

# VJ 3505 GSM Interference Immune Tuning Circuit

## VJ 3505 GSM INTERFERENCE IMMUNE TUNING CIRCUIT

VJ 3505 is a narrow band antenna that requires an active digital tuning circuit to allow it to cover the UHF band which spans between 470 MHz and 860 MHz. The tuning circuit typology is designed to withstand external interference such as GSM transmission. Nevertheless, in cases where the GSM transmitter is in close proximity to VJ 3505, the tuning circuit typology should be modified to eliminate the risk of antenna detuning. The following document describes in detail the GSM interference immune tuning circuit.

Vishay offers an evaluation kit fitted with the GSM immune tuning circuit and the VJ 3505 miniature UHF antenna to allow designers to measure the antenna parameters.

For any technical support please contact: [mlcc@vishay.com](mailto:mlcc@vishay.com)

### CHOOSING THE CORRECT TUNING CIRCUIT

Vishay Vitramon division provides two tuning circuit reference designs:

- Standard tuning circuit - described in detail in a separate application note titled "EVK 3505 User Guide"
- Active digital tuning circuit controlled by two input lines allowing full coverage of the UHF band 470 to 860 (MHz)
- GSM immune tuning circuit - described hereafter

The standard typology enables excellent antenna performance while maintaining minimal cost. However, the standard tuning circuit can withstand GSM interference up to 0 dBm, measured at the VJ 3505 antenna feed. The power received by VJ 3505 can be measured using the test setup described in figure 1.

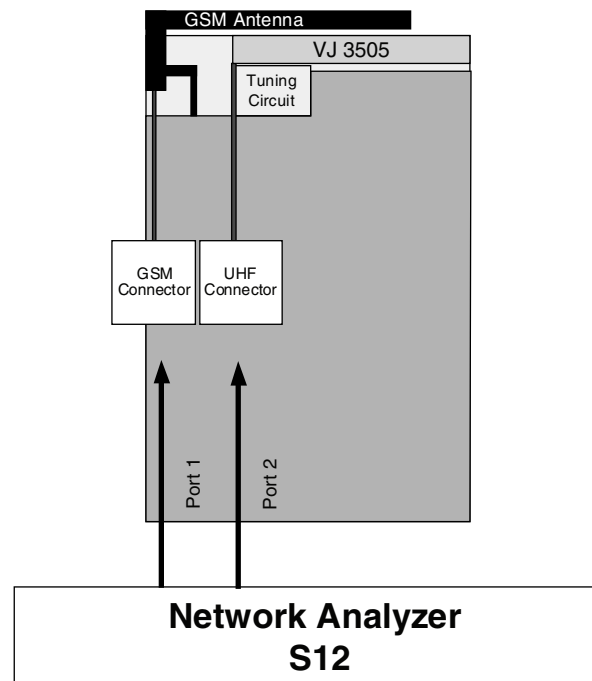


Fig. 1 - Test Setup

A test PCB should be designed to accommodate both VJ 3505 and the GSM antennas. The two antennas should be positioned as far from each other as allowed by the mechanical constraints of the application. Using a network analyzer, the coupling between the antennas can be directly measured for each of the four channels offered by the tuning circuit. The same test setup can later be used to fine tune the tuning element components to negate any detuning caused by the GSM antenna, or other nearby components.

Once the coupling factor is measured, the received power at the VJ 3505 feed can be estimated as follows:

$$\text{Received Power} = \text{Transmitted Power} + \text{Coupling Factor}$$

Example:

If the GSM peak power output is + 33 dBm and the coupling factor was found to be - 15 dB then the maximum received power would be + 18 dBm.

**The GSM immune tuning circuit should be used in cases where the peak received power is greater than 0 dBm.**

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### GSM IMMUNE TUNING CIRCUIT TOPOLOGY

#### SCHEMATICS

Figure 2 presents the schematic drawing of the recommended tuning circuit.

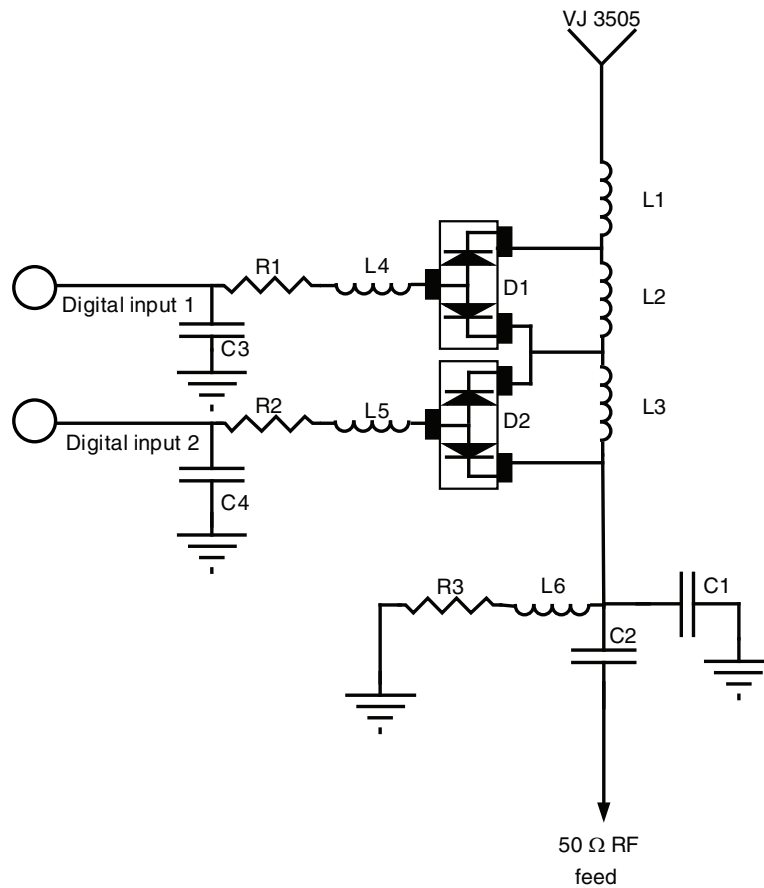


Fig. 2 - Tuning Circuit Schematics

## VJ 3505 GSM Interference Immune Tuning Circuit

### LAYOUT

Figure 3 shows the recommended layout of the tuning circuit. Layout should be as compact as possible.

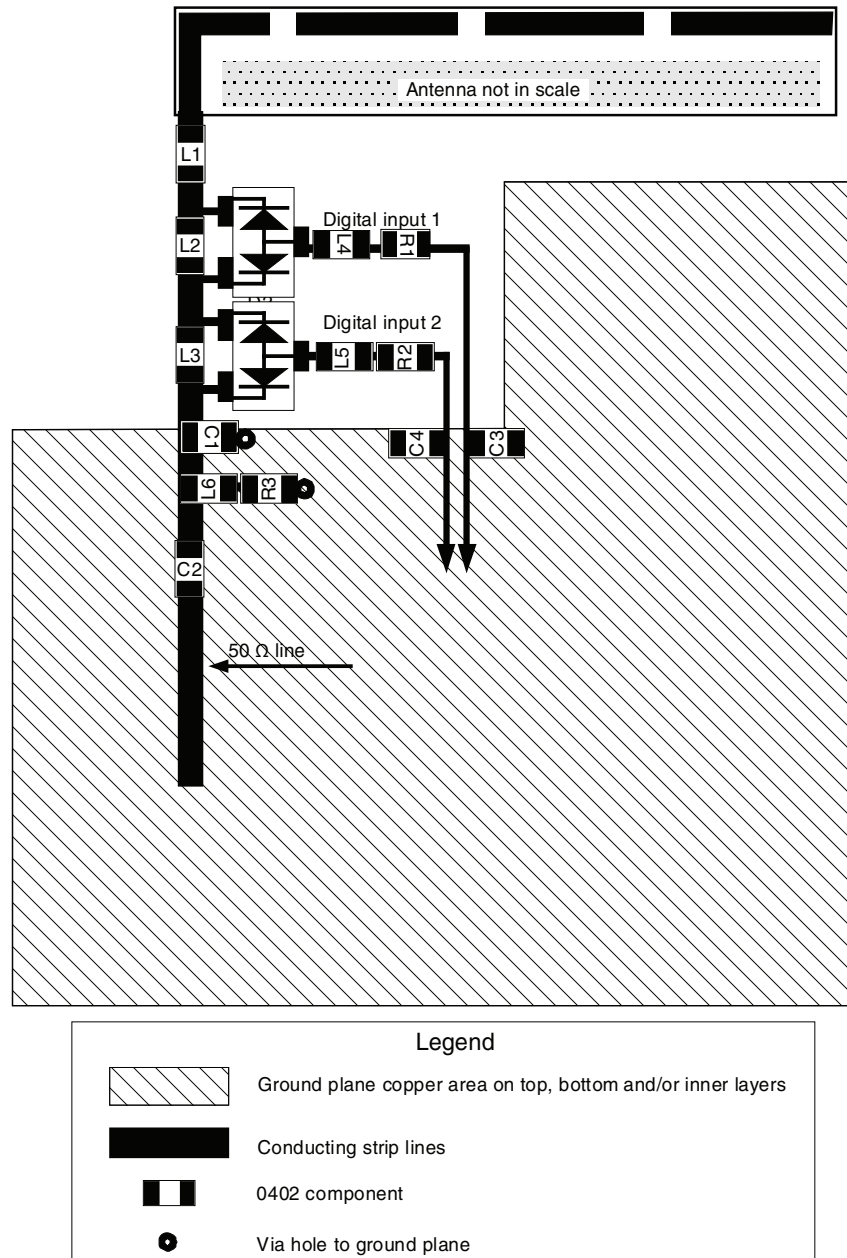


Fig. 3 - Tuning Circuit Layout

# VJ 3505 GSM Interference Immune Tuning Circuit

### LAYOUT GUIDELINES

1. The distance between the tuning circuit components should be minimized
2. Inductor L1 should be located as close as possible to the antenna
3. Inductors L4 and L5 should be as close as possible to the PIN diodes
4. It is recommended to remove all ground planes from under the tuning circuit. The ground plane should be added to insure a 50 Ω wave guide after capacitor C1

### REFERENCE TUNING CIRCUIT BOM

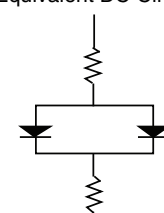
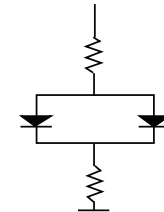
TABLE 1 - TUNING CIRCUIT BILL OF MATERIALS				
VALUE	REFERENCE	QUANTITY PER CIRCUIT	PART NUMBER	MANUFACTURER
120 nH	L4, L5, L6	3	HK 1005 R12J-T	Taiyo Yuden
PIN diode	D1, D2	2	BAR63-06W	Infineon
15 nH	L1	1	IMC0402ER15NJ	Vishay
12 nH	L2	1	IMC0402ER12NJ	Vishay
27 nH	L3	1	IMC0402ER27NJ	Vishay
3.9 pF	C1	1	VJ0402A3R9BXACW1BC	Vishay
220 pF	C2, C3, C4	3	VJ0402A221JXACW1BC	Vishay
330 Ω	R1, R2, R3	3	CRCW0402330RFKED	Vishay

#### Note

- Any changes made in the reference BOM might result in loss of radiation efficiency.

### CONTROL SIGNAL INTEGRITY

The following table describes the desired control signal properties:

TABLE 2 - SIGNAL INTEGRITY FOR ELECTRICAL CONTROL ALTERNATIVE						
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	COMMENTS
Logical LOW	$V_{il}$	- 0.3	0	0.2	V	Equivalent DC Circuit 
Logical HIGH	$V_{ih}$	3	3.3	5	V	Equivalent DC Circuit 
Source current	$I_{source}$	4	4.2	5	mA	$V_{in} = 5 V$ Diode reverse leakage current
Sink current	$I_{sink}$	0	0.01	0.05	mA	$V_{in} = - 0.3 V$



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### CHANNEL CHARACTERISTICS

The two digital control lines offer four frequency channels as described in table 3 below. This table shows the typical peak gain obtained in each of the four channels.

TABLE 3 - PEAK GAIN OBTAINED IN EACH OF THE FOUR CHANNELS				
PARAMETER	D1	D2	BAND (MHz)	S11 (dB)
1	L	L	470 to 540	
2	H	L	540 to 620	
3	L	H	620 to 750	
4	H	H	750 to 860 <sup>(1)</sup>	

**Note**

<sup>(1)</sup> Applications withstanding strong GSM interference will incorporate a band pass filter designed to filter out the interfering signal. Such a filter will add significant attenuation above 750 MHz.

The company's products are covered by one or more of the following:  
 WO2008250262 (A1), US2008303720 (A1), US2008305750 (A1), WO2008154173 (A1). Other patents pending.

ORDERING INFORMATION	VISHAY MATERIAL	PACKAGING QUANTITY
VJ 3505	VJ3505M011SXMSRA0	1000 pieces