CAN bus protection
Is this presentation suited for you?

Where do you stand with CAN bus protection?

Beginner?
I am not familiar with this subject. I am in the discovery phase and would like an overview and a basic understanding of the technology.

Overview

Intermediate?
I have a basic understanding of this subject. I would like to go deeper in details and tackle more aspects of this subject.

Basic

Advanced?
I am very familiar with this subject. I would like to deepen my knowledge and become an expert.

In depth

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Basics on CAN bus

CAN stands for Controller Area Network

It is very popular in the automotive industry

It is a serial bi-directional half-duplex multi-master communication bus

2 lines:
- CAN_H (CAN High)
- CAN_L (CAN Low)

2 standards:
- Low-speed, fault-tolerant
- High-speed

Benefits of CAN
- Cost-effective
- Light-weight
- Reliable / transmission safety
- Information available for all nodes
Where is CAN

• As the CAN bus is reliable, it is used to connect together most of the modules in the car, including safety and critical functions.
# Basics on CAN bus

<table>
<thead>
<tr>
<th>Parameters</th>
<th>High-speed CAN</th>
<th>Low-speed CAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical layer standards</td>
<td>ISO 11898-2</td>
<td>ISO 11898-3</td>
</tr>
<tr>
<td>Data rate</td>
<td>Up to 1 Mbit/s</td>
<td>Up to 125 kbit/s</td>
</tr>
<tr>
<td>Maximum length</td>
<td>30 m</td>
<td>500 m</td>
</tr>
<tr>
<td>Termination</td>
<td>120 Ω shunt</td>
<td>2.2 kΩ serial on each line</td>
</tr>
<tr>
<td>Recessive voltage level</td>
<td>$V_{\text{CAN}_L} = 3.25 \text{ V}$</td>
<td>$V_{\text{CAN}<em>H} = V</em>{\text{CAN}_L} = 2.5 \text{ V}$</td>
</tr>
<tr>
<td>Dominant voltage level</td>
<td>$V_{\text{CAN}_L} = 1 \text{ V}$</td>
<td>$V_{\text{CAN}<em>H} - V</em>{\text{CAN}_L} = 2 \text{ V}$</td>
</tr>
</tbody>
</table>

![Graphs showing voltage levels](image)
Why protection is needed?

- Automotive systems require a high level of robustness and must be 100% reliable when they control safety devices.

- The automotive industry has defined standards to guarantee the robustness of car embedded electronics.
**Why protection is needed?**

CAN protection must comply with the following main standards

<table>
<thead>
<tr>
<th>Hazards</th>
<th>Type</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD protection</td>
<td>Voltage spikes due to electro-static discharges.</td>
<td>ISO 10605</td>
</tr>
<tr>
<td>Surge protection</td>
<td>Voltage spikes due to switching processes (influenced by capacitance and inductances of the wiring harness)</td>
<td>ISO 7637-3 pulse 3a/3b</td>
</tr>
<tr>
<td>Jump start</td>
<td>Application of 24 V on all inputs to simulate a jump start with a 24 V battery</td>
<td>ISO 16750</td>
</tr>
<tr>
<td>Reverse battery</td>
<td>Application of -28 V (during 60 s) to simulate a reversed battery connection in case of using an auxiliary starting device</td>
<td>ISO 16750</td>
</tr>
</tbody>
</table>
CAN protection portfolio

- **ESDCAN01-2BLY**
- **ESDCAN03-2BWY**
- **ESDCAN24-2BLY**
- **ESDCAN02-2BWY**

Package

- SOT23
- SOT323

Minimum breakdown voltage ($V_{BR}$)

- 25 V
- 26.5 V
- 27 V
- 28.5 V
## ESDCAN series versus standards

<table>
<thead>
<tr>
<th>Hazards</th>
<th>Standards</th>
<th>ESDCAN24-2BLY</th>
<th>ESDCAN01-2BLY</th>
<th>ESDCAN02-2BWY</th>
<th>ESDCAN03-2BWY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD protection</td>
<td>ISO 10605</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>+30 kV contact</td>
<td></td>
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</tr>
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<td>Surge protection</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>$V_{BR}$ min (reverse) = 27 V</td>
<td>$V_{BR}$ min (reverse) = 25 V</td>
<td>$V_{BR}$ in (reverse) = 28.5 V</td>
<td>$V_{BR}$ in (reverse) = 26.5 V</td>
<td></td>
</tr>
<tr>
<td>Reverse battery</td>
<td>ISO 16750</td>
<td>✓</td>
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ESDCAN series: quality of protection

- Not only protection features must comply with standards, but they must efficiently protect against surges.

- The quality of protection features is measured by its ability to clamp overvoltages and overcurrent, thus protect the IC (CAN controller) against EOS / ESD

- The lower the clamping voltage, the greater the circuit’s better ESD immunity.
Let’s go further

Protection of automotive electronics - guidelines for design and component selection
Application note AN2689

Pspice models

In-depth information

Selection & sampling

Our product selector: Automotive dataline ESD protection
Our selection guide: Automotive-grade protection devices and rectifiers (.pdf)