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Road vehicles — Automotive multimedia interface —

Part 7: Physical specification

Véhicules routiers — Interface multimédia pour l'automobile —

Partie 7: Spécifications physiques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22902-7 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 22902 consists of the following parts, under the general title *Road vehicles — Automotive multimedia interface*:

— *Part 1: General technical overview*

— *Part 2: Use cases*

— *Part 3: System requirements*

— *Part 4: Network protocol requirements for vehicle interface access*

— *Part 5: Common message set*

— *Part 6: Vehicle interface requirements*

— *Part 7: Physical specification*

Introduction

This part of ISO 22902 describes environmental conditions and tests to be applied to AMI-C compliant electrical and electronic equipment and some subcomponents directly mounted in or on the vehicle. It is not intended for direct application to all parts or assemblies that are part of that equipment. For example, it should not be directly applied to integrated circuits (ICs) and discrete components, printed circuit boards (PCBs), gages, displays, controls, etc. that are subassemblies of the equipment. Electrical, mechanical, climatic and chemical loads permitted for such parts and assemblies can be quite different than those described in this part of ISO 22902.

Road vehicles — Automotive multimedia interface —

Part 7: **Physical specification**

1 Scope

The scope of this part of ISO 22902 is limited to conditions and testing at the equipment level; it does not include all conditions and testing necessary for complete verification and validation of the vehicle system. Environmental and reliability testing at lower and higher levels are required to ensure that vehicle quality and reliability objectives are met.

It addresses the following requirements relating to the design and manufacture of automotive components and of devices intended to be used in vehicles:

— **Environment**. The conditions in and on a vehicle that a component or device must function within. These conditions include chemical, climatic, electromagnetic and mechanical factors and stress.

— **Power management**. The requirements for power supply and delivery from a vehicle to its components and the devices used in that vehicle.

— **Interconnectivity**. The requirements for delivering data within a vehicle. These requirements differ depending on the delivery method selected by the automaker or supplier.

— **Packaging**. The standards for locating, securing, protecting, and enclosing or covering components and devices.

— **Homologation**. An overview of the legal requirements that apply to AMI-C compliant vehicles.

— **Diagnostic functional requirements**. An overview of the sensing and analysis that AMI-C compliant components and devices shall support. This section also recommends characteristics of diagnostic tools.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11452-4, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 4: Bulk current injection [BCI]*

ISO 16750-1, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

ISO 16750-2, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads*

ISO 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 1817, *Rubber, vulcanized — Determination of the effects of liquids*

ISO 6722, *Road vehicles — 60 V and 600 V single-core cables — Dimensions, test methods and requirements*

ISO 7637-1, *Road vehicles — Electrical disturbances by conduction and coupling — Part 1: Definitions and general considerations*

ISO 7637-2, *Road vehicles — Electrical disturbances by conduction and coupling — Part 2: Electrical transient conduction along supply lines only*

ISO 8092-2, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 2: Definitions, test methods and general performance requirements*

ISO 16750-3, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads*

ISO 16750-4, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads*

ISO 16750-5, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads*

IEC 60068-2-27, *Environmental testing. Part 2: Tests — Test Ea and guidance: Shock*

IEC 60068-2-28, *Environmental testing. Part 2: Tests — Guidance for damp heat tests*

IEC 60068-2-32, *Environmental testing. Part 2: Tests — Test Ed: Free fall*

IEC 60695-11-10, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test*

IEC 60793-1-40, *Optical fibres — Part 1-40: Measurement methods and test procedures — Attenuation*

IEC 60794-1-2, *Optical fibre cables — Part 1-2: Generic specification — Basic optical cable test procedures*

IEC 61280-1-1, *Fibre optic communication subsystem basic test procedures — Part 1-1: Test procedures for general communication subsystems — Transmitter output optical power measurement for single-mode optical fibre cable*

IEC 61300-3-8, *Fibre optic interconnecting devices and passive components — Basic test and measurement procedures — Part 3-8: Examinations and measurements — Ambient light susceptibility*

3 Environment

3.1 Mounting location in the vehicle

In current or future designs of road vehicles, systems, components and devices are mounted in almost any location of the vehicle. The environmental requirements for each specific application depend highly on its mounting location. Each location in the vehicle has a distinct set of environmental loads. For example, the range of temperatures in the luggage compartment differs from the range of temperatures in the passenger compartment. Devices installed in doors are exposed to a high number of mechanical shocks from door slamming.

3.2 Component or device compliance test procedure

The following tests shall be conducted as appropriate to ensure that physical components or devices comply with performance requirements. The pass/fail criteria listed for each test constitutes the performance requirements for the parameter being tested. Perform the sequences of a test in order, as indicated by the sequence number.

3.2.1 Visual and dimensional inspection

Sample size: 2 AMI-C compliant devices

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Visual and dimensional	EIA 455-13A	Verify material, finish, and standards. Perform dimensional inspection for compliance with detailed drawing.	No non-conformances.

3.2.2 General inspection

The following quantities assume all tests are run.

Sample size: 54 devices

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Functional, visual and parametric	EIA 455-13A	Confirm part number, condition, conformance.	No defects that would impair normal operation or deviate from dimensional tolerances

3.2.3 Combined environment

This test simulates the environment in a vehicle.

Sample size: 12 devices

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Durability	EIA 455-21	Mate & un-mate connector 10 times	Functional class A as defined in ISO 16750-1
2	High temperature aging	ISO 16750-4	Temperature aging 500 hours at 85 °C	Functional class A as defined in ISO 16750-1

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
3	Vibration	ISO 16750-3	Combined temperature and vibration Max temperature Class 2: 85 °C	Functional class A as defined in ISO 16750-1
4	Thermal shock	ISO 16750-4	Rapid change of temperature Max temperature 85 °C	Functional class A as defined in ISO 16750-1
5	Humidity (cyclic)	ISO 16750-3	Para: temperature / humidity cycling	Functional class A as defined in ISO 16750-1

3.2.4 Temperature exposure

Sample size: 12 devices.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Low temperature exposure and operation	ISO 16750-4	Para - low temperature exposure with and without electrical operation. 24 hrs at –40 °C/Tmin for 24 hrs.	Functional class A as defined in ISO 16750-1 Failure mode is insufficient frost resistance/electrical malfunction.
2	High temperature exposure and operation	ISO 16750-4	Para - high temperature exposure with (6 devices) and without (6 devices) electrical operation. Dry heat @ +85 °C for 48 hrs/ Dry heat at Tmax for 96 hrs.	Functional class A as defined in ISO 16750-1 Failure mode is insufficient heat resistance/electrical malfunction.
3	Powered thermal cycle	ISO 16750-4	Para 5.3.2, varying temperatures with electrical operation	Functional class A as defined in ISO 16750-1 Failure mode is electrical malfunction.
4	Thermal shock resistance	ISO 16750-4	Para 5.3.3 Rapid change of temperature with specified transition duration – 6 cycles	Functional class A as defined in ISO 16750-1 Failure modes are mechanical cracking of materials or seal failures.
5	Powered vibration endurance/ audible noise under vibration	See *Powered vibration endurance test criteria* (4.7.11) in this document.	See *Powered vibration endurance test criteria* (4.7.11) in this document.	Functional class A as defined in ISO 16750-1
6	Medium mechanical shock	IEC 68-2-27 IEC 68-2-32	Subject component to six 50G 10msec half-sine shock pulses, one in each opposite direction of each perpendicular axis.	Functional class A as defined in ISO 16750-1

3.2.5 Water, humidity resistance

Sample size: 6 devices.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Humidity and temperature cycle	ISO 16750-4	Para - Simulate the use of the component/device under high ambient humidity.	Functional class A as defined in ISO 16750-1 Failure mode is electrical malfunction caused by moisture.
2	Water/ fluid ingress	ISO 16750-4	Para - water/fluid spills on component/device.	Functional class A as defined in ISO 16750-1 Failure mode is electrical malfunction.

3.2.6 Salt, chemical resistance

Sample size: 6 devices.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Salt mist - Atmosphere	ISO 16750-4	Para - resistance to corrosion	Functional class A as defined in ISO 16750-1 Failure mode is corrosion.
2	Chemical resistance	ISO 16750-5	Resistance to chemical agents.	Functional class A as defined in ISO 16750-1

3.2.7 Mechanical endurance

Sample size: 6 devices.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Thermal shock resistance	ISO 16750-4	Para - rapid change of temp with specified transition duration – 6 cycles	Functional class A as defined in ISO 16750-1 Failure modes are mechanical cracking of materials or seal failures.
2	Powered vibration endurance	See *Powered vibration endurance test criteria* in this document.	See *Powered vibration endurance test criteria* in this document.	Functional class A as defined in ISO 16750-1
3	Dust intrusion	ISO 16750-4	Para - resistance to dust intrusion.	Functional class A as defined in ISO 16750-1

3.2.8 Thermal shock

Sample size: 3 devices.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Thermal shock endurance	ISO 16750-4	Para - Rapid change of temp with specified transition duration – 1000 cycles	Functional class A as defined in ISO 16750-1

3.2.9 Temperature life

Sample size: 6 devices

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	High Temperature Endurance	IEC 68-2-2B	Cycle between modes every 10 hrs for a total test time of 1000 hrs at the test maximum operating temperature Tmax.	Functional class A as defined in ISO 16750-1

3.2.10 Mechanical shock

Sample size: 3 devices

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Package drop	ISO 16750-3	Para - free fall	Functional class A as defined in ISO 16750-1 Failure mode is mechanical damage.

3.2.11 Powered vibration endurance test criteria

Sample size 3

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Vibration endurance	AMI-C specified		

Table 1 — Vibration endurance test criteria

Frequency	Amplitude	Sweep	Time Sweep	Number of axes	Number of sweeps per axis	Total	
						Sweeps	Duration
5-12.2 Hz 12.2-100 Hz 101-200 Hz	10 mm peak to peak 3.0 G 0 peak 1.5 G 0 peak	log	20 min	3	18	54	18 H

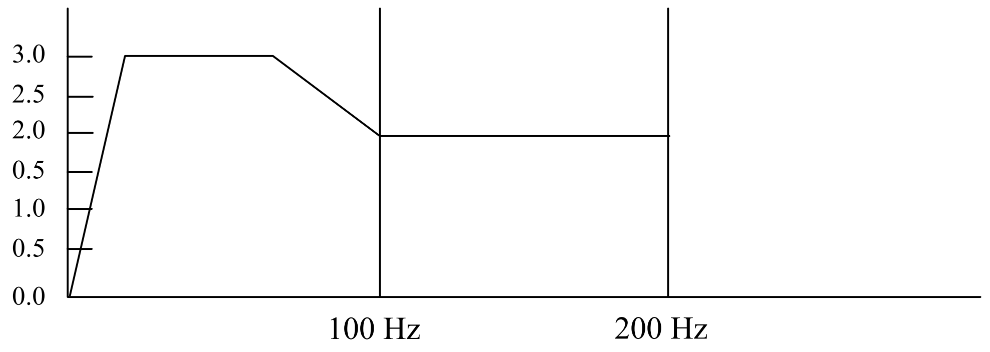


Figure 1 — Powered vibration endurance test criteria

3.2.11.1 Vibration pass/fail criteria

The following items are the requirements for measuring audible noise under vibration:

— The units shall be tested with a sinusoidal acceleration from 10 to 200 Hz.

— Acceleration amplitude shall be 1G 0 peak from 10 to 100 Hz and 0.5 0 peak from 101 to 200 Hz.

— Frequency sweep shall be linear, constant time per frequency, and have a duration of 10 minutes to cover 10 to 200 Hz range.

— Under the above vibration profile, the unit shall not emit an overall "A" weighted noise SPL greater than 70 dB using 1/3 octave analysis for the 25 Hz to 20 kHz frequency range, 1/8 second integration time per sample and peak hold mode.

— Place the microphone between 0.1 and 1 meter from the unit. Adjust reported noise measurements to reflect equivalent SPL at 0.1 meter. The above noise requirements (70 dB maximum SPL) are for the 0.1 meter placement.

3.3 Component or device electromagnetic compatibility test procedure

This standard establishes verification requirements for the control of the electromagnetic interference characteristics (emission and susceptibility) of electronic, electrical, equipment and subsystems designed or procured in compliance with this standard requirements. Such equipment and subsystems may be used independently or as an integral part of other subsystems or systems.

The following tests shall be conducted as appropriate to ensure that physical components or devices comply with this standard performance requirements. The pass/fail criteria listed for each test constitutes the performance requirements for the parameter being tested. Perform the sequences of a test in order, as indicated by the sequence number.

3.3.1 General inspection

The following quantities assume all tests are run.

Sample size: 8 devices

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Functional, visual and parametric	EIA 455-13A	Confirm part number, condition, conformance.	No defects that would impair normal operation or deviate from dimensional tolerances

3.3.2 Emissions test procedure

Sample size: 2 devices

Seq #	Test	Reference spec	Test criteria	Pass / fail criteria
1	Radiated Emissions	CISPR 25	See Table 2.	Radiated emissions below requirements
2	Conducted Emissions	CISPR 25	See Table 3.	Conducted emissions below requirements

3.3.2.1 Radiated emissions test criteria

The table below shows the number of frequencies per band during emissions testing.

Table 2 — Narrowband radiated emissions specification

Frequency (MHz)	dBuV/m	Comments
0.15…30	30	Plotted in typical CISPR format up to 1000 MHz
30…400	10	Plotted in typical CISPR format up to 1000 MHz
400…1000	22…32	Plotted in typical CISPR format up to 1000 MHz
1567-1574 1574-1576 1576-1583	50-10 10 10-15	Use of high gain *(38 dB gain, 0.5 dB noise figure)* Low Noise Amplifier is required to decrease noise floor, Plotted as individual band
2308…2362	25	Use of high gain *(38 dB gain, 0.5 dB noise figure)* Low Noise Amplifier is required to decrease noise floor, Plotted as individual band

Table 3 — Narrowband conducted emissions specification

Frequency (MHz)	dBuV/m	Comments
0.15…0,.45	60	Plotted in typical CISPR format
0.45…1.75	34	
1.75…30	39	

3.3.3 Radiated and conducted immunity test procedure

Sample size: 2 devices

Seq #	Test	Reference spec	Test criteria	Pass / fail criteria
1	Direct radiation test	SAE J1113-21	See 3.3.3.1 and Table 4	Operate properly during and after exposure - according to test plan created with appendix B
2	Bulk current injection	ISO 11452-4	See - Critical vehicle functions are considered “Level 2” functions and non-critical functions are considered “Level 1” functions.	Operate properly during and after exposure - according to test plan created with appendix B
3	Parallel wire misc. noise	SAE J1113-12 Appendix B	See - Noise from the relay shall not affect the operation of the Device Under Test (DUT). This test will be performed by simulating the coupling on one unshielded twisted pair (UTP) at a time. Each UTP will be exposed to the noise for 10 seconds.	Operate properly during and after exposure - according to test plan created with appendix B

3.3.3.1 Radiated immunity – test criteria

The following table shows the requirements levels when using the direct radiation chamber to measure the immunity of components and subsystems to electromagnetic fields.

Table 4 — Radiated immunity reverberation requirement table

Freqency range	Level 2 (V/m)	Level 1 (V/m)	Modulation
400 MHz to 1 GHz	100	50	CW,
1 GHz to 2 GHz	30	15	CW, AM 80%
800 MHz to 2 GHz	70	70	Pulse PRR=50 Hz, PD=6.67 msec and Pulse PRR=217 Hz, PD=0.57 msec

Pass / fail criteria: Shall operate as designed during and after exposure.

The field strength requirements are peak levels.

The table below shows the number of frequencies per band during radiated immunity testing.

Table 5 — Radiated immunity frequency

Frequency band (MHz)	Base freq (MHz)	Number of frequencies	N	Method	Input levels
1 to 30	1	34	7	BCI	See Table 6.
30 to 400	30	93	25	BCI	See Table 6.
400 to 1000	400	33	25	Direct Radiation	See Table 6.
1000 to 10000	1000	167	50	Direct Radiation	See Table 6.

The test frequency computation is as follows:

$$f_{test} = f_o \; 2 \cdot^{\left(\frac{k}{N}\right)}$$

where

f_{test} is the frequency to be tested;

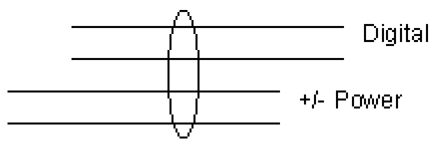
f_o is the base frequency;

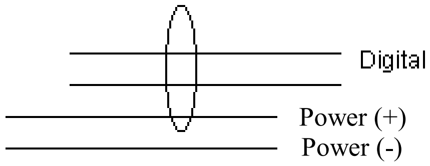
N is the number of steps per octave.

3.3.3.2 Radiated immunity – bulk current injection test criteria

The following table shows the requirement levels and location of both injection and monitoring probes using the common mode bulk current injection (CBCI) for 1-30 MHz and differential mode bulk current injection (DBCI) for 30-400 MHz. As an option, either CBCI or DBCI or both test configurations may be specified by the automaker.

Table 6 — BCI immunity configuration table

Frequency range	Level	Method	Modulation
1 MHz to 10 MHz	#1 - 74 to 100 dB (μA)	DBCI	CW, off / on, on / off, AM 80%
1 MHz to 10 MHz	#2 -80 to 106 dB (μA)	DBCI	CW, off / on, on / off, AM 80%
10 MHz to 30 MHz	#1 - 100 dB (μA)	DBCI	CW, off / on, on / off, AM 80%
10 MHz to 30 MHz	# 2 - 106 dB (μA)	DBCI	CW, off / on, on / off, AM 80%
30 MHz to 400 MHz	#1 -100 to 89 dB (μA)	CBCI	CW, off / on, on / off, AM 80%
30 MHz to 400 MHz	#2 106 to 95 dB (μA)	CBCI	CW, off / on, on / off, AM 80%
	CBCI Injection & monitoring probe configuration 		

Frequency range	Level	Method	Modulation
NOTES	**DBCI Injection & monitoring probe configuration** 		
	2. On/Off & Off/On modulation: Maximum overshoot – 0.5 dB Maximum rise time = 3 msec Minimum power step = 20 dB 3. Test duration: Conducted per ISO 11452-4		

Success criteria: If deviations are observed, the induced current shall be reduced until the DUT functions normally. Then the induced current shall be increased until the deviation occurs. This level shall be reported as the deviation threshold.

3.3.4 Electrostatic discharge immunity test procedure

Sample size: 2 devices

Seq #	Test	Reference spec	Test criteria	Pass / fail criteria
1	Non-powered – (Shipment & Handling)	ISO 10605		Operate properly during and after exposure (Be sure to discharge directly to pins of device, unless pins are recessed and surrounded by metalized connector)
2	Powered – (Accessible and non-accessible points)	ISO 10605		Operate properly during and after exposure (Be sure to discharge directly to pins which are accessible by test tools also)

3.3.4.1 Electrostatic discharge testing criteria

NOTE Discharges per point are to be applied at one-second intervals.

Table 7 — Non-powered handling ESD requirements

Type of discharge	Discharge network	Discharges per point	Level	Deviations
Contact	C = 150 pF, R = 2 kΩ	10	+/– 4 kV	No deviations allowed
Contact	C = 150 pF, R = 2 kΩ	10	+/– 6 kV	No deviations allowed
Air	C = 150 pF, R = 2 kΩ	10	+/– 8 kV	No deviations allowed

Table 8 — Powered (non-accessible) ESD requirements

Type of discharge	Discharge network	Discharges per point	Level	Deviations
Air and contact	C = 330 pF, R = 2 kΩ	10	+/– 4 kV	No deviations allowed
Air	C = 330 pF, R = 2 kΩ	10	+/– 6 kV	No deviations allowed
Contact	C = 330 pF, R = 2 kΩ	10	+/– 6 kV	Momentary self-recoverable deviations allowed
Air and contact	C = 330 pF, R = 2 kΩ	10	+/– 8 kV	Momentary self-recoverable deviations allowed
Air only	C = 330 pF, R = 2 kΩ	10	+/– 15 kV	Momentary self-recoverable deviations allowed

3.4 Plastic optical fiber connector test procedure

The following tests shall be conducted as appropriate to ensure the POF connectors comply with the environmental conditions found in AMI-C compliant vehicles. The Pass/Fail requirement for each test constitutes the performance requirement for each connection being tested. It must be noted that the test stresses and parameters for 1394 and MOST are equivalent. However, the pass/fail criteria cannot be directly compared numerically due to differences in test measurement techniques. The measurement techniques for each system are called out in the respective specification documents and must be adhered to for valid test measurements. For 1394 POF connectors please refer to 1394 TA document 2001018. For MOST POF connectors refer to “MOST Compliance test of Physical layer” document.

3.4.1 Basic construction

Sample description	Quantities for visual check
POF header socket with integrated FOT not assembled to printed circuit board	2
Inline POF cable socket not assembled to POF cable	2
Inline POF cable plug not assembled to POF cable	2
POF inline cable socket not assembled to POF cable	2

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Visual and dimensional	EIA 455-13A	Verify material, finish, and standards. Perform a dimensional inspection to verify compliance with detailed drawing.	No defects that would impair normal operation or deviate from dimensional tolerances	No defects that would impair normal operation or deviate from dimensional tolerances

3.4.2 General inspection

The following quantities assume all POF tests are run.

Sample description	Total quantities for all tests
POF header socket with integrated FOT not assembled to printed circuit board	14
POF header sockets with integrated FOT assembled to printed circuit board	91
POF inline cable plug not assembled to POF cable	14
POF inline cable plug assembled to 7 ± 0.1 m POF cable	182
POF inline cable socket not assembled to POF cable	14
POF inline cable socket assembled to 7 ± 0.1 m POF cable	91

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Pretest: Functional, visual, and parametric	EIA 455-13A	Confirm part number, condition, conformance to specifications.	No defects that would impair normal operation or deviate from dimensional tolerances.	No defects that would impair normal operation or deviate from dimensional tolerances.

3.4.3 Temperature life

The temperature life test sequence is designed to stress the POF connection system in a manor similar to the types of stresses found in typical automotive environments.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Pretest: Functional, visual, and parametric	EIA 455-13A	Confirm part number, condition, conformance to specifications.	No defects that would impair normal operation or deviate from dimensional tolerances.	No defects that would impair normal operation or deviate from dimensional tolerances.

Sample description	Quantities for temperature life test
POF header sockets with integrated FOT assembled to printed circuit board	6
POF inline cable plug assembled to 7 ± 0.1 m POF cable	12
POF inline cable socket assembled to 7 ± 0.1 m POF cable	6

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST[1]
1	Durability	EIA 455-21 A	Mate / un-mate connector 10 times. At a rate of 300 cycles per hour	**Header transmitter**: Initial baseline measurement $\geqslant -10.25$ dBm	**Header transmitter**: Initial baseline measurement between −1.5 dBm and −10.0 dBm
				Header receiver: Initial baseline measurement $\leqslant -21.25$ dBm	**Header receiver**: Initial baseline measurement between −2.0 dBm and −24.0 dBm
				In-line connector: Initial baseline measurement not to exceed 2.5 dB	**In-line connector**: Initial baseline measurement not to exceed 2.5 dB
2	High temperature aging	ISO 8092-2	Para– Temperature Aging Collect data at 100, 200, 500 and 1008 hrs at 85 °C	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST[1]
				Header transmitter: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –11.75 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Header receiver: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –20.25 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.4.4 Stepped temperature and thermal shock

The stepped temperature and thermal shock represents the type of thermal changes found in automotive environments.

Sample description	Quantities for stepped temperature and thermal shock test
POF header sockets with integrated FOT assembled to printed circuit board	11
POF inline cable plug assembled to 7 ± 0.1 m POF cable	22
POF inline cable socket assembled to 7 ± 0.1 m of POF cable	11

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Durability	EIA 455-21a	Mate and un-mate the connector 10 times. At a rate of 300 cycles per hour	**Header transmitter**: initial baseline measurement ⩾ –10.25 dBm	**Header transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
				Header receiver: Initial baseline measurement ⩽ –21.25 dBm	**Header receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
				In-line connector: Initial baseline measurement not to exceed 2.5 dB	**In-line connector**: Initial baseline measurement not to exceed 2.5 dB
2	Stepped temperature	ISO 16750-4	Para – Temperature steps • Min temperature = –40 °C	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
			• Max temperature = 85 °C • Parts are energized during test		
			Output power: EIA 455-20A-96	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Initial baseline measurement ⩽ –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-3AA	**In-line connector:** initial baseline measurement not to exceed 2.5 dBm	**Header receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
3	Thermal shock	ISO 8092-2	Para – Rapid change of temperature • Max temperature 85°C • Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter:** Initial baseline measurement ⩾ –10.25dBm	**In-line connector:** Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
			Sensitivity: EIA-455-20A-96	**Header receiver:** Initial baseline measurement ⩽ –21.25 dBm	**Header transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-3AA	**In-line connector:** initial baseline measurement not to exceed 2.5 dBm	**Header receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.4.5 Dust, mechanical shock, vibration, and impact

The dust, mechanical shock vibration and impact test sequence is designed to identify stresses similar to those found during normal handling and installed applications in the automotive environment.

Sample description	Quantities for dust, mechanical shock, vibration and impact test
POF header sockets with integrated FOT assembled to printed circuit board	11
Inline POF cable plug assembled to 7 ± 0.1 m POF cable	22
POF inline cable socket assembled to 7 ± 0.1 m POF cable	11

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Durability	EIA 455-21A	Mate / un-mate connector 10 times.	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**Header transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
				Header receiver: Initial baseline measurement ⩽ –21.25 dBm	**Header receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
				In-line connector: Initial baseline measurement not to exceed 2.5 dB	**In-line connector**: Initial baseline measurement not to exceed 2.5 dB
2	Dust	ISO 8092-2	Parts are energized during test • 6 h at 23 °C • 16 h @ 63 °C (no Dust)	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
			• 6 h @ 63 °C • Mated 8 h agitated every 15 min		
			Output power: EIA-455-20A-96	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Initial baseline measurement ⩽ –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-3AA	**In-line connector**: initial baseline measurement not to exceed 2.5 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
3	Mechanical shock	ISO 8092-2	Para – Mechanical shock	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Initial baseline measurement ⩽ –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-3AA	**In-line connector**: initial baseline measurement not to exceed 2.5 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
4	Vibration	ISO 8092-2	Para – Combined temperature and vibration • Max temperature Class 2: 85 °C • Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Initial baseline measurement ⩽ –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion loss: EIA-455-3AA	**In-line connector**: Initial baseline measurement not to exceed 2.5 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
5	Impact	ISO 8092-2	8 drops from 1.2m Mated; Energized	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Initial baseline measurement ⩽ –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm

			Insertion loss: EIA-455-3AA	**In-line connector**: initial baseline measurement not to exceed 2.5 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.4.6 Mechanical durability

Mechanical durability is testing is meant to simulate the normal connection and disconnection found in the automotive environment.

Sample description	Quantities for mechanical durability test
POF header sockets with integrated FOT assembled to printed circuit board	11
POF inline cable plug assembled to 7 ± 0.1 m POF cable	22
POF inline cable socket assembled to 7 ± 0.1 meters of POF cable	11

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Mating forces	ISO 8092-2	Para – Connection and disconnection	Mating force < 45 N Un-mating force > 50 N	Mating force < 45 N Un-mating force > 50 N
				Header transmitter: Initial baseline measurement ⩾ –10.25 dBm	**Header transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
				Header receiver: Initial baseline measurement ⩽ –21.25 dBm	**Header receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
				In-line connector: Initial baseline measurement not to exceed 2.5 dB	**In-line connector**: Initial baseline measurement not to exceed 2.5 dB

3.4.7 Humidity stress

This sequence of tests is designed to measure the response of the connections system to Humidity stress.

Sample description	Quantities for humidity stress test
POF header sockets with integrated FOT assembled to printed circuit board	11
POF inline cable plug assembled to 7 ± 0.1 m POF cable	22
POF inline cable socket assembled to 7 ± 0.1 meters of POF cable	11

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST[1]
1	Durability	EIA 455-21A	Mate / Un-mate connector 10 times.		
			Output power: EIA-455-20A-96	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**Header transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
			Sensitivity: EIA-455-20A-96	**Header receiver**: Initial baseline measurement ⩽ –21.25 dBm	**Header receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
			Insertion Loss: EIA-455-3AA	**In-line connector**: initial baseline measurement not to exceed 2.5 dBm	**In-line connector**: Initial baseline measurement not to exceed 2.5 dB
2	Humidity (cyclic)	ISO 8092-2	Para 4.10 – Temperature / humidity cycling Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter**: Maximum change of 1.5 dBm from initial baseline measurement with a minimum value not to exceed –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Maximum change of 1.0 dBm from initial baseline measurement with a maximum value not to exceed –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-34A	**In-line connector**: Maximum change of 1.5 dBm from initial baseline measurement with a maximum value not to exceed 2.5 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.4.8 Key life

The key life test focuses on POF connectors' output power, sensitivity and insertion loss when subjected to thermal age, vibration thermal shock, and humidity stress.

Sample description	Quantities for key life test
POF header sockets with integrated FOT assembled to printed circuit board	11
POF inline cable plug assembled to 7 ± 0.1 m POF cable	22
POF inline cable socket assembled to 7 ± 0.1 meters of POF cable	11

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Durability	EIA 455-21	Mate / un-mate connector 10 times.	**Header transmitter**: Initial baseline measurement ⩾ –10.25 dBm	**Header transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
				Header receiver: Initial baseline measurement ⩽ –21.25 dBm	**Header receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
				In-line connector: initial baseline measurement not to exceed 2.5 dBm	**In-line connector**: Initial baseline measurement not to exceed 2.5 dB
			Output power: EIA-455-20A-96	**Header transmitter**: Maximum change of 1.5 dBm from initial baseline measurement with a minimum value not to exceed –10.25 dBm	**In-line connector**: Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver**: Maximum change of 1.0 dBm from initial baseline measurement with a maximum value not to exceed –21.25 dBm	**Header transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-34A	**In-line connector**: Maximum change of 1.5 dBm from initial baseline measurement with a maximum value not to exceed 2.5 dBm	**Header receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
2	High Temperature Aging	ISO 8092-2	Para - temperature aging • 500 hours at 85 °C • Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
			Output power: EIA-455-20A-96	**Header transmitter:** Maximum change of 1.5 dBm from initial baseline measurement with a minimum value not to exceed –10.25dBm	**In-line connector:** Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB.
			Sensitivity: EIA-455-20A-96	**Header receiver:** Maximum change of 1.0 dBm from initial baseline measurement with a maximum value not to exceed –21.25 dBm	**Header** transmitter: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-34A	**In-line connector:** Maximum change of 1.5 dBm from initial baseline measurement with a maximum value not to exceed 2.5 dBm	**Header receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
3	Vibration	ISO 8092-2	Para - combined temperature and vibration • Max temperature Class 2: 85 °C • Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter:** Maximum change of 1.5 dBm from initial baseline measurement with a minimum value not to exceed –10.25 dBm	**In-line connector:** Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver:** Maximum change of 1.0 dBm from initial baseline measurement with a maximum value not to exceed –21.25 dBm	**Header transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
			Insertion Loss: EIA-455-34A	**In-line connector:** Maximum change of 1.5 dBm from initial baseline measurement with a maximum value not to exceed 2.5 dBm	**Header receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
4	Thermal Shock	ISO 8092-2	Para - Rapid change of temperature • Max temperature 85 °C • Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec.	Detector sensitivity at 50% of open circuit voltage for 1 µsec.
			Output power: EIA-455-20A-96	**Header transmitter:** Maximum change of 1.5 dBm from initial baseline measurement with a minimum value not to exceed –10.25dBm	**In-line connector:** Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB
			Sensitivity: EIA-455-20A-96	**Header receiver:** Maximum change of 1.0 dBm from initial baseline measurement with a maximum value not to exceed –21.25dBm	**Header transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0dBm
			Insertion Loss: EIA-455-34A	**In-line connector:** Maximum change of 1.5 dBm from initial baseline measurement with a maximum value not to exceed 2.5 dBm	**Header receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
5	Humidity (cyclic)	ISO 8092-2	Para - Temperature / humidity cycling Parts are energized during test	Detector sensitivity at 50% of open circuit voltage for 1 µsec	Detector sensitivity at 50% of open circuit voltage for 1 µsec
			Output power: EIA-455-20A-96	**Header transmitter:** Maximum change of 1.5 dBm from initial baseline measurement with a minimum value not to exceed –10.25dBm	**In-line connector:** Maximum change of 1.5 dB from initial baseline measurement and maximum insertion loss value not to exceed 2.5 dB

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
			Sensitivity: EIA-455-20A-96	**Header receiver:** Maximum change of 1.0 dBm from initial baseline measurement with a maximum value not to exceed –21.25 dBm	**Header transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
			Insertion Loss: EIA-455-34A	**In-line connector:** Maximum change of 1.5 dBm from initial baseline measurement with a maximum value not to exceed 2.5 dBm	**Header receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.4.9 Chemical fluid resistance

This sequence of tests is designed to verify that the connection system is capable of withstanding exposure to commonly found automotive chemical fluids. It is not a requirement to operate the connection system during exposure. One sample for each chemical fluid needs to be provided.

Sample description	Quantities for fluid resistance test
POF header socket with integrated FOT not assembled to printed circuit board	14
POF inline cable plug not assembled to POF cable	14
POF inline cable socket not assembled to POF cable	14

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria IDB 1394	Pass/fail criteria MOST
1	Commercial fluids 25 °C	ISO 175 fluid specs	ISO 8092-2 Para - Test procedure , using the following fluids: Coffee, Cola, hand lotion, 10% alcohol based cleaner, 10% ammonia based cleaner Immersion time 1 hr	No visible degradation	No visible degradation
2	Automotive fluids 25 °C	ISO 8092-2	Para - Chemical fluids	No visible degradation	No visible degradation

3.4.10 General

The following sequence of tests identifies several basic product characteristics of POF connection systems. Each test is independent of the others and requires 10 samples.

Sample description	Quantities for general tests
POF header sockets with integrated FOT assembled to printed circuit board	30
POF inline cable plug assembled to 7 ± 0.1 m POF cable	60
POF inline cable socket assembled to 7 ± 0.1 m POF cable	30

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria	Pass/fail criteria MOST[1]
1	Cavity to Cavity Isolation	IEC 61300-3-8	Optional test	–30 dB less than reference sensitivity	–30 dB less than reference sensitivity
2	Cable Axial Pull	EIA 364-38A-85	Condition E	No failure when 111 N force is applied	No failure when 111 N force is applied
3	Cable Flexing	EIA 364-41B-89	Optional test	No Failure with 100 cycles of 180° bending over rollers.	No Failure with 100 cycles of 180° bending over rollers.

3.5 IDB 1394 consumer connector port test procedure

The following tests shall be conducted as appropriate to ensure the CCP connectors comply with the environmental conditions found in AMI-C compliant vehicles. The Pass/Fail requirement for each test constitutes the performance requirement for each connection being tested.

3.5.1 Basic construction

This series of tests is designed to verify that parts meet the basic dimensional criteria.

Sample description	Number of CCP samples
Sockets, not assembled to printed circuit board	4
Plugs, not assembled to cable	4

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Visual and dimensional	EIA 364-18A-84	Verify material, finish, and standards. Perform a dimensional inspection to ensure compliance with detailed drawing.	No defects that would impair normal operation or deviate from dimensional tolerances
2	Plating Thickness	EIA 364-18A-84		No deviation of plating materials and thickness from specification.

3.5.2 General inspection

The following quantities assume all CCP tests are run.

Sample description	Total quantities for all tests
Sockets, not assembled to printed circuit board	52
Sockets assembled to printed circuit board	21
Inline cable plug not assembled to cable	9
Inline cable plug assembled to 25 ± 1 cm cable	54

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Pretest: Functional, visual, and parametric	EIA 455-13A	Confirm part number, condition, and conformance to specifications.	No defects that would impair normal operation or deviate from dimensional tolerances.

3.5.3 Mechanical shock, vibration

The mechanical shock and vibration test sequence is designed to identify stresses similar to those found during normal handling associated with vehicle assembly and installed applications in the automotive environment.

Sample description	Number of CCP samples
Sockets, assembled to printed circuit board	4
Inline cable plug assembled to 25 ± 1 cm cable	4

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Mating & un-mating forces	EIA 364-13A-83	EIA 364-23A-85, low level contact resistance	50 mΩ maximum initial per mated contact
2	Vibration	EIA 364-28D-99 Condition I	EIA 364-46A-98, continuity	No discontinuity for each contact at 1 μs or longer during test
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test
3	Mechanical Shock	EIA 364-27B-96 Condition A	EIA 364-46A-98, continuity	No discontinuity for each contact at 1 μs or longer during test
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial measurement per mated contact at end of test

3.5.4 Thermal shock and humidity stress

This sequence of tests is designed to measure the response of the connections system to thermal shock and humidity stress.

Sample description	Number of CCP samples
Sockets, assembled to printed circuit board	4
Inline cable plug assembled to 25 ± 1 cm cable	4

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Mating & un-mating forces	EIA 364-13A-83	EIA 364-23A-85, low level contact resistance	50 mΩ maximum initial per mated contact
2	Thermal Shock	EIA 364-32B-92	Condition I 10 cycles	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
3	Humidity	EIA 364-31A-83	Condition A, Method II 96 hours	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test

3.5.5 Thermal shock and humidity stress

This sequence of tests is designed to measure the response of the CCP socket to thermal shock stresses.

Sample description	Number of CCP samples
Sockets, not assembled to printed circuit board	4

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Withstanding voltage	EIA 364-20A-83	Method C, un-mated Test voltage: 100 V DC ± 10 V DC	• No flashover • No spark over • No excessive leakage • No breakdown
2	Thermal Shock	EIA 364-32B-92	Condition I, 10 cycles	
	measurement		ANAI/EIA 364-20A-83 withstanding voltage Method C, un-mated Test voltage: 100 V DC ± 10 V DC	• No flashover • No spark over • No excessive leakage • No breakdown
	Insulation Resistance	EIA 364-21B-95	Method C, un-mated Test voltage: 100 V DC ± 10 V DC	100 Mohm minimum between adjacent contacts and contacts and shell
3	Humidity	EIA 364-31A-83	Condition A, Method III, omit 7a and 7b 96 hours	
	measurement		EIA 364-21B-95, insulation resistance Method C, un-mated Test voltage: 100 V DC ± 10 V DC	100 Mohm minimum between adjacent contacts and contacts and shell

3.5.6 Mechanical cycling and corrosive gas exposure

This sequence of tests is designed to measure the response of the connections system to mechanical cycling and to the effects of exposure to corrosive gases.

Sample description	Number of CCP samples
Sockets, assembled to printed circuit board	6
Inline cable plug assembled to 25 ± 1 cm cable	42

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Mating & un-mating forces	EIA 364-13A-83	EIA 364-23A-85, low level contact resistance	50 mΩ maximum initial per mated contact
2	Continuity	EIA 364-06A-83		50 mΩ maximum change from initial from braid to inner shield at 100 mA 5 VDC open circuit max
3	Durability	EIA 364-09C-99	4 mated pairs, 3750 cycles. Cycle at 500 cycles / hr ± 50 cycles / hr. Replace plugs every 750 cycles	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test
4	Continuity	EIA 364-06A-83		50 mΩ maximum change from initial from braid to inner shield at 100 mA 5 VDC open circuit max
5	Mixed flowing gas	EIA 364-65-97	Class II exposure 2 pairs, 1 day un-mated 4 pairs, 10 days mated	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test
6	Durability	EIA 364-09C-99	4 mated pairs, 3750 cycles. Cycle at 500 cycles / hr ± 50 cycles / hr. Replace plugs every 750 cycles	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test
7	Mixed flowing gas	EIA 364-65-97	Class II exposure 2 pairs, 1 day un-mated 4 pairs, 10 days mated	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test
8	Continuity	EIA 364-06A-83	See Figure 2 and Figure 3 below for test locations.	50 mΩ maximum change from initial from braid to inner shield at 100 mA 5 VDC open circuit max

3.5.7 Temperature life

The temperature life test sequence is designed to stress the connection system in a manor similar to the types of stresses found in typical automotive environments.

Sample description	Number of CCP samples
Sockets, assembled to printed circuit board	4
Inline cable plug assembled to 25 ± 1 cm cable	4

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Mating & un-mating forces	EIA 364-13A-83	EIA 364-23A-85, low level contact resistance	50 mΩ maximum initial per mated contact
2	Continuity	EIA 364-06A-83	See Figure 2 and Figure 3 below for test locations.	50 mΩ maximum change from initial from braid to inner shield at 100 mA 5 V DC open circuit max
3	Temperature life	EIA 364-17B-99	Method A, Condition 2 96 hrs mated	
	measurement		EIA 364-23A-85, low level contact resistance	30 mΩ maximum change from initial per mated contact at end of test
4	Continuity	EIA 364-06A-83	See Figure 2 and Figure 3 below for test locations.	50 mΩ maximum change from initial from braid to inner shield at 100 mA 5 V DC open circuit maximum
5	Mating & un-mating forces	EIA 364-13A-83		Final un-mating force: 10.0 N to 39.0 N maximum

3.5.8 Mechanical retention and durability

Mechanical durability is testing is meant to simulate the normal connection and disconnection found in the automotive environment.

Sample description	Number of CCP samples
Sockets, not assembled to printed circuit board	6
Plugs, not assembled to cable	6

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Mating & un-mating forces	EIA 364-13A-83	Un-mate at 25 mm / min.	Initial un-mating force: • 10.0 N minimum • 39.0 N maximum
2	Durability	EIA 364-09C-99	7500 cycles Cycle at 500 cycles / hr ± 50 cycles / hr Replace plugs every 750 cycles	Un-mating force at end of durability cycles: • 10.0 N minimum • 39.0 N maximum

3.5.9 Chemical fluid resistance

This sequence of tests is designed to verify that the connection system is capable of withstanding exposure to commonly found automotive Chemical fluids. It is not a requirement to operate the connection system during exposure. Since the cable and plug are not considered to be OEM equipment there is no requirement to comply with this portion of the specification.

Sample description	Number of CCP samples
Sockets, not assembled to printed circuit board	39

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Commercial fluids 25 °C	ISO 175	Immerse 3 samples for 1.0 hr in each of the following: • Coffee • Cola • 10 % alcohol based cleaner • 10 % ammonia based cleaner • Hand lotion	
	measurement		EIA-364-18A-84, visual	No visible degradation
2	Automotive fluids 25 °C	ISO 1817	Immerse 3 samples for 1.0 hr in each of the following: • Sulfuric acid 1.26 specific gravity • 85 % ethanol + 15 % ASTM Ref. Fuel C • 90 % ASTM IRM-903 + 10 % xylem	
	measurement		EIA-364-18A-84, visual	No visible degradation
3	Automotive fluids 25 °C	ISO 175	Immerse 3 samples for 1.0 hr in each of the following: • 50 % ethylene glycol + 50 % distilled water • ASTM IRM-903	
	measurement		EIA-364-18A-84, visual	No visible degradation
4	Automotive fluids 25 °C	ISO 175	Immerse 3 samples for 1.0 hr in each of the following: • SAE RM66-04 • Citgo #33123 • ASTM IRM-902	
	measurement		EIA-364-18A-84, visual	No visible degradation

3.5.10 Polarization effectiveness

Polarization effectiveness testing is designed to test the effectiveness of the polarization features during the improper mating of the connection.

Sample description	Number of CCP samples
Sockets, not assembled to printed circuit board	3
Sockets, assembled to printed circuit board	3
Plugs, not assembled to cable	3

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Polarization effectiveness	EIA 364-04	60 N applied by plug to the face of the socket mounted on a PC board	No impairment of normal operation

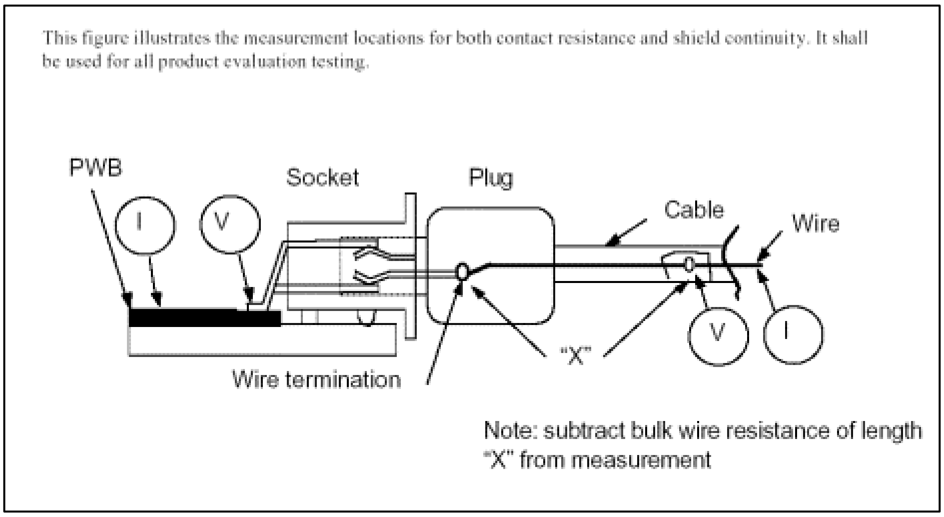


Figure 2 — Contact resistance and shield measurement locations (part 1)

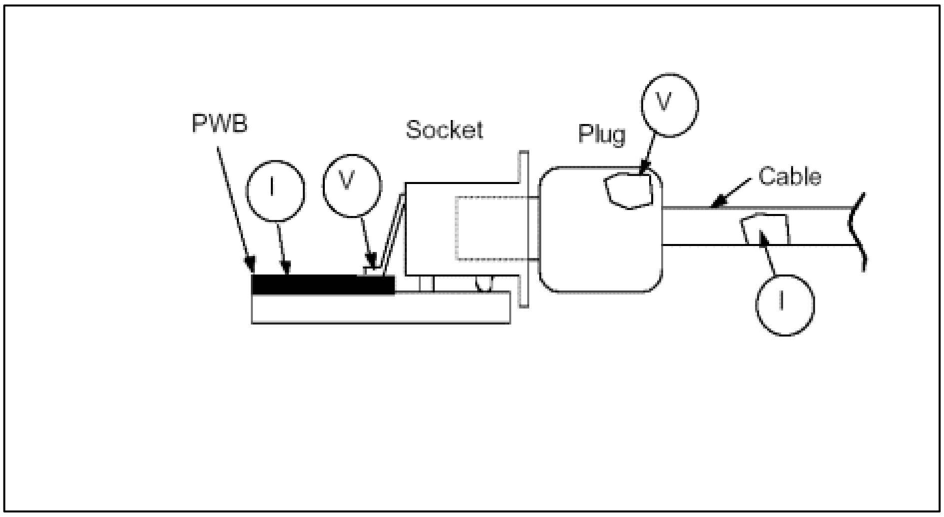


Figure 3 — Contact resistance and shield measurement locations (part 2)

3.6 Plastic optical fiber cable (POF) test procedure

The following tests shall be conducted as appropriate to ensure the POF cable complies with the environmental conditions found in AMI-C compliant vehicles. The Pass/Fail criteria for each test constitute the performance criteria for the cable being tested.

3.6.1 General inspection

Inspect all units prior to running the test sequence. The following quantities assume all CCP tests are run.

Sample description	Total quantities for all tests
POF cables (2 cores) 7± 0.1 m Long	30
POF cables (2 cores) 3 ± 0.1 m Long	76

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Pretest: Functional, visual, and parametric	EIA 455-13A	Confirm part number, condition, conformance to specifications.	No defects that would impair normal operation or deviate from dimensional tolerances.

3.6.2 Temperature life

Sample description	Number of samples
POF cables (2 cores) 7 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 1.75 dB
1	Temperature life	IEC 60794-1-2-F-1	• 7 m length of cable. • 1 cycle 3000 hrs at 85 °C	Maximum change from initial baseline measurement of 1.7 dB with a maximum value of 3.45 dB

3.6.3 Low temperature

Sample description	Number of samples
POF cables (2 cores) 7 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 1.75 dB
1	Low temperature	IEC 60794-1-2-F-1	• 7 m length of cable. • 1 cycle 3000 hrs at –40 °C	Maximum change from initial baseline measurement of 1.7 dB with a maximum value of 3.45 dBm

3.6.4 Thermal shock and humidity

Sample description	Number of samples
POF cables (2 cores) 7 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 1.75 dBm
1	Thermal Shock	IEC 60794-1-2-F-1	• 7 m length of cable. • 30 min at –40 °C. • Transition to 85 °C within 5 min. • Hold at 85 °C for 30 min. • Transition to –40 °C within 5 min. 1000 cycles.	Maximum change from initial baseline measurement of 1.7 dB with a maximum value of 3.45 dBm
2	Humidity	IEC 60794-1-2-F-1	• 7 m length of cable. • 85% RH at 85 °C for 96 hrs	Maximum change from initial baseline measurement of 1.7 dB with a maximum value of 3.45 dB

3.6.5 Bending stress

Sample description	Number of samples
POF cables (2 cores) 3 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 0.75 dB
1	Static bending 90°	IEC 60794-1-2-E-11	Mandrel radius = 25 mm.	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB
2	Static bending 180°	IEC 60794-1-2-E-11	Mandrel radius = 25 mm.	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB
3	Cyclic bending 180°	IEC 60794-1-2-E-6	• Mandrel radius = 25 mm • 10,000 cycles	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB

3.6.6 Torsion stress

Sample description	Number of samples
POF cables (2 cores) 3 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 0.75 dB
1	Static torsion	IEC 60794-1-2-E-7	• 360° torsion • 10 cycles	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB
2	Cyclic torsion	IEC 60794-1-2-E-10	• ±180° torsion • 10,000 cycles	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB

3.6.7 Chemical fluid resistance

Sample description	Number of samples
POF cables (2 cores) 3 ± 0.1 m long	36

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 0.75 dB
1	Commercial fluids 25 °C	ISO 175 fluid specs Coffee, Cola, hand lotion, 10 % alcohol based cleaner, 10 % ammonia based cleaner		
	Attenuation	IEC 60793-1-40		Maximum initial baseline measurement of 1.55 dB and maximum change of 0.8 dBm
	Visible degradation	EIA-455-13A		No visual degradation
2	Automotive fluids 25 °C	ISO 1817 fluids Sulfuric acid of 1.26 specific gravity (battery acid), windshield washer fluid, 85 % ethanol +15 % Ref fuel C (alcohol based fuel) 90 % IRM 903 + 10 % t-xylene (diesel fuel)	ISO 6722 Para 11.1, fluid compatibility • Sample length 3 m • Immersed length 1 m • Immersion time 1 hr	
	Attenuation	IEC 60793-1-40		Maximum initial baseline measurement of 1.55 dB and maximum change of 0.8 dBm
	Visible degradation	EIA-455-13A		No visual degradation

3.6.8 Compressive load

Sample description	Number of samples
POF cables (2 cores) 3 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 0.75 dB
1	Crush test	IEC 60794-1-2-E-3	Para 7, crush • Total weight applied – 105 kg • Duration – 3 min • Edge profile, reference TA document 2001018/1.1:6 figure 8-19	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB

3.6.9 Cyclic impact

Sample description	Number of samples
POF cables (2 cores) 3 ± 0.1 m long	10

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 0.75 dB
1	Impact (edge)	IEC 60794-1-2-E-4	Para - impact • 5 samples • Number of impacts – 2 per sample • Impact energy – 1 kg from 50 mm height • Test temperature 25 °C • Edge test setup: reference TA document 2001018/1.1:6 figure 8-19	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB
2	Impact (plane)	IEC 60794-1-2-E-4	Para - impact • 5 samples • Number of impacts – 2 per sample • Impact energy – 1 kg from 50 mm height • Test temperature 25 °C • Edge test setup: reference TA document 2001018/1.1:6 figure 8-19	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB

3.7 Fiber optic transceiver (FOT) test procedure

The following optional tests may be conducted as pre-qualifying tests of FOTs. This series of tests is designed to give FOT manufacturers insight into environmental conditions found in this standard compliant vehicles. Performance requirements found in the Pass/fail criteria column are for reference only and are based on connector header criteria.

3.7.1 Temperature life

Sample description	Number of samples
FOT(s) assembled to PC board	22

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
	Initial baseline measurement	IEC 60793-1-40		Initial baseline measurement not to exceed 0.75 dB
1	Impact (edge)	IEC 60794-1-2-E-4	Para - impact • 5 samples • Number of impacts – 2 per sample • Impact energy – 1 kg from 50 mm height • Test temperature 25 °C • Edge test setup: reference TA document 2001018/1.1:6 figure 8-19	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB
2	Impact (plane)	IEC 60794-1-2-E-4	Para - impact • 5 samples • Number of impacts – 2 per sample • Impact energy – 1 kg from 50 mm height • Test temperature 25 °C • Edge test setup: reference TA document 2001018/1.1:6 figure 8-19	Maximum change from initial baseline measurement of 0.8 dB with a maximum value of 1.55 dB

3.7.2 Stepped temperature and thermal shock

Sample description	Number of samples
FOT(s) assembled to PC board	22

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria for 1394	Pass/fail criteria for MOST
	Output power baseline measurement	IEC 61280-1-1		FOT only initial measurement –7.5 dBm	**FOT transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
	Sensitivity initial measurement	IEC 61280-1-1		FOT only initial measurement –22 dBm	**FOT receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
1	Stepped temperature	ISO 16750-4	Para - temperature steps • Min temperature = –40 °C • Max temperature = 85 °C • Device to be energized during test	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
2	Thermal Shock	ISO 8092-2	Para - rapid change of temperature Max temperature 85 °C Min temperature –40 °C Device to be energized during test 100 cycles	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.7.3 Mechanical shock, vibration, impact

Sample description	Number of samples
FOT(s) assembled to PC board	22

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria for 1394	Pass/fail criteria for MOST
	Output power baseline measurement	IEC 61280-1-1		FOT only initial measurement –7.5 dBm	**FOT transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
	Sensitivity initial measurement	IEC 61280-1-1		FOT only initial measurement –22 dBm	**FOT receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
1	Mechanical Shock	ISO 8092-2	Para - mechanical shock	Transmitter: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
2	Vibration	ISO 8092-2	Para - combined temperature and vibration Max temperature Class 2: 85 °C Device to be energized during test	Transmitter: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria for 1394	Pass/fail criteria for MOST
3	Impact	ISO 8092-2	Para - drop	Transmitter: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter:** Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver:** Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.7.4 Humidity stress

Sample description	Number of samples
FOT(s) assembled to PC board	22

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria for 1394	Pass/fail criteria for MOST
	Output power baseline measurement	IEC 61280-1-1		FOT only initial measurement –7.5 dBm	**FOT transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
	Sensitivity initial measurement	IEC 61280-1-1		FOT only initial measurement –22 dBm	**FOT receiver**: Initial baseline measurement between –2.0 dBm and –24.0 dBm
1	Humidity (cyclic)	ISO 8092-2	Para - temperature / humidity cycling Device to be energized during test	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

3.7.5 Key life

Sample description	Number of samples
FOT(s) assembled to PC board	22

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria for 1394	Pass/fail criteria for MOST
	Output power baseline measurement	IEC 61280-1-1		FOT only initial measurement –7.5 dBm	**FOT transmitter**: Initial baseline measurement between –1.5 dBm and –10.0 dBm
	Sensitivity initial measurement	IEC 61280-1-1		FOT only initial measurement –22 dBm	**FOT receiver**: Initial baseline measurement between –2.0 dBm and 24.0 dBm
1	High Temp Aging	ISO 8092-2	Para - temperature aging • 500 hours at 85 °C • Device to be energized during test	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
2	Vibration	ISO 8092-2	Para - combined temperature and vibration • Max temperature Class 2: 85 °C • Device to be energized during test	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria for 1394	Pass/fail criteria for MOST
3	Thermal Shock	ISO 8092-2	Para – Rapid change of temperature • Max temperature 85 °C • Device to be energized during test • Number of cycles 100 cycles	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm
4	Humidity (cyclic)	ISO 8092-2	Para - temperature / humidity cycling • Device to be energized during test • Number of cycles 10 cycles or 240 hours	**Transmitter**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –8.5 dBm.	**Transmitter**: Maximum change of 1.5 dB from initial baseline measurement with a minimum value not to exceed –10.0 dBm
				Receiver: Maximum change of 0.5 dB with a maximum value of –21.5 dBm.	**Receiver**: Maximum change of 1.0 dB from initial baseline measurement with a maximum value not to exceed –24.0 dBm

4 Power management

4.1 Boundary

This clause of the document describes the power management requirements for in-vehicle networks that conform to standard 12 V automotive power supply.

4.2 Typical vehicle power characteristics

The values in this section provide direction only: this is not a testing sequence. For specific values, refer to ISO 16750 automotive power supply specifications.

— 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.

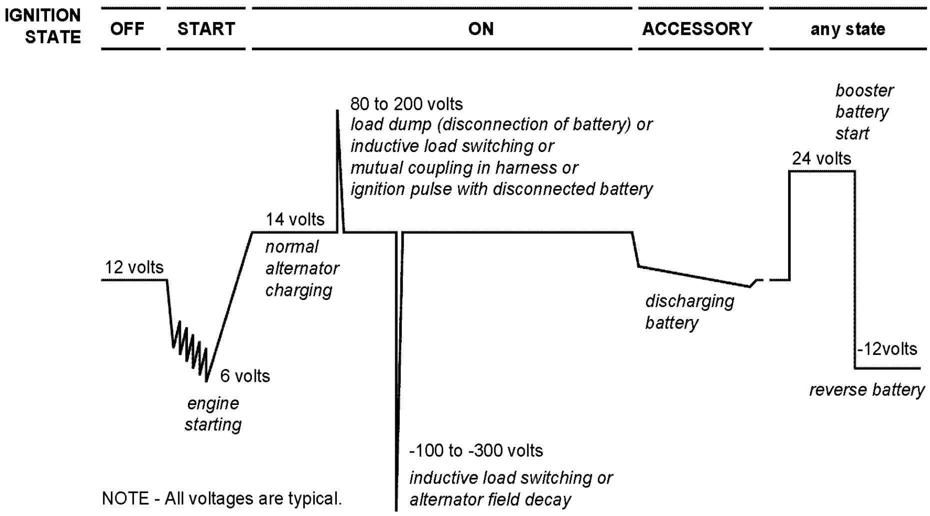


Figure 4 — Typical automotive power characteristics

4.3 Vehicle 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 AMI-C 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 AMI-C 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 AMI-C functions may be impaired.

4.4 AMI-C network power mode considerations

All AMIC-C compliant networks shall support three distinct power modes: ON, OFF and SLEEP. ON supports all component or device functions on the network. OFF implies that all component or device functions have been shut down. SLEEP results in low power consumption from components or devices, with no data communications occurring.

The desired AMI-C network power mode will be transmitted to network components or devices by means of the Power Mode Signal (PMODE). The PMODE signal could be a message on the AMI-C network or (as an option) a circuit in the AMI-C vehicle services interface connector defined as the PMODE line. It signals all AMI-C components or devices to change to a specific state, based on requests initiated from sources such as the ignition switch, an active system timer, external signal, or the waking of other components or devices.

Primary control of the PMODE signal is under management of the vehicle services interface power management circuitry. A PMODE ON message indicates to the AMI-C Network that the desired power mode is ON. A PMODE OFF message indicates to the AMI-C network that the desired power mode is OFF.

There are three ways to determine the power states of components or devices: the power mode (PMODE) signal on the AMI-C network, internal module functions, or network activity.

4.4.1 PMODE signal change from the ON to OFF

When the PMODE signal is changed from ON to OFF, all components or devices connected to the AMI-C vehicle services interface connector are requested, via network message from the vehicle services interface, to cease normal operation by changing to an OFF or SLEEP state.

Each network component or device must respond to the Vehicle Services Interface with an affirmative message. When all components or devices agree, the Vehicle Services Interface switches the PMODE to OFF and all components or devices respond by shutting down. If there is no response from one or more of the components or devices within 60 seconds (as a default time period), the PMODE will be set to OFF.

Depending on the component or device's function, it may need to shut down at a later time, perhaps after it finishes a task, after some programmed time period, or after appropriate shutdown chores are completed. When there is a specific requirement for a component or device to persist operation, it will respond to the Vehicle Services Interface shutdown message request with a message requesting an extended period and the time duration. The Vehicle Services Interface will extend the default value of 60 seconds to accommodate this request. At the end of this requested period and after all other component or device requests have been satisfied, the PMODE state will change to OFF.

4.4.2 PMODE signal change from the OFF to ON

When the PMODE signal changes from OFF to ON, all components or devices on the standard AMI-C networks must change to the ON state. As long as the vehicle services interface receives a POWER_ON message from the vehicle, the PMODE is held ON.

Any component or device may wake up the bus by sending a POWER_ON message to the vehicle service interface. This action causes the vehicle services interface to send the PMODE signal ON by maintaining a PMODE ON request. Upon PMODE transition to ON, all components or devices equipped with wake-up circuitry are requested to power ON.

Upon wake-up, the activating component or device sets a “worst case” duration for the requested activity to occur. This is sent via a network message to the Vehicle Services Interface, along with the activating NODEID. The Vehicle Services Interface will turn the PMODE OFF when that time has elapsed and the Power mode is OFF. During the initiated activity, the originating component or device may send a message to update the timer, if necessary.

Upon completion of the activity that initiated the wake-up, the activating component or device sends a message to the Vehicle Services Interface requesting the network to go into SLEEP mode. The shut down sequence then follows the procedure as specified in Power mode changes from the ON to OFF state.

4.5 AMI-C network power consumption management

4.5.1 Management mechanisms

The AMI-C Network supports three methods to manage current consumption. These methods allow a vehicle to remain standing in a parking lot for several weeks without discharging the battery to a point that it will not start the vehicle:

The first method allows components or devices, during the key OFF state, to go into a SLEEP state that reduces the normal module power consumed (see section 4.9.2) to a very low level.

A second method allows components or devices to stay active after the Ignition key is turned off to perform a variety of functions. The components or devices then turn themselves off by switching off the internal power supply or go to SLEEP when the tasks are completed or after a pre-determined time.

The third method provides that the Vehicle Services Interface may shut off the power to the AMI-C interface connector after a predefined period of inactivity, based on the input from an internal clock / calendar function. This function facilitates shutting down all current draw of the system for extended storage conditions, such as long term parking conditions, distribution centers, and storage facilities.

Several methods may be allowed to shut off the power supply from the Vehicle Services Interfaces:

- Clock calendar;
- Battery removable;
- Remote service activation.

Shutting down this power supply can only occur when the Ignition Key is OFF and the PMODE state is OFF (except battery removal). Once in this state, the only way to restore power to the system is to turn the Ignition Key to a position other than OFF.

This function would be a service provided by the Vehicle Services Interface with the time duration defined by the automaker. Vehicle Services Interface not using this feature provide continuous power to the Power Supply Line at all times.

4.6 AMI-C Network power and ground requirements

This section describes and specifies several aspects of the automotive power supply system to achieve interchangeability among the wide variety of electrical and electronic components or devices required to operate in the AMI-C compliant system. This section covers power and ground circuits and circuit voltage offsets.

4.6.1 Power pin

AMI-C compliant components and devices can draw limited power from the power pin of its AMI-C vehicle services interface connector. These requirements apply to embedded AMI-C components and devices and do not apply the CCP connection. Requirements for the CCP connection can be found in 1394 TA documents 1999001 parts 1, 2 and 3. The current values described here for embedded components and devices were based on the AMI-C vehicle services interface connector using 0.64mm pins in the connection system.

The maximum internal current draw from the power pin of any connector comprising the AMI-C vehicle services interface connector set is limited to 0.5 amp for each component or device. Current requirements of a component or device that exceed this maximum amount must be provided through a separate connector and separately fused circuit.

Systems with a total current requirement of more than the 5.0 amp current draw on an AMI-C vehicle services interface connector requires a break in the series circuit and a second power source inserting an additional 5.0 amps supply (refer to Figure 5). This device provides extension of the daisy-chained power circuit to an additional 10 components or devices.

For aftermarket components or devices depending on current draw, the device shall be powered by means of the data bus or a separate connector. As an alternate, the automaker may provide a separate fuse within an existing power distribution center or a separate power distribution center for after market installation.

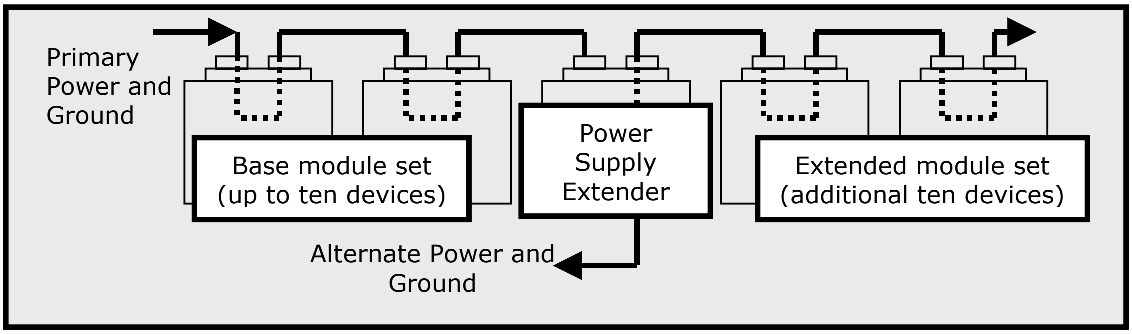


Figure 5 — Extended power supply

4.6.2 Power terminal is hot at all times

The power terminal of the AMI-C vehicle services interface connector is at battery voltage potential at all times (except during long storage periods, see Low battery charge state). This allows AMI-C components or devices to remain powered independent of the Ignition Key state.

4.6.3 Ground circuit

The Ground circuit of the AMI-C vehicle services interface connector sinks current from the AMI-C components or devices back to battery ground.

The maximum current returned to ground allowed in each AMI-C vehicle services interface connector shall be 5.0 amp DC.

The Ground circuit of the AMI-C system shall be connected to vehicle ground at only one point in the vehicle system. For the purposes of this specification, this single point will be referred to as the AMI-C Common Ground Point. It is assumed that this will occur on the automaker's side of the vehicle services interface connector. Ground loops shall be avoided.

Components or devices having secondary connectors providing power to them must use isolated ground return lines for those circuits back to a single common point in the vehicle. This secondary ground return must also be isolated within the component or device from the vehicle services interface connector ground.

4.7 AMI-C network components or devices

4.7.1 Vehicle services interface PMODE control

4.7.1.1 Vehicle services Interface component

An AMI-C compliant vehicle is only required to have one component – the AMI-C Vehicle Services Interface. It is assumed that this interface component will provide the required power for the vehicle services interface connector, as defined in the remainder of this section of the specification.

4.7.1.2 PMODE signal controlled from vehicle services interface

The PMODE signal is controlled from the Vehicle Services Interface because it is the only component that is standard on an AMI-C compliant vehicle, and it serves as the PMODE master. All other components or devices are optional. Furthermore, the Vehicle power mode input to the Vehicle Services Interface is the primary input for the activation of the PMODE signal.

4.7.1.3 Control sources to switch ON

The PMODE signal can be switched ON by several signals (logical or functional):

- Vehicle Power mode turned to ON or ACC (primarily but not exclusively derived from Ignition Position);
- POF light activation (any IDB-1394 network device can initiate) if the AMI-C network is designed for optical wake-up.

4.7.1.4 Optional signal sources to switch PMODE ON

Components or devices connected to the network through Consumer Port Connectors can be allowed to wake-up the system. However, OEMs may take appropriate action to prevent external portable devices from activation to the system without proper validation. Other possible means to switch the PMODE signal to ON are:

- internal (Vehicle Services Interface) timer;
- clock / calendar event;
- HMI switch on IP;
- an embedded AMI-C network component or device.

4.7.1.5 Control sources to switch PMODE OFF

The PMODE line can be switched to OFF state by:

- Vehicle Power mode turned to OFF (primarily but not exclusively derived from Ignition Position);
- if Power state is OFF, concurrence by network components determines that activity is finished (see PMODE OFF).

4.7.1.6 Optional signals used to switch PMODE OFF

Optionally, other signals can be used by the automaker to switch the PMODE off:

- internal (Vehicle Services Interface) timer;
- clock/ calendar event;
- HMI switch on IP;
- an embedded AMI-C network component or device.

The Vehicle Services Interface is the PMODE "master" control, which monitors and prohibits any single component or device from holding the system awake indefinitely due to failure or error.

4.7.1.7 Signals specified by the automaker

The Vehicle Services Interface may have the option to wake up the system (when the Vehicle Power mode is OFF) through signals specified by the automaker (see PMODE OFF).

The Vehicle Services Interface will use the following procedure to manage a graceful shutdown, after the initiating activity has finished:

1) Upon completion of the activity that initiated the wake-up, the Vehicle Services Interface broadcasts a message requesting the network to go to SLEEP (and Power mode is still OFF).

2) Each network component or device must respond to the Vehicle Services Interface with an affirmative message.

3) When all components or devices agree, the Vehicle Services Interface switches the PMODE signal OFF. If there is no response from one or more of the nodes within 60 seconds, the PMODE will shut OFF.

4.8 Device power mode implementations

Power management implementations vary, based on component or device type and level. The power modes used by any particular component or device are determined by its function and manufacturer. Simple devices may only use ON and OFF modes. Intermediate components and devices without sophisticated computers may use ON, OFF, and SLEEP.

Hosts and some types of controllers may use internal power management mechanisms to shutdown some internal functions or slow down the internal clock speed of the processor to minimize power consumption. Since these additional modes are not controlled or known outside of the components that use them, they are not system related and are defined in the Architecture Specifications.

NOTE A transition from SLEEP to ON mode always requires a reset (or reboot) with an inherent delay before full operation is realized. The component or device cannot respond to network messages until operation is restored.

4.9 Component or device power consumption states

4.9.1 Normal operation

Components or devices do not have a restriction on total current usage in normal operation, providing they meet all of the other requirements of the Automotive power supply system defined during normal operation. (See voltage range during normal operation. See 4.6, also.)

4.9.2 Sleep (inactive) state

During the sleep state, current consumption must be less than 0.1 mA per component or device, unless it contains a function that remains active during Sleep, such as a wireless transceiver. Components or devices that utilize transceivers (for example, cell phone, wireless, etc.) shall use less than 2.0 mA in the sleep state. However all components or devices are subject to total vehicle parasitic power consumption.

4.9.3 OFF state

The OFF state refers to an inactive state, where all internal functions have ceased. A component or device in the OFF state is generally disconnected from the power sources or the internal power supply has been shut off. The current consumption is reduced to essentially zero (0). However, some leakage current may be evident.

4.9.4 Parasitic power consumption

For purposes of AMI-C, parasitic electrical loads consist of all electrical energy consumed by embedded components or devices when the vehicle power mode is OFF. Typically vehicle manufactures are concerned with current draw during this time to ensure that the vehicle will be able to be restarted after a certain period of time, typically 30-45 days. The calculation is made by establishing the starting and ending states of charge of the vehicle storage battery (that is, 90 % to 60 % state of charge).

The total current consumed by the component or device consists of two parts:

— The current required by the component or device when it is in the OFF power mode.

— Any power consumed by periodic wake ups to check vehicle status or perform functions would be averaged over the time period in the off mode.

Since battery charge is given in percentage and battery sizes vary an exact calculation cannot be made.

Some other assumptions are valid:

- Component or devices installed by the automaker will be accommodated by the vehicle power budget and provisions must be in the vehicle power budget for after market devices.
- Assume after market installations will be small—on average, 4 to 6 in any one vehicle.
- Assume that not all components or devices will need periodic wakeup.

If no wake up is required for the component or device current drain shall be 100 μA. For those components or devices requiring wakeup the current drain shall be 500 μA. Based on the assumption that there will be AMI-C compliant open network vehicle should allow additional 1.25 mA current draw as a guideline. This current draw is in addition to the parasitic budget established for equipped devices by the automaker.

4.10 AMI-C component or device electrical test procedures

The following tests shall be conducted as appropriate to ensure that the physical components or devices comply with the electrical environment found in AMI-C compliant vehicles. The pass/fail criteria listed for each test constitutes the performance requirements for the component or device being tested.

Sample size for all test sequences: 12 units.

4.10.1 Over voltage

This test simulates the condition where the regulator at the generator fails.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Over voltage	ISO 16750-2	Over voltage	

4.10.2 Superimposed alternating voltage

This test simulates a residual AC on the DC supply.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Superimposed alternating voltage	ISO 16750-2	Superimposed alternating voltage	

4.10.3 Slow decrease and increase of supply voltage

This test simulates a gradual decrease and recharge of the battery.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Slow decrease and increase of supply voltage	ISO 16750-2	Slow decrease and increase of supply voltage	

4.10.4 Discontinuities in supply voltage

This test simulates the effects of a fuse activation in another circuit on the power supply circuit of the DUT.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Discontinuities in supply voltage	ISO 16750-2	Momentary drop in supply voltage	
2			Reset behavior at voltage drop	
3			Starting profile	

4.10.5 Reversed voltage

This test checks the effects on the DUT of a reversed battery from an auxiliary starting device.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Reversed voltage	ISO 16750-2	Reversed voltage	

4.10.6 Open circuit tests

This test simulates the effects of various types of open circuits on the DUT.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Open circuit tests	ISO 16750-2	Individual circuits	
2			Connector	
3			Micro interruptions of supply voltage	

4.10.7 Short circuit protection

This test simulates short circuits to the inputs and outputs of a device.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Short circuit protection	ISO 16750-2	Short circuit protection	

4.10.8 Withstand voltage

This test checks the insulation behavior of circuits with galvanic separation such as connector pins, relays or cables.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Withstand voltage	ISO 16750-2	Withstand voltage	

4.10.9 Insulation resistance

This test checks the insulation behavior of circuits with galvanic separation such as connector pins, relays or cables.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Insulation Resistance	ISO 16750-2	Insulation resistance	

4.10.10 Conducted transient immunity

This test is a simulation of transients due to power supply disconnection form inductive loads.

Seq #	Test	Reference spec	Test criteria	Pass/fail criteria
1	Conducted Transient Immunity	ISO 7637-2	Test Pulse 1 Sudden interruption of inductive load in parallel with device	ISO 7637-1 Annex A Para A4 Functional class C
2	Conducted Transient Immunity	ISO 7637-2	Test Pulse 2a Sudden interruption of inductive load in series with device	ISO 7637-1 Annex A Para A4 Functional class C
3	Conducted Transient Immunity	ISO 7637-2	Test Pulse 3A and 3B Sudden interruption of load influenced by distributed inductance and capacitance	ISO 7637-1 Annex A Para A4 Functional class C
4	Conducted Transient Immunity	ISO 7637-2	Test Pulse 4 Voltage supply reduction from energized starter motor	ISO 7637-1 Annex A Para A4 Functional class C
5	Conducted Transient Immunity	ISO 7637-2	Test Pulse 5b Load dump Transient	ISO 7637-1 Annex A Para A4 Functional class C
6	Conducted Transient Immunity	ISO 7637-2	Test Pulse 6 Momentary interruption in ignition coil	ISO 7637-1 Annex A Para A4 Functional class C

5 Interconnectivity

5.1 Plastic optical fiber connectors

The header connector shall accommodate sleeved, pigtail or sleeveless connector headers.

5.1.1 IDB 1394 connector

Only 2+0 (2 optical fiber + 0 copper wire) connector configurations are permitted for the header or inline connector. The design requirements for this connection system are found in 1394 TA document number 2001018.

5.1.2 MOST connector

The MOST connector shall meet or exceed the design requirements found in The MOST physical specification.

5.1.3 IDB 1394 fiber optic transceiver

The Fiber Optic Transceiver (FOT) may be incorporated into the POF header socket. A reference performance validation sequence is provided to assist in the connector manufacturers' qualification of FOT devices to minimize risk in the integration with the header. The FOT shall have the following characteristics:

- The fiber optic transceiver shall be capable of working in both a 3.3 +/– 0.3 Vdc and 5 +/– 0.25 Vdc systems.
- The FOT shall have a maximum of 0.55 Numerical Aperture (NA). Its center wavelength (FWHM) at 25 °C shall be 640 to 660 nm with a maximum spectral width of 40 nm.
- The FOT shall have a minimum extinction ratio of 10 dB with a maximum overshoot of 25 %.
- The mean launch power shall be average between –7.5 dB and –2 dB.
- The average minimum receiver input power of the FOT shall be –22 dBm at 25 °C.
- The minimum receiver overload shall average –2 dBm average at 25 °C.

5.1.4 MOST fiber optic transceiver

The MOST FOT is specified in the MOST physical specification.

5.1.5 Materials plastic optical fiber (POF) connections

Material used to manufacture the POF header with integrated FOT connectors must be capable of withstanding soldering temperatures. Thermoplastic materials used for the POF connectors and cable shall have a flammability rating of "HB" according to IEC 60695-11-10. All POF connector and cable materials shall not have their performance adversely affected as stated in the environmental section of the physical specification.

5.1.6 Keying view

5.1.6.1 IDB 1394 connector

The keying or indexing specified by 1394 TA document 2001018 is referred to as indexing 0. As additional keying views are developed, they will be incorporated into that document.

5.1.6.2 MOST connector

The keying or indexing for the MOST connector is specified in the MOST physical specification Version 1.

5.2 Plastic optical fiber cable

The POF cable shall have a step index core of polymethyl methacrylate (PMMA). The POF cable core diameter shall be 980 ± 45μm and the clad diameter shall be 1000 ± 45μm with a single numerical aperture (NA) of 0.60 ± 0.05 or a dual (0.5/0.6) numerical aperture. The POF cable construction shall be either single or dual jacketed and single or duplex core.

5.3 Consumer convenience port (CCP)

5.3.1 Performance criteria

The CCP is a highly desirable device found in an AMI-C network: it connects portable devices with the embedded vehicle. The CCP socket shall be accessible from the passenger compartment of a vehicle. The mating interface dimensions and performance criteria depend on the type of network embedded in the vehicle. The required performance criteria of the CCP include a minimum durability of 7500 cycles for the CCP socket and a minimum durability of 750 cycles for the CCP plug. A maximum force of 60N applied to the front of the CCP socket shall not result in damage to the socket. No dust cap is required for the CCP socket but it is recommended for protection of the device.

The qualification tests for CCP connections are found in section 3.5 of this document.

All exposed edges and corners that are accessible to the consumer shall be rounded to avoid sharp edges. The female connector housing assembly shall not make contact with the male terminals during mis-insertion of the housing assembly. The worst-case mis-insertion angle shall not permit the housing assembly to come closer than 1.0 mm from the terminals. The consumer convenience port connector design shall accommodate Consumer Electronics (CE) device connectivity whenever a “portable” or after market component or device is added by the end user. A detent feature shall be included in the connector. The pull-out force of the connector including the detent feature shall not exceed 40 +/– 5 N.

Pull-out forces for the consumer connector port have been established to be 40 N. This number is based on the following sequence (from most desirable to least desirable). When a consumer pulls on a cable, the following shall hold true:

1) The connector disconnects. This ensures the least damage since the connector can simply be reinserted into the cavity. The minimum pullout resistance that can be expected would be the resistance provided by a fully-populated connection system. The terminal-disengaging force used was 2 N/terminal or 24 N for the connection system.

2) The terminal should pull out of the cavity. While this is not desirable, the terminal can be replaced and reinserted by a qualified technician. The force used was 50 N. Since the consumer will most likely pull on the cable bundle, the force would be distributed over all of the terminals. However, in the case of a single short wire in the bundle, the force could be concentrated on a single wire.

3) The terminal crimp should break. Again, this is not desirable, but does define the location of a cable break within a confined area for repair. Terminal crimps should be designed to break at a force less than the break strength of the cable. A crimp break of 80% of the minimum gauge wire or 69 N is assumed.

4) The cable actually breaking represents the least desirable situation. This is because the break could occur at any location and may not result in cable jacket separation, making repair very difficult. Using the desired sequence and establishing the smallest gauge wire (22 auwg) places the break strength at approximately 86 N.

5.3.2 IDB 1394 consumer connector port

The CCP socket mating interface dimensions and inner and outer shield isolation shall be as defined in IEEE 1394b.

The CCP socket shall mate with either of the IEEE 1394b bilingual-type 2 cable assemblies.

All dimensions relating to the placement of the CCP socket with respect to the mounting panel as specified above shall be met.

5.4 RF connector systems

5.4.1 Performance criteria

— The RF connector shall meet the applicable SAE/USCAR-2 performance specification for automotive electrical connectors.

— The RF connector shall meet the applicable SAE/USCAR-17 performance specification for automotive RF connector systems.

— Exception: USCAR-17 4.4.2.2, sentence 1a and b.

For the overall length of samples, refer to EIA 364-101. This length needs to be 610 mm to minimize the reflection that occurs from the SMA connectors that are used to build the test assembly.

5.4.2 Coaxial cable connector interface

5.4.2.1 RF connector round FAKRA SMB

The FAKRA SMB RF connector shall meet or exceed SAE/USCAR-18.

5.4.2.2 RF connector square outer

The square outer conductor shall meet or exceed SAE/USCAR-19.

6 Packaging

6.1 Package location

Embedded components or devices are assumed to be in the vehicle interior cabin or trunk and not exposed to water or chemical contamination.

— The location shall provide the capability for the component or device to operate under the full range of vehicle environmental conditions appropriate for the location within the vehicle.

— The location shall provide the capability for the component or device to survive effects from sun load including elevated temperatures and direct sunlight without any degradation in performance.

— The location shall provide the capability for the component or device to survive the effects from prolonged exposure to low temperatures down to –40 °C without any degradation in performance.

— The location shall provide the capability for the component or device to survive the effects from outside contaminants such as sunscreen, moisturizing creams or other lotions brought into the vehicle by the consumer without any degradation in performance.

6.2 Specifications for packaging

The following are general packaging guidelines for compliant components, devices and networks.

— Network interfaces shall be securely mounted in a workmanlike manner so as to withstand the insertion and removal forces of the mating and un-mating cycles of the installed connectors.

— Compliant component or devices shall remain connected when vehicle is in motion. Vertical orientation is not recommended.

— Compliant component or devices shall meet the fluid resistance requirements of ISO 16750-5.

— All permanently installed cables and/or harnesses shall be routed in such a way as to prevent a snagging or tripping hazard to the end user.

— Overhead mounting of compliant component or devices is not recommended. Dangling cords present a potential choking hazard.

- Compliant component or devices shall be accessible by the driver.
- Compliant component or devices shall not be visible to driver, that is, not in driver's normal operating visual range during operation of the vehicle so as not to become a distraction.
- Compliant component or devices shall be accessible without removing any other embedded vehicle components.
- Compliant component or devices shall be kept clear of any and all “KEEP OUT ZONES”, such as pedal foot zones.
- Portable AMI-C compliant component or devices shall provide adequate hand access for connector mating and un-mating.
- Compliant component or devices shall meet all homologation.

Specifying a “break-away” force that will ensure any loose cords will disconnect before becoming a trip hazard must be investigated. At the same time, the retention forces must be sufficient to ensure reliable operation: 100 N.

Annex A
(normative)

EMC test plan data requirements

All required specifications for DUTs (Device Under Test) component EMC testing must be contained in the required EMC Test Plan. All data supplied in compliance with this testing shall be derived and provided by an accredited laboratory in accordance with the Automotive Electromagnetic Compatibility Laboratory Accreditation Program (AEMCLAP) as administered by a third party accrediting body.

Additional environmental requirements must also be specified for some E/E components that may be exposed to unique vehicle environmental conditions that are more severe than defined in this document. These requirements must also be specified in the component specifications' EMC test plan.

A.1 Overview

The EMC Test Plan shall be prepared and submitted to the approving activity 60 days prior to commencement of EMC testing. The purpose for this test plan is to develop and document a well thought out procedure to verify that DUTs are robust to the anticipated electromagnetic environment that they must operate within. The test plan also provides a mechanism for ongoing enhancements and improvements to the test setup that better correlates with vehicle level testing.

A.2 Preparation of test plan

The DUT EMC Test Plan shall be prepared in accordance with the template shown in **Error! Reference source not found.**. The test plan requires collaborations between the design engineer along with the EMC applications and test engineers.

A.3 Test report requirements

A.3.1 DUT design level (PWB number(s), software version, DV/PV)

1) PWB numbers(s)

2) Software version

3) DV/PV

A.3.2 General

Include the following:

1) Plots, tabular data, photographs, etc.

2) Provide data/observation sheets used for recording data. Actual data sheets should be included in the test report.

3) If there are differences in the actual testing vs. the test plan, they shall be noted in the Report.

4) Other Items to be included in test report:

— RI, CI: Frequency, test level, anomaly description

— Use codes if anomalies fall into categories (e.g., 1 = speedometer fluctuations, 2 = injector signal change). Also quantify anomaly (e.g., speedometer increases 10 MPH, duty cycle decreases 50 %).

Example `Frequency` `Anomaly description`

```
25 - 30 MHz 1: 10 MPH increase, 2: DC decreases 50 %
```

A.3.3 Test facilities report

The following is the pro-forma that should be used to prepare the EMC Test Facilities Report that must accompany all EMC test plans. Details may be omitted for those tests that have attained A2LA Automotive EMC accreditation for specifically related tests.

A.3.4 Location of test services

Provide detail of the geographic location of the test facility. Also include the names and phone/fax numbers of key contacts.

A.3.5 Company overview

Provide information about the company including overall size, age, and the number of years providing EMC services.

A.3.6 Description of test laboratory and test equipment

Provide information about the test laboratory and equipment, including, for example, equipment model numbers and calibration schedule.

Annex B
(informative)

Informative references

The following referenced documents are in relation with the application of this document. Reference specifications may change. The user must check with the publishing organization and/or automakers for the current requirements.

— CISPR 25, Limits and Methods of Measurement of Radio Disturbance Characteristics for the Protection of Receivers used on Board Vehicles

— CMVSS 114, Theft Protection

— CMVSS 201, Occupant Protection in Interior Impact

— CMVSS 302, Flammability of Interior Materials

— ECE 18 – 01

— ECE 21_01

— EEC 74/60_78/632

— EEC 74/61_95/56

— EEC 95/28_00/00

— EIA 364-04, Normal force test procedure for electrical connectors

— EIA 364-06A-83, Contact resistance test procedure for electrical connectors

— EIA 364-09C-1999, Durability Test Procedure for Electrical Connectors and Contacts

— EIA 364-101, Attenuation Test Procedure for Electrical Connectors, Sockets, Cable Assemblies or Interconnection Systems

— EIA 364-13A-83, Mating and un-mating forces test procedure for electrical connectors

— EIA 364-17B-1999, Temperature life with or without electrical load test procedure for electrical connectors and sockets

— EIA 364-18A-84, Test Procedure #18A Visual and dimensional inspection procedure for electrical connectors

— EIA 364-20A-83, Withstanding voltage test procedure for electrical connectors, sockets and coaxial contacts

— EIA 364-21B-95, Insulation resistance test procedure for electrical connectors, sockets, and coaxial contacts

— EIA 364-23A-85, Low level contact resistance test procedure for electrical connectors and sockets

— EIA 364-32B, Thermal shock (temperature cycling) test procedure for electrical connectors and sockets

- EIA 364-38A-85, Cable Pull-Out Test Procedure for Electrical Connectors
- EIA 364-41B, Cable Flexing Test Procedure for Electrical Connectors
- EIA 364-41B-89, Cable Flexing Test Procedure for Electrical Connectors
- EIA 364-65-97
- EIA 455-13A, Visual and Mechanical Inspection of Fibers, Cables, Connectors and/or Other Fiber Optic Devices
- EIA 455-21A, Mating Durability for Fiber Optic Interconnecting Devices
- EIA-364-31A, Humidity test procedure for electrical connectors and sockets
- EIA-455-20A, FOTP-20 Measurement of change in optical transmittance
- EIA-455-34A, Interconnection device insertion loss test
- FMVSS Part 571, Standard 302 Flammability of Interior Materials
- IEEE 1394b, Draft Standard for a High Performance Serial Bus
- MOST specification of physical layer
- SAE J1113-12, Electrical Interference by Conduction and Coupling – Coupling Clamp and Chattering Relay
- SAE J1113-21, Road Vehicles-Electrical Disturbances by Narrowband Radiated Electromagnetic Energy-Component Test Methods part 21 – Absorber-Lined Chamber
- SAE/USCAR-17, Performance Specification for Automotive RF Connector Systems
- SAE/USCAR-18, FAKRA SMB RF Connector Supplement
- SAE/USCAR-19, Coaxial Cable Connector Interface – Square Outer Conductor
- SAE/USCAR-2, Performance Standard for Automotive Electrical Connector Systems
- TA Document 2001018: 1394 Automotive Specification (IDB-1394)

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