

1.0 General Description

The AMIS-42671 CAN transceiver with autobaud is the interface between a controller area network (CAN) protocol controller and the physical bus. It may be used in both 12V and 24V systems. The transceiver provides differential transmit capability to the bus and differential receive capability to the CAN controller. Due to the wide common-mode voltage range of the receiver inputs, the AMIS-42671 is able to reach outstanding levels of electromagnetic susceptibility (EMS). Similarly, extremely low electromagnetic emission (EME) is achieved by the excellent matching of the output signals.

The AMIS-42671 is primarily intended for industrial network applications where long network lengths are mandatory. Examples are elevators, in-building networks, process control and trains. To cope with the long bus delay the communication speed needs to be low. AMIS-42671 allows low transmit data rates down 10 Kbit/s or lower. The autobaud function allows the CAN controller to determine the incoming baud rate without influencing the CAN communication on the bus.

2.0 Key Features

- Fully compatible with the ISO 11898-2 standard
- Autobaud function
- Wide range of bus communication speed (0 up to 1 Mbit/s)
- Allows low transmit data rate in networks exceeding 1 km
- Ideally suited for 12V and 24V industrial and automotive applications
- Low electromagnetic emission (EME) common-mode choke is no longer required
- Differential receiver with wide common-mode range (+/- 35V) for high EMS
- No disturbance of the bus lines with an un-powered node
- Thermal protection
- Bus pins protected against transients
- Silent mode in which the transmitter is disabled
- Short circuit proof to supply voltage and ground
- Logic level inputs compatible with 3.3V devices
- ESD protection for CAN bus at ± 8 kV

3.0 Technical Characteristics

Table 1: Technical Characteristics

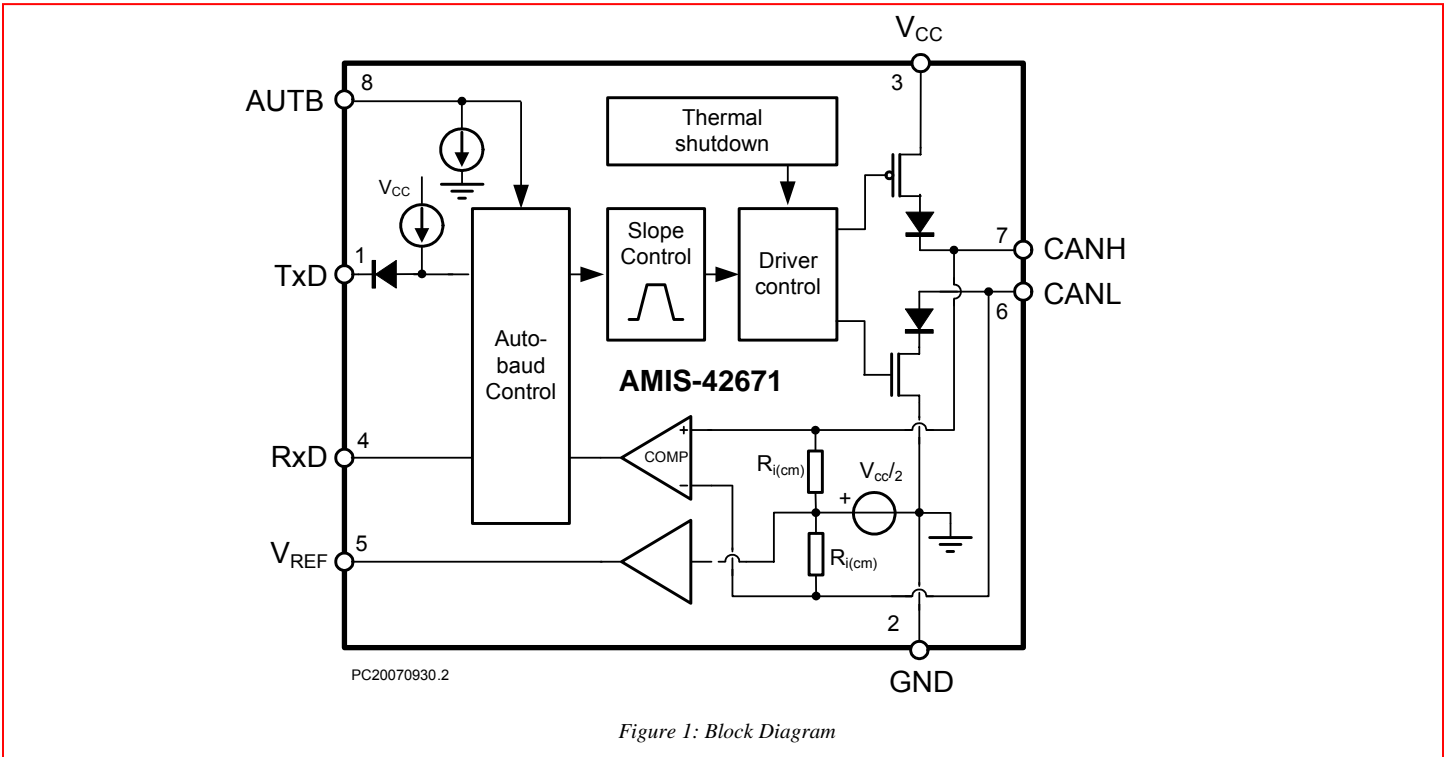
| Symbol | Parameter | Conditions | Min. | Max. | Unit |
|------------------------|---|--|------|------|------|
| V_{CANH} | DC voltage at pin CANH | $0 < V_{CC} < 5.25V$; no time limit | -45 | +45 | V |
| V_{CANL} | DC voltage at pin CANL | $0 < V_{CC} < 5.25V$; no time limit | -45 | +45 | V |
| $V_{I(dif)(bus_dom)}$ | Differential bus output voltage in dominant state | $42.5\Omega < R_{LT} < 60\Omega$ | 1.5 | 3 | V |
| $t_{pd(rec-dom)}$ | Propagation delay TxD to RxD | See Figure 8 | 70 | 245 | ns |
| $t_{pd(dom-rec)}$ | Propagation delay TxD to RxD | See Figure 8 | 100 | 245 | ns |
| $C_{M-range}$ | Input common-mode range for comparator | Guaranteed differential receiver threshold and leakage current | -35 | +35 | V |
| $V_{CM-peak}$ | Common-mode peak | See Figure 9 and Figure 10 (Notes) | -500 | 500 | mV |
| $V_{CM-step}$ | Common-mode step | See Figure 9 and Figure 10 (Notes) | -150 | 150 | mV |

Note: The parameters $V_{CM-peak}$ and $V_{CM-step}$ guarantee low electromagnetic emission.

4.0 Ordering Information

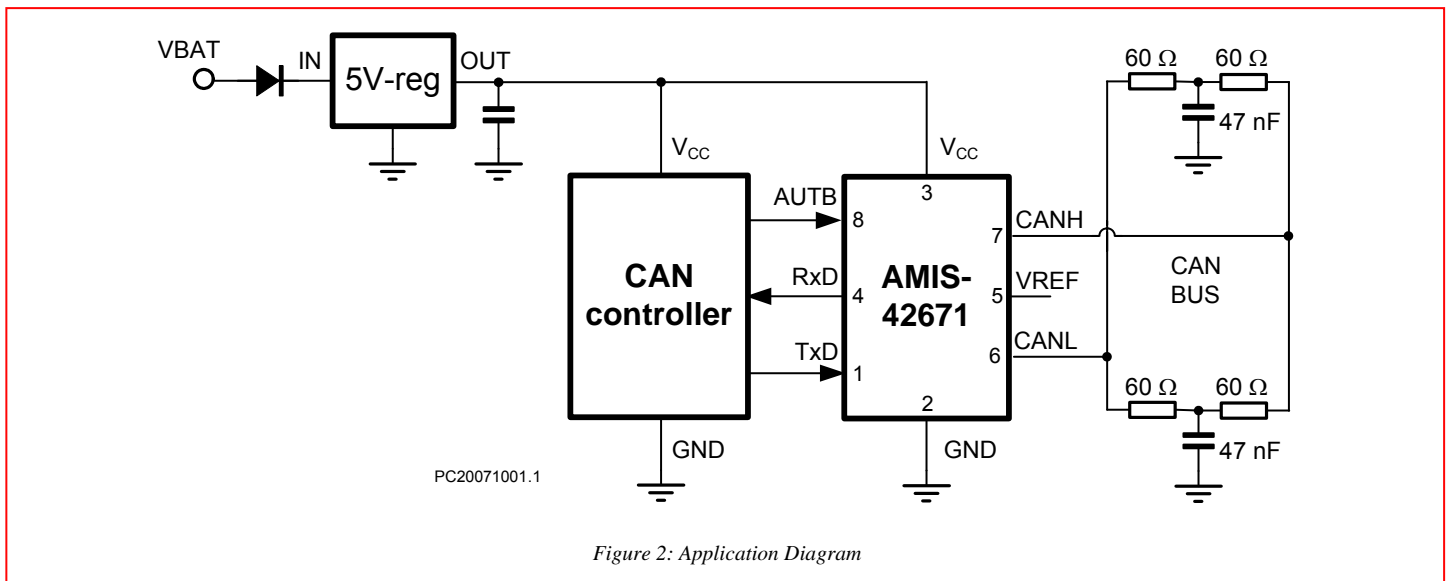
| Ordering Code (Tubes) | Ordering Code (Tape) | Marketing Name | Package | Temp. Range |
|-----------------------|----------------------|----------------|--------------|---------------|
| 0ICAB-001-XTD | 0ICAB-001-XTP | AMIS 42671AGA | SOIC-8 GREEN | -40°C...125°C |

5.0 Block Diagram



6.0 Typical Application

6.1 Application Schematic



6.2 Pin Description

6.2.1. Pin Out (Top View)

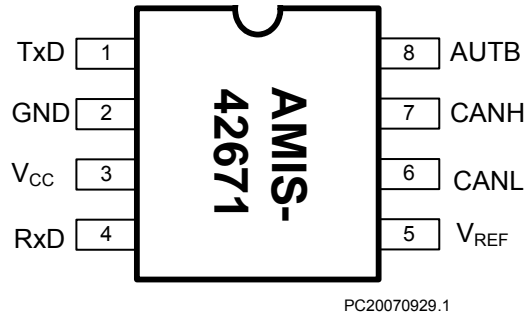


Figure 3: Pin Configuration

6.3 Pin Description

Table 2: Pin Out

| Pin | Name | Description |
|-----|------------------|--|
| 1 | TxD | Transmit data input; low input → dominant driver; internal pull-up current |
| 2 | GND | Ground |
| 3 | V _{CC} | Supply voltage |
| 4 | RxD | Receive data output; dominant transmitter → low output |
| 5 | V _{REF} | Reference voltage output |
| 6 | CANL | Low-level CAN bus line (low in dominant mode) |
| 7 | CANH | High-level CAN bus line (high in dominant mode) |
| 8 | AUTB | Autobaud mode control input; internal pull-down current |

7.0 Functional Description

7.1 Operating Modes

The behavior of AMIS-42671 under various conditions is illustrated in Table 3 below. In case the device is powered, one of two operating modes can be selected through pin AUTB.

Table 3: Functional table of AMIS-42671 when not connected to the bus; X = don't care

| VCC | pin TxD | pin AUTB | pin CANH | pin CANL | Bus state | pin RxD |
|----------------------|-----------------|-----------------|-------------|-------------|-----------|---------|
| 4.75 to 5.25.V | 0 | 0 (or floating) | High | Low | Dominant | 0 |
| 4.75 to 5.25.V | X | 1 | VCC/2 | VCC/2 | Recessive | 1 |
| 4.75 to 5.25.V | 1 (or floating) | X | VCC/2 | VCC/2 | Recessive | 1 |
| VCC<PORL (unpowered) | X | X | 0V<CANH<VCC | 0V<CANL<VCC | Recessive | 1 |
| PORL<VCC<4.75V | >2V | X | 0V<CANH<VCC | 0V<CANL<VCC | Recessive | 1 |

7.1.1. High-Speed Mode

If pin AUTB is pulled low (or left floating), the transceiver is in its high-speed mode and is able to communicate via the bus lines. The signals are transmitted and received to the CAN controller via the pins TxD and RxD. The slopes on the bus line outputs are optimized to give extremely low electromagnetic emissions.

7.1.2. Autobaud Mode

If pin AUTB is pulled high, AMIS-42671 is in Autobaud mode. The transmitter is disabled while the receiver remains active. All other IC functions also continue to operate. Normal bus activity can be monitored at the RxD pin and transmit data on TxD is looped back to RxD without influencing the CAN communication.

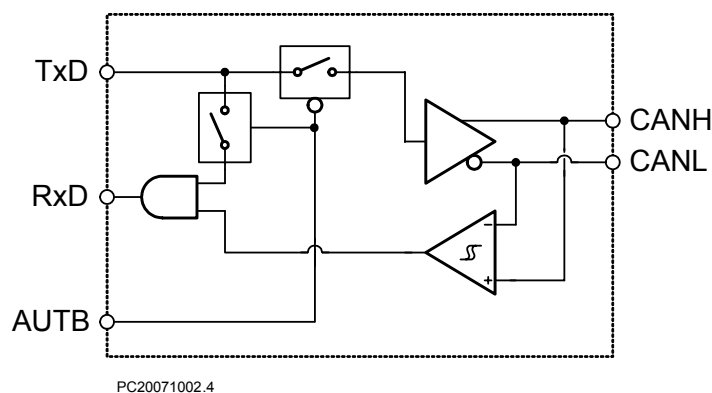


Figure 4: Simplified Schematic Diagram of Autobaud Function

In Autobaud mode the local CAN controller is able to detect the used communication speed of other transmitting network nodes. Bus communication is received and via the RxD pin sent to the CAN controller. If the CAN controller operates at the wrong baud rate, it will transmit an error frame. This message will be looped back to the CAN controller which will increment its error counter. The CAN controller will be reset with another baud rate. When an error-free message is received, the correct baud rate is detected. A logic low may now be applied to pin AUTB, returning to the High-Speed Mode.

7.2 Over-temperature Detection

A thermal protection circuit protects the IC from damage by switching off the transmitter if the junction temperature exceeds a value of approximately 160°C. Because the transmitter dissipates most of the power, the power dissipation and temperature of the IC is reduced. All other IC functions continue to operate. The transmitter off-state resets when pin TxD goes high. The thermal protection circuit is particularly necessary when a bus line short-circuits.

7.3 High Communication Speed Range

The transceiver is primarily intended for industrial applications. It allows very low baud rates needed for long bus length applications. But also high speed communication is possible up to 1Mbit/s.

7.4 Fail-safe Features

A current-limiting circuit protects the transmitter output stage from damage caused by an accidental short-circuit to either positive or negative supply voltage, although power dissipation increases during this fault condition. The pins CANH and CANL are protected from automotive electrical transients (according to "ISO 7637"; see Figure 5). Pin TxD is pulled high internally should the input become disconnected.

8.0 Electrical Characteristics

8.1 Definitions

All voltages are referenced to GND (pin 2). Positive currents flow into the IC. Sinking current means the current is flowing into the pin; sourcing current means the current is flowing out of the pin.

8.2 Absolute Maximum Ratings

Stresses above those listed in the following table may cause permanent device failure. Exposure to absolute maximum ratings for extended periods may affect device reliability.

Table 4: Absolute Maximum Ratings

| Symbol | Parameter | Conditions | Min. | Max. | Unit |
|------------------|---|--------------------------------------|------------|----------------|---------|
| V_{CC} | Supply voltage | | -0.3 | +7 | V |
| V_{CANH} | DC voltage at pin CANH | $0 < V_{CC} < 5.25V$; no time limit | -45 | +45 | V |
| V_{CANL} | DC voltage at pin CANL | $0 < V_{CC} < 5.25V$; no time limit | -45 | +45 | V |
| V_{TxD} | DC voltage at pin TxD | | -0.3 | $V_{CC} + 0.3$ | V |
| V_{RxD} | DC voltage at pin RxD | | -0.3 | $V_{CC} + 0.3$ | V |
| V_{AUTB} | DC voltage at pin AUTB | | -0.3 | $V_{CC} + 0.3$ | V |
| V_{REF} | DC voltage at pin V_{REF} | | -0.3 | $V_{CC} + 0.3$ | V |
| $V_{tran}(CANH)$ | Transient voltage at pin CANH | Note 1 | -150 | +150 | V |
| $V_{tran}(CANL)$ | Transient voltage at pin CANL | Note 1 | -150 | +150 | V |
| V_{esd} | Electrostatic discharge voltage at all pins | Note 2 Note 4 | -4 -500 | +4 +500 | kV V |
| Latch-up | Static latch-up at all pins | Note 3 | | 100 | mA |
| T_{stg} | Storage temperature | | -55 | +155 | °C |
| T_{amb} | Ambient temperature | | -40 | +125 | °C |
| T_{junc} | Maximum junction temperature | | -40 | +150 | °C |

Notes:

1. Applied transient waveforms in accordance with ISO 7637 part 3, test pulses 1, 2, 3a, and 3b (see Figure 4).
2. Standardized human body model ESD pulses in accordance to MIL883 method 3015.7.
3. Static latch-up immunity: static latch-up protection level when tested according to EIA/JESD78.
4. Standardized charged device model ESD pulses when tested according to EOS/ESD DS5.3-1993.

8.3 Thermal Characteristics

Table 5: Thermal Characteristics

| Symbol | Parameter | Conditions | Value | Unit |
|----------------|--|-------------|-------|------|
| $R_{th(vi-a)}$ | Thermal resistance from junction to ambient in SO8 package | In free air | 150 | K/W |
| $R_{th(vi-s)}$ | Thermal resistance from junction to substrate of bare die | In free air | 45 | K/W |

8.4 DC and Timing Characteristics

$V_{CC} = 4.75$ to $5.25V$; $T_{junc} = -40$ to $+150^{\circ}C$; $R_{LT} = 60\Omega$ unless specified otherwise.

Table 6: DC and Timing Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|------------------------|------------------------|------------------------|----------|
| Supply (Pin V_{CC}) | | | | | | |
| I _{CC} | Supply current | Dominant; V _{TxD} = 0V Recessive; V _{TxD} = V _{CC} | 25 2 | 45 4 | 65 8 | mA mA |
| Transmitter Data Input (Pin TxD) | | | | | | |
| V _{IH} | High-level input voltage | Output recessive | 2.0 | - | V _{CC} +0.3 | V |
| V _{IL} | Low-level input voltage | Output dominant | -0.3 | - | +0.8 | V |
| I _{IH} | High-level input current | V _{TxD} = V _{CC} | -1 | 0 | +1 | μA |
| I _{IL} | Low-level input current | V _{TxD} = 0V | -75 | -200 | -350 | μA |
| C _i | Input capacitance | Not tested | - | 5 | 10 | pF |
| Mode Select (Pin AUTB) | | | | | | |
| V _{IH} | High-level input voltage | Autobaud mode | 2.0 | - | V _{CC} +0.3 | V |
| V _{IL} | Low-level input voltage | High-speed mode | -0.3 | - | +0.8 | V |
| I _{IH} | High-level input current | V _S = 2V | 20 | 30 | 50 | μA |
| I _{IL} | Low-level input current | V _S = 0.8V | 15 | 30 | 45 | μA |
| Receiver Data Output (Pin RxD) | | | | | | |
| V _{OH} | High-level output voltage | I _{RxD} = -10mA | 0.6 x V _{CC} | 0.75 x V _{CC} | | V |
| V _{OL} | Low-level output voltage | I _{RxD} = 6mA | | 0.25 | 0.45 | V |
| Reference Voltage Output (Pin V_{REF}) | | | | | | |
| V _{REF} | Reference output voltage | -50μA < I _{VREF} < +50μA | 0.45 x V _{CC} | 0.50 x V _{CC} | 0.55 x V _{CC} | V |
| V _{REF_CM} | Reference output voltage for full common mode range | -35V < V _{CANH} < +35V; -35V < V _{CANL} < +35V | 0.40 x V _{CC} | 0.50 x V _{CC} | 0.60 x V _{CC} | V |
| Bus Lines (Pins CANH and CANL) | | | | | | |
| V _{o(reces)(CANH)} | Recessive bus voltage at pin CANH | V _{TxD} = V _{CC} ; no load | 2.0 | 2.5 | 3.0 | V |
| V _{o(reces)(CANL)} | Recessive bus voltage at pin CANL | V _{TxD} = V _{CC} ; no load | 2.0 | 2.5 | 3.0 | V |
| I _{o(reces)(CANH)} | Recessive output current at pin CANH | -35V < V _{CANH} < +35V; 0V < V _{CC} < 5.25V | -2.5 | - | +2.5 | mA |
| I _{o(reces)(CANL)} | Recessive output current at pin CANL | -35V < V _{CANL} < +35V; 0V < V _{CC} < 5.25V | -2.5 | - | +2.5 | mA |
| V _{o(dom)(CANH)} | Dominant output voltage at pin CANH | V _{TxD} = 0V | 3.0 | 3.6 | 4.25 | V |
| V _{o(dom)(CANL)} | Dominant output voltage at pin CANL | V _{TxD} = 0V | 0.5 | 1.4 | 1.75 | V |
| V _{i(dif)(bus)} | Differential bus input voltage (V _{CANH} - V _{CANL}) | V _{TxD} = 0V; dominant; 42.5 Ω < R _{LT} < 60 Ω V _{TxD} = V _{CC} ; recessive; No load | 1.5 -120 | 2.25 0 | 3.0 +50 | V mV |
| I _{o(sc)(CANH)} | Short circuit output current at pin CANH | V _{CANH} = 0V; V _{TxD} = 0V | -45 | -70 | -95 | mA |
| I _{o(sc)(CANL)} | Short circuit output current at pin CANL | V _{CANL} = 36V; V _{TxD} = 0V | 45 | 70 | 120 | mA |
| V _{i(dif)(th)} | Differential receiver threshold voltage | -5V < V _{CANL} < +10V; -5V < V _{CANH} < +10V; See Figure 6 | 0.5 | 0.7 | 0.9 | V |
| V _{thcm(dif)(th)} | Differential receiver threshold voltage for high common-mode | -35V < V _{CANL} < +35V; -35V < V _{CANH} < +35V; See Figure 6 | 0.25 | 0.7 | 1.05 | V |
| V _{i(dif)(hys)} | Differential receiver input voltage hysteresis | -5V < V _{CANL} < +10V; -5V < V _{CANH} < +10V; See Figure 6 | 50 | 70 | 100 | mV |
| R _{i(cm)(CANH)} | Common-mode input resistance at pin CANH | | 15 | 25 | 37 | KΩ |
| R _{i(cm)(CANL)} | Common-mode input resistance at pin CANL | | 15 | 25 | 37 | KΩ |
| R _{i(cm)(m)} | Matching between pin CANH and pin CANL common-mode input resistance | V _{CANH} = V _{CANL} | -3 | 0 | +3 | % |
| R _{i(dif)} | Differential input resistance | | 25 | 50 | 75 | KΩ |
| R _{i(cm)(m)} | Matching between pin CANH and pin CANL common-mode input resistance | V _{CANH} = V _{CANL} | -3 | 0 | +3 | % |
| R _{i(dif)} | Differential input resistance | | 25 | 50 | 75 | KΩ |

Table 7: DC and Timing Characteristics (continued)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|--|--|------|------|------|-------------|
| $C_{i(CANH)}$ | Input capacitance at pin CANH | $V_{TxD} = V_{CC}$; not tested | | 7.5 | 20 | pF |
| $C_{i(CANL)}$ | Input capacitance at pin CANL | $V_{TxD} = V_{CC}$; not tested | | 7.5 | 20 | pF |
| $C_{i(dif)}$ | Differential input capacitance | $V_{TxD} = V_{CC}$; not tested | | 3.75 | 10 | pF |
| $I_{LI(CANH)}$ | Input leakage current at pin CANH | $V_{CC} = 0V$; $V_{CANH} = 5V$ | 10 | 170 | 250 | μA |
| $I_{LI(CANL)}$ | Input leakage current at pin CANL | $V_{CC} = 0V$; $V_{CANL} = 5V$ | 10 | 170 | 250 | μA |
| $V_{CM-peak}$ | Common-mode peak during transition from dom \rightarrow rec or rec \rightarrow dom | See Figure 9 and Figure 10 | -500 | | 500 | mV |
| $V_{CM-step}$ | Difference in common-mode between dominant and recessive state | See Figure 9 and Figure 10 | -150 | | 150 | mV |
| Power-on-Reset (POR) | | | | | | |
| PORL | POR level | CANH, CANL, V_{ref} in tri-state below POR level | 2.2 | 3.5 | 4.7 | V |
| Thermal Shutdown | | | | | | |
| $T_{I(sd)}$ | Shutdown junction temperature | | 150 | 160 | 180 | $^{\circ}C$ |
| Timing Characteristics (see Figure 7 and Figure 8) | | | | | | |
| $t_{d(TxD-BUSon)}$ | Delay TxD to bus active | $V_s = 0V$ | 40 | 85 | 130 | ns |
| $t_{d(TxD-BUSoff)}$ | Delay TxD to bus inactive | $V_s = 0V$ | 30 | 60 | 105 | ns |
| $t_{d(BUSon-RxD)}$ | Delay bus active to RxD | $V_s = 0V$ | 25 | 55 | 105 | ns |
| $t_{d(BUSoff-RxD)}$ | Delay bus inactive to RxD | $V_s = 0V$ | 65 | 100 | 135 | ns |
| $t_{pd(rec-dom)}$ | Propagation delay TxD to RxD from recessive to dominant | $V_s = 0V$ | 70 | | 245 | ns |
| $t_{d(dom-rec)}$ | Propagation delay TxD to RxD from dominant to recessive | $V_s = 0V$ | 100 | | 245 | ns |

8.5 Measurement Set-ups and Definitions

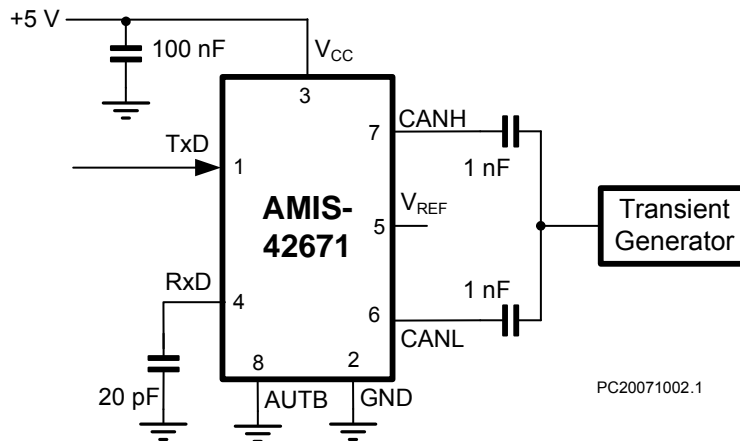


Figure 5: Test Circuit for Transients

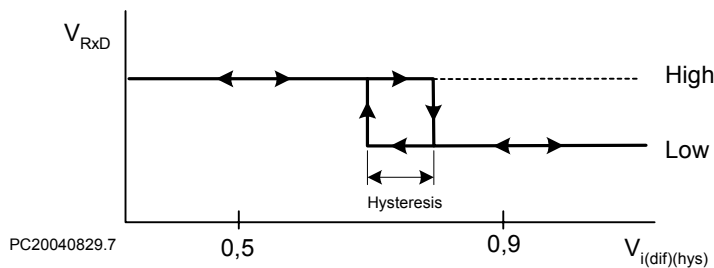


Figure 6: Hysteresis of the Receiver

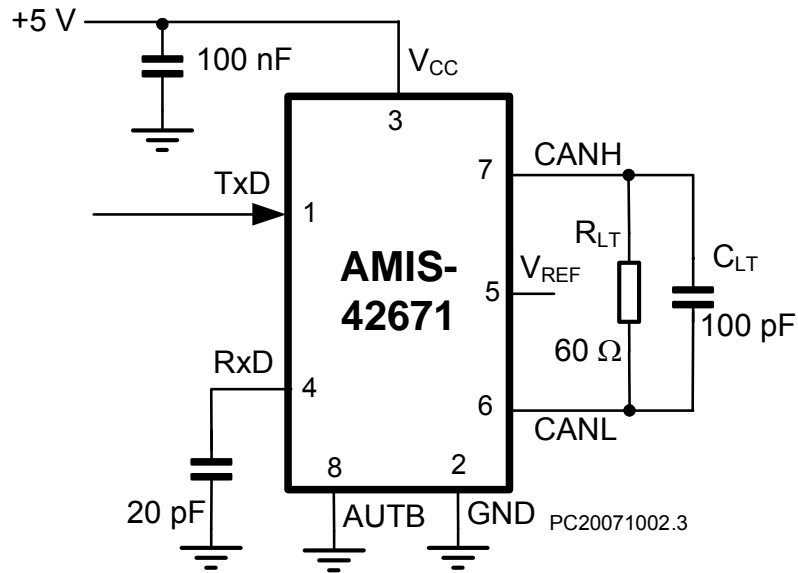


Figure 7: Test Circuit for Timing Characteristics

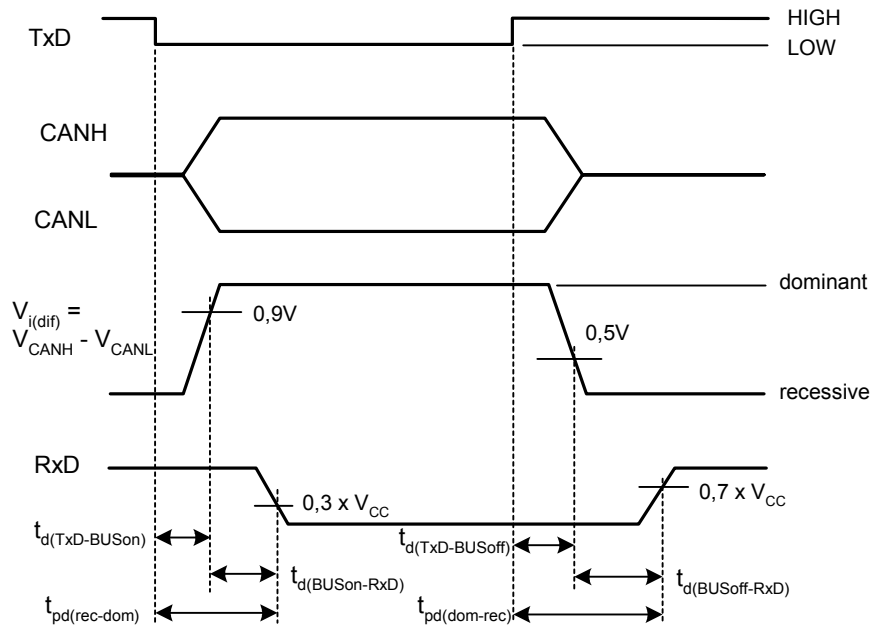
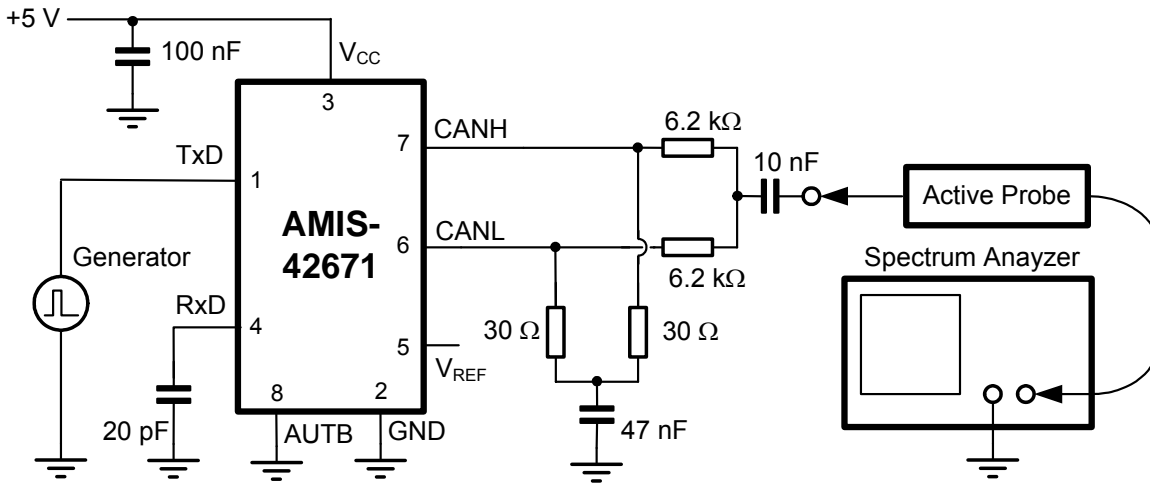
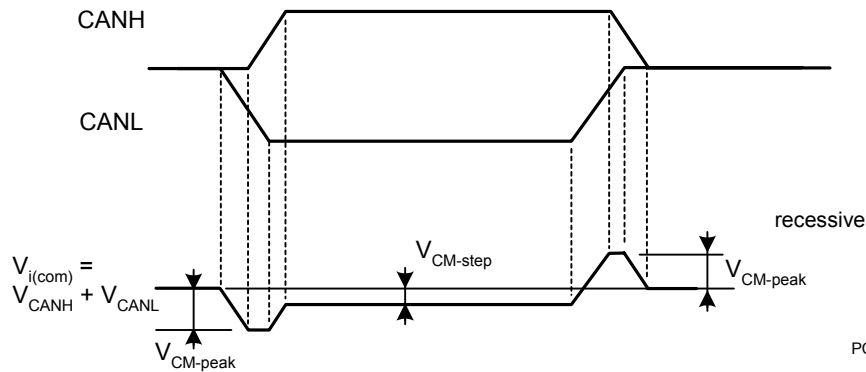


Figure 8: Timing Diagram for AC Characteristics



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Figure 9: Basic Test Set-up for Electromagnetic Measurement

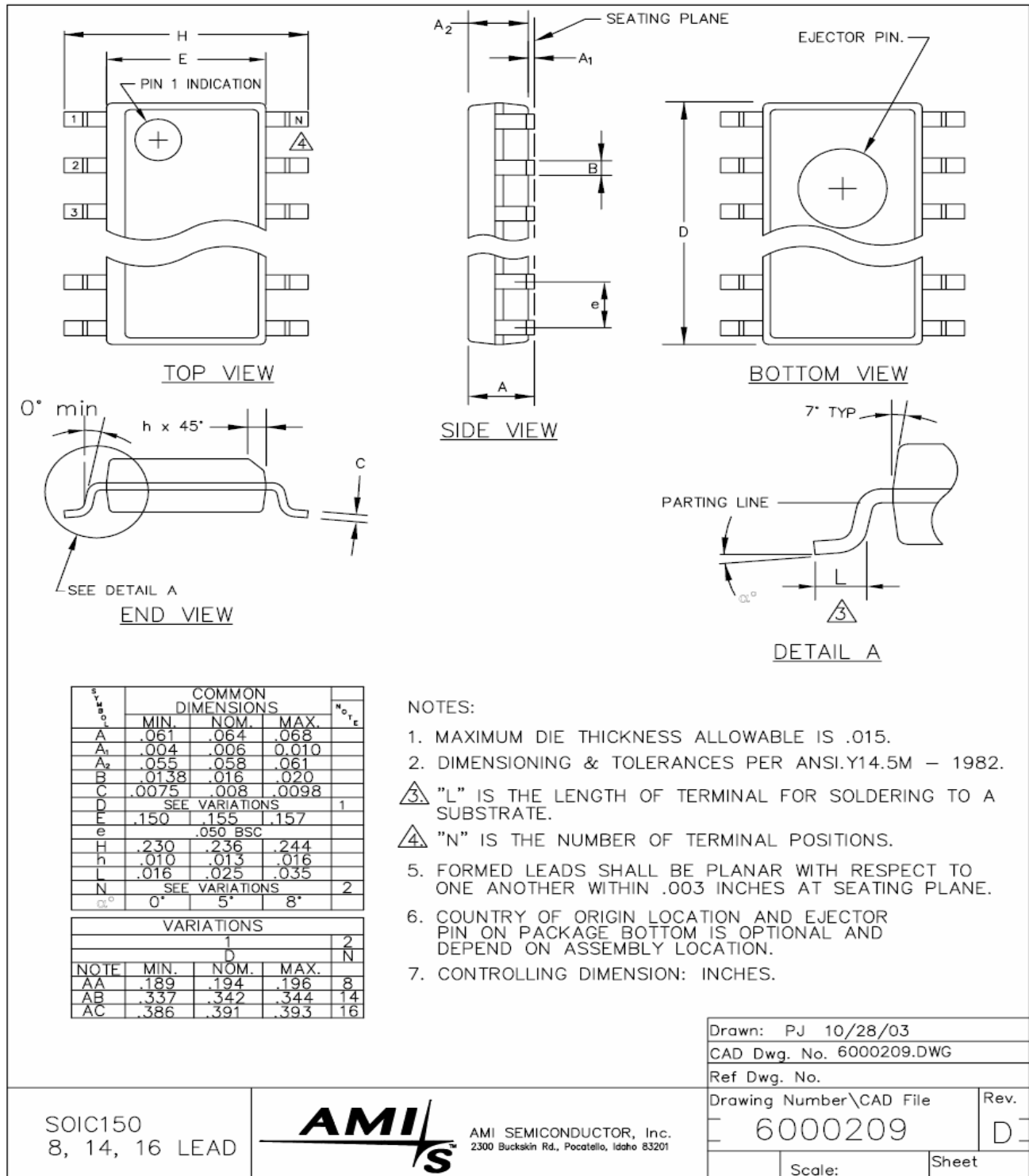


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Figure 10: Common-mode Voltage Peaks (see measurement set-up Figure 9)

9.0 Package Outline

SOIC-8: Plastic small outline; eight leads; body width 150mil



SOIC150
8, 14, 16 LEAD



10.0 Soldering

10.1 Introduction

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in the AMIS “Data Handbook IC26; Integrated Circuit Packages” (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering is not always suitable for surface mount ICs, or for printed circuit boards with high population densities. In these situations reflow soldering is often used.

10.2 Re-flow Soldering

Re-flow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for re-flowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds, depending on heating method.

Typical reflow peak temperatures range from 215 to 250°C. The top-surface temperature of the packages should preferably be kept below 230°C.

10.3 Wave Soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used, the following conditions must be observed for optimal results:

- Use a double-wave soldering method, comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
 - For packages with leads on two sides and a pitch (e):
 - Larger than or equal to 1.27mm, the footprint longitudinal axis is preferred to be parallel to the transport direction of the printed-circuit board.
 - Smaller than 1.27mm, the footprint longitudinal axis must be parallel to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves at the downstream end.
- For packages with leads on four sides, the footprint must be placed at a 45 degree angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is four seconds at 250°C. A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

10.4 Manual Soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to ten seconds at up to 300°C.

When using a dedicated tool, all other leads can be soldered in one operation within two to five seconds, between 270 and 320°C.

Table 8: Soldering

| Package | Soldering Method | |
|---------------------------------|------------------------|------------|
| | Wave | Reflow (1) |
| BGA, SQFP | Not suitable | Suitable |
| HLQFP, HSQFP, HSOP, HTSSOP, SMS | Not suitable (2) | Suitable |
| PLCC (3) , SO, SOJ | Suitable | Suitable |
| LQFP, QFP, TQFP | Not recommended (3)(4) | Suitable |
| SSOP, TSSOP, VSO | Not recommended (5) | Suitable |

- Notes:
1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the “Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods.”
 2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heat sink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
 3. If wave soldering is considered, then the package must be placed at a 45 degree angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
 4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65mm.
 5. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5mm.

11.0 Company or Product Inquiries

For more information about AMI Semiconductor's high-speed Industrial CAN transceivers, visit our Web site at: <http://www.amis.com>

12.0 Document History

| Date | Revision | Change |
|--------------|----------|-----------------|
| October 2007 | 1.0 | Initial release |

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