

## Protocol overview

Similar to other MOGLabs products, the command interface follows an ASCII-encoded “request-reply” architecture, where each message is terminated with CRLF=`\x13\x10`. Every request sent to the device will generate a CRLF-terminated response message, which *must* be handled by the client.

In the event of an error, the response message begins with the character string “ERR:” followed by a description of the error to be raised to the application. Commands that cause a change to occur will respond with “OK”, generally followed by a description of the new state.

Command parsing is case insensitive, and parameters are converted to uppercase unless explicitly enclosed in double quotes. Arguments are passed as a comma-separated list at the end of the function name.

Example command sequence demonstrating value query, value set, and error statement (where arrows indicate transfer direction):

```
>> ISET\r\n<< 100.00 mA\r\n\n>> ISET,120\r\n<< OK: Now 120.00 mA\r\n\n>> ILIM\r\n<< 150 mA\r\n\n<< ISET,180\r\n<< ERR: Max current is 150 mA\r\n
```

The tables on the following pages list the commands available for user applications.

- RO = Read only query, whose response will either be a string, decimal, or floating-point value. If units are applicable on the returned value, there is a space between the value and units string.
- RD = Read only with dictionary response, which is an LF-delimited sequence of key-value pairs, each separated by the “:” character. Typically used to provide an overall snapshot summary of device functionality.
- RW = Read/write, where supplying an additional argument will change the parameter to the specified value (or the closest available value)
- CMD = Command only, has no query form. Triggers some action to occur and responds with “OK” on success.

System overview		
<b>INFO</b>	<b>RO</b>	String containing the device type, serial number, version, and any user-assigned name
<b>VER</b>	<b>RD</b>	Dictionary containing the version numbers of the various system components
<b>DEVNAME</b>	<b>RW</b>	String containing the user-facing name of the dDLC to ease in identification when multiple dDLCs are present on the same network. The name is a string of up to 16 characters, and spaces are automatically replaced by underscores. Use the special name "*" to remove any previously-set name.
<b>UPTIME</b>	<b>RO</b>	Floating point uptime of the system since last power-cycle, reported as seconds, minutes or hours as appropriate.
<b>TEMP</b>	<b>RO</b>	Comma-separated list of the measured internal system temperatures, in °C.
<b>STATUS</b>	<b>RO</b>	String indicator describing the state of the system – in particular if there is a boot error or some other system-level issue preventing normal operation of the DDLC.

Application settings		
<b>REPORT</b>	<b>RD</b>	Dictionary providing a snapshot of overall device status and setpoints.
<b>ISET</b>	<b>RW</b>	Floating-point laser setpoint current, in mA.
<b>ILIM</b>	<b>RW</b>	Floating-point hardware current limit value, in mA. Automatically reduces the setpoint current if it exceeds the new value for the limit. Should be set to at least ISET+IBIAS
<b>IBIAS</b>	<b>RW</b>	Bias current, in mA. Adjusted to improve the modehop-free scan range of the laser, by adjusting the current over the piezo sweep. Signed floating-point value in the range $\pm 20\text{mA}$ .
<b>IDITHER</b>	<b>RW</b>	Amplitude of the dither modulation applied to the laser diode current, relative to full-scale. Increasing the dither current can yield a stronger error signal, at the expense of increasing the laser power in the dither sidebands and increasing non-linearity. Set to zero to disable, should not be used in combination with ICOIL.
<b>ICOIL</b>	<b>RW</b>	Amplitude of the dither output to the rear panel "MOD OUT" connector, intended to be connected to a coil for Zeeman modulation. Set to zero to disable, should not be used in combination with IBIAS.
<b>ILD</b>	<b>RO</b>	Measured laser current, in mA. This diagnostic reading is taken at the current source without any current modulation or the hardware current limiter. There may be a small discrepancy ( $<1\text{mA}$ ) between the setpoint and measured current.
<b>VLD</b>	<b>RO</b>	Voltage measured across the laser diode at the dDLC output, in volts. Used for detecting potential short/open-circuit scenarios.
<b>HBMOD</b>	<b>RW</b>	The laser headboard includes an SMA connector for rapid modulation of the laser current (e.g. fast external servo, or dither). The modulation input can be configured as NONE (disabled), DC (DC-coupled, recommended for external servo) or AC (AC-coupled, recommended for dithering). Changing this option may cause a small perturbation to the current through the laser diode.
<b>PDOFFSET</b>	<b>RW</b>	The DC offset voltage applied to the photodiode signal, in volts
<b>PHASE</b>	<b>RW</b>	Phase of the lock-in amplification used to generate the error signal from the photodiode signal for AC locking, in degrees. The phase should be adjusted to maximise the slope of the error signal around the locking feature of interest. Also accepts the special argument string "INV" to swap sign of phase and "Q" to rotate the quadrature (i.e. adjust by $+90^\circ$ ).

<b>MON, ch, LIST</b>	<b>RO</b>	Return a comma-separated list of available channel selections for the rear-panel monitor output ch, which is either "A" or "B"
<b>MON, ch[, se1]</b>	<b>RW</b>	String identifying the diagnostic channel selected for output on the rear-panel monitor output ch, which is either "A" or "B".

### Sweep settings

<b>SPAN</b>	<b>RW</b>	Peak-to-peak height of the sweep span, in percentage full-scale piezo output.
<b>OFFSET</b>	<b>RW</b>	Offset of the sweep in percentage full-scale in the range -100% to 100%. Automatically limited by the chosen SPAN to prevent truncation of the sweep.
<b>SWEEP, FREQ</b>	<b>RW</b>	Sweep rate of the frequency scan, in Hz.
<b>SWEEP, DUTY</b>	<b>RW</b>	Sweep duty cycle, in %. In practice should be limited to the range 10-90% to avoid problematic acceleration of the PZT driver at the ends of the sweep.
<b>SWEEP, INV</b>	<b>RW</b>	Get/set the sweep inversion bit to change the direction of the sweep. Also swaps the sign of the bias current.

### TEC settings

<b>TEC, REPORT</b>	<b>RD</b>	Query string with TEC-related setpoints and readings.
<b>TEC, ONOFF</b>	<b>RW</b>	Enable/disable the TEC PID controller. Disabling the TEC controller automatically switches off the laser current, if active.
<b>TSET TEC, TSET</b>	<b>RW</b>	Desired TEC setpoint temperature, in °C.
<b>TEC, TEMP</b>	<b>RO</b>	Measured laser temperature as recorded by the headboard thermistor, in °C. Returns error if thermistor cannot be read.
<b>TEC, ILIM</b>	<b>RW</b>	Maximum drive current of the TEC, in amps.
<b>TEC, TPCB</b>	<b>RO</b>	Measured temperature of the TEC driver PCB, in °C.
<b>TEC, I TEC, V</b>	<b>RO</b>	Measured current/voltage of the TEC, in amps/volts as appropriate.
<b>TEC, INV</b>	<b>RW</b>	ON/OFF setting for TEC polarity inversion, which controls whether positive drive current induces cooling or heating of the TEC.
<b>TEC, TMIN TEC, TMAX</b>	<b>RW</b>	Acceptable temperature range for TEC operation, in °C. Used as a sanity-check to prevent the user operating the TEC in the wrong polarity which can potentially cause damage to the laser diode.
<b>TEC, RMIN TEC, RMAX</b>	<b>RW</b>	Acceptable range of effective TEC resistances, in ohms. Used for sanity-checking TEC open/closed circuit scenarios.
<b>TEC, VAL</b>	<b>RO</b>	Query the output value of the TEC controller, used for long-term monitoring of TEC stability.

### LOCK settings

<b>LOCK, STATUS</b>	<b>RO</b>	String indicator of overall lock status of the device. <ul style="list-style-type: none"> <li>UNLOCKED = neither servo is locked, sweep is active.</li> <li>LOCKED = one or more of the servos is active, so the system is locking.</li> <li>WARNING = lock detect algorithm has measured a metric outside of typical ranges, indicating the operator should check the lock to verify it is OK.</li> <li>FAILED = lock detect algorithm has measured a metric railing, indicating the lock has almost certainly failed and is unlikely to have recovered.</li> </ul>
---------------------	-----------	--

For the below commands, the argument *type* is either “FAST” or “SLOW”

<b>LOCK, type, STATUS</b>	<b>RO</b>	Same as LOCK, STATUS but for only the specified servo type.
<b>LOCK, type, KP</b> <b>LOCK, type, KI</b> <b>LOCK, type, KM</b>	<b>RW</b>	The proportional (P), integral (I) and master (M) gains associated with the lock, which is a floating-point value in the range (0,1]. Adjusting the master gain will affect the amplitude of the associated error signal. Note that reducing gain to identically zero may have unintended consequences for lock stability.
<b>LOCK, type, OFFSET</b>	<b>RW</b>	The error offset on the associated lock, which is used to define the desired lock point for DC-locking, or adjusting for residual background in AC-locking.
<b>LOCK, type, INV</b>	<b>RW</b>	Option to invert the action of the associated lock. Some laser geometries cause the action of the FAST and SLOW controllers to be reversed, requiring the control action to be inverted.
<b>LOCK, type, LOCK</b> <b>LOCK, type, UNLOCK</b>	<b>CMD</b>	Instruct the controller to engage/disengage the lock. Equivalent to toggling the lock state from the front-panel push-buttons.
<b>LOCK, type, VAL</b>	<b>RO</b>	Query the output of the PID controller in the range [-1, +1], used for long-term monitoring.
<b>LOCK, FAST, BLOCK</b>	<b>RW</b>	Enable/disable the DC block for the FAST servo. The DC block is recommended to prevent competition between the FAST and SLOW controllers at low frequencies.
<b>LOCK, SLOW, AUX</b>	<b>RW</b>	Configure the slow servo to be controlled directly by the specified AUX input, one of “A”, “B” and “NONE”. When set to “A” or “B”, the internal slow servo is disabled and the control signal is taken directly from the associated rear-panel AUX input (e.g. for use with an external servo such as the MOGLabs FSC).