APPLICATION NOTE

Spatium™ Operating Instructions

Covering Spatium Units with an Integrated Bias Card

Introduction

This document provides application information for the Qorvo® Spatium™ Solid State Power Amplifiers (SSPA) with Integrated Bias Cards.

Referenced Documents

The reference documents below take precedence over the contents of this application note, and should always be consulted for the latest information.

QPBxxxxN Spatium unit data sheets.

Additional information provided by Qorvo Applications and/or Design Engineering.

Spatium Integrated Bias Card Description, Operation, and Control

The current series of Spatium units come equipped with an integrated bias control card (QPB4220, QPB4221, or QPB4222). This card performs the interface function between the prime power supply and the amplifier, provides status monitor signals through a sub-D connector, and also performs housekeeping duties for the amplifier (e.g., driving the required amplifier gate voltages, sequencing application of gate and drain bias, fault detection, providing pulsed drain voltage (if so equipped)).

The bias card allows the user to control the Spatium blade circuits by independently adjusting the gate voltage setpoint for each channel in the system. Communications for programming at the factory are handled through an I2C bus accessed through the DSUB26 (J1) connector interface. Channels are organized into groups of 4 by use of both a device and RDAC address. Blades 1-4 are on device address 0101111 with RDAC address 00 for channel 1, 01 for channel 2, etc. Blades 5-8 are on device address 0100011, blades 9-12 are on device address 0100000, and blades 13-16 are on device address 0101100 with channel number and RDAC both increasing similarly. Control voltages are established through a RDAC value between 0x00 to 0xFF (decimal 0 to 255) with 0xFF being equivalent to a gate voltage of -3.3 V and 0x00 being equivalent to -1.2 V, allowing coverage for a range of GaN devices.

All integrated bias cards are pre-programmed for standard operating conditions when paired with a given Spatium product. Any change of bias from this condition needs to be evaluated from both an electrical and thermal perspective. Qorvo strongly recommends working with our applications and design engineering teams for proper programming of devices should system needs require.

The interface pin definitions for the bias and interface connectors may be found on the associated Spatium data sheet.

Interconnect Cables

Table 1 shows which integrated bias card design is used with which Spatium SSPA unit. The table also indicates the power and sub-D connectors used on the respective bias cards, and the mating connectors to be used for power and signal interface wiring harnesses. Other appropriate mating connectors and sockets may be used. The lead lengths of the wiring harnesses is dependent on the customer's particular conditions and configuration.

Generally, the customer will not need to connect to the sub-D connector. The Spatium only requires connection to a power supply for operation; the only time connection is needed to the sub-D connector is for DC drain pulsing the unit (for Spatiums equipped with the QPB4221/QPB4222 interface cards) and for current / temperature monitoring. For DC drain pulsing, the thickest/shortest wires should be used between the Spatium unit and the customer's power supply.

For Spatium's with an integrated QPB4220 bias card (currently only the QPB2731N), the customer needs to provide +5 V to the bias card for the unit to operate.

Spatium SSPA	Integrated Bias Card	Spatium Prime Power Connector	Mating Power Connector, Contact	Spatium Sub-D Connector	Mating Sub-D Connector
QPB2731N	QPB4220	Molex 0768290004	Molex 1716920104, 1720630311	NorComp 180-M26-13R911	NorComp 180-026-273L000
QBB1111, QPB2040N, QPB3238N	QPB4221	Molex 0768290004	Molex 1716920104, 1720630311	NorComp 180-M26-13R911	NorComp 180-026-273L000
QPB0206N, QPB0218N, QPB0220N, QPB0618N	QPB4222	Harwin KA1-MV10205M1	Harwin KA1-2010298F1, KA1-0400005	NorComp 180-M26-13R911	NorComp 180-026-273L000

Table 1. Connectors Used for Variuos Spatium SSPA Units

Connections and Spatium Turn-On

Refer to Figure 1, below, for this section.

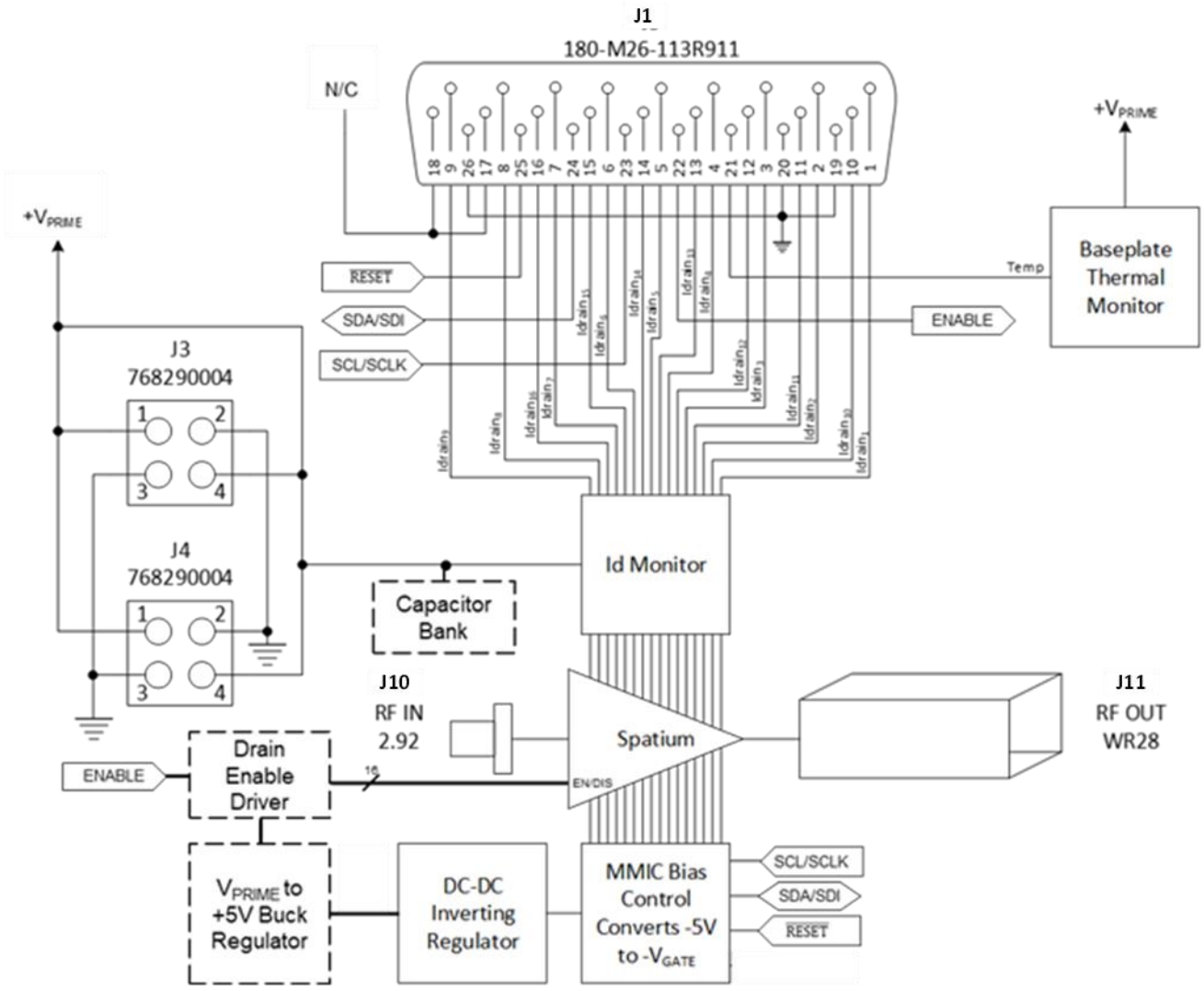

Figure 1. Block diagram of typical Spatium SSPA with Integrated Bias Card (QPB3238N used as reference). Refer to the specific Spatium data sheet for that unit's block diagram.

The operating voltage and current requirements of the Spatium unit to be tested or operated are available in the specific Spatium unit's data sheet. The data on the specific Spatium unit is available from Qorvo.

Detailed Operating Instructions

1. Ensure that the Spatium unit is properly attached to the required heat sinks (see next section on thermal interface recommendations).
2. Ensure that the prime power supply is in the OFF condition before connecting cables to the unit.
3. If using a laboratory supply, set it to provide the recommended prime voltage to the unit. Set the supply to an adequate current limit. Ensure that the power supply is set to the required voltage and current limits required for proper Spatium operation.
4. Connect the two power cables from the prime power supply to connectors J3 and J4 of the Spatium unit's bias card. Proper pin assignments for the J3 and J4 connectors are shown in Figure 1.
5. Connect the sub-D connector and wiring harness (if needed) to the mating J1 connector of the Spatium unit's bias card. Note that connection to pins on the sub-D connector are required only if using the ENABLE line for pulsing the drain voltage, monitoring the VTEMP line for temperature sensing, and/or monitoring the bias condition for each of the blades assemblies.
6. Ensure that the RF input and output connectors of the Spatium unit are properly terminated into 50 ohms.
7. Ensure that the control signals from the controller unit, either a lab computer or the system controller, are ready for use. If operating under pulse conditions (where applicable), ensure the pulse control signal to the ENABLE pin on the sub-D connector is set to the appropriate pulse conditions (+5 V positive logic, CMOS compatible). If operating in a CW mode, the ENABLE signal on the sub-D connector may be left floating or tied to +5 V (preferred).
8. Apply prime power to the Spatium unit by turning the lab supply output ON, or activating the system's power supply.
9. Turn-off is the reverse of the above steps.

Thermal Interface Recommendations

Typical heat sink mating locations are shown in Figure 2 (QPB3238N shown as a reference); refer to the specific Spatium data sheet for heat sink mating locations, as these may be different depending on the Spatium unit to be used.

Various heat sinks (finned heat sinks with forced air cooling, liquid-cooled chillers, etc.) may be used with Spatium amplifiers, depending on the power dissipated and the capability of the thermal management system to maintain safe operating temperatures in a given operating environment. (For example, Spatium units are tested at Qorvo by mounting cold plates to the indicated heat sink mating surfaces in Figure 2.) Thermal interface material (e.g., thermal grease, graphite sheet material ,etc.) should be applied between the Spatium and the heat sinks to ensure minimal thermal resistance at the mating surfaces.

Temperature monitoring shall be performed using the provided VTEMP monitor pin on the sub-D connector. Additional information on using the signal may be obtained in the relevant Spatium data sheet.

Clamp mounting surface temperatures shall be monitored and maintained between -40 °C to +71 °C. The clamp mounting surface temperature shall not exceed +71 °C. Permanent damage, degradation of performance, and reduced life of the equipment may occur.

Additional thermocouples (at least one, preferably more) can be placed as close as possible to the Spatium clamp surface for additional temperature monitoring (this is especially helpful in a lab environment when evaluating the Spatium for a particular system application). Figures 3 and 4 show the available hole locations on microwave and millimeter-wave Spatium unit clamps in which additional thermocouples may be installed.

Thermocouples can also be placed within the heat sink plates as close the clamp as possible if mating the thermocouples to the Spatium clamp is not possible in the given application.

Please contact Qorvo applications and design engineering should there be questions on the capability of the thermal management system to be used.

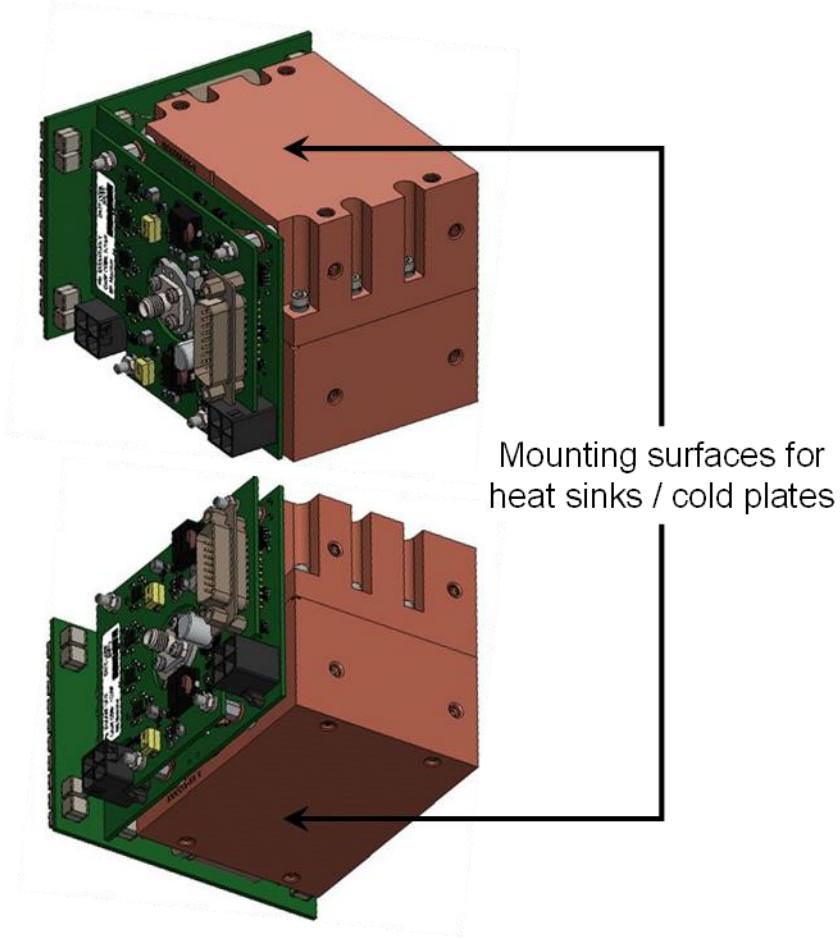

Figure 2. Heat sink mounting locations on typical Spatium clamp surfaces.

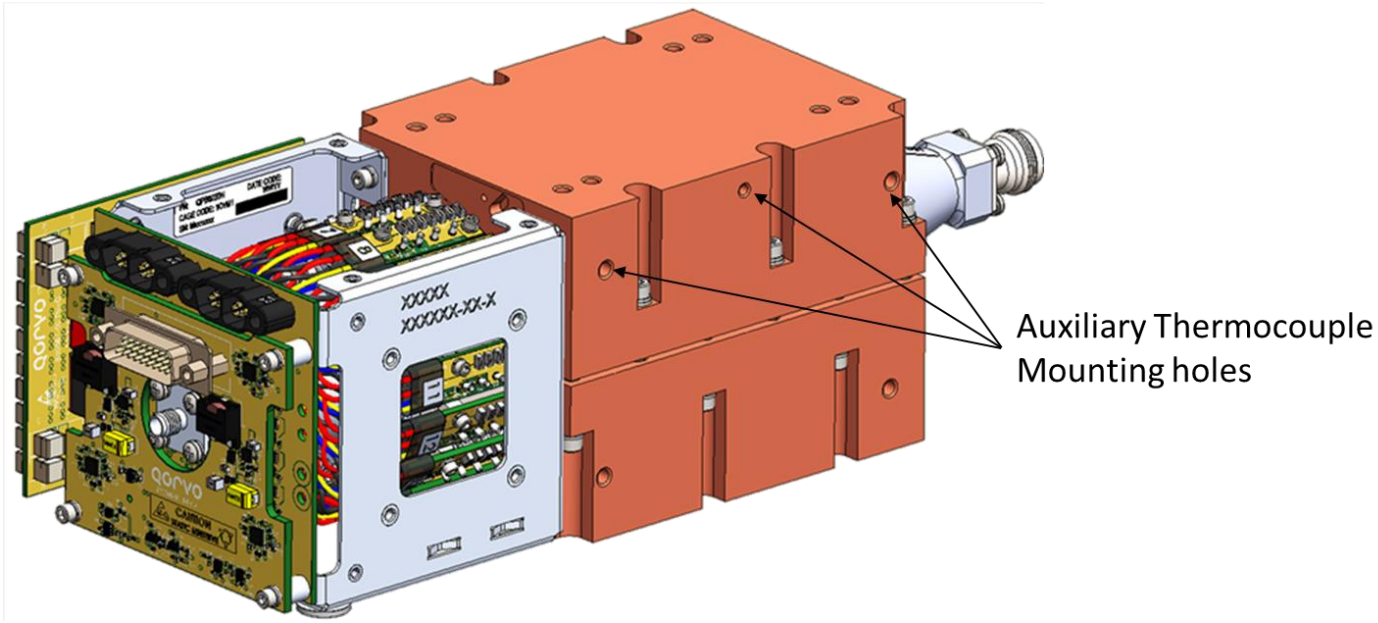

Figure 3. Microwave Spatium SSPA with additional thermocouple location holes (#6-32 UNC) shown.

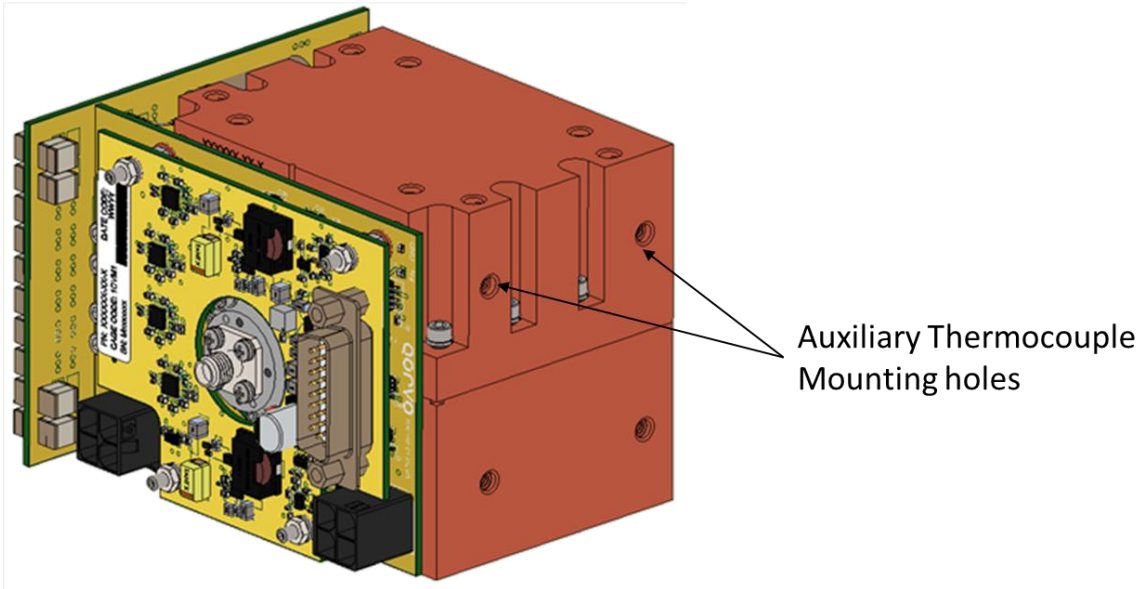

Figure 4. Millimeter-wave Spatium SSPA with additional thermocouple location holes (#6-32 UNC) shown.

Support Data

Qorvo's Engineering team has performance data on all Spatium SSPA units. This data, along with other information to facilitate design in a particular application, is available by request.

Additional Information

For additional information on Spatium SSPA units, please contact Qorvo for general guidelines.

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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