

# SPINNER 5G Broadcast



## New Ways to Distribute Content – Achieve Wider Coverage and Lower Costs

Edition A/2023

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You can get the latest edition of our 5G broadcast catalogue in the download section of our website. Please follow this link: [www.spinner-group.com/downloads](https://www.spinner-group.com/downloads)

The specifications given here as well as the illustrations are for information only. They shall only be confirmed by SPINNER's written offer and are subject to technical amendments.

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## Introduction

### What's Behind of 5G Broadcast

Mobile networks are carrying steadily growing data volumes. Over the last decade, this trend has been driven by a significant increase in mobile phone use, data consumption, and interconnectivity. Two approaches currently address it:

#### 1. Overlay networks (HPHT)

Medium- to high-power broadcasting and multicasting stations for serving rural and suburban areas

#### 2. Supplementary downlinks (LPLT)

Cellular networks with broadcasting and multicasting modes for urban areas

As a creator of low-, medium- and high-power broadcasting equipment, we focus on overlay networks. Also called "5G Broadcast", this approach is based on the FeMBMS standard. By providing linear services such as coverage of live sport events and other services like public safety and smart device updating, it reduces the load of mobile networks. In addition, it is characterized by lower latency and wider coverage.

### FeMBMS: The Standard Behind 5G Broadcast

Release 14 of the 3GPP mobile broadband standard defines an LTE-based approach known as 5G Broadcast for FeMBMS (which stands for "further enhanced/evolved multimedia broadcast multicast service"). It involves supplementing a cellular network with an overlaid high-power/high-tower (HPHT) network. The fact is noteworthy that, for the first time, it makes it possible to devote 100% of transmission capacity to broadcasting services.

#### What's so special about FeMBMS?

- 100% downlink signal
- Supports SFN networks

### 5G Broadcast Trials

FeMBMS is being used in 5G Broadcast trials worldwide to shed light on the potential of broadcasting solutions based on the new 5G technology.

For example, in 2018 and 2019 the 5G TODAY test field was successfully operated in Bavaria with two SFN stations incorporating SPINNER products. And in the UK, the BBC has installed a 5G network on a remote island to test live streaming. There have also been other trials, for example at the Rock Rio Festival in Brazil and in Beijing, China.

When you work with SPINNER to create your 5G Broadcast solution, you benefit from our extensive experience in both broadcast and mobile communications.

Whether you start with only a vague idea, a well-developed plan, or a detailed block diagram, you're in good hands with us. We've been developing and implementing complex systems to link transmitters and antennas for more than 50 years.



The SPINNER 5G Broadcast 5MHz mask filter, which has been installed in the Torre de Collserola in Barcelona in 2020 and elsewhere

## Introduction

### What could 5G Broadcast Systems look like?

The success of a 5G Broadcast installation depends crucially on having a viable plan that is geared to the existing equipment in your TV tower. Broadcasting stations equipped with SPINNER systems are particularly easy to upgrade to 5G Broadcast. Thanks to our intimate familiarity with the technical data and mechanical dimensions of the installed equipment, we can quickly and easily draw up a concept.

SPINNER's portfolio spans a wide variety of components that can be inserted between the transmitter and antenna in radio stations.

If you don't have a radio transmitter system yet, just ask us to help you. We'll custom-design a system with SPINNER components that ideally suits you.

In addition to rigid line components, switches, patch panels, absorbers and monitoring couplers, our core product range also includes filters and combiners.

The chapters of this catalog focus on the product groups of our broadcast portfolio. If you need more detailed information on individual products, please consult our broadcast catalog. It's available on our website, where it's easy to find specific products using our Product Finder. The corresponding links are on the first page of this catalog.



Mask Filters

Combiners

Loads

Monitoring Couplers

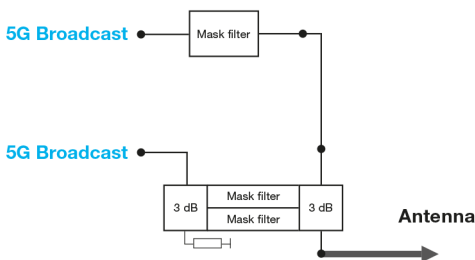
Cable Connectors

## Introduction

Depending on how an existing radio system is designed, there are various possible scenarios for integrating 5G Broadcast. In the following, we take a closer look at the options for configuring the system between the transmitter and the antenna, depending on the on-site situation.

**Scenario 1:** 5G Broadcast implemented as an autonomous system for transmitting via an antenna that is independent of existing television infrastructure.

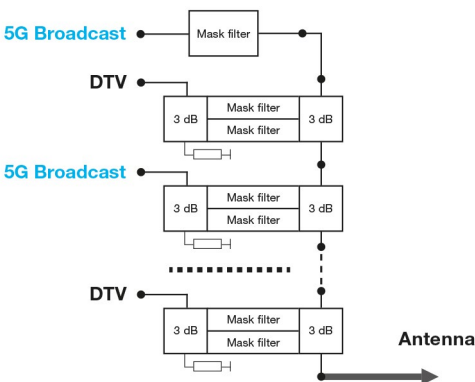
### Independent System



One or more 5G Broadcast-compliant transmitters are installed and operated at a broadcasting facility independently of the existing infrastructure. If there is only one transmitter, a mask filter is enough. If multiple signals need to be transmitted via the same antenna, they can be bundled using a so-called combiner consisting of 3 dB couplers and mask filters as shown in the graphic above. Other configurations are also possible, however.

**Scenario 2:** 5G Broadcast integrated in a TV combiner chain for transmission via a shared antenna  
The situation: one of a series of existing TV combiners, e.g. for DVB-T2, is no longer in use and has therefore been permanently bypassed using a patch panel.

### Mixed System



The solution: With only minimal effort, this obsolete combiner can be replaced with a suitable 5G Broadcast version that is mechanically perfectly compatible thanks to the SPINNER CCS (Compact Combining and Switching) design. It can be integrated in the combiner chain via the same patch panel that is now used to bypass it.



Typical design of SPINNER CCS combiners

Another possibility is to feed a 5G Broadcast signal into the broadband connection of the TV combiner chain via a mask filter. First, of course, it's necessary to check how much power can be fed into the broadband port of the system.

The aspects that need to be considered also include the power and voltage handling capabilities of the rigid line components and filters. The latter must be checked with especially great care if they carry signals in directly adjacent frequency ranges. This can be the case with two different 5G Broadcast signals or with a preexisting radio signal and a 5G Broadcast signal.

With adjacent-channel operation, it's also essential to look carefully at the filter tuning in the critical range and adjust it to the new adjacent channel if necessary.

## Introduction

If it's wished to integrate more than one service for 5G Broadcast, a good solution is to use a mask filter for the broadband signal together with a replacement combiner. A configuration of this kind is schematically illustrated in the figure above.

In case none of the TV combiners can be replaced with a 5G Broadcast combiner, there are other options. For example, the combiner chain for the antenna can be supplemented with a combiner that complies with the 5G Broadcast standard. In this case, the new combiner needs to support the total power. Any adjacent channels also have to be checked as described.

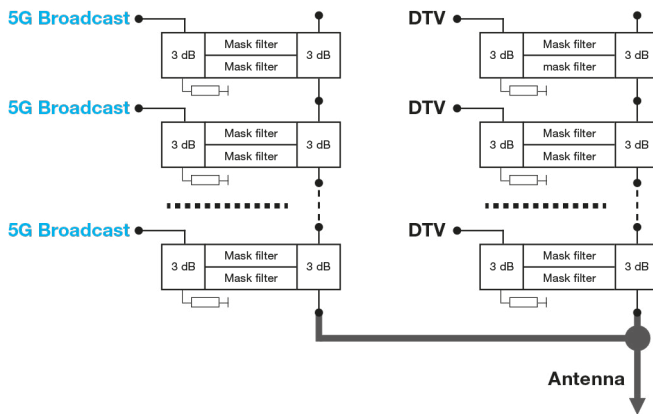
### Scenario 3: 5G Broadcast as an independent combiner chain for broadcasting via a shared antenna.

This scenario resembles the first scenario with 5G Broadcast as an independent system, with the difference that in this case 5G Broadcast lacks its own antenna. It is implemented as follows: a single filter, a single combiner or possibly a chain of combiners is combined with a series of TV combiners via an extremely broadband, high-performance combiner. The sum signal is then emitted via a broadcast antenna.

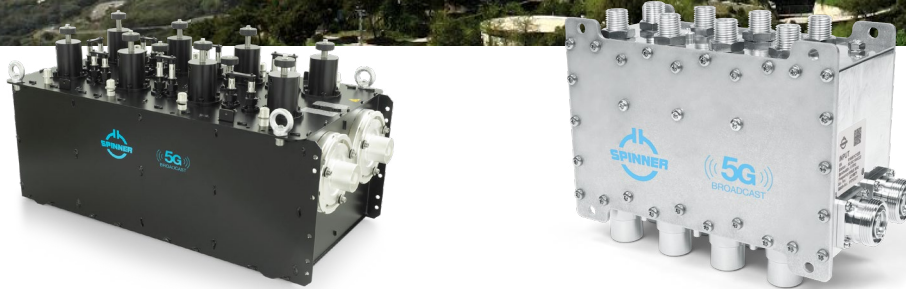
As we've seen, quite a few things need to be considered when designing infrastructure for 5G Broadcast. But there are many ways to achieve optimal results that flexibly combine the best of both worlds going forward. We at SPINNER are happy to advise and support you with everything from initial planning to dealing with mechanical and electrical details, backed by a comprehensive portfolio of UHF components.

In order to provide you with further information on our products in advance, you'll find a brief description of the product as well as an overview with the most important data at the beginning of each of this catalog's chapters.

### Independent Combiner Chain with Shared Antenna



## Bandpass Filters



**Bandpass and low-pass filters are inserted between a broadcasting transmitter's output and the antenna to limit out-of-channel emissions based on various mask specifications such as FeMBMS for LTE-based 5G Terrestrial Broadcast.**

SPINNER supplies coaxial bandpass and low-pass filters for various frequency ranges, including the UHF band.

Our filters can be tuned for different bandwidths:  
5 MHz, 6 MHz, 7 MHz, 8 MHz, 10 MHz

In this chapter, we show you a selection of our UHF mask filters for the typical bandwidths of mobile networks. For information on tuning for the typical bandwidths used for terrestrial digital television (6, 7 and 8 MHz), please refer to our broadcast catalog.



## Bandpass Filters

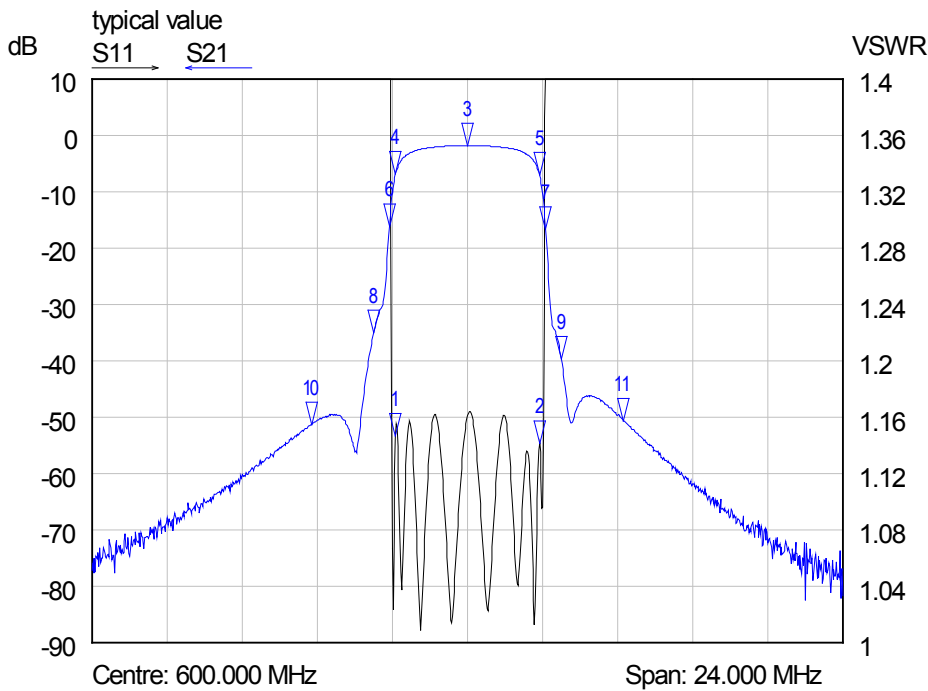
Alternative filter tunings are also available for other mask requirements, applications and bandwidths. Please don't hesitate to ask us.

"The environmental conditions for broadcast products" listed in the annex to this document must be ensured during operation, transportation and storage. The maximum rating of the filter depends on environmental conditions like temperature, cooling and elevation above sea level.

Most filters can be operated at up to 2300 meters above sea level (masl) at the power specified in the data sheet. For stations at higher altitudes, the power must be reduced as indicated in the environmental conditions for broadcast products.

For some filters with liquid cooling, derating must be carried out at altitudes above 500 masl as shown in the data sheets. The input and output ports of all bandpass filters terminate inside the resonators with an open or a short and therefore block DC and low frequencies.

Most bandpass filters have cross couplings to achieve steeper slopes for mask filtering. These are used in multi-channel combiners to enable adjacent channels.



Typical tuning of a 5 MHz filter BN 616661

## 80 W – 120 W UHF FeMBMS Bandpass Filter

- Mask filter for FeMBMS
- With cross coupling (notch function)
- Temperature compensation
- DC block
- For horizontal or vertical installation
- Low-profile design
- Other bandwidths available on request



| Part Number               | BN 616661C1225  |  | BN 616661C1025                                |  |
|---------------------------|---|--|---|--|
| Number/size of cavities   | <b>8/40</b>   |  |   |  |
| Harmonics attenuation     | ≥ 50 dB for f ≤ 1400 MHz  |  |   |  |
| <b>TV standard</b>        | FeMBMS @ 5 MHz<br>( $\dot{U}/U_{rms}=13$ dB)  | FeMBMS @ 8 MHz<br>( $\dot{U}/U_{rms}=13$ dB) | FeMBMS @ 10 MHz<br>( $\dot{U}/U_{rms}=13$ dB) |  |
| Frequency range           | 605 - 758 MHz   | 470 - 862 MHz                                | 620 - 803 MHz                                 |  |
| Average input power       | ≤ <b>80 W</b>   | ≤ <b>120 W</b>                               | ≤ <b>120 W</b>                                |  |
| VSWR (passband range)     | ≤ 1.17  | ≤ 1.15                                       | ≤ 1.17  |  |
| Temperature stability     | ≤ 2 kHz / K   |  |   |  |
| Connector                 | 7-16 female   |  |   |  |
| Dimensions (L x W x H) mm | 230 x 94 x 170  |  |   |  |
| Weight                    | ≈ 3.5 kg  |  |   |  |
| Environmental conditions  | See the "Environmental Conditions for Broadcast Products" on the last page for limitations. |  |   |  |

## 220 W – 375 W UHF FeMBMS Bandpass Filter

- Mask filter for FeMBMS
- With cross coupling (notch function)
- Temperature compensation
- DC block
- For horizontal or vertical installation
- Low-profile design
- Other bandwidths available on request



| Part Number               | BN 616568C1025  |   |
|---------------------------|---|---|
| Number/size of cavities   | 8/60  |   |
| Harmonics attenuation     | ≥ 50 dB for $f \leq 1200$ MHz   |   |
| <b>TV standard</b>        | FeMBMS @ 5 MHz<br>( $\dot{U}/U_{\text{rms}}=13$ dB)   | FeMBMS @ 8 MHz<br>( $\dot{U}/U_{\text{rms}}=13$ dB) |
| Frequency range           | 700 - 790 MHz   | 470 - 860 MHz                                       |
| Average input power       | ≤ <b>220 W</b>  | ≤ <b>375 W</b>                                      |
| VSWR (passband range)     | ≤ 1.17  | ≤ 1.15  |
| Temperature stability     | ≤ 2 kHz / K   |   |
| Connectors                | 7-16 female   |   |
| Dimensions (L x W x H) mm | 322 x 129 x 175   |   |
| Weight                    | ≈ 7.6 kg  |   |
| Environmental conditions  | See the "Environmental Conditions for Broadcast Products" on the last page for limitations. |   |

## 375 W – 750 W UHF FeMBMS Bandpass Filter

- Mask filter for FeMBMS
- With cross coupling (notch function)
- Temperature compensation
- DC block
- For horizontal or vertical installation
- Low-profile design
- Other bandwidths available on request



|                           |   |   |
|---------------------------|---|---|
| <b>Part Number</b>        | <b>BN 616403</b>  |   |
| Number/size of cavities   | <b>8/84</b>   |   |
| Harmonics attenuation     | $\geq 50$ dB for $f \leq 950$ MHz   |   |
| <b>TV standard</b>        | FeMBMS @ 5 MHz<br>( $\hat{U}/U_{\text{rms}}=13$ dB)   | FeMBMS @ 8 MHz<br>( $\hat{U}/U_{\text{rms}}=13$ dB) |
| Frequency range           | 605 - 803 MHz   | 470 - 860 MHz                                       |
| Average input power       | $\leq$ <b>375 W</b>   | $\leq$ <b>750 W</b>                                 |
| VSWR (passband range)     | $\leq 1.17$   | $\leq 1.15$   |
| Temperature stability     | $\leq 2$ kHz / K  |   |
| Connectors                | 7-16 female   |   |
| Dimensions (L x W x H) mm | 411 x 174 x 377   |   |
| Weight                    | $\approx 14$ kg   |   |
| Environmental conditions  | See the "Environmental Conditions for Broadcast Products" on the last page for limitations. |   |

## 1.20 kW – 2.0 kW UHF FeMBMS Bandpass Filters

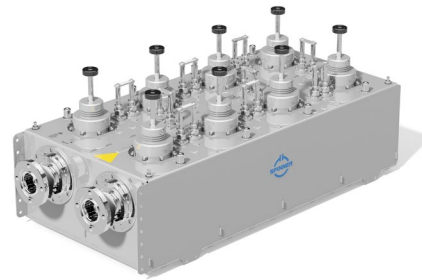
- Mask filters for FeMBMS
- With cross coupling (notch function)
- Temperature compensation
- DC block
- For horizontal or vertical installation
- Other bandwidths available on request



| Part Number               | BN 616542C1033  | BN 616542C1031                               |
|---------------------------|---|--|
| Number/size of cavities   | 8/150   |  |
| Harmonics attenuation     | ≥ 50 dB for f ≤ 860 MHz   |  |
| <b>TV standard</b>        | FeMBMS @ 5 MHz<br>( $\dot{U}/U_{rms}=13$ dB)  | FeMBMS @ 8 MHz<br>( $\dot{U}/U_{rms}=13$ dB) |
| Frequency range           | 605 - 803 MHz   | 470 - 860 MHz                                |
| Average input power       | ≤ <b>1.20 kW</b>  | ≤ <b>2.0 kW</b>                              |
| VSWR (passband range)     | ≤ 1.17  | ≤ 1.15                                       |
| Temperature stability     | ≤ 2 kHz / K   |  |
| Connectors                | 1 5/8" EIA  | 1 5/8" unflanged                             |
| Dimensions (L x W x H) mm | 675 x 326 x 411   |  |
| Weight                    | ≈ 36 kg   |  |
| Environmental conditions  | See the "Environmental Conditions for Broadcast Products" on the last page for limitations. |  |

## 3 kW – 6.25 kW UHF FeMBMS Bandpass Filters

- Mask filters for FeMBMS
- With cross coupling (notch function)
- Temperature compensation
- DC block
- For horizontal or vertical installation
- Low-profile design
- Natural, fan or liquid cooling
- Other bandwidths available on request



| Part Number               | <b>BN 616578C1031</b><br>1 5/8" SMS unflanged<br><b>BN 616578C1033</b><br>1 5/8" EIA | <b>BN 616578C2031</b><br>1 5/8" SMS unflanged<br><b>BN 616578C2033</b><br>1 5/8" EIA<br><b>BN 616578C2041</b><br>3 1/8" SMS unflanged<br><b>BN 616578C2043</b><br>3 1/8" EIA | <b>BN 616578C4031</b><br>1 5/8" SMS unflanged<br><b>BN 616578C4033</b><br>1 5/8" EIA<br><b>BN 616578C4041</b><br>3 1/8" SMS unflanged<br><b>BN 616578C4043</b><br>3 1/8" EIA |
|---------------------------|--|--|--|
| Cooling                   | Natural Cooling  | Liquid Cooling   | Fan Cooling  |
| Number/size of cavities   | <b>8/171</b>   |  |  |
| Harmonics attenuation     | ≥ 50 dB for f ≤ 1000 MHz   |  |  |
| <b>Mask filtering</b>     | FeMBMS @ 8 MHz<br>( $\hat{U}/U_{rms}=13$ dB)   |  | FeMBMS @ 10 MHz<br>( $\hat{U}/U_{rms}=13$ dB)  |
| Frequency range           | 470 - 700 MHz  |  | 605 - 695 MHz  |
| Average input power       | ≤ <b>3 kW</b> natural cooling<br>≤ <b>6.25 kW</b> forced cooling                     |  | ≤ <b>3 kW</b> natural cooling<br>≤ <b>6.25 kW</b> liquid cooling   |
| VSWR (passband range)     | ≤ 1.15   |  | ≤ 1.17   |
| Temperature stability     | ≤ 2 kHz / K  |  |  |
| Dimensions (L x W x H) mm | ≈ 730 x 352 x 330  |  |  |
| Weight                    | ≈ 38 kg  |  |  |
| Coolant/flow rate         | -  | Mix: glycol and water<br><b>BN 154567</b> / ≥ 3 l/min.   | Air  |
| Coolant temperature       | -  | 10 °C – 55 °C  |  |
| Cooling interface         | -  | Stainless steel tube 12 x 1 mm<br>with straight unflanged termina-<br>tion on connector side<br>(on request: straight or upward<br>termination at rear)                      | Power supply for fans:<br>24 V DC / typ. 25 W<br>Connector AMP 1-480703-0  |
| Cooling accessories       | -  | See "Accessories for Fan- and Liquid-CooledFilters".   |  |
| Environmental conditions  | See the "Environmental Conditions for Broadcast Products" for limitations.           |  |  |

## 2.5 kW – 7.0 kW UHF FeMBMS Bandpass Filters

- Mask filters for FeMBMS
- For 6, 7 and 8 MHz channel bandwidth
- With cross coupling (notch function)
- Temperature compensation
- For horizontal or vertical installation
- DC block
- Natural, fan or liquid cooling
- Other bandwidths available on request



| Part Number                | BN 616544C1033<br>1 5/8" EIA   | BN 616544C2033<br>1 5/8" EIA<br>BN 616544C2041<br>3 1/8" SMS unflanged<br>BN 616544C2043<br>3 1/8" EIA | BN 616544C4033<br>1 5/8" EIA<br>BN 616544C4041<br>3 1/8" SMS unflanged<br>BN 616544C4043<br>3 1/8" EIA |
|----------------------------|--|--|--|
| Cooling                    | Natural Cooling  | Liquid Cooling   | Fan Cooling  |
| Number/size of cavities    | 8/200  |  |  |
| Harmonics attenuation      | ≥ 50 dB for f ≤ 860 MHz  |  |  |
| <b>Mask filtering</b>      | FeMBMS @ 5 MHz<br>( $\dot{U}/U_{rms}=13$ dB)                               | FeMBMS @ 8 MHz<br>( $\dot{U}/U_{rms}=13$ dB)   | FeMBMS @ 10 MHz<br>( $\dot{U}/U_{rms}=13$ dB)  |
| Frequency range            | 605 - 705 MHz  | 470 - 870 MHz  | 470 - 860 MHz  |
| Average input power        | ≤ 2.5kW natural cooling<br>≤ 5 kW liquid cooling @0-500m                   | ≤ 4 kW natural cooling<br>≤ 7 kW forced cooling @0-500m  | ≤ 4 kW natural cooling<br>≤ 7 kW forced cooling @0-500m  |
| VSWR (passband range)      | ≤ 1.17   | ≤ 1.10   | ≤ 1.10   |
| Temperature stability      | ≤ 2 kHz / K  |  |  |
| Dimensions (L x W x H) mm  | ≈ 893 x 450 x 440  |  |  |
| Weight                     | ≈ 65 kg  |  |  |
| Coolant/flow rate          | –  | Mix: glycol and water<br>BN 154567 / ≥ 3 l/min.  | Air  |
| Temperature of the coolant | –  | 20 °C – 60 °C  | –  |
| Cooling interface          | –  | Stainless steel tube 12 x 1 mm<br>(straight unflanged termination<br>at rear)                          | Power supply for fans:<br>24 V DC / Typ. 25 W<br>connector AMP 1-480703-0                              |
| Cooling accessories        | –  | See "Accessories for Fan- and Liquid-CooledFilters".   |  |
| Environmental conditions   | See the "Environmental Conditions for Broadcast Products" for limitations. |  |  |

## 8 kW – 20 kW UHF DTV Bandpass Filter

- Mask filters for DTV and ATV
- For 6 MHz channel bandwidth
- With cross coupling (notch function)
- Temperature compensation
- Upright installation
- DC block
- Natural or liquid cooling



| Part Number  | BN 616508C1051   | BN 616508C2051   |
|--|--|--|
| Cooling  | Natural Cooling  | Liquid Cooling   |
| Number/size of cavities  | <b>8/300</b>   |  |
| Harmonics attenuation  | ≥ 67 dB for f ≤ 700 MHz  |  |
| <b>Mask filtering</b>  | FeMBMS @ 5 MHz<br>( $\dot{U}/U_{rms}=13$ dB)                               |  |
| Frequency range  | 470 - 530 MHz  |  |
| Average input power<br>The input power of liquid-cooled filters must be reduced if installed more than 2300 m above sea level. | ≤ <b>8 kW</b> natural cooling<br>≤ <b>20 kW</b> forced cooling             |  |
| VSWR (passband range)  | ≤ 1.17   |  |
| Temperature stability  | ≤ 2 kHz / K  |  |
| Connectors   | 4 1/2" unflanged   |  |
| Dimensions (L x W x H) mm  | ≈ 630 x 720 x 1480   |  |
| Weight   | ≈ 160 kg   |  |
| Coolant/flow rate  | –  | Mix: glycol and water BN 154567<br>≥ 6 l/min   |
| Coolant temperature  | –  | 10 °C – 55 °C  |
| Cooling interface  | –  | Stainless steel tube with G 1/2" thread (DIN EN ISO 228-1) – adapters available on request |
| Cooling accessories  | –  | See "Accessories for Fan- and Liquid-Cooled Filters".                                      |
| Environmental conditions   | See the "Environmental Conditions for Broadcast Products" for limitations. |  |



## 200 W – 10 kW Low-Pass Filters

- Low-pass filters for suppressing harmonics
- Compact design
- Low attenuation in passband



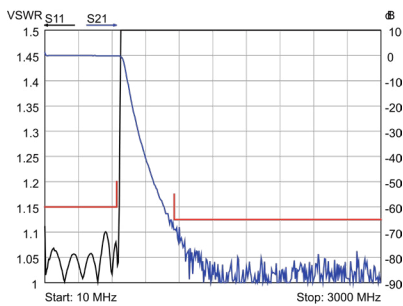
**BN 616453**



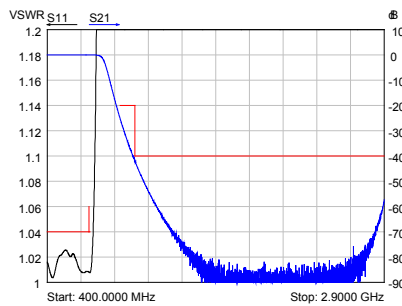
**BN 616455c0033**



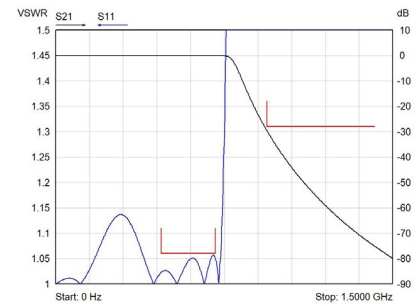
**BN 616456c0043**



Typical diagram



Typical diagram



Typical diagram

| Part Number<br>Connector  | <b>BN 616453</b><br>N-female / N-male                                      | <b>BN 616455C0031</b><br>1 5/8" SMS unflanged<br><b>BN 616455C0033</b><br>1 5/8" EIA | <b>BN 616456C0041</b><br>3 1/8" SMS unflanged<br><b>BN 616456C0043</b><br>3 1/8" EIA |
|---------------------------|--|--|--|
| Passband                  | 0 - 650 MHz  | 400 - 710 MHz  | 470 - 710 MHz  |
| Average input power       | <b>200 W</b>   | <b>≤ 4 kW</b>  | <b>≤ 10 kW</b>   |
| Passband insertion loss   | ≤ 0.2 dB   | 400 - 710 MHz ≤ 0.05 dB  | 470 - 710 MHz ≤ 0.05 dB  |
| Stopband attenuation      | 1160 MHz > 65 dB<br>1500 MHz > 80 dB<br>3000 MHz > 80 dB                   | 940 - 1060 MHz ≥ 20 dB<br>1060 - 2900 MHz ≥ 40 dB                                    | 940 - 1060 MHz ≥ 28 dB<br>1060 - 2900 MHz ≥ 40 dB                                    |
| VSWR (passband range)     | 1.15   | ≤ 1.04   | 470 - 710 MHz ≤ 1.06   |
| Group delay variation     | $\Delta\tau \leq 5$ ns   | $\Delta\tau \leq 2$ ns   | $\Delta\tau \leq 2$ ns   |
| Proof voltage             | 1.5 kV   | 7 kV   | 14 kV  |
| Dimensions (L x W x H) mm | 277 x 26,5 x 26,5  | BN 616455C0031: 470 x 42 x 42<br>BN 616455C0033: 500 x 90 x 90                       | BN 616456C0041: 455 x 80 x 80<br>BN 616456C0043: 502 x 130 x 130                     |
| Weight                    | ≈ 0.8 kg   | ≈ 1.1 kg   | ≈ 3.5 kg   |
| Environmental conditions  | See the "Environmental Conditions for Broadcast Products" for limitations. |  |  |

## Accessories for Fan- and Liquid-Cooled Filters

SPINNER supplies fan- and liquid-cooled filters and combiners for high transmitter power levels.

Fan and liquid cooling are almost equally effective. However, it is simpler to install fan cooling systems because they only require DC wiring, whereas hoses and pumps are needed for liquid cooling systems.

Another difference is that fan cooling spreads the heat around the room, while liquid cooling can carry it outdoors. Which cooling system is best in a given case depends on things like whether a liquid cooling system already exists, the capacity of an available air conditioning system, and redundancy requirements.

If forced cooling fails, operation can be continued with natural cooling at reduced power. SPINNER supplies all cooled filters and combiners with a temperature switch that shows whether the filter is too hot (85°C or more) and it is therefore necessary to reduce the power.

The fans have to be powered with 24V DC from an existing source or via a SPINNER BN 155815 power adapter, which has capacity for up to 10 filters. SPINNER has many options for implementing liquid-cooled filters, either to supplement existing cooling systems or for use as standalone combiner cooling systems with heat sinks:

- Various interfaces for cooling pipes
- Cooler unit with heat sinks



Pump unit and UHF combiner with liquid cooled filter



Pump unit and indoor cooler

## Accessories for Fan- and Liquid-Cooled Filters

| <b>Cooling tube accessories</b>  | <b>Part Number</b>    |
|--|-----------------------|
| Tube fitting hose barb connector 1/2"                                    | <b>BN A72955</b>      |
| Tube fitting gauge connector 3/8" female straight                        | <b>BN A74262</b>      |
| Tube fitting gauge connector 3/8" male straight                          | <b>BN A74263</b>      |
| Tube fitting gauge connector 3/8" female 90° elbow                       | <b>BN A74318</b>      |
| Tube fitting gauge connector 3/8" male 90° elbow                         | <b>BN A74320</b>      |
| Tube fitting gauge connector 1/2" female straight                        | <b>BN A74260</b>      |
| Tube fitting gauge connector 1/2" male straight                          | <b>BN A74261</b>      |
| Tube fitting gauge connector 1/2" female 90° elbow                       | <b>BN A74317</b>      |
| Tube fitting gauge connector 1/2" male 90° elbow                         | <b>BN A74319</b>      |
| <b>Coolant</b>   |                       |
| 25-liter canister with coolant (mix glycol and water and anti corrosive) | <b>BN 154567</b>      |
| <b>Cooler</b>  |                       |
| Cooling unit with reservoir, twin pump, water splitter, valves           | <b>BN 155729</b>      |
| <b>Fan cooling accessories</b>   |                       |
| 24V power supply with Schuko plug  | <b>BN 155815</b>      |
| 24V power supply with US plug  | <b>BN 155815C0001</b> |
| Spare fan  | <b>BN B22410</b>      |
| DC distribution cables   | <b>BN 155817</b>      |
| <b>Temperature switches</b>  |                       |
| Normally closed contact opening at 71 °C (optional)                      | <b>BN A72406</b>      |
| Normally closed contact opening at 85 °C (included)                      | <b>BN B18100</b>      |

## Channel Combiners



**SPINNER offers different types of combiners such as starpoint, manifold and CIB combiners with constant impedance. Most of the combiners are supplied with integrated mask filters.**

### Multichannel Combiners

In order for multiple transmitters to broadcast via a shared antenna, it is necessary to connect the transmitter outputs using a combiner so that they can't interfere with one another (isolation) and route all of the RF power to the antenna (insertion loss).

Bandpass filters are a key component of multichannel combiners. They set the frequencies in the combiners and can suppress spurious emissions, e.g. with mask filtering for FeMBMS.

## Channel Combiners

### Starpoint and Manifold Combiners

Transmitters can be isolated from one other by connecting a bandpass filter to each output. To achieve good matching of the operating channels, the outputs of these filters must be connected via a suitable matching network.

It's important to keep in mind that this system will exhibit a total mismatch outside the operating channels, due to total reflection by the bandpass filters.

Frequency changes or extensions are difficult to accomplish with combiners of these kinds, because the matching networks have to be optimized for the new frequencies.

### Constant Impedance Broadband (CIB) Combiners

Good isolation, broadband matching and easy modification can be achieved in the CIB combiner with a combination of bandpass filters and 3 dB couplers.

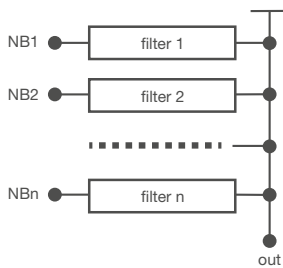
Please note that the CIB combiners only have mask filtering for the narrowband input. If mask filtering of the wideband input is required, appropriate bandpass filters must be additionally inserted.

All of the ports are broadband-matched (yielding constant impedance across a broad band).

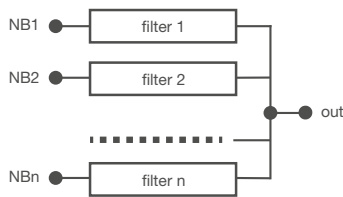
Any transmitter signal can be fed into the wideband input as long as the frequency spacing across the filters' pass-band range is large enough to ensure total reflection. Even adjacent channels can be combined if the slopes of the filter curves are steep enough. CIB combiners are the preferred components for designing multichannel combiners because they provide the greatest flexibility for configuring channels and power levels.

After choosing a combiner type (CIB, starpoint, manifold or stretchline), you need to select a model with an adequate power rating.

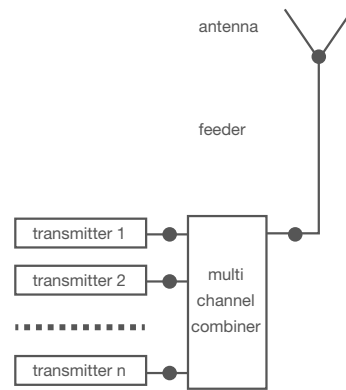
SPINNER's combiner engineers will be happy to help you select and plan combiner systems. Please send a table indicating the channels and specifications to [info@spinner-group.com](mailto:info@spinner-group.com).



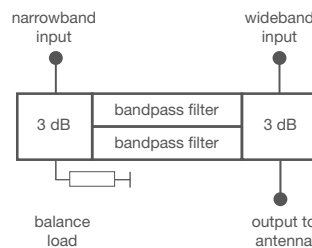
Manifold combiner



Starpoint combiner



Multichannel combiner



Constant impedance broadband combiner

## Patch Panels



**Patch panels are used to route transmitter signals to single, half or backup antennas or dummy loads or to bypass intermediate systems such as combiners or splitters.**

Switching can be performed by motorized switches or manually with U-links. All patch panels have an interlock system that briefly switches off the transmitter during the switchover.

All input and output connectors terminate horizontally with an EIA flange system behind the front panel.

The systems connected to the patch panel can be easily, quickly and precisely measured with test adapters.

SPINNER supplies patch panels for all frequency ranges and sizes (7-16 to 6 1/8"). On request, patch panels can

also be equipped with 3dB couplers for use as power splitters or with measurement couplers.

**Note:**

With digital signal operation, the transmittable power is limited either by the proof voltage (while taking the crest factor into account), or by the average power.

When operating multiple transmitters, please apply the sum of the individual voltages. This is also true of analog systems.

## Patch Panels

### Most Common Designs

Our 2-, 3- and 4-port patch panels are often integrated into a combining system with one patch panel per combiner unit. This way, it's easy to individually bypass each unit for maintaining.

The most common application for 6-port patch panels is operation of two half antennas. Our suitable products are equipped with power splitters, or as already mentioned with hybrid couplers. They are supplied inside an open rack or integrated into a system.

The photo below shows a combining system with integrated 4-port patch panels. Also included is a 6-port antenna patch panel with power splitter.



## Parallel Switching Units and Switchless Combiners



**Parallel switching units are used to double the output power by combining two transmitters that operate at the same frequency and have a phase differential of 90°.**

Typically, the failure of a transmitter will cause the output power to drop by 75% because half of the power from the working transmitter then flows into the balancing load of the 3 dB coupler.

The SPINNER parallel switching unit can reroute transmitter 1 or transmitter 2 straight to the antenna and transmitter 2 or transmitter 1 to the dummy load within seconds.

As a result, 50% of the original output power then once again becomes available and the disconnected transmitter is freed for repair or maintenance work. The combined

output of both transmitters can also be routed to the dummy load for measurements.

Switching is done by remotely controlled, motorized two-way switches. In an emergency, the switches can also be operated manually or replaced by U-links. Interlock contacts are available for all cases.

SPINNER supplies parallel switching units for FM, VHF and UHF with various power ratings for analog and digital transmission.



## UHF 30 kW Switchless Combiners

SPINNER has supplied many conventional parallel switching units with U-links or motorized switches and also offers switchless combiners in “SPINNER quality” as an alternative. Before explaining the details of the switchless combiner, we will compare the advantages of these two competing approaches and explain why SPINNER offers both.

Parallel switching units with U-links or motorized switches:

- No hot switching
- High isolation of transmitters by galvanic separation of RF paths via switches or U-links
- Functionality defined by switch positions independently of the operating frequency

Switchless combiner with trombone line phase shifter:

- Hot switching
- Transmitters are not galvanically isolated; 35 dB of isolation is provided by 3 dB couplers
- Functionality is defined by the position of the trombone and requires readjustment if the frequency changes.

The SPINNER switchless combiner consists of two hybrid couplers connected by a fixed transmission line and a motor-driven trombone line acting as a mechanical phase shifter. A sophisticated control unit makes the switchless combiner as easy to handle as a parallel switching unit, permitting both local and remote control.

The transmitters can continue operating without interruption while the phase shifter is moving; the input ports are always matched, and the power is correctly routed at all times.

The SPINNER switchless combiner also includes safety and emergency functions:

- It retains its position even if control signals or the power supply are interrupted, resuming operation when the signals return.
- It can be operated manually.
- There is a set of potential-free signaling switches that are independent of the control unit and power supply. They indicate whether the switchless combiner has gone into the right operating mode.
- The control unit sends warning and error signals.

The switchless combiner can be readjusted on-site to any channel in the UHF band.

SPINNER supplies a full range of accessories for installing, retuning and operating the switchless combiner:

- Loads
- Monitoring couplers
- Measurement adapters and calibration kits

SPINNER supplies the switchless combiner as an alternative for network operators whose priority is to prevent any interruption of transmission.

**Note:**

The RF signals from the transmitters must be adjusted to ensure that they are in phase at the inputs.

## Two-Way Coaxial Switches



**SPINNER supplies a wide variety of switch types for highly demanding applications. Their RF ratings range from a few watts to several hundred kilowatts, and they are available for sizes from N to 8 3/16" and frequencies up to 6 GHz.**

SPINNER's RF switches consist of different drive types (lifting magnet, impulse solenoid or motor drive) for switching times from 25 ms up to about one second. The two-way switches, which come in from N up to 8 3/16", are the fastest RF switches available in the marketplace.

Due to their extremely compact dimensions and exceptional dependability, SPINNER switches are preferred for

systems that must be highly reliable. The 2+1 and 4+1 switching units developed by SPINNER are excellently suited for ensuring operation of redundant systems. In 19" rack systems, these compact switching systems have a height of only 1 rack unit yet are able to keep remote stations broadcasting even if a transmitter should fail.

## Two-Way Coaxial Switches

### Manual Operation

With manually operated switches, the switch position is selected using a knob. The switch locks at its end positions to reliably maintain them even if it is subjected to vibrations or rotates around a rotor axis

### Impulse Solenoid Drive

In switches with an impulse solenoid drive, the rotor torque is generated by a rotating permanent magnet surrounded by a stationary coil. The drive system has two stable switching positions and locks in both end positions (i.e. it is latching). A pulse is therefore sufficient as a control signal (no control voltage is required after switching). In the event of a power failure or system restart, the most recent switch position is retained.

There is also a failsafe switch version that is reset to its initial position by a spring if the power fails.

### Lifting Magnet Drive

In this version, electromagnetic force moves a lever from its resting position to its final position. When the current stops, the lever is reset to its resting position by an externally applied force such as a spring. Either the drive is not locked in either position (monostable) or else it is held in place by an auxiliary magnet (bistable).

### Motor Drive

Motorized switches are turned by a special gear mechanism developed by SPINNER (see “hypocycloid gear mechanism” below). This drive system rotates by 90° and locks in both end positions.

### Hypocycloid Gear Mechanism

The drive and switch base (rotor) are connected by a special gear mechanism developed by SPINNER. This mechanism varies the torque and angular velocity across the switch’s rotational range. Initially, the torque is very high while the angular velocity of the switch rotor is very low. Then, as the angle increases the angular velocity steadily increases while the torque decreases. After passing the middle of the range, this is reversed and the angular velocity decreases while the torque increases. The drive mechanically locks in both end positions.

### Signaling and Interlock Contacts

Potential-free SPDT contacts (signaling contacts) indicate the current switch position.

The interlock contacts are coupled with RF contacts for interrupting RF power before and during switching. They open before the RF contacts separate and close after the RF contacts are in their new positions.

The maximum switching limits of these contacts are 42.4 V ACpk / 60 V DC / 0.5 A. For BN 512663 and BN 512665 the limits are 42.4 V ACpk / 50 V DC / 0.1 A.

### Ingress Protection

The ingress protection class is IP40 (EN60529), meaning that the switches are only suitable for indoor use. Switches for outdoor installation are available on request.

### Power Ratings

All power ratings apply to room temperature (about 25 °C), normal air pressure (about 1000 hPa), relative humidity of about 50% and an RF-matched state. Specified power ratings are for the highest given frequency and can be transmitted via both switch paths concurrently. If you require operation with pulsed power, please ask us for assistance.

### Dimensions

All dimensions are in mm.

### Note:

The maximum average transmittable power of digital signals (e.g. DAB, DVB-T, ATSC, ISDB-T etc.) is rated by applying an RF proof voltage while taking the crest factor into account. When operating multiple transmitters with analog or digital signals, the sum of their voltages must be considered.

## Rigid Lines and Cable Connectors



**SPINNER supplies three types of rigid line systems: EIA, SMS and flaring (BT).**

## Rigid Lines and Cable Connectors

### EIA System

Coaxial flange connectors, generally known as “EIA flanges”, are connected by a coupling element. The flange connector system complies with EIA STD RS-225, 339 IEC, DIN EN 122150 and MIL-F 24044. EIA flange connectors are excellently suited for pressurized systems and outdoor installations.

### SMS System

The SPINNER quick clamping system, called “SMS”, complies with international rigid line standards including EIA STD RS 225, 339 IEC and DIN EN 122150.

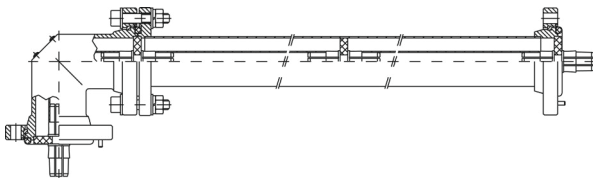
Its parts are connected by line splices and secured by clamps. The major advantage of the SMS system is that customers can easily cut the rigid line to length on site

without the need for flaring or brazing. Assembly is therefore very simple and requires no special tools. The SMS system is only suitable for indoor use.

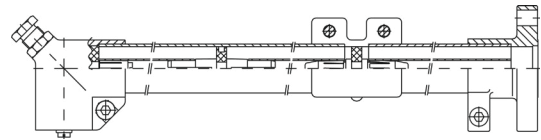
### Flaring System (BT)

The outer conductor tube is flared using a SPINNER flaring tool. Its parts are connected by coupling elements. The electrical contact at the outer conductor consists of a metal ring mounted on the edge of the coupling elements’ insulation disk. The resulting very stable connection ensures high RF tightness and a repeatable electrical length.

The 52-120 BT flaring system is intended for indoor use and designed to handle RF power at levels up to 860 MHz. Please keep in mind that internal supports may be required, depending on the line length, to prevent the inner conductor from sagging.



Example of EIA assembly



Example of SMS assembly

## Cable Connectors and Accessories

SPINNER carries N, 4.3-10, 7-16, 7/8" EIA, 1 5/8" EIA, 3 1/8" EIA, 4 1/2" EIA (339 IEC 50-105) and 6 1/8" EIA connectors for cables made by leading manufacturers. They are famous for their superior RF performance and reliability going back over 60 years:

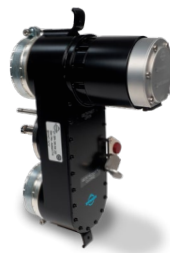
- CAF® design for ultrafast installation: simply push the stripped cable end into the connector.
- Premium design with flared inner and outer contacts for maximum reliability at high RF power levels

- Connectors for air dielectric cables are tight (the barrier and mating are face-sealed) and have inlets for pressurization.
- There is no risk of water ingress and corrosion, since the gap between the outer conductor and the connector is sealed with Plast 2000 or a custom-shaped gasket.



## AMS Antenna Monitoring System

Distance to Fault Detection



**The SPINNER Antenna Monitoring System (AMS) protects broadcasting infrastructure by continuously monitoring the entire antenna system. If any faults occur, such as arcing or water ingress, you are warned in time to prevent a severe failure.**

Radio and television broadcasters worldwide rely on their systems to deliver content to listeners and viewers. Although their infrastructure may be robust, it can still be vulnerable.

Arcing or water ingress can occur for various reasons such as damaged components by bad weather or long-term use, improper installation, RF overloads, or even unexpected events.

The heat generated by the arc can damage the infrastructure or even cause a fire, thus completely disabling the broadcast system. The resulting long off-air times and financial losses incurred by repairs and legal claims are often substantial.

Operators therefore need a reliable early failure detection system to prevent serious damage. The SPINNER Antenna Monitoring System can help with this.

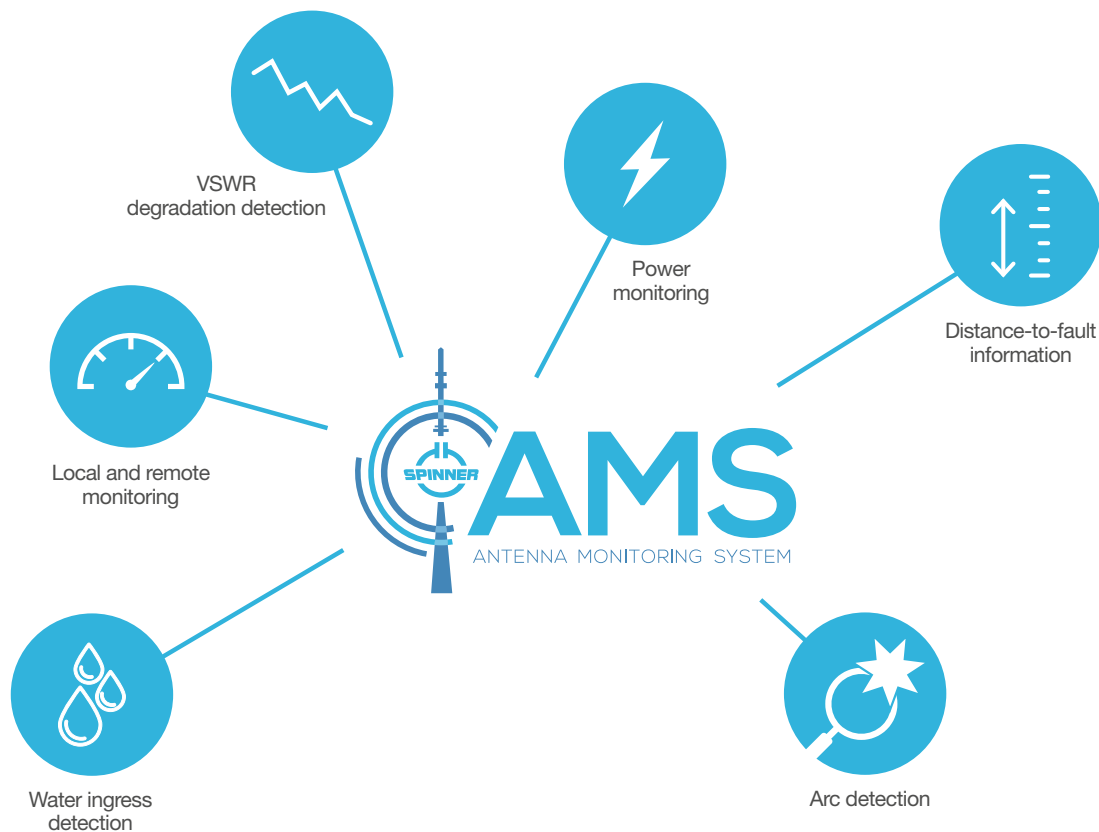
## AMS Antenna Monitoring System

The AMS uses two different measurement methods to reliably detect any type of arc, even ones that won't cause VSWR degradation. It also informs you where the problem is so it can be quickly repaired, thus saving you both time and money.

If a fault is detected, you are informed not only locally by LED lamps, but also remotely via SNMP and a user-friendly web interface. Optionally, you can also connect the AMS to the interlock loop of your transmitter, switching it off in the event of an alarm to protect the infrastructure.

Optionally, a power monitoring add-on is also available. It monitors the power level and return losses on up to four RF channels (eight RF probes). Different thresholds for warnings and alarms can be individually set. All of the information is displayed on the web interface and also sent via SNMP. An interlock interface is also available.

It has an ingeniously simple design, with quick and easy installation. All the components are housed indoors. There are no invasive changes to the system, and no signals are injected into your antenna.



### Features & benefits:

- ✓ Fault detection, as arcing and water ingress
- ✓ Distance-to-fault information
- ✓ Optional power monitoring add-on
- ✓ Remote monitoring via SNMP and web interface
- ✓ Local signaling via LEDs and status relays
- ✓ Protection by integration in interlock loop
- ✓ Detection in antennas up to 750m / 2460 feet
- ✓ Compact design
- ✓ Fast and easy installation
- ✓ All components indoors
- ✓ No signal injected into antenna line
- ✓ Suitable for pressurized lines
- ✓ 4 digital inputs for any use, e.g. pressure sensors

## Adapters and Measurement Accessories



**SPINNER carries a comprehensive range of accessories for facilitating measurement and maintenance work.**

For example, we supply adapters for almost all common international connector systems, directional couplers for measuring forward and reflected power.

SPINNER is also a world-class supplier of high-precision components for testing and calibration up to 110 GHz. Terrestrial broadcasting applications typically operate at much lower frequencies, so we have also put together a selection of components that come in handy for performing

the most common tests and measurements required for broadcasting equipment: calibration kits, precision adapters and cables, etc.

Also included in our measurement accessories portfolio are direct access units, which facilitate access to coaxial line systems for measurement purposes.



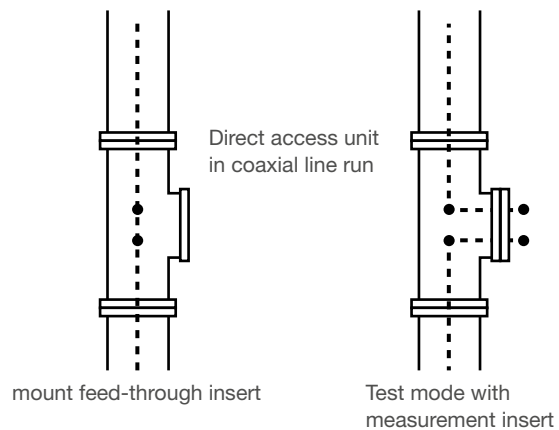
## Adapters and Measurement Accessories

### Direct Access Units

The most versatile and sophisticated solution for accessing coaxial line systems are so-called direct access units. They ensure excellently matched, full galvanic contact with the coaxial line for making measurements and ensuring full performance during normal operation.

- Measurements of all kinds can be made in minutes without dismantling any part of the coaxial system.
- No degradation of VSWR or power rating during normal operation thanks to a feed-through insert
- No need for adaptors, because the test ports are equipped with high-quality 7-16 DIN or N-female connectors

If you're interested in getting more information on this product, we'll be happy to advise you. You can also check out our Application Note TD-00178.



## Loads



**Loads and attenuators have to meet diverse requirements in terms of performance and connector systems, and a new system makes it simple for you to get exactly what you need.**

SPINNER supplies loads for various applications including:

- Precise low-power loads for testing and calibrating network analyzers at up to 67 GHz
- Low PIM loads for testing
- Medium-power loads for terminating ports and balancing channel and power combiners
- High-power loads for testing transmitters up to 55 kW

Different cooling types are available depending on the absorbed power and application:

- Natural cooling for loads up to 2.5 kW
- Fan cooling for loads up to 5 kW
- Liquid cooled loads with integrated or external coolers

## Environmental Conditions for Broadcast Products (TD-00060)

These environmental conditions for broadcasting products apply unless otherwise stated on a product page.

| Products   | Combiners, Filters   | Patch Panels, Switches, Coaxial Rigid Line Components   |
|--|--|---|
| Operational conditions                           | ETSI EN 300 019-1-3 V2.3.2 (2009-1) class 3.1 N  |   |
| Ambient temperature                              | -10 °C ≤ θ ≤ +45 °C  |   |
| Condensation                                     | Not allowed  |   |
| Relative humidity                                | ≤ 95 %   |   |
| Derating of input power with increasing altitude | <p>The maximum input power can be applied up to 2286 m or 7500 ft above sea level unless noted otherwise in the data sheet. Above this height the maximum input power must be reduced as shown in the diagram.</p> | <p>The maximum input power can be applied up to 500 m or 1600 ft above sea level unless noted otherwise in the data sheet. Above this height the maximum input power must be reduced as shown in the diagram.</p> |
| Derating of voltage with increasing altitude     | Included in the derating of input power  | <p>The maximum voltage can be applied up to 500 m or 1600 ft above sea level unless noted otherwise in the data sheet. Above this height the voltage must be reduced as shown in the diagram.</p>                 |
| Transportation conditions                        | ETSI EN 300 019-1-2 V2.1.4 (2003-04) class 2.2   |   |
| Ambient temperature                              | -25 °C ≤ θ ≤ +70 °C  |   |
| Rain, condensation, ice                          | Not allowed  |   |
| Storage conditions                               | ETSI EN 300 019-1-1 V2.1.4 (2003-04) class 1.2   |   |
| Ambient temperature                              | -10 °C ≤ θ ≤ +45 °C  |   |
| Rain, condensation, ice                          | Not allowed  |   |
| Safety   | EN 60215 (1994) / IEC 215 (1993)   |   |



## HIGH FREQUENCY PERFORMANCE WORLDWIDE

SPINNER designs and builds cutting-edge radio frequency systems, setting performance and longevity standards for others to follow. The company's track record of innovation dates back to 1946, and many of today's mainstream products are rooted in SPINNER inventions.

Industry leaders continue to count on SPINNER's engineering excellence to drive down their costs of service and ownership with premium-quality, off-the-shelf products and custom solutions. Headquartered in Munich, Germany, the global frontrunner in RF components remains the first choice in simple-yet-smart RF solutions.

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