# VJ 6040 GSM Interference Immune Tuning Circuit

## VJ 6040 GSM INTERFERENCE IMMUNE TUNING CIRCUIT

VJ 6040 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 6040, 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 6040 miniature UHF antenna to allow designers to measure the antenna parameters.

For any technical support please contact: 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 6040 User Guide”.
- 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 6040 antenna feed. The power received by VJ 6040 can be estimated using the test setup described in figure 1.

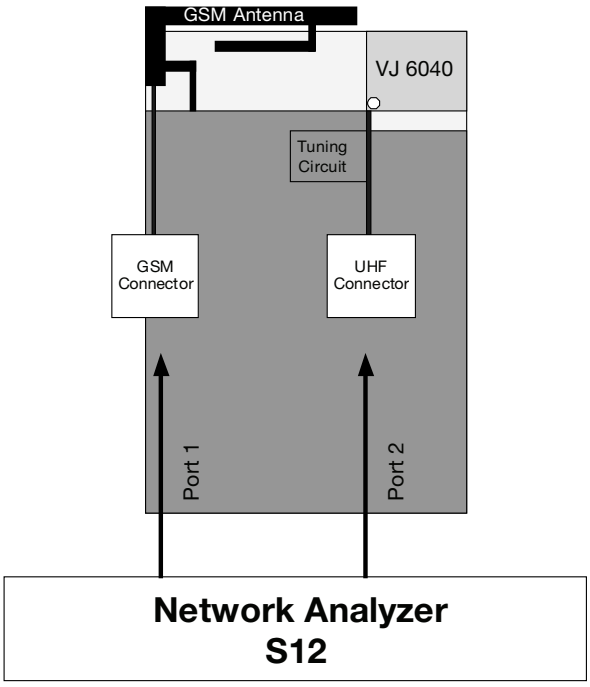


Fig. 1 - Test Setup

A test PCB should be designed to accommodate both VJ 6040 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 6040 feed can be estimated as follows:

**Received Power = Transmitted Power + 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.**

APPLICATION NOTE

# VJ 6040 GSM Interference Immune Tuning Circuit

## GSM IMMUNE TUNING CIRCUIT TYPOLOGY

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

**Schematics**

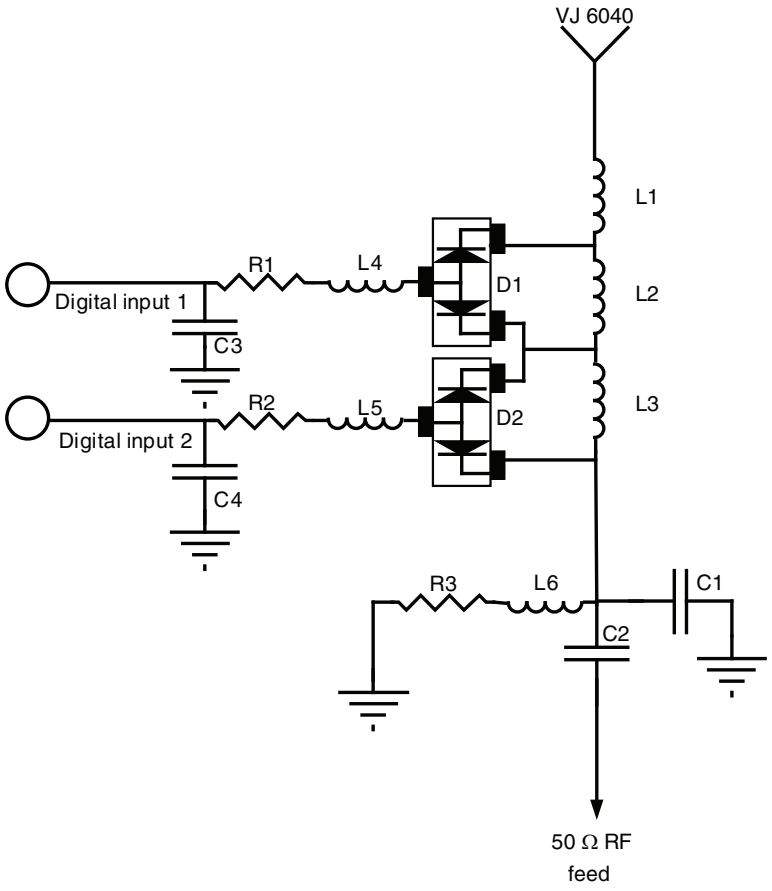


Fig. 2 - Tuning Circuit Schematics

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## LAYOUT

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

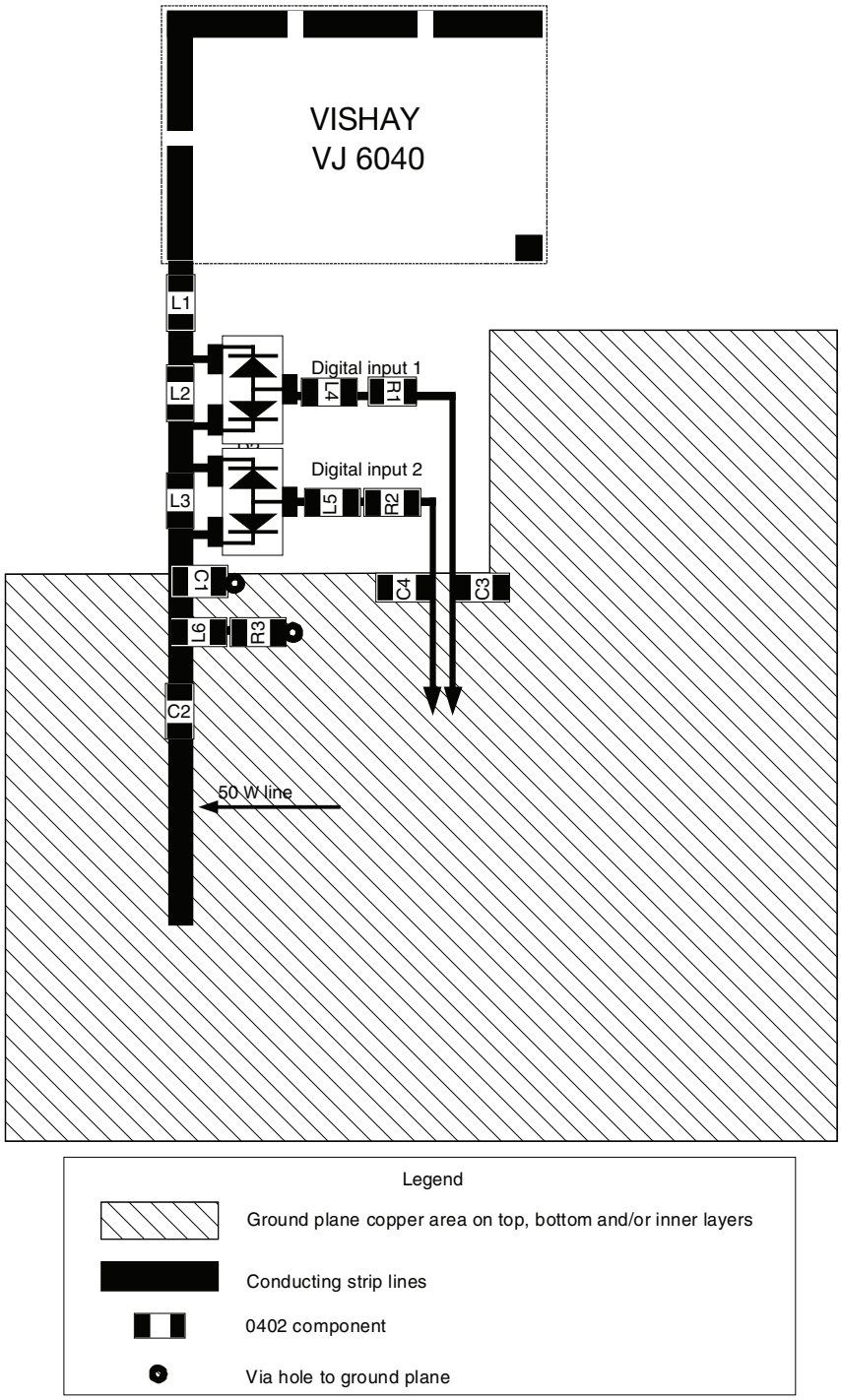



Fig. 3 - Tuning Circuit Layout

# VJ 6040 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 | BAR63-05W | Infineon |
| 39 nH | L1 | 1 | IMC0402ER39NJ | Vishay |
| 22 nH | L2 | 1 | IMC0402ER22NJ | 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 |

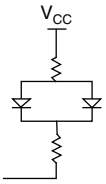
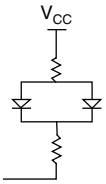
**Note**

- 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 | $V_{ih}$ | 2 | 3 | 5 | V | Equivalent DC Circuit   |
| Source current | $I_{source}$ | 0 | 0.01 | 0.05 | mA | $V_{in}$ = 5 V<br>Diode reverse leakage current |
| Sink current | $I_{sink}$ | 4 | 4.2 | 5 | mA | $V_{in}$ = - 0.3 V |

APPLICATION NOTE

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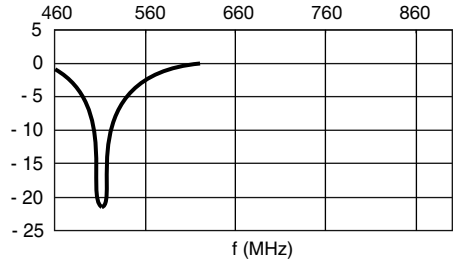
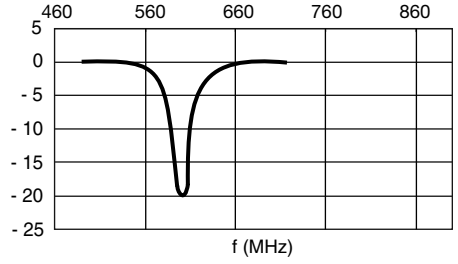
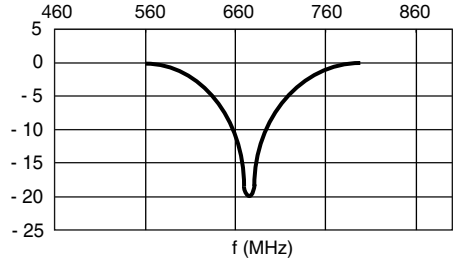
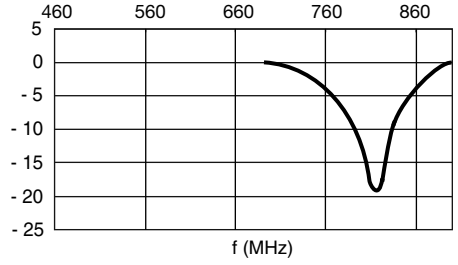
## CHANNEL CHARACTERISTICS

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 | H | H | 470 to 540 |  |
| 2 | L | H | 540 to 620 |  |
| 3 | H | L | 620 to 750 |  |
| 4 | L | L | 750 to 860 (1) |  |



**Note**

(1) 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 6040 | VJ6040M011SXISRA0 | 1000 pieces |