

# **SCTE** | **STANDARDS**

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**Interface Practices Subcommittee**

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**AMERICAN NATIONAL STANDARD**

**ANSI/SCTE 153 2021**

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

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## Document Types and Tags

Document Type: Specification

Document Tags:

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|-------------------------------------------------------|------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> Test or Measurement          | <input type="checkbox"/> Checklist | <input type="checkbox"/> Facility                     |
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## Document Release History

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Note: Standards that are released multiple times in the same year use: a, b, c, etc. to indicate normative balloted updates and/or r1, r2, r3, etc. to indicate editorial changes to a released document after the year.

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## 1. Introduction

### 1.1. Executive Summary

The purpose of this document is to identify common characteristics of splitters, couplers and power inserters used on premises connected to broadband hybrid fiber-coax (HFC) networks.

### 1.2. 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. 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.

DOCSIS 4.0 specifications include operation at frequencies up to 1794 MHz. Many service providers would like to futureproof their networks for eventual operation up to 3000 MHz. This document provides specifications or procedures for frequencies up to 1794 MHz.

Device specifications are segmented into classifications as follows:

- Class 3: Products that meet specifications through 1794 MHz
- Class 2: Products that meet specifications through 1218 MHz
- Class 1: Products that meet specifications through 1002 MHz

Devices that meet the electrical and mechanical requirements, but not environmental are designated as “Indoor Use Only” and the products are required to be marked to guide users in their appropriate application.

### 1.3. Benefits

Signal splitting / combining devices are an integral component of a broadband network. This specification provides a uniform method of interconnecting on-premises devices with acceptable electrical and mechanical performance.

### 1.4. Intended Audience

This document is intended for installers, equipment manufacturers, and end users of this product.

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

Specifications or procedures for frequencies up to 3000 MHz 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**

- ANSI/SCTE 01 2021: “F” Port (Female Outdoor) Physical Dimensions
- ANSI/SCTE 02 2021: “F” Port (Female Indoor) Physical Dimensions
- ANSI/SCTE 48-1 2015: Test Method for Measuring Shielding Effectiveness of Passive and Active Devices Using a GTEM Cell
- ANSI/SCTE 81 2018: Surge Withstand Test Procedure
- ANSI/SCTE 129 2020 SCTE Standard for Bonding Blocks (Without Surge protection)
- ANSI/SCTE 143 2018: Test Method for Salt Spray
- ANSI/SCTE 144 2017: Test Procedure for Transmission and Reflection
- ANSI/SCTE 145 2015: Second Harmonic Testing Using a Single Carrier

## **2.2. Standards from Other Organizations**

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

## **2.3. Published Materials**

- No normative published 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.

- No informative references are applicable.

### **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

<i>shall</i>	This word or the adjective “ <i>required</i> ” means that the item is an absolute requirement of this document.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this document.
<i>forbidden</i>	This word means the value specified shall never be used.
<i>should</i>	This word or the adjective “ <i>recommended</i> ” 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.
<i>should not</i>	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.
<i>may</i>	This word or the adjective “ <i>optional</i> ” 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.
<i>deprecated</i>	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. Abbreviations

dB	decibel
HFC	hybrid fiber-coax
MHz	megahertz
mm	millimeter
SCTE	Society of Cable Telecommunications Engineers

## 6. Mechanical

### 6.1. RF Ports

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

### 6.2. Mounting

Mounting holes or slots *may* be located at the manufacturers preferred locations provided that they meet the requirements of this section.



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)

Mounting holes, slots or bonding points *shall* be located as to not interfere with open-end wrench access to the F ports.

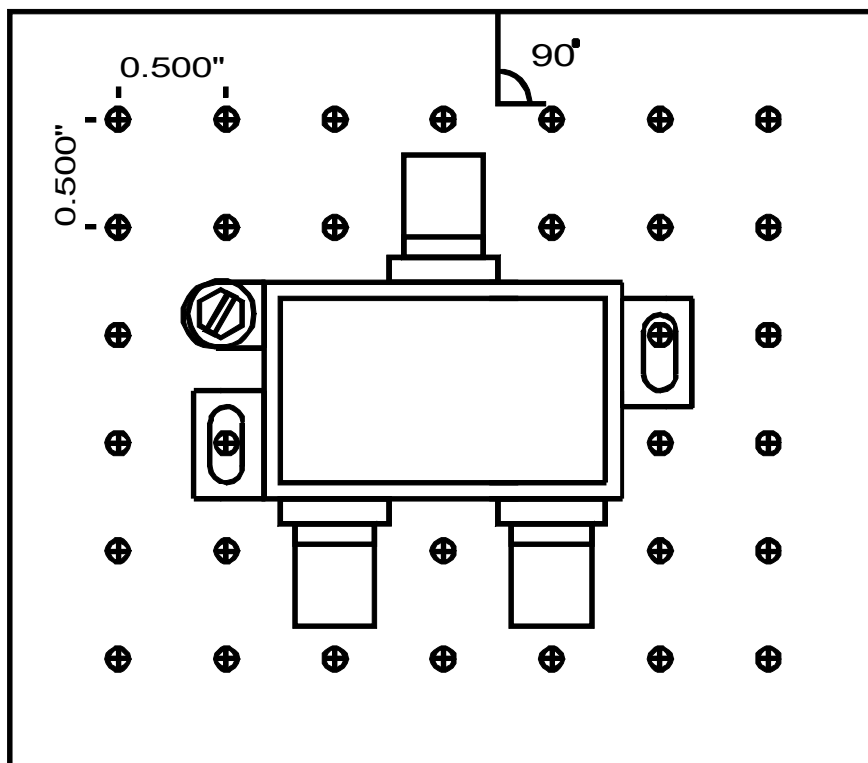


Figure 1 - Orthogonal Mounting of Device on 0.500" Hole Pattern

### 6.3. Bond Wire Attachment

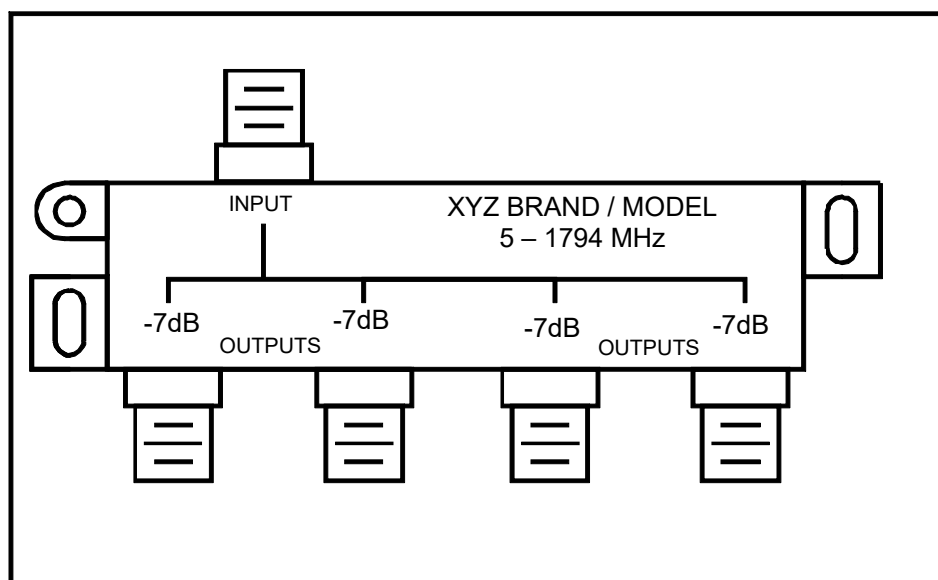
Outdoor-rated units *shall* be equipped with an integral bonding wire attachment point.

All integral bonding wire attachment points *shall* conform to the requirements of ANSI/SCTE 129, Sections 5.4 through 5.7.

### 6.4. Labeling

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

1. The common port *may* be labeled "COMMON", "IN" or "INPUT" at the manufacturer's option.



**Figure 2 - Example of Conforming Labeling**

2. In the case of splitters, each of the splitter output ports *may* be labeled “OUT” or “OUTPUT” and *may* include a port number. Each port *shall* 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.
3. 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. The port receiving the lower percentage of the input signal *shall* be labeled “TAP” and *shall* also be labeled with the nominal loss from the input in the form “-n dB”, where “n” is the nominal loss in dB.
4. 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.
5. For devices with power ports, the maximum voltage *shall* be stated.
6. 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.
7. All labels *shall* incorporate the manufacturer’s model number and rated bandwidth of the device.
8. Devices which do not meet the environmental criteria as specified in section 8 *shall* be labeled “For Indoor Use Only”.
9. Labeling *shall* be designed to be legible for a period of at least 10 years under typical environmental exposure and handling.

## 7. Electrical

### 7.1. Bandwidth

All devices *shall* be classified as Class 3, Class 2, or Class 1 as defined in this section.

- Class 3: Products that meet specifications through 1794 MHz
- Class 2: Products that meet specifications through 1218 MHz
- Class 1: Products that meet specifications through 1002 MHz

All Class 3 devices *shall* meet all performance requirements over a minimum bandwidth of 5 MHz to 1794 MHz.

All Class 2 devices *shall* meet all performance requirements over a minimum bandwidth of 5 MHz to 1218 MHz.

All Class 1 devices *shall* meet all performance requirements over a minimum bandwidth of 5 MHz to 1002 MHz.

### 7.2. Passband Response

The passband response measured from the input port to any output port *shall not* exceed  $\pm 0.5$  dB relative to the slope loss of the device as measured and defined in ANSI/SCTE 144.

### 7.3. 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 as specified in the Table 1 for Class 1, Table 2 for Class 2 and Table 3 for Class 3 devices. All measurements *shall* be made using the methods specified in ANSI/SCTE 144.

**Table 1 - Allowable Insertion Loss, Class 1 Devices**

Device	Insertion Loss Input Port To:	Loss (dB) / Frequency (MHz)		
		5 - 400	400 - 600	600 - 1,002
2 - Way Splitter	Any Output	$\leq 3.6$	$\leq 4.0$	$\leq 4.4$
3 - Way Balanced	Any Output	$\leq 6.1$	$\leq 6.5$	$\leq 7.0$
3 - Way Unbalanced	Hi Output	$\leq 3.6$	$\leq 4.0$	$\leq 4.4$
	Low Output	$\leq 7.2$	$\leq 7.8$	$\leq 8.8$
4 - Way Splitter	Any Output	$\leq 7.2$	$\leq 7.8$	$\leq 8.6$
8 - Way Splitter	Any Output	$\leq 11.3$	$\leq 11.6$	$\leq 12.5$
6 dB Coupler	Through	$\leq 1.8$	$\leq 2.2$	$\leq 2.8$
	Tap	$6.0 \pm 1.5$		
9 dB Coupler	Through	$\leq 1.4$	$\leq 1.8$	$\leq 2.1$
	Tap	$9.0 \pm 1.5$		
12 dB Coupler	Through	$\leq 1.0$	$\leq 1.2$	$\leq 1.5$
	Tap	$12.0 \pm 1.5$		

16 dB Coupler	Through	≤ 0.8	≤ 0.9	≤ 1.5
	Tap	16.0 ± 1.5		
20 dB Coupler	Through	≤ 0.8	≤ 0.9	≤ 1.4
	Tap	20.0 ± 1.5		
24 dB Coupler	Through	≤ 0.7	≤ 0.8	≤ 1.2
	Tap	24.0 ± 1.5		
27 dB Coupler	Through	≤ 0.7	≤ 0.8	≤ 1.2
	Tap	27.0 ± 1.5		
30 dB Coupler	Through	≤ 0.7	≤ 0.8	≤ 1.2
	Tap	30.0 ± 1.5		
Power Inserter	Output	≤ 0.7	≤ 0.8	≤ 1.2

**Table 2 - Allowable Insertion Loss, Class 2 devices**

Device	Insertion Loss Input Port To:	Loss (dB) / Frequency (MHz)			
		5 - 400	400 - 600	600 - 1,002	1,002 - 1,218
2 - Way Splitter	Any Output	≤ 3.6	≤ 4.0	≤ 4.4	≤ 4.6
3 - Way Balanced	Any Output	≤ 6.1	≤ 6.5	≤ 7.0	≤ 8.0
3 - Way Unbalanced	Hi Output	≤ 3.6	≤ 4.0	≤ 4.4	≤ 4.8
	Low Output	≤ 7.2	≤ 7.8	≤ 8.8	≤ 8.9
4 - Way Splitter	Any Output	≤ 7.2	≤ 7.8	≤ 8.8	≤ 8.9
8 - Way Splitter	Any Output	≤ 11.3	≤ 11.6	≤ 12.5	≤ 14.3
6 dB Coupler	Through	≤ 1.8	≤ 2.2	≤ 2.8	≤ 2.8
	Tap	6.0 ± 1.5			
9 dB Coupler	Through	≤ 1.4	≤ 1.8	≤ 2.1	≤ 2.3
	Tap	9.0 ± 1.5			
12 dB Coupler	Through	≤ 1.0	≤ 1.2	≤ 1.5	≤ 1.5
	Tap	12.0 ± 1.5			
16 dB Coupler	Through	≤ 0.8	≤ 0.9	≤ 1.5	≤ 1.5
	Tap	16.0 ± 1.5			
20 dB Coupler	Through	≤ 0.8	≤ 0.9	≤ 1.4	≤ 1.5
	Tap	20.0 ± 1.5			
24 dB Coupler	Through	≤ 0.7	≤ 0.8	≤ 1.2	≤ 1.5
	Tap	24.0 ± 1.5			
27 dB Coupler	Through	≤ 0.7	≤ 0.8	≤ 1.2	≤ 1.5
	Tap	27.0 ± 1.5			
30 dB Coupler	Through	≤ 0.7	≤ 0.8	≤ 1.2	≤ 1.5
	Tap	30.0 ± 1.5			
Power Inserter	Output	≤ 0.7	≤ 0.8	≤ 1.2	≤ 1.5

**Table 3 - Allowable Insertion Loss, Class 3 devices**

Device	Insertion Loss Input Port To:	Loss (dB) / Frequency (MHz)				
		5 - 400	400 - 600	600 - 1,002	1,002 - 1,218	1,218 - 1,794
2 - Way Splitter	Any Output	≤ 4.2	≤ 4.4	≤ 4.5	≤ 4.8	≤ 6.5
3 - Way Balanced	Any Output	≤ 6.1	≤ 6.5	≤ 7.0	≤ 8.0	≤ 9.1
3 - Way Unbalanced	Hi Output	≤ 4.3	≤ 4.5	≤ 4.6	≤ 4.8	≤ 6.7
	Low Output	≤ 7.8	≤ 7.9	≤ 8.8	≤ 9.2	≤ 11.0
4 - Way Splitter	Any Output	≤ 7.8	≤ 7.8	≤ 10.0	≤ 12.0	≤ 14.0
8 - Way Splitter	Any Output	≤ 11.3	≤ 11.6	≤ 12.5	≤ 14.3	≤ 16.0

#### 7.4. Return Loss

The return loss, as measured at any RF port, with all other ports terminated, *shall not* exceed the values as listed in the Table 4. All measurements *shall* be made in accordance with the procedures outlined in ANSI/SCTE 144.

**Table 4 – Allowable Return Loss, All Device Classes**

Class	Frequency (MHz)	Return Loss (dB)
1	5 - 1002	≥ 18
2	1002 - 1218	≥ 18
3	1218 - 1794	≥ 16

#### 7.5. Isolation

The isolation between any two RF output ports, with all other ports terminated, *shall not* exceed the values as specified in Table 5 for Class 1, Table 6 for Class 2 and

Table 7 for Class 3 devices. Measurements *shall* be made using the procedures specified in ANSI/SCTE 144.

**Table 5 – Class 1 Minimum Port to Port Isolation**

Device	Output Port to Output Port Isolation - Loss (dB) / Frequency (MHz)			
	5 - 10	10 - 65	65 - 870	870 - 1,002
Splitter / Coupler (All)	≥ 22.0	≥ 30.0	≥ 25.0	≥ 22.0

**Table 6 – Class 2 Minimum Port to Port Isolation**

Device	Output Port to Output Port Isolation - Loss (dB) / Frequency (MHz)				
	5 - 10	10 - 65	65 - 870	870 - 1,002	1,002 - 1,218
Splitter / Coupler (All)	≥ 22.0	≥ 30.0	≥ 25.0	≥ 22.0	≥ 20.0

**Table 7 – Class 3 Minimum Port to Port Isolation**

Device	Output Port to Output Port Isolation - Loss (dB) / Frequency (MHz)					
	5 - 10	10 - 65	65 - 870	870 - 1,002	1,002 - 1,218	1,218 - 1,794
	≥ 20.0	≥ 28.0	≥ 25.0	≥ 22.0	≥ 20.0	≥ 18.0

## 7.6. Shielding Effectiveness

The shielding effectiveness of components when measured in accordance with ANSI/SCTE 48-1 **shall** be defined in Table 8.

Power Inserter **shall** be tested with associated power supply connected, and shielding measured along the power carrying cable and the power supply.

**Table 8 – Shielding Effectiveness, All Device Classes**

Class	Frequency (MHz)	Shielding Effectiveness (dB)
1	5 - 1002	≥ 120
2	1002 - 1218	≥ 110
3	1218 - 1794	≥ 100

## 7.7. Surge Withstand

The surge withstand of components when measured in accordance with ANSI/SCTE 81 **shall** be at minimum compliant with IEEE C62.41-1991 Category A3, Ring Wave 6 kV 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 6 kV applied to the Mains plug.

## 7.8. Intermodulation Distortion

The intermodulation distortion of the device **shall** be better than –95 dB relative to the injected signal when tested in accordance with SCCTE 145. Intermodulation tests **shall** be performed immediately after the surge withstand test in order to test for any ferrite magnetization detrimental effects.

# 8. Environmental

## 8.1. Applicability

The following requirements apply for all devices. Devices which do not meet the requirement in section 8.2 **shall** be labeled “For Indoor Use Only”.

## 8.2. Salt Spray

The device **shall** meet all performance requirement as outlined in section 7, after a minimum of 1000 hours of salt spray when tested in accordance with ANSI/SCTE 143. The device **shall** 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.

### **8.3. Temperature**

The device *shall* 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