

# Hybrid Systems - Register and Control Requirements

Fillable Manufacturer Questionnaire for PV, Battery and Meter Control

This form is used to clearly document the control registers required to integrate a hybrid inverter. For each control function, we need not only the setpoint, but the complete sequence of all enable steps, modes, register write operations and readback values.

## Important information for the manufacturer

The steps entered must establish the actual physically effective state. Merely describing a setpoint register without the necessary enable steps, mode selection, Apply/Heartbeat or meter assignment is not sufficient.

Sections 3-10: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.

## 1. System Data

|                             |                      |                              |                      |
|-----------------------------|----------------------|------------------------------|----------------------|
| Manufacturer / System       | <input type="text"/> | Hybrid inverter model / type | <input type="text"/> |
| Firmware / Software         | <input type="text"/> | System configuration         | <input type="text"/> |
| Register document / Version | <input type="text"/> | Address base / notation      | <input type="text"/> |

## 2. Communication and Contact

Supported interface(s): ☐ Modbus TCP ☐ Modbus RTU ☐ other documented protocol

|                                  |                      |                             |                      |
|----------------------------------|----------------------|-----------------------------|----------------------|
| TCP Port                         | <input type="text"/> | Unit ID / Slave ID          | <input type="text"/> |
| Serial parameters                | <input type="text"/> | Read / Write Function Codes | <input type="text"/> |
| Byte / Word Order                | <input type="text"/> | Recommended write cycle     | <input type="text"/> |
| P sign convention                | <input type="text"/> | Q sign convention           | <input type="text"/> |
| Watchdog / communication failure |                      | <input type="text"/>        |                      |

### Direct contact - development / interface

Name

E-mail

Phone / Teams

### 3. PV Active Power Limitation - Generating Unit [AC]

#### What we want to achieve with this function

We specify a maximum permissible active power value for the AC output of the hybrid inverter. The hybrid inverter may coordinate PV and battery internally so that this value is not exceeded at its AC terminals. The decisive value is the actual physical AC active power at the inverter; the meter point/PCC is not the control point for this function.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

#### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                                  | Register / Address / FC | Value / Data type / Scaling |
|---|------------------------------------------------|-------------------------|-----------------------------|
| 1 | Enable external control / Remote Control       | <input type="text"/>    | <input type="text"/>        |
| 2 | Select P control mode for generating unit [AC] | <input type="text"/>    | <input type="text"/>        |
| 3 | Write active power limit                       | <input type="text"/>    | <input type="text"/>        |
| 4 | Set ramps / priorities if required             | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat             | <input type="text"/>    | <input type="text"/>        |

#### Readback / Verification

| Value to verify                             | Register / Address / FC | Data type / Scaling / Unit |
|---------------------------------------------|-------------------------|----------------------------|
| Actual active power at generating unit [AC] | <input type="text"/>    | <input type="text"/>       |
| Active mode / limit / limit status          | <input type="text"/>    | <input type="text"/>       |

#### Notes / Fallback / Special considerations

#### Example

Pmax = 60 kW -> Remote ON -> AC limit mode -> 60 kW -> Apply; verify: P\_AC <= 60 kW.

## 4. PV Active Power Limitation - Generating Unit [DC]

### What we want to achieve with this function

We want to limit only the PV/MPPT side in terms of active power. The battery is charged or discharged in parallel by our EMS. Therefore, the PV limitation must not force its own battery setpoint or overwrite an external battery setpoint. We need the register that actually limits the total PV DC or MPPT power.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                            | Register / Address / FC | Value / Data type / Scaling |
|---|------------------------------------------|-------------------------|-----------------------------|
| 1 | Enable external control / Remote Control | <input type="text"/>    | <input type="text"/>        |
| 2 | Select PV/MPPT DC control mode           | <input type="text"/>    | <input type="text"/>        |
| 3 | Write PV DC power limit                  | <input type="text"/>    | <input type="text"/>        |
| 4 | Set MPPT/string assignment if required   | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat       | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify           | Register / Address / FC | Data type / Scaling / Unit |
|---------------------------|-------------------------|----------------------------|
| Total PV DC / MPPT power  | <input type="text"/>    | <input type="text"/>       |
| Active PV DC limit / mode | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

### Example

Limit PV DC to 50 kW, charge battery separately at 20 kW -> PV\_DC <= 50 kW regardless of battery power flow.

## 5. PV Active Power Setpoint - Meter [AC]

### What we want to achieve with this function

Our EMS specifies an active power setpoint at the meter point / point of common coupling (PCC). The hybrid inverter must use the external meter as feedback and internally coordinate PV and battery until the setpoint at the PCC is reached. Local loads are therefore automatically taken into account. Please document in particular the meter assignment and activation of the PCC control mode.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                                             | Register / Address / FC | Value / Data type / Scaling |
|---|-----------------------------------------------------------|-------------------------|-----------------------------|
| 1 | Assign meter / measurement source / communication address | <input type="text"/>    | <input type="text"/>        |
| 2 | Activate PCC active power control                         | <input type="text"/>    | <input type="text"/>        |
| 3 | Write active power setpoint at PCC                        | <input type="text"/>    | <input type="text"/>        |
| 4 | Set control parameters / priority if required             | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat                        | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify                      | Register / Address / FC | Data type / Scaling / Unit |
|--------------------------------------|-------------------------|----------------------------|
| Actual active power at meter / PCC   | <input type="text"/>    | <input type="text"/>       |
| Active PCC setpoint / control status | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

**Example** PCC setpoint +20 kW export -> meter source -> PCC P mode -> +20 kW; verify: P\_PCC approx. +20 kW.

## 6. PV Active Power Limitation - Meter [AC]

### What we want to achieve with this function

We specify a maximum permissible export power at the meter point / PCC. This is a limit and not a fixed power setpoint: with low PV power or higher self-consumption, the system does not have to be raised to the limit. The external meter must be part of the control loop, and local loads must be taken into account when limiting export.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                                             | Register / Address / FC | Value / Data type / Scaling |
|---|-----------------------------------------------------------|-------------------------|-----------------------------|
| 1 | Assign meter / measurement source / communication address | <input type="text"/>    | <input type="text"/>        |
| 2 | Activate PCC export limit / feed-in limitation            | <input type="text"/>    | <input type="text"/>        |
| 3 | Write maximum export power                                | <input type="text"/>    | <input type="text"/>        |
| 4 | Set deadband / control parameters if required             | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat                        | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify                    | Register / Address / FC | Data type / Scaling / Unit |
|------------------------------------|-------------------------|----------------------------|
| Actual active power at meter / PCC | <input type="text"/>    | <input type="text"/>       |
| Active export limit / limit status | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

### Example

Export limit 0 kW -> Export Limit mode -> 0 kW; verify: no positive grid export.

## 7. PV Reactive Power Setpoint - Generating Unit

### What we want to achieve with this function

Our EMS specifies reactive power Q directly at the AC terminals of the hybrid inverter. Absolute setpoints in var/kvar or a relative setpoint in %Qnom are accepted. A cos-phi or power-factor setpoint alone is not sufficient for this function. Please clearly state the sign convention for inductive/capacitive or underexcited/overexcited.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                             | Register / Address / FC | Value / Data type / Scaling |
|---|-------------------------------------------|-------------------------|-----------------------------|
| 1 | Enable external control / Remote Control  | <input type="text"/>    | <input type="text"/>        |
| 2 | Select Q control mode                     | <input type="text"/>    | <input type="text"/>        |
| 3 | Write Q setpoint [kvar / var / %Qnom]     | <input type="text"/>    | <input type="text"/>        |
| 4 | Set Qnom / scaling / priority if required | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat        | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify                               | Register / Address / FC | Data type / Scaling / Unit |
|-----------------------------------------------|-------------------------|----------------------------|
| Actual reactive power at generating unit [AC] | <input type="text"/>    | <input type="text"/>       |
| Active Q setpoint / Q control mode            | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

**Example** Q = +15 kvar -> Q mode -> +15 kvar; verify: Q\_AC approx. +15 kvar. Specify sign convention.

## 8. PV Reactive Power Setpoint - Meter

### What we want to achieve with this function

Our EMS specifies a reactive power setpoint at the meter point / PCC. The hybrid inverter must use the external meter as feedback and take local reactive power consumption into account. Here as well, we require a direct Q setpoint in var/kvar or %Qnom; pure cos-phi/PF control is not sufficient. Please document the meter assignment and Q sign convention.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                                             | Register / Address / FC | Value / Data type / Scaling |
|---|-----------------------------------------------------------|-------------------------|-----------------------------|
| 1 | Assign meter / measurement source / communication address | <input type="text"/>    | <input type="text"/>        |
| 2 | Activate PCC reactive power control                       | <input type="text"/>    | <input type="text"/>        |
| 3 | Write Q setpoint [kvar / var / %Qnom]                     | <input type="text"/>    | <input type="text"/>        |
| 4 | Set Qnom / control parameters if required                 | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat                        | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify                        | Register / Address / FC | Data type / Scaling / Unit |
|----------------------------------------|-------------------------|----------------------------|
| Actual reactive power at meter / PCC   | <input type="text"/>    | <input type="text"/>       |
| Active PCC Q setpoint / control status | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

**Example**      Q\_PCC = -10 kvar -> meter source -> PCC Q mode -> -10 kvar; verify: Q\_PCC approx. -10 kvar.

## 9. Battery Charge Power Setpoint

### What we want to achieve with this function

Our EMS must be able to directly specify the battery charging power. If permitted by the system and project approval, targeted charging from the public grid must also be activatable. An external charging setpoint must remain controllable independently of a PV DC limitation. Please document all required enable steps, operating modes and sign conventions.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                                    | Register / Address / FC | Value / Data type / Scaling |
|---|--------------------------------------------------|-------------------------|-----------------------------|
| 1 | Enable external battery control / Remote Control | <input type="text"/>    | <input type="text"/>        |
| 2 | Enable grid charging / Grid Charge if required   | <input type="text"/>    | <input type="text"/>        |
| 3 | Select battery power mode                        | <input type="text"/>    | <input type="text"/>        |
| 4 | Write charging power setpoint                    | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat               | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify                                   | Register / Address / FC | Data type / Scaling / Unit |
|---------------------------------------------------|-------------------------|----------------------------|
| Actual battery power / charging power             | <input type="text"/>    | <input type="text"/>       |
| Available charging power / SOC / operating status | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

**Example** Charge battery at 50 kW -> External Battery Control -> Grid Charge ON -> 50 kW; verify: battery charges at approx. 50 kW.

## 10. Battery Discharge Power Setpoint

### What we want to achieve with this function

Our EMS must be able to directly specify the battery discharge power, e.g. for energy communities or other external EMS strategies. Depending on project approval, the power may be supplied up to the public grid. Direct external power control is required; a manufacturer EMS must not be the only available interface for the setpoint.

**Dynamic response requirement: max. 500 ms from successful Modbus write to physical implementation at the AC terminal / relevant control point.**  
Acknowledgement, internal register update or merely starting the power change does not count as implementation.

Manufacturer confirmation:

☐

Yes

☐

No

☐

Partially

If partially:

### Required registers and write sequence

Only enter steps that are actually required; leave unnecessary rows blank.

| # | Required step                                    | Register / Address / FC | Value / Data type / Scaling |
|---|--------------------------------------------------|-------------------------|-----------------------------|
| 1 | Enable external battery control / Remote Control | <input type="text"/>    | <input type="text"/>        |
| 2 | Select battery power mode                        | <input type="text"/>    | <input type="text"/>        |
| 3 | Set discharge enable / export enable             | <input type="text"/>    | <input type="text"/>        |
| 4 | Write discharge power setpoint                   | <input type="text"/>    | <input type="text"/>        |
| 5 | Execute Apply / Enable / Heartbeat               | <input type="text"/>    | <input type="text"/>        |

### Readback / Verification

| Value to verify                                    | Register / Address / FC | Data type / Scaling / Unit |
|----------------------------------------------------|-------------------------|----------------------------|
| Actual battery power / discharge power             | <input type="text"/>    | <input type="text"/>       |
| Available discharge power / SOC / operating status | <input type="text"/>    | <input type="text"/>       |

### Notes / Fallback / Special considerations

### Example

Discharge battery at 70 kW -> External Battery Control -> 70 kW; verify: battery discharges at approx. 70 kW.