Version

2

User's Guide

MILLIMETER WAVE PRODUCTS, INC

529 Series Programmable Phase Shifter

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Table of Contents

1

Specifications

Supply Voltage……..……+24 V

Phase Shifter Speed……90 deg./s

Max Phase Shift……... 0 to 360 deg.

Resolution…….0.1 deg.

USB Protocol.……...……2.0

GPIB Protocol……National Instruments 488.2

Initial Setup

Initial Setup can be accessed by pressing MENU from the Front Panel, only when the unit is not in operation.

Refer to Figure 1 and Figure 2 for Front Panel View and Back Panel View respectively.

1. Power: Connect the Power Adapter on the Back Panel to DC Input and Turn ON the Power Switch. The unit will enter its pre-saved power up state of either local or remote mode.

2. Remote Mode: To enter Remote Mode, press **MENU** followed by **10.0** on the Front Panel. Then press **MENU** a second time to exit. The unit will also enter Remote Mode upon receiving a USB or GPIB command.

3. Local Mode: The unit can switch back to Local Mode by pressing **MENU** followed by **100** and a second **MENU** press to exit. The unit will be switched Local to Remote Mode upon receiving a GPIB or USB command.

4. Product Information and Settings: To view Serial Number, Manufacturing Date, and Frequency Band, press **1.0**. After displaying the product information, the clock must be set to the correct date/time by

pressing **100** and **10** until the correct values are listed. Press **ENTER** to save. Next, the default power up mode must be selected. Press **100** to have the unit always power up in remote mode. Press **10** to keep the factory setting of powering up in local mode. After selecting the default power up mode, the choice to enable or disable automic responses will appear. Press **100** to disable all automatic responses in order to minimize bus activity. Press **10** to enable responses and have the unit automatically respond with its current Phase after each completed USB or GPIB command. These settings will be saved for all future powerups.

5. GPIB Address: To set the GPIB address, press **0.1** to select the desired address in range 1-30. ON/OFF Power cycling will not change the address.

2

Local Mode Operation

1. Local Mode: The unit can switch to Local Mode by pressing **MENU** followed by **100** and a second **MENU** press to exit.

2. Upon entering Local Mode, the unit will automatically set the phase shift to 0 deg. To select a new phase shift, first press 100 to change the displayed value to 000.0 deg. Each time **100** is pressed, the phase shifter will increase by 100 deg. until 360 deg. is reached, at which point the phase shifter will start back at 000.0 deg. with another button press. Pressing **10** will increase the displayed value by 10 deg, and so forth for the **1** and **.1** buttons.

3. After the desired Phase value is displayed, press **ENTER** to set it. A "?" displayed next to the Phase shows that **ENTER** has not yet been pressed.

4. The unit will exit Local Mode and directly enter Remote Mode if a USB or GPIB command is received. Pressing **MENU** will also exit Local Mode.

3

Front and Back Panel View

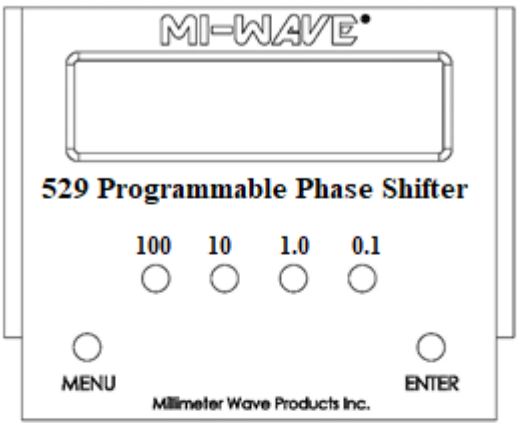

Figure 1: Front Panel View

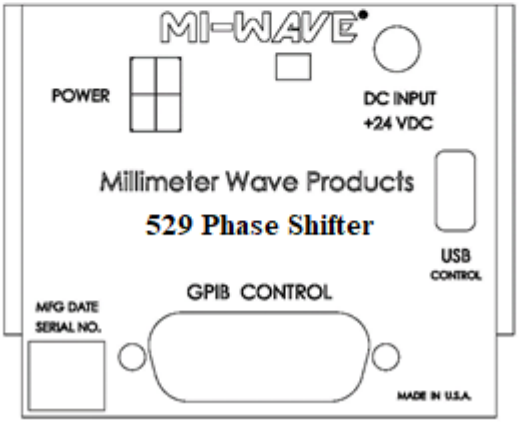

Figure 2: Back Panel View

4

Implementing Custom GPIB Connection

Command Set:

nnn.n = Move to given phase shift value

R = Reset to 0 deg.

I = Report identification string for the unit

S = Report value of serial poll byte

G = Report value of current Phase

Bit	Definition
7	Unit is busy
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Command error in received message

1. Initial Software Installation and requirements:

    a. Microsoft .NET Framework 4.5 or above

    b. National Instruments 488.2 GPIB Driver with support for .NET Framework option

2. Configure GPIB Settings. This can be done through the Interactive GPIB Utility installed with the National Instruments Driver or via custom code.
    a. **Initiate GPIB Connection via the National Instruments command "ibdev".** Refer to Figure 3
        i. Enter board index of GPIB Adapter that the device is connected to. If the board index is unknown, open National Instrument's Measurement & Automation Explorer (NI MAX), click the "DEVICES AND INTERFACE" tab. Device will be listed as "NI GPIB-USB-HS GPIBx " where "x" is the board index.
        ii. Enter the primary GPIB address of the unit. To change the primary GPIB address, refer to section 1.5
        iii. Secondary address is never used and must always be set to 0.
        iv. For timeout, enter 13
        v. Enter 1 for 'EOI on last byte' flag
        vi. Enter 0 for end-of-string mode/byte
        vii. The unit will then exit the screen stating "Initiate GPIB or USB connection," (This is based off of the GPIB REN line being asserted upon calling "ibdev").

    b. Set desired frequency Phase levels via the command "ibwrt".
    The Phase input for "ibwrt" must be a string ranging from 0 to 360 terminated by EOI and may contain termination characters "\r" (CR), "\n" (LF), or "\r\n" (CRLF). An example implementation of "ibwrt" is shown below in Figure 4.

Figure 3: Screenshot of command "ibdev" initiated with National Instruments GPIB Interactive Control utility

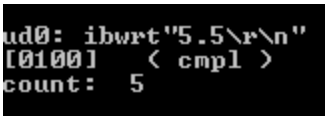

Figure 4: Screenshot of command "ibwrt" to set Phase to 5.5 deg. immediately after the above call to "ibdev"

c. **Read a response string from GPIB command via "ibrd".**
If a response from each Phase command is desired (see section 1.4), call "ibrd" immediately after sending an "ibwrt" command. Calling "ibrd" will return the string "GPIB CMD: nnn.n deg. complete." It should be noted that only custom software can send "ibrd" in time to catch the response (typing "ibrd" manually in the Interactive GPIB Utility after an "ibwrt" is too slow).

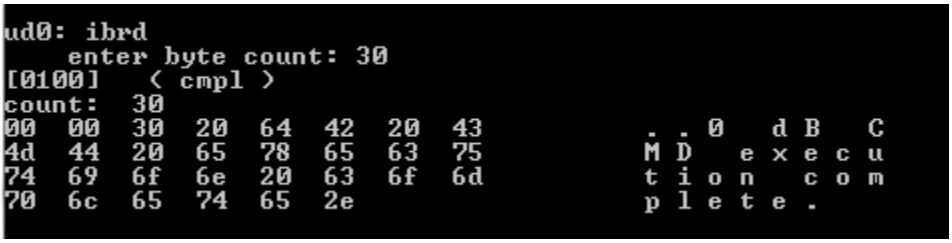

Figure 5: Screenshot of command "ibrd" to read response from GPIB

d. **Conduct a serial poll with "ibrsp" to read back the serial poll byte.**
The function "ibrsp" will trigger a serial poll and the unit will respond with its status byte. Calling "ibrsp" or sending any successful GPIB commands will reset the status byte to 0.

e. **Close GPIB connection via command "ibonl", followed by the respective GPIB board index when finished.**
The command "ibonl" ends the GPIB connection and cleans up memory resources for all devices connected to the respective board index entered in the command. This should be called before closing any custom GPIB communication programs with the device. A demonstration is shown below in Figure 6 for board index 0.

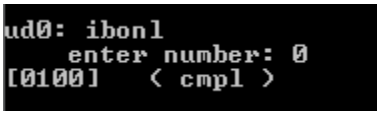

Figure 6: Screenshot of command "ibonl" for board index 0

Warning:

1. Always leave a 200 ms delay between GPIB commands to account for status byte updates. Rapidly sent commands may be lost.
2. Never leave unconnected GPIB cables attached to the device during use; this can distort sent commands and incoming responses.
3. Always call "ibonl" or unplug the GPIB cable before powering the device off. Failing to do so will result in an incomplete device reset. See section 4.2e for more information on "ibonl".

5

Implementing Custom USB Connection

Command Set:

nnn.n = Move to given phase shift value

R = Reset to Phase to 0 deg.

I = Report identification string for the unit

S = Report value of Status byte

G = Report value of current Phase

Status Bit Values:

Bit	Definition
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Command error in received message

1. **Initial Software Installation:**

   Download and Install VCP (Virtual COM Port) driver from FTDI website:

   http://www.ftdichip.com/Drivers/VCP.html

2. **Configure serial port settings**
   a. Locate device COM port number. In Windows "Device Manager," the device can be found under "Ports." It will be listed as "USB Serial Port," with its respective COM port number located next to it.
   b. Baud rate should be set to 57600.
   c. 8 data bits
   d. No Parity
   e. 1 stop bit
   f. No Flow Control

   Any method of creating a serial port connection with these settings will suffice. One simple solution is to use the C# .NET "SerialPort," class to create custom USB communication software for the device.

3. **Send commands terminated via "\r" (CR), "\n" (LF), or "\r\n" (CRLF)**
   If each command is not terminated the serial buffer on the device will continue to fill up with commands but none will be processed.

4. **A response to each USB command**
   Once the motor has completed its motion, "USB CMD: xxx.x degrees complete.\r\n" will be sent across USB from the device (if configured to do so as described in section 1.4). Read the incoming serial buffer as a string to receive the message.

Index