SCTE | STANDARDS

Interface Practices Subcommittee

AMERICAN NATIONAL STANDARD

ANSI/SCTE 129 2021

Drop Passives: Bonding Blocks (Without Surge Protection)

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140 Philips Road
Exton, PA 19341

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1. Introduction

1.1. Executive Summary

This specification provides the mechanical and electrical performance of the bonding block which is a device to provide a connection point for a bonding conductor in accordance with requirements of the National Electrical Code or local building requirements.

1.2. Scope

The purpose of this document is to specify the minimum mechanical and electrical performance for broadband radio frequency (RF) devices whose primary purpose is to provide a transition point between the network operator's service cable (the "drop") and the distribution wiring within premises. An important function of the device is to provide a connection point for a bonding conductor in accordance with requirements of the National Electrical Code or local building requirements. The scope of this specification is limited to 75 ohm devices whose ports are provided with female type F ports.

DOCSIS 4.0 specifications include operation at frequencies up to 1794 MHz and many service providers would like to futureproof their networks for eventual operation up to 3000 MHz.

The bonding block is capable of 3000 MHz operation as a stand-alone interface but, is also an integral interconnection component with a bandwidth performance dependent on the connection it is attached to.

1.3. Benefits

This specification is necessary to provide manufacturers and users of this product a basic set of standard dimensional and performance requirements from which to gauge design performance.

It's useful for cable and equipment manufacturers to ensure proper mating with varied connector manufactured designs. This specification provides confidence to end users that designs which meet these minimum criteria will perform properly in their systems.

1.4. Intended Audience

Manufacturers, test laboratories, and end-users.

1.5. Areas for Further Investigation or to be Added in Future Versions

None

2. Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this document. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision; and while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

2.1. SCTE References

- ANSI/SCTE 01 2020, Specification for “F” Port, Female, Outdoor
- ANSI/SCTE 04 2014, Test Method for “F” Connector Return Loss
- ANSI/SCTE 05 2020, Test Method for “F” Connector Return Loss In-Line Pair
- ANSI/SCTE 29 2018, Torque Requirements for Bond Wire Penetration of Bonding Set Screw
- ANSI/SCTE 48-1 2015, Test Method for Measuring Shielding Effectiveness of Passive and Active Devices Using a GTEM Cell
- ANSI/SCTE 74 2011, Specification for Braided 75 Ohm Flexible RF Coaxial Drop Cable
- ANSI/SCTE 81 2018, Surge Withstand Test Procedure
- ANSI/SCTE 123 2020, Specification for “F” Connector, Male, Feed-Through
- ANSI/SCTE 124 2020; Specification for “F” Connector, Male, Pin Type
- ANSI/SCTE 143 2018, Test Method for Salt Spray
- ANSI/SCTE 144 2017, Test Procedure for Measuring Transmission and Reflection
- ANSI/SCTE 149 2019, Test Method for Withstand Tightening Torque – “F” Female
- ANSI/SCTE 153 2016, Drop Passives: Splitters, Couplers and Power Inserters
- SCTE 158 2016, Recommended Environmental Condition Ranges for Broadband Communications Equipment
- ANSI/SCTE 191 2018, Test Method for Axial Pull Force, Female "F" Port
- SCTE 269 2021, Test Procedure for “F” Port Center Conductor Retention Force

2.2. Standards from Other Organizations

- 12.14. Military Standard MIL-STD-889 (Dissimilar Metals)
- NFPA 70 National Electric Code 2017
- C62.41-1991: IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

2.3. Published Materials

- No normative references are applicable.

3. Informative References

The following documents might provide valuable information to the reader but are not required when complying with this document.

3.1. SCTE References

- No informative references are applicable.

3.2. Standards from Other Organizations

- No informative references are applicable.

3.3. Published Materials

- No informative references are applicable.

4. Compliance Notation

shall	This word or the adjective "***required***" means that the item is an absolute requirement of this document.
shall not	This phrase means that the item is an absolute prohibition of this document.
forbidden	This word means the value specified shall never be used.
should	This word or the adjective "*recommended*" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
should not	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
may	This word or the adjective "*optional*" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.
deprecated	Use is permissible for legacy purposes only. Deprecated features may be removed from future versions of this document. Implementations should avoid use of deprecated features.

5. Mechanical

5.1. RF Ports

All RF ports ***shall*** be type "F" female and ***shall*** conform to the requirements of ANSI/SCTE 01 for outdoor use.

5.1.1. Port Spacing

Where more than one "F" female connector (RF port) exits from a common surface of the device, RF port spacing ***shall*** comply with ANSI/SCTE 153.

5.1.2. Axial Force

There ***shall not*** be any bracket bending or breakage when 160 +/- 5 pounds of force (72.6 +/- 2.27 kg) is applied to either end while following the procedure in ANSI/SCTE 191.

5.1.3. RF Port Mount Rotational Torque

When tested per ANSI/SCTE 149, Test Method for Withstand Tightening Torque – "F" Female, for applying clockwise (CW) and counter-clockwise (CCW) rotational torque, each "F" Port to Bracket Mount ***shall*** withstand 100 inch pounds torque (115cm-kgs) in both the CW and CCW directions.

5.2. Center Conductor Mating and Retention Force

The center conductor contact of both ends ***shall*** accept male "F" connector center conductors whose diameters are between 0.030 inches (0.76 mm) and 0.042 inches (1.066 mm). The center conductor ports of both ends ***shall*** meet the requirements of SCTE 269 2021.

5.3. Mounting

Mounting holes or slots ***shall*** meet the requirements of mounting specifications in SCTE 153, Drop Passives: Splitters, Couplers and Power Inserters. Refer to Figure 1.

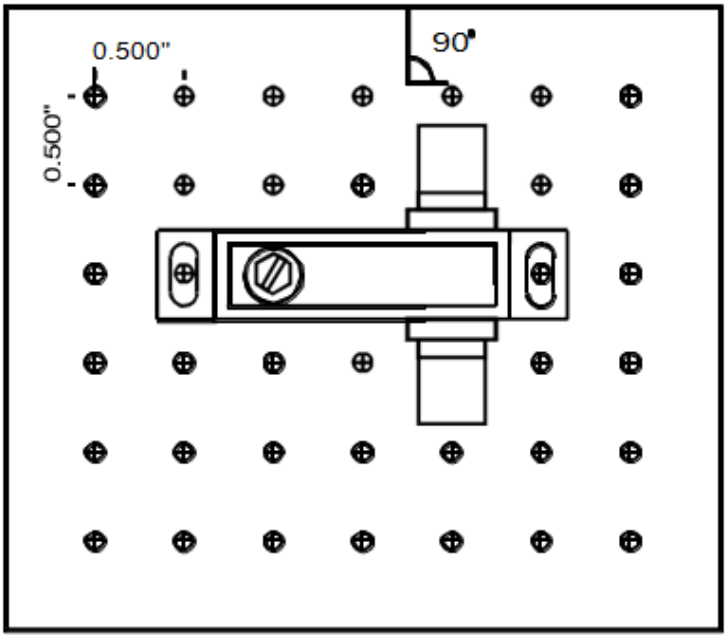

Figure 1 - Orthogonal Mounting of Device on Centerline Pattern

5.4. Bonding

Bonding wire attachment points ***shall*** use a multi-drive head and a flat point (or mechanically equivalent non-piercing) bonding device to maximize surface area contact.

The bonding fastener dual-drive screw ***shall*** provide a 1/4 inch SAE or 7/16 inch SAE head size. The head size *should* be a hexagon drive head and *may* include a slotted and/or Phillips drive (see Figure 2).

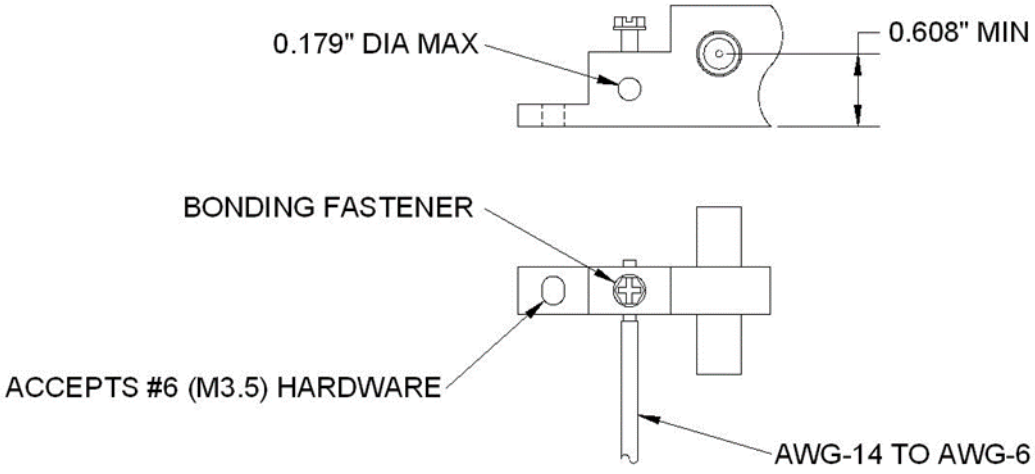

Figure 2 - Bonding Wire Seizure Arrangement

The bonding wire attachment point ***shall*** accommodate wire sizes from AWG #6 to AWG #14, with maximum wire access 0.179" (4.55 mm) diameter. See Table 1 for reference.

Table 1 - AWG Size, Hole Size, Terminal Screw Size and Torque

AWG Size	AWG Dia. inch/(mm)	Minimum Terminal Screw Size UL 467 (CSA C22.2 41-07)	Torque in-lb/(cm-kgs) +/-2 NEC 110.14
14	0.0641/(1.63)	#10	20/(23.0)
12	0.0808/(2.05)	#10	20/(23.0)
10	0.1019/(2.59)	#10	20/(23.0)
8	0.1285/(3.26)	#10	25/(28.8)
6	0.1620/(4.11)	1/4"	35/(40.3)

For AWG #14 through AWG #8, neither the seizure screw, nor the mating part ***shall*** break nor ***shall*** the threads strip when 30 inch pounds of torque (34.5cm-kgs) is applied to the screw head. For AWG #6, neither the seizure screw, nor the mating part ***shall*** break nor ***shall*** the threads strip when 45 inch pounds of torque (51.8cm-kgs) is applied to the screw head.

Penetration of the seizure screw or clamp device into AWG #6 through AWG #10 annealed copper wire ***shall not*** exceed 25% of the wire outside diameter, when 30 inch-pounds of torque (34.5cm-kgs) is applied to the screw head. Penetration into AWG #12 or AWG #14 annealed copper wire ***shall not*** exceed 25% at 20 inch pounds of torque (23cm-kgs) applied to the screw head. Compliance ***shall*** be tested using ANSI/SCTE 29.

5.5. Galvanic Compatibility

The bonding block wire attachment point ***shall*** be galvanically compatible with the bond wire employed. Standard practice has established this wire type to be bare annealed copper, which has an anodic index of 0.35 V.

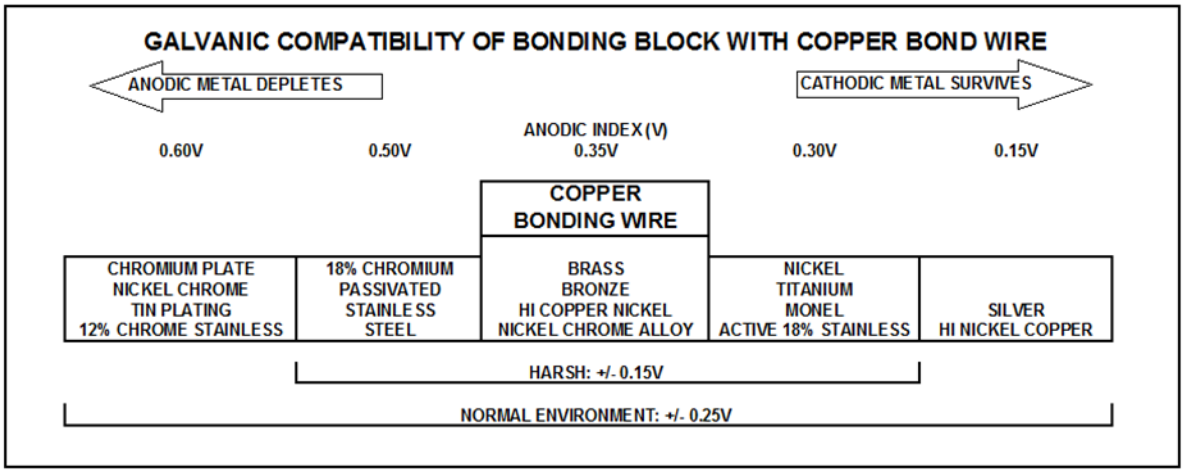

Figure 3 - Galvanic Compatibility as per MIL-STD-889

Galvanic compatibility is defined as the differential in anodic index voltage between the various metals at the junction. MIL-STD-889 (Dissimilar Metals) shows the anodic index (V) of various common metals and platings. See Figure 3 and Table 2.

Table 2 - Allowable Military/Aviation/Marine Limits

Environment	Anodic Index
Salt Spray, Outdoor, High Humidity	+/-0.15 V
Normal Environment: Indoor non-temperature and non-humidity controlled	+/-0.25 V
Controlled Environments	+/-0.50V

5.6. Listing Requirements

All bonding blocks ***shall*** be listed per NEC requirements for use with AWG bonding conductors that the product accepts.

Note: Bond point hole sizes are for AWG (solid conductors) only.

Table 3 - Wire Size vs. Hole Size

AWG Size	AWG Dia. (inch)	Bond Point Hole		Bond Block Label "Accepts AWG…"	Minimum Terminal Screw Size
		(Inch Dia.)	(mm Dia.)		
14	0.0641	0.074	1.88	#14	#10
12	0.0808	0.091	2.31	#14 - #12	#10
10	0.1019	0.112	2.84	#14 - #10	#10
8	0.1285	0.139	3.52	#14 - #8	#10
6	0.1620	0.172	4.37	#14 - #6	1/4"

5.7. Listing Stamp Requirements

All bonding blocks ***shall*** be listed. Bonding blocks accepting a given conductor size ***shall not*** be stamped as “listed” unless it applies to that wire conductor size or conductor size range. Refer to Table 3.

6. Electrical

6.1. Bandwidth

All devices ***shall*** be designed to operate over a bandwidth of 5 MHz to 3000 MHz with an impedance of 75 ohms.

6.2. Insertion Loss / Return Loss

The insertion loss of the device, measured from the input port to the output port, ***shall not*** exceed the values in Table 4 when tested in accordance to ANSI/SCTE 144 2012, Test Procedure for Measuring Transmission and Reflection.

The return loss, as measured at either RF port, with the other port terminated into 75 ohms, shall meet the requirements listed in Table 4 when mated with cables of size 6-series and/or 11-series, which meet the requirement of ANSI/SCTE 74 and which have male “F” connectors meeting and installed in accordance

with ANSI/SCTE 123 for 6-series cables or ANSI/SCTE 124 for 11-series cables. All measurements *should* be made in accordance with the procedures outlined in ANSI/SCTE 144.

ANSI/SCTE 04 and/or ANSI/SCTE 05 *may* be used as guidance in conducting these measurements.

All electrical specifications ***shall*** apply to both ports and either signal flow direction.

Table 4 - Insertion Loss / Return Loss

Frequency (MHz)	Insertion Loss (dB)	Return Loss (dB)
5 - 1002	≤ 0.05	≥ 30
1002 - 1218	≤ 0.05	≥ 30
1218 - 1794	≤ 0.10	≥ 25
1794 - 2250	≤ 0.15	≥ 20
2250 - 3000	≤ 0.20	≥ 18

6.3. Shielding Effectiveness

The shielding of components when measured in accordance with ANSI/SCTE 48-1 ***shall*** be at least 100 dB.

6.4. Surge Withstand

The surge withstand of components when measured in accordance with ANSI/SCTE 81 ***shall*** be a minimum of IEEE C62.41-1991, Category B3 Combo Wave, 6 kV, 3 kA at the F Port, with the second port terminated into a short circuit.

Post surge ***shall*** maintain center conductor DC Resistance and electrical requirements of ANSI/SCTE 01, Specification for “F” Port, Female, Outdoor.

6.5. Bonding effectiveness

The bonding wire attachment method employed ***shall*** exhibit a contact resistance between the device and bonding wire of less than 50 milliohms as measured with a standard low resistance milliohm meter.

DC resistance to connector ***shall*** be <0.010 ohms when torqued at 35 in lbs (40.3cm-kgs) as measured with a standard low resistance milliohm meter.

7. Environmental

7.1. Salt Spray

Devices ***shall*** meet all performance requirements after conditioning as specified in ANSI/SCTE 143 for a minimum of 1,000 hours. The device ***shall*** exhibit less than 0.050 inch (1.25 mm) material depth corrosion, and maintain <50 milliohm contact resistance as specified in section 6.5.

7.2. Temperature

The devices ***shall*** meet all performance requirements during and after exposure to temperatures ranging from -40 °F (-40 °C) to +140 °F (+60 °C) as per ANSI/SCTE 158, Class 1, Condition A.

The temperature cycle ***shall*** be:

1. 2 hours at low limit
2. 1 hour transition to high limit
3. 2 hours at high limit
4. 1 hour transition to low limit
5. Repeat for 15 cycles