Intersil's Rad Tolerant CAN Transceivers ESA | CAN in Space Workshop

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Outline

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ISL7202xSEH 3.3V CAN Bus Transceiver Family

ISL72026SEH

Listen Mode & Loopback

1 D	RS 8
2 GND	CANH 7
3 VCC	CANL 6
4 R	LBK 5

ISL72027SEH

Listen Mode & Split Termination



ISL72028SEH

Low Power Mode & Split Termination



Features

- Bus Fault Protection up to ±20V
 - Supply range 3V to 3.6V
- Common Mode Range = -7V to +12V
- Cold Spare Capable
 - Ideal for N+1 Redundant Systems
- Current Fold Back OC Protection
- Programmable Driver Rise/Fall Times
- Radiation Tolerance
 - High Dose Rate = 75krad(Si)
 - No SEB up to 60MeV·cm²/mg
 - SEL Immune BiCMOS SOI Process







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"Once we adapt a total CAN bus protocol, we expect satellites will achieve sensible mass and power reductions and manufacturers will have the ability to add several millions of dollars of functional capability."

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Current Status of Transceivers (1/2)

Intersil Qualification Status and Strategy

- Industry's first Class V Rad Tolerant 3.3V CAN Bus Transceiver Family
- Devices are fully compliant to QML Class V and on an SMD # 5962-15228

• DLA has given these devices an RHA designator of "L"

- This is for devices rated for a TID 50krad(Si) however...

<u>3/</u> For θ_{JC} , the case temperature location is the center of the exposed metal pad on the package underside.

<u>4</u>/ Device types 01, 02, 03 have been tested at low dose rate only. The radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, method 1019, condition D to a maximum total ionizing dose (TID) level of 75 krads(Si). Device types 01, 02, 03 are wafer acceptance tested to 75 krads(Si) total ionizing dose per MIL-STD-883, method 1019, condition D, per customer request, and are marked at the standard 50 krads(Si) level.

<u>5</u>/ Device types 01, 02, 03 use silicon on insulator (SOI) technology. No single-event burnout (SEB) or single-event latchup (SEL) was observed when irradiated with Pr ions at normal incidence, corresponding to a surface LET of 60 MeV·cm²/mg. The normal particle range into silicon for Pr ions after 30 mm of air is about 110 µm and the Bragg peak range is 37 µm, resulting in ion penetration well beyond the sensitive volume of the devices.

Current Status of Transceivers (2/2)

Complete Release Package

- Final datasheets on all devices are available on the web: Datasheet
- Evaluation board and user guides are available for all the devices
 - Design files are also available: BoM, schematic and art files
- PSPICE and IBIS models are available on the web
- ELDRS and SEE test report is available

Orders, Deliveries and Lead Times

- To date we have multiple orders for flight models
 - We have sampled all major European customers and have interest from India, Canada and US
- In stock we have >250 / PROTO devices available for immediate shipment
- ~500 Class V qualified material in stock available
- Lead times are running 16-18 weeks.

Qualification Status at our customers

 Intersil ISL72026SEH device is qualified in AIRBUS equipment MPIU (Modular Payload Interface Unit) for E3000 Satcom platform



Export Classification of Transceivers

• Intersil received a classification (CCATS) from Commerce that classified the CAN BUS under ECCN 5A991.b

- ECCN 5A991.b controls Telecommunication transmission equipment and systems
 - i.e. radio equipment (transmitters, receivers and transceivers), repeater equipment, multiplex equipment
- The only country that would require a license for export is Sudan
- Any integration of the CAN BUS into a higher level assembly or other major component does not make that component or higher level assembly subject to US export law provided that the total sum content of all US origin materials and minor components/parts does not exceed 10% for reexports to certain countries: Cuba, Iran, North Korea, Sudan or Syria.
- If US origin content exceeds 10% in total then cannot re-export that higher level assembly to any
 of the following countries: Cuba, Iran, North Korea, Sudan or Syria.
- All other destinations worldwide there is no de minimis restriction. China and Russia export free.



ISO 11898-2 Compatible vs Compliant

- The Intersil rad hard CAN transceivers are not fully compliant with ISO11898-2 standard. They are compatible with the standard and meet the key electrical specifications of the standard.
- The Intersil parts are essentially compliant to Table 1, Table 2, Table 4, Table 5 and Table 6
 - Exceptions
 - Table 5: The output bus voltage minimum for CAN_H is 2.25V vs. the ISO Spec of 2.75V and CAN_L is 0.1V vs. the ISO spec of 0.5V
 - Table 6: Typical Cin is 35pF and Cdiff = 15pF vs. ISO typical values of 20pF and 10pF
- We are not compliant with Table 3 where it states for a battery voltage of 24V, the voltage at CANH and CANL must tolerate 32V.

- Our parts can handle ±20V on the bus lines with ±18V under beam (this is acceptable with ESA spec.).

• For Table 12 "Bus failure detection", Intersil worked with the ESA to identify the requirements for Table 12 for space applications

- See ECSS-E-ST-50-15C (May 1, 2015) Section 5.3.3 on pages 33 - 38.



Total Ionizing Dose Performance

Intersil CAN transceivers are wafer by wafer tested to 75krad(Si)

- All test are performed per MIL-STD-883, TM1019 and used a dose rate of 10mrad(Si)/s
- 24 devices of each type were irradiated up to 75krad(Si) followed by an anneal (168 hrs, 100°C)
- All devices were bin 1 compliant after testing was complete





Single Event Effects (SEE) Performance

• Destructive SEE test summary

- The parts are immune to damaging SEE effects at $60 \text{MeV} \cdot \text{cm}^2/\text{mg}$ while operating at or below the voltages of VCC = 4.5V and bus common-mode voltages of ±18V

Single Event Transients (SET) summary

- The ISL7202xSEH exhibited SET susceptibility up to LET = $43MeV \cdot cm^2/mg$.
 - SET was defined as any transition in the receiver output for static biasing conditions and any received bit outside of 40% to 60% duty-cycle for a 50% transmitted bit stream (250kHz and 500kHz)



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What is next for Intersil CAN Bus Transceivers?

• Redundant applications require two devices per node

- 1 active device and 1 cold spare device
- We have discussed developing a multi-chip module solution



Isolated CAN Transceivers

- Eliminate ground loops which can degrade data signals, cause excessive EMI or even damage
- Active R&D on new process development to implement capacitive coupling isolation
- Active R&D on the use of Giant Magneto Resistive (GMR) isolators
 - Allows isolation for fast switching signals and for DC level signals
 - Provides 4kV of Galvanic isolation
 - Can be integrated in to the silicon
 - Reduces complexities of multi-chip packaging



What is next for Intersil CAN Bus Transceivers?

• Transceivers for CAN FD (flexible data rate) support

- CAN flexible data-rate allows for a faster transmission rate of the payload data
 - Arbitration phase and acknowledge phase still synchronized at <1Mbps
 - Typical FD speeds are in the range of 2Mbps
- Intersil has tested device performance at data rates higher >1Mbps
 - Confident we can support data rates >2Mbps rates

Two board connected with a 3m cable, double terminated with 120Ω, with 150pF differential capacitance on driver and receiver.



1Mbps

2Mbps

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What is next for Intersil CAN Bus Transceivers?

Transceivers with more fault protection

 Dominate timeout timer prevents the bus from being set to the dominant state permanently in case a fault sets the transmitter input to a low level permanently.



Any other features or trends for the transceivers you would like to see?



