SGA-8543Z Amplifier Application Circuits

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:

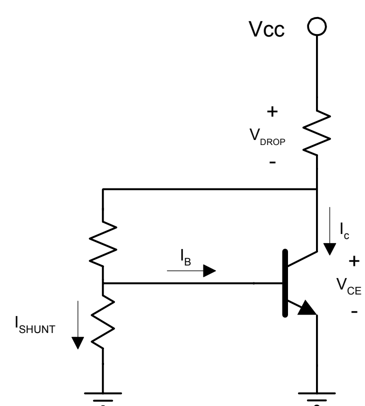
Material: GETEK™ ML200C
Core thickness: 0.031"
Copper cladding: 1 oz. both sides
Dielectric constant: 4.1
Dielectric loss tangent: 0.0089 (@ 1 GHz)

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.

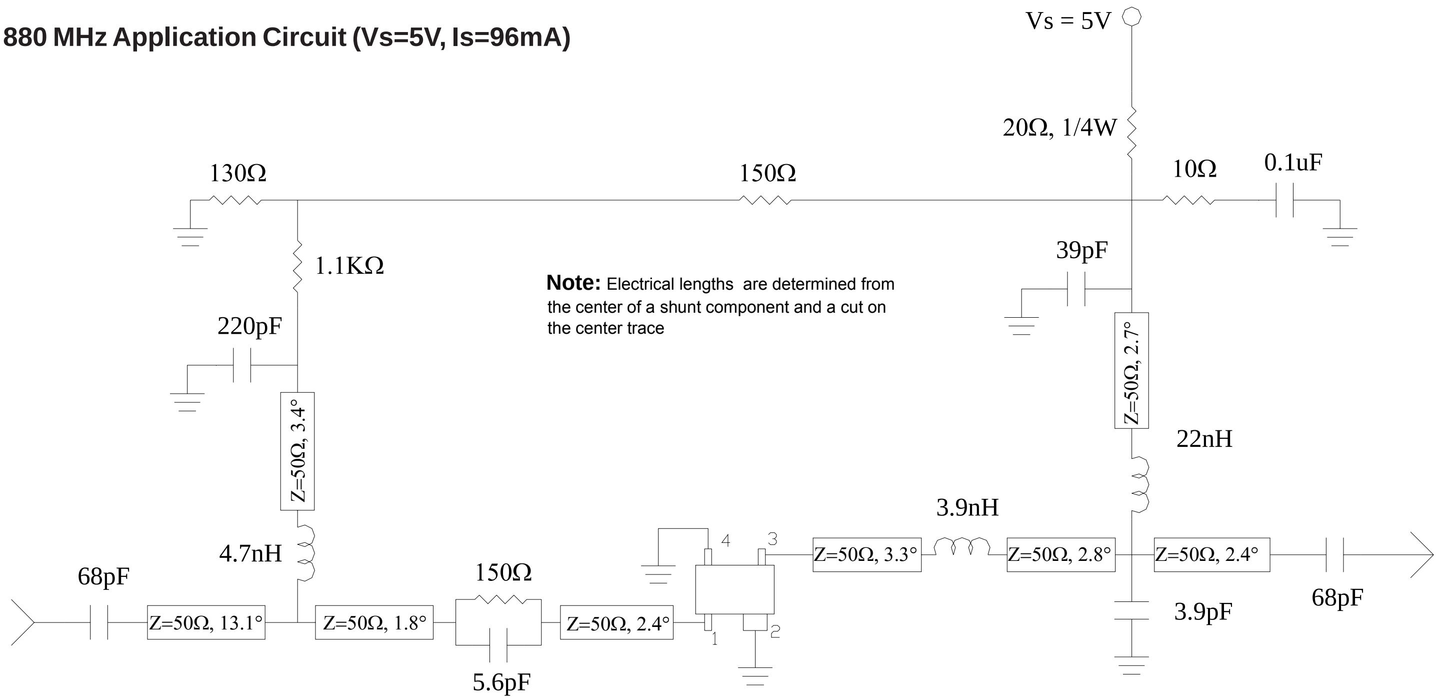
Design Considerations and Trade-offs -Biasing Techniques

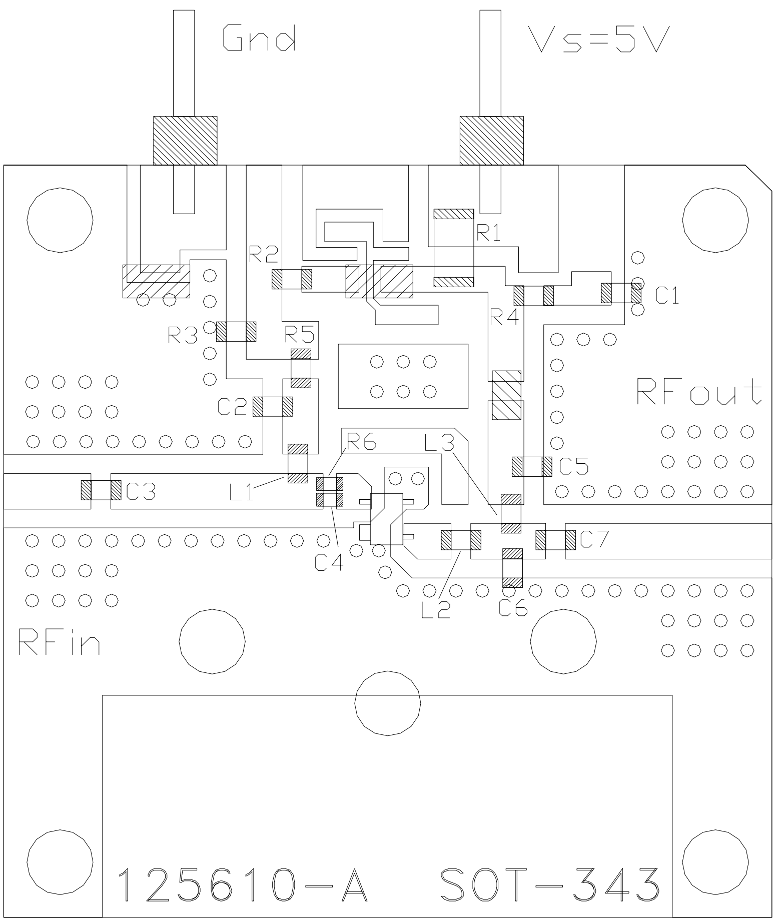
All HBT amplifiers are subject to device current variation due to the decreasing nature of the internal V_{BE} with increasing temperature. In the absence of an active bias circuit or resistive feedback, the decreasing V_{BE} will result in increased base and collector currents. As the collector current 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.



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

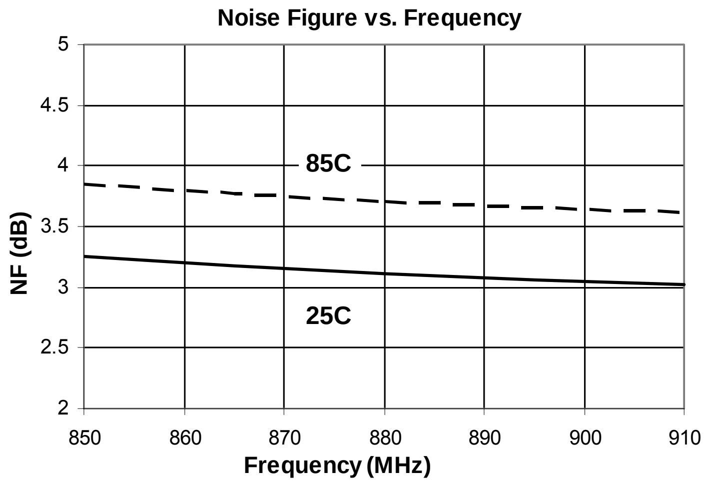


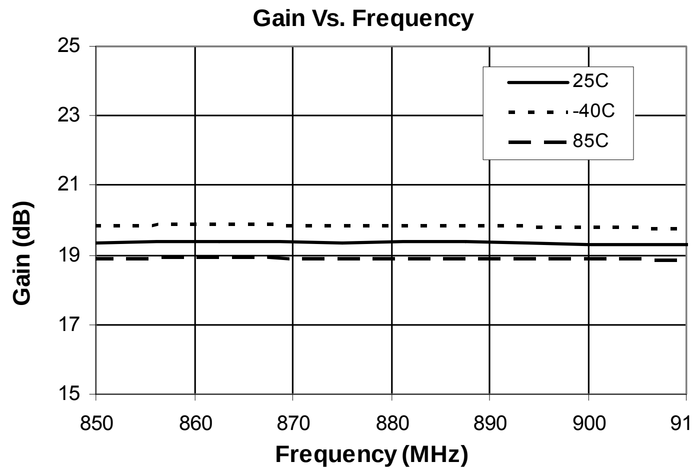


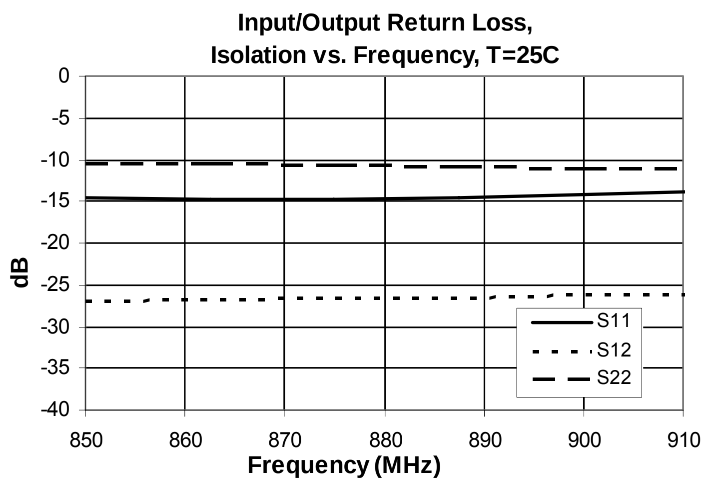
Bill of Materials

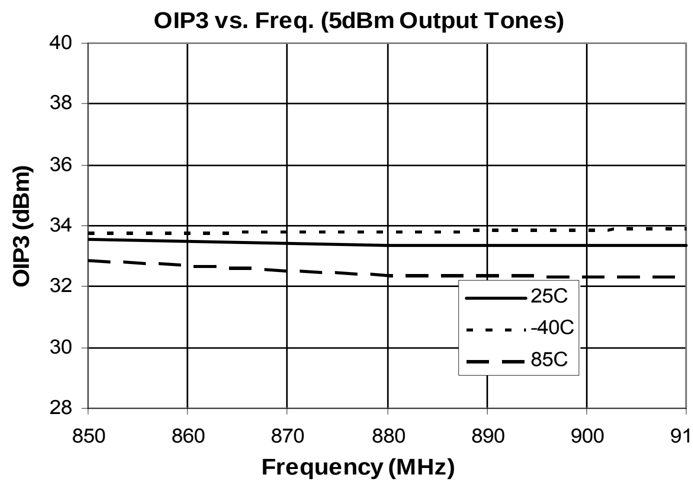
C1	MCH182CN104K Rohm 0.1uF
C2	MCH185A221JK Rohm 220pF
C3	MCH185A680JK Rohm 68pF
C4	MCH155A5R6DK Rohm 5.6pF (0402)
C5	MCH185A390JK Rohm 39pF
C6	MCH185A3R9CK Rohm 3.9pF
C7	MCH185A680JK Rohm 68pF
L1	LL1608-FS4N7S Toko 4.7nH
L2	LL1608-FS3N9S Toko 3.9nH
L3	LL1608-FS22NJ Toko 22nH
R1	20Ω 1206, 1/4W res (5%)
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

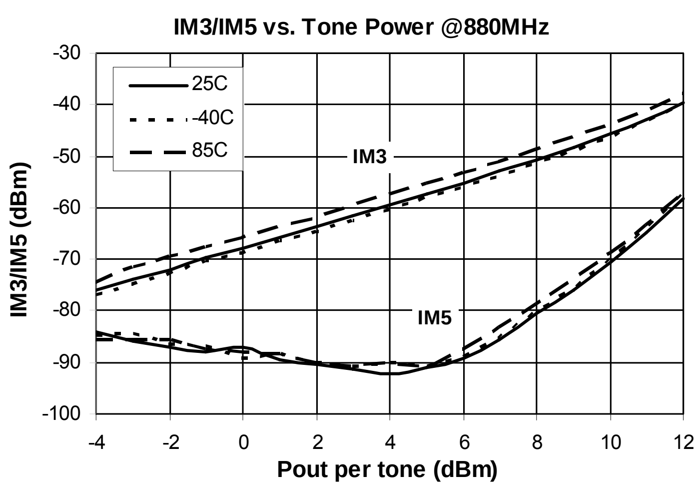
880 MHz Application Circuit Data, V_S= 5V, I_S= 96mA

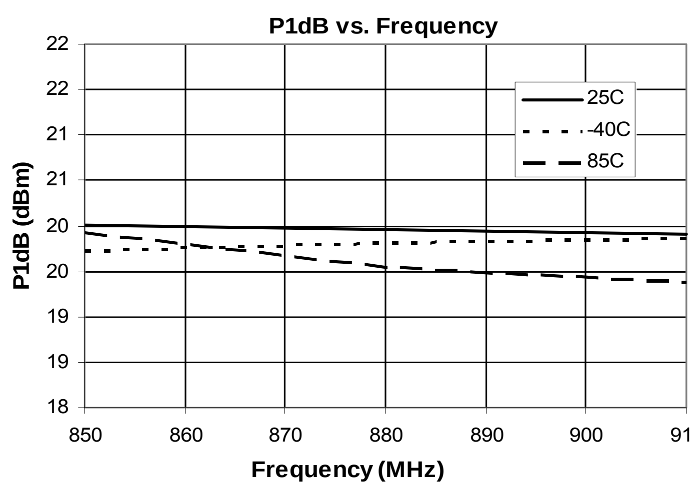




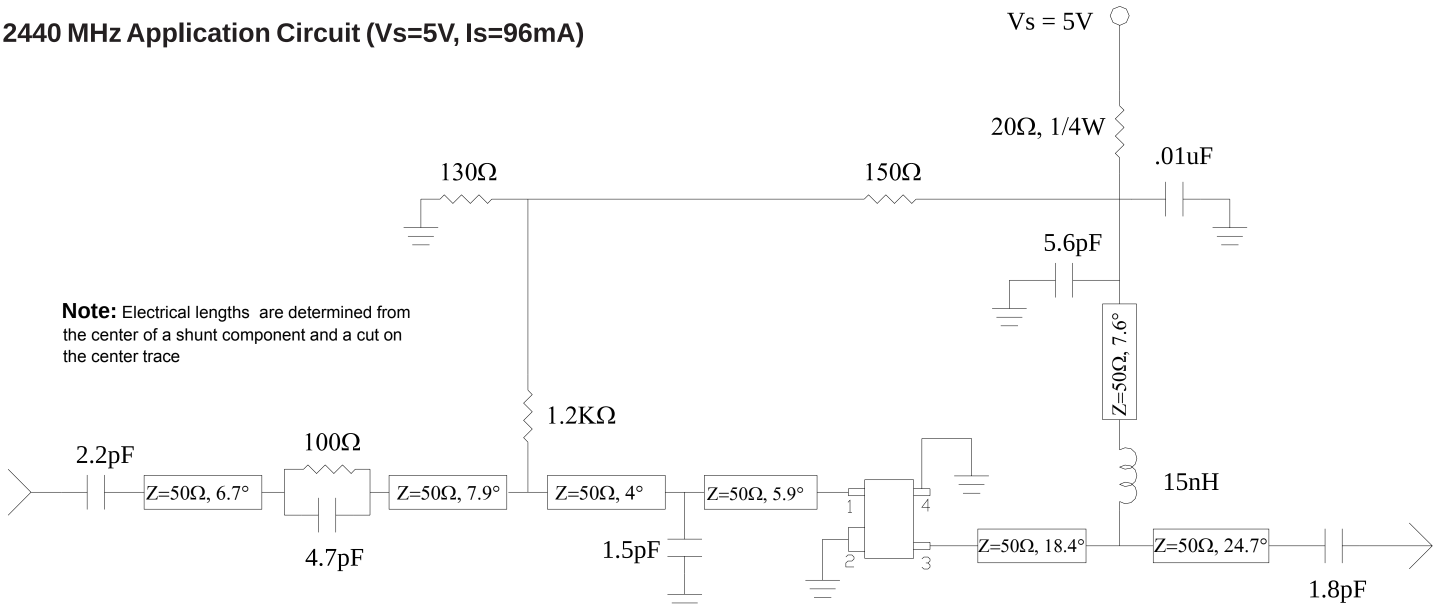


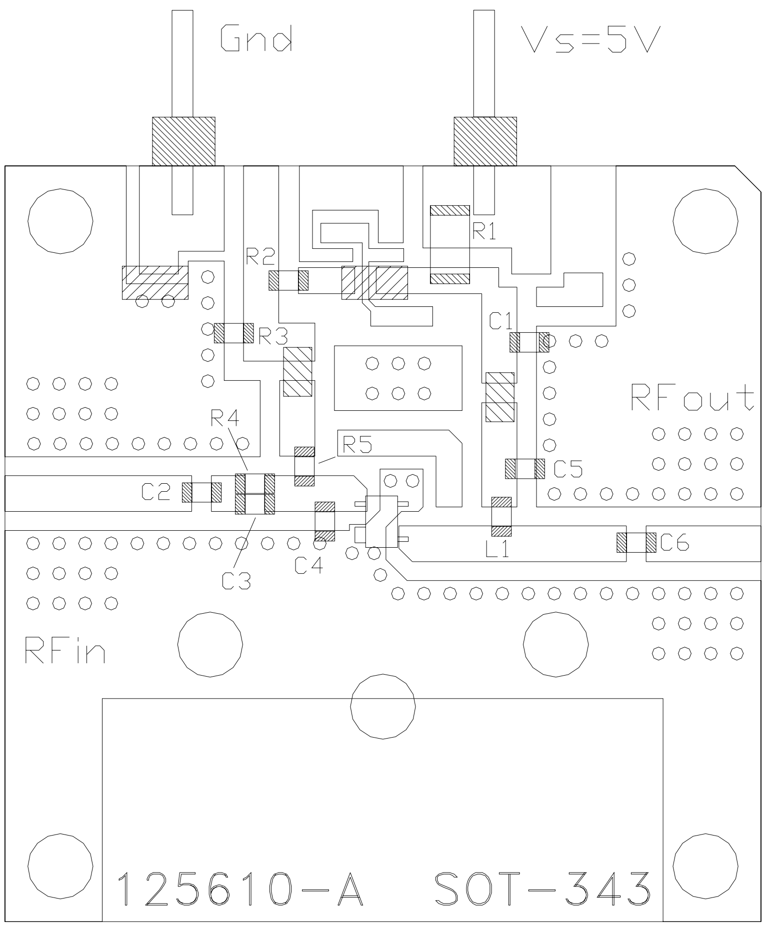






2440 MHz Application Circuit (Vs=5V, Is=96mA)





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