AEROSPACE STANDARD

AS5726™	REV. A

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Superseding AS5726

Interface Standard, Interface for Micro Munitions

RATIONALE

This standard was developed by SAE International. It defines implementation requirements for the electrical interface between Hosts and Micro Munitions. The intent of this standard is to minimize proliferation of electrical interfaces between Micro Munitions and associated Hosts and thereby promote interoperability of Micro Munitions across different programs and services. This document was revised to incorporate editorial and technical comments received and coordinated by SAE AS-1B1 Micro Munitions Interface Task Group.

AS5726A has been reaffirmed to comply with the SAE Five-Year Review policy.

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1. SCOPE

This standard only defines interconnect, electrical and logical (functional) requirements for the interface between a Micro Munition and the Host. The physical and mechanical interface between the Micro Munition and Host is undefined. Individual programs will define the relevant requirements for physical and mechanical interfaces in the Interface Control Document (ICD) or system specifications. It is acknowledged that this does not guarantee full interoperability of Interface for Micro Munitions (IMM) interfaces until further standardization is achieved.

1.1 Purpose

The purpose of this standard is to minimize proliferation of divergent electrical interfaces between the Host and Micro Munitions to promote interoperability across different programs and services.

1.2 Application

This standard applies to all Hosts and Micro Munitions that electrically interface with each other. A Micro Munition is a weapon characterized by a mass up to 25 kg and a minimum outer diameter of 38 millimeters. Other munitions may use this standard.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 General

The documents listed in this section are referenced in Sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in Sections 3, 4, and 5 of this standard, whether or not they are listed.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS5653 High Speed Network for MIL-STD-1760

AS39029/56 Contacts, Electrical Connector, Socket, Crimp Removable (For MIL-C-38999 Series I, III, and IV Connectors)

AS39029/58 Contacts, Electrical Connector, Pin, Crimp Removable (For MIL-C-24308, MIL-C-38999 Series I, II, III, and IV, and MIL-C-55302/69 and MIL-C-83733 Connectors)

2.1.2 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

FC-PI ANSI INCITS 352-2002 Fibre Channel - Physical Interfaces

2.1.3 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, http://quicksearch.dla.mil/.

MIL-DTL-38999L	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification For
MIL-DTL-38999L Supplement 1	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification For
MS27488N	Plug, End Seal, Electrical Connector
MIL-STD-1760E	Interface Standard For Aircraft/Store Electrical Interconnection System

2.2 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Definitions

Definitions applicable to this standard are as follows.

3.1.1 Host

Any system capable of carrying, interfacing with, and employing Micro Munitions. The term includes Platforms such as aircraft, ground vehicle (armored vehicles, trucks), armed man portable, installations, nautical vehicle (boat, ship or submersible), cruise missiles, and Micro Munition Carriage Systems.

3.1.2 Electrical Interface Types

The two electrical interface types for the Host/Micro Munition electrical interconnection system are specified below.

3.1.2.1 Micro Munition Host Interface (MMHI)

The electrical interface on the Host structure where the Micro Munition is electrically connected either directly (blind mate) or via an interconnecting umbilical cable.

3.1.2.2 Interface for Micro Munitions (IMM)

The electrical interface on the Micro Munition external structure or interconnecting umbilical cable that mates with an MMHI.

3.1.3 Micro Munition

A Micro Munition is a weapon typically characterized by a mass up to 25 kg and a minimum outer diameter of 38 mm.

3.1.4 Fibre Channel (FC)

FC is the name for a high-speed network standard defined by a series of ANSI INCITS standards.

3.1.5 Safety Critical

An interface operation (electrical, logical or a combination of both) at the MMHI or IMM is deemed safety critical when it causes the Micro Munition to perform functions that have the potential to generate Micro Munition behavior that may present a hazard to the Host, crew or ground handling personnel.

3.2 Acronyms and Abbreviations

The following acronyms and abbreviations are applicable.

AC	Alternating Current
ANSI	American National Standards Institute
dBV	Decibel voltage relative to 1 Volt
DC	Direct Current
DFC	Down Fibre Channel
ENB	Enable
F	Frequency
FC	Fibre Channel
FC-PI	Fibre Channel – Physical Interface
GHz	Gigahertz
ICD	Interface Control Document
IMM	Interface for Micro Munitions
INCITS	International Committee for Information Technology Standards
kg	Kilogram
kohm	Kilohm
MHz	Megahertz
MMHI	Micro Munition Host Interface
ms	Milliseconds
ns	Nanoseconds
mV	Millivolt
RD	Receive Data
TD	Transmit Data
UFC	Up Fibre Channel

µH	Microhenry
V	Volt
W	Watt

4. GENERAL

4.1 Interface Set and Classes

The interface set, as shown in Figure 1, consists of interfaces for digital data transfer, discrete signals, and power. Data and power share the same physical interfaces. Detailed electrical requirements for each of these interfaces at the MMHI and IMM are specified in Section 5.

Two IMM classes are defined, providing different capabilities over the same set of physical interfaces:

Class I provides 28 V DC regulated power on the Operating Power interface, and the power available on this interface is 85 W continuous.

Class II provides 56 V DC regulated power on the Operating Power interface, and the power available on this interface is 200 W continuous.

For either Class I or Class II, Safety Enable Power is 28 V DC as further specified in 5.1.4.2.

This standard includes provisions to ensure that Class I Micro Munitions will not be damaged when connected to Class II Hosts.

Class II Micro Munitions may also operate with a full or diminished capability as Class I Micro Munitions.

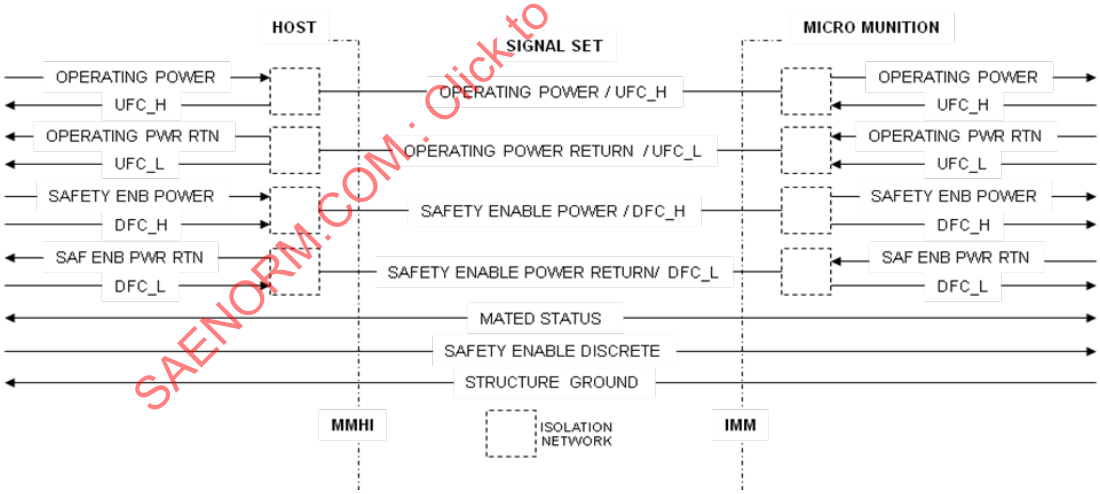


FIGURE 1 – INTERFACE SIGNAL SET

Figure 2 represents a concept schematic of the IMM signal set and of the interactions between Host and Micro Munition functional circuits.

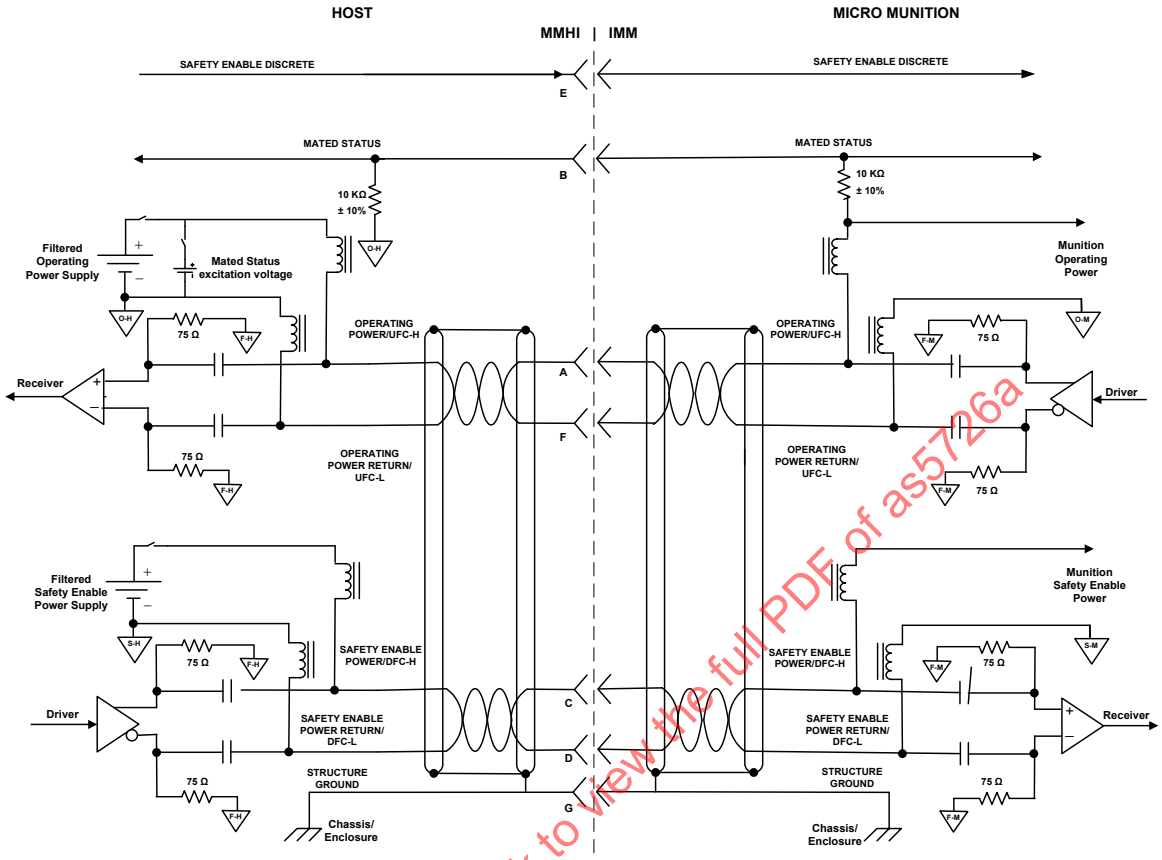


FIGURE 2 – DIGITAL DATA AND POWER INTERFACES SCHEMATIC

4.1.1 Overlay of Digital Data and Power Interfaces

This interface provides power and data to the Micro Munition on the same signal pair. Data from the Micro Munition is transferred on the same signal pair as Operating Power and Operating Power Return. Data to the Micro Munition is transferred on the same signal pair as Safety Enable Power and Safety Enable Power Return. This is accomplished by inserting a low pass filter on the DC path, and a high pass filter on the data path as exemplified in Figure 2.

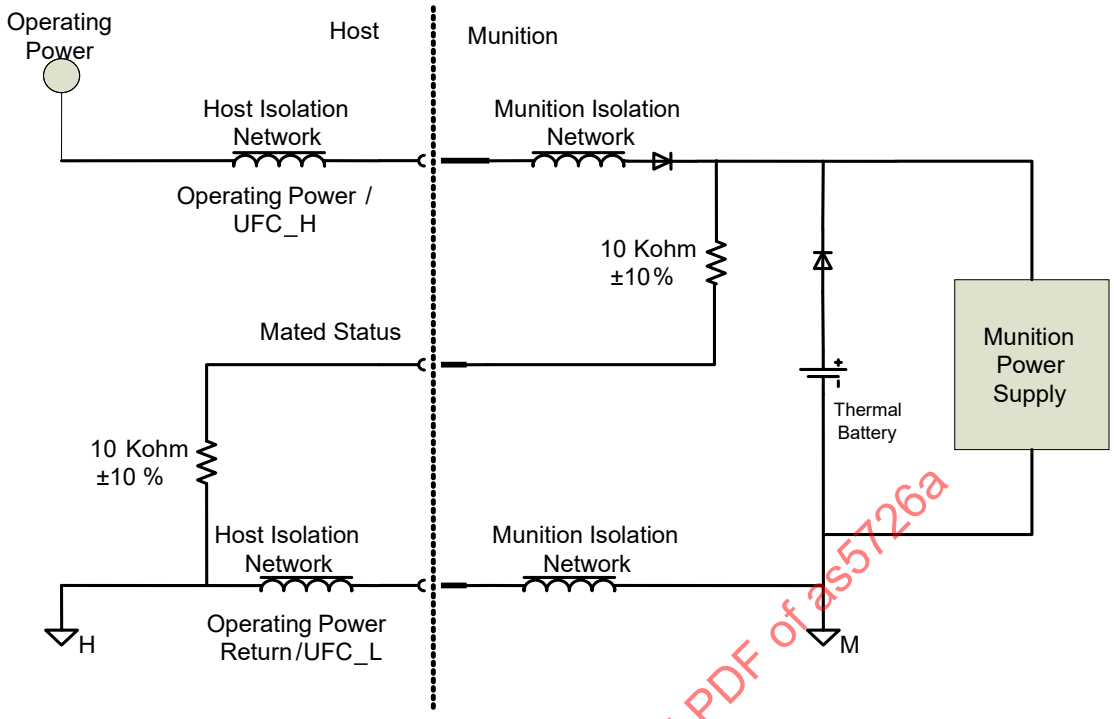
4.1.2 Digital Data Interfaces

The digital data interface consists of a high speed network (Down Fibre Channel (DFC) and Up Fibre Channel (UFC)) in accordance with AS5653 (High Speed Network for MIL-STD-1760) as modified by the requirements of Section 5 herein.

The Host assigns, controls, and routes FC messages to their proper destinations by means of the services provided by the FC protocol.

4.1.3 Mated Status Interface

The Mated Status interface is a discrete signal path available for both the Host and Micro Munition to monitor the electrically mated status of the other. Figure 3 depicts the use of the Mated Status interface.



Note: Only DC path of isolation networks shown. Diodes on the Munition side of the interface are assumed as part of a typical implementation, but not required by the standard.

FIGURE 3 – MATED STATUS INTERFACE SCHEMATICS

4.1.4 Safety Enable Discrete Interface

The Safety Enable Discrete interface is a low power discrete used only to enable and inhibit safety critical Micro Munition functions which are commanded via the DFC interface (see 4.1.2).

CAUTION

The Safety Enable Discrete interface is provided to enable a safety or irreversible function within the Micro Munition. The discrete should only be enabled when the Host determines that safety criteria for the Micro Munition safety or irreversible function have been met.

4.1.5 Power Interfaces

The Host supplies and controls all power to Micro Munitions through the MMHI. One Operating Power and one Safety Enable Power source are supplied through each interface. A dedicated power return is provided through the interface for each power source.

The Host may apply Operating Power at any time after sensing that the Micro Munition Mated Status is mated as defined in 5.1.2.

4.1.5.1 Operating Power

Operating Power is supplied to each Micro Munition by the Host for basic operation of Micro Munition internal electronics and performance of non-safety-critical functions.

Class I Hosts supply 28 V DC ± 5% on the Operating Power interface.

Class II Hosts supply 28 V DC followed by 56 V DC ± 5% on the Operating Power interface.

Both Class I and Class II Hosts may also supply a lower excitation voltage, prior to application of Operating Power, in order to test for the presence of a Micro Munition.

4.1.5.2 Safety Enable Power

Safety Enable Power is supplied by the Host to each Micro Munition as the power source for functions designated as safety critical. The Safety Enable Power will be energized by the Host for a maximum duration of 2 seconds per application.

4.1.6 Structure Ground interface

The Structure Ground interface provides an electrical connection between the Host and Micro Munition structures to minimize shock hazards to personnel.

5. REQUIREMENTS

5.1 Host requirements

The interface requirements for the Host are defined in the following sections.

5.1.1 Host: Mated Status Interface

The Host shall provide a connection for a Mated Status interface at the MMHI. The Mated Status interface shall be connected to the Operating Power Return node within the Host. The path between the Host Mated Status interface and the Operating Power Return node shall have a resistance of 10 kohm ± 10% when measured at the MMHI.

The Host shall interpret its status as mated when the voltage between Mated Status and Operating Power Return exceeds 20% of the voltage between Operating Power and Operating Power Return, when the operating power voltage complies with Class I, Class II, or Mated Status excitation voltage.

5.1.2 Host: Safety Enable Discrete Interface

The Host shall provide a Safety Enable Discrete interface at the MMHI for transferring an enable/inhibit signal to the connected Micro Munition. Safety Enable Discrete, when in the enabled state, shall indicate Host consent for the Micro Munition to perform safety-critical functions, including but not limited to Commit to Separate Store or Submunition function (bit D8) or the Fire, Launch or Release function (bit D10) of the Critical Control 1 data word in the Mission Store Control message (see Appendix B of MIL-STD-1760) when commanded over the DFC interface. If required by the system specification or ICD, other bits in the Critical Control 1 and Critical Control 2 words may also be interlocked with the release consent interface. When in the inhibited state, the Safety Enable Discrete at an MMHI shall be electrically isolated by a minimum 100 kohm at dc from the Safety Enable Discrete at all other MMHIs. The host shall require specific authorization command(s) to generate the enabled state of the Safety Enable Discrete.

5.1.2.1 Host: Voltage Level

The voltage level measured between the Safety Enable Discrete connection and Safety Enable Power Return connection at the MMHI shall be:

a. Steady state conditions

(1) Enable: Minimum voltage of 19.0 V DC

Maximum voltage of 29.4 V DC

(2) Inhibit:1.50 V DC (maximum)

b. Voltage transients shall not exceed the limits defined for Safety Enable Power.

5.1.2.2 Host: Current Level

Micro Munitions may require up to 100 milliamperes steady state through the MMHI during the enable state and the Host shall be able to supply that current. The Host shall comply with the requirements herein for Micro Munition imposed load currents of 5.0 milliamperes minimum through the MMHI.

5.1.2.3 Host: Stabilization Time

With any resistive load between 320 ohms and 3.8 kohm between Safety Enable Discrete and Safety Enable Power Return, the voltage at the MMHI shall reach steady state levels (see 5.1.2.1.a) within 3 ms during transition between enable and inhibit states.

5.1.2.4 Host: Enable Lead Time

The Safety Enable Discrete signal shall be applied to the MMHI at least 10 ms before transmitting any safety critical command over the DFC interface.

5.1.2.5 Host: Duration of Application to Micro Munition

Once the Safety Enable Discrete signal has been enabled by the Host to the Micro Munition in conjunction with the commanding of either the Commit to Separate Store or Submunition D8 (bit 2) or the Fire, Launch or Release D10 (bit 0) of the Critical Control word in the Mission Store Control message (see Appendix B of MIL-STD-1760), it shall be maintained at that state until one of the following conditions arises:

(a) The Host receives from the Micro Munition, a Mission Store Monitor Message with the Fired, Launched or Released (bit 0) or Committed to Store or Submunition Separation (bit 2) set in the Critical Monitor 1 word.

(b) The Host determines that the Micro Munition has prematurely terminated its preparations because of Micro Munition failure;

(c) The Host terminates the launch sequence prematurely.

5.1.2.6 Host: Ground Reference

The Safety Enable Power Return connection at the MMHI shall be the ground reference for the Safety Enable Discrete signal.

5.1.3 Host: Fibre Channel Interface

The Host shall provide a FC interface consisting of Up Fibre Channel (UFC) and Down Fibre Channel (DFC) signals at the MMHI for full duplex transfer of digital data. The Host shall send digital messages through the MMHI to a FC node in the connected Micro Munition on the DFC signal connection. The Host shall receive digital messages through the MMHI from a FC node in the connected Micro Munition on the UFC signal connection. The FC interface shall meet the requirements specified in AS5653 except as noted below.

5.1.3.1 Host: Fibre Channel Physical Layer Characteristics

The physical layer of AS5653 at the MMHI shall comply with Fibre Channel Physical Interface [FC-PI 100-DF-EL-S] with the following signal assignments.

MMHI signal	FC-PI signal
DFC_H	TD+
DFC_L	TD-
UFC_H	RD+
UFC_L	RD-

In addition, the physical connections for the FC signals shall be overlaid with the MMHI power interfaces as follows:

DFC_H also carries the Safety Enable Power

DFC_L also carries the Safety Enable Power Return

UFC_H also carries the Operating Power

UFC_L also carries the Operating Power Return

5.1.3.2 Host: Logical Interface Requirements

5.1.3.2.1 Host: Communication Rules and Message Requirements

The FC data bus shall comply with the requirements of Appendix D of MIL-STD-1760.

5.1.3.2.2 Host: Critical Control 1 and Critical Control 2 Address Confirm

The Host shall set Address Confirm field of Critical Control 1 (MIL-STD-1760 Table B-XIV) and Critical Control 2 (MIL-STD-1760 Table B-XV) to zero when used.

5.1.4 Host: Power Interfaces

The Host shall provide a set of power interfaces at each MMHI, comprising connections for Operating Power and Safety Enable Power along with associated returns.

5.1.4.1 Host: Operating Power

The Host shall provide an Operating Power interface through the MMHI for powering Micro Munition electronics and under the assumption that all Micro Munition functions so powered are either not safety critical or that multiple safety interlocks exist within the Micro Munition such that Micro Munition safety is not significantly degraded by activation of Operating Power.

5.1.4.1.1 Host: Independent Control

The Host shall be capable of sourcing and independently controlling the Operating Power interface through each MMHI.

5.1.4.1.2 Host: Voltage Level

Class I interface

The steady state voltage at the MMHI between the Operating Power connection and the associated Operating Power Return connection shall be 28 V ± 5% at any load up to the full rated load of 85 W. Voltage transients less than 1 ms shall be 28 V ± 10%. All transients of duration of greater than or equal to 1 ms shall remain within steady state voltage regulation requirement.

Class II interface

The steady state voltage at the MMHI between the Operating Power connection and the associated Operating Power Return connection shall be 56 V ± 5% at any load up to the full rated load of 200 W. Voltage transients less than 1 ms shall be 56 V ± 10%. All transients of duration of greater than or equal to 1 ms shall remain within steady state voltage regulation requirement.

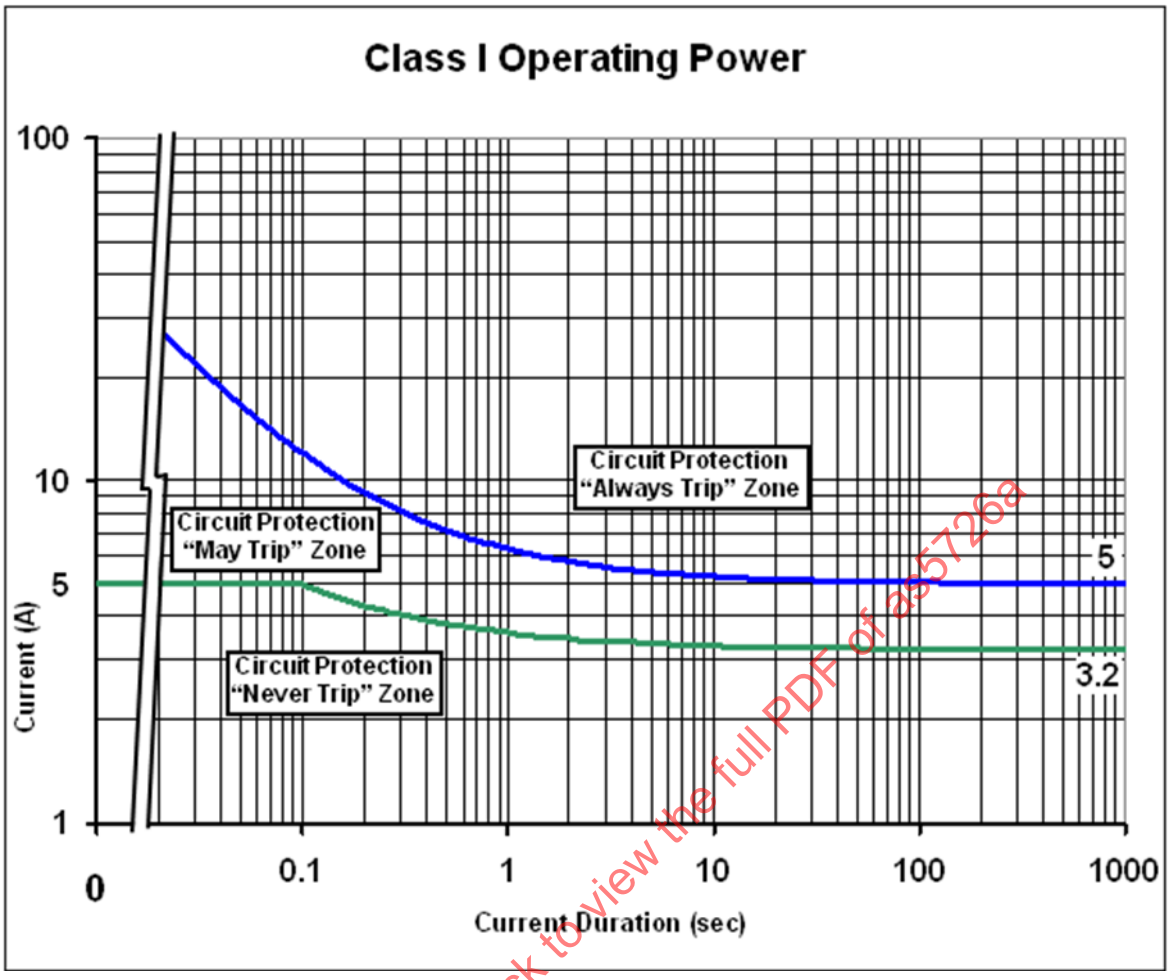
Prior to applying either a Class I or Class II interface, the Host may apply a Mated Status excitation voltage between 3.0 and 12.0 V DC between Operating Power and associated Operating Power Return connection, in order to determine the Mated Status.

5.1.4.1.3 Host: Ripple and Noise

Ripple shall remain under 150 mV peak to peak for Class I or Class II Operating Power. Noise amplitude shall remain under 10.0 mV peak to peak at 10 MHz and higher.

5.1.4.1.4 Host: Current Capacity

The Host shall be capable of sourcing the maximum load current levels of Figure 4 through the Class I Operating Power interface. The Host shall be capable of sourcing the maximum load current levels of Figure 5 through the Class II Operating Power interface.



Always Trip:

$$I_{max\_overload} = (0.056)\left(\frac{75}{t} - 0.25\right)^{0.73} + 5 \quad \text{for } t \le 300 \text{ seconds}$$

$$I_{max\_overload} = 5.0 \quad \text{for } t > 300 \text{ seconds}$$

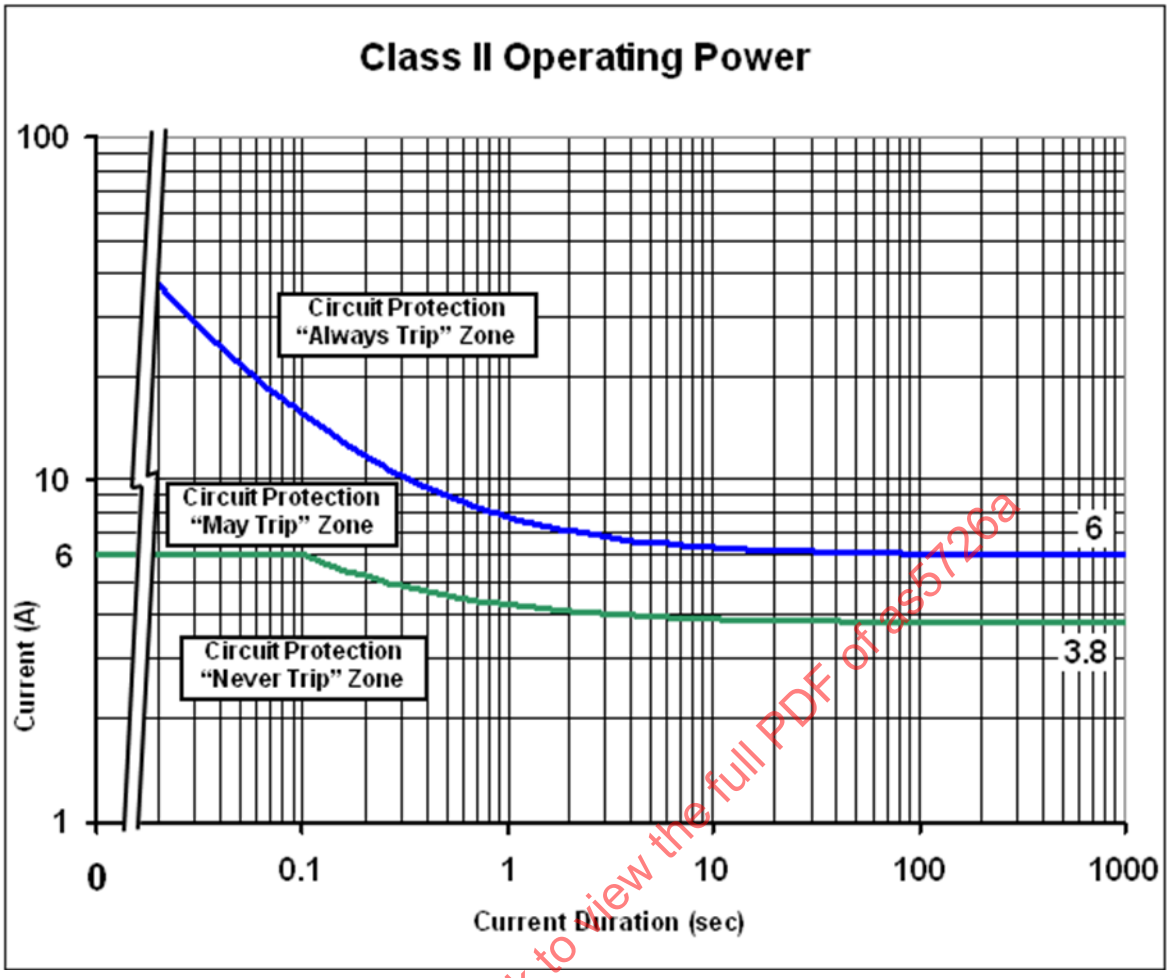
Never Trip:

$$I_{max\_load} = 5.0 \quad \text{for } t < 0.1 \text{ seconds}$$

$$I_{max\_load} = (0.022)\left(\frac{85}{t} - 0.25\right)^{0.65} + 3.2 \quad \text{for } 0.1 \le t \le 300 \text{ seconds}$$

$$I_{max\_load} = 3.2 \quad \text{for } t > 300 \text{ seconds}$$

FIGURE 4 – CLASS I MICRO MUNITION OPERATING POWER CURRENT LEVEL



Always Trip:

$$I_{max\_overload} = (0.076)\left(\frac{75}{t} - 0.25\right)^{0.73} + 6 \quad \text{for } t \le 300 \text{ seconds}$$

$$I_{max\_overload} = 6.0 \quad \text{for } t > 300 \text{ seconds}$$

Never Trip:

$$I_{max\_load} = 6.0 \quad \text{for } t < 0.1 \text{ seconds}$$

$$I_{max\_load} = (0.028)\left(\frac{85}{t} - 0.3\right)^{0.65} + 3.8 \quad \text{for } 0.1 \le t \le 100 \text{ seconds}$$

$$I_{max\_load} = 3.8 \quad \text{for } t > 100 \text{ seconds}$$

FIGURE 5 – CLASS II MICRO MUNITION OPERATING POWER CURRENT LEVEL

5.1.4.1.5 Host: Overcurrent Protection

The Host shall ensure that the current flow through the Operating Power connection does not exceed the maximum overcurrent limits of Figure 4 for Class I Micro Munitions and Figure 5 for Class II Micro Munitions. The Host may achieve overcurrent protection by the deactivation of the Operating Power interface at the associated MMHI.

5.1.4.1.6 Host: Off-State Leakage Current

The off-state leakage current from the Operating Power MMHI output to its return shall be less than 1.0 milliamp DC into a 1 ohm load.

5.1.4.1.7 Host: Stabilization Time

When tested with a resistive load connected to the MMHI, the voltage at the MMHI Operating Power interface shall reach steady state levels (see 5.1.4.1.2) within 5 ms of power application and 10 ms of power removal at any current up to the full rated load. Figure 6 depicts stabilization time.

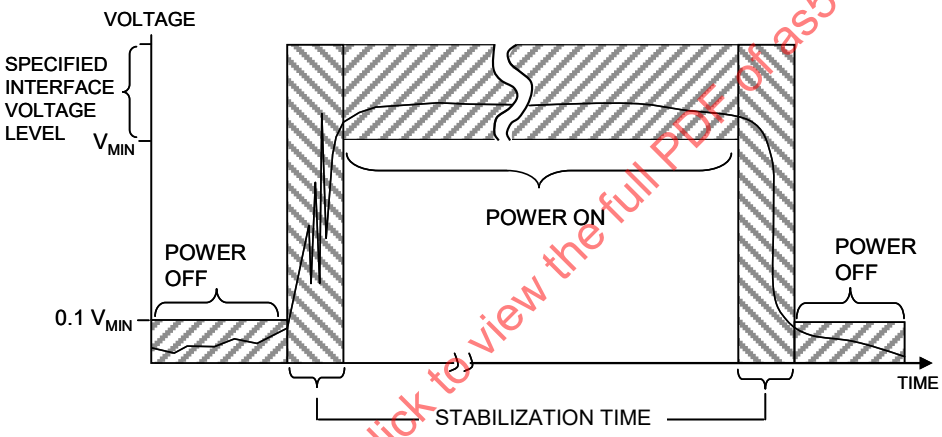


FIGURE 6 – STABILIZATION TIME

5.1.4.1.8 Host: Ground Reference

The Operating Power Return connection in the MMHI shall be the ground reference for the associated Operating Power connection.

5.1.4.2 Host: Safety Enable Power

A short term Safety Enable Power source shall be provided through the MMHI by the Host for performing safety critical functions within the Micro Munition.

CAUTION
The Safety Enable Power interface is provided to power a safety or irreversible function within the Micro Munition. The power is enabled when the Host determines that safety criteria for the Micro Munition safety or irreversible function have been met.

5.1.4.2.1 Host: Independent Control

The Host shall be capable of sourcing and independently controlling Safety Enable Power interface through each MMHI.

5.1.4.2.2 Host: Voltage Level

The steady state voltage at the MMHI between the Safety Enable Power connection and the associated Safety Enable Power Return connection shall be 28 V DC ± 5% at any load up to the full rated load of 3.2 A. Voltage transients less than 1 ms shall be 28 V DC ± 10%. All transients of duration of greater than or equal to 1 ms shall remain within steady state voltage regulation requirement.

5.1.4.2.3 Host: Ripple and Noise

Ripple shall remain under 150 mV peak to peak for Safety Enable Power. Noise amplitude shall remain under 10.0 mV peak to peak at 10 MHz and higher.

5.1.4.2.4 Host: Off-state Leakage Current

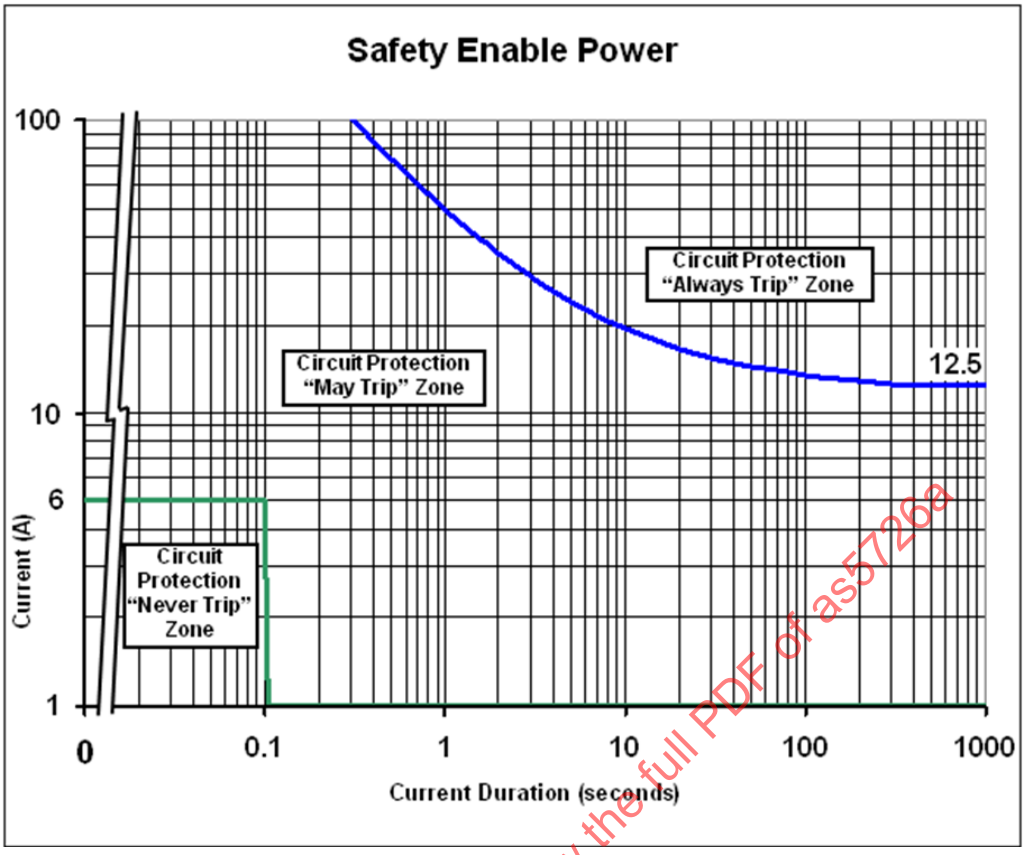
The off-state leakage current from the Safety Enable Power MMHI output to its return shall be less than 1.0 milliamp DC into a 1 ohm load.

5.1.4.2.5 Host: Current Capacity

The Host shall be capable of sourcing the maximum load-current levels of Figure 7 through the Safety Enable Power interface while also sourcing the maximum operating power load current levels specified in 5.1.4.1.4.

5.1.4.2.6 Host: Overcurrent Protection.

The Host shall ensure that current flow through the Safety Enable Power connection does not exceed the maximum overcurrent limits of Figure 7. The Host may achieve this current limit operation by the deactivation of the Safety Enable Power interface at the associated MMHI.



Always Trip:

$$I_{max\_overload} = (1.6)\left(\frac{75}{t} - 0.25\right)^{0.73} + 12.5 \quad \text{for } t \leq 300 \text{ seconds}$$

$$I_{max\_overload} = 12.5 \quad \text{for } t > 300 \text{ seconds}$$

FIGURE 7 – SAFETY ENABLE POWER INTERFACE CURRENT LEVEL

5.1.4.2.7 Host: Stabilization Time

The Host shall meet the stabilization time requirements of 5.1.4.1.7 for Safety Enable Power.

5.1.4.2.8 Host: Ground Reference

The Safety Enable Power Return connection in the MMHI shall be the ground reference for the associated Safety Enable Power connection.

5.1.4.2.9 Host: Power Application

The Host shall only energize Safety Enable Power when a determination has been made that it is safe to do so. This power source shall be activated to the interface by the Host at least 10 ms prior to any command to the Micro Munition to initiate a function which utilizes Safety Enable Power and shall remain activated at least 120 ms after any such command. The maximum duration of the application of power on this interface shall be 2 seconds per employment of the Micro Munition. See Figure 8 for timeline depiction.

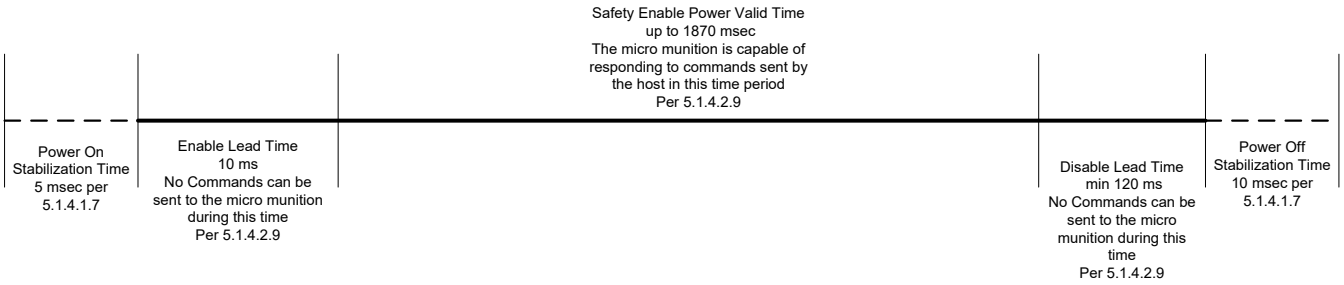


FIGURE 8 – SAFETY ENABLE POWER TIMELINE

5.1.5 Host: Structure Ground Interface

The Host shall provide a conductive path from the MMHI structure ground interface to Host structure, capable of carrying overcurrents associated with the power limits specified in 5.1.4.1.5. The structure ground interface may only become a signal return path or power return path under fault conditions within the Micro Munition. The voltage drop between the MMHI structure ground interface and the Host system ground shall be less than 0.2 V when conducting 3.8 amperes (continuous).

5.2 Micro Munition Requirements

Micro Munitions shall provide IMMs with the following characteristics.

5.2.1 Micro Munition: Mated Status Interface

The Micro Munition shall provide a connection for a Mated Status interface at the IMM. The Mated Status interface shall be connected to the junction between operating power and Micro Munition internal power with a 10 kohm (±10%) series resistance.

The Micro Munition shall interpret its status as unmated when the voltage between Mated Status and the junction between operating power and Micro Munition internal power exceeds 80% of the voltage between Operating Power and Operating Power Return, when operating power voltage complies with Class I or Class II voltages. See Figure 3.

5.2.2 Micro Munition: Safety Enable Discrete Interface

The Micro Munition shall provide connections for a Safety Enable Discrete interface in the IMM signal set. The Micro Munition shall use the Safety Enable Discrete interface if the Commit to Separate Store or Submunition function (bit D8) or the Fire, Launch or Release function (bit D10) of the Critical Control 1 data word in the Mission Store Control message (see Appendix B of MIL-STD-1760) is implemented. The Micro Munition shall act on these safety critical commands received over the DFC interface only if the Safety Enable Discrete signal is in the enabled state.

The Micro Munition is not required to use the Safety Enable Discrete interface in other instances. However, if required by the system specification or ICD, other bits in the Critical Control 1 and Critical Control 2 words may also be protected by the Safety Enable Discrete. If the Safety Enable Discrete interface is used, the Micro Munition shall comply with the requirements below.

If the Safety Enable Discrete is not used, the resistance between the Safety Enable Discrete connection and the Safety Enable Power Return connection shall be greater than 100 kohm (at DC).

The Micro Munition shall not execute any safety critical functions (e.g., arm or employ) solely as a result of the activation of Safety Enable Discrete.

CAUTION

The Safety Enable Discrete interface is provided to enable a safety or irreversible function within the Micro Munition. The discrete is enabled when the Host determines that safety criteria for the Micro Munition safety or irreversible function have been met.

5.2.2.1 Micro Munition: Voltage Level

The Micro Munition shall establish the appropriate enable or inhibit state when the following voltage levels are applied to the Safety Enable Discrete connection (referenced to the Safety Enable Power Return connection) at the IMM:

a. Steady-state conditions:

Enable: ≥ 15.0 V DC and ≤ Maximum voltage as defined in MIL-STD-704 for 28 V DC

Inhibit: ≥ -0.5 V DC and ≤ 5.5 V DC

b. Voltage transients up to the limits specified for Safety Enable Power.

5.2.2.2 Micro Munition: Current Level

The Micro Munition shall limit the load current to a range of 5.0 to 100 milliamperes when the steady state enable voltages (see 5.1.2.1.a) are applied to the IMM.

5.2.2.3 Micro Munition: Stabilization Time

The Micro Munition shall be compatible with the Host which deliver a signal to the IMM with a transition time (between enable and inhibit states) of up to 6.0 ms.

5.2.2.4 Micro Munition: Enable Lead Time

The Micro Munition shall be capable of executing safety critical commands received from the Host no later than 10 ms after the Safety Enable Discrete has reached the enable state.

5.2.2.5 Munition: Inhibit Lead Time

The Micro Munition shall ignore safety critical commands received from the Host greater than or equal to 10 ms after the Safety Enable Discrete has reached the Inhibit state.

5.2.2.6 Micro Munition: Ground Reference

The Safety Enable Power Return connection at the IMM shall be the ground reference for the Safety Enable Discrete signal.

5.2.3 Micro Munition: Fibre Channel Interface

The Micro Munition shall provide connections for an Up Fibre Channel (UFC) and Down Fibre Channel (DFC) interface at each primary signal set IMM. The FC interface shall be used for full duplex transfer of digital data. The Micro Munition shall send digital messages through the MMHI to a FC terminal (node) in the connected Host system on the UFC signal connection. The Micro Munition shall receive digital messages through the IMM from a FC terminal (node) in the connected Host on the DFC signal connection.

Each FC full-duplex link shall meet the requirements specified in AS5653 except as noted below.

5.2.3.1 Micro Munition: Fibre Channel Physical Layer Characteristics

The physical layer of the FC interface shall comply with Fibre Channel Physical Interface [FC-PI 100-DF-EL-S] with the following signal assignments.

MMSI signal	FC-PI signal
DFC_H	RD+
DFC_L	RD-
UFC_H	TD+
UFC_L	TD-

In addition, the physical connections for the FC signals shall be overlaid with the IMM power signals as follows:

DFC_H also carries the Safety Enable Power signal

DFC_L also carries the Safety Enable Power Return signal

UFC_H also carries the Operating Power signal

UFC_L also carries the Operating Power Return signal

5.2.3.2 Micro Munition: Logical Interface Requirements

5.2.3.2.1 Micro Munition: Communication Rules and Message Requirements

The FC data bus shall comply with the requirements of Appendix D of MIL-STD-1760

5.2.3.2.2 Micro Munition: Critical Control 1 and Critical Control 2 Address Confirm

The Micro Munition shall verify Address Confirm field of Critical Control 1 (MIL-STD-1760 Table B-XIV) and Critical Control 2 (MIL-STD-1760 Table B-XV) are set to zero when used.

5.2.4 Micro Munition: Power Interfaces

The Micro Munition shall provide a set of power connections in the IMM signal set. This shall include connections for Operating Power and Safety Enable Power along with associated returns. These connections shall be overlaid with the data bus connections as described in 5.5. Use of these interfaces by Micro Munitions shall comply with the IMM requirements below.

If the Safety Enable Power interface is not used by the Micro Munition, the resistance between the unused Safety Enable Power connection and the associated Safety Enable Power Return connection at the IMM shall be greater than 100 kohm (at DC).

5.2.4.1 Micro Munition: Operating Power

The Micro Munition shall use Operating Power to derive operating power for internal electronics. The Micro Munition shall be immune from entering an unsafe condition upon the application of operating power.

Upon application of the Mated Status Excitation Voltage specified in 5.2.4.1.1, the Micro Munition shall support mated status sensing by the host, prohibit all other functions and remain safe.

5.2.4.1.1 Micro Munition: Voltage Level

The Micro Munition shall be compatible with operating power voltages at the IMM which comply with the following:

Class I interface

The steady state voltage at the IMM between the Operating Power connection and the associated power return connection shall be 28 V ± 5% at any load up to the full rated load of 85 W. Voltage transients less than 1 ms shall be 28 V ± 10%. All transients of duration of greater than or equal to 1 ms shall remain within steady state voltage regulation requirement.

Class II interface

The steady state voltage at the IMM between the Operating Power connection and the associated power return connection shall be 56 V ± 5% at any load up to the full rated load of 200 W. Voltage transients less than 1 ms shall be 56 V ± 10%. All transients of duration of greater than or equal to 1 ms shall remain within steady state voltage regulation requirement.

Excitation Voltage

The Micro Munition shall be compatible with a 3.0 to 12.0 V excitation, prior to application of Operating Power.

5.2.4.1.2 Micro Munition: Misapplication of Operating Power

The Class I Micro Munition shall remain safe if Class II Operating Power is applied.

5.2.4.1.3 Micro Munition: Load Current

The Micro Munition shall comply with the load requirements stated herein when the IMM operating power voltage is within the specified limits for the appropriate Micro Munition class. Under fault free conditions, the Micro Munition load applied to the Operating Power connection at the IMM shall be within the maximum load current level of Figure 4 for Class I Micro Munitions and Figure 5 for Class II Micro Munitions.

5.2.4.1.4 Micro Munition: Load Isolation

The Micro Munition shall provide a minimum isolation of 100 kohm (at DC) between the IMM Operating Power and Safety Enable Power connections. The Micro Munition may provide DC continuity between the associated internal power return connections (i.e., the O-M and S-M points in Figure 2), but not directly between pins D and F at the IMM.

5.2.4.1.5 Micro Munition: Overcurrent Compatibility

The Micro Munition shall remain safe when fault currents up to the maximum overcurrent level of Figure 4 for Class I and Figure 5 for Class II Micro Munitions are sourced into the IMM Operating Power connection.

5.2.4.1.6 Micro Munition: Off-State Leakage Current

The Micro Munition shall be compatible with off-state leakage current supplied to the IMM of up to 1.0 milliampere DC between the Operating Power connection and its return.

5.2.4.1.7 Micro Munition: Stabilization Time

The Micro Munition shall be compatible with IMM Operating Power voltages which are below those specified in 5.2.4.1.1 for 5 ms during power up and 10 ms during power down as shown in Figure 6.

5.2.4.1.8 Micro Munition: Ground Reference

The Operating Power Return connection at the IMM shall be the ground reference for the associated Operating Power connection.

5.2.4.1.9 Micro Munition: Power Utilization

The Micro Munition shall utilize operating power only for powering those functions which are not safety critical or which have sufficient safety interlocks such that Micro Munition safety is not degraded with the activation of operating power.

5.2.4.2 Micro Munition: Safety Enable Power

The Micro Munition shall utilize Safety Enable Power to energize those safety critical functions for which insufficient interlocks exist in the Micro Munition to assure that the required level of munition safety can be achieved once the associated power interface is activated. The Micro Munition shall prevent enabling of any safety critical functions (e.g., arm or employ) solely as a result of the activation of Safety Enable Power.

CAUTION

The Safety Enable Power interface is provided to power a safety or irreversible function within the Micro Munition. The power is enabled when the Host determines that safety criteria for the Micro Munition safety or irreversible function have been met.

5.2.4.2.1 Micro Munition: Voltage Level

The Micro Munition shall be compatible with steady state voltage at the IMM between the Safety Enable Power connection and the associated Safety Enable Power Return connection of 28 V DC ± 5% and Voltage transients less than 1 ms of 28 V DC ± 10%.

5.2.4.2.2 Micro Munition: Load Current

The Micro Munition shall comply with the load current requirements stated herein when the IMM Safety Enable Power voltage is within the specified range. Under fault free conditions, the Micro Munition load applied to the Safety Enable Power connection at the IMM shall be within the maximum load current level of Figure 7. Current above a leakage level of 1.0 milliampere maximum shall only be drawn by the Micro Munition for a period of 100 ms maximum, while critical functions are performed in response to an external command.

5.2.4.2.3 Micro Munition: Load Isolation

The Micro Munition shall provide a minimum isolation of 100 kohm (at DC) between the IMM Safety Enable Power and Operating Power connections (see 5.2.4.1.4).

5.2.4.2.4 Micro Munition: Overcurrent Compatibility

The Micro Munition shall remain safe if fault currents up to the maximum overcurrent level of Figure 7 are sourced into the IMM Safety Enable Power connection.

5.2.4.2.5 Micro Munition: Off-state Leakage Current.

The Micro Munition shall be compatible with off-state leakage currents supplied to the IMM of up to 1.0 milliampere DC between the Safety Enable Power connection and its return.

5.2.4.2.6 Micro Munition: Stabilization Time

The Micro Munition shall be compatible with IMM Safety Enable Power voltages which are below those specified in 5.2.4.2.1 for 10 ms during power up and 20 ms during power down as shown in Figure 6.

5.2.4.2.7 Micro Munition: Ground Reference

The Safety Enable Power Return connection at the IMM shall be the reference for the associated Safety Enable Power connection.

5.2.4.2.8 Micro Munition: Safety Enable Power Utilization

The Micro Munition may ignore Safety Critical Commands received in the first 10 ms of the stabilization of Safety Enable Power.

The Safety Enable Power to the Micro Munition is required as defined in 5.1.4.2.9 to be valid for a minimum of 120 ms after the last Safety Critical Command received.

5.2.5 Micro Munition: Structure Ground Interface

The Micro Munition shall provide a conductive path from the IMM structure ground to Micro Munition structure, capable of carrying overcurrents associated with the power limits specified in 5.2.4.1.5. The Structure Ground interface shall be isolated from signal return paths or power return paths except under fault conditions within the Micro Munition. The voltage drop between the IMM Structure Ground interface and the Micro Munition ground shall remain less than 0.2 V when conducting 3.8 amperes (continuous).

5.3 Interface Initialization

The requirements in 5.3 shall apply unless the system has established a different initialization procedure based on specific system knowledge.

5.3.1 Host Initialization Requirements

5.3.1.1 Pre-initialization Conditions

The Host shall begin the initialization process with all power interfaces deactivated at the MMHI. The host shall ensure that the Safety Enable Discrete interface is in the inhibit state.

NOTE: Digital Data interfaces and Host Mated Status interface may be active.

The Host may apply the Mated status excitation voltage to the Operating Power interface in order to detect the mated status of the Micro Munition.

5.3.1.2 Class I Host Power Application

The Host shall apply 28 V DC Operating Power to the MMHI.

5.3.1.3 Class II Host Power Application

The Host shall apply 28 V DC Operating Power to the MMHI and attempt first communication. If the Host achieves Fibre Channel Link Initialization with the Micro Munition per AS5653, initialization shall proceed as specified in 5.3.1.4. If first communication is unsuccessful, the Host shall apply 56 V DC Operating Power to the MMHI and attempt first communication. If the Host achieves Fibre Channel Link Initialization with the Micro Munition per AS5653, initialization shall proceed as specified in 5.3.1.4. If first communication is unsuccessful the host may perform fault processing.