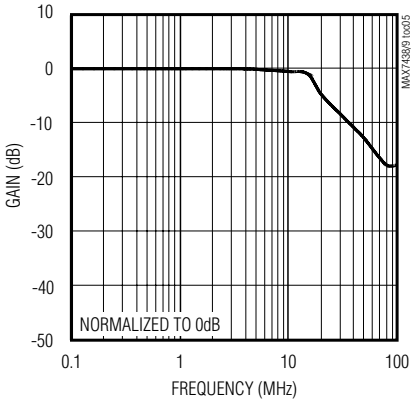
## Typical Operating Characteristics (continued)

($V_{CC}$ = +5V, $V_{SS}$ = -5V, $R_{OUT_}$ = 150Ω, $R_{EXT}$ = 10kΩ, no boost, $T_A$ = +25°C, unless otherwise noted.)

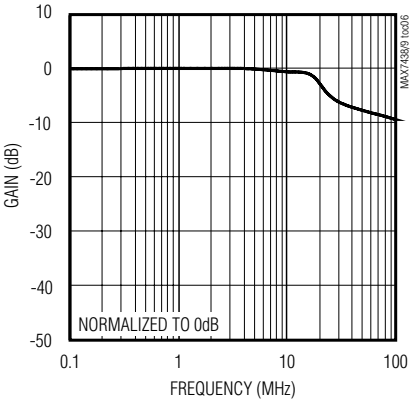
**MAX7439**
**PASSBAND AMPLITUDE vs. FREQUENCY**



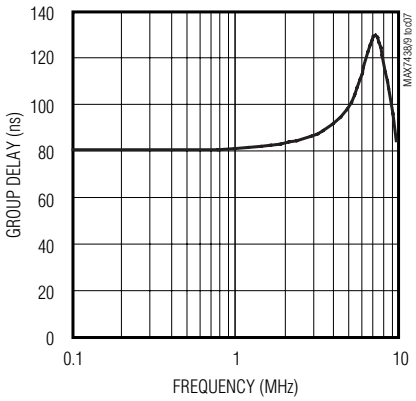

**MAX7438**
**CHANNEL RESPONSE (BYPASS MODE)**



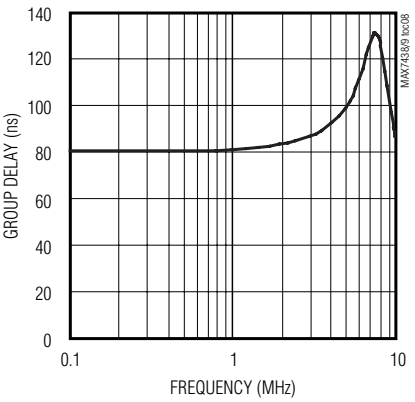

**MAX7439**
**CHANNEL RESPONSE (BYPASS MODE)**



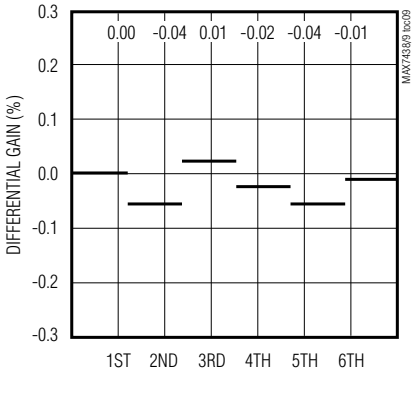

**MAX7438**
**GROUP DELAY vs. FREQUENCY**



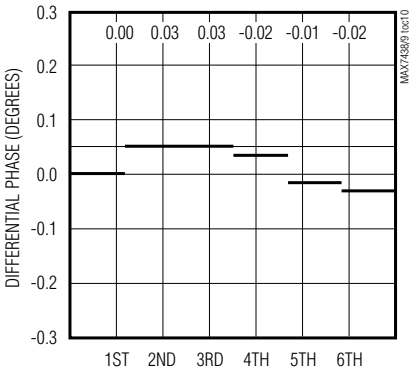

**MAX7439**
**GROUP DELAY vs. FREQUENCY**



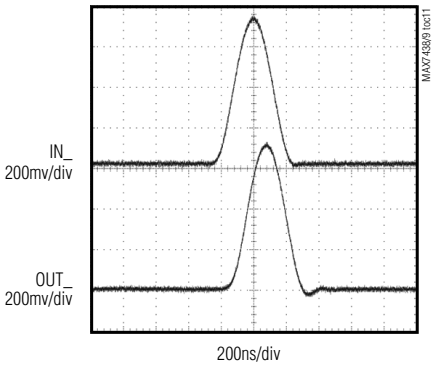

**DIFFERENTIAL GAIN**



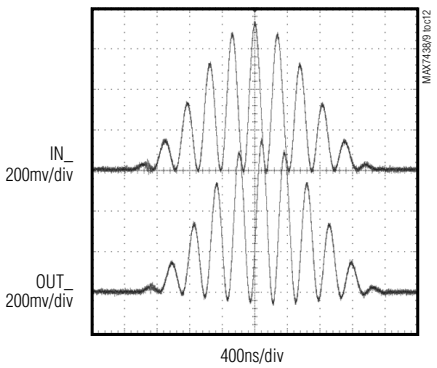

**DIFFERENTIAL PHASE**




**2T RESPONSE**




**12.5T RESPONSE**

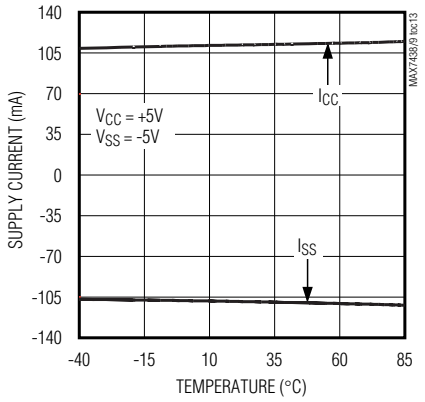


# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

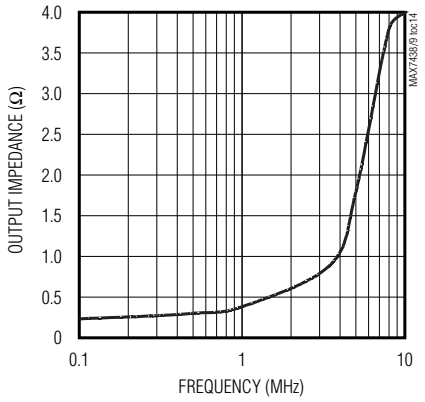
## Typical Operating Characteristics (continued)

($V_{CC}$ = +5V, $V_{SS}$ = -5V, $R_{OUT_}$ = 150Ω, $R_{EXT}$ = 10kΩ, no boost, $T_A$ = +25°C, unless otherwise noted.)

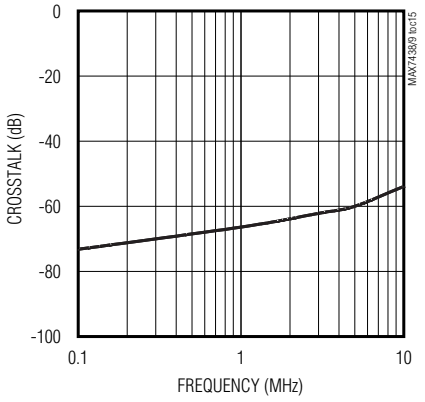
**SUPPLY CURRENT VS. TEMPERATURE**



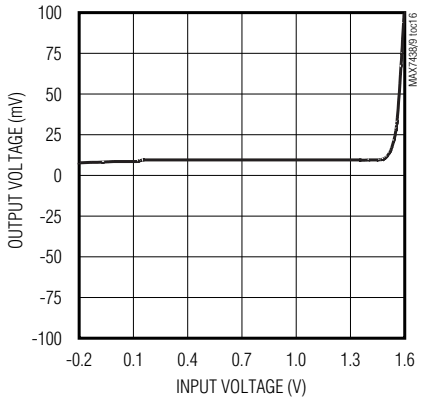

**OUTPUT SOURCE IMPEDANCE vs. FREQUENCY**



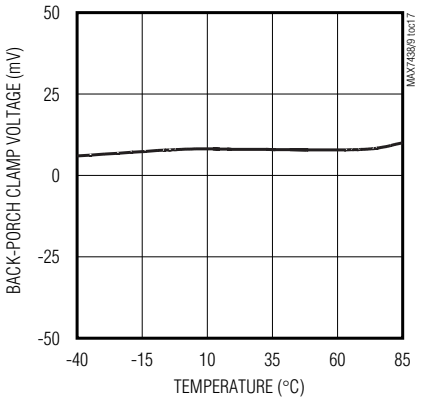

**PASSBAND CHANNEL-TO-CHANNEL CROSSTALK vs. FREQUENCY**




**BACK-PORCH LEVEL OUTPUT VOLTAGE vs. INPUT VOLTAGE**




**BACK-PORCH CLAMP VOLTAGE vs. TEMPERATURE**



# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

## Pin Description

| PIN | NAME | FUNCTION |
|---|---|---|
| 1, 4, 7, 10, 11, 13, 15, 19 | GND | Ground |
| 2 | IN1 | Channel 1 Video Input |
| 3 | HFB1 | Channel 1 High-Frequency Boost and Filter Bypass Control Input. Connect external resistors to HFB1 for high-frequency boost and filter bypass control. See Table 1. |
| 5 | OUT1 | Channel 1 Video Output |
| 6 | $V_{CC}$ | +5V Power Input |
| 8 | OUT2 | Channel 2 Video Output |
| 9 | $V_{SS}$ | -5V Power Input. Connect the backside exposed pad to $V_{SS}$. |
| 12 | OUT3 | Channel 3 Video Output |
| 14 | HFB3 | Channel 3 High-Frequency Boost and Filter Bypass Control Input. Connect external resistors to HFB3 for high-frequency boost and filter bypass control. See Table 1. |
| 16 | IN3 | Channel 3 Video Input |
| 17 | HFB2 | Channel 2 High-Frequency Boost and Filter Bypass Control Input. Connect external resistors to HFB2 for high-frequency boost and filter bypass control. See Table 1. |
| 18 | IN2 | Channel 2 Video Input |
| 20 | EXT | External Bias Resistor. Connect a 10kΩ resistor from EXT to GND. |
| — | EP | Exposed Paddle. Connect to $V_{SS}$. Do not connect to GND. |

**Table 1. External Resistor Values for Bypass Mode and High-Frequency Boost Control**

| MODE | $R_{HFB_-1}$ (kΩ) | $R_{HFB_-2}$ (kΩ) | $V_{HFB_}$ (V) ($V_{CC}$ = 5V) | NOMINAL BOOST (dB)/ BYPASS (MAX7438) | NOMINAL BOOST (dB)/ BYPASS (MAX7439) |
|---|---|---|---|---|---|
| Bypass | Open | 0 | 0 | Bypass | Bypass |
| No boost | 15 | 1 | 0.318 | 0 | 0 |
| Boost 1 | 11.3 | 2 | 0.758 | 0.5 | 0.75 |
| Boost 2 | 16.5 | 7.32 | 1.53 | 1.0 | 1.5 |
| Boost 3 | 11.3 | 11.3 | 2.5 | 1.5 | 2.25 |
| Boost 4 | 4.42 | 18.2 | 4.027 | 2.0 | 3.0 |

## Detailed Description

### Filter

#### Filter Response

The MAX7438/MAX7439 reconstruction filters consist of three separate lowpass filters with Butterworth-type response. The filter features a maximally flat passband for NTSC and PAL bandwidths, while maintaining good group delay characteristics. The stopband offers excellent attenuation at frequencies of 27MHz and above (see the *Typical Operating Characteristics* section).

The autotrimming circuit digitally controls the corner frequency to maintain the frequency characteristics over process and temperature.

#### High-Frequency Boost

The high-frequency boost compensates for signal degradation and roll-off in the signal path prior to the MAX7438/MAX7439 to increase image sharpness. Program the level of high-frequency boost for each channel by selecting the corresponding external resistor values ($R_{HFB_-1}$ and $R_{HFB_-2}$, as shown in the *Typical Operating Circuit* section) given in Table 1. The

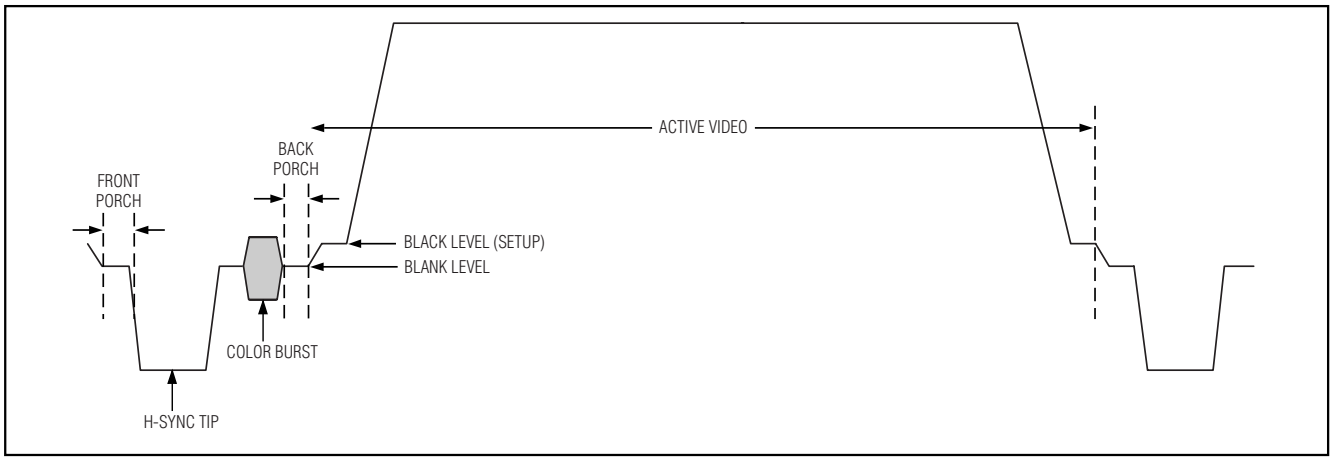



*Figure 1. Standard Video Signal*

external resistors form a voltage-divider between $V_{CC}$ and GND. The values in the fourth column ($V_{HFB_}$ (V)) are calculated using the following equation:

$$V_{HFB_} = V_{CC} \times R_{HFB_-2} / (R_{HFB_-1} + R_{HFB_-2})$$

where $V_{CC}$ = 5V.

Apply an external voltage to HFB_ in place of $R_{HFB_-1}$ and $R_{HFB_-2}$ as an alternative. See the *Electrical Characteristics* section. Filter boost modes can also be controlled from a microprocessor. See the *Applications Information* section.

### Filter Bypass

The MAX7438/MAX7439 offer selectable filter bypassing that allows any of the video inputs to be filtered or unfiltered. Select the filter bypass mode for a given channel by setting the corresponding values for $R_{HFB_-1}$ and $R_{HFB_-2}$ according to Table 1.

### Output Buffer

The output buffer is able to drive two standard 150Ω video loads with a $2V_{P-P}$ signal. The MAX7438 output buffer has a preset gain of 2V/V, and the MAX7439 output buffer has a gain of 3V/V. The MAX7439 is ideal for a DAC output whose voltage range is between 0.67V and 1V. Set the DAC output to 0.67V to achieve a 2V/V signal on OUT_.

### Back-Porch Clamp

The MAX7438/MAX7439 feature a back-porch clamp to set the output blanking level. This clamp shifts the DC level of the video signal so that the back-porch level is close to ground (see Figure 1). The devices sense the voltage during back porch and feed back into a control system that provides the appropriate DC-level shift in the filter channel to clamp the output to ground. The back-porch clamp to ground eliminates the need for large output-coupling capacitors that can introduce unwanted line-time distortion (tilt), cost, and board space. This feedback network and the on-chip capacitors introduce a finite settling time (50 lines max) after power-up or any dramatic shift in input voltage (see the *Electrical Characteristics* section).

Channel 1 requires a video signal with sync information (CVBS, Y, or G), since the other two channels are clamped from channel 1. In the absence of a sync on channel 1, the circuit forces all outputs actively and continuously to ground.

## Applications Information

### Power-Supply Bypassing and Layout

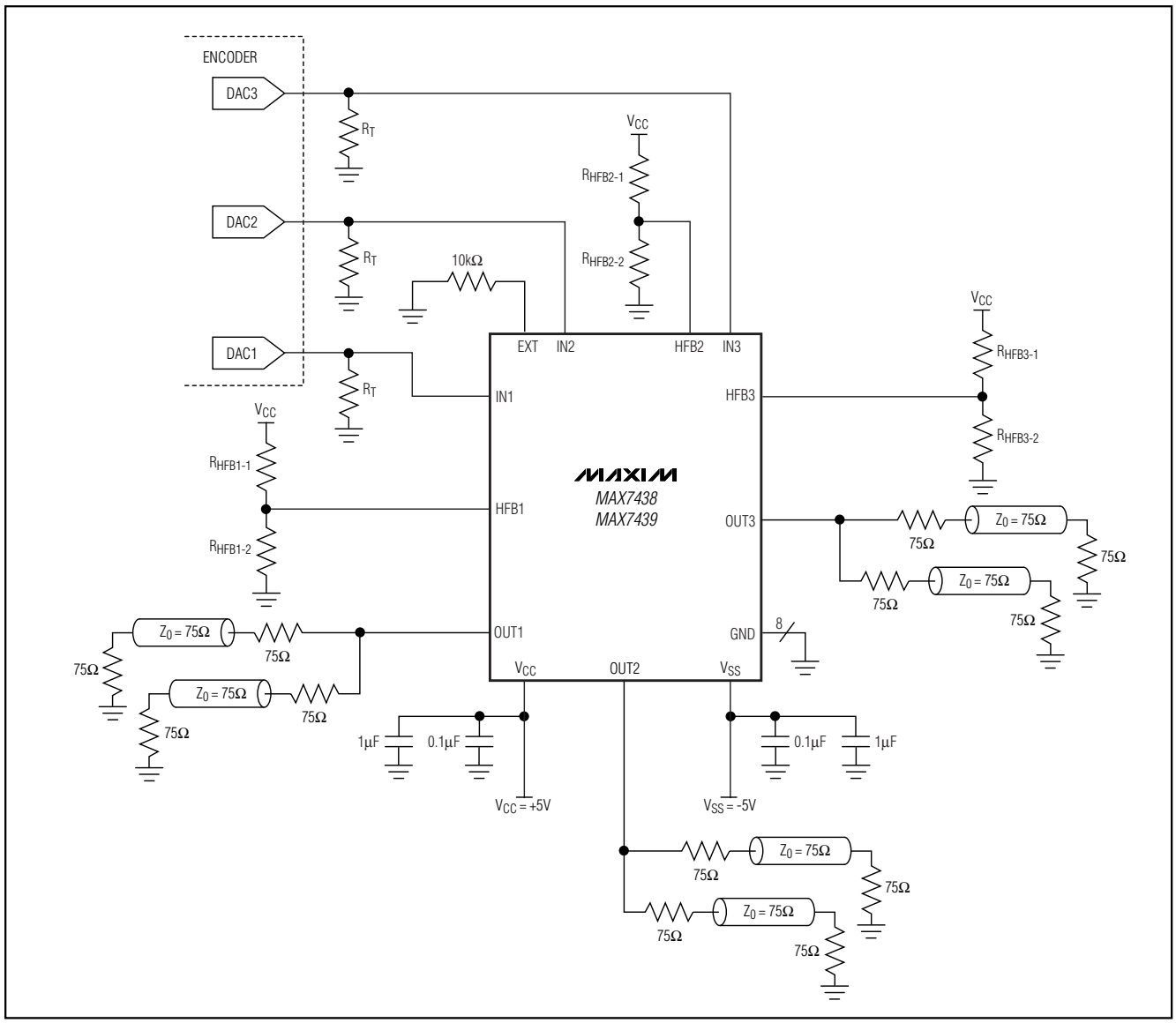
The MAX7438/MAX7439 operate from dual ±5V supplies. Bypass $V_{CC}$ and $V_{SS}$ to GND with 0.1µF capacitors in parallel with 1µF capacitors. Place the 0.1µF capacitors as close to the power inputs as possible. Since EXT is a sensitive input, place $R_{EXT}$ close to the device to avoid signals coupling into EXT. Do not route any input, output, or dynamic signal near this pin and the accompanying trace.

**Note:** The exposed paddle is electrically connected to VSS.

Do not connect the exposed paddle to ground. Refer to the MAX7438 EV kit for layout examples, as well as a proven PC board layout example.

# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

## Typical Operating Circuit




### Microprocessor Control of High-Frequency Boost and Bypass

Use a DAC output to control the bypass and high-frequency boost levels on each channel (see Figure 2). Set the DAC output voltage to the corresponding bypass or boost levels desired (see Table 1).

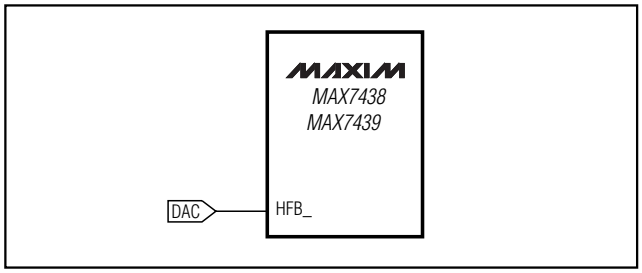
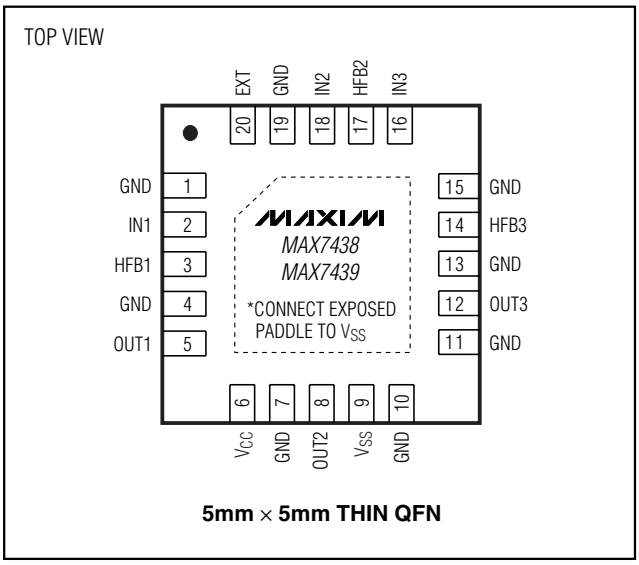



*Figure 2. DAC Control of High-Frequency Boost and Bypass*

# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

## Pin Configuration




**5mm × 5mm THIN QFN**

## Chip Information

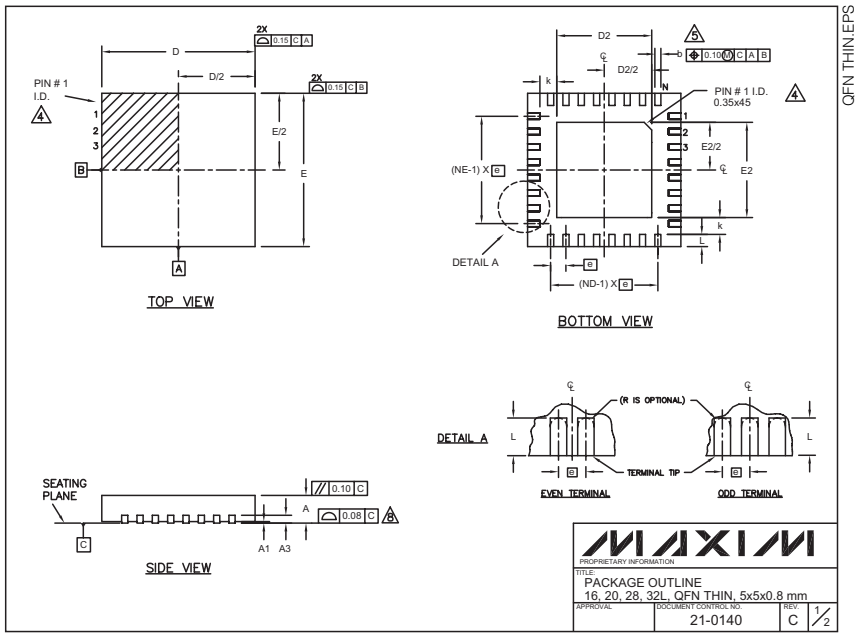
TRANSISTOR COUNT: 6418

PROCESS: BiCMOS

# Triple-Channel Video Reconstruction Filters with Back-Porch Clamp to GND

## Package Information

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




COMMON DIMENSIONS

| PKG. | 16L 5x5 | | | 20L 5x5 | | | 28L 5x5 | | | 32L 5x5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYMBOL | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 |
| A3 | 0.20 REF. | | | 0.20 REF. | | | 0.20 REF. | | | 0.20 REF. | | |
| b | 0.25 | 0.30 | 0.35 | 0.25 | 0.30 | 0.35 | 0.20 | 0.25 | 0.30 | 0.20 | 0.25 | 0.30 |
| D | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 |
| E | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 |
| e | 0.80 BSC. | | | 0.65 BSC. | | | 0.50 BSC. | | | 0.50 BSC. | | |
| k | 0.25 | - | - | 0.25 | - | - | 0.25 | - | - | 0.25 | - | - |
| L | 0.45 | 0.55 | 0.65 | 0.45 | 0.55 | 0.65 | 0.45 | 0.55 | 0.65 | 0.30 | 0.40 | 0.50 |
| N | 16 | | | 20 | | | 28 | | | 32 | | |
| ND | 4 | | | 5 | | | 7 | | | 8 | | |
| NE | 4 | | | 5 | | | 7 | | | 8 | | |
| JEDEC | WHHB | | | WHHC | | | WHHD-1 | | | WHHD-2 | | |

EXPOSED PAD VARIATIONS

| PKG. CODES | D2 | | | E2 | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| T1655-1 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T2055-2 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T2855-1 | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 |
| T2855-2 | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 |
| T3255-2 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |

NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
9. DRAWING CONFORMS TO JEDEC MO220.
10. WARPAGE SHALL NOT EXCEED 0.10 mm.

PROPRIETARY INFORMATION
TITLE:
PACKAGE OUTLINE
16, 20, 28, 32L, QFN THIN, 5x5x0.8 mm
APPROVAL
DOCUMENT CONTROL NO.
21-0140
REV.
C
2/2

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