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Standard Definition Video Reconstruction Filters and Buffers

MAX7428/MAX7430/MAX7432

General Description

The MAX7428/MAX7430/MAX7432 filters are low-cost, high-performance replacements for standard discrete filter and buffer solutions. The MAX7428/MAX7430/MAX7432 are ideal for anti-aliasing and DAC smoothing video applications, when analog video is reconstructed from a digital data stream. These devices require a single +5V supply and the filters have a cutoff frequency optimized for NTSC, PAL, and standard definition digital TV (SDTV) video signals. The MAX7428/MAX7430/MAX7432 feature Maxim's Single Pin Bus (MSPB™) interface to digitally control channel selection (IN_A or IN_B), adjust high-frequency boost, bypass the filter, configure luma vs. chroma operation, and control the output disable. The MAX7428 single-channel filter is ideal for composite (CVBS) video signals. The MAX7430 dual filter is optimized for S-Video (Y/C) applications. The MAX7432 triple filter is optimized for component (Y_PP_r or embedded synchronous RGB) video signals. The MAX7428 is available in a tiny 8-pin SOT23 package, the MAX7430 is available in a miniature 10-pin μMAX® package, and the MAX7432 is available in a 14-pin TSSOP package. The MAX7428/MAX7430/MAX7432 are fully specified over the -40°C to +85°C extended temperature range.

Applications

- Set-Top Boxes
- DVD Players
- Hard-Disk Recorders
- Camcorders

Features

- ◆ Ideal for CVBS, Y/C (S-Video), and RGB (Y P_b P_r) Outputs for NTSC, PAL, and SDTV
- ◆ 6th-Order Lowpass Filter
- ◆ Drives Two 150Ω Video Loads
- ◆ Four Levels of Passband High-Frequency Boost Control
- ◆ Input 2 to 1 Multiplexer
- ◆ Output Disable
- ◆ Filter Bypassing
- ◆ +5V Single-Supply Voltage
- ◆ Tiny 8-Pin SOT23 Package (MAX7428), 10-Pin μMAX Package (MAX7430), and 14-Pin TSSOP Package (MAX7432)

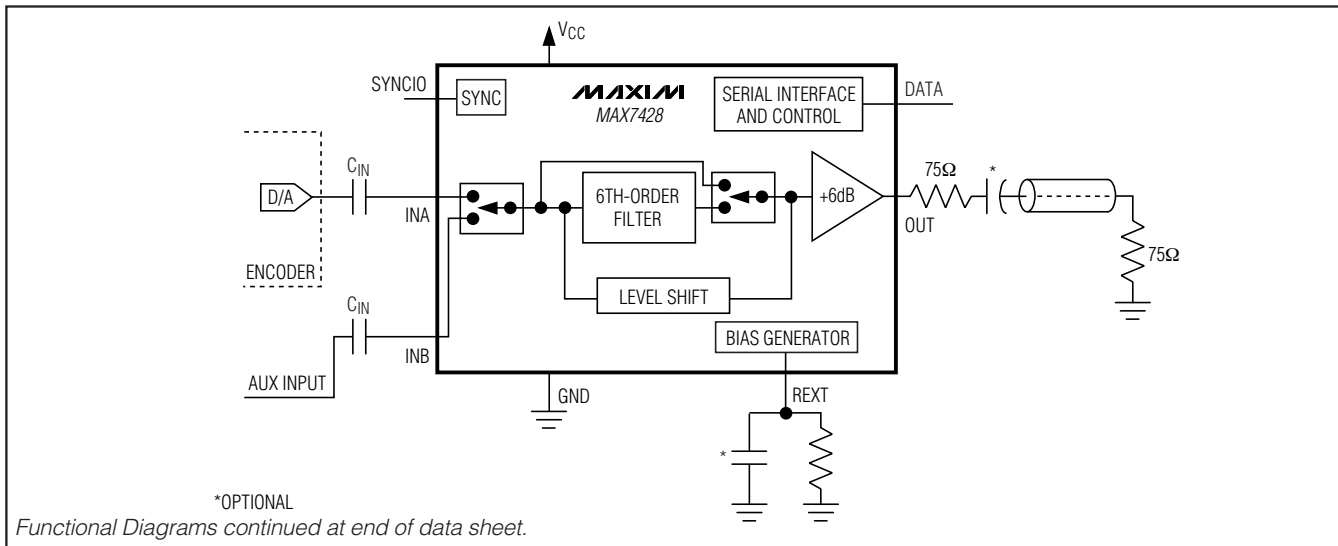
Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE | TOP MARK |
|--------------|----------------|-------------|----------|
| MAX7428EKA-T | -40°C to +85°C | 8 SOT23-8 | AAIU |
| MAX7430EUB | -40°C to +85°C | 10 μMAX | — |
| MAX7432EUD | -40°C to +85°C | 14 TSSOP | — |

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Pin Configurations appear at end of data sheet.

Functional Diagrams



Standard Definition Video Reconstruction Filters and Buffers

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND+6V
 All Other Pins to GND-0.3V to (V_{CC} + 0.3V)
 Maximum Current Into Any Pin±50mA
 Continuous Power Dissipation (T_A = +70°C)
 8-Pin SOT23 (derate 9.71mW/°C above +70°C).....777mW
 10-Pin μMAX (derate 6.94mW/°C above +70°C).....555.5mW
 14-Pin TSSOP (derate 9.1mW/°C above +70°C)727mW

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 ±10%, R_{REXT} = 300kΩ ±1%, C_{IN} = 0.1μF, C_{REXT} = (1nF to 1μF) ±1%, C_{LOAD} = 0 to 20pF; BOOST0_, BOOST1_ = 0, 0; T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------------------------|------------------------|--|------|-------|------|---------|
| Passband Response | | f = 100kHz to 4.2MHz relative to 100kHz | -0.5 | | +0.5 | dB |
| | | f = 100kHz to 5MHz relative to 100kHz | -1.0 | | +1.0 | |
| Stopband Attenuation | A _{sb} | f ≥ 27MHz | 48 | | | dB |
| HF Boost Relative Step Size, 4 Levels | | f = 4.2MHz to 5MHz | 0.2 | 0.4 | 0.6 | dB |
| Differential Gain | dG | 5-step modulated staircase | | 0.2 | | % |
| Differential Phase | dθ | 5-step modulated staircase | | 0.2 | | degrees |
| Harmonic Distortion | THD | f = 100kHz to 5MHz | | 0.1 | 0.5 | % |
| Signal-to-Noise Ratio | SNR | Peak signal (2Vp-p) to RMS noise, f = 100Hz to 50MHz | 72 | | | dB |
| Group Delay Deviation | Δt _g | Deviation from 100kHz to 3.58 (4.43)MHz | | | 20 | ns |
| Line-Time Distortion | H _{dist} | 18μs, 100 IRE bar | | | 0.3 | % |
| Field-Time Distortion | V _{dist} | 130 lines, 18μs, 100 IRE bar | | | 0.5 | % |
| Clamp Settling Time | t _{clamp} | to ±1% (Note 1) | | | 100 | Lines |
| Output DC Clamp Level | | CLEVEL = 0 | 0.8 | | 1.3 | V |
| | | CLEVEL = 1 | 1.35 | | 1.85 | |
| Low-Frequency Gain | A _v | Gain at 100kHz | 1.9 | 1.975 | 2.05 | V/V |
| Group Delay Matching | t _g (MATCH) | Low frequency channel-to-channel matching f = 100kHz | | 2 | | ns |
| Low-Frequency Gain Matching | A _v (MATCH) | Channel-to-channel gain matching, f = 100kHz | | | 5 | % |
| Channel-to-Channel Crosstalk | X _{TALK} | Channel-to-channel crosstalk, f = 100kHz to 5.5MHz | | -60 | | dB |
| Output Short-Circuit Current | I _{SC} | OUT_ shorted to ground or V _{CC} | | 50 | | mA |
| Input Leakage Current | I _{IN} | | | | 10 | μA |
| Input Dynamic Swing | Y _{INp-p} | CLEVEL = 0 | | 1.4 | | Vp-p |
| | C _{INp-p} | CLEVEL = 1 | | 0.9 | | |
| V _{CC} Supply Range | V _{CC} | | 4.5 | | 5.5 | V |

Standard Definition Video Reconstruction Filters and Buffers

MAX7428/MAX7430/MAX7432

ELECTRICAL CHARACTERISTICS (continued)

($V_{CC} = +5V \pm 10\%$, $R_{REXT} = 300k\Omega \pm 1\%$, $C_{IN} = 0.1\mu F$, $C_{REXT} = (1nF \text{ to } 1\mu F) \pm 1\%$, $C_{LOAD} = 0 \text{ to } 20pF$; $BOOST0_$, $BOOST1_ = 0$, 0 ; $T_A = T_{MIN} \text{ to } T_{MAX}$, unless otherwise noted. Typical values are at $T_A = +25^\circ C$.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|------------------------------|----------------------------------|--|-----------------------|-----|-----|-------|
| Supply Current | I _{CC} | No load | MAX7428 | 24 | 32 | mA |
| | | | MAX7430 | 45 | 62 | |
| | | | MAX7432 | 68 | 86 | |
| Power-Supply Rejection Ratio | PSRR | V _{IN} = 100mVp-p, f = 0 to 5.5MHz | | 40 | | dB |
| IN_A/IN_B Crosstalk | | V _{IN} = 100mVp-p, f = 100kHz to 5.5MHz | | -60 | | dB |
| LOGIC CHARACTERISTICS | | | | | | |
| Logic Input High Voltage | V _{IH} | | 2 | | | V |
| Logic Input Low Voltage | V _{IL} | | | | 0.8 | V |
| Logic Input Current | I _{IH} /I _{IL} | V _{IL} = 0 (source), V _{IH} = V _{CC} (sink) | | | 10 | μA |
| Logic Output High Voltage | V _{OH} | I _(SOURCE) = 500μA | V _{CC} - 0.5 | | | V |
| Logic Output Low Voltage | V _{OL} | I _(SINK) = 500μA | | | 0.4 | V |

MSPB INTERFACE TIMING SPECIFICATIONS

($V_{CC} = +5V \pm 10\%$, $R_{REXT} = 300k\Omega \pm 1\%$, $C_{REXT} = (1nF \text{ to } 1\mu F) \pm 1\%$, $C_{LOAD} = 0 \text{ to } 20pF$, $T_A = T_{MIN} \text{ to } T_{MAX}$, unless otherwise noted. Typical values are at $T_A = +25^\circ C$.) (Figures 4 through 9)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|---------------------------------|------------|-----|-----|-----|-------|
| MSPB TIMING | | | | | | |
| Logic-Zero/Prompt Pulse Width | t ₀ , t _P | | 1 | 5 | 8 | μs |
| Logic-One Pulse Width | t ₁ | | 24 | 30 | 36 | μs |
| Transaction Pulse Width | t _T | | 80 | 100 | 120 | μs |
| Separation Between Pulses | t _{WAIT} | | 0.5 | | | μs |
| Bus Release Time by Host After Prompt Pulse | t _{RELEASE} | | | | 1 | μs |
| Bus Reclaim Time by Host After Prompt Pulse | t _{RECLAIM} | | 13 | | | μs |
| Read Back Data Valid Window After the Prompt Pulse | t _{READ} | | 2.3 | | 4.7 | μs |

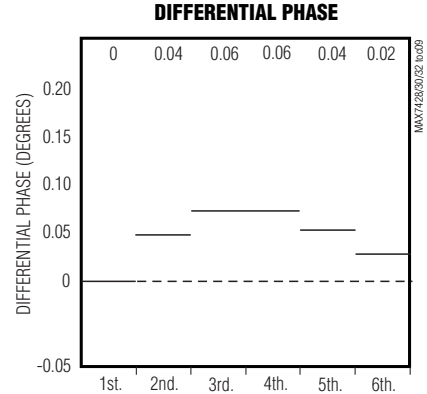
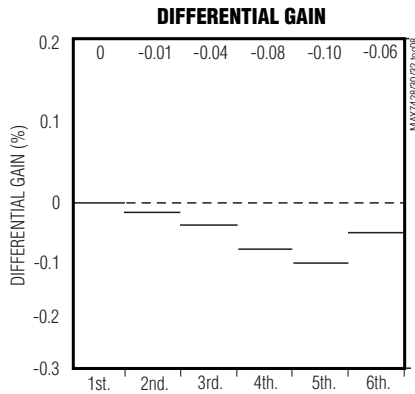
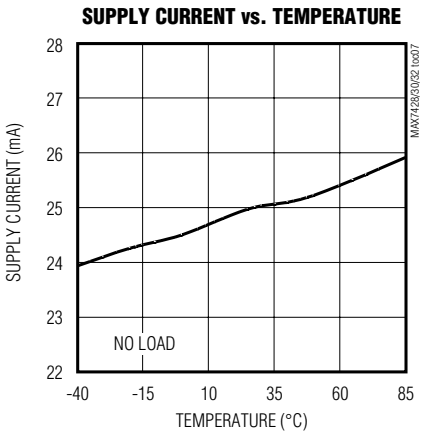
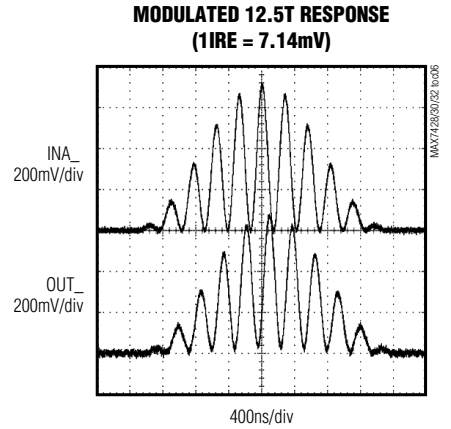
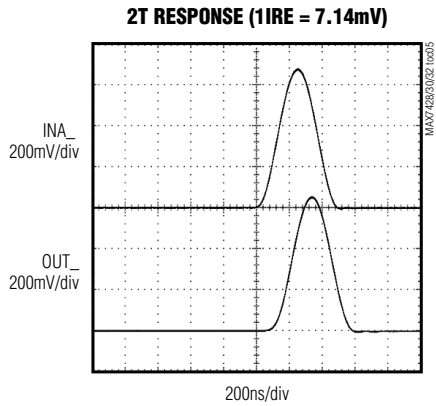
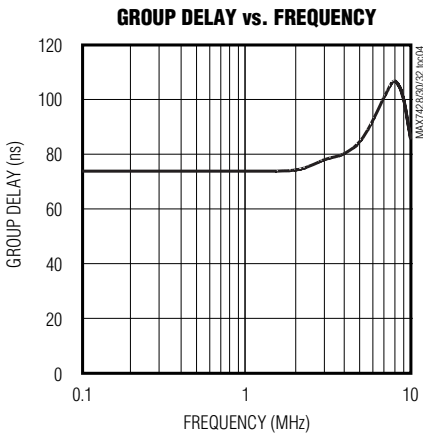
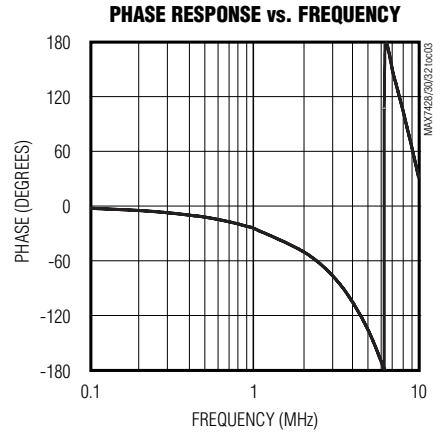
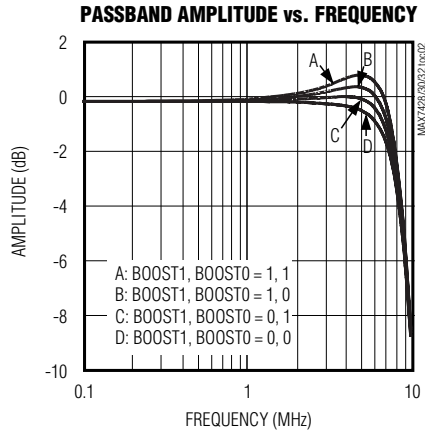
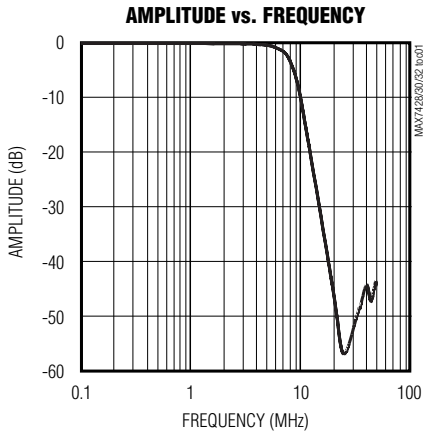
Note 1: One horizontal line = 63.5μs.

Note 2: MAX7428 devices are 100% production tested at $T_A = +25^\circ C$ and are guaranteed by design from $T_A = T_{MIN} \text{ to } T_{MAX}$.

Standard Definition Video Reconstruction Filters and Buffers

Typical Operating Characteristics

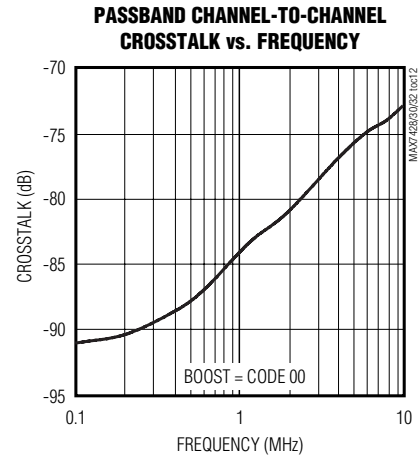
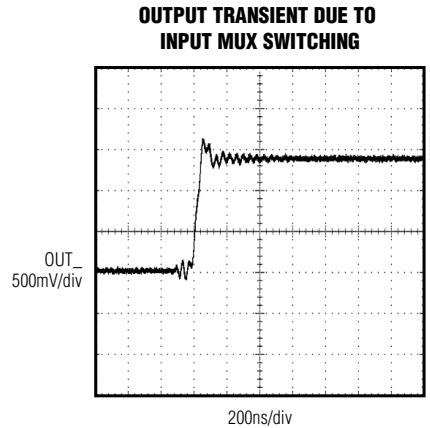
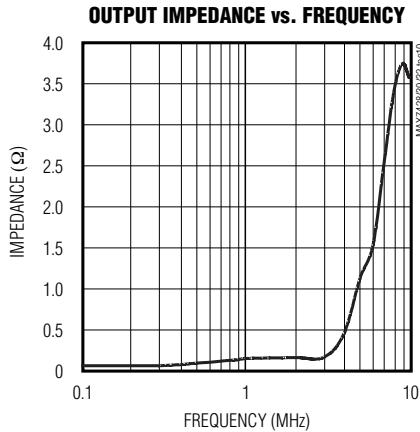
($V_{CC} = +5V$, $R_{REXT} = 300k\Omega$; $BOOST0_$, $BOOST1_ = 0, 0$; $V_{IN_} = 1V_{p-p}$, $T_A = +25^\circ C$, unless otherwise noted.)



Standard Definition Video Reconstruction Filters and Buffers

Typical Operating Characteristics (continued)

($V_{CC} = +5V$, $R_{REXT} = 300k\Omega$; $BOOST0_$, $BOOST1_ = 0, 0$; $V_{IN} = 1V_{p-p}$, $T_A = +25^\circ C$, unless otherwise noted.)



Pin Description

| PIN | | | NAME | FUNCTION |
|---------|---------|---------|------|--|
| MAX7432 | MAX7430 | MAX7428 | | |
| 1 | 1 | — | IN1A | Video Input 1A. Master channel, sync signal required. Use a 0.1 μ F series input capacitor for proper operation. |
| 2 | 2 | — | IN2A | Video Input 2A. Slave channel, clamping controlled by master channel sync. Use a 0.1 μ F series input capacitor for proper operation. |
| 3 | — | — | IN3A | Video Input 3A. Slave channel, clamping controlled by master channel sync. Use a 0.1 μ F series input capacitor for proper operation. |
| 4, 10 | 8 | 4 | GND | Ground |
| 5 | 4 | — | IN1B | Video Input 1B. Master channel, sync signal required. Use a 0.1 μ F series input capacitor for proper operation. |
| 6 | 5 | — | IN2B | Video Input 2B. Slave channel, clamping controlled by master channel sync. Use a 0.1 μ F series input capacitor for proper operation. |
| 7 | — | — | IN3B | Video Input 3B. Slave channel, clamping controlled by master channel sync. Use a 0.1 μ F series input capacitor for proper operation. |
| 8 | 6 | 6 | DATA | Serial Data Interface |
| 9 | — | — | OUT3 | Buffer Output 3 |
| 11 | 7 | — | OUT2 | Buffer Output 2 |
| 12 | 3 | 7 | REXT | External Resistor. Connect a 300k Ω resistor from REXT to GND for internal biasing. Connect a 1nF to 1 μ F capacitor from REXT to GND for chip-address programming (see Table 3). |

Standard Definition Video Reconstruction Filters and Buffers

Pin Description (continued)

| PIN | | | NAME | FUNCTION |
|---------|---------|---------|--------|---|
| MAX7432 | MAX7430 | MAX7428 | | |
| 13 | 9 | — | OUT1 | Buffer Output 1 |
| 14 | 10 | 2 | VCC | +5V Supply Voltage |
| — | — | 1 | INA | Video Input A. Use a 0.1μF series input capacitor for proper operation. |
| — | — | 3 | INB | Video Input B. Use a 0.1μF series input capacitor for proper operation. |
| — | — | 5 | SYNCIO | Sync Pulse Input or Output |
| — | — | 8 | OUT | Buffer Output |

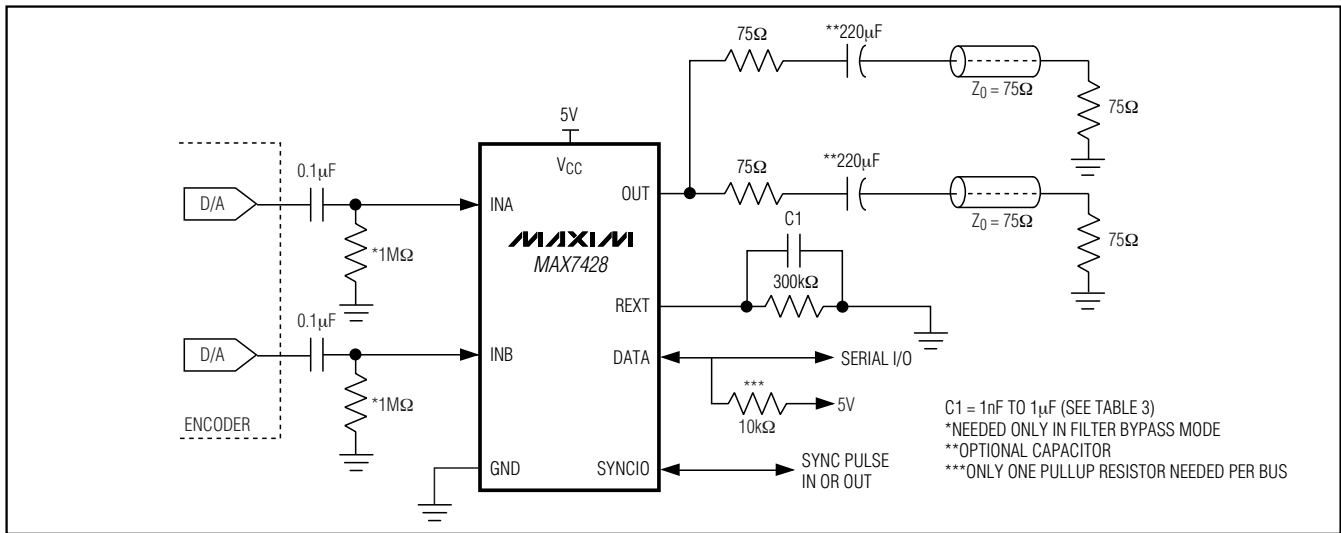


Figure 1. MAX7428 Typical Application Circuit

Detailed Description

The MAX7428/MAX7430/MAX7432 filter and buffer the outputs of DAC encoder chipsets that process digital video information in applications such as set-top boxes, hard-disk recorders, DVD players, recorders, and digital VCRs. These devices also filter and “clean-up” analog video signals. Each channel in the MAX7428/MAX7430/MAX7432 includes an input mux to select the input channel, a 6th-order Sallen-Key filter with four adjustable high-frequency boost levels, an output buffer with a 6dB gain, a sync detector and clamp, and an external resistor to set internal bias levels. Output disable adds additional multiplexing in a wired-OR configuration. Filter bypass, in conjunction with the two inputs, can be used to provide filtered and unfiltered video signal processing. Maxim’s Single Pin Bus

(MSPB) interface controls all of the above features. An external capacitor is used to assign each device a unique address that allows control of up to 16 devices on the same bus. Typical application circuits for the MAX7428/MAX7430/MAX7432 are shown in Figures 1, 2, and 3.

Input Considerations

Use a 0.1μF ceramic capacitor to AC-couple the input to the MAX7428/MAX7430/MAX7432. This input capacitor stores a DC level to level-shift the input signal to an optimal point between VCC and GND. The ABSEL bit on the Control Register sets which channel (IN_A or IN_B) is selected (*Control Register* section). The IN_A and IN_B inputs have a typical input resistance of 50kΩ.

Standard Definition Video Reconstruction Filters and Buffers

MAX7428/MAX7430/MAX7432

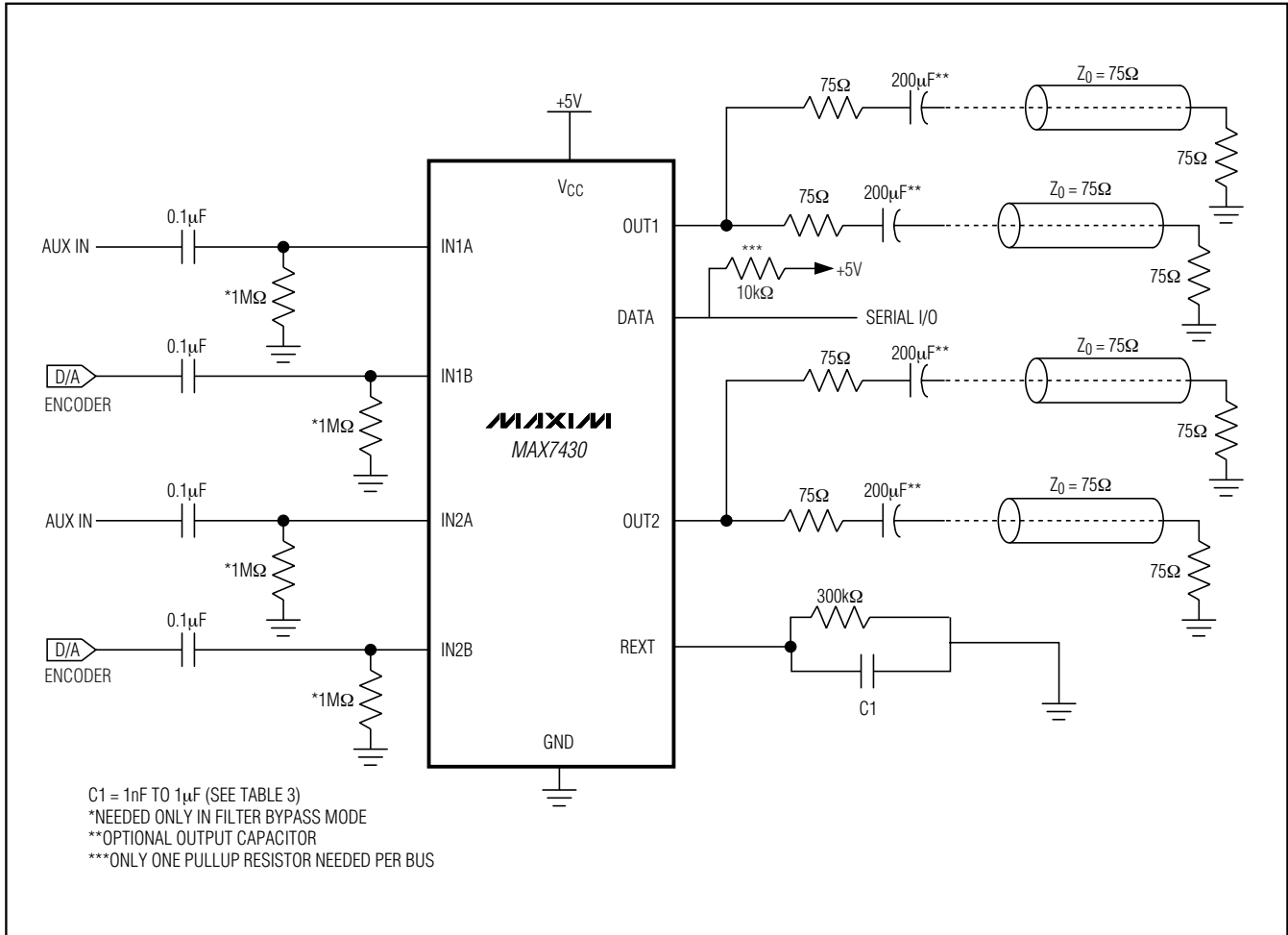


Figure 2. MAX7430 Typical Application Circuit

Standard Definition Video Reconstruction Filters and Buffers

MAX7428/MAX7430/MAX7432

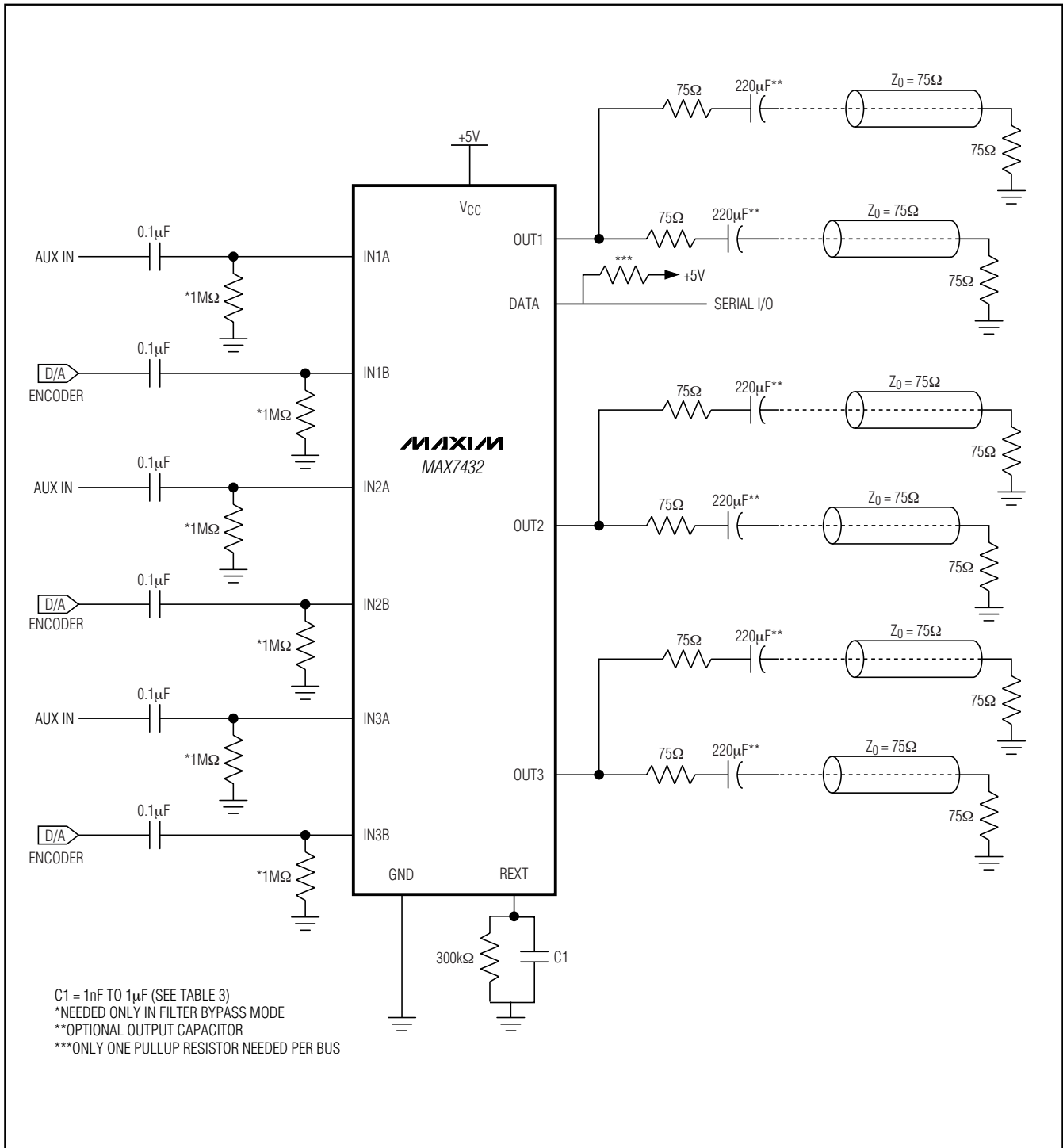


Figure 3. MAX7432 Typical Application Circuit

Standard Definition Video Reconstruction Filters and Buffers

Table 1. MAX7428 Control Register

| | (MSB) | | | | | | | FIRST BIT (LSB) |
|---------|--------|-------|--------|--------|--------|--------|------------|-----------------|
| NAME | SYNCIO | ABSEL | BYPASS | CLEVEL | BOOST1 | BOOST0 | OUTDISABLE | — |
| DEFAULT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

Filter

Filter Response

The reconstruction filter consists of a 6th-order Butterworth filter in three second-order stages. The Butterworth filter features a maximally flat passband for NTSC and PAL bandwidths. The stopband offers typically 50dB of attenuation at sampling frequencies of 25MHz and above (see *Typical Operating Characteristics*).

The corner frequency is not critical since the response of the filter meets both the stopband and passband specifications. The MAX7428/MAX7430/MAX7432 incorporate an autotrimming feature that reduces the corner frequency variation digitally. It is possible, although not likely, that a discrete shift in the corner frequency may occur due to an external environmental change. The autotrimming operates continuously so that the corner frequency remains centered over the full operating temperature range.

High-Frequency Boost

The high-frequency boost compensates for signal degradation and roll-off in the signal path prior to the MAX7428/MAX7430/MAX7432. High-frequency boost is programmable in four steps to increase image sharpness.

Output Buffer

The output buffer is able to drive two 150Ω video loads with a 2Vp-p signal. The +6dB gain of the output buffer is independent of the filter bypass or input selection. The output buffer drives the 75Ω backmatch resistors and series capacitor (typically 220μF). The MAX7428/MAX7430/MAX7432 are able to drive the video load directly without using the 220μF capacitor. This feature is common in SCART applications. The OUTDISABLE bit of the control register disables the output (mute) (see *Control Register* section).

Filter Bypass

The MAX7428/MAX7430/MAX7432 offer selectable filter bypassing that allows either of the video inputs to be filtered or unfiltered. The 1MΩ optional input resistors are needed only in filter bypass mode to provide a discharge path for the input coupling capacitors.

Serial Interface

Maxim's Single Pin Bus (MSPB) interface uses DATA to transfer data to and from the microprocessor (μP) and the MAX7428/MAX7430/MAX7432. This negative logic protocol uses three different pulse widths to represent a logic "1", logic "0", and control commands. MSPB allows up to 16 devices to be connected on the same bus by assigning a unique 4-bit identification address to each device. The μP can communicate to each device individually or by sending a "broadcast" message to all the devices. The unique address for each device is set by means of the time constant set by the external capacitor connected in parallel with the external 300kΩ resistor (see *Initializing the MAX7428/MAX7430/MAX7432* section).

MAX7428 Control Register

Table 1 defines the structure of the MAX7428 8-bit control register programmed by MSPB. This register controls the selection of INA or INB, SYNCIO functionality, filter bypassing, clamp-level selection, high-frequency boost control, and output disable. See *Maxim's Single Pin Bus Interface (MSPB)* section for detailed programming instructions.

SYNCIO: SYNCIO Select bit. A logic 0 sets the SYNCIO pin to function as an output while a logic 1 sets SYNCIO to function as an input.

ABSEL: Channel Select bit. A logic 0 selects the input at INB to be processed while a logic 1 selects the input at INA to be processed.

BYPASS: Filter Bypass Select bit. A logic 1 selects the filter while a logic 0 bypasses the filter.

Table 2. Boost Level Programming

| BOOST1 | BOOST0 | RELATIVE HIGH-FREQUENCY BOOST |
|--------|--------|-------------------------------|
| 0 | 0 | 0 |
| 0 | 1 | 0.45dB |
| 1 | 0 | 0.90dB |
| 1 | 1 | 1.35dB |

Standard Definition Video Reconstruction Filters and Buffers

Table 3. MAX7430 Control Register

| (MSB) | | | | | | | | |
|---------|---|--------|---------|---------|-----------|-----------|--------------|---|
| NAME | — | ABSEL2 | BYPASS2 | CLEVEL2 | BOOST1(2) | BOOST0(2) | OUT DISABLE2 | — |
| DEFAULT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

| NAME | — | ABSEL1 | BYPASS1 | CLEVEL1 | BOOST1(1) | BOOST0(1) | OUT DISABLE1 | — |
|---------|---|--------|---------|---------|-----------|-----------|--------------|---|
| DEFAULT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

FIRST BIT
(LSB)

CLEVEL: Clamp Level bit. A logic 0 selects a clamp level of 1V while a logic 1 selects a clamp level of 1.5V at the output.

[BOOST1, BOOST0]: High-Frequency Boost Control bits. The adjust bits select the amount of high-frequency boost for the filter. Table 2 defines four levels of adjustment.

OUTDISABLE: Output Disable bit. A logic 0 selects normal operation while a logic 1 places the output in a high-impedance state.

MAX7430 Control Register

Table 3 defines the structure of the MAX7430 16-bit control register programmed by MSPB. This register controls the selection of IN_A or IN_B, selection of filter 1 or 2, filter bypassing, clamp-level selection, high-frequency boost control, and output disable. See *Maxim's Single Pin Bus Interface (MSPB)* section for detailed programming instructions.

ABSEL_: Channel Select bit. A logic zero selects the input at IN_B to be processed while a logic 1 selects the input at IN_A to be processed.

BYPASS_: Filter Bypass Select bit. A logic 1 selects the channel filter while a logic 0 bypasses the channel filter.

CLEVEL_: Clamp Level bit. A logic 0 selects a channel clamp level of 1V while a logic 1 selects a channel clamp level of 1.5V at the output.

[BOOST1_, BOOST0_]: High-Frequency Boost Control bits. The adjust bits select the amount of high-frequency boost for the channel filter. Table 4 defines four levels of adjustment.

OUTDISABLE_: Output Disable bit. A logic 0 selects normal channel output operation while a logic 1 puts the channel output in a high-impedance state.

Table 4. Boost Level Programming

| BOOST1_ | BOOST0_ | RELATIVE HIGH-FREQUENCY BOOST |
|---------|---------|-------------------------------|
| 0 | 0 | 0 |
| 0 | 1 | 0.45dB |
| 1 | 0 | 0.90dB |
| 1 | 1 | 1.35dB |

MAX7432 Control Register

Table 5 defines the structure of the MAX7432 24-bit control register programmed by MSPB. This register controls the selection of IN_A or IN_B, selection of filter 1, 2, or 3, filter bypassing, clamp-level selection, high-frequency boost control, and output disable. See *Maxim's Single Pin Bus Interface (MSPB)* section for detailed programming instructions.

ABSEL_: Channel Select bit. A logic zero selects the input at IN_B to be processed while a logic 1 selects the input at IN_A to be processed.

BYPASS_: Filter Bypass Select bit. A logic 1 selects the channel filter while a logic 0 bypasses the channel filter.

CLEVEL_: Clamp Level bit. A logic 0 selects a channel clamp level of 1V while a logic 1 selects a channel clamp level of 1.5V at the output.

[BOOST1_, BOOST0_]: High-Frequency Boost Control bits. The adjust bits select the amount of high-frequency boost for the channel filter. Table 6 defines four levels of adjustment.

OUTDISABLE_: Output Disable Bit. A logic 0 selects normal channel output operation while a logic 1 puts the channel output in high-impedance state.

Standard Definition Video Reconstruction Filters and Buffers

Table 5. MAX7432 Control Register

| (MSB) | | | | | | | | |
|---------|---|--------|---------|---------|-----------|-----------|--------------|---|
| NAME | — | ABSEL3 | BYPASS3 | CLEVEL3 | BOOST1(3) | BOOST0(3) | OUT DISABLE3 | — |
| DEFAULT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

| NAME | — | ABSEL2 | BYPASS2 | CLEVEL2 | BOOST1(2) | BOOST0(2) | OUT DISABLE2 | — |
|---------|---|--------|---------|---------|-----------|-----------|--------------|---|
| DEFAULT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

| NAME | — | ABSEL1 | BYPASS1 | CLEVEL1 | BOOST1(1) | BOOST0(1) | OUT DISABLE1 | — |
|---------|---|--------|---------|---------|-----------|-----------|--------------|---|
| DEFAULT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

FIRST BIT (LSB)

Applications Information

Maxim's Single Pin Bus (MSPB) Serial Interface

The MSPB interface uses three pulses of different widths to represent commands and data bits. Figure 4 shows the set of pulses that the single pin interface uses to communicate with the device. A combination of the one pulse (t_1), zero pulse (t_0), transaction pulse (t_T), and prompt pulse (t_P), writes to, reads back from, and sends broadcast data to the devices on the bus.

Note: The zero pulse and prompt pulse are the same. Initialization pulses are significantly longer and are used only on power-up or software reset.

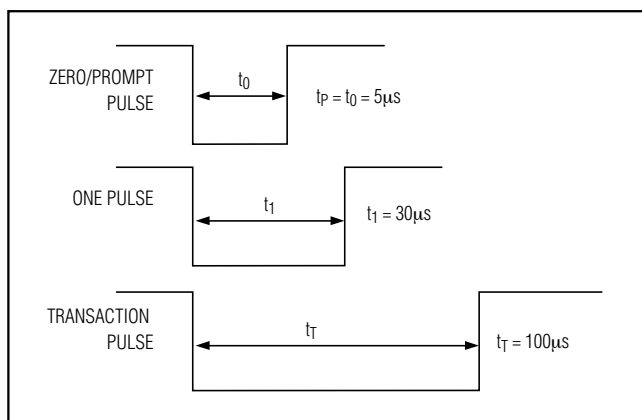


Figure 4. MSPB Interface Pulses

Table 6. Boost Level Programming

| BOOST1_ | BOOST0_ | RELATIVE HIGH-FREQUENCY BOOST |
|---------|---------|-------------------------------|
| 0 | 0 | 0 |
| 0 | 1 | 0.45dB |
| 1 | 0 | 0.90dB |
| 1 | 1 | 1.35dB |

Initializing the MAX7428/MAX7430/MAX7432

Initialization is performed only after power-up or software reset. It assigns a unique address to each device on the bus. The time constant of the capacitor connected to REXT in parallel with the 300kΩ resistor determines the order in which the devices are initialized (address assigned). The device with the largest time constant is initialized first and so on, in descending order. Table 7 shows the “Initialize Wait” and “Initialize Time” pulse widths needed for a specific capacitor value and tolerance. Program each device on the bus with this command sequence starting with the device with the biggest capacitor. To reinitialize a device, cycle the power or use a software reset. The following is the command sequence and timing diagram (Figure 5) for initialization as shown below. Chip ID is entered LSB first.

Note: If there is only one device on the bus, no initialization is needed. Communicate to the device using the broadcast command described on page 13.

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Table 7. Initialization Capacitor Values and Pulse Widths
(CREXT = ±10% Tolerance, RREXT = ±1% Tolerance)

| CAPACITOR VALUE (nF) | INITIALIZING WAIT PERIOD (ms) (t _{INTWAIT}) | INITIALIZING TIME PERIOD (ms) WITH R _{REXT} = 300kΩ (t _{INT}) | | |
|----------------------|---|--|---------------|---------------|
| | | MIN | TYP | MAX |
| 1000 | 20.000 | 162 (136.8) | 171 (144) | 179 (151.2) |
| 680 | 13.600 | 112 | 118 | 123 |
| 470 | 9.400 | 52.6 (44.1) | 55.4 (46.4) | 58.2 (48.72) |
| 220 | 4.400 | 35.90 | 37.80 | 39.70 |
| 150 | 3.000 | 23.90 (13.7) | 25.20 (14.4) | 26.50 (15.1) |
| 100 | 2.000 | 16.25 | 17.10 | 17.95 |
| 68 | 1.360 | 11.21 (4.4) | 11.80 (4.64) | 12.39 (4.9) |
| 47 | 0.940 | 5.26 | 5.54 | 5.82 |
| 22 | 0.440 | 3.59 | 3.78 | 3.97 |
| 15 | 0.300 | 2.39 | 2.52 | 2.65 |
| 10 | 0.200 | 1.625 (1.37) | 1.710 (1.44) | 1.795 (1.51) |
| 6.8 | 0.136 | 1.121 | 1.180 | 1.239 |
| 4.7 | 0.094 | 0.526 (0.441) | 0.554 (0.464) | 0.582 (0.487) |
| 2.2 | 0.044 | 0.359 | 0.378 | 0.397 |
| 1.5 | 0.030 | 0.239 | 0.252 | 0.265 |
| 1 | 0.020 | 0.162 (0.137) | 0.171 (0.144) | 0.179 (0.151) |

Note: () Indicates the time periods associated with 20% capacitors. This limits the maximum number of devices on the bus to seven.

| Initialization Command Sequence: | | | | |
|----------------------------------|------|-----------------|---------------------|------|
| Initialize wait | T011 | Initialize Time | Address ID = 4-bits | T111 |

Programming the MAX7428/MAX7430/MAX7432

An address sequence precedes a write or read operation to determine with which device to communicate. If the address transmitted in this mode matches with a device's address, the device and μP can initiate data transfer. When entering the four address bits, ensure that the LSB is entered first. The following is the command sequence and timing diagram (Figure 6) for an address sequence.

| Address Command Sequence: | | |
|---------------------------|------------------|------|
| T010 | Address = 4-bits | T111 |

Use a write sequence to load data into the data register of the device. It must follow an address sequence. Transmit a minimum of eight data bits for the MAX7428, 16 data bits for the MAX7430, or 24 data bits for the MAX7432 to make this transaction valid starting with the LSB first. The last 8/16/24 data bits are used if more

than 8/16/24 bits are loaded into the register. The following is the command sequence and timing diagram (Figure 7) for a write sequence.

| Write Command Sequence: | | |
|-------------------------|--|------|
| T001 | Data ≥ 8-bits (MAX7428, See Table 1) Data ≥ 16-bits (MAX7430, See Table 3) Data ≥ 24-bits (MAX7432, See Table 5) | T111 |

During the read sequence, the μP sends a prompt pulse causing the device to output the data word LSB first. Similar to the write transaction, the read transaction must be preceded by an address sequence. If more than 8 prompts (MAX7428), 16 prompts (MAX7430), or 24 prompts (MAX7432) are available, the device outputs the same data starting with the LSB again. The following is the command sequence and timing diagram (Figure 8) for a read sequence.

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| Read Command Sequence: | | |
|------------------------|---|------|
| T101 | Prompts ≥ 8 (MAX7428) Prompts ≥ 16 (MAX7430) Prompts ≥ 24 (MAX7432) | T111 |

The broadcast sequence writes data to the control registers of all the devices on the bus at the same time. Write data with the LSB first. The following is the command sequence and timing diagram (Figure 9) for the broadcast transaction. No address sequence is required. Use the broadcast command when there is only one device on the bus.

| Broadcast Command Sequence: | | |
|-----------------------------|---|------|
| T000 | Data ≥ 8-bits (MAX7428) Data ≥ 16-bits (MAX7430) Data ≥ 24-bits (MAX7432) | T111 |

Executing a software reset serves the same function as a power-on reset and is achieved by transmitting all data bits (eight or more) for the MAX7428, sixteen or

| Software Reset Command Sequence: | | |
|----------------------------------|--|------|
| T000 | 8 or more 1s (MAX7428) 16 or more 1s (MAX7430) 24 or more 1s (MAX7432) | T111 |
| OR | | |
| T010 | Address = 4-bits | T111 |
| T001 | 8 or more 1s (MAX7428) 16 or more 1s (MAX7430) 24 or more 1s (MAX7432) | T111 |

more ones for the MAX7430, or 24 or more ones for the MAX7432 to that device register.

Composite Video Filtering

The MAX7428 is ideally suited for filtering composite video signals. Program the SYNCIO as an output when processing composite video signals. In the rare occasion that an external sync pulse is needed to process the composite video, program the SYNCIO as an input.

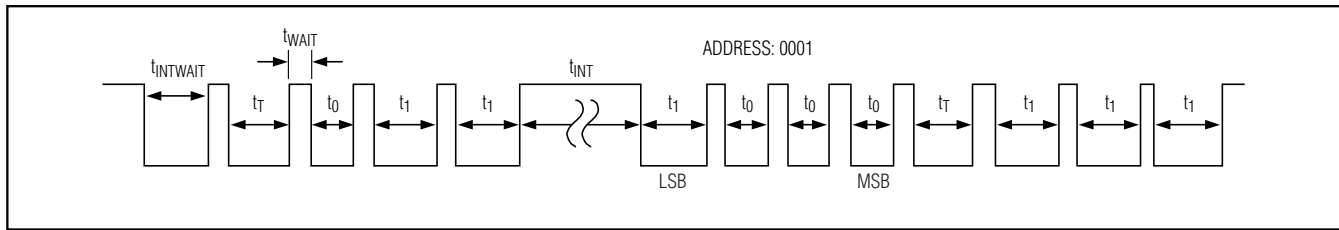


Figure 5. Initialization Timing Diagram

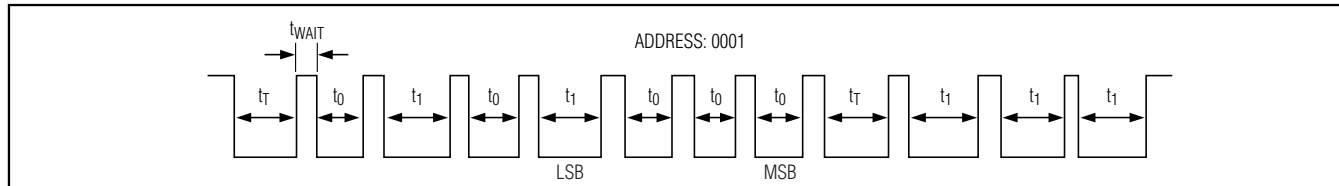


Figure 6. Address Timing Diagram

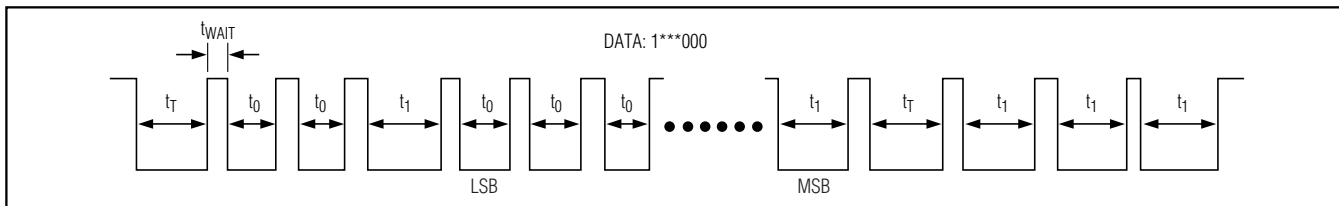


Figure 7. Write Timing Diagram

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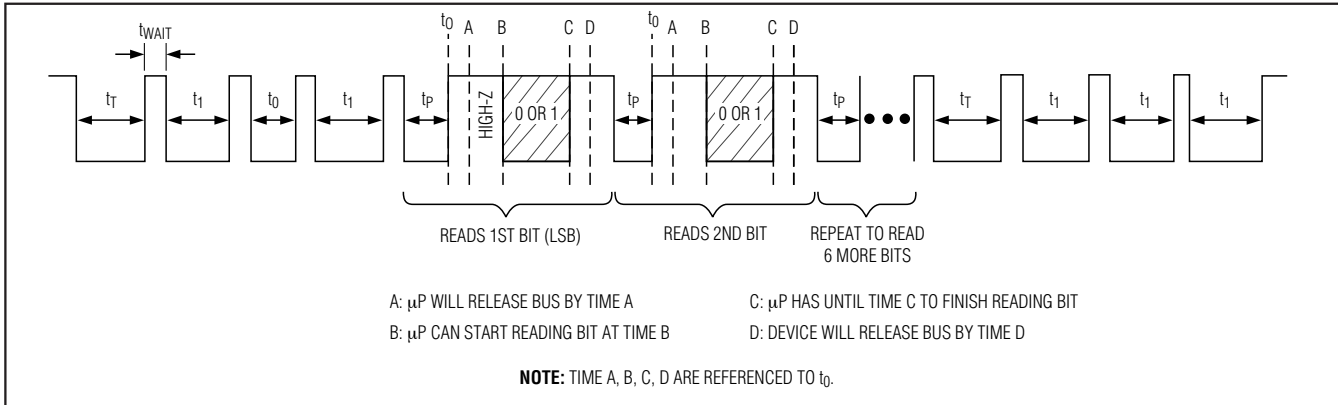


Figure 8. Read Timing Diagram

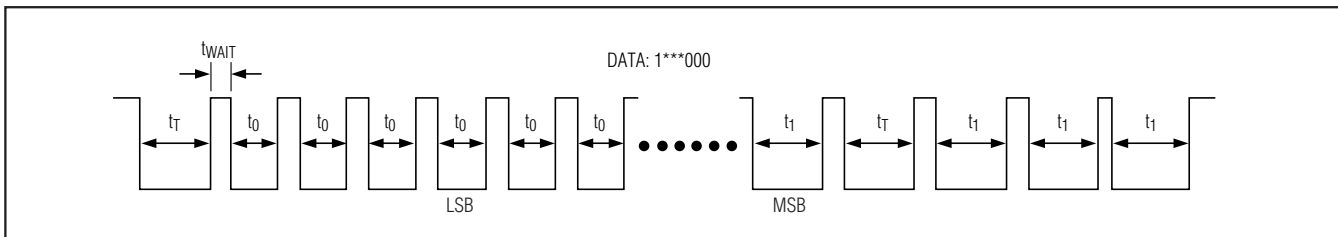


Figure 9. Broadcast Timing Diagram

When processing composite video set the clamp level to +1V (CLEVEL = 0). Use the MAX7430 to process two synchronous composite signals simultaneously. Use the MAX7432 to process three synchronous composite signals simultaneously.

Y/C Video Filtering

The MAX7430 is ideally suited for processing S-Video (Y/C) signals (Figure 10). Ensure that IN1_ filters the signal that contains the sync information (Y) since the clamping on IN2_ is internally controlled by the master channel (IN1_) sync. Set the clamp level for IN1_ to +1V (CLEVEL1 = 0) and set the clamp level for IN2_ to +1.5V (CLEVEL2 = 1).

Use two MAX7428s for Y/C video filtering. Since only the Y signal contains the sync, a typical Y/C video-filtering application requires a master-slave configuration of the SYNCIO. The MAX7428 processing the Y signal should have SYNCIO configured as an output, which in turn drives the SYNCIO of the second MAX7428, processing the C signal that has its SYNCIO configured as an input (Figure 11). Clamping level for the Y signal should be set for +1V (CLEVEL = 0), and clamping level for the C signal should be set for +1.5V (CLEVEL = 1). Use the MAX7432 to filter one Y/C and one composite video signal that are synchronous.

Component Video (RGB or Y P_b P_r) Filtering

Component video consists of three separate signals. Typically the three signals are separate red, green, and blue (RGB) signals or Y (luma) and two color difference signals: B-Y (P_b) which is blue minus luma and R-Y (P_r), which is red minus luma. Sync information is included with the Y signal of Y P_b P_r component video, or in the case of RGB, sync is usually carried on the G or on a separate H sync line. The MAX7432 is ideally suited for filtering component video signals. Ensure that the sync signal (Y for Y P_b P_r signals and usually G for RGB signals) is filtered by IN1_ since IN2_ and IN3_ are internally synced to IN1_. Set the clamp level for IN1_ to +1V (CLEVEL1 = 0) and set the clamp levels for IN2_ and IN3_ to +1.5V (CLEVEL2, 3 = 1) for Y P_b P_r filtering (Figure 12) and set all clamp levels to 1V (CLEVEL_ = 0) for RGB filtering (Figure 13). A Y P_b P_r component video-filter application requires three MAX7428s with SYNCIO master-slave configuration. The MAX7428 processing the Y signal has its SYNCIO configured as an output, which in turn drives the SYNCIO inputs of the other MAX7428s (Figure 14). For RGB video signal filtering with a separate horizontal sync signal, configure all MAX7428s for SYNCIO as an input (Figure 15).

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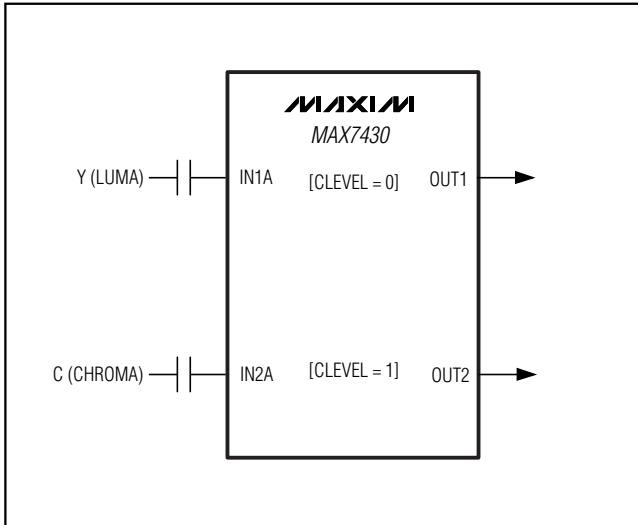


Figure 10. MAX7430 Y/C Video Filter Application

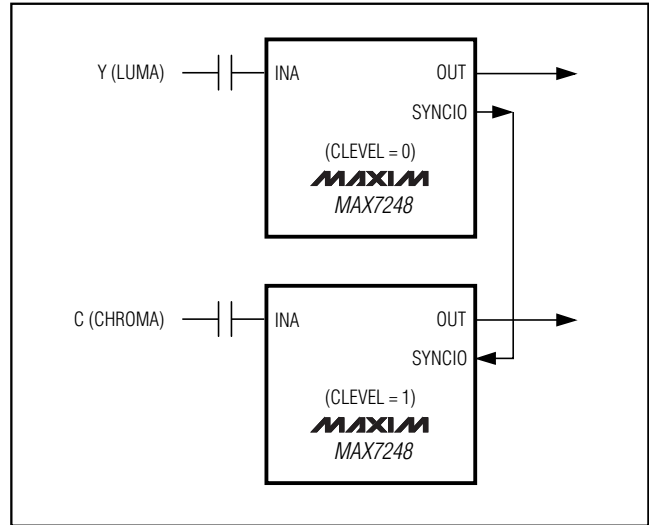


Figure 11. Y/C Video Filter Application

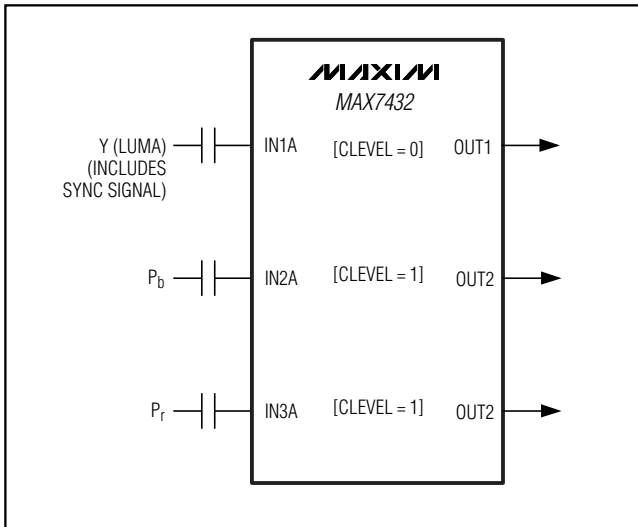


Figure 12. MAX7432 Y Pb Pr Video Filter Application

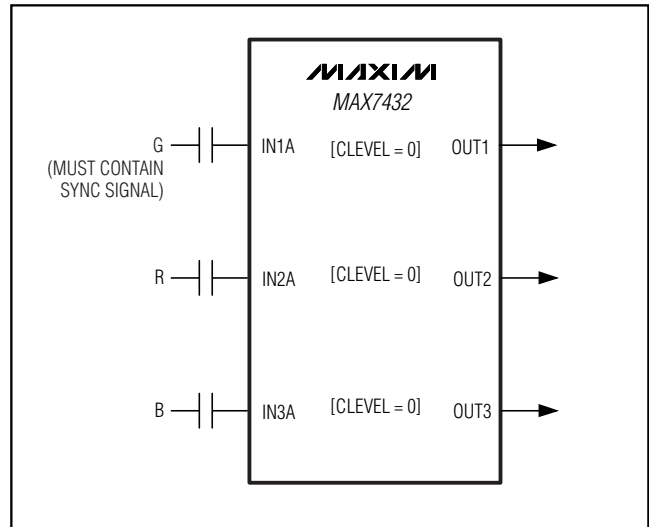


Figure 13. MAX7432 RGB Video Filter with Embedded Sync Application

Set the clamping levels for component video so the MAX7428 processing Y clamps at +1V (CLEVEL = 0). The remaining two MAX7428s should have clamp levels set to +1.5V (CLEVEL = 1). For RGB video with external sync (H), all three MAX7428s should have clamp levels set to +1V (CLEVEL = 0).

Power-Supply Bypassing and Layout

The MAX7428/MAX7430/MAX7432 operate from a single +5V supply. Bypass VCC to GND with a 0.1µF capacitor. Place all external components as close to the devices as possible. Refer to the MAX7428EVKIT for a proven PC board layout example.

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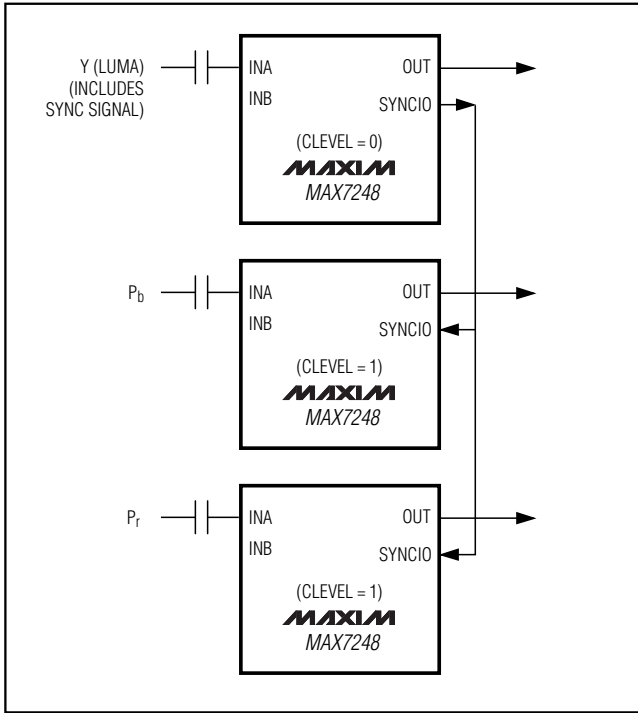


Figure 14. Y Pb Pr Video Filter Application

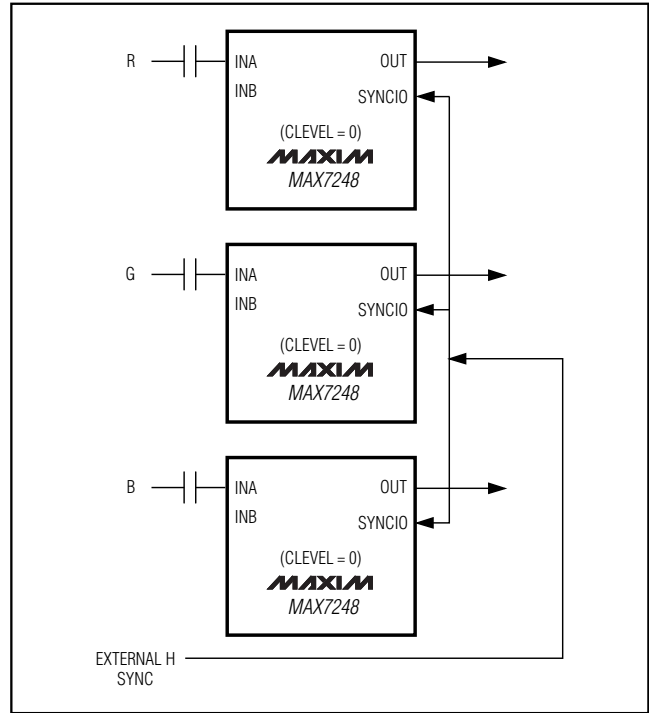


Figure 15. RGB Video Filter with External Sync Application

Chip Information

TRANSISTOR COUNT: MAX7428 = 4955

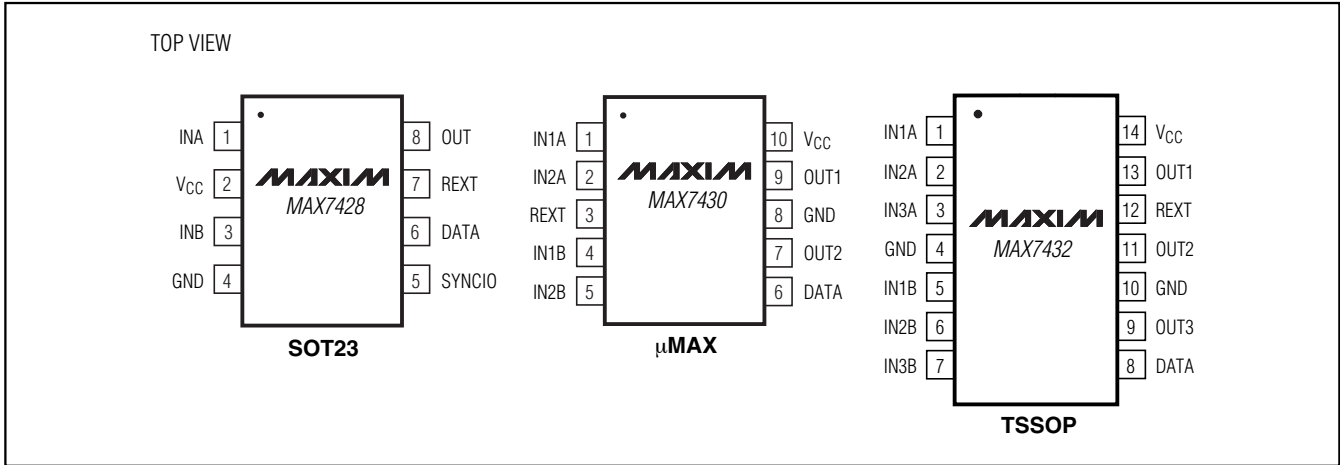
MAX7430 = 7413

MAX7432 = 9873

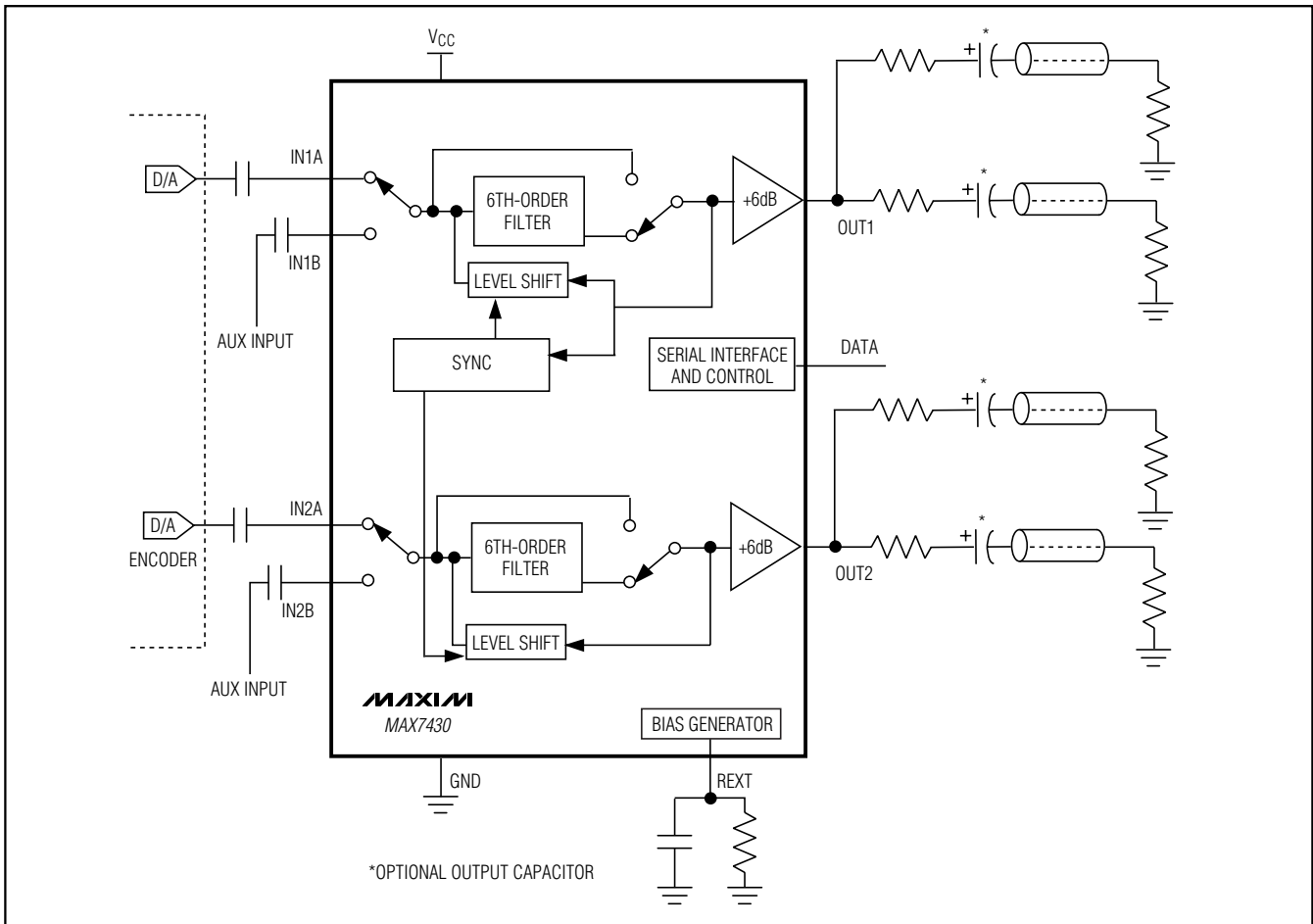
PROCESS: BiCMOS

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Pin Configurations



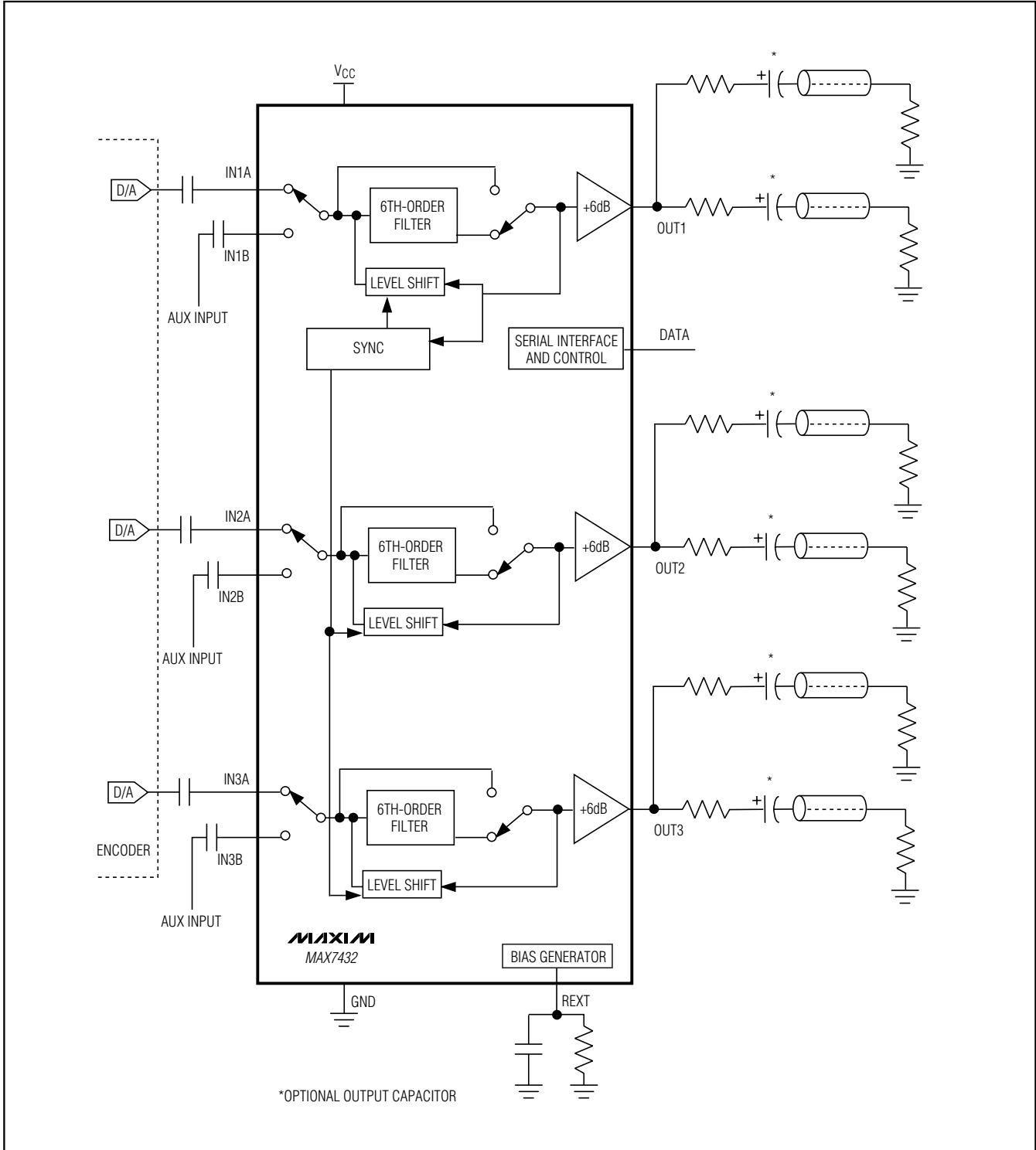
Functional Diagrams (continued)



MAX7428/MAX7430/MAX7432

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Functional Diagrams (continued)

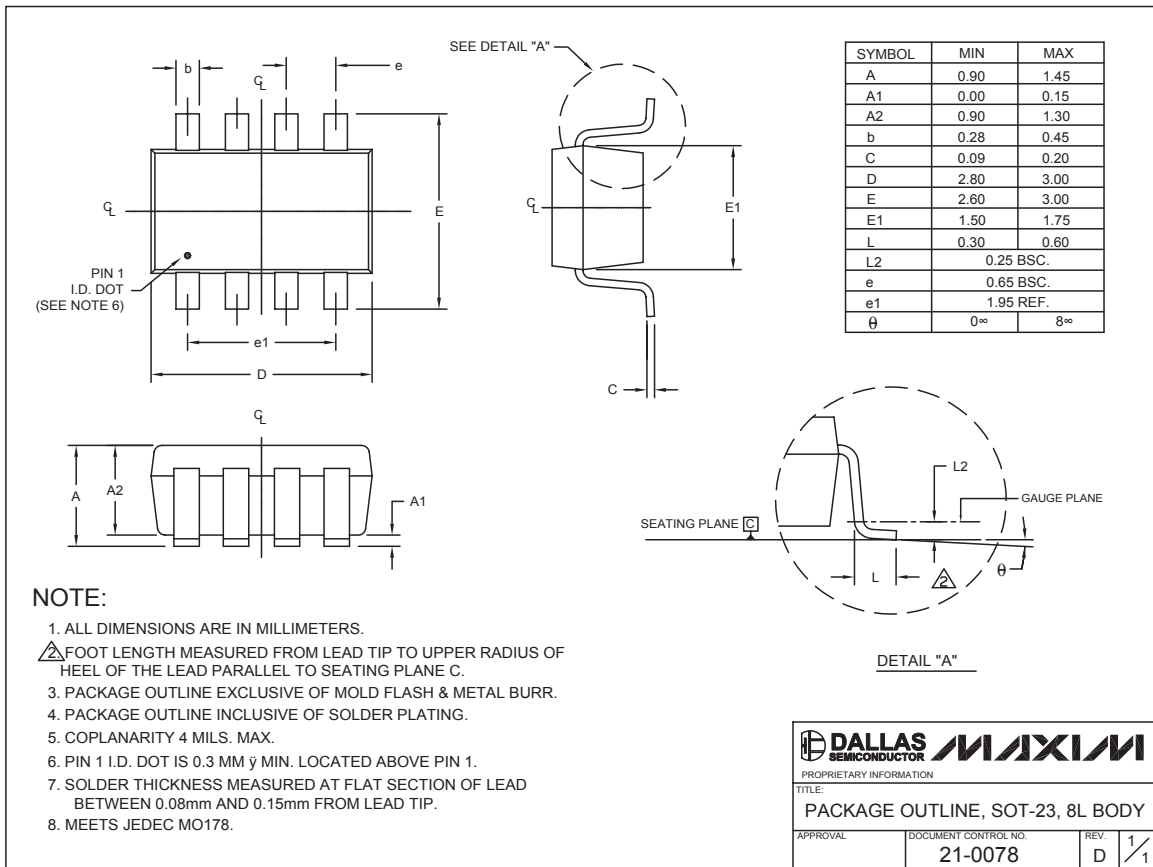


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Package Information

(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.)

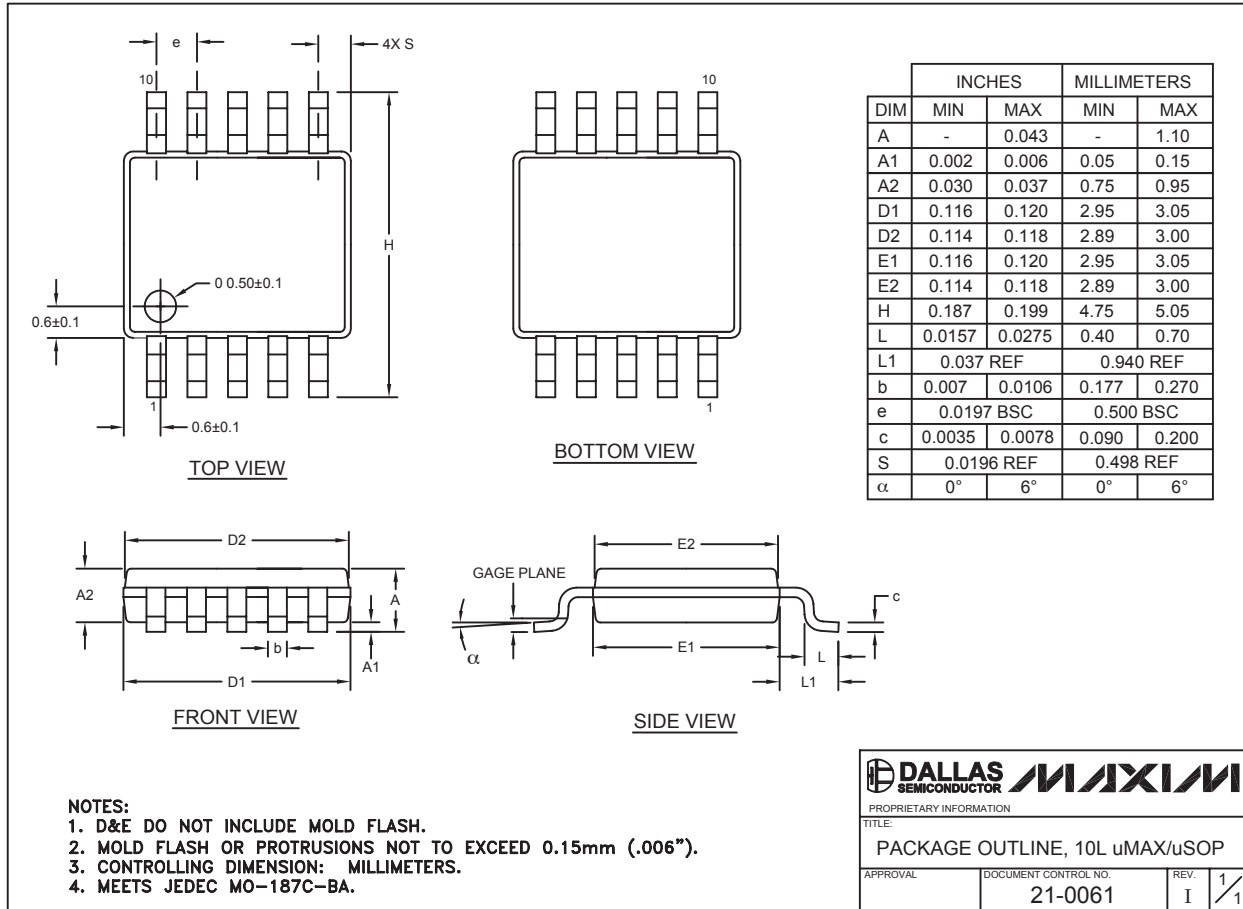
MAX7428/MAX7430/MAX7432



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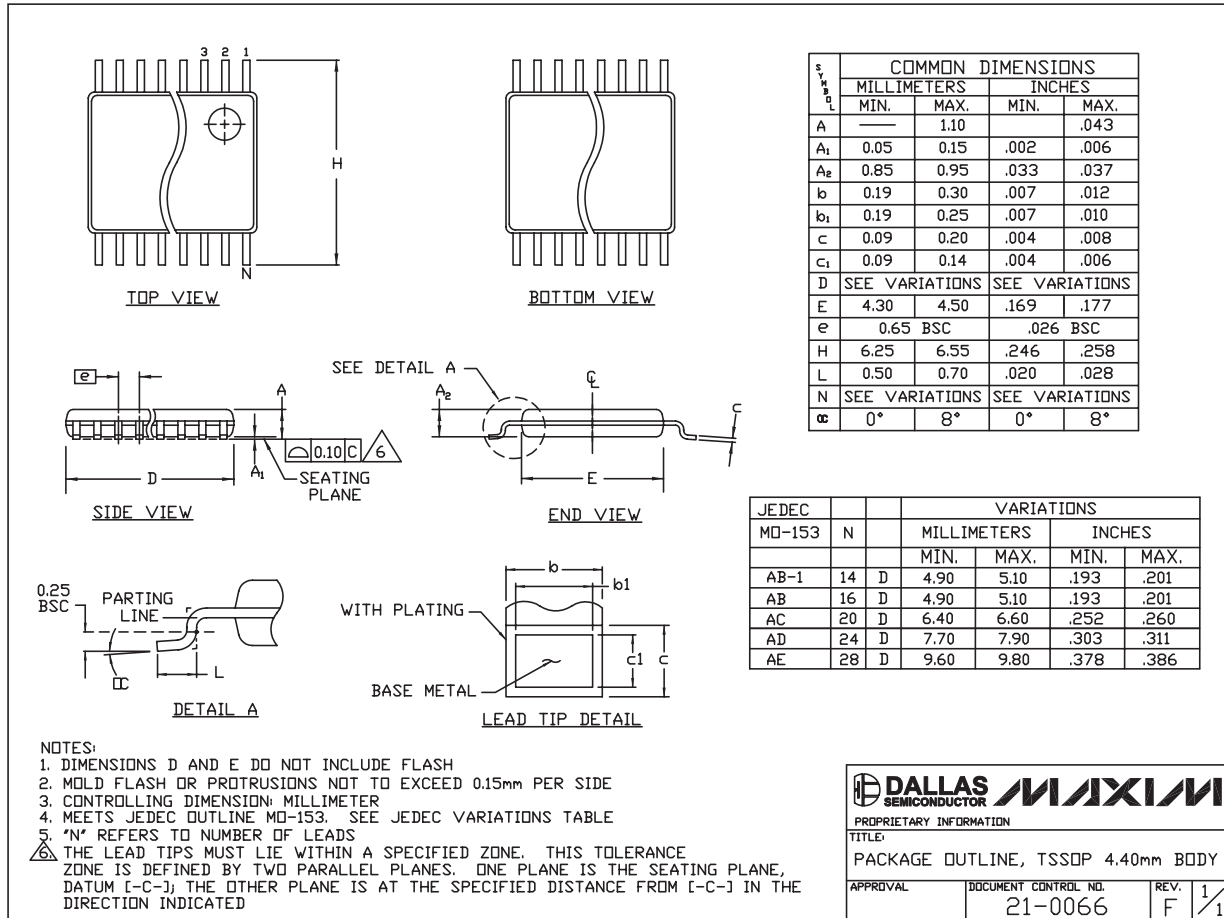
10LUMAX.EPS

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Package Information (continued)

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MAX7428/MAX7430/MAX7432



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