1.0 General Description

The AMIS-30663 CAN transceiver is the interface between a controller area network (CAN) protocol controller and the physical bus and may be used in both 12V and 24V systems. The digital interface level is powered from a 3.3V or 5V supply providing true I/O voltage levels for 3.3V or 5V CAN controllers.

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-30663 is able to reach outstanding levels of electromagnetic susceptibility. Similarly, extremely low electromagnetic emission is achieved by the excellent matching of the output signals.

2.0 Key Features

- True 3.3V or 5V digital input/output
- Fully compatible with the "ISO 11898-2" standard
- Certified "Authentication on CAN Transceiver Conformance (d1.1)"
- High speed (up to 1Mbaud)
- 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 for high electro magnetic susceptibility (EMS) (+/- 35V)
- No disturbance of the bus lines with an unpowered node
- Transmit data (TXD) dominant time-out function
- Thermal protection
- Bus pins protected against transients in an automotive environment
- Power down mode in which the transmitter is disabled
- Short circuit proof to supply voltage and ground

3.0 Technical Characteristics

Table 1. Technical Characteristics

| Symbol	Parameter	Conditions	Min	Max	Unit
V_{CANH}	DC voltage at pin CANH	0 < VCC < 5.25V; no time limit	-45*	+45*	V
V_{CANL}	DC voltage at pin CANL	0 < VCC < 5.25V; no time limit	-45*	+45*	V
Vi(dif) (bus_dom)	Differential bus output voltage Dominant	$42.5\Omega < RLT < 60\Omega$	1.5	3	V
Tpd(rec-dom) and Tpd(dom-rec)	Propagation delay TxD to RxD	See Figure 7	70	245	ns
CM-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 8 and 9 (Note)	-500	500	mV
$V_{CM-step}$	Common-mode step	See Figure 8 and 9 (Note)	-150	150	mV

Notes : The parameters $V_{CM-peak}$ and $V_{CM-step}$ guarantee low electromagnetic emission.
* -85V min and +60V max also possible. Please contact your local sales representative for details.
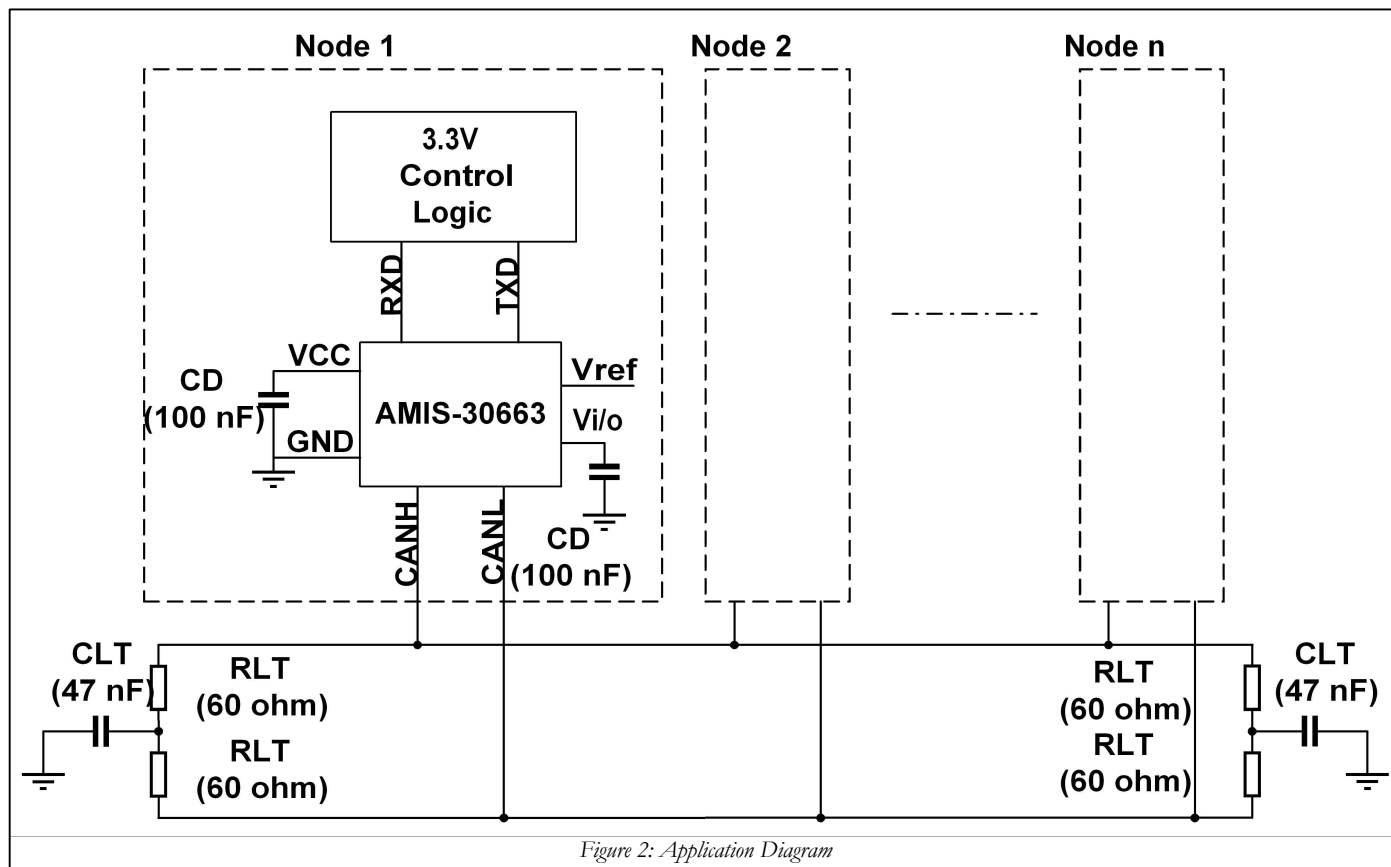
4.0 Ordering Information

Part N°	**AMIS-30663**
Package	**SO-8**
Temp. Range	**-40°C…125°C**

5.0 Block Diagram

Figure 1: Block Diagram
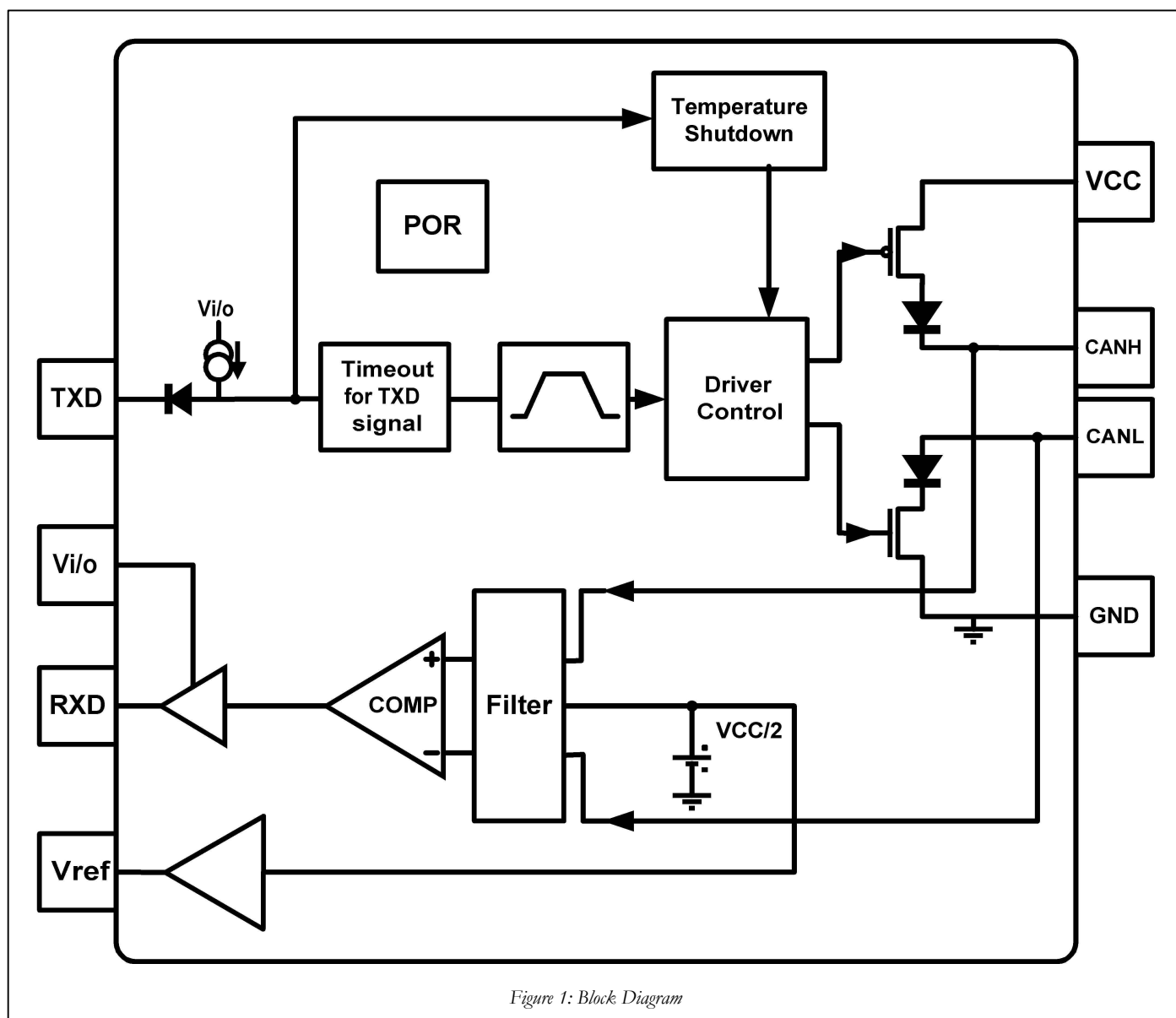
6.0 Typical Application Schematic

6.1 Application Schematic

Figure 2: Application Diagram

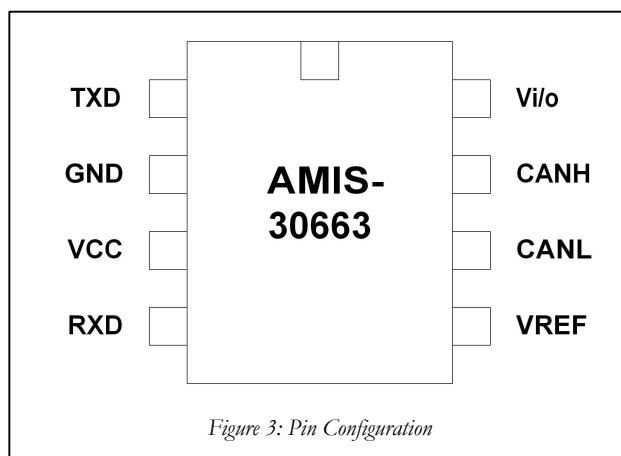## 6.2 Typical External Components

Table 2. Typical External Components

Comp.	Function	Value	Units
RLT	Line termination resistor	60	O
CLT	Line termination capacitor	47	nF
CD	Decoupling capacitor	100	nF

6.3 Pin Description

6.3.1 Pin Out (top view)

Figure 3: Pin Configuration

6.3.2 Pin Description

Table 3: Pin Description

Nr	Name	Type	Description
1	TXD		Transmit data input
2	GND		Ground
3	VCC		Supply voltage
4	RXD		Receive data output
5	Vref		Reference voltage output
6	CANL		Low-level CAN bus line (low in dom. mode)
7	CANH		High-level CAN bus line (high in dom. mode)
8	Vi/o		3.3V/5V supply for digital I/O

7.0 Functional Description

The AMIS-30663 is the interface between the CAN protocol controller and the physical bus. The device may be used to interface with 3.3V and 5V controllers by use of the Vi/o pin (PIN8). This pin may be supplied with 3.3V or 5V to have the corresponding digital interface voltage level. It is intended for use in automotive and industrial applications requiring baud rates up to 1Mbaud. It provides differential transmit capability to the bus and differential receiver capability to the CAN protocol controller. It is fully compatible to the "ISO 11898-2" standard.

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.

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.

The pins CANH and CANL are protected from automotive electrical transients (according to "ISO 7637"; see Figure 4).

A 'TXD dominant time-out' timer circuit prevents the bus lines being driven to a permanent dominant state (blocking all network communication) if pin TXD is forced permanently low by a hardware and/or software application failure. The timer is triggered by a negative edge on pin TXD. If the duration of the low-level on pin TXD exceeds the internal timer value, the transmitter is disabled, driving the bus into a recessive state. The timer is reset by a positive edge on pin TXD.

Table 4: Function Table of the CAN Transceiver

VCC	TXD	CANH	CANL	BUS State	RXD
4.75V to 5.25V	X	0.5VCC	0.5VCC	Recessive	1
4.75V to 5.25V	1 (or floating)	0.5VCC	0.5VCC	Recessive	1
VCC < PORL (POR-level; not powered)	X	0 V < VCANH < VCC	0V < VCANL < VCC	Recessive	1
PORL < VCC < 4.75V	> 2V	0 V < VCANH < VCC	0V < VCANL < VCC	Recessive	1

X = doesn't care

8.0 Electrical Characteristics

8.1 Definitions

All voltages are referenced to GND (pin 2). Positive currents flow into the IC. Sinking current means that the current is flowing into the pin. Sourcing current means that 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 effect device reliability.

Table 5: Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
VCC	Supply voltage		-0.3	+7	V
Vi/o	Supply voltage		-0.3	+7	V
VCANH	DC voltage at pin CANH	0 < VCC < 5.25V; no time limit	-45	+45	V
VCANL	DC voltage at pin CANL	0 < VCC < 5.25V; no time limit	-45	+45	V
VTXD	DC voltage at pin TXD		-0.3	VCC + 0.3	V
VRXD	DC voltage at pin RXD		-0.3	VCC + 0.3	V
Vref	DC voltage at pin Vref		-0.3	VCC + 0.3	V
Vtran(CANH)	Transient voltage at pin CANH	Note 1	-150	+150	V
Vtran(CANL)	Transient voltage at pin CANL	Note 1	-150	+150	V
Vesd	Electrostatic discharge voltage at all pins	Note 2	-4000	+4000	V
		Note 4	-500	+500	V
Latch-up	Static latch-up at all pins	Note 3		100	mA
Tstg	Storage temperature		-55	+155	°C
Tamb	Ambient temperature		-40	+125	°C
Tjunc	Maximum junction temperature		-40	+150	°C

* -85V min and +60V max also possible. Please contact your local sales representative for details.

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.
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 6: Thermal Characteristics

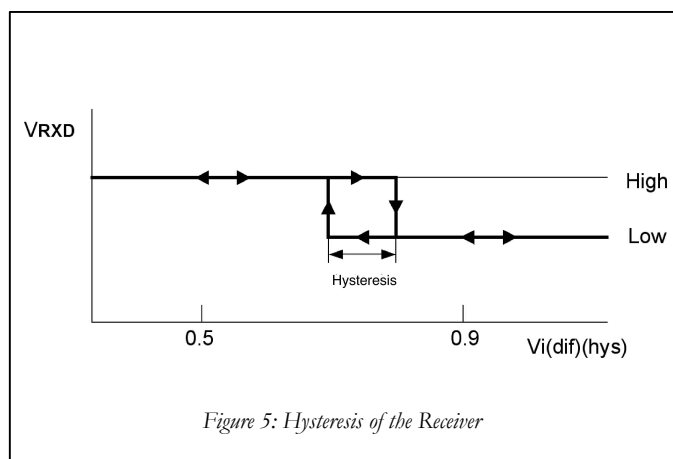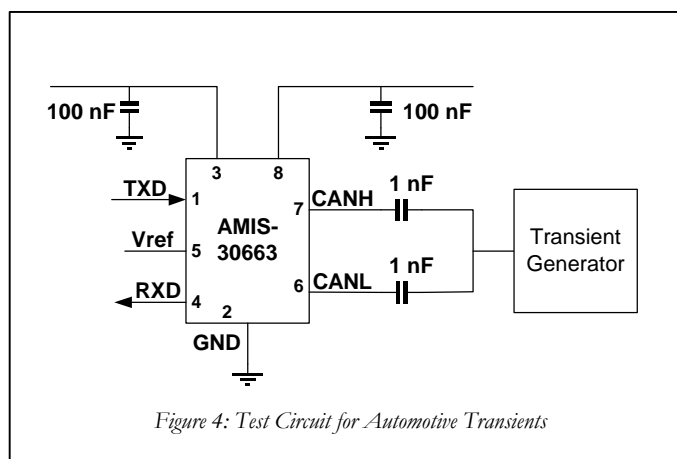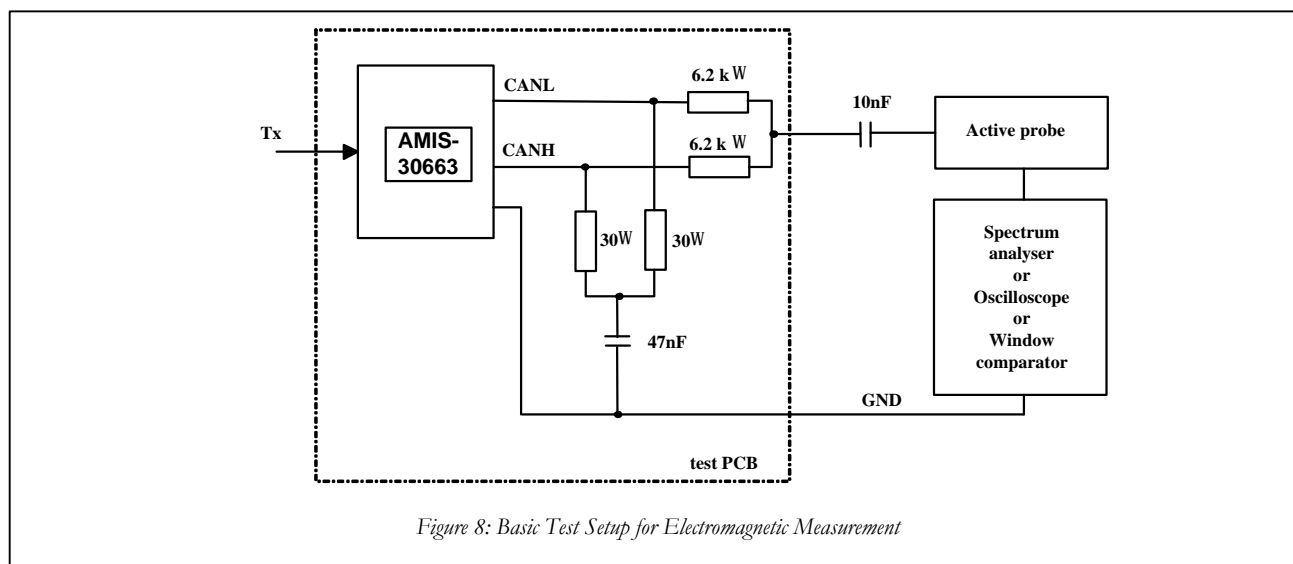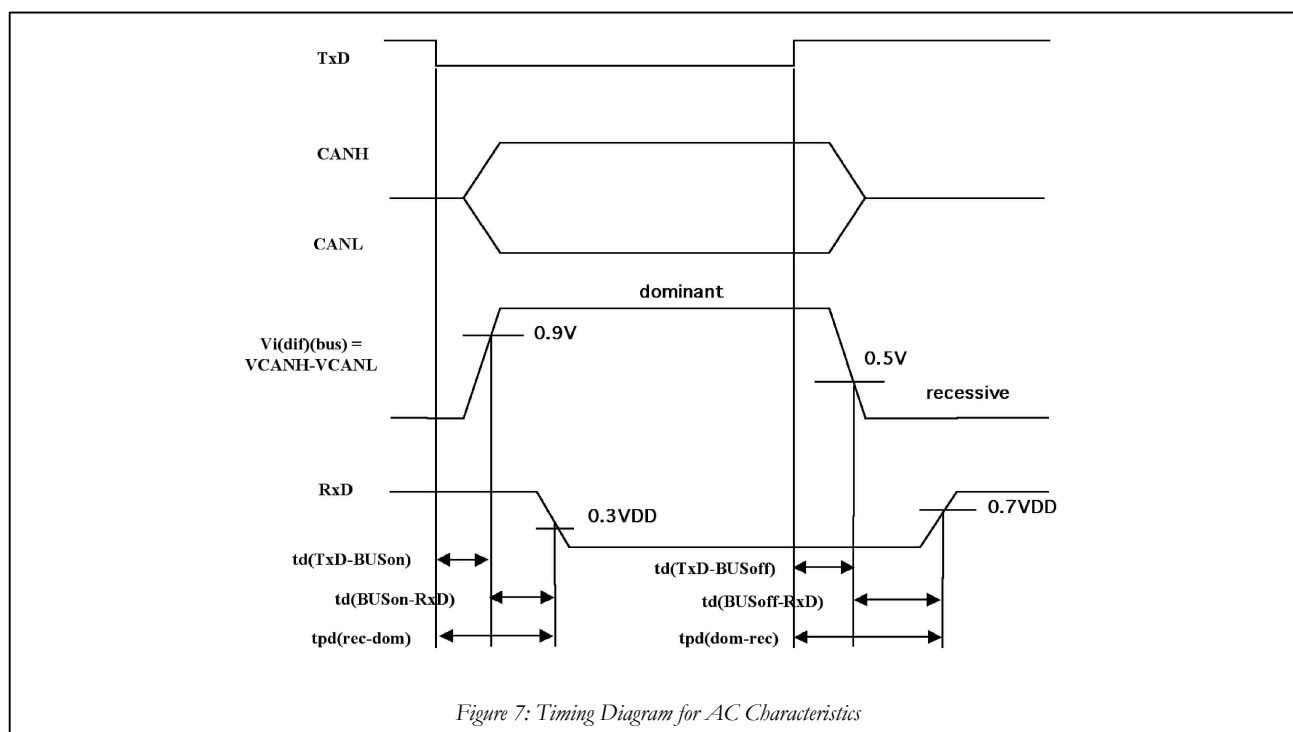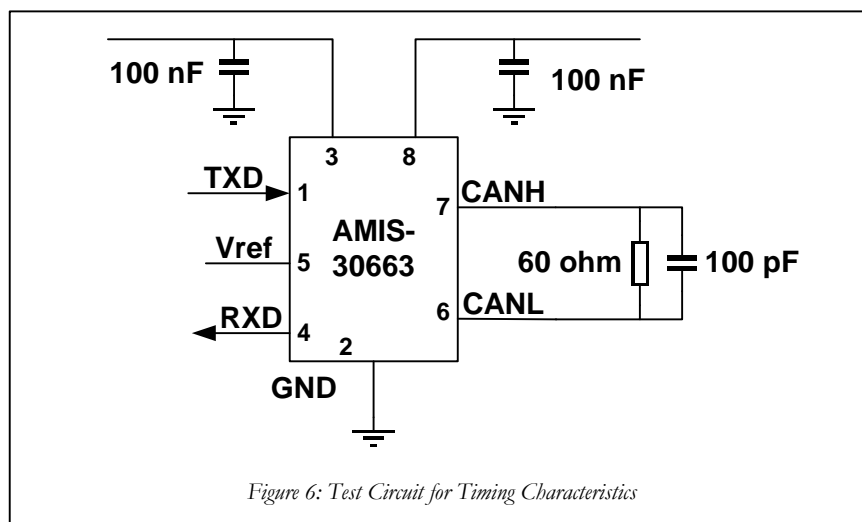| Symbol	Parameter	Conditions	Value	Unit
Rth(vj-a)	Thermal resistance from junction to ambient in SO8 package (2 layer PCB)	In free air	150	K/W
Rth(vj-s)	Thermal resistance from junction to substrate of bare die	In free air	45	K/W

8.4 Characteristics

VCC = 4.75V to 5.25V; Vi/o = 2.9V to 3.6V; Tjunc = -40°C to +150°C; RLT = 60Ω unless otherwise specified.

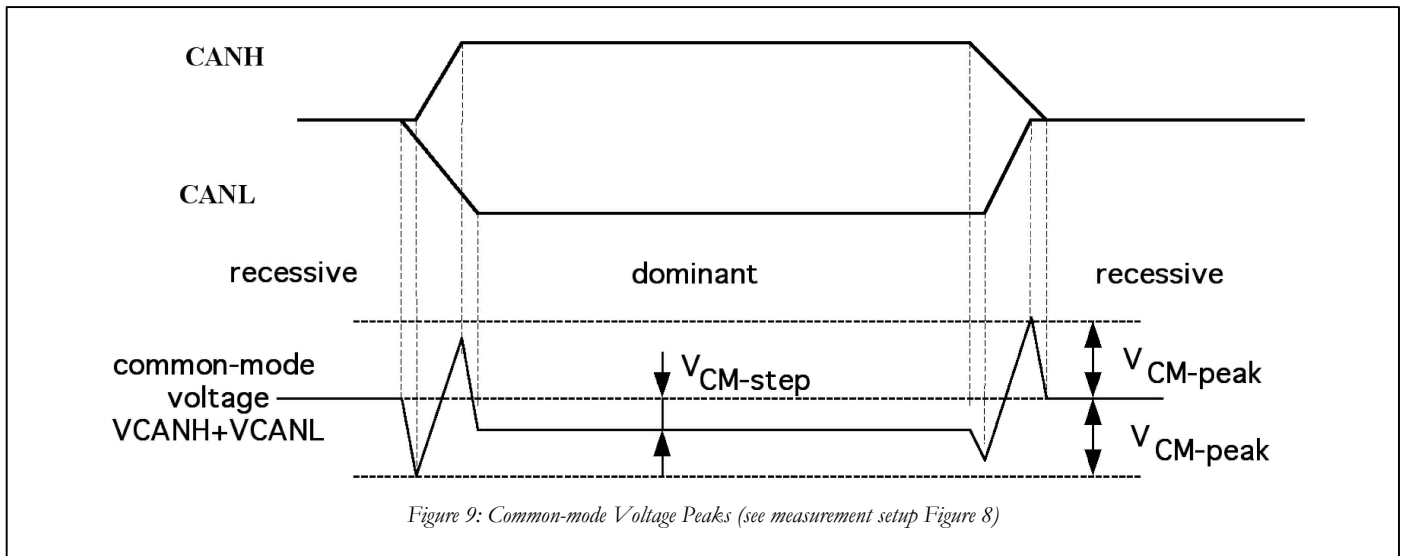Table 7: Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		Supply (pin VCC)				
ICC	Supply current	Dominant VTXD = 0V		44	65	MA
		Recessive VTXD = VCC		5	8	mA
Vi/o	supply current	Vi/o = 3.3V (20pF, 1Mbps)		30	100	μA
Vi/o	supply current	Vi/o = 5.0V (20pF, 1Mbps)		50	170	μA
		Transmitter data input (pin TXD)				
VIH	High-level input voltage	Output recessive	2.0		VCC + 0.3	V
VIL	Low-level input voltage	Output dominant	-0.3		+0.8	V
IIH	High-level input current	Vi/o = 5V	-5	0	+5	μA
IIH	High-level input current	Vi/o = 3.3V	-45	0	+215	μA
IIL	Low-level input current	VTXD = 0V	-75	-200	-350	μA
Ci	Input capacitance	Not tested		5	10	pF
		Receiver data output (pin RXD)				
VOH	High-level output voltage	IRXD = -10mA	0.6 x Vi/o		0.75 x Vi/o	VCC
VOL	Low-level output voltage	IRXD = 5mA		0.25	0.45	V
		Reference voltage output (pin Vref)				
Vref	Reference output voltage at pin Vref	-50μA < IVref < +50μA	0.45	0.5	0.55	VCC
Vref_CM	Reference output voltage at pin Vref for full CM range	-35V < VCANH < +35V -35V < VCANL < +35V	0.4	0.5	0.6	VCC
		Bus lines (pins CANH and CANL)				
Vo(reces) (CANH)	Recessive bus voltage at pin CANH	VTXD = VCC; no load	2.0	2.5	3.0	V
Vo(reces) (CANL)	Recessive bus voltage at pin CANL	VTXD = VCC; no load	2.0	2.5	3.0	V
Io(reces) (CANH)	Recessive output current at pin CANH	-35V < VCANH < +35V; 0V < VCC < 5.25V	-2.5		+2.5	mA
Io(reces) (CANL)	Recessive output current at pin CANL	-35V < VCANL < +35V; 0V < VCC < 5.25V	-2.5		+2.5	mA
Vo(dom) (CANH)	Dominant output voltage at pin CANH	VTXD = 0V	3.0	3.6	4.25	V
Vo(dom) (CANL)	Dominant output voltage at pin CANL	VTXD = 0V	0. 5	1.4	1.75	V
Vi(dif) (bus)	Differential bus input voltage (VCANH - VCANL)	VTXD = 0V; dominant; 42.5Ω < RLT < 60Ω	1.5	2.25	3.0	V
		VTXD = VCC; recessive; no load	-120	0	+50	mV
Io(sc) (CANH)	Short-circuit output current at pin CANH	VCANH = 0V; VTXD = 0V	-45	-70	-95	mA
Io(sc) (CANL)	Short-circuit output current at pin CANL	VCANL = 36V; VTXD = 0V	45	70	120	mA
Vi(dif)(th)	Differential receiver threshold voltage	-5 V < VCANL < +12V; -5 V < VCANH < +12V; see Figure 5	0.5	0.7	0.9	V
Vihcm(dif) (th)	Differential receiver threshold voltage for high common-mode	-35 V < VCANL < +35V; -35 V < VCANH < +35V; see Figure 5	0.30	0.7	1.05	V
Vi(dif) (hys)	Differential receiver input voltage hysteresis	-5 V < VCANL < +12V; -5 V < VCANH < +12V; see Figure 5	50	70	100	mV
Ri(cm)(CANH)	Common-mode input resistance at pin CANH		15	25	37	KΩ
Ri(cm) (CANL)	Common-mode input. Resistance at pin CANL		15	25	37	KΩ
Ri(cm)(m)	Matching between pin CANH and pin CANL Common-mode input resistance	VCANH = VCANL	-3	0	+3	%
Ri(dif)	Differential input resistance		25	50	75	KΩ
Ci(CANH)	Input capacitance at pin CANH	VTXD = VCC; not tested		7.5	20	pF
Ci(CANL)	Input capacitance at pin CANL	VTXD = VCC; not tested		7.5	20	pF
Ci(dif)	Differential input capacitance	VTXD = VCC; not tested		3.75	10	pF
ILI(CANH)	Input leakage current at pin CANH	VCC = 0V; VCANH = 5V	10	170	250	μA
ILI(CANL)	Input leakage current at pin CANL	VCC = 0V; VCANL = 5V	10	170	250	μA
VCM-peak	Common-mode peak during transition from dom → rec or rec → dom	See Figure 8 and 9	-500		500	mV
VCM-step	Difference in common-mode between dom and recessive state	See Figure 8 and 9	-150		150	mV

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power on reset						
PORL	POR level	CANH, CANL, Vref in tri-state below POR level	2.2	3.5	4.7	V
Thermal shutdown						
Tj(sd)	Shutdown junction temperature		150	160	180	°C
Timing characteristics (see Figures 6 and 7)						
td(TXD-BUSon)	Delay TXD to bus active	VS = 0V	40	85	130	ns
td(TXD-BUSoff)	Delay TXD to bus inactive	VS = 0V	30	60	105	ns
td(BUSon-RXD)	Delay bus active to RXD	VS = 0V	25	55	105	ns
td(BUSoff-RXD)	Delay bus inactive to RXD	VS = 0V	65	100	155	ns
tpd(rec-dom)	Propagation delay TXD to RXD from recessive to dominant	VS = 0V	70		230	ns
td(dom-rec)	Propagation delay TXD to RXD from dominant to recessive	VS = 0V	100		245	ns
tdom(TXD)	TXD dominant time for time out	VTXD = 0V	250	450	750	µs

Figure 4: Test Circuit for Automotive Transients

Figure 5: Hysteresis of the Receiver

Figure 6: Test Circuit for Timing Characteristics

Figure 7: Timing Diagram for AC Characteristics

Figure 8: Basic Test Setup for Electromagnetic Measurement

Figure 9: Common-mode Voltage Peaks (see measurement setup Figure 8)

8.5 Soldering

Introduction to soldering surface mount packages. This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "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.

8.6 Reflow Soldering

Reflow 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 reflowing. 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°C to 250°C. The top surface temperature of the packages should preferably be kept below 230°C.

8.7 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):
  o 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;
  o 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° 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.

8.8 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 10 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°C 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 heatsink (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° 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.