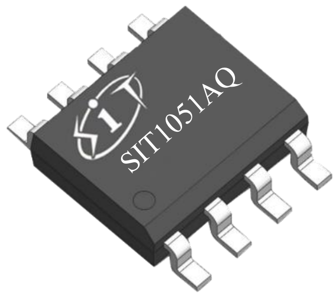
FEATURES

- Compatible with the SAE J2284-1 to SAE J2284-5 standard
- AEC-Q100 qualified
- Thermally protected
- ±58V BUS protection
- Driver (TXD) dominant overtime function
- Silent receive mode
- SIT1051AQT/E with off mode in low power consumption
- SIT1051AQT/3 can be interfaced directly to microcontrollers with supply voltages from 3V to 5V
- Undervoltage protection on VCC and VIO power supply pins
- Timing guaranteed for data rates up to 5 Mbit/s in the (CAN FD) fast phase
- The typical loop delay from TXD to RXD is less than 100ns
- Very low ElectroMagnetic Emission (EME)
- Unpowered nodes do not interfere with the bus
- Provide DFN3*3-8, small outline, leadless package

PRODUCT APPEARANCE



Provide Green and Environmentally Friendly Lead-free package

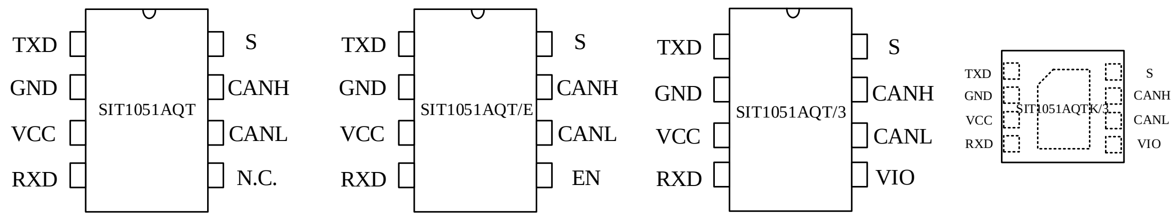
DESCRIPTION

SIT1051AQ is an interface chip used between the CAN protocol controller and the physical bus. It can be used for in-vehicle, industrial control and other fields. It supports 5Mbps (CAN FD), and has ability to perform differential signal transmission between bus and the CAN protocol controller.

The SIT1051AQ is an upgraded version of the SIT1051Q with improved bus signal symmetry and lower electromagnetic radiation performance. In addition, the SIT1051AQ is fully compatible with SIT1051Q.

PARAMETER	SYMBOL	CONDITION	MIN.	MAX.	UNIT
Supply voltage	VCC		4.5	5.5	V
MCU side port supply voltage	VIO		2.8	5.5	V
Maximum transmission rate	$1/t_{bit}$	Non-return to zero code	5		Mbaud
CANH/CANL input or output voltage	V_{can}		-58	+58	V
Bus differential voltage	V_{diff}		1.5	3.0	V
Virtual junction temperature	T_j		-40	150	℃

PIN CONFIGURATION



PIN DESCRIPTION

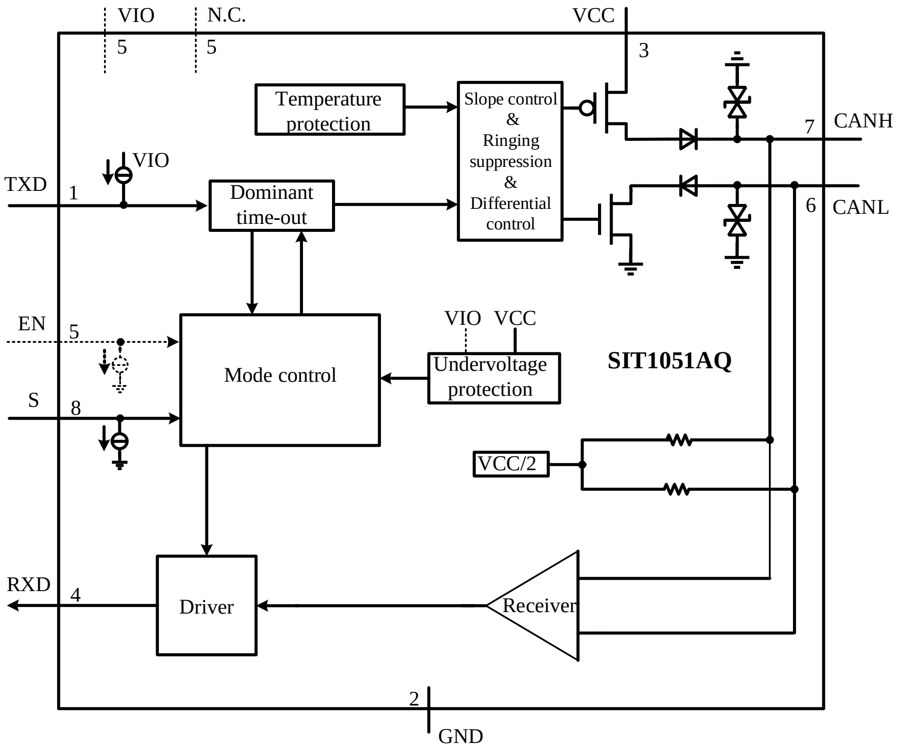
PIN	SYMBOL	DESCRIPTION
1	TXD	transmit data input
2	GND	ground
3	VCC	supply voltage
4	RXD	receive data output; reads out data from the bus lines
5	N.C.	no connection (SIT1051AQT version)
5	VIO	transceiver I/O level conversion power supply voltage (SIT1051AQT/3 version)
5	EN	off mode enable pin. The low level is the off mode (SIT1051AQT/E version)
6	CANL	LOW-level CAN-bus line
7	CANH	HIGH-level CAN-bus line
8	S	silent mode control input, low level is high speed mode

LIMITING VALUES

PARAMETER	SYMBOL	VALUE	UNIT
Supply voltage	VCC	-0.3~7	V
MCU side port	TXD, RXD, S, EN, VIO	-0.3~7	V
Bus side input voltage	CANL, CANH	-58~58	V
Bus differential breakdown voltage	$V_{CANH-CANL}$	-58~58	V
Storage temperature	T_{stg}	-55~150	℃
Virtual junction temperature	T_j	-40~150	℃
Welding temperature range		300	℃

The maximum limit parameters mean that exceeding these values may cause irreversible damage to the device. Under these conditions, it is not conducive to the normal operation of the device. The continuous operation of the device at the maximum allowable rating may affect the reliability of the device. The reference point for all voltages is ground.

INTERNAL CIRCUIT BLOCK DIAGRAM



DRIVER ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
CANH dominant output voltage	$V_{OH(D)}$	Normal mode, TXD=0V, R_L=50Ω to 65Ω	2.75	3.5	4.5	V
CANL dominant output voltage	$V_{OL(D)}$	Normal mode, TXD=0V, R_L=50Ω to 65Ω	0.5	1.5	2.25	V
Bus dominant differential output voltage	$V_{OD(D)}$	Normal mode, TXD=0V, R_L=50Ω to 65Ω	1.5		3	V
		Normal mode, TXD=0V, R_L=45Ω to 70Ω	1.4		3.3	V
		Normal mode, TXD=0V, R_L=2240Ω (1)	1.5		5	V
Bus recessive output voltage	$V_{O(R)}$	Normal mode, TXD=VIO, No load	2	$0.5V_{CC}$	3	V
Bus recessive differential output voltage	$V_{OD(R)}$	Normal mode, TXD=VIO, No load	-500		50	mV
Transmitter dominant voltage symmetry	$V_{dom(TX)sym}$ (1)	$V_{dom(TX)sym}$=VCC- CANH - CANL	-400		400	mV
Transmitter voltage symmetry	V_{TXsym} (1)	V_{TXsym}= CANH + CANL, R_L=60Ω, C_{SPLIT}=4.7nF, f_{TXD}=250kHZ, 1MHz, 2MHz Fig 5	$0.9V_{CC}$		$1.1V_{CC}$	V
Dominant-recessive common-mode output voltage difference	$V_{cm(step)}$ (1)	Fig 3, Fig 5	-150		150	mV
Dominant-recessive common-mode peak-to-peak	$V_{cm(p-p)}$ (1)	Fig 3, Fig 5	-300		300	mV
Dominant short-circuit output current	$I_{O(SC)DOM}$	Normal mode, TXD=0V, CANH=-15V to 40V	-100	-70	-40	mA
Dominant short-circuit output current	$I_{O(SC)DOM}$	Normal mode, TXD=0V, CANL=-15V to 40V	40	70	100	mA

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Recessive short-circuit output current	$I_{O(SC)REC}$	Normal mode, TXD=VIO, CANH=CANL=-27V to 32V	-3		3	mA

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

(1) Not tested in production, guaranteed by design.

DRIVER SWITCHING CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation delay time, low-to-high level output	$t_{d(TXD\text{-}busdom)}$ (1)	Normal mode, Fig 1, Fig 4		45		ns
Propagation delay time, high-to-low level output	$t_{d(TXD\text{-}busrec)}$ (1)	Normal mode, Fig 1, Fig 4		55		ns
Differential output signal rise time	$t_{r(BUS)}$ (1)			45		ns
Differential output signal fall time	$t_{f(BUS)}$ (1)			45		ns

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

(1) Not tested in production, guaranteed by design.

RECEIVER ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Receiver threshold voltage	$V_{th(RX)dif}$	Normal mode and silent mode, -30V<V_{CM}<30V	0.5		0.9	V
Receiver threshold voltage hysteresis range	$V_{hys(RX)dif}$	Normal mode and silent mode, -30V<V_{CM}<30V	50	120	400	mV
Receiver recessive voltage range	$V_{rec(RX)}$	Normal mode and silent mode, -30V<V_{CM}<30V	-3		0.5	V
Receiver dominant voltage range	$V_{dom(RX)}$	Normal mode and silent mode, -30V<V_{CM}<30V	0.9		8	V
Bus leakage current	I_L	VCC=VIO=0V, CANH=CANL=5V	-10		10	µA
CANH, CANL input resistance	R_{IN}	-2V≤CANH≤7V -2V≤CANL≤7V	9	15	28	kΩ

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
CANH, CANL differential-input resistance	R_{ID}	-2V≤CANH≤7V -2V≤CANL≤7V	19	30	52	kΩ
CANH, CANL input resistance mismatch	$\triangle R_{IN}$	0V≤CANH≤5V 0V≤CANL≤5V	-2		2	%
CANH, CANL input capacitance to ground	C_{IN} (1)	TXD=VIO		24		pF
CANH, CANL differential-input capacitance	C_{ID} (1)	TXD=VIO		12		pF
Bus slew rate	SR (1)	Bus differential voltage dominant to recessive edge			70	V/μs

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

(1) Not tested in production, guaranteed by design.

RECEIVER SWITCHING CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation delay time, low-to-high level output	$t_{d(busdom-RXD)}$ (1)	Normal mode Fig 1, Fig 4		45		ns
Propagation delay time, low-to-high level output	$t_{d(busrec-RXD)}$ (1)	Normal mode Fig 1, Fig 4		45		ns
RXD signal rise time	$t_{r(RXD)}$ (1)			8		ns
RXD signal fall time	$t_{f(RXD)}$ (1)			8		ns

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.(1)

(1) Not tested in production, guaranteed by design.

DEVICE SWITCHING CHARACTERISTIC

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Loop delay 1, TXD falling edge to RXD falling edge	t_{loop1} (1)	Normal mode Fig 1, Fig 4	40		160	ns
Loop delay 2, TXD rising edge to RXD rising edge	t_{loop2} (1)	Normal mode Fig 1, Fig 4	40		175	ns

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Bit time of BUS output pin	$t_{bit(BUS)}$ (1)	$t_{bit(TXD)}$=500ns	435		530	ns
		$t_{bit(TXD)}$=200ns	155		210	ns
Bit time of RXD output pin	$t_{bit(RXD)}$ (1)	$t_{bit(TXD)}$=500ns	400		550	ns
		$t_{bit(TXD)}$=200ns	120		220	ns
Time difference between BUS and RXD output bits	Δt_{rec} (1)	$\Delta t_{rec}=t_{bit(RXD)}-t_{bit(BUS)}$; $t_{bit(TXD)}$=500ns	-65		40	ns
		$\Delta t_{rec}=t_{bit(RXD)}-t_{bit(BUS)}$; $t_{bit(TXD)}$=200ns	-45		15	ns
TXD dominant timeout	t_{dom_TXD} (1)		0.8	2	4	ms

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

(1) Not tested in production, guaranteed by design.

TXD PIN CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
HIGH-level input current	I_{IH}(TXD)	TXD=VIO	-5		5	μA
LOW-level input current	I_{IL}(TXD)	TXD=0V	-260	-150	-30	μA
Leakage current of TXD without power	I_O(off)	VCC=VIO=0V, TXD=5.5V	-1		1	μA
HIGH-level input voltage	V_{IH}	SIT1051AQT/3	0.7VIO (1)		VIO+0.3	V
LOW-level input voltage	V_{IL}	SIT1051AQT/3	-0.3		0.3VIO	V
HIGH-level input voltage	V_{IH}	SIT1051AQT	2		VCC+0.3	V
LOW-level input voltage	V_{IL}	SIT1051AQT	-0.3		0.8	V
Open voltage on TXD pin	TXD_O			H		logic

(1) SIT1051QT/E version, VIO=VCC;

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

S PIN CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
HIGH-level input current	I_{IH}(S)	S=VIO	1		10	μA
LOW-level input current	I_{IL}(S)	S=0V	-1		1	μA
Leakage current of S without power	I_O(off)	VCC=VIO=0V, S=5.5V	-1		1	μA
HIGH-level input voltage	V_{IH}	SIT1051AQT/3	0.7VIO (1)		VIO+0.3	V
LOW-level input voltage	V_{IL}	SIT1051AQT/3	-0.3		0.3VIO	V
HIGH-level input voltage	V_{IH}	SIT1051AQT	2		VCC+0.3	V
LOW-level input voltage	V_{IL}	SIT1051AQT	-0.3		0.8	V
Open voltage on S pin	S_O		L			logic

(1) SIT1051QT/E version, VIO=VCC;

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

EN PIN CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
HIGH-level input current	I_{IH}(EN)	EN=VCC	1		10	μA
LOW-level input current	I_{IL}(EN)	EN=0V	-1		1	μA
HIGH-level input voltage	V_{IH}		0.7VCC		VCC+0.3	V
LOW-level input voltage	V_{IL}		-0.3		0.3VCC	V
Leakage current of EN without power	I_O(off)	VCC=0V EN=5.5V	-1		1	μA
Open voltage on EN pin	EN_O		L			logic

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

RXD PIN CHARACTERISTICS

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
HIGH-level input current	I_{OH}(RXD)	VIO=VCC, RXD=VIO-0.4V	-8	-3	-1	mA
LOW-level input current	I_{OL}(RXD)	RXD=0.4V, Bus dominant	2	5	12	mA
Leakage current of RXD without power	I_O(off)	VCC=VIO=0V, RXD=5.5V	-1		1	μA

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

SUPPLY CURRENT

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
VCC supply current	I_{CC_D}	Normal mode dominant		45	70	mA
	I_{CC_R}	Normal mode recessive		5	10	mA
	I_{CC_S}	Silent mode		1.5	3	mA
	I_{CC_OFF}	Off mode (SIT1051AQT/E)		5	8	μA
VIO supply current	I_{IO_D}	TXD=0V		170	300	μA
	I_{IO_R}	TXD=VIO		15	30	μA

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

OVERTEMPERATURE PROTECTION

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Shutdown junction temperature	$T_{j(sd)}$ (1)			190		°C

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

(1) Not tested in production, guaranteed by design.

UNDERVOLTAGE PROTECTION

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
VCC undervoltage protection	V_{uvd_VCC}		3.7	4	4.3	V
VIO undervoltage protection	V_{uvd_VIO}		1.7	2	2.3	V

Unless otherwise stated, all typical values are measured at 25°C, supply voltage VCC=5V, VIO=5V (if applicable), R_L=60Ω.

ESD PERFORMANCE

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
CAN bus pin contact discharge model (IEC)	V_{ESD_IEC}	IEC 61000-4-2: Contact discharge (CANH, CANL)	-4		+4	kV
Human body model (HBM)	V_{ESD_HBM}	All ports	-8		+8	kV
Charged device model (CDM)	V_{ESD_CDM}		-750		+750	V
Machine model (MM)	V_{ESD_MM}		-300		+300	V

FUNCTION TABLE

Table1. CAN TRANSCEIVER TRUTH TABLE

TXD (1)	S (1)	CANH (1)	CANL (1)	BUS STATE	RXD (1)
L	L or open	H	L	Dominate	L
H or open	L	0.5VCC	0.5VCC	Recessive	H
X	H	0.5VCC	0.5VCC	Recessive	H

(1) H=high level; L=low level; X=irrelevant.

Table 2. RECEIVER FUNCTION TABLE

V_{ID}=CANH-CANL	BUS STATE	RXD (1)
$V_{ID} \geq 0.9V$	Dominate	L
$0.5 < V_{ID} < 0.9V$	?	?
$V_{ID} \leq 0.5V$	Recessive	H

(1) H= high level; L= low level; ?= uncertain.

Table 3. UNDERVOLTAGE PROTECTION STATUS TABLE

VCC	VIO (1)	BUS STATE	BUS OUTPUT (2)	RXD (2)
$VCC > V_{uvd\_VCC}$	$VIO > V_{uvd\_VIO}$	Normal	According to S and TXD	Follow the bus
$VCC < V_{uvd\_VCC}$	$VIO > V_{uvd\_VIO}$	Protected status	Z	H
$VCC > V_{uvd\_VCC}$	$VIO < V_{uvd\_VIO}$	Protected status	Z	H
$VCC < V_{uvd\_VCC}$	$VIO < V_{uvd\_VIO}$	Protected status	Z	H

(1) SIT1051AQT/3 and SIT1051AQTK/3 version;

(2) H=high level; Z=high ohmic.

TIMING WAVEFORM

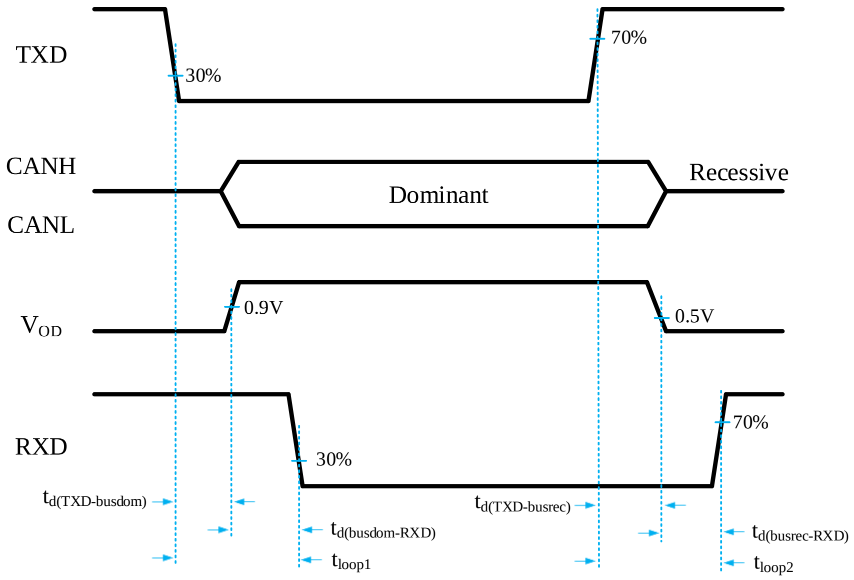


Fig 1 Transceiver transmission delay

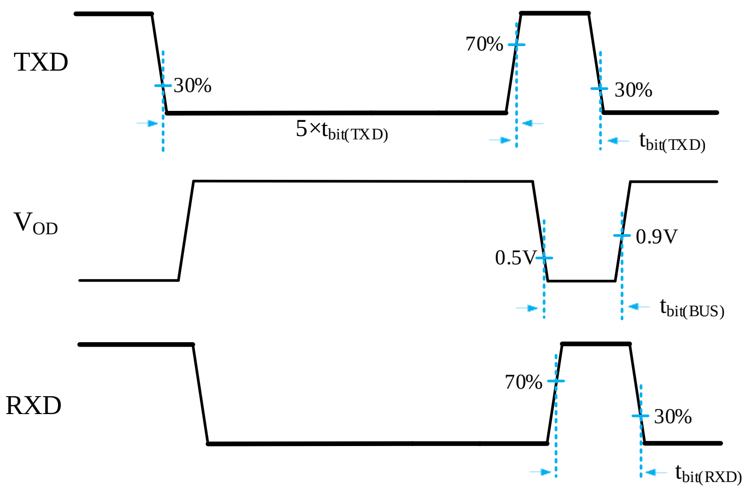


Fig 2 t_{bit} delay

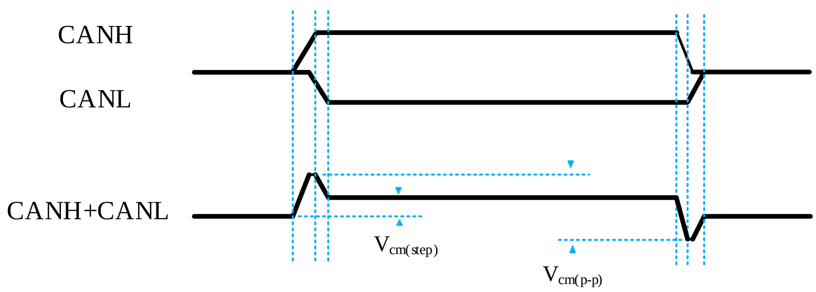


Fig 3 Bus common-mode voltage (SAE 1939-14)

TEST CIRCUIT

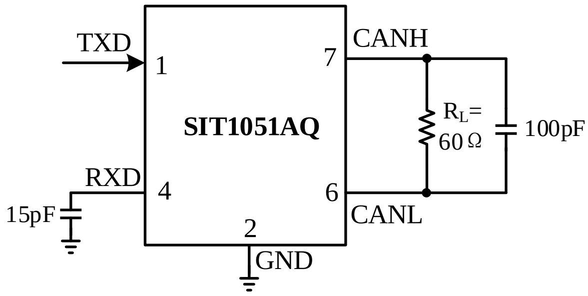


Fig 4 Transceiver timing sequence test circuit

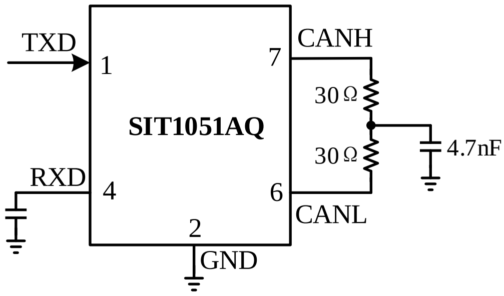


Fig 5 Transceiver bus symmetry test circuit

TYPICAL APPLICATION DIAGRAM

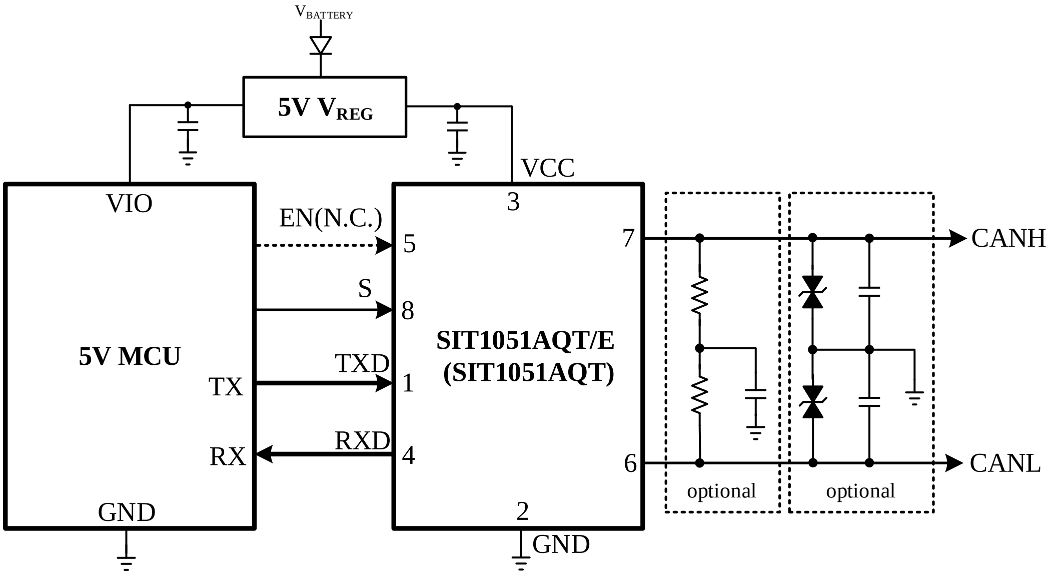


Fig 6 SIT1051AQT/E (or SIT1051AQT) and 5V MCU typical application diagram

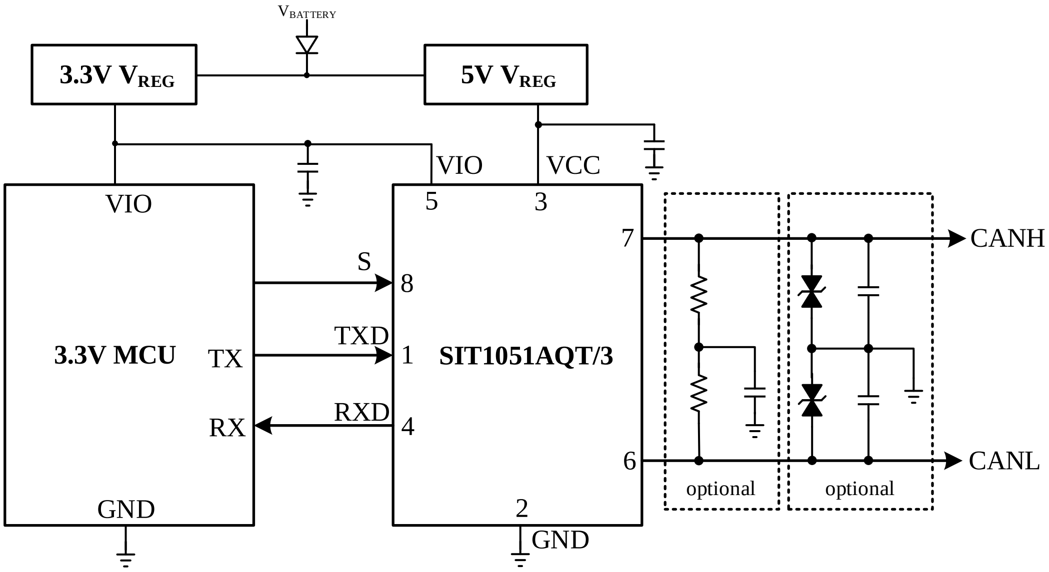


Fig 7 SIT1051AQT/3 and 3.3V MCU typical application diagram

ADDITIONAL DESCRIPTION

1 Sketch

SIT1051AQ is an interface chip applied between the CAN protocol controller and the physical bus. It can be used for in-vehicle, industrial control and other fields. It supports 5Mbps flexible data rate (CAN FD) and has ability to transmit differential signals between the bus and the CAN protocol controller. Compatible with the SAE J2284-1 to SAE J2284-5 standard.

2 Short-circuit protection

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.

3 Overtemperature protection

SIT1051AQ has an overtemperature protection function. When the overtemperature protection is triggered, the current of the driver stage will be reduced. Because the driver tube is the main energy consuming component, the current reduction will reduce the power consumption and thus reduce the chip temperature. Meanwhile, the rest of the chip still works.

4 Undervoltage protection

The SIT1051AQ power pin has an undervoltage detection function to place the device in protected mode, which can protect the bus (bus output high ohmic state) when VCC is below V_{uvd_VCC} or VIO is below V_{uvd_VIO} (if applicable).

5 Control mode

The control pin S allows two modes of operation to be selected: high speed mode and silent mode.

The high-speed mode is the normal operating mode and is optional by grounding pin S or floating it. CAN driver and the receiver can work completely normally and CAN communication is bidirectional.

Set pin S to high level to activate silent mode. The CAN driver will shut off and the receiver will continue working.

6 TXD dominant time-out function

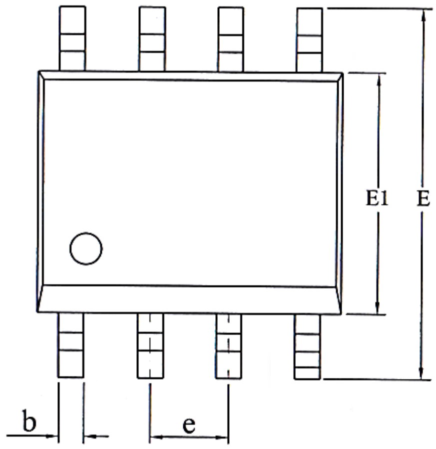
A ‘TXD dominant time-out’ timer circuit prevents the bus lines from being driven to a permanent dominant state (blocking all network communication) if pin TXD is forced permanently LOW by a hardware and/or software application failure. The timer is triggered by a negative edge on pin TXD.

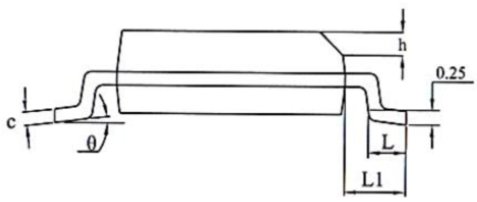
If the duration of the LOW level on pin TXD exceeds the internal timer value (t_{dom}), the transmitter is disabled, driving the bus lines into a recessive state. The timer is reset by a positive edge on pin TXD.

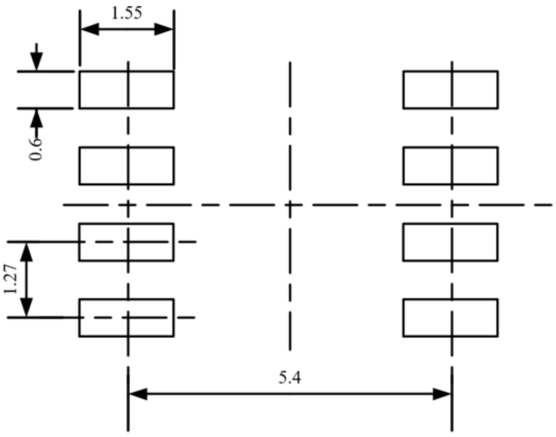
SOP8 DIMENSIONS

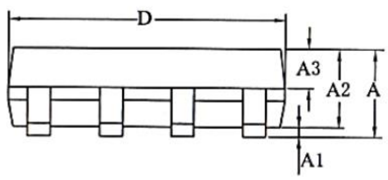
PACKAGE SIZE

SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	1.40	-	1.80
A1	0.10	-	0.25
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.38	-	0.51
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
L	0.40	0.60	0.80
L1	1.05REF		
c	0.20	-	0.25
θ	0°	-	8°







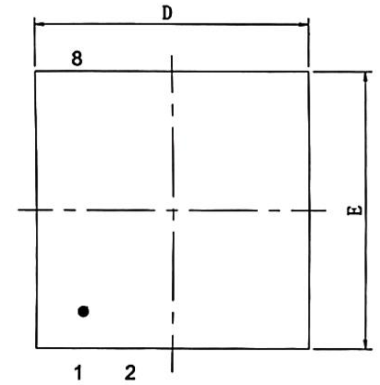


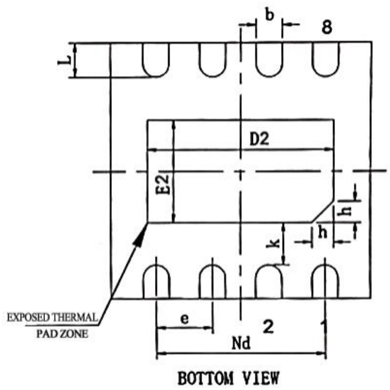
LAND PATTERN EXAMPLE (Unit: mm)

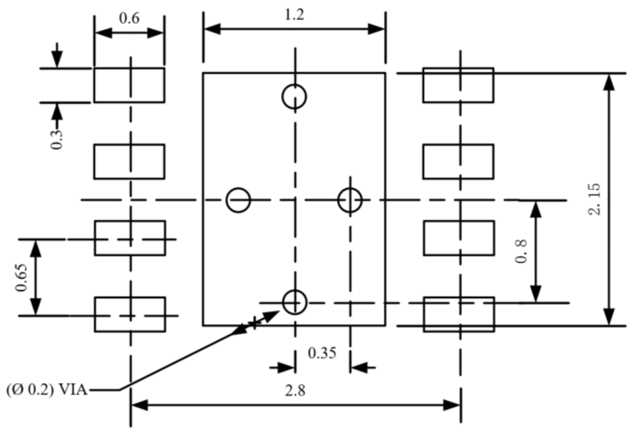
DFN3*3-8 DIMENSIONS

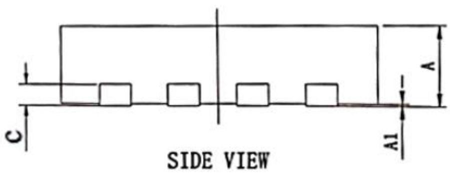
PACKAGE SIZE

SYMBOL	MIN/mm	TYP /mm	MAX/mm
A	0.70	0.75	0.80
A1	0	0.02	0.05
A3	0.203 REF		
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D2	2.05	2.15	2.25
Nd	1.95BSC		
E2	1.10	1.20	1.30
b	0.25	0.30	0.35
e	0.65 TYP		
k	0.50REF		
L	0.35	0.4	0.45
h	0.20	0.25	0.30



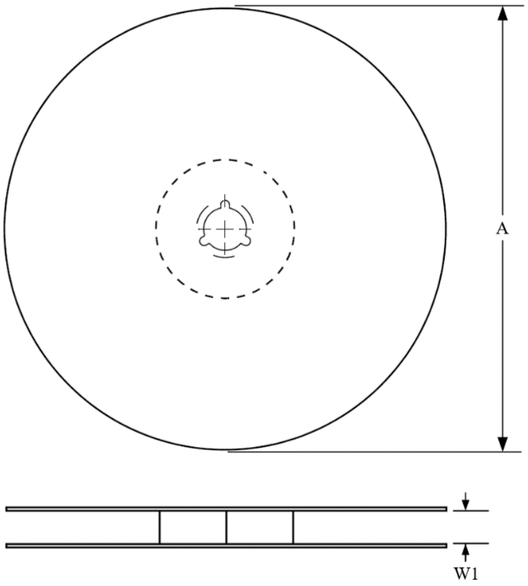




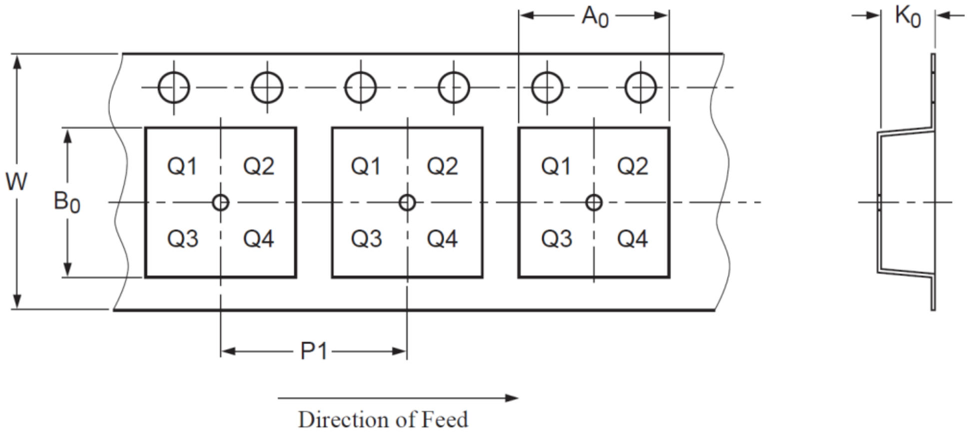


LAND PATTERN EXAMPLE (Unit: mm)

TAPE AND REEL INFORMATION



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers



PIN1 is in quadrant 1

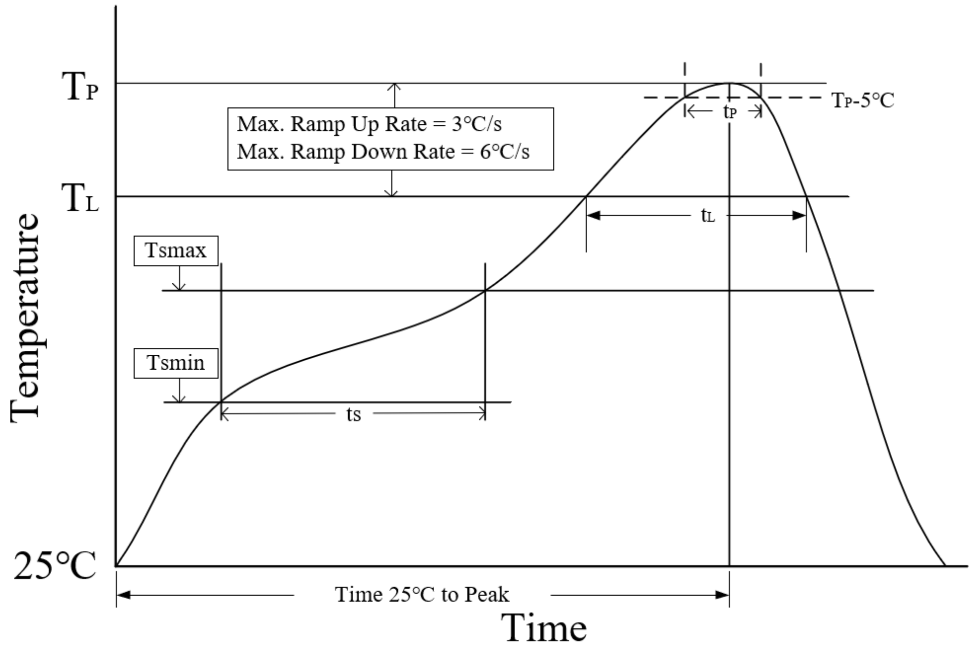
Package Type	Reel Diameter A (mm)	Tape width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)
SOP8	330±1	12.4	6.60±0.1	5.30±0.10	1.90±0.1	8.00±0.1	12.00±0.1
DFN3*3-8	329±1	12.4	3.30±0.1	3.30±0.1	1.10±0.1	8.00±0.1	12.00±0.3

ORDERING INFORMATION

TYPE NUMBER	PACKAGE	PACKING
SIT1051AQT	SOP8	Tape and reel
SIT1051AQT/E	SOP8	Tape and reel
SIT1051AQT/3	SOP8	Tape and reel
SIT1051AQTK/3	DFN3*3-8, small shape, no leads, 8 terminals	Tape and reel

SOP8 is packed with 2500 pieces/disc in braided packaging. Leadless DFN3*3-8 is packed with 6000 pieces/disc in braided packaging.

REFLOW SOLDERING



Parameter	Lead-free soldering conditions
Ave ramp up rate (T_L to T_P)	3 °C/second max
Preheat time ts (T_{smin}=150 °C to T_{smax}=200 °C)	60-120 seconds
Melting time t_L (T_L=217 °C)	60-150 seconds
Peak temp T_P	260-265 °C
5°C below peak temperature t_P	30 seconds
Ave cooling rate (T_P to T_L)	6 °C/second max
Normal temperature 25°C to peak temperature T_P time	8 minutes max

Important statement

SIT reserves the right to change the above-mentioned information without prior notice.

REVISION HISTORY

Version number	Datasheet status	Revision Date
V1.0	Initial version.	August 2022
V1.1	Updated package dimension schematic (size unchanged); Added AEC-Q100 qualified.	March 2023
V1.2	Added the VIO recommended work value; Added "Guaranteed by design" remarks; Adjusted format.	November 2023
V1.3	Updated the limiting value of $V_{CANH-VCANL}$.	December 2023
V1.4	Added “Compatible with the SAE J2284-1 to SAE J2284-5 standard”.	April 2024