1. General Description

The WJ1040-AT is a high speed, high reliability CAN transceiver. It is the interface between the Controller Area Network (CAN) protocol controller and the physical bus. It is primarily intended for high speed applications, up to 1Mbps, in passenger cars. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller.

The bus lines of WJ1040-AT can withstand direct voltage from -27V to 40V along with electrostatic discharge voltage of ±6kV in human body model which make it suitable applications in the automotive industry.

The WJ1040-AT provides short-circuit protect when bus lines connect to power supply or ground and limits the currents approximately 70mA(typical). The WJ1040-AT also provides thermal protection and transmit data dominant time-out function.

The WJ1040-AT high speed transceivers are available in standard SOP-8 and DFN3 × 3-8 package. Standard products are Pb-free and Halogen-free.

2. Features

- AEC-Q100: Qualified for Automotive Applications
  Temperature Grade 1: -40~+125ºC T_A
- Meets the Requirements of ISO 11898-2:2016 and ISO 11898-5:2007 Physical Layer Standards
- Low ElectroMagnetic Emission and High ElectroMagnetic Immunity
- Data Rates: up to 1Mbps
- Standby Mode Current: 10μA (typical)
- DC Voltage on Bus: -27V~40V
- Differential Voltage of Bus: 2V(typical)
- Common-mode Input Resistance: 25kΩ(typical)
- Propagation Delay: 110ns (typical)
- At Least 110 Nodes can be Connected

3. Applications

- Automobile, train, ship and other transportation fields
- Sensors, mechanical manufacturing, automatic instrument, robotics
- Other portable fields

4. Typical Application

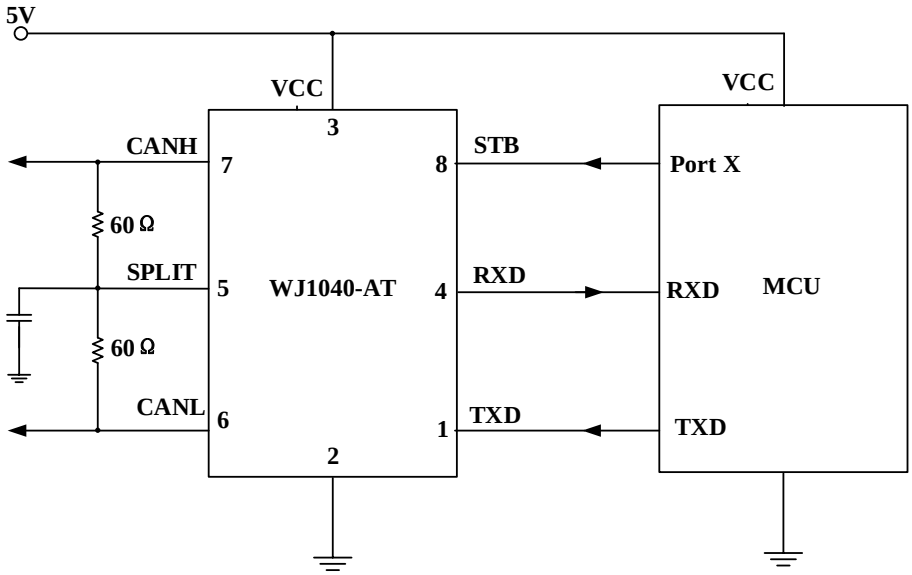
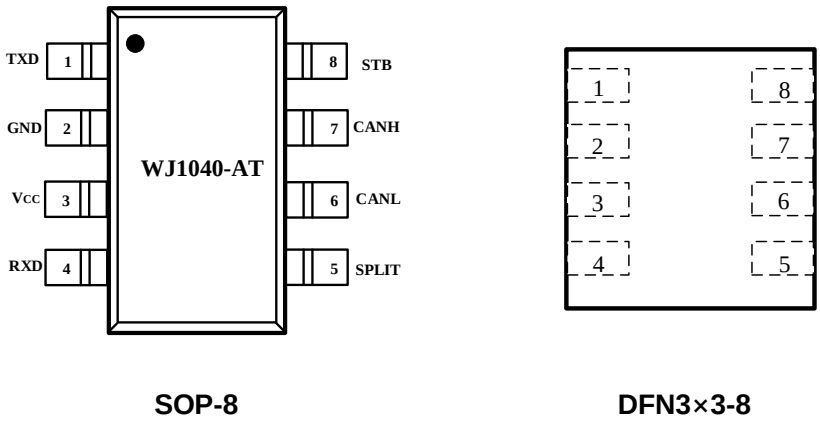


Figure 1. Typical application of WJ1040-AT

5. Pin Configuration

(Top View)



SOP-8 **DFN3×3-8**

Figure 2. Pin configuration

6. Pin Description

PIN NUMBER	PIN NAME	PIN FUNCTION
1	TXD	Transmit data input
2	GND	Ground
3	V_{CC}	Supply voltage
4	RXD	Receive data output; reads out data from the bus lines
5	SPLIT	Common-mode stabilization output
6	CANL	LOW-level CAN bus line
7	CANH	HIGH-level CAN bus line
8	STB	Standby mode control input

7. Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)[1]

SYMBOL	PARAMETER	RATING	UNIT
Vcc	Supply voltage	-0.3~+6	V
V_{TXD}, V_{RXD}, V_{STB}	DC voltage on TXD/RXD/STB pins	-0.3~V_{CC}+0.3	V
V_{CANH}, V_{CANL}	Voltage range at any bus terminal (CANH, CANL, SPLIT)	-27~+40	V
$V_{trt(CANH)}$,$V_{trt(CANL)}$	Transient voltage on pins CANH, CANL and SPLIT	-200~+200	V
HBM	Electrostatic discharge voltage on pins CANH, CANL and SPLIT(HBM)	±6	kV
	Electrostatic discharge voltage on other pins (HBM)	±4	kV
T_{STG}	Storage temperature	-55~+150	℃
T_J	Virtual junction temperature	-40~+150	℃

NOTE1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8. Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Supply Voltage	+4.75	+5.25	V
I_{OH}	RXD Terminal High Level Output Current	-0.1	-1	mA
I_{OL}	RXD Terminal Low Level Output Current	+2	+12	mA
T_A	Operating Ambient Temperature	-40	+125	°C

9. Static Characteristics

(V_{cc} = 4.75 to 5.25V, T_A=-40 to 125°C and R_L=60Ω unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Supply (pin V_{CC})						
I_{CC}	Supply current	standby mode	5	10	20	μA
		normal mode recessive; $V_{TXD}=V_{CC}$ dominant; V_{TXD}=0V	 2.5 30	 5 50	 10 70	 mA mA
Standby mode control input (pin STB)						
V_{IH}	HIGH-level input voltage		2	-	V_{CC} +0.3	V
V_{IL}	LOW-level input voltage		-0.3	-	+0.8	V
I_{IH}	HIGH-level input current	$V_{STB}=V_{CC}$	-	0	-	μA
I_{IL}	LOW-level input current	V_{STB}=0V	-1	-4	-10	μA
Transmit data input (pin TXD)						
V_{IH}	HIGH-level input voltage		2	-	V_{CC} +0.3	V
V_{IL}	LOW-level input voltage		-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	normal mode; V_{TXD}=0V	-100	-200	-300	μA
C_i	Input capacitance		-	5	10	pF
Receive data output (pin RXD)						
V_{OH}	HIGH-level output voltage	standby mode; I_{RXD}=-100μA	V_{CC} - 1.1	V_{CC} - 0.7	V_{CC} - 0.4	V
I_{OH}	HIGH-level output current	normal mode; $V_{RXD}=V_{CC}$-0.4V	-0.1	-0.4	-1	mA
I_{OL}	LOW-level output current	V_{RXD}=0.4V	2	6	12	mA

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Bus lines (pins CANH and CANL)						
$V_{O(dom)}$	Dominant output voltage	V_{TXD}=0V pin CANH pin CANL	 3 0.5	 3.5 1.5	 4.25 1.75	V
$V_{O(dom)(m)}$	Matching of dominant output voltage (V_{CC}-V_{CANH}-V_{CANL})		-300	0	+150	mV
$V_{O(dif)(bus)}$	Differential bus output voltage (V_{CANH}-V_{CANL})	V_{TXD}=0V; dominant; 45Ω<R_L<65Ω	1.5	-	3.0	V
		V_{TXD}=V_{CC}; recessive; no load	-50	-	50	mV
$V_{O(reces)}$	Recessive output voltage	normal mode; V_{TXD}=V_{CC}; no load	2	0.5 V_{CC}	3	V
		standby mode; no load	-0.1	0	+0.1	V
$I_{O(sc)}$	Short-circuit output current	V_{TXD}=0V pin CANH; V_{CANH}=0V pin CANL; V_{CANL}<40V	 -40 40	 -70 70	 -95 100	mA
$I_{O(reces)}$	Recessive output current	-27V<V_{CAN}<+32V	-2.5	-	+2.5	mA
$V_{dif(th)}$	Differential receiver threshold voltage	-8V<V_{CANH}<+12V; -8V<V_{CANL}<+12V normal mode standby mode	 0.5 0.4	 0.7 0.7	 0.9 1.15	 V V
$V_{hys(dif)}$	Differential receiver hysteresis voltage	normal mode; -8V<V_{CANH}<+12V; -8V<V_{CANL}<+12V	50	70	100	mV
I_{LI}	Input leakage current	V_{CC}=0V; V_{CANH}=V_{CANL}=5V	-5	0	+5	μA
$R_{i(cm)}$[1]	Common-mode input resistance	standby or normal mode	15	25	35	kΩ
$R_{i(cm)(m)}$[1]	Common-mode input resistance matching	V_{CANH}=V_{CANL}	-3	0	+3	%
$R_{i(dif)}$	Differential input resistance	standby or normal mode	25	50	75	kΩ
$C_{i(cm)}$	Common-mode input capacitance	V_{TXD}=V_{CC}	-	-	20	pF

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
$C_{i(dif)}$	Differential input capacitance	$V_{TXD}=V_{CC}$	-	-	10	pF
Common-mode stabilization output (pin SPLIT)						
V_O	Output voltage	normal mode; -500μA<I_O<+500μA	$0.3V_{CC}$	$0.5V_{CC}$	$0.7V_{CC}$	V
$\lvert I_L \rvert$	Leakage current	standby mode; -22V<V_{SPLIT}<+35V	-	0	15	μA
Thermal shutdown						
$T_{j(sd)}$	Shutdown junction temperature		155	165	180	ºC

Note1: $V_{CANH}=V_{CANL}$, $V_{CANH}\leq 5.9V$, $V_{CANL}\leq 5.9V$.

10. Dynamic Characteristics

(V_{cc} = 4.75 to 5.25V, T_A=-40 to 125°C and R_L=60Ω unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Timing characteristics						
$t_{d(TXD-BUSon)}$	Delay TXD to bus active	normal mode	25	70	110	ns
$t_{d(TXD-BUSoff)}$	Delay TXD to bus inactive		10	50	95	ns
$t_{d(BUSon-RXD)}$	Delay bus active to RXD		15	65	115	ns
$t_{d(BUSoff-RXD)}$	Delay bus inactive to RXD		35	100	160	ns
$t_{PD(TXD-RXD)}$	Propagation delay TXD to RXD	V_{STB}=0V	40	-	255	ns
$t_{dom(TXD)}$	TXD dominant time-out	V_{TXD}=0V	300	600	1000	μs
t_{BUS}	Dominant time for wake-up via bus	standby mode	0.75	1.75	5	μs
$t_{d(stb-norm)}$	Delay standby mode to normal mode	normal mode	-	7.5	15	μs

11. Test Circuit

(V_{CC} = 4.75 to 5.25V, T_A=-40 to 125°C and R_L=60Ω unless otherwise noted)

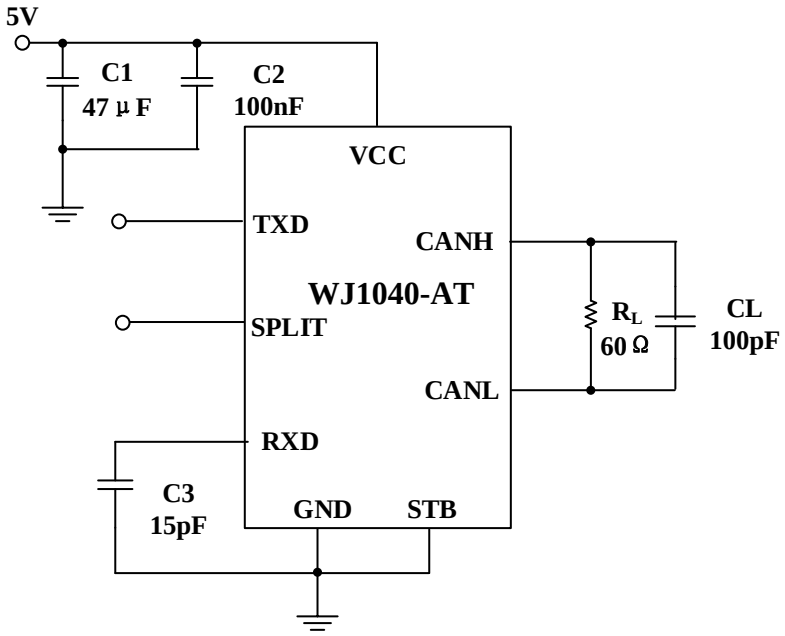


Figure 3. Test circuit for characteristics

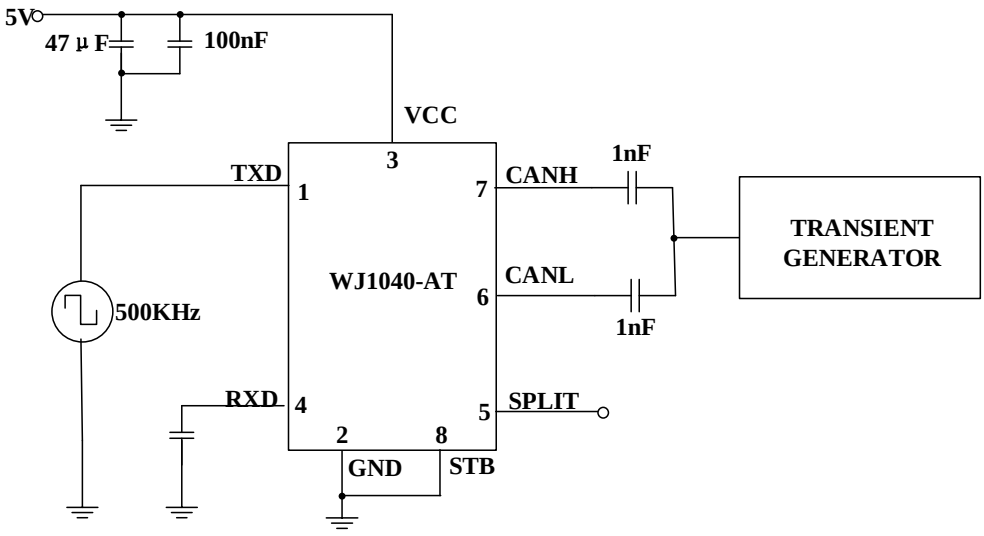


Figure 4. Test circuit for automotive transients

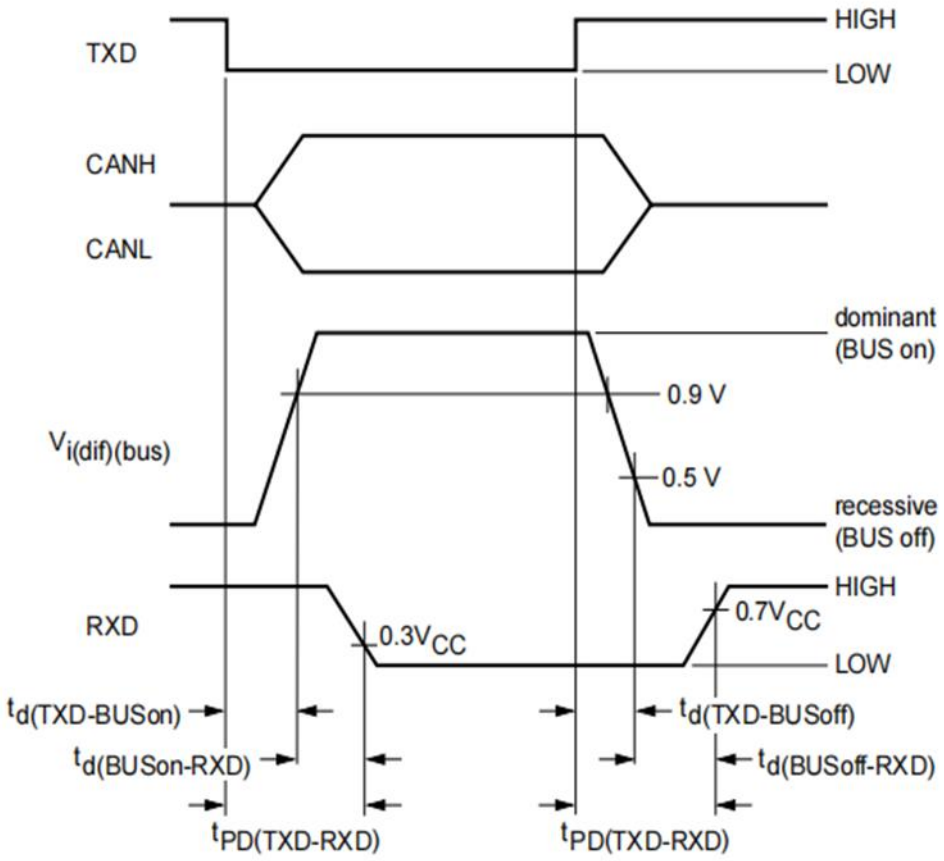


Figure 5. Timing diagram

12. Typical Performance Characteristics

(Vcc = 4.75 to 5.25V, T_A=-40 to 125°C and R_L=60Ω unless otherwise noted)

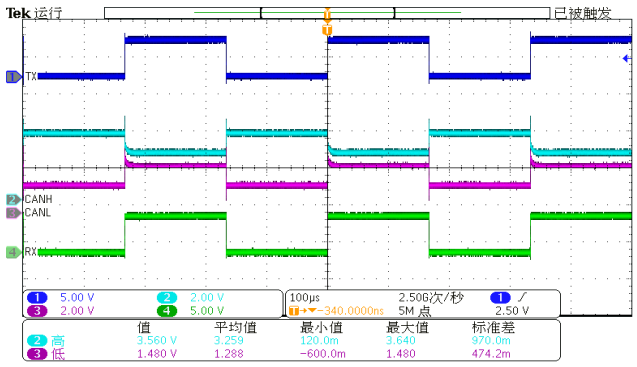


Figure 6. $V_{O(dom)}$

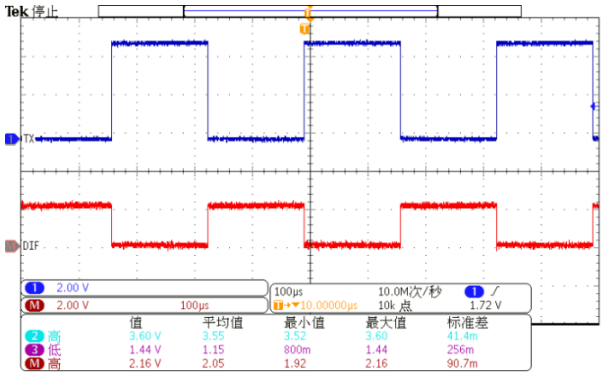


Figure 7. $V_{O(dif)bus}$ dominant

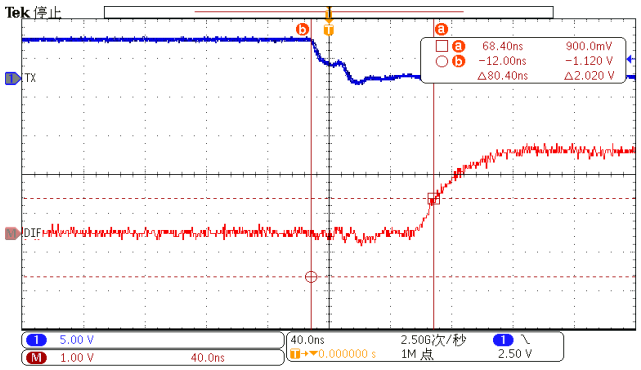


Figure 8. $t_{d(TXD-BUSon)}$

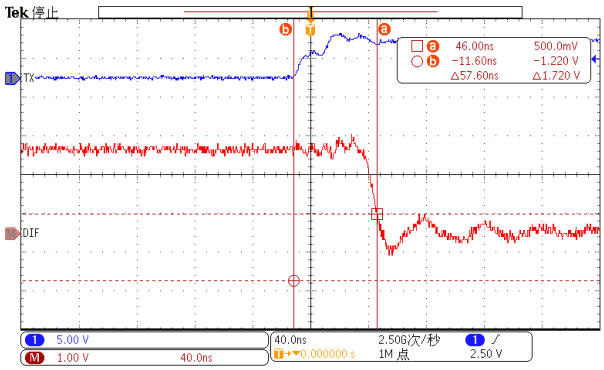


Figure 9. $t_{d(TXD-BUSoff)}$

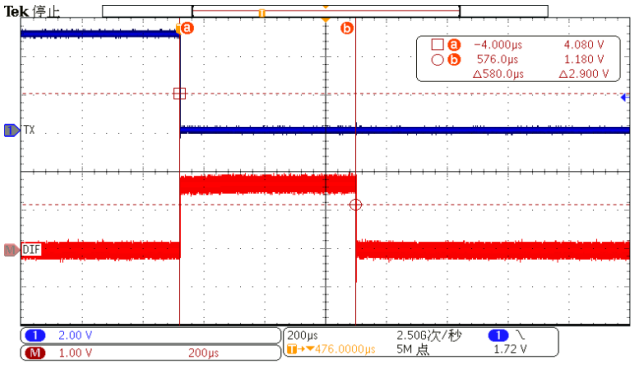


Figure 10. $t_{dom(TXD)}$

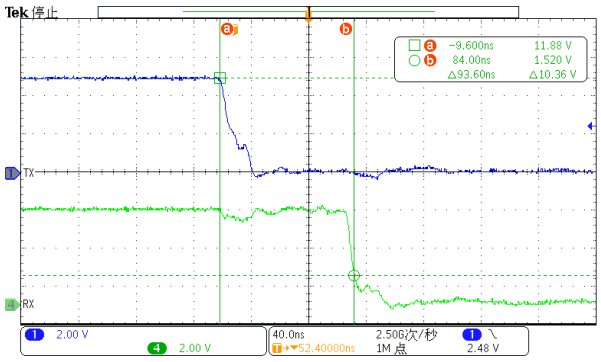


Figure 11. $t_{PD(TXD-RXD)}$ TXD：H→L

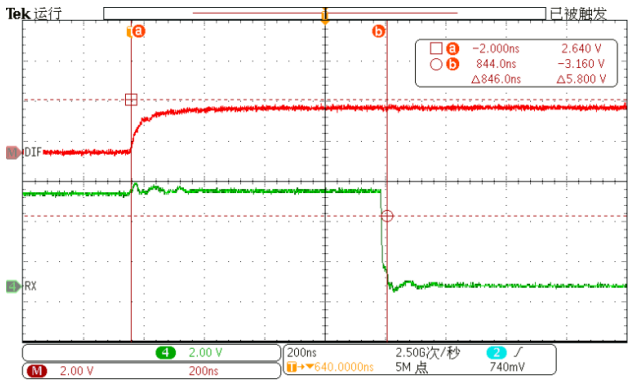


Figure 12. t_{BUS} rising edge→RXD

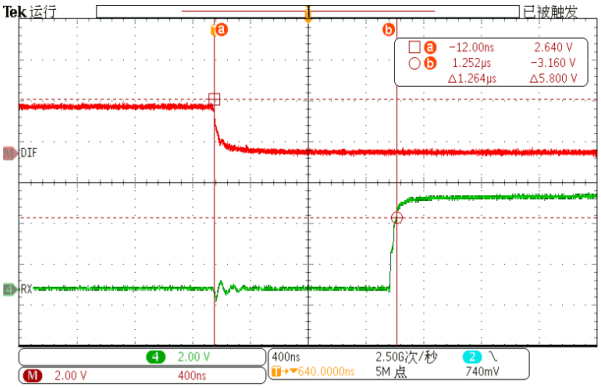


Figure 13. t_{BUS} falling edge→RXD

13. Function Description

13.1 Overview

The WJ1040-AT is high performance high speed and high reliability CAN transceiver which is capable of transmitting and receiving data at data rates up to 1Mbps. The device also offers low quiescent current, low-electromagnetic emission and high electromagnetic immunity and fully compatible with ISO11898 standard. The WJ1040-AT is designed to be used in a variety of applications especially for automobile, train, ship and other transportation fields.

13.2 Block Diagram

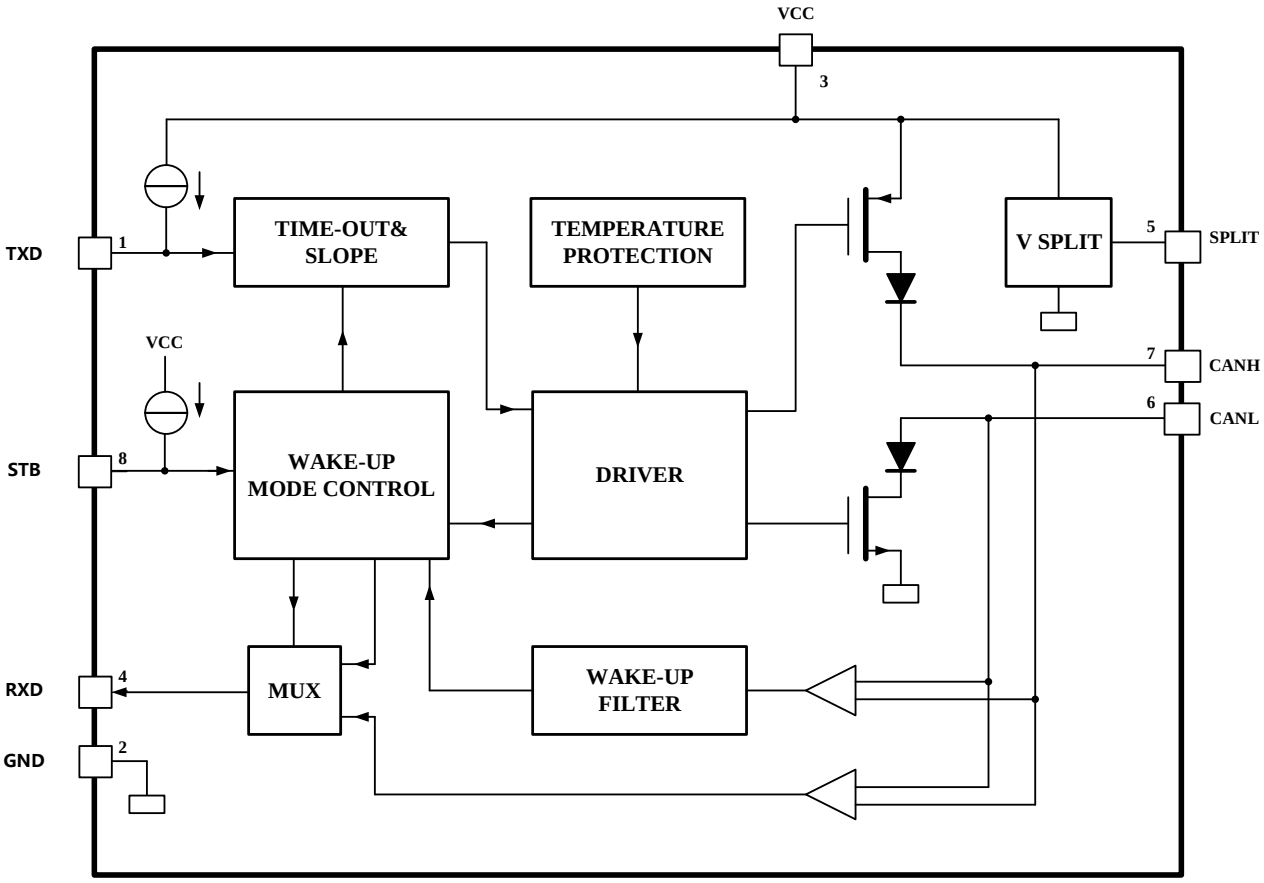


Figure 14. Block diagram

13.3 Feature Description

13.3.1 Split circuit

Pin SPLIT provides a DC stabilized voltage of $0.5V_{CC}$. It is turned on only in normal mode. In standby mode pin SPLIT is floating. The V_{SPLIT} circuit can be used to stabilize the recessive common-mode voltage by connecting pin SPLIT to the centre tap of the split termination. In cases of a recessive bus voltage<$0.5V_{CC}$ due to the presence of an unsupplied transceiver in the network with a significant leakage current from the bus lines to ground, the split circuit will stabilize this recessive voltage to $0.5V_{CC}$. So a start of transmission does not cause a step in the common-mode signal which would lead to poor electromagnetic emission behavior.

13.3.2 Wake-up

In the standby mode the bus lines are monitored via a low-power differential comparator. Once the low-power differential comparator has detected a dominant bus level for more than t_{BUS}, pin RXD will become LOW.

13.3.3 Over-temperature detection

The output drivers are protected against over-temperature conditions. If the virtual junction temperature exceeds the shutdown junction temperature $T_{j(sd)}$, the output drivers will be disabled until the virtual junction temperature becomes lower than $T_{j(sd)}$ and TXD becomes recessive again.
By including the TXD condition, the occurrence of output driver oscillation due to temperature drifts is avoided.

13.3.4 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.

13.3.5 Current limiting

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.

13.3.6 Fail-safe features

Pin TXD provides a pull-up towards V_{CC} in order to force a recessive level in case pin TXD is unsupplied.
Pin STB provides a pull-up towards V_{CC} in order to force the transceiver into standby mode in case pin STB is unsupplied.
In the event that the V_{CC} is lost, pins TXD, STB and RXD will become floating to prevent reverse supplying conditions via these pins.

13.3.7 Operating modes

The WJ1040-AT provides two modes of operation which are selectable via pin STB. See Table 1 for a description of the modes of operation.

Table 1 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

13.3.7.1 Normal mode

In this mode the transceiver is able to transmit and receive data via the bus lines CANH and CANL. The differential receiver converts the analog data on the lines into digital data which is output to pin RXD via the multiplexer (MUX). The slope of the output signals on the bus lines is fixed and optimized in a way that lowest electromagnetic emission is guaranteed.

13.3.7.2 Standby mode

In this mode the transmitter and receiver are switched off, and the low-power differential receiver will monitor the bus lines. A HIGH level on pin STB activates this low-power receiver and the wake-up filter, and after t_{BUS} the state of the CAN bus is reflected on pin RXD.
The supply current on V_{CC} is reduced to a minimum in such a way that electromagnetic immunity is guaranteed and a wake-up event on the bus lines will be recognized.

14. Evaluation Modules

Evaluation Modules (EVMs) are available to help evaluate initial circuit performance. We have evaluation modules for different packages, you can contact us to get the evaluation module or schematic.

The module names are listed in the following table.

NAME	PACKAGE	EVALUATION MODULE
WJ1040-AT	SOP-8	WAYON CAN EVM V1.1 -SOP8

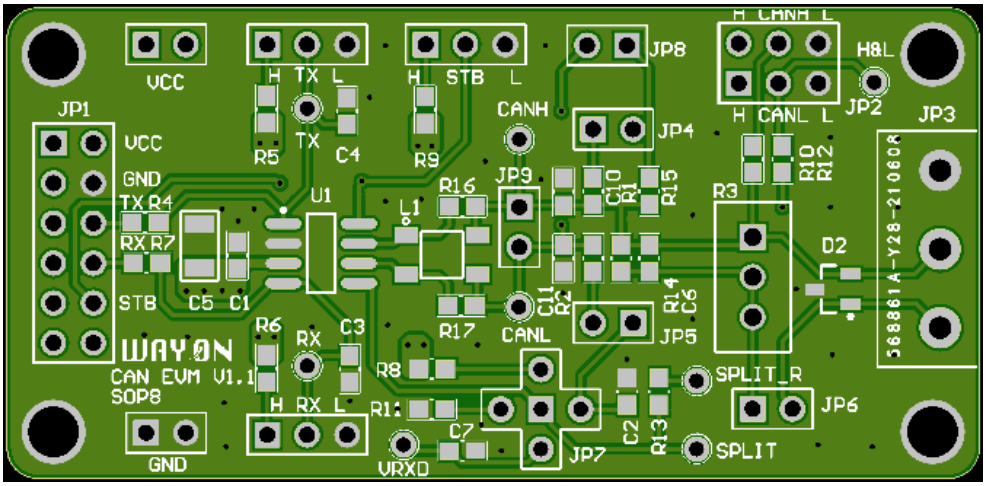


Figure 15. EVM

15. Naming Conventions

WJ AAAA-BBBC-AT

WJ: WAYON Interface

AAAA: Serial Number

BBB: S80-Package, SOP-8

FE8-Package, DFN3×3-8

C: R-Reel & T-tube

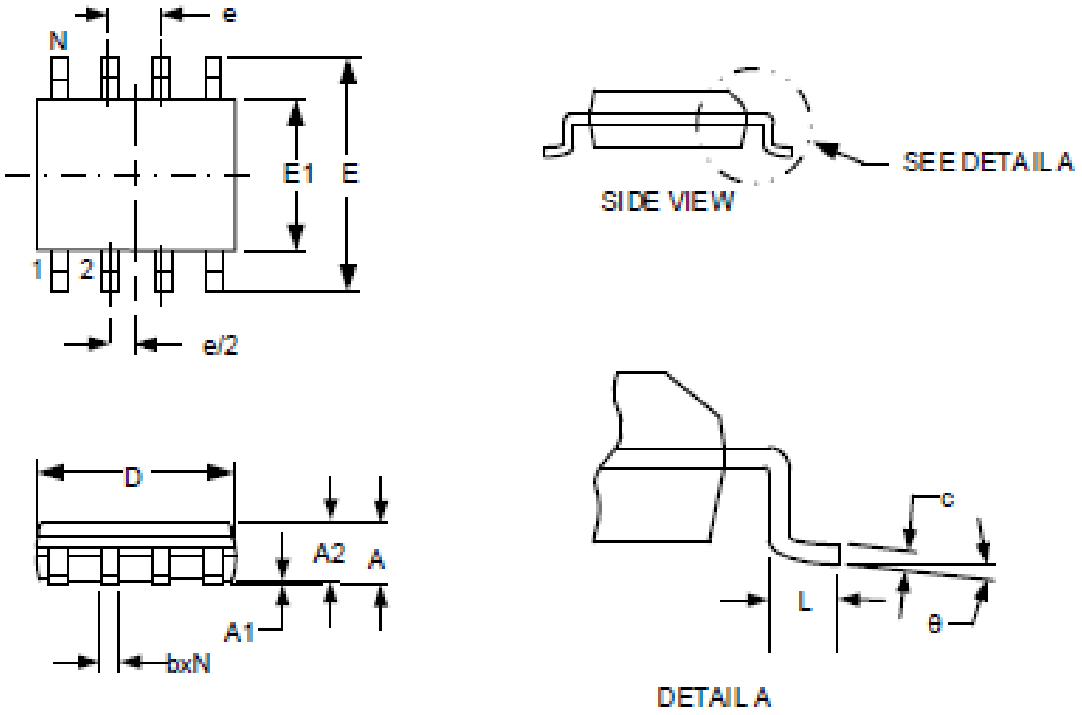
AT: Automotive

16. Electrostatic Discharge Warning

ESD can cause irreversible damage to integrated circuits, ranging from minor performance degradation to device failure. Precision ICs are more susceptible to damage because very minor parameter changes can cause the device to be out of compliance with its published specifications. WAY-ON recommends that all ICs be handled with proper precautions. Failure to follow proper handling practices and installation procedures may damage the IC.

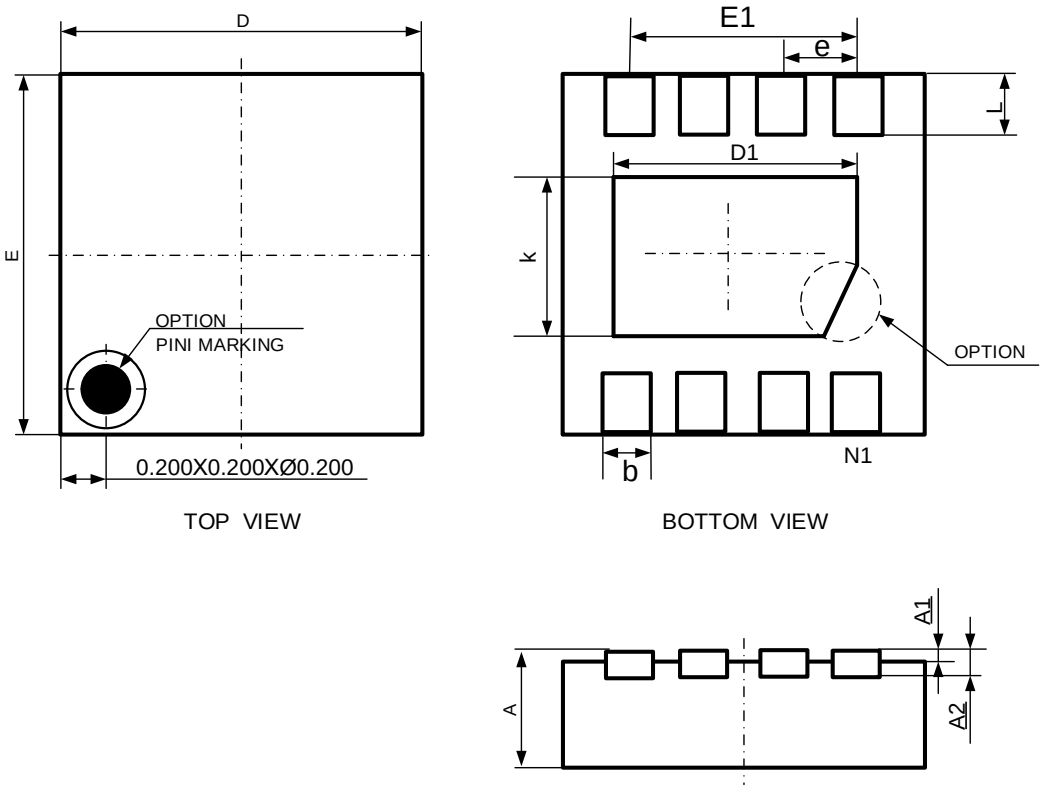
17. Package Information

SOP-8



SYMBOL	DIMENSIONS IN MILLIMETERS	
	MIN	MAX
A	1.25	1.90
A1	0.00	0.25
A2	1.25	1.65
b	0.31	0.51
c	0.15	0.30
D	4.70	5.20
E1	3.70	4.10
E	5.75	6.25
e	1.27BSC	
L	0.4	1.27
θ	0°	8°
N	8	

DFN3×3-8



SYMBOL	DIMENSIONS IN MILLIMETERS	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A2	0.203	
D	2.90	3.10
E	2.90	3.10
E1	1.95REF	
D1	2.20	2.60
K	1.40	1.65
b	0.20	0.35
e	0.65BSC	
L	0.25	0.60

18. Ordering Information

PART NUMBER	PACKAGE	PACKING QUANTITY	MARKING*
WJ1040-S80R-AT	SOP-8	4k/Reel	WJ1040 Q XXXX
WJ1040-FE8R-AT	DFN3×3-8	3k/Reel	WJ1040 Q XXXX

* XXXX is variable.

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WAYON website: http://www.way-on.com
For additional information, please contact your local Sales Representative.
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Specifications are subject to change without notice.
The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time.
Users should verify actual device performance in their specific applications.

Product Specification Statement

- The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.
- The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.
- WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.
- Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.
- The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.
- Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.