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LEAD APPROVAL	DATE	FINAL APPROVAL	DATE

TOLERANCES

M. MORALES	030805	G. SWEEZEY	030805

DECIMAL
.XX = N/A
.XXX = N/A

TITLE

OPERATING MANUAL, LDD
MODEL 7701A

ANGULAR X = N/A	SCALE N / A	SIZE A	FSCM 61651	SHEET 1 OF 14	DRAWING NUMBER	6555	REV. -

OPERATING MANUAL
FOR
MODEL 7701A

HIGH POWER PULSED OR CW
OEM LASER DIODE DRIVER

Analog Modules, Inc.
126 Baywood Avenue
Longwood, FL 32750

Approval:

Gary Sweezey, Product Manager

Miguel Morales, Product Engineer

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CAUTION

READ THIS BEFORE
PROCEEDING FURTHER

The voltages applied to this equipment are DANGEROUS. To avoid electrocution, good care and judgment must be used. Connection to this unit should not be made until AC power lines are disconnected from external power sources. All storage capacitors should be discharged before any attempt is made to access parts of the unit, or touch the input terminal strip or buss bars. If any doubt exists, check terminals or capacitors with a voltmeter. Ensure all metal chassis parts have a protective earth connection.

When shipping, the equipment should be appropriately supported or removed from other equipment as required to avoid damage due to shock. Inspect all cable connections to ensure proper contact and visually inspect connectors for signs of damage. Do not support unit by single support only -- use multiple supports. The input DC buss bars and terminal strip should be shielded to prevent inadvertent contact by the user.

The system integrator must make sure that the capacitor bank storage will fully discharge after power is removed.

SECTION 1.0

INTRODUCTION

The Model 7701A is an OEM Laser Diode Driver power supply designed to power high current laser diodes and arrays in CW or pulsed mode. The floating output is capable of driving grounded anode or grounded cathode emitters. The unit operates to the maximum value specified for each variable independently. The manufacturer will determine the maximum output power capability, by the specific combination of input voltage, current and duty cycle for each application.

SECTION 2.0

SET-UP AND INTERFACE

(See DWG. 6551)

2.1 <u>Power Requirements</u>:

115VAC $\pm$ 10%, 1$\varnothing$, 50-60 Hz (Factory selectable)
198 - 253VAC, 1$\varnothing$, 50-60 Hz (Factory selectable)

Via 3-position terminal block

1 - Line 1
2 - N/C
3 - Line 2 or Neutral

High Voltage for Laser Driver (up to 300VDC) Via #8 buss bar holes.

Protective Earth connection located on chassis side.

2.2 <u>System Interface</u>

Laser Diode connections:
Low inductance connector with 1 meter flat cable

Connector: AMP   P/N 765527-1
Output cable: AMP   P/N 765985-1   (+) Anode, (-) Cathode

I/O Interface

The I/O interface is provided via a 25 pin D type connector.

MODEL 7701A INTERFACE DESCRIPTION (25 PIN D)

Pin No.	Signal	Description
1	ENABLE IN HIGH	Input, + 24V @ 10mA to enable control pulses to the output. Optically isolated.
14	ACTIVATE CROWBAR	Input, +5 to +15 VDC activates the crowbar, 2 kΩ load impedance.
2	GROUND	
15	NOT CONNECTED	
3	CURRENT MONITOR OUT	Output, 0 to 10 volts yields 0 to max output current @10 mA typical.
16	CROWBAR OUT	Output, latched signal indicates crowbar tripped, active high, 15 volts, output impedance 1 kΩ.
4	GROUND	
17	NOT CONNECTED	
5	PULSE IN HIGH	Input, +5 volts @ 10 mA. Optically isolated with an internal 300Ω resistor.
18	NOT CONNECTED	
6	GROUND	
19	MODE IN LOW	Input, +24 volts @ 7.2 mA. Optically isolated signal with an internal 3.32 kΩ pull low for CW mode.
7	CURRENT CONTROL IN	Input, 0 to 10VDC yields 0 to max output current (50 kΩ impedance)
20	DIFF. VOLTAGE OUT	Output, Impedance isolated pulsed signal, 0 to 10V yields 0 to 20V across the driver.
8	GROUND	
21	NOT CONNECTED	
9	PULSE IN LOW	Input, +5 volts @ 10mA. Optically isolated signal, active low, pulsewidth determines output pulsewidth.
22	NO LOAD SIGNAL	Output, 100Ω output impedance. Pull low when no load condition is detected. 15V indicates normal operation.
10	GROUND	
23	NOT CONNECTED	
11	NOT CONNECTED	
24	GROUND	
12	VOLTAGE MONITOR OUT	Output, Impedance isolated pulsed signal, 0 to 10VDC yields 0 to 300V across the load.
25	NOT CONNECTED	
13	NOT CONNECTED	

ADDITIONAL NOTES ON SOME USEFUL I/O SIGNALS

    1.   Activate Crowbar (Pin 14)

The crowbar circuit in the Model 7701A is intended to protect the laser diode from overcurrents that may cause irreparable damage. This circuit is internally set to operate at current levels above 120% of the maximum driver current. This circuit will operate only if a failure occurs in the unit. The crowbar enable signal provided in the I/O connector is an additional external activation of this circuit.

    2.   Crowbar Out (Pin 16)

The crowbar output signal is a response to the crowbar circuit activation. This active high latched signal can be used to inhibit the DC power supply, which may prevent damage to the load or the unit. The user will need to clear the fault and cycle the input AC power to reset the system and return to normal operation.

    3.   Differential Voltage Out (Pin 20)

This isolated signal provides information of the voltage drop across the driver when the unit pulses. For 300A units, the required headroom voltage across the driver for proper regulation is $\approx$ 20V ($\approx$ 15V for 200A and $\approx$ 10V for 100A). If there is not enough headroom across the 7701A, then it will not regulate the output current properly. Therefore, the minimum required DC input voltage applied to the unit should be:
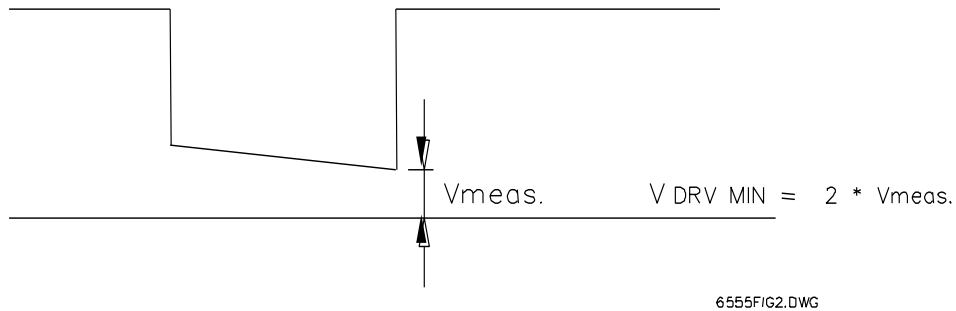
$$V_{IN} = V_{DRV\ MIN} + V_{LASER\ DIODE}$$

where

    $V_{LASER\ DIODE}$ = Voltage across the laser when pulsing

    $V_{DRV\ MIN}$ = Minimum required voltage across the 7701A when pulsing

    V_{IN} = DC Input voltage to 7701A

5

The waveform on this pin measured with an oscilloscope is:

$$V_{meas}. \qquad V\,DRV\,MIN = 2 * V_{meas}.$$

6555FIG2.DWG

Measuring at the end of the waveform and multiplying by 2 will be the minimum differential voltage across the 7701A. As stated above, this voltage has to be a minimum of 20V @ 300A, 15V @ 200A and 10V @ 100A. Increasing the differential voltage beyond these values by increasing the DC input voltage will produce higher and unnecessary dissipation losses in the driver.

The losses in the driver can be estimated by:

$$P_{DRIVER} = V_{DRV} \times I_{LASER\ DIODE} \times PW \times PRF$$

And should never exceed 350 watts.

4. <u>No Load Signal</u>

During normal operation this signal is set high at about 15V. If the driver is powered and commanded to output current with no load connected, the 7701A will be disabled and the NO LOAD signal will be pulled low to reset this condition. The power must be recycled to the unit.

SECTION 3.0

OPERATING INSTRUCTIONS

3.1   Start-up Procedure

PULSE MODE

The 7701A is set at the factory to operate at maximum voltage and current. Pulsewdith is pre-set at a minimum 100µs and pulse repetition rate at 10Hz. The user has control over the maximum pulsewidth and rep rate desired for their application.

To operate the unit in Pulse Mode and adjust PW and PRF to your application, perform the following steps:

1.   Apply AC main power to the unit. No DC input should be applied at this time.

2.   Apply +24V to ENABLE IN HIGH. MODE IN LOW should be left floating to operate in pulse mode. ACTIVATE CROWBAR should zero volts and no pulse signal should be applied. Set the CURRENT CONTROL IN to a low value (1V for example) (no output current) and verify CROWBAR OUT is zero (crowbar inactive). Install an oscilloscope to CURRENT MONITOR OUT. Oscilloscope ground can be connected to any ground pin in the 25 pin D interface connector. All grounds are common and isolated from the laser diode driver output.

3.   Apply DC input to the unit. The magnitude of the DC input is determined by the load and required operating parameters. Always check power driver dissipation as explained in step 6.

4.   To pulse: A 5V signal capable of delivering 10mA should be applied to PULSE IN HIGH. When PULSE IN LOW is pulled low, a current pulse will be applied to the load. The output current pulsewdith will be determined by the time PULSE IN LOW signal is low (see attached simplified schematic). Set the pulsewidth in your control circuit to 100µs and 2Hz and start pulsing.

5. The purpose of this step is to set the desired minimum PW and PRF limits for the application. Slowly increase the current control voltage until the desired pulse current is measured on the oscilloscope. The CURRENT MONITOR OUT is a scaled signal; 0-10V represents 0 to I_{MAX} in the unit.

Increase the pulsewidth in your control circuit to the desired value (example: 500μs). The output current pulse will change little because it is internally clamped at 100μs. Slowly turn potentiometer R83 clockwise and the output current pulse width will increase accordingly. Keep adjusting R83 until the output pulse trigger matches the input command. To check the setting try to increase your input pulsewidth to verify the new pulsewidth limit.

6. Setting the PRF – To set the frequency to the desired value, consider first your output power dissipation and also the power dissipated on the driver especially if you are using a low inductance resistor to set the frequency instead of a laser diode.

The power delivered to the load will be:

$P_L = V_L \times I_L \times PW \times PRF$

Assuming V = 100V, current was set at 20A and PW at 100μs

$P_L = 100 \times 20 \times 100μs \times PRF$

If PRF is desired to be set at 500Hz.

$P = 100W$

If the DC input voltage supply is 120V, then approximately, the voltage across the driver will be:

$V_{DRV} = V_S - v_L$

$V_{DRV} = 120 - 100 = 20V$

And the power dissipated in the driver will be

$P_{DRV} = 20 \times 20 \times 100μs \times 500$

$P_{DRV} = 20W$

Maximum driver dissipation is 350W.

If both power levels, in the load and the driver, are under these max. ratings, increase the PRF of your control circuit up to the desired level and then turn pot R85 CW until desired frequency is reached.

The value of the current set at 20A was an arbitrary selection and the user may consider higher or lower depending on the power to be delivered or the power dissipated on the driver itself.

It is always a good practice to check the power levels at the load and the driver for any of the many combinations of voltage, current, pulsewidth, and rep rate that this driver can handle.

Sometimes a limiting factor in a particular application with large output currents and long pulsewidth and/or rep rate is the voltage droop on the DC input. The voltage droop in the internal capacitor can be excessive and lead into lack of headroom regulation. In these cases, external capacitors with the proper voltage values and rms current ratings can be added to reduce or eliminate the voltage droop. Consult the manufacturer if you need technical support for your application.

CW MODE

1.   Verify ENABLE, CROWBAR IN, MODE IN and PULSE signals are inactive.
2.   Apply AC main voltage to the system.
3.   Apply required DC High Voltage. (See note 2)
4.   To start CW: Set the Current Control at the desired value. The current scale for CW mode is the same as for pulse mode. Example: If the unit is rated at 200A, then 10V control yields 200A. Consequently, 50A CW equates to 2.5V. An internal current clamp will limit the CW current to 1.1 x I_{CW} max. (approximately). MODE signal needs to be pulled low and ENABLE must be high.
5.   Pull low PULSE IN LOW. For quasi-CW mode, pulse this signal as required. Another way to operate in quasi-CW mode is pulling low signal PULSE IN LOW and toggling the ENABLE signal.

3.2   Power-Down Procedure

    1.   Remove the High Voltage DC IN.

    2.   Remove control pulses.

    3.   Disable the unit pulling low or leaving open the ENABLE input signal.

    4.   Switch off the AC mains to the unit.

Please Note: This is an OEM unit. The system integrator should ensure for safety purposes that the external and internal capacitors are fully discharged after power has been removed. If the Model 7701A is kept enabled and operating after the DC voltage is removed, it will automatically dump all the energy stored in the input capacitors. If the Model 7701A needs to be disabled before the capacitors are fully discharged, external provisions to dump this energy need to be made. In some applications external capacitors may be required when operating at high currents with long pulsewidth.

Note 1:   The input voltage in pulse mode needs to be adjusted to supply the required diode load plus the voltage drop across the driver (10VDC for 100A units, 15VDC for 200A units and 20VDC for 300A units) plus any input voltage droop associated with the operating specifications. For some applications with high current and long pulsewidth, the input voltage droop may be excessive for adequate current regulation. In these cases, adding more input capacitors will solve the problem. Please contact the manufacturer to evaluate your specific application.

Note 2:   The input voltage in CW mode needs to be adjusted to supply the required diode load plus the voltage drop across the driver (<5 volts). The voltage drop across the driver should be as low as possible to achieve the desired output current. This will result in the minimum power dissipation and maximize efficiency.

3.3   Interfacing the 7701A with the 5700 Series

The 7701A Laser Diode Driver can be used along with the AMI 5700 series of capacitor charging power supplies. We recommend the use of Model 5705 for voltages up to 200V and Model 5704 for voltages higher than 200V. Both chargers can be operated as a single unit or in parallel (2 or more) in a MASTER-SLAVE configuration.

Figure 1 shows a typical wiring diagram of a 7701A Laser Diode Driver operating with a 5700 series charger.

SECTION 4.0

MAINTENANCE AND
RECOMMENDED SPARES

4.1   <u>Maintenance</u>

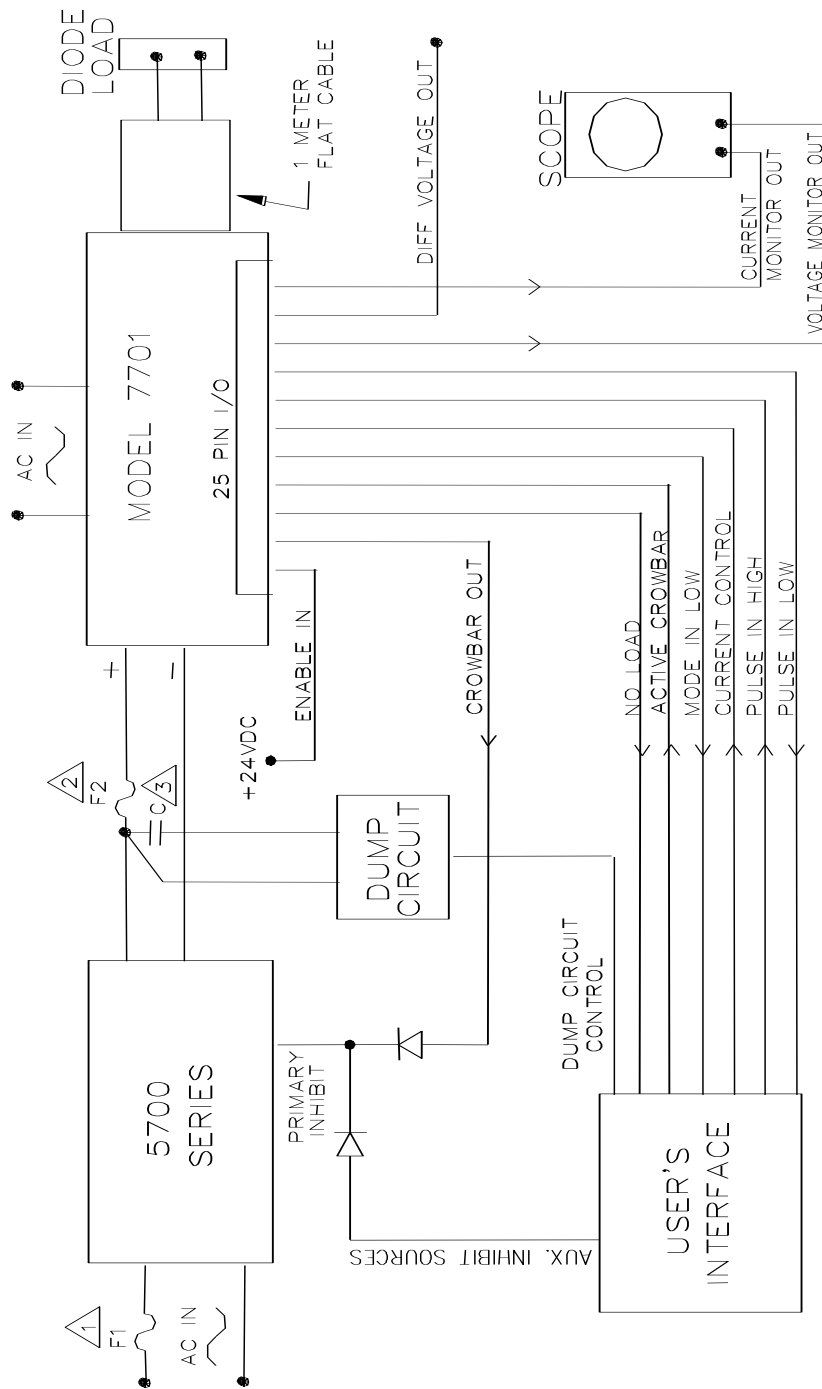No scheduled maintenance is required

4.2   <u>Recommended Spares</u>

No spares are recommended for the Model 7701A laser diode driver.

SECTION 5.0

DOCUMENTATION

See attached prints for layout and connector pinout description

Title	Drawing Number
7701A Data Sheet	DS-7701A
Final Unit Assy	6551
Simplified Schematic Interface	P6559
Interfacing 7701A with 5700 series	Figure 1

DIODE LOAD

1 METER FLAT CABLE

DIFF VOLTAGE OUT

SCOPE

CURRENT MONITOR OUT

VOLTAGE MONITOR OUT

6555FIG1.DWG

MODEL 7701

25 PIN I/O

AC IN

+
−

⚠2 F2

C⚠3

+24VDC

ENABLE IN

CROWBAR OUT

NO LOAD

ACTIVE CROWBAR

MODE IN LOW

CURRENT CONTROL

PULSE IN HIGH

PULSE IN LOW

FIG 1

DUMP CIRCUIT

5700 SERIES

PRIMARY INHIBIT

DUMP CIRCUIT CONTROL

USER'S INTERFACE

⚠1 F1

AC IN

AUX. INHIBIT SOURCES

⚠1 SELECT F1 ACCORDING TO MANUFACTURER RECOMMENDATIONS FOR 5700 SERIES.

⚠2 SELECT F2 FOR 1.2 I,rms MAXIMUM.

⚠3 SELECT CAPACITOR ACCORDING TO MAXIMUM VOLTAGE, rms CURRENT AND
VOLTAGE DROOP, CHECK WITH MANUFACTURER FOR ASSISTANCE.