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GTD BENCHMARKING SOFTWARE

Installation and test run

Steve Fernandes – Technical Development Manager
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Steve Fernandes

- 19 years at Intertek working on Audio Visual and ICT testing.
- Projects - European Commission, UK Government, Market Surveillance, NGOs and manufacturers
- Conduct Qualification and Verification testing, write test methodologies and answer technical queries.
- Represents BSI on CENELEC and IEC Technical Committees as the UK principal expert in the field of standby, networked standby, efficiency of external power supplies and measurement of power consumption of televisions and computers.

OVERVIEW

- A.C. Power Measurement: Considerations

- Creating USB Stick

- USB Stick Install on UUT
- USB Stick Install on Controller Computer
- Start power data acquisition on Controller Computer
- Start Full Run on UUT

- Merge power data with benchmark data

A.C. POWER MEASUREMENT: CONSIDERATIONS

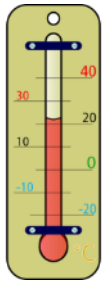
Disclaimer

While every precaution has been followed in the preparation of this document, including careful internal review by competent and experienced technical experts, this work does involve measurements of mains voltage and current in a test laboratory. The procedure set out in this document should only be attempted by competent, experienced technical experts who have worked with power measurements of computers or similar equipment in the past and are familiar with the best laboratory safety procedures and practices.

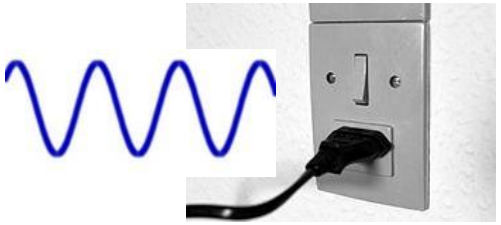
CLASP, GTD GmbH and Intertek do not accept any liability for any direct, indirect, punitive, incidental, special, or consequential damages arising out of, or in connection with, the use or misuse of any information provided in this report, the accompanying software and any other instructions or deliverables provided in association with this project. This information is provided as a free resource for measuring the energy efficiency and performance of computers and users of this test method acknowledge and agree that any use of this information is done so at their own risk.

A.C. POWER MEASUREMENT: ENVIRONMENTAL CONSIDERATIONS

1. **Environmental conditions**



2. **Power source qual/stability**



EN 62623 specifies:

23 ±5°C

10% to 80% RH

Specified Voltage ±1%

Specified Frequency ±1%

THD (V) < 2%

A.C. POWER MEASUREMENT: POWER METER WIRING

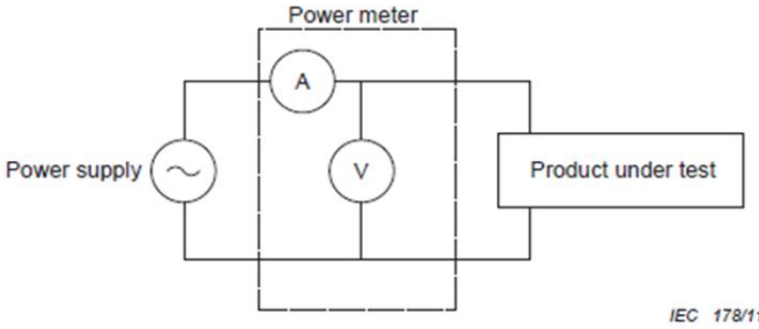
Measurement of Power:

We normally measure the current flow from supply to load by placing the ammeter between the two while measuring the voltage across the load. This is fine when measuring high power.

The WT310 voltmeter resistance is 2 MΩ (very high) and the ammeter resistance is 16 mΩ (very low), but when measuring low power, the resistance of the ammeter and voltmeter will alter the flow of current very slightly in the circuit in which we are taking measurements and this can be significant in comparison to the low power measurement.

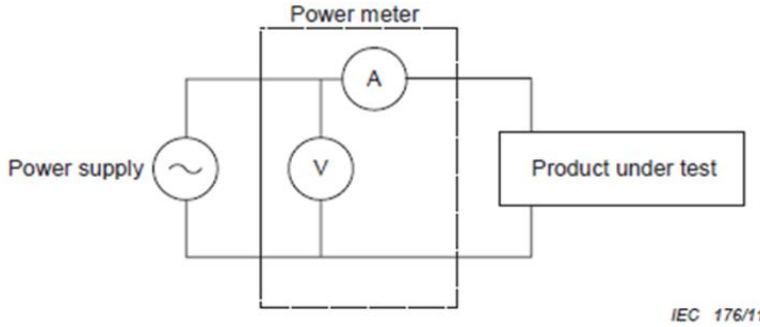
These effects produced by the internal power consumption of the measurement instrument can be minimised simply by adjusting the position of the voltmeter in the circuit. In general, for low power measurements, the voltmeter should measure across the supply side, while for higher power, measure across the load side.

A.C. POWER MEASUREMENT: POWER METER WIRING



Connection arrangement for a product powered directly from the a.c. main supply for higher power loads

Selected this test setup for this project



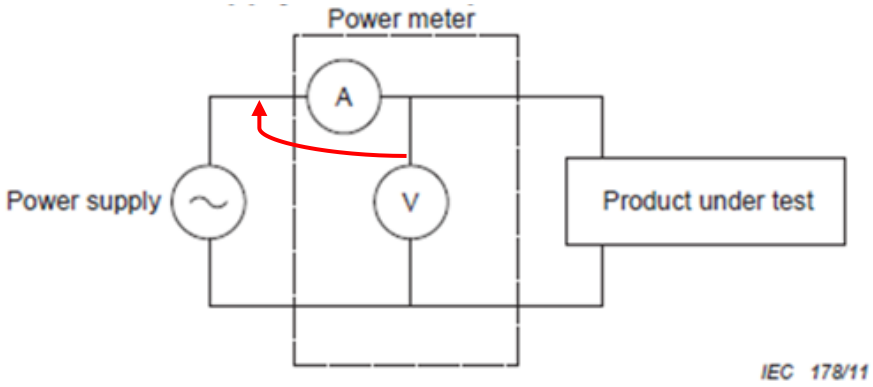
Connection arrangement for products powered directly from an a.c. power supply for lower power loads

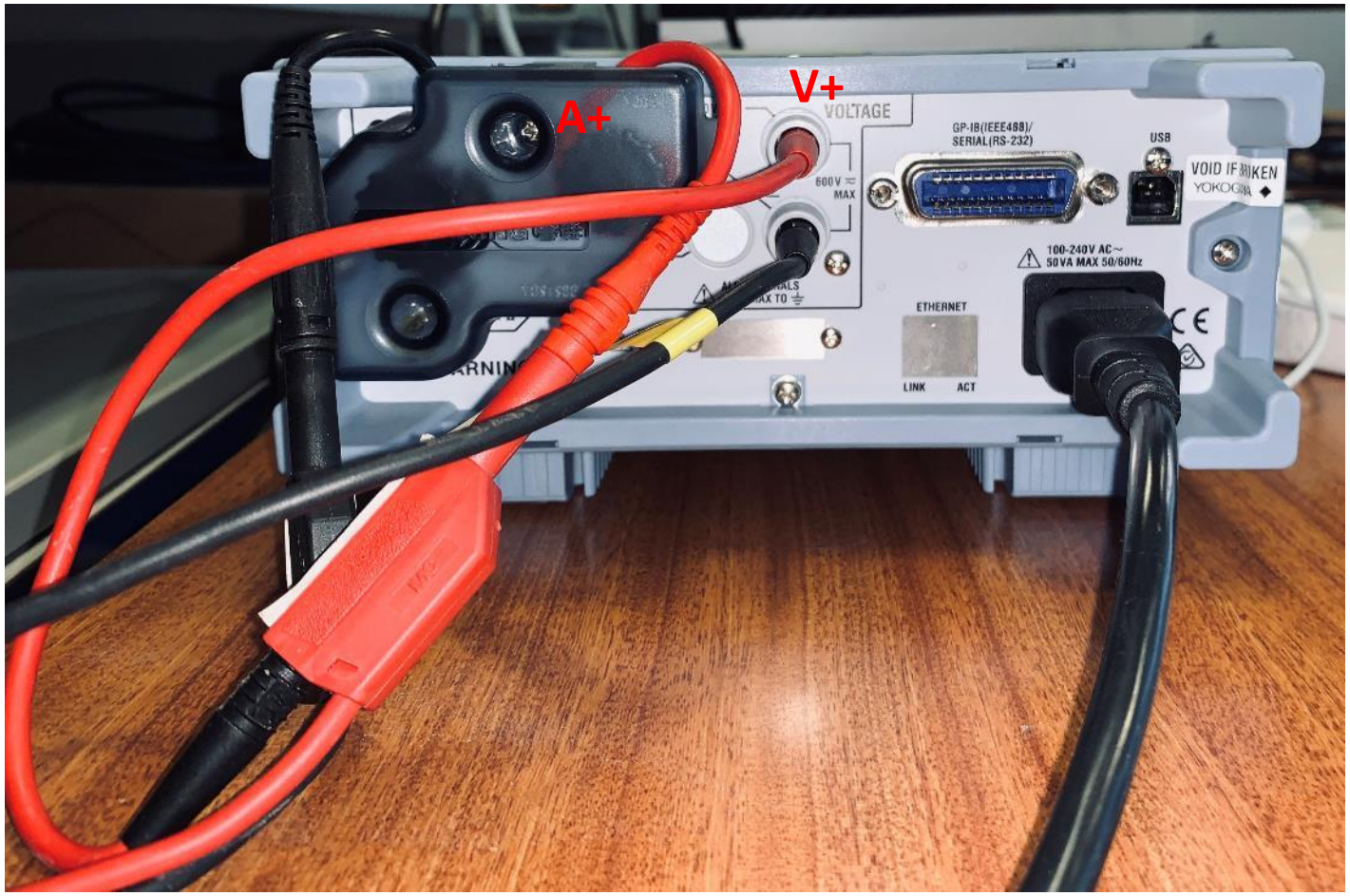
Refer to EN 50564:2011, Annex B for a detailed explanation and method for calculating the best configuration..

A.C. POWER MEASUREMENT: POWER METER WIRING

Easily achieved by replacing the positive voltage connection to the meter with a bridge to the positive current terminal.

Use shrouded plugs intended for mains voltages please.





Back of the Yokogawa WT310

A.C. POWER MEASUREMENT: OVERVIEW

- Knowing which settings are important and why
  - Ranges
  - How ranges are specified
  - Crest Factor

- Menu Navigation
  - The setup button
  - The up/down buttons
  - Exit without changing settings

- Changing ranges and meter settings
  - Voltage, current, crest factor
- How to avoid surprises
  - Pre-test - like a dry run
  - Log the data so that it can be graphed

A.C. POWER MEASUREMENT: MEASUREMENT RANGES

It is important to use the appropriate instrument range to take your measurement.

On measurement instruments, the accuracy of measurement is generally greatest at or near a full scale reading, i.e. near the maximum value of the range selected.

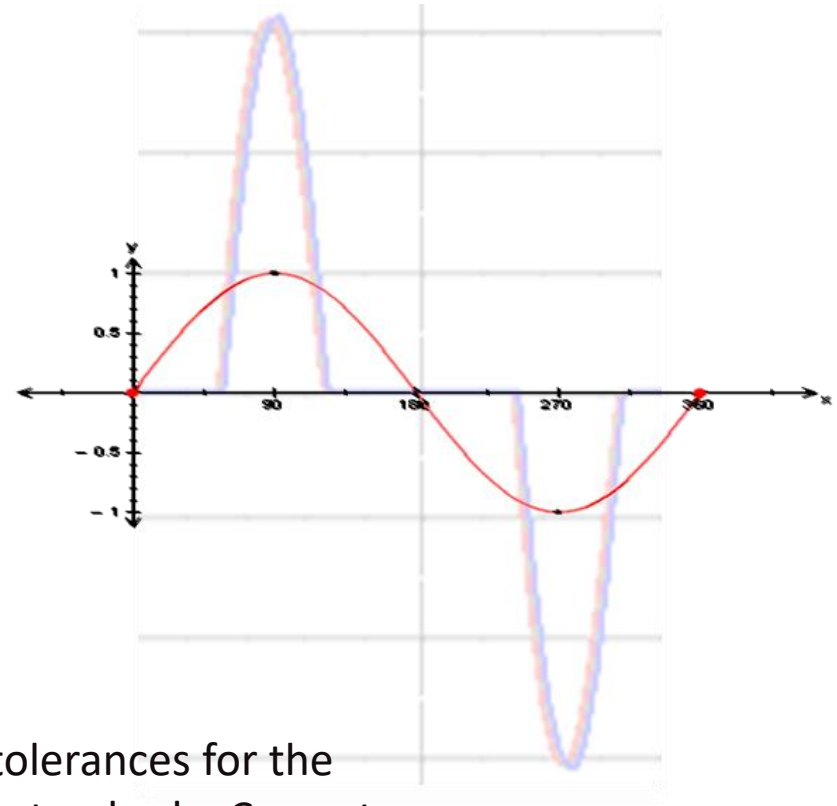
On the Yokogawa WT310 the published accuracy is applicable from 1% to 130% of the range, i.e. on a 1 A range, the accuracy claim is valid from 10 mA to 1.3 A and not just for a “sweet spot” within that range.

For computer testing, we tend to use a current range of either 0.5 A or 1 A.

A.C. POWER MEASUREMENT: METER CREST FACTOR

While measuring power, the ideal situation is to have perfectly sinusoidal wave forms for voltage and current so that all values that lie within the selected ranges, are captured and digitised.

However this is often not the case and significant divergence from this in the waveform may pose a problem to the meter. Large peaks can fall outside the ranges selected and may not be captured.



This ratio of peak to r.m.s. is referred to as the crest factor. While tolerances for the allowable Voltage crest factor are often specified in measurement standards, *Current* crest factor is often overlooked.

The important thing to remember is that in order to measure correctly, the crest factor setting of your meter must be higher than the crest factor you intend to measure. Alternatively, you can increase the current range to accommodate your peaks. On the WT310 this amounts to the same thing.

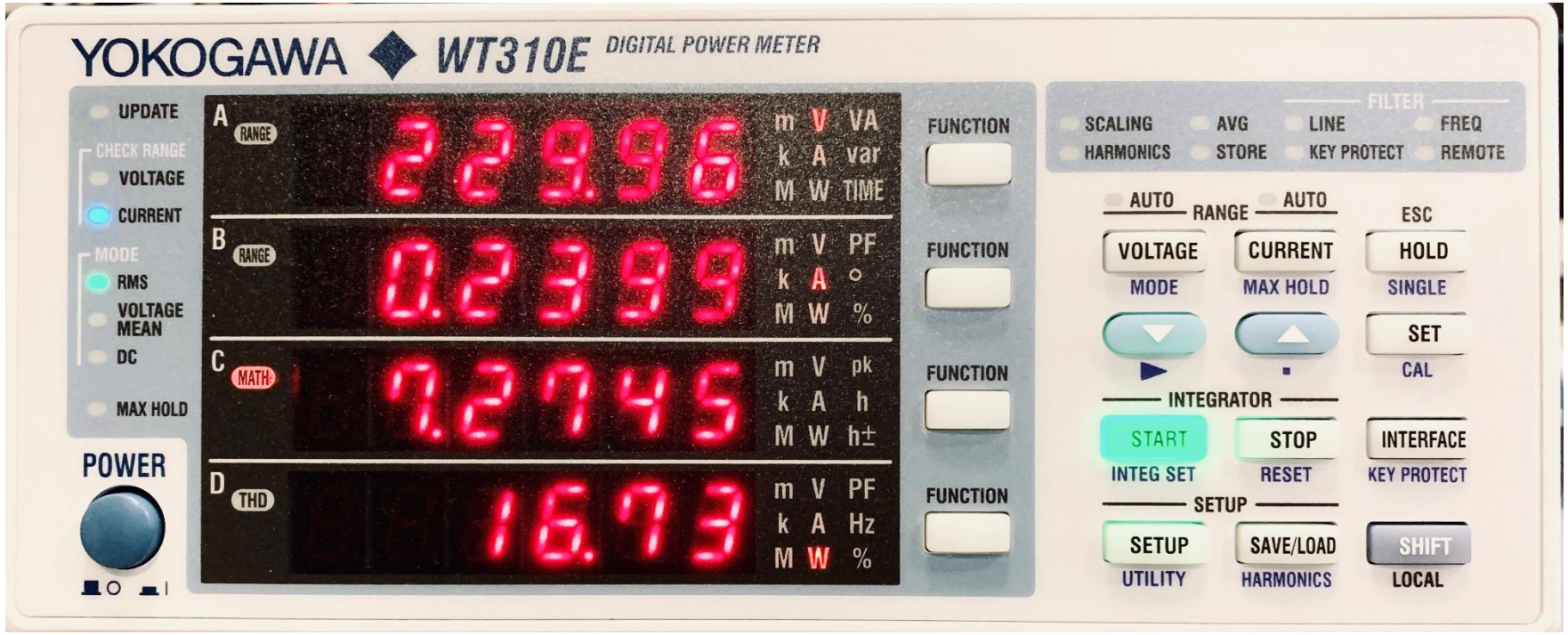
A.C. POWER MEASUREMENT: OVERVIEW

- Knowing which settings are important and why
  - Ranges
  - How ranges are specified
  - Crest Factor Current

- Yokogawa Menu Navigation
  - The setup button
  - The up/down buttons
  - Exit without changing settings

- Changing ranges and meter settings
  - Voltage, current, crest factor
- Check Power Source
  - Check Power source Total Harmonic Distortion of the Voltage Waveform

A.C. POWER MEASUREMENT: METER MENU NAVIGATION



- Press the SETUP button once to get into the menu.
- Use the ˅/^ buttons to scroll through settings and press Enter to select. Make the change and press Enter again.
- To exit the setup menu without making a change, e.g. if you are just checking a setting, press SETUP again instead of ENTER.

Note: The SETUP button will not operate during integration (press STOP, then SHIFT then RESET).

A.C. POWER MEASUREMENT: SELECTING RANGES

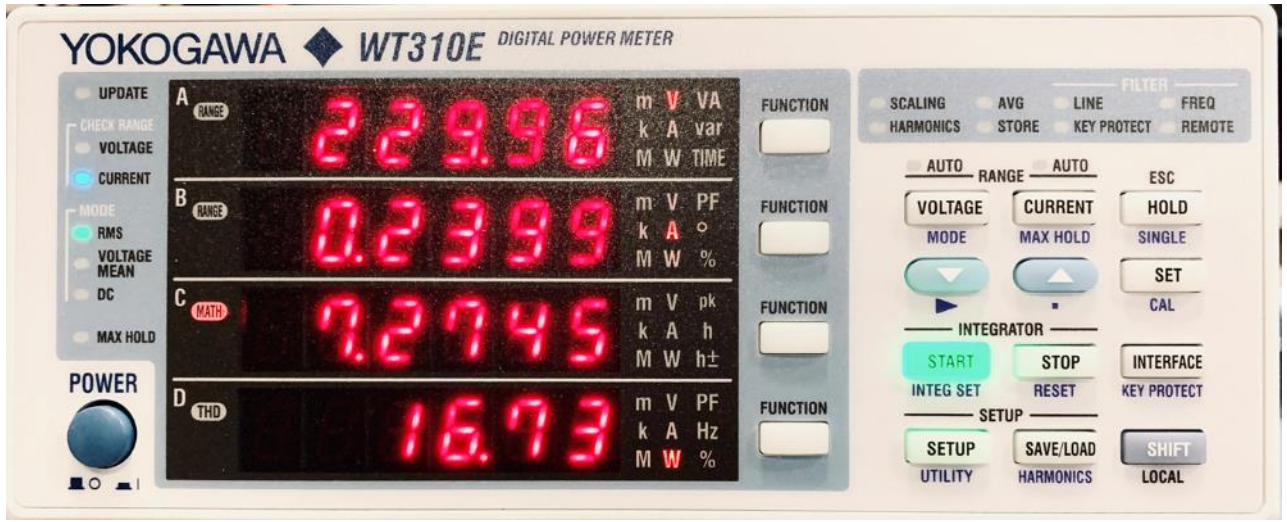
The primary settings are:

1. **Voltage range**

   Press the VOLTAGE button and use the ˅/^ buttons to select the correct range to match the source voltage that you are testing with.
   For Europe 230 V, range = 300 V
   For US 115V, range = 150 V
   Press SET to save and exit

2. **Current range**

   Press the CURRENT button and use the ˅/^ buttons to select the appropriate range to match the current that your sample will draw.
   Although the “Auto” range setting should never be used during formal testing, if you do not know what range to select, as a quick guide, use the ˅ or ^ buttons to scroll to “Auto” and select it to see what range has been automatically selected and then set it to this manually.



If the meter is set to auto range, it can automatically jump between ranges, losing data while doing so. Also you won’t know what range it’s on at any particular stage, so you won’t know how to calculate your uncertainties of measurement – but that’s for another presentation!

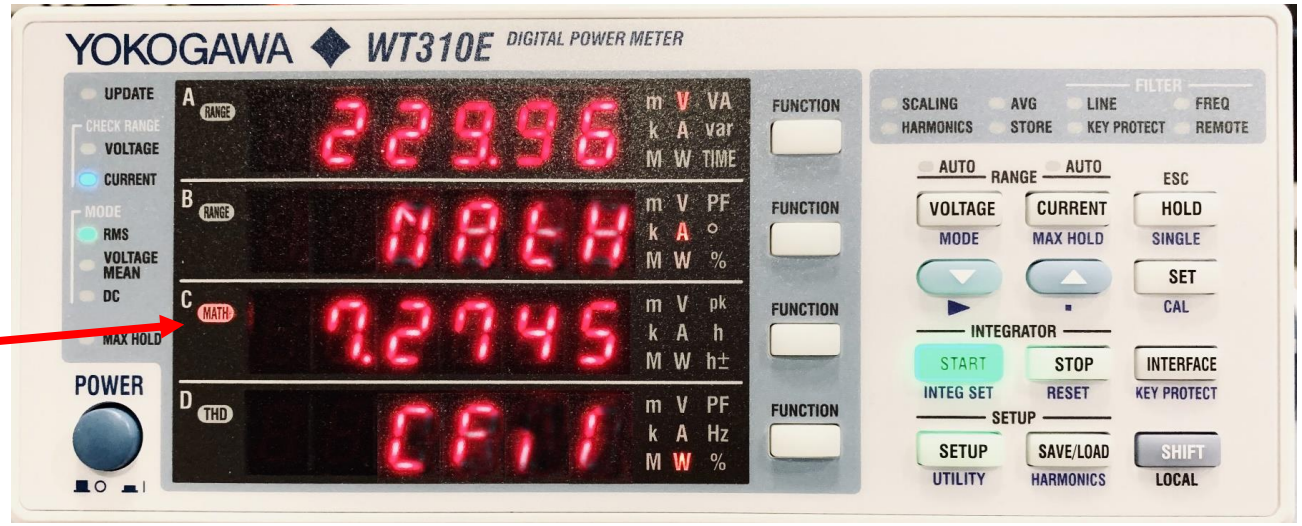
A.C. POWER MEASUREMENT: CURRENT CREST FACTOR

3. **Crest Factor**

- The Crest factor of the voltage and current waveform can be measured using one of the MATH functions.

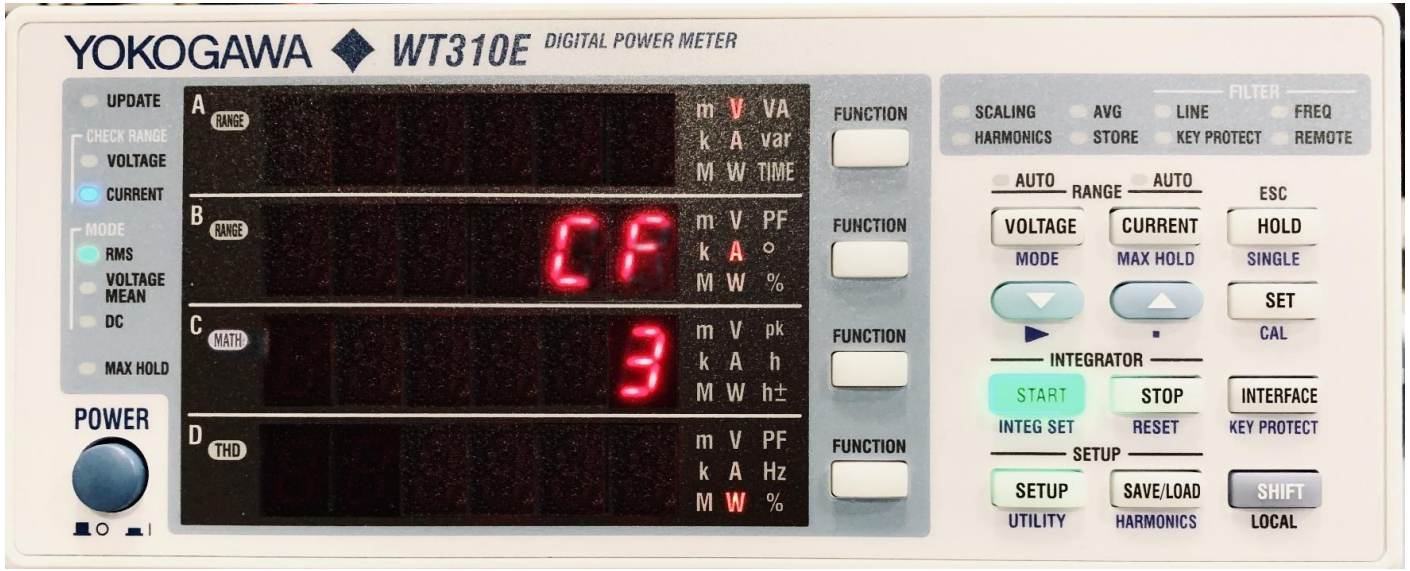
- <u>Prepare the display</u> - On element C, press the FUNCTION button repeatedly until MATH is illuminated on the left. This signifies that the result of the selected MATH function will be displayed here.

- <u>Selecting the CF(I) MATH function</u> – Press SETUP, then ˅ or ^ repeatedly until the word “MATH” is displayed on the digits of element B.
- Press SET, then ^ repeatedly until “CF il” is displayed on the digits of element C.
- Press SET to save and exit.



A.C. POWER MEASUREMENT: METER CURRENT CREST FACTOR

- If the current crest factor on element C is less than or equal to 3, the meter's crest factor setting must be set to 3. Crest factor 3 means that maximum allowable input peak is 3 times the RMS value.
- If the current crest factor is greater than 3, the meter's crest factor must be set to 6.
- To do this, Press SHIFT, press SETUP
- Press ^ or ˅ repeatedly until CF is displayed on element B.
- Press SET and then Press ^ or ˅ to cycle between 3 and 6.
- Press SET to save and exit.
- YOU MUST RECHECK YOUR VOLTAGE AND CURRENT RANGES.

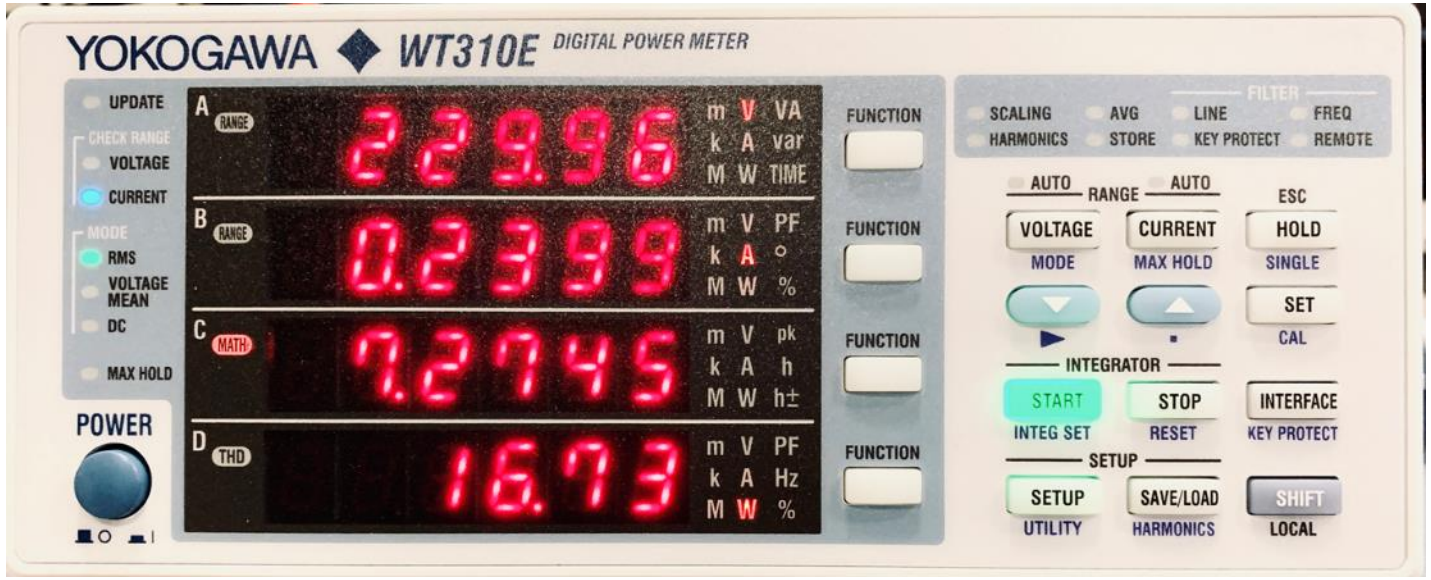


A.C. POWER MEASUREMENT: POWER SOURCE THD

4. **Total Harmonic Distortion**

- IEC 62623 specifies a power source requirement of < 2% THD(V). If it is greater, you need a better power source.

- The THD of the voltage source can be displayed on element D.
- Press the FUNCTION button repeatedly until “THD”, % and V are illuminated.



OVERVIEW

- A.C. Power Measurement: Considerations

- Creating USB Stick

- USB Stick Install on UUT
- USB Stick Install on Controller Computer
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- Start Full Run on UUT

- Merge power data with benchmark data

MEDIA CREATION

USB media for Windows, Mac OSX, Linux is:

- Used to install the benchmarking software on the UUT

AND

- Used to run the controller computer, which acquires the data from the power meter and stores the logged the power data directly on the stick.

DOWNLOAD

Test Suite Software

- Here you can download the image file required to create a USB key containing the Computer Efficiency Test Software.
- The most current version of the zipped image file can be downloaded from the link here:

  ⇒ **Download**
- 16 GB - ISO image for bootable USB stick

Suggest 32GB USB 3.0 stick so you can store multiple results

Follow GTD's detailed instructions to create the USB Stick

To summarise

- 3 Options to create the USB stick

1. Using Windows (download Rufus and run)
2. Using Mac OSX (using Terminal)
3. Using Linux (using Terminal)

- Suggest picking the easiest option depending on your available computer

01

SETUP & INSTALLATION

YOU WILL NEED

1. Test sample (Unit Under Test or UUT)
2. USB stick (prepared earlier)
3. Controller computer, (e.g. Windows 10) with 2 x USB 2.0 or greater ports,
4. Power meter (currently Yokogawa WT310/E supported) with USB Type B to A lead
5. Regulated Power supply with < 2% THD(V)
6. External display (for all computers) running at 1920 x 1080, 60Hz (if external display is not supplied)
7. USB Keyboard (for desktops & integrated computers if keyboard is not supplied)
8. USB Mouse (for desktops & integrated computers if mouse is not supplied)
9. Download the 62623Desktop.png screen background image file from http://gtd-gmbh.de/pceet/

SAMPLES FOR TESTING

7 computers from around 2017 were selected to test on.

1. Two laptops (1 Windows and 1 OSX)
2. Two integrated computers (1 Windows, and 1 OSX)
3. Three desktop computers (3 Windows (1 AMD processor, 1 Intel i7 with integrated graphics and 1 Intel i7 with discreet graphics)

- The Windows computers had the OS removed and replaced with the latest version of Windows 10.
- The two OSX computers had the OS removed and replaced with the latest version of Mac OSX Catalina.
- One Windows desktop and one Windows laptop were configured to dual boot into Ubuntu 20.
- The aim was to ensure the software would produce useful data, initially by conducting short runs and later by completing full runs on all samples, while providing feedback to GTD in order to improve the software and user guide.

Test Setup


External Display
Controller PC
UUT
Power Meter
Supplied Keyboard & Mouse

Power Source

Power Meter

Stabilised Power Supply with < 2% THD (V)

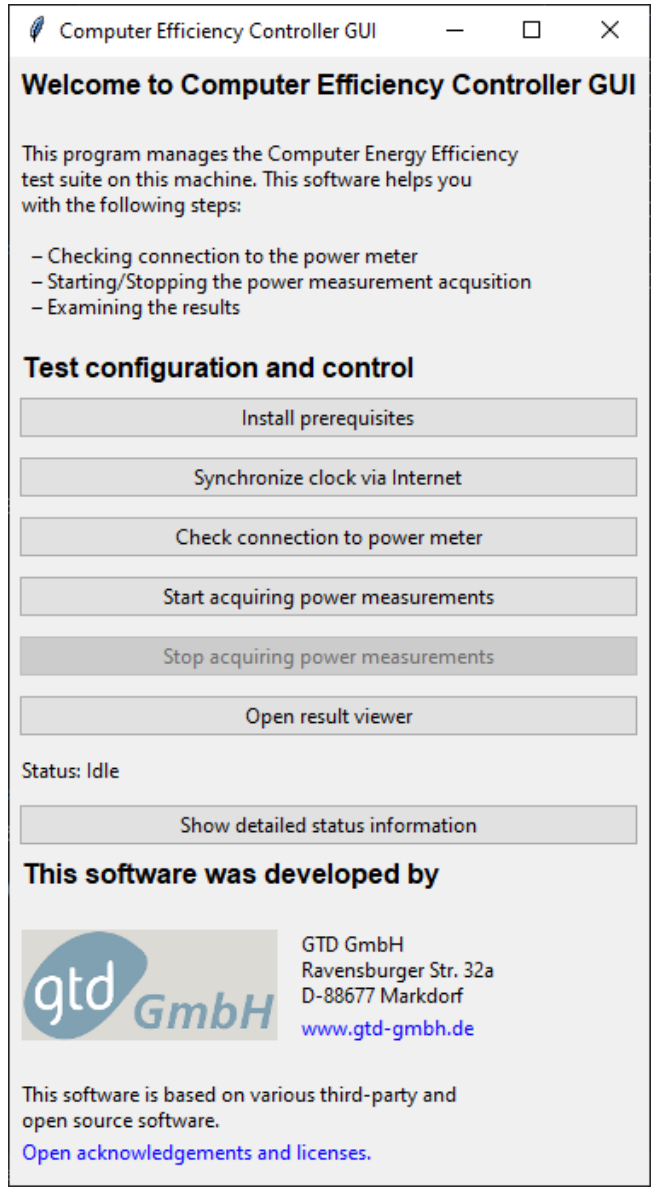
CONNECTIONS

- Confirm that the regulated power source and unregulated mains supply outlet switches are off before making connections. Do not switch on either until all connections are made.
- Connect
  1. UUT to external display
  2. Keyboard and mouse to UUT (if testing a desktop or integrated computer)
  3. Power meter wiring to measurement adapter
  4. UUT to measurement adapter supply outlet
  5. Power meter inlet to unregulated mains supply outlet
  6. Measurement adapter to stabilised power source
  7. Power meter to Controller Computer via USB
  8. Controller Computer inlet to unregulated mains supply outlet

- Power on the mains supply, stabilised power supply then the 2 computers and monitor
  9. Ensure the UUT is connected to the Internet.
  10. Download and install any OS updates, then disable OS auto updates and any other auto update processes e.g. anti-virus updates.

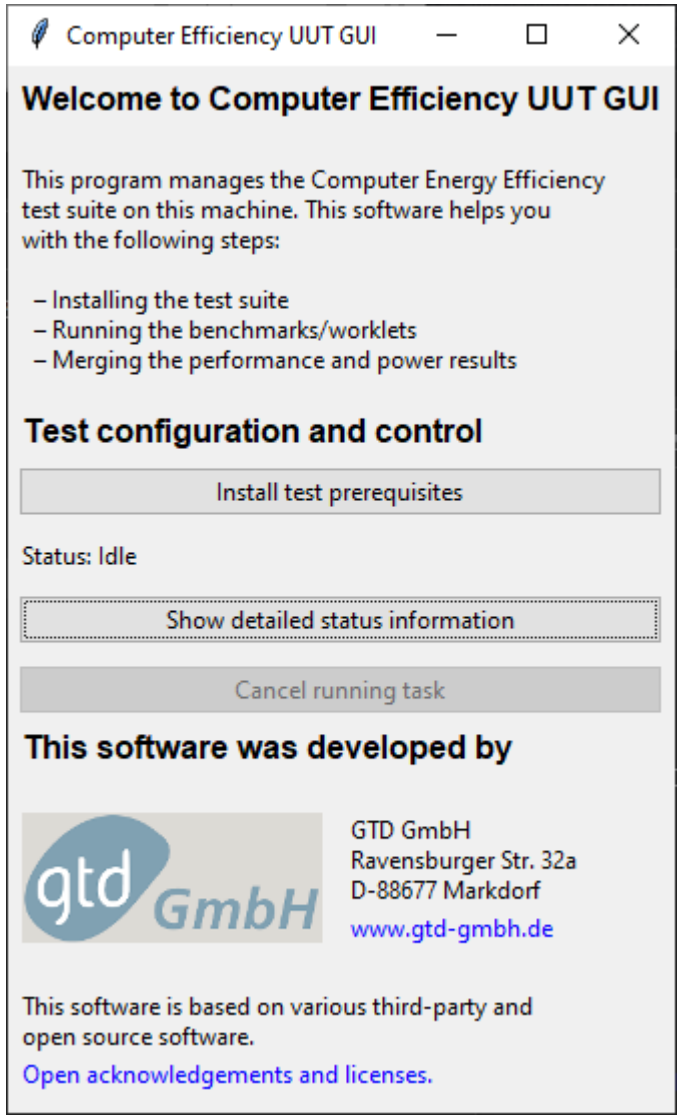
CONTROLLER INSTALLATION

1. Insert the USB stick into an available USB slot (preferably USB 3.0 or greater) on the Controller Computer
2. Navigate to the stick contents and run either windows_controller.exe, macosx_controller.exe or linux_controller.exe, depending on the OS of the Controller Computer
3. A graphical user interface should appear in a few seconds.
4. Click on **Install prerequisites** and let the UUT install the Power Meter's USB driver.
5. When completed, close the Zadig utility
6. Click, "**Check connection to power meter**". A window should pop up to confirm connection. If it does not, check your USB connection to the power meter and ensure the power meter is on. Then click, "Check connection to power meter" to check again.
7. When completed (after less than 1 minute), eject and remove the USB Stick. You will need it in the next step.



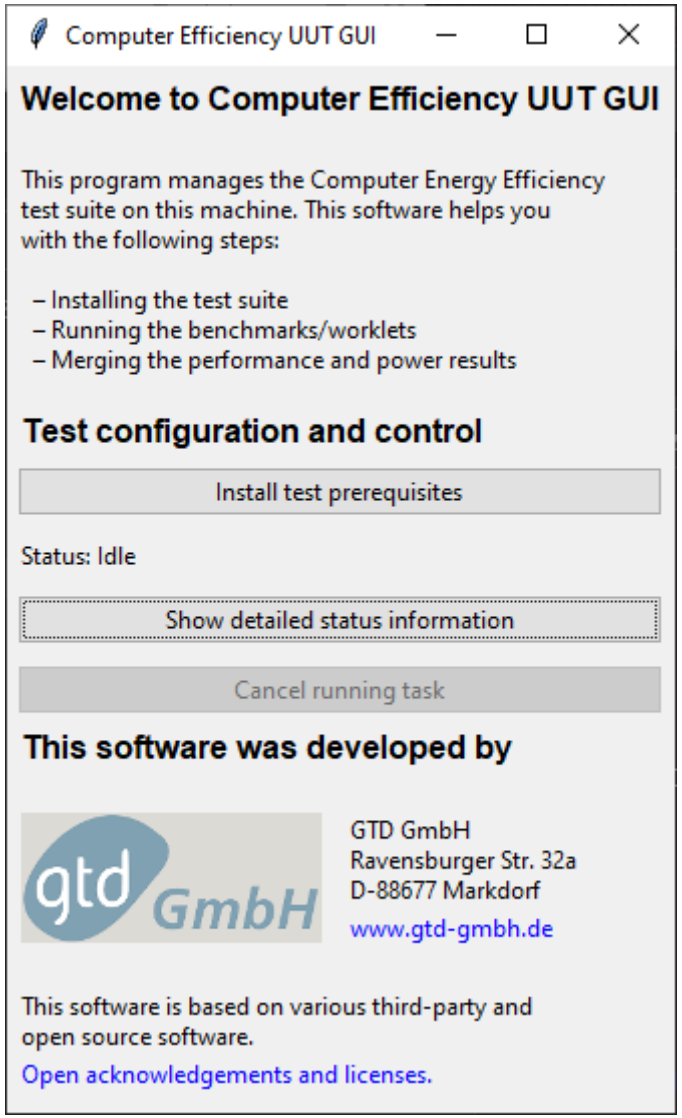
UUT INSTALLATION

1. Ensure any Firewalls and Anti-Virus software is disabled.
2. Go to Power Settings and disable the Screen Saver, Screen Dimming, Screen Off and Sleep settings
3. Ensure the UUT is connected to the Internet.
4. Download and install any OS updates. This may require several restarts.
5. Use the 62623Desktop.png you downloaded as your desktop background as per EN 62623
6. Once you are confident that the updates are all done, disable OS auto updates and any other auto update processes e.g. anti-virus updates.
7. Insert the USB stick into an available USB slot (preferably USB 3.0 or greater) on the UUT



UUT INSTALLATION

8. Navigate to the stick contents and run either windows_uut_install.exe , macosx_uut_install.exe or linux_uut_install.exe, depending on the UUT you are testing. If this does not run under Linux, please refer to section 4.3.3 in the *Test Procedure* document in order to mount the USB Stick with appropriate permissions.
9. A graphical user interface should appear in a few seconds.
10. Click on **Install prerequisites** and let the UUT download and install all the necessary applications. This may take about half an hour depending on download speed and UUT speed.
    - If any further OS updates occur, you must re-run this installation. Only required elements will be reinstalled.
11. When completed, eject and remove the USB Stick.
12. If the UUT is running OSX, you are advised to refer to section 4.3.2 in the *Test Procedure* document in order to ensure the unsigned installed applications will run successfully during the benchmarking. This issue is due to an OSX security feature.



02

RUN TEST

RUNNING THE BENCHMARK

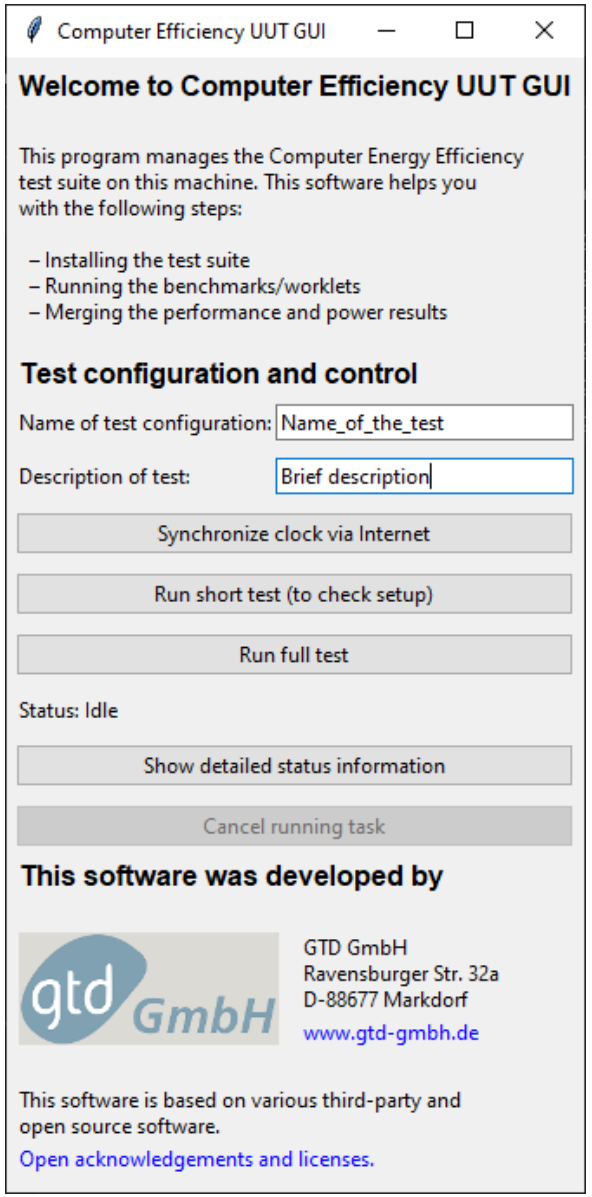
ON THE CONTROLLER COMPUTER:

1. Insert the USB stick into an available USB slot on the Controller Computer
2. Navigate to the stick contents and run either windows_controller.exe, macosx_controller.exe or linux_controller.exe, depending on the OS of the Controller Computer
3. A graphical user interface should appear in a few seconds.
4. Click on "**Synchronize clock via internet**". When the process is finished a message pops up. If it fails, keep trying until successful. If it still does not work it can be actioned via the Time & Date settings in the Control Panel.
5. It is preferable to maintain the Internet connection to the Controller Computer for the purposes of time synchronisation.

RUNNING THE BENCHMARK

ON THE UUT:

1. If the UUT has a rechargeable battery, i.e. it is a laptop, remove the battery for the test. If the battery cannot be removed, ensure that the battery is charged to 100% before starting a test run
2. Navigate to the folder created on the desktop called, “energy-efficiency testing” and run either windows_uut_run.exe, macosx_uut_run.exe or linux_uut_run.exe, depending on the UUT you are testing
3. Click on “**Synchronize clock via internet**”. When the process is finished a message pops up. If it fails, keep trying until successful. If it still does not work it can be actioned via the Time & Date settings in the Control Panel.
4. Disconnect the Internet from the LAN, but maintain the LAN connection.
5. Provide a test name and description.
   - Note: the name must not contain spaces.



RUNNING THE BENCHMARK

ON THE CONTROLLER COMPUTER:

- Click on “**Start acquiring power measurements**”. The Interface status will change from “*Idle*” to “*Working*”

ON THE UUT:

- Click on “**Run full test**”. The Interface status will change from “*Idle*” to “*Working*”
- You may experience some errors which are acceptable, e.g. if a worklet fails and displays a dialogue box, respond to accept it and allow the run to continue.

03

GETTING RESULTS

COMPLETING THE BENCHMARK

ON THE UUT:

- After the complete suite of tests has been run, the message "*Insert USB key with power measurements from controller computer*", will appear.

ON THE CONTROLLER COMPUTER:

- Click on "**Stop acquiring power measurements**". The Interface status will change from "*Working*" to "*Idle*".
- The USB Stick will now contain all the power data in a file named ,"*sys_power.csv*". This will be merged with the benchmark data in the following steps.
- Safely remove the USB key from the Controller Computer

BACK ON THE UUT:

- Insert the USB stick into an available USB slot and press **Enter**. When the result combining process is finished the message "*Finished system sensor monitoring process*" will display in the text window
- To archive and analyse the results on another computer (for example the Controller Computer), copy the "test-results" folder that has been created in "energy-efficiency-testing" folder on the desktop of the UUT computer to the USB key

SUMMARY

Download image file & Create USB stick

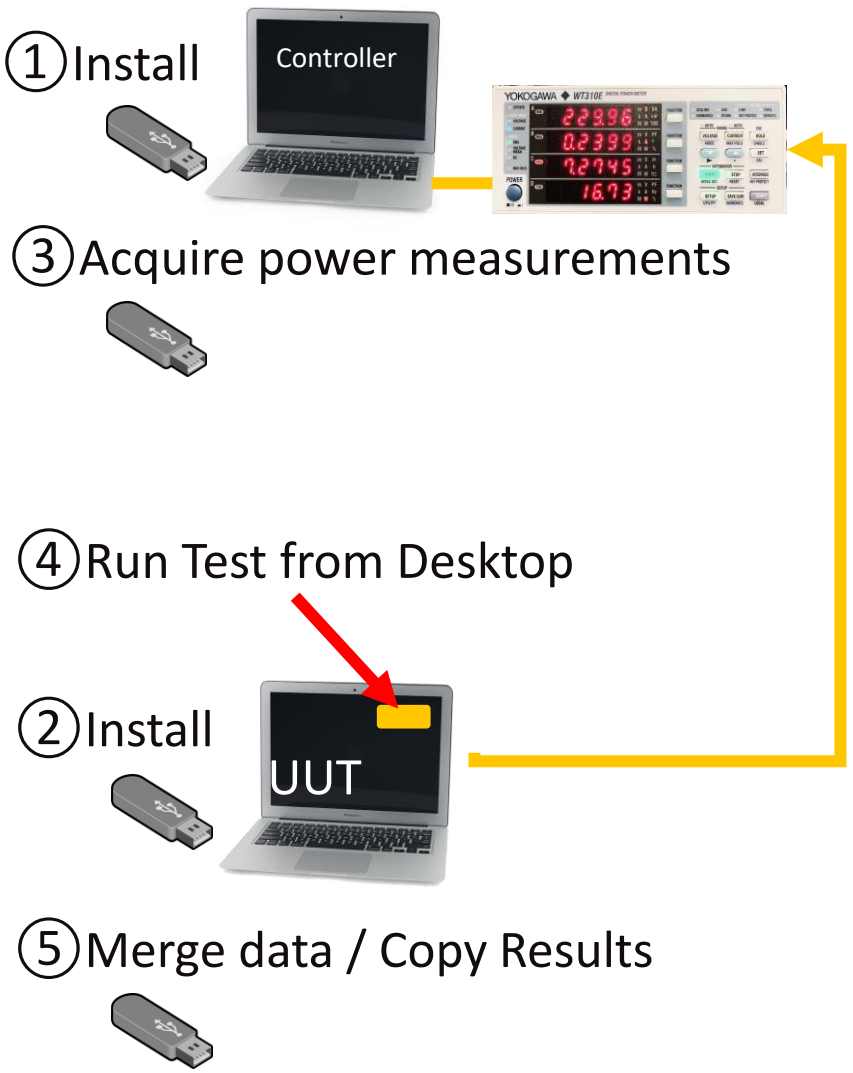
1. USB Stick Install on Controller Computer
2. Synchronise
3. USB Stick Install on UUT
4. Synchronise then disconnect Internet from LAN
5. Remove USB Stick and insert back in Controller Computer

6. Start data acquisition on Controller Computer (runs off USB Stick)
7. Run GUI via folder on desktop UUT
8. Start Full Run on UUT

9. When completed, Stop data acquisition on Controller computer
10. Remove USB Stick and insert back in UUT and press Enter

11. Copy Results folder to USB Stick

OVERVIEW


①Install
Controller
YOKOGAWA WT310E
③Acquire power measurements
④Run Test from Desktop
②Install
UUT
⑤Merge data / Copy Results

Steve Fernandes

+44 (0)1908 857712

Stephen.Fernandes@intertek.com

intertek.com

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