Controller Area Network (CAN)

UT64CAN333x CAN FD Transceivers

Released Datasheet

Cobham.com/HiRel

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The most important thing we build is trust

COBHAM

FEATURES

- Single 3.3 V supply voltage
- 5 V tolerant digital I/O
- Compatible with ISO 11898-2 and 11898-5 standards
- 10 kbps to 8 Mbps baud rates
- Class 2 ESD for non-CAN bus pins
- Class 3A ESD for CAN bus pins (CANL, CANH)
- Bus-Pin fault protection:
  - ±36 V terrestrial
  - ±16 V in orbit
- Common-mode range: -7 to +12 V
- Over current protection
- Low current standby mode: $I_{DD} \leq 1500$ µA
- Cold spare of digital I/O
- Product options:
  - Sleep mode (Figure 1)
  - Diagnostic loopback mode (Figure 2)
  - Loopback for auto-baud mode (Figure 3)
- Packaging:
  - 8-lead ceramic flat pack
  - Weight: 0.444 g
- Standard Microelectronics Drawing (SMD)
  - 5962-15232
- QML Q and QML V qualified
- Evaluation board available (UT64CANEVB333x)

OPERATIONAL ENVIRONMENT

- Total dose: up to 100 krad(Si)
- Latch-up immune (LET ≤ 117 MeV-cm^2/mg)

APPLICATIONS

- Avionic/Aerospace sensor monitoring
- Avionic/Aerospace system telemetry
- Avionic/Aerospace command and control
- Utility Plane Communication
- Smart Sensor Communication
- ARINC825 applications
- Time Triggered (TTP/C and TTP/A) applications

INTRODUCTION

Cobham Semiconductor Solutions UT64CAN333x series of Controller Area Network (CAN) transceivers are developed in accordance with the ISO 11898-2 standard. The CAN transceiver provides the physical layer that permits operation on a differential CAN bus. This series of CAN transceivers are capable of baud rates between 10 kbps to 8 Mbps and include a slope-control mode to control the slew rate of the transmissions for baud rates of up to 500 kbps. A standby mode disables the transmitter circuit to conserve power while monitoring the bus for activity. The UT64CAN333x series of transceivers can support up to 120 nodes.

The three transceiver options are:

- The UT64CAN3330 provides a low power sleep mode of operation
- The UT64CAN3331 supports a bus isolated diagnostic loopback
- The UT64CAN3332 offers the ability to monitor bus traffic enabling the local controller to change its baud rate to match the operations of the bus

OVERVIEW

The UT64CAN333x series CAN transceivers are low power serial communications devices developed to handle the demands of harsh space and terrestrial environments. The UT64CAN333x transceivers are compatible with the ISO 11898-2 and 11898-5 standards, operating as the physical layer between the bus and the CAN controller. All of the transceivers operate on a single +3.3 V power supply and receive data with an input common-mode in the range of -7 V to +12 V. The CANH and CANL outputs are fault protected against short-circuits by over-current shutdown circuitry. Each UT64CAN333x CAN transceiver is capable of:

- Operations on any 5 V bus or 3 V bus
    - The CAN bus is not actively driven during recessive (logic high) transmission and actively driven during the dominant (logic low) transmission. During this time, the differential voltage of both 5 V and 3.3 V devices is the same; however, the common mode output voltage will vary between the 5 V and 3.3 V devices. Since the common mode output voltage may vary slightly, Cobham recommends that system level testing be performed to understand and maximize the performance of operations when using mixed supply CAN buses. Cobham also recommends using split termination to filter common mode high frequency noise from bus lines to reduce emissions.
- Being a cold spare back-up to an active transceiver
- Programmable slew control on the bus driver
- Operating at baud rates up to 8 Mbps
- Low-power standby mode. The standby mode permits the transceiver to enter a low-current, listen only, mode by disabling the driver while the receiver remains active. The local controller has the option to disable low-power standby mode when bus activity resumes
- The RS pin on the UT64CAN333x series CAN transceivers provides three functional modes of operation:
    - High-speed: The high-speed mode of operation is selected by connecting pin 8 directly to ground, allowing the driver output to achieve a baud rate up to 8 Mbps
    - Slope control: The rise and fall slopes are adjusted by connecting a resistor to ground at pin 8. The slope of the driver output signal is proportional to the pin's output current. This slope control is implemented with an external resistor value between 10 kΩ to 100 kΩ. These values control to slew rates between ~2.0 V/μs to ~20 V/μs
    - Low-power standby mode: If RS is set to a high-level input (> $0.75*V_{DD}$), the transceiver enters a low-current, listen only mode of operation. In this mode, the CAN bus driver is disabled and the receiver remains active. The CAN controller has ability to disable low-power standby mode once bus activity resumes

Along with the common functionality described, the UT64CAN333x family of transceivers includes three members, each with a unique mode of operation.

The UT64CAN3330, Figure 1, provides the option to place the transceiver into a low power sleep mode to conserve power when CAN activity is suspended. Sleep mode disables the driver and receiver circuit when the $\overline{ZZ}$ pin is biased ≤ V_{IL}. The part resumes operations when the $\overline{ZZ}$ pin is biased ≥ V_{IH}.

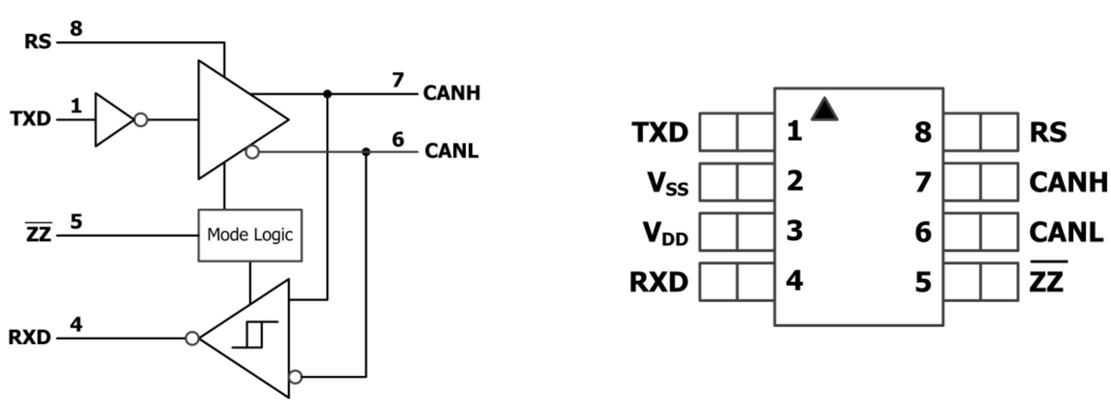


Figure 1: UT64CAN3330 (Sleep)

The UT64CAN3331, Figure 2, provides the option to isolate the transceiver bus connections to permit local node diagnostics, without interrupting operations on the bus. Diagnostic Loopback mode is enabled when the LBK pin is biased ≥ V_{IH}. Diagnostic Loopback mode is disabled when the LBK pin is biased ≤ V_{IL}. In the Diagnostic Loopback mode, the CANH/CANL output is placed in the recessive mode.

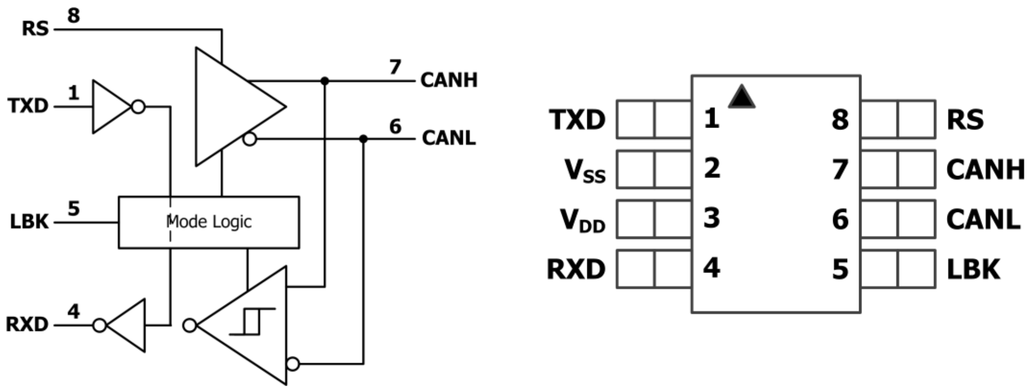


Figure 2: UT64CAN3331 (Diagnostic Loopback)

The UT64CAN3332, Figure 3, provides the option to automatically synchronize the baud rate of the transceiver by matching the bit timing to the traffic on the bus. The Auto Baud Loopback mode is enabled when the AB pin is biased ≥ V_{IH}. Auto Baud Loopback mode is disabled when the AB pin is biased ≤ V_{IL}. In the Auto-Baud mode, the CANH/CANL output is placed in the recessive mode.

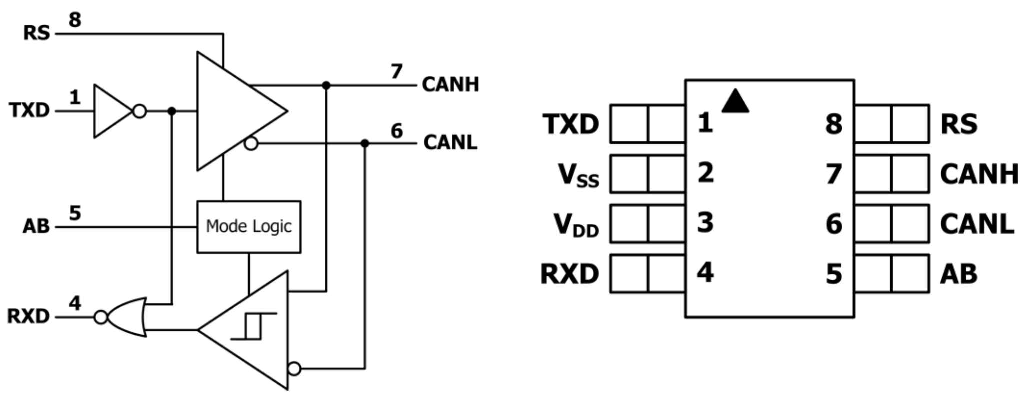


Figure 3: UT64CAN3332 (Auto-Baud Loopback)

PINLIST

I = LVTTL Compatible Input
IPU = LVTTL Compatible Input with Internal Pull-up
IPD = LVTTL Compatible Input with Internal Pull-down
O = LVTTL Compatible Output
I/O = LVTTL Compatible Bi-Direct
AI = Analog Multi-Function Input
AO = Analog Output
DIO = Differential Input/Output

Table 1: Pinlist

NUMBER	NAME	TYPE	DEFAULT	DESCRIPTION
1	TXD	IPU	--	Driver Input Data
4	RXD	O	*	Receiver Output Data
7	CANH	DIO	*	High-Level CAN Voltage Input/Output
6	CANL	DIO	*	Low-Level CAN Voltage Input/Output
5	$\overline{ZZ}$	IPD	--	Active LOW, low-current sleep mode - driver/receiver circuits deactivate (UT64CAN3330 only)
	LBK	IPD	--	Active High, diagnostic loopback mode pin (UT64CAN3331 only)
	AB	IPD	--	Active HIGH, bus listen-only loopback mode pin (UT64CAN3332 only)
8	RS	AI	0.7V	Operational Mode Select: • Slope Control • High speed • Standby
3	VDD	POWER	--	Supply voltage
2	VSS	POWER	--	Ground

NOTE:
* Output follows the input (TXD = Logic Low (Dominant) causes CANH-CANL = 3.0V (Dominant) and RXD = Logic Low (Dominant) or input (TXD = Logic High (Recessive) causes CANH-CANL = 0V (Recessive) and RXD = Logic High (Recessive)

ABSOLUTE MAXIMUM RATINGS [1, 2]

Table 2: Absolute Maximum Ratings

SYMBOL	PARAMETER	MIN	MAX	UNITS
V_{DD}	Supply Voltage Range	-0.3	6.0	V
$V_{I/O}$	Voltage on TTL pins during operation RXD, TXD, RS, AB, $\overline{ZZ}$, LBK	-0.3	5.5	V
$V_{CANH/L}$	Voltage on CANH and CANL bus terminal pin (On-orbit) [3]	-16	+16	V
	Voltage on CANH and CANL bus terminal pin (Terrestrial) [3]	-36	+36	V
$I_{I/O}$	LVTTL Input/Output DC Current	-10	+10	mA
Θ_{JC}	Thermal resistance, junction-to-case	--	15	°C/W
T_J	Junction Temperature	--	+150	°C
T_{STG}	Storage Temperature	-65	+165	°C
P_D	Maximum package power dissipation permitted at T_C=125°C[4]	--	1.67	W
ESD_{HBM}	ESD Protection (CANL, CANH) [5]	--	4000	V
ESD_{HBM}	ESD Protection (TXD, RXD, RS, $\overline{ZZ}$, AB, LBK) [5]	--	2000	V

NOTE:

1. Stresses outside the listed absolute maximum ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond limits indicated in the operational sections of this specification are not recommended. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and performance.
2. All voltages referenced to V_{SS}
3. Radiation effects can adversely affect the reliability and performance of the device during this condition. Contact a factory representative to evaluate the reliability based on the exposure to radiation.
4. Per MIL-STD-883, method 1012, section 3.4.1, $P_D=(T_J(max)-T_C(max))/\theta_{JC}$)
5. Per MIL-STD-883, method 3015, Table 3

OPERATIONAL ENVIRONMENT [1]

Table 3: Operational Environment

SYMBOL	PARAMETER	LIMIT	UNITS
TID	Total Ionizing Dose[2]	100	krad(Si)
SEL	Single Event Latchup Immunity[3]	≤117	MeV-cm^2/mg

NOTE:

1. For devices procured with a total ionizing dose tolerance guarantee, post-irradiation performance is guaranteed at 25°C per MIL-STD-883 Method 1019, Condition A up to maximum TID level procured.
2. Per MIL-STD-883, method 1019, condition A
3. SEL is performed at VDD = 3.6V at 125°C

RECOMMENDED OPERATING CONDITIONS [1]

Table 4: Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNITS
V_{DD}	Supply Voltage Range	3.0	3.6	V
V_{CANH}	Voltage on CANH bus terminal pin	-7.0	+12.0	V
V_{CANL}	Voltage on CANL bus terminal pin	-7.0	+12.0	V
T_C	Case Temperature Range	-55	+125	°C
$V_{I/O}$	Voltage on TTL pins during operation RXD, TXD, RS, AB, $\overline{ZZ}$, LBK	0	5.5	V
V_{ID}	Differential input voltage	-6	6	V
RS_{BIAS}	Bias input to RS pin for standby	$0.75*V_{DD}$	V_{DD}	V
	Resistor value between the RS pin and ground for slope control	10	100	kΩ
	Bias input to RS pin for high speed (8 Mbps)	V_{SS}	0.3	V
I_{OHC}	High-level output current CANH, CANL	-50	--	mA
I_{OLC}	Low-level output current CANH, CANL	--	50	mA
I_{IHC}	High-level input current CANH, CANL	-10	--	mA
I_{ILC}	Low-level input current CANH, CANL	--	10	mA

NOTE:

1. All voltages referenced to V_{SS}

DC ELECTRICAL CHARACTERISTICS [1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C +< +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 5: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNITS
I_{DD1}	Supply current maintaining a dominant output	TXD=0V, R_L=∞, RS=0V, AB=0V, $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 4	--	18	mA
I_{DD2}		TXD=0V, R_L=60Ω ±1%, RS=0V, AB=0V, $\overline{ZZ}$=V_{DD}, LBK=0V See Figure 4	--	60	
I_{DD3}	Supply current receiving a dominant bus input	TXD=V_{DD}, R_L=60Ω ±1%, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{ID}=1.4V, V_{IC}=2.5V See Figure 4	--	3	mA
I_{DD4}	Supply current maintaining a Recessive output	TXD=V_{DD}, R_L=∞, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 4	--	3	mA
I_{DD5}		TXD=V_{DD}, R_L=60Ω ±1%, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 4	--	3	
I_{DD6}		TXD=V_{DD}, R_L=60Ω ±1%, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{ID}=0.0V, V_{IC}=2.5V See Figure 4	--	3	
I_{DD7}	Sleep supply current (UT64CAN 3330 only)	R_L=∞, $\overline{ZZ}$=0V, TXD=V_{DD}, RS=0V or V_{DD} See Figure 4	--	60	µA
I_{DD7A}		R_L=60Ω ±1%, $\overline{ZZ}$=0V, TXD=V_{DD}, RS=0V or V_{DD} See Figure 4	--	60	
I_{DD8}		R_L=60Ω ±1%, , $\overline{ZZ}$=0V, TXD=V_{DD}, RS=0V or V_{DD}, V_{ID}=0.0V, V_{IC}=2.5V See Figure 4	--	115	
I_{DD9}	Standby supply current	R_L=∞, RS=V_{DD}, TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 4	--	1.6	mA
I_{DD10}		R_L=60Ω ±1%, RS=V_{DD}, TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 4	--	1.65	
I_{DD11}		R_L=60Ω ±1%, RS=V_{DD}, TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{ID}=0.0V, V_{IC}=2.5V See Figure 4	--	1.6	
I_{DD12}	Supply Current Under High Voltage Fault[2]	R_L=∞, RS=0V, TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, $V_{CANH/L}$=+/-24V See Figure 4	--	6	mA
I_{DD13}	Supply Current Operating in Auto Loopback (UT64CAN 3332 only)	R_L=∞, RS=0V, TXD=0V, AB=V_{DD} See Figure 4	--	3	mA
I_{DD13A}		R_L=60Ω ±1%, RS=0V, TXD=0V, AB=V_{DD} See Figure 4	--	3	
I_{DD13B}		R_L=60Ω ±1%, RS=0V, TXD=0V, AB=V_{DD}, V_{ID}=1.4V, V_{IC}=2.5V See Figure 4	--	3	
I_{DD14}	Supply Current Operating in Diagnostic Loopback (UT64CAN 3331 only)	R_L=∞, RS=0V, TXD=0V, LBK=V_{DD} See Figure 4	--	3	mA
I_{DD14A}		R_L=60Ω ±1%, RS=0V, TXD=0V, LBK=V_{DD} See Figure 4	--	3	

NOTE:

1. All voltages referenced to V_{SS}
2. Guaranteed by characterization for $V_{CANH/L}$ = +/-36V

DRIVER [1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 6: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNITS
V_{CANH1}	Bus output voltage (dominant) CANH	TXD=0V, RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	2.25	V_{DD}	V
V_{CANL1}	Bus output voltage (dominant) CANL	TXD=0V, RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	0.50	1.25	V
V_{CANH2}	Bus output voltage (recessive) CANH	TXD= V_{DD}, RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	2.0	3.0	V
V_{CANL2}	Bus output voltage (recessive) CANL	TXD=V_{DD}, RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	2.0	3.0	V
V_{ODD1}	Differential output voltage (dominant)	TXD=0V, RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	1.5	3.0	V
V_{ODD2}		TXD=0V, RS=0V, V_{TEST} = -7 to +12V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 6 and Figure 7	1.2	3.0	
V_{ODR1}	Differential output voltage (recessive)	TXD=V_{DD}, RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	-120	12	mV
V_{ODR2}		TXD=V_{DD}, RS=0V, R_L=∞, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 5 and Figure 6	-500	50	mV
I_{OSH1}	Short-circuit output[2]	VCANH=-7 V, CANL=∞, TXD=0V, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 8	-250	--	mA
I_{OSH2}		VCANH=12 V, CANL=∞, TXD=0V, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 8	--	3	
I_{OSL1}		VCANL=-7 V, CANH=∞, TXD=0V, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 8	-1	--	
I_{OSL2}		VCANL=12 V, CANH=∞, TXD=0V, RS=0V, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V See Figure 8	--	250	

NOTE:

1. All voltages referenced to V_{SS}
2. Guaranteed by characterization

RECEIVER [1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 7: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS		MIN	MAX	UNIT
V_{IT+}	Positive-going input threshold voltage	AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{IC}=2.5V See Figure 9 and Table 13		--	900	mV
V_{IT-}	Negative-going input threshold voltage			500	--	
V_{HST}	Hysteresis voltage	$V_{HST}=V_{IT+} - V_{IT-}$		20	--	
I_{IR1}	Bus input current	V_{CANH} or V_{CANL} = 12V	TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, Other bus pin (V_{CANH} or V_{CANL}) at 0V	--	500	µA
I_{IR2}		V_{CANH} or V_{CANL} = 12V and V_{DD} ≤ V_{SS}+0.3V		--	600	
I_{IR3}		V_{CANH} or V_{CANL} = –7V		-610	--	
I_{IR4}		V_{CANH} or V_{CANL} = –7V and V_{DD} ≤ V_{SS}+0.3V		-450	--	
C_H	CANH capacitance[2]	CANH to V_{SS}, V_I=0.025*Sin(2E6πt)+2.3V, TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V		--	50	pF
C_L	CANL capacitance[2]	CANL to V_{SS}, V_I=0.025*Sin(2E6πt)+2.3V, TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V		--	50	
C_{ID}	Differential capacitance[2]	CANH to CANL, V_I = 0.025*Sin(2E6πt), TXD=V_{DD}, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V		--	25	
R_{ID}	Differential input resistance	AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V		40	100	kΩ
R_H	Single ended input resistance CANH			20	50	
R_L	Single ended input resistance CANL			20	50	
R_M	Percent difference between RH and RL	$\frac{2 * \lvert(R_L - R_H)\rvert}{(R_L + R_H)} * 100$		--	3.0	%

NOTE:
1. All voltages referenced to V_{SS}
2. Capacitance is measured for initial qualification and when design changes might affect the input/output capacitance

ANALOG INPUT (RS)[1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 8: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V_{RS1}	Input voltage for enabling High-speed mode (8Mbps operation)	TXD=V_{DD}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V	V_{SS}	300	mV
V_{RS2}	Input Voltage for enabling Standby mode	TXD=V_{DD}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V	0.75*V_{DD}	5.5	V
I_{RS1}	High-Speed mode input current	V_{RS}=0V	-500	-100	µA
I_{RS2}	Standby mode input current	V_{RS}=0.75*V_{DD}	--	30	µA
I_{RS3}	Standby mode input current	V_{RS}=5.5V	--	50	µA
I_{RS4}	Cold sparing leakage current	V_{RS}=5.5V or V_{RS} ≤ 0.3V, V_{DD} ≤ V_{SS}+0.3V	-20	20	µA

NOTE:

1. All voltages referenced to V_{SS}

TTL I/O (TXD, $\overline{ZZ}$, AB, RXD, LBK) [1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 9: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V_{IH}	Input Voltage High		2.0	--	V
V_{IL}	Input Voltage Low		--	0.8	V
I_{IOD}	Input leakage current on TXD	V_{in}=0V or V_{in}=5.5V	-60	100	µA
I_{IO}	Input leakage current on pins ($\overline{ZZ}$, AB, LBK)	V_{in}=0V or V_{in}=5.5V	-10	100	µA
I_{CS}	Cold sparing leakage current (TXD, $\overline{ZZ}$, AB, RXD, LBK)	V_{in}=0.0V and V_{in}=5.5V, V_{DD} ≤ V_{SS}+0.3V	-20	20	µA
V_{OH}	Output high voltage on RXD	I_{OH}=-4mA	2.4	--	V
V_{OL}	Output Low voltage on RXD	I_{OL}=4mA	--	0.4	V
C_{IO}	Input Capacitance[2]	TXD or $\overline{ZZ}$ or AB or RXD or LBK to V_{SS}, V_I=0.025*Sin(2E6πt), RS=0V	--	10	pF

NOTE:

1. All voltages referenced to V_{SS}
2. Guaranteed by characterization

AC ELECTRICAL CHARACTERISTICS

DRIVER [1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 10: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
t_{PLHT1}	Propagation delay time (TXD input dominant to CAN dominant)[2]	RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	85	ns
t_{PLHT2}		RS with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125 kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	260	
t_{PLHT3}		RS with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK= V, V_{TXD} ≤ 125 kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	1200	
t_{PHLT1}	Propagation delay time, (TXD recessive to CAN recessive) [2]	RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	120	ns
t_{PHLT2}		RS with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	485	
t_{PHLT3}		RS with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	1650	

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
t_{SKPT1}	Pulse skew ($\lvert t_{PHL} - t_{PLH} \rvert$)(2)	RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	75	ns
t_{SKPT2}		RS with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	--	450	
t_{SKPT3}		RS with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O 50Ω), See Figure 10	--	1250	
t_{RT1}	Differential CAN signal rise time(2) (3)	RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	5	80	ns
t_{RT2}		RS with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6 s, tf ≤ 6ns, Z_O=50Ω), See Figure 10	14	250	
t_{RT3}		RS with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	40	1000	
t_{FT1}	Differential CAN signal fall time(2) (3)	RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	20	75	ns
t_{FT2}		RS with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	30	185	
t_{FT3}		RS with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 10	40	800	
t_{ENS}	Enable time from standby deactivate to CAN dominant	TXD=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{RS} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω, RS < 0.75*V_{DD}), See Figure 11	--	1.50	μs
t_{ENZ}	Enable time from sleep deactivate to CAN dominant	RS=0V, TXD=0V, R_L=60Ω ±1%, $V_{\overline{ZZ}}$ ≤ 50kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 12 (UT64CAN3330 Only)	--	7	μs

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
t_{DISS}	Disable time from standby assert to CAN recessive	TXD=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{RS} ≤ 125kHz (Square wave , 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω, RS ≥ 0.75*V_{DD}), See Figure 11	--	150	ns
t_{DISZ}	Disable time from sleep assert to CAN recessive	RS=0V, TXD=0V, R_L=60Ω ±1%, $V_{\overline{ZZ}}$ ≤ 50kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 12 (UT64CAN3330 Only)	--	100	ns

NOTE:

1. Per MIL-STD-883, method 3012
2. C_L = 50 pF or equivalent on the ATE or 15 pF ±20% for bench test characterization
3. Guaranteed by characterization

RECEIVER [1]

(V_{DD} = 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 11: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
t_{PLHR}	Propagation delay time (CANH recessive to RXD recessive) [2]	RS=0V, TXD=V_{DD}, $R_L=\infty$, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, $V_{CANH} \leq$ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O =50Ω), V_{CANL}=1.5V, See Figure 13	--	60	ns
t_{PHLR}	Propagation delay time (CANH dominant to RXD dominant) [2]	RS=0V, TXD=V_{DD}, $R_L=\infty$, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, $V_{CANH} \leq$ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), V_{CANL}=1.5V, See Figure 13	--	60	ns
t_{SKPR}	Pulse skew	$t_{SKPR} = (\lvert t_{PHLR} - t_{PLHR} \rvert)$, See Figure 13	--	25	ns
t_{RR}	RXD output signal rise time [2] [3]	RS=0V, TXD=V_{DD}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, $V_{CANH} \leq$ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), V_{CANL}=1.5V, See Figure 13	--	5	ns
t_{FR}	RXD output signal fall time [2] [3]	RS=0V, TXD=V_{DD}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, $V_{CANH} \leq$ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), V_{CANL}=1.5V, See Figure 13	--	5	ns

NOTE:

1. Per MIL-STD-883, method 3012
2. C_L = 50 pF or equivalent on the ATE or 15 pF ±20% for bench test characterization
3. Guaranteed by characterization

TRANSCEIVER LOOPBACK [1]

(V_{DD}= 3.3V ± 0.3V, -55°C < T_C < +125°C); Unless otherwise noted, T_C is per the temperature range ordered

Table 12: DC Electrical Characteristics

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
t_{LOOPD1}	Total loop delay, TXD to RXD, dominant[2]	RS=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 14	--	125	ns
t_{LOOPD2}		R_S with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 14	--	800	
t_{LOOPD3}		R_S with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 14	--	1500	
t_{LOOPR1}	Total loop delay, TXD to RXD, recessive[2]	R_S=0V, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 14	--	125	ns
t_{LOOPR2}		R_S with 10kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 14	--	800	
t_{LOOPR3}		R_S with 100kΩ to V_{SS}, R_L=60Ω ±1%, AB=0V or $\overline{ZZ}$=V_{DD} or LBK=0V, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 14	--	1650	
t_{LBK}	Loopback delay, TXD to RXD[2]	R_S=0V, R_L=60Ω ±1%, LBK=V_{DD}, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 15 (UT64CAN3331 Only)	--	20	ns
t_{AB1}	Loopback delay, TXD to RXD[2]	R_S=0V, R_L=60Ω ±1%, AB=V_{DD}, V_{TXD} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 16 (UT64CAN3332 Only)	--	20	ns
t_{AB2}	Loopback delay, CAN input to RXD[2]	R_S=0V, TXD=V_{DD}, R_L=∞, AB=V_{DD}, V_{CANH} ≤ 125kHz (Square wave, 50% duty cycle, tr ≤ 6ns, tf ≤ 6ns, Z_O=50Ω), See Figure 17 (UT64CAN3332 Only)	--	60	

NOTE:

1. Per MIL-STD-883, method 3012
2. C_L = 50 pF or equivalent on the ATE or 15 pF ±20% for bench test characterization

TABLES AND FIGURES

Table 13: Differential Input Voltage Threshold Test

INPUT (V)		OUTPUT		MEASURED (V)
V_{CANH}	V_{CANL}	R		$\lvert V_{ID} \rvert$
−6.1	−7.0	L	V_{OL}	0.9
12.0	11.1	L		0.9
−1.0	−7.0	L		6.0
12.0	6.0	L		6.0
−6.5	−7.0	H	V_{OH}	0.5
12.0	11.5	H		0.5
−7.0	−1.0	H		6.0
6.0	12.0	H		6.0
Open	Open	H		X

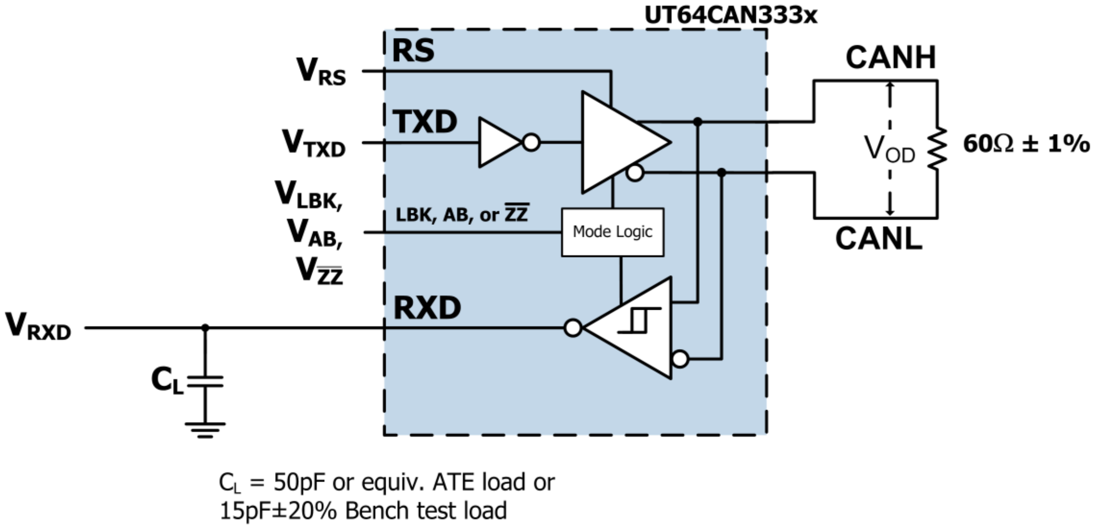


Figure 4: DC Test Configuration

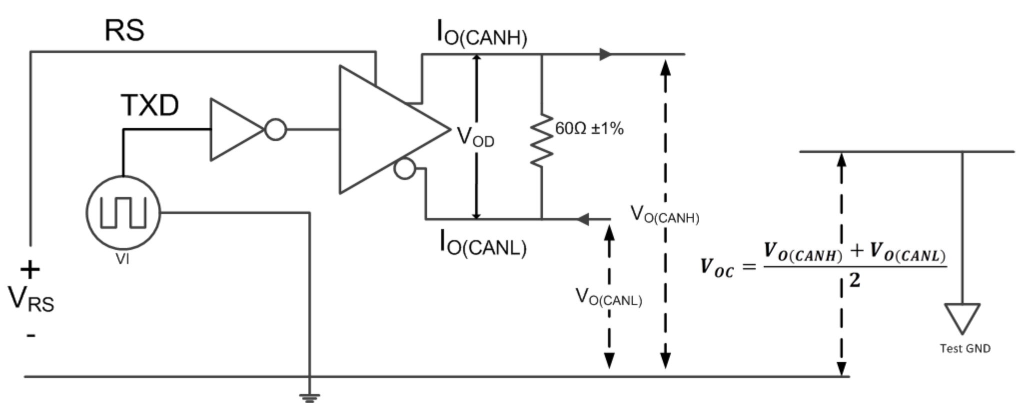


Figure 5: Driver Voltage, Current, and Test Definition

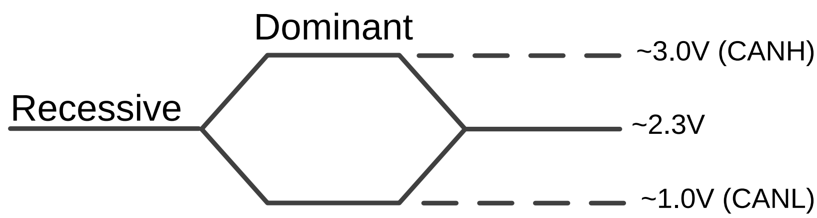


Figure 6: Bus Logic State Voltages Definitions

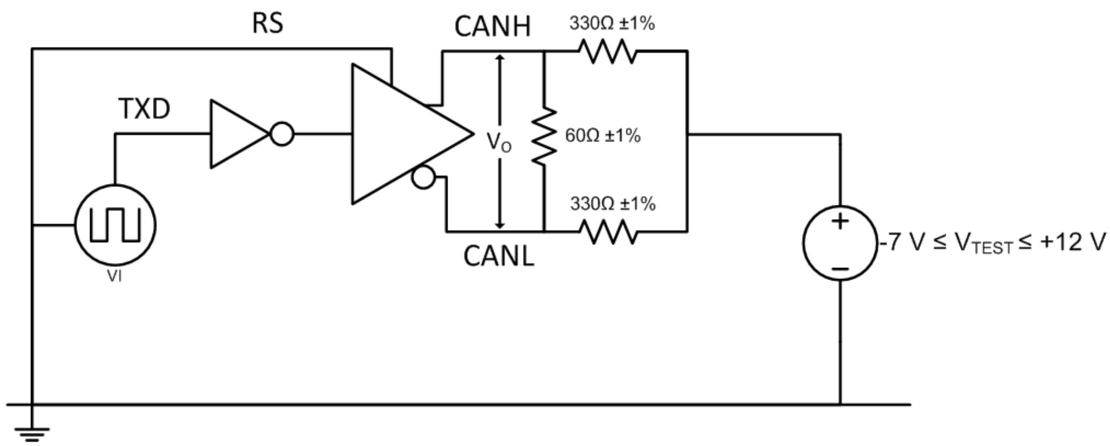


Figure 7: Driver V_{OD}

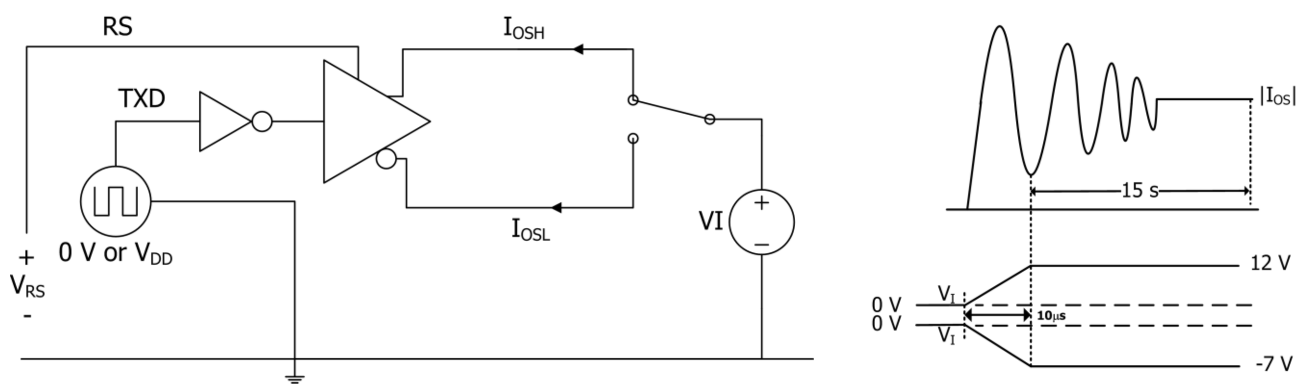


Figure 8: IOS Test Circuit and Waveforms

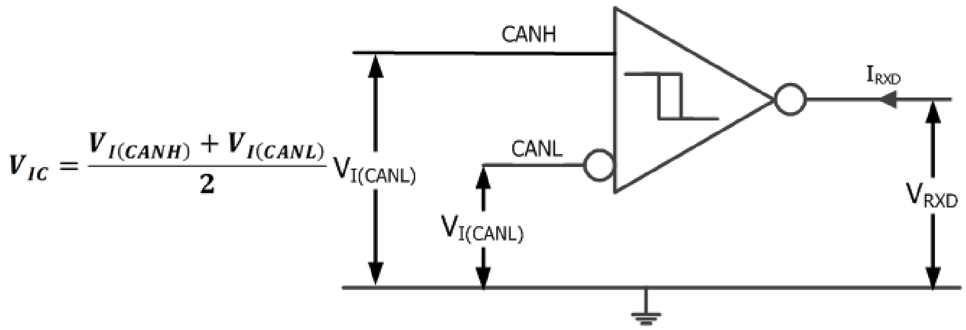


Figure 9: Receiver Voltage and Current Definitions

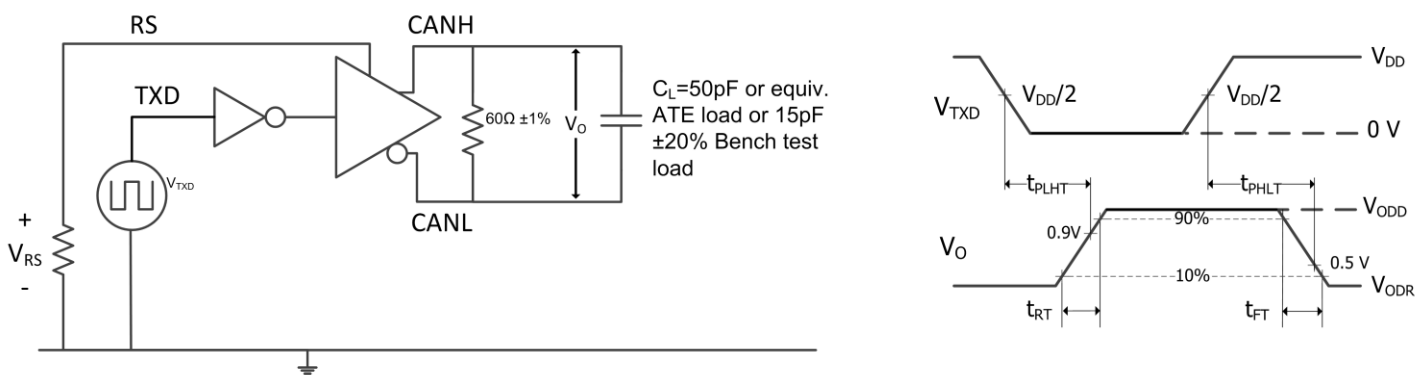


Figure 10: Drive Test Circuit and Voltage Waveforms

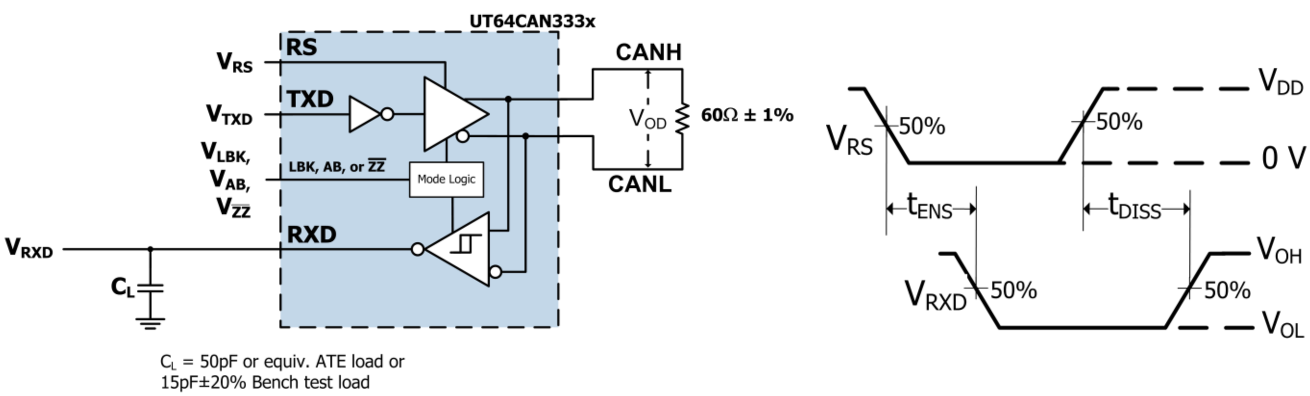


Figure 11: t_{ENS} and t_{DISS} Test Circuit and Voltage Waveforms

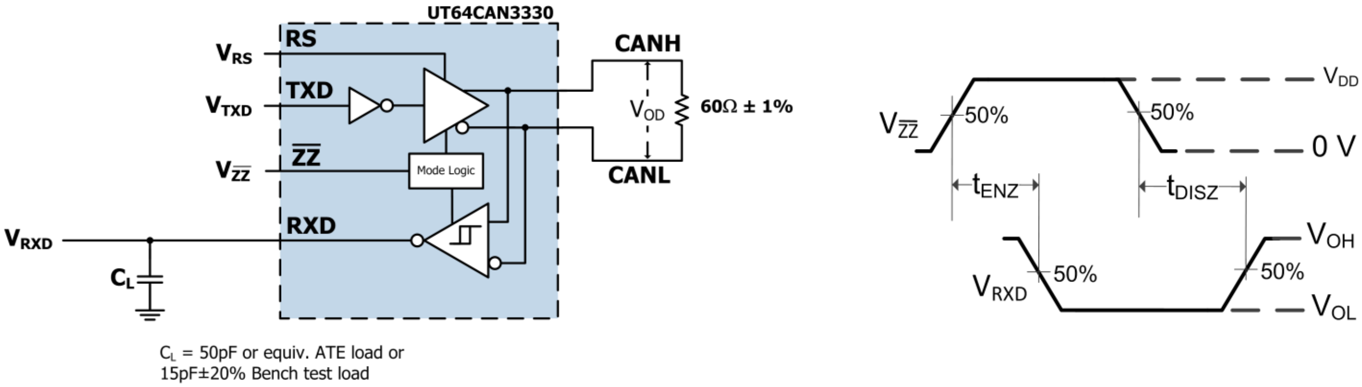


Figure 12: t_{ENZ} Test Circuit and Voltage Waveforms

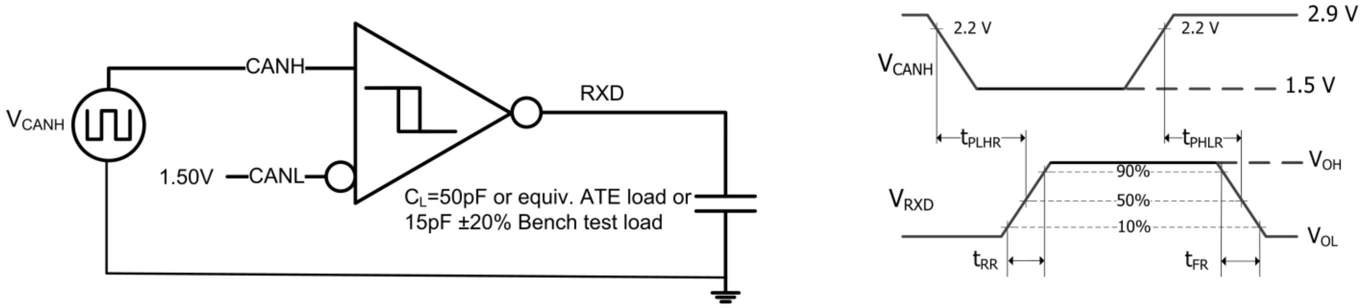


Figure 13: Receiver Test Circuit and Voltage Waveforms

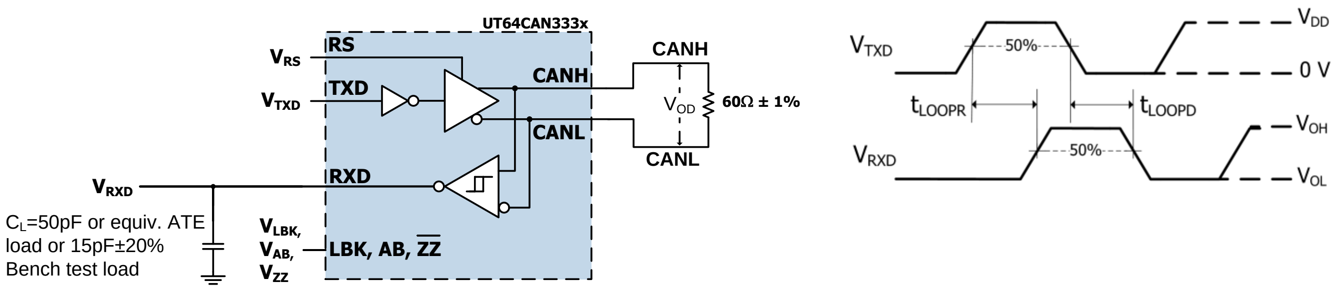
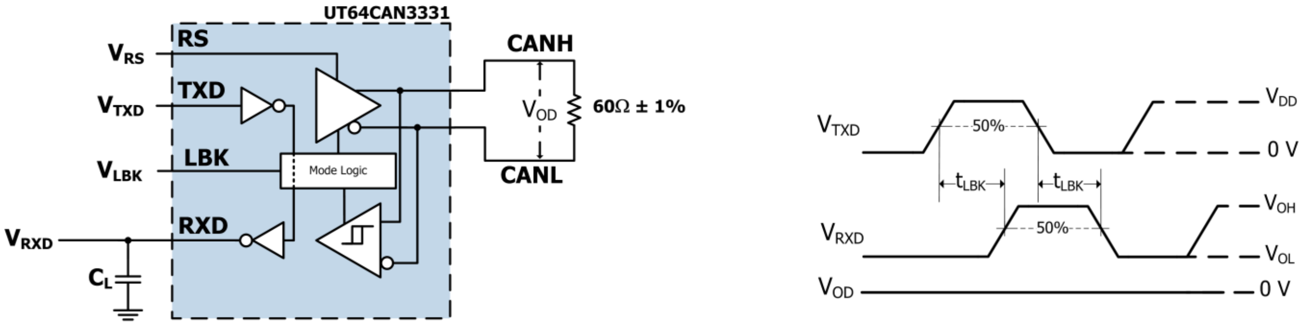
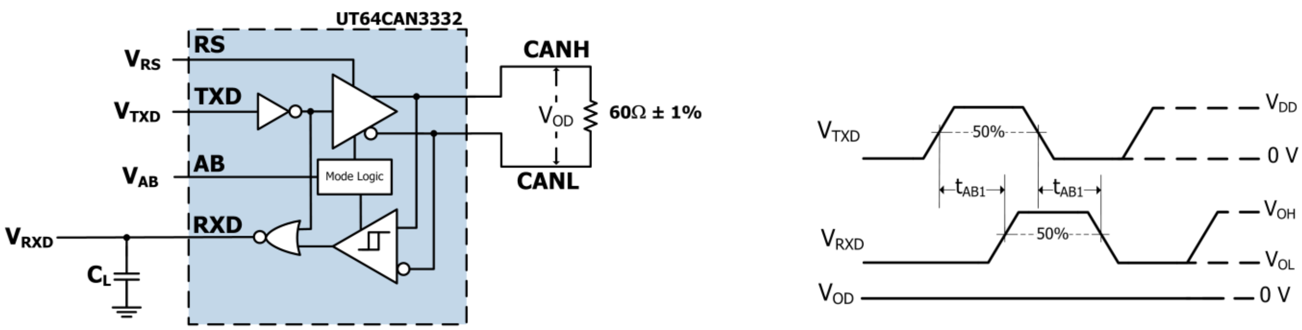


Figure 14: t_{LOOP} Test Circuit and Voltage Waveforms



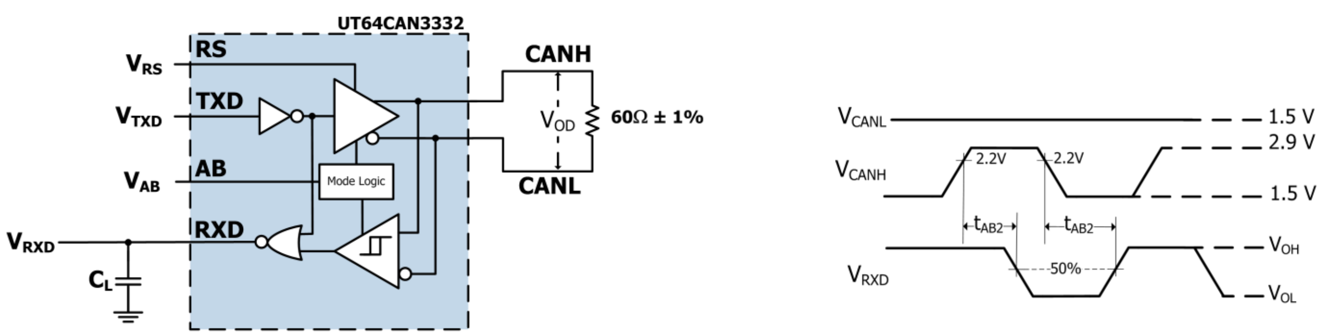
C_L = 50pF or equiv. ATE load or
15pF±20% Bench test load

Figure 15: t_{LBK} Test Circuit and Voltage Waveforms



C_L = 50pF or equiv. ATE load or
15pF±20% Bench test load

Figure 16: t_{AB1} Test Circuit and Voltage Waveforms



C_L = 50pF or equiv. ATE load or
15pF±20% Bench test load

Figure 17: t_{AB2} Test Circuit and Voltage Waveforms

TEST LOADS

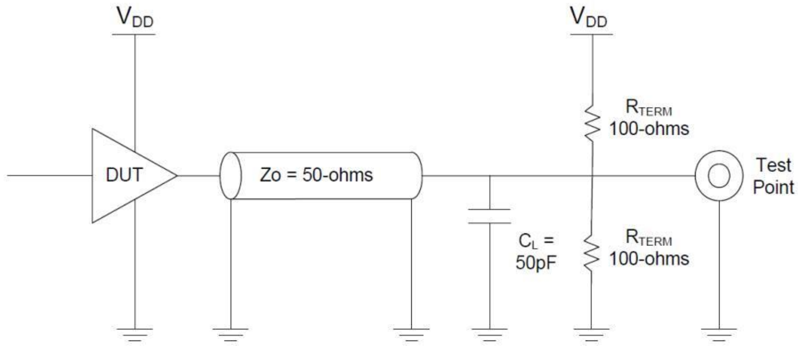
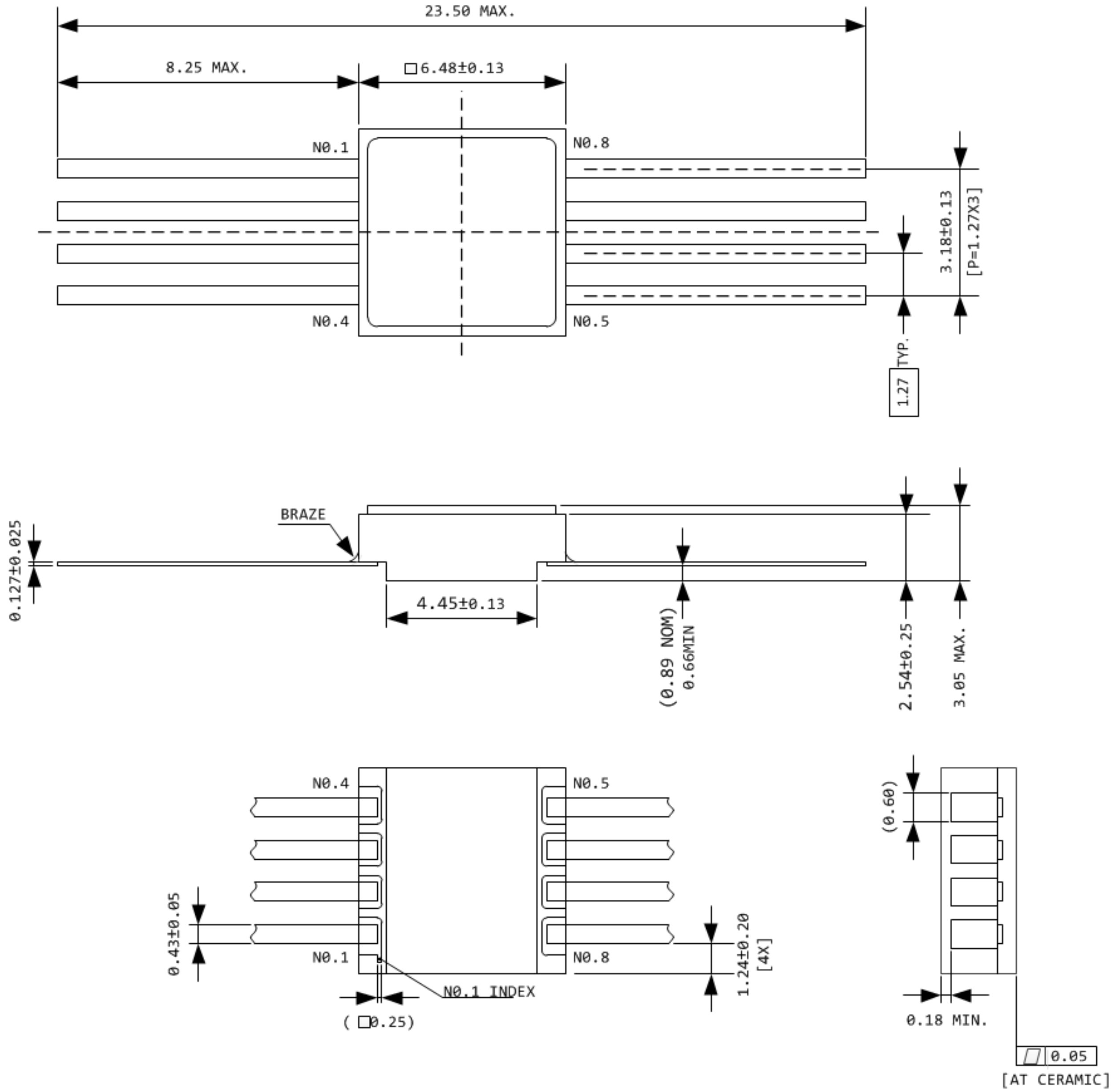


Figure 18: Standard Test Load

NOTE:

1. C_L = 50 pF minimum or equivalent (includes scope probe and test socket)
2. Measurement of data output occurs at the low to high or high to low transition mid-point, typically $V_{DD}/2$

PACKAGING



NOTES:
1. Package Material: Opaque 90% Minimum Alumina Ceramic.
2. All Exposed metal areas must be gold plated 100 to 225 microinches thick over electroplated nickel undercoating 100 to 350 microinches thick per MIL-PRF-38535.
3. The seal ring is electrically connected to V_{SS}.
4. Finished Package Weight: 450 mg (maximum)

Figure 19: 8-lead Ceramic Flatpack (Units in mm)

ORDERING INFORMATION

Generic Datasheet Part Numbering

UT64CAN * *** * * *

Lead Finish: (Notes: 1, 2)
(A) = Hot Solder Dipped or Tinned
(C) = Gold

Screening Level: (Notes: 3, 4)
(P) = Prototype Flow (Temperature Range: 25°C only)
(C) = HiRel Flow (Temperature Range: -55°C to +125°C)

Case Outline:
(X) = 8-lead Flatpack (dual-in-line)

Device Type:
(3330) = Sleep
(3331) = Diagnostic Loopback
(3332) = Auto-baud Loopback

Radiation Hardness Level:
(-) = None

NOTES:
1. Lead finish (A,C, or X) must be specified.
2. If and "X" is specified when ordering, then the part marking will match the lead finish applied to the device shipped
3. Prototype Flow per Aeroflex Manufacturing Flows Document. Lead finish is GOLD "C" only. Radiation is neither tested nor guaranteed.
4. HiRel Flow per Cobham Manufacturing Flows Document. Radiation TID tolerance may not be ordered.

ORDERING INFORMATION

SMD Part Numbering

5962 - 15232 ** * * *

Lead Finish: (Notes: 1,2)
(A) = Hot Solder Dipped or Tinned
(C) = Gold
(X) = Factory Option (Gold, Solder, or Tinned)

Case Outline: (Note: 2)
(X) = 8-lead Flatpack (dual-in-line)

QML/Jan Class:
(Q) = QML Class Q
(V) = QML Class V

Device Type:
(01) = UT64CAN3330 w/ Sleep
(02) = UT64CAN3331 w/ Diagnostic Loopback
(03) = UT64CAN3332 w/ Auto-baud Loopback

SMD Project Number:
(15232) = CAN FD Transceiver

Radiation Hardness Assurance: (Note: 3)
(R) = 100 krad(Si)

NOTES:

1. Lead finish (A,C, or X) must be specified.
2. If and "X" is specified when ordering, then the part marking will match the lead finish applied to the device shipped
3. Total dose radiation must be specified when ordering. QML Q and QML V are not available without radiation hardening. For prototype inquiries, contact factory.

REVISION HISTORY

Table 14: Revision History

Date	Rev. #	Change Description
11/17/15	2.0.0	Initial release of Preliminary Datasheet
12/15/15	2.1.0	Removed VOCPP spec, corrected typos, updated RXD rise and fall time spec, and updated figure 13.
12/17/15	2.2.0	Updated SEL limit on feature page, Changed note 3 in table 2, changed note 3 and SEL limit in table 3, updated figures and tables, updated RXD rise and fall time spec, removed transient overvoltage spec, removed I/O capacitance minimum
1/28/15	2.3.0	QML Q approved. Minor updates to formatting and added ATE equivalent circuit. Added mixed signal bus operation and split termination verbiage.
05/01/16	2.4.0	Changed tPLHT3 from 870ns to 1200ns.
05/17/16	2.5.0	Removed the Recommended PCB Footprint
10/07/16	2.5.1	Revised Iosh2 specification from 1 mA to 3 mA. Updated the VCANH1 minimum specification to 2.25. Updated figures to show CL=50pF. Updated Tables 2 and 4 with LBK signal. Updated Figures 2, 3, 11, 12, 13, 14, and 17.

Cobham Semiconductor Solutions – Datasheet Definitions

Advanced Datasheet - Product In Development

Preliminary Datasheet - Shipping Prototype

Datasheet - Shipping QML & Reduced Hi – Rel

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