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Technical Manual

The technical design of the laser system is strictly a proprietary nature. The passing on of any information even internal, requires the explicit and detailed consent of CryLaS GmbH. Manufacturer reserves the right to modifications without advance notice.

Overview

1.1 Brief Description

The Q-Series laser system consists of a laser head and a control unit.

The laser head is a diode-pumped, passively Q-switched solid-state laser based on a microchip laser with multiple frequency conversion stages. The laser medium Nd³⁺:YAG (YAG, Yttrium Aluminium Granat) is diffusion bonded to the passively Q-switch crystal Cr⁴⁺:YAG. Instead of separately resonator mirrors, the end faces of the crystals are antireflective and high reflective di-electrical coated (microchip). The laser is sealed in aluminum housing, enabling it to operate even under relatively harsh environmental conditions without loss of reliability. Heat loss of laser head is dissipated via thermal conduction through a base plate. Because of the laser system's special technical design, it works in transversal single-mode, vertical polarization, with high peak to peak pulse power stability, good power output stability, as well as short pulse duration. The laser system is compact and heavy-duty structure allows easy system integration of the laser head and controller. It is a pulsed laser with repetition rates up to 20 kHz and an average power of up to 150mW (depends on model and repetition rate). The laser system is suitable for use in portable devices and for applications in analytical instrumentation.

The control unit operates and controls the laser system. It is connected to the laser head by a cable with plug-in connections on both sides (26 pin HD-Sub). The sophisticated electronics enables precise control of the repetition rate via the internal trigger generator or an external, user supplied trigger signal. The user can vary the repetition rate from single shot up to the maximum (model depending) repetition rate. The control unit is equipped with an RS232 serial and an USB interface for remote control and polling of data. In addition, several TTL-compatible and analog signals are provided to communicate with external control systems. For example, the pulse energy can be monitored by an analog output signal, and TTL inputs are provided to switch the laser on or off, or to change between internal and external triggering mode.

1.2 Model Overview

The Q-Series Laser Systems are available as different models, which differ in wavelengths and power level. The four available wavelengths are 1064nm, 532nm, 355nm and 266nm, which correspond to the type designations DSS1064, FDSS532, FTSS355, and FQSS266. The four available power levels are distinguished the suffix -Q1, -Q2, -Q3 and -Q4, respectively. Besides the wavelength and the power level the models differ in several parameters, in particular in the laser classification. The tables in section 7.1 and 7.5 give an overview over the optical, mechanical and electrical parameters.

All models are available as either Stand-Alone or as OEM version. Furthermore the Stand-Alone or OEM versions are also available as IL (hardware Interlock) versions. The Stand-Alone version is equipped with all the accessories needed for operation according to the safety regulations for laser systems. The stand-alone control unit (see Figure 1) is embedded in a table-top housing, including a key-switch and a push-button for turning the laser on or off. The laser head comes with a manual beam shutter and a mounting plate.



Figure 1: Stand-Alone control unit

The OEM laser model comes with the OEM control unit (see Figure 2), which is most suitable for system integration. It does not contain any additional safety accessories and no push button. Laser operation is done solely by remote control, using one of the available interfaces (RS232, USB).



Figure 2: OEM control unit

The DSS1064 laser head has been made substantially shorter than the other models, because it do not need any frequency conversion stage (see Figure 3).

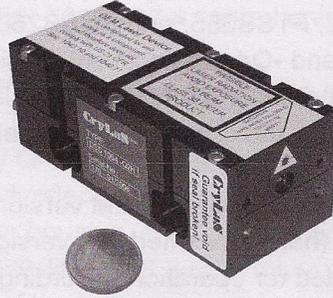


Figure 3: DSS1064 laser head

Due to the frequency conversion stage, the laser heads of model FDSS532, FTSS355 or FQSS266 are longer than the DSS1064 laser head (compare in section 7.5).

All laser heads are black anodized (see Figure 4).



Figure 4: Example laser head

2 Directives/ Declarations

We, the manufacturer **Crystal Laser Systems**, Ostendstraße 25, 12459 Berlin, Germany, herewith declares under our sole responsibility that the product Pulsed Laser Series „Q“ at 266, 355, 532 or 1064nm conforms with the provisions of the

- **Directive 2006 / 95 / EC**
(Low voltage Directive)
- **Directive 2004 / 108 / EC**
(EMC Directive: The application of the directive is according to the declaration in the instruction manual).
- **CE-Marking Standard 93 / 68 / EEC**

Furthermore **Crystal Laser Systems** declares that the following standards have been applied:

Safety:

- **EN 61010 - 1: 2010**
- **EN 60825 - 1: 2007**

EMC:

- **Emission:**
 - **EN 61000 - 6 - 3: 2007-09 – Class B**
- **Immunity:**
 - **EN 61000 - 6 - 1: 2007-10**

Fixing of the CE-Marking:

- **Since 2007**

Place and date of issue:

Berlin, 2012-03-30

Name, function and signature of authorized person:

Andreas Wenzel
Managing Director

This explanation loses its validity on alteration at the appliance voted not with us!

3 Warnings and Precautions

3.1 General Information on the Laser System

Everybody near the laser system must be aware of the risks involved. For safe operation of the laser system, all users must be familiar with its function and properties of coherent intense light.

Warning! Avoid direct eye contact with the laser beam! Otherwise, severe eyesight injury and possible blindness may occur.



Laser beam reflections can also cause eyesight injury and possible blindness.

Do not even look at the laser beam with optical instruments such as binoculars or microscopes, as severe eyesight injury may occur!

Avoid direct beam contact to skin! Otherwise, skin may damage and skin cancer cannot be ruled out.

Warning! Keep volatile substances such as alcohol, gasoline, and other highly inflammable solvents out of reach of the laser beam!



Warning! Light sensitive elements in video cameras, photocopy machines, and photodiodes can be damaged by the laser beam!



Warning! Never open the laser head housing as invisible infrared radiation, Class 4, which poses a greater risk to the user, will be emitted. Under no circumstances may the laser system be operated when the housing is open!



3.2 Laser Labeling

Laser systems and installations are divided into laser classes from 1 to 4. The laser head is labeled accordingly. The laser class of the Q-Series laser system is either 3B or 4, depending on the specific model (see section 7.1). Furthermore the laser is labeled with its general parameters. A warning label as shown in Figure 5 and laser type label as shown in Figure 6 are applied to the laser head. The labeling according to the label plan is shown in Figure 7.

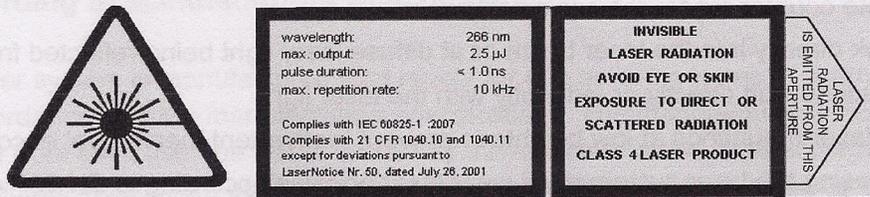


Figure 5: Example laser head warning labels



Figure 6: Example laser type label, contains type, serial No. and date of manufacture.

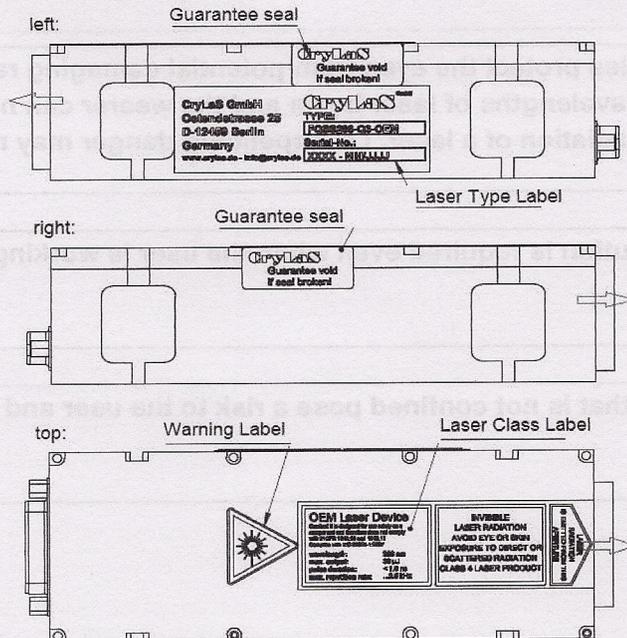


Figure 7: label positions on laser head.

Install the laser system according to the following steps:

1. Unpack the individual parts and compare them with the scope of delivery (Figure 5 or Figure 8).
2. Mount the laser head with M3 screws and washers to a heat sink (cooling body, for example blackened aluminum plate or 100mm x 300mm x 15mm metal plate with a heat conduction resistance < 0.8 K/W). For the Stand-Alone system a heat sink plate (head mounting plate, see section 7.5) is a part of the delivery scope.
3. Connect the laser head to the control unit by means of the enclosed head cable. Tighten the locking screws of both connectors.
4. Put the interlock plug into the 15-Pin "Interlock" connector on the back panel of the control unit.
5. Insert the enclosed CD into the CD drive of the windows computer and follow the instructions of the installation wizard (see Figure 10). If the installation wizard does not start automatically, start the wizard manually by double-clicking the "SETUP.EXE" program on the CD folder.
6. Connect the USB interface of the control unit to an unused USB port of the Windows computer (for RS232-remote control: connect the RS232-interface of the control unit to an unused COM-port of the Windows computer using a standard RS232-cable (non-crossed, Sub-D 9 pin female to Sub-D 9 pin male).
7. Connect the power supply to the line voltage (Stand-alone version: turn the key switch clockwise to position "1").
8. Follow the instructions of the Windows installer for the USB driver. Specify the location with driver information as the CD drive, where the enclosed software CD has been inserted to.
9. After finishing the installation procedure turn the key switch counterclockwise to the "0" position or disconnect the power supply from the line voltage, respectively.

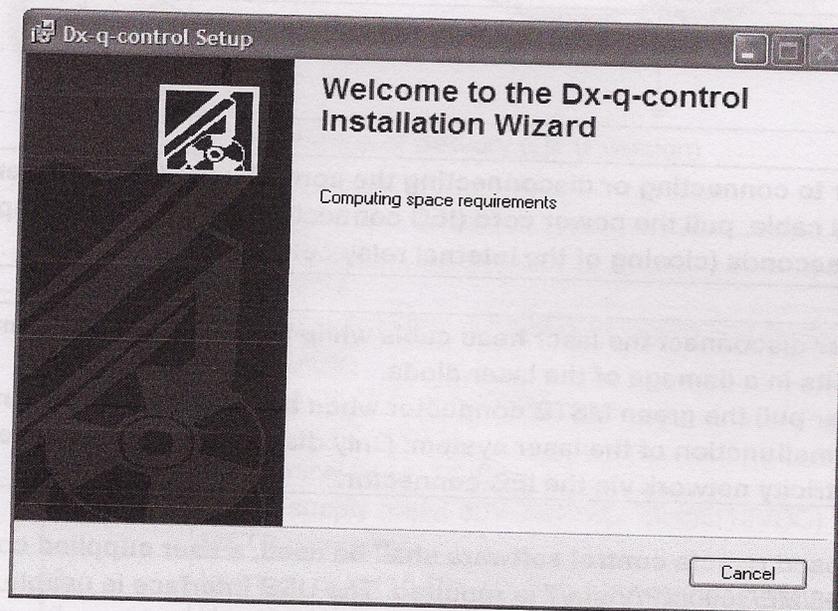


Figure 10: Software installation wizard

5 Operation

Warning! Prior to starting the laser system, pay special attention to the information in section 3: Warnings and Precautions!



Minimum technical knowledge of the laser system is required because of its easy-to-use operation concept. The laser systems current operating state is indicated by a dual color LED.

Note: The interlock in the OEM control unit is software based and did not fulfill the safety requirements EN/IEC 60825-1.

At the Stand-Alone control unit, the Stand-Alone-IL control unit and the OEM-IL control unit the power supply for the laser emission is interrupted by a relay when the interlock is open.

The user is responsible for all necessary safety requirements regarding the laser system application!

Note: If an error occurs during start-up, the laser system cannot be operated. To find out the reason for the malfunction, the RS232/USB Interface can be used to request an error listing of the control unit. Additionally the dual color LED at the controller will light up orange.

The relevant operating status of the laser system, important commands and special measured values can be transferred to a PC connected with the control unit via the RS232/USB interface. Before operation the laser system has to be installed according to the instructions in section 4. Depending on the application, the suitable operation modes may be chosen: Local (push button) operation (Stand-Alone version only) or remote control operation. Remote control operation is done either via TTL signals or via RS232/USB interface.

Two different trigger modes are selectable:

- **Internal trigger mode:** The pulse repetition rate of the laser is controlled by an internal trigger generator. The frequency of the trigger generator may be changed by using the software "DX-Q-CONTROL.EXE" (see section 5.2.2). The adjustable range of trigger frequency may extend from 1 Hz up to 20 kHz, depending on the laser model (see section 7).
- **External trigger mode:** The pulse repetition rate is controlled by an external TTL-signal (0...+5 V-DC), which is connected to the "External Trigger Input" (pin 6 of the Interlock connector). The external trigger mode is used, if the laser output shall be synchronized by a user supplied "master" trigger signal.

5.1 Local Operation (Stand-Alone Version only)

To switch the laser system 'On', proceed according to the following procedure:

1. Connect the power supply to the line voltage and turn the power on by turning the key switch on the front panel clockwise. The status LED on the front panel will blink green, unless an error occurred. In this case the status LED will light up orange.
2. Wait some minutes until the status LED stops blinking and turns to shine continuously green, indicating that the internal temperature servo loops are balanced and the laser system is ready for starting up (stand-by).
3. Push the 'Laser On/Off' button on the front panel to start laser emission. The status LED will light up continuously red and the laser emission starts.

To switch the laser system 'Off', proceed as follows:

1. Press the 'Laser On/Off' button on the front panel to stop the laser emission.
2. The status LED will light up green again and the laser emission will cease immediately.
3. Switch off the power by turning the key switch counterclockwise. The status LED will extinguish.

Note! In the external trigger mode, laser emission will occur only, if an external trigger signal is applied.

5.2 Remote Control Operation

The Q-series laser system may be remote controlled in two different ways: The TTL remote control mode and the serial interface (RS232 or USB) remote control mode. Both the "OEM" and the "Stand-Alone" version can be operated in remote control mode of either type.

5.2.1 TTL Remote Control

In the TTL remote control mode the user has to supply TTL-signals from a computer interface or simple external push buttons to the "Interlock" connector, in order to remote control the laser (see 5.2.5). For this, the "Laser On/Off" button input (pin 3) and the "External trigger" button input (pin 2) have to be set to TTL low level for a short time period of some milliseconds. To control the laser by external push buttons, these buttons simply have to be connected to pins 2 and 15 (GND), or pin 3 and 15, respectively.

Pin 10 is an output, informing about the actual trigger mode: low for external trigger mode and high for internal trigger mode. When using the internal trigger mode, the output of the internal trigger generator is supplied at pin 14. If the external trigger mode is used, the user supplied trigger signal (TTL) may be connected to pin 6 of the "Interlock" connector. Pin 5 supplies an analog voltage in the range 0V to 4V, which is a measure for the laser pulse energy. Pin 7 is a TTL voltage output, informing about the timing of the laser diode current modulation.

7 Technical data

7.1 General Data

Model	DSS1064			
	- Q1	- Q2	- Q3	- Q4
Wavelength (nm)	1064			
Pulse Energy (μJ)	> 10 @ 15kHz	> 20 @ 10kHz	> 50 @ 1kHz	> 90 @ 1 kHz
Max. Repetition Rate (kHz)	20	10	2.5	1
Pulse Width FWHM (ns)	≤ 1.5			
Polarization Ratio	>100:1, vertical			
Power Stability (% rms over 6 hours) ⁴⁾	< ± 5	< ± 3	< ± 3	< ± 3
Beam Divergence (mrad)	< 3.0	< 3.0	< 4.0	< 4.0
Beam Diameter (μm)	600 \pm 100	500 \pm 100	600 \pm 100	650 \pm 100
Spatial Mode	TEM ₀₀			
Operating Voltage direct / with AC Adapter	12V DC / 90...240V			
Power Consumption Mean / Max (W)	10 / 40	13 / 40	15 / 70	22 / 80
Communication Interfaces	RS232, USB			
Warm-up Time (minutes)	< 5			
Laser Class	4 / IV	4 / IV	3B / IIIb	3B / IIIb

Table 9: DSS1064 Data

Model	FDSS532				
	- Q1	- Q2	- Q3	- Q4	- Q4_1.2k
Wavelength (nm)	532				
Pulse Energy (μJ)	> 2 @15kHz	> 6 @10kHz	> 20 @1kHz	> 42 @1kHz	>42 @1.2kHz
Max. Repetition Rate (kHz)	20	10	2.5	1	1.2
Pulse Width FWHM (ns)	≤ 1.3				
Polarization Ratio	>100:1, vertical				
Power Stability (% rms over 6 hours) ⁴⁾	< ± 5	< ± 3	< ± 3	< ± 3	< ± 3
Beam Divergence (mrad)	< 3.5				
Beam Diameter (μm)	250 \pm 50	260 \pm 50	300 \pm 80	400 \pm 100	400 \pm 100
Spatial Mode	TEM ₀₀				
Operating Voltage direct / with AC Adapter	12V DC / 90...265V				
Power Consumption Mean / Max (W)	15 / 40	17 / 40	20 / 70	40 / 70	40 / 70
Communication Interfaces	RS232, USB				
Warm-up Time (minutes)	< 5				
Laser Class	3B / IIIb				

Table 10: FDSS532 Data

⁴⁾ after 5 min warm up, temperature variation ± 3 °C and < 3 °C/hour

Model	FTSS355			
	- Q1	- Q2	- Q3	- Q4
Wavelength (nm)	355			
Pulse Energy (μJ)	> 0.3 @ 15kHz	> 3 @ 10kHz	> 15 @ 1kHz	> 42 @ 1kHz
Max. Repetition Rate (kHz)	20	10	2.5	1
Pulse Width FWHM (ns)	≤ 1.1			≤ 1.4
Polarization Ratio	>100:1, vertical			
Power Stability (% rms over 6 hours) ⁴⁾	< ± 5	< ± 3	< ± 3	< ± 3
Beam Divergence (mrad)	< 3.0	< 3.5	< 4.0	< 4.0
Beam Diameter (μm)	190 \pm 50	200 \pm 50	200 \pm 50	300 \pm 80
Spatial Mode	TEM ₀₀			
Operating Voltage direct / with AC Adapter	12V DC / 90...265V			
Power Consumption Mean / Max (W)	15 / 40	17 / 40	20 / 70	40 / 70
Communication Interfaces	RS232, USB			
Warm-up Time (minutes)	< 5			
Laser Class	3B / IIIb			

Table 11: FTSS355 Data

Model	FQSS266			
	- Q1	- Q2	- Q3	- Q4
Wavelength (nm)	266			
Pulse Energy (μJ)	> 0.3 @ 15kHz	> 0.6 @ 10kHz	> 6 @ 1kHz	> 12 @ 1kHz
Max. Repetition Rate (kHz)	20	10	2.5	1
Pulse Width FWHM (ns)	≤ 1.0			
Polarization Ratio	>100:1, vertical			
Power Stability (% rms over 6 hours) ⁴⁾	< ± 5	< ± 3	< ± 3	< ± 3
Beam Divergence (mrad)	< 2.0	< 2.0	< 2.0	< 2.0
Beam Diameter (μm)	800 \pm 200	800 \pm 200	800 \pm 200	800 \pm 200
Spatial Mode	TEM ₀₀ (horizontal) / sync ² (vertical)			
Operating Voltage direct / with AC Adapter	12V DC / 90...265V			
Power Consumption Mean / Max (W)	15 / 40	17 / 40	20 / 70	40 / 70
Communication Interfaces	RS232, USB			
Warm-up Time (minutes)	< 5			
Laser Class	4 / IV			

Table 12: FQSS266 Data

7.2 Beam profile

A typical beam profile of the output beam from a 266nm laser at a distance of about 1m from the exit window is shown in the Figures below. The beam profile is composed of a near Gaussian central part and some outer fringes. The pictures demonstrate that the imaging method influences the subjective impression of the beam profile.

In the first picture a professional CCD camera with good linearity has been used to generate a discoloured picture.

In the second picture a piece of paper has been illuminated by the laser beam. The paper fluorescence has been photographed by a commercial digital camera. This picture is most similar to the subjective impression one gets, if looking at the beam fluorescence from a piece of paper. By non-linearity the weak parts of the beam profile are overemphasized.

In the right hand picture the beam has been attenuated by about 1:1000 and photographed with more sensitivity. In this case the fluorescence picture seems to be more linear and the subjective impression is more similar to the objective measures.

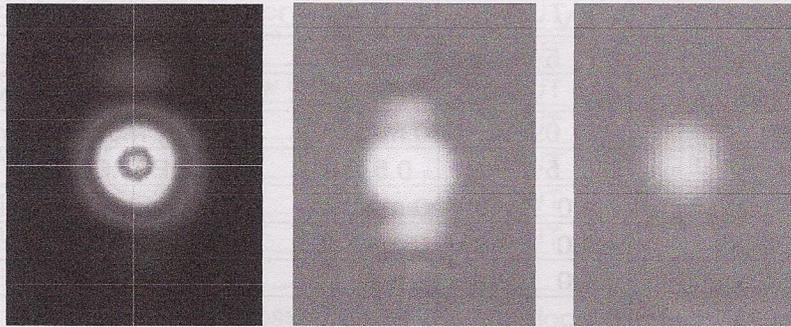


Figure 22: typical beam profile of 266nm-laser

7.3 Electrical Connectors

Warning! Do not connect any voltage to a pin marked as output.

Do not connect any voltage below 0V or above 5V.



7.3.1 Connector "Laser Head"

The 26-pin high density sub-D laser-connector as shown in Figure 23 is used for connecting the laser head with the control unit by means of the "head cable".

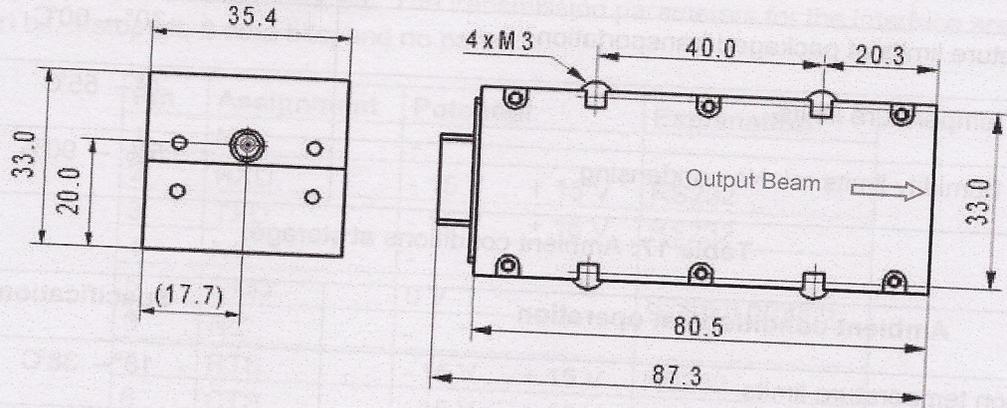
Warning! Do not connect any other device to the laser head than the original control unit.

Do not use any other cable than the supplied cable.

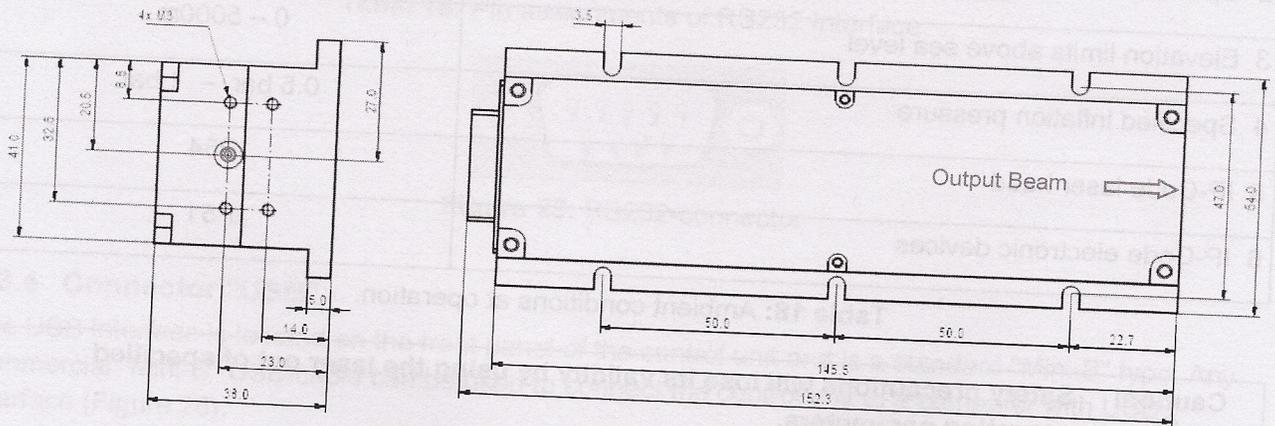


7.5 Dimension drawings

Dimension of model DSS1064 in millimeters



Dimensions of the old model FDSS532 in millimeters



Dimension of model FQSS266 , FTSS355 and FDSS532 in millimeters

