MODEL 755R
MODEL 760R
Superconducting Rock Magnetometer

Electronics Operating Manual
and Technical Reference

July 2003

6.0 Communications

An RS-232 communication port is included in the 581 and is accessed by means of connectors on the rear panel. This port enables commands to be sent to the 581 and data to be retrieved by an external computer. The RS-232 port can be daisy-chained, combining up to 3 systems on one RS-232 port.

The COM 1 port is the input port from either a master controller such as a computer, or from the COM 2 port of another unit.

The address of each unit is set by a digiswitch on the main p.c. board inside the 581 console. The unit address is 1 (or X), 2 (or Y), or 3 (or Z) depending upon whether switch 1, 2 or 3 of S1 (see Fig 15) is on.

The pinout of the COM 1 and COM 2 ports on the rear of the 581 is as follows:

COM 1

pin	
1	Data carrier detect
2	Transmit data to external computer
3	Receive data from external computer
4	Data terminal ready
5	Signal ground
6	Data set ready
7	Request to send
8	Clear to send
9	Not used

The COM 2 port of the 5 81 has a pinout identical to the COM 1 port except pins 2 and 3 are reversed. This means that by connecting one 581 COM 2 port (input) with a straight cable to another 581 COM 1 port (output), connection to both units is achieved.

A TTL hardware reset input is wired to pin 9 of COM 2 if this option is included. This input is active low. An input pulse of >0.1 second is required to activate reset.

7.0 ASCII protocol for the 581 computer interface

The basic protocol consists of ASCII characters sent from the controlling computer and ASCII characters returned by the 581 magnetometer electronics. The protocol is polled, meaning that the 581 electronics responds only by request from the controlling computer. The character level is 8 data bits, with no parity and one stop bit sent at 1200 baud. The magnetometer electronics will ignore any transmission from the computer that it cannot interpret. In this case, the controlling computer must time out and attempt the transmission again. No handshaking protocol is implemented between the 581 and the external computer.

Transmissions that originate from the controlling computer are called commands, while transmissions originating in the electronics are called responses. The length of responses varies with the initiating command. Note that only upper case letters are accepted in commands.

Commands and responses are discussed in Sections 7.1 and 7.2 respectively. The 581 console has an address designated X, Y or Z. Setting of addresses is discussed in Section 6.0.

7.1 DC SQUID Commands

Commands are at most five characters in length including a carriage return <CR>. The syntax is as follows:

"<device><command><subcommand><data><CR>"

The subcommands and data fields may not be present. Some example command strings are:

"ARC<CR>" Reset counter on all axes.
"XCFT<CR>" Configure X-axis for 10 Hz filter.
"YSD<CR>" Instruct Y-axis to send analog data.

<DEVICE>
The device field of the command string contains the axis to which the command is directed. Many commands can be sent to all axes. The destination field may be any one of the following:

"A" Commands to be sent to all axes.
"X" Commands to be sent to X-axis.
"Y" Commands to be sent to Y-axis.
"Z" Commands to be sent to Z-axis.

<COMMAND>
There are four possible command field values:

"R" Reset
"C" Configure
"L" Latch
"S" Send

Each of these commands have subcommands and data fields which further specify the command. Each command is explained in more detail below:

RESET

The RESET command is used to reset to zero the initial flux counter. RESET may be issued to all axes at once. Note that the feedback loop is also reset by this command. The RESET subcommand is:

"C" Reset counter; the internal counter within the DC SQUID electronics is set to zero. The RESET command does not trigger any response from the addressed DC SQUID electronics.

CONFIGURE

The CONFIGURE command is used to set the magnetometer electronics to a known state. Seven configure subcommands are available. Like the RESET command, the CONFIGURE command may be used to all axes at once. The CONFIGURE subcommands follow:

"F" Set filter configuration. The data subfield sets the filter to the indicated range. The four possible data values are:

"1"	One Hertz Filter;	1 Hz
"T"	Ten Hertz Filter;	10 Hz
"H"	One hundred Hertz Filter;	100 Hz
"W"	Wide band filter;	WB

"R" Set DC SQUID electronic range. The data subfield selects the range desired. The four possible data values are:

"1"	One time range;	1x
"T"	Ten times range;	10x
"H"	One hundred times range;	100x
"E"	Extended range;	1000x

"S" Set/Reset the fast-slew option. Two data values are possible:

"E" Enable the fast-slew; turn it on.
"D" Disable the fast-slew; turn it off.

"L" This subcommand opens or closes the SQUID feedback loop or

resets the analog signal to +/- 1/2 flux quantum about zero. The three possible data values are:

"O" Open the feedback loop.
(This command also zeros the flux counter)
"C" Close the feedback loop.
"P" Pulse-reset (open then close) the feedback loop.
(This command also zeros the flux counter)

LATCH

This command causes the magnetometer electronics to latch the indicated values. The LATCH command may be issued to any or all axes. Two latch subcommands are possible:

"D" Latch the analog Data. The magnetometer reacts by latching the current analog signal output.
"C" Latch the Counter. The magnetometer electronics reacts by latching the current counter value.

SEND

The SEND command requests data from the magnetometer electronics. Since this command triggers a response from the addressed unit it cannot have "ALL" as the destination axis. The destination must be "X", "Y", or "Z". Three send subcommands are available:

"D" Send back the analog data last captured with the LATCH command. The <data> field is not required.
"C" Send back the counter value last captured with the LATCH command. The <data> field is not required.
"S" Send back status. Various pieces of status can be sent by the magnetometer electronics.

More than one <data> field may be specified. The following <data> field values are possible:

"A" Send back all status.
"F" Send back all filter status.
"R" Send back all range status.
"S" Send back slew status.
"L" Send back SQUID feedback loop status.

7.2 Magnetometer Responses

Responses by the electronics are triggered by the SEND command. The syntax of the response is determined by the type of SEND command sent. Responses vary in length. All responses are terminated by a carriage return <CR>. Some typical responses are:

"+24216<CR>" Counter value of +24126. (Maximum counter value is ±32768)
"F1<CR>" Status value indicating that the 1 Hz filter is selected.
"SD<CR>" Status value indicating that the fast slew is disabled (off).
"+0.87651" Analog data as indicated.

The response will be 7 characters for the counter value and 9 characters for the analog data value including the carriage return. The first character of the analog and counter data is one of two values:

"+" Sign of value is positive.
"-" Sign of value is negative.

In the counter data response, the next 5 characters are decimal digits (0-9) with no decimal point. In the analog data response, the next 7 characters include 6 decimal digits, and an embedded decimal point.

The response to the SEND status command is the most complex response. Each status request triggers a two character response, except the "ALL" status request which triggers a 12 character response. The response returned for the magnetometer map exactly to the CONFIGURE commands and the RESET electronics command. The response is exactly the subcommand and data field values that would be issued by the CONFIGURE or RESET commands. For example:

Command: "XSSF<CR>" Have X-axis return filter status.

```
    Response: "F1<CR>"     Filter set at 1 Hertz.

     Command: "YSSS<CR>"   Have Y-axis return fast slew status.
    Response: "SD<CR>"     Fast slew disabled.

     Command: "ZSSL<CR>"   Have Z-axis return electronic loop (feedback) status.
    Response: "LO"         Loop Open
```

If all status is requested from the DC SQUID electronics, then all four possible status values are returned in character pairs. For example:

```
     Command: "XSSA"              X Axis send status All
    Response: "FT RH SE LC<CR>"   Filter is on, ten hertz, range hundred,
                                  slew enabled, loop closed.
```

7.3 Combining Count and DVM Data

When the flux counting mode is used on the 1X range the DVM is calibrated to read signal amplitude directly in units of Φ. For example, on the 1X range, if a DVM signal is +.71000, then this represents = 0.71000 Φ. The count value is expressed directly in Φ. For example, if the count = 92, then this is 92 Φ.

Before a sample is measured, the analog output and the count are normally reset by sending the command: "ARC" (All Reset Count). The DVM will normally then be adjusted with the DC offset control to near zero. For flux counting mode select the 1X range only since reliable high speed counting does not occur on the other ranges.

When the SQUID flux input changes, the DVM will change and so will the count if the flux change is significantly large. To merge the DVM reading and the count, algebraically combine the count with the analog (DVM) output. For example, if the DVM reads -.50000 and the count is +90, the total signal S is:

```
      S = +90-.5000 = 89.5000 &#934;
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To obtain the signal in magnetic moment units when using the 581 system with Rock Magnetometer Systems, multiply the signal S by the system calibration constant in emu per flux quanta for the specific axis on which the measurement was taken.

When the 10X, 100X and 1000X ranges are utilized, the use of the flux counting mode is not recommended. For these ranges, the analog output signals only should be used.