AMIS-42675

High Speed Low Power CAN Transceiver for Long Wire Networks

ON Semiconductor®

http://onsemi.com

Description

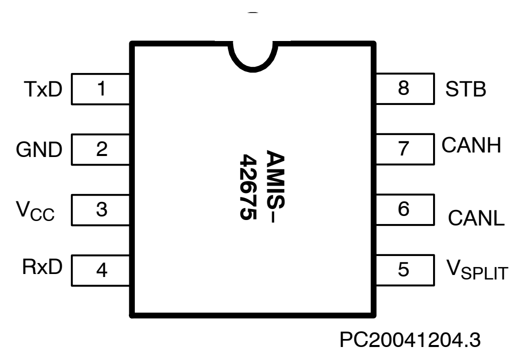
The AMIS−42675 CAN transceiver is the interface between a controller area network (CAN) protocol controller and the physical bus. It may be used in both 12 V and 24 V systems. The transceiver provides differential transmit capability to the bus and differential receive capability to the CAN controller.

Due to the wide common−mode voltage range of the receiver inputs, the AMIS−42675 is able to reach outstanding levels of electro−magnetic susceptibility (EMS). Similarly, extremely low electromagnetic emission (EME) is achieved by the excellent matching of the output signals.

The AMIS−42675 is the industrial version of the AMIS−42665 and primarily 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−42675 allows low transmit data rates down 10 Kbit/s or lower.

The AMIS−42675 is the low power member of the CAN high−speed transceiver family and offers the following additional features:

PIN ASSIGNMENT



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

Features

- Ideal Passive Behavior When Supply Voltage is Removed
- Wake−up Over Bus
- Extremely Low Current Standby Mode
- Compatible With the ISO 11898 standard (ISO 11898−2, ISO 11898−5 and SAE J2284)
- Wide Range of Bus Communication Speed (0 up to 1 Mbit/s)
- Ideally Suited for 12 V and 24 V Industrial and Automotive Applications
- Allows Low Transmit Data Rate in Networks Exceeding 1 km
- Extremely Low Current Standby Mode with Wake−up via the Bus
- Low Electromagnetic Emission (EME): Common−Mode Choke is No Longer Required
- Differential Receiver with Wide Common−Mode Range (±35 V) for High EMS
- Voltage Source via V_{SPLIT} Pin for Stabilizing the Recessive Bus Level (Further EMC Improvement)
- No Disturbance of the Bus Lines with an Unpowered Node
- Thermal Protection
- Bus Pins Protected Against Transients
- Power Down Mode in Which the Transmitter is Disabled
- Bus and V_{SPLIT} Pins Short Circuit Proof to Supply Voltage and Ground
- Logic Level Inputs Compatible with 3.3 V Devices
- At Least 110 Nodes can be Connected to the Same Bus
- 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.

December, 2008 − Rev. 2

Publication Order Number:
AMIS−42675/D

Table 1. TECHNICAL CHARACTERISTICS

Symbol	Parameter	Condition	Max	Max	Unit
V_{CC}	Power Supply Voltage		4.75	5.25	V
V_{STB}	DC Voltage at Pin STB		−0.3	V_{CC}	V
V_{TxD}	DC Voltage at Pin TxD		−0.3	V_{CC}	V
V_{RxD}	DC Voltage at Pin RxD		−0.3	V_{CC}	V
V_{CANH}	DC Voltage at Pin CANH	$0 < V_{CC} < 5.25$ V; No Time Limit	−35	+35	V
V_{CANL}	DC Voltage at Pin CANL	$0 < V_{CC} < 5.25$ V; No Time Limit	−35	+35	V
V_{SPLIT}	DC Voltage at Pin V_{SPLIT}	$0 < V_{CC} < 5.25$ V; No Time Limit	−35	+35	V
$V_{O(dif)(bus\_dom)}$	Differential Bus Output Voltage in Dominant State	$42.5\ \Omega < R_{LT} < 60\ \Omega$	1.5	3	V
CM−range	Input Common−Mode Range for Comparator	Guaranteed Differential Receiver Threshold and Leakage Current	−35	+35	V
$V_{CM-peak}$	Common−Mode Peak	Note 1	−500	500	mV
C_{load}	Load Capacitance on IC Outputs			15	pF
$t_{pd(rec-dom)}$	Propagation Delay TxD to RxD	See Figure 4	70	230	ns
$t_{pd(dom-rec)}$	Propagation Delay TxD to RxD	See Figure 4	100	245	ns
$V_{CM-step}$	Common−Mode Step	Note 1	−150	150	mV
T_{junc}	Junction Temperature		−40	150	°C

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

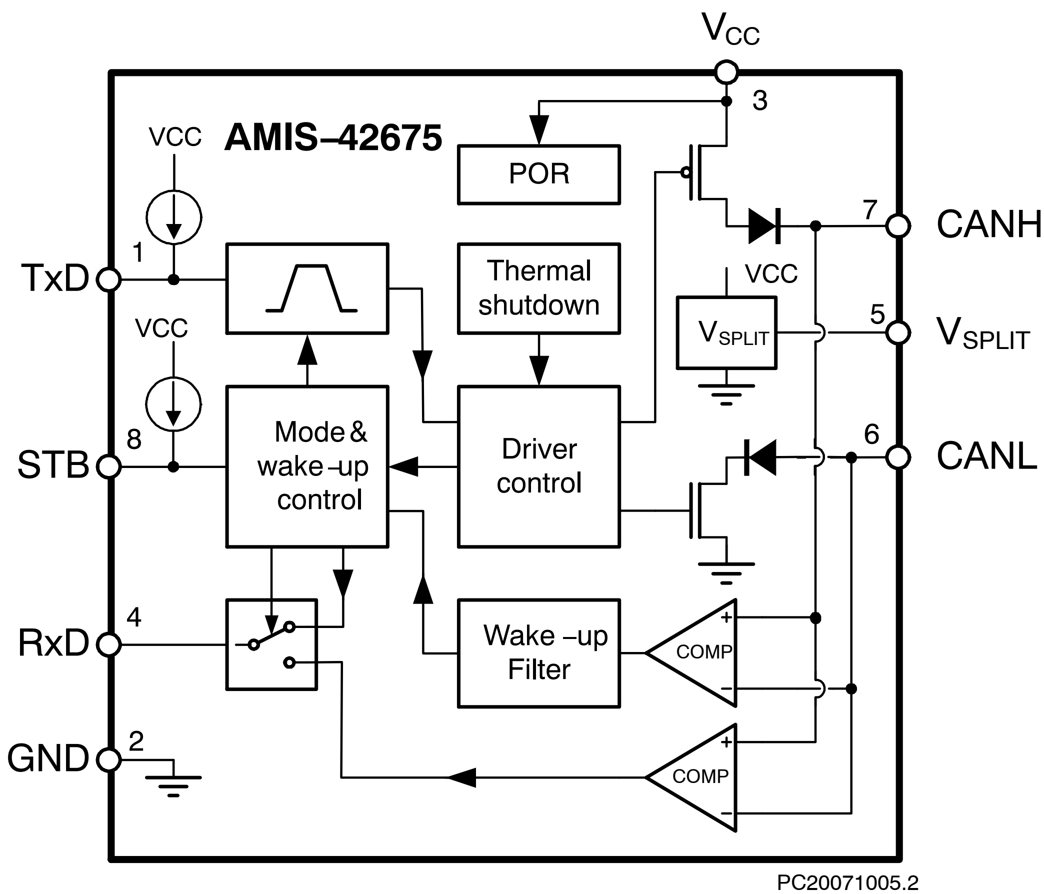


Figure 1. Block Diagram

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_{SPLIT}	Common−Mode Stabilization Output
6	CANL	Low−Level CAN Bus Line (Low in Dominant Mode)
7	CANH	High−Level CAN Bus Line (High in Dominant Mode)
8	STB	Standby Mode Control Input

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	−50	+50	V
V_{CANL}	DC Voltage at Pin CANL	0 < V_{CC} < 5.25 V; No Time Limit	−50	+50	V
V_{SPLIT}	DC Voltage at Pin V_{SPLIT}	0 < V_{CC} < 5.25 V; No Time Limit	−50	+50	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_{STB}	DC Voltage at Pin STB		−0.3	V_{CC} + 0.3	V
$V_{tran(CANH)}$	Transient Voltage at Pin CANH	Note 2	−300	+300	V
$V_{tran(CANL)}$	Transient Voltage at Pin CANL	Note 2	−300	+300	V
$V_{tran(VSPLIT)}$	Transient Voltage at Pin V_{SPLIT}	Note 2	−300	+300	V
$V_{esd(}$	Electrostatic Discharge Voltage at all Pins	Note 4 Note 5	−5 −750	+5 +750	kV V
Latch−up	Static Latch−up at All Pins	Note 4		120	mA
T_{stg}	Storage Temperature		−55	+150	°C
T_A	Ambient Temperature		−40	+125	°C
T_J	Maximum Junction Temperature		−40	+170	°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 electrostatic discharge (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	145	k/W
$R_{th(vj-s)}$	Thermal Resistance from Junction−to−Substrate of Bare Die	In Free Air	45	k/W

APPLICATION SCHEMATIC

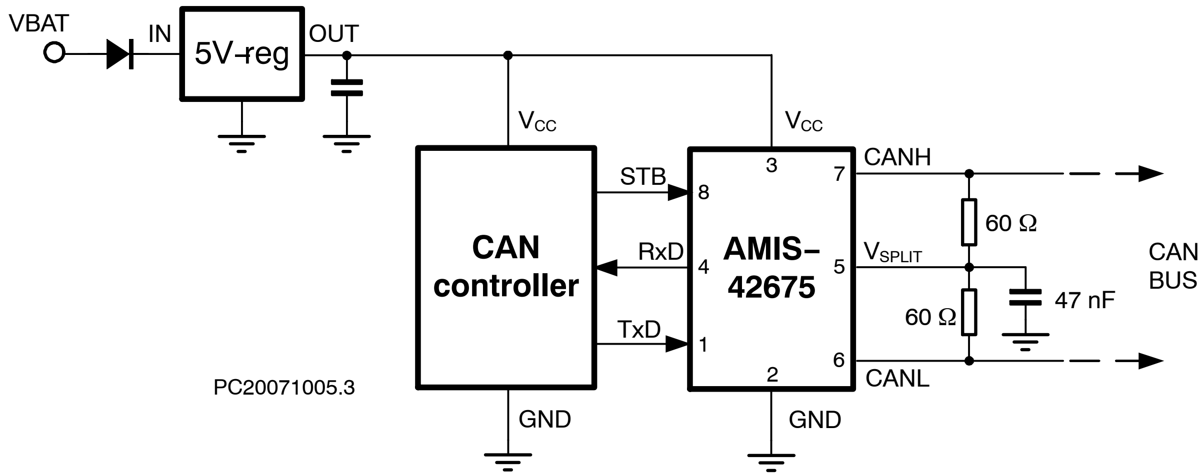


Figure 2. Application Diagram

FUNCTIONAL DESCRIPTION

Operating Modes

AMIS−42675 provides two modes of operation as illustrated in Table 5. These modes are selectable through Pin STB.

Table 5. OPERATING MODES

Mode	Pin STB	Pin RXD	
		Low	High
Normal	Low	Bus Dominant	Bus Recessive
Standby	High	Wake−up Request Detected	No wake−up Request Detected

Normal Mode

In the normal mode, the transceiver 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 lines outputs are optimized to give extremely low EME.

Standby Mode

In stand−by mode both the transmitter and receiver are disabled and a very low−power differential receiver monitors the bus lines for CAN bus activity. The bus lines are terminated to ground and supply current is reduced to a minimum, typically 10 μA. When a wake−up request is detected by the low−power differential receiver, the signal is first filtered and then verified as a valid wake signal after a time period of t_{BUS}, the RxD Pin is driven low by the transceiver to inform the controller of the wake−up request.

Split Circuit

The V_{SPLIT} Pin is operational only in normal mode. In standby mode this pin is floating. The V_{SPLIT} is connected as shown in Figure 2 and its purpose is to provide a stabilized DC voltage of 0.5 x V_{CC} to the bus avoiding possible steps in the common−mode signal therefore reducing EME. These unwanted steps could be caused by an un−powered node on the network with excessive leakage current from the bus that shifts the recessive voltage from its nominal 0.5 x V_{CC} voltage.

Wake−up

Once a valid wake−up (dominant state longer than t_{BUS}) has been received during the standby mode, the RxD Pin is driven low.

Overtemperature 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 needed 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 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). Pins TxD and STB are pulled high internally should the input become disconnected. Pins TxD, STB and RxD will be floating, preventing reverse supply should the V_{CC} supply be removed.

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_J = −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} = 0 V Recessive; V_{TxD} = V_{CC}		45 4	65 8	mA
I_{CCS}	Supply Current in Standby Mode	$T_{junc,max}$ = 100°C		10	15	μA
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}	−5	0	+5	μA
I_{IL}	Low−Level Input Current	V_{TxD} = 0 V	−75	−200	−350	μA
C_i	Input Capacitance	Not Tested	−	5	10	pF
TRANSMITTER MODE SELECT (Pin STB)						
V_{IH}	High−Level Input Voltage	Standby Mode	2.0	−	V_{CC} + 0.3	V
V_{IL}	Low−Level Input Voltage	Normal Mode	−0.3	−	+0.8	V
I_{IH}	High−Level Input Current	V_{STB} = V_{CC}	−5	0	+5	μA
I_{IL}	Low−Level Input Current	V_{STB} = 0 V	−1	−4	−10	μA
C_i	Input Capacitance	Not Tested	−	5	10	pF
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} = 5 mA		0.25	0.45	V
I_{oh}	High−level output current	V_o = 0.7 x V_{CC}	−5	−10	−15	mA
I_{ol}	Low−level output current	V_o = 0.3 x V_{CC}	5	10	15	mA
BUS LINES (Pins CANH and CANL)						
$V_{o(reces)(norm)}$	Recessive Bus Voltage	V_{TxD} = V_{CC}; No Load Normal Mode	2.0	2.5	3.0	V
$V_{o(reces)(stby)}$	Recessive Bus Voltage	V_{TxD} = V_{CC}; No Load Standby Mode	−100	0	100	mV
$I_{o(reces)(CANH)}$	Recessive Output Current at Pin CANH	−35 V < V_{CANH} < +35 V; 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; 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
$V_{o(dif)(bus\_dom)}$	Differential Bus Output Voltage (V_{CANH} − V_{CANL})	V_{TxD} = 0 V; Dominant; 42.5 Ω < R_{LT} < 60 Ω	1.5	2.25	3.0	V
$V_{o(dif)(bus\_rec)}$	Differential Bus Output Voltage (V_{CANH} − V_{CANL})	V_{TxD} = V_{CC}; Recessive; 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	−120	mA

Table 6. DC CHARACTERISTICS V_{CC} = 4.75 V to 5.25 V, T_J = −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)						
$I_{o(sc)(CANL)}$	Short Circuit Output Current at Pin CANL	V_{CANL} = 36 V; V_{TxD} = 0 V	45	70	120	mA
$V_{i(dif)\ (th)}$	Differential Receiver Threshold Voltage (see Figure 4)	−5 V < V_{CANL} < +12 V; −5 V < V_{CANH} < +12V;	0.5	0.7	0.9	V
$V_{ihcm(dif)(th)}$	Differential Receiver Threshold Voltage for High Common−Mode (see Figure 4)	35 V < V_{CANL} < +35 V; − 35 V < V_{CANH} < +35 V;	0.40	0.7	1.00	V
$V_{i(dif)(hys)}$	Differential Receiver Input Voltage Hysteresis (see Figure 4)	−35 V < V_{CANL} < +35 V; −35 V < V_{CANH} < +35 V;	50	70	100	mV
$R_{i(cm)(CANH)}$	Common−Mode Input Resistance at Pin CANH		15	26	37	kΩ
$R_{i(cm)(CANL)}$	Common−Mode Input Resistance at Pin CANL		15	26	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
$C_{i(CANH)}$	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
COMMON−MODE STABILIZATION (Pin V_{SPLIT})						
V_{SPLIT}	Reference Output Voltage at Pin V_{SPLIT}	Normal Mode; −500 μA < I_{SPLIT} < 500 μA	0.3 x V_{CC}	−	0.7 x V_{CC}	
$I_{SPLIT(i)}$	V_{SPLIT} Leakage Current	Standby Mode	−5		+5	μA
$I_{SPLIT(lim)}$	V_{SPLIT} Limitation Current	Normal Mode	−3		+3	mA
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 3 and 4)						
$t_{d(TxD-BUSon)}$	Delay TXD to Bus Active	C_l = 100 pF between CANH to CANL	40	85	105	ns
$t_{d(TxD-BUSoff)}$	Delay TXD to Bus Inactive	C_l = 100 pF between CANH to CANL	30	60	105	ns
$t_{d(BUSon-RXD)}$	Delay Bus Active to RXD	C_{rxd} = 15 pF	25	55	105	ns
$t_{d(BUSoff-RXD)}$	Delay Bus Inactive to RXD	C_{rxd} = 15 pF	40	100	105	ns
$t_{pd(rec-dom)}$	Propagation Delay TXD to RXD from Recessive to Dominant	C_l = 100 pF between CANH to CANL	90		230	ns
$t_{d(dom-rec)}$	Propagation delay TXD to RXD from Dominant to Recessive	C_l = 100 pF between CANH to CANL	90		245	ns
$t_{d(stb-nm)}$	Delay Standby Mode to Normal Mode		5	7.5	10	μs
t_{dbus}	Dominant Time for Wake−up via Bus		0.75	2.5	5	μs

MEASUREMENT SETUPS AND DEFINITIONS

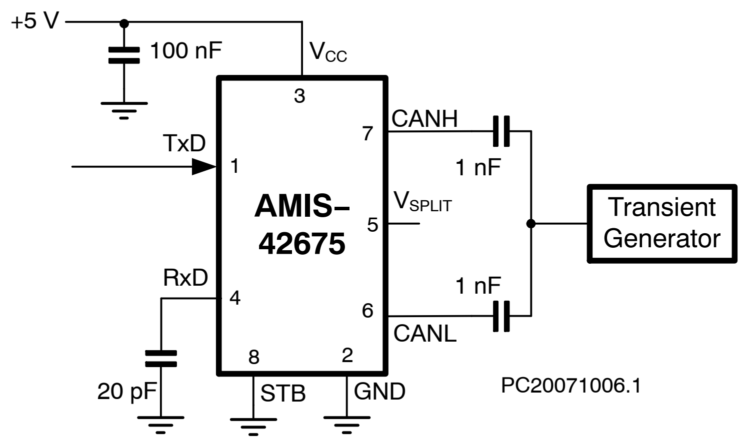


Figure 3. Test Circuit for Transients

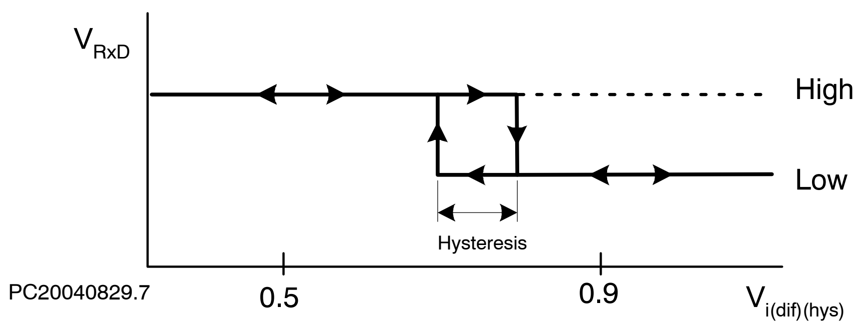


Figure 4. Hysteresis of the Receiver

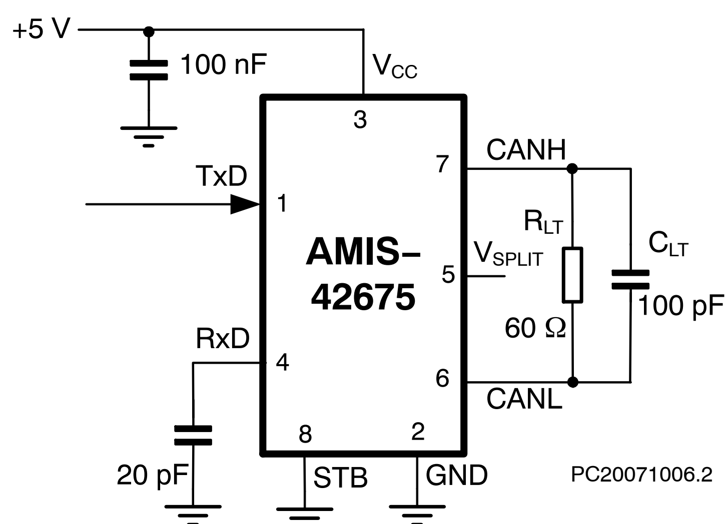


Figure 5. Test Circuit for Timing Characteristics

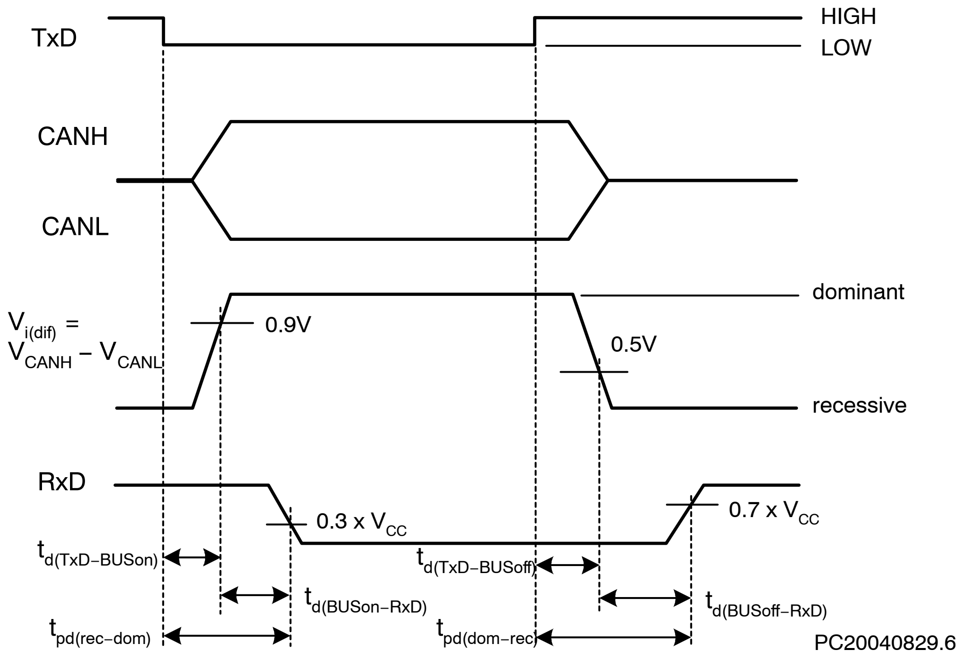


Figure 6. Timing Diagram for AC Characteristics

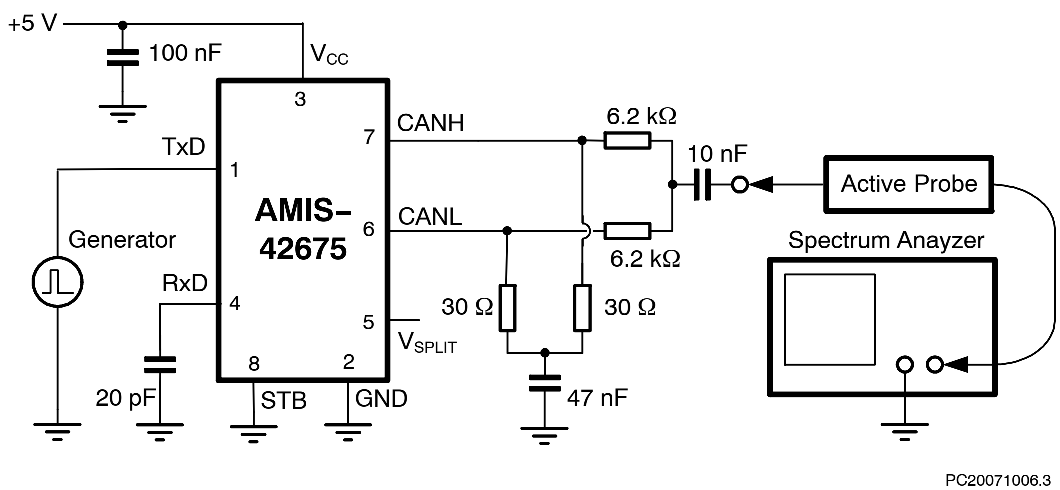


Figure 7. Basic Test Set−up for EME

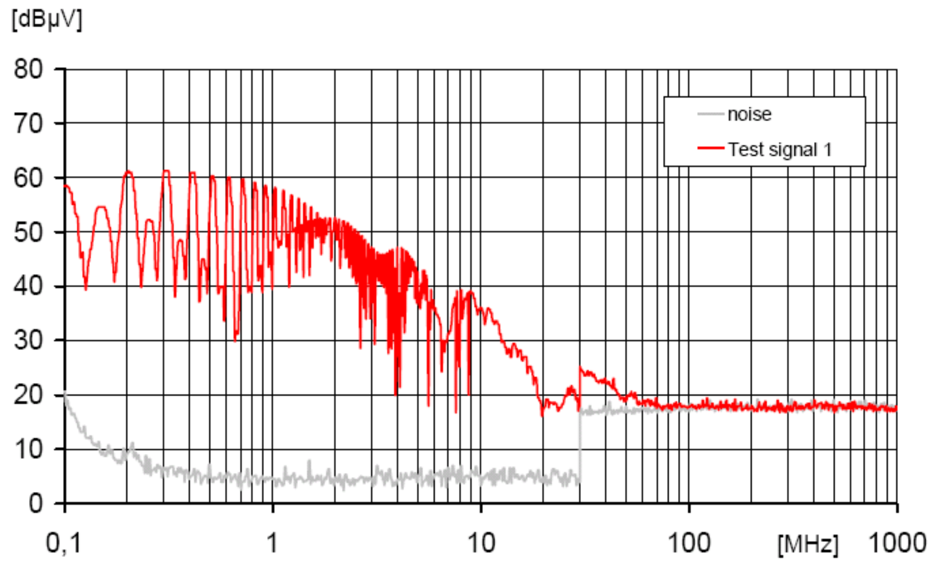


Figure 8. EME Measurements

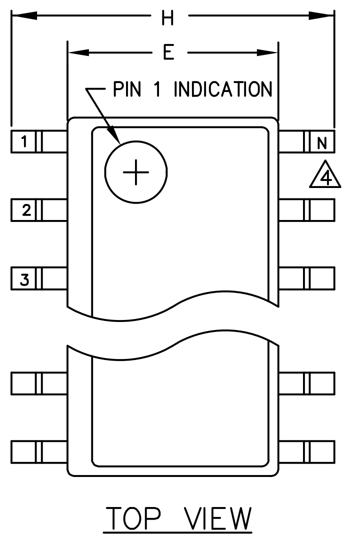
DEVICE ORDERING INFORMATION

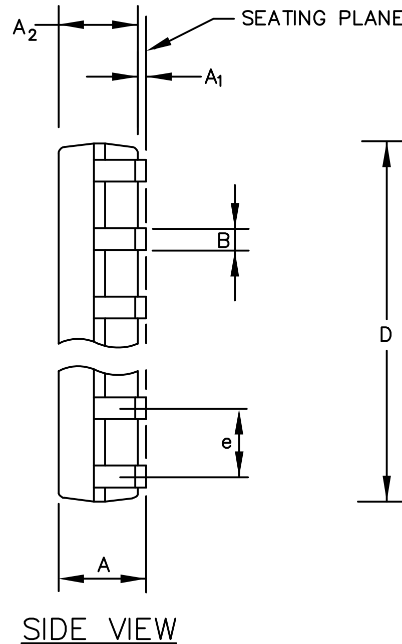
Part Number	Temperature Range	Package Type	Shipping†
AMIS42675ICAH2G	−40°C − 125°C	SOIC−8 (Pb−Free)	96 Tube / Tray
AMIS42675ICAH2RG	−40°C − 125°C	SOIC−8 (Pb−Free)	3000 / Tape & Reel

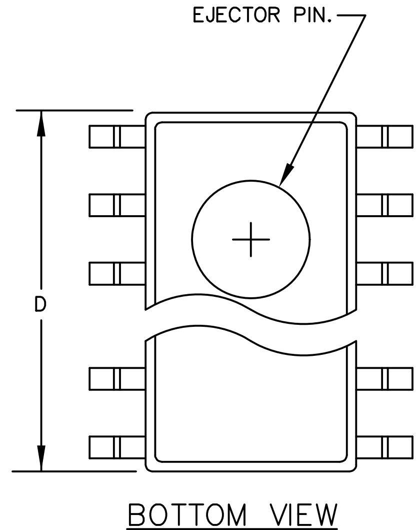
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

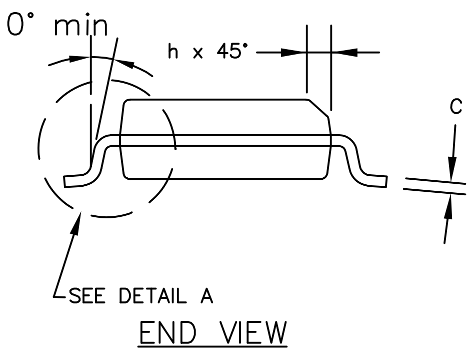
PACKAGE DIMENSIONS

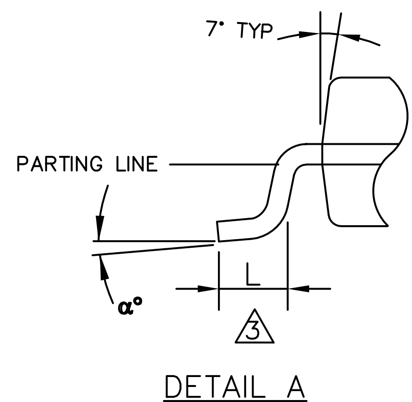
SOIC 8
CASE 751AZ−01
ISSUE O











SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	.061	.064	.068	
A_1	.004	.006	0.010	
A_2	.055	.058	.061	
B	.0138	.016	.020	
C	.0075	.008	.0098	
D	SEE VARIATIONS			1
E	.150	.155	.157	
e	.050 BSC			
H	.230	.236	.244	
h	.010	.013	.016	
L	.016	.025	.035	
N	SEE VARIATIONS			2
α°	0°	5°	8°	

VARIATIONS				
	1			2
	D			N
NOTE	MIN.	NOM.	MAX.	
AA	.189	.194	.196	8
AB	.337	.342	.344	14
AC	.386	.391	.393	16

1. ALL DIMENSIONS ARE IN MILLIMETERS.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
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