

**Abstract**

RFMD SGA-8543Z is a high performance SiGe amplifier designed for operation from 50 MHz to 3.5 GHz. This application note illustrates application circuits for the 880 MHz and 2440 MHz frequency bands.

**Introduction**

The application circuits were designed to achieve the optimum combination of NF, P1dB, and OIP3, while maintaining flat gain and reasonable return losses. Special consideration was given to insure amplifier stability at low frequencies, where the device exhibits high gain. These designs were created to illustrate the general performance capabilities of the device under CW conditions. Users may wish to modify these designs to achieve optimum performance under specific input conditions and system requirements.

All recommended components are standard values available from well-known manufacturers. Components specified in the bill of materials (BOM) have known parasitics which in some cases are critical to the circuit's performance. Deviating from the recommended BOM may result in a performance shift due to varying parasitics. Matching component placement is critical to each circuit's performance.

**Circuit Details**

RFMD will provide the detailed layout (AutoCad format) to users wishing to use the exact same layout and substrate material shown in the following circuits. The circuits recommended within this application note were designed using the following PCB stackup:

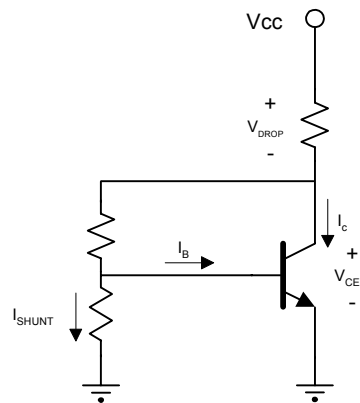
- Material: GETEK™ ML200C
- Core thickness: 0.031"
- Copper cladding: 1 oz. both sides
- Dielectric constant: 4.1
- Dielectric loss tangent: 0.0089 (@ 1 GHz)

Customers not wishing to use the exact material and layouts shown in this application note can design their own PCB using the critical transmission line impedances and phase lengths shown in the BOMs and layouts.

**Design Considerations and Trade-offs -Biasing Techniques**

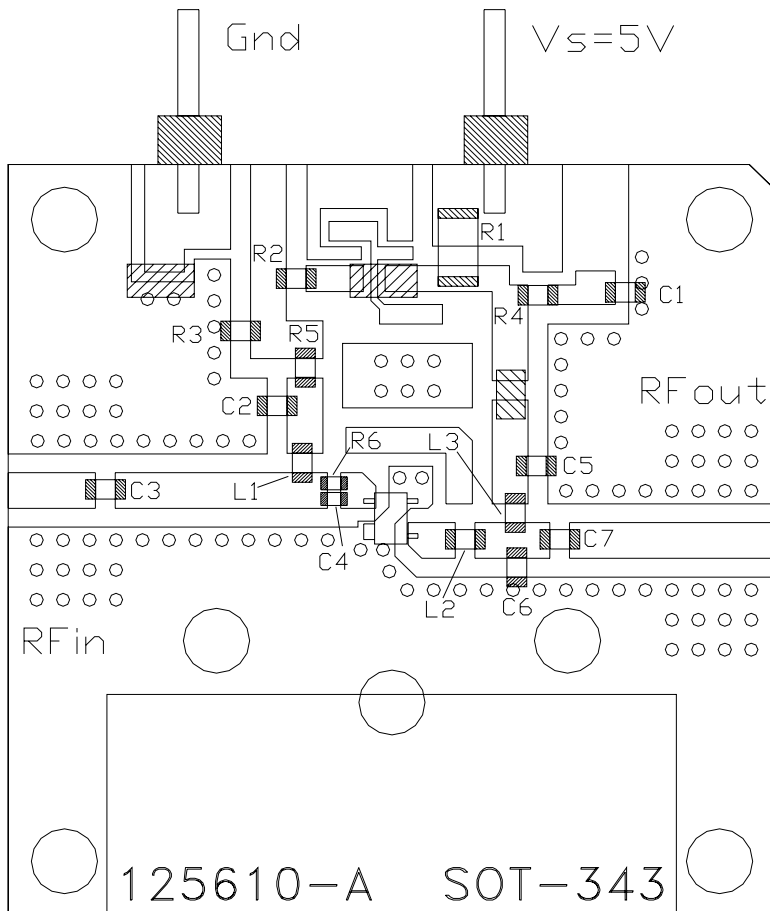
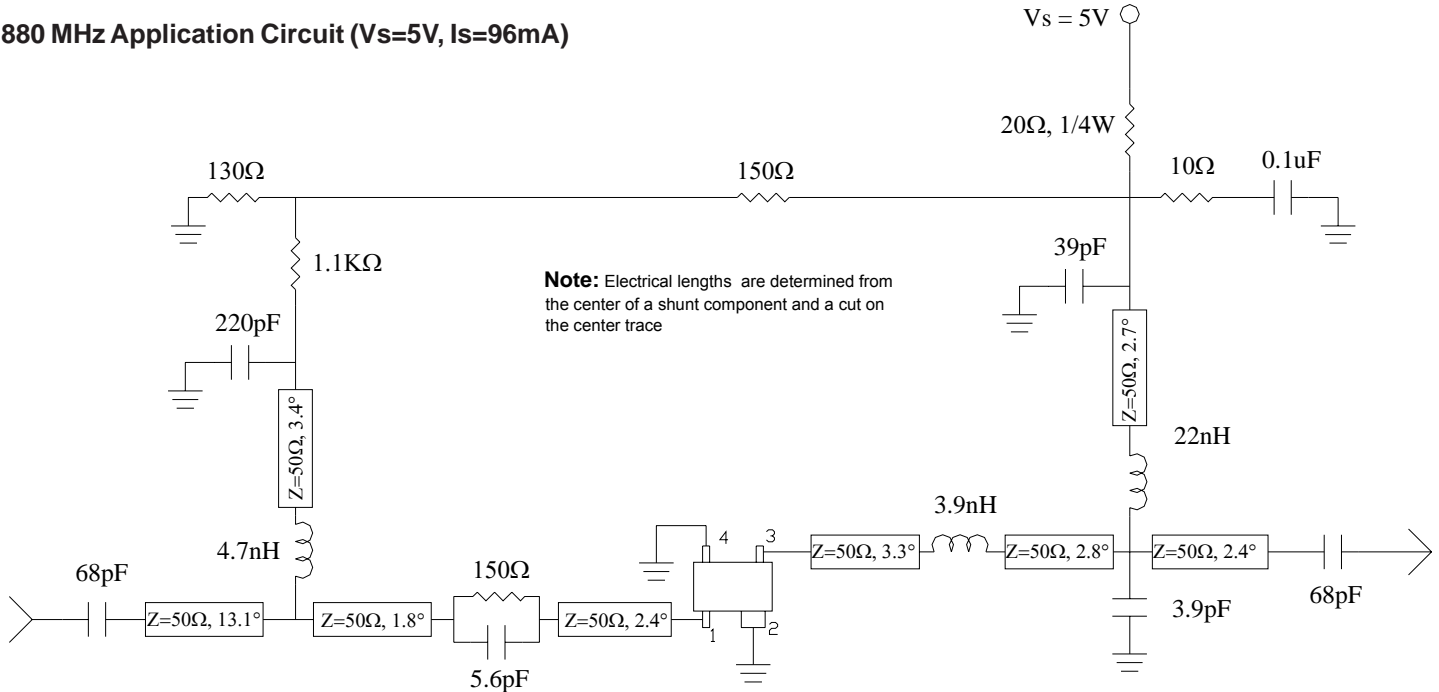
All HBT amplifiers are subject to device current variation due to the decreasing nature of the internal  $V_{BE}$  with increasing temperature. In the absence of an active bias circuit or resistive feedback, the decreasing  $V_{BE}$  will result in increased base and collector currents. As the collector current continues to increase under constant  $V_{CE}$  conditions the device may eventually exceed its maximum dissipated power limit resulting in permanent device damage. The designs included in this application note contain passive bias circuits that stabilize the device current over temperature and desensitize the circuit to device process variation.

The passive bias circuits used in these designs include a dropping resistor in the collector bias line and a voltage divider from collector-to-base. Using this scheme the amplifier can be biased from a single supply voltage. The collector-dropping resistor is sized to drop >20%  $V_{CE}$  depending on the desired  $V_{CE}$ . The voltage divider from collector-to-base, in conjunction with the dropping resistor will stabilize the device current over temperature. Configuring the voltage divider such that the shunt current is 5-10 times larger than the desired base current desensitizes the circuit to beta variation. These two feedback mechanisms are sufficient to insure consistent performance over temperature and device process variations. Note that the voltage drop is clearly dependent on the nominal collector current and can be adjusted to generate the desired  $V_{CE}$  from a fixed supply rail. The user should test the circuit over the operational extremes to guarantee adequate performance if the feedback mechanisms are reduced.



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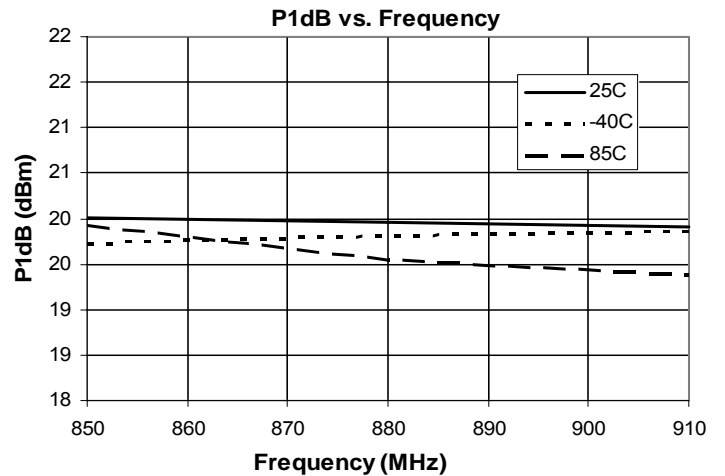
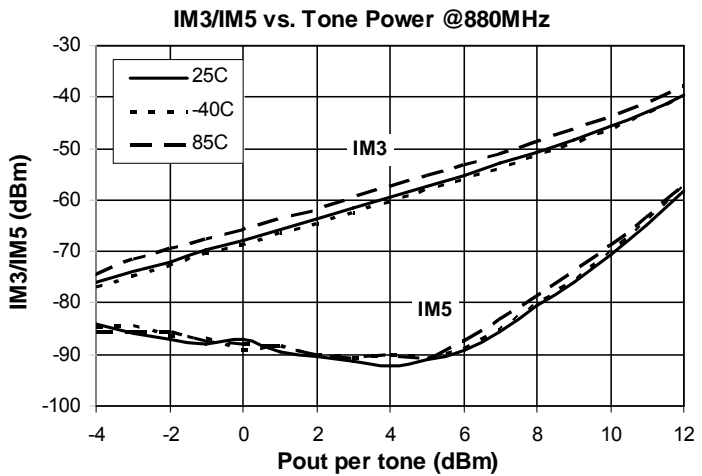
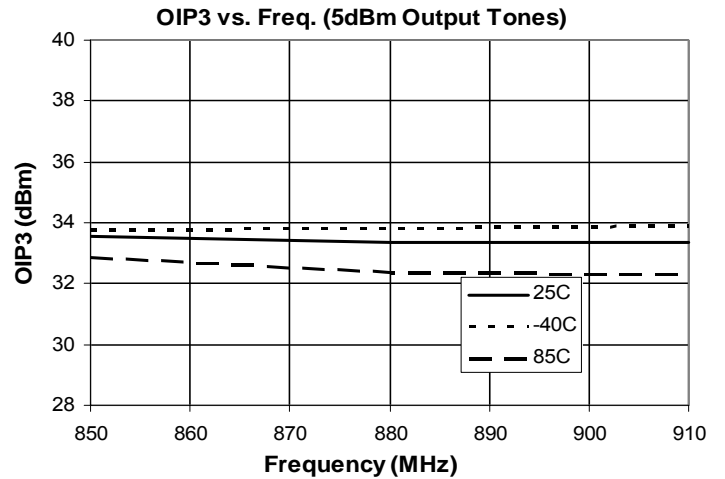
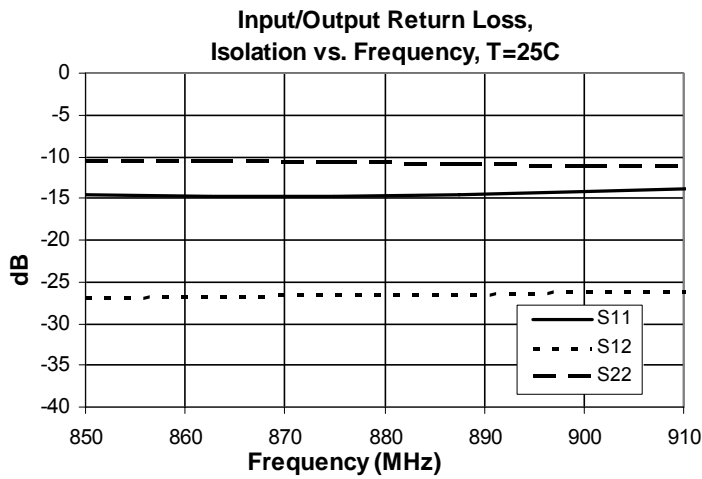
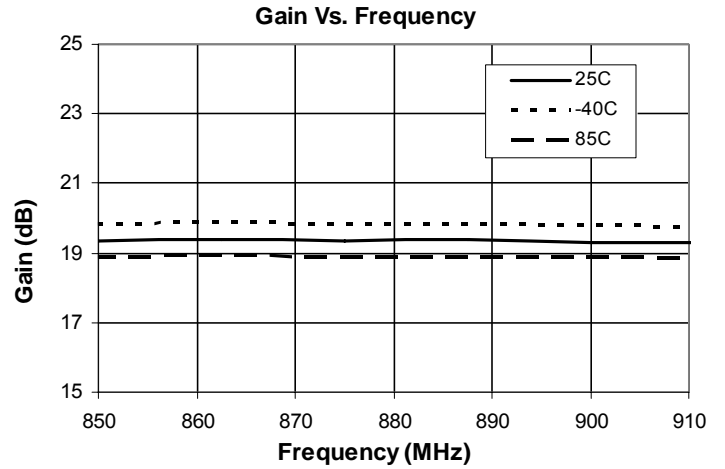
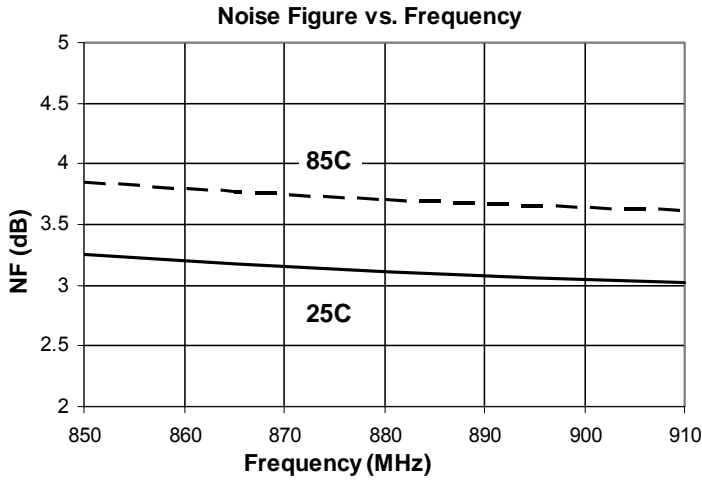
### 880 MHz Application Circuit (Vs=5V, Is=96mA)



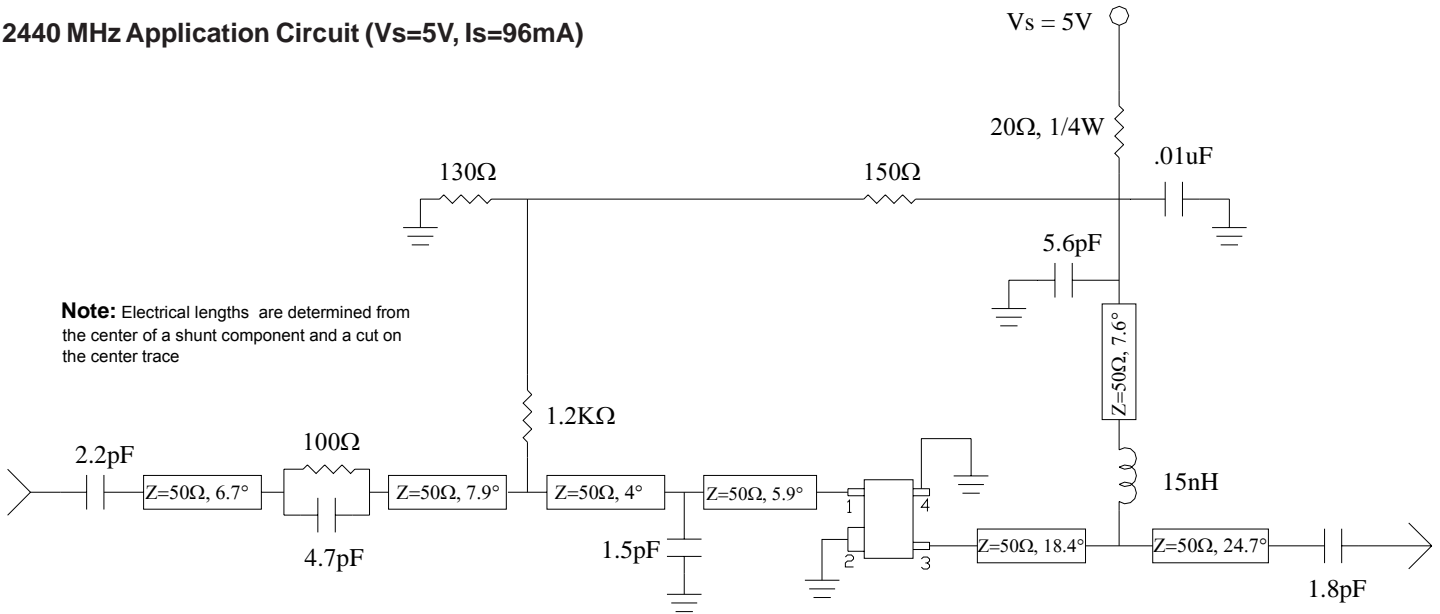
### Bill of Materials

C1	MCH182CN104K	Rohm	0.1uF
C2	MCH185A221JK	Rohm	220pF
C3	MCH185A680JK	Rohm	68pF
C4	MCH155A5R6DK	Rohm	5.6pF (0402)
C5	MCH185A390JK	Rohm	39pF
C6	MCH185A3R9CK	Rohm	3.9pF
C7	MCH185A680JK	Rohm	68pF
L1	LL1608-FS4N7S	Toko	4.7nH
L2	LL1608-FS3N9S	Toko	3.9nH
L3	LL1608-FS22NJ	Toko	22nH
R1	20Ω	1206, 1/4W res (5%)	
R2	150Ω	0603 res (5%)	
R3	130Ω	0603 res (5%)	
R4	10Ω	0603 res (5%)	
R5	1.1KΩ	0603 res (5%)	
R6	150Ω	0402 res (5%)	
Connectors	2x PSF-S01-1mm	GigaLane Co.	
Heat sink	EEF-102059		
PCB	SOT-343	Rev B	

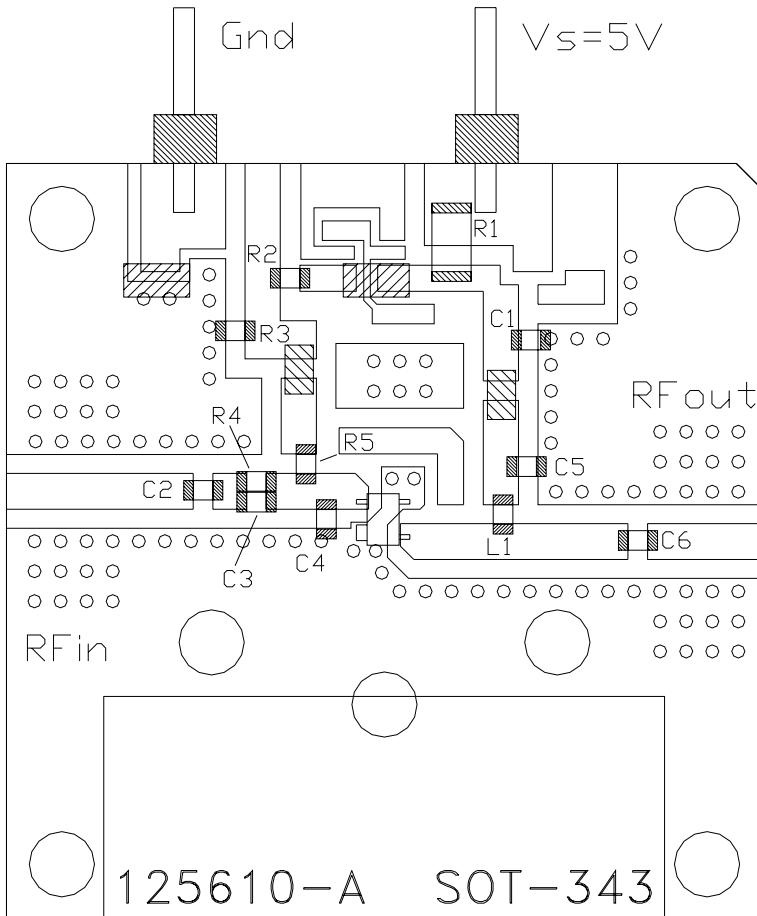
**880 MHz Application Circuit Data,  $V_s = 5V$ ,  $I_s = 96mA$**



**2440 MHz Application Circuit (Vs=5V, Is=96mA)**



**Note:** Electrical lengths are determined from the center of a shunt component and a cut on the center trace



**Bill of Materials**

C1	MCH182CN104K	Rohm	0.1uF
C2	MCH185A2R2CK	Rohm	2.2pF
C3	MCH185A4R7CK	Rohm	4.7pF
C4	MCH185A1R5CK	Rohm	1.5pF
C5	MCH185A5R6DK	Rohm	5.6pF
C6	MCH185A1R8CK	Rohm	1.8pF
L1	LL1608-FS15NJ	Toko	15nH
R1	20Ω 1206,	1/4W res	(5%)
R2	150Ω 0603	res	(5%)
R3	130Ω 0603	res	(5%)
R4	100Ω 0603	res	(5%)
R5	1.2KΩ 0603	res	(5%)
Connectors	2x PSF-S01-1mm	GigaLane Co.	
Heat sink	EEF-102059		
PCB	SOT-343	Rev B	

**2440 MHz Application Circuit Data,  $V_s = 5V$ ,  $I_s = 96mA$**

