

## Dual CAN Flexible Data-Rate Transceiver

### Features

- Supports both “classic” CAN 2.0 and CAN FD physical layer requirements
- Optimized for CAN FD (Flexible Data-Rate) at 2, 5 and 8 Mbps Operation:
  - Maximum Propagation Delay: 120 ns
  - Loop Delay Symmetry: -10%/+10% (2 Mbps)
- Implements ISO-11898-2 and ISO-11898-5 Standard Physical Layer Requirements
- Very Low Standby Current (5  $\mu$ A per transceiver, typical)
- Two Fully Independent  $V_{DDX}$  and  $V_{SSX}$  Pins per CAN FD Transceiver for Added Flexibility and Reliability:
  - Optimal for redundant CAN networks
- Compatible to 5V MCUs
- Functional Behavior Predictable Under All Supply Conditions:
  - Device is in Unpowered mode if  $V_{DDX}$  drops below undervoltage level
  - An unpowered node or brown-out event will not load the CAN bus
- Detection of Ground Fault:
  - Permanent dominant detection on  $T_{XDX}$
  - Permanent dominant detection on bus
- Power-on Reset and Undervoltage Lock-out on  $V_{DDX}$  Pin
- Protection against Damage due to Short-Circuit Conditions (positive or negative battery voltage)
- Protection against High-Voltage Transients in Automotive Environments
- Automatic Thermal Shutdown Protection
- Suitable for 12V and 24V Systems
- Meets or exceeds Stringent Automotive Design Requirements, including “*Hardware Requirements for LIN, CAN and FlexRay™ Interfaces in Automotive Applications*”, Version 1.3, May 2012:
  - Conducted emissions @ 2 Mbps with Common-Mode Choke (CMC)
  - Direct Power Injection (DPI) @ 2 Mbps with CMC
- Meets SAE J2962/2 “*Communication Transceivers Qualification Requirements – CAN*”:
  - Passes radiated emissions at 2 Mbps without a CMC
- High Noise Immunity due to Differential Bus Implementation
- High ESD Protection on CANHx and CANLx, Meets IEC61000-4-2, up to  $\pm 6$  kV
- Available in 14-Lead SOIC

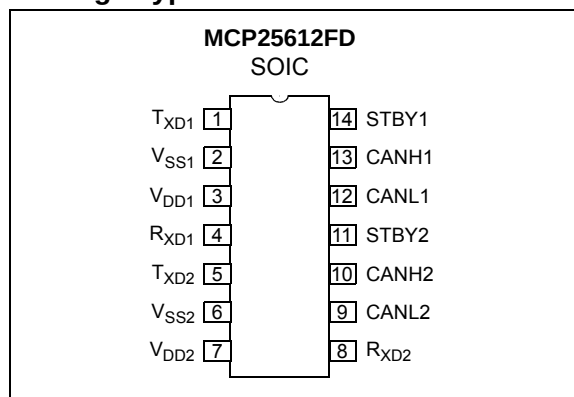
- Temperature Ranges:
  - Extended (E): -40°C to +125°C
  - High (H): -40°C to +150°C

### Description

The MCP25612FD is a second generation, dual CAN FD transceiver from Microchip Technology Inc. It offers all of the features from two fully independent MCP2561FD CAN transceivers, except for the SPLIT pin. It ensures Loop Delay Symmetry in order to support the higher data rates required for CAN FD. The maximum propagation delay is improved to support a longer bus length.

The device meets the automotive requirements for CAN FD bit rates, low quiescent current, robust Electromagnetic Compatibility (EMC) and Electrostatic Discharge (ESD).

### Package Types



### Typical Applications

#### Automotive

- Powertrain
- Body Control
- Gateway
- Chassis and Safety
- Infotainment

#### Industrial

- Factory Automation
- Gateway
- Server Backplanes
- Elevators
- Robotics

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## 1.0 DEVICE OVERVIEW

The MCP25612FD is a dual fully independent, CAN FD transceiver Fault tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The MCP25612FD device provides differential transmit and receive capability for the CAN protocol controller, and is fully compatible with the ISO 11898-2 and ISO 11898-5 standards.

The Loop Delay Symmetry is ensured to support data rates up to 8 Mbps for CAN FD (Flexible Data-Rate). The maximum propagation delay was improved to support longer bus length.

Typically, each node in a CAN system must have a device to convert the digital signals generated by a CAN controller to signals suitable for transmission over the bus cabling (differential output). It also provides a buffer between the CAN controller and the high-voltage spikes that can be generated on the CAN bus by outside sources.

### 1.1 Mode Control Block

The MCP25612FD supports two modes of operation between the two CAN transceivers independently:

- Normal Mode
- Standby Mode

These modes are summarized in [Table 1-1](#).

#### 1.1.1 NORMAL MODE

Normal mode is selected by applying low-level voltage to the STBYx pin. The driver block is operational and can drive the bus pins. The slopes of the output signals on CANHx and CANLx are optimized to produce minimal Electromagnetic Emissions (EME).

The high-speed differential receiver is active.

#### 1.1.2 STANDBY MODE

The device may be placed in Standby mode by applying a high-level voltage to the STBYx pin. In Standby mode, the transmitter and the high-speed part of the receiver are switched off to minimize power consumption. The low-power receiver and the wake-up filter blocks are enabled to monitor the bus for activity. The Receive pin (R<sub>XDx</sub>) will show a delayed representation of the CAN bus due to the wake-up filter.

The CAN controller gets interrupted by a negative edge on the R<sub>XDx</sub> pin (Dominant state on the CAN bus). The CAN controller must put the MCP25612FD back into Normal mode, using the STBYx pin, in order to enable high-speed data communication.

The CAN bus wake-up function requires V<sub>DDx</sub> to be in valid range.

**TABLE 1-1: MODES OF OPERATION**

| Mode    | STBYx Pin | R <sub>XDx</sub> Pin        |                             |
|---------|-----------|-----------------------------|-----------------------------|
|         |           | Low                         | High                        |
| Normal  | Low       | Bus is dominant             | Bus is recessive            |
| Standby | High      | Wake-up request is detected | No wake-up request detected |

## 1.2 Transmitter Function

The CAN bus has two states:

- Dominant state
- Recessive state

A Dominant state occurs when the differential voltage between CANHx and CANLx is greater than  $V_{DIFFX(D)(I)}$ . A Recessive state occurs when the differential voltage is less than  $V_{DIFFX(R)(I)}$ . The Dominant and Recessive states correspond to the Low and High state of the  $T_{XDX}$  input pin, respectively. However, a Dominant state initiated by another CAN node will override a Recessive state on the CAN bus.

## 1.3 Receiver Function

In Normal mode, the  $R_{XDX}$  output pin reflects the differential bus voltage between CANHx and CANLx. The Low and High states of the  $R_{XDX}$  output pin correspond to the Dominant and Recessive states of the CAN bus, respectively.

## 1.4 Internal Protection

CANHx and CANLx are protected against battery short circuits and electrical transients that can occur on the CAN bus. This feature prevents destruction of the transmitter output stage during such a Fault condition.

The device is further protected from excessive current loading by thermal shutdown circuitry that disables the output drivers when the junction temperature exceeds a nominal limit of +175°C. All other parts of the chip remain operational and the chip temperature is lowered due to the decreased power dissipation in the transmitter outputs. This protection is essential to protect against bus line short-circuit induced damage. The activation of the internal protection in one of the transceivers will not affect the other one since these are fully independent.

## 1.5 Permanent Dominant Detection

The MCP25612FD device prevents two conditions:

- Permanent dominant condition on  $T_{XDX}$
- Permanent dominant condition on the bus

In Normal mode, if the MCP25612FD detects an extended Low state on the  $T_{XDX}$  input, it will disable the CANHx and CANLx output drivers in order to prevent the corruption of data on the CAN bus. The drivers will remain disabled until  $T_{XDX}$  goes to the High state.

In Standby mode, if the MCP25612FD detects an extended Dominant condition on the bus, it will set the  $R_{XDX}$  pin to the Recessive state. This allows the attached controller to go to Low-Power mode until the dominant issue is corrected.  $R_{XDX}$  is latched high until a Recessive state is detected on the bus and the wake-up function is enabled again.

Both conditions have a time-out of 1.25 ms (typical). This implies a maximum bit time of 69.44  $\mu$ s (14.4 kHz), allowing up to 18 consecutive dominant bits on the bus. The permanent dominant detection in one of the transceivers will not affect the other one since these are fully independent.

## 1.6 Power-on Reset (POR) and Undervoltage Detection

The MCP25612FD has undervoltage detection on the  $V_{DDX}$  supply pin. The typical undervoltage threshold is 4V.

When the device is powered on, CANHx and CANLx remain in a High-Impedance state until  $V_{DDX}$  exceeds its undervoltage level. Once powered on, CANHx and CANLx will enter a High-Impedance state if the voltage level at  $V_{DDX}$  drops below the undervoltage level, providing voltage brown-out protection during normal operation.

In Normal mode, the receiver output is forced to the Recessive state during an undervoltage condition on  $V_{DDX}$ . In Standby mode, the low-power receiver is only enabled when the  $V_{DDX}$  supply voltage rises above its undervoltage threshold. Once the threshold voltage is reached, the low-power receiver is no longer controlled by the POR comparator and remains operational down to about 2.5V on the  $V_{DDX}$  supply.

## 2.0 ELECTRICAL CHARACTERISTICS

### 2.1 Absolute Maximum Ratings†

|                                                                                                                     |                           |
|---------------------------------------------------------------------------------------------------------------------|---------------------------|
| $V_{DDX}$ .....                                                                                                     | 7.0V                      |
| DC Voltage at $T_{XDX}$ , $R_{XDX}$ , $STBYx$ and $V_{SSX}$ .....                                                   | -0.3V to $V_{DDX} + 0.3V$ |
| DC Voltage at $CANHx$ and $CANLx$ .....                                                                             | -58V to +58V              |
| Transient Voltage on $CANHx$ , $CANLx$ (ISO-7637) (see Figure 2-4).....                                             | -150V to +100V            |
| Storage Temperature .....                                                                                           | -55°C to +150°C           |
| Operating Ambient Temperature .....                                                                                 | -40°C to +150°C           |
| Virtual Junction Temperature, $T_{VJ}$ (IEC60747-1) .....                                                           | -40°C to +190°C           |
| Soldering Temperature of Leads (10 seconds) .....                                                                   | +300°C                    |
| ESD Protection on $CANHx$ and $CANLx$ Pins (IEC 61000-4-2); 330 $\Omega$ /150 pF; Unpowered; Contact Discharge..... | $\pm 6$ kV                |
| ESD Protection on $CANHx$ and $CANLx$ Pins (IEC 801; Human Body Model); 1500 $\Omega$ /100 pF .....                 | $\pm 8$ kV                |
| ESD Protection on All Other Pins (IEC 801; Human Body Model); 1500 $\Omega$ /100 pF.....                            | $\pm 4$ kV                |
| ESD Protection on All Pins (IEC 801; Machine Model); 0 $\Omega$ /200 pF .....                                       | $\pm 300V$                |
| ESD Protection on All Pins (IEC 801; Charge Device Model).....                                                      | $\pm 750V$                |

† **NOTICE:** Stresses above those listed under “Maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

### 2.2 Specifications

**TABLE 2-1: DC ELECTRICAL SPECIFICATIONS**

| <b>Electrical Characteristics:</b> Extended (E): $T_{AMB} = -40^{\circ}C$ to $+125^{\circ}C$ ; High (H): $T_{AMB} = -40^{\circ}C$ to $+150^{\circ}C$ ; $V_{DDX} = 4.5V$ to $5.5V$ , $R_{LX} = 60\Omega$ , $C_{LX} = 100$ pF; unless otherwise specified. |            |     |     |     |         |                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|-----|-----|---------|---------------------------------|
| Characteristic                                                                                                                                                                                                                                           | Sym        | Min | Typ | Max | Units   | Conditions                      |
| <b>Supply (<math>V_{DDX}</math> Pin)</b>                                                                                                                                                                                                                 |            |     |     |     |         |                                 |
| Voltage Range                                                                                                                                                                                                                                            | $V_{DDX}$  | 4.5 | —   | 5.5 |         |                                 |
| Supply Current (per transceiver)                                                                                                                                                                                                                         | $I_{DD}$   | —   | 5   | 10  | mA      | Recessive; $V_{TXDX} = V_{DDX}$ |
|                                                                                                                                                                                                                                                          |            | —   | 45  | 70  |         | Dominant; $V_{TXDX} = 0V$       |
| Standby Current (per transceiver)                                                                                                                                                                                                                        | $I_{DDS}$  | —   | 5   | 15  | $\mu A$ |                                 |
| High Level of the POR Comparator                                                                                                                                                                                                                         | $V_{PORH}$ | 3.8 | —   | 4.3 | V       |                                 |
| Low Level of the POR Comparator                                                                                                                                                                                                                          | $V_{PORL}$ | 3.4 | —   | 4.0 | V       |                                 |
| Hysteresis of the POR Comparator                                                                                                                                                                                                                         | $V_{PORD}$ | 0.3 | —   | 0.8 | V       |                                 |

**Note 1:** Characterized; not 100% tested.

**2:** -12V to 12V is ensured by characterization, tested from -2V to 7V.

# MCP25612FD

**TABLE 2-1: DC ELECTRICAL SPECIFICATIONS (CONTINUED)**

| Electrical Characteristics: Extended (E): T <sub>AMB</sub> = -40°C to +125°C; High (H): T <sub>AMB</sub> = -40°C to +150°C; V <sub>DDX</sub> = 4.5V to 5.5V, R <sub>LX</sub> = 60Ω, C <sub>LX</sub> = 100 pF; unless otherwise specified. |                          |      |                      |                  |       |                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------|----------------------|------------------|-------|----------------------------------------------------------------------------------------------------|
| Characteristic                                                                                                                                                                                                                            | Sym                      | Min  | Typ                  | Max              | Units | Conditions                                                                                         |
| Bus Line Transmitter (CANHx, CANLx)                                                                                                                                                                                                       |                          |      |                      |                  |       |                                                                                                    |
| CANHx, CANLx: Recessive Bus Output Voltage                                                                                                                                                                                                | V <sub>O(R)</sub>        | 2.0  | 0.5 V <sub>DDX</sub> | 3.0              | V     | V <sub>TXDX</sub> = V <sub>DDX</sub> ; no load                                                     |
| CANHx, CANLx: Bus Output Voltage in Standby                                                                                                                                                                                               | V <sub>O(S)</sub>        | -0.1 | 0.0                  | +0.1             | V     | STBYx = V <sub>TXDX</sub> = V <sub>DDX</sub> ; no load                                             |
| Recessive Output Current                                                                                                                                                                                                                  | I <sub>O(R)</sub>        | -5   | —                    | +5               | mA    | -24V < V <sub>CAN</sub> < +24V                                                                     |
| CANHx: Dominant Output Voltage                                                                                                                                                                                                            | V <sub>O(D)</sub>        | 2.75 | 3.50                 | 4.50             | V     | T <sub>TXDX</sub> = 0; R <sub>LX</sub> = 50 to 65Ω                                                 |
| CANLx: Dominant Output Voltage                                                                                                                                                                                                            |                          | 0.50 | 1.50                 | 2.25             |       | R <sub>LX</sub> = 50 to 65Ω                                                                        |
| Symmetry of Dominant Output Voltage (V <sub>DDX</sub> - V <sub>CANHX</sub> - V <sub>CANLX</sub> )                                                                                                                                         | V <sub>O(D)(M)</sub>     | -400 | 0                    | +400             | mV    | V <sub>TXDX</sub> = V <sub>SSX</sub> (Note 1)                                                      |
| Dominant: Differential Output Voltage                                                                                                                                                                                                     | V <sub>O(DIFF)</sub>     | 1.5  | 2.0                  | 3.0              | V     | V <sub>TXDX</sub> = V <sub>SSX</sub> ; R <sub>LX</sub> = 50 to 65Ω (see Figure 2-1 and Figure 2-3) |
| Recessive: Differential Output Voltage                                                                                                                                                                                                    |                          | -120 | 0                    | 12               | mV    | V <sub>TXDX</sub> = V <sub>DDX</sub> (see Figure 2-1 and Figure 2-3)                               |
|                                                                                                                                                                                                                                           |                          | -500 | 0                    | 50               | mV    | V <sub>TXDX</sub> = V <sub>DDX</sub> ; no load (see Figure 2-1 and Figure 2-3)                     |
| CANHx: Short-Circuit Output Current                                                                                                                                                                                                       | I <sub>O(SC)</sub>       | -120 | 85                   | —                | mA    | V <sub>TXDX</sub> = V <sub>SSX</sub> ; V <sub>CANHX</sub> = 0V; CANLx: Floating                    |
|                                                                                                                                                                                                                                           |                          | -100 | —                    | —                | mA    | Same as above, but V <sub>DDX</sub> = 5V; T <sub>AMB</sub> = +25°C (Note 1)                        |
| CANLx: Short-Circuit Output Current                                                                                                                                                                                                       |                          | —    | 75                   | +120             | mA    | V <sub>TXDX</sub> = V <sub>SSX</sub> ; V <sub>CANLX</sub> = 18V; CANHx: Floating                   |
|                                                                                                                                                                                                                                           |                          | —    | —                    | +100             | mA    | Same as above, but V <sub>DDX</sub> = 5V; T <sub>AMB</sub> = +25°C (Note 1)                        |
| Bus Line Receiver (CANHx, CANLx)                                                                                                                                                                                                          |                          |      |                      |                  |       |                                                                                                    |
| Recessive Differential Input Voltage                                                                                                                                                                                                      | V <sub>DIFFX(R)(I)</sub> | -1.0 | —                    | +0.5             | V     | Normal mode; -12V < V <sub>(CANHX, CANLX)</sub> < +12V (see Figure 2-5) (Note 2)                   |
|                                                                                                                                                                                                                                           |                          | -1.0 | —                    | +0.4             |       | Standby mode; -12V < V <sub>(CANHX, CANLX)</sub> < +12V (see Figure 2-5) (Note 2)                  |
| Dominant Differential Input Voltage                                                                                                                                                                                                       | V <sub>DIFFX(D)(I)</sub> | 0.9  | —                    | V <sub>DDX</sub> | V     | Normal mode; -12V < V <sub>(CANHX, CANLX)</sub> < +12V (see Figure 2-5) (Note 2)                   |
|                                                                                                                                                                                                                                           |                          | 1.0  | —                    | V <sub>DDX</sub> |       | Standby mode; -12V < V <sub>(CANHX, CANLX)</sub> < +12V (see Figure 2-5) (Note 2)                  |

**Note 1:** Characterized; not 100% tested.

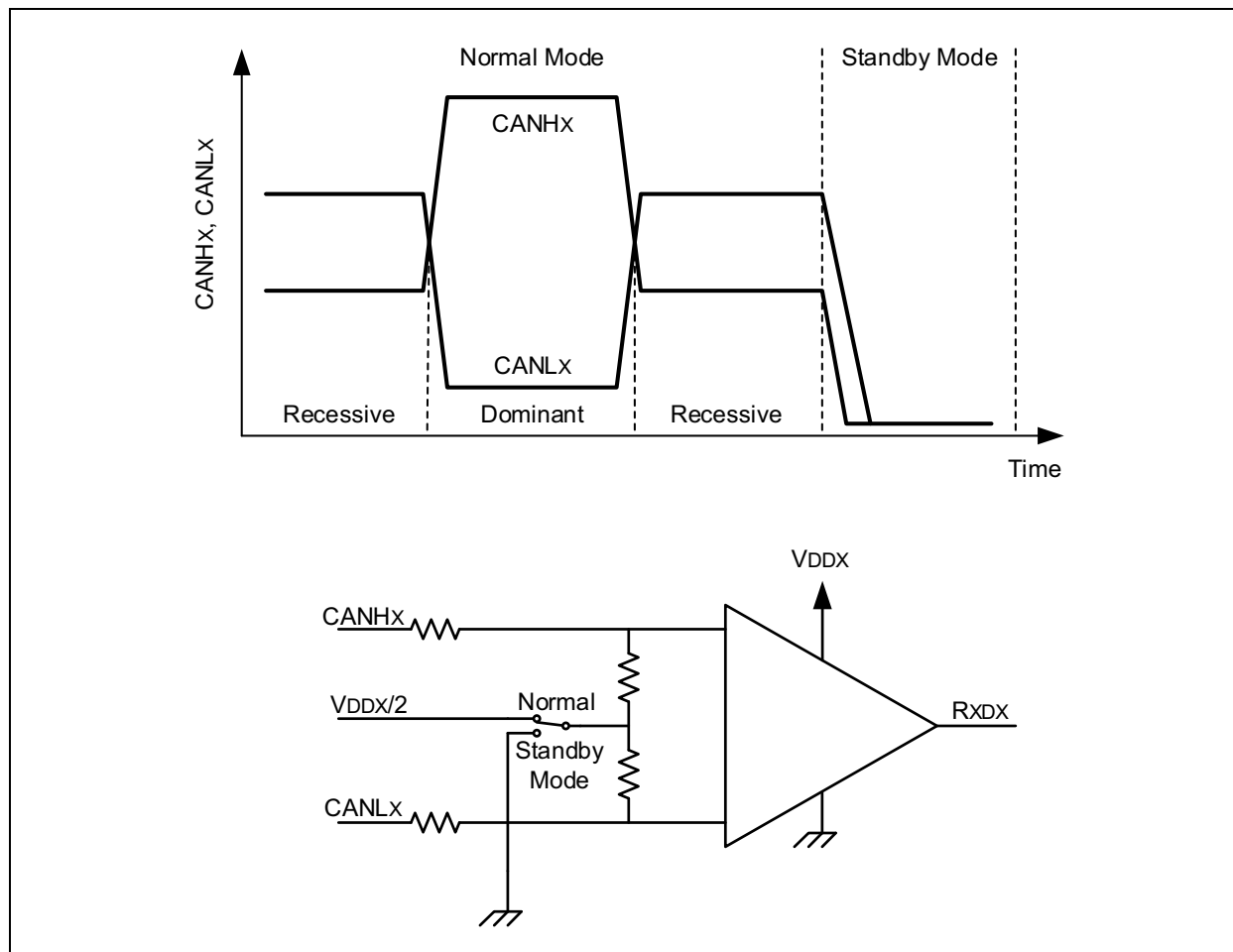
**2:** -12V to 12V is ensured by characterization, tested from -2V to 7V.

TABLE 2-1: DC ELECTRICAL SPECIFICATIONS (CONTINUED)

| Electrical Characteristics: Extended (E): $T_{AMB} = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ ; High (H): $T_{AMB} = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ ; $V_{DDX} = 4.5\text{V}$ to $5.5\text{V}$ , $R_{LX} = 60\Omega$ , $C_{LX} = 100\text{pF}$ ; unless otherwise specified. |                 |                 |      |                 |                    |                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|------|-----------------|--------------------|------------------------------------------------------------------------------------------|
| Characteristic                                                                                                                                                                                                                                                                                     | Sym             | Min             | Typ  | Max             | Units              | Conditions                                                                               |
| <b>Bus Line Receiver (CANHx, CANLx) (Continued)</b>                                                                                                                                                                                                                                                |                 |                 |      |                 |                    |                                                                                          |
| Differential Receiver Threshold                                                                                                                                                                                                                                                                    | $V_{TH(DIFF)}$  | 0.5             | 0.7  | 0.9             | V                  | Normal mode; $-12\text{V} < V_{(CANHX, CANLX)} < +12\text{V}$ (see Figure 2-5) (Note 2)  |
|                                                                                                                                                                                                                                                                                                    |                 | 0.4             | —    | 1.0             |                    | Standby mode; $-12\text{V} < V_{(CANHX, CANLX)} < +12\text{V}$ (see Figure 2-5) (Note 2) |
| Differential Input Hysteresis                                                                                                                                                                                                                                                                      | $V_{HYS(DIFF)}$ | 50              | —    | 200             | mV                 | Normal mode (see Figure 2-5) (Note 1)                                                    |
| Common-Mode Input Resistance                                                                                                                                                                                                                                                                       | $R_{IN}$        | 10              | —    | 30              | k $\Omega$         | (Note 1)                                                                                 |
| Common-Mode Resistance Matching                                                                                                                                                                                                                                                                    | $R_{IN(M)}$     | -1              | 0    | +1              | %                  | $V_{CANHX} = V_{CANLX}$ (Note 1)                                                         |
| Differential Input Resistance                                                                                                                                                                                                                                                                      | $R_{IN(DIFF)}$  | 10              | —    | 100             | k $\Omega$         | (Note 1)                                                                                 |
| Common-Mode Input Capacitance                                                                                                                                                                                                                                                                      | $C_{IN(CM)}$    | —               | —    | 20              | pF                 | $V_{TXDX} = V_{DDX}$ (Note 1)                                                            |
| Differential Input Capacitance                                                                                                                                                                                                                                                                     | $C_{IN(DIFF)}$  | —               | —    | 10              |                    | $V_{TXDX} = V_{DDX}$ (Note 1)                                                            |
| CANHx, CANLx: Input Leakage                                                                                                                                                                                                                                                                        | $I_{LI}$        | -5              | —    | +5              | $\mu\text{A}$      | $V_{DDX} = V_{TXDX} = V_{STBYX} = 0\text{V}$ ; $V_{CANHX} = V_{CANLX} = 5\text{V}$       |
| <b>Digital Input Pins (<math>T_{XDX}</math>, <math>STBYx</math>)</b>                                                                                                                                                                                                                               |                 |                 |      |                 |                    |                                                                                          |
| High-Level Input Voltage                                                                                                                                                                                                                                                                           | $V_{IH}$        | $0.7 V_{DDX}$   | —    | $V_{DDX} + 0.3$ | V                  |                                                                                          |
| Low-Level Input Voltage                                                                                                                                                                                                                                                                            | $V_{IL}$        | -0.3            | —    | $0.3 V_{DDX}$   | V                  |                                                                                          |
| High-Level Input Current                                                                                                                                                                                                                                                                           | $I_{IH}$        | -1              | —    | +1              | $\mu\text{A}$      |                                                                                          |
| $T_{XDX}$ : Low-Level Input Current                                                                                                                                                                                                                                                                | $I_{IL(TXDX)}$  | -270            | -150 | -30             | $\mu\text{A}$      |                                                                                          |
| $STBYx$ : Low-Level Input Current                                                                                                                                                                                                                                                                  | $I_{IL(STBYX)}$ | -30             | —    | -1              | $\mu\text{A}$      |                                                                                          |
| <b>Receive Data Output (<math>R_{XDX}</math>)</b>                                                                                                                                                                                                                                                  |                 |                 |      |                 |                    |                                                                                          |
| High-Level Output Voltage                                                                                                                                                                                                                                                                          | $V_{OHX}$       | $V_{DDX} - 0.4$ | —    | —               | V                  | $I_{OH} = -2\text{mA}$ ; typical -4 mA                                                   |
| Low-Level Output Voltage                                                                                                                                                                                                                                                                           | $V_{OLX}$       | —               | —    | 0.4             | V                  | $I_{OL} = 4\text{mA}$ ; typical 8 mA                                                     |
| <b>Thermal Shutdown</b>                                                                                                                                                                                                                                                                            |                 |                 |      |                 |                    |                                                                                          |
| Shutdown Junction Temperature                                                                                                                                                                                                                                                                      | $T_{J(SD)}$     | 165             | 175  | 185             | $^{\circ}\text{C}$ | $-12\text{V} < V_{(CANHX, CANLX)} < +12\text{V}$ (Note 1)                                |
| Shutdown Temperature Hysteresis                                                                                                                                                                                                                                                                    | $T_{J(HYST)}$   | 20              | —    | 30              | $^{\circ}\text{C}$ | $-12\text{V} < V_{(CANHX, CANLX)} < +12\text{V}$ (Note 1)                                |

**Note 1:** Characterized; not 100% tested.

**2:** -12V to 12V is ensured by characterization, tested from -2V to 7V.



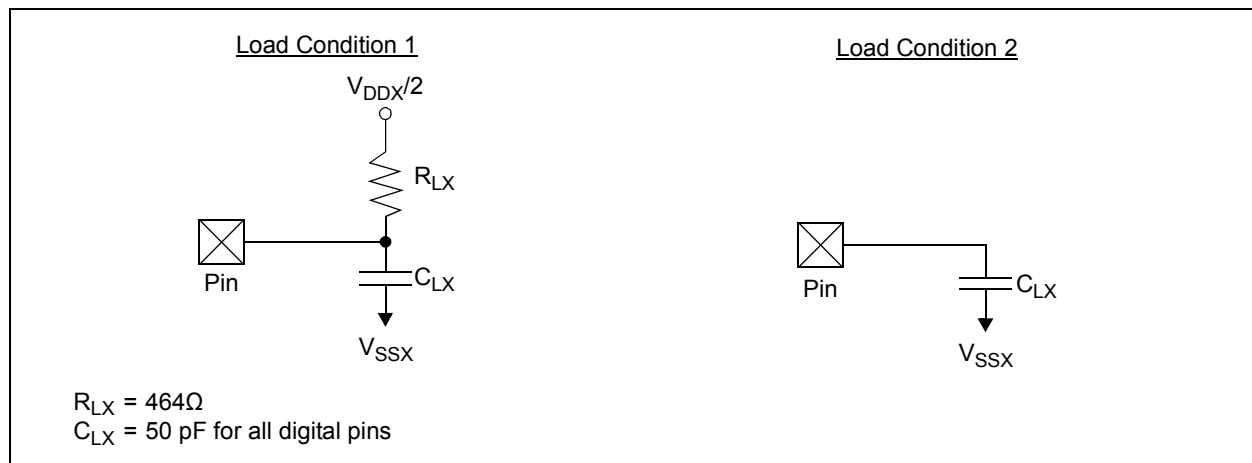
**FIGURE 2-1:** Physical Bit Representation and Simplified Bias Implementation.



**TABLE 2-2: AC ELECTRICAL SPECIFICATIONS**

| <b>Electrical Characteristics:</b> Extended (E): $T_{AMB} = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ ; High (H): $T_{AMB} = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ ; $V_{DDX} = 4.5\text{V}$ to $5.5\text{V}$ , $R_{LX} = 60\Omega$ , $C_{LX} = 100\text{pF}$ ; unless otherwise specified. |                    |                                                                      |       |      |       |               |                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------|-------|------|-------|---------------|-----------------------------------------------------------------------------------------------------------|
| Param. No.                                                                                                                                                                                                                                                                                                | Sym                | Characteristic                                                       | Min   | Typ  | Max   | Units         | Conditions                                                                                                |
| 1                                                                                                                                                                                                                                                                                                         | $t_{BIT}$          | Bit Time                                                             | 0.125 | —    | 69.44 | $\mu\text{s}$ |                                                                                                           |
| 2                                                                                                                                                                                                                                                                                                         | $f_{BIT}$          | Bit Frequency                                                        | 14.4  | —    | 8000  | kHz           |                                                                                                           |
| 3                                                                                                                                                                                                                                                                                                         | $t_{TXDX-BUSON}$   | Delay $T_{XDX}$ Low to Bus Dominant                                  | —     | 65   | —     | ns            | (Note 1)                                                                                                  |
| 4                                                                                                                                                                                                                                                                                                         | $t_{TXDX-BUSOFF}$  | Delay $T_{XDX}$ High to Bus Recessive                                | —     | 90   | —     | ns            | (Note 1)                                                                                                  |
| 5                                                                                                                                                                                                                                                                                                         | $t_{BUSON-RXDX}$   | Delay Bus Dominant to $R_{XDX}$                                      | —     | 60   | —     | ns            | (Note 1)                                                                                                  |
| 6                                                                                                                                                                                                                                                                                                         | $t_{BUSOFF-RXDX}$  | Delay Bus Recessive to $R_{XDX}$                                     | —     | 65   | —     | ns            | (Note 1)                                                                                                  |
| 7                                                                                                                                                                                                                                                                                                         | $t_{TXDX-RXDX}$    | Propagation Delay $T_{XDX}$ to $R_{XDX}$                             | —     | 90   | 120   | ns            |                                                                                                           |
|                                                                                                                                                                                                                                                                                                           |                    |                                                                      | —     | 120  | 180   | ns            | $R_{LX} = 120\Omega$ , $C_{LX} = 200\text{pF}$ (Note 1)                                                   |
| 8a                                                                                                                                                                                                                                                                                                        | $t_{BIT(RXDX),2M}$ | Recessive Bit Time on $R_{XDX} - 2\text{Mbps}$ , Loop Delay Symmetry | 450   | 485  | 550   | ns            | $t_{BIT(TXDX)} = 500\text{ns}$ (see Figure 2-10)                                                          |
|                                                                                                                                                                                                                                                                                                           |                    |                                                                      | 400   | 460  | 550   | ns            | $t_{BIT(TXDX)} = 500\text{ns}$ (see Figure 2-10); $R_{LX} = 120\Omega$ , $C_{LX} = 200\text{pF}$ (Note 1) |
| 8b                                                                                                                                                                                                                                                                                                        | $t_{BIT(RXDX),5M}$ | Recessive Bit Time on $R_{XDX} - 5\text{Mbps}$ , Loop Delay Symmetry | 160   | 185  | 220   | ns            | $t_{BIT(TXDX)} = 200\text{ns}$ (see Figure 2-10)                                                          |
| 8c                                                                                                                                                                                                                                                                                                        | $t_{BIT(RXDX),8M}$ | Recessive Bit Time on $R_{XDX} - 8\text{Mbps}$ , Loop Delay Symmetry | 85    | 105  | 140   | ns            | $t_{BIT(TXDX)} = 120\text{ns}$ (see Figure 2-10) (Note 1)                                                 |
| 9                                                                                                                                                                                                                                                                                                         | $t_{FLTR(WAKE)}$   | Delay Bus Dominant to $R_{XDX}$ (Standby mode)                       | 0.5   | 1    | 4     | $\mu\text{s}$ | Standby mode                                                                                              |
| 10                                                                                                                                                                                                                                                                                                        | $t_{WAKE}$         | Delay Standby to Normal Mode                                         | 5     | 25   | 40    | $\mu\text{s}$ | Negative edge on $STBYx$                                                                                  |
| 11                                                                                                                                                                                                                                                                                                        | $t_{PDT}$          | Permanent Dominant Detect Time                                       | —     | 1.25 | —     | ms            | $T_{XDX} = 0\text{V}$                                                                                     |
| 12                                                                                                                                                                                                                                                                                                        | $t_{PDTR}$         | Permanent Dominant Timer Reset                                       | —     | 100  | —     | ns            | The shortest Recessive pulse on $T_{XDX}$ or CAN bus to reset Permanent Dominant Timer                    |

**Note 1:** Characterized, not 100% tested.



**FIGURE 2-2:** Test Load Conditions.

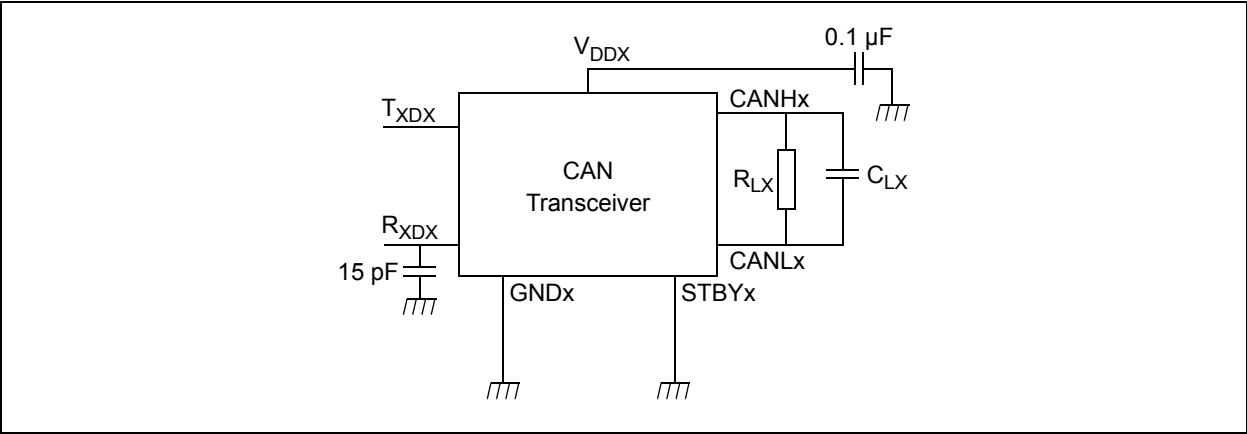
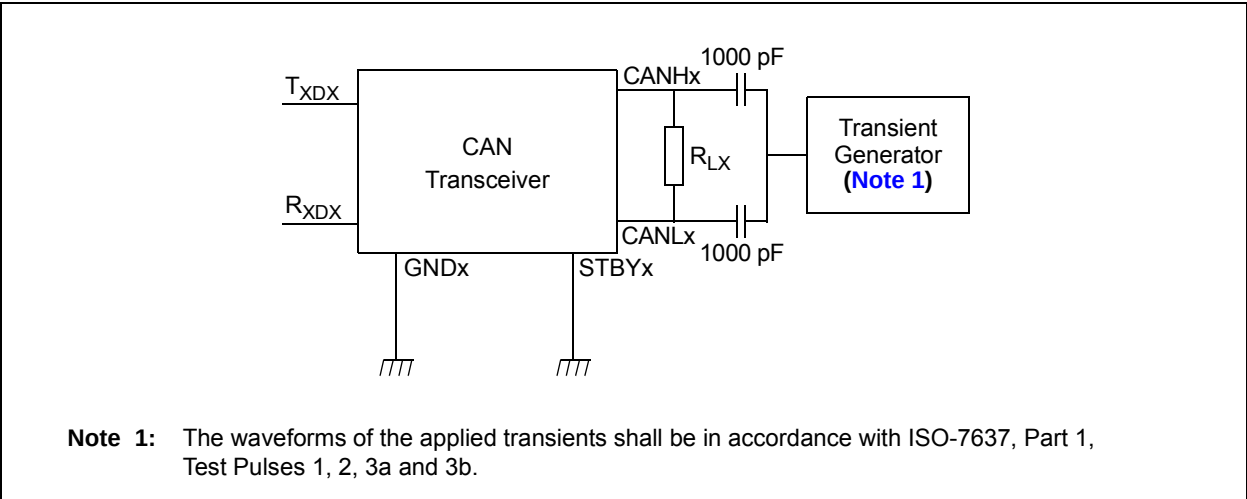


FIGURE 2-3: Test Circuit for Electrical Characteristics.



**Note 1:** The waveforms of the applied transients shall be in accordance with ISO-7637, Part 1, Test Pulses 1, 2, 3a and 3b.

FIGURE 2-4: Test Circuit for Automotive Transients.

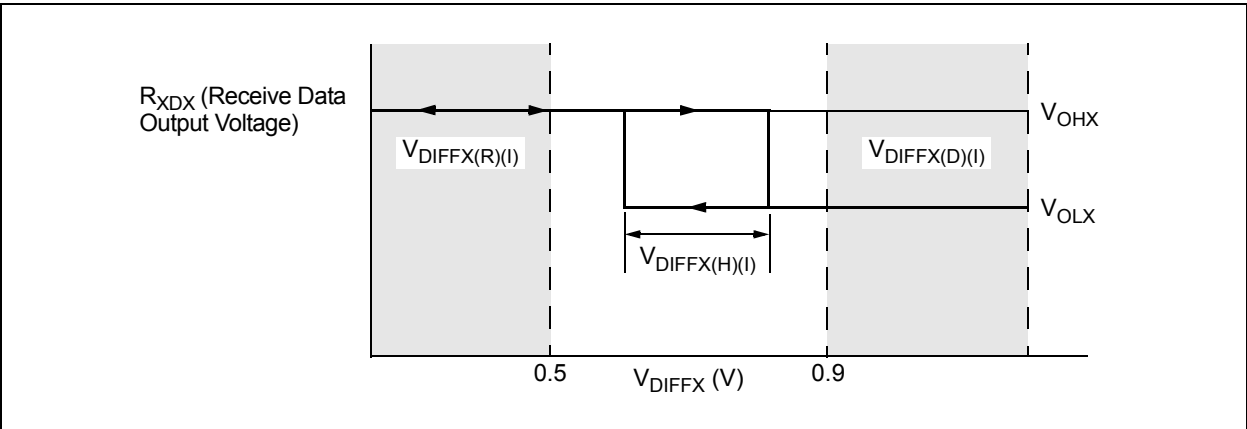


FIGURE 2-5: Hysteresis of the Receiver.

## 2.3 Terms and Definitions

A number of terms are defined in ISO-11898 that are used to describe the electrical characteristics of a CAN transceiver device. These terms and definitions are summarized in this section.

### 2.3.1 BUS VOLTAGE

$V_{CANLX}$  and  $V_{CANHX}$  denote the voltages of the bus line wires, CANLx and CANHx, relative to the ground of each individual CAN node.

### 2.3.2 COMMON-MODE BUS VOLTAGE RANGE

Boundary voltage levels of  $V_{CANLX}$  and  $V_{CANHX}$ , with respect to ground, for which proper operation will occur if up to the maximum number of CAN nodes are connected to the bus.

### 2.3.3 DIFFERENTIAL INTERNAL CAPACITANCE, $C_{DIFF}$ (OF A CAN NODE)

Capacitance seen between CANLx and CANHx during the Recessive state, when the CAN node is disconnected from the bus (see [Figure 2-6](#)).

### 2.3.4 DIFFERENTIAL INTERNAL RESISTANCE, $R_{DIFF}$ (OF A CAN NODE)

Resistance seen between CANLx and CANHx, during the Recessive state, when the CAN node is disconnected from the bus (see [Figure 2-6](#)).

### 2.3.5 DIFFERENTIAL VOLTAGE, $V_{DIFFX}$ (OF CAN BUS)

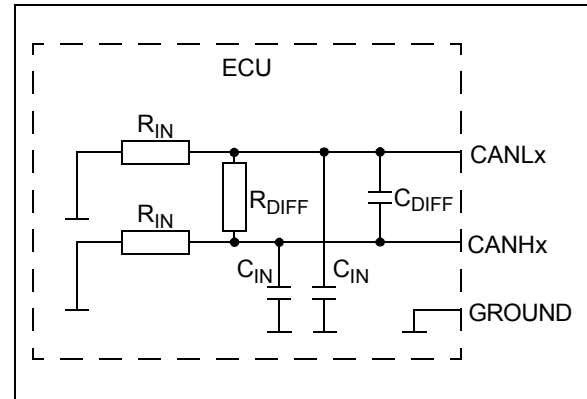
Differential voltage of the two-wire CAN bus value:  
 $V_{DIFFX} = V_{CANHX} - V_{CANLX}$ .

### 2.3.6 INTERNAL CAPACITANCE, $C_{IN}$ (OF A CAN NODE)

Capacitance seen between CANLx (or CANHx) and ground, during the Recessive state, when the CAN node is disconnected from the bus (see [Figure 2-6](#)).

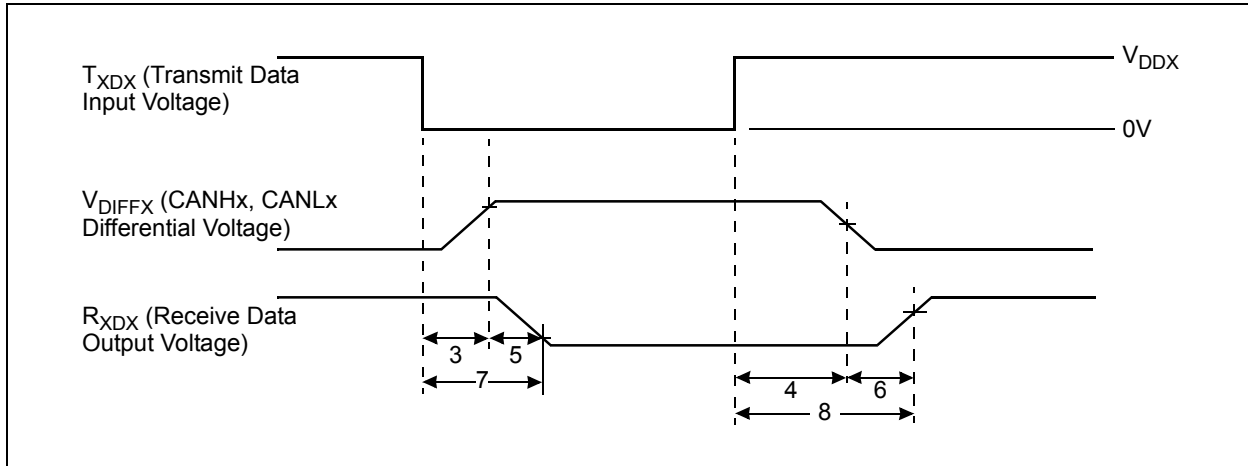
### 2.3.7 INTERNAL RESISTANCE, $R_{IN}$ (OF A CAN NODE)

Resistance seen between CANLx (or CANHx) and ground, during the Recessive state, when the CAN node is disconnected from the bus (see [Figure 2-6](#)).

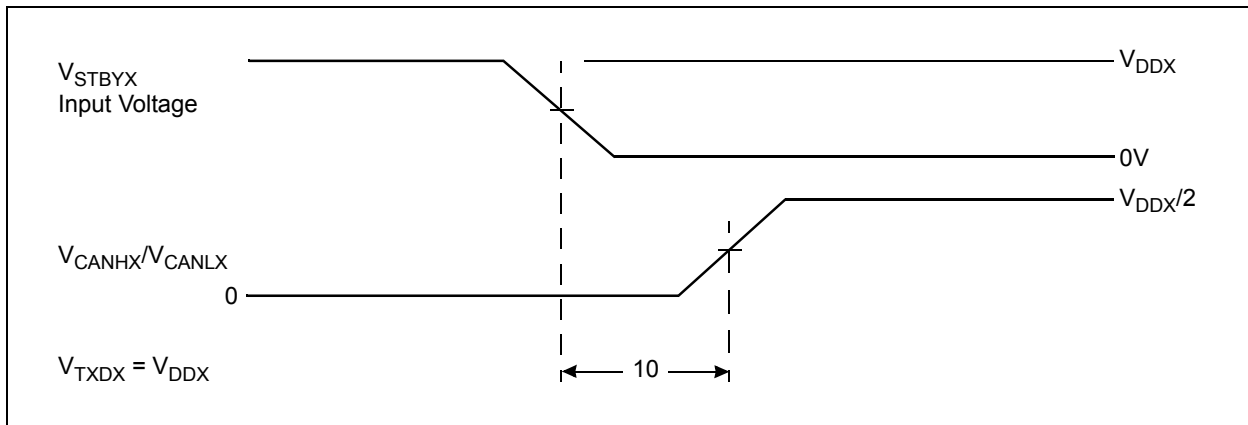


**FIGURE 2-6:** Physical Layer Definitions.

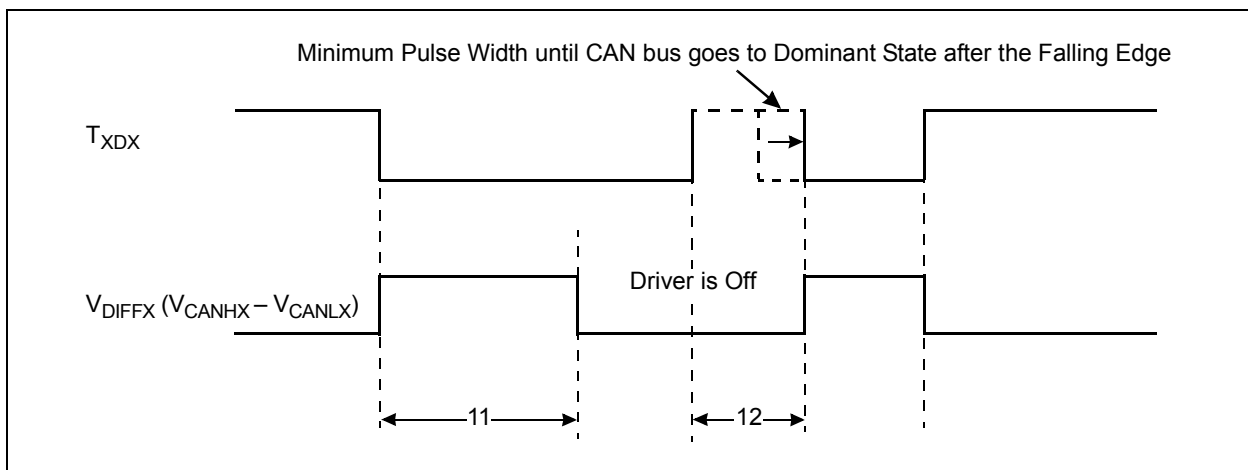
## 2.4 Timing Diagrams and Specifications



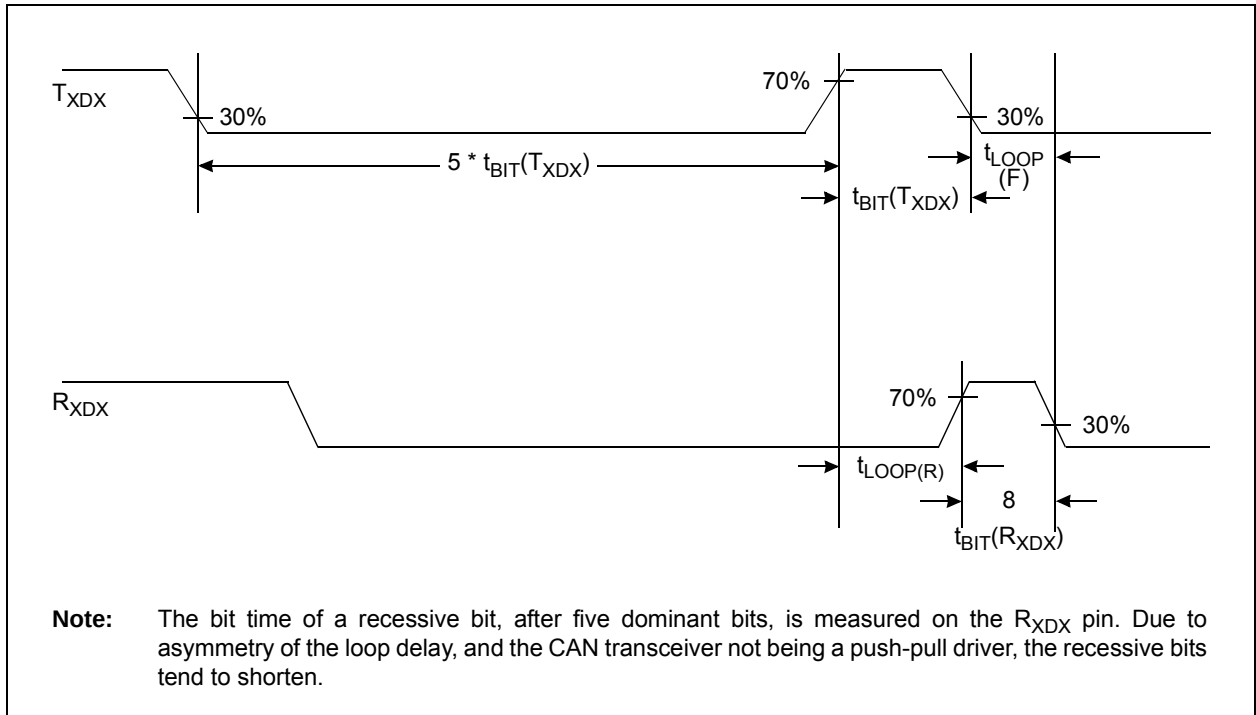
**FIGURE 2-7:** Timing Diagram for AC Characteristics.



**FIGURE 2-8:** Timing Diagram for Wake-up from Standby.



**FIGURE 2-9:** Permanent Dominant Timer Reset Detect.



**FIGURE 2-10:** Timing Diagram for Loop Delay Symmetry.

**TABLE 2-3: THERMAL SPECIFICATIONS**

| Parameter                         | Symbol        | Min. | Typ. | Max. | Units | Test Conditions |
|-----------------------------------|---------------|------|------|------|-------|-----------------|
| <b>Temperature Ranges</b>         |               |      |      |      |       |                 |
| Specified Temperature Range       | $T_A$         | -40  | —    | +125 | °C    |                 |
|                                   |               | -40  | —    | +150 |       |                 |
| Operating Temperature Range       | $T_A$         | -40  | —    | +150 | °C    |                 |
| Storage Temperature Range         | $T_A$         | -55  | —    | +150 | °C    |                 |
| <b>Thermal Package Resistance</b> |               |      |      |      |       |                 |
| Thermal Resistance, 14L-SOIC      | $\theta_{JA}$ | —    | 90.8 | —    | °C/W  |                 |

# MCP25612FD

## 3.0 PIN DESCRIPTIONS

Table 3-1 describes the MCP25612FD device pinout.

TABLE 3-1: MCP25612FD PIN FUNCTIONS

| SOIC | Pin Name         | Pin Type | Pin Function                     |
|------|------------------|----------|----------------------------------|
| 1    | T <sub>XD1</sub> | I        | Transmit Data Input              |
| 2    | V <sub>SS1</sub> | Power    | Ground                           |
| 3    | V <sub>DD1</sub> | Power    | Transceiver Supply Voltage       |
| 4    | R <sub>XD1</sub> | O        | Receive Data Output              |
| 5    | T <sub>XD2</sub> | I        | Transmit Data Input              |
| 6    | V <sub>SS2</sub> | Power    | Ground                           |
| 7    | V <sub>DD2</sub> | Power    | Transceiver Supply Voltage       |
| 8    | R <sub>XD2</sub> | O        | Receive Data Output              |
| 9    | CANL2            | I/O      | CAN Low-Level Bus Line           |
| 10   | CANH2            | I/O      | CAN High-Level Bus Line          |
| 11   | STBY2            | I        | Standby Mode Input (active-high) |
| 12   | CANL1            | I/O      | CAN Low-Level Bus Line           |
| 13   | CANH1            | I/O      | CAN High-Level Bus Line          |
| 14   | STBY1            | I        | Standby Mode Input (active-high) |

### 3.1 Transmitter Data Input Pin (T<sub>XDx</sub>)

The CAN transceivers drive the differential output pins, CANHx and CANLx, according to T<sub>XDx</sub>. T<sub>XDx</sub> is usually connected to the transmitter data output of the CAN controller device. When T<sub>XDx</sub> is low, CANHx and CANLx are in the Dominant state. When T<sub>XDx</sub> is high, CANHx and CANLx are in the Recessive state, provided that another CAN node is not driving the CAN bus with a Dominant state. T<sub>XDx</sub> is connected to an internal pull-up resistor (nominal 33 kΩ) to V<sub>DDx</sub>.

### 3.2 Ground Supply Pin (V<sub>SSx</sub>)

Ground supply pin.

### 3.3 Supply Voltage Pin (V<sub>DDx</sub>)

Positive supply voltage pin. Supplies the transmitter and receiver, including the wake-up receiver.

### 3.4 Receiver Data Output Pin (R<sub>XDx</sub>)

R<sub>XDx</sub> is a CMOS-compatible output that drives high or low, depending on the differential signals on the CANHx and CANLx pins, and is usually connected to the receiver data input of the CAN controller device. R<sub>XDx</sub> is high when the CAN bus is in the Recessive state and low in the Dominant state. R<sub>XDx</sub> is supplied by V<sub>DDx</sub>.

### 3.5 CAN Low Pin (CANLx)

The CANLx output drives the low side of the CAN differential bus. This pin is also tied internally to the receive input comparator. CANLx disconnects from the bus when MCP25612FD is not powered.

### 3.6 CAN High Pin (CANHx)

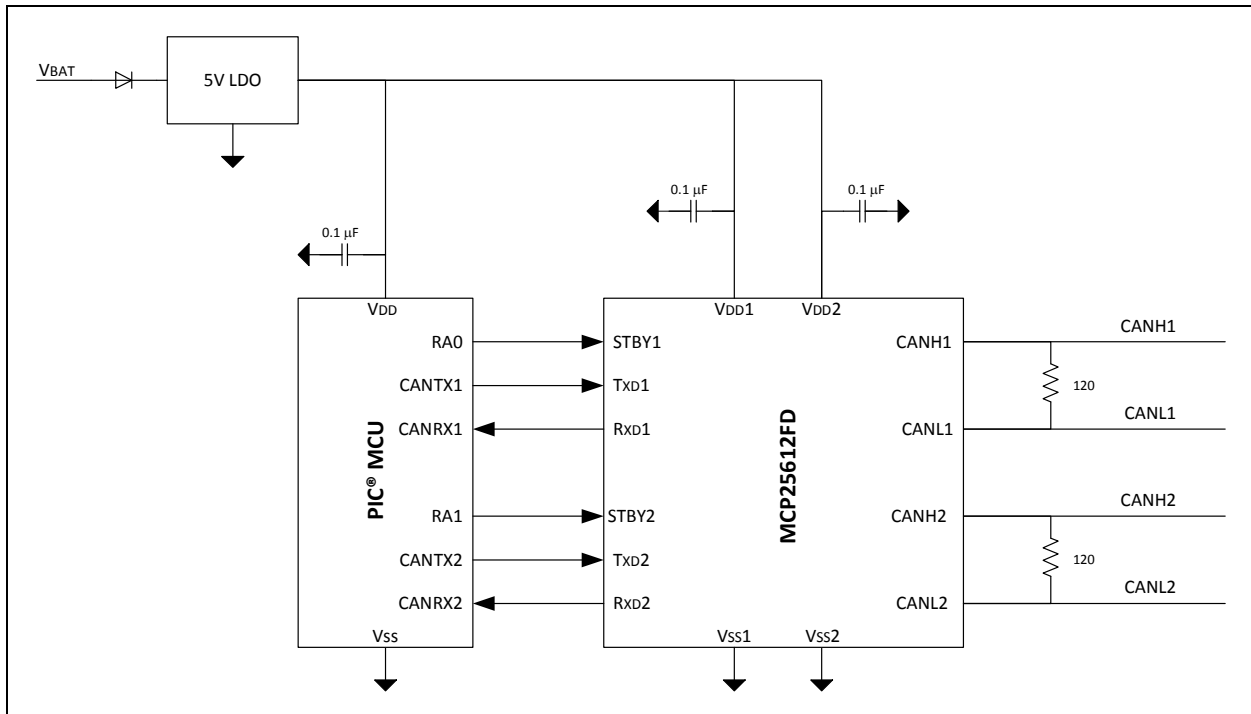
The CANHx output drives the high side of the CAN differential bus. This pin is also tied internally to the receive input comparator. CANHx disconnects from the bus when MCP25612FD is not powered.

### 3.7 Standby Mode Input Pin (STBYx)

This pin selects between Normal or Standby mode. In Standby mode, the transmitter and high-speed receiver are turned off; only the low-power receiver and wake-up filter are active. STBYx is connected to an internal MOS pull-up resistor to V<sub>DDx</sub>. The typical value is 660 kΩ.

## 4.0 TYPICAL APPLICATIONS

In order to meet some EMC/EMI requirements, a Common-Mode Choke (CMC) may be needed for data rates greater than 1 Mbps.



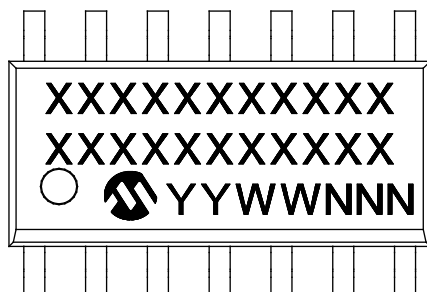
**FIGURE 4-1:** MCP25612FD Application.

# MCP25612FD

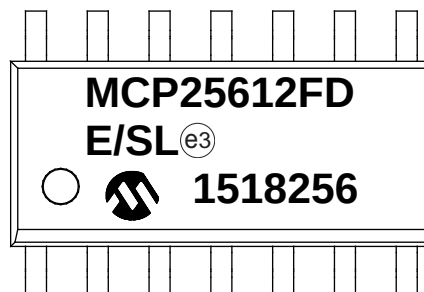
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

14-Lead SOIC (3.90 mm)



Example



|                |        |                                                                                                                  |
|----------------|--------|------------------------------------------------------------------------------------------------------------------|
| <b>Legend:</b> | XX...X | Customer-specific information                                                                                    |
|                | Y      | Year code (last digit of calendar year)                                                                          |
|                | YY     | Year code (last 2 digits of calendar year)                                                                       |
|                | WW     | Week code (week of January 1 is week '01')                                                                       |
|                | NNN    | Alphanumeric traceability code                                                                                   |
|                | (e3)   | Pb-free JEDEC designator for Matte Tin (Sn)                                                                      |
|                | *      | This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package. |

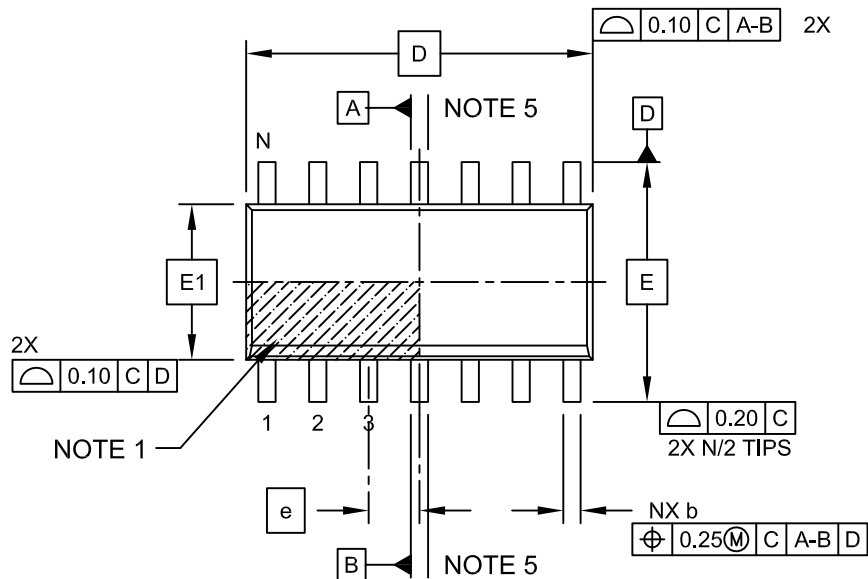
**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.



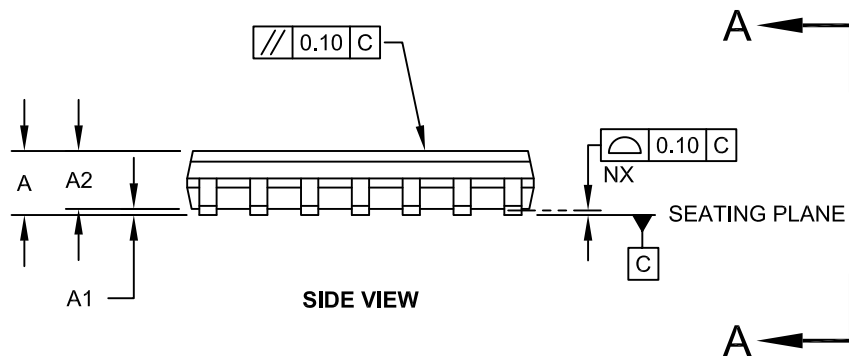
## 5.2 Package Details

### 14-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

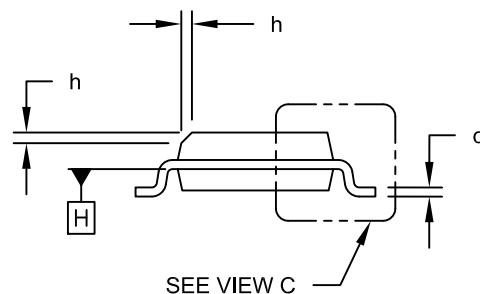
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



TOP VIEW



SIDE VIEW



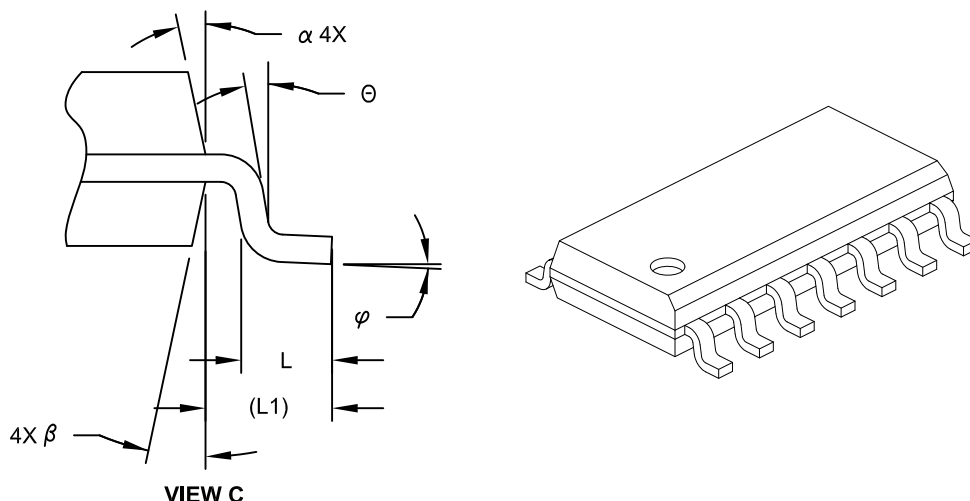
VIEW A-A

Microchip Technology Drawing No. C04-065C Sheet 1 of 2

# MCP25612FD

## 14-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



| Units                    |    | MILLIMETERS |     |      |
|--------------------------|----|-------------|-----|------|
| Dimension Limits         |    | MIN         | NOM | MAX  |
| Number of Pins           | N  | 14          |     |      |
| Pitch                    | e  | 1.27 BSC    |     |      |
| Overall Height           | A  | -           | -   | 1.75 |
| Molded Package Thickness | A2 | 1.25        | -   | -    |
| Standoff §               | A1 | 0.10        | -   | 0.25 |
| Overall Width            | E  | 6.00 BSC    |     |      |
| Molded Package Width     | E1 | 3.90 BSC    |     |      |
| Overall Length           | D  | 8.65 BSC    |     |      |
| Chamfer (Optional)       | h  | 0.25        | -   | 0.50 |
| Foot Length              | L  | 0.40        | -   | 1.27 |
| Footprint                | L1 | 1.04 REF    |     |      |
| Lead Angle               | Θ  | 0°          | -   | -    |
| Foot Angle               | φ  | 0°          | -   | 8°   |
| Lead Thickness           | c  | 0.10        | -   | 0.25 |
| Lead Width               | b  | 0.31        | -   | 0.51 |
| Mold Draft Angle Top     | α  | 5°          | -   | 15°  |
| Mold Draft Angle Bottom  | β  | 5°          | -   | 15°  |

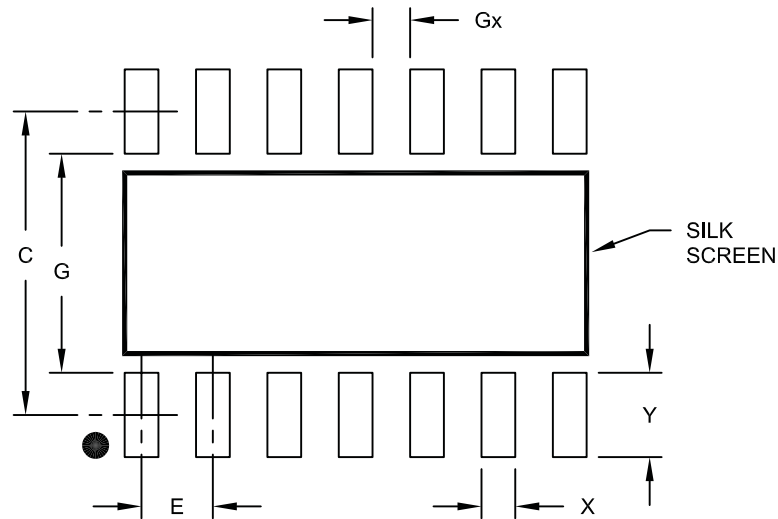
### Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M
  - BSC: Basic Dimension. Theoretically exact value shown without tolerances.
  - REF: Reference Dimension, usually without tolerance, for information purposes only.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-065C Sheet 2 of 2

## 14-Lead Plastic Small Outline (SL) - Narrow, 3.90 mm Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



### RECOMMENDED LAND PATTERN

| Dimension Limits      | Units | MILLIMETERS |      |      |
|-----------------------|-------|-------------|------|------|
|                       |       | MIN         | NOM  | MAX  |
| Contact Pitch         | E     | 1.27 BSC    |      |      |
| Contact Pad Spacing   | C     |             | 5.40 |      |
| Contact Pad Width     | X     |             |      | 0.60 |
| Contact Pad Length    | Y     |             |      | 1.50 |
| Distance Between Pads | Gx    | 0.67        |      |      |
| Distance Between Pads | G     | 3.90        |      |      |

#### Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2065A

# MCP25612FD

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NOTES:

## APPENDIX A: REVISION HISTORY

### Revision A (June 2015)

Original release of this document.

# MCP25612FD

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NOTES:

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact the factory or one of the sales offices listed on the back page.

| <u>PART NO.</u>           | <u>-X</u>                                                                                      | <u>/XX</u> |
|---------------------------|------------------------------------------------------------------------------------------------|------------|
| Device                    | Temperature Range                                                                              | Package    |
| <b>Device:</b>            | MCP25612FD: Dual CAN FD Transceiver<br>MCP25612FDT: Dual CAN FD Transceiver<br>(Tape and Reel) |            |
| <b>Temperature Range:</b> | E = -40°C to +125°C (Extended)<br>H = -40°C to +150°C (High)                                   |            |
| <b>Package:</b>           | SL = 14-Lead Plastic Small Outline - Narrow,<br>3.90 mm Body                                   |            |

**Examples:**

- a) MCP25612FD-E/SL: Extended Temperature, 14LD SOIC package
- b) MCP25612FDT-E/SL: Tape and Reel, Extended Temperature, 14LD SOIC package
- c) MCP25612FD-H/SL: High Temperature, 14LD SOIC package.
- d) MCP25612FDT-H/SL: Tape and Reel, High Temperature, 14LD SOIC package

# MCP25612FD

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NOTES:



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ISBN: 978-1-63277-484-2

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**Sweden - Stockholm**  
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**UK - Wokingham**  
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Fax: 44-118-921-5820

## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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