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Drop Amplifiers

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1. Scope

The purpose of this specification is to recommend mechanical and electrical standards for broadband radio frequency (RF) devices whose primary purpose is to amplify signals presented to an input port and deliver the amplified signals to one or more output ports. The devices are also required to pass signals in a different range of frequencies in the return direction and, optionally, may provide amplification of such return signals. The specification's scope is limited to 75 ohm devices whose ports are provided with F connectors. The most common use for such devices is on-premises RF signal distribution.

Devices covered by this specification include products commonly known as Drop Amplifiers. They may be mounted within Network Interface Device (NID) housings on dwellings or independently within dwellings. They are not intended to be cascaded with other Drop Amplifiers.

Two levels of compliance are specified. Devices meeting all electrical, mechanical and environmental specifications may be specified as meeting the requirements of this specification without qualification. Those meeting electrical and mechanical, but not the environmental requirements specified in Section 6 may be designated as meeting this specification with the suffix "For 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.

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 2015: Specification for "F" Port, Female, Outdoor
- ANSI/SCTE 02 2015: Specification for "F" Port, Female, Indoor
- ANSI/SCTE 06 2015: Composite Distortion Measurements (CSO & CTB)
- ANSI/SCTE 16 2012: Test Procedure for Hum Modulation
- ANSI/SCTE 17 2007: Test Procedure for Carrier to Noise (C/N, CCN, CIN, CTN)
- ANSI/SCTE 45 2012: Test Method for Group Delay
- ANSI/SCTE 48-1 2015: Test Method for Measuring Shielding Effectiveness of Passive and Active Devices Using a GTEM Cell
- ANSI/SCTE 58 2012: AM Cross Modulation Measurements
- ANSI/SCTE 62 2012: Measurement Procedure for Noise Figure
- ANSI/SCTE 81 2012: Surge Withstand Test Procedure
- ANSI/SCTE 115 2011: Test Method for Reverse Path (Upstream) Intermodulation Using Two Carriers
- ANSI/SCTE 124 2011: Specification for "F" Connector, Male, Pin Type
- ANSI/SCTE 129 2007: Drop Passives: Bonding Blocks (Without Surge Protection)
- ANSI/SCTE 135-1 2013: DOCSIS 3.0 Part 1: Physical Layer Specification
- ANSI/SCTE 144 2012: Test Procedure for Measuring Transmission and Reflection
- ANSI/SCTE 153 2008: Drop Passives: Splitters, Couplers and Power Inserters

2.2. Standards from Other Organizations

- No normative references are applicable.

2.3. Published Materials

- No normative references are applicable.

3. Mechanical

3.1. RF Ports

1. All RF ports shall be type F. F-female ports shall conform to the requirements of ANSI/SCTE 01 2015 (for outdoor use) or ANSI/SCTE 02 2015 (indoor use). F-male ports shall conform to the requirements of ANSI/SCTE 124 2011.
2. Where more than one connector exits from a common surface of the device, connectors will be spaced a minimum of 0.925" (23.49 mm) apart, center-to-center. Refer to Figure 1.

3.2. Power Port

The power port, if provided, may be a type 'F' female connector, a permanently attached cord, or some other connector of the manufacturer's choice. The device must meet all requirements of this specification in all powering configurations.

3.3. Mounting

Mounting holes or slots may be located at the manufacturers' preferred locations provided they meet the requirements of 3.3.1 and 4.3.2 herein. Mounting holes or slots may be located at the manufacturers' preferred locations provided they meet the requirements of this section below:

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" (12.7mm x 12.7mm), 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.

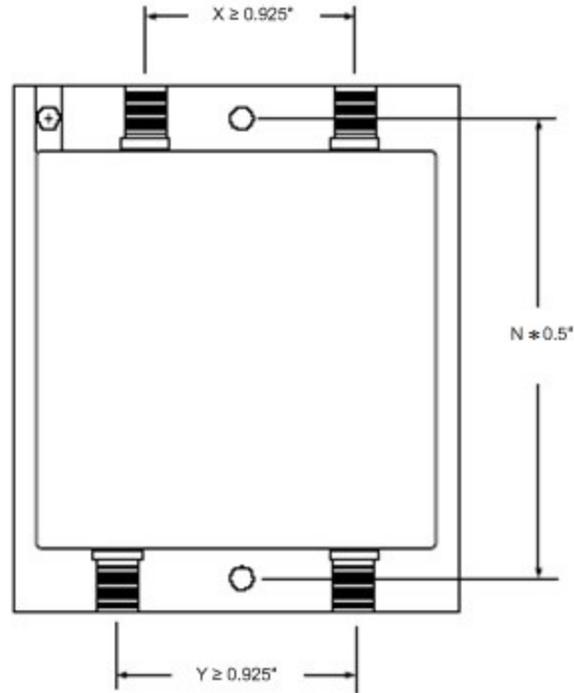


Figure 1 – Mechanical Configuration Example

Note: N = integer

4. Bond Wire Attachment

1. Devices labeled "For indoor use only" are not required to be equipped with bonding wire attachment points. Devices rated for exterior use must be equipped with bonding wire attachment points.
2. Integral bonding wire point must conform to the requirements of ANSI/SCTE 129 2007.

5. Labeling

1. Each part of the device must be labeled. Designations must be in accordance with the following:
 - The forward input port label shall contain the word "IN" or "Input".
 - Output port label(s) shall contain the word "OUT" or "Output" and may include a port number at the manufacturer's option.
 - Power port label(s) shall contain the word "Power" or "PWR."
 - The voltage and amperage requirements of the device shall be indicated on the label.
2. A label must be prominently displayed that will include information on the Return and Forward bandwidths.

A label must also display the nominal Forward gain from input to any output. Additionally, if Return amplification is incorporated, the nominal return gain shall also be included on the label.
3. Components which do not meet the environmental requirements of Section 9 shall be prominently and permanently labeled "For indoor use only."

4. Labels shall include such other information as necessary to meet the requirements of other agencies, such as the FCC or recognized testing laboratories (UL, CSA etc.). Devices designed to be connected to commercial power shall include line voltage and power consumption information.
5. So long as the function of each port is clear and the gain 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.

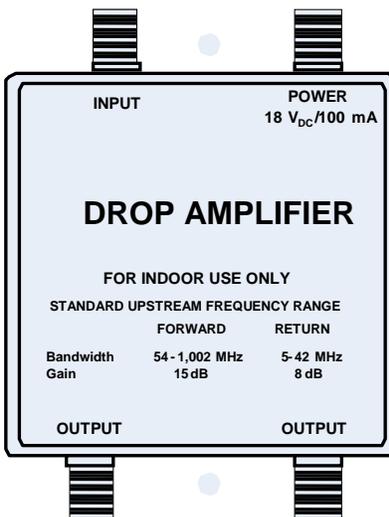


Figure 2 – Labeling Example

6. Labeling shall be designed to be legible for a period of at least 10 years under typical environmental exposure and handling.

6. Electrical

6.1. Bandwidth

Devices shall be designed to operate with a forward minimum bandwidth of 1,002 MHz. Units with a rated forward bandwidth of 54 to 1,002 MHz and return bandwidth of 5 to 42 MHz will be considered Standard Upstream capable, while units with a forward bandwidth of 108 to 1218 MHz and return bandwidth of 5 to 85 MHz will be considered Extended Upstream capable. The terminologies of Standard and Extended Upstreams are in keeping with ANSI/SCTE 135-1 2013 definitions. Other mid-split configurations are permitted as per operator requirements. However, the minimum rated forward bandwidth will be 1,002 MHz.

6.2. Passband Response

The passband response over the specified forward or return bandwidth as measured from the input port to any output port shall not exceed the following deviations relative to the specified slope of the device as measured and defined in ANSI/SCTE 144 2012.

±0.5 dB in the forward bandwidth for 1 port devices

±0.8 dB in the forward bandwidth for 2, 4, and 8 port devices

± 0.5 dB in the return bandwidth for all return-enabled devices

6.3. Gain

The forward and return gain of the device, measured from the input port to any output port for forward gain and from any output port to the input port for return gain, with all other ports terminated, shall match the labeled value with a tolerance of +2 dB/-1 dB across the full specified forward and return bandwidths respectively. If the slope plus flatness of the device exceeds this tolerance, the slope shall be separately specified and shall be indicated on the label. All measurements shall be made using the methods specified in ANSI/SCTE 144 2012.

The return signal loss for devices without return amplification shall not exceed 2 dB for devices without internal signal splitting. For devices with internal splitting, additional loss is allowed in an amount not to exceed that specified in ANSI/SCTE 153 2008 for passive splitters with the same number of output ports.

6.4. Return Loss

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

6.5. Port-to-Port Isolation

The port-to-port isolation as measured between any two output ports of a multiple output amplifier with all other ports terminated shall be a minimum of 20 dB for all devices over the full specified forward and return bandwidths. All measurements shall be made in accordance with the procedures outlined in ANSI/SCTE 144 2012.

6.6. Rated Output Power Capability

The “Rated” output power capability shall be defined, for purposes of this specification, as the maximum output level per carrier (with the levels adjusted for equal output power per carrier) which will allow the amplifier to meet the distortion specifications listed in Sections 6.7 and 6.8.

The forward rated output power capability shall be specified by the manufacturer and shall be at least $(+20-10\log n)$ dBmV per carrier at each output port, where n is the number of output ports. In no case shall this rated output power capability per port be less than +10 dBmV, regardless of the number of ports on the device.

If a return amplifier is supplied, its return rated output power capability shall also be specified and shall be at least +50 dBmV per carrier at the forward input port.

Amplifier manufacturers shall prominently identify the power output capability as defined by this specification as the “SCTE Rated Output Power Capability” in all published materials which discuss signal handling capabilities of the device.

6.7. Forward Distortion

1. Distortion measurements shall be made with a spectrum of unmodulated carriers, all on ANSI/EIA-542 defined “standard” frequency plan visual frequencies from the lower rated forward band edge through 547.25 MHz, and “white noise” or QAM signals to the upper bandwidth limit.

2. The level of each unmodulated carrier shall be equal to the rated output power capability of the device. If 64 or 256 QAM signals are used instead of white noise, the average power of each digital channel shall be equal to the rated output power capability of the device minus 6 dB.
3. Composite Distortion Measurement (CSO & CTB): When loaded as specified in Sections 6.7.1 and 6.7.2, and when measured in accordance with ANSI/SCTE 06 2012, the CTB shall be no greater than -70 dBc and the CSO shall be no greater than -60 dBc.
4. Cross Modulation (XMOD): When loaded as specified in Sections 6.7.1 and 6.7.2, but with the carriers 100% synchronously modulated, and when measured in accordance with ANSI/SCTE 129 2007, the XMOD shall be no greater than -65 dB relative to 100% modulation.
5. Carrier to Composite Noise (CCN): When loaded as specified in Sections 6.7.1 and 6.7.2, and when measured in accordance with ANSI/SCTE 17 2007, the CCN shall be no less than 55 dB.

6.8. Return Distortion

When loaded using unmodulated carriers at 13 and 19 MHz fed into a forward output port and whose amplitudes at the forward input port are equal to the specified return rated output power capability, and when measured in accordance with ANSI/SCTE 115 2011, the return path intermodulation distortion shall be no less than 55 dBc.

6.9. Noise Figure

Noise figures shall be measured in accordance with ANSI/SCTE 62 2012.

Amplifiers shall have a forward noise figure of ≤ 8 dB.

Active return units shall have return effective noise figures according to their output configurations as listed below:

- ≤ 8 dB for 1-port devices
- ≤ 12 dB for 2-port devices
- ≤ 16 dB for 4-port devices
- ≤ 20 dB for 8-port devices

6.10. Hum Modulation

Hum modulation, as measured on both forward and return signals, shall be no greater than -60 dB relative to FCC-defined 100% modulation when measured in accordance with ANSI/SCTE 16 2012. This test must be performed for every possible powering scenario, including powering through a power port, powering through RF output port(s), and powering through the RF input port. If a power inserter is provided, each RF port powered test must be conducted through the provided power inserter.

6.11. Shielding Effectiveness

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

6.12. Group Delay

Group delay is to be measured in accordance with ANSI/SCTE 45 2012.

1. Forward band chrominance-to-luminance delay shall not exceed ± 30 ns in the first ANSI/EIA 542 Standard channel, ± 15 ns in the second ANSI/EIA Standard channel, and ± 5 ns on any other channel above the specified lower bandwidth limit.
2. Return band group delay variation, measured with an aperture of 0.1 MHz, shall not exceed ± 5 ns over any 1 MHz span for frequencies between 10MHz and 6MHz below the upper specified bandwidth, ± 20 ns over any 1MHz span at frequencies below and above these frequencies to the rated bandwidth limits.

6.13. Surge Withstand

The amplifier shall meet all specifications after being subjected to surges, in accordance with ANSI/SCTE 81 2012. At a minimum, tests should include the IEEE C62.41-1991 Category A-3 Ring Wave, 6 kV, 200 A on the RF input port and all RF output ports, and IEEE C62.41-1991 Category B-3 Combination Wave 6 kV, 3 kA at the 120 VAC side of the power supply while the drop amplifier is connected to the low voltage side of the power adapter.

7. General

7.1. Furnished Instructions

Recommended guidelines, complete specifications and technical instructions must be included with each device when packaged for individual sales at retail.

7.2. Temperature Rise

No external surface shall have a temperature rise greater than 45 Fahrenheit degrees (25 Celsius degrees) above ambient when operated without external heat sinking.

7.3. Shock Resistance

The device shall withstand a $\sim 3'$ (1m) drop onto a concrete surface in all six axes without damage or degraded performance (excluding F connector thread damage).

8. Powering

8.1. Voltage Range

Line-powered devices must meet all specifications over a voltage range of 105 through 130 VAC, 60 Hz.

8.2. Power Consumption

Total power consumption must be specified by the manufacturer.

8.3. Power Inserter

If a power inserter is utilized, it must conform to ANSI/SCTE 153 2008.

9. Environmental

9.1. Applicability

The following specifications apply to all components rated for exterior use.

9.2. Salt Spray

Components must pass the salt spray requirements specified in ANSI/SCTE 153 2008 for a minimum of 1,000 hours.

9.3. Temperature/Humidity

1. Devices must meet all specifications when operated in an ambient temperature ranging from -22 to +122 degrees Fahrenheit (-30 to +50 degrees Celsius) and relative humidity from 5 to 99%, non-condensing.
2. Devices must withstand temperatures of -40 to +140 degrees Fahrenheit (-40 to +60 degrees Celsius) while operating without failure or permanent performance degradation.