

MELLES GRIOT
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**06 DLD 203A,
06 DLD 203A/IEEE
DIODE LASER DRIVER
OPERATOR'S
MANUAL**

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1. INTRODUCTION

1.1 Copyright and Manual Notice

This manual describes the operation of the 06 DLD 203A Precision Diode Laser Driver and its /IEEE optional interface. Melles Griot Inc. reserves the right to make changes to this manual and to the equipment described herein without notice. Melles Griot Inc. has made considerable efforts to ensure that the information in this manual is accurate and complete. However, Melles Griot Inc. will not be liable for any technical or editorial errors or omissions made herein or the incidental, special, or consequential damages of any nature resulting from the furnishing of this manual, or operation and performance of equipment in connection with this manual.

1.2 06 DLD 203A Diode Laser Driver

The 06 DLD 203A is a microprocessor driven, low noise current source and precision temperature controller. The unit can be used to drive diode lasers requiring up to 300 mA of operating current, in both current and power stabilized modes of operation. The output is fully floating, permitting case grounding of the diode laser. Two user selectable analog modulation bandwidth ranges are available, DC to 3 KHz and DC to 1 MHz. Since output current noise is directly related to bandwidth, this feature permits optimizing noise performance for an application's given modulation requirements. An IEEE 488.2 interface is optionally available for use in integrating the driver into remote data acquisition systems.

The thermoelectric cooler controller may be used to operate any Peltier element requiring up to 2 amps at 8 volts using thermistor temperature feedback. An adjustable current limit is provided for thermoelectric cooler protection.

Upon loss of AC power, the instrument saves the present operating configuration to nonvolatile memory. The saved parameters include laser package type, operating current limit, operating current value, photocurrent value, photodiode range setting, modulation bandwidth range, thermoelectric cooler current limit, set temperature and the mode (current or power stabilized). This feature prevents having to configure the unit before each session of use.

The 06 DLD 203A provides an isolated, high-speed monitor port for evaluating the dynamic properties of any laser or temperature value. The desired parameter can be selected via the front panel or over the GPIB.

1.3 User Safety

Grounded Power Supply

To minimize shock hazards, the driver must be connected to an electrical ground. The driver is equipped with a three-conductor AC power cable that must be plugged into an approved three-contact electrical outlet.

Line Voltage Selection and Fusing

The 06 DLD 203A is compatible with 100/120 and 220/240 VAC (50-60Hz) supplies. The driver is shipped without fuses installed. Check that the operating voltage is correctly set with the appropriate fuses are installed before attempting to connect it to line voltage.

WARNING - For continued protection against fire, replace line fuses only with fuse of specified type and rating.

Ventilation

The DLD203A ventilation holes on the sides, and fan port on the rear, must be unobstructed for proper cooling. A minimum spacing of 4" on all sides of the driver is required.

Servicing

Dangerous voltages exist inside the driver, even with the power switched off. Only qualified personnel should remove the cover. There are no user replaceable parts inside of the driver.

FCC Compliance

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a CLASS A computing device pursuant to subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against interference when operated in a commercial environment. Operation of this equipment in residential areas is likely to cause interference, in which case, the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES.

OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS:

- (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE.

(2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRE OPERATION.

2. SPECIFICATIONS

2.1 Current Source

CURRENT STABILIZED MODE

Ranges	5-100/5-300 mA, floating
Resolution	100 μ A
Temperature Coefficient	<100 ppm/ $^{\circ}$ C
Modulation	DC - 3 kHz, low bandwidth; DC - 1 MHz, high bandwidth
Mod. Transfer Function	21 mA/V (LO) 63 mA/V (HI)
Noise	<1.2 μ A RMS, low BW; <4.9 μ A RMS, high BW
Voltage Compliance	>5 VDC @ 300mA
Display Accuracy	\pm 0.2% of Full Scale

POWER STABILIZED MODE

Ranges	0.010 - 2.000 mA, photo low 0.010 - 10.00 mA, photo high
Resolution	1 μ A/10 μ A (Photo Low/Hi)
Modulation	DC - 10 kHz, low bandwidth DC - 500 kHz, high bandwidth
Mod. Transfer Function	0.42 mA/V, photo low 2.0 mA/V, photo high
Voltage Compliance	>5 VDC @ 300mA

Note: Modulation bandwidth, noise, and temperature coefficient are dependent upon the diode laser type used in power stabilized mode.

CURRENT LIMIT (Both modes)

Ranges	10 - 100 mA 10 - 300 mA
Display resolution	0.1 mA
Trip Point accuracy	\pm 1% of FS
Temperature Coefficient	<300 ppm/ $^{\circ}$ C (typ)

2.2 Temperature Controller

OUTPUT

Maximum Output Current	±2 A
Maximum Output Voltage	±8 V
Current Limit Range	0.1 – 2 A
Current Limit Accuracy	± 50 mA

DISPLAY

Range	± 0 – 2A
Resolution	10 mA
Accuracy	± 50 mA

2.3 Temperature Sensing

THERMISTOR (specifications depend on thermistor used)

Range	100Ω to 125kΩ
Long Term Drift @ 25°C	0.002°C typical (1 hour)
Resolution	100 ohms
Accuracy	± 1% of thermistor Res. Degrees readout <±10% for 10K thermistors only

IC TEMPERATURE SENSOR

IC Sensor Types	AD590/AD592CN/LM335
Temperature Range	-35°C to 60°C
Long Term Drift @25°C	0.005°C typical (1 hour) (Sensor dependent)
Resolution	0.01°C
Accuracy	Sensor dependent

2.4 GPIB OPTION

Type

IEEE-488.2 Implements
talker and listener functions

2.5 General and Environmental

Safety

Complies with US 21
CFR 1040.10

Size (mm)

180 W x 105 H x 300 D

Weight

4.4 kg

Power Requirements

100/120 VAC @ 2A or
220/240 VAC @ 1A
50-60 Hz

Temperature

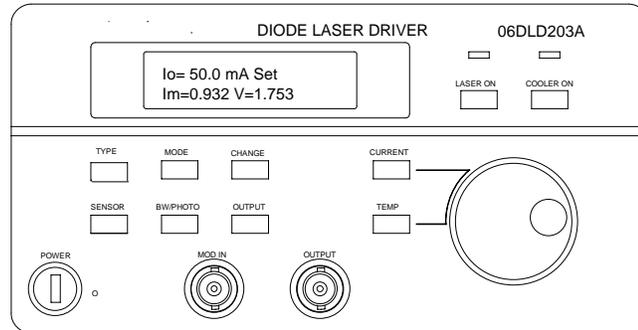
-40 to 70°C, storage
10°C to 40°C, operating

3. FUNCTIONAL DESCRIPTION OF SWITCHES, INDICATORS, AND INPUT / OUTPUTS

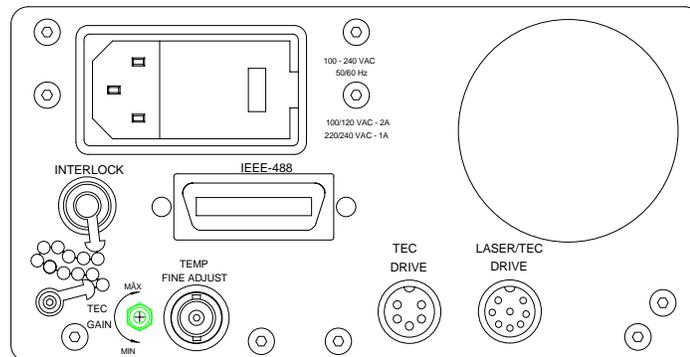
Before operating the 06 DLD 203A Diode Laser Driver, it is important that the user be familiar with the switches, indicators, and input/output ports. The function and operation of most of these is fairly self-explanatory from the labeling and display prompts. However, caution is recommended to avoid the costly mistake of damaging a diode laser.

3.1 Front and Rear Panel Views

FRONT PANEL VIEW



REAR PANEL VIEW



3.2 Front Panel

POWER ON/OFF KEY SWITCH

The POWER ON key switch activates power to the entire unit. Upon power-up the diode laser is always off. Powering-down the 06 DLD 203A with the key switch will save all settings and will not damage a diode laser even if the laser is turned on when the key switch is turned off.

DISPLAY

The display is a 16 X 2 character backlit alphanumeric liquid crystal display (LCD).

LASER ON KEY

The LASER ON key turns the laser on or off. If the laser is off and the key is pressed, a 3 second delay will ensue before the laser turns on. During this three second delay, the LASER LED will blink, issuing a warning that the laser is about to be turned on. When the laser has turned on, the LASER LED will turn on steady. If the current limit is reached while the laser is on, the LED blinks rapidly. If the laser is on and the LASER ON key is pressed, the laser turns off immediately, as does the LASER LED.

Every time the laser is first turned on the thermoelectric cooler will turn on automatically lighting the COOLER ON LED. The user can turn the thermoelectric cooler off by pressing the COOLER ON key.

COOLER ON KEY

The COOLER ON key turns the thermoelectric cooler on and off. The COOLER ON LED illuminates any time the thermoelectric cooler is on. If the TEC current limit is reached, the LED blinks.

LEVEL KNOB

The Level Knob controls all current and temperature set-point values and current limit values. The particular set-point affected by the knob depends on what current or temperature value is displayed on the LCD top row. The current or temperature value to be read or set is selected by the CURRENT or TEMP key. The level knob sensitivity is such that if the knob is rotated slowly, the associated value will change slowly. If the knob is rotated quickly, the value will change quickly. Anytime the level knob is used to attempt to set a value above a previously set limit, an enunciator will sound.

CURRENT LEVEL KEY

The CURRENT level key is used to scroll through three control screens when the diode laser is off and five control screens when the laser is on. When the laser is off, the following two display screens are possible:

Current Level Set

This screen displays the operating current, photocurrent and laser voltage. It is the primary screen for setting the desired current level for diode laser operation, and is active when the laser is both on and off. The top row displays either the photodiode or operating current set point value (depending on if power or current control is selected) and a cursor prompting the user to enter a value. The bottom row displays the other current and the laser voltage.

When the laser current is being displayed the level knob will allow setting the laser current between 5 mA and the current limit value. The enunciator will alert the user if a current value higher than the limit is input.

When the photocurrent is being displayed the level knob will allow setting the photocurrent between 0.01 mA and 1.999 mA if the PHOTO LOW selection has been made. If the PHOTO HIGH selection has been made, the range is 0.01 mA to range limit.

Limit Level Set

This screen displays the operating current limit value, the appropriate secondary current type (operating current or photocurrent), depending on which mode the unit is in, and laser voltage. As a safety precaution, the laser will turn off if the limit value is changed with the laser turned on.

When the laser limit is being displayed, the laser current limit may be adjusted between 5 mA and 100 mA or 5 mA and 300 mA depending on the range. Adjusting the current limit below the current set point value causes the current set point value to decrease to the limit value.

Operating Current Range

This display shows the output current range. Pressing the change key allows selecting between the 5 to 100 mA range and the 5 to 300 mA.

When the diode laser is turned on, the following screens are added:

Lock-Out (Safety) Screen

This screen displays the same parameters as the Current Level Set screen, however, the user cannot enter or change any current level. After the diode laser current limit and operating current level have been established, this screen can be selected to lock-out the front panel knob and prevent an accidental change of set values.

Quiet Mode Screen

This screen follows the Current Level Set screen, and should be used in applications which require the lowest output current noise possible. When in Quiet Mode, the display top row shows the primary control current type and cursor, and the bottom row shows "Quiet Mode". When operating in Quiet Mode, any additional key presses removes the instrument from Quiet Mode. The front panel knob may be used to change current level set points, but the unit will not read and display actual values.

TEMP LEVEL KEY

The TEMP level key is used to scroll through three temperature control screens. They are the same regardless of whether the laser or cooler is on or off. The following control screens are possible:

Temperature Level Set

This screen shows the set point thermistor resistance (degrees C for IC sensors) in the top row and the actual resistance (degrees C for IC sensors) in the bottom row. Thermistor values between 100 Ω and 125k Ω can be used with 06 DLD 203A. If the thermistor resistance value is out of this range, the value appearing on the bottom row of the display may be inaccurate.

Thermoelectric Cooler Current Limit & Voltage Range Set

CAUTION - The thermoelectric cooler will turn-off if the voltage range is changed with the TEC on. The TEC must be manually turned back on by pressing the COOLER ON key.

This display shows the thermoelectric cooler current limit set point and TEC voltage range in the top row. On the bottom row, directly below each parameter, are the current instrument settings.

Parameters are selected with successive presses of the TEMP key; TEC current limit is adjusted with the knob, and the TEC voltage range toggles by pressing the CHANGE key. The actual TEC current will be zero until the thermoelectric cooler is activated by pressing the COOLER ON key.

The thermoelectric cooler current may be limited between 0.1 A and 2 A. The limit may be adjusted without turning the TEC off.

Lock-Out (Safety) Screen

This screen displays the same parameters as the Temperature Level Set screen, however, the user cannot change the temperature set level. After the desired temperature has been established, this screen can be selected to lock-out the front panel knob and prevent accidentally changing the set temperature.

PARAMETER KEYS

The five parameter keys are located under the display on the left side of the front panel. These keys are used to configure the 06 DLD 203A for its desired operation with various diode lasers and thermoelectric coolers. Pressing any key once, except CHANGE, will display the present configuration of the 06 DLD 203A pertaining to that key, and will not affect diode laser operation in any way. Pressing the same key a second time will change the parameter associated with the key.

CHANGE KEY

Pressing CHANGE will cause the configuration of whatever parameter is being displayed to change. *It is normal for some changes to momentarily turn off the laser if it is on.*

If the laser is on and CHANGE is pressed, the laser will be turned off prior to a configuration change (for laser diode protection purposes), except in the case of a MODE parameter change (see MODE key).

MODE KEY

The MODE key selects either constant current or constant power mode of operation. In constant current mode, the laser is driven with a very stable current. In constant power mode, feedback from the diode laser's internal photodiode is used to keep the laser's output power constant. Before turning the laser on, either laser current (CONSTANT CURRENT) or photodiode current (CONSTANT POWER) may be preset, but not both. Once the laser is turned on, both laser and photocurrent may be read with the CURRENT level key, and may be adjusted with the knob. The particular current affected by the knob depends on what MODE is selected. In CURRENT MODE only laser current may be adjusted directly. In POWER MODE photocurrent is affected directly, laser current is not. If the laser is on and the MODE KEY is pressed, followed by pressing the CHANGE key (to change modes), the laser turns off for a very short time (approximately 100 msec) and then turns back on with the mode change. The value of laser or photocurrent to be held constant will be whatever the value was at the time of the mode change; i.e., no knob adjustment is necessary to maintain the same laser output level.

LASER TYPE KEY

The LASER TYPE key is used to configure the 06 DLD 203A for the diode laser type to be used. There are 4 possible configurations of laser/photodiode pairs. To select a laser type, identify the diode laser's pin configuration from the manufacturer's data sheet. Press the LASER TYPE key (this shows the current selection and allows the SELECT key to scroll through the laser type selections). Scroll through the laser type menu by pressing the SELECT key until the desired laser type (A,B,C,D) appears on the display.

When changing the laser type, the laser is turned off to protect the laser diode when scrolling through the various laser types.

TYPE A

Type A diode lasers have the laser and photodiode cathodes connected together.

TYPE B

Type B diode lasers have the laser anode connected to the photodiode cathode.

TYPE C

Type C diode lasers have no wired connection between the laser and the photodiode.

TYPE D

Type D diode lasers have the laser cathode connected to the photodiode anode.

SENSOR KEY

The SENSOR key allows selecting the type of temperature sensor to be used. Pressing the SENSOR key scrolls through the list of different sensors.

BW / PHOTO/ GPIB ADDRESS KEY

The BW/PHOTO key is a multiple parameter display key, similar to the CURRENT and TEMP control keys. This key is also used to enter the GPIB address, for use with the IEEE 488.2 interface. Pressing BW/PHOTO sequentially scans through the available parameters appearing in the display's top row. Asterisks border the active parameter. The CHANGE key is used to scroll through the options available for the active parameter.

Imon Rg (Monitor diode current range)

The Imon column is used to select the photocurrent range. Pressing CHANGE toggles the photocurrent range between 2 mA and 10 mA range. Changing the photocurrent range will turn the laser off.

BW (Instrument bandwidth)

The BW column is used to select the analog modulation bandwidth. Pressing CHANGE toggles the bandwidth range between LOW and HIGH. Changing the bandwidth will turn the laser off. The LOW bandwidth mode provides the lowest current noise.

MOD (External modulation Switch)

The MOD column is used to turn modulation on or off. Pressing CHANGE toggles between ON and OFF. If modulation is not used, this parameter should be off for lowest current noise.

Pressing the BW/PHOTO key again causes the following screen to appear:

GPIB ADDRESS 15

PRESS CHANGE KEY

Pressing the CHANGE key allows selecting the GPIB address (1-30) that will be used for IEEE-488 operation. After the address has been set, press the BW/PHOTO key again. Local lock-out is not supported for GPIB operation.

MODULATION INPUT

The modulation input BNC allows modulation of laser current or photodiode current (laser power). The input ground connection is electrically isolated from earth ground, however, the maximum voltage between modulation input terminals and chassis is 9 V peak. The modulation transfer functions are approximately:

- 21 mA/V in constant current mode, low range
- 63 mA/V in constant current mode, high range
- 0.4 mA/V in constant power mode, photo low
- 2.1 mA/V in constant power mode, photo high

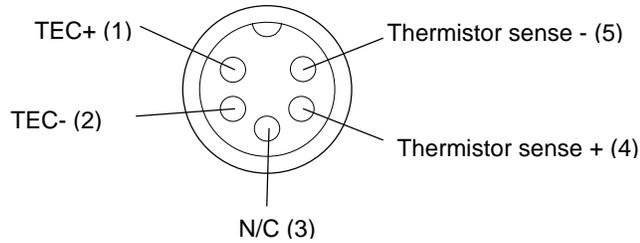
MONITOR OUTPUT

The monitor output allows the monitoring of a particular parameter on the monitor BNC. The BNC output is driven by a circuit ground isolated differential amplifier which is intended for connection to a 100K Ω or greater load. The particular parameter available at the monitor may be selected by the front panel OUTPUT select key. Note, the maximum voltage between the monitor output pins and chassis ground is 9 V peak.

3.3 Rear Panel

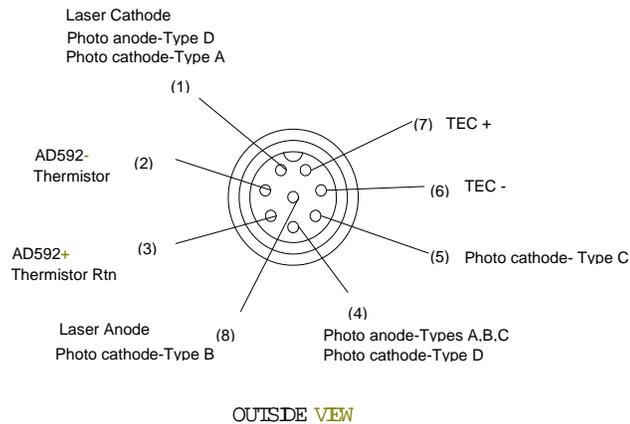
TEC DRIVE CONNECTOR

This 5-pin male connector is used for connecting the 06 DLD 203A to remote thermoelectric cooler modules and temperature transducers. The pin-out for the connector is shown below.



LASER/TEC DRIVE CONNECTOR

This 8-pin connector is used for connecting diode laser assemblies. The pin-out for this connector follows:



VOLTAGE SELECTION/FUSING

The 06 DLD 203A is compatible with 100/120 and 220/240 VAC (50-60 Hz) supplies. The driver is shipped without fuses installed. Check that the driver

operating voltage is correctly set with the appropriate fuses installed before attempting to connect it to line voltage.

SAFETY INTERLOCK CONNECTOR

This interlock BNC connector allows the user to turn the laser off remotely in compliance with CDRH regulations. During normal operation the connection is grounded. Removing the shorting plug turns the laser off. The laser will not restart when the short is restored.

TEMP FINE ADJUST

This BNC connector allows the temperature set point to be externally adjusted. The temperature value set by the front panel knob or over the GPIB can be trimmed with an external analog voltage with a $250 \Omega/V$ transfer functions. There may be slight deviations from this transfer function; it is suggested the user calibrate his individual unit's transfer function if absolute adjustments are required.

TEC GAIN

The TEC GAIN adjust allows the gain of the temperature control loop to be adjusted. A recessed 25-turn potentiometer is provided on the rear panel for this adjustment. The unit is set at the factory for minimum gain (counter-clockwise), and the gain can be increased by adjusting the potentiometer clockwise. Increasing the gain reduces the time constant of the dominant pole in the control loop. The response time for small thermal mass loads can be improved by increasing the gain. Increased gain for large thermal mass loads may cause instability. When adjusting the gain, the over-shoot and settling time for a step change in set temperature, should be monitored. Excessive overshoot is an indication of potential instability. Most products with thermoelectric cooling have a large mass and perform best with no adjustments made to the factory gain setting.

GPIB CONNECTOR

This is the standard connector as defined in ANSI/IEEE Std 488.1-1987.

4. SETUP AND INSTALLATION

This section describes how to correctly set-up the 06 DLD 203A diode laser driver for operation.

DANGER: The radiation emitted by a diode laser may cause severe damage to the human eye. When a laser is being operated, never direct the beam or even a weak reflection of it towards an eye. To adjust the alignment of the laser beam and optical components, use an infrared sensitive card, viewer, or vidicon camera to follow the beam. Warning labels are attached to diode laser drivers and laser heads in compliance with CDRH regulations. One of these labels is reproduced below for familiarity:



WARNING: Diode lasers can be damaged or completely destroyed by small amounts of static electricity or sharp transient currents. Once a laser is correctly connected to the diode laser driver, it is very well protected against accidental damage, providing the system is operated according to this manual. However, unless the following instructions are closely followed, there is a high probability of destroying a diode laser even before the system is properly running. This is particularly true for operators with little or no prior experience working with diode lasers. Never connect or disconnect the driver to the laser with the driver switched on.

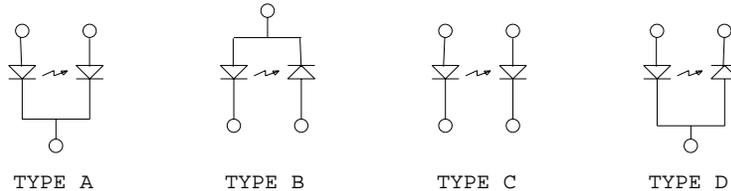
VOLTAGE SELECTION/FUSING

The 06 DLD 203A is compatible with 100/120 and 220/240 VAC (50-60 Hz) supplies. The driver is shipped without fuses installed. Check that the driver operating voltage is correctly set with the appropriate fuses installed before attempting to connect it to line voltage.

IMPORTANT

Before operating the 06 DLD 203A Diode Laser Driver, it is important that the user be familiar with the switches, indicators, and input/output ports. The function and operation of most of these is fairly self-explanatory from the labeling and display prompts. However, caution is recommended to avoid the costly mistake of damaging a diode laser.

Make sure the diode laser driver is plugged into a properly grounded power line and the main power key switch is off. Before attempting to use 06 DLD 203A, determine the diode laser type (electrical pin-out configuration) by comparing the diode laser to be used with the following diagram:



4.2 Factory Default Settings

The default configuration of the 06 DLD 203A, as shipped from the factory is:

Mode: constant current

Laser Type: B

PhotoRange: high (0-10 mA)

Bandwidth: low

Modulation: off

BNC Output: ground

Temp Sense Type: AD 590/92

TEC Volt Range: 4 V

Laser Lim: 50 mA

Iop Set: 35 mA

Imon Set: 1 mA

TEC Lim: 1 A

Set Temp: 25 °C

GPIB Address: 15 (does not change with *RST command)

5. SYSTEM OPERATION

The 06 DLD 203A can be used to operate diode lasers and laser assemblies requiring up to 1000 mA of drive current. The unit provides four different operating modes. These are:

- 1) **Current Stabilized Operation** - constant current is supplied to the diode laser. Output power of the laser will change as its temperature changes.
- 2) **Power Stabilized Operation** - the laser is driven so that its output power remains constant.
- 3) **Analog Current Modulation** - an external voltage applied to the modulation input produces a current which is algebraically summed *with the operating current* set by the control knob.
- 4) **Analog Output Power Modulation** - an external voltage applied to the modulation input produces a current which is algebraically summed *with the monitor current* set by the control knob. In this mode, the laser's output power can be directly modulated.

5.1 Installing the Diode Laser

WARNING - Before handling a diode laser you must take adequate anti-static precautions. To safeguard against electrostatic discharge from the body or clothing, an operator should always be grounded through a high resistance (1M Ω) when handling a diode laser.

Do not touch the window of a diode laser. Dirt or scratches on the surface of the glass will reduce the output power and distort the far-field irradiance distribution. If the window becomes dirty, gently clean it with a lint-free lens tissue and optical grade ethanol.

Connect the cable to the laser drive connector on the rear panel of the diode laser driver. Customer furnished diode lasers should also be connected to the male eight-pin connector located on the rear panel. The mating eight-pin female connector is supplied allowing custom cables to be constructed.

5.2 Constant Current Operation and Current Modulation

WARNING - *The current limit is the only means for independently limiting the output current when external modulation is used. Always set the current limit before using/connecting a external modulation signal.*

In this mode, the driver supplies a constant current level regardless of any impedance changes in the diode laser. Unless the laser is temperature stabilized, the output power will fluctuate slightly due to thermal drift, which changes the threshold point of the diode laser. Constant current is a useful mode for controlling the laser as a simple source of coherent light and for evaluating the optical performance characteristics of a diode laser.

An analog voltage can be applied to the driver to modulate the operating current delivered to the diode laser. The total current delivered to the laser is the algebraic sum of the current set point value from front panel (or over the GPIB) and the current generated by the modulation voltage. As an example, if 50 mA was set via front panel control in the low current range, and a +0.1VDC signal was applied to the modulation input (approx. 21 mA/V transfer function), the current delivered to the laser would be 52.1 mA, and a -0.1VDC signal would produce about 47.9 mA.. Avoid applying modulation voltages which would try and force the current delivered to the laser to be less than one milliamp in the low range, or 3 milliamps in the high range.

OPERATION

- 1) Connect the diode laser to the 06 DLD 203A.
- 2) Turn the diode laser driver on using the main key switch. The unit will "wake-up" by running an internal diagnostic routine, displaying the software revision level and finally displaying the CURRENT SET screen.
- 3) Press the LASER TYPE key to configure the 06 DLD 203A for the laser type being used.
- 4) The original factory setting for mode of operation is Constant Current. Pressing the MODE key confirms this.
- 5) Press the BW/PHOTO key. The screen displays three parameter selections: photodiode current range (I_{mon}), modulation bandwidth (BW), modulation select (MOD), and GPIB addresses selection. Press the BW/PHOTO key until photodiode current range is the active parameter. Depending on the type of diode laser being used, press the CHANGE key

to select either the 2 mA or 10 mA range. The original factory setting is 10 mA.

Pressing the BW/PHOTO KEY again sets Bandwidth as the active parameter. Press CHANGE to select either Low or High bandwidth. The original factory setting is Low bandwidth. If modulation is not being used, leave the unit in Low bandwidth mode.

Pressing the BW/PHOTO key again selects modulation as the active parameter. Press CHANGE to turn modulation ON or OFF. The original factory setting is OFF.

Pressing the BW/PHOTO key again activates GPIB address selection as the active parameter. Press CHANGE to scroll through GPIB addresses 1-30. The original factory setting is address 15. This screen also proves useful while controlling the 06 DLD 203A over the GPIB. The top row of the display will echo the command sent, while the second row returns actual values for query commands.

- 6) Press the CURRENT key near the knob. The 06 DLD 203A now displays the first of several screens relating to setting and reading operating current and the current limit.

IMPORTANT

Press the CURRENT key until the current limit set screen is displayed. The original factory setting for the current limit is 50 mA. Enter the desired current limit value by rotating the knob. Consult the manufacturer's data sheet for the specific value for the diode laser being used. A good rule of thumb for choosing the current limit value is 1.2 X the nominal operating current.

- 7) Press the CURRENT key again, and select the desired current range with the CHANGE key.
- 8) Press the CURRENT key until the current level set screen is displayed. The unit now is ready to have the desired value of operating current entered. Rotate the knob until the desired current value is reached. If the operating current reaches the current limit setting, the 06 DLD 203A produces an audible warning tone.

If using current modulation connect the voltage modulation source to the MOD IN input on the front panel. Do not yet turn on the modulation voltage source. If the modulation is symmetric with zero offset, then the display will show the average operating current value (the display reads

average current). If the modulation voltage is asymmetric, the display will reflect the change in mean current.

- 9) If temperature stabilization is being used, press the TEMP key until the TEC current limit/voltage set screen is displayed. Rotate the knob until the desired current limit is reached. The bottom row will read 0.0 A because the TE cooler has not yet been activated. The original factory TEC current limit is 1.0 A. Press the TEMP key again to select the voltage range as the active parameter. Select the desired voltage range by pressing the CHANGE key.

WARNING

Do not operate any diode laser head with an integral thermoelectric cooler without activating the thermoelectric cooler. The thermoelectric cooler will act as a thermal insulator when it is not being operated.

- 10) Press the COOLER ON key if thermoelectric stabilization is being used. Pressing the TEMP key scrolls through the screens which display actual thermistor resistance (or degrees Celsius if selected), actual TEC current and display lock-out.
- 11) The laser is now ready to be operated. Press the CURRENT key until the CURRENT SET screen is displayed. Press the LASER ON key. The green indicator will flash for the three second delay, then current will be directed to the diode laser.
- 12) If using current modulation, turn on the modulating source.

EXTERNAL MONITORING

The operating current, photocurrent, laser voltage, actual thermistor resistance and TEC current can be externally monitored through the OUTPUT BNC connector on the front of the unit. Connections to the OUTPUT BNC should be to a 100 K Ω load or larger. To monitor one of the parameters described above, press the OUTPUT key. Press the CHANGE key to scroll through and select the desired parameter to be monitored. The transfer functions for each parameter are displayed in the bottom row of the LCD. The default setting for the OUTPUT is ground.

POWER DOWN

To turn off the system, follow the instructions below exactly for maximum protection against diode laser damage.

- 1) Remove current to the diode laser by pressing the LASER ON key.
- 2) If thermoelectric cooling is being used, turn cooler off by pressing the COOLER ON key.
- 3) Remove power to the 06 DLD 203A by rotating the key switch counter-clockwise.

5.3 Constant Power Operation and Power Modulation

WARNING - *The current limit is the only means for independently limiting the output current when external modulation is used. Always set the current limit before using/connecting a external modulation signal.*

In this mode the driver controls the operating current to the diode laser to keep the monitor current constant. Constant power mode prevents changes in the diode laser's output power due to ambient temperature changes.

An analog voltage can be applied to the driver to modulate the monitor current set-point of the diode laser. The transfer function of the modulation input is 0.5 mA/V in Photo Low mode, 2.5 mA/V in Photo High mode. As an example, in Photo Low mode, if the front panel set-point is at 1.0 mA, and a +1 VDC signal is applied to the modulation input, the diode laser driver will deliver operating current to the diode laser so 1.5 mA photodiode current is produced. Similarly, if a - 1 VDC is applied, the monitor current produced by the diode laser will be controlled at 0.5 mA.

Operation

- 1) Connect the diode laser to the 06 DLD 203A.
- 2) Turn the diode laser driver on using the main key switch. The unit will "wake-up" by running an internal diagnostic routine, displaying the software revision level and finally displaying the CURRENT SET screen.
- 3) Press the LASER TYPE key to configure the 06 DLD 203A for the laser type being used
- 4) The original factory setting for the mode of operation is Constant Current. Press the MODE key, and then the CHANGE key to select constant power operation, or, press the MODE key twice.
- 5) Press the BW/PHOTO key. The screen displays three parameter selections: photodiode current range (I_{mon}), modulation bandwidth (BW), modulation select (MOD), or GPIB address. Press the BW/PHOTO key until photodiode current range is the active parameter. Depending on the type of diode laser being used, press the CHANGE key to select either the 2 mA or 10 mA range. The original factory setting is the 10 mA range.

Pressing the BW/PHOTO KEY again sets Bandwidth as the active parameter. Press CHANGE to select either Low or High bandwidth. The

default setting is Low bandwidth. If modulation is not being used, leave the unit in Low bandwidth mode.

Pressing the BW/PHOTO key again activates modulation select as the active parameter. Press CHANGE to turn modulation ON if modulation will be used. The original factory setting is OFF.

Pressing the BW/PHOTO key again activates GPIB address selection as the active parameter. Press CHANGE to scroll through GPIB addresses 1-30. The original factory setting is address 15. This screen also proves useful while controlling the 06 DLD 203A over the GPIB. The top row of the display will echo the command sent, while the second row returns actual values for query commands.

- 6) Press the CURRENT select key near the knob. The 06 DLD 203A now displays the first of two screens relating to setting and reading photocurrent and the current limit.

IMPORTANT

Press the CURRENT key until the current limit set screen is displayed. The original factory setting for the current limit is 50 mA. Enter the desired current limit value by rotating the knob. Consult the manufacturer's data sheet for the specific value for the diode laser being used. A good rule of thumb for choosing the current limit value is 1.2 X the operating current.

WARNING - *The current limit is the only means for limiting the output current when operating in power stabilized mode. Always set the current limit before using the driver in power mode.*

- 7) Press the CURRENT key again, and select the desired current range with the CHANGE key.
- 8) Press the CURRENT select key again. Now enter the desired value of photocurrent. Rotate knob until the desired photocurrent value is reached. If using power modulation connect the modulation source to the MOD IN input on the front panel. Do not yet turn on the modulation source. The modulation voltage produces a modulation of the diode laser output power proportional to the magnitude of the applied voltage. This modulation is then added to the DC power level controlled by the power adjustment knob.
- 9) If temperature stabilization is being used, press the TEMP key until the TE current limit/voltage set screen is displayed. Rotate the knob until the

desired current limit is reached. The bottom row will read 0.0 A because the TE cooler has not yet been activated. The original factory TEC current limit is 1.0 A. Press the TEMP key again to select the voltage range as the active parameter. Select the desired voltage range by pressing the CHANGE key.

WARNING

Do not operate any diode laser head with an integral thermoelectric cooler without activating the thermoelectric cooler. The thermoelectric cooler will act as a thermal insulator when it is not being operated.

- 10) Press the COOLER ON key if thermoelectric stabilization is being used. Pressing the TEMP key scrolls through the various screens which display actual thermistor resistance (or degrees Celsius if selected), actual TEC current and display lock-out.
- 11) The laser is now ready to be operated. Press the CURRENT key until the current level set screen is displayed. Press the LASER ON key. The green indicator will flash for the three second delay, then current will be directed to the diode laser. The unit will supply current to the laser until the desired photocurrent level is reached. An audible warning tone will sound if the operating current limit is reached.
- 12) If using power modulation, turn on the modulation source.

EXTERNAL MONITORING

The operating current, photocurrent, laser voltage, actual thermistor resistance and TEC current can be externally monitored through the OUTPUT BNC connector on the front of the unit. Connections to the OUTPUT BNC should be to a 100 k Ω or greater load. To monitor one of the parameters described above, press the OUTPUT key. Press the CHANGE key to scroll through and select the desired parameter to be monitored. The transfer functions for each parameter are displayed in the bottom row of the LCD. The default setting for the OUTPUT is ground.

POWER DOWN

To turn off the system, follow the instructions below for maximum protection against diode laser damage.

- 1) Remove current to the diode laser by pressing the LASER ON key.
- 2) If thermoelectric cooling is being used, turn cooler off by pressing the COOLER ON key.
- 3) Remove power to the 06 DLD 203A by rotating the key switch counter-clockwise.

6. OPTIONAL GPIB INTERFACE OPERATION

The ANSI/IEEE STD 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation, deals with systems that use a byte-serial, bit parallel means to distribute digital data among a group of instrumentation and system components. The IEEE-488 standard is sometimes referred to as the General Purpose Interface Bus; these terms are interchangeably used in this manual. Local lock-out is not implemented in the 06 DLD 203A.

To assist with troubleshooting and de-bugging, it is suggested that the operator use the front panel **BW/PHOTO** key to activate the GPIB control screen. Pressing the **BW/PHOTO** key four times causes this screen to appear. When under IEEE control and with this screen active, the top row of the display echoes the IEEE command being sent. The second row of the display reads back the value of queried parameters.

6.1 Required Commands/Queries Group

***IDN? (Query Only)**

Returns Factory ID in comma delimited string in following format:<Manufacturer>,<Model>,<Serial Number>,<Firmware Level> example as returned by 06 DLD 203A: Melles Griot, 06 DLD 203A,S/N 00001, Revision 2.10r

***RST (Command Only)**

Resets the 06 DLD 203A to "factory defaults". This does NOT affect the GPIB address setting -- that will be left to the number last set, if different from 15.

***TST? (Query Only)**

Returns the result of the Self-Test when the 06 DLD 203A is powered up. A self-test is NOT performed at query-time, since this would force the unit to pre-power-up states internally.

***CLS (Command Only)**

Clear Status command. Clears status data structures, and causes 06 DLD 203A to return to the command idle state (clears any pending commands).

***WAI (Command Only)**

Waits until the previous command has fully executed before continuing to process commands (Useful after "DRIV:STAT ON" is given -- there is a 3 second delay associated with that command before completion).

***OPC (Command)**

Causes the 06 DLD 203A to generate the operation complete message in the Standard Event Status Register when all pending selected device operations have been finished.

***OPC? (Query)**

Places the ASCII character 1 into the 06 DLD 203A's output queue when all pending operations have been completed.

***SRE [VALUE] (Command)**

Service Request Enable command -- sets the Service Request Enable Register bits. Command form must be accompanied by a number between 0 and 255.

***SRE? (Query)**

Returns value of Service Request Enable Register, in decimal format.

***STB? (Query)**

Returns the value of the Status byte.

***ESE [VALUE] (Command)**

Sets the standard Event Status Enable register bits.

***ESE? (Query)**

Returns the value of the standard Event Status Enable register bits.

SYST:ERR? (Query only)

Reports any errors stored in the error buffer. If no errors have been recorded, the response will be 0, "No Errors"; if the error buffer has been filled, the reply - 350, "Queue Overflow" will be returned, and no further errors will be entered in the buffer. Error messages are returned on a "last recorded, first returned" basis. The 06 DLD 203A produces an audible tone if a syntax error occurs, or if an entered value exceeds established limits, etc.

GPIB:ADDR[?] (Command)

Immediately sets the GPIB address (1-30).

GPIB:ABOR (Command)

Clears any pending commands causing the instrument to lock-up, returns GPIB queue to idle state.

6.2 Status Command Group

STAT:OPER:COND?

Returns the value of the operating condition byte (0-255)

STAT:OPER:ENAB[?]

Sets>Returns bits of the operating mask.

STAT:OPER:NTR[?]

Sets>Returns bits of negative transition operating mask.

STAT:OPER:PTR[?]

Sets>Returns bits of positive transition operating mask.

STAT:QUES:COND[?]

Sets>Returns bits of the questionable events word. (0-255)

STAT:QUES:NTR[?]

Sets>Returns bits of questionable events negative transition operating mask.

STAT:QUES:PTR[?]

Sets>Returns bits of questionable events positive transition operating mask.

6.3 Current Source Commands

The 06 DLD 203A accepts context-based arguments. For example, the command "DRIV:CURR:LIM? 150" will be interpreted as "DRIV:CURR:LIM? 150e-3"; "DRIV:CURR:LIM? 150e-3" and "DRIV:CURR:LIM? 0.15" are equivalent. The value returned from the query, in all the above cases, would be "150.0e-3 A". When a compound command form (set/query) is sent, as above, the actions are (1) set the value, and (2) read the value.

DRIV:CURR:LIM[?] <value>

Set/Query the current limit of the 06 DLD 203A. <value> may be between 10 and 300 mA. If the <value> is greater than the range setting allows the current limit is set to the maximum value for the range. If <value> is less than the currently established value of Laser Operating set current, Laser Operating set current is decremented by the needed amount. If this happens and the Laser is ON, the Laser is turned OFF.

DRIV:MODE[?] [CURR | POW]

Places the 06 DLD 203A in the constant current or constant power mode of operation.

DRIV:BAND[?] [LOW | HI]

Sets the bandwidth of the 06 DLD 203A low or high.

DRIV:MODU:STAT[?] [OFF | ON]

Connects or disconnects the external modulation input from affecting the laser.

DRIV:CURR:RANG:IMON[?] [<2 | <10]

Set the current range of the Laser monitor current. The instrument will accept "0", "<2", or "LOW" for the 2mA range, and "1", "<10", or "HI" for the 10mA range. The returned message (response to the query form) will be either 0,"<2" or 1,"<10".

DRIV:CURR:RANG:IOP[?] [<1 | <3]

Set the current range of the Laser monitor current. The instrument will accept "0", "<1", or "LOW" for the 5-100 mA range, and "1", "<3", or "HI" for the 5-300 mA range. The returned message (response to the query form) will be either 0,"<1" or 1,"<3".

DRIV:CURR:REF:IMON[?] <value>

Sets the value to use for photodiode feedback reference. The <value> must be within the range specified by DRIV:CURR:RANG:IMON, (2mA or 10mA) and is used only in the DRIV:MODE POW mode of operation.

DRIV:CURR:REF:IOP[?] <value>

Sets the value to use when in the DRIV:MODE CURR mode of operation.

DRIV:OUTP:SEL[?] [GND | IOP | IMON | ITEC | VLAS | TEMP]

Selects the signal routed to the output BNC monitor on the front panel.

DRIV:LASE:TYPE[?] [A | B | C | D]

Selects the type of laser used.

DRIV:STAT[?] [OFF | ON]

Turns the laser on or off. When the command DRIV:STAT ON is issued, a 3 second time delay occurs before current is actually supplied to the laser. There are 3 possible return states in the query form: 0,"OFF" -- 1,"ON" -- and -1,"PENDING". This last state indicates that the

instrument has initiated a turn-on sequence, but the laser does not yet have current supplied to it.

6.4 Thermoelectric Cooler Commands

TEC:VOLT:RANG[?] [4V | 8V]

Sets the maximum voltage supplied to the TEC connected.

TEC:CURR:LIM[?] <value>

Establishes the maximum amount of current supplied to the TEC connected.

TEC:THER:REF[?]

Specifies the resistance to match. The driver will do elementary interpretation of units -- 10e3, 10K, or 0.01M will all evaluate to 10,000 (ohms).

TEC:STAT[?] [OFF | ON]

Turns the output of the TEC ON or OFF.

6.5 Measure and Read Commands

For the following commands, READ will return the currently stored value without waiting for a fresh update; MEAS will wait until a fresh value has been presented by the A/D converters before replying. ALL commands are of the query-only form, and will not accept an argument.

READ:IMON?

MEAS:IMON?

Returns the value of the laser photomonitor current.

READ:IOP?

MEAS:IOP?

Returns the value of the laser operating current.

READ:ITEC?

MEAS:ITEC?

Returns the value of the thermoelectric cooler being supplied.

READ:TEMP?

MEAS:TEMP?

Returns the temperature. Returned value is always in the context of the currently selected sensor calibration.

READ:VLAS?

MEAS:VLAS?

Returns the value of the laser voltage.

6.6 GPIB Error Messages

The 06 DLD 203A will return the following errors in response to a command it cannot parse or execute:

-100,"Command Error"

The 06 DLD 203A could not build a command based on the input verbiage. This is most commonly caused by misspelling a command, such as issuing "DRIV:STET off" instead of "DRIV:STAT off"

-113,"Undefined Header"

The 06 DLD 203A found all the words supplied, but has no corresponding execution sequence matching the supplied command.

-108,"Parameter not allowed"

The command does not allow parameters (data) supplied with it. An example would be "*IDN? my Instrument". The command is a query only form.

-120,"Numeric data error"

A numeric parameter was issued that could not be accepted by 06 DLD 203A.

-141,"Invalid string data"

A parameter was issued that the 06 DLD 203A interpreted to be string data. This is frequently seen when an accidental letter is supplied with an argument, such as "DRIV:CURREF:IOP m75e-3". (Sensitive keyboard error).

-148,"Character data not allowed"

The data argument supplied must be numeric.

-222,"Data out of range"

The data argument supplied was not within range. An example would be "DRIV:CURREF:IMON 10e-3", with the instrument in the "low" IMON range.

-240,"Hardware error"

A hardware error has occurred.

-400,"Query error"

Generally, the query form of the command is required, but the command was given without the question mark. ("*IDN" will return this)

7. APPENDICES

7.1 Warranty Statement

All Melles Griot products are warranted against defective materials and workmanship for a period of twelve months from the date of purchase, unless otherwise specified.

Melles Griot will at its own option repair or replace without charge any item found to be defective. Melles Griot supplies comprehensive technical data regarding all of its products. In addition, technical assistance is available to aid customers in the selection and use of its products. Specifications are current at the time of publication, however, the right to change and improve products without notice is reserved. There are no limited warranties or merchantability or if fitness for a particular purpose given in connection with the sales of any goods. Melles Griot does not assume liability for consequential, incidental, or special damages. The purchaser's sole and exclusive remedy and the limit of Melles Griot's liability for any loss whatsoever, shall not exceed the purchase price paid by the customer for the unit(s) or equipment to which this claim is made.

7.2 Service and Repair

For technical support and service please contact the appropriate Customer Service department of Melles Griot. Obtain a Return Authorization Number (RMA Number) prior to any return of products for repair. Goods must be returned in their original packing with the RMA number displayed on the outside and all shipping costs prepaid. Returns will only be accepted within 30 days of receipt of the goods. Goods must be received in new condition, and a restocking fee will be charged on all goods accepted for return to stock. Melles Griot is unable to accept the return of specially designed non-catalog items.

Failure Analysis Questionnaire

If the operation of the 06 DLD 203A is believed to be faulty, contact your nearest Melles Griot Sales office for assistance. **If the driver needs to be sent back to the factory for repair, the Failure Analysis Questionnaire on the following page must accompany the product when it is returned.** Otherwise, unnecessary delays at the factory may occur.

FAILURE ANALYSIS QUESTIONNAIRE FOR MODEL 06 DLD 203A

This form must be filled in and accompany each returned 06 DLD 203A series diode laser driver. Please fill in as many fields as possible.

Customer Information

DATE	
COMPANY	
CONTACT	
TELEPHONE / FAX	

Product Information

SERIAL NUMBER	
SOFTWARE REVISION	
MANUFACTURE DATE	
AC MAIN VOLTAGE SETTING	

Diode Laser Being Controlled:

MODEL NUMBER	
DESCRIPTION	
IS IT TE COOLED?	

Failure Analysis

1) Mechanical or Functional Failure

Description: _____

continued

System Settings at the time of failure:

Laser type:		Mode (current or power):	
Iop Limit:		GPIB used (yes / no):	
Iop set:		PD response:	
Bandwidth:		I mon range:	
TEC temp sensor value:		I tec limit:	

Additional

Comments: _____

7.3 Sales / Service and Technology Support

7.4 Accessory Products

Listed below are a variety of companion products which are compatible with the 06 DLD 203A. For additional information on these products, contact your nearest Melles Griot sales office.

7.5 Error Messages

The following are error messages which can be displayed on the LCD of the 06 DLD 203A at power-up or reset. A front panel key must be pressed to continue operation:

“Self Test ERROR” “Self Test ERROR” “Self Test ERROR” “Self Test ERROR”
 “CAL LOST” “MEMORY FAULT” “HDWE FAULT” “POWER FAULT”

“Therm Range Err” “High System Temp”
 “Laser & TEC OFF” “Laser & TEC OFF”

Troubleshooting Table

Error Message	Action
CAL LOST	The unit must be sent back to the factory for repair
MEMORY FAULT HDWE FAULT POWER FAULT	Try plugging the unit into a different AC mains outlet Try turning the unit OFF, and then back ON again. If the error message is still displayed, send the unit back to the factory for repair.
THERM RANGE ERROR	Automatic shutdown of laser and TEC if a temperature outside of 0 to 45C is sensed. In situations when the laser must be operated without a thermistor temperature sensor connected, connect a 10K resistor across the thermistor pins to defeat the automatic shutdown feature.
HIGH SYSTEM TEMP	Automatic shutdown of the driver due to high internal temperature. Make sure that ventilation holes or the fan are not blocked. Wait for the driver to cool down and resume normal operation.

Generally, if one of these error messages occur, the unit will need factory servicing. Because of the special calibration the product requires, field servicing

is not possible. The most common cause of memory, hardware or power errors is an unstable AC mains supply.

Error Messages over the GPIB

The error messages given above can be retrieved over the GPIB. They are added to the GPIB error buffer as they are encountered, and are retrieved in order when using the “syst:err?” command.

The *TST? command forces the 06 DLD 203A to perform a self test. The command will produce one of the following:

0, “Self Test OK”, or,

#, “ERR+ERR+ERR+ERR”

where, # is the number of self test power-up errors (0 - 4),
each ERR is the type of error found.