ABB INDUSTRIAL DRIVES

DCT880

Power Optimizer Control Manual

Safety Instructions

What this chapter contains

This chapter contains the safety instructions you must follow when installing, operating and servicing the thyristor power controller. If ignored, physical injury or death may follow, or damage may occur to the thyristor power controller or the connected equipment. Read the safety instructions before you work on the unit.

To which products this chapter applies

The information is valid for the whole range of the product DCT880.

Usage of warnings and notes

There are two types of safety instructions throughout this manual: warnings and notes. Warnings caution you about conditions, which can result in serious injury or death and/or damage to the equipment, and advice on how to avoid the danger. Notes draw attention to a particular condition or fact, or give information on a subject. The warning symbols are used as follows:

Dangerous voltage warning warns of high voltage, which can cause physical injury or death and/or damage to the equipment.

General danger warning warns about conditions, other than those caused by electricity, which can result in physical injury or death and/or damage to the equipment.

Electrostatic sensitive devices warning warns of electrostatic discharge, which can damage the equipment.

Installation and maintenance work

These warnings are intended for all who work on the thyristor power controller, the cables or the connected equipment. Ignoring the instructions can cause physical injury or death and/or damage to the equipment.

WARNING!

- **Only qualified electricians are allowed to install and maintain the thyristor power controller!**
- Never work on the thyristor power controller, the cables or the connected equipment when main power is applied. Always ensure by measuring with a multimeter (impedance at least 1 MΩ) that:
  1. Voltage between thyristor power controller input phases U1, V1, W1 and the frame is close to 0 V.
  2. Voltage between thyristor power controller output phases U2, V2, W2 and the frame is close to 0 V.
- Do not work on the control cables when power is applied to the thyristor power controller or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the thyristor power controller even when the main power on the thyristor power controller is switched off.
- Do not make any insulation resistance or voltage withstand tests on the thyristor power controller.
- Isolate the cables to the equipment from the thyristor power controller when testing the insulation resistance or voltage withstand of the cables or the equipment.
- When reconnecting the cables to the equipment, always check that the U2, V2 and W2 cables are connected with the proper terminal.

Notes:

- The output phase cable terminals on the thyristor power controller are at a dangerously high voltage when the main power is on.

- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the relay outputs of the drive system (e.g. XRO1 … XRO3).
- DCT880 with enclosure extension: Before working on the thyristor power controller, isolate the whole thyristor power controller system from the supply.

Grounding

These instructions are intended for all who are responsible for the grounding of the thyristor power controller. Incorrect grounding can cause physical injury, death and/or equipment malfunction and increase electromagnetic interference.

WARNING!

- Ground the thyristor power controller, the connected equipment and adjoining devices to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and pick-up.
- Make sure that grounding conductors are adequately sized and marked as required by safety regulations.
- In a multiple thyristor power controller installation, connect each thyristor power controller separately to protective earth (PE ⏚).
- Minimize EMC emission and make a 360° high frequency grounding (e.g. conductive sleeves) of screened cable entries at the cabinet lead-through plate.

Note:

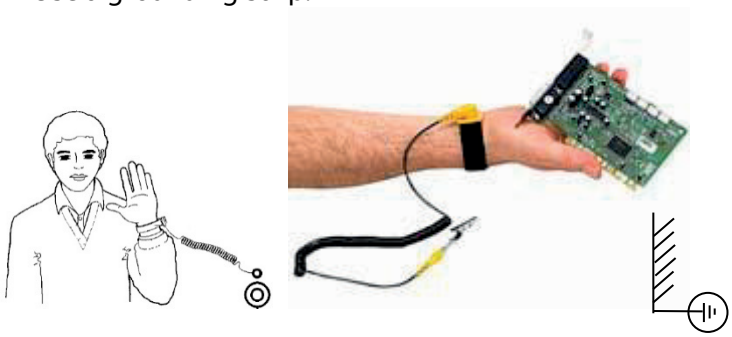
- Power cable shields are suitable as equipment grounding conductors only when adequately sized to meet safety regulations.
- As the normal leakage current of the thyristor power controller is higher than 3.5 mA_{AC} or 10 mA_{DC} (stated by EN 50178, 5.2.11.1), a fixed protective earth connection is required.

Printed circuit boards and fiber optic cables

These instructions are intended for all who handle the circuit boards and fiber optic cables. Ignoring the following instructions can cause damage to the equipment.

WARNING!

- The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wristband when handling the boards. Touch the boards only when necessary.
- Use a grounding strip:



- ABB order no.: 3ADV050035P0001

Mechanical installation

These notes are intended for all who install the thyristor power controller. Handle the unit carefully to avoid damage and injury.

WARNING!

- DCT880 sizes T4 and T5:
  - The thyristor power controller is heavy. Do not lift it alone.
  - Do not lift the unit by the front cover.
  - Place units T4 and T5 only on its back.
- Make sure that dust from drilling does not enter the thyristor power controller when installing. Electrically conductive dust inside the unit may cause damage or lead to malfunction.
- Ensure sufficient cooling.
- Do not fasten the drive by riveting or welding.

Operation

These warnings are intended for all who plan the operation of the thyristor power controller or operate the thyristor power controller. Ignoring the instructions can cause physical injury or death and/or damage to the equipment.

WARNING!

- Before adjusting the thyristor power controller and putting it into service, make sure that all connected equipment is suitable for operation throughout the voltage/current range provided by the thyristor power controller.
- Do not control the connected equipment with the disconnecting device (disconnecting mains); instead, use the control panel keys and , or commands via the I/O board of the thyristor power controller.
- Mains connection:
  You can use a disconnect switch (with fuses) to disconnect the electrical components of the thyristor power controller from the mains for installation and maintenance work. The type of disconnect switch used must be as per EN 60947-3, Class B, so as to comply with EU regulations, or a circuit-breaker type which switches off the load circuit by means of an auxiliary contact causing the breaker's main contacts to open. The mains disconnect must be locked in its "OPEN" position during any installation and maintenance work.
- EMERGENCY POWER OFF buttons must be installed at each control desk and at all other control panels requiring an emergency off function. Pressing the Stop button on the control panel of the thyristor power controller will not cause an emergency off by the thyristor power controller and it will not disconnect the thyristor power controller from any dangerous potential.
  To avoid unintentional operating states, or to shut the unit down in case of any imminent danger according to the standards in the safety instructions it is not sufficient to merely shut down the drive via signals Run, Off or Emergency Off respectively from control panel or PC tool.
- Intended use:
  The operating instructions cannot take into consideration every possible case of configuration, operation or maintenance. Thus, they mainly give such advice only, which is required by qualified personnel for normal operation of the machines and devices in industrial installations.
  If in special cases the electrical machines and devices are intended for use in non-industrial installations - which may require stricter safety regulations (e.g. protection against contact by children or similar) - these additional safety measures for the installation must be provided by the customer during assembly.

Note:

- When the control location is not set to Local (Local not shown in the status row of the display), the Stop key on the control panel will not stop the thyristor power controller.

To stop the thyristor power controller using the control panel, press the Loc/Rem key and then the Stop key  .

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DCT880 Manual set	DCT880 Manual set	EN							
DCT880 Units									
DCT880 Flyer	3ADW000429	EN	DE	IT	ES	FR		ZH	RU
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Drive (IEC61131-3) application programming manual	3AUA0000127808	EN							
NETA-21 remote monitoring tool	3AUA0000096939	EN							
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Introduction

Many industrial processes use large amounts of heat. The energy they use is expensive. If they require high peak power it can be even more so. ABB's DCT880 is a thyristor power controller for heating applications whose integrated power optimization algorithms save cost by reducing peak power demand. This is done fully automatically without affecting the production process or schedule. The main ingredient is an optimization suite that runs on the DCT880 without the need for further supervisory equipment like additional PLCs. The key to optimization is a micro time energy scheduling algorithm. This shifts the periods in which energy is consumed by amounts small enough that the heating process is not affected. However, by cleverly applying those changes, the peak power demand can, in many cases, be greatly reduced.

A significant cost factor in all heating applications is energy. When heating electrically, the total energy cost is often greatly increased by the extra cost of power peaks. Such cost penalties are very common for larger customers as it helps to keep the grid and power production stable. This penalization strategy is becoming more prevalent as more renewable power generators join the grid.

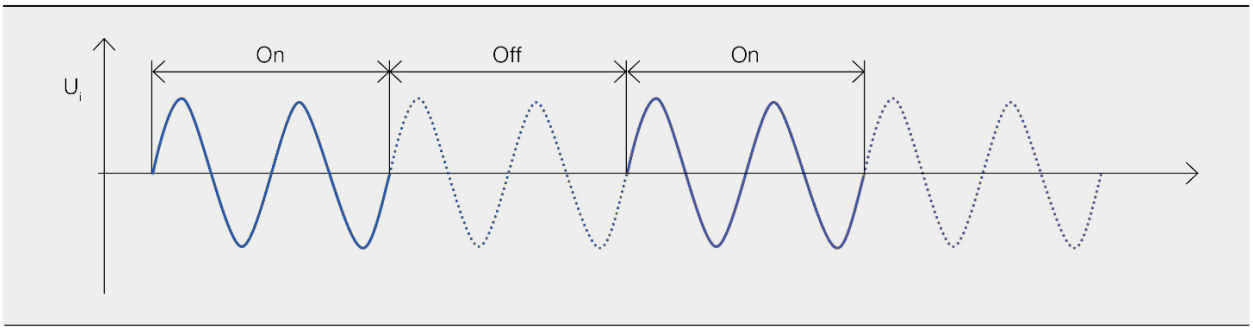
One way to decrease the peak consumption would be to distribute energy-intensive process tasks evenly over the day. However, this approach would not prevent peaks that occur over a smaller timescale. The DCT880 offers a different solution – it distributes the load to minimize peaks. In this way, the DCT880 can cost-optimize thyristor control of resistive, inductive and infrared heaters in annealing, drying, melting, and heating in the glass, plastics and metal industries.

The DCT880 power optimization algorithms help users avoid expensive peaks in their power consumption (1)

General application description

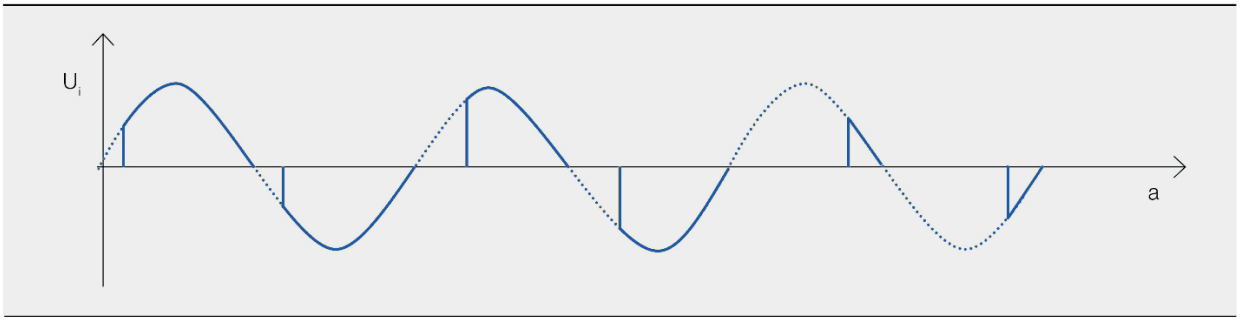
Many industrial heating applications consist of numerous heating elements at the same site. These heating devices may have different energy consumptions when switched on; some may operate in a coupled manner; and they could all be controlled by one supervisory control or independently by local PID-controllers.

Regardless of which setup is actually used, one requirement is ubiquitous: good power quality. This can be achieved by using full-wave burst firing, i.e., by either letting full sine waves pass or by completely blocking them to switch the device fully on or off.



Full-wave burst firing (2)

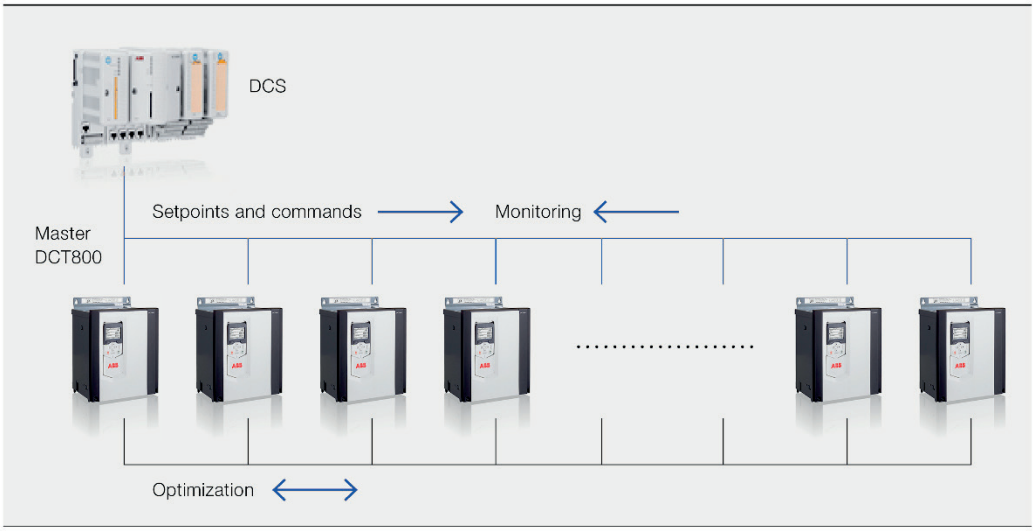
When doing power optimization, the DCT880 uses full-wave burst firing. Besides this mode, the DCT880 also offers other control methods like half-wave control, soft starts and soft downs as well as phase-angle control.



Phase-angle control (3)

A heating application is often subdivided into cycles that are between 1 and 20 s long, with each cycle controlled independently. Directly before the start of a new cycle, sensor measurements are made and – for each heating device – the amount of energy to be distributed throughout the next cycle is calculated. Knowing the operating power of the heating device, it then is easy to calculate the length of the next cycle. The overall heating process is slow enough that it does not matter exactly when during the cycle the energy is distributed (i.e., when the heating device is switched on).

Depending on the load type, each DCT880 can control up to three loads that are independent of each other. Many configurations are possible, such as several single-phase, delta, star, multi-tap, open delta, etc. If more than three loads are to be controlled, one (standard) DCT880 will act as master and will be responsible for the power optimization calculations. Any DCT880 can be made master by setting a software switch. However, there may be only one master at a time per system.

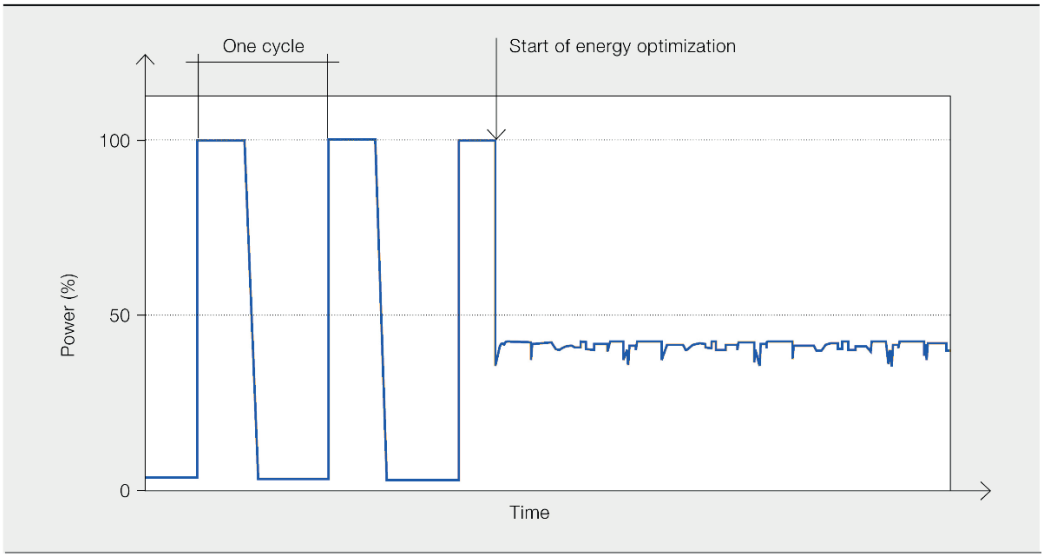


Communication architecture of the DCT880 (4)

After a DCT880 follower receives the information on the power demand for the next cycle, it passes that information to the master. When the master has received this information from all its follower DCT880s, it performs the optimization step – i.e., for each heating device it calculates when to switch it on and off so as not to negatively affect the heating process. The results are then passed to the follower DCT880s so they can control their heating devices in the next cycle.

How is optimization done?

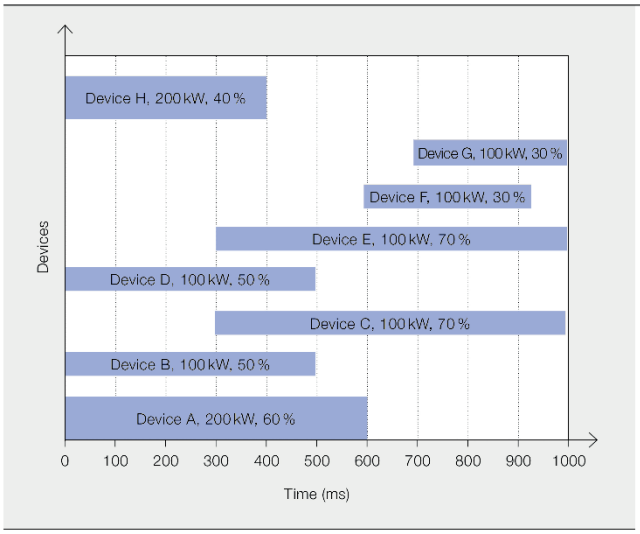
The diagram in demonstrates the dramatic difference power optimization makes.



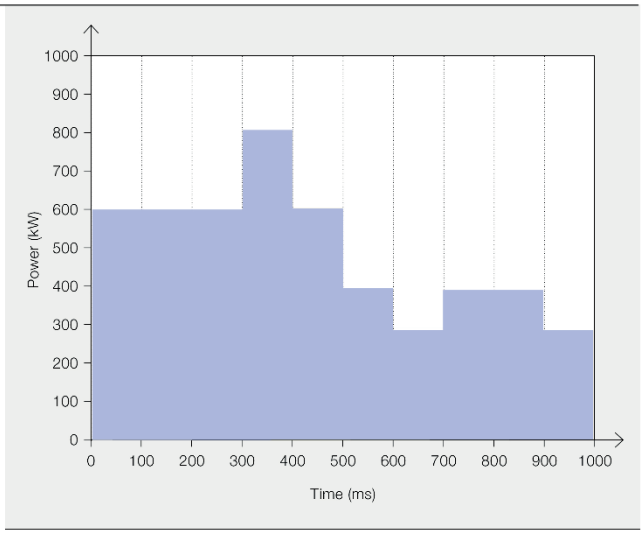
Energy consumption (relative to the sum of the power of all heaters) of an installation with 14 consumers without (left half of graph (5a)) and with (right half (5b)) power optimization (5)

When the DCT880 power optimization takes charge, the peak power curve volatility disappears and the curve becomes much smoother, never exceeding 50 percent of the installed capacity. How can this be achieved?

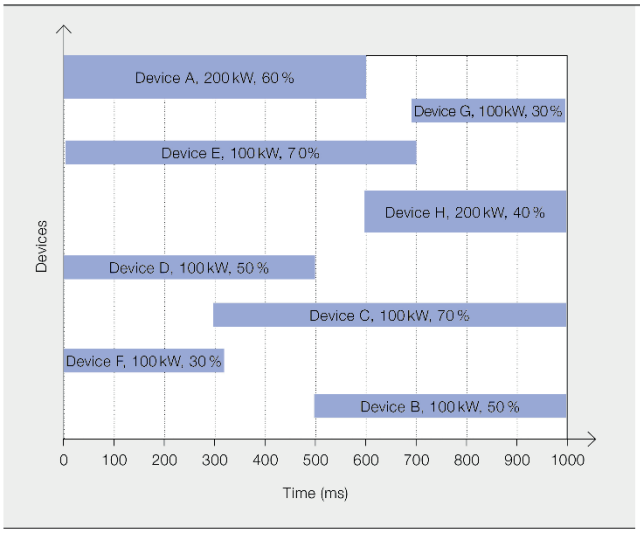
The principle is illustrated in figure 5. In figure 5a eight heat consumers are shown that have 100 kW and 200 kW operating powers and a utilization between 30 percent and 70 percent over the 1 s cycle time. Figure 5b shows that the accumulated power consumption is uneven, with a peak after 300 ms.



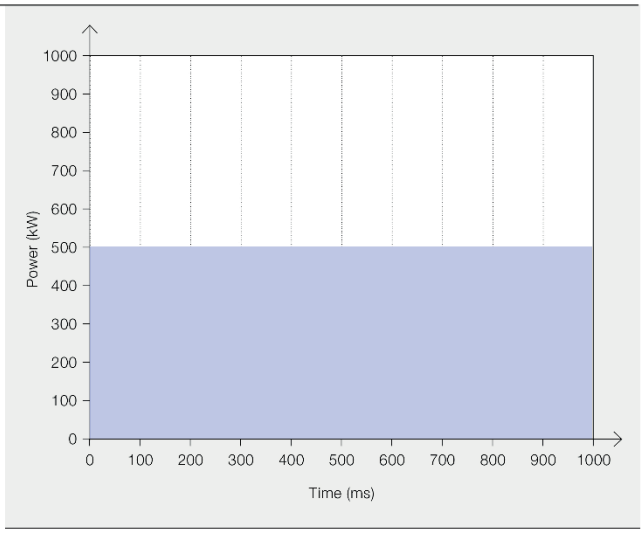
Eight consumers spread over a 1 s cycle (6a)



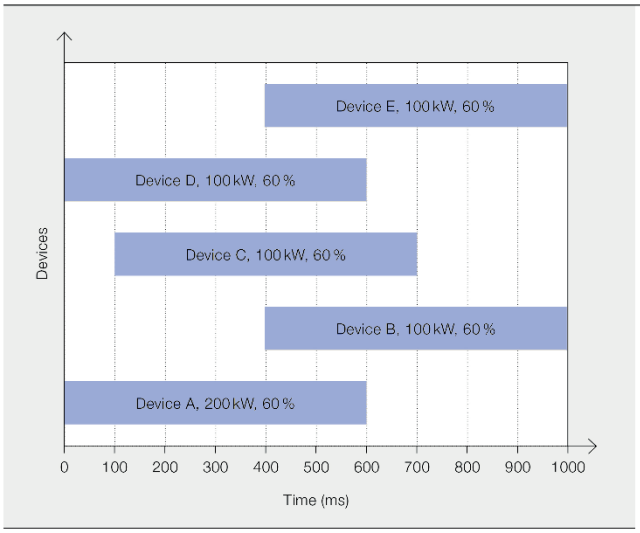
After 300 ms, power consumption peaks (6b)



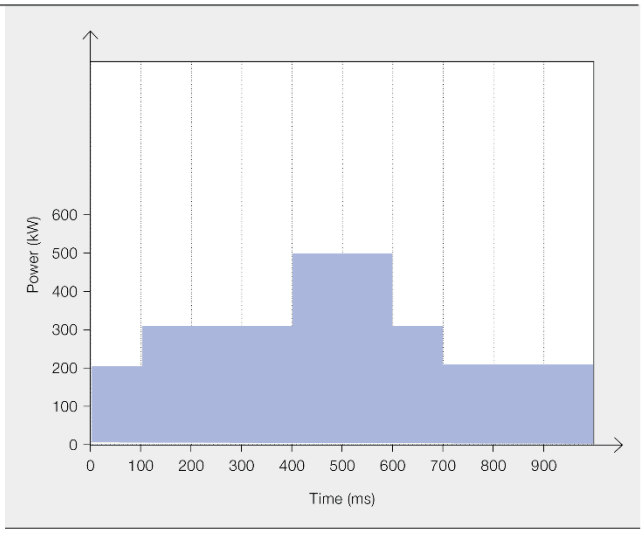
Consumers are distributed across the cycle (7a)



The optimal distribution of the consumers means that no power peaks are present (7b)



Loads may occupy a large portion of the cycle (8a)

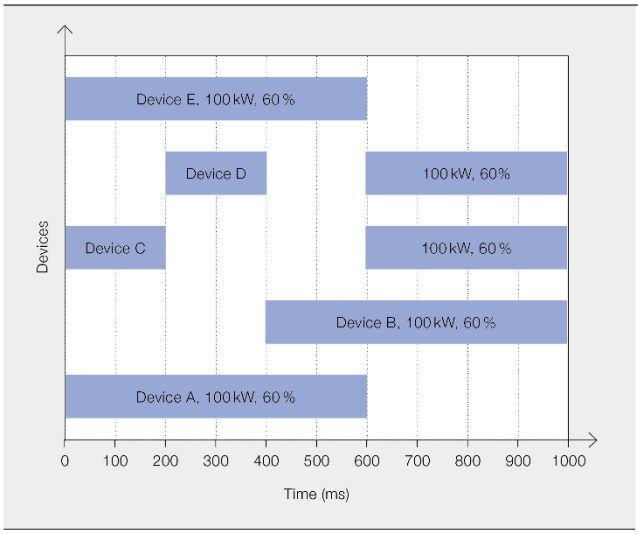


A peak somewhere is inevitable in mid-load situations without splitting (8b)

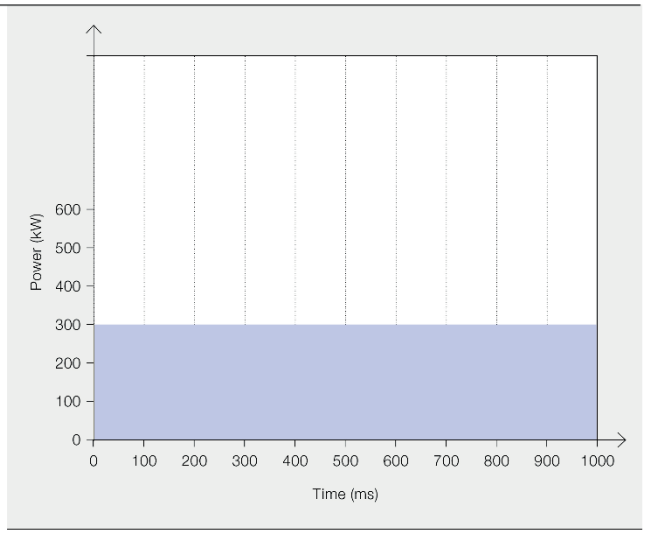
Introduction

Figure 6 shows the same situation, but with a mathematically optimal solution. The periods in which the consumers are switched on are perfectly distributed across the cycle (**6a)**. No peak exists in the overall demand (**6b)**.

A special feature of DCT880 power optimization is its handling of mid-load situations. In figure **7a** all devices are working at 60 percent utilization of the cycle time so no matter which consumer switching strategy is chosen, there will be a peak somewhere (**7b)**. The problem can be overcome by splitting – i.e., switching a consumer on and off twice during the cycle (**8)**. Splitting is the only way to achieve this perfect solution.



During the cycle some consumers can be switched on and off twice (9a)



Splitting is the only way to reach a perfect solution (8b)

Benefits of the ABB solution

The DCT880 optimization solution reduces the customer's process energy costs. It also helps to enforce grid stability and power quality. It is easy to use as it dispenses with hard-to-understand tuning parameters, which means commissioning and maintenance can be done without the aid of specialists.

A further significant advantage of the solution is its architecture: The optimization is performed completely separate from the rest of the setup – i.e., all units report their set points to the master unit and receive optimized commands in return. Hence, the optimization can be integrated into any setting - it does not matter if there is a supervisory control PLC or if each DCT880 is controlled locally by a separate controller.

Further, the production process is not affected by the optimization routine so there is no need to adapt operational planning.

The feature redundant master allows to keep the optimization working in the case of switching off or loss of the power optimizer master or its communication. This leads to a better availability of the whole system and to a better usability as it is possible to switch off some of the units without reconfiguring devices.

General Information

Power Optimization

Release:	1.7.1.0 / 3ADT403319R01
DCT880 software version >=	2.01.1.0
Related documents:	Power Optimization DCT880 3ADT061065 Rev. G
Ordering information:	by pluscode: +S552 by separate memory unit: 3ADT786242R0201

Power optimization is needed for each power controller

Hardware Connection

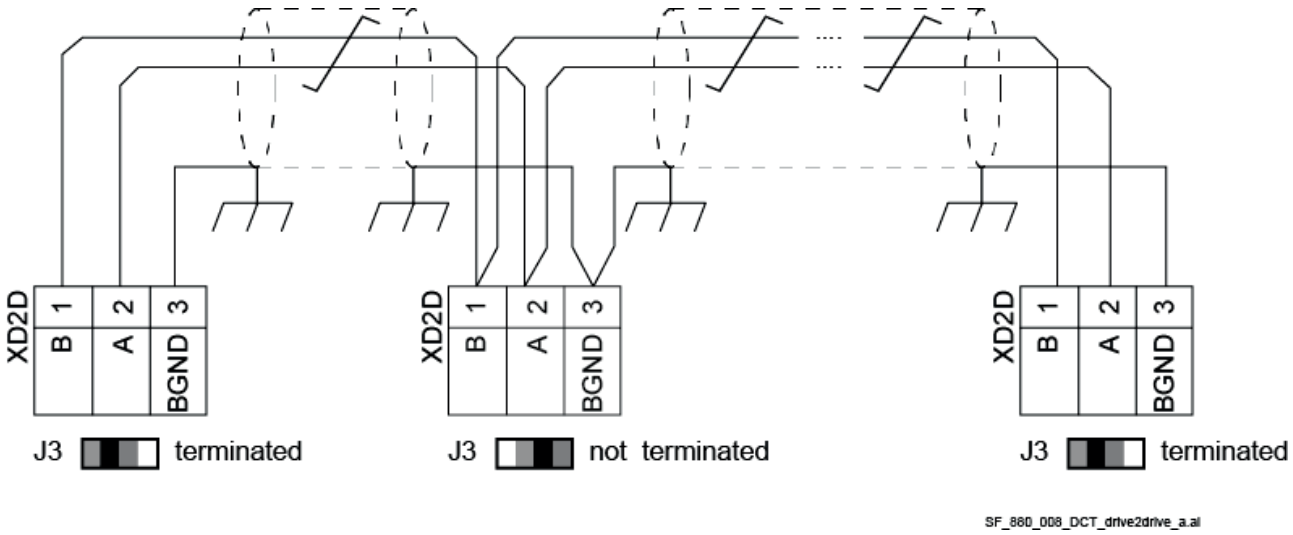
Power optimization uses on board D2D link communication for distribution of signals.

XD2D: D2D link

B	Maximum wire size 2.5 mm^2
A	Physical layer: RS-485 Termination by switch J3

The D2D link is a daisy-chained RS-485 transmission line with one master and multiple followers.
Set the termination switches J3 next to terminal block XD2D to terminated ( ) at the two physical ends of the D2D link. All intermediate switches have to be set to not terminated ( ).
Use shielded twisted-pair cable (~100 , for example, PROFIBUS compatible cable) for the wiring. For best immunity, high quality cable is recommended. Keep the cable as short as possible. The maximum complete length of the link is 50 meters. Avoid unnecessary loops and running the link near power cables.
The following diagram shows the wiring of the D2D link.

Attention: Wrong bus termination (e. g. unplugging D2D cables) can lead to various communication problems.



Timing of the Algorithm

Each node in each DCT8880 unit can be configured to have up to 3 consumers, one for each leg. If the other legs follow node 1, it has only one consumer. The Power optimizer application can optimize up to 50 consumer.
The following chapters describe the optimization cycle and the setpoint delay.

Optimization Cycle

Each node in the power optimization system is accessed via the D2D link by the master. Due to the time this communication takes, the minimum power optimization cycle is 1.0 seconds. The recommended setting is 1 second or longer.

It is possible to configure a shorter cycle time (down to 0.2 s) in parameter 66.02. In this case multiple (switching-) cycles take place within 1 optimization cycle. Nevertheless, changes in the reference values are not realized before the start of the next optimization cycle.

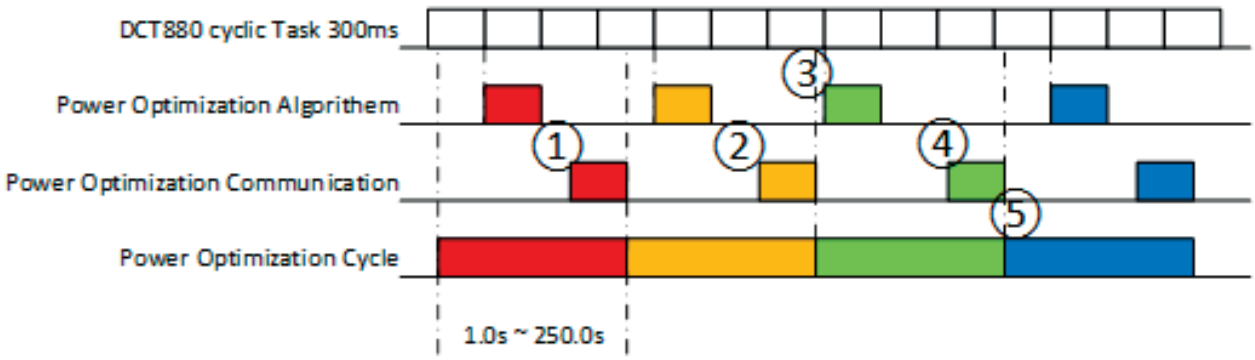
Setpoints

The maximum setpoint delay is the worst-case delay from changing the reference value until the begin of the next power optimization cycle, in which the changed references become effective.

For the power optimizer cycle time (66.02) **t ≥ 1 s** (recommended) the delay is given by the simple formula:
(2t + 0.4) s
Where t is the power optimizer cycle time (66.02) in seconds. 0.4 s is an internal communication delay.

Note: The same delay applies also to changes of the optimization process time.

The picture below allows to understand this time delay:
Worst case, a change in the reference value happens just at the start of the power optimization communication slot ①. Then the values are handed over not until the next communication slot ②. The power optimization algorithm then optimizes the load ③. The optimized firing timing is handed over to the power optimization communication slot ④. Thus, the optimized units take over the new reference value ⑤ after a time ranging from 1 cycle time + 0.4 s up to 2 cycle times + 0.4 s.



Technical details:
As noted above, some applications might prefer a faster on/off cycle time.
For 66.02 power optimizer cycle time < 1 s, it is given by:

$[2(n \cdot t)+0.4]$ s

Where t is the power optimizer cycle time (66.02) in seconds, n = number of multi-cycles).
n is the minimal value that holds $n \cdot t \geq 1$ s.

Examples:

Cycle time = 1.0 s, → n= 1:	2.4 s
Cycle time = 0.9 s, → n = 2:	4.0 s (not recommended)
Cycle time = 0.5 s, → n = 2:	2.4 s
Cycle time = 0.2 s, → n = 5:	2.4 s

Thus, only the cycle times values of 0.2 s, 0.5 s, 1 s and longer than 1 s give the minimum possible set point delay, which is desired. Other values are not recommended.

Note: The same delay applies also to changes of the optimization process time.

Redundant master

The redundant master of the power optimizer allows for an automatic take-over of the master role by any follower, in case the power optimizer master is not available / not working for any reason. This feature can also be used to maintain the power optimization routine, if only some of the optimized DCT880s are in operation, without reconfiguring the system.

All units are connected by electric cables using the D2D-link. All units which take part in this dynamic mode must be set to 66.01 = 3: PowerOptAutomatic; units with 2: PowOpt follower cannot become master.
To begin with, the units are be numbered with consecutively numbered nodes (60.02). Node numbers change automatically during the switchover. For simplicity, this is not shown in the following graph. For details on this, see the last paragraph of this chapter.

The redundant master feature is depicted in the following scheme and works as follows:

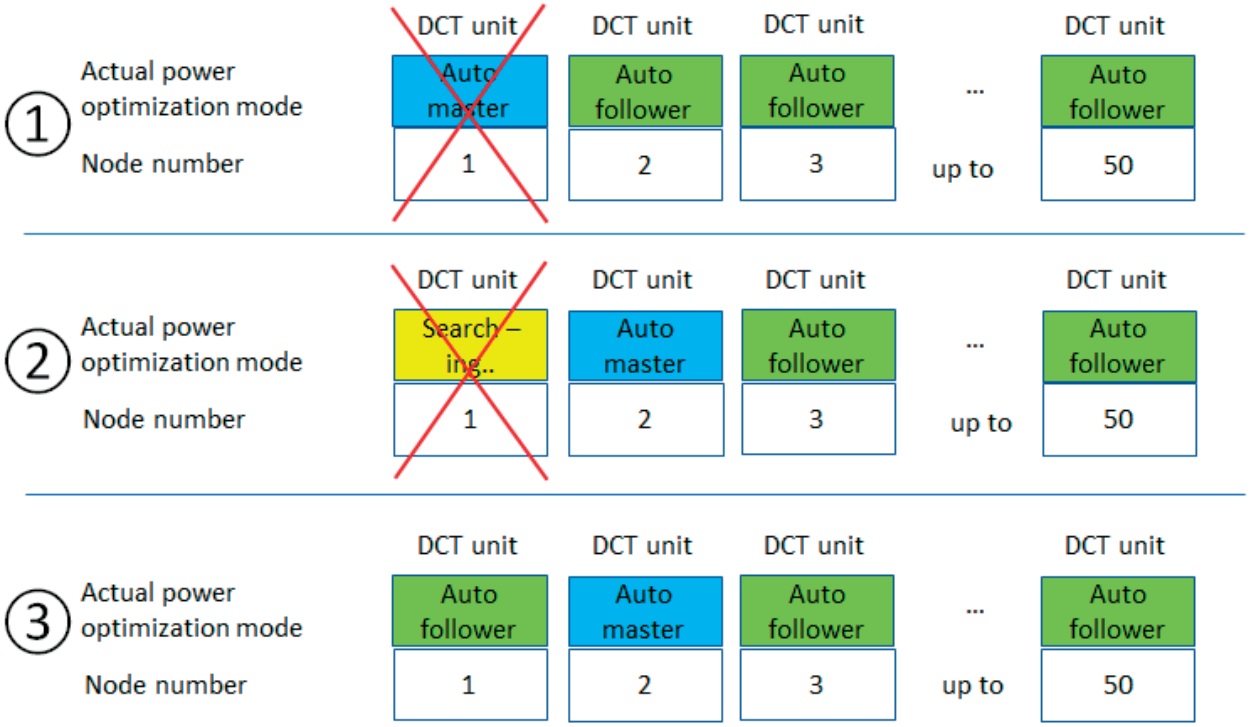


Figure 1: Redundant Master

① Node number 1 starts as master (if it is available). The current role a unit takes, can be seen in 65.51 Actual power optimization mode. In normal operation, there is one unit with status 1: Auto master and all others with 2: Auto follower, or 5: Fix follower for the units that are set not to become master (66.01 = 2).

The master might be not available, because of

a) loss of the D2D-link connection: If for at least two optimization cycles, the only node that answers is the master node (i.e. the unit itself; node 1 in the given example).
b) loss of the 24 V supply
c) loss of the grid synchronization (enable signal = 0 or open mains contactor): Fault 3853 PowOpt sync loss

②Units with no connection lose the master function and show the status 3: Searching… Then the unit with the lowest node number among the remaining units that is active takes over the master role.

The time to take for a specific unit is given by :
2.0 s + 1.75 s * (node number – 1)
Example:
The time to take over is 3.75 s s in case the next unit takes over,
5.75 s for the third unit taking over and 86 s for the last (unit 49) taking over.

③ Once a connection is re-established, a unit with status Searching.. can resume working as a follower (65:51 = auto follower). If the active master is not available according to a), b) and c) as described above, it would return to be the master again (not shown).

If the DDCS communication (or cable) should be broken, after the split a second power optimizer group can become active This only happens if each of these groups has at least two participants. The two power optimizer groups work independently, until the connection is re-established. This can lead to the situation, that two masters with node number 1 are active. Then the unit which had the lower node number to start with becomes the master of all connected units again.

Technical Notes:

As mentioned above, the application automatically changes parameters, in case a master switchover happens:

- Master unit:
  A master unit which lost the DDCS communication, the enable state, the 24 V supply or the synchronization to the grid ceases to be master at once. It switches from 60.03 M/F mode = 3: ApplPrg-Master to 4: ApplPrg-Follower. It switches 60.02 node number to 61, if it was 1 before.
- Follower unit:
  A follower unit which takes over the master role switches over after the node depending time (see above). It switches from 60.03 M/F mode 4: ApplPrg-Follower to 3: ApplPrg-Master, sets its node number to 66.02 = 1 and saves its initial node number internally.

Upon releasing these functions, the values 60.02 and 60.03 are set to their initial values respectively.

All these changes happen automatically. For addressing these units for diagnosis purposes (Group 67), nothing changes.

Detailed information on the mentioned parameters can be found in the chapter parameters. The redundant master feature with its corresponding parameters are available only with controller firmware version 2.01.1.0 or later and application version 1.07.1.0 or higher.

Getting started

This chapters describes a setup recipe to get a power optimization system running. Note that you might need further parameters or that some parameters might not by optimal for your specific application.
General parameters that have to be set for a single DCT880 are not included and can be found in the DCT880 manual (3ADW000431)..

When you have no experience with the DCT880 Power Optimizer solution, it is recommended to start with configuring the power optimizer static mode. The reason is, that in power optimizer mode automatic some parameters might change unexpectedly during setting up and lead to confusion. Once the power optimizer static mode is configured, it can be easily changed to automatic mode.

Settings for static power optimizer roles

The following settings do not include the redundant master. Therefore, a master that is not available leads to a loss of the power optimizer function.
Start the settings beginning with the master. Followers have the same settings, except for 60.02 M/F node address and 66.01 Power optimization mode. After choosing 66.01, some of the parameters in group 66 become invisible. These don't have to be set.

Static power optimizer roles

No.	Name	Recommended Value	Description
60.01	M/F communication port	7: XD2D	Master-follower link, communication port. Selects the connection used by the master-follower link. 0: Not in use; not in use, disable communication. 7: XD2D; activates connector XD2D.
60.02	M/F node address	1 (for the Master) 2 … 50 (Follower units are numbered consecutively without gaps)	Defines the node address of the unit for master-follower link. Two units with the same node address are not allowed. Notes: - The allowable address for the master is 1. - The allowable addresses for Power optimizer followers are 2 … 50. It is useful to number the units in a way, that the units that are most likely to take over the master role, get the lowest numbers to reduce changeover times. **Note:** Power optimization mode automatic: A master unit which lost DDCS communication, 24 V supply, enable state or synchronization to the grid switches its node number to 61, if it started with node number 1. A Follower unit which takes over the master role sets its node number to 1. With reversing the roles, these values are restored to their initial values. **Attention:** When setting up multiple units, this can lead to the situation, where more than one unit has the node address 61. This leads to communication problems. In this case, manually set this parameter in all units to the correct node number again. A reboot might be required.

No.	Name	Recommended Value	Description
60.03	M/F mode	**	Master-follower mode (master and followers). Automatically set by the application. **Note:** For firmware versions older than 2.01.1.0 and application versions older than 1.07.1.0 the correct settings were 1: FDCO-XD2-Master and 1: FDCO-XD2-Follower.
60.05	M/F HW connection	1: Star	Master-follower link, hardware connection. Selects the topology of the master-follower link. 1: Star; the units are connected in a star topology (e.g. through a branching unit) or via device-to-device link. Forwarding of messages is disabled. To be set when using connector XD2D.
60.08	M/F comm loss timeout	**	Master-follower link, communication loss timeout. Irrelevant due to the application automatically setting 60.09 to 0: NoAction (followers). **Note:** For firmware versions older than 2.01.1.0 and application versions older than 1.07.1.0 the correct setting was value of 66.02 cycle time in ms
60.09	M/F comm loss function	**	Master-follower communication loss action (master and followers). Automatically set to 0: NoAction (followers) by the application. Losses of followers in the power optimizer are handled via 66.06 and 66.07. **Note:** For firmware versions older than 2.01.1.0 and application versions older than 1.07.1.0 the correct setting was 0: NoAction (followers)
60.14	M/F follower selection	0: Broadcast	Master-follower link, follower supervision selection (master only). Defines the supervised followers. Reaction see 60.17 Follower fault action. **Note:** Wrong setting of 60.14 M/F follower selection causes either warning 1223 Master-follower link communication or fault 5228 Master-follower link communication depending on 60.09 M/F comm loss function. 0: Broadcast; supervision is disabled. Supervision is not used with power optimizer
66.01	Power optimization mode	1: PowerOpt master (for node 1) 2: PowerOpt follower (other nodes)	See chapter Group 66.
66.02	Cycle time	0.2 … 250	See chapter Group 66; application specific
66.04	Last node	(number of drives)	See chapter Group 66; number of units in power optimizer
66.06	PowerOpt comm timeout	2	See chapter Group 66.

No.	Name	Recommended Value	Description
66.07	PowOpt comm timeout function	3: Warning / Stand alone	See chapter Group 66. In the Stand alone mode the parameters in group 99 are used. Note that the cycle times in this group are in periods. Use the grid frequency to calculate the cycle time with the value of parameter 66.02.
66.08	Node configuration	Bit 1: 1 allow split for leg 1	See chapter Group 66 This list assumes that all legs are controlled together. If the legs are optimized independently, choose Bit 0, Bit 1, Bit 2 and Bit 3.
66.10	Leg1 power	(connected power)	See chapter Group 66.
66.12	Leg1 MinSplit	10	See chapter Group 66.
66.13	Leg1 in optimization mode	1: Active	See chapter Group 66.
99.10	Leg 1 Control Mode	2: Full wave fix cycle	2: Full wave fix cycle; full wave (burst) with fix cycle control. The load power depends on 22.11 Leg 1 Actual Ref and 99.11 Leg 1 Cycle Time. Power optimizer application works only with this setting.
99.25	Leg 2 Control Mode	13: follow leg 1	This list assumes that all legs are controlled together. If the legs are optimized independently, the other legs have to be specified similar to Leg1 using group 99 and parameters 66.20 to 66.34.
99.40	Leg 3 control mode	13: follow leg 1.	

** Parameters are set automatically by the power optimizer.

Settings for power optimization mode automatic

The following table is for the redundant master feature. Therefore, the power optimizer function is maintained, even if the initial master is deactivated or not available. The initial followers work as backup masters.

When a DCT880 unit changes its role (65.51 Actual power optimization mode), the parameters in drive composer are reloaded because some of them change visibility or get (de)activated. When using one or more panels to do the commissioning, it is recommended to attach parameter 65.51 Actual power optimization mode to the start screen for a better understanding and easier commissioning.

Note: When you change the mode from static to automatic, you will notice that some parameters from the table before mentioned are missing. These are set automatically by the application and do not need to be changed.

No.	Name	Recommended Value	Description
60.01	M/F communication port	7: XD2D	Master-follower link, communication port. Selects the connection used by the master-follower link. 0: Not in use; not in use, disable communication. 7: XD2D; activates connector XD2D.
60.02	M/F node address	1 (for initial Master) Other units numbered consecutively without gaps	Defines the node address of the unit for master-follower link. Two units with the same node address are not allowed. Notes: - The allowable address for the master is 1. - The allowable addresses for Power optimizer followers are 2 … 50. It is useful to number the units in a way, that the units that are most likely to take over the master role, get the lowest numbers to reduce changeover times. **Note:** Power optimization mode automatic: A master unit which lost DDCS communication, 24 V supply, enable state or synchronization to the grid switches its node number to 61, if it started with node number 1. A Follower unit which takes over the master role sets its node number to 1. With reversing the roles, these values are restored to their initial values. **Attention:** When setting up multiple units, this can lead to the situation, where more than one unit has the node address 61. This leads to communication problems. In this case, manually set this parameter in all units to the correct node number again. A reboot might be required.
60.03	M/F mode	**	Master-follower mode (master and followers). Automatically set by the application. **Note:** For firmware versions older than 2.01.1.0 and application versions older than 1.07.1.0 the correct settings were 1: FDCO-XD2-Master and 1: FDCO-XD2-Follower.

No.	Name	Recommended Value	Description
60.05	M/F HW connection	1: Star	Master-follower link, hardware connection. Selects the topology of the master-follower link. 1: Star; the units are connected in a star topology (e.g. through a branching unit) or via device-to-device link. Forwarding of messages is disabled. To be set when using connector XD2D.
60.08	M/F comm loss timeout	**	Master-follower link, communication loss timeout. Irrelevant due to the application automatically setting 60.09 to 0: NoAction (followers). **Note:** For firmware versions older than 2.01.1.0 and application versions older than 1.07.1.0 the correct settings was value of 66.02 cycle time in ms
60.09	M/F comm loss function	**	Master-follower communication loss action (master and followers). Automatically set to 0: NoAction (followers) by the application. Losses of followers in the power optimizer are handled via 66.06 and 66.07. **Note:** For firmware versions older than 2.01.1.0 and application versions older than 1.07.1.0 the correct setting was 0: NoAction (followers)
60.14	M/F follower selection	0: Broadcast	Master-follower link, follower supervision selection (master only). Defines the supervised followers. Reaction see 60.17 Follower fault action. **Note:** Wrong setting of 60.14 M/F follower selection causes either warning 1223 Master-follower link communication or fault 5228 Master-follower link communication depending on 60.09 M/F comm loss function. 0: Broadcast; supervision is disabled. Supervision is not used with power optimizer
66.01	Power optimization mode	3: PowerOpt automatic (2: PowerOpt follower.)	See chapter 10.2. (normally for all units) Specific units can be excluded to become the master by choosing: 2: PowOpt follower.
66.02	Cycle time	1… 250	See chapter 10.2.; application specific
66.04	Last node	(number of drives)	See chapter 10.2. number of units in power optimizer
66.06	PowerOpt comm timeout	2	See chapter 10.2.
66.07	PowOpt comm timeout function	3: Warning / Stand alone	See chapter 10.2. In the Stand alone mode the parameters in group 99 are used. Note that the cycle times in this group are in periods. Use the grid frequency to calculate the cycle time with the value of parameter 66.02.

No.	Name	Recommended Value	Description
66.08	Node configuration	Bit 1: 1 allow split for leg 1	A This list assumes that all legs are controlled together. If the legs are optimized independently, choose Bit 0, Bit 1, Bit 2 and Bit 3.
66.10	Leg1 power	(connected power)	See chapter 10.2.
66.12	Leg1 MinSplit	10	See chapter 10.2.
66.13	Leg1 in optimization mode	1: Active	See chapter 10.2.
99.10	Leg 1 Control Mode	2: Full wave fix cycle	2: Full wave fix cycle; full wave (burst) with fix cycle control. The load power depends on 22.11 Leg 1 Actual Ref and 99.11 Leg 1 Cycle Time. Power optimizer application works only with this setting.
99.25	Leg 2 Control Mode	13: follow leg 1	This list assumes that all legs are controlled together. If the legs are optimized independently, the other legs have to be specified similar to Leg1 using group 99 and parameters 66.20 to 66.34.
99.40	Leg 3 control mode	13: follow leg 1.	

** Parameters are set automatically by the power optimizer.

Parameters

For the power optimizer the additional parameters groups 65 to 67 have been implemented. For all other groups, please refer to chapter Getting started and the DCT880 manual (3ADW000431).

Depending on the setting of parameter 66.01 Power optimization mode, not all parameters in these groups are visible at all times, (see the corresponding groups for details).

Independent of the visibility, some parameters are only effective in a certain role (see signal 66.51 Actual power optimization mode). This is described in the first line of the parameters in question.

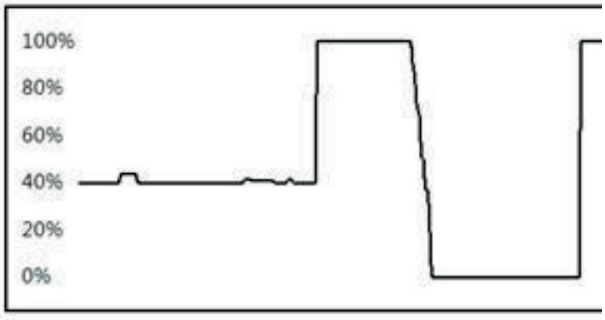
Group 65: Power Optimization Signals

Group 65 shows control signals received from the power optimizer.
Some signals are visible depending of the setting of 66.01 Power optimization mode.
Visibility is described in the last line of each parameter in question.

Index	**Name**						
	Text						
	Range	**Default**	**Unit**	**Scale / Fbeq16**	**Volatile**	**Change - running**	**Type**
65.01	Mains sync tick						
	This signal shows the free running half wave counter as updated by the unit's firing unit. This update is enabled by the drive state enable (06.08.b00).						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.02	Burst sync counter						
	This signal shows the half wave counter within 1 optimization cycle.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.03	Mains sync start						
	This signal shows the command from the power optimization function to the unit's firing unit: Bit 0: TRUE: Power optimization control active Bit 1: TRUE: Start command for leg 1 Bit 2: TRUE: Start command for leg 2 Bit 3: TRUE: Start command for leg 3 Bit 4: TRUE: Power optimization cycle active (validates Bit 5; Bit 0 isn't checked by firmware for average power calculation due to backward compatibility reasons) Bit 5: Power optimization cycle toggle for average power calculation						
	0000h … ffffh	0000h		1 = 1	y	y	Signal
65.04	Cycle length						
	This signal shows the used power optimization cycle length in half waves. The master distributes this signal to all followers. Parameters 99.11 / 99.26 / 99.41 are not active during power optimization.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.05	Sync error counter						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	This signal is effective in the followers only. This signal shows the number of power optimization cycles without valid burst synchronization message reception (limited to 10000). As long as no message has been received after a power-up, the sync error counter is held at value -1.						
	-32768 … 32768	0		1 = 1	y	y	Signal
65.06	Data status						
	This signal is the data status used for flow control. 0: Cycle started (PowOptAlgorithm program started) 1: Solution ready (Switching points were generated) 2: Communication started (Master only) If 65.06 was 1 before and communications slot is reached 3: Communication 1 ready (Master only). After communication round 1) 4: Communication 2 ready (Master only. After communication round 2) Visible in master / automatic units only.						
	0 … 4	0		1 = 1	y	y	Signal
65.07	Last faulted node						
	This signal shows the last (highest) node number in the system without valid response message. Visible in master / automatic units only.						
	0 … 50	0		1 = 1	y	y	Signal
65.08	PowOpt status						
	This signal shows status information used by the unit's system software: Bit 0: TRUE: Ping: unit has been selected via the link diagnosis value (see 67.20) in the master. Warning 2851 PowOpt Ping is active. Bit 1: TRUE: Leg1 Active (see 66.13 Leg1 in optimization mode) Bit 2: TRUE: Leg2 Active (see 66.23 Leg2 in optimization mode) Bit 3: TRUE: Leg3 Active (see 66.33 Leg3 in optimization mode) Bit 4: TRUE: Fault 3850 Burst sync. timeout is active (follower only)* Bit 5: TRUE: Warning 2850 Burst sync. timeout is active (follower only)* Bit 6: TRUE: Warning 2852 At least one of the configured nodes (see 66.04 Last node) is missing (didn't respond to its messages) (master only)) Bit 8: TRUE: Fault 3853 Sync loss fault is active (master only)** Bit 9: TRUE: Warning 2853 Sync loss warning is active (master only)** Bit 12:TRUE: Parameter table has changed (e.g. for Drive Composer) Bit 14: TRUE: Unit is master Bit 15: TRUE: Burst sync. timeout (regardless of parameter 66.07) (follower only) *) Burst sync timeout is the timeout of the synchronization via the D2D communication. **) Sync-info is taken from 06.14.b02 Leg 1 Status Word						
	0000h … ffffh	0000h		1 = 1	y	y	Signal
65.09	Active off delay						
	This signal shows the number of half waves needed by firing unit to switch off a certain unit (common for all legs). It depends on the unit's power configuration.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.10	Leg1 Start 1						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	This signal shows the switching-on point (in half waves within the optimization cycle) of leg 1's split 1. If there are no independent legs (only 1 consumer in the unit), only the leg1 parameters apply.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.11	Leg1 On length 1						
	This signal shows the leg 1's split 1 on length in half waves. If there are no independent legs (only 1 consumer in the unit), only the leg1 parameters apply.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.12	Leg1 Start 2						
	This signal shows the switching-on point (in half waves within the optimization cycle) of leg 1's split 2 (if used). If there are no independent legs (only 1 consumer in the unit), only the leg1 parameters apply.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.13	Leg1 On length 2						
	This signal shows the leg 1's split 2 on length in half waves. If there are no independent legs (only 1 consumer in the unit), only the leg1 parameters apply.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.20	Leg2 Start 1						
	This signal shows the switching-on point (in half waves within the optimization cycle) of leg 2's split 1. **Note:** This parameter is only valid for independently controlled legs.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.21	Leg2 On length 1						
	This signal shows the leg 2's split 1 on length in half waves **Note:** This parameter is only valid for independently controlled legs.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.22	Leg2 Start 2						
	This signal shows the switching-on point (in half waves within the optimization cycle) of leg 2's split 2 (if used). **Note:** This parameter is only valid for independently controlled legs.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.23	Leg2 On length 2						
	This signal shows the leg 2's split 2 on length in half waves. **Note:** This parameter is only valid for independently controlled legs						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.30	Leg3 Start 1						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	This signal shows the switching-on point (in half waves within the optimization cycle) of leg 3's split 1. **Note:** This parameter is only valid for independently controlled legs						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.31	Leg3 On length 1						
	This signal shows the leg 3's split 1 on length in half waves **Note:** This parameter is only valid for independently controlled legs.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.32	Leg3 Start 2						
	This signal shows the switching-on point (in half waves within the optimization cycle) of leg 3's split 2 (if used). **Note:** This parameter is only valid for independently controlled legs.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.33	Leg3 On length 2						
	This signal shows the leg 3's split 2 on length in half waves. **Note:** This parameter is only valid for independently controlled legs.						
	0 … 65535		Half wave	1 = 1	y	y	Signal
65.40	Total power						
	This signal shows the total (available) power of the optimization system in kW. Only consumers in active status are counted, consumers in inactive or missing status are not counted (0). Units in Fault states are still counted, unless the mains contactor of these units is open. **Note:** ① Visible in master / automatic units only.						
	0 … 325000		kW	1 = 1	y	y	Signal
65.41	Actual power						
	This signal shows the actual power of the system in kW. It is calculated by the simulation level in the master every 10 ms. **Note:** ① Visible master / automatic units only.						
	0 … 325000		kW	1 = 1	y	y	Signal
65.42	Actual power percent						
	This signal is the actual power in percent of signal 66.05 Maximum power.  **Note:** ① Visible in master / automatic units only						
	0 … 325		%	1 = 1	y	y	Signal
65.43	Average power						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	This signal is the average actual power of the entire system during the previous cycle. **Note:** ① Visible in master / automatic units only.						
	0 … 325000		kW	1 = 1	y	y	Signal
65.50	Node of the master						
	Actual node number of the master **Note:** ① An active master always shows 60.02 M/F node address = 1. This node number is the one before starting the process, keep in mind, that thepower optimization mode automatic (66.01 = 3) leads to dynamic changes of 66.02.						
	0 … 60			1 = 1	y	y	Signal
65.51	Actual power optimization mode						
	0: Not in use 66.01 = 0 1: Auto master 66.01 = 3 2: Auto follower 66.03 = 3 3: Searching.. 66.03 = 3, no master found 4: Fix master 66.03 = 1 5: Fix follower 66.03 = 2 6: No master 66.03 = 2, no master found **Note:** ①						
	0 … 6			1 = 1	y	y	Signal

① Signals are available only with controller firmware version 1.6.0.0 and higher and application version 1.4.1.0 and higher.

Group 66: Power Optimization Settings

Group 66 is used to configure the power optimizer units.

Some parameters are visible in master / automatic units only (if 66.01 Power optimization mode = 1 or 3). Others are visible only if a unit is a follower / automatic unit (if 66.01 Power optimization mode = 2 or 3).
Visibility is described in the last line of each parameter in question.

Index	**Name**						
	Text						
	Range	**Default**	**Unit**	**Scale / Fbeq16**	**Volatile**	**Change - running**	**Type**
66.01	Power optimization mode						
	Defines the operation mode for each unit 0: Not in use: (hides all other power optimizer parameters) 1: PowerOpt master; unit acts as a (static) master for power optimization. Only one master unit is allowed. May only be selected for the unit with node number 1. 2: PowerOpt follower: unit acts as (static) follower for power optimization. May not be selected for a unit with node number 1. 3: PowOpt automatic: All nodes are followers by default. Depending on the time elapsed without receiving any heartbeat message and its node number, the lowest available follower node becomes master. **Note:** If the automatic master function is used, this setting must be used in at least 2 units of the system! Units configured as static followers will not be able to take the master role.						
	0 … 3	Not in use		1 = 1	n	y	Parameter
66.02	Cycle time						
	This parameter is effective in the actual master only. It defines the power optimization cycle time; it is distributed to the follower units via D2D link. The minimum optimization cycle time t is 1 s. Recommended values for these parameters are 1 s and longer. For these values of the cycle time, the maximum set point delay is (2t + 0.4) s **Note 1:** It is possible to choose values shorter than 1 second. This allows for a faster on/off switching pattern but does not allow for faster control. However, only the values 0.2 s, 0,5 s also result in the minimum worst-case set point delay of 2.4 seconds due to internal rounding. Other values are not recommended. For details, see chapter Setpoints. **Note 2:** The cycle time is internal rounded-up to complete mains periods. **Note 3:** Active power optimization takes priority over settings in 99.11 / 99.26 and 99.41. Visible in master / automatic units only.						
	0.2 … 250.00	10.00	s	1 = 0.01	n	y	Parameter
66.03	Mains frequency						
	This parameter is effective in the actual master only. It selects the nominal mains frequency (either 50Hz (default) or 60Hz). It is used to calculate half wave count of 1 optimization cycle. Visible in master / automatic units only.						
	50 Hz / 60 Hz	50	Hz	1 = 1	n	y	Parameter
66.04	Last Node						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	This parameter is effective in the actual master only. It defines the last (highest) node number in the system. A system can have up to 50 consumers. A node has 2 or 3 consumers, if its legs are controlled independently by the power optimizer. The node number is set with parameter 60.02 MF Node address locally in all units). It also defines the number of nodes in the system. If at least one node between 1 and 66.04 last node has been inactive, i.e. consumer mode = 1: inactive, warning 2852 PowerOpt Missing is set in the master. If all followers (except node 1) are missing, the master assumes the D2D communication to be broken. The masters power part then ceases to be master and works as specified in 66.07. **Note:** due to the restriction of DDCS communication, the (static) master must mandatory be set to node number 1. Visible in master / automatic units only.						
	1 … 50	1		1 = 1	n	y	Parameter
66.05	Maximum power						
	This parameter is effective in the actual master only. It defines the maximum power (in kW) of the power optimization system. If this power is exceeded load shedding will be performed. Visible in master / automatic units only.						
	0 … 325000	325000	kW	1 = 10	n	y	Parameter
66.06	PowOpt comm timeout						
	This parameter is effective in the followers only. If there were more than the programmed optimization cycles without valid burst synchronization message reception (see signal 65.05), the system status word is requested via signal 65.08.b04 or 65.08.b05 to set an event according to parameter 66.07. 0: inactive 1 … 100 optimization cycles Visible in follower / automatic units only.						
	0 … 100	0	Cycles	1 = 1	n	y	Parameter
66.07	PowOpt comm timeout function						
	This parameter is effective in the followers only. If a burst synchronization timeout has been detected, an event is set according to the programmed function: 0: No action 1: Fault 3850 PowOpt comm timeout 2: Warning/Last reference (default) Warning 2850 PowOpt comm timeout This leads to the unit not reacting to reference values, until power optimizer function is restored, or unit is rebooted. 3: Warning / Stand alone (resets Bit 0 of 65.3) Warning 2850 PowOpt comm timeout Power optimizer acts as an independent unit. The parameters 99.10 to 99.47 are used. If the unit is in the stand-alone state and 3 independent legs are configured, it works as a power optimizer for these legs, until a connection is re-established. This works also with two independent legs for a W02 unit (set 66.33 = inactive). **Note:** as long as no synchronization message has been received at all, the setting 1 (Fault) results in an alarm according to setting 2 (Warning/Last reference). Visible in follower / automatic units only.						

<table>
<tr><td>Index</td><td colspan="7">Name</td></tr>
<tr><td rowspan="3"></td><td colspan="7">Text</td></tr>
<tr><td>Range</td><td>Default</td><td>Unit</td><td>Scale / Fbeq16</td><td>Volatile</td><td>Change - running</td><td>Type</td></tr>
<tr><td>0 … 3</td><td>Warning</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.08</td><td colspan="7">Node configuration</td></tr>
<tr><td rowspan="2"></td><td colspan="7">This parameter defines basic configurations of the node:
Bit 0: TRUE: node consists of 3 independent legs (3 consumers); or 2 legs (2 consumers for a W02 unit).
Bit 1: TRUE: allow split for leg 1
Bit 2: TRUE: allow split for leg 2
Bit 3: TRUE: allow split for leg 3
Bit 4: TRUE: increment OffDelay This additional delay could be used to compensate a delay in the firing unit.</td></tr>
<tr><td>0000h … ffffh</td><td>0000h</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.09</td><td colspan="7">Off delay</td></tr>
<tr><td rowspan="2"></td><td colspan="7">This parameter defines the number of half waves required by the unit (common for all legs) to switch off. This depends mainly on power configuration of the unit.
With setting -1 (automatic) the required value is taken from signal 65.09
provided by the unit’s firmware.</td></tr>
<tr><td>-1 … 5</td><td>-1</td><td>Half wave</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.10</td><td colspan="7">Leg1 power</td></tr>
<tr><td rowspan="2"></td><td colspan="7">This parameter defines the power of leg1. If there are no independent legs (only 1 consumer in the unit), only the leg1 parameters apply. 0: consumer is switched off
1 … 32500 kW</td></tr>
<tr><td>0 … 32500</td><td>0</td><td>kW</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.11</td><td colspan="7">Leg1 load shedding priority</td></tr>
<tr><td rowspan="2"></td><td colspan="7">This parameter defines the priority for load shedding, in case the maximum power 66.05 is exceeded. It is used by the power optimization algorithm. The higher the load shedding priority is set the later the consumer is switched off in case of lacking power capacity.</td></tr>
<tr><td>0 … 100</td><td>0</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.12</td><td colspan="7">Leg1 MinSplit</td></tr>
<tr><td rowspan="2"></td><td colspan="7">This parameter defines the minimum half wave number of a single split.</td></tr>
<tr><td>0 … 10000</td><td>0</td><td>Half wave</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.13</td><td colspan="7">Leg1 in optimization</td></tr>
<tr><td rowspan="2"></td><td colspan="7">This parameter is a bit pointer parameter to select the source of the active burst mode status. Only if this mode is active, a certain consumer participates on the power optimization.
Inactive: not part of power optimization
Active: part of power optimization
Automatic: Burst operation 06.14.b09 (high active)
2nd Mode switching 06.14.b09
other: use other parameter to control this parameter
Phase Angle | Burst
| ON
Phase Angle | Burst
| ON</td></tr>
<tr><td></td><td>Automatic</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.14</td><td colspan="7">Leg1 Actual ref.</td></tr>
<tr><td></td><td colspan="7">Actual Reference, copy of 22.11</td></tr>
</table>

<table>
<tr><td>Index</td><td colspan="7">Name</td></tr>
<tr><td></td><td colspan="7">Text</td></tr>
<tr><td></td><td>Range</td><td>Default</td><td>Unit</td><td>Scale / Fbeq16</td><td>Volatile</td><td>Change - running</td><td>Type</td></tr>
<tr><td></td><td>0 … 325.00</td><td></td><td>%</td><td>1 = 0.01</td><td>n</td><td>y</td><td>Signal</td></tr>
<tr><td>66.20</td><td>Leg2 power</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="7">See description of 66.10</td></tr>
<tr><td></td><td>0 … 32500</td><td>0</td><td>kW</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.21</td><td colspan="7">Leg2 load shedding priority</td></tr>
<tr><td></td><td colspan="7">See description of 66.11</td></tr>
<tr><td></td><td>0 … 100</td><td>0</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.22</td><td colspan="7">Leg2 MinSplit</td></tr>
<tr><td></td><td colspan="7">See description of 66.12</td></tr>
<tr><td></td><td>0 … 10000</td><td>0</td><td>Half wave</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.23</td><td colspan="7">Leg2 in optimization</td></tr>
<tr><td></td><td colspan="7">This parameter is a bit pointer parameter to select the source of the active burst mode status. Only if this mode is active, a certain consumer participates on the power optimization.
Inactive: not part of power optimization
Active: part of power optimization
Automatic: Burst operation 06.15.b09 (high active)
2nd Mode switching 06.14.b09 | Phase Angle: Burst; : ON
other: use other parameter to control this parameter | Phase Angle: Burst</td></tr>
<tr><td></td><td></td><td>Automatic</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.24</td><td colspan="7">Leg2 Actual ref.</td></tr>
<tr><td></td><td colspan="7">Actual Reference, copy of 24.11</td></tr>
<tr><td></td><td>0 … 325.00</td><td></td><td>%</td><td>1 = 0.01</td><td>n</td><td>y</td><td>Signal</td></tr>
<tr><td>66.30</td><td colspan="7">Leg3 power</td></tr>
<tr><td></td><td colspan="7">See description of 66.10</td></tr>
<tr><td></td><td>0 … 32500</td><td>0</td><td>kW</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.31</td><td colspan="7">Leg3 load shedding priority</td></tr>
<tr><td></td><td colspan="7">See description of 66.11</td></tr>
<tr><td></td><td>0 … 100</td><td>0</td><td></td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.32</td><td colspan="7">Leg3 MinSplit</td></tr>
<tr><td></td><td colspan="7">See description of 66.12</td></tr>
<tr><td></td><td>0 … 10000</td><td>0</td><td>Half wave</td><td>1 = 1</td><td>n</td><td>y</td><td>Parameter</td></tr>
<tr><td>66.33</td><td colspan="7">Leg3 in optimization</td></tr>
</table>

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	This parameter is a bit pointer parameter to select the source of the active burst mode status. Only if this mode is active, a certain consumer participates on the power optimization. Inactive: not part of power optimization Active: part of power optimization Automatic: Burst operation 06.16.b09 (high active) 2nd Mode switching 06.14.b09: Phase Angle → Burst; ON other: use other parameter to control this parameter						
		Automatic		1 = 1	n	y	Parameter
66.34	Leg3 Actual ref.						
	Actual Reference, copy of 26.11						
	0 … 325.00		%	1 = 0.01	n	y	Signal
66.40	PowOpt sync loss function:						
	This parameter is effective in the actual master only. It specifies the reaction to a loss of the grid synchronization (for example if mains contactor is open) . 0: Fault 3853 PowOpt sync loss, block sync. Messages 1: Warning 2853 PowOpt sync loss, block sync. messages (default) **Note:** blocking the sync. messages causes PowOpt comm timeout in the followers. Their specific reaction depends on their setting of parameter 66.07 PowOpt comm timeout function. Visible in follower / automatic units only.						
	0 … 1			1 = 1	y	y	Signal

Group 67: Power Optimization Diagnosis

The diagnosis function in parameter group 67 provides information of all consumers in the power optimization system and can be used for supervision or troubleshooting.
It only shows correct values in the active master only (if 65.51 = 1 Auto master or 4: Fix master).

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
67.01	Consumer selection						
	Write value to select a certain consumer here: Leg number [1, 2 or 3] *100 + Node number The signals 67.02 to 67.10 give information about the selected consumer.						
	0 … 350	0		1 = 1	n	y	Parameter
67.02	Error counter						
	Cycles without node response from the selected consumer						
	0 … 65535	0		1 = 1	n	y	Signal
67.03	Power						
	Power (in kW) of the selected consumer						
	0 … 65535	0	kW	1 = 1			
67.04	Demand						
	Demanded On time duration (in half waves) of the selected consumer						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	0 … 65535	0	Half waves	1 = 1	n	y	Signal
67.05	Setpoint						
	Active setpoint of the selected consumer in percent						
	0 … 325	0	%	1 = 1	y	y	Signal
67.06	Power optimization consumer mode						
	consumer mode of the selected consumer: 0: Missing 1: Inactive 2: Active 3: Inactive / NoBurstOp Mode 3 is displayed if a consumer is inactive, but bit 4 (Operating) of the according leg status word (6.14 … 6.16) is TRUE (see parameters 66.13/23/33).						
	0 … 3	0		1 = 1	y	y	Signal
67.07	Start 1						
	Switching-on point of split 1 of the selected consumer (in half waves within the optimization cycle)						
	0 … 65535	0	Half waves	1 = 1	n	y	Signal
67.08	On length 1						
	Split 1 on length of the selected consumer (in half waves)						
	0 … 65535	0	Half waves	1 = 1	n	y	Signal
67.09	Start 2						
	Switching-on point of split 2 of the selected consumer (in half waves within the optimization cycle)						
	0 … 65535	0	Half waves	1 = 1	n	y	Signal
67.10	On length 2						
	Split 2 on length of the selected consumer (in half waves)						
	0 … 65535	0	Half waves	1 = 1	n	y	Signal
67.20	Link diagnosis						
	Write value to turn on. Accepted values are either the consumer’s node number, or Leg number [1, 2 or 3] *100 + Node number Ping written to all consumers. This causes Warning 2851 PowOpt Ping in the selected unit. Link diagnosis answer is returned in signal 67.21.						
	0 … 350	0		1 = 1	n	y	Signal
67.21	Link diagnosis acknowledge						
	Received Link diagnosis value that is mirrored back by the selected consumer responsible unit						
	0 … 350	0		1 = 1	n	y	Signal
67.22	Node status 1						
	Parameters 67.22 to 67.25 show the nodes that are currently connected in the DDCS communication in a bitwise manner. Shows existing nodes 1 … 16						

Index	Name						
	Text						
	Range	Default	Unit	Scale / Fbeq16	Volatile	Change - running	Type
	Note: Meant are the original node numbers as set in the parameters, not the dynamic node number (see redundant master feature). **Example:** The master unit (node 1) becomes not available. The new master (node 2) shows node 1 as missing, until the former master works again as a follower.						
	0 … 65535	0		1 = 1	y	y	Signal
67.23	Node status 2						
	See description of 67.22. Shows existing nodes 17 … 32						
	0 … 65535	0		1 = 1	y	y	Signal
67.24	Node status 3						
	See description of 67.22. Shows existing nodes 33 ... 48						
	0 … 65535	0		1 = 1	y	y	Signal
67.25	Node status 4						
	See description of 67.22. Shows existing nodes 49 … 50						
	0 … 3	0		1 = 1	y	y	Signal

Fault tracing

Numerical list of power optimizer warning and fault codes

In this chapter, the power optimizer specific warning- or fault codes on the control panel or 7-segment display are described.
General fault codes and warning codes are described in the DCT880 manual (3ADW000431).
As listed below, some warnings and fault codes are followed by auxiliary codes (see event log in the PC tool) that show detailed problem causes.

Warnings

	Warning code	**Message**	**Additional information**
Power Optimizer	0x2850	PowerOpt comm timeout	A power optimizer follower cannot find a working power optimizer master (burst synchronization timeout). Following 66.07 = 2 / 3, this warning is set in the follower. **Possible causes:** - D2D plug unplugged / cable broken - Power optimizer master is not available, with no other unit taking over.
Power Optimizer	0x2851	PowerOpt Ping	The unit has been selected via the link diagnosis value (67.20) by the master. The only purpose of this warning is for information and troubleshooting. **Cause:** Link diagnosis. Set 67.20 = 0.
Power Optimizer	0x2852	PowerOpt Missing	At least one power optimizer follower is missing. If a node between 1 and 66.04 last node has been inactive, i.e. consumer mode = 1: inactive, this warning is set in the master. If all followers (except node 1) are missing, the master assumes the D2D communication to be broken. The masters power part then works as specified in 66.07, without power optimization function. An additional warning / fault for this case can be generated using 60.08. Note power optimization mode automatic: When a follower takes over the master role, the former master (normally node 1) is shown missing. The node of the follower that takes over doesn't generate this warning as it is working (just with the dynamic node number 1). **Possible causes:** Check the auxiliary code (format 0000 00YY). "YY" specifies the node number of the first unit that is detected missing. For further information check 67.22 to 67.25 which nodes are missing.

			Diagnosis parameter 67.06 in the master can be used to verify the consumer mode status of a specific node.
Power Optimizer	0x2853	PowOpt sync loss	There is a loss of the grid synchronization. According to 66.40 = 1, this warning is set in the master. This blocks the sync. messages to the followers which causes PowOpt comm timeout in the followers. Their specific reaction depends on their setting of parameter 66.07 PowOpt comm timeout function. **Possible causes:** - mains contactor is open - grid power not available - Enable is not set: see 19.01 / 03 / 05 enable local IO) and / or 19.10 / 11 / 12

Faults

	Warning code	**Message**	**Additional information**
Power Optimizer	0x3850	PowerOpt comm timeout	A power optimizer follower cannot find a working power optimizer master (burst synchronization timeout). Following to 66.07 = 1, this fault is set in the follower. **Possible causes:** - D2D plug unplugged / cable broken - Power optimizer master is not available, with no other unit taking over.
Power Optimizer	0x3853	PowOpt sync loss	There is a loss of the grid synchronization. According to 66.40 = 0, this fault is set in the master. This blocks the sync. messages to the followers which causes PowOpt comm timeout in the followers. Their specific reaction depends on their setting of parameter 66.07 PowOpt comm timeout function. **Possible causes:** - mains contactor is open - grid power not available - Enable is not set: see 19.01 / 03 / 05 enable local IO) and / or 19.10 / 11 / 12

Trouble shooting

In the following, some specific power optimizer issues and their solution are listed.

1. Double D2D network Node number

Observation:
The device will be shown as missing at its desired D2D network node number in the master (67.22 to 67.25).
The double used D2D network node number will be shown as missing as well.
The master will issue a warning.

Tracing the issue:
By means of 67.20 link diagnostics both devices will indicate the warning at the double used node number.

Resolving the issue:
Reprogram the node to its correct node number by means of 60.02

2. D2D plug removed

Observation:
The master will indicate warning 2852 PowOpt Missing.
Affected devices will show that they are missing their master (warning 2850 / Fault 3850 PowerOpt comm timeout) and continue working as a stand-alone power controller or working with the last setpoint without reacting to a setpoint change (both depends on the setting of 66.07).

Resolving the issue:
Check the connection of the plug and the communication cable, also check setting of Jumper J3.

3. Double PowerOpt Master

Observation:
Both master devices will show node missing.
The followers will take their commands stochastic from one master or the other.

Resolving the issue:
Only one master is allowed, so one device has to be programmed as follower (using 66.01).

4. Issue: PowerOpt Master node 1 does not take over the master role

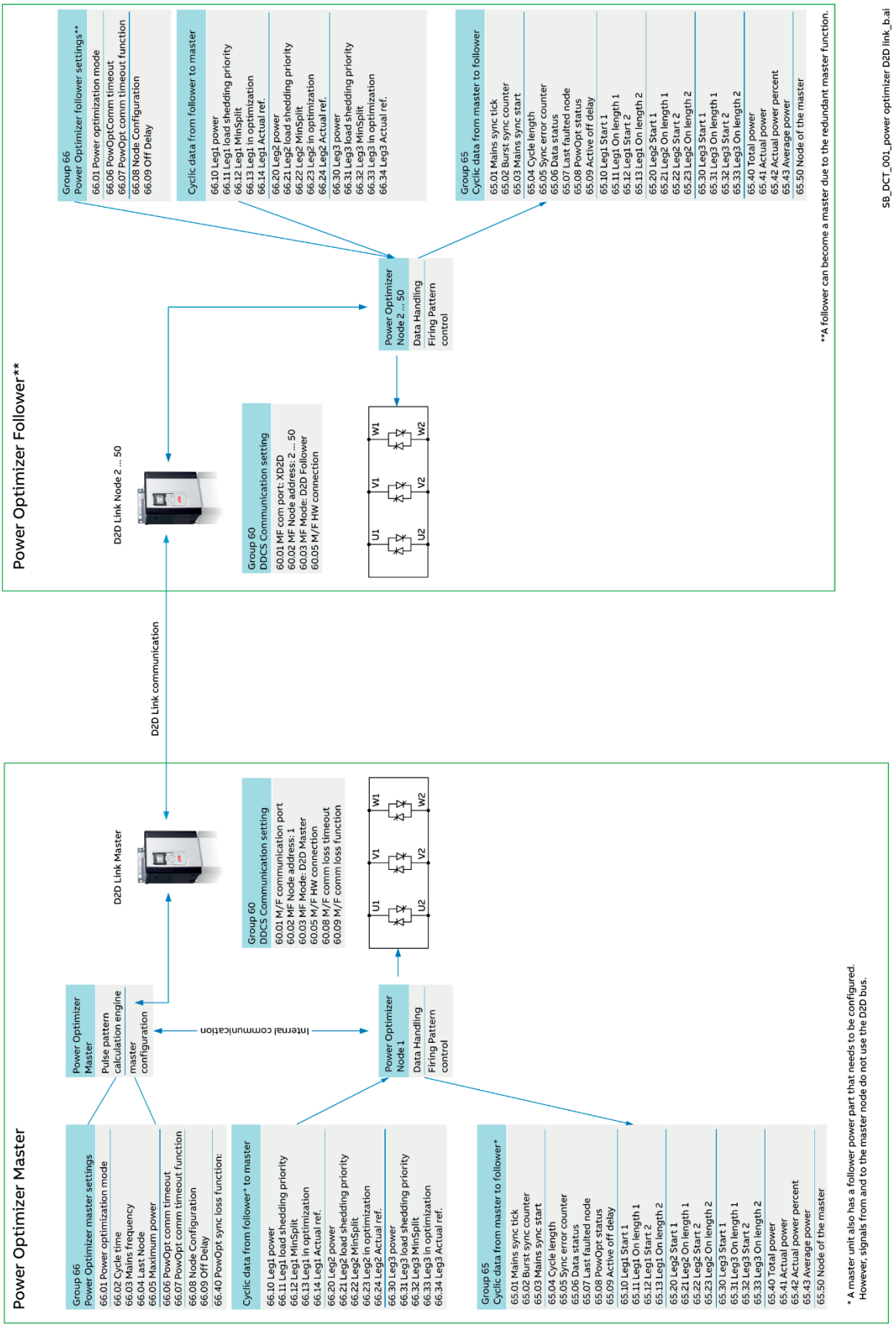
Observation:
Power Optimizer Automatic mode:
Other unit with higher node number has taken over the master role, though the master is available (D2D link connected, 24 V available, mains contactor closed and enable signal =1). Parameter 65.50 (in any unit) shows a node number larger than 1, the expected Master shows 60.02 = 61 instead of expected 1.

Resolving the issue:
This is most likely a communication problem.
Check the Jumper settings J3 (see chapter XD2D: D2D link) and set the bus termination correctly.
A disconnected D2D cable at a unit with bus termination has the same effect.

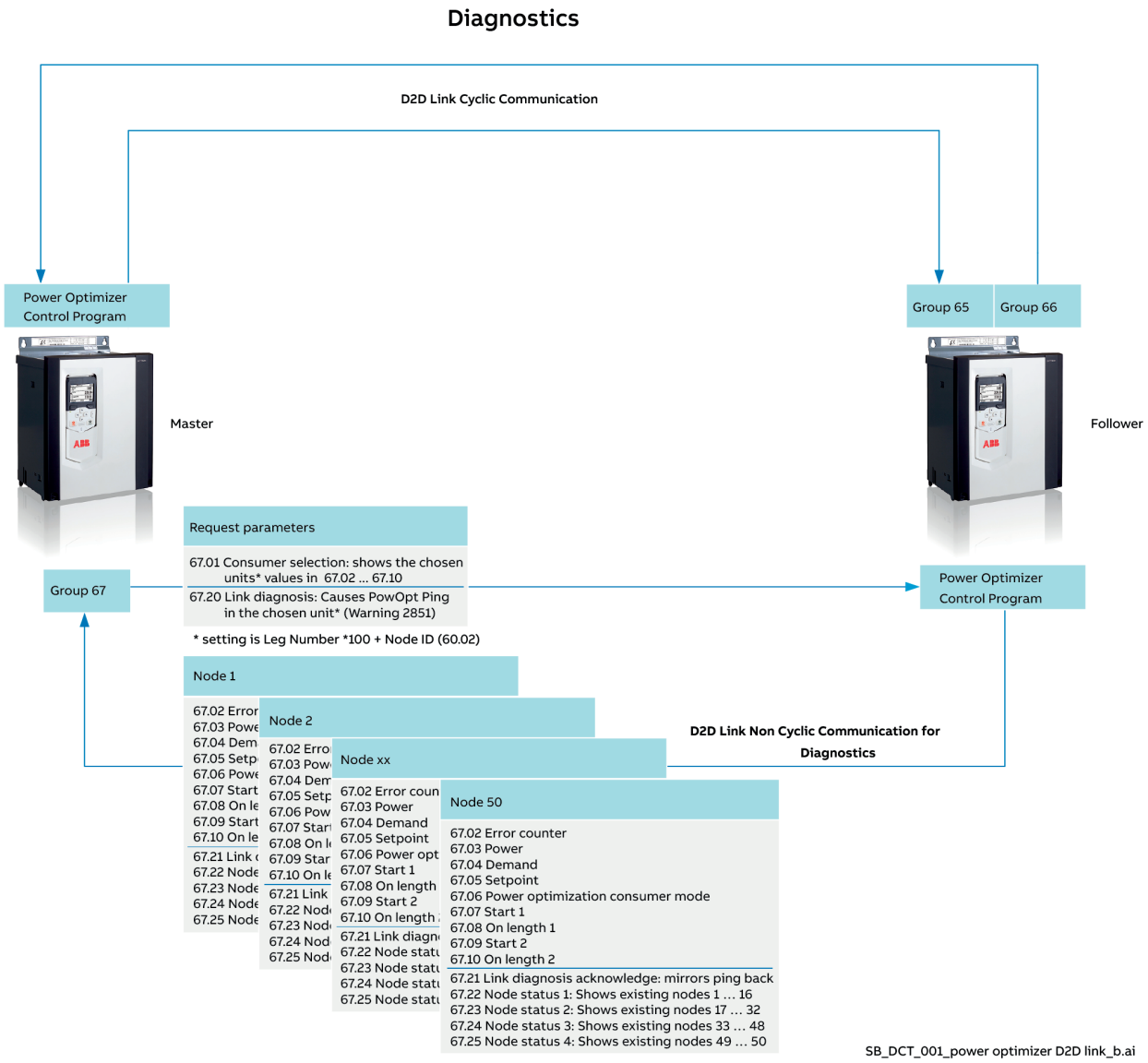
Appendix

Power Optimizer Group Information	Group function	Master	Follower
Group 65 Power Optimization Signals	Optimization engine information (read only)	x	X
Group 66 Power Optimization Settings	Bridge Control	x	X
Group 67 Power Optimization Diagnosis	Diagnostics	x	zero values visible in automatic followers (65.51=2)

Power Optimizer: D2D Link Cyclic Data Exchange



Power optimizer cyclic communication schematic



Power Optimizer non-cyclic diagnostic communication schematic

DCS Familie

DCS550-S modules
The compact drive for machinery application

20 ... 1,000 A_{DC}
0 ... 610 V_{DC}
230 ... 525 V_{AC}
IP00

- Compact
- Robust design
- Adaptive and winder program
- High field exciter current

DCS880 modules
For safe productivity

20 ... 5,200 A_{DC}
0 ... 1,600 V_{DC}
230 ... 1,000 V_{AC}
IP00

- Safe torque off (STO) built in as standard
- Compact and robust
- Single drives, 20 A to 5,200 A, up to 1,600 V_{DC}
- IEC 61131 programmable
- Intuitive control panel and PC tool with USB connection and start up assistant
- Wide range of options to serve any DC motor application

DCS800-A enclosed converters
Complete drive solutions

20 ... 20,000 A_{DC}
0 ... 1,500 V_{DC}
230 ... 1,200 V_{AC}
IP21 – IP54

- Individually adaptable to customer requirements
- User-defined accessories like external PLC or automation systems can be included
- High power solutions in 6- and 12-pulse up to 20,000 A, 1,500 V
- In accordance to usual standards
- Individually factory load tested
- Detailed documentation

DCT880 modules
Thyristor controller

20 ... 4,200 A_{AC}
110 ... 990 V_{AC}
IP00

- Precise power control in industrial heating applications
- Two or three phase devices
- Power optimizer for peak load reduction
- Built on ABB's all-compatible drives architecture
- Intuitive control panel and PC tool with USB connection and start up assistant
- Application control programs and drive application programming with IEC 61131 programming

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