In-Vehicle Networking

Lecture 9 CAN Physical Layers
ISO 11898, ISO 11783 Part 2, J1939-11,12,13 Physical Layers
BAE 5030 - 353
Fall 2008
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ISO 11898

- 11898-2 High speed physical layer
  - Other parts describe other physical layers and CAN
- Most used physical layer standard for CAN
- Differential voltage signaling on a two wire end terminated bus
- Data rate defined to 1 Mbit/s
- Bus length to 40 m at 1 Mbit/s
- Number of nodes limited by electrical busload
- The characteristic impedance 120 Ohms
- Signaling voltages
  - Common mode nominal 2.5 V
  - CAN_L nominal 1.5 V
  - CAN_H nominal 3.5 V
- Nominal specific propagation delay 5ns/m

ISO 11898 Tranceivers

Manufacturer	Bosch	Mietec	Philips Semicon-ductors	Philips Semicon-ductors	SGS-Thomson	Temic (Siliconix)	Unitrode
type no.	CF150B	MTC-3054	82C250	82C251	L9615	Si9200EY	UC5350
data rate max. [Mbd]	0.5	1	1	1	0.5	1	1
short circuit [V]	-5...+36	-3...+65	-8...+18	-36...+36	-5...+36	GND...+16	-8...+36
transient [V]	-200...+200	-200...+200	-150...+100	-200...+200	-200...+200	-60...+60	-150...+100
ESD [kV]	2	2	2	2.5	2	2	2
thermal shutdown	(1,2)	n.a.	yes	yes	(1, 2)	yes	yes
slope control	on/off	variable	variable	variable	on/off	none	variable
CMR [V]	-2...+7 (3)	-7...+12	-7...+12	-7...+12	-2...+7 (3)	-2...+7	-25...+18
delay [ns]	230	100	170	170	230	120 (4)	100 (4)
fan out (5)	32	32	64 (110)	110	32	32	n.a. (6)
supply current [mA]	<80	110	<70	<80	<80	70	70
stand-by current [µA]	n.a.	300	<170	<250	n.a.	n.a.	1000
packaging	SOIC-8	SOP-16	SO-8, DIP-8	SO-8, DIP-8	SO-8	SO-8	SOIC-8,DIL-8

(1) short circuit detection and shutdown (2) overvoltage detection and shutdow (3) measured CMR: -12...+18V

(4) 50 ns for transmit (5) higher fan out possible, depends on application

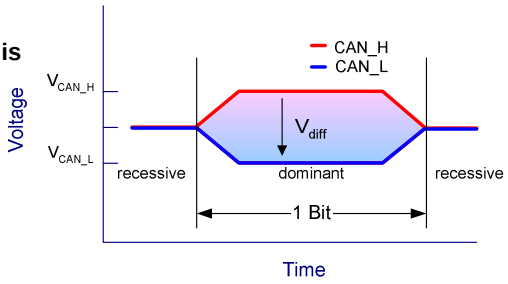
(6) under specific circumstances more than 128 n.a.: data not available

Remarks: 82C250 and UC5350 are pin compatible; L9615 is licenced by Bosch

http://www.softing.com/home/en/industrial-automation/products/can-bus/more-can-bus/high-speed/iso-hs-transceivers.php?navanchor=3010560

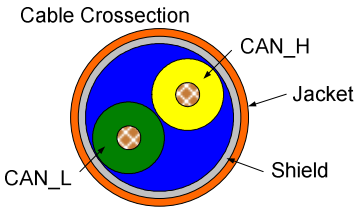
ISO 11898 Signaling

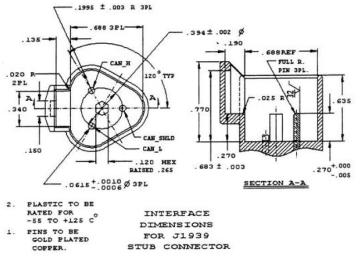
- **Recessive if CAN_H voltage is not higher than CAN_L plus 0.5 V.**
- **Dominant if CAN_H voltage is at least 0.9 V higher than CAN_L**
- **Nominal voltage in the dominant state is 3.5 V for CAN_H line and 1.5 V for CAN_L**



SAE J1939-11

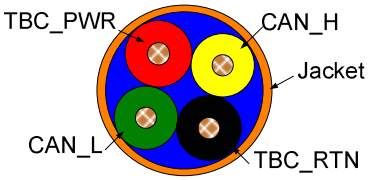
- Bit rate
  - 250 kBaud
- Signaling
  - Two wire, differentially driven, end terminated bus
- Cable
  - shielded twisted pair
  - 18 or 20 gauge
  - 120 ohm characteristic impedance
- 40 m bus with 1 m stubs max
- 30 ECUs max
- Bus voltages
  - Recessive: 2.5 V nominal
  - Dominant:
    - CAN_H 3.5 V nominal
    - CAN_L 1.5 V nominal
    - 2 V differential
  - Maximum ground offset 2V
- ISO 11898 drivers are compatible





ISO 11783

- Bit rate
  - 250 kBaud
- Signaling
  - Two wire, differentially driven, end terminated bus
- Active terminations powered by one of two cable pairs
- Cable
  - Unshielded twisted quad
  - 18 gauge
  - 75 ohm characteristic impedance
- 40 m bus with 1 m stubs max
- 30 ECUs max
- Bus voltages
  - Recessive: 2.5 V nominal
  - Dominant:
    - CAN_H 3.5 V nominal
    - CAN_L 1.5 V nominal
    - 2 V differential
  - Maximum ground offset 2V
- ISO 11898 drivers are compatible

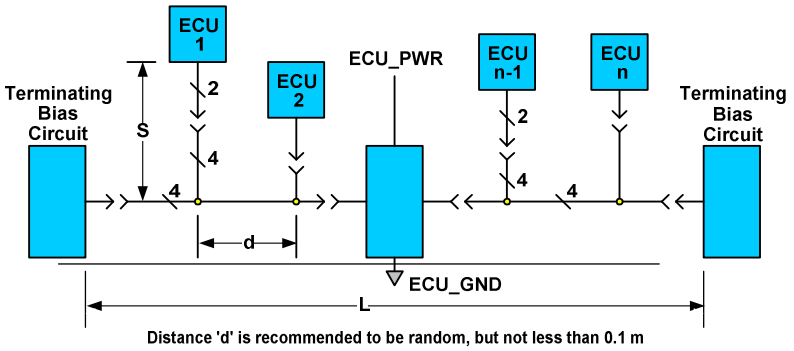


ISO 11783 Physical Layer

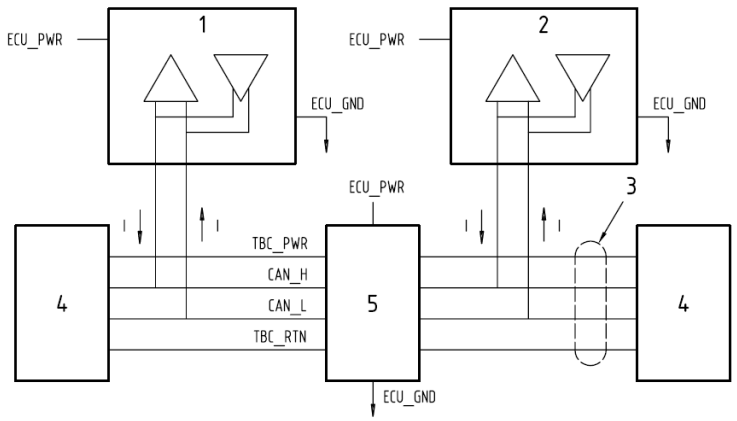
- Bus Fault Tolerance:
  - Continued communications (emissions failure?)
    - CAN_H shorted to V_{bat} or Ground or interrupted
    - CAN-L shorted to V_{bat} or Ground or interrupted
  - Communications Failure
    - CAN_H Shorted to CAN_L
    - Terminator power interrupted
- Termination: High impedance at nodes
  - Active terminators - differential current control
- ECU Conformance Testing: Specified

ISO 11783 Bus Length and Geometry

- Maximum Segment Length (L): 40 m
- Maximum Drop Length (S): 1.0 m
- Minimum Node Separation (d): 0.1 m



ISO 11783 Bus electrical schematic



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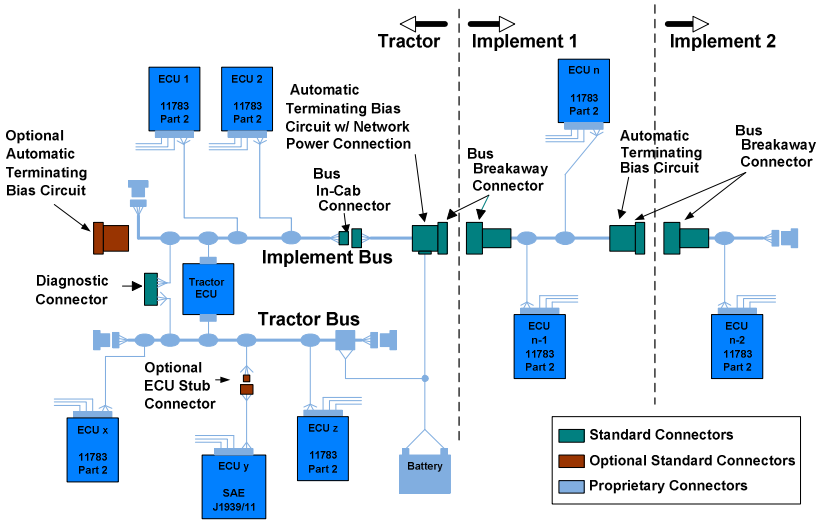
ISO 11783 Connectors



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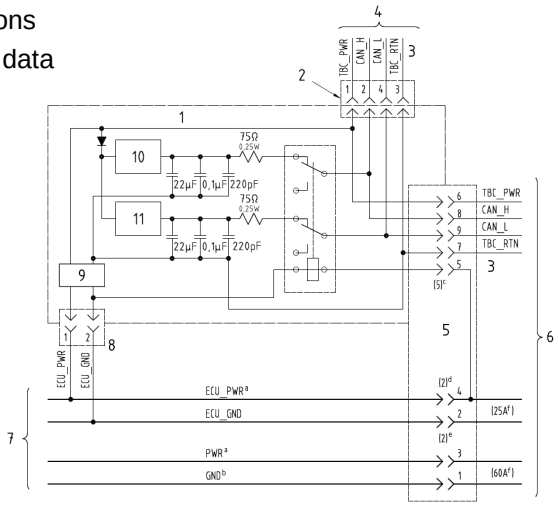
ISO 11783 Automatic Terminating Bias Connector

- Disconnection does not disrupt communications
- Provides Power and data



ISO 11783 Bus Extension

- Bridges could be used to extend the bus but are not permitted in the main implement bus on ISO 11783
- Repeaters cannot be used
  - They extend propagation delay and are not an advantage in extending the bus