LMC LOKE Measuring Systems

KHU-LMC-J-0040-1/2-RS422-CC82

User Manual

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LOKE ENGINEERING

Dear User

You are advised to read this User Manual carefully before you start using the KHU-LMC-J-0040-1/2-RS422-CC82 laser distance measurement module.

This is necessary to ensure that you will be able to utilize all the capabilities which your new acquisition provides.

This technology is subject to continuously ongoing development.

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NOTE

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1. General

The KHU-LMC-J-0040-1/2-RS422-CC82 is a laser range finder to measure distances from 0.1 m to more than 100 m with pinpoint accuracy.

A given target can be clearly identified with the help of a red laser sighting point. In terms of operating reach, the KHU-LMC-J-0040-1/2-RS422-CC82 performs depending on the reflectance, morphology and qualities of the target to be measured.

The range finder works based on comparative phase measurement. It emits modulated high-frequency light which is diffusely reflected back from the target with a certain shift in phase to be compared with a reference signal. From the amount of phase shift, a required distance can then be determined with millimeter accuracy.

A distance measuring cycle can be triggered in three different ways:

- By sending a command from the PC or another equivalent control unit
- By making appropriate prior parameter settings for the autostart command and applying supply voltage
- By external triggering (in remote-trigger mode).

For a more detailed description of these three trigger options, you should consult section

Special performance features are:

- Provides high accuracy and great reach under extreme outdoor temperatures.
- Works in a wide range of operating voltages from 10 V= to 30 V= from an on-board vehicle supply point, an industrial direct voltage supply net or a DC power pack.
- Features consistently low power consumption of <1.5 W (without IAlarm).
- Up to 30 m reach for distance measurement, with potential for more than 100 m reach if additional reflectors are mounted onto the target (depending on reflectance and environmental conditions).
- Visible laser beam for easier sighting.
- RS232 interface port for input of measuring functions and commands from, and output of measured values to, a PC or a laptop.
- Switching output and analog output are separately programmed.
- Switching output with adjustable limit to indicate positive and negative excession of preselectable distance range window by sighting distance.
- Measured values can be displayed in meters, decimeters, centimeters, feet, inches due to.
- Option for remote triggering of a measurement from an external trigger device.

The KHU-LMC-J-0040-1/2-RS422-CC82 measuring module is shipped in a rugged cardboard box with adequate padding for safe transportation.

2. Safety Instructions

2.1 Basic Notes

These safety and operating instructions should be carefully read and followed during practical work with the KHU-LMC-J-0040-1/2-RS422-CC82.

There is danger of laser radiation or electrical shock. For necessary repair work, the KHU-LMC-J-0040-1/2-RS422-CC82 may not be opened by anyone other than Manufacturer personnel. Unauthorized intervention into the inner product space will void any warranty claims.

Compliance with all specified operating conditions is necessary.
Failure to observe advisory notes or information contained in this Manual or nonconforming product usage may cause physical injury to the user or material damage to the KHU-LMC-J-0040-1/2-RS422-CC82.
Cable connectors must not be plugged or unplugged, as long as voltage is supplied. Remember to turn voltage supply off before you begin working on cable connections.

2.2 Intended & Conforming Use

- Measurement of distances
- Special measuring functions
- Compliance with prescribed temperatures for operation and storage
- Operation at correct voltage level
- Application of specified signal levels to the appropriate data lines.

2.3 Nonconforming Use

- Do not operate the KHU-LMC-J-0040-1/2-RS422-CC82 in any other way than described under "Intended & Conforming Use" above and only in a proper working condition.
- Safety devices must not be defeated or otherwise rendered ineffective.
- Information and warning signs must not be removed.
- Repair work on the KHU-LMC-J-0040-1/2-RS422-CC82 must not be carried out by anyone other than LOKE personnel.
- Refrain from using the KHU-LMC-J-0040-1/2-RS422-CC82 in an explosive environment.
- Measurement with the KHU-LMC-J-0040-1/2-RS422-CC82 pointed at the sun or other strong lightsources may produce faulty results.
- Measurement of targets with poor surface reflectance in a strongly reflecting environment may also result in faulty measurement values.
- Measurement of strongly reflecting surfaces may deliver faulty results.
- Measurement performed through transparent optical media, for example, glass, optical filters, plexiglass, etc. may equally produce incorrect results.
- Rapidly changing measuring conditions are likely to falsify the result of measurement.

2.4 Laser Classification

The KHU-LMC-J-0040-1/2-RS422-CC82 is a class 2 laser product as stipulated in IEC825-1/DIN EN 60825-1:2001-11 and a class II product under FDA21 CFR. In the event of accidental, short-time laser exposure, the human eye is sufficiently protected by its own optico-facial winking reflex. This natural reflex may be impaired by medication, alcohol and drugs.

Although the product can be operated without taking special safety precautions, one should refrain from directly looking into the laser beam. Do not direct the laser beam onto persons.

Caution:
There is class 2 laser radiation. Do not look into the beam!

2.5 Electric Supply

Use only 10 V to 30 V direct voltage for KHU-LMC-J-0040-1/2-RS422-CC82 operation. Use only the specially designated connector terminal for voltage supply.

Specified signal levels must not be exceeded, in order to guarantee correct data communication.

2.6 Important Operating Advice

To make full use of the system's inherent performance capabilities and achieve a long service life, you should always follow these operating rules:

- Do not turn the module on if there is fogging or soiling on its optical parts!
- Do not touch any of the module's optical parts with bare hands!
- Proceed with care when removing dust or contamination from optical surfaces!
- Prevent exposure to shock impacts during transportation of the KHU-LMC-J-0040-1/2-RS422-CC82!
- Prevent overheating of the KHU-LMC-J-0040-1/2-RS422-CC82!
- Prevent major temperature variances during KHU-LMC-J-0040-1/2-RS422-CC82 operation.
- In accordance with IP65 internal protection standards, the KHU-LMC-J-0040-1/2-RS422-CC82 is designed to be splashproof and dustproof.

Read these safety and operating instructions with due care and follow them in practical use.

3. Technical Data

3.1 Laser

Laser:	650 nm laser diode; red light
Laser class:	650 nm, visible, laser class 2, conforming to standard IEC825-1/EN60825, class II (FDA21 CFR)
Output power:	< 1mW
Laser divergence:	0.6 mrad
Beam diameter:	< 6 mm at 10 m distance < 30 mm at 50 m distance < 60 mm at 100 m distance

3.2 Measuring Performance

Measuring range[1]:	0.2 m to 50 m with natural surfaces (for DT, DF or DM and ST =0), more than 100 m if target reflectance high enough	
Measuring accuracy:	± 3 mm (15 °C.35 °C), ± 2 mm for distance range from 0.1 m to 30 m under defined measuring conditions Max.: ± 5 mm (across full temp. range and for any type of surfaces)	
Measured value resolution:	Depends on scale factor (1 mm with SF = 1)	
Time to measure:	Typ.:	160 ms. 6s in standard mode measuring any type of surface
		100 ms in "DW" measuring mode
		20 ms in "DX" measuring mode (only LMC-J-0040-2)
Max. target motion speed:	5 m/s in "DX" measuring mode (only LMC-J-0040-2)	
Max. acceleration:	2.5 m/s² in "DX" measuring mode (only LMC-J-0040-2)	

[1] conditional on target reflectance, ambient light influences and atmospheric conditions

3.3 Interface

Type of connection:	12-pole M18 flange-mount connector (Binder series 723)	
Supply voltage (UV):	DC 10 V.30 V	
Max. power consumption (in no-load state):	< 1,5 W	
Data interface: (Please specify on ordering sheet!)	RS232 or RS422	
	Baud rate:	9,6 kBaud (2,4/4,8/19,2/ 38,4 kBaud selectable)
	Data bits:	8
	Parity:	none
	Stop bit:	1
	Handshake:	nonen
	Protocol:	ASCII
Digital switching output:	HIGH = UV – 2 V, LOW < 2 V, rated for loads up to 0.5 A, switching threshold and hysteresis selectable, can be inverted	
Analog output:	4 mA.20 mA, distance range limits can be set, behavior on error report can be preselected	
	Load resistance:	≤ 500 W against GND
	Accuracy:	± 0.15 %
	Max. temperature drift:	50 ppm/K
Trigger input:	Trigger voltage	3 V . 24 V
	Trigger threshold	+ 1.5 V,
	Trigger flank	to start of measurement preset at 5 ms + delay time
	Trigger pulse length	≥ 1 ms
	Delay time (trigger delay)	selectable from 0 ms to 9999 ms
	Trigger flank	selectable
Max. input voltages:	UV = 30 V (protected against polarity reversal) RxD = ± 25 V RX+, RX- = ± 14 V TRIG = - 25 V	
Output voltages:	TxD ≥ 5 V TX+/- 2 V, 2 x 50 W load differential ALARM U_V – 2	

3.4 Environment & Ambient Conditions

Operating temperature:	- 10 °C bis + 60 °C
Storage temperature:	- 20 °C bis + 70 °C
Protection type:	IP65

3.5 Mechanical Mounting Conditions

Casing:	Extruded aluminum profile with powder-coat paint finish, front-side & rear-side cover and tube anodized
Dimensions (L x W x H):	182 mm x 96 mm x 50 mm
Weight:	850 g

The casing consists of a rugged, corrosion-resistant extruded aluminum profile with front-side and rear-side covers also in corrosion-resistant design. Four mounting holes are provided in the baseplate for mechanical attachment of the KHU-LMC-J-0040-1/2-RS422-CC82 (Figure 1 Dimensional drawing).

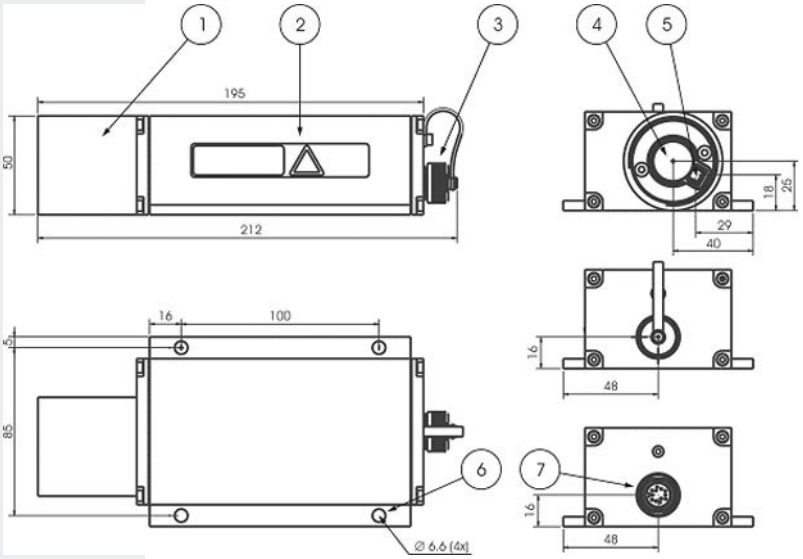

Figure 1 Dimensional drawing

1 Equalizer tube at front cover
2 Casing
3 Protective cap for flange-mount connector
4 Receiver optics
5 Sender optics
6 Mechanical mounting holes (four)
7 12-pole M18 flange-mount connector (Binder series 723)

To protect the range finder's optical surfaces from dust, physical contact, mechanical impacts, etc., the casing has a special equalizer tube attached to it. This tube can be extended or removed as necessary to meet the customer's operating needs . Please note that measurement cannot be guaranteed to function correctly if the equalizer tube is removed by unqualified action!

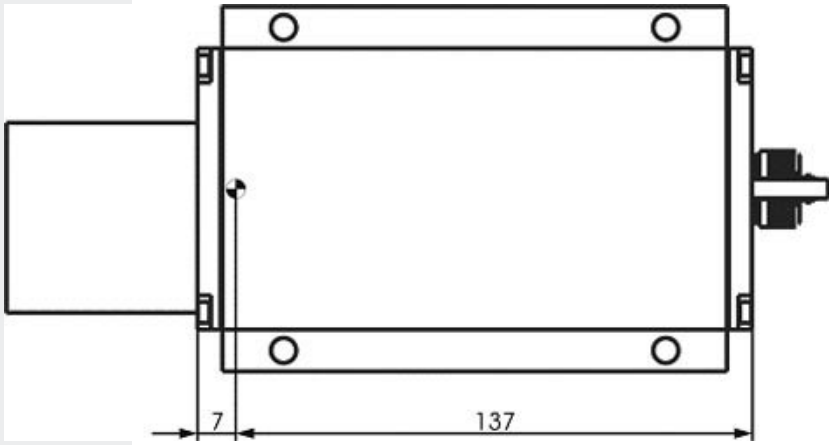

Figure 2 Offset against zero-edge

The KHU-LMC-J-0040-1/2-RS422-CC82's zero-point is located 7 mm behind the outer surface of the front cover or 137 mm before the back cover outside face respectively. This zero-point has been introduced for constructional design reasons. It can be compensated with the help of parameter "OF" (see section 4.2.19 „OF.display/set distance offset").

3.6 Electrical Mounting Conditions

Located on the back cover is a connector terminal. A 12-pole round-type (flange-mount) series 723 connector from Binder has been selected for this purpose. It is sealed against the casing to comply with IP 65 requirements. This connector type guarantees optimized screening and a high IP degree. The required counterpart is a cable jack (series 423 from Binder) with grading ring.
A cable set with open ends is optionally available.
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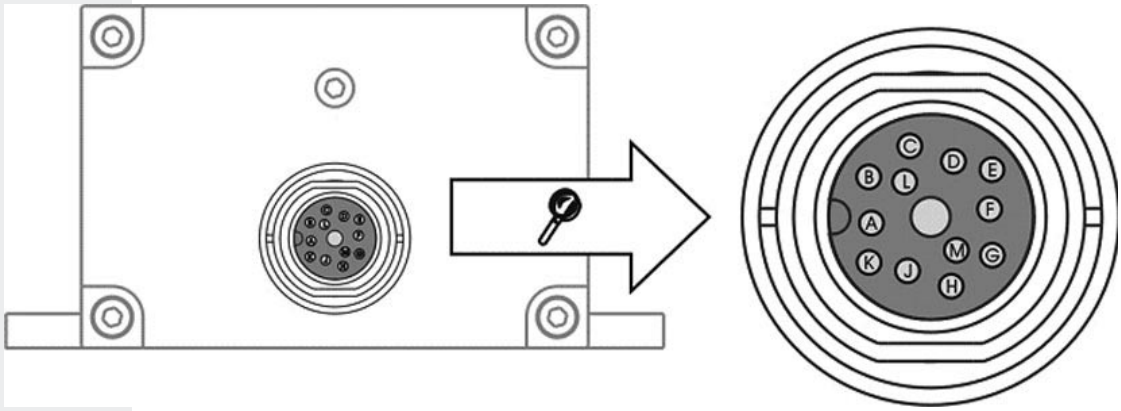

Figure 3 View of KHU-LMC-J-0040-1/2-RS422-CC82 pole assignments

Pin	Interface-cable	LMC-J-0040-1		LMC-J-0040-2	
A	Green	TxD	RS232-send data	RX+	RS422-receive data +
B	Yellow	RxD	RS232-receive data	RX-	RS422-receive data -
C	Brown	TRIG	External trigger input	TRIG	External trigger input
D	Red	IOUT	Analog output	IOUT	Analog output
E	Black	n.c.		TX-	RS422-send data -
F	Violet	n.c.		TX+	RS422-send data +
G	Orange	UV	Supply voltage	UV	Supply voltage
H	White	ALARM	Digital switching output	ALARM	Digital switching output
J	Gray	GND	GND	GND	GND
K	-	n.c.		n.c.	
L	Blue	GND	GND	GND	GND
M	-	n.c.		n.c.	

Table 2 - Pinout assignments

GND wires are connected to an internal collective ground point. They provide the reference potential for all voltage values quoted below.

If input signals are applied to an output port, this may damage the KHU-LMC-J-0040-1/2-RS422-CC82!

For data communication via RS232, you are recommended to use cable 4 (gray, GND) for signal ground and cable 7 (blue, GND) for supply ground!

The limiting values of voltages, load rates and logic levels are in accordance with RS232 and RS422 standard requirements.

All outputs are protected against steady short-circuit currents.

3.7 Interface Cable

Caution:
Both cable ends are exposed! The user is responsible to take precautions that will prevent any kind of shorts!

For interface cable wire assignments, refer to Table 2.
The interface cable can be provided in 2 m and 5 m length version. Customized cable lengths are optionally available by previous agreement with LOKE Engineering.

Figure 4 Interface Cable

Interface cable extension is possible. One should, however, observe some important rules, depending on the particular application scenario:

KHU-LMC-J-0040-1-RS422-CC82: RxD and TxD data lines should be kept as short as possible in all cases, because they tend to have an interference emitting and interference receiving effect, notably, when in open state. Especially in environments with strong spurious radiation there may be faults that may in some cases require a reset (turning the KHU-LMC-J-0040-1-RS422-CC82 off and on again). In cases where no RS232 interface communication is required after parameterization, you should provide for a termination wiring as shown in Figure 5.

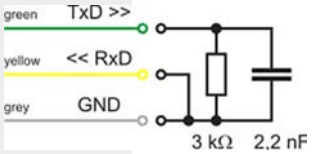

Figure 5 Recommended termination wiring for work with open RS232

LMC-J-0040-2: Extension and termination according to standard requirements.

For correct screening, three essential rules must be followed:

1. Use screened cable, e.g. "10XAWG224CULSW", remember to extend also the cable screen!
2. Connect screen to reference potential of UV on cable end.
3. For integration with vehicles:
   where attachment point and reference potential (GND or "-") have equal potentials, it may be necessary to electrically isolate the KHU-LMC-J-0040-1/2-RS422-CC82 casing, in order to prevent ground loops.

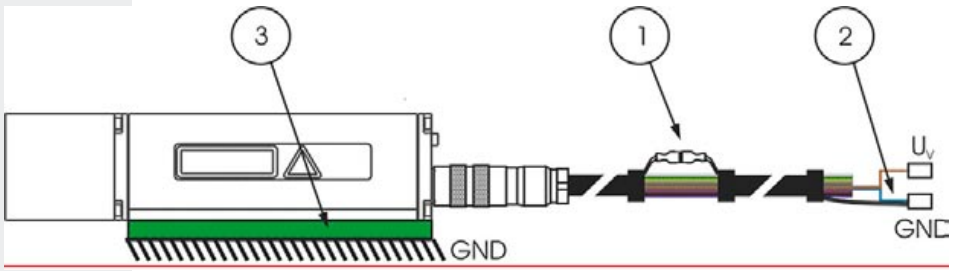

Figure 6 Correct screening of KHU-LMC-J-0040-1/2-RS422-CC82

4. Communication Protocol

The easiest way to trigger and parameterize the KHU-LMC-J-0040-1/2-RS422-CC82 is by using a PC with RS232 communication port (see 5.1 RS232) and a terminal program (see 4.3 Example: Establishing Communication with Hyperterminal). The communications protocol is available in ASCII format.
Before an operating session begins, desired parameter settings can be made in a smart selection procedure until the measuring module is optimally adapted to the particular measuring site conditions and the measuring job

All valid settings will be preserved on turning the KHU-LMC-J-0040-1/2-RS422-CC82 off! They can only be replaced with new value entries or changed back to their standard values by running an initialization routine.

The following is a short overview of the communications protocol

Command	Description
DT	Starts distance tracking
DW	Starts distance tracking on white target at 10 Hz
DX	Starts distance tracking on white target at 50 Hz (only LMC-J-0040-2)
DF	Starts remote-triggered single distance measurement (single shot)
DM	Starts single distance measurement (single shot)
TP	Queries inner temperature
SA	Queries / sets floating average value (1.20)
SD	Queries / sets output format (dec/hex)
ST	Queries / sets time to measure (0.25)
SF	Queries / sets scale factor
SE	Queries / sets error mode (0, 1, 2)
AC	Queries / sets alarm center
AH	Queries / sets alarm hysteresis
RB	Queries / sets beginning of range (4 mA)
RE	Queries / sets end of range (20 mA)
TD	Queries / sets trigger delay
BR	Queries / sets baud rate
AS	Queries / sets autostart
OF	Queries / sets offset
SO	Sets current distance as offset
LO	Turns laser on
LF	Turns laser off
PA	Displays all parameter values
PR	Resets all parameters to standard values

Table 3 Short overview of communications protocol

4.1 Online Help

Once communication has been established with a PC (as described above), an online help tool can be called up by triggering an ID [Enter] or id [Enter] command at the keypad. Its purpose is to support work with distance measurement and parameterization commands. [Enter] corresponds to hexadecimal 0Dh (carriage return)

DT[Enter]	distancetracking
DW[Enter]	distancetracking with cooperative target (10Hz)
DX[Enter]	distancetracking with cooperative target (50Hz)5
DF[Enter]	distance measurement with external trigger
DM[Enter]	distance measurement
TP[Enter]	internal temperature [C]
SA[Enter] / SAxx[Enter]	display/set average value [120]
SD[Enter] / SDxx[Enter]	display/set display format [d/h]
ST[Enter] / STxx[Enter]	display/set measure time [025]
SF[Enter] / SFx.x[Enter]	display/set scale factor
SE[Enter] / SEx[Enter]	display/set error mode [0/1/2] 0Iout=const., ALARM=const. 1Iout: 4mA @RE>RB, 20mA @RE<RB, ALARM: OFF@AH>0, ON@AH<0 2Iout: 20mA @RE>RB, 4mA @RE<RB, ALARM: ON@AH>0, OFF@AH<0
AC[Enter] / ACx.x[Enter]	display/set ALARM center
AH[Enter] / AHx.x[Enter]	display/set ALARM hysterese
RB[Enter] / RBx.x[Enter]	display/set distance of Iout=4mA
RE[Enter] / REx.x[Enter]	display/set distance of Iout=20mA
TD[Enter] / TDxx x[Enter]	display/set trigger delay [09999ms] trigger level [0/1]
BR[Enter] / BRxxxx[Enter]	display/set baud rate [240038400]
AS[Enter] / ASdd[Enter]	display/set autostart command [DT/DW/DX/DF/DM/TP/LO]
OF[Enter] / OFx.x[Enter]	display/set distance offset
SO[Enter]	set current distance to offset (offset = - distance)
LO[Enter]	laser on
LF[Enter]	laser off
PA[Enter]	display settings
PR[Enter]	reset settings

Figure 7 Start protocol of connection establishment

4.2 Commands and Their Functions

- Command entries are not case-sensitive. This means that small and capital lettering can be used for commands.
- Any command which is to be sent to the sensor must be terminated by a hexa-decimal 0Dh (carriage return) character.
- Where decimal digits are to be entered, they must be separated by period (2Eh).
- For command paramater entries, one must distinguish between parameter settings and parameter queries.
- Querying is achieved with a command in simple format. e.g. (for alarm center parameters): AC[Enter]
- For parameter setting, a new value must be added after the command with no delimitation sign in between, for example: AC20.8[Enter]

In the given example, the alarm center will be set to 20.8.

4.2.1 DT Distancetracking

Input parameter SA, SD, SE, SF, ST, OF
Output RS232/RS422, digital switching output, analog output

DT mode can be chosen for distance measurement of different kinds of surfaces (varying reflectance). In this type of distance tracking mode, the KHU-LMC-J-0040-1/2-RS422-CC82 uses internal algorithms to continuously evaluate the quality of the laser radiation signal that is coming back. This may cause longer measuring times in the case of poor reflectance or sudden jumps in distance.
The minimum time to measure is 160 ms, the maximum time is 6 s. If the measuring signal fails to reach a specified quality within six seconds, an error message is output.
The time to measure may also be limited by setting the ST parameter to a desired value.

4.2.2 DW Distancetracking with cooperative target (10Hz)

Input parameter SA, SD, SE, SF, OF
Output RS232/RS422, digital switching output, analog output

DW mode performs at a steady measuring rate of 10 Hz (KHU-LMC-J-0040-1-RS422-CC82 only). The selected object must have a white target board for measured values to be stable.

4.2.3 DX Distancetracking with cooperative target (50Hz)

Input parameter SA, SD, SE, SF, OF
Output RS232/RS422, digital switching output, analog output

DX mode performs at a steady measuring rate of 50 Hz (LMC-J-0040-2 only). The selected object must have a white target board for measured values to be stable.

4.2.4 DF Distance measurement with external trigger

Input parameter SD, SE, SF, ST, OF, TD
Output RS232/RS422, digital switching output, analog output

DF mode allows a measurement that is triggered by an external trigger pulse. Initially, after selecting this mode, the operator does not receive any response. As soon as the trigger pulse has been detected, the KHU-LMC-J-0040-1/2-RS422-CC82 will send data and switches to digital and/or analog output.
Settings for trigger delay (delay) and trigger flank can be defined via parameter TD. (see 4.2.16 TDdisplay/set trigger delay [09999ms] trigger level [0/1])

4.2.5 DM Distance measurement

Input parameter SD, SE, SF, ST, OF
Output RS232/RS422, digital switching output, analog output

DM mode triggers a single measurement (single shot).

4.2.6 TP Internal temperature [C]

TP queries the value of the inner KHU-LMC-J-0040-1/2-RS422-CC82 temperature.

Note: In tracking mode, the inner temperature may exceed the surrounding temperature level by as much as 10 K.

4.2.7 SA Display/set average value [120]

Standard setting: 1
SA allows you to calculate a floating average value from 1 to 20 measured values. Calculation is based on this formula:

$$\text{Average value } x = \frac{x_1 + x_2 + x_3 + \ldots + x_{n\ (20)}}{n}$$

4.2.8 SD Display/set display format [d/h]

Standard setting: d

SD switches between decimal (d) and hexadecimal (h) output format of measured value data. SD affects all commands that output a distance value.

A hexadecimal output value is calculated from a given measured distance value (in mm), multiplied by the scale factor SF.

Negative distance values are output in two's complement notation.

Example:

Distance = 4.996 m, SF1	dec:	4.996
	hex:	001384 (= 4996 mm × SF1)
Distance = 4.996 m, SF10	dec:	49.960
	hex:	00C328 (= 49960 = 4996 mm × SF10)

4.2.9 ST Display/set measure time [025]

Standard setting: 0

Measuring time is directly conditional on the selected measuring mode. As a general rule, one may say: the poorer the reflectance of the surface of a particular target, the more time the KHU-LMC-J-0040-1/2-RS422-CC82 will require to determine the distance with specified accuracy. For example, if error message E15 is output because of poor reflectance and insufficient time to measure, this latter setting must be increased.

The available value range for measuring time is 0 to 25. Basically, the greater the time setting is the more time will be available for measurement and the lower the resulting measuring rate.

An exception therefrom is zero-value. In this case, the KHU-LMC-J-0040-1/2-RS422-CC82 automatically picks the smallest possible time value for measurement!

The KHU-LMC-J-0040-1/2-RS422-CC82 comes factory-set with ST = 0. ST is effective in the DT, DF and DM mode of operation.

The measuring time setting option can also be used to modify the measuring rate, for example, in order to restrict the data volume or for synchronization purposes. The following sample time setting can only be regarded as providing an approximate value:

Measuring time ≈ ST×240 ms (except ST=0)

Example:

The target distance is 25 m, but the target's reflectance is not ideal. With a measuring time setting of ST 2, E15 will be output following measurement. The user must increase the time to measure in this case!

4.2.10 SF Display/set scale factor

Standard setting: 1
SF multiplies a calculated distance value with a user-selectable factor for changes in resolution or outputs in a different unit of measure. The scale factor may also be negative.

Scale factor	Resolution	Output	Unit of measure
SF1	1 mm	12.345	m
SF10	0,1 mm	123.45	dm
SF1.0936	0,01 yard	13.500	yard
SF3.28084	0,01 feet	40.501	feet
SF0.3937	1 inch	4.860	100 inch
SF-1	1 mm	-12.345	m

Table 4 Examples of scale factor

Note: Following a change in the scale factor, the settings for digital and/or analog output and offset must be matched accordingly!

4.2.11 SE Display/set error mode [0/1/2]

Standard setting: 1
SE allows you to configure how the digital switching output (alarm) and/or the analog output is to behave on occurrence of an error message (E15, E16, E17, E18).
Depending on the particular KHU-LMC-J-0040-1/2-RS422-CC82 application, different reactions to an error message are possible.
Available selection options are 0, 1 and 2 with the following effects in the event of an error message:

SE	Digital switching output (alarm)	Analog output (4 - 20 mA)
0	Preserves the state of a latest valid measurement	Outputs the current of a latest valid measurement
1	Positive alarm hysteresis = LOWNegative alarm hysteresis = HIGH	RE > RB: current = 4 mA RE < RB: current = 20 mA
2	Positive alarm hysteresis = HIGHNegative alarm hysteresis = LOW	RE > RB: current = 20 mA RE < RB: current = 4 mA

Table 5 Digital switching output and analog output for SE = 0, 1 and 2

4.2.12 AC Display/set ALARM center

Standard setting: 1000

AC corresponds to the distance, on identification of which the switching output switches. AC must be defined taking into consideration the currently valid scale factor (SF) value.

As soon as the predefined distance threshold is negatively or positively exceeded, the alarm output will switch from HIGH to LOW or vice versa with a certain delay as set under alarm hysteresis (AH).

(see 5.3 Digital Switching Output)

4.2.13 AH Display/set ALARM hysterese

Standard setting: 0.1

AH sets the switching hysteresis of the switching output. AH must be selected so it is properly matched to the currently valid scale factor (SF).

As soon as the predefined distance threshold is negatively or positively exceeded, the alarm output will switch from HIGH to LOW or vice versa with a certain delay as set under alarm hysteresis (AH).

(see 5.3 Digital Switching Output)

4.2.14 RB Display/set distance of Iout=4mA

Standard setting: 1000

RB (Range Begin) defines the point of a distance range at which the analog output will begin to deliver varying distance readings. At a distance of RB, the output current will be 4 mA. RB must be selected so it is properly matched to the currently valid scale factor (SF) setting. RB can be smaller or greater than RE!

(see 5.4 Analog output)

4.2.15 RE Display/set distance of Iout=20mA

Standard setting: 2000

RE (Range End) defines the point of a distance range at which the analog output will cease to deliver varying distance readings. At a distance of RE, a current of 20 mA will be output. RE must be selected so it is properly matched to the currently valid scale factor (SF) value. RE can be greater or smaller than RB!

(see 5.4 Analog output)

4.2.16 TD Display/set trigger delay [09999ms] trigger level [0/1]

Standard setting: 0 0
TD is solely intended for behavioral configuration of the remote trigger input (DF mode) (see 4.2.4). TD consists of two subparameters, of the actual delay value, i.e. the delay time, and the trigger level.
"trigger delay" corresponds to the time from arrival of the trigger signal to the starting point of a measurement. It may be set to any value between 0 and 9999 ms. With the help of the trigger level one may define if measurement is to begin on a rising or a falling pulse edge.
Trigger delay and trigger level must be separated by space (20h) in the entry line.

Example:
TD1000_60[Enter]
In the given example, the delay has been set to 1000 ms and the trigger flank to "rising" (LOW-to-HIGH transition).

4.2.17 BR Display/set baud rate [240038400]

Standard setting: 9600
Available baud rate settings are: 2400, 4800, 9600, 19200, 38400. Faulty entries will be rounded to the nearest baud rate.
A fixed data format of eight data bits, with no partiy and one stop bit is used.

4.2.18 AS Display/set autostart command [DT/DW/DX7/DF/DM/TP/LO]

Standard setting: ID
AS (autostart) defines which function will be carried out when power becomes available to the KHU-LMC-J-0040-1/2-RS422-CC82.
Possible entries are those delivering a measured value on the output side, an ID command or the command for turning the laser on (LO).
For example, if ASDT has been parameterized, the KHU-LMC-J-0040-1/2-RS422-CC82 will begin with distance tracking on turning on power.

4.2.19 OF Display/set distance offset

Standard setting: 0
With the help of **OF** (offset) the user may define a zero-point for his/her application. For details on the position of the module's zero-point, refer to section 3.5 Mechanical.
OF must be selected so it is properly matched to the currently valid scale factor setting (SF).
OF may also take on negative values

4.2.20 SO Set current distance to offset (offset = - distance)

SO performs a distance measurement and saves the measured reading as an offset value with inverted mathematical sign (OF).

4.2.21 LO Laser on

LO turns the laser on. This function can be used for orientation or functional testing of the KHU-LMC-J-0040-1/2-RS422-CC82.

4.2.22 LF Laser off

LF turns the laser off.

4.2.23 PA Display settings

PA lists all parameters in a table.

4.2.24 PR Reset settings

PR resets all parameters (except for baud rate) to their standard settings.

average value[SA]	1
display format[SD]	d
measure time[ST]	0
scale factor[SF]	1
error mode[SE]	1
ALARM center[AC]	1000
ALARM hysterese[AH]	0.1
distance of Iout=4mA [RB]	1000
distance of Iout=20mA [RE]	2000
trigger delay, trigger level[TD]	0 0
baud rate[BR]	9600
autostart command[AS]	ID
distance offset[OF]	0

Figure 8 Standard settings

5. Operating Modes

Make sure that all cable ends are protected against short circuit effects before you turn power supply on!
Connect cable terminals as required for the particular operating mode. To prevent short circuits, you should seal unused cable ends! For starting up, a PC with RS232 or RS422 data interface and a terminal program such as the setup-tool software or hyperterminal are required.
As part of preparative actions, the KHU-LMC-J-0040-1/2-RS422-CC82 must be properly installed in the designated working site, oriented onto the target and kept in a stable position. The target to be measured should preferentially have a homogeneous, white surface.

Caution: Do not use any retroreflectors!

Alignment is facilitated by the visible[8] laser beam of the KHU-LMC-J-0040-1/2-RS422-CC82. It can easily be turned on at the PC.

5.1 RS232

Initially, RS232 communication interfaces purely functioned as PC communication ports. They have become the established standard tool for serial data transmission over short cable lengths. With greater transmission lengths, the interface is highly susceptible to interferences, notably, in the vicinity of strong electromagnetic noise emitters.
Therefore, it should only be used for KHU-LMC-J-0040-1/2-RS422-CC82 configuration.

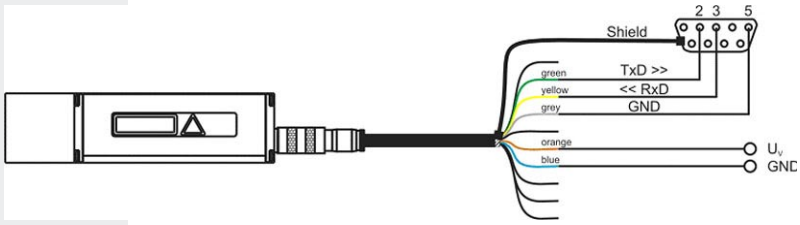

Figure 14 Diagram of RS232 wiring at 9-position D-Sub cable jack

Figure 15 Diagram of RS232 wiring at 25-pole D-Sub cable jack

[8] depending on ambient light and target to be measured

5.2 RS422

For configuration purposes and permanent data transmissions over a greater length, the RS422 can be used. This type of interface is insusceptible to interference and noise influences and qualifies for industrial use. Where twisted cable pairs are involved, transmissions lengths up to 1200 m can be handled.

Figure 16 RS422 wiring diagram

Since a standard PC typically includes no RS422 communication port, you require an RS422 interface card or an RS422-to-RS232 converter for communication.

5.3 Digital Switching Output

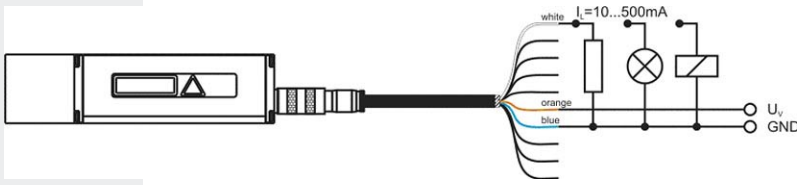

Figure 17 Wiring diagram of digital switching output

With the help of a user-selectable distance threshold, the switching output can be set to monitor objects or conditions for positive or negative excession.
Configuration settings to this end can be made in "Alarm Center" (AC) and "Alarm Hysteresis" (AH) (see 4.2.12 and 4.2.13).
Of decisive significance for the switching output's logic state is the mathematical sign of the hysteresis condition. It can be used as a quasi-inverter of the switching output. In the case of positive hysteresis, the output changes from LOW to HIGH condition with increasing distance if AC + AH/2 was positively exceeded, and from HIGH to LOW with decreasing distances if AC - AH/2 was negatively exceeded.
In the case of negative hysteresis, the output changes from HIGH to LOW with increasing distance if AC + |AH/2| was positively exceeded, and from LOW to HIGH with decreasing distance if AC - |AH/2| was negatively exceeded.

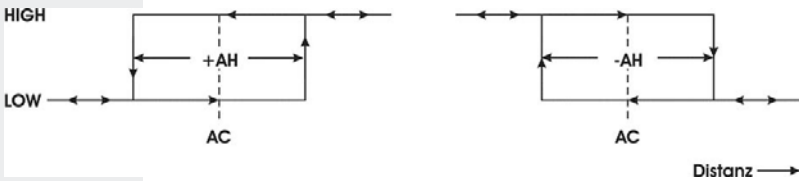

Figure 18 Digital switching output behavior with positive and negative hysteresis

Example:
For the given sample situation, it is assumed that a moving object needs to be monitored. The output is to switch at a distance of 10 m (AC10) with 20 cm hysteresis (AH0.2 and AH-0.2 respectively):

	Increasing distance ->					Decreasing distance ->			
AH	9,8 m	9,9 m	10,0 m	10,1 m	10,2 m	10,1 m	10,0 m	9,9 m	9,8 m
(+)AH	L	L	L	H	H	H	H	H	L
-AH	H	H	H	L	L	L	L	L	H

L = LOW, H = HIGH

How the switching output is to behave on occurrence of an error message (E15, E16, E17, E18) can be defined by making suitable settings under "SE" (see 4.2.11).

5.4 Analog Output

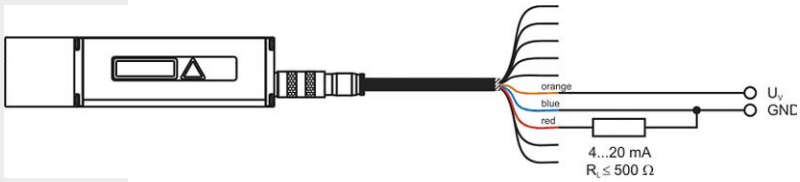

Figure 19 Wiring diagram of analog output

The analog output is designed to allow normalized analog distance data transmission over greater length via a two-wire cable.
The current which is injected into the cable is proportional to the measured target distance. This applies within a distance interval that is marked by the two limiting parameters "Range Begin" (RB) and "Range End" (RE) (see 4.2.14 und 4.2.15), where RE may be greater or smaller than RB.
The output current value is calculated according to this equation:

$$\text{RE} > \text{RB}: \quad I_{OUT}\,[\text{mA}] = 4\ \text{mA} + 16 \cdot \left(\frac{\text{Distanz - RB}}{\text{RE - RB}}\right) \cdot \text{mA}$$

$$\text{RE} < \text{RB}: \quad I_{OUT}\,[\text{mA}] = 20\ \text{mA} - 16 \cdot \left(\frac{\text{Distanz - RE}}{\text{RB - RE}}\right) \cdot \text{mA}$$

If RB is negatively exceeded (in RE > RB direction) or positively exceeded (in RE < RB direction) by the actual distance value, the analog output current will be 4 mA.
If RE is positively exceeded (in RE > RB direction) or negatively exceeded (in RE < RB direction) by the actual distance value, the analog output current will be 20 mA.

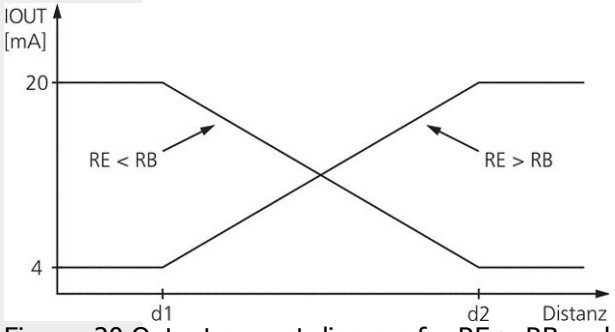

Figure 20 Output current diagram for RE > RB and RE < RB

To match analog output behavior in the event of an error message (E15, E16, E17, E18), appropriate settings can be made under "SE" (ì 4.2.11).

5.5 Trigger Input

Figure 21 Wiring diagram of trigger input

The trigger input is intended for triggering a distance measurement with an external signal that is applied as a voltage pulse between 3 V and 24 V.

It is for the user to specify a desired delay time and a pulse flank to be selected for synchronization (see 4.2.16). Having done this, he/she must switch the KHU-LMC-J-0040-1/2-RS422-CC82 to trigger mode (DF).

6. Error Messages

Code	Description
E15	Reflexes are too weak, use target board, or distance from sensor (front edge) to target is less than 0.1 m
E16	Reflexes are too strong, use target board
E17	Too much steady light (e.g. sun)
E18	DX mode (only LMC-J-0040-2): reflexes too weak, use target board, or distance from sensor (front edge) to target is less than 0.1 m
E23	Temperature below – 10°C
E24	Temperature above + 60°C
E31	EEPROM checksum
E51	Failed to set avalanche voltage
E52	Excessively high laser current/laser defect
E53	Division by 0
E54	PLL range
E55	Unknown error
E61	Faulty command
E62	Illegal parameter, invalid command
E63	SIO parity error
E64	SIO framing error

7. Service, Maintenance, Warranty

The warranty period is one year.
To ensure that all functions are regularly checked and your KHU-LMC-J-0040-1/2-RS422-CC82 operates faultlessly over a long period of time, you are advised to have the KHU-LMC-J-0040-1/2-RS422-CC82 laser distance measurement module inspected at our location at annual intervals. If a repair becomes necessary, you should carefully pack and send the KHU-LMC-J-0040-1/2-RS422-CC82 to our address:

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Otto-Hahn-Strasse 5
69190 Walldorf
Germany

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