SD5902 Waveguide Switch Driver

OPERATION AND MAINTENANCE
MANUAL

Version 1.3

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CONTENTS

WARRANTY

Flann warrants each product of its manufacture to be free from defects in material and workmanship. Our obligation under this warranty is limited to servicing or adjusting any products returned to our address for that purpose and to make good at our facility any part or parts thereof (transistors, integrated circuits, batteries, diodes and displays) within one year after making delivery to the original purchaser and which in our examination shall disclose to our satisfaction to have been thus defective. Such returns must have prior authorization from Flann and must be returned as our detailed instructions with transportation charges prepaid. Warranty returns or repairs must first be authorized by Flann. Flann does not authorize any third party to assume for them any other liability in connection with the original sale than the foregoing. ***Unauthorized tampering with sealed screws will invalidate the warranty and may result in damage to the product.***

DESIGN CHANGES

Flann reserves the right to make changes in the design of its products without reference and without incurring any obligation to make the same alterations on products previously purchased.

FIRMWARE UPGRADES

Users will be able to upgrade to the latest version of the SD5902 firmware over the USB interface by following the instructions given in the Flann Microwave Ltd. website.

SPECIFICATION CHANGES

Flann Microwave reserves the right to change any specification noted herein without prior notice.

REPAIRS

When wishing to return instruments for repairs, or for any other reason, please contact this Company for shipping instructions. To expedite repair service, it is important to provide type number, serial number and a detailed description of the reason, including all fault symptoms, for the return of the instrument.

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GENERAL INFORMATION

Product Description

The SD5902 Waveguide Switch Driver is designed to control and operate Flann Microwave's range of Series 333 Precision Waveguide Switches. It provides the interface between an IEEE 488 Bus (GPIB) or Universal Serial Bus (USB) and Precision Waveguide Switches, and allows for manual operation with display of current status. The SD5902 will drive either a 2 channel or a 3 channel switch without the need to reconfigure.

Flann's Precision Waveguide Switches offer unrivalled repeatability, high reliability and extremely long service life, making them ideal for automated test and systems applications. They are four port devices and are available with either a two- or three-channel rotor. (See Figure 1). They provide high R.F. isolation between non coupled ports by means of an efficient choke design. Accurate channel to port alignment and excellent repeatability are achieved by a light and positive rotor locating mechanism.
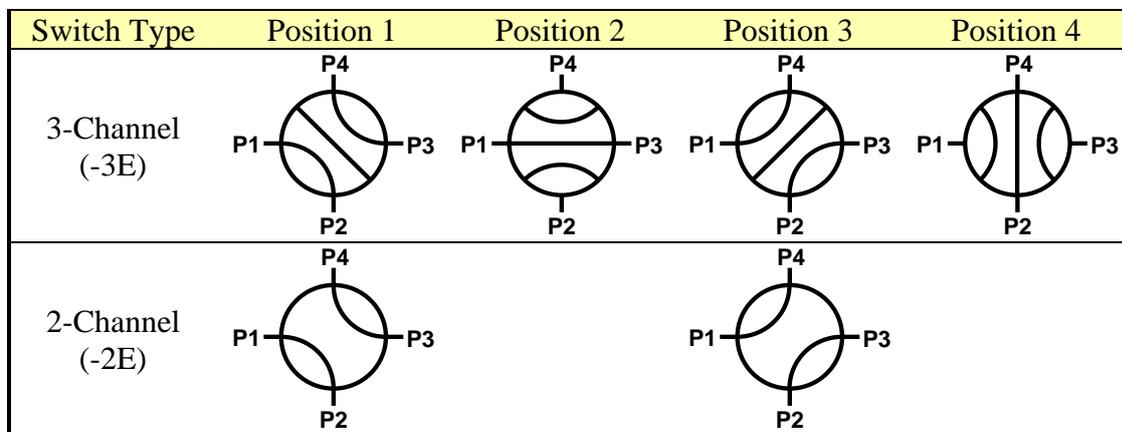
Switch Type	Position 1	Position 2	Position 3	Position 4
3-Channel (-3E)	P4 P1 P3 P2	P4 P1 P3 P2	P4 P1 P3 P2	P4 P1 P3 P2
2-Channel (-2E)	P4 P1 P3 P2		P4 P1 P3 P2	

Figure 1: Precision Waveguide Switch Rotor Positions

Series 333 switches, in conjunction with the SD5902, allow the user to choose between 'Precision Mode' and 'Speed Mode'. There are two alternative rotor positions for each of the switch channel configurations, spaced by 180°, that have identical waveguide paths. In Precision Mode, only one of these two alternative rotor positions is used, ensuring optimum microwave path repeatability. In Speed Mode, switching time is minimised by using all possible rotor positions.

All switches are supplied in the E plane configuration as standard.

The opto electronic position sensors provide either two or four signals depending upon the type of rotor (2 or 3 channel). The outputs of the sensors are TTL compatible, positive logic. The motor output shaft drives the microwave switch rotor through a loose coupling, which is designed to allow the precision indexing mechanism to operate correctly without excessive settling time. Full power is only applied to the motor during switch repositioning.

The Model Number and Serial Number of the Waveguide Switch Driver will be found on the rear panel. Similar information for the Microwave Switch will be found on the switch top cover. It is essential to quote the model and serial numbers of both the Waveguide Switch Driver and the instruments connected to it when contacting the manufacturer for service information.

Specifications

System Performance

Max Switching Time   (2 Channel)   180ms* (Speed Mode), 475ms* (Precision Mode – worst case)
                     (3 Channel)   250ms* (Speed Mode), 500ms* (Precision Mode – worst case)

*Note that the indicated switching times are measured from the initial command to the motor stopping, and do not include the rotor settling time. Consult the Flann Microwave sales team for more details.

Power Requirements

This is a safety class 1 product (provided with a protective earth terminal). A non-interruptible safety earth ground must be provided from the main power source to the Waveguide Switch Driver power input terminals and power cord. Whenever the safety earth ground has been impaired, the instrument must be made inoperative and secured against any unintended operation. If this instrument is to be energised via an autotransformer (NOT RECOMMENDED) for voltage reduction, make sure that the common terminal is connected to the earth pole of the power source.

Line Voltage   90 – 264 V AC
Line Frequency   47-63 Hz
Power Consumption   50W Max (Motor Running), 25W Max (Motor Stationary)
Supply Fuse   20mm T2.5A Slow Blow (On rear panel)

Electrical Specifications

GPIB Connector   24-Way, compatible with Amphenol 57 Series (IEEE488 Standard)
Switch Output Connector   15-Way D-Type Female
Switch Cable Length   5m Max
Motor Steps per Revolution   500

Mechanical Specifications

Operating Orientation   Any
Dimensions (mm)   58H $\times$ 483W $\times$ 300D mm (2.28H $\times$ 19.0W $\times$ 11.8D inch)
Weight   2.15 kg (4.74 lb)
Direction of Rotation   Unidirectional: Counter-clockwise when viewed from the top

Environmental Specifications

Operating Temperature Range   0 °C to +40 °C
Storage Temperature Range   -20 °C to +60 °C
Humidity   90%, No condensation

INSTALLATION

Interconnection of System Components

The SD5902 Waveguide Switch Driver may be connected to other GPIB instruments using standard IEEE488 (GPIB) cables. Users should pay particular attention to the cable length limitations: total length less than 20 m (60 ft), maximum 2 m between GPIB devices.

Waveguide Switches may be connected to the Waveguide Switch Driver via the 2 m (6ft) cables supplied. Alternatively, any length of cable up to 5 m (16 ft) may be supplied on request or made up by the user. Table 1 shows the wiring details for the 15-way D-type connector

Pin No.	Function
1	Large Motor
2	Motor Phase 5
3	Motor Common
4	Motor Phase 1
5	Motor Phase 3
6	Motor Phase 2
7	Motor Phase 4
8	Logic 0v
9	LNT (Precision Mode)
10	Not Used
11	Logic +5v
12	Output 1 (P1-P2, P3-P4)
13	Output 2 (P1-P3)
14	Output 3 (P2-P3, P1-P4)
15	Output 4 (P2-P4)

Table 1: 15-way D-Type Connections

Use connectors with a casing that incorporates earth terminals and connect the cable screen at both ends to ensure earthing integrity. **Failure to do so may allow EMI radiation to exceed acceptable levels when the motor is running.**

NOTE: All pins, other than Pin 10, must be connected regardless of the type of switch in use.
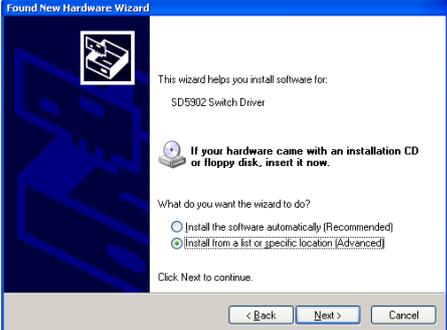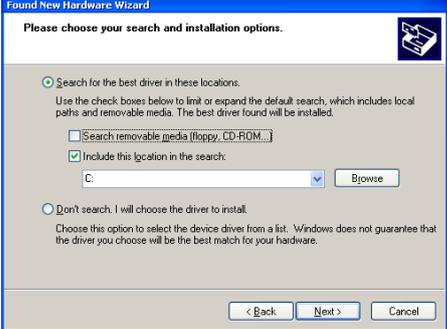
Care of Microwave Flanges

The microwave flange surfaces require careful handling to ensure consistent results and long life. In particular, avoid scratching, over-tightening the screws, or leaving the flange surfaces unprotected. Always cover the flanges with the protective covers supplied with the switch to prevent ingress of dust, etc., when not in use.

WARNING: Any grit or protrusions on flange surfaces will cause damage to the mating flange. Before mating flanges, each surface should be cleaned with alcohol to remove any grease or particles which may have accumulated, and inspected to ensure that the flange is undamaged. Ensure that debris from cleaning materials is not deposited into the waveguide apertures during the cleaning process.

Do not, at any time, insert objects into the waveguide ports as the slightest damage to the inner surfaces will impair the microwave performance of the switch.

USB Driver Installation

If the switch driver is to be connected to a computer via the USB interface, the supplied driver must be installed on the computer. The driver supplied is compatible with Windows 2000, XP, XP 64bit, Vista, Vista 64bit, 7, 8, & 10. Windows XP installation is as follows:

1.	Start up the computer and connect a USB cable between the switch driver and computer. Power up the switch driver. The computer should identify the switch driver and open the 'Found New Hardware Wizard':	
2.	Select 'No, not this time' and press 'Next'	
4.	Select 'Install from a list or specific location (Advanced)'.	
5.	Select 'Include this location in the search' and Browse for the SD5902.inf driver file on CD. Then press 'Next'.	
6.	The installer may warn about 'Windows Logo Testing'. The .inf installation file supplied makes use of drivers which are a part of Windows, so it is inherently compatible with Windows. Press 'Continue Anyway'.	
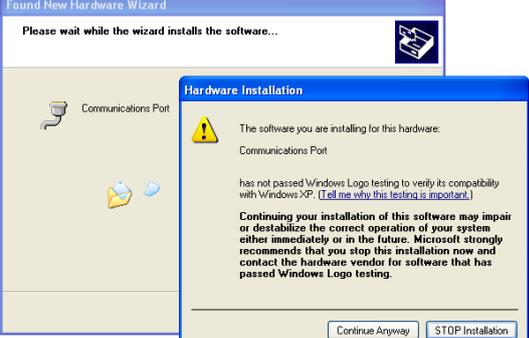
7. When the installation is complete, the switch driver will appear as a USB 'COM' port. Windows may allocate any COM number to the switch driver, but on most systems it will be allocated COM7 or higher. It is possible to verify which port has been allocated to the switch driver by checking the Windows Device Manager.	

Firmware Upgrades

Users will be able to upgrade to the latest version of the SD5902 firmware over the USB interface by following the instructions given in the Flann Microwave Ltd. website, www.flann.com .

A copy of the latest issue of this manual is also available for download.

MANUAL OPERATION

Front Panel Description

The front panel is shown in Figure 2 below. At the far left is the power switch which is on (and illuminated) when switched down.

There are two groups of switches and LEDs marked 'Instrument A' and 'Instrument B' and a group relating to the IEEE488.2 (GPIB) interface

Figure 2: SD5902 Waveguide Switch Driver Front Panel Layout

Manual Control

Manual control of the microwave switch position is accomplished by selecting and pressing one of the four push buttons of the appropriate channel. The actual position is indicated by the green LEDs above the buttons.

Note that a position push button will be ignored if it is pressed in any of the following conditions:
1.   While the REMOTE light is on. It is necessary to press the LOCAL push button first.
2.   While the switch is repositioning.
3.   The microwave switch is in the position corresponding to the push-button being pressed, and Precision Mode has been selected. See below

At power on, it is possible that the microwave switch is between detent positions, and that, consequently, none of the LED position indicators will light. If this is the case, press any one button, and the switch will drive to the selected position.

There are two modes of operation - Precision Mode and Speed Mode. These are explained in detail in the Product Description section on page 5. The instrument is shipped set to Precision Mode by default, and this may be changed by holding down button '2' in the Instrument 'B' group at power-up. Instructions for this are given in the GPIB Address and Instrument Settings section on page 12.

In Speed Mode, if the switch is already at the requested position, the rotor will rotate through 180°. In Precision Mode, the rotor would rotate through 360°, therefore the instruction is ignored, i.e. the switch will not move.

If a pushbutton is pressed and then held in that position, it will not cause repetitive operation of the microwave switch.

Error Indicators

If an ERROR indication is shown for a particular channel, it means that the switch driver has failed to carry out an instruction successfully. The most likely causes of error indications are:

*   If a two channel switch has been asked to move to position 2 or position 4. These positions only relate to three channel switches.
*   No switch is connected or the connections are not secure.

Temperature Warning

If the internal temperature of the Waveguide Switch Driver exceeds +55°C, the instrument will stop functioning. In this state, the green and red front panel LEDs will flash alternately, and the Temperature Error bit (Bit 3) in the Status Byte will be set.

Cool the Waveguide Switch Driver immediately. Reset the instrument by power cycling it.

REMOTE OPERATION

Compatibility

The SD5902 Waveguide Switch Driver may be remotely controlled using the IEEE488 (GPIB) or Universal Serial Bus (USB) Interfaces. This instrument has been designed to be backwards compatible with the GPIB command structure of earlier SD5741 and SD5742 series of Waveguide Switch Drivers, and is interchangeable with the earlier instruments. This means that whilst the SD5902 is largely compliant with the latest IEEE488.2 interface standard, there are some necessary deviations from compliance. In particular, not all of the standard IEEE488.2 commands are available, and the instrument will always respond with a message describing the switch positions if it is addressed to talk when a command is sent that has no response.

The SD5902 Waveguide Switch Driver GPIB Bus Capability is as follows:

Capability	Description
SH1	Source handshake (Complete capability)
AH1	Acceptor handshake (Complete capability)
T2	Talker (Basic talker, serial poll, no talk only mode, no unaddressed if MLA.)
L2	Listener (Basic listener, no listen only mode, no unaddressed if MTA.)
LE0	Extended listen (No capability)
TE0	Extended talker (No capability)
SR1	Service Request (Complete capability)
RL1	Remote/Local (Complete capability)
PP0	Parallel poll (No capability)
DC0	Device clear (No capability)
DT0	Device trigger (No capability)
C0	Controller (No capability)

Table 2: SD5902 GPIB Bus Capability

GPIB Address and Instrument Settings

The SD5902 stores its GPIB Address and other status information in non-volatile EEPROM memory. The instrument defaults to GPIB Address 1 but the address can be changed with the ADDRSET command. At power-up, the 8 green lights show the current GPIB address and instrument settings as follows:
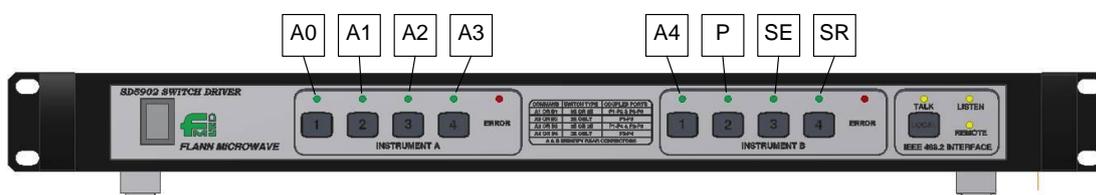
[A0:A4]   Binary indication of current GPIB Address (weights 1,2,4,8,16 respectively)
[P]   Precision Mode (On), Speed Mode (Off)
[SE]   Service Request on Error
[SR]   Service Request on Ready

Figure 3: GPIB Address and Instrument Settings Indication

For Example:

⬤ ◯ ◯ ◯   ◯ ⬤ ◯ ◯ Address 1, Precision Mode, No Service Requests
◯ ⬤ ◯ ⬤   ⬤ ◯ ⬤ ◯ Address 26, Speed Mode, Service Request on Error

In the event that an invalid GPIB address is set, or that the GPIB address is set to conflict with the GPIB controller, holding the [Local] button at power-up will cause the GPIB address to be reset to 1. Similarly, holding the buttons below the [P], [SE] or [SR] lights at power-up will cause the settings to be toggled and stored.

Status Byte

The Status Byte is returned from the Switch Driver in response to a Serial Poll or the *STB? command. The content of the byte is shown in Table 3 below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Mode	Service Request	Ready	Busy	Temp Error	User Error	Error B	Error A

Bit	Description
7 – Mode	Speed Mode (0), Precision Mode (1) These are explained in detail in the Product Description section on page 5.
6 – Service Request	No SRQ (0), SRQ (1) A Service Request may be generated in one of two ways, defined by the instrument power-on settings described in the GPIB Address and Instrument Settings section on page 12: **SRQ ON ERROR**: If the [SE] LED illuminates on power-on, then a Service Request will be generated upon detection of an error. **SRQ ON READY**: If the [SR] LED illuminates on power-on, then a Service Request will be generated when the status changes from BUSY to READY.
5 – Ready	Not Ready (0), Ready (1) When this bit is at logic "1", the Switch Driver is ready to receive new instructions.
4 – Busy	Not Busy (0), Busy (1) When the Switch Driver is busy during changing the setting of the microwave switch, the BUSY bit will be at logic "1". In this state, device dependant data will not be read from the GPIB. Only interface messages will be read.
3 – Temp Error	No Error (0), Error (1) When the Switch Driver detects excessive temperature, the front panel lights will flash and Bit 3 will be set. Cool and reset or power cycle the instrument.
2 – User Error	No Error (0), Error (1) If this bit is at logic "1", it indicates that a syntax error has been detected in the last instruction received. If any part of a single sequence of instructions is determined to be incorrect, the whole instruction may be ignored.
1 – Error B	No Error (0), Error (1) If this bit is at logic "1", it indicates that an error has been detected for microwave switch "B".
0 – Error A	No Error (0), Error (1) If this bit is at logic "1", it indicates that an error has been detected for microwave switch "A".

Table 3: SD5902 Status Byte

Remote Control Commands

Remote control commands may be issued to the SD5902 singly, or combined in a string with other commands. The string may optionally be terminated with an ASCII linefeed character (hex 0A, decimal 10), and commands may optionally be separated by the semicolon character ';'. The SD5902 is not case sensitive so combinations of upper and lower case are acceptable.

Command descriptions

Command:	**A1**
Function:	Move Switch 'A' to Position 1
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 1 in the 'Instrument A' group

Command:	**A2**
Function:	Move Switch 'A' to Position 2
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 2 in the 'Instrument A' group

Command:	**A3**
Function:	Move Switch 'A' to Position 3
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 3 in the 'Instrument A' group

Command:	**A4**
Function:	Move Switch 'A' to Position 4
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 4 in the 'Instrument A' group

Command:	**A?**
Function:	Return Switch 'A' Position
Response:	GPIB and USB: A single digit '1', '2', '3', '4' indicating the position, or '0' if the switch is not present or is in an error condition
Front Panel:	None

Command:	**B1**
Function:	Move Switch 'B' to Position 1
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 1 in the 'Instrument B' group

Command:	**B2**
Function:	Move Switch 'B' to Position 2
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 2 in the 'Instrument B' group

Command:	**B3**
Function:	Move Switch 'B' to Position 3
Response:	GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel:	Button 3 in the 'Instrument B' group

Command: **B4**
Function: Move Switch 'B' to Position 4
Response: GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel: Button 4 in the 'Instrument B' group

Command: **B?**
Function: Return Switch 'B' Position
Response: GPIB and USB: A single digit '1', '2', '3', '4' indicating the position, or '0' if the switch is not present or is in an error condition
Front Panel: None

Command: **P**
Function: Set Precision Mode until changed by GPIB command or power cycle
Response: GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel: Holding down button 2 in the 'Instrument B' group at power up to cause the light above to illuminate. See GPIB Address and Instrument Settings on page 12.

Command: **S**
Function: Set Speed Mode until changed by GPIB command or power cycle
Response: GPIB: Data Message in format a,b as shown below, if no other query command is present in the command string. USB: None
Front Panel: Holding down button 2 in the 'Instrument B' group at power up to cause the light above to extinguish. See GPIB Address and Instrument Settings on page 12.

Command: **H**
Function: Return diagnostic opto data (See description in Data Message section below).
Response: GPIB and USB: Data Message in format a,b .
Front Panel: None

Command: **ADDRSETnn (GPIB only)**
Function: Set GPIB Address to nn where nn is in the range 0 to 30. See GPIB Address and Instrument Settings on page 12.
Response: None
Front Panel: GPIB Address can be reset to the default value of 1 by holding down the [Local] button at power up. See GPIB Address and Instrument Settings on page 12.

Command: ***IDN?**
Function: Return instrument identification string
Response: GPIB and USB: Instrument ID string, eg "Flann Microwave Ltd, SD5902,V1.0".
Front Panel: None

Command: ***RST**
Function: Perform device reset equivalent to power cycling instrument.
        Note that this command will terminate USB communication with the instrument until it is explicitly re-established.
Response: None
Front Panel: Power switch

Command: ***STB?**
Function: Return instrument serial poll byte
Response: GPIB and USB: Serial status byte encoded as a decimal number from 0 to 255
Front Panel: NONE

Command Line Examples

The following examples show valid command strings:

"P;A1;B1;*STB?"	Set precision mode, move Switch 'A' to Position 1, move Switch 'B' to Position 1, return Status Byte.
"a3B4a1H*IDN?"	Move Switch 'A' to Position 3, move Switch 'B' to Position 4, move Switch 'A' to Position 1, return diagnostic opto data, return instrument identification string.
"A1"	Move Switch 'A' to Position 1.
"a4b2"	Move Switch 'A' to Position 4, move Switch 'B' to Position 2.
"B1A3"	Move Switch 'B' to Position 1, move Switch 'A' to Position 3.
"h"	Return diagnostic opto data.

The following examples are **not** valid command strings:

"A2;3"	"3" is not allowed to follow ";".
"A4,B1"	"," is not a valid separator.
"A4; B1"	Spaces are only permitted at the end of the command line.

If any part of the Command Line does not conform to the specification, the whole line may be ignored and Bit 2 (User Error) of the Status Byte will be "1".

Data Message

The Data Message is the default response from the Waveguide Switch Driver and is returned when the unit is addressed to talk, and contains the current switch setting information in the following format:

    a,b

where "a" is the numerical value assigned to the current setting of switch "A", and "b" is the numerical value assigned to the current setting of switch "B". See Figure 1 on page 5. This message is retained for compatibility with earlier switch driver models.

There are two modes of operation. Normally, the numbers assigned to a switch position will be 1, 2, 3, or 4 (for a three-channel switch) and 1, or 3 (for a two-channel switch). If a switch is producing an invalid combination of position signals, the returned value will be "0".

However, under fault conditions, it may be desirable to determine precisely what combination of optic signals is generating the error. By sending the command "H" (or "h"), the returned values will be computed as follows:

    Optic signal 1 has a binary weighting of 1 (0001)
    Optic signal 2 has a binary weighting of 2 (0010)
    Optic signal 3 has a binary weighting of 4 (0100)
    Optic signal 4 has a binary weighting of 8 (1000)

All binary weightings are added together to give a value in the range 0 to 15.

For example, if the returned values in normal mode were 3,0 then the values returned after sending the "H" command might be 4,5 indicating that switch "A" was in position "3", but that two optic lines were active for switch "B", optic "1" and optic "3".

Under USB control, the switch driver does not return this data message with every command sent. Instead it only returns values when addressed with a command that specifically requires a response. These are: A?, B?, H, *IDN?, *STB?.

Remote Command Summary

Command	Function
A1	Move Waveguide Switch 'A' to Position 1
A2	Move Waveguide Switch 'A' to Position 2
A3	Move Waveguide Switch 'A' to Position 3
A4	Move Waveguide Switch 'A' to Position 4
A?	Respond with Waveguide Switch 'A' Position
B1	Move Waveguide Switch 'B' to Position 1
B2	Move Waveguide Switch 'B' to Position 2
B3	Move Waveguide Switch 'B' to Position 3
B4	Move Waveguide Switch 'B' to Position 4
B?	Respond with Waveguide Switch 'B' Position
P	Set Precision Mode
S	Set Speed Mode
H	Respond with Waveguide Switch Opto Data
*RST	Reset Switch Driver
	Note that this command will terminate USB communication with the instrument until it is explicitly re-established.
*IDN?	Respond with Instrument Identification
*STB?	Respond with Status Byte
ADDRSETnn	Change GPIB Address to nn **(GPIB Only)**

MAINTENANCE AND SERVICE

No routine maintenance is required except for cleaning.

The case and front panel may be cleaned with a damp cloth, but no harsh or abrasive solvents or cleaning products should be used.

This unit contains no user-serviceable parts. In the event of a system malfunction, the following steps are suggested:

- Check Line power is available, and the power switch is illuminated. If not, check the supply and fuses and replace where necessary. The instrument has no internal fuses.
- Check Waveguide Switch cables to confirm that they are securely connected and undamaged.

If neither of these steps rectify the problem, please contact Flann Microwave Ltd. for advice.

REGULATORY INFORMATION

Declaration of Conformity

Manufacturer	Flann Microwave Ltd Dunmere Road Bodmin Cornwall PL31 2QL United Kingdom
Product	Waveguide Switch Driver Model Number: SD5902
European Standards	EN61000-6-1:2001 EN61000-6-3:2001
Technical File Number	TCF07

It is declared that the above product conforms to the essential requirements of the Electromagnetic Compatibility Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC when used in accordance with the instructions for use, as detailed in the appropriate technical file.

I R Crane
For and on behalf of Flann Microwave Ltd.
Date: 12 February 2009

Waste Electrical and Electronic Equipment (WEEE) Regulations

Flann Microwave is registered with the United Kingdom Environment Agency as a supplier of electrical and electronic equipment, and makes the required declarations in accordance with WEEE Regulations.

Where this product was supplied to a customer in the United Kingdom:

When this product is at the end of its life, Flann Microwave will accept its return for safe disposal and recycling, if required by the Customer. Please contact Flann Microwave for full instructions before returning any WEEE. The return address is:

> Flann Microwave Ltd
> Dunmere Road
> Bodmin
> Cornwall PL31 2QL
>
> Tel. 01208 77777

Where this product was supplied to a customer outside the United Kingdom:

Please follow local regulations regarding the disposal and recycling of WEEE, or contact your distributor for advice.

Flann Microwave Ltd can provide information on the materials used in this instrument to assist in their recycling or safe disposal.