1 QUESTION

Where and how can I use the digital inputs of the SENTRON PAC meters?

What are the guidelines and restrictions?

2 ANSWER

The digital inputs (DIs) of the SENTRON PACs can be separated into

- Dry contacts or passive digital inputs (wiring with $24V_{DC}$ external auxiliary power supply)
- Wet contacts or active digital inputs with internal power supply (wiring optionally without external auxiliary power supply)

	Number of passive digital inputs	Number of active digital inputs	MLFB
SENTORN PAC3100	---	2	7KM3133-0BA00-3AA0
SENTRON PAC3200	1	---	7KM2112-0BA00-2AA0 7KM2112-0BA00-3AA0 7KM2111-1BA00-3AA0
SENTRON PAC4200	2	---	7KM4212-0BA00-2AA0 7KM4212-0BA00-3AA0
SENTRON Expansion Module PAC 4DI/2DO	---	4	7KM9200-0AB00-0AA0

Table 1: Number and type of digital inputs

There are many possible applications for the digital inputs of SENTRON PACs. This FAQ will describe the most important ones in a short overview:

- State monitoring of connected signal encoders. Example: Open or closed status of a breaker
- Universal counter for example for gas, water, electricity or heat by way of pulse inputs
- Control input for switching between on-peak and off-peak tariff
- Synchronization of demand periods
- Time synchronization via top-of-minute impulse
- Control input for the process energy counters and for the process operating hours counters
    - Start / stop
    - Reset
    - Copy and reset

2.1 STATE MONITORING

2.1.1 OVERVIEW

SENTRON PACS can monitor the state of other devices of the low-voltage power distribution system and communicate it to a higher-level system. This is a great benefit for the user, because he gets a comprehensive overview of the low-voltage power distribution system and in case of a defect he will be able to find out the location of the defect faster. Some examples for devices that can be monitored via the digital inputs of SENTRON PACs are:

- Circuit breakers with aux. contacts (e.g. 3WL, 3VL)
- Switch disconnect strips with aux. contacts (e.g. 3NJ6)
- Fuse-switch disconnectors with aux. contacts (e.g. 3NP1)

In addition to that the signal at the integrated inputs of SENTRON PAC4200 can be used for Boolean logic functions for example to control an output.

Figure 1 shows a possible set-up for monitoring the state of five SENTRON 3VL circuit breakers via a SENTRON PAC4200 with two expansion modules PAC 4DI/2DO. Each of the five circuit breakers provides the two signals *on/off* and *tripped/not tripped* to the digital inputs of the PAC4200. The visualization of the PAC4200 measuring values and the states of the circuit breakers is done directly at the PAC4200 device and additionally in the PC application SENTRON powermanager:

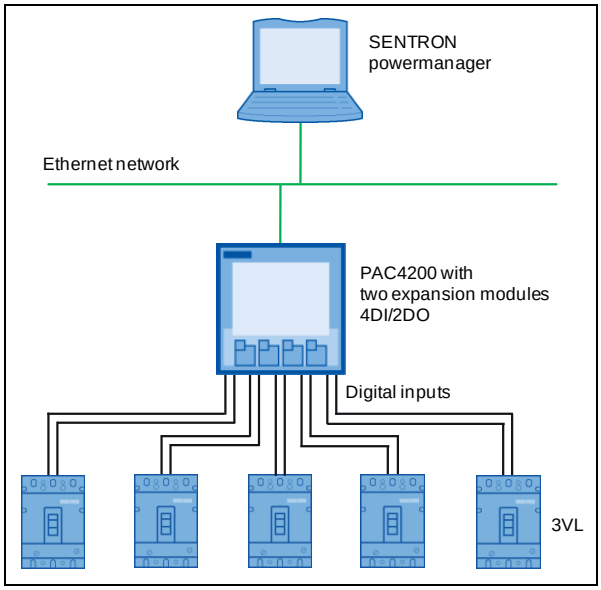

Figure 1: SENTRON PAC4200 for state monitoring of five 3VL circuit breakers

The outputs of four circuit breakers can be connected directly without any external auxiliary power supply to the eight active inputs of the two expansion modules PAC 4DI/2DO.The fifth circuit breaker may be connected to the two integrated digital inputs. The internal inputs are passive inputs and require an external power supply of $24V_{DC}$.

2.1.2 SUPPORTED DEVICES

The following power monitoring devices support the application *state monitoring from contact inputs* such as aux. contacts from a breaker:

- SENTRON PAC3100
- SENTRON PAC3200
- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

2.2 UNIVERSAL COUNTERS

2.2.1 OVERVIEW

The digital inputs of the SENTRON PACs can be used as counter inputs for

- State changes of for example other devices of the low-voltage power supply system (see chapter 2.1)
- Energy pulses (KY / KYZ pulses) of other energy meters

Figure 2 shows the usage of a SENTRON PAC4200 as a master device for logging the energy counted by other energy meters:

- Power meter (active-, reactive- and apparent energy)
- Water meter
- Compressed air / steam meter
- Gas meter

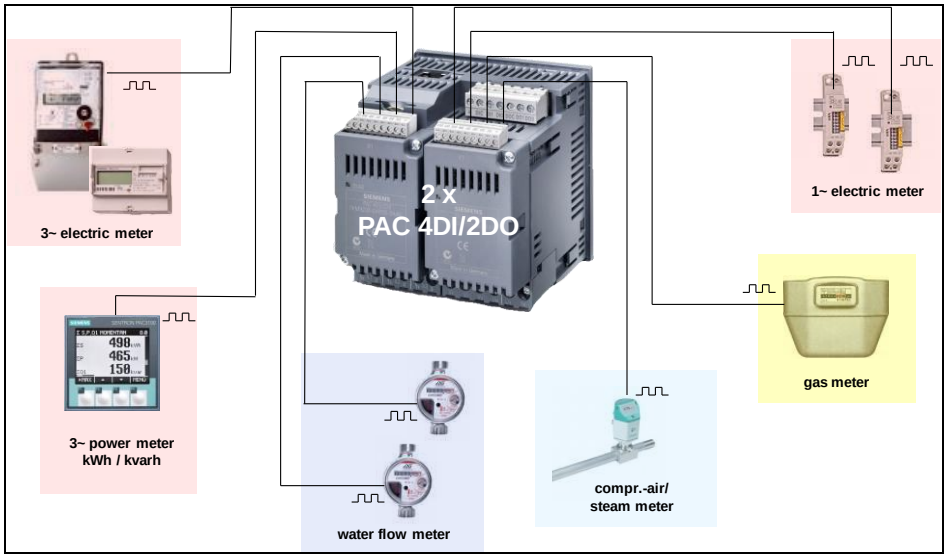

Figure 2: PAC4200 for logging the energy of other energy meters

The consumptions of the different types of energy are transmitted via KY / KYZ pulses to the SENTRON PAC4200 storing them in individual counters. For displaying the correct energy consumption it is possible to configure both, the unit and the weight (e.g. 10 pulses per kWh) independently for each of these counters. The energy consumption from multiple counters can also be summed even if the unit of measure is different

2.2.2 SUPPORTED DEVICES

The following power monitoring devices support the application *universal counter for state changes*:

- SENTRON PAC3200
- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

The following power monitoring devices support the application *universal counter for energy*:

- SENTRON PAC3200 (units for electrical energy only)
- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

2.3 SWITCHING BETWEEN ON-PEAK AND OFF-PEAK TARIFF

2.3.1 OVERVIEW

One main application for the power monitoring devices SENTRON PAC is to meter electrical energy. This happens with some internal counters and optionally for the devices being described in chapter 2.2. SENTRON PAC3200 and SENTRON PAC4200 provide separate on-peak and off-peak counters for the internally metered energy. The tariff switch between on-peak and off-peak is done by way of a communication interface or via an external signal at a digital input.

2.3.2 SUPPORTED DEVICES

The following power monitoring devices support the application *on-peak / off-peak switching*:

- SENTRON PAC3200
- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

2.4 SYNCHRONIZATION OF THE DEMAND PERIODS

2.4.1 OVERVIEW

Usually the electricity bill for companies with high power consumption consists of two major positions

- Demand rate (depends on the maximum demand value)
- Energy rate (depends on the energy consumption)

Consequently it is important for the negotiations with the utilities about the rates for **future periods** to have a good estimation for both, the maximum demand value and the energy consumption for the future period. For these negotiations it is also important to know that a fine may become due if the real maximum demand value is higher than the one being part of the energy delivery contract.

To be aware of the demand values it is necessary that the periods for gathering these values (usually 15 or 30 minutes) are identical for SENTRON PACs and for the energy meters of the utility. This synchronization of the demand periods (start of the periods) can be done by way of communication, time or digital inputs in the SENTRON PACs.

2.4.2 SUPPORTED DEVICES

The following power monitoring devices support the application *synchronization of demand periods using digital inputs*:

- SENTRON PAC3200
- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

2.5 TIME SYNCHRONIZATION VIA TOP-OF-MINUTE PULSE

2.5.1 OVERVIEW

SENTRON PAC4200 has an internal clock proving time-stamps for

- Maximum and minimum values of measuring variables
- Entries in the event memory
- Entries in the demand memory

For these applications it is required that the SENTRON PAC4200 provides the exact time. One possibility to synchronize the time of the SENTRON PAC4200 with an external clock master is a top-of-minute pulse. This pulse, being sent at the start of a minute to a digital input of the SENTRON PAC4200, causes a reset of the seconds to zero. The minutes are rounded correctly depending on the device time before the device received a top-of-minute pulse:

Example 1:

The current device time is 12:06:51 and the SENTRON PAC4200 receives a top-of-minute pulse. Consequently the device time is set to 12:07:00.

Example 2:

The current device time is 12:07:11 and the SENTRON PAC4200 receives a top-of-minute pulse. Consequently the device time is set to 12:07:00.

2.5.2 SUPPORTED DEVICES

The following power monitoring devices support the application *time synchronization using top-of-minute pulse*:

- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

2.6 CONTROL INPUT FOR PROCESS COUNTERS

2.6.1 OVERVIEW

For a lot of manufacturing processes it is important to meter the power consumption either per piece or for each production-process or sub-process. The process counters of the SENTRON PAC4200 are suited very well for this task. They register the consumption of active, reactive and apparent energy separately and can be

- started and stopped
- reset
- copied to a intermediate buffer and reset

by way of a digital input.

The energy consumption per piece or for each production-process or sub-process is a good base for

- a source-related cost allocation and
- optimization of the energy consumption and thus a reduction of the energy costs

2.6.2 SUPPORTED DEVICES

The following power monitoring devices support the application *control input for process counters*:

- SENTRON PAC4200
- SENTRON PAC4200 with SENTRON expansion module PAC 4DI/2DO

2.7 RESTRICTIONS

As shown above, the digital inputs of the power monitoring devices SENTRON PAC can be used for many different applications. However due to its functional principles it is not allowed to use a **mixture of active and passive** digital inputs of SENTRON PACs in series or in parallel. It is possible to have either several passive inputs in parallel or several active inputs in parallel separately.

	Number of passive digital inputs	Number of active digital inputs
SENTORN PAC3100	---	2
SENTRON PAC3200	1	---
SENTRON PAC4200	2	---
SENTRON Expansion Module PAC 4DI/2DO	---	4

Table 2: Number and types of the digital inputs

The combinations listed below are valid examples of switching to on and off peak tariff from a common signal for multiple SENTRON PAC meters:

Combination 1:

SENTRON PAC3200 and / or SENTRON PAC4200 (with or without expansion module PAC 4DI/2DO)

- ⇨ Exclusive usage of the integrated digital inputs
- ⇨ Digital inputs of the expansion module PAC 4DI/2DO must **not** be used

Combination 2:

SENTRON PAC4200 with expansion module PAC 4DI/2DO

- ⇨ Exclusive usage of the digital inputs of the expansion module PAC 4DI/2DO

The figures below show some supported and unsupported examples for the connection and combination of dry and self-wetting digital inputs:

2.7.1 CONNECTION EXAMPLES: INTERNAL DIGITAL INPUTS OF SENTRON PAC4200

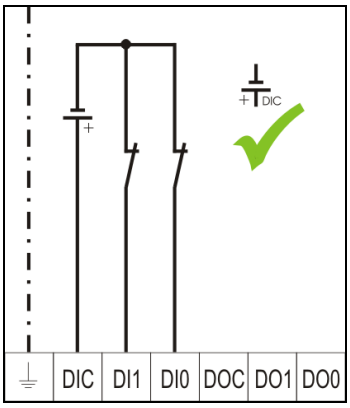

Figure 3: Connection example for the internal digital inputs of PAC4200 (DIC = +)

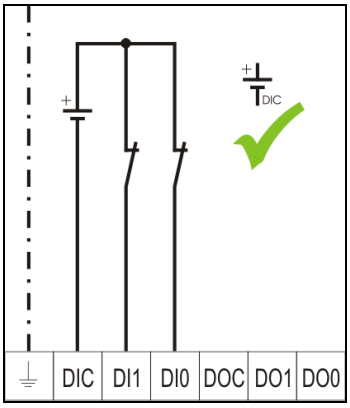

Figure 4: Connection example for the internal digital inputs of PAC4200 (DIC = -)

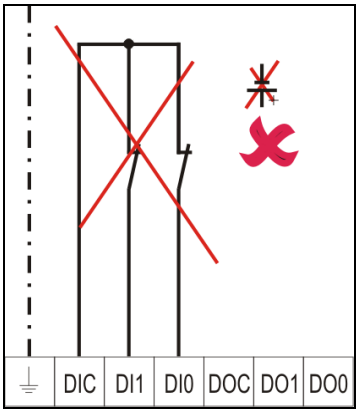

Figure 5: Unsupported connection example for the internal digital inputs of PAC4200

2.7.2 CONNECTION EXAMPLES: DIGITAL INPUTS OF EXPANSION MODUL PAC 4DI/2DO

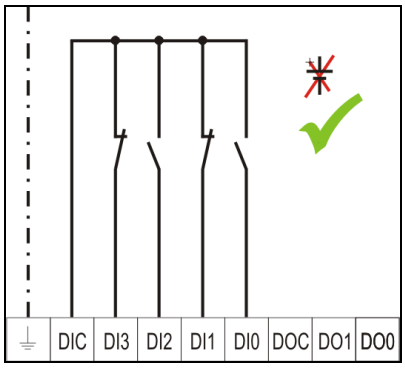

Figure 6: Connection example for the expansion module PAC 4DI/2DO

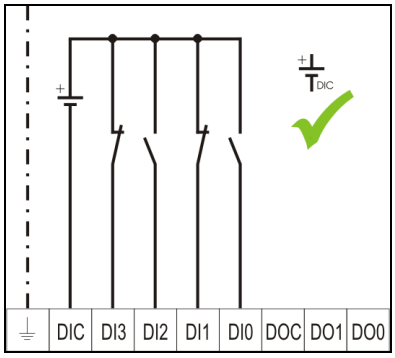

Figure 7: Connection example for the expansion module PAC 4DI/2DO (DIC = -)

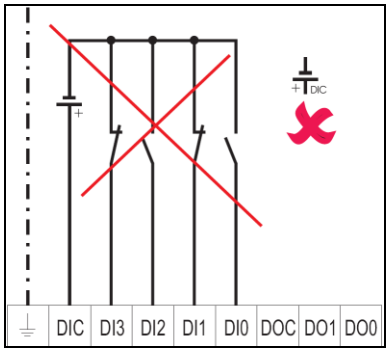

Figure 8: Unsupported connection example for the expansion module PAC 4DI/2DO (DIC = +)

2.7.3 CONNECTION EXAMPLES: COMBINATIONS

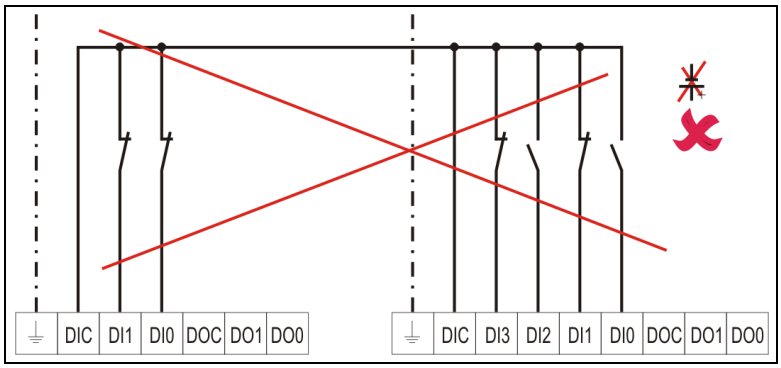

Figure 9: Unsupported combination of active and passive digital inputs

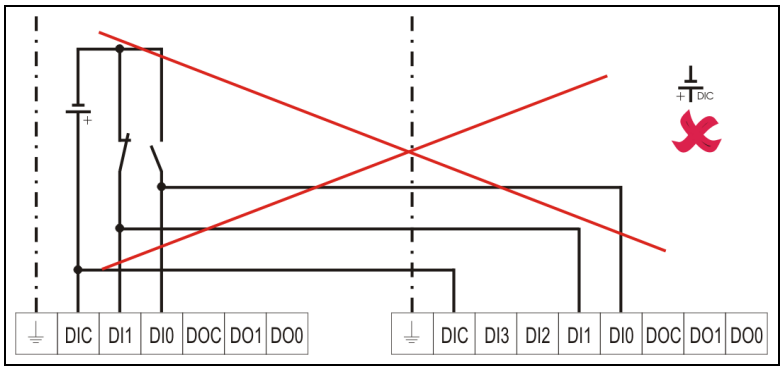

Figure 10: Unsupported combination of active and passive digital inputs (DIC = +)

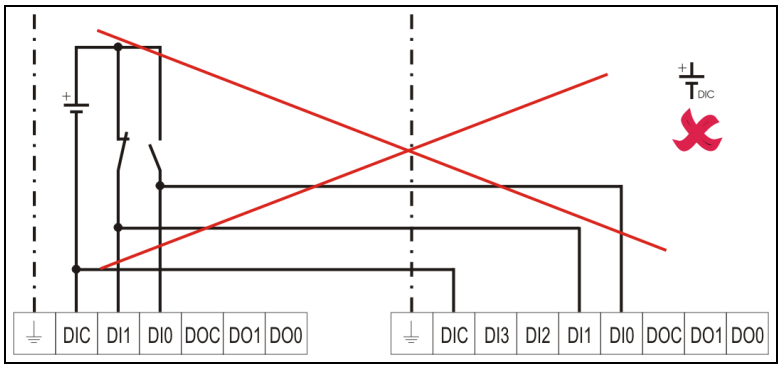

Figure 11: Unsupported combination of active and passive digital inputs (DIC = -)

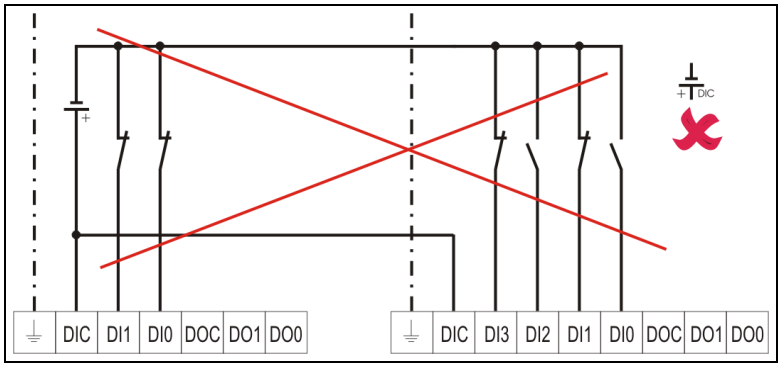

Figure 12: Unsupported combination of active and passive digital inputs (DIC = +)

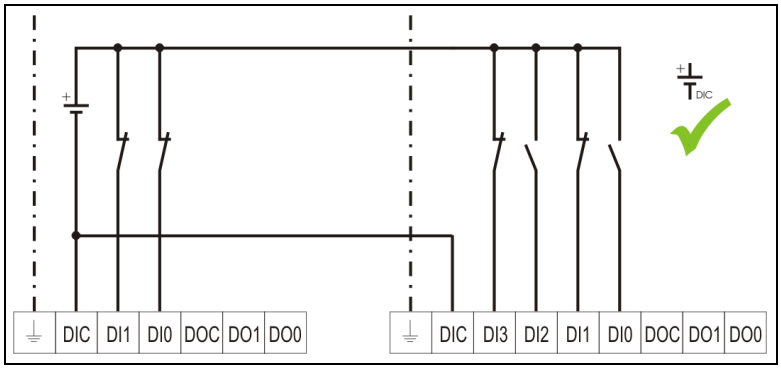

Figure 13: Combination of active and passive digital inputs (DIC = -)