AN-SL2001-03 800W VCSEL Evaluation Board

Introduction

This Application Note contains the evaluation board description with specifications, board pictures, schematics and layout of the printed circuit board, bill-of-materials, and performance data for the SLE2001-V01, which is a 800W Vertical Cavity Surface Emitting Laser (VCSEL) Load Evaluation Board using Silanna Semiconductor's SL2001 laser driver IC. The typical performance data is shown along with pictures from the SL200X GUI for Vin voltages varying from 3.25V up to 24V. For more specific information about the component placement and board layout guidelines, please refer to AN-SL2001-05.

Evaluation Board Description

This report describes a simple 800W peak power and less than 5ns FWHM resonant flash TOF laser system with wide input range from 2.8V to 24V. The design uses SL2001 (Integrated Resonant Mode Laser Diode Drive System). The design shows the high peak power with very narrow laser FWHM pulse that can be achieved due to the high level of integration of the SL2001 controller.

Specifications

Table 1 shows the key specs for the evaluation board for SL2001.

Parameter	Value	Unit
Input Voltage (min)	2.8	V
Input Voltage (max)	24	V
Peak Power (max)	800	W
Laser FWHM Pulse Width (min)	5	ns
System No Load Power Consumption	< 5	mW
Rep Rate Switching Frequency	10	MHz

Table 1: Key Specifications

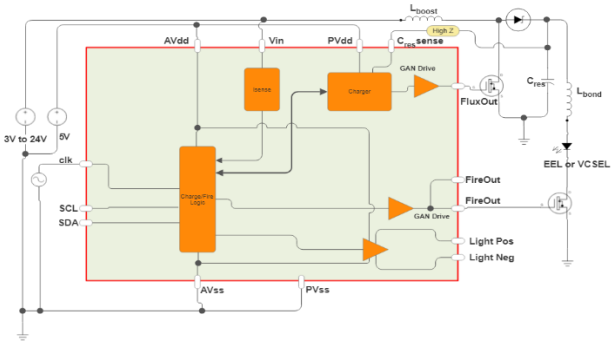

Figure1. Typical Application Diagram

SL2001 Key Features

- Flexible architecture can provide laser FWHM pulses less than 2ns
- Dual Drive Outputs Support Peak Power up to 1000W
- High charging efficiency from a single 2.8V to 24V supply
- Integrates needed blocks for Charging and Firing Resonant Mode Diode Lasers utilizing either EEL Diodes or VCSEL Arrays
- Integrated GAN/MOS Drive for Charging Resonant Capacitor
- Inductor Current Control offers precise Resonant Capacitor Energy even with Input Voltage Fluctuations
- < 5 mW System No Load Power Consumption
- Up to 10 MHz Rep Rate limited by temperature rise in laser and other board components
- Dual Polarity LIGHT Output signal to indicate when laser fires with extremely low jitter (time error jitter < 0.1ns)
- Minimal external components enable extremely integrated and efficient layout
- Integrated I²C interface and non-volatile memory for Output Power Control and Fault monitoring
- 1 mm x 3.5 mm WLCSP Package utilizing bumped die

Applications

- Laser TOF Measurement Systems
- LIDAR Array
- Range Finding
- 3D Mapping
- ADAS

Safety Warning

This device is capable of driving laser diodes to generate high power optical pulses. Such pulses are capable of causing PERMANENT VISION DAMAGE AND BLINDNESS as well as additional injury or property damage. Laser diodes emit light that may be outside of the users' visual range which can cause PERMANENT VISION DAMAGE AND BLINDNESS as well as additional injury or property damage. Users are fully responsible for following proper laser safety procedures to prevent injury or damage. We recommend the use of Laser Eye Safety Goggles for all testing.

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Board Pictures

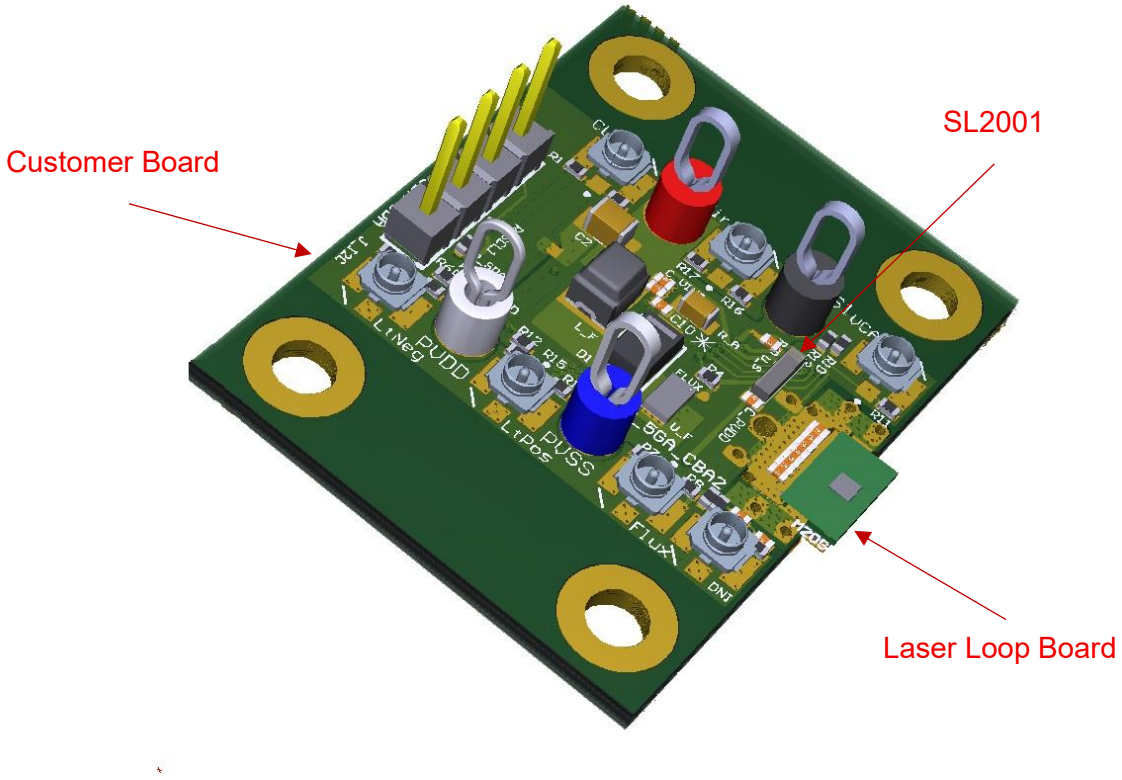

Figure 2. 3-D Picture of the Board

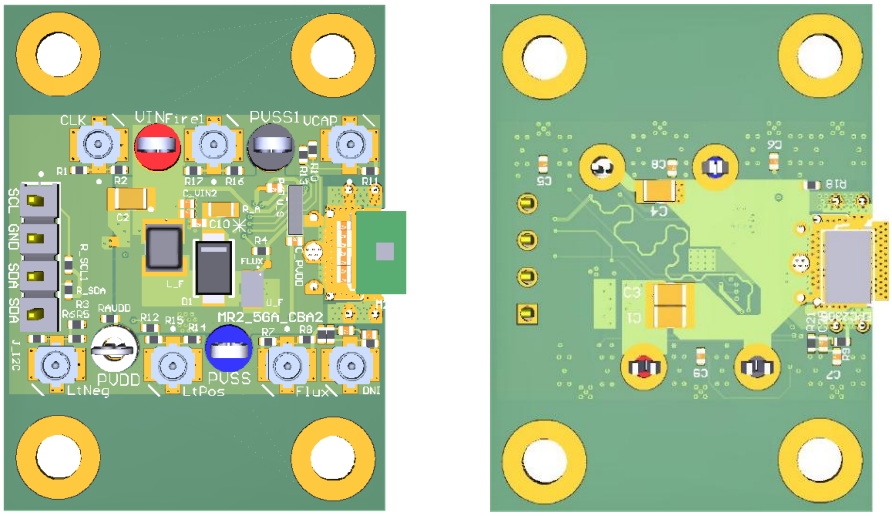

Figure 3. Top and Bottom View

Schematics and Layout

Figures 4 and 5 show the Schematic of the Customer Board and Laser Loop Board

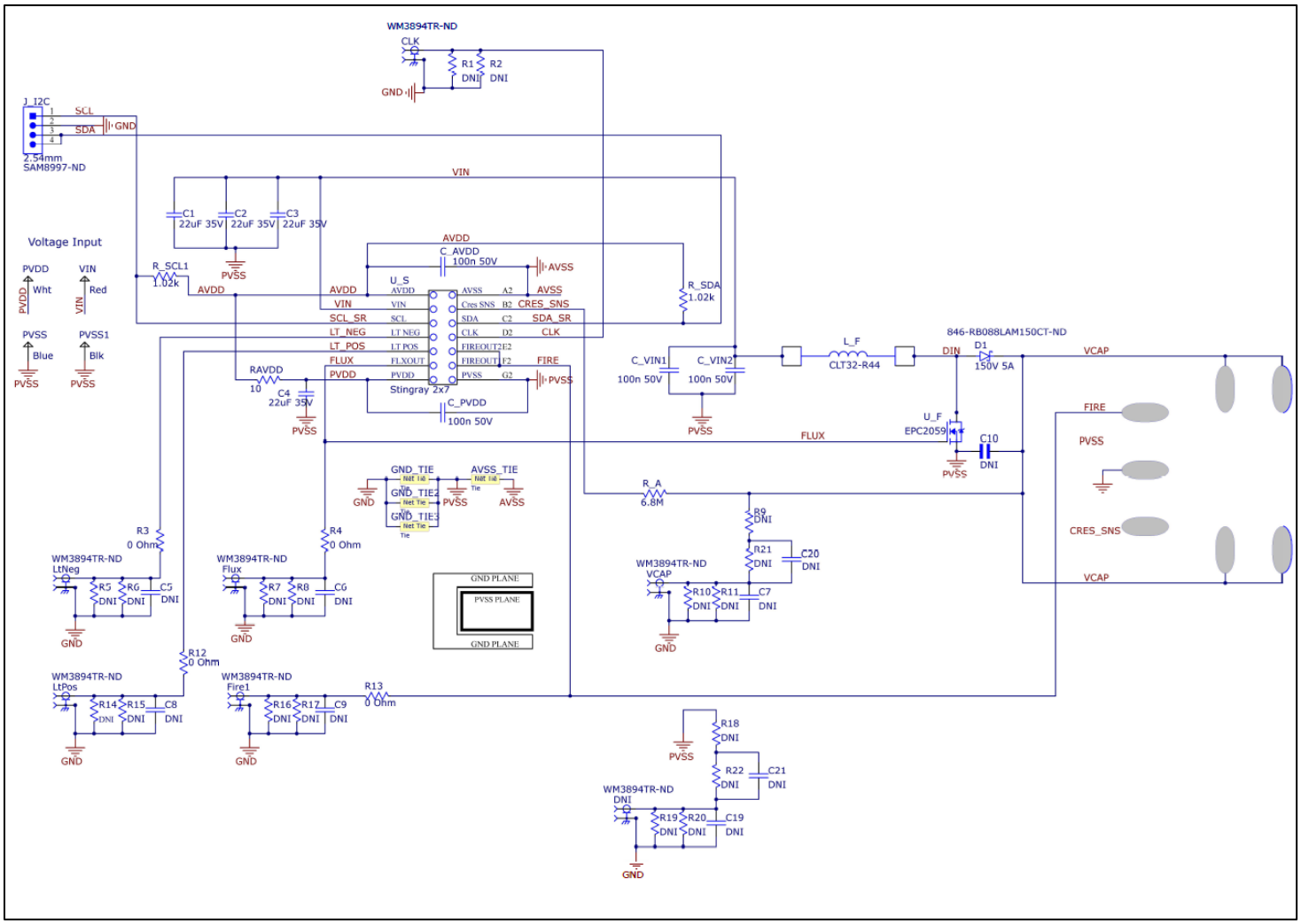

Figure 4: Customer Board Schematic

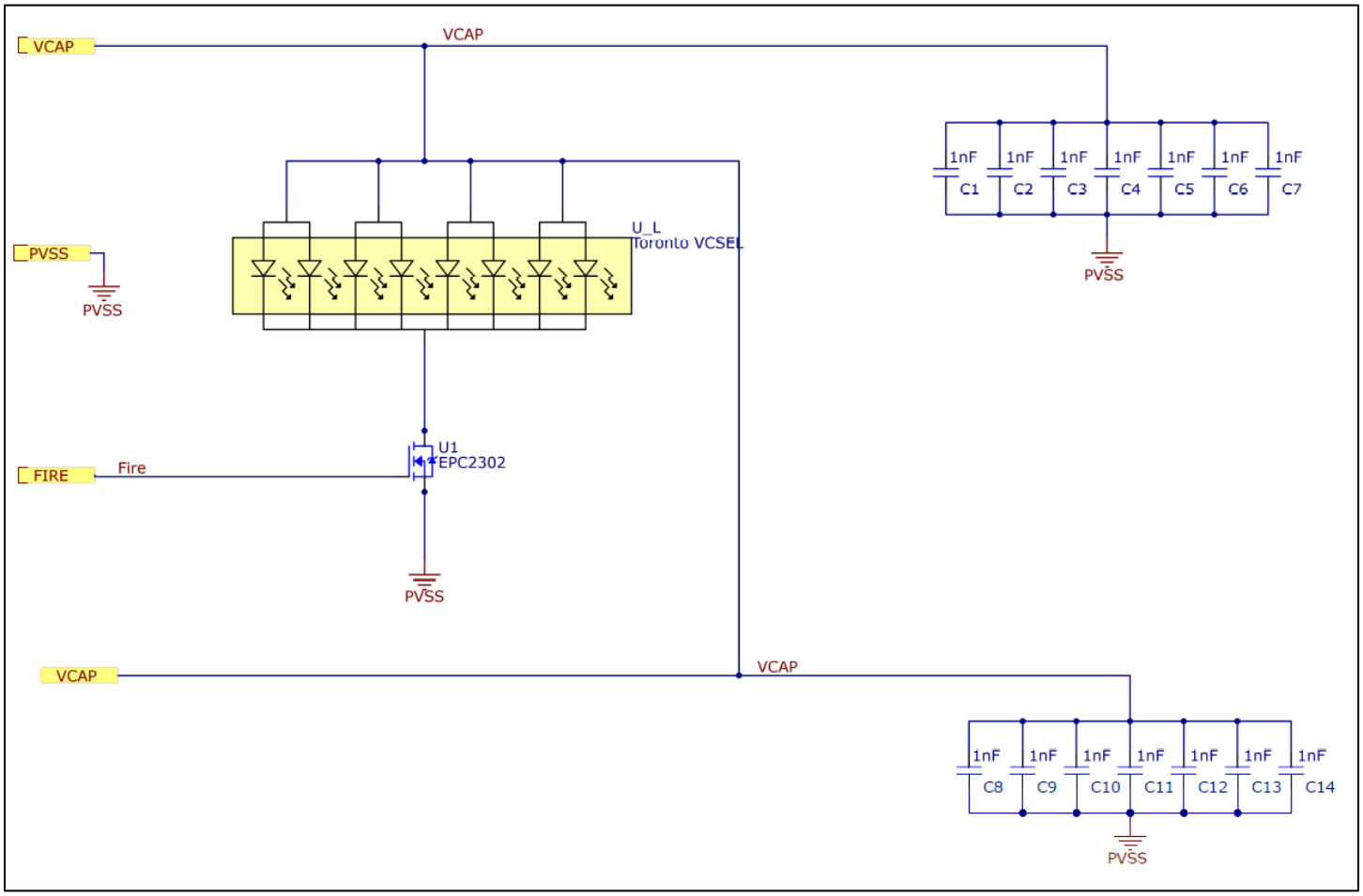

Figure 5: Laser Loop Board Schematic

Figures 5 and 6 show the layouts of the Customer Board (6 layers) and the Laser Loop Board (2-layers), respectively.

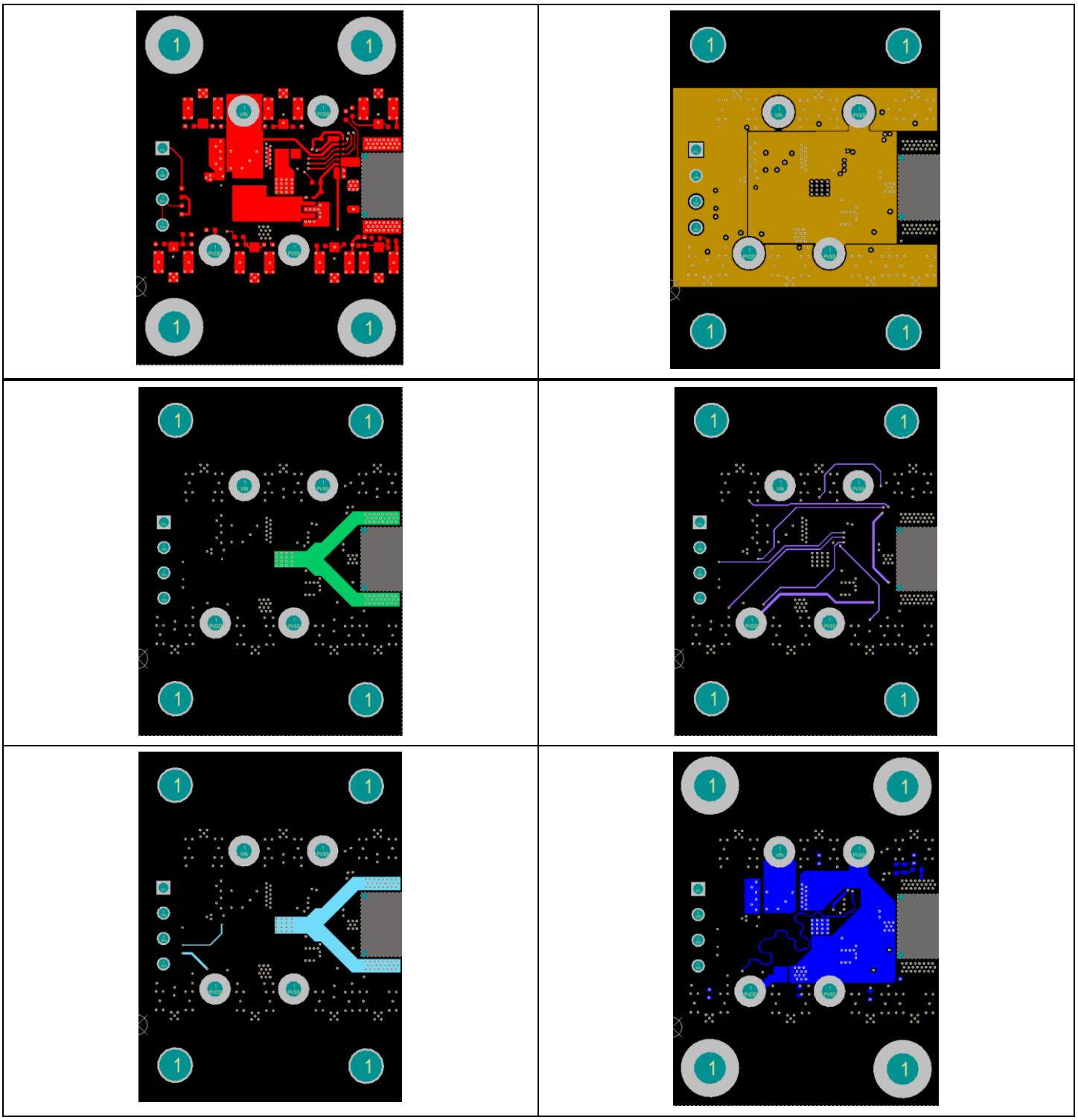

Figure 6: Layout of the customer board (6-layers)

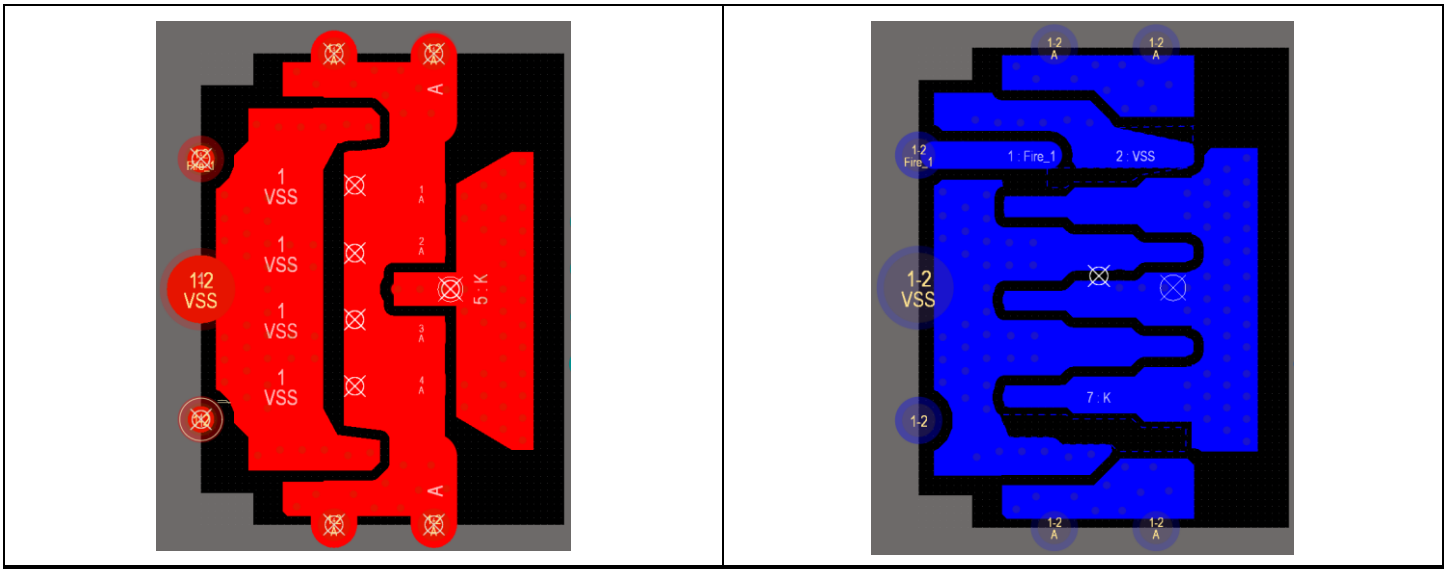

Figure 7: Layout of the Laser Loop Board (2-layers)

Bill of Materials (BOM)

MR2_5GA_CBA2 BOM				
Designator	Description	MFR P/N	MFR Name	Quantity
C1, C2, C3, C4	CAP CER 22UF 35V X5R 0805	C2012X5R1V22M125AC	TDK Corporation	4
CLK, Fire1, Flux, LtNeg, LtPos, VCAP, CATH	CONN UMC RCPT STR 50 OHM SMD	0734120114	Molex	7
C_AVDD, C_VIN1, C_VIN2	CAP CER 0.1UF 50V X7R 0402	C1005X7R1H104K050BB	TDK Corporation	3
C_PVDD	CAP CER 0.1UF 25V X5R 0201	02013D104KAT2A	Kyocera AVX	1
D1	DIODE SCHOTTKY 150V 5A PMDTM	RB088LAM150TR	Rohm Semiconductor	1
J_I2C	CONN HEADER VERT 4POS 2.54MM	TSW-104-07-F-S	Samtec Inc	1
L_F	440 nH Shielded Molded Inductor 10.1 A 7.6mOhm 4-SMD	CLT32-R44	EPCOS-TDK Electronics	1
VIN	PC TEST POINT MULTIPURPOSE RED	5010	Keystone Electronics	1
PVDD	PC TEST POINT MULTIPURPOSE WHITE	5012	Keystone Electronics	1
PVSS	PC TEST POINT MULTIPURPOSE BLUE	5127	Keystone Electronics	1
PVSS1	PC TEST POINT MULTIPURPOSE BLACK	5011	Keystone Electronics	1
RAVDD	RES 10 OHM 1% 1/16W 0402	RC0402FR-0710RL	Yageo	1
R_A	Thick Film Resistors - SMD 0603 6.8Mohm 1% Anti Surge AEC-Q200	ESR03EZPF6804	Rohm Semiconductor	1
R_SCL1, R_SDA	RES 1K OHM 5% 1/16W 0402	RC0402JR-071KL	Yageo	2
R3, R4, R9, R12, R13, R18, R21, R22	RES 0 OHM JUMPER 1/16W 0402	RC0402JR-070RL	Yageo	8
U_F	TRANS GAN 170V DIE .009OHM	EPC2059	EPC	1
U_S	Integrated Resonant Mode Laser Diode Drive System	SL2001	Silanna	1
C5, C6, C7, C8, C9, C19, C20, C21		DNI		0
C10		DNI		0
R1, R2, R5, R6, R7, R8, R10, R11, R14, R15, R16, R17, R19, R20		DNI		0

M20G Laser Loop Board BOM				
Designator	Description	MFR P/N	MFR Name	Quantity
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14	CAP CER 1000PF 100V C0G/NP0 0402	GRM1555C2A102GE01D	Murata Electronics	14
U1	TRANS GAN 100V DIE .0018OHM	EPC2302	EPC	1
D3	Toronto PCB with Toronto – 800W 905nm VCSEL	D3	Osram	1

Table 1: Bill of Materials

Test Set-up

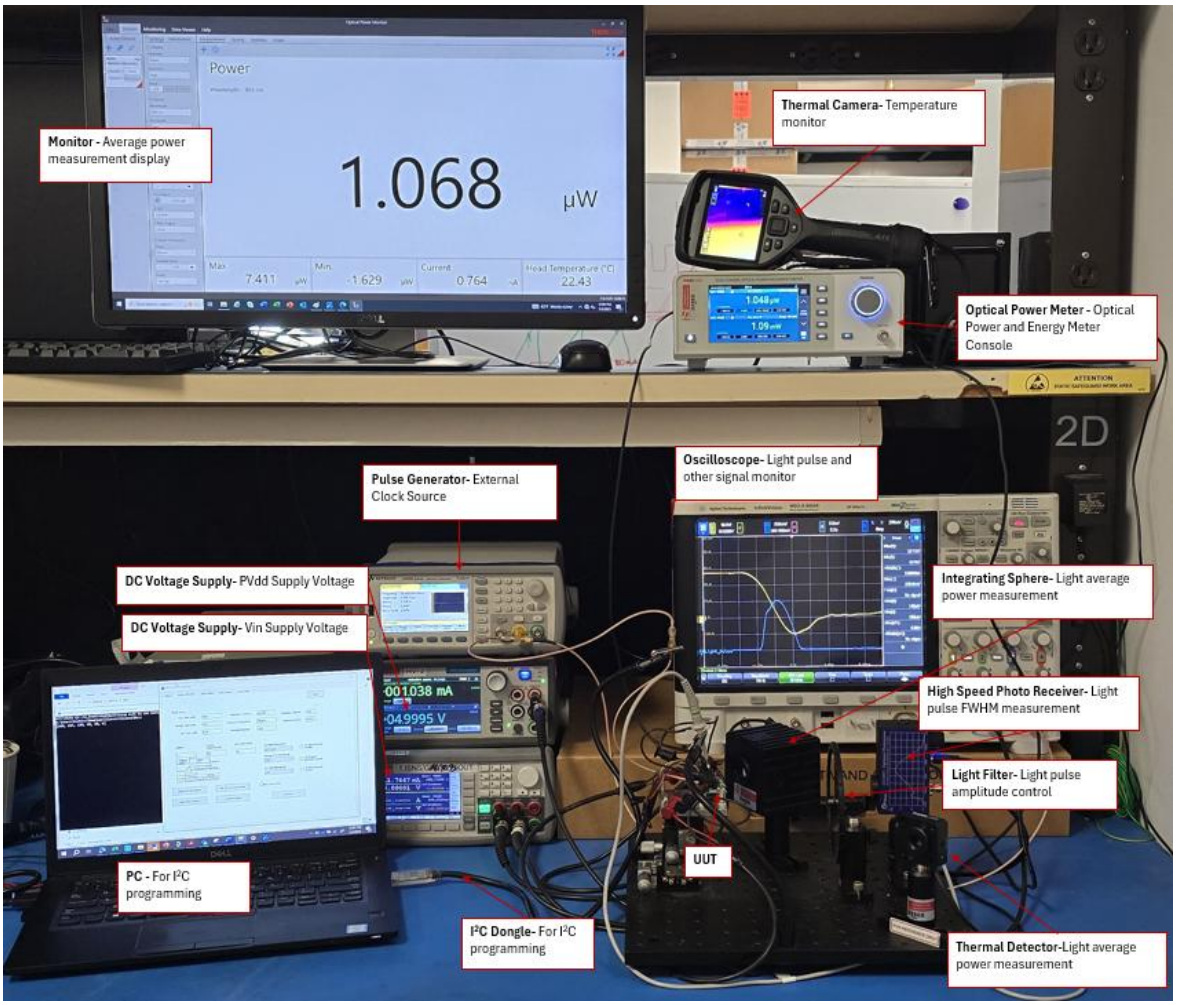

Figure 8. Test Set-up

Equipment	Description/Model/Setting
Oscilloscope	Agilent Technologies MSO-x 6004 Data Acquisition Setting: Averaging 1024 ; 6GHz ; 10.0Gsa/s
Oscilloscope Probe	Agilent N2894A
Optical Power Meter	Thorlabs PM5020
Integrating Sphere	Thorlabs S142C
Optical Receiver	iCHaus iC212NST High-Speed Photo Receiver
Pulse Generator	Keysight 33500B Series Wave Generator
DC Voltage Supply, Vin	Keysight B2912A Precision Source/Measure Unit
DC Voltage Supply, Vdd	Agilent 6613C System DC Power Supply

Table 2: List of Equipment Used

Performance Data

This section provides details about the GUI settings and the corresponding Test Results from the evaluation board. The first bank of MTP (multi-time programmable) memory in the SL2001 on the Evaluation Board is pre-programmed with settings that will achieve a peak power of ~400W. The GUI can be used to program the settings to achieve 800W Light peak power with 5ns FWHM pulse. Refer to AN-SL2001-01 (GUI) Application Note on how to use the I2C GUI. The performance data presented in this section was captured using the optimized settings to achieve ~800W for this particular type of evaluation board.

NOTE: While all settings of the SL2001 can be changed during operation, care must be taken to not accidentally apply damaging voltages to the board components; therefore, we recommend that the external clock input to the evaluation board be paused prior to changing the Flux Time Code and/or Vin voltage (for example, changing from Vin = 5V settings to Vin = 12V settings). We recommend that the clock is paused, then the Flux Time Code is changed, and the Vin voltage is changed. Only after then, the external clock input to the board is restarted.

Test Condition				
Vdd	5.75V			
Clock	10KHz			
* Fire Pulse width (calculated)	4.8 ns			
*Vcap before Firing	80.00 V			
Test Data				
Vin	5.00 V	3.24 V	12.00 V	23.85 V
PlightPeak	863.1W	865.2 W	866.8 W	866.8 W
FWHM	4.3 ns	4.3 ns	4.3 ns	4.3 ns

Table 3: Test Data Summary 800W

* In order to achieve the performance data above, the pulse width settings shown in the pictures below were used. Refer to AN-SL2001 (GUI) on how to use the I2C GUI.

** Before making any changes to the pulse width settings, it is recommended to set the fault thresholds by setting the Fault Config sheet in the GUI as shown in Figure below

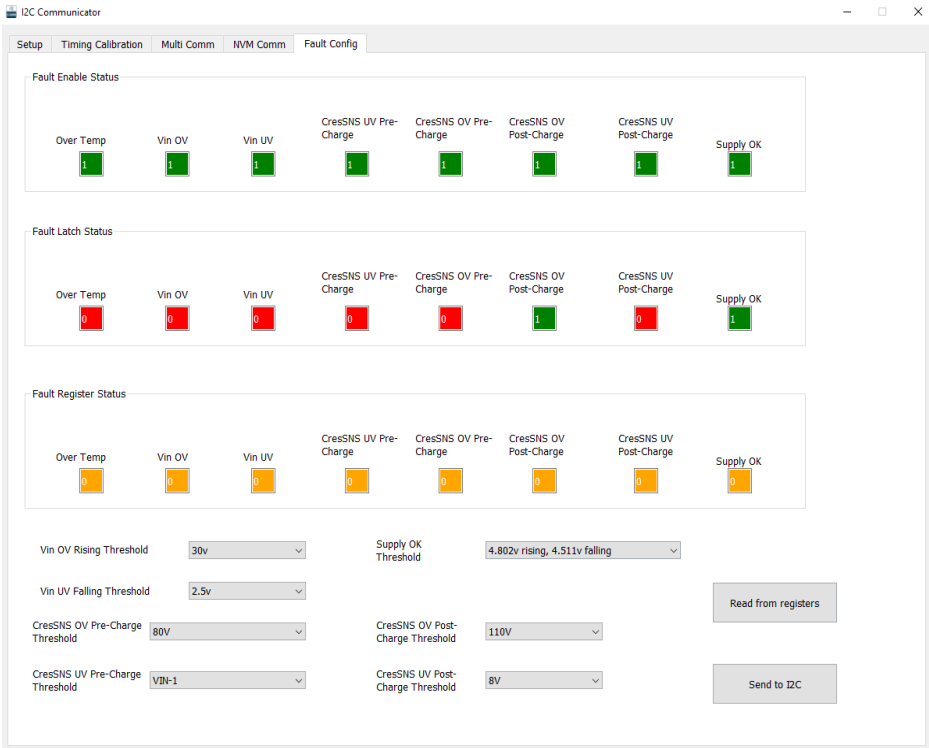

Figure 9: Fault Config Set-up

Vin = 5.00V

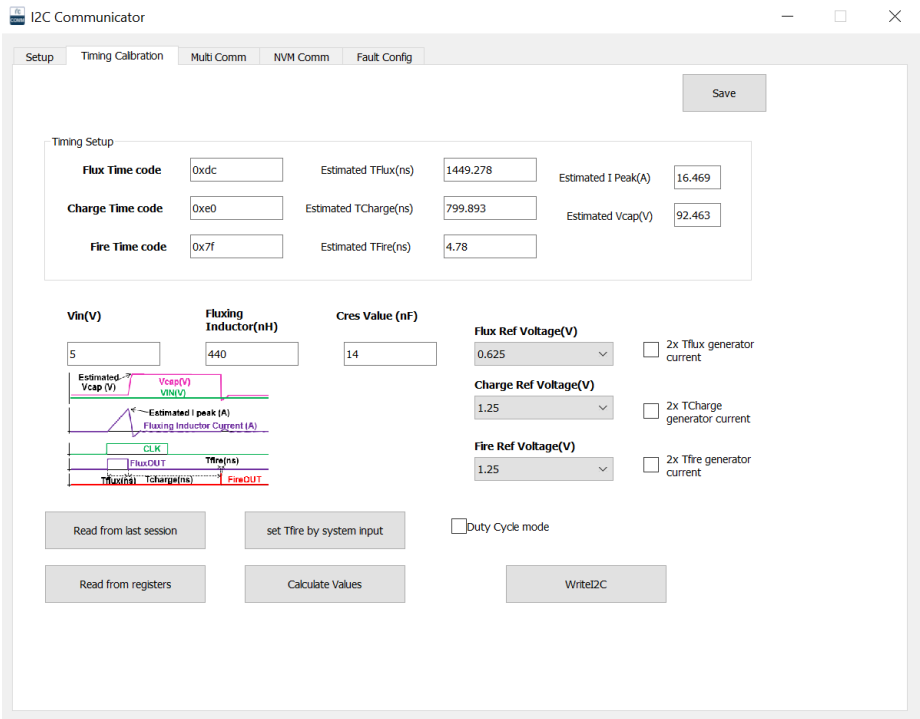

Figure 10: Timing Calib Setting 5V Vin and 800W Peak Power

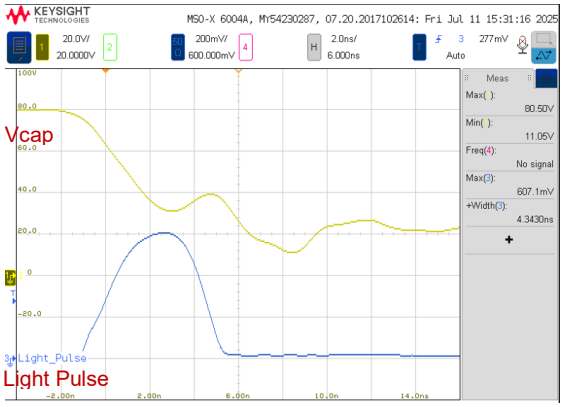

Figure 11: Vcap and Light Pulse (5V Vin and 800W)

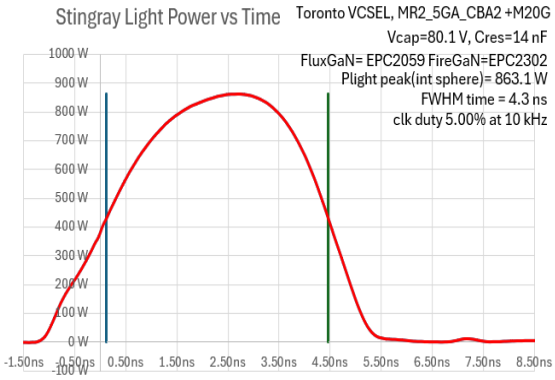

Figure 12: Peak Power vs Time (5V Vin/ 800W)

Vin = 3.24V

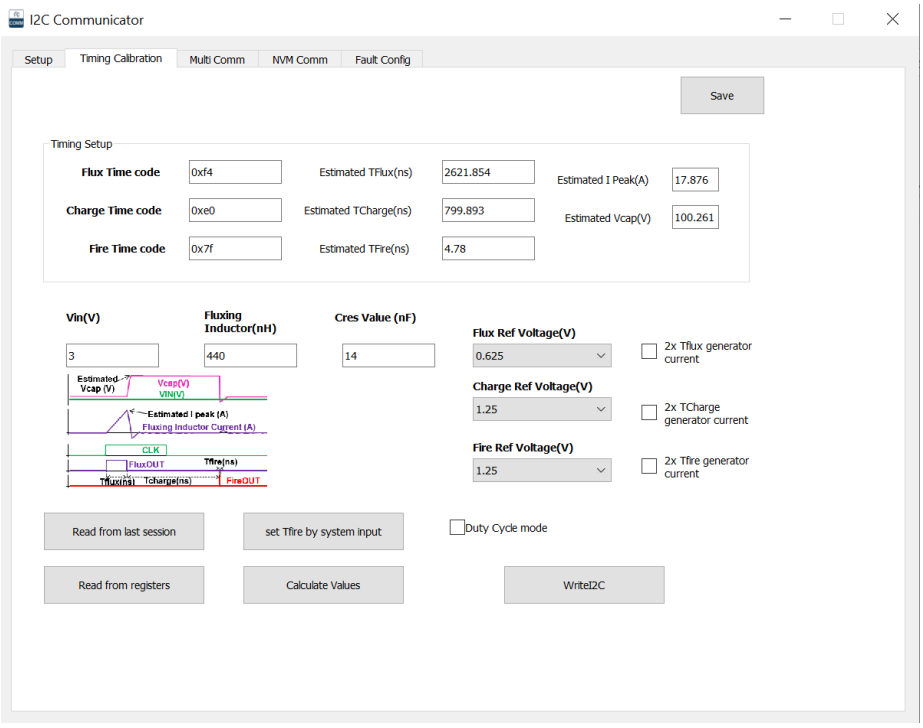

Figure 13: Timing Calib Setting 3V Vin and 800W Peak Power

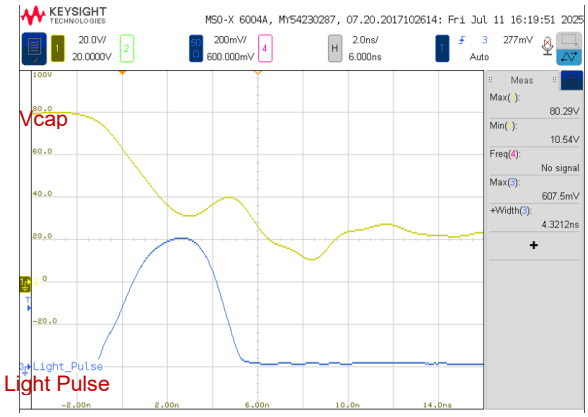

Figure 14: Vcap and Light Pulse (3V Vin and 800W)

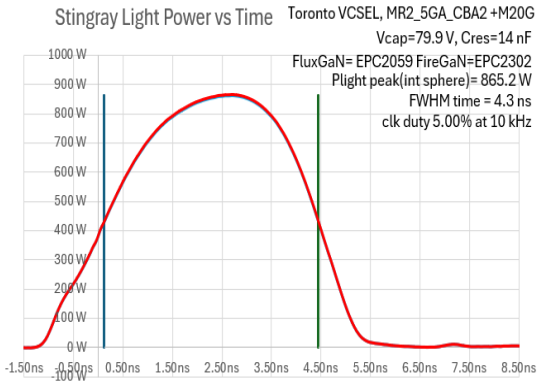

Figure 15: Peak Power vs Time (3V Vin/ 800W)

Vin = 12.0V

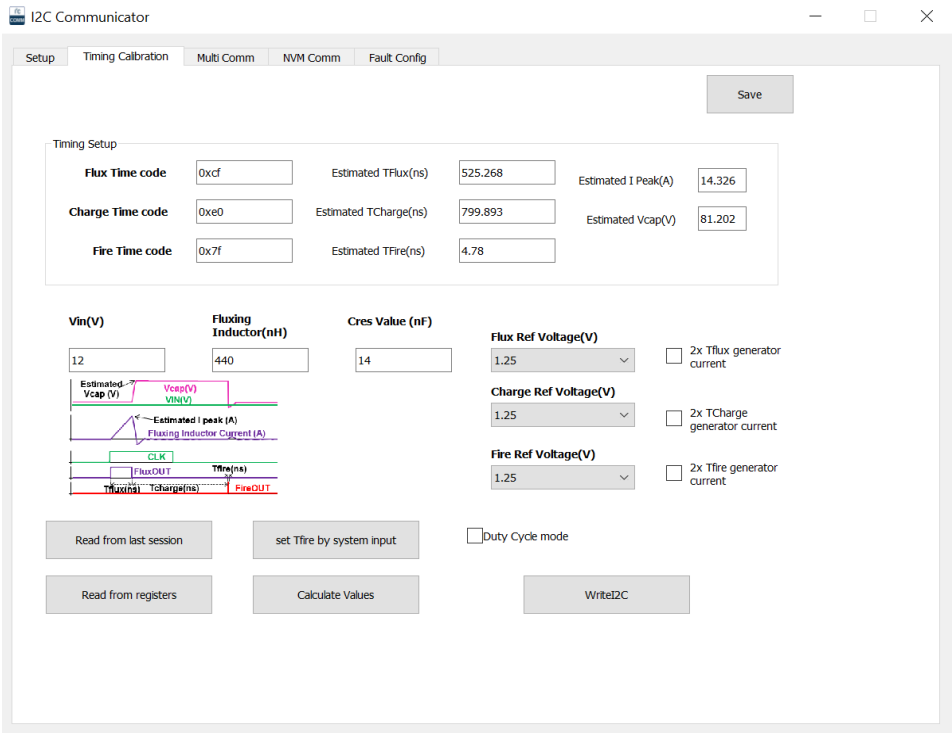

Figure 16: Timing Calib Setting 12V Vin and 800W Peak Power

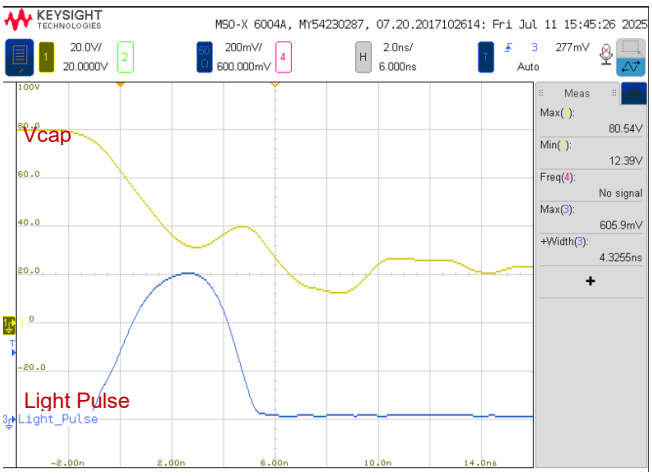

Figure 17: Vcap and Light Pulse (12V Vin and 400W)

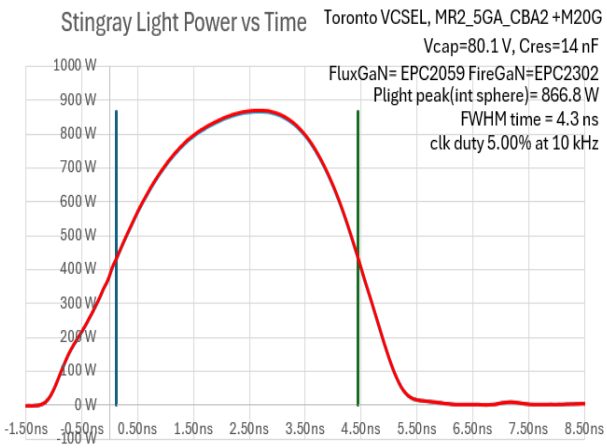

Figure 18: Peak Power vs Time (12V Vin/ 800W)

Vin = 23.85V

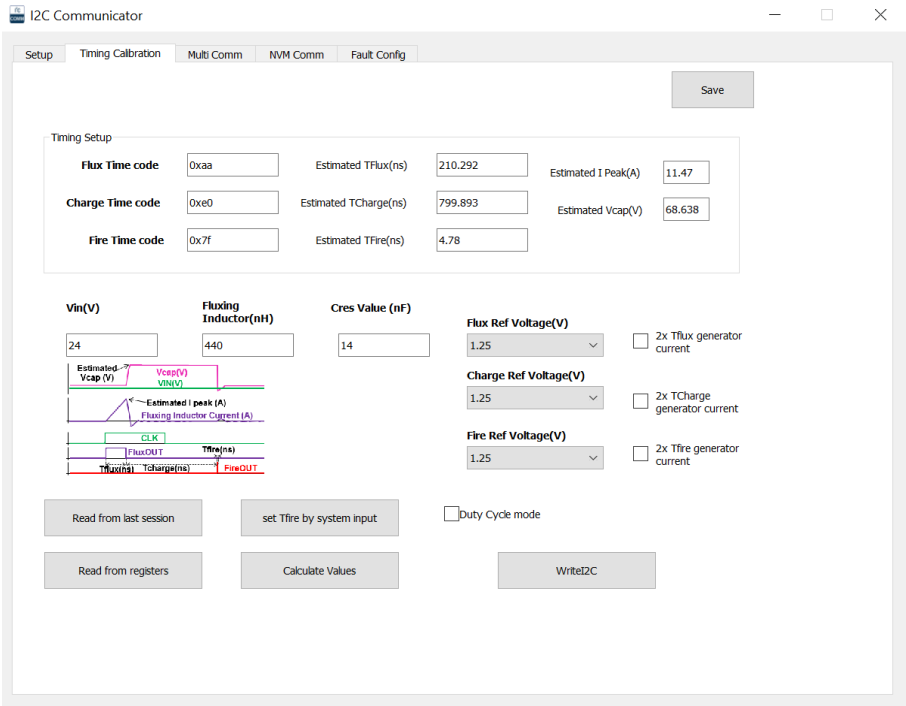

Figure 19: Timing Calib Setting 24V Vin and 800W Peak Power

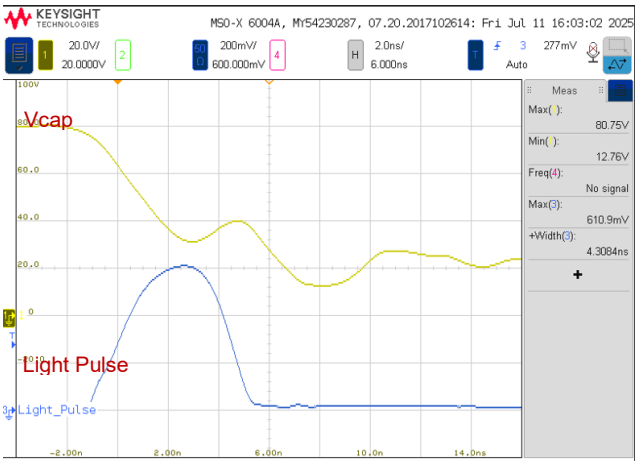

Figure 20: Vcap and Light Pulse (24V Vin and 800W)

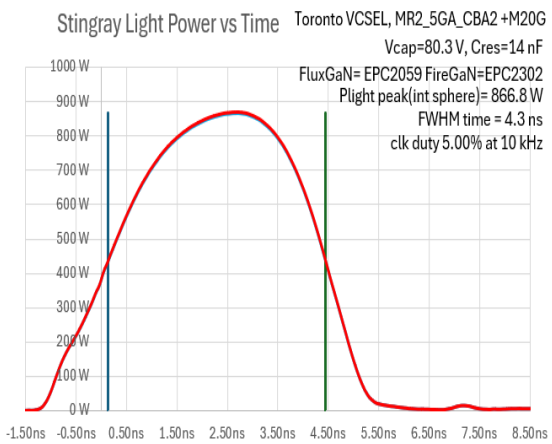

Figure 21: Peak Power vs Time (24V Vin/ 800W)

Summary and Conclusions

This application note provides detailed description of the 800W VCSEL Load Evaluation Board using SL2001, including the test results for various GUI settings. Silanna's Application and Marketing team would encourage the customers to go through this Application Note and try duplicating at least some of the tests shown here, to ensure the board is functioning properly. This will also familiarize the user with the evaluation board hardware and the GUI software. In case of any questions or concerns, please contact Silanna Semiconductor's Application team (bcabico@silanna.com).

Revision History

Revision	Date	Author	Note
0.1	21 Mar 2025	BGC	Draft release.
1.0	26 Aug 2025	BGC/ AZ	Updated Schematics Added Introduction and Conclusions Sections Document Control Release