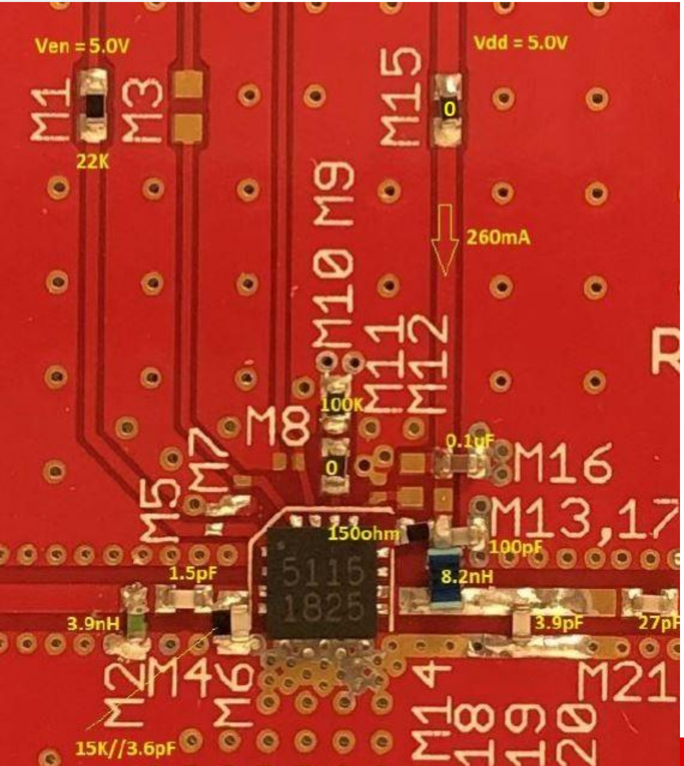
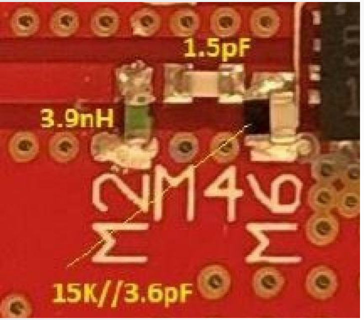
GRF5115 Matching Guidelines

To be discussed herein, how to configure and match GRF5115 for best performance. Each pin/area of the device/circuit will be covered using the 1700-2000 MHz application note shown here (and others where applicable) for reference. Matches ranging from 20 – 2700 MHz can be found In the “App Notes” tab on website GRF5115 landing page.



Resistor M1, in this case 22K, sets Iddq for a given Venable (Ven) value. In data sheet match, 1900 – 2000 MHz, and all other app notes ranging from 1300 – 2700 MHz, the value here is 22K with Ven = 5.0V. Data sheet bias R charts can be used to determine M1 value for lower Ven values. In some application notes < 1300 MHz, the value for M1 is < 22K. Reasons will be discussed in section at end of the presentation.

1700-2000 MHz



Input match:

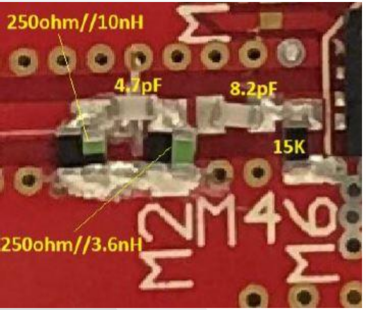
The first commonality we see is a 15K shunt resistor immediately at input. It is incorporated into data sheet along with every GRF5115 application note and should be considered mandatory. This resistor acts a clamp to prevent self bias under drive with device off (Vdd = 5.0V and Venable = 0.0V).

See that all matches use, looking back from device, high pass C-L matches. In the 600 – 1000 MHz case, two stages for broadband match.

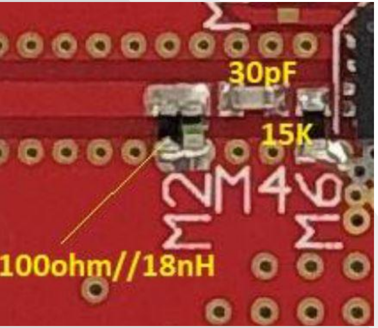
In the 600 – 1000 MHz and 230 – 270 MHz matches, shunt resistors are used to improve S11 and/or reduce gain.

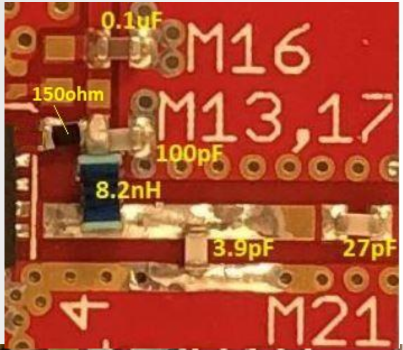
For low noise amplifer applications, low value shunt input resistors will be avoided as seen with 1700-2000 MHz. This for best noise figure.

600-1000 MHz

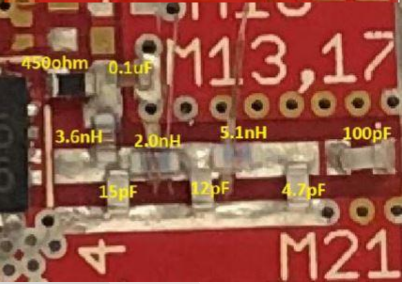


220-270 MHz

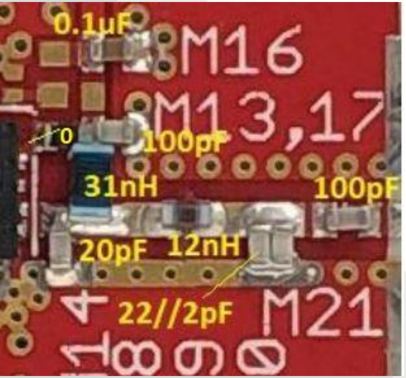




1700-2000 MHz



600-1000 MHz



220-270 MHz

Output Match:

Output match typically employs RF choke + series L + shunt C + DC block. This topology transforms 50 ohm system to a lower impedance load. 1700 – 2000 MHz uses distributed trace length inductance in place of lumped inductor, as will be the case at higher frequency.

600 – 1000 MHz match uses multi-stage L-C to achieve broadband performance.

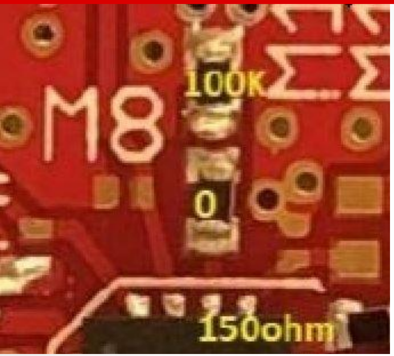
Bottom 2 matches also see additional shunt C near/at choke location to dial in impedance for optimal performance.

Finally, we see different values for resistor feeding bias pin 12: 150, 450 and 0 ohm. This resistor is set between 0 → 500ohm, at value which optimizes OIP3 performance. The proper value, or close to it, can be easily surmised by referencing one of many available application notes near the frequency band of interest.

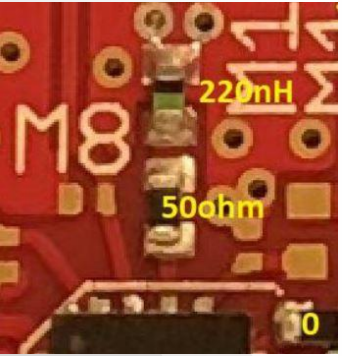
App Note (MHz)	max OP1dB over band (dBm)	Zload @ max OP1dB (ohm)
26 - 34	30.9	8.3+j0.3
220 - 270	30.9	10+j2.5
400 - 500	31.4	9.4+j2.4
470 - 800	32.4	6.2-j0.2
600 - 1000	31.8	8.3-j1.7
824 - 894	32	7.6 + j1.0
1030 - 1090	31.6	5.2+j4.8
1000 - 1400	32.3	5.8-j4.0
1300 - 1500	32.8	6.4-j4.4
1300 - 1700	32.7	6.2-j4.4
1400 - 1800	33.1	4.8-j3.5
1700 - 2000	32.7	5.5-j3.0
1800 - 2100	33	5.0-j5.2
2100 - 2200	33.1	4.3-j3.8
2200 - 2500	33.3	3.5-j4.7
2300 - 2700	32.8	3.7-j6.2

Output Match (cont'd):

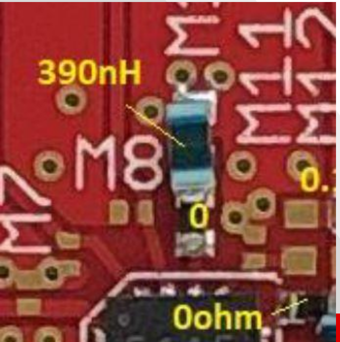
Table showing load impedance presented to GRF5115 over frequency for each application note. The general trend is for lower impedance vs. frequency.



1700-2000 MHz



400-500 MHz



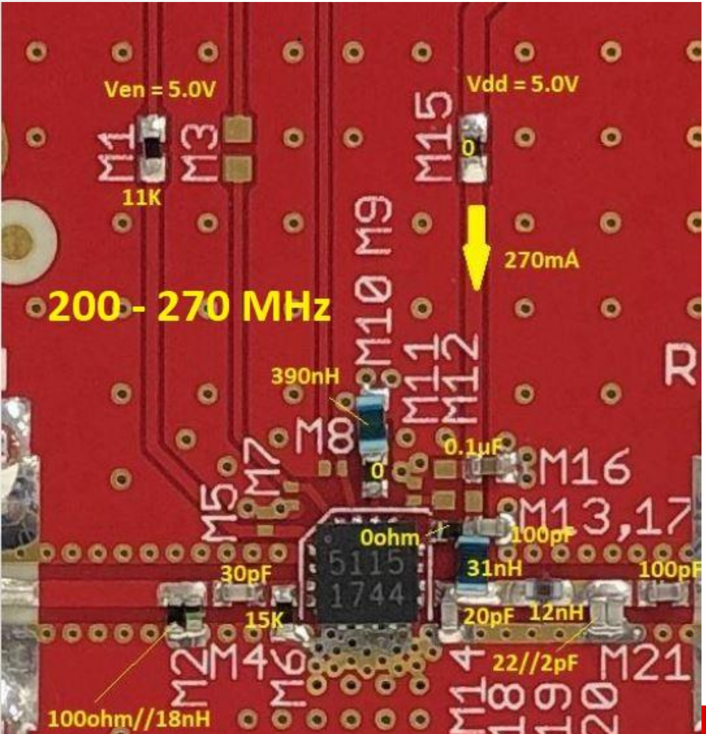
220-270 MHz

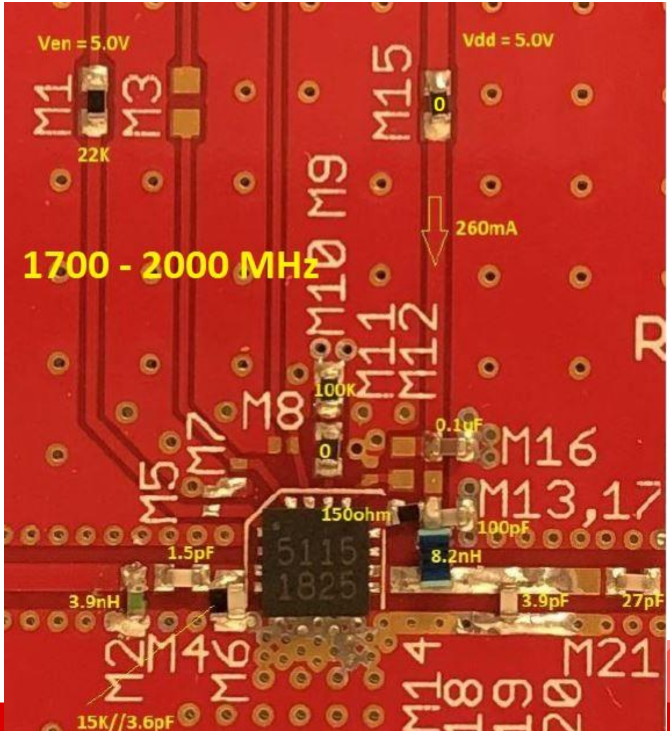
Bias Ground Leg (BGL):

BGL termination is found at pin 14 and consists of 2 series elements. It can be optimized for IP3 linearity. The majority of app notes, as in the case of 1700-2000 MHz, use 0 ohm + 100K. Some of the lower frequency tunes, like 400-500 MHz and 220-270 MHz, have an empirically determined configuration such as the ones shown. Note that in all cases, a resistor/inductor/ferrite bead must be used.

Bias Ground Leg (BGL) (cont'd):

This section covers BGL influence on DC bias current (quiescent current), Iddq.   See below that the two configurations draw about the same current, yet they use much different bias R at M1 (11K vs. 22K). The value for M9 in BGL explains it. 200-270 MHz M9 = 390nH (DC short), while 1700-2000 MHz M9 = 100K. The 100K resistor lifts internal gate voltage resulting in much higher Iddq for a given M1 value. Thus, M1 value at right needs to be larger vs. that on left. As mentioned already, the majority of application notes use M9 = 100K, so 22K will be in place at M1.





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