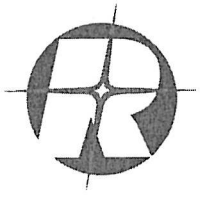
2D LASER SCANNER

LMS-Q240i

Technical Data



RIEGL
LASER MEASUREMENT SYSTEMS
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2D LASER SCANNER

LMS-Q240i

Technical Data

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Rev. 08-05-2006 (V58.8C)
Rev. 19-04-2006 (V58.8C)
Rev. 09-02-2006 (V58.8C)

Contents

3 Technical Data

3.1 Specifications

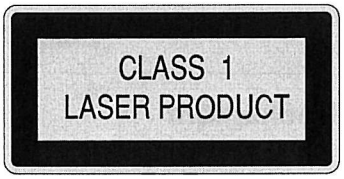
3.1.1 Scanner

LMS-Q240i-60	
Scanning Mechanism	rotating polygon mirror
Number of Mirror Facets	4
Scanning Range [1)]	up to ± 30 deg = 60 deg total
Angular Movement	Linear
Scanning Rate	6 lines/s up to max. 80 lines/s
Angle Step Width Δ ϑ [1)] between consecutive laser shots	Δ ϑ ≥ 0.04 deg
Angular Resolution	0.005 deg

LMS-Q240i-80	
Scanning Mechanism	rotating polygon mirror
Number of Mirror Facets	3
Scanning Range [1)]	up to ± 40 deg = 80 deg total
Angular Movement	Linear
Scanning Rate	5 lines/s up to max. 60 lines/s
Angle Step Width Δ ϑ [1)] between consecutive laser shots	Δ ϑ ≥ 0.04 deg
Angular Resolution	0.005 deg

[1)] Scanning parameters can be set via RS232 or TCP/IP configuration interface.

3.1.2 Distance Meter

Measurement Principle	Single-shot time-of-flight measurement
Maximum Measurement Range [1)] **for natural targets, ρ >= 20%** **for natural targets, ρ >= 80%**	 320 m 650 m
Minimum Range	2 m
Accuracy [2)]	20 mm
Precision [2)]	15 mm
Target Detection Modes [3)]	First target, last target [4)], or alternating
Laser Pulse Repetition Rate PRR [5)]	30 000 Hz
Effective Measurement Rate	10 000 Hz [5)]
Laser Wavelength	near infrared
Laser Beam Divergence [6)]	2.7 mrad
Eye safety [7)] according to IEC60825-1: 1993+A1:1997+A2:2001	

1) The following conditions are assumed:
   - target is larger than the footprint of laser beam
   - normal incidence of laser beam
   - visibility 10 km
   - average ambient brightness
2) Standard deviation one sigma @ 50 m range under *RIEGL* test conditions.
3) Only one target distance per measurement can be supplied.
4) For last target measurement, the last echo of up to 4 echoes is supplied.
   For n echoes with n > 4, always echo number 4 is supplied as last pulse target distance.
5) Average measurement rate is 1/3 of PRR rate @ full scan angle range
6) Foot print of laser beam: 26.5 cm at 100 m, 52.5 cm at 200 m, 105 cm at 400 m, 157 cm at 600 m
7) The classification is based upon the assumption that the laser beam is continuously scanned.

3.1.3 Interfaces

RS232 Serial Interface	Bidirectional interface for scanner control/configuration
ECP Parallel Interface	ECP compatible data output, provides online 2D scan data
LAN - TCP/IP Interface	Ethernet Network interface, 10/100 MBit, using the TCP/IP protocol
Power Supply and Additional Control Line	Connector for power supply and • Laser safety lock line • TTL input for synchronization e.g. Optional Time Synchronization to GPS or optional SCAN SYNC – Rotation Synchronization (GPS-1PPS-pulse output connected to this input) For pinning refer to 3.5.1.2 Pulse requirements: - High Level: 3 - 5 V - Low Level: 0 – 0.4 V - Rise Time: < 1 µs - Fall Time: < 1 µs - Minimum Pulse width: 15 µs Selectable trigger on rising edge or falling edge - Input Resistance: ≈ 10 kΩ - Input Capacitance: ≈ 3 nF

The pin assignment of the interface connectors can be found in chapter 3.5 Connectors, Cables and Fuses

3.1.4 Physical and Electrical Data

Main Dimensions	180 x 374 (diameter x length)
Weight	approx. 7 kg
Protection Class	IP64
Temperature Range **Operation** **Storage**	 -10°C up to +50°C -20°C up to +60°C
Power Consumption **(scanning operation)**	approx. 45 W
Voltage Supply Range	18 – 32V DC

3.2 Mechanical Design

The housing of the LMS-Q240i laser scanner is designed to meet the requirements for an installation on board of aircrafts, ground vehicles or in harsh industrial environment. On the other hand allows the compact and lightweight housing the use under narrow space conditions (e.g. small single-engined planes, robotic vehicles etc.).

The housing is made of an aluminium tube with end cover plates at both sides. Each of these plates carries 3 pcs. M6 steel thread inserts for mounting purposes.

The rear plate carries a connector board for power supply connector, LAN interface and serial and parallel data interface and fuse holders.

The top plate provides a valve for nitrogen purging and a desiccant cartridge.

The beam exit window is located at the bottom side of the housing, for easy replacement of damaged panes, the support frame holding the glass panes can be exchanged from outside.

An aluminium rail with stainless steel thread inserts is attached to the top side of the housing, which can be used either for mounting purposes of the instrument itself or for mounting of additional equipment on the laser scanner (e.g. IMU).

All outer parts are colorless anodized.

3.3 Mechanical Drawings

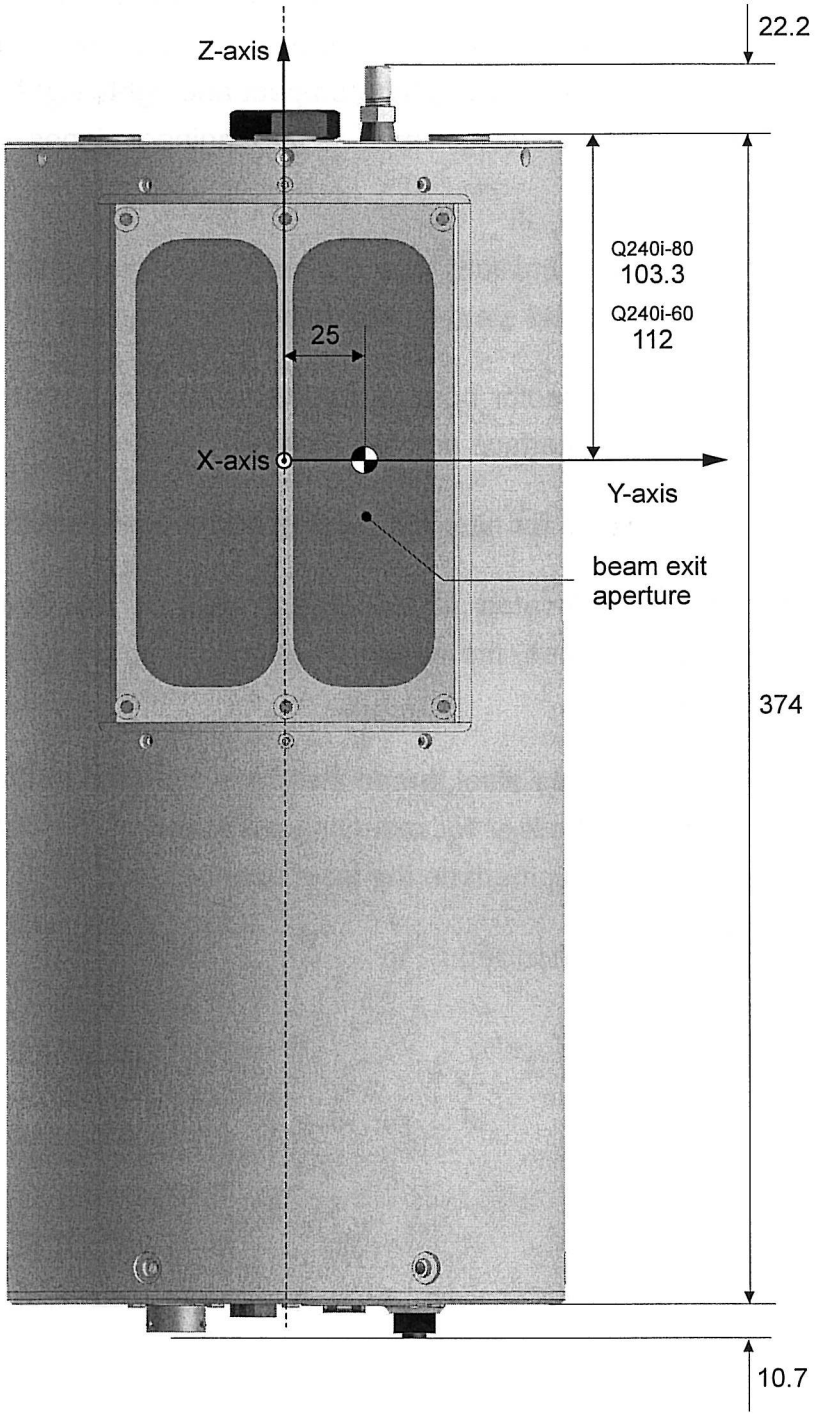


Fig. 1 Bottom view of LMS-Q240i, all dimensions in mm

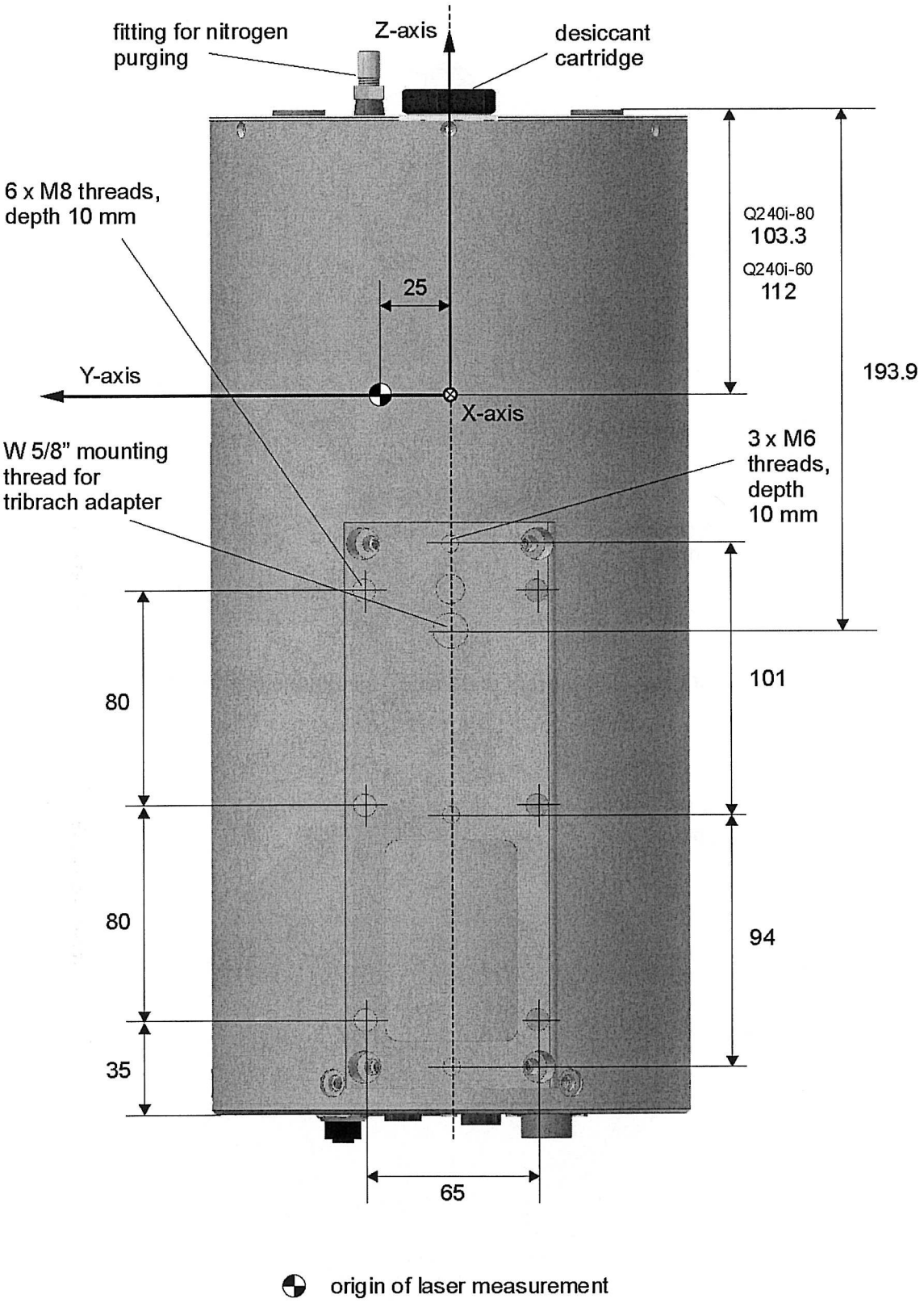


Fig. 2 Top view of LMS-Q240i, all dimensions in mm

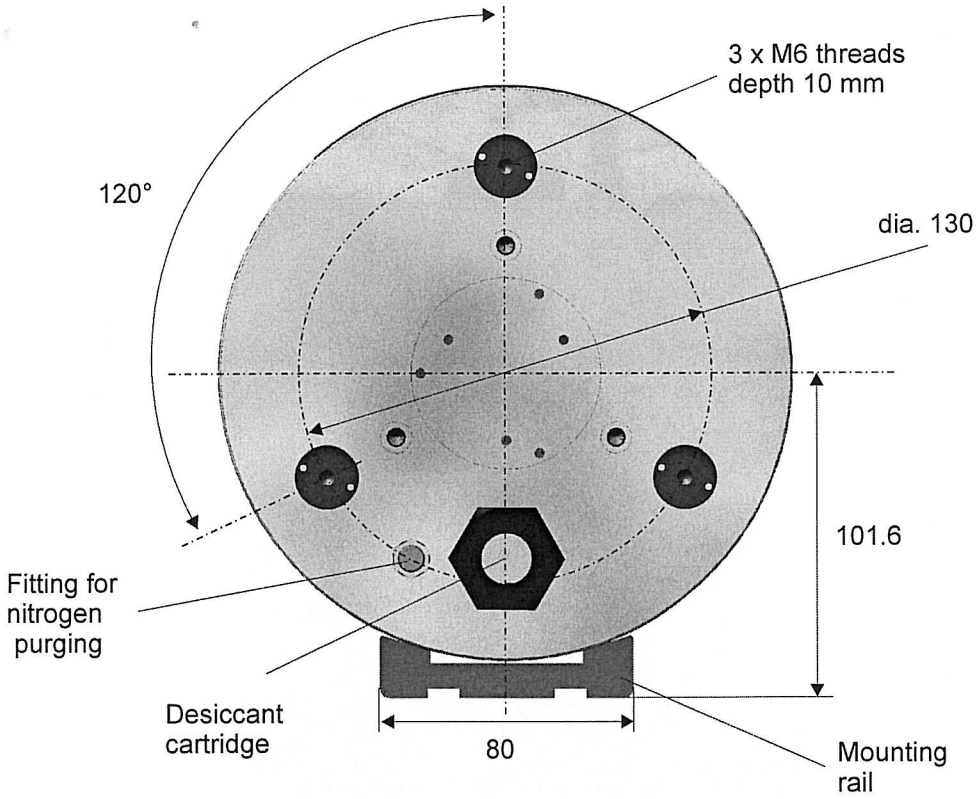


Fig. 3 Front view of LMS-Q240i (front plate side), all dimensions in mm

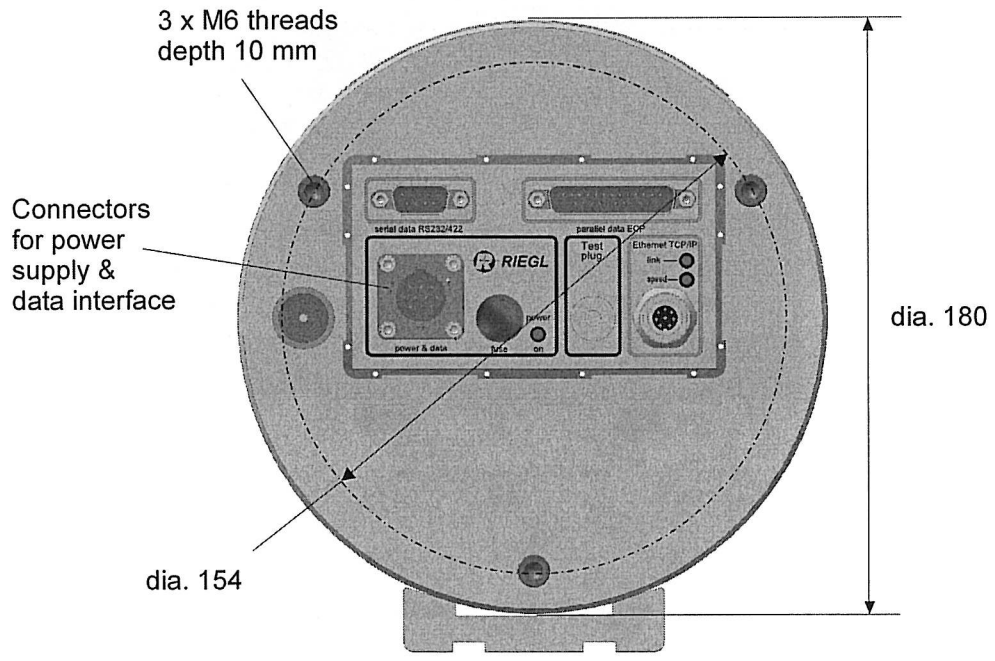


Fig. 4 Rear view of LMS-Q240i (rear plate side), all dimensions in mm

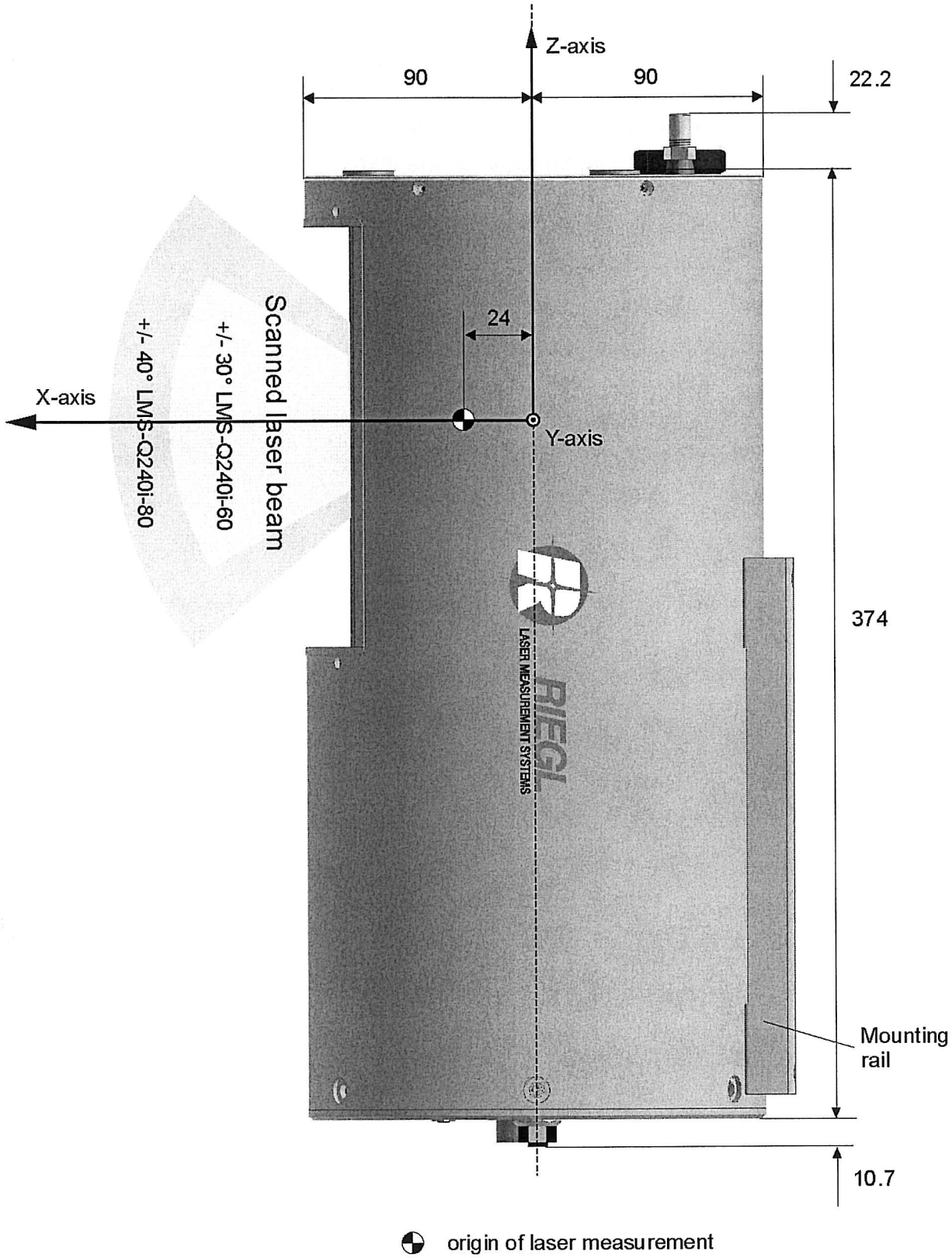
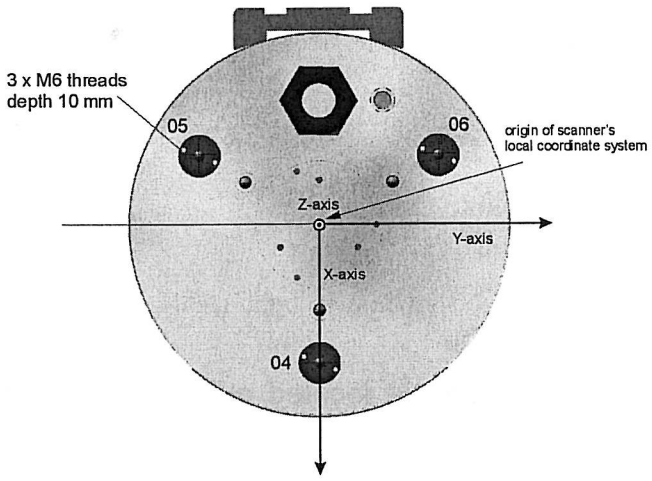


Fig. 5 Side view of LMS-Q240i, all dimensions in mm

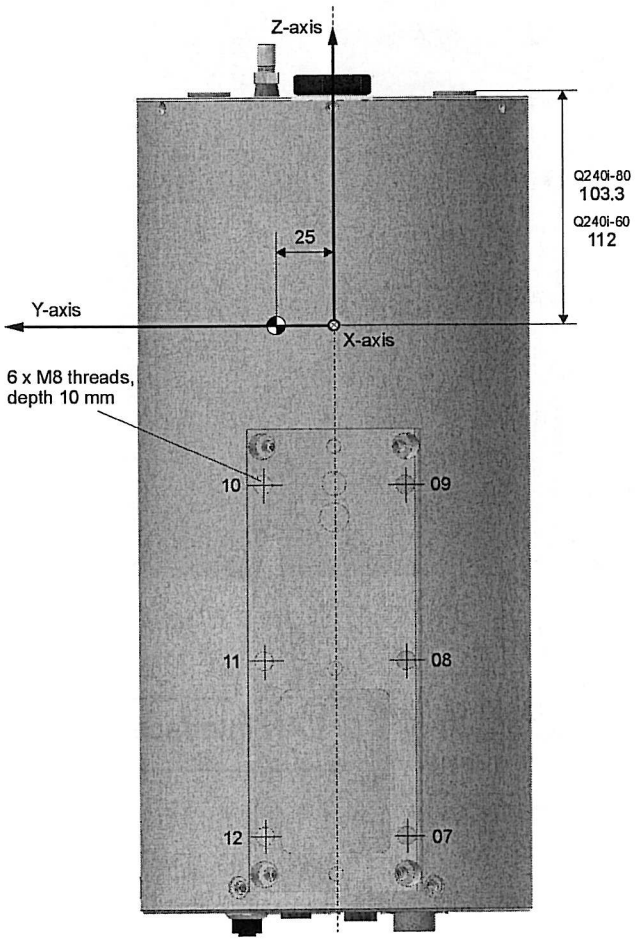
3.4 Mounting the LMS-Q240i

The laser scanner LMS-Q240i can either be mounted using e.g. L-shape brackets and the M6 mounting threads located at both side plates of the housing or by means of the mounting rail on the top side of the housing.

See Fig. 6 “Position of mounting threads” on the text page.



Coordinates of mounting points with reference to origin of scanner's local coordinate system				
point no.	X	Y	Z (LMS-Q240i/80)	Z (LMS-Q240i/60)
01	38.5	-66.68	-270.72	-262.02
02	38.5	66.68	-270.72	-262.02
03	-77	0	-270.72	-262.02
04	65	0	103.28	112
05	-32.5	-56.29	103.28	112
06	-32.5	56.29	103.28	112
07	-101.63	-32.5	-235.72	-227.02
08	-101.63	-32.5	-155.72	-147.02
09	-101.63	-32.5	-75.72	-67.02
10	-101.63	32.5	-75.72	-67.02
11	-101.63	32.5	-155.72	-147.02
12	-101.63	32.5	-235.72	-227.02



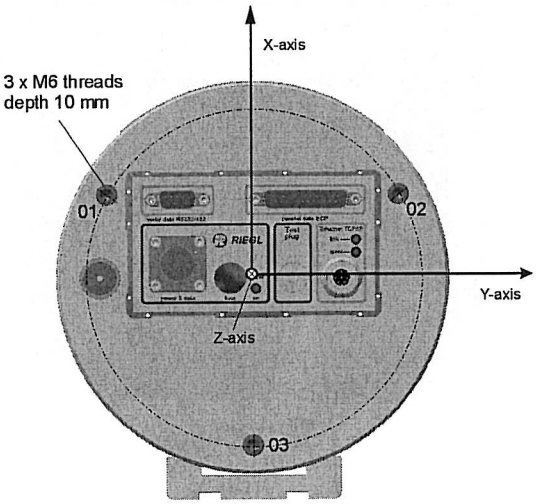


Fig. 6 Position of mounting threads, all dimensions in mm

3.5 Connectors, Cables and Fuses

3.5.1 Connectors

3.5.1.1 Connectors Overview

The connectors for power supply and data interface are located at the rear cover plate of the stationary part of the instrument.

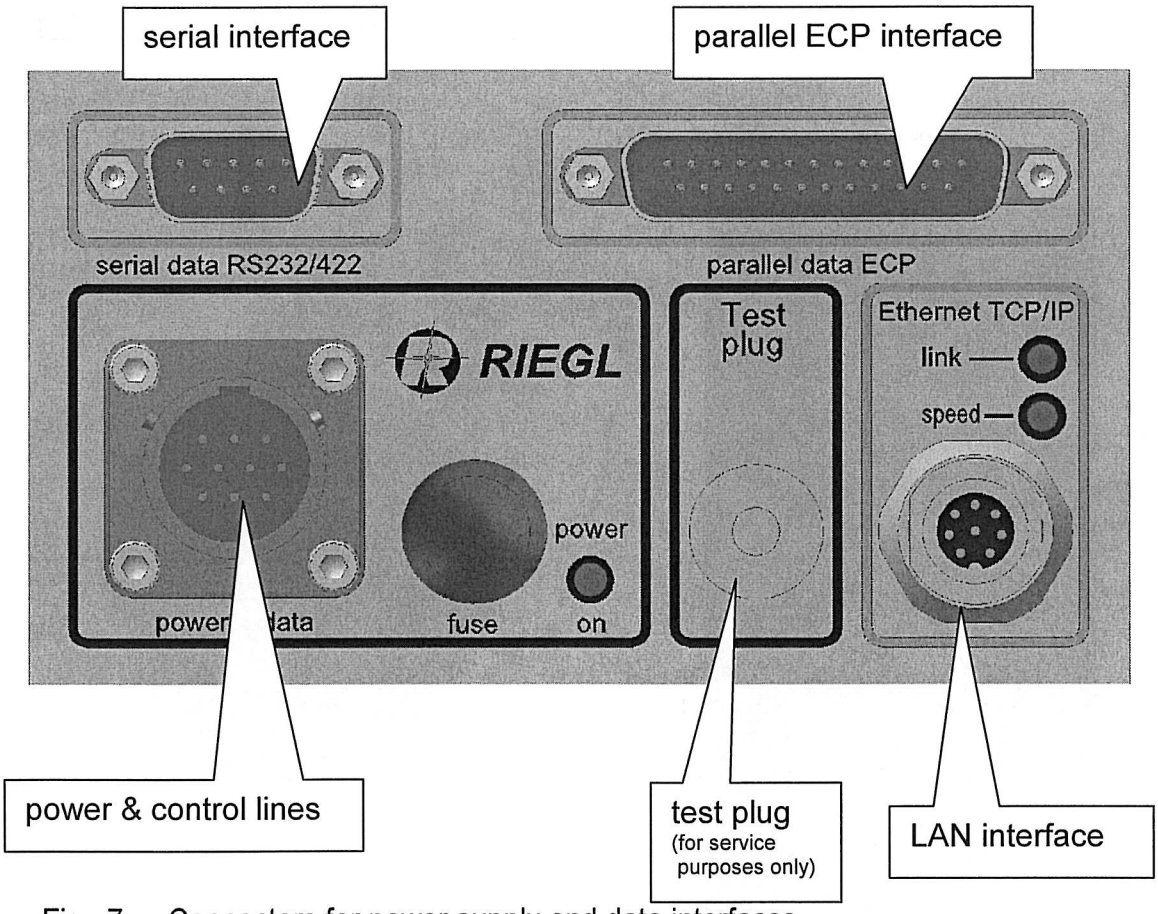
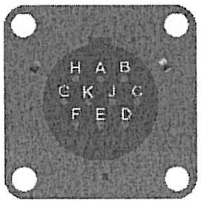


Fig. 7 Connectors for power supply and data interfaces

3.5.1.2 Connector Power Supply



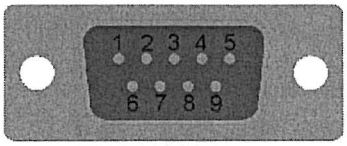
Type of connector: Souriau 851 02E 12-10 P50, male

Pin	Assignment	Color	Note
A	Laser safety lock	brown	
B			*) not used
C	GNDin	yellow green	Power Supply Ground
D			*) not used
E	Trigger	yellow	Input for external SYNC signal
F	Marker	green	TTL output factory internal usage
G	+UB 18-32 VDC	black 2	Power Supply
H	GNDout	white	
J	GNDin	black 3	Power Supply Ground
K	+UB 18-32 VDC	black 1	Power Supply

The *RIEGL* power supply cable connects Pin "GNDout" to Pin "Laser safety lock", enabling laser emission in scanning mode. Laser radiation can be disabled by opening this connection between GNDout and Laser safety lock (no range measurement possible).

*) Any use of these pins for whatever connections can damage the data output and is, therefore, strictly prohibited!

3.5.1.3 Connector for RS232 Interface

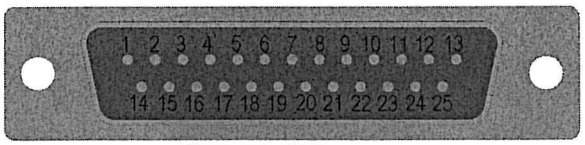


Type of connector : Sub-D, 9-pin, male

Pin	Assignment	Color	Note
1	must not be connected		*)
2	RxD		RS232 data input
3	TxD		RS232 data output
4	must not be connected		*)
5	GND		Signal GND
6	must not be connected		*)
7	must not be connected		*)
8	must not be connected		*)
9	must not be connected		*)

*) Any use of these pins for whatever connections can damage the data output and is, therefore, strictly prohibited!

3.5.1.4 Connector for ECP Parallel Interface



Type of connector: Sub-D, 25-pin, male

Pin	Source	Name	Centronics Name
1			
2	RD	Data 1 (LSB)	Data 1
3	RD	Data 2	Data 2
4	RD	Data 3	Data 3
5	RD	Data 4	Data 4
6	RD	Data 5	Data 5
7	RD	Data 6	Data 6
8	RD	Data 7	Data 7
9	RD	Data 8 (MSB)	Data 8
10	RD	PeriphClk	nAck
11			
12			
13			
14	PC	HostAck	nAutoFd
15			
16	PC	Direction	nInit
17			
18		Signal GND	
19		Signal GND	
20		Signal GND	
21		Signal GND	
22		Signal GND	
23		Signal GND	
24		Signal GND	
25		Signal GND	

PC...Personal Computer
RD...*RIEGL* Device
Levels are TTL-levels

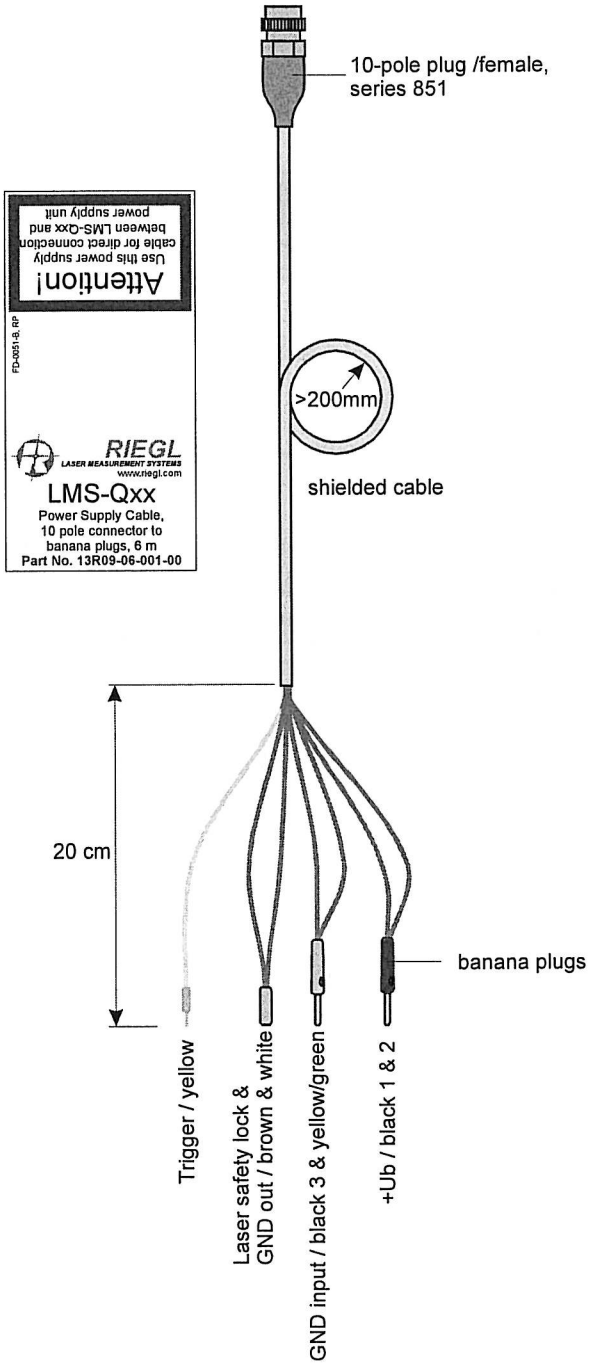
3.5.1.5 Connector for LAN – TCP/IP Interface

Type of connector: Lumberg Inc, Micro (M12) Female/S3426 Receptable, 8 Pin

Pin	Assignment
1	
2	
3	
4	Tx-
5	Rx+
6	Tx+
7	
8	Rx-

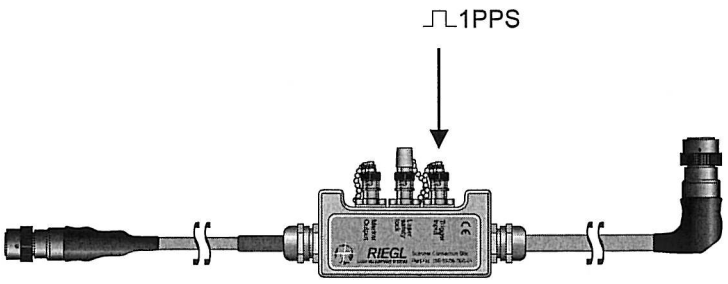
3.5.2 Cables

3.5.2.1 Power Supply Cable



3.5.2.2 Special Power Supply Cable - OPTIONAL

For external connection and reset of the OPTIONAL internal Sync Timer.



Notes:

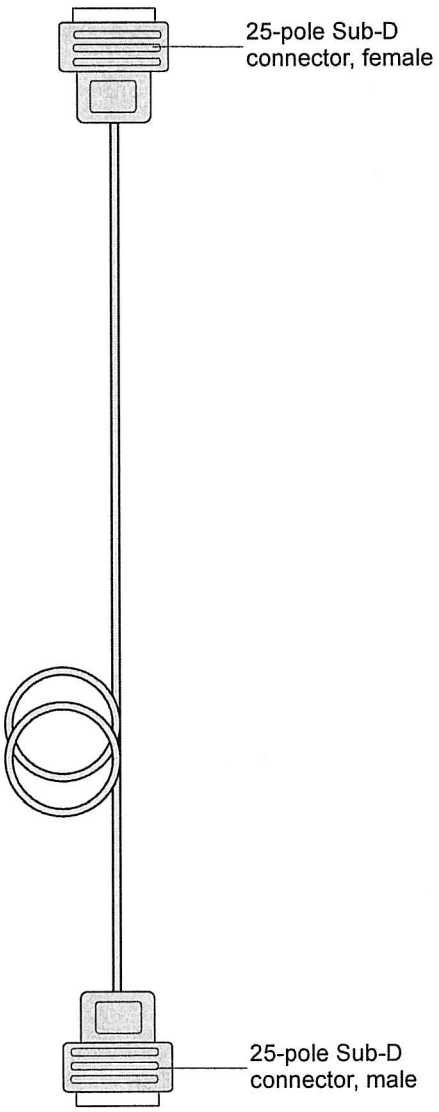
The laser lock input must be connected to ground to switch the laser on.

The cap for the laser safety lock input (middle connector, with colorized plastic top) includes a 50 Ω termination. If you do not connect a control line to the laser lock input, **KEEP THE LASER SAFETY LOCK CAP ON for laser operation.**

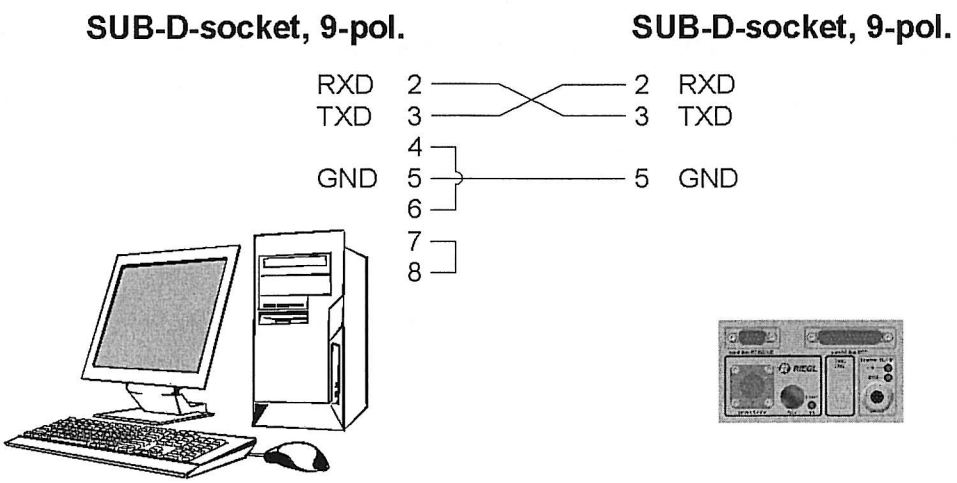
For requirements concerning the TRIGGER INTPUT, see chapter 3.1.3 Interfaces).

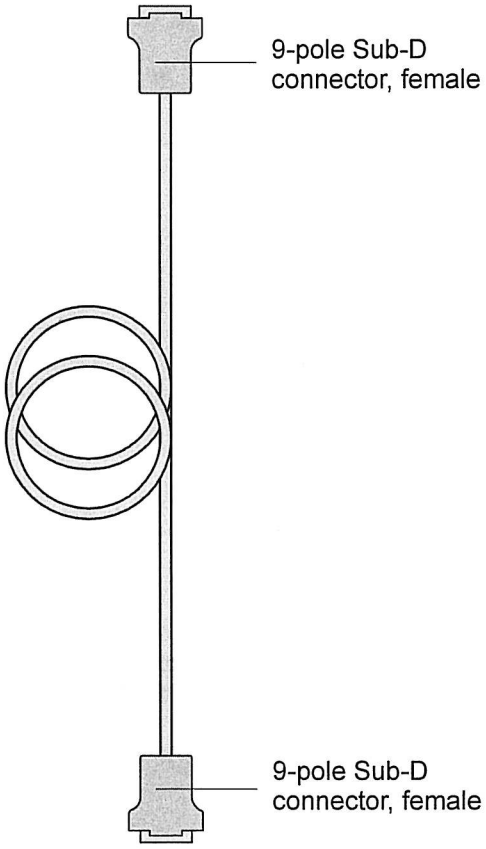
3.5.2.3 ECP Parallel Port Data Cable

The parallel data cable uses a standard PC-printer cable pinning, but needs improved noise immunity to ensure highest possible data transfer rates. The cable has to meet the requirements of IEEE Std. 1284-1994. The end of the parallel cable is equipped with 25-pole Sub-D connectors enabling to connect the scanner directly to the LPT printer port of a personal computer.



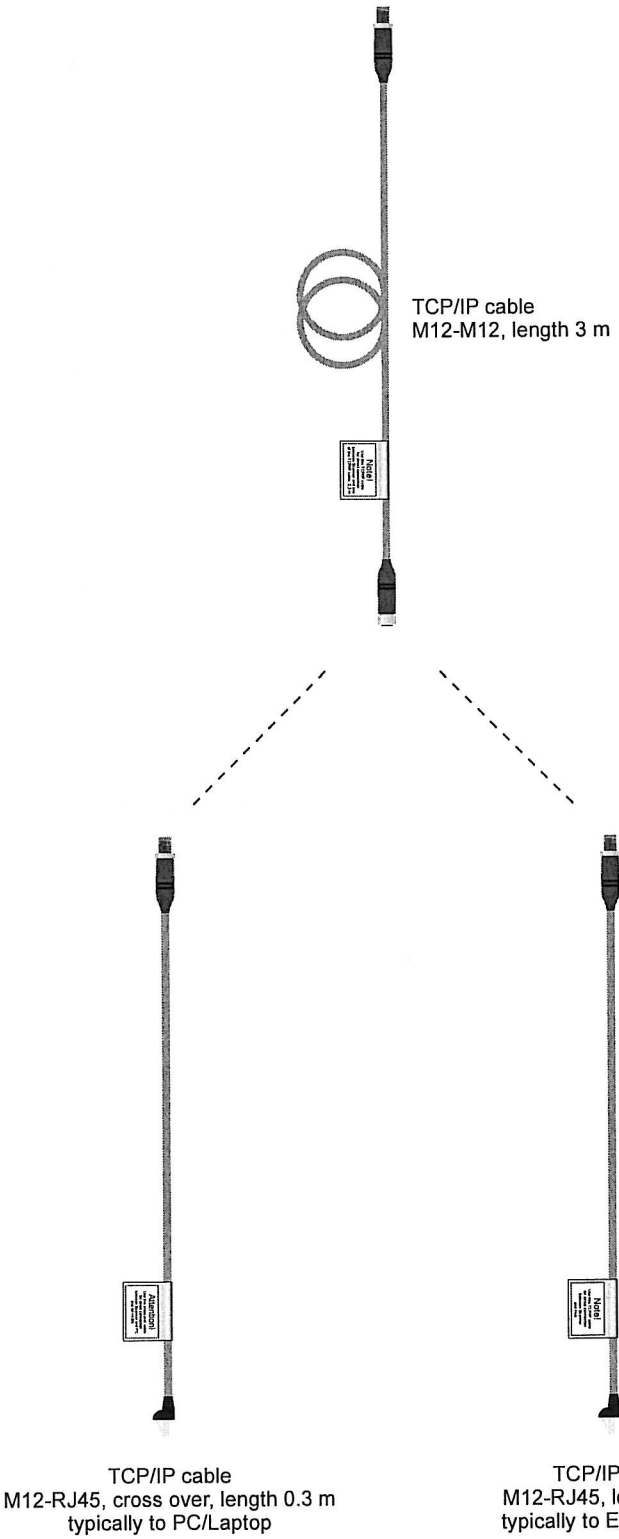
3.5.2.4 RS232 Port Data Cable





3.5.2.5 LAN – TCP/IP Data Cable

Using the included Ethernet Interface cables the scanner can be connected to an Ethernet hub or to a PC/Laptop Ethernet connector.



3.5.3 Fuses

The electric circuits of the Laser Scanner are protected by 2 glass tube fuses. The fuse holders are located at the rear side of the instrument.

Fuse holder for scanning mechanism
2.5 A quick-acting (LMS-Q240i-80)
3.15 A quick-acting (LMS-Q240i-60)
(according to IEC60127 and EN60127)

Fuse holder for rangefinder electronics
1 A quick-acting
(according to IEC60127 and EN60127)

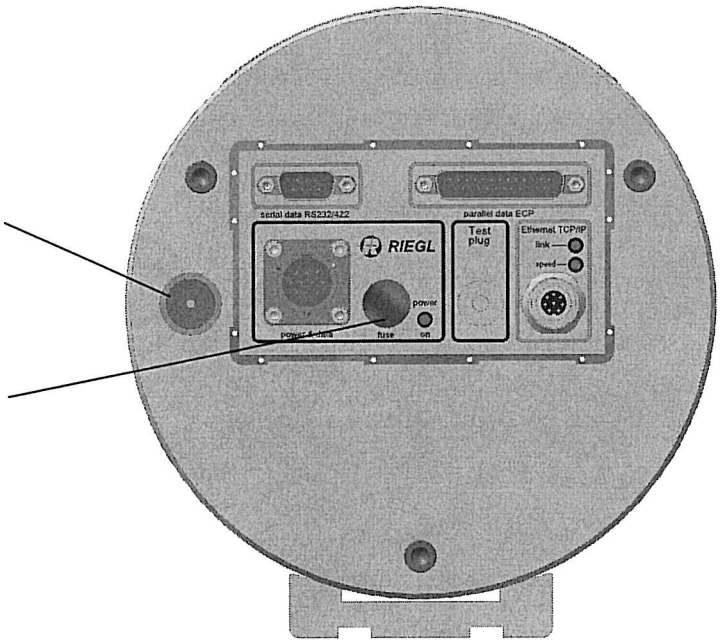
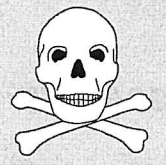


Fig. 8 Fuse Holders LMS-Q240i

The fuse holders can be opened and closed by means of a coin used like a screw driver. **Note**: Replace a blown fuse only with specified type and rated fuse!

3.6 Operating Notes and Requirements

3.6.1 Power Supply Requirements



The instrument must never be connected to 110, 230, or 400 VAC ! Opening the instrument is unacceptable due to the danger presented by the high voltages, and must therefore be avoided at all costs.

- The power supply cable is to be connected to a suitable DC power supply with a voltage within a range specified in chapter 3.1 Specifications. The negative pole of the supply voltage has to be grounded.

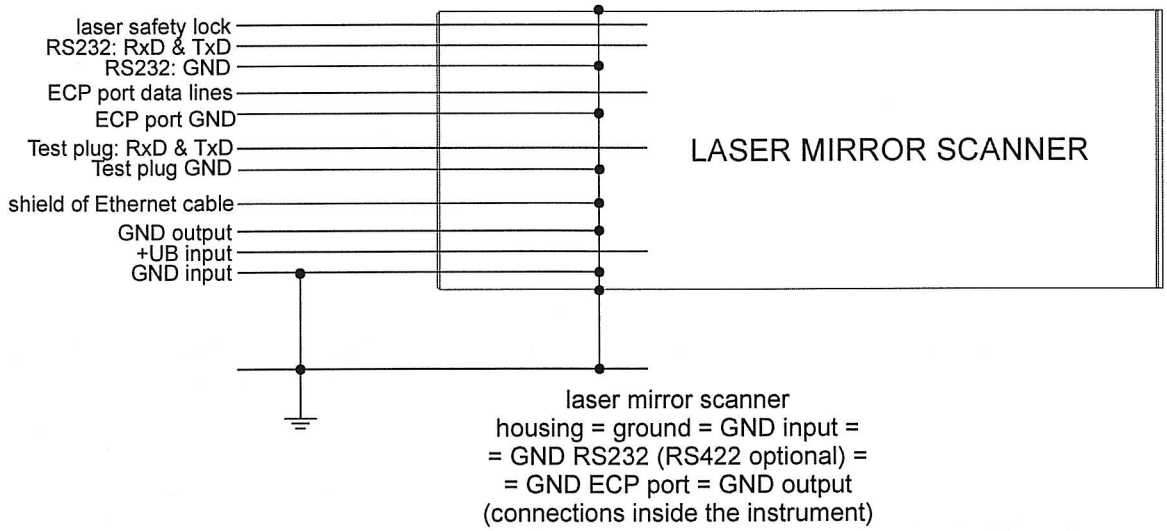
- When using a long power supply cable, the drop of voltage should be considered when adjusting the supply voltage.

- The internal resistance of the power supply must be low enough for the supply voltage not to fall short below the minimum voltage of the instrument.

The current drain capacity of the power supply must be at least THREE TIMES the sum of the rated currents of all fuses, so the fuses can be activated reliably if necessary (for example, in the case of false polarity connection).
Power supplies limiting the current output to a value below may damage the instrument when connected with wrong polarity or when the supply voltage exceeds the nominal voltage range specified for the instrument.

- Although the instrument's positive pole of the power supply cable is internally protected by fuses, the **positive pole of the power supply unit** has also to be protected by a fuse, which current specification is the sum of the rated current of all fuses. This additional fuse is necessary to protect the power supply unit and the power supply cables as well as the instrument in case of wrong electrical connections!

- All **ground terminals** of data interfaces, control lines and power supply and the housing are internally connected (Common Ground). Details are shown by the following scheme:



laser mirror scanner
housing = ground = GND input =
= GND RS232 (RS422 optional) =
= GND ECP port = GND output
(connections inside the instrument)

- The connections between the ground terminals and the housing, which are within the instrument, are **not suitable to drain off potential differences**. Therefore, for fixed installations further ground connections between housing and power supply ground have to be established by the customer installation.

- The DC-power supply has to fulfill the requirements for 'Limited Circuit' according to EN 61010-1 and the requirements for 'SELV' circuits according to EN 60950.

- All interfaces and control lines of the laser mirror scanner may be connected to equipment only, which are fulfilling the requirements for 'SELV' circuits according to EN 60950.

For electromagnetic compatibility, use only original *RIEGL* power supply cables and low-noise power supply units, which meet the relevant CE requirements.

3.7 Safety Instructions

3.7.1 General Safety

LMS-Q240i meets or exceeds the requirements of the following European Standard: **EN 61010-1:2001** *Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General Requirements*

Note the following explanations and important instructions:

Temperature

See chapter 3.1.4 Physical and Electrical Data for temperature limits for storage and operation.

Storage and operation at temperatures outside the specified temperature ranges may cause wrong measurement results or even damage of the instrument.

Sunlight

The instrument makes use of the optical time-of-flight technique to determine the distance to the target. For this purpose it comprises sensitive optical, electric and mechanical components. Thus it requires appropriate handling:

Unnecessary exposure of the internal optical and electronic parts to direct sunlight via the front window should be avoided.

Altitude

The unit is specified for an altitude up to 2000 m (operation).

Relative Humidity

The unit is specified for a maximum relative humidity of 80% at or below +31°C; linearly decreasing to 50% at +40°C.

Enclosure

The instrument is water resistant on the outside but must not however be subjected to rain or dripping water or submerged under water.

The optical glass panes should be treated with the care customarily due to optical instruments and, only when absolutely necessary, should they be gently cleaned using a suitable lens cleaning fluid (e.g. pure ethylene alcohol).

Never apply mechanical force or shock to the front window or to the housing itself !

As with other optical instruments, the instrument should be protected from being shaken or knocked.

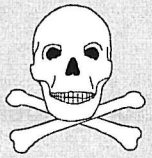
Mounting

When mounting the instrument do not under any circumstances use force. Never use rough tools e.g. a hammer or chisel even if the fitting is not good.

Power Supply

Before operating the instrument make sure that its case is properly grounded.

The power supply cable is to be connected with a suitable DC-power supply, see chapter 3.1.4 Physical and Electrical Data for voltage range.



The instrument **must never** be connected to 110, 230, or 400 VAC ! Opening the instrument is unacceptable due to the danger presented by the high voltages, and must therefore be avoided at all costs.

The negative pole of the external line voltage is directly connected to the instrument's housing. This should be remembered when connecting it to other instruments.

SAFETY HINT:

The instrument is equipped with a real-time clock including a rechargeable battery. Thus, it is strongly recommended to **power the instrument for at least 5 hours within a period of 6 months**, so the battery can be charged properly.

ANY USE OF THE ***LMS-Q240i*** IN CONTRADICTION TO THE INSTRUCTIONS AS GIVEN IN THE MANUAL CAN BE DANGEROUS AND IS, THEREFORE, STRICTLY FORBIDDEN!

3.7.2 Electromagnetic Compatibility

Laser scanner ***LMS-Q240i*** meets or exceeds the requirements of the following European Standard:

EN 61326 + A1 + A2 + A3 : 2004
Electrical equipment for measurement, control and laboratory use - EMC requirements; (IEC 61326:1997 + A1:1998 + A2:2000+ Corrigendum 2002)

The ***LMS-Q240i*** has passed the tests for class A equipment (industrial environment) as well as for class B equipment (residential and commercial environment).

The labeling of the ***LMS-Q240i***, which is affixed on the rear side of the housing of the instrument, meets the requirements of directive 2004/108/EC of the European Parliament and of the Council:

CE

The tests have been run using typical (default) instrument parameter settings. The tests have been performed using original *RIEGL* data and power supply cables, powered with 24 V DC provided by a PbGel-Powerpack.

To maintain emission requirements when connecting to the I/O interface of the ***LMS-Q240i*** use only a high-quality shielded data interface cable. The cable shield must have low impedance connections to both connector housings.

Any changes or modifications to the standard equipment not expressly approved by *RIEGL* as well as any non-observance of the directions for installation may cause harmful interference and void the authorization to operate this equipment.

The following table lists the applied standards and the performance criteria (see also definition below) for the evaluation of the immunity test results:

CISPR 16-1 Edition 2.1: 2002
Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus

CISPR 16-2 Edition 1.2: 2002
Specification for radio disturbance and immunity measuring apparatus and methods; Part 2: Methods of measurement of disturbances and immunity

EN 61000-4-2 + A1 + A2 : 2002
Electromagnetic compatibility (EMC); Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (IEC 61000-4-2:1995 + A1:1998 + A2:2001)
Performance Criterion B

EN 61000-4-3 + A1: 2004
Electromagnetic compatibility (EMC); Part 4-3: Testing and measurement techniques - Radiated, radio frequency, electromagnetic field immunity test (IEC 61000-4-3:2002 + A1:2002)
Performance Criterion A

EN 61000-4-4 + A1 + A2: 2002
Electromagnetic compatibility (EMC); Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4:1995 + A1:2000 + A2:2001)
Performance Criterion B

EN 61000-4-5 + A1: 2002
Electromagnetic compatibility (EMC); Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5:1995 + A1:2001)
Performance Criterion C

EN 61000-4-6 + A1: 2002
Electromagnetic compatibility (EMC); Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio frequency fields (IEC 61000-4-6:1996 + A1:2000)
Performance Criterion A

Definition of the performance criteria and acceptable degradations:

Performance Criterion A: during testing, normal performance within defined limits

- increased standard deviation up to 5 times the nominal value, distance depending error increased up to 5 times the nominal value;
- reduced maximum range
- additional angle error up to 5 times the nominal value;
- reduced data transfer rate of Ethernet interface;

(Nominal values to be found in chapter 3.1 "Specifications".)

Performance Criterion B: during testing, temporary degradation or loss of function or performance which is self-recovering

- loss or heavy degradation of functionalities during testing with self-recovering after finishing the test;
- loss of the TCP-connection with following readiness for acceptance of a new start of connection;

Performance Criterion C: during testing, temporary degradation or loss of function or performance which requires operator intervention or system reset occurs

- loss or heavy degradation of functionalities during testing with self-recovering after finishing the test; a system reset may occur;
- loss or heavy degradation of functionalities which require simple user intervention, e.g. replacement of a fuse, switching the device Off and On, restoration of settings;

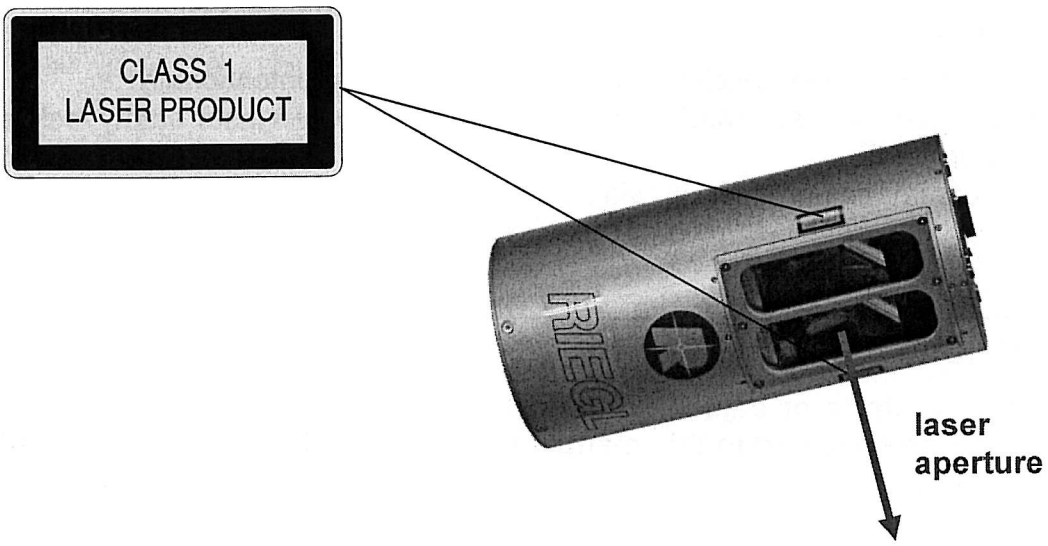
3.7.3 Laser Safety

The laser scanner instrument **LMS-Q240i** is classified as **Class 1** laser product in compliance with the International Standard **IEC60825-1:1993 +A1:1997+A2:2001** (abbreviated subsequently as IEC60825-1:2001) and the European Standard **EN60825-1:1994+A1:2002+A2:2001** *Safety of Laser Products, Equipment Classification, Requirements and User's Guide.*

The following clause applies for instruments delivered into the United States: Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

***Class 1**: Lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing (IEC60825-1:2001, Sub-clause 8.2).*

The labeling of the **LMS-Q240i** meets the requirements of the above standard (IEC60825-1:2001, sub-clause 5.1 and 5.2). It is affixed 2 times near the front pane on the LMS-Q240i.



Radiation output and standard information (IEC60825-1:2001, Sub-clause 5.8):

Max. average output	140 µW
Pulse duration approx.	8 ns
wavelength	905 nm
Standard	IEC60825-1:2001

CAUTION! The invisible laser radiation inside the instrument may exceed the accessible emission limits of laser class 1, thus **never open the instrument's housing**! Do not operate evidently damaged instruments! If the instrument is handled incompetently, the manufacturers absolve themselves from granting any guarantee or insurance whatsoever.

For class 1 laser products:

Do not unnecessarily look into the transmitter aperture!
Do not unnecessarily point the transmitter aperture at people's eyes!

CAUTION!
Aligning the infrared laser instrument with infrared night vision devices may result in damage to them.

IMPORTANT NOTE: The classification is based on the condition that the laser beam is continuously scanned. The **LMS-Q240i** emits laser radiation only, when in scanning operation. In case of any fault of the driving mechanism, the laser is switched off immediately.

Some means are available to switch off the infrared laser beam intentionally:

- via hardware: open the laser safety-lock-line (laser is on, when laser safety lock is connected to ground)
- via software: commanding "laser off" via interface

CAUTION!

Use of controls or adjustments or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.