

The image features the Delphi logo in a bold, black, sans-serif font on a light blue background. To the right of the logo is a complex, abstract graphic with blue and white lines, resembling a stylized sunburst or a network of data connections. The overall design is modern and technological.

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Automotive Electrical

Operational Modes

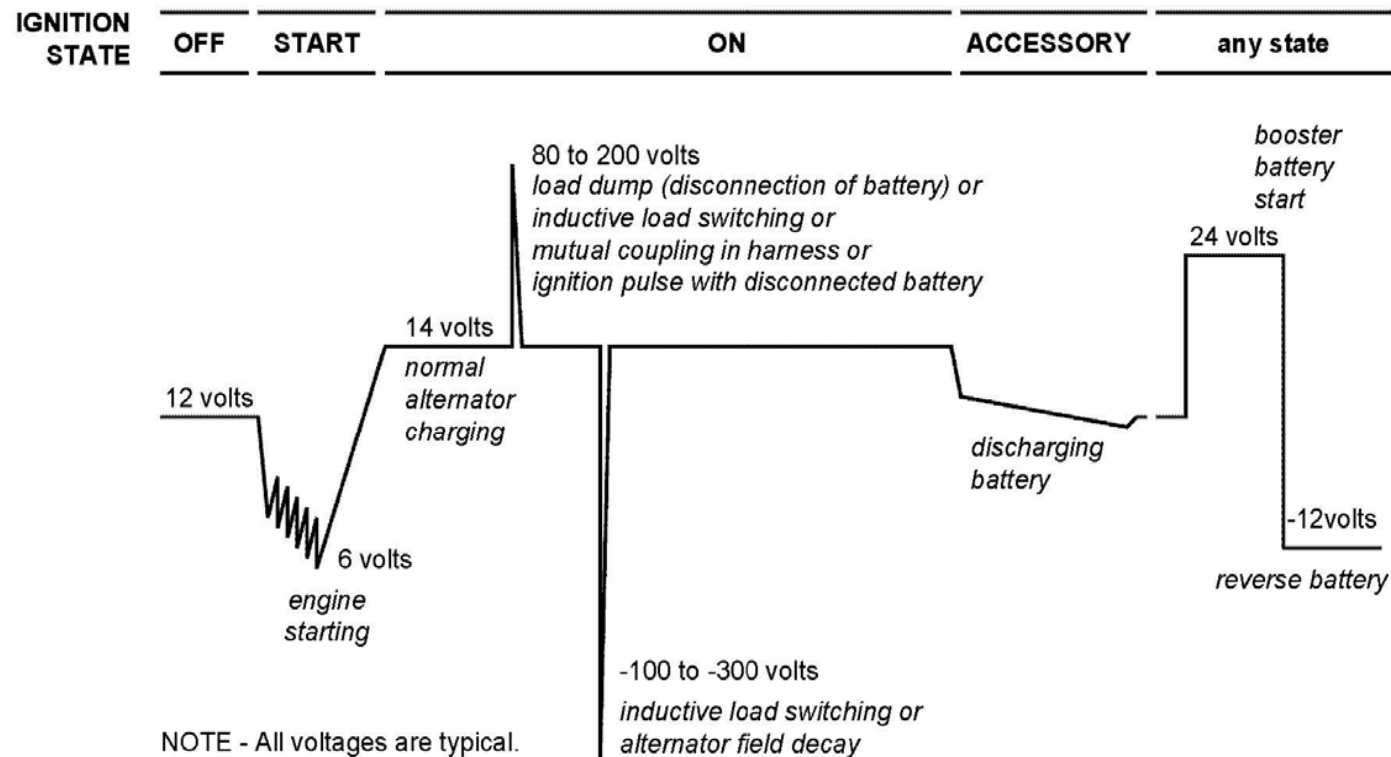
- ◆ The operational mode of the vehicle establishes the vehicle power modes (ON or OFF). Historically these modes have fallen into four general categories OFF, ON, START and ACCESSORY.
- ◆ The OFF operational mode implies a condition in which most Automotive functions are required to power down. This mode is generally used when the vehicle is in the non-running or parked condition.
- ◆ The ON operational mode implies a condition in which Automotive functions are generally required to be operational. This is the normal operating condition of the vehicle with the engine running.
- ◆ The START operational mode occurs during the time that the engine is being rotated by the cranking motor.
- ◆ The ACCESSORY operational mode occurs at all other times. During the START and ACCESSORY operational modes the vehicle typically powers a subset of vehicle functions, which will vary from automaker to automaker, and certain Automotive functions may be impaired.

Automotive Electrical Environment

The values in this section provide direction only: this is not a testing sequence.

- ◆ Typical system voltage range during normal operation with the engine running above idle speeds is 12 to 15 V.
- ◆ Typical voltage range with the ignition key in RUN or ACC and the engine off or with the engine running at idle speed is 6 to 12 V.
- ◆ Low battery charge state: Typical voltage range during engine cranking (with the starter engaged) is 5 to 9 V. The lowest voltage occurs during extremely low temperatures or when the battery has a low charge.
- ◆ Transient voltage peaks during alternator load dump between +80 to 200 V.
- ◆ Transient voltage peaks during load switching or alternator field decay from -100 to -300 V.
- ◆ Typical voltage when a battery is jump-started ranges between 12 and 24 V.
- ◆ Typical voltage when a battery is connected in reverse (during an error in servicing) ranges between -8 to -12 V.

Automotive Electrical Environment



Typical automotive electrical range

EMC Opinions

- ◆ For the signal integrity (SI) and EMC aspects of cable and connectors
 - There is also durability, environmental, vibration, durability, flexing, etc. that must be considered
- ◆ Once there is a decision on the cable (STP, STP w/drain, UTP, STP parallel lay, etc...) and connector
 - EMC and SI test plan should be developed
 - If power is also included in data pair analysis then power integrity must be considered
 - If there are multiple pairs then need to examine the cross talk parameters that need to be measured
- ◆ Testing the cable and connector without electronics allows for the cable to be used with multiple chipsets
 - If a chipset were to change there is not a need to revalidate cable and connector.
 - However performing CISPR25 RE antenna method, for instance, on just cable and connector is difficult the electronics effect the outcome
- ◆ We suggest testing to the ISO and CISPR documents instead of SAE
 - Present trend is that SAE is eliminating or just referring to the ISO and CISPR documents
- ◆ We recommend good 4 port analysis of cable and connector assemblies including at minimum the following for a single pair;
 - capacitance
 - TDD11 & TDD22 differential impedance
 - SDD21 & SDD12 differential insertion loss
 - SCD21 & SCD12 differential to common-mode conversion
 - propagation delay
 - propagation delay skew at frequency
 - mathematical simulation of intended protocols eye diagram

Specification Reference

◆ Here is the most in use list of automotive component ISO/CISPR EMC specs

- Each OEM adds or deletes due to unique history
- Reference Ford test specs at www.fordemc.com they are public domain and available to all as example
- CISPR25. This as the RF radiated emission and conducted RF emission
 - » Generally not important to data comm. Cable and connectors
 - » This is very difficult without using actual electronics. Not practical for only cables and connectors.
 - » SCD21 should capture this during cable/connector test
- ISO11452-2 immunity to radiated electric (RE) fields absorber lined shielded enclosure (ALSE) method.
 - » This is an important test to run (400 - 2000) MHz with the recommended modulation
 - » Delphi is developing a test for just cable and connector
- ISO11452-4 immunity to radiated electric fields bulk current injection (BCI).
 - » This test is run from (1 - 400) MHz
 - » With UTP look at transceiver and transceiver first level schematic
 - » For Ethernet it should not be extremely critical
- ISO7637-2 immunity to conducted transients on power lines
 - » This is generally not an issue for the data comm. cable and connectors
 - » This could, with some setup, be used to test cable and connector without electronics
- ISO7637-3 immunity to electrical disturbance by conduction and coupling via lines other than supply lines.
 - » This is recommended data comm. cable and connectors

Specification Reference

- ISO10605 ESD
 - » This is recommended for data comm. cable and connector.
 - » This is very difficult without using actual electronics. Not practical for only cables and connectors.
- ISO7637-4 chattering relay is under development at ISO
 - » Recommend to use Ford RI130 and RI150 until ISO7637-4 is official
- ISO11452-9 Component test methods for electrical disturbances from narrowband radiated electromagnetic energy Portable transmitters
 - » Similar comments for ISO11452-2

◆ SAE Specifications for reference



SAE EMC
Documents

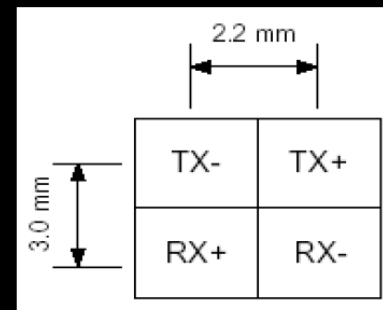
Electrical MOST

	Test Procedure	Method	Criteria
Emission	CISPR25	- ALSE method - Frequency: 1 - 1000MHz	Class 5
Immunity	ISO11452-2 (Antenna)	-Test Severity Level 4 - Frequency: 200 -1000MHz	Class A
	ISO11452-3 (TEMcell)	-Test Severity Level 4 - Frequency : 1 - 200MHz	Class A
	ISO11452-5 (Stripline)	-Test Severity Level 3 - Frequency : 1 - 400MHz	Class A
Coupling	ISO7637-3	-Test Level 4 -Test Pulse : a & b - Power supply : 12V	Class A

- Wire harness

Wire harness	Unshielded twisted pair cable
Gauge	0.22mm ²
Twist length	Less than 45mm
Untwisted wire length	Less than 10cm

- Connector



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Electrical MOST System Evaluation

System evaluation items	Requirement
1) Max number of nodes	Functional testing: 64 nodes Actual testing: 30 nodes
2) Max number of connector between the nodes	8 connectors
3) Max length of wire harness between the nodes	10 meters
4) Worst case of system / connection pattern	Combination of 1, 2 and 3.

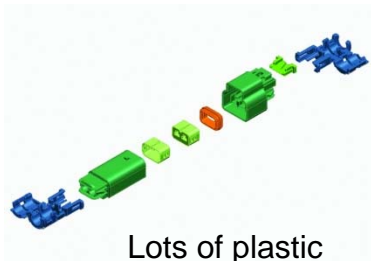
Auto Terminology 101

◆ Automotive speak

- Plug is connector
- Socket is header
- “Sex” of connector is determined by the metal terminal
- Generally Blade and box is the favored terminal style
- Terminals come in two basic styles with and without locking tang
- Plenty of “plastic” around the terminal



Variety



Lots of plastic



Male terminal



Female terminal



Connector and header



inline

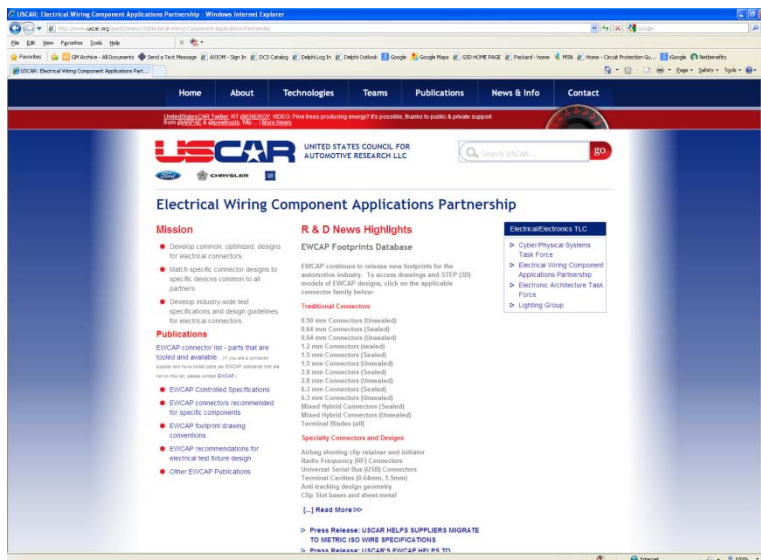
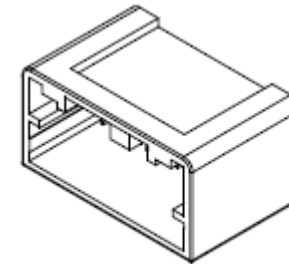
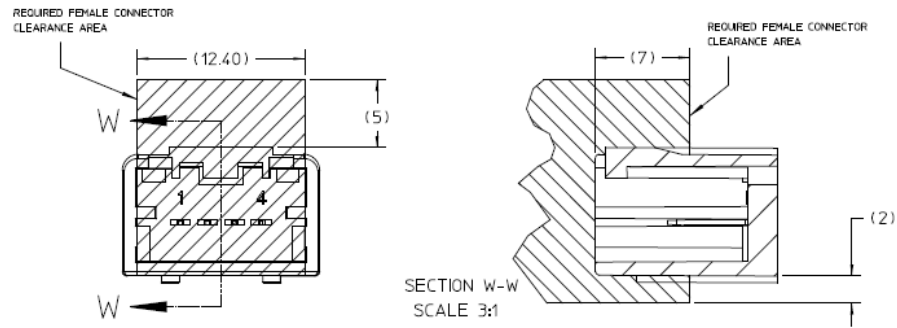


Female connector

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USCAR Example

PACKAGING VIEW



<http://www.uscar.org/guest/teams/10/Electrical-Wiring-Component-Applications-Partnership>

Typically USCAR provides mating view

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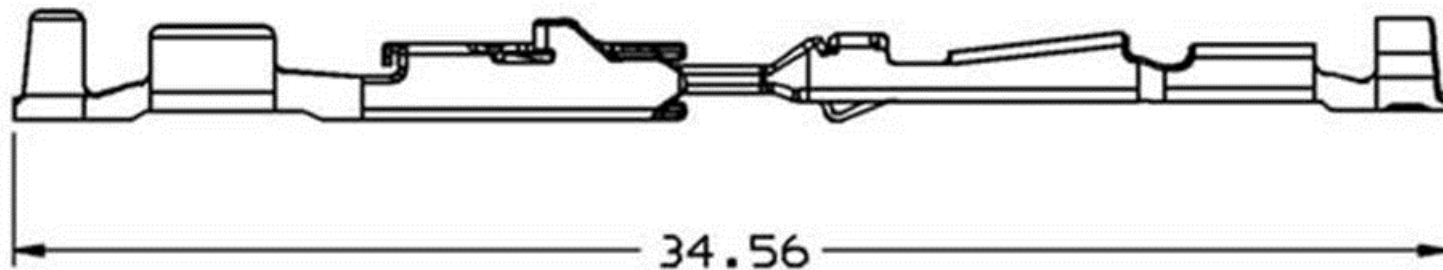
Proposal for Ethernet work group channel definition

◆ Unshielded twisted pair FLR2X-A Cable

- 22 ga (0.35mm² XLPE) and 26 ga (0.13mm² PVC) cable
- 1,3,5 m lengths (+80% fall in this range)
- Twist length less than 45mm per turn (22.2 twists/m 6-7 turns/foot)
- Untwisted wire at connector 50mm (100 per inline connection)
- Insulation PVC or cross linked poly ethylene thin wall (wall thickness 0.25mm)

◆ Connector USCAR standard footprint (common design)

- 3 sizes 0.5, 1.2, 1.5 blade sizes
 - » 0.5 center line spacing 2.0mm, mated pair length 27-29mm
 - » 1.2 center line spacing 2.54mm, mated pair length 33-35mm
 - » 1.5 center line spacing 3.5mm, mated pair length ~33-35mm (tbd)



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