

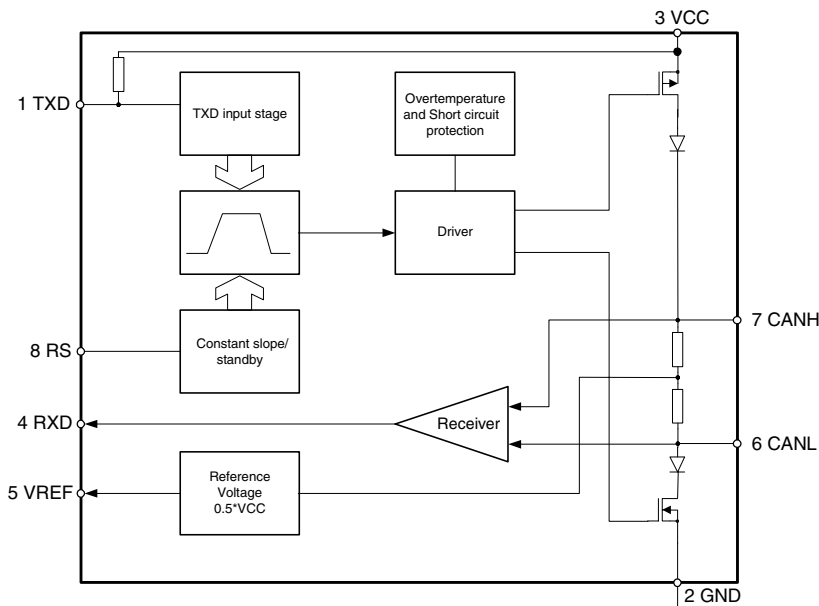
## Features

- Usable for Automotive 12 V/24 V and Industrial Applications
- Maximum High-speed Data Transmissions up to 1 Mbaud
- Fully Compatible with ISO 11898
- Controlled Slew Rate
- Standby Mode
- TXD Input Compatible to 3.3 V
- Short-circuit Protection
- Overtemperature Protection
- High Voltage Bus Lines Protection, -40 V to +40 V
- High Speed Differential Receiver Stage with a Wide Common Mode Range, -10 V to +10 V, for High Electromagnetic Immunity (EMI)
- Fully Controlled Bus Lines, CANH and CANL to Minimize Electromagnetic Emissions (EME)
- High ESD Protection at CANH, CANL HBM 8 kV, MM 300 V

## Description

The ATA6660 is a monolithic circuit based on the Atmel's Smart Power BCD60-III technology. It is especially designed for high speed CAN-Controller (CAN-C) differential mode data transmission between CAN-Controllers and the physical differential bus lines.

Figure 1. Block Diagram



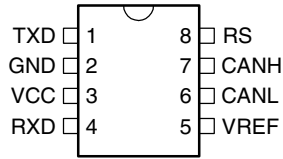
## High-speed CAN Transceiver

## ATA6660



## Pin Configuration

Figure 2. Pinning SO8



## Pin Description

Pin	Symbol	Function
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 voltage input/output
7	CANH	High level CAN voltage input/output
8	RS	Switch standby mode/normal mode

## Functional Description

The ATA6660 is a monolithic circuit based on Atmel's Smart Power BCD60-III technology. It is especially designed for high-speed differential mode data transmission in harsh environments like automotive and industrial applications. Baudrate can be adjusted up to 1 Mbaud. The ATA6660 is fully compatible to the ISO11898, the developed standard for high speed CAN-C (Controller Area Network) communication.

## Voltage Protection and ESD

High voltage protection circuitry on both line pins, CANH (Pin 7) and CANL (Pin 6), allow bus line voltages in the range of -40 V to +40 V. ESD protection circuitry on line pins allow HBM = 8 kV, MM = 300 V. The implemented high voltage protection on bus line output/input pins (7/6) makes the ATA6660 suitable for 12 V automotive applications as well as 24 V automotive applications.

## Slope Control

A fixed slope is adjusted to prevent unsymmetrical transients on bus lines causing EMC problems. Controlled bus lines, both CANH and CANL signal, will reduce radio frequency interference to a minimum. In well designed bus configurations the filter design costs can be reduced dramatically.

## Overcurrent Protection

In the case of a line shorts, like CANH to GND, CANL to VCC, integrated short current limitation allows a maximum current of  $I_{CANH\_SC}$  or  $I_{CANL\_SC}$ . If junction temperature rises above 165°C an internal overtemperature protection circuitry shuts down both output stages, the receiver will stay activated.

## Standby Mode

The ATA6660 can be switched to standby mode by forcing the voltage  $V_{RS} > 0.87 \times V_{CC}$ . In standby mode the supply current will reduce dramatically, supply current during standby mode is typical  $600 \mu A$  ( $I_{VCC\_stby}$ ). Transmitting data function will not be supported, but the opportunity will remain to receive data. A high-speed comparator is listening for activities on the bus. A dominant bus signal will force the output RXD to a low level in typical  $t_{dRXDL} = 400 \text{ ns}$ . If the RS pin is not connected, causing through a broken connection to the controller, the ATA6660 will switch to standby mode automatically.

## High-speed Receiver

In normal mode a fast receiver circuitry combined with a resistor network is able to detect differential bus line voltages  $V_{rec\_th} > 0.9 \text{ V}$  as dominant bit, differential bus line voltages  $V_{rec\_th} < 0.5 \text{ V}$  as recessive bit.

The wide receiver common mode range,  $-10 \text{ V}$  to  $+10 \text{ V}$ , combined with a symmetrical differential receiver stage offers high immunity against electromagnetic interference. A typical hysteresis of  $70 \text{ mV}$  is implemented. Dominant differential bus voltages forces RXD output (Pin 4) to low level, recessive differential bus voltages to high level.

## TXD Input

The input stage Pin 1 (TXD) is compatible for  $3.3 \text{ V}$  output levels from new controller families. Pull-up resistance ( $25 \text{ k}\Omega$ ) forces the IC to recessive mode, if TXD-Pin is not connected. TXD low signal drives the transmitter into dominant state.

## Transmitter

A integrated complex compensation technique allows stable data transmission up to  $1 \text{ MBaud}$ . Low level on TXD input forces bus line voltages CANH to  $3.5 \text{ V}$ , CANL to  $1.5 \text{ V}$  with a termination resistor of  $60 \Omega$ . In the case of a line short circuit, like CANH to GND, CANL to VCC, integrated short current limitation circuitry allows a maximum current of  $150 \text{ mA}$ . If junction temperature rises above typical  $163^\circ\text{C}$  an internal overtemperature protection shuts down both output stages, the receive mode will stay activated.

## Split Termination Concept

With a modified bus termination (see Figure 5) a reduction of emission and a higher immunity of the bus system can be achieved. The one  $120 \Omega$  resistor at the bus line end nodes is split into two resistors of equal value, i.e., two resistors of  $60 \Omega$ . The resistors for the stub nodes is recommended with two resistors of  $1,3 \text{ k}\Omega$ . (for example 8 stub nodes and 2 bus end nodes) Notice: The bus load of all the termination resistors has to stay within the range of  $50 \Omega$  to  $65 \Omega$ .

The common mode signal at the centre tap of the termination is connected to ground via a capacitor of e.g.,  $C_{split} = 10 \text{ nF}$  to  $100 \text{ nF}$ . A separate ground lead to the ground pin of the module connector is recommended.

## Absolute Maximum Ratings

Parameters	Symbol	Conditions	Min.	Max.	Unit
Supply voltage	$V_{CC}$		-0.3	+6	V
DC voltage at Pins 1, 4, 5 and 8	$V_{TXD}$ , $V_{REF}$ , $V_{RS}$ , $V_{RXD}$		-0.3	$V_{CC} + 0.3$	V
DC voltage at Pins 6 and 7	$V_{CANH}$ , $V_{CANL}$	$0\text{ V} < V_{CC} < 5.25\text{ V}$ ; no time limit	-40.0	+40.0	V
Transient voltage at Pins 6 and 7			-150	+100	V
Storage temperature	$T_{Stg}$		-55	+150	°C
Operating ambient temperature	$T_{amb}$		-40	+125	°C
ESD classification	All pins	HBM ESD S.5.1 MM JEDEC A115A	±3000 ±200		V V
ESD classification	Pin 6, 7 versus Pin 2	HBM 1.5 kΩ, 100 pF MM 0Ω, 200 pF	±8000 ±300		V V

## Thermal Resistance

Parameters	Symbol	Value	Unit
Thermal resistance from junction to ambient	$R_{thJA}$	160	K/W

## Truth Table

VCC	TXD	RS	CANH	CANL	Bus State	RXD
4.75 V to 5.25 V	0	$< 0.3 \times V_{CC}$	3.5 V	1.5 V	Dominant	0
4.75 V to 5.25 V	1 (or floating)	$< 0.3 \times V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	Recessive	1
4.75 V to 5.25 V	X	$> 0.87 \times V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	Recessive	1

## RS (Pin 8) Functionality

Slope Control	Mode	Voltage and Current Levels
$V_{RS} > 0.87 \times V_{CC}$	Standby	$I_{RS} <  10\ \mu\text{A} $
$V_{RS} < 0.3 \times V_{CC}$	Constant slope control	$I_{RS} \leq 500\ \mu\text{A}$

## Electrical Characteristics

$V_{CC} = 4.75\text{ V to }5.25\text{ V}$ ;  $T_{amb} = -40^{\circ}\text{C to }+125^{\circ}\text{C}$ ;  $R_{Bus} = 60\ \Omega$ ; unless otherwise specified

All voltages referenced to ground (Pin 2); positive input current.

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
<b>1</b>	<b>Supply Current</b>								
1.1	Supply current dominant	$V_{TXD} = 0\text{ V}$ $V_{RS} = 0\text{ V}$	3	$I_{VCC\_dom}$		45	60	mA	A
1.2	Supply current recessive	$V_{TXD} = 5\text{ V}$ $V_{RS} = 0\text{ V}$	3	$I_{VCC\_rec}$		10	15	mA	A
1.3	Supply current stand-by	$V_{RS} = 5\text{ V}$	3	$I_{VCC\_stby}$		600	980	$\mu\text{A}$	A
<b>2</b>	<b>Transmitter Data Input TXD</b>								
2.1	HIGH level input voltage	$V_{TXD} = 5\text{ V}$ $V_{RS} = 0\text{ V}$	1	$V_{TXDH}$	2		$V_{CC}+0.3$	V	A
2.2	LOW level input voltage	$V_{TXD} = 0\text{ V}$ $V_{RS} = 0\text{ V}$	1	$V_{TXDL}$	-0.3		+1	V	A
2.3	HIGH level input current	$V_{TXD} = V_{CC}$	1	$I_{IH}$	-1		0	$\mu\text{A}$	A
2.4	LOW level input voltage	$V_{TXD} = 0\text{ V}$	1	$I_{IL}$	-500		-50	$\mu\text{A}$	A
<b>3</b>	<b>Receiver Data Output RXD</b>								
3.1	High level output voltage	$I_{RXD} = -100\ \mu\text{A}$	4	$V_{RXDH}$	$0.8 \times V_{CC}$		$V_{CC}$	V	A
3.2	Low level output voltage	$I_{RXD} = 1\text{ mA}$	4	$V_{RXDL}$	0		$0.2 \times V_{CC}$	V	A
3.3	Short current at RXD	$V_{TXD} = 5\text{ V}$ $V_{RXD} = 0\text{ V}$	4	$I_{RXDs1}$	-3		-1	mA	A
3.4	Short current at RXD	$V_{TXD} = 0\text{ V}$ $V_{RXD} = 5\text{ V}$	4	$I_{RXDs2}$	2		6	mA	A
<b>4</b>	<b>Reference Output Voltage VREF</b>								
4.1	Reference output voltage normal mode	$V_{RS} = 0\text{ V}$ ; $-50\ \mu\text{A} < I_5 < 50\ \mu\text{A}$	5	$V_{ref\_no}$	$0.45 V_{CC}$	-	$0.55 V_{CC}$	V	A
4.2	Reference output voltage standby mode	$V_{RS} = 5\text{ V}$ ; $-5\ \mu\text{A} < I_5 < 5\ \mu\text{A}$	5	$V_{ref\_stby}$	$0.4 \times V_{CC}$	-	$0.6 V_{CC}$	V	A
<b>5</b>	<b>DC Bus Transmitter CANH; CANL</b>								
5.1	Recessive bus voltage	$V_{TXD} = V_{CC}$ ; no load	6, 7	$V_{CANH}$ ; $V_{CANL}$	2.0	2.5	3.0	V	A
5.2	$I_{O(CANH)(reces)}$ $I_{O(CANL)(reces)}$	$-40\text{ V} < V_{CANH}$ ; $V_{CANL} < 40\text{ V}$ ; $0\text{ V} < V_{CC} < 5.25\text{ V}$	6, 7	$I_{O\_reces}$	-5		+5	mA	A
5.3	CANH output voltage dominant	$V_{TXD} = 0\text{ V}$	6, 7	$V_{CANH}$	2.8	3.5	4.5	V	A
5.4	CANL output voltage dominant	$V_{TXD} = 0\text{ V}$	6, 7	$V_{CANL}$	0.5	1.5	2.0	V	A

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

## Electrical Characteristics (Continued)

$V_{CC} = 4.75\text{ V to }5.25\text{ V}$ ;  $T_{amb} = -40^{\circ}\text{C to }+125^{\circ}\text{C}$ ;  $R_{Bus} = 60\ \Omega$ ; unless otherwise specified

All voltages referenced to ground (Pin 2); positive input current.

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
5.5	Differential bus output voltage ( $V_{CANH} - V_{CANL}$ )	$V_{TXD} = 0\text{ V}$ ; $R_L = 45\ \Omega\text{ to }60\ \Omega$ ; $V_{CC} = 4.9\text{ V}$	6, 7	$V_{diff\_dom}$	1.5	2	3.0	V	A
5.6		$V_{TXD} = V_{CC}$ ; no load	6, 7	$V_{diff\_rec}$	-500		+50	mV	A
5.7	Short-circuit CANH current	$V_{CANH} = -10\text{ V}$ $TXD = 0\text{ V}$	6, 7	$I_{CANH\_SC}$	-35		-100	mA	A
5.8	Short-circuit CANL current	$V_{CANL} = 18\text{ V}$ $TXD = 0\text{ V}$	6, 7	$I_{CANL\_SC}$	50	-	150	mA	A
<b>6</b>	<b>DC Bus Receiver CANH; CANL</b>								
6.1	Differential receiver threshold voltage normal mode	$-10\text{ V} < V_{CANH} < +10\text{ V}$ $-10\text{ V} < V_{CANL} < +10\text{ V}$	6, 7	$V_{rec\_th}$	0.5	0.7	0.9	V	A
6.2	Differential receiver threshold voltage stand-by mode	$V_{RS} = V_{CC}$	6, 7	$V_{rec\_th\_stby}$	0.5	0.7	0.9	V	A
6.3	Differential input hysteresis		6, 7	$V_{diff(hys)}$		70		mV	A
6.4	CANH and CANL common mode input resistance		6, 7	$R_i$	5	15	25	$k\Omega$	A
6.5	Differential input resistance		6, 7	$R_{diff}$	10	30	100	$k\Omega$	A
6.6	Matching between CANH and CANL common mode input resistance		6, 7	$R_{i\_m}$	-3		+3	%	A
6.7	CANH, CANL input capacitance		6, 7	$C_i$			20	pF	D
6.8	Differential input capacitance		6, 7	$C_{diff}$			10	pF	D
6.9	CANH, CANL input leakage input current	$V_{CC} = 0\text{ V}$ $V_{CANH} = 3.5\text{ V}$ $V_{CANL} = 1.5\text{ V}$	6, 7	$I_{LI(CANH)}$ ; $I_{LI(CANL)}$			250	$\mu\text{A}$	A
<b>7</b>	<b>Thermal Shut-down</b>								
7.1	Shut-down junction temperature for CANH/CANL			$T_{J(SD)}$	150	163	175	$^{\circ}\text{C}$	B
7.2	Switch on junction temperature for CANH/CANL			$T_{J(SD)}$	140	154	165	$^{\circ}\text{C}$	B
7.3	Temperature hysteresis			$T_{Hys}$		10		K	B

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

## Electrical Characteristics (Continued)

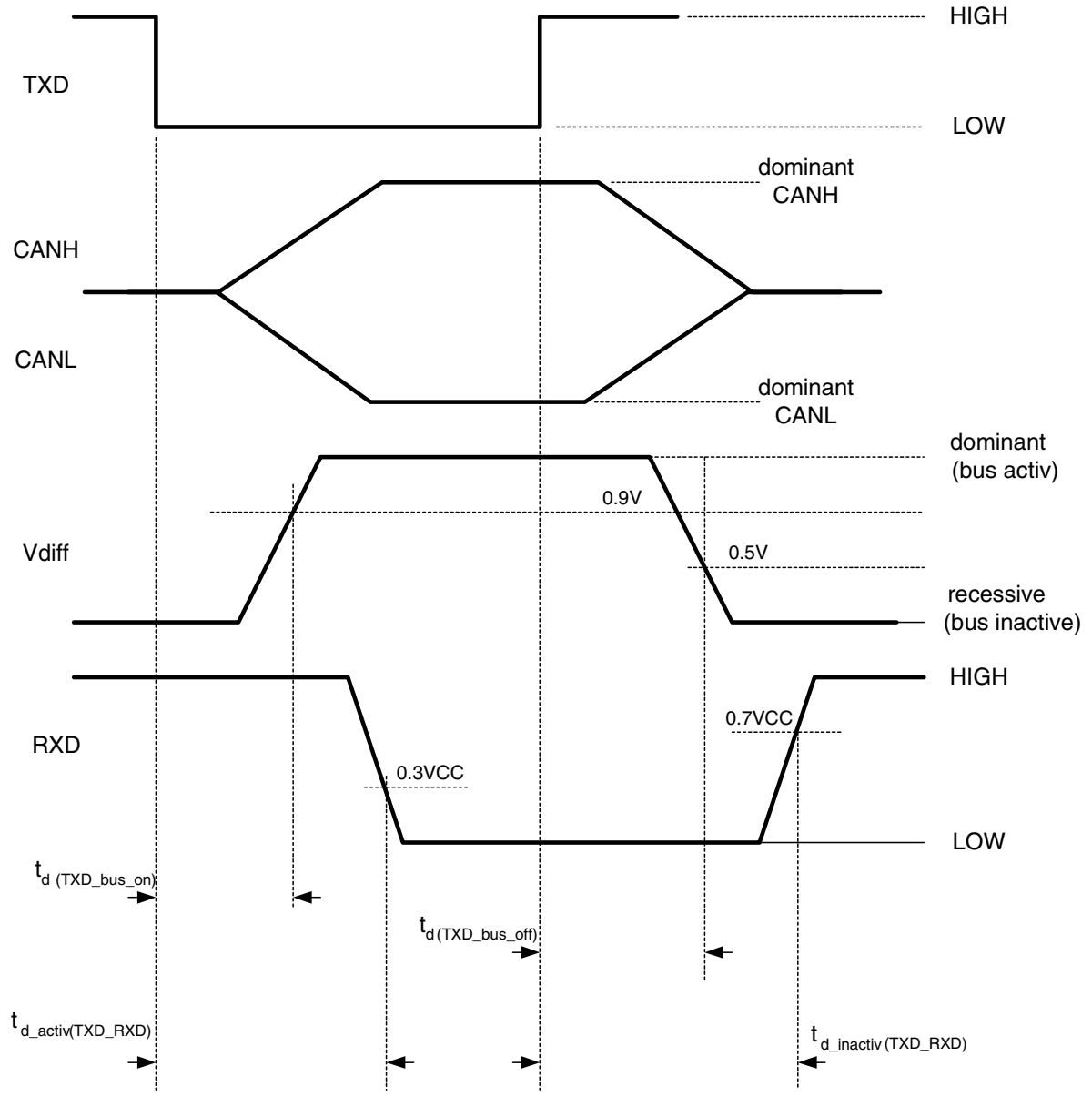
$V_{CC} = 4.75\text{ V to }5.25\text{ V}$ ;  $T_{amb} = -40^{\circ}\text{C to }+125^{\circ}\text{C}$ ;  $R_{Bus} = 60\ \Omega$ ; unless otherwise specified

All voltages referenced to ground (Pin 2); positive input current.

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
<b>8</b>	<b>Timing Characteristics Normal Mode , <math>V_{RS} \leq 0.3 \times V_{CC}</math> (see Figure 3)</b>								
8.1	Delay TXD to bus active	$V_{RS} = 0\text{ V}$		$t_{d(\text{TXD-BUS\_ON})}$		120	180	ns	A
8.2	Delay TXD to bus inactive	$V_{RS} = 0\text{ V}$		$t_{d(\text{TXD-BUS\_OFF})}$		50	100	ns	A
8.3	Delay TXD to RXD, recessive to dominant	$V_{RS} = 0\text{ V}$	6, 7	$t_{d\_activ(\text{TXD-RXD})}$		200	420	ns	A
8.4	Delay TXD to RXD, dominant to recessive	$V_{RS} = 0\text{ V}$		$t_{d\_inactiv(\text{TXD-RXD})}$		180	460	ns	A
8.5	Difference between Delay TXD to RXD dominant to Delay recessive	$t_{diff} = t_{d\_activ(\text{TXD-RXD})} - t_{d\_inactiv(\text{TXD-RXD})}$		$t_{diff}$	-280		80	ns	A
<b>9</b>	<b>Timing Characteristics Stand-by Mode <math>V_{RS} \geq 0.87 \times V_{CC}</math></b>								
9.1	Bus dominant to RXD low in stand-by mode	$V_{RS} = V_{CC}$	4	$t_{dRxDL}$	-	300	450	ns	A
9.2	Wake up time after stand-by mode (time delay between stand-by to normal mode and to bus dominant)	TXD = 0 V $V_{RS}$ from 0 V to $V_{CC}$	6, 7	$T_{wake\_up}$			2	$\mu\text{s}$	A
<b>10.1</b>	<b>Standby/Normal Mode Selectable via RS (Pin 8)</b>								
10.1	Input voltage for normal mode	$V_{RS} = V_{CC}$	8	$V_{RS}$	-	-	$0.3 \times V_{CC}$	V	A
10.2	Input current for normal mode	$V_{RS} = 0\text{ V}$	8	$I_{RS}$	-700			$\mu\text{A}$	A
10.3	Input voltage for stand-by mode		8	$V_{stby}$	$0.87 \times V_{CC}$			V	A

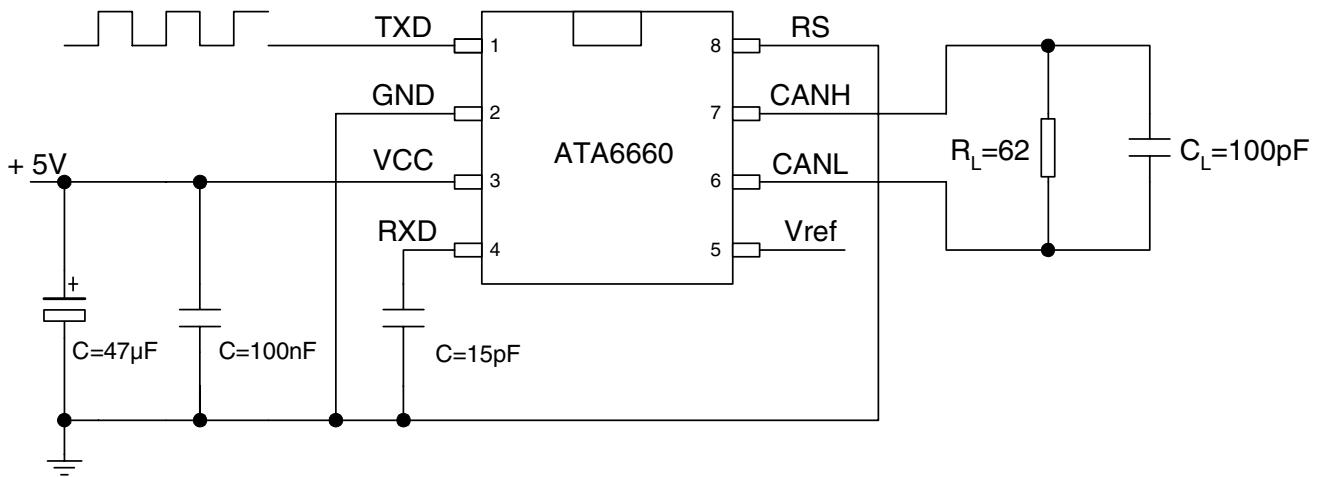
\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

**Figure 3. Timing Diagrams**

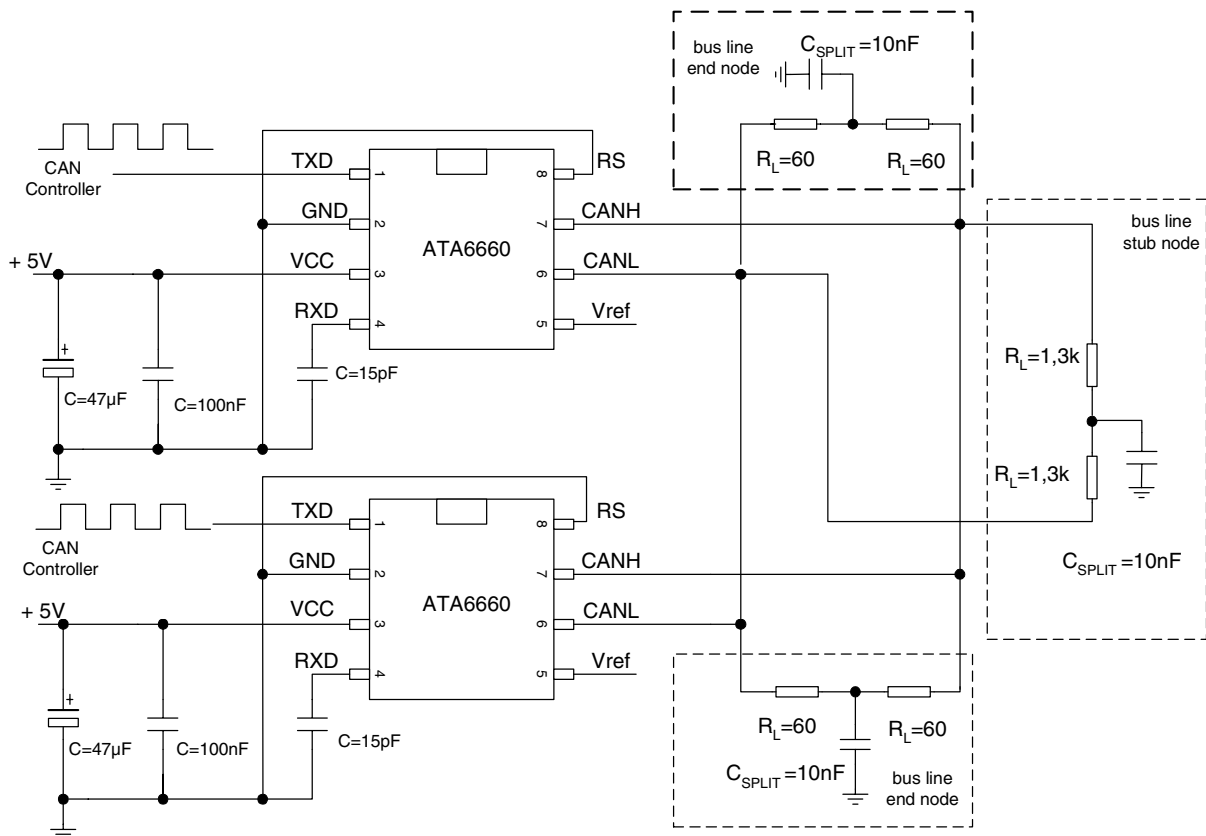




**Figure 4.** Test Circuit for Timing Characteristics



**Figure 5.** Bus Application with Split Termination Concept



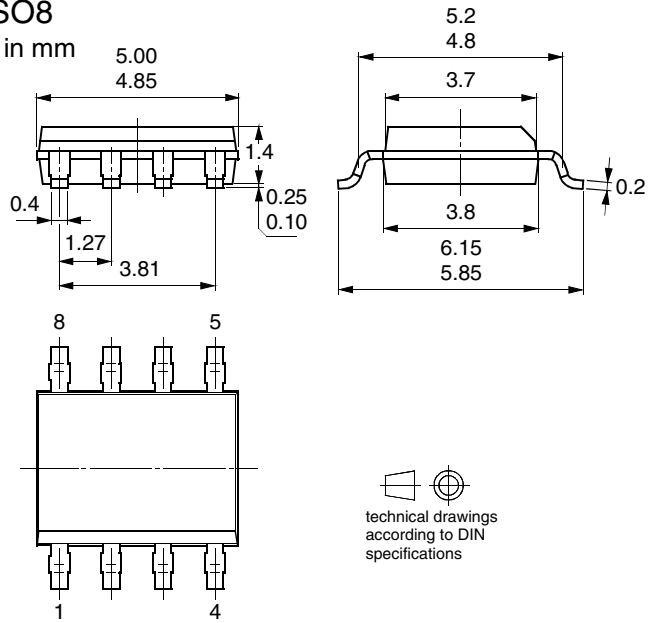
## Ordering Information

Extended Type Number	Package	Remarks
ATA6660	SO8	–

## Package Information

### Package SO8

Dimensions in mm





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