

DISCLAIMER FOR COMMUNICATION INTERFACES

Fluke provides communications interfaces (“as provided in the relevant communications interface document”) for development and use by its customers (“Users”) for their own use and within User’s controlled environment. Fluke uses and has verified the functionality of these communications interfaces in accordance with its own in-house performance standards using accepted test procedures.

Except for liability which cannot be excluded by law, Fluke shall have no responsibility for User’s development or use of these communications interfaces nor for any loss, corruption or limitation of access to the communications interfaces. Fluke is not responsible for any trouble shooting nor is it responsible for any damages incurred to any device used for testing (whether a Fluke device or third-party device), the equipment being tested or any person. Fluke will not be responsible for any injuries sustained due to unauthorized equipment modifications.

These communications interfaces are provided to User as-is and provided without warranty of any kind, whether statutory, written, oral, express or implied (including any warranties of merchantability or fitness for a particular purpose or any warranties arising from course of dealing or usage of trade). Fluke does not warrant that the communications interfaces will be delivered free of any interruptions, delays, omissions or errors or in a secure manner or that any faults or trouble shooting will be corrected.

Follow any other instructions in the relevant communications interface document and do not touch the Fluke device while deploying the communications interfaces as this may result in electrical shock hazards or improper operation.

No responsibility is assumed by Fluke for the use or reliability of communications interfaces that are not supplied by Fluke.

FLUKE Biomedical ProSim 8 Communications Interface

Revision 3.17 05/02/2018

INTRODUCTION

This document specifies the communications interface for the ProSim 8 patient simulator.

The ProSim 8 can be controlled remotely by sending it commands receiving responses, including test data.

ProSim 8 has a USB Device Port (peripheral) that can be connected to a computer (PC). This port can be configured to look like a COM port to the PC or to look like a regular USB Device.

ProSim 8 also has a wireless interface compatible with IEEE 802.15.4.

USB INTERFACE

USB CABLE CONNECTION

The ProSim 8 USB Device Port (peripheral) has a Mini Type B connector. It connects to a PC USB Controller Port that has a Type A rectangular connector.

Connect the ProSim 8 to your PC with the USB Type A to Mini Type B cable supplied.

OPERATING SYSTEM REQUIREMENT

Fluke supports connecting the ProSim 8 to a PC running Windows XP, Vista, Windows7, or a later version.

WINDOWS SOFTWARE DRIVER

The ProSim 8 USB port is built from an integrated circuit (IC) device that is commonly used inside adapter cables that convert USB to RS232. When this device is connected to a PC it looks like a COM port to the PC. When Windows enumerates the device it assigns a COM port number to it. It is called a virtual COM port (VCP).

The IC is an FT232R from the FTDI company. It is compatible with the USB Version 2.0 Full Speed specification.

Versions of Windows XP, Vista, Windows7, and later, include a software driver for FTDI USB Serial Converters, including the FT232R. The USB ID numbers are: VID 0403 and PID 6001.

When you connect the ProSim 8 to your PC for the first time, Windows should recognize and register your ProSim 8 as a USB Serial Converter and USB Serial Port (COMx).

The ProSim 8 can be controlled as a virtual COM port or from the FTDI D2XX Direct Interface API. Typically, single users typing commands in a terminal emulation program would use the COM interface. Users writing their own programs might prefer D2XX.

The Fluke Ansur program uses D2XX to communicate with ProSim 8.

If you are only using Ansur you do not need the virtual COM port. You can turn it off in Device Manager.

VIRTUAL COM PORT

When using the virtual COM port, USB port resides inside the ProSim 8, but the PC acts like it now has an additional COM port and that COM port is connected to an RS232 serially controlled instrument.

D2XX INTERFACE

When using the D2XX exclusively, such as when only using the Ansur program to communicate with ProSim 8, you can turn off the virtual COM port in Device Manager.

DEVICE MANAGER

The ProSim 8 is configured to enable COM port enumeration unless turned off in device manager.

Run Device Manager to check the status of the ProSim 8 COM port. When viewing by Type, your ProSim 8 shows up in two places:

- Universal Serial Bus controllers / USB Serial Converter.
- Ports (COM & LPT) / USB Serial Port (COMx).

If you view by Connection, the ProSim 8 will be under one of the USB Root Hubs as:

- USB Serial Converter / USB Serial Port (COMx).

If Device Manager only lists the USB Serial Converter but not the COM port it could be that the Virtual COM Port driver is not enabled. Open USB Serial Converter Properties and go to Advanced. Check the Load VCP box if it is not already checked and press OK. Then the COM port should show up.

You can change the COM port number assigned by Windows in Device Manager. Open the Properties for the USB Serial Port (COMx), go to Port Settings and press Advanced. Select the desired COM Port Number from the dropdown list box and press OK. To get the device list to show the new COM port number perform a Scan for hardware changes.

If Device Manager says that a COM port number is in use, it may be from another USB device that is no longer being used. You can click through the error message and force it to the number you want.

If you unplug your ProSim 8, you can still see it in Device Manager by selecting View / Show hidden devices. It will be shown grayed out.

If you do not want a COM port enumerated, open USB Serial Converter Properties and go to Advanced. Uncheck the Load VCP box and press OK. Then you can go to any COM ports already enumerated for ProSim 8 and delete them.

ADVANCED USERS

Advanced users can get more information about the FT232R from the FTDI web site: www.ftdichip.com. You can get new software drivers, application notes, and USB utilities. You can learn how to view your USB connections and load and/or delete all FTDI drivers from your PC. You can get drivers for other operating systems. You can learn how to use the D2XX direct interface API to include in your own custom interface programs if you don't want to use a COM port.

COM PORT SETTINGS

Settings for the COM port should be made by the program that opens and uses the COM port such as a terminal emulation program (HyperTerminal, Tera Term or other). The settings in Device Manager are usually irrelevant because they are overridden by the controlling program.

The COM port should be set to:

- 115,200 baud
- No parity
- 8 data bits
- 1 stop bit
- Hardware handshaking should be turned on.

HANDSHAKING

ProSim 8 uses hardware handshaking.

ProSim 8 does not use XON/XOFF software handshaking.

WIRELESS INTERFACE

A wireless interface is included on the ProSim 8. It is compatible with IEEE 802.15.4. A PC with a compatible wireless interface can control ProSim 8 using the same command protocol as the USB interface.

The ProSim 8 detects that the wireless interface is installed. The ProSim 8's wireless module is configured on a fixed channel (12) and fixed PANID (0x0FBC). 16 bit addressing is disabled. All communication must use 64 bit addresses.

The ProSim 8 wireless interface does not enumerate directly on a PC as a COM port. Therefore, the PC must use the API of its interface to communicate.

PC interface to ProSim 8's wireless interface is designed to work with Digi XStick 802.15.4. Configure the XStick module to the same channel (12) and PANID (0x0FBC) as ProSim 8. Current design allows for only 1:1 communication, the XStick should be configured as an End Device, not a coordinator.

ProSim 8 devices can be found using the Node Discover (ND) command. ProSim 8's serial number (test units may have nickname strings, instead) will be broadcast in response to the ND command, along with its 64-bit address and signal strength level.

ProSim 8 devices can be paired to by setting the destination (DH and DL) registers to the address of the ProSim 8. Then send the ProSim 8 the command:

PAIR= <i>High, Low</i>	Pairs wireless interface.
<i>High</i>	ASCII hexadecimal address of PC dongle's destination high DH register
<i>Low</i>	ASCII hexadecimal address of PC dongle's destination low DL register

Note: Pairing may take up to 3 attempts to return success ("**"). Typical timeout for pairing is 10 seconds, with multiple retries it could be shortened to 5 seconds.

Once paired, a ProSim 8 can be unpaired by sending the command:

UNPAIR	Unpairs wireless interface.
---------------	-----------------------------

COMMAND PROTOCOL

COMMANDS

Commands are made up of alphanumeric characters. The first character must be alphabetic. Alphabetic characters may be sent in upper or lower case.

Some commands are designed to pass from the ProSim 8 directly to the plugged in SpO2 or other Auxiliary device. These commands are prefixed with @. Then the command, with the @ removed is passed through to the Auxiliary port.

Special characters are:

Name	Abbreviation	Hex Value
Carriage Return	CR	0D
Line Feed	LF	0A
Space	SP	20
Backspace	BS	08
Escape	ESC	1B
Start text	STX	02
End text	ETX	03
Acknowledge	ACK	06
Negative acknowledge	NAK	15

- Commands must be terminated by **CR** or **LF** or both.
- **SP** characters are ignored.
- **BS** erases the last character from the command.
- **ESC** erases all characters from the command.

- Some commands require one or more parameters to be sent with them. Where a command needs parameters, the command is followed by an equal sign and the parameters. Multiple parameters are separated by commas.
- In the command specification, parameters are given names in *lower case italics* which are place holders for the actual parameter to be sent with the command.
- For numeric parameters where the number of digits is specified, the format is fixed. Digits and decimal point must be as indicated.
- Signed numeric parameters must include polarity sign: + or –.
- Boolean parameters are **TRUE** or **FALSE** or can be shortened to **T** or **F**.

COMMAND RESPONSES

After receiving a command, the ProSim 8 will not store or respond to additional received characters until it has executed the command and responded to it.

The ProSim 8 always responds to a command after it has executed it, by returning a response, terminated by **CR** and **LF**.

The standard command response is "*", unless other data is to be returned. "*" indicates that the command was understood and executed.

Incorrect commands return the following error coded messages.

Error Coded Message	Description
!	Command empty, no characters
!01 Unknown command	Command not recognized
!02 Illegal command	Command not legal for current mode or flag state
!03 Illegal parameter	Parameter not legal for command
!04 Buffer overflow	Command too long for buffer
!21 Memory error	ProSim 8 memory error
!22 Can't zero pressure	Pressure measurement zero factor out of range of ±10.00 mmHg.
!27 Aux/SpO2 Communication Error	Error trying to communicate with Aux/SpO2 module.

CONTROL STATES AND MODES

LOCAL CONTROL MODE

The ProSim 8 powers up initially under Local control by user keys.

REMOTE CONTROL MODE(S)

In Remote control, the ProSim 8 accepts commands and executes them. The user interface is disabled. Some commands are only legal in certain modes. The modes are listed in the table:

Mode Mnemonic	Type	Description
LOCAL	Local	Local control.
RMAIN	Main	Main Remote control mode

The **LOCAL** command brings the ProSim 8 back to local control. Also, a key press is available to return to Local control.

COMMAND SPECIFICATIONS

Unless specified otherwise:

- Commands return *.

GENERAL COMMANDS

IDENT	Ask for the instrument identification and firmware version.
Legal modes:	All modes
Returns:	Model number: PROSIM8 , followed by comma, followed by firmware version number, including build: ex. " PROSIM8 , 1 . 00 . 06 "

SN	Ask for the serial number.
Returns:	The serial number: 7 digits.

LOCAL	Go to Local control mode.
Legal modes:	RMAIN
Returns:	LOCAL.

REMOTE	Go to Remote control RMAIN mode.
Legal modes:	LOCAL
Returns:	RMAIN.

QMODE	Query the mode.
Legal modes:	All modes
Returns:	The Remote mode mnemonic per table above.

QBAT	Query the battery level of charge.
Returns:	Battery charge level in percentage of remaining capacity, 3 digits.

RESET	Reset the instrument.
Returns:	Does not return *, once reset the normal power on response is sent.

ECG SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

ECGRUN=on	Turn on/off running Ecg wave.
<i>on</i>	Boolean: TRUE runs Ecg wave, FALSE turns off.

NSRA=rate	Set Ecg wave to Normal Sinus Rhythm Adult, at a rate.
<i>rate</i>	Ecg rate in bpm: 3 digits: 010 to 360.

NSRP=rate	Set Ecg wave to Normal Sinus Rhythm Pediatric, at a rate.
<i>rate</i>	Ecg rate in bpm: 3 digits: 010 to 360.

NSRAX=axis	Set Ecg axis for Normal Sinus Rhythm.
<i>axis</i>	INT Intermediate HOR Horizontal VER Vertical

STDEV=dev	Set ST Deviation for Normal Sinus Rhythm, adult only.
<i>dev</i>	Deviation in mV: Signed 2 digits w/dp: ±0.00 ±0.05 ±0.10 to ±0.80 [by .10]
ECGAMPL=ampl	Set Ecg amplitude.
<i>ampl</i>	Amplitude in mV: 3 digits w/dp: 0.05 to 0.45 [by 0.05] 0.50 to 5.00 [by 0.25]
EART=artifact	Set Ecg Artifact.
<i>artifact</i>	OFF Off 50 50 Hz Sine 60 60 Hz Sine MSC Muscular WAND Wandering Baseline RESP Respiration
EARTSZ=size	Set Ecg artifact size in percent.
<i>size</i>	Size in %: 3 digits: 025, 050, or 100.
EARTLD=lead	Set Ecg artifact lead.
<i>lead</i>	ALL for All leads or for one individual lead: RA, LL, LA, V1, V2, V3, V4, V5, or V6.
SPVWAVE=wave	Set Ecg wave to a Supraventricular arrhythmia.
<i>wave</i>	AFL Atrial Flutter SNA Sinus Arrhythmia MB80 Missed Beat at 80 bpm MB120 Missed Beat at 120 bpm ATC Atrial Tachycardia PAT Paroxysmal Atrial Tachycardia NOD Nodal Rhythm SVT Supraventricular Tachycardia
PREWAVE=wave	Set Ecg wave to a Premature arrhythmia.
<i>wave</i>	PAC Premature Atrial Contraction PNC Premature Nodal Contraction PVC1 Premature Ventricular Contraction, Left, Standard PVC1E PVC 1, Left, Early PVC1R PVC 1, Left, R on T PVC2 PVC 2, Right, Standard PVC2E PVC 2, Right, Early PVC2R PVC 2, Right, R on T MF Multi-focal PVCs

VNTWAVE= <i>wave</i>	Set Ecg wave to a Ventricular arrhythmia.
<i>wave</i>	PVC6M PVCs 6 per minute PVC12M PVCs 12 per minute PVC24M PVCs 24 per minute FMF Frequent Multi-focal PVCs TRIG Trigeminy BIG Bigeminy PAIR Pair of PVCs RUN5 Run of 5 PVCs RUN11 Run of 11 PVCs ASYS Asystole

CNDWAVE= <i>wave</i>	Set Ecg wave to a Conduction arrhythmia.
<i>wave</i>	1DB 1st Degree Block 2DB1 2nd Degree Block Type I Wenckebach 2DB2 2nd Degree Block Type II 3DB 3rd Degree Block RBBB Right Bundle Branch Block LBBB Left Bundle Branch Block

TVPPOL= <i>chamber, polarity</i>	Set the Pacer pulse polarity for TV Paced waves.
<i>chamber</i>	Heart chamber: A for atrium or V for Ventricle.
<i>polarity</i>	Pacer amplitude: P for positive, N for negative.

TVPAMPL= <i>chamber, ampl</i>	Set the Pacer pulse amplitude for TV Paced waves.
<i>chamber</i>	Heart chamber: A for atrium or V for Ventricle.
<i>ampl</i>	Pacer amplitude in mV: 3 digits: 000, 002, 004, 006, 008, 010, 012, 014, 016, 018, 020, 050, 100, 200, 500, or 700.

TVPWID= <i>chamber, width</i>	Set the Pacer pulse width for TV Paced waves.
<i>chamber</i>	Heart chamber: A for atrium or V for Ventricle.
<i>width</i>	Pacer width: 2 digits w/dp: 0.1, 0.2, 0.5, 1.0, or 2.0.

TVPWAVE= <i>wave</i>	Set Ecg wave to a TV Paced arrhythmia.
<i>wave</i>	ATR Atrial ASY Asynchronous DFS Demand Frequent Sinus DOS Demand Occasional Sinus AVS Atrio-ventricular Sequential NCP Non-Capture NFN Non-Function

ACLSWAVE= <i>wave</i>	Set Ecg wave to an ACLS arrhythmia.
<i>wave</i>	SBC Sinus Bradycardia PTU Poly VTach Unstable MTU Mono VTach Unstable NSI Narrow QRS Tach Sinus

	NSV Narrow QRS Tach SVT WSI Wide QRS Tach Sinus WSV Wide QRS Tach SVT TDP Torsade de Pointes
AFIB=granularity	Set Ecg wave to Atrial Fibrillation 1. This is the new afib with increased randomness.
<i>granularity</i>	COARSE or FINE .
AFIB2=granularity	Set Ecg wave to Atrial Fibrillation 2. This is the original afib that is not as random as the new one.
<i>granularity</i>	COARSE or FINE .
VFIB=granularity	Set Ecg wave to Ventricular Fibrillation. This is the original vfib, same as VFIB1 .
<i>granularity</i>	COARSE or FINE .
VFIB1=granularity	Set Ecg wave to Ventricular Fibrillation. This is also the original vfib, same as VFIB .
<i>granularity</i>	COARSE or FINE .
VFIB2=granularity	Set Ecg wave to Ventricular Fibrillation. This is the new vfib that is 50% faster.
<i>granularity</i>	COARSE or FINE .
MONOVTACH=rate	Set Ecg wave to Monophasic Ventricular Tachycardia at rate.
<i>rate</i>	Ecg rate to run in bpm: 3 digits: 120 to 300.
POLYVTACH=type	Set Ecg wave to Polyphasic Ventricular Tachycardia
<i>type</i>	Type of Poly VTach: 1 digit: 1 to 5.
PULSE=rate	Set Ecg wave to Pulse
<i>rate</i>	Rate in bpm: 30, 60, or 80.
SQUARE=freq	Set Ecg wave to Square
<i>freq</i>	Frequency in Hz: 0.125, 2.0, or 2.5.
SINE=freq	Set Ecg wave to Sine.
<i>freq</i>	Frequency in Hz: 0.05, 0.5, 1, 2, 5, 10, 25, 30, 40, 50, 60, 100, or 150.
TRI=freq	Set Ecg wave to Triangle.
<i>freq</i>	Frequency in Hz: 0.125, 2.0, or 2.5.
RDET=width,rate	Set Ecg wave to R Wave Detection at width and rate.
<i>width</i>	Width in ms: 3 digits: 008 to 200.
<i>rate</i>	Rate in bpm: 30, 60, 80, 120, 200, or 250.

QRS=width,rate	Set Ecg wave to QRS Detection at width and rate.
<i>width</i>	Width in ms: 3 digits: 008 to 200.
<i>rate</i>	Rate in bpm: 30, 60, 80, 120, 200, or 250.

TALLT=percent	Set Ecg wave to Tall T Rejection.
<i>percent</i>	T wave height in percent of R wave: 3 digits: 000 to 150 [by 010].

EHA FIBS	Set Ecg wave to Special Hartwell Atrial Fib Slow 80 +/- 20 bpm
-----------------	---

EHA FIBF	Set Ecg wave to Special Hartwell Atrial Fib Fast 130 +/- 20 bpm
-----------------	--

EHA FL43	Set Ecg wave to Special Hartwell Atrial Flutter 43 bpm 7 P waves
-----------------	---

EHA FL50	Set Ecg wave to Special Hartwell Atrial Flutter 50 bpm 6 P waves
-----------------	---

EHA FL60	Set Ecg wave to Special Hartwell Atrial Flutter 60 bpm 5 P waves
-----------------	---

EHA FL75	Set Ecg wave to Special Hartwell Atrial Flutter 75 bpm 4 P waves
-----------------	---

EHA FL100	Set Ecg wave to Special Hartwell Atrial Flutter 100 bpm 3 P waves
------------------	--

EHA FL150	Set Ecg wave to Special Hartwell Atrial Flutter 150 bpm 2 P waves
------------------	--

RESPIRATION SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

RES PRUN=on	Turn on/off running Respiration wave.
<i>on</i>	Boolean: TRUE runs Respiration wave, FALSE turns off.

RES P WAVE=wave	Set Respiration wave.
<i>wave</i>	NORM Normal VENT Ventilated

RES PRATE=rate	Set Respiration rate.
<i>rate</i>	Respiration rate in brpm: 3 digits: 010 to 150.

RES PRATIO=ratio	Set Respiration ratio.
<i>ratio</i>	Respiration ratio: 1 digit: 1 to 5.

RESPAMPL= <i>ampl</i>	Set Respiration amplitude.
<i>ampl</i>	Amplitude: 3 digits w/dp: 0.00 to 5.00 [by 0.05].
RESPBASE= <i>base</i>	Set the respiration baseline impedance.
<i>base</i>	Respiration baseline impedance in ohms: 4 digits: 0500, 1000, 1500, or 2000.
RESPLEAD= <i>lead</i>	Set the respiration lead impedance.
<i>lead</i>	Respiration lead: LA or LL .
RESPAPNEA= <i>on</i>	Set Respiration apnea.
<i>on</i>	Boolean: TRUE turns on apnea, FALSE turns off.

INVASIVE BLOOD PRESSURE (IBP) SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

IBPS= <i>channel, Pressure</i>	Set an IBP channel to a static pressure.
<i>channel</i>	IBP channel: 1 or 2.
<i>pressure</i>	Signed static pressure: 3 digits: -010 to +300.

IBPW= <i>channel, wave</i>	Set an IBP channel to a dynamic wave.
<i>channel</i>	IBP channel: 1 or 2.
<i>wave</i>	ART Arterial RART Radial Artery LV Left Ventricle LA Left Atrium RV Right Ventricle PA Pulmonary Artery PAW PA Wedge RA Right Atrium (CVP)

IBPP= <i>channel, syst, diast</i>	Set an IBP channel to a dynamic pressure.
<i>channel</i>	IBP channel: 1 or 2.
<i>syst</i>	Systolic pressure: unsigned 3 digits: 000 to 300.
<i>diast</i>	Diastolic pressure: unsigned 3 digits: 000 to 300.

IBPARTP= <i>channel, Artifact</i>	Set an IBP channel's artifact by percent. Valid for Arterial, Radial Artery and Left Ventricle.
<i>channel</i>	IBP channel: 1 or 2.
<i>artifact</i>	Artifact percentage: 0, 5, or 10 (0 is off).

IBPARTM= <i>channel, Artifact</i>	Set an IBP channel's artifact by mmHg. Valid for Left Atrium, Right Ventricle, Pulmonary Artery, PA Wedge, Right Atrium (CVP).
<i>channel</i>	IBP channel: 1 or 2.
<i>artifact</i>	Artifact in mmHg: 0, 5, or 10 (0 is off).

IBPSNS=channel, <i>Sensitivity</i>	Set IBP circuit sensitivity in $\mu\text{V}/\text{V}/\text{mmHg}$.
<i>channel</i>	IBP channel: 1 or 2.
<i>sensitivity</i>	Sensitivity: 40 or 5.

TEMPERATURE SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

TEMP=degrees	Set the temperature.
<i>degrees</i>	Temperature in degrees C: 3 digits w/dp: 30 . 0 to 42 . 0 [by 00 . 5].

CARDIAC OUTPUT SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

COBASE=base	Set Cardiac Output baseline temperature.
<i>base</i>	Baseline temperature in degrees C: 2 digits: 36 to 38 [by 01].

COINJ=inj	Set Cardiac Output injectate temperature.
<i>inj</i>	Injectate temperature in degrees C: 2 digits: 00 or 24.

COWAVE=wave	Set Cardiac Output wave.												
<i>wave</i>	<table border="0"> <tr> <td>2.5</td> <td>2.5 l/min</td> </tr> <tr> <td>5</td> <td>5 l/min</td> </tr> <tr> <td>10</td> <td>10 l/min</td> </tr> <tr> <td>FAULTY</td> <td>Faulty Injectate</td> </tr> <tr> <td>LRSHUNT</td> <td>Left/Right Shunt</td> </tr> <tr> <td>CAL</td> <td>Calibrated Pulse</td> </tr> </table>	2.5	2.5 l/min	5	5 l/min	10	10 l/min	FAULTY	Faulty Injectate	LRSHUNT	Left/Right Shunt	CAL	Calibrated Pulse
2.5	2.5 l/min												
5	5 l/min												
10	10 l/min												
FAULTY	Faulty Injectate												
LRSHUNT	Left/Right Shunt												
CAL	Calibrated Pulse												

CORUN=on	Runs the Cardiac Output wave.				
<i>on</i>	<table border="0"> <tr> <td>TRUE</td> <td>Turns on running wave. When the wave is finished, it will turn itself off.</td> </tr> <tr> <td>FALSE</td> <td>Turns off a wave if running.</td> </tr> </table>	TRUE	Turns on running wave. When the wave is finished, it will turn itself off.	FALSE	Turns off a wave if running.
TRUE	Turns on running wave. When the wave is finished, it will turn itself off.				
FALSE	Turns off a wave if running.				

NON-INVASIVE BLOOD PRESSURE (NIBP) SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

NIBPRUN=on	Turns on/off the NIBP simulation.
<i>on</i>	Boolean: TRUE runs NIBP simulation, FALSE turns off.

NIBPP=syst,diast	Set the NIBP dynamic pressure.
<i>syst</i>	Systolic pressure: unsigned 3 digits: 000 to 400.
<i>diast</i>	Diastolic pressure: unsigned 3 digits: 000 to 400.

NIBPV=volume	Set the NIBP volume.
<i>volume</i>	Volume in mL: 3 digits w/dp: 0 . 10 to 1 . 25 [by 0 . 05].

NIBPES=shift	Set the NIBP envelope shift.
<i>shift</i>	Envelope shift percentage: 2 digits signed: -10 to +10.

ZPRESS	Zero the pressure measurement sensor to improve the accuracy of the pressure measurement used for all NIBP functions. This command assumes that the ProSim pressure connection is open to the ambient air. Zeroing the pressure when there any pressure in the system other than ambient will result in a subsequent measurement error. The zero factor is saved in non-volatile memory.
Returns:	The pressure zero factor reading with 0.01 mmHg resolution: 3 digits, signed w/dp. Except if the zero factor is outside of the range ± 10.00 mmHg, returns: !22 Can't zero pressure.

UZPRESS	Asks for the pressure zero factor.
Returns:	The pressure zero factor reading with 0.01 mmHg resolution: 3 digits, signed w/dp.

CZPRESS	Clear the pressure zero factor. The zero factor is saved in non-volatile memory.
----------------	--

NIBP MEASUREMENT AND CONTROL COMMANDS

Legal in **RMAIN** Remote mode:

Note: pressures and leak rate returned during leak test or pop off test are with 0.1 resolution, signed, 4 digits w/dp.

NIBPLEAK= <i>target, time</i>	Start an NIBP Leak Test.
<i>target</i>	Target pressure: unsigned 3 digits: 015 to 400.
<i>time</i>	Time in seconds: unsigned 3 digits: 000 to 300.

LKOFF	Turn off a currently running Leak Test.
--------------	---

LKSTAT	Asks for the status of the currently running or the most recent Leak Test.
Returns:	<p>Status:</p> <p>NONE Leak test not on</p> <p>SOURCING Pumping up to source pressure</p> <p>SETTLING Letting pressure settle for 15 seconds prior to test</p> <p>ON: startpressure, time Leak test running, having started at the startpressure in mmHg, with time remaining in seconds: 3 digits.</p> <p>DONE: startpressure, endpressure, time, leakrate Leak test done with results: startpressure and endpressure in mmHg, time in seconds, 3 digits, leakrate in mmHg/minute.</p>

NIBPPOP= <i>target</i>	Start an NIBP Pressure Relief Test
<i>target</i>	Target pressure: unsigned 3 digits: 100 to 400.

POPOFF	Turn off a currently running Pressure Relief Test
---------------	---

POPSTAT	Asks for the status of the currently running or the most recent Pressure Relief test.
Returns:	<p>Status:</p> <p>NONE Pressure relief test not on</p> <p>SOURCING Pressure relief test running, pumping up.</p> <p>DONE: maxpressure, result</p> <p>Pressure relief test done with results: maxpressure in mmHg, result message:</p> <p>TRIPPED Pressure relief tripped successfully</p> <p>UNTRIPPED Pressure relief did not trip (target pressure reached)</p> <p>FAILED Test timed out, couldn't pump up pressure</p>
PST= <i>pressure</i>	Sets the target for the Pressure Source
<i>pressure</i>	Target pressure: unsigned 3 digits: 015 to 400.
PS= <i>on</i>	Turns on/off the Pressure Source.
<i>on</i>	Boolean: TRUE turns on, FALSE turns off.
PRESS	Asks for the pressure measurement.
Returns:	The NIBP system pressure in mmHg: 3 digits, signed.
PRESSX	Asks for the pressure measurement.
Returns:	The NIBP system pressure in mmHg with 0.1 mmHg resolution: 4 digits, signed, w/dp.
ZPRESS	Zero the pressure measurement sensor to improve the accuracy of the pressure measurement used for all NIBP functions. This command assumes that the ProSim pressure connection is open to the ambient air. Zeroing the pressure when there any pressure in the system other than ambient will result in a subsequent measurement error. The zero factor is saved in non-volatile memory.
Returns:	The pressure zero factor reading with 0.01 mmHg resolution: 3 digits, signed w/dp.
UZPRESS	Asks for the pressure zero factor.
Returns:	The pressure zero factor reading with 0.01 mmHg resolution: 3 digits, signed w/dp.
CZPRESS	Clear the pressure zero factor. The zero factor is saved in non-volatile memory.

SpO2 SIMULATION COMMANDS

Legal in **RMAIN** Remote mode:

SAT= <i>saturation</i>	Sets SpO2 saturation percentage.
<i>saturation</i>	Unsigned 3 digits: 000 to 100.
PERF= <i>perfusion</i>	Sets SpO2 perfusion, the pulse amplitude in percent.
<i>perfusion</i>	2 digits w/dp: 00.01 to 20.00 [by 0.01].

TRANS=ppm	Sets SpO2 transmission in PPM.
<i>ppm</i>	3 digits w/dp: 000.01 to 300.00 [by 0.01]. Dark, Thick Finger is 030.00 Medium Finger is 060.00 Light, Thin Finger is 090.00 Infant Foot is 098.00

Ambient Light

These commands set the amount of ambient light simulated, enabled/disabled by **AMBM=ON/OFF**. Levels that correspond to User Interface settings are:

Sunlight **AMBS=2.0** **AMBF=DC**
 Indoor **AMBS=0.2** **AMBF=frequency**

AMBM=mode	Sets SpO2 ambient mode
<i>mode</i>	ON Turns on SpO2 ambient simulation, OFF turns it off.

AMBS=size	Sets SpO2 ambient size, the relative amplitude of ambient light.
<i>size</i>	0.2 or 2.0 User Interface settings are 0.2 for indoor, 2.0 for sunlight

AMBF=size	Sets SpO2 ambient frequency
<i>size</i>	DC 50Hz 60Hz 1KHz 2KHz 3KHz 4KHz 5KHz 6KHz 7KHz 8KHz 9KHz 10KHz User Interface uses DC setting for sunlight.

RESPM=mode	Sets SpO2 respiration mode
<i>mode</i>	ON Turns on SpO2 respiration simulation, OFF turns it off.

RESPS=size	Sets SpO2 respiration size.
<i>size</i>	Unsigned 1 digit: 0 to 5. (%) Size is 5% in UI, default to this setting.

SPO2TYPE=type	Sets SpO2 Type (R-Curve) to a built-in type.
<i>type</i>	NELCR MASIM MASIMR NONIN OHMED PHIL NIHON MINDR BCI NONIN610XCX NONIN810XSX NONIN810XAX

SPO2UTYPE=index	Sets SpO2 Type (R-Curve) to a user loaded type.
<i>index</i>	Unsigned 2 digits: 00 to 19. Index of user loaded Type to set. Must be within range of loaded R-Curves.

QSP02TYPE	Queries the currently selected SpO2 Type (R-Curve).
Returns:	The zero based index of the selected SpO2 Type, either the built-in type or the user loaded Type: 2 digits, 00 to maximum. If a built-in Type is selected: B followed by the 2 digit index of built-in types as listed under SPO2TYPE , example B04 for NONIN . If a user loaded Type is selected: U followed by the 2 digit index of user loaded Types, example U02 .

QURCURVES	Queries the number of user R-Curves loaded.
Returns:	Number of user R-Curves loaded: 2 digits, 00 to 20.

QURCURVE=index	Queries the name of a user loaded R-Curve.
<i>index</i>	Index of the user loaded R-Curve queried: 2 digits, 00 to 19.
Returns:	Name of the user loaded R-Curve per index.

SPO2IDENT	Ask for the SpO2 instrument identification and firmware version.
Returns:	Model and firmware version

QSTAT	Ask for the SpO2 status information.
Returns:	Status code in hex Bit definitions: 0 Sensor attached 1 Self test failed (see STEST) 2 ProSim 8 update command error