# AMIS-42670

# High-Speed CAN Transceiver for Long Networks

## Description

The AMIS−42670 CAN transceiver is the interface between a controller area network (CAN) protocol controller and the physical bus and may be used in both 12 V and 24 V 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−42670 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−42670 is the industrial version of the AMIS−30660 and primarily intended for 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−42670 allows low transmit data rates down 10 kbit/s or lower.

## Features

- Fully Compatible with the ISO 11898−2 Standard
- Certified "Authentication on CAN Transceiver Conformance (d1.1)"
- Wide Range of Bus Communication Speed (0 Mbit/s up to 1 Mbit/s)
- Allows Low Transmit Data Rate in Networks Exceeding 1 km
- Ideally Suited for 12 V and 24 V Industrial and Automotive Applications
- Low Electromagnetic Emission (EME) Common−Mode Choke is No Longer Required
- Differential Receiver with Wide Common−Mode Range ($\pm 35$ V) for High EMS
- No Disturbance of the Bus Lines with an Unpowered Node
- Thermal Protection
- Bus Pins Protected Against Transients
- Silent Mode in which the Transmitter is Disabled
- Short Circuit Proof to Supply Voltage and Ground
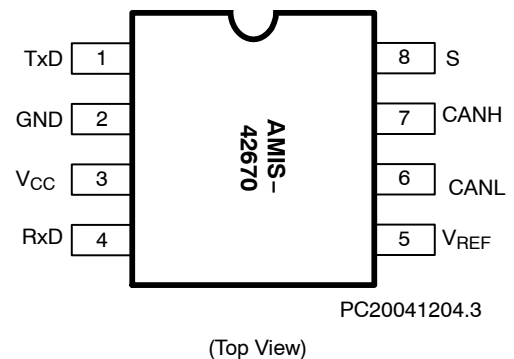- Logic Level Inputs Compatible with 3.3 V Devices
- These are Pb−Free Devices*

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## ON Semiconductor®

### PIN ASSIGNMENT

| | | |
|---|---|---|
| TxD | 1 | 8 | S |
| GND | 2 | 7 | CANH |
| $V_{CC}$ | 3 | 6 | CANL |
| RxD | 4 | 5 | $V_{REF}$ |

AMIS−42670

PC20041204.3

(Top View)

# AMIS−42670

## Table 1. TECHNICAL CHARACTERISTICS

| Symbol | Parameter | Condition | Max | Max | Unit |
|--------|-----------|-----------|-----|-----|------|
| $V_{CANH}$ | DC Voltage at Pin CANH | $0 < V_{CC} < 5.25$ V; no time limit | −45 | +45 | V |
| $V_{CANL}$ | DC Voltage at Pin CANL | $0 < V_{CC} < 5.25$ V; no time limit | −45 | +45 | V |
| $V_{o(dif)(bus\_dom)}$ | 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 6 | 70 | 245 | ns |
| $t_{pd(dom-rec)}$ | Propagation Delay TxD to RxD | See Figure 6 | 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 Figures 7 and 8 (Note 1) | −500 | 500 | mV |
| $V_{CM-step}$ | Common−Mode Step | See Figures 7 and 8 (Note 1) | −150 | 150 | mV |

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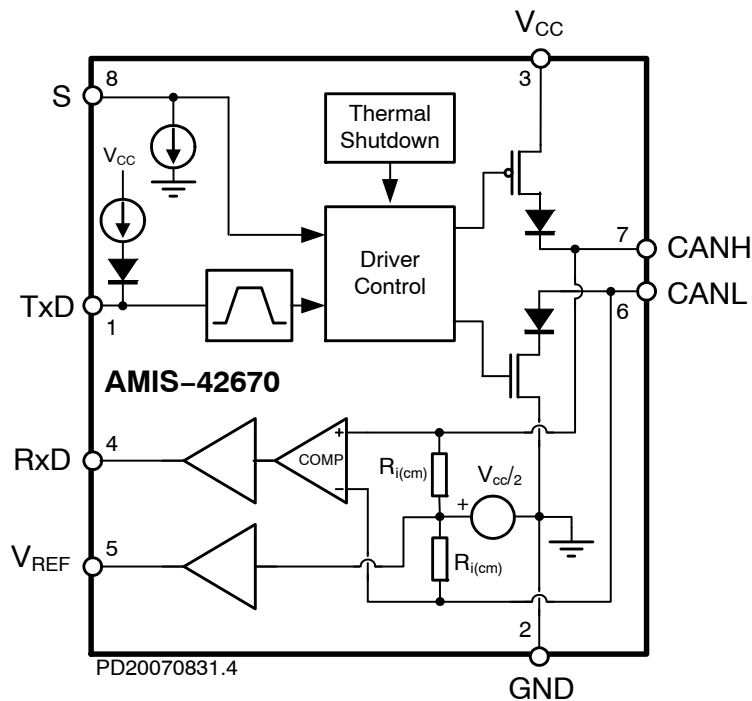


**Figure 1. Block Diagram**

## Table 2. PIN DESCRIPTION

| Pin | Name | Description |
|-----|------|-------------|
| 1 | TxD | Transmit Data Input; Low Input → Dominant Driver; Internal Pullup 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 | S | Silent Mode Control Input; Internal Pulldown Current |

# AMIS−42670

## Table 3. 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 < $V_{CC}$ < 5.25 V; no time limit | −45 | +45 | V |
| $V_{CANL}$ | DC Voltage at Pin CANL | 0 < $V_{CC}$ < 5.25 V; 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 |
| $V_S$ | DC Voltage at Pin S | | −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 2 | −150 | +150 | V |
| $V_{tran(CANL)}$ | Transient Voltage at Pin CANL | Note 2 | −150 | +150 | V |
| $V_{esd}$ | Electrostatic Discharge Voltage at All Pins | Note 3<br>Note 5 | −4<br>−750 | +4<br>+750 | kV<br>V |
| Latch−up | Static Latch−up at All Pins | Note 4 | | 100 | mA |
| $T_{stg}$ | Storage Temperature | | −55 | +155 | °C |
| $T_A$ | Ambient Temperature | | −40 | +125 | °C |
| $T_J$ | Maximum Junction Temperature | | −40 | +150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

## Table 4. THERMAL CHARACTERISTICS

| Symbol | Parameter | Conditions | Value | Unit |
|---|---|---|---|---|
| $R_{th(vj−a)}$ | Thermal Resistance from Junction−to−Ambient in SOIC−8 Package | In Free Air | 150 | k/W |
| $R_{th(vj−s)}$ | Thermal Resistance from Junction−to−Substrate of Bare Die | In Free Air | 45 | k/W |

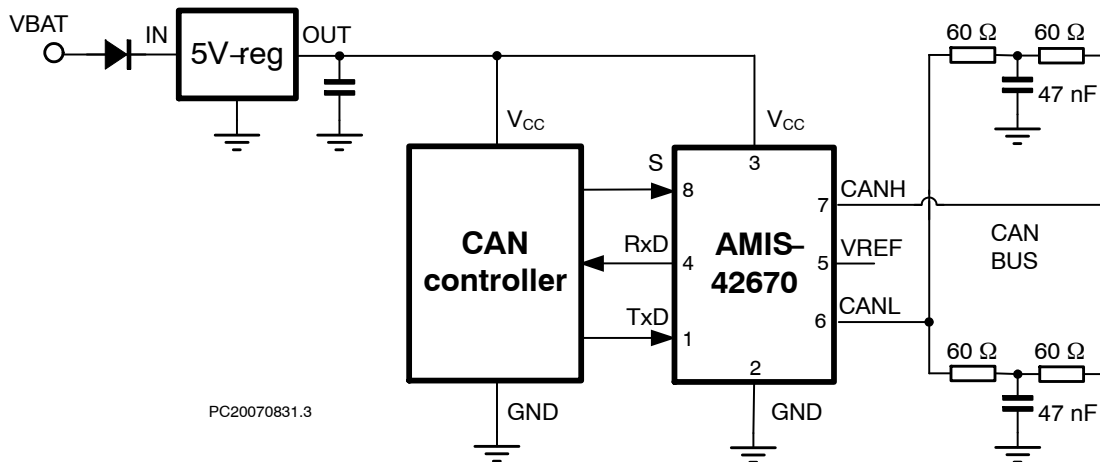## APPLICATION INFORMATION



**Figure 2. Application Diagram**

## FUNCTIONAL DESCRIPTION

**Operating Modes**

The behavior of AMIS−42670 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 S.

**Table 5. FUNCTIONAL TABLE OF AMIS−42670; x = don't care**

| VCC | Pin TxD | Pin S | Pin CANH | Pin CANL | Bus State | Pin RxD |
|---|---|---|---|---|---|---|
| 4.75 V to 5.25 V | 0 | 0 (or Floating) | High | Low | Dominant | 0 |
| 4.75 V to 5.25 V | x | 1 | $V_{CC}/2$ | $V_{CC}/2$ | Recessive | 1 |
| 4.75 V to 5.25 V | 1 (or Floating) | X | $V_{CC}/2$ | $V_{CC}/2$ | Recessive | 1 |
| $V_{CC}$ < PORL (Unpowered) | x | X | 0 V < CANH < $V_{CC}$ | 0 V < CANL < $V_{CC}$ | Recessive | 1 |
| PORL < $V_{CC}$ < 4.75 V | > 2 V | X | 0 V < CANH < $V_{CC}$ | 0 V < CANL < $V_{CC}$ | Recessive | 1 |

**High−Speed Mode**

If Pin S 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.

**Silent Mode**

In silent mode, the transmitter is disabled. All other IC functions continue to operate. The silent mode is selected by connecting Pin S to $V_{CC}$ and can be used to prevent network communication from being blocked, due to a CAN controller which is out of control.

**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.

**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 1 Mbit/s.

**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 3). Pin TxD is pulled high internally should the input become disconnected.

## ELECTRICAL CHARACTERISTICS

**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.

**Table 6. DC CHARACTERISTICS** $V_{CC}$ = 4.75 V to 5.25 V, $T_A$ = −40°C to +150°C; $R_{LT}$ = 60 Ω unless specified otherwise.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SUPPLY** (Pin $V_{CC}$) | | | | | | |
| $I_{CC}$ | Supply Current | Dominant; $V_{TXD}$ = 0V<br>Recessive; $V_{TXD}$ = $V_{CC}$ | 25<br>2 | 45<br>4 | 65<br>8 | 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 | $V_{TxD}$ = 0 V | −75 | −200 | −350 | µA |
| $C_i$ | Input Capacitance | Not Tested | − | 5 | 10 | pF |
| **MODE SELECT** (Pin S) | | | | | | |
| $V_{IH}$ | High−Level Input Voltage | Silent 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 | $V_S$ = 2 V | 20 | 30 | 50 | µA |
| $I_{IL}$ | Low−Level Input Current | $V_S$ = 0.8 V | 15 | 30 | 45 | µA |
| **RECEIVER DATA OUTPUT** (Pin RxD) | | | | | | |
| $V_{OH}$ | High−Level Output Voltage | $I_{RXD}$ = −10 mA | 0.6 x $V_{CC}$ | 0.75 x $V_{CC}$ | | V |
| $V_{OL}$ | Low−Level Output Voltage | $I_{RXD}$ = 6 mA | | 0.25 | 0.45 | V |
| **REFERENCE VOLTAGE OUTPUT** (Pin $V_{REF}$) | | | | | | |
| $V_{REF}$ | Reference Output Voltage | −50 µA < $I_{VREF}$ < +50 µA | 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 | −35 V < $V_{CANH}$ < +35 V;<br>−35 V < $V_{CANL}$ < +35 V | 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 | −35 V < $V_{CANH}$ < +35 V;<br>0 V < $V_{CC}$ < 5.25 V | −2.5 | − | +2.5 | mA |
| $I_{o(reces)(CANL)}$ | Recessive Output Current at Pin CANL | −35 V < $V_{CANL}$ < +35 V;<br>0 V < $V_{CC}$ < 5.25 V | −2.5 | − | +2.5 | mA |
| $V_{o(dom)(CANH)}$ | Dominant Output Voltage at Pin CANH | $V_{TxD}$ = 0 V | 3.0 | 3.6 | 4.25 | V |
| $V_{o(dom)(CANL)}$ | Dominant Output Voltage at Pin CANL | $V_{TxD}$ = 0 V | 0. 5 | 1.4 | 1.75 | V |
| $V_{o(dif)(bus)}$ | Differential Bus Output Voltage ($V_{CANH}$ − $V_{CANL}$) | $V_{TxD}$ = 0 V; Dominant;<br>42.5 Ω < $R_{LT}$ < 60 Ω | 1.5 | 2.25 | 3.0 | V |
| | | $V_{TxD}$ = $V_{CC}$; Recessive;<br>No Load | −120 | 0 | +50 | mV |
| $I_{o(sc)(CANH)}$ | Short Circuit Output Current at Pin CANH | $V_{CANH}$ = 0 V; $V_{TxD}$ = 0 V | −45 | −70 | −95 | mA |
| $I_{o(sc)(CANL)}$ | Short Circuit Output Current at Pin CANL | $V_{CANL}$ = 36 V; $V_{TxD}$ = 0 V | 45 | 70 | 120 | mA |

**Table 6. DC CHARACTERISTICS** $V_{CC}$ = 4.75 V to 5.25 V, $T_A$ = −40°C to +150°C; $R_{LT}$ = 60 Ω unless specified otherwise.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **BUS LINES** (Pins CANH and CANL) | | | | | | |
| $V_{i(dif)(th)}$ | Differential Receiver Threshold Voltage | −5 V < $V_{CANL}$ < +10 V; −5 V < $V_{CANH}$ < +10 V; See Figure 4 | 0.5 | 0.7 | 0.9 | V |
| $V_{ihcm(dif)(th)}$ | Differential Receiver Threshold Voltage for High Common−Mode | −35 V < $V_{CANL}$ < +35 V; −35 V < $V_{CANH}$ < +35 V; See Figure 4 | 0.25 | 0.7 | 1.05 | V |
| $V_{i(dif)(hys)}$ | Differential Receiver Input Voltage Hysteresis | −5 V < $V_{CANL}$ < +10 V; −5 V < $V_{CANH}$ < +10 V; See Figure 4 | 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 |
| $C_{i(CANH)}$ | 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 | $V_{CC}$ = 0 V; $V_{CANH}$ = 5 V | 10 | 170 | 250 | μA |
| $I_{LI(CANL)}$ | Input Leakage Current at Pin CANL | $V_{CC}$ = 0 V; $V_{CANL}$ = 5 V | 10 | 170 | 250 | μA |
| $V_{CM−peak}$ | Common−Mode Peak During Transition from Dom → Rec or Rec → Dom | See Figures 7 and 8 | −500 | | 500 | mV |
| $V_{CM−step}$ | Difference in Common−Mode Between Dominant and Recessive State | See Figures 7 and 8 | −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** | | | | | | |
| $T_{J(sd)}$ | Shutdown Junction Temperature | | 150 | 160 | 180 | °C |
| **TIMING CHARACTERISTICS** (see Figures 5 and 6) | | | | | | |
| $t_{d(TxD−BUSon)}$ | Delay TxD to Bus Active | $V_s$ = 0 V | 40 | 85 | 130 | ns |
| $t_{d(TxD−BUSoff)}$ | Delay TxD to Bus Inactive | $V_s$ = 0 V | 30 | 60 | 105 | ns |
| $t_{d(BUSon−RxD)}$ | Delay Bus Active to RxD | $V_s$ = 0 V | 25 | 55 | 105 | ns |
| $t_{d(BUSoff−RxD)}$ | Delay Bus Inactive to RxD | $V_s$ = 0 V | 65 | 100 | 135 | ns |
| $t_{pd(rec−dom)}$ | Propagation delay TxD to RxD from Recessive to Dominant | $V_s$ = 0 V | 70 | | 245 | ns |
| $t_{d(dom−rec)}$ | Propagation Delay TxD to RxD from Dominant to Recessive | $V_s$ = 0 V | 100 | | 245 | ns |

## MEASUREMENT SETUPS AND DEFINITIONS
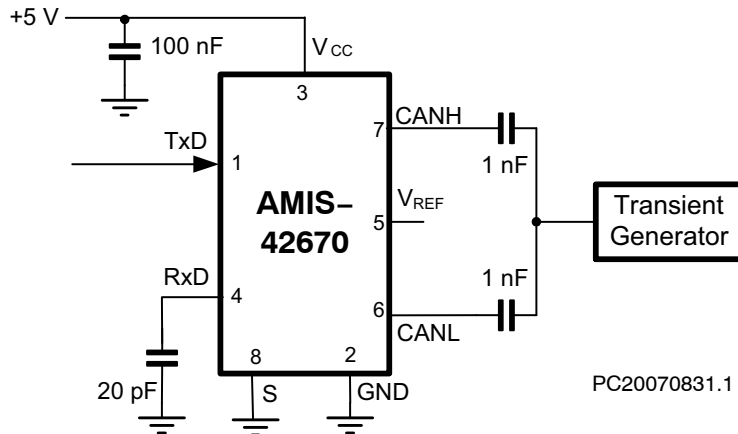
**Figure 3. Test Circuit for Transients**
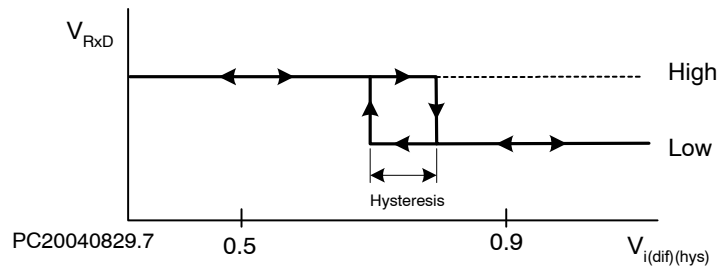
**Figure 4. Hysteresis of the Receiver**
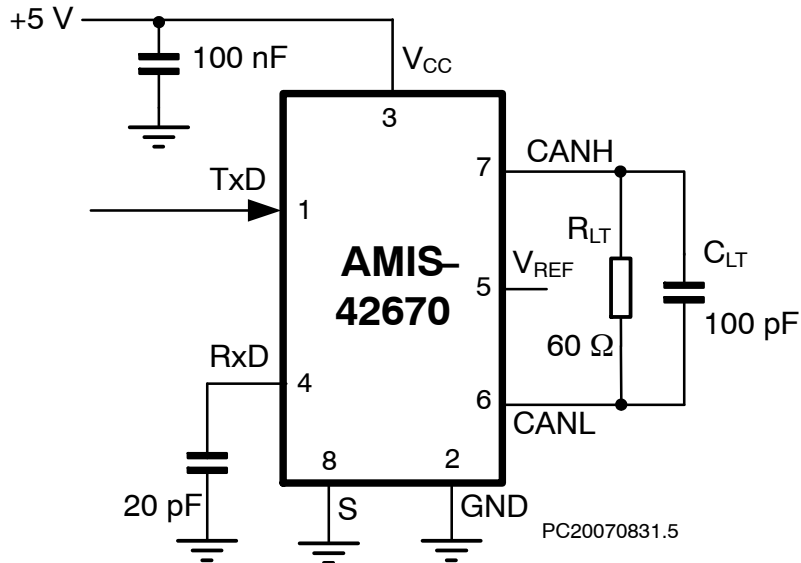
**Figure 5. Test Circuit for Timing Characteristics**
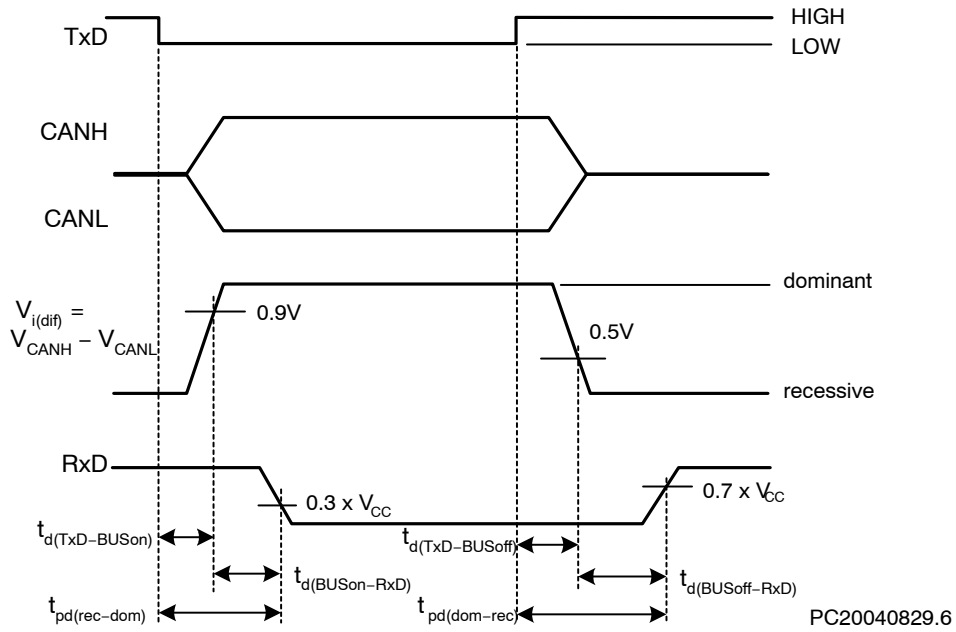
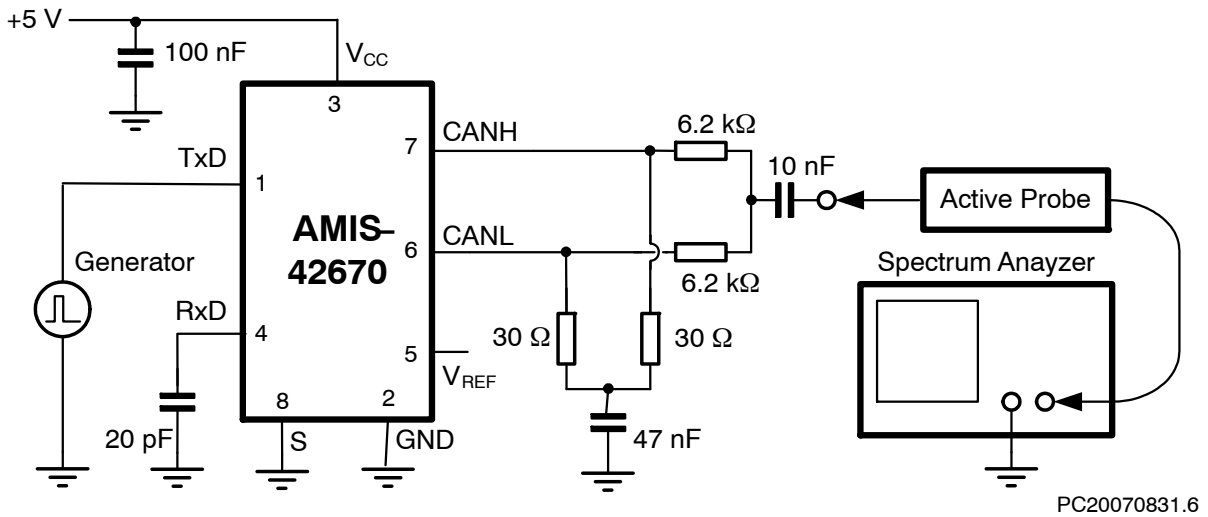**Figure 6. : Timing Diagram for AC Characteristics**



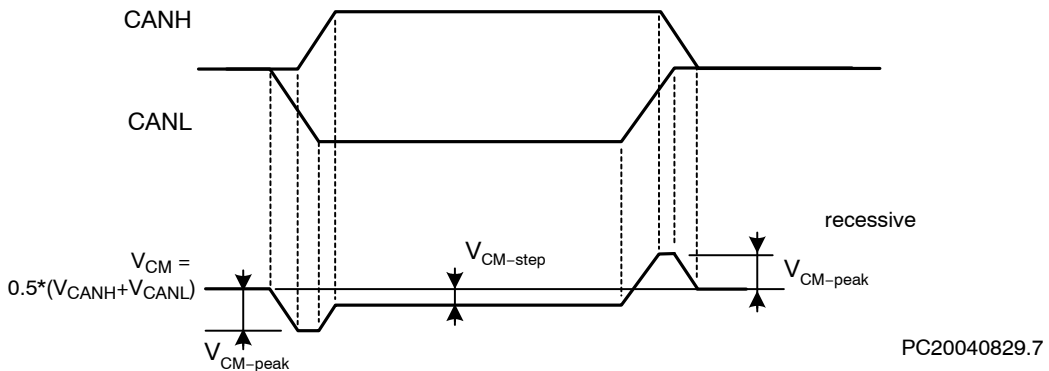**Figure 7. Basic Test Setup for Electromagnetic Measurement**



**Figure 8. Common−Mode Voltage Peaks (See Measurement Setup Figure 7)**
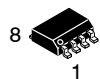
**DEVICE ORDERING INFORMATION**

| Part Number | Temperature Range | Package Type | Shipping[†] |
|---|---|---|---|
| AMIS42670ICAH2G | −40°C − 125°C | SOIC−8 (Pb−Free) | 96 Tube / Tray |
| AMIS42670ICAH2RG | −40°C − 125°C | SOIC−8 (Pb−Free) | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

**ON Semiconductor®**

8

1

**SCALE 1:1**

**SOIC−8**
CASE 751AZ
ISSUE B

DATE 18 MAY 2015

NOTES 4&5

NOTES 4&5

NOTE 6

2X

NOTE 6

**TOP VIEW**

NOTES 3&7

45° CHAMFER

**DETAIL A**

SEATING PLANE

**SIDE VIEW**

SEATING PLANE

NOTE 8

**END VIEW**

DETAIL A

NOTE 7
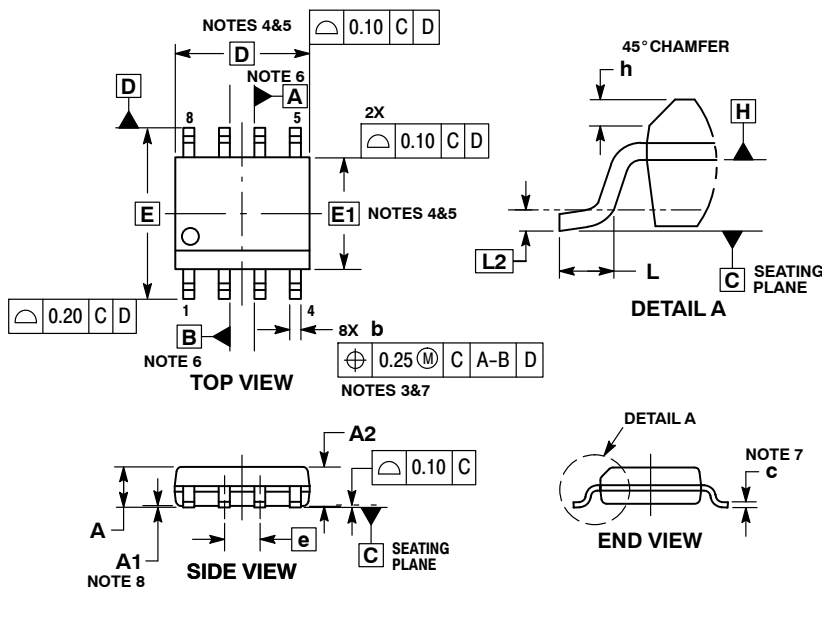
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.004 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.006 mm PER SIDE. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.010 mm PER SIDE.
5. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM. DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
6. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM H.
7. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10 TO 0.25 FROM THE LEAD TIP.
8. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

| DIM | MILLIMETERS | |
| --- | --- | --- |
| | MIN | MAX |
| A | --- | 1.75 |
| A1 | 0.10 | 0.25 |
| A2 | 1.25 | --- |
| b | 0.31 | 0.51 |
| c | 0.10 | 0.25 |
| D | 4.90 BSC | |
| E | 6.00 BSC | |
| E1 | 3.90 BSC | |
| e | 1.27 BSC | |
| h | 0.25 | 0.41 |
| L | 0.40 | 1.27 |
| L2 | 0.25 BSC | |

## RECOMMENDED SOLDERING FOOTPRINT*

8X
0.76

8X
1.52

7.00

1

1.27
PITCH
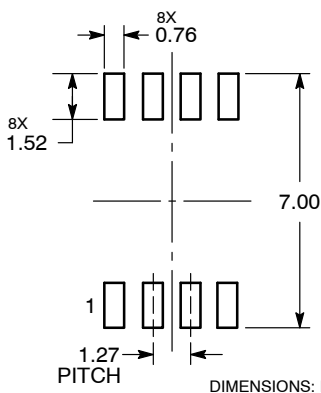
DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## GENERIC MARKING DIAGRAM*

8

XXXXX
ALYWX

1
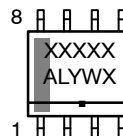
XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G", may or not be present.

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
**Email Requests to:** orderlit@onsemi.com

**onsemi Website:** www.onsemi.com

**TECHNICAL SUPPORT**
**North American Technical Support:**
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

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