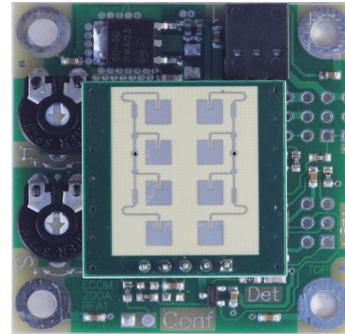


### Features

- Low Power Radar Movement Detector
- Adjustable Sensitivity 1m to 10m for Persons
- Adjustable Hold 1Second ... 30 Minutes
- Object Detection from 1cm/s ... 80km/h
- Selectable Continuous and Pulsed Mode
- Power Supply 6V ... 15VDC
- 7mA Supply Current in Pulsed Mode
- Fluorescent Lamp Interference Suppression



Actual size

### Applications

- Energy Saving Applications
- General Movement and Presence Detection
- Surveillance Applications
- Equipment Activation on Presence
- Automatic Advertising Applications
- Lighting Control

### Description

RFA1 is a Radar based movement detector for objects moving up to 80km/h in continuous mode.

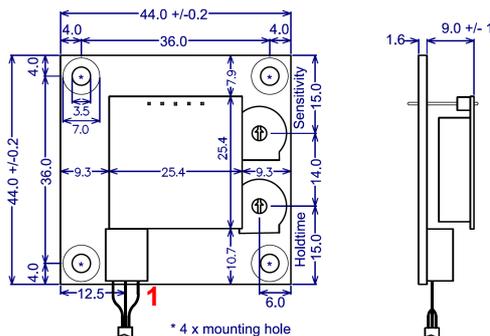
It consists of a Radar sensor and a processing board. The output is an open collector driver with adjustable hold time from 1 to 30 minutes.

Advanced pulsed technology allows low current operation at less than 10mA.

Sensitivity is adjustable between 1m and 10m for persons.

RFA1 is expandable by different I/O modules.

### Outline Dimensions



### Pin Configuration

Pin arrangement: see left picture.

Pin	Description	Typical Value
1	GND	0V, GND
2	VCC	6 ... 24VDC
3	Output	no detection: high impedance detection: sink to ground: 1V @ 20mA

### Settings



Hold time ranges from 1 second until 30 minutes. Time setting is progressive.



Sensitivity sets the maximal distance range. Setting is approximately linear. Standard version ranges from 1m ..10m.

## RFA1 RADAR ACTIVATOR

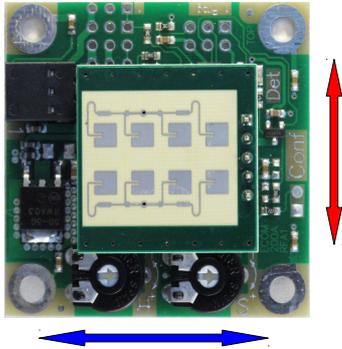
## Datasheet

## Characteristics

Parameter	Conditions / Notes	Symbol	Min	Typ	Max	Unit
<b>Operating conditions</b>						
Supply voltage		$V_{CC}$	6		24	VDC
Supply current	Pulsed mode (no detection)	$I_{CC}$		6.5	8	mA
	Pulsed mode (detection)	$I_{CC}$		10	12	mA
	Continuous mode	$I_{CC}$		35	45	mA
Output Sink Current	$V_{out} < 1.5V$	$I_{out}$			20	mA
Operating temperature		$T_{op}$	-20		+80	°C
Storage temperature		$T_{st}$	-20		+80	°C
<b>Settings</b>						
Sensitivity continuous mode	Persons, frontal, continuous mode	$R_{Cap}$	1		10	m
Sensitivity pulsed mode	Sensitivity pulsed (energy saving) mode	$R_{Cap2}$	1		7	m
Hold Time		$T_H$	1s		30 min	
Pulse Mode	can be enabled / disabled during power up	$t_{ON} / t_{OFF}$		5/200		$\mu s$
<b>Radar</b>						
Capturing range	Persons, frontal	$R_{Cap}$			10	m
Detectable object speed range		$v$	0.1		80	km/h
Transmitter frequency	$U_{VCC} = 5V, T_{amb} = -20^{\circ}C \dots +80^{\circ}C$	$f_{TX}$	24.050	24.150	24.250	GHz
Output power	EIRP	$P_{TX}$	+12	+15	+17	dBm
Spurious emission	According to ETSI 300 440	$P_{spur}$			-30	dBm
<b>Antenna</b>						
Horizontal -3dB beamwidth	E-Plane	$W_{\phi}$		80		°
Vertical -3dB beamwidth	H-Plane	$W_{\theta}$		34		°
<b>Body</b>						
Outline Dimensions	length x width x height			45x45x15		mm <sup>3</sup>
Weight				13		g
Connector ( Note 1)	Terminal Block PTSM 0,5/ 3-2,5-H THR R32			3		pins

Note 1) Phoenix terminal connector type PTSM 0,5/ 3-2,5-H THR R32:  
Spring cage type. No needs for tooling. Wires AWG24...20. / 0.2mm<sup>2</sup> ... 0.5mm<sup>2</sup>

Detection Field



RFA1 can be mounted as shown on the left to get horizontally a “narrow field”. Rotating the module by 90° results in a wider field.

Fig. 1 and Fig. 2 show typical detection fields for a walking person at different sensitivity settings. Please note: these values are typical and depend on many parameters. Please refer also to chapter Application Notes.

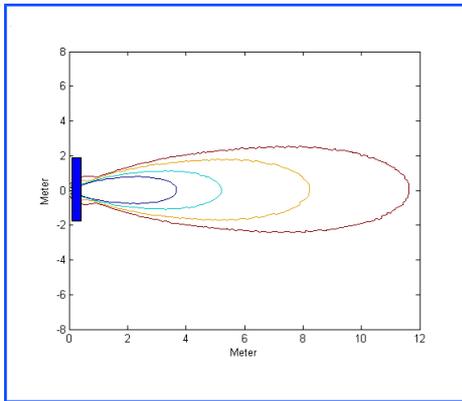


Fig. 1 : Frontal response diagram

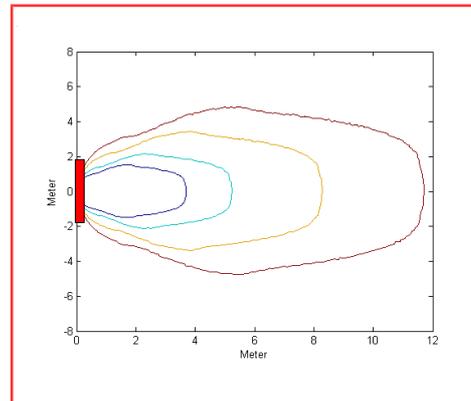
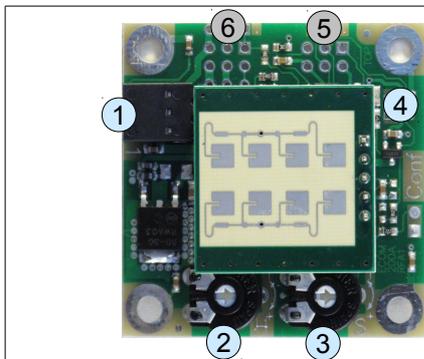


Fig. 2: Frontal response, RFA1 turned by 90°

Other characteristics are available for OEMs as options. Please contact [info@RFbeam.ch](mailto:info@RFbeam.ch).

Connectors and Control Elements



- (1) Power and output connector
- (2) Hold time setting
- (3) Sensitivity setting
- (4) Detection indicator LED
- (5) Programming pads
- (6) Expansion pads

Fig. 3: Control elements

## Principle of Operation

RFA1 is a movement sensor containing a Doppler Radar module [K-LC1a](#). Signal acquisition, amplifier and digitizer are built in hardware, while timing and output are processed in a microcontroller.

RFA1 can operate in two modes:

- Continuous mode, where the Radar module is always powered.
- In pulsed mode, the Radar module is powered during approx. 4 $\mu$ s and switched off during 200 $\mu$ s (i.e. duty cycle of around 2%). During the off time, signal is stored in a sample&hold (S&H) circuit.

Signal output frequency of the Radar module is 44Hz/km/h or 158Hz/m/s. Radar output voltage depends on reflectivity, distance and direction of the moving object. It ranges from a few  $\mu$ V to some mV.

This input signal is filtered and passes a band-stop at 100Hz. This reduces the influence of fluorescent lights in countries with a mains frequency of 50Hz.

After a gain-adjustable amplifier, the amplified signal passes a window comparator. Comparator signal contains double frequency of the input signal and is read by a microcontroller. Microcontroller performs some digital filtering, timing and output control.

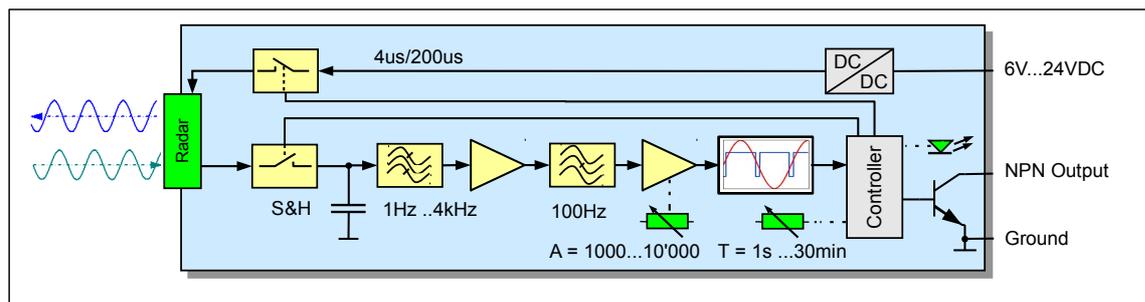


Fig. 4: Block Diagram

## Application Notes

### Connection Diagrams

Open collector output is universal and allows many different configurations. [Fig. 5](#) shows two typical situations. Output and RFA1 operating voltage may also be connected to separate power supplies.

Maximum output current should not exceed 20mA.

Maximum supply current is 45mA (continuous mode) or 10mA (energy saving mode).

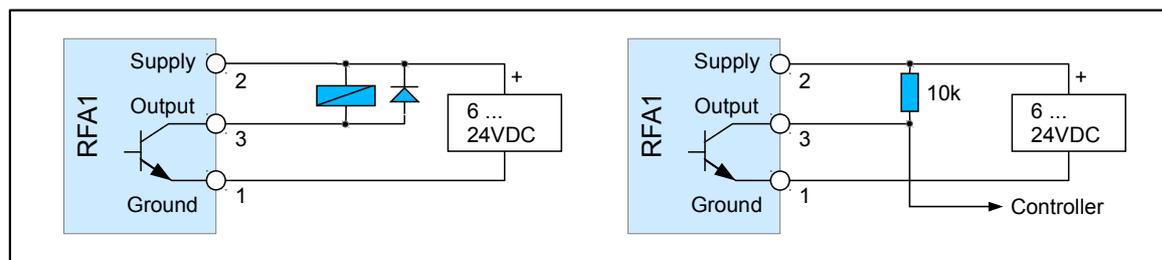


Fig. 5: Examples: Left Relais, Right Controller

## Continuous and Energy Saving Mode

### Mode Selection

RFA1 can operate in two modes:

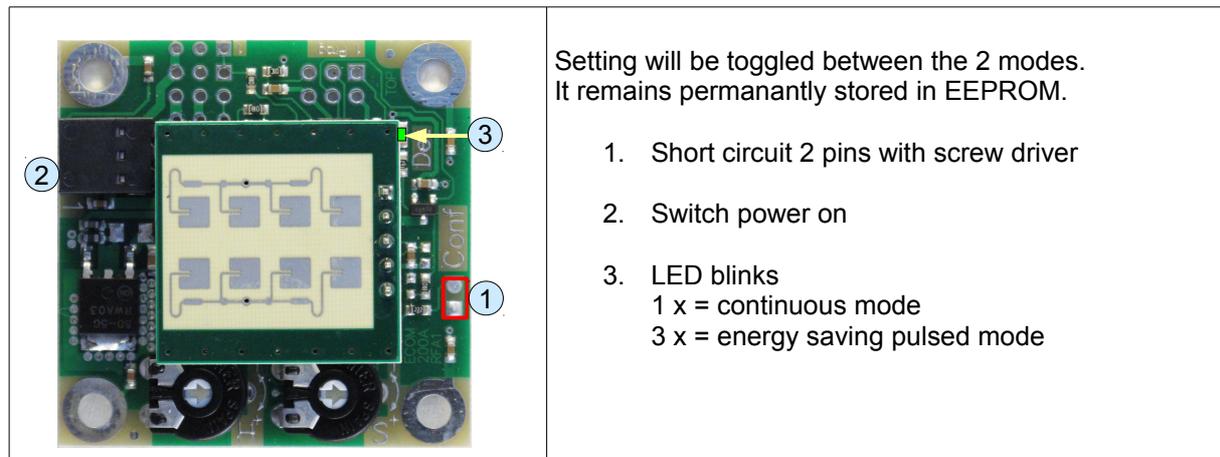
- **Continuous mode:** Radar module is always powered.
- **Energy Saving mode** (also called pulsed mode): Radar module is powered during approx. 4us and switched off during 200us (i.e. duty cycle of around 2%).

These modes can be selected once and remain stored until changed again. See settings instruction in [Fig. 6](#).

Here are some major differences between the two modes:

	Continuous mode	Energy Saving mode	Comment
Current consumption	35mA	6.5mA	No detection
	38mA	10mA	During detection / Hold time
Maximum sensitivity	10m	7m	Walking person
Max. detectable speed	80km/h	60km/h	higher speeds decrease sensitivity

**Table 1: Typical characteristics of operation modes**



**Fig. 6: Setting the operation mode**

### Installation Tips

Radar for movement detection is a very reliable and robust technology. It is insensitive to heat, wind, dust, sunlight and other influences.

However, there are some important issues to take into consideration:

- Sensitivity to fluorescent light
- Material and thickness of cover
- Sensitivity to vibrations

The following application notes should help to optimize your application.

### Cover

Every cover has some influence on the shape of detection field and the achievable maximum distance. Radar can „view“ through plastic and glass of any color. This makes a high degree of design freedom. Nevertheless, some rules should be considered.



- Cover must not be metallic.
- Plastic coating with colors NOT containing metallic or carbon particles.
- Distance between cover and front of Radar sensor > 1cm
- Best cover material is Polycarbonat or ABS
- Best cover thickness is 3-4mm
- Vibrations of RFA1 relatively to the cover should be avoided, because this generates signals that can trigger the output

### Interference Factors

All these interferences can lead to false triggers of the output. Use RFA1 at the lowest possible sensitivity for your application.

### Fluorescence Light



- Do not mount RFA1 directly facing to fluorescent lamps
- Use RFA1 at the lowest possible sensitivity for your certain application

Radar is susceptible to fluorescent lamps, even if controlled by electronic ballasts. These lamps produce a 100Hz (50Hz mains, Europe) or 120Hz (60Hz mains, USA) Radar signal that is similar to the signals produced by a person walking at about 2km/h.

RFA1 is equipped with a 100Hz filter, that can absorb a certain amount of fluorescent light interference. However, 100% protection against fluorescent light susceptibility is technically not possible.

### Rain



- Prevent cover to get wet
- The larger the distance to rainy environment, the smaller the rain effect.

Raindrops can be interpreted by Radar as moving objects and may trigger the output.

### Vibrations, Ventilators etc.



- RFA1 and its cover should be mounted stable to prevent vibrations
- Try to prevent objects like ventilators in the sight of RFA1

RFA1 Radar detects moving objects. Vibrations, ventilators, moving plants etc can also be interpreted as moving objects. Such objects can therefore trigger RFA1.

## Sensitivity and Maximum Range

Sensitivity defines the necessary signal strength at the Radar sensor to trigger the output. RFA1 allows adjusting sensitivity by a potentiometer.



Trigger distance at same sensitivity setting can vary depending on

- Type of moving object (person, car etc.).
- Moving direction of the object or the angle of RFA1 to the moving direction respectively

Frontal distance for detecting persons can be adjusted from approximately 1m to 10m. This corresponds to approximately 2m to 20m for cars.

## Expansions

RFA1 can be expanded by RFbeam or OEMs according to their needs. Contact [info@RFbeam](mailto:info@RFbeam) for more informations on expanding RFA1.

RFA1 can be mounted as “piggy back” on top of a mother board. Examples of possible RFA1 expansions:

- Relais output
- Mains power supply
- Additional light sensor

## Ordering Information

- Standard version with K-LC1a module soldered Part# RFA1
- Evaluation version with 5 pin sensor connector. Module **not** included. Part# RFA1\_EVAL
- OEM version with individual module soldered (K-LC3, K-LC5 ... ) Part# RFA1\_OEM

## Datasheet Revision History

V0.9	2011-09-27	Initial preliminary release
V0.9a	2011-10-11	Typing and reference errors corrected
V1.0	2013-01-17	Ordering information added

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