FEASA LED ANALYSER
FUNCTIONAL VERSION

User Manual for Feasa Functional Models

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About this Manual

Feasa operates a policy of continuous development. Feasa reserves the right to make changes and improvements to any of the products described in this document without prior notice.

Feasa reserves the right to revise this document or withdraw it at any time without prior notice.

This manual is written for models Feasa Functional Led Analysers. The model numbers are Feasa x-F, Feasa x-FB, Feasa x-LT (where x is the number of fibers either 2,3,5,6,10,20).

The **Feasa 20-F** is a standard 20 channel Analyser which will test up to 20 LED's while the **Feasa 3-F** is a standard 3 channel Analyser testing up to 3 LED's.

The **Feasa 20-FB** is a High Brightness 20 channel unit which will test up to 20 LED's while the **Feasa 3-FB** is a 3 channel High Brightness unit testing up to 3 LED's.

The **Feasa 20-LT** is a Life Tester 20 channel unit which will test up to 20 LED's in an oven while the **Feasa 3-LT** is a 3 channel Life Tester unit testing up to 3 LED's.

The interface on these units is USB or RS232-Serial.

FEASA LED ANALYSER
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Introduction

The ***Feasa LED Analyser*** is an instrument that tests the HSI (Hue, Saturation, Intensity), RGB (Red, Green, Blue Colour content of a single LED), xyChromaticity, Dominant Wavelength and cct Colour temperature of Light Emitting Diodes (LEDs) in a test process. An individual Led Analyser can have up to 20***** 1mm flexible Fiber-Optic Light Guides which are mounted individually over the LEDs to be tested.

The Feasa Led Analyser can be trained to read other Led Parameters like Absolute Intensity and CIEXYZ in Luminous flux (lm), Luminous intensity (cd, mcd), Luminance (cd/m^2). It can also be trained to interpret the data from an RGB Led. These outputs will require the use of the Feasa Led Spectrometer.

Emitted Light from the LEDs is guided through these Fiber-Optic Light Guides to the Analyser where the raw data is stored. The raw data can then be read out of the Analyser through the Serial or USB Interfaces.

The USB Interface is 2.0 compatible.

The Serial Interface is a 3-Pin Connector with a 3 pin to 9 pin dtype cable (supplied) compatible with the RS-232C ports on machines.

All Colours are derived from the three primary Colours, Red, Green and Blue (RGB). The RGB values are used to identify different Colour LEDs.

The raw data from the Led under test is stored on the Led Analyser and output in different formats as required through the USB and Serial interfaces.

***** Other options include 2,3,5,6,10.

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IMPORTANT INFORMATION for Programmers

set / put Commands

The *Set / Put* commands are used to adjust various settings in the LED Analyser such as Intensity, Exposure and offsets.

The *Set* commands are written to the on-board Flash.

These settings remain programmed in the Analyser even when the power is removed.
The Led Analyser has a capacity limit of approximately 100,000 writes to the flash.

Use the Set command only to store relevant information on the Led Analyser. Please refrain from using *Set* commands in your high volume production programs as this constant writing to the Flash will eventually corrupt the Led Analyser. Use the Put command instead.

The *Put* commands are written to the on-board RAM.

These settings will NOT remain programmed in the Analyser after the power is removed.

Use the Put command as often as you need in your program. This will prolong the life of the Led Analyser particularly in high volume testing environment.

Commands are transmitted and received using ASCII characters and are **case-insensitive**.
All commands must be terminated with a **<CR>** or **<LF>** character.

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Colour and Saturation

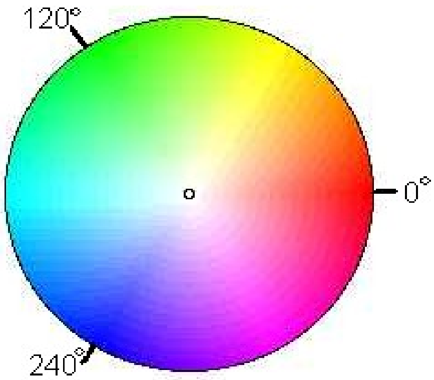

Figure 1: Hue (Colour) Wheel

RED	=	*0º*
GREEN	=	*120º*
BLUE	=	*240º*

Colours can represented by a 360° degree circular Colour wheel. The three Primary RGB values can also be represented as a single value called ***Hue***. Hue is a measured location on a Colour wheel and is expressed in degrees. For example, Red will have a Hue value near 0°, Green will have a Hue value near 120° and Blue will have a value near 240°.

A pure Colour will be represented on the Colour wheel as a point near the outer edge. White will be represented by a point near the center of the wheel. The degree of whiteness in a LED will affect its position on the wheel – the greater the amount of white the closer it will be to the center.

The Feasa Led Analyser output of ***Saturation*** is NOT part of the International System of Units. and is not an absolute or traceable unit of colour measurement. It is part of the Hue Saturation and Relative intensity (HSI) system of describing colour. The degree of whiteness emitted by the LED is represented by the term ***Saturation***. A Saturation value of 0% represents pure White. A Saturation value of 95 - 100% represents a pure Colour such as Red, Blue, Green, etc. It is a relative output much the same as the Relative Intensity output, and is used to compare similarly coloured LEDs under test. The Saturation values are calculated within the Feasa Led Analyser for each channel of the LED Analyser, relative to the LED under test.

There is a consistency in the Saturation readings between all Feasa Led Analysers, for LEDs of a similar colour, in a similarly constructed fixture.

Usually the user must determine the Hue and Saturation values by testing a number of LED's and recording the results.

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The RGB and Hue values in *Figure 2* show how different Colour LEDs can be identified.

LED	***R***	***G***	***B***	***HUE***	***SATURATION***
Red	253	1	1	0	100%
Green	24	208	23	120	89%
Blue	2	13	240	238	99%
Yellow	76	171	8	95	96%
Orange	224	28	2	7	99%
White	71	72	112	See Page 13	21%

Figure 2.

The RGB or Hue values are used to identify different Colour LEDs.

Every LED tested by the LED Analyser will have a set of RGB values generated for analysis. These values are converted automatically to Hue and Saturation (whiteness) and can be read out through the Serial or ICT ports.

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Intensity

Intensity is a measure of the amount of light being emitted by the LED. The Analyser tests the Intensity of each LED and outputs this value to the Test System. The value is output as a number in the range ***0 - 99,999***. The Analyser is calibrated to a fixed standard and all measurements are relative. The Intensity output reading is NOT part of the *International System of Units* and is not an absolute or traceable unit of colour measurement. It is part of the Hue Saturation and Relative intensity (HSI) system of describing colour.

The Analyser can be set in either **Linear** mode or **Logarithmic** modes to measure Intensity of the LED. The units are shipped from the factory in Logarithmic mode. See set/putlog and set/putlin commands to determine how to set the mode of the analyser. Use the getintensitymode command to determine which intensity measure mode the Analyser is set to

Factors that influence Intensity Measurement:

- The position of the Fiber in relation to the LED.
- Offset from the Optical Centre of the LED.
- The Gap between the end of the Fiber Light Guide and LED to be measured.
- The condition of the Fiber end. It must be kept clean with a 90º Cleave.
- Is the LED Static or Flashing ?
- External Influences – Other LEDs in close proximity, Ambient Lighting.
- Is an Optical Head being used.

There are 6 capture ranges each with an intensity output range of 0 to 99,999. Feasa recommends that the UUT readings should be in the 55K to 85K range for the best stability.

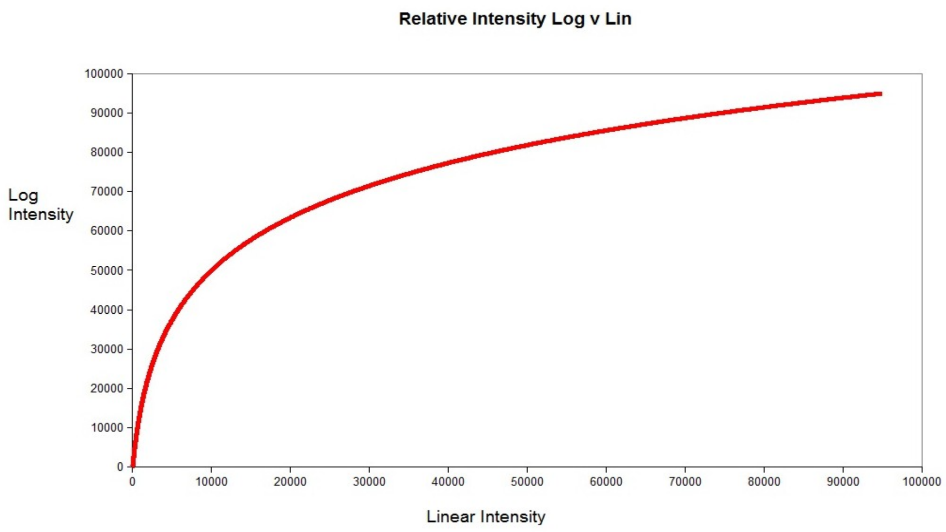

Figure 3a. Intensity for the LED Analyser in LOGARITHMIC Mode

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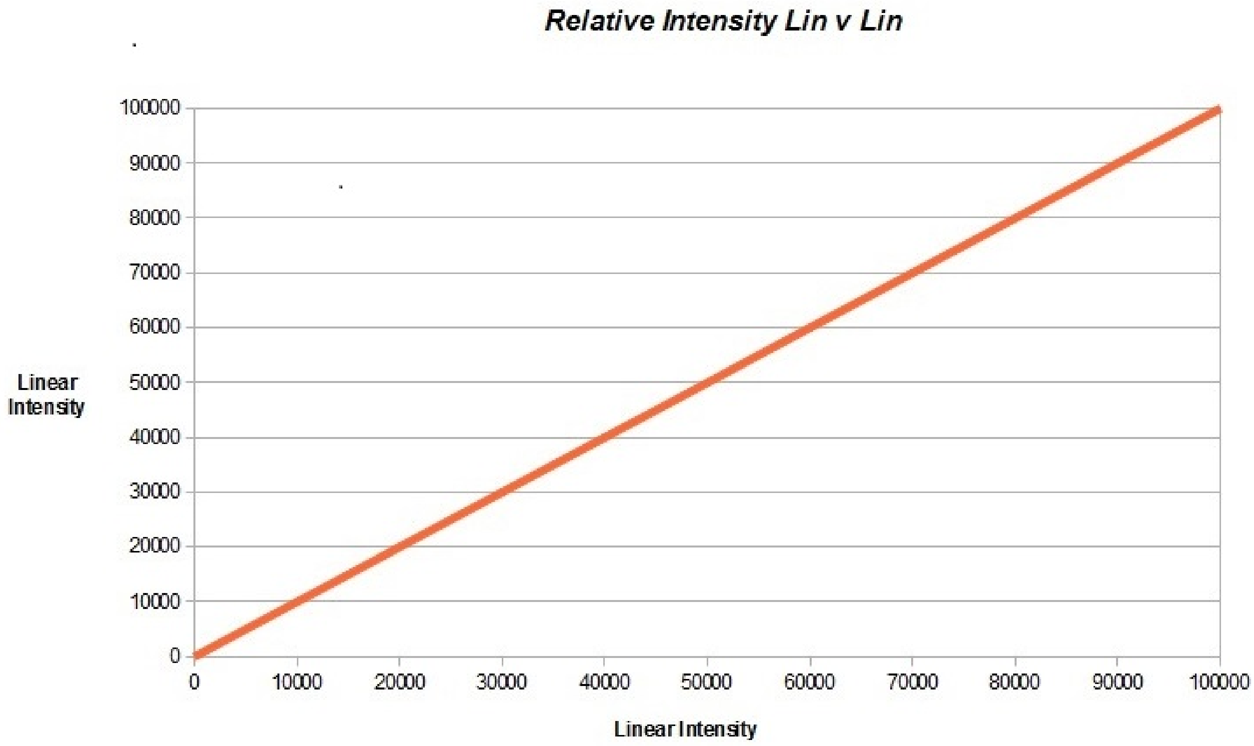

Figure 3b. Intensity for the LED Analyser in LINEAR Mode

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Photopic Response

For everyday light levels, the photopic luminosity function best approximates the response of the human eye. The photopic curve is the CIE standard curve used in the CIE 1931 color space.

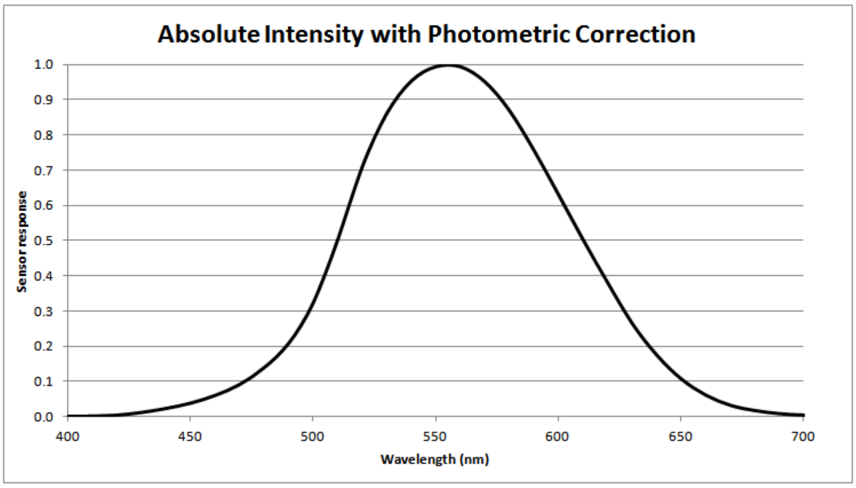

Figure 3c

The Led Analyser is shipped from the factory in this mode. This corrects the Absolute Intensity to reproduce the photometric response (for lm, mcd). This can be verified by typing the command *getphotopic* with the answer 1. The Analyser can be set in this mode by using the command *setphotopic1.*

The photopic mode can be set for a radiometric response by sending the command *setphotopic2.* This corrects the Absolute Intensity to reproduce the radiometric response (for mW). This can be verified by typing the command *getphotopic* with the answer 2.

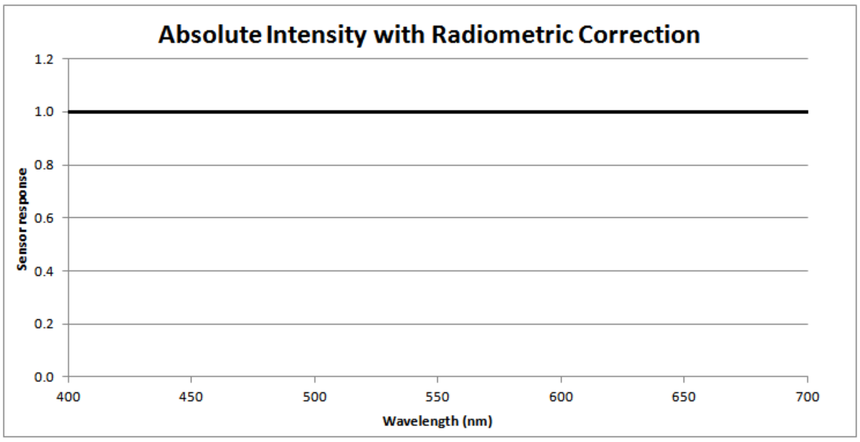

Figure 3d.

The user also has the option to turn the photopic response off *setphotopic0.* With the Analyser in this mode there is no effect on Absolute Intensity. This can be verified by typing the command *getphotopic* with the answer 0. **This command is only available on Software Rev F210 upwards**

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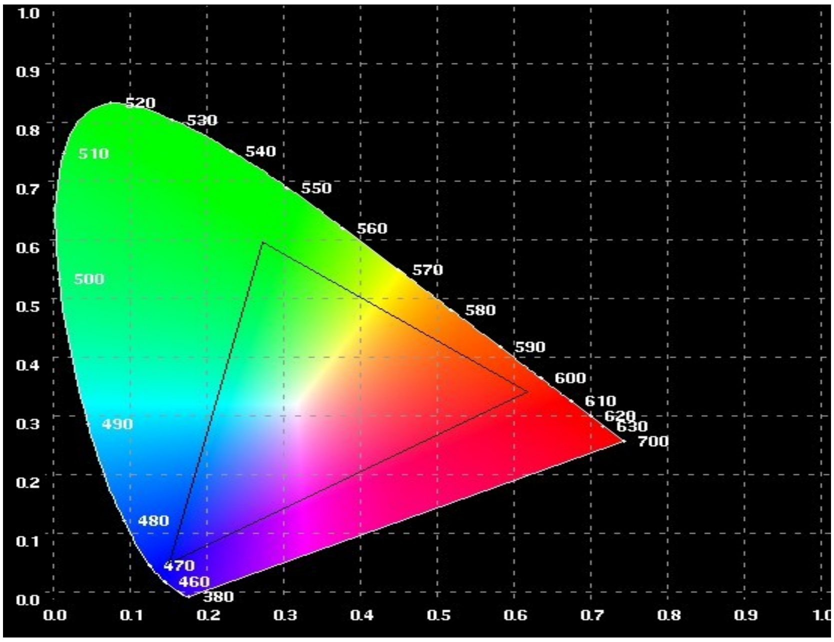
White LED's

White LED's must be treated differently to coloured LED's when being tested. White is not a colour – it is a mix of all other colours. The three Primary colours Red, Green and Blue will be mixed in approximately equal proportions to display a White Colour. The Saturation values must be used when testing White LED's. The Saturation is a value between 0% and 100%. A value of 0% indicates a pure white and a value of 100% indicates a pure Colour.

In reality, the Saturation value of white LED's vary significantly with values of 30% being typical. Remember, the Saturation value is an indication of how white the LED is.
The correct values must be determined experimentally with the particular LED's to be tested.

Most LED manufacturers will specify their White LED's using Chromaticity co-ordinates xy*.* This is a two-dimensional Chart with x on the horizontal axis and y on the vertical axis. The range of x and y lies between 0 and 1.



y

x

Figure 4. CIE 1931 Chromaticity Co-Ordinates

White LED's will have approximate co-ordinates of 0.33, 0.33. This may vary depending on the manufacturer of the LED where some LED's will have a Blue tint (cool white) and the other LED's will have a Red tint (Warm White).

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Setting Tolerance Limits for Colour and Intensity

The test procedure requires the user to set the Pass/Fail limits for Colour and Intensity for each LED which then becomes the standard against which LEDs to be tested are compared. The Pass/Fail limits for Colour are chosen, in conjunction with manufacturer's specifications, from measurements taken from a sample number of typical LEDs.
Because Hue is expressed as a single number it is more convenient to set the limits for the colour in terms of their Hue value.

Sample Hue Pass/Fail Limits

LED	Minimum	Maximum
Red	0	2
Green	110	130
Blue	220	250
Amber	2	10
Yellow	80	110
Orange	10	20

The Saturation value must be taken into account when testing White LED's. The Saturation is a value between 0% and 100%. A pure white will have a value close to 0% while a pure colour will have a value close to 100%. The Pass/Fail limits for intensity are chosen from the average intensity values from a number of sample LEDs.

Sample Intensity Pass/Fail Limits in Auto Mode

Relative Intensity Value	Upper Limit	Lower Limit	Comments
125	150	100	This represents a Very Dim LED, Recommend using Manual Capture Range C1, C2 or C1PWM, C2PWM
20000	25000	16000	This represents an Average LED, Recommend using Manual Capture Range, C2, C3 or C2PWM, C3PWM
70000	85000	55000	This represents a Bright LED, Auto capture use is OK but Manual Range C3, C4, C5 or C3PWM, C4PWM, C5PWM would be recommended.

Figure 5.

Note:- the Relative Intensity Value will depend on the Range selected.
Note:- Feasa recommends selecting a Capture Range to achieve Relative Intensity Reading of 55K to 85K for the best results.

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Physical Layout

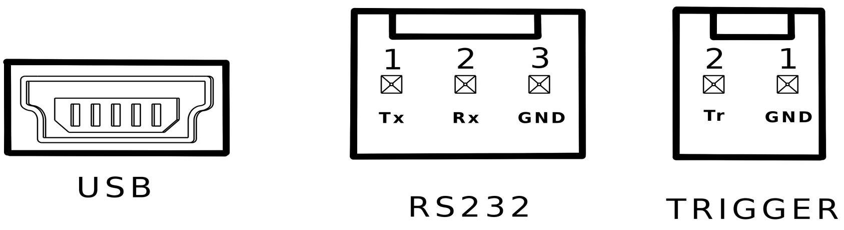

Figure 6a (Front Panel).

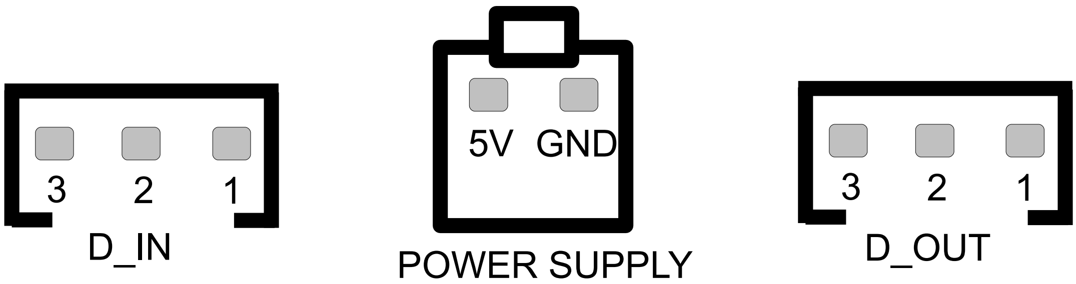

Figure 6b (Rear Panel).

This shows the layout of the Connectors viewed from the edge of the board.

Figure 6a shows the physical layout of the Feasa x-F, x-FB and x-LT Analyser Front Panels.
Figure 6b shows the physical layout of the Feasa x-F, x-FB and x-LT Analyser Rear Panels.

These units are enclosed in an Aluminium Case. The Serial port is a 3 pin connector with the Serial and Power cables supplied and the USB connector is the mini usb again the cable is supplied with the unit.

Please refer to the Fixturing Guidelines Manual for connector pin out details.

USB Port Control

Connect the LED Analyser to the PC using the supplied USB cable.

Power is supplied through the USB Cable so there is no need to plug in the Power cable.

The installed Software Driver will configure the USB Port automatically.

The USB Port is configured as a Virtual Com Port and will be designated a name such as COM5, COM6, etc.

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Serial Port Control (RS232)

For serial communications the LED Analyser must be connected from the 3-pin Serial Connector to the PC or Controller using the supplied serial cable (LA-SER-02).

5VDC @ 200mA must be supplied to the 2-pin Power Connector using the Power Cable provided (LA-PWR-01). See figure 7. ***Prolonged Voltages > 7V can damage the Analyser.***

The Green LED should turn on to indicate the Analyser is ready for use.

The default serial communications settings are **57,600 Baud, 8 Data bits, 1 Stop bit and No Parity**.

The baud rate can be changed to any of the following:- 9600, 19200, 38400, 57600, 115200. See the setbaud command for more details.

Serial Connector (RS232C)

Pin	*Signal*	*Pin on 9-Pin D-type*
1	Tx from LED Analyser	2
2	Rx from LED Analyser	3
3	GND	5

Power Connector

Pin No	*Signal*
1	Power (5V 200mA DC)
2	GND

Figure 7.

Please Ensure the RS232 GND (pin3) and the PSU GND are connected together.

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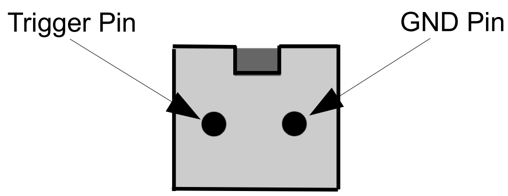
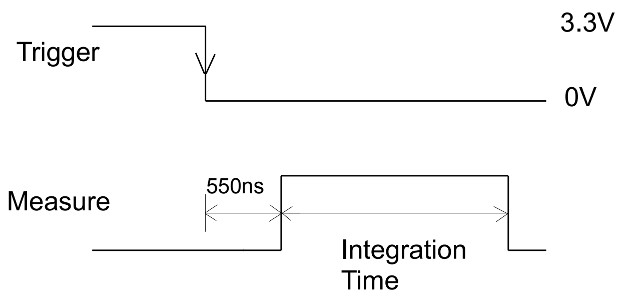
Trigger Port Control

The Feasa Led Analyser includes a Trigger function that allows an external signal to trigger a capture. For Trigger Function to operate the LED Analyser must be connected from the 2-pin Trigger Connector to the PC or Controller using the supplied serial cable (LA-TR-01). The Trigger function must first be enabled by sending commands to the Led Analyser. The capture is triggered by a high-to-low transition on the Trigger Pin. See the **External Trigger Mode** section of this manual for the programming details.



The layout of the Trigger Connector is shown above. The trigger is activated on the Trigger Pin. This pin has an internal pull-up resistor to 3.3V. The Trigger is activated by driving this pin to GND. The Trigger timing sequence is shown below.



When the Trigger is activated there is a 550ns +/- 50ns delay before the light capture begins. The commands must be transmitted through the USB or Serial Port of the Led Analyser. The Feasa Terminal program can be used to perform this task.

Trigger Connector

Pin	***Signal***
1	Trigger Pin
2	GND

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Capture Commands

The Capture commands are used to capture the parameters (colour, saturation, intensity, xy, uv, wavelength, cct) of the LED's to be tested and store the results in the memory of the Analyser.

These results can be read out later using the ***GET DATA*** commands.

Commands are transmitted and received using ASCII characters and are **NOT case-sensitive**. All commands must be terminated with a **<CR>** or **<LF>** character. All responses from the Led Analyser are also terminated with <**CR**> <**LF**>

The **Terminal Program** supplied on the CD is used to send/receive commands to/from the Analyser. This program is also available as a drop down box in the **User** program and the **Test** Software program.

The **Feasa LED Analyser USER** Program is a graphical tool that can be used to send commands and receive results from the Analyser. It allows one LED to be tested at a time. This Program also allows a Terminal Window to be opened so that the User can type the commands directly and send them to the Analyser. The responses from the Analyser can be observed in the Window.

The **Feasa LED Analyser TEST** Program allows the User to test all the LED's together. Pass and Fail limits can be set and results can be printed and logged.

Alternately, the User may generate a customised Program that sends commands and receives data through the virtual USB Com Port or RS232 Serial Port.

Capture Times Static Leds

The Capture Time for each range is outlined on the following Table.

Range	Capture Time
Range 1 low	650ms
Range 2 medium	200ms
Range 3 high	22ms
Range 4 super	4ms
Range 5 ultra	2ms
Auto Range	350ms

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Capture Mode

AUTO CAPTURE - Store LED Data

Transmit	Receive
capture **c**	**OK** **OK**

Description

This Auto Range Capture instructs the LED Analyser to capture and store the data of all the LED's positioned under the fibers. The Analyser automatically determines the correct settings to capture the LED data based on the Intensity. In the case of a 20 channel unit the data for all 20 LED's are captured simultaneously and stored in internal memory of the LED Analyser. The data is stored until the power is removed or another **capture** command is issued. When completed the Analyser will transmit the character **OK** on the receive line to the transmitting device (i.e. the PC).

This command uses a wide Intensity range to be able to test dim and bright LED's simultaneously. However, if the LED's to be tested are of similar Intensity then better results will be obtained by using the *Capture#* command described on the next page.

Example:

The PC transmits **capture** to the LED Analyser and the LED Analyser sends **OK** to the PC to acknowledge that the command is completed.

capture
OK

or

C
OK

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Capture Mode

MANUAL CAPTURE - Store LED Data for a specific range

Transmit	Receive
capture# **c#**	**OK** **OK**

Where:
represents the ranges 1, 2, 3, 4, 5.

The LED brightness level for each range is as follows:-
Range 1 = Low
Range 2 = Medium
Range 3 = High
Range 4 = Super
Range 5 = Ultra

Description
This command uses a pre-selected exposure time designated Range1, Range2 etc. For low light or dim LED's use Range 1 and for brighter LED's use higher ranges. The higher ranges lead to faster test times because the exposure time is shorter.
This command instructs the LED Analyser to read and store the Colour and Intensity of all the LED's positioned under the fibers using a fixed range.

The range setting must be specified. The data is stored until the power is removed or another **capture#** command is issued. When completed the Analyser will transmit the character **OK** on the receive line to the transmitting device (i.e. the PC).

Example:
The PC transmits **capture#** to the LED Analyser and the LED Analyser sends **OK** to the PC to acknowledge that the command is completed.

capture2
OK

or

c2
OK

There are 5 manual capture ranges each with an intensity output range of 0 to 99,999. Feasa recommends that the UUT readings should be in the 55K to 85K range for the best stability.

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Capture Mode

Capture Times PWM Leds

The Capture Time for each range is outlined on the following Table.

Range	Capture Time
Range 1 low C1PWM	4.5s
Range 2 med C2PWM	3.5ms
Range 3 high C3PWM	2.5s
Range 4 super C4PWM	500ms
Range 5 ultra C5PWM	250ms
Auto Range CPWM	2 s

AUTO CAPTUREPWM - Store PWM LED Data

Transmit	Receive
capturepwm **cpwm**	**OK** **OK**

Description
Pulse-Width-Modulated(PWM) LED's are switched on and off rapidly to save power and to control Intensity. The Analyser automatically determines the correct settings required to execute the test.
This command uses the *auto-ranging* feature and a pre-set *averaging factor* to capture the LED data. This command is useful if it is required to test very dim and very bright PWM LED's together.
The command instructs the LED Analyser to read and store the Colour and Intensity of all the LED's positioned under the fibers. The data is stored until the power is removed or another **capture** command is issued. When completed the Analyser will transmit the character **OK** on the receive line to the transmitting device (i.e. the PC).

Example:
The PC transmits **capturepwm** to the LED Analyser. The Analyser sends **OK** to the PC to acknowledge that the command is completed.
capturepwm
OK
or
cpwm
OK

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Capture Mode

MANUAL CAPTUREPWM - Store PWM LED Data for a specific Range

Transmit	Receive
capture#pwm@@ **capture#pwm**	**OK** **OK**

Where:

\#	represents the exposure Range 1 – 5.
@@	represents an averaging factor in the range 1 - 15.
@@	If the @@ digits are omitted then a default setting of 07 is used.

Description

This command allows the User to specify the *exposure range* ***#*** and an *averaging factor* **@@** when testing PWM LED's. Select the *exposure range # (1-5) to match the* ***Intensity*** *of the LED's.* The Analyser tests these LED's by taking a number of readings and averaging the results. A larger Averaging factor will lead to more stable results but increased Test Times. The *averaging factor* @@ is a number in the range 1-15. If this number is omitted from the command the default value is 07.

This command instructs the LED Analyser to read and store the Colour and Intensity of all the LED's positioned under the fibers. The data is stored until the power is removed or another **capture** command is issued. When completed the Analyser will transmit the character **OK** on the receive line to the transmitting device (i.e. the PC).

capture1pwm10
OK

or

c1pwm10
OK

There are 5 manual capture ranges each with an intensity output range of 0 to 99,999. Feasa recommends that the UUT readings should be in the 55K to 85K range for the best stability.

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Capture Mode

CAPTUREMULTI - Multiple Capture Command

Transmit	Receive
setrange@@#	**OK**
putrange@@#	**OK**
getrange@@	**1 to 5**
capturemulti	**OK**

Where:

@@ represents the fiber number in the range 01 – 20.
# represents the capture range 1 - 5

Description

The *capturemulti* or *cm* command will capture the LED data for the specified fiber at the specified range.

The setrange@@# or *putrange@@#* commands will set the required range for each declared individual fiber. The *getrange@@* will return the range the user has enables for this fiber.

Example:

The DUT has 5 leds with 5 very different intensity values. You can now specify fiber 1 to range Ultra (C5), Fiber 2 to range Super (C4), Fiber 3 to range High (C3), Fiber 4 to range Medium (C2) and Fiber 5 to range Low (C1). Do one *capturemulti* or *CM* command to get your 5 readings.

Putrange015 (Fiber 1, Range Ultra / 5)
putrange024 (Fiber 2, Range Super / 4)
putrange033 (Fiber 3, Range High / 3)
putrange042 (Fiber 4, Range Medium / 2)
putrange051 (Fiber 5, Range Low / 1)
capturemulti

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Get Data Commands

The *get data* commands are used to read out the Colour, Saturation and Intensity data stored by the *capture* commands.

The data from the last *capture* command remains in memory until a new *capture* command is issued or the power is removed from the Analyser.

Commands are transmitted and received using ASCII characters and are **NOT case-sensitive**. All commands must be terminated with a **<CR>** or **<LF>** character.

Under Range Condition

An under range condition will occur when insufficient light from the LED reaches the sensor for the range selected. This will be indicated by **999.99 999 00000** for **HSI,**
000 000 000 00000 for **RGBI** and **0.0000 0.0000** for xy and uv.

If this condition occurs select the next **lower** range and test again.

Over Range Condition

An over range condition will occur when too much light from the LED reaches the sensor for the range selected by the switch. This will be indicated by **999.99 999 99999** for **HSI,**
255 255 255 99999 for **RGBI** and **0.0000 0.0000** for xy and uv.

If this condition occurs select the next **higher** range and test again.

Incorrect Capture Mode

An incorrect capture mode condition will occur when a blinking (pwm) light from the LED reaches the sensor when the Autorange C capture is selected. This will be indicated by **XXX.XX XXX XXXXX** for **HSI, XXX XXX XXX XXXXX** for **RGBI** and **X.XXXX X.XXXX** for xy and uv.

The manual Capture Ranges C1 – C5 are unaffected by this.

If this condition occurs in Software Rev F201 – F206 use the **CPWM** command instead of the **Capture** command.
For software Rev F207 upwards you can set the capture command to mimic the cpwm command by typing *setautopwm1*. This can be verified using the getstatus or getautopwm commands. To turn this function off type the command *setautopwm0*.

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Get Data Mode

getRGBI## - Get RGB and Intensity for a LED

Transmit	Receive
getrgbi## **getrgbiall**	**Rrr ggg bbb iiiii**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

rrr , ggg and **bbb** are the **red, green** and **blue** components of the LED Colour.
These values are normalized and are in the range 0 – 255.

iiiii represents the intensity value of the LED under Fiber xx. This 5-digit number is in the range 00000 – 99999. 00000 represents no Intensity or under range(i.e. the LED is off) and 99999 will represent over range or the LED is too bright.

Description

This command instructs the LED Analyser to return RGB and Intensity data for fiber ## (01-20) in format **rrr ggg bbb iiiii** where **rrr**, **ggg** and **bbb** are the red, green and blue components of the Colour. The **iiiii** value indicates the intensity value.
This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *getrgbiall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getrgbi05** to the LED Analyser to instruct it to send the stored Colour and Intensity data for the LED positioned under Fiber No 5. The LED Analyser will return a string **rrr ggg bbb iiiii** to the PC.

getrgbi05
006 230 018 06383

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Get Data Mode

getHSI## - Get Hue, Saturation and Intensity

Transmit	Receive
gethsi## **gethsiall**	**hhh.hh sss iiiii**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

hhh.hh represents the Hue (Colour) and is a number in the range 0.00 – 360.00.

sss represents the Saturation (whiteness) and is a number in the range 0–100.

iiiii represents the intensity value of the LED under fiber **##**. This 5-digit number is in the range 00000 – 99999. 00000 represents no Intensity or under range(i.e. the LED is off) and 99999 will represent over range or the LED is too bright.

Description

This command instructs the LED Analyser to return the Hue, Saturation and Intensity data for fiber ## (01-20) in format **hhh.hh sss iiiii** where **hhh.hh** represents the Hue(Colour), **sss** represents the Saturation(whiteness) and **iiiii** represents the intensity value of the LED under Fiber ##.

This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order using gethsi01. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *gethsiall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **gethsi05** to the LED Analyser to instruct it to send the stored Colour and Intensity data for the LED positioned under Fiber No 5. The LED Analyser will return a string **hhh.hh sss iiiii** to the PC.

gethsi05
123.47 098 06383

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Get Data Mode

getxy## - Return the xy Chromaticity values

Transmit	Receive
getxy## **getxyall**	**0.xxxx 0.yyyy**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

0.xxxx represents the x Chromaticity value
0.yyyy represents the y Chromaticity value

Description

This command is used to return the xy Chromaticity value for the LED under the Fiber number ##. This command is used for testing White LED's.

This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *getxyall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getxy01** to the LED Analyser to instruct it to send the stored xy Chromaticity data for the LED positioned under Fiber No 1. The LED Analyser will return a string **0.xxxx 0.yyyy** to the PC.

getxy01
0.6461 0.3436

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Get Data Mode

getxyi## - Return the xy Chromaticity & Relative Intensity values

Transmit	Receive
getxyi## **getxyiall**	**0.xxxx 0.yyyy IIIII**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

0.xxxx represents the x Chromaticity value
0.yyyy represents the y Chromaticity value
IIIII represents the Relative Intensity value

Description

This command is used to return the xy Chromaticity and Relative Intensity values for the LED under the Fiber number ##. This command is used for testing White LED's.

This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *getxyiall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getxyi01** to the LED Analyser to instruct it to send the stored xy Chromaticity and Relative Intensity data for the LED positioned under Fiber No 1. The LED Analyser will return a string **0.xxxx 0.yyyy 12345** to the PC.

getxyi01
0.6461 0.3436 03456

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Get Data Mode

getCIEXYZ## - Return the CIE 1931 XYZ Colour values

Transmit	Receive
getCIEXYZ@@	**0.0000e+00 0.0000e+00 0.0000e+00**

Where:

@@ represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

0.0000e+00 represents the X value
0.0000e+00 represents the Y value (Absolute Intensity *)
0.0000e+00 represents the Z value

Description
This Led Analyser is capable of measuring the CIE 1931 XYZ components. The **Y component** is the photometric magnitude corresponding to the brightness of the source and corresponds to the photometric quantity that was used to calibrate the LED Analyser.
When the Feasa Spectrometer and:
- the Integrating Sphere (SPxx) was used then the Photometric Quantity is - Luminous flux (in lm)
- or the Millicandela Head (CDxx) was used then the Photometric Quantity is - Luminous intensity (in cd)
- or the Luminance Head (LUxx) was used then the Photometric Quantity is - Luminance (in cd/m^2)

This can also be referred to as the Absolute Intensity. The command getCIEXYZ@@ is used to return the CIE XYZ Colour value for the LED under the Fiber number @@ after a Capture.

To achieve the XYZ values from the Led Analyser there are a couple of steps to follow:

* Calibrate each Channel/Fiber of the Led Analyser for **Absolute Intensity**.
* When Calibration is complete, do a **Capture** to ensure valid Data is stored in the memory of the LED Analyser
* The data for each LED can be read out one-at-the-time, in any order using the command **getciexyz@@**. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Example:

The PC transmits **getciexyz01** to the LED Analyser to instruct it to send the stored CIEXYZ Colour data for the LED positioned under Fiber No 1. The LED Analyser will return a string in the format **0.0000e+00 0.0000e+00 0.0000e+00** to the PC.

getciexyz01
1.2345e+04 9.8765e-01 5.6789e+03

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Get Data Mode

getUV## - Return the u'v' Chromaticity values

Transmit	Receive
getuv## **getuvall**	**0.uuuu 0.vvvv**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

0.uuuu represents the u Chromaticity value
0.vvvv represents the v Chromaticity value

Description

This command is used to return the u'v' Chromaticity value for the LED under the Fiber number ##. This command is used for testing White LED's. The u'v' values are derived from the xy Chromaticity co-ordinates including any xy offsets that may be applied.

This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *getuvall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getuv01** to the LED Analyser to instruct it to send the stored **uv** data for the LED positioned under Fiber No 1. The LED Analyser will return a string **0.uuuu 0.vvvv** to the PC.

getuv01
0.1809 0.4414

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Get Data Mode

getWAVELENGTH## - Get the Dominant Wavelength

Transmit	Receive
getwavelength## **getwavelengthall**	**XXX**

Where:

represents the Fiber Number and is a number in the range 1 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

xxx represents the dominant wavelength of the LED in nanometers.

Description

This command is used to get the value of the Dominant Wavelength for the LED under the Fiber number ##.
This command should be preceded by the **capture C** command to ensure valid LED data is stored in the memory of the LED Analyser. The **C1-C5** commands are available but are not as accurate. The data for each LED can be read out one-at-the-time, in any order.

Alternatively use the *getwavelengthall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getwavelength01** to the LED Analyser to instruct it to send the stored dominant wavelength for the LED positioned under Fiber No 1. The LED Analyser will return a string **xxx** to the PC.

getwavelength01
513

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Get Data Mode

getWI## - Get the Dominant Wavelength & Intensity

Transmit	Receive
getwi## **getwiall**	**XXX YYYYY**

Where:

represents the Fiber Number and is a number in the range 1 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

XXX represents the dominant wavelength of the LED in nanometers.
YYYYY represents the intensity of the LED.

Description

This command is used to get the value of the Dominant Wavelength for the LED under the Fiber number ##.This command should be preceded by the **capture C** command to ensure valid LED data is stored in the memory of the LED Analyser. The **C1-C5** commands are available but are not as accurate. The data for each LED can be read out one-at-the-time, in any order.

Alternatively use the *getwiall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getwi01** to the LED Analyser to instruct it to send the stored dominant wavelength & Intensity for the LED positioned under Fiber No 1. The LED Analyser will return a string **xxx yyyyy** to the PC.

getwi01
513 12345

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Get Data Mode

getWSI## - Get the Dominant Wavelength, Saturation & Intensity

Transmit	Receive
getwsi## **getwsiall**	**XXX SSS YYYYY**

Where:

represents the Fiber Number and is a number in the range 1 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

XXX represents the dominant wavelength of the LED in nanometers.
SSS represents the Saturation (whiteness) and is a number in the range 0–100.
YYYYY represents the intensity of the LED.

Description

This command is used to get the value of the Dominant Wavelength for the LED under the Fiber number ##. This command should be preceded by the **capture C** command to ensure valid LED data is stored in the memory of the LED Analyser. The **C1-C5** commands are available but are not as accurate. The data for each LED can be read out one-at-the-time, in any order.

Alternatively use the *getwsiall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getwsi01** to the LED Analyser to instruct it to send the stored dominant wavelength & Intensity for the LED positioned under Fiber No 1. The LED Analyser will return a string **xxx yyyyy** to the PC.

getwsi01
513 100 12345

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Get Data Mode

getCCT## - Get the Correlated Colour Temperature

Transmit	Receive
getcct## **getcctall**	**ccccc +/-d.dddd**

Where:

represents the Fiber Number and is a number in the range 1 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

ccccc represents the Correlated Colour Temperature of the LED.
d.dddd represents the perpendictular distance the LED is from the Plankian locus (*Delta E*). This result can be + or-

Description

This command is used to get the value of the Correlated Colour Temperature (CCT) for the LED under the Fiber number *#*.

This command should be preceded by the **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order.

Alternatively use the *getcctall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getcct01** to the LED Analyser to instruct it to send the stored Correlated Colour Temperature for the LED positioned under Fiber No 1. The LED Analyser will return a string **ccccc d.dddd** to the PC.

getcct1
04621 +0.0340

getCCT is NOT Valid when measuring pure color Leds (Red, Green, Blue). The output from the Analyser will report 0 for CCT and +0.5555 for delta uv.

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Get Data Mode

getINTENSITY## - Get the Relative Intensity

Transmit	Receive
getintensity## **getintensityall**	**iiiii**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

iiiii represents the intensity value of the LED under fiber ##. This 5-digit number is in the range 00000 – 99999. 00000 represents no Intensity or under range(i.e. the LED is off) and 99999 will represent over range or the LED is too bright.

Description

This command is used to get the Intensity value for the LED under the Fiber number. This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order using the getintensity## command or all data can be read simultaneously using the getintensityall command. Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *getintensityall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getintensity01** to the LED Analyser to instruct it to send the stored Intensity data for the LED positioned under Fiber No 1. The LED Analyser will return a string **iiiii** to the PC.

getintensity01
06734

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Get Data Mode

getABSINT@@ Get the Absolute Intensity Value of the Led under test.

Transmit	Receive
getabsint@@	**#.####e±##**

Where:
@@ represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

#.####e±## represents the Intensity reading

Description:

This command will allow the user to interrogate the Led Analyser to return the absolute Intensity Value for the Led under test at Fiber@@.

This command should only be used in conjunction with the Feasa LED Spectrometer. Absolute Intensity values must first be measured with the Spectrometer. The LED Analyser must then be calibrated with these values using the ***usercal*** program supplied with the Analyser.

Alternatively use the *getabsintall* command to read back the LED data for all 20 leds in one command.

Example:

Place fiber 01 over the Led to be tested. Using any of the **Capture** commands, capture the data for that Led. Type the command **getabsint01** and the analyser will respond with with the intensity reading in the format **#.####e±##**

getabsint01
2.5000e-02

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Get Data Mode

getSIGNALLEVEL## - Get the Relative Intensity in a percentage of the Range

Transmit	Receive
getsignallevel## **getsignallevelall**	**iii%**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
all represents the 20 Fibers in a Feasa 20F, or 3 Fibers in a 3F.

iii% represents the intensity value in percentage terms of the LED under fiber ##. This 3-digit number is in the range 001 – 100. 000% represents no Intensity or under range(i.e. the LED is off) and 999% will represent over range or the LED is too bright.

Description

This command is used to get the level of Intensity in percentage terms for each range for the LED under the Fiber number ##. This command should be preceded by a **capture** command to ensure valid LED data is stored in the memory of the LED Analyser. The data for each LED can be read out one-at-the-time, in any order.
Note: it is important for the PC to use 01, 02, 03, etc to indicate Fibers 1, 2 and 3, etc.

Alternatively use the *getsignallevelall* command to read back the LED data for all 20 leds in one command.

Example:

The PC transmits **getsignallevel01** to the LED Analyser to instruct it to send the stored Intensity data for the LED positioned under Fiber No 1. The LED Analyser will return **iii%** to the PC.

getsignallevel01
050%

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Get Data Mode

getFACTOR - Get the exposure Factor

Transmit	Receive
getfactor	**xx**

Where:

xx represents the exposure factor value 01 to 15. The default value is 01.

Description

This command is used to get the exposure factor value for all Fibers.
The default value set at the factory are 01. The values can be adjusted by the SetFactor command.

Example:

The PC transmits **getfactor** to the LED Analyser to instruct it to send the stored exposure factor for all Fibers. The default value is 01.

getfactor
01

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Get Data Mode

get7SEG#   - Get the value of a 7 Segment Display

Transmit	Receive
get7seg#	**x**

Where:
\#   represents the Number 1 or 2
x   represents the value of the display 0 - 9
Description
The LED Analyser can be used to test LED-based 7-Segment displays. To set up the LED Analyser to interrogate a single 7-Segment display, fit fibers labelled 1 to 7 over segments a-g on the 7-Segment display. See *Figure 28* .
To set up the LED Analyser to interrogate an additional 7-Segment display, fit fibers labelled 11 to 17 over segments a-g on the additional display.

To interrogate the digit displayed on the first 7-Segment Display send the command **get7seg1** to the LED Analyser. The LED Analyser will return the digit displayed. The LED Analyser will return the character **X** when the displayed value is not recognized **(0 to 9)**.
To interrogate the digit displayed on the second 7-Segment display send the command **get7seg2** to the LED Analyser. The LED Analyser will return the digit displayed. Again, the LED Analyser will return the character **X** when the displayed value is not recognized **(0 to 9)**.

Note:- it is not necessary to send any *capture* commands prior to using the **get7seg1** or **get7seg2** commands.

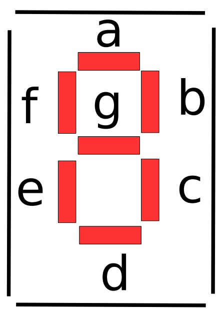

Figure 28.

Example:

The PC transmits **get7seg1** to the LED Analyser and the Analyser will return the value of the display.

get7seg1
6

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Get Data Mode

getAUTOPWM - Get which Auto Capture Mode is active C or CPWM

Transmit	Receive
getautopwm	**0 or 1**

Where: **0 is Standard Auto Capture (c) and 1 is PWM Auto Capture (cpwm)**

Description

This command will verify the Capture mode of the Analyser between Auto Capture (C) and Auto PWM Capture (CPWM).

Example:

Connect the Led Analyser to the Feasa Terminal Window and type getstatus. The Analyser will report Auto PWM Mode: OFF or type getautopwm and the Analyser will report 0.

Set a fiber over a Led to test and do an Auto Capture (C). If its a non-pwm Led the Analyser will report useable data for HSI, RGB or XY as requested. However if the LED is actually a PWM Led the Analyser will detect un-useable data in the form XXX. Type the command *setautopwm1* to change the capture mode. Repeat the test, The analyser will now mimic the c capture as a cpwm capture and report useable data. Doing a getstatus will now show Auto PWM Mode: ON or *getautopwm* will report a 1. It will remain in this mode until the user changes the mode by typing the command *setautopwm0*.

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Get Data Mode

getintensitymode - Get which Intensity Mode is active Logarithmic or Linear

Transmit	Receive
getintensitymode	**Log or Lin**

Where: **Log is the Logarithmic Mode and Lin is the Linear Mode**

Description

The Led Analyser is shipped from the factory in Logarithmic Mode. However it is possible to change the mode to Linear by using the commands set/putlin. To reset the analyser back to log mode use the command set/putlog.

Refer to pages 10,11 of this document for more details

Example:

Connect the Led Analyser to the Feasa Terminal Window and type getintensitymode. The Analyser will report the mode the Intensity output of the Analyser is set to.

Set the Analyser is Linear mode and verify.

putLin
getintensitymode
Linear

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Get Data Mode

getPHOTOPIC - Get which Photopic Mode is active

Transmit	Receive
getphotopic	**0 or 1 or 2**

Where: **0 is Photopic Response OFF**
1 is Response Photometric
2 is Response Radiometric

Description

The Led Analyser is shipped from the factory in photopic mode 1. This corrects the Absolute Intensity to reproduce the photometric response (for lm, mcd). This can be verified by typing the command *getphotopic* with the answer 1.

The photopic mode can be set to a radiometric response by sending the command *setphotopic2.* This corrects the Absolute Intensity to reproduce the radiometric response (for mW)

This command is only available on Software Rev F210 upwards

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General Commands

getBAUD- Get the Baud Rate

Transmit	Receive
getBAUD	**X bps**

Where: **X** = 9600, 19200, 38400, 57600, 115200 for **Serial RS232 Port**

Where: **X** = 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 for **USB Port**

Description

This command will get the baud rate of the Serial and USB Port's that the Analyser is communication through.

The default Port settings of the Analyser are 57,600, 8 Data bits, 1 Stop bit and No Parity.

It can also be seen on the comment section of the Feasa terminal window.

Example:

To get the baud rate of the Analyser transmit the command **getbaud** to the Analyser.

getbaud
57600 bps

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General Commands

getHW - Get the Hardware Version

Transmit	Receive
getHW	**Feasa XX-YY**

Where: XX-YY is an alphanumeric value.

Description

This command will return the hardware version the Analyser.

Example:

The PC transmits **gethw** to the LED Analyser an it will return **Feasa XX-YY** to the PC.

gethw
Feasa 20-F
or
Feasa 20FB

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General Commands

getSTATUS - Get a summary of the Led Analyser details

Transmit	Receive
getstatus	**See details below**

Information Received back from the Analyser:

Hardware: Feasa xx-y
Serial number : Xyyy
Firmware Version : Iyyy
Intensity Mode : Logarithmic
Photopic response: ON
Exposure Factor : 01
Capture : Manuel 04
Auto PWM mode: OFF
Number of Fibers : 05
External Trigger status: Disabled
Colour Gains: xxx xxx xxx
End of Transmission Character: Disabled
Selected calibration set: 00
user calibration date: dd/mm/yyyy
Factory calibration date: dd/mm/yyyy

Description
This command will return a summary of the Led Analyser details.

Example:
The PC transmits **getstatus** to the LED Analyser and it will return to the PC.

Led Analyser STATUS
Hardware: Feasa 20-F
Serial Number : J001
Firmware Version :F123
Intensity Mode : Logarithmic
Photopic response: ON
Exposure Factor: 01
Last Capture : Manuel 04
Auto PWM Mode: OFF
Number of Fibers : 20
External Trigger Status: Disabled
Colour Gains: 100 150 100
End of Transmission Character: Disabled
Selected calibration set: 0
User Calibration Date: 01/01/2015
Factory calibration date: 23/10/2016

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General Commands

getSERIAL Get the Serial Number of the Analyser

Transmit	Receive
getSerial	**xxxx**

Where: xxxx is an alphanumeric value. (Always 4 characters)

Description

This command will return the Serial Number of the Analyser. This is a unique number and is useful if multiple LED Analysers are used in a System. The Controlling Software can query each LED Analyser for it's Serial Number to ensure the correct Analyser is being controlled.

Example:

The PC transmits **getserial** to the LED Analyser an it will return **xxxx** to the PC.

getserial
75A6

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General Commands

getVERSION - Get the Firmware Version

Transmit	Receive
getVersion	**xxxx**

Where: xxxx is an alphanumeric value. (Always 4 characters)

Description

This command will return the Version Number of the firmware in the Analyser.

Example:

The PC transmits **getversion** to the LED Analyser an it will return **xxxx** to the PC.

getversion
F122

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General Commands

EOT - *End of Transmission* ***Character***

Transmit	Receive
enableeot **disableeot**	**See details below**

Description

Every command sent to the LED Analyser or response received from the Led Analyser, ends with a set of characters that indicates that the command or response has finished. Those characters are CR + LF, which are ASCII characters 13 and 10 respectively. Alternatively, responses from the LED Analyser can also have an end-of-transmission format like CR + LF + EOT, which are the ASCII characters 13, 10 and 04 respectively. CR + LF are always present, but character EOT can be enabled or disabled using the commands ENABLEEOT and DISABLEEOT. Having EOT character enabled can be extremely useful in multi-line commands, since this allows to differentiate between the end of a line and the end of a transmission.

The EOT command is disabled by default. To enable EOT simply send the command enableeot using Feasa Terminal software. The Analyser will maintain the EOT state even when powered off. To disable the state just send the command disableeot.

Information Received back from the Analyser using the **getstatus** command is as follows:

Hardware: Feasa xx-y
Serial number : Xyyy
Firmware Version : Iyyy
Intensity Mode : Logarithmic
Photopic response: ON
Exposure Factor : 01
Capture : Manuel 04
Auto PWM mode : OFF
Number of Fibers : 05
External Trigger status: Disabled
Colour Gains: 100 150 100
End of Transmission Character: **Disabled**
Selected calibration set: 0
user calibration date: dd/mm/yyyy
Factory calibration date: dd/mm/yyyy

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General Set/Put Commands

General Set / Put Commands

IMPORTANT INFORMATION for Programmers

set / put Commands

The *Set / Put* commands are used to adjust various settings in the LED Analyser such as Intensity, Exposure and offsets.

The *Set* commands are written to the on-board Flash.

These settings remain programmed in the Analyser even when the power is removed.
The Led Analyser has a capacity limit of approximately 100,000 writes to the flash.

Use the Set command only to store relevant information on the Led Analyser. Please refrain from using *Set* commands in your high volume production programs as this constant writing to the Flash will eventually corrupt the Led Analyser. Use the Put command instead.

The *Put* commands are written to the on-board RAM.

These settings will NOT remain programmed in the Analyser after the power is removed.

Use the Put command as often as you need in your program. This will prolong the life of the Led Analyser particularly in high volume testing environment.

Commands are transmitted and received using ASCII characters and are **case-insensitive**.
All commands must be terminated with a **<CR>** or **<LF>** character.

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Set Data Mode

set/putFACTOR## - Set the Exposure Factor

Transmit	Receive
setfactor## **putfactor##**	**OK** **OK**

Where:

represents the Factor Number and is in the range 01 – 15 (default 01).

Description

This command allows the user to adjust the *Exposure Factor* for **all** Fibers.
This is useful when it is required to test very dim LED's. The Factory default setting is 01. The value can be adjusted from 01 to 15. The exposure time will be increased when the factor is increased which will lead to longer test times and higher Intensity readings, For Example.

Capture Range	Factor 01 / Intensity	Factor 05 / Intensity	Factor 10 / Intensity	Factor 15 / Intensity
C3 (High)	22ms / 23K	110ms / 50K	220ms / 64K	330ms / 72K

Try using the lowest capture range first (c1) before adjusting the Exposure Factor.

These set values are stored permanently in memory and can only be changed by using the *setfactor* command again, power on/off will NOT effect the set Factor.

The put values are stored in RAM memory and must be changed by using the *putfactor* command each time after Power On/Off.

The current value can be read out using the getfactor command.

Example:
Set the Factor Number for all Fibers to 05.
setfactor05
OK

Example:
Set the Factor Number for all Fibers to 05.
putfactor05
OK

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Set Data Mode

set/putLOG - Change the Intensity Response of the Analyser to Logarithmic mode

Transmit	Receive
setlog **putlog**	**OK** **OK**

Description

This command will change the Intensity Response of the Analyser to measure in Logarithmic mode. All Analysers shipped from the factory are set in Log mode.

Please refer to the Intensity Section of this document page 8 Intensity

The set command is stored permanently in memory and can only be changed by using the *setlog* command again, power on/off will NOT effect the setlog

The put values are stored in RAM memory and must be changed by using the *putlog* command each time after Power On/Off.

Example:
setlog
OK

Example:
putlog
OK

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Set Data Mode

set/putLIN - Change the Intensity response of the Analyser to Linear Mode

Transmit	Receive
setlin **putlin**	**OK** **OK**

Description

This command will change the Intensity Response of the Analyser to measure in Linear mode. All Analysers shipped from the factory are set in Log mode.

Please refer to the Intensity Section of this document page 8 Intensity

The set command is stored permanently in memory and can only be changed by using the *setlin* command again, power on/off will NOT effect the setlin

The put values are stored in RAM memory and must be changed by using the *putlin* command each time after Power On/Off.

Example:
setlin
OK

Example:
putlin
OK

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General set/put Commands

setBAUD - Change the baud rate

Transmit	Receive
Setbaudxxxxx	**OK**

Where: **X** = 9600, 19200, 38400, 57600, 115200 for **Serial RS232 Port**

Where: **X** = 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 for **USB Port**

Description

This command will change the baud rate of the Serial and USB Port's in the Analyser.

The default Port settings of the Analyser are 57,600, 8 Data bits, 1 Stop bit and No Parity.
If an incompatible baud rate is selected the Analyser will not respond. Please disconnect and reconnect the Analyser to return the Analyser to the default 57600 bps. A correct baud rate selected will remain stored in memory even after power off.
The command getbaud will return the set baud rate. It can also be seen on the comment section of the Feasa terminal window.

Test times are improved by increasing the baudrate from the default to higher values and this can be further enhanced by decreasing the latency (windows default 16) to latency of 1. Refer to the App Note in the documentation folder of the CD to carry out this.

Example:

To change the baud rate to 19,200 transmit the command **setbaud19200** to the Analyser .

setbaud19200
OK

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General set/put Commands

setAUTOPWM# - *Change the Auto Capture mode to Auto PWM Mode*

Transmit	Receive
setautopwm#	**OK**

Where: **# = 0 for OFF and 1 for ON,**

Description

This command will change the Auto Capture mode of the Analyser from an Auto Capture to an Auto PWM Capture should the Led Analyser detect a blinking Led.

Example:

Connect the Led Analyser to the Feasa Terminal Window and type getstatus. The Analyser will report Auto PWM Mode: OFF. Set your fiber over a Led and do an Auto Capture (C). If its a standard Led the Analyser will report useable data for HSI, RGB or XY as requested. However if the LED is actually a PWM Led the Analyser will detect un-useable data in the form XXX. To compensate for for this type the command *setautopwm1* to change the capture mode. Repeat the test, The analyser will now mimic the c capture as a cpwm capture and report useable data. Doing a getstatus will now show Auto PWM Mode: ON or *getautopwm* will report a 1. It will remain in this mode until the user changes the mode by typing the command *setautopwm0*.

This command is only available on Software Rev F207 upwards

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Get Data Mode

setPHOTOPIC - Set which Photopic Mode you require

Transmit	Receive
setphotopic#	**OK**

Where #: **0 is Photopic Response OFF**
1 is Response Photometric (Default from the Factory)
2 is Response Radiometric

Description

The Led Analyser is shipped from the factory in photopic mode 1. This corrects the Absolute Intensity to reproduce the photometric response (for lm, mcd). This can be verified by typing the command *getphotopic* with the answer 1.

The photopic mode can be set to a radiometric response by sending the command *setphotopic2.* This corrects the Absolute Intensity to reproduce the radiometric response (for mW)

The photopic mode can be turned OFF by sending the command *setphotopic0.* With the Analyser in this mode there is no effect on Absolute Intensity.

This command is only available on Software Rev F210 upwards

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User Calibration Mode

Introduction:

The user calibration mode function allows up to 51 (00 to 50) different calibration sets to be simultaneously stored on the Led Analyser. The Analyser is shipped from the factory in set mode 00. setcalibration## (## is 00 to 50) will enable which set you want to work in. While in this mode you can vary the Relevant Intensity, Absolute Intensity, xy offset, wavelength offset, and RGB gains and then save them in that *version* or *set.* The date of this user calibration can also be saved using the command setcalibrationdatedd/mm/yyyy. Using the getstatus or getcalibrationset commands the Led Analyser will display which user calibration set you are enabled in and also the date you set it up.
For example if you are testing a board which has 2 different led Colour options you could setcalibration01, adjust your gains or offsets as necessary and proceed to test your version 01 board. setcalibration02 and now adjust you gains or offsets as necessary for your other version of the board and proceed to test your version 02 of the board. The user calibration date for each set can be saved also.

Before doing the Calibration, we recommend you select the proper capture mode and range for the Leds you are testing. **Standard Capture** (C, C1, C2….) mode is recommended for static Leds whereas **Capture PWM** (eg. c2pwm05) is recommended for RGB LEDs that are pulsing.

Select the relevant **Range** (Low, Medium High, Super & Ultra) by measuring the Led color to be measured in the production. Ensure the **signal level is > 30 %** in order to maximize the repeatability.

For PWM mode you also need to select the best **average factor** (00-15) by doing a repeatability analysis on the final colour. The higher the average number, the more repeatable the results will be, However the higher the average the longer the capture time will be required. The Feasa User software has a repeatability test analysis to help you on this task.

When this data is accumulated then proceed with the calibration. Feasa provide a program called UserCal on the CD to accomplish this process. However should you wish to undertake the process manually please refer to the procedure below.

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User Calibration Mode

This is a manual procedure to calibrate the Led Analyser. However we recommend to use the Feasa UserCal program provided on the CD. Each command is detailed in the section below.

UserCal Manual Procedure:

1. Select Calibration set
   - setcalibrationset## (00-50)

2. Reset Analyser to factory defaults:
   - resetusercal (Reset all parameters to Factory default)

3. Capture (auto, manual, pwm)
   - capture

4. Dominant Wavelength reading
   - getwavelength@@

   Dominant Wavelength Correction Offset
   - setwavelengthoffset@@##

5. Relative Intensity Reading for Fiber @@
   - getintensity@@

   Relative Intensity Correction Factor
   - setintgain@@###

6. CIE xy Reading for Fiber@@
   - getxy@@

   CIE Correction Offsets
   - setxoffset@@± 0.###
   - setyoffset@@± 0.###

7. Absolute Intensity Reading for Fiber@@
   - getabsint@@

   Absolute Intensity Correction Factor
   - setabsintmult@@1.00000e+00 (set the multiplier to 1)
   - capture (auto, manual, pwm)
   - getabsint@@ (get the absolute intensity using a multiplier of 1)
   - i.iiiie±00 (absolute intensity based on a multiplier of 1)
   - Divide the **Desired Intensity** by **i.iiiie±00** (result will be new multiplier m.mmmmmE±ee)
   - setabsintmult@@m.mmmmmE±ee (set the new multiplier to o/p the desired Absolute Int.)
   - getabsint@@ (get the absolute intensity using new multiplier)
   - #.####e±## (Absolute Intensity in Scientific Notation Format)

8. Set the user calibration date:
   - setcalibrationdatedd/mm/yyyy

Note1: you can skip the adjustment of a particular parameter if you don't need it.
Note2: if you require dominant wavelength and absolute intensity, make sure the wavelength correction is done first as it affects the absolute intensity readings.

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User Calibration Mode

set/putINTGAIN - Set the Intensity GainFactor

Transmit	Receive
Setintgain##xxx **putintgain##xxx**	**OK** **OK**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
xxx represents a 3 digit gain factor, default 100.

Description

This command allows the user to adjust the Intensity Gain Factor for each Fiber.
This is useful when it is required to balance all or some of the Fibers to give the same Intensity when testing similar LED's. The Factory default setting is 100 and the value for each Fiber can be adjusted from 050 – 200.

These set values are stored permanently in memory and can only be changed by using the *setIntGain* command again.

The put values are stored in RAM memory and must be changed by using the *putIntGain* command each time after Power On/Off.

The command *getIntGain* will display the current stored gain setting.

Example:

Set the Intensity gain for Fiber 1 to 095.
setintgain01095
OK

Example:

Set the Intensity gain for Fiber 1 to 095.
putintgain01095
OK

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User Calibration Mode

getINTGAIN## - Get the Intensity Gain Factor

Transmit	Receive
getIntGain##	**xxx**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
xxx represents the Intensity gain value. Default 100.

Description

This command is used to get the Intensity gain value for each Fiber.
The default values set at the factory are 100 i.e. 100% of nominal. The values can be adjusted by the SetIntGain command.

Example:

The PC transmits **getintgain01** to the LED Analyser to instruct it to send the stored intensity gain data for Fiber No 1.

getintgain01
100

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User Calibration Mode

set/putXOFFSET##0.xxx - Set the x Chromaticity Offset

Transmit	Receive
setxoffset##±0.xxx **putxoffset##±0.xxx**	**OK** **OK**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
0.xxx represents the x Chromaticity offset value (±0.000 – 0.300).

Description

This set command is used to set an offset to the displayed x Chromaticity value. The limit of the offset is ±0.300 which means values must be in the range ±0.000 – 0.300. This command is useful when the user wishes to set the x Chromaticity to be the same as that specified by the LED Manufacturer. The default value of the offset is 0.000. The offset is stored in non-volatile memory and will remain at the programmed setting until changed by a new *Setxoffset* command.

This put command is used to set an offset to the displayed x Chromaticity value. The limit of the offset is ±0.300 which means values must be in the range ±0.000 – 0.300. This command is useful when the user wishes to set the x Chromaticity to be the same as that specified by the LED Manufacturer. The default value of the offset is 0.000. The offset is stored in RAM memory and will remain at the programmed setting until changed by a new *Setxoffset* command or power OFF.

Example:
The PC transmits **setxoffset01+0.050** to the LED Analyser to instruct it to set the x offset on Fiber 01 to +0.050.

setxoffset01+0.050
OK

Example:
The PC transmits **setxoffset01+0.050** to the LED Analyser to instruct it to set the x offset on Fiber 01 to +0.050.

putxoffset01+0.050
OK

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User Calibration Mode

set/putYOFFSET##0.xxx - Set the y Chromaticity Offset

Transmit	Receive
setyoffset##±0.xxx	**OK**
putyoffset##±0.xxx	**OK**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
0.xxx represents the y Chromaticity offset value (±0.000 – 0.300).

Description

This set command is used to set an offset to the displayed y Chromaticity value. The limit of the offset is ±0.300 which means values must be in the range ±0.000 – 0.300. This command is useful when the user wishes to set the y Chromaticity to be the same as that specified by the LED Manufacturer. The default value of the offset is 0.000. The offset is stored in non-volatile memory and will remain at the programmed setting until changed by a new *Setyoffset* command.

This put command is used to set an offset to the displayed y Chromaticity value. The limit of the offset is ±0.300 which means values must be in the range ±0.000 – 0.300. This command is useful when the user wishes to set the y Chromaticity to be the same as that specified by the LED Manufacturer. The default value of the offset is 0.000. The offset is stored in RAM memory and will remain at the programmed setting until changed by a new *Setyoffset* command or power OFF.

Example:
The PC transmits **setyoffset01+0.050** to the LED Analyser to instruct it to set the y offset on Fiber 01 to +0.050.

setyoffset01+0.050
OK

Example:
The PC transmits **putyoffset01+0.050** to the LED Analyser to instruct it to set the y offset on Fiber 01 to +0.050.

putyoffset01+0.050
OK

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User Calibration Mode

getXOFFSET## - Return the x Chromaticity offset

Transmit	Receive
getxoffset##	**±0.xxx**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
±0.xxx represents the x Chromaticity offset

Description

This command is used to return the x Chromaticity offset for the LED under the Fiber number ##. The value of this offset must be set by the setxoffset## command. The default value is 0.000.

Example:

The PC transmits **getxoffset01** to the LED Analyser to instruct it to send the stored x Chromaticity offset for the LED positioned under Fiber No 1. The LED Analyser will return a string **±0.xxx** to the PC.

getxoffset01
+0.155

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User Calibration Mode

getYOFFSET## - Return the y Chromaticity offset

Transmit	Receive
getyoffset##	**±0.yyy**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
±0.yyy represents the y Chromaticity offset

Description

This command is used to return the y Chromaticity offset for the LED under the Fiber number ##. The value of this offset must be set by the setyoffset## command. The default value is 0.000.

Example:

The PC transmits **getyoffset01** to the LED Analyser to instruct it to send the stored y Chromaticity offset for the LED positioned under Fiber No 1. The LED Analyser will return a string **±0.yyy** to the PC.

getyoffset01
-0.025

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User Calibration Mode

set/putWAVELENGTHOFFSET@@±## - Set the wavelength Offset

Transmit	Receive
setwavelengthoffset##±xx **putwavelengthoffset##±xx**	**OK** **OK**

Where:

@@ represents the Fiber Number and is a number in the range 01 – 20.
xx represents the wavelength offset value (±99).

Description

This set command is used to set an offset to the wavelength value. The limit of the offset is ±99. This command is useful when the user wishes to set the wavelength to be the same as that specified by the LED Manufacturer. The default value of the offset is 00. The offset is stored in non-volatile memory and will remain at the programmed setting until changed by a new *setwavelengthoffset* command.

This put command is used to set an offset to the wavelength value. The limit of the offset is ±99. This command is useful when the user wishes to set the wavelength to be the same as that specified by the LED Manufacturer. The default value of the offset is 00. The offset is stored in RAM memory and will remain at the programmed setting until changed by a new *setwavelengthoffset* command or power OFF.

Example:

The PC transmits **setwavelengthoffset01-05** to the LED Analyser to instruct it to set the wavelength offset on Fiber 01 to -05.
setwavelengthoffset01-05
OK

Example:

The PC transmits pu**twavelengthoffset01-05** to the LED Analyser to instruct it to set the wavelength offset on Fiber 01 to -05.
putwavelengthoffset01-05
OK

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User Calibration Mode

getWAVELENGTHOFFSET@@ - Get the Dominant Wavelength Offset

Transmit	Receive
getwavelengthoffset@@	**+/-XX**

Where:

@@ represents the Fiber Number and is a number in the range 1 – 20.
+/- xx represents the wavelength offset set of the LED in nanometers.

Description

This command is used to get the value of the Dominant Wavelength Offset set for Fiber number @@.
The range of value that can be programmed is +/-99, however setting a value of greater than +/-10 would probably indicate an error in your measurement setup

Example:

The PC transmits **getwavelengthoffset01** to the LED Analyser to instruct it to send the programmed dominant wavelength offset for the LED positioned under Fiber No 1. The LED Analyser will return a string +/- **xx** to the PC.

getwavelengthoffset01
+07

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User Calibration Mode

set/putABSINTMULT@@ - Set the Absolute Intensity Multiplier Factor

Transmit	Receive
setabsintmult@@m.mmmmme+mm **putabsintmult@@m.mmmmme+mm**	**OK** **OK**

Where:

@@ represents the Fiber Number and is a number in the range 01 – 20.
m.mmmmme+mm represents the Absolute Intensity Multiplier Factor

Description

The command **setabsintmult@@m.mmmmme+mm** directs the LED Analyser to set the Absolute Intensity Multiplier Factor on Fiber @@ to m.mmmmme+mm

Example:
send the command **setabsintmult@@m.mmmmme+mm** to the LED Analyser to instruct it to set the Absolute Intensity Multiplier Factor on Fiber 3 to 1

setabsintmult031.00000e+00
OK

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User Calibration Mode

getABSINTMULT@@ Get the Absolute Intensity Correction Factor of the Led under test.

Transmit	Receive
getabsintmult@@	**#.####e±##**

Where:
@@ represents the Fiber Number and is a number in the range 01 – 20.
#.#####e+## represents the Absolute Intensity Correction Factor

Description:

This command will allow the user to interrogate the Led Analyser to return the absolute Intensity Correction Factor or Multiplier Value for the Led under test at Fiber@@.

Example:

Type the command **getabsintmult01** and the analyser will respond with with the Multiplier in the format **0.00000e+00**

getabsintmult01
0.00000e+00

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User Calibration Mode

setCALIBRATION## - Select the Calibration Set to use

Transmit	Receive
setcalibration## **putcalibration##**	**OK** **OK**

Where:
represents the set value (## can be 00 to 50).

Description

This command will select which calibration set you are accessing. The Led analyser is capable of storing fifty one (51) separate user Calibration sets on the board.

The command SETCALIBRATION## stores the Calibration sets both on RAM and on EEPROM (stays after power cycle but limits the number of *set* command operations to ~ 100K).

The command PUTCALIBRATION## only stores them on RAM and the analyser will default back to what values were stored in the EEPROM after a power cycle.

The default calibration set is 00

Example:
If you want to select set No.3
setcalibration03
OK

Example:
If you want to select set No.3
putcalibration03
OK

The command GETCALIBRATIONSET will return the number of which stored Calibration set of values are currently selected.

Example:

calibrationset03

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FEASA™

User Calibration Mode

getCALIBRATIONset - Select the Calibration Set to use

Transmit	Receive
getcalibrationset	**##**

Where:
represents the set value (## can be 00 to 50).

Description

This command will retrieve which calibration set you are accessing. The Led analyser is capable of storing fifty one (51) separate user Calibration sets on the board.

The command SETCALIBRATION## stores the Calibration sets both on RAM and on EEPROM (stays after power cycle but limits the number of *set* command operations to ~ 100K).

The command PUTCALIBRATION## only stores them on RAM and the analyser will default back to what values were stored in the EEPROM after a power cycle.

The default calibration set is 00

Example:
If you want to know what set is active
getcalibrationset

03

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User Calibration Mode

ResetUserCal##- Reset the standard usercal setting to factory default

Transmit	Receive
resetusercal##	**OK**

Where: ## is the calibration set number

Description
This command will reset the calibrationset back to factory default values. The Led analyser is capable of storing fifty one (00-50) separate user Calibration sets on the board. Each one must be reset separately.

The command resetusercal## resets the selected Calibration set to factory default.
The command resets:

- Absolute intensity factors to 0
- Relative intensity gains to 100
- xy and dominant wavelength offsets to 0
- User calibration date to 00/00/0000
- Reset RGB mode if selected and come back to standard mode
- Exposure factor to 1
- Log mode

of all the fibers in the user calibration set selected.

Example:
If you want to reset calibration set No.25
setcalibration25
OK
resetusercal
OK

The command GETCALIBRATIONSET will return the number of which stored Calibration set of values are currently selected.

Example:

calibrationset03

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User Calibration Mode

ResetRGBM - Reset the RGB usercal setting to factory default

Transmit	Receive
resetrgbm@@ **resetrgbmall**	**OK**

Where: @@ is the individual fiber number to be reset from 01-20
ALL will reset all 20 fibers in a specific calibration set

Description:

This command will reset the RGB calibration values (of the RGB calibration mode) to 0 for a particular fiber or for all fibers in a Calibration set. The Led analyser is capable of storing fifty one (00-50) separate user Calibration sets on the board. Each one must be reset separately.

Example:
If you want to reset RGB values for all fibers in calibration set No.25
setcalibration25
OK
resetrgbmall
OK

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User Calibration Mode

SetCalibrationDateddmmyyyy - Set the user Cal Date

Transmit	Receive
Setcalibrationdateddmmyyyy	**OK**

Where:

dd represents the 2 digit Day (01, 02....21, 30)
mm represents the 2 digit Month (01, 02...12)
yyyy represents a 4 digit Year. (2019)

Description

This command allows the user to input the Calibration Date for the Led Analyser. This command is used in conjunction with the user calibration set mode.

These dates are stored permanently in memory and can only be changed by using the *setcalibrationdate* command again.

The command *getcalibrationdate* will display the current stored Calibration Date setting and calibration mode settings.

Example:

Set the user Calibration Date for August 1st 2015.
setcalibrationdate01082015
OK

The commands *getcalibrationdate* *or* *getstatus* will display the current stored user Calibration Date and calibration set mode.

Example:

.
.
calibrationset3
user calibration date 01/08/2015

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User Calibration Mode

getcalibrationdate   Get the Calibration Date set by the user.

Description:

This command will allow the user to interrogate the Led Analyser to return the actual USER Calibration Date in the format dd/mm/yyyy. This is the date set by the user for a specific cal version.

Example:

Connect the Analyser to the Terminal Window and using the getcalibrationdate command, read the data for that Led. Type the command **getcalibrationdate** and the analyser will respond with with the user calibration date in the format **dd/mm/yyyy**

getcalibrationdate
21/01/2015

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User Calibration for RGB Leds

Notes:

The RGB user calibration mode function allows up to 51 (00 to 50) different calibration sets to be simultaneously stored on the Led Analyser. The Analyser is shipped from the factory in set mode 00. setcalibration## (## is 00 to 50) will enable which set you want to work in. While in this mode you can vary the RGB gains and then save them in that *version* or *set.* The date of this user calibration can also be saved using the command setcalibrationdatedd/mm/yyyy. Using the getstatus or getcalibrationset commands the Led Analyser will display which user calibration set you are enabled in and also the date you set it up.

For example if you are testing a board which has 2 different led Colour options you could setcalibration01, adjust your gains or offsets as necessary and proceed to test your version 01 board. setcalibration02 and now adjust you gains or offsets as necessary for your other version of the board and proceed to test your version 02 of the board. The user calibration date for each set can be saved also.

Feasa provide a program called UserCal on the CD to accomplish this process.

Before doing the RGB calibration, we recommend you select the proper capture mode and range for the Leds you are testing. **Standard Capture** (C, C1, C2….) mode is recommended for static Leds whereas **Capture PWM** (eg. c2pwm05) is recommended for RGB LEDs that are pulsing.

Select the relevant **Range** (Low, Medium High, Super & Ultra) by measuring the final color combination that is going to be measured in the production and also the Blue Led segment (Normally the Blue segment will have the highest Intensity) from the Led under test. Ensure the **signal level is > 30 %** in order to maximize the repeatability. Use the range which captures these Intensity levels best.

For PWM mode you also need to select the best **average factor** (00-15) by doing a repeatability analysis on the final colour. The higher the average number, the more repeatable the results will be, However the higher the average the longer the capture time will be required. The Feasa User software has a repeatability test analysis to help you on this task.

When this data is accumulated then proceed to the UserCal Program provided to set the RGB gains.

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External Trigger Mode

External Trigger Method:

Functional Led Analysers have a 2 pin input port (Tr) to activate an external trigger capture. Prior to activation the programmer must set the **External Trigger Capture mode** and the **External Trigger Output mode.** When set to the correct modes ***connecting*** pin 1 to pin 2 will activate a capture and output the relevant readings as selected. No External Voltages are required.

Transmit	Receive
Setexternalcapture## **Putexternalcapture##** **getexternalcapture**	**See details below**

Where **##** is as follows:

00 Disable Trigger
01 Capture1 or C1 (Range Low)
02 Capture2 or C2 (Range Medium)
03 Capture3 or C3 (Range High)
04 Capture4 or C4 (Range Super)
05 Capture5 or C5 (Range Ultra)
06 Capture or C (Range Auto)

10 Capturepwm or CPWM (Range Auto)
11 Capturepwm1 or CPWM1
12 Capturepwm2 or CPWM2
13 Capturepwm3 or CPWM3
14 Capturepwm4 or CPWM4
15 Capturepwm5 or CPWM5

50 Sequencecapture mode

Transmit	Receive
Setexternaloutput#### **Putexternaloutput####** **getexternaloutput**	**See details below**

Where **####** is as follows:

No output **setexternaloutputnone**
HSI **setexternaloutputhsi**
XYI **setexternaloutputxyi**
RGBI **setexternaloutputrgbi**
CCTI **setexternaloutputcct**
ABSINT **setexternaloutputabsint**
WSI **setexternaloutputwsi**

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Sequence Capture Mode:

Introduction

The Sequence Capture functionality of the LED Analyser allows the user to take multiple captures in rapid succession and store them in the LED Analyser. The results of these captures can be downloaded at any time after the capture sequence has been completed.

This feature is useful when testing LEDs, that when combined, are generating a visual pattern that the user can see. An example of this would be 'soft start' lighting when entering or exiting a vehicle. Another example is when testing the 'visual sweep' on sequential Indicators in vehicles.

The number of captures that can be stored in memory depends on the number of fibers used during the test. If all 20 fibers of a 20 Channel Analyser are used the maximum number of captures that can be stored is 3500. If a single fiber is used then the number of captures increases to 9999.

There are two ways to store commands in the Analyser – one way stores the command in RAM memory and the second way stores the command in Flash memory. When a command is stored in Flash memory it is not lost when power is removed from the Analyser. When the command is stored in RAM it will be lost when power is removed.

However, there is a limit to the number of write cycles to Flash memory so it is recommended to store commands that are being changed under program control in RAM memory.

Commands that begin with "***put***" will be stored in RAM while commands that begin with "***set***" will be stored in Flash memory.

All commands can use upper or lower case characters.

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Sequence Capture Mode

This is a simple procedure to use the Capture Sequence Mode in the Led Analyser. Each command is detailed in the following section.

Capture Sequence Procedure:

Assumption: Blinking Led sequence to be tested here is blink 1 second on 1 second off.

Setup: Place the Led Analyser Fiber and Optical Head over the Leds to be tested.

1. Open Terminal window

2. Connect the Led Analyser.

3. Setup the sequence parameters, wait for the OK reply in each case..

Type	-	putsequencemode#	(0 for All fibers, 1 for single fiber)
		putsequencechannel##	(*## is Fiber Number, Use ONLY if 1 above*)
	-	putsequencecapture100	(100ms, Capture Time depends on the Led Intensity)
	-	putsequencewait100	(100ms, Wait time between captures)
	-	putsequencenumber0050	(50, The number of captures or samples to store)

4. Perform a capture
   Type - CS (Capture Sequence, Based on the info above the total capture time here is 10seconds, (100ms+100ms)x 50captures))

5. Retrieve the Data.
   Type - gethsiall (This will return the Hue, Saturation, Intensity for all fibers, getxyiall, getwiall etc can be used as required.)

6. Interpret the data.
   The results will be listed in the terminal window in columns for each fiber showing the ON/OFF data.

7. Type - getfrequency## (## represents the fiber number)

8. Interpret the data.
   The result will show *000.5Hz 050.0%* (Frequency in Hertz, Dutycycle in %)

Note1: There are other data interrogation commands listed below.

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Sequence Capture Mode

Set/Put SequenceMode#   - Set sequence mode for Fibers

Transmit	Receive
setsequencemode# **putsequencemode#**	**OK** **OK**

Where:
represents the sequence mode and is a number in the range 0 – 1.

Description
This command is used to set the number of fibers that will be used in the capture sequence command. PutSequencemode***0*** will set ***all*** Fiber Channels for the Capture Sequence. PutSequencemode***1*** sets a ***single*** Fiber Channel for the capture sequence.

If *putsequencemode**1*** is selected the Fiber Channel must be set using the ***putSequenceChannel@@*** command. Also, when this mode is selected up to 9999 captures can be stored in memory.

If putsequencemode***0*** is selected the number of captures is limited to 3500.
putsequencemode# commands are stored in RAM memory while ***setsequencemode#*** commands are stored in Flash memory.

Example 1:
The PC transmits *putsequencemode0* to the LED Analyser to instruct it to do sequence capture on all Fibers. The LED Analyser will return a string **OK** to the PC.
putsequencemode0
OK

Example 2:
The PC transmits *putsequencemode1* to the LED Analyser followed by *putsequencechannel05* to instruct it to do sequence capture on Fiber No. 5. The LED Analyser will return a string **OK** to the PC.
putsequencemode1
OK
putsequencechannel05
OK

To determine which sequence mode is set, use the command ***getsequencemode****.* It will return a 1 or a 0.

getsequencemode

0   (All Fibers)

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Sequence Capture Mode

Set/Put SequenceChannel@@ - Select sequence mode Fiber No.

Transmit	Receive
setsequencechannel@@ **putsequencechannel@@**	**OK** **OK**

Where:
@@ represents the Fiber and is a number in the range 01 -20.

Description
This command is used to set the Fiber number associated with the ***Capture Sequence*** command. The command ***putSequencemode1*** should be executed before this command.

In addition, the commands ***putsequencecapture@@***, ***putsequencewait##*** and ***putsequencenumber###*** should be issued before this command.

The Analyser can store up to 9999 captures in memory when this mode is selected.

putsequencechannel@@ commands are stored in RAM memory while ***setsequencechannel@@*** commands are stored in Flash memory.

Example:
The PC transmits **putsequencechannel04** to the LED Analyser to instruct it to do sequence capture on Fiber 04 only. The LED Analyser will return a string **OK** to the PC.

putsequencechannel04
OK

To determine which Fiber Number is set, use the command ***getsequencechannel***. It will return a number in the range 01 to 20.

getsequencechannel

05 (Fiber Number 5)

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Sequence Capture Mode

Set/Put SequenceCapture##(#) - Set Sequence Capture Time

Transmit	Receive
setsequencecapture##	**OK**
putsequencecapture##	**OK**
setsequencecapture###	**OK**
putsequencecapture###	**OK**

Where:
represents the capture time in milliseconds (01 – 99 msec)
represents the capture time in milliseconds (001 – 999 msec)

Description
This command is used to set the Capture Time. The Capture Time can be set to any value in the range 001 – 999 milliseconds. This capture time is set for all Fiber Channels enabled by the ***setSequencemode# or putSequencemode#*** command.

Some experimentation may be required to determine the correct Capture Time because it depends on the brightness level of the LED(s) being tested. If the Capture Time is too short the Analyser may indicate an under-range condition and if the time is too long it may cause an over-range to be reported.

PutSequencecapture##, PutSequencecapture### commands are stored in RAM memory while
SetSequencecapture##, SetSequencecapture### commands are stored in Flash memory.

Example:
The PC transmits **putsequencecapture05** or **putsequencecapture005** to the LED Analyser to instruct it to set the Capture Time to 5 msec. The LED Analyser will return a string **OK** to the PC.

putsequencecapture005
OK

To determine which Capture Time is set, use the command ***getsequencecapture*** It will return a time in milliseconds.

getsequencecapture

005 ms (5 milliseconds)

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Sequence Capture Mode

Set/Put SequenceWait##(#)   - Set Sequence Wait Time

Transmit	Receive
setsequencewait##	**OK**
putsequencewait##	**OK**
setsequencewait###	**OK**
putsequencewait###	**OK**

Where:
represents the wait time in milliseconds (00 – 99 msec)
represents the wait time in milliseconds (000 – 999 msec)

Description
This command is used to set the *Wait* time between captures. The *Wait* time can be set to any value in the range 000 – 999 milliseconds. This *Wait* time is set for all Fiber Channels enabled by the ***setSequencemode# or putSequencemode#*** command.

PutSequencewait##, PutSequencewait### commands are stored in RAM memory while ***SetSequencewait##, SetSequencewait###*** commands are stored in Flash memory.

Example:

The PC transmits ***putsequencewait10*** to the LED Analyser to instruct it to set the wait time between captures to 10 msec. The LED Analyser will return a string **OK** to the PC.

putsequencewait10
OK

To determine what Wait Time between Sequence Captures is set to, use the command ***getsequencewait### .*** It will return a time in milliseconds.

getsequencewait

005 ms (5 milliseconds)

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Sequence Capture Mode

Set/Put SequenceNumber###(#) - Set the Number of Captures

Transmit	Receive
putsequencenumber### **setsequencenumber###** **putsequencenumber####** **setsequencenumber####**	**OK** **OK** **OK** **OK**

Where:
represents the number of captures to store in the range 000 - 999.
represents the number of captures to store in the range 000 – 9999.

Description
This command is used to set the number of captures or samples to store. If the ***setsequencemode# or putsequencemode#*** is set to 0 then the number of samples that can be stored is 3500.

If the ***setsequencemode# or putsequencemode#*** is set to 1 then the number of stored samples increases to 9999.

PutSequencenumber###, PutSequencenumber#### commands are stored in RAM memory while ***SetSequencenumber###, SetSequencenumber####*** commands are stored in Flash memory.

Example:
The PC transmits **putsequencenumber050** to the LED Analyser to instruct it to store 50 captures when the ***CaptureSequence*** command is issued. The LED Analyser will return a string **OK** to the PC.

putsequencenumber050
OK

To determine the number of Sequence Captures stored, use the command ***getsequencenumber*** It will return a number in the range 0 - 9999

getsequencenumber

0250 (250 Captures)

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Sequence Capture Mode

Set/Put SequenceThreshold##### - Set the Intensity Threshold

Transmit	Receive
putsequencethreshold##### **setsequencethreshold#####**	**OK** **OK**

Where:
represents the Intensity threshold.

Description
This command is used to set an Intensity threshold so that Intensities above the threshold will be converted to binary 1's and Intensities below the threshold will be converted to binary 0's.

This binary data is used to generate a timing sequence for LEDs that are being switched on and off such as in an automotive Indicator. The timing sequence can be read out using the command ***getsequencetimes***.

PutSequencethreshold##### commands are stored in RAM memory while ***SetSequencethreshold#####*** commands are stored in Flash memory.

Example:
The PC transmits **setsequencethreshold09500** or **putsequencethreshold09500** to the LED Analyser to instruct it to treat intensities greater than 9,500 as binary 1 and intensities less than 9,500 as binary 0. The LED Analyser will return a string **OK** to the PC.

putsequencethreshold09500
OK

To determine the minimum Intensity level acceptable as a PASS, use the command ***getsequencethreshold .*** It will return an Intensity Value in the range 0 - 99999

getsequencethreshold

9500 **(Min Intensity Level 9500)**

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Sequence Capture Mode

Set/Put SequenceStartDelay### - Set delay in ms before sequencecapture starts

Transmit	Receive
putsequencestartdelay### **setsequencestartdelay###**	**OK** **OK**

Where:
represents the delay in milliseconds before executing a ***capturesequence*** and is in the range 001-999ms.

Description
This command is used to set a delay in milliseconds before the capturesequence starts. This can be useful when using the external trigger mode.

PutSequencestartdelay### commands are stored in RAM memory while ***SetSequenceStartDelay###*** commands are stored in Flash memory.

Example:
The PC transmits **setsequencestartdelay100 or putsequencestartdelay100** to the LED Analyser to instruct it to wait 100ms before starting the capturesequence. The LED Analyser will return a string **OK** to the PC.

putsequencestartdelay100
OK

To determine the delay in milliseconds before the sequence capture is initiated use the command ***getsequencestartdelay*** It will return an time in the range 000 - 999ms

getsequencestartdelay

123 ms **(Delay before Sequence Capture is 123ms)**

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Sequence Capture Mode

CaptureSequence - Start the Captures

Transmit	Receive
Capturesequence or CS	**OK**

Description

This command starts the sequence capture function. The LED Analyser will capture and store the Intensity results of each capture up to the number of captures specified by the ***setsequencenumber### or putsequencenumber###*** command.

The execution time for this command will depend on the time set for each capture, the wait time between captures and the number of captures.

Example:

The PC transmits **capturesequence or cs** to the LED Analyser to instruct it to begin capturing data. The LED Analyser will return a string **OK** to the PC.

cs
OK

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Sequence Capture Mode

StoreSequence## - Store the sequence pattern

Transmit	Receive
storesequence##	**OK**

Where:

represents a sequence pattern number and is a value in the range 00 - 20.

Description

This command stores the sequence pattern from the last ***capturesequence*** command. The pattern is identified by a number in the range 00 – 20. Up to 21 patterns can be stored. This feature allows the Analyser to identify patterns by comparing them against patterns stored in memory.

The **set*sequencemode#, setsequencechannel@@, setsequencenumber###***, ***sequencecapture###***, ***sequencenumber, sequencethreshold#####, sequencestartdelay###*** and ***sequencewait###*** commands must be executed before this command takes effect

The ***StoreSequence##*** commands are stored in Flash memory.

Example:

The PC transmits **storesequence01** to the LED Analyser to instruct it to store the current pattern under the pattern number 01. The LED Analyser will return **OK** to the PC.

storesequence01
OK

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Sequence Capture Mode

IdentifySequence - Identify the current sequence pattern

Transmit	Receive
identifysequence	**##**

Where:

represents the number of a stored sequence pattern and is a value in the range 00 – 20 which compares to the current sequence capture executed.

Description

This command compares the current sequence pattern with a stored list of patterns and identifies it. The pattern is identified by a number in the range 00 – 20. Up to 21 patterns can be stored. This feature allows the Analyser to identify patterns by comparing them against patterns stored in memory.

The ***setsequencemode#, setsequencechannel@@, setsequencenumber###***, ***sequencecapture###***, ***sequencenumber, sequencethreshold#####, sequencestartdelay###*** and ***sequencewait###*** commands must be executed before this command takes effect. Also, a ***capturesequence*** command must be issued before the ***identifysequence*** command.

Example:

The PC transmits **identifysequence** to the LED Analyser to instruct it to identify the current pattern and return its identity number.

identifysequence
04

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Sequence Capture Mode

ResetSequence## - Reset a sequence pattern

Transmit	Receive
Resetsequence## **resetsequenceall**	**OK**

Where:

represents the number of a sequence pattern and is a value in the range 00 - 20.
all represents the all sequence patterns stores in the Analyser. (max 21 patterns)

Description

This command resets the sequence pattern number ##. The pattern is identified by a number in the range 00 – 20. Up to 21 patterns can be stored.

The sequence pattern ## will be deleted from memory.

Example:

The PC transmits **resetsequence01** to the LED Analyser to instruct it to delete sequence pattern 01.

resetsequence01
OK

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Sequence Capture Mode

GetSequenceStored## - Get a sequence pattern

Transmit	Receive
getsequencestored##	**OK**

Where:
Represents the Sequence pattern stored previously.

Description

The pattern is identified by a number in the range 00 – 20. Up to 21 patterns can be stored. This feature allows the user to recall a stored pattern from memory. If you have stored x different patterns you can recall any one if you know the pattern number.

Example:

getsequencestored05 will recall the sequencecapture number 05.

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Sequence Capture Mode

GetSequence@@ - Get the binary sequence of Intensities

Transmit	Receive
getsequence@@	**Binary data 0101..**

Where:

@@ represents the Fiber number to be interrogated and is a value in the range 01 - 20.

Description

This command returns the Intensity values for Fiber## represented as a binary number. Intensities greater than the threshold value are converted to binary 1's while Intensities less than the threshold are converted to binary 0's.

The threshold value is set by the command ***putsequencethreshold#####*** *or* ***setsequencethreshold#####***. The number of Intensities returned is set by the ***putsequencenumber###*** or ***setsequencenumber###*** command.

Example:

The PC transmits **getsequence01** to the LED Analyser to instruct it to output a binary sequence representing the Intensities that have been captured. The LED Analyser will return a **binary sequence** to the PC.

getsequence01
0
1
1
.
.

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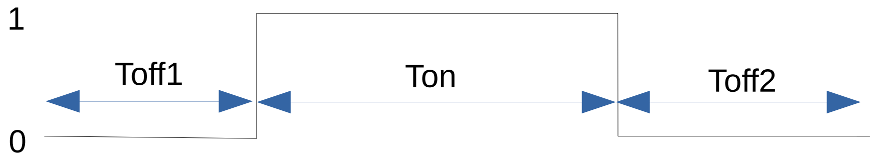
Sequence Capture Mode

GetSequenceTimes@@- Get the Duty Cycle of the Sequence

Transmit	Receive
getsequencetimes@@	**Toff1 Ton Toff2**

Where:
@@ represents the Fiber number and is a value in the range 01 – 20.

Toff1 represents the time the LED is off at the beginning of the sequence.
Ton represents the time the LED is on during the sequence.
Toff2 represents the time the LED is off at the end of the sequence.



Description
This command returns three time intervals for Fiber##. The times are in milliseconds and represent the time the LED is 'off' at the beginning, the 'on' time and the 'off' time at the end of the sequence. A valid ***capturesequence*** command must be issued before this command in order to get valid data. The resolution of the times Toff1, Ton and Toff2 depends on the sequence capture and sequence wait time settings.

Example:
The PC transmits **getsequencetimes01** to the LED Analyser to instruct it to output the time intervals for Fiber 01.

getsequencetimes01
Toff1 = 00350ms Ton = 00340 ms Toff2 = 76910ms

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Sequence Capture Mode

GetSequenceTimesAll - Get the Duty Cycle of the Sequence for all fibers

Transmit	Receive
getsequencetimesall	**Toff1 Ton Toff2**

Where:
ALL represents the total number of Fibers used in the sequence capture.

Toff1 represents the time the LED is off at the beginning of the sequence.
Ton represents the time the LED is on during the sequence.
Toff2 represents the time the LED is off at the end of the sequence.

Description
This command returns three time intervals for each Fiber. The times are in milliseconds and represent the time the LED is 'off' at the beginning, the 'on' time and the 'off' time at the end of the sequence. A valid ***capturesequence*** command must be issued before this command in order to get valid data. The resolution of the times Toff1, Ton and Toff2 depends on the sequence capture and sequence wait time settings.

Example:
The PC transmits **getsequencetimesall** to the LED Analyser to instruct it to output the time intervals for Fiber 01, Fiber 02, Fiber 03, Fiber 04, ...

getsequencetimesall
Toff1 = 00350ms Ton = 00340 ms Toff2 = 76910ms
Toff1 = 00350ms Ton = 00340 ms Toff2 = 76910ms
Toff1 = 00350ms Ton = 00340 ms Toff2 = 76910ms
Toff1 = 00350ms Ton = 00340 ms Toff2 = 76910ms
.
.
.
.

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Sequence Capture Mode

GetFrequency## - Returns the frequency and duty cycle of Led

Transmit	Receive
getfrequency##	**Fff.f Hz xxx.x %**

Where:

represents the Fiber Number and is a value in the range 01 - 20.
fff.f Hz represents the Frequency in Hertz.
Xxx.x % represents the Duty Cycle in Percentage.

Description

This command reports the Frequency in Hertz and the Duty Cycle in % of the Led under test after the capture is complete.

Example:

The PC transmits **getfrequency01** to the LED Analyser to instruct it to report the Frequency and duty cycle of fiber 1

getfrequency01
123.4Hz 067.8%

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Sequence Capture Mode

Get(Max/Min/Avg)Intensity## - Returns the Max/Min or Avg Intensity for the Seq Cap.

Transmit	Receive
getmaxintensity## **getminintensity##** **getavgintensity##**	**iiiii @xxxxx ms** **iiiii @xxxxx ms** **iiiii**

Where:

Represents the Fiber Number and is a value in the range 01 – 20.
iiiii Represents the intensity value of the LED under fiber ##. This 5-digit number is in the range 0000 – 99999. 0000 represents no Intensity or under range(i.e. the LED is off) and 99999 will represent over range or the LED is too bright.
@xxxxx ms Represents the time in ms after the sequence capture has started, when the maximum (or minimum) intensity measurement has been taken.

Description

This command reports the Maximum, Minimum or Average Intensity of the Led under test after the sequence capture is complete.

Example:

The PC transmits **getmaxintensity01** or **getminintensity01** or **getavgintensity** to the LED Analyser to instruct it to report the Maximum or Minimum or Average Intensity of fiber No.1

getmaxintensity01
99800 @00234 ms

getminintensity01
00200 @00012 ms

getavgintensity01
05650

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Sequence Capture Mode

GetFlicker## - Returns the Flicker Index and frequency after a Seq Cap.

Transmit	Receive
getflicker##	**xxx.x %, y.yyyyyy, fff.f Hz**

Where:

##	represents the Fiber Number and is a value in the range 01 – 20.
xxx.x	represents the Flicker Duty Cycle in Percentage.
y.yyyyyy	represents the Flicker Index.
fff.f Hz	represents the Flicker Frequency in Hertz.

Description

This command reports the Flicker Duty Cycle, Flicker Index and Frequency of the Led under test after the sequence capture is complete.

Example:

The PC transmits **getflicker01 t**o the LED Analyser to instruct it to report the Flicker Index Frequency of fiber No.1

getflicker01
Flicker : 100.0%   Flicker index: 0.283214   Flicker Frequency: 100.0 Hz

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Sequence Capture Mode

GetSequenceMode# - Get sequence mode for Fibers

Transmit	Receive
getsequencemode#	**0 or 1**

Where:
represents the sequence mode and is a number in the range 0 – 1.

To determine which sequence mode is set, use the command ***getsequencemode***. It will return a 1 or a 0.

getsequencemode

1 (All Fibers)

getsequencemode

0 (Individual Fibers)

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Sequence Capture Mode

GetSequenceChannel - Select sequence mode Fiber No.

Transmit	Receive
getsequencechannel	**01 to 20**

Where:
01 – 20 represents the Fiber Number and is in the range 01 -20.

To determine which Fiber Number is set, use the command ***getsequencechannel***. It will return a number in the range 01 to 20.

getsequencechannel

05 (Fiber Number 5)

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Sequence Capture Mode

GetSequenceCapture - Get Sequence Capture Time

Transmit	Receive
getsequencecapture	**xx ms or xxx ms**

Where:
represents the capture time in milliseconds (01 – 99)
represents the capture time in milliseconds (001 – 999)

To determine which Capture Time is set, use the command ***getsequencecapture*** It will return a time in milliseconds.

getsequencecapture

005 ms (5 milliseconds)

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Sequence Capture Mode

GetSequenceWait - Get Sequence Wait Time

Transmit	Receive
getsequencewait	**xx ms or xxx ms**

Where:
xx represents the wait time in milliseconds (00 – 99)
xxx represents the wait time in milliseconds (000 – 999)

To determine what Wait Time between Sequence Captures is set to, use the command ***getsequencewait*** *.* It will return a time in milliseconds.

getsequencewait

005 ms (5 milliseconds)

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Sequence Capture Mode

GetSequenceNumber - Get the Number of Captures

Transmit	Receive
getsequencenumber	**xxxx**

Where:
xxxx represents the number of captures stored.

To determine the number of Sequence Captures stored, use the command ***getsequencenumber*** It will return a number in the range 0 - 9999

getsequencenumber

0250 (250 Captures)

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Sequence Capture Mode

GetSequenceThreshold - Get the Intensity Threshold

Transmit	Receive
getsequencethreshold	**xxxxx**

Where:
xxxxx represents the Intensity threshold.

To determine the minimum Intensity level acceptable as a PASS, use the command ***getsequencethreshold*** . It will return an Intensity Value in the range 0 - 99999

getsequencethreshold

9500 (Min Intensity Level 9500)

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Sequence Capture Mode

GetSequenceStartDelay - Get the delay before the CS command

Transmit	Receive
getsequencestartdelay	**xxx**

Where:
xxx represents the delay in milliseconds

To determine the delay in milliseconds before the sequence capture is initiated use the command ***getsequencestartdelay*** It will return a time in the range 000 - 999ms

getsequencestartdelay

123 ms **(Delay before Sequence Capture is 123ms)**

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Daisy Chain Mode

There are two options when connecting the Daisy Chain Function USB and Serial RS232 :

Daisy Chain USB Wiring Method:

The Daisy chain is a method used to communicate with multiple Led Analyser units to save connections and simplify the wiring.
The 1st Led analyser in the chain is connected to the computer using the USB cable supplied. The remaining LED Analysers are interconnected in a Daisy Chain Bus using the cables provided. The Daisy Chain OUT connector on Led Analyser No1 is connected to the Daisy Chain IN Connector on Led Analyser No2 and so on.(See Fig 9a below). Each Analyser except for No1 must be powered to 5V @220mA. This completes your wiring requirements.

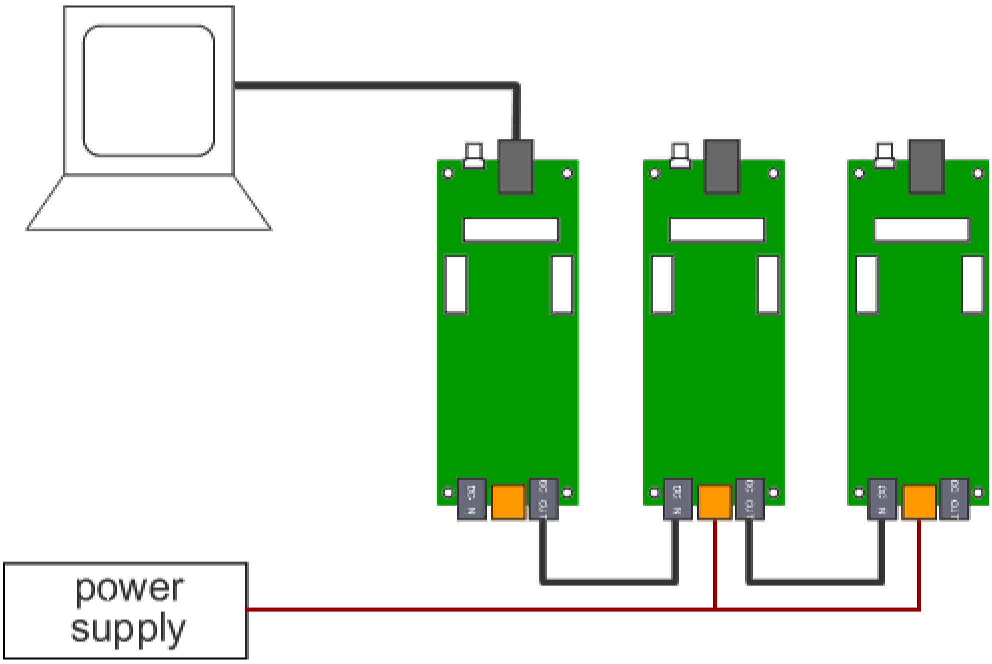

Figure 9a USB Setup

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Daisy Chain Mode

Daisy Chain Serial RS232 Wiring Method:

The Daisy chain is a method used to communicate with multiple Led Analyser units to save connections and simplify the wiring.
The 1st Led analyser in the chain is connected to the computer using the Serial cable supplied. The remaining LED Analysers are interconnected in a Daisy Chain Bus using the cables provided. The Daisy Chain OUT connector on Led Analyser No1 is connected to the Daisy Chain IN Connector on Led Analyser No2 and so on.(See Fig 9b below). Each Analyser must be powered to 5V @220mA. This completes your wiring requirements.

Please Ensure the RS232 GND (pin3) and the PSU GND are connected together.

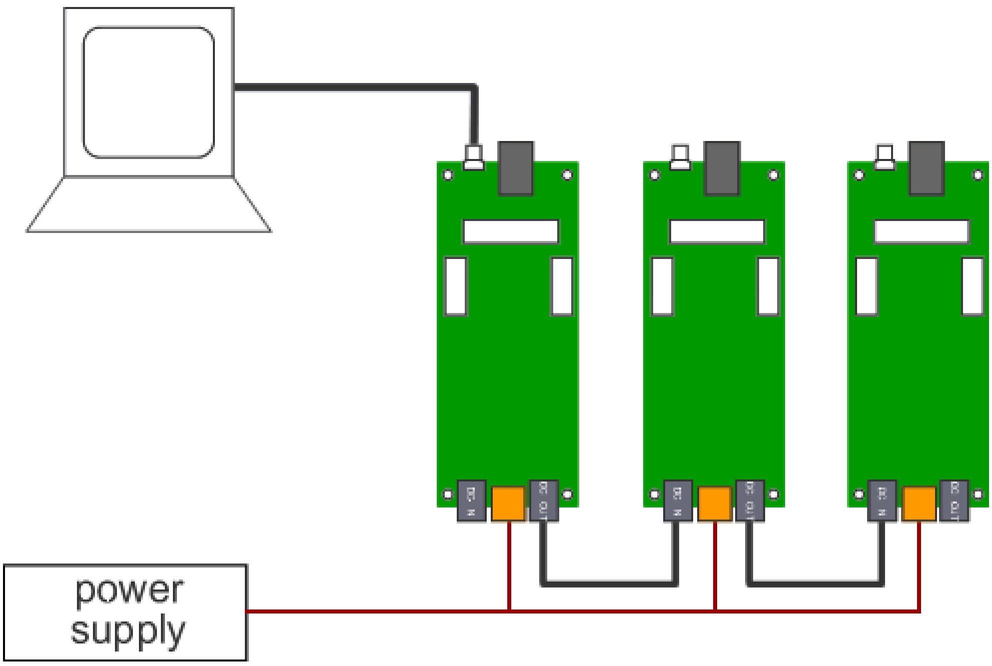

Figure 9b Serial Setup

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Daisy Chain Mode

Daisy Chain Baudrate:

The default Port settings of the Analysers are 57,600, 8 Data bits, 1 Stop bit and No Parity.
If an incompatible baud rates are selected the Analyser will not respond. Please disconnect the Analysers from the Daisy Chain and reconnect each Analyser in turn using USB or Serial RS232 port and set the required baudrate. All baudrates must be the same for communication purposes. A correct baud rate selected will remain stored in memory even after power off.
The command getbaud will return the set baud rate. It can also be seen on the comment section of the Feasa terminal window.

Test times are improved by increasing the baudrate from the default to higher values and this can be further enhanced by decreasing the latency (windows default 16) to latency of 1. Refer to the App Note in the documentation folder of the CD to carry out this.

The LED Analyser connected to the computer receives a command and this command is received by all the other LED Analysers through the Daisy Chain Bus. All Analysers in the chain are active but only the selected LED Analyser is active to give result Data. All responses received by the Computer will be from this active LED Analyser.

Daisy Chain Identification:

Each LED Analyser is identified using a unique 4-character *Serial Number*. This *Serial Number* is fixed to each Analyser or can be read out using the getSerial command.

Feasa provides a **Terminal Program** on the CD for the customers use. When you connect your 1st analyser the terminal program will detect which port you are connected to. At this time you have the option of connecting to the Standalone option or the Daisy Chain option from the drop down box. If you select the Daisy Chain option you will be asked for the serial Number of the 1st analyser in your chain.

There are a number of commands which are used to control the Analysers in the Daisy Chain. These commands are described on the following pages.

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Daisy Chain Mode

BusFree - Deactivate any active Analysers

Transmit	Receive
busfree	**OK**

Description

This command is used to deactivate any active Analysers on the Daisy Chain Bus. This will free the Bus to allow an Analyser to be made active. This command should be issued at the start of a sequence. It is the responsibility of the Controlling Computer to issue commands and monitor the responses. If an Analyser does not respond within 500mSec then the Controlling Computer should issue a new BusFree command and report an error.

The Analyser connected to the computer will operate as a standalone unit after the command is issued.

Example:

The PC transmits **busfree** to free up the Daisy Chain Bus.

busfree
OK

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Daisy Chain Mode

BusGet#### - Activate a LED Analyser

Transmit	Receive
busget####	**OK**

Where:

represents the Serial Number of the Analyser.

Description

This command will activate the LED Analyser with the specified Serial Number.
This command should be preceded by a *BusFree* command. All the *Capture*, *Set, Get*, etc commands can now be used with the active Analyser in the chain.

It is the responsibility of the Controlling Computer to issue commands and monitor the responses. If an Analyser does not respond within 500mSec then the Controlling Computer should issue a new BusFree command and report an error.

Example:

The PC transmits **BusGet####** to the Master LED Analyser to instruct it to activate the LED Analyser with Serial Number ####.

busgetF044
OK

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Daisy Chain Mode

BusC - Initiate Capture for all LED Analyser's

Transmit	Receive
busc	**OK**

Description

This command will cause all LED Analysers in the Daisy Chain to initiate a capture sequence using the Automatic Range Mode. To specify a Range manually see the command *BusC#* on the next page.

After the capture cycle use the command BusGet#### to activate a specific LED Analyser. All the standard commands can then be used to read back the LED Test data.

Example:

The PC transmits **busc** to instruct all LED Analysers in the Daisy Chain to initiate a Capture cycle.

busc
OK

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Daisy Chain Mode

BusC# - Initiate Capture for all LED Analyser's

Transmit	Receive
busc#	**OK**

Where:

represents the ranges 1, 2, 3, 4, 5.

The LED brightness level for each range is as follows:-

Range 1 = Low
Range 2 = Medium
Range 3 = High
Range 4 = Super
Range 5 = Ultra

Description
This command uses a pre-selected exposure time designated Range1, Range2 etc. For low light or dim LED's use Range 1 and for brighter LED's use higher ranges. The higher ranges lead to faster test times because the exposure time is shorter.
This command should be preceded by a *BusFree* command.

This command instructs all LED Analyser's in the Daisy Chain to capture and store the Colour and Intensity of all the LED's positioned under the fibers using a fixed range.

The range setting must be specified. The data is stored until the power is removed or another capture command is issued. When completed the Analyser will transmit the character OK on the receive line to the transmitting device (i.e. the PC).Example:

The PC transmits **busc#** to instruct all LED Analysers in the Daisy Chain to initiate a Capture cycle.

busc2
OK

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Daisy Chain Mode

BusC#pwm@@ - Store PWM LED Data for a specific Range

Transmit	Receive
Busc#pwm **Busc#pwm@@**	**OK** **OK**

Where:

represents the exposure Range 1 – 5.
@@ represents an averaging factor in the range 1 - 15.
@@ If the @@ digits are omitted then a default setting of 07 is used.

Description

This command allows the User to specify the *exposure range* **#** and an *averaging factor* **@@** when testing PWM LED's. Select the *exposure range # (1-5) to match the* ***Intensity*** *of the LED's.* The Analyser tests these LED's by taking a number of readings and averaging the results. A larger Averaging factor will lead to more stable results but increased Test Times. The *averaging factor* @@ is a number in the range 1-15. If this number is omitted from the command the default value is 07.

This command instructs the LED Analyser to read and store the Colour and Intensity of all the LED's positioned under the fibers. The data is stored until the power is removed or another **capture** command is issued. When completed the Analyser will transmit the character **OK** on the receive line to the transmitting device (i.e. the PC).

busc1pwm10
OK

There are 5 manual capture ranges each with an intensity output range of 0 to 99,999. Feasa recommends that the UUT readings should be in the 55K to 85K range for the best stability.

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Daisy Chain Mode

BusCE#### - Poll each LED Analyser to verify a capture is complete

Transmit	Receive
busce####	**0 or 1**

Where:

represents the Serial Number of the Led Analyser.

If reply is 1 Then Capture is complete
If reply is 0 No Capture
No reply Led Analyser is busy - Timeout 10mS

Description

This command is used to verify that after a busc (global capture) each Analyser in the chain has complete its capture.

The PC transmits **busce####** to chech each LED Analysers in the Daisy Chain has complete a Capture cycle.

BusceF123 **(Where F123 is the s/n of the Analyser)**
1

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Daisy Chain Mode

Ports Description and Wiring.

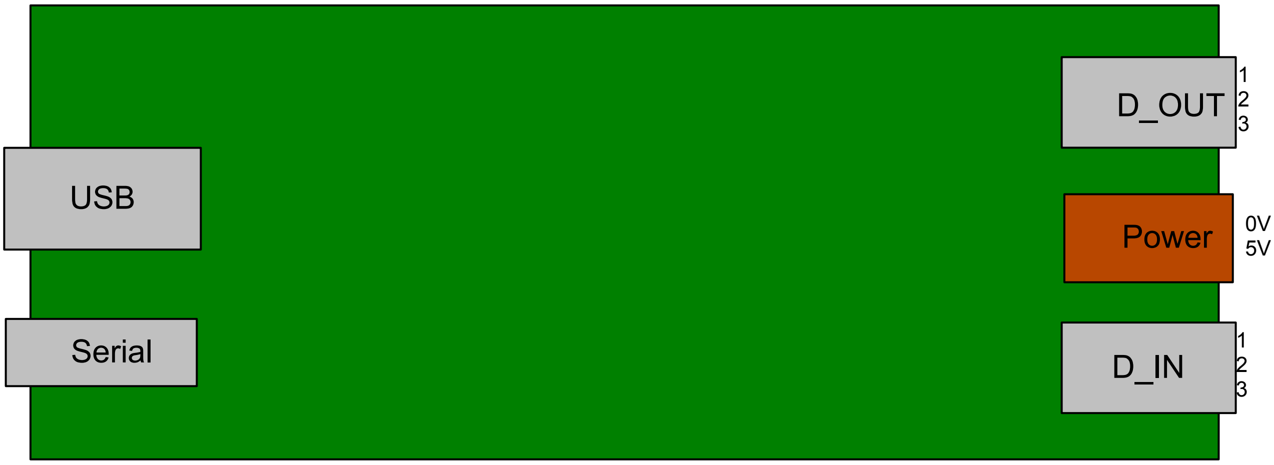

Figure 10

The Daisy Chain Connectors are shown on the right-hand side of figure 10.
The D_OUT connector is connected to the D_IN connector of the next Analyser in the chain.

The Power Connector is used to supply +5V DC to each Analyser in the chain.
Allow 220mA @5V for each Analyser and ensure the wiring is adequate to supply the current without incurring large voltage drops. **For reliable operation it is necessary to have 5V at the Power Connector of each Analyser**. Do not exceed 6V for a prolonged period as this will damage the Analyser.

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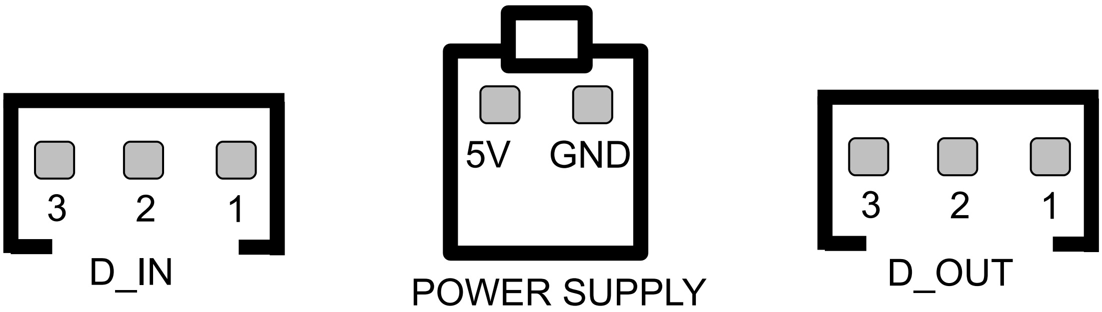
Daisy Chain Mode

Daisy Chain Pinout



PIN	D_IN	D_OUT
1	RX_in	RX_out
2	TX_out	TX_in
3	GND	GND

Figure 11

Figure 11 shows the layout of the Connectors viewed from the edge of the board.
The *GND* line of *D_OUT* is connected with the *GND* line of *D_IN*, the *RX_out* of *D_OUT* is connected to *RX_in* of *D_IN* and the line *TX_in* of *D_OUT* is connected to the line *TX_out* of *D_IN*.

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Daisy Chain Mode

Step-by-Step method for Daisy Chaining

To sucessfully implement Daisychaining the following steps are recommended:-

1. Decide how many Analysers are to be daisychained.

2. Make a list of the Serial Numbers of the Analysers and note the order in which they will be interconnected. For example we have 4 analysers as follows:

Chain Order	Serial No	Comments
1	F304	Tests D40 – D59 Connected to PC
2	F461	Tests D60 - D69
3	F201	Tests LED01 – LED20 All White
4	F006	Tests LED21 – LED40 All Red

3. Set the required baud rate on each Analyser (All baudrates must be the same).

4. Locate the Daisy Chain cables and connect the Daisy_Out of s/n F304 to the Daisy_In of s/n F461.   Connect Daisy_Out of s/nF461 to Daisy_In of s/nF201. Connect Daisy_Out of s/nF201 to Daisy_In of s/nF006.

5. Next locate the 2-pin Power cable supplied to s/n F461, s/n F201 and s/n F006 Analysers. It is necessary to apply 5V @220mA to each of these Analysers in the chain. The green power Led should be visible on these 3 analysers.

6. Connect s/n F304 to the PC using the usb cable. The green power led should come on. If you don't have a usb port available and only a Serial port please connect the s/n F304 to the PC using the Serial Cable provided **AND** connect the 2 pin power connector to the 5V 220mA supply.

7. The supplied Terminal Program can be used to verify the operation of the Daisy Chain. Connect to the port on which the 1st Analyser is installed. See USB Port Control

8. Send **capture** to verify the communications with the 1st Analyser. The response should be **OK**.

9. Send **getserial** and the response should be **F304**.

Daisy Chain Mode

10. To connect to Analyser 2 (s/n F461) send:-

busfree
OK Response from the Analyser
busgetF461
OK Response from the Analyser

The host computer is now connected to Analyser 2 (s/n F461).
This can be verified by requesting the Serial Number:-

getserial
F461 Response from the Analyser

All the LED Analyser commands can now be directed to Analyser 2.

11. To connect to Analyser 3 (s/n F201) send the following:-

busfree
OK Response from the Analyser
busgetF201
OK Response from the Analyser

12. It is possible to instruct all Analysers in the chain to capture LED data simultaneously. This makes programming easier and saves time. There are six capture commands in total but only one can be used at a time. The commands are ***busc, busc1, busc2, busc3, busc4 and busc5***. ***Busc*** uses the automatic capture range whereas ***busc1 – busc5*** use pre-selected manual ranges.

13. If you are have difficulty reading from Analysers at the end of your chain please verify your voltage to each of these units is 5V.

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Daisy Chain Mode

Example

Busfree	'free the bus
OK	
busc3	'All Analysers capture using range 3 High
OK	
busceF304	'poll the analyser F304
1	
busgetF304	'Connect to the Analyser F304
OK	
getserial	'Confirm s/n of the Analyser
F304	
gethsi01	'Get the Data for Fiber 1
000.51 100 36491	
gethsi02	
.	
.	
gethsi20	
120.51 100 66542	'Data for Fiber 20
busfree	
OK	
busceF461	
1	
busgetF461	'Connect to the next Analyser F461
OK	
getserial	'Confirm to Analyser
F461	
gethsi01	'Get the Data for Fiber 1
000.51 100 36491	
gethsi02	
gethsi20	'Get the Data for Fiber 20

.
Repeat this sequence for all Analysers in the chain.

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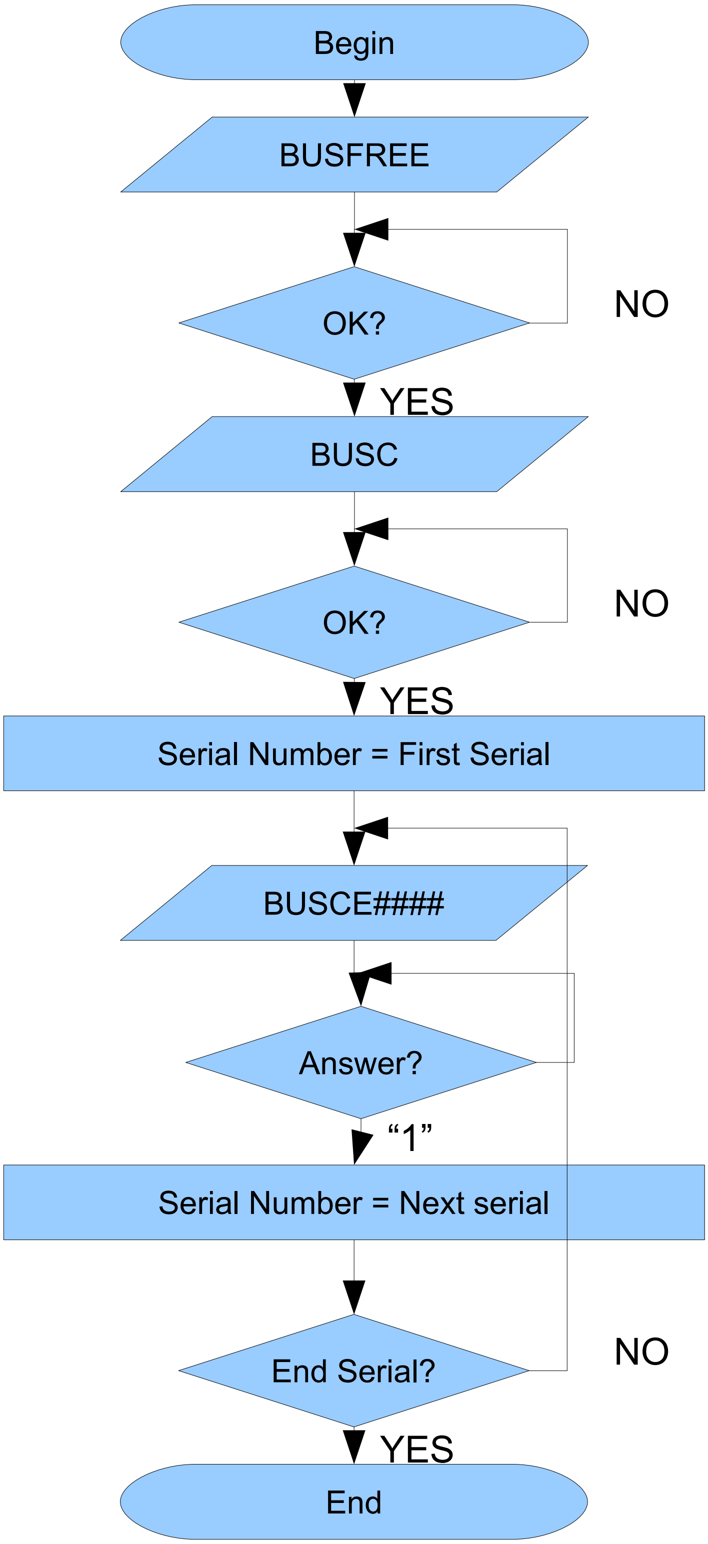
Begin
BUSFREE
OK?
NO
YES
BUSC
OK?
NO
YES
Serial Number = First Serial
BUSCE####
Answer?
“1”
Serial Number = Next serial
End Serial?
NO
YES
End

Step-by-Step approach to Testing a LED

Standard Capture Mode

To Test the Colour and Intensity of up to 20 LEDs simultaneously carry out the following:

1. Ensure that the LEDs to be Tested are turned on and that the fibers are centered over the LEDs.

2. To Test the Colour and Intensity in **RGB** first send the command **capture** to the LED Analyser. The LED Analyser will return the characters **OK** indicating that the Colour and Intensity data for the LEDs has been stored in the internal memory.

3. Transmit the command **getrgbi01** to retrieve the results for Fiber 1. Any fiber can be queried by sending the command **getrgbixx** to the LED Analyser, where **xx** is the fiber number in the range **01 to 20**. The LED Analyser will return the results in the format **rrr ggg bbb iiiiiE** where **rrr**, **ggg** and **bbb** are the **red**, **green** and **blue** components of the light in decimal format in the range **000 to 255**. The **iiiii** value indicates the intensity value of the light in the range **00000 to 99,999**.

4. Alternatively, the Led Analyser may also be queried to retrieve the Hue, Saturation and Intensity results for the LEDs under test. After step 2 send the command **gethsixx** to the LED Analyser where **xx** is the fiber number. The LED Analyser will return the results for that fiber in the format **hhh.hh sss iiiiiE** where **hhh.hh** is the Hue, **sss** is the Saturation(whiteness) and **iiiii** are the Intensity results for that Fiber.

5. An Intensity value of 0 will indicate that the LED under test is not bright enough. To compensate for this move the fiber closer to the LED or increase the LED intensity. An Intensity value of 99,999 will indicate that the LED is too bright and the LED Analyser has an over-range condition. In this case increase the distance of the LED to the Fiber or decrease the LED Intensity.

6. In general, try to keep the Intensity less than 80,000 and greater than 20,000.

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Effect of PWM on Intensity Testing

The effect of Pulse Width Modulation (PWM) of a typical LED on the Analyser Intensity can be seen in Figure 29. In this graph the LED will always be on at 100% modulation. The Intensity has been normalised to 100% at 100% modulation. When the modulation has been reduced to 50% (i.e. the LED is off 50% of the time) the relative Intensity drops to approximately 80%.

At 20% modulation (the LED is off 80% to the time) the relative Intensity drops to approximately 50%.

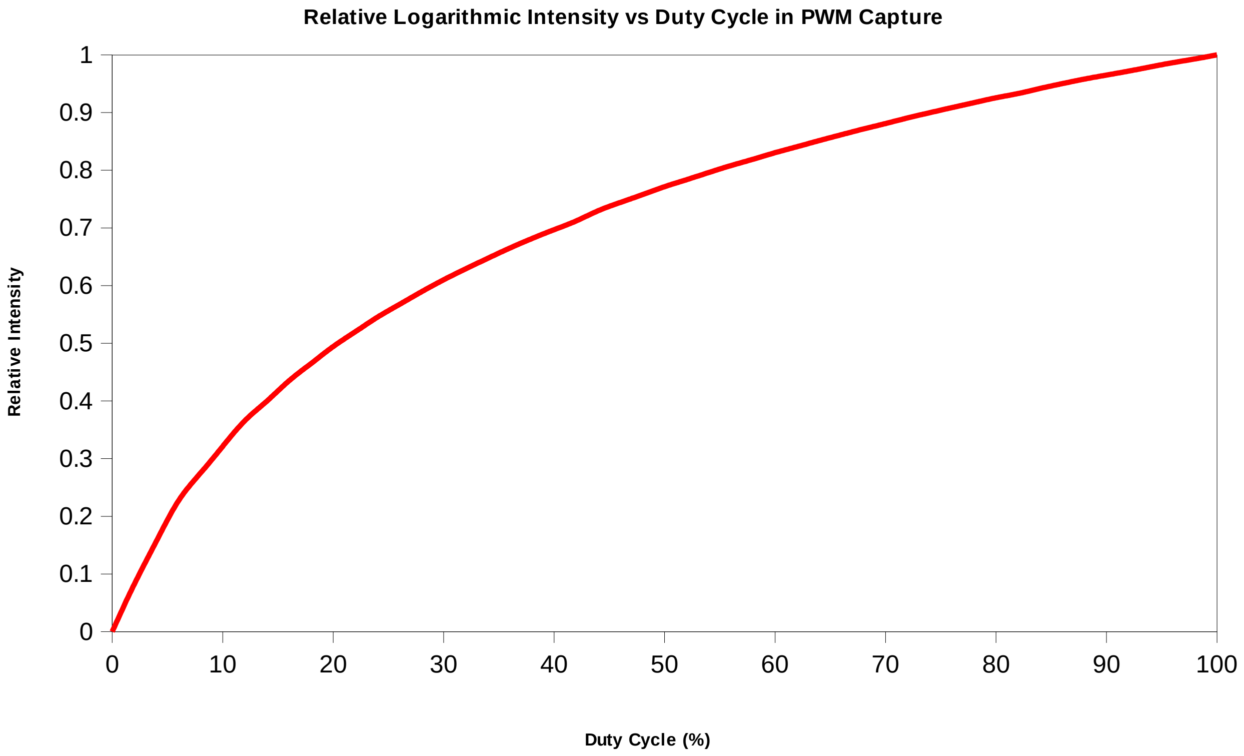

Figure 29: Normalized Intensity versus Modulation

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Step-by-Step approach to Testing a PWM LED

PWM LED Mode

To test PWM LEDs use the following commands on the LED Analyser for Fiber 1:

1. Decide how many readings are required to test the PWM LED's. The Analyser can be programmed to take between 1 and 15 readings. The more readings that are taken the greater the stability of the results.

2. Send the command **CAPTURE#PWM@@**, where **@@** is the number of readings to take and **#** is the Intensity range. The LED Analyser will capture and store the Colour, Saturation and Intensity data for all fibers. The LED Analyser will respond with the Characters **OK** indicating that the command has been completed.

3. To read back the RGB and Intensity of the LED under fiber **xx** send the command **GETRGBIxx** to the LED Analyser. The LED Analyser will return the data in the format **rrr ggg bbb iiiii** where **rrr**, **ggg** and **bbb** are the **red**, **green** and **blue** components of the Colour. The **iiiii** value indicates the intensity value.

4. To read back the Hue, Saturation and Intensity of the LED under fiber **xx** send the command **GETHSIxx** to the LED Analyser. The LED Analyser will return the data in the format **hhh.hh sss iiiii** where **hhh.hh** represents the Hue value, **sss** represents the Saturation(whiteness) and **iiiii** indicates the Intensity value.

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Testing a 7-Segment Display

The LED Analyser can be used to test LED-based 7-Segment displays. To set up the LED Analyser to interrogate a single 7-Segment display, fit fibers labeled 1 to 7 over segments a-g on the 7-Segment display.
To set up the LED Analyser to interrogate an additional 7-Segment display, fit fibers labeled 11 to 17 over segments a-g on the additional display.

To interrogate the digit displayed on the first 7-Segment Display send the command **get7seg1** to the LED Analyser. The LED Analyser will return the digit displayed. The LED Analyser will return the character **X** when the displayed value is not recognized **(0 to 9)**.

To interrogate the digit displayed on the second 7-Segment display send the command **get7seg2** to the LED Analyser. The LED Analyser will return the digit displayed. Again, the LED Analyser will return the character **X** when the displayed value is not recognized **(0 to 9)**.

Note:- it is not necessary to send any *capture* commands prior to using the **get7seg1** or **get7seg2** commands.

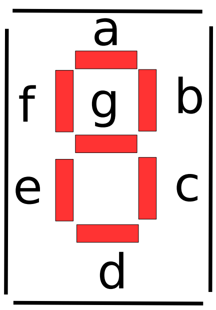

Figure 30. 7 Segment Display

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Command Summary:

COMMAND	DESCRIPTION
Capture	Store LED Data - Auto Range
Capture#	Store LED Data - Manual Range
CapturePWM	Store PWM LED Data – Auto Range
Capture#PWM@@	Store PWM LED – Manual Range
Capturemulti	Store LED Data – Specific Range, Specific Fiber
CaptureSequence	Store LED Data – Sequence Mode
getRGBI##	Get RGB, Saturation and Intensity for a LED
getHSI##	Get Hue, Saturation and Intensity for a LED
getxy##	Get the xy Chromaticity values
getxyi##	Get the xy Chromaticity and Intensity values
getCCT##	Get Colour Temperature for LED
getWI##	Get Wavelength & Intensity for LED
getWSI##	Get Wavelength, Saturation & Intensity for LED
getUV##	Get the u'v' Chromaticity values
getWAVELENGTH##	Get Dominant Wavelength for LED
getCIEXYZ@@	Get the XYZ data for a LED
getINTENSITY##	Get the Intensity for a LED
getsignallevel##	Get the Intensity of the LED in % mode
getAbsint@@	Get the Absolute Intensity for a LED
get7SEG#	Get the value of a 7segment display
getSTATUS	Get the summary details of a Led Analyser
getHW	Get the Hardware Version of the Analyser
getSERIAL	Get the Serial Number of the Analyser
getVERSION	Get the Firmware Revision of the Analyser

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Command Summary:

COMMAND	DESCRIPTION
setLOG	Set the Intensity Response to Logarithmic Mode
setLIN	Set the Intensity Response to Linear Mode
setBAUD	Set the baud rate of the Serial Port
getBAUD	Get the Baud Rate the Analyser is set to
setRange@@#	Set the capture range of the Analyser for the capturemulti command
getRange@@	Get the capture range of the Analyser for the capturemulti command
setFACTOR##	Set the Sensitivity Level (Exposure Factor) of the Led Analyser
getFACTOR	Get the Exposure Factor
setphotopic#	Set photopic mode OFF for the Led Analyser
getphotopic	Verify what photopic mode is set
setautopwm	Change Auto Capture mode to an Auto PWM Capture mode
getautopwm	Verify if the Analyser is in Auto capture or Autopwm capture mode
setabsintmulti@@m.mmmmme+mm	Set the Absolute Intensity Correction Factor of the Led under test.
getabsintmulti@@m.mmmmme+mm	Get the Absolute Intensity Correction Factor of the Led under test.
setINTGAIN	Set the Intensity Gain of the Led Analyser
getINTGAIN##	Get the Intensity Gain Factor
setXOFFSET	Set the X Offset of the Led Analyser
getXOFFSET##	Get the x Chromacicity Offset
SetYOFFSET	Set the Y Offset of the Led Analyser
getYOFFSET##	Get the y Chomacicity Offset
setWavelengthOFFSET##	Set the Wavelength Offset of the Led Analyser
getWAVELENGTHOFFSET@@	Get the wavelength offset for fiber
setcalibration##	Set the Calibration version of the USER
setCalibrationDateddmmyyyy	Set the Calibration Date of the USER
getcalibrationdate	Get the Calibration Date set by the user

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Command Summary:

setSequenceMode#	Set the No. of Fibers in the CS Mode -0 is ALL -1 is individual Channel
getsequencemode	Determine which sequence mode is set
setSequenceChannel@@	Set the Channel No's for the Capture Sequence Mode
getsequencechannel	Determine which Channel No's for the Capture Sequence Mode
setSequenceCapture###	Set the Capture Time in Capture Sequence Mode (CS mode)
getsequencecapture	Determine which capture time is set in CS mode
setSequenceWait###	Set the WAIT time between Captures in CS Mode
getsequencewait	Determine what is the wait time between captures in CS mode
setSequenceNumber####	Set the NUMBER of Captures to store in CS Mode
getsequencenumber	Determine the number of captures stored in CS mode
setSequenceThreshold#####	Set the Intensity Threshold in CS Mode
getsequencethreshold	Determine a Minimial Intensity level acceptacle as a PASS in CS mode
getSequence@@	Get the Intensity Value in 1's or 0's based on threshold set by user
setsequencestartdelay###	Set a delay time in mSec before executing a CS
getsequencestartdelay	Get the delay time set before executing a CS
getsequencestored##	Retrieve a previously stored CS
getSequenceTimes@@	Get the OFF.. ON.. OFF times of the Fiber in CS Mode
StoreSequence##	Stores the Last CS Mode
identifysequence##	Compare the current CS Mode to Stored CS Modes
resetsequence##	Delete a CS Pattern from memory
GetMaxIntensity##	Get the Maximium Intensity recorded in Sequence Capture Mode
GetMinIntensity##	Get the Minimium Intensity recorded in Sequence Capture Mode
getaverageIntensity##	
GetFlicker##	Get the Flicker Index and Frequency after a Sequence Capture
Getfrequency##	Get the Frequency and Duty Cycle of the Led under test in Sequence Capt.
EnableEOT	Enable End of line transmission character
DisableEOT	Disable End of line transmission character
setexternalcapture####	Set the External Trigger Capture mode
getexternalcapture	Verify what capture mode the external trigger is set at.

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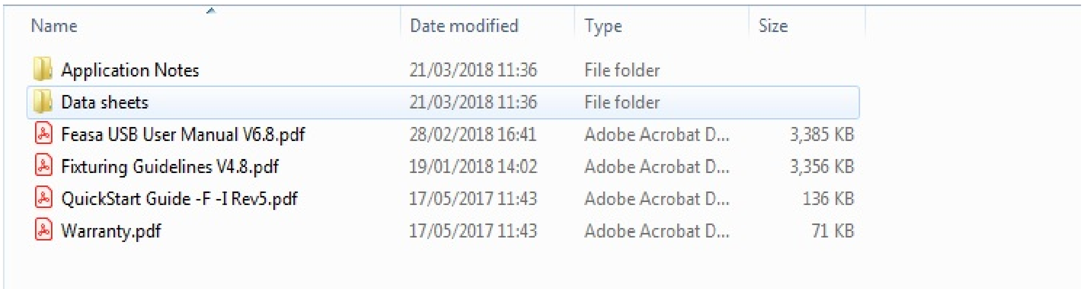
Feasa Software

All Feasa Led Analysers are supplied with a data CD.

The following Software and Documentation packages are available on this CD. The contents of the CD can be installed automatically to a designated Windows Folder. ***FEASA LED Analyser.***

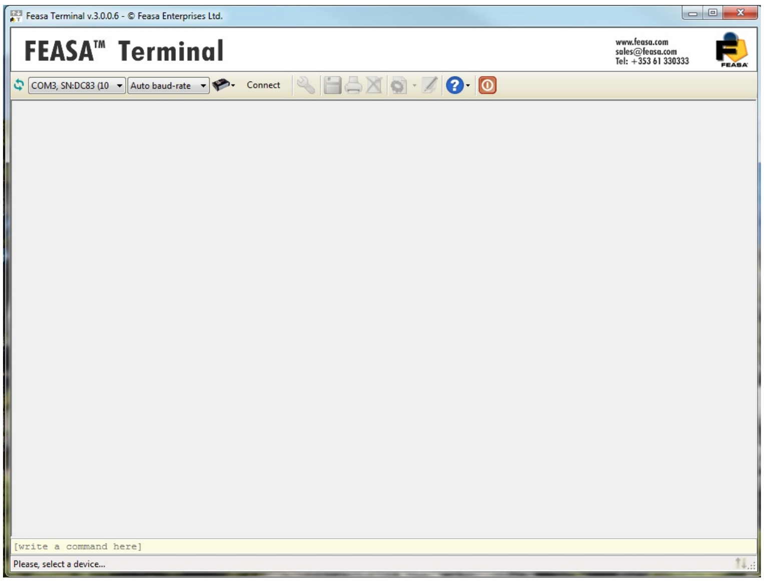
The following folders can be installed. Each Program is supplied with a help guide.

Documentation Folder



Name	Date modified	Type	Size
Application Notes	21/03/2018 11:36	File folder	
Data sheets	21/03/2018 11:36	File folder	
Feasa USB User Manual V6.8.pdf	28/02/2018 16:41	Adobe Acrobat D...	3,385 KB
Fixturing Guidelines V4.8.pdf	19/01/2018 14:02	Adobe Acrobat D...	3,356 KB
QuickStart Guide -F -I Rev5.pdf	17/05/2017 11:43	Adobe Acrobat D...	136 KB
Warranty.pdf	17/05/2017 11:43	Adobe Acrobat D...	71 KB

Feasa Terminal



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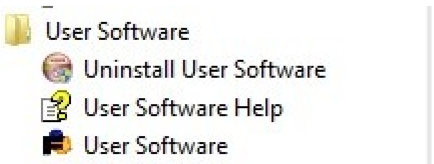
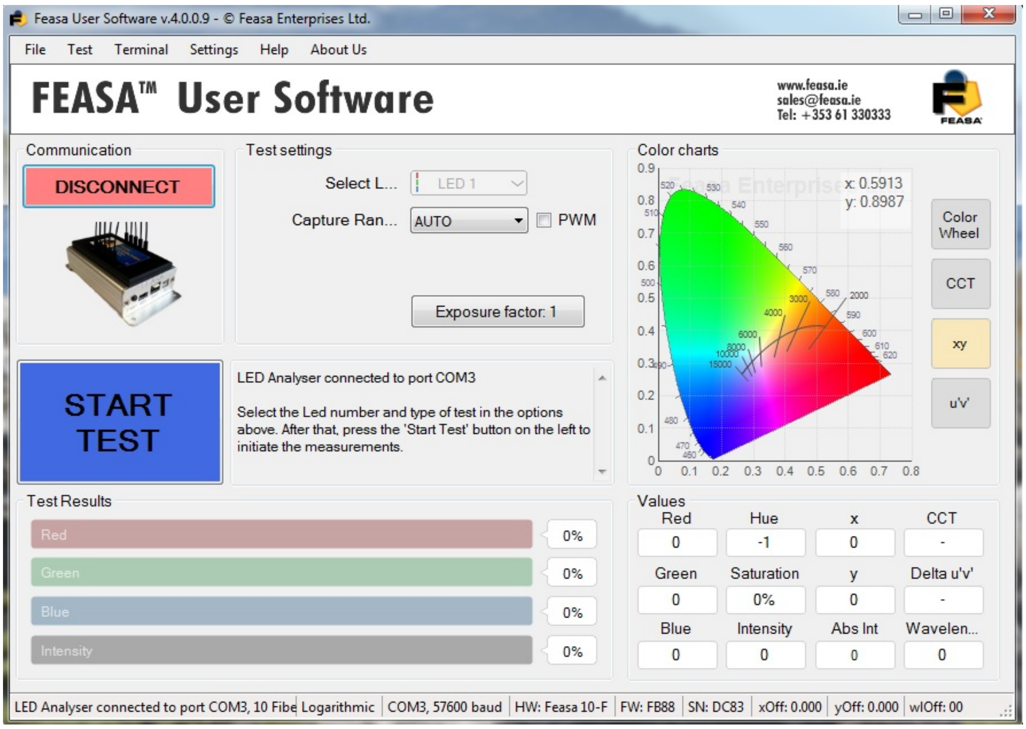
User Software





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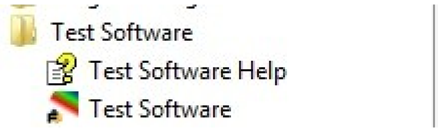
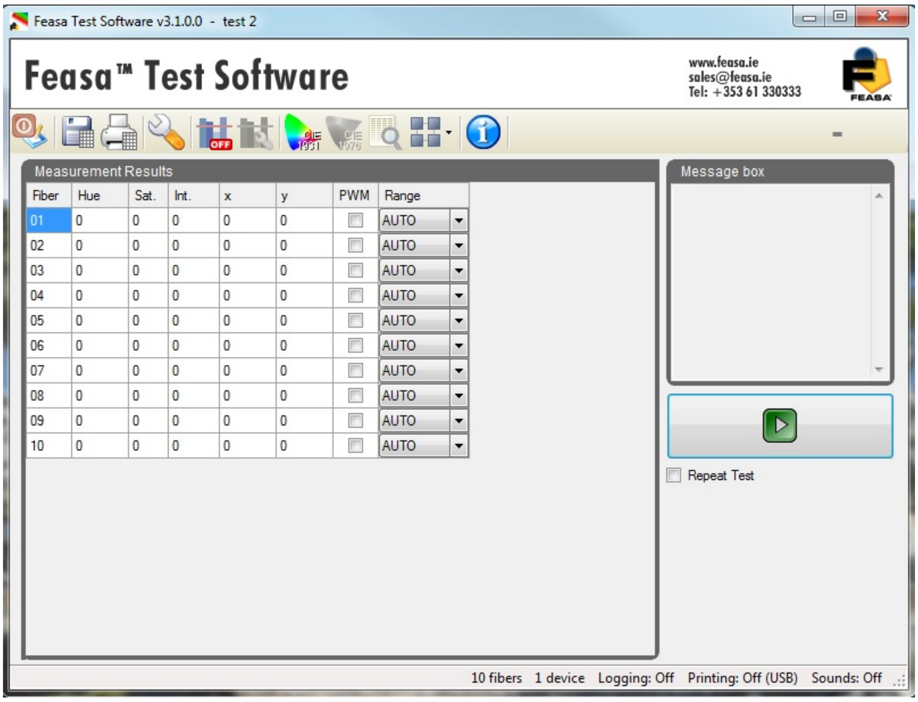
Test Software





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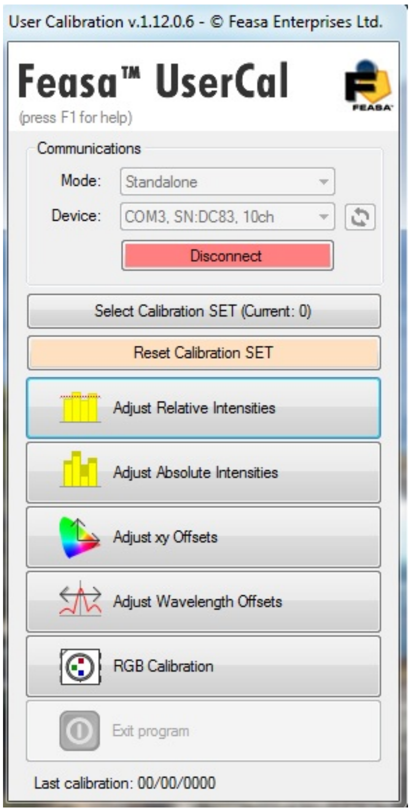
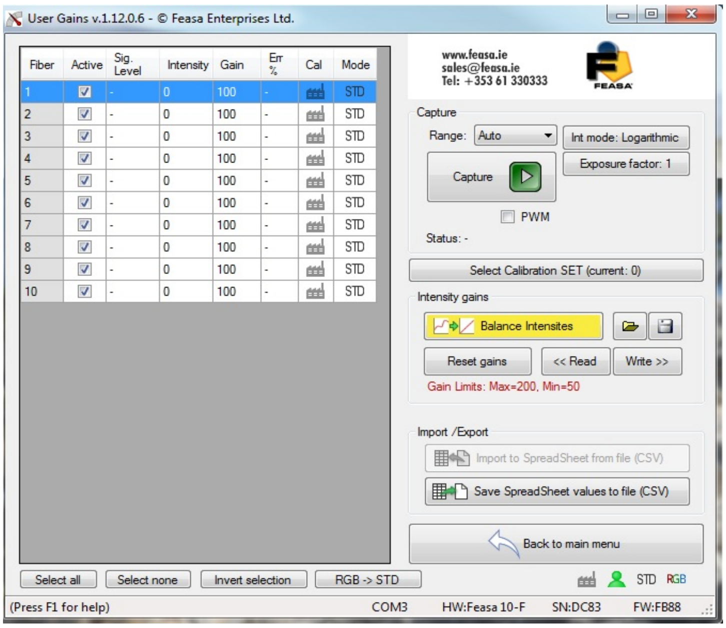
User Calibration





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Programming

- Programming
  - LabView
  - Other languages

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FEASA™

Specifications

Part Number(s)

Feasa 20-F	Standard LED Analyser with 20 Fibers
Feasa 10-F	Standard LED Analyser with 10 Fibers
Feasa 6-F	Standard LED Analyser with 6 Fibers
Feasa 5-F	Standard LED Analyser with 5 Fibers
Feasa 3-F	Standard LED Analyser with 3 Fibers
Feasa 2-F	Standard LED Analyser with 2 Fibers
Feasa 20-FB	High Brightness LED Analyser with 20 Fibers
Feasa 10-FB	High Brightness LED Analyser with 10 Fibers
Feasa 6-FB	High Brightness LED Analyser with 6 Fibers
Feasa 5-FB	High Brightness LED Analyser with 5 Fibers
Feasa 3-FB	High Brightness LED Analyser with 3 Fibers
Feasa 2-FB	High Brightness LED Analyser with 2 Fibers
Feasa 20-LT	Life Tester LED Analyser with 20 Glass Fibers
Feasa 10-LT	Life Tester LED Analyser with 10 Glass Fibers
Feasa 5-LT	Life Tester LED Analyser with 5 Glass Fibers
Feasa 3-LT	Life Tester LED Analyser with 3 Glass Fibers

Physical- F, -FB

Dimensions 145mm x 54mm x 39*mm (L x W x H)
Dimensions 104mm x 54mm x 39*mm (L x W x H)
* does NOT include Fiber bend Radius
Plastic Fiber Length 0.6m
Plastic Fiber Diameter 1.0mm
Fiber Core Diameter 0.5mm
Fiber Bend Radius 15mm
Plastic Fiber Temperature Range -40^{0}C to +70^{0}C
Number of Fibers 2, 3, 5, 6, 10, 20
Led Analyser Operating Temperature Range 0^{0}C to +50^{0}C

Physical – LT

Dimensions 145mm x 54mm x 39*mm (L x W x H)
Dimensions 104mm x 54mm x 39*mm (L x W x H)
* does NOT include Glass Fiber bend Radius
Glass Fiber Length 1.0m
Glass Fiber Diameter 1.1mm
Glass Fiber Core Diameter 0.6mm
Fiber Bend Radius 50mm
Glass Fiber Temperature Range -65^{0}C to +125^{0}C
Number of Fibers 3, 5, 10, 20
Led Analyser Operating Temperature Range 0^{0}C to +50^{0}C

Electrical

Supply Voltage 5.0V +/- 0.5V
Supply Current 200 mA max in Stand Alone Mode
Supply Current 220 mA max in Daisy Chain Mode
USB 2.0 Interface, Serial RS232 Interface
Output Data Format RGB, HSI, XY, UV, Wavelength, CCT & Intensity

Optical

Red Peak Efficiency Wavelength	615 nm
Green Peak Efficiency Wavelength	540 nm
Blue Peak Efficiency Wavelength	465 nm
Total Operating Wavelength Range	450 nm to 650 nm

Accuracy

White X=± 0.01, Y = ± 0.01 @ x=0.33, y=0.33 using OH-3 Optical Head

Red (630nm)	± 4nm
Green (520nm)	± 2nm
Blue (450nm)	± 5nm
Yellow (590nm)	± 2nm

These accuracy's are based on the Led Analyser being calibrated at a point in time against known set values.

Capture Test Times

Auto Range	350ms
Range 1 (Low Intensity)	650ms
Range 2 (Medium Intensity)	200ms
Range 3 (High Intensity)	22ms
Range 4 (Super Intensity)	4ms
Range 5 (Ultra Intensity)	2ms

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Warranty

1. Feasa Enterprises Limited (herein referred to as Feasa) warrants Feasa hardware, accessories and supplies against defects in materials and workmanship for the period of one year. If Feasa receives notice of such defects during the warranty period, Feasa will, at its option, either repair or replace products which prove to be defective. Replacement products may be either new or like-new.

2. Feasa warrants that Feasa software will not fail to execute its programming instructions, for the period of one year, due to defects in material or workmanship when properly installed and used. If Feasa receives notice of defects during the warranty period, Feasa will replace software media which does not execute its programming instructions due to such defects.

3. Feasa does not warrant that the operation of Feasa products will be uninterrupted or error free. If Feasa is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product to Feasa.

4. Feasa products may contain re-manufactured parts equivalent to new in performance or may have been subject to incidental use

5. The warranty period begins on the date of deliver

6. Warranty does not apply to defects resulting from:
   (a) improper or inadequate maintenance or calibration,
   (b) software, interfacing, parts or supplies not supplied by Feasa,
   (c) unauthorized modification or misuse,
   (d) operation outside the published environmental specifications for the product, or
   (e) improper site preparation or maintenance.

7. TO THE EXTENT ALLOWED BY LOCAL LAW, THE ABOVE WARRANTIES ARE EXCLUSIVE AND NO OTHER WARRANTY OR CONDITION, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED AND FEASA SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, SATISFACTORY QUALITY, AND FITNESS FOR A PARTICULAR PURPOSE.

8. TO THE EXTENT ALLOWED BY LOCAL LAW, THE REMEDIES IN THIS WARRANTY STATEMENT ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. EXCEPT AS INDICATED ABOVE, IN NO EVENT WILL FEASA OR ITS SUPPLIERS BE LIABLE FOR LOSS OF DATA OR FOR DIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING LOST PROFIT OR DATA), OR OTHER DAMAGE WHETHER BASED IN CONTRACT, TORT, OR OTHERWISE.

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