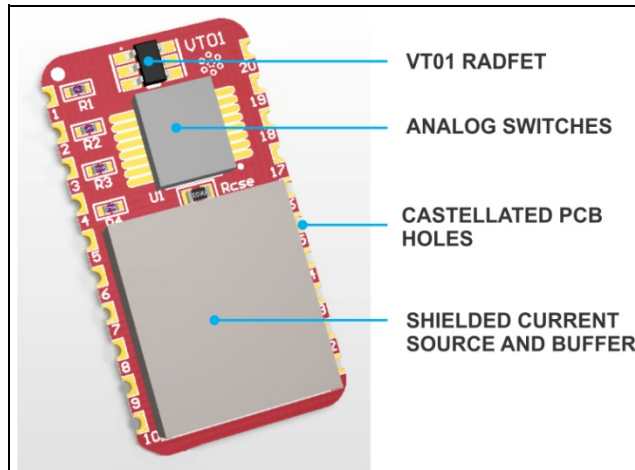


# TECHNICAL DATA

## RM-VT01

### VT01 RADFET Readout Module



## Description

The RM-VT01 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-VT01 contains the VT01 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-VT01 can easily be integrated into customer's system by soldering directly onto the PCB or via a standard through-hole header connector.

RM-VT01 is specially designed for and optimized around Varadis VT01 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

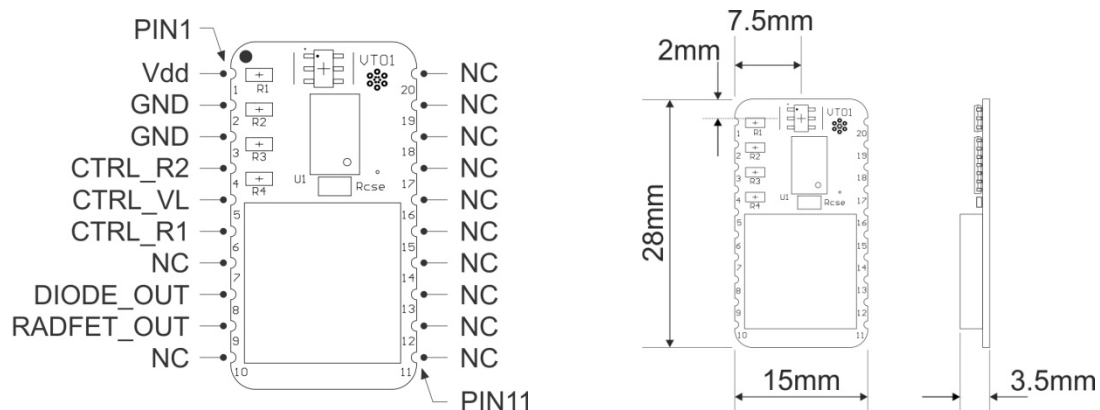
- Facilitates optimum RADFET read-out and saves on our customer's development time and costs
- Contains VT01 RADFET and critical read-out circuitry
- Supports Read-out and Irradiation modes of RADFET operation
- Main features:
  - Individually adjusted current source to minimize temperature influence
  - 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 1 cGy to 1 kGy (1 rad to 100 krad)

## Typical applications

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

## Connector Assignment and Dimensions

RM-VT01 connector assignment and PCB outline drawing are given in Figure 1, and pin description in Table 1.



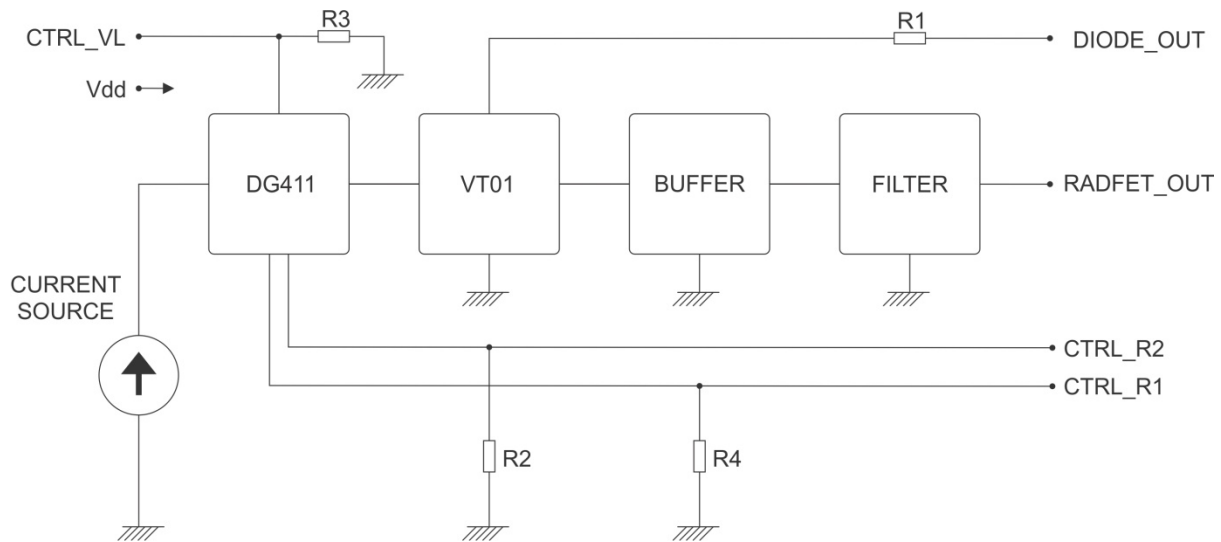
**Figure 1:** RM-VT01 connector assignment and PCB outline drawing and dimensions.

**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 $\mu$ 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.
8	DIODE_OUT	Analog OUT	VT01 DIODE, Diode anode
9	RADFET_OUT	Analog OUT	VT01 RADFET output voltage, selectable via control signals.
10-20	NC	-	Not connected; these pins should be left floating.

## Block Diagram

The block diagram of the RM-VT01 is shown in Figure 2. More detailed schematic is available, please contact us at [support@varadis.com](mailto:support@varadis.com).



**Figure 2:** RM-VT01 block diagram.

## Operation Principle

The main element of the RM-VT01 readout module is the VT01 part, operation and specifications of which are described in VT01 datasheet on [“Our Products” web page](#). The part consists of two identical RADFETs, R1 and R2, and a diode. 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 signals CTRL\_R1 and CTRL\_R2 as per truth logic table in Table 2. In Irradiation mode, all RADFET terminals are grounded. In Read-out mode, selected 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-VT01 is optimized for stability and its current level RC\_I is individually adjusted for each VT01 part to minimize temperature drift. The  $V_{TH}$  signal is multiplexed, buffered and filtered, and made available at Pin 9 (RADFET\_OUT).

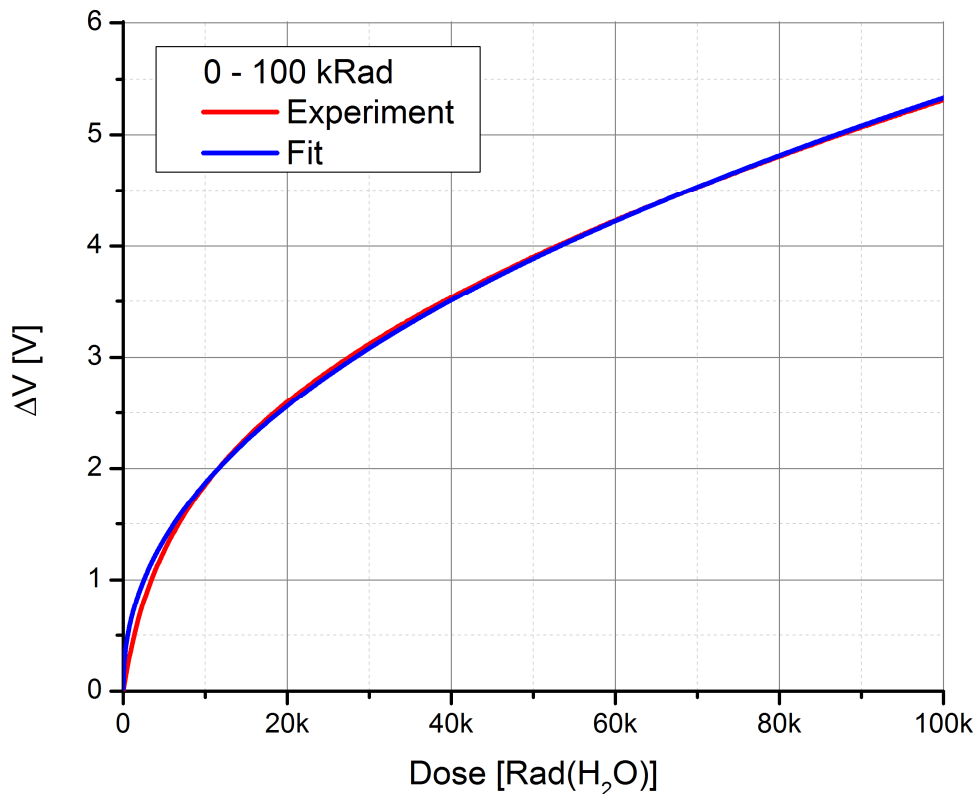
**Table 2:** Truth table.

CTRL_R2	CTRL_R1	RADFET_OUT	Description
0	0	0 V	R1 and R2 in Irradiation mode (all terminals grounded)
0	1	$V_{TH}$ (R1)	R1 in Read-out mode, R2 in Irradiation mode
1	0	$V_{TH}$ (R2)	R1 in Irradiation mode, R2 in Read-out mode
1	1	Not allowed <sup>1</sup>	N/A

<sup>1</sup> Do not use this logic set, it can result in wrong  $V_{TH}$  readings.

## Radiation Calibration Data

The calibration curve for the RM-VT01 shows evolution of  $\Delta V$  (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  $\sim 50$  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-VT01 recommended operating conditions are given in Table 3.

**Table 3:** Recommended operating conditions.

Symbol	Parameter	Value	Unit
V <sub>DD</sub>	Supply voltage, referenced to GND	24	V
V <sub>L</sub>	Logic reference voltage level	5	V
V <sub>CR1</sub>	RADFET R1 selection signal	5	V
V <sub>CR2</sub>	RADFET R2 selection signal	5	V
T	Ambient operating temperature	22	°C
ARH	Ambient relative humidity (non-condensing)	< 85	%

## DC Electrical Characteristics

RM-VT01 DC electrical characteristics are given in Table 4.

**Table 4:** DC electrical characteristics.

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V <sub>DD</sub>	Supply voltage, referenced to GND	T=22 °C	See Note <sup>1</sup>	24	36	V
I <sub>DD</sub>	Supply current			2		mA
V <sub>TH</sub>	RADFET threshold voltage	I <sub>out</sub> =0.1mA	0.8	1.8	12	V
I <sub>OUT</sub>	RADFET threshold voltage output current			-0.1	-10	mA
V <sub>CR1</sub> , V <sub>CR2</sub>	Control signal voltage			5		V
V <sub>L</sub>	Logic reference voltage level			5		V
T <sub>ON</sub>	CTRL_R1, CTRL_R2 on time		0.025	0.25	1	s
T <sub>OFF</sub>	CTRL_R1, CTRL_R2 off time		15			s

**Notes:**

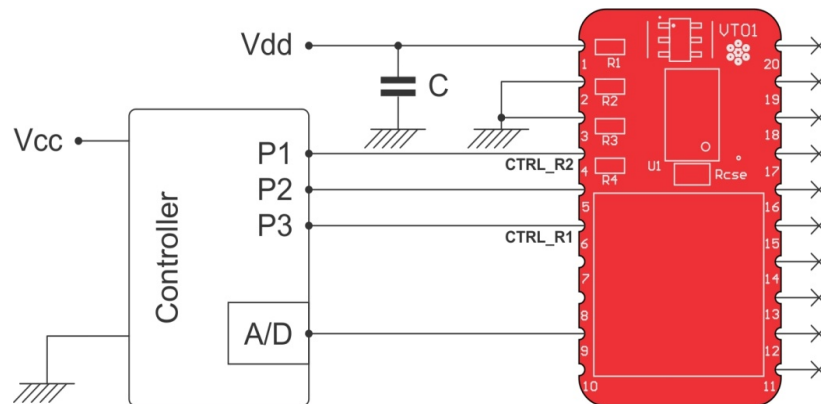
<sup>1</sup> The minimum supply voltage is determined by the following condition: V<sub>DD</sub> = V<sub>TH</sub> (HIGHER of R1 or R2) + 12 [V].

<sup>2</sup> The RADFET threshold voltage is dependent on accumulated radiation dose, please see VT01 datasheet for more details.

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

## Recommended Circuit Interface

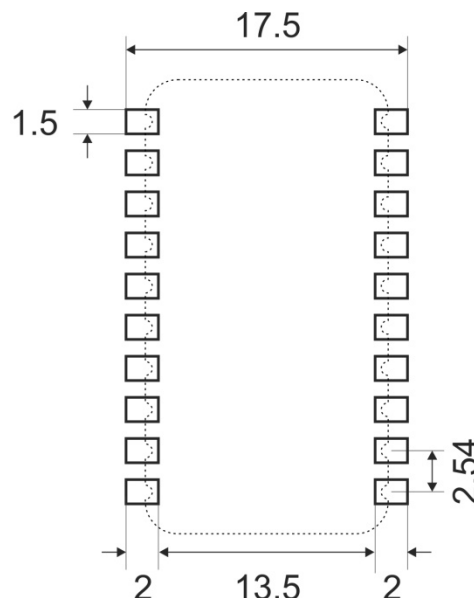
An example of a circuit interface is shown in Figure 4.



**Figure 4:** RM-VT01 interface with microcontroller.

## Soldering and Mounting

It is important that the RM-VT01 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](mailto:support@varadis.com). RM-VT01 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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