CAN Reference Guide

- Industrial and Factory Automation
- Motion Control
- Transportation
- Sensors
- Backplanes

ISO1050, SN65HVD230, SN65HVD231, SN65HVD232, SN65HVD233
SN65HVD234, SN65HVD235, SN65HVD251, SN65HVD252, SN65HVD253
SN65HVD1040, SN65HVD1050, SN65HVDA540, SN65HVDA541
SN65HVDA542, SN65HVDA1040A, SN65HVDA1050A
SN65HVD255, SN65HVD256, SN65HVD257

www.ti.com/can
**Introduction to CAN (Controller Area Network)**

Whether you are looking for 5V CAN, 3.3V CAN, isolated CAN, automotive CAN or industrial CAN, Texas Instruments provides what you need. TI is committed to solving specialized networking requirements while optimizing various higher level buses and higher level communication protocols. These standards include:

- **ARNIC825**: CAN-based communication standard for airborne systems used by current and future aircraft. Driven by Airbus, Boeing and partners. [www.arinc825.com](http://www.arinc825.com)
- **CANaerospace**: Communication protocol on top of CAN designed for aerospace. [canaerospace.net](http://canaerospace.net)
- **CAN Kingdom**: Communication protocol on top of CAN designed as fieldbus.
- **CANopen (EN 50325-4)**: CAN-based, higher-layer protocol for embedded control system. [www.can-cia.org](http://www.can-cia.org)
- **DeviceNet**: Industrial network system based on CAN. [www.odva.org](http://www.odva.org)
- **ISO11898-x**: Road vehicles. [www.iso.org](http://www.iso.org)
- **ISO11783**: Tractors and machinery for agriculture and forestry - serial control and communications data network. [www.iso.org](http://www.iso.org)
- **NMEA 2000**: National Marine Electronics Association – serial network utilizing CAN. [www.nmea.org](http://www.nmea.org)
- **SAEJ1939**: Recommended practice for a serial control & communications vehicle network. [www.sae.org](http://www.sae.org)
- **SAEJ2284**: High-speed CAN (HSC) for vehicle applications. [www.sae.org](http://www.sae.org)
- **SafetyBUS p**: Protocol on top of CAN designed for fieldbus to SIL 3. [www.safety-network.de](http://www.safety-network.de)

**CAN Applications**

Standardized CAN Data Bus/Protocol: ARINC 825, CANaerospace, CAN Kingdom, CANopen, DeviceNet, ISO11783, NMEA2000, SAEJ1939, SAEJ2284, SafetyBUS p

- Automotive (-Q1 versions)
- Industrial automation
- Building automation
- Process control equipment
- Elevators & lifts
- Backplane communication
- Construction equipment
- Farm equipment

**CAN-Based Buses and Protocols**

Various higher level buses and higher level communication protocols have been implemented using or deriving from CAN protocol and physical layer standards. These standards include:

- **SafetyBUS p**: Protocol on top of CAN designed for fieldbus to SIL 3. [www.safety-network.de](http://www.safety-network.de)

**5V CAN transceivers**
- “Turbo” CAN
- Programmable slew rate
- EMC and speed optimized
- Low-power modes
- Wake-up via CAN network traffic
- Protection features
- Level shifting and 3.3V compatible
- Small VSON package
- Loopback for autobaud

**3.3V CAN transceivers**
- Voltage rail and regulator simplification (no 5V required)
- Power savings vs. 5V
- Programmable slew rate
- Low-power modes
- Protection features
- Loopback for autobaud & diagnostic purposes

**Isolated CAN transceivers**
- Isolation up to 5000VRMS
- Failsafe outputs
- 3.3V/5V I/O
- 25-year life at rated working voltage
**CAN PHY Basics (ISO11898-2 & -5)**

High-Speed Medium Access Unit = HS CAN Transceiver with Transmission Rates of up to 1 Mbit/s

HS CAN is a Differential Bus (CANH & CANL Lines) with Two States:

**Recessive:**
- Logic H
- Vdiff <= 0.5V
- CANH and CANL weakly biased to Vcc/2

**Dominant:**
- Logic L
- Vdiff = >0.9V
- CANH and CANL driven differentially by PHY driver
- Dominant overwrites recessive (enables CAN arbitration to work)

**HS CAN Bus Topology**

ISO11898 defined CAN as a linear bus topology. The original standard defined the electrical characteristics of a 30node, 40m bus capable of 1mbps. This basic topology is easily modified to support various configurations through the use of tradeoffs in data rate, number of nodes and bus length.
## TI CAN Transceiver Portfolio

### Selection Table

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New products are listed in **bold red**. Preview products are listed in **bold blue**.
5V Typical Applications

5V System with 1050 Type Transceiver
Normal and Silent Modes

- Optimized 5V System with no CAN Wake
  - No extra components.
  - Lower cost V\text{REG} (systems normally powered so no low power mode or low I\text{Q} requirements).
  - Silent (receive only) mode for software diagnostics on CAN bus.
  - V\text{REF} may be left open or connected with bypass cap to GND if unused for driving split termination.

5V System with 1040 Type Transceiver
Normal and Low Power Standby (with CAN Wake) Modes

- Optimized 5V System with Low Power CAN Wake
  - No extra components.
  - Low power Standby Mode (5\text{µA} typical) with CAN bus initiated wake up request to µP via RXD.
  - Low quiescent current (I\text{Q}) V\text{REG} needed to keep system current (power) low if wake up from CAN in low power standby mode is used.
  - SPLIT may be left open or connected with bypass cap to GND if unused for driving split termination.

3.3V Typical Applications

3.3V System with HVD230 3.3V Transceiver
Normal and Standby Modes

- Optimized 3.3V System Including Low Power CAN Wake
  - No extra components.
  - Low power Standby Mode (370\text{µA} typical) with wake from CAN bus.
  - Lower cost V\text{REG} used for systems not requiring low power wake up; if low power wake up needed then a low quiescent current (I\text{Q}) V\text{REG} is needed to keep system current (power) low.
  - V\text{REF} may be left open or connected with bypass cap to GND if unused for driving split termination.

3.3V I/O MCU with 5V HVD256 Transceiver
Normal and Silent Modes

- 3.3V I/O MCU with 5V CAN PHY
  - I/O level shifter allows 5V CAN bus with direct interfacing to 3.3V µP.
  - Can be used with various power supply rail and I/O voltage level schemes.
  - Silent (receive only) mode for software diagnostics on CAN bus.
**CAN Reference Guide**

**Support: Evaluation Boards**

**CAN EVM:**
SN65HVD255D Evaluation Module

**Isolated CAN EVM:**
ISO1050 Evaluation Module

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**Industrial Interface Support Forum**
Ask questions, share knowledge, explore ideas and help solve problems with fellow engineers

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D011012
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