

## BIDIRECTIONAL I<sup>2</sup>C ISOLATORS WITH UNIDIRECTIONAL DIGITAL CHANNELS

### Features

- Independent, bidirectional SDA and SCL isolation channels
  - Open drain outputs with 35 mA sink current
  - Supports I<sup>2</sup>C clocks up to 1.7 MHz
- Unidirectional isolation channels support additional system signals (Si8605, Si8606)
- Up to 5000 V<sub>RMS</sub> isolation
- UL, CSA, VDE, CQC recognition
- 60-year life at rated working voltage
- High electromagnetic immunity
- Wide operating supply voltage
  - 3.0 to 5.5 V
- Wide temperature range
  - -40 to +125 °C
- Transient immunity 50 kV/μs
- AEC-Q100 qualification
- RoHS-compliant packages
  - SOIC-8 narrow body
  - SOIC-16 wide body
  - SOIC-16 narrow body

### Applications

- Isolated I<sup>2</sup>C, PMBus, SMBus
- Power over Ethernet
- Motor Control Systems
- Hot-swap applications
- Intelligent Power systems
- Isolated SMPS systems with PMBus interfaces

### Description

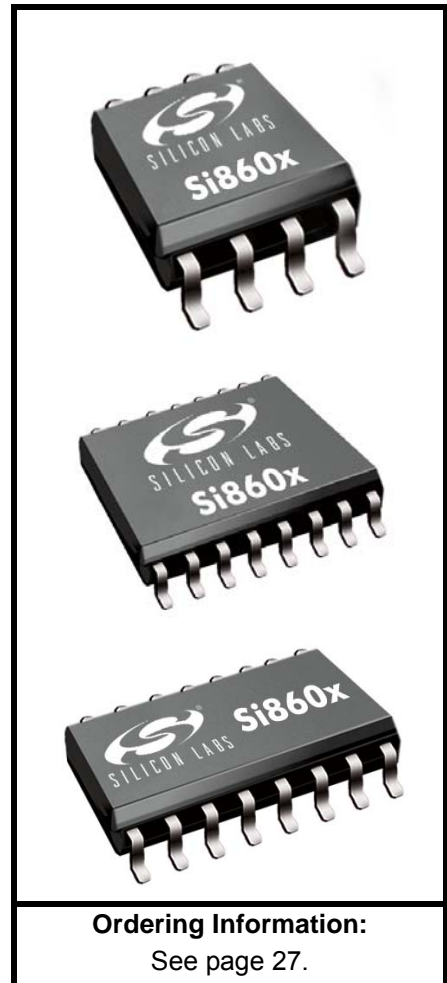
The Si860x series of isolators are single-package galvanic isolation solutions for I<sup>2</sup>C and SMBus serial port applications. These products are based on Silicon Labs proprietary RF isolation technology and offer shorter propagation delays, lower power consumption, smaller installed size, and more stable operation with temperature and age versus opto couplers or other digital isolators.

All devices in this family include hot-swap, bidirectional SDA and/or SCL isolation channels with open-drain, 35 mA sink capability that operate to a maximum frequency of 1.7 MHz. The 8-pin version (Si8600) supports bidirectional SDA and SCL isolation; the Si8602 supports bidirectional SDA and unidirectional SCL isolation, and the 16-pin versions (Si8605, Si8606) feature two unidirectional isolation channels to support additional system signals, such as interrupts or resets. All versions contain protection circuits to guard against data errors when an unpowered device is inserted into a powered system.

Small size, low installed cost, low power consumption, and short propagation delays make the Si860x family the optimum solution for isolating I<sup>2</sup>C and SMBus serial ports.

### Safety Regulatory Approval

- UL 1577 recognized
  - Up to 5000 V<sub>RMS</sub> for 1 minute
- CSA component notice 5A approval
  - IEC 60950-1, 61010-1, 60601-1 (reinforced insulation)
- VDE certification conformity
  - IEC 60747-5-2 (VDE0884 Part 2)
  - EN60950-1 (reinforced insulation)
- CQC certification approval
  - GB4943.1



**Ordering Information:**  
See page 27.



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# Si860x

## 1. Electrical Specifications

**Table 1. Recommended Operating Conditions**

| Parameter                      | Symbol | Min | Typ | Max  | Unit |
|--------------------------------|--------|-----|-----|------|------|
| Ambient Operating Temperature* | $T_A$  | -40 | 25  | 125* | °C   |
| Supply Voltage                 | AVDD   | 3.0 | —   | 5.5  | V    |
|                                | BVDD   | 3.0 | —   | 5.5  | V    |

\*Note: The maximum ambient temperature is dependent on data frequency, output loading, number of operating channels, and supply voltage.

**Table 2. Si860x Power Characteristics\***

3.0 V < VDD < 5.5 V.  $T_A = -40$  to  $+125$  °C. Typical specs at 25 °C (See Figures 2 and 10 for test diagrams.)

| Parameter                    | Symbol           | Test Condition                            | Min | Typ | Max  | Unit |
|------------------------------|------------------|-------------------------------------------|-----|-----|------|------|
| <b>Si8600 Supply Current</b> |                  |                                           |     |     |      |      |
| AVDD Current                 | I <sub>dda</sub> | All channels = 0 dc                       | —   | 5.4 | 7.6  | mA   |
| BVDD Current                 | I <sub>ddb</sub> |                                           | —   | 4.3 | 6.5  | mA   |
| AVDD Current                 | I <sub>dda</sub> | All channels = 1 dc                       | —   | 2.6 | 3.9  | mA   |
| BVDD Current                 | I <sub>ddb</sub> |                                           | —   | 1.9 | 2.9  | mA   |
| AVDD Current                 | I <sub>dda</sub> | All channels = 1.7 MHz                    | —   | 3.3 | 5.0  | mA   |
| BVDD Current                 | I <sub>ddb</sub> |                                           | —   | 2.6 | 3.9  | mA   |
| <b>Si8602 Supply Current</b> |                  |                                           |     |     |      |      |
| AVDD Current                 | I <sub>dda</sub> | All channels = 0 dc                       | —   | 1.8 | 2.7  | mA   |
| BVDD Current                 | I <sub>ddb</sub> |                                           | —   | 1.8 | 2.7  | mA   |
| AVDD Current                 | I <sub>dda</sub> | All channels = 1 dc                       | —   | 4.7 | 7.1  | mA   |
| BVDD Current                 | I <sub>ddb</sub> |                                           | —   | 3.1 | 4.7  | mA   |
| AVDD Current                 | I <sub>dda</sub> | All channels = 1.7 MHz                    | —   | 2.5 | 3.8  | mA   |
| BVDD Current                 | I <sub>ddb</sub> |                                           | —   | 2.1 | 3.2  | mA   |
| <b>Si8605 Supply Current</b> |                  |                                           |     |     |      |      |
| AVDD Current                 | I <sub>dda</sub> | All non-I <sup>2</sup> C channels = 0     | —   | 3.4 | 5.1  | mA   |
| BVDD Current                 | I <sub>ddb</sub> | All I <sup>2</sup> C channels = 1         | —   | 2.7 | 4.1  | mA   |
| AVDD Current                 | I <sub>dda</sub> | All non-I <sup>2</sup> C channels = 1     | —   | 7.2 | 10.1 | mA   |
| BVDD Current                 | I <sub>ddb</sub> | All I <sup>2</sup> C channels = 0         | —   | 6.2 | 8.7  | mA   |
| AVDD Current                 | I <sub>dda</sub> | All non-I <sup>2</sup> C channels = 5 MHz | —   | 4.2 | 6.3  | mA   |
| BVDD Current                 | I <sub>ddb</sub> | All I <sup>2</sup> C channels = 1.7 MHz   | —   | 3.6 | 5.4  | mA   |

\*Note: All voltages are relative to respective ground.

**Table 2. Si860x Power Characteristics\* (Continued)**

3.0 V &lt; VDD &lt; 5.5 V. TA = -40 to +125 °C. Typical specs at 25 °C (See Figures 2 and 10 for test diagrams.)

| Parameter                                                     | Symbol           | Test Condition                            | Min | Typ | Max  | Unit |
|---------------------------------------------------------------|------------------|-------------------------------------------|-----|-----|------|------|
| <b>Si8606 Supply Current</b>                                  |                  |                                           |     |     |      |      |
| AVDD Current                                                  | I <sub>dda</sub> | All non-I <sup>2</sup> C channels = 0     | —   | 2.8 | 4.2  | mA   |
| BVDD Current                                                  | I <sub>ddb</sub> | All I <sup>2</sup> C channels = 1         | —   | 3.0 | 4.5  | mA   |
| AVDD Current                                                  | I <sub>dda</sub> | All non-I <sup>2</sup> C channels = 1     | —   | 8.3 | 11.6 | mA   |
| BVDD Current                                                  | I <sub>ddb</sub> | All I <sup>2</sup> C channels = 0         | —   | 5.5 | 7.7  | mA   |
| AVDD Current                                                  | I <sub>dda</sub> | All non-I <sup>2</sup> C channels = 5 MHz | —   | 4.1 | 6.2  | mA   |
| BVDD Current                                                  | I <sub>ddb</sub> | All I <sup>2</sup> C channels = 1.7 MHz   | —   | 3.5 | 5.3  | mA   |
| <b>*Note:</b> All voltages are relative to respective ground. |                  |                                           |     |     |      |      |

**Table 3. Si8600/02/05/06 Electrical Characteristics for Bidirectional I<sup>2</sup>C Channels<sup>1</sup>**

3.0 V &lt; VDD &lt; 5.5 V. TA = -40 to +125 °C. Typical specs at 25 °C unless otherwise noted.

| Parameter                                                                                                                                                                                                                                                                                                | Symbol                                                                         | Test Condition                         | Min    | Typ      | Max    | Unit     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------|--------|----------|--------|----------|
| Logic Levels Side A                                                                                                                                                                                                                                                                                      |                                                                                |                                        |        |          |        |          |
| Logic Input Threshold <sup>2</sup>                                                                                                                                                                                                                                                                       | I <sup>2</sup> CV <sub>T</sub> (Side A)                                        | ISDAA, ISCLA<br>(>0.5 mA, <3.0 mA)     | 410    | —        | 540    | mV       |
| Logic Low Output Voltages                                                                                                                                                                                                                                                                                | I <sup>2</sup> CV <sub>OL</sub> (Side A)                                       |                                        | 540    | —        | 800    | mV       |
| Input/Output Logic Low Level Difference <sup>3</sup>                                                                                                                                                                                                                                                     | I <sup>2</sup> CΔV (Side A)                                                    |                                        | 50     | —        | —      | mV       |
| Logic Levels Side B                                                                                                                                                                                                                                                                                      |                                                                                |                                        |        |          |        |          |
| Logic Low Input Voltage                                                                                                                                                                                                                                                                                  | I <sup>2</sup> CV <sub>IL</sub> (Side B)                                       | ISCLB = 35 mA                          | —      | —        | 0.8    | V        |
| Logic High Input Voltage                                                                                                                                                                                                                                                                                 | I <sup>2</sup> CV <sub>IH</sub> (Side B)                                       |                                        | 2.0    | —        | —      | V        |
| Logic Low Output Voltage                                                                                                                                                                                                                                                                                 | I <sup>2</sup> CV <sub>OL</sub> (Side B)                                       |                                        | —      | —        | 500    | mV       |
| SCL and SDA Logic High Leakage                                                                                                                                                                                                                                                                           | I <sub>sdaa</sub> , I <sub>sdab</sub><br>I <sub>scla</sub> , I <sub>sclb</sub> | SDAA, SCLA = VSSA<br>SDAB, SCLB = VSSB | —      | 2.0      | 10     | μA       |
| Pin Capacitance SDAA, SCLA,<br>SDAB, SDBB                                                                                                                                                                                                                                                                | CA<br>CB                                                                       |                                        | —<br>— | 10<br>10 | —<br>— | pF<br>pF |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                            |                                                                                |                                        |        |          |        |          |
| 1. All voltages are relative to respective ground.                                                                                                                                                                                                                                                       |                                                                                |                                        |        |          |        |          |
| 2. V <sub>IL</sub> < 0.410 V, V <sub>IH</sub> > 0.540 V.                                                                                                                                                                                                                                                 |                                                                                |                                        |        |          |        |          |
| 3. I <sup>2</sup> CΔV (Side A) = I <sup>2</sup> CV <sub>OL</sub> (Side A) – I <sup>2</sup> CV <sub>T</sub> (Side A). To ensure no latch-up on a given bus, I <sup>2</sup> CΔV (Side A) is the minimum difference between the output logic low level of the driving device and the input logic threshold. |                                                                                |                                        |        |          |        |          |
| 4. Side A measured at 0.6 V.                                                                                                                                                                                                                                                                             |                                                                                |                                        |        |          |        |          |

# Si860x

**Table 3. Si8600/02/05/06 Electrical Characteristics for Bidirectional I<sup>2</sup>C Channels<sup>1</sup> (Continued)**

3.0 V < VDD < 5.5 V. TA = -40 to +125 °C. Typical specs at 25 °C unless otherwise noted.

| Parameter                                                                                                                                                                                                                                                                                                | Symbol | Test Condition      | Min | Typ | Max | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------|-----|-----|-----|------|
| <b>Timing Specifications (Measured at 1.40 V Unless Otherwise Specified)</b>                                                                                                                                                                                                                             |        |                     |     |     |     |      |
| Maximum I <sup>2</sup> C Bus Frequency                                                                                                                                                                                                                                                                   | Fmax   |                     | —   | —   | 1.7 | MHz  |
| Propagation Delay<br>5 V Operation                                                                                                                                                                                                                                                                       |        |                     |     |     |     |      |
| Side A to Side B Rising <sup>4</sup>                                                                                                                                                                                                                                                                     | Tphab  | No bus capacitance, | —   | 38  | 45  | ns   |
| Side A to Side B Falling <sup>4</sup>                                                                                                                                                                                                                                                                    | Tplab  | R1 = 1400,          | —   | 15  | 26  | ns   |
| Side B to Side A Rising                                                                                                                                                                                                                                                                                  | Tphba  | R2 = 499,           | —   | 33  | 46  | ns   |
| Side B to Side A Falling                                                                                                                                                                                                                                                                                 | Tplba  | See Figure 2        | —   | 11  | 22  | ns   |
| 3.3 V Operation                                                                                                                                                                                                                                                                                          |        |                     |     |     |     |      |
| Side A to Side B Rising <sup>4</sup>                                                                                                                                                                                                                                                                     | Tphab  |                     | —   | 44  | 55  | ns   |
| Side A to Side B Falling <sup>4</sup>                                                                                                                                                                                                                                                                    | Tplab  | R1 = 806            | —   | 17  | 29  | ns   |
| Side B to Side A Rising                                                                                                                                                                                                                                                                                  | Tphba  | R2 = 499            | —   | 30  | 40  | ns   |
| Side B to Side A Falling                                                                                                                                                                                                                                                                                 | Tplba  |                     | —   | 14  | 27  | ns   |
| Pulse Width Distortion<br>5 V                                                                                                                                                                                                                                                                            |        | No bus capacitance, |     |     |     |      |
| Side A Low to Side B Low <sup>4</sup>                                                                                                                                                                                                                                                                    | PWDAB  | R1 = 1400,          | —   | 22  | 32  | ns   |
| Side B Low to Side A Low                                                                                                                                                                                                                                                                                 | PWDBA  | R2 = 499,           | —   | 21  | 32  | ns   |
| 3.3 V                                                                                                                                                                                                                                                                                                    |        | See Figure 2        |     |     |     |      |
| Side A Low to Side B Low <sup>4</sup>                                                                                                                                                                                                                                                                    | PWDAB  | R1 = 806,           | —   | 27  | 35  | ns   |
| Side B Low to Side A Low                                                                                                                                                                                                                                                                                 | PWDBA  | R2 = 499            | —   | 15  | 25  | ns   |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                            |        |                     |     |     |     |      |
| 1. All voltages are relative to respective ground.                                                                                                                                                                                                                                                       |        |                     |     |     |     |      |
| 2. V <sub>IL</sub> < 0.410 V, V <sub>IH</sub> > 0.540 V.                                                                                                                                                                                                                                                 |        |                     |     |     |     |      |
| 3. I <sup>2</sup> CΔV (Side A) = I <sup>2</sup> CV <sub>OL</sub> (Side A) – I <sup>2</sup> CV <sub>T</sub> (Side A). To ensure no latch-up on a given bus, I <sup>2</sup> CΔV (Side A) is the minimum difference between the output logic low level of the driving device and the input logic threshold. |        |                     |     |     |     |      |
| 4. Side A measured at 0.6 V.                                                                                                                                                                                                                                                                             |        |                     |     |     |     |      |

**Table 4. Electrical Characteristics for Unidirectional Non-I<sup>2</sup>C Digital Channels (Si8602/05/06)**

3.0 V &lt; VDD &lt; 5.5 V. TA = -40 to +125 °C. Typical specs at 25 °C

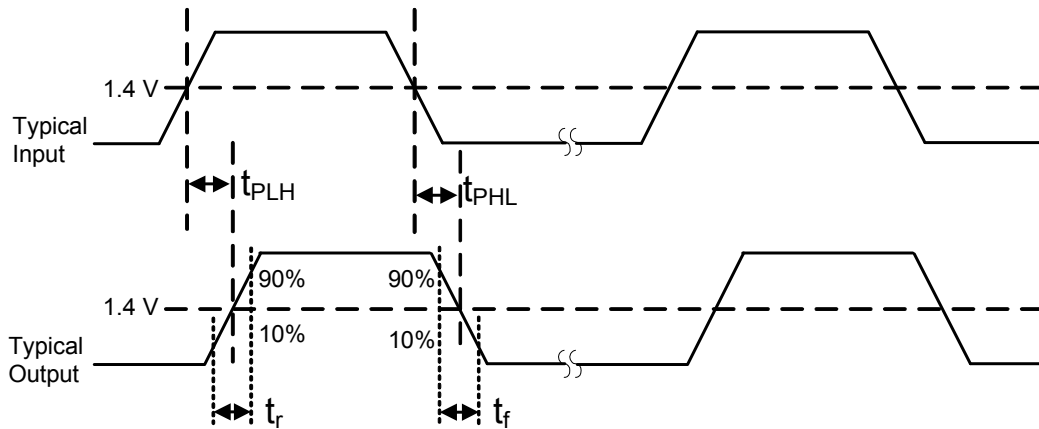
| Parameter                                                                                                                                                                                                                                                                                                                                                                                                | Symbol                              | Test Condition                                         | Min                | Typ  | Max  | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------|--------------------|------|------|------|
| Positive-Going Input Threshold                                                                                                                                                                                                                                                                                                                                                                           | VT+                                 | All inputs rising                                      | 1.4                | 1.67 | 1.9  | V    |
| Negative-Going Input Threshold                                                                                                                                                                                                                                                                                                                                                                           | VT-                                 | All inputs falling                                     | 1.0                | 1.23 | 1.4  | V    |
| Input Hysteresis                                                                                                                                                                                                                                                                                                                                                                                         | V <sub>HYS</sub>                    |                                                        | 0.38               | 0.44 | 0.50 | V    |
| High Level Input Voltage                                                                                                                                                                                                                                                                                                                                                                                 | V <sub>IH</sub>                     |                                                        | 2.0                | —    | —    | V    |
| Low Level Input Voltage                                                                                                                                                                                                                                                                                                                                                                                  | V <sub>IL</sub>                     |                                                        | —                  | —    | 0.8  | V    |
| High Level Output Voltage                                                                                                                                                                                                                                                                                                                                                                                | V <sub>OH</sub>                     | I <sub>oh</sub> = -4 mA                                | AVDD, BVDD<br>-0.4 | 4.8  | —    | V    |
| Low Level Output Voltage                                                                                                                                                                                                                                                                                                                                                                                 | V <sub>OL</sub>                     | I <sub>ol</sub> = 4 mA                                 | —                  | 0.2  | 0.4  | V    |
| Input Leakage Current                                                                                                                                                                                                                                                                                                                                                                                    | I <sub>L</sub>                      |                                                        | —                  | —    | ±10  | µA   |
| Output Impedance <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                            | Z <sub>O</sub>                      |                                                        | —                  | 50   | —    | Ω    |
| <b>Timing Characteristics</b>                                                                                                                                                                                                                                                                                                                                                                            |                                     |                                                        |                    |      |      |      |
| Maximum Data Rate                                                                                                                                                                                                                                                                                                                                                                                        |                                     |                                                        | 0                  | —    | 10   | Mbps |
| Minimum Pulse Width                                                                                                                                                                                                                                                                                                                                                                                      |                                     |                                                        | —                  | —    | 40   | ns   |
| Propagation Delay                                                                                                                                                                                                                                                                                                                                                                                        | t <sub>PHL</sub> , t <sub>PLH</sub> | See Figure 1                                           | —                  | —    | 20   | ns   |
| Pulse Width Distortion<br> t <sub>PLH</sub> - t <sub>PHL</sub>                                                                                                                                                                                                                                                                                                                                           | PWD                                 | See Figure 1                                           | —                  | —    | 12   | ns   |
| Propagation Delay Skew <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                      | t <sub>PSK(P-P)</sub>               |                                                        | —                  | —    | 20   | ns   |
| Channel-Channel Skew                                                                                                                                                                                                                                                                                                                                                                                     | t <sub>PSK</sub>                    |                                                        | —                  | —    | 10   | ns   |
| Output Rise Time                                                                                                                                                                                                                                                                                                                                                                                         | t <sub>r</sub>                      | C <sub>3</sub> = 15 pF<br>See Figure 1 and<br>Figure 2 | —                  | 2.5  | 4.0  | ns   |
| Output Fall Time                                                                                                                                                                                                                                                                                                                                                                                         | t <sub>f</sub>                      | C <sub>3</sub> = 15 pF<br>See Figure 1 and<br>Figure 2 | —                  | 2.5  | 4.0  | ns   |
| Peak Eye Diagram Jitter                                                                                                                                                                                                                                                                                                                                                                                  | t <sub>JIT(PK)</sub>                |                                                        | —                  | 350  | —    | ps   |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                                                                                                                            |                                     |                                                        |                    |      |      |      |
| 1. The nominal output impedance of a non-I <sup>2</sup> C isolator driver channel is approximately 50 Ω, ±40%, which is a combination of the value of the on-chip series termination resistor and channel resistance of the output driver FET. When driving loads where transmission line effects will be a factor, output pins should be appropriately terminated with controlled impedance PCB traces. |                                     |                                                        |                    |      |      |      |
| 2. t <sub>PSK(P-P)</sub> is the magnitude of the difference in propagation delay times measured between different units operating at the same supply voltages, load, and ambient temperature.                                                                                                                                                                                                            |                                     |                                                        |                    |      |      |      |

**Table 5. Electrical Characteristics for All I<sup>2</sup>C and Non-I<sup>2</sup>C Channels**

3.0 V < VDD < 5.5 V. TA = -40 to +125 °C. Typical specs at 25 °C

| Parameter                      | Symbol             | Test Condition                                                                     | Min  | Typ  | Max   | Unit  |
|--------------------------------|--------------------|------------------------------------------------------------------------------------|------|------|-------|-------|
| VDD Undervoltage Threshold     | VDDUV+             | V <sub>DD1</sub> , V <sub>DD2</sub> rising                                         | 1.95 | 2.24 | 2.375 | V     |
| VDD Undervoltage Threshold     | VDDUV-             | V <sub>DD1</sub> , V <sub>DD2</sub> falling                                        | 1.88 | 2.16 | 2.325 | V     |
| VDD Undervoltage Hysteresis    | VDD <sub>HYS</sub> |                                                                                    | 50   | 70   | 95    | mV    |
| Common Mode Transient Immunity | CMTI               | V <sub>I</sub> = V <sub>DD</sub> or 0 V<br>V <sub>CM</sub> = 1500 V (see Figure 3) | 35   | 50   | —     | kV/μs |
| Shut Down Time from UVLO       | t <sub>SD</sub>    |                                                                                    | —    | 3.0  | —     | μs    |
| Start-up Time*                 | t <sub>START</sub> |                                                                                    | —    | 15   | 40    | μs    |

\*Note: Start-up time is the time period from the application of power to valid data at the output.



**Figure 1. Propagation Delay Timing (Non-I<sup>2</sup>C Channels)**



## 1.1. Test Circuits

Figure 2 depicts the timing test diagram; Figure 3 depicts the CMTI test diagram.

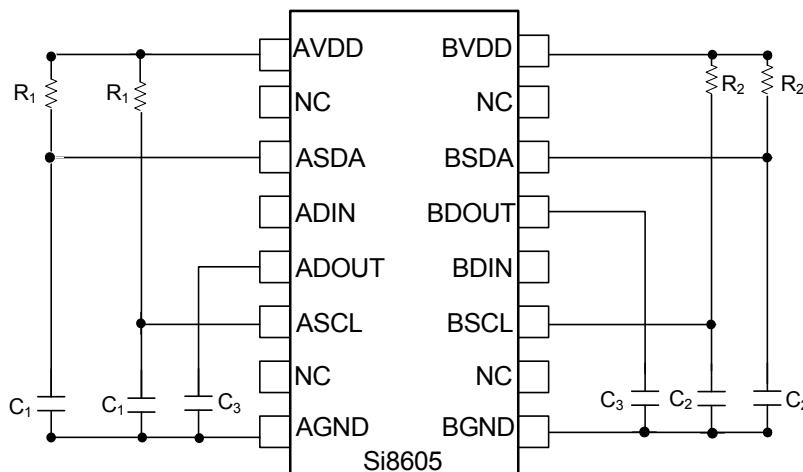


Figure 2. Simplified Timing Test Diagram

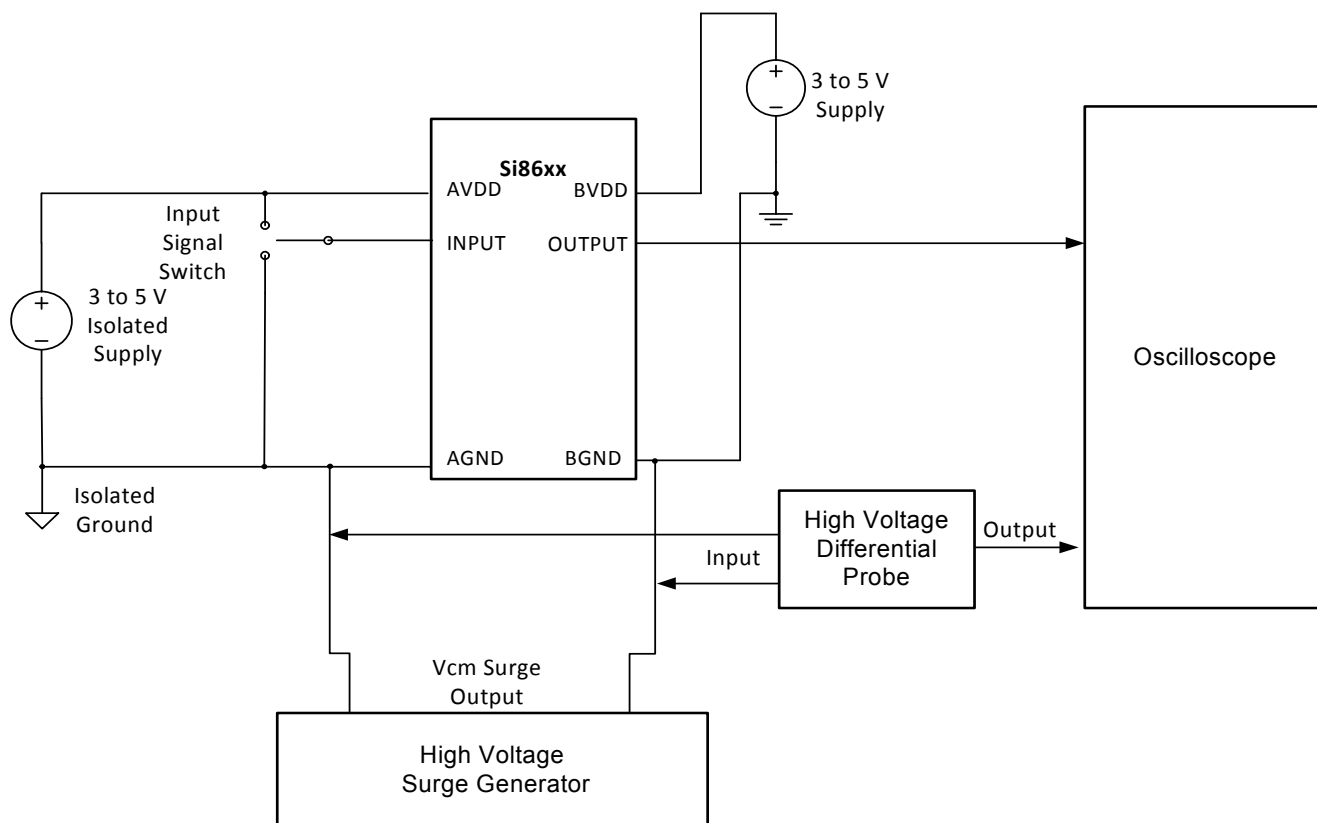


Figure 3. Common Mode Transient Immunity Test Circuit

**Table 6. Regulatory Information\***

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CSA</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| The Si860x is certified under CSA Component Acceptance Notice 5A. For more details, see File 232873.                                                                                                                                                                                                                                                                                                                                                                                                  |
| 61010-1: Up to 600 V <sub>RMS</sub> reinforced insulation working voltage; up to 600 V <sub>RMS</sub> basic insulation working voltage.                                                                                                                                                                                                                                                                                                                                                               |
| 60950-1: Up to 600 V <sub>RMS</sub> reinforced insulation working voltage; up to 1000 V <sub>RMS</sub> basic insulation working voltage.                                                                                                                                                                                                                                                                                                                                                              |
| 60601-1: Up to 125 V <sub>RMS</sub> reinforced insulation working voltage; up to 380 V <sub>RMS</sub> basic insulation working voltage.                                                                                                                                                                                                                                                                                                                                                               |
| <b>VDE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| The Si860x is certified according to IEC 60747-5-2. For more details, see File 5006301-4880-0001.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 60747-5-2: Up to 1200 V <sub>peak</sub> for basic insulation working voltage.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 60950-1: Up to 600 V <sub>RMS</sub> reinforced insulation working voltage; up to 1000 V <sub>RMS</sub> basic insulation working voltage.                                                                                                                                                                                                                                                                                                                                                              |
| <b>UL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| The Si860x is certified under UL1577 component recognition program. For more details, see File E257455.                                                                                                                                                                                                                                                                                                                                                                                               |
| Rated up to 5000 V <sub>RMS</sub> isolation voltage for basic protection.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>CQC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| The Si860x is certified under GB4943.1-2011. For more details, see certificates CQC13001096110 and CQC13001096239.                                                                                                                                                                                                                                                                                                                                                                                    |
| Rated up to 600 V <sub>RMS</sub> reinforced insulation working voltage; up to 1000 V <sub>RMS</sub> basic insulation working voltage.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>*Note:</b> Regulatory Certifications apply to 2.5 kV <sub>RMS</sub> rated devices which are production tested to 3.0 kV <sub>RMS</sub> for 1 sec.<br>Regulatory Certifications apply to 3.75 kV <sub>RMS</sub> rated devices which are production tested to 4.5 kV <sub>RMS</sub> for 1 sec.<br>Regulatory Certifications apply to 5.0 kV <sub>RMS</sub> rated devices which are production tested to 6.0 kV <sub>RMS</sub> for 1 sec.<br>For more information, see "6.Ordering Guide" on page 27. |

Table 7. Insulation and Safety-Related Specifications

| Parameter                                         | Symbol          | Test Condition               | Value            |                  |                  | Unit             |
|---------------------------------------------------|-----------------|------------------------------|------------------|------------------|------------------|------------------|
|                                                   |                 |                              | NB SOIC-8        | NB SOIC-16       | WB SOIC-16       |                  |
| Nominal Air Gap (Clearance) <sup>1</sup>          | L(101)          |                              | 4.9              | 4.9              | 8.0              | mm               |
| Nominal External Tracking (Creepage) <sup>1</sup> | L(102)          |                              | 4.01             | 4.01             | 8.0              | mm               |
| Minimum Internal Gap (Internal Clearance)         |                 |                              | 0.014            | 0.014            | 0.014            | mm               |
| Tracking Resistance (Proof Tracking Index)        | PTI             | IEC60112                     | 600              | 600              | 600              | V <sub>RMS</sub> |
| Erosion Depth                                     | ED              |                              | 0.040            | 0.019            | 0.019            | mm               |
| Resistance (Input-Output) <sup>2</sup>            | R <sub>IO</sub> |                              | 10 <sup>12</sup> | 10 <sup>12</sup> | 10 <sup>12</sup> | Ω                |
| Capacitance (Input-Output) <sup>2</sup>           | C <sub>IO</sub> | f = 1 MHz                    | 1.0              | 2.0              | 2.0              | pF               |
| Input Capacitance <sup>3</sup>                    | C <sub>I</sub>  | Non-I <sup>2</sup> C Channel | 4.0              | 4.0              | 4.0              | pF               |
|                                                   |                 | I <sup>2</sup> C Channel     | 10               | 10               | 10               | pF               |

**Notes:**

1. VDE certifies the clearance and creepage limits as 4.7 mm minimum for the NB SOIC-8 and SOIC-16 packages and 8.5 mm minimum for the WB SOIC-16 package. UL does not impose a clearance and creepage minimum for component level certifications. CSA certifies the clearance and creepage limits as 3.9 mm minimum for the NB SOIC-8 and SOIC-16 packages and 7.6 mm minimum for the WB SOIC-16 package.
2. To determine resistance and capacitance, the Si860x, SO-16, is converted into a 2-terminal device. Pins 1–8 (1–4, SO-8) are shorted together to form the first terminal and pins 9–16 (5–8, SO-8) are shorted together to form the second terminal. The parameters are then measured between these two terminals.
3. Measured from input pin to ground.

Table 8. IEC 60664-1 (VDE 0844 Part 2) Ratings

| Parameter                   | Test Conditions                             | Specification     |            |
|-----------------------------|---------------------------------------------|-------------------|------------|
|                             |                                             | NB SOIC-8 SOIC-16 | WB SOIC-16 |
| Basic Isolation Group       | Material Group                              | I                 | I          |
| Installation Classification | Rated Mains Voltages ≤ 150 V <sub>RMS</sub> | I-IV              | I-IV       |
|                             | Rated Mains Voltages ≤ 300 V <sub>RMS</sub> | I-III             | I-IV       |
|                             | Rated Mains Voltages ≤ 400 V <sub>RMS</sub> | I-II              | I-III      |
|                             | Rated Mains Voltages ≤ 600 V <sub>RMS</sub> | I-II              | I-III      |

# Si860x

**Table 9. IEC 60747-5-2 Insulation Characteristics for Si86xxxx\***

| Parameter                                            | Symbol     | Test Condition                                                                                                         | Characteristic |                   | Unit     |
|------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|----------|
|                                                      |            |                                                                                                                        | WB SOIC-16     | NB SOIC-8 SOIC-16 |          |
| Maximum Working Insulation Voltage                   | $V_{IORM}$ |                                                                                                                        | 1200           | 630               | Vpeak    |
| Input to Output Test Voltage                         | $V_{PR}$   | Method b1<br>( $V_{IORM} \times 1.875 = V_{PR}$ , 100%<br>Production Test, $t_m = 1$ sec,<br>Partial Discharge < 5 pC) | 2250           | 1182              | Vpeak    |
| Transient Overvoltage                                | $V_{IOTM}$ | t = 60 sec                                                                                                             | 6000           | 6000              | Vpeak    |
| Pollution Degree<br>(DIN VDE 0110, Table 1)          |            |                                                                                                                        | 2              | 2                 |          |
| Insulation Resistance at $T_S$ ,<br>$V_{IO} = 500$ V | $R_S$      |                                                                                                                        | $>10^9$        | $>10^9$           | $\Omega$ |

**\*Note:** Maintenance of the safety data is ensured by protective circuits. The Si86xxxx provides a climate classification of 40/125/21.

**Table 10. IEC Safety Limiting Values<sup>1</sup>**

| Parameter                             | Symbol | Test Condition                                                                                                                                   | NB SOIC-8 | NB SOIC-16 | WB SOIC-16 | Unit |
|---------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|------------|------|
| Case Temperature                      | $T_S$  |                                                                                                                                                  | 150       | 150        | 150        | °C   |
| Safety Input Current                  | $I_S$  | $\theta_{JA} = 100$ °C/W (WB SOIC-16),<br>105 °C/W (NB SOIC-16), 140 °C/W<br>(NB SOIC-8)<br>AVDD, BVDD = 5.5 V,<br>$T_J = 150$ °C, $T_A = 25$ °C | 160       | 210        | 220        | mA   |
| Device Power Dissipation <sup>2</sup> | $P_D$  |                                                                                                                                                  | 220       | 275        | 275        | mW   |

**Notes:**

- Maximum value allowed in the event of a failure. Refer to the thermal derating curve in Figures 4, 5, and 6.
- The Si86xx is tested with AVDD, BVDD = 5.5 V;  $T_J = 150$  °C;  $C_1, C_2 = 0.1$   $\mu$ F;  $C_3 = 15$  pF;  $R_1, R_2 = 3k\Omega$ ; input 1 MHz 50% duty cycle square wave.

Table 11. Thermal Characteristics

| Parameter                             | Symbol        | NB SOIC-8 | NB SOIC-16 | WB SOIC-16 | Unit                        |
|---------------------------------------|---------------|-----------|------------|------------|-----------------------------|
| IC Junction-to-Air Thermal Resistance | $\theta_{JA}$ | 140       | 105        | 100        | $^{\circ}\text{C}/\text{W}$ |

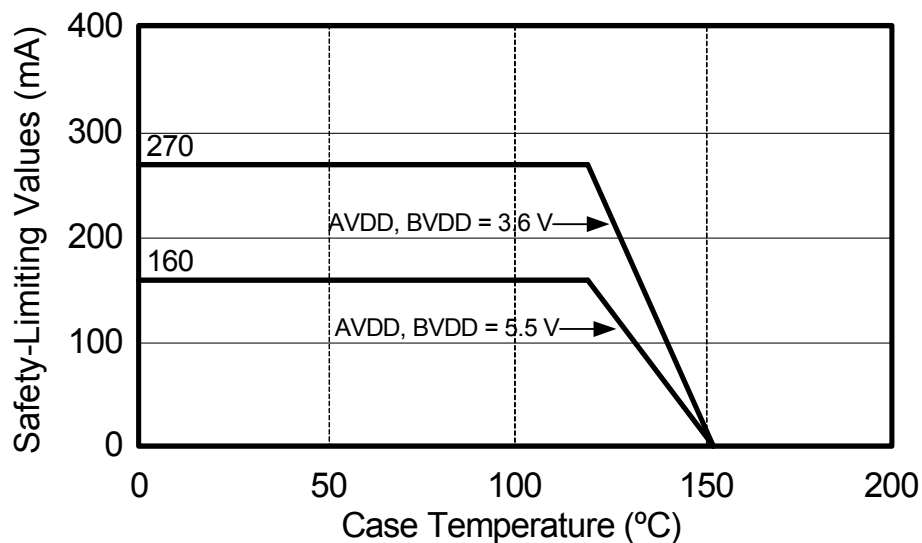


Figure 4. NB SOIC-8 Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-2

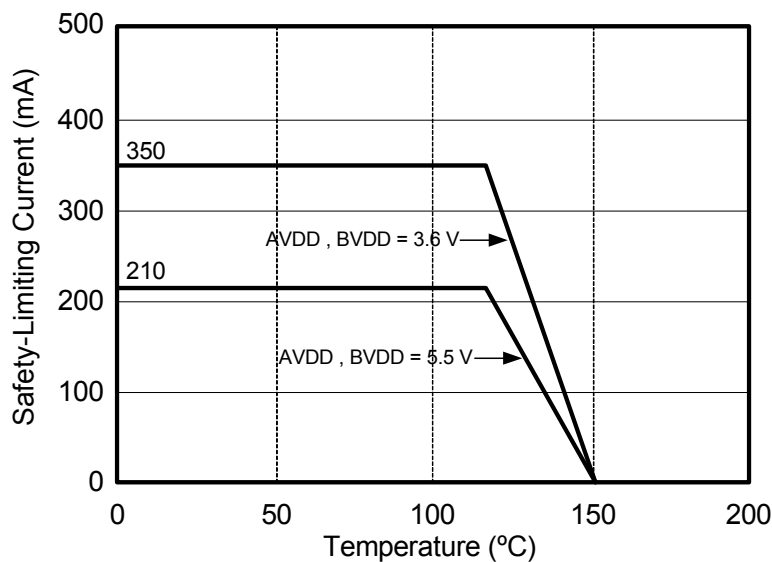
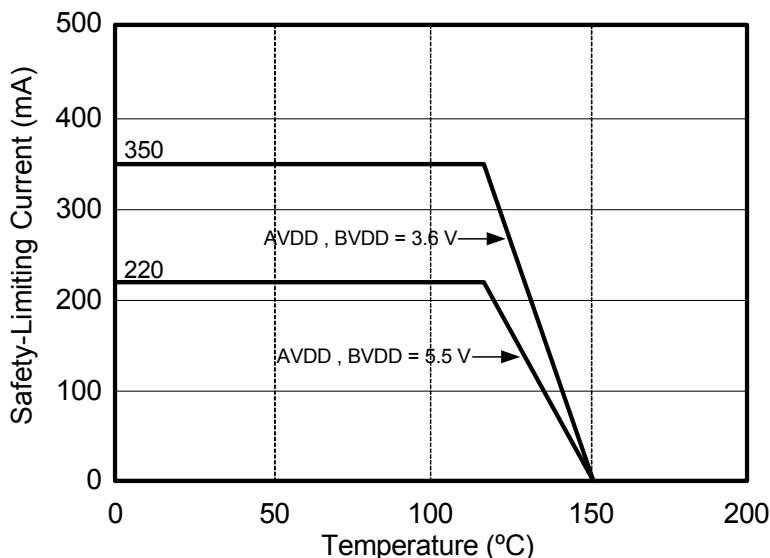


Figure 5. NB SOIC-16 Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-2



**Figure 6. WB SOIC-16 Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-2**

**Table 12. Absolute Maximum Ratings<sup>1</sup>**

| Parameter                                                         | Symbol    | Min  | Max            | Unit      |
|-------------------------------------------------------------------|-----------|------|----------------|-----------|
| Storage Temperature <sup>2</sup>                                  | $T_{STG}$ | -65  | 150            | °C        |
| Ambient Temperature Under Bias                                    | $T_A$     | -40  | 125            | °C        |
| Junction Temperature                                              | $T_J$     | —    | 150            | °C        |
| Supply Voltage                                                    | $V_{DD}$  | -0.5 | 7.0            | V         |
| Input Voltage                                                     | $V_I$     | -0.5 | $V_{DD} + 0.5$ | V         |
| Output Voltage                                                    | $V_O$     | -0.5 | $V_{DD} + 0.5$ | V         |
| Output Current Drive (non-I <sup>2</sup> C channels)              | $I_O$     | —    | ±10            | mA        |
| Side A output current drive (I <sup>2</sup> C channels)           | $I_O$     | —    | ±15            | mA        |
| Side B output current drive (I <sup>2</sup> C channels)           | $I_O$     | —    | ±75            | mA        |
| Lead Solder Temperature (10 s)                                    |           | —    | 260            | °C        |
| Maximum Isolation (Input to Output) (1 sec)<br>NB SOIC-8, SOIC-16 |           | —    | 4500           | $V_{RMS}$ |
| Maximum Isolation (Input to Output) (1 sec)<br>WB SOIC-16         |           | —    | 6500           | $V_{RMS}$ |

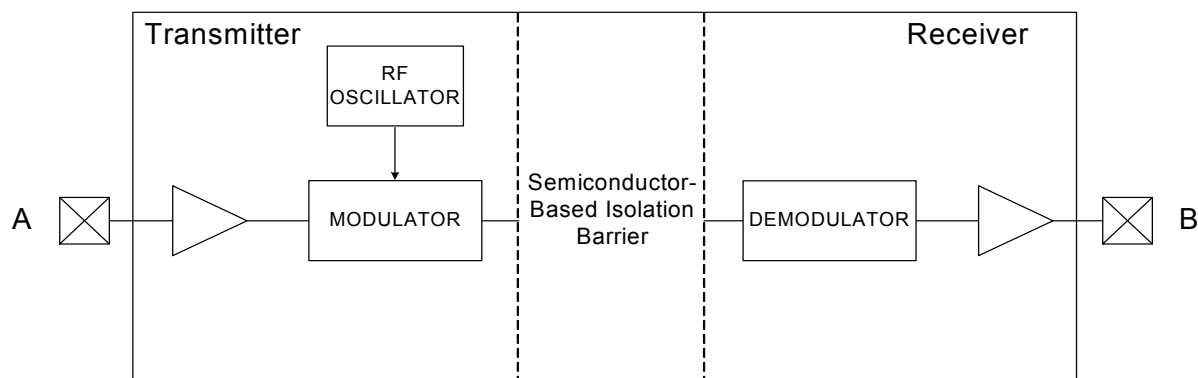
**Notes:**

1. Permanent device damage may occur if the absolute maximum ratings are exceeded. Functional operation should be restricted to conditions as specified in the operational sections of this data sheet.
2. VDE certifies storage temperature from -40 to 150 °C.

## 2. Functional Description

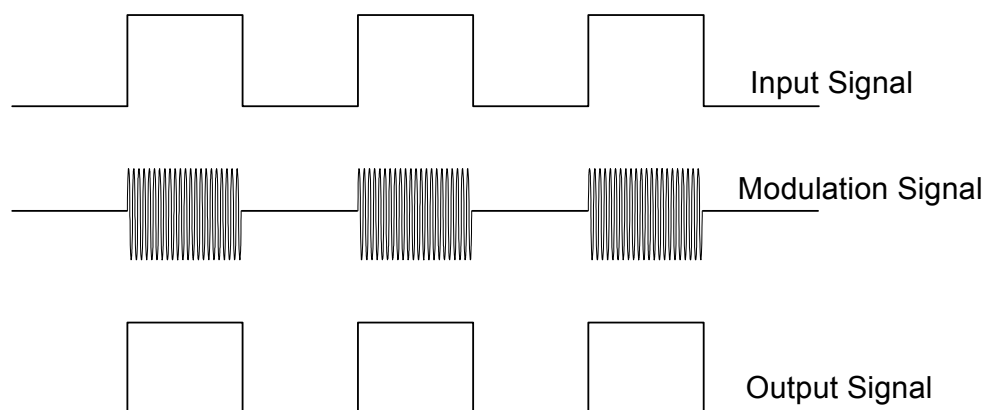
### 2.1. Theory of Operation

The operation of an Si86xx channel is analogous to that of an opto coupler, except an RF carrier is modulated instead of light. This simple architecture provides a robust isolated data path and requires no special considerations or initialization at start-up. A simplified block diagram for a single unidirectional Si86xx channel is shown in Figure 7.



**Figure 7. Simplified Channel Diagram**

A channel consists of an RF Transmitter and RF Receiver separated by a semiconductor-based isolation barrier. Referring to the Transmitter, input A modulates the carrier provided by an RF oscillator using on/off keying. The Receiver contains a demodulator that decodes the input state according to its RF energy content and applies the result to output B via the output driver. This RF on/off keying scheme is superior to pulse code schemes as it provides best-in-class noise immunity, low power consumption, and better immunity to magnetic fields. See Figure 8 for more details.



**Figure 8. Modulation Scheme**

## 3. Typical Application Overview

### 3.1. I<sup>2</sup>C Background

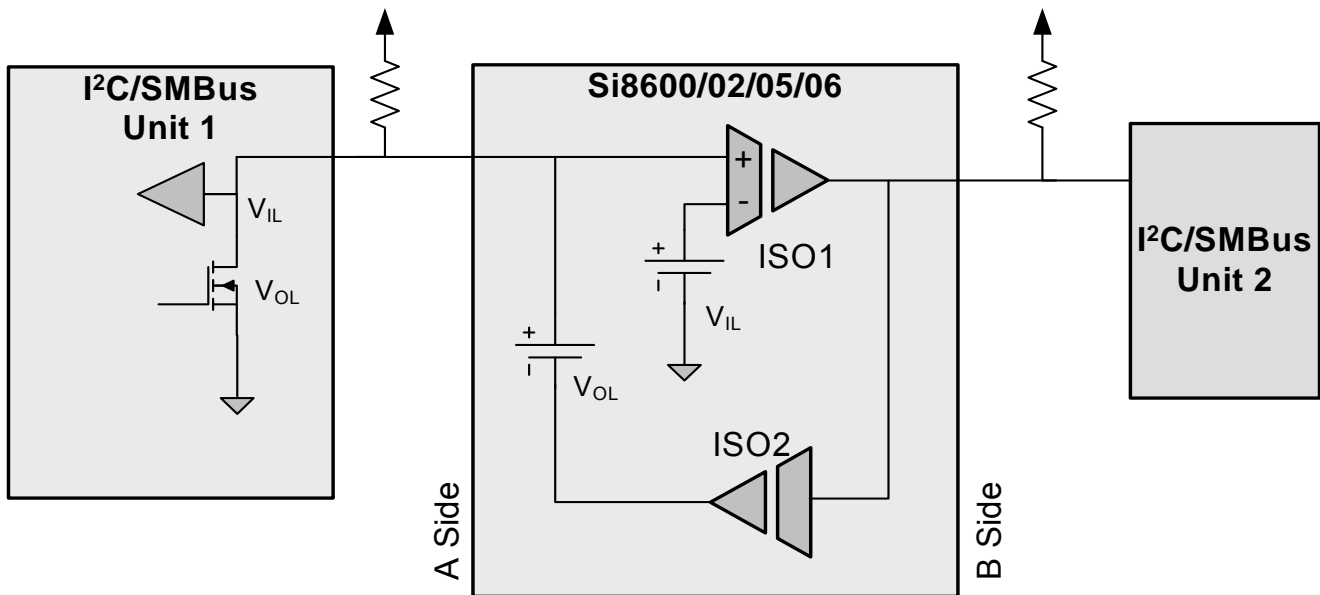
In many applications, I<sup>2</sup>C, SMBus, and PMBus interfaces require galvanic isolation for safety or ground loop elimination. For example, Power over Ethernet (PoE) applications typically use an I<sup>2</sup>C interface for communication between the PoE power sourcing device (PSE), and the earth ground referenced system controller. Galvanic isolation is required both by standard and also as a practical matter to prevent ground loops in Ethernet connected equipment.

The physical interface consists of two wires: serial data (SDA) and serial clock (SCL). These wires are connected to open collector drivers that serve as both inputs and outputs. At first glance, it appears that SDA and SCL can be isolated simply by placing two unidirectional isolators in parallel, and in opposite directions. However, this technique creates feedback that latches the bus line low when a logic low asserted by either master or slave. This problem can be remedied by adding anti-latch circuits, but results in a larger and more expensive solution. The Si860x products offer a single-chip, anti-latch solution to the problem of isolating I<sup>2</sup>C/SMBus applications and require no external components except the I<sup>2</sup>C/SMBus pull-up resistors. In addition, they provide isolation to a maximum of 5.0 kV<sub>RMS</sub>, support I<sup>2</sup>C clock stretching, and operate to a maximum I<sup>2</sup>C bus speed of 1.7 Mbps.

### 3.2. I<sup>2</sup>C Isolator Operation

Without anti-latch protection, bidirectional I<sup>2</sup>C isolators latch when an isolator output logic low propagates back through an adjacent isolator channel creating a stable latched low condition on both sides. Anti-latch protection is typically added to one side of the isolator to avoid this condition (the “A” side for the Si8600/02/05/06).

The following examples illustrate typical circuit configurations using the Si8600/02/05/06.



**Figure 9. Isolated Bus Overview (I<sup>2</sup>C Channels Only)**

The “A side” output low ( $V_{OL}$ ) and input low ( $V_{IL}$ ) levels are designed such that the isolator  $V_{OL}$  is greater than the isolator  $V_{IL}$  to prevent the latch condition.



### 3.3. I<sup>2</sup>C Isolator Design Constraints

Table 13 lists the I<sup>2</sup>C isolator design constraints.

**Table 13. Design Constraints**

| Design Constraint                                                                                                | Data Sheet Values                                                                                                                                                       | Effect of Bus Pull-up Strength and Temperature                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| To prevent the latch condition, the isolator output low level must be greater than the isolator input low level. | Isolator $V_{OL}$ 0.7 V typical<br>Isolator $V_{IL}$ 0.5 V typical<br><br>Input/Output Logic Low Level Difference<br>$\Delta V_{SDA1}, \Delta V_{SCL1} = 50$ mV minimum | This is normally guaranteed by the isolator data sheet. However, if the pull up strength is too weak, the output low voltage will fall and can get too close to the input low logic level. These track over temperature.                           |
| The bus output low must be less than the isolator input low logic level.                                         | Bus $V_{OL} = 0.4$ V maximum<br><br>Isolator $V_{IL} = 0.41$ V minimum                                                                                                  | If the pull up strength is too large, the devices on the bus might not pull the voltage below the input low range. These have opposite temperature coefficients. Worst case is hot temperature.                                                    |
| The isolator output low must be less than the bus input low.                                                     | Bus $V_{IL} 0.3 \times V_{DD} = 1.0$ V minimum for $V_{DD} = 3.3$ V<br><br>Isolator $V_{OL} = 0.8$ V maximum                                                            | If the pull up strength is too large, the isolator might not pull below the bus input low voltage.<br>Si8600/02/05/06 Vol: $-1.8$ mV/C<br>CMOS buffer: $-0.6$ mV/C<br>This provides some temperature tracking, but worst case is cold temperature. |

### 3.4. I<sup>2</sup>C Isolator Design Considerations

The first step in applying an I<sup>2</sup>C isolator is to choose which side of the bus will be connected to the isolator A side. Ideally, it should be the side which:

1. Is compatible with the range of bus pull up specified by the manufacturer. For example, the Si8600/02/05/06 isolators are normally used with a pull up of 0.5 mA to 3 mA.
2. Has the highest input low level for devices on the bus. Some devices may specify an input low of 0.9 V and other devices might require an input low of  $0.3 \times V_{DD}$ . Assuming a 3.3 V minimum power supply, the side with an input low of  $0.3 \times V_{DD}$  is the better side because this side has an input low level of 1.0 V.
3. Have devices on the bus that can pull down below the isolator input low level. For example, the Si860x input level is 0.41 V. As most CMOS devices can pull to within 0.4 V of GND this is generally not an issue.
4. Has the lowest noise. Due to the special logic levels, noise margins can be as low as 50 mV.

## 3.5. Typical Application Schematics

Figures 10 through 15 illustrate typical circuit configurations using the Si8600, Si8602, Si8605, and Si8606.

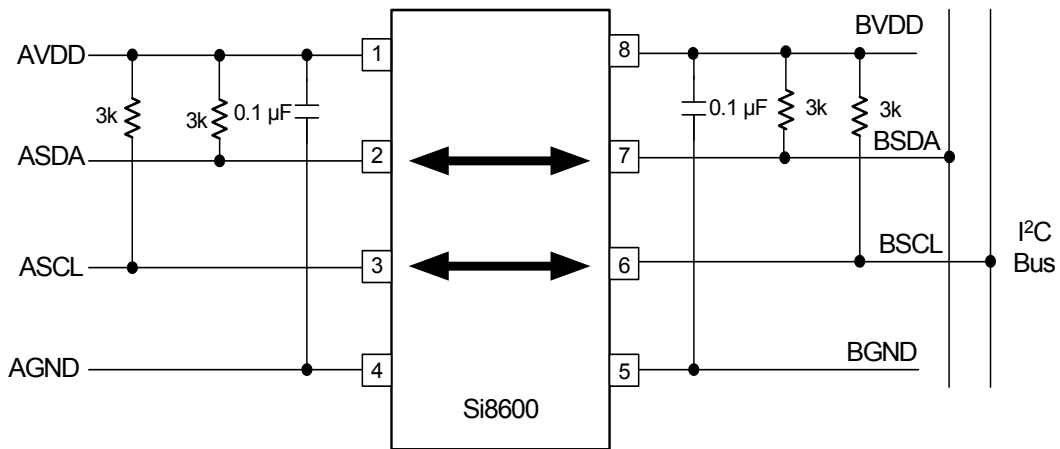


Figure 10. Typical Si8600 Application Diagram

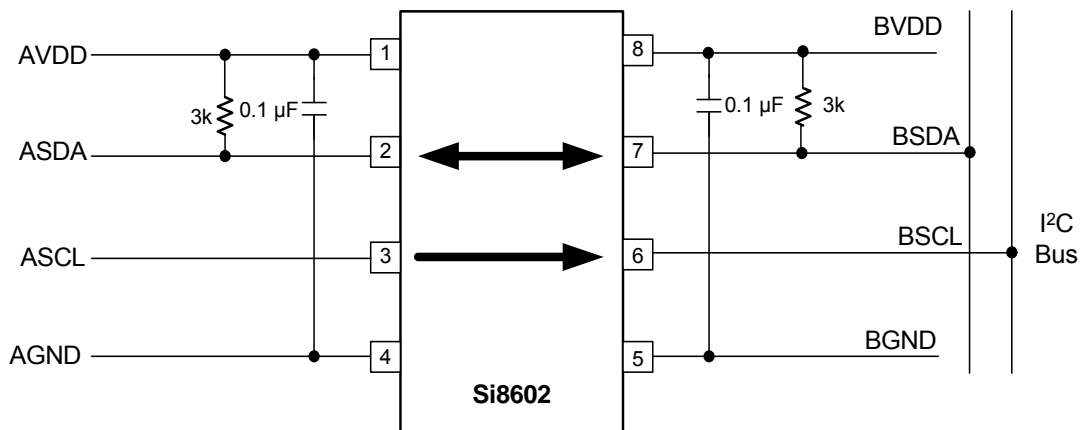


Figure 11. Typical Si8602 Application Diagram

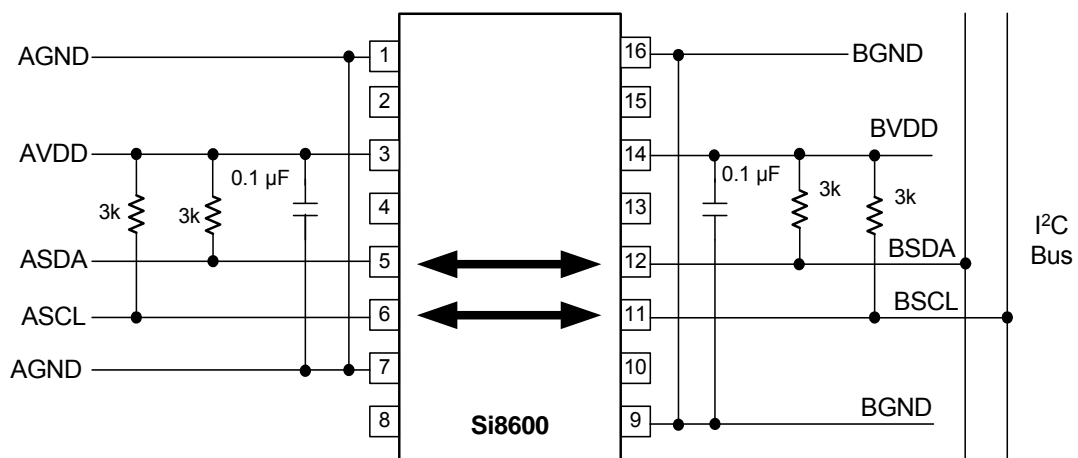
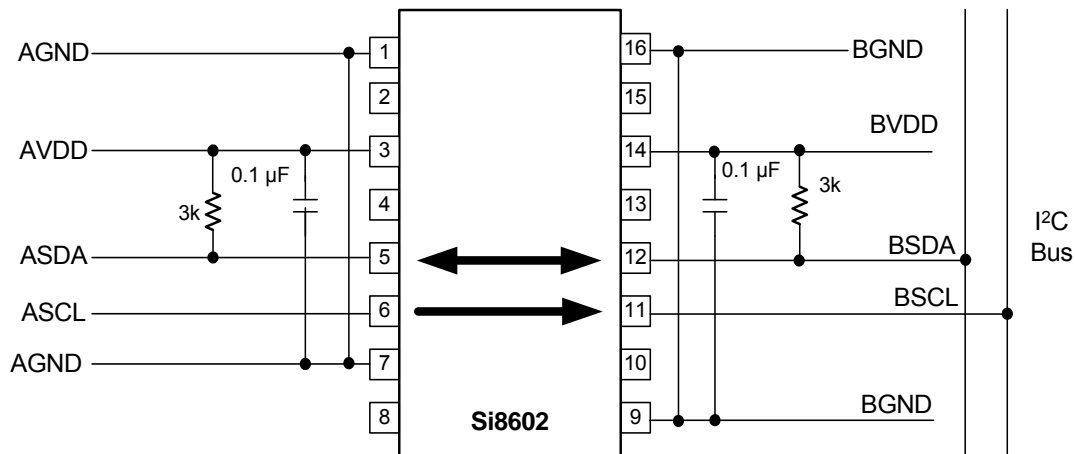
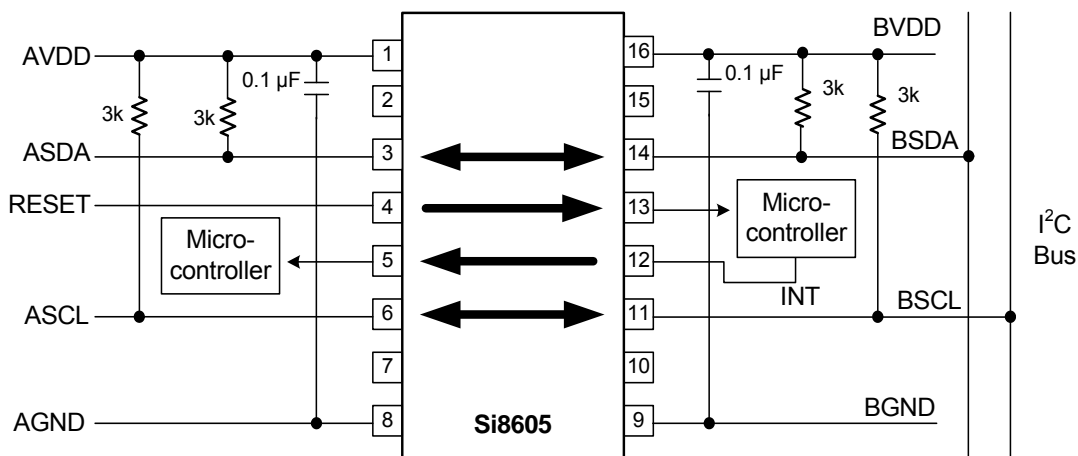


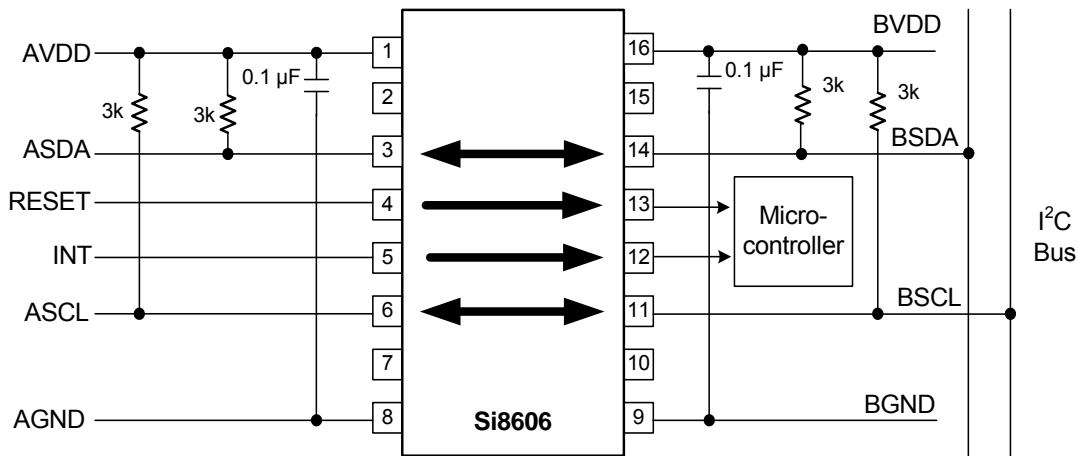
Figure 12. Typical Si8600 Application Diagram



**Figure 13. Typical Si8602 Application Diagram**



**Figure 14. Typical Si8605 Application Diagram**



**Figure 15. Typical Si8606 Application Diagram**

## 4. Device Operation

Device behavior during start-up, normal operation, and shutdown is shown in Figure 16, where UVLO+ and UVLO- are the positive-going and negative-going thresholds respectively. Refer to Table 14 to determine outputs when power supply (VDD) is not present.

### 4.1. Device Startup

Outputs are held low during powerup until VDD is above the UVLO threshold for time period  $t_{START}$ . Following this, the outputs follow the states of inputs.

### 4.2. Undervoltage Lockout

Undervoltage Lockout (UVLO) is provided to prevent erroneous operation during device startup and shutdown or when VDD is below its specified operating circuits range. Both Side A and Side B each have their own undervoltage lockout monitors. Each side can enter or exit UVLO independently. For example, Side A unconditionally enters UVLO when AVDD falls below  $AVDD_{UVLO-}$  and exits UVLO when AVDD rises above  $AVDD_{UVLO+}$ . Side B operates the same as Side A with respect to its BVDD supply.

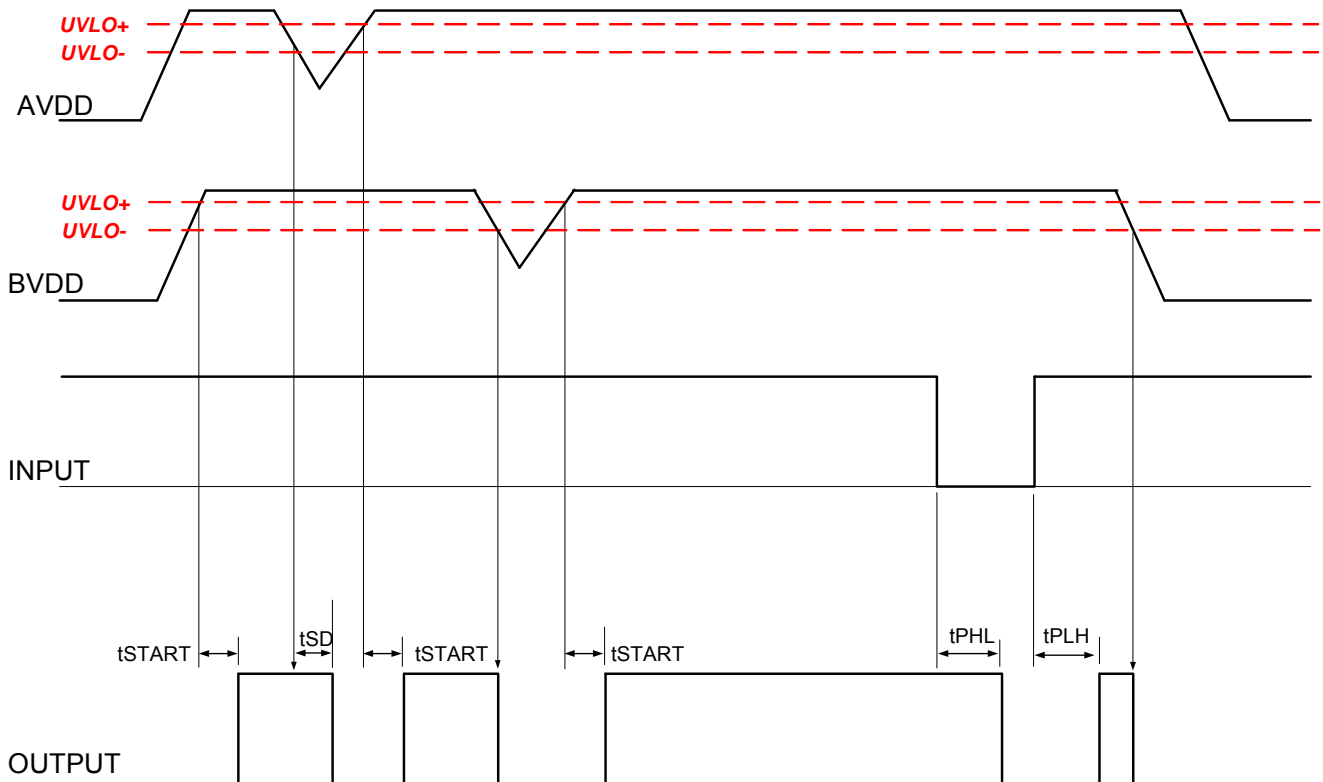


Figure 16. Device Behavior during Normal Operation

### 4.3. Input and Output Characteristics for Non-I<sup>2</sup>C Digital Channels

The unidirectional Si86xx inputs and outputs are standard CMOS drivers/receivers. The nominal output impedance of an isolator driver channel is approximately 50  $\Omega$ ,  $\pm 40\%$ , which is a combination of the value of the on-chip series termination resistor and channel resistance of the output driver FET. When driving loads where transmission line effects will be a factor, output pins should be appropriately terminated with controlled impedance PCB traces. Table 14 details powered and unpowered operation of the Si86xx's non-I<sup>2</sup>C digital channels.

**Table 14. Si86xx Operation Table**

| V <sub>I</sub> Input <sup>1,4</sup> | VDDI State <sup>1,2,3</sup> | VDDO State <sup>1,2,3</sup> | V <sub>O</sub> Output <sup>1,4</sup> | Comments                                                                                                                              |
|-------------------------------------|-----------------------------|-----------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| H                                   | P                           | P                           | H                                    | Normal operation.                                                                                                                     |
| L                                   | P                           | P                           | L                                    |                                                                                                                                       |
| X <sup>5</sup>                      | UP                          | P                           | L <sup>6</sup>                       | Upon transition of VDDI from unpowered to powered, V <sub>O</sub> returns to the same state as V <sub>I</sub> in less than 1 $\mu$ s. |
| X <sup>5</sup>                      | P                           | UP                          | Undetermined                         | Upon transition of VDDO from unpowered to powered, V <sub>O</sub> returns to the same state as V <sub>I</sub> within 1 $\mu$ s.       |

**Notes:**

1. VDDI and VDDO are the input and output power supplies. V<sub>I</sub> and V<sub>O</sub> are the respective input and output terminals.
2. Powered (P) state is defined as 3.0 V < VDD < 5.5 V.
3. Unpowered (UP) state is defined as VDD = 0 V.
4. X = not applicable; H = Logic High; L = Logic Low.
5. Note that an I/O can power the die for a given side through an internal diode if its source has adequate current.
6. For I<sup>2</sup>C channels, the outputs for a given side go to Hi-Z when power is lost on the opposite side.

## 4.4. Layout Recommendations

To ensure safety in the end user application, high voltage circuits (i.e., circuits with  $>30 V_{AC}$ ) must be physically separated from the safety extra-low voltage circuits (SELV is a circuit with  $<30 V_{AC}$ ) by a certain distance (creepage/clearance). If a component, such as a digital isolator, straddles this isolation barrier, it must meet those creepage/clearance requirements and also provide a sufficiently large high-voltage breakdown protection rating (commonly referred to as working voltage protection). Table 6 on page 10 and Table 7 on page 11 detail the working voltage and creepage/clearance capabilities of the Si86xx. These tables also detail the component standards (UL1577, IEC60747, CSA 5A), which are readily accepted by certification bodies to provide proof for end-system specifications requirements. Refer to the end-system specification (61010-1, 60950-1, 60601-1, etc.) requirements before starting any design that uses a digital isolator.

### 4.4.1. Supply Bypass

The Si860x family requires a  $0.1 \mu F$  bypass capacitor between AVDD and AGND and BVDD and BGND. The capacitor should be placed as close as possible to the package. To enhance the robustness of a design, the user may also include resistors ( $50\text{--}300 \Omega$ ) in series with the inputs and outputs if the system is excessively noisy.

### 4.4.2. Output Pin Termination

The nominal output impedance of a non- $I^2C$  isolator channel is approximately  $50 \Omega$ ,  $\pm 40\%$ , which is a combination of the value of the on-chip series termination resistor and channel resistance of the output driver FET. When driving loads where transmission line effects will be a factor, output pins should be appropriately terminated with controlled impedance PCB traces.

### 4.5. Typical Performance Characteristics

The typical performance characteristics depicted in the following diagrams are for information purposes only. Refer to Tables 2, 3, 4, and 5 for actual specification limits.

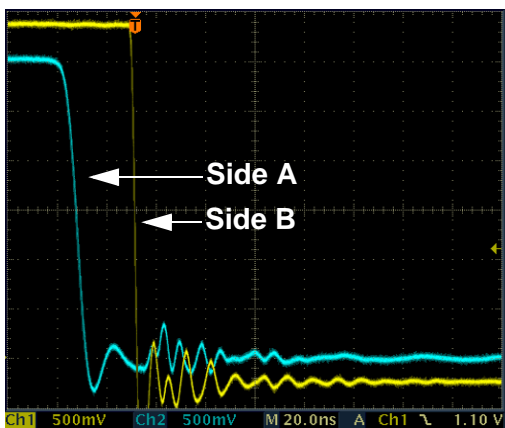


Figure 17. I<sup>2</sup>C Side A Pulling Down (1100 Ω Pull-Up)

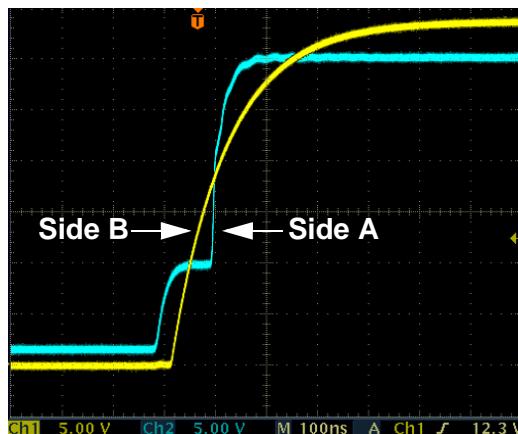


Figure 20. I<sup>2</sup>C Side A Pulling Up, Side B Following

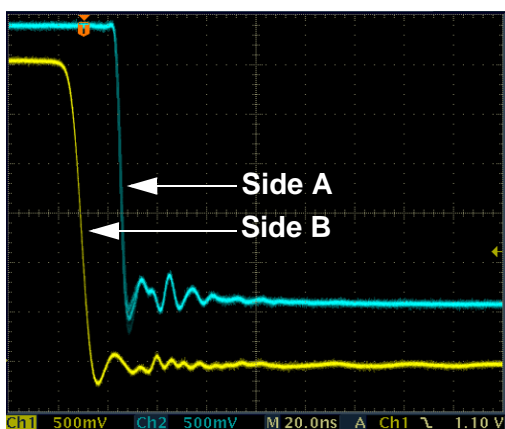


Figure 18. I<sup>2</sup>C Side B Pulling Down

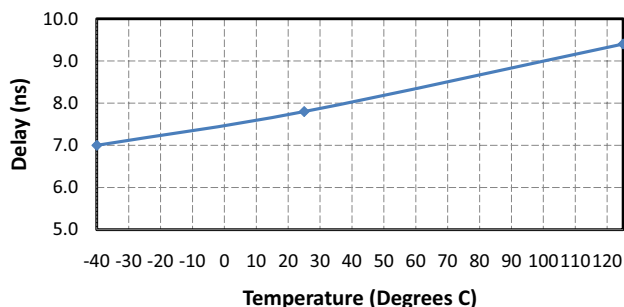


Figure 21. Non I<sup>2</sup>C Channel Propagation Delay vs. Temperature

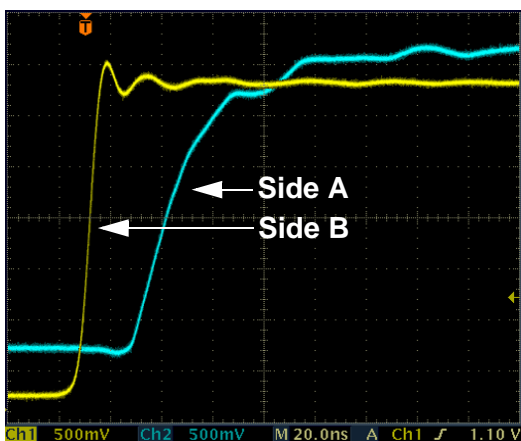
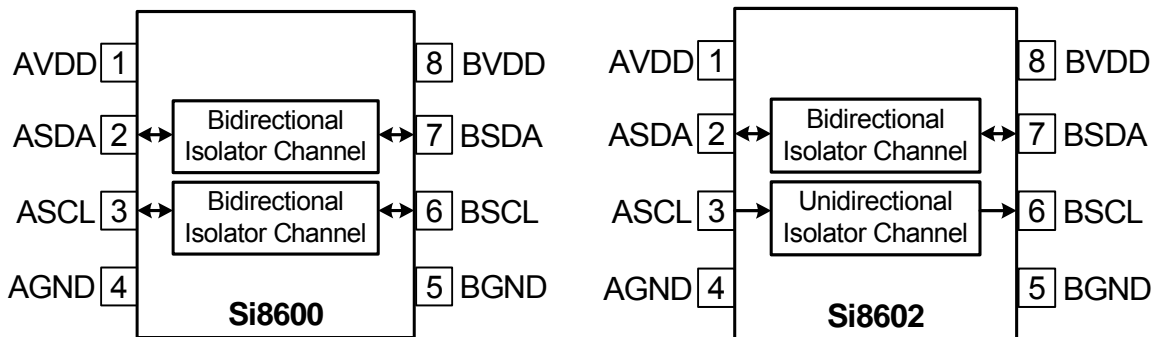


Figure 19. I<sup>2</sup>C Side B Pulling Up, Side A Following

# Si860x

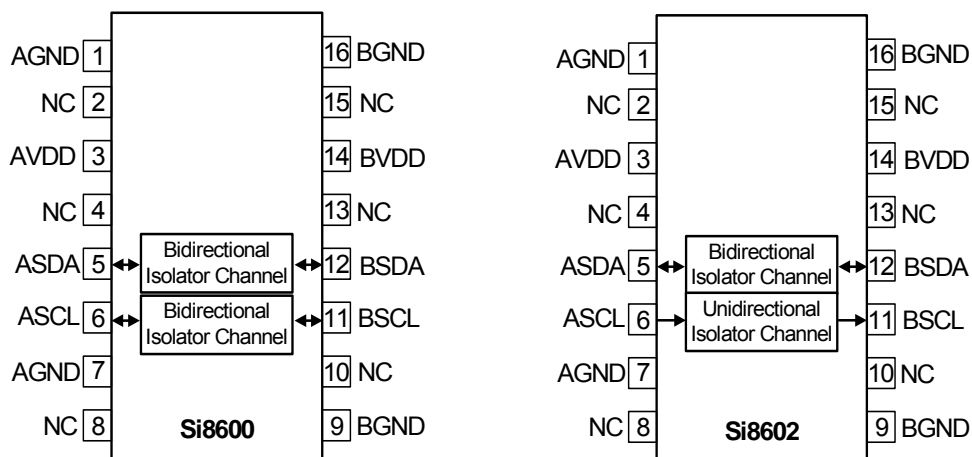
## 5. Pin Descriptions



**Table 15. Si8600/02 in SOIC-8 Package**

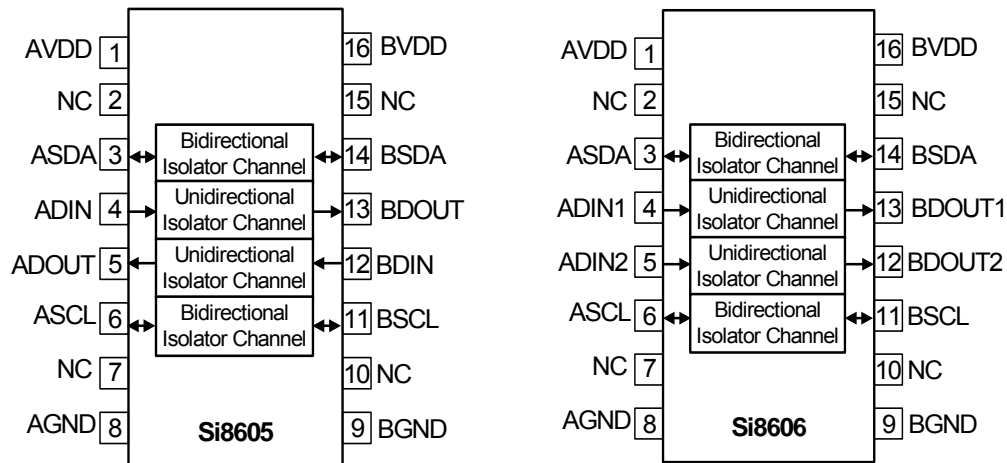
| Pin | Name | Description                                                                                 |
|-----|------|---------------------------------------------------------------------------------------------|
| 1   | AVDD | Side A power supply terminal; connect to a source of 3.0 to 5.5 V.                          |
| 2   | ASDA | Side A data (open drain) input or output.                                                   |
| 3   | ASCL | Side A clock input or output.<br>Open drain I/O for Si8600. Standard CMOS input for Si8602. |
| 4   | AGND | Side A ground terminal.                                                                     |
| 5   | BGND | Side B ground terminal.                                                                     |
| 6   | BSCL | Side B clock input or output.<br>Open drain I/O for Si8600. Push-pull output for Si8602.    |
| 7   | BSDA | Side B data (open drain) input or output.                                                   |
| 8   | BVDD | Side B power supply terminal; connect to a source of 3.0 to 5.5 V.                          |





**Table 16. Si8600/02 in Narrow and Wide-Body SOIC-16 Packages**

| Pin | Name | Description                                                        |
|-----|------|--------------------------------------------------------------------|
| 1   | AGND | Side A Ground Terminal.                                            |
| 2   | NC   | No connection.                                                     |
| 3   | AVDD | Side A power supply terminal. Connect to a source of 3.0 to 5.5 V. |
| 4   | NC   | No connection.                                                     |
| 5   | ASDA | Side A data open drain input or output.                            |
| 6   | ASCL | Side A data open drain input or output.                            |
| 7   | AGND | Side A Ground Terminal.                                            |
| 8   | NC   | No connection.                                                     |
| 9   | BGND | Side B Ground Terminal.                                            |
| 10  | NC   | No connection.                                                     |
| 11  | BSCL | Side B data open drain input or output.                            |
| 12  | BSDA | Side B data open drain input or output.                            |
| 13  | NC   | No connection.                                                     |
| 14  | BVDD | Side B power supply terminal. Connect to a source of 3.0 to 5.5 V. |
| 15  | NC   | No connection.                                                     |
| 16  | BGND | Side B Ground Terminal.                                            |



**Table 17. Si8605/06 in Narrow and Wide-Body SOIC-16 Packages**

| Pin | Name         | Description                                                                                                                   |
|-----|--------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1   | AVDD         | Side A power supply terminal. Connect to a source of 3.0 to 5.5 V.                                                            |
| 2   | NC           | No connection.                                                                                                                |
| 3   | ASDA         | Side A data (open drain) input or output.                                                                                     |
| 4   | ADIN/ADIN1   | Side A standard CMOS digital input (non I <sup>2</sup> C).                                                                    |
| 5   | ADOUT/ADIN2  | Side A digital input/output (non I <sup>2</sup> C)<br>Standard CMOS digital input for Si8606.<br>Push-Pull output for Si8605. |
| 6   | ASCL         | Side A clock input or output.<br>Open drain I/O for Si8605/06.                                                                |
| 7   | NC           | No connection.                                                                                                                |
| 8   | AGND         | Side A Ground Terminal.                                                                                                       |
| 9   | BGND         | Side B Ground Terminal.                                                                                                       |
| 10  | NC           | No connection.                                                                                                                |
| 11  | BSCL         | Side B clock input or output.<br>Open drain I/O for Si8605/06.                                                                |
| 12  | BDIN/BDOUT2  | Side B digital input/output (non I <sup>2</sup> C)<br>Standard CMOS digital input for Si8605.<br>Push-Pull output for Si8606. |
| 13  | BDOUT/BDOUT1 | Side B digital push-pull output (non I <sup>2</sup> C).                                                                       |
| 14  | BSDA         | Side B data open drain input or output.                                                                                       |
| 15  | NC           | No connection.                                                                                                                |
| 16  | BVDD         | Side B power supply terminal. Connect to a source of 3.0 to 5.5 V.                                                            |

## 6. Ordering Guide

Table 18. Ordering Guide<sup>1,2</sup>

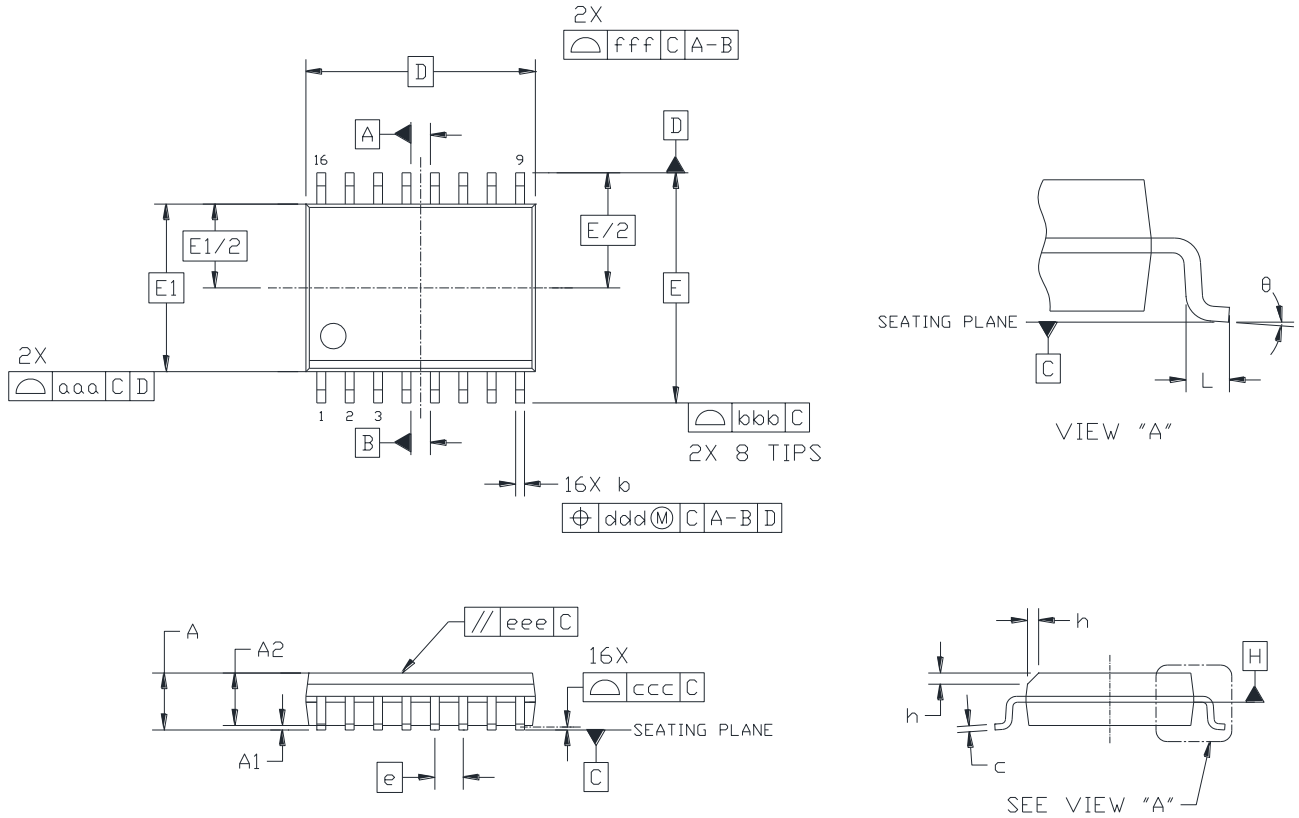
| Ordering Part Number (OPN) | Number of Bidirectional I <sup>2</sup> C Channels | Max I <sup>2</sup> C Bus Speed (MHz) | Number of Unidirectional Non-I <sup>2</sup> C Channels | Max Data Rate of Non-I <sup>2</sup> C Unidirectional Channels (Mbps) | Isolation Ratings (kVrms) | Temp Range (°C) | Package    |
|----------------------------|---------------------------------------------------|--------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------|---------------------------|-----------------|------------|
| Si8600AB-B-IS              | 2                                                 | 1.7                                  | 0                                                      | —                                                                    | 2.5                       | –40 to 125      | NB SOIC-8  |
| Si8600AC-B-IS              | 2                                                 | 1.7                                  | 0                                                      | —                                                                    | 3.75                      | –40 to 125      | NB SOIC-8  |
| Si8600AD-B-IS              | 2                                                 | 1.7                                  | 0                                                      | —                                                                    | 5.0                       | –40 to 125      | WB SOIC-16 |
| Si8602AB-B-IS              | 1                                                 | 1.7                                  | 1                                                      | 10                                                                   | 2.5                       | –40 to 125      | NB SOIC-8  |
| Si8602AC-B-IS              | 1                                                 | 1.7                                  | 1                                                      | 10                                                                   | 3.75                      | –40 to 125      | NB SOIC-8  |
| Si8602AD-B-IS              | 1                                                 | 1.7                                  | 1                                                      | 10                                                                   | 5.0                       | –40 to 125      | WB SOIC-16 |
| Si8605AB-B-IS1             | 2                                                 | 1.7                                  | 1 Forward<br>1 Reverse                                 | 10                                                                   | 2.5                       | –40 to 125      | NB SOIC-16 |
| Si8605AC-B-IS1             | 2                                                 | 1.7                                  | 1 Forward<br>1 Reverse                                 | 10                                                                   | 3.75                      | –40 to 125      | NB SOIC-16 |
| Si8605AD-B-IS              | 2                                                 | 1.7                                  | 1 Forward<br>1 Reverse                                 | 10                                                                   | 5.0                       | –40 to 125      | WB SOIC-16 |
| Si8606AC-B-IS1             | 2                                                 | 1.7                                  | 2 Forward                                              | 10                                                                   | 3.75                      | –40 to 125      | NB SOIC-16 |
| Si8606AD-B-IS              | 2                                                 | 1.7                                  | 2 Forward                                              | 10                                                                   | 5.0                       | –40 to 125      | WB SOIC-16 |

**Notes:**

1. All packages are RoHS-compliant with peak reflow temperature of 260 °C according to the JEDEC industry standard classifications and peak solder temperature.
2. “Si” and “SI” are used interchangeably.

## 7. Package Outline: 16-Pin Wide Body SOIC

Figure 22 illustrates the package details for the Si860x Digital Isolator. Table 19 lists the values for the dimensions shown in the illustration.



**Figure 22. 16-Pin Wide Body SOIC**

Table 19. Package Diagram Dimensions

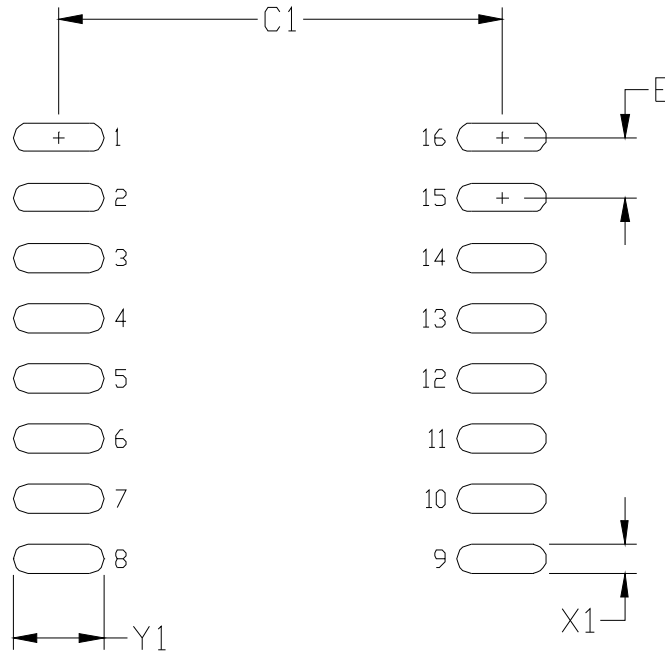
| Dimension | Min       | Max  |
|-----------|-----------|------|
| A         | —         | 2.65 |
| A1        | 0.10      | 0.30 |
| A2        | 2.05      | —    |
| b         | 0.31      | 0.51 |
| c         | 0.20      | 0.33 |
| D         | 10.30 BSC |      |
| E         | 10.30 BSC |      |
| E1        | 7.50 BSC  |      |
| e         | 1.27 BSC  |      |
| L         | 0.40      | 1.27 |
| h         | 0.25      | 0.75 |
| $\theta$  | 0°        | 8°   |
| aaa       | —         | 0.10 |
| bbb       | —         | 0.33 |
| ccc       | —         | 0.10 |
| ddd       | —         | 0.25 |
| eee       | —         | 0.10 |
| fff       | —         | 0.20 |

**Notes:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to JEDEC Outline MS-013, Variation AA.
4. Recommended reflow profile per JEDEC J-STD-020C specification for small body, lead-free components.

## 8. Land Pattern: 16-Pin Wide-Body SOIC

Figure 23 illustrates the recommended land pattern details for the Si860x in a 16-pin wide-body SOIC. Table 20 lists the values for the dimensions shown in the illustration.



**Figure 23. 16-Pin SOIC Land Pattern**

**Table 20. 16-Pin Wide Body SOIC Land Pattern Dimensions**

| Dimension | Feature            | (mm) |
|-----------|--------------------|------|
| C1        | Pad Column Spacing | 9.40 |
| E         | Pad Row Pitch      | 1.27 |
| X1        | Pad Width          | 0.60 |
| Y1        | Pad Length         | 1.90 |

**Notes:**

1. This Land Pattern Design is based on IPC-7351 pattern SOIC127P1032X265-16AN for Density Level B (Median Land Protrusion).
2. All feature sizes shown are at Maximum Material Condition (MMC) and a card fabrication tolerance of 0.05 mm is assumed.

## 9. Package Outline: 8-Pin Narrow Body SOIC

Figure 24 illustrates the package details for the Si860x in an 8-pin SOIC (SO-8). Table 21 lists the values for the dimensions shown in the illustration.

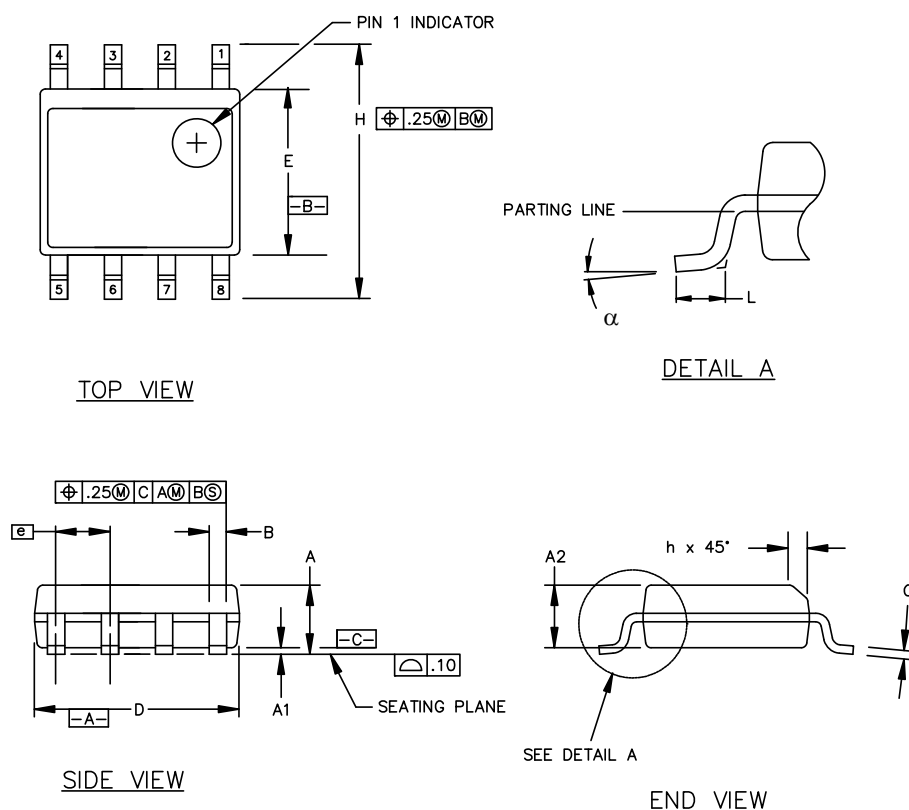


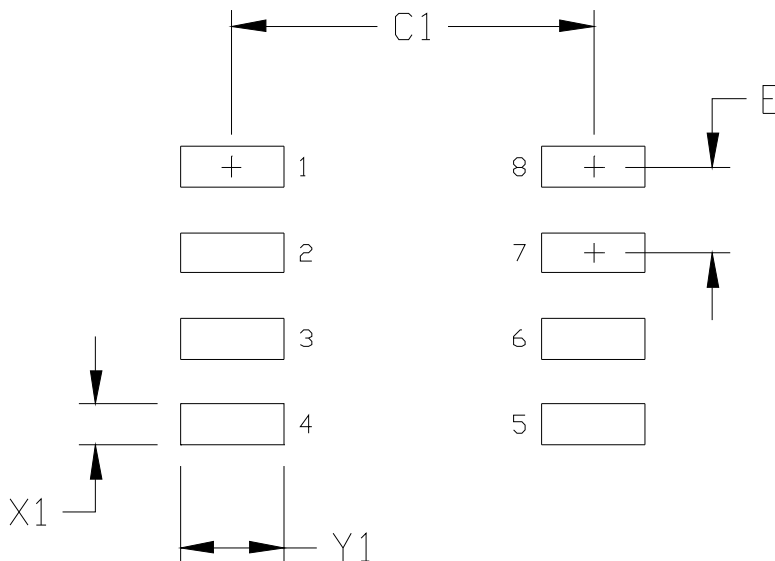
Figure 24. 8-pin Small Outline Integrated Circuit (SOIC) Package

Table 21. Package Diagram Dimensions

| Symbol   | Millimeters |          |
|----------|-------------|----------|
|          | Min         | Max      |
| A        | 1.35        | 1.75     |
| A1       | 0.10        | 0.25     |
| A2       | 1.40 REF    | 1.55 REF |
| B        | 0.33        | 0.51     |
| C        | 0.19        | 0.25     |
| D        | 4.80        | 5.00     |
| E        | 3.80        | 4.00     |
| e        | 1.27 BSC    |          |
| H        | 5.80        | 6.20     |
| h        | 0.25        | 0.50     |
| L        | 0.40        | 1.27     |
| $\alpha$ | 0°          | 8°       |

## 10. Land Pattern: 8-Pin Narrow Body SOIC

Figure 25 illustrates the recommended land pattern details for the Si860x in an 8-pin narrow-body SOIC. Table 22 lists the values for the dimensions shown in the illustration.



**Figure 25. PCB Land Pattern: 8-Pin Narrow Body SOIC**

**Table 22. PCM Land Pattern Dimensions (8-Pin Narrow Body SOIC)**

| Dimension                                                                                                                                                                                                                                                                                                       | Feature            | (mm) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|
| C1                                                                                                                                                                                                                                                                                                              | Pad Column Spacing | 5.40 |
| E                                                                                                                                                                                                                                                                                                               | Pad Row Pitch      | 1.27 |
| X1                                                                                                                                                                                                                                                                                                              | Pad Width          | 0.60 |
| Y1                                                                                                                                                                                                                                                                                                              | Pad Length         | 1.55 |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                                   |                    |      |
| <ol style="list-style-type: none"> <li>1. This Land Pattern Design is based on IPC-7351 pattern SOIC127P600X173-8N for Density Level B (Median Land Protrusion).</li> <li>2. All feature sizes shown are at Maximum Material Condition (MMC) and a card fabrication tolerance of 0.05 mm is assumed.</li> </ol> |                    |      |



### 11. Package Outline: 16-Pin Narrow Body SOIC

Figure 26 illustrates the package details for the Si860x in a 16-pin narrow-body SOIC (SO-16). Table 23 lists the values for the dimensions shown in the illustration.

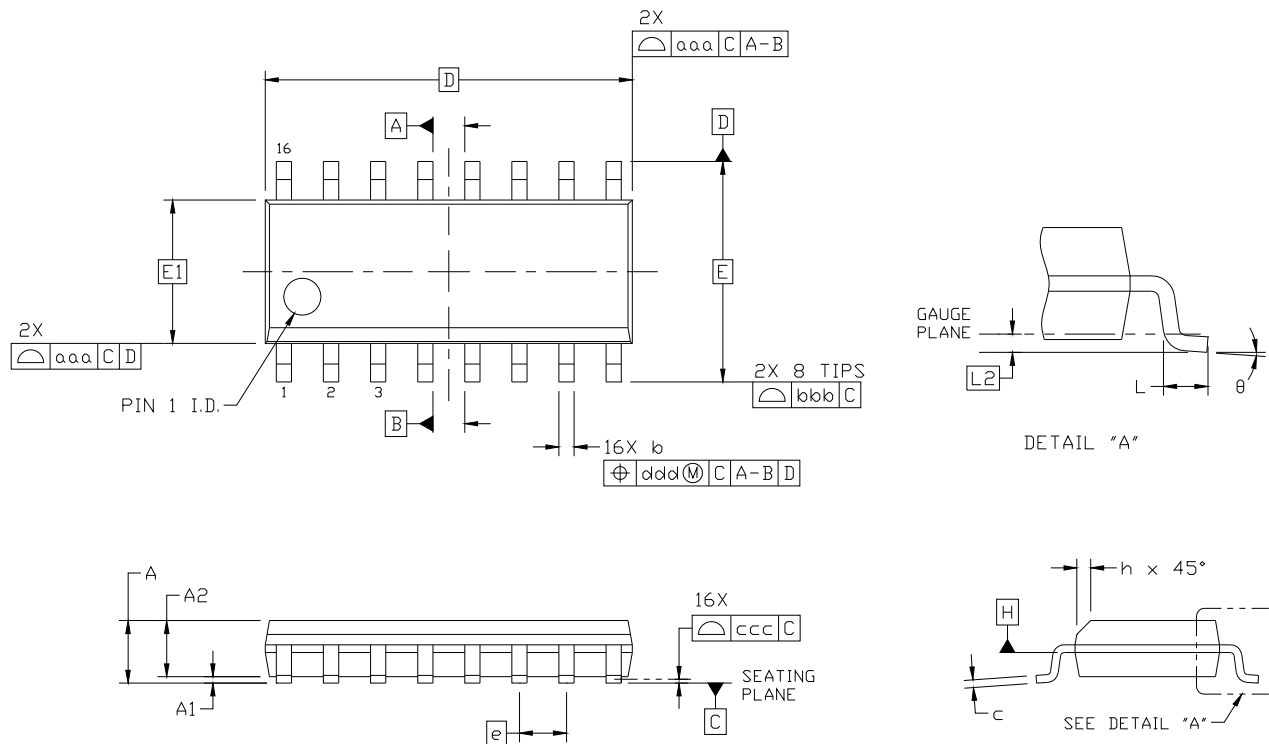


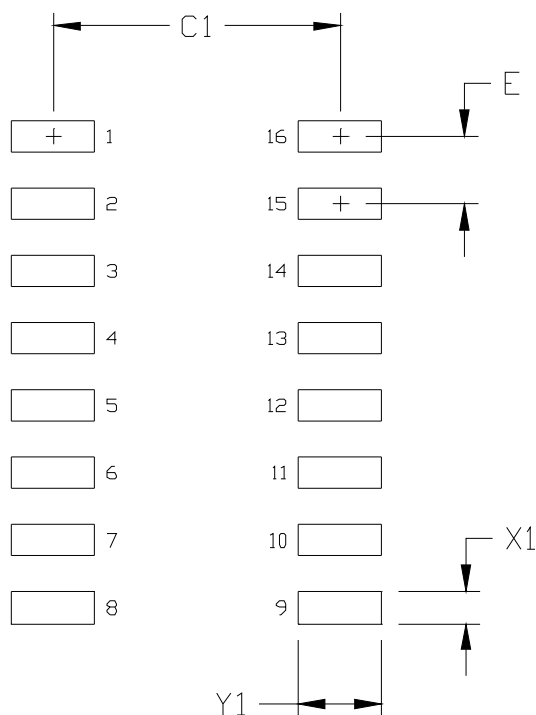
Figure 26. 16-pin Small Outline Integrated Circuit (SOIC) Package

**Table 23. Package Diagram Dimensions**

| Dimension                                                                                                                                                                                                                                                                                                                                                                                             | Min      | Max  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|
| A                                                                                                                                                                                                                                                                                                                                                                                                     | —        | 1.75 |
| A1                                                                                                                                                                                                                                                                                                                                                                                                    | 0.10     | 0.25 |
| A2                                                                                                                                                                                                                                                                                                                                                                                                    | 1.25     | —    |
| b                                                                                                                                                                                                                                                                                                                                                                                                     | 0.31     | 0.51 |
| c                                                                                                                                                                                                                                                                                                                                                                                                     | 0.17     | 0.25 |
| D                                                                                                                                                                                                                                                                                                                                                                                                     | 9.90 BSC |      |
| E                                                                                                                                                                                                                                                                                                                                                                                                     | 6.00 BSC |      |
| E1                                                                                                                                                                                                                                                                                                                                                                                                    | 3.90 BSC |      |
| e                                                                                                                                                                                                                                                                                                                                                                                                     | 1.27 BSC |      |
| L                                                                                                                                                                                                                                                                                                                                                                                                     | 0.40     | 1.27 |
| L2                                                                                                                                                                                                                                                                                                                                                                                                    | 0.25 BSC |      |
| h                                                                                                                                                                                                                                                                                                                                                                                                     | 0.25     | 0.50 |
| θ                                                                                                                                                                                                                                                                                                                                                                                                     | 0°       | 8°   |
| aaa                                                                                                                                                                                                                                                                                                                                                                                                   | 0.10     |      |
| bbb                                                                                                                                                                                                                                                                                                                                                                                                   | 0.20     |      |
| ccc                                                                                                                                                                                                                                                                                                                                                                                                   | 0.10     |      |
| ddd                                                                                                                                                                                                                                                                                                                                                                                                   | 0.25     |      |
| <b>Notes:</b>                                                                                                                                                                                                                                                                                                                                                                                         |          |      |
| <ol style="list-style-type: none"> <li>1. All dimensions shown are in millimeters (mm) unless otherwise noted.</li> <li>2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.</li> <li>3. This drawing conforms to the JEDEC Solid State Outline MS-012, Variation AC.</li> <li>4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.</li> </ol> |          |      |

## 12. Land Pattern: 16-Pin Narrow Body SOIC

Figure 27 illustrates the recommended land pattern details for the Si860x in a 16-pin narrow-body SOIC. Table 24 lists the values for the dimensions shown in the illustration.



**Figure 27. 16-Pin Narrow Body SOIC PCB Land Pattern**

**Table 24. 16-Pin Narrow Body SOIC Land Pattern Dimensions**

| Dimension | Feature            | (mm) |
|-----------|--------------------|------|
| C1        | Pad Column Spacing | 5.40 |
| E         | Pad Row Pitch      | 1.27 |
| X1        | Pad Width          | 0.60 |
| Y1        | Pad Length         | 1.55 |

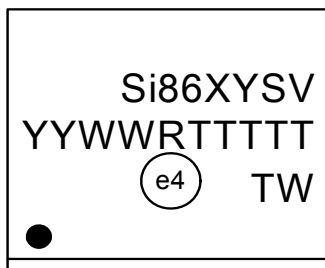
**Notes:**

1. This Land Pattern Design is based on IPC-7351 pattern SOIC127P600X165-16N for Density Level B (Median Land Protrusion).
2. All feature sizes shown are at Maximum Material Condition (MMC) and a card fabrication tolerance of 0.05 mm is assumed.

# Si860x

## 13. Top Markings

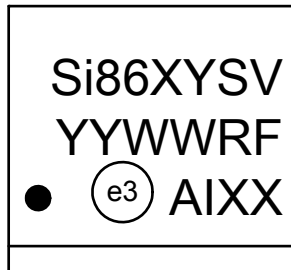
### 13.1. Si860x Top Marking (16-Pin Wide Body SOIC)



### 13.2. Top Marking Explanation (16-Pin Wide Body SOIC)

|                        |                                                                                        |                                                                                                                                                                                                                                                                                                                             |
|------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Line 1 Marking:</b> | Base Part Number<br>Ordering Options<br><br>(See Ordering Guide for more information). | Si86 = Isolator product series<br>XY = Channel Configuration<br>05 = Bidirectional SCL, SDA; 1- forward and 1-reverse unidirectional channel<br>06 = Bidirectional SCL, SDA; 2- forward unidirectional channels<br>S = Speed Grade<br>A = 1.7 Mbps<br>V = Isolation rating<br>A = 1 kV; B = 2.5 kV; C = 3.75 kV; D = 5.0 kV |
| <b>Line 2 Marking:</b> | YY = Year<br>WW = Workweek                                                             | Assigned by assembly subcontractor. Corresponds to the year and workweek of the mold date.                                                                                                                                                                                                                                  |
|                        | RTTTTT = Mfg Code                                                                      | Manufacturing code from assembly house<br>"R" indicates revision                                                                                                                                                                                                                                                            |
| <b>Line 3 Marking:</b> | Circle = 1.7 mm Diameter<br>(Center-Justified)                                         | "e4" Pb-Free Symbol                                                                                                                                                                                                                                                                                                         |
|                        | Country of Origin ISO Code<br>Abbreviation                                             | TW = Taiwan                                                                                                                                                                                                                                                                                                                 |

### 13.3. Si860x Top Marking (8-Pin Narrow Body SOIC)

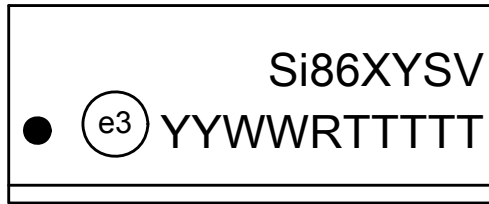


### 13.4. Top Marking Explanation (8-Pin Narrow Body SOIC)

|                        |                                                                                        |                                                                                                                                                                                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Line 1 Marking:</b> | Base Part Number<br>Ordering Options<br><br>(See Ordering Guide for more information). | Si86 = Isolator I <sup>2</sup> C Product Series:<br>XY = Channel Configuration<br>00 = Bidirectional SCL and SDA channels<br>02 = Bidirectional SDA channel;<br>Unidirectional SCL channel<br>S = Speed Grade<br>A = 1.7 Mbps<br>V = Isolation rating<br>A = 1 kV; B = 2.5 kV; C = 3.75 kV |
| <b>Line 2 Marking:</b> | YY = Year<br>WW = Work week                                                            | Assigned by assembly contractor. Corresponds to the year and work week of the mold date.                                                                                                                                                                                                   |
|                        | R = Product Rev<br>F = Wafer Fab                                                       | First two characters of the manufacturing code from Assembly.                                                                                                                                                                                                                              |
| <b>Line 3 Marking:</b> | Circle = 1.1 mm Diameter<br>Left-Justified                                             | “e3” Pb-Free Symbol                                                                                                                                                                                                                                                                        |
|                        | A = Assembly Site<br>I = Internal Code<br>XX = Serial Lot Number                       | Last four characters of the manufacturing code from assembly.                                                                                                                                                                                                                              |

# Si860x

## 13.5. Si860x Top Marking (16-Pin Narrow Body SOIC)



## 13.6. Top Marking Explanation (16-Pin Narrow Body SOIC)

|                        |                                      |                                                                                                                                                                                                                                                                                                                       |
|------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Line 1 Marking:</b> | Base Part Number<br>Ordering Options | Si86 = Isolator product series<br>XY = Channel Configuration<br>05 = Bidirectional SCL, SDA; 1- forward and<br>1-reverse unidirectional channel<br>06 = Bidirectional SCL, SDA; 2- forward<br>unidirectional channels<br>S = Speed Grade<br>A = 1.7 Mbps<br>V = Isolation rating<br>A = 1 kV; B = 2.5 kV; C = 3.75 kV |
|                        | <b>Line 2 Marking:</b>               | Circle = 1.2 mm Diameter                                                                                                                                                                                                                                                                                              |
|                        | YY = Year<br>WW = Work Week          | "e3" Pb-Free Symbol<br>Assigned by the Assembly House. Corresponds to the<br>year and work week of the mold date.                                                                                                                                                                                                     |
|                        | RTTTTT = Mfg Code                    | Manufacturing code from assembly house<br>"R" indicates revision                                                                                                                                                                                                                                                      |
|                        | Circle = 1.2 mm diameter             | "e3" Pb-Free Symbol.                                                                                                                                                                                                                                                                                                  |

## DOCUMENT CHANGE LIST

### Revision 0.1 to Revision 0.2

- Si8601 replaced by Si8602 throughout.
- Added chip graphics on page 1.
- Moved Table 12 to page 14.
- Updated Table 3, "Si8600/02/05/06 Electrical Characteristics for Bidirectional I2C Channels<sup>1</sup>," on page 5.
- Updated Table 7, "Insulation and Safety-Related Specifications," on page 11.
- Updated Table 9, "IEC 60747-5-2 Insulation Characteristics for Si86xxx\*," on page 12.
- Moved "3. Typical Application Overview" to page 16.
- Moved "Typical Performance Characteristics" to page 23.
- Updated "5.Pin Descriptions" on page 24.
- Updated "6.Ordering Guide" on page 27.

### Revision 0.2 to Revision 0.3

- Added chip graphics on page 1.
- Moved Tables 1 and 2 to page 4.
- Updated Table 7, "Insulation and Safety-Related Specifications," on page 11.
- Updated Table 9, "IEC 60747-5-2 Insulation Characteristics for Si86xxx\*," on page 12.
- Moved Table 13 to page 17.
- Moved Table 14 to page 21.
- Updated "5.Pin Descriptions" on page 24.
- Updated "6.Ordering Guide" on page 27.

### Revision 0.3 to Revision 1.0

- Reordered spec tables to conform to new convention.
- Removed "pending" throughout document.

### Revision 1.0 to Revision 1.1

- Updated Figures 12 and 13.
  - Updated Pin 7 AGND connection.
- Updated "6.Ordering Guide" on page 27 to include MSL2A.

### Revision 1.1 to Revision 1.2

- Updated Table 12 on page 14.
  - Added junction temperature spec.
- Updated "4.4.1.Supply Bypass" on page 22.
- Updated "6.Ordering Guide" on page 27.
  - Removed Rev A devices.
- Updated "7.Package Outline: 16-Pin Wide Body SOIC" on page 28.
- Updated Top Marks.
  - Added revision description.

### Revision 1.2 to Revision 1.3

- Added Figure 3, "Common Mode Transient Immunity Test Circuit," on page 9.
- Added references to CQC throughout.
- Added references to 2.5 kV<sub>RMS</sub> devices throughout.
- Removed Fail-safe operating mode throughout.
- Updated "6.Ordering Guide" on page 27.
- Updated "13.1.Si860x Top Marking (16-Pin Wide Body SOIC)" on page 36.

### Revision 1.3 to Revision 1.4

- Updated Table 6 on page 10.
  - Added CQC certificate numbers.
- Corrected Device Power Dissipation units in Table 10 on page 12.
- Updated "6.Ordering Guide" on page 27.
  - Removed references to moisture sensitivity levels.
  - Removed Note 2.

## CONTACT INFORMATION

### Silicon Laboratories Inc.

400 West Cesar Chavez  
Austin, TX 78701  
Tel: 1+(512) 416-8500  
Fax: 1+(512) 416-9669  
Toll Free: 1+(877) 444-3032

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