

Laser Classification

Model	LMS-Q680i
Serial number	9998082
Date of test	07.04.2016
Tested by	Wb

The classification is carried out according to the Standard EN60825-1:2007, "Safety of laser products - Part 1: Equipment classification, requirements", equivalent to IEC 60825-1:2007.

The standard outlines conditions for the tests to be performed (Section 9.2, "Measurement of laser radiation").

The diameters of the measurement apertures and measurement distances to be used for classification measurements are outlined in Table 11.

For scanned systems the standard states (9.3):

"For power and energy measurement of scanned laser radiation, condition 3 shall be used". The measurement apertures and distances for condition 3 are specified in table 11.

Table 11 states for the wavelength range 1400 nm to 4000 nm an aperture of 25 (7x3.5) mm for the stationary case and apertures ranging from 1 mm to 3.5 mm for scanned laser radiation depending on the exposure time.

The effective angle of acceptance for the detector is defined by (9.3.3 b 2)) to be 100 mrad.

The time base for Laser Class 1 is 100 sec (8.3.e.2).

Scanning laser radiation is defined in the standard (compare 3.76) as: *"Laser radiation having a time-varying direction, origin or pattern of propagation with respect to a stationary frame of reference."*

Parameters	
Wavelength	1550 nm
Pulse width	3,00 ns
Beam divergence	0,3 mrad
Beam diameter	8,00 mm
Time base	100 sec
Pulse repetition rate	400000 Hz
Maximum number of pulses per scan within 3.5 mm aperture with 100 mrad acceptance angle	4430
Corresponding scan rate	4 Hz
Number of facets of polygon mirror	4
Stationary Test:	
Average power detected through 25 mm aperture with 100 mrad acceptance angle	< 4410,0 mW
Average power detected through 3.5 mm aperture with 100 mrad acceptance angle	< 1290,0 mW
Scanned Operation:	
Average power detected through 3.5 mm aperture with 100 mrad acceptance angle	< 49,00 mW
Calculated pulse energy in 25 mm	11025,0 nJ
Calculated pulse energy in 3.5 mm	3225,0 nJ

Accessible Emission Limits (AELs)	
Class 1	
AEL (pulse energy)	8 mJ
AEL (mean power)	10 mW
Class 3R	
AEL (pulse energy)	40 mJ
AEL (mean power)	50 mW
Class 3B	
AEL (pulse energy)	125 mJ
AEL (mean power)	500 mW

Stationary Mode (not feasible)		
Class 1		
AEL (pulse energy) 25 mm	fulfilled	0%
AEL (mean power) 25 mm	exceeded	44100%
Class 3R		
AEL (pulse energy) 25 mm	fulfilled	0%
AEL (mean power) 25 mm	exceeded	8820%
Class 3B		
AEL (pulse energy) 25 mm	fulfilled	0%
AEL (mean power) 25 mm	exceeded	882%
<p>If stationary operation of the LMS-Q680i would be feasible it would have to be classified as</p> <p style="text-align: center;">LASER CLASS 4</p> <p>according to IEC 60825-1:2007. Note that stationary operation is not accessible for an operator.</p> <p>Margin to the accessible emission limits of the specified laser class: n.a.</p>		

Scanned Mode		
Class 1		
AEL (pulse energy) 3.5 mm	fulfilled	0%
AEL (mean power) 3.5 mm	exceeded	490%
Class 3R		
AEL (pulse energy) 3.5 mm	fulfilled	0%
AEL (mean power) 3.5 mm	fulfilled	98%
Class 3B		
AEL (pulse energy) 3.5 mm	fulfilled	0%
AEL (mean power) 3.5 mm	fulfilled	10%
<p>Consequently, the LMS-Q680i operated in scanning mode has to be classified as</p> <p style="text-align: center;">LASER CLASS 3R</p> <p>according to IEC 60825-1:2007.</p> <p>Margin to the accessible emission limits of the specified laser class: 2%</p> <p>Nominal Hazard Distance = 0,98 m</p> <p>Extended Nominal Hazard Distance = 7,02 m</p>		

Conclusion	
<p>The LMS-Q680i can only be operated in the scanned mode. In the case the scanner motor stops, the laser is switched off instantaneously. Therefore, the LMS-Q680i has to be classified as</p> <p style="text-align: center;">CLASS 3R LASER PRODUCT</p>	