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FLUKE Biomedical
ESA612/615 Communications Interface

Revision 1.2 03/12/2018

INTRODUCTION

This document specifies the communications interface for the ESA612/615 patient simulator.

The ESA612/615 can be controlled remotely by sending it commands receiving responses, including test data.

ESA612/615 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.

USB INTERFACE

USB CABLE CONNECTION

The ESA612/615 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 ESA612/615 to your PC with the USB Type A to Micro Type B cable supplied.

OPERATING SYSTEM REQUIREMENT

Fluke supports connecting the ESA612/615 to a PC running Windows 7, or later.

WINDOWS SOFTWARE DRIVER

The ESA612/615 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 7 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 Impulse to your PC for the first time, Windows should recognize and register your ESA612/615 as a USB Serial Converter and USB Serial Port (COMx).

The ESA612/615 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.

VIRTUAL COM PORT

When using the virtual COM port, the USB port resides inside the ESA612/615, but the PC acts like it now has an additional COM port and that COM port is connected to an RS232 serially controlled instrument.

DEVICE MANAGER

The ESA612/615 is configured to enable COM port enumeration unless turned off in device manager.

Run Device Manager to check the status of the ESA612/615 COM port. When viewing by Type, your ESA612/615 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 ESA612/615 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 drop down 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 ESA612/615, you can still see it in Device Manager by selecting View / Show hidden devices. It will be shown grayed out.

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

ESA612/615 uses hardware handshaking.
ESA612/615 does not use XON/XOFF software handshaking.

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.

Special characters are:

Name	Abbreviation	Hex Value
Carriage Return	**CR**	**0D**
Line Feed	**LF**	**0A**
Space	**SP**	**20**
Backspace	**BS**	**08**
Escape	**ESC**	**1B**

- Commands must be terminated by **CR**, **LF**, or both.
- **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* that are placeholders for the actual parameter to be sent with the command.
- Boolean parameters are **TRUE** or **FALSE**.

COMMAND RESPONSES

After receiving a command, the ESA612/615 will not store or respond to additional received characters until it has executed the command and responded to it.

The ESA612/615 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.

Sticky commands turn on something then stay active until turned off: On initiation, sticky commands return "*" immediately. Some sticky commands return data responses, either:

- Once, after which the command turns itself off, or
- Periodically, staying active.

An active sticky command shall turn off if the slave receives the Escape character. Then the slave returns "*" indicating the command is turned off.

CONTROL STATES AND MODES

LOCAL CONTROL MODE

ESA612/615 powers up initially under Local control by user keys.

REMOTE CONTROL MODE(S)

In Remote control, ESA612/615 accepts commands and executes them. The user interface is disabled except for a single touch that can return to Local Control Mode. Some commands are legal in other modes. The modes are listed in the table:

Mode Mnemonic	Type	Description
LOCAL	Local	Local control
REMOTE	Remote	Remote control mode

The **LOCAL** command brings the ESA612/615 back to local control.

COMMAND SPECIFICATIONS

Unless specified otherwise:

- Commands return *****.

LOCAL Mode Commands

COMMAND	PARAMETERS	DESCRIPTION
IDENT		Returns Analyzer Model, UI Firmware Version, and Meter Processor Firmware Version.
REMOTE		Puts the ESA in Remote Control Mode.
STAT		Returns UI status word.

REMOTE Mode Commands

COMMAND	PARAMETERS	DESCRIPTION
ALTEARTH	**C**	Close the Meter+ to EO GND only during Alternate Equipment Leakage function.
	O	Open the Meter+ to EO GND only during Alternate Equipment Leakage function.
AP=	**[Parts +] / [Parts -] / [Remaining Parts]**	Selects parts to connect to meter +, parts to connect to meter -, and what to connect remaining parts to. Parameters are: 1) Parts = RL, RA, LA, LL, V1, or ALL. 2) Remaining Parts = OPEN or GND. IE: a typical command example would be: "AP=RL,LL/RA,V1/GND" This would connect RL,LL to meter (+), RA,V1 to meter (-), and all other leads to GND. Possible combinations are: AP=<Parts list>//[GND or OPEN] AP=<Parts list>/<Parts list>/[GND or OPEN] AP=//[GND or OPEN] If neither GND or OPEN are selected as a third parameter, OPEN is assumed.
APINS		Select Applied Parts Insulation Test
AUX		Select Patient Aux Leakage Test.
DIFF		Select Differential Current Test.
DIRL		Select Direct Leakage Test.
DMAP		Select Direct Applied part Leakage test (uses MAP voltage)
EARTH=	**C**	Close the Ground Line to the Equipment Outlet.
	O	Open the Ground Line to the Equipment Outlet.
EARTHL		Select Earth Leakage Test.
ECG		Enters ECG Simulation Mode and connects all parts to ECG.
ENCL		Select Enclosure Leakage Test.
EQCURR		Select Equipment Current Test.
ERES= **(ERES with no params also selects 200mA current)**	**LOW**	Select Earth Resistance 200ma current.
FN		Returns current function number: 0: No function selected 1: Mains voltage 2: Equipment current 3: Earth resistance 4: Mains to earth insulation 5: Applied parts to earth insulation 6: Earth leakage 7: Enclosure leakage 8: Patient leakage 9: Patient auxiliary leakage 10: Direct equipment leakage 11: Direct applied parts leakage 12: MAP leakage 13: Alternative applied parts leakage 14: Alternative equipment leakage

		15: Differential leakage 16: Not used 17: Point to point leakage 18: Not used 19: Point to point voltage 20: Point to point resistance 21: Mains to neutral insulation 22: Applied parts to neutral insulation 23: Mains to applied parts insulation 24: Lead isolation leakage
GFI=	**5MA**	Selects Ground Fault Interrupt trip level.
	10MA	
	25MA	
GFIR		Resets Ground Fault Interrupt ATTENTION.
IDENT		Returns Analyzer Model, UI Firmware Version, and Meter Processor Firmware Version. (IE: "ESA, UI-1.00, MTR-2.01")
IDLE		Turns off all relays & asw's, clears faults & status words
INS=	**LOW**	Select 250V Insulation Voltage
	HIGH	Select 500V Insulation Voltage (default)
INSB		Select Insulation test B
INSD		Select Insulation test D
INSE		Select Insulation test E
LEAD_ISO		Selects the Lead Isolation function.
LOAD=	**601**	Selects the load for the Meter Input.
	AAMI	
	NONE	
LOCAL		Puts the ESA in Local Control Mode.
MAINS=	**L1-L2**	Measure AC, Hot to Neutral.
	L1-GND	Measure AC, Hot to GND.
	L2-GND	Measure AC, Neutral to GND.
MAP= **(MAP with no params selects MAP function)**	**LOW**	Switches to MAP Level of 100%.
	NORM	Switches to Normal Polarity MAP voltage.
	REV	Switches to Reverse Polarity MAP voltage.
	1MA	Sets maximum MAP current limit to 1 ma
	3.5MA	Sets maximum MAP current limit to 3.5 ma
	7.5MA	Sets maximum MAP current limit to 7.5 ma
MINS		Select mains Insulation Test.
MODE=	**AC**	Selects "Volts AC" measurement Mode.
	DC	Selects "Volts DC" measurement Mode.
	ACDC	Selects "Volts AC + DC" measurement Mode.
MREAD		Returns Meter Readings continuously (within every 400ms) until an Escape character is received.
NEUT=	**C**	Close the Neutral Line to the Equipment Outlet.
	O	Open the Neutral Line to the Equipment Outlet.
NOMINAL=	**ON**	Causes all leakages except Differential to be multiplied by the ratio of Nominal Mains/Actual Mains when ON.
	OFF	
	(value)	
NOMINAL?		Returns the current store value for NOMINAL.
OVR		Resets Over Voltage ATTENTION.
PAT		Select Patient Leakage Test.
POL=	**OFF**	Set AC power to the Equipment Outlet either

	N	Normal, Reversed, or Off.
	R	
PPL		Select Point to Point Leakage Test.
PPR= **(PPR with no params just selects test)**	**LOW**	Select low current Point to Point Resistance Test (200ma only).
PPV		Select Point to Point Voltage Test.
READ		Returns a single Meter Reading.
RESEND		Resends the last response to the PC
RPTIME=	**(1-5, 15, 30, 60)**	Sets EO polarity switch time 0-5 sec without saving in non-volatile memory.
RPTIMES=	**(1-5, 15, 30, 60)**	Same as above except 1-5 sec,and does save in non-volatile memory.
RSTUI		Resets the ESA.
SAF		Select Substitute Appliance Fault Leakage Test
SN		Returns ESA Serial Number (IE: 1234567).
SPAT		Select Substitute Patient Leakage Test.
STAT		Returns UI Status Word.
STAT1		returns ASCII Hex status word 1
STAT2		returns ASCII Hex status word 2
STAT3		returns ASCII Hex status word 3 and clears the ATTENTION line, if set.
STD=	**353**	Selects the standard to be used during tests. It automatically sets the load, GFI trip level, and MAP voltage and current values.
	601	
	AAMI	
	ASNZ	
ZERO		Zero the Resistance Meter.

ECG Simulation Mode Commands

ITEM	COMMAND	PARAMETERS	DESCRIPTION
1	**CPL30**		Runs ECG complex wave @ 30 bpm.
2	**CPL60**		Runs ECG complex wave @ 60 bpm.
3	**CPL120**		Runs ECG complex wave @ 120 bpm.
4	**CPL180**		Runs ECG complex wave @ 180 bpm.
5	**CPL240**		Runs ECG complex wave @ 240 bpm.
6	**EXIT**		Exits ECG Simulation Mode and disconnects all Applied Parts.
7	**IDENT**		Returns Analyzer Model, UI Firmware Version, and Meter Processor Firmware Version. (IE: “ESA, UI-1.00, MTR-2.01”)
8	**PLS30**		Runs ECG 63ms pulse @ 30 bpm.
9	**PLS60**		Runs ECG 63ms pulse @ 60 bpm.
10	**RESEND**		Resends the last response to the PC.
11	**SN**		Returns ESA Serial Number (IE: 1234567).
12	**SN10**		Runs ECG sine wave @ 10 Hz.
13	**SN40**		Runs ECG sine wave @ 40 Hz.
14	**SN50**		Runs ECG sine wave @ 50 Hz.
15	**SN60**		Runs ECG sine wave @ 60 Hz.
16	**SN100**		Runs ECG sine wave @ 100 Hz.
17	**SQ125**		Runs ECG square wave @ 0.125Hz.
18	**SQ2**		Runs ECG square wave @ 2.0Hz.
19	**STAT**		Returns a UI status word.
20	**STAT1**		returns ASCII Hex status word 1
21	**STAT2**		returns ASCII Hex status word 2
22	**STAT3**		returns ASCII Hex status word 3 and clears the ATTENTION line, if set.
23	**TR2**		Runs ECG triangle wave @ 2 Hz.
24	**VFIB**		Runs ECG Ventricular Fibrillation

SERIAL INTERFACE RETURN ERROR CODES

00	NO CMDS ALLOWED NOW
01	UNKNOWN CMD
02	ILLEGAL_CMD
03	ILLEGAL_PARAM
04	RECEIVE BUFFER OVERRUN
05	GENERAL FAILURE
06	OPTION NOT INSTALLED
21	ADC OUT OF RANGE
30	TEST PASS INDICATOR
31	TEST FAIL INDICATOR
32	NO CURRENT
33	CANNOT NULL
37	READING NOT AVAILABLE
38	LOAD DISCHARGE TIMEOUT
40	OVER TEMPERATURE
42	INITIALIZATION ERROR
50	GFI
51	OVER VOLTAGE
52	UNIT OUT OF CAL
53	MAINS OUT OF RANGE
54	OPEN GND
55	REVERSE VOLTAGE
56	POLARITY TIMER WAIT
57	ZIGBEE ERROR
58	EXTERNAL MEMORY ERROR
70	SD CARD OPER ATION FAILED

STATUS WORD DEFINITIONS

UI STATUS WORD Bit Definitions

POWER_UP	0x0001	device is in Power Up mode
LOCAL	0x0002	device is in Local mode
REMOTE	0x0004	device is in Remote mode

STATUS WORD 1 Bit Definitions

REMOTE	0x0001	device is in Remote mode
ECG	0x0008	device is in ECG mode
SPARE	0x0010	Spare
SVOLTS	0x0020	measure from 0 to 300 volts
SLEAK	0x0040	measure from 0 to 10,000 ua
SOHMS	0x0080	measure from 0 to 2 ohms @ 200 ma
SPARE	0x0100	Spare
SMEG	0x0200	measure from 0 to 100 megohms
SEQUIP	0x0400	measure from 0 to 20 amps AC
SDIFF	0x0800	measure from 0 to 10 ma AC
AC_ONLY	0x1000	measure AC only
DC_ONLY	0x2000	measure DC only
ACDC	0x4000	measure AC + DC
SPARE	0x8000	Spare

STATUS WORD 2 Bit Definitions

LDAAMI	0x0001	AAMI load selected
SPARE	0x0002	Spare
LD601	0x0004	601 Load selected
EO	0x0008	Equipment Outlet ON
SPARE	0x0010	Spare
MAPR	0x0020	MAP Reverse selected
MAPON	0x0040	MAP Voltage ON
L2OPEN	0x0080	Neutral Open
EOPEN	0x0100	Earth Open
POLR	0x0200	EO Polarity reversed
GFIL	0x0400	GFI Low selected
GFIH	0x0800	GFI High selected
INS_ON	0x1000	INSULATION VOLTAGE On
RCURON	0x2000	Resistance Current ON
MAINS0	0x4000	MAINS0-MAINS1 = mains parameter selection
MAINS1	0x8000	MAINS0-MAINS1: 00 = unused 01 = L2-GND 10 = L1-GND 11 = L1-L2#