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S-BAND SATCOM SOLID STATE POWER AMPLIFIERS CATALOGUE

Revision A

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S Band Power Amplifiers

BHE has been supporting the Space segment for more than twenty years. Its productions are operating on ground, aerial, and space level. As key part of the satellite communication systems BHE developed and manufactured numbers of amplifiers which have led to comprehensive portfolio in this area. The collection includes standard and custom tailored solutions too. Flexibility, reliability and more than twenty years of experience make BHE be professional amplifier manufacturer. BHE has the honour to supply major companies worldwide which are leaders in the space resource and development segment.

As a result of modular thinking BHE's power amplifiers contains four sub-blocks. The conceptual block diagram of the power amplifier is shown in Figure 1. The sub-blocks are:

- preamplifier
- high power final stage
- control board
- power supply

PC based graphical user interface keeps the connection between the user and the equipment. Ethernet, RS 232, RS-485, RS-422 interface can be applied as a remoter control interface (gain, output power, RF ON/OFF, etc). As option, an indoor control unit can be selected to control remotely the power amplifier without PC.

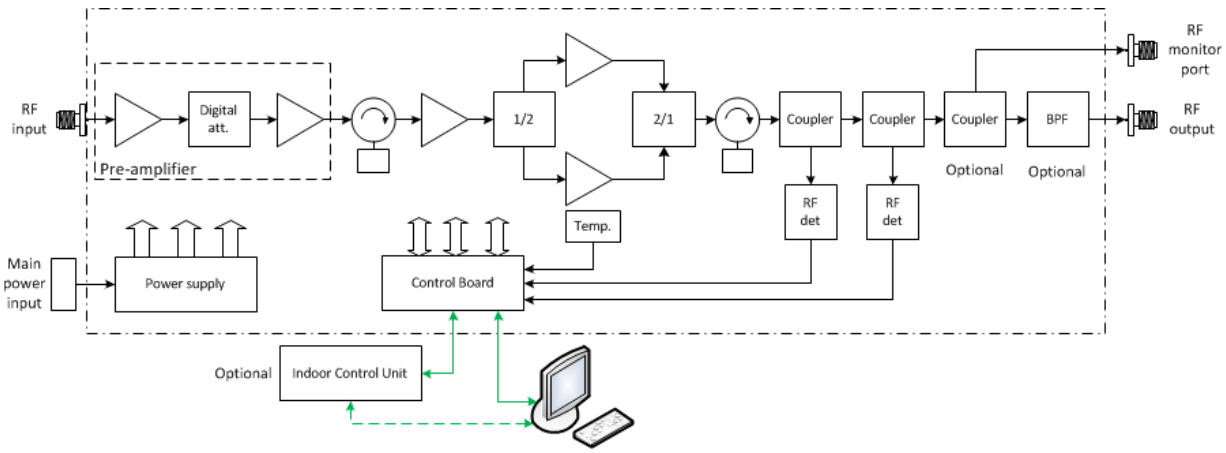

Figure 1. Conceptual block diagram of S band SSPA

Preamplifier

The preamplifier section generally incorporates two to three amplifier stages and a digitally controlled attenuator to adjust the overall gain value of the amplifier. This section makes the major part of the gain and gives appropriate signal level to the high power final stage.

The bias voltage and current values are monitored in the preamplifier stage; moreover the input signal level can be monitored if necessary. The pre-amplifier can have low noise parameter, high dynamic range or limiter section can be implemented according to the application environmental.

Thanks to the state-of-the-art semiconductors are applied the input section has minimal gain variation even in wide or narrow band, respectively.

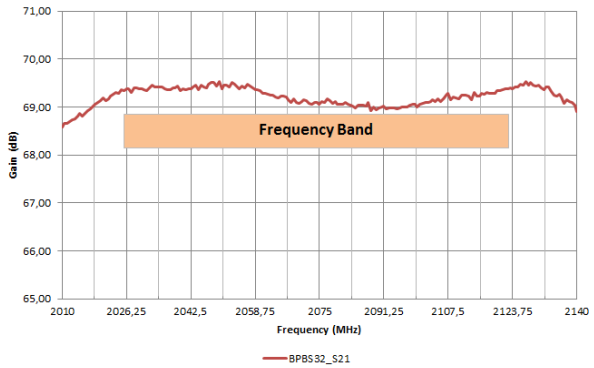

Figure 2. Typical transfer characteristic

High Power Final Stage

The high power final stage consists of one or more high power FET, according to the requested output power. When high output power is necessary generally more high power FET operate parallel. Their output power is combined at the output of the final stage. All the bias voltage and current values are monitored individually FET by FET. Each sub-module has a temperature sensor which monitors the temperature of the module. If the temperature exceeds the threshold the amplifier switches the final stage off, in order to prevent damage.

The final stage has medium gain value but provides high output power level. Basically GaN semiconductors are applied as power FETs.

In order to provide proper information the forward and reflected power are monitored at the output of the final stage. The RF detectors give DC signal which proportional the RF power. For output signal and power monitor purposes an additional directional coupler gives an RF sample at the RF monitor port which typically less than the forward power by 30-50 dB.

When high harmonics rejection value is required an extra filter is taken place at the output which can provide typically 60 dB rejection on the second harmonics frequency. All the additional losses of the couplers and filter are compensated in order to achieve the nominal output power.

Control board

This is the brain of the state-of-the-art power amplifier product. The embedded software in the centre processor unit does all the necessary control and monitoring tasks. This CPU monitors all the bias values temperature, forwarded and reflected power. The main control board gets commands either form the indoor control unit or remotely via remote control interface. The graphical user interface provides user friendly control and monitor options to the user. The remote control interface can be either serial port (RS-232 or RS-485, RS-422) or Ethernet interface. On the top of the control and monitoring the CPU provides alarm signals which must be handled with high priority.

Figure 3. Indoor control unit for satellite SSPA

Power supply

The main function of this block is to provide appropriate DC voltage to the sub-blocks. The power amplifier include high efficiency AC/DC and/or DC/DC amplifier modules which provides stabile DC voltage and current. Thanks to the high efficiency low power consumption and high reliability performance is provided. The input power is basically 230 V AC, 50 Hz, 1 phase.

Figure 4. BPBS32 S band SSPA

SSPA M&C Software

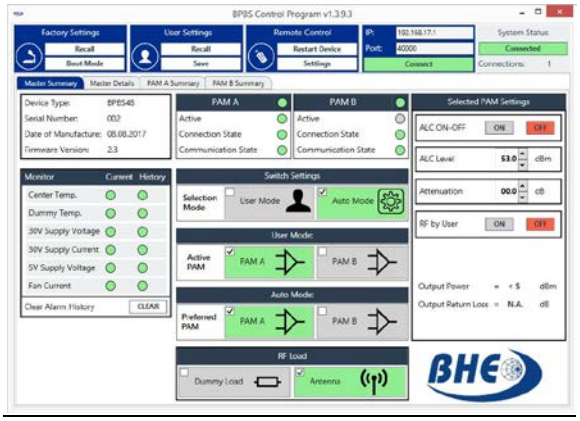

Figure 5. M&C SW Master Summary Screenshot

The M&C Software (Monitoring & Control Software) is essential part of the SSPAs. It provides a useful and reliable tool in effective and professional exploitation of the amplifiers. By means of it, all amplifier parameters – down even to the fan currents – can be measured and monitored, and all control, setting, fine-tuning and measurement data request operations can be performed remotely.

Figure 6. M&C SW PAM Summary Screenshot

500 W SSPA System

The main sub-blocks are the same that were mentioned above. The sub-blocks are installed separately into individual racks. The 100 W preamplifier section can be used as a standalone PA. The completed system implemented into standard 19" rack system and needs overall 12 U height. The sub-blocks are connected to the Centre unit via serial communication interface. The conceptual block diagram of the amplifier system can be seen in the Figure 5.

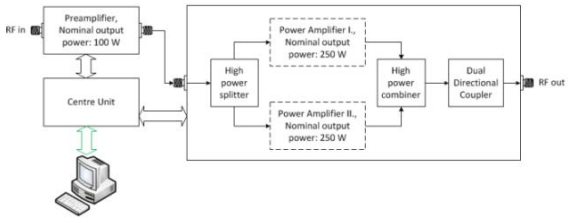

Figure 7. Conceptual block diagram of 500 W system

The preamplifier has 100 W nominal output power which can be used individually for amplification purposes. In the high power section a power splitter divides the incoming signal into half to feed the amplifier sub-blocks. The nominal output power of both amplifier sub-blocks are 250 W which gets combined in phase by a high power combiner to achieve the 500 W nominal output power.

Figure 8. S band 500 W system

Redundant systems

In order to increase reliability BHE can support 1:1 redundant systems. The conceptual block diagram of the redundant systems can be seen in Figure 7. The key building blocks are based on general considerations like modularity and consist of high reliable and excellent sub-blocks.

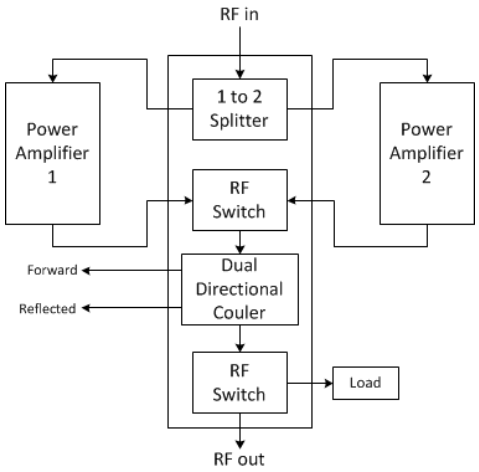

Figure 9. Conceptual block diagram of S band 1:1 redundant system

Figure 10. BPBS11 S band redundant SSPA system

The Centre Unit (CU) represents the soul of the system. The CU is responsible for the surveillance of the whole system via internal data bus.

The vital information of the status of the amplifiers are collected and sent toward the user. Monitoring the system conditions the CU can make decision if switch over to the backup amplifier is needed or not. Besides automatic switch over, the backup amplifier can be activated manually as well. Various remote interfaces (RS 232, RS-485 or Ethernet) can be chosen in order that the amplifier system can be inserted in the currently implemented satellite ground station. Increasing the reliability of the system all the amplifiers in a redundant system can be used as standalone amplifiers because all of them have remote control interface as well.

Regarding the construction the standard housing provides IP65 (IP68 fan) protection in order to operate in outdoor environmental.

Redundant amplifier system with 1 kW output power

Using modular construction BHE designed and manufactured a redundant system with 1 kW output power for S band application. This system uses the same fundamental building boxes to achieve excellent RF performance, high reliability and high output power. The redundancy is implemented on preamplifier level while the system incorporates one high power final stage. Each necessary passive component like harmonics filter, load and RF switch are designed and chosen properly in order to maximize reliability. The status of the sub-blocks and operation conditions are monitored down to bias level. The built in protection functions protect the system against overheating and extreme load conditions.

Figure 11. Redundant S band amplifier system with 1 kW output power

25 W outdoor amplifier

This solid state power amplifier is intended as uplink SSPA or driver stage. It is to be installed directly to the antenna. The outdoor construction protects the amplifier against harsh environmental conditions. The SSPA can be fully remotely monitored and controlled via the built-in Ethernet interface.

Figure 12. 25 W S-band outdoor SSPA

Summary

Thanks to the experience which have been collecting for more than 20 years in the field of microwave development and manufacturing BHE has comprehensive portfolio of amplifiers by now. The products have excellent RF parameters, high reliability and availability. The modular construction makes our product be flexible and custom tailored. All components are selected carefully in order to achieve the highest level of reliability and working perfectly for long time on 24/7 basis.

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BHE SSPA models selection

Model	Output Power	Output Level	Frequency Band	Redundancy	Power Gain	Nois Figure	Indoor/ Outdoor	Control & Monitoring Interface	Operating Temperature	Dimensions
BPBS47	25 W	44 dBm	2200 to 2300MHz	Single	65 dB	< 3 dB	Outdoor	Ethernet	-40 to +60^{0}C	312 x 364 x 95 mm
BPBS40	50 W	47 dBm	1980 to 2010 MHz	Single	75 dB	< 3 dB	Outdoor	Ethernet	-40 to +60^{0}C	560 x 306 x 170 mm
BPBS41	100 W	50 dBm	2025 to 2120 MHz	Single	70 dB	< 3 dB	Indoor	Ethernet	+5 to +40^{0}C	19" rack / 3U high
BPBS44	100 W	50 dBm	2025 to 2120 MHz	1:1 Redundant	70 dB	< 8 dB	Outdoor	Ethernet	-40 to +60^{0}C	572 x 716 x 170 mm
BPBS45	100 W	50 dBm	2025 to 2120 MHz	Single	75 dB	< 3 dB	Outdoor	Ethernet	-40 to +60^{0}C	560 x 306 x 170 mm
BPBS46	200 W	53 dBm	2200 to 2300 MHz	Single	65 dB	< 3 dB	Outdoor	Ethernet	-40 to +60^{0}C	560 x 306 x 170 mm
BPBS48	200 W	53 dBm	2025 to 2120 MHz	1:1 Redundant	70 dB	< 8 dB	Outdoor	Ethernet	-40 to +60^{0}C	605 x 855 x 170 mm
BPBS49	200 W	53 dBm	2025 to 2120 MHz	Single	75 dB	< 3 dB	Outdoor	Ethernet	-40 to +60^{0}C	560 x 306 x 170 mm
BPBS22	300 W	55 dBm	2200 to 2300 MHz	Single	60 dB	< 3 dB	Outdoor	RS-485	-40 to +60^{0}C	582 x 406 x 230 mm

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About us

BHE has been supporting the RF and Microwave industry since 1991. Its products are operating on ground, aerial and space level. As key part of such communication systems BHE developed and manufactured a number of frequency converters which have led to a comprehensive portfolio in this area. The selection includes both standard and custom-tailored solutions. Flexibility, reliability and more than twenty years of experience make BHE a professional manufacturer.

BHE has the honour to supply major companies worldwide who are leaders in the RF satellite communication and supporting segment. Existing models cover the generally used frequency ranges from L to Ku band. BHE puts great efforts to select all key components carefully not compromising when it comes to state-of-the-art semiconductors.

The assembling and testing are done in professionally equipped assembling and microwave test laboratories. Beyond RF testing BHE established special EMC and environmental testing facility in order to keep in one hand all the essential testing processes. Unwanted signal emissions, immunity measurement, checking proper operation during vibration or in extreme temperature ranges are just some of the test processes we can perform.

As a result of the compounded experience in the field of microwave development and manufacturing BHE has a comprehensive portfolio of RF frequency converter equipment by now. The products have excellent RF parameters, and high reliability. The modular construction makes BHE's products flexible and custom tailored. All components are selected carefully in order to achieve the highest level of reliability and working perfectly for long time on a 24/7 basis.

Further information can be found in our web site on

www.bhe-mw.eu

or ask a quotation via

sales@bhe-mw.eu