# INTEGRATION MANUAL

QINSTRUMENTS
A BICO COMPANY

Version: 010.5

# APPLICABLE DEVICES AND FIRMWARE

| Device | Firmware | Abbreviation used in this document |
|---|---|---|
| BioShake 3000 Series \| BioShake 5000 Series \| BioShake D-30 Series \| HeatPlate | ≥ 1.6 | BS |
| BioShake Q1 \| BioShake Q1 3mm \| BioShake Q2 | ≥ 1.0 | TC* |
| ColdPlate \| ColdPlate slim | ≥ 2.4 | TC* |

* The abbreviation TC stands for Thermo Control. This is related to the ability of all the devices in the two rows (BioShake Q1 ... ColdPlate slim) to heat and cool. All these devices therefore have an adapted set of commands due to the underlying firmware.

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# 1. INTRODUCTION

QINSTRUMENTS devices are optimized to be integrated seamlessly into automation platforms. The simple and over all our devices standardized command set allows you to easily set and control process parameters and read out sensor values. Through the integrated microelectronics no other external components or control devices are necessary. All units are designed for continuous 24 hour hands-free operation when utilizing sound scientific methods

Providing long term stable hard- and software interfaces and supporting industry standard like SiLA®, paves the way to a superior level of lab automation. Due to the outstanding integration support we are happy to call the leading providers for lab automation our partners.

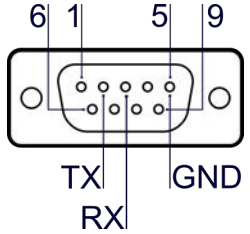
If not stated otherwise, the presented information applies to all applicable QINSTRUMENTS devices (see: "Applicable Devices and Firmware" on page 2). In case there are differences between the devices or the information just applies to a certain type this will be marked.

# 2. COMMUNICATION INTERFACE

## 2.1 HARDWARE

The RS232 interface is available through the 9-pin D-subminiature connector. Pins 2 (TX), 3 (RX) and 5 (GND) on the connector are used (see picture below).

| | |
|---|---|
| Baud rate | 9600 |
| Parity | None |
| Data bits | 8 |
| Stop bits | 1 |
| Hardware or software handshake (XON/XOFF) | Not supported |




The power connection is realized via a barrel connector (ID 2.5 mm x OD 5.5 mm). For all devices the power supply must fulfill the following requirements. Only use the delivered power supply (Mean Well GST120A24) to fully stay within the device certification.

| | |
|---|---|
| Input | 100 - 240 V AC \| 50 - 60 Hz |
| Output | 24 V DC \| Imax: 5.0 A \| Pmax: 120 Watt |
| Approvals | CE/UL/CS, 85-264 V AC, 47-63 Hz<br>IEC/EN60320-1 C14 |


## 2.2 SOFTWARE

The device functions and parameters are controlled via the commands which are provided by QINSTRUMENTS and are explained in detail in chapter: "Software Interface" on the next page. Keep in mind that these commands are just the building blocks for a device driver. It is required to deal with device errors, logging, communication errors and lags, command timings and so on to realize a stable, solid and productive devices control. Additionally specific requirements that are related to the platform in which the unit is integrated might need to be addressed.

Device driver development efforts can be reduced by using the provided SiLA® driver (Order no. 2016-0200).

SiLA Rapid Integration

SiLA® is the global initiative to standardize software interfaces in the field of life science research instrumentation. Instigated by the pharmaceutical industry's need for flexible laboratory automation, the initiative is supported by major device and software suppliers worldwide.

Information is available at: https://sila-standard.com/

# 3. SOFTWARE INTERFACE

## 3.1 GENERAL INFORMATION

| Information | BS | TC |
|---|---|---|
| All commands need to be terminated with: <CR>* | O | O |
| All return values are terminated with: <CR><LF>** | O | O |
| Sending an unknown command returns: u->'unknown command'<CR><LF> | O | O |
| Target speed will be set to 0 rpm after any kind of stop command (soff, seoff, ...) and needs to be set anew before each start of mixing. | O | O |
| Target acceleration (ssa<value>) needs to be set anew after restarting the device. The value is not saved to EEPROM. | O | O |
| If the device has an error or the command which is send interferes with the current status of the device, the device returns: e<CR><LF>*** | O | O |
| If an error occurs (smart LED turns red), the device must be reset, to clear its internal failure memory and continue working normally.**** | O | O |
| When the power supply is connected and active, the system is automatically started (boot process) and all hardware components will be checked. This process takes about 5 seconds for the Q1 and CP devices and about 30 seconds for the BS devices. | O | O |
| After setting a parameter value or changing the device status with a set command, recheck the parameter value\|status with the related get command. This ensures a correct operation of hardware and software. | O | O |
| The waiting time for status requests with get command is minimum 100 milliseconds. | O | O |
| Between two sent signs may be a maximum of 5 seconds. After 5 seconds and without receiving a termination character <CR>, the internal receiver unit is reset and waits for the first character of the next instruction. | - | O |
| If no communication cable (RS232 cable) is connected, the smart LED turns yellow. | - | O |
| If the shaker is not used for longer than 15 min, please switch to the ECO mode with the command setEcoMode<CR> to save energy and decrease abrasion. Wake up the shaker with leaveEcoMode<CR>. | O | - |

O \| - Applicable function \| Not applicable information

* <CR> is the term for the control character “carriage return” in ASCII code (decimal 13, hexadecimal 0x0D)

** <LF> is the term for the control character “line feed” in ASCII code (decimal 10, hexadecimal 0x0A)

*** Getting e as return value does not necessarily mean that the device has an error. Device errors are written to the error list, which can be accessed with the gel command. An example for status interference is when the command shakeOn is send while the device is already shaking.

**** Exception: The error 33020 required to switch the device on and off (separate from power supply). A software reset is not enough. (see: "Error Codes" on page 16)

| Information | BS | TC |
|---|---|---|
| The following commands (if applicale to the device) are changing a shaker parameter permanently. This means the value is saved to EEPROM and kept even if the device is powered off.<br><br>disableBootScreen\| enableBootScreen \| disableCLED \| enableCLED \| setShakeDefaultDirection \| setShakeSpeedLimitMax \| setShakeSpeedLimitMin \| setTemp40Calibr \| setTemp90Calibr \| setTempLimiterMax \| setTempLimiterMin \| setElmSelftest \| setElmStartupPosition | O | O |

## 3.2 COMMAND LIST

| | Long Form<CR> | Short Form<CR> | Return value<CR><LF> | BS | TC |
|---|---|---|---|---|---|
| INITIALIZATION | disableBootScreen | | ok | - | O |
| | disableCLED | | ok | O | O |
| | enableBootScreen | | ok | - | O |
| | enableCLED | | ok | O | O |
| | flashLed | fled | ok | - | O |
| | getCLED | | <value> | - | O |
| | getDescription | | <unit type> | O | O |
| | getErrorList | gel | {'$e_1$'; ... ;'$e_n$'} | O | O |
| | getSerial | | <device serial number> | O | O |
| | getVersion | | <fw version> | O | O |
| | info | | <boot text> | O | O |
| | resetDevice | reset | ok | O | O |
| | setBuzzer<value> | | ok | - | O |
| | version | v | <unit type + fw version> | O | O |
| ECO | leaveEcoMode | lem | ok | O | - |
| | setEcoMode | sem | ok | O | - |
| SHAKING | getShakeAcceleration | gsa | <value> | O | O |
| | getShakeAccelerationMax | gsamax | <value> | O | O |
| | getShakeAccelerationMin | gsamin | <value> | O | O |
| | getShakeActualSpeed | gsas | <value> | O | O |
| | getShakeDefaultDirection | | <value> | - | O |
| | getShakeDirection | gsd | <value> | - | O |
| | getShakeMaxRpm | gsmax | <value> | O | O |
| | getShakeMinRpm | gsmin | <value> | O | O |
| | getShakeRemainingTime | gsrt | <value> | O | O |
| | getShakeSpeedLimitMax | | <value> | - | O |
| | getShakeSpeedLimitMin | | <value> | - | O |
| | getShakeState | gsst | <value> | O | O |
| | getShakeStateAsString | gsstas | <value> | O | O |
| | getShakeTargetSpeed | gsts | <value> | O | O |
| | getShakeZPV | | <valuex>-<valuey> | O | - |
| | setShakeAcceleration<value> | ssa<value> | ok | O | O |
| | setShakeDefaultDirection<value> | | ok | - | O |
| | setShakeDirection<value> | ssd<value> | ok | - | O |

| | Long Form<CR> | Short Form<CR> | Return value<CR><LF> | BS | TC |
|---|---|---|---|---|---|
| SHAKING | setShakeSpeedLimitMax <value> | | ok | - | O |
| | setShakeSpeedLimitMin<value> | | ok | - | O |
| | setShakeTargetSpeed<value> | ssts<value> | ok | O | O |
| | shakeEmergencyOff | seoff | ok | O | O |
| | shakeGoHome | sgh | ok | O | O |
| | shakeOff | soff | ok | O | O |
| | shakeOffNonZeroPos | soffnzp | ok | O | O |
| | shakeOffWithDeenergizeSoleonid | soffwds | ok | O | - |
| | shakeOn | son | ok | O | O |
| | shakeOnWithRuntime<value> | sonwr<value> | ok | O | O |
| TEMPERATURE | getTemp40Calibr | | <value> | O | - |
| | getTemp90Calibr | | <value> | O | - |
| | getTempActual | gta | <value> | O | O |
| | getTempLimiterMax | gtlmax | <value> | - | O |
| | getTempLimiterMin | gtlmin | <value> | - | O |
| | getTempMax | gtmax | <value> | O | O |
| | getTempMin | gtmin | <value> | O | O |
| | getTempState | gts | <value> | O | O |
| | getTempStateAsString | gtsas | <value> | O | O |
| | getTempTarget | gtt | <value> | O | O |
| | setTemp40Calibr<value> | | ok | O | - |
| | setTemp90Calibr<value> | | ok | O | - |
| | setTempLimiterMax<value> | stlmax<value> | ok | - | O |
| | setTempLimiterMin<value> | stlmin<value> | ok | - | O |
| | setTempTarget<value> | stt<value> | ok | O | O |
| | tempOff | toff | ok | O | O |
| | tempOn | ton | ok | O | O |
| ELM | getElmSelftest | | <value> | - | O |
| | getElmStartupPosition | | <value> | - | O |
| | getElmState | ges | <value> | O | O |
| | getElmStateAsString | gesas | <value> | O | O |
| | setElmLockPos | selp | ok | O | O |
| | setElmSelftest<value> | | ok | - | O |
| | setElmStartupPosition<value> | | ok | - | O |
| | setElmUnlockPos | seup | ok | O | O |

## 3.3 COMMAND DETAILS

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | | <Example Return Value><CR><LF><br>*Additional information* | BS | TC |
|---|---|---|---|---|---|---|
| INITIALIZATION | **disableBootScreen** | disableBootScreen | >> | ok | - | O |
| | *Permanent deactivation of the boot screen startup text.* | | | | | |
| | **disableCLED** | disableCLED | >> | ok | O | O |
| | *Permanent deactivation of the LED indication lights. The instrument will reset after this command.* | | | | | |
| | **enableBootScreen** | enableBootScreen | >> | ok | - | O |
| | *Permanent activation of the boot screen startup text.* | | | | | |
| | **enableCLED** | enableCLED | >> | ok | O | O |
| | *Permanent activation of the LED indication lights. The instrument will reset after this command.* | | | | | |
| | **flashLed \| fled** | flashLed | >> | ok | - | O |
| | *User device LED flashes five times.* | | | | | |
| | **getCLED** | getCLED | >> | 1 | - | O |
| | *Returns the status LED state.* | | | *1 LED is enabled*<br>*2 LED is disabled* | | |
| | **getDescription** | getDescription | >> | Q.MTP-BIOSHAKE 3000 | O | O |
| | *Returns model type.* | | | | | |
| | **getErrorList \| gel** | getErrorList | >> | {22150; 32022} | O | O |
| | *Returns a semicolon-separated list with errors and warnings which can occur during processing.* | | | *Note: Please see also section "Error control" in this document.* | | |
| | **getSerial** | getSerial | >> | 0000012345 | O | O |
| | *Returns the device serial number.* | | | | | |
| | **getVersion** | getVersion | >> | 1.8.00 | O | O |
| | *Returns the firmware version number.* | | | | | |
| | **info** | info | >> | <boot screen text> | O | O |
| | *Returns the boot screen text.* | | | | | |
| | **resetDevice \| reset** | resetDevice | >> | ok | O | O |
| | *Restarts the controller.* | | | *Note: This takes about 30 seconds for BS units and 5 for the Q1, CP models* | | |
| | **setBuzzer**<value> | setBuzzer500 | >> | ok | - | O |
| | *Let's the buzzer beep for the given time in milliseconds.* | | | *Note: <value> range from 50 to 999* | | |
| | **version \| v** | version | >> | Q.MTP-BIOSHAKE 3000 v1.8.00 | O | O |
| | *Returns model type and fw version number.* | | | | | |

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | <Example Return Value><CR><LF><br>*Additional information* | BS | TC |
|---|---|---|---|---|---|
| ECO | **leaveEcoMode \| lem** | leaveEcoMode >> | ok | O | - |
| | *Leaves the economical mode and switches into the normal operating state.* | | | | |
| | **setEcoMode \| sem** | setEcoMode >> | ok | O | - |
| | *Switches the shaker into economical mode. It will reduce electricity consumption by deactivation the solenoid that locks the home position and deactivation of the ELM function.* | | *Note: Home position is not locked!*<br>*Note: All commands other than leaveEcoMode will return: e* | | |
| SHAKING | **getShakeAcceleration\| gsa** | getShakeAcceleration >> | 5 | O | O |
| | *Returns the acceleration/deceleration value.* | | | | |
| | **getShakeAccelerationMax \| gsamax** | getShakeAccelerationMax >> | 30 | O | O |
| | *Returns the maximum accelration/deceleration time in seconds.* | | | | |
| | **getShakeAccelerationMin \| gsamin** | getShakeAccelerationMin >> | 1 | O | O |
| | *Returns the minimum accelration/deceleration time in seconds.* | | | | |
| | **getShakeActualSpeed \| gsas** | getShakeActualSpeed >> | 399.000000 | O | O |
| | *Returns the current mixing speed.* | | | | |
| | **getShakeDefaultDirection** | getShakeDefaultDirection >> | 0 | - | O |
| | *Returns the mixing direction when the device starts up.* | | *0 Clockwise mixing direction (CW)*<br>*1 Counter clockwise mixing direction (CCW)* | | |
| | **getShakeDirection \| gsd** | getShakeDirection >> | 0 | - | O |
| | *Returns the current mixing direction.* | | *0 Sets clockwise mixing direction (CW)*<br>*1 Sets counter clockwise mixing direction (CCW)* | | |
| | **getShakeMaxRpm \| gsmax** | getShakeMaxRpm >> | 3000 | O | O |
| | *Returns the device specific maximum target speed.* | | | | |
| | **getShakeMinRpm \| gsmin** | getShakeMinRpm >> | 200 | O | O |
| | *Returns the device specific minimal target speed.* | | | | |
| | **getShakeRemainingTime \| gsrt** | getShakeRemainingTime >> | 41 | O | O |
| | *Returns the remaining time in seconds if device was started with the command: shakeOnWithRuntime* | | | | |
| | **getShakeSpeedLimitMax** | getShakeSpeedLimitMax >> | 2000 | - | O |
| | *Returns the upper limit for the target speed.* | | *Note: See command: setShakeSpeedLimitMax<value>* | | |
| | **getShakeSpeedLimitMin** | getShakeSpeedLimitMin >> | 400 | - | O |
| | *Returns the lower limit for the target speed.* | | *Note: See command: setShakeSpeedLimitMin<value>* | | |

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | | <Example Return Value><CR><LF><br>*Additional information* | | BS | TC |
|---|---|---|---|---|---|---|---|
| SHAKING | **getShakeState \| gsst** | getShakeState | >> | 0 | | | |
| | *Returns Shaker state.* | | | *0* | *Running* | *O* | *O* |
| | | | | *1* | *Detected a stop command* | *O* | *-* |
| | | | | *2* | *Braking mode* | *O* | *-* |
| | | | | *3* | *Stopped and is locked at home position* | *O* | *O* |
| | | | | *4* | *Manual mode for external control* | *O* | *-* |
| | | | | *5* | *Accelerates* | *O* | *O* |
| | | | | *6* | *Decelerates* | *O* | *O* |
| | | | | *7* | *Decelerates to stop* | *O* | *O* |
| | | | | *8* | *Decelerates to stop at home position* | *-* | *O* |
| | | | | *9* | *Stopped and is **not** locked* | *-* | *O* |
| | | | | *10* | *State is for service purpose only* | *-* | *O* |
| | | | | *90* | *ECO mode* | *O* | *-* |
| | | | | *99* | *Boot process running* | *O* | *-* |
| | | | | *Note: state 8 is only available with a special configuration of the device* | | | |
| | **getShakeStateAsString \| gsstas** | getShakeStateAsString | >> | RUN | | | |
| | *Returns Shaker state.* | | | *RUN* | *Running* | *O* | *O* |
| | | | | *STOP* | *Stopped and is locked at home pos* | *O* | *O* |
| | | | | *ESTOP* | *Emergency Stop* | *O* | *-* |
| | | | | *RAMP+* | *Accelerates* | *O* | *O* |
| | | | | *RAMP-* | *Decelerates* | *O* | *O* |
| | | | | *dec-stop* | *Decelerates to stop* | *-* | *O* |
| | | | | *dec-stop-home* | *Decelerates to stop at home pos* | *-* | *O* |
| | | | | *stopped* | *Stopped and is **not** locked* | *-* | *O* |
| | | | | *aligned* | *State is for service purpose only* | *-* | *O* |
| | **getShakeTargetSpeed \| gsts** | getShakeTargetSpeed | >> | 1800.000000 | | O | O |
| | *Returns the target mixing speed.* | | | | | | |
| | **getShakeZPV** | getShakeZPV | >> | 0-0012 | | O | - |
| | *Returns the state of zero position and the coded voltage.* | | | *0-xxxx* | *Not defined and not locked zero position* | | |
| | | | | *1-xxxx* | *Correct zero position* | | |
| | | | | *Note: This command is only used for service.* | | | |
| | **setShakeAcceleration**<value> \| **ssa**<value> | setShakeAcceleration12 | >> | ok | | O | O |
| | *Sets the acceleration/deceleration value in seconds.* | | | *Note: <value> range: [AccMin] – [AccMax] (1 or 2-digit value withoutcomma)* | | | |

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | | <Example Return Value><CR><LF><br>*Additional information* | BS | TC |
|---|---|---|---|---|---|---|
| SHAKING | **setShakeDefaultDirection**<value> | setShakeDefaultDirection0 | >> | ok | - | O |
| | *Sets the default mixing direction after device start up.* | | | *0* *Sets clockwise mixing direction (CW)*<br>*1* *Sets counter clockwise mixing direction (CCW)* | | |
| | **setShakeDirection**<value> \| **ssd**<value> | setShakeDirection0 | >> | ok | - | O |
| | *Sets the mixing direction.* | | | *0* *Sets clockwise mixing direction (CW)*<br>*1* *Sets counter clockwise mixing direction (CCW)* | | |
| | **setShakeSpeedLimitMax**<value> | setShakeSpeedLimitMax1900 | >> | ok | - | O |
| | *Set upper limit for the target speed.* | | | *Note: <value> range: 0 to 3000 (1 to 4 digit value without comma)*<br>*Note: <value> must not be lower than the minimum limit* | | |
| | **setShakeSpeedLimitMin**<value> | setShakeSpeedLimitMin500 | >> | ok | - | O |
| | *Set lower limit for the target speed.* | | | *Note: <value> range: 0 to 3000 (1 to 4 digit value without comma)*<br>*Note: <value> must not be greater than the maximum limit*<br>*Note: Speed values below 200 RPM are possible, but not recommended* | | |
| | **setShakeTargetSpeed**<value> \| **ssts**<value> | setShakeTargetSpeed1400 | >> | ok | O | O |
| | *Sets the target mixing speed.* | | | *Note: <value> range: [MinRpm] – [MaxRpm] (3 to 4-digit without comma)* | | |
| | **shakeEmergencyOff \| seoff** | shakeEmergencyOff | >> | ok | O | O |
| | *Shaker stops immediately at an undefined position ignoring the defined deceleration time.* | | | | | |
| | **shakeGoHome \| sgh** | shakeGoHome | >> | ok | O | O |
| | *Shaker moves to the home position and locks in place.* | | | *Note: Minimum response time is less than 4 sec (internal failure timeout).* | | |
| | **shakeOff \| soff** | shakeOff | >> | ok | O | O |
| | *Stops shaking within the defined deceleration time, go to the home position and locks in place.* | | | | | |
| | **shakeOffNonZeroPos \| soffnzp** | shakeOffNonZeroPos | >> | ok | O | O |
| | *Stops shaking within the defined deceleration time, do **not** go to home position and do **not** lock in home position.* | | | | | |
| | **shakeOffWithDeenergizeSoleonid \| soffwds** | shakeOffWithDeenergizeSoleonid | >> | ok | O | - |
| | *Stops shaking within the defined deceleration time, go to the home position and locks in place for 1 second, then unlock home position* | | | *Note: Prevents unwanted temperature raise caused by an energized solenoid* | | |
| | **shakeOn \| son** | shakeOn | >> | ok | O | O |
| | *Starts shaking with defined speed with defined acceleration time.* | | | | | |
| | **shakeOnWithRuntime**<value> \| **sonwr**<value> | shakeOnWithRuntime30 | >> | ok | O | O |
| | *Starts shaking with defined speed with defined acceleration time for given time value in seconds.* | | | *Note: <value> range: 0 – 999999 (1 to 6-digits, without comma)* | | |

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | | <Example Return Value><CR><LF><br>*Additional information* | BS | TC |
|---|---|---|---|---|---|---|
| TEMPERATURE | **getTemp40Calibr** | getTemp40Calibr | >> | 40.100000 | O | - |
| | *Returns the offset value at the 40 °C calibration point.* | | | | | |
| | **getTemp90Calibr** | getTemp90Calibr | >> | 89.800000 | O | - |
| | *Returns the offset value at the 90 °C calibration point.* | | | | | |
| | **getTempActual** | getTempActual | >> | 74.400000 | O | O |
| | *Returns the current temperature.* | | | *Note: Deprecated command: getActualTemp, gat* | | |
| | **getTempLimiterMax \| gtlmax** | getTempLimiterMax | >> | 70.000000 | - | O |
| | *Returns the upper limit for the target temperature.* | | | *Note: Can be adjust with setTempLimiterMax* | | |
| | **getTempLimiterMin \| gtlmin** | getTempLimiterMin | >> | 4.000000 | - | O |
| | *Returns the lower limit for the target temperature.* | | | *Note: Can be adjust with setTempLimiterMin* | | |
| | **getTempMax \| gtmax** | getTempMax | >> | 99.999999 | O | O |
| | *Returns the device specific maximum target temperature.* | | | | | |
| | **getTempMin \| gtmin** | getTempMin | >> | -20.999999 | O | O |
| | *Returns the device specific minimum target temperature.* | | | | | |
| | **getTempState\| gts** | getTempState | >> | 0 | O | O |
| | *Returns the state of the temperature control feature.* | | | *0* *Temperature control is disabled*<br>*1* *Temperature control is enabled* | | |
| | **getTempStateAsString\| gtsas** | getTempStateAsString | >> | on | O | O |
| | *Returns the state of the temperature control feature as as string.* | | | *off* *Temperature control is disabled*<br>*on* *Temperature control is enabled* | | |
| | **getTempTarget \| gtt** | getTempTarget | >> | 64.000000 | O | O |
| | *Returns the target temperature.* | | | *Note: Deprecated command: getTargetTemp* | | |
| | **setTemp40Calibr**<value> | setTemp40Calibr401 | >> | ok | O | - |
| | *Sets the offset value at the 40 °C calibration point in 1/10 °C increments.* | | | *Note: <value> range: 000 – 990 (3-digits, without comma)* | | |
| | **setTemp90Calibr**<value> | setTemp40Calibr892 | >> | ok | O | - |
| | *Sets the offset value at the 90 °C calibration point in 1/10 °C increments.* | | | *Note: <value> range: 000 – 990 (3-digits, without comma)* | | |
| | **setTempLimiterMax**<value> \| **stlmax**<value> | setTempLimiterMax700 | >> | ok | - | O |
| | *Sets the upper limit for the target temperature in 1/10 °C increments.* | | | *Note: <value> range: -200 to 999 (3-digits, without comma)*<br>*Note: <value> must not be lower than the device specific TempMin* | | |

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | | <Example Return Value><CR><LF><br>*Additional information* | BS | TC |
|---|---|---|---|---|---|---|
| TEMPERATURE | **setTempLimiterMin**<value> \| **stlmin**<value> | setTempLimiterMin40 | >> | ok | - | O |
| | *Sets the lower limit for the target temperature in 1/10 °C increments.* | | | *Note: <value> range: -200 to 999 (3-digits, without comma)*<br>*Note: <value> must not be higher than the device specific TempMax* | | |
| | **setTempTarget**<value> \| **stt**<value> | setTempTarget640 | >> | ok | O | O |
| | *Sets the target temperature between TempMin and TempMax in 1/10 °C increments.* | | | *Note: <value> range: TempMin to TempMax (3-digits, without comma)*<br>*Note: Temperature value is automatically limited to the min/max value*<br>*Note: Best cooling is achieved if the set temperature is within the boundaries of the technical specifications and not if it is set ot the minimal value.* | | |
| | **tempOff \| toff** | tempOff | >> | ok | O | O |
| | *Switches off the temperature control feature and stops heating/cooling.* | | | | | |
| | **tempOn \| ton** | tempOn | >> | ok | O | O |
| | *Switches on the temperature control feature and starts heating/cooling.* | | | *Note: It is strongly recommended to control if the desired temperature is reached (see command getTempActual)* | | |
| ELM | **getElmSelftest** | getElmSelftest | >> | *0* | - | O |
| | *Returns whether the ELM self-test is enabled or disabled at device startup.* | | | *0* *ELM self-test is disabled at startup*<br>*1* *ELM self-test is enabled at startup* | | |
| | **getElmStartupPosition** | getElmStartupPosition | >> | *0* | - | O |
| | *Returns the ELM position after device startup.* | | | *0* *ELM is locked after the device startup*<br>*1* *ELM is unlocked after the device startup* | | |
| | **getElmState \| ges** | getElmState | >> | 1 | O | O |
| | *Returns the ELM status.* | | | *0* *ELM is moving*<br>*1* *ELM is locked*<br>*3* *ELM is unlocked*<br>*9* *ELM error occurred* | | |
| | **getElmStateAsString \| gesas** | getElmStateAsString | >> | 1 | | |
| | *Returns the ELM status as a string.* | | | *ELMUndefined* *ELM is moving* - *O*<br>*ELMLocked* *ELM is locked* *O* *O*<br>*ELMUnlocked* *ELM is unlocked* *O* *O*<br>*ELMError* *ELM error occurred* *O* *O* | | |
| | **setElmLockPos \| selp** | setElmLockPos | >> | ok | O | O |
| | *Closes the ELM.* | | | *Note: The runtime is less than 3 seconds.*<br>*Note: This position is a current-free static state.*<br>*Note: Deprecated command: setElmShakePos, sesp* | | |

| | **Command**<CR> \| **Short Form**<CR><br>*Command description* | <Example Execution><CR> | | <Example Return Value><CR><LF><br>*Additional information* | BS | TC |
|---|---|---|---|---|---|---|
| ELM | **setElmSelftest**<value> | setElmSelftest0 | >> | ok | - | O |
| | *Set whether the ELM self-test is enabled or disabled at device startup.* | | | *0* *ELM self-test is disabled at startup*<br>*1* *ELM self-test is enabled at startup* | | |
| | **setElmStartupPosition**<value> | setElmStartupPosition0 | >> | ok | - | O |
| | *Set the ELM position after device startup.* | | | *0* *ELM is locked after device startup*<br>*1* *ELM is unlocked after device startup* | | |
| | **setElmUnlockPos \| seup** | setElmUnlockPos | >> | ok | O | O |
| | *Opens the ELM* | | | *Note: The runtime is less than 3 seconds.*<br>*Note: This position is a current-free static state.*<br>*Note: The ELM should only be used when the tablar is in the home position. Otherwise it does not open as wide as possible and it is likely that the position of the tablar changes, while opening.* | | |

## 3.4 ERROR CODES

In case of failure the device smart LED turns red and the device error code is accessible via the command: `getErrorList`

If an error occurred and not stated otherwise the device must be reset to clear its internal failure memory and continue working normally. If the error cannot be solved by restarting the device, please get in contact with our "Support" on page 32

**BS DEVICES**

| | Code | Description |
|---|---|---|
| SHAKING | 101[1] | Error by the DC motor controller. |
| | 102 | Error due speed failure, for example happens through mechanical locking. |
| | 103 | Errors caused by an uninitialized shaker or incorrect initialization parameters after switch on. |
| | 104[1] | Errors caused by unsuccessful initialization routine. |
| | 105[1] | Errors caused by not achieving the home position at stop command. |
| | 106[1] | Errors caused by over speed. |
| TEMPERATURE | 201[1] | Error due failed answers from temperature sensors or incorrect internal settings of temperature sensors. |
| | 202[1] | Error due temperature communication bus system. |
| | 203 | Sensor with the requested ID is not found while working. |
| | 204 | Errors caused by a faulty temperature measurement while working. |
| | 206[1] | Error caused by checksum of the internal temperature sensor. |
| | 207[1] | Error caused by checksum of the main temperature sensor. |
| | 208[1] | Error caused by general checksum. |
| | 209[1] | Error caused by unknown temperature method. |
| | 210[1] | Error caused by over heating. |
| ELM | 300[1] | General error. |
| | 301[1] | IC-Driver error. |
| | 303 | Verification error by the unlock position. |
| | 304 | Error caused by unsuccessful reach the lock position (timeout). |
| | 305 | Error caused by unsuccessful reach the unlock position (timeout). |
| | 306 | Error caused by unsuccessful reach the lock position (over current). |
| | 307 | Error caused by unsuccessful reach the unlock position (over current). |

**TC DEVICES**

| | Code | Description |
|---|---|---|
| BASIC | 10002 or 10003 | Instruction sent with an invalid parameter. |
| | 100xx[2] | Internal firmware sequence failure. |
| | 2xxxx[2] | Internal MCU periphery error. |
| | 310xx[2] | EEPROM data verification failed. |
| TEMPERATURE | 320xx[2] | Communication with internal temperature sensors failed. |
| | 33010[3] | Device internal temperature too hot. |
| | 33020[3, 4] | Emergency shutdown of the temperature fuse has triggered. |
| | 33030 | Emergency temperature sensor validation has failed. |
| | 34010 or 34110 | FAN-1 or FAN-2 power supply invalid. |
| | 34020 or 34120 | FAN-1 or FAN-2 has stalled. |
| | 34030 or 34130 | FAN-1 or FAN-2 airway clogged. |
| | 35010 | TEC power supply invalid. |
| | 35020 | TEC power supply short circuit detected. |
| | 35030 | TEC power supply open circuit detected. |
| | 360xx[2] | Internal temperature controller failure. |
| SHAKING | 37030 | Shaker has stalled. |
| | 37040 | Shaker cannot move because the solenoid does not unlock. |
| | 37060 | Unable to lock Shaker in the home position. |
| | 37070 | “Shaker find home position” timeout occurred. |
| | 370xx[2] | Internal shake controller failure. |
| | 39030 | Solenoid motion timeout occurred. |
| | 390xx[2] | Internal solenoid controller failure. |
| ELM | 38030 | ELM motion timeout occurred. |
| | 38090 | ELM self-test has failed. |
| | 380xx[2] | Internal ELM controller failure. |

[1] - Please get in contact with the QINSTRUMENTS service team.
[2] - Value for x can be ignored.
[3] - Please let the device cool down, before performing a reset.
[4] - The power of the device must be turned off to clear the error.

## 3.5 EXAMPLE

The following example shows a simple process routine, where the device is brought into home position, the ELM is opened and closed to grab a microplate, shaking parameters are set and the device is started and stopped after a defined amount of time.

This is a working but simplified example (no error handling, communication control, ...) and is hence, not suitable for productive use. In this example Python 3.6.1 and PySerial 3.3 are used.

| | Python Code | Print Output | Description |
|---|---|---|---|
| INIT | `import serial; import time` | | Import of required python modules |
| | `ser = serial.Serial('COM3', timeout=1)` | | Open the connection to COM-Port 3 where the device is connected to |
| | `ser.write(b'`**`getShakeState`**`\r'); time.sleep(0.2)` | | Get device status to check if device reached home position; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **3**<CR><LF> | Device is in home position |
| ELM | `ser.write(b'`**`setElmUnlockPos`**`\r'); time.sleep(3)` | | Open ELM; Wait at least 3 seconds to execute ELM movement |
| | `print(ser.read(ser.in_waiting))` | **ok**<CR><LF> | Command was executed successfully |
| | `ser.write(b'`**`getElmState`**`\r'); time.sleep(0.2)` | | Get ELM status; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **3**<CR><LF> | ELM is open |
| | **Place the microplate on the device** | | |
| ELM | `ser.write(b'`**`setElmLockPos`**`\r'); time.sleep(3)` | | Close ELM; Wait at least 3 seconds to execute ELM movement |
| | `print(ser.read(ser.in_waiting))` | **ok**<CR><LF> | Command was executed successfully |
| | `ser.write(b'`**`getElmState`**`\r'); time.sleep(0.2)` | | Get ELM status; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **1**<CR><LF> | ELM is closed |
| SHAKING | `ser.write(b'`**`setShakeTargetSpeed1500`**`\r'); time.sleep(0.2)` | | Set mix velocity to 1500 rpm; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **ok**<CR><LF> | Command was executed successfully |
| | `ser.write(b'`**`setShakeAcceleration5`**`\r'); time.sleep(0.2)` | | Set time for acceleration/deceleration to 5 seconds; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **ok**<CR><LF> | Command was executed successfully |
| | `ser.write(b'`**`shakeOn`**`\r'); time.sleep(7)` | | Start mixing; Wait 7 seconds (5 sec. acceleration + extra time) before read the command response |
| | `print(ser.read(ser.in_waiting))` | **ok**<CR><LF> | Command was executed successfully |
| | `ser.write(b'`**`getShakeState`**`\r'); time.sleep(0.2)` | | Get device status to check if device is shaking; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **0**<CR><LF> | Devise is running |
| | `ser.write(b'`**`getShakeActualSpeed`**`\r'); time.sleep(0.2)` | | Get device speed as additional check of status; ; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **1490.000000**<CR><LF> | Set speed is reached |
| | `time.sleep(60)` | | Keep mixing for 60 seconds |
| | `ser.write(b'`**`shakeOff`**`\r'); time.sleep(7)` | | Stop mixing; Wait 7 seconds (5 sec. deceleration + extra time) before read the command response |
| | `print(ser.read(ser.in_waiting))` | **ok**<CR><LF> | Command was executed successfully |
| | `ser.write(b'`**`getShakeState`**`\r'); time.sleep(0.2)` | | Get device status to check if device stopped; Wait 0.2 seconds before read the command response |
| | `print(ser.read(ser.in_waiting))` | **3**<CR><LF> | Devise is stopped and is locked at home position |

## 3.6 EXTENDED PROGRAMMING INFORMATION

This chapter presents additional information on programming while using the device commands.

**Return value 'e'**

Information — It is important to know that there are several situations in which the return value of a command is `e`, although there is no error in the device error list. This is due to point that the return value `e` is also returned if the command does not fit to the current status of the device or other criteria.

Examples are:

- Sending `son` or `sonwr` if speed is not set
- Sending `son` or `sonwr` command while Shaker is already running.
- Sending `son` or `sonwr` command while the ELM is open
- Most commands while in ECO mode
- `seup` while ELM is already open and the other way around
- `ton` while temperature control is already running
- ...

Tip — Use the get commands (`getShakeState, getTempState, getElmState`) to evaluate the current device status before sending commands to prevent erroneous usage of commands.

**setElmLockPos | setElmUnlockPos | setEcoMode**

Information — After sending the command `setElmLockPos, setElmUnlockPos, setEcoMode` the device does not send an immediately response. The `ok` value is written to the serial input buffer after the ELM reached the (un)lock position, ECO mode. In the meantime, all commands that are send to the device will be buffered and executed after the device reached the new status.

Tip — To determine the end of the `setElmLockPos, setElmUnlockPos, setEcoMode` command, read from the serial input buffer until the ok value is received. Do not send any commands in the meantime.

**leaveEcoMode | resetDevice**

Information — After sending the command `leaveEcoMode, resetDevice` the device immediately writes `ok` to the serial input buffer although the change of the status has not finished and commands that are send in the meantime will not be executed or return `e`.

Tip — To determine the end of the `leaveEcoMode, resetDevice` command poll for the device status with the `getShakeState` command until it reaches the status `3` (Shaker stopped and is locked in home position).

# 4. HARDWARE INTERFACE

## 4.1 DEVICE INSTALLATION

All QINSTRUMENTS devices are mounted via the same physical interface and have one corner for the cable outlets, as can be seen in the schematic top view on the device, below.

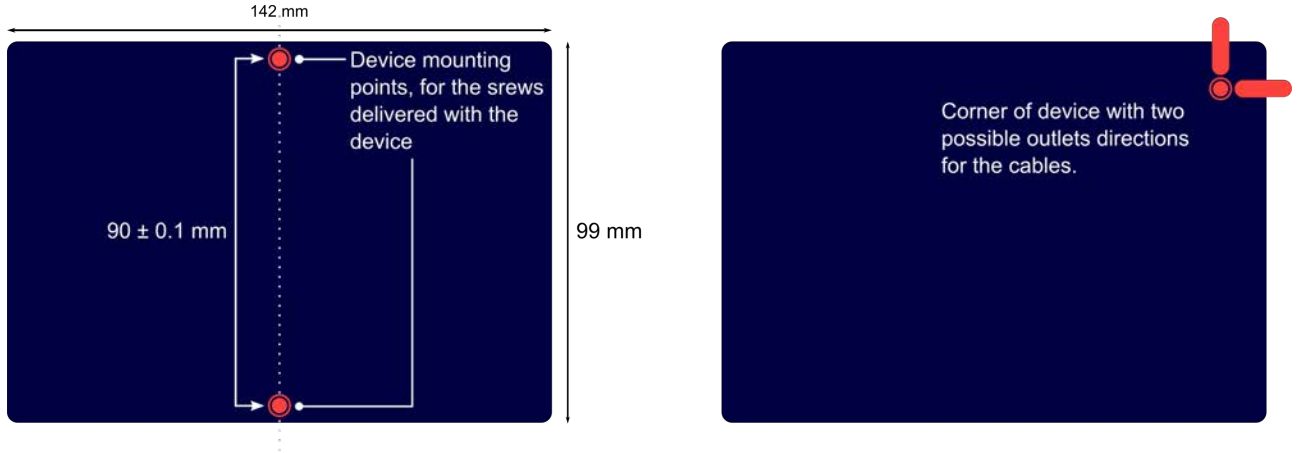



Figure 1 Schematic device top view showing the mounting points and cable outlet options

Besides mounting, other important aspects like the

- cable length (2 m by default)
- sufficient venting for devices with heat/cool feature
- deal with condensation water for devices with cooling feature
- space between Shakers if multiple Shakers are integrated (space for ELM movement, air inlet and outlet, other Labware nearby, ...)
- height of adapters
- robot specific requirements (device height, clearance, collision areas, ...)
- ...

need to be addressed when integrating one or multiple devices. A detailed description about the installation procedure, in depth device specifications and further device specific information is available in the device specific Operation manual.

Required device installation information for each device is available online This information is mandatory required to successfully integrate a device.

## 4.2 DEVICE FEATURE OVERVIEW

In the table below an overview of the most important device features is presented. These features and the related requirements must be taken care of, for a successful integration approach. Especially for devices that can **heat/cool** or are equipped with an **adapter** the impact for additional space and venting must be considered. Please use the Operation Manual of the device for further information.

Detailed device specification are available for each product on our homepage and as a technical data sheet and Operation manual

| | Article name | Part number | Link to Manual | ELM | Orbit* [mm] | Speed** [rpm] | Heat | Cool | Adapter is usable | Width [mm] | Length [mm] | Height*** [mm] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BS | BioShake 3000 | 2016-0016 | | - | 2 | 3000 | - | - | O | 99 | 142 | 60.75 |
| | BioShake 3000 elm | 2016-0017 | | O | 2 | 3000 | - | - | - | 99 | 142 | 55.35 |
| | BioShake 3000 elm DWP | 2016-0018 | | O | 2 | 3000 | - | - | - | 99 | 142 | 55.35 |
| | BioShake 3000-T | 2016-0516 | | - | 2 | 3000 | O | - | O | 99 | 142 | 62.7 |
| | BioShake 3000-T elm | 2016-0517 | | O | 2 | 3000 | O | - | O | 99 | 142 | 60.55 |
| | BioShake 5000 elm | 2016-0022 | | O | 1.2 | 5000 | - | - | - | 99 | 142 | 55.35 |
| | BioShake D30 | 2016-0015 | | - | 3 | 2000 | - | - | O | 99 | 142 | 60.75 |
| | BioShake D30 elm | 2016-0025 | | O | 3 | 2000 | - | - | - | 99 | 142 | 55.35 |
| | BioShake D30-T | 2016-0519 | | - | 3 | 2000 | O | - | O | 99 | 142 | 62,7 |
| | BioShake D30-T elm | 2016-0518 | | O | 3 | 2000 | O | - | O | 99 | 142 | 60.55 |
| | HeatPlate | 2016-0100 | | - | - | - | O | - | O | 99 | 142 | 62.7 |
| TC | ColdPlate | 2016-0110 | | - | - | - | O | O | O | 99 | 142 | 79 |
| | ColdPlate slim | 2016-0111 | | - | - | - | O | O | O | 99 | 235 | 45.5 |
| | BioShake Q1 | 2016-0600 | | O | 2 | 3000 | O | O | O | 99 | 142 | 97.7 |
| | BioShake Q1 3mm | 2016-0601 | | O | 3 | 2000 | O | O | O | 99 | 142 | 97.7 |
| | BioShake Q2 | 2016-0620 | | - | 3 | 2000 | O | O | O | 99 | 142 | 90.2 |

* Amplitude = 0.5 x Orbit

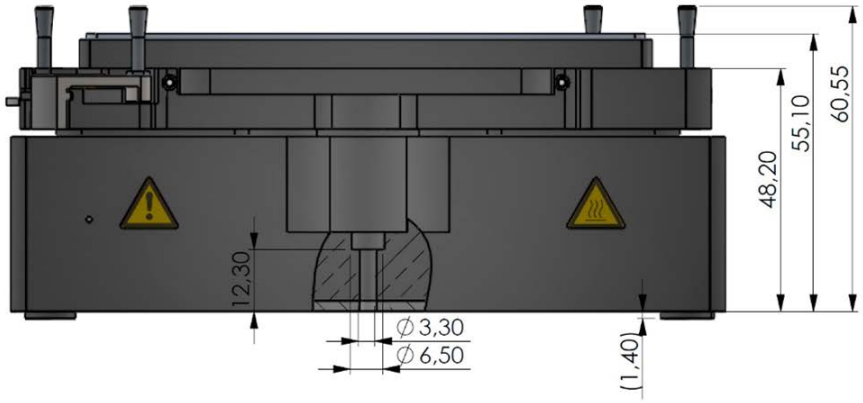
** The given value is the maximum speed of the device The minimum speed for all devices is 200 rpm. The actual speed that should be used, strongly depends on several parameter like the adapter and microplate that is used, the amount of liquid and much more. It will therefore be potentially lower. Please refer to the Operation Manual of your device for further information.

*** The given value is the maximum height of the device. This encompasses the standard pins but **not** the adapter that might be mounted and **not** the rubber feet (height of 1.4 mm)

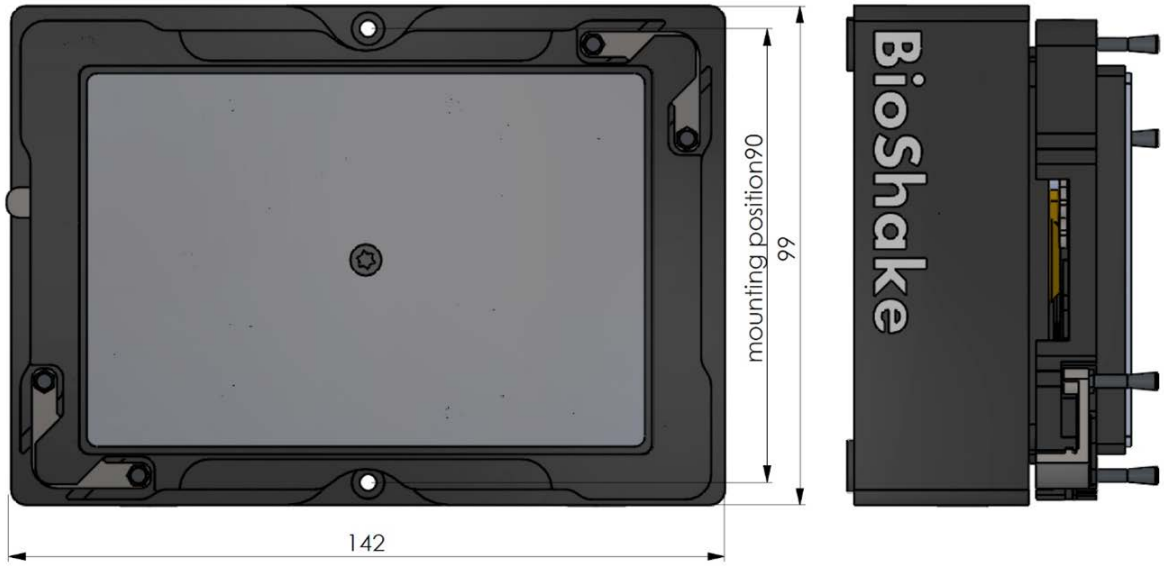
## 4.3 DEVICE DIMENSIONS AND IMAGES

### BioShake 3000-T elm | BioShake D30-T elm

2016-0517 2016-0518

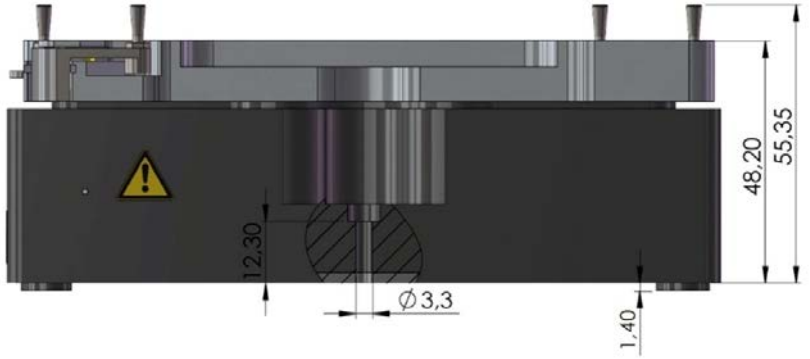




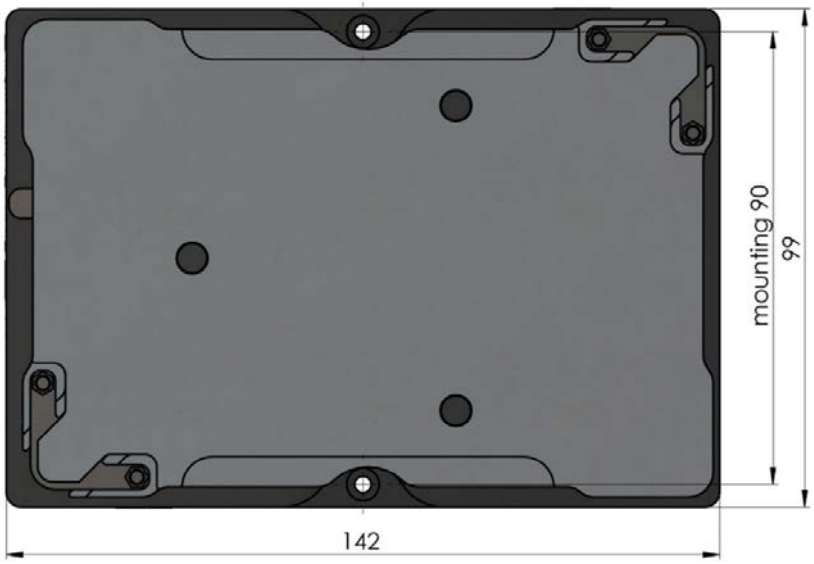


# BioShake 3000 elm (DWP) | BioShake 5000 elm | BioShake D30 elm

2016-0017 (2016-0018) 2016-0022 2016-0025

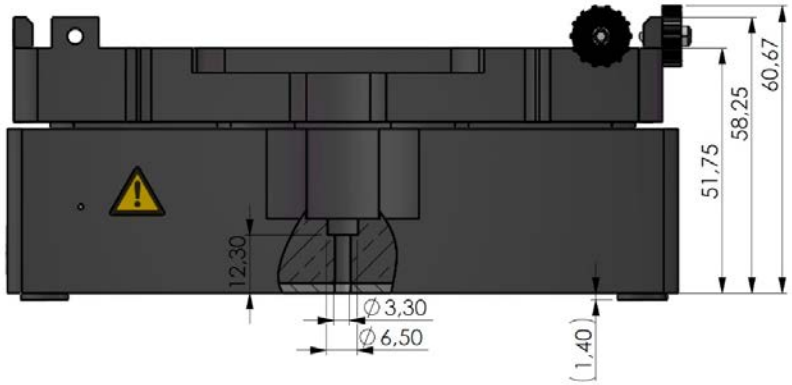


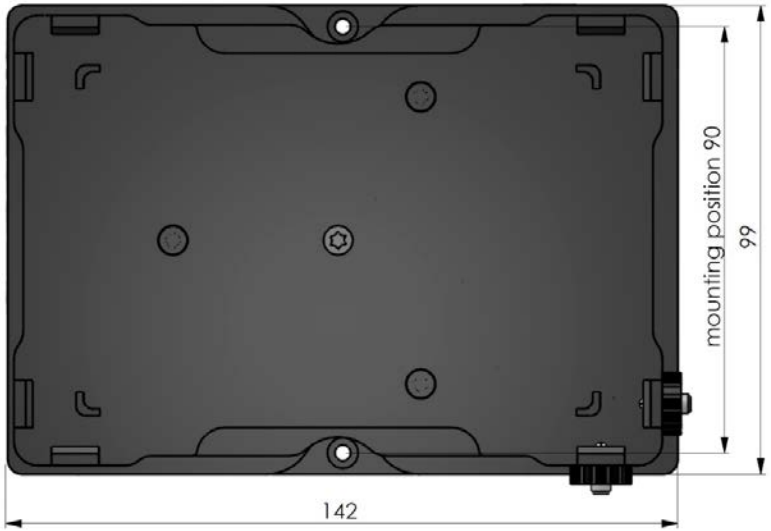


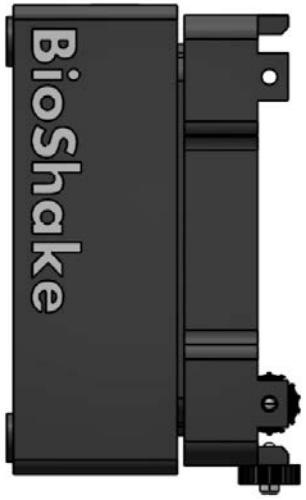



# BioShake 3000 | BioShake D30

2016-0016 2016-0015

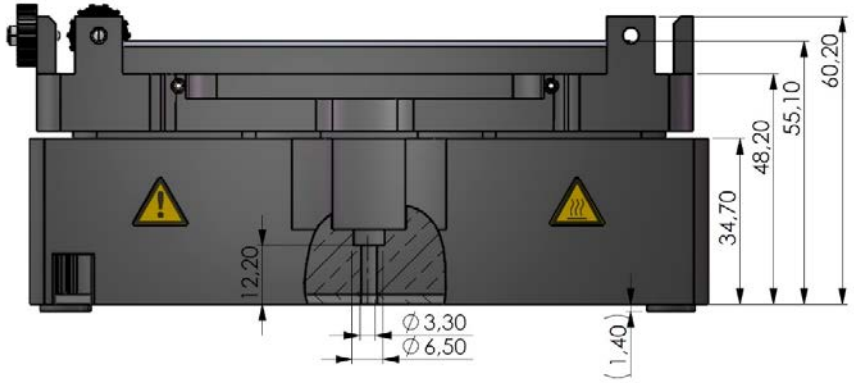


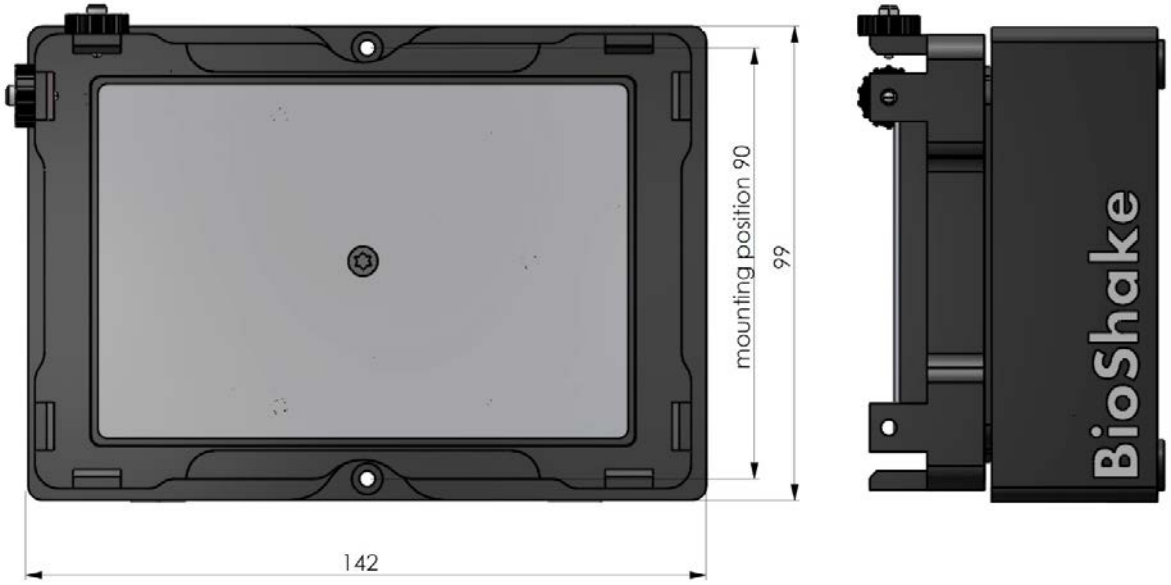



# BioShake 3000-T | HeatPlate | BioShake D30-T

2016-0516 2016-0100 2016-0519

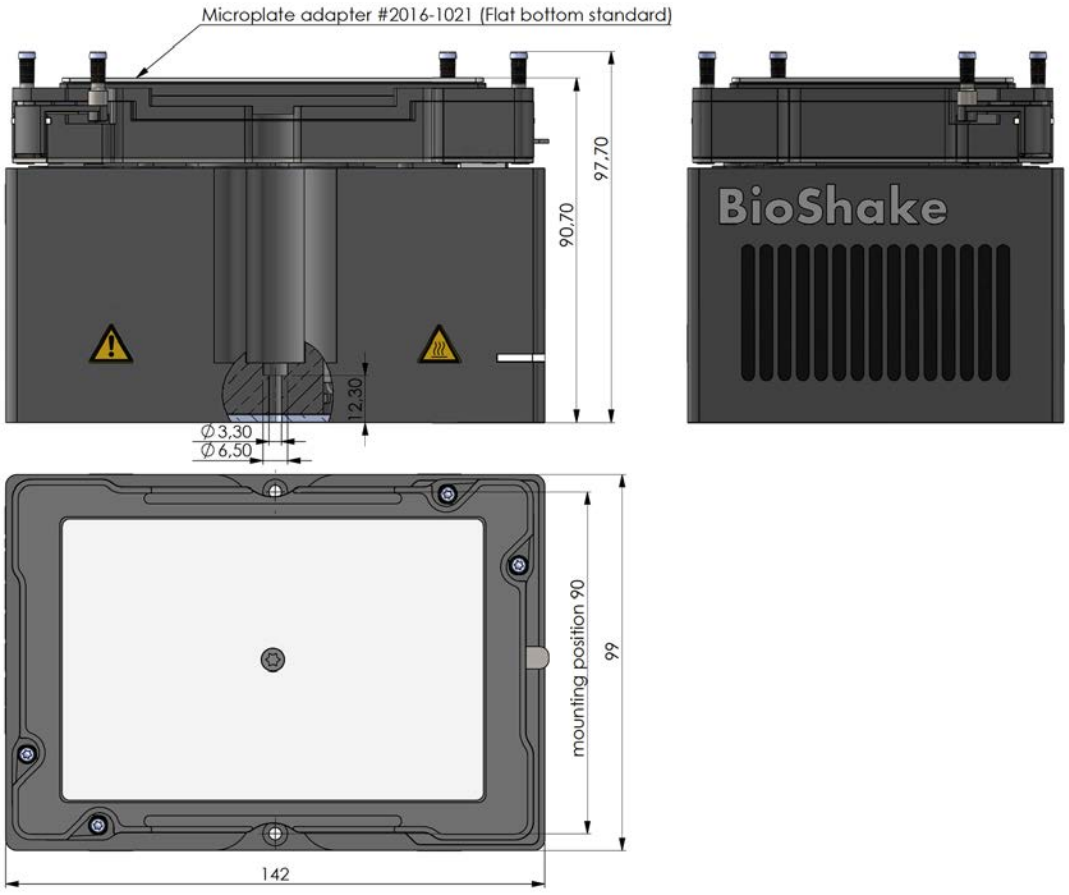






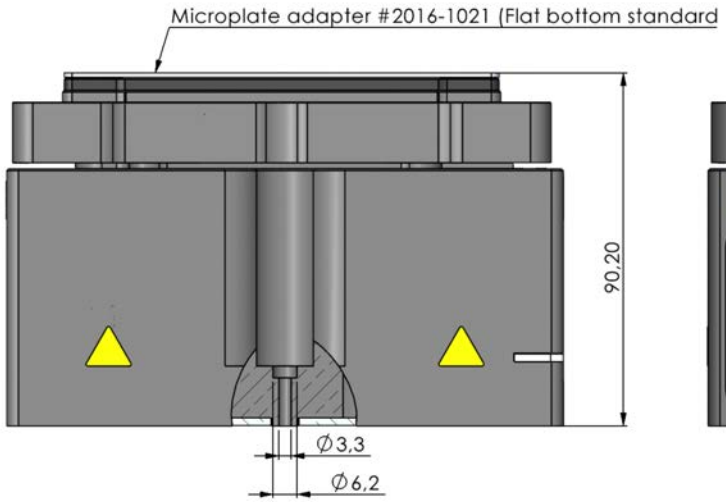
# BioShake Q1 | BioShake Q1 3mm

2016-0600 2016-0601

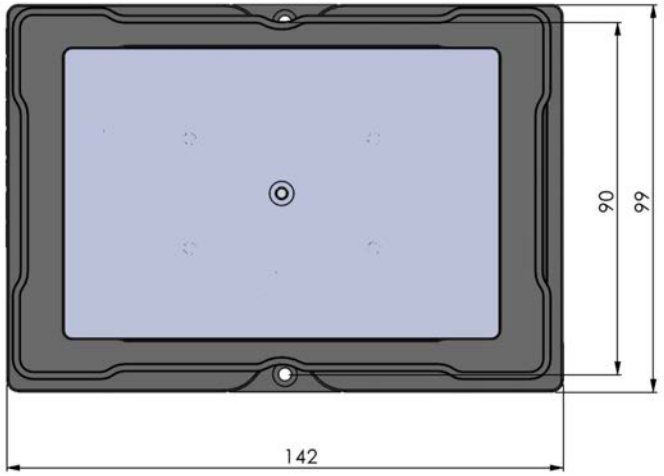



# BioShake Q2

2016-0620

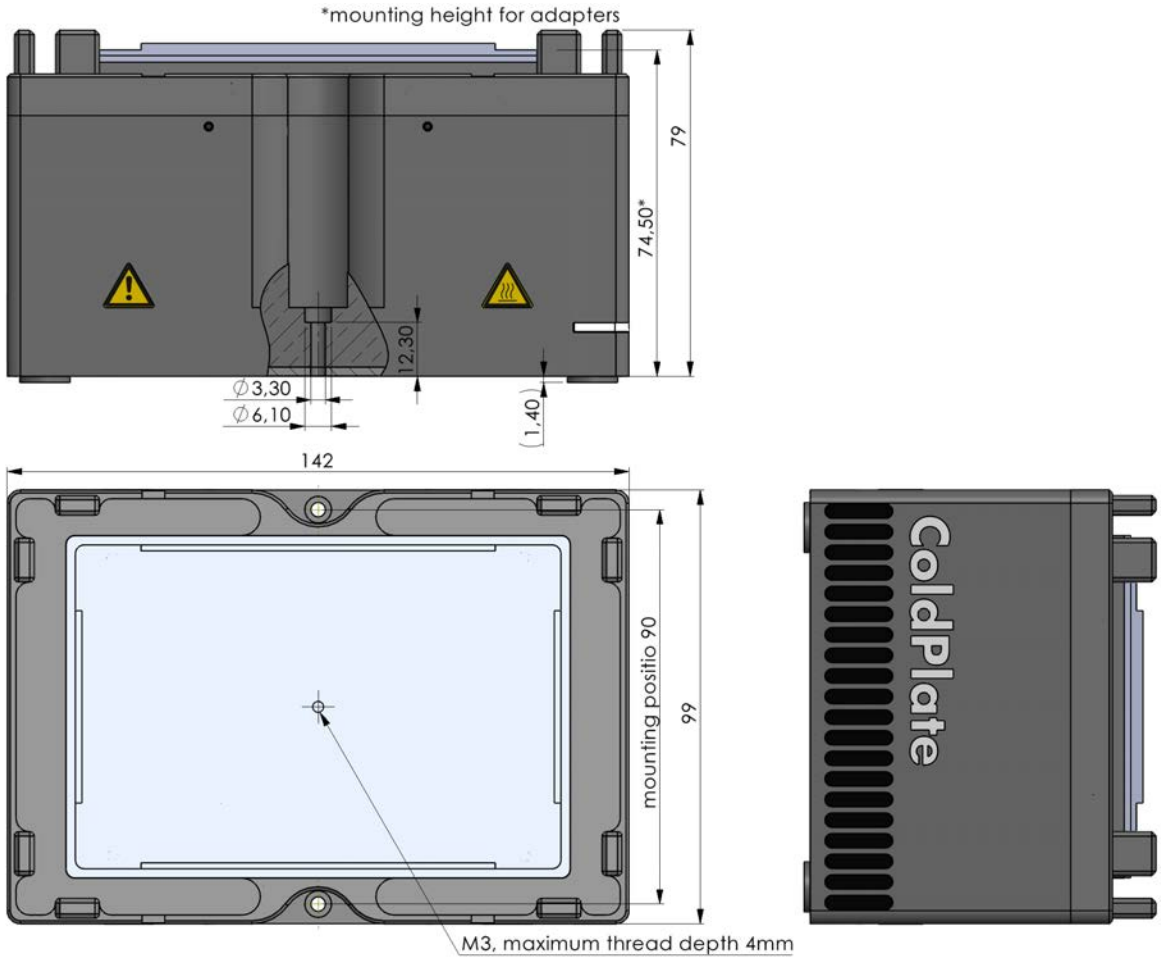




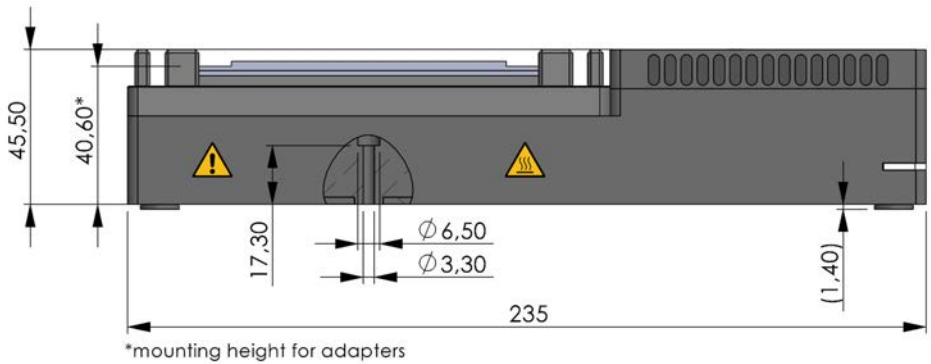
# ColdPlate

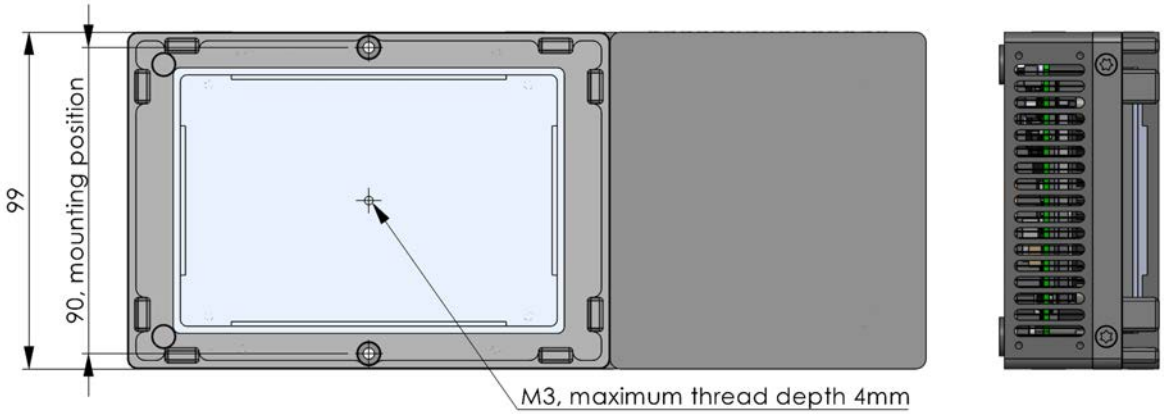
2016-0110




# ColdPlate slim

2016-0111

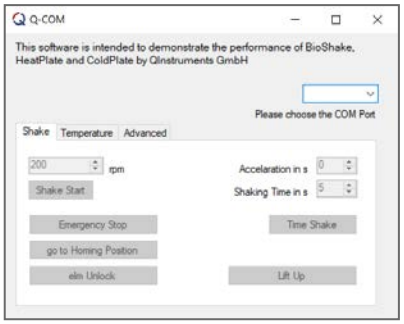


# 5. TEST SOFTWARE

## 5.1 QCOM 1

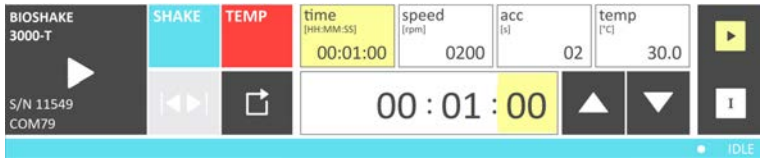
QCOM1 is a simple test tool for Windows to start using the shaker in moments and to exercise all shaker features. Plug in the RS232 cable from the single BioShake module into a free port of your computer. If it's necessary, please use a USB/RS232 converter.




## 5.2 QCOM 2

QCOM2 is a small test software with a graphical user interface (GUI) to control lab automation instruments from QINSTRUMENTS, eg. BioShake, ColdPlate, HeatPlate.

The main purpose of QCOM2 is to get easy access to the unit to execute initial testing.




To start the program, execute QCOM2.exe. By default, the program scans through the available COM ports and detects if a supported QINSTRUMENTS device is connected to that port. The first valid device that is found is used, the scanning process is stopped, and the program starts using the identified device. Device features will be detected at start-up, and the GUI will be adapted to the following features: mixing, ELM, temperature control.

For more details on how to use the software, please refer to the manual that is part of the QCOM2 download.

# 6. CHANGELOG

| Version | Information |
|---|---|
| 010.5 | Fixed error in command spelling and added note to shaker state |
| 010.4 | Added Q1 3mm, Q2 \| CP, Q1, Q1 3mm, Q2 forming a new group: TC (thermo control) \| Update QCOM 2 pic \| Prog. example fixed |
| 010.3 | Fixed error in command list and description <getSerial> \| Fixed error in <setElmStartupPosition>, <getCLED> description |
| 010.2 | Fixed error in error number \| Fixed links to Operational Manuals \| Added Information for constant change of parameters |
| 010.1 | Improvement of spelling mistakes |
| 010.0 | Initial Creation<br>• Merge of two distinct Integration Manuals for BioShake devices with cooling feature and without<br>• New design integrating BICO branding |

# 7. NOTES

# 8. SUPPORT

## DISCLAIMER, LEGAL NOTICES AND TRADEMARKS