



***Society of Cable
Telecommunications
Engineers***

**ENGINEERING COMMITTEE
Interface Practices Subcommittee**

AMERICAN NATIONAL STANDARD

ANSI/SCTE 153 2016

**Drop Passives: Splitters, Couplers and Power
Inserters**

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1. Introduction

1.1. Scope

The purpose of this document is to recommend mechanical, environmental and electrical standards for broadband radio frequency (RF) devices whose primary purpose is to divide signals presented to an input port among two or more output ports with a fixed division ratio that is nominally independent of frequency within the specified bandwidth limits of the device. Alternately, such devices can be used to combine signals from several input ports into a common output port. Its scope is limited to 75-ohm devices whose ports are provided with type F connectors. The most common use for such devices is on-premises RF signal distribution.

Products covered by this specification include signal splitters (2, 3, 4, and 8-way), directional couplers, combined splitter/directional couplers and power inserters.

Devices meeting all electrical, mechanical and environmental specifications are specified as meeting the requirements of this specification. Those meeting electrical and mechanical, but not environmental requirements are designated as “Indoor Use Only” and the products must be marked as specified herein to guide users in their appropriate application.

The specification is not intended to apply to specialty devices, nor is it intended to limit or restrict any manufacturer’s innovation and improvement.

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

This document provides specifications or procedures for frequencies up to 1002 MHz. DOCSIS 3.1 specifications include operation at frequencies up to 1218 MHz, and optionally, to 1794 MHz. Specifications or procedures for those higher frequencies should be considered in a future revision of this document.

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

1. ANSI/SCTE 01 2015: “F” Port (Female Outdoor) Physical Dimensions.
2. ANSI/SCTE 02 2015: “F” Port (Female Indoor) Physical Dimensions.
3. ANSI/SCTE 48-1 2015: Test Method for Measuring Shielding Effectiveness of Passive and Active Devices Using a GTEM Cell
4. ANSI/SCTE 81 2012: Surge Withstand Test Procedure
5. ANSI/SCTE 129 2007 SCTE Standard for Bonding Blocks (Without Surge protection)
6. ANSI/SCTE 143 2013: Test Method for Salt Spray
7. ANSI/SCTE 144 2012: Test Procedure for Transmission and Reflection
8. ANSI/SCTE 145 2015: Second Harmonic Testing Using a Single Carrier

2.2. Standards from Other Organizations

9. IEEE C62.41-1991: "IEEE Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits"

2.3. Published Materials

10. No normative published references are applicable.

3. Mechanical

3.1. RF Ports

1. RF ports on devices intended for indoor applications must conform to the requirements of ANSI/SCTE 02 2015.
2. RF ports on devices intended to be rated for outdoor use must conform to the requirements of ANSI/SCTE 01 2015.
3. Where more than one connector exits from a common surface of the device, connectors will be spaced a minimum of 0.925" apart, center-to-center.

3.2. Mounting

Mounting holes or slots may be located at the manufacturers preferred locations provided that they meet the requirements of 2.2.1 and 2.2.2 herein.

1. Mounting holes or slots shall be of such size and location as to allow orthogonal mounting of the device on a hole pattern grid of 0.500" by 0.500" (12.7 mm x 12.7 mm), capable of employing standard #6 (M3.5) hardware. (Figure 1)
2. Mounting holes, slots or bonding points shall be located as to not interfere with open-end wrench access to the F ports.

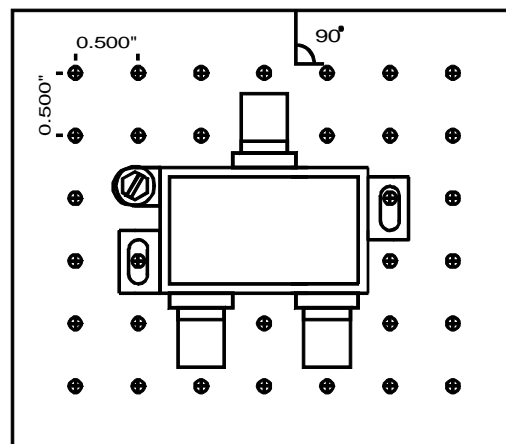


Figure 1 - Orthogonal Mounting of Device on 0.500" Hole Pattern

3.3. Bond Wire Attachment

1. Outdoor-rated units must be equipped with an integral bonding wire attachment point.

- Integral bonding wire point must conform to the requirements of ANSI/SCTE 129 2007, Section 2.3

3.4. Labeling

Each port of the device must be labeled. Designations must be in accordance with the following:

- The common port may be labeled “COMMON”, “IN” or “INPUT” at the manufacturer’s option.

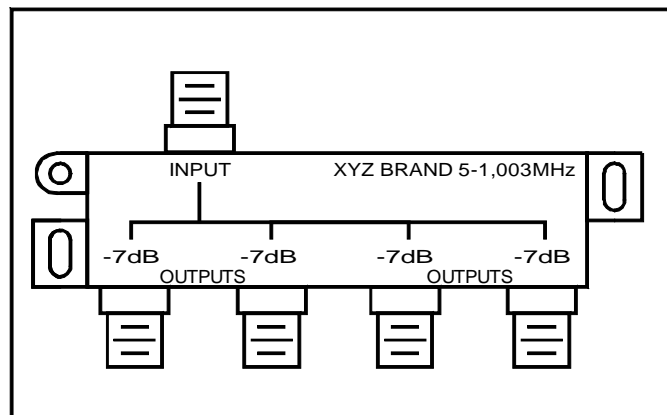


Figure 2 - Example of Conforming Labeling

- In the case of splitters, each of the splitter output ports may be labeled “OUT” or “OUTPUT” and may include a port number at the manufacturers option. Each port must also indicate the nominal loss from the input to that port in the form “-n dB” where n is the nominal loss. The “Nominal Loss” is the manufacturer's specified highest rated frequency loss rounded up to the next 0.5 dB.
- In the case of directional couplers, the port receiving the greatest percentage of the input signal may be labeled “THRU”, “THROUGH”, “OUT”, “OUTPUT” or other clearly understood term, at the manufacturers option. The port receiving the lower percentage of the input signal shall be labeled “TAP” and must also be labeled with the nominal loss from the input in the form “-n dB”, where “n” is the nominal loss in dB.
- In the case of Power Inserters, the Power port may be labeled as "DC", "AC" or "PWR". The port with RF only should be labeled "RF" or "TV", and the port with power and RF should be labeled "RF + PWR", "AC", or other clearly understood term, at the manufacturers option. Maximum voltage must also be stated.
- So long as the function of each port is clear and the loss from the input to each output port is clear, manufacturers may use any labeling layout they choose. See Figure 2 for an example of conforming labeling.
- All labels must incorporate the manufacturers model number and rated bandwidth of the device.
- Devices which do not meet the environmental criteria as specified in section 4.2 shall be labeled “For Indoor Use Only”.
- Labeling shall be designed to be legible for a period of at least 10 years under typical environmental exposure and handling

4. Electrical

1. Bandwidth

All devices shall be designed to operate over a bandwidth of at least 5 MHz to 1002 MHz.

2. Passband Response

The Passband response measured from the input port to any output port shall not exceed ± 0.5 dB relative to the slope loss of the device as measured and defined in ANSI/SCTE 144 2012.

3. Insertion Loss

The insertion loss of the device, measured from the input port to the designated output port, with all other ports terminated, shall not exceed the values specified in Table 1. All measurements shall be made using the methods specified in ANSI/SCTE 144 2012:

Table 1 - Allowable Insertion Loss

TABLE 1 DEVICE	INSERTION LOSS FROM INPUT PORT TO:	LOSS (dB)/FREQUENCY (MHz)		
		5-400	400-600	600-1,002
2-WAY SPLITTER	ANY OUTPUT	≤ 3.6	≤ 4.0	≤ 4.4
3-WAY BALANCED	ANY OUTPUT	≤ 6.1	≤ 6.5	≤ 7.0
3-WAY UNBALANCED	HI OUTPUT	≤ 3.6	≤ 4.0	≤ 4.4
	LOW OUTPUTS	≤ 7.2	≤ 7.8	≤ 8.8
4-WAY SPLITTER	ANY OUTPUT	≤ 7.2	≤ 7.8	≤ 8.8
8-WAY SPLITTER	ANY OUTPUT	≤ 11.0	≤ 12.0	≤ 13.2
16-WAY SPLITTER	ANY OUTPUT	≤ 15.0	≤ 16.0	≤ 17.6
6dB COUPLER	THROUGH	≤ 1.8	≤ 2.2	≤ 2.8
	TAP	6.0 ± 1		
9dB COUPLER	THROUGH	≤ 1.4	≤ 1.8	≤ 2.1
	TAP	9.0 ± 1		
12dB COUPLER	THROUGH	≤ 1.0	≤ 1.2	≤ 1.7
	TAP	12.0 ± 1		
16dB COUPLER	THROUGH	≤ 0.8	≤ 0.9	≤ 1.5
	TAP	16.0 ± 1		
20dB COUPLER	THROUGH	≤ 0.8	≤ 0.9	≤ 1.4
	TAP	20.0 ± 1		
24dB COUPLER	THROUGH	≤ 0.7	≤ 0.8	≤ 1.2
	TAP	24.0 ± 1		
27dB COUPLER	THROUGH	≤ 0.7	≤ 0.8	≤ 1.2
	TAP	27.0 ± 1		
30dB COUPLER	THROUGH	≤ 0.7	≤ 0.8	≤ 1.2
	TAP	30.0 ± 1		
POWER INSERTER	OUTPUT	≤ 0.7	≤ 0.8	≤ 1.2

4. Return Loss

The return loss, as measured at any RF port, with all other ports terminated, shall be a minimum of 18 dB. All measurements shall be made in accordance with the procedures outlined in ANSI/SCTE 144 2012.

5. Isolation

The isolation between any two RF output ports, with all other ports terminated, shall be as defined in Table 2. Measurements shall be made using the procedures specified in ANSI/SCTE 144 2012.

Table 2 - Minimum Port to Port Isolation

TABLE 2 DEVICE	MINIMUM OUTPUT PORT TO OUTPUT PORT ISOLATION			
	5-10MHz	10-65MHz	65-870MHz	870-1,002MHz
SPLITTERS/COUPLERS (ALL)	≥22dB	≥30dB	≥26dB	≥23dB

6. Shielding Effectiveness

The shielding effectiveness of components when measured in accordance with ANSI/SCTE 48-1 2015 shall be a minimum of 100 dB.

- Power Inserters will be tested with associated power supply connected, and shielding measured along the power carrying cable and the power supply.

7. Surge Withstand

The surge withstand of components when measured in accordance with ANSI/SCTE 81 2012 shall be at minimum compliant with IEEE C62.41-1991 Category A3, Ring Wave 6KV at the F Ports. Power Inserter and associated power supply shall be connected together and subjected to IEEE C62.41-1991 Category B3, Combination Wave 6KV applied to the Mains plug.

8. Intermodulation Distortion

The Intermodulation Distortion of the device must be better than -95 dB relative to the injected signal when tested in accordance with SCTE 145 2013. Intermodulation Tests shall be performed immediately after Surge Withstand Test in order to test for any Ferrite Magnetization detrimental effects.

5. Environmental

1. Applicability

The following requirements apply for all devices. Devices which do not meet the requirement in section 4.2 shall be labeled "For Indoor Use Only".

2. Salt Spray

The device must meet all performance requirement as outlined in section 4, after a minimum of 1000 hours of salt spray when tested in accordance with ANSI/SCTE 143 2013. The device must exhibit corrosion penetration of less than 50% metal thickness, and show no evidence of internal damage. F Ports shall be appropriately sealed during testing to prevent salt water compound entry via the ports.

3. Temperature

The device must meet all performance requirement during and after temperature cycles ranging from -40 °F (-40 °C) to +140 °F (+60 °C) inclusive (Outdoor Rated Devices), and +32 °F (0 °C) to +140 °F (+60 °C) inclusive (Indoor Rated Devices) with 95% relative humidity at both types of devices at the high temperature limit.

Temperature Cycles shall be:

- 2 hours at the low limit
- 1 hour transition to high limit
- 2 hours at the high limit
- 1 hour transition to the low limit; repeat for 15 cycles