

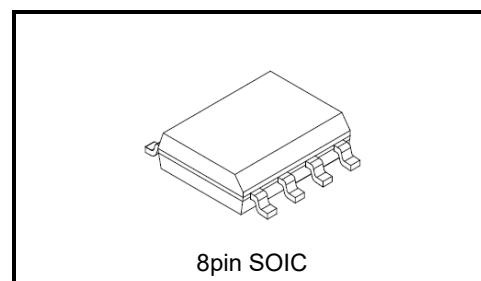
DCM320D00

Dual - channel High speed Logic for Automotive equipment, Default High output

1. Description

The DCM320D00 is a 8-pin SOIC package default High-output, quad-channel high-speed digital isolator with the primary and secondary sides insulated and coupled by a magnetic coupling structure.

With a high isolation voltage of 3000 V_{rms}, it is suitable for control applications such as in-vehicle communication line insulation.



8pin SOIC

Weight: 0.07 g (typ.)

2. Applications

- Battery Control in Automotive Equipment
- Fuel Battery Control in Automotive Equipment
- Application for Electrical Vehicle
- Data Converter Isolation

3. Features

- Data rate : 50 Mbps (Max)
- Default Output : High
- Number of channels : 2 channels (Forward 2 : Revers 0)
- Suitable operating voltage : 3.3 V or 5 V
- Isolation voltage : 3000 V_{rms}
- Common-Mode Transient Immunity : ±100 kV/μs (Typ.)
- Safety standards
 - AEC-Q100 (Grade1 qualified)
 - UL : UL1577 , File No. E519997
 - cUL: CSA Component Acceptance Service Notice No. E519997

Note: Typical test conditions: V_{DD1} = V_{DD2} = 3.3 V or 5 V , T_a = 25 °C; unless otherwise specified.

4. Mechanical Parameters

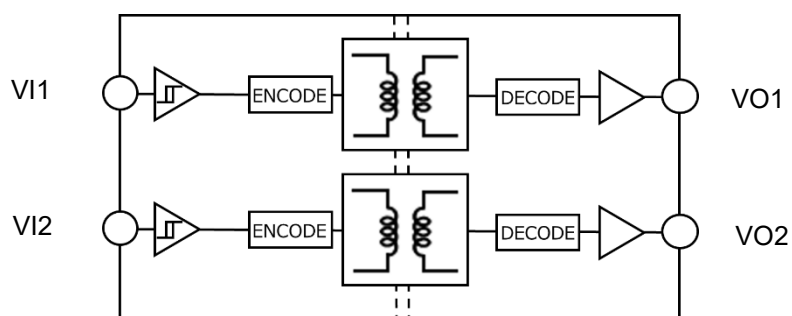
Table 4.1 Mechanical parameters

| Characteristics | Symbol | unit | Unit |
|---------------------------------|--------|-----------|------|
| Creepage distances | CPG | 3.8 (Min) | mm |
| Clearance distances | CLR | 3.8 (Min) | mm |
| Distance Through the Insulation | DTI | 17 | μm |

Start of commercial production
2025-04

5. Block Diagram

DCM320D00



Note: Some of the functional blocks, circuits or constants labels in the block diagram may have been omitted or simplified for clarity.

Figure 5.1 Block Diagram

6. Pin Assignments

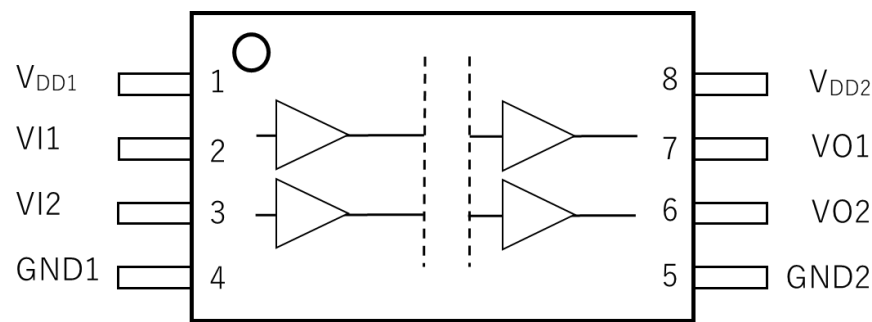


Figure 6.1 Pin Assignments (top view)

7. Pin Description

Table 7.1 Pin Description

| Pin No | Pin name | I/O | Description |
|--------|----------|-----|---------------------------------|
| 1 | VDD1 | — | Power Supply, side 1 |
| 2 | VI1 | IN | Logic Input, Channel1 |
| 3 | VI2 | IN | Logic Input, Channel2 |
| 4 | GND1 | — | GND connection for VDD1, side 1 |
| 5 | GND2 | — | GND connection for VDD2, side 2 |
| 6 | VO2 | OUT | Logic Output, Channel2 |
| 7 | VO1 | OUT | Logic Output, Channel1 |
| 8 | VDD2 | — | Power Supply, side 2 |

8. Functional Description

8.1. Specifications of External Components

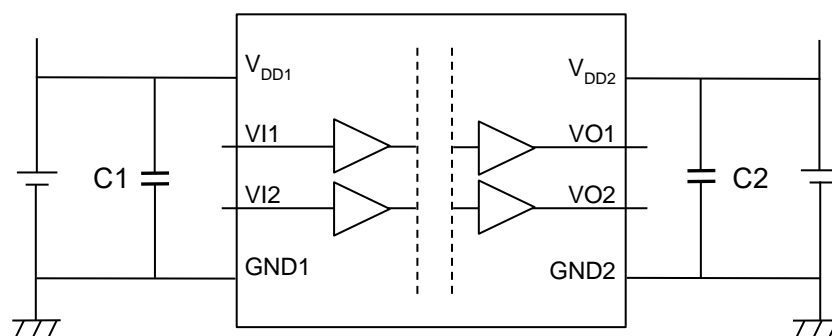


Figure 8.1 Pin Assignments (top view)

Table 8.1 External component specification (Note)

| Component Name | Recommended Value | Pin | Description |
|----------------|-------------------|-----------|-------------|
| C1 | 0.1 μ F | V_{DD1} | — |
| C2 | 0.1 μ F | V_{DD2} | — |

Note: Use Ceramic capacitors (C1,C2) with good high frequency characteristics.

Note: Ceramic capacitors (C1,C2) should be connected between pin 1 (V_{DD1}) and pin 2 (GND1) for V_{DD1} and between pin 16 (V_{DD2}) and pin 15 (GND2) for V_{DD2} , and should be the layout on the IC as close as possible (less than 10mm).

Otherwise, the IC may not switch properly.

8.2. IC Startup Procedure

8.2.1. Functional description

Table 8.2 Pin Functional Description (Note)

| | V _{DDI} Input side V _{DD} | V _{DDO} Output side V _{DD} | Input (VI1 , VI2) | Output (VO1 , VO2) | State Description |
|----------|---|--|------------------------|-------------------------|---|
| 1 | PU | PU | Low | Low | Normal Operation |
| 2 | PU | PU | High | High | Normal Operation |
| 3 | PU | PU | OPEN | High | Default mode |
| 4 | PD | PU | Low or OPEN | High | Default mode |
| 5 | PU | PD | Undetermined | Undetermined | When V _{DD2} is unpowered, a channel output is undetermined. |
| 6 | PD | PD | Low or OPEN | | |

Note: PU = Powered Up (V_{DD} ≥ 2.25 V) , PD = Powered Down (V_{DD} ≤ 1.7 V)

Note: V_{DDI} = Input-side V_{DD}, V_{DDO} = Output-side V_{DD}

9. Absolute Maximum Ratings (Note)

Table 9.1 Absolute Maximum Ratings (Note)

($T_a = 25^\circ\text{C}$ unless otherwise specified)

| Characteristics | Condition | Symbol | Rating | Unit |
|-----------------------------|--|----------------------------------|--|------------------|
| Junction temperature | — | T_J | -40 to 150 | $^\circ\text{C}$ |
| Storage temperature range | — | T_{stg} | -65 to 150 | $^\circ\text{C}$ |
| Operation temperature range | — | T_{opr} | -40 to 125 | $^\circ\text{C}$ |
| Soldering temperature | 10 s | T_{sol} | 260 | $^\circ\text{C}$ |
| Supply voltage (DC) | — | $V_{\text{DD1}}, V_{\text{DD2}}$ | -0.5 to 6.0 | V |
| | | $V_{\text{I1}}, V_{\text{I2}}$ | -0.5 to $V_{\text{DD1}} + 0.5$ (Note 1) | V |
| | | $V_{\text{O1}}, V_{\text{O2}}$ | 0.5 to $V_{\text{DDO}} + 0.5$ (Note 1) | V |
| Output Current | — | I_O | ± 15 | mA |
| Isolation voltage | 1 min | BV_S | 3000 | V _{rms} |
| Output current | $V_{\text{DD1}} = V_{\text{DD2}} = 5.5\text{ V}$, $T_J = 150^\circ\text{C}$, $T_a = 25^\circ\text{C}$ | I_{S1} | 255 | mA |
| | $V_{\text{DD1}} = V_{\text{DD2}} = 3.6\text{ V}$, $T_J = 150^\circ\text{C}$, $T_a = 25^\circ\text{C}$ | I_{S2} | 390 | mA |
| Power dissipation | $T_J = 150^\circ\text{C}$, $T_a = 25^\circ\text{C}$ | $P_{\text{d Max}}$ | 1403 | mW |

Note: The absolute maximum ratings of a semiconductor device are a set of specified parameter values, which must not be exceeded during operation, even for an instant.

If any of these rating would be exceeded during operation, the device electrical characteristics may be irreparably altered, and the reliability and lifetime of the device can no longer be guaranteed. Moreover, these operations with exceeded ratings may cause break down, damage, and/or degradation to any other equipment. Applications using the device should be designed such that each maximum rating will never be exceeded in any operating conditions.

Before using, creating, and/or producing designs, refer to and comply with the precautions and conditions set forth in this document.

Note 1: Maximum voltage must not exceed 6V.

9.1. Power Dissipation

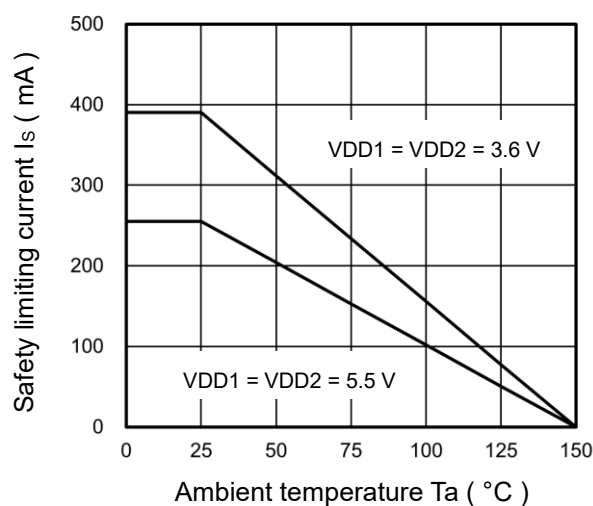


Figure 9.1 Thermal derating curve for safety limiting current - T_a

10. Recommended operating conditions

Table 10.1 Recommended Operating Ranges (Note)

| Characteristics | Symbol | Min | Max | Unit |
|-----------------------|--------------------|-----|-----|------|
| Operation voltage | V_{DD1}, V_{DD2} | 3.0 | 5.5 | V |
| Junction temperature | T_J | -40 | 150 | °C |
| Operating temperature | T_{opr} | -40 | 125 | °C |

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this data sheet should also be considered.

11. Electrical Characteristics

11.1. DC characteristics – 5V Supply

Table 11.1 DC characteristics – 5V Supply (Note)

($V_{DD1} = V_{DD2} = 4.5\text{ V to } 5.5\text{ V}$ over recommended operating conditions unless otherwise noted)

| Characteristics | Symbol | Test condition | Min | Typ. | Max | Unit |
|--|--------------|---|----------------------|-----------------|----------------------|---------------|
| V_{DD} Under Voltage Lockout threshold Voltage | V_{DDxUV+} | Positive V_{DDx} Threshold | — | 2.1 | 2.25 | V |
| | V_{DDxUV-} | Negative V_{DDx} Threshold | 1.7 | 1.9 | — | |
| | V_{DDxUVH} | V_{DDx} Hysteresis | 0.1 | 0.2 | — | |
| Logic High-level output voltage | V_{OH} | $V_{IX} = H, I_{OH} = -20\text{ }\mu\text{A}$ | $V_{DDO} - 0.1$ | V_{DDO} | — | V |
| | | $V_{IX} = H, I_{OH} = -4\text{ mA}$ | $V_{DDO} - 0.4$ | $V_{DDO} - 0.2$ | — | |
| Logic Low-level output voltage | V_{OL} | $V_{IX} = L, I_{OL} = 20\text{ }\mu\text{A}$ | — | 0 | 0.1 | V |
| | | $V_{IX} = L, I_{OL} = 4\text{ mA}$ | — | 0.2 | 0.4 | |
| Output Impedance | Z_O | — | — | 50 | — | Ω |
| Logic High-level input Threshold voltage | V_{IH} | — | $0.7 \times V_{DDI}$ | — | — | V |
| Logic Low-level input Threshold voltage | V_{IL} | — | — | — | $0.3 \times V_{DDI}$ | V |
| Logic Input threshold voltage hysteresis | V_{HYS} | — | — | 0.37 | — | V |
| Input current | I_I | $V_I = V_{DDI}$ or 0 V | — | — | ± 10 | μA |

Note: V_{DDI} = Input-side V_{DD} , V_{DDO} = Output-side V_{DD}

11.2. Switching Characteristics – 5 V Supply

Table 11.2 Switching Characteristics – 5 V Supply

(V_{DD1} = V_{DD2} = 4.5 V to 5.5 V over recommended operating conditions unless otherwise noted)

| Characteristics | Symbol | Test condition | Min | Typ. | Max | Unit |
|--|-------------------------------------|--|-----|------|------|-------|
| Data Rate | t _{bps} | — | DC | — | 50 | Mbps |
| Propagation Delay | t _{PHL} , t _{PLH} | 50 kHz, Duty = 50 %, C _L = 15 pF | — | 10.9 | 18.3 | ns |
| Pulse Width Distortion | PWD | t _{PHL} – t _{PLH} | — | 0.8 | 5.1 | ns |
| Propagation Delay Skew (Between any two units) | t _{PSK} | (Note1) | — | — | 13 | ns |
| Channel Matching | t _{skCD} | — | — | — | 4.4 | ns |
| Output signal rise time | t _r | 10 % to 90 % | — | 0.9 | — | ns |
| Output signal fall time | t _f | 90 % to 10 % | — | 0.9 | — | ns |
| Common-Mode Transient Immunity | CMTI | V _I = V _{DD1} or 0 V, V _{CM} = 1500 V | — | 100 | — | kV/μs |

Note1: The Propagation delay skew, t_{PSK}, is equal to the magnitude of the difference in propagation delay.

That will be seen between units at the same given conditions (supply voltage, input current, temperature, etc.).

11.3. Supply Current Characteristics – 5 V Supply

Table 11.3 Supply Current Characteristics – 5 V Supply

(V_{DD1} = V_{DD2} = 4.5 V to 5.5 V over recommended operating conditions unless otherwise noted)

| Characteristics | | Symbol | Test condition | Min | Typ. | Max | Unit |
|----------------------------|----------------------------|-----------------------|--|-----|------|-----|------|
| DC Supply Current | Primary side | I _{DDQ1(0)5} | V _I = High | — | 1.1 | 1.7 | mA |
| | | I _{DDQ1(1)5} | V _I = Low | — | 10.5 | 16 | |
| | Secondary side | I _{DDQ2(0)5} | V _I = High | — | 2.6 | 4.0 | mA |
| | | I _{DDQ2(1)5} | V _I = Low | — | 2.9 | 4.3 | |
| Supply Current (AC signal) | t _{bps} = 1 Mbps | Primary side | f _{CLK} = 500 kHz, Duty = 50 % square wave, C _L = 15 pF | — | 5.9 | 9.2 | mA |
| | | Secondary side | | — | 2.8 | 4.4 | |
| | t _{bps} = 25 Mbps | Primary side | f _{CLK} = 12.5 MHz, Duty = 50 % square wave, C _L = 15 pF | — | 5.9 | 8.7 | mA |
| | | Secondary side | | — | 5.2 | 7.4 | |
| | t _{bps} = 50 Mbps | Primary side | f _{CLK} = 25 MHz, Duty = 50 % square wave, C _L = 15 pF | — | 6.1 | 8.0 | mA |
| | | Secondary side | | — | 7.0 | 9.6 | |

11.4. Supply Current Characteristics – 3.3 V Supply

Table 11.4 Supply Current Characteristics – 3.3 V Supply (Note)

(V_{DD1} = V_{DD2} = 3.0 V to 3.6 V over recommended operating conditions unless otherwise noted)

| Characteristics | Symbol | Test condition | Min | Typ. | Max | Unit |
|---|---------------------|--|------------------------|------------------------|------------------------|----------|
| V_{DD} Under Voltage Lockout threshold Voltage | V _{DDxUV+} | Positive VDDx Threshold | — | 2.1 | 2.25 | V |
| | V _{DDxUV-} | Negative VDDx Threshold | 1.7 | 1.9 | — | |
| | V _{DDxUVH} | VDDx Hysteresis | 0.1 | 0.2 | — | |
| Logic High-level output voltage | V _{OH} | VIX = H, I _{OH} = -20 μ A | V _{DDO} - 0.1 | V _{DDO} | — | V |
| | | VIX = H, I _{OH} = -4 mA | V _{DDO} - 0.4 | V _{DDO} - 0.2 | — | |
| Logic Low-level output voltage | V _{OL} | VIX = L, I _{OL} = 20 μ A | — | 0 | 0.1 | V |
| | | VIX = L, I _{OL} = 4 mA | — | 0.2 | 0.4 | |
| Output Impedance | Z _O | — | — | 50 | — | Ω |
| Logic High-level input Threshold voltage | V _{IH} | — | 0.7 x V _{DDI} | — | — | V |
| Logic Low-level input Threshold voltage | V _{IL} | — | — | — | 0.3 x V _{DDI} | V |
| Logic Input threshold voltage hysteresis | V _{HYS} | — | — | 0.32 | — | V |
| Input current | I _I | V _I = V _{DDI} or 0 V | — | — | ± 10 | μ A |

Note: V_{DDI} = Input-side V_{DD}, V_{DDO} = Output-side V_{DD}

11.5. Switching Characteristics – 3.3 V Supply

Table 11.5 Switching Characteristics – 3.3 V Supply

($V_{DD1} = V_{DD2} = 3.0 \text{ V}$ to 3.6 V over recommended operating conditions unless otherwise noted)

| Characteristics | Symbol | Test condition | Min | Typ. | Max | Unit |
|---|--------------------|--|-----|------|------|-------------------|
| Data Rate | t_{bps} | — | DC | — | 50 | Mbps |
| Propagation Delay | t_{PHL}, t_{PLH} | 50 kHz, Duty = 50 %, $C_L = 15 \text{ pF}$ | — | 11.6 | 19.1 | ns |
| Pulse Width Distortion | PWD | $ t_{PHL} - t_{PLH} $ | — | 0.8 | 5.1 | ns |
| Propagation Delay Skew (Between any two units) | t_{PSK} | (Note1) | — | — | 13 | ns |
| Channel Matching | t_{skCD} | — | — | — | 4.4 | ns |
| Output signal rise time | t_r | 10 % to 90 % | — | 0.8 | — | ns |
| Output signal fall time | t_f | 90 % to 10 % | — | 0.8 | — | ns |
| Common-Mode Transient Immunity | CMTI | $V_I = V_{DDI}$ or 0 V , $V_{CM} = 1500 \text{ V}$ | — | 100 | — | kV/ μs |

Note1: The Propagation delay skew, t_{PSK} , is equal to the magnitude of the difference in propagation delay.

That will be seen between units at the same given conditions (supply voltage, input current, temperature, etc.).

11.6. Supply Current Characteristics – 3.3 V Supply

Table 11.6 Supply Current Characteristics – 3.3 V Supply

($V_{DD1} = V_{DD2} = 3.0 \text{ V}$ to 3.6 V over recommended operating conditions unless otherwise noted)

| Characteristics | | Symbol | Test condition | Min | Typ. | Max | Unit |
|----------------------------|-----------------------------|-------------------------------|---|-----|------|------|------|
| DC Supply Current | Primary side | $I_{DDQ1(0)3}$ | $V_I = \text{High}$ | — | 1.1 | 1.5 | mA |
| | | $I_{DDQ1(1)3}$ | $V_I = \text{Low}$ | — | 10.4 | 15.5 | |
| | Secondary side | $I_{DDQ2(0)3}$ | $V_I = \text{High}$ | — | 2.6 | 3.8 | mA |
| | | $I_{DDQ2(1)3}$ | $V_I = \text{Low}$ | — | 2.8 | 4.2 | |
| Supply Current (AC signal) | $t_{bps} = 1 \text{ Mbps}$ | Primary side $I_{DD1(1)3}$ | $f_{CLK} = 500 \text{ kHz}$, Duty = 50 % square wave, $C_L = 15 \text{ pF}$ | — | 5.7 | 9.0 | mA |
| | | Secondary side $I_{DD2(1)3}$ | | — | 2.7 | 4.2 | |
| | $t_{bps} = 25 \text{ Mbps}$ | Primary side $I_{DD1(25)3}$ | $f_{CLK} = 12.5 \text{ MHz}$, Duty = 50 % square wave, $C_L = 15 \text{ pF}$ | — | 5.7 | 8.3 | mA |
| | | Secondary side $I_{DD2(25)3}$ | | — | 4.4 | 6.4 | |
| | $t_{bps} = 50 \text{ Mbps}$ | Primary side $I_{DD1(50)3}$ | $f_{CLK} = 25 \text{ MHz}$, Duty = 50 % square wave, $C_L = 15 \text{ pF}$ | — | 5.8 | 8.4 | mA |
| | | Secondary side $I_{DD2(50)3}$ | | — | 5.3 | 8.4 | |

12. Characteristic Chart (Note)

12.1. Supply Current vs Data rate

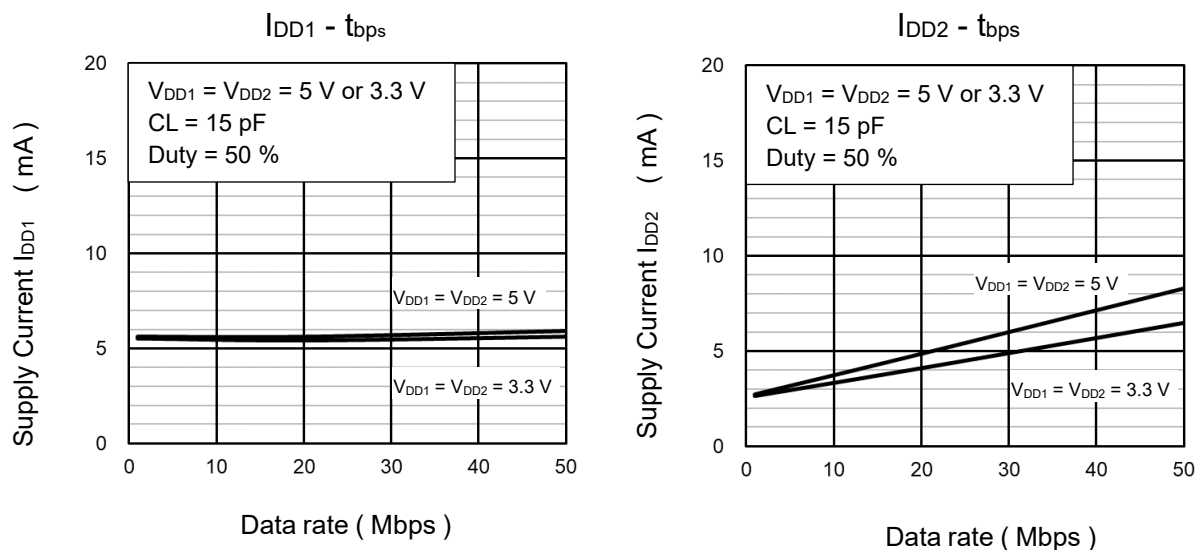


Figure 12.1 Supply Current – Data rate

12.2. Output Voltage vs Output Current

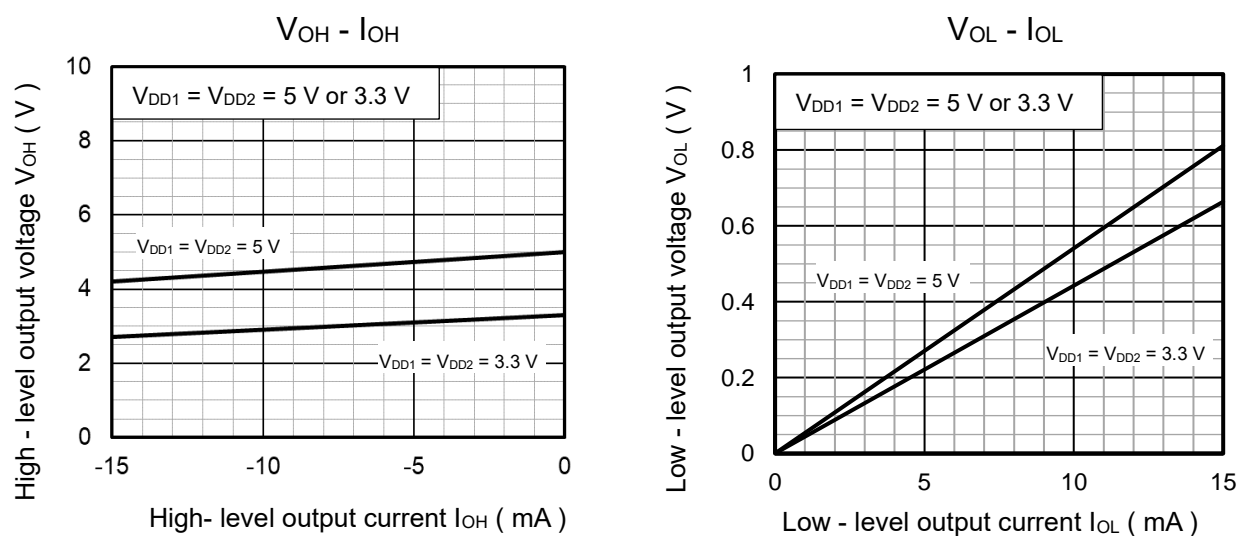


Figure 12.2 Output Voltage – Output Current

Note: The following characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

12.3. Propagation Delay Time vs Ambient Temperature

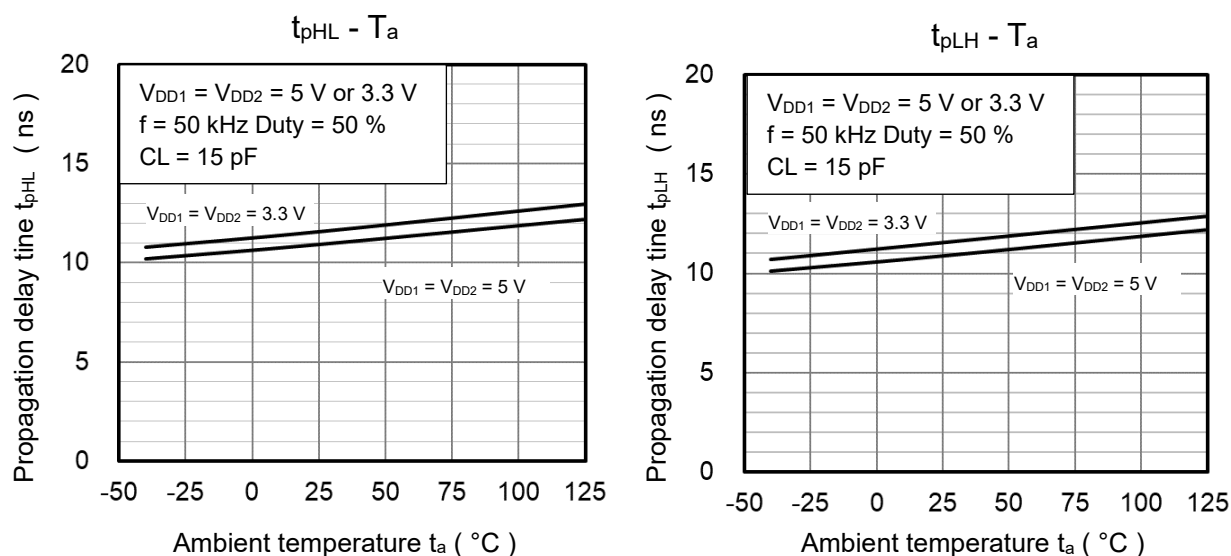


Figure12.3 Propagation Delay Time vs Ambient Temperature

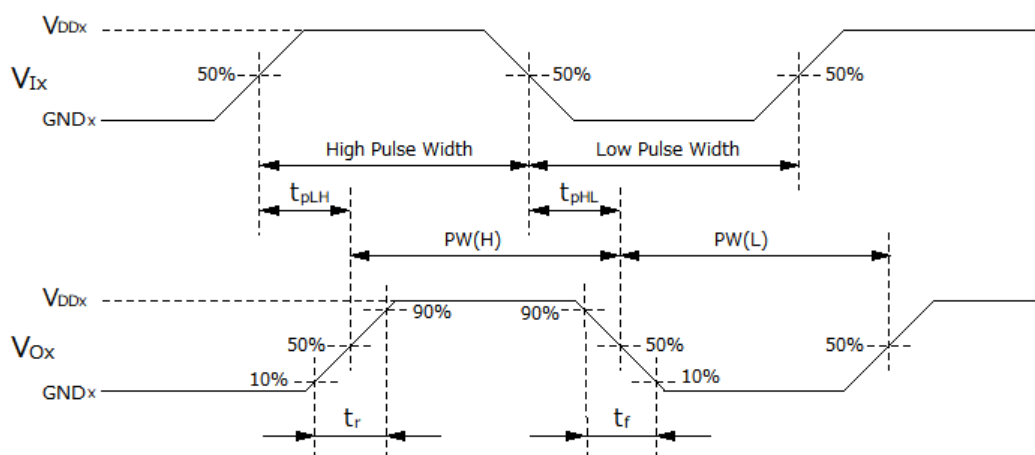


Figure12.4 Switching Waveforms

Note: The following characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

13. Package Information

Table 13.1 Insulation Related Specifications (Note)

| Parameters | Symbol | DCM320D00 | Unit |
|------------------------------|--------|-----------|------|
| Minimum clearance | CLR | 3.8 | mm |
| Minimum creepage distance | CPG | 3.8 | mm |
| Minimum insulation thickness | DTI | 17 | μm |
| Comparative tracking index | CTI | 550 | V |

Note: If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. (e.g., at a standard distance between soldering eye centers of 3.8 mm). If this is not permissible, the user shall take suitable measures.

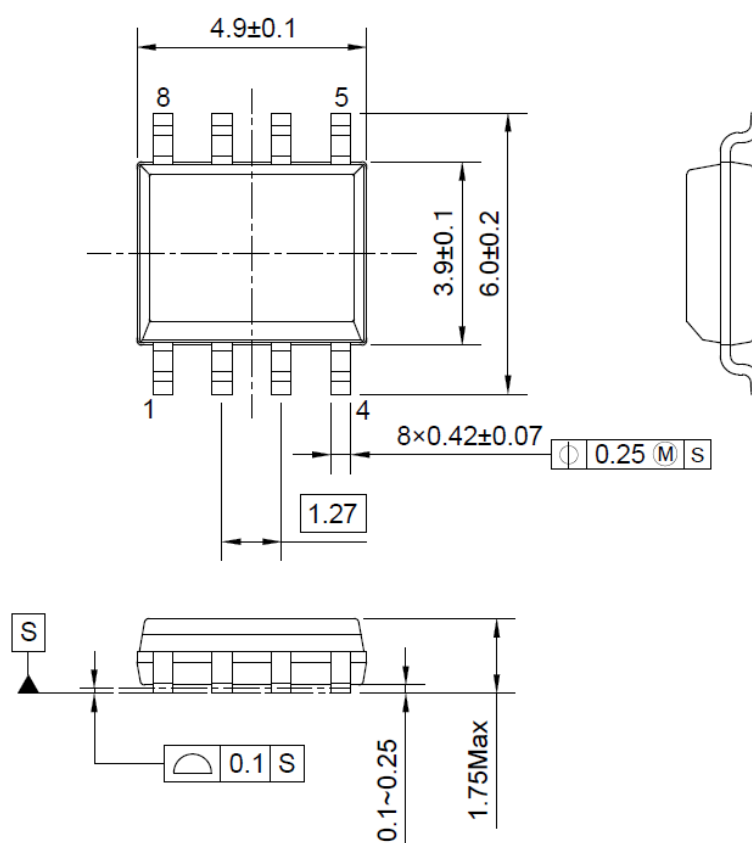
Note: This photocoupler is suitable for safe electrical isolation only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

14. Package Information

14.1. Package Dimensions

8pin SOIC
(P-SOP8-0405-1.27-002)

UNIT: mm



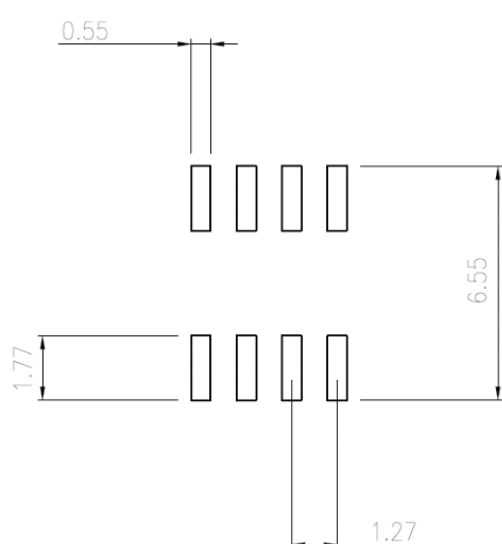
Weight: 0.07 g (typ.)

Figure 14.1 Package Dimensions

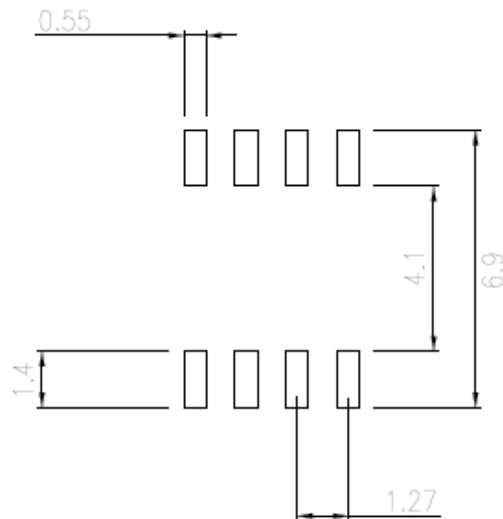
14.2. Land Pattern Dimensions for Reference only

8pin SOIC
(P-SOP8-0405-1.27-002)

Unit: mm



Complies with JEITA ET-7501 Level 3 Normal



Isolation option

Figure 14.2 Land Pattern Dimensions for Reference only

Notes.

- Unless otherwise indicated, dimensions are given in millimeters.
- This document is a reference drawing in accordance with JEITA ET-7501 Level 3. The Company does not guarantee the accuracy or completeness of the diagrams and information.
- The customer should fully evaluate the various conditions (soldering conditions, etc.) and adjust at their own risk.
- The diagrams in this document do not accurately show the actual shape and dimensions. Do not use the dimensions of the actual product as a basis for designing the product.
- When designing and using the product, check the latest information on the product and the operating instructions of the equipment in which the product is to be used, and follow these instructions.

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