



Application Note

Setting Bias R at Venable

GRF-AN012

Guerrilla RF amplifiers commonly use a Venable pin to turn on device and set idle/quiescent current using bias resistance at M5.

Vdd = main supply voltage

Iddq = bias current

Ven = system enable voltage

M5 = bias R value

Ven_pin = resultant enable voltage at device pin

Data sheets contain bias R charts for setting Iddq with commonly used Vdd/Ven/Iddq combinations. In the event that a desired Vdd/Ven/Iddq solution is not charted, this application note will outline methodology for obtaining required bias R.

Understand that Iddq is purely a function of Vdd, Ven_pin and I_{en}.

For a 2 stage device (i.e. GRF5509) process to follow can be done on both Ven1 and Ven2. When using Ven1, set Ven2 = 0.0 V (and vice versa).

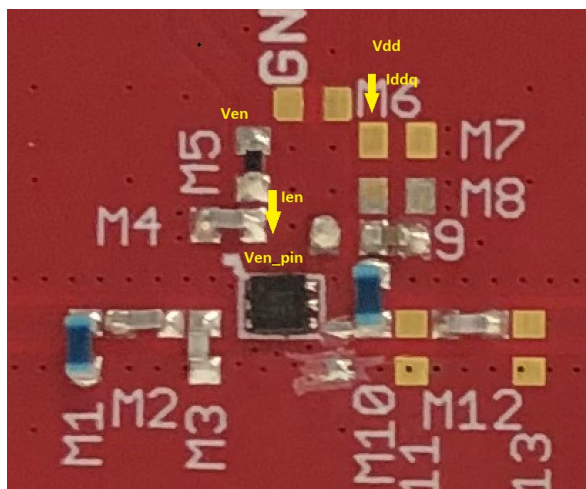


Figure 1. Evaluation board bias connections at M5

Determining Bias R with a Current Meter

Using the shown test set, we can determine required bias $R = M5$ as follows: Note that $M5$ is initially set to 0 ohm in this process. Thus, $V_{en} = V_{en_pin}$ as there is no voltage drop across $M5$.

Steps:

1. Set V_{dd} to system value.
2. Start at 0.0V and slowly increase $V_{en} = V_{en_pin}$ (V) until desired I_{ddq} is reached.
3. Record I_{en} (A).
4. Bias R solution = $(\text{system } V_{en} - V_{en_pin})/I_{en} = V/A$

For a 2 stage device (i.e. GRF5509) this process can be done on both V_{en1} and V_{en2} . When using V_{en1} , set $V_{en2} = 0.0$ V (and vice versa).

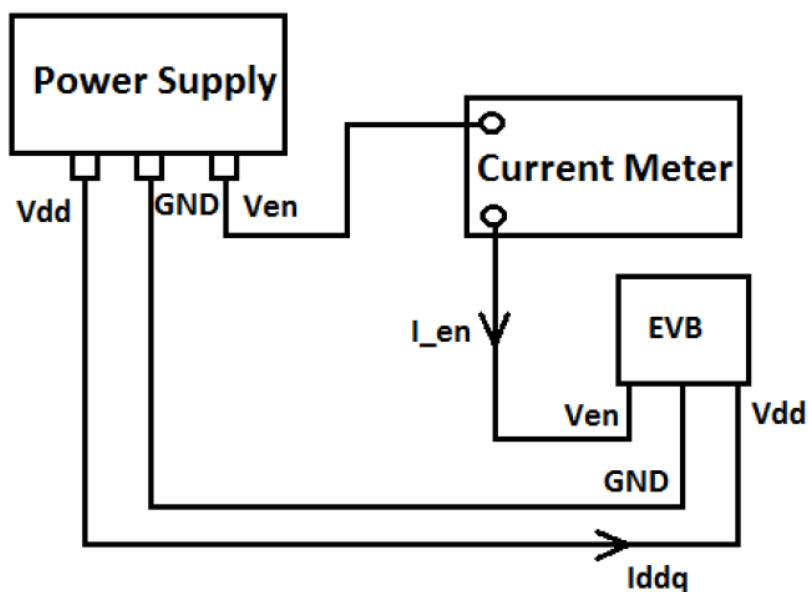


Figure 2. Current meter test set with $M5$ initially set to 0 ohm

Determining Bias R with a Resistor Box

An alternate, perhaps more convenient method, involves using a resistor box as shown. M5 on EVB is initially set to 0 ohm in this process.

Steps:

1. Viewing bias curves on data sheet, set resistor box for a larger value than required.
2. Apply system Vdd and Ven. Iddq will be very low or even non-existent.
3. Decrease resistance in box until desired Iddq is reached.
4. Record resistor box setting (bias R solution).
5. Place bias R solution at M5 on evaluation board.
6. Remove resistor box from test set, apply system Vdd/Ven and confirm Iddq is as desired.

For a 2 stage device (i.e. GRF5509) this process can be done on both Ven1 and Ven2. When using Ven1, set Ven2 = 0.0 V (and vice versa).

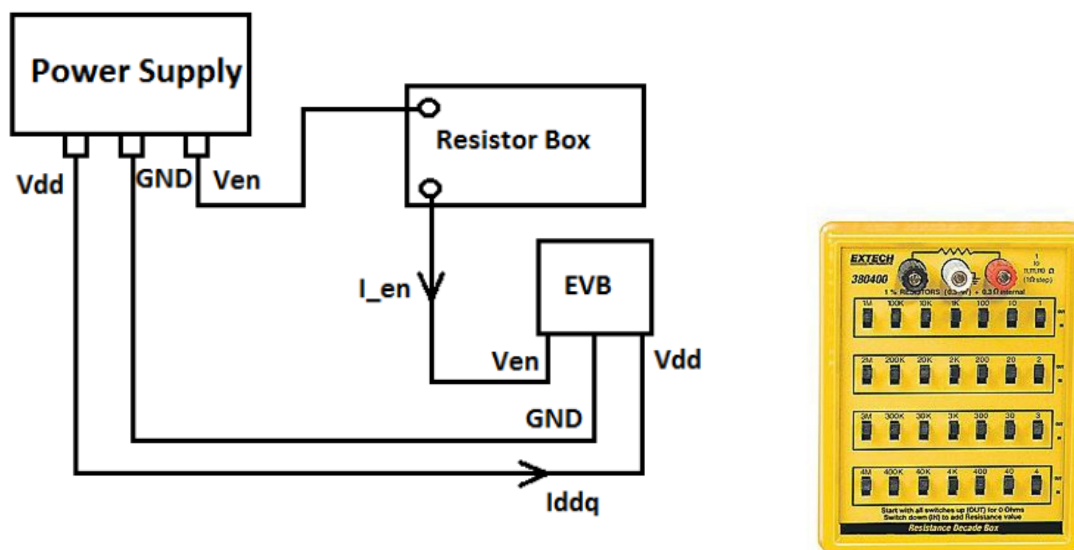


Figure 3. Resistor box test set and resistor box example

Using Interpolation from Bias Curves

In most cases, the above mentioned methods will not be necessary. We can often use simple interpolation to quickly arrive at a solution. As an example, consider GRF2013 bias R charts in Figure 4 for $V_{dd} = 5.0V$.

Suppose the application calls for $V_{dd}/I_{ddq} = 3.3V/65mA$. $V_{dd} = 3.3V$ would shift all curves in Figure 4 down and the solution would fall between $V_{en} = 3.0V$ and $V_{en} = 5.0V$. Choosing bias $R = 400\text{ ohm}$ would make sense for the 1st iteration. 400 ohm result would then tell us which direction to move:

If result $> (<)$ 65mA, we would adjust bias R value up (down).

An acceptable solution would be arrived at quickly after only a few iterations.

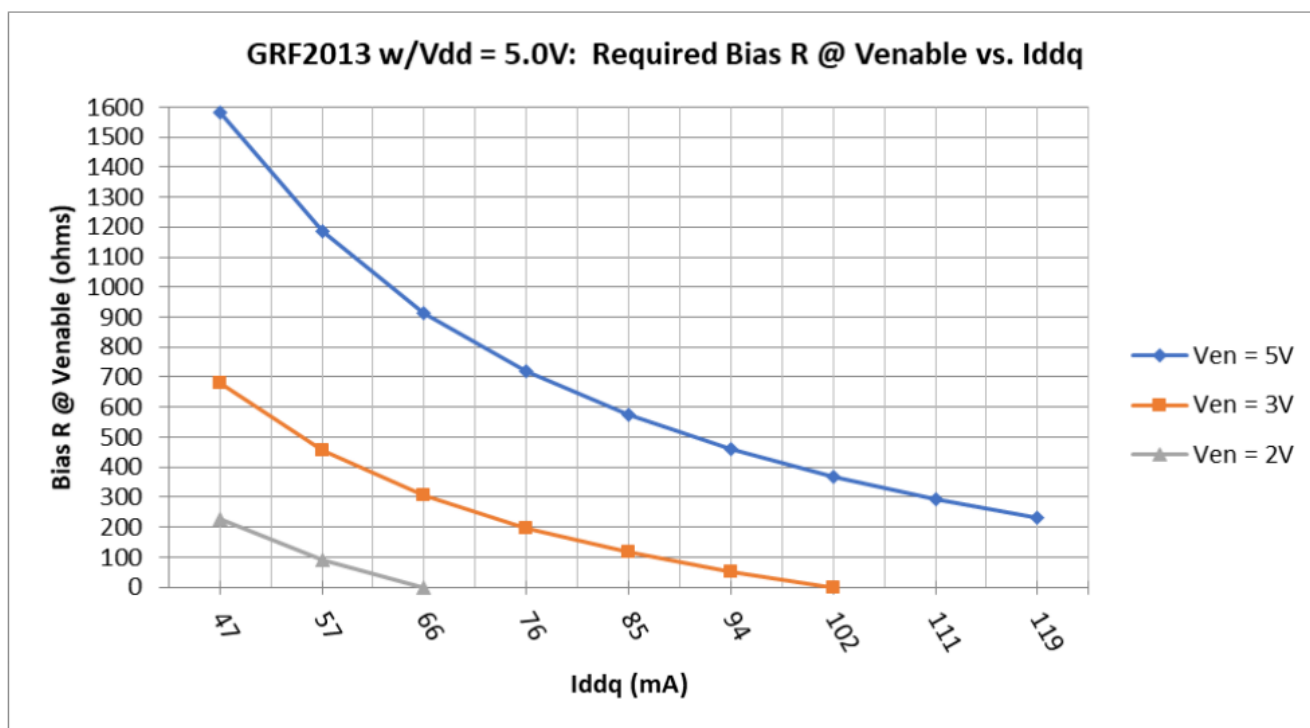


Figure 4. GRF2013 required Bias R at Venable vs. I_{ddq} for $V_{dd} = 5.0V$



Calculating Bias R from a Software Sweep

Perhaps the most accurate and comprehensive method is to employ software with a 0 ohm resistor in place for bias R. With Vdd set, Ven (at device pin due to 0 ohm bias R) is swept and current meter reads accurate I_{en}. Once the sweep is done, bias R vs. Iddq can be calculated and graphed using calculations shown in Table 1. In this example we used GRF2071 with Vdd = 3.5V. See we can calculate bias R for desired system Ven (in this case 3.5V or 1.8V).

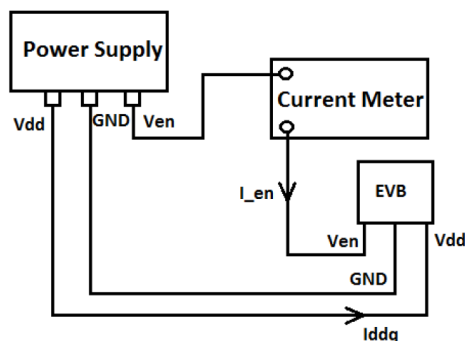


Figure 5. Current meter test set for the software sweep

Table 1. GRF2071 calculated bias resistance at Vdd = 3.5V

descriptor	Vdd V	Iddq mA	Ven1 pin V	Ienable mA	Bias R for Ven = 3.5V	Bias R for Ven = 1.8V
GRF2071	3.5	25	0.85	0.753	3519	1262
GRF2071	3.5	27	0.9	0.837	3106	1075
GRF2071	3.5	29	0.95	0.921	2769	923
GRF2071	3.5	31	1	1.006	2485	795
GRF2071	3.5	33	1.05	1.091	2246	687
GRF2071	3.5	35	1.1	1.177	2039	595
GRF2071	3.5	37	1.15	1.263	1861	515
GRF2071	3.5	38	1.2	1.349	1705	445
GRF2071	3.5	40	1.25	1.436	1567	383
GRF2071	3.5	42	1.3	1.523	1445	328
GRF2071	3.5	44	1.35	1.61	1335	280
GRF2071	3.5	45	1.4	1.698	1237	236
GRF2071	3.5	47	1.45	1.785	1148	196
GRF2071	3.5	48	1.5	1.873	1068	160
GRF2071	3.5	50	1.55	1.961	994	127
GRF2071	3.5	52	1.6	2.049	927	98
GRF2071	3.5	53	1.65	2.138	865	70
GRF2071	3.5	55	1.7	2.226	809	45
GRF2071	3.5	56	1.75	2.314	756	22
GRF2071	3.5	58	1.8	2.403	707	0

$$\text{Bias R} = (\text{Ven} - \text{Ven pin}) / (\text{Ienable} / 1000)$$

$$1262 = (1.8 - 0.85) / (0.753 / 1000)$$

$$3519 = (3.5 - 0.85) / (0.753 / 1000)$$



Contact Us

Contact our applications team at applications@guerrilla-rf.com with any questions!

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Revision History

Revision	Date Reason for Revision
Initial Release	October 13, 2026