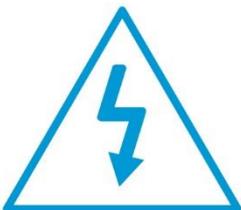




RIGEL MEDICAL
TESTED, TRUSTED... WORLDWIDE.

UniPulse 400

USER 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/register

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 into service.

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

www.rigelmedical.com/calibration

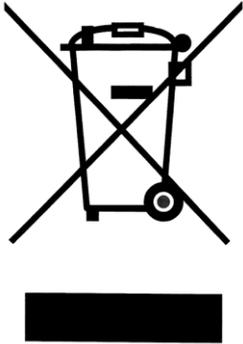
Rx Only: Federal Law restricts this device to sale by or on the order of a physician.

© Copyright 2021

All rights reserved. Nothing from this edition may be reproduced, or made public in any form, either electronically, mechanically, by photocopying, recording, or in any manner, without prior written consent from Rigel Medical. This also applies to accompanying drawings and diagrams.

Due to a policy of continuous development Rigel Medical 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 NiMH battery:

- Do not disassemble, crush, or puncture the battery.
- Do not short the external contacts on the battery.
- Do not dispose of the battery in fire or water.
- Do not expose the 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 the battery pack has leaking fluids, do not touch these fluids.
- Dispose of a leaking battery.

1. Warnings and Cautions	6
1.1. User Notes	6
1.2. Safety Notes	6
2. Introduction	8
2.1. Intended use and capabilities of the UniPulse 400	8
2.2. In the Box	9
2.3. Getting to Know Your UniPulse 400	9
2.4. Optional Accessories and Replacement Spare Parts	10
2.5. Charging the UniPulse 400	10
2.6. Battery Status	11
2.7. Powering the UniPulse 400 On and Off	12
2.8. Icons	13
3. Setting up the UniPulse 400	14
3.1. Setting the Time and Date	14
3.2. Connecting to a Bluetooth Device	16
3.3. Connecting to the Test n Tag Elite 2 printer	18
3.4. Connecting to the Bluetooth Barcode Scanner	19
3.5. Deleting Bluetooth Selections	20
3.6. Local Settings	21
3.7. Results Memory	22
3.8. Restoring Factory Settings	23
3.9. Displaying UniPulse 400 Information	24
4. Getting started	25
4.1. Accessing the UniPulse 400 Tests	25
5. Analysing Defibrillators	28
5.1. Connecting a Defibrillator to the UniPulse 400	28
5.2. Start Asset Option – Saving Test Results	29
5.3. Testing Defibrillator Energy Discharge	30
5.4. Testing Charge Time	32
5.5. Testing Cardiac Synchronisation	33
6. Analysing Automated External Defibrillators (AED)	34
6.1. Connecting a Defibrillator to the UniPulse 400	34
6.2. Start Asset Option – Saving Test Results	35
6.3. Testing AED Energy Discharge	36

7. Simulating ECG Waveforms	39
7.1. Connecting ECG leads to the UniPulse 400	39
7.2. Start Asset Option – Saving Test Results	40
7.3. Simulating an ECG Sinus Waveform	41
7.4. Simulating an ECG Ventricular Arrhythmia Waveform	43
7.5. Simulating an ECG Atrial Conduction Waveform	45
7.6. Simulating an ECG Atrial Waveform	47
7.7. Simulating an ECG Pacer Waveform	49
7.8. Simulating an ECG Performance Waveform	52
8. Analysing Transcutaneous Pacers – Pacer Variable Load Input	54
8.1. Connecting to the Pacer Variable Load Input	54
8.2. Start Asset Option – Saving Test Results	55
8.3. Testing the Pacer Function	56
8.4. Testing the Pacer Pulse Mode	57
8.5. Testing the Refractory Mode	60
8.6. Testing the Pacer Sensitivity	62
8.7. Testing the Pacer Immunity	64
9. Analysing Transcutaneous Pacers – Defibrillator Paddle Input	67
9.1. Connecting to the Defibrillator Paddle Input	67
9.2. Start Asset Option – Saving Test Results	69
9.3. Testing the Pacer Function	70
9.4. Testing the Pacer Pulse Mode	71
9.5. Testing the Refractory Mode	74
9.6. Testing the Pacer Sensitivity	76
9.7. Testing the Pacer Immunity	78
10. Handling Data	81
10.1. Start Asset Option – Saving Test Results	81
10.2. Saving a Test Result	82
10.3. Viewing a Saved Test Result	83
10.4. Printing a Saved Test Result	85
10.5. Downloading Test Results	87
10.6. Deleting a Saved Test Result	88
11. Environmental Conditions	89
12. Maintaining the Rigel UniPulse 400	90

12.1. Cleaning	90
12.2. User Maintenance	90
13. Specifications	91
13.1. Technical Specifications	91
13.2. General Specifications	95
14. Support	96
14.1. Contact Us	96

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.
- The instrument is for indoor use only

2. Introduction

2.1. Intended use and capabilities of the UniPulse 400

The UniPulse 400 Defibrillator/Pacemaker Analyzer is used to determine that a defibrillator and a defibrillator equipped with transcutaneous pacemaker capability are performing within their performance specifications through the measurement of energy output. The UniPulse 400 is intended to be used in the laboratory environment, outside of the patient care vicinity and is not intended to be used on patients or to test devices while connected to patients.

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

Transcutaneous Pacer Analysis

- 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

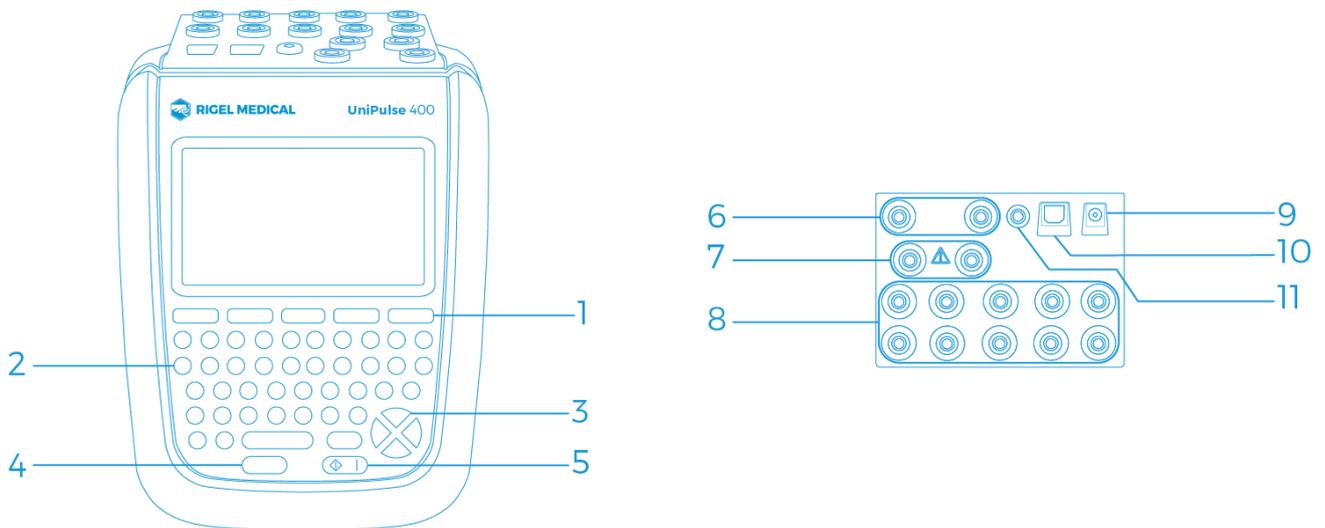
2.2. In the Box



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

2.3. Getting to Know Your UniPulse 400



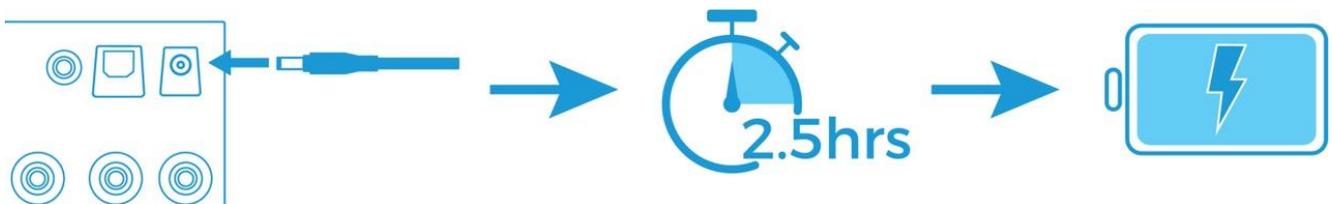
- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> 1. Function keys F1-5 2. QWERTY keyboard 3. Directional navigation keys 4. Stop/End button 5. Power ON/Start button | <ul style="list-style-type: none"> 7. Pacer connection 8. Universal ECG connections x10 9. Power supply socket 10. USB connection 11. ECG Hi output |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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 Adaptor (pack of 10)	404A951
AC power supply	386A011
Battery pack 9.6V/2400mAh (NiMH)	386A008
Replacement Carry Case	410A950
Med-eBase software	383A910
www.rigelmedical.com/med-ebase	

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.



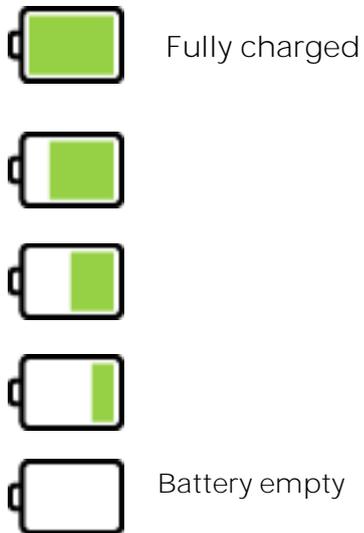
Whilst the UniPulse 400 is powered on, you will also see the below symbols on the display.

-  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.

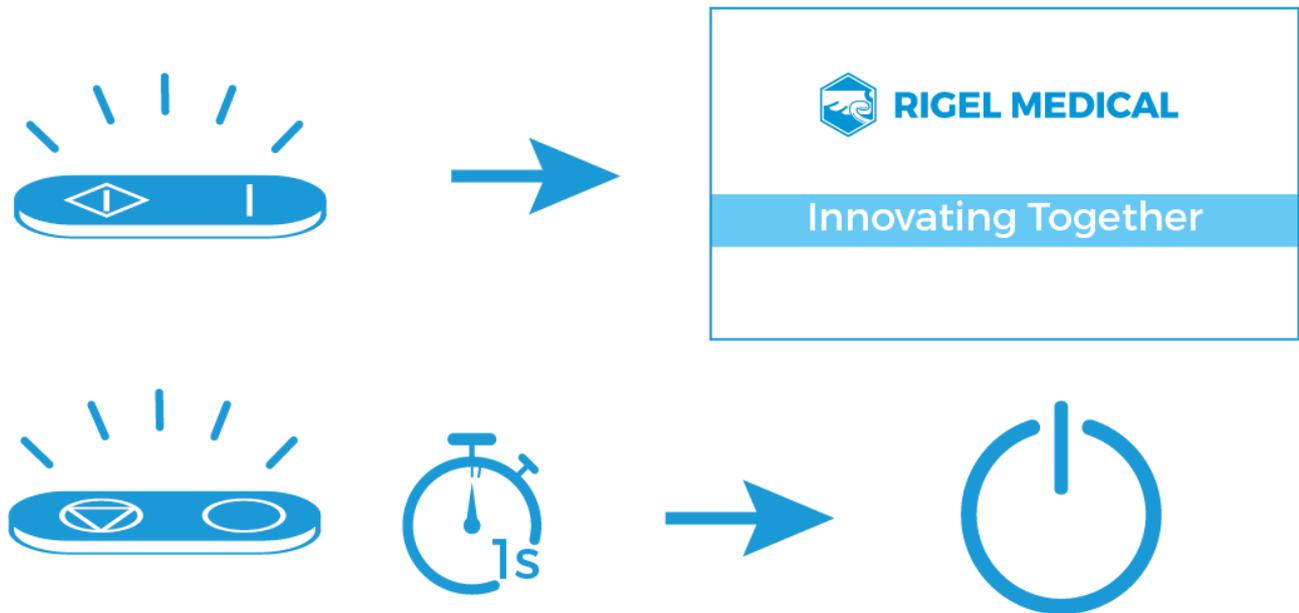


The UniPulse 400 will warn the user of a low battery with an audible tone. Should this occur, connect the UniPulse 400 to mains via the supplied 18V PSU and allow the unit to charge.

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:

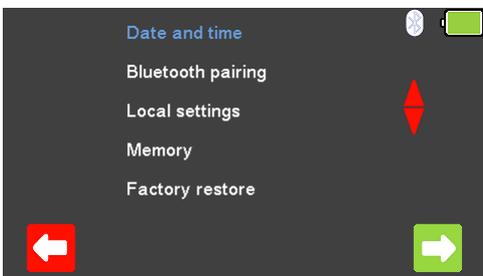
	Defibrillator mode		Pulse amplitude		Keyboard entry
	Charge time mode		Frequency selection		Delete
	Cardiac Synch mode		Heart rate		Search
	AED mode		Start		Load selection
	ECG simulation		Confirm		Scanner
	Waveform selection		Back without saving		BPM recycle
	Arrhythmia waveform		Back		Computer
	Performance 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. Setting up the UniPulse 400

3.1. Setting the Time and Date



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

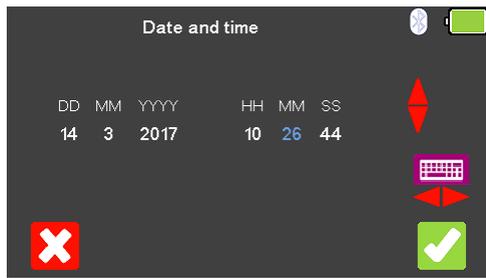


From the Setup Menu, use the   arrow keys to highlight Date and time and select using the ↵ (return) key or  (F5).



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 .

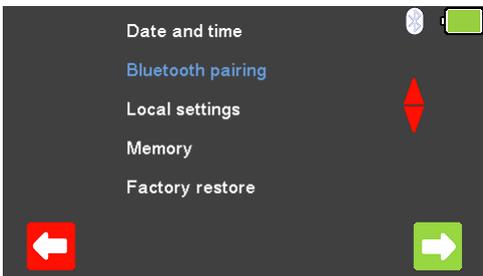


Select  (F5) to confirm and save the changes, or  (F1) to exit without saving.

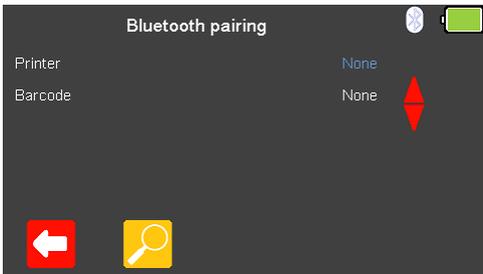
3.2. Connecting to a Bluetooth Device



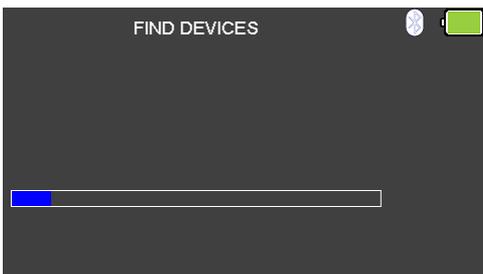
From the Main Menu, use the  arrow keys to highlight Setup and select using the ↵ (return) key.



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.

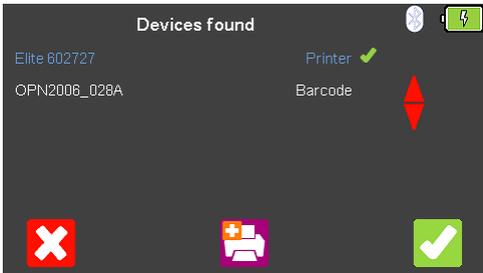




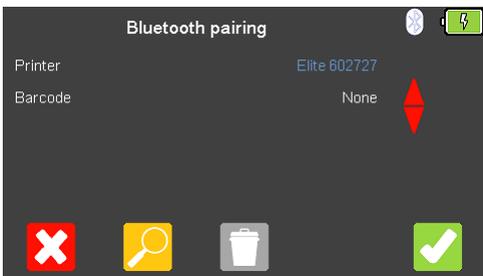
Once the devices have been found, use the  arrow keys to select a Printer  (F3) or Barcode  scanner (F2).

3.3. 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.



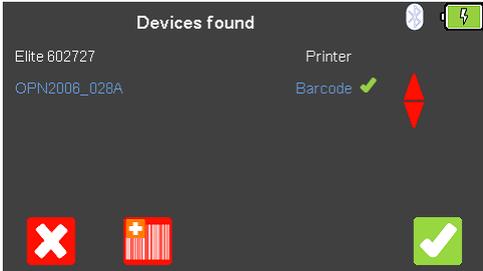
Use  (F3) to select the device to be paired with and then use  (F5) to confirm.



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

3.4. 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.

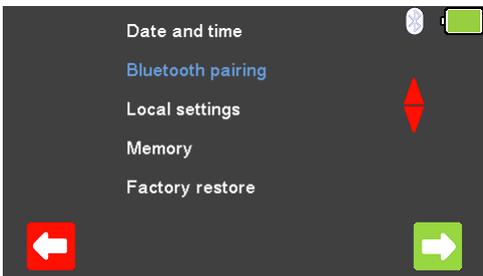


Finally, select  (F5) again to complete the connection.

3.5. 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).

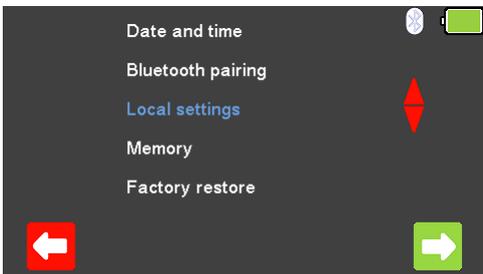


Highlight the Bluetooth printer or scanner to be deleted using the   arrow keys. Delete using the  (F3) key and then confirm using  (F5).

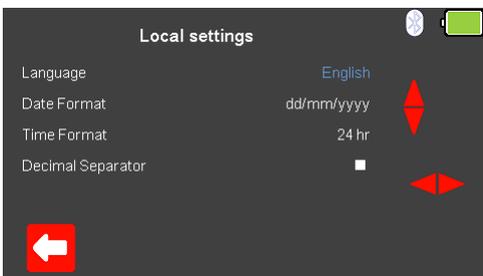
3.6. Local Settings



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

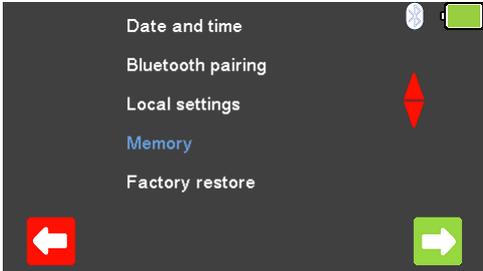


altered using the   and   arrow keys.

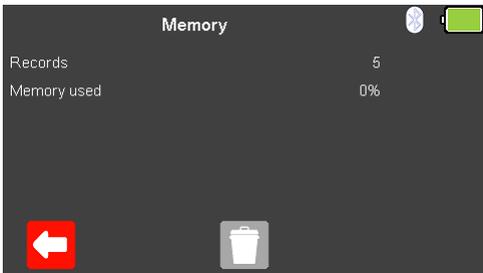
Select  (F5) to confirm and save the changes, or  (F1) to exit without saving.

3.7. Results Memory

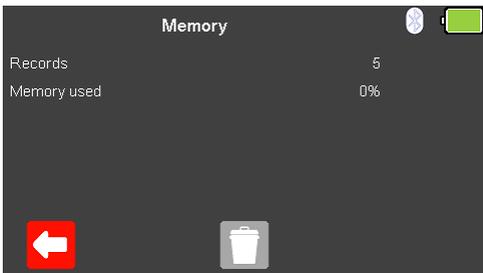
To delete an individual test result, please see “Deleting a Saved Test Result” in the “Handling Data” section of this manual.



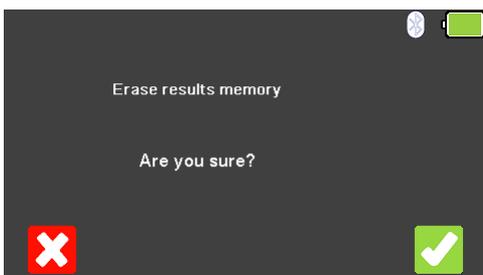
From the Setup Menu, use the   arrow keys to highlight Memory and select using the ↵ (return) key or  (F5).



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

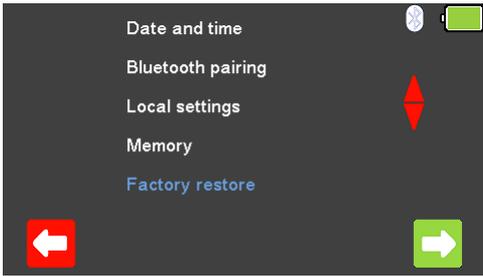


To exit without changing select  (F1).
Select  (F3) to delete the results memory,

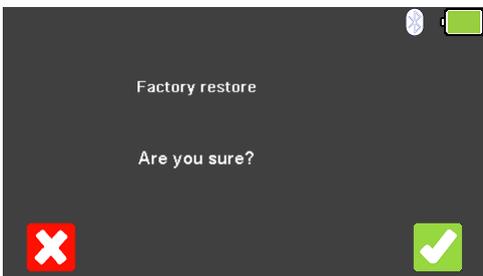


To exit without deleting select  (F1) or select  (F5) to erase the results memory.

3.8. Restoring Factory Settings



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



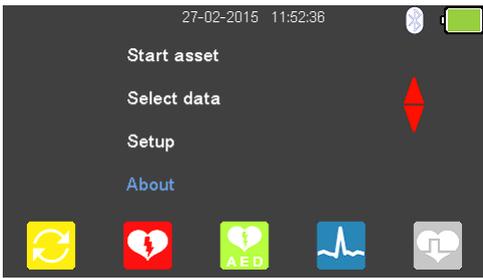
To exit without changing select  (F1) or select  (F5) to restore factory settings.

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.

3.9. 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.

4. Getting started

4.1. 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.



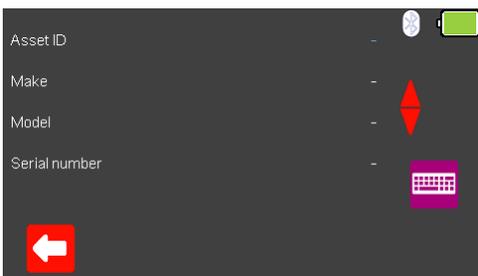
(F3) for Automated External Defibrillator (AED) Mode.



(F4) for Electrocardiogram (ECG) Simulation Mode.

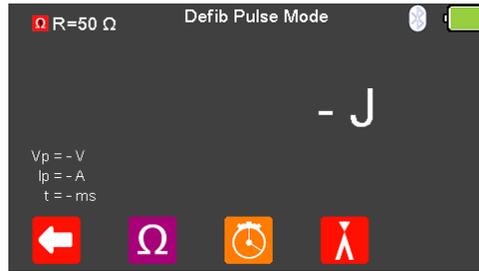
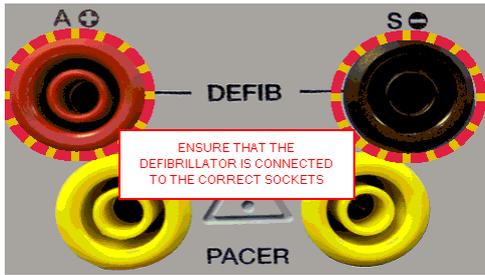


(F5) for Pacer Mode.



(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.

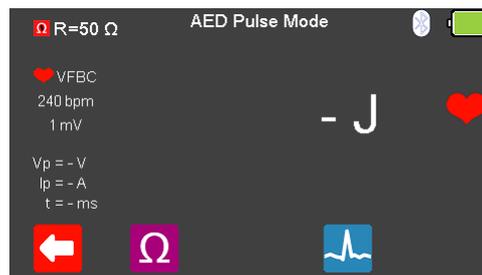
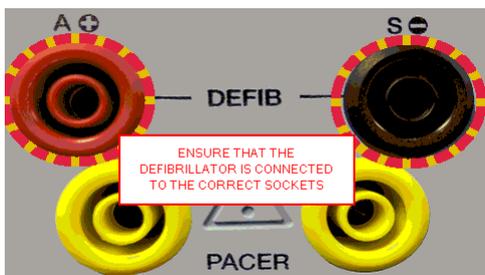


 (F2) for Defibrillator Mode

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

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

Note: 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.

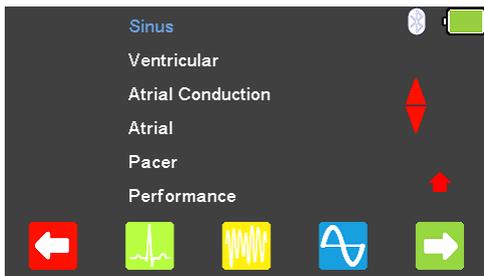


 (F3) for Automated External Defibrillator (AED) Mode

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

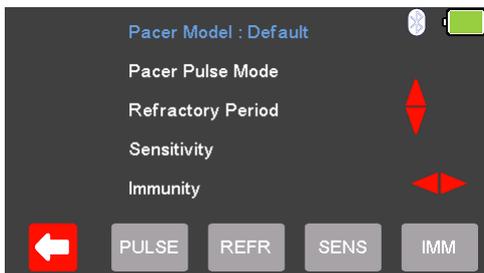
 Do not use the defibrillator to shock the PACER or ECG terminals

Note: 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.

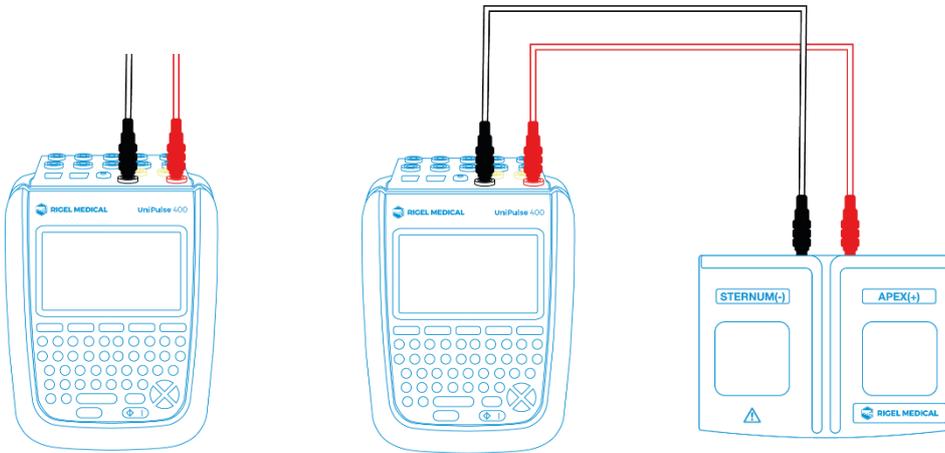


(F5) for Pacer Simulation

Use this mode to analyse the Pacer Function, Pulse Mode, Refractory Mode, Sensitivity and Immunity set-ups. See section 8.0 or 9.0, respectively, for more details.

5. Analysing Defibrillators

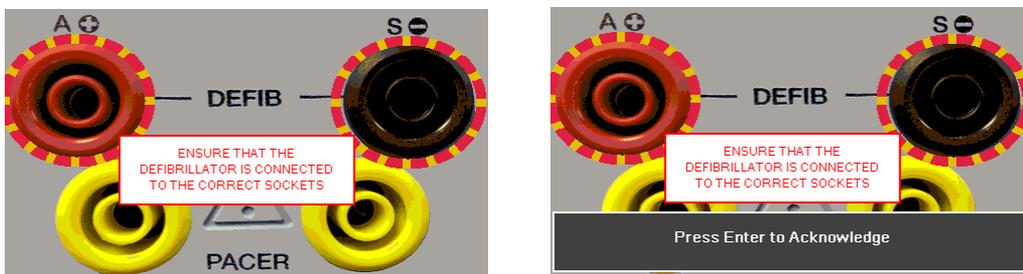
5.1. Connecting a Defibrillator to the UniPulse 400



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

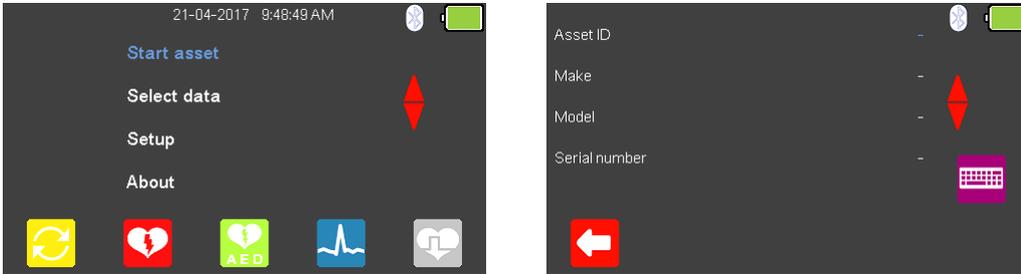


Note¹: to enter the Defibrillator Pulse or AED mode you have to accept the connections warning, using the ↵ (return) key, – the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.

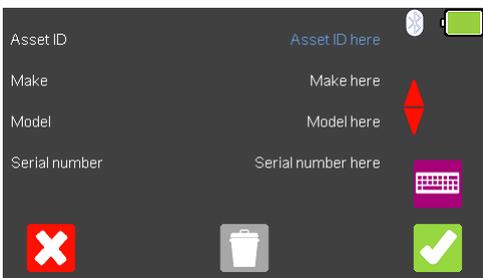
Note²: if using the fixed load Paddle Adaptor Box (part number 386A950), an internal resistance of 50Ω should be selected.

5.2. Start Asset Option - Saving Test Results

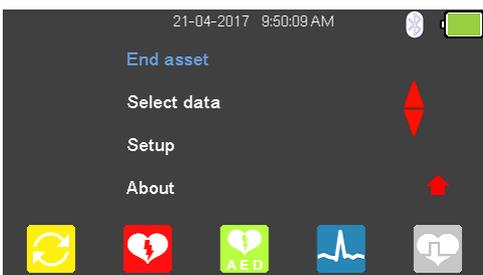
If the tests you are about to perform require the results to be saved then the Start asset option needs to be selected from the Main Menu, using (F1), this displays a new asset option;



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

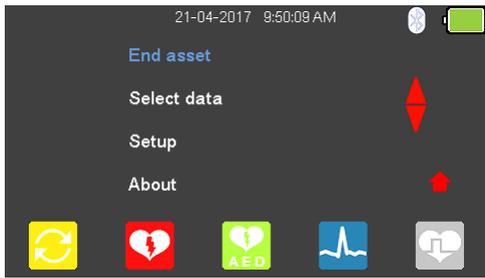


To confirm the asset details, select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).

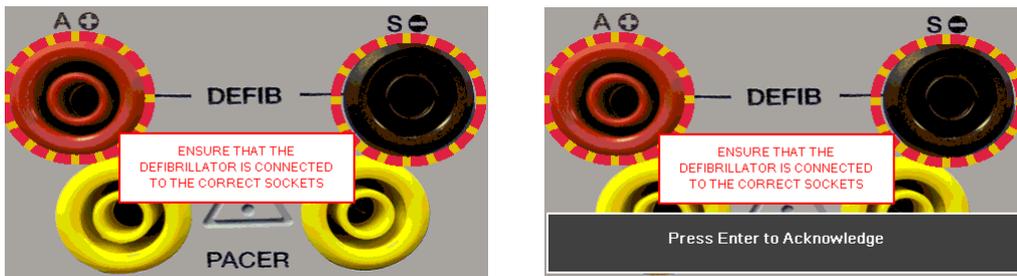


Selecting  (F5) returns the instrument to the Main Menu, however, the Start asset option is now displayed as End asset. Note; if End asset is selected the display reverts back to Start asset and the asset details previously entered can no longer be used.

5.3. Testing Defibrillator Energy Discharge



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

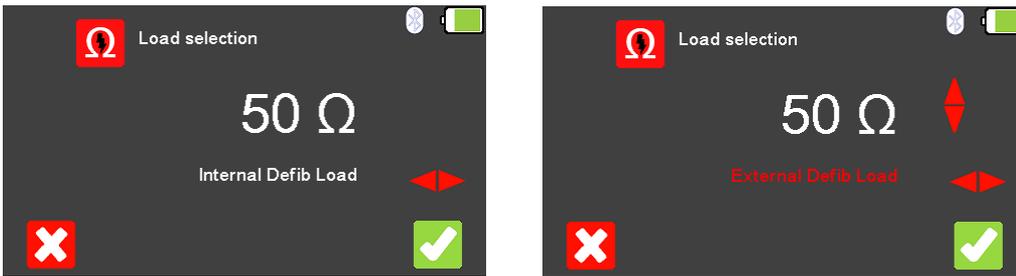


To enter the Defibrillator Pulse mode, you have to accept the connections warning, using the ↵ (return) key, - the red and black 4mm defibrillator terminals are highlighted with a flashing red / yellow image.



-  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.

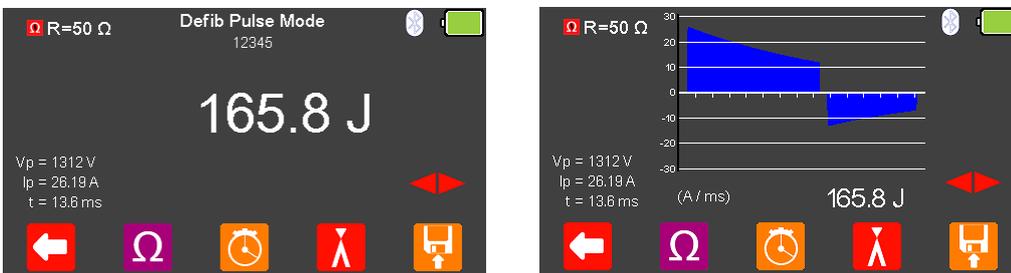
From the Defib Pulse Mode Menu select Ω (F2) to alter the Defib Load selection.



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

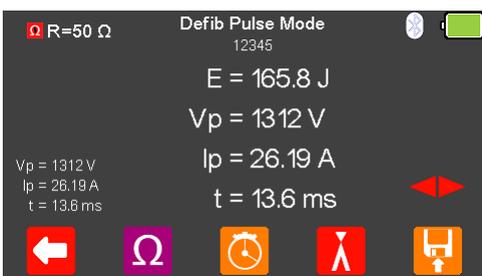
Note¹: if using the fixed load Paddle Adaptor Box (part number 386A950), an internal resistance of 50 Ω should be selected.

Note²: if External Defib Load is selected, the user requires suitable external resistance. An internal resistance of 50 Ω is always in circuit. For 25 Ω – a suitable 50 Ω should be placed in parallel with the internal 50 Ω . For 50 to 200 Ω – suitable resistance should be placed in series with the internal 50 Ω .



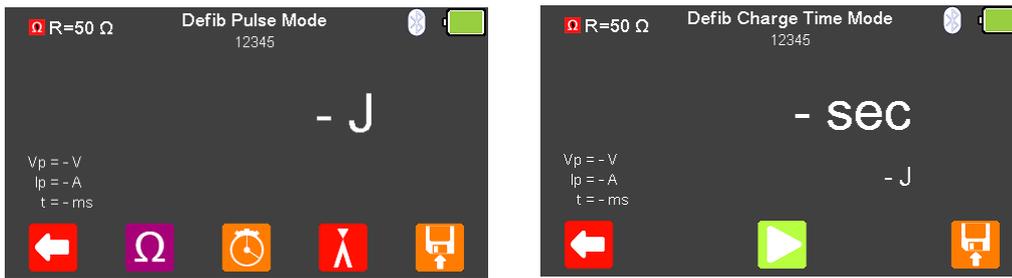
The measured energy will be displayed on the UniPulse 400 screen as well as the peak voltage, peak current and pulse duration.

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



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

5.4. Testing Charge Time



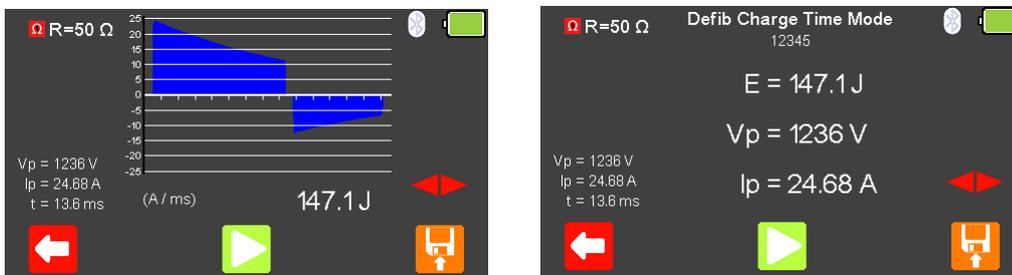
From the Defib Pulse Mode menu select (F3) for Defib Charge Time Mode.

-  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.



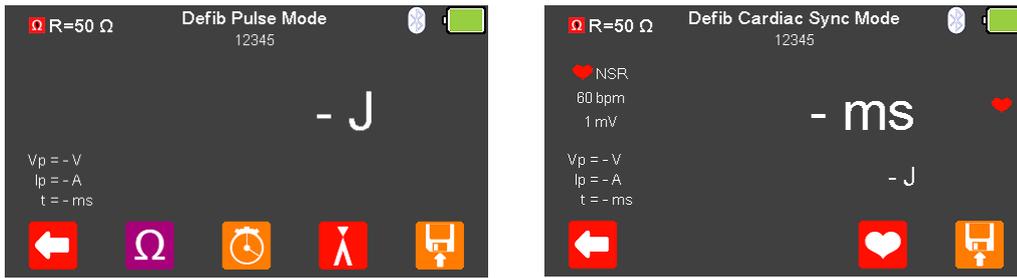
To accurately measure charge time the defibrillator charge must be initiated at exactly the same time as  (F3) is selected to begin the timer.

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.

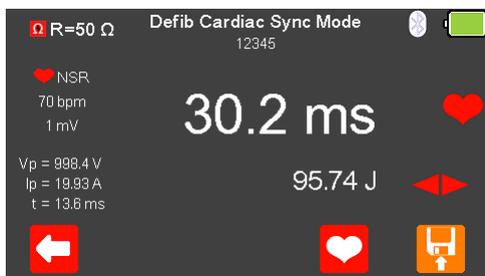
5.5. Testing Cardiac Synchronisation



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.

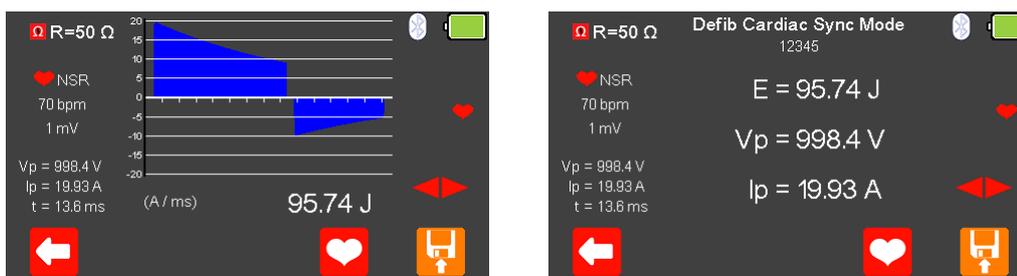
Use  (F4) to change the Heart rate selection to values between 20 and 115 BPM. Note: values can be typed in using the keyboard  and either saved using  (F5) or cancelled with  (F1). To exit without changing select  (F1).

-  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.

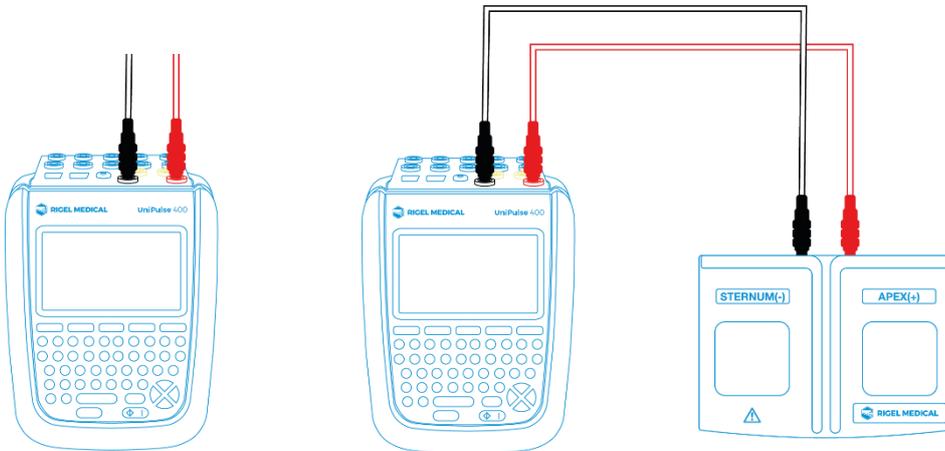
Select the   key to view the waveform graph and a measurement summary.



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

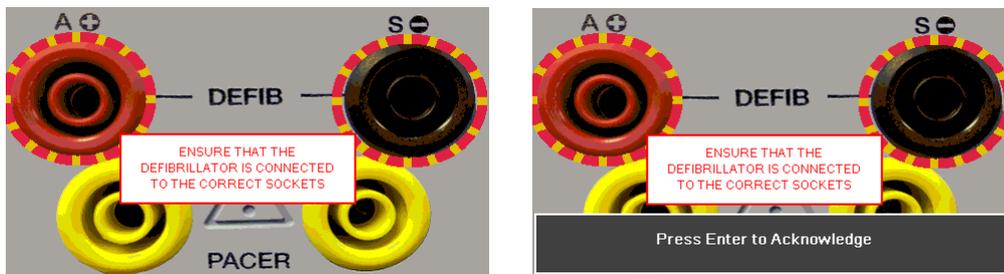
6. Analysing Automated External Defibrillators (AED)

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



Note¹: 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.

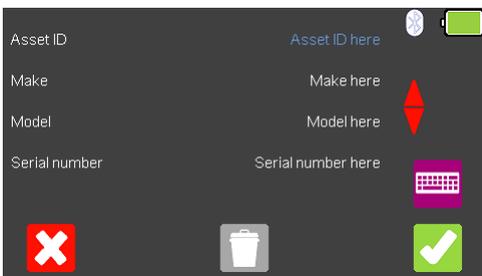
Note²: if using the fixed load Paddle Adaptor Box (part number 386A950), an internal resistance of 50Ω should be selected.

6.2. Start Asset Option – Saving Test Results

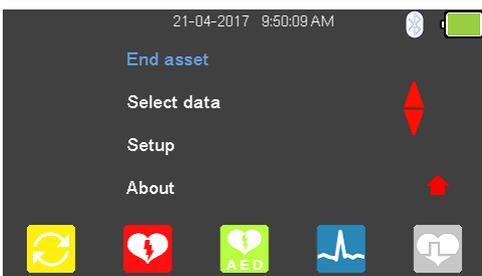
If the tests you are about to perform require the results to be saved then the Start asset option needs to be selected from the Main Menu, using  (F1), this displays a new asset option;



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

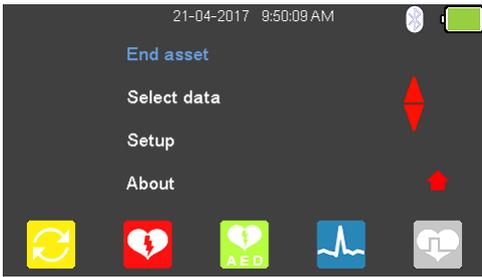


To confirm the asset details, select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).

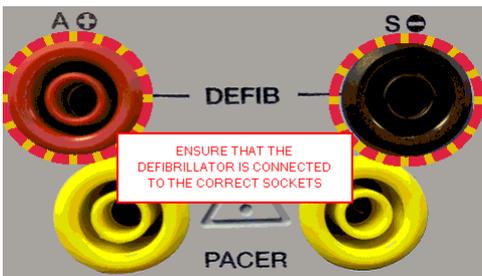


Selecting  (F5) returns the instrument to the Main Menu, however, the Start asset option is now displayed as End asset. Note; if End asset is selected the display reverts back to Start asset and the asset details previously entered can no longer be used.

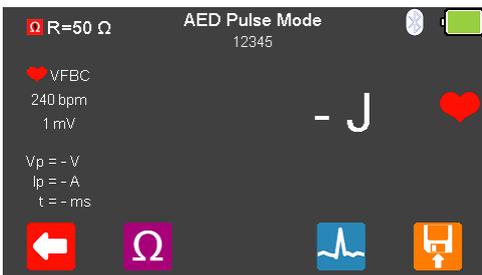
6.3. Testing AED Energy Discharge



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

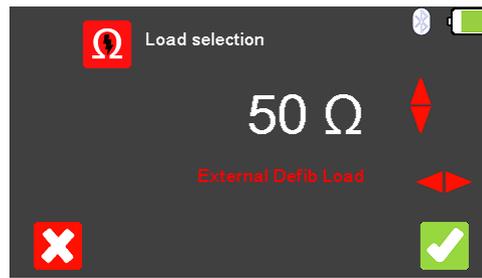
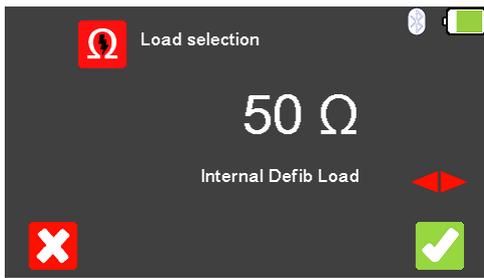


If a shock is advised, use the shock/discharge button to safely deliver the electrical energy into the UniPulse 400.



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

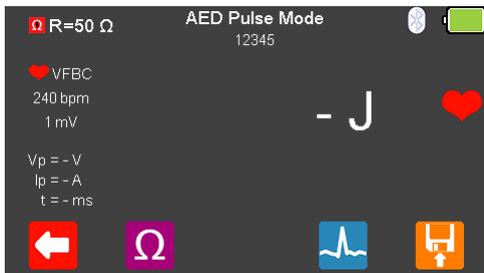
From the AED Pulse Mode Menu select  (F2) to alter the Defib Load selection.



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).

Note1: If using the fixed load Paddle Adaptor Box (part number 386A950), an internal resistance of 50Ω should be selected.

Note2: If External Defib Load is selected, the user requires suitable external resistance. An internal resistance of 50Ω is always in circuit. For 25Ω – a suitable 50Ω should be placed in parallel with the internal 50Ω. For 50 to 200 Ω – suitable resistance should be placed in series with the internal 50 Ω.



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

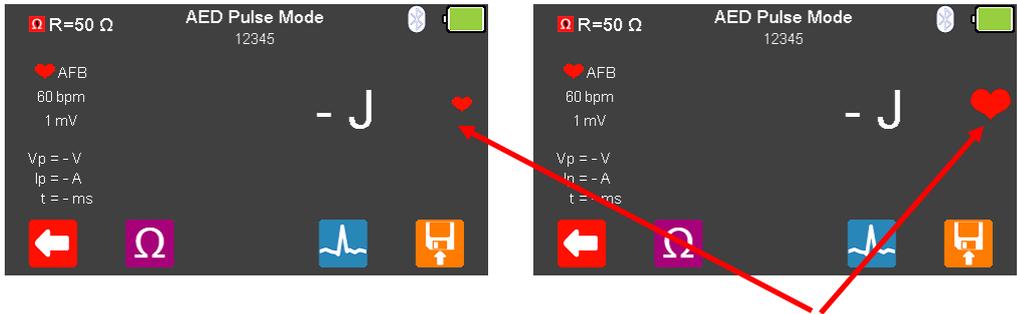
Use the arrow keys to scroll through the available rhythms:

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).

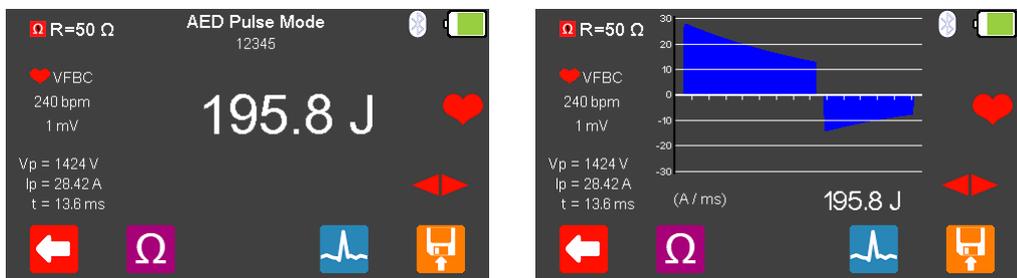
Note: values can be typed in via the keyboard and either saved using  (F5) or cancelled with  (F1).



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

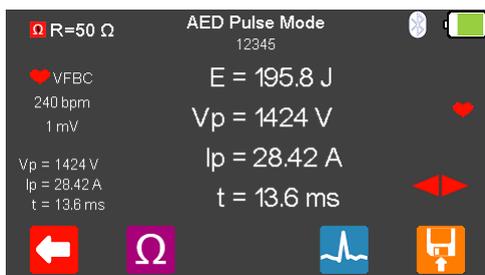
Power on the AED and follow the instructions. The AED will monitor the output rhythm and confirm whether a shock is necessary.

-  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.

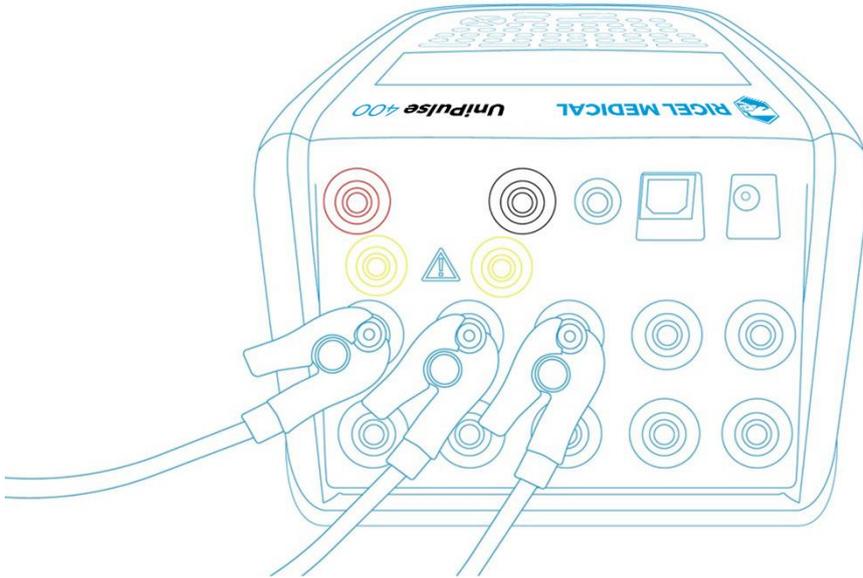
Press the   key to view the waveform graph and a measurement summary.



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.



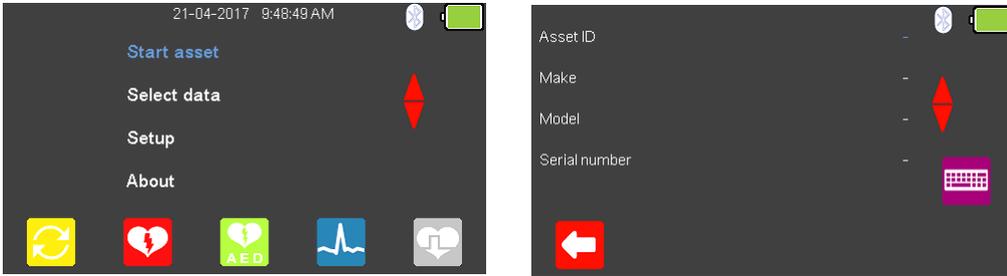
Do not use the defibrillator to shock the PACER or ECG terminals



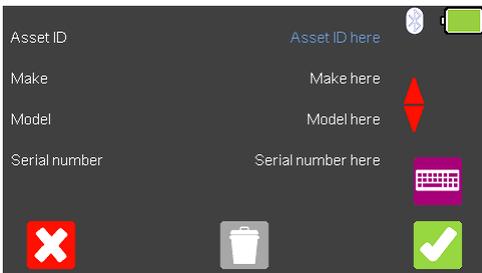
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.

7.2. Start Asset Option – Saving Test Results

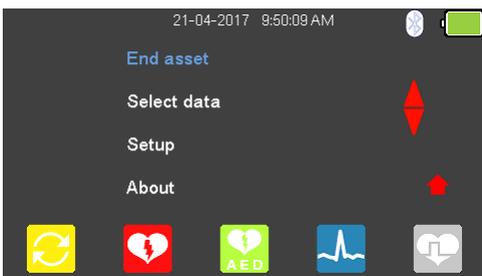
If the tests you are about to perform require the results to be saved then the Start asset option needs to be selected from the Main Menu, using  (F1), this displays a new asset option;



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

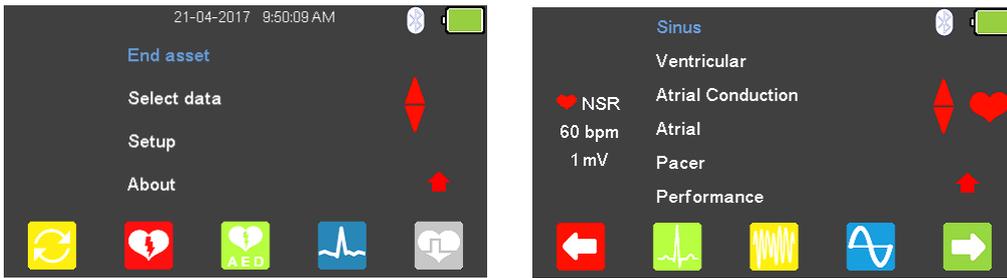


To confirm the asset details, select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).

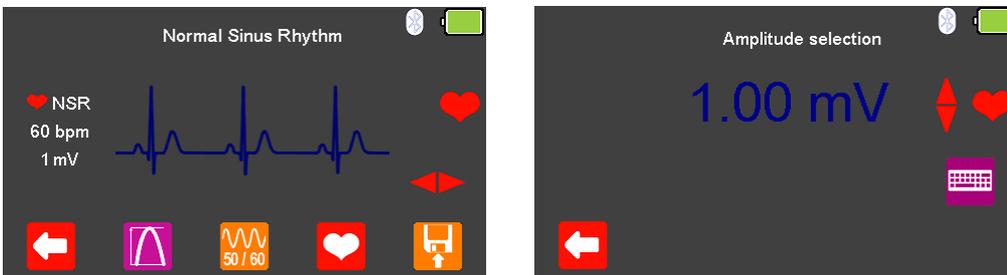


Selecting  (F5) returns the instrument to the Main Menu, however, the Start asset option is now displayed as End asset. Note; if End asset is selected the display reverts back to Start asset and the asset details previously entered can no longer be used.

7.3. Simulating an ECG Sinus Waveform

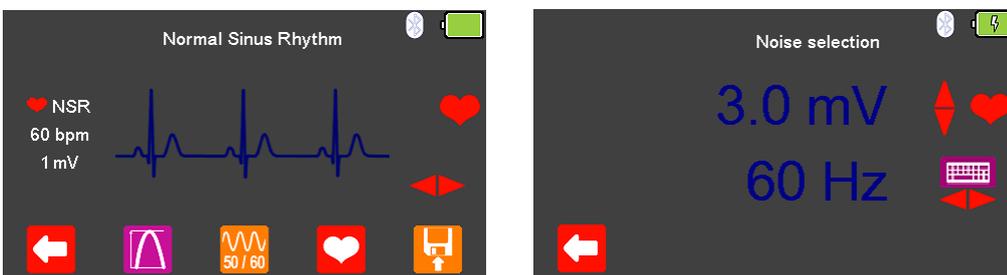


From the Main Menu select  (F4) for ECG simulation and either select  (F2), or highlight Sinus using the  arrow keys and confirm using the  (return) key or select  (F5).



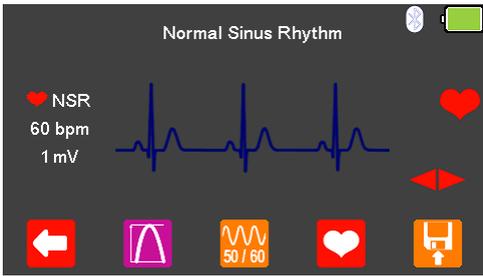
Use the   arrow keys to move between the available simulation waveforms. If applicable, select  (F2) to change the Amplitude selection to a fixed value between 0.5mV to 5.0mV, changes are made using the  arrow keys, selecting  (F1) confirms this selection.

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



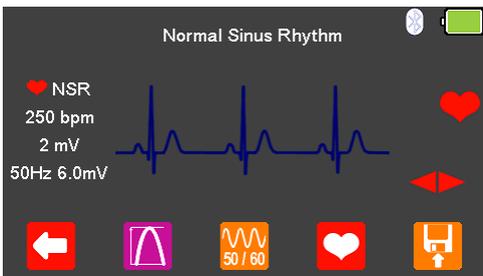
Select  (F3) to change the Noise selection to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the   arrow keys), changes are made using the  arrow keys, selecting  (F1) confirms this selection.

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:

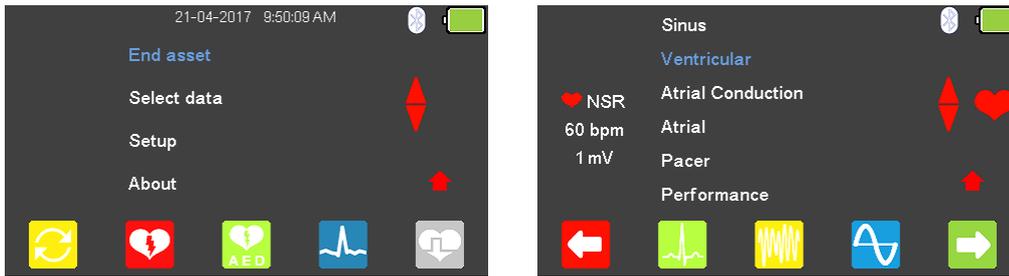
ECG Waveforms – Sinus

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)	

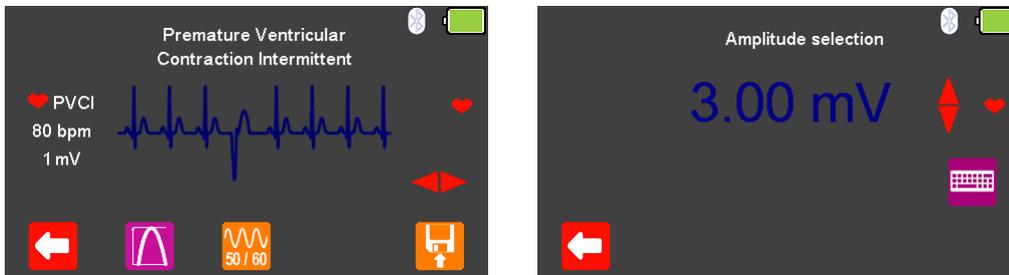
ECG Noise Selection

Amplitude	0 – 10.00mV
Frequency	50 - 60Hz

7.4. Simulating an ECG Ventricular Arrhythmia Waveform



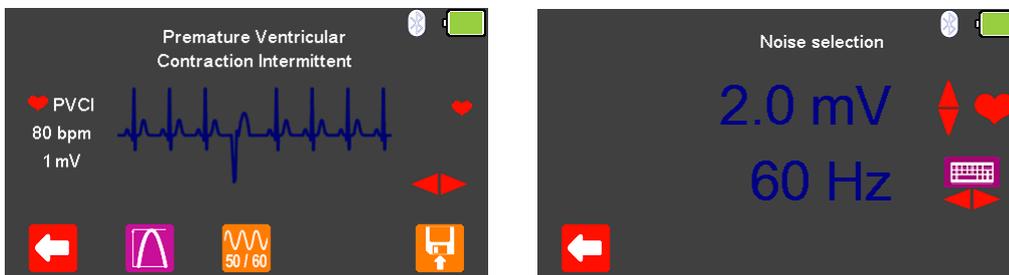
From the Main Menu select  (F4) for ECG simulation and either select  (F3), or highlight Ventricular using the   arrow keys and confirm using the ↵ (return) key or select  (F5).



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.

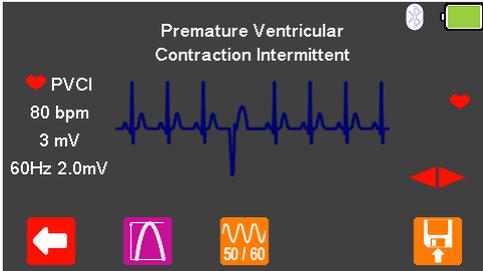
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



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:

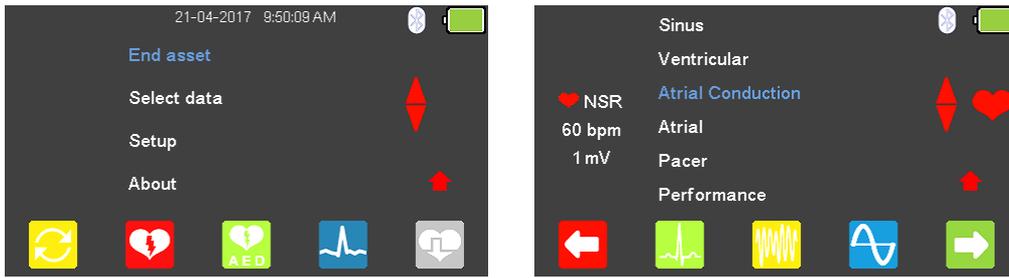
ECG Waveforms – Ventricular Arrhythmias

Premature Ventricular Contraction – Intermittent (P/VC)	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%)

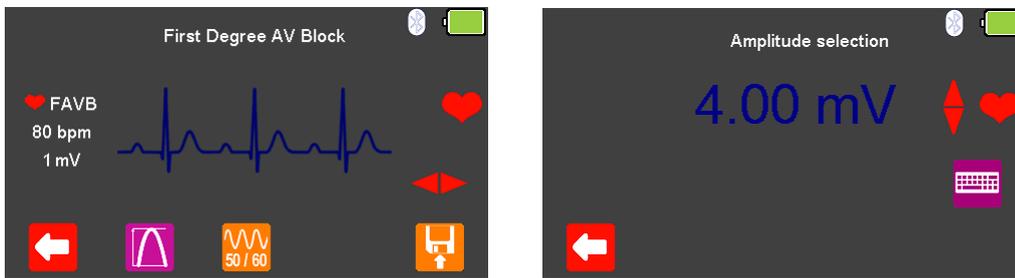
ECG Noise Selection

Amplitude	0 - 10.00mV
Frequency	50 - 60Hz

7.5. Simulating an ECG Atrial Conduction Waveform



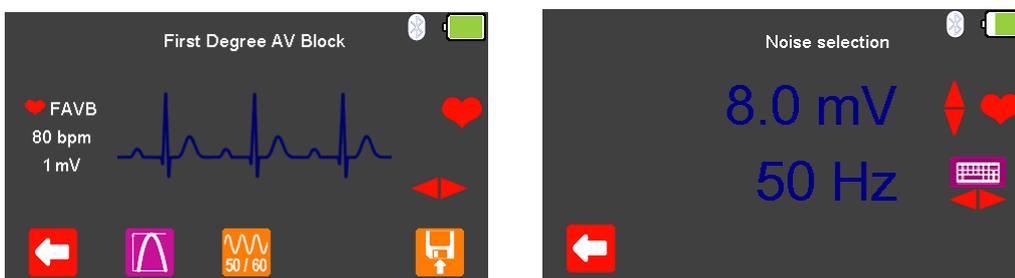
From the Main Menu select  (F4) for ECG simulation and highlight Atrial Conduction using the   arrow keys and confirm using the  (return) key or select  (F5).



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

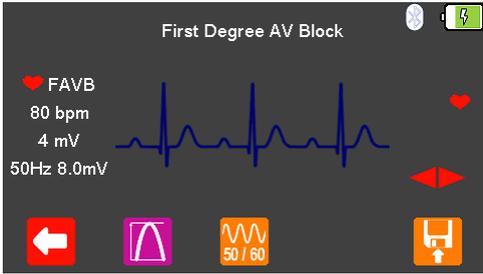
If applicable, select  (F2) to change the Amplitude selection to a fixed value between 0.5mV to 5.0mV, changes are made using the   arrow keys, selecting  (F1) confirms this selection.

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:

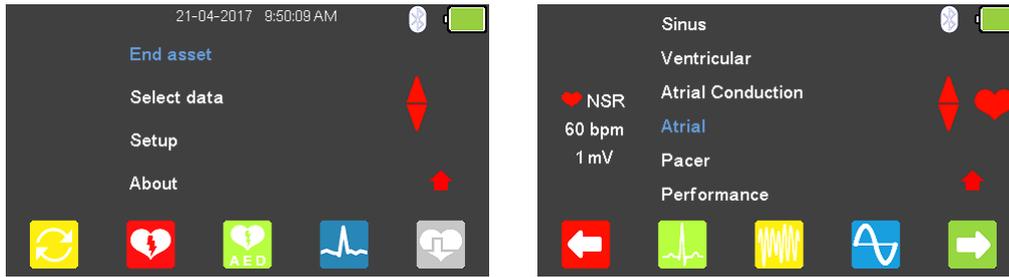
ECG Waveforms - Atrial Conduction Arrhythmias

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%)

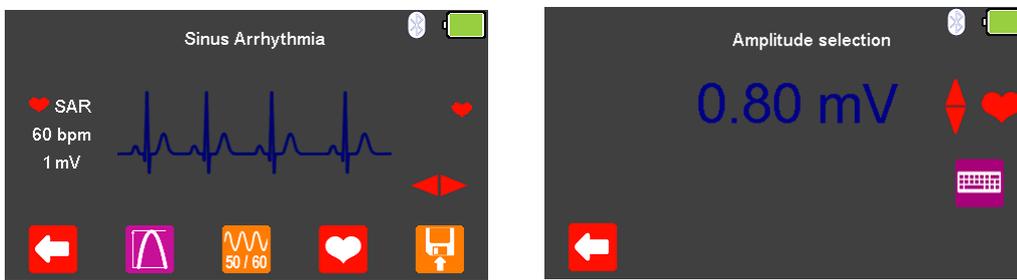
ECG Noise Selection

Amplitude	0 - 10.00mV
Frequency	50 - 50Hz

7.6. Simulating an ECG Atrial Waveform



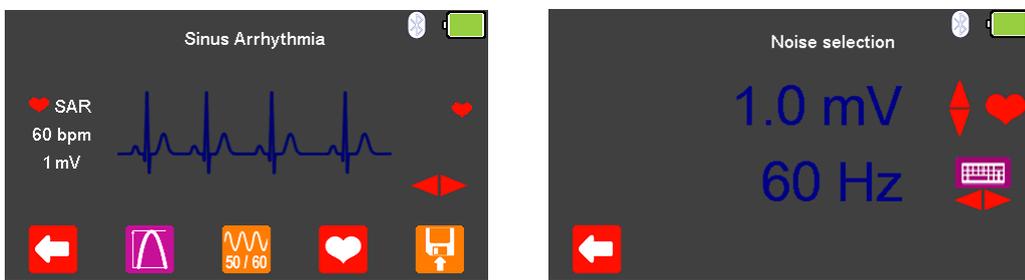
From the Main Menu select (F4) for ECG simulation and highlight Atrial using the arrow keys and confirm using the ↵ (return) key or select (F5).



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

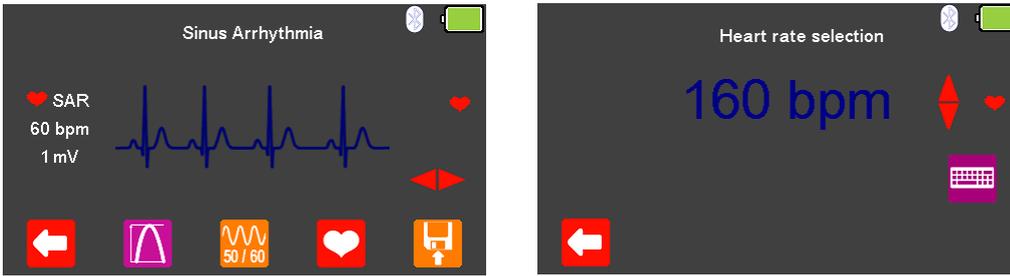
Select (F2) to change the Amplitude selections to a fixed value between 0.5mV to 5.0mV, changes are made using the arrow keys, selecting (F1) confirms this selection.

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



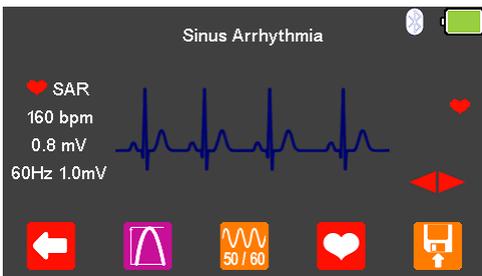
Select (F3) to change the Noise selection to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the arrow keys), changes are made using the arrow keys, selecting (F1) confirms this selection.

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:

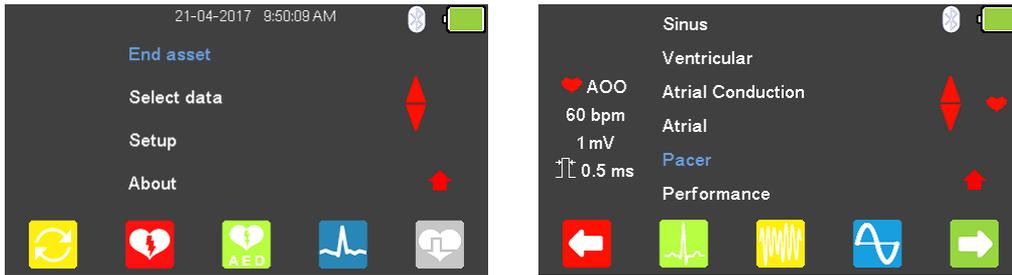
ECG Waveforms – Atrial Arrhythmias

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%)

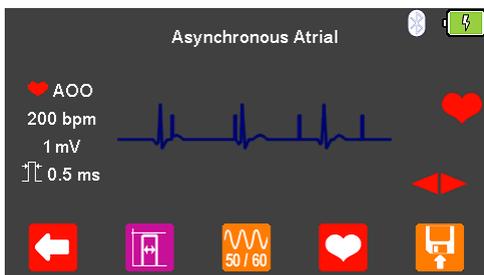
ECG Noise Selection

Amplitude	0 - 10.00mV
Frequency	50 – 60Hz

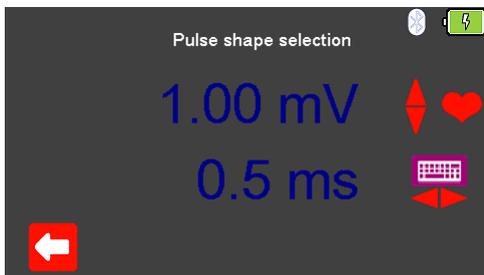
7.7. Simulating an ECG Pacer Waveform



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



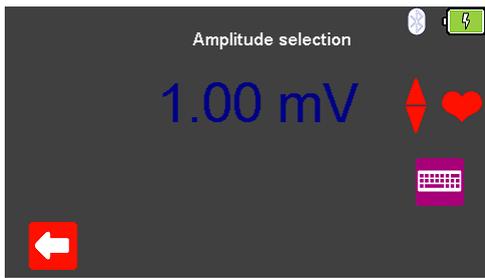
Use the   arrow keys to move between the available simulation waveforms.



If applicable, select  (F2) to change the 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.

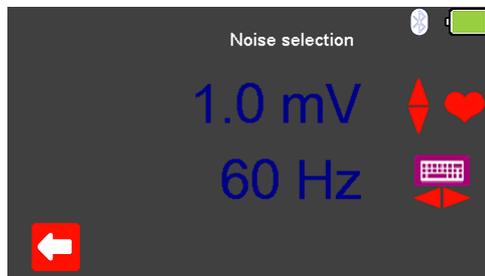
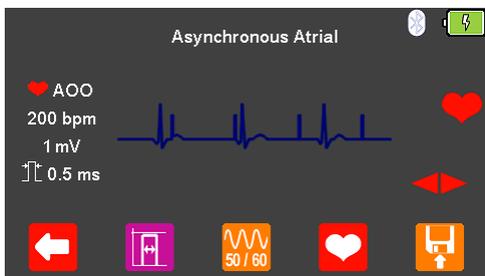
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

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.

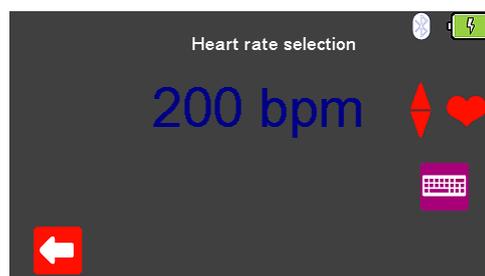
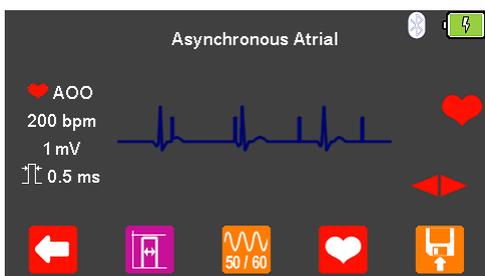


If applicable, select  (F2) to change the Amplitude selection to a fixed value between 0.5mV to 5.0mV, changes are made using the   arrow keys, selecting  (F1) confirms this selection.

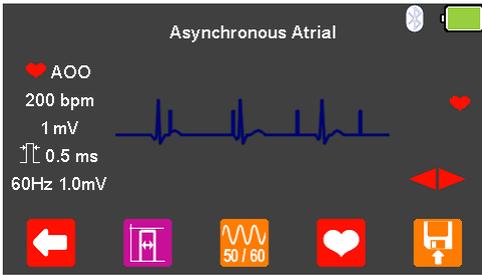
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).



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:

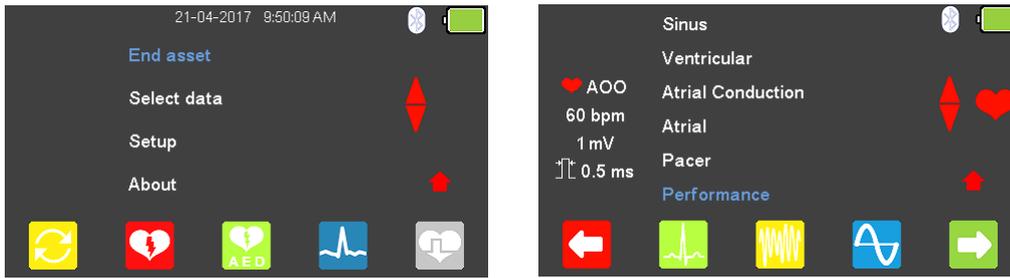
ECG Pacer Waveforms

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

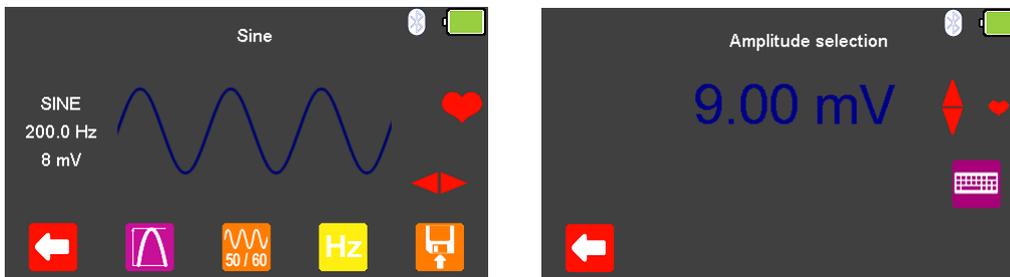
ECG Noise Selection

Amplitude	0 - 10.00mV
Frequency	50 - 60Hz

7.8. Simulating an ECG Performance Waveform



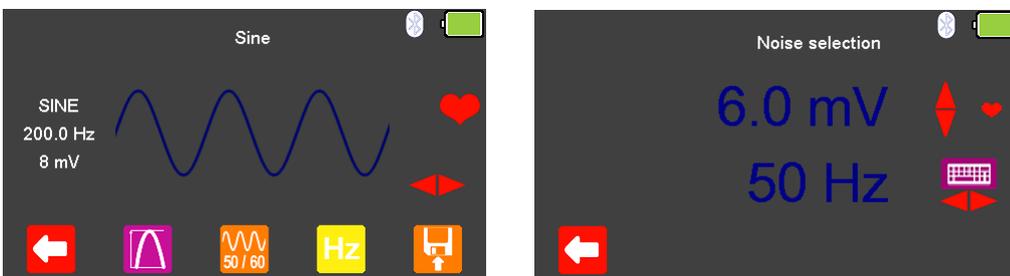
From the Main Menu select (F4) for ECG simulation and either select (F4), or highlight Performance using the arrow keys and confirm using the (return) key or select (F5).



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

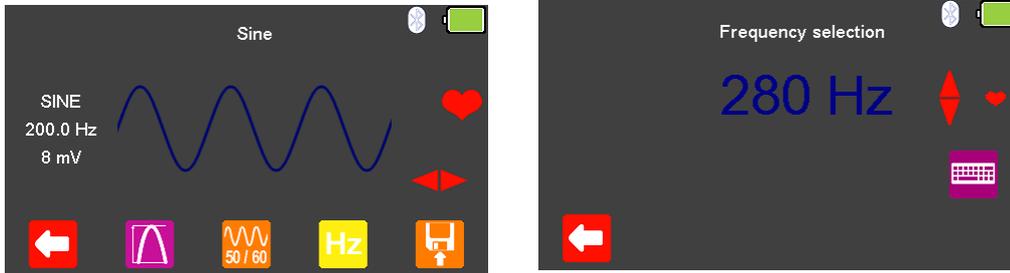
Select (F2) to change the Amplitude selection to a fixed value between 0.5mV to 5.0mV or 1.0mV to 10.0mV, where applicable, changes are made using the arrow keys, selecting (F1) confirms this selection.

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



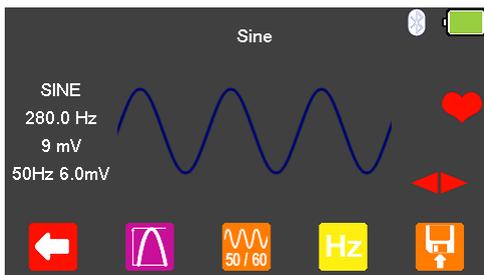
Select (F3) to change the Noise selection to a fixed value between 0mV to 10.0mV and a frequency of either 50Hz or 60Hz (using the arrow keys),

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

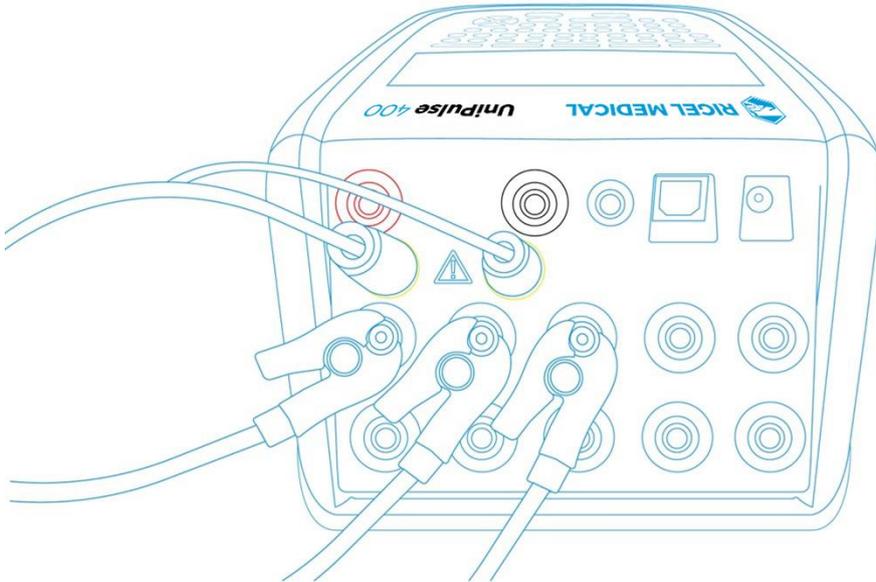
Sine (SINE)	0.1 - 300Hz, 1.00 - 10.00mV
Square (SQ)	0.1 - 300Hz, 1.00 - 10.00mV
Triangle (TRI)	0.1 - 300Hz, 1.00 - 10.00mV
Sawtooth (SAW)	0.1 - 300Hz, 1.00 - 10.00mV
Inverse Sawtooth (INVSAW)	0.1 - 300Hz, 1.00 - 10.00mV
Pulse (PULSE)	0.1 - 300Hz, 0.50 - 5.00mV

ECG Noise Selection

Amplitude	0 - 10.00mV
Frequency	50 - 60 Hz

8. Analysing Transcutaneous Pacers – Pacer Variable Load Input

8.1. Connecting to the Pacer Variable Load Input



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



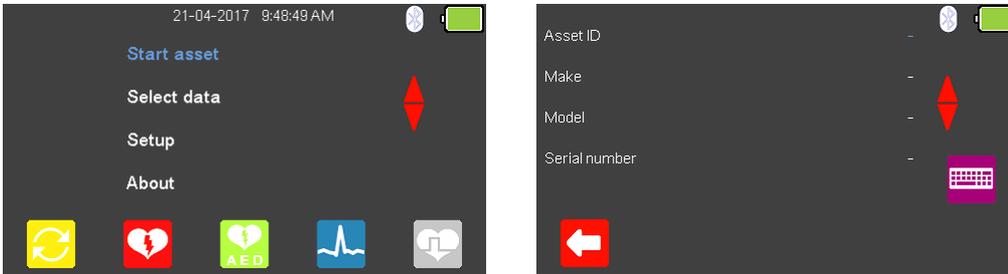
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



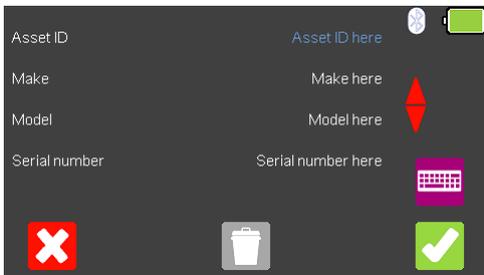
It is possible to test a pacemaker using the internal / external DEFIB load. This is necessary to avoid damaging the UniPulse 400 when there is the possibility of the EUT automatically delivering a Defib pulse during pacer testing in response to it recognising a VF pattern or similar in the ECG produced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

8.2. Start Asset Option – Saving Test Results

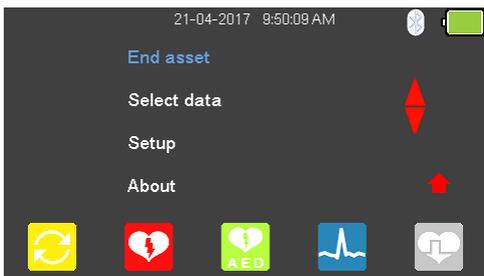
If the tests you are about to perform require the results to be saved then the Start asset option needs to be selected from the Main Menu, using  (F1), this displays a new asset option;



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

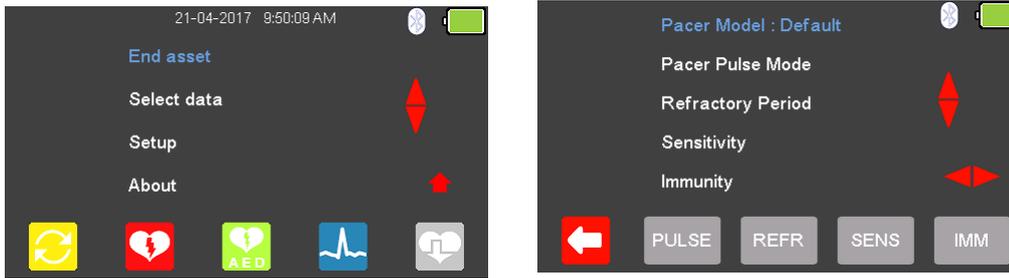


To confirm the asset details, select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



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



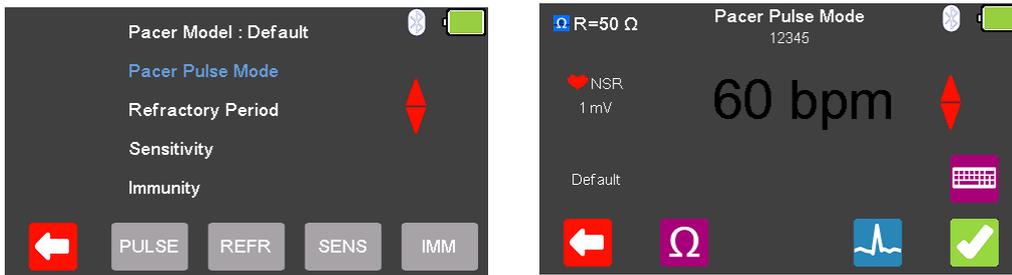
From the Main Menu select  (F5) for Pacer Mode.

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.

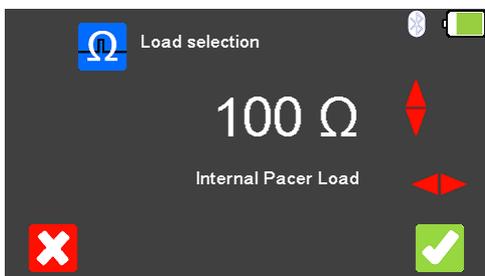
The available Pacer Manufacturer waveforms are: Default, CU Medical, GE, HP, Laerdal, Mindray, Philips, Physio-Control, Schiller, Welch Allyn, and Zoll.

8.4. Testing the Pacer Pulse Mode

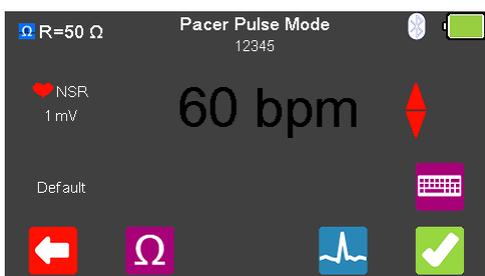


From the Pacer Menu use the   arrow keys to highlight Pacer Pulse Mode and confirm using the ↵ (return) key or select  (F2).

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

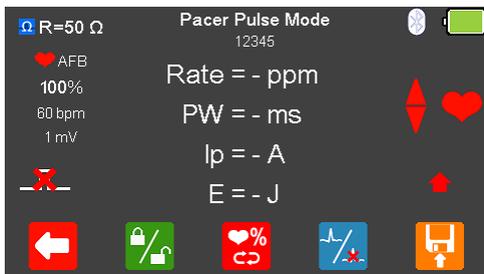
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)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

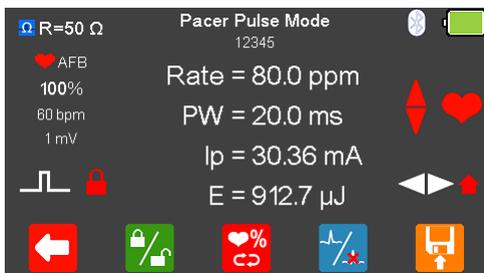
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

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.

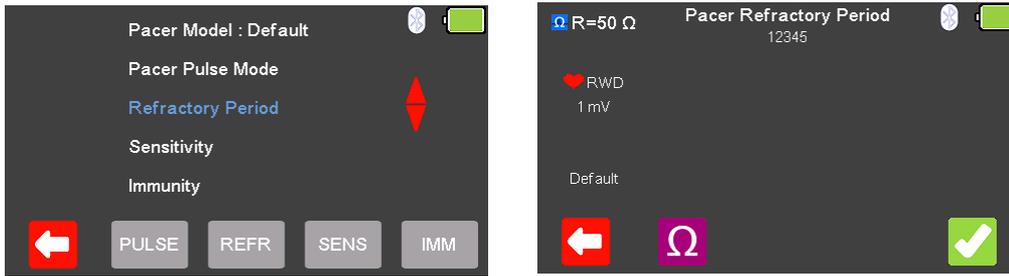
The output displayed on the screen can be frozen by selecting  (F2), when selected a red padlock is displayed.

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).

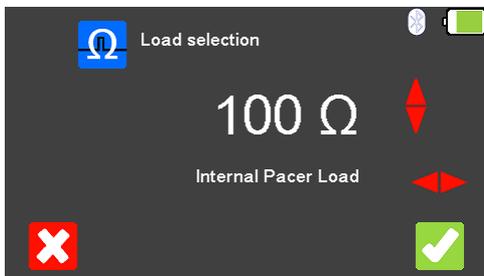
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

8.5. Testing the Refractory Mode



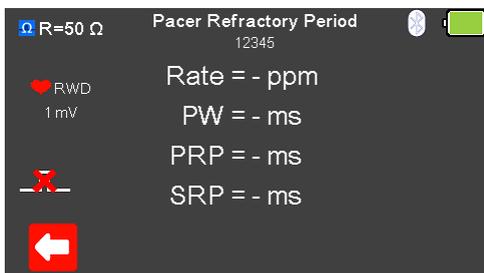
From the Pacer Menu use the   arrow keys to highlight Refractory Period and confirm using the ↵ (return) key or select  (F3).

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

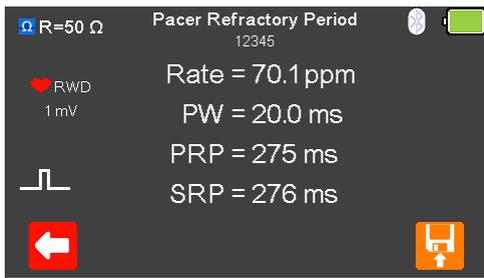


To exit without changing select  (F1). Use the   key to select the Internal Pacer Load (variable between 50 and 1600Ω), use the   arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

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.

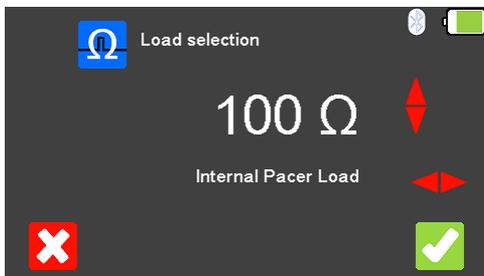
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

8.6. Testing the Pacer Sensitivity



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.

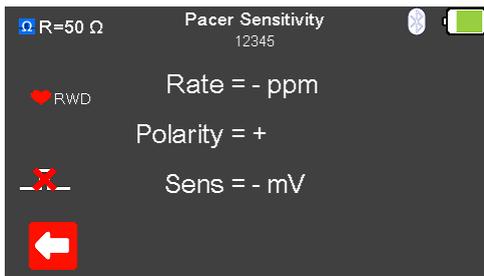


To exit without changing select  (F1). Use the   key to select the Internal Pacer Load (variable between 50 and 1600Ω), use the   arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting  (F1).

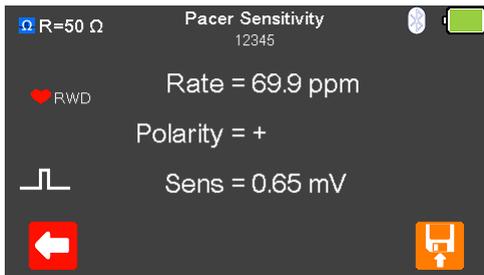


The Polarity of the Pacer Sensitivity can be selected using the   arrow key.

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



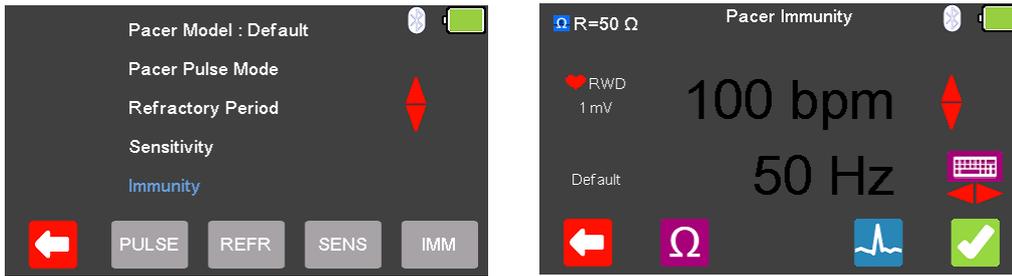
If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



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

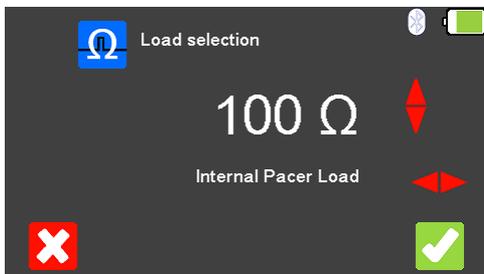
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

8.7. Testing the Pacer Immunity

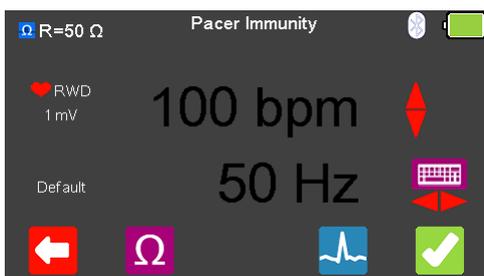


From the Pacer Menu use the   arrow keys to highlight Pacer Immunity and confirm using the ↵ (return) key or select  (F5).

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%)

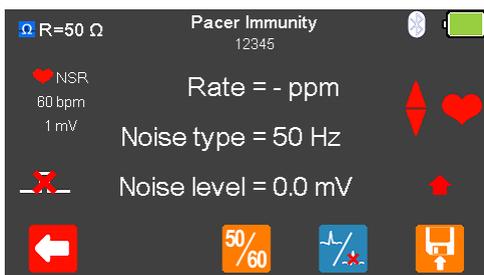
Where applicable, in the simulation waveform selection mode, select  (F4) to change the Heart rate selection to values between 20 and 300 BPM. Selecting  (F1) confirms this selection.

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

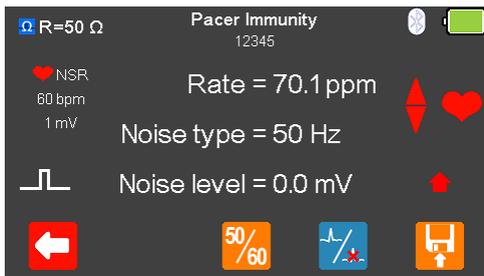
Note; where a waveform with variable Heart rate is selected the current value is displayed  in the centre of the Pacer Pulse Mode screen, using the  arrow keys, or free typing on the keyboard, allows this to be altered.

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).

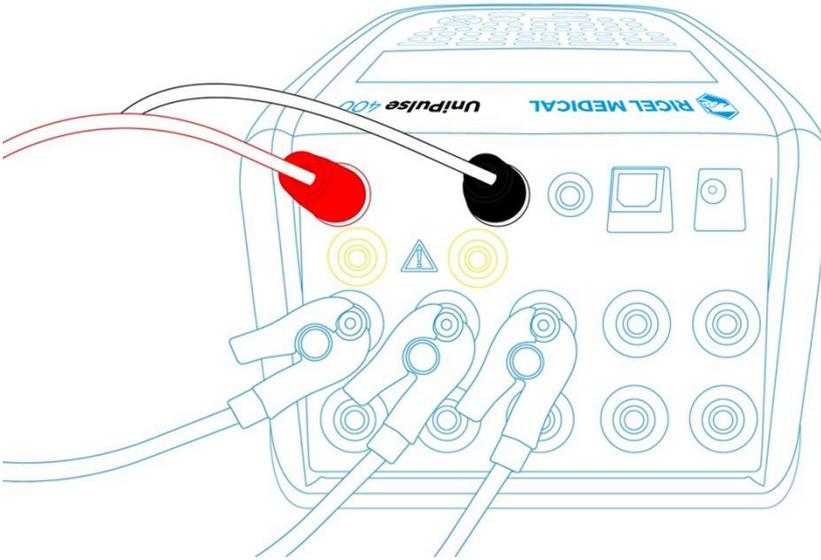
The waveform can be switched to asystole by selecting  (F4).

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 Transcutaneous Pacers – Defibrillator Paddle Input

9.1. Connecting to the Defibrillator Paddle Input

Method 1 – Direct Connection



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

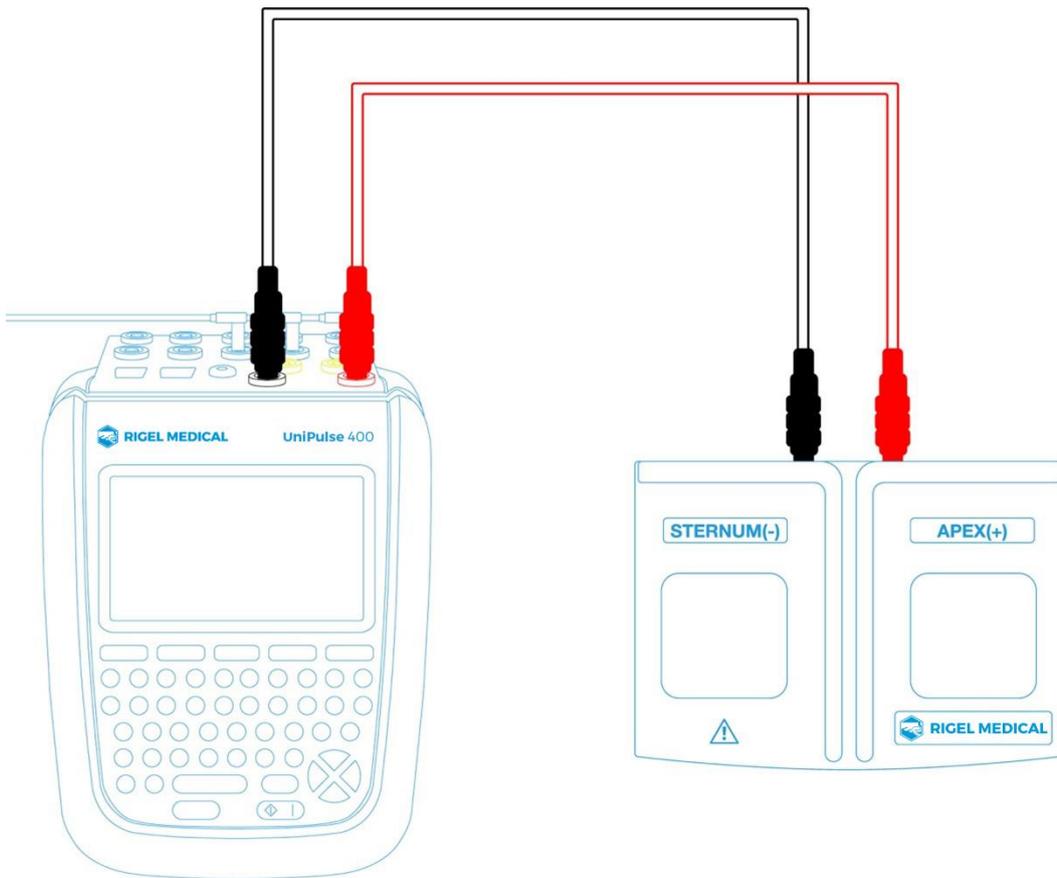


Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



It is possible to test a pacemaker using the internal / external DEFIB load. 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 - Paddle Box Connection



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



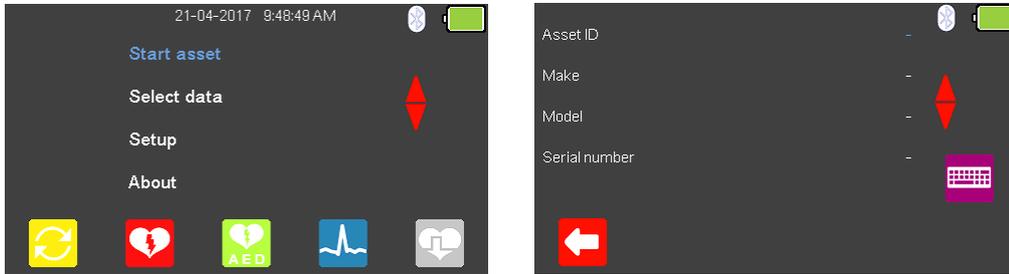
Ensure all safety precautions and safe operating procedures are observed as highlighted in the manufacturer operating instructions for your device.



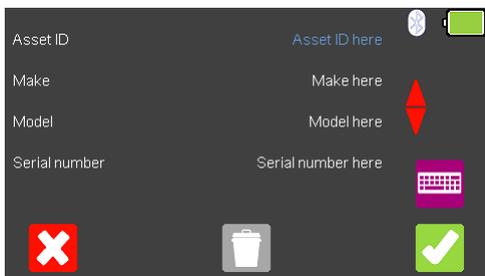
It is possible to test a pacemaker using the internal / external DEFIB load. This is necessary to avoid damaging the UniPulse 400 when there is the possibility of the EUT automatically delivering a Defib pulse during pacemaker testing in response to it recognising a VF pattern or similar in the ECG produced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

9.2. Start Asset Option – Saving Test Results

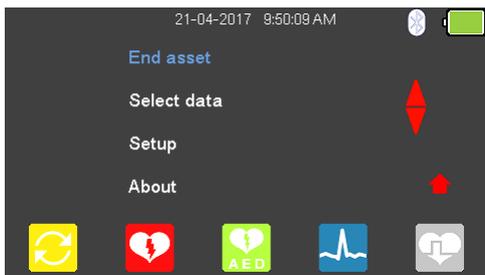
If the tests you are about to perform require the results to be saved then the Start asset option needs to be selected from the Main Menu, using  (F1), this displays a new asset option;



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

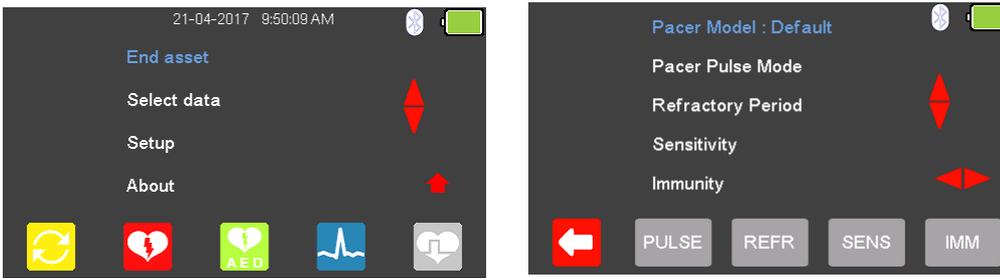


To confirm the asset details, select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



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



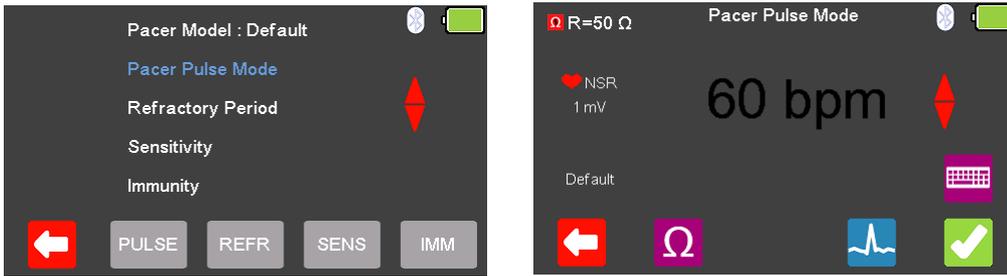
From the Main Menu select  (F5) for Pacer Mode.

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.

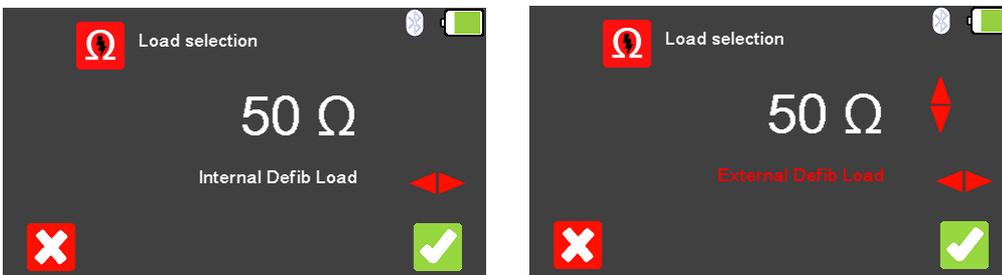
The available Pacer Manufacturer waveforms are: Default, CU Medical, GE, HP, Laerdal, Mindray, Philips, Physio-Control, Schiller, Welch Allyn, and Zoll.

9.4. Testing the Pacer Pulse Mode



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

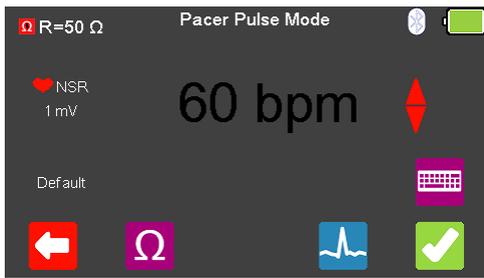
From the Pacer Pulse Mode select  (F2) to alter the Load selection.



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).

Note¹; if using the fixed load Paddle Adaptor Box (part number 386A950), an internal resistance of 50Ω should be selected.

Note²; if External Defib Load is selected, the user requires suitable external resistance. An internal resistance of 50Ω is always in circuit. For 25Ω – a suitable 50Ω should be placed in parallel with the internal 50Ω. For 50 to 200 Ω – suitable resistance should be placed in series with the internal 50 Ω.



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

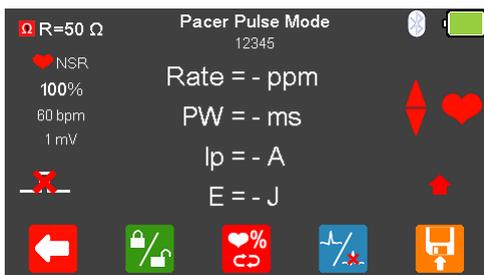
Normal Sinus Rhythm (NSR)	20 - 300 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Coarse (VFBC)	240 BPM, Amplitude 1.00mV(±2%)
Ventricular Fibrillation - Fine (VFBF)	240 BPM, Amplitude 1.00mV(±2%)
Monomorphic Ventricular Tachycardia (MVT)	210 BPM, Amplitude 1.00mV(±2%)
Atrial Fibrillation (AFB)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

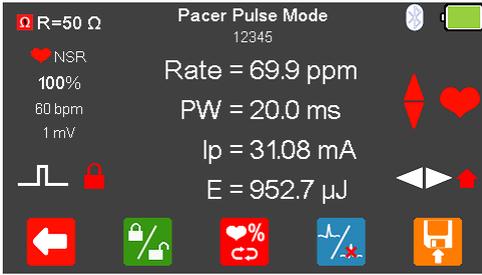
Note; values can be typed in using the keyboard and either saved using  (F5) or cancelled with  (F1).

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.

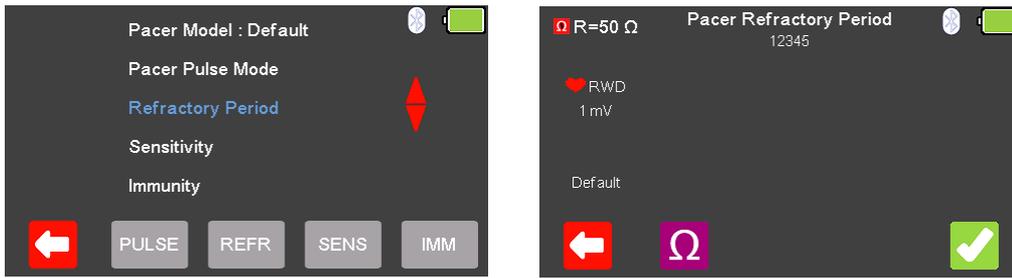
The output displayed on the screen can be frozen by selecting  (F2), when selected a red padlock is displayed.

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).

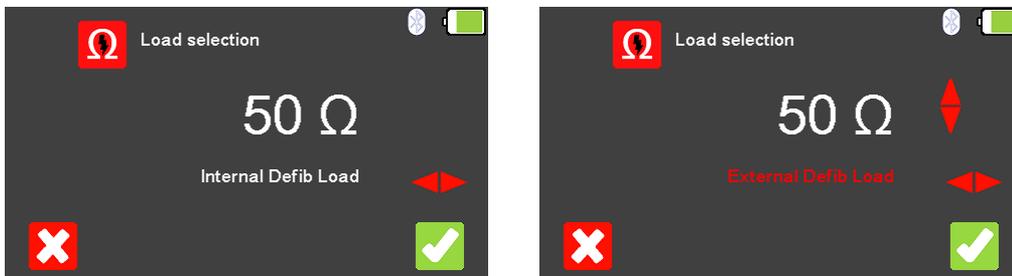
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

9.5. Testing the Refractory Mode



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.

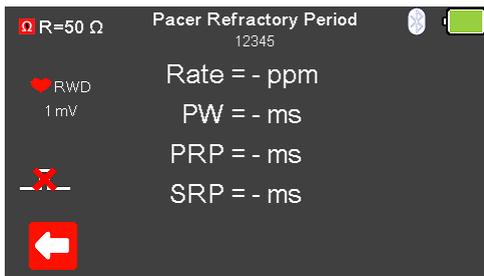


To exit without changing select  (F1). Use the   key to select either the Internal Defib Load (fixed at 50Ω) or External Defib Load (variable between 25 and 200Ω), use the   arrow keys to select the load resistance. To confirm the load select  (F5) or exit without changing the resistance by selecting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

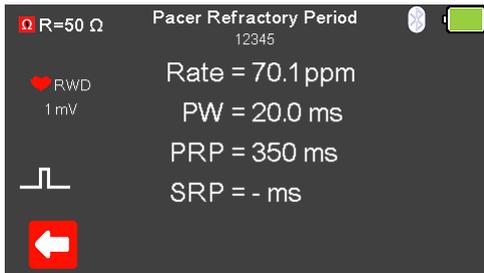
Note¹; if using the fixed load Paddle Adaptor Box (part number 386A950), an internal resistance of 50Ω should be selected.

Note²; if External Defib Load is selected, the user requires suitable external resistance. An internal resistance of 50Ω is always in circuit. For 25Ω – a suitable 50Ω should be placed in parallel with the internal 50Ω. For 50 to 200 Ω – suitable resistance should be placed in series with the internal 50 Ω.

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



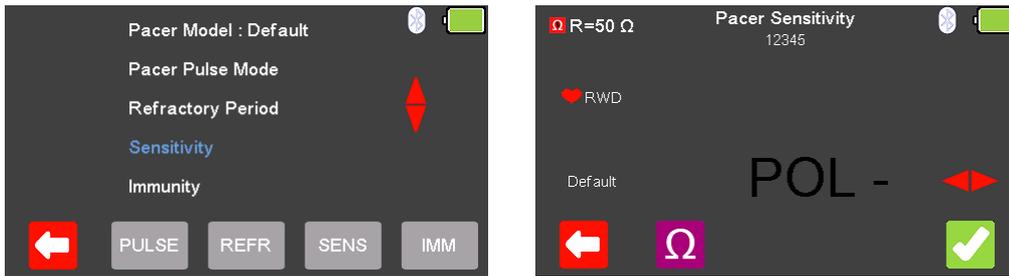
If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



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

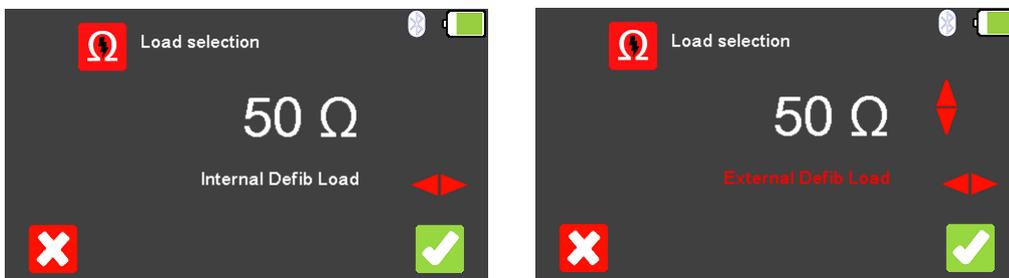
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

9.6. Testing the Pacer Sensitivity



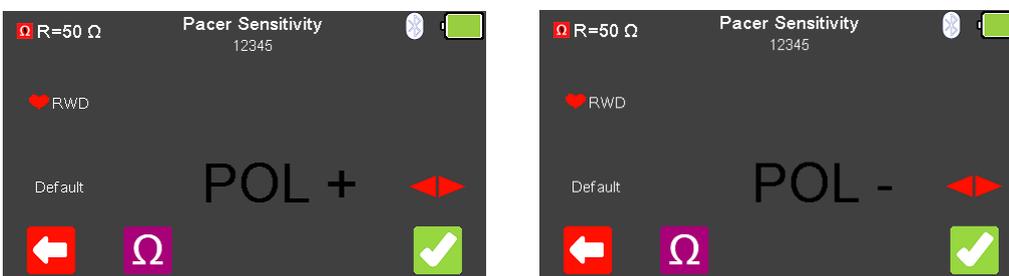
From the Pacer Menu use the arrow keys to highlight Sensitivity and confirm using the key or select (F4).

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



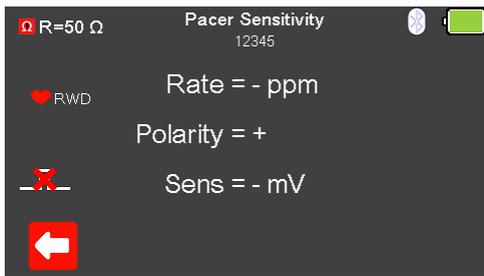
To exit without changing select (F1). Use the key to select either the Internal Defib Load (fixed at 50Ω) or External Defib Load (variable between 25 and 200Ω), use the arrow keys to select the load resistance. To confirm the load, select (F5) or exit without changing the resistance by selecting (F1).

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

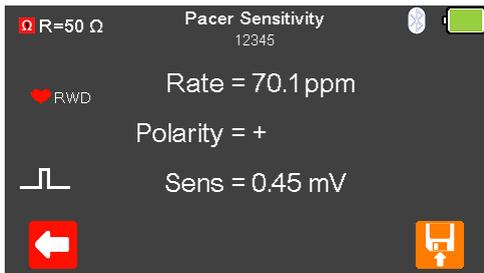


The Polarity of the Pacer Sensitivity can be selected using the arrow key.

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



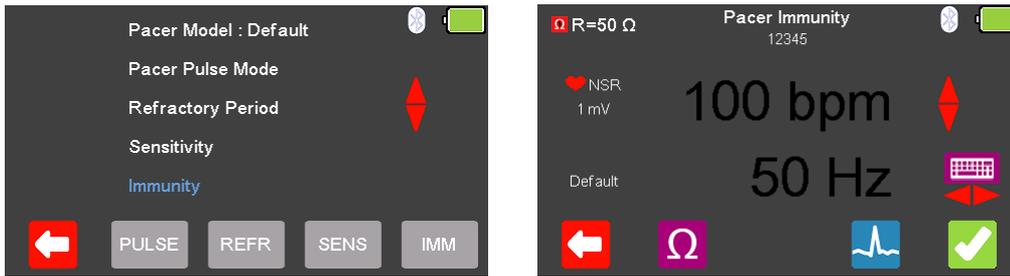
If no pacer signal is received from the EUT then a red cross appears in the pulse waveform.



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

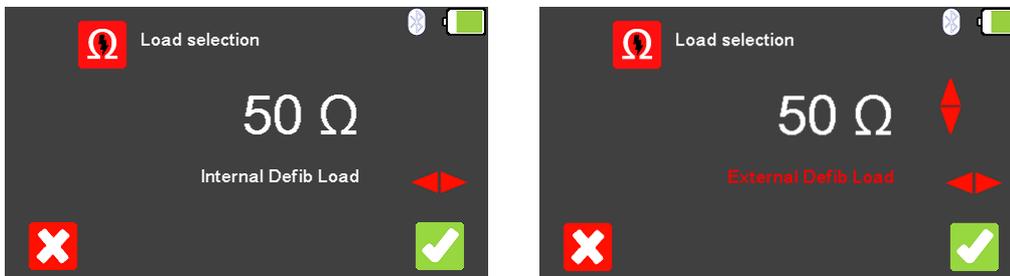
After testing is complete select  (F5) to save this under the asset details created earlier. Please note; this option is only available if it has been set up before the test was started.

9.7. Testing the Pacer Immunity



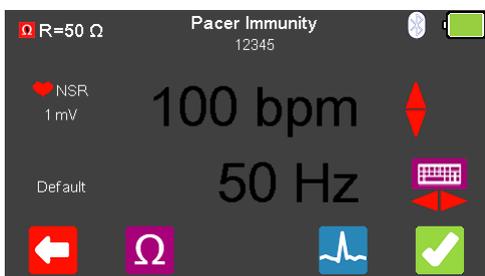
From the Pacer Menu use the   arrow keys to highlight Pacer Immunity and confirm using the ↵ (return) key or select  (F5).

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 internal 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%)

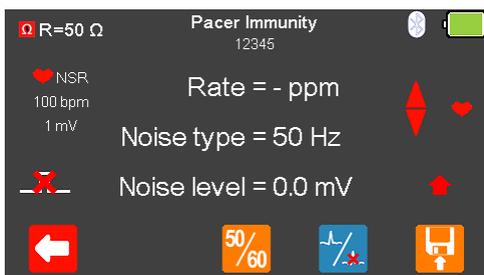
Where applicable, in the simulation waveform selection mode, select  (F4) to change the Heart rate selection to values between 20 and 300 BPM. Selecting  (F1) confirms this selection.

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

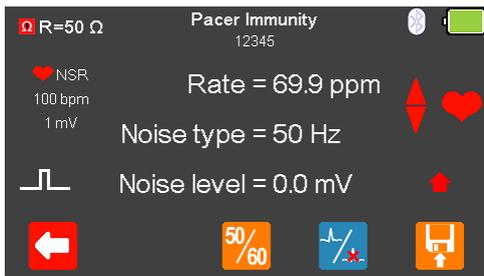
Note; where a waveform with variable Heart rate is selected the current value is displayed  in the centre of the Pacer Pulse Mode screen, using the  arrow keys, or free typing on the keyboard, allows this to be altered.

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).

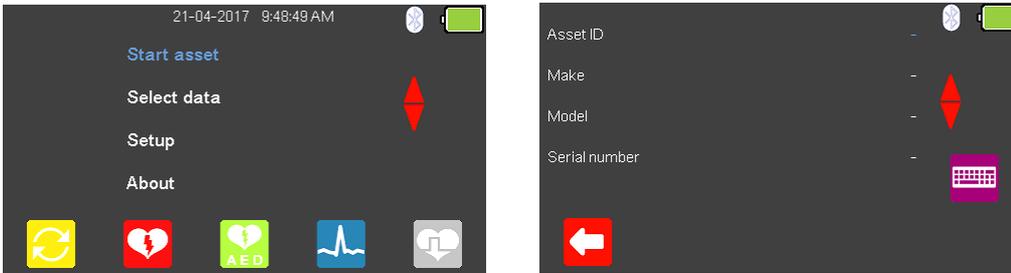
The waveform can be switched to asystole by selecting  (F4).

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.

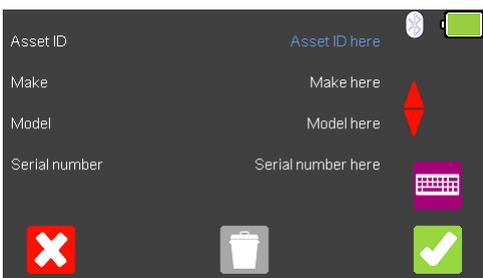
10. Handling Data

10.1. Start Asset Option – Saving Test Results

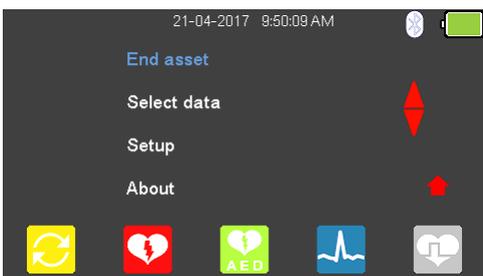
If the tests you are about to perform require the results to be saved then the Start asset option needs to be selected from the Main Menu, using  (F1), this displays a new asset option;



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



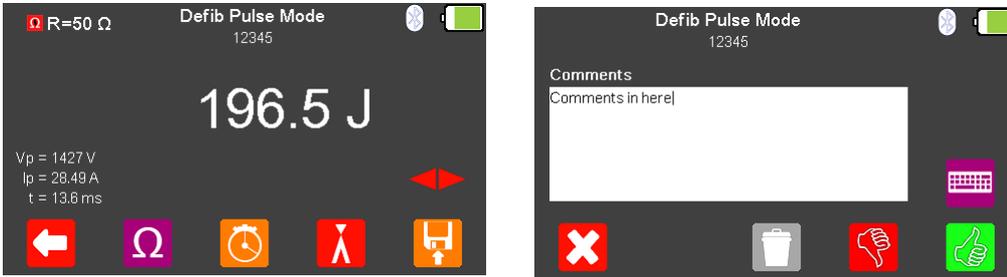
To confirm the asset details, select  (F5). Once information is entered, data on an individual line can be deleted using the  (F3) key or to exit without creating an asset select  (F1).



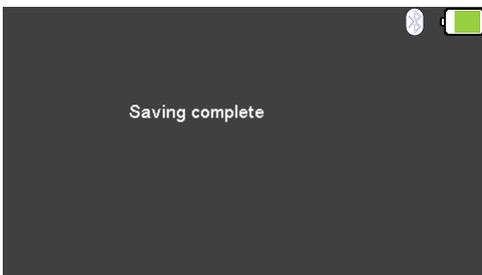
Selecting  (F5) returns the instrument to the Main Menu, however, the Start asset option is now displayed as End asset. Note; if End asset is selected the display reverts back to Start asset and the asset details previously entered can no longer be used.

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).

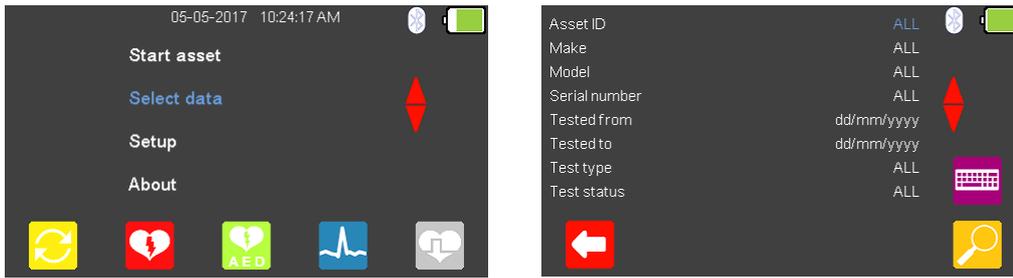


At the end of a test select  (F5) to save, additional comments can be added using the keyboard, entered data can be deleted using the  (F3) key.

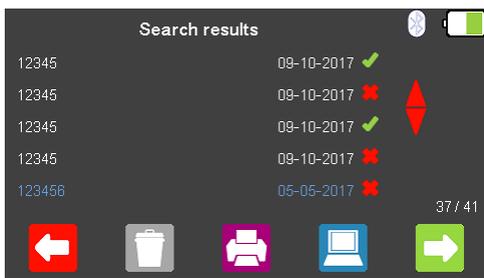


Once all of the information has been entered either select  (F5) to save the test as a pass or select  (F4) to save the test as a fail. A message will be displayed to confirm Saving complete in either case.

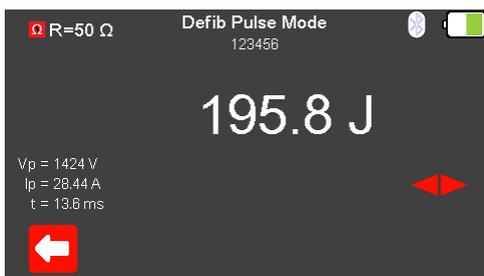
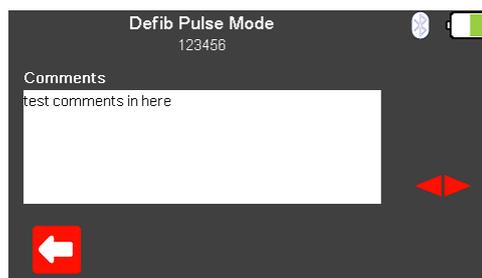
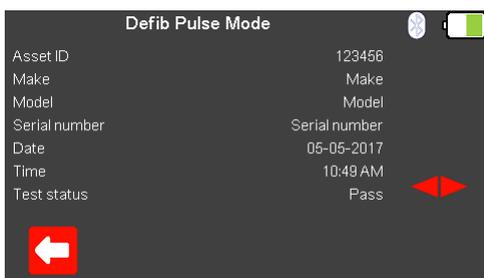
10.3. Viewing a Saved Test Result

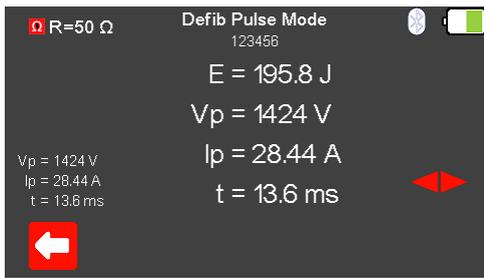


From the Main Menu, use the   arrow keys to highlight Select data and select the  (return) key to enter the asset menu. The  arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard or using the   arrow keys, where applicable (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.

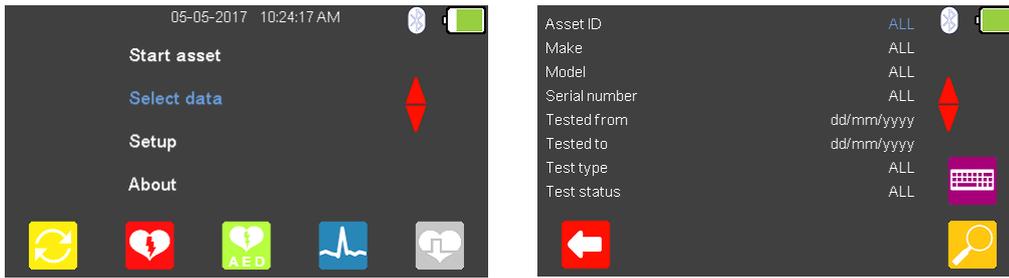




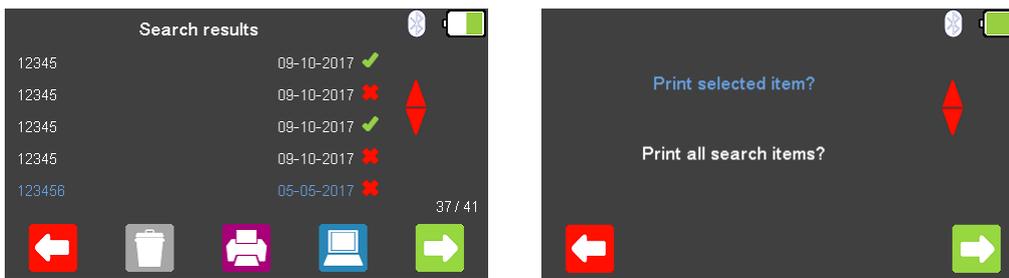
Using the   arrow keys allows the various test result screens to be viewed on the UniPulse 400. The format of these depends on the original test performed.

Selecting  (F1) returns to the Search results menu.

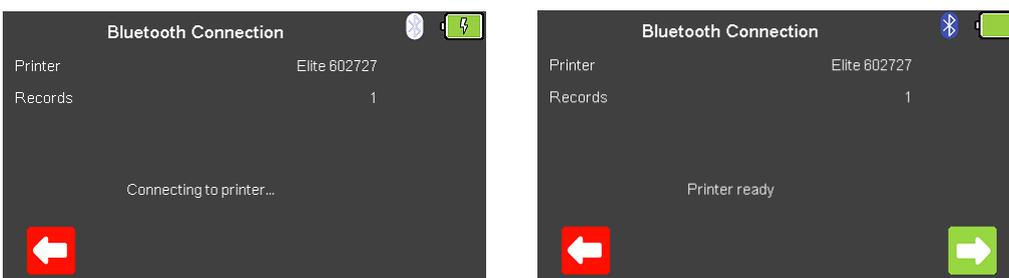
10.4. Printing a Saved Test Result



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.

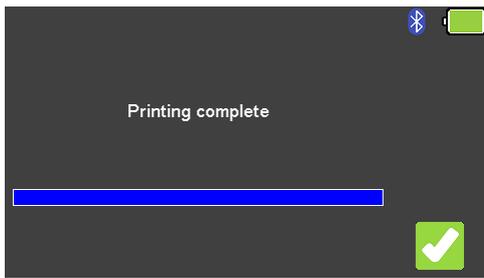


Use the arrow keys to highlight the asset you wish to print and select (F3) to either print this test result or to print results for all items in the list.



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

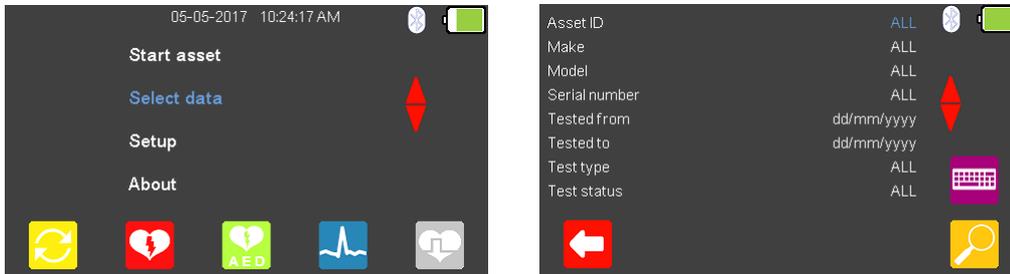
Selecting (F1) returns to the Search results menu, without printing.



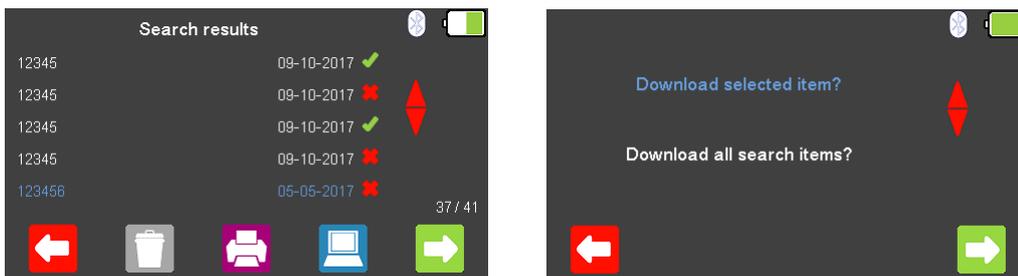
Once the printing is complete a message is displayed confirming this, the Search results menu can be viewed again by selecting  (F5).

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.

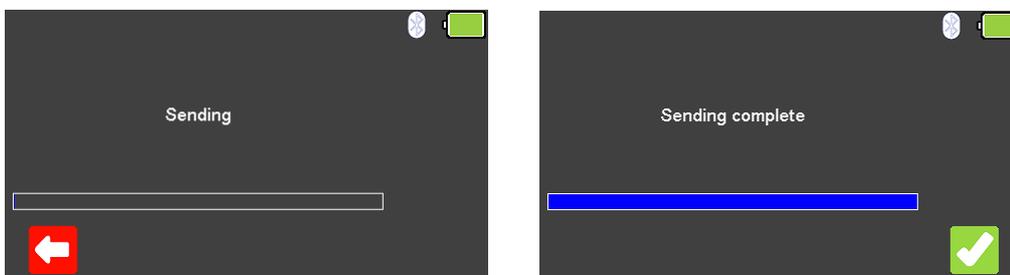


From the Main Menu, use the arrow keys to highlight Select data and select the (return) key to enter the asset menu. The arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard or using the arrow keys, where applicable (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.

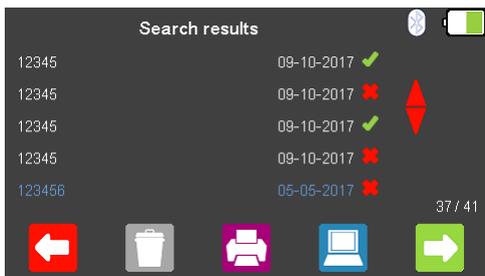


Select (F5) to send the data from the UniPulse 400 connected to a PC via the USB lead. Once the download is complete a message is displayed confirming this, the Search results menu can be viewed again by selecting (F5).

10.6. Deleting a Saved Test Result

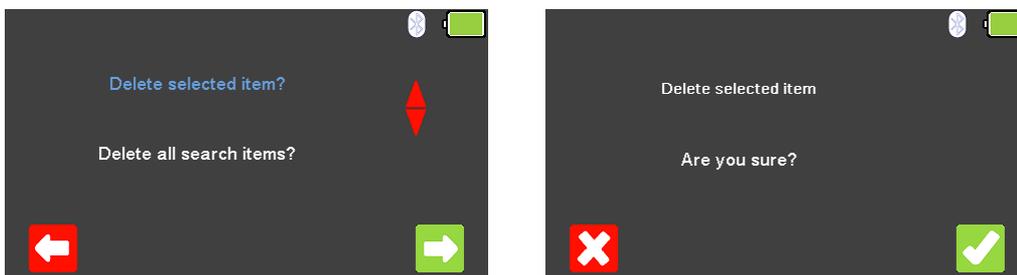


From the Main Menu, use the arrow keys to highlight Select data and select the (return) key to enter the asset menu. The arrow keys can be used to highlight the item to be used in the search criteria. The search criteria can be either changed using the keyboard or using the arrow keys, where applicable (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, clearly stating 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 - 600 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 (capture time)	5us – 120ms

Charge Time

Measurement is initiated by pressing the function key and simultaneously charging the defibrillator. Charge time is recorded after the defibrillator has discharged into the UniPulse 400

Clock accuracy	0.10s to 100s +/-0.05s
----------------	------------------------

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 simulation with high-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 (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%)
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	5-lead ECG and on Paddles Output Jack
Hi Level	

ECG Accuracy

Rate	± 1% bpm
Amplitude	± 2% (LA-LL), ± 10% (Paddles) Lead II : 1 – 10 mV (in steps of 0.5 mV). Other leads are proportional to Lead II by the following percentages: Lead I : 60 % Lead II : 100 % Lead III : 40 % V1 : 63 % [Reference LA] V2 : 71 % [Reference LA] V3 : 68 % [Reference LA] V4 : 80 % [Reference LA] V5 : 55 % [Reference LA] V6 : 49 % [Reference LA]

Pacer Input	
Fix Load	50 Ω
Accuracy	1 %, non-inductive
Over voltage protection	5000V
Variable Load	50 to 1600 Ω in 50 Ω 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	1 μ J – 2.00J
Accuracy	+/- 4% + 10 μ J
Pacer Manufacturer Algorithms	
CU Medical, GE, HP, Laerdal, Mindray, Philips, Physio-Control, Schiller, Welch Allyn, Zoll	
Pacer Refractory Periods	
Refractory Period test	15 – 500mS (Paced and sensed)
Accuracy	+/- 1ms
Pacer Sensitivity Test	
Wave form, R Wave	Polarity Normal and Reversed, selectable
Dynamic Sensitivity	0.05mV to 5.00mV in 50 μ V steps
Pacer Interference Test (Immunity):	
Heart rate	20-300 bpm
Frequency	50 or 60 Hz
Noise level in mV	0-15.0mV
Defib Synchronisation Test	
Measurement	Simulated R-wave peak to the defib pulse peak
Range	-999.9 to 999.9ms
Resolution	0.1ms
Accuracy	+/- 1ms

13.2. General Specifications

Dimensions	220mm x 150mm x 90mm (L x W x H)
Weight	1.5kg
Operation	9.6V/2400mAh Nickel Metal Hydride battery pack
Battery charge time	2.5 hours
Battery capacity (fully charged)	12 hours
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
Altitude	2000m
Environmental Protection	IP 40
Pollution degree	2
Communication	USB
Display	LCD colour graphic display ¼" 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

Technical enquiries

Tel: +44 (0) 191 586 3511

Email: support@rigelmedical.com

Service, Calibration and Repair

Tel: +44 (0) 191 587 8739

Fax: +44 (0) 191 518 4666

Email: info@calibrationhouse.com

Rigel Medical

15 - 18 Bracken Hill

South West Industrial Estate

Peterlee

County Durham

SR8 2SW

United Kingdom



RIGEL MEDICAL
TESTED, TRUSTED... WORLDWIDE.

Rev 2.1