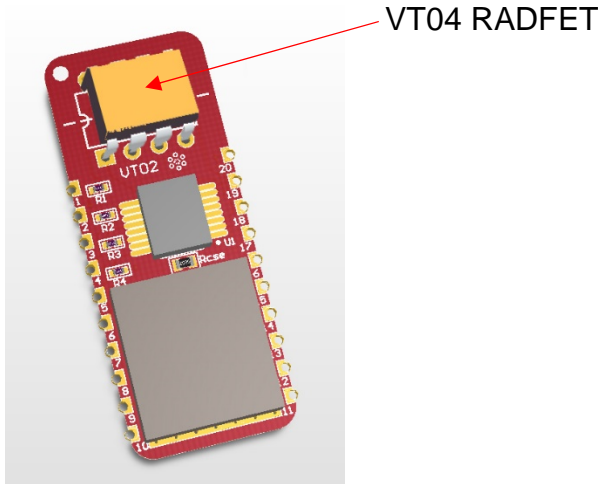


TECHNICAL DATA

RM-VT04-A

VT04 RADFET Readout Module



Description

The RM-VT04-A RADFET Read-out Module is a result of many years of experience of Varadis engineers in designing RADFET read-out circuitry. Aimed at providing an optimized RADFET read-out and cutting customers' development time and cost, the RM-VT04-A contains the VT04 RADFET and key circuitry for its readout. The module outputs a buffered analog voltage (RADFET threshold voltage), which is related to accumulated radiation dose of the RADFET. Due to its small size, RM-VT04-A can easily be integrated into customer's system by soldering directly onto the PCB or via a standard through-hole header connector.

RM-VT04-A is specially designed for and optimized around Varadis VT04 RADFET, with current source individually adjusted for each part to minimize RADFET threshold voltage drift due to temperature.

The threshold voltage of the RADFET is buffered for easier integration with standard analog to digital converters, significantly simplifying customer's electronics design.

Both Read-out and Irradiation (sense) modes of RADFET operation are supported. The user can easily select the desired mode by TTL logic level control signals.

Features

- Facilitates optimum RADFET read-out and saves on our customer's development time and costs
- Contains VT04 RADFET and critical read-out circuitry
- Supports Read-out and Irradiation modes of RADFET operation
- Main features:
 - Individually adjusted current source to minimize temperature influence
 - Buffered analog output voltage
 - TTL Logic control
 - Single supply
 - Low power
- Easy integration with customer's system as a surface mounted component or through-hole standard header pin connector
- Dose range from 0.3 cGy to 10 Gy (0.3 rad to 1 krad)

Typical applications

- General purpose radiation detection
- Satellites
- Medical equipment
- Accelerator facilities
- Nuclear power stations

Connector Assignment and Dimensions

RM-VT04-A connector assignment and PCB outline drawing are given in Figure 1, and pin description in Table 1.

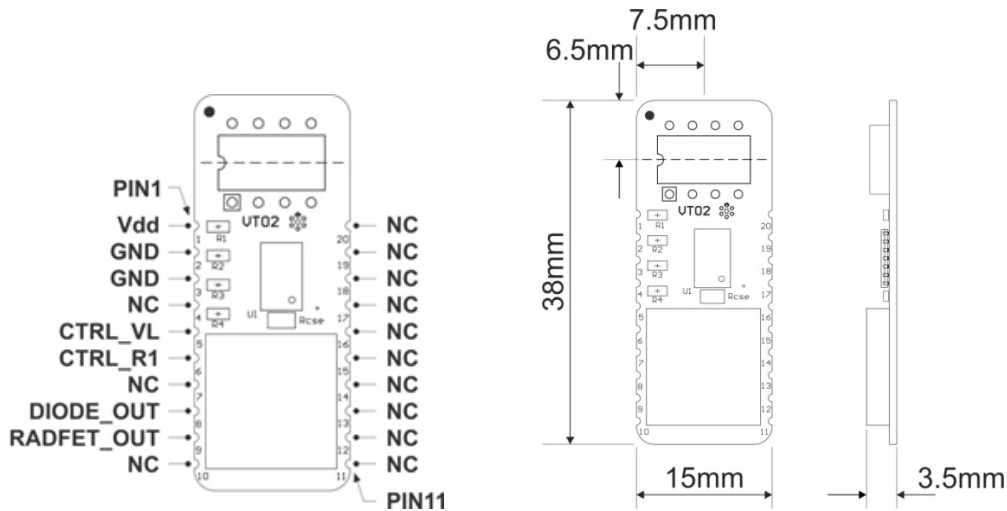


Figure 1: RM-VT04-A connector assignment and PCB outline drawing and dimensions.

Table 1: Pin description.

| Pin No. | Pin name | Pin type | Description / Recommendations |
|---------|------------|------------|---|
| 1 | Vdd | POWER | Positive power supply; this pin must be decoupled with 10 μ F ceramic, low ESR capacitor. |
| 2 | GND | GND | Connect to power supply ground. |
| 3 | GND | GND | Connect to power supply ground. |
| 4 | CTRL_R2 | Digital IN | RADFET R2 selection signal. |
| 5 | CTRL_VL | Digital IN | Logic reference voltage level. |
| 6 | CTRL_R1 | Digital IN | RADFET R1 selection signal. |
| 7 | NC | - | Not connected; this pin should be left floating or connected to GND. |
| 8 | DIODE_OUT | Analog OUT | Anode of the VT04 diode on chip ¹ . |
| 9 | RADFET_OUT | Analog OUT | VT04 RADFET output voltage, selectable via control signals. |
| 10-20 | NC | - | Not connected; these pins should be left floating or connected to GND. |

¹ The VT04 chip consists of one RADFET and one semiconductor diode. The diode is not radiation-sensitive and it can be used as thermometer for indication of the VT04 chip (die) temperature. This pin can be accessed at any time during RADFET sense mode and it does not require any digital control.

Block Diagram

The block diagram of the RM-VT04-A is shown in Figure 2. More detailed schematic is available, please contact us at support@varadis.com.

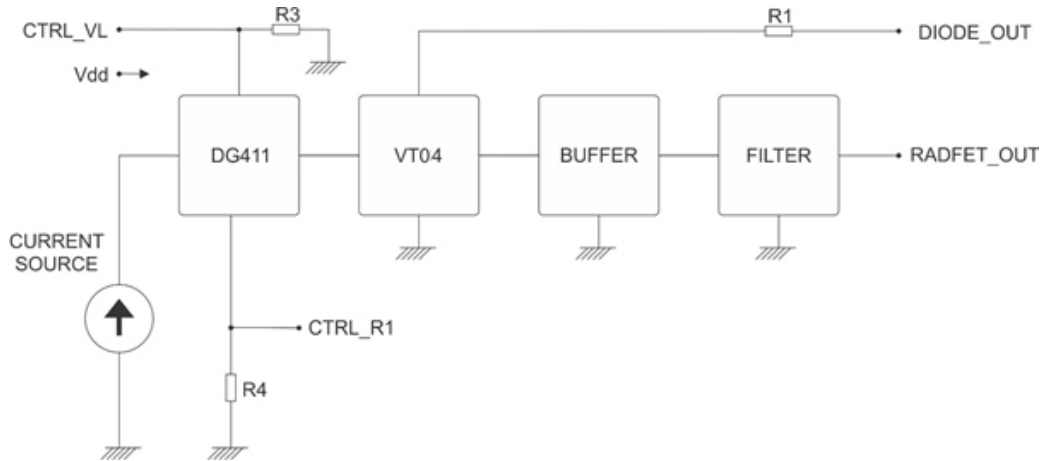


Figure 2: RM-VT04-A block diagram.

Operation Principle

The main element of the RM-VT04-A readout module is the VT04 part specifications of which are described in VT04 datasheet on [“Our Products” web page](#). The part consists of one RADFET, R1 and a diode. The RM-VT04-A module can be irradiated in active (powered) and passive (unpowered, $V_{dd}=0V$) mode, we recommend using active mode. Irradiation (sense) and Read-out modes are implemented by a series of analog switches (DG411), which provide appropriate biasing conditions. Biasing configuration is set by control signal CTRL_R1 as per truth logic table in Table 2. In Irradiation mode, all RADFET terminals are grounded. In Read-out mode, the RADFET is biased in Reader Circuit configuration – Drain/Gate tied together and grounded, Source/Bulk tied together, constant DC current source connected to Source/Bulk, RADFET Reader Circuit threshold voltage ($RC_V = V_{TH}$) read at Source/Bulk. The current source in RM-VT04-A is optimized for stability and its current level RC_I individually adjusted for each VT04 part to minimize temperature drift. The V_{TH} signal is buffered and filtered and made available at Pin 9 (RADFET_OUT).

Table 2: Truth table.

| CTRL_R1 | RADFET_OUT | Description |
|---------|---------------|---|
| 0 | 0 V | R1 in Irradiation (Sense) mode (all terminals grounded) |
| 1 | V_{TH} (R1) | R1 in Read-out mode |

Radiation Calibration Data

The calibration curve for the RM-VT04-A shows evolution of ΔV (the change in RC threshold voltage $RC_V = V_{TH}$ with reference to its pre-irradiation value) with dose. Note that a specific calibration curve, obtained using the Co-60 source, is associated with each RADFET production batch. The calibration curve, together with analytical equation and fitting coefficients, will be provided with the supplied parts. For illustration, typical calibration curve is shown in Figure 3.

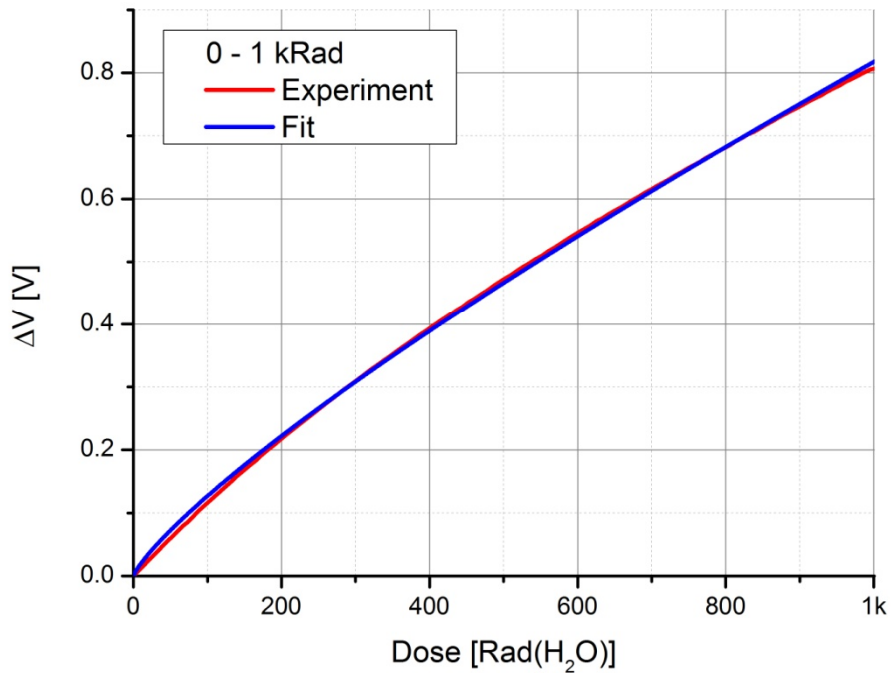


Figure 3: Typical calibration curve indicating change in RC_V during irradiation. Irradiation at room temperature with Co-60 gamma source, dose rate ~ 30 Gy/h (5 krad/h). Voltage measurements performed at room temperature every 120 s using current pulses of 250 ms duration. All terminals grounded between voltage measurements.

Recommended Operating Conditions

RM-VT04-A module recommended operating conditions are given in Table 3.

Table 3: Recommended operating conditions.

| Symbol | Parameter | Value | Unit |
|------------------|--|-------|------|
| V _{DD} | Supply voltage, referenced to GND | 24 | V |
| V _L | Logic reference voltage level | 5 | V |
| V _{CR1} | RADFET R1 selection signal | 5 | V |
| T | Ambient operating temperature | 22 | °C |
| ARH | Ambient relative humidity (non-condensing) | < 85 | % |

DC Electrical Characteristics

RM-VT04-A module DC electrical characteristics are given in Table 4.

Table 4: DC electrical characteristics.

| Symbol | Parameter | Conditions | Limits | | | Unit |
|------------------|---|----------------------------|-----------------------|----------------|-----|------|
| | | | Min | Typ | Max | |
| V _{DD} | Supply voltage, referenced to GND | T=22 °C | See Note ¹ | 24 | 36 | V |
| I _{DD} | Supply current | | | 2 | | mA |
| V _{TH} | RADFET threshold voltage | I _{OUT} = -0.1 mA | 5 | 7 | 10 | V |
| I _{OUT} | RADFET threshold voltage output current | | 0 | -0.1 | -1 | mA |
| V _L | Logic reference voltage level | | 3.3 | 5 | 5.5 | V |
| V _{CR1} | Control signal voltage | | | V _L | | V |
| T _{ON} | CTRL_R1 on time | | 0.025 | 0.25 | 1 | s |
| T _{OFF} | CTRL_R1 off time | | 15 | | | s |

Notes:

¹ The minimum supply voltage is determined by the following condition: V_{DD} = V_{TH} (HIGHER of R1 or R2) + 12 [V].

² The RADFET threshold voltage is dependent on accumulated radiation dose, please see VT04 datasheet for more details.

³ The min/max ambient temperature can affect the accuracy, please contact us for more details.

Recommended Circuit Interface

An example of a circuit interface is shown in Figure 4.

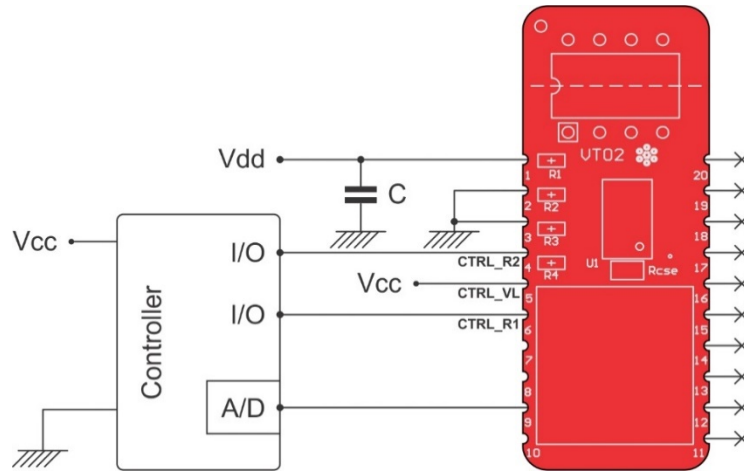


Figure 4: RM-VT04-A interface with microcontroller.

Soldering and Mounting

It is important that the RM-VT04-A is the last component to be hand soldered onto a circuit board. If different soldering profile is required, please contact us at support@varadis.com. RM-VT04-A can be soldered directly on the customer PCB (treated as SMD) or via standard through hole 10-pin header connector with a pitch of 2.54 mm; example (Mfr. No: 1-826629-0). Recommended dimensions for solder pad layout are given in Figure 5.

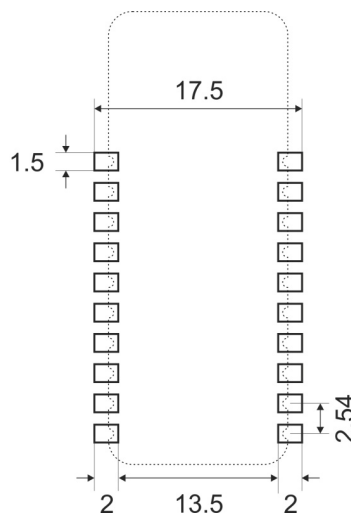


Figure 5: Recommended solder pad layout. All dimensions are in millimeters. Note the drawing is not to scale.

Handling

All assembled boards undergo 100% electrical test and visual inspection immediately prior to shipment. Therefore, all boards should reach the customer in excellent condition. To ensure that the boards remain in this condition, please handle the parts as carefully as possible and observe standard precautions related to ESD sensitive devices.

Notes

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