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OPHIR

MODEL DGX
RS232 DATA INTERFACE

INSTRUCTIONS

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MODEL DGX.
RS232 DATA INTERFACE
INSTRUCTIONS

1. INTRODUCTION

Ophir Optics' model DGX has a versatile RS232 data interface which can be used to send power and energy data to any remote computer, printer or data recorder which has an RS232 interface. Additionally, the interface makes it possible for the DGX instrument to be controlled remotely by a host computer, allowing the computer to control any feature of the DGX instrument which would normally be controlled using the "soft keys" of the instrument.

There are two basic ways in which the interface can be used.

1.1 Automatic mode

When measuring power in automatic transmission mode, the DGX instrument periodically transmits the power reading, and when measuring energy, it sends the energy of each pulse. In this mode, the DGX can not receive any instructions through the serial link. This mode can be used to transmit data to a remote printer or data logger which is incapable of transmiting instructions.

1.2 PC mode (Also called polled mode)

A remote computer sends commands to the DGX, and the DGX responds immediately with the requested data or action. In this mode, the DGX can be requested to transmit power or energy data, or can be given instructions which control some feature of the DGX instrument.

1.3 It is always possible to control the DGX instrument from the instrument's keyboard, irrespective of whether RS232 communications are going on at the same time.

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2. SETTING UP THE INTERFACE

If you are using an IBM PC, AT or compatible, with the supplied software and lead, simply connect the DGX instrument to the COM1 port of the PC and you are ready to start.

Insert the Ophir utilities diskette into drive A and type DGX232 at the a⟩prompt. Follow the instructions on the computer screen. The software is menu based; use the up and down arrows to select the function you want and press (Enter). Alternatively you can simply press the first letter of the desired function. For details of the other utilities on the diskette, view the READ. ME file supplied on the diskette. You may prefer to copy the supplied files to hard disk, if you have one. In any event, it is advisable to back up your Ophir utilities diskette by copying its contents onto a blank diskette.

2.1 Baud rate

If you are not using an IBM PC, AT or compatible, or if you are writing your own software, you will need to match the RS232 parameters of your system to that of the DGX instrument. The DGX communicates with 8 bits per byte, no parity bit, two stop bits and at any of the following baud rates: 300, 1200, 2400, 4800, 9600. In order to change the baud rate of the DGX, follow these instructions.

2.1.1 Switch the DGX on and use the key sequence:
MORE →CHANGE HEAD SETUP OR CAL →RS232 SETUP

2.1.2 Press the BAUD RATE key until the required baud rate is displayed.

2.1.3 Press the EXIT key.
To save the change permanently, follow steps 2.1.4 to 2.1.6.

2.1.4 Switch the DIP switch number 2 on the rear panel of the DGX down.
This disables the write protection of the EEROM (Permanent memory) of the DGX instrument.

2.1.5 Use the key sequence: ENERGY →CONFIG →SAVE →EXIT →POWER.

2.1.6 Switch DIP switch number 2 Back up.

3. ELECTRICAL CONNECTIONS

If you need to prepare your own cables, you need only hook up 2 or 3 pins of each connector.

If you are using a computer, connect pins as shown:

DGX instrument connector			Computer	
Pin number	**Function**		**Pin number**	**Function**
2	Transmit	←— — — — — — — — →	3	Receive
3	Receive	←— — — — — — — — →	2	Transmit
5	Ground	←— — — — — — — — →	7	Ground

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If you are using a printer or "dumb" terminal, connect pins as shown:

DGX instrument connector		Printer	
Pin number	**Function**	**Pin number**	**Function**
2	Transmit ← — — — — — — — →	2	Receive
5	Ground ← — — — — — — — →	7	Ground

4. COMMUNICATIONS USING THE AUTOMATIC MODE

In order to enter the automatic transmission mode, use the following key sequence:

MORE —→CHANGE HEAD SETUP OR CAL —→RS232 SETTINGS

Press DATA SEND so that the word AUTO appears. Press EXIT.

If your wish to make this the default setting at switch-on, follow steps 2.1.4. to 2.1.6 above.

Data will now be transmitted automatically at the selected baud rate, and the DGX instrument will not respond to any commands which it receives through the RS232 interface until the mode is returned to PC (polled) mode.

Power readings are transmitted at the rate selected on the RS232 settings screen, and energy data are transmitted every time a pulse arrives.

The data are transmitted in standard scientific notation. For example if the reading is 123.4 watts, the data will be sent as +1.234E+2 followed by carriage-return and line-feed.

5. COMMUNICATIONS USING POLLED (PC) MODE.

The DGX Instrument is configured to run in polled mode when it leaves the factory. If the mode has been changed, then in order to enter the polled (PC) communication mode, use the following key sequence:

MORE —→CHANGE HEAD SETUP OR CAL —→RS232 SETTINGS

Press DATA SEND so that the letters PC appears. Press EXIT.

If your wish to make this the default mode, then follow steps 2.1.4. to 2.1.6 above.

Once the instrument is in polled mode, it can receive an instruction at any time, and will return either the required response or, if necessary, an appropriate error message.

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5.1 Polled mode communication protocol

5.1.1 Commands sent to the DGX have the following format.

- The $ character (ASCII code 36 decimal)
- The two letters which constitute the command. These may be upper or lower case in any combination.
- An optional space.
- Any parameters if required.
- A carriage-return character (CR).
- An optional line-feed character.

5.1.2 The DGX instrument replies with either a valid response, or an error message.

- A valid response always begins with an asterisk (*) (ASCII 42)
- An error message begins with a question mark (?) (ASCII 63)
- The content of the response which follows is described under the heading Command Set below.
- Polled responses are terminated by a carriage-return character.
- Do not send one command until the response to the previous command is complete.

6. DGX COMMAND SET

The following is a complete description of syntax and function of the 8 commands to which the DGX responds in polled mode.

6.1 $SP Send Power

Request to send current power reading when in power measurement mode. The response is in Watts in standard scientific format as described in section 4 above.
Example: Command: $SP (CR) (LF) Response: *+1.732E–1 (CR)

6.2 $SE Send Energy

Request to send the energy of the last pulse measured. The response is in Joules and is also in scientific notation.
Example: Command: $SE (CR) (LF) Response: *+2.718E+1 (CR)

6.3 $EF Send Energy Flag

The energy flag is a number which equals 1 if the DGX has detected a laser pulse, but has not yet transmitted its value down the RS232 interface. Otherwise the value of the energy flag equals zero.

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This command is typically used as follows: The host computer periodically (e.g. once per second) sends the EF command, and usually the response is O. That means that no new energy reading has been made. If the response is 1, the host computer then sends an SE command to read the value of the energy of the pulse. It then continues to send EF periodically until the next pulse arrives. See the programming examples (section 7) for a further example of this.

Example:	**Commands**	**Responses**
	$EF (CR)	*0 (CR)
	$EF (CR)	*0 (CR)

At this point a laser energy pulse is detected by the DGX.

	$EF (CR)	*1 (CR)

The host computer now knows that a new pulse has been measured.

	$SE (CR)	*+2.133E–1 (CR)
	$EF (CR)	*0 (CR)

6.4 $SK Simulate pressing of Soft Key

This command, and the next three that follow, are useful for remote control of the DGX by a computer.

Syntax: $SK (Optional space) (Digit 1 to 5) (CR)

Soft keys are numbered 1 to 5 from left to right.

Example: Command: $SK1 (CR) Response: * (CR).

This has exactly the same effect as pressing the leftmost soft key.

Note: Although most commands return a reply within about 80 milliseconds, this command, and EP below, can take up to 1 second to return the asterisk. Do not send further commands until the asterisk arives.

6.5 $FP Force Power State

This command causes the instrument to go into a fixed measurement mode, namely auto-ranging power measurement with bar-graph. It will do so irrespective of what the instrument is doing at the time.

Example: Command: $FP (CR) Response: * (CR).

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6.6 $KL Key Legends

Request to send the soft-key legends currently visible at the bottom of the DGX's display screen.
Example: Command: $KL (CR) Response: *energy zoom zero ratio more (CR).

Technical note: Note that legends which appear with a dark background are transmited as blanks.

6.7 $ER Energy Ready

The command $ER will return *1 if the instrument is ready to measure the energy of a pulse (equivalent to the message "ready" appearing on the DGX screen in energy mode).

If the DGX is not ready yet for the next pulse it will return * 0.

A typical use of this and other commands is shown schematically in flow charts 1, 2 and 3. below which set up s system for automatically firing and measuring laser energy.

6.8 $VE. Software VErsion

Request to send ROM software version number of DGX.
Example: Command: $VE(CXR) Response: v1.0(CR).

FP	(No response)	The DGX will not respond to any command unless preceded by a $
$(anything)	(No response)	Something is obviously wrong. Check that: Connections are correct Baud rates etc are matched The DGX is in PC (polled) mode.

7. PROGRAMMING EXAMPLES AND TIPS

If you wish to gain familiarity with the interface and the command set, it is suggested that you use the "computer terminal" option which is part of the utility program supplied. This allows you to send commands one by one and see the instrument's response.

Any programming language that supports RS232 communications can be used to write interface programs for the DGX instrument. BASIC has been chosen for illustration since it is widely available, and input/output operations are defined within the language. Some BASIC interpreters or compilers will require slight modifications from the code shown, and some will not require line numbers. The example is fully compatible with BASICA, GWBASIC and Microsoft QuickBasic.

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7.1 Example. BAS

A simple but complete program to display energy readings on the computer screen. It essentially follows the principle explained in paragraph 6.3 above.

```
100 OPEN "COM1: 9600,N,8,2,RS,CS,DS" FOR RANDOM AS #1
110 CLS: PRINT "Energy readings follow: Press any key to quit"
120 WHILE 1
130    NEWDATA = 0
140    WHILE NEWDATA = 0 AND DONE = 0
150       PRINT #1, "$EF"                                  ' Request energy flag
160       LINE INPUT #1, REPLY$
170       NEWDATA = VAL (RIGHT$(REPLY$, 1))                ' Remove asterisk
180       IF INKEY$<>"" THEN CLOSE: END                    ' Check keyboard
190    WEND
200    PRINT #1, "$SE"                                     ' Request energy data
210    LINE INPUT #1, VALUE$
220    ENERGY = VAL(RIGHT$(VALUE$, LEN(VALUE$) - 1))       ' Remove asterisk
230    PRINT "Time = "; TIME$, "Energy ="; ENERGY
240 WEND
```

This program uses BASIC's LINE INPUT command to read all data coming into the RS232 port until a carriage return is received. When compiling code in other languages, it is important to ensure that a similar input routine is used, i.e. a routine which awaits the arrival of the carriage return.

The source code of the utility program DGX232T is provided on the diskette. If you have a Microsoft QuickBasic 4.x compiler you can edit this code to suit you needs.

When writing larger programs for data collection, especially those which must run unattended, it becomes important to recover from errors ocurring in communications. For example if the DGX instrument is switched off when EXAMPLE.BAS above is run, the program will wait indefinitely for a reply. Most high level languages provide means for experienced programmers to write programs which can recover from almost any kind of communications problem. See the source code of the utility program for an example of a routine (called send232) which can recover from the situation just described.

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There is, of course, no need to write your own communications routines: many third party software houses offer "communications tools" which provide advanced and tested communications routines for the various high level languages.
Logitech MODULA–2 comes complete with such a package. For programmers using C or Pascal, Blaise Computing Inc (Berkeley CA USA) can provide very extensive support packages.

7.2 Sample Flow Diagrams

The following are flow charts for automatically firing laser pulses when the DGX is ready and recordins the measured energies.

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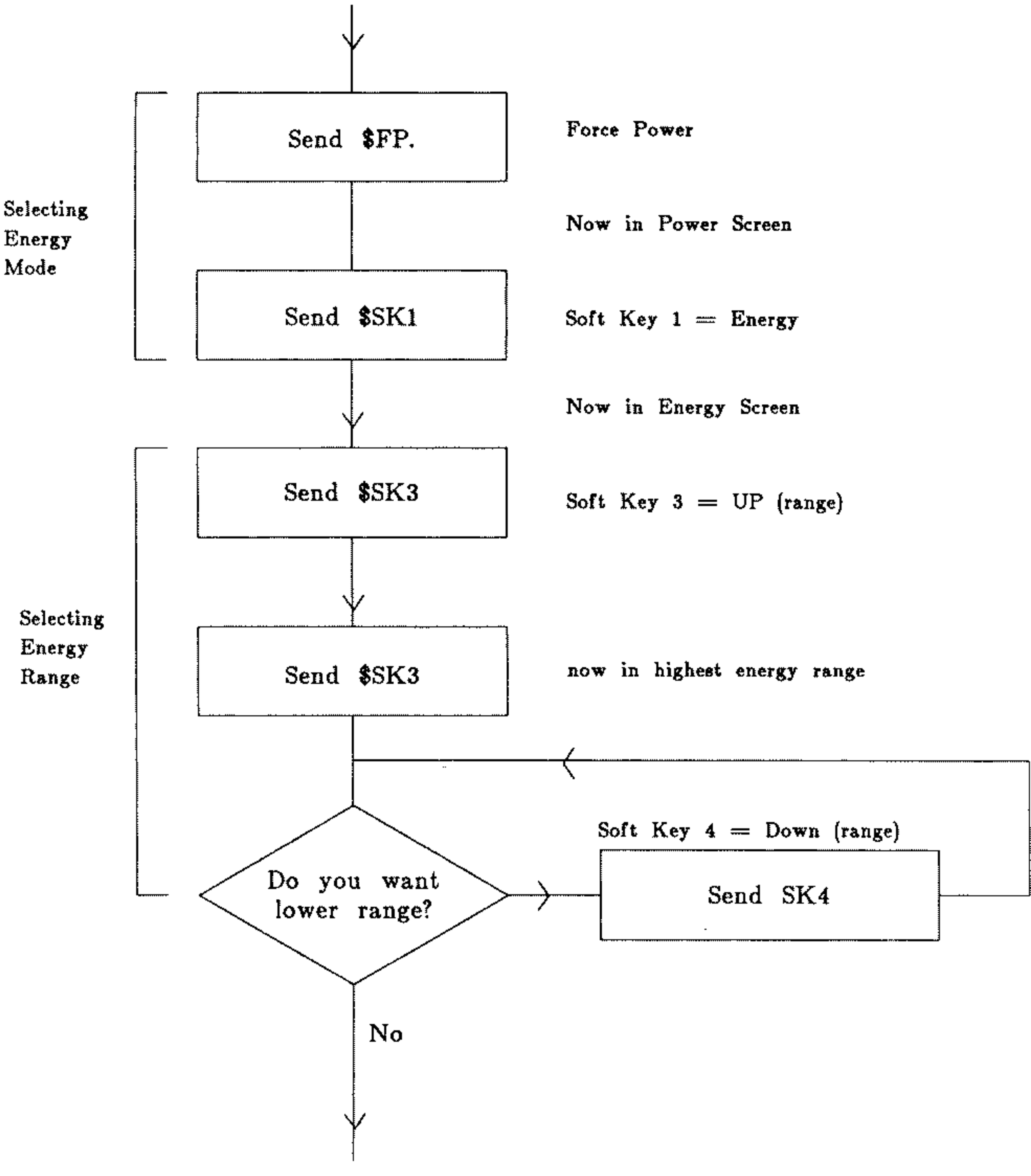
FLOW CHART 1

Measuring Several Energy Pulses

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FLOW CHART 2

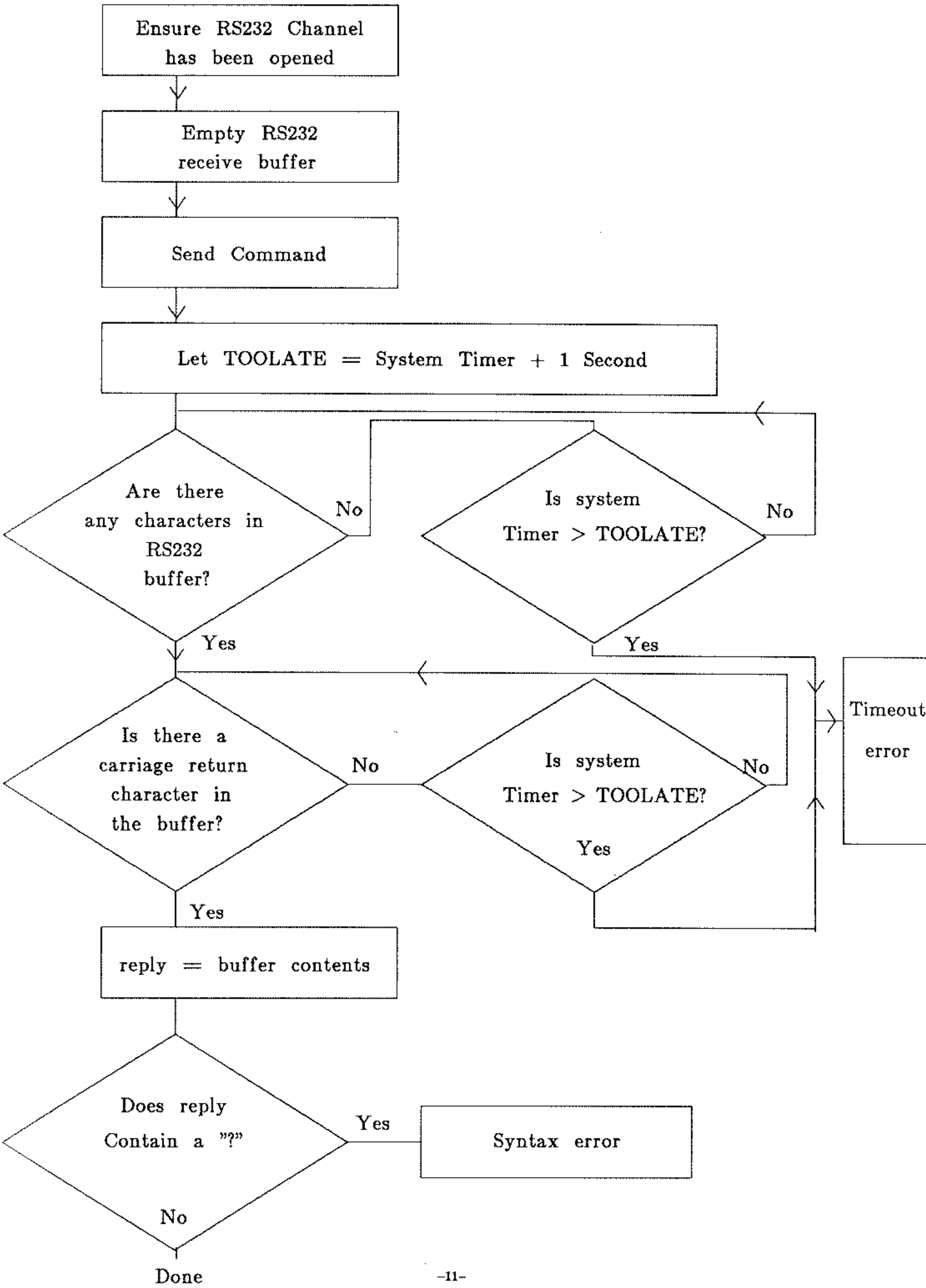
Initialising Energy



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FLOW CHART 3 - Low leval structure

Sending an RS232 instruction with timeout and error handling



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