



# **DVE MultiTool**

## **Manual**

### **Version 1.5 / 716006**

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## 1 General information

This manual describes the DVE MultiTool 1.4.0 and its use in combination with DVE products. This version of MultiTool is compatible with the GFIxK2 series of inverters.

### 1.1 System requirements

- 1GHz processor
- 512Mb RAM
- 2GB free disk space
- Windows 7
- .NET Framework 4
- USB-A male / USB-B male

## 2 Safety instructions

### 2.1 General safety instructions

***All changes of parameterizing with the MultiTool must be done under controlled operating conditions.***

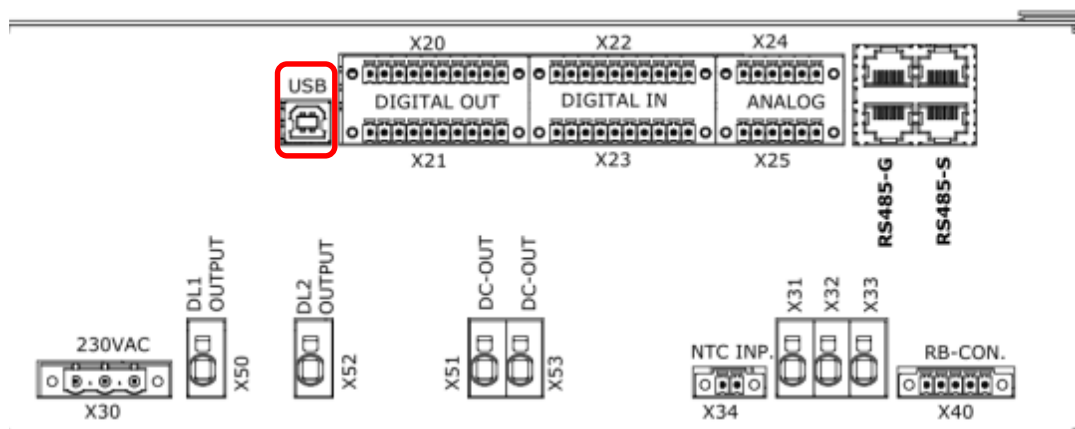
For simple monitoring the application state is not relevant.

Only trained staff is allowed to apply DVE products system parameters with the MultiTool.

## 3 Data connection

### 3.1 Connecting to the GFI

The connection inside the GFI enclosure can be found in the bottom of the GFI input module.



Connect the USB cable in the USB connector and to any USB port of a computer compliant with the system requirements.



## **4 Installation**

### **4.1 Software installation**

Put the MultiTool into any folder on your PC then double-click on the executable "MultiTool.exe" to launch it.

### **4.1 USB driver installation**

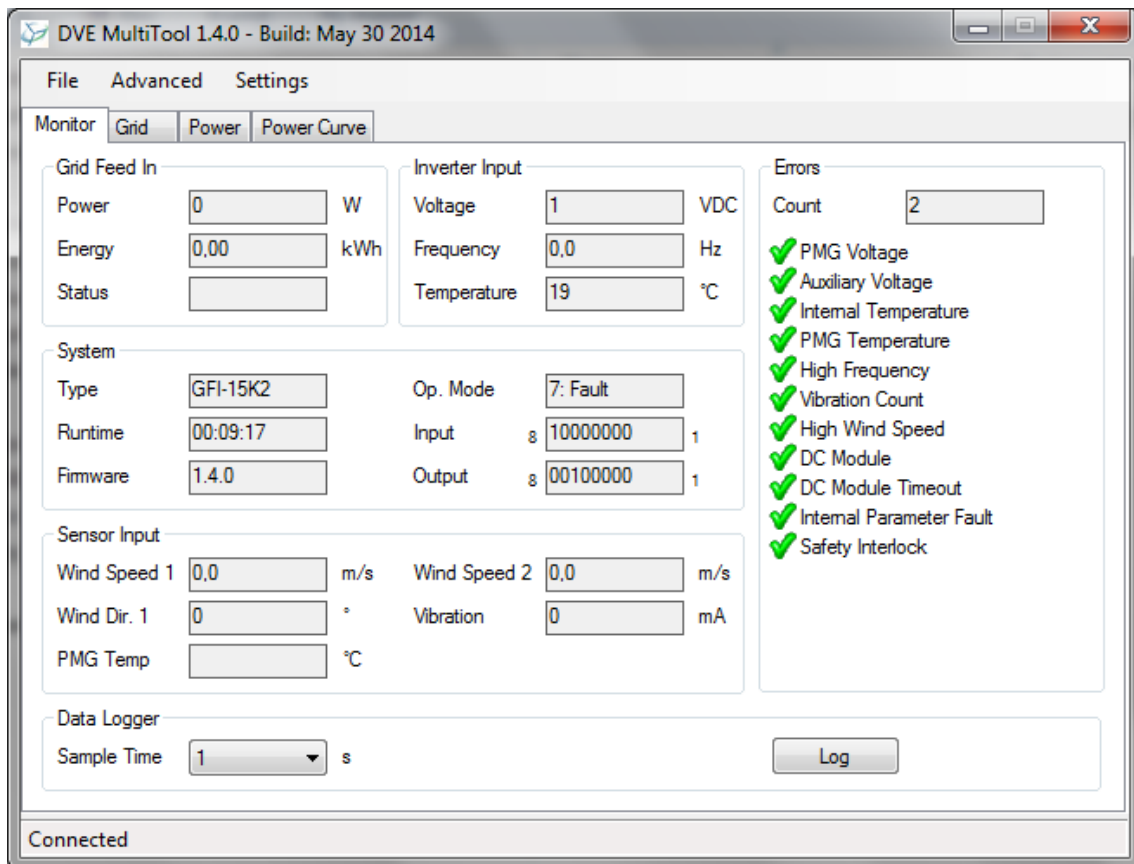
Windows automatically installs the USB driver shortly after the GFI has been connected to your PC. First connect the USB cable to the GFI and then connect it to your PC.

**The interface is HID compliant.**

## 5 Operating the MultiTool

When trying to establish a connection to the GFI it can be either powered down or actively powered from either the grid or the generator. If the GFI is not actively powered the GFI is powered by the USB port for parameterizing during maintenance.

### 5.1 MultiTool User Interface Explanation



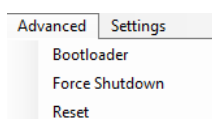
The user interface of the MultiTool:

- **Title bar:** Shows the name, version, and build date.
- **Menu bar:** Similar to that of common Windows applications.
- **Tab pages:** Structures the operating functions thematically.
- **Status bar:** Shows if the MultiTool is connected to the GFI.

#### 5.1.1 Menu Bar

##### Advanced

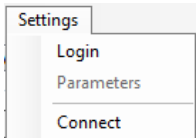
*These operating functions can only be used if the user has OEM user rights.*



- **Bootloader:** Forces the GFI into boot loading mode for updating firmware.

- **Force Shutdown:** Forces the GFI to shut down the system. This activates the brakes if available and sets the Dump Load voltage reference to value in the parameter "Dump Load Level During Shutdown"
- **Reset:** Resets and initializes the GFI.

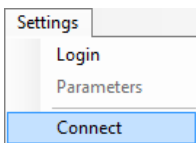
## Settings



- **Login/Logout:** Opens the dialog box "Login" to log in or log out a user.
- **Parameters:** Opens the dialog box "Parameters" to access the parameters as applied in the GFI *if the user has sufficient user rights*. Parameters are protected by password.
- **Connect/Disconnect:** Tries to establish a connection to or disconnects from the GFI.

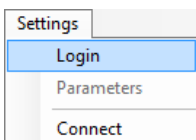
### 5.1.2 Connection

Select **Settings, Connect** to try to establish a connection to the GFI.

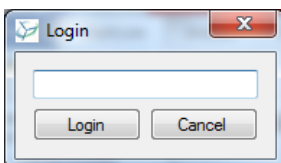


### 5.1.3 User Rights

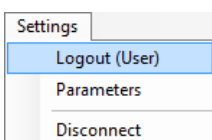
Select **Settings, Login** to open the dialog box "Login" to log in or log out a user.



The user is assigned its user rights according to the password.



If logged in, select **Settings, Logout** to log out.



Select **Settings, Logout (xx)** to view what level the user is actually logged in as.



User levels:

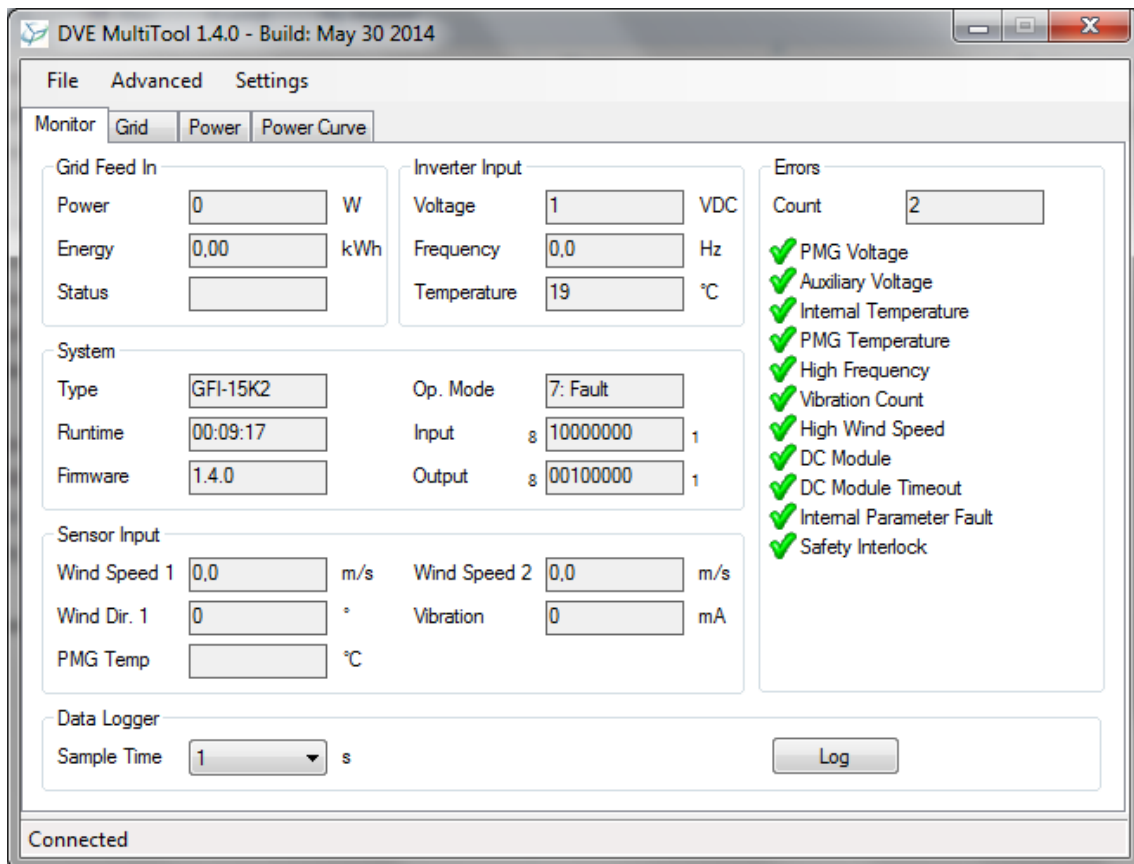
- **OEM (1111)**: Can access all tabs and access all parameters.
- **User (1010)**: Can access the tabs "Monitor" and "Grid" and view parameters.
- **Logged out**: Can access only the tab "Monitor".

After launching the MultiTool the user is assigned the lowest user rights i.e. logged out.



## 5.2 MultiTool Monitor

If the GFI is only powered by the USB port not all the data is valid since only the main controller of the GFI is actively powered.



### Grid Feed In

- **Power:** Power dissipation
- **Energy:** Total energy dissipated
- **Status:** Status of the grid module

### Inverter Input

- **Voltage:** DC voltage from the generator
- **Frequency:** Frequency of the AC voltage from the generator
- **Temperature:** Internal temperature of the GFI

### System

- **Type:** Hardware type
- **Run Time:** Running time since last power-up
- **Firmware:** Firmware version of the GFI's main controller
- **Op. Mode:** Operating mode of the GFI
- **Input:** State of the digital inputs
- **Output:** State of the digital outputs

### Sensor Input

- **Wind Speed 1 / 2:** Wind speeds from suitable transducers
- **Wind Dir.1:** Wind direction from a suitable transducer
- **PMG Temp:** Temperature of the generator
- **Vibration:** Vibration level from a suitable transducer

## Errors

- **Count:** The number of errors since last power-up.
- **PMG Voltage:** The DC voltage from the generator is too high.
- **Auxiliary Voltage:** The auxiliary supply voltage is too low.
- **Internal Temperature:** The internal temperature of the GFI is too high.
- **PMG Temperature:** The temperature of the generator is too high.
- **High Frequency:** The frequency of the AC voltage from the generator is too high.
- **Vibration Count:** The vibration level is too high.
- **High Wind Speed:** The wind speed is too high.
- **DC Module:** One or more DC modules have errors.
- **DC Module Timeout:** One or more DC modules are not responding.
- **Internal Parameter Fault:** One or more parameters are corrupted.
- **Safety interlock:** The safety interlock circuit is open.



There is **NO ERROR**



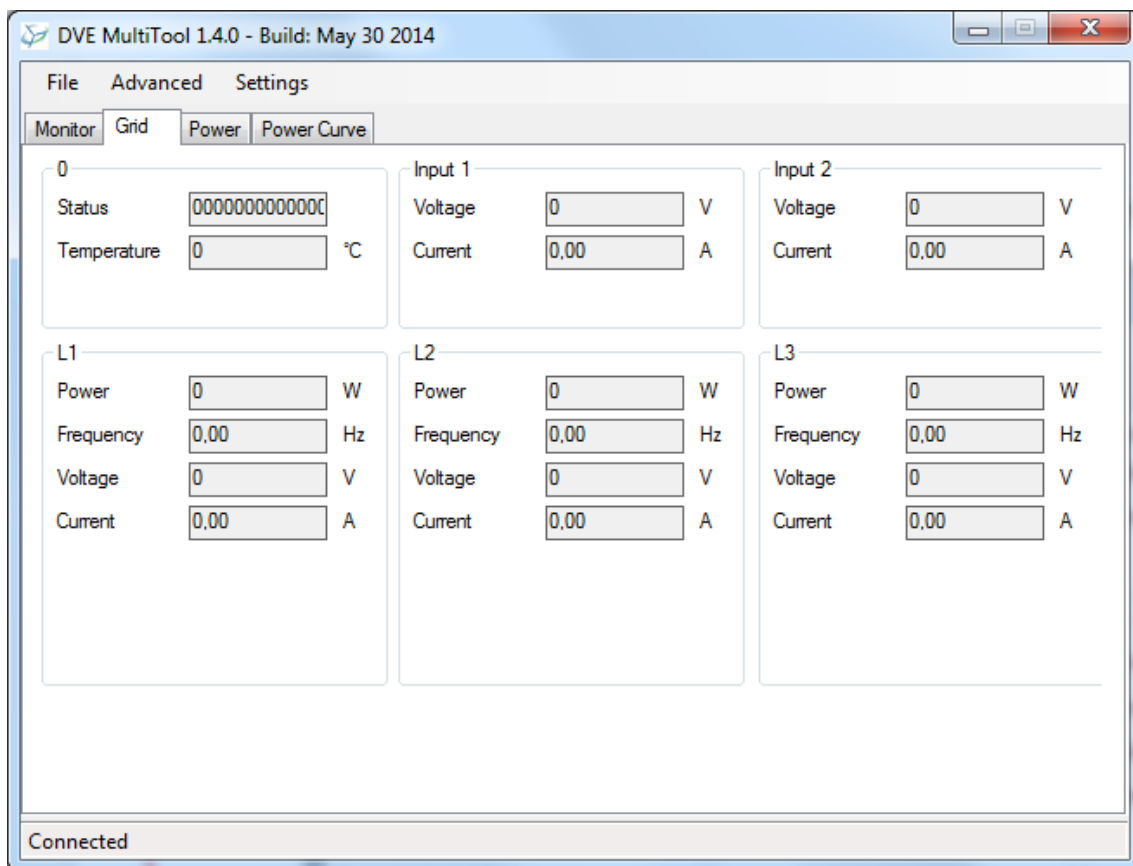
There is **AN ERROR**

## Data Logger

- **Sample Time:** Sample rate
- **Log / Dump:** Starts or stops a log

### 5.3 MultiTool Grid

When the GFI is operating, the data for the grid connection can be obtained.



**Serial Number:** Serial number of the installed grid AC module

- **Status:** Status-bits of grid module
- **Temperature:** Temperature of the grid module.

**Input 1, Input 2:** Input measurements from the grid module.

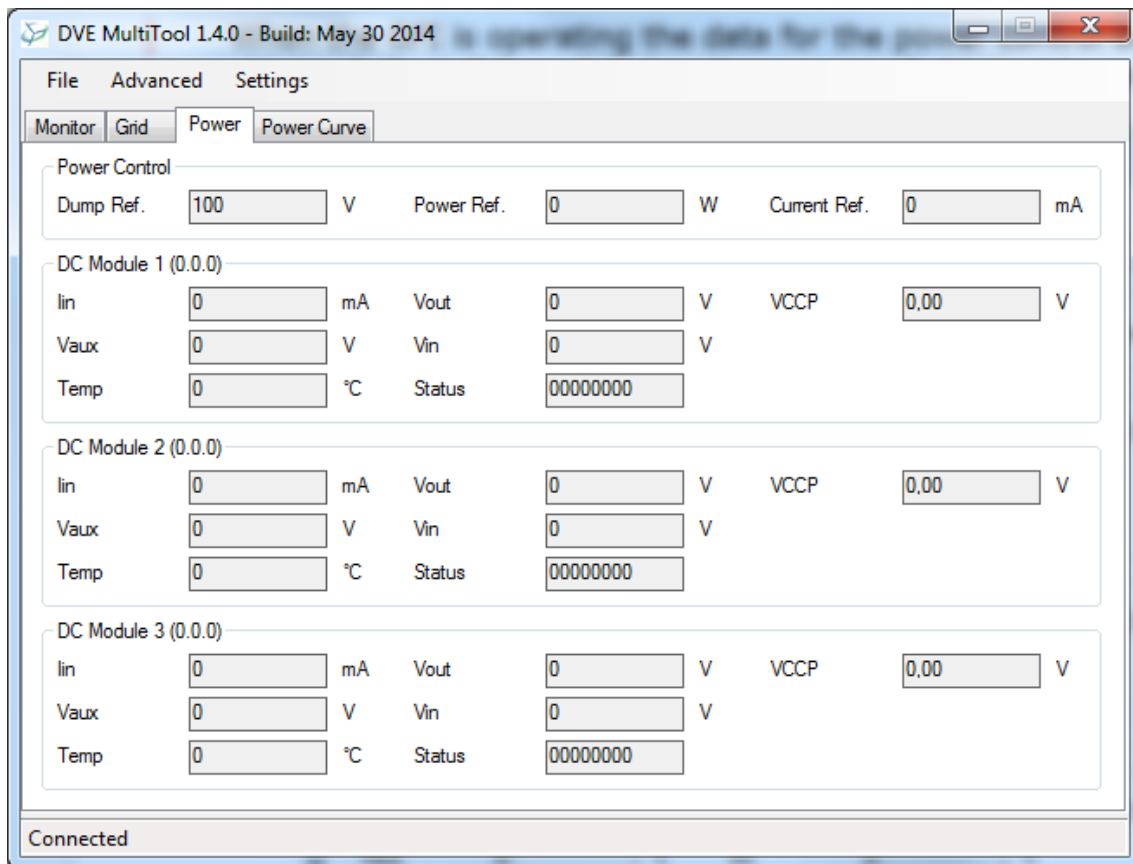
- **Voltage:** DC input voltage to the grid module
- **Current:** DC input current to the grid module

**L1, L2, L3:** Output measurements per grid phase

- **Power:** Power dissipation to the grid
- **Frequency:** AC grid frequency
- **Voltage:** AC grid voltage
- **Current:** AC grid current

## 5.4 MultiTool Power

When the GFI is operating the data for the power control and the DC modules can be obtained. Each DC module has its own set of obtainable parameters.



### Power Control

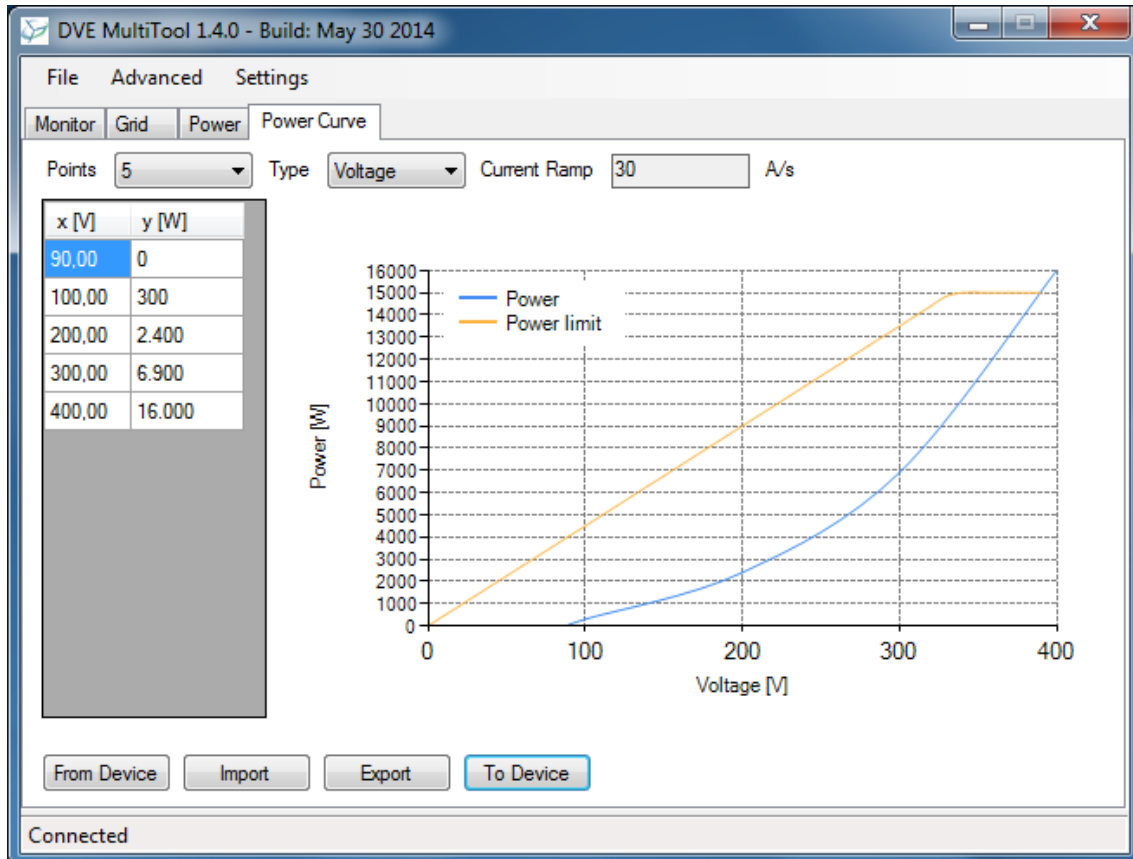
- **Dump Ref.:** Activation DC voltage for the dump load
- **Power Ref.:** Power set-point for the GFI while on grid
- **Current Ref.:** Current set-point for the GFI while on grid

### DC Module 1,2,3 (x.x.x): SW version of each DC module

- **Iin:** DC input current
- **Vaux:** Auxiliary power supply DC voltage
- **Temp:** Internal temperature
- **Vout:** DC output voltage to grid AC module
- **Vin:** DC input voltage after rectifier
- **Status:** Status-bits
- **VCCP:** Internal supply voltage

## 5.5 MultiTool Power Curve

The GFI limits the power intake from the generator by a configurable power curve – a visual representation of a series of set-points relating the power and an operating input which is either generator input DC voltage or generator frequency.



- **Points:** Number of set-points
  - **Type:** Operating input. Either generator DC voltage or generator frequency
  - **Current Ramp:** Dynamic power response of the GFI
  - **From Device:** Loads the power curve from the GFI.
  - **Import:** Imports a power curve from file.
  - **Export:** Exports the power curve to a file.
  - **To Device:** Saves the power curve to the GFI.
- 
- **x [V]:** DC voltage operating point
  - **x [Hz]:** Generator frequency operating point
  - **y [W]:** Power intake from the generator at the given operating point
  - **Power:** Visual representation of the series of set-points
  - **Power limit:** Maximum power intake of the GFI

### 5.5.1 Configuring the power curve

*The power curve can only be configured if the user has sufficient user rights.*

The GFI has two operating inputs used for calculating the power draw from the generator:

- **Voltage:** Operates according to DC voltage.
- **Frequency:** Operates according to generator AC voltage frequency.

When using frequency control a relationship between generator frequency and RPM is often useful. To calculate from frequency to RPM or vice versa the number of poles of the generator is necessary. The following relationship between frequency and RPM exists:

$$\text{Generator frequency (f=Hz)} = \frac{\text{Revolutions per minute of the generator (N)} * \text{Number of magnetic poles (P)}}{120}$$

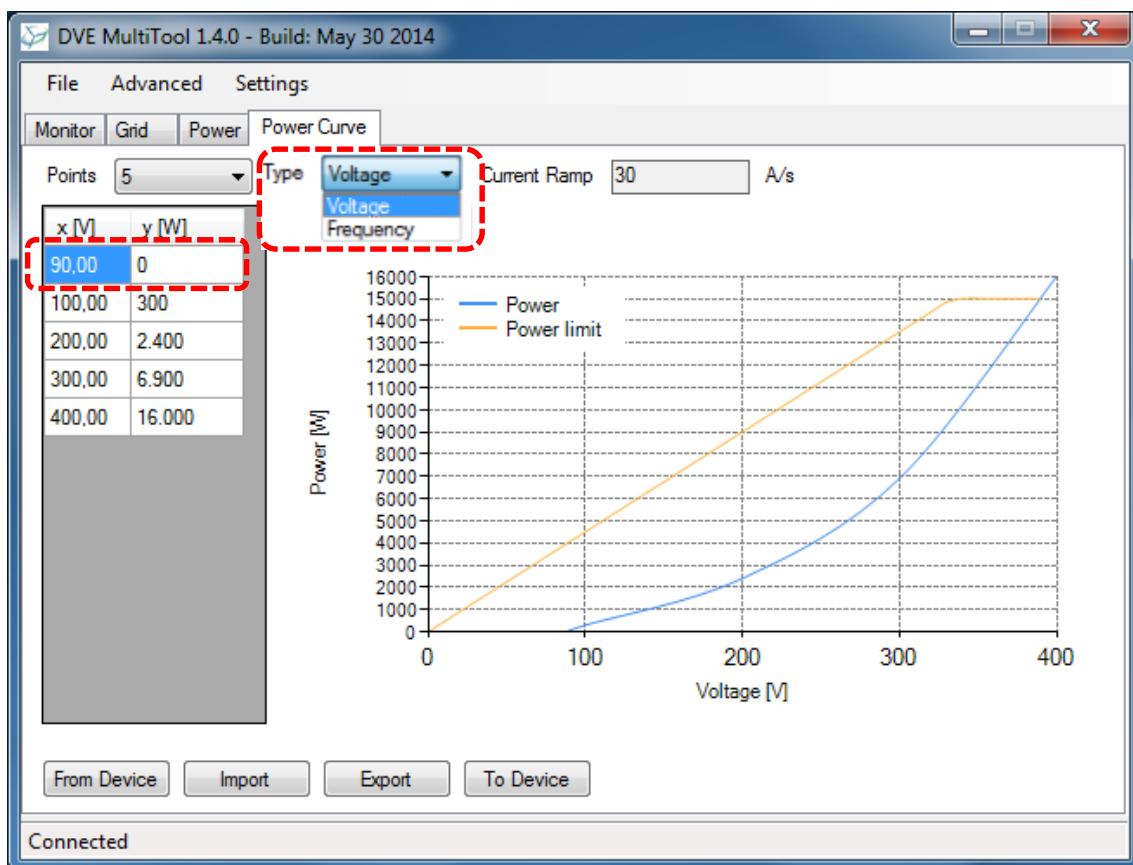
Conversely:

$$P = 120 * f / N$$

Or:

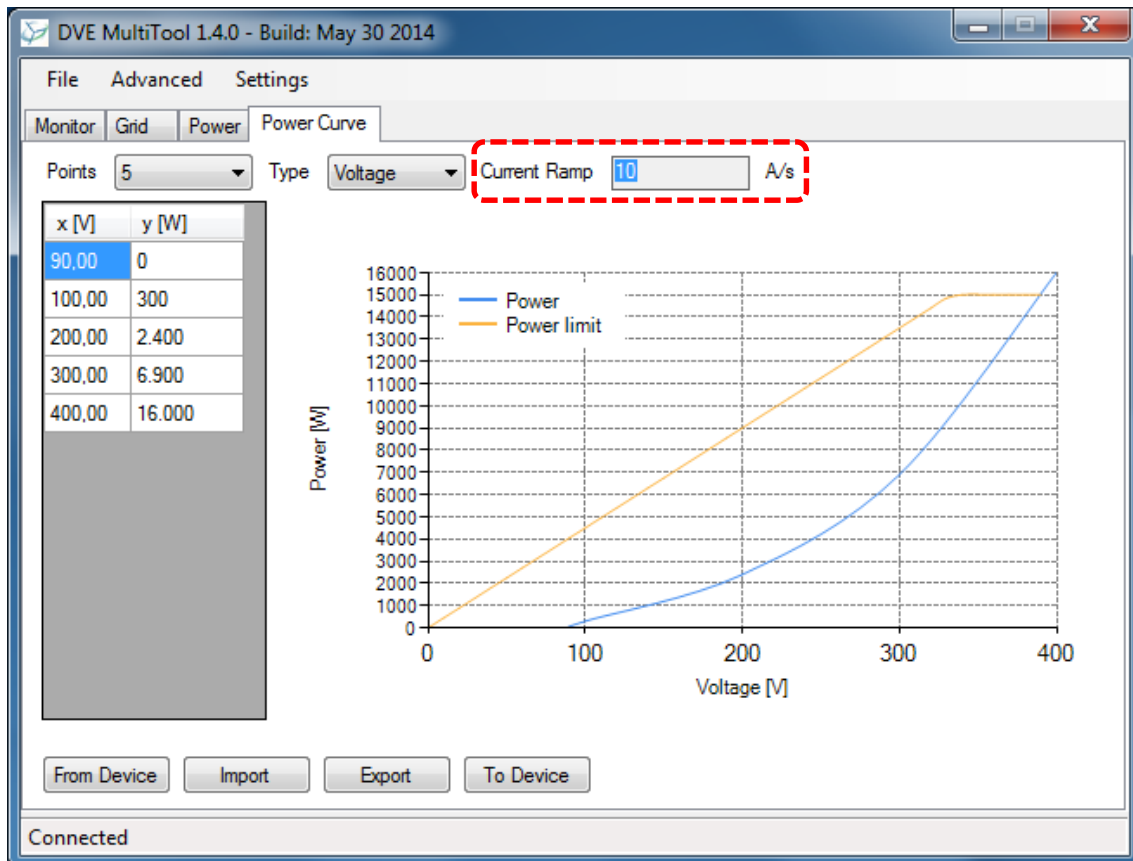
$$f = P * N / 120$$

*It is important to define a voltage or frequency point with zero power which is different from 0 V or 0 Hz, since it is not possible to draw power at 0 speed.*



### Current Ramp

The current ramp controls how fast the GFI reacts to changes in its power set-point according to the generator DC voltage or frequency.



### Example

Let the GFI have a current ramp of 10A/s. At an operating point of 100VDC, the 10A/s results in a maximum power response of 1000W/s ( $100V \cdot 10A/s$ ). At a new operating point of 300VDC, the 10A/s results in a maximum power response of 3000W/s ( $300V \cdot 10A/s$ ). In this way, the dynamic power response is more aggressive in the high end of the power spectrum.

### Typical current ramps for various GFIs:

- **1-3kW systems = 3-8A/s**
- **3-6kW systems = 7-15A/s**
- **6-10kW systems = 10-25A/s**
- **10-20kW systems = 15-35A/s**

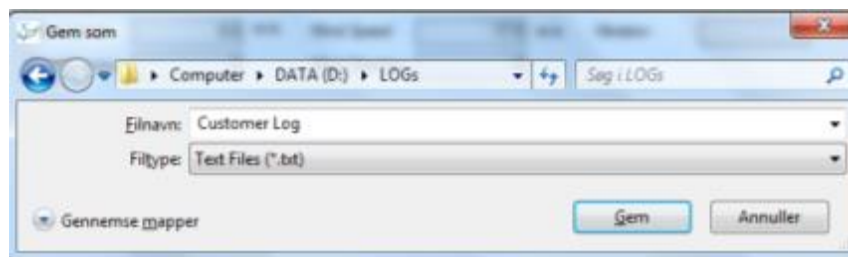
Select **To Device** to save the newly configured power curve to the GFI.

## 6. Data logger

The data logger is used for logging the following data from the system:

- **Time [Windows clock]**
- **Voltage [VDC]**
- **Power [W]**
- **Energy [kWh]**
- **Temp [deg. C]**
- **Wind Speed 1 [m/s]**
- **Wind Speed 2 [m/s]**
- **Frequency [Hz]**
- **Vibration [mA]**
- **Mode**
- **Errors**
- **DI**
- **DO**
- **Grid Status**

Set the sample rate in **Sample Time**. Select **Log** to open the dialog box "Save as" to specify where the file should be saved to. Each log is split into more files when a certain file size is reached to limit the size and to ease the post processing. Each file is named as **name\_[filenumber].txt**.



### 6.1 Decoding data logger files

CSV files can be imported to most spread sheet programs for further analysis.

#### 6.1.1 Data logger analyser spread sheet


DVE has prepared an Excel spread sheet for importing and decoding the files of the log generated by the MultiTool. It is included with the MultiTool as "DVE Technology Data Logger analyser.xlsm". **To use the spread sheet macros must be enabled.**

Select "Import DVE MultiTool Log File" To import data

You will be prompted for the log file.  
Select the log file and **Open**

The spread sheet will import the data for further analysis.





**Import DVE MultiTool Log File. (press to be prompted for file location)**  
*Note: Facet macros must be enabled*

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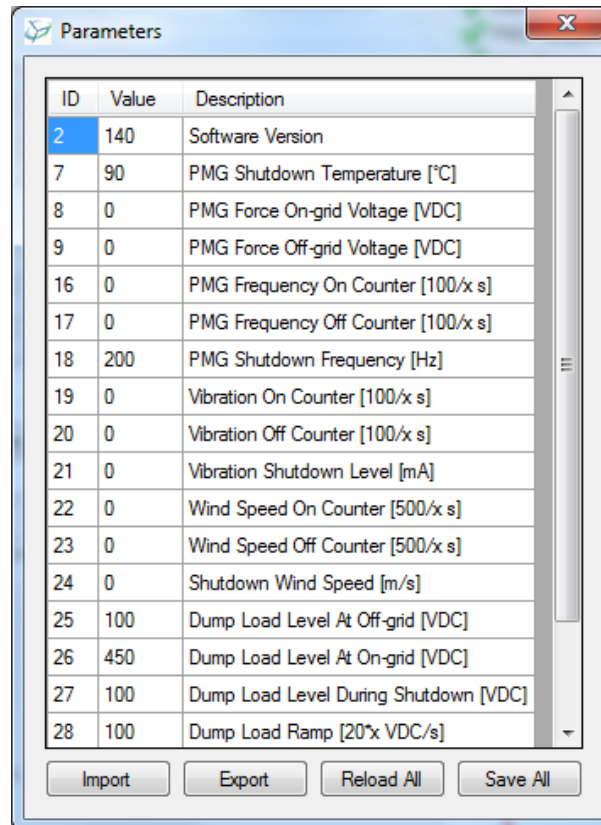
**Multitool Log Imported Data.**

Time	Voltage [VDC]	Power [W]	Energy [kWh]	Temp [deg. C]	Wind Speed 1 [m/s]	Wind Speed 2 [m/s]	Frequency [Hz]	Mode	Errors	DI	DO
21 09:47:53	295,04	1152	7,7	22,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
22 09:47:54	294,91	1153	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
23 09:47:55	295,04	1153	7,7	22,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
24 09:47:56	295,47	1152	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
25 09:47:57	295,85	1153	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
26 09:47:58	294,51	1152	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
27 09:47:59	295,9	1153	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
28 09:48:00	295,27	1153	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
29 09:48:01	294,62	1153	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
30 09:48:02	294,94	1151	7,7	22,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
31 09:48:03	295,2	1152	7,7	22,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
32 09:48:04	296,1	1152	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
33 09:48:05	294,46	1152	7,7	22,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
34 09:48:06	295,43	1153	7,7	23,4	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
35 09:48:07	294,72	1153	7,7	23,2	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
36 09:48:08	295,59	1153	7,7	23,6	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
37 09:48:09	295,23	1153	7,7	23,8	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
38 09:48:10	294,83	1153	7,7	23,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
39 09:48:11	295,7	1153	7,7	23,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
40 09:48:12	295,29	1153	7,7	23,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
41 09:48:13	295,69	1152	7,7	23,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
42 09:48:14	295,52	1152	7,7	23,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
43 09:48:16	295,38	1151	7,7	23,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
44 09:48:17	294,84	1151	7,7	23,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
45 09:48:18	295,9	1151	7,7	23,9	0	0	27,4	5 00 00 00 00	10 00 00 00	01 11 11 11	
46 09:48:19	296,04	1150	7,7	23,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	
47 09:48:20	294,79	1150	7,7	23,9	0	0	27,5	5 00 00 00 00	10 00 00 00	01 11 11 11	

## 7. Parameters

Parameters can only be accessed and changed if the user has sufficient user rights.

Select **Settings, Parameters** to open the "Parameters" dialog box to access the parameters of the GFI.



- **Import:** Import a parameter file
- **Export:** Export a parameter file
- **Reload All:** Reload all parameters from the GFI
- **Save All:** Save all the parameters in the dialog box "Parameters" to the GFI

### 7.1 Description of parameters

Name	Description
Software Version	The control software version in the GFI.
PMG Shutdown Temperature [°C]	The system is shut down when the generator temperature reaches this limit.
PMG Force On-grid Voltage [VDC]	The voltage level at which the GFI connects to the grid.
PMG Force Off-grid Voltage [VDC]	The voltage level at which the GFI disconnects from the grid.
PMG Frequency On Counter [100/x s]	The frequency must be above the shutdown frequency for this period before the system shuts down.
PMG Frequency Off Counter [100/x s]	The frequency must be below the shutdown frequency for this period before the system is

	reinitialized.
PMG Shutdown Frequency [Hz]	When the generator reaches this frequency the GFI shuts down the system after the period defined in "PMG Frequency On Counter"
Vibration On Counter [100/x s]	The vibration level must be above the shutdown level for this period before the systems shuts down.
Vibration Off Counter [100/x s]	The vibration level must be below the shutdown level for this period before the system is reinitialized.
Vibration Shutdown Level [mA]	When the vibration sensor reaches this level, the GFI shuts down the system after the period defined in "Vibration On Counter"
Wind Speed On Counter [500/x s]	The wind speed must be above the shutdown level for this period before the systems shuts down.
Wind Speed Off Counter [500/x s]	The wind speed must be below the shutdown level for this period before the system is reinitialized.
Shutdown Wind Speed [m/s]	When the wind speed reaches this level the GFI shuts down the system after the period defined in "Wind Speed On Counter"
Dump Load Level At Off-grid [VDC]	When the GFI is off grid, the Dump load is activated at this level.
Dump Load Level At On-grid [VDC]	When the GFI is on grid, the Dump load is activated at this level.
Dump Load Level During Shutdown [VDC]	When the system is in shut down mode the dump load reference is set to this level.
Dump Load Ramp [20*x VDC/s]	When the dump load voltage reference levels are changed it is ramped with this value.
Error Release Time [s]	The duration from an error disappears until the GFI initializes to normal operation.
Force Shutdown	The system is forced to stay in shut down mode when this value is set to 1.

## 7.2 Changing parameters

According to the user rights, a parameter can be changed immediately by changing its value in the column "Value". Before applying a new value, it is validated by the GFI.

**Try again, if a parameter reverts. However, if it reverts again it may be out of range, or the user may not have sufficient user rights.**

**Parameters are used immediately so all changes of parameterizing with the MultiTool must be done under controlled operating conditions.**

## 7.3 Exporting to parameter file

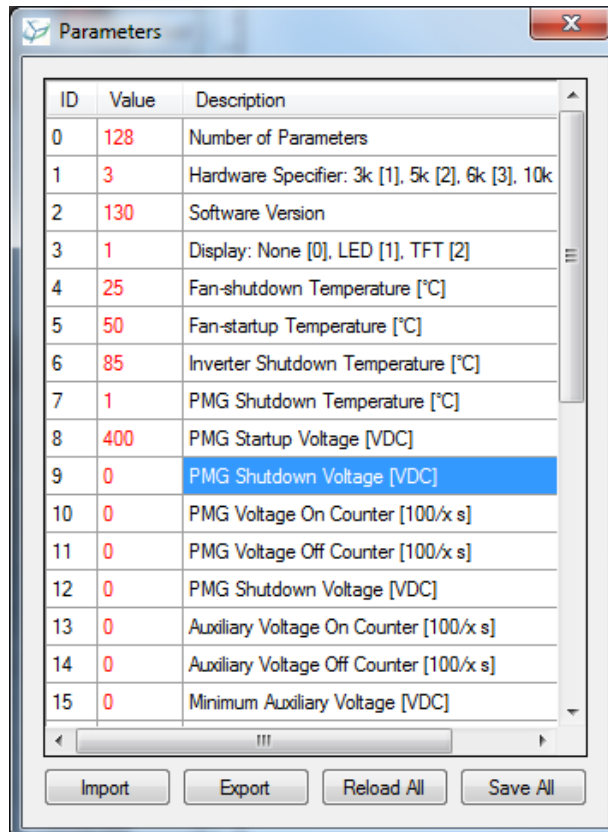
Select **Export** to export all the parameters in the dialog box "Parameters" to a parameter file, even if the MultiTool is disconnected. At the time of writing, the values are still validated by the GFI, so a parameter file created in offline mode may include non-valid values.

## 7.4 Importing a parameter file

Select **Import** to import a parameter file.

Parameters imported from a parameter file are not changed immediately effectively leaving them open for review. Values that have been imported but not yet changed are written in **red**.

Select **Save All** to ensure the parameters are saved to the GFI.



ID	Value	Description
0	128	Number of Parameters
1	3	Hardware Specifier: 3k [1], 5k [2], 6k [3], 10k
2	130	Software Version
3	1	Display: None [0], LED [1], TFT [2]
4	25	Fan-shutdown Temperature [°C]
5	50	Fan-startup Temperature [°C]
6	85	Inverter Shutdown Temperature [°C]
7	1	PMG Shutdown Temperature [°C]
8	400	PMG Startup Voltage [VDC]
9	0	PMG Shutdown Voltage [VDC]
10	0	PMG Voltage On Counter [100/x s]
11	0	PMG Voltage Off Counter [100/x s]
12	0	PMG Shutdown Voltage [VDC]
13	0	Auxiliary Voltage On Counter [100/x s]
14	0	Auxiliary Voltage Off Counter [100/x s]
15	0	Minimum Auxiliary Voltage [VDC]

## **8. Guarantee and liability**

The guarantee period is 1 year from the date of delivery.

Guarantee claims are excluded:

- when the device has been employed beyond its intended use
- when the device has been mounted non-standard or improperly, especially by untrained personal
- when the device has been employed although the protection equipment was defective
- through improper operation
- when the device or its equipment have been modified
- when the device was affected by foreign material or force majeure

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