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Drop Amplifiers

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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

This specification provides the mechanical and electrical requirements of a drop amplifier primarily used within the premises..

1.2. 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. The scope of this specification does not include drop amplifiers with MoCA functionality.

1.3. Benefits

Drop amplifiers are used to amplify the broadband signal to overcome excessive passive loss due to long coaxial cable lengths or splitter loss within a premise. This standard provides the key characteristics of the drop amplifier.

1.4. Intended Audience

This document is intended as a technical guide for the minimum device requirement for proper operation of a drop amplifier including technicians, manufacturers, and end users.

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

Future versions may include downstream bandwidths to 1794 MHz and other upstream/downstream diplex frequency splits.

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

[SCTE 01] ANSI/SCTE 01 2021: Specification for “F” Port, Female, Outdoor

[SCTE 02] ANSI/SCTE 02 2021: Specification for “F” Port, Female, Indoor

[SCTE 06] ANSI/SCTE 06 2019: Composite Distortion Measurements (CSO & CTB)

[SCTE 16] ANSI/SCTE 16 2018: Test Procedure for Hum Modulation

[SCTE 17] ANSI/SCTE 17 2018: Test Procedure for Carrier to Noise (C/N, CCN, CIN, CTN)

[SCTE 45] ANSI/SCTE 45 2017: Test Method for Group Delay

[SCTE 48-1] ANSI/SCTE 48-1 2021: Test Method for Measuring Shielding Effectiveness of Passive and Active Devices Using a GTEM Cell

[SCTE 58] ANSI/SCTE 58 2017: AM Cross Modulation Measurements

[SCTE 62] ANSI/SCTE 62 2018: Measurement Procedure for Noise Figure

[SCTE 81] ANSI/SCTE 81 2018: Surge Withstand Test Procedure

[SCTE 115] ANSI/SCTE 115 2019: Test Method for Reverse Path (Upstream) Intermodulation Using Two Carriers

[SCTE 124] ANSI/SCTE 124 2021: Specification for “F” Connector, Male, Pin Type

[SCTE 129] ANSI/SCTE 129 2021: Drop Passives: Bonding Blocks (Without Surge Protection)

[SCTE 143] ANSI/SCTE 143 2018: Test Method for Salt Spray

[SCTE 144] ANSI/SCTE 144 2017: Test Procedure for Measuring Transmission and Reflection

[SCTE 153] ANSI/SCTE 153 2021: 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. 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. Abbreviations

CSO	composite second order
CTB	composite triple beat
HFC	hybrid fiber-coax
Hz	hertz
MoCA	Multimedia over Coax Alliance
NID	network interface device
QAM	quadrature amplitude modulation
SCTE	Society of Cable Telecommunications Engineers
XMOD	cross modulation

6. Mechanical

6.1. RF Ports

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

6.2. 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.

6.3. Mounting

Mounting holes or slots *may* be located at the manufacturers' preferred locations provided they meet the requirements of 6.3.1 and 6.3.2 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.

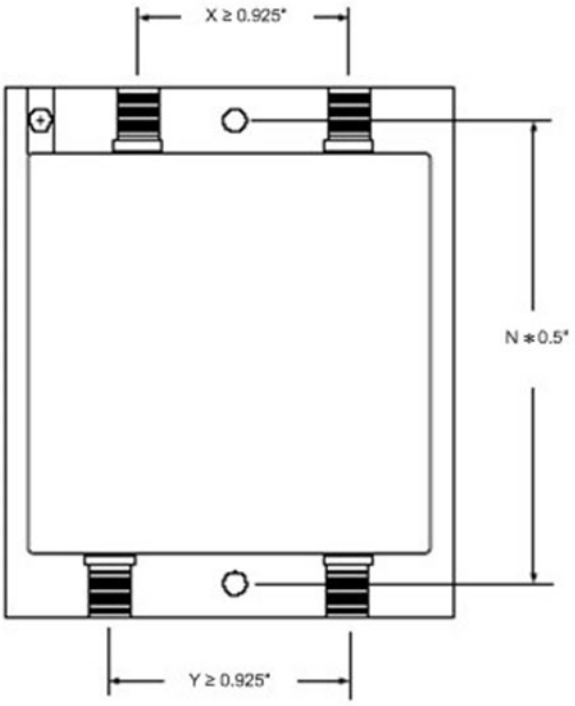

Figure 1 - Mechanical Configuration Example

Note: N = integer

7. 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 ***shall*** be equipped with bonding wire attachment points.
2. Integral bonding wire point ***shall*** conform to the requirements of [SCTE 129].

8. Labeling

1. Each port of the device ***shall*** be labeled. Designations ***shall*** 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 ***shall*** be prominently displayed that will include information on the Return and Forward bandwidths.
3. A label ***shall*** 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.
4. Components which do not meet the environmental requirements of Section 12 ***shall*** be prominently and permanently labeled “For indoor use only.”
5. 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.

6. 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.

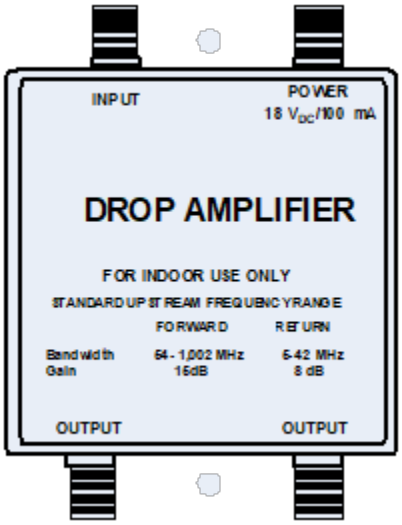

Figure 2 - Labeling Example

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

9. Electrical

9.1. Bandwidth and Forward/Return Frequency Splits

All devices ***shall*** be classified as Class 2 or Class 1 as defined per the forward bandwidth in this section.

- Class 2: Products that meet forward band specifications through 1218 MHz
- Class 1: Products that meet forward band specifications through 1002 MHz

Some common forward and return frequency splits are listed in Table 1.

Table 1 - Forward/Return Frequency Split Options

Split Name	Return Frequency Band	Forward Lower Band Edge Frequency
Sub-split	5-42 MHz	54 MHz
Euro-split	5-65 MHz	85 MHz
Mid-split	5-85 MHz	108 MHz
High-split	5-204 MHz	258 MHz

9.2. 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 [SCTE 144]

±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

9.3. 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 [SCTE 144]

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 [SCTE 153] for passive splitters with the same number of output ports.

9.4. 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 [SCTE 144].

9.5. 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 [SCTE 144].

9.6. 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 9.7 and 9.8.

The forward rated output power capability ***shall*** be specified by the manufacturer and ***shall*** be at least (+20-10log 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 return output 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.

9.7. 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 9.7.1 and 9.7.2, and when measured in accordance with [SCTE 06], the CTB ***shall*** be no greater than -70 dBc and the CSO ***shall*** be no greater than -60 dBc.
4. Cross Modulation (AM-XMOD): When loaded as specified in Sections 9.7.1 and 9.7.2, but with the carriers 100% synchronously modulated, and when measured in accordance with [ANSI/SCTE 58], 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 9.7.1 and 9.7.2, and when measured in accordance with [SCTE 17], the CCN ***shall*** be no less than 55 dB.

9.8. 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 [SCTE 115], the return path intermodulation distortion ***shall*** be no less than 55 dBc.

9.9. Noise Figure

Noise figures ***shall*** be measured in accordance with [SCTE 62].

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

9.10. 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 [SCTE 16]. 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.

9.11. Shielding Effectiveness

The shielding effectiveness of components when measured in accordance with [SCTE 48-1] ***shall*** be a minimum of 100 dB.

9.12. Group Delay

Group delay is to be measured in accordance with [SCTE 45].

1. Forward band chrominance-to-luminance delay ***shall not*** exceed ±30ns in the first ANSI/EIA 542 Standard channel, ±15ns 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 ±5ns over any 1 MHz span for frequencies between 10MHz and 6MHz below the upper specified bandwidth, ±20ns over any 1MHz span at frequencies below and above these frequencies to the rated bandwidth limits.

9.13. Surge Withstand

The amplifier ***shall*** meet all specifications after being subjected to 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. The amplifier *should* meet all specifications after being subjected to the and IEEE C62.41-1991 Category B-3 Combination Wave 6 kV, 3 kA on the forward RF input port. All surges are to be tested per [SCTE 81].

10. General

10.1. Furnished Instructions

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

10.2. 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.

10.3. Shock Resistance

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

11. Powering

11.1. Voltage Range

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

11.2. Power Consumption

Total power consumption ***shall*** be specified by the manufacturer.

11.3. Power Inserter

If a power inserter is utilized, it ***shall*** conform to [SCTE 153].

11.4. Power Supply Noise

With the amplifier powered, the switching power supply noise from the power supply ***shall*** be less than -38 dBmV when measured on any RF port from 1 MHz to 45 MHz in a 30 kHz resolution bandwidth.

12. Environmental

12.1. Applicability

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

12.2. Salt Spray

Components ***shall*** pass the salt spray requirements specified in [SCTE 143] for a minimum of 1,000 hours.

12.3. Temperature/Humidity

1. Devices ***shall*** 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 ***shall*** withstand temperatures of -40 to +140 degrees Fahrenheit (-40 to +60 degrees Celsius) and relative humidity from 5 to 99%, non-condensing, while operating without failure or permanent performance degradation.