Application Note: Dynamic Active/Reactive Power and Power Factor Control Over Modbus

The following document describes the Modbus map for dynamic control of the Active/Reactive Power and Power Factor of SolarEdge inverters.

Using this map, an external controller can control the active power production percentage and the reactive power settings, and required CosPhi with pre-configuration for fallback values after a timeout and ramp up/down rates.

Before configuring Power and CosPhi, configure Modbus using SetApp or the inverter display (depending on the inverter model). For Modbus configuration options and response time information, refer to the SolarEdge Technical Note – *SunSpec Logging in SolarEdge Inverters*. For the inverter installation and configuration, refer to the installation guide supplied with the product and available on the SolarEdge website.

The base register of the dynamic-commands block is set to 0xF300:

- **Enable Dynamic Power Control** on address 0xF300 is disabled (set to 0) by default and should be enabled (set to 1) for dynamic power control functionality.
- **Max Active Power** is the inverter rated active power. This is a read-only register.
- All other settings described for the enhanced dynamic power control block are related to these ratings.

Address	Size	R/W	Name	Type	Value Range	Units
F300	1	R/W	Enable Dynamic Power Control	Uint16	0 or 1	N/A
F304	2	R	Max Active Power	Float32	Inverter rating	W

Enabling the Dynamic Power Control Mode

→ **To enable Dynamic Power Control:**

1. Set the following:

   - Set **AdvancedPwrControlEn** on address 0xF142 to 1 (enable). It is 0 (disabled) by default.
   - Set **ReactivePwrConfig** on address 0xF104 to 4 for either Q or CosPhi control. The default value is 0 (Fixed CosPhi mode).

     NOTE: If the registers are already set to the correct value, do not re-write them.

2. Issue a **Commit Power Control Settings** command on address 0xF100 (set to 1) in order to put the settings into effect. This command stops production and restarts the inverter.

3. Initialize the enhanced power control settings on addresses 0xF308–0xF320.

4. **Enable Dynamic Power Control** (set to 1). It is 0 (disabled) by default. Note: Dynamic Power Control should be enabled only after the initialization of the enhanced power control operation in the previous step.

Configurations of this map can also be changed dynamically.

Configuring the Enhanced Power Control

To configure the enhanced power control, use the following registers:

→ **The following registers maintain their value following an inverter restart.**

◢ **Active/Reactive Preference** sets the priority between active and reactive power.

- When set to 1, active power has higher priority than reactive power. This means that the inverter attempts to reach the active power limit first and then attempts to comply with the reactive power limits.

- When set to 0, reactive power has higher priority than reactive power.

◢ **CosPhi/Q Preference** sets whether the reactive power is controlled by CosPhi or by Q:

- When set to 1, the reactive power is controlled by Q.

- When set to 0, the reactive power is controlled by CosPhi.

◢ **Active Power Limit** sets the limits for the dynamic active power control.

◢ **Command Timeout** sets the timeout interval for dynamic commands. If the inverter doesn't receive one of the dynamic commands within this time frame, it will revert to the fallback settings described in the bullets below. The controller command interval must be at least Command Timeout interval / 2.

◢ **Fall-back Active Power Limit** sets the fallback limit for the dynamic active power control.

◢ **Fall-back Reactive Power Limit** sets the fallback limit for the dynamic reactive power control.

◢ **Fall-back CosPhi** sets the fallback limit for the dynamic CosPhi control.

◢ **Active Power Ramp-up Rate** controls the ramp-up rate of the dynamic active power change. It is set as the percentage per minute of the inverter's active power limit register setting. A value of -1 indicates that the ramp-up is disabled and that the change is immediate.

◢ **Active Power Ramp-down Rate** controls the ramp-down rate of the dynamic active power change. It is set as the percentage per minute of the inverter's active power limit register setting. A value of -1 indicates that the ramp-down is disabled and that the change is immediate.

◢ **Reactive Power Ramp-up Rate** controls the ramp-up rate of the dynamic reactive power change. It is set as the percentage per minute of the inverter's reactive power limit register setting. A value of -1 indicates that the ramp-up is disabled and that the change is immediate.

◢ **Reactive Power Ramp-down Rate** controls the ramp-down rate of the dynamic reactive power change. It is set as the percentage per minute of the inverter's reactive power limit register setting. A value of -1 indicates that the ramp-down is disabled and that the change is immediate.

◢ **Phi Change Rate** controls the change rate of the dynamic angle change. It is set in radians per minute.

The properties of the registers described above are detailed in the table below.

Address	Size	R/W	Name	Type	Value Range	Units
F308	1	R/W	Active/Reactive Preference	Uint16	0 or 1	N/A
F309	1	R/W	CosPhi/Q Preference	Uint16	0 or 1	N/A
F310	2	R/W	Command Timeout	Uint32	0-MAX_UINT32	Sec
F312	2	R/W	Fall-back Active Power Limit	Float32	0-100	%
F314	2	R/W	Fall-back Reactive Power Limit	Float32	-100 to +100	%
F316	2	R/W	Fall-back CosPhi	Float32	-1 to 1	N/A
F318	2	R/W	Active Power Ramp-up Rate	Float32	-1*, 0-100	%/min
F31A	2	R/W	Active Power Ramp-down Rate	Float32	-1*, 0-100	%/min
F31C	2	R/W	Reactive Power Ramp-up Rate	Float32	-1*, 0-100	%/min
F31E	2	R/W	Reactive Power Ramp-down Rate	Float32	-1*, 0-100	%/min
F320	2	R/W	Phi Change Rate	Float32	0 - pi	rad/min

* Support for the -1 value was introduced in CPU versions: 3.2545 and 4.10.25

→ **The following registers are not saved upon reset, and must be re-configured after the inverter restarts.**

▰ **Dynamic Active Power Limit** controls the active power limit of the inverter dynamically. It is set as the percentage of the Active Power Limit register setting. The dynamic active power limit can be sent in Modbus broadcast. The Modbus address space consists of 256 addresses:

0	From 1 to 247	From 248 to 255
Broadcast address	Individual follower inverter addresses	Reserved

In broadcast mode, the leader inverter sends a request to all followers. No response is returned.

▰ **Dynamic Cos Phi Limit** controls the CosPhi of the inverter dynamically. The sign of CosPhi determines the sign of the expected reactive power.

Address	Size	R/W	Name	Type	Value Range	Units
F322	2	R/W	Dynamic Active Power Limit	Float32	0-100	%
F324	2	R/W	Dynamic Reactive Power Limit	Float32	-100 to +100	%
F326	2	R/W	Dynamic CosPhi Limit	Float32	-1 to 1	N/A

When accessing the registers, note the following:

- Each register contains two bytes in big-endian order (MSB-LSB).
- Each 32-bit value spans over two registers in the little-endian word order (LSB-MSB).
    - If the controller does not support the little-endian word order, another map using the big-endian word order correlating to this one exists at an offset of 0x800 from this map.
    - The two registers must be written together using Modbus function 16.

The following table summarizes all the registers mentioned above, in order of address.

Address	Size	R/W	Name	Type	Value Range	Units
F300	1	R/W	Enable Dynamic Power Control	Uint16	0 or 1	N/A
F304	2	R	Max Active Power	Float32	Inverter rating	W
F308	1	R/W	Active/Reactive Preference	Uint16	0 or 1	N/A
F309	1	R/W	CosPhi/Q Preference	Uint16	0 or 1	N/A
F310	2	R/W	Command Timeout	Uint32	0-MAX_UINT32	Sec
F312	2	R/W	Fall-back Active Power Limit	Float32	0-100	%
F314	2	R/W	Fall-back Reactive Power Limit	Float32	-100 to +100	%
F316	2	R/W	Fall-back CosPhi	Float32	-1 to 1	N/A
F318	2	R/W	Active Power Ramp-up Rate	Float32	-1*, 0-100	%/min
F31A	2	R/W	Active Power Ramp-down Rate	Float32	-1*, 0-100	%/min
F31C	2	R/W	Reactive Power Ramp-up Rate	Float32	-1*, 0-100	%/min
F31E	2	R/W	Reactive Power Ramp-down Rate	Float32	-1*, 0-100	%/min
F320	2	R/W	Phi Change Rate	Float32	0-pi	rad/min
F322	2	R/W	Dynamic Active Power Limit	Float32	0-100	%
F324	2	R/W	Dynamic Reactive Power Limit	Float32	-100 to +100	%
F326	2	R/W	Dynamic CosPhi Limit	Float32	-1 to 1	N/A

* Support for the -1 value was introduced in CPU versions: 3.2545 and 4.10.25

Disclaimer

Internal control mechanisms may supersede the external controller's request if required by certification authorities.