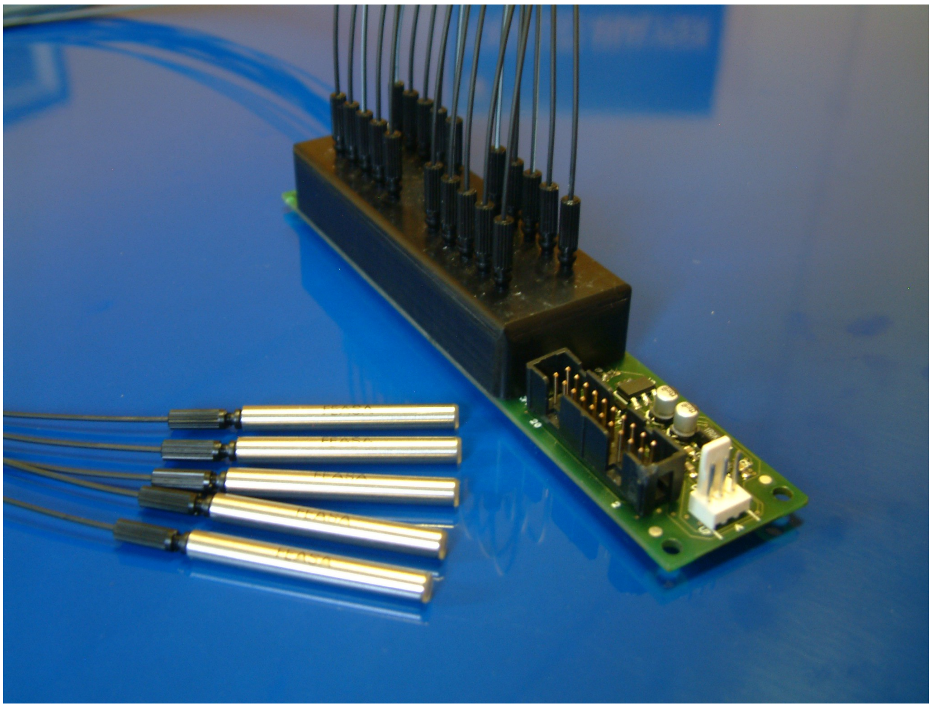
FEASA LED ANALYSER
ICT VERSION

User Manual for Feasa -I 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 the Feasa In Circuit Test (ICT) Led Analysers. The model numbers are Feasa x-I (where x is the no. of fibers either 2,3,5,6,10,20).

The Feasa 20-I is a 20 channel unit which will test up to 20 LEDs while the Feasa 2-I is a 2 channel unit testing up to 2 LED's.

The interface on these units is Serial or ICT Interface (Frequency Mode / Synchronous Serial Mode).

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Introduction

The **Feasa LED Analyser** is an instrument that tests the Color and Intensity of Light Emitting Diodes (LEDs) in a test process. The Analyser can have up to 20* flexible Fiber-Optic Light Guides which are mounted individually over the LEDs to be tested.

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 ICT Interfaces.

The ICT Interface is a 20-Pin Connector compatible with In-Circuit Test machines. There is a choice of two operating modes using the ICT Interface. The first mode uses frequencies to output the LED Colour, Saturation and Intensity (HSI) and the second mode uses a high-speed Synchronous Serial Bus to output the HSI or the RGB.

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

Every LED tested by the LED Analyser will have a set of RGB values generated for analysis. The RGB results for each LED tested can be read out through the Serial or ICT Port.

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

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Color and Saturation

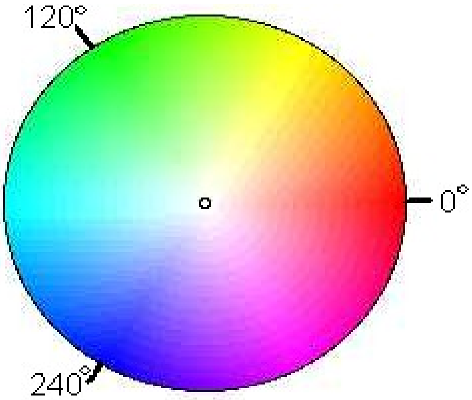

Figure 1: Hue (Color) Wheel

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 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 100% represents a pure Colour such as Red, Blue, Green, etc.

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 9	37%

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 Analyser can be set in either Linear mode or Logrithmic modes to measure Intensity of the LED. The units are shipped from the factory in Logarithmic mode. See setlog and setlin commands to determine how to set the mode of the analyser. Use the getinfo 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.

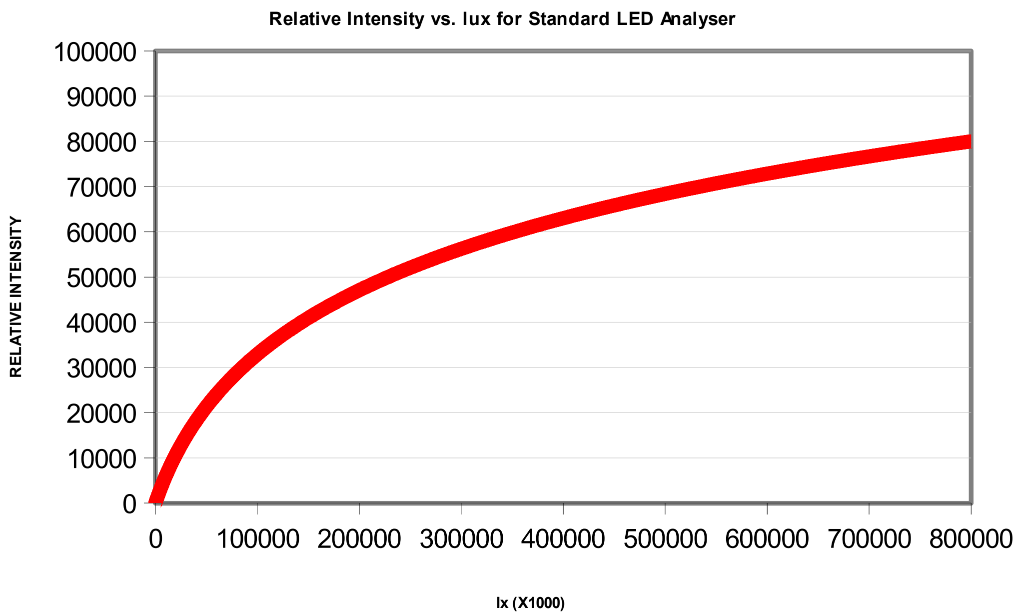

Figure 3a. Relative Intensity vs LUX for the LED Analyser in *LOGARITHMIC* Mode

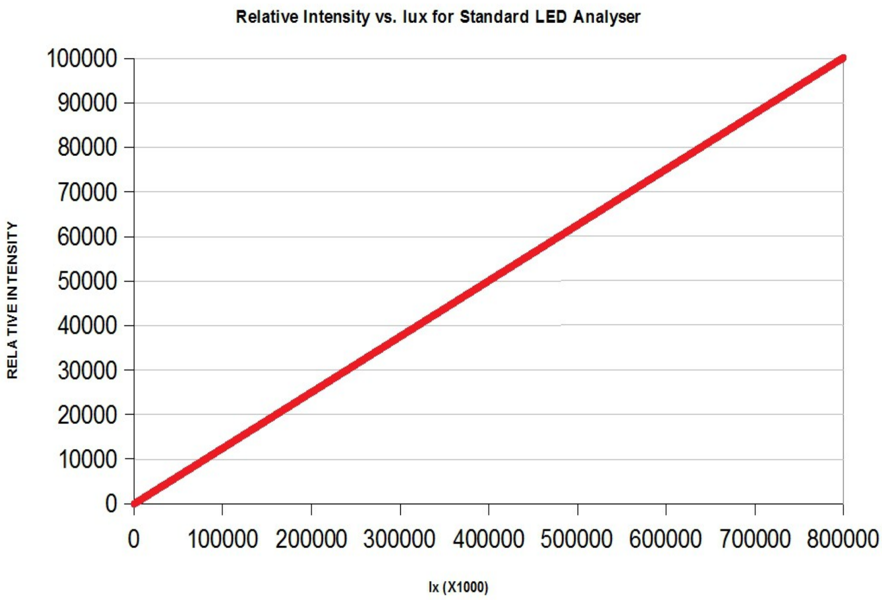

Figure 3b. Relative Intensity vs LUX for the LED Analyser in *LINEAR* mode

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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 is the LED being tested. 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 x on the vertical axis. The range of x and x lies between 0 and 1.

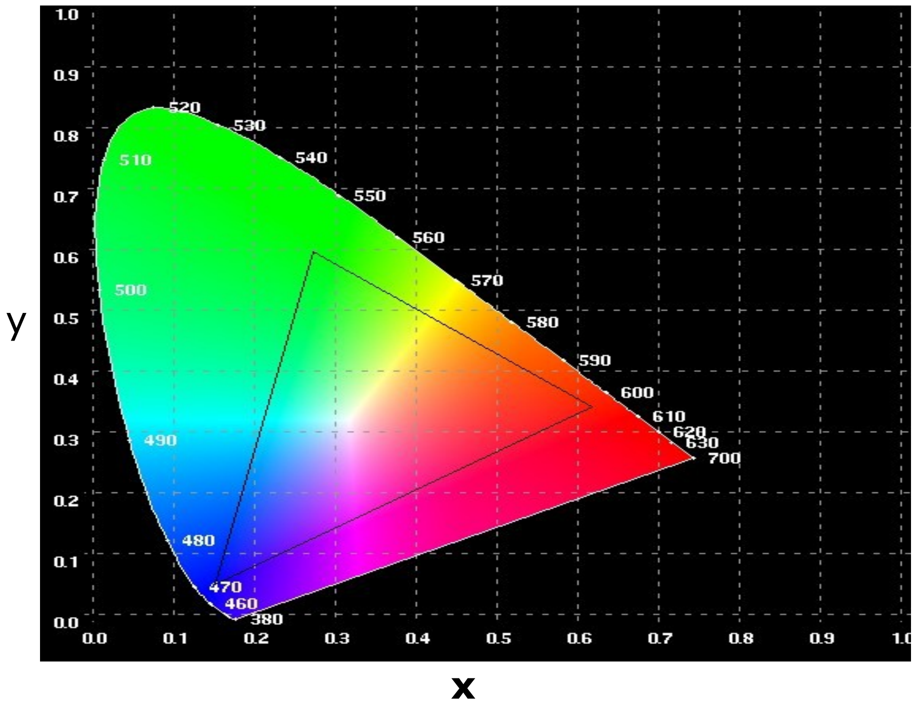

Figure 4. CIE 1931 Chromaticity Co-Ordinates

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 other LED's will have an 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 become 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

Intensity Value	Upper Limit	Lower Limit	Comments
125	150	100	Dim LED
5000	6000	4000	Average LED
20000	24000	16000	Bright LED

Note:- the Intensity Value will depend on the Range selected

Figure 5.

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Physical Layout

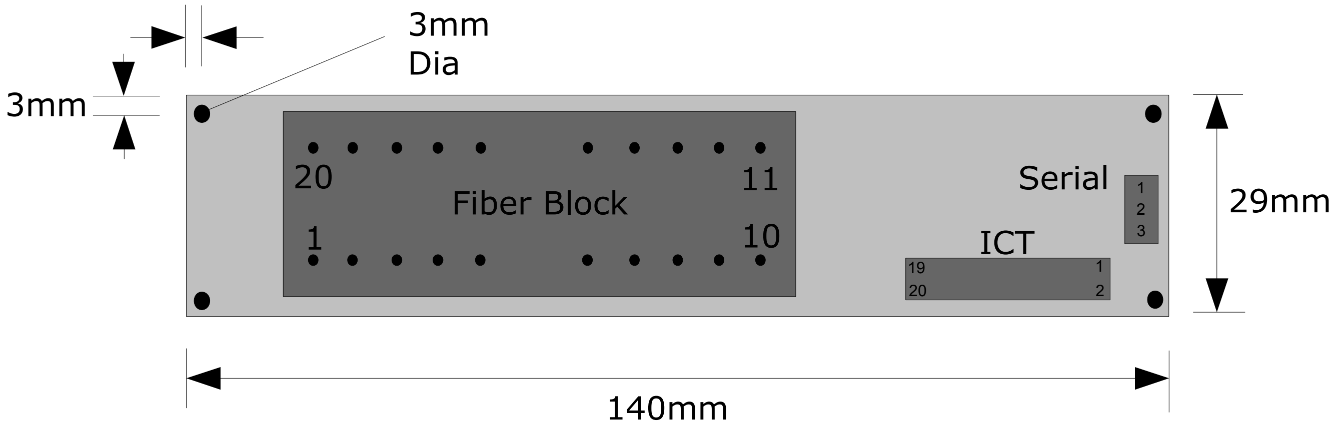

Figure 6a (Feasa 20I).

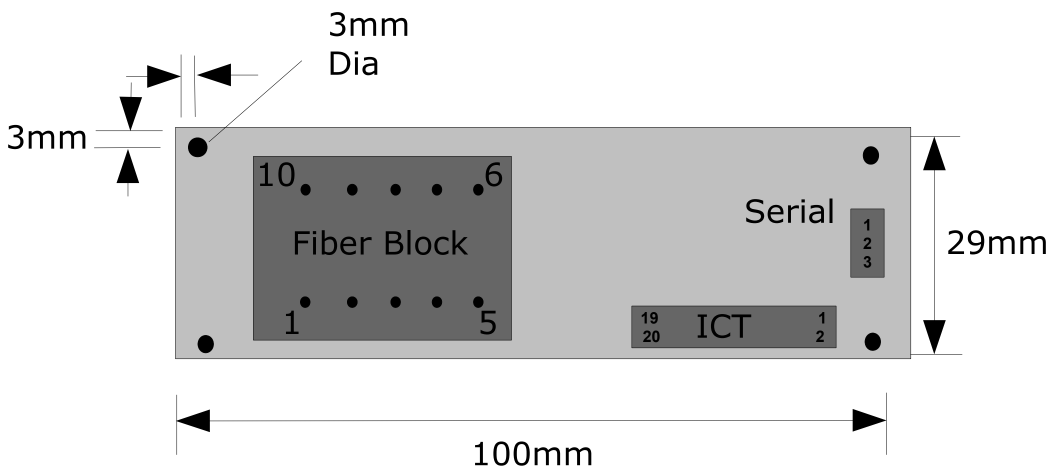

Figure 6b (Feasa 2I, 3I, 5I, 6I, 10I)

Figure 6a shows the physical layout of the Feasa 20-I Analyser.

Figure 6b shows the physical layout of the Feasa 10-I Analyser.
The fibers are labeled 1-10. Options include Feasa 2-I, Feasa 3-I, Feasa 5-I, Feasa 6-I.

There are four 3mm diameter Mounting holes at the corners.
The ICT Port is a 20-pin connector while the Serial Port is a 3-pin connector.
The PCB has been designed so that it can easily be fitted in the top or bottom side of a Fixture.

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In-Circuit Test Mode

In addition to the Serial Port Communications the Led Analyser provides a Port for In-Circuit Testing. There are two methods that can be used with this Interface. The first method uses frequencies to represent the Color, Saturation and Intensity (HSI) data for each LED. The second method uses a Synchronous Serial digital mode to read the data. The Frequency method is easier to implement and debug while the Synchronous Serial method is more complex but is faster especially for large numbers of LED's.

The LED Analyser can only operate one of these modes at a time. By default, the LED Analyser is set to the *Frequency Output* mode at the Factory. To place the Analyser in *Synchronous Serial* mode the command *setSyncSerial* must be sent through the Serial Port. When *Synchronous Serial* mode is enabled the *Frequency Output* mode is disabled. To place the Analyser back into the *Frequency Output* mode use the command *setFrequencyOut*. The command *getICTStatus* will display which mode has been selected. The configuration is stored in Flash memory and need only be implemented once i.e. It will remain in the selected mode until instructed to change.

Frequency Out Port Protocol

This method is based on extracting Colour, Saturation and Intensity data from the frequency of square wave output signals. There are three separate outputs – one each for Colour, Saturation and Intensity. The frequency of the square wave (duty cycle is always at 50%) signal from the Led Analyser is in the range 1KHz to 100KHz. This is a fast and simple method of communication and is efficient in terms of tester resources where a frequency counter is usually available.
The Frequency value for Intensity (pin 15), Colour (pin 16) and Saturation (pin 17) of the LED are output simultaneously at the ICT Port.

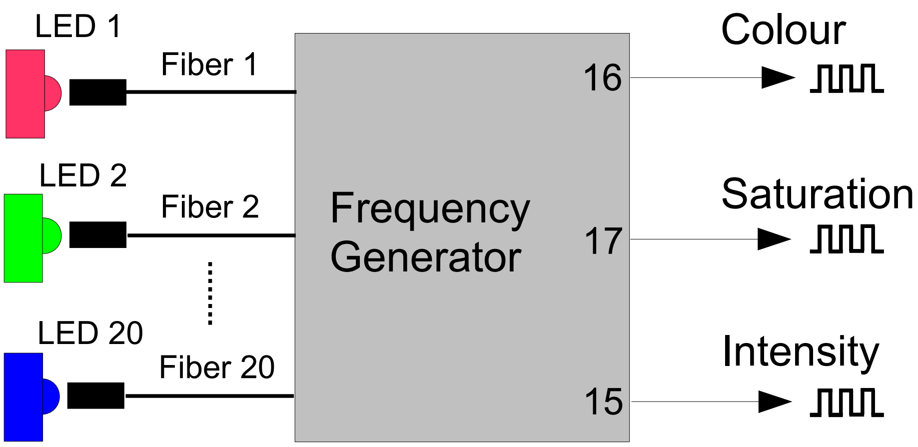

Figure 7.

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In-Circuit Test Mode

ICT Connector Pin-out

The ICT Port consists of a 20-way connector which includes all the signals necessary to interface with the LED Analyser. These pins are shown in Figure 8.

Pin	Type	Name	Function
1	Output	Ser_Out	Synchronous Serial Output
2	Input	Ser_In	Synchronous Serial Input
3	Input	SCK	Synchronous Serial Clock
4	Ground	GND	Ground
5	Input	Reset	Reset input
6	Input	/OE	Output Enable – Active low
7	Input	Trigger	For External Capture
8	Input	PWM_bar	Select PWM mode - Active low.
9	Input	Addr0/LA_Select	LSB of Fiber Address (also used for Synchronous Serial mode)
10	Input	Addr1	Fiber Address
11	Input	Addr2	Fiber Address
12	Input	Addr3	Fiber Address
13	Input	Addr4	MSB of Fiber Address
14	Input	/WE	Active Low.
15	Output	Int_freq	Frequency Out Square wave for Intensity
16	Output	Color_freq	Frequency Out Square wave for Color
17	Output	Sat_freq	Frequency Out Square wave for Saturation
18	Output	RY_BY	Ready Busy Output(Also Used for Syncronous Serial mode)
19	Power	VCC	Power Supply 5V DC at 180mA
20	Ground	GND	Ground

Figure 8.

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In-Circuit Test Mode

ICT Connector Pin Descriptions

Reset Pin 5
This input resets the LED Analyser and is active low. When /Reset goes high the Analyser starts operating in normal mode.

Output Enable (/OE) Pin 6
This input disables the Frequency Output Buffers when driven low. The Ready/Busy output RY_BY is also disabled. It does not disable the Synchronous Serial Bus.

Trigger Pin 7
A Falling edge on the pin will trigger a capture on the Led Analyser. For this function to work an External Capture command must be activated. (see External Capture Section)

PWM_bar Pin 8
This input pin is used to select between Standard Capture (Static LED's) and PWM modes. If this pin is high Standard Capture mode is enabled and if this pin is low PWM mode is selected. This pin is pulled up internally by the Analyser so that Standard Capture mode is selected if left floating. This pin is active during the capture cycle.

Addr0 - Adr4 Pins 9 - 13

The 5 Address inputs are used in the Frequency Output mode. A complete list of all the Addresses is shown in Figure 12. In Addition, Addr0 is used in the Synchronous Serial mode to select the Analyser (LA_Select).

Write Pin 14
This input is used to write commands into the Analyser. It is active low.

Int_Freq Pin 15
This pin outputs the Intensity frequency for the selected LED. It is a square-wave signal (0 – 3V) and will have a frequency in the range 1KHz – 100KHz.

Color_Freq Pin 16
This pin outputs the Color (Hue) frequency for the selected LED. It is a square-wave signal (0 – 3V) and will have a frequency in the range 1KHz – 100KHz.

Sat_Freq Pin 17
This pin outputs the Saturation (Whiteness) frequency for the selected LED. It is a square-wave signal (0 – 3V) and will have a frequency in the range 1KHz – 100KHz.

In-Circuit Test Mode

ICT Connector Pin Descriptions Cont'd

VCC Pin 19

This is the Voltage supply pin to the Analyser. The power requirements are 5V DC at 180mA.

GND Pins 4, 20

These are the ground pins for the Analyser. Ensure this ground is tied to System Ground for correct operation.

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In-Circuit Test Mode

Colour and Saturation Frequencies

A list of typical Colour and Saturation frequencies for different LED's is shown in *Figure 9.* These values can be used initially to set up test limits in a Test Program. Adjustments should be made during the debug process to suit the actual LED's being tested. *Figure 9a* shows the under range, over range conditions that will be reported.

LED Colour	***Colour Frequency***	***Saturation Frequency***
Red	1.0KHZ	100KHz
Green	43KHz	98.5KHz
Blue	71Khz	100KHz
Orange	7.5KHz	100KHz
Yellow	37KHz	100KHz
Warm White	22KHz	65KHz
Neutral White	35KHz	25KHz
Cool White	44KHz	48KHz

Figure 9.

Condition	**Hue**	**Saturation**	**Intensity**
Good	1K - 100K	1K - 100K	1k - 96K
Over Range	500Hz	500Hz	100K
Under Range	500Hz	500Hz	1K
Error	500Hz	500Hz	500Hz

Figure 9a.

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Hue and Saturation Responses

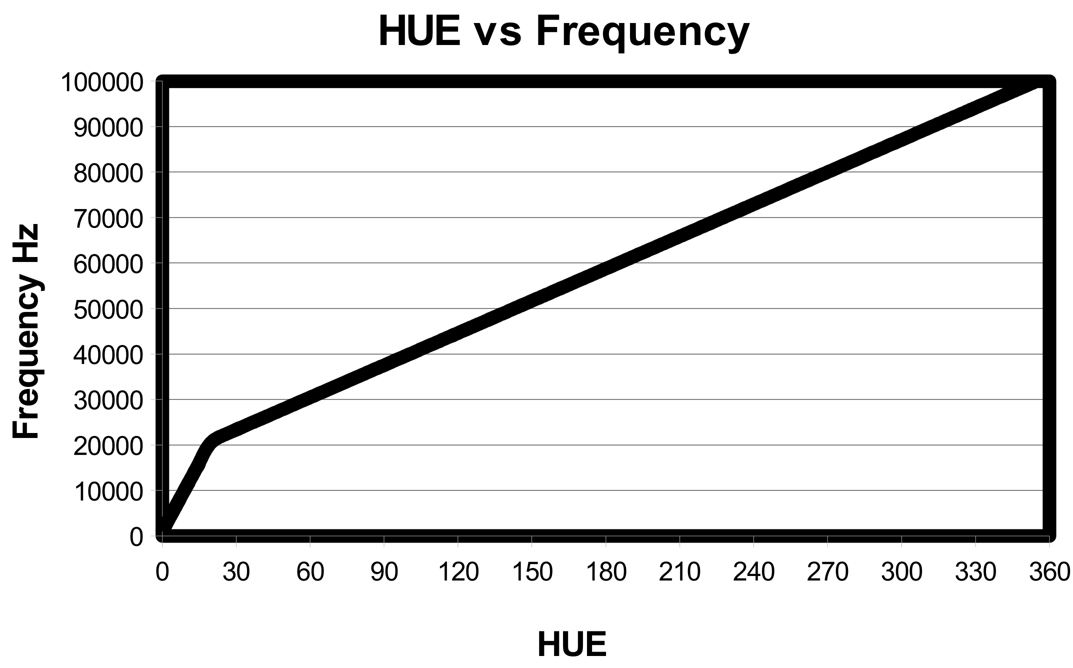

Figure 10.

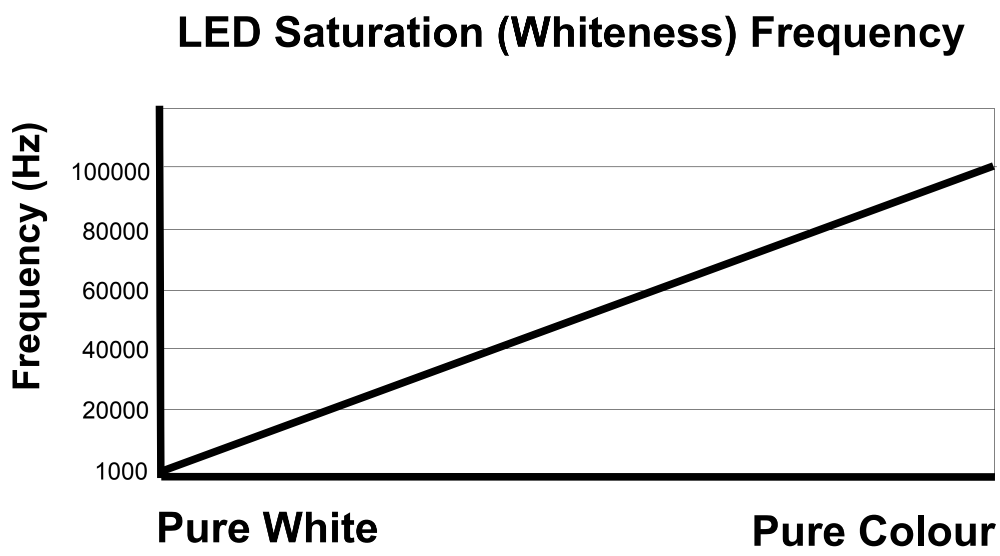

Figure 11.

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In-Circuit Test Mode

In-Circuit Test Frequency Mode

This mode is the easiest to implement at In-Circuit Test provided a method is available to measure the output frequencies. The frequencies range from 1KHz to 100KHz and the output is a square wave signal with a voltage swing from 0V to 3V.

The following sequence must be used to test the LED's successfully:-

1/ Turn on the LED's to be tested.

2/ Apply power to the LED Analyser.

3/ Reset the Analyser.

4/ Capture the LED Data.

5/ Read and Test the Color Frequency.

6/ Read and Test the Saturation Frequency.

7/ Read and Test the Intensity Frequency.

The Analyser will measure all the LED's in one capture operation. However, the data for each LED is read out one at the time. The data from last capture is stored in the Analyser until a new capture is done or power is removed.
Each Fiber or LED has an Address associated with it. Since there can be up to 20 LED's to be tested - Hexadecimal Addesses 0x01 – 0x14 are used to access the data for each individual LED. LED1 will have address 0x01, LED2 will have address 0x02, LED20 will have address 0x14, etc.
Since the Analyser can test LED's that are dim to very bright - the correct intensity range should be used. There are five ranges available – *Low, Medium, High, Super* and *Ultra*. The low range is for dim LED's and the ultra is used for the very bright LED's. There is also an *auto* range and should only be used when both dim and bright LED's must be tested together.

Figure 12 shows all the addresses that can be input to the LED Analyser and the function of each address.

These functions will be explained in the following sections.

ADDRESS	LED Analyser Function
0000	Capture using the Automatic Range
0001	Address of Fiber 1
0010	Address of Fiber 2
0011	Address of Fiber 3
0100	Address of Fiber 4
0101	Address of Fiber 5
0110	Address of Fiber 6
0111	Address of Fiber 7
1000	Address of Fiber 8
1001	Address of Fiber 9
1010	Address of Fiber 10
1011	Address of Fiber 11
1100	Address of Fiber 12
1101	Address of Fiber 13
1110	Address of Fiber 14
1111	Address of Fiber 15
10000	Address of Fiber 16
10001	Address of Fiber 17
10010	Address of Fiber 18
10011	Address of Fiber 19
10100	Address of Fiber 20
10101	Capture using Range1 (*Low* Intensity)
10110	Capture using Range2 (*Medium* Intensity)
10111	Capture using Range3 (*High* Intensity)
11000	Capture using Range4 (*Super* Intensity)
11001	Capture using Range5 (*Ultra* Intensity)
11010	CapturePWM
11011	Unused
11100	Decrement the Exposure Factor by 1 (minimum = 1)
11101	Reset the Exposure Factor to 1
11110	Increment the Exposure Factor by 1 (Maximum = 15)
11111	Reset the LED Analyser

Figure 12.

In-Circuit Test Mode

Reset the LED Analyser

This function will reset the LED Analyser and make it ready to capture new LED Test data.
This function should be executed before each capture cycle.
Figure 13 shows the timing for this function.

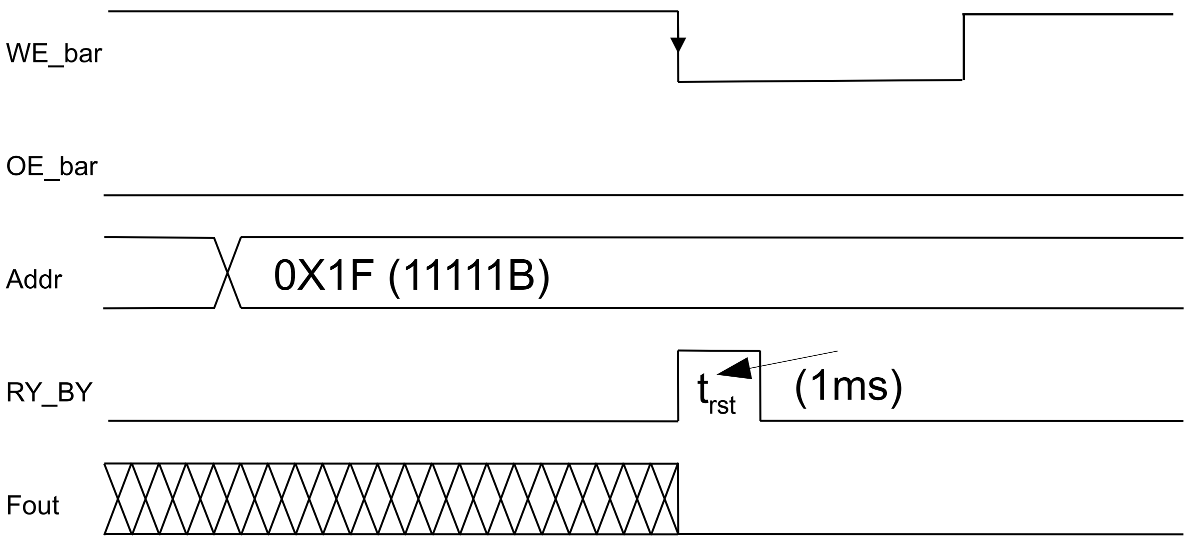

Figure 13.

The timing sequence is as follows:-

1/ WE_bar is driven high and OE_bar is driven low. Ry_By (pin18) will be driven low by the Analyser.

2/ The address bus is then driven to 11111 (0x1F).

3/ WE_bar is driven low and the Analyser will drive RY_BY high for approx 1mS. All the frequencies (from the previous capture) will be turned off at this time. Ater the time T_{rst} = 1mSec RY_BY will be driven low by the Analyser to indicate it is ready for the next function.

4/ WE_bar will be driven High any time after RY_BY has gone Low.

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In-Circuit Test Mode

Capture LED Color, Saturation and Intensity non-PWM LED's

This function will capture the Colour, Saturation and Intensity of all the LED's and store this data in memory ready for output.
The timing for this function is shown in Figure 14.

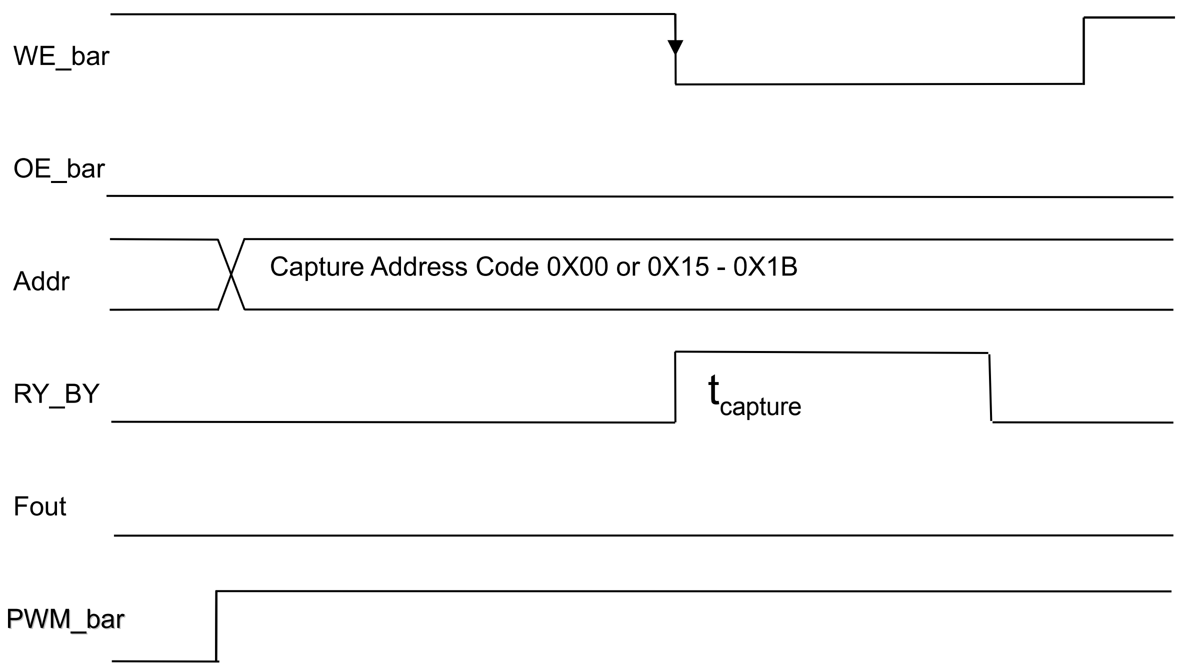

Figure 14.

The timing sequence is as follows:-

1/ WE_bar, PWM_bar are driven high and OE_bar is driven low. Ry_By (pin18) will be driven low by the Analyser.

2/ The address bus is then driven to the capture code (see Figure 12).

3/ WE_bar is driven low and the Analyser will drive RY_BY high. All the frequencies (from the previous capture) will be turned off at this time. Ater the time $T_{capture}$ RY_BY will be driven low by the Analyser to indicate it is ready for the next function. The time for $T_{capture}$ will vary depending on the range selected. The test system should loop on the RY_BY signal and wait for it to go low.

4/ WE_bar will be driven High any time after RY_BY has gone Low.

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In-Circuit Test Mode

Capture LED Color, Saturation and Intensity PWM LED's

This function will capture the Colour, Saturation and Intensity of all the LED's that are controlled by Pulse Width Modulation (PWM) and store this data in memory ready for output.
PWM LED's are switched on and off rapidly to control the LED Intensity.
The PWM_bar (pin 8) signal is pulled up on the Analyser.
The timing for this function is shown in Figure 15.

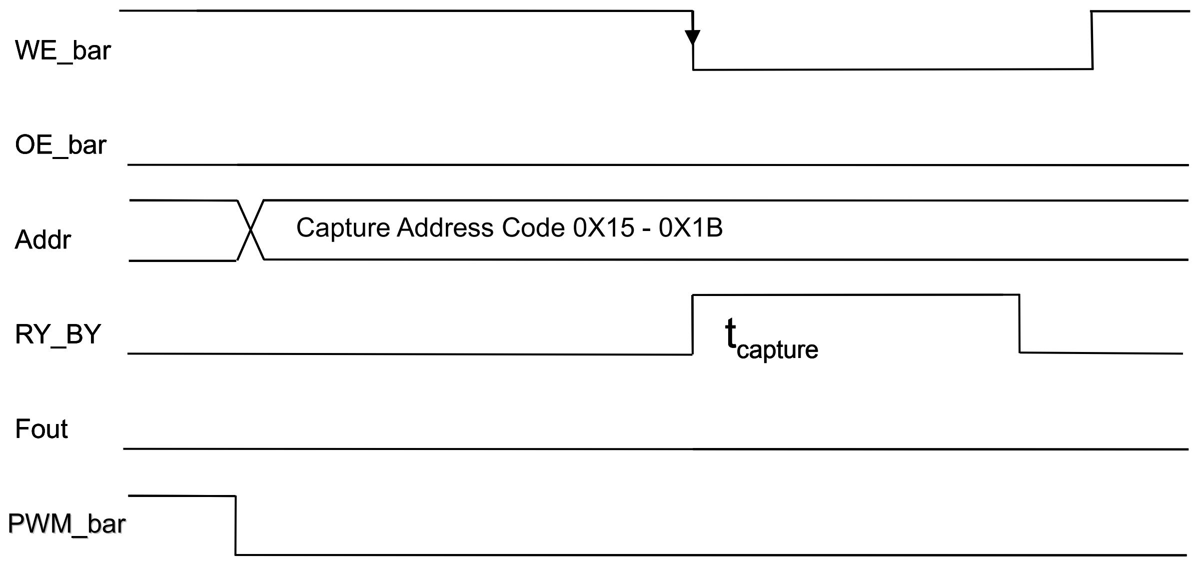

Figure 15.

The timing sequence is as follows:-

1/ WE_bar is driven high, OE_bar and PWM_bar are driven low. Ry_By (pin18) will be driven low by the Analyser.

2/ The address bus is then driven to the capture code (see Figure 12).

3/ WE_bar is driven low and the Analyser will drive RY_BY high. All the frequencies (from the previous capture) will be turned off at this time. Ater the time $T_{capture}$ RY_BY will be driven low by the Analyser to indicate it is ready for the next function. The time for $T_{capture}$ will vary depending on the range selected. The test system should loop on the *RY_BY* signal and wait for it to go low.

4/ After $T_{capture}$ is complete WE_bar will be driven High any time after RY_BY has gone Low.

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In-Circuit Test Mode

Test LED Color, Saturation and Intensity

This function is used to test the Colour, Saturation and Intensity of a LED. Three frequencies representing these properties are output. Each LED has a Fiber Address which must be input to the Analyser. A capture must be executed prior to this function to ensure valid data is stored in the Analyser.

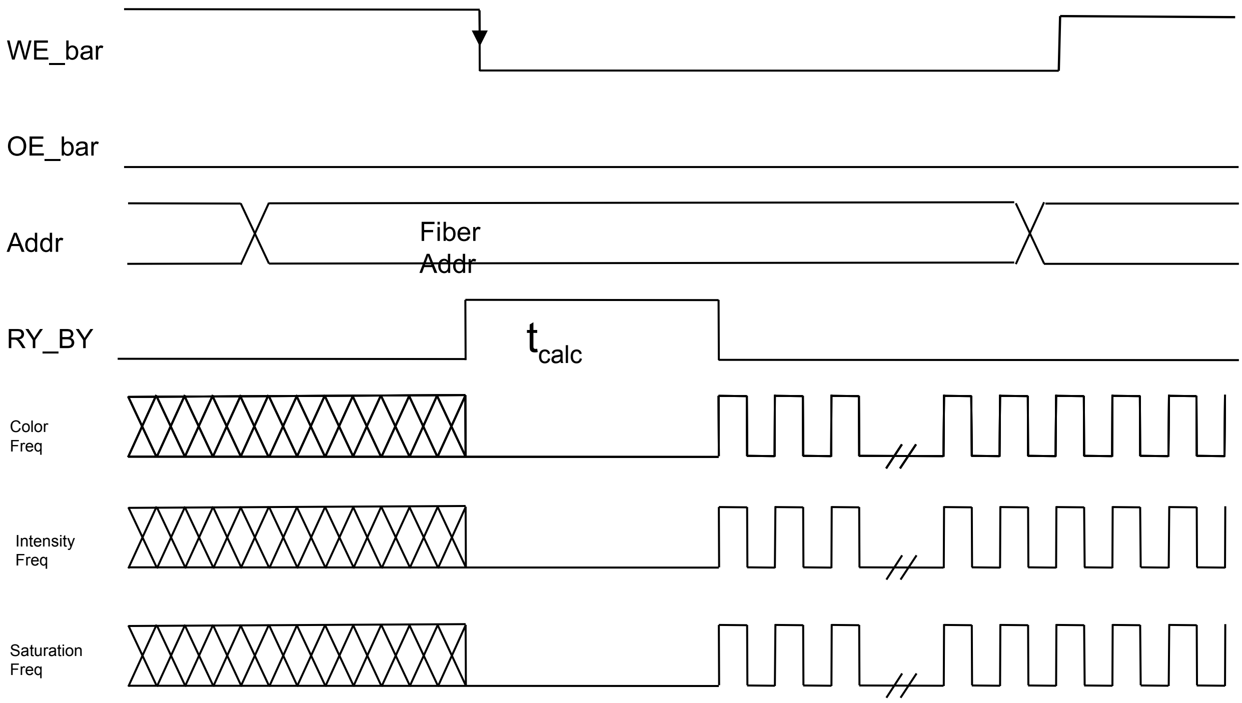

Figure 16.

The timing sequence is as follows:-

1/ WE_bar is driven high and OE_bar is driven low. Ry_By (pin18) will be driven low by the Analyser.

2/ The LED Fiber Address bus is then input to the Analyser (see Figure 12).

3/ WE_bar is driven low and the Analyser will drive RY_BY high. The Intensity, Color and Saturation frequencies will be output on pins 15, 16 and 17 of the ICT connector after the time T_{calc}. RY_BY will be driven low by the Analyser to indicate the outputs are valid. The time for T_{calc} is 200mSec.

4/ After T_{calc} is complete WE_bar will be driven High any time after RY_BY has gone Low.

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In-Circuit Test Mode

Step-by Step Sequence for LED Analyser Auto Capture

1. **/Reset /Initialize Function**

Initialize all inputs to the following logic levels
set Reset to "1"
set WE_bar to "1"
set OE_bar to "0"

set Addr_0 to "1"
set Addr_1 to "1"
set Addr_2 to "1"
set Addr_3 to "1"
set Addr_4 to "1"

set WE_bar to "0" ! This executes the reset command

Wait for RyBy_bar to go to Logic "1"
Wait for RyBy_bar to go to Logic "0" !If RYBY_bar goes high and low the reset command has been successful

set WE_bar to "1"

2. **/Auto Capture Function**

Hold all logic levels as per the end of the reset function

! Auto Range Capture Address 00000 00 dec(350ms)
! Manual Range #1 Capture Address 10101 21 dec(650ms)
! Manual Range #2 Capture Address 10110 22 dec(200ms)
! Manual Range #3 Capture Address 10111 23 dec(22ms)
! Manual Range #4 Capture Address 11000 24 dec(4ms)
! Manual Range #5 Capture Address 11001 25 dec(2ms)
! PWM Low Range Capture Address 11010 26 dec
! PWM high Range Capture Address 11011 27 dec
! Decrement exposure factor Address 11100 28 dec
! Reset exposure factor Address 11101 29 dec
! Increment exposure factor Address 11110 30 dec

set Addr_0 to "0"
set Addr_1 to "0"
set Addr_2 to "0"
set Addr_3 to "0"
set Addr_4 to "0" !Address 00000 is auto capture

set WE_bar to "0"

Wait for RyBy_bar to go to Logic "1"
Wait for RyBy_bar to go to Logic "0" !If RYBY_bar goes high and low the command has been successful

set WE_bar to "1"

3. **Read the Hue(Colour), Saturation and Intensity of Fiber number 1**

Hold all logic levels as per the end of the Capture function

set Addr_0 to "1"
set Addr_1 to "0"
set Addr_2 to "0"
set Addr_3 to "0"
set Addr_4 to "0" !Select Fiber 01

set WE_bar to "0"

Wait for RyBy_bar to go to Logic "1"
Wait for RyBy_bar to go to Logic "0" ! If RYBY_bar goes high and low the command has been successful

Measure the Hue, Sat and Intensity frequencies on pins 15, 16 and 17
set WE_bar to "1"

4. **Read the Hue(Colour), Saturation and Intensity of Fiber number 2**

Hold all logic levels

set Addr_0 to "0"
set Addr_1 to "1"
set Addr_2 to "0"
set Addr_3 to "0"
set Addr_4 to "0" !Select Fiber 02

set WE_bar to "0"

Wait for RyBy_bar to go to Logic "1"
Wait for RyBy_bar to go to Logic "0" ! If RYBY_bar goes high and low the command has been successful

Measure the Hue, Sat and Intensity frequencies on pins 15, 16 and 17
set WE_bar to "1"

Repeat the above steps for fibers 3 to 20

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In-Circuit Test Mode

Capture Times ICT Mode – non PWM 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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Synchronous Serial Mode

Synchronous Serial Mode

The LED Analyser can be controlled using a Synchronous Serial bus, through which commands can be sent and the results read back for testing LED's. To enable this mode the command ***SetSyncSerial*** must be issued through the Serial Port. To put the analyser into Frequency Out mode use the command ***setFrequencyOut***.

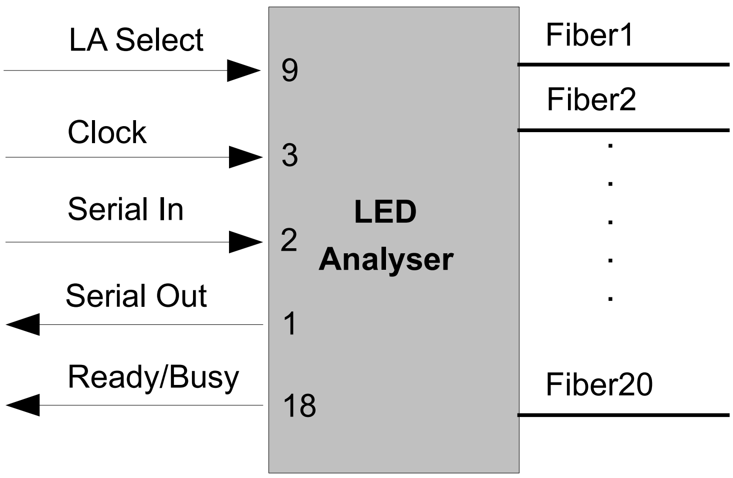

Figure 17.

Figure 17 shows a block diagram of the Synchronous serial bus. There are 5 lines used to implement the Synchronous serial mode. These signals are described in Figure 18.

Pin Number	Signal	Input/Out	Description
9	LA Select	Input	Used to select the Led Analyser
3	Clock	Input	Synchronous Clock
2	Serial In	Input	Serial Data Input
1	Serial Out	Output	Serial Clock input
18	Ready/Busy	Output	Ready Busy Status output

Figure 18.

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Synchronous Serial Mode

Synchronous Serial Pin Descriptions

Serial Out Pin 1
This is the Synchronous Serial Data output pin. The Synchronous Serial is a 5-pin data bus designed for high-speed data transfer between the LED Analyser and the controlling computer. All data transfers are synchronized to the Serial Clock Pin 3.

Serial In Pin 2
This is the Synchronous Serial Data input pin. The data on this pin is synchronized to the Serial Clock.

Serial Clock Pin 3
This is the Synchronous Serial Clock input pin. All data transfers on pins 1 and 2 must be synchronized to this clock. Data is valid on the *falling* edge of this clock.

Addr0 Pins 9
Addr0 is used in the Synchronous Serial mode to select the Analyser (LA_Select).This signal is Active High.

RY_BY Pin 18
This is the Ready/Busy output pin. It is used to indicate the status of the LED Analyser during operation. A high on this pin indicates the Analyser is busy and a low indicates the Analyser is ready for the next operation.

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Synchronous Serial Mode

Synchronous Serial Commands

The following table lists the commands that can be executed through the Synchronous Serial Port. All data transmitted and received is in a binary format.
The Most Significant Bit (MSB) is transmitted/received first.

Command	Data Transmitted	Data Received
Clear Comms Buffer	0xFF (1 byte)	
Initialize the LA	0xAA (1 byte)	
Capture Auto Mode	0x55	0xD5 or 0xEE (error condition)
Capture using Range 1	0xA1	0xD5 or 0xEE (error condition)
Capture using Range 2	0xA2	0xD5 or 0xEE (error condition)
Capture using Range 3	0xA3	0xD5 or 0xEE (error condition)
Capture using Range 4	0xA4	0xD5 or 0xEE (error condition)
Capture using Range 5	0xA5	0xD5 or 0xEE (error condition)
Capture Status	0xBB	0xD5 or 0xEE (error condition)
CapturePWM using Range 1	0xB1	0xD5 or 0xEE (error condition)
CapturePWM using Range 2	0xB2	0xD5 or 0xEE (error condition)
CapturePWM using Range 3	0xB3	0xD5 or 0xEE (error condition)
CapturePWM using Range 4	0xB4	0xD5 or 0xEE (error condition)
CapturePWM using Range 5	0xB5	0xD5 or 0xEE (error condition)
Read HSI	0x20 + fiber num (1byte)	Hue(2bytes) + Sat(1byte) + Int(3byte)
Read RGB	0x30 + fiber num (1byte)	R(1byte) + G(1byte) +B(1byte) +Int(3byte)
Set Sensitivity Factor	0x40 + factor(0x01 - 0x0F)	factor(0x01 - 0x0F)

Figure 19.

Note:- The code *0xD5* indicates the command completed correctly. If the code *0xEE* is received then an error has occurred and the command should be re-transmitted.

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Synchronous Serial Mode

Clear Comms Buffer

This command will clear the Communications Buffer of the Synchronous Serial Port of any data bits. The sequence for this command is shown in Figure 20.

Binary 11111111 (0xFF) is clocked into the LED Analyser while the *LA_Select* signal is held low.

The command is clocked in on the falling edge of *SCK*.

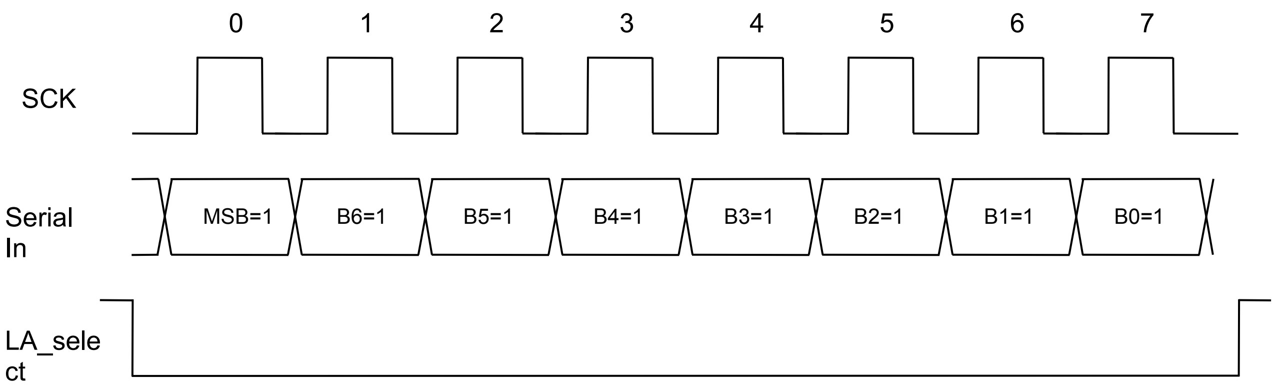

Figure 20.

The signal *LA_Select* must be driven low while 0xFF is clocked into the Analyser.

For all other commands the signal *LA_Select* should be driven high.

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Synchronous Serial Mode

Initialize the LED Analyser

This command will initialize the LED Analyser and make it ready for a *Capture* command. The sequence for this command is shown in Figure 21.

Binary 10101010 (0xAA) is clocked into the LED Analyser while the *LA_Select* signal is held high.

The command is clocked in on the falling edge of *SCK*.

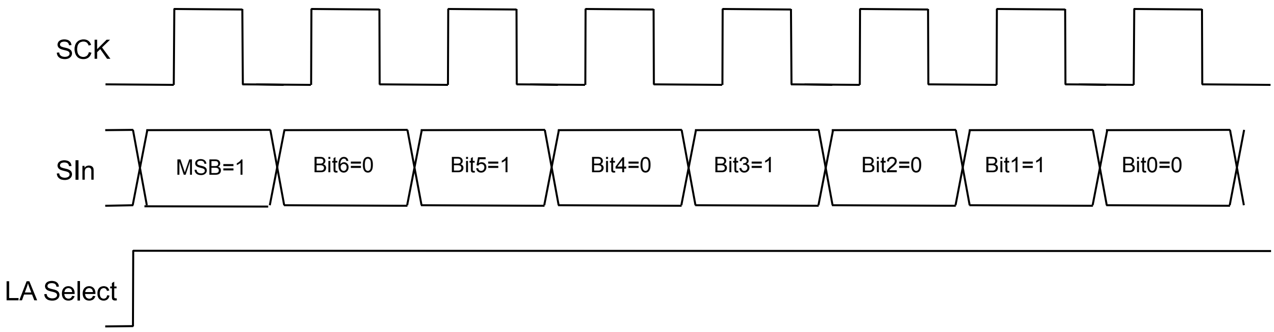

Figure 21.

The signal *LA_Select* must be driven high while 0xAA is clocked into the Analyser.

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Synchronous Serial Mode

Capture for non-PWM LED's

This command will instruct the LED Analyser to capture and store all the LED Colour, Saturation and Intensity data. There are six Intensity ranges that can be specified to get the best results from the test.
There are five manual ranges designated Range1, Range2, Range3, Range4 and Range5. Range1 has the highest sensitivity for low light conditions and the sensitivity is reduced progressively to Range5 which has the lowest sensitivity. This means that for brighter LED's the higher Ranges should be used.

The sixth Range uses an automatic exposure and covers the full Intensity range of the Analyser. This should only be used when it is required to test very dim and very bright LED's together.

The command codes are shown in Figure 22.

Command	Data Transmitted	Data Received
Capture Auto Mode	0x55	0xD5 or 0xEE (error condition)
Capture using Range 1	0xA1	0xD5 or 0xEE (error condition)
Capture using Range 2	0xA2	0xD5 or 0xEE (error condition)
Capture using Range 3	0xA3	0xD5 or 0xEE (error condition)
Capture using Range 4	0xA4	0xD5 or 0xEE (error condition)
Capture using Range 5	0xA5	0xD5 or 0xEE (error condition)

Figure 22.

The code 0xD5 indicates a successful completion of the command. If an error occurs then the code 0xEE will be received. The command should then be re-transmitted.

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Synchronous Serial Mode

Capture Command Timing

Transmit Command Code to LED Analyser

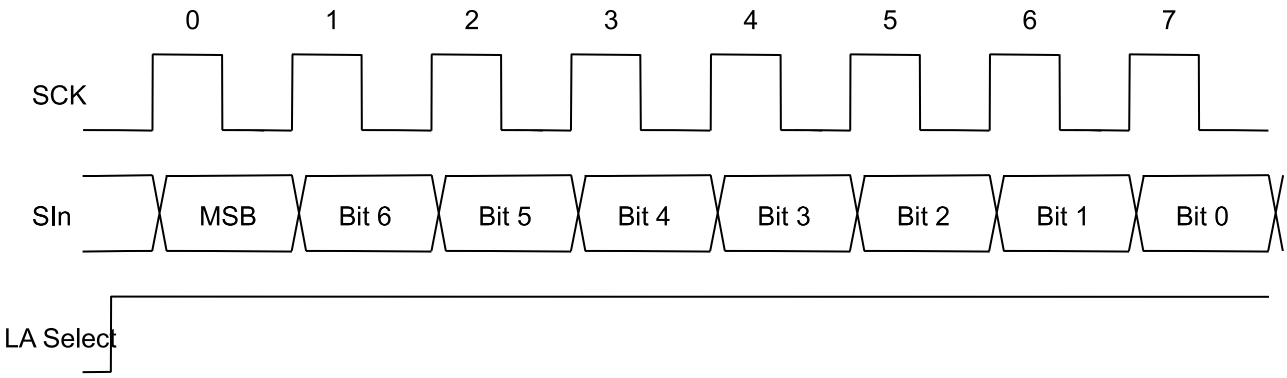

Figure 23.

Receive Status Code from LED Analyser

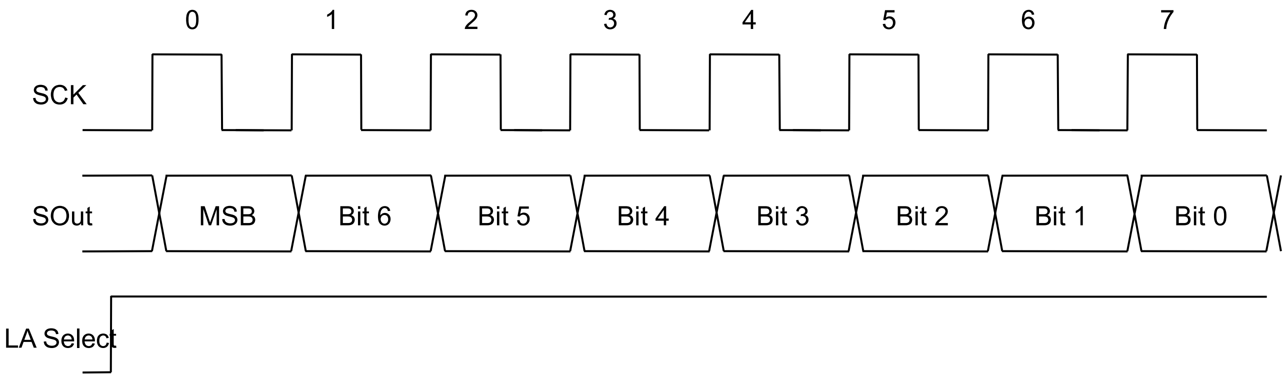

Figure 24.

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Synchronous Serial Mode

Step-by Step Sequence for LED Analyser Capture non-PWM LED's

1.**Initialize the board**
- Set LA_Select = 0
- Set Clock_in = 0
- Set Data_in to 0

2. **Clear Comms Buffer**
- Set Data_In to 1
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

3. **Set Data_in to 0**

4. **Set LA_Select to 1**
- Data_Out goes to 0
- RY_BY goes to to 0

5. **Wait 1m**

6. **Initialize the capture**
- Set Data_in to 10101010
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit
- Data_out goes to 1
- RY_By goes to 1

7. **Send one capture command from the following list**
- (0X55) Auto Range
- (0XA1) Manual Range #1 (Low)
- (0XA2) Manual Range #2 (Medium)
- (0XA3) Manual Range #3 (High)
- (0XA4) Manual Range #4 (Super High)
- (0XA5) Manual Range #5 (Ultra)
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

8. **Read back the Capture Acknowledge as follows**
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit
- Read back 0xD5 (8 bits after each falling edge of the clock)

9. **Check that RY_BY is high**

Synchronous Serial Mode

Step-by Step Sequence for LED Analyser Capture con'td

10 **Check that RY_BY goes low after the capture time.**

11. **Send the Capture Status command (0xBB)**
- Set Data_in to (0XBB) (10111011)
- Set Clock_in to 1 and 0   repeat [8] times to clock in each bit

12. **Receive Response**
- Set Clock_in to 1 and 0   repeat [8] times to clock in each bit
- Read back 8 bits after each falling edge of the clock
- (0xD5 is positive response and 0xEE is error response)

Capture Times Synchronous Mode – non PWM Leds

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

These are the maximum Capture Times for each range.

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Synchronous Serial Mode

Capture for PWM LED's

Pulse-Width-Modulated(PWM) LED's are switched on and off rapidly to save power and to control Intensity. The Analyser contains a special set of commands for testing PWM LED's. There are five Intensity ranges that can be specified to get the best results from the test. The ranges are designated Range1, Range2, Range3, Range4 and Range5. Range1 has the highest sensitivity for low light conditions. The sensitivity is reduced progressively to Range5 which has the lowest sensitivity. This means that for brighter LED's the higher Ranges should be used.

The command codes are shown in Figure 25.

Command	Data Transmitted	Data Received
Capture using Range 1	0xB1 + byte2	0xD5 or 0xEE (error condition)
Capture using Range 2	0xB2 + byte2	0xD5 or 0xEE (error condition)
Capture using Range 3	0xB3 + byte2	0xD5 or 0xEE (error condition)
Capture using Range 4	0xB4 + byte2	0xD5 or 0xEE (error condition)
Capture using Range 5	0xB5 + byte2	0xD5 or 0xEE (error condition)

Figure 25.

The data in byte2 is a hexadecimal number in the range 0x01 – 0x0F. This number represents the *Averaging Factor* for PWM testing. The smaller the value the faster the test will be to execute. However, this value should be derived experimentally to determine the best compromise between speed and stability.

It is recommended to use a initial value of 0x07.

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Synchronous Serial Mode

Step-by-Step Sequence for LED Analyser Capture for PWM LED's

1. **Initialize the board**
 - Set LA_Select = 0
 - Set Clock_in = 0
 - Set Data_in to 0

2. **Clear Comms Buffer**
 - Set Data_In to 1
 - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit

3. **Set Data_in to 0**

4. **Set LA_Select to 1**
 - Data_Out goes to 0
 - RY_BY goes to 0

5. **Wait 1m**

6. **Initialize the capture**
 - Set Data_in to 10101010
 - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit
 - Data_out goes to 1
 - RY_By goes to 1

7. **Send one capture command from the following list**
 - (0xB1) PWM Manual Range #1 (Low)
 - (0xB2) PWM Manual Range #2 (Medium)
 - (0xB3) PWM Manual Range #3 (High)
 - (0xB4) PWM Manual Range #4 (Super High)
 - (0xB5) PWM Manual Range #5 (Ultra)
 - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit

8. **Send the PWM Averaging Time as follows**
 - Set Data_in to one value between (0x01 to 0x0F) (Default 0x07)
 - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit

9. **Read back the Capture Acknowledge as follows**
 - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit
 - Read back 8 bits after each falling edge of the clock
 - (0xD5 is positive response) (0xEE is an error response)

Synchronous Serial Mode

10. **Check that RY_BY is high**

11. **Check that RY_BY goes low after the capture time**

12. **Send the Capture Status command (0xBB)**
    - Set Data_in to (0XBB) (10111011)
    - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit

13. **Receive Response**
    - Set Clock_in to 1 and 0   repeat [8] times to clock in each bit
    - Read back 8 bits after each falling edge of the clock
    - (0xD5 is positive response and 0xEE is an error response)

Capture Times Synchronous Mode – PWM Leds

Range	Capture Time
Range 1 low	9.60Sec
Range 2 medium	6.4Sec
Range 3 high	3.3Sec
Range 4 super	932mSec
Range 5 ultra	740mSec

Note: These PWM Capture times are based on an averaging factor of 07.

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Synchronous Serial Mode

Read Hue, Saturation and Intensity (HSI)

This command will instruct the LED Analyser to output the Hue, Saturation and Intensity of a LED. All the LED data should have been previously captured.

The code for this command is 0x20 – this must be transmitted to the LED Analyser followed by the Fiber Number of the LED to be tested. The Fiber Number is a hexadecimal number in the range 0x01 – 0x14 (in decimal this represents numbers 1 -20). The Analyser will return 6 bytes of data – 2 bytes for Hue, 1 byte for Saturation and 3 bytes for Intensity.

Command	Data Transmitted	Data Received
Read HSI	0x20 + fiber num (1byte)	Hue(2bytes) + Sat(1byte) + Int(3byte)

To convert the Hue data to a decimal number use the formula:-

Hue = (byte1*256 + byte2)/100

The Saturation value will be in the 3rd byte and will represent a number in the range 0 – 100.

Saturation = (byte3)

The Intensity value is output in the last 3 bytes with the most significant byte first.

To convert the Intensity data to a decimal number use the formula:-

Intensity = (byte4 * 65536) + (byte5 * 256) + byte6

Note:- The data output in all the bytes are hexadecimal numbers.

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Synchronous Serial Mode

Step-by Step Sequence to Read Hue, Saturation and Intensity (HSI)

Initialize the board
- Set LA_Select = 0
- Set Clock_in = 0
- Set Data_in to 0

2. **Clear the Comms Buffer**
- Set Data_In to 1
- Set Clock_in to 1 and 0 [8] times to clock in each bit

3. **Send the command to read HSI as follows**
- Set Data_In to 0X20 (00100000)
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

4. **Send Fiber Number to Read**
- Send (0x01 to 0x14) (1-20 decimal)
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

5. **Read back 6 bytes of data**
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Hue** high byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Hue** low byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Saturation** byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Intensity** high byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Intensity** middle byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Intensity** low byte]

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Synchronous Serial Mode

Read RGB and Intensity

This command will instruct the LED Analyser to output the RGB colour and Intensity of a LED. All the LED data should have been previously captured.

The code for this command is 0x30 – this must be transmitted to the LED Analyser followed by the Fiber Number of the LED to be tested. The Fiber Number is a hexadecimal number in the range 0x01 – 0x14 (in decimal this represents numbers 1 -20). The Analyser will return 6 bytes of data – 1 byte each for Red, Green, Blue and 3 bytes for Intensity.

Command	Data Transmitted	Data Received
Read RGB + Intensity	0x30 + fiber num (1byte)	R(1byte)+G(1byte)+B(1byte) + Int(3byte)

Red = (byte1)

Green = (byte2)

Blue = (byte3)

The Intensity value is output in the last 3 bytes with the most significant byte first.

To convert the Intensity data to a decimal number use the formula:-

Intensity = (byte4 * 65536) + (byte5 * 256) + byte6

Note:- The data output in all the bytes are hexadecimal numbers.

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Synchronous Serial Mode

Step-by Step Sequence to Read RGB and Intensity (RGBI)

1. Initialize the board
- Set LA_Select = 0
- Set Clock_in = 0
- Set Data_in to 0

2. **Clear the Comms Buffer**
- Set Data_In to 1
- Set Clock_in to 1 and 0 [8] times to clock in each bit

3. **Send the command to read RGBI as follows**
- Set Data_In to 0X30 (00110000)
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

4. **Send Fiber Number to Read**
- Send (0x01 to 0x14) (1-20 decimal)
- Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

5. **Read back 6 bytes of data**
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Red** byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Green** byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Blue** byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Intensity** high byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Intensity** middle byte]
- Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
- Data_Out = [**Intensity** low byte]

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Synchronous Serial Mode

Set the Sensitivity Factor

The Sensitivity of the Analyser can be adjusted to allow longer exposure times. This is useful when testing dim LED's. There are 15 adjustment steps numbered 1 – 15.

Number 1 has the shortest exposure and number 15 will have the longest. The Factory default value is 1.

Once programmed the Sensitivity Factor remains unchanged even when power is removed.

Step-by Step Sequence to Set the Sensitivity Factor

1. **Initialize the board**
   - Set LA_Select = 0
   - Set Clock_in = 0
   - Set Data_in to 0

2. **Clear the Comms Buffer**
   - Set Data_In to 1
   - Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

3. Wait 100u

4. **Send the Set Sensitivity Factor (0x40) command**
   - Set Data_In to 01000000 (0x40)
   - Set Clock_in to 1 and 0 repeat [8] times to clock in each bit

5. **Send the Sensitivity Factor (0X01 to 0X0F) (Default 0x01)**
   - Set Data_In to [a number in the range 0x01-0x0F]
   - Set Clock_in to 1 and 0 repeat [8] times to clock in each bit
   - RY_BY output goes high

6. Wait 50m
   - RY_BY output goes low

7. **Read back the Sensitivity Factor set in Step 5**
   - Set Clock_in to 1 and 0 repeat [8] times to clock out each bit
     – Data_Out = [[a number in the range 0x01-0x0F]
       - The value read back is the same as the Sensitivity factor programmed in step 5

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External Capture Mode

There is an external capture function on the Feasa ICT units.
A falling edge on the **pin 7** of the ICT connector would trigger a capture on the Led Analyser.

Set up the external capture

The command "SETEXTERNALCAPTURE##" will activate the external capture. ## can be:
00: then external capture is disabled (default factory value)
01 to 05: range capture 1 to 5 is selected (CAPTURE#)
06: automatic capture is selected (CAPTURE)
11-15: PWM capture is selected (CAPTURE#PWM)

The command "GETEXTERNALCAPTURE" reads back the external capture mode from the unit.

Set up the data report

Once the external capture has been finished, the analyser can output the data corresponding to a particular parameter (HSI, RGBI…). The commands to configure the data report are:

"SETEXTERNALOUTPUTNONE": no data is reported over the RS232 port after the capture. This mode is the default factory.

"SETEXTERNALOUTPUTRGBI": red, green, blue and intensity are reported for all the fibres automatically after an external trigger has been applied:
01 rrr ggg bbb iiiii
02 rrr ggg bbb iiiii
…
20 rrr ggg bbb iiiii

"SETEXTERNALOUTPUTHSI": hue, saturation and intensity are reported for all the fibres automatically after an external trigger has been applied:
01 hhh.hh sss iiiii
02 hhh.hh sss iiiii
…
20 hhh.hh sss iiiii

"SETEXTERNALOUTPUTXYI": xy coordinates and intensity are reported for all the fibres automatically after an external trigger has been applied:
01 0.xxxx 0.yyyy iiiii
02 0.xxxx 0.yyyy iiiii
…
20 0.xxxx 0.yyyy iiiii

External Capture Mode

"SETEXTERNALOUTPUTCCTI": CCT, Duv and intensity are reported for all the fibres automatically after an external trigger has been applied:
01 ccccc +0.dddd iiiii
02 ccccc +0.dddd iiiii
…
20 ccccc +0.dddd iiiii

"SETEXTERNALOUTPUTWI": dominant wavelength and intensity are reported for all the fibres automatically after an external trigger has been applied:
01 www iiiii
02 www iiiii
…
20 www iiiii

The command "GETEXTERNALOUTPUT" returns the report mode selected.

Serial Port Control

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.

5V DC @ 180mA Power must be supplied to Pins 19 and 20 of the 20-way Connector.
See *Figure 26*.

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. These can be selected using the setbaud command.

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

20-Way Connector

Pin No	*Signal*
19	Power (5V DC)
20	GND

Figure 26.

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Capture Commands

The Capture commands are used to capture the parameters (color, 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 raw data 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 Serial Com Port.

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Capture Mode

CAPTURE - Store LED Data

Transmit	Receive
capture	**OK**

Description

This command instructs the LED Analyser to read 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. In the case of a 20 channel unit the data for all 20 LED's is 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

CAPTURE# - Store LED Data for a specific range

Transmit	Receive
capture#	**OK**

Where:

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

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 Color 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

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Capture Mode

CAPTUREPWM - Capture PWM LED Data

Transmit	Receive
capturepwm	**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 Color 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

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Capture Mode

CAPTURE#PWM@@ - Capture PWM LED Data for a specific range

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

Where:

\#   represents the exposure Range 1 – 5.
@@ represents an averaging factor in the range 1 - 15.

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.

This command instructs the LED Analyser to read and store the Color 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

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Get Data Commands

The *get data* commands are used to read out the Color, 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 **case-insensitive**. 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.

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Get Data Mode

getRGBI## - Get RGB and Intensity for a LED

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

Where:

represents the Fiber Number and is a number in the range 01 – 20.

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

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.

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 color. 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 only 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.

Example:

The PC transmits **getrgbi05** to the LED Analyser to instruct it to send the stored Color 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##	**hhh.hh sss iiiii**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
hhh.hh represents the Hue (color) 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 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.

Description

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

Example:

The PC transmits **gethsi05** to the LED Analyser to instruct it to send the stored Color 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##	**0.xxxx 0.yyyy**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
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 only 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.

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

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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Get Data 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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Get Data Mode

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

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

Where:

represents the Fiber Number and is a number in the range 01 – 20.
0.uuuu represents the u Chromaticity value
0.vvvv represents the v Chromaticity value

Description

This command is used to return the uv 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 only 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.

Example:

The PC transmits **getuv01** 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.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##	**XXX**

Where:

represents the Fiber Number and is a number in the range 1 – 20.
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 only be read out one-at-the-time, in any order.

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

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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Get Data Mode

getWI## - Get the Dominant Wavelength & Intensity

Transmit	Receive
getwi##	**XXX YYYYY**

Where:

represents the Fiber Number and is a number in the range 1 – 20.
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 only be read out one-at-the-time, in any order.

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

getCCT## - Get the Correlated Colour Temperature

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

Where:

represents the Fiber Number and is a number in the range 1 – 20.
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 only be read out one-at-the-time, in any order.

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

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Get Data Mode

getINTENSITY## - Get the Intensity

Transmit	Receive
getINTENSITY##	**IIIII**

Where:

represents the Fiber Number and is a number in the range 01 – 20.
IIIII represents the Intensity value.

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 only 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.

Example:

The PC transmits **getintensity01** 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 **IIIII** to the PC.

getintensity01
06734

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Get Data 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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Get Data Mode

getFACTOR - Get the exposure Factor

Transmit	Receive
getfactor	**xx**

Where:

xx represents the exposure factor value. 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

getICTSTATUS - get the mode status of ICT Interface

Transmit	Receive
getictstatus	**x x x**

Where:

x x x represents the mode status of the ICT Interface.

Description

This command will cause the Analyser to output the current mode of the ICT Interface.
If the Analyser is set to Frequency Output mode then the string **Frequency Out Mode** will be returned.
If the Analyser is in Synchronous Serial mode then the string **Sync Serial Mode** will be returned.

The ICT mode can be changed using the *SetSyncSerial* or the *SetFrequencyOut* commands.

Example:

getictstatus
Frequency out mode

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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 labeled 1 to 7 over segments a-g on the 7-Segment display. See *Figure 27* .
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.

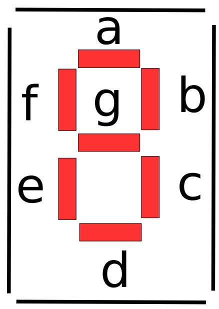

Figure 27.

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

getxxxALL Get the data for ALL leds on the Analyser

getRGBIall	Get Red Green Blue and Intensity for all LEDs
getHSIall	Get Hue Saturation & Intensity for all LED's
getXYall	Get the X,Y for all LED's
getUVall	Get the UV for all LED's
getWIall	Get Wavelength & Intensity for all LED's
getWAVELENGTHall	Get the Wavelength for all LED's
getINTENSITYall	Get the Intensity for all LED's
getCCTall	Get the CCT for for all LED's

Description:

This command will allow the user to interrogate the data stored on the Analyser from the last capture for all the fibers simultaneously. For example when using a Feasa 20F the getxxxALL command will report 20 results, for a Feasa 3F the getxxxALL command will return 3 results.

Example:

Using a Feasa-3F testing 3 similar leds.
The PC transmits **gethsiall** to the LED Analyser to instruct it to send the stored Color and Intensity data for the LED positioned under Fiber No's 1,2,3. The LED Analyser will return a string **xx hhh.hh sss iiiii** to the PC for all three fibers (Fiber No., Hue, Saturation, Intensity)

gethsiall
01 123.47 098 06383
02 123.47 098 06383
03 123.47 098 06383

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Set Commands

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

These settings remain programmed in the Analyser even when the power is removed.

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

SetINTGAIN - Set the Intensity GainFactor

Transmit	Receive
Setintgain##xxx	**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 values are stored permanently in memory and can only be changed by using the *setIntGain* command again.

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

Example:

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

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Set Data Mode

SetFACTOR## - Set the Exposure Factor

Transmit	Receive
Setfactor##	**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 i.e. Factor 02 will double the test time, factor 03 will treble the test time etc.

Try the low range(*capture1*) first before adjusting the Exposure Factor.

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

Example:

Set the Factor Number for all Fibers to 05.

setfactor05
OK

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Set Data Mode

setXOFFSET##0.xxx - Set the x Chromaticity Offset

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

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

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Set Data Mode

setYOFFSET##0.yyy - Set the y Chromaticity Offset

Transmit	Receive
Setyoffset##±0.yyy	**OK**

Where:

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

Description

This 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.

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

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Set Data Mode

setWAVELENGTHOFFSET@@±## - Set the wavelength Offset

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

Where:

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

Description

This 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.

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

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Set Data Mode

setSYNCSERIAL - Set the ICT Interface to Synchronous Serial Mode

Transmit	Receive
SetSyncSerial	**OK**

Description

This command is used to set the Analyser ICT Interface to Synchronous Serial mode.
It must be issued through the Serial Port. The unit will remain in this mode until instructed otherwise. The status of the ICT Interface can be determined using the *getICTStatus* command. To put the analyser into Frequency Out mode use the command *setFrequencyOut*.

Example:

The PC transmits **setsyncserial** to the LED Analyser to instruct it to set Synchronous Serial mode.

setsyncserial
OK

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Set Data Mode

setFREQUENCYOUT - Set the ICT Interface to Frequency Output Mode

Transmit	Receive
SetFrequencyOut	**OK**

Description

This command is used to set the Analyser ICT Interface in *Frequency Output* mode.
It must be issued through the Serial Port. The unit will remain in this mode until instructed otherwise. The status of the ICT Interface can be determined using the *getICTStatus* command. To put the analyser into Synchronous Serial mode use the command setSyncSerial.

Example:

The PC transmits **setfrequencyout** to the LED Analyser to instruct it to set Frequency Output mode.

setfrequencyout
OK

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General Commands

SetBAUD- Change the baud rate

Transmit	Receive
Setbaudxxxxx	**OK**

Where: **xxxxxx** = 9600,19200,38400,57600,115200

Description

This command will change the baud rate of the Serial Port in the Analyser.

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

The maximium allowed baud rate for the Serial Port is 115200.

Example:

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

setbaud19200
OK

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General Commands

SetLOG - Change the Intensity Response of the Analyser to Logarithmic mode

Transmit	Receive
Setlog	**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

setlog
OK

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General Commands

SetLIN - Change the Intensity response of the Analyser to Linear Mode

Transmit	Receive
Setlin	**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

NOTE: For units shipped with versions i113 to i117 please type the following command when setting the analyser to Linear mode. This need only be done once as the command will be stored. **Setabsolute1.0000**

setlin
OK

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General Commands

getSERIAL Get the Serial Number of the Analyser

Transmit	Receive
getSerial	**xxxx**

Where: xxxx is an alphanumeric value.

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.

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
I100

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General Commands

getHW - Get the Hardware Version

Transmit	Receive
getHW	**xxxxxxxxxx**

Where: xxxxxxxxxx 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 **xxxxxxxxxx** to the PC.

gethw
Feasa 20-I

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General Commands

GetINFO - Get a summary of the Led Analyser details

Transmit	Receive
getinfo	**See details below**

Information Received back from the Analyser:

Serial Number : Xyyy
Firmware Version : Iyyy
Intensity Mode : Logarithmic
Last Capture : Capture
Number of Fibers : 006
Exposure Factor : 001

Description

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

Example:

The PC transmits **getinfo** to the LED Analyser and it will return to the PC.

Serial Number : E123
Firmware Version : I116
Intensity Mode : Logarithmic
Last Capture : Capture
Number of Fibers : 006
Exposure Factor : 001

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General Commands

HELP - Command Summary Listing

Transmit	Receive
help	**Command listing**

Description

This command will generate a summary listing of all the LED Analyser commands. This is useful when using a terminal program such as HyperTerminal.

Example:

To generate the listing transmit **help** to the Analyser .

help

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Step-by-Step approach to Testing a LED

Standard Capture Mode

To Test the Color 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 Color and Intensity in **RGB** first send the command **capture** to the LED Analyser. The LED Analyser will return the characters **OK** indicating that the Color 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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PWM LED Mode

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 28. 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 90%.

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

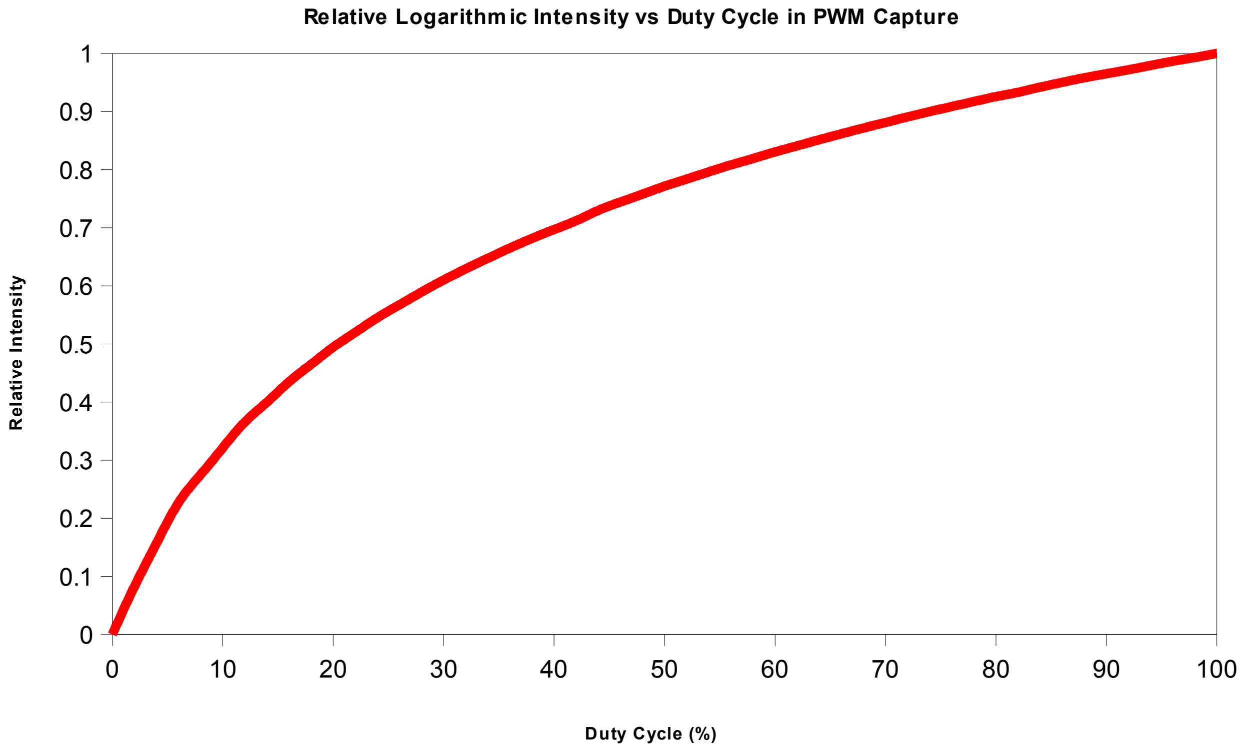

Figure 28: Normalized Intensity versus Modulation

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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 Color, 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 color. 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.

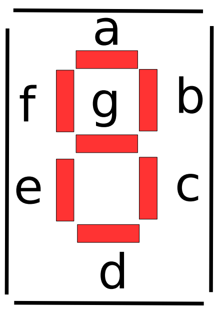

Figure 29. 7 Segment Display

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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
getRGBI##	Get RGB, Saturation and Intensity for a LED
getHSI##	Get Hue, Saturation and Intensity for a LED
getxy##	Get the xy Chromaticity values
getxoffset##	Get the x Chromacicity Offset
getxoffset##	Get the y Chomacicity Offset
getuv##	Get the u'v' Chromaticity values
getWavelength##	Get Dominant Wavelength for LED
getCCT##	Get Color Temperature for LED
getWI##	Get Wavelength & Intensity for LED
getWavelengthOffset@@	Get the wavelength offset for fiber
getINTENSITY##	Get the Intensity for a LED
getIntGain##	Get the Intensity Gain Factor
getFactor	Get the Exposure Factor
getICTStatus	Get the mode status of the Analyser
getSerial	Get the Serial Number of the Analyser
getVersion	Get the Firmware Revision of the Analyser
getHW	Get the Hardware Version of the Analyser
getinfo	Get the summary details of a Led Analyser
Setbaud	Set the baud rate of the Serial Port
setlog	Set the Intensity Response to Logarithmic Mode
setlin	Set the Intensity Response to Linear Mode
help	Command Summary Listing
get7seg#	Get the value of a 7segment display

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Specifications

Part Number(s)

Feasa 20-I	LED Analyser with 20 Fibers
Feasa 10-I	LED Analyser with 10 Fibers
Feasa 6-I	LED analyser with 6 Fibers
Feasa 5-I	LED Analyser with 5 Fibers
Feasa 3-I	LED Analyser with 3 Fibers
Feasa 2-I	LED Analyser with 2 Fibers

Physical

Dimensions 140mm x 29mm x 50mm (L x W x H) – Feasa 20-I, 10-I, 6-I
Dimensions 100mm x 29mm x 50mm (L x W x H) – Feasa 10-I, 5-I, 3-I, 2-I
Fiber Length 0.6m
Fiber Diameter 1.0mm
Fiber Core Diameter 0.5mm
Number of Fibers 2, 3, 5, 6, 10, 20
Operating Temperature Range 0^0C to $+50^0$C

Electrical

Supply Voltage 5.0V
Supply Current 180 mA
ICT Interface, Serial RS232 Interface
Output Data Format RGB, HSI, xy, uv, wavelength, cct

Color (Frequency):	1-100 KHz
Saturation (Frequency):	1-100 KHz
Intensity (Frequency):	1-100 KHz

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 = ± 0.0015, y = ± 0.0015
Red (630nm)	± 3nm
Green (540nm)	± 4nm
Blue (630nm)	± 3nm

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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 remanufactured parts equivalent to new in performance or may have been subject to incidental use.

5. The warranty period begins on the date of delivery.

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.

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