



THE BRICK

Gas Mixer for Microscopy

Operator's Manual
Software Rev. 2.90

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1 WARNING SYMBOLS



The lightning flash with arrowhead within an equilateral triangle is intended to alert the operator to the presence of dangerous voltage within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons and to indicate possible risk of equipment damage.



The exclamation point within an equilateral triangle is intended to alert the operator to potential dangers not arising directly from electrical hazards. It is also used to emphasize the presence of important operating and maintenance instructions in the documentation accompanying the device.

2 TABLE OF CONTENTS

| | |
|--|----------|
| THE BRICK | 1 |
| 1 WARNING SYMBOLS..... | 2 |
| 2 TABLE OF CONTENTS..... | 3 |
| 3 A NOTE ON INSTALLATION AND SAFETY | 4 |
| 4 PANEL LEGEND | 5 |
| 5 INSTALLATION..... | 6 |
| 5.1 <i>Connecting the gas supply</i> | 6 |
| 5.2 <i>Connecting the environmental system</i> | 7 |
| 6 OPERATION..... | 8 |
| 6.1 <i>Navigation</i> | 8 |
| 6.2 <i>Start-up</i> | 8 |
| 6.3 <i>Main Menu</i> | 9 |
| 6.4 <i>Start</i> | 9 |
| 6.5 <i>Resume</i> | 9 |
| 6.6 <i>Calibrate</i> | 10 |
| 6.6.1 Valve..... | 10 |
| 6.6.2 CO ₂ | 10 |
| 6.7 <i>Preferences</i> | 10 |
| 6.7.1 Return to Menu..... | 11 |
| 6.7.2 Backlight: ON OFF 15 sec 30 sec 1 min 2 min..... | 11 |
| 6.7.3 Bepper: ON OFF..... | 11 |
| 6.7.4 Auto-Resume: ON OFF..... | 11 |
| 6.7.5 DC Motor Out: 0 – 255..... | 11 |
| 6.7.6 Online: Monitor Control..... | 11 |
| 6.7.7 System Gas: Air N ₂ O ₂ | 11 |
| 6.7.8 HumV 0% / 100%..... | 11 |
| 6.8 <i>Info</i> | 11 |
| 6.9 <i>Console</i> | 12 |
| 6.10 <i>System Warnings</i> | 12 |
| 7 COMMUNICATION FUNCTIONS | 13 |
| 7.1 <i>Setup</i> | 13 |
| 7.2 <i>Monitor Mode</i> | 13 |
| 7.3 <i>Control Mode</i> | 13 |
| 7.3.1 Command string (sent by the host computer)..... | 13 |
| 7.3.2 Response string (sent by THE BRICK)..... | 14 |
| 7.3.3 Legend..... | 14 |
| 7.3.4 Parameter numbers..... | 14 |
| 7.3.5 End codes..... | 15 |
| 7.3.6 FCS Calculation..... | 15 |
| 7.3.7 Examples..... | 15 |
| 8 MAINTENANCE..... | 16 |
| 8.1 <i>Cleaning</i> | 16 |
| 8.2 <i>Firmware Updates</i> | 16 |

3 A NOTE ON INSTALLATION AND SAFETY

THE BRICK Gas Mixer should be installed on any stable surface. It is recommended to place it on a different surface than the microscope stand to avoid transmission of unwanted vibrations.



THE BRICK generates heat and thus requires some ventilation. Do not place it on a soft surface that it could sink into. Allow enough space between THE BRICK and other equipment or the wall.



THE BRICK is specified to work only as a gas mixer together with the humidifier column, the CUBE&BOX temperature control system and microscope stage-top incubators and chambers supplied by LIFE IMAGING SERVICES. It is not designed for other uses. Any other use voids the warranty.

The use for medical applications is strictly prohibited.

Any collateral damages caused to other equipment or persons as a consequence of misuse of THE BRICK are solely the responsibility of the purchaser.



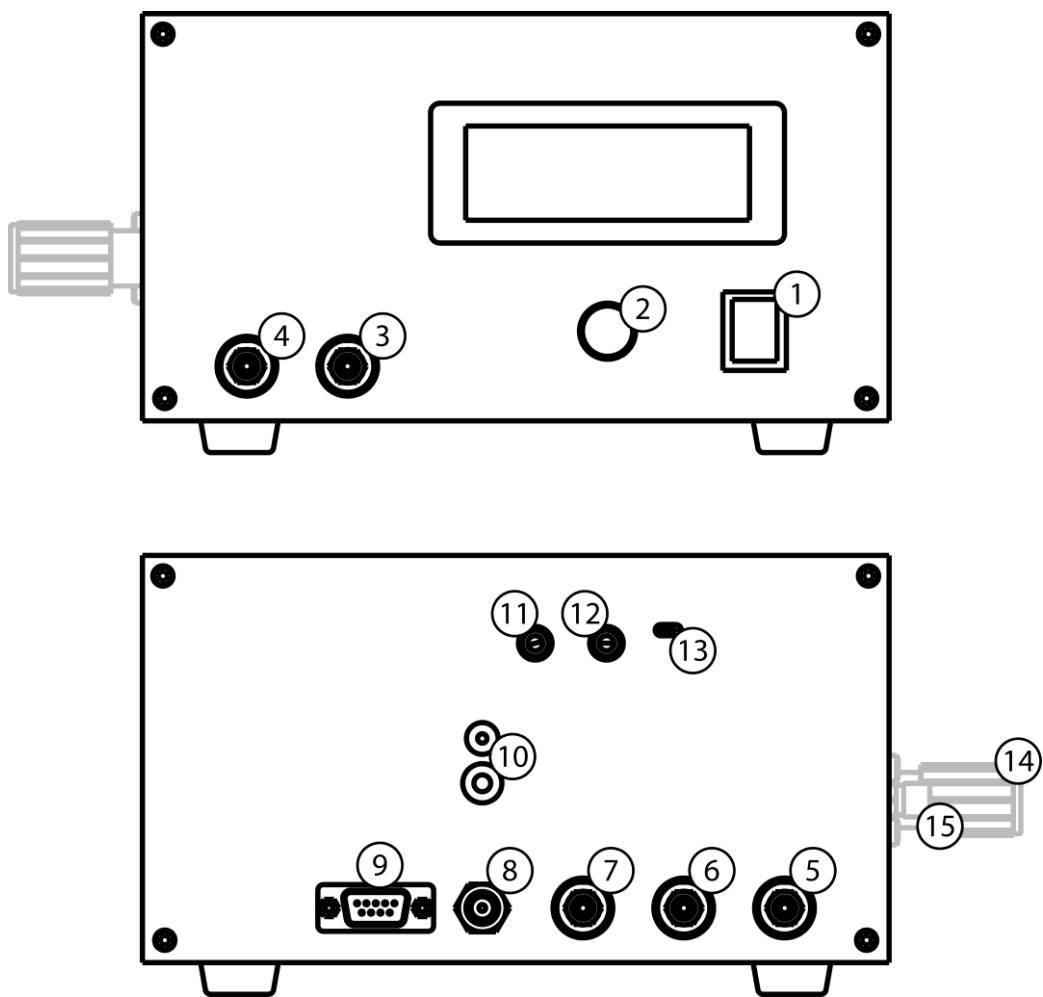
Caution: To prevent fire or shock hazard, do not permit THE BRICK to get wet. If liquid is accidentally spilled on it, immediately unplug the power supply. Allow sufficient time for complete evaporation to occur before operating THE BRICK again. If the liquid is anything else than water (e.g. physiological saline or organic solvents) THE BRICK should be examined by a qualified technician before power is applied. **Do not remove the cover, or attempt to modify or repair THE BRICK yourself. Refer all service to LIFE IMAGING SERVICES**



The brick does not contain any user serviceable parts. Opening the housing voids the warranty. In the case of device malfunction, contact LIFE IMAGING SERVICES for further instructions.

4 PANEL LEGEND

The following sections of the manual refer to these panel features:



- | | |
|---|--|
| 1. Power switch | 9. Serial port (RS-232C) |
| 2. Encoder knob (turn & click) | 10. Connectors for optional humidity sensor and heating unit |
| 3. ‘AIR’ in (max. 1.2 bar) | 11. Display contrast |
| 4. Main outlet | 12. Display brightness |
| 5. N ₂ inlet (max. 8 bar) * | 13. Mode switch |
| 6. O ₂ inlet (max. 8 bar) * | 14. Auxiliary outlet valve * |
| 7. CO ₂ inlet (max. 8 bar) * | 15. Auxiliary outlet * |
| 8. Power connector 12VDC 40W | |

* selected models only

5 INSTALLATION

Note: The first installation is normally performed by LIFE IMAGING SERVICES or by an authorized dealer designated by LIFE IMAGING SERVICES. If the operator performs the first installation or if the system is dismantled and re-installed at another location the instructions below should be followed carefully.

5.1 CONNECTING THE GAS SUPPLY

After secure placing of THE BRICK the gas supply tubing should be attached to the corresponding ports (3), (5), (6), (7) on the front and on the back panels of the brick. All models of THE BRICK require a supply of pressured system gas (air, pure gas, or mixed gas re-circulated from a LIS stage-top incubator or chamber) to the 'AIR' input (3) on the front panel. The table below lists the possible configurations. The pressure on the 'AIR' input defines the system pressure which drives the entire system. Depending on the individual model and the desired configuration, THE BRICK further requires supplies of CO₂, and, for certain models, O₂ and N₂, at 5-7 bar connected to the respective inlets (5), (6), (7) on the back panel.



All gases must be free of particles and humidity must be non-condensing. Use the supplied 4x1mm PUR tubing to connect the BRICK to the gas sources. Ensure that all gas pressures are within the designated pressure range for the respective inlet. Exceeding the respective maximum pressure may damage the equipment and lead to injury.

| | <i>Inlet/ Config</i> | <i>'AIR' in (3)</i> | <i>CO₂ (7)</i> | <i>O₂ (6)</i> | <i>N₂ (5)</i> | <i>Recommended Range</i> |
|---|--------------------------|-------------------------|---------------------------|--------------------------|--------------------------|---|
| <i>Recommended pressure</i> | | <i>1.0-1.2 bar</i> | <i>5 – 7 bar</i> | <i>5 – 7 bar</i> | <i>5 – 7 bar</i> | |
| <i>BRICK CO₂</i> | 1 | Air | CO ₂ | - | - | 1-15% CO ₂ |
| <i>BRICK CO₂+O₂ 25%</i> | 2 | Air | CO ₂ | O ₂ | N ₂ | 1-15% CO ₂ 4-25% O ₂ |
| | 3 | N ₂ | CO ₂ | O ₂ | - | 1-15% CO ₂ 1-21% O ₂ |
| | 4 | N ₂ | CO ₂ | Air | - | 1-15% CO ₂ 0.5-15% O ₂ |
| <i>BRICK CO₂+O₂ 60%</i> | 5 | AIR | CO ₂ | O ₂ | N ₂ | 1-15% CO ₂ 5-60% O ₂ |
| | 6 | AIR | CO ₂ | O ₂ | - | 1-15% CO ₂ 21-60% O ₂ |
| | 7 | N ₂ | CO ₂ | O ₂ | - | 1-15% CO ₂ 2-60% O ₂ |

Lower pressures are allowed but may limit the regulation range of the BRICK. Under any circumstance, the pressure of the regulated gases at the CO₂, O₂, and N₂ inlets must be higher than that of the system gas at the 'Air in' inlet.

The quality and purity of the gases should be appropriate for your application. Typically, 'medical quality' is suitable.

5.2 CONNECTING THE ENVIRONMENTAL SYSTEM

Connect the Main Out to the inlet of the LIS humidifier column using the supplied 4x1mm PUR tubing.

Note: The CO₂ sensor is compensated for a certain backpressure range typically generated by the microfilter candle in the humidifier column. Increasing or decreasing the backpressure outside this range will result in inaccurate CO₂ readings.

6 OPERATION

6.1 NAVIGATION

The brick control software is navigated using the bi-functional encoder knob (2) on the front panel. Turn the knob to move the cursor (▶) to the desired menu item. Click the knob to select or activate the item. If the item is an editable parameter, the cursor is inverted to indicate the edit mode (◀). Adjust the parameter value by turning the knob and exit the edit mode again by clicking.

6.2 START-UP

When the brick is switched on, the following display appears after a few seconds.

```

+-----+
|   THE   BRICK   |
+-----+
Warming up...

```

The duration of the warm-up phase is dependent on the sensor types installed. To abort the warm-up procedure, click the knob (2). Confirm that you want to abort the warm up to proceed directly to the Main menu (6.3).

```

Abort warm-up ?
  (Initial readings
   may deviate)
YES   ▶NO

```

Note: All measurements may be inaccurate until the sensors have warmed up to their working temperature.

If the system has been reset, e.g. after new software has been installed or when the device has been turned off for several days, you are asked to let the system perform a calibration procedure to determine the response parameters of the gas valves.

```

  SYSTEM MESSAGE
  _____
  Valve Calibration
  is required.
▶CALIBRATE  CANCEL

```

Please refer to chapter 6.6 for further information on the calibration procedure.

Note: The calibration is required for proper function of the brick. The possibility to skip the calibration is given solely to proceed directly to diagnostic procedures and preference settings. You will not be allowed to use the Start or Resume functions (see chapters 6.4 and 6.5) before the calibration has been performed.

6.3 MAIN MENU

In the main menu, select a menu item and click the knob (2) to proceed to one of the six sub-menus.

| MAIN MENU | |
|-----------|---------|
| ▶Start | Prefs |
| Resume | Info |
| Calibrate | Console |

6.4 START

Selecting the Start item switches the brick into normal running mode. Depending on the Brick configuration, the display shows the currently measured values of the CO₂ sensor, the O₂ sensor, and the flow meters of the Main outlet (M) and the Auxiliary outlet (A). If the optional feature for humidity control is installed the value for the relative humidity is displayed in the fourth column, alternating with the Auxiliary outlet readout. Without Auxiliary outlet rh-values are displayed constantly. The third row shows the set point values for the CO₂ control, O₂ control, Main flow control, Auxiliary flow control and/or relative humidity.

| %CO2 | %O2 | M l/h | A | rh% |
|-------|------|-------|-----|-----|
| 0.2 | 20.7 | 0 | 0 | 52 |
| off | off | off | off | off |
| Timer | off | ▶STOP | | |

All set points default to [off] initially. Adjust the set points to the desired values. In order to save gas during unattended time-limited applications, the timer can be used to set a period up to 99 hours after which the gas flow is switched off automatically.

Note: The Auxiliary outlet is secondary to the Main outlet, i.e. it will only be active together with the Main outlet.

Note: The gas regulation only becomes active once the total flow rate for the Main and Auxiliary outlets exceeds 3 liters per hour.

| %CO2 | %O2 | M l/h | %rh |
|-------|-------|-------|-----|
| 5.3 | 23.7 | 24 | 92 |
| 10.0 | 30.0 | ▶ 25 | 92 |
| Timer | 28:45 | STOP | |

Note: The control of the flow rate is comparatively fast and tight. Owing to the slow response of the gas sensors and the need to drive the gas control valves with a dynamic range that exceeds the technical specification of proportional valves by more than an order of magnitude, control of the gas concentrations may show a considerable lag and may take some time to reach the set point.

Select [STOP] to return to the main menu. All valves will shut off.

6.5 RESUME

This switches THE BRICK into running mode while remembering the previous set points and process values. A message warns you of unexpected effects that may occur if external conditions (e.g. input pressures) have changed since the previous session.

```

Unexpected effects
may occur if
conditions changed!
▶CANCEL      PROCEED
    
```

6.6 CALIBRATE

```

CALIBRATION
-----
▶VALVE      CO2
    
```

6.6.1 Valve

This function measures the response parameters of the proportional gas valves. It should be performed if the response of becomes unusually slow or if the valves do not fully close anymore. In some instances, THE BRICK may also request a calibration.

To calibrate the valves, the Main outlet (4) should be disconnected and the pressure at the 'Air' inlet (3) should be reduced to 0.3-0.5 bar. Other gas input pressures should be normal.

```

CALIBRATION
Air+Gas Pressure ON?
Aux Valve Closed ?
▶OK      CANCEL
    
```

Note for models with an auxiliary outlet only: The manual valve must be fully closed. On certain models, you will be asked to close the AIR inlet (3) during the calibration procedure.

6.6.2 CO₂ (Zero Point and Response Curve)

```

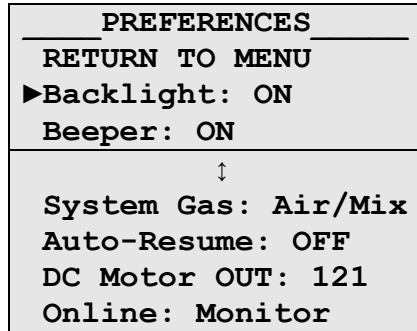
CALIBRATE CO2 SENSOR
Calibrate zero or
response curve?
▶ZERO RESPONSE-CURVE
    
```

Zero point calibration should be performed yearly. The Main outlet (4) should be disconnected and the 'Air' inlet (3) pressurized with 1 bar N₂

Response curve calibration is currently implemented for factory use only. It has no effect (other than wasting gas and time) when selected by the end user.

6.7 PREFERENCES

In the Preferences dialog, the system preferences can be adjusted. Turn the knob (2) to scroll the list.



6.7.1 Return to Menu

Select to return to the main menu

6.7.2 Backlight: ON | OFF | 15 sec | 30 sec | 1 min | 2 min

Select to switch the LCD display backlight on or off. When a time settings is selected, the backlight will remain on for a defined time after the knob is pressed and the switches off automatically.

6.7.3 Beeper: ON | OFF

Select and adjust to switch the system beeper on or off.

6.7.4 Auto-Resume: ON | OFF

Note: The functionality of this feature differs from previous software version

With auto-resume active, the BRICK will automatically resume operation when it is switched on after it had been switched off while in run mode.

6.7.5 DC Motor Out: 0 – 255

This regulates the voltage of the pump connector from 0-12V by pulswidth modulation. This can be used to drive an external gas recirculation pump. The maximum current allowed is 1A.

6.7.6 Online: Monitor | Control

In Monitor mode, measured values and set point values are transmitted from the serial port (9) once every second. In Control Mode, THE BRICK responds to commands sent by the host computer.

See chapter 7 for further information

6.7.7 System Gas: Air | N₂ | O₂

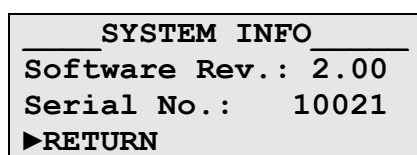
Set this to the type of gas that is supplied to the ‘AIR’ input. This is only relevant for O₂-regulating versions of the Brick.

6.7.8 HumV 0% / 100%

Calibration of the humidity sensor. Enter the values printed on the cable of the sensor. Return to the main menu and restart the BRICK for changes to take effect.

6.8 INFO

The System Info dialog shows the version of the software installed and the serial number of the device the software was compiled for.



Note: If the serial number does not correspond to the actual serial of the device, it means that the wrong software was installed. This may cause malfunction.

Press the knob to return to the main menu.

6.9 CONSOLE



The console mode is used for diagnostic purposes only and must be entered only on direct instruction of the manufacturer. In console mode, safety limits are disabled and severe damage may result if incorrect settings are used. Using the console mode without explicit instruction by the manufacturer voids the warranty.

```

Proceed only on
instruction of the
manufacturer!
▶CANCEL    PROCEED
    
```

```

!!! WARNING !!!
Safety Limits
will be disabled
▶CANCEL    PROCEED
    
```

```

C 32464 C 27200 129
O 02708 O▶24800 STP
A 02710 N 32800
F 03951 F 42300
    
```

6.10 SYSTEM WARNINGS

If the system pressure exceeds the safety limit of approx. 1.5 bar, the Brick stops operating. It closes all inlet valves and opens all outlet valves to reduce the overpressure as quickly and effectively as possible.

```

!!!WARNING!!!
Pressure Limit
Exceeded
▶CONTINUE?
    
```

After correcting the condition that caused the overpressure (typically a blockage of the output), click to resume operation.

7 COMMUNICATION FUNCTIONS

7.1 SETUP

Connect the 9-pole Sub-D socket (9) on the back panel of THE BRICK to a serial port (RS232C) of your computer using a link cable (a.k.a. null-modem or crossed cable). The parameters of the serial interface are

```
9600 bps
8 bit
no parity
1 stop bit
no flow control
```

7.2 MONITOR MODE

When the online preference setting (see 6.7.6) is set to [Monitor], THE BRICK transmits measured values and set point values once every second in a literal, tab-delimited format while in running mode. This makes it simple to capture and graph the data, e.g. using standard terminal and spreadsheet software.

Sample:

```
...
MV(CO2): →9.9 →SP(CO2): →10.0 →MV(Main) →53 →SP(Main) →60 →[CR][LF]
MV(CO2): →9.8 →SP(CO2): →10.0 →MV(Main) →56 →SP(Main) →60 →[CR][LF]
MV(CO2): →9.9 →SP(CO2): →10.0 →MV(Main) →58 →SP(Main) →60 →[CR][LF]
MV(CO2): →10.1 →SP(CO2): →10.0 →MV(Main) →59 →SP(Main) →60 →[CR][LF]
MV(CO2): →10.0 →SP(CO2): →10.0 →MV(Main) →60 →SP(Main) →60 →[CR][LF]
...
```

```
→      = Tab Code           (ASCII 9)
[CR]   = Carriage Return Code (ASCII 13)
[LF]   = Line Feed Code      (ASCII 10)
```

7.3 CONTROL MODE

When the online preference setting (see 6.7.6) is set to [Control], THE BRICK responds to commands sent by the host computer while in running mode. Measured values can be only be queried whereas set point values can be both queried and changed. This enable dynamic external control of the operation.

7.3.1 Command string (sent by the host computer)

| @ | Unit # | | Cmd Type | Parm # | | Data | | | | FCS | | * | [CR] |
|---|--------|---|----------|--------|---|------|---|---|----|-----|----|----|------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |

7.3.2 Response string (sent by THE BRICK)

| @ | Unit # | | Cmd Type | Parm # | | End Code | | Data | | | | FCS | | * | [CR] |
|---|--------|---|----------|--------|---|----------|---|------|----|----|----|-----|----|----|------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

7.3.3 Legend

| | bytes | Description |
|--------------|-------|---|
| „@“ | 1 | Command start character. This character must be inserted before the leading byte. |
| Unit # | 2 | Ignored. Use „00“ |
| Command type | 1 | Specifies the command type by codes „1“ = read parameter, and „2“ = write parameter |
| Parm # | 2 | This specifies which parameter will be read or written (see 7.3.4) |
| End Code | 2 | In response string only. Indicates the status of the command (see 7.3.5) |
| Data | 4 | Specifies the value or setting content. Use „0000“ if Command type is „1“ (read) |
| FCS | 2 | Frame check sequence. The XOR sum of the previous bytes in hexadecimal notation. Alternatively, you can use „**“. In that case, the BRICK accepts the command without checking the FCS. This helps when entering commands manually or with a software that cannot calculate the FCS. |
| „*“ | 1 | Command end character. This indicates the end of the command block. |
| [CR] | 1 | Carriage return. |

7.3.4 Parameter numbers

| Parm # | Cmd Type | Description |
|--------|----------|---|
| 20 | 1 | CO2 measured value, unit [0.1%], e.g. 9.2% = “0092” |
| 21 | 1 | O2 measured value, unit [0.1%], e.g. 61% = “0610” |
| 22 | 1 | Main out measured value, unit [liters per hour] |
| 23 | 1 | Aux out measured value, unit [liters per hour] |
| 24 | 1 | Relative humidity measured value, unit [%] |
| 40 | 1,2 | CO2 set point value, unit [0.1%], e.g. 9.2% = “0092”. Values are automatically rounded to the next allowed value. |
| 41 | 1,2 | O2 set point value, unit [0.1%], e.g. 61% = “0610”. Values are automatically rounded to the next allowed value. |
| 42 | 1,2 | Main out set point value, [unit liters per hour]. Values are automatically rounded to the next allowed value. |

| | | |
|----|-----|--|
| 44 | 1,2 | Relative humidity set point value, unit [%]. Values are automatically rounded to the next allowed value. |
|----|-----|--|

7.3.5 End codes

| End code | Description |
|----------|--|
| 00 | Command executed successfully. |
| 01 | Devices not present. |
| 02 | Device or communication malfunction |
| 03 | Unspecified error |
| 04 | FCS incorrect The data portion of the response string contains the transmitted and the calculated FCS |
| other | Device-specific error code |

7.3.6 FCS Calculation

The sample code below shows how to calculate the frame check sequence in a generic BASIC dialect

```
FCS = 0
For N = 1 To Len (SEND$)
    FCS = FCS Xor Asc (Mid$ (SEND$, N, 1))
Next
FCS$ = Right$ ("0"+Hex$ (FCS), 2)
```

7.3.7 Examples

Read CO₂ measured value: @ 00 1 20 0000 73 * [CR]
 Read Flow set point: @ 00 1 42 0000 ** * [CR] (without FCS)
 Write O₂ set point 20.5%: @ 00 2 41 0205 70 * [CR]
 Write Humidity set point to 98%: @ 00 2 44 0098 73 * [CR]

Note: Skip spaces in sample strings, they are shown for easier reading only

8 MAINTENANCE

8.1 CLEANING

After prolonged use dust deposits may form on THE BRICK which can be removed by wiping the enclosure with a soft cloth.

8.2 FIRMWARE UPDATES

Requirements: PC running Microsoft Windows 98 or later with a serial port (a.k.a. RS232C or COM port)

Firmware updates will become available which improve or extend the functionality of THE BRICK. Occasionally, an update to the device-specific data may also be required. To become eligible for free updates, please register by sending the serial number of your BRICK and your contact information an e-mail message to info@lis.ch. You will receive major firmware updates and instructions on how to install them by e-mail.