



LIV Laser Diode Characterization System

HIGHLIGHTS

- High throughput
- Pulse duration 150ns-2ms
- Maximum current 200A
120A and 40A also available
- Current rise time 400ns

APPLICATIONS

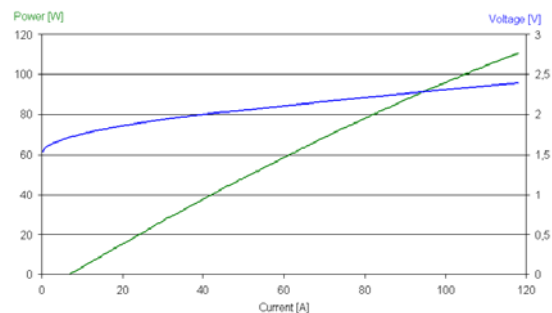
- Pre-packaging laser diode testing
- Production quality assurance
- R&D
- OEM

PRINCIPLE OF OPERATION

The LIV100 laser diode measurement system is a μ C-controlled autonomous system comprising an analogue-digital signal processing unit (ADSPU), current driver and an integrating sphere. The LIV measurement consists of pulsing the laser diode with a specific current and measuring the output light power (L) via the integrating sphere - photodiode - transimpedance amplifier combination and also the voltage drop (V) across the laser diode. The current is then increased by a fixed amount and the measurement repeated. This is repeated many times to produce a staircase increase in current and measurements of L and V for each current. The data are subsequently used to generate L/I and V/I curves giving specific information about the quality of the laser diode under test.

FIELDS OF APPLICATION

The LIV100 has been designed for testing laser diodes at the chip or bar level prior to packaging. Thus the manufacturer can determine the quality of the individual laser diodes before spending the time and resources on packaging defective or deficient diodes. Since proper temperature control cannot be realized on the naked laser diode chips, the LIV100 performs all tests using current pulses as short as 150ns in duration. This avoids any significant thermal loading which may affect results.



ABSOLUTE MAXIMUM VALUES

| | |
|----------------------------|-----------|
| Temperature range | 0 – 60 °C |
| Power supply input voltage | 12V |

ORDERING INFORMATION

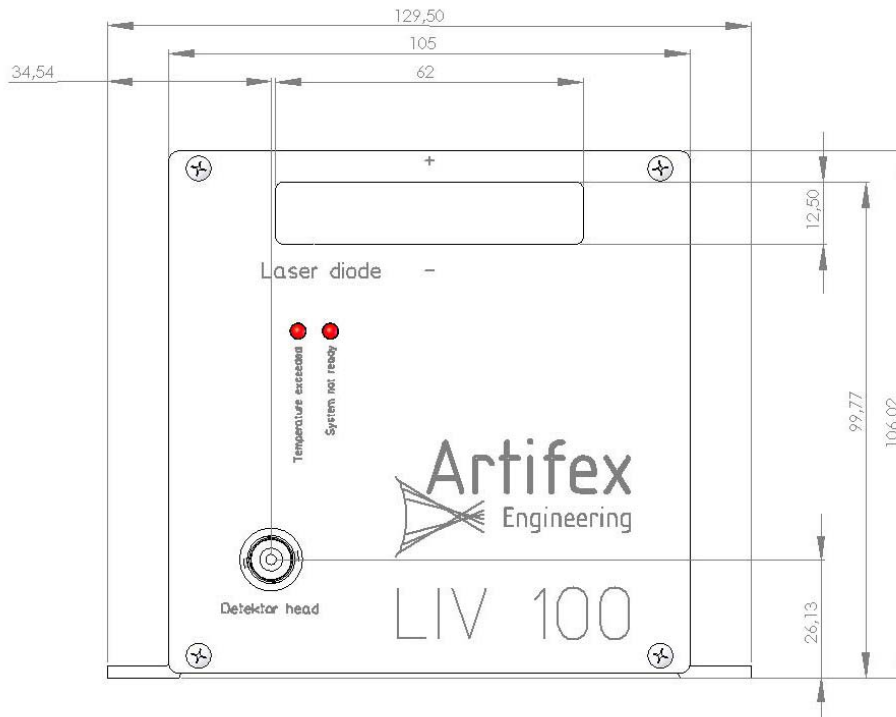
Full order code: LIV 100 **c**

| | Options | Units |
|-------------------------------|---------|-------|
| Maximum current (c): | 40 | A |
| | 120 | |
| | 200 | |

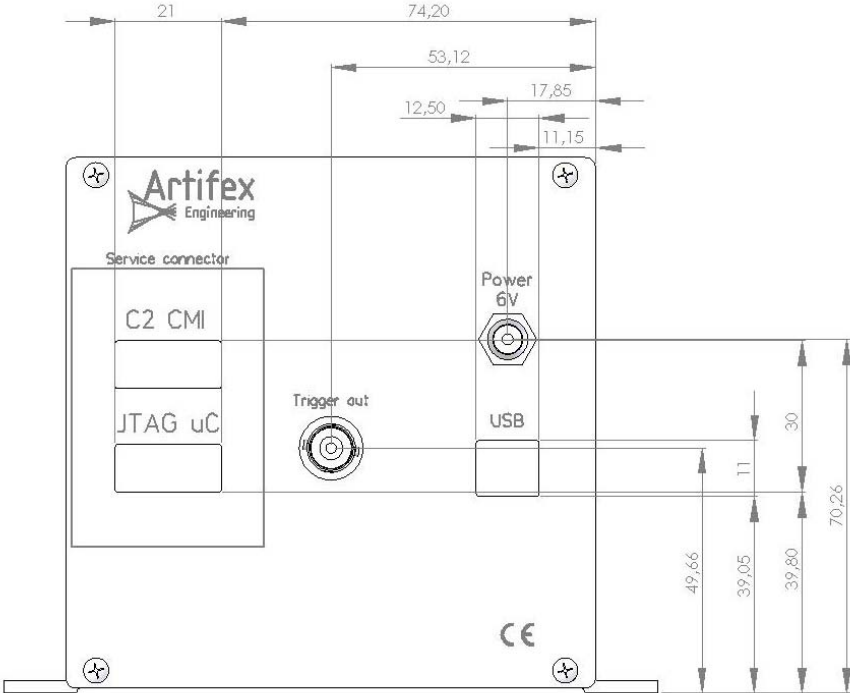
We will gladly configure the system to meet your particular requirements. Please contact us to discuss your details.

CASE STYLE

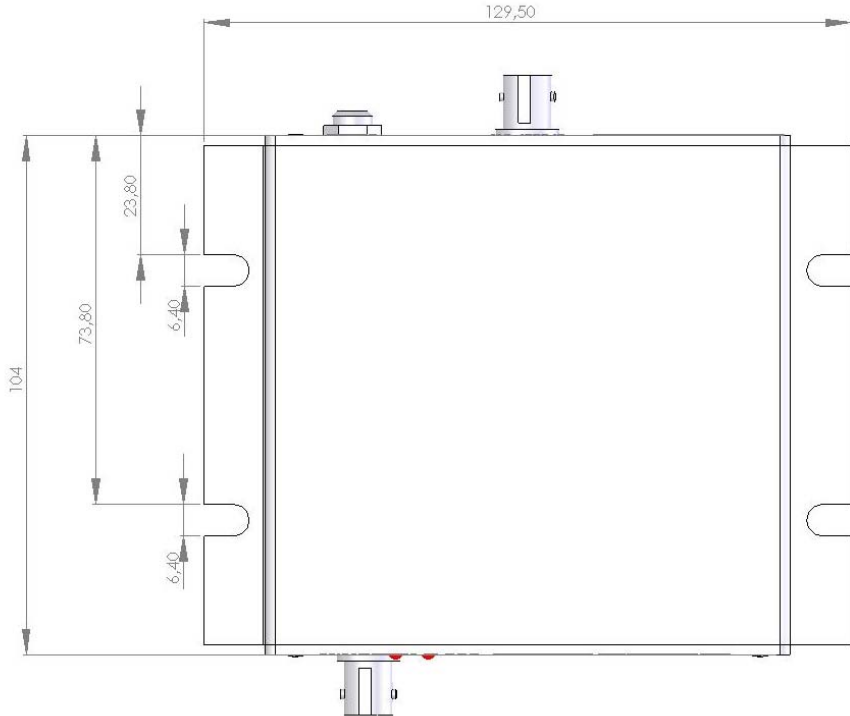
Front view:



Back view:



Top view:



SPECIFICATIONS

| PARAMETER | CONDITIONS | RESOLUTION | MIN | TYP | MAX | UNITS |
|---|---------------------------------------|----------------------|--------------------------------|-------------------------|------------------|-------|
| INPUT | | | | | | |
| Sampling rate | | n.a. | 1 | | 20 | MS/s |
| A/D conversion resolution | | | | 12 | | bit |
| Photodiode transimpedance amplifier gain | Optimum gain determined automatically | | | 1 10 100 | | V/mA |
| Transimpedance amplifier rise time ¹ | Input capacitance <20pF, gain = 1 kΩ | | | 50 | | ns |
| OUTPUT | | | | | | |
| Pulse duration | | 0.050 | 0.150 | | 2000 | μs |
| Current overshoot | At maximum current ² | | | 0 | 1 | % |
| Pulse separation | | 50 | 100 ³ | | 50 000 | μs |
| Current range | LIV100-40 LIV100-120 LIV100-200 | 0.01 0.03 0.05 | 0.01 0.03 0.05 | | 40 120 200 | A |
| D/A conversion resolution | | | | 12 | | bit |
| SIGNAL PROCESSING | | | | | | |
| SRAM depth of storage (large data set) | | | | 512 | | kB |
| Number of measurement channels ⁴ | | | 2 | 3 | 6 | |
| Number of measurement cycles for averaging | | 1 | 1 | | 250 | |
| PC INTERFACE | | | | | | |
| Typ | | | | USB FT232R, isolated | | |
| Transfer rate | | | | 100 | | kB/s |
| POWER SUPPLY | | | | | | |
| Voltage | Provided by user | | 9 | 9 | 12 | V |
| Current | Provided by user | | | 5 | | A |
| DIMENSIONS | | | | | | |
| | DAQ unit | | 130 x 104 x 106 mm (B x L x H) | | | mm |

¹ Per ANSI/IEEE Standard 181-1977: 10% to 90%.

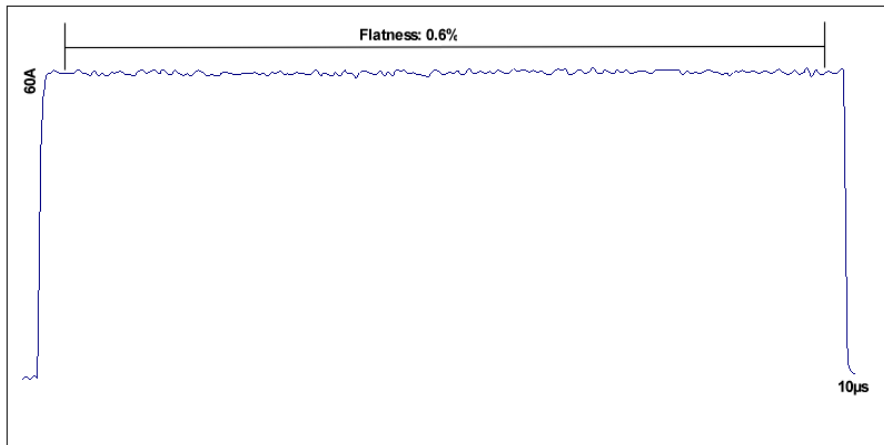
² With optimized current transmission line.

³ At large sample sizes within the pulse, this minimum value may not be realized. See pages 10 and 13 for details.

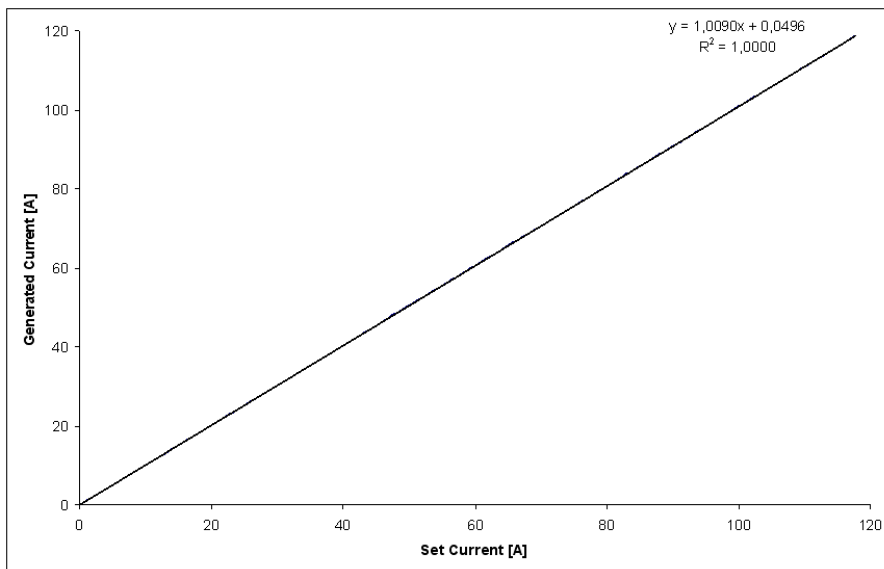
⁴ Fixed at time of manufacture. Two transimpedance amplifier and four voltage input channels are available. Typically, one transimpedance amplifier is used for the laser power measurement. The second may be used for the laser's internal power monitor photodiode if required. One voltage input channel is typically used for monitoring the laser voltage and one for monitoring the actual drive current. Two further voltage input channels are free for further monitoring as required.

TYPICAL PERFORMANCE DATA

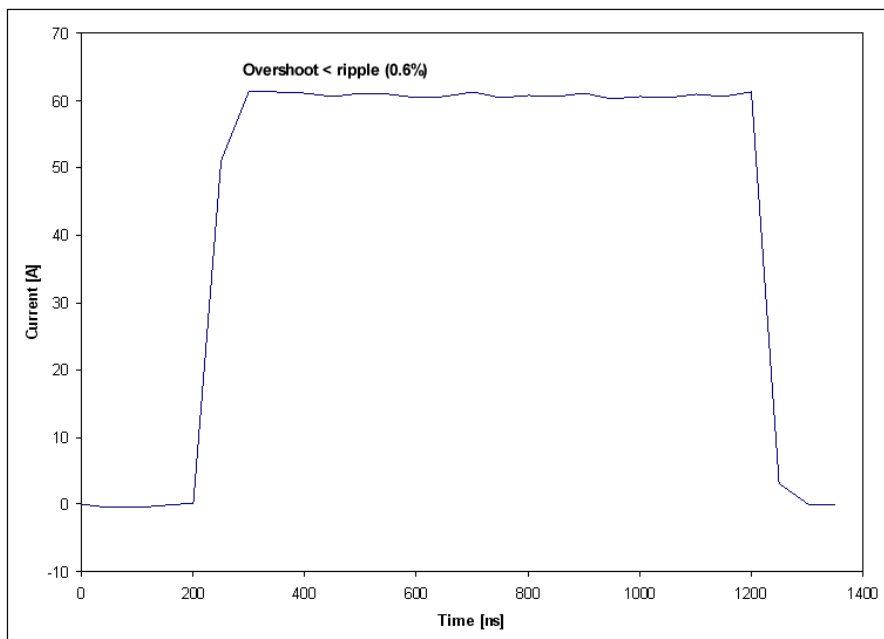
Flatness



Current Linearity



Overshoot



Measurement time including parameter upload and data download:

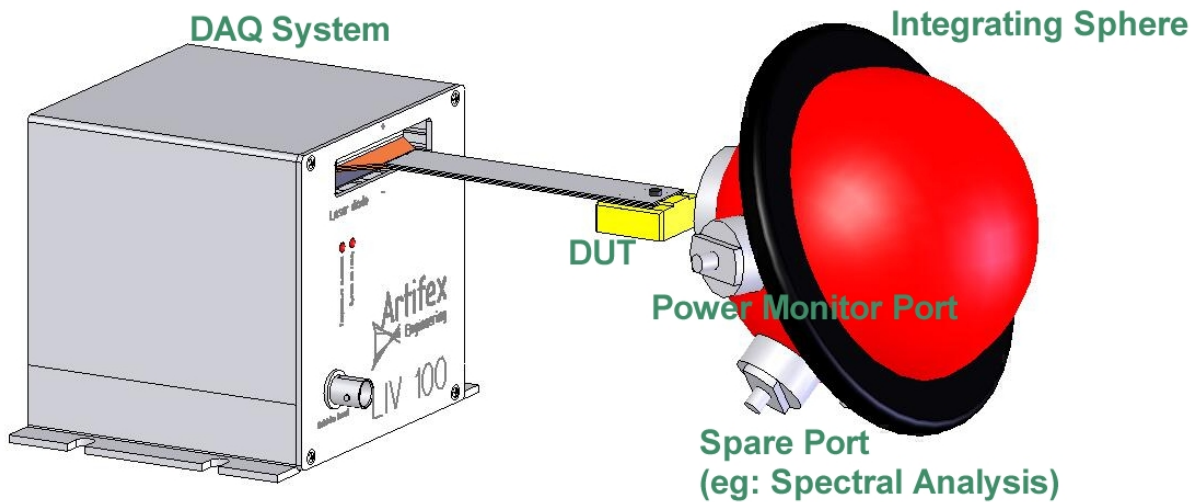
| Approximate Duration ⁵ [ms] | Conditions |
|--|---|
| 200 | 128 current steps, 1 μ s pulse duration, 0.1% duty cycle, no averaging |
| 1000 | 128 current steps, 10 μ s pulse duration, 1% duty cycle, no averaging |
| 2100 | 128 current steps, 1 μ s pulse duration, 0.1% duty cycle, averaging over 16 sequences |
| 2800 | 128 current steps, 10 μ s pulse duration, 1% duty cycle, averaging over 16 sequences |

⁵ Dependant on host computer configuration and demands.

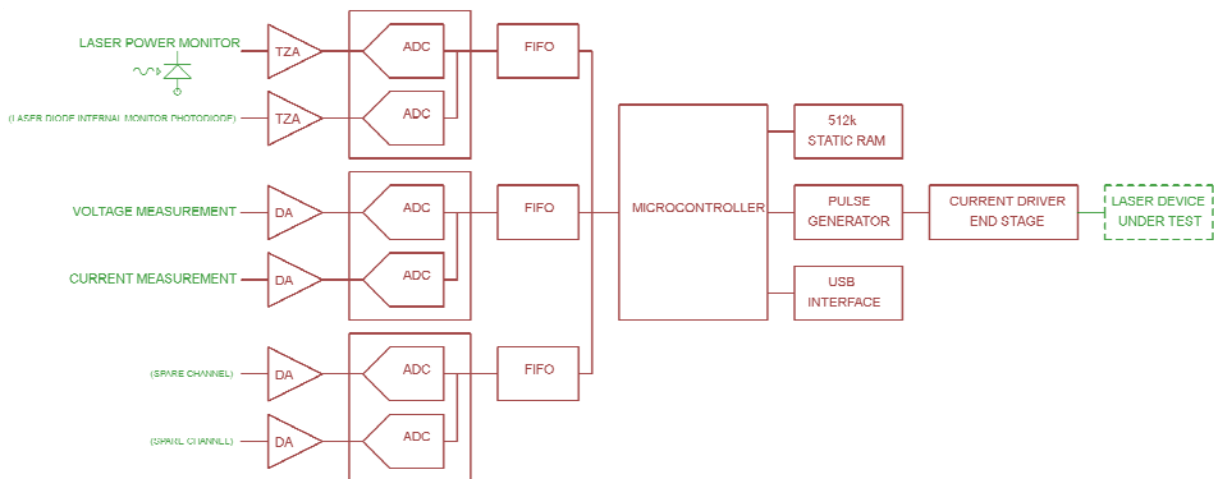
PRINCIPLES OF OPERATION

The LIV measurement is the concurrent measurement of light power (L), current (I) and voltage (V) from laser diodes or laser diode arrays during the fabrication process. A laser diode array consists of a 1xN array of single laser diodes. Each diode in an array can be tested separately or the full array at once, depending on the configuration of the electrode contacting and the integrating sphere.

The LIV100 system comprises an analog-digital signal processing unit, current driver, current transmission system and an integrating sphere. The complete system is depicted as follows:



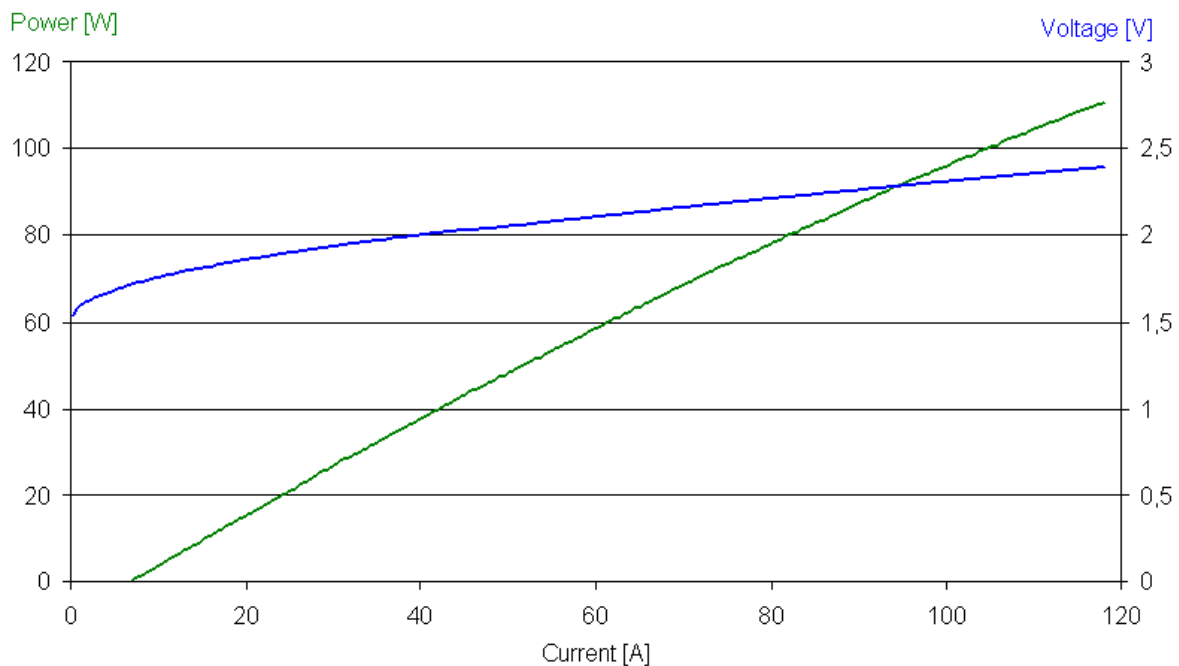
SYSTEM BLOCK DIAGRAMME



The LIV measurement consists of pulsing the DUT (laser diode) with a specific current and measuring the output light power (L) via the integrating sphere-photodiode-transimpedance amplifier combination and also the voltage drop (V) across the laser diode. The current is then increased by a fixed amount and the measurement repeated. This is repeated many times to produce a staircase increase in current and measurements of L and V for each current. The data will subsequently be used to generate L/I and V/I curves giving specific information about the quality of the laser diode under test.

Since in this stage of manufacture the laser diode typically cannot be thermally controlled or protected, the LIV100 system allows for very short current pulses to avoid any thermal loading. With a typical rise time of 400ns, current pulses as short as 1 μ s with current overshoot <1% may be realized. In order to avoid data corruption, a proprietary plateau detection is used during measurement in order to analyse only those data points not affected by transients.

A typical measurement result will appear as follows:



The LIV100 is designed for maximum throughput in the measurement cycle. To achieve this, the host computer communication during the actual measurement is reduced to error signalling alone. To begin the measurement sequence a parameter set from the host computer is uploaded to the LIV100 and the system is started with a “go” command. The LIV100 thereafter performs analyses and stores all data autonomously. If indicated in the parameter set, multiple measurement sequences will be performed for signal averaging. At the end of the sequence, the LIV100 indicates the availability of data for downloading before a new measurement sequence can begin.

A complete flow chart detailing the measurement sequence is given in “Measurement Sequence Flow Chart”, page 18 ff of this document.

TRIGGER OUT

For the purpose of system debugging or for timing peripheral hardware, the LIV100 is provided with a trigger output (BNC connector) on the back plane. This trigger signal is a 5V square wave whose duration equals the duration of each current pulse and is synchronous with the current pulses. Every current pulse is reproduced at the trigger output including the fixed length 10 μ s pulses used for checking laser contact and for determining the optimum photodiode gain (see “Measurement Sequence Flow Chart”, panels 4 and 6, page 19).

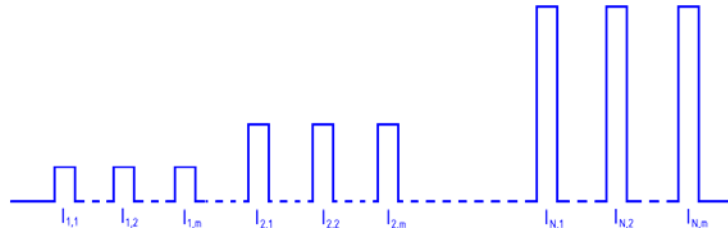
MEASUREMENT SEQUENCE

A measurement sequence involves setting a minimum and maximum current level, as well as a current step size. This results in a staircase of current pulses with measurements of the selected laser parameter (light power, voltage and current) at each pulse.

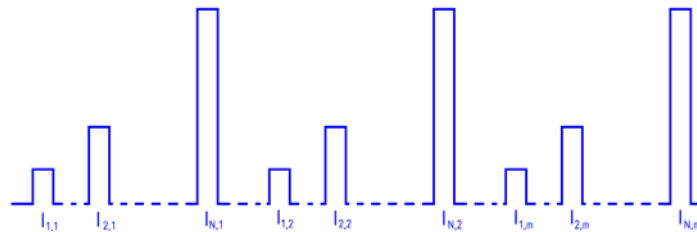
AVERAGING METHOD

In order to improve signal to noise ratio (at the cost of measurement time), the measurement sequence may be automatically repeated up to 250 times and the results averaged. This is relevant for the small data set only (see "Data Set").

Parallel ($a=0$): each current is pulsed "m" times before setting the next current as depicted here.



Serial ($a=1$): each averaging cycle is repeated "m" times before beginning the next cycle as depicted here.



If the large data set is chosen ($t=1$) then "m" is irrelevant. Only one data set at all "n" current values is measured and stored.

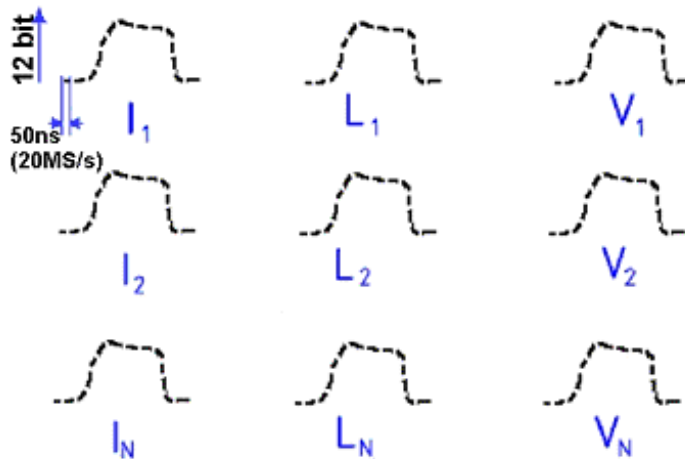
DATA SET

Two types of data set are available.

Large Data Set ($t=1$) (Oscilloscope mode)

The full, raw data set of each sample measured is downloaded to the host computer. This measurement provides full information on each active channel equivalent to a digital sampling oscilloscope operating at the sampling frequency selected in the parameter upload. This mode of operation is useful in the initial setting up of a new measurement environment, or new line of laser diodes or for debugging a setup.

This mode is not recommended for on-line quality assurance as the throughput is low due to the time required for downloading the large volume of data.



Schematic Representation of the Large Data Set

Data format of the SRAM memory (large data set)

- current stepping index: $k=0..N-1$
- channel index: $j=0..M-1$
- sample index of a single pulse waveform: $i=0..L-1$

The data are offset corrected, signed integers. The total number of ADC data is $N*M*L$. After sending $M*L$ values, a 16-bit CRC (cyclic redundancy check, see "Measurement Sequence Flow Chart", panel 14, pg. 21) is calculated and sent for each current value. This provides a simple check of data integrity so that the host computer can reread data if any error occurred during transmission.

A "valid data" check is also implemented: if the measurement has been unsuccessful, reading data will return an error.

The data are sent to the host in the following format and order:

| Data | representation |
|---|---|
| number of samples in a recorded pulse (L) | byte |
| number of measured channels (M) | byte |
| number of currents (N) | byte |
| zero (place holder), | byte |
| Photodiode #1 gain code (0..2) | byte |
| Photodiode #2 gain code (0..2) | byte |
| zero (place holder) | byte |
| pulse separation flag ⁶ | byte |
| ADC data k=0,j=0,i=0 | signed 16 bit integer, little endian ⁷ |
| ... | |
| ADC data k=0,j=0,i=L-1 | signed 16 bit integer, little endian |
| ADC data k=0,j=1,i=0 | signed 16 bit integer, little endian |
| ... | |
| ADC data k=0,j=M-1,i=L-1 | signed 16 bit integer, little endian |
| 16-bit CRC | signed 16 bit integer, little endian |
| ADC data k=1,j=0,i=0 | signed 16 bit integer, little endian |
| ... | |
| ADC data k=1,j=M-1,i=L-1 | signed 16 bit integer, little endian |
| 16-bit CRC | signed 16 bit integer, little endian |
| ... | |
| ADC data k=N-1,j=M-1,i=L-1 | signed 16 bit integer, little endian |
| 16-bit CRC | signed 16 bit integer, little endian |

There is a timeout for sending data: if the PC does not respond within 2 seconds and does not enable data receive, the microcontroller will stop sending data. Also, the PC may terminate long data transfers by sending ESC (27) during data upload.

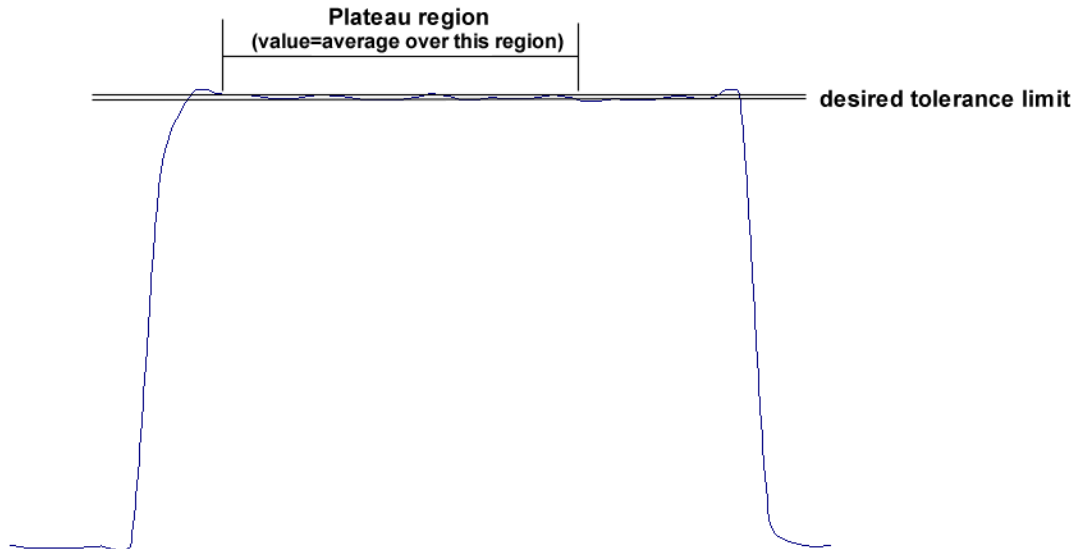
⁶ Value = 0 if the selected pulse separation has been achieved. At large numbers of samples within a pulse, the pulse separation may not be achieved due to the calculation time involved in processing the pulse. In this case, the flag value is 1. The maximum number of samples within a pulse for a given setting of pulse separation are as follows:

| s | max pulse width (large dat set) |
|---|---------------------------------|
| 2 | 6 |
| 3 | 35 |
| 4 | 65 |
| 5 | 95 |
| 6 | 124 |
| 7 | 154 |
| 8 | 183 |
| 9 | 212 |

⁷ Two byte word with least significant byte (LSB) first. Only the most significant 12 bits carry valid data. If any data value's LSB is set to 1, then a data out of range error occurred. That is, the LSB is used to flag this error state.

Small Data Set (t=0) (data acquisition mode)

Each sampled pulse is analysed on board to determine the appropriate value of the pulse measured. This value represents the average of all of the samples within the pulse plateau as depicted here.



This mode of operation is the standard measurement mode providing the compact data for the LIV analysis. Throughput is high in this mode as the time for data download to the host computer is minimized.

The plateau region is determined via a proprietary algorithm based on two user selectable input parameters. These are:

1. Maximum deviation from the mean
2. Minimum number of samples

Using these two values, the LIV100 automatically determines the largest region of the pulse (block of data samples) for which the maximum deviation from the mean value just satisfies the parameter as set by the user. Then the number of samples within this block is determined and compared to the minimum number required by the user. If this is valid, then the LIV100 determines the average value of the samples within this block and stores this single value as the measurement result. In this manner, the LIV100 can avoid analysing data from the transient region of the pulse or from overly noisy pulses. This provides clean, anomalous-kink-free analysis of the LIV data.

Note that the signal to noise ratio of a measurement depends critically on the choice of sampling rate. Since the calculation involves averaging the sample values within the plateau, it is best to maximize the number of samples within each pulse. Therefore the highest sampling rate (lowest value of parameter "r") should be chosen consistent with the pulse duration and duty cycle required for the measurement.

Data format of the SRAM memory (small data set)

- current stepping index: $k=0..N-1$
- channel index: $j=0..M-1$

The data are offset corrected, signed integers. The total number of plateau data is $N*M$. After sending the data set, a 16-bit CRC (cyclic redundancy check, see “Measurement Sequence Flow Chart”, panel 14, pg. 21) is calculated and sent to the host computer. This provides a simple check of data integrity so that the host computer can reread data if any error occurred during transmission.

A “valid data” check is also implemented: if the measurement has been unsuccessful, reading data will return an error.

The data are sent to the host in the following format and order:

| Data | representation |
|--------------------------------------|---|
| number of samples in the plateau (P) | byte |
| number of measured channels (M) | byte |
| number of currents (N) | byte |
| number of averages (A) | byte |
| Photodiode #1 gain code (0..2) | byte |
| Photodiode #2 gain code (0..2) | byte |
| plateau start | byte |
| pulse separation flag ⁸ | byte |
| Plateau data $k=0,j=0$, | signed 16 bit integer, little endian ⁹ |
| Plateau data $k=0,j=1$ | signed 16 bit integer, little endian |
| ... | |
| Plateau data $k=0,j=M-1$ | signed 16 bit integer, little endian |
| Plateau data $k=1,j=0$, | signed 16 bit integer, little endian |
| ... | |
| Plateau data $k=N-1,j=M-1$ | signed 16 bit integer, little endian |
| 16-bit CRC | signed 16 bit integer, little endian |

⁸ Value = 0 if the selected pulse separation has been achieved. At large numbers of samples within a pulse, the pulse separation may not be achieved due to the calculation time involved in processing the pulse. In this case, the flag value is 1. The maximum number of samples within a pulse for a given setting of pulse separation are as follows:

| s | max plateau points (small data set) |
|---|-------------------------------------|
| 2 | 30 |
| 3 | 70 |
| 4 | 110 |
| 5 | 148 |
| 6 | 187 |
| 7 | 228 |

⁹ Two byte word with least significant byte (LSB) first. Only the most significant 12 bits carry valid data. If any data value's LSB is set to 1, then a data out of range error occurred. That is, the LSB is used to flag this error state.

The data values must now be scaled by the appropriate scaling parameter to calculate the actual measurement result (voltage, current or power, as appropriate). These scaling parameters are given below and in the calibration data sheet delivered with the system.

Furthermore, the voltage drop across the laser diode must be corrected for the series resistance of the strip line connecting the DAQ system to the laser diode according to:

$$V_{\text{laser, k}} = V_{\text{measured, k}} - (\text{Current}_k \times R_{\text{strip line}})$$

This series resistance is also given in the calibration data sheet provided with the system.

In order to calculate the measurement values, the digital value returned from the LIV100 must be scaled appropriately. In the following, the parameter “x” refers to the maximum representable value for a given channel, the total range is therefore -x..+x.

The scale factors are as follows:

Voltage channel: $x = 4V$

Current channel: $x =$ 400A (LIV100-40)
 1200A (LIV100-120)
 2000A (LIV100-200)

Optical channel: $x = 1/(\eta \cdot G)$

where η is the sensitivity of the optical system for the wavelength in question (see calibration data sheet or the calibration data file provided with the system) and G is the photodiode gain from the data set.

Since the 4 LSBs do not contain measurement value information, a four bit arithmetic right shift must now be performed. Then the data range and scaling of the data will be as follows (“x” = channel maximum value as defined above):

```
0000 0111 1111 1111 : 2047*x/2048
0000 0111 1111 1110 : 2046*x/2048
.
.
.
0000 0000 0000 0010 : 2*x/2048
0000 0000 0000 0001 : x/2048
0000 0000 0000 0000 : 0
1111 1111 1111 1111 : -x/2048
1111 1111 1111 1110 : -2*x/2048
.
.
.
1111 1000 0000 0001 : -2047*x/2048
1111 1000 0000 0000 : -2048*x/2048 = -x
```

C example code: (“data” must be declared as short, “x” as double):

```
value = (data >> 4)*(x/2048)
```

PARAMETERS FOR THE MEASUREMENT SEQUENCE

The following parameter list is uploaded from the host computer to the LIV100 prior to measurement. These parameters determine the conditions for the complete measurement sequence.

| Parameter code | Parameter description | Units | Resolution | Min. value | Max. value |
|----------------|---|---------------|----------------|----------------|--|
| r | | | n.a. | 1 | 20 |
| | sampling rate (R) $R=(20\text{MS/s})/r$ | MS/s | n.a. | 1 | 20 |
| d | | | 1 | 1 | 2000 |
| | pulse duration (D) $D=d/R$ | ns | 50^{10} | 150 | $2\,000\,000^{11}$ |
| s | | | 1 | 2 | 1000 |
| | pulse separation (S) $S=s*(100\mu\text{s})$ | μs | 50 | 100 | 50 000 |
| c | | | 1 | 1 | 4000 |
| | minimum current (C) $C=c*(\text{abs.max.})/256$ | mA | 10 30 50 | 10 30 50 | $40\,000^{12}$ $120\,000^{13}$ $200\,000^{14}$ |
| x | | | 1 | 1 | 4000 |
| | maximum current (X) $X=x*(\text{abs.max.})/256$ | mA | 10 30 50 | 10 30 50 | $40\,000^{12}$ $120\,000^{13}$ $200\,000^{14}$ |
| n | current step value | | 1 | 1 | 4000 |
| | current step (N) $N=n*(\text{abs.max.})/256$ | mA | 10 30 50 | 10 30 50 | $40\,000^{12}$ $120\,000^{13}$ $200\,000^{14}$ |
| u | | | 1 | 1 | 255 |
| | contact test min. voltage (U) $U=u*4/256$ | V | 0.02 | 0.02 | 4 |
| v | | | 1 | 1 | 255 |
| | contact test max. voltage (V) $V=v*4/256$ | V | 0.02 | 0.02 | 4 |
| p | | | 1 | 1 | 255 |
| | plateau: maximum deviation from the mean (P) $P=p*<\text{sample set}>/256$ | | 1/256 | 1/256 | 1 |
| q | Note: default to 1 if t=1 | | 1 | 1 | 2000 |
| | Minimum number of samples within the plateau. | | 1 | 1 | 2000 |
| m | number of measurement cycles for averaging | | 1 | 1 | 250 |
| a | averaging method | | | 0=„parallel“ | 1=„serial“ |
| t | type of data set | | | 0=„small“ | 1=„large“ |

¹⁰ Max. sample rate = 20MHz → resolution = 50nm

¹¹ Min. sample rate = 1MHz, 15px overhead for pre and post pulse analysis → Max. pulse duration = $1\mu\text{s} \times (255-15) = 240\mu\text{s}$

¹² Version: LIV100-40

¹³ Version: LIV100-120

¹⁴ Version: LIV100-200

COMMANDS

The host computer has several commands available to control the functioning of the LIV100 measurement system. These are detailed as follows:

| Command code | Meaning | Action |
|--------------|-------------------|---|
| @p | Upload parameters | The host computer uploads all parameters from the list detailed under "Parameters for the Measurement Sequence", pg. 15. |
| @g | Start measurement | The LIV100 measurement system will begin its autonomous measurement cycle based on the parameters stored in its volatile memory. |
| @r | Receive data | The LIV100 measurement system sends all measurement data to the host computer. |
| @o | Calibrate offset | The LIV100 measurement system sets the drive current to 0A and measures the values of all active channels. These values are stored as offset values in non-volatile memory which will be subtracted from the values of all subsequent measurements. Upon power-up, the last set of values are reloaded. |
| @m | Modulator status | The LIV100 measurement system sends information on the status of the current modulator (driver end stage) to the host computer. This includes "ready" status and temperature. |

ERROR CODES

During a measurement sequence, several conditions are monitored and may lead to abortion of the process. In such cases, the LIV100 will send an error code (in some cases with further information flags) to the host computer for analysis of the situation. These error codes are detailed as follows:

| Error code | Meaning | Action |
|------------|---|---|
| !h | hardware error with flags: <ul style="list-style-type: none"> excess temperature active ready flag inactive internal communication error | stop measurement sequence |
| !o | uploaded measurement parameter invalid | LIV lists invalid parameter codes ¹⁵ and waits for new @p command |
| !m | memory overflow | For large data set selection only (t=1): the set of parameters sent to the LIV system would result in a memory overflow. LIV waits for new parameter set upload |
| !t | timeout during parameter upload | LIV waits for new @p command |
| !c | contact test failed | LIV waits for new command |
| !p | plateau test failed | LIV waits for new command |
| !i | offset measurement out of range | do not store new offsets, inform user and wait for new command |

Any error code may also be followed by flags. If flags are set, these indicate that a hardware error occurred during the process for which the error code is defined. If the flags are not set then the error code indicates that the measurement is out of the valid range of acceptance. The meanings of the flag bits are as follows:

| Bit | meaning |
|-------------|--|
| Bit 0 (LSB) | Current modulator excess temperature |
| Bit 1 | Current modulator not ready |
| Bit 2 | Interboard communication error (within the LIV100) |
| Bit 3 | Timeout with host communication |
| Bit 4 | Flash memory write error (calibration coefficients could not be written) |
| Bit 5 | Data out of range error |

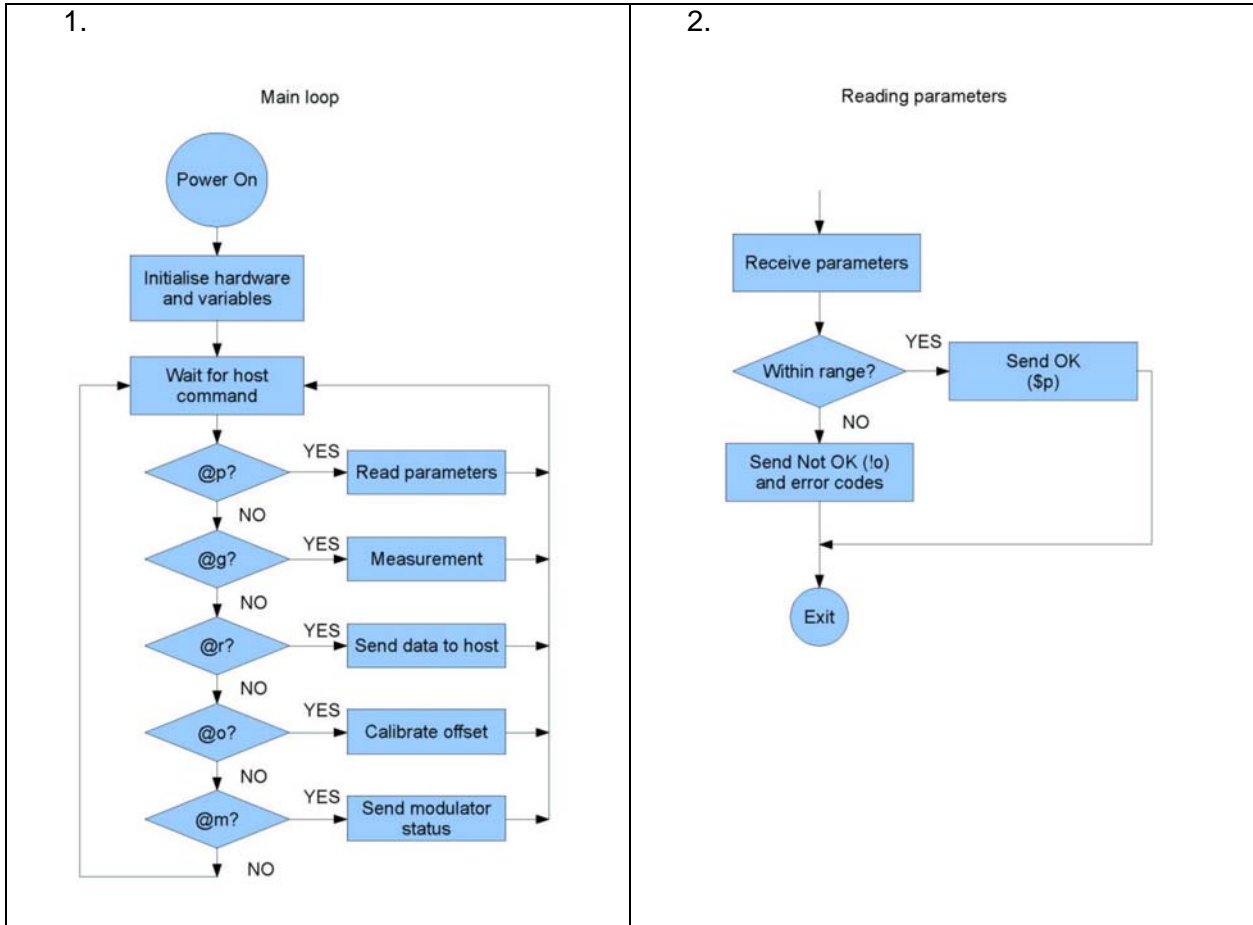
¹⁵ For example:

!osxm

indicates that errors occurred (!o) and the invalid parameters are: pulse separation (s), max current (x) and number of averages (m).

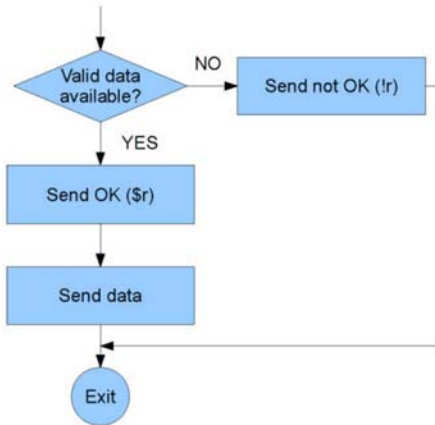
MEASUREMENT SEQUENCE FLOW CHART

Full details on the measurement sequence and use of commands and error flags are given below:



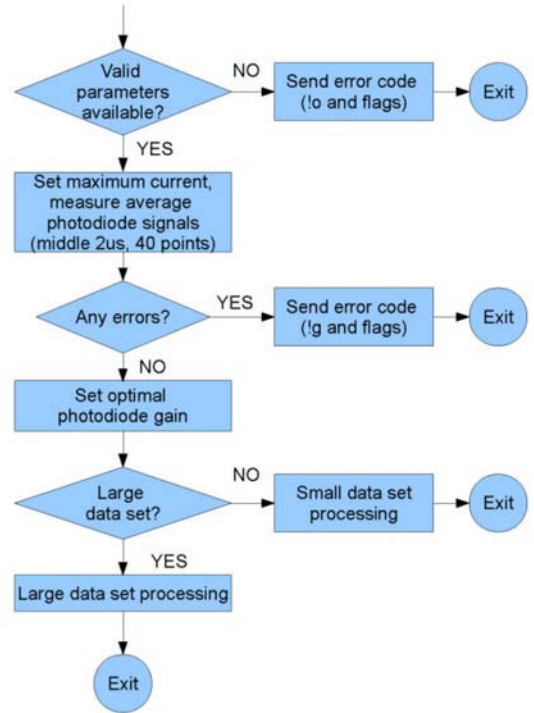
3.

Sending measured data



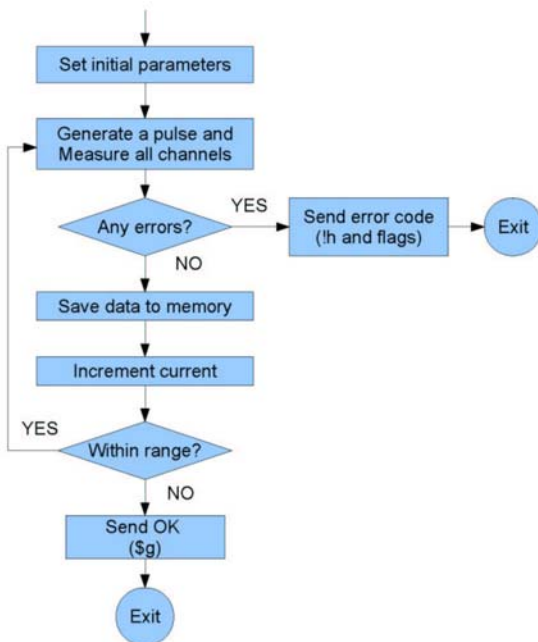
4.

Measurement cycle



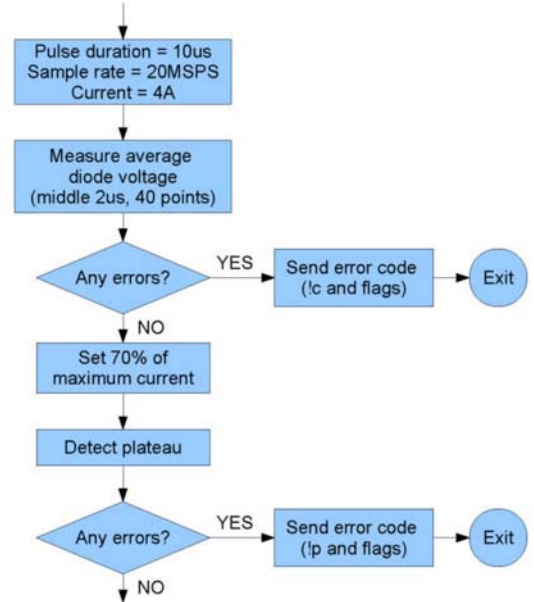
5.

Large data set processing



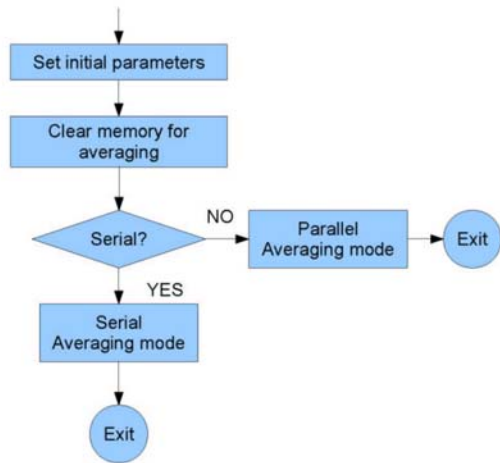
6.

Small data set processing



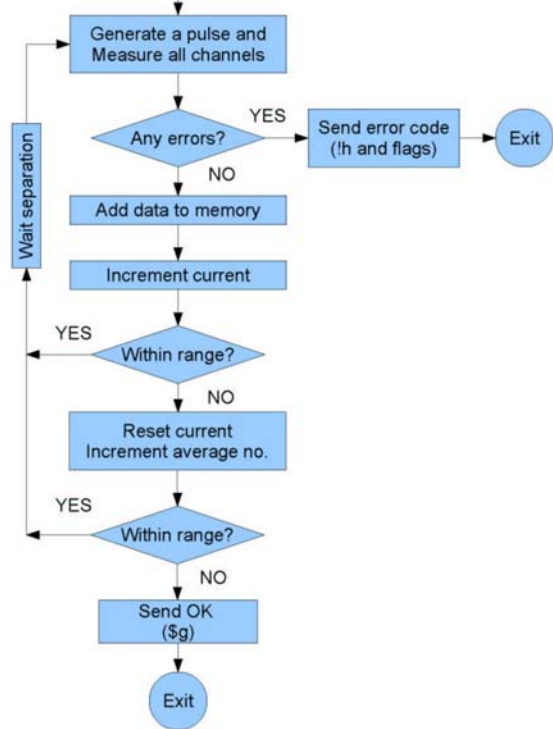
7.

Small data set processing (continued)



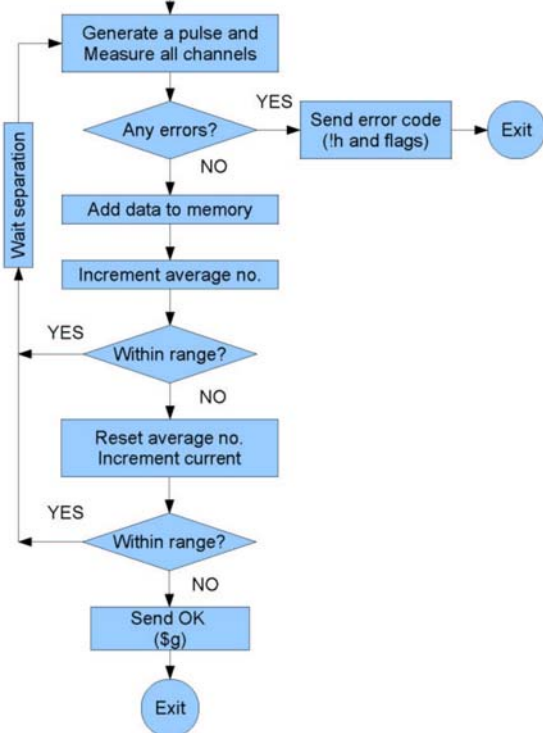
8.

Small data set serial mode processing



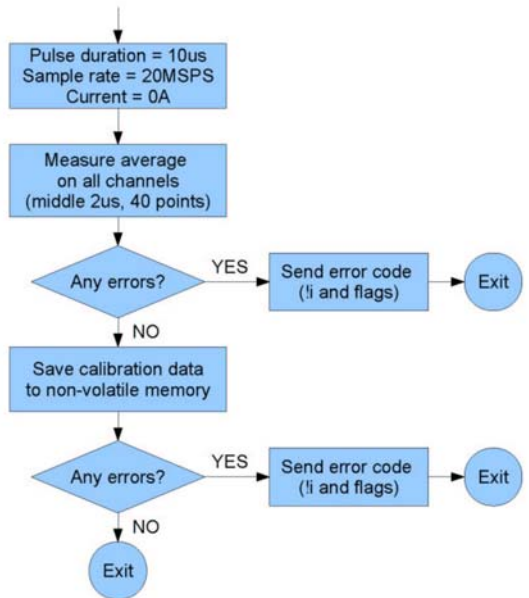
9.

Small data set parallel mode processing



10.

Offset calibration procedure



11.

Communication flowcharts

The following flowcharts show how the instrument handles communication.

The FTDI FT232RL chip must be programmed for:

- 1Mbit/s transfer rate
- 8-bit binary data
- no parity
- RTS/CTS handshaking

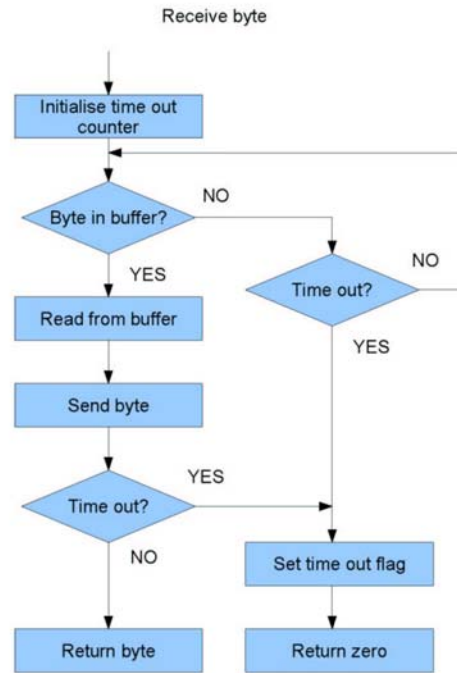
Notes:

The host must drive its RTS active (low) to enable sending bytes by the instrument (via its CTS line). It must not be done by the user software, RTS/CTS handshaking must be turned on.

A 2 seconds time out is used by the instrument for sending and receiving data. The behaviour depends on the specific task.

A 16-bit CRC is calculated and can be used to check measured data integrity.

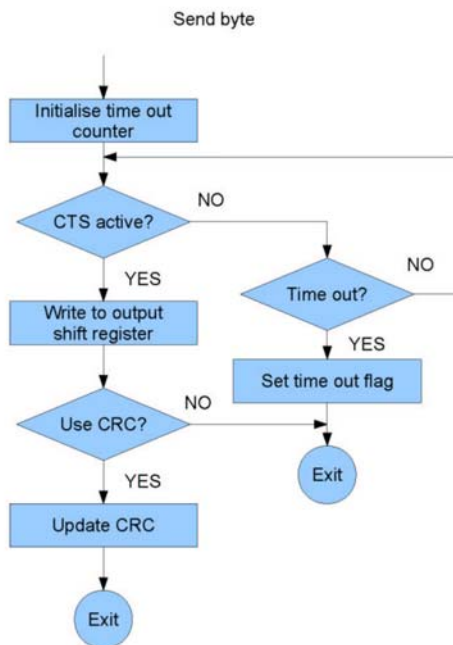
12.



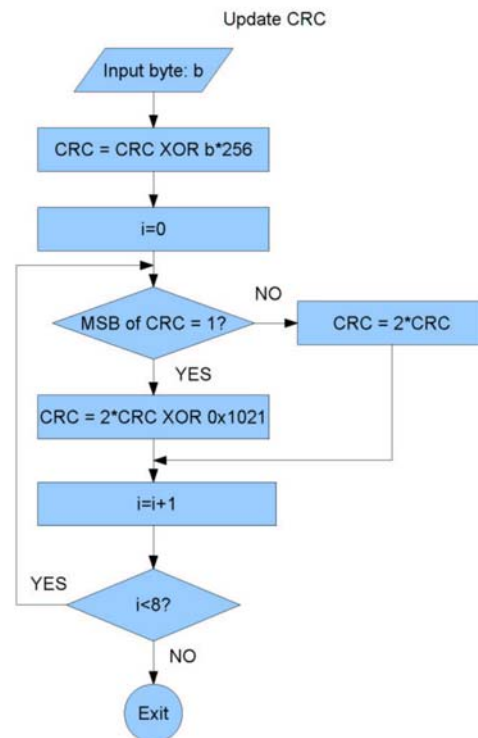
Note:

Every received byte will be sent back to the host. The host must send one byte at a time and wait for getting it back before sending the next byte (software handshaking).

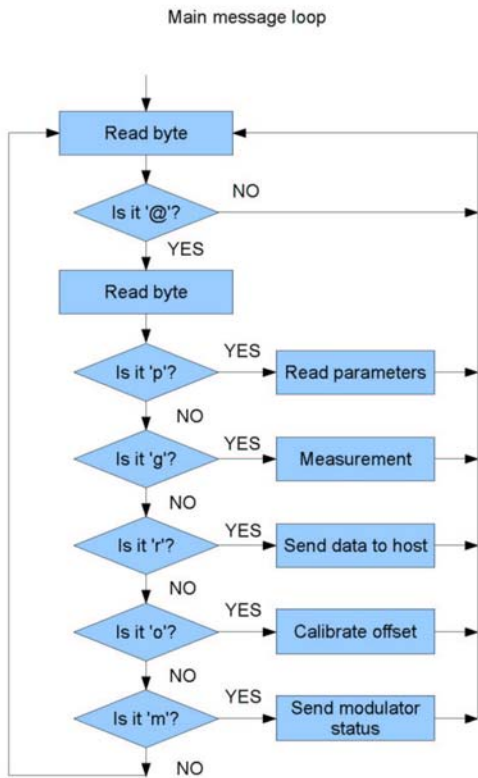
13.



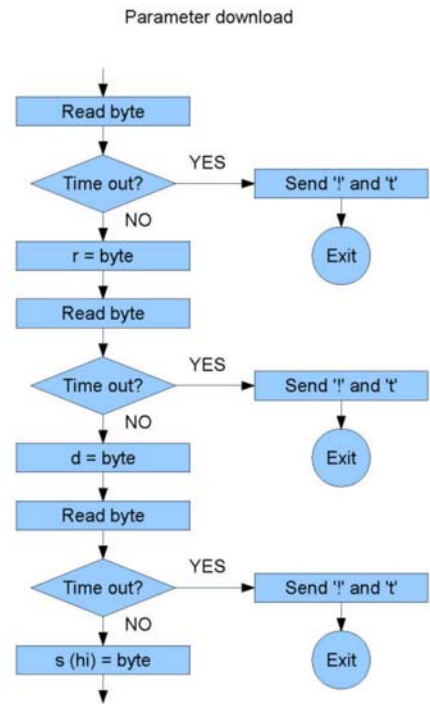
14.



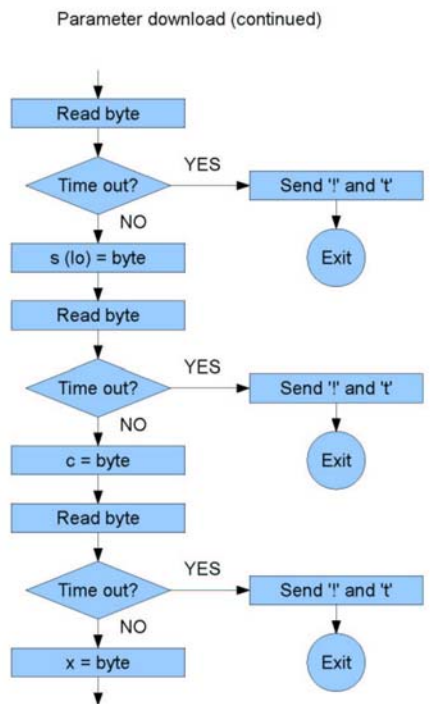
15.



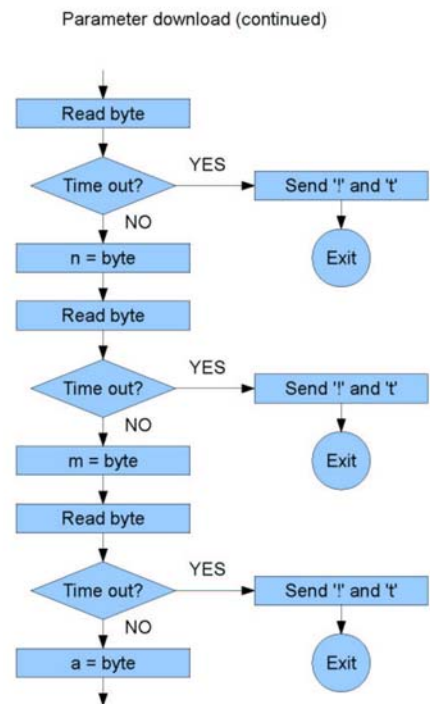
16.



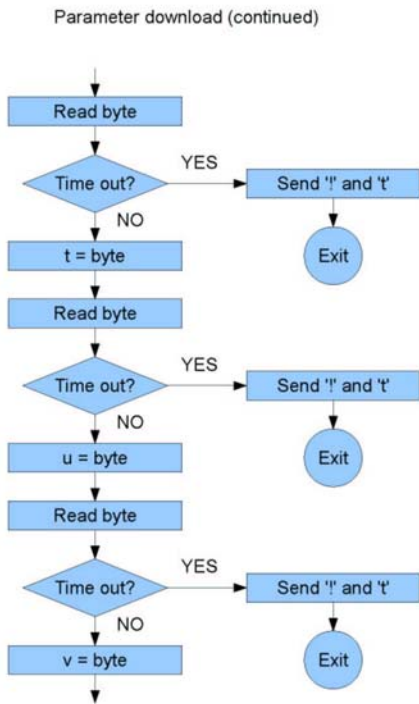
17.



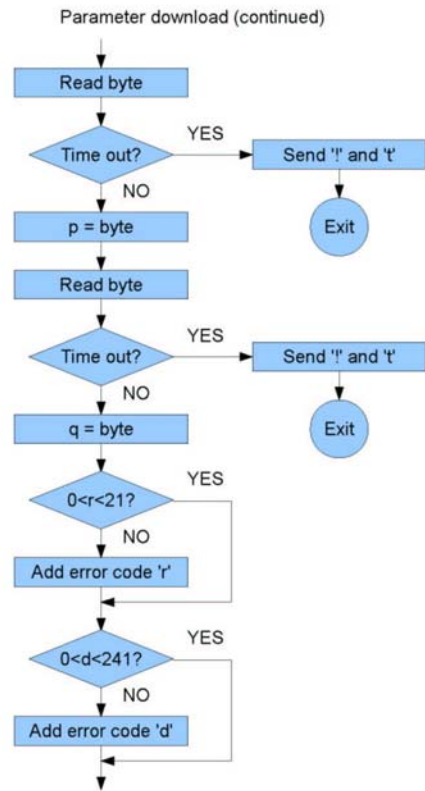
18.



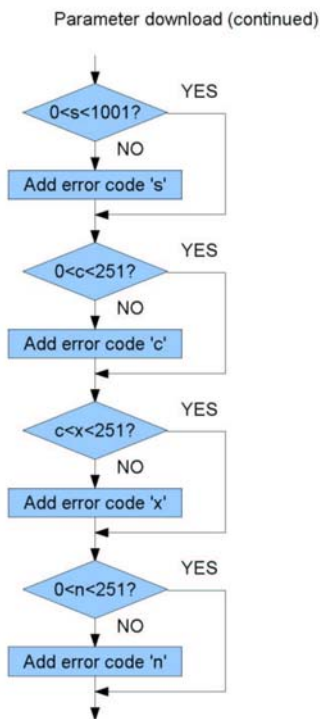
19.



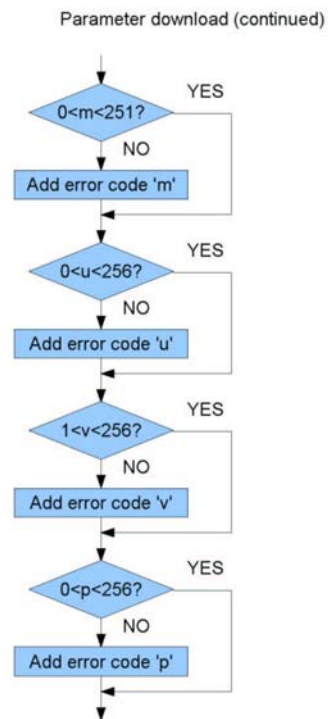
20.



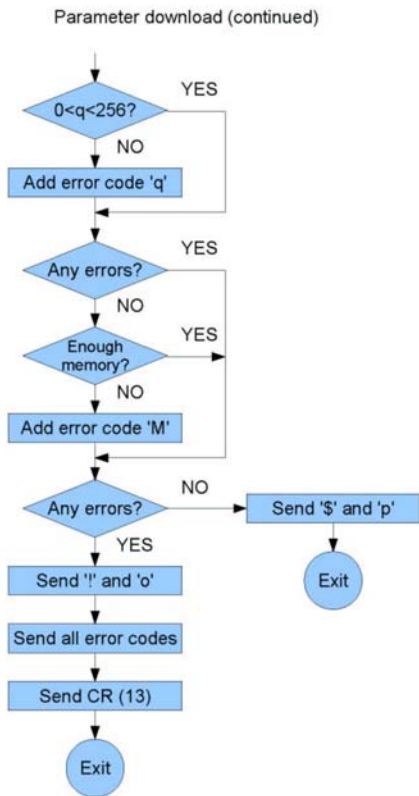
21.



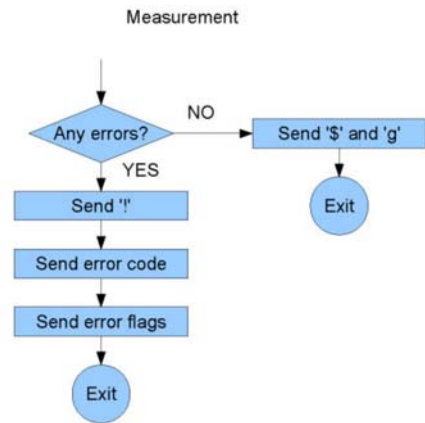
22.



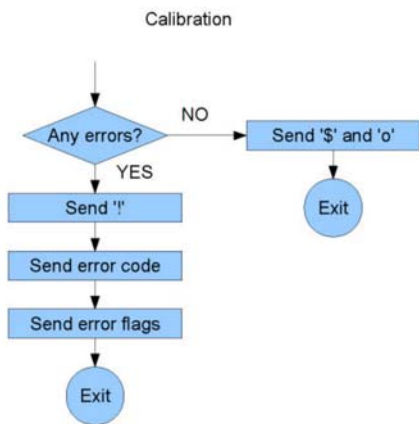
23.



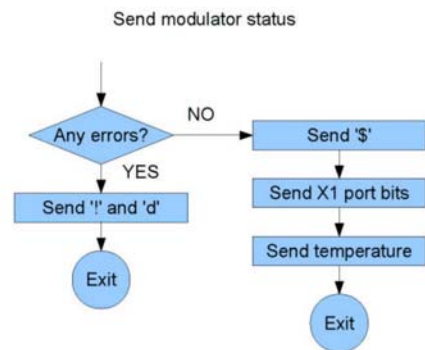
24.



25.



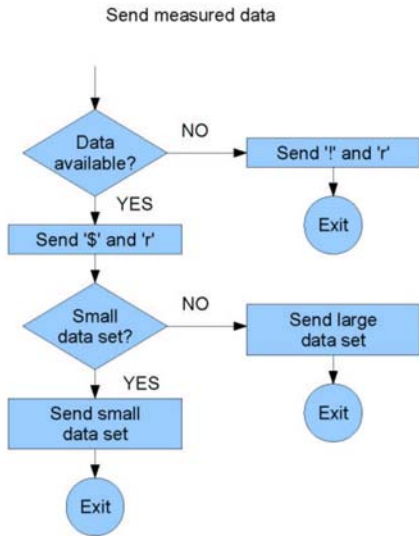
26.



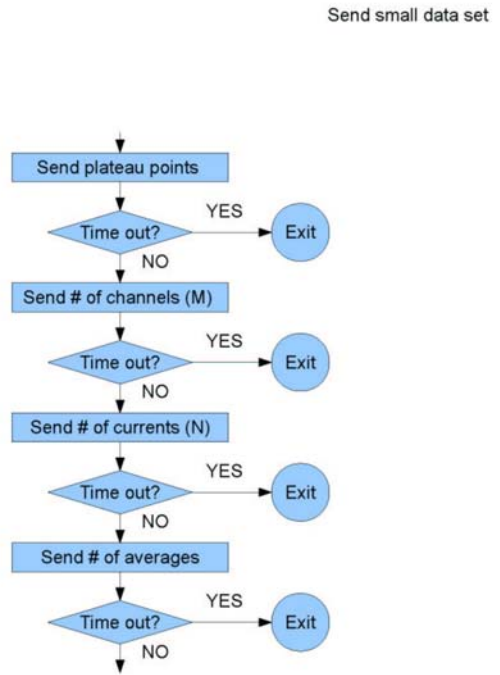
X1 port bits:

| Bit position | low | high |
|--------------|--------------------|--------------------|
| 0 | Excess temperature | Normal temperature |
| 1 | Not ready | Ready |
| 2 | undefined | undefined |
| 3 | Reset active | Reset inactive |
| 4 | Enable active | Enable inactive |
| 5 | undefined | undefined |
| 6 | undefined | undefined |
| 7 | undefined | undefined |

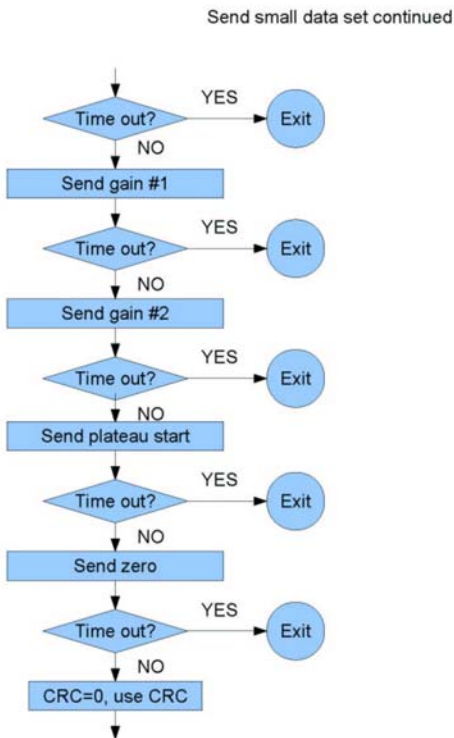
27.



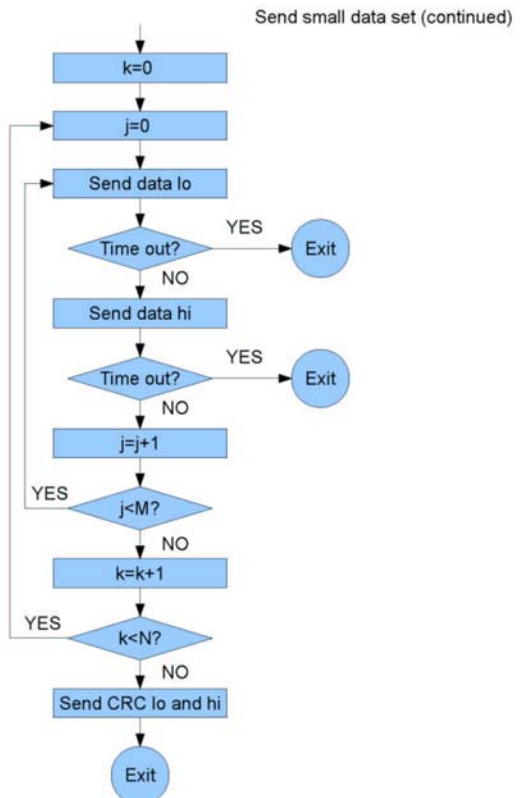
28.



29.

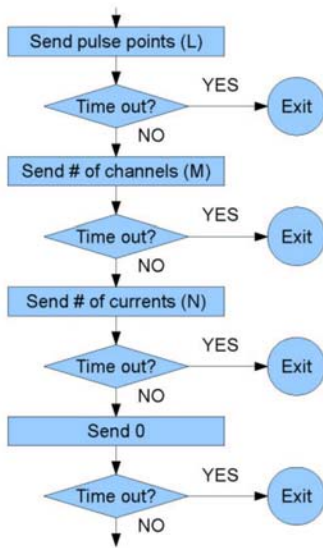


30.



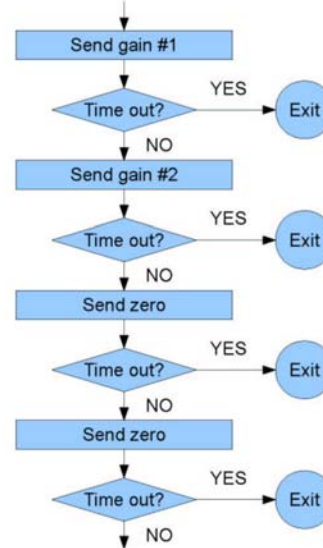
31.

Send large data set



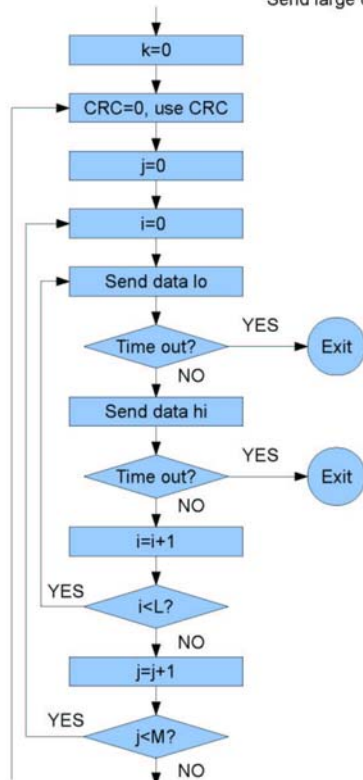
32.

Send large data set (continued)



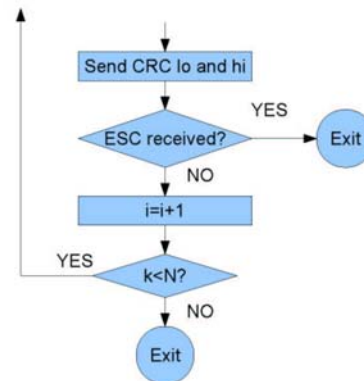
33.

Send large data set (continued)



34.

Send large data set (continued)



DRIVER INSTALLATION

Before using the LIV100, the FTDI software driver for the USB port must be installed. When the system is connected to the USB port for the first time, the windows operating system will begin the installation procedure in the usual manner. The appropriate file is provided in the software package delivered with the unit.

The user may communicate using the virtual COM port mode or a native and more flexible mode using the supplied D2XX driver.

When connecting the port, please wait sufficient time for connection to be established. The system may require up to 10 seconds to establish connection before opening the port.

SOFTWARE UPDATING

In the progress of further system development, software updates may become available. For this purpose, the programming headers for the microcontrollers are accessible from the back plane of the unit. In case of a software update, an update manual will be provided to detail the hardware and steps required.

DAMAGE

The unit may be damaged by exceeding the maximum average input power. Please read "Absolute Maximum Values", pg.2 before working with the instrument.

TROUBLESHOOTING

In the event that a measurement is not successful, the LIV100 will generate an error code to indicate the problem encountered. If this does not occur, the following possibilities should be analysed:

- LIV100 is not powered
- LIV100 is not connected to the USB port of the host computer

| Symptom | Possible Errors | Correction |
|-----------|--|--|
| No output | <ul style="list-style-type: none">• LIV100 is not connected to the USB port of the host computer | <ul style="list-style-type: none">• Connect the unit to the USB port |
| No output | <ul style="list-style-type: none">• LIV100 is not powered | <ul style="list-style-type: none">• Check power supply connection• Ensure that the power supply voltage is within the valid range |

In the unlikely event that you are not able to obtain a measurement in spite of these troubleshooting measures, please contact us. We will be pleased to help you solve your problem.

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Attention: The LIV100 series of laser diode test systems is designed for use with lasers. Personnel who use this instrument must, therefore, be instructed in the safe use of lasers and laser beams.

Always wear the proper laser safety glasses designed for the laser in use!

Never allow the direct or reflected laser beam to impinge on the eyeball or to come into contact with the skin!

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