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Impulse 6000D/7000DP ventricular fibrillation amplitudes

Application Note

Introduction

Fluke has made some changes to the Impulse 6000D/7000DP ECG amplitudes to improve customer satisfaction with the instrument. This paper describes the implications for the VFib waves.

Reference lead

The reference lead is the lead that matches the ECG Amplitude setting. For example, with a Lead II reference, at a setting of 1 mV Amplitude, Lead II is 1 mV.

All other leads will be a defined percentage of the reference lead.

Firmware change

Firmware changed from version 1.02 to 1.03.

For firmware 1.02 and earlier, Lead I was the ECG reference lead.

For firmware 1.03 and later, you can select either lead I or lead II to be the reference lead, but Lead II is the default selection. The selection is stored in non-volatile memory.

Hardware ECO (Engineering Change Order)

The defib paddle ECG amplitude is always proportional to Lead II.

Originally, the defib paddle ECG amplitude was 40 % of Lead II. The ECO changed 2 resistors in the circuit to make it equal to Lead II.

ECG amplitudes

Normal Sinus wave ECG amplitudes, as a percentage of reference lead setting:

Reference Lead	I	II	III	Defib Paddles with ECO	Defib Paddles before ECO
II	70	100	30	100	40
I	100	150	50	150	60

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Ventricular fibrillation (VFIB)

VFib is an important wave needed by Automated External Defibrillators (AEDs). It is an irregular wave that varies throughout but its overall peak to peak amplitude is proportional to a Normal Sinus wave. Fine VFib is 1/2 the amplitude of Coarse VFib:

Wave	Percentage of Normal Sinus
Vfib Coarse	85
VFib Fine	42

Therefore, the amplitude of VFib Coarse as a percentage of Reference is:

Reference Lead	I	II	III	Defib Paddles with ECO	Defib Paddles before ECO
II	60	85	25	85	34
I	85	128	42	128	51

And the amplitude of VFib Fine as percentage of Reference Lead is:

Reference Lead	I	II	III	Defib Paddles with ECO	Defib Paddles before ECO
II	30	42	12	42	17
I	42	64	21	64	26

To get an AED to recognize VFib, the user should be aware of these amplitudes.

If the amplitude is too small, the AED might not get enough signal to recognize it.

If the amplitude is too large, the AED might think the VFib transitions are beats instead of fibrillation.

The user can adjust the ECG Amplitude setting as needed to get the AED to recognize the VFib.

Viac informácií nájdete na: http://www.elso.sk/product.php?id_product=1272

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Fluke Biomedical is the world's leading manufacturer of quality biomedical test and simulation products. In addition, Fluke Biomedical provides the latest medical imaging and oncology quality-assurance solutions for regulatory compliance. Highly credentialed and equipped with a NVLAP Lab Code 200566-0 accredited laboratory, Fluke Biomedical also offers the best in quality and customer service for all your equipment calibration needs.

Today, biomedical personnel must meet the increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

Fluke Biomedical Regulatory Commitment

As a medical test device manufacturer, we recognize and follow certain quality standards and certifications when developing our products. We are ISO 9001 and ISO 13485 medical device certified and our products are:

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- NIST Traceable and Calibrated
- UL, CSA, ETL Certified, where required
- NRC Compliant, where required

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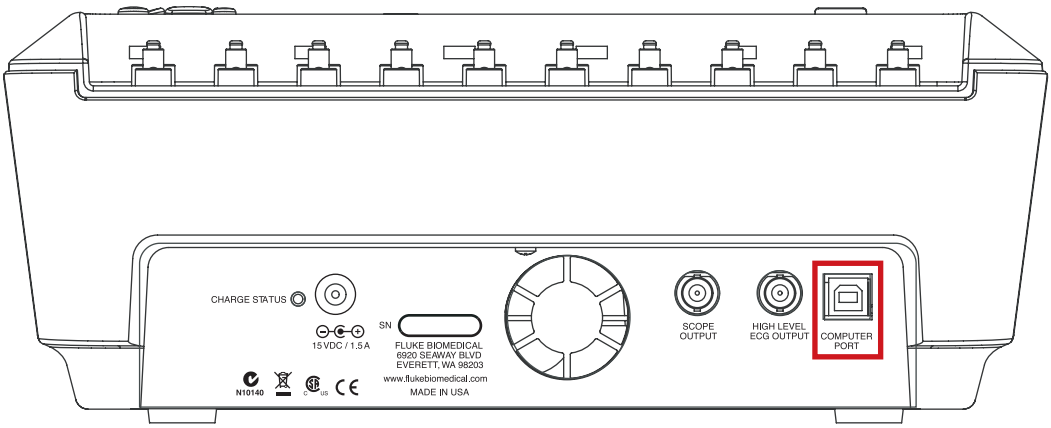
Impulse 6000D/7000DP: remote communications interface

Application Note

Introduction

The Impulse 6000D and Impulse 7000DP can be controlled remotely through a computer port: a USB Interface port that looks like a COM port to a personal computer (PC).

It is possible to control the Impulse by sending commands to it and receiving responses, including test data, through the COM port.



Operating system requirement

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

Virtual COM port

The Impulse USB port is built from an integrated circuit (IC) device that is commonly used inside adapter cables that convert USB to RS-232. 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.

The USB port may reside inside the Impulse, but the PC acts like it now has an additional COM port and that COM port is connected to an RS-232 serially controlled instrument.

Once your Impulse is connected and the COM port is enumerated, you can control it by sending remote commands to the COM port and receiving responses.

Computer cable connection

The Impulse Computer Port is a USB Device Port (peripheral) with a Type B square connector. It connects to a PC USB Controller Port that has a Type A rectangular connector.

Connect the Impulse to your PC with a standard USB Type A to Type B cable such as the one supplied with the Impulse.

Windows software driver

Versions of Windows XP, Vista, 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 Impulse as a USB Serial Converter and USB Serial Port (COMx).

Device manager

Run Device Manager to check the status of the Impulse COM port. When viewing by Type, your Impulse 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 Impulse will be under one of the USB Root Hubs as:

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

Note: 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. The COM port should then appear.

Note: 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.

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

Note: If you unplug your Impulse, you can still see it in Device Manager by selecting View/Show hidden devices. It will appear 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 even use their 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:

- Terminal emulation program (HyperTerminal, Tera Term or other)
- Your custom Impulse controller program
- Fluke Ansur Test Automation System program

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.

Command protocol

Commands may be sent in upper or lower case.

Commands must be terminated by a Carriage Return (CR) (0x0D) and/or a Line Feed (LF) (0x0A).

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.

Space (SP) (0x20) characters are ignored. The Backspace (BS) (0x08) character removes the previously transmitted character from the command. The Escape (ESC) (0x1B) character erases all previously transmitted characters.

Command responses

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

The Impulse always responds to a command after it has executed it, by returning a response, terminated by a Carriage Return (0x0D) and a Line Feed (0x0A).

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

A few commands remain active after returning an initial response, as described below.

Incorrect commands return the following error codes:

Code	Description
!	Command empty, no characters
!00	No commands allowed now
!01	Unknown command
!02	Illegal command, not allowed in current mode
!03	Illegal parameter
!04	Receive error
!05	General failure
!06	Option not installed, such as Pacer command sent to Impulse 6000D
!20	Defib data not available
!21	Gas gauge bad read
!24	Data corrupted
!25	Calibration data entry out of range
!26	Calibration measurement out of range

Local control

The Impulse powers up initially under local control by user keys. Then, the only legal command is REMOTE that brings Impulse to remote control.

Remote control

In remote control, Impulse accepts commands and executes them. Some commands set Impulse into special modes. Some commands are only legal in certain modes. The modes are listed in the table:

Mode Mnemonic	Description
MAIN	Main remote mode
DEFIB	Measure defib pulses
PAPULSE	Measure pacer pulse parameters
PASENSE	Test pacer sensitivity
PAREFRACT	Measure pacer refractory periods
ECG	Simulate ECG waves
ECGPACED	Simulate ECG interactively with pacer
ECGPERF	Simulate ECG waves for performance testing
ECGNOISE	Simulate noise on ECG
DIAG	Diagnostic tests
CAL	Calibrate the instrument

The LOCAL command brings Impulse back to local control.

Pacer commands (Impulse 7000DP only)

Commands for pacer functions only work with the Impulse 7000DP. The Impulse 6000D will respond to them with the !06 error code.

Command specifications

Note: Unless specified otherwise, commands return *.

General commands		
Remote	Modes:	Local control.
	Description:	Goes to remote control MAIN mode.
Local	Modes:	All.
	Description:	Exits remote control and returns to local control.
Ident	Modes:	All.
	Description:	Asks for the identification with option and software version number.
	Returns:	The identification: TBD.
Ver	Modes:	All.
	Description:	Asks for the software version number.
	Returns:	The software version: 3 digits with decimal point, format n.nn.
Mode=Mode	Modes:	Main.
	Mode:	The mode to go to: The mnemonic of the mode.
	Description:	Go to the designated mode.
Qmode	Modes:	All.
	Description:	Queries the mode.
	Returns:	The current mode mnemonic.
Exit	Modes:	All.
	Description:	Turns off measurement and ECG. Exits the current mode and goes to main mode.
Global setup commands		
Painput=Input	Model:	Impulse 7000DP only
	Mode:	All modes except CAL and DIAG.
	Input:	The pacer input: DEFIB or PACER.
	Description:	Sets the input to be used for pacer tests.
Paload=Load	Model:	Impulse 7000DP only
	Mode:	All.
	Load:	The pacer load in ohms: 4 digits: 0050 to 1500 by 0050.
	Description:	Sets the load to be used for pacer tests. Connects that load to the pacer jacks.

Pabrand=Brand	Model:	Impulse 7000DP only		
	Modes:	All.		
	Brand:	The pacer brand: NONE, MEDTRONIC, PHILIPS, ZOLL, CARDIAC, MRL, SCHILLER, or MDE.		
	Description:	Sets the pacer brand algorithm to be used for pacer tests.		
Ecgampl= Amplitude	Modes:	All modes except PASENSE and ECGNOISE.		
	Amplitude:	The amplitude in mV: 3 digits with decimal point: 0.05 to 5.00.		
	Description:	Sets the ECG wave amplitude for all ECG waves except for Pacer Sensitivity and ECG Noise waves.		
Defib mode comands				
Dconvert=Wave	Mode:	DEFIB.		
	Wave:	The defib post-shock conversion wave:		
			CONVERT: Convert to normal sinus 60 bpm.	
			NOCONVERT: No change to wave.	
			ASYSTOLE: Change to asystole wave.	
			SYNCCONVERT: Convert to normal sinus 60 bpm only if sync time within range of –120 to +380 ms, otherwise change to asystole.	
	Description:	Sets the defib post-shock conversion wave.		
Dafib=Gran	Mode:	DEFIB.		
	Gran:	The afib granularity: COARSE or FINE.		
	Description:	Runs the afib wave.		
Dvfib=Gran	Mode:	DEFIB.		
	Gran:	The vfib granularity: COARSE or FINE.		
	Description:	Runs the vfib wave.		
Dmonovtach= Rate	Mode:	DEFIB.		
	Rate:	The mono vtach rate in BPM: 3 digits: 120 to 300.		
	Description:	Runs the mono vtach wave at the specified rate.		
Dpolyvtach=Code	Mode:	DEFIB.		
	Code:	The poly vtach code: 1 digit: 1 to 5.		
	Description:	Runs the poly vtach wave of the specified code.		
Dnsr=Rate	Mode:	DEFIB.		
	Rate:	The normal sinus rate in BPM: 3 digits: 150 to 300.		
	Description:	Runs the normal sinus wave at the specified rate.		
Dasystole	Mode:	DEFIB.		
	Description:	Runs the asystole wave.		
Dready	Mode:	DEFIB.		
	Description:	Ready the measurement system to wait for and measure a defib pulse.		
	Returns:	*(CrLf). Then waits for the defib pulse.		
		After detecting and processing the defib pulse:		
		Returns the defib data in numeric fields separated by commas:		
			Type of pulse:	
				1 for Monophasic
				2 for Bi-Phasic
				3 for Pulsed Bi-Phasic

Dready cont.		For type 1 pulse, the remaining fields are:		
			Energy (J): XXX.X	
			Peak Voltage (V): XXXX	
			Peak Current (A): XXX.X	
			Pulse Width 50% (ms): XX.X	
			Pulse Width 10% (ms): XX.X	
			Sync Time (ms): ±XXX	
			ECG Wave now running:	
				N for no change.
				C for converted to NSR at 60 bpm.
				A for Asystole.
			Charge Time (s): XXX.X	
			Example: 1,123.4,2000,040.2,08.3,12.4,+120,N,012.3	
		For type 2 pulse, the remaining fields are:		
			Energy (J): XXX.X	
			Phase 1 Peak Voltage (V): XXXX	
			Phase 1 Average Voltage (V):XXXX	
			Phase 1 Peak Current (A): XXX.X	
			Phase 1 Average Current (A): XXX.X	
			Phase 1 Pulse Width (ms): XX.X	
			Phase 2 Peak Voltage (V): XXXX	
			Phase 2 Average Voltage (V): XXXX	
			Phase 2 Peak Current (A): XXX.X	
			Phase 2 Average Current (A): XXX.X	
			Phase 2 Pulse Width (ms): XX.X	
			Inter-Phase Delay (ms): XX.X	
			Tilt (%): XX	
			Sync Time (ms): ±XXX	
			ECG Wave now running:	
				N for no change.
				C for converted to NSR at 60 bpm.
				A for Asystole.
			Charge Time (s): XXX.X	
		Example: 2,123.4,2000,1453,040.2,033.1,10.3,1256,0967,032.2,018.1,09.2,02.3 ,12,+120,N,012.3		
		For type 3 pulses, the remaining fields are:		
			Energy (J): XXX.X	
			Phase 1 Peak Voltage (V): XXXX	
			Phase 1 Average Voltage (V): XXXX	
			Phase 1 Peak Current (A): XXX.X	
			Phase 1 Average Current (A): XXX.X	
			Phase 1 Pulse Width (ms): XX.X	
			Phase 2 Peak Voltage (V): XXXX	
			Phase 2 Average Voltage (V): XXXX	
			Phase 2 Peak Current (A): XXX.X	
			Phase 2 Average Current (A): XXX.X	
			Phase 2 Pulse Width (ms): XX.X	
			Inter-Phase Delay (ms): XX.X	
			Tilt (%): XX	
			Frequency (Hz): XXXX	

Dready cont.			Duty Cycle (%): XX	
			Sync Time (ms): ±XXX	
			ECG Wave now running:	
				N for no change.
				C for converted to NSR at 60 bpm.
				A for Asystole.
			Charge Time (s): XXX.X	
		Example: 3,123.4,2000,1453,040.2,033.1,10.3,1256,0967,032.2,018.1,09.2, 02.3,12,4023,41,+120,N,012.3		
	Exit:	If no defib pulse comes, exits after receiving any character, then returns * and quits.		
Dwavedata	Mode:	DEFIB.		
	Description:	Ready the measurement system to wait for and measure a defib pulse.		
	Returns:	The defib wave data from the last measured defib pulse: 2,500 signed current readings, 20 µs apart, formatted: ±XXX.X, separated by commas. With a CRLF after every 10 readings. Example: +001.2,+002.3,–043.2,+100.0, ...		
	ErrorMessage:	Returns !20 if no defib pulse data available.		
Pacer pulse commands				
Paready	Model:	Impulse 7000DP only		
	Modes:	Papulse.		
	Description:	Ready the measurement system to wait for and measure pacer pulses continuously.		
	Returns:	*. Then waits for pacer pulses. After processing each pacer pulse, returns the pacer data in numeric fields separated by commas:		
			Rate (PPM): XXX.X	
			Pulse Width (ms): XXX.XX	
			Energy (uJ): XXXXXXX	
			Amplitude (mA): ±XXX.XX	
		Example: 120.4,021.63,0146343,+118.62 It takes 2 pulses to calculate a rate. For the 1st pulse, the rate will be returned as 000.0.		
	Exit:	Continues sending pacer data until receiving any character. Than returns another * and quits.		
Pacer sensitivity commands				
Pasrwave= Wave,Width, Polarity	Model:	Impulse 7000DP only		
	Modes	PASENSE.		
	Wave:	The wave shape: 3 characters: FLT for flat (off), SQR for square, TRI for triangle, SIN for sine.		
	Width:	The width in ms: 3 digits: 001 to 300.		
	Polarity:	The polarity: 0 for positive, 1 for negative.		
	Description:	Runs the specified pacer sensitivity test pulse.		
Pasampl= Amplitude	Model:	Impulse 7000DP only		
	Mode:	PASENSE.		
	Amplitude:	The amplitude in mV: 3 digits with decimal point: 0.05 to 5.00.		
	Description:	Sets the pacer sensitivity wave amplitude.		
Pasauto	Model:	Impulse 7000DP only		
	Mode:	PASENSE.		
	Description:	Runs the sensitivity test automatically. This test takes several seconds depending on the rate. The test interacts with pacer pulses to determine the sensitivity threshold amplitude for the sensitivity wave that is running.		

Pasauto cont.	Returns:	Intermediate and final test data for amplitude. Returns data after every pacer pulse:		
			A~X.XX	Intermediated amplitude, every pacer pulse.
			A=X.XX	Final amplitude, only once.
	Exit:	This test will exit before completion if it receives any character. Then it returns *.		
Pacer refractory commands				
Parauto	Model:	Impulse 7000DP only		
	Mode:	PAREFRACT.		
	Description:	Runs the refractory period test automatically. This test takes several seconds depending on the pacing rate. The test interacts with pacer pulses to determine the Pulse Refractory Period (PRP), then the Sense Refractory Period (SRP).		
	Returns:	Intermediate and final test data for pacing rate, PRP and SRP. Returns data after every pacer pulse:		
	R=XXX	Pacing rate, only once, after 2 pulses.		
	P~XXX	Intermediate PRP, every pacer pulse after rate.		
	P=XXX	Final PRP, only once.		
	S~XXX	Intermediate SRP, every pacer pulse after final PRP.		
	S=XXX	Final SRP, only once.		
	Exit:	This test will exit before completion if it receives any character. Then it returns *.		
ECG noise commands				
Noise= Frequency,ECG	Modes:	ECGNOISE.		
	Frequency:	The noise frequency in Hz: 50 or 60.		
	ECG:	Flag to turn ECG NSR60 wave on or off, added to the noise: T (on) or F (off).		
	Description:	Runs the specified noise wave.		
Noiseampl= Amplitude	Modes:	ECGNOISE.		
	Amplitude:	The noise amplitude in mV: 3 digits with decimal point: 00.0 to 10.0.		
	Description:	Sets the noise amplitude.		
ECG commands				
Atrpace=Width, Amplitude	Mode:	ECG.		
	Width:	The width in ms: 2 digits with decimal: 0.1, 0.2, 0.5, 1.0, or 2.0.		
	Amplitude:	The amplitude in mV: 3 digits with sign: ±000 to ±700 (for zero, 0000 also valid).		
	Description:	Sets the width and amplitude for the simulated TV atrial pacer pulse.		
Ventpace=Width, Amplitude	Mode:	ECG.		
	Width:	The width in ms: 2 digits with decimal: 0.1, 0.2, 0.5, 1.0, or 2.0.		
	Amplitude:	The amplitude in mV: 3 digits with sign: ±000 to ±700 (for zero, 0000 also valid).		
	Description:	Sets the width and amplitude for the simulated TV ventricular pacer pulse.		
Nsr=Rate	Mode:	ECG.		
	Rate:	The normal sinus rate in BPM: 3 digits: 030 to 360.		
	Description:	Runs the normal sinus wave at the specified rate.		
Afib=Gran	Mode:	ECG.		
	Gran:	The afib granularity: COARSE or FINE.		
	Description:	Runs the afib wave.		
Vfib=Gran	Mode:	ECG.		
	Gran:	The vfib granularity: COARSE or FINE.		
	Description:	Runs the vfib wave.		
Monovtach=Rate	Mode:	ECG.		
	Rate:	The vtach rate in BPM: 3 digits: 120 to 300.		
	Description:	Runs the vtach wave at the specified rate.		

Polyvtach=Code	Mode:	ECG.		
	Code:	The poly vtach code: 1 digits: 1 to 5.		
	Description:	Runs the poly vtach wave of the specified code.		
Spvwave=Wave	Mode:	ECG.		
	Wave:	The supraventricular wave to run:		
			AFL	Atrial Flutter
			SNA	Sinus Arrhythmia
			MBT	Missed Beat
			ATC	ATach
			PAT	Paroxysmal ATach
			NOD	Nodal Rhythm
			SVT	Supra VTach
	Description:	Runs the supraventricular ECG wave.		
Prewave=Wave	Mode:	ECG.		
	Wave:	The premature wave to run:		
			PAC	Atrial PAC
			PNC	Nodal PNC
			PVC1	PVC1 Left Vent
			PVC1E	PVC1 LV Early
			PVC1R	PVC1 LV R on T
			PVC2	PVC2 Right Vent
			PVC2E	PVC2 RV Early
			PVC2R	PVC2 RV R on T
			MF	Multifocal PVCs
	Description:	Runs the premature ECG wave.		
Vntwave=Wave	Mode:	ECG.		
	Wave:	The ventricular wave to run:		
			PVC6M	PVCs 6/min
			PVC12M	PVCs 12/min
			PVC24M	PVCs 24/min
			FMF	Freq Multifocal
			TRIG	Trigeminy
			BIG	Bigeminy
			PAIR	Pair PVCs
			RUN5	Run 5 PVCs
			RUN11	Run 11 PVCs
			ASYS	Asystole
	Description:	Runs the ventricular ECG wave.		
Cndwave=Wave	Mode:	ECG.		
	Wave:	The conduction wave to run:		
			1DB	1° Block
			2DB1	2° Block Type I
			2DB2	2° Block Type II
			3DB	3° Block
			RBBB	RBBB
			LBBB	LBBB
	Description:	Runs the conduction ECG wave.		

Tvpwave=Wave	Mode:	ECG.		
	Wave:	The TV paced wave to run:		
			ATR	Atrial 80 BPM
			ASY	Async 75 BPM
			DFS	Demand Freq Sinus
			DOS	Demand Occ Sinus
			AVS	AV Sequential
			NCP	Non-Capture
			NFN	Non-Function
	Description:	Runs the TV paced ECG wave.		
ECG paced commands				
Epathresh= Threshold	Model:	Impulse 7000DP only		
	Mode:	ECGPACED.		
	Threshold:	Pacer response threshold mA: 3 digits: 000 to 250 (000 turns off threshold check and allows all pacer pulses to trigger).		
	Description:	Sets the threshold of pacer amplitude to trigger pacer response wave for pacer interactive ecg waves.		
Epawave=Wave	Model:	Impulse 7000DP only		
	Mode:	ECGPACED.		
	Wave:	The ECG paced wave to run:		
			ASY	Asynchronous
			NCP	Non-Capture
			NFN	Non-Function
	Description:	Runs the wave.		
Epademand=Rate	Model:	Impulse 7000DP only		
	Mode:	ECGPACED.		
	Rate:	The normal sinus rate in BPM for the Demand wave in this mode: 3 digits: 030 to 360.		
	Description:	Runs the Demand wave at the rate.		
ECG performance commands				
Epfwave=Wave, Frequency	Modes	ECGPERF.		
	Wave:	The wave shape: 3 characters: FLT for flat (off), SQR for square, TRI for triangle, SIN for sine.		
	Frequency:	The frequency in Hz: 3 digits with no decimal point 001 to 200; or 4 digits with decimal point 0.050 to 9.999.		
	Description:	Runs the specified performance wave.		
Epfrwave=Wave, Width,Rate	Modes	ECGPERF.		
	Wave:	The wave shape: 3 characters: FLT for flat (off), SQR for square, TRI for triangle, SIN for sine.		
	Width:	The width in ms: 3 digits: 001 to 300.		
	Rate:	The rate in BPM: 3 digits: 030 to 300.		
	Description:	Runs the specified performance pulse.		

About Fluke Biomedical

Fluke Biomedical is the world's leading manufacturer of quality biomedical test and simulation products. In addition, Fluke Biomedical provides the latest medical imaging and oncology quality-assurance solutions for regulatory compliance. Highly credentialed and equipped with a NVLAP Lab Code 200566-0 accredited laboratory, Fluke Biomedical also offers the best in quality and customer service for all your equipment calibration needs.

Today, biomedical personnel must meet the increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

Fluke Biomedical Regulatory Commitment

As a medical test device manufacturer, we recognize and follow certain quality standards and certifications when developing our products. We are ISO 9001 and ISO 13485 medical device certified and our products are:

- CE Certified, where required
- NIST Traceable and Calibrated
- UL, CSA, ETL Certified, where required
- NRC Compliant, where required

Fluke Biomedical.
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Application Notes

Impulse 7010 Defibrillator Selectable Load Accessory

The Impulse 7010 Defibrillator Selectable Load Accessory, in conjunction with Impulse 7000 Defibrillator/External Pacer Analyzer, is specifically designed to facilitate compliance with the IEC 60601-2-4 and AAMI DF80 standards.

For defibrillation to be successful, a sufficient amount of electrical current must be delivered to the heart muscle. Defibrillation current is affected by transthoracic impedance (the body's resistance) to the current flow. Measured in ohms of resistance, impedance comes from all body tissues. Impedance in humans has been shown to vary anywhere from 25 to 180 ohms with the average impedance of an adult around 70 to 80 ohms according to a study conducted by the American Heart Association (AHA).[1]

Section 6.8.3 of the IEC 60601-2-4 standard and AAMI DF80 standards require defibrillators to be tested on different resistance loads of 25, 50, 75, 100, 125, 150, and 175 ohms to ensure proper current is delivered to patients with different impedances. Impulse 7010 is the only tool available today with the capability to test defibrillators beyond 175 ohms. A 200-ohms option gives manufactures the capability to test defibrillators under extreme impedance conditions.

A well-designed defibrillation waveform must measure patient impedance electrically and adjust the waveform shape and duration accordingly to optimize waveform performance across the range of anticipated impedance values.

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[1] American Heart Association. Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Care. *Circulation Supplement.* 2000; 102:8

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Application Notes

Below are defibrillator discharge curves captured by Ansur PC-based automation software. To compensate for the resistance change (increasing from 50 ohms to 150 ohms), the defibrillator[2] automatically adjusted the current level (reduced), voltage level (increased) and pulse width (increased) to maintain constant energy (100 Joules).

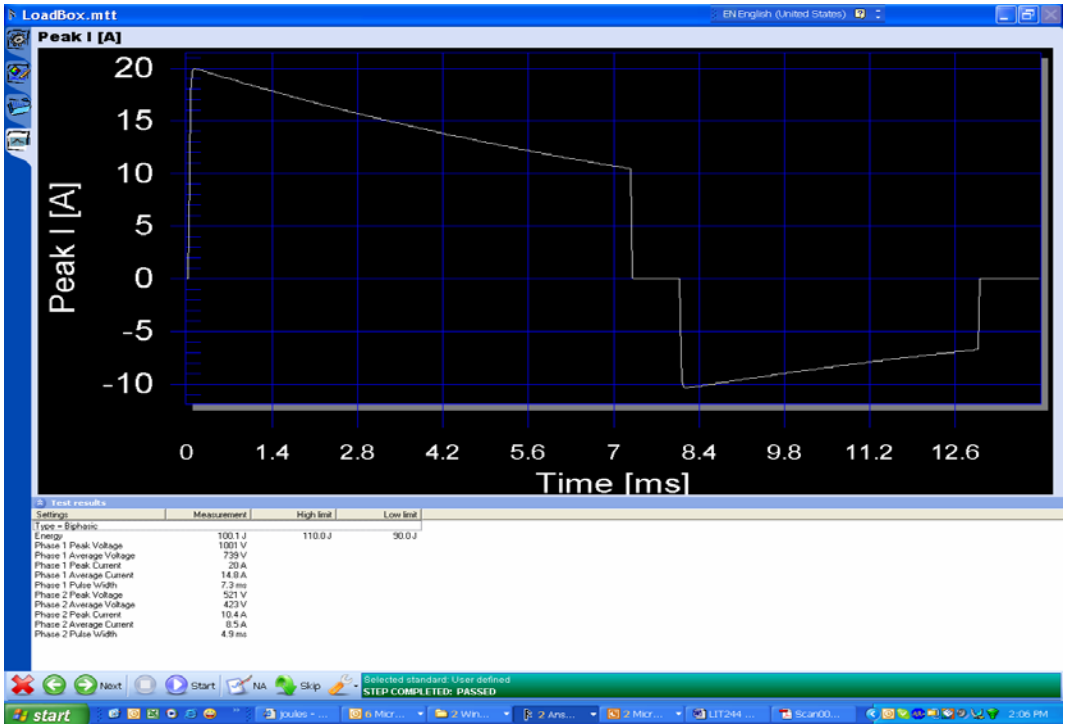

Figure 1: defibrillator discharge curve during energy measurement test (external load 50 ohms, preset energy level 100J)

[2] LIFEPAK 20 used in this example

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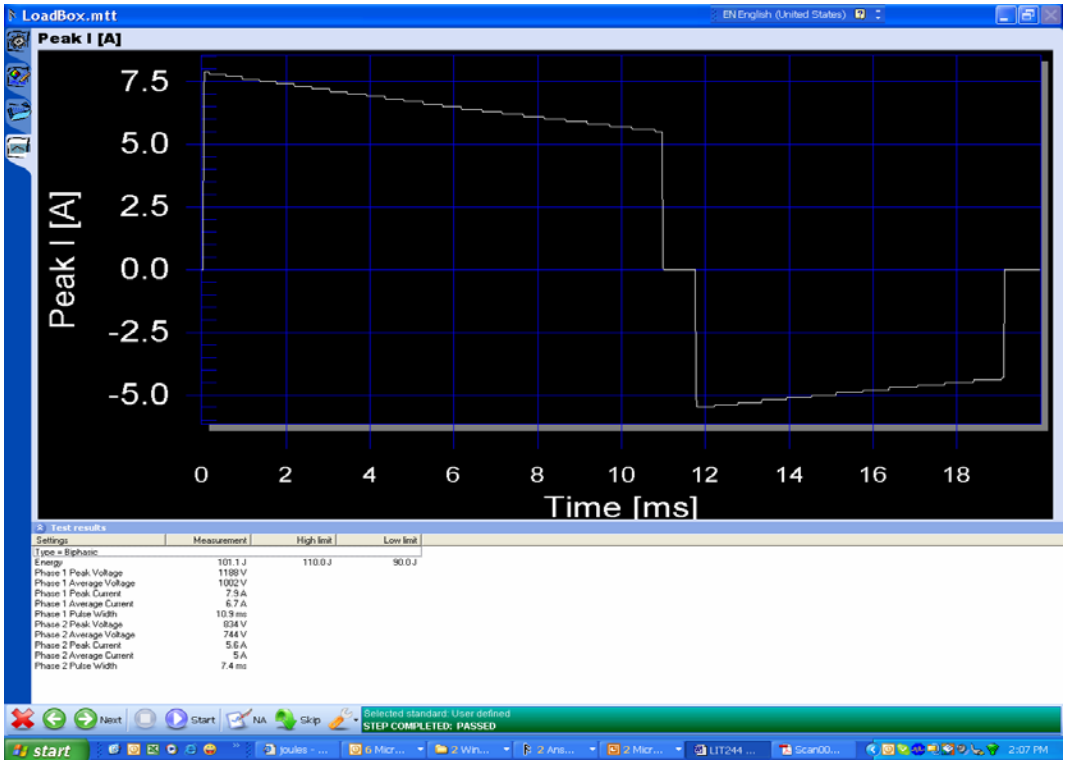

Figure 2: defibrillator discharge curve during energy measurement test (external load 150 ohms, preset energy level 100J)

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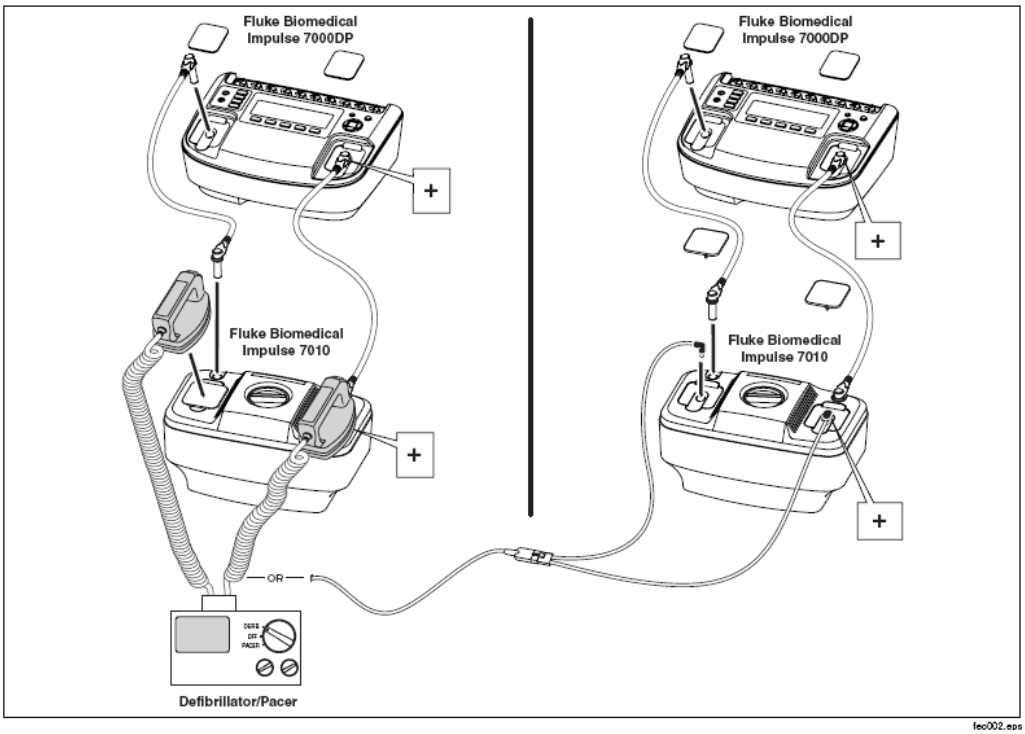
Use of Impulse 7010 is easy. Simply connect the Impulse 7010 output connectors to the input connectors of Impulse 7000 as shown in the figure 3 below. The various connection combinations available through the Impulse 7010's rotary switch provide eight different loads for a defibrillator discharge.



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