

# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### General Description

The MAX44006/MAX44008 integrate six sensors in two products: red, green, blue (RGB) sensors; an ambient light (clear) sensor; a temperature sensor; and an ambient infrared sensor with an I<sup>2</sup>C interface. These highly integrated optical sensors include a temperature sensor to improve reliability and performance.

The devices compute the light information with six parallel data converters allowing simultaneous light measurement in a very short time. The devices consume only 15μA (MAX44006) and 16μA (MAX44008) separately in RGBC + TEMP + IR mode, and also have the ability to operate at 1.7V to 2.0V (MAX44006) and 2.7V to 5.5V supply voltage (MAX44008).

The devices' RGB sensing capability improves the performance of end products by providing robust and precise information for ambient color-sensing and color-temperature measurement.

The devices' superior infrared and 50Hz/60Hz rejection provide robust readings. The wide dynamic range light measurement makes these products perfect candidates for many color measurement applications.

The on-chip ambient sensor has the ability to make wide dynamic range (0.002~8388.61μW/cm<sup>2</sup>) lux measurements. The devices' digital computation power provides programmability and flexibility for end-product design. A programmable interrupt pin minimizes the need to poll the devices for data, freeing up microcontroller resources, reducing system software overhead, and ultimately reducing power consumption. All these features are included in a tiny 2mm x 2mm x 0.6mm optical package.

### Applications

TVs/Display Systems  
Tablet PCs/Notebooks/e-Readers  
Printers  
LED and Laser Projectors  
Digital Light Management  
Industrial Sensors  
Tablets  
Color Correction

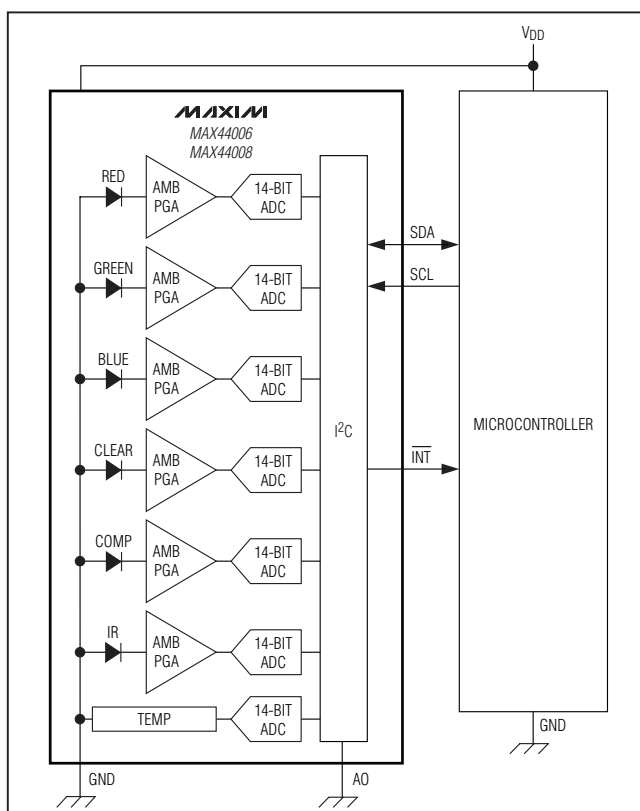
**Ordering Information** appears at end of data sheet.

For related parts and recommended products to use with this part, refer to [www.maximintegrated.com/MAX44006.related](http://www.maximintegrated.com/MAX44006.related).

### Features

- ◆ **Optical Sensor Fusion for True Color Sensing**
  - ✧ Seven Parallel ADCs
  - ✧ R, G, B, IR, ALS Sensing
- ◆ **Superior Sensitivity**
  - ✧ 0.001 Lux
- ◆ **Optimized for Overall System Power Consumption**
  - ✧ 10μA (MAX44006)/10μA (MAX44008) in Ambient Mode
  - ✧ 15μA (MAX44006)/16μA (MAX44008) in RGBC + IR Mode
  - ✧ 0.01μA (MAX44006)/0.5μA (MAX44008) in Shutdown Mode
- ◆ **Digital Functionalities**
  - ✧ Programmable Channel Gains
  - ✧ Adjustable Interrupt Thresholds
- ◆ **High-Level Integration**
  - ✧ Six Sensors in a 2mm x 2mm x 0.6mm Package

### Functional Diagram



**For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at [www.maximintegrated.com](http://www.maximintegrated.com).**

# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### ABSOLUTE MAXIMUM RATINGS

|                                                  |                |                                      |                |
|--------------------------------------------------|----------------|--------------------------------------|----------------|
| V <sub>DD</sub> to GND (MAX44006) .....          | -0.3V to +2.2V | Continuous Power Dissipation         |                |
| V <sub>DD</sub> to GND (MAX44008) .....          | -0.3V to +6.0V | (derate 11.9mW/°C above +70°C) ..... | 953mW          |
| A0, INT, SCL, SDA to GND .....                   | -0.3V to +6.0V | Operating Temperature Range .....    | -40°C to +85°C |
| Output Short-Circuit Current Duration .....      | Continuous     | Soldering Temperature (reflow) ..... | +260°C         |
| Continuous Input Current into Any Terminal ..... | ±20mA          |                                      |                |

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.

### PACKAGE THERMAL CHARACTERISTICS (Note 1)

|                                                               |           |
|---------------------------------------------------------------|-----------|
| OTDFN (Note 1)                                                |           |
| Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ) .... | +83.9°C/W |
| Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ) .....   | +37°C/W   |

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

### ELECTRICAL CHARACTERISTICS

(V<sub>DD</sub> = 1.8V (MAX44006), V<sub>DD</sub> = 3.3V (MAX44008), T<sub>A</sub> = +25°C, min/max are from -40°C to +85°C, unless otherwise noted.) (Note 2)

| PARAMETER                           | SYMBOL          | CONDITIONS                                                                                                                         | MIN | TYP    | MAX | UNITS                     |
|-------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|-----|--------|-----|---------------------------|
| <b>COLOR-SENSOR CHARACTERISTICS</b> |                 |                                                                                                                                    |     |        |     |                           |
| Maximum Sensitivity (Note 3)        |                 | Clear = 538nm                                                                                                                      |     | 0.002  |     | $\mu\text{W}/\text{cm}^2$ |
|                                     |                 | Red = 630nm                                                                                                                        |     | 0.002  |     |                           |
|                                     |                 | Green = 538nm                                                                                                                      |     | 0.002  |     |                           |
|                                     |                 | Blue = 470nm                                                                                                                       |     | 0.004  |     |                           |
|                                     |                 | Infrared = 850nm                                                                                                                   |     | 0.002  |     |                           |
| Maximum Sense Capability            |                 | Clear = 538nm                                                                                                                      |     | 8388   |     | $\mu\text{W}/\text{cm}^2$ |
|                                     |                 | Red = 630nm                                                                                                                        |     | 8388   |     |                           |
|                                     |                 | Green = 538nm                                                                                                                      |     | 8388   |     |                           |
|                                     |                 | Blue = 470nm                                                                                                                       |     | 16,777 |     |                           |
|                                     |                 | Infrared = 850nm                                                                                                                   |     | 8388   |     |                           |
| Total Error                         | TE              | Power = 10 $\mu\text{W}/\text{cm}^2$ , red = 630nm, green = 538nm, blue = 470nm, T <sub>A</sub> = +25°C, clear = 538nm, IR = 850nm |     | 2      | 15  | %                         |
| Gain Matching                       |                 | Red to green to blue, T <sub>A</sub> = +25°C                                                                                       |     | 0.5    | 10  | %                         |
| Power-Up Time                       | t <sub>ON</sub> |                                                                                                                                    |     | 10     |     | ms                        |
| Dark-Level Counts                   |                 | 6.25ms conversion time, 0 lux, T <sub>A</sub> = +25°C                                                                              |     |        | 2   | Counts                    |
| ADC Conversion Time                 |                 | 14-bit resolution (Note 4)                                                                                                         |     | 400    |     | ms                        |
|                                     |                 | 14-bit resolution, T <sub>A</sub> = +25°C                                                                                          |     | 100    |     |                           |
|                                     |                 | 12-bit resolution                                                                                                                  |     | 25     |     |                           |
|                                     |                 | 10-bit resolution                                                                                                                  |     | 6.25   |     |                           |
|                                     |                 | 8-bit resolution                                                                                                                   |     | 1.5625 |     |                           |

# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### ELECTRICAL CHARACTERISTICS (continued)

(V<sub>DD</sub> = 1.8V (MAX44006), V<sub>DD</sub> = 3.3V (MAX44008), T<sub>A</sub> = +25°C, min/max are from -40°C to +85°C, unless otherwise noted.) (Note 2)

| PARAMETER                                        | SYMBOL              | CONDITIONS                                     | MIN | TYP  | MAX | UNITS  |
|--------------------------------------------------|---------------------|------------------------------------------------|-----|------|-----|--------|
| ADC Conversion Accuracy                          |                     | T <sub>A</sub> = +25°C                         |     | 1    | 10  | %      |
|                                                  |                     | T <sub>A</sub> = -40°C to +85°C (Note 5)       |     | 2    | 15  |        |
| TEMPERATURE SENSOR                               |                     |                                                |     |      |     |        |
| Accuracy (Note 5)                                |                     | T <sub>A</sub> = +25°C~+55°C                   |     | ±1   | ±3  | °C     |
|                                                  |                     | T <sub>A</sub> = 0°C~+70°C                     |     | ±2   | ±5  |        |
| Resolution                                       |                     |                                                |     | 0.25 |     | °C/LSB |
| POWER SUPPLY                                     |                     |                                                |     |      |     |        |
| Power-Supply Voltage                             | V <sub>DD</sub>     | MAX44006, guaranteed by total error            | 1.7 |      | 2   | V      |
|                                                  |                     | MAX44008, guaranteed by total error            | 2.7 |      | 5.5 |        |
| Quiescent Current                                | I <sub>DD</sub>     | MAX44006, CLEAR mode                           |     | 10   | 18  | μA     |
|                                                  |                     | MAX44006, RGBC + IR mode                       |     | 15   | 30  |        |
|                                                  |                     | MAX44008, CLEAR mode                           |     | 10   | 18  |        |
|                                                  |                     | MAX44008, RGBC + IR mode                       |     | 16   | 30  |        |
| Software Shutdown Current                        | I <sub>SHDN</sub>   | MAX44006, T <sub>A</sub> = +25°C               |     |      | 1   | μA     |
|                                                  |                     | MAX44008, T <sub>A</sub> = +25°C               |     |      | 1.5 |        |
| DIGITAL CHARACTERISTICS—SDA, INT, A0             |                     |                                                |     |      |     |        |
| Output Low Voltage SDA                           | V <sub>OL</sub>     | I <sub>SINK</sub> = 6mA                        |     |      | 0.4 | V      |
| I <sup>2</sup> C Input Voltage High              | V <sub>IH</sub>     | SDA, SCL, A0                                   | 1.4 |      |     | V      |
| I <sup>2</sup> C Input Voltage Low               | V <sub>IL</sub>     | SDA, SCL, A0                                   |     |      | 0.4 | V      |
| Input Hysteresis                                 | V <sub>HYS</sub>    |                                                |     | 200  |     | mV     |
| Input Capacitance                                | C <sub>IN</sub>     |                                                |     | 10   |     | pF     |
| Input Leakage Current                            | I <sub>IN</sub>     | V <sub>IN</sub> = 0V, T <sub>A</sub> = +25°C   |     |      | 0.1 | μA     |
|                                                  |                     | V <sub>IN</sub> = 5.5V, T <sub>A</sub> = +25°C |     |      | 0.1 |        |
| I <sup>2</sup> C TIMING CHARACTERISTICS (Note 6) |                     |                                                |     |      |     |        |
| Serial Clock Frequency                           | f <sub>SCL</sub>    |                                                | 0   |      | 400 | kHz    |
| Bus Free Time Between STOP and START             | t <sub>BUF</sub>    |                                                | 1.3 |      |     | μs     |
| Hold Time (Repeated) START Condition             | t <sub>HD,STA</sub> |                                                | 0.6 |      |     | μs     |
| Low Period of the SCL Clock                      | t <sub>LOW</sub>    |                                                | 1.3 |      |     | μs     |
| High Period of the SCL Clock                     | t <sub>HIGH</sub>   |                                                | 0.6 |      |     | μs     |
| Setup Time for a Repeated START                  | t <sub>SU,STA</sub> |                                                | 0.6 |      |     | μs     |
| Setup Time for STOP Condition                    | t <sub>SU,STO</sub> |                                                | 0.6 |      |     | μs     |
| Data Hold Time                                   | t <sub>HD,DAT</sub> |                                                | 0   |      | 0.9 | μs     |
| Data Setup Time                                  | t <sub>SU,DAT</sub> |                                                | 100 |      |     | ns     |
| Bus Capacitance                                  | C <sub>B</sub>      |                                                |     |      | 400 | pF     |

# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### ELECTRICAL CHARACTERISTICS (continued)

( $V_{DD} = 1.8V$  (MAX44006),  $V_{DD} = 3.3V$  (MAX44008),  $T_A = +25^\circ C$ , min/max are from  $-40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.) (Note 2)

| PARAMETER                       | SYMBOL   | CONDITIONS | MIN               | TYP | MAX | UNITS |
|---------------------------------|----------|------------|-------------------|-----|-----|-------|
| SDA and SCL Receiving Rise Time | $t_R$    |            | 20 +<br>0.1 $C_B$ |     | 300 | ns    |
| SDA and SCL Receiving Fall Time | $t_F$    |            | 20 +<br>0.1 $C_B$ |     | 300 | ns    |
| SDA Transmitting Fall Time      | $t_f$    |            | 20 +<br>0.1 $C_B$ |     | 250 | ns    |
| Pulse Width of Suppressed Spike | $t_{SP}$ |            | 0                 |     | 50  | ns    |

**Note 2:** 100% production tested at  $T_A = +25^\circ C$ . Specifications over temperature limits are guaranteed by bench or ATE characterization.

**Note 3:** In AMBTIM[2:0] mode (100ms integration time).

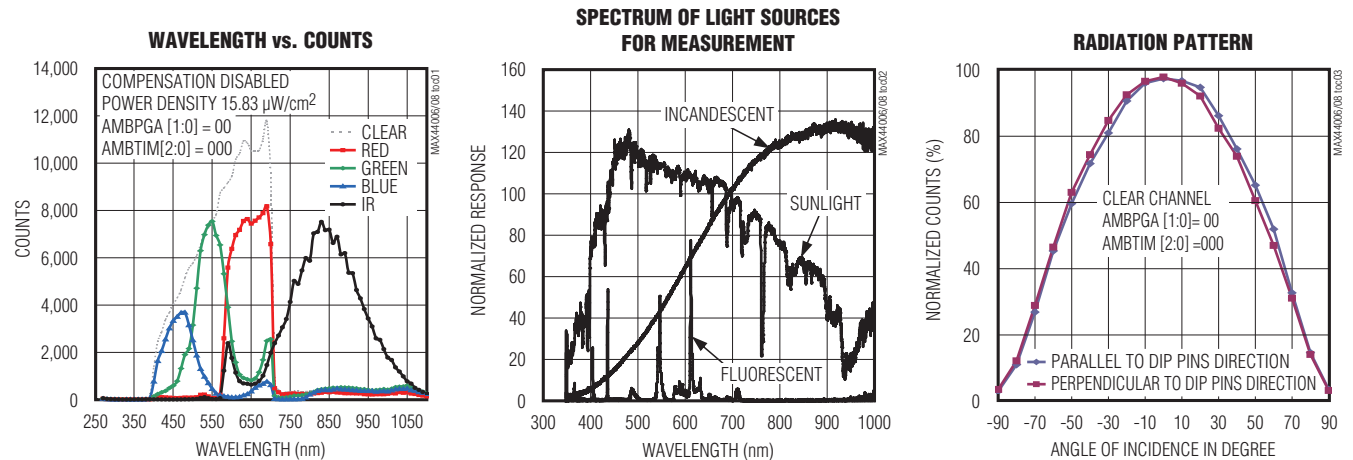
**Note 4:** At 14-bit resolution mode. Sensitivity is 4 times higher with 400ms integration time than 100ms integration time.

**Note 5:** Production tested only at  $+25^\circ C$ , guaranteed by bench characterization across temperature.

**Note 6:** Design guidance only, not production tested.

### Typical Operating Characteristics

( $V_{DD} = 1.8V$  (MAX44006),  $V_{DD} = 3.3V$  (MAX44008),  $T_A = +25^\circ C$ , min/max are from  $-40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.)



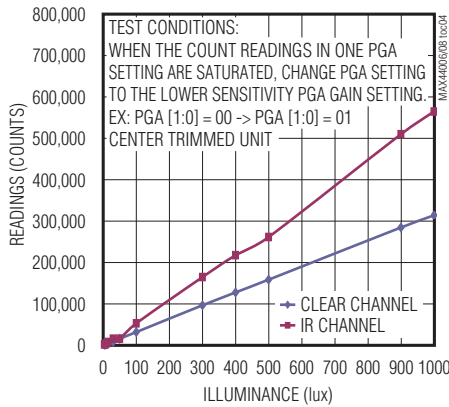
# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

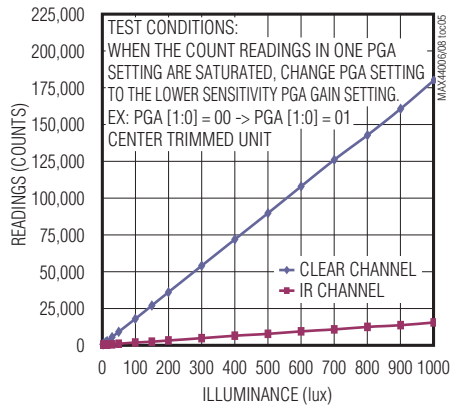
### Typical Operating Characteristics (continued)

( $V_{DD} = 1.8V$  (MAX44006),  $V_{DD} = 3.3V$  (MAX44008),  $T_A = +25^\circ C$ , min/max are from  $-40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.)

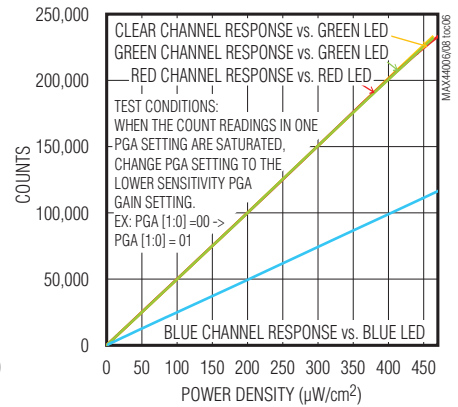
**RESPONSE OF CLEAR AND IR CHANNELS WITH INCANDESCENT LIGHT**



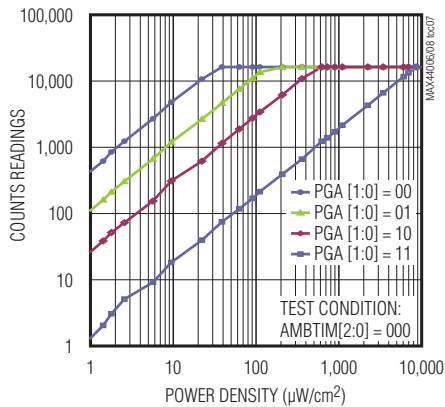
**RESPONSE OF CLEAR AND IR CHANNELS WITH FLUORESCENT LIGHT**



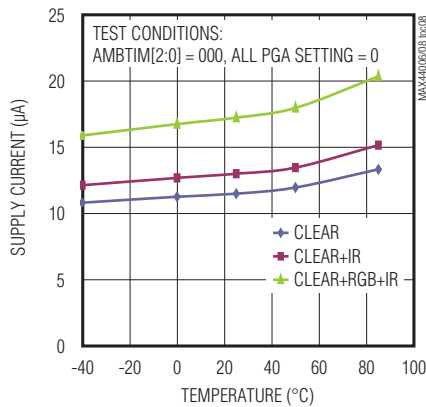
**LINEARITY RESPONSE vs. RGB LED**



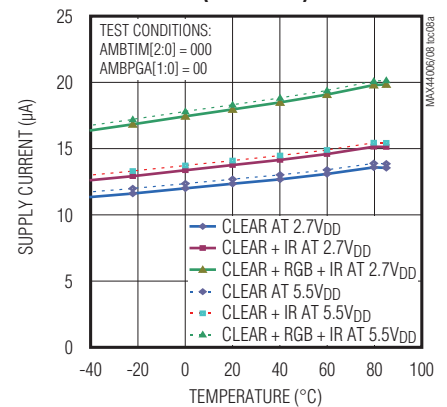
**CLEAR CHANNEL RESPONSE TO WHITE LED**



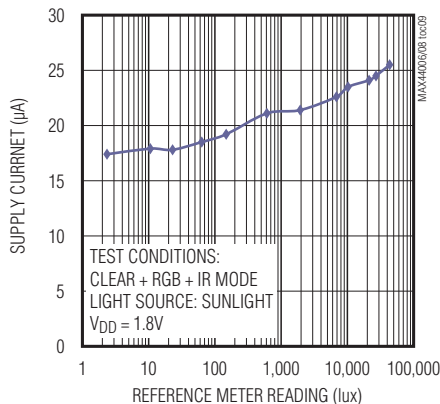
**SUPPLY CURRENT vs. TEMPERATURE (MAX44006)**



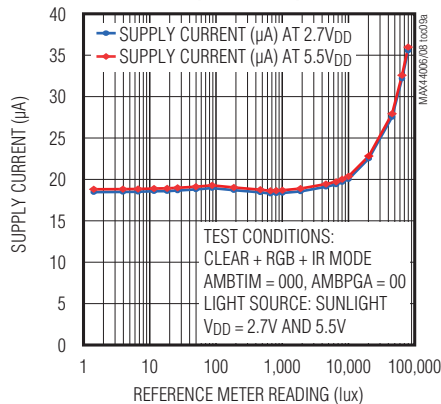
**SUPPLY CURRENT vs. TEMPERATURE (MAX44008)**



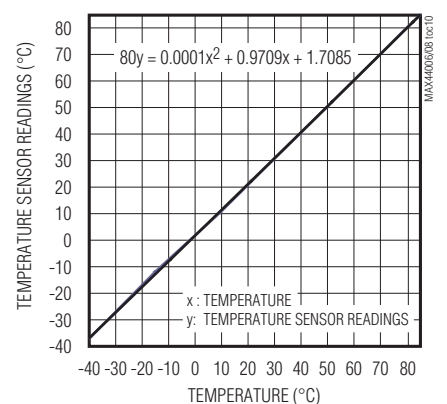
**SUPPLY CURRENT vs. LUX (MAX44006)**



**SUPPLY CURRENT vs. LUX (MAX44008)**



**TEMPERATURE SENSOR READINGS vs. TEMPERATURE**

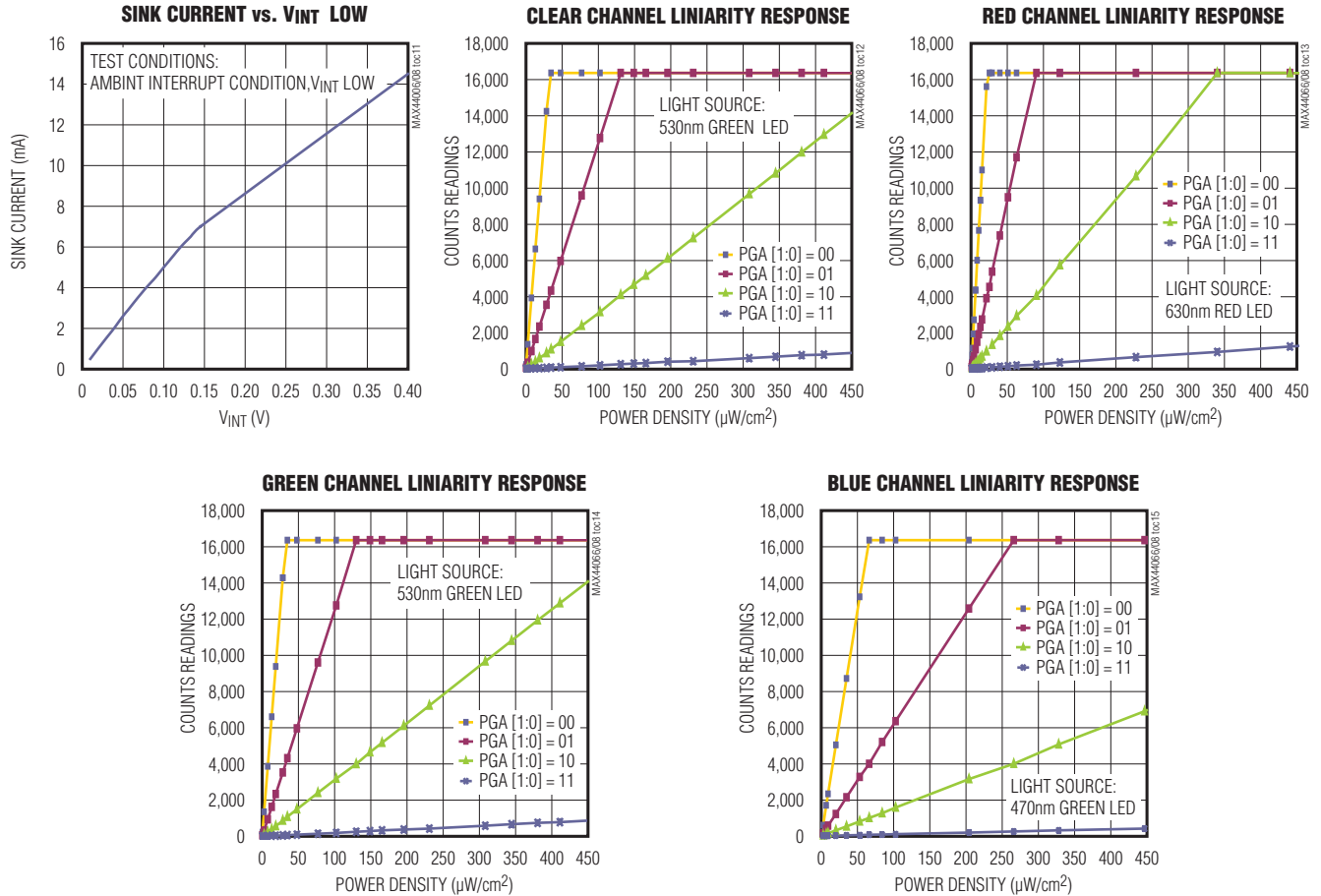


# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### Typical Operating Characteristics (continued)

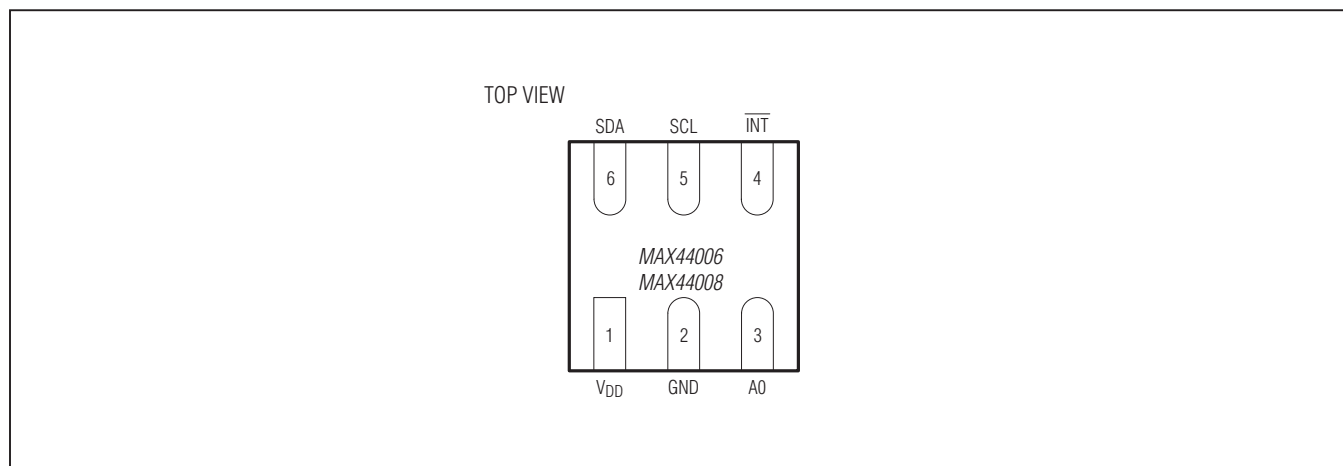
( $V_{CC} = 1.8V$  (MAX44006),  $V_{CC} = 3.3V$  (MAX44008),  $T_A = +25^\circ C$ , min/max are from  $-40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.)



# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### Pin Configuration



### Pin Description

| PIN | NAME                    | FUNCTION                                                                                                                                                    |
|-----|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | $V_{\text{DD}}$         | Power Supply                                                                                                                                                |
| 2   | GND                     | Ground                                                                                                                                                      |
| 3   | A0                      | Address Select. Pull high to select address 1000 100x (MAX44006), 1000 000x (MAX44008) or low to select address 1000 101x (MAX44006), 1000 001x (MAX44008). |
| 4   | $\overline{\text{INT}}$ | Interrupt                                                                                                                                                   |
| 5   | SCL                     | I <sup>2</sup> C Clock                                                                                                                                      |
| 6   | SDA                     | I <sup>2</sup> C Data                                                                                                                                       |

### Detailed Description

The MAX44006/MAX44008 combine a wide-dynamic range color sensor capable of measuring red, green, and blue (RGB) and infrared content of ambient light. The devices also have a digital I<sup>2</sup>C interface, advanced TEMP sensor, and interrupt pin functionality to make interfacing with it easy. The die is placed inside an optically transparent (OTDFN) package.

A photodiode array inside the devices converts the light to a current, which is then processed by low-power circuitry and a sigma-delta ADC into a digital bit stream.

The data is then stored in an output register that can be read by an I<sup>2</sup>C master.

The user can choose whether to read just the clear channel, or clear + IR channel, or clear + RGB + IR channels. Due to parallel conversion by on-chip ADCs, there is no additional delay in making ambient light conversions for multiple channels.

Key features of the devices include high-level integration, low-power design, small packaging, and interrupt pin operation. An on-chip programmable interrupt function eliminates the need to continually poll the devices for data, resulting in a significant power saving.

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### Ambient Light Sensing

Ambient light sensors are designed to detect brightness the same way human eyes do. To achieve this, the light sensor needs to have a spectral sensitivity that is identical to the photopic curve of the human eye. See [Figure 1](#).

The devices' color sensors are designed to accurately derive the color chromaticity and intensity of ambient light. With parallel ADC conversion circuits, conversion data from multiple channels can be read at the same time. An interrupt signal can also be dynamically configured with higher and lower thresholds, and a persist timer. The interrupt is latched until the master reads the Interrupt Status register. This allows the master to stay in power-efficient sleep mode until a change in lighting condition alerts it.

Variation between light sources can extend beyond the visible spectral range—fluorescent, incandescent, and sunlight, for example, have substantially different IR radiation content. The devices incorporate on-chip measurement of RGBC and IR of compensation of ambient light, allowing accurate lux detection in a variety of lighting conditions, as well as identification of type of light source.

On-chip user-programmable clear, RGB, infrared channel gain registers allow the light sensor response to also

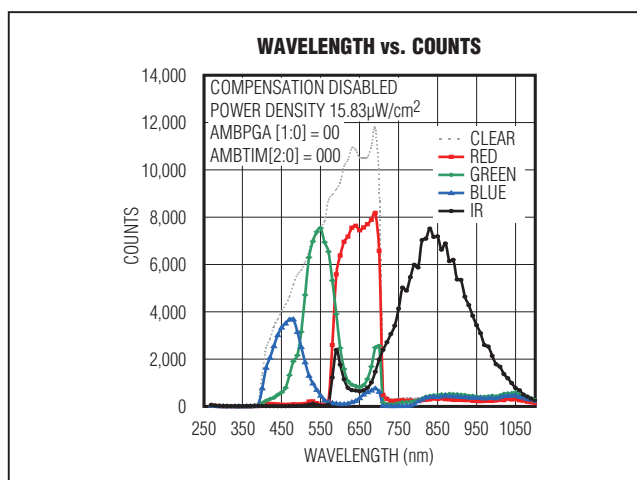


Figure 1. Wavelength vs. Counts

be tailored for specific applications, such as when the light sensor is placed under a colored or black glass.

### Temperature Sensor

The devices also integrate a temperature sensor that can be used for ambient temperature measurement and compensation. A nonlinear response is designed to replicate the effect of temperature on the photodiodes used on the chip.

## Register Description

| REGISTER              | BIT7 | BIT6   | BIT5      | BIT4  | BIT3        | BIT2  | BIT1        | BIT0    | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|-----------------------|------|--------|-----------|-------|-------------|-------|-------------|---------|------------------|----------------------|-----|
| <b>STATUS</b>         |      |        |           |       |             |       |             |         |                  |                      |     |
| Interrupt Status      |      |        |           | RESET | SHDN        | PWRON |             | AMBINTS | 0x00             | 0x04                 | R/W |
| <b>CONFIGURATION</b>  |      |        |           |       |             |       |             |         |                  |                      |     |
| Main Configuration    |      |        | MODE[1:0] |       | AMBSEL[1:0] |       |             | AMBINTE | 0x01             | 0x00                 | R/W |
| Ambient Configuration | TRIM | COMPEN | TEMPEN    |       | AMBTIM[2:0] |       | AMBPGA[1:0] |         | 0x02             | 0x20                 | R/W |



# MAX44006/MAX44008

## RGB Color, Infrared, and Temperature Sensors

### Register Description (continued)

| REGISTER                   | BIT7            | BIT6 | BIT5             | BIT4 | BIT3 | BIT2 | BIT1 | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|----------------------------|-----------------|------|------------------|------|------|------|------|------|------------------|----------------------|-----|
| AMBIENT READING            |                 |      |                  |      |      |      |      |      |                  |                      |     |
| Ambient CLEAR High Byte    |                 |      | AMB_CLEAR[13:8]  |      |      |      |      |      | 0x04             | 0x00                 | R   |
| Ambient CLEAR Low Byte     | AMB_CLEAR[7:0]  |      |                  |      |      |      |      |      | 0x05             | 0x00                 | R   |
| Ambient RED High Byte      |                 |      | AMB_RED[13:8]    |      |      |      |      |      | 0x06             | 0x00                 | R   |
| Ambient RED Low Byte       | AMB_RED[7:0]    |      |                  |      |      |      |      |      | 0x07             | 0x00                 | R   |
| Ambient GREEN High Byte    |                 |      | AMB_GREEN[13:8]  |      |      |      |      |      | 0x08             | 0x00                 | R   |
| Ambient GREEN Low Byte     | AMB_GREEN[7:0]  |      |                  |      |      |      |      |      | 0x09             | 0x00                 | R   |
| Ambient BLUE High Byte     |                 |      | AMB_BLUE[13:8]   |      |      |      |      |      | 0x0A             | 0x00                 | R   |
| Ambient BLUE Low Byte      | AMB_BLUE[7:0]   |      |                  |      |      |      |      |      | 0x0B             | 0x00                 | R   |
| Ambient INFRARED High Byte |                 |      | AMB_IR[13:8]     |      |      |      |      |      | 0x0C             | 0x00                 | R   |
| Ambient INFRARED Low Byte  | AMB_IR[7:0]     |      |                  |      |      |      |      |      | 0x0D             | 0x00                 | R   |
| Ambient IR COMP High Byte  |                 |      | AMB_IRCOMP[13:8] |      |      |      |      |      | 0x0E             | 0x00                 | R   |
| Ambient IR COMP Low Byte   | AMB_IRCOMP[7:0] |      |                  |      |      |      |      |      | 0x0F             | 0x00                 | R   |
| TEMP High Byte             |                 |      | TEMP[13:8]       |      |      |      |      |      | 0x12             | 0x00                 | R   |

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## RGB Color, Infrared, and Temperature Sensors

### Register Description (continued)

| REGISTER                              | BIT7       | BIT6                 | BIT5        | BIT4 | BIT3 | BIT2 | BIT1       | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|---------------------------------------|------------|----------------------|-------------|------|------|------|------------|------|------------------|----------------------|-----|
| TEMP Low Byte                         | TEMP[7:0]  |                      |             |      |      |      |            |      | 0x13             | 0x00                 | R   |
| INTERRUPT THRESHOLDS                  |            |                      |             |      |      |      |            |      |                  |                      |     |
| AMB Upper Threshold—High Byte         |            |                      | UPTHR[13:8] |      |      |      |            |      | 0x14             | 0xFF                 | R/W |
| AMB Upper Threshold—Low Byte          | UPTHR[7:0] |                      |             |      |      |      |            |      | 0x15             | 0xFF                 | R/W |
| AMB Lower Threshold—High Byte         |            |                      | LOTHR[13:8] |      |      |      |            |      | 0x16             | 0x00                 | R/W |
| AMB Lower Threshold—Low Byte          | LOTHR[7:0] |                      |             |      |      |      |            |      | 0x17             | 0x00                 | R/W |
| Threshold Persist Timer               |            |                      |             |      |      |      | AMPST[1:0] |      | 0x18             | 0x00                 | R/W |
| AMBIENT ADC GAINS                     |            |                      |             |      |      |      |            |      |                  |                      |     |
| Digital Gain Trim of CLEAR Channel    |            | TRIM_GAIN_CLEAR[6:0] |             |      |      |      |            | 0x1D | 0xFF             | R/W                  |     |
| Digital Gain Trim of RED Channel      |            | TRIM_GAIN_RED[6:0]   |             |      |      |      |            | 0x1E | 0xFF             | R/W                  |     |
| Digital Gain Trim of GREEN Channel    |            | TRIM_GAIN_GREEN[6:0] |             |      |      |      |            | 0x1F | 0xFF             | R/W                  |     |
| Digital Gain Trim of BLUE Channel     |            | TRIM_GAIN_BLUE[6:0]  |             |      |      |      |            | 0x20 | 0xFF             | R/W                  |     |
| Digital Gain Trim of INFRARED Channel |            | TRIM_GAIN_IR[6:0]    |             |      |      |      |            | 0x21 | 0xFF             | R/W                  |     |

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The individual register bits are explained below.

### Interrupt Status (0x00)

| REGISTER         | BIT7 | BIT6 | BIT5 | BIT4  | BIT3 | BIT2  | BIT1 | BIT0    | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|------------------|------|------|------|-------|------|-------|------|---------|------------------|----------------------|-----|
| Interrupt Status |      |      |      | RESET | SHDN | PWRON |      | AMBINTS | 0x00             | 0x04                 | R/W |

The AMBINTS bit in the Interrupt Status register 0x00 is a read-only bit, and indicates that an ambient light-interrupt condition has occurred. If any of these bits (PWRON, AMBINTS) are set to 1, the  $\overline{\text{INT}}$  pin is pulled low. The PWRON bit in the Interrupt Status register 0x00 is a read-only bit, and if set, indicates that a power-on-reset (POR) condition has occurred, and any user-programmed thresholds may not be valid anymore. The SHDN bit in the Interrupt Status register 0x00 is a read/write bit, and can be used to put the part into and bring out of shutdown for power saving. All register data is retained during this operation. The RESET bit in the Interrupt Status register 0x00 is also a read/write bit, and can be used to reset all the registers back to a power-on default condition.

Reading the Interrupt Status register clears the PWRON and AMBINTS bits if set, and deasserts the  $\overline{\text{INT}}$  pin ( $\overline{\text{INT}}$  pin is pulled high by the off-chip pullup resistor). The AMBINTS bits are disabled and set to 0 if the respective INTE Interrupt Enable bits in Register 0x01 are set to 0.

**Table 1. Ambient INTERRUPT STATUS Flag (AMBINTS)**

| BIT0 | OPERATION                                                                                                                                                                                                                                                                                                                                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | No interrupt trigger event has occurred.                                                                                                                                                                                                                                                                                                    |
| 1    | The ambient light has exceeded the designated window limits defined by the threshold registers for longer than persist timer count AMBPST[1:0]. It also causes the $\overline{\text{INT}}$ pin to be pulled low. Once set, the only way to clear this bit is to read this register. This bit is always set to 0 if AMBINTE bit is set to 0. |

**Table 2. Power-On INTERRUPT STATUS Flag (PWRON)**

| BIT2 | OPERATION                                                                                                                                                                                                                                                                                                                                                                                                |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Normal operating mode.                                                                                                                                                                                                                                                                                                                                                                                   |
| 1    | The part went through a power-up event, either because the part was turned on, or because there was a power-supply voltage glitch. All interrupt threshold settings in the registers have been reset to power-on default states, and should be examined if necessary. The $\overline{\text{INT}}$ pin is also pulled low. Once this bit is set, the only way to clear this bit is to read this register. |

**Table 3. Shutdown Control (SHDN)**

| BIT3 | OPERATION                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | The part is in normal operation. When the part returns from shutdown, note that the value in data registers is not current until the first conversion cycle is completed.                                                                                                                                                                                                                                                      |
| 1    | The part can be put into a power-save mode by writing a 1 to this bit. Supply current is reduced to approximately 0.01 $\mu\text{A}$ (MAX44006) and 0.5 $\mu\text{A}$ (MAX44008) with no I <sup>2</sup> C clock activity. While all registers remain accessible and retain data, ADC conversion data contained in them may not be current. Writeable registers also remain accessible in shutdown. All interrupts are cleared. |

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**Table 4. Reset Control (RESET)**

| BIT4 | OPERATION                                                                                                                                                                                                                                                                                                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | The part is in normal operation.                                                                                                                                                                                                                                                                                                        |
| 1    | The part undergoes a forced POR sequence. All configuration, threshold, and data registers are reset to a power-on state by writing a 1 to this bit, and an internal hardware reset pulse is generated. This bit then automatically becomes 0 after the RESET sequence is completed. After resetting, the PWRON interrupt is triggered. |

### Main Configuration (0x01)

| REGISTER           | BIT7 | BIT6 | BIT5      | BIT4 | BIT3        | BIT2 | BIT1 | BIT0    | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|--------------------|------|------|-----------|------|-------------|------|------|---------|------------------|----------------------|-----|
| Main Configuration |      |      | MODE[1:0] |      | AMBSEL[1:0] |      |      | AMBINTE | 0x01             | 0x20                 | R/W |

Writing to the Main Configuration register does not abort any ambient data conversion (registers 0x04 to 0x0F) if already in progress. It applies the new settings during the next conversion period.

**Table 5. Ambient Interrupt Enable (AMBINTE)**

| BIT0 | OPERATION                                                                                                                                                                                                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | The AMBINTS bit and $\overline{\text{INT}}$ pin remain unasserted even if an ambient interrupt event has occurred. The AMBINTS bit is set to 0 if previously set to 1. See Table 1 for more details.                                    |
| 1    | Detection of ambient interrupt events is enabled (see the AMBINTS bit for more details). An ambient interrupt can trigger a hardware interrupt ( $\overline{\text{INT}}$ pin pulled low) and set the AMBINTS bit (register 0x00, BIT0). |

**Note:** Detection of an ambient interrupt event sets the AMBINTS bit (register 0x00, BIT0) only if AMBINTE bit is set to 1. If AMBINTS bits are set to 1, it pulls the interrupt  $\overline{\text{INT}}$  pin low (asserts it). A read of the Interrupt Status register clears AMBINTS bits if set to 1, and deasserts the  $\overline{\text{INT}}$  pin if pulled low.

The 2 AMBSEL[1:0] bits define four operating modes for the devices. Ensure that the respective ambient channels also enable use of the MODE[1:0] bits.

**Table 6. Ambient Interrupt Select (AMBSEL[1:0])**

| AMBSEL[1:0] | OPERATION                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------|
| 00          | CLEAR channel data is used to compare with ambient interrupt thresholds and ambient timer settings. |
| 01          | GREEN channel data is used to compare with ambient interrupt thresholds and ambient timer settings. |
| 10          | IR channel data is used to compare with ambient interrupt thresholds and ambient timer settings.    |
| 11          | TEMP channel data is used to compare with ambient interrupt thresholds and ambient timer settings.  |

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The 2 MODE[1:0] bits define three operating modes for the devices, as shown in [Table 7](#).

**Table 7. MODE[1:0]**

| MODE[1:0] | OPERATING MODE   | COMMENTS                                 |
|-----------|------------------|------------------------------------------|
| 00        | Clear            | CLEAR + TEMP* channels active            |
| 01        | Clear + IR       | CLEAR + TEMP* + IR channels active       |
| 10        | Clear + RGB + IR | CLEAR + TEMP* + RGB + IR channels active |

\*When TEMPEN set to 1.

### Ambient Configuration Register (0x02)

| REGISTER              | BIT7 | BIT6   | BIT5   | BIT4        | BIT3 | BIT2 | BIT1        | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|-----------------------|------|--------|--------|-------------|------|------|-------------|------|------------------|----------------------|-----|
| Ambient Configuration | TRIM | COMPEN | TEMPEN | AMBTIM[2:0] |      |      | AMBPGA[1:0] |      | 0x02             | 0x00                 | R/W |

Writing to the Ambient Configuration register aborts any ambient data conversion (registers 0x04 to 0x0F) if already in progress, applies the new settings immediately, and initiates a new conversion.

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The 2 AMBPGA[1:0] bits set the gain of the clear/red/green/blue/IR channel measurements according to [Table 8](#).

**Table 8. AMBPGA[1:0]**

In AMBTIM[2:0] = 000 Mode (100ms integration time)

| AMBPGA[1:0] | CLEAR                       |                                  | RED                         |                                  | GREEN                       |                                  |
|-------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|
|             | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) |
| 00          | 2                           | 32.768                           | 2                           | 32.768                           | 2                           | 32.768                           |
| 01          | 8                           | 131.072                          | 8                           | 131.072                          | 8                           | 131.072                          |
| 10          | 32                          | 524.288                          | 32                          | 524.288                          | 32                          | 524.288                          |
| 11          | 512                         | 8388.61                          | 512                         | 8388.61                          | 512                         | 8388.61                          |

| AMBPGA[1:0] | BLUE                        |                                  | IR                          |                                  |
|-------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|
|             | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) |
| 00          | 4                           | 65.536                           | 2                           | 32.768                           |
| 01          | 16                          | 262.144                          | 8                           | 131.072                          |
| 10          | 64                          | 1048.573                         | 32                          | 524.288                          |
| 11          | 1024                        | 16777.2                          | 512                         | 8388.61                          |

In AMBTIM[2:0] = 100 Mode (400ms integration time)

| AMBPGA[1:0] | CLEAR                       |                                  | RED                         |                                  | GREEN                       |                                  |
|-------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|
|             | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) |
| 00          | 0.5                         | 8.192                            | 0.5                         | 8.192                            | 0.5                         | 8.192                            |
| 01          | 2                           | 32.768                           | 2                           | 32.768                           | 2                           | 32.768                           |
| 10          | 8                           | 131.072                          | 8                           | 131.072                          | 8                           | 131.072                          |
| 11          | 128                         | 2097.153                         | 128                         | 2097.153                         | 128                         | 2097.153                         |

| AMBPGA[1:0] | BLUE                        |                                  | IR                          |                                  |
|-------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|
|             | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) | nW/cm <sup>2</sup> per LSB* | FULL SCALE (μW/cm <sup>2</sup> ) |
| 00          | 1                           | 16.384                           | 0.5                         | 8.192                            |
| 01          | 4                           | 65.536                           | 2                           | 32.768                           |
| 10          | 16                          | 262.1433                         | 8                           | 131.072                          |
| 11          | 256                         | 4194.3                           | 128                         | 2097.153                         |

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The 3 AMBTIM[2:0] bits set the integration time for the red/green/blue/IR/temp channel ADC conversion, as shown in [Table 9](#).

**Table 9. AMBTIM[2:0]**

| AMBTIM[2:0] | INTEGRATION TIME (ms) | FULL-SCALE ADC (COUNTS) | BIT RESOLUTION | RELATIVE LSB SIZE FOR FIXED AMBPGA[1:0] |
|-------------|-----------------------|-------------------------|----------------|-----------------------------------------|
| 000         | 100                   | 16,384                  | 14             | 1x                                      |
| 001         | 25                    | 4,096                   | 12             | 4x                                      |
| 010         | 6.25                  | 1,024                   | 10             | 16x                                     |
| 011         | 1.5625                | 256                     | 8              | 64x                                     |
| 100         | 400                   | 16,384                  | 14             | 1/4x                                    |
| 101         | Reserved              | Not applicable          | Not applicable | Not applicable                          |
| 110         | Reserved              | Not applicable          | Not applicable | Not applicable                          |
| 111         | Reserved              | Not applicable          | Not applicable | Not applicable                          |

**TEMPEN**

**Table 10. TEMPEN**

| BIT6 | OPERATION                    |
|------|------------------------------|
| 0    | Disables temperature sensor. |
| 1    | Enables temperature sensor.  |

The integration time of temperature sensor is controlled by the ambient mode settings. The temperature sensor is enabled only if the clear channel is on.

**COMPEN**

**Table 11. COMPEN**

| BIT5 | OPERATION                                              |
|------|--------------------------------------------------------|
| 0    | Disables IR compensation.                              |
| 1    | Enables IR compensation. Only for MODE[1:0] = 00 Mode. |

The integration time of compensation channel is controlled by the AMB mode settings. The compensation is enabled only when the clear channel is on. When COMPEN = 1, the CLEAR data is automatically compensated for stray IR leakeds and temperature variations. When COMPEN = 0, the IR compensation is disabled, but the output of the IR compensation data exits.

**Table 12. TRIM Adjust Enable (TRIM)**

| BIT7 | OPERATION                                                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Use factory-programmed gains for all the channels. Ignore any bytes written to TRIM_GAIN_GREEN[6:0], TRIM_GAIN_RED[6:0], TRIM_GAIN_BLUE[6:0], TRIM_GAIN_CLEAR[6:0], and TRIM_GAIN_IR[6:0] registers. |
| 1    | Use bytes written to TRIM_GAIN_GREEN[6:0], TRIM_GAIN_RED[6:0], TRIM_GAIN_BLUE[6:0], TRIM_GAIN_CLEAR[6:0], and TRIM_GAIN_IR[6:0] registers to set the gain for each channel.                          |

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### AMBIENT Data Register (0x04–0x0F)

| REGISTER                   | BIT7            | BIT6 | BIT5             | BIT4 | BIT3 | BIT2 | BIT1 | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|----------------------------|-----------------|------|------------------|------|------|------|------|------|------------------|----------------------|-----|
| AMBIENT READING            |                 |      |                  |      |      |      |      |      |                  |                      |     |
| Ambient CLEAR High Byte    |                 |      | AMB_CLEAR[13:8]  |      |      |      |      |      | 0x04             | 0x00                 | R   |
| Ambient CLEAR Low Byte     | AMB_CLEAR[7:0]  |      |                  |      |      |      |      |      | 0x05             | 0x00                 | R   |
| Ambient RED High Byte      |                 |      | AMB_RED[13:8]    |      |      |      |      |      | 0x06             | 0x00                 | R   |
| Ambient RED Low Byte       | AMB_RED[7:0]    |      |                  |      |      |      |      |      | 0x07             | 0x00                 | R   |
| Ambient GREEN High Byte    |                 |      | AMB_GREEN[13:8]  |      |      |      |      |      | 0x08             | 0x00                 | R   |
| Ambient GREEN Low Byte     | AMB_GREEN[7:0]  |      |                  |      |      |      |      |      | 0x09             | 0x00                 | R   |
| Ambient BLUE High Byte     |                 |      | AMB_BLUE[13:8]   |      |      |      |      |      | 0x0A             | 0x00                 | R   |
| Ambient BLUE Low Byte      | AMB_BLUE[7:0]   |      |                  |      |      |      |      |      | 0x0B             | 0x00                 | R   |
| Ambient INFRARED High Byte |                 |      | AMB_IR[13:8]     |      |      |      |      |      | 0x0C             | 0x00                 | R   |
| Ambient INFRARED Low Byte  | AMB_IR[7:0]     |      |                  |      |      |      |      |      | 0x0D             | 0x00                 | R   |
| Ambient IR COMP High Byte  |                 |      | AMB_IRCOMP[13:8] |      |      |      |      |      | 0x0E             | 0x00                 | R   |
| Ambient IR COMP Low Byte   | AMB_IRCOMP[7:0] |      |                  |      |      |      |      |      | 0x0F             | 0x00                 | R   |

AMB\_CLEAR[13:0], AMB\_RED[13:0], AMB\_GREEN[13:0], AMB\_BLUE[13:0], AMB\_IR[13:0], and AMB\_IRCOMP[13:0] hold the 14-bit ADC data of the clear/red/green/blue/IR/COMP channels. AMB\_IRCOMP[13:0] can be used to enhance overtemperature performance of the devices. The resolution and bit length of the result is controlled by the value of the AMBTIM[2:0] and AMBPGA[1:0] bits. The result is always right justified in the registers, and the unused high bits are set to zero.



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### Temperature Data Register (0x12–0x13)

| REGISTER       | BIT7      | BIT6 | BIT5       | BIT4 | BIT3 | BIT2 | BIT1 | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|----------------|-----------|------|------------|------|------|------|------|------|------------------|----------------------|-----|
| TEMP High Byte |           |      | TEMP[13:8] |      |      |      |      |      | 0x12             | 0X00                 | R   |
| TEMP Low Byte  | TEMP[7:0] |      |            |      |      |      |      |      | 0x13             | 0X00                 | R   |

### Ambient Interrupt Threshold Registers (0x14–0x17)

| REGISTER                      | BIT7       | BIT6 | BIT5        | BIT4 | BIT3 | BIT2 | BIT1 | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|-------------------------------|------------|------|-------------|------|------|------|------|------|------------------|----------------------|-----|
| AMB Upper Threshold—High Byte |            |      | UPTHR[13:8] |      |      |      |      |      | 0x14             | 0xFF                 | R/W |
| AMB Upper Threshold—Low Byte  | UPTHR[7:0] |      |             |      |      |      |      |      | 0x15             | 0xFF                 | R/W |
| AMB Lower Threshold—High Byte |            |      | LOTHR[13:8] |      |      |      |      |      | 0x16             | 0x00                 | R/W |
| AMB Lower Threshold—Low Byte  | LOTHR[7:0] |      |             |      |      |      |      |      | 0x17             | 0x00                 | R/W |

The ambient upper threshold and lower threshold (UPTHR[13:0] and LOTHR[13:0]) set the window limits that are used to trigger an ambient interrupt, AMBINTS. It is important to set these values according to the selected bit resolution/integration time chosen for the ambient measurement based on the AMBTIM[2:0] and AMBPGA[1:0] settings. The upper 2 bits are always ignored. If the AMBINTE bit is set, and the selected ambient channel data is outside the upper or lower thresholds for a period greater than that defined by the AMBPST persist time, the AMBINTS bit in the Status register is set and the  $\overline{\text{INT}}$  pin is pulled low.

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### Ambient Threshold Persist Timer Register (0x18)

| REGISTER                | BIT7 | BIT6 | BIT5 | BIT4 | BIT3 | BIT2 | BIT1       | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|-------------------------|------|------|------|------|------|------|------------|------|------------------|----------------------|-----|
| Threshold Persist Timer |      |      |      |      |      |      | AMPST[1:0] |      | 0x18             | 0x00                 | R/W |

AMPST[1:0] sets one of four persist values in [Table 13](#) that control a time delay before the interrupt logic reacts to a detected event. This feature is added in order to reduce false or nuisance interrupts.

**Table 13. AMPST[1:0]**

| AMPST[1:0] | NO. OF CONSECUTIVE MEASUREMENTS REQUIRED TO TRIGGER AN INTERRUPT |
|------------|------------------------------------------------------------------|
| 00         | 1                                                                |
| 01         | 4                                                                |
| 10         | 8                                                                |
| 11         | 16                                                               |

When AMPST[1:0] is set to 00, and the AMBINTE bit is set to 1, the first time an AMB interrupt event is detected, the AMBINTS interrupt bit is set and the  $\overline{\text{INT}}$  pin goes low. If AMPST[1:0] is set to 01, then four consecutive interrupt events must be detected on four consecutive measurement cycles. Similarly, if AMPST[1:0] is set to 10 or 11, then 8 or 16 consecutive interrupt events must be detected. If there is an intervening measurement cycle where no interrupt event is detected, then the count is reset to zero.

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### Gain Trim Registers (0x1D–0x21)

| REGISTER                              | BIT7 | BIT6                 | BIT5 | BIT4 | BIT3 | BIT2 | BIT1 | BIT0 | REGISTER ADDRESS | POWER-ON RESET STATE | R/W |
|---------------------------------------|------|----------------------|------|------|------|------|------|------|------------------|----------------------|-----|
| Digital Gain Trim of CLEAR Channel    |      | TRIM_GAIN_CLEAR[6:0] |      |      |      |      |      |      | 0x1D             | 0xFF                 | R/W |
| Digital Gain Trim of RED Channel      |      | TRIM_GAIN_RED[6:0]   |      |      |      |      |      |      | 0x1E             | 0xFF                 | R/W |
| Digital Gain Trim of GREEN Channel    |      | TRIM_GAIN_GREEN[6:0] |      |      |      |      |      |      | 0x1F             | 0xFF                 | R/W |
| Digital Gain Trim of BLUE Channel     |      | TRIM_GAIN_BLUE[6:0]  |      |      |      |      |      |      | 0x20             | 0xFF                 | R/W |
| Digital Gain Trim of INFRARED Channel |      | TRIM_GAIN_IR[6:0]    |      |      |      |      |      |      | 0x21             | 0xFF                 | R/W |

TRIM\_GAIN\_CLEAR is used to trim the gain of the clear channel. TRIM\_GAIN\_RED is used to trim the gain of the red channel, TRIM\_GAIN\_GREEN is used to trim the gain of the green channel, TRIM\_GAIN\_BLUE is used to trim the gain of the blue channel, and TRIM\_GAIN\_IR is used to trim the gain of the IR channel.

These registers are loaded with the factory-trimmed gains on power-up. When the TRIM bit in register 0x02 is set to 1, these registers can be overwritten with user-chosen gains. When the TRIM bit is set back to 0, these registers are automatically reloaded with factory-trimmed values.



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dition occurs (e.g., when ambient lux readings exceed threshold limits for a period greater than that set by the Persist Timer register). The interrupt status bit is cleared automatically if register 0x00 is read or if the interrupts are disabled.

A PWRON interrupt bit is set to alert the master of a chip-reset operation in case of a power-supply glitch, as can happen in instruments during vibration or power fluctuations.

It is recommended to utilize the  $\overline{\text{INT}}$  pin on the devices to alert the master to read measurements from the devices. This eliminates the need for the microcontroller (I<sup>2</sup>C master) to continually poll the devices for information. Due to the use of pullup resistors on the I<sup>2</sup>C bus, minimizing I<sup>2</sup>C bus activity can reduce power consumption substantially. In addition, this frees up the microcontroller resources to service other background processes to improve the devices' performance. The wide variety of smarts available on the chip, such as the ability to set the threshold levels and to count persist timer limits, allow the part to operate in an autonomous mode most of the time.

### Typical Operating Sequence

The typical operating sequence for the master to communicate to the devices is shown below:

- 1) Setup:
  - a) Read the Interrupt Status register (0x00) to confirm only the PWRON bit is set (usually at power-up only). This also clears the hardware interrupt.
  - b) Set Threshold and Persist Timer registers for ambient measurements.
  - c) Write 0x00 to Ambient Configuration register (register 0x02) to set the AMB sensor in the most sensitive gain setting, and the AMB ADCs in 14-bit modes of operation.

- d) Write 0x21 to the Main Configuration register (register 0x01) to set the part in CLEAR + TEMP + RGB + IR mode and to enable AMB interrupt.

- e) (Optional: Set new CLEAR, RGB, and infrared channel gains if necessary and set TRIM bit in register 0x02 to 1).

2) Wait for interrupt.

3) On interrupt:

- a) Read the Interrupt Status register (0x00) to confirm the IC to be the source of interrupt. This should clear the hardware interrupt on the part, if set.

- b) If an AMB interrupt has occurred, read AMB registers (register 0x04–0x0D) and take appropriate action (e.g., sets new backlight strength/change display gamma). Set new AMB thresholds, if necessary.

- c) Return to Step 2.

### I<sup>2</sup>C Serial Interface

The devices feature an I<sup>2</sup>C /SMBus™-compatible, 2-wire serial interface consisting of a serial data line (SDA) and a serial clock line (SCL). SDA and SCL facilitate communication between the devices and the master at clock rates up to 400kHz. [Figure 3](#) shows the 2-wire interface timing diagram. The master generates SCL and initiates data transfer on the bus. A master device writes data to the devices by transmitting the proper slave address followed by the register address and then the data word. Each transmit sequence is framed by a START (S) or Repeated START (Sr) condition and a STOP (P) condition. Each word transmitted to the devices is 8 bits long and is followed by an acknowledge clock pulse. A master reading data from the IC transmits the proper slave address followed by a series of nine SCL

**Table 14. Slave Address**

| A0              | SLAVE ADDRESS FOR WRITING | SLAVE ADDRESS FOR READING |
|-----------------|---------------------------|---------------------------|
| <b>MAX44006</b> |                           |                           |
| GND             | 1000 1010                 | 1000 1011                 |
| V <sub>DD</sub> | 1000 1000                 | 1000 1001                 |
| <b>MAX44008</b> |                           |                           |
| GND             | 1000 0010                 | 1000 0011                 |
| V <sub>DD</sub> | 1000 0000                 | 1000 0001                 |

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pulses. The devices transmit data on SDA in sync with the master-generated SCL pulses. The master acknowledges receipt of each byte of data. Each read sequence is framed by a START or Repeated START condition, a not acknowledge (NACK), and a STOP condition. SDA operates as both an input and an open-drain output. A pullup resistor, typically greater than  $500\Omega$ , is required on the SDA bus. SCL operates as only an input. A pullup resistor, typically greater than  $500\Omega$ , is required on SCL if there are multiple masters on the bus, or if the master in a single-master system has an open-drain SCL output. Series resistors in line with SDA and SCL are optional. Series resistors protect the digital inputs of the devices from high-voltage spikes on the bus lines and minimize crosstalk and undershoot of the bus signal.

### Bit Transfer

One data bit is transferred during each SCL cycle. The data on SDA must remain stable during the high period of the SCL pulse. Changes in SDA while SCL is high are control signals. See the [START and STOP Conditions](#)

section. SDA and SCL idle high when the I<sup>2</sup>C bus is not busy.

### START and STOP Conditions

SDA and SCL idle high when the bus is not in use. A master initiates communication by issuing a START condition. A START condition is a high-to-low transition on SDA with SCL high. A STOP condition is a low-to-high transition on SDA while SCL is high ([Figure 4](#)). A START condition from the master signals the beginning of a transmission to the IC. The master terminates transmission, and frees the bus by issuing a STOP condition. The bus remains active if a Repeated START condition is generated instead of a STOP condition.

### Early STOP Conditions

The devices recognize a STOP condition at any point during data transmission except if the STOP condition occurs in the same high pulse as a START condition. For proper operation, do not send a STOP condition during the same SCL high pulse as the START condition.

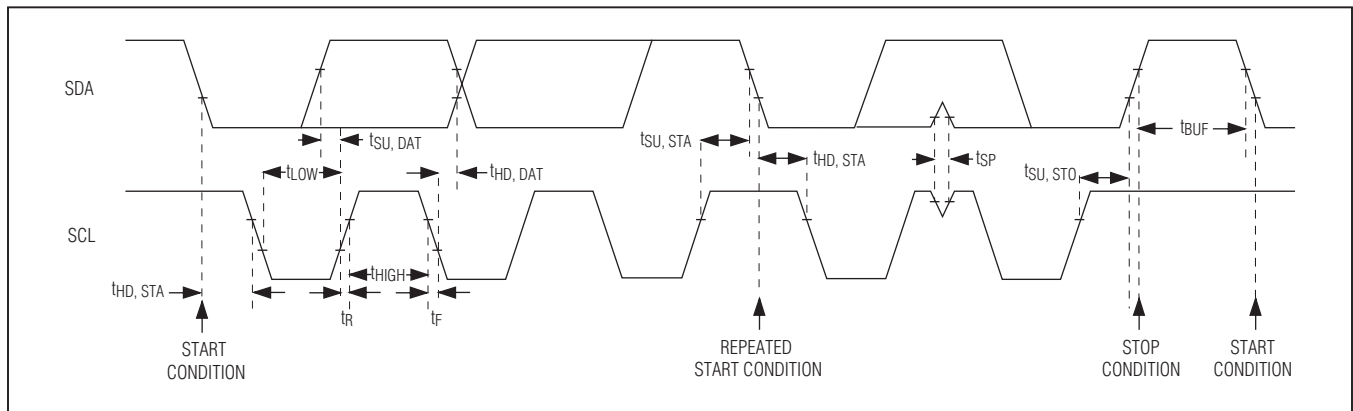


Figure 3. 2-Wire Interface Timing Diagram

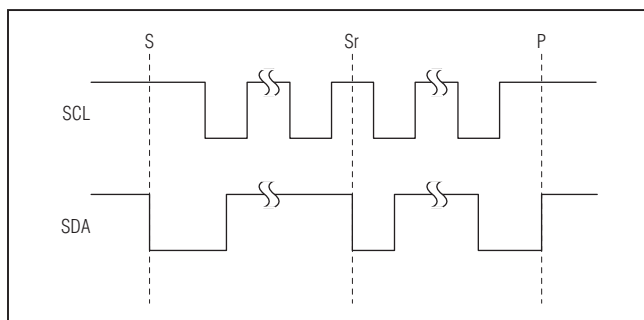


Figure 4. START, STOP, and Repeated START Conditions

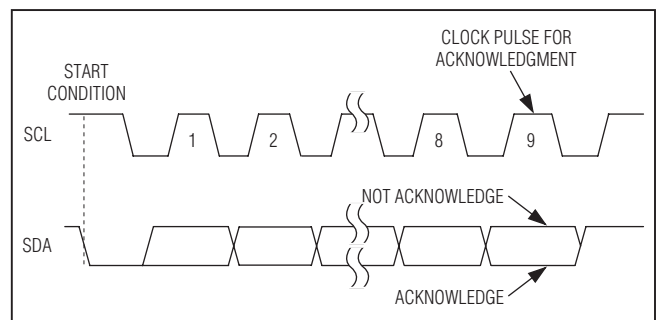


Figure 5. Acknowledge

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### Acknowledge

The acknowledge bit (ACK) is a clocked 9th bit that the devices use to handshake receipt of each byte of data when in write mode (Figure 5). The devices pull down SDA during the entire master-generated ninth clock pulse if the previous byte is successfully received. Monitoring ACK allows for detection of unsuccessful data transfers. An unsuccessful data transfer occurs if a receiving device is busy or if a system fault has occurred. In the event of an unsuccessful data transfer, the bus master can retry communication. The master pulls down SDA during the ninth clock cycle to acknowledge receipt of data when the devices are in read mode. An acknowledge is sent by the master after each read byte to allow data transfer to continue. A not acknowledge (NACK) is sent when the master reads the final byte of data from the device, followed by a STOP condition.

### Write Data Format

A write to the devices includes transmission of a START condition, the slave address with the  $R/\bar{W}$  bit set to 0, 1 byte of data to configure the internal register address pointer, 1 or more bytes of data, and a STOP condition.

Figure 6 illustrates the proper frame format for writing 1 byte of data to the devices. Figure 7 illustrates the frame format for writing n-bytes of data to the devices.

The slave address with the  $R/\bar{W}$  bit set to 0 indicates that the master intends to write data to the devices. The devices acknowledge receipt of the address byte during the master-generated ninth SCL pulse.

The second byte transmitted from the master configures the devices' internal register address pointer. The pointer tells the devices where to write the next byte of data. An acknowledge pulse is sent by the devices upon receipt of the address pointer data.

The third byte sent to the devices contains the data that is written to the chosen register. An acknowledge pulse from the devices signals receipt of the data byte. The address pointer autoincrements to the next register address after each received data byte. This autoincrement feature allows a master to write to sequential registers within one continuous frame. Figure 8 illustrates how to write to multiple registers with one frame. The master signals the end of transmission by issuing a STOP condition.

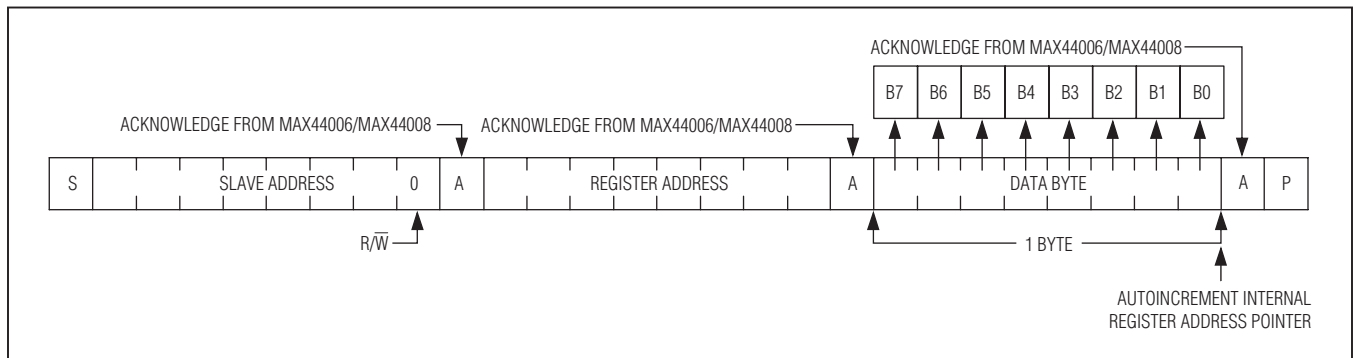


Figure 6. Writing 1 Byte of Data to the MAX44006/MAX44008

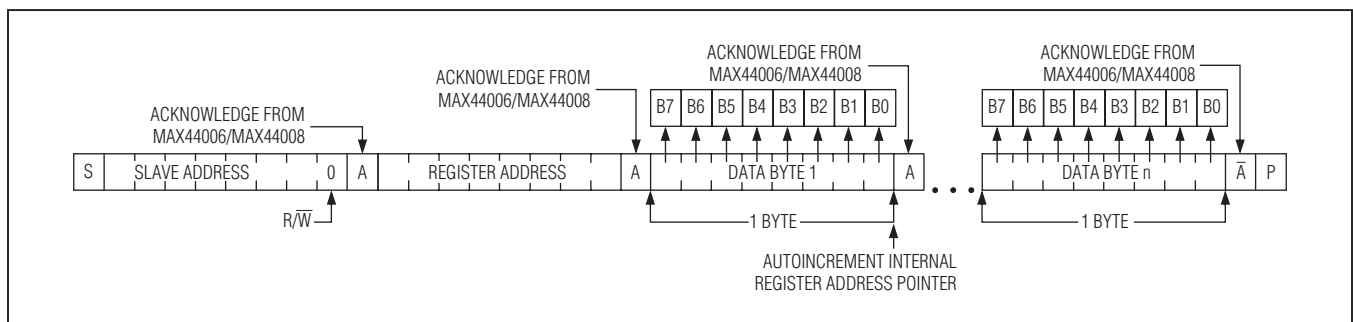


Figure 7. Writing n-Bytes of Data to the MAX44006/MAX44008

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### Read Data Format

Send the slave address with the  $R/\bar{W}$  bit set to 1 to initiate a read operation. The devices acknowledge receipt of the slave address by pulling SDA low during the ninth SCL clock pulse. A START command followed by a read command resets the address pointer to register 0x00. The first byte transmitted from the devices comprises the contents of register 0x00. Transmitted data is valid on the rising edge of the master-generated serial clock (SCL). The address pointer autoincrements after each read data byte. This autoincrement feature allows all registers to be read sequentially within one continuous frame. A STOP condition can be issued after any number of read data bytes. If a STOP condition is issued, followed by another read operation, the first data byte to be read is from register 0x00 and subsequent reads autoincrement the address pointer until the next STOP condition. The address pointer can be preset to a specific register before a read command is issued. The

master presets the address pointer by first sending the devices' slave address with the  $R/\bar{W}$  bit set to 0, followed by the register address. A Repeated START condition is then sent, followed by the slave address with the  $R/\bar{W}$  bit set to 1. The devices transmit the contents of the specified register. The address pointer autoincrements after transmitting the first byte. Attempting to read from register addresses higher than 0xFF results in repeated reads of 0xFF. Note that 0xF6 to 0xFF are reserved registers. The master acknowledges receipt of each read byte during the acknowledge clock pulse. The master must acknowledge all correctly received bytes except the last byte. The final byte must be followed by a NACK from the master and then a STOP condition. [Figure 8](#) illustrates the frame format for reading 1 byte from the devices. [Figure 9](#) illustrates the frame format for reading multiple bytes from the devices. [Figure 10](#) illustrates the frame format for reading two registers consecutively without a STOP condition in between reads.

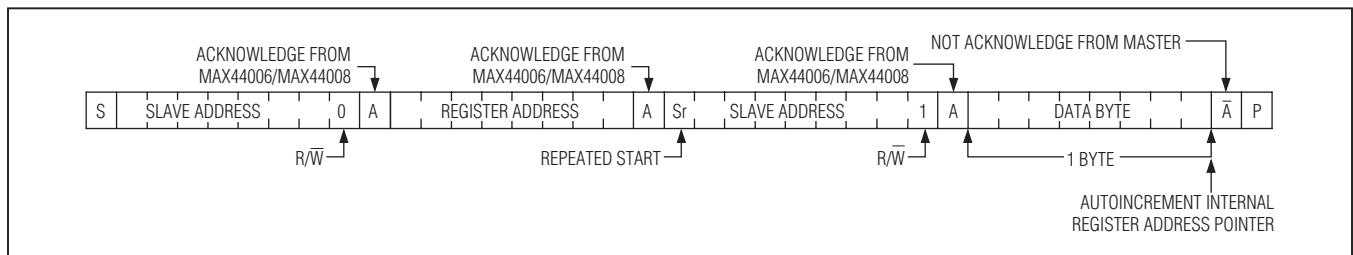


Figure 8. Reading 1 Indexed Byte of Data from the MAX44006/MAX44008

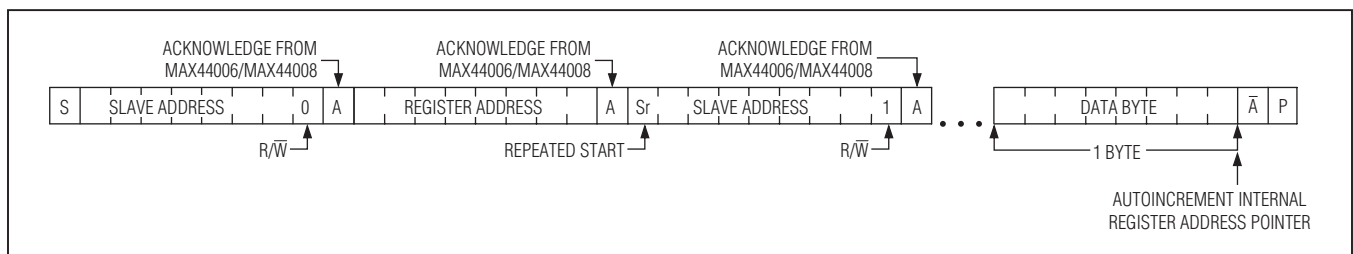


Figure 9. Reading n-Bytes of Indexed Data from the MAX44006/MAX44008

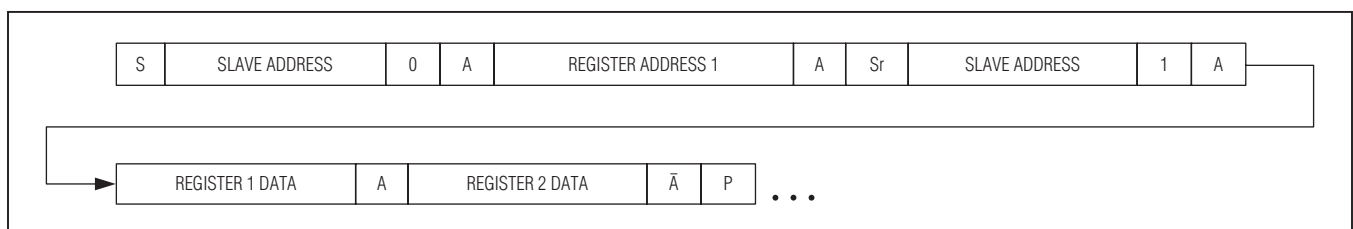


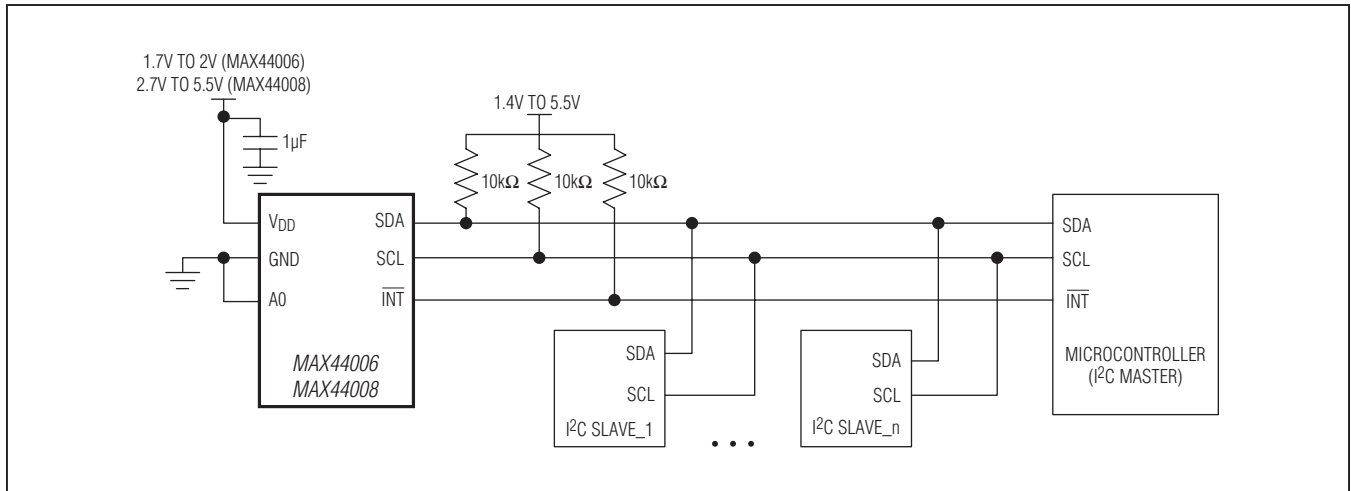
Figure 10. Reading Two Registers Consecutively Without a STOP Condition in Between Reads



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### Typical Operating Circuit



### Ordering Information

| PART                 | TEMP RANGE     | PIN-PACKAGE |
|----------------------|----------------|-------------|
| <b>MAX44006</b> EDT+ | -40°C to +85°C | 6 OTDFN     |
| MAX44006EDT+T        | -40°C to +85°C | 6 OTDFN     |
| <b>MAX44008</b> EDT+ | -40°C to +85°C | 6 OTDFN     |
| MAX44008EDT+T        | -40°C to +85°C | 6 OTDFN     |

+Denotes a lead(Pb)-free/RoHS-compliant package.  
T = Tape and reel.

### Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.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.        |
|--------------|--------------|-------------------------|-------------------------|
| 6 OTDFN      | D622CN+1     | <a href="#">21-0606</a> | <a href="#">90-0376</a> |

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### Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                                                                                                                                                | PAGES<br>CHANGED    |
|--------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 0                  | 7/12             | Initial release                                                                                                                                            | —                   |
| 1                  | 8/12             | Updated the <i>General Description</i> , <i>Features</i> , <i>Pin Description</i> , <i>AMBIENT Data Register (0x04–0x0F)</i> sections, and Tables 3 and 14 | 1, 7, 11,<br>16, 21 |



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time. The parametric values (min and max limits) shown in the Electrical Characteristics table are guaranteed. Other parametric values quoted in this data sheet are provided for guidance.

**Maxim Integrated 160 Rio Robles, San Jose, CA 95134 USA 1-408-601-1000**

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