User Manual

RF601

Version 1.0

Dear User,

You are advised to carefully read this User Manual before turning on the Laser Distance Sensor RF601 for the first time.

This is necessary to ensure that you will be able to use all the capabilities and features provided by your new purchase.

This product is subject to ongoing technological developments.

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Handbuchversion:	V 1.0
Datei:	Manual_RF601_EN_V1.0.docx

Note:

Proper care has been used in compiling this document. No liability will be accepted in the event of damage resulting from the failure to comply with the information contained herein.

Revision history

Manual version	Date	Changes
1.0	01.09.2021	Established

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I. Inhaltsverzeichnis

1 General

The compact Laser-based Distance Measurement Module RF601 is used for the fast and very precise determination of distances between 20 and 3000 m. The OEM module combines perfectly matching optical and electronical components within minimum space. Specially developed and optimized filter algorithms enable the detection and evaluation of smallest measuring signals.

Features:

- Configurable for numerous applications
- Distance resolution 0.1 m
- Eye-safe 905 nm laser source
- Shock resistance up to 1,0 g
- Available in different configurations (temperature sensor, 6-axis-sensor)
- Input voltage range 1.9 – 5.2 VDC
- Measurement rate freely programmable
- Every module is calibrated and adjusted for immediate use

Areas of application:

- Construction and engineering surveying
- Industry automation
- Sports and leisure purposes (nature observation, golf, etc.)
- Additional module in infrared cameras and hunting weapon target optics
- Long range distance detection in railroad and shipping applications

2 Safety and operating instructions

2.1 Basic safety advice

The non-compliance of the safety and operating instructions may cause health dangers, damage the device, affect the proper functioning and the loss of warranty.

The OEM Laser range finder modules RF601 and RF601F use a laser source with 905 nm wavelength. The RF601F corresponds to IEC class 1M, classified as "nonhazardous for all conditions of use except when passed through magnifying optics " and not visible to the human eye.

The RF601 corresponds to IEC laser class 1.

Please observe the following safety instructions

- Do not point the RF601 / RF601F towards human's or animals' eyes during measurement operation.
- Do not point the RF601 / RF601F towards humans which using binoculars or other optical equipment if there is a possibility they can look towards the RF601 / RF601F.
- Read the operating instructions carefully prior to commissioning the RF601 / RF601F.
- Avoid pointing on direct sunlight as well as on bright sources of light.
- Do not position any ray bundling elements as lenses or binoculars in front of the RF601 / RF601F.
- Unauthorized interferences may lead to threats of one's own health as well as destruction of the module.
- It is possible that high voltage elements will be exposed by unauthorized interferences.
- Operate the module only under the environmental conditions described in this document.
- Protect the module against wet and moist conditions.
- Keep the module out of the reach of children.
- Avoid the measurement of strongly reflecting targets in near surroundings.

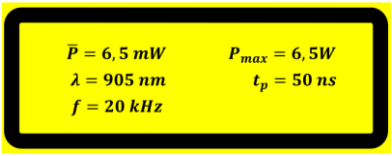
2.2 Laser class

RF601

The RF601 applies to Laser class 1 according to EN 60825-1:2014. It uses a non-visible infrared laser with 905 nm wavelength.

RF601F

The RF601F applies to **Laser class 1M** according to EN 60825-1:2014. It uses a non-visible infrared laser with 905 nm wavelength.



3 Specifications

3.1 Type definitions

Type	Order number	Description
RF601	10-2054-00	Long rang OEM distance sensor module
RF601F	10-2054-01	Long rang OEM distance sensor module with enhanced range and measurement rate

3.2 Technical data

Type	RF601	RF601F
Measurement range[1)]	20 m … 2500m	20 m … 3000 m
Target range (refl. 30%, target size 1.5 m x 0.5 m)	1350 m	1900 m
Accuracy (1σ @ 500 m / 700 m, 30 % albedo, 10 km visibility, 20 °C)	± 0.5 m	
Resolution	0.1 m	
Measuring time	0.05 s … 1.5 s	0.0025 s … 1.5 s
Measuring frequency	0.1 Hz … 10 Hz	0.1 Hz … 400 Hz
Laser class (acc. EN 60825-1:2014)	Class 1	Class 1M
Laser wavelength	905 nm (infrared)	
Laser divergence	1.4 mrad x 0.4 mrad	
Opto-mechanical alignment accuracy	0.2 mrad	
Serial interface	UART, CMOS-Level, 3.3 V	
Interface connector (module)	Molex 5040500601	
Interface connector (supply electronics)	Molex 5040510601 or Molex 15132-0602 (OTS cable)	
Power supply	1.9 V … 5.2 VDC	
Power consumption	1 W … 1.5 W (measurement running) 40 mW (stand-by)	
Operating temperature	-32 °C … +55 °C	

Storage temperature	-45 °C … +80 °C
Dimensions (W x H x L)	28 mm x 39 mm x 49.5 mm
Weight	< 60 g
Protection class	IP00 (no housing)
Mounting	3 threads M3, top and bottom side (see drawing)

3.4 Assembly drawing

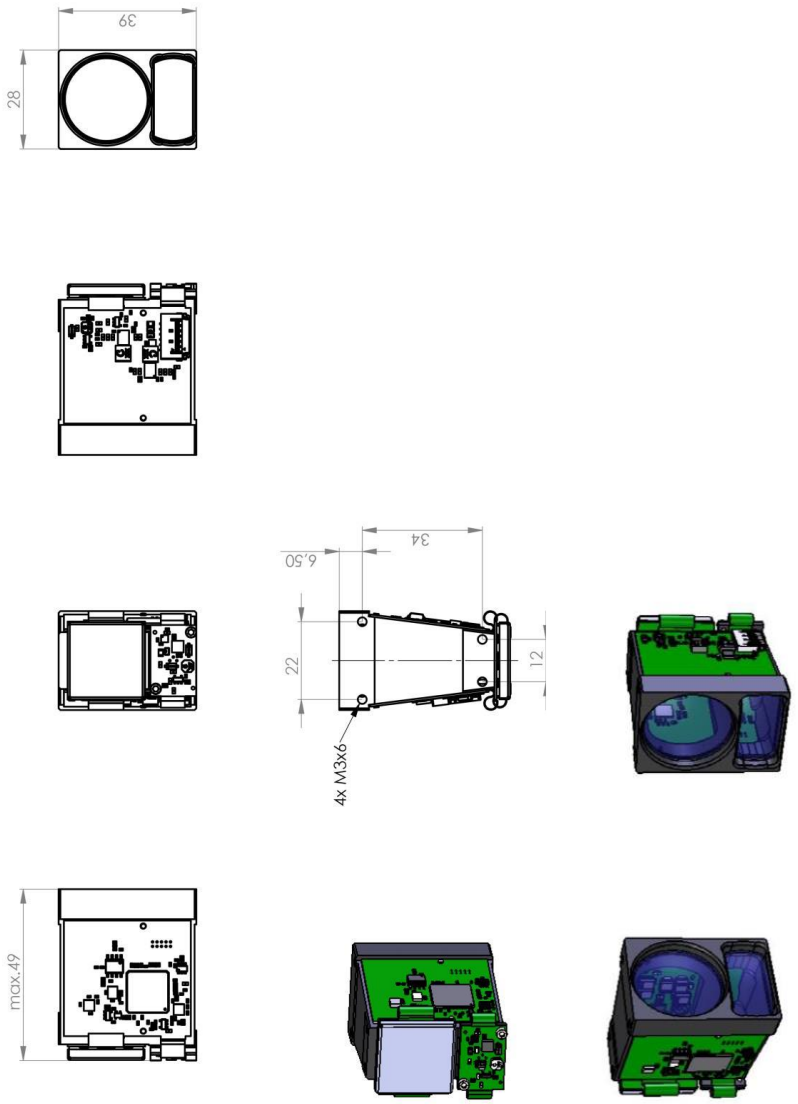


Figure 1: RF601 / RF601F assembly drawing

4 Introduction

4.1 Functioning of the RF601

The Distance Measurement Module RF601 / RF601F will be delivered as OEM version to enable the easy integration into different systems and devices. The distance measurement is based on the time of flight measurement between one, only nanoseconds short, eye-safe laser pulse and the reverse pulse reflected by the target (figure 1). The module has a fast signal processor on which different specially developed mathematical filters have been implemented to detect signals that get lost in the noise by other laser distance modules. The high-quality optics as well as the modern circuity concepts enable the distance measurements up to 3000 m depending on visibility conditions and characteristics of targets. Optical filters reduce the dependency on direct sunlight to a minimum.

The maximum measurable distance depends, amongst other, on the following conditions:

- Sight (haze, fog, smog, rain and snow make visibility worse)
- Sunlight (impairment of the measurement by direct sunlight onto the optics)
- Size and shape of the target
- Reflectivity (Albedo) 1 = 100 % reflectivity
    - Snow approx. 0.85
    - Fields approx. 0.25
    - Forest approx. 0.20

4.2 Geometric alignment of the laser beam

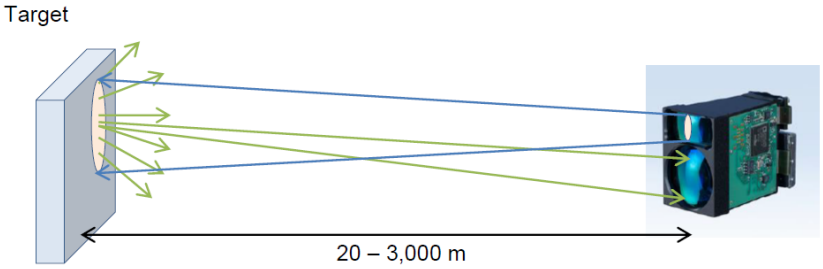


Figure 2: Laser beam alignment

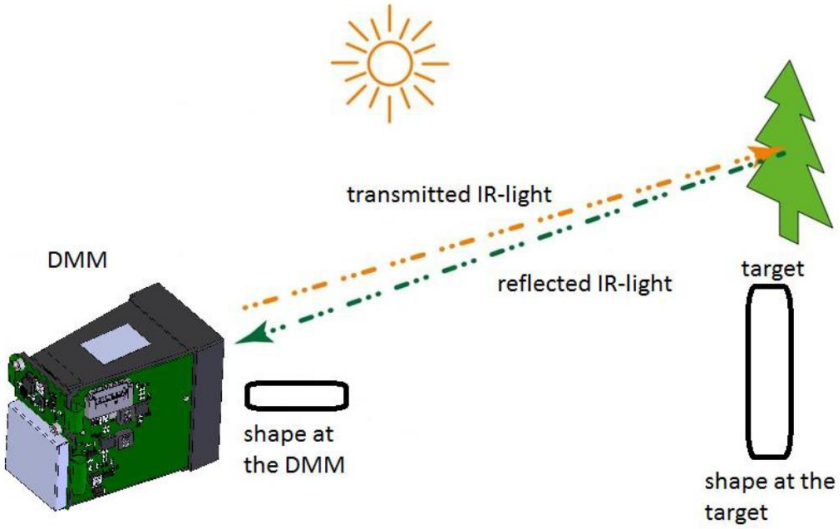


Figure 3: Laser beam shape

5 Electrical interface

The RF601 and RF601F will be connected by a 6-pin socket type Molex 504050-0691 with compatible crimp contacts type Molex 504051-0601.

There is also an OTS (off-the-shelf) connection cable type Molex 15132-0602 available.

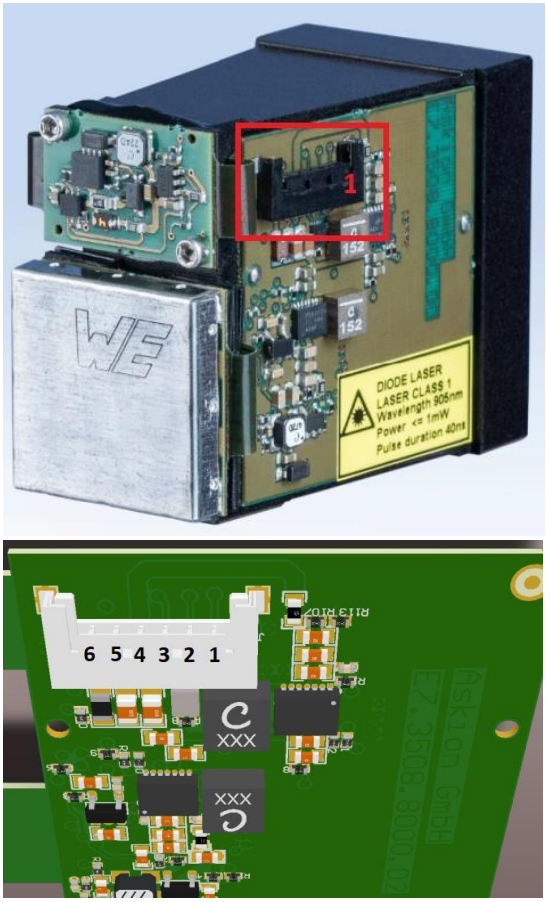


Figure 4: Connector location and pin order

5.1 Pin assignment and electrical conditions

Pin	Description	Min	Typical	Max	Unit
1	UART Tx	0 / 3.0	0 / 3.3	0.4 / 3.4	V DC
2	UART Rx	0 / 2.6	0 / 3.3	0.4 / 3.4	V DC
3*	Start measurement (SM)	2.6	3.3	3.4	V DC
4**	Module enable	0.6	Open	Ub	V DC
5	GND	0	0	0	V DC
6	Voltage Input (Ub)	1.9	3.3	5.2	V DC

* A Rising edge on pin 3 starts a new measurement. Function is only available if previous measurement has been completed. Leave the pin open if pin shall not be used.

** GND level causes stand-by mode and switches all functions off ($I_b \leq 10$ µA)

5.2 Typical connection scheme

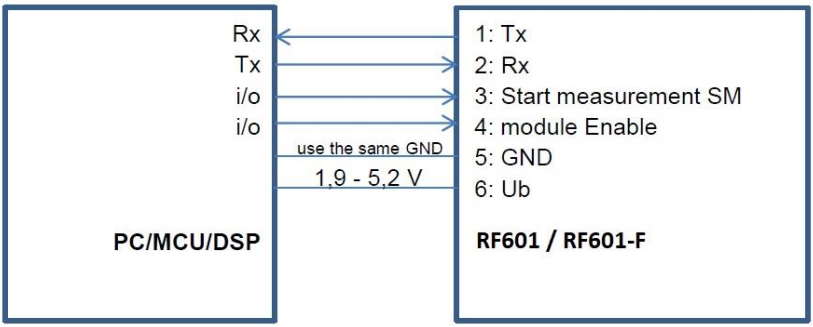


Figure 5: Typical connection scheme

A suitable USB/RS232 adapter cable can be used for evaluation. With 3.3 V power supply from the adapter the RF601 / RF601F can be operated directly by the computer.

6 Operation and Data communication

6.1 Start up and stand-by

After applying the supply voltage and a configurable break time (default 30 sec.) the RF601 / RF601F switches into the stand-by mode after measurement.

6.2 Measuring mode

When starting the measurement (by pin 3 or command) from stand-by mode the first measurement result is available after appr. 1 sec.

The start of further measurements takes place without any time delay until the module switches back to stand-by mode after the configured duration.

While measurement mode is active the red LED on the module flashes at a ratio of 1:1 with a rate of 1 Hz.

6.3 UART interface specifications

The RF601 / RF601F provides a LVTTL-level (3.3 V) UART interface. Connecting the UART pins to a standard RS232 interface (PC) directly will destroy the module.

RF601 UART settings:

9600 Baud, no parity, 8 data bits, 1 stop bit, no flow control (RTS/CTS)

RF601F UART settings:

115200 Baud, no parity, 8 data bits, 1 stop bit, no flow control (RTS/CTS)

6.4 Command syntax RF601

<command item> <space> <parameter 1> <comma> <parameter 2><CR><LF>

e.g. cmfr 30<CR><LF> need to be sent to set measuring rate at the continuous measurement mode to 3 Hz.

Numerical parameter must be provided as ASCII strings. Each command has to be terminated by CR (carriage return, 0x0D) and LF (line feed, 0x0A).

6.5 Command syntax RF601F

<ÿ> <command item> <space> <numerical parameter> <CR><LF>

e.g.: ÿcmfr 30<CR><LF> need to be sent to set measuring rate at the continuous measurement mode to 3 Hz

Numerical parameter must be provided as ASCII strings. Each command has to be terminated by CR (carriage return, 0x0D) and LF (line feed, 0x0A).

The start symbol ÿ (ASCII hex: 0xFF) is necessary to wake up the module from stand-by mode. Otherwise a correct interpretation of the send command cannot be guaranteed if the module is in stand-by.

6.6 Commands

ver? Version query (returns firmware version)

gun Get unique number (returns unique device ID)

df x Set distance unit

- 0 - internal raw value
- 1 - meter
- 2 - meter, tenth
- 3 - feet
- 4 - yard

df? Get distance format

stby x Set standby time in seconds, 0 = standby disables

x means the time in seconds between last action and entering power saving stand-by mode

Waking up from stand-by takes about 1 second until device is ready for measurement.

stby? Returns currently used standby time in seconds

sm Start measurement (returns distance value in chosen format),

Means the same action as using wired pin 3 (SM) for hardware-controlled start of measurement.

smx Start extended measurement (Returns the distance in chosen format and amplitude of optical response)

This mode is useful for optical alignment.

cmq Quit continuous measurement

cmfr x Set the measuring rate for continuous measurement mode, enter in 0.1 Hz (e.g. cmfr 20 = 2 Hz)

cmfr? Return the programmed measuring rate in 0.1 Hz

ds? Returns general module information

6.7 Commands only for RF601F

rept x Set measurement repetition time, enter in 0.1 Hz

(e.g. rept 10 = repetition time of 1 s)
The measurement time is 0.5 x repetition time

rept? Returns the programmed measurement repetition time in 0.1 s

led x Enables / Disables the red LED on the module

(x = 0 – LED off, x = 1 – LED in normal operation mode)

lptr x Enables / disables the laser pointer mode.

In laser pointer mode laser radiation is emitted permanently for up to 30 s. At latest after 30 s laser pointer mode is disabled automatically

slftst Starts the device self-test. While test is running the device does not execute any measurement. The self-test can only be started if the module is in idle mode (no measurement active).

If the self-test is passed, the module returns “success”, otherwise it returns an error. Following errors are defined:

100 - Temperature sensor error
101 - EEPROM error
102 - Clock error
103 - ADC error
104 - Receiver error
105 - OPV error
106 - Laser error

rst Resets the device

ntarg x Sets number of targets to be detected. If multiple targets are in range, x defines the maximum number of targets to detect. Measured targets are sorted according to distance

ntarg? Read the number of targets to detect

pwr x Set optical output power. This affects single and continuous measurement. The laser power is set between calibrated minimum and maximum power, whereas a power of 1 equals the minimum and 100 equals the maximum laser power. Setting laser power to 0 enables the automatic laser power adjustment.

Note: it is recommended to set the device to automatic mode.

pwr? Reads the optical power output

wlcnt Write accumulated laser counts to EEPROM

Emitted laser pulses are counted in the RAM. To store the laser count persistently, this command has to be executed to write the accumulated data to the device EEPROM.

lcnt? Read laser count value from EEPROM

7 Storage and maintenance

The RF601 / RF601F is a complex high-precision optical measuring device. Please pay attention to the following notes to provide the quality for many years:

- Avoid contamination as well as strong mechanical loads
- Clean the lenses only with detergents intended for optics
- Avoid rapid temperature changes
- Operate and store the module only under the environmental conditions described
- Do not touch the lenses with your hand
- Ensure ESD compliant working and storage conditions
- All repair work has to be performed by authorized service personnel

8 What to do when

RF601 / RF601F does not output any measured values via the serial interface:

- Operating voltage applied? (LED flashes?)
- Are the wires and the described interface parameter correct and plausible?

The measured value is 0:

The RF601 / RF601F shows invalid measured values as measured value 0:

- short distances (< 20 m)
- too low received signals (bad/non-reflective target)
- too great distances > 3,000 m

The power consumption is too high:

The parameter stby x has been programed with value 0. The RF601 / RF601F does not switch into the stand-by-mode with this programming.

9 EG Declaration of conformity

We herewith declare, represented by the signatories, that the following designated product

OEM laser range finder modules

RF601
RF601F

agree with the following directives:

2011/65/EU	RoHS Directive

The following harmonized standards were considered:

EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

The following additional standards/specifications were considered:

EN 60825-1:2014 (IEC 60825-1:2014)	Safety of Laser products - Part 1: Equipment classification, requirements and user guide RF601: Laser class 1 RF601F: Laser class 1M

Rostock, September 09th 2021

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10 Notes