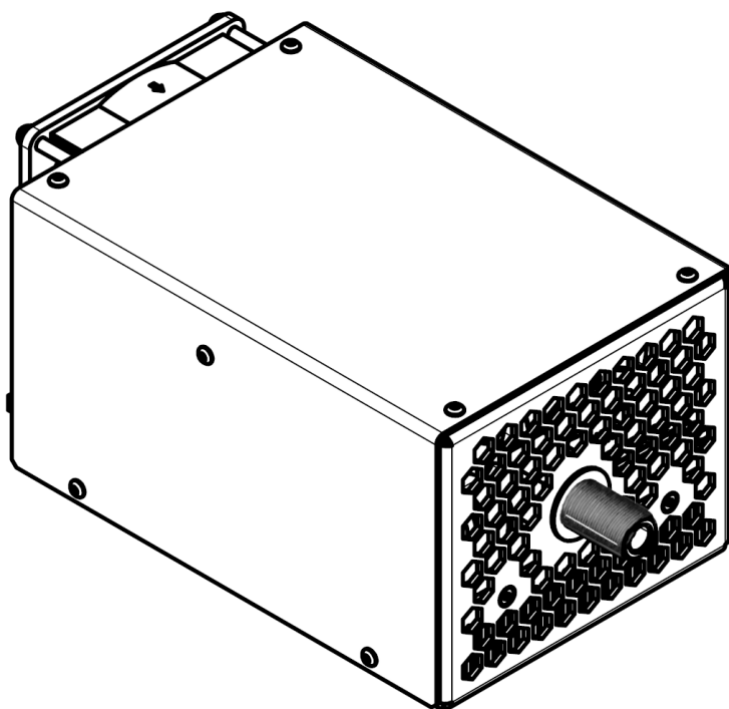


RFGM-series RF power modules

User manual



Warning! This equipment may be dangerous.
Please read the entire user manual carefully before using the product.

Table of content

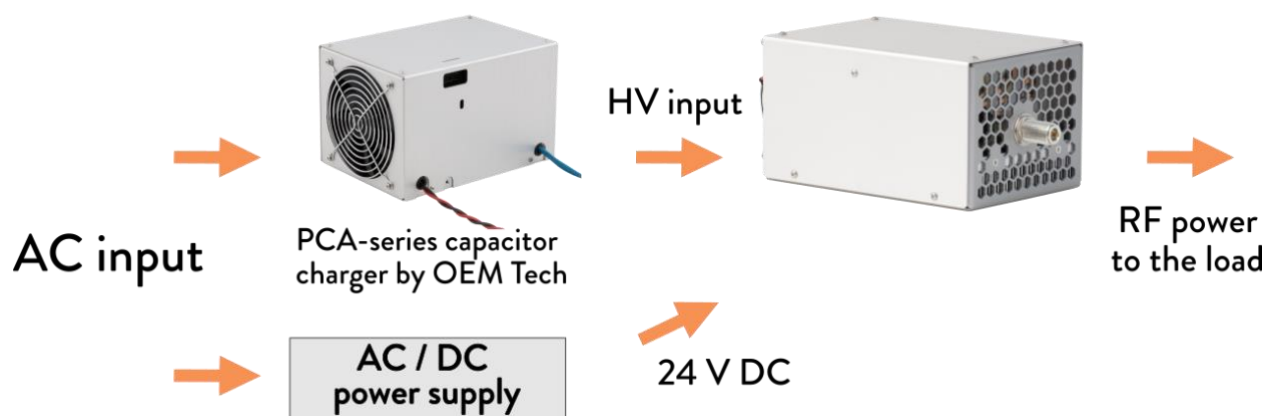
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Description

RFGM is a series of RF power modules providing at its output a high voltage sine wave in a single frequency mode from the radio-frequency range. Output frequency is selectable at the moment of order from sub-megahertz range to 81.36MHz, factory fixed. Output power varies from 300W to 1500W in dependence on model. See also *How to order?* section on page 13 for details and a list of available models.

All modules are cooled with a built-in fan. The fan rotation speed is controlled by the module's MCU.

Please note that the modules are not a stand-alone solution and require external sources of high (300–500 VDC) and low (24 VDC) voltage of the appropriate power to operate properly. A typical application schema is given below:



An average output power of the module can be regulated in two different ways:

- by varying the input DC voltage (the output power of the RFGM module increases with the rise of its input voltage)
- by a multi-kilohertz PWM of the output (set either by the Power control signal or via RS-485). The average output power in this case is linear to duty cycle.

A power combining of multiple modules is possible on request. An output power obtained in this case can reach 3000W and beyond.

RFGM-series power modules can be controlled in two different ways – either via RS-485 digital interface or, alternatively, via signals from the INTERFACE connector.

RFGM modules have advanced measuring circuits. Forward power, reflected power, load impedance are continuously and precisely monitored.

Appearance and layout



Side 1: Inputs and interfaces

Side 1 contains the module high voltage input (300VDC-500VDC), the module low voltage input (24VDC), all the interfaces connectors (both digital and analogue) as well as a grounding stud



Side 2: RF Output

Side 2 contains only RF output

Contents of delivery

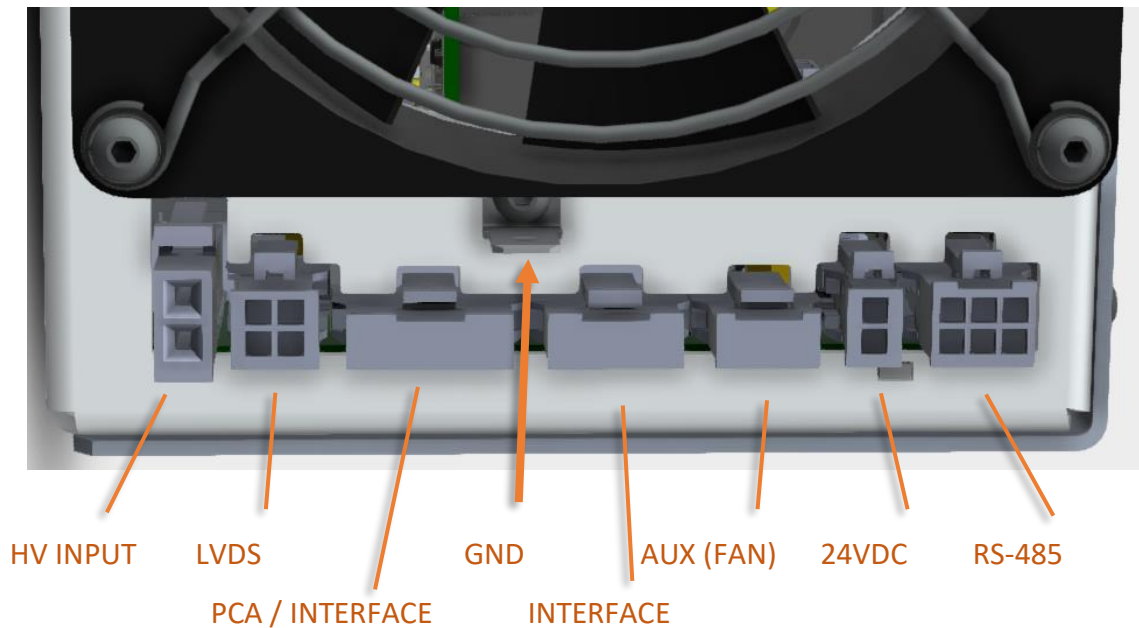
By default, the delivery package of the RFGM generator module contains the items as listed below:

- RFGM generator module – 1pc
- 24VDC input cable – 1pc (50cm)
- INTERFACE cable – 1pc (50cm)
- PCA / INTERFACE cable – 1pc (50cm)
- RS-485 cable – 1pc (3m)
- RS-485 aux bootloader cable – 1pc (4cm)
- USB/RS-485 adapter – 1pc
- USB Flash drive with software – 1pc

RF output cables are not included into the delivery package. Customized delivery content is available on request.

Please note, the PCA-10 (PCA-20) AC/DC power supply is not included into the delivery package and should be purchased separately.

Connectors, pins, interface signals



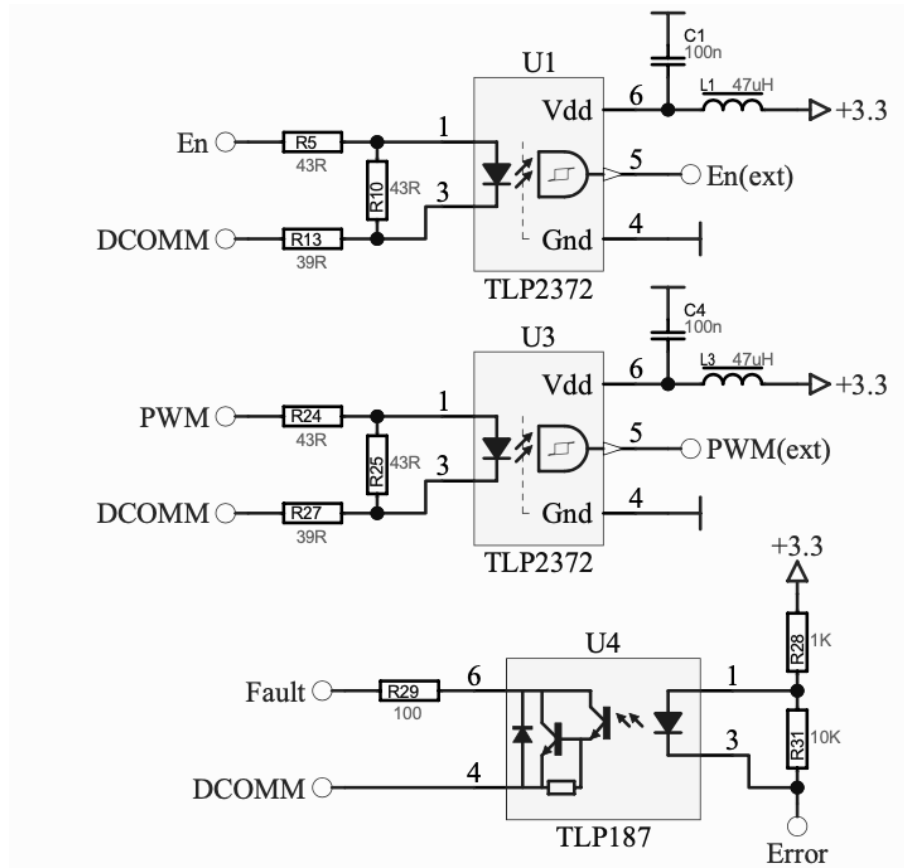
RS-485: Molex 43045-0601

Designation	Pin	Description
-	1, 4	Reserved for future use
RS485 B	2	Inverting Driver Output/Receiver Input
RS485 A	3	Non-inverting Driver Output/Receiver Input
RS485 SCREEN	5	Ground point for electrical screen of RS485 cable (N/C by default, available on request)
RS485 COMM	6	Common wire for 'RS485 A' and 'RS485 B' signals

INTERFACE: Molex 43650-0400

Designation	Pin	Description
Fault	1	Logic output, open collector, active low – indicates either an internal failure of the module or that the module isn't ready to work Once Fault occurs, 'Enable' should be reactivated to reset the Fault state
Interface return (DCOMM)	2	Common wire for 'Enable', 'Power control' and 'Fault' signals
Enable (En)	3	Logic input, 5V TTL/CMOS, active high – general enable to the module Input impedance – approx. 120 Ohm

Power control (PWM)	4	<p>Logic input, 5V TTL/CMOS , active high – module generates RF power when both 'Enable' and 'Power control' signals are 'high' state</p> <p>Switching of Power control signal with multi-kilohertz frequency can be used to adjust the average output power of the RFGM module</p> <p>Input impedance – approx. 120 Ohm</p> <p>Nominal frequency range from 1 kHz to 10 kHz. Duty cycle limitations are as follows: '1' state – 3 us min '0' state – 10 us min</p>
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Circuits of INTERFACE signals

PCA/INTERFACE: Molex 43650-0500

A capacitor charger of PCA-series is to be connected here.

Designation	Pin	Description
Interface return	1	See the PCA-series capacitor charger user manual for the detailed signal description
Fault	2	
Inhibit	3	
Voltage program	4	
15V DC	5	

AUX (FAN): Molex 43650-0301

An auxiliary connector is used only to connect the fan cooling RFGM module.

24VDC: Molex 43045-0202

The module low voltage input

Designation	Pin	Description
+24VDC	1	24VDC power supply connection
COMM 24VDC	2	Maximum current consumption – 1A

HV INPUT: Molex 2601-3114

The module high voltage input (up to 500VDC)

Designation	Pin	Description
HV	1	High voltage power supply connection
COMM HV	2	Maximum input voltage – 500VDC Nominal input voltage is model dependent

LVDS: Molex 43045-0401

The LVDS input is used either to run the module in external synchronization mode or to organize a parallel connection of multiple modules. By default, the LVDS connector is non-functional, but available on customer's request (see also *How to order?* section, p.13).

Designation	Pin	Description
+IN for 'slave' modules +OUT for 'master' modules	1	Logic input, LVDS – external oscillator non-inverting input (output)
-IN for 'slave' modules -OUT for 'master' modules	2	Logic input, LVDS – external oscillator inverting input (output)
LVDS COMM	3	Common wire for external oscillator input (output)
LVDS SCREEN	4	Ground point for electrical screen of external oscillator cable (N/C by default, available on request)

GROUND: 6.35mm Quick-Connect terminal, male

The protective grounding should be organized by using this stud.

RF OUTPUT: N-TYPE

The N-TYPE RF connector by Amphenol (5/8-24 thread, female).
The RF Output return is interconnected to the RFGM chassis.

Grounding policy

The following considerations should be taken into account:

1. The RF Output return is interconnected to RFGM chassis.
2. Due to safety reasons, the RFGM chassis must be protectively grounded.

Specifications

ELECTRICAL

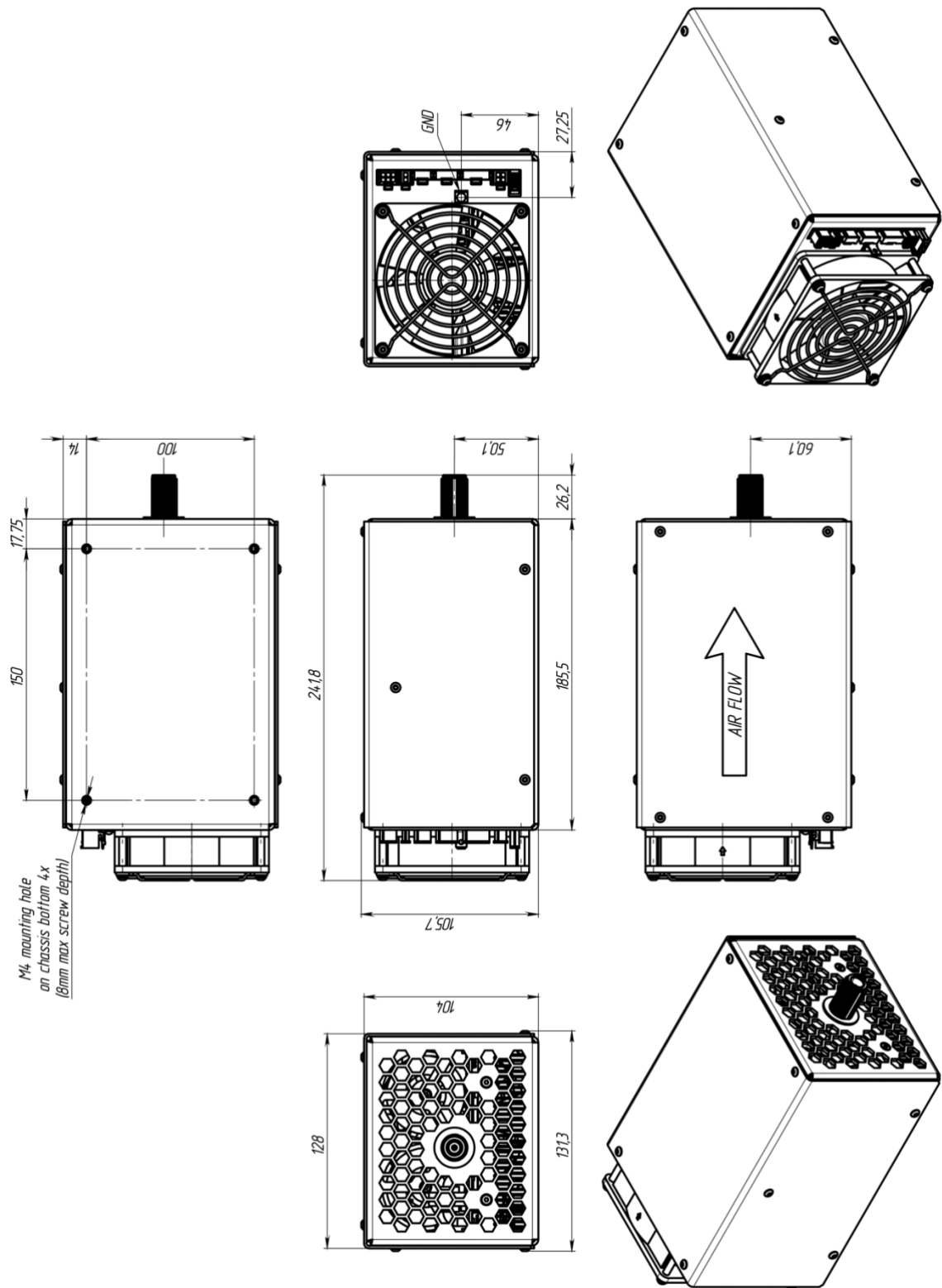
General	
Product	RF power module
Schematics	Class E power generator
Input	
HV Input	DC voltage, regulated, 300V-500V max (model dependent)
HV power consumption	2000W max (model dependent)
LV Input	24VDC
LV current consumption	1A max
Output	
Load impedance	50 Ohm
Frequency	6.78MHz, 13.56MHz, 27.12MHz, 40.68MHz, 81.36MHz (other on request), fixed, selectable at the moment of order
Peak power (W_{MAX})	1500W max (model dependent)
Duty cycle	0-100%
Average power	0- W_{MAX}
Output connector	N-TYPE RF connector by Amphenol (5/8-24 thread)
Interfaces	
Analogue	A set of TTL signals
Digital	RS-485 by default, other on request
Other	
Protections	- Overtemperature protection

	<ul style="list-style-type: none"> - Short-circuit tolerance - Open-circuit tolerance (short-time) - Protection from too high reflected power
Output measurements	<ul style="list-style-type: none"> - Forward power - Reflected power - Load impedance
Safety features	<ul style="list-style-type: none"> - Forward power monitor, load impedance measurement - Capacitive coupling of the output
Grounding	Output return is connected to the chassis
Cooling	Forced air cooling with built-in fan
Power combining of multiple modules	Two modules can be connected in master-slave mode; for connection of three and more modules an appropriate controller is needed; an appropriate power combiner is needed in all cases

MECHANICAL

Dimensions (LxWxH)	Approx. 242x131x106mm (see also the dimensional drawing below)
Weight	Approx. 2.5 kg

Dimensional drawing



How to order?

RFGM-XXX-YYY-ZZ, where:

- XXX means the working frequency of the module;
the most standard frequencies are 6.78MHz, 13.56MHz, 27.12MHz, 40.68MHz and 81.36MHz, other frequencies are available on request
- YYY means the maximum output power of the module;
typically the maximum power is in range from 300W to 1500W, other output power values can be considered on request
- ZZ means the type of the module;
none or 0 – stand-alone module (not suitable for master-slave operations)
M – master (master unit for master-slave operations)
S – slave (slave unit for master-slave operations)

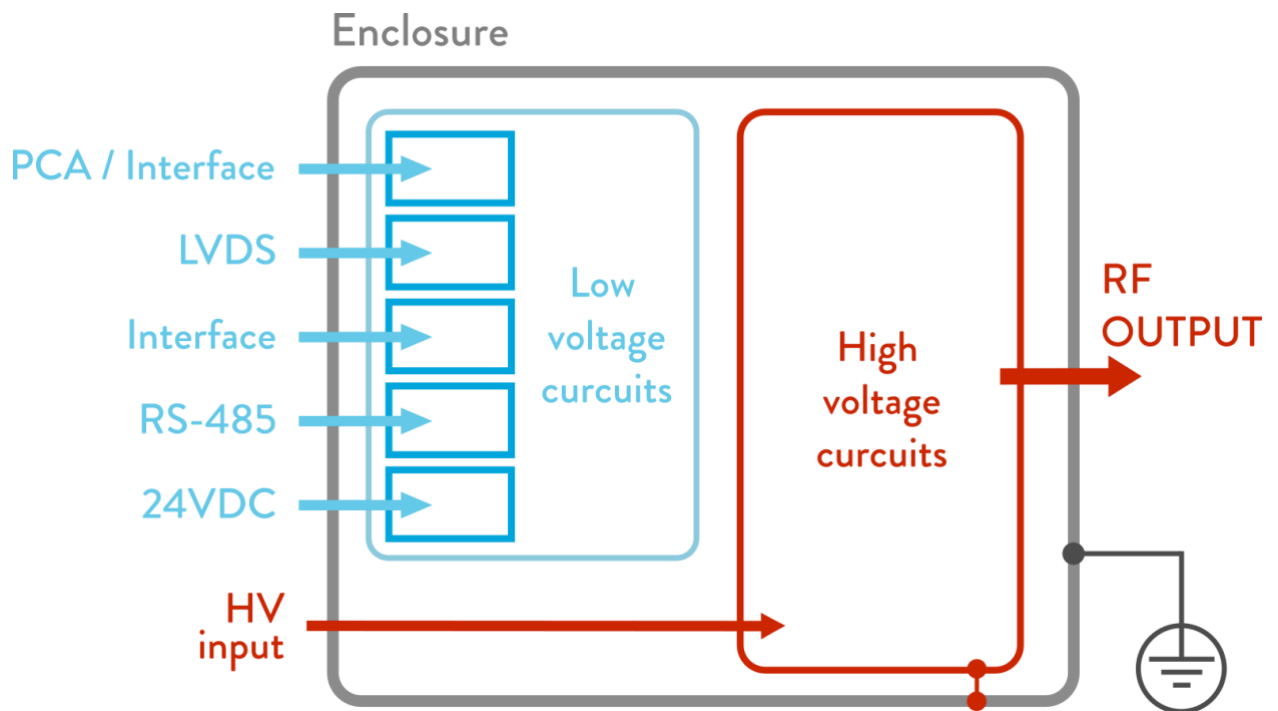
Master-slave connection of two modules allows to increase the maximum output power twice and achieve 1000W to 3000W power levels.

Examples (the most popular modifications):

Frequency	Output power	Description	Part numbers
0.5-4MHz	Up to 1500W	Easily available as modifications of 6.78MHz model All parameters are configurable	Custom
6.78MHz	800W	Suggested HVDC source - PCA-10-300V-PD	RFGM-6.78-800
	1500W	Suggested HVDC source - PCA-20-500V-PD	RFGM-6.78-1500
13.56MHz	800W	Suggested HVDC source - PCA-10-300V-PD	RFGM-13.56-800
	1500W	Suggested HVDC source - PCA-20-500V-PD	RFGM-13.56-1500
27.12MHz	500W	Suggested HVDC source - PCA-10-300V-PD	RFGM-27.12-500
	1000W	Suggested HVDC source - PCA-10-300V-PD for 800W operations and below or PCA-20-500V-PD for 1000W operations	RFGM-27.12-1000
40.68MHz	500W	Suggested HVDC source - PCA-10-300V-PD	RFGM-40.68-500
81.36MHz	300W	Suggested HVDC source - PCA-10-300V-PD	RFGM-81.36-300

Other modifications with different output power, operating frequency as well as other parameters are available on request.

Insulation diagram (safety diagram)



Gray – chassis (must be protectively grounded)

Red – high voltage circuits and circuits with no galvanic insulation from high voltage circuits

Blue – low voltage circuits; insulation of low voltage circuits from high voltage circuits is 4mm creepages, 4mm clearances, 1500V test voltage; insulation of low voltage circuits from other low voltage circuits is 2.5mm creepages, 2.5mm clearances, 1500V test voltage

Grounding policy

The following considerations should be taken into account:

1. RF Output return is interconnected to RFGM chassis.
2. Due to safety reasons, RFGM chassis must be protectively grounded.

Appendix 1. Demo software, its description

There is a demo software utility, which is supplied for free together with the RFGM generator module to simplify its integration into the customer's system. Please request the description from the manufacturer if you need it in advance.

The screenshot displays the RUnit Control Demo Utility software interface. The main window is titled "RUnit Control Demo Utility" and shows a "Connected" status. The interface includes a "Select serial port" dropdown set to "COM4", a "Connect" button, and a "Data acq. interval, ms" field set to "250". The "Monitor Window" button is visible in the top right.

The main window is divided into several sections:

- Status:** Shows "SR1" as 0x0015 and "SR2" as 0x40B0. It contains a list of status indicators with checkboxes and colored squares (green, yellow, red).
- Power Control:** Features a "Mode" section with buttons for "PID Regulated Power", "Estimated Power", and "Burst Sequence". Below this is a "Required" section with a "Power, W" field set to "90" and a checkmark. The "Burst" section includes "Time (ms)" (1), "Max Energy, J" (0.0), "Repetitions" (1), and "Period, ms" (2). At the bottom are "ON" and "OFF" buttons.
- Modbus Server counters:** Shows "Error stack Top" as "no error", "In" as 23151, "Out" as 23151, and "Err" as 0.
- FW Version:** 3.1.0 and "UC_ID:0461P4P-15-00510034".

The "Monitor Window" on the right displays the following data:

- T, °C: 38
- Voltage, V: 90.5
- Forward Power, W: 94.2
- Reflected Power, W: 0.0
- RF Voltage, RMS, V: 68.5
- RF Current, RMS, A: 1.358
- Load Impedance:**
 - |Z|, Ω: 50.5
 - Z, Ω: 50.4 - j1.3
- Last Burst Energy, Joules: 0.0
- Last Burst Duration, ms: 0
- Burst Sequence Energy, Joules: 0.0
- Exposure Total Duration, ms: 0

Appendix 2. RS-485 communicative protocol, its description

A complete description of the current version of the RS-485 communication protocol is supplied with the RFGM module. Please request the description from the manufacturer if you need it in advance.