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MAIMAN ELECTRONICS

MBL1500A

Laser diode power supply

Datasheet & User Manual

Before powering on your driver, read this manual thoroughly.
If you have any doubt or suggestion, please do not hesitate to contact us!

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Table of content

1. Laser diode driver features

- **Low current ripple ≤ 10µA**
- **Current stability 0.1%**
- **No need to adjust voltage**
- **Soft-start**
- **Reverse current protection**
- **Crowbar circuit protection**

2. TEC controller features

- **Low current ripple ≤ 2µA**
- **Integrated PID controller, doesn't require setup**
- **Adjustable TEC output voltage limit**
- **Working with sensor NTC 10kOhm**

3. Applications

- **Supplying laser diodes in butterfly case**

4. Description

Laboratory power supply MBL1500 – high stability laser diode (LD) controller, optimized for Butterfly LD. Contains the LD power supply channel, temperature controller (TEC) and integrated LD seat, compatible with pinouts LD Type 1 and Type 2 Butterfly 14-pin.

MBL1500A can be controlled from the front panel using buttons and/or touchscreen or remotely via USB.

The LD power supply channel provides current up to 1.5A with noises no more than 10-15µA.

The TEC channel provides a temperature change from +12 to +40°C with stability 0,01°C. TEC contains integrated self-adjusted PID controller, providing optimal temperature regulation.

5. Package set

- **Laser diode power supply – 1 pcs**
- **Power cord – 1 pcs**
- **USB cable – 1 pcs**
- **Interlock connector – 1 pcs**
- **Datasheet & User Manual – 1 pcs**

6. Overall dimensions and weight

MBL1500 has overall dimensions of 257 x 271 x 117 mm and a weight of 3.4 kg.

7. Electrical characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Vin		90		264	V
Consumption power	Operative		45	50	W
Interlock threshold				1	V

8. Electrical characteristics LD power supply channel

PARAMETER	MIN	TYP	MAX	UNIT
Output voltage	0.5		3	V
Output current	0		1500	mA
Current ripple		10	15	µA
Current set step		0.5		mA
Current set accuracy		±2		%

9. Electrical characteristics TEC

PARAMETER	MIN	TYP	MAX	UNIT
Output voltage	0		±4	V
Output current	0		±4	A
Current ripple		2	4	mA
Temperature set range	+12		+40	°C
Internal measurements accuracy		±2		%

10. Typical Performance Characteristics

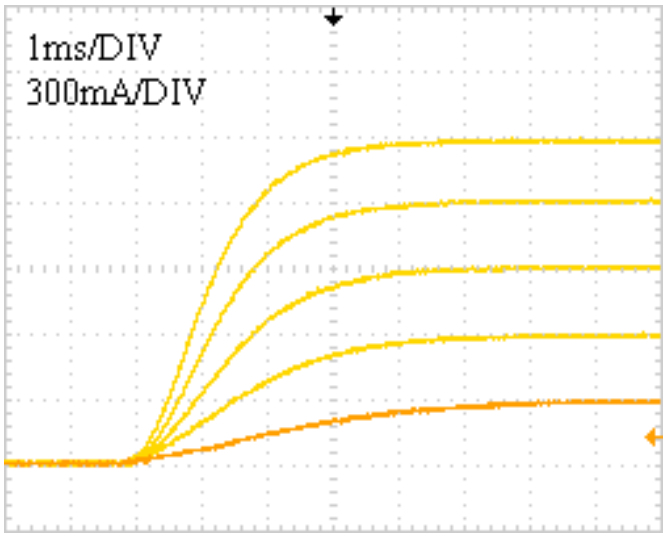

Fig. 1 – Typical start up sequence

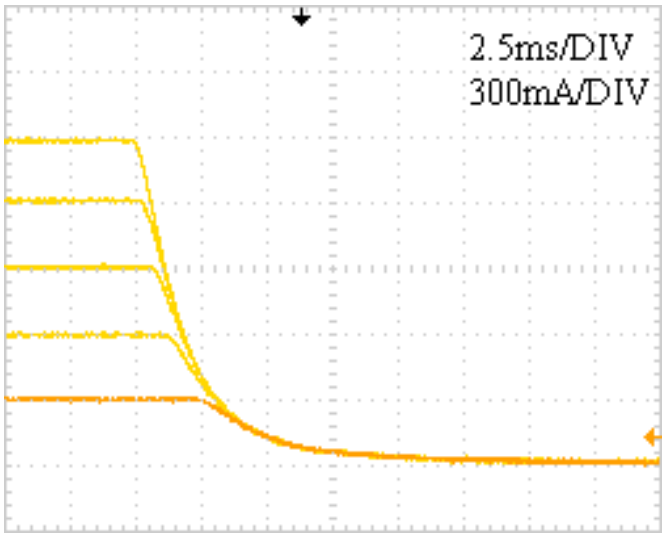

Fig. 2 – Typical stop sequence

11. Protections

The power supply includes various protections that prevent damage to the LD.

External interlock

External interlock function provides multiply protections at the same time:

- Prevents inadvertent use;
- Allows to connect an external emergency switch;
- Allows to connect an external auto protect device (e.g. over-temperature switches).

The laser can only be turned on with shorted Interlock.

Soft-start

The soft-start function protects against unwanted overshoot of the LD in the power up process.

LD max current limiting

LD max current limit (*LD max current*) is described in paragraph 15.7. You cannot set the operating current above LD max current.

Laser diode temperature protection window

This function protects the LD from unwanted temperature in combination with a thermal controller. If you set the temperature window limits close to the set temperature, the laser can be turned off permanently (the measured temperature will be outside the LD temperature window). LD

temperature protection window can be set in 13.7 *Settings* submenu using parameters *TEC max temperature* and *TEC min temperature*.

Over-temperature protection

The MBL1500 has automatic overheating protection. If the set *TEC max temperature* is exceeded, the LD power supply will be automatically turned off. After the temperature returns to normal, the LD power supply can be switched on again.

State after switching on

After turning on the MBL1500 with the *Standby* button the LD power supply and TEC will always be turned off.

Memorization of parameters

In case of an interruption/unplanned shutdown, the MBL1500 remembers the settings that were set at the time of the last On/Off Laser or TEC command.

12. Controls

Front panel

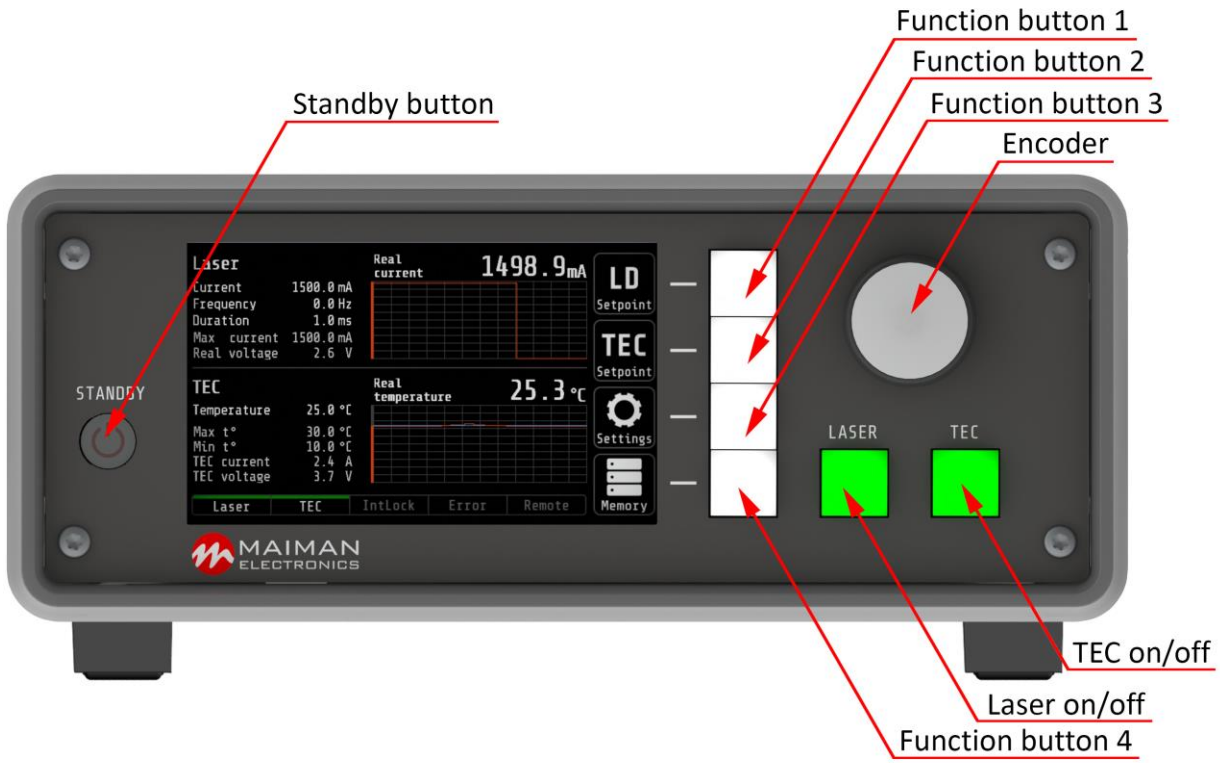

Fig. 3 – Front panel description

Back panel

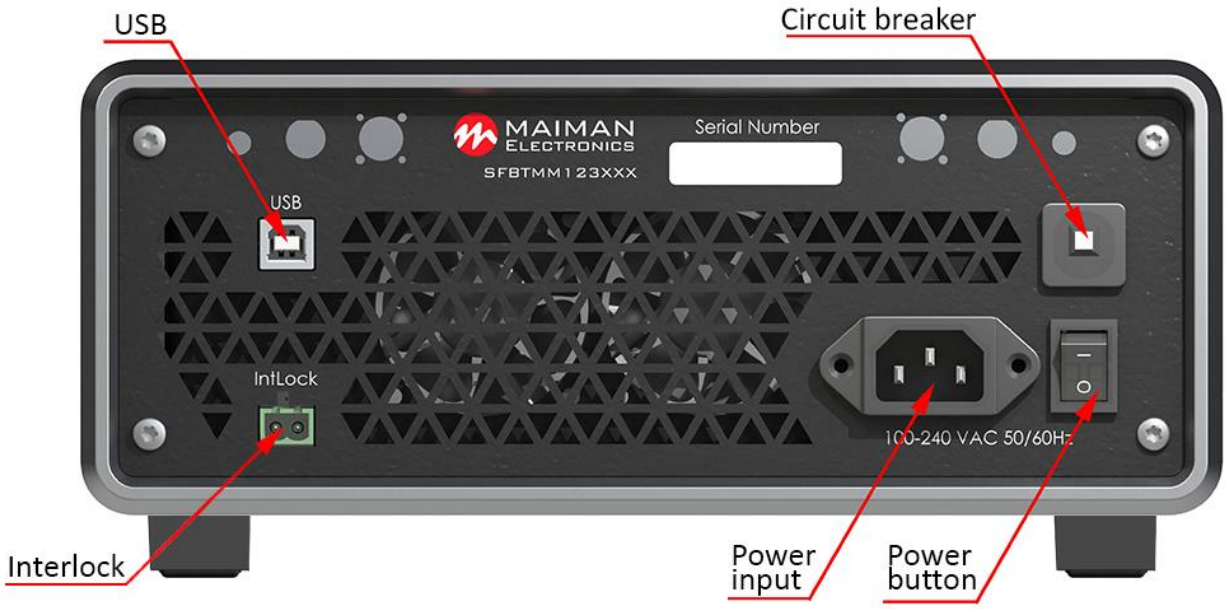

Fig. 4 – Back panel description

13. LD connection

MBL1500A compatible with pinouts LD Type 1 and Type 2 Butterfly 14-pin.

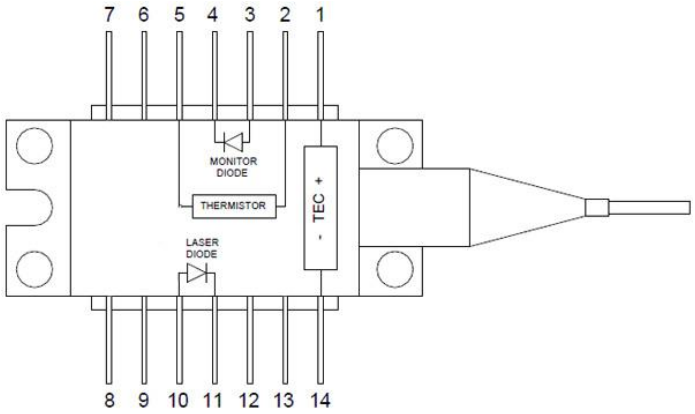

Fig. 5 – Pin functions type 1 Butterfly 14-pin

Table 1. Pin functions type 1 Butterfly 14-pin

№	Description	№	Description
1	TEC anode (+)	8	n/c
2	Thermistor	9	n/c
3	PD anode (+)	10	LD anode (+)
4	PD cathode (-)	11	LD cathode (-)
5	Thermistor	12	n/c
6	n/c	13	n/c
7	n/c	14	TEC cathode (-)

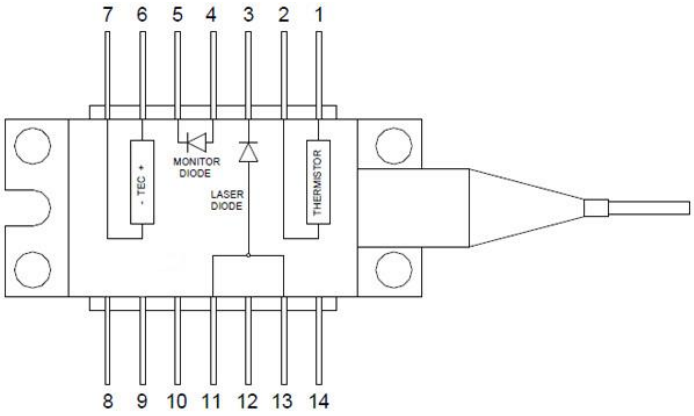

Fig. 6 – Pin functions type 2 Butterfly 14-pin

Table 2. Pin functions type 2 Butterfly 14-pin

№	Description	№	Description
1	Thermistor	8	n/c
2	Thermistor	9	n/c
3	LD cathode (-)	10	n/c
4	PD anode (+)	11	LD anode (+)
5	PD cathode (-)	12	n/c
6	TEC anode (+)	13	LD anode (+)
7	TEC cathode (-)	14	n/c

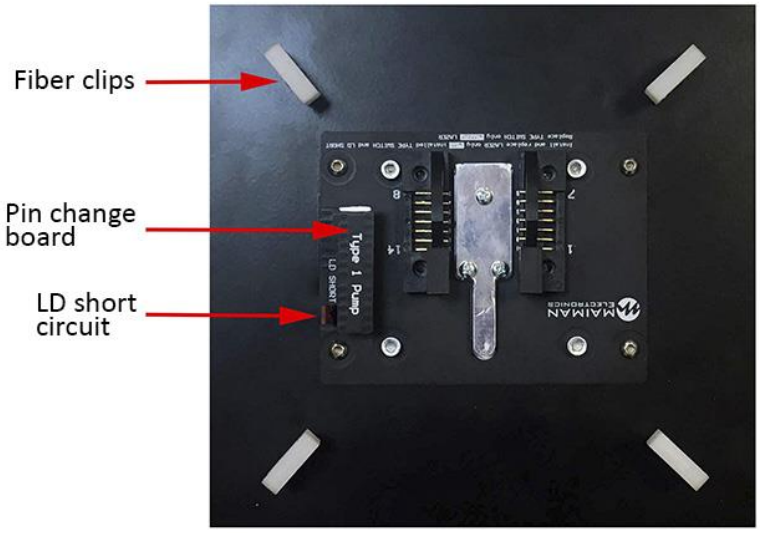

Fig. 7 – LD seat for type 1 Butterfly 14-pin

All works on the installation of the laser diode are performed with the MBL1500A power off!

Replacement of the pin change board is allowed only without the installed laser diode!

Laser diode installation is made only when the short circuit and the pin change board are installed!

Laser diode installation

Remove the 4 screws on the top cover, 2 each left and right, and remove the cover;

1. Determine the required pinout type in accordance with the description on the LD. Install the pin change board in the LD seat (Figure 7). Please note that the position of the pin change board key (white stripe) must correspond to the position of the LD seat key;
2. Open fiber clips;
3. Apply thermal grease to the aluminum plate of the LD seat and install the LD;
4. Place the fiber and close the clips;
5. After installing LD remove the short circuit;

14. How to get started

When you turn on the MBL1500A without the installed LD, the operation and information on the screen will be incorrect!

1. Unpack the MBL1500A;
2. Connect the LD (paragraph 13. LD connection);
3. Connect the power cord. Plug the power cord into the outlet;
4. Check the Interlock connection. The Interlock status bar should not be highlighted in red (paragraph 15.1 The *Main* screen);
5. Press the power button on the back panel;
6. Press the *Standby* button. A splash screen will appear. The Main screen loads. The function buttons should be white. Buttons *Laser* and *TEC* should be red;
7. Set the required parameters and settings (paragraph 15. Screen description);
8. To turn on, press the *Laser* and *TEC* buttons. The buttons will light up in green. Status bars *Current LD* and *TEC* will light up in green. If you turn on LD without TEC, the TEC button will flash. If you

failed to turn on the Laser and TEC, check the status bars *Error* and *Interlock*. They should not be highlighted in red (paragraph 15.1 The *Main* screen);

9. To turn on, press the *Laser* and *TEC* buttons again. The buttons will light up in red. Press the *Standby* button. Turn off the power by button on the back panel.

15. Screen description

Before switching on the TEC and Laser, set the parameters and settings for the MBL1500A in accordance with the specification of the laser diode. The next section describes setting parameters and settings in detail.

15.1. The *Main* screen

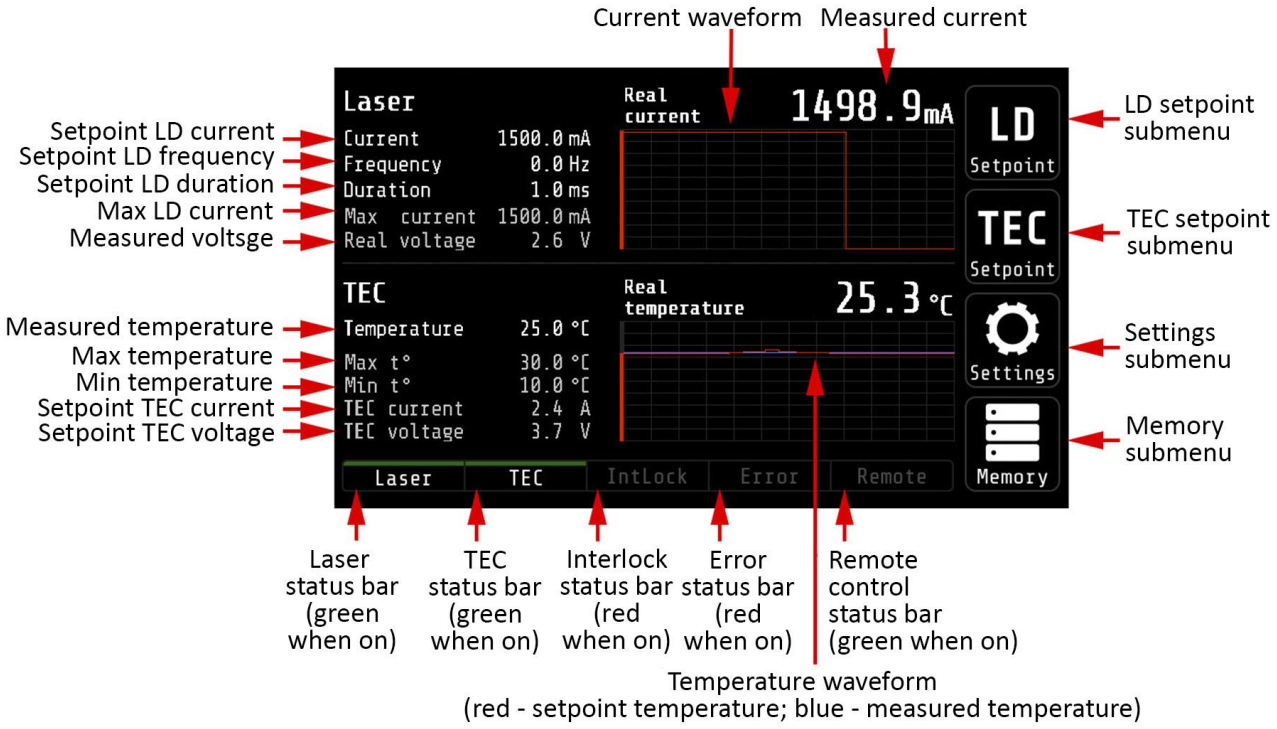

Fig. 8 – The Main screen

MBL1500A has a duplicate control using buttons and encoder and/or touchscreen. Button control will be described at first. Touchscreen control will be described later, as an option.

Table 3. The Main screen submenus description

Submenu	Description
LD Setpoint	Allows to change LD current, frequency and duration *(Function button 1)*
TEC Setpoint	Allows to change temperature *(Function button 2)*
Settings	Allows to set limits, calibrate LD and TEC current, adjust screen brightness, get general information, disable/enable touchscreen, etc. (*Function button* 3)
Memory	Allows to save the set parameters (*Function button 4*)

Control with buttons and encoder

To go to the submenu, press the *Function button* that corresponds to the required submenu.

Control with touchscreen

To go to the submenu, tap the button icon on the screen that corresponds to the required submenu.

15.2. The *LD Setpoint* screen

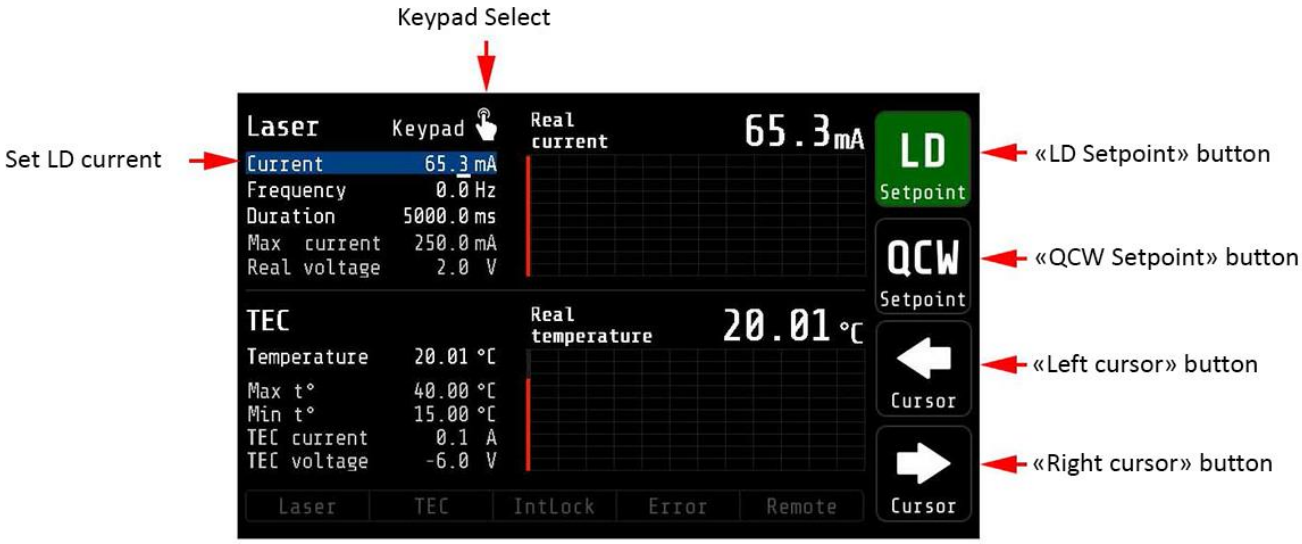

Fig. 9 – The LD Setpoint screen

Fig. 10 – Parameter change cursor

Table 4. The LD Setpoint screen submenus description

Submenu	Description
LD Setpoint	Allows to return to the *Main* menu *(Function button 1)*
QCW Setpoint	Allows to go to the QCW submenu *(Function button 2)*
Left cursor	Moves the change cursor to the left (*Function button* 3)
Right cursor	Moves the change cursor to the right (*Function button* 4)

Control with buttons and encoder

Use the *Left cursor* and *Right cursor* buttons to select the integer or fractional part of the LD current that you plan to change. Turn the encoder to change the current (clockwise to increase, counterclockwise to decrease). To return to the *Main* menu, press the *LD Setpoint* button. To go to the *QCW Setpoint* submenu, press the *Function button* that corresponds to the required submenu.

Control with touchscreen

To set the current, tap on the field next to the *Keypad Select* icon. To return to the *Main* menu or go to the *QCW Setpoint* submenu, tap the button icon on the screen that corresponds to the required menu or submenu.

15.3. The *I Current Keypad* screen

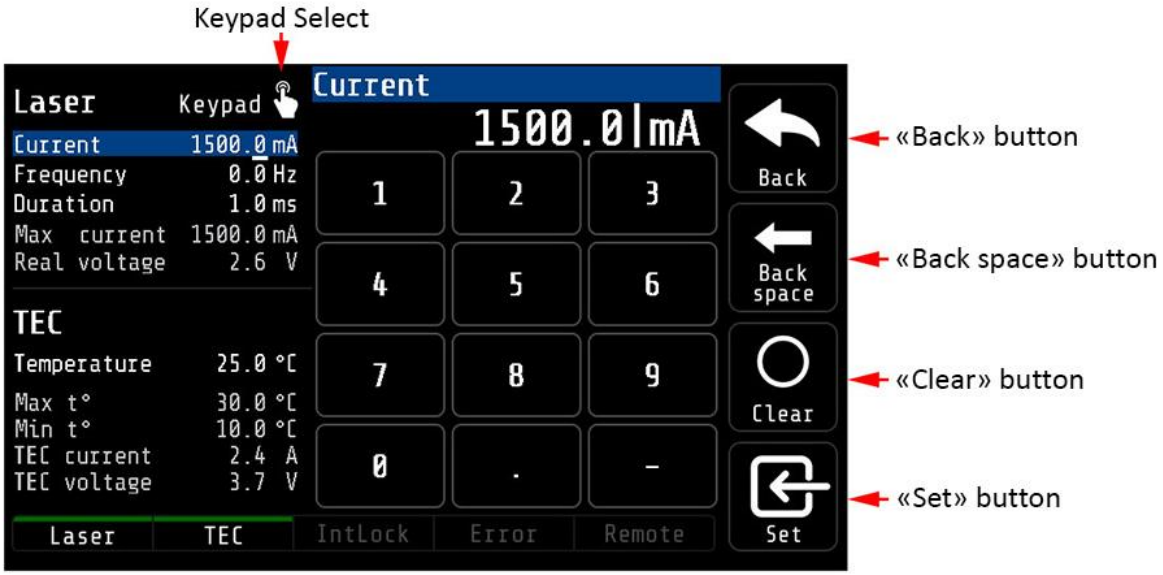

Fig. 11 – The I Current Keypad screen

Table 5. The I Current Keypad screen submenus description

Button	Description
Back	Allows to return to the *I Current* submenu *(Function button 1)*
Back space	Delete symbol *(Function button 2)*
Clear	Clear input window *(Function button 3)*
Set	Set value *(Function button 4)*

Control with touchscreen

If you need to set a new value, clear the input window using the *Clear* button. If you only want to edit the value, use the *Back space* button to remove unwanted symbols. Set the required value using the numeric keypad. Use the *Set* button to set the value. To return to the *I Current* submenu, tap the *Back* button or tap the field next to the *Keypad select* icon.

Control with buttons and encoder

To go to a submenu or perform an action, press the *Function button* that corresponds to the required submenu or action. Changing the current in the *I Current Keypad* submenu is possible only with a touchscreen.

15.4. The *QCW Setpoint* screen

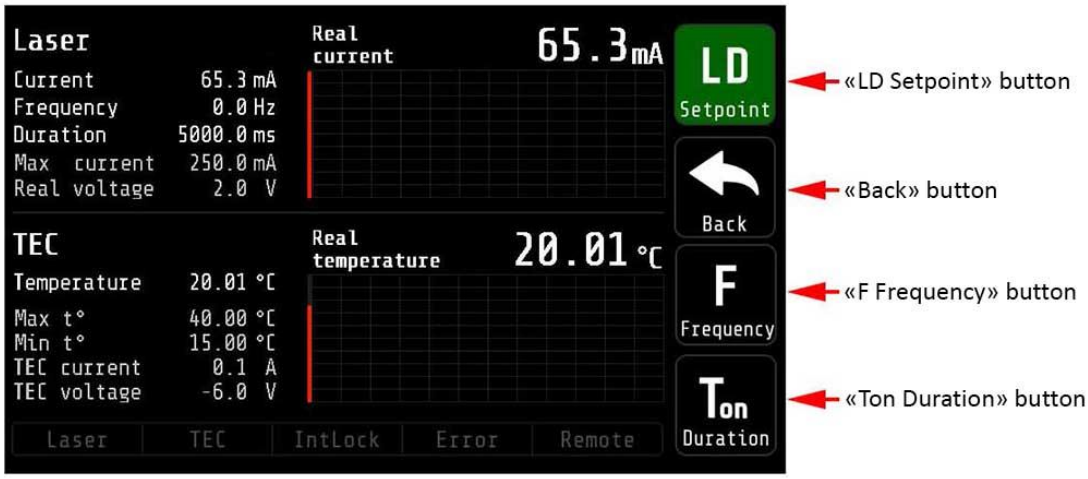

Fig. 12 – The QCW Setpoint screen

Table 6. The QCW Setpoint screen submenus description

Button	Description
LD Setpoint	Allows to return to the *Main* menu (*Function button* 1)
Back	Allows to return to the *LD Setpoint* submenu (*Function button* 2)
F Frequency	Allows to change the frequency *(Function button 3)*
Ton Duration	Allows to change the duration *(Function button 4)*

Control with buttons and encoder

To go to the *F Frequency* or *Ton Duration* submenu, press the *Function button* that corresponds to the required submenu. To return to the *QCW Setpoint* submenu, press the *Back* button.

To return to the *Main* menu, press the *LD Setpoint* button.

Control with touchscreen

To go to the submenu, tap the button icon on the screen that corresponds to the required submenu.

15.5. The *F Frequency и Ton Duration* screen

The *F Frequency* and *Ton Duration* screens have the same ergonomics and control principle as the *LD Setpoint* screen (paragraphs 15.2 and 15.3). While setting the frequency and duration, it is necessary to take into account that the MBL1500A has a rise time of about 4.5ms and a fall time of about 7ms. If the pulse duration is short, the current will not have time to increase and you will not receive a pulse of the required shape.

15.6. The *TEC Setpoint* screen

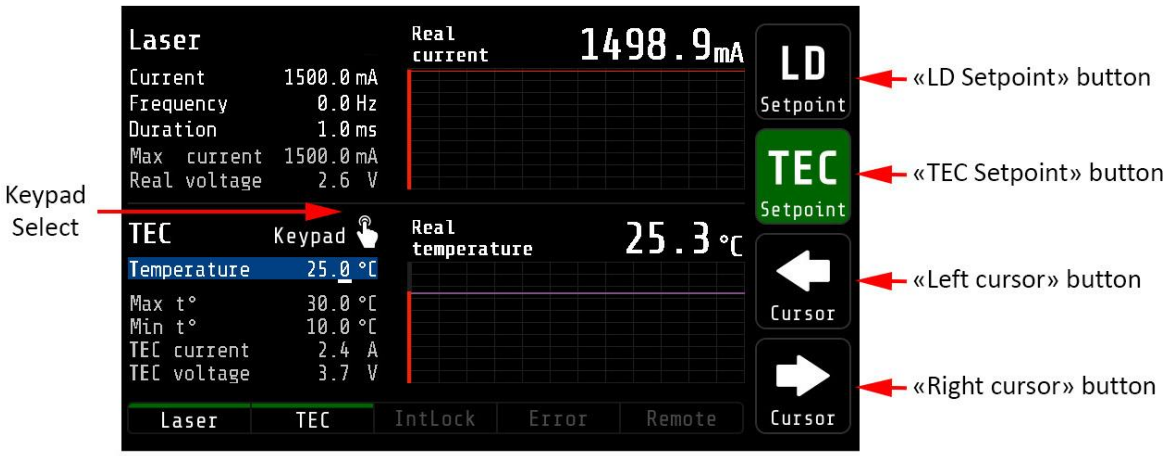

Fig. 13 –The TEC Setpoint screen

Table 7. TEC Setpoint screen submenus description

Button	Description
LD Setpoint	Allows to return to the *LD Setpoint* submenu *(Function button 1)*
TEC Setpoint	Allows to return to the *Main* menu *(Function button 2)*
Left cursor	Moves the change cursor to the left *(Function button 3)*
Right cursor	Moves the change cursor to the right *(Function button 4)*

Control with buttons and encoder or touchscreen

The *TEC Setpoint* submenu has the same control principle as the *LD Setpoint* screen (paragraphs 15.2 and 15.3).

15.7. The *Settings* screen

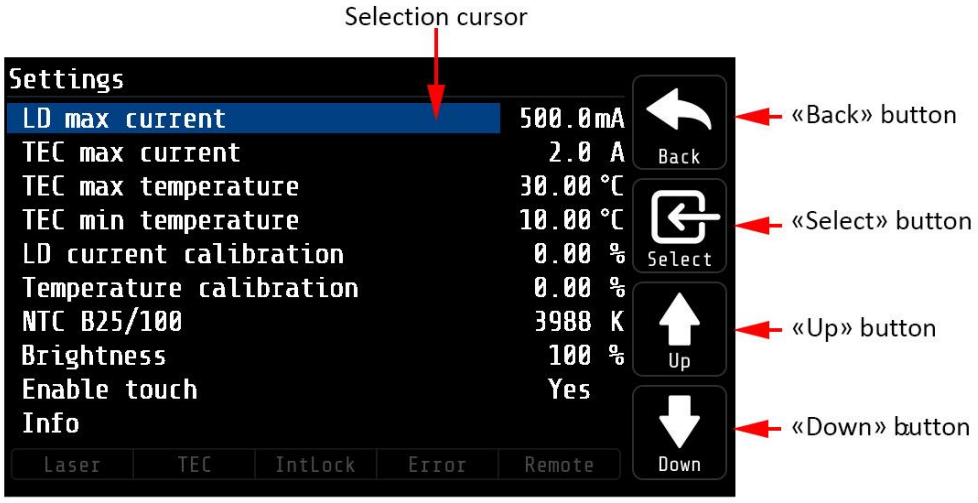

Fig. 14 –The Settings screen

Table 8. The Settings screen submenus description

Button	Description
Back	Allows to return to the *Main* menu *(Function button 1)*
Select	Button to select the parameter to change *(Function button 2)*
Up	Scroll up *(Function button 3)*
Down	Scroll down *(Function button 4)*

Control with buttons and encoder

Use the *Up* and *Down* buttons to move the selection cursor to the parameter you want to change. Press the *Select* button to select a parameter. To return to the *Main* menu, press the *Back* button.

Control with touchscreen

Tap on the setting you plan to change to set the selection cursor. Tap again to select the setting option. Tap a third time to bring up the keypad. Set the required parameter value using the keypad (the principle of keyboard control is the same as in 13.3 The *I Current Keypad* screen). Tap the *Back* button to return to the *Main* menu.

15.8. The *Settings LD max current* screen

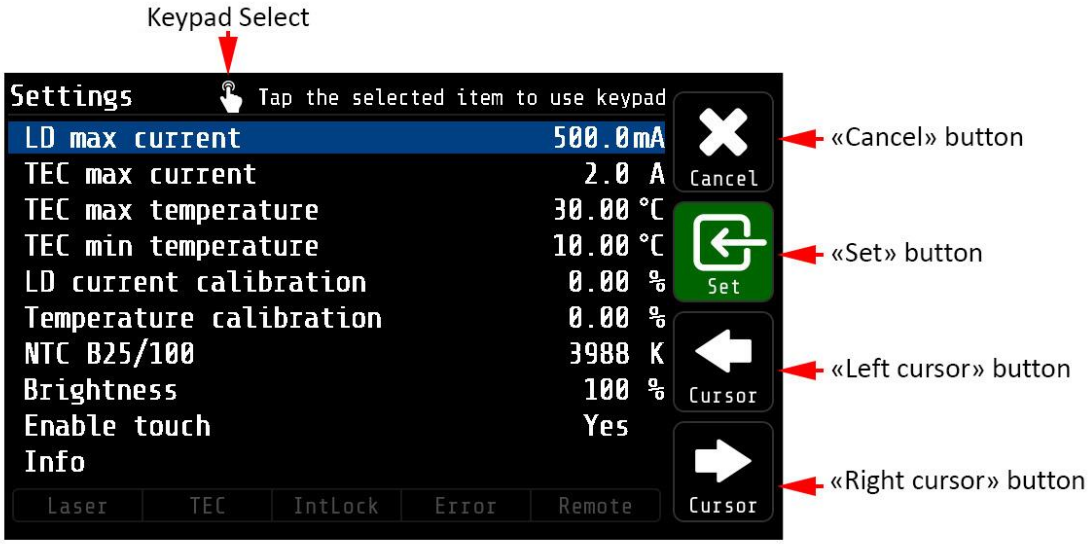

Fig. 15 – The Setting LD max current screen

Table 9. The Setting LD max current screen submenus description

Button	Description
Cancel	Cancel setting parameter *(Function button 1)*
Set	Set value *(Function button 2)*
Left Cursor	Moves the change cursor to the left *(Function button 3)*
Right Cursor	Moves the change cursor to the right *(Function button 4)*

Control with buttons and encoder

Use the *Left Cursor* and *Right Cursor* buttons to select the integer or fractional part of the LD current you want to change. Turn the encoder to change the current (clockwise to increase, counterclockwise to decrease). Press the *Set* button to set the parameter value or the *Cancel* button to discard the changes.

15.9. The *Memory* screen

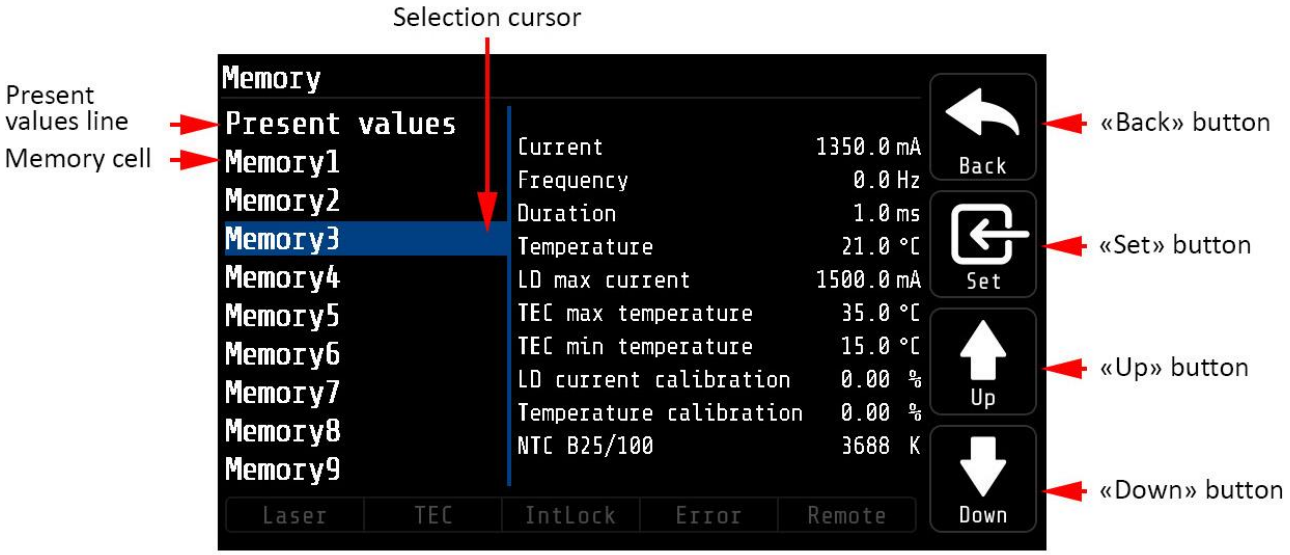

Fig. 16 – The Memory screen

Table 10. The Memory screen submenus description

Button	Description
Back	Allows to return to the *Main* menu *(Function button 1)*
Set	Set value *(Function button 2)*
Up	Scroll up *(Function button 3)*
Down	Scroll down *(Function button 4)*

Control with buttons and encoder

To save the present values, move the selection cursor using the *Up* and *Down* buttons to the *Present values* line. Click the *Save* button to save the values. Using the *Up* and *Down* buttons, select the memory cell from *Memory1* to *Memory9* to save the current values, and click the *Save* button. To load values, move the selection cursor using the *Up* and *Down* buttons to the line with the required memory cell (*Memory1* - *Memory9*). Press the *Set* button to load values from the memory cell. To go to the *Main* menu, press the *Back* button.

Control with touchscreen

To save the present values, tap on the *Present values* line. Tap the *Save* button to save the values. Select the memory cell from *Memory1* to *Memory9* to save the values and tap the *Save* button. To load the values, tap on the line with the required memory cell (*Memory1* - *Memory9*). Tap the *Set* button to load values from the memory cell. To go to the *Main* menu, press the *Back* button.

15.10. The *Memory Keypad* screen

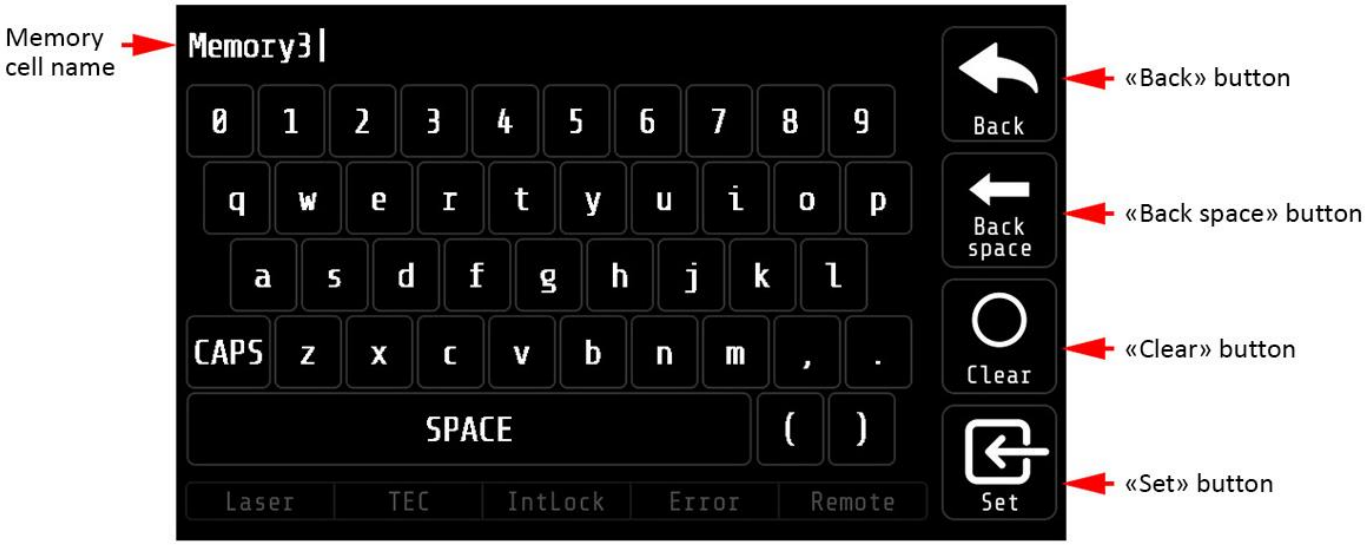

Fig. 17 -The Memory Keypad screen

Table 11. The Memory Keypad screen submenus description

Button	Description
Back	Allows to return to the *Memory* menu *(Function button 1)*
Back space	Delete symbol *(Function button 2)*
Clear	Clear input window *(Function button 3)*
Set	Set cell name *(Function button 4)*

Control with buttons and encoder

The *Memory Keypad* screen is available only with a touchscreen.

Control with touchscreen

To go to the *Memory Keypad* screen in the *Memory* screen, double-tap on the cell from *Memory1* to *Memory9*. If you need to set a new name, clear the input window using the *Clear* button. If you only want to edit cell name, use the *Back space* button to remove unwanted symbols. Set the required name of the memory cell using the keypad. Use the *Set* button to set the name. To return to the *Memory* submenu, press the *Back* button.

15.11. The *Info* screen

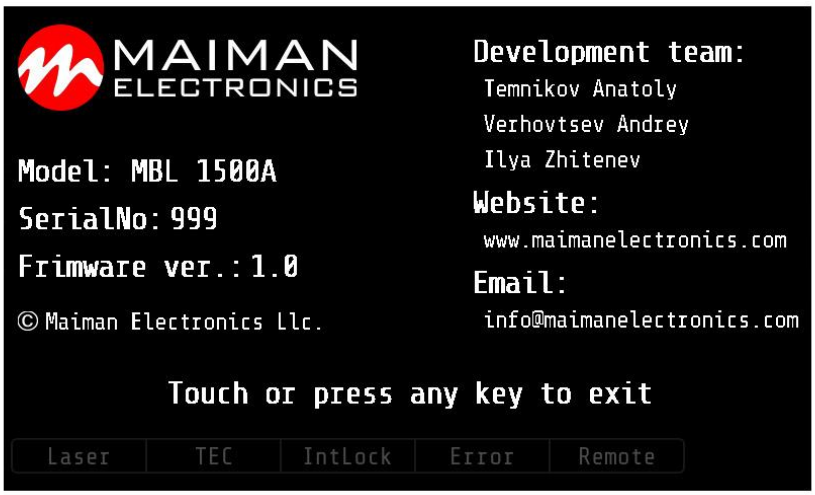

Fig. 18 – The Info screen

The *Info* submenu provides general information. Tap on the touchscreen or any button to exit.

16. Digital control description

When the input voltage applied the driver is always in "analogue current set, external enable and allowing interlock" state. Any other state should be set any time after powering the driver if needed.

Default serial port settings:

Baud rate	Data bits	Stop bits	Parity	Flow control
115200	8	1	none	none

Data exchange between the driver and the PC is only initiated by the PC. All commands are sent in plain text format. All commands are sent with prefix. Number of command follows the prefix without any symbols. If there is the value after the command they separates with "space" symbol. The command ends with "carriage return" symbol.

Table 12. The format of the command to set the value (P-type)

Number of byte	Value	Comment
1	P (50h)	Set prefix
2-5	Number of parameter	Hex-number of the parameter. For example, 0100h
6	'space' symbol (20h)	
7-10	New value of the parameter	Hex-value of the parameter, 0000h
11	'return carriage' symbol <CR> (0Dh)	End of the command

The device does not respond to P-type commands by default. (see section "the protocol extension").

You can request the value of parameter by the J-type command. The device will return a value of requested parameter.

Table 13. The format of the command to get the value (J-type)

Number of byte	Value	Comment
1	J (4Ah)	Request prefix
2-5	Number of parameter	Hex-number of the parameter. For example, 0100h
6	'return carriage' symbol <CR> (0Dh)	End of the command

Table 14. The format of the response

Number of byte	Value	Comment
1	K (4Bh)	Response prefix
2-5	Number of parameter	Hex-number of the requested parameter
6	'space' symbol (20h)	
7-10	Returned value of the parameter	Hex-value of the parameter
11	'return carriage' symbol <CR> (0Dh)	End of the command

If the device could not recognize a command, it returns an error message with error code.

Table 15. The format and codes of errors

Error (returned command)	Reasons
E0000	1) Internal buffer of device is overflowed 2) Cannot find <CR> (0x0D) or\and <LF> (0x0A) 3) Format of command is invalid
E0001	1) Unknown command (it does not P- or J-type command) 2) The device failed to correctly interpret a command

Table 16. Available parameters and its description

Action			R/W	HEX-number of parameters
Frequency (0,1 Hz)	Value		R/W	0100
	Minimum		R	0101
	Maximum		R	0102
Duration (0,1 ms)	Value		R/W	0200
	Minimum		R	0201
	Maximum		R	0202
Current (0,01 A)	Value		R/W	0300
	Minimum		R	0301
	Maximum		R	0302
	Measured value (0,1 A)		R	0307
Current set calibration (0,01%)[1]	Value		R/W	030E
Voltage (0,1 V)	Measured value		R	0407
State of the device (bit mask)	Start (Enable)	0008h	W	0700
	Stop (Disable)	0010h		
	Internal current set	0020h		
	External current set	0040h		
	External Enable	0200h		
	Internal Enable	0400h		
	Allow Interlock	1000h		
	Deny Interlock	2000h		
	Deny NTC Interlock	4000h		
	Allow NTC Interlock	8000h		

[1] Default – 100.00% (2710h), calibration range is from 95.00% (251Ch) to 105.00% (2904h).

State of the device (bit mask)	0 bit	1 - Device is powered on (always = 1)	R	0700
	1st bit	0 – Stopped; 1 – Started		
	2nd bit	Current set: 0 – External; 1 – Internal		
	4th bit	Enable: 0 – External; 1 – Internal		
	6th bit	External NTC Interlock: 0 – Allowed; 1 – Denied		
	7th bit	Interlock: 0 – Allowed; 1 – Denied		
Serial number	Return the hex-value of the serial number		R	0701
Device model and version ID	Return identification number		R	0702
Information about parameters that you can change (bit mask)	0 bit	1 – the device supports this option	R	0703
	1st bit	Frequency		
	2nd bit	Duration		
	3rd bit	Current		
Lock status (bit mask)	0 bit	Reserve	R	0800
	1st bit	Interlock		
	3rd bit	Over current		
	4th bit	Overheat (warning)		
	5th bit	External NTC Interlock		
TEC temperature (0,01°)	Set value		R/W	0A10
	Upper limit		R/W	0A11
	Lower limit		R/W	0A12
	Absolute maximum		R	0A13
	Absolute minimum		R	0A14
	Measured value		R	0A15
TEC current (0,1 A)	Measured value		R	0A16
	Upper limit		R/W	0A17
	Absolute maximum		R	0A1C
TEC voltage (0,1 B)	Measured value		R	0A18
	Upper limit		R/W	0A19
	Absolute maximum		R	0A1D

State of the TEC (bit mask)	Start	0008h	W	0A1A
	Stop	0010h		
	Allow Interlock	1000h		
	Deny Interlock	2000h		
	0 bit	1 - Device is powered on (always = 1)	R	
	1st bit	0 – Stopped; 1 – Started		
	6th bit	Interlock: 0 – Allowed; 1 – Denied		
TEC	Calibration coefficient		R/W	0A1E
TEC NTC	$B_{25/100}$		R/W	0A1F

The maximum duration depends on the set value of the frequency. When you change frequency, a new value of the maximum duration is compute automatically. The duration of pulse cannot be less than 2 ms and more than period of frequency minus 2 ms. For low frequencies the duration cannot be more than 5000 ms.

Set the zero frequency to switch the device into CW mode or set not zero frequency value to switch the device into QCW (long pulses) mode. If you try to set a value more or less than limits, then the value will be rounded to limit. Any attempts to set a new state of the device, except “start”, forcibly switch the device to the state “stop”. Some states of the device are mutually exclusive, for example, if you set “Ext. Enable”, then you will not be able to set the state “start”. If you send “start” and “stop” commands to each other, the device will save all parameters in the internal memory. The saving process lasts about 300 ms. In this time the device does not respond to any actions. The device is able to save the next parameters in the internal memory:

- Frequency with limits;
- Duration with limits;
- Current with limits and calibration;
- Temperature limits and B25/100;

17. SCPI control description

Enter SCPI mode by using the command “P0704 0800”.

Exit SCPI mode by using the “SCPI OFF” command.

As in the standard protocol, all commands must be terminated with a carriage return symbol CR (0Dh).

The separation of command levels occurs with the “:” symbol. To request a value, use the “?” symbol without a space immediately after the parameter. To set the value, the new value is specified with a space after the parameter. The separator of the integer and fractional part is the point “.”. In the angle brackets < > specify the parameters for which you want to specify a numeric value. In curly brackets {} through the separator | specify the possible set of commands.

For example, line “freq:value {<frequency>|?}” means that the user can either set a new frequency value, or request the current.

Frequency request: “frequency:value?”.

Setting a new frequency value: “frequency:value 30.5”.

Some commands have a full and shortened version. The full version is shown in the table, and the shortened version is shown by UPPERCASE. For example, frequency value can be requested in two ways: “frequency:value?” and “freq:value?”.

The device responds using the command version that was used by the user, and the parameter value is specified in the full version.

Table 17. Available list of SCPI protocol commands

Commands level				**Description**	
SCPI	OFF			Exit SCPI mode	
FREQuency	:MIN	?		Minimum	Frequency (0,1 Hz)
	:MAX	?		Maximum	
	:VALUE	{<0.0>|?}		Value	
DURation	:MIN	?		Minimum	Duration (0,1 ms)
	:MAX	?		Maximum	
	:VALUE	{<0.0>|?}		Value	
CURRent	:MIN	?		Minimum	Current (0,1 A)
	:MAX	?		Maximum	
	:VALUE	{<0.0>|?}		Value	
	:REAL	?		Measured value	
	:CALibrate	{<>|?}		Current set calibration (0,01%)	
VOLTage	:REAL	?		Measured value	Voltage (0,1 V)
DEVice	**:START**	**{?|ON|OFF}**		**Start/stop**	**Device state**
	:CMODe	{?|INTernal|EXTernal}		Internal/external current set	
	:SYNC	{?|INTernal|EXTernal}		Internal/external Enable	
	:BLOck	{?|USE|IGNore}		Allow/deny Interlock	
	:TEMPBlock	{?|USE|IGNore}		Allow/deny NTC Interlock	

SERial	?			Serial number	
BLOCKs[2]	?			Lock status	
NTC	:BOTtom	{<0.0>|?}		Lower limit	NTC sensor temperature (0,1°)
	:UPper	{<0.0>|?}		Upper limit	
	:REAL	?		Measured value	
TEC	:TEMPerature	:VALUE	{<0.00>|?}	Measured value	TEC temperature (0,01°)
		:REAL	?	Measured value	
		:UPper	{<0.00>|?}	Upper limit	
		:BOTtom	{<0.00>|?}	Lower limit	
		:MAX	?	Absolute maximum	
		:MIN	?	Absolute minimum	
	:CURRent	:REAL	?	Measured value	TEC current (0,1 A)
		:UPper	{<0.0>|?}	Upper limit	
		:MAX	?	Absolute maximum	
	:VOLTage	:REAL	?	Measured value	TEC voltage (0,1 V)
		:UPper	?	Upper limit	
		:MAX	?	Absolute maximum	
	:CALibrate	{<0>|?}		Calibration coefficient	
	:START	{?|ON|OFF}		Start/stop TEC	
	:BLOck	{?|USE|IGNore}		Allow/deny Interlock	

[2] Several possible answers are separated by "|": Intlock, overcurrent, overheat, ntc block, tec error, selfheat or no blocks in the absence of blocks.

18. Mechanical dimensions

All dimensions are in millimeters.