SDI
SPECTRADYNAMICS, INC.

Delay Line DL-1
Operating Manual

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DL-1 Ver. 1.0 Description

The DL-1 is a delay line unit that can be used to insert up to 128 ns of time delay. Calibrated transmission lines are switched in and out to adjust the delay from input to output. An adjustable and motorized line stretcher is used for continuous delay adjustment with a range of 0 to 500 ps. The unit has an additional input port that bypasses the long coaxial delay sections for better VSWR performance at high frequencies where long delays are not needed. All delay line unit functions are accessible from the front panel. The unit is also supplied with a RS-232 interface for remote control and automation.

Safety and Preparation for Use

CAUTION!
Voltages capable of causing injury or death are present in this instrument. Use extreme caution whenever the instrument cover is removed.

Line Voltage
This instrument can be setup to operate on 100-120 or 220-240 VAC and a line frequency of 50 to 60 Hz.   For conversion to a different line voltage please contact SDI.

Fuse
A 1.0 Ampere 250V slow blow fuse is used in this instrument for 100-120 VAC line voltage. A 0.5 Ampere 250V slow blow fuse is used for 220-240 VAC line voltage. Do not replace with a larger fuse.

Line Cord
The instrument has a detachable, three wire power cord for connection to a grounded power source. The enclosure of the unit is directly connected to the outlet ground to protect against electrical shock. Always use an outlet with a protective ground and do not disable this safety mechanism.

Service
Do not attempt to service or adjust the instrument unless another person, capable of providing first aid or resuscitation, is present.

Operation
To operate the unit, locate the AC power entry connector on the rear panel and connect the power cable. When power is applied to the unit, a red led located on the front panel, labeled "on", should light up.

The Front Panel

The DL-1 has two delay lines. The first one provides 9 insertable delays from 64 ns to 0.5 ns and the second one provides a continuously adjustable delay from 0 to 500 ps. The practical frequency range for the first delay line IN1 – OUT1 is DC to 500 MHz. The frequency range for the second delay line is DC – 4 GHz.

ON
The led is on when power is applied to unit and the unit is operating properly. **Note that this is not a button.**

REMOTE
This button is used to enter remote control mode via RS-232. When the   instrument   is in remote mode the button will be illuminated. To return to front panel control press this button again.

IN1
SMA input to the first delay line. The insertable delays are activated by pressing the appropriate button. The delay is inserted when the button is illuminated.

OUT1
SMA output of the first delay line. The is output may be connected to IN2, the input to the second delay line.

IN2
SMA input to the second delay line. The led bar graph indicates the approximate value of the time delay. The time delay is varied by pressing the Up button or the Down button.
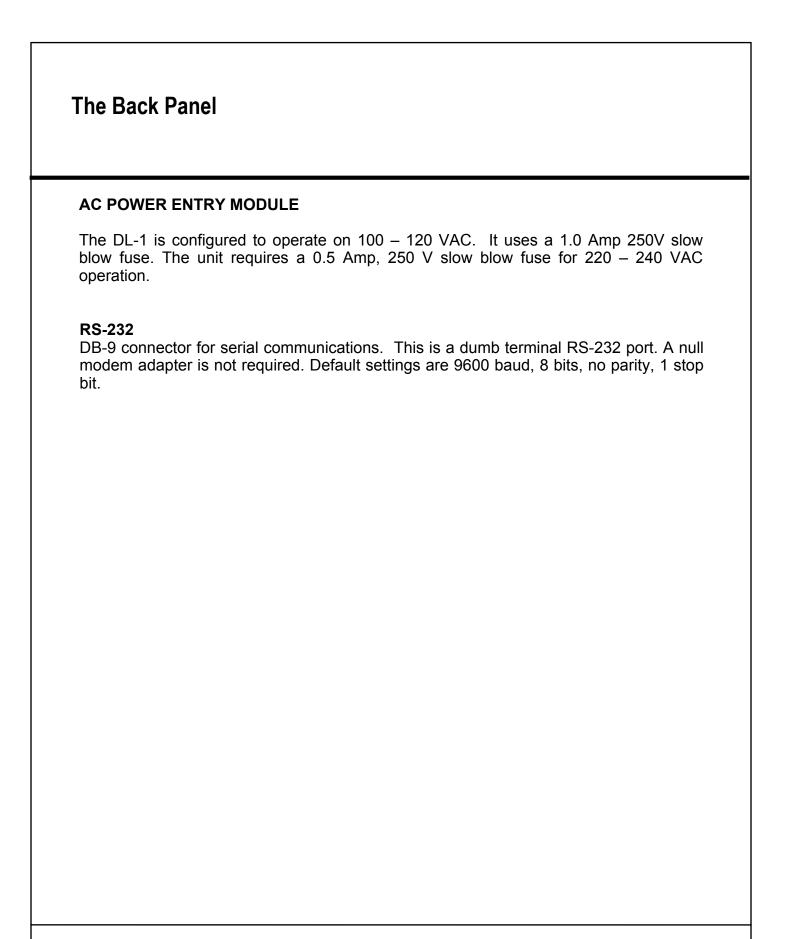
OUT2
SMA output of the continuously adjustable delay line.

Buttons 0.5 ns to 64 ns
These buttons are used to insert the time delay indicated by the label. The button is illuminated when the time delay is selected.

Buttons Up and Down
These buttons control the time delay provided by a continuously adjustable line stretcher. The Up button increases the time delay and the Down button decreases the time delay. The relative position of the line stretcher is indicated by the led bar graph located above the control buttons.

The Back Panel

AC POWER ENTRY MODULE

The DL-1 is configured to operate on 100 – 120 VAC. It uses a 1.0 Amp 250V slow blow fuse. The unit requires a 0.5 Amp, 250 V slow blow fuse for 220 – 240 VAC operation.

RS-232

DB-9 connector for serial communications. This is a dumb terminal RS-232 port. A null modem adapter is not required. Default settings are 9600 baud, 8 bits, no parity, 1 stop bit.

RS-232 Port

RS-232 Communication Port
The DL-1 functions are accessed through the RS-232 port located on the back panel. A standard serial cable with a DB-9 connector can be used to interface to the DL-1. The user can input commands using a simple dumb terminal program on a remote computer or more sophisticated control can be used with software such as Labview.

Port Settings
On power-up the RS-232 port settings are:

Baud rate   9600   8 Bits 1 Stop Bit No Parity.

Hardware handshaking is not used. The DB-9 connector pinout is described below.

Pin	Function
1	NC
2	Data out
3	Data in
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

Specifications

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Operational Bandwidth	IN1 - OUT1	-	DC - 400	-	MHz
	IN2 - OUT2	-	DC - 4	-	GHz
VSWR	IN1 - OUT1	-	<1.5	-	
	IN2 - OUT2	-	<1.5	-	
Insertion Loss	IN1 – OUT1 @ 100 MHz w/ 128 ns delay		<4		dB
	IN2 – OUT2 @ 1 GHz w/ 500 ps delay		<1		dB
Adjustable Delay Range	IN1 - OUT1		128		ns
	IN2 - OUT2		500		ps

Half Rack Enclosure
Size: 3.5" X 8.5" X 16"
Weight: 20 lbs

AC Power
110–120/ 220–240VAC

ASCII Command Set

The DL-1 command set is used to control all DL-1 functions via RS-232. The characters sent to the DL-1 must be upper case ASCII characters.

Command Arguments

cval	Coarse delay parameter { 0-255 }
fval	Fine delay parameter { 0-1023 }

CDLY, CDLY?

CDLY selects the time delay to be inserted in the RF path from IN1 to OUT1.

CDLY [cval]<cr>

CDLY has 1 parameter and is executed following the carriage return <cr>

cval   valid values are 0-255

0 – no time delay inserted
1 – 0.5 ns
2 – 1 ns
3 – 1.5 ns
4 – 2 ns
8 – 4 ns
16 – 8 ns
32 – 16 ns
64 – 32 ns
128 – 64 ns
255 – 127.5 ns

Example: CDLY 33<cr>

Sets the inserted time delay to 16.5 ns. <cr> is a carriage return.

CDLY? Queries the time delay setting.

CDLY?<cr>

CDLY? is executed following the carriage return <cr>

The results of the query are in the following format.

CDLY? <cr>

Example: CDLY?<cr>

Queries the time delay setting of the RF path IN1 to OUT1. <cr> is a carriage return.
The function will return:

CDLY? 16.5<cr>

FDLY, FDLY?

FDLY sets the time delay inserted in the RF path from IN2 to OUT2.

FDLY [fval]<cr>

FDLY has 1 parameter and is executed following the carriage return <cr>

fval valid values are 0 – 1023

0 no time delay inserted
512 approximately 250 ps
1023 approsimately 500 ps

The time delay is set by a motorized line stretcher and the range of 500 ps is divided into 1024 segments when in remote control mode.

Example: FDLY 512 <cr>

Sets the time delay ro approximately 250 ps <cr> is a carriage return.

FLDY? Queries the time delay setting.

FDLY?<cr>

FDLY? is executed following the carriage return <cr>

The results of the query are in the following format.

FDLY? [fval]<cr>

Example: FDLY?<cr>

Queries the time delay setting of the RF path from IN2 to OUT2. <cr> is a carriage return.

The function will return:

FDLY? 512<cr>

HELP

HELP display a listing of available commands.

HELP <cr>

HELP is executed following the carriage return <cr>

LOCL

LOCL exits remote control mode and the front panel controls are activated.

LOCL <cr>

LOCL is executed following the carriage return <cr>

*SRE, *CLS

***SRE** queries the instrument for the value of the status register.

***SRE<cr>**

*SRE is executed following a carriage return.

The results of the query are in the following format.

SRE [status]<cr>

status is an 8-bit value that contains the sum of the error conditions. status is 0 when there are no errors.

Invalid command	0x01
invalid parameter	0x02
Delay setting failed	0x04
User interrupted command	0x08

Example: ***SRE<cr>** query status

SRE 2 the return value indicates that an invalid parameter was sent to the synthesizer.

***CLS** clears the status register.

***CLS<cr>**

*CLS is executed following a carriage return.

WARRANTY

Warranty

The DL-1 is warranted to be free of defects under normal operating conditions, as specified, for one year from date of original shipment from SpectraDynamics, Inc (SDI). SDI's obligation and liability under this warranty is expressly limited to repairing or replacing, at SDI's option, any product not meeting the said specifications. This warranty shall be in effect for one (1) year from the date a DL-1 is sold by SDI. SDI makes no other warranty, express or implied, and makes no warranty of the fitness for any particular purpose. SDI's obligation under this warranty shall not include any transportation charges or costs of installation or any liability for direct, indirect, or consequential damages or delay. Any improper use, operation beyond capacity, substitution of parts not approved by SDI, or any alteration or repair by others in such manner as in SDI's reasonable judgment affects the product materially and adversely shall void this warranty. No employee or representative of SDI is authorized to change this warranty in any way or grant any other warranty.