

5 kV LED EMULATOR INPUT, 4.0 A ISOLATED GATE DRIVERS

Features

- Pin-compatible, drop-in upgrades for popular high speed opto-coupled gate drivers
- Low power diode emulator simplifies design-in process
- 0.6 and 4.0 Amp peak output drive current
- Rail-to-rail output voltage
- Performance and reliability advantages vs. opto-drivers
 - Resistant to temperature and age
 - 10x lower FIT rate for longer service life
 - 14x tighter part-to-part matching
 - Higher common-mode transient immunity: >50 kV/μs typical
- Robust protection features
 - Multiple UVLO ordering options (5, 8, and 12 V) with hysteresis
- 60 ns propagation delay, independent of input drive current
- Wide V_{DD} range: 5 to 30 V
- Up to 5000 V_{RMS} isolation and 10 kV surge protection
- AEC-Q100 qualified
- Wide operating temperature range
 - -40 to +125 °C
- RoHS-compliant packages
 - SOIC-8 (Narrow body)
 - DIP8 (Gull-wing)
 - SDIP6 (Stretched SO-6)
 - LGA8

Applications

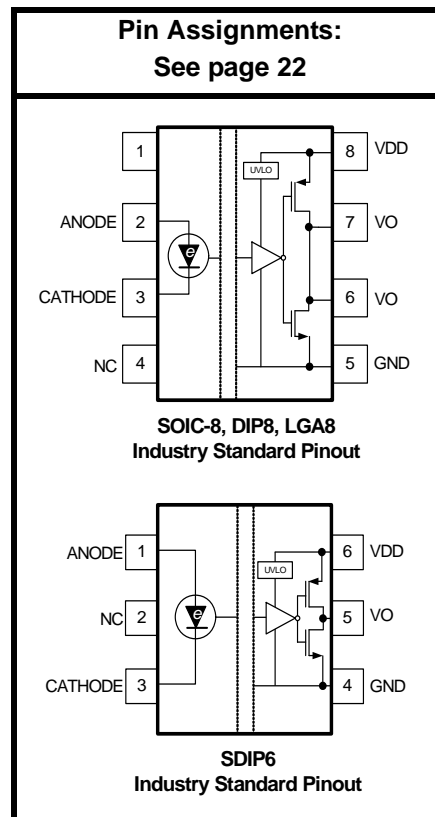
- IGBT/ MOSFET gate drives
- Industrial, HEV and renewable energy inverters
- AC, Brushless and DC motor controls and drives
- Variable speed motor control in consumer white goods
- Isolated switch mode and UPS power supplies

Safety Regulatory Approvals

- UL 1577 recognized
 - Up to 5000 Vrms for 1 minute
- CSA component notice 5A approval
 - IEC 60950-1, 61010-1, 60601-1 (reinforced insulation)
- VDE certification conformity
 - IEC60747-5-5/VDE0884 Part 10 (basic/reinforced insulation)
- CQC certification approval
 - GB4943.1

Description

The Si826x isolators are pin-compatible, drop-in upgrades for popular opto-coupled gate drivers, such as 0.6 A ACPL-0302/3020, 2.5 A HCPL-3120/ACPL-3130, HCNW3120/3130, and similar opto-drivers. The devices are ideal for driving power MOSFETs and IGBTs used in a wide variety of inverter and motor control applications. The Si826x isolated gate drivers utilize Silicon Laboratories' proprietary silicon isolation technology, supporting up to 5.0 kV_{RMS} withstand voltage per UL1577 and 10kV surge protection per IEC60747. This technology enables higher-performance, reduced variation with temperature and age, tighter part-to-part matching, and superior common-mode rejection compared to opto-coupled gate drivers. While the input circuit mimics the characteristics of an LED, less drive current is required, resulting in higher efficiency. Propagation delay time is independent of input drive current, resulting in consistently short propagation times, tighter unit-to-unit variation, and greater input circuit design flexibility. As a result, the Si826x series offers longer service life and dramatically higher reliability compared to opto-coupled gate drivers.



Patent pending

Si826x

Functional Block Diagram

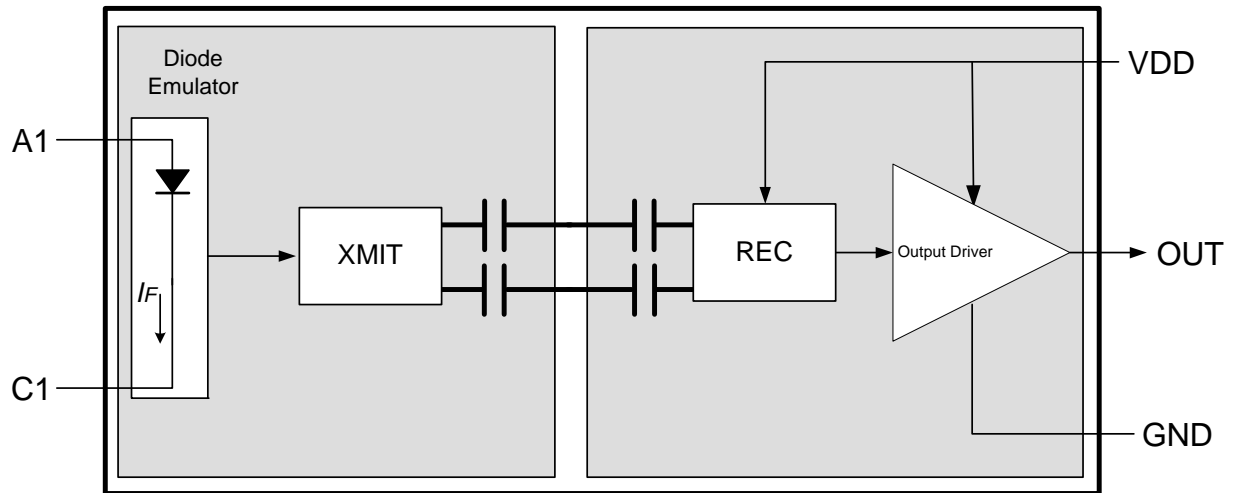


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Si826x

1. Electrical Specifications

Table 1. Recommended Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Unit |
|---------------------------------|-------------------------------|-----|-----|-----|------|
| Supply Voltage | V_{DD} | 5 | — | 30 | V |
| Input Current | $I_{F(ON)}$ (see Figure 1) | 6 | — | 30 | mA |
| Operating Temperature (Ambient) | T_A | -40 | — | 125 | °C |

Table 2. Electrical Characteristics ¹

$V_{DD} = 15\text{ V or }30\text{ V}$, $GND = 0\text{ V}$, $I_F = 6\text{ mA}$, $T_A = -40\text{ to }+125\text{ °C}$; typical specs at 25 °C

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|--------------|--|-----|------|-----|------|
| DC Parameters | | | | | | |
| Supply Voltage ² | V_{DD} | $(V_{DD} - GND)$ | 5 | — | 30 | V |
| Supply Current (Output High) | I_{DD} | $I_F = 10\text{ mA}$ | — | 1.8 | 2.4 | mA |
| | | $V_{DD} = 15\text{ V}$ $V_{DD} = 30\text{ V}$ | — | 2.0 | 2.7 | mA |
| Supply Current (Output Low) | I_{DD} | $V_F = 0\text{ V}$; $I_F = 0\text{ mA}$ | — | 1.5 | 2.1 | mA |
| | | $V_{DD} = 15\text{ V}$ $V_{DD} = 30\text{ V}$ | — | 1.7 | 2.4 | mA |
| Input Current Threshold | $I_{F(TH)}$ | | — | — | 3.6 | mA |
| Input Current Hysteresis | I_{HYS} | | — | 0.34 | — | mA |
| Input Forward Voltage (OFF) | $V_{F(OFF)}$ | Measured at ANODE with respect to CATHODE. | — | — | 1 | V |
| Input Forward Voltage (ON) | $V_{F(ON)}$ | Measured at ANODE with respect to CATHODE. | 1.6 | — | 2.8 | V |
| Input Capacitance | C_I | $f = 100\text{ kHz}$, $V_F = 0\text{ V}$, $V_F = 2\text{ V}$ | — | 15 | — | pF |
| Output Resistance High (Source) ³ | R_{OH} | Si826xAxx devices | — | 15 | — | Ω |
| | | Si826xBxx devices ($I_{OH} = -1\text{ A}$) | — | 2.6 | 5.1 | |
| Output Resistance Low (Sink) ³ | R_{OL} | Si826xAxx devices | — | 5.0 | — | |
| | | Si826xBxx devices ($I_{OL} = 2\text{ A}$) | — | 0.8 | 2.0 | |

Notes:

1. See "8.Ordering Guide" on page 23 for more information.
2. Minimum value of $(V_{DD} - GND)$ decoupling capacitor is 1 μF .
3. Both V_O pins are required to be shorted together for 4.0 A compliance.
4. When performing this test, it is recommended that the DUT be soldered down to the PCB to reduce parasitic inductances, which may cause over-stress conditions due to excessive ringing.
5. Guaranteed by characterization.

Table 2. Electrical Characteristics (Continued)¹

$V_{DD} = 15\text{ V or }30\text{ V}$, $GND = 0\text{ V}$, $I_F = 6\text{ mA}$, $T_A = -40\text{ to }+125\text{ }^\circ\text{C}$; typical specs at $25\text{ }^\circ\text{C}$

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|-------------|---|----------------|-----------------|-----|------|
| Output High Current (Source) ^{3,4} | I_{OH} | Si826xAxx devices ($I_F = 0$), ($t_{PW_IOH} \leq 250\text{ ns}$) (see Figure 3) | — | 0.4 | — | A |
| | | Si826xBxx devices ($I_F = 0$), ($t_{PW_IOH} \leq 250\text{ ns}$), ($V_{DD} - V_O = 7.5\text{ V}$) (see Figure 3) | 0.5 | 1.8 | — | |
| Output Low Current (Sink) ^{3,4} | I_{OL} | Si826xAxx devices ($I_F = 10\text{ mA}$), ($t_{PW_IOL} \leq 250\text{ ns}$) (see Figure 2) | — | 0.6 | — | A |
| | | Si826xBxx devices ($I_F = 10\text{ mA}$), ($t_{PW_IOL} \leq 250\text{ ns}$), ($V_O - GND = 4.2\text{ V}$) (see Figure 2) | 1.2 | 4.0 | — | |
| High-Level Output Voltage | V_{OH} | Si826xAxx devices ($I_{OUT} = -100\text{ mA}$) | — | $V_{DD} - 0.4$ | — | V |
| | | Si826xBxx devices ($I_{OUT} = -100\text{ mA}$) | $V_{DD} - 0.5$ | $V_{DD} - 0.25$ | — | |
| | | Si826xBxx devices ($I_{OUT} = 0\text{ mA}$), ($I_F = 0\text{ mA}$) | — | V_{DD} | — | |
| Low-Level Output Voltage | V_{OL} | Si826xAxx devices ($I_{OUT} = 100\text{ mA}$), ($I_F = 10\text{ mA}$) | — | 320 | — | mV |
| | | Si826xBxx devices ($I_{OUT} = 100\text{ mA}$), ($I_F = 10\text{ mA}$) | — | 80 | 200 | |
| UVLO Threshold + (Si826xxAx mode) | V_{DDUV+} | See Figure 11 on page 16. V_{DD} rising | 5 | 5.6 | 6.3 | V |
| UVLO Threshold – (Si826xxAx mode) | V_{DDUV-} | See Figure 11 on page 16. V_{DD} falling | 4.7 | 5.3 | 6.0 | V |

Notes:

1. See "8.Ordering Guide" on page 23 for more information.
2. Minimum value of ($V_{DD} - GND$) decoupling capacitor is $1\text{ }\mu\text{F}$.
3. Both V_O pins are required to be shorted together for 4.0 A compliance.
4. When performing this test, it is recommended that the DUT be soldered down to the PCB to reduce parasitic inductances, which may cause over-stress conditions due to excessive ringing.
5. Guaranteed by characterization.

Table 2. Electrical Characteristics (Continued)¹

$V_{DD} = 15\text{ V or }30\text{ V}$, $GND = 0\text{ V}$, $I_F = 6\text{ mA}$, $T_A = -40\text{ to }+125\text{ }^\circ\text{C}$; typical specs at $25\text{ }^\circ\text{C}$

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|----------------|--|------|------|------|-------------------|
| UVLO lockout hysteresis (Si826xxAx mode) | $V_{DD_{HYS}}$ | | — | 300 | — | mV |
| UVLO Threshold + (Si826xxBx mode) | $V_{DD_{UV+}}$ | See Figure 12 on page 16. V_{DD} rising | 7.5 | 8.4 | 9.4 | V |
| UVLO Threshold – (Si826xxBx mode) | $V_{DD_{UV-}}$ | See Figure 12 on page 16. V_{DD} falling | 6.9 | 7.9 | 8.9 | V |
| UVLO lockout hysteresis (Si826xxBx mode) | $V_{DD_{HYS}}$ | | — | 500 | — | mV |
| UVLO Threshold + (Si826xxCx mode) | $V_{DD_{UV+}}$ | See Figure 13 on page 16. V_{DD} rising | 10.5 | 12 | 13.5 | V |
| UVLO Threshold – (Si826xxCx mode) | $V_{DD_{UV-}}$ | See Figure 13 on page 16. V_{DD} falling | 9.4 | 10.7 | 12.2 | V |
| UVLO lockout hysteresis (Si826xxCx mode) | $V_{DD_{HYS}}$ | | — | 1.3 | — | V |
| AC Switching Parameters | | | | | | |
| Input noise filter cut-off pulse width | t_{NFC} | | — | — | 15 | ns |
| Minimum pulse width | $t_{P_{MIN}}$ | | — | 30 | — | ns |
| Propagation delay (Low-to-High) | t_{PLH} | $C_L = 200\text{ pF}$ | 20 | 40 | 60 | ns |
| Propagation delay (High-to-Low) | t_{PHL} | $C_L = 200\text{ pF}$ | 10 | 30 | 50 | ns |
| Pulse Width Distortion | PWD | $ t_{PLH} - t_{PHL} $ | — | 17 | 28 | ns |
| Propagation Delay Difference ⁵ | PDD | $t_{PHL_{MAX}} - t_{PLH_{MIN}}$ | -1 | — | 25 | ns |
| Rise time | t_R | $C_L = 200\text{ pF}$ | — | 5.5 | 15 | ns |
| Fall time | t_F | $C_L = 200\text{ pF}$ | — | 8.5 | 20 | ns |
| Device Startup Time | t_{START} | | — | 16 | 30 | μs |
| Common Mode Transient Immunity | CMTI | Output = low or high ($V_{CM} = 1500\text{ V}$), ($I_F \geq 6\text{ mA}$) (See Figure 4) | 35 | 50 | — | kV/ μs |

Notes:

1. See "8.Ordering Guide" on page 23 for more information.
2. Minimum value of ($V_{DD} - GND$) decoupling capacitor is $1\text{ }\mu\text{F}$.
3. Both V_O pins are required to be shorted together for 4.0 A compliance.
4. When performing this test, it is recommended that the DUT be soldered down to the PCB to reduce parasitic inductances, which may cause over-stress conditions due to excessive ringing.
5. Guaranteed by characterization.

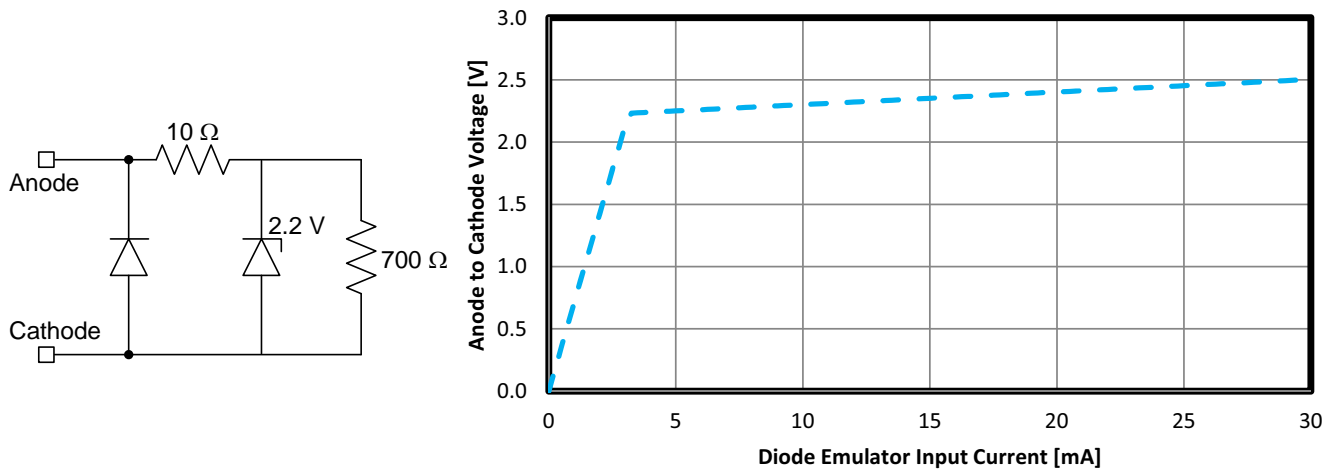


Figure 1. Diode Emulator Model and I-V Curve

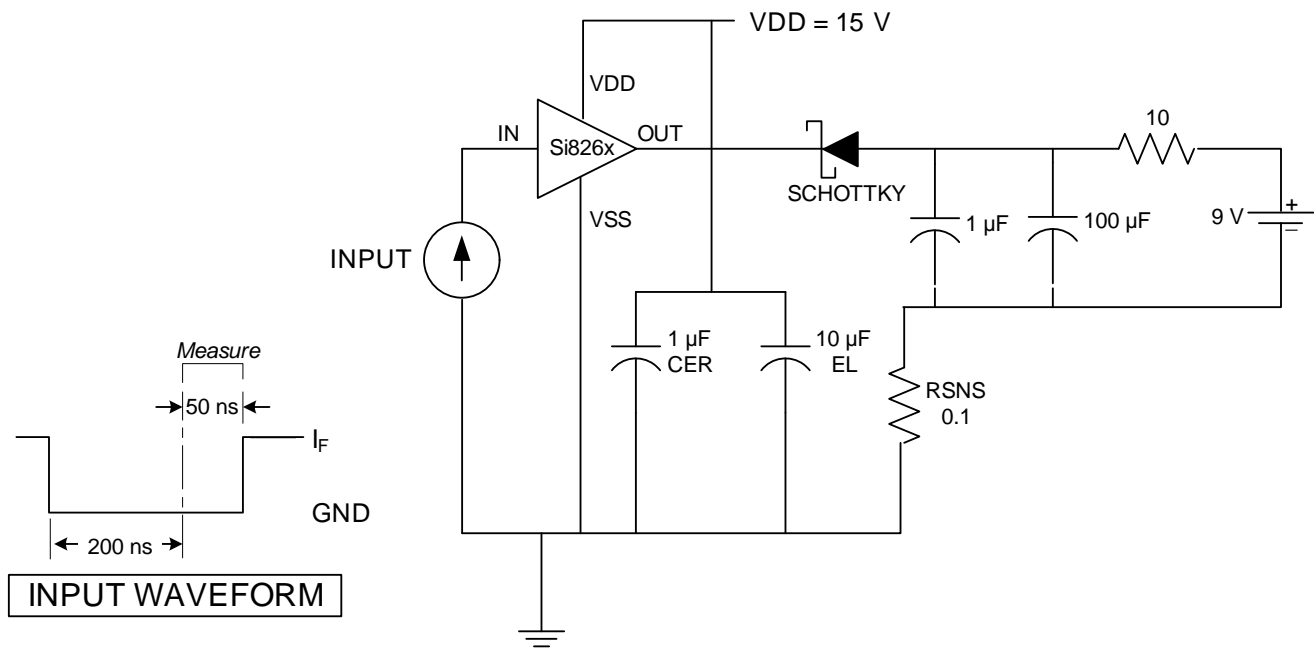


Figure 2. IOL Sink Current Test Circuit

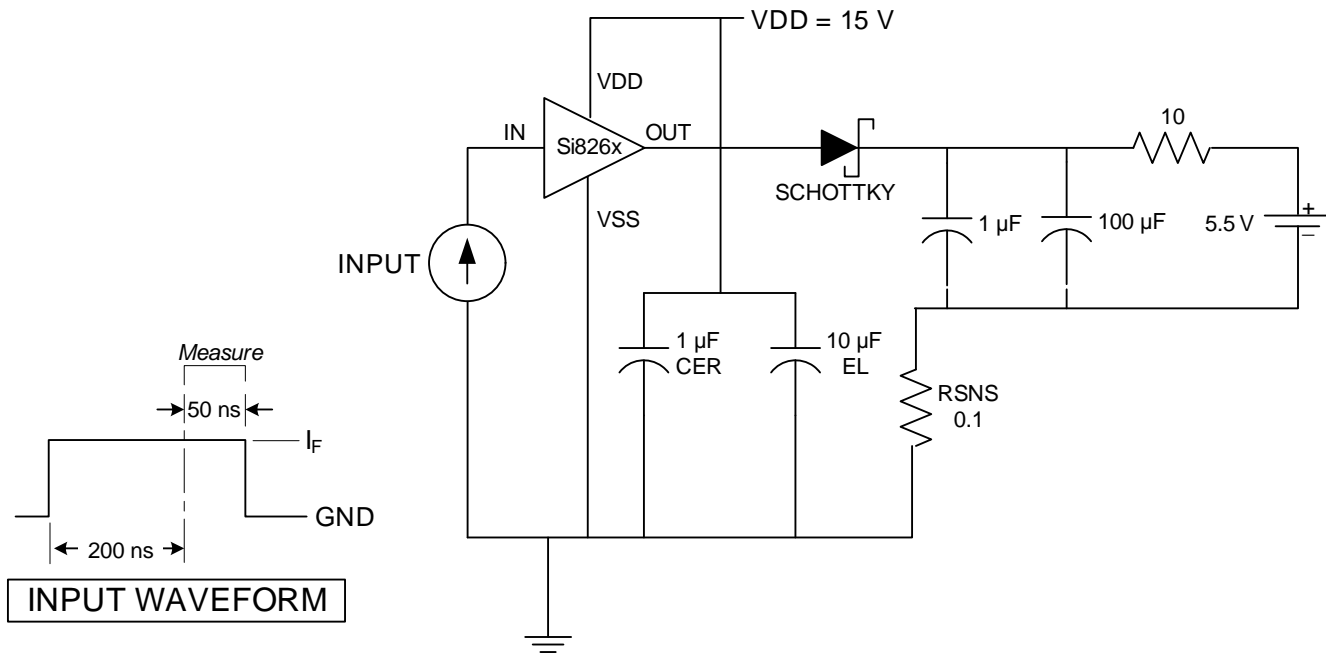


Figure 3. IOH Source Current Test Circuit

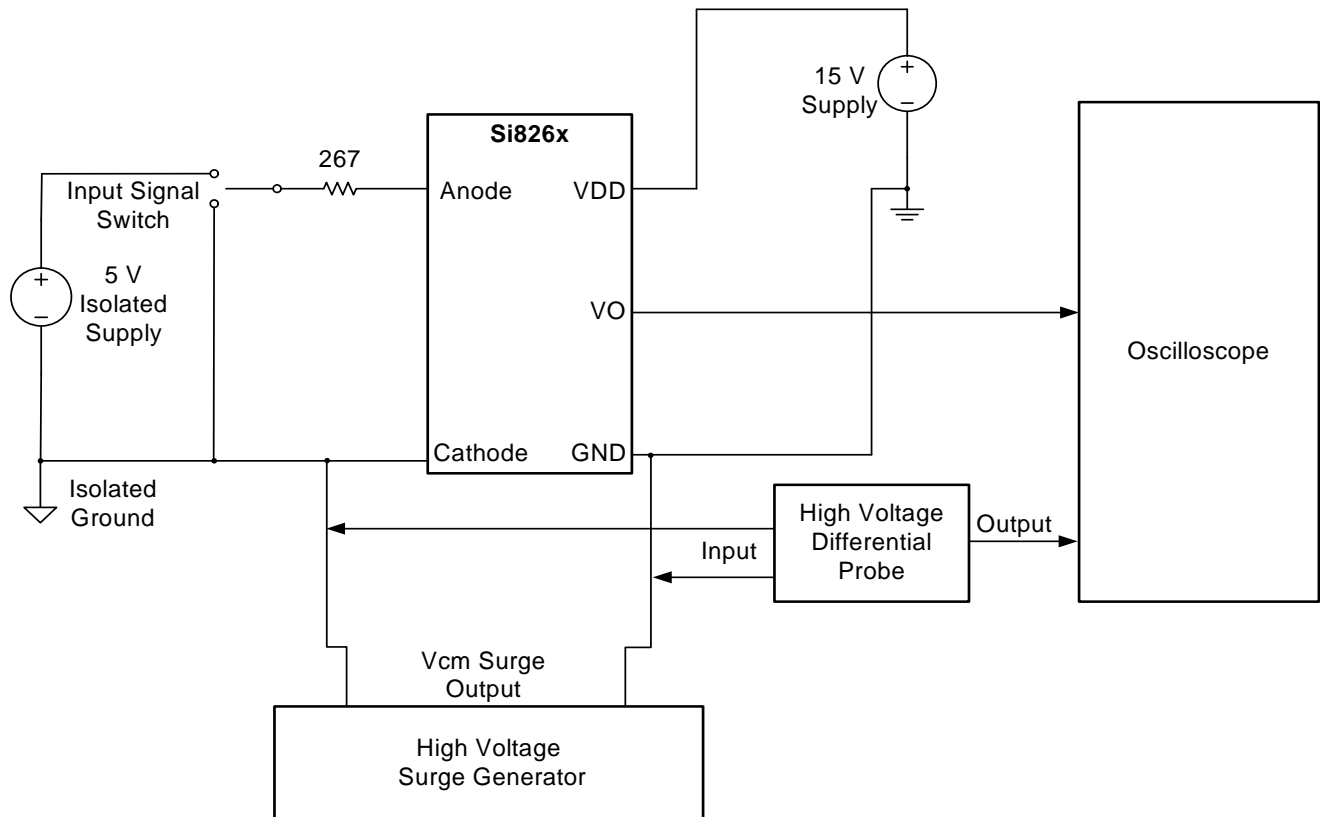


Figure 4. Common Mode Transient Immunity Characterization Circuit

2. Regulatory Information

Table 3. Regulatory Information*

| CSA | |
|--|--|
| The Si826x is certified under CSA Component Acceptance Notice 5A. For more details, see File 232873. | |
| 61010-1: Up to 600 V _{RMS} reinforced insulation working voltage; up to 600 V _{RMS} basic insulation working voltage. | |
| 60950-1: Up to 1000 V _{RMS} reinforced insulation working voltage; up to 1000 V _{RMS} basic insulation working voltage. | |
| 60601-1: Up to 250 V _{RMS} reinforced insulation working voltage; up to 500 V _{RMS} basic insulation working voltage. | |
| VDE | |
| The Si826x is certified according to IEC60747 and VDE0884. For more details, see File 5006301-4880-0001. | |
| 60747-5-5: Up to 1414 V _{peak} for basic insulation working voltage. | |
| VDE0884 Part 10: Up to 1414 V _{peak} for reinforced insulation working voltage. | |
| UL | |
| The Si826x is certified under UL1577 component recognition program. For more details, see File E257455. | |
| Rated up to 5000 V _{RMS} isolation voltage for basic protection. | |
| CQC | |
| The Si826x is certified under GB4943.1-2011. For more details, see File V2012CQC001041. | |
| Rated up to 1000 V _{RMS} reinforced insulation working voltage; up to 1000 V _{RMS} basic insulation working voltage. | |
| <p>*Note: Regulatory Certifications apply to 3.75 kV_{RMS} rated devices which are production tested to 4.5 kV_{RMS} for 1 sec. Regulatory Certifications apply to 5.0 kV_{RMS} rated devices which are production tested to 6.0 kV_{RMS} for 1 sec. For more information, see "8.Ordering Guide" on page 23.</p> | |

Table 4. Insulation and Safety-Related Specifications

| Parameter | Symbol | Test Condition | Value | | | | Unit |
|--|-----------------|----------------|------------------|------------------|------------------|------------------|------|
| | | | SOIC-8 | DIP8 | SDIP6 | LGA8 | |
| Nominal Air Gap (Clearance) | L(IO1) | | 4.7 min | 7.2 min | 9.6 min | 10.0 min | mm |
| Nominal External Tracking (Creepage) | L(IO2) | | 3.9 min | 7.0 min | 8.3 min | 10.0 min | mm |
| Minimum Internal Gap (Internal Clearance) | | | 0.016 | 0.016 | 0.016 | 0.016 | mm |
| Tracking Resistance (Proof Tracking Index) | PTI | IEC60112 | 600 | 600 | 600 | 600 | V |
| Erosion Depth | ED | | 0.031 | 0.031 | 0.057 | 0.021 | mm |
| Resistance (Input-Output)* | R _{IO} | | 10 ¹² | 10 ¹² | 10 ¹² | 10 ¹² | Ω |
| Capacitance (Input-Output)* | C _{IO} | f = 1 MHz | 1 | 1 | 1 | 1 | pF |
| <p>*Note: To determine resistance and capacitance, the Si826x is converted into a 2-terminal device. Pins 1–4 (1–3, SDIP6) are shorted together to form the first terminal, and pins 5–8 (4–6, SDIP6) are shorted together to form the second terminal. The parameters are then measured between these two terminals.</p> | | | | | | | |

Table 5. IEC 60664-1 (VDE 0844 Part 2) Ratings

| Parameter | Test Conditions | Specification | | | |
|-----------------------------|--|---------------|-------|-------|-------|
| | | SOIC-8 | DIP8 | SDIP6 | LGA8 |
| Basic Isolation Group | Material Group | I | I | I | I |
| Installation Classification | Rated Mains Voltages $\leq 150 V_{RMS}$ | I-IV | I-IV | I-IV | I-IV |
| | Rated Mains Voltages $\leq 300 V_{RMS}$ | I-IV | I-IV | I-IV | I-IV |
| | Rated Mains Voltages $\leq 450 V_{RMS}$ | I-III | I-III | I-IV | I-IV |
| | Rated Mains Voltages $\leq 600 V_{RMS}$ | I-III | I-III | I-IV | I-IV |
| | Rated Mains Voltages $\leq 1000 V_{RMS}$ | — | — | — | I-III |

Table 6. IEC 60747-5-5 Insulation Characteristics*

| Parameter | Symbol | Test Condition | Characteristic | | | | Unit |
|---|------------|---|----------------|---------|---------|---------|----------|
| | | | SOIC-8 | DIP8 | SDIP6 | LGA8 | |
| Maximum Working Insulation Voltage | V_{IORM} | | 630 | 891 | 1140 | 1414 | V peak |
| Input to Output Test Voltage | V_{PR} | Method b1 ($V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test, $t_m = 1$ sec, Partial Discharge < 5 pC) | 1181 | 1671 | 2138 | 2652 | V peak |
| Transient Overvoltage | V_{IOTM} | $t = 60$ sec | 6000 | 6000 | 8000 | 8000 | V peak |
| Surge Voltage | V_{IOSM} | 1.2 μ s rise, 50 μ s fall 50% | 10 | 10 | 10 | 10 | kV peak |
| Pollution Degree (DIN VDE 0110, Table 1) | | | 2 | 2 | 2 | 2 | |
| Insulation Resistance at T_S , $V_{IO} = 500$ V | R_S | | $>10^9$ | $>10^9$ | $>10^9$ | $>10^9$ | Ω |

***Note:** This isolator is suitable for reinforced electrical isolation only within the safety limit data. Maintenance of the safety data is ensured by protective circuits. The Si826x provides a climate classification of 40/125/21.

Table 7. IEC Safety Limiting Values*

| Parameter | Symbol | Test Condition | Max | | | | Unit |
|------------------|--------|---|--------|------|-------|------|-------------|
| | | | SOIC-8 | DIP8 | SDIP6 | LGA8 | |
| Case Temperature | T_S | | 140 | 140 | 140 | 140 | $^{\circ}C$ |
| Input Current | I_S | $\theta_{JA} = 110$ $^{\circ}C/W$ (SOIC-8), 110 $^{\circ}C/W$ (DIP8), 105 $^{\circ}C/W$ (SDIP6), 220 $^{\circ}C$ (LGA8), $V_F = 2.8$ V, $T_J = 140$ $^{\circ}C$, $T_A = 25$ $^{\circ}C$ | 370 | 370 | 390 | 185 | mA |
| Output Power | P_S | | 1 | 1 | 1 | 0.5 | W |

***Note:** Maximum value allowed in the event of a failure; also see the thermal derating curve in Figures 5, 6, 7, and 8.

Table 8. Thermal Characteristics

| Parameter | Symbol | Typ | | | | Unit |
|---------------------------------------|---------------|--------|------|-------|------|-----------------------------|
| | | SOIC-8 | DIP8 | SDIP6 | LGA8 | |
| IC Junction-to-Air Thermal Resistance | θ_{JA} | 110 | 110 | 105 | 220 | $^{\circ}\text{C}/\text{W}$ |

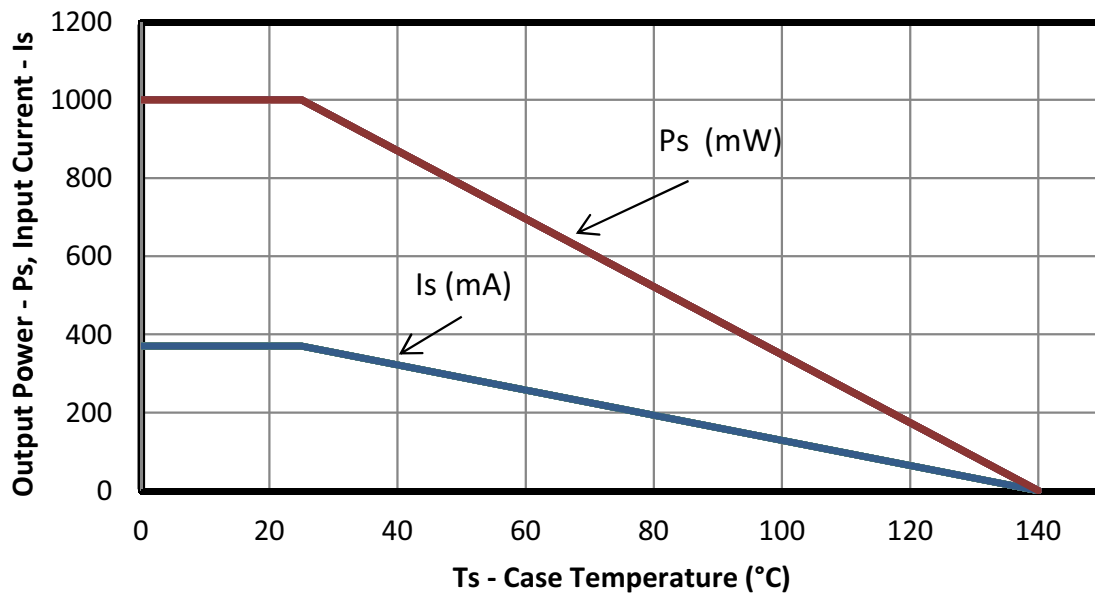


Figure 5. (SOIC-8) Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-5 and VDE0884 part 10

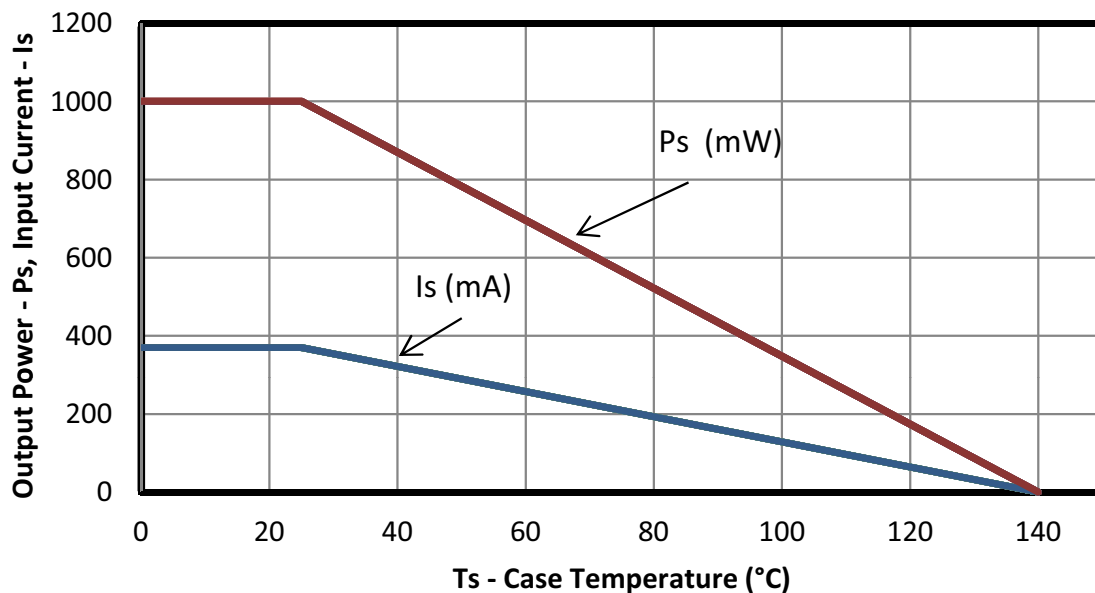


Figure 6. (DIP8) Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-5 and VDE0884 part 10

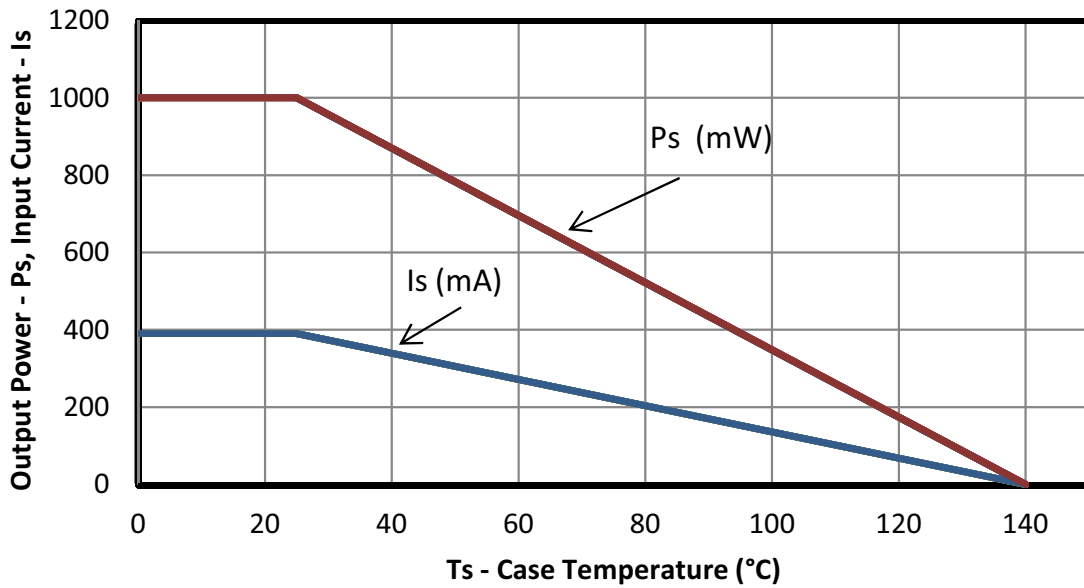


Figure 7. (SDIP6) Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-5 and VDE0884 part 10

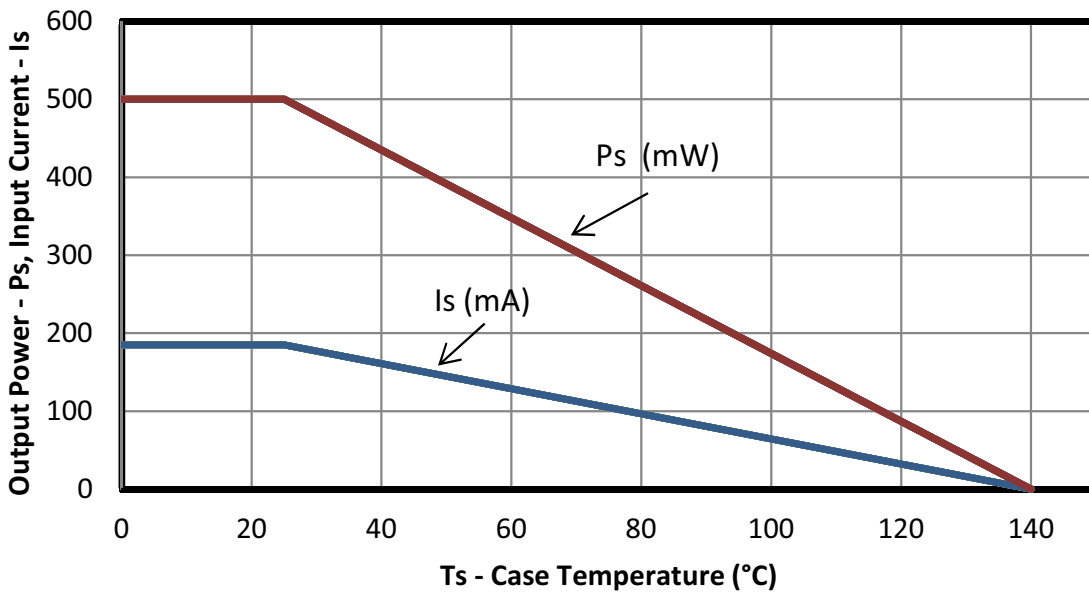


Figure 8. (LGA8) Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN EN 60747-5-5 and VDE0884 part 10

Table 9. Absolute Maximum Ratings*

| Parameter | Symbol | Min | Max | Units |
|---|--------------|------|------|-----------|
| Storage Temperature | T_{STG} | -65 | +150 | °C |
| Operating Temperature | T_A | -40 | +125 | °C |
| Junction Temperature | T_J | — | +140 | °C |
| Average Forward Input Current | $I_{F(AVG)}$ | — | 30 | mA |
| Peak Transient Input Current ($< 1 \mu s$ pulse width, 300 ps) | I_{FTR} | — | 1 | A |
| Peak Output Current ($t_{PW} = 10 \mu s$) (Si826xA) | I_{OPK} | — | 0.6 | A |
| Peak Output Current ($t_{PW} = 10 \mu s$) (Si826xB) | I_{OPK} | — | 4.0 | A |
| Reverse Input Voltage | V_R | — | 0.3 | V |
| Supply Voltage | VDD | -0.5 | 36 | V |
| Output Voltage | V_{OUT} | -0.5 | 36 | V |
| Output Current | $I_{O(AVG)}$ | — | 10 | mA |
| Input Power Dissipation | P_I | — | 75 | mW |
| Output Power Dissipation | P_O | — | 225 | mW |
| Total Power Dissipation (all packages limited by thermal derating curve) | P_T | — | 300 | mW |
| Lead Solder Temperature (10 s) | | — | 260 | °C |
| HBM Rating ESD | | 4 | — | kV |
| Machine Model ESD | | 300 | — | V |
| CDM | | 2000 | — | V |
| Maximum Isolation Voltage (1 s) SOIC-8 | | — | 4500 | V_{RMS} |
| Maximum Isolation Voltage (1 s) DIP8 | | — | 6500 | V_{RMS} |
| Maximum Isolation Voltage (1 s) SDIP6 | | — | 6500 | V_{RMS} |
| Maximum Isolation Voltage (1 s) LGA8 | | — | 6500 | V_{RMS} |
| *Note: Permanent device damage may occur if the absolute maximum ratings are exceeded. Functional operation should be restricted to the conditions specified in the operational sections of this data sheet. | | | | |

3. Functional Description

3.1. Theory of Operation

The Si826x is a functional upgrade for popular opto-isolated drivers, such as the Avago HPCL-3120, HPCL-0302, Toshiba TLP350, and others. The operation of an Si826x 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. The Si826x also includes a noise filter that suppresses propagation of any pulse narrower than 15 ns. A simplified block diagram for the Si826x is shown in Figure 9.

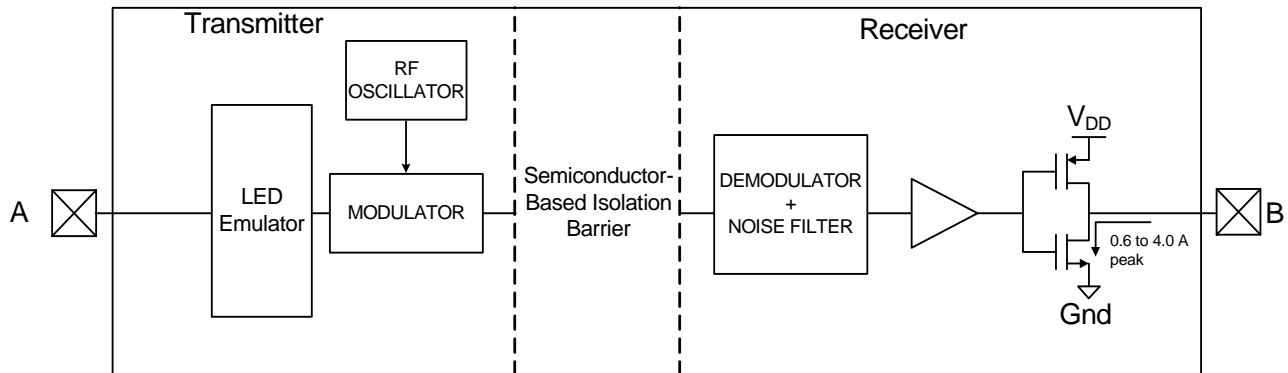


Figure 9. Simplified Channel Diagram

4. Technical Description

4.1. Device Behavior

Truth tables for the Si826x are summarized in Table 10.

Table 10. Si826x Truth Table Summary*

| Input | V _{DD} | V _O |
|-------|-----------------|----------------|
| OFF | > UVLO | LOW |
| OFF | < UVLO | LOW |
| ON | > UVLO | HIGH |
| ON | < UVLO | LOW |

*Note: This truth table assumes V_{DD} is powered. If V_{DD} is below UVLO, see "4.3. Under Voltage Lockout (UVLO)" on page 16 for more information.

4.2. Device Startup

Output V_O is held low during power-up until V_{DD} rises above the UVLO+ threshold for a minimum time period of t_{START}. Following this, the output is high when the current flowing from anode to cathode is > I_{F(ON)}. Device startup, normal operation, and shutdown behavior is shown in Figure 10.

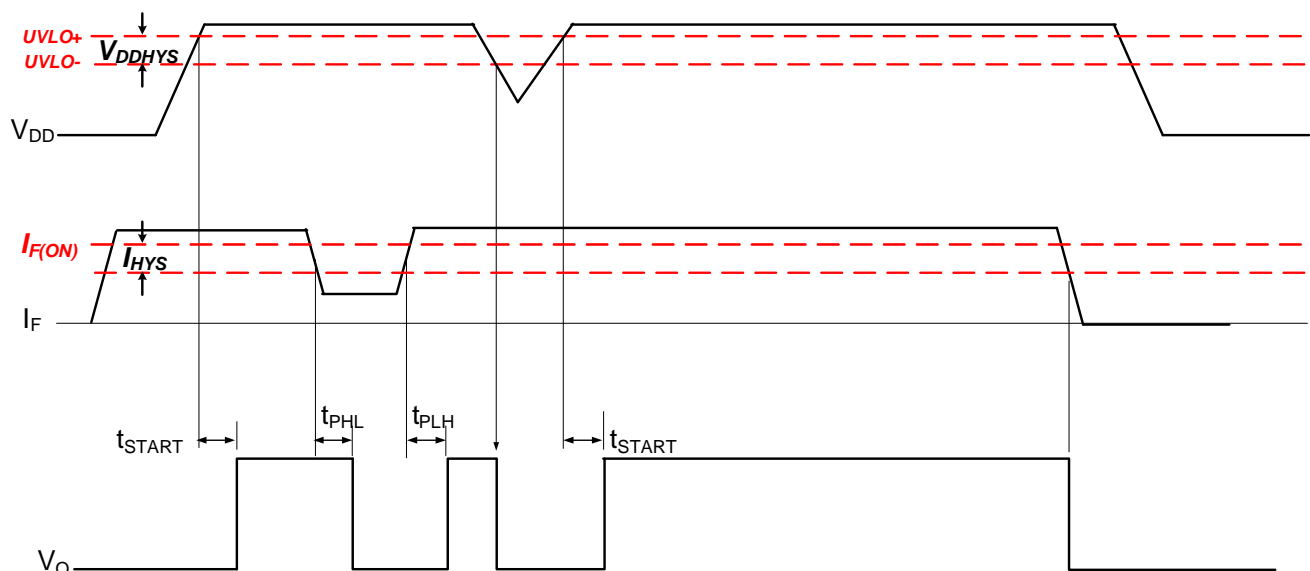


Figure 10. Si826x Operating Behavior ($I_F \geq I_{F(MIN)}$ when $V_F \geq V_{F(MIN)}$)

4.3. Under Voltage Lockout (UVLO)

The UVLO circuit unconditionally drives V_O low when V_{DD} is below the lockout threshold. Referring to Figures 11 through 13, upon power up, the Si826x is maintained in UVLO until V_{DD} rises above $V_{DD_{UV+}}$. During power down, the Si826x enters UVLO when V_{DD} falls below the UVLO threshold plus hysteresis (i.e., $V_{DD} \leq V_{DD_{UV+}} - V_{DD_{HYS}}$).

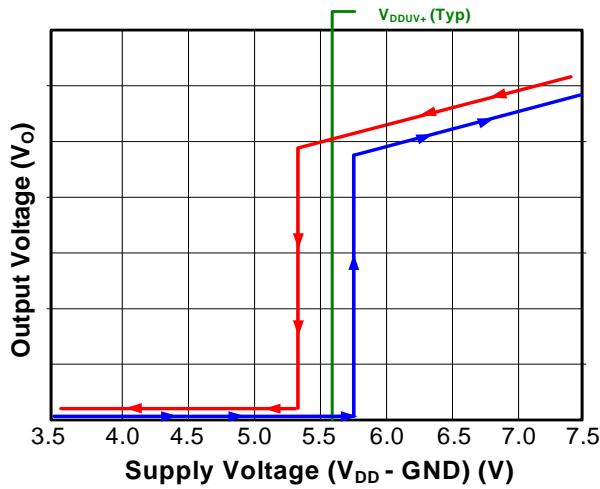


Figure 11. Si826xxAx UVLO Response (5 V)

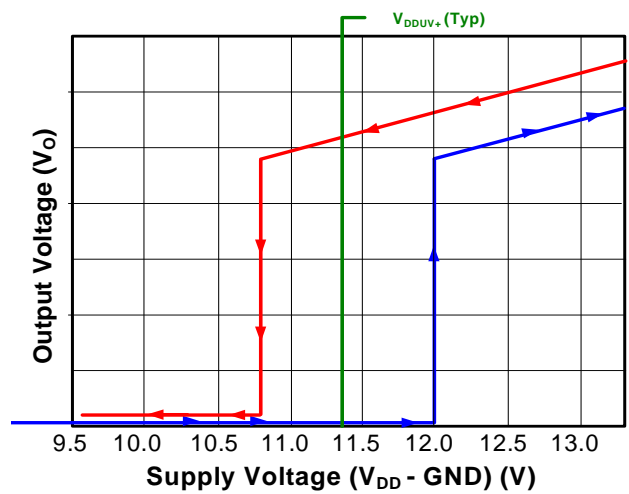


Figure 13. Si826xxCx UVLO Response (12 V)

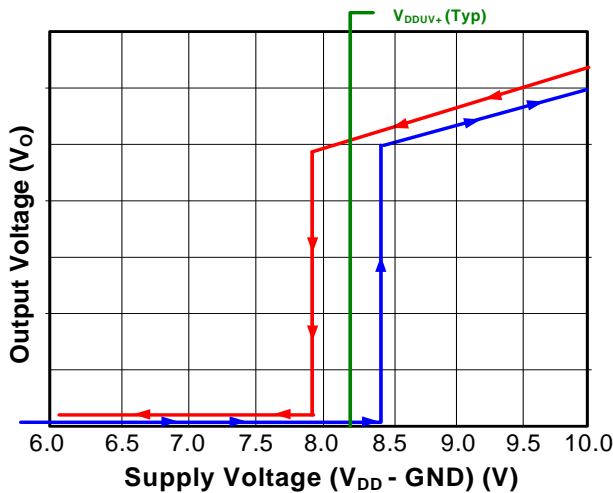


Figure 12. Si826xxBX UVLO Response (8 V)

5. Applications

The following sections detail the input and output circuits necessary for proper operation. Power dissipation and layout considerations are also discussed.

5.1. Input Circuit Design

Opto driver manufacturers typically recommend the circuits shown in Figures 14 and 15. These circuits are specifically designed to improve opto-coupler input common-mode rejection and increase noise immunity.

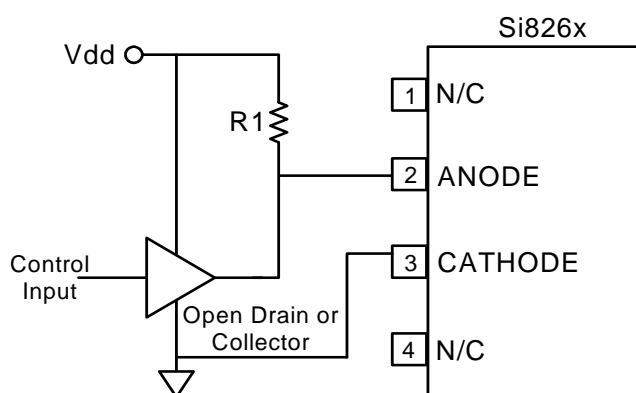


Figure 14. Si826x Input Circuit

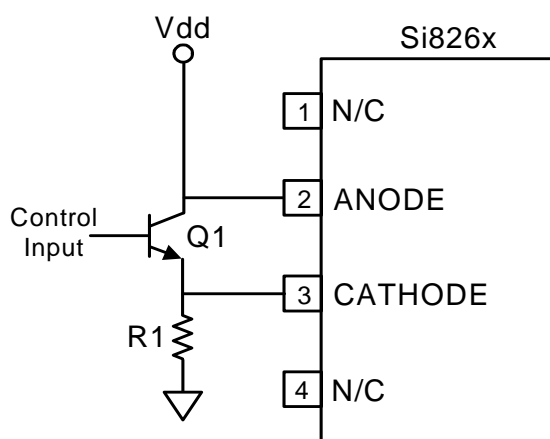


Figure 15. High CMR Si826x Input Circuit

The optically-coupled driver circuit of Figure 14 turns the LED on when the control input is high. However, internal capacitive coupling from the LED to the power and ground conductors can momentarily force the LED into its off state when the anode and cathode inputs are subjected to a high common-mode transient. The circuit shown in Figure 15 addresses this issue by using a value of R1 sufficiently low to overdrive the LED, ensuring it remains on during an input common-mode transient. Q1 shorts the LED off in the low output state, again increasing common-mode transient immunity.

Some opto driver applications recommend reverse-biasing the LED when the control input is off to prevent coupled noise from energizing the LED. The Si826x input circuit requires less current and has twice the off-state noise margin compared to opto couplers. However, high CMR opto coupler designs that overdrive the LED (see Figure 15) may require increasing the value of R1 to limit input current I_F to its maximum rating when using the Si826x. In addition, there is no benefit in driving the Si826x input diode into reverse bias when in the off state. Consequently, opto coupler circuits using this technique should either leave the negative bias circuitry unpopulated

Si826x

or modify the circuitry (e.g., add a clamp diode or current limiting resistor) to ensure that the anode pin of the Si826x is no more than -0.3 V with respect to the cathode when reverse-biased.

New designs should consider the input circuit configurations of Figure 16, which are more efficient than those of Figures 14 and 15. As shown, S1 and S2 represent any suitable switch, such as a BJT or MOSFET, analog transmission gate, processor I/O, etc. Also, note that the Si826x input can be driven from the I/O port of any MCU or FPGA capable of sourcing a minimum of 6 mA (see Figure 16B). Additionally, note that the Si826x propagation delay and output drive do not significantly change for values of I_F between $I_{F(\text{MIN})}$ and $I_{F(\text{MAX})}$.

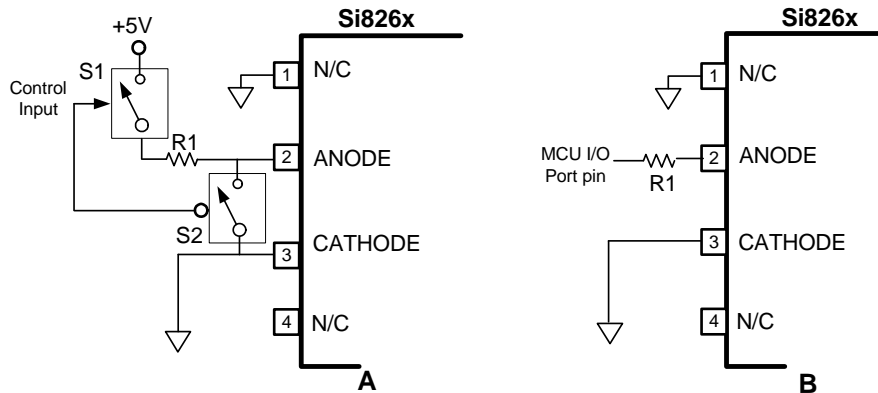


Figure 16. Si826x Other Input Circuit Configurations

5.2. Output Circuit Design

GND can be biased at, above, or below ground as long as the voltage on V_{DD} with respect to GND is a maximum of 30 V . V_{DD} decoupling capacitors should be placed as close to the package pins as possible. The optimum values for these capacitors depend on load current and the distance between the chip and its power source. It is recommended that 0.1 and $10\text{ }\mu\text{F}$ bypass capacitors be used to reduce high-frequency noise and maximize performance.

5.3. Layout Considerations

It is most important to minimize ringing in the drive path and noise on the V_{DD} lines. Care must be taken to minimize parasitic inductance in these paths by locating the Si826x as close as possible to the device it is driving. In addition, the V_{DD} supply and ground trace paths must be kept short. For this reason, the use of power and ground planes is highly recommended. A split ground plane system having separate ground and V_{DD} planes for power devices and small signal components provides the best overall noise performance.

5.4. Power Dissipation Considerations

Proper system design must assure that the Si826x operates within safe thermal limits across the entire load range. The Si826x total power dissipation is the sum of the power dissipated by bias supply current, internal switching losses, and power delivered to the load, as shown in Equation 1.

$$P_D = I_F \times V_F \times DC + V_{DD} \times [I_{DDQ} + (Q_d + C_L \times V_{DD}) \times f]$$

where: P_D is the total device power dissipation (W)

I_F is the diode current (30 mA max)

V_F is the diode anode to cathode voltage (2.8 V max)

DC is duty cycle (0.5 typical)

V_{DD} is the driver-side supply voltage (30 V max)

I_{DDQ} is the driver maximum bias current (2.5 mA)

Q_d is 3 nC

C_L is the load capacitance

f is the switching frequency (Hz)

Equation 1.

The maximum allowable power dissipation for the Si826x is a function of the package thermal resistance, ambient temperature, and maximum allowable junction temperature, as shown in Equation 2.

$$P_{Dmax} \leq \frac{T_{jmax} - T_A}{\theta_{ja}}$$

where:

P_{Dmax} is the maximum allowable power dissipation (W)

T_{jmax} is the maximum junction temperature (140 °C)

T_A is the ambient temperature (°C)

θ_{ja} is the package junction-to-air thermal resistance (110 °C/W)

Equation 2.

Substituting values for P_{Dmax} , T_{jmax} , T_A , and θ_{ja} into Equation 2 results in a maximum allowable total power dissipation of 1.0 W. Note that the maximum allowable load is found by substituting this limit and the appropriate datasheet values from Table 2 on page 4 into Equation 1 and simplifying. Graphs are shown in Figures 17 and 18. All points along the load lines in these graphs represent the package dissipation-limited value of C_L for the corresponding switching frequency.

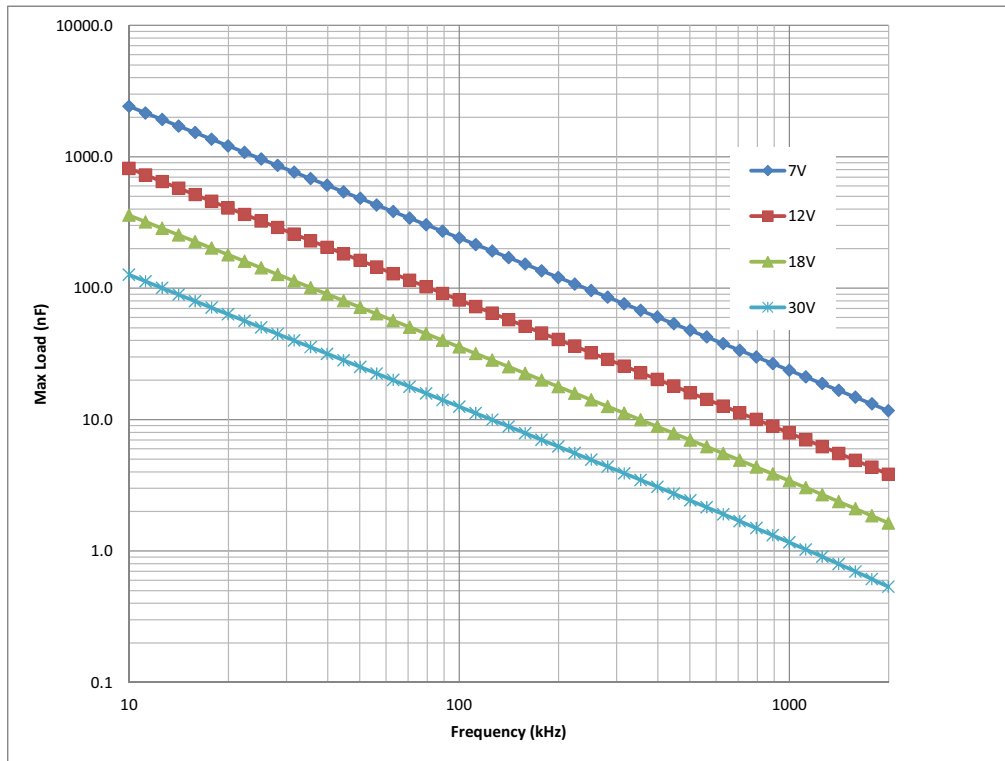


Figure 17. (SOIC-8, DIP8, SDIP6) Maximum Load vs. Switching Frequency (25 °C)

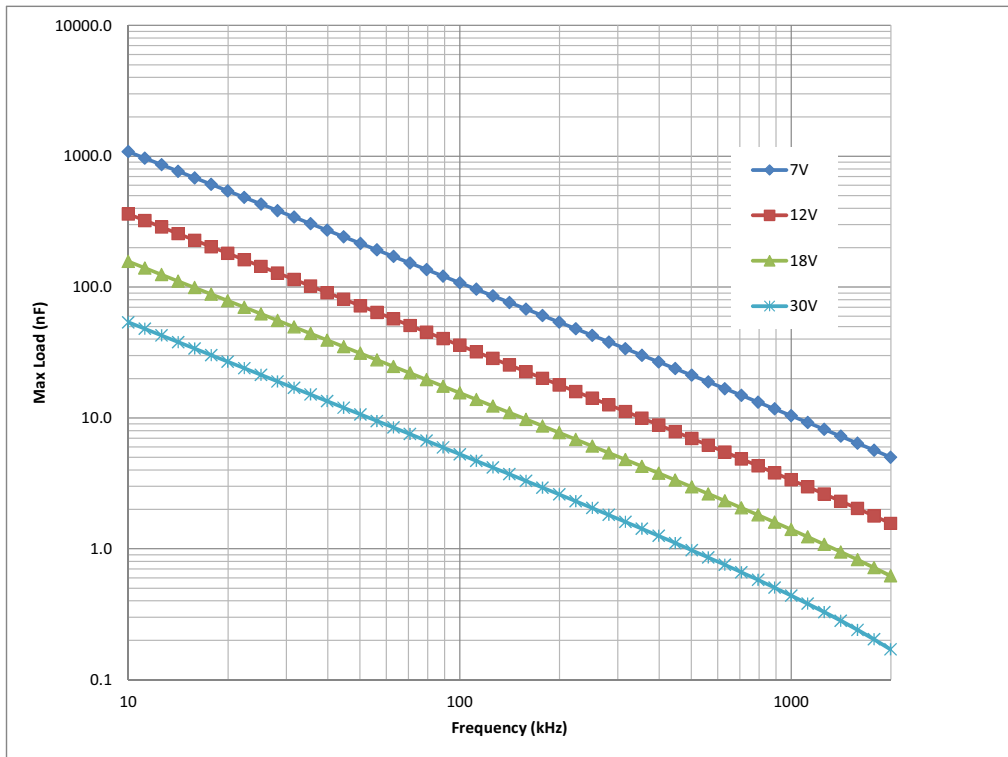


Figure 18. (LGA8) Maximum Load vs. Switching Frequency (25 °C)

6. Pin Descriptions (SOIC-8, DIP8, LGA8)

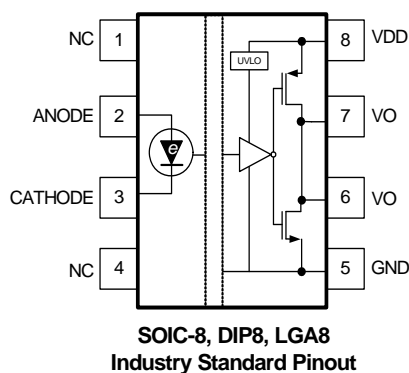


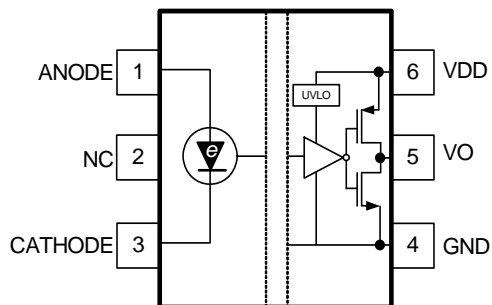
Figure 19. Pin Configuration

Table 11. Pin Descriptions (SOIC-8, DIP8, LGA8)

| Pin | Name | Description |
|-----|----------|---|
| 1 | NC* | No connect. |
| 2 | ANODE | Anode of LED emulator. V_O follows the signal applied to this input with respect to the CATHODE input. |
| 3 | CATHODE | Cathode of LED emulator. V_O follows the signal applied to ANODE with respect to this input. |
| 4 | NC* | No connect. |
| 5 | GND | External MOSFET source connection and ground reference for V_{DD} . This terminal is typically connected to ground but may be tied to a negative or positive voltage. |
| 6 | V_O | Output signal. Both V_O pins are required to be shorted together for 4.0 A compliance. |
| 7 | V_O | Output signal. Both V_O pins are required to be shorted together for 4.0 A compliance. |
| 8 | V_{DD} | Output-side power supply input referenced to GND (30 V max). |

***Note:** No Connect. These pins are not internally connected. To maximize CMTI performance, these pins should be connected to the ground plane.

7. Pin Descriptions (SDIP6)



SDIP6
Industry Standard Pinout

Figure 20. Pin Configuration

Table 12. Pin Descriptions (SDIP6)

| Pin | Name | Description |
|-----|----------|---|
| 1 | ANODE | Anode of LED emulator. V_O follows the signal applied to this input with respect to the CATHODE input. |
| 2 | NC* | No connect. |
| 3 | CATHODE | Cathode of LED emulator. V_O follows the signal applied to ANODE with respect to this input. |
| 4 | GND | External MOSFET source connection and ground reference for V_{DD} . This terminal is typically connected to ground but may be tied to a negative or positive voltage. |
| 5 | V_O | Output signal. |
| 6 | V_{DD} | Output-side power supply input referenced to GND (30 V max). |

***Note:** No Connect. These pins are not internally connected. To maximize CMTI performance, these pins should be connected to the ground plane.

8. Ordering Guide

Table 13. Si826x Ordering Guide^{1,2,3}

| New Ordering Part Number (OPN) | Ordering Options | | | | | |
|--------------------------------|----------------------|----------------------|--------------|-------------------|----------------|----------|
| | Output Configuration | Cross Reference | UVLO Voltage | Insulation Rating | Temp Range | Pkg Type |
| Si8261AAC-C-IS (Sampling) | 0.6 A driver | HCPL-0314 | 5 V | 3.75 kVrms | –40 to +125 °C | SOIC-8 |
| Si8261BAC-C-IS (Sampling) | 4.0 A driver | — | 5 V | 3.75 kVrms | –40 to +125 °C | SOIC-8 |
| Si8261AAC-C-IP (Sampling) | 0.6 A driver | HCPL-3140 | 5 V | 3.75 kVrms | –40 to +125 °C | DIP8/GW |
| Si8261BAC-C-IP (Sampling) | 4.0 A driver | TLP 350 HCPL-3120 | 5 V | 3.75 kVrms | –40 to +125 °C | DIP8/GW |
| Si8261AAD-C-IS (Sampling) | 0.6 A driver | ACPL-W314 | 5 V | 5.0 kVrms | –40 to +125 °C | SDIP6 |
| Si8261BAD-C-IS (Sampling) | 4.0 A driver | TLP 700F | 5 V | 5.0 kVrms | –40 to +125 °C | SDIP6 |
| Si8261AAD-C-IM (Sampling) | 0.6 A driver | — | 5 V | 5.0 kVrms | –40 to +125 °C | LGA8 |
| Si8261BAD-C-IM (Sampling) | 4.0 A driver | HCNW-3120 | 5 V | 5.0 kVrms | –40 to +125 °C | LGA8 |

Notes:

1. All packages are RoHS-compliant. Moisture sensitivity level is MSL3 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.
3. AEC-Q100 qualified.

Table 13. Si826x Ordering Guide^{1,2,3}

| New Ordering Part Number (OPN) | Ordering Options | | | | | |
|--------------------------------|----------------------|----------------------|--------------|-------------------|----------------|----------|
| | Output Configuration | Cross Reference | UVLO Voltage | Insulation Rating | Temp Range | Pkg Type |
| Si8261ABC-C-IS (Sampling) | 0.6 A driver | HCPL-0314 | 8 V | 3.75 kVrms | -40 to +125 °C | SOIC-8 |
| Si8261BBC-C-IS (Sampling) | 4.0 A driver | — | 8 V | 3.75 kVrms | -40 to +125 °C | SOIC-8 |
| Si8261ABC-C-IP (Sampling) | 0.6 A driver | HCPL-3140 | 8 V | 3.75 kVrms | -40 to +125 °C | DIP8/GW |
| Si8261BBC-C-IP (Sampling) | 4.0 A driver | TLP 350 HCPL-3120 | 8 V | 3.75 kVrms | -40 to +125 °C | DIP8/GW |
| Si8261ABD-C-IS (Sampling) | 0.6 A driver | ACPL-W314 | 8 V | 5.0 kVrms | -40 to +125 °C | SDIP6 |
| Si8261BBD-C-IS (Sampling) | 4.0 A driver | TLP 700F | 8 V | 5.0 kVrms | -40 to +125 °C | SDIP6 |
| Si8261ABD-C-IM (Sampling) | 0.6 A driver | — | 8 V | 5.0 kVrms | -40 to +125 °C | LGA8 |
| Si8261BBD-C-IM (Sampling) | 4.0 A driver | HCNW-3120 | 8 V | 5.0 kVrms | -40 to +125 °C | LGA8 |

Notes:

1. All packages are RoHS-compliant. Moisture sensitivity level is MSL3 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.
3. AEC-Q100 qualified.

Table 13. Si826x Ordering Guide^{1,2,3}

| New Ordering Part Number (OPN) | Ordering Options | | | | | |
|--------------------------------|----------------------|----------------------|--------------|-------------------|----------------|----------|
| | Output Configuration | Cross Reference | UVLO Voltage | Insulation Rating | Temp Range | Pkg Type |
| Si8261ACC-C-IS (Sampling) | 0.6 A driver | HCPL-0314 | 12 V | 3.75 kVrms | –40 to +125 °C | SOIC-8 |
| Si8261BCC-C-IS (Sampling) | 4.0 A driver | — | 12 V | 3.75 kVrms | –40 to +125 °C | SOIC-8 |
| Si8261ACC-C-IP (Sampling) | 0.6 A driver | HCPL-3140 | 12 V | 3.75 kVrms | –40 to +125 °C | DIP8/GW |
| Si8261BCC-C-IP (Sampling) | 4.0 A driver | TLP 350 HCPL-3120 | 12 V | 3.75 kVrms | –40 to +125 °C | DIP8/GW |
| Si8261ACD-C-IS (Sampling) | 0.6 A driver | ACPL-W314 | 12 V | 5.0 kVrms | –40 to +125 °C | SDIP6 |
| Si8261BCD-C-IS (Sampling) | 4.0 A driver | TLP 700F | 12 V | 5.0 kVrms | –40 to +125 °C | SDIP6 |
| Si8261ACD-C-IM (Sampling) | 0.6 A driver | — | 12 V | 5.0 kVrms | –40 to +125 °C | LGA8 |
| Si8261BCD-C-IM (Sampling) | 4.0 A driver | HCNW-3120 | 12 V | 5.0 kVrms | –40 to +125 °C | LGA8 |

Notes:

1. All packages are RoHS-compliant. Moisture sensitivity level is MSL3 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.
3. AEC-Q100 qualified.

9. Package Outline: 8-Pin Narrow Body SOIC

Figure 21 illustrates the package details for the Si826x in an 8-pin narrow-body SOIC package. Table 14 lists the values for the dimensions shown in the illustration.

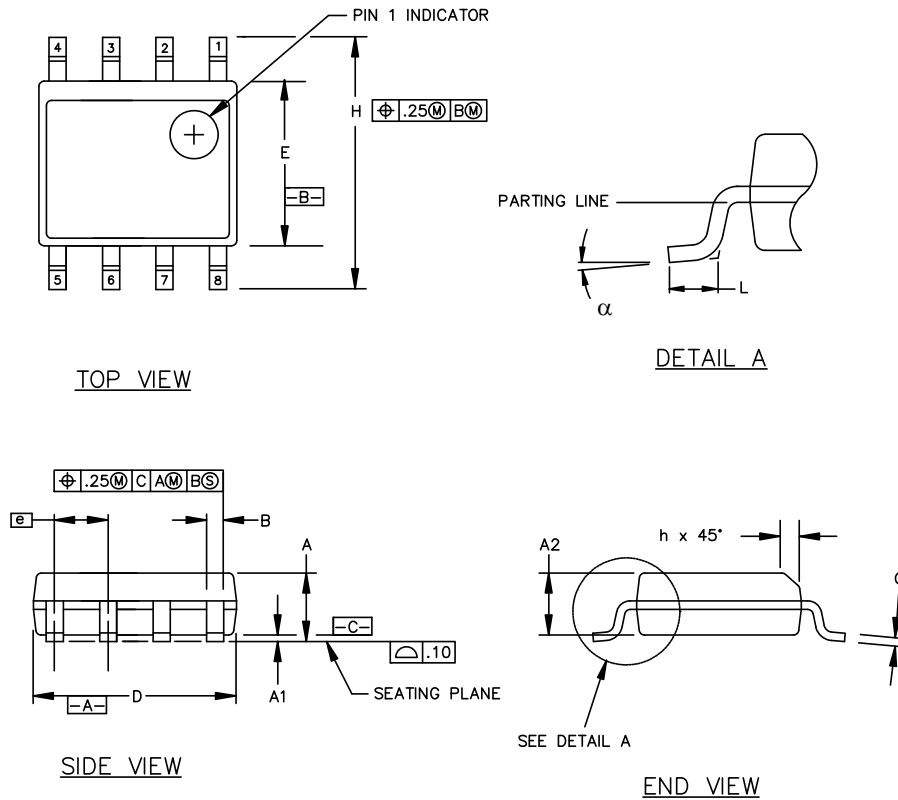


Figure 21. 8-Pin Narrow Body SOIC Package

Table 14. 8-Pin Narrow Body SOIC 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 |
| α | 0° | 8° |

10. Land Pattern: 8-Pin Narrow Body SOIC

Figure 22 illustrates the recommended land pattern details for the Si826x in an 8-pin narrow-body SOIC. Table 15 lists the values for the dimensions shown in the illustration.

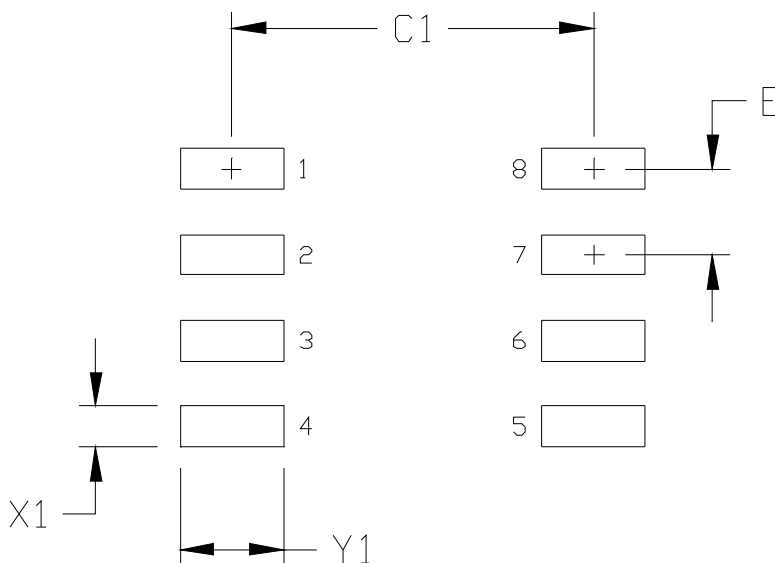


Figure 22. 8-Pin Narrow Body SOIC Land Pattern

Table 15. 8-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 SOIC127P600X173-8N 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.

11. Package Outline: DIP8

Figure 23 illustrates the package details for the Si826x in a DIP8 package. Table 16 lists the values for the dimensions shown in the illustration.

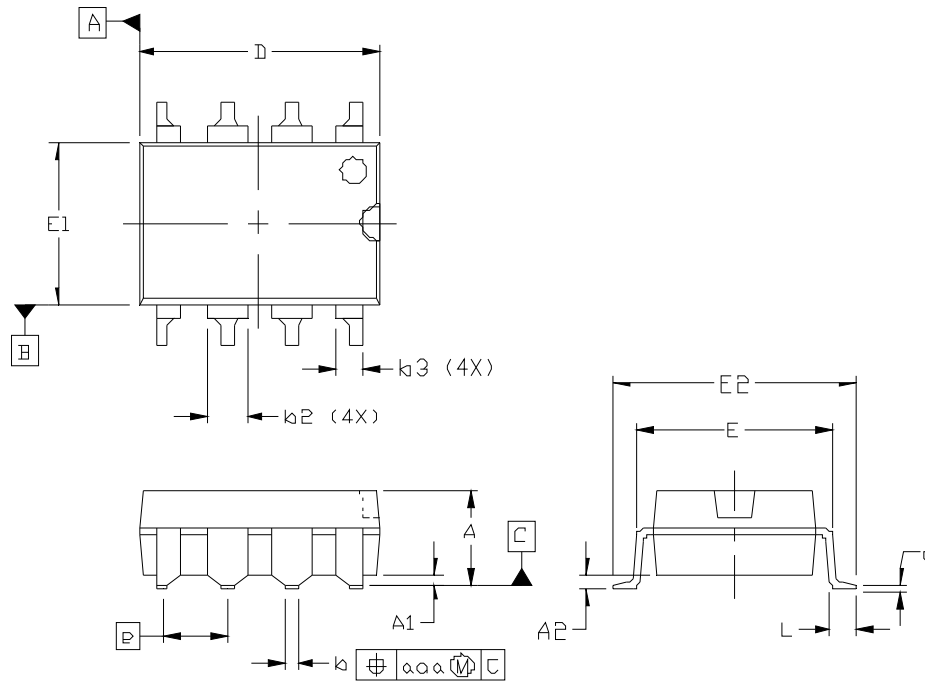


Figure 23. DIP8 Package

Table 16. DIP8 Package Diagram Dimensions

| Dimension | Min | Max |
|-----------|-----------|------|
| A | — | 4.19 |
| A1 | 0.55 | 0.75 |
| A2 | 3.17 | 3.43 |
| b | 0.35 | 0.55 |
| b2 | 1.14 | 1.78 |
| b3 | 0.76 | 1.14 |
| c | 0.20 | 0.33 |
| D | 9.40 | 9.90 |
| E | 7.37 | 7.87 |
| E1 | 6.10 | 6.60 |
| E2 | 9.40 | 9.90 |
| e | 2.54 BSC. | |
| L | 0.38 | 0.89 |
| aaa | — | 0.25 |

Notes:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.

12. Land Pattern: DIP8

Figure 24 illustrates the recommended land pattern details for the Si826x in a DIP8 package. Table 17 lists the values for the dimensions shown in the illustration.

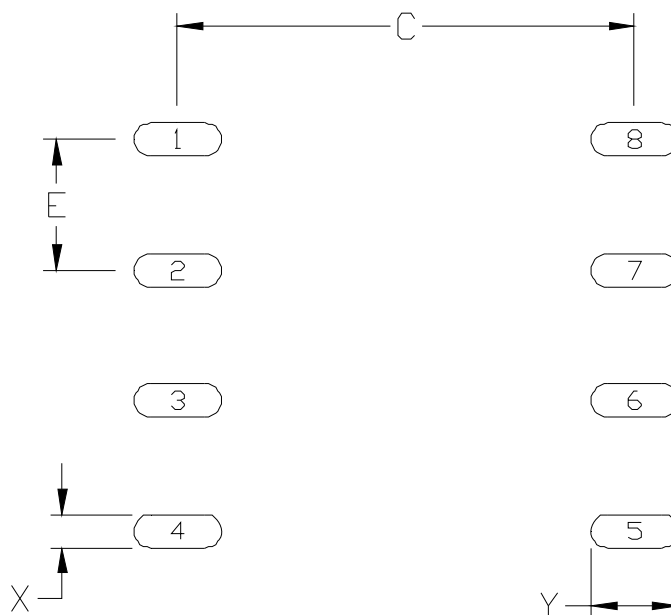


Figure 24. DIP8 Land Pattern

Table 17. DIP8 Land Pattern Dimensions*

| Dimension | Min | Max |
|-----------|----------|------|
| C | 8.85 | 8.90 |
| E | 2.54 BSC | |
| X | 0.60 | 0.65 |
| Y | 1.65 | 1.70 |

***Note:** This Land Pattern Design is based on the IPC-7351 specification.

13. Package Outline: SDIP6

Figure 25 illustrates the package details for the Si826x in an SDIP6 package. Table 18 lists the values for the dimensions shown in the illustration.

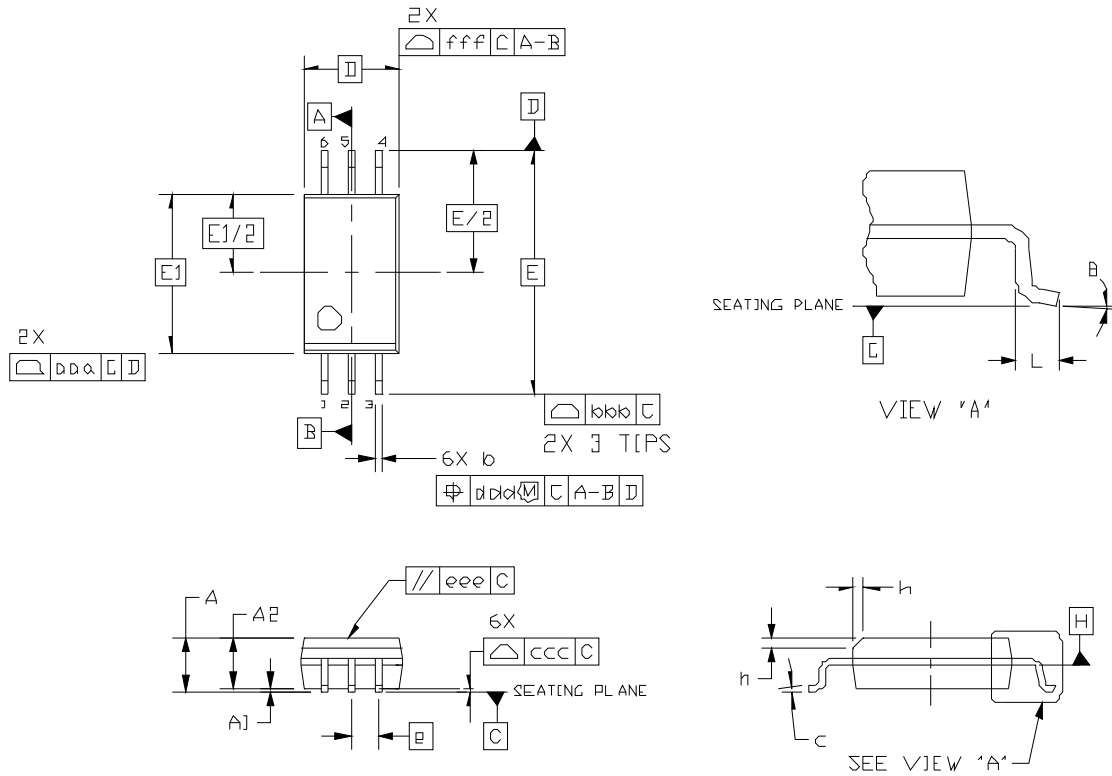


Figure 25. SDIP6 Package

Table 18. SDIP6 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 | 4.58 BSC | |
| E | 11.50 BSC | |
| E1 | 7.50 BSC | |
| e | 1.27 BSC | |
| Notes: | | |
| 1. All dimensions shown are in millimeters (mm) unless otherwise noted. | | |
| 2. Dimensioning and Tolerancing per ANSI Y14.5M-1994. | | |

Table 18. SDIP6 Package Diagram Dimensions (Continued)

| Dimension | Min | Max |
|-----------|------|------|
| L | 0.40 | 1.27 |
| h | 0.25 | 0.75 |
| θ | 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.

14. Land Pattern: SDIP6

Figure 26 illustrates the recommended land pattern details for the Si826x in an SDIP6 package. Table 19 lists the values for the dimensions shown in the illustration.

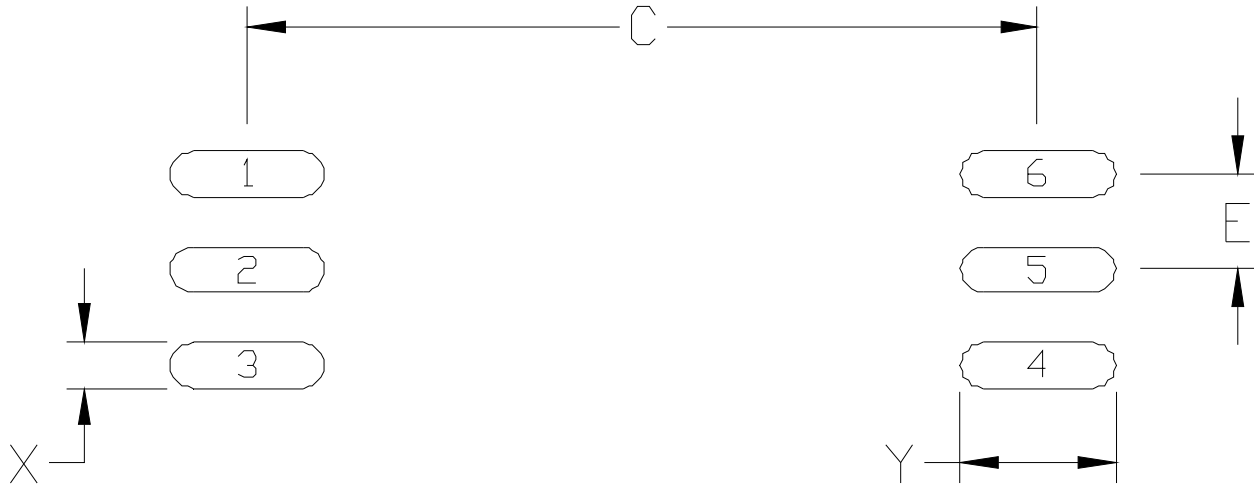


Figure 26. SDIP6 Land Pattern

Table 19. SDIP6 Land Pattern Dimensions*

| Dimension | Min | Max |
|--|----------|-------|
| C | 10.45 | 10.50 |
| E | 1.27 BSC | |
| X | 0.55 | 0.60 |
| Y | 2.00 | 2.05 |
| *Note: This Land Pattern Design is based on the IPC-7351 specification. | | |

15. Package Outline: LGA8

Figure 27 illustrates the package details for the Si826x in an LGA8 package. Table 20 lists the values for the dimensions shown in the illustration.

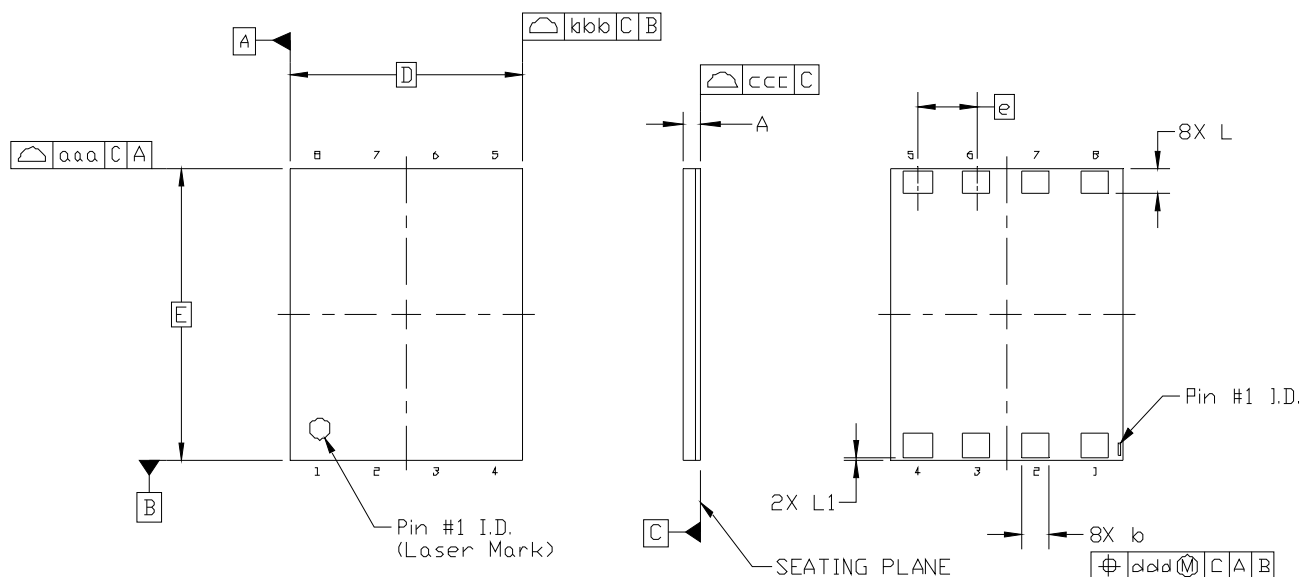


Figure 27. LGA8 Package

Table 20. Package Diagram Dimensions

| Dimension | Min | Nom | Max |
|--|------------|------|------|
| A | 0.74 | 0.84 | 0.94 |
| b | 1.15 | 1.20 | 1.25 |
| D | 10.00 BSC. | | |
| e | 2.54 BSC. | | |
| E | 12.50 BSC. | | |
| L | 1.05 | 1.10 | 1.15 |
| L1 | 0.05 | 0.10 | 0.15 |
| aaa | — | — | 0.10 |
| bbb | — | — | 0.10 |
| ccc | — | — | 0.10 |
| ddd | — | — | 0.10 |
| Notes: | | | |
| 1. All dimensions shown are in millimeters (mm) unless otherwise noted. | | | |
| 2. Dimensioning and Tolerancing per ANSI Y14.5M-1994. | | | |
| 3. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components. | | | |

16. Land Pattern: LGA8

Figure 28 illustrates the recommended land pattern details for the Si826x in an LGA8 package. Table 21 lists the values for the dimensions shown in the illustration.

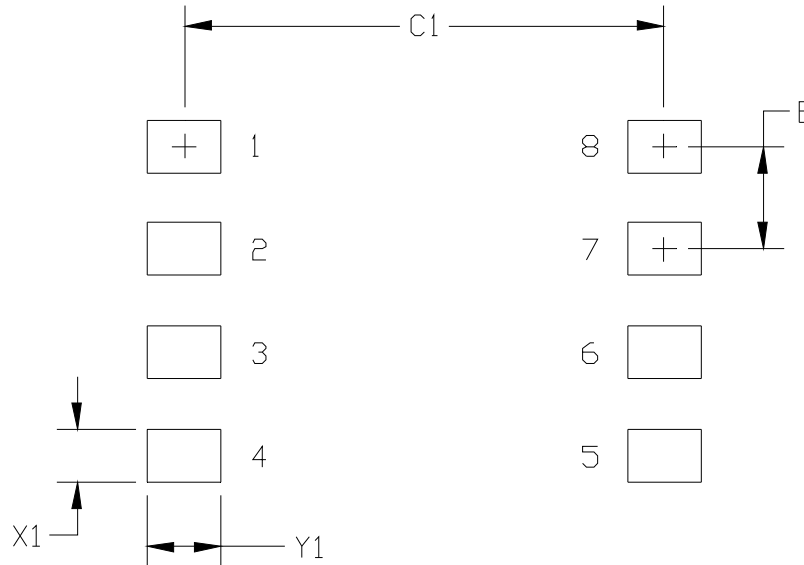


Figure 28. LGA8 Land Pattern

Table 21. LGA8 Land Pattern Dimensions

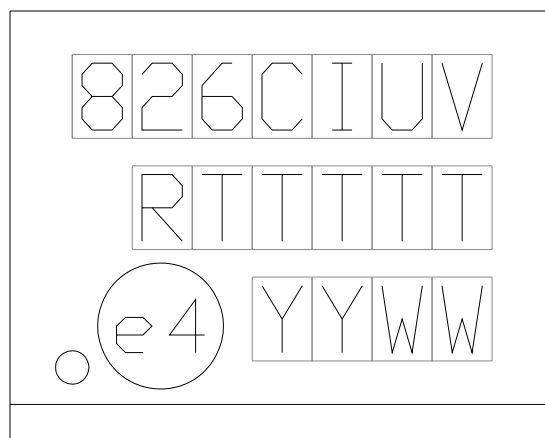
| Dimension | Feature | (mm) |
|-----------|--------------------|-------|
| C1 | Pad Column Spacing | 11.80 |
| E | Pad Row Pitch | 2.54 |
| X1 | Pad Width | 1.30 |
| Y1 | Pad Length | 1.80 |

Notes:

1. This Land Pattern Design is based on IPC-7351 specifications.
2. All feature sizes shown are at Maximum Material Condition (MMC) and a card fabrication tolerance of 0.05 mm is assumed.

17. Top Markings

17.1. Si826x Top Marking (Narrow Body SOIC)

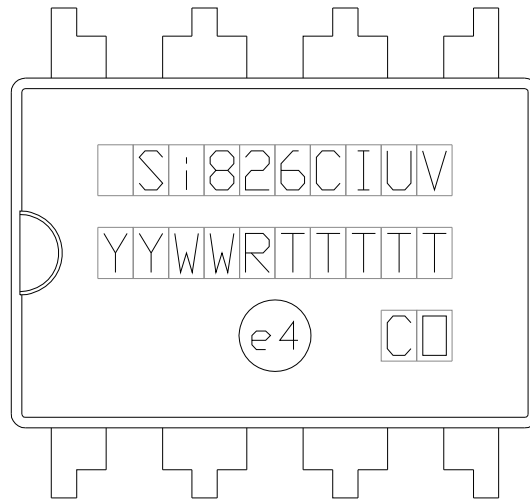


17.2. Top Marking Explanation

| | | |
|------------------------|---|--|
| Line 1 Marking: | Customer Part Number | 826 = ISOdriver product series C = Input configuration 1 = Opto input type I = Peak output current A = 0.6 A; B = 4.0 A U = UVLO level A = 5 V; B = 8 V; C = 12 V V = Isolation rating C = 3.75 kV; D = 5.0 kV |
| Line 2 Marking: | RTTTTT = Mfg Code | Manufacturing Code from the Assembly Purchase Order form. "R" indicates revision. |
| Line 3 Marking: | Circle = 43 mils Diameter Left-Justified | "e4" Pb-Free Symbol |
| | YY = Year WW = Work Week | Assigned by the Assembly House. Corresponds to the year and work week of the mold date. |

Si826x

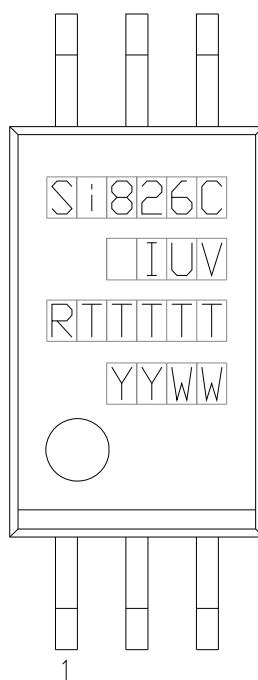
17.3. Si826x Top Marking (DIP8)



17.4. Top Marking Explanation

| | | |
|------------------------|---|--|
| Line 1 Marking: | Customer Part Number | Si826 = ISOdriver product series C = Input configuration 1 = Opto input type I = Peak output current A = 0.6 A; B = 4.0 A U = UVLO level A = 5 V; B = 8 V; C = 12 V V = Isolation rating C = 3.75 kV; D = 5.0 kV |
| Line 2 Marking: | YY = Year WW = Work Week | Assigned by the Assembly House. Corresponds to the year and work week of the mold date. |
| | RTTTTT = Mfg Code | Manufacturing Code from the Assembly Purchase Order form. "R" indicates revision. |
| Line 3 Marking: | Circle = 51 mils Diameter Center-Justified | "e4" Pb-Free Symbol |
| | CO = Country of Origin | Country of Origin ISO Code Abbreviation |

17.5. Si826x Top Marking (SDIP6)

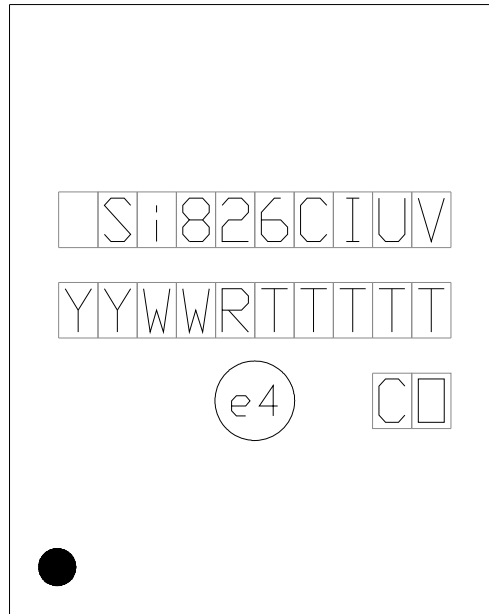


17.6. Top Marking Explanation

| | | |
|------------------------|-----------------------------|--|
| Line 1 Marking: | Device | Si826 = ISOdriver product series C = Input configuration 1 = Opto input type |
| Line 2 Marking: | Device Rating | I = Peak output current A = 0.6 A; B = 4.0 A U = UVLO level A = 5 V; B = 8 V; C = 12 V V = Isolation rating C = 3.75 kV; D = 5.0 kV |
| Line 3 Marking: | RTTTTT = Mfg Code | Manufacturing Code from the Assembly Purchase Order form. "R" indicates revision. |
| Line 4 Marking: | YY = Year WW = Work Week | Assigned by the Assembly House. Corresponds to the year and work week of the mold date. |

Si826x

17.7. Si826x Top Marking (LGA8)



17.8. Top Marking Explanation

| | | |
|------------------------|---|--|
| Line 1 Marking: | Device Part Number | Si826 = ISOdriver product series C = Input configuration 1 = Opto input type I = Peak output current A = 0.6 A; B = 4.0 A U = UVLO level A = 5 V; B = 8 V; C = 12 V V = Isolation rating C = 3.75 kV; D = 5.0 kV |
| Line 2 Marking: | YY = Year WW = Work Week | Assigned by the Assembly House. Corresponds to the year and work week of the assembly release. |
| | RTTTTT = Mfg Code | Manufacturing Code from the Assembly Purchase Order form. "R" indicates revision. |
| Line 3 Marking: | Circle = 1.6 mm Diameter Center-Justified | "e4" Pb-Free Symbol |
| | CO = Country of Origin | Country of Origin ISO Code Abbreviation |
| Line 4 Marking: | Circle = 0.75 mm Diameter Lower Left-Justified | Pin 1 Identifier |

DOCUMENT CHANGE LIST

Revision 0.9 to Revision 1.0

- Updated Table 2 on page 4.
- Added Figure 1 on page 7.
- Updated "3.1.Theory of Operation" on page 14.
- Updated Figures 11, 12, and 13 on page 16.
- Removed "5.5. Parametric Differences between Si826x and HCPL-0302 and HCPL-3120 Opto Drivers" .

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