Universal Serial Bus

Application Specific Connector Addendum

PlusPower

Electro-Mechanical Specification

Version 0.8f

Contents

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- NCR
- Berg
- Microsoft

1.3 Revision History

Date	Version	Contents
990326	0.8e	Section 3.1.1.4 replaced (strange format) drawing Section 3.1.2.3.2 Change voltage tolerance Section 4.2.3 and 4.3.3, key position 2 current changes Section 4.3.4, phrase added: “clamping diode”
990308	0.8d	Section 4: Power management section replaced. Section 3.1.2.3: Voltage tolerances modified. Section 3.1.1.7: TBD (Plug perspective) removed. Section 3.1.1.9: TBD (interface dimensions) removed. Section 2.1: Tertiary document reference removed. Section 1.4: TBD section removed.
981109	0.8	Updated illustrations Removed key positions 3 & 4 from Host connector description Added current specs to Power Mgmt section Removed “optional” from Power Mgmt section
981019	0.7D	Section 1.1, IP Disclaimer: Added statement Section 3.1, Upstream Connection: Updated drawings Section 3.2, Downstream Connection: Added Polarizing Information Updated Table of Contents
981007	0.7C	Section 1.3, Revision History: Put table in reverse order per committee recommendation Section 3.1, Upstream Connection: Added paragraph describing 2 versions of PlusPower connector Section 3.1.1.2, Key Position Colors: Corrected color assignment table Section 3.2, Downstream Connection: Updated drawings with metric dimensions. Section 3.2.2.3 Contact Assignments and Plugging Sequence: Added table Updated Table of Contents
980824	0.7B	Section 3.2, Downstream Connection: Added details of recommended device connector. Updated Table of Contents
980707	0.7A	Modified Outline Structure of Document Section 3.1, Upstream Connection: Added basic PlusPower description Section 3.1.1, Mechanical: Added information describing PlusPower connector including color information, retention latch description and placeholder for interface dimensions Section 3.1.2.4, Electrical: Added Plugging Sequence Section 3.2, Downstream Connection: Reworded paragraph Section 4.2.2, Safety Circuit: Reworded paragraph to reflect IEC 950 reqmts. Updated Table of Contents
980629	0.6C	Section 3.1, Mechanical: Added plug illustration (more to be added at next revision) Section 3.1.2 Downstream (Device-Side) Connection: Added statement concerning captive cable assemblies. Section 3.2.3.1, Key Position 1 Voltage Table: Removed note allowing variable voltages for key position 1. Section 3.3, Power Management: Removed portion added for V 0.6B and added simplified revision.
980512	0.6B	Section 3.1, Mechanical: Added illustrations (more to be added at a later revision) Section 3.3, Power Management: Added definitions and details
980415	0.6A	Section 2.1, Scope: Modified description of ASCSI documents Section 3.2, Electrical: Added table showing voltage assignments Section 3.3, Power Management: Added table describing power management

		options
980128	0.6	Initial Revision

2 Introduction

2.1 Scope

This document describes the electrical and mechanical characteristics of the USB PlusPower connectors and cable.

This document is one of a set of closely related documents. The primary document is the USB Core Specification, which constitutes the baseline specification. This document is a secondary document and is called an “Application-Specific Connector Addendum” (ASCA); it is an addendum to the primary document. The ASCA document defines the electrical and mechanical characteristics that differ from the definitions in the baseline document. Only those characteristics that differ from the baseline are defined in this document. That is, if a particular mechanical or electrical characteristic of the PlusPower connector is not present in this document, the user of this document must refer to the baseline document for those characteristics.

2.2 Purpose

The purpose of this document is to publish the mechanical and electrical design characteristics of the USB PlusPower connectors and cable.

2.3 References / Related Documents

USB Specification 1.0 (or later)

3 Hardware Specifications

3.1 Upstream (Host-side) Connection

The USB PlusPower connector mated pair consists of a board-mounted receptacle and a mating cable-attached shielded plug. The PlusPower connector is fully compliant with the standard USB Type A host or upstream connector, but is designed to provide a significant new function. The primary new function is to provide additional power from the host or hub to devices that need more power than is available from the USB standard Type A connector. This additional power is supplied through another set of contacts contained within the PlusPower connector. The secondary new function provided by the PlusPower connector is a positive mechanical retention latch between the plug and receptacle. This feature prevents a device cable assembly from backing out of a PlusPower receptacle.

The PlusPower connector is specified in at least two versions; one will supply 12VDC power and the other will supply 24VDC power. Other versions may be made specified as needed. The different versions are mechanically polarized to prevent mis-plugging.

3.1.1 Mechanical

The PlusPower connector consists of two connector portions integrated within a common shielded housing. The two portions are stacked vertically inside the common housing. The upper portion contains four contacts used for additional power. The lower portion is fully compliant with a USB Type A connector. The Type A section of the board-mounted USB PlusPower receptacle will mate with either a standard USB Type A plug or a USB PlusPower plug.

3.1.1.1 Polarizing Key Locations

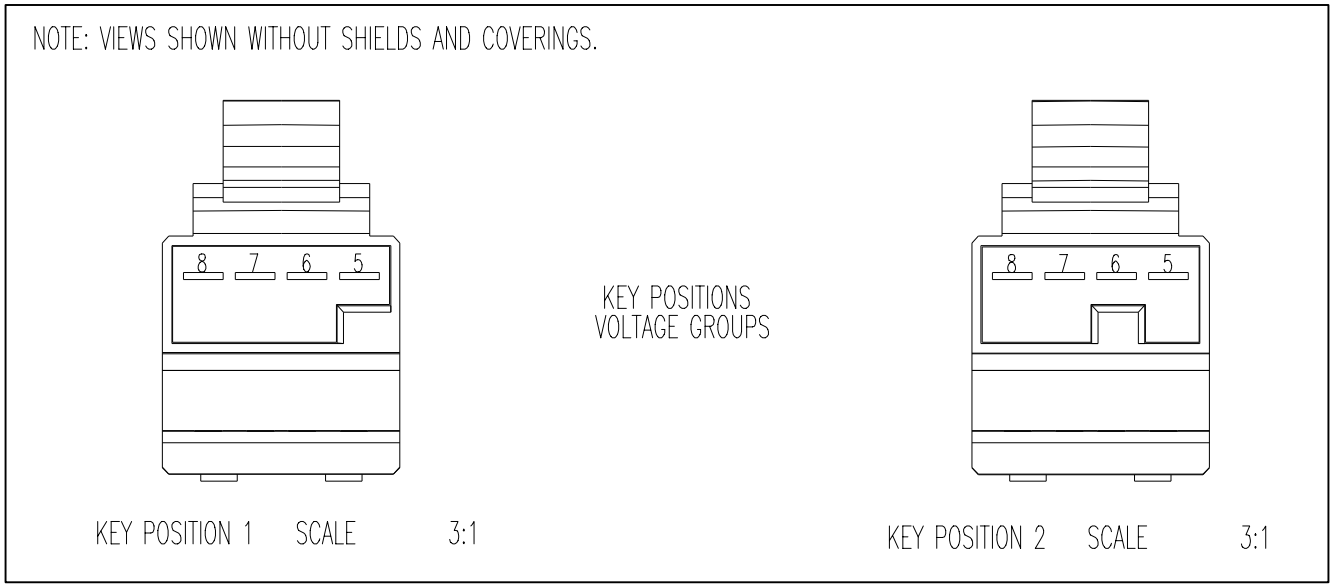


Figure 1 - Key Position Location

3.1.1.2 Key Position Colors

The PlusPower connectors can be color-coded based on key position to provide a visual aid for the end user in connecting a PlusPower cable to the proper PlusPower receptacle. Color-coding is optional; however, if color-coding is used, the following specific colors are recommended. If color-coding is not used, black is the preferred color.

Key Position	PlusPower Plug Color
1	Pantone Teal 3262C
2	Pantone Red 032C

3.1.1.3 Retention Latch

Integrally molded into the power portion of the connector is a retention latch feature. The latch arm is molded into the plug and the receptacle has a mating slot. The latch will snap positively into position as the PlusPower cable assembly is mated with the PlusPower receptacle. The latch can be released with a simple one-handed operation.

3.1.1.4 Receptacle – perspective

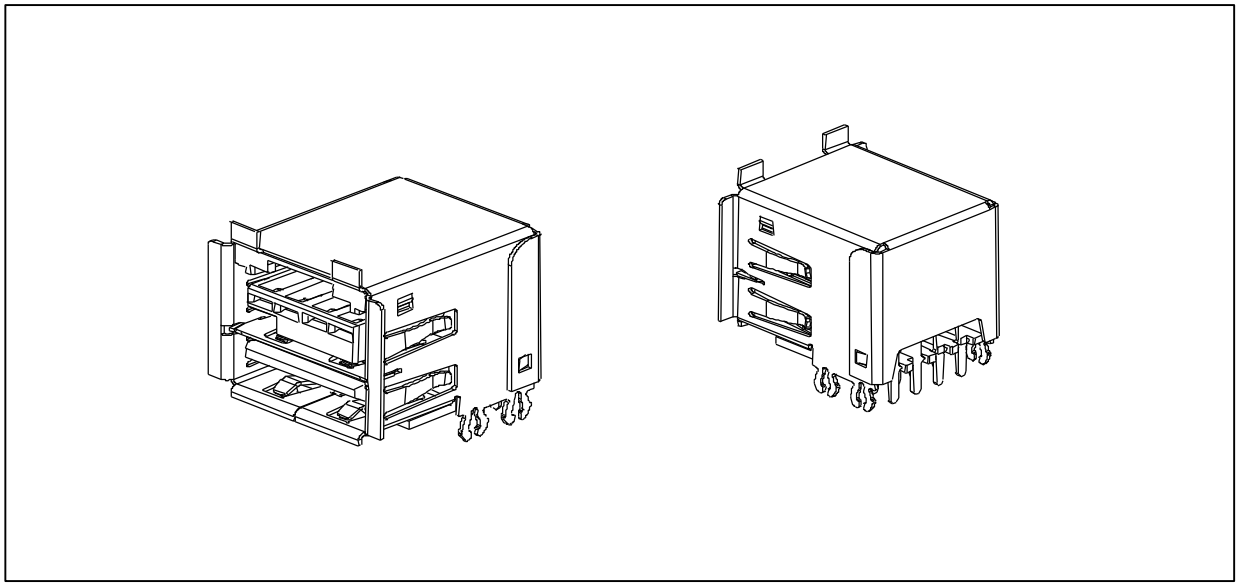


Figure 2 - Receptacle perspective

3.1.1.5 Receptacle – hole pattern

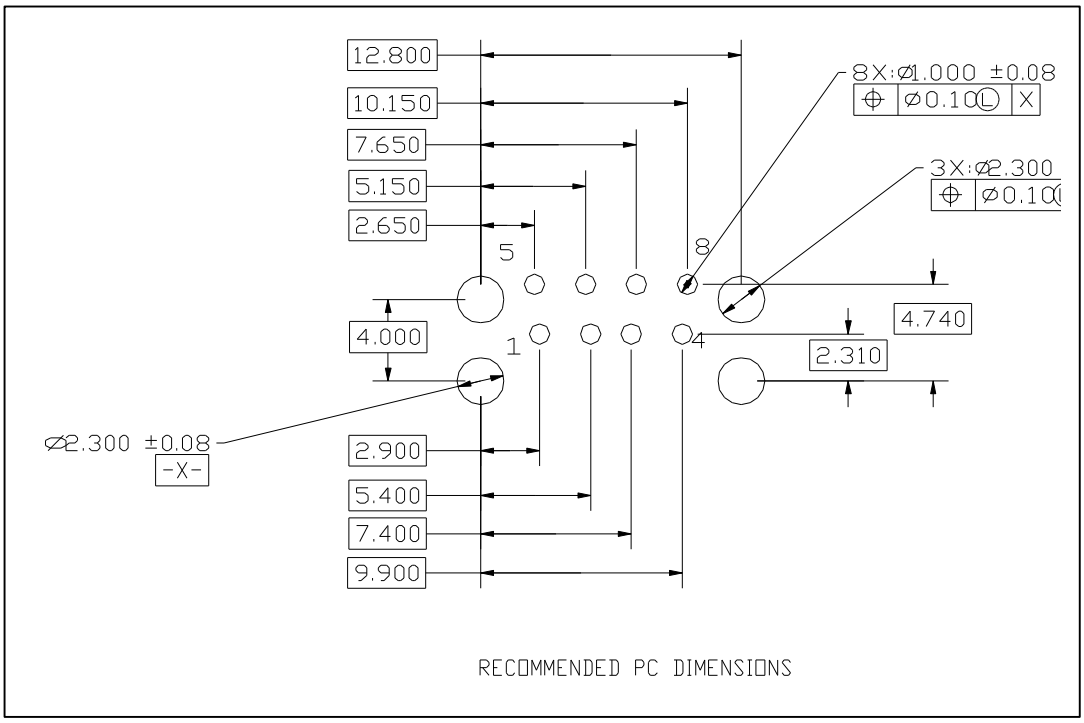


Figure 3 - Receptacle hole pattern

3.1.1.6 Receptacle – dimensions

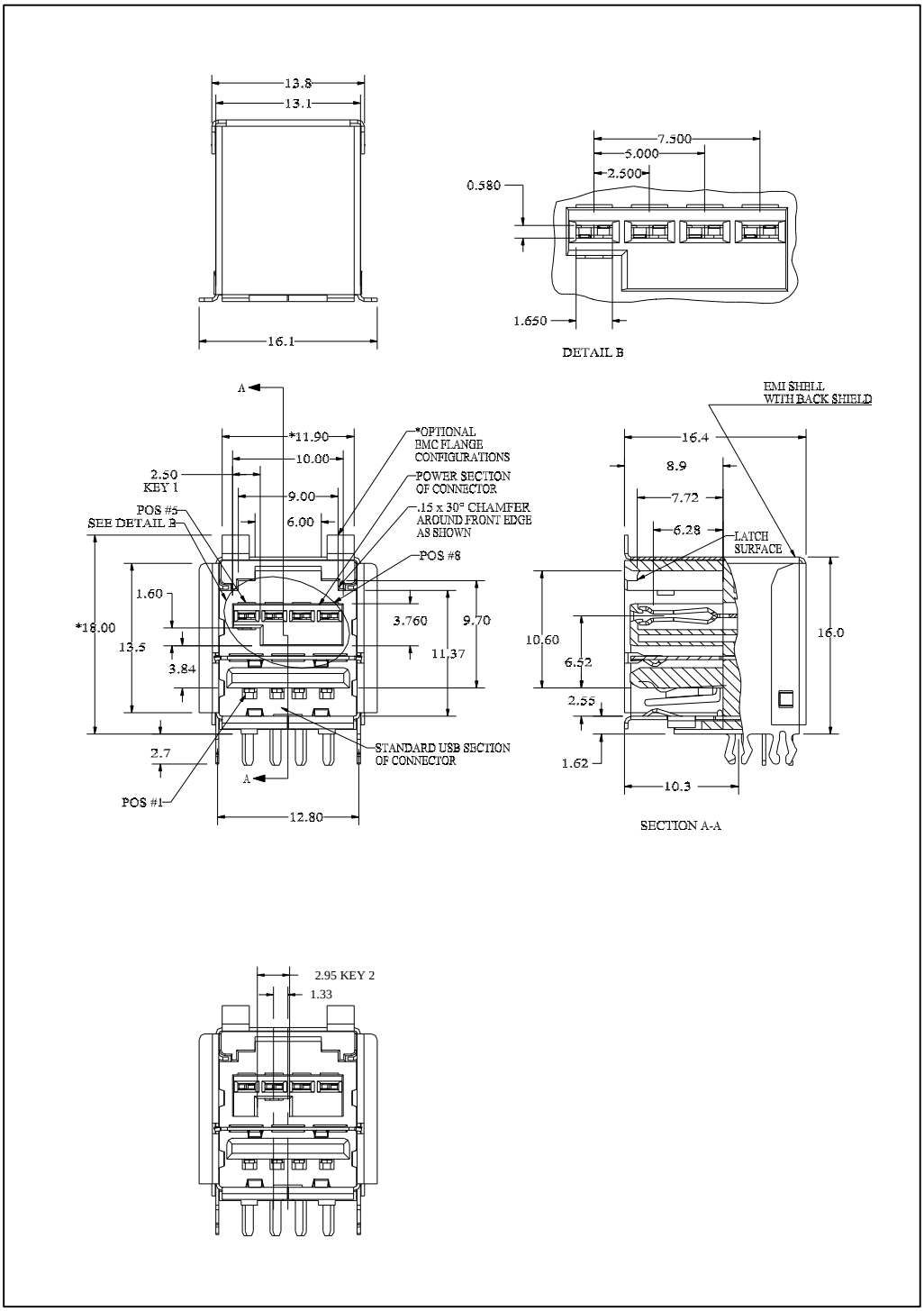


Figure 4 - Receptacle dimensions

3.1.1.7 Plug perspective

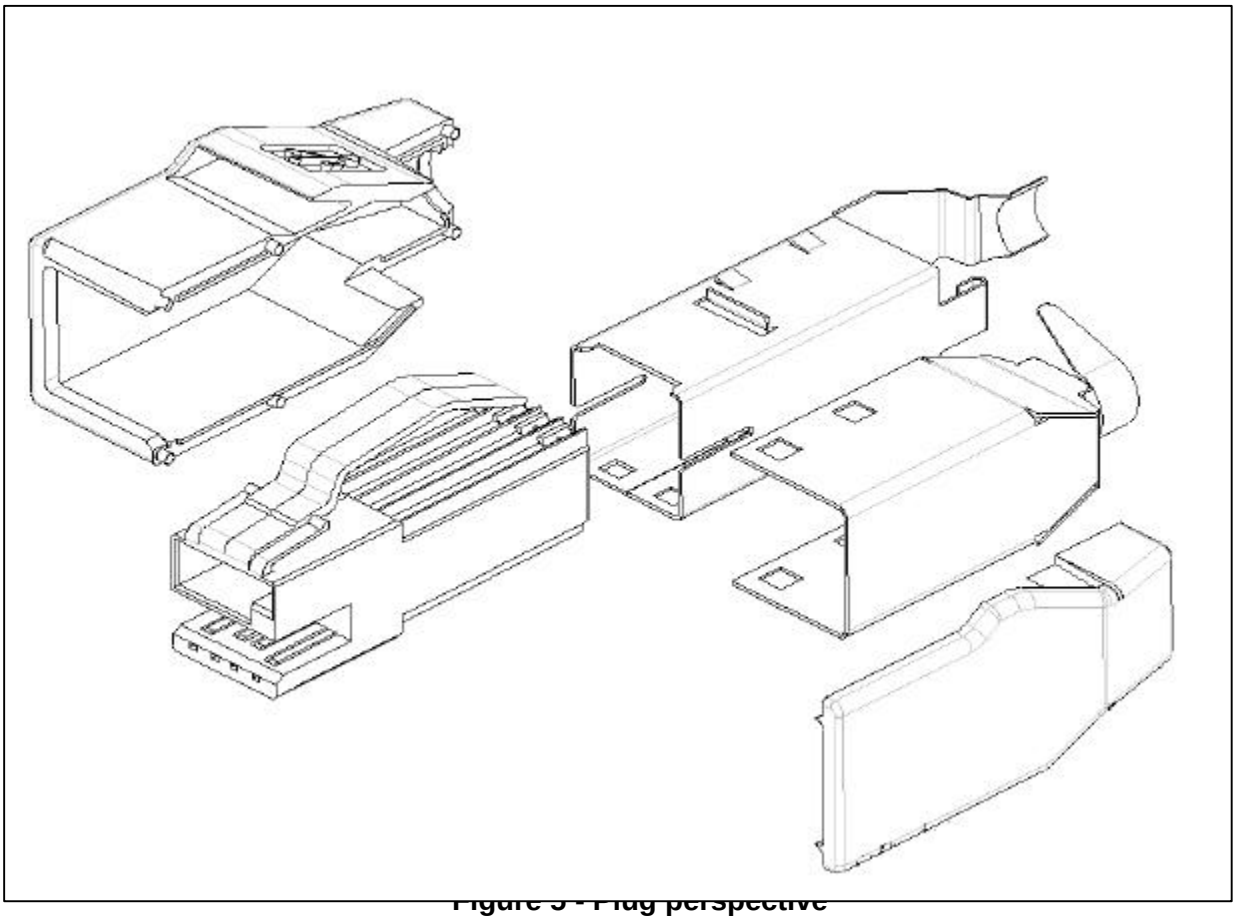


Figure 5 - Plug perspective

3.1.1.8 Plug – dimensions

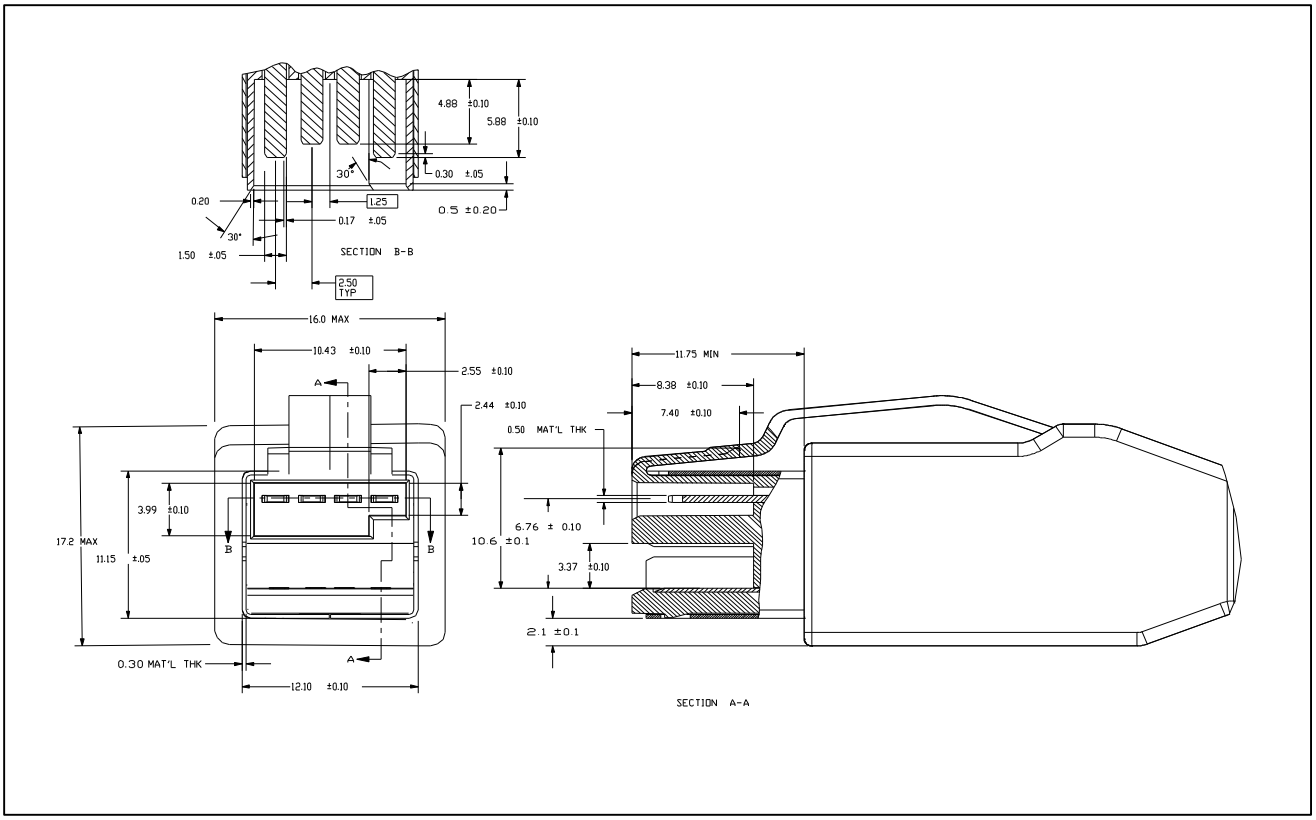


Figure 6 - Plug dimensions

3.1.2 Cable

USB Plus Power cable consists of up to eight conductors. For a fully loaded cable, the following parameters apply.

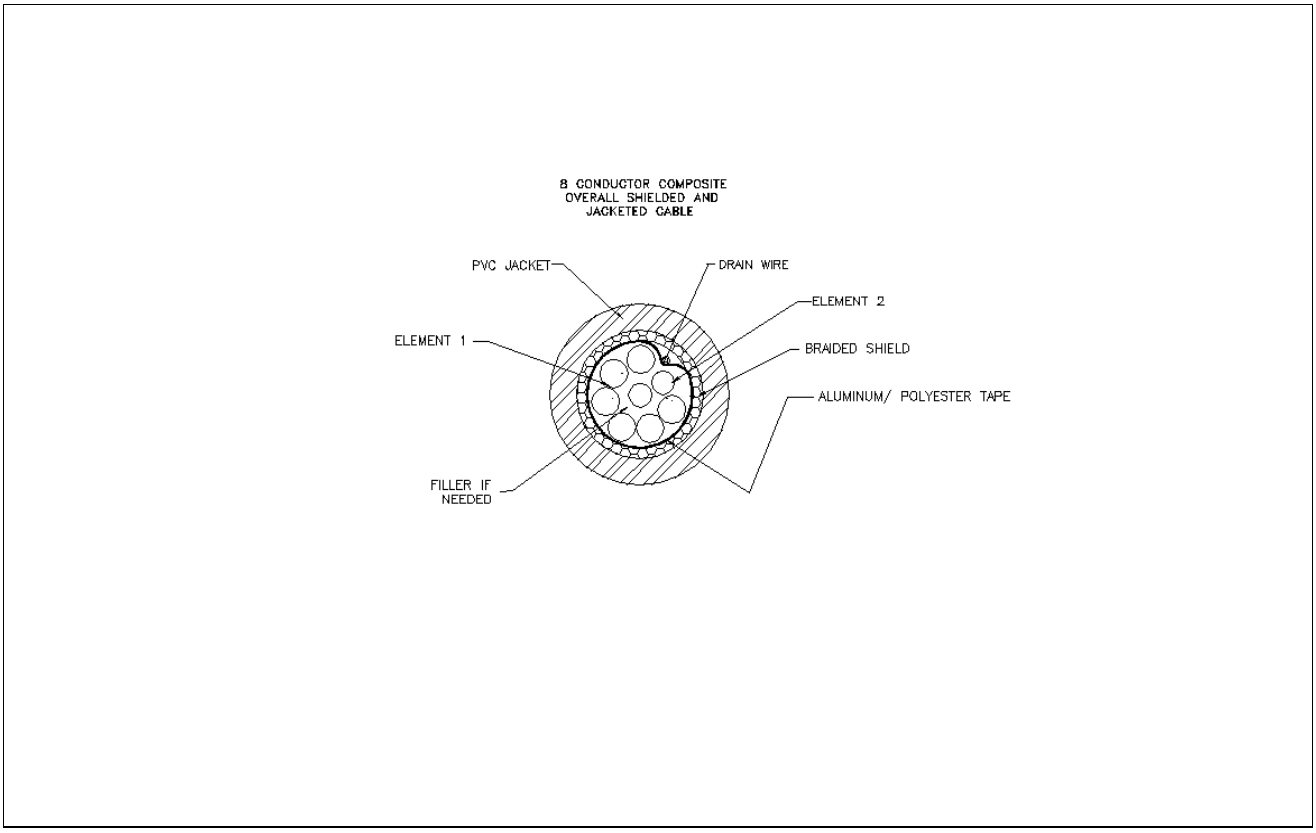


Figure 7 - Bulk Cable

Overall cable
6.7 ± 0.25 mm (.264" ±.010") diameter

Finished Product Requirements
UL Listing Type CM per Article 800 of the

Element 1: 6 Primaries
Element 2: 1 Pair
Aluminum (Out) Polyester Tape, 25% Overlap
28 AWG (7/36) Tinned copper drain wire over tape
Filler: Optional
Braided Shield:
36 AWG Tinned copper, 85% minimum coverage
AWG
Separator: Tissue tape, optional

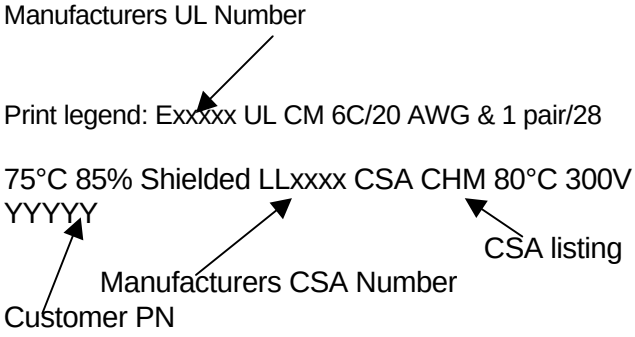
Element 1:
20 AWG (19 X 32) Tinned copper
Semi-rigid Polyvinyl Chloride, 55% min coverage
0.58" ±0.002 dia.
Number of primaries: 6
Color code:
1. Red
2. Black
3. Brown
4. Blue
5. Orange
6. Yellow

Element 2:
28 AWG (7/36) Tinned copper
Polypropylene 0.032" ± 0.002" dia.
Twisted pair:
Number of pairs: 1

Jacket: Polyvinyl chloride 0.032" wall thickness

Conductor name	Color	Element Number
USB Data +	Green	2
USB Data -	White	2
USB VBUS (Vcc)	Red	1
USB Power Gnd	Black	1
Ext Power V	Brown	1
Ext Power Gnd	Blue	1
Ext Power V	Orange	1
Ext Power Gnd	Yellow	1

National Electrical Code and CSA Certified as Type CMH or CMG



Electrical requirements:
Impedance (Differential): 90 Ohms Nominal
Capacitance (Mutual): 20pf/ft Max. 10 Khz
Time delay: 1.55 ns/ft Nom. From 1-16 MHz
Insulation resistance: 50 K MOhms/ft Max. 20° C
Conductor resistance: 070 Ohms/ft Max 20° C
Conductor resistance unbalanced: 5% Max
Pair-ground capacitance unbalanced: 1000 pf per 1000 ft Max. 1 KHz

Attenuation:
5.2 db/1000 ft Nom. 64 KHz
7.1 db/1000 ft Nom 256 KHz
8.5 db/1000 ft Nom 512 KHz
9.7 db/1000 ft Nom 772 KHz
12.0 db/1000 ft Nom 1 MHz
23.0 db/1000 ft Nom 4 MHz
31.0 db/1000 ft Nom 8 MHz
34.0 db/1000 ft Nom 10 MHz
43.0 db/1000 ft Nom 16 MHz

3.1.3 Electrical

3.1.3.1 Current
The PlusPower contacts are rated to carry 3 amp DC (or better).

3.1.3.2 Voltage

Maximum allowed voltage between any two contacts is 250 v.

3.1.3.3 Voltage Assignments

Tables describing the voltage assignments for the various key positions are shown below. Note that for either key position, Pins 6 and 7 constitute one supply with a total current carrying capacity of 6 amps. They are electrically bonded at the supply end and represent the same power supply. There is no requirement that they be bonded at the device end. However, the device must not attempt to draw more than 3 amps from either supply pin.

3.1.3.3.1 Key Position 1 (PC and POS Applications) Voltage Assignments

Pin Number	5	6	7	8
Voltage	Gnd	12vdc+/-10%	12vdc+/-10%	Gnd

3.1.3.3.2 Key Position 2 (POS Printer Applications) Voltage Assignments

Pin Number	5	6	7	8
Voltage	Gnd	25vdc+/-1.4v	25vdc+/-1.4v	Gnd

3.1.3.4 Plugging Sequence

The host end PlusPower contact plugging sequence is as follows. The unplugging sequence is the reverse of the plugging sequence.

Contact Number	**Signal Name**	**Plugging Sequence**
Shell	Shield	1
1	Vbus	2
2	D-	3
3	D+	3
4	Ground	2
5	Ground	2
6	Vplus	3
7	Vplus	3
8	Ground	2

3.2 Downstream (Device-Side) Connection

The device-side connection shall not be or appear to be a PlusPower upstream connector, nor shall it be or appear to be a USB Type A or Type B connector, with the following two exceptions:

1. It is permitted that the device-side connection consist of a USB Type B connector and a separate vendor-specific connector that carries the PlusPower additional power or,
2. The following device-side connector may be used in order to combine the USB and power portions of the interface.

The USB PlusPower (Series "B") connectors defined in this specification are the recommended connectors for devices attached to a host or hub by means of a USB PlusPower cable assembly. Other style connectors may be used for other application-specific programs. The connector mated pair consists of a board-mounted shielded receptacle and a mating cable-attached shielded plug. The connector has a positive mechanical latch to assure retention of the plug to the receptacle.

3.2.1 Mechanical

The Series "B" PlusPower connector defined in this specification consists of an 8-position connector in a 2-row by 4-position (2X4) configuration.

3.2.1.1 Retention Latch

Integrally molded into the Series "B" PlusPower connector is a retention latch feature. The latch arm is molded into the plug and the receptacle has a mating slot. The latch will snap positively into position as the cable assembly is mated with the receptacle. The latch can be released with a simple one-handed operation.

3.2.1.2 Receptacle - perspective

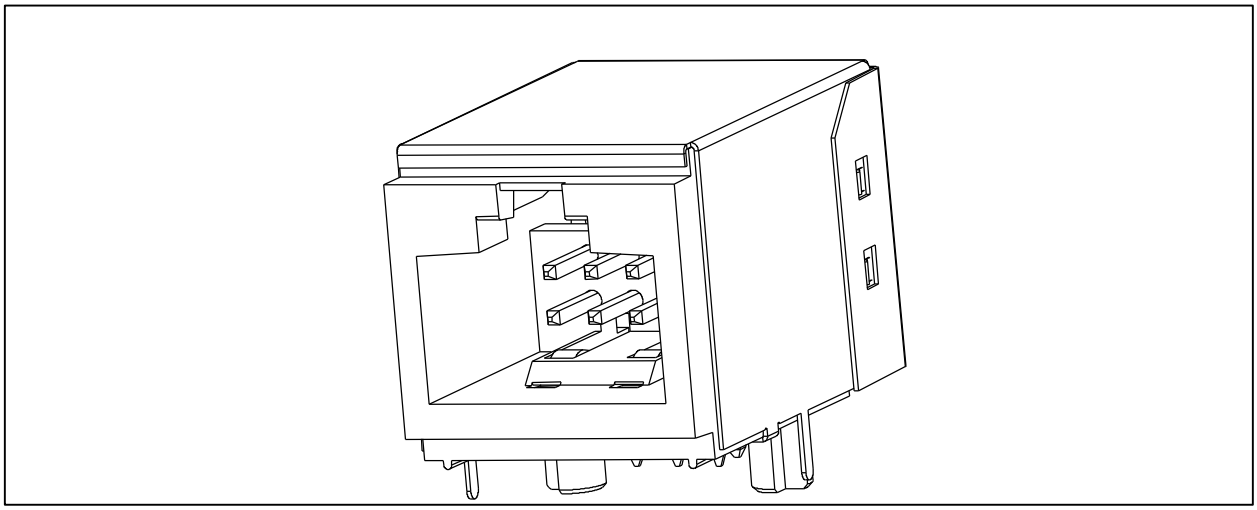


Figure 8 - Receptacle perspective

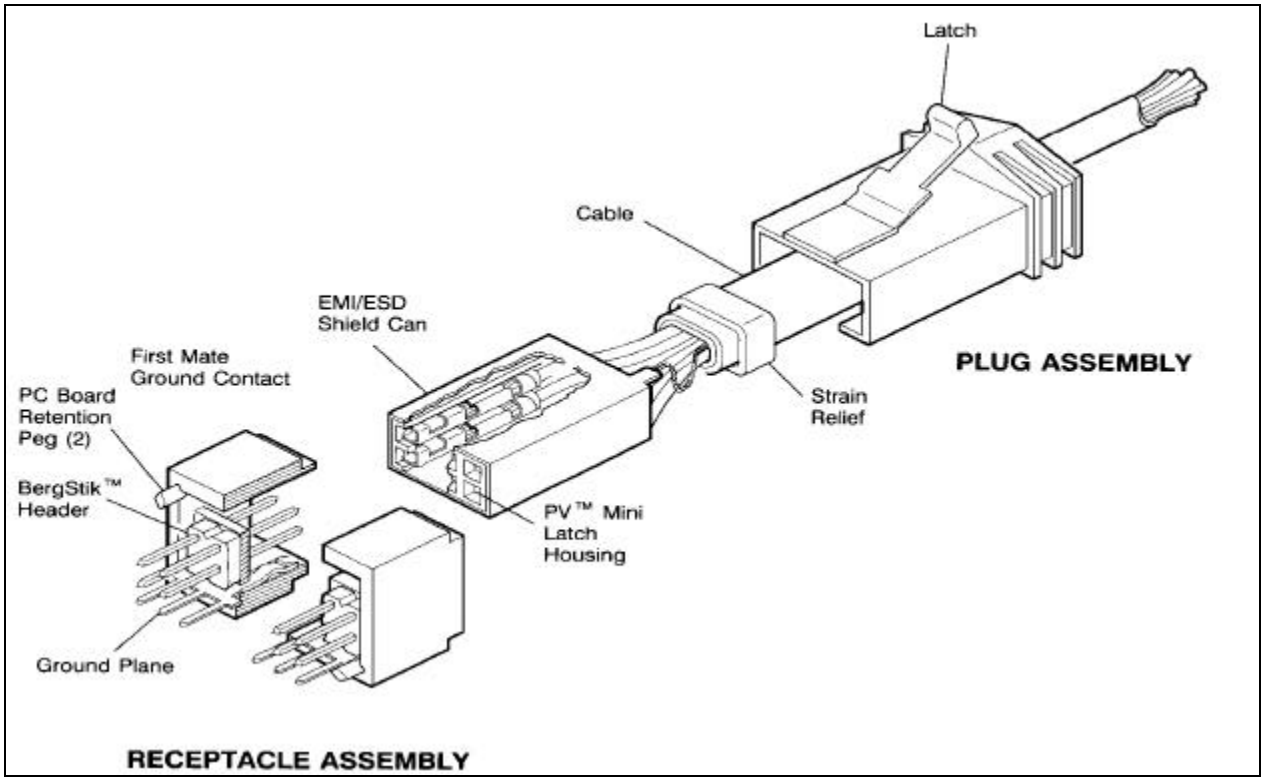


Figure 9 - Exploded view

3.2.1.3 Receptacle hole - pattern

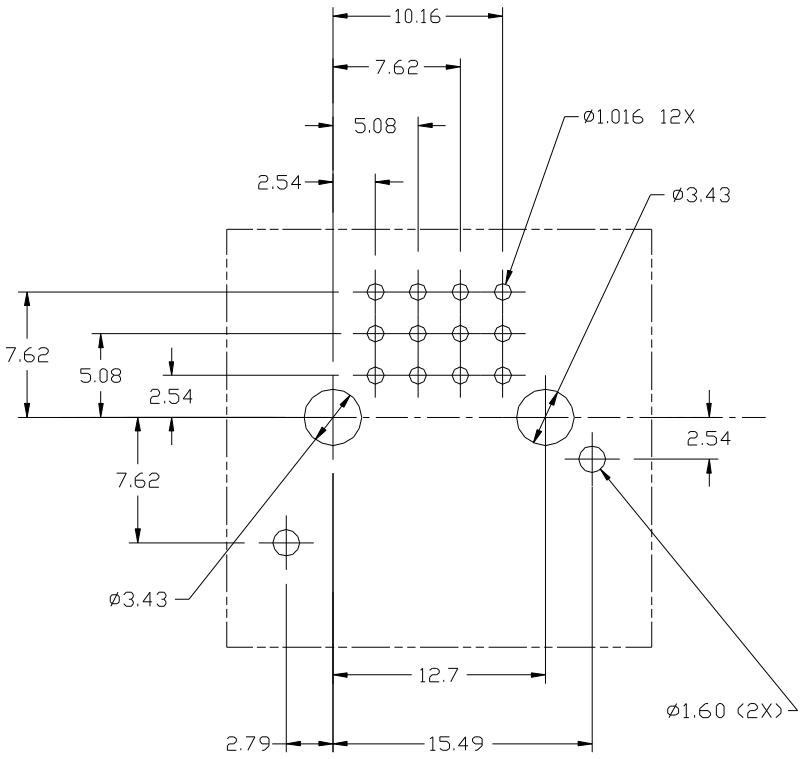


Figure 10 - Fixed board hole pattern

3.2.1.4 Receptacle - dimensions

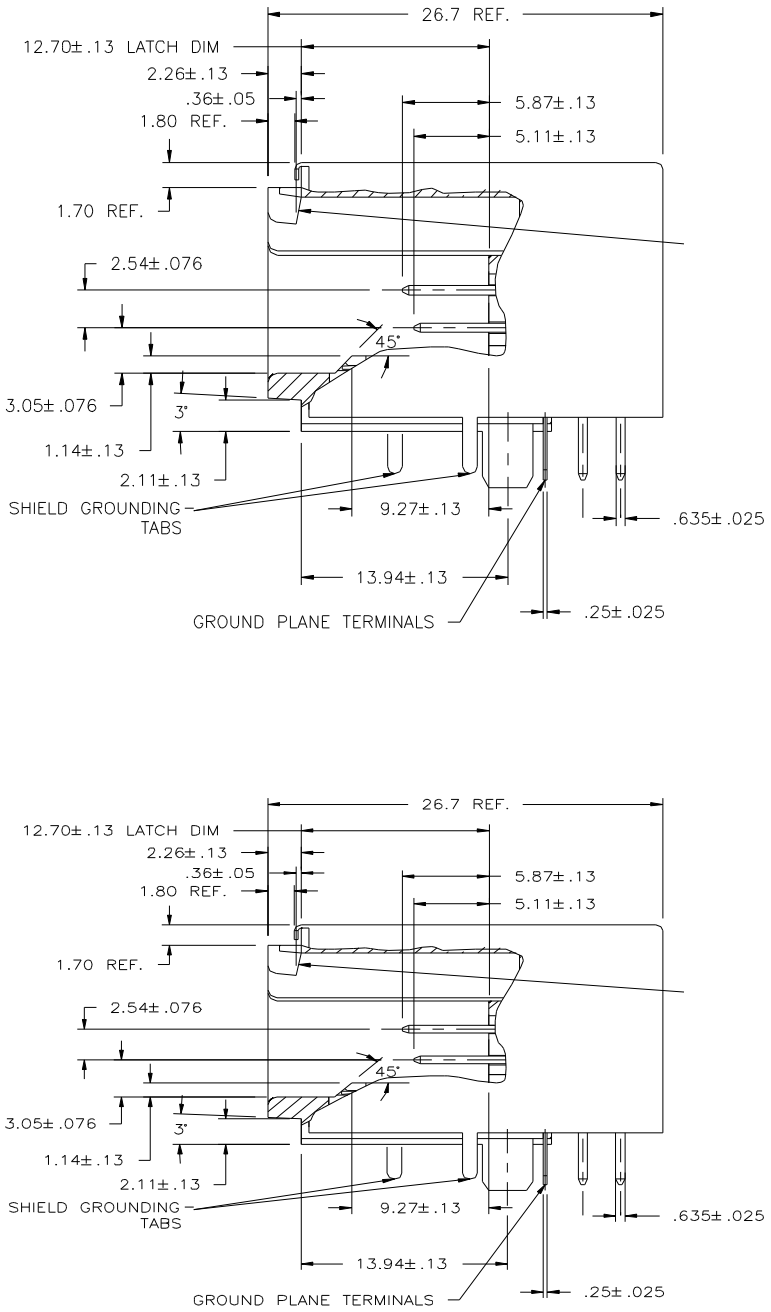


Figure 11 - Receptacle dimensions

3.2.1.5 Plug- perspective

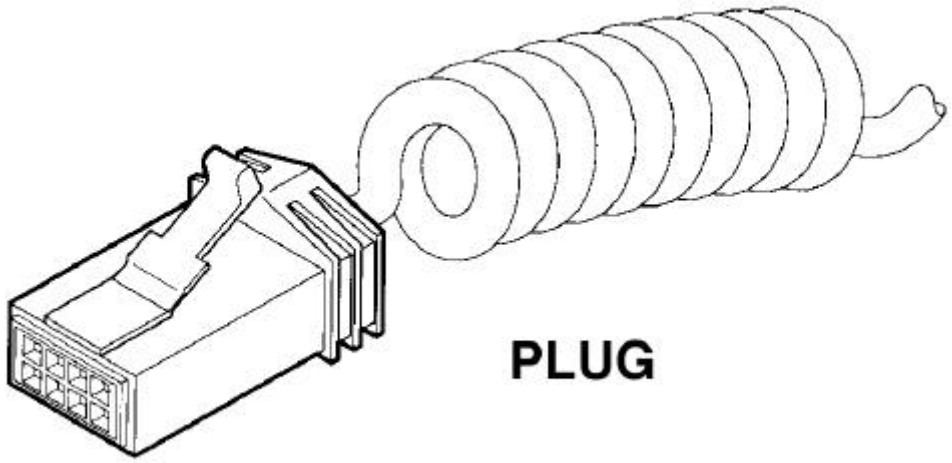


Figure 12 - Plug perspective

3.2.1.6 Plug - dimensions

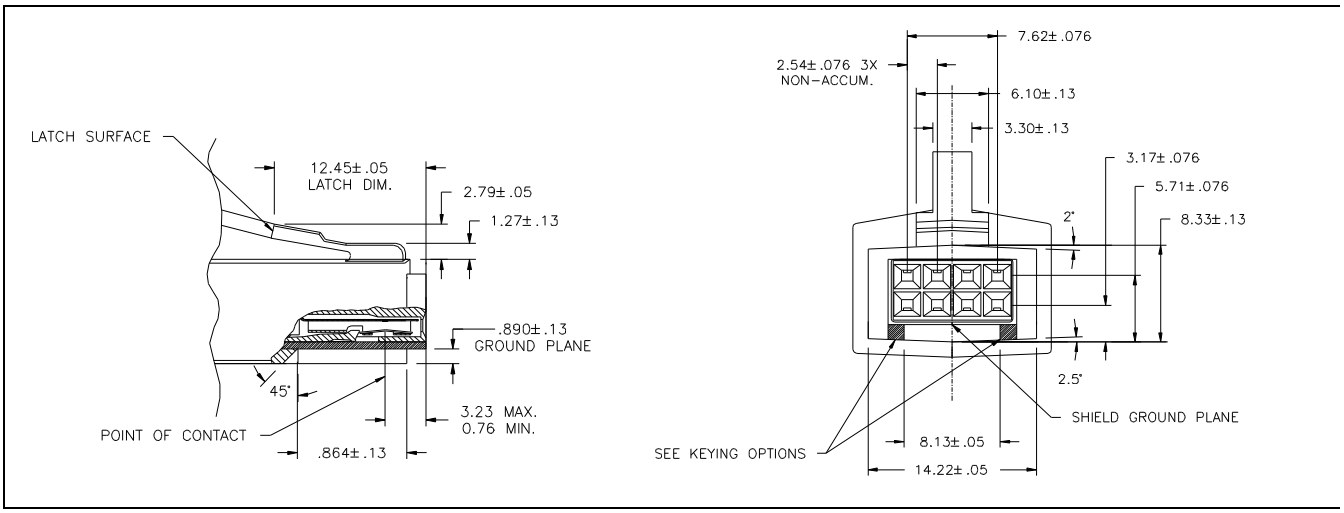


Figure 13 - Plug dimensions

3.2.1.7 Receptacle/Plug Interface Dimensions

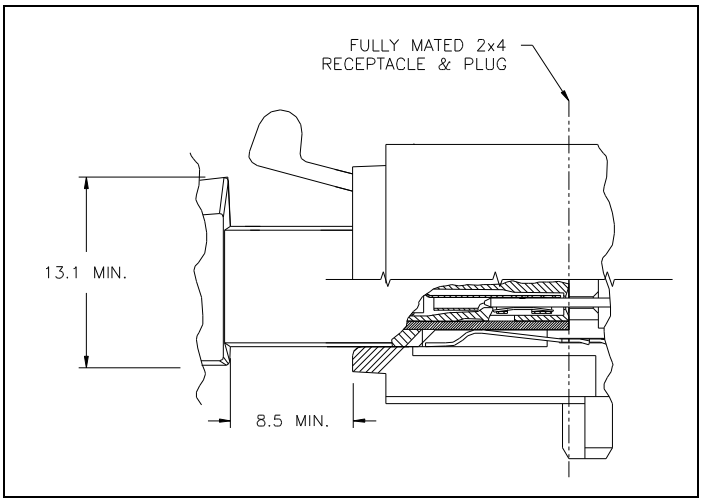


Figure 14 - Interface dimensions

3.2.1.8 Polarizing Key Locations

Integrally molded into the connector is a polarizing key. The key can be in one of two possible positions as shown below. Each key position corresponds to a specific PlusPower voltage as specified for the host end connector in section 3.1.2.3. Although the contact number assignments are different for the host and device ends of a USB PlusPower cable assembly, the PlusPower voltage used for Key Position 1 on the host end connector will also be used for the Key Position 1 version of the Device end connector.

It should be noted that either polarized plug would mate with a non-polarized receptacle.

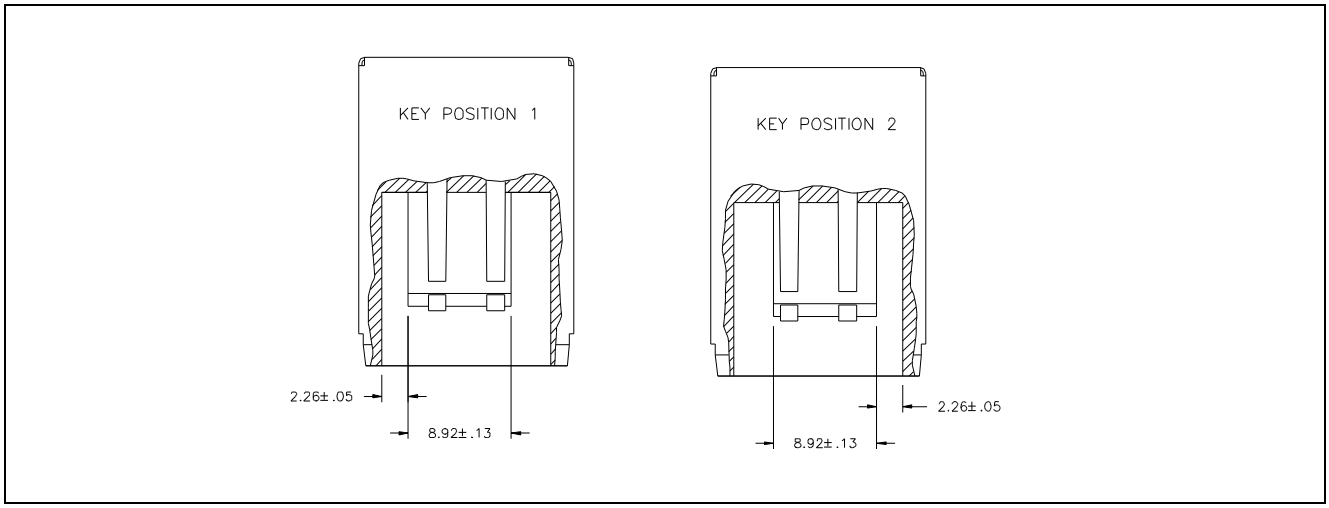


Figure 15 - Polarizing key location receptacle

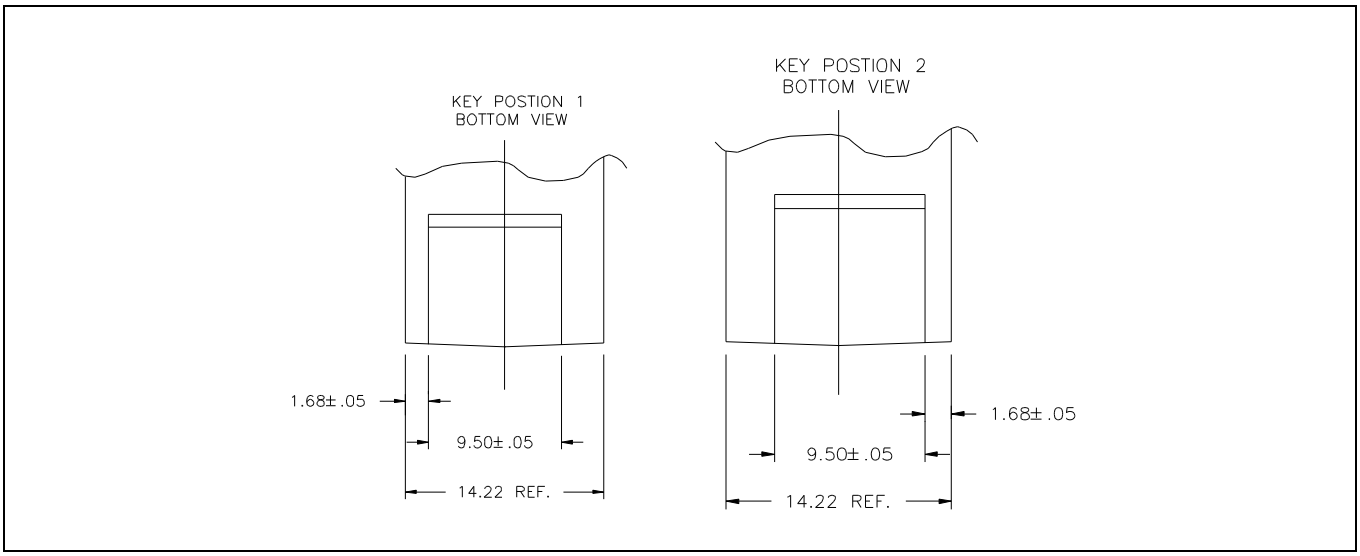


Figure 16 - Polarizing key location plug

3.2.2 Electrical

3.2.2.1 Current

The PlusPsower contacts are rated to carry 3 amp DC.

3.2.2.2 Voltage

Maximum allowable voltage between two contacts is 250 v.

3.2.2.3 Contact Assignments and Plugging Sequence

In the plugging sequence shown in the chart below, the top row of contacts (second in the sequence) mates before the bottom row of contacts (third in the sequence). This plugging sequence matches the one on the host end connector.

Contact Number	Signal Name	Plugging Sequence
Shell	Shield	1
1	Ground	2
2	Vplus	3
3	Vbus	2
4	D+	3
5	Ground	2
6	D-	3
7	Ground	2
8	Vplus	3

4 Power Management

4.1 Overview

This section defines the required power management environment for equipment using the PlusPower connector. Minimum requirements are defined enabling the inter-operability of PlusPower 'Suppliers' and 'Consumers'.

The system components involved in defining the power management requirements are defined as follows:
PlusPower voltage - Vplus, a specific voltage level assigned to a particular PlusPower connector key position
Supplier - typically a system unit, the supplier supplies PlusPower voltage for devices at a particular current. The 'supplier', as defined in this document could also be a USB self-powered hub.
Consumer - requires PlusPower voltage, possibly in addition to normal USB Vbus; if Vbus is not used the device can be considered 'self-powered" under existing USB terminology. The 'consumer' as defined in this document could be a device or a USB self-powered hub.

4.2 Minimum Requirements for all PlusPower Suppliers

4.2.1 Overcurrent Protection

All suppliers must provide overcurrent protection on Vplus.

4.2.2 Safety Circuit

For Information Technology Equipment (ITE) that must comply with the product safety standard IEC 950, the host must use a Safety Extra Low Voltage (SELV) circuit to supply power to the PlusPower connector. The maximum energy that may be present on any specific PlusPower connector on the host is 240VA as per IEC 950 requirements.

4.2.3 Supply Current Specification

The Current available from a PlusPower Supplier shall be available at any time that the Supplier itself has sufficient power. The initial current available to a newly connected device shall be no less than the following, per key position:

For Key Position 1 (12VDC): 1 amp RMS (0.5 amps/contact), with a peak current no greater than 1.5 amps for 2 seconds. Additionally, the power supplier shall be able to supply an inrush or surge current of up to 12 mA-sec while maintaining voltage regulation. Note that a 12 mA-sec impulse corresponds to hot plugging a purely capacitive load of 1000uF.

For Key Position 2 (24VDC): 2 amps RMS (1 amp/contact), with a peak current no greater than 5 amps for 2 seconds. Additionally, the power supplier shall be able to supply an inrush or surge current of up to 12 mA-sec while maintaining voltage regulation. Note that a 12 mA-sec impulse corresponds to hot plugging a purely capacitive load of 500uF.

4.3 Minimum Requirements for all PlusPower Consumers

4.3.1 Removal of Device Voltage

Power can be withdrawn at any time from the device without warning and shall not result in any unrecoverable device behavior.

4.3.2 In-Rush Current Control

For devices with large capacitance on Vplus, it is recommended, but not required, that the device employ current control to prevent power supply shutdown or blown fuses if the PlusPower connector is hot plugged. A recommended power supply compatibility specification is that the device limit current flow to less than 1 A until 90% of the final voltage is reached under normal power-on while plugged in. In no case shall in-rush current be allowed to exceed current draw specifications defined below.

4.3.3 Current Draw Specification

A PlusPower consumer may draw current as specified herein from the moment of initial connection. The current drawn by a PlusPower consumer shall be no greater than the following, per key position:

For Key Position 1 (12VDC): 1 amp RMS (0.5 amps/contact), with a peak current no greater than 1.5 amps for 2 seconds. Additionally, the power consumer shall not draw an inrush or surge current of more than 12 mA-sec. Note that a 12 mA-sec impulse corresponds to hot plugging a purely capacitive load of 1000uF.

For Key Position 2 (24VDC): 2 amps RMS (1 amp/contact), with a peak current no greater than 5 amps for 2 seconds. Additionally, the power consumer shall not draw an inrush or surge current of more than 12 mA-sec. Note that a 12 mA-sec impulse corresponds to hot plugging a purely capacitive load of 500uF.

4.3.4 Hot-Plugging/Hot-Unplugging Considerations

The PlusPower connector is not rated to withstand any specific number of arcs, which may occur during hot plugging or hot unplugging. Since equipment users will associate USB with hot plugging and hot unplugging, is recommended that devices be designed to avoid connector degradation or electronic component failure which could occur if arcing is not suppressed.

PlusPower ground makes contact before Vplus; this feature allows for electrical suppression of arcing to be designed into devices.

Adherence to the in-rush current control compatibility specification may also have the effect of eliminating arcing during hot-plugging in many applications. Devices with large inductive loads should consider voltage control circuitry such as a clamping diode to prevent arcing during hot-unplugging.