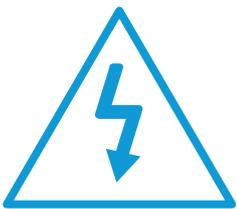


# UniPulse 400

## Manual



Warning of electrical danger!  
Warnung vor elektrischer Gefahr!  
Avertissement: Danger électrique!  
Advertencia de riesgo eléctrico  
Ryzyko porażenia elektrycznego!  
Avvertimento di pericolo elettrico!  
警告电气危险!



Important, follow the documentation!  
Wichtig, Anweisungen befolgen!  
Important, suivez la documentation!  
Importante, ¡Siga la documentación!  
Ważne, postępuj zgodnie z dokumentacją!  
Importante, seguire la documentazione!  
重要事项, 参照文档!

## **Rigel Medical 2 year Warranty Statement**

To activate your 2 year warranty, register your product at the below link. Terms and conditions apply.

[www.rigelmedical.com/userfiles/form-register-product.php](http://www.rigelmedical.com/userfiles/form-register-product.php)

## **Calibration Statement**

The UniPulse 400 Analyser is fully calibrated and found to be within the specified performance and accuracy at the time of production. The Seaward Group provides its products through a variety of channels; therefore it may be possible that the calibration date on the provided certificate may not represent the actual date of first use.

Experience has indicated that the calibration of this instrument is not affected by storage prior to receipt by the user. We therefore recommend that the recalibration period be based on a 12 month interval from the first date the unit is placed in to service.

For information on service or calibration please go to the link below.

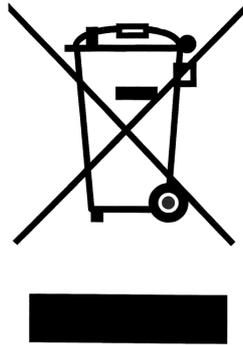
[www.rigelmedical.com/calibration](http://www.rigelmedical.com/calibration)

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Due to a policy of continuous development the SEAWARD GROUP reserves the right to alter the equipment specification and description outlined in this publication without prior notice and no part of this publication shall be deemed to be part of any contract for the equipment unless specifically referred to as an inclusion within such contract.

## Disposal of old product



The UniPulse 400 has been designed and manufactured with high quality materials and components, which can be recycled and reused.

Please familiarise yourself with the appropriate local separate collection system for electrical and electronic products or contact your local supplier for further information.

Please dispose of this product according to local regulations. Do not dispose of this product along with normal waste material. By offering your old products for recycling, you will help prevent potential negative consequences for the environment and human health.

## User Notes

These operating instructions are intended for the use of adequately trained personnel.

 Important, follow the documentation! This symbol indicates that the operating instructions must be adhered to in order to avoid danger.

If the UniPulse 400 is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

This product contains a lithium ion battery:

- Do not disassemble, crush, or puncture a battery
- Do not short the external contacts on a battery
- Do not dispose of a battery in fire or water
- Do not expose a battery to temperatures above 60 °C (140 °F)
- Keep the battery away from children
- Avoid exposing the battery to excessive shock or vibration
- Do not use a damaged battery
- If a battery pack has leaking fluids, do not touch any fluids.
- Dispose of a leaking battery pack

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# 1. Warnings and Cautions

## 1.1. User Notes

The following symbols are used throughout this Instruction Manual.



Warning of electrical danger!  
Indicates instructions must be followed to avoid danger to persons.



Important, follow the documentation! This symbol indicates that the operating instructions must be adhered to in order to avoid danger.

## 1.2. Safety Notes



Do not connect the UniPulse 400 to a patient or any devices connected to a patient.



Do not use the defibrillator to shock the PACER or ECG terminals



When connecting to the DEFIB terminals, 4mm shrouded non-stackable plugs must be used.



The DEFIB terminals (red and black) are rated to 5kV/120A/600J MAX.



The PACER terminals (yellow) are rated to 275V MAX.



The UniPulse 400 is designed for use by adequately trained technical personnel only.



No unauthorised user modifications of the instrument.



Do not use the instrument in an application beyond the published specifications.



Use extreme caution when working with voltages greater than 30 Volts, for example a DEFIB shock.



No user serviceable parts.



Do not spray or pour liquid onto the unit. This may result in damaging of the electronics within the unit.



Do not use the UniPulse 400 with the 18V PSU attached unless it is connected directly to mains power.



Where safe operation of the UniPulse 400 is no longer possible it should be immediately shut down and secured to prevent accidental operation. It must be assumed that safe operation is no longer possible:

- If the instrument or leads show any sign of damage or
- The instrument does not function or
- After long periods of storage under adverse environmental conditions or
- Do not use the UniPulse 400 in wet conditions or surrounded in explosive gases or dust.

## 2. Introduction

### 2.1. Intended use and capabilities of the UniPulse 400

The UniPulse 400 is capable of the following simulations and analysis:

#### Analysing Defibrillators

- Defibrillator Energy Discharge
- Charge Time
- Defib Synchronisation Measurement
- Defib Pulse Peak Voltage Measurement
- Defib Pulse Peak Current Measurement
- Defib Pulse Length Measurement

#### Analysing Automated External Defibrillator (AED)

- Defibrillator Energy Discharge
- Defib Pulse Peak Voltage Measurement
- Defib Pulse Peak Current Measurement
- Defib Pulse Length Measurement

#### Simulating ECG Waveforms

- ECG Sinus Waveforms
- ECG Ventricular Arrhythmia Waveforms
- ECG Atrial Conduction Arrhythmia Waveforms
- ECG Atrial Arrhythmia Waveforms
- ECG Pacer Waveforms
- ECG Performance Waveforms

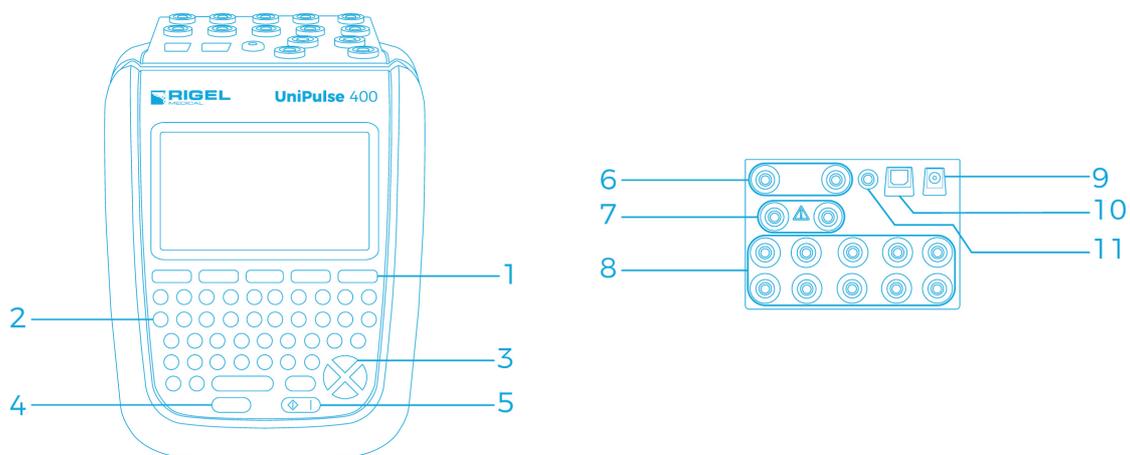
#### Analysing Pacers – Invasive set-up (Low Energy) and Non-Invasive set-up (High Energy)

- Pacer Function
- Pacer Pulse Mode
- Pacer Refractory Mode
- Pacer Sensitivity
- Pacer Immunity

The UniPulse 400 forms part of a comprehensive range of high performance specialist biomedical test equipment supplied by Rigel Medical, part of the Seaward Group.

For further information go to [www.rigelmedical.com](http://www.rigelmedical.com)

## 2.2. Getting to Know Your UniPulse 400



- 1- Function keys F1-5
- 2- QWERTY keyboard
- 3- Directional navigation keys
- 4- Stop/End button
- 5- Power ON/Start button
- 6- Defib/Paddle Adaptor Box connection
- 7- Pacer connection
- 8- Universal ECG connections x10
- 9- Power supply socket
- 10- USB connection
- 11- ECG Hi output

## 2.3. In the Box



Carefully unpack all items from the box and ensure the following items are included:

- AC Power Supply
- USB cable
- ECG Snap Adapters (pack of 10)
- Calibration Certificate
- UniPulse 400 Analyser
- UniPulse 400 Carry Case
- UniPulse 400 Quick Start Guide

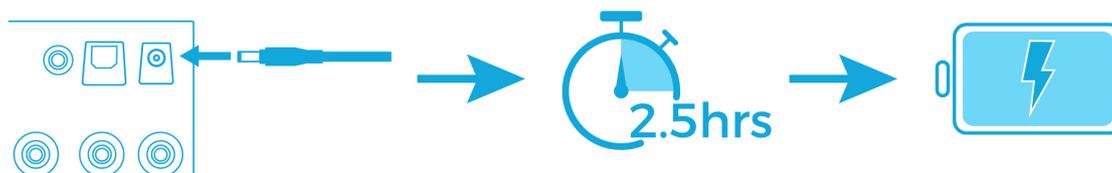
## 2.4. Optional Accessories and Replacement Spare Parts

Bluetooth barcode scanner	339A923
Test 'n' Tag Elite 2 Bluetooth printer	339A989
Thermal label rolls (pack of 5)	339A949
Paddle Adaptor Box	386A950
Paddle Adaptor Box lead (Red)	386A952
Paddle Adaptor Box lead (Black)	386A953
Applied Part Adaptors (pack of 10)	404A951
AC power supply	386A011
Battery pack 9.6V/2400mAh	386A008
Replacement Carry Case	410A950
Med-eBase software	383A910
	<a href="http://www.rigelmedical.com/med-ebase">www.rigelmedical.com/med-ebase</a>

## 2.5. Charging the UniPulse 400



Do not use the UniPulse 400 with the 18V PSU attached unless it is connected directly to mains power.



Whilst the UniPulse 400 is powered on, you will also see the below symbols on the display.



Bulk charging

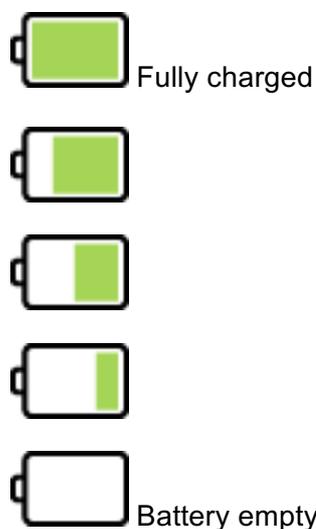


Trickle charging

The UniPulse 400 may be used whilst charging, however, displayed signal quality may be reduced on some monitor types.

## 2.6. Battery Status

During normal use, the UniPulse 400 automatically checks the battery status and shows the closest representation using the symbols below.

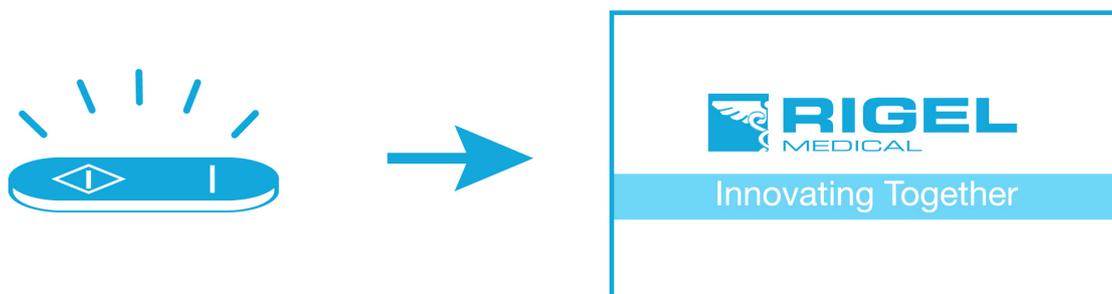


The UniPulse 400 will warn the user of a low battery with an audible tone. Should this occur, connect the UniPulse 400 to mains via the supplied 18V PSU and allow the unit to charge

## 2.7. Powering the UniPulse 400 On and Off

To turn the UniPulse 400 ON, press and hold the green ON key until the Rigel Medical splash screen appears.

To turn the UniPulse 400 OFF, press and hold the red OFF key until the screen goes black and the unit switches off.



## 2.8. Icons

To make navigating through the options of the UniPulse 400 an easier and more intuitive experience, the traditional menu format has been replaced by a unique set of easily recognisable icons:

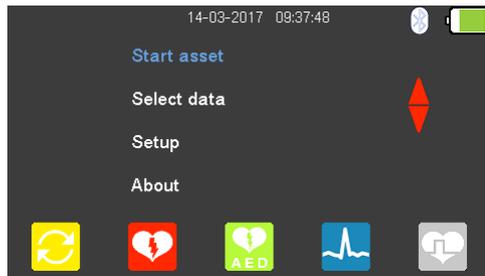
	Defibrillator mode		Pulse amplitude		Keyboard entry
	Charge time mode		Frequency selection		Delete
	Cardiac Synchronisation mode		Heart rate		Search
	AED mode		Start		Load selection
	ECG simulation		Confirm		Scanner
	Waveform selection		Back without saving		BPM recycle
	Arrhythmia waveform		Back		Computer
	Performance waveform		Asset menu		Printer
	Pacer mode		Scroll up/down		Save
	Pulse width selection		Scroll left/right		Start timing
	Bluetooth active		Save an appliance (pass)		Save an appliance (Fail)
	ECG waveform (on / off)		Freeze / unfreeze result		Noise selection
	Defib load selection		Pacer load selection		Pacer pulse mode
	Pacer refractory period		Pacer sensitivity mode		Pacer immunity mode

## 3. Getting started

### 3.1. Accessing the UniPulse 400 Tests

From the main menu you can access the following test menus using the function keys **F1-F5**:

#### Main Menu



Select:



(F1) for Asset Menu.



(F2) for Defibrillator Mode.



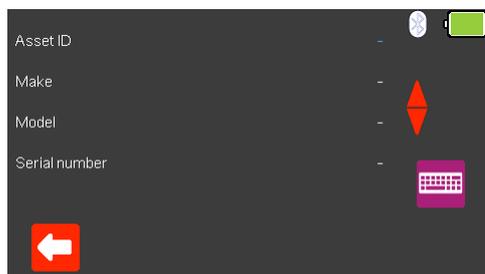
(F3) for Automated External Defibrillator (AED) Mode.



(F4) for Electrocardiogram (ECG) Simulation Mode.

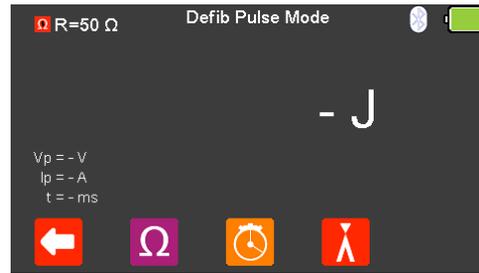
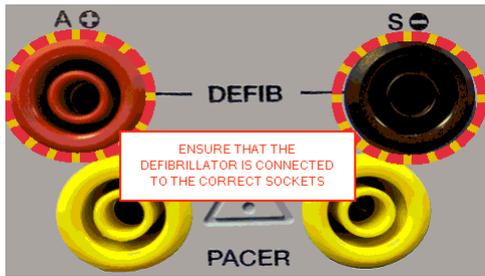


(F5) for Pacer Mode.



(F1) for **Asset Menu**

If test records are required, the Asset Menu screen is used to record the current Asset ID, Make, Model and Serial Number of the equipment under test. See section 10.1 for more details.

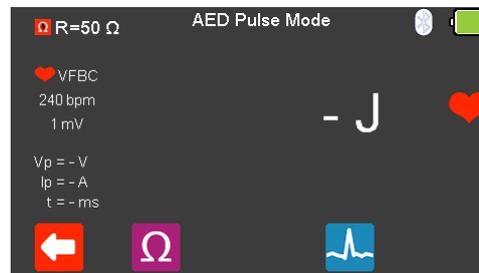
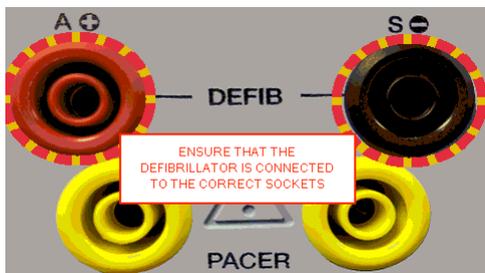


 (F2) for **Defibrillator Mode**

Use this mode to analyse the Defibrillator Energy Discharge, Defib Charge Time, Defib Synchronisation, Defib Pulse Peak Voltage, Defib Pulse Peak Current or a Defib Pulse Length Measurements. See section 5.0 for more details.

Do not use the defibrillator to shock the PACER or ECG terminals

Note 1; to enter the Defibrillator Pulse or AED mode you have to accept the connections warning, using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.

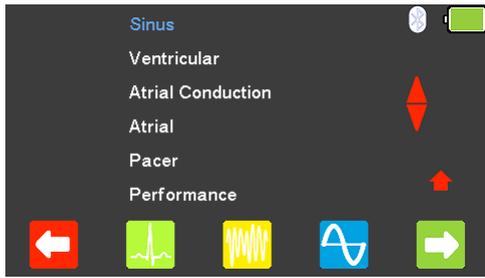


 (F3) for **Automated External Defibrillator (AED) Mode**

Use this mode to analyse the Defibrillator Energy Discharge, Defib Pulse Peak Voltage, Defib Pulse Peak current or a Defib Pulse Length Measurements. See section 6.0 for more details.

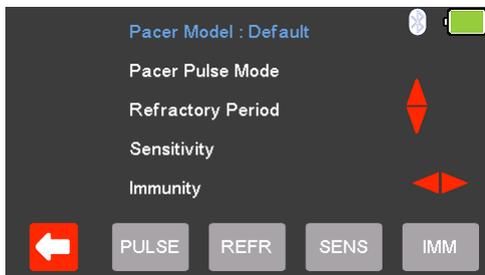
Do not use the defibrillator to shock the PACER or ECG terminals

Note 1; to enter the Defibrillator Pulse or AED mode you have to accept the connections warning, using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.



(F4) for **Electrocardiogram (ECG) Simulation Mode**

Use this mode to simulate ECG Sinus, ECG Ventricular Arrhythmia, ECG Atrial Conduction Arrhythmia, ECG Atrial Arrhythmia, ECG Pacer and ECG Performance Waveforms. See section 7.0 for more details.

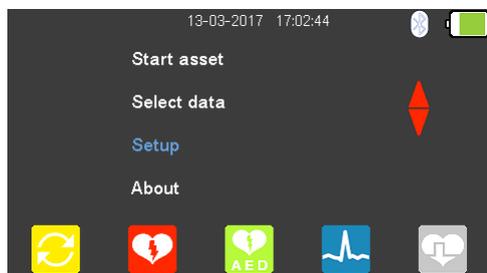


(F5) for **Pacer Simulation**

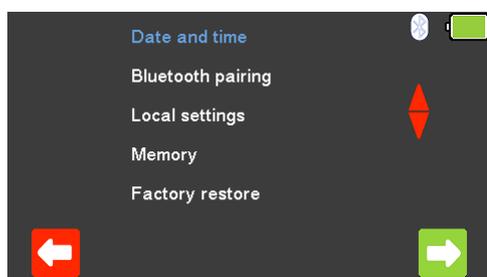
Use this mode to analyse the Pacer Function, Pulse Mode, Refractory Mode, Sensitivity and Immunity for both Invasive (Low Energy) and Non-Invasive (High Energy) set-ups. See section 8.0 or 9.0, respectively, for more details.

## 4. Setting up the UniPulse 400

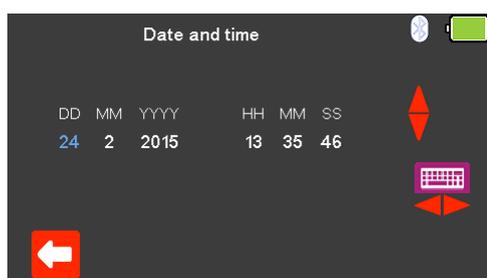
### 4.1. Setting the Time and Date



From the **Main Menu**, use the   arrow keys to highlight **Setup** and select using the ↵ (return) key.



From the **Setup Menu**, use the   arrow keys to highlight **Date and time** and select using the ↵ (return) key or  (F5).



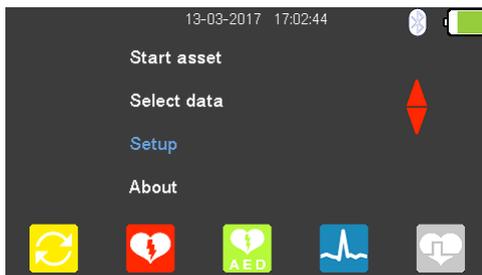
Use  (F1) to exit the **Date and time** setup screen without saving.

Use the   arrow keys to select the date or time element to change. The   arrow keys can be used to change this or typed in using the keyboard .

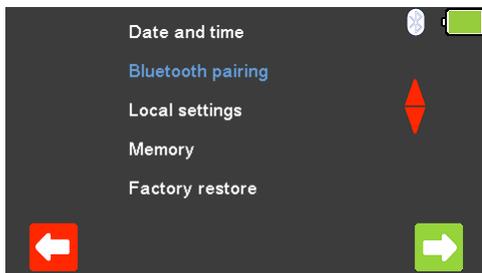


Select  (F5) to confirm and save the changes, or  (F1) to exit without saving.

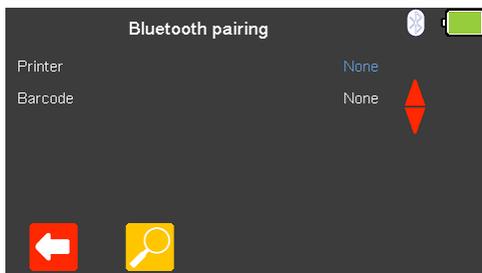
## 4.2. Connecting to a Bluetooth Device



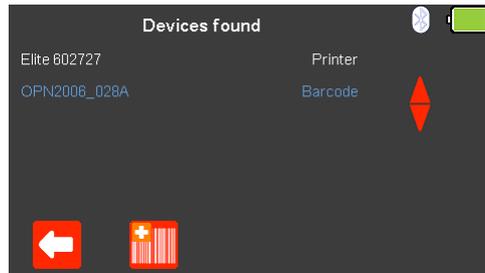
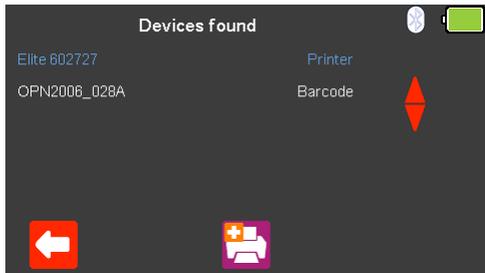
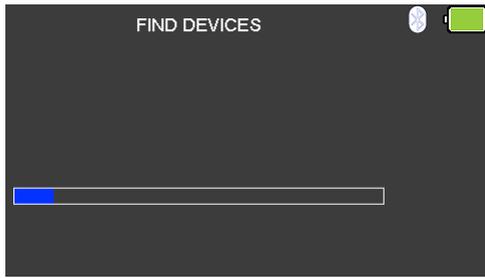
From the **Main Menu**, use the   arrow keys to highlight **Setup** and select using the ↵ (return) key.



From the **Setup Menu**, use the   arrow keys to highlight **Bluetooth pairing** and select using the ↵ (return) key or  (F5). Ensure the Test 'n' Tag Elite 2 Printer / Bluetooth Scanner is switched on.



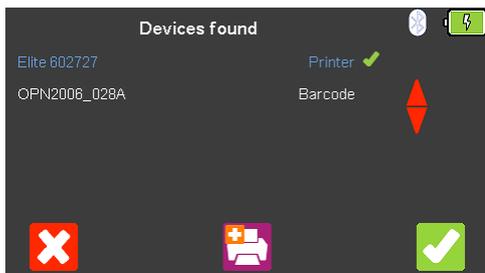
Use  (F1) to exit the **Bluetooth pairing** setup screen without saving. The search function  (F2) can be used to search for Bluetooth devices.



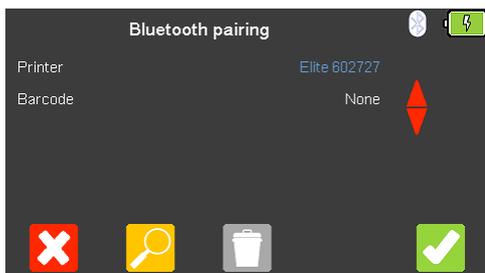
Once the devices have been found, use the   arrow keys to select a **Printer**  (F3) or **Barcode**  scanner (F2).

#### 4.3. Connecting to the Test n Tag Elite 2 printer

A list of available Bluetooth devices will be displayed once Bluetooth searching is complete (see connecting a Bluetooth Device). Use the   arrow keys to scroll through the list, printers will be shown by the add **Printer**  icon.



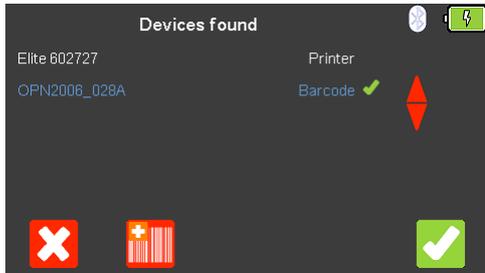
Use  (F3) to select the device to be paired with and then use  (F5) to confirm.



Finally, select  (F5) again to complete the connection.

## 4.4. Connecting to the Bluetooth Barcode Scanner

A list of available Bluetooth devices will be displayed once Bluetooth searching is complete (see connecting a Bluetooth Device). Use the   arrow keys to scroll through the list, barcode scanners will be shown by add **Barcode Scanner**  icon.

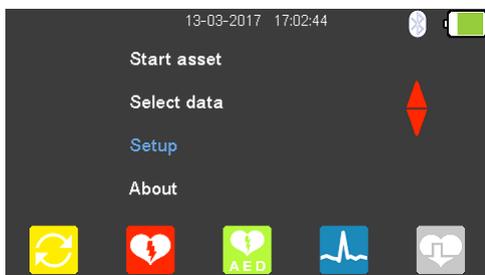


Use  (F2) to select the device to be paired with and then use  (F5) to confirm.

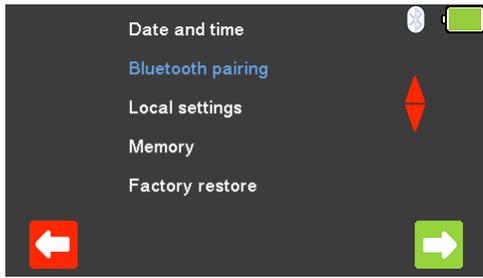


Finally, select  (F5) again to complete the connection.

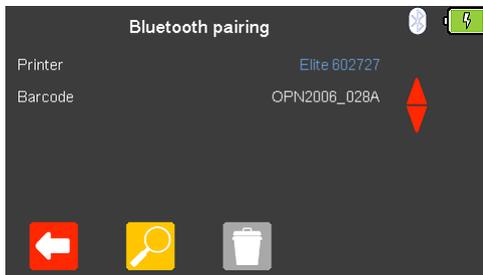
## 4.5. Deleting Bluetooth Selections



From the **Main Menu**, use the   arrow keys to highlight **Setup** and select using the ↵ (return) key.

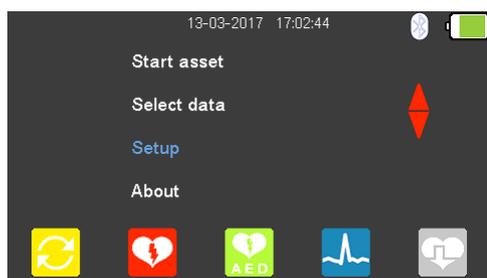


From the **Setup Menu**, use the   arrow keys to highlight **Bluetooth pairing** and select using the ↵ (return) key or  (F5).

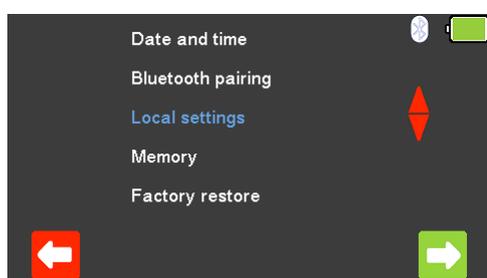


Highlight the Bluetooth printer or scanner to be deleted using the   arrow keys. Delete using the  (F3) key and then confirm using  (F5).

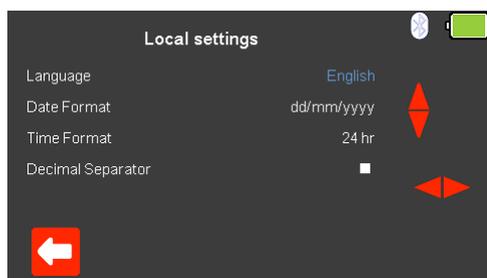
## 4.6. Local Settings



From the **Main Menu**, use the   arrow keys to highlight **Setup** and select using the ↵ (return) key.



From the **Setup Menu**, use the   arrow keys to highlight **Local settings** and select using the ↵ (return) key or  (F5).



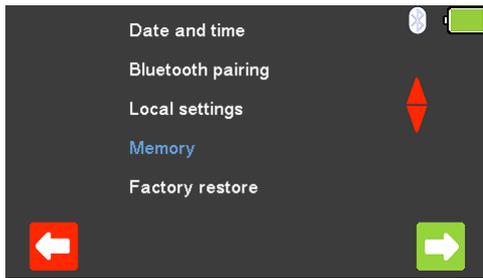
Use  (F1) to exit the **Local settings** screen without saving.

The **Language**, **Date Format**, **Time Format** or **Decimal Separator** can be selected

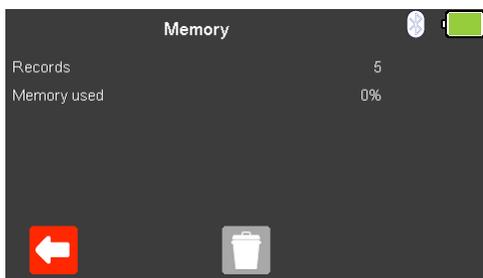
and then altered using the   and   arrow keys.

Select  (F5) to confirm and save the changes, or  (F1) to exit without saving.

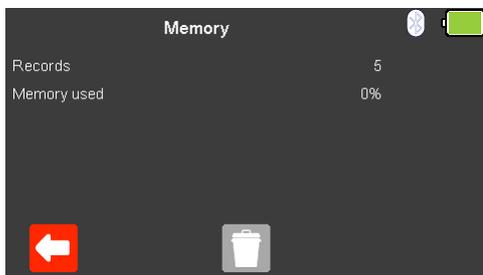
## 4.7. Results Memory



From the **Setup Menu**, use the   arrow keys to highlight **Memory** and select using the ↵ (return) key or  (F5).

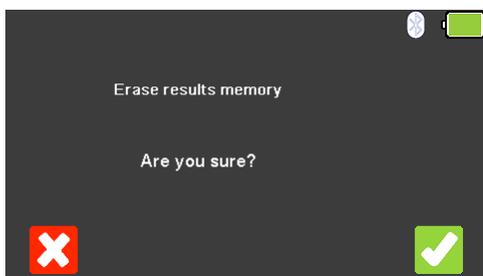


The **Memory** screen displays the number of **Records** recorded and the amount of **Memory used** to store these.



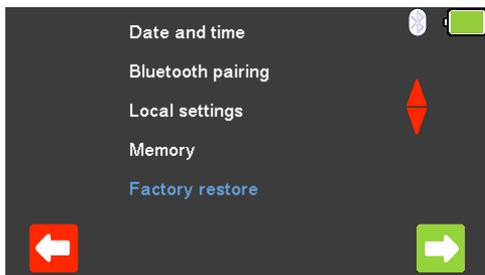
To exit without changing select  (F1).

Select  (F3) to delete the results memory,

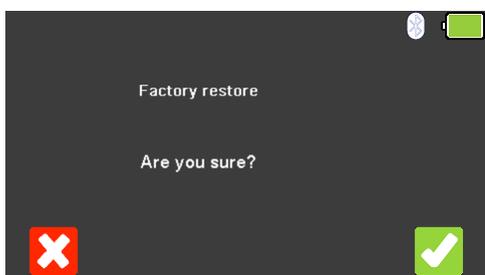


To exit without deleting select  (F1) or select  (F5) to erase the results memory.

## 4.8. Restoring Factory Settings



From the **Setup Menu**, use the   arrow keys to highlight **Factory restore** and select using the ↵ (return) key or  (F5).



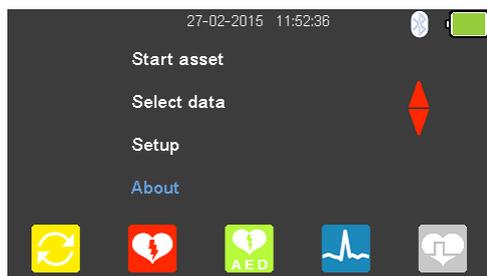
To exit without changing select  (F1) or select  (F5) to restore factory settings.

Note; factory reset will reset the UniPulse 400 settings to the following:

Language = English  
Date Format = dd/mm/yyyy  
Time Format = 24hr  
Decimal Separator = .

All Bluetooth settings are also reset.

## 4.9. Displaying UniPulse 400 Information



From the **Main Menu**, use the   arrow keys to highlight **About** and select using the ↵ (return) key.

Use the   arrow keys to allow the following screens to be viewed, in turn;

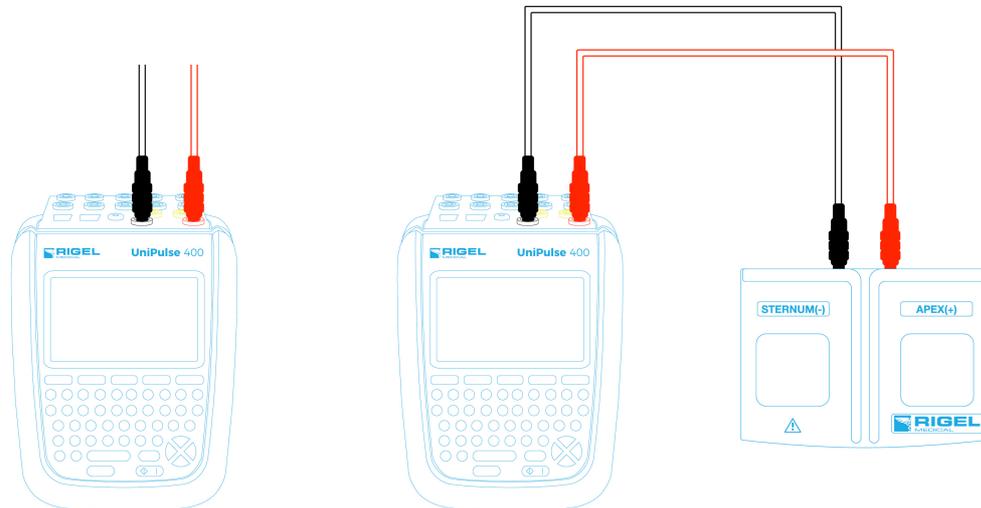
- Telephone number / email and website addresses
- Serial number / Firmware versions / Bluetooth ID
- Calibration status
- Service information



Select  (F1) at any time to exit and return to the **Main Menu**.

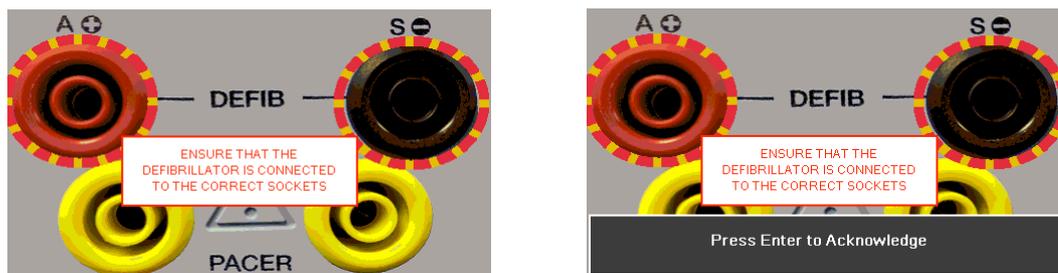
## 5. Analysing Defibrillators

### 5.1. Connecting a Defibrillator to the UniPulse 400



The defibrillator or AED under test can be connected directly to the UniPulse 400 using 4mm connectors, or the Paddle Adaptor Box can be used as shown above.

 Do not use the defibrillator to shock the PACER or ECG terminals

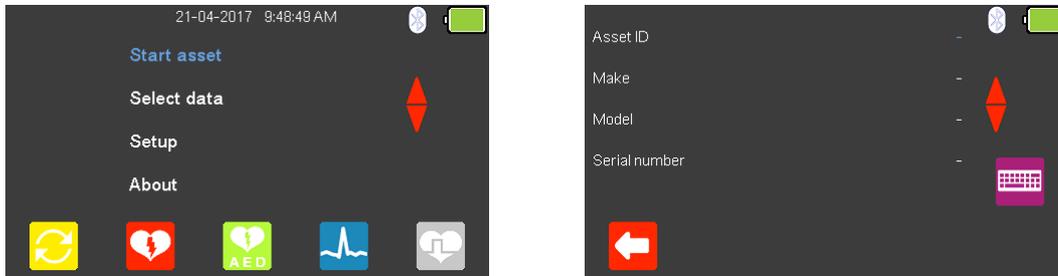


Note 1; to enter the Defibrillator Pulse or AED mode you have to accept the connections warning, using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.

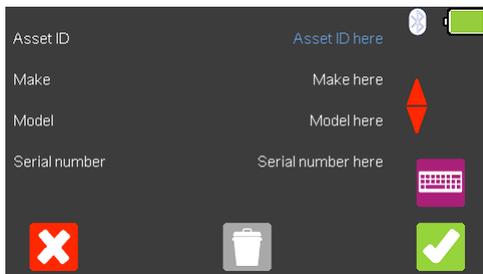
Note 2; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.

## 5.2. Start Asset Option – Saving Test Results

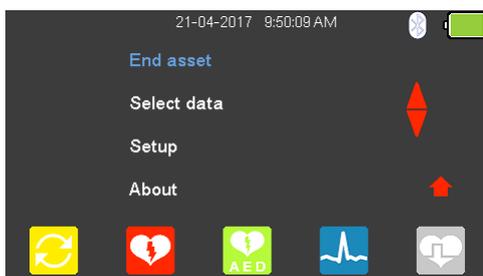
If the tests you are about to perform require the results to be saved then the **Start asset** option needs to be selected from the **Main Menu**, using  (F1), this displays a new asset option;



The **Asset ID**, **Make**, **Model** and **Serial Number** of the appliance under test can be added, to exit without saving select  (F1).

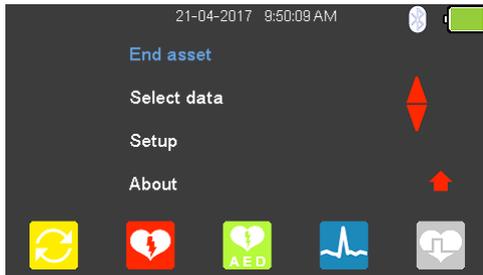


To confirm the asset details select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).

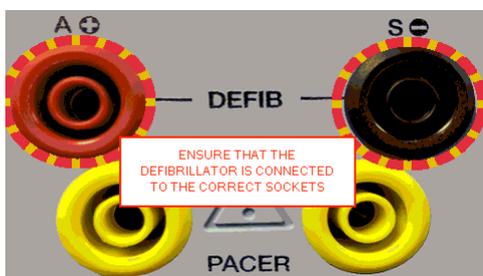


Selecting  (F5) returns the instrument to the **Main Menu**, however, the **Start asset** option is now displayed as **End asset**. Note; if **End asset** is selected the display reverts back to **Start asset** and the asset details previously entered can no longer be used.

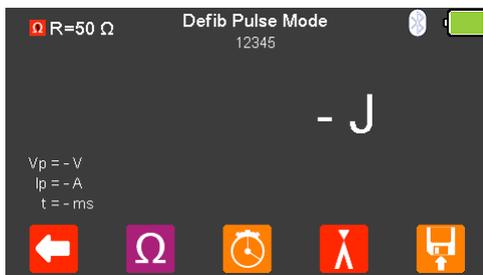
### 5.3. Testing Defibrillator Energy Discharge



From the **Main Menu** select  (F2) for Defibrillator mode.



To enter the **Defibrillator Pulse mode** you have to accept the connections warning, using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.



Do not use the defibrillator to shock the PACER or ECG terminals

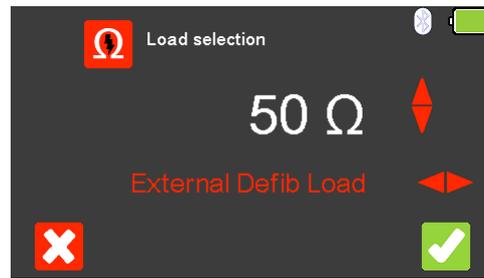
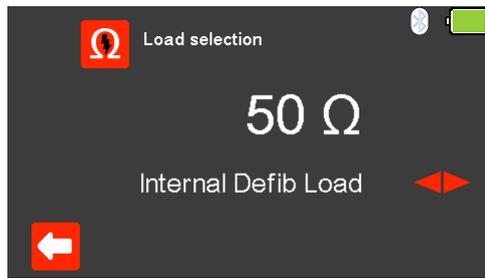


Charge the defibrillator. Once the defibrillator is charged, use the shock/discharge button to safely deliver the electrical energy into the UniPulse 400.



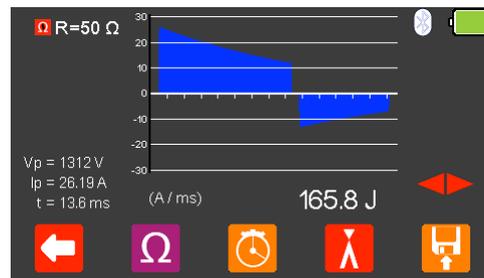
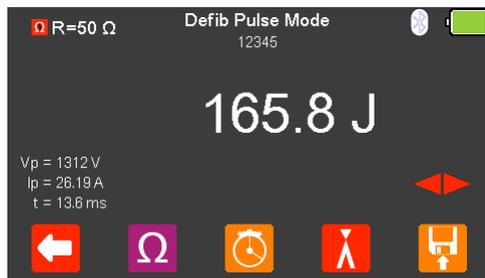
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.

From the **Defib Pulse Mode** Menu select  $\Omega$  (F2) to alter the Defib **Load selection**.



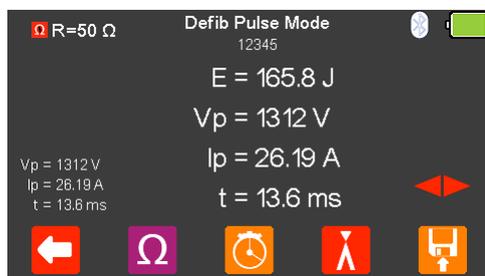
To exit without changing select  (F1). Use the   arrow keys to select either the **Internal Defib Load** (fixed at 50Ω) or **External Defib Load** (variable between 25 and 200Ω, use the   arrow keys to select the external Defib load resistance). To confirm the load select  (F5) or to exit without changing the resistance select  (F1).

Note; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.



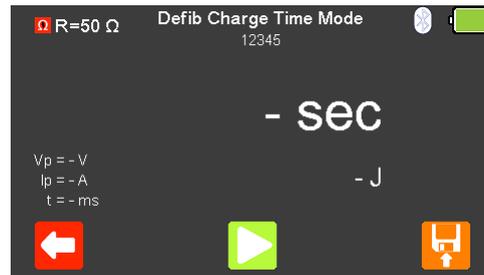
The measured energy will be displayed on the UniPulse 400 screen as well as the peak voltage, peak current and pulse duration.

Use the   arrow keys to view the waveform graph and a measurement summary.



Select  (F5) to save the test result or  (F1) to exit.

## 5.4. Testing Charge Time



From the **Defib Pulse Mode** menu select  (F3) for **Defib Charge Time Mode**.



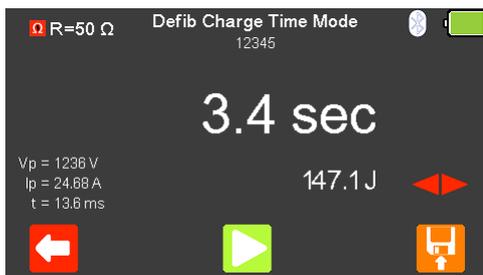
Do not use the defibrillator to shock the PACER or ECG terminals



Charge the defibrillator. Once the defibrillator is charged, use the shock/discharge button to safely deliver the electrical energy into the UniPulse 400.

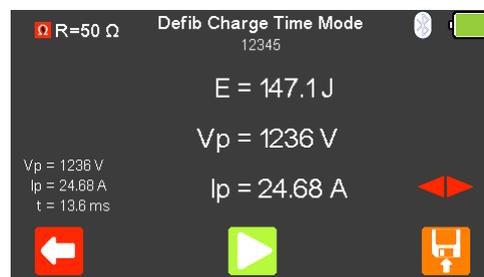
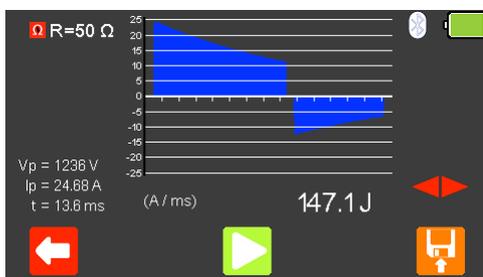


Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



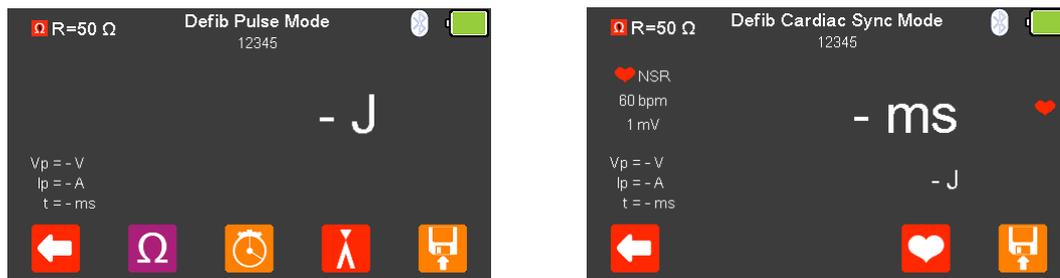
To accurately measure charge time the defibrillator charge must be initiated at exactly the same time as  (F3) is selected to begin the timer.

Once the energy discharge is registered by the UniPulse 400 the timer will stop.



The measured energy will be displayed on the UniPulse 400 screen as well as the peak voltage, peak current and pulse duration. Select the  key to view the waveform graph and a measurement summary. Select  (F5) to save the test result or  (F1) to exit.

## 5.5. Testing Cardiac Synchronisation



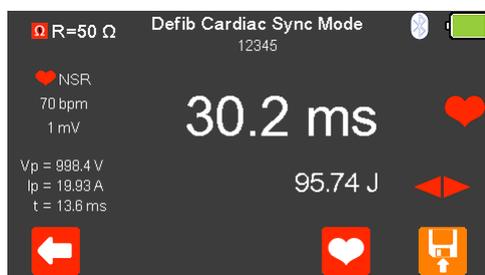
From the **Defib Pulse Mode** menu select  (F4) for **Defib Cardiac Sync Mode**. The UniPulse 400 is now ready to measure the cardiac synchronisation time.

Use  (F4) to change the **Heart rate selection** to values between 20 and 115 BPM. Note; values can be typed in using the keyboard  and either saved using  (F5) or cancelled with  (F1). To exit without changing select  (F1).

 Do not use the defibrillator to shock the PACER or ECG terminals

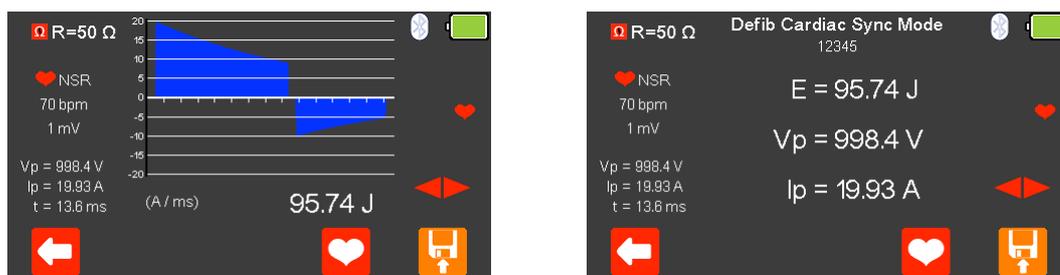
 Charge the defibrillator. Once the defibrillator is charged, use the shock/discharge button to safely deliver the electrical energy into the UniPulse 400.

 Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



The cardiac synchronisation time will be displayed on the UniPulse 400 screen as well as the measured energy, peak voltage, peak current and pulse duration.

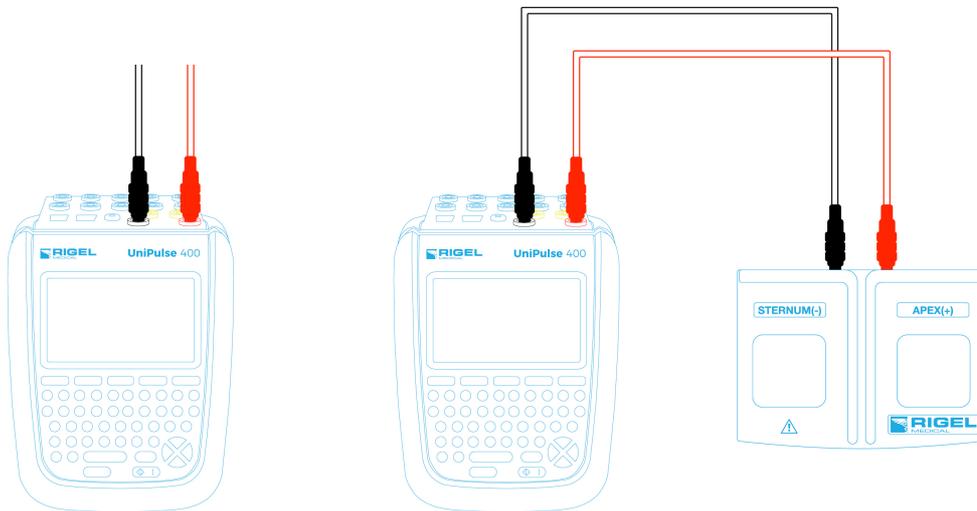
Select the   key to view the waveform graph and a measurement summary.



Press  (F5) to save the test result or  (F1) to exit.

## 6. Analysing Automated External Defibrillators (AED)

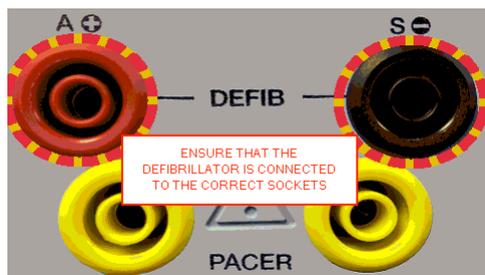
### 6.1. Connecting a Defibrillator to the UniPulse 400



The defibrillator or AED under test can be connected direct to the UniPulse 400 using 4mm connectors, or the Paddle Adaptor Box can be used as shown above.



Do not use the defibrillator to shock the PACER or ECG terminals



Note 1; to enter the Defibrillator Pulse or AED mode you have to accept the connections warning, using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.

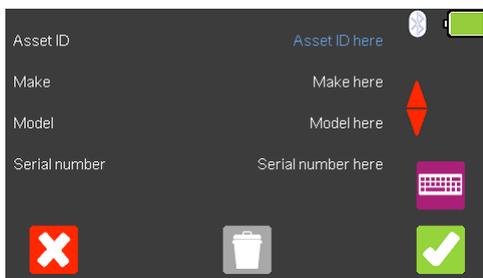
Note 2; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.

## 6.2. Start Asset Option – Saving Test Results

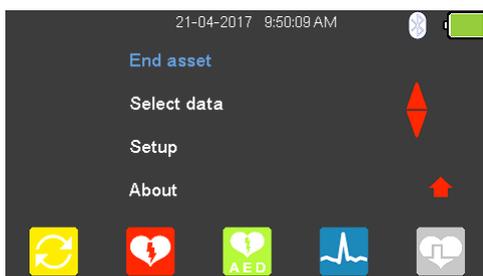
If the tests you are about to perform require the results to be saved then the **Start asset** option needs to be selected from the **Main Menu**, using  (F1), this displays a new asset option;



The **Asset ID**, **Make**, **Model** and **Serial Number** of the appliance under test can be added, to exit without saving select  (F1).

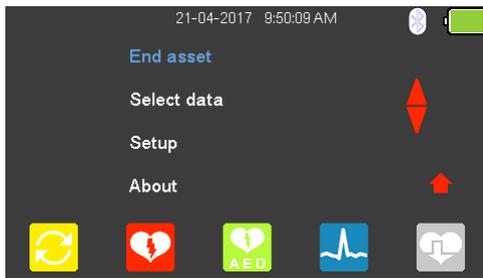


To confirm the asset details select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



Selecting  (F5) returns the instrument to the **Main Menu**, however, the **Start asset** option is now displayed as **End asset**. Note; if **End asset** is selected the display reverts back to **Start asset** and the asset details previously entered can no longer be used.

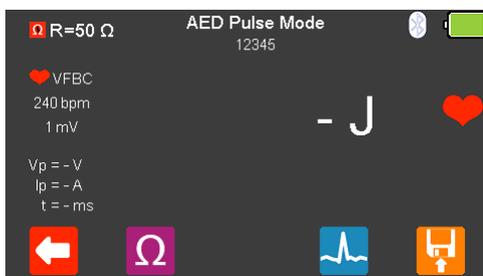
### 6.3. Testing AED Energy Discharge



From the **Main Menu** select  (F3) for **AED mode**.



To enter the **AED Pulse mode** you have to accept the connections warning using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.



Do not use the defibrillator to shock the PACER or ECG terminals

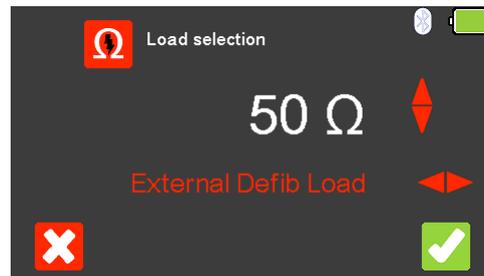
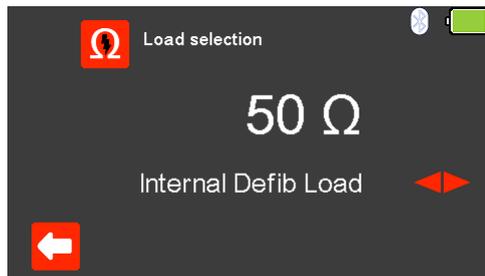


If a shock is advised, use the shock/discharge button to safely deliver the electrical energy into the UniPulse 400.



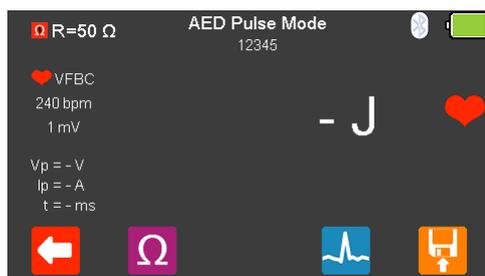
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.

From the **AED Pulse Mode** Menu select  (F2) to alter the Defib **Load selection**.



To exit without changing select  (F1). Use the   arrow keys to select either the **Internal Defib Load** (fixed at 50Ω) or **External Defib Load** (variable between 25 and 200Ω, use the  arrow keys to select the external Defib load resistance). To confirm the load select  (F5) or to exit without changing the resistance select  (F1).

Note; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.



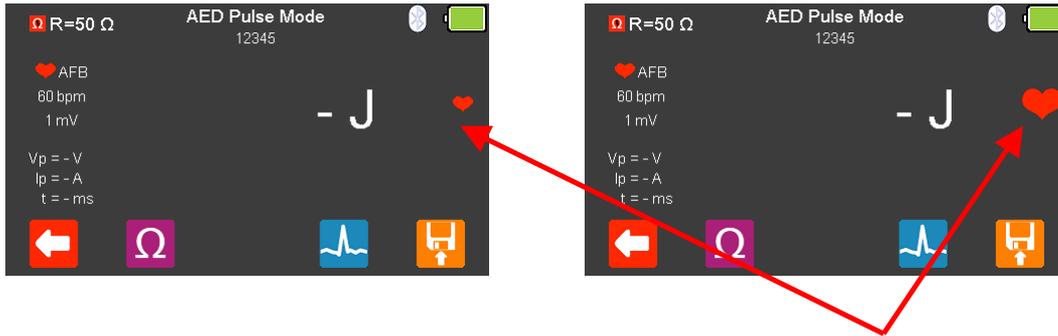
Select  (F4) to change the output waveform of the UniPulse 400.

Use the   arrow keys to scroll through the available rhythms:

The following AED Waveforms are available:

AED Pulse Mode Waveforms	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Asystole (ASYS)	
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 1.00mV(±2%)

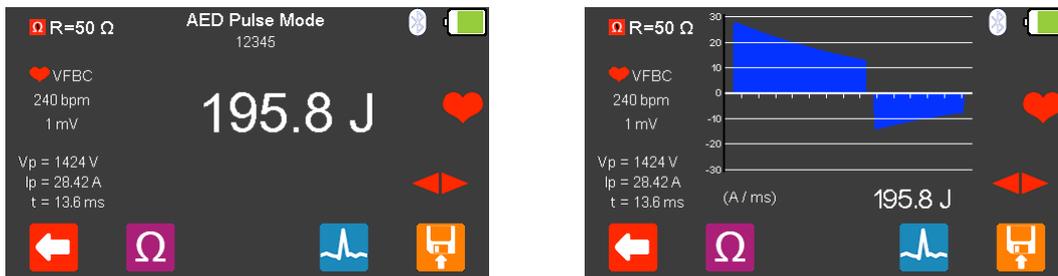
Where applicable, select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM. This is only available for NSR and AFB (VFBC, VFBF, and MVT are set to a default). Note; values can be typed in via the keyboard and either saved using  (F5) or cancelled with  (F1).



The simulation (output from the UniPulse 400) is active when the red heart symbol is pulsing.

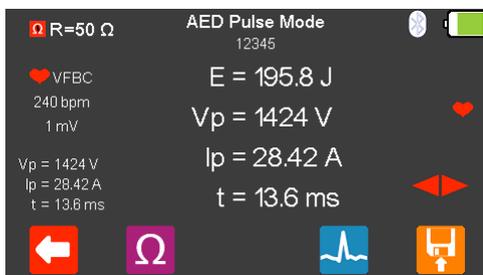
Power on the AED and follow the instructions. The AED will monitor the output rhythm and confirm whether a shock is necessary.

-  Do not use the defibrillator to shock the PACER or ECG terminals
-  If a shock is advised, use the shock/discharge button to safely deliver the electrical energy into the UniPulse 400.
-  Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



The measured energy will be displayed on the UniPulse 400 screen as well as the peak voltage, peak current and pulse duration.

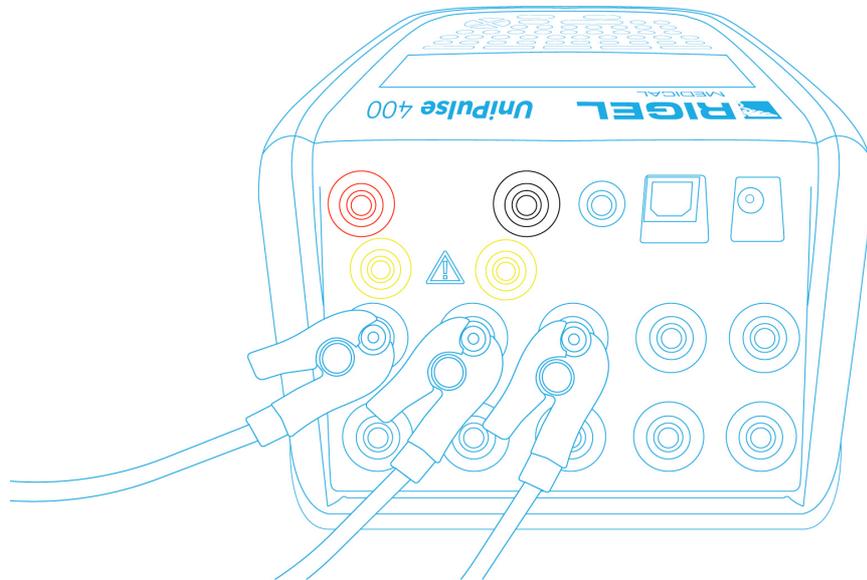
Press the   key to view the waveform graph and a measurement summary.



Press  (F5) to save the test result or  (F1) to exit.

## 7. Simulating ECG Waveforms

### 7.1. Connecting ECG leads to the UniPulse 400



Use the supplied ECG snap connectors to connect ECG leads to the 4mm ECG terminals on the rear of the UniPulse 400. The ECG connectors are colour coded as per international standards.



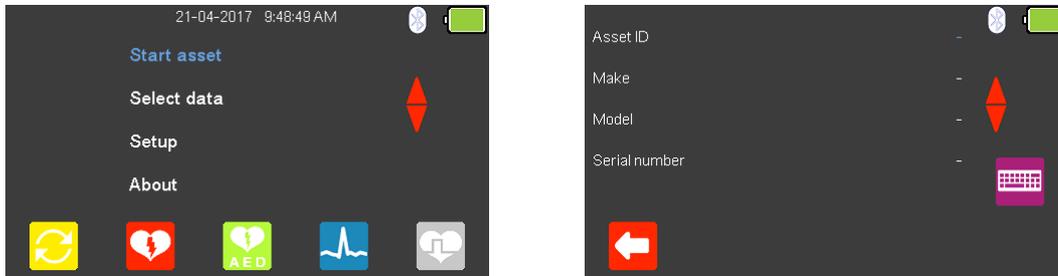
Do not use the defibrillator to shock the PACER or ECG terminals



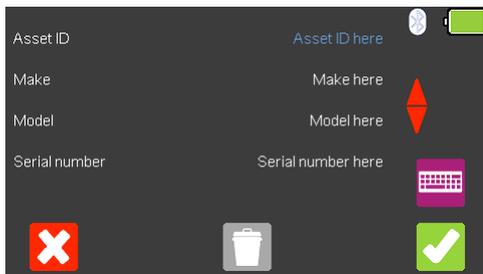
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.

## 7.2. Start Asset Option – Saving Test Results

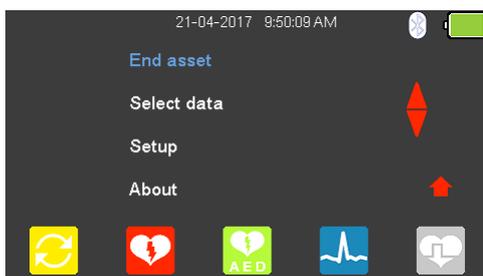
If the tests you are about to perform require the results to be saved then the **Start asset** option needs to be selected from the **Main Menu**, using  (F1), this displays a new asset option;



The **Asset ID**, **Make**, **Model** and **Serial Number** of the appliance under test can be added, to exit without saving select  (F1).

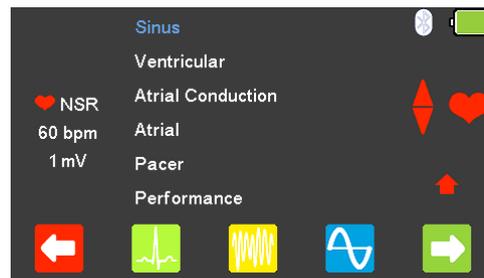
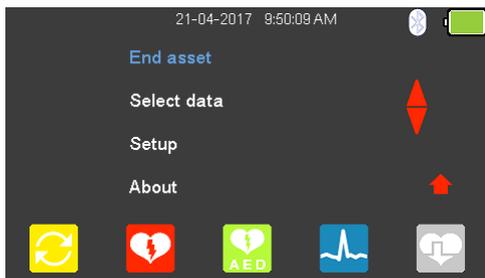


To confirm the asset details select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).

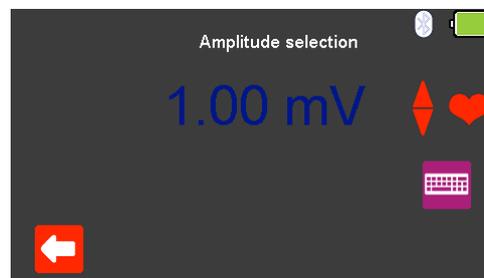
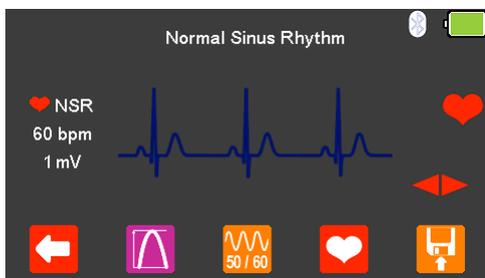


Selecting  (F5) returns the instrument to the **Main Menu**, however, the **Start asset** option is now displayed as **End asset**. Note; if **End asset** is selected the display reverts back to **Start asset** and the asset details previously entered can no longer be used.

### 7.3. Simulating an ECG Sinus Waveform

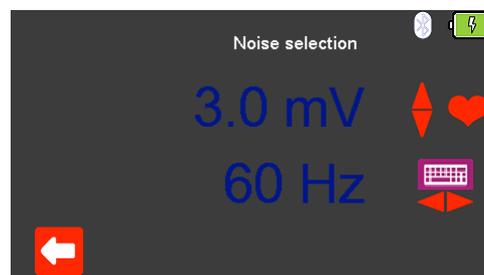
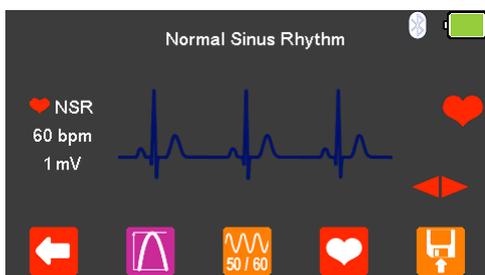


From the **Main Menu** select  (F4) for ECG simulation and either select  (F2), or highlight **Sinus** using the  arrow keys and confirm using the ↵ (return) key or select  (F5).



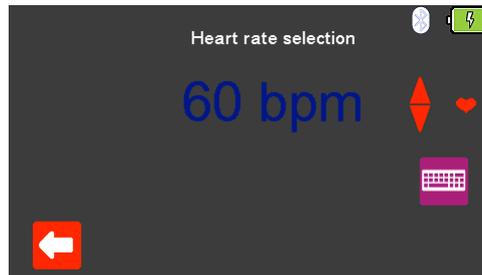
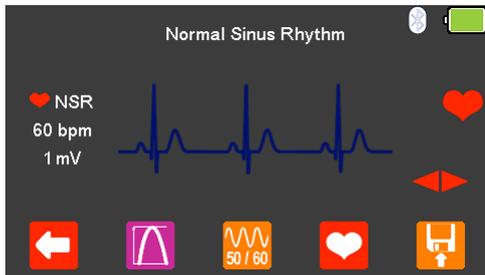
Use the   arrow keys to move between the available simulation waveforms. If applicable, select  (F2) to change the **Amplitude selection** to a fixed value  between 0.5mV to 5.0mV, changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



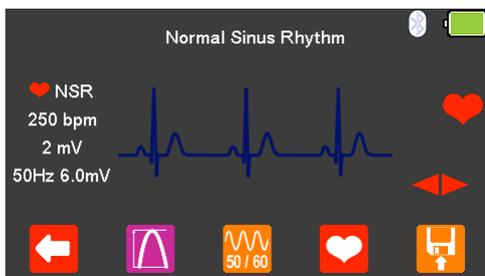
Select  (F3) to change the **Noise selection** to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys), changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



Select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM, where applicable, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



The **Heart rate, Amplitude, and Noise** settings are displayed on the left hand side of the display.

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

The following ECG Waveforms are available:

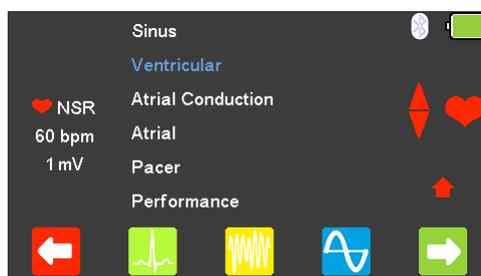
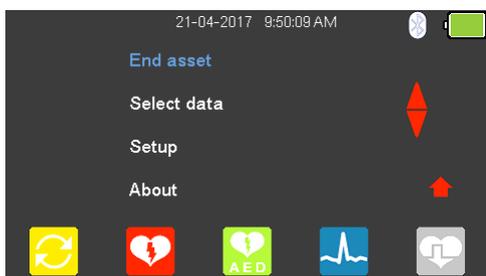
ECG Waveforms – Sinus

Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
ST Elevation (STE)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
ST Depression (STD)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Myocardial Infarction (MI)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Tall T (TT)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Asystole (ASYS)	

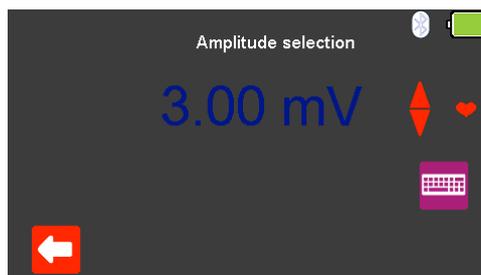
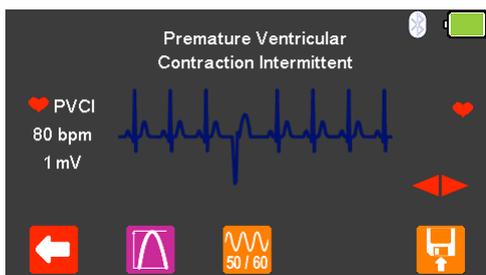
ECG Noise Selection

Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

## 7.4. Simulating an ECG Ventricular Arrhythmia Waveform



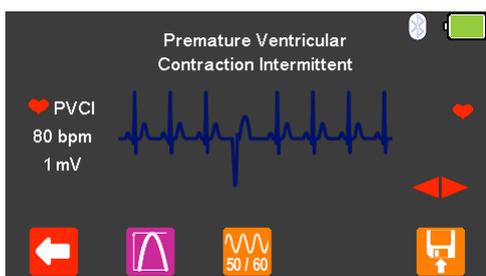
From the **Main Menu** select  (F4) for ECG simulation and either select  (F3), or highlight **Ventricular** using the  arrow keys and confirm using the ↵ (return) key or select  (F5).



Use the   arrow keys to move between the available simulation waveforms.

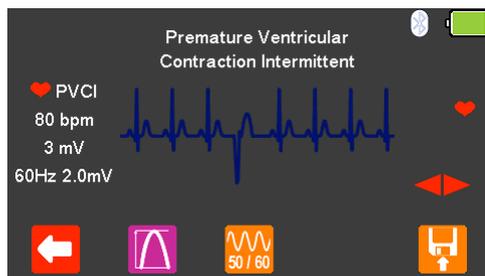
If applicable, select  (F2) to change the **Amplitude selection** to a fixed value  between 0.5mV to 5.0mV, changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



Select  (F3) to change the **Noise selection** to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys), changes are made using the   arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



The **Heart rate**, **Amplitude**, and **Noise** settings are displayed on the left hand side of the display.

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

The following ECG Waveforms are available:

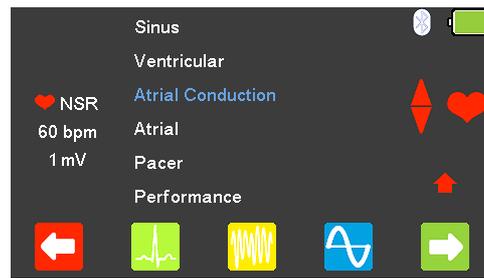
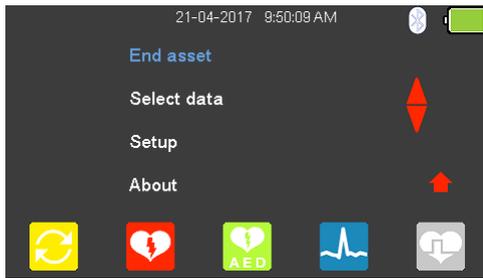
ECG Waveforms – Ventricular Arrhythmias

Premature Ventricular Contraction - Intermittent (PVC)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Bigeminy (BIG)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Trigeminy (TRIG)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Right-focal Premature Ventricular Contraction (RFPVC)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Ventricular Flutter (VFLT)	240 BPM, Amplitude 0.50 - 5.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 0.50 - 5.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 0.50 - 5.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 0.50 - 5.00mV(±2%)

ECG Noise Selection

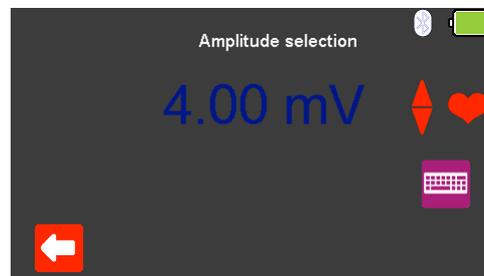
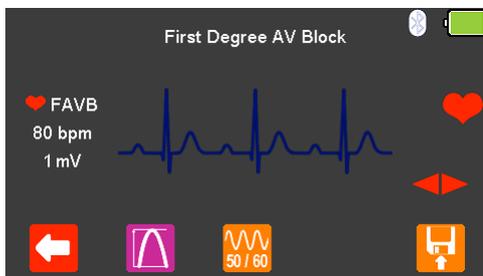
Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

## 7.5. Simulating an ECG Atrial Conduction Waveform



From the **Main Menu** select  (F4) for ECG simulation and highlight **Atrial**

**Conduction** using the  arrow keys and confirm using the ↵ (return) key or select  (F5).

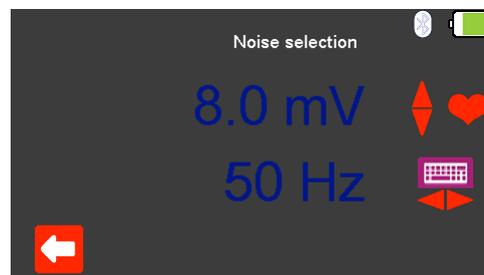
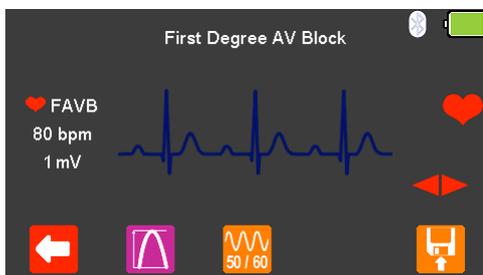


Use the   arrow keys to move between the available simulation waveforms.

If applicable, select  (F2) to change the **Amplitude selection** to a fixed value

between 0.5mV to 5.0mV, changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

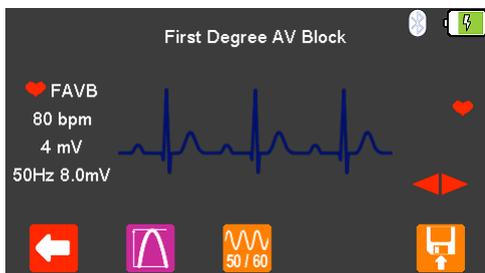


Select  (F3) to change the **Noise selection** to a fixed value between 0mV to

10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys),

changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



The **Heart rate**, **Amplitude**, and **Noise** settings are displayed on the left hand side of the display.

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

The following ECG Waveforms are available:

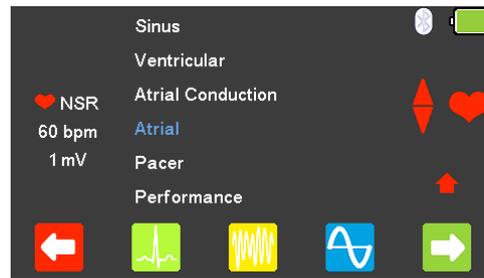
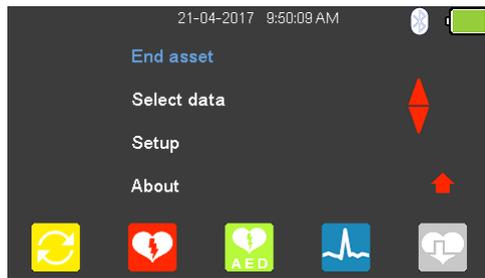
ECG Waveforms – Atrial Conduction Arrhythmias

First Degree AV Block (FAVB)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Second Degree AV Block - Mobitz I (SAVB_MI)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Second Degree AV Block - Mobitz II (SAVB_MII)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Third Degree AV Block (TAVB)	50 BPM, Amplitude 0.50 - 5.00mV(±2%)

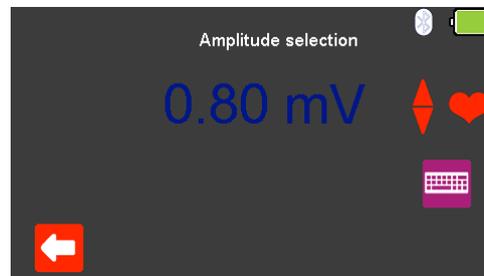
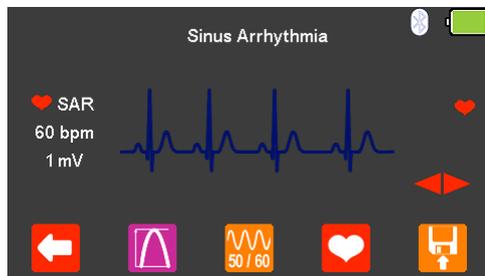
ECG Noise Selection

Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

## 7.6. Simulating an ECG Atrial Waveform



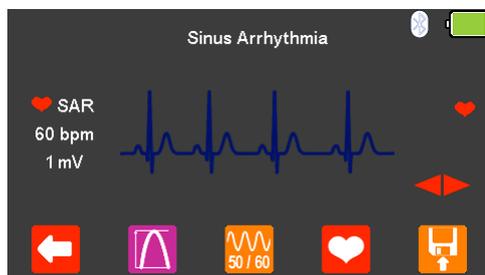
From the **Main Menu** select  (F4) for ECG simulation and highlight **Atrial** using the  arrow keys and confirm using the  (return) key or select  (F5).



Use the   arrow keys to move between the available simulation waveforms.

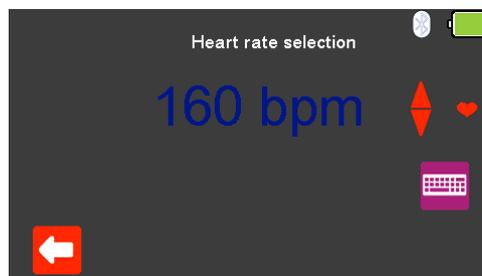
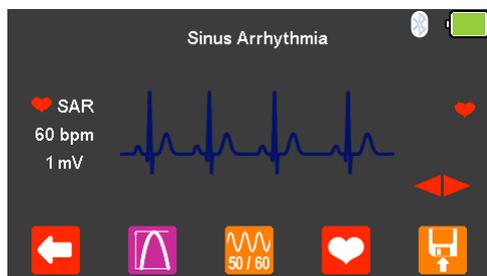
Select  (F2) to change the **Amplitude selections** to a fixed value between 0.5mV to 5.0mV, changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



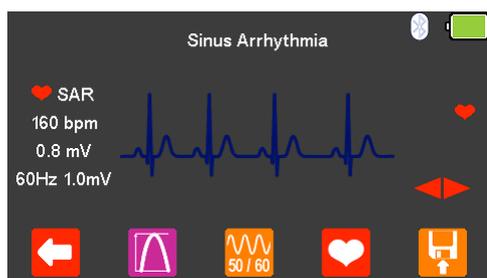
Select  (F3) to change the **Noise selection** to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys), changes are made using the  arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



Where applicable, select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



The **Heart rate**, **Amplitude**, and **Noise** settings are displayed on the left hand side of the display.

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

The following ECG Waveforms are available:

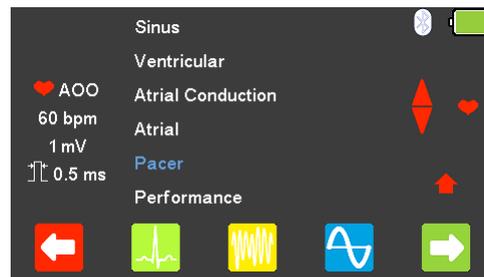
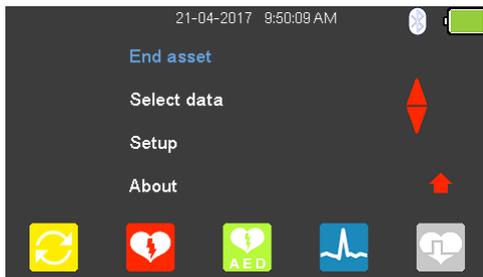
#### ECG Waveforms – Atrial Arrhythmias

Sinus Arrhythmia (SAR)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Missing Beat (MB)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Atrial Flutter (AFLT)	300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Paroxysmal Atrial Tachycardia (PAT)	180 BPM, Amplitude 0.50 - 5.00mV(±2%)
Premature Junctional Contraction (PJC)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)

#### ECG Noise Selection

Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

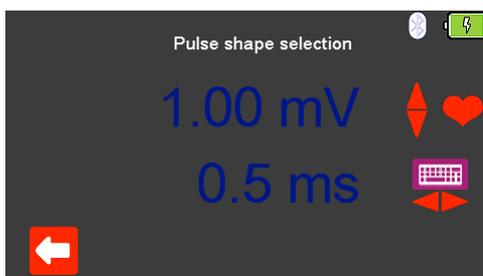
## 7.7. Simulating an ECG Pacer Waveform



From the **Main Menu** select  (F4) for ECG simulation and highlight **Pacer** using the  arrow key, then use the  arrow key and confirm using the ↵ (return) key or select  (F5).



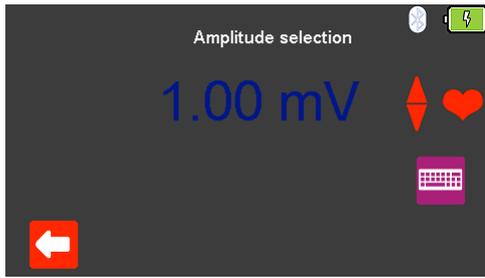
Use the   arrow keys to move between the available simulation waveforms.



If applicable, select  (F2) to change the **Pulse shape selection** to a fixed amplitude between 0.5mV to 5.0mV, changes are made using the   arrow keys. Selecting  (F1) confirms this selection.

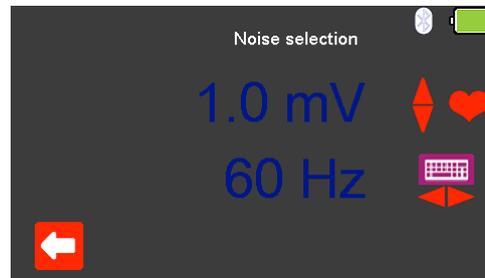
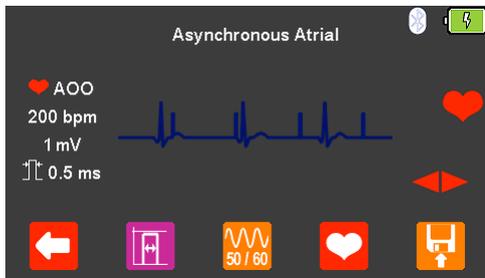
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

The time period can be set to a value between 0.1ms and 2.0ms, using the   arrow keys. Finally, selecting  (F1) or using  (F5) confirms these selections.

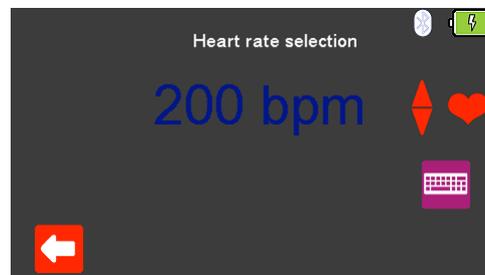
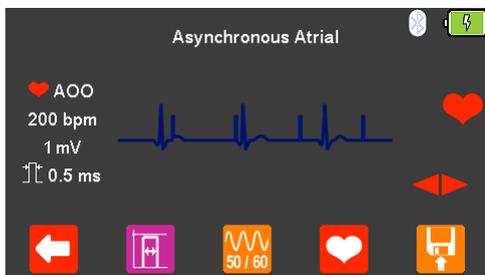


If applicable, select  (F2) to change the **Amplitude selection** to a fixed value between 0.5mV to 5.0mV, changes are made using the   arrow keys, selecting  (F1) confirms this selection.

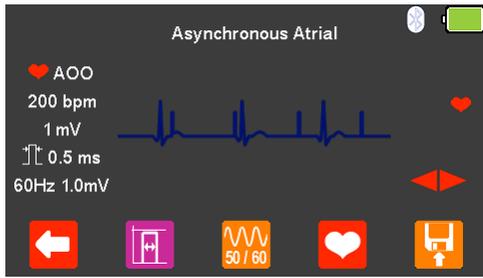
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



Select  (F3) to change the **Noise selection** to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys), changes are made using the   arrow keys, selecting  (F1) confirms this selection. Note; values can be typed in  using the keyboard and either saved using  (F5) or cancelled with  (F1).



Select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM, selecting  (F1) confirms this selection. Note; values can be typed in  using the keyboard and either saved using  (F5) or cancelled with  (F1).



The **Heart rate**, **Amplitude**, and **Noise** settings are displayed on the left hand side of the display.

After testing is complete select (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

The following ECG Waveforms are available:

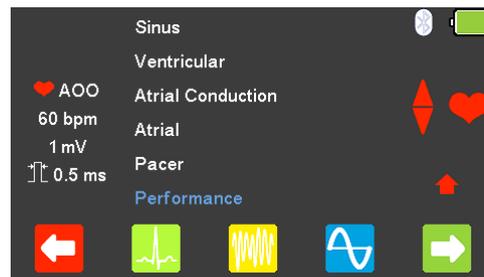
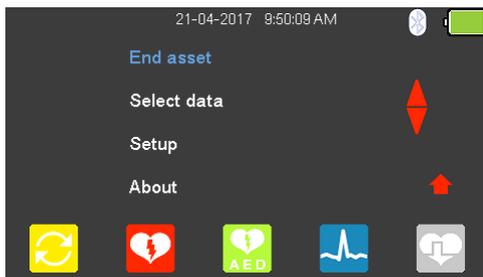
ECG Pacer Waveforms

Asynchronous Atrial (AOO)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Synchronous Atrial (AAI)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Ventricular Pacer (VVI)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Atrial & Ventricular Pacer (DDD)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
R-Wave Detection (RWD)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV
Pacer (PCR)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms

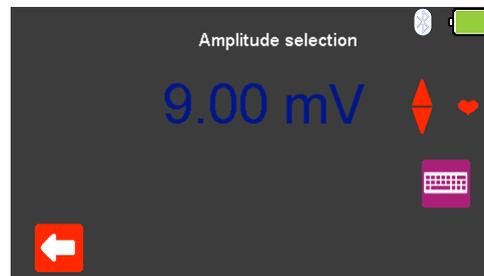
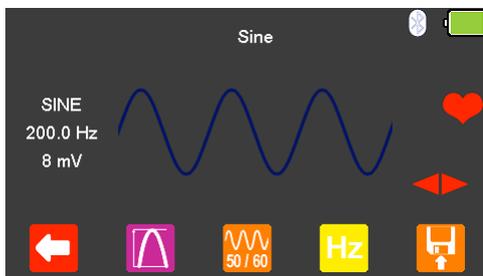
ECG Noise Selection

Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

## 7.8. Simulating an ECG Performance Waveform



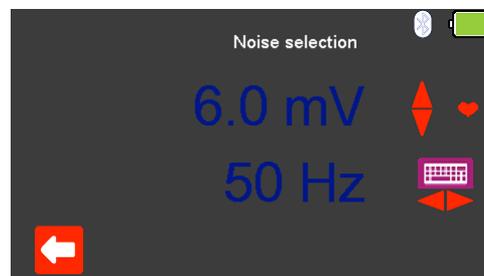
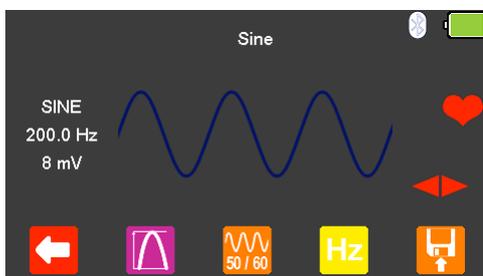
From the **Main Menu** select  (F4) for ECG simulation and either select  (F4), or highlight **Performance** using the  arrow keys and confirm using the  $\downarrow$  (return) key or select  (F5).



Use the   arrow keys to move between the available simulation waveforms.

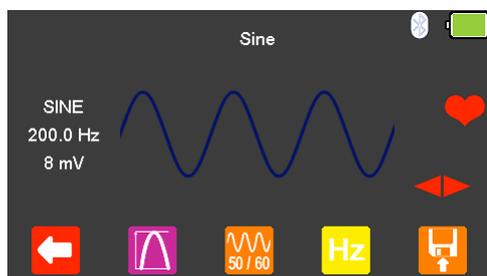
Select  (F2) to change the **Amplitude selection** to a fixed value between 0.5mV to 5.0mV or 1.0mV to 10.0mV, where applicable, changes are made using the   arrow keys, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



Select  (F3) to change the **Noise selection** to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys), changes are made using the   arrow keys, selecting  (F1) confirms this

selection. Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



Select  (F4) to change the **Frequency selection** to values between 0.1 and 300Hz, selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



The new **Frequency, Amplitude** and **Noise** settings are displayed on the left hand side of the display.

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

The following ECG Waveforms are available:

ECG Performance Waveforms

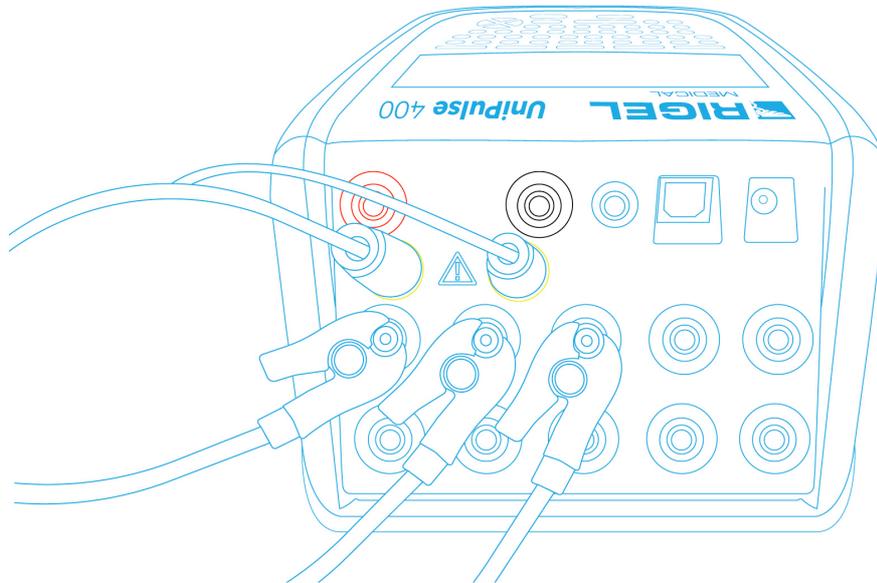
Sine (SINE)	0.1 - 300Hz, 1.00 – 10.00mV
Square (SQ)	0.1 - 300Hz, 1.00 – 10.00mV
Triangle (TRI)	0.1 - 300Hz, 1.00 – 10.00mV
Sawtooth (SAW)	0.1 - 300Hz, 1.00 – 10.00mV
Inverse Sawtooth (INVSAW)	0.1 - 300Hz, 1.00 – 10.00mV
Pulse (PULSE)	0.1 - 300Hz, 0.50 – 5.00mV

ECG Noise Selection

Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

## 8. Analysing Pacers – Invasive set-up (Low Energy)

### 8.1. Connecting an Invasive (Low Energy) Pacer to the UniPulse 400



Connect the Pacer leads to the yellow 4mm PACER terminals on the rear of the UniPulse 400.

Use the supplied ECG snap connectors to connect ECG leads to the 4mm ECG terminals on the rear of the UniPulse 400. The ECG connectors are colour coded as per international standards.



Do not use the defibrillator to shock the PACER or ECG terminals



Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



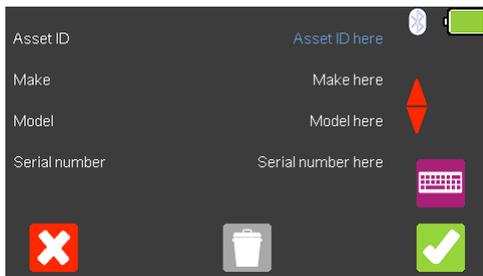
It is possible to test a pacemaker using the internal / external **DEFIB load** (Non-Invasive High Energy set-up). This is necessary to avoid damaging the UniPulse 400 when there is the possibility of the EUT automatically delivering a Defib pulse during pacer testing in response to it recognising a VF pattern or similar in the ECG produced by the UniPulse 400.

## 8.2. Start Asset Option – Saving Test Results (Low Energy)

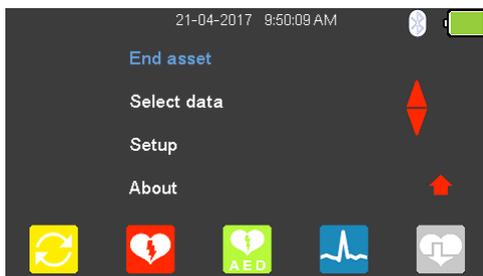
If the tests you are about to perform require the results to be saved then the **Start asset** option needs to be selected from the **Main Menu**, using  (F1), this displays a new asset option;



The **Asset ID**, **Make**, **Model** and **Serial Number** of the appliance under test can be added, to exit without saving select  (F1).

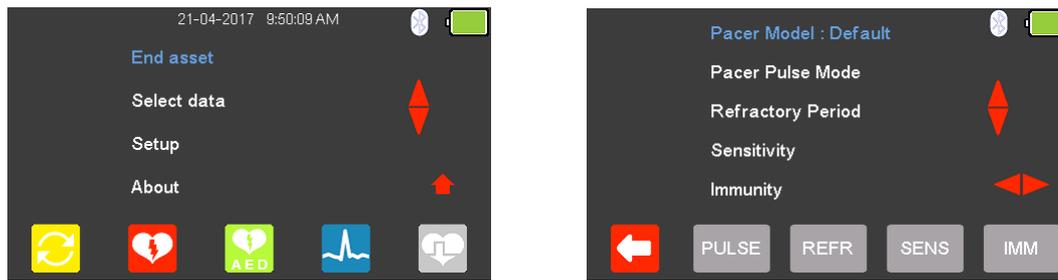


To confirm the asset details select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



Selecting  (F5) returns the instrument to the **Main Menu**, however, the **Start asset** option is now displayed as **End asset**. Note; if **End asset** is selected the display reverts back to **Start asset** and the asset details previously entered can no longer be used.

### 8.3. Testing the Pacer Function (Low Energy)

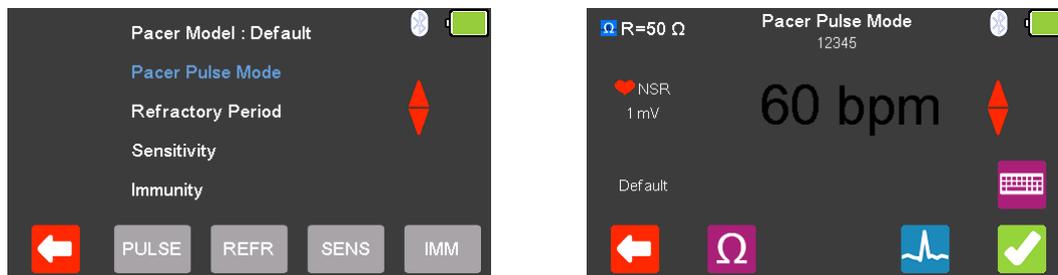


From the **Main Menu** select  (F5) for **Pacer Mode**.

The available Pacer Manufacturer waveforms can be changed by highlighting **Pacer Model : Default**, using the   arrow keys, and a waveform selected using the   arrow keys.

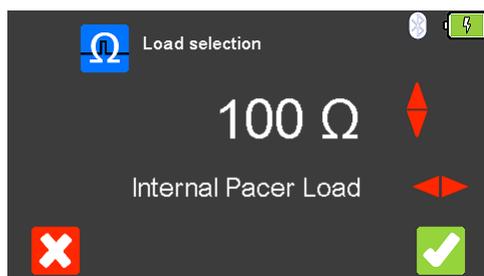
The available Pacer Manufacturer waveforms are: Default, CU Medical, GE, HP, Laerdal, Mindray, Philips, PhysioControl, Schiller, WelchAllyn, and Zoll.

### 8.4. Testing the Pacer Pulse Mode (Low Energy)

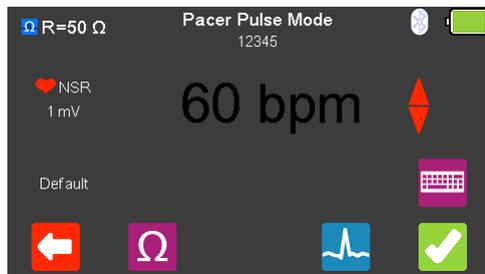


From the **Pacer Menu** use the   arrow keys to highlight **Pacer Pulse Mode** and confirm using the ↵ (return) key or select  (F2).

From the **Pacer Pulse Mode** select  (F2) to alter the **Load selection**.



To exit without changing select  (F1). Use the   key to select the **Internal Pacer Load** (variable between 50 and 1600Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).



From the **Pacer Pulse Mode** select  (F4) to alter the simulation waveform selection. Use the   arrow keys to move between the available simulation waveforms.

The following Waveforms are available:

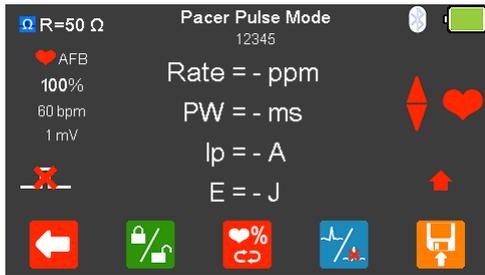
Pacer Pulse Mode Waveforms	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Missing Beat (MB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
R Wave Detection (RWD)	20 - 300 BPM, Amplitude 1.00mV(±2%)

Where applicable, in the simulation waveform selection mode, select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM. Selecting  (F1) confirms this selection.

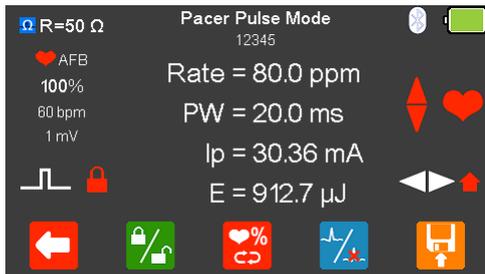
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

Note; where a waveform with variable **Heart rate** is selected the current value is  displayed in the centre of the **Pacer Pulse Mode** screen, using the  arrow keys, or free typing on the keyboard, allows this to be altered.

Once the desired settings have been chosen, **Pacer Pulse Mode** can be tested by selecting  (F5).



If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate, pulse width, peak current and energy are displayed.

The output displayed on the screen can be frozen by selecting  (F2), when selected a red padlock is displayed.

The BPM can be increased to 115% or decreased to 85% of the set value by selecting  (F3).

The waveform can be switched to asystole by selecting  (F4).

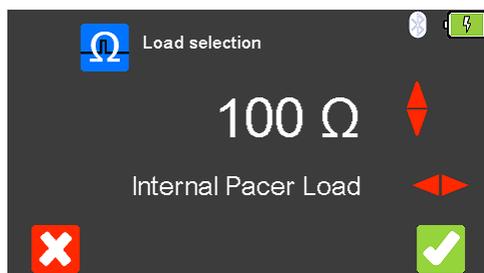
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 8.5. Testing the Refractory Mode (Low Energy)



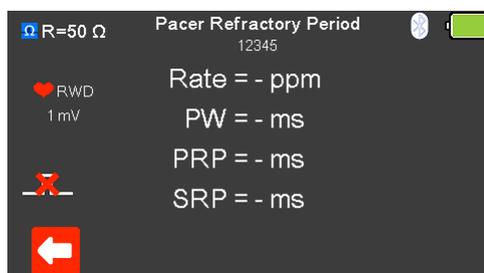
From the **Pacer Menu** use the   arrow keys to highlight **Refractory Period** and confirm using the ↵ (return) key or select  (F3).

From the Pacer **Refractory Period** menu select  (F2) to alter the Load selection.

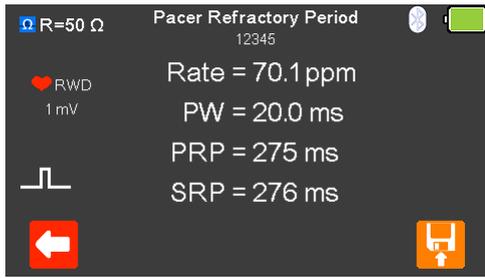


To exit without changing select  (F1). Use the   key to select the **Internal Pacer Load** (variable between 50 and 1600Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

Once the desired load resistance has been chosen, the **Pacer Refractory Period** can be tested by selecting  (F5).



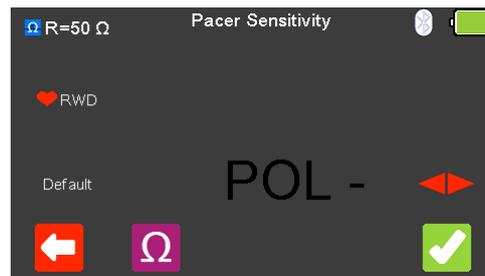
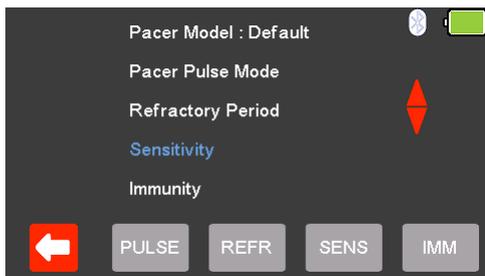
If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate and pulse information are displayed.

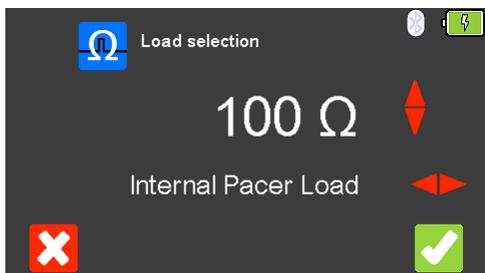
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 8.6. Testing the Pacer Sensitivity (Low Energy)

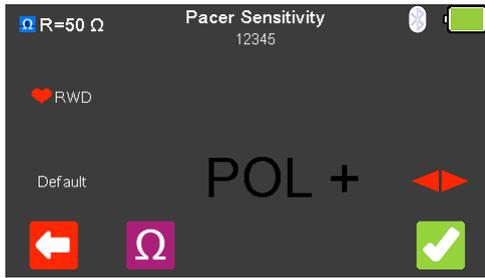


From the **Pacer Menu** use the   arrow keys to highlight **Sensitivity** and confirm using the ↵ key or select  (F4).

From the **Pacer Sensitivity** menu select  (F2) to alter the Load selection.

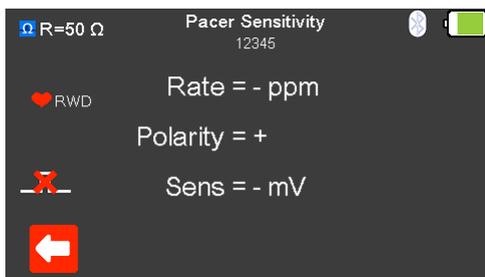


To exit without changing select  (F1). Use the   key to select the **Internal Pacer Load** (variable between 50 and 1600Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

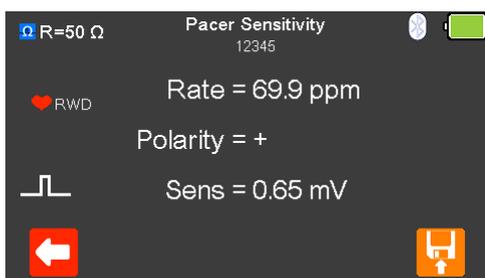


The Polarity of the **Pacer Sensitivity** can be selected using the  arrow key.

Once the desired load resistance and polarity have been chosen, the **Pacer Sensitivity** can be tested by selecting  (F5).



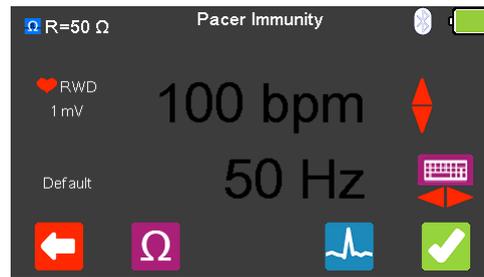
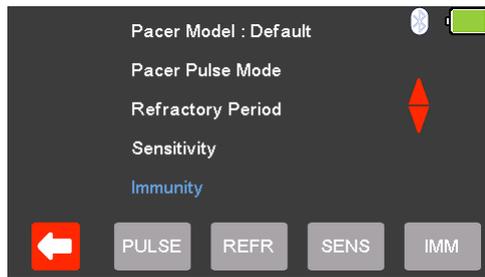
If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate, polarity and sensitivity are displayed.

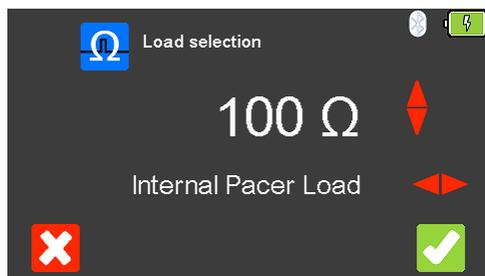
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 8.7. Testing the Pacer Immunity (Low Energy)

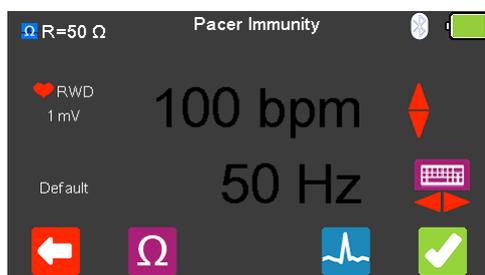


From the **Pacer Menu** use the   arrow keys to highlight Pacer **Immunity** and confirm using the ↵ (**return**) key or select  (F5).

From the **Pacer Pulse Mode** select  (F2) to alter the **Load selection**.



To exit without changing select  (F1). Use the   key to select the **Internal Pacer Load** (variable between 50 and 1600Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).



From the **Pacer Immunity** Menu select  (F4) to alter the simulation waveform selection. Use the   arrow keys to move between the available simulation waveforms.

The following Waveforms are available:

Pacer Pulse Mode Waveforms	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Missing Beat (MB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
R Wave Detection (RWD)	20 - 300 BPM, Amplitude 1.00mV(±2%)

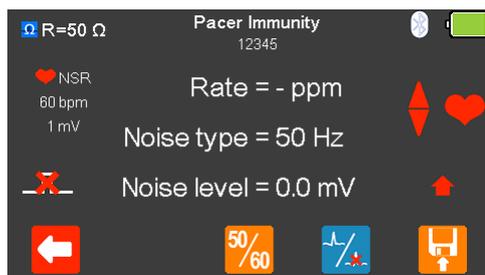
Where applicable, in the simulation waveform selection mode, select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM. Selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

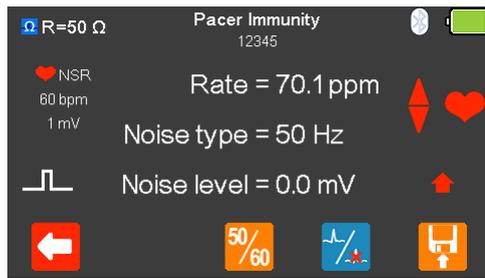
Note; where a waveform with variable **Heart rate** is selected the current value is  displayed in the centre of the **Pacer Pulse Mode** screen, using the  arrow keys, or free typing on the keyboard, allows this to be altered.

Use the   arrow keys to alter the immunity **Noise Type**, to either 50 or 60Hz the available simulation waveforms.

Once the desired settings have been chosen, **Pacer Immunity** can be tested by selecting  (F5).



If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate, noise type and noise level are displayed.

The Noise Type can be alternated between 50 or 60Hz using  (F3).

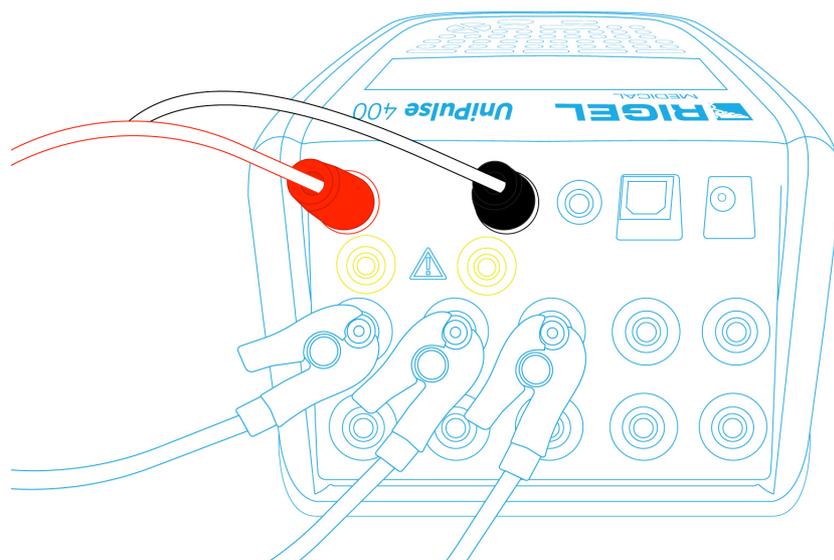
The waveform can be switched to asystole by selecting  (F4).

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 9. Analysing Pacers – Non-Invasive set-up (High Energy)

### 9.1. Connecting a Non-Invasive (High Energy) Pacer to the UniPulse 400

#### Method 1 - Non-Invasive set-up (High Energy)



Connect the Pacer leads to the red and black 4mm DEFIB terminals on the rear of the UniPulse 400.

Use the supplied ECG snap connectors to connect ECG leads to the 4mm ECG terminals on the rear of the UniPulse 400. The ECG connectors are colour coded as per international standards.



Do not use the defibrillator to shock the PACER or ECG terminals

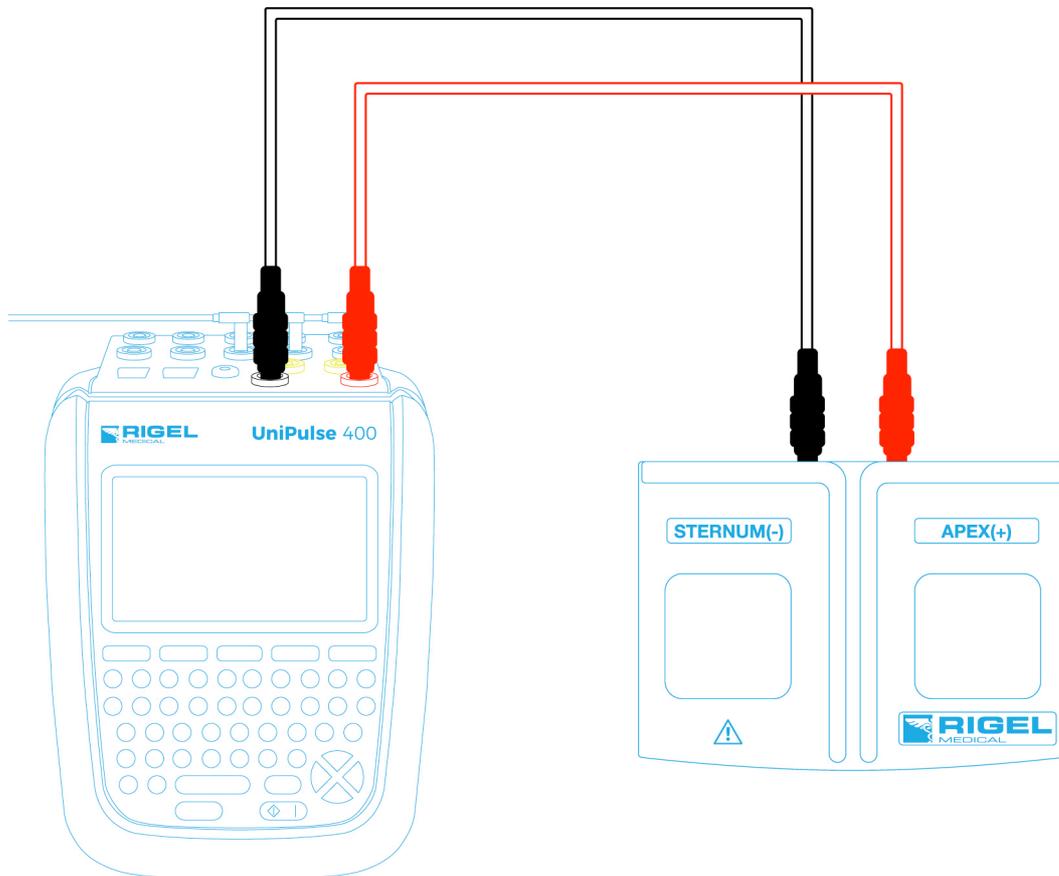


Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



It is possible to test a pacemaker using the internal / external **DEFIB load** (Non-Invasive High Energy set-up). This is necessary to avoid damaging the UniPulse 400 when there is the possibility of the EUT automatically delivering a Defib pulse during pacer testing in response to it recognising a VF pattern or similar in the ECG produced by the UniPulse 400.

## Method 2 - Non-Invasive set-up (High Energy)



Connect the Paddle Adaptor Box using the red and black 4mm leads to the DEFIB terminals on the rear of the UniPulse 400.

Use the supplied ECG snap connectors to connect ECG leads to the 4mm ECG terminals on the rear of the UniPulse 400. The ECG connectors are colour coded as per international standards.



Do not use the defibrillator to shock the PACER or ECG terminals



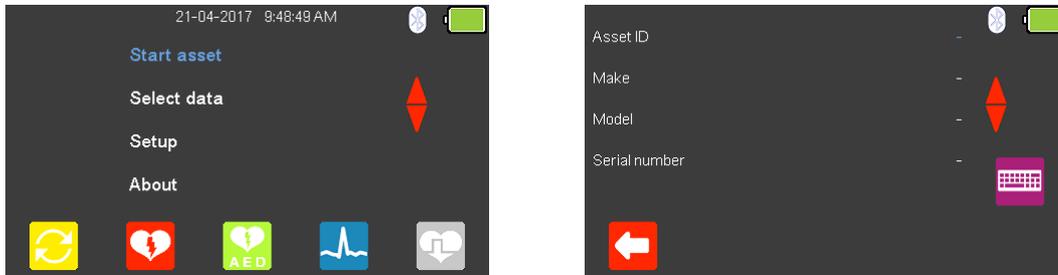
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



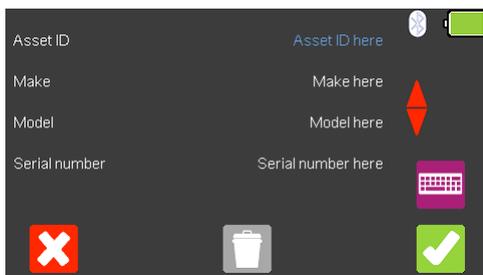
It is possible to test a pacemaker using the internal / external **DEFIB load** (Non-Invasive High Energy set-up). This is necessary to avoid damaging the UniPulse 400 when there is the possibility of the EUT automatically delivering a Defib pulse during pacemaker testing in response to it recognising a VF pattern or similar in the ECG produced by the UniPulse 400.

## 9.2. Start Asset Option – Saving Test Results (High Energy)

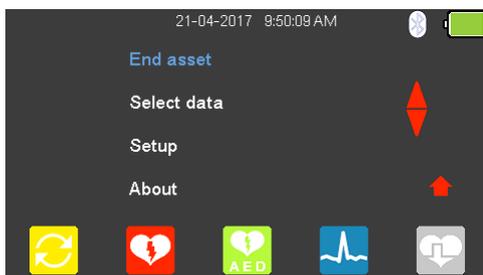
If the tests you are about to perform require the results to be saved then the **Start asset** option needs to be selected from the **Main Menu**, using  (F1), this displays a new asset option;



The **Asset ID**, **Make**, **Model** and **Serial Number** of the appliance under test can be added, to exit without saving select  (F1).

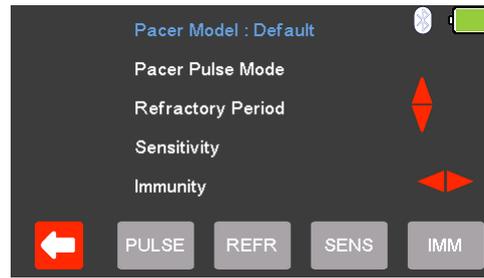
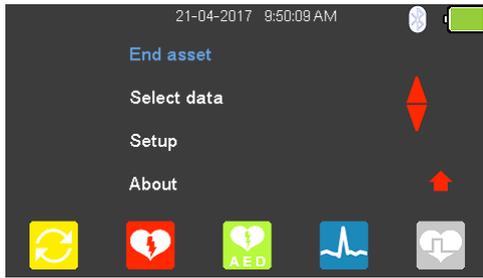


To confirm the asset details select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



Selecting  (F5) returns the instrument to the **Main Menu**, however, the **Start asset** option is now displayed as **End asset**. Note; if **End asset** is selected the display reverts back to **Start asset** and the asset details previously entered can no longer be used.

### 9.3. Testing the Pacer Function (High Energy)



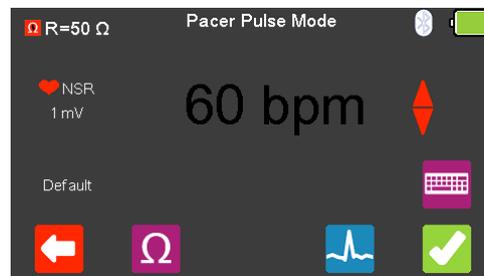
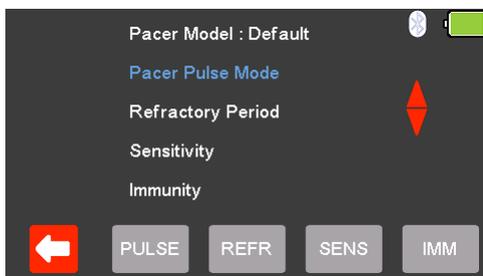
From the **Main Menu** select  (F5) for **Pacer Mode**.

The available Pacer Manufacturer waveforms can be changed by highlighting **Pacer**

**Model : Default**, using the   arrow keys, and a waveform selected using the   arrow keys.

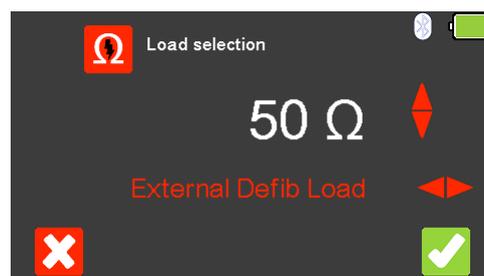
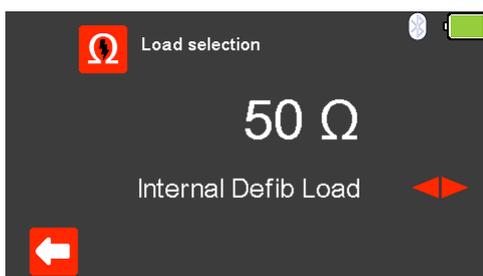
The available Pacer Manufacturer waveforms are: Default, CU Medical, GE, HP, Laerdal, Mindray, Philips, PhysioControl, Schiller, WelchAllyn, and Zoll.

### 9.4. Testing the Pacer Pulse Mode (High Energy)



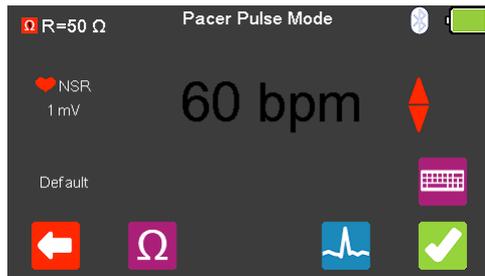
From the **Pacer Menu** use the   arrow keys to highlight **Pacer Pulse Mode** and confirm using the ↵ (return) key or select  (F2).

From the **Pacer Pulse Mode** select  (F2) to alter the **Load selection**.



To exit without changing select  (F1). Use the   key to select either the **Internal Defib Load** (fixed at 50Ω) or **External Defib Load** (variable between 25 and 200Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

Note; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.



From the **Pacer Pulse Mode** select  (F4) to alter the simulation waveform selection. Use the   arrow keys to move between the available simulation waveforms.

The following Waveforms are available:

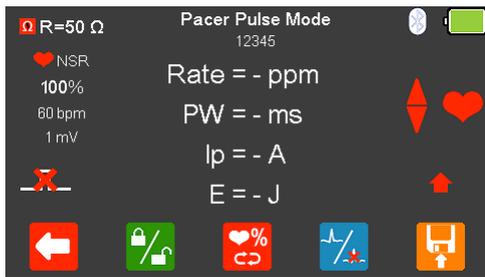
Pacer Pulse Mode Waveforms	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Missing Beat (MB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
R Wave Detection (RWD)	20 - 300 BPM, Amplitude 1.00mV(±2%)

Where applicable, in the simulation waveform selection mode, select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM. Selecting  (F1) confirms this selection.

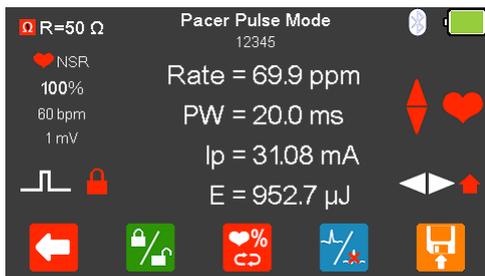
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

Note; where a waveform with variable **Heart rate** is selected the current value is  displayed in the centre of the **Pacer Pulse Mode** screen, using the  arrow keys, or free typing on the keyboard, allows this to be altered.

Once the desired settings have been chosen, **Pacer Pulse Mode** can be tested by selecting  (F5).



If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate, pulse width, peak current and energy are displayed.

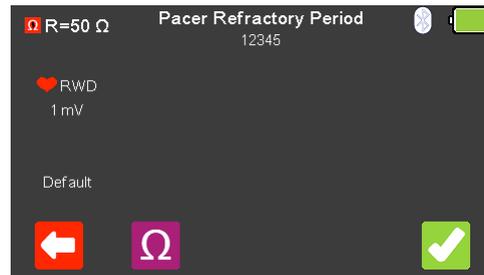
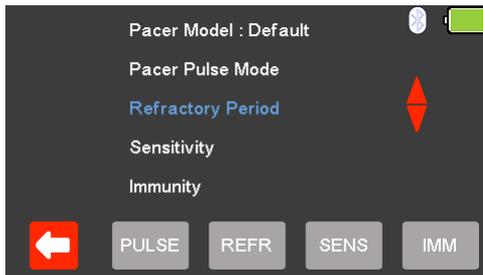
The output displayed on the screen can be frozen by selecting  (F2), when selected a red padlock is displayed.

The BPM can be increased to 115% or decreased to 85% of the set value by selecting  (F3).

The waveform can be switched to asystole by selecting  (F4).

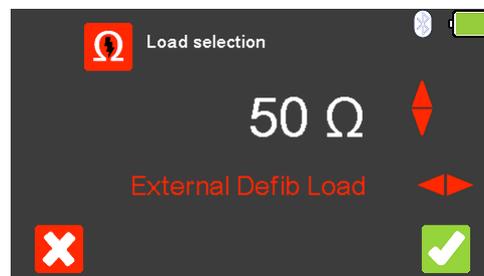
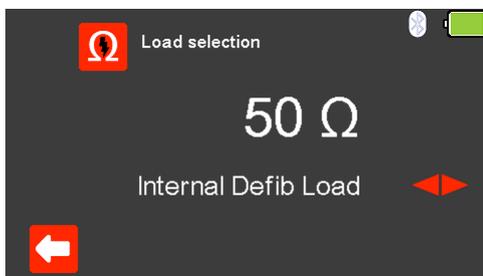
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 9.5. Testing the Refractory Mode (High Energy)



From the **Pacer Menu** use the   arrow keys to highlight **Refractory Period** and confirm using the ↵ (return) key or select  (F3).

From the Pacer **Refractory Period** menu select  (F2) to alter the Load selection.

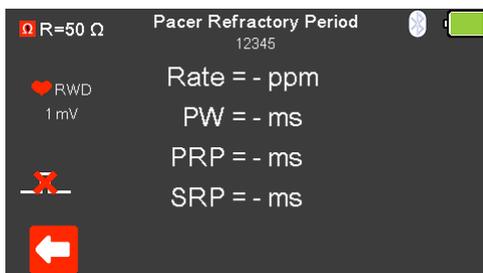


To exit without changing select  (F1). Use the   key to select either the **Internal Defib Load** (fixed at 50Ω) or **External Defib Load** (variable between 25 and

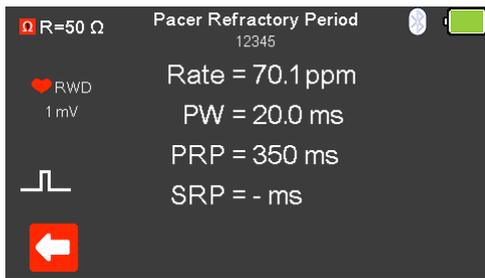
 200Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

Note; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.

Once the desired load resistance has been chosen, the **Pacer Refractory Period** can be tested by selecting  (F5),



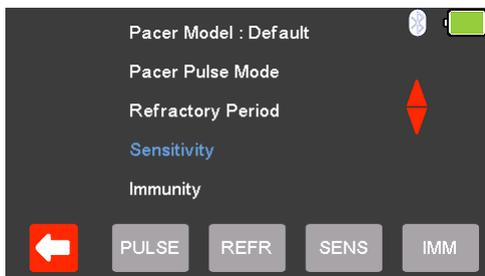
If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate and pulse information are displayed.

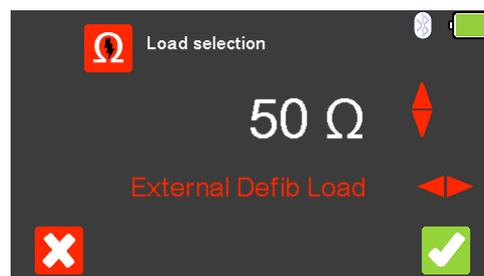
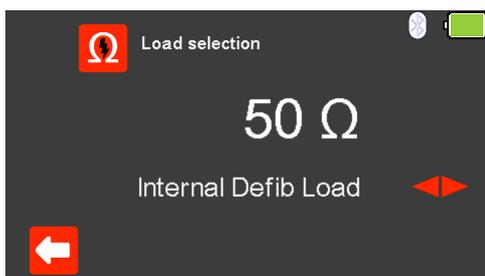
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 9.6. Testing the Pacer Sensitivity (High Energy)



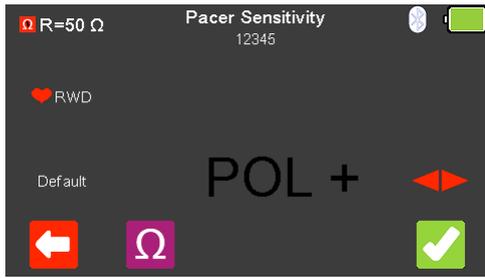
From the **Pacer Menu** use the   arrow keys to highlight **Sensitivity** and confirm using the  key or select  (F4).

From the **Pacer Sensitivity** menu select  (F2) to alter the Load selection.



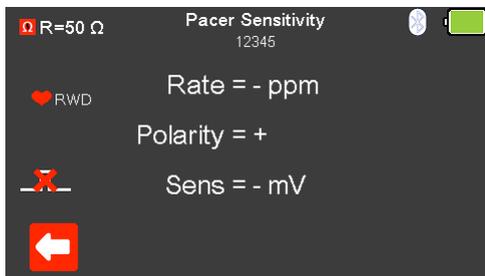
To exit without changing select  (F1). Use the   key to select either the **Internal Defib Load** (fixed at 50Ω) or **External Defib Load** (variable between 25 and 200Ω), use the   arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

Note; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.

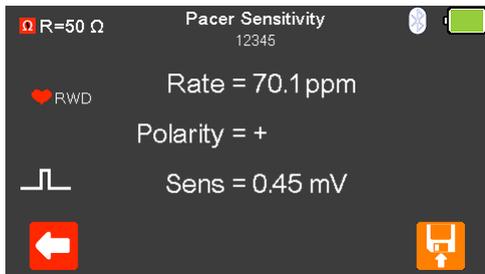


The Polarity of the **Pacer Sensitivity** can be selected using the  arrow key.

Once the desired load resistance and polarity have been chosen, the **Pacer Sensitivity** can be tested by selecting  (F5).



If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



With the EUT pacing, the rate, polarity and sensitivity are displayed.

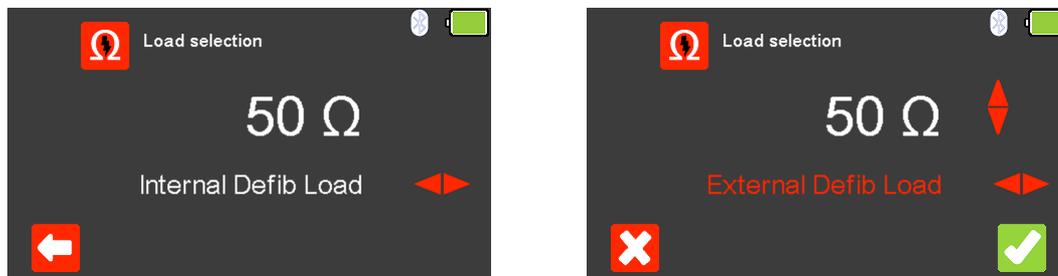
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

## 9.7. Testing the Pacer Immunity (High Energy)



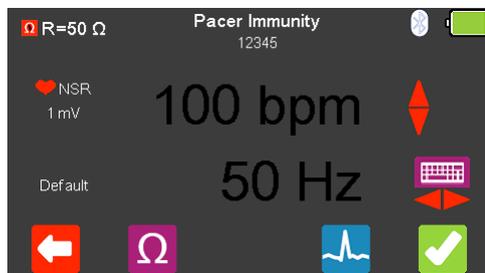
From the **Pacer Menu** use the   arrow keys to highlight Pacer **Immunity** and confirm using the  (**return**) key or select  (F5).

From the **Pacer Pulse Mode** select  (F2) to alter the **Load selection**.



To exit without changing select  (F1). Use the   key to select either the **Internal Defib Load** (fixed at 50Ω) or **External Defib Load** (variable between 25 and 200Ω), use the  arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

Note; if using the fixed load Paddle Adaptor Box (part number 386A950), an external resistance of 50Ω should be selected.



From the **Pacer Immunity** Menu select  (F4) to alter the simulation waveform selection. Use the   arrow keys to move between the available simulation waveforms.

The following Waveforms are available:

Pacer Pulse Mode Waveforms	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Missing Beat (MB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
R Wave Detection (RWD)	20 - 300 BPM, Amplitude 1.00mV(±2%)

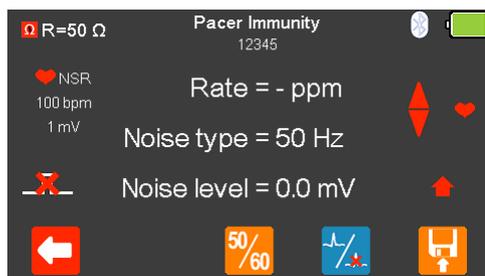
Where applicable, in the simulation waveform selection mode, select  (F4) to change the **Heart rate selection** to values between 20 and 300 BPM. Selecting  (F1) confirms this selection.

Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

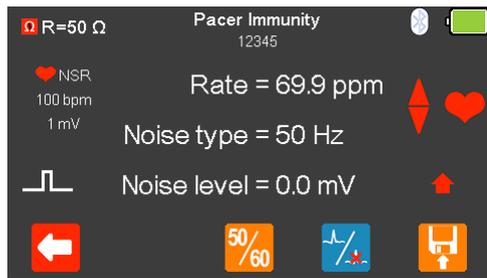
Note; where a waveform with variable **Heart rate** is selected the current value is  displayed in the centre of the **Pacer Pulse Mode** screen, using the  arrow keys, or free typing on the keyboard, allows this to be altered.

Use the   arrow keys to alter the immunity **Noise Type**, to either 50 or 60Hz the available simulation waveforms.

Once the desired settings have been chosen, **Pacer Immunity** can be tested by selecting  (F5).



If no pacer signal is received from the EUT then a cross appears in the pulse waveform.



With the EUT pacing, the rate, noise type and noise level are displayed.

The Noise Type can be alternated between 50 or 60Hz using  (F3).

The waveform can be switched to asystole by selecting  (F4).

After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

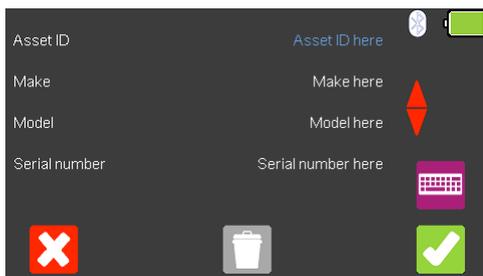
## 10. Handling Data

### 10.1. Start Asset Option – Saving Test Results

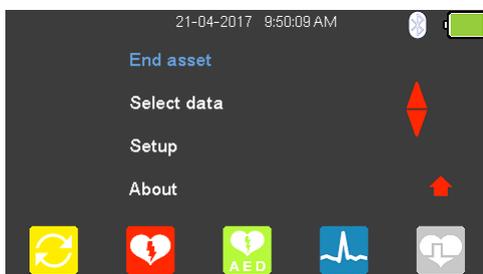
If the tests you are about to perform require the results to be saved then the **Start asset** option needs to be selected from the **Main Menu**, using  (F1), this displays a new asset option;



The **Asset ID**, **Make**, **Model** and **Serial Number** of the appliance under test can be added, to exit without saving select  (F1).



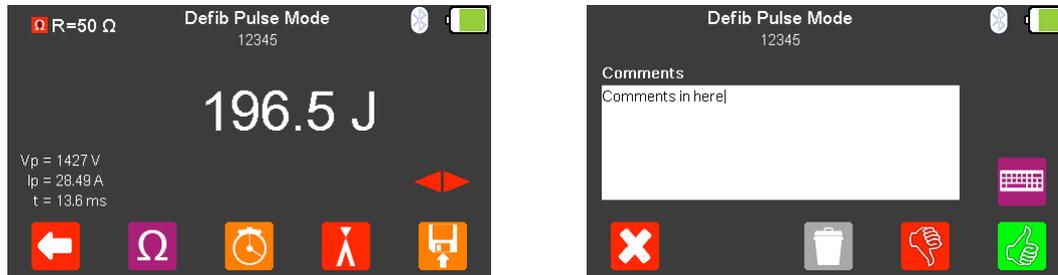
To confirm the asset details select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



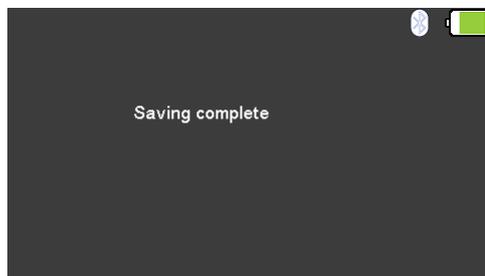
Selecting  (F5) returns the instrument to the **Main Menu**, however, the **Start asset** option is now displayed as **End asset**. Note; if **End asset** is selected the display reverts back to **Start asset** and the asset details previously entered can no longer be used.

## 10.2. Saving a Test Result

Before saving a test result, the Asset ID will need to have been previously set-up (note the  symbol will already be displayed).



At the end of a test select  (F5) to save, additional comments can be added using the keyboard, entered data can be deleted using the  (F3) key.

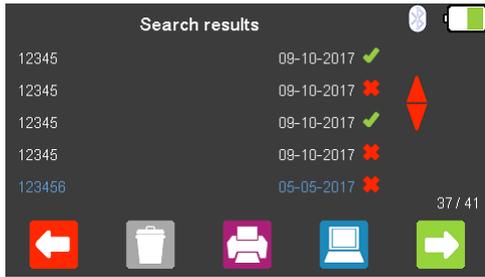


Once all of the information has been entered either select  (F5) to save the test as a pass or select  (F4) to save the test as a fail. A message will be displayed to confirm **Saving complete** in either case.

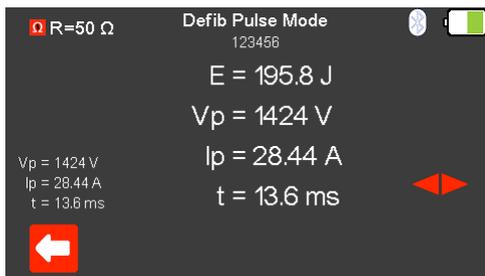
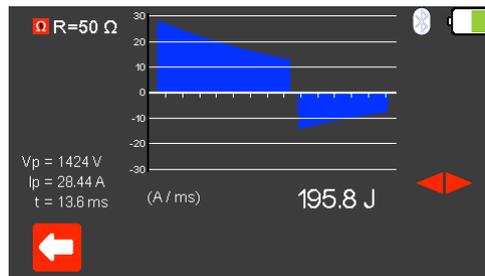
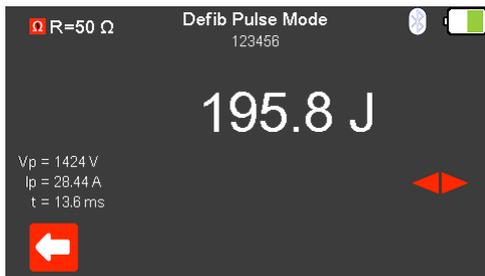
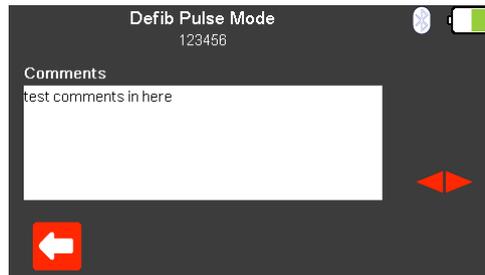
## 10.3. Viewing a Saved Test Result



From the **Main Menu**, use the   arrow keys to highlight **Select data** and select the  (return) key to enter the asset menu. The   arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard or using the   arrow keys, where applicable (note the Bluetooth scanner can be used to input the **Asset ID**). Select  (F5) to display the results.



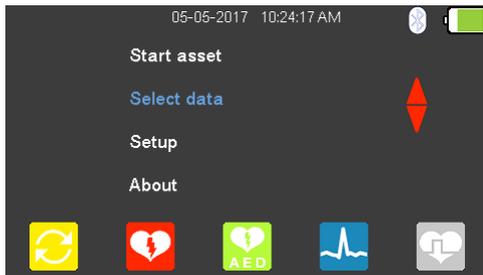
Use the  arrow keys to highlight the asset you wish to view and select  (F5) to view the test result.



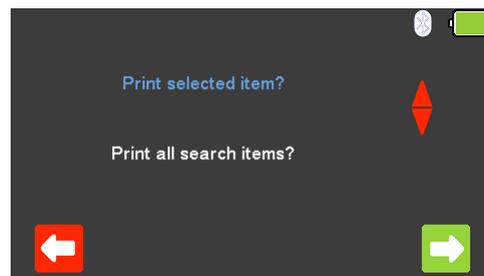
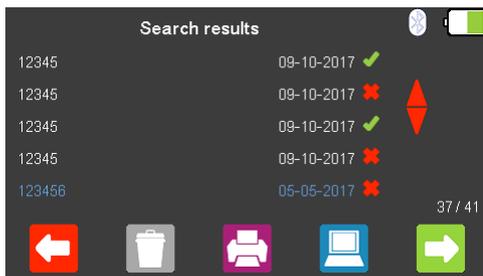
Using the  arrow keys allows the various test result screens to be viewed on the UniPulse 400. The format of these depends on the original test performed.

Selecting  (F1) returns to the **Search results** menu.

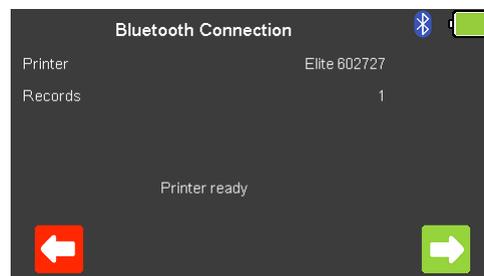
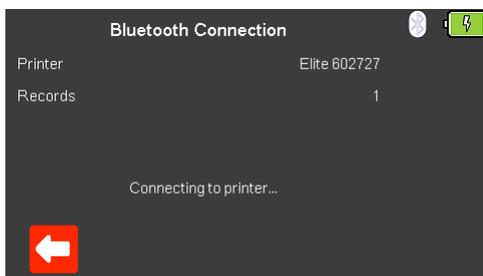
## 10.4. Printing a Saved Test Result



From the **Main Menu**, use the   arrow keys to highlight **Select data** and select the  (return) key to enter the asset menu. The   arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard or using the   arrow keys, where applicable (note the Bluetooth scanner can be used to input the **Asset ID**). Select  (F5) to display the results.

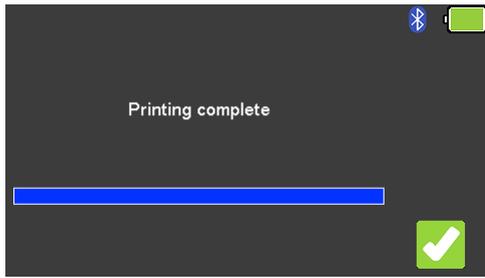


Use the   arrow keys to highlight the asset you wish to print and select  (F3) to either print this test result or to print results for all items in the list.



Select  (F5) to connect to the printer, once connected, **Printer ready** and the Bluetooth icon are displayed, and selecting  (F5) prints the result.

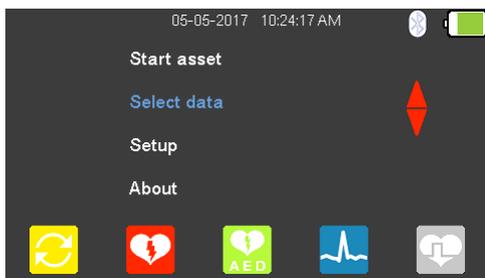
Selecting  (F1) returns to the **Search results** menu, without printing.



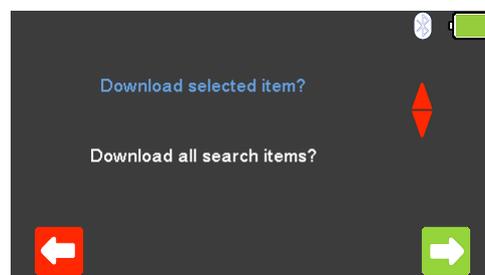
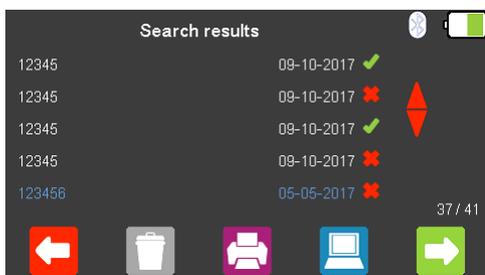
Once the printing is complete a message is displayed confirming this, the **Search results** menu can be viewed again by selecting  (F5).

## 10.5. Downloading Test Results

Note results can only be downloaded from the UniPulse 400 to Med-eBase version 2.6 (or above) using only a USB lead.

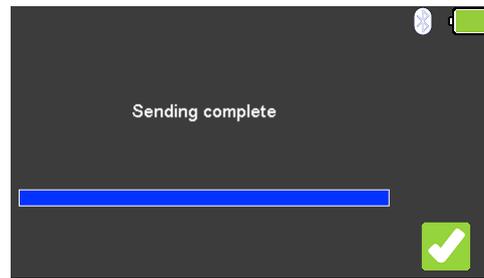
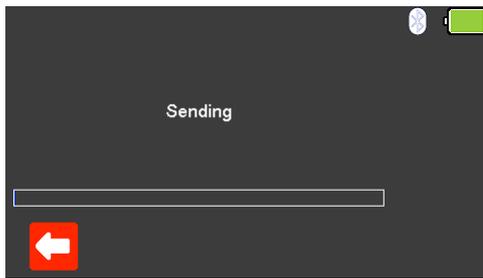


From the **Main Menu**, use the   arrow keys to highlight **Select data** and select the  (return) key to enter the asset menu. The   arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard  or using the   arrow keys, where applicable (note the Bluetooth scanner can be used to input the **Asset ID**). Select  (F5) to display the results.



Use the   arrow keys to highlight the asset you wish to download and select  (F4) to either download this test result or to download results for all items in the list.

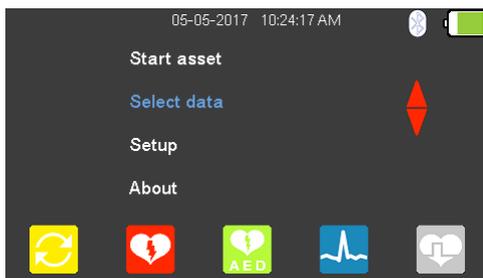
Selecting  (F1), where available, returns to the **Search results** menu, without downloading .



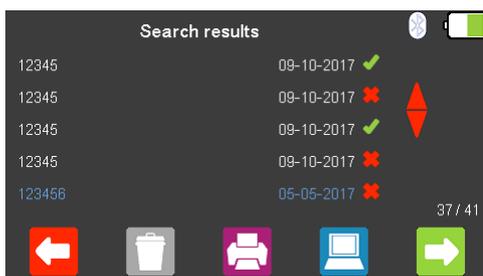
Select  (F5) to send the data from the UniPulse 400 connected to a PC via the USB lead.

Once the download is complete a message is displayed confirming this, the **Search results** menu can be viewed again by selecting  (F5).

## 10.6. Deleting a Saved Test Result



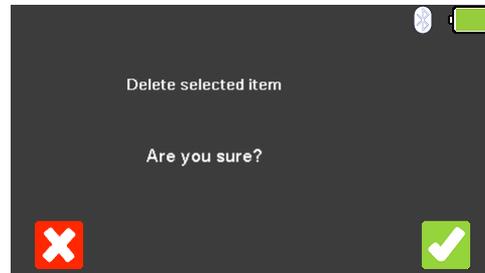
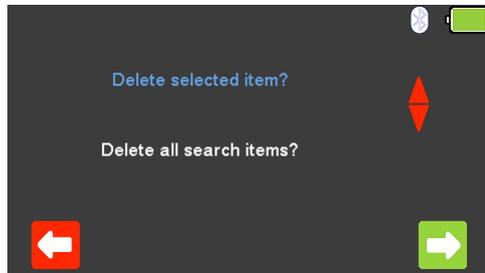
From the **Main Menu**, use the   arrow keys to highlight **Select data** and select the  (return) key to enter the asset menu. The   arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard or using the   arrow keys, where applicable (note the Bluetooth scanner can be used to input the **Asset ID**). Select  (F5) to display the results.





Use the  arrow keys to highlight the asset you wish to delete and select  (F2) to delete this test result or to delete results for all items in the list.

Selecting  (F1) returns to the **Search results** menu, without deleting.



Select  (F5) to confirm the selection. A second message asks “**Are you sure?**” confirmation is performed by selecting  (F5) or you can return to the previous screen by selecting  (F1).

## 11. Environmental Conditions

The Rigel UniPulse 400 has been designed to perform tests and measurements in a dry environment.

Maximum barometric elevation for making measurements is 2000m.

Protective system IP40 according to IEC 60529.

Electromagnetic compatibility (EMC). Interference immunity and emitted interference conforming to IEC 61326-1.

Operating temperature range of 0°C to +40°C, without moisture condensation.

The UniPulse 400 can be stored at any temperature in the range -15°C to +60°C (relative humidity up to 90%).

Operating altitude 0 to 2000m.

## 12. Maintaining the Rigel UniPulse 400

### 12.1. Cleaning

Clean the external case of the Rigel UniPulse 400 with a clean dry cloth. Avoid using solvents and abrasive scouring agents to clean the external case of the Rigel UniPulse 400.

Do not allow liquid inside the Rigel UniPulse 400 or near the sockets. Do not use abrasives, solvents or alcohol.

If the UniPulse 400 is subject to liquid ingress, the unit should be returned for repair, stating clearly the cause for repair.

### 12.2. User Maintenance

The Rigel UniPulse 400 is a rugged quality instrument. However, care should always be taken when using, transporting and storing this type of equipment. Failure to treat the product with care will reduce both the life of the instrument and its reliability.

- Always check the UniPulse 400 and all accessories for damage and signs of wear before use.
- Do not attempt to open the UniPulse 400.
- Maintenance should only be performed by authorised personnel.
- The UniPulse 400 contains no user serviceable parts.
- Keep the UniPulse 400 and accessories clean and dry.
- The recommended calibration period for this unit is 12 months.

## 13. Specifications

### 13.1. Technical Specifications

Defib - Energy Measurement	
Load Resistance	50Ω ± 1% non-inductive
Range	0 - 199.9 Joules
Accuracy	± 1% of reading ± 0.1 Joule
Range (High)	200 - 360 Joules
Accuracy	± 1% of reading ± 1 Joule
Resolution	0.1 Joules
Voltage	0 - 5000 Volts
Current	0 - 100 Amps
Sampling Rate	250 kHz sampling frequency
Maximum pulse width	5us – 120ms
AED Pulse Mode Waveforms	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Asystole (ASYS)	
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 1.00mV(±2%)
ECG Simulator	
ECG full 12-lead simulation including hi-level output.	
ECG Waveforms - Sinus	
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
ST Elevation (STE)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
ST Depression (STD)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Myocardial Infarction (MI)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Tall T (TT)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Asystole (ASYS)	
ECG Waveforms – Ventricular Arrhythmias	
Premature Ventricular Contraction - Intermittent (PVCi)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Bigeminy (BIG)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Trigeminy (TRIG)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Ventricular Flutter (VFLT)	240 BPM, Amplitude 0.50 - 5.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 0.50 - 5.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 0.50 - 5.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 0.50 - 5.00mV(±2%)
Right-focal Premature Ventricular Contraction (RFPVC)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
ECG Waveforms – Atrial Conduction Arrhythmias	
First Degree AV Block (FAVB)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Second Degree AV Block - Mobitz I (SAVB_MI)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Second Degree AV Block - Mobitz II (SAVB_MII)	80 BPM, Amplitude 0.50 - 5.00mV(±2%)
Third Degree AV Block (TAVB)	50 BPM, Amplitude 0.50 - 5.00mV(±2%)
ECG Waveforms – Atrial Arrhythmias	
Sinus Arrhythmia (SAR)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Missing Beat (MB)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Atrial Flutter (AFLT)	300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Atrial Fibrillation (AFB)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
Paroxysmal Atrial Tachycardia (PAT)	180 BPM, Amplitude 0.50 - 5.00mV(±2%)

Premature Junctional Contraction (PJC)	20 - 300 BPM, Amplitude 0.50 - 5.00mV(±2%)
ECG Pacer Waveforms	
Synchronous Atrial (AAI)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Asynchronous Atrial (AOO)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Pacer (PCR)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Ventricular Pacer (VVI)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
Atrial & Ventricular Pacer (DDD)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV, Pulse width 0.1 – 2.0ms
R-Wave Detection (RWD)	20 - 300 BPM, Pulse amplitude 0.50 – 5.00mV
ECG Performance Waveforms	
Sine (SINE)	0.1 - 300Hz, 1.00 – 10.00mV
Square (SQ)	0.1 - 300Hz, 1.00 – 10.00mV
Triangle (TRI)	0.1 - 300Hz, 1.00 – 10.00mV
Sawtooth (SAW)	0.1 - 300Hz, 1.00 – 10.00mV
Inverse Sawtooth (INVSAW)	0.1 - 300Hz, 1.00 – 10.00mV
Pulse (PULSE)	0.1 - 300Hz, 0.50 – 5.00mV
ECG Noise Selection	
Amplitude	0 – 10.00mV
Frequency	50 - 60Hz
ECG Waveform Output	
Low Level	12-lead ECG and on Paddles
Hi Level	Output Jack
ECG Accuracy	
Rate	± 1%
Amplitude	± 2% (LA-LL), ± 10% (Paddles)
Pacer Input	
Fix Load	50Ω
Accuracy	1 %, non-inductive
Over voltage protection	5000V
Variable Load	50 to 1600Ω in 50Ω steps
Accuracy	1 %, non-inductive
Pulse Rate	5.0 to 800 ppm
Accuracy	+/- (0.5% rdg + 0.1ppm)
Heart rate selection	20 – 300 bpm
Under & overdrive	85% (20 bpm min) and 115% (300 bpm max)
Wave form selection	NSR, VFibC, VFibF, MVT, AFib, Missing Beat, R-Wave detection
Pulse Current Amplitude	5.00 – 200mA
Accuracy	+/- (1% rdg +0.02mA)
Current Measurements	Average (RMS), Leading edge, Trailing edge, Peak (the highest during the pulse)
Pulse Width	1.00 - 100ms
Accuracy	+/- (0.5% rdg + 0.01ms)
Pulse Energy	1μJ – 2.00J
Accuracy	+/- 4% + 10μJ
Pacer Manufacturer Algorithms	
CU Medical, GE, HP, Laerdal, Mindray, Philips, PhysioControl, Schiller, WelchAllyn, Zoll	

Pacer Refractory Periods	
Refractory Period test Accuracy	15 – 500mS (Paced and sensed) +/- 1ms
Pacer Sensitivity Test	
Wave form	R Wave
Polarity	Normal and Reversed, selectable
Pacer Interference Test (Immunity):	
Heart rate	20-300 bpm
Frequency	50 or 60 Hz
Noise level in mV	0-15.0mV

## 13.2. General Specifications

Dimensions	220mm x 150mm x 90mm (L x W x H)
Weight	1.5kg
Operation	12V/2400mAh Nickel Metal Hydride battery pack
Mains Supply	110/230V AC; 48 to 66Hz, 35VA power supply
Storage Environment	-15°C to +60°C
Operating Conditions	0°C to +40°C
Environmental Protection	IP 40
Communication	USB
Display	LCD colour graphic display 1/4" VGA
Memory	100 test results including graphs
Impact rating	5J

## 14. Support

### 14.1. Contact Us

#### Sales and Delivery enquiries

Tel: +44 (0) 191 586 3511

Fax: +44 (0) 191 586 0227

Email: [sales@rigelmedical.com](mailto:sales@rigelmedical.com)

#### Technical enquiries

Tel: +44 (0) 191 586 3511

Email: [support@rigelmedical.com](mailto:support@rigelmedical.com)

#### Service, Calibration and Repair

Tel: +44 (0) 191 587 8739

Fax: +44 (0) 191 518 4666

Email: [info@calibrationhouse.com](mailto:info@calibrationhouse.com)

#### Rigel Medical

15 - 18 Bracken Hill

South West Industrial Estate

Peterlee

County Durham

SR8 2SW

United Kingdom

