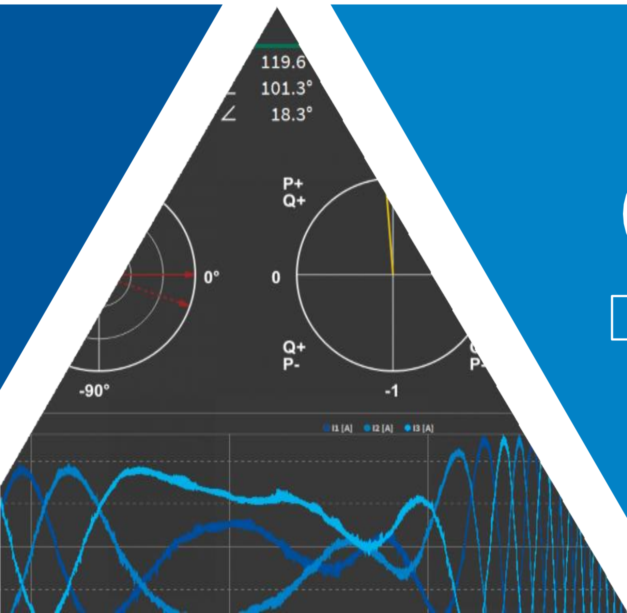
DEWETRON

OXYGEN Power Realtime

SOFTWARE MANUAL



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Available for OXYGEN 8.1 and above in Ubuntu 24.04

CHAPTER

ONE

DOCUMENT HISTORY

Table 1.1: Document History

Date	Author	SW Version	Change	Doc. Rev.
29.06.2026	MK, TK, MS	OXYGEN 8.1	Initial release for Ubuntu 24.04	1.0
05.08.2026	MK	OXYGEN 8.2	EtherCAT output added	1.1

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CHAPTER

TWO

PREFACE

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CHAPTER

THREE

OVERVIEW

The DEWETRON Realtime Power Option uses an Ubuntu Realtime Operating System with TRION(3) Boards and DEWE3 Chassis.

Existing Hardware like a PA8 or other DEWE3 Chassis with Hardware capable of power measurements can be converted to a Realtime Power Analyzer. Data Output is done over Ethernet via **UDP** Packets or over **EtherCAT**. Output over EtherCAT requires the TRION-EtherCAT-1-SLAVE module. Power values and raw waveform data can be output with an update rate up to 1000 Hz. With typical performance, **delays are < 2ms (max. 4ms)**.

Configuration of the Realtime Power Calculation and Output is done with OXYGEN.

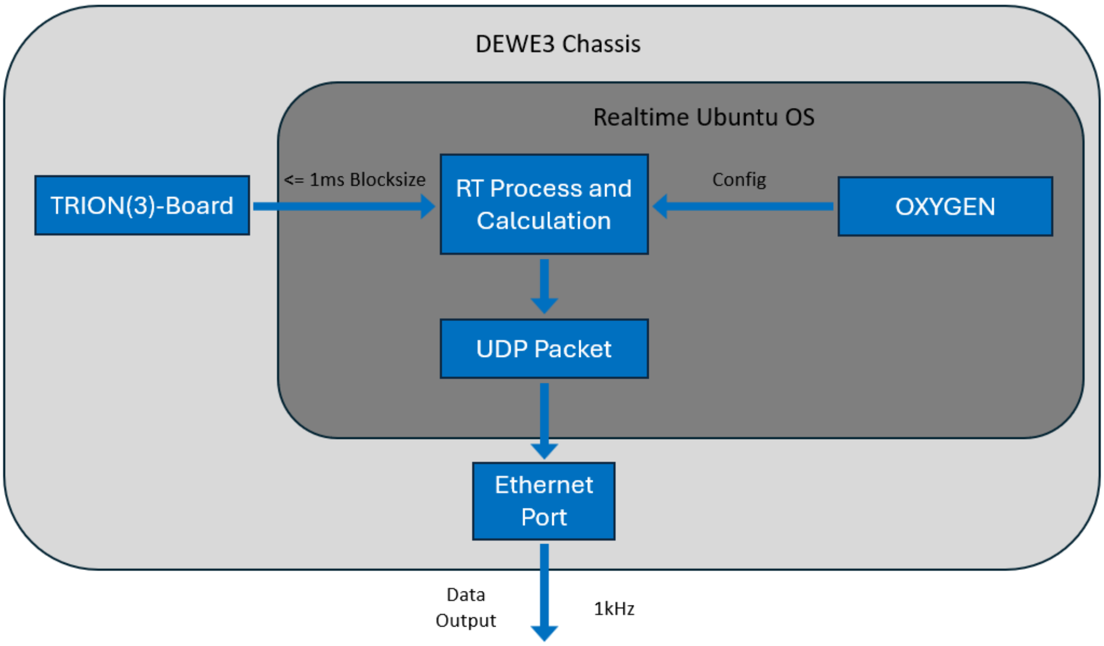

Fig. 3.1: OXYGEN Realtime Power Schematic

Only TRION(3) channels are supported as inputs for the Realtime Power Group. Software computated channels like Formulas, Statistics, Filters are not allowed as inputs for the Realtime Power Calculation, because these would cause the delays to be too high.

The Realtime Power Calculation is done its own process. The conventional OXYGEN Power-Group non realtime calculation will be not affected and done in parallel. Both Calcuation Principle Output channels will be visible in the OXYGEN channel list: - OXYGEN Non-Realtime Power-Group channels - OXYGEN Realtime Power-Group channels

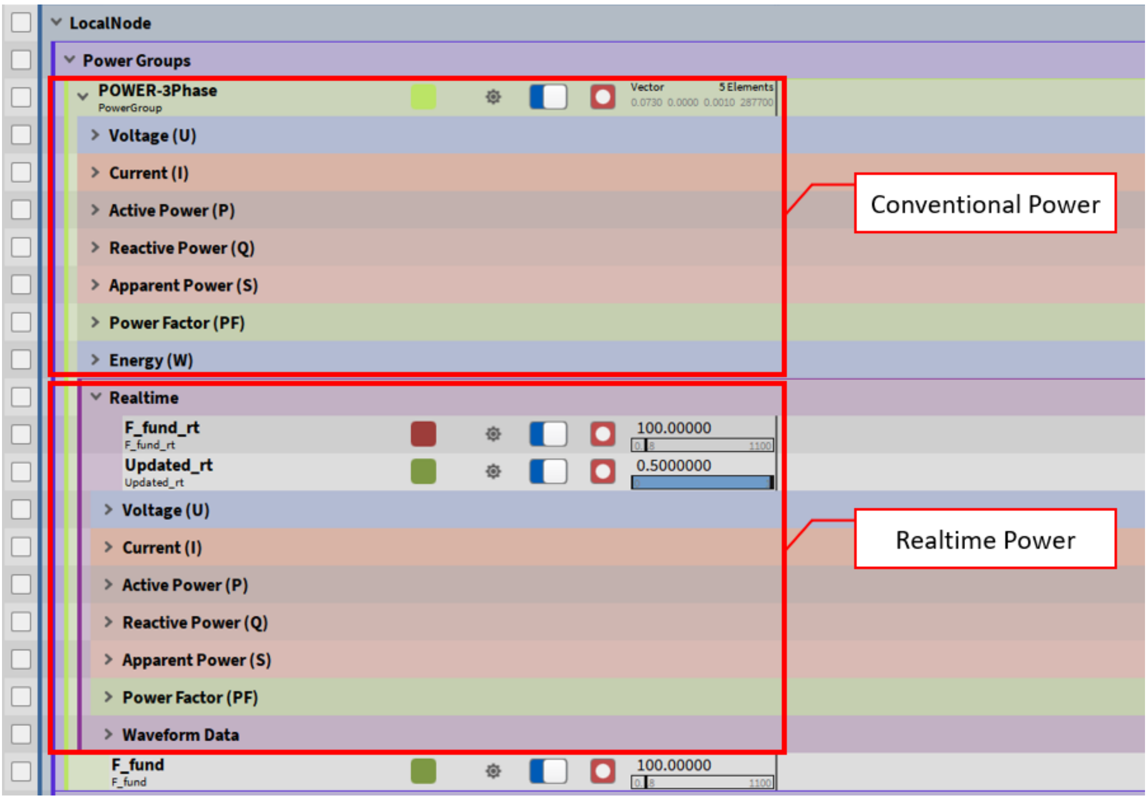

Fig. 3.2: OXYGEN Realtime and Non-Realtime Power Outputs

All Wiring Types (1 Phase, 3 Phase Delta, 3 Phase Star, 6 Phase), except Wiring Type **Other** is supported.

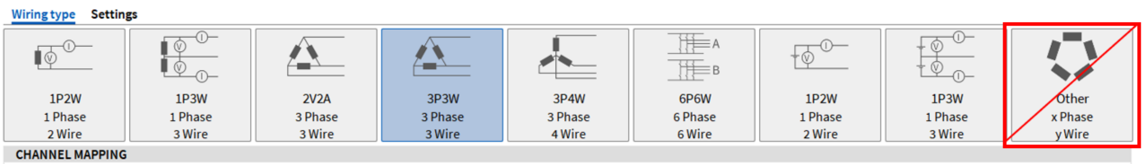

Fig. 3.3: Supported Wiring Types

Tip

This manual is only referring to the DEWETRON Realtime Power Analyzer. For general hardware or software instructions, please refer to the latest version of the other technical reference manuals available on the Customer Care Center CCC-portal (https://ccc.dewetron.com/).

CHAPTER

FOUR

SETTING UP UBUNTU 24.04

4.1 Operating system & Ubuntu kernel version

Power Group Realtime calculations require an Ubuntu 24.04 Linux operating system. To provide realtime calculation with low latency, a Linux kernel version >= 6.12 or RT-kernel must be used. In addition, the scheduler needs to be configured to be fully preemptive.

Tip

The software must be installed on a native Linux operating system running directly on the hardware. It will not provide realtime latency inside a virtual machine (e.g., VirtualBox, VMware) or a compatibility layer/containerized environment (e.g., WSL, Docker).

4.1.1 1. Check Linux kernel version

Enter `uname -a` into a terminal to query the kernel version.

```
dewetron@DEWE3-RM16-0:~$ uname -a
Linux DEWE3-RM16-0 6.17.0-29-generic #29~24.04.1-Ubuntu SMP PREEMPT_
↪DYNAMIC Mon May 11 10:30:58 UTC 2 x86_64 x86_64 x86_64 GNU/Linux
```

4.1.2 2. Check preemptive scheduler

Enter `sudo cat /sys/kernel/debug/sched/preempt` to read the current scheduler setting. It needs to be set to `(full)`. This setting is important to let the CPU quickly switch to the highest priority task even before a lower priority task is completed. The result is a low latency of real-time computations and outputs, while the general system stays unaffected (except for a reduced system throughput).

```
dewetron@DEWE3-RM16-0:~$ sudo cat /sys/kernel/debug/sched/preempt
none voluntary (full) lazy
```

If the preempt is set to any other than `(full)`, the low latency **cannot** be guaranteed, even if the kernel is >= 6.12

4.1.3 3. Automatically configure scheduler at startup

After installing OXYGEN, the use should modify the boot configuration with the optimized scheduler settings. Enter following commands and **reboot** the system.

- `cd /etc/default/grub.d/`
- `sudo ln -s /usr/share/Oxygen/grub/99-oxygen-preempt.cfg`
- `sudo update-grub`

```
dewetron@DEWE3-RM16-0:~$ cd /etc/default/grub.d/
dewetron@DEWE3-RM16-0:/etc/default/grub.d$ sudo ln -s /usr/share/Oxygen/
↪grub/99-oxygen-preempt.cfg
dewetron@DEWE3-RM16-0:/etc/default/grub.d$ sudo update-grub
Sourcing file `/etc/default/grub'
Sourcing file `/etc/default/grub.d/99-oxygen-preempt.cfg'
...
done
```

After a reboot of the system, the preempt setting should be `(full)`. Note that for OXYGEN 8.1, the cfg file is located at `/usr/Oxygen/grub/99-oxygen-preempt.cfg`.

Check with command in *2. Check preemptive scheduler*.

4.1.4 4. Setting Power Mode to Performance

It is also recommended to set the Ubuntu Power Mode to **Performance** to benefit from maximum CPU capability. To set the Power Mode to Performance following steps are necessary:

1. Open **Settings**.
2. Select **System → Power**.
3. Find **Power Mode**.
4. Choose **Performance**.
5. Close **Settings**.

Power Mode Settings:

```
Settings
└── System
    └── Power
        └── Power Mode
            ├── Performance  ← Select this
            ├── Balanced
            └── Power Saver
```

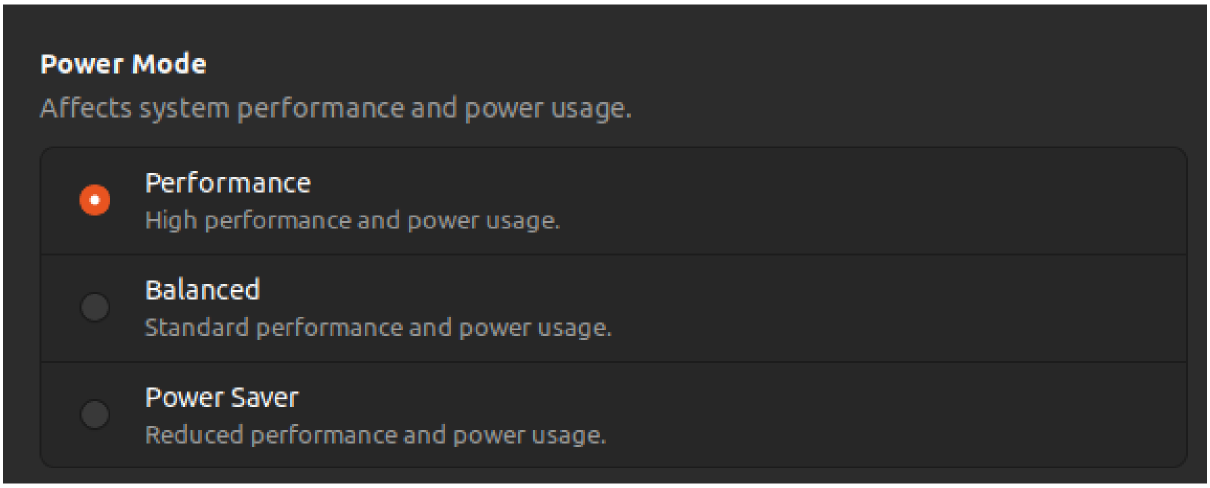

Fig. 4.1: Ubuntu Power Modes.

This Power Mode setting will also be saved for next startup.

CHAPTER

FIVE

SETTING UP OXYGEN

5.1 OXYGEN DAQ Hardware Setting

To enable the realtime tab in the power group, activate **Enable real-time computations** in the the DAQ Hardware settings and restart OXYGEN. Find the setting in the following image in the red outlined box Fig. 5.1.

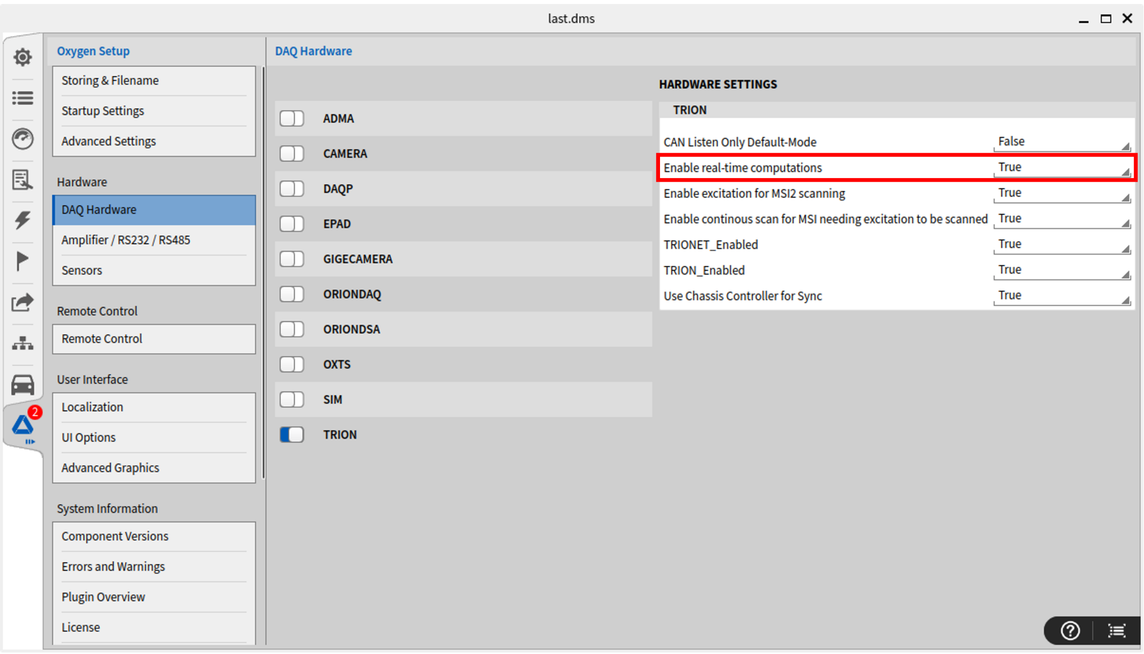

Fig. 5.1: DAQ Hardware *Enable real-time calculation* setting.

5.2 Power Group Realtime Settings

With the DAQ Hardware setting enabled, an additional Realtime tab becomes available after creating a power group.

As shown in figure Fig. 5.2, in the Realtime tab click the toggle **Enable realtime calculations** to enable the real-time module. It has the following settings:

- **Cycle-Rate**: Sets the frequency in which the power group calculates and emits output values.
- **Averaging (periods)**: The power group values are calculated based on the average of N periods of the fundamental frequency signal. This does not affect the cycle rate but will average N periods

of the fundamental for the output. For example this can be used to average a machine with 4 pole-pairs to 4 periods to smooth out mechanical speed or electical frequency.

- **Apply configuration**: Real-Time computations require an acquisition restart to reflect changed settings. This button applies all parameters changes and restart realtime calculation immediately (this happens automatically when closing the channel list).

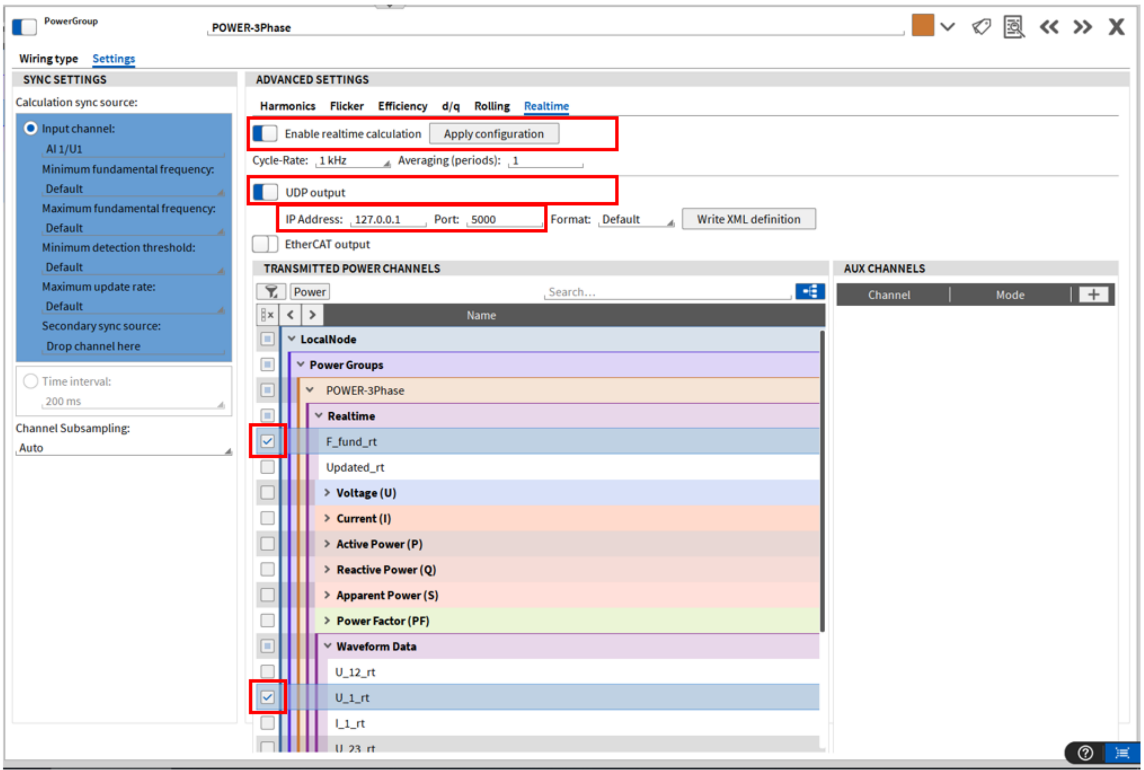

Fig. 5.2: OXYGEN Power Group Realtime tab and UDP settings.

> **Tip**
>
> It is recommended to hit the button *Apply configuration* when changing a parameter like *Cycle-Rate* or *IP Address*.

5.2.1 UDP Output

Enable the **UDP output** and select the channels to transfer in the Output channels list and click **Apply configurations**.

- **IP-Address**: Defines the target IP Address (receiver).
- **Port**: Defines the UDP port where the data is sent to.
- **Format**: Default or OXYGEN. The layout of the UDP packet is described in the XML file generated via the `Write XML definition` button.

UDP packets are sent at the configured cycle rate with a typical delay of less than 1ms after the cycle has finished. There are currently two UDP packet formats:

Default: A generic format with some headers, timestamp and data

Table 5.1: UDP Default Packet Structure

Field	Offset (bytes)	Size (bytes)	Data type	Description
Packet ID	0	1	uint8	Fixed value of 2.
Sequence number	1	4	uint32	an incresing number per packet
Timestamp	5	8	uint64	Milliseconds since acquisition start
N	13	4	uint32	N = number of float32 data values in this packet
Data	17	N * 4	N * float32	Realtime power group data (see definition XML for exact order of fields)

OXYGEN: A format with a timestamp in milliseconds since midnight - suited to be processed by OXYGEN Ethernet receiver.

Table 5.2: UDP OXYGEN Packet Structure

Field	Offset (bytes)	Size (bytes)	Data type	Description
Timestamp	0	4	uint32	Milliseconds since midnight
Data	4	N * 4	N * float32	Realtime power group data (see definition XML for exact order of fields)

5.2.2 EtherCAT Output

This feature is available with OXYGEN 8.2 and newer releases.

Only one instance of an **EtherCAT output** can be set, because it reserves the TRION-EtherCAT-1-SLAVE for this output. This means that only one Power Group can use the **EtherCAT output** for the Realtime Computations.

Enable the **EtherCAT output** and select the channels to transfer in the Output channels list and click **Apply configurations**.

- **Output channel**: Some EtherCAT masters, like a PySOEM expect the Master to output a dummy channel to an EtherCAT slave. If this is necessary, then set this option to **True**. Most industrial EtherCAT Masters do not need this, then set this option to **False**
- **Send timestamp**: Set if the EtherCAT output should include a timestamp or not. The layout of the EtherCAT data is described in the ESI (EtherCAT Subdevice Information) file generated via the `Write ESI file` button.

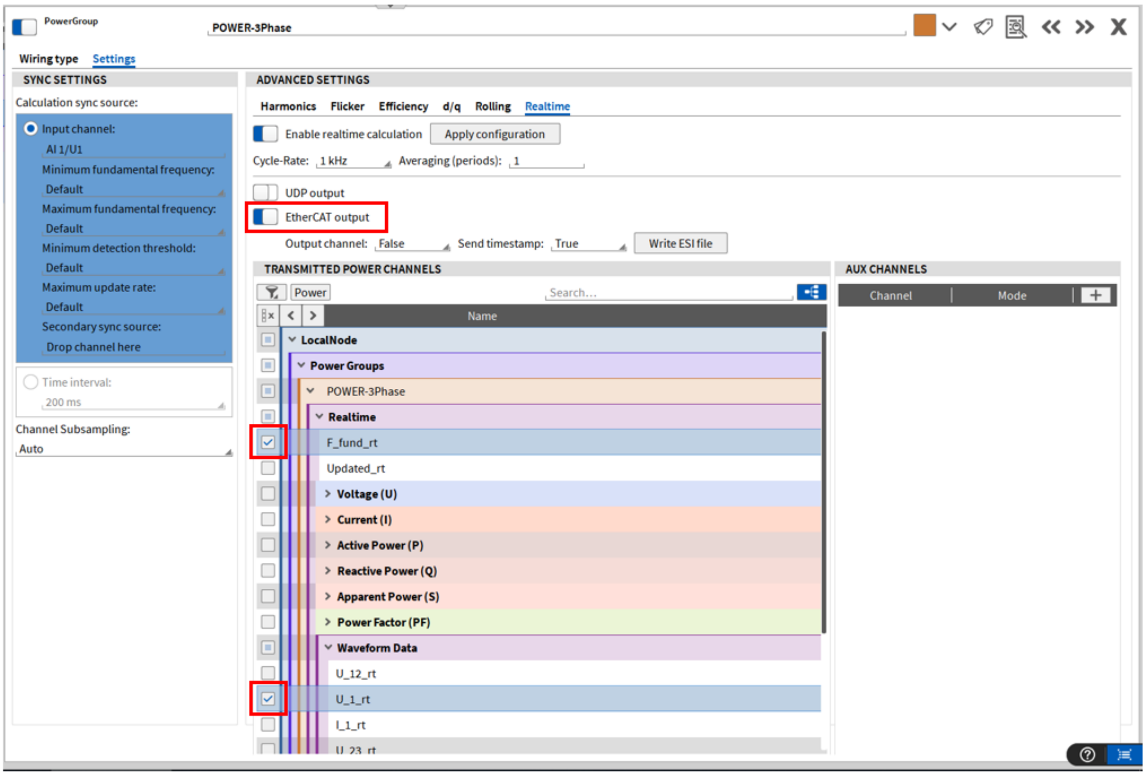

Fig. 5.3: OXYGEN Power Group Realtime tab and EtherCAT settings.

Tip

It is recommended to hit the button *Apply configuration* when changing a parameter like *Cycle-Rate* or *Send timestamp*.

if the **EtherCAT output** option does not appear in the Power Group Realtime Advanced Settings make sure:

- That a TRION-EtherCAT-1-SLAVE board is installed in the system
- The EtherCAT drivers for the board are installed

To install the EtherCAT drivers use the following commands in the Terminal:

```
cd /usr/lib/dewetron-ethercat/driver
sudo ./build_install_driver

   y (if asked for overwrite permission)
   y (if asked for DMA support type)
```

5.2.3 AUX Channels

The **AUX** or **auxiliary** Channels on the right side of the **Realtime settings** allow any analog TRION input channel to be transferred alongside the Power Values via UDP or EtherCAT. For example channels from:

- TRION3-1820-MULTI
- TRION3-2420-ACC
- TRION-2402-dSTG
- and many more

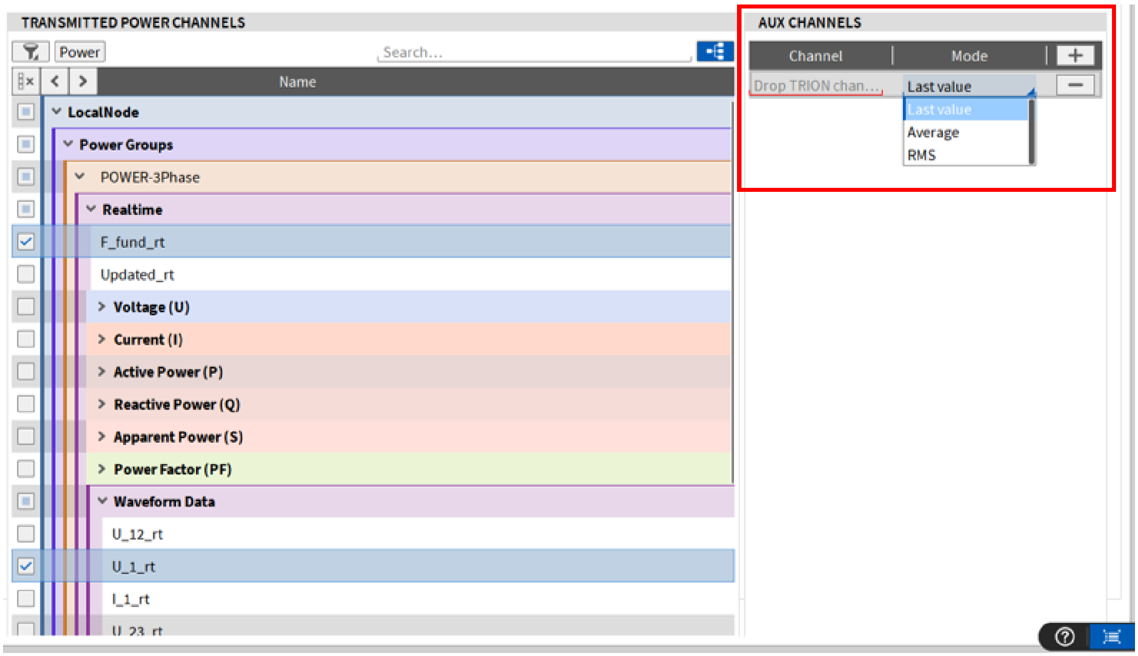

Fig. 5.4: OXYGEN Power Group Realtime tab and AUX Channels.

Within the AUX Channels section, any analog TRION input channel can now be assigned to the real-time output with update rates of up to 1 kS/s. Available output modes include:

- **Average** - Block-wise average based on the configured cycle rate
- **RMS** - RMS calculation based on the configured cycle rate
- **Last Value** - Last acquired sample

The statistics window of the **Average** and **RMS** output modes is set to the cycle rate.

These auxiliary channel outputs are available for both UDP and EtherCAT, enabling transmission of power values alongside additional analog measurement data.

5.3 Available Power Group Realtime Channels

As a reference the following image Fig. 5.5. shows the available power group realtime channels for a 1-Phase power group without efficiency calculation.

Fig. 5.5: Example overview for available relatime channels with a 1-phase power group.

For an examples how to use the realtime option for a 3-phase example with efficiency calculation see chapter *Application Examples*.

For troubleshooting and tipps see chapter *Troubleshooting / Tipps*.

CHAPTER

SIX

REALTIME CHANNEL LIST

Following channels are calculated by the OXYGEN Power realtime group:

> **Tip**
>
> If line-line wiring is applied, the power group values are calculated per single phase U_1 and between phases U_{12}.

- **Freq** - The fundamental frequency of the assigned phase
- **PhaseUpdated** - Boolean indicator when the power values are updated, meaning the power period is complete
- **Voltage (U)** - Grouping for voltage based channels
  - U_tRMS_RT - Total effective voltage over all phases
  - U_n _tRMS_RT - Effective voltage of phase n
  - U_n _tPP_RT - Peak-Peak voltage of phase n
  - U_n _tAVG_RT - Average voltage of phase n
- **Current (I)** - Grouping for current based channels
  - I_tRMS_RT - Total effective current over all phases
  - I_n _tRMS_RT - Effective current of phase n
  - I_n _tPP_RT - Peak-Peak current of phase n
  - I_n _tAVG_RT - Average current of phase n
- **Active Power (P)**
  - P_t_RT - Total active power over all phases
  - P_n _t_RT - Active power per single phase
- **Reactive Power (Q)**
  - Q_t_RT - Total reactive power over all phases
  - Q_n _t_RT - Reactive power per single phase n
- **Apparent Power (S)**
  - S_t_RT - Total apparent power over all phases
  - S_n _t_RT - Apparent power per single phase n

- **Power Factor (PF)**
  - PF_t_RT - Power factor over all phases
  - PF_n _t_RT - Power factor per single phase n
- **DC**
  - U_n _DC_RT - DC voltage per single phase n
  - I_n _DC_RT - DC current per single phase n
  - P_n _DC_RT - DC active power per single phase n
  - U_DC_RT - DC voltage over all DC groups (same as U1_DC for only one group)
  - I_DC_RT - DC current over all DC groups (same as I1_DC for only one group)
  - P_DC_RT - DC active Power over all DC groups (same as P1_DC for only one group)
- **Mechanical**
  - n_n _AVG_RT - Average of speed per mechanical power analysis updated after every Period or multiple if set with **Averaging (periods)**
  - M_n _AVG_RT - Average of torque per mechanical power analysis updated after every Period or multiple if set with **Averaging (periods)**
  - P_m_n _RT - Power per mechanical power analysis for mechanical group n
  - P_m_RT - Power over all mechanical groups
- **Efficiency**
  - Eta_dc_ac_RT - Efficiency from DC to AC
  - Eta_m_RT - Efficiency from AC to mechanical
  - Eta_sys_RT - System efficiency from DC to mechanical
- **Waveform Data** - Grouping for waveform data channels
  - U_n _RT - Resampled voltage raw data per phase
  - I_n _RT - Resampled current raw data per phase
  - n_n _RT - Resampled speed raw data per mechanical power analysis
  - M_n _RT - Resampled torque raw data per mechanical power analysis
  - AI 1/1_rt - AUX channel in **Last value** mode, only available if added with **AUX CHANNELS** (see section *AUX Channels*)
  - AI 1/1_rt_AVG - AUX channel in **AVG** mode, only available if added with **AUX CHANNELS** (see section *AUX Channels*)
  - AI 1/1_rt_RMS - AUX channel in **RMS** mode, only available if added with **AUX CHANNELS** (see section *AUX Channels*)

CHAPTER

SEVEN

APPLICATION EXAMPLES

7.1 Power group overview

Most basic power group channels are also calculated in the power group realtime analysis. The power instrument only shows normal power group channels and cannot display the realtime channels. Any realtime channels is available in the channel list and can be used in other instruments.

A list of available channels is listed below figure Fig. 7.1.

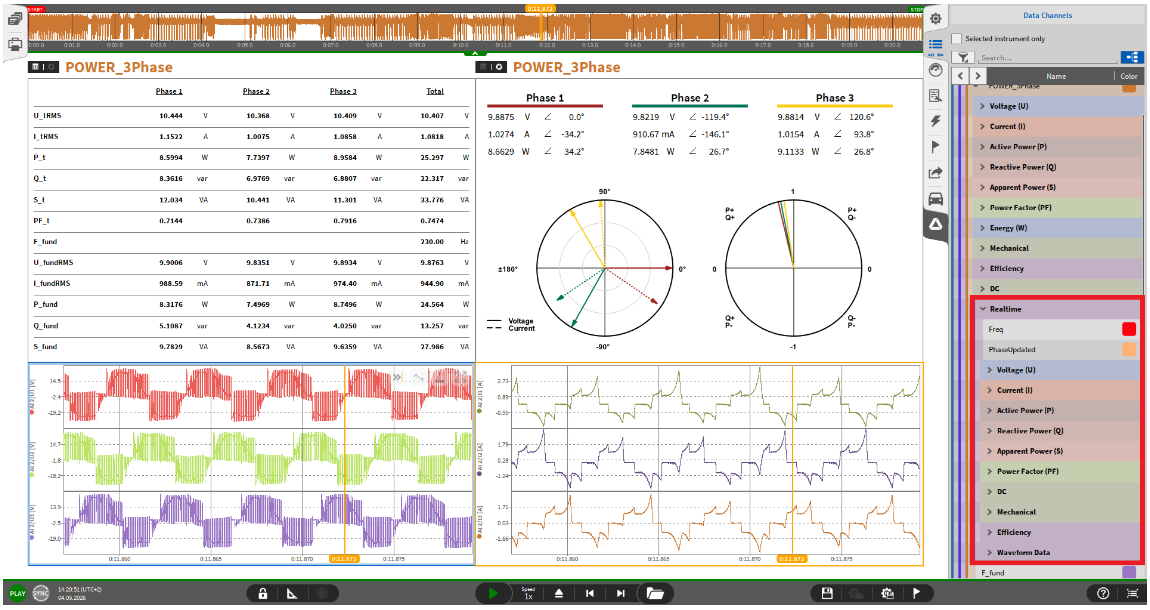

Fig. 7.1: Example of power group realtime channels on the measurement screen.

7.2 Setting up a 3-phase line-line power group

Figure Fig. 7.2 shows an example 3-phase line-line wiring. If the fundamental frequency gets detected based on the first voltage e.g. U1, the power values are calculated and can be previewed below the LOAD.

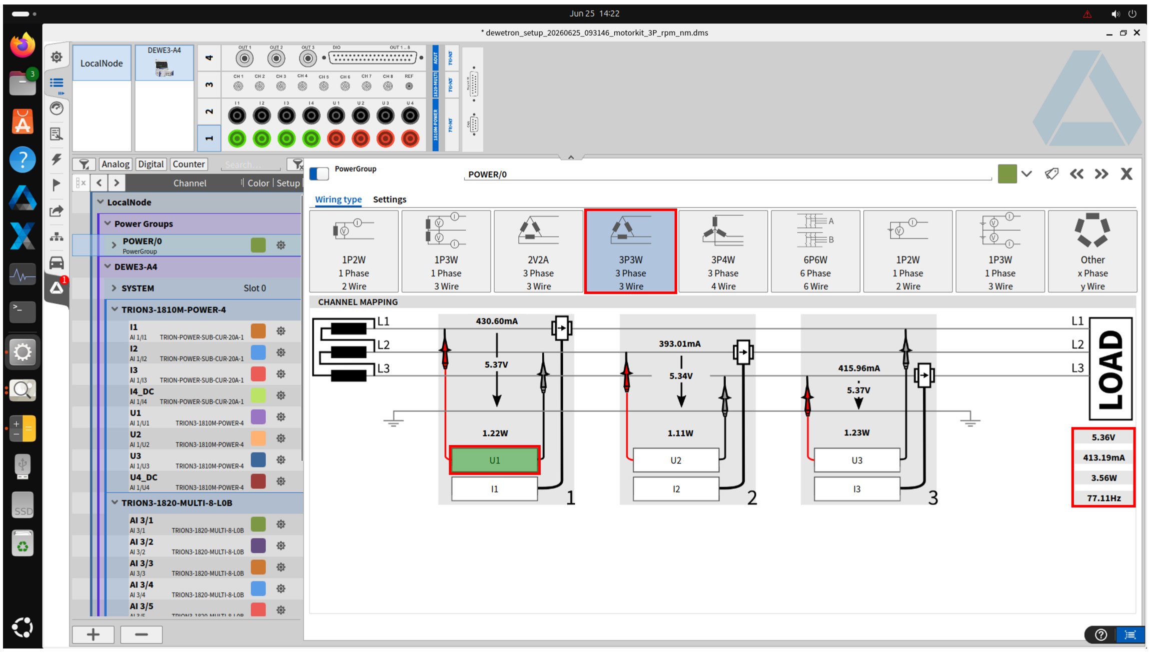

Fig. 7.2: Example of power group 3-phase line-line configuration

7.3 Power group settings

7.3.1 Efficiency tab

The first relevant tab for the power group realtime analysis is the *Efficiency* tab see figure Fig. 7.3.

- DC power analysis requires an analog input for *Voltage U_DC* and for *Current I_DC*.
  - Create up to 6 DC power analysis and assign a DC voltage and current to each.
- Mechanical analysis requires a analog input for the *Rotational speed* and for the *Torque*
  - Create up to 6 mechanical power analysis and assign a analog torque und speed intput to each.

Tip

The speed usually is a software channel, but for the realtime calculation a hardware input e.g. *CNT 3/1* is required. The next figure Fig. 7.4 shows how to configure the counter input to be usable for the realtime calculation.

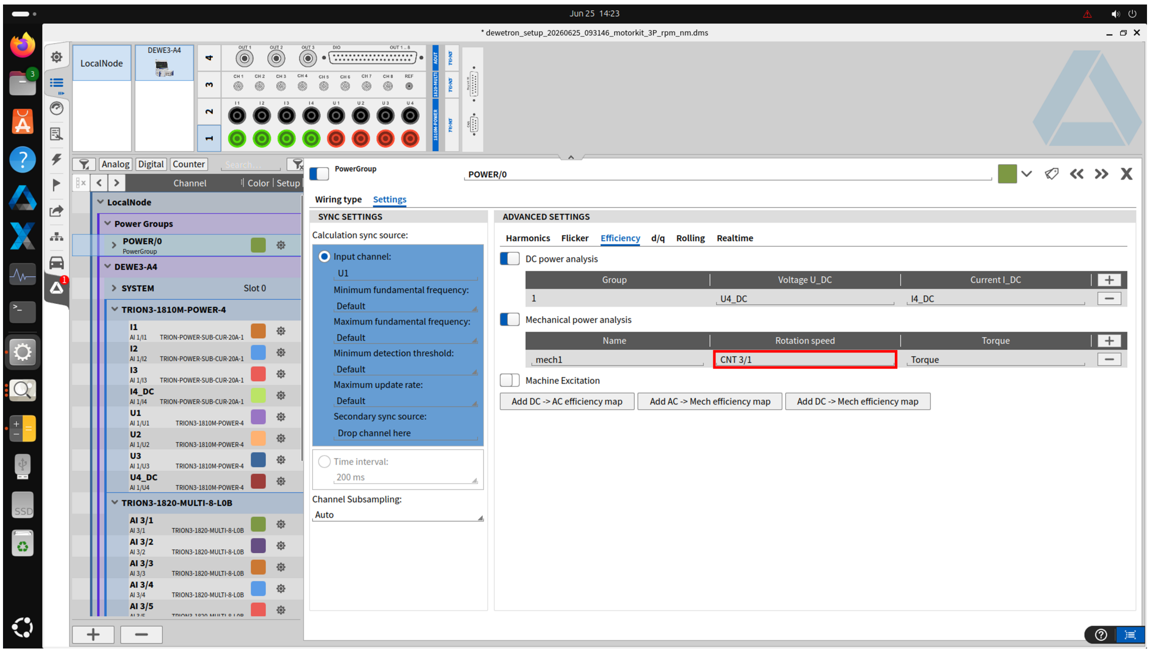

Fig. 7.3: Example of power group efficiency tab with DC and mechanical efficiency

7.3.2 Configure counter for realtime speed input

Example how to set the counter input *CNT 3/1* to be usable as the power group realtime speed channel is shown in figure Fig. 7.4.

1. Change the counter mode to *Frequency*
2. Set the unit to rpm
3. Set the scalling to 60/(pulses per rotation), e.g. 4 pulse per rotation results in a scaling of 15.

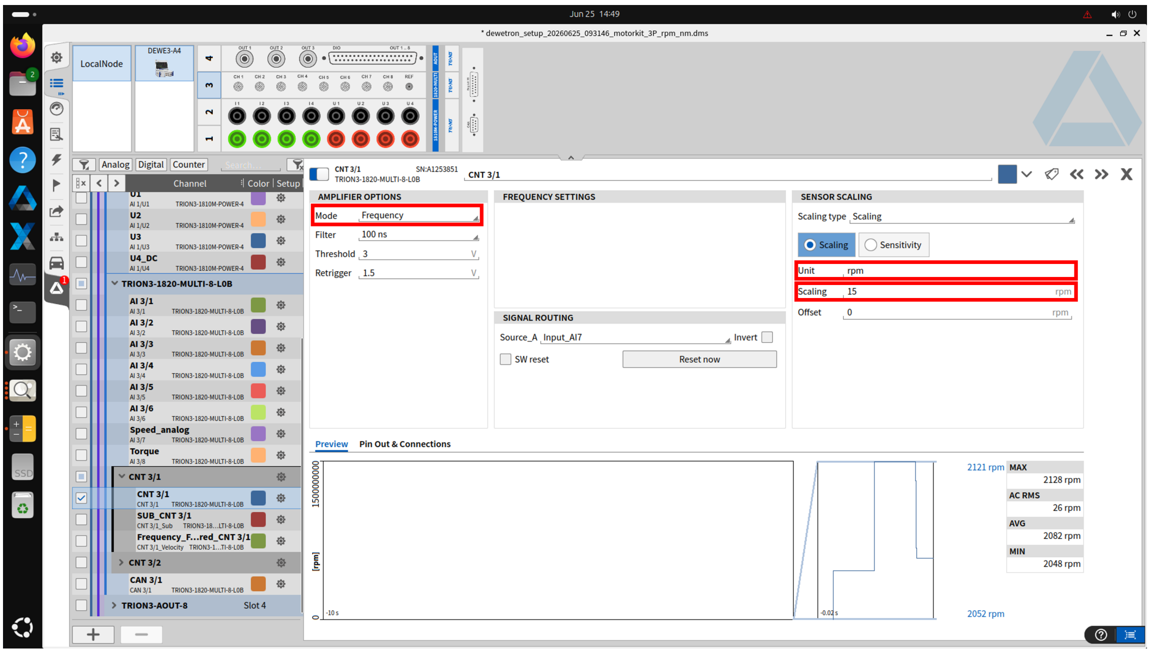

Fig. 7.4: Example of speed via scaled frequency channel

7.3.3 Realtime tab

The final tab to configure the power group realtime calculation is shown in figure Fig. 7.5.

With OXYGEN 8.2 and higher, the AUX channels tab enables to include some additional analog inputs in the realtime output options.

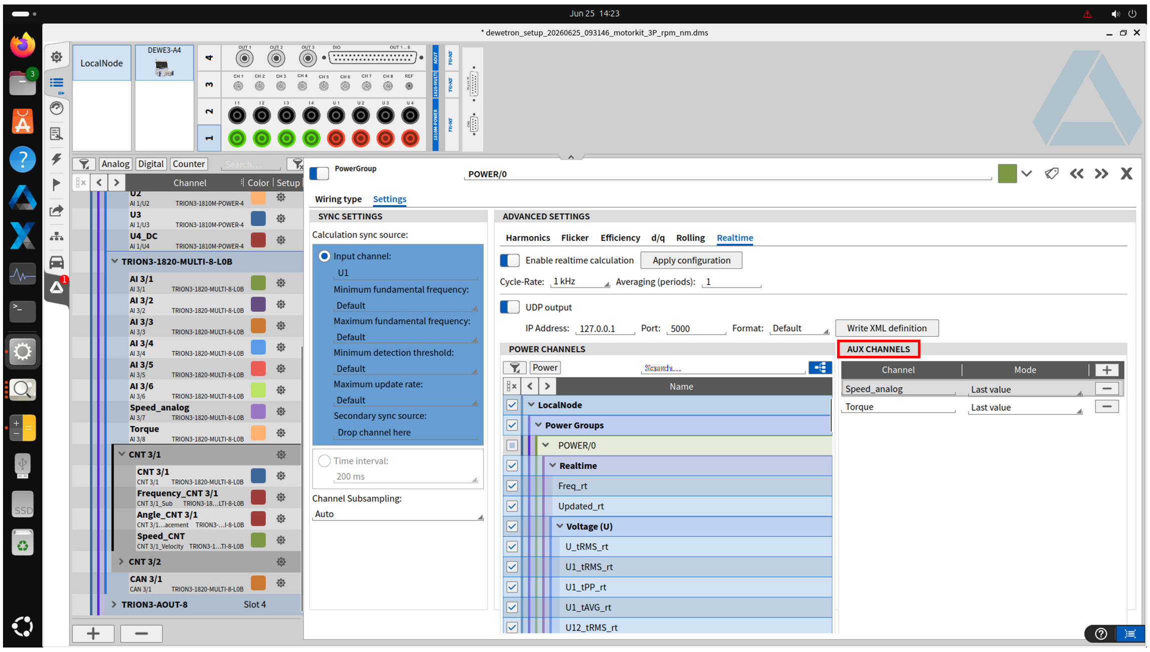

Fig. 7.5: Example of power group realtime tab

CHAPTER

EIGHT

TROUBLESHOOTING / TIPPS

8.1 Realtime power option not available

OXYGEN Power realtime requires a seperate license but is available with an evaluation license. Realtime computations are not supported on Microsoft Windows. See chapter *Setting up OXYGEN* on how to enable and set up the Realtime computations.

8.2 Only TRION hardware channels are valid for realtime calculations

The power group realtime calculations require TRION hardware channels and cannot work with software or network-transmitted channels.

This means also for efficiency calculations only hardware channels can be computed.

Otherwise following warning occurs *Incompatible … channels for realtime calculation*.

8.3 Replacing the counter speed channel by the scaled frequency channel

Usually the speed channel of the counter channels is used for the mechanical efficiency calculation. This speed channel is a calculated (software) channel and thus the realtime calculation cannot access it.

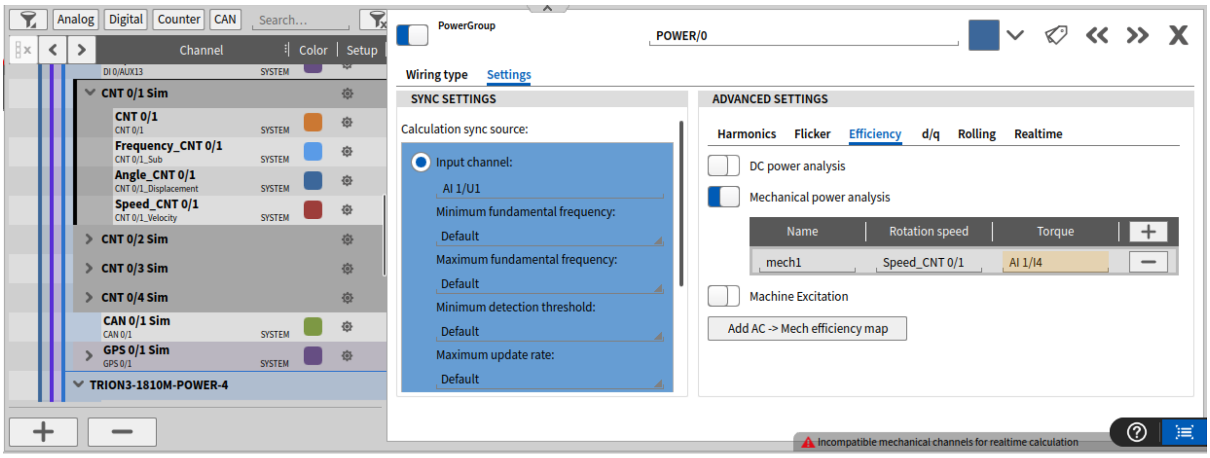

Fig. 8.1: Mechanical efficiency with software channels.

The solution is to use the hardware channels of the counter. This means scaling the CNT channel to represent rpm. See the configuration in the application example figure Fig. 7.4.

8.4 Fundmental Frequency not detected correctly

Detecting the fundamental power frequency works a bit differently for the Realtime and Conventional Power Calculation because the convential FFT method would create a too large delay. If the fundamental frequency seems too large (jumping to inverter switching frequency for example) or not showing any values at all, try the follwing:

- Set the **Maximimum fundmental frequency** in the *Calculation sync source* settings of the Power group to about 2-10 times the maximum expected fundemental frequency of the duplication
- Set the **Minimum detection threshold** in the *Calculation sync source* settings of the Power group to a lower value, 0.01% for example

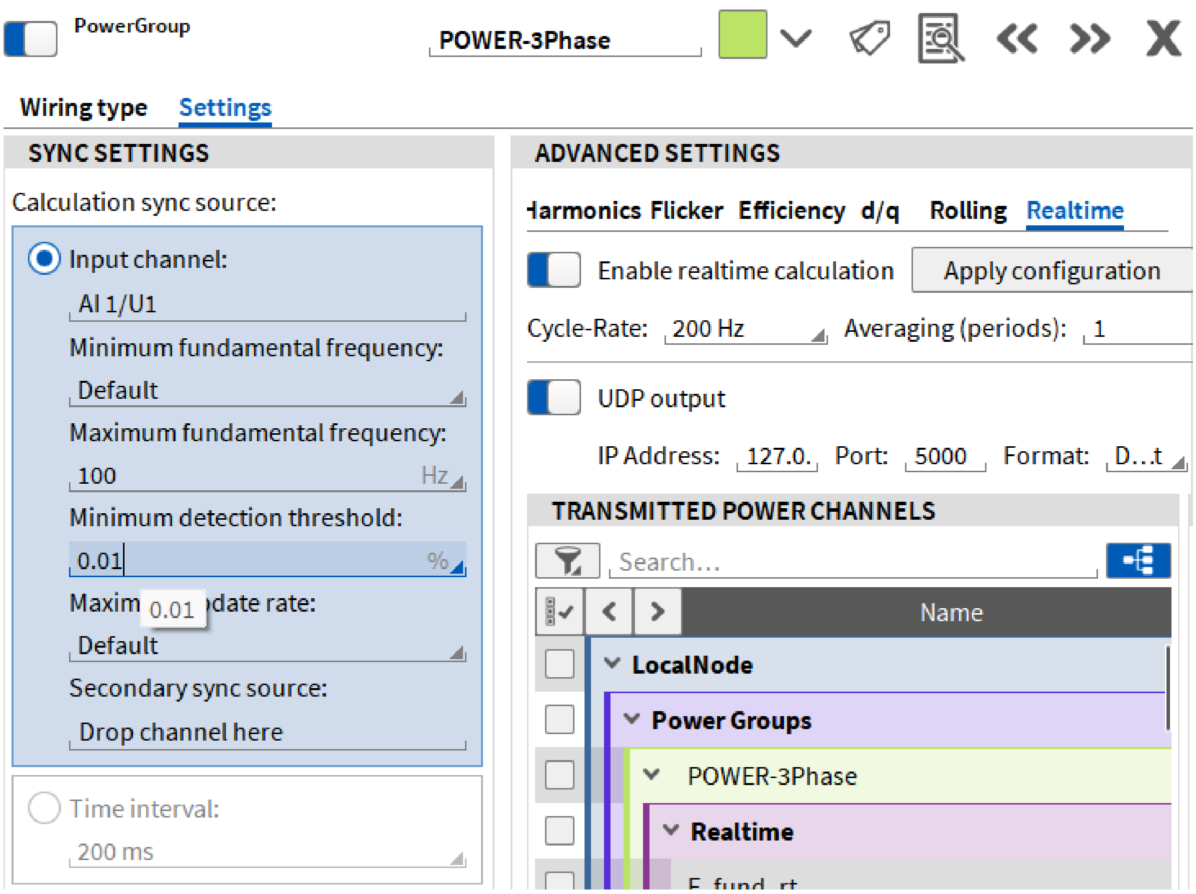

Fig. 8.2: Fundamental Frequency Detection Tipps.

8.5 EtherCAT slave not sending the correct channels

Make sure the EtherCAT slave board is reserved for the Realtime output, not the conventional 200ms delayed OXYGEN output. For this you can **deactivate** the conventional EtherCAT Slave Plugin in the Plugin Overview, then restart OXYGEN.

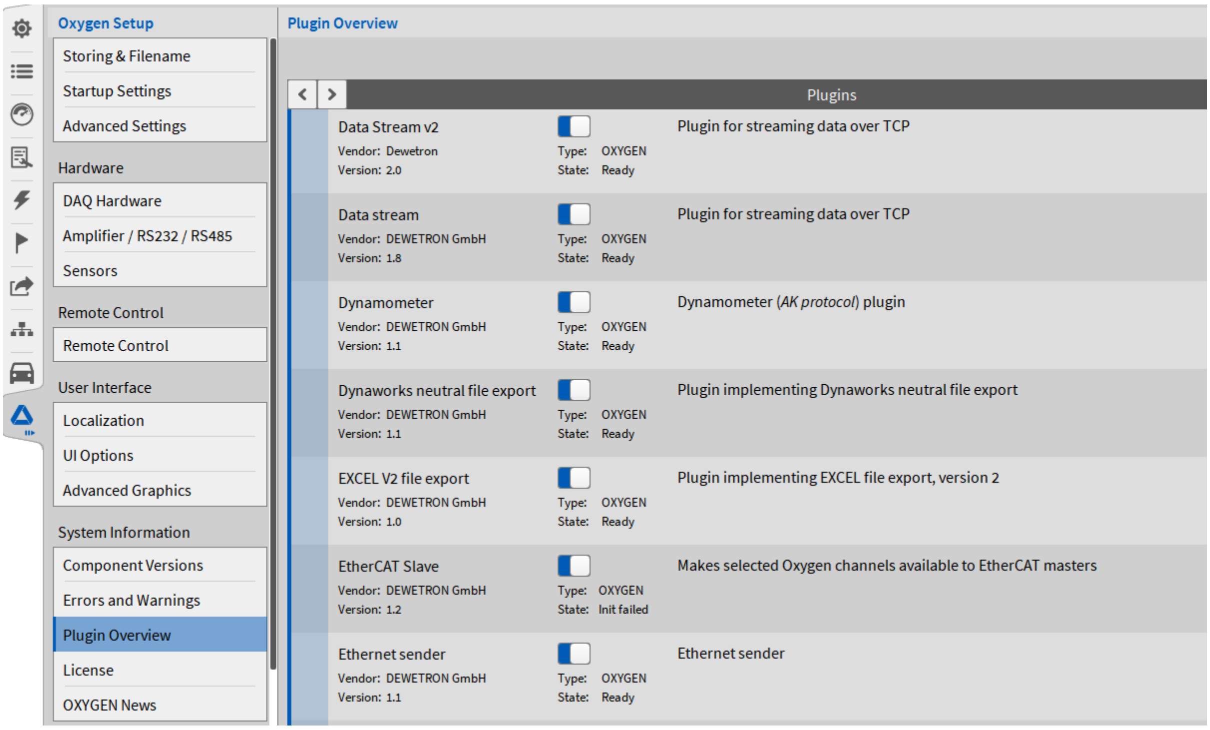

Fig. 8.3: EtherCAT Slave Plugin Setting.