INGECON SUN® EMS Gateway

Especificaciones de la funcionalidad
Functionality Specifications

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1 Introduction

Ingeteam presents the *INGECON SUN® EMS Gateway* functionality for the control of generation and storage facilities, in a uniform, simple and scalable way.

This functionality allows remote control of the INGECON SUN® EMS using the Modbus TCP communication standard.

INFO

To download the latest version of this document visit: www.ingeteam.com.

1.1 Symbols

Throughout this document, warnings are included to highlight certain information. In relation to the nature of the text, there are three types of warnings.

DANGER This indicates a hazard to personnel or the device.

CAUTION It indicates importance.

INFO Additional information or references to other parts of the document(s).

2 Modbus TCP Communication Requirements

The Modbus TCP communication requirements with the INGECON SUN® EMS Gateway are as follows:

- The TCP Modbus Server Port is 522.
- The Modbus ID is 01.
- The Modbus TCP server has a one-hour downtime for downtime. Once this time has passed, the server will close the existing connection.
- In case there is no active connection, the INGECON SUN® EMS will perform control according to the strategy configured by default.

The Modbus TCP client must follow these requirements in its connection to the Modbus TCP server of the INGECON SUN® EMS Gateway.

3 Control Types

There are two types of control using the INGECON SUN® EMS Gateway.

- Dynamic control of Ingeteam's strategy
  - Modo: Strategy Dynamic
- Direct control of the system
  - Mode: Fix Setpoint
  - Mode: Override

INFO

The change of control type can be done dynamically, and it is not necessary to restart the INGECON SUN® EMS.

3.1 Dynamic control of Ingeteam's strategy

This mode should be used when the INGECON SUN® EMS is required to control the devices of the installation autonomously, under the Ingeteam's self-consumption strategy, but, in addition, it is desired to dynamically change certain control parameters through Modbus TCP such as Grid target, loading and unloading schedules, SOC levels, etc.

INFO

This is the default boot mode of the INGECON SUN® EMS.

3.2 Direct control of the system

This control mode should be used when the external controller is going to directly control the installation using its algorithms and control strategies. In this mode, the INGECON SUN® EMS Gateway acts as a gateway between the external controller and the devices defined in the installation (inverters, wattmeters, etc...), so that the INGECON SUN® EMS Gateway is responsible for transcribing the general setpoint of the external controller to the devices of the installation.

In this direct control mode, the INGECON SUN® EMS Gateway has 2 operating modes, *Fixed Setpoint* and *Override*.

In *Fixed Setpoint mode,* the INGECON SUN® EMS Gateway forwards the Setpoint received from the external controller and keeps it fixed until the external controller sends a new setpoint.

In *Override* mode, the external controller must send a setpoint with a periodicity of less than 1.15s for the INGECON SUN® EMS to forward it to the plant devices (otherwise the timeout of the inverters will jump and then the installation will go to power 0).

The devices available at the facility are: photovoltaic inverters, inverters with storage, and electric vehicle charger.

These devices can be sent:

- Generation setpoint for photovoltaic inverters
- Battery charge/discharge setpoint for inverters with storage
- Power available at the installation for electric vehicle charging.

Each of these setpoints has its own records defined to indicate which devices a certain setpoint is going to be sent to.

4 Modbus Map of the INGECON SUN® EMS Gateway

4.1 Input registers – Online Data

Below are the Input registers showing the online data of the system controlled under the INGECON SUN® EMS Gateway. This information will be consulted by the external controller via Modbus TCP to monitor the status of the installation.

The information is divided into single-phase, three-phase information blocks and a common area with alarms and the general status of the installation. The external controller will use the necessary monitoring zones depending on the devices and the type of installation.

4.1.1 Single-phase information

Start Address	Modbus Register	Description	Type	Magnitude	Category
0	30001	Grid: Active Power	int32	W	Phase R
2	30003	reserved	-	-	Phase R
4	30005	PV: Active Power generation	int32	W	Phase R
6	30007	reserved	-	-	Phase R
8	30009	Battery: Active Power discharge	int32	W	Phase R
10	30011	reserved	-	-	Phase R
12	30013	Battery: Charge Power	int32	W	Phase R
14	30015	Battery: SOC	uint16	%	Phase R
15	30016	Battery: Voltage	uint16	V	Phase R
16	30017	PV: Total installed power	uint32	W	Phase R
18	30019	Battery: Total installed power	uint32	W	Phase R
20	30021	Rev Station: Power consumed	int32	W	Phase R

40	30041	Grid: Active Power	int32	W	Phase S
42	30043	reserved	-	-	Phase S
44	30045	PV: Active Power generation	int32	W	Phase S
46	30047	reserved	-	-	Phase S
48	30049	Battery: Active Power discharge	int32	W	Phase S
50	30051	reserved	-	-	Phase S
52	30053	Battery: Charge Power	int32	W	Phase S
54	30055	Battery: SOC	uint16	%	Phase S
55	30056	Battery: Voltage	uint16	V	Phase S
56	30057	PV: Total installed power	uint32	W	Phase S
58	30059	Battery: Total installed power	uint32	W	Phase S
60	30061	Rev Station: Power consumed	int32	W	Phase S

80	30081	Grid: Active Power	int32	W	Phase T
82	30083	reserved	-	-	Phase T
84	30085	PV: Active Power generation	int32	W	Phase T
86	30087	reserved	-	-	Phase T
88	30089	Battery: Active Power discharge	int32	W	Phase T

90	30091	reserved	-	-	Phase T
92	30093	Battery: Charge Power	int32	W	Phase T
94	30095	Battery: SOC	uint16	%	Phase T
95	30096	Battery: Voltage	uint16	V	Phase T
96	30097	PV: Total installed power	uint32	W	Phase T
98	30099	Battery: Total installed power	uint32	W	Phase T
100	30101	Rev Station: Power consumed	int32	W	Phase T

4.1.2 Three-phase information

Start Address	Modbus Register	Description	Type	Magnitude	Category
200	30201	Grid: Active Power	int32	W	Triphasic
202	30203	reserved	-	-	Triphasic
204	30205	PV: Active Power generation	int32	W	Triphasic
206	30207	reserved	-	-	Triphasic
208	30209	Battery: Active Power discharge	int32	W	Triphasic
210	30211	reserved	-	-	Triphasic
212	30213	Battery: Charge Power	int32	W	Triphasic
214	30215	Battery: SOC	uint16	%	Triphasic
215	30216	Battery: Voltage	uint16	V	Triphasic
216	30217	PV: Total installed power	uint32	W	Triphasic
218	30219	Battery: Total installed power	uint32	W	Triphasic
220	30221	Rev Station: Power consumed	int32	W	Triphasic

4.1.3 Status Overview

Start Address	Modbus Register	Description	Type	Magnitude	Category
300	30301	Alarms	flags		Plant
		Power meter lost for more than 15 minutes	bit 0		Plant
		Battery inverter lost for more than 15 minutes	bit 1		Plant
		PV inverter lost between 10:00 and 15:00	bit 2		Plant
301	30302	Status	flags		Plant
		Power meter lost	bit 0		Plant
		Battery inverter lost	bit 1		Plant
		PV inverter lost	bit 2		Plant
		Battery inverter with alarms	bit 3		Plant
		PV inverter with alarms	bit 4		Plant

4.2 Holding registers – Configuration Parameters and Setpoints

Below are the holding registers of the INGECON SUN® EMS Gateway. These read/write registers will be used by the external controller, to configure and establish the different modes of control of the installation, sending instructions, etc...

4.2.1 Registration for Control Mode

Start Address	Modbus Register		Description	Type	Unit	Min	Max	Category
0	40001		Control Mode Register					1 - MODBUS CONTROL MODE
		Bit 1-0	Control mode					1 - MODBUS CONTROL MODE
			• 00 : STRATEGY DYNAMIC					1 - MODBUS CONTROL MODE
			• 01 : FIXED SETPOINT					1 - MODBUS CONTROL MODE
			• 10 : OVERRIDE					1 - MODBUS CONTROL MODE
		Bit 2	PV Active Control					1 - MODBUS CONTROL MODE
			• 0 : Disable					1 - MODBUS CONTROL MODE
			• 1 : Enable					1 - MODBUS CONTROL MODE
		Bit 3	Battery Control					1 - MODBUS CONTROL MODE
			• 0 : Disable					1 - MODBUS CONTROL MODE
			• 1 : Enable					1 - MODBUS CONTROL MODE
		Bit 5	Rev Station available power update					1 - MODBUS CONTROL MODE
			• 0 : Disable					1 - MODBUS CONTROL MODE
			• 1 : Enable					1 - MODBUS CONTROL MODE

4.2.2 Registers for Strategy Dynamic

Start Address	Modbus Register		Description	Type	Unit	Min	Max	Category
20	40021		Active Power: Grid Target	int32	W			2 - STRATEGY DYNAMIC CONTROL
100	40101		Peak-shaving (Only for three phase inverters)	int32	W			7 - PEAK SHAVING
102	40103		Limit battery charge from grid	enum [decimal]				8 - LIMIT BATTERY CHARGE FROM GRID
			• 0 : Disabled					8 - LIMIT BATTERY CHARGE FROM GRID
			• 1 : Enabled					8 - LIMIT BATTERY CHARGE FROM GRID
103	40104		Maximum charge power	int32				8 - LIMIT BATTERY CHARGE FROM GRID
	40106		Force SOCs to Inverters					9 - BATTERY SOC LEVELS
			• 0 : Disabled					9 - BATTERY SOC LEVELS
			• 1 : Enabled					9 - BATTERY SOC LEVELS
106	40107		SOC Minimum	short	%	0	100	9 - BATTERY SOC LEVELS
107	40108		SOC Maximum	short	%	0	100	9 - BATTERY SOC LEVELS
108	40109		SOC Recovery	short	%	0	100	9 - BATTERY SOC LEVELS
109	40110		Status	enum [decimal]				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 0 : Disabled	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 1 : All week	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 2 : Weekdays	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 3 : Weekend	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
110	40111		From: Hour	short	hh	0	23	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
111	40112		From: Minute	short	mm	0	59	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
112	40113		To: Hour	short	hh	0	23	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
113	40114		To: Minute	short	mm	0	59	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
114	40115		SOC Grid	short	%	0	100	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
115	40116		Status	enum [decimal]				11 - BATTERY CHARGE FROM GRID SCHEDULE 2

			• 0 : Disabled	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
			• 1 : All week	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
			• 2 : Weekdays	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
			• 3 : Weekend	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
116	40117		From: Hour	short	hh	0	23	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
117	40118		From: Minute	short	mm	0	59	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
118	40119		To: Hour	short	hh	0	23	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
119	40120		To: Minute	short	mm	0	59	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
120	40121		SOC Grid	short	%	0	100	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
121	40122		Status	enum [decimal]				12 - BATTERY DISCHARGE SCHEDULE 1
			• 0 : Disabled	int				12 - BATTERY DISCHARGE SCHEDULE 1
			• 1 : All week	int				12 - BATTERY DISCHARGE SCHEDULE 1
			• 2 : Weekdays	int				12 - BATTERY DISCHARGE SCHEDULE 1
			• 3 : Weekend	int				12 - BATTERY DISCHARGE SCHEDULE 1
122	40123		From: Hour	short	hh	0	23	12 - BATTERY DISCHARGE SCHEDULE 1
123	40124		From: Minute	short	mm	0	59	12 - BATTERY DISCHARGE SCHEDULE 1
124	40125		To: Hour	short	hh	0	23	12 - BATTERY DISCHARGE SCHEDULE 1
125	40126		To: Minute	short	mm	0	59	12 - BATTERY DISCHARGE SCHEDULE 1
126	40127		Status	enum [decimal]				13 - BATTERY DISCHARGE SCHEDULE 2
			• 0 : Disabled	int				13 - BATTERY DISCHARGE SCHEDULE 2
			• 1 : All week	int				13 - BATTERY DISCHARGE SCHEDULE 2
			• 2 : Weekdays	int				13 - BATTERY DISCHARGE SCHEDULE 2
			• 3 : Weekend	int				13 - BATTERY DISCHARGE SCHEDULE 2
127	40128		From: Hour	short	hh	0	23	13 - BATTERY DISCHARGE SCHEDULE 2
128	40129		From: Minute	short	mm	0	59	13 - BATTERY DISCHARGE SCHEDULE 2
129	40130		To: Hour	short	hh	0	23	13 - BATTERY DISCHARGE SCHEDULE 2
130	40131		To: Minute	short	mm	0	59	13 - BATTERY DISCHARGE SCHEDULE 2

Peak-shaving (W)
Consumo mínimo de red para activar la descarga de batería. La consigna de descarga será la diferencia entre este parámetro y el pico de consumo. Sólo para inversores trifásicos.
0

Limitar carga de batería desde red
No Sí

Máxima potencia de carga (W)
Máxima potencia de carga desde la red/generador
0

Niveles de SOC de la batería

SOC Min (%)
Estado de carga por debajo del cual no se permite la descarga de la batería habiendo conexión a red. Es necesario alcanzar SOC Recovery para reanudar el autoconsumo con aporte de batería.
30

SOC Max (%)
Estado de carga máximo para cargar las baterías desde la energía fotovoltaica.
100

SOC Recovery (%)
Estado de carga por encima del cual se reanuda la descarga de la batería, una vez que se viene desde SOC Min. Se evita un ciclado excesivo de la batería alargando su vida útil.
60

Horario para carga de batería desde la red

Horario 1: Entre semana (L-V)
Desde 8 : 0 hh:mm
Hasta 16 : 0 hh:mm

Horario 2: Fin de semana (S-D)
Desde 0 : 0 hh:mm
Hasta 0 : 0 hh:mm

SOC Grid (%)
Estado de carga máximo para cargar las baterías desde la red. Este valor debe ser mayor que el SOC mínimo
0

SOC Grid (%)
Estado de carga máximo para cargar las baterías desde la red. Este valor debe ser mayor que el SOC mínimo
0

Horario para descarga de batería

Horario 1: Desactivado

Horario 2: Desactivado

4.2.3 Registers for Direct Control (Fixed Setpoint / Override)

Start Address	Modbus Register		Description	Type	Unit	Min	Max	Category
40	40041		PV: Setpoint	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
41	40042		Battery: Setpoint	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
42	40043		reserved					
70	40071		PV: Setpoint R	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
71	40072		PV: Setpoint S	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
72	40073		PV: Setpoint T	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
73	40074		Battery: Setpoint R	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
74	40075		Battery: Setpoint S	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
75	40076		Battery: Setpoint T	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
76	40077		reserved					
77	40078		reserved					
78	40079		reserved					
79	40080		Available Power R	int32	W			6 - AVAILABLE: REV CHARGE
81	40082		Available Power S	int32	W			6 - AVAILABLE: REV CHARGE
83	40084		Available Power T	int32	W			6 - AVAILABLE: REV CHARGE

200	40201		PV Setpoint mode	enum [decimal]				3 - SETPOINT: PV INVERTER
			• 0 : Percentage					3 - SETPOINT: PV INVERTER
			• 1 : Watts					3 - SETPOINT: PV INVERTER
201	40202		Battery Setpoint mode	enum [decimal]				4 - SETPOINT: BATT INVERTER
			• 0 : Percentage					4 - SETPOINT: BATT INVERTER
			• 1 : Watts					4 - SETPOINT: BATT INVERTER
202	40203		PV: Active Power	int32	W	0		3 - SETPOINT: PV INVERTER (W)
204	40205		Battery: Setpoint	int32	W			4 - SETPOINT: BATT INVERTER (W)

206	40207		PV: Active Power R	int32	W	0		3 - SETPOINT: PV INVERTER (W)
208	40209		PV: Active Power S	int32	W	0		3 - SETPOINT: PV INVERTER (W)
210	40211		PV: Active Power T	int32	W	0		3 - SETPOINT: PV INVERTER (W)
212	40213		Battery: Setpoint R	int32	W			4 - SETPOINT: BATT INVERTER (W)
214	40215		Battery: Setpoint S	int32	W			4 - SETPOINT: BATT INVERTER (W)
216	40217		Battery: Setpoint T	int32	W			4 - SETPOINT: BATT INVERTER (W)

Note:

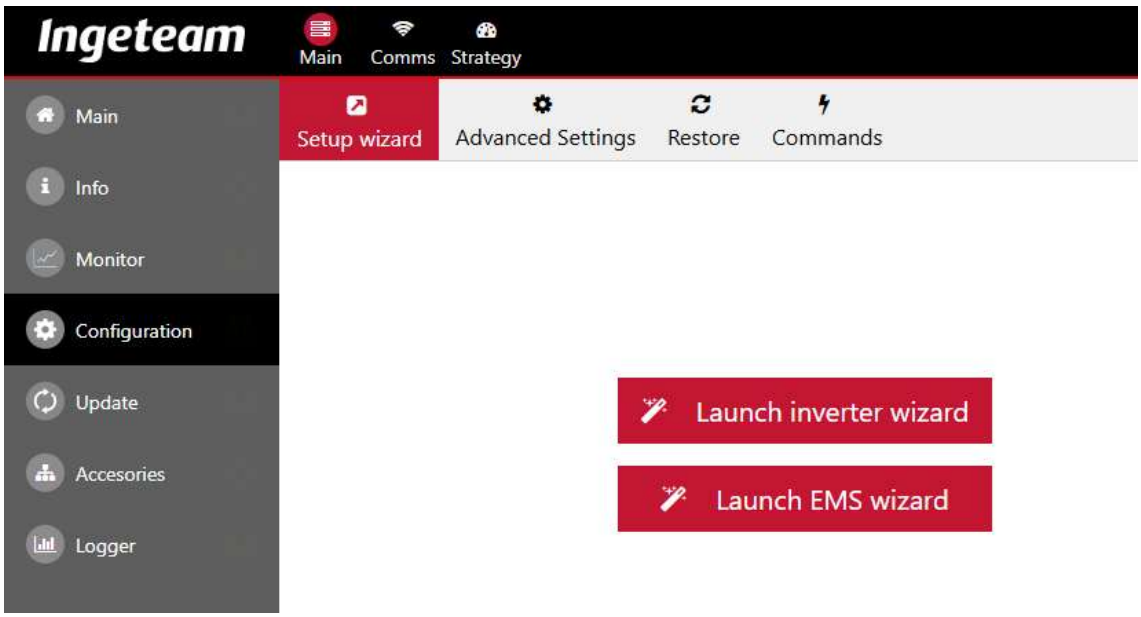
- The percentages to be sent as a setpoint are on the nominal power of the equipment. For example, in the case of the ISS 100TL the rated charging power is 60kW and the discharge power is 100kW. 50% charging would be equivalent to 30kW, as well as 50% discharge would be equivalent to 50kW.
- Battery: Setpoint > 0 -> Discharge
- Battery: Setpoint < 0 -> Charge
- Battery: Setpoint = 0 -> No Charge/No Discharge

5 Commissioning of the system and the INGECON SUN® EMS

The first step consists of commissioning and configuring all the devices of the installation (photovoltaic inverters, storage inverters, wattmeters, etc...), in addition to the INGECON SUN® EMS through its initial wizard.

5.1 Run the Inverter Setting Wizard

On each inverter in the installation, run the start-up Wizard. In this step, the configuration is made as regulation, frequency and nominal AC voltage (V), mode of operation of each inverter.

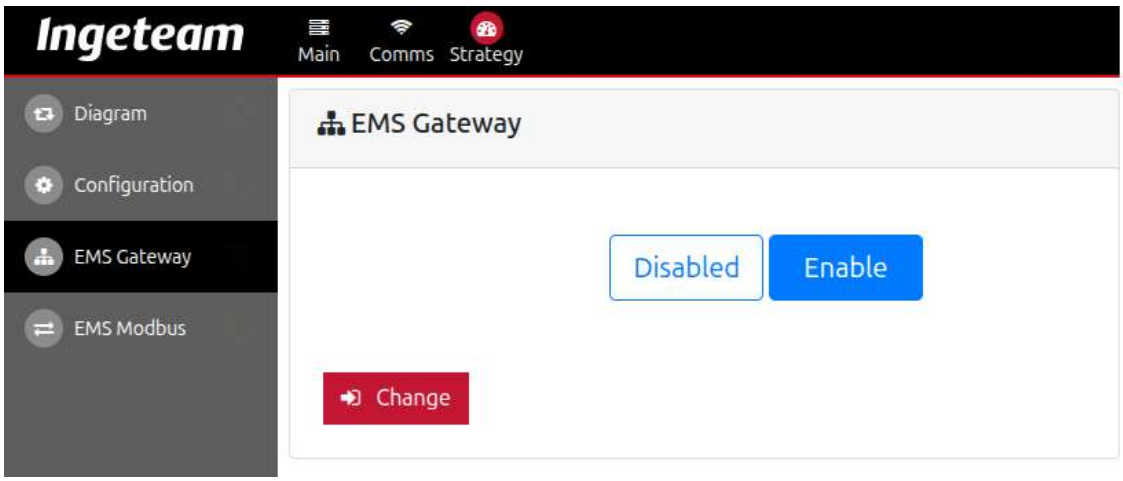


5.2 Running the EMS Wizard

On the EMS master inverter, run the EMS Wizard to register all devices in the installation. This step is used to register all devices (PV inverters, storage inverters, wattmeters and electric vehicle charger) will be controlled by the INGECON SUN® EMS.

6 Enable INGECON SUN® EMS Gateway

Once we have completed all the steps and have the installation up and running and controlled under the INGECON SUN® EMS, we proceed to enable the INGECON SUN® EMS Gateway. To do this, on the EMS Master Inverter, the user needs to go to *Strategy* > *EMS Gateway* and select the *Enable* option shown below.



Once the Modbus option is active, the INGECON SUN® EMS can be controlled via Modbus TCP.

7 Control Examples

Below are some examples of control via the INGECON SUN® EMS Gateway.

The type of control to be carried out will depend on the devices we have in our installation (solar inverters, storage inverters, electric vehicle charger, etc...).

7.1 Strategy Dynamic

In this mode, the INGECON SUN® EMS controls the devices of the installation in accordance with the control strategy defined by Ingeteam. By means of the registers defined in section 4.2.2, the external controller will be able to dynamically modify parameters such as Grid target, battery charging and discharging schedules, etc.

7.1.1.1 Operation via Modbus

a) Start Control

Writing the Operating Mode (Holding Registers)

- Writing 0x0000 to Holding Register 40001, for Strategy Dynamic Mode

b) Read the status information

Read the holding registers described in section 4.1 depending on the type of installation, single-phase or three-phase, and the status information.

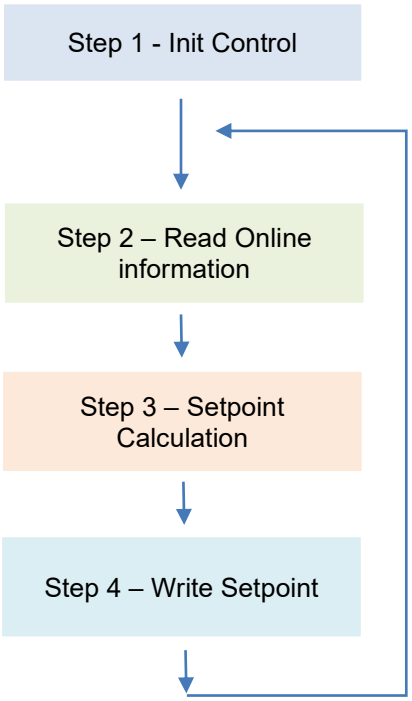
c) Decide on the parameter to modify

The external controller's algorithm decides which parameter to act on.

d) Entering the parameter to be modified (Holding Registers)

Write in the corresponding modbus zone described in section 4.2.2.

7.1.1.2 Control Diagram



7.2 Direct Control (Fixed Setpoint / Override)

This control mode should be used when the external controller is going to directly control the installation using its algorithms and control strategies. In this mode, the INGECON SUN® EMS Gateway acts as a gateway between the external controller and the devices defined in the installation (inverters, wattmeters, etc...), so that the INGECON SUN® EMS Gateway is responsible for transcribing the general setpoint of the external controller to the devices of the installation.

By means of the registers defined in section 4.2.3, the external controller may send photovoltaic generation setpoints, charging and discharging setpoints to the batteries, etc.

7.2.1 Direct control of photovoltaic generation

7.2.1.1 Operation via Modbus

a) Start Control

Writing the Operating Mode (Holding Registers)

- Writing 0x0005 to Holding Register 40001, for *Fixed Point Mode*
- Writing 0x0006 to Holding Register 40001, for *Override Mode*

Enter the Locker Type (Holding Registers)

- Write 0x0000 in the Holding Register 40201, for a deposit in %
- Write 0x0001 in the Holding Register 40001, for a W-entry

b) Read the status information

- For single-phase control

Start Address	Modbus Register	Description	Type	Unit	Category
4	30005	PV: Active Power generation	int32	W	Phase R
16	30017	PV: Total available power	uint32	W	Phase R
40	30041	Grid: Active Power	int32	W	Phase S
56	30057	PV: Total available power	uint32	W	Phase S
80	30081	Grid: Active Power	int32	W	Phase T
96	30097	PV: Total available power	uint32	W	Phase T

- For three-phase control

Start Address	Modbus Register	Description	Type	Unit	Category
204	30205	PV: Active Power generation	int32	W	Triphasic
216	30217	PV: Total available power	uint32	W	Triphasic

- For installation status information

Start Address	Modbus Register	Description	Type	Unit	Category
300	30301	Alarms	flags		Plant
		Not used	Bit 0		Plant
		Not used	Bit 1		Plant
		PV inverter lost between 10:00 and	Bit 2		Plant

		15:00			
301	30302	Status	flags		Plant
		Not used	Bit 0		Plant
		Not used	Bit 1		Plant
		PV inverter lost	Bit 2		Plant
		Not used	Bit 3		Plant
		PV inverter with alarms	Bit 4		Plant

c) Calculate the photovoltaic setpoint

Calculate the photovoltaic setpoint based on records 30017, 30057 and 30097 for single-phase control and 30217 for three-phase control.

For example, if there are 4 INEGCON SUN 3Play 110kW three-phase inverters:

- Reg: 30217: Photovoltaic: Total available power = 440,000 W

Setpoint in %

If the external controller requires:

- 330,000 W, the setpoint will be 75 (75%) at register 40041
- 220,000 W, the setpoint will be 50 (50%) at register 40041

W Setpoint

If the external controller requires:

- 330,000 W, the setpoint will be 330,000 at register 40203
- 220,000 W, the setpoint will be 220,000 at register 40203

d) Write the photovoltaic slogan (Holding Registers)

Setpoint in %

- For single-phase control

StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
70	40071	PV: Active Power R			int32	3 - SETPOINT: PV INVERTER (%)
71	40072	PV: Active Power S			int32	3 - SETPOINT: PV INVERTER (%)
72	40073	PV: Active Power T			int32	3 - SETPOINT: PV INVERTER (%)

- For three-phase control

StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
40	40041	PV: Active Power			int32	3 - SETPOINT: PV INVERTER (%)

W Setpoint

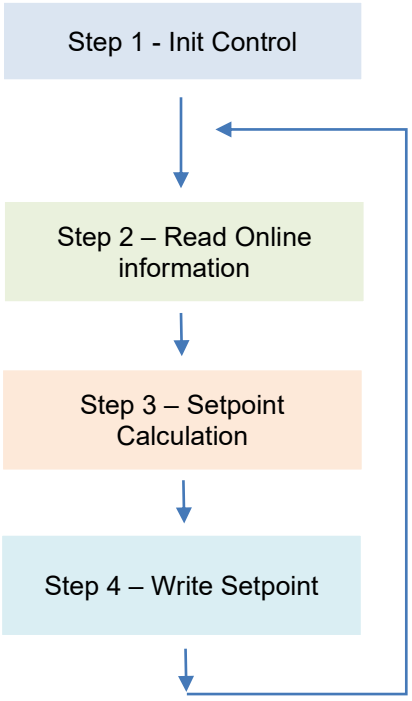
- For single-phase control

StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
206	40207	PV: Active Power R			int32	3 - SETPOINT: PV INVERTER (W)
207	40208	PV: Active Power S			int32	3 - SETPOINT: PV INVERTER (W)
208	40209	PV: Active Power T			int32	3 - SETPOINT: PV INVERTER (W)

- For three-phase control

StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
202	40203	PV: Active Power			int32	3 - SETPOINT: PV INVERTER (W)

7.2.1.2 Control Diagram



7.2.2 Direct control over storage

7.2.2.1 Operation via Modbus

a) Start Control

Writing the Operating Mode (Holding Registers)

- Writing 0x0009 to Holding Register 40001, for *Fixed Point Mode*
- Writing 0x000A to Holding Register 40001, for *Override Mode*

Enter the Locker Type (Holding Registers)

- Write 0x0000 in the Holding Register 40201, for a deposit in %
- Write 0x0001 in the Holding Register 40001, for a W-entry

Writing SOC (Holding Registers) Values

StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
106	40107	SOC Minimum	0	100	short	9 - BATTERY SOC LEVELS
107	40108	SOC Maximum	0	100	short	9 - BATTERY SOC LEVELS
108	40109	SOC Recovery	0	100	short	9 - BATTERY SOC LEVELS

b) Read the status information

- For three-phase control

Start Address	Modbus Register	Description	Type	Unit	Category
208	30209	Battery: Active Power discharge	int32	W	Triphasic
210	30211	reserved			
212	30213	Battery: Charge Power	int32	W	Triphasic
214	30215	Battery: SOC	uint16	%	Triphasic
215	30216	Battery: Voltage	uint16	V	Triphasic
216	30217	Not used			
218	30219	Battery: Total available power discharge	uint32	W	Triphasic
220	30221	Not used			
222	30221	Battery: Total available power charge	uint32	W	Triphasic

- For installation status information

Start Address	Modbus Register	Description	Type	Unit	Category
300	30301	Alarms	flags		Plant
		Not used	bit 0		
		Battery inverter lost for more than 15 minutes	bit 1		
		Not used	bit 2		
301	30302	Status	flags		Plant
		Not used	bit 0		
		Battery inverter lost	bit 1		
		Not used	bit 2		
		Battery inverter with alarms	bit 3		
		Not used	bit 4		

c) Calculate the battery setpoint

Calculate the loading/unloading setpoint based on entry records 30219 or 30221.

For example, if there are four 100kW INEGCON SUN 3Play battery inverters

- Reg: 30219: Battery: Total available discharge power = 400,000 W
- Reg: 30221: Battery: Total available charging power = 240,000 W

Setpoint in %

If the external controller requires:

- discharge at 300,000 W, the setpoint value will be 75 (75%) in register 40042.
- discharge at 200,000 W, the setpoint value will be 50 (50%) in register 40042.
- Load at 200,000 W, the setpoint will be -50 (-50%) in register 40042.
- Charging at 300,000 W (more than 240,000 W), the setpoint will be -75 (-75%) in register 40042, but the system will be limited to 60%.

W Setpoint

If the external controller requires:

- discharge at 300,000 W, the setpoint value will be 300,000 in register 40205.
- discharge at 200,000 W, the setpoint value will be 200,000 in register 40205.
- Load at 200,000 W, the setpoint value will be -300,000 in register 40205.

d) Write the Holding Registers

Setpoint in %

- For three-phase control

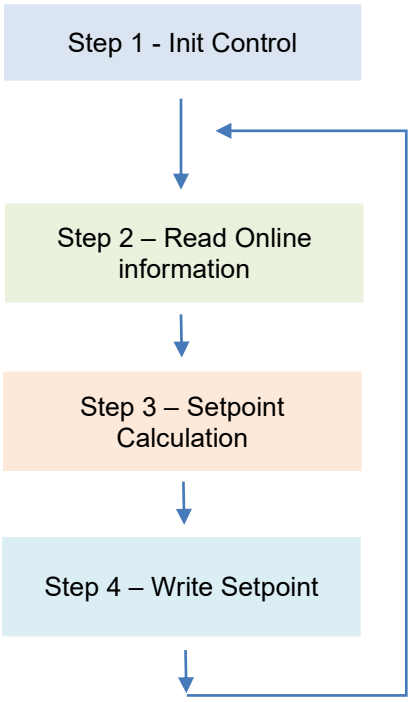
StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
41	40042	Battery: Setpoint	-100	100	int16	4 - SETPOINT: BATT INVERTER (%)

W Setpoint

- For three-phase control

StartAddress	Modbus Register	Description	Min Value	Max Value	Type	Category
204	40205	Battery: Setpoint			int32	4 - SETPOINT: BATT INVERTER (W)

7.2.2.2 Control Diagram



7.2.3 Direct control of photovoltaic generation and storage

In this mode of operation, we must follow the steps described in the previous points, indicating at the beginning the control of both types of devices.

7.2.3.1 Operation via Modbus

e) Start Control

Writing the Operating Mode (Holding Registers)

- Writing 0x000D to Holding Register 40001, for *Fixed Point Mode*
- Writing 0x000E to Holding Register 40001, for *Override Mode*

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1 Introducción

Ingeteam presenta la funcionalidad *INGECON SUN® EMS Gateway* para el control de las instalaciones de generación y almacenamiento, de manera uniforme, sencilla y escalable.

Esta funcionalidad permite realizar un control remoto del INGECON SUN® EMS utilizando el estándar de comunicación Modbus TCP.

INFO

Para descargar la última versión de este documento visite: www.ingeteam.com.

1.1 Símbolos

A lo largo de este documento, se incluyen advertencias para resaltar cierta información. En relación con la naturaleza del texto, existen tres tipos de advertencias.

⚠ DANGER	Esto indica un peligro para el personal o el dispositivo.
⚠ CAUTION	Indica importancia.
INFO	Información adicional o referencias a otras partes del documento o documentos.

2 Requerimientos de comunicación Modbus TCP

Los requisitos de comunicación Modbus TCP con el INGECON SUN® EMS Gateway son los siguientes:

- El Puerto Servidor Modbus TCP es el 522.
- El Modbus ID es el 01.
- El servidor Modbus TCP tiene un timeout de una hora por inactividad. Una vez pasado este tiempo, en servidor cerrará la conexión existente.
- En caso de no existsir ninguna conexión activa, el INGECON SUN® EMS realizará en control en función de la estrategia configurada por defecto.

El cliente Modbus TCP deberá seguir estos requisitos en su conexión al servidor Modbus TCP del INGECON SUN® EMS Gateway.

3 Tipos de control

Existen dos tipos de control mediante el INGECON SUN® EMS Gateway.

- Control dinámico de la estrategia de Ingeteam
  - Modo: Strategy Dynamic
- Control directo de la instalación
  - Modo: Fix Setpoint
  - Modo: Override

INFO

El cambio del tipo de control puede hacerse de manera dinámica y no es necesario reiniciar el INGECON SUN® EMS.

3.1 Control dinámico de la estrategia de Ingeteam

Este modo debe usarse cuando se requiera que el INGECON SUN® EMS controle los dispositivos de la instalación de manera autónoma, bajo la estrategia de autoconsumo del Ingeteam, pero, además, se desee cambiar de manera dinámica ciertos parámetros de control a través de Modbus TCP como Grid target, horarios de carga y descarga, niveles de SOC, etc…

INFO

Este es el modo de arranque por defecto del INGECON SUN® EMS.

3.2 Control directo de la instalación

Este modo de control debe usarse cuando el controlador externo va a controlar directamente la instalación mediante sus algoritmos y estrategias de control. En este modo, el INGECON SUN® EMS Gateway actúa como una pasarela entre el controlador externo y los dispositivos definidos en la instalación (inversores, vatímetros, etc…), de modos que, el INGECON SUN® EMS Gateway se encarga de transcribir la consigna general del controlador externo a los dispositivos de la instalación.

En este modo de control directo, el INGECON SUN® EMS Gateway dispone de 2 modos de funcionamiento, *Setpoint Fijo* y *Override*.

En el modo *Setpoint Fijo* el INGECON SUN® EMS Gateway reenvía el Setpoint recibido desde el controlador externo y lo mantiene fijo hasta que el controlador externo vuelva a enviar un nuevo setpoint.

En el modo *Override*, el controlador externo debe enviar un setpoint con una periodicidad menor a 1,15s para que el INGECON SUN® EMS lo reenvíe a los dispositivos de la planta (ya que sino saltará el timeout de los inversores y se entonces la instalación irá a potencia 0).

Los dispositivos disponibles en la instalación son: inversores fotovoltaicos, inversores con almacenamiento, y cargador de vehículo eléctrico.

A estos dispositivos se les puede enviar:

- Setpoint de generación para inversores fotovoltaicos
- Setpoint de carga/descarga de la batería para inversores con almacenamiento
- Potencia disponible en la instalación para la carga de vehículo eléctrico.

Cada una de estas setpoints tienen definidos unos registros propios para indicar a qué dispositivos se va a enviar un determinado setpoint.

4 Mapa Modbus del INGECON SUN® EMS Gateway

4.1 Input registers – Datos Online

A continuación, se presentan los Input registers que muestran los datos Online de la instalación controlada bajo el INGECON SUN® EMS Gateway. Dicha información será consultada mediante Modbus TCP por el controlador externo, para monitorizar el estado de la instalación.

La información está dividida en bloques de información monofásica, trifásica y una zona común con alarmas y el estado general de la instalación. El controlador externo utilizará las zonas de monitorización necesarias en función de los dispositivos y el tipo de instalación.

4.1.1 Información monofásica

Start Address	Modbus Register	Description	Type	Magnitude	Category
0	30001	Grid: Active Power	int32	W	Phase R
2	30003	reserved	-	-	Phase R
4	30005	PV: Active Power generation	int32	W	Phase R
6	30007	reserved	-	-	Phase R
8	30009	Battery: Active Power discharge	int32	W	Phase R
10	30011	reserved	-	-	Phase R
12	30013	Battery: Charge Power	int32	W	Phase R
14	30015	Battery: SOC	uint16	%	Phase R
15	30016	Battery: Voltage	uint16	V	Phase R
16	30017	PV: Total installed power	uint32	W	Phase R
18	30019	Battery: Total installed power	uint32	W	Phase R
20	30021	Rev Station: Power consumed	int32	W	Phase R

40	30041	Grid: Active Power	int32	W	Phase S
42	30043	reserved	-	-	Phase S
44	30045	PV: Active Power generation	int32	W	Phase S
46	30047	reserved	-	-	Phase S
48	30049	Battery: Active Power discharge	int32	W	Phase S
50	30051	reserved	-	-	Phase S
52	30053	Battery: Charge Power	int32	W	Phase S
54	30055	Battery: SOC	uint16	%	Phase S
55	30056	Battery: Voltage	uint16	V	Phase S
56	30057	PV: Total installed power	uint32	W	Phase S
58	30059	Battery: Total installed power	uint32	W	Phase S
60	30061	Rev Station: Power consumed	int32	W	Phase S

80	30081	Grid: Active Power	int32	W	Phase T
82	30083	reserved	-	-	Phase T
84	30085	PV: Active Power generation	int32	W	Phase T
86	30087	reserved	-	-	Phase T
88	30089	Battery: Active Power discharge	int32	W	Phase T

90	30091	reserved	-	-	Phase T
92	30093	Battery: Charge Power	int32	W	Phase T
94	30095	Battery: SOC	uint16	%	Phase T
95	30096	Battery: Voltage	uint16	V	Phase T
96	30097	PV: Total installed power	uint32	W	Phase T
98	30099	Battery: Total installed power	uint32	W	Phase T
100	30101	Rev Station: Power consumed	int32	W	Phase T

4.1.2 Información trifásica

Start Address	Modbus Register	Description	Type	Magnitude	Category
200	30201	Grid: Active Power	int32	W	Triphasic
202	30203	reserved	-	-	Triphasic
204	30205	PV: Active Power generation	int32	W	Triphasic
206	30207	reserved	-	-	Triphasic
208	30209	Battery: Active Power discharge	int32	W	Triphasic
210	30211	reserved	-	-	Triphasic
212	30213	Battery: Charge Power	int32	W	Triphasic
214	30215	Battery: SOC	uint16	%	Triphasic
215	30216	Battery: Voltage	uint16	V	Triphasic
216	30217	PV: Total installed power	uint32	W	Triphasic
218	30219	Battery: Total installed power	uint32	W	Triphasic
220	30221	Rev Station: Power consumed	int32	W	Triphasic

4.1.3 Información general de estado

Start Address	Modbus Register	Description	Type	Magnitude	Category
300	30301	Alarms	flags		Plant
		Power meter lost for more than 15 minutes	bit 0		Plant
		Battery inverter lost for more than 15 minutes	bit 1		Plant
		PV inverter lost between 10:00 and 15:00	bit 2		Plant
301	30302	Status	flags		Plant
		Power meter lost	bit 0		Plant
		Battery inverter lost	bit 1		Plant
		PV inverter lost	bit 2		Plant
		Battery inverter with alarms	bit 3		Plant
		PV inverter with alarms	bit 4		Plant

4.2 Holding registers – Parámetros de Configuración y Setpoints

A continuación, se presentan los Holding registers del INGECON SUN® EMS Gateway. Estos registros de lectura/escritura serán utilizados por el controlador externo, para configurar y establecer los diferentes modos de control de la instalación, envío de consignas, etc…

4.2.1 Registro para el Modo de Control

Start Address	Modbus Register		Description	Type	Unit	Min	Max	Category
0	40001		Control Mode Register					1 - MODBUS CONTROL MODE
		Bit 1-0	Control mode					1 - MODBUS CONTROL MODE
			• 00 : STRATEGY DYNAMIC					1 - MODBUS CONTROL MODE
			• 01 : FIXED SETPOINT					1 - MODBUS CONTROL MODE
			• 10 : OVERRIDE					1 - MODBUS CONTROL MODE
		Bit 2	PV Active Control					1 - MODBUS CONTROL MODE
			• 0 : Disable					1 - MODBUS CONTROL MODE
			• 1 : Enable					1 - MODBUS CONTROL MODE
		Bit 3	Battery Control					1 - MODBUS CONTROL MODE
			• 0 : Disable					1 - MODBUS CONTROL MODE
			• 1 : Enable					1 - MODBUS CONTROL MODE
		Bit 5	Rev Station available power update					1 - MODBUS CONTROL MODE
			• 0 : Disable					1 - MODBUS CONTROL MODE
			• 1 : Enable					1 - MODBUS CONTROL MODE

4.2.2 Registros para Control dinámico (Strategy Dynamic)

Start Address	Modbus Register		Description	Type	Unit	Min	Max	Category
20	40021		Active Power: Grid Target	int32	W			2 - STRATEGY DYNAMIC CONTROL
100	40101		Peak-shaving (Only for three phase inverters)	int32	W			7 - PEAK SHAVING
102	40103		Limit battery charge from grid	enum [decimal]				8 - LIMIT BATTERY CHARGE FROM GRID
			• 0 : Disabled					8 - LIMIT BATTERY CHARGE FROM GRID
			• 1 : Enabled					8 - LIMIT BATTERY CHARGE FROM GRID
103	40104		Maximum charge power	int32				8 - LIMIT BATTERY CHARGE FROM GRID
	40106		Force SOCs to Inverters					9 - BATTERY SOC LEVELS
			• 0 : Disabled					9 - BATTERY SOC LEVELS
			• 1 : Enabled					9 - BATTERY SOC LEVELS
106	40107		SOC Minimum	short	%	0	100	9 - BATTERY SOC LEVELS
107	40108		SOC Maximum	short	%	0	100	9 - BATTERY SOC LEVELS
108	40109		SOC Recovery	short	%	0	100	9 - BATTERY SOC LEVELS
109	40110		Status	enum [decimal]				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 0 : Disabled	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 1 : All week	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 2 : Weekdays	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
			• 3 : Weekend	int				10 - BATTERY CHARGE FROM GRID SCHEDULE 1
110	40111		From: Hour	short	hh	0	23	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
111	40112		From: Minute	short	mm	0	59	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
112	40113		To: Hour	short	hh	0	23	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
113	40114		To: Minute	short	mm	0	59	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
114	40115		SOC Grid	short	%	0	100	10 - BATTERY CHARGE FROM GRID SCHEDULE 1
115	40116		Status	enum [decimal]				11 - BATTERY CHARGE FROM GRID SCHEDULE 2

			• 0 : Disabled	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
			• 1 : All week	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
			• 2 : Weekdays	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
			• 3 : Weekend	int				11 - BATTERY CHARGE FROM GRID SCHEDULE 2
116	40117		From: Hour	short	hh	0	23	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
117	40118		From: Minute	short	mm	0	59	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
118	40119		To: Hour	short	hh	0	23	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
119	40120		To: Minute	short	mm	0	59	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
120	40121		SOC Grid	short	%	0	100	11 - BATTERY CHARGE FROM GRID SCHEDULE 2
121	40122		Status	enum [decimal]				12 - BATTERY DISCHARGE SCHEDULE 1
			• 0 : Disabled	int				12 - BATTERY DISCHARGE SCHEDULE 1
			• 1 : All week	int				12 - BATTERY DISCHARGE SCHEDULE 1
			• 2 : Weekdays	int				12 - BATTERY DISCHARGE SCHEDULE 1
			• 3 : Weekend	int				12 - BATTERY DISCHARGE SCHEDULE 1
122	40123		From: Hour	short	hh	0	23	12 - BATTERY DISCHARGE SCHEDULE 1
123	40124		From: Minute	short	mm	0	59	12 - BATTERY DISCHARGE SCHEDULE 1
124	40125		To: Hour	short	hh	0	23	12 - BATTERY DISCHARGE SCHEDULE 1
125	40126		To: Minute	short	mm	0	59	12 - BATTERY DISCHARGE SCHEDULE 1
126	40127		Status	enum [decimal]				13 - BATTERY DISCHARGE SCHEDULE 2
			• 0 : Disabled	int				13 - BATTERY DISCHARGE SCHEDULE 2
			• 1 : All week	int				13 - BATTERY DISCHARGE SCHEDULE 2
			• 2 : Weekdays	int				13 - BATTERY DISCHARGE SCHEDULE 2
			• 3 : Weekend	int				13 - BATTERY DISCHARGE SCHEDULE 2
127	40128		From: Hour	short	hh	0	23	13 - BATTERY DISCHARGE SCHEDULE 2
128	40129		From: Minute	short	mm	0	59	13 - BATTERY DISCHARGE SCHEDULE 2
129	40130		To: Hour	short	hh	0	23	13 - BATTERY DISCHARGE SCHEDULE 2
130	40131		To: Minute	short	mm	0	59	13 - BATTERY DISCHARGE SCHEDULE 2

Peak-shaving (W)
Consumo mínimo de red para activar la descarga de batería. La consigna de descarga será la diferencia entre este parámetro y el pico de consumo. Sólo para inversores trifásicos.
0

Limitar carga de batería desde red
No Sí

Máxima potencia de carga (W)
Máxima potencia de carga desde la red/generador
0

Niveles de SOC de la batería

SOC Min (%)
Estado de carga por debajo del cual no se permite la descarga de la batería habiendo conexión a red. Es necesario alcanzar SOC Recovery para reanudar el autoconsumo con aporte de batería.
30

SOC Max (%)
Estado de carga máximo para cargar las baterías desde la energía fotovoltaica.
100

SOC Recovery (%)
Estado de carga por encima del cual se reanuda la descarga de la batería, una vez que se viene desde SOC Min. Se evita un ciclado excesivo de la batería alargando su vida útil.
60

Horario para carga de batería desde la red

Horario 1: Entre semana (L-V)
Desde 8 : 0 hh:mm
Hasta 16 : 0 hh:mm

Horario 2: Fin de semana (S-D)
Desde 0 : 0 hh:mm
Hasta 0 : 0 hh:mm

SOC Grid (%)
Estado de carga máximo para cargar las baterías desde la red. Este valor debe ser mayor que el SOC mínimo
0

SOC Grid (%)
Estado de carga máximo para cargar las baterías desde la red. Este valor debe ser mayor que el SOC mínimo
0

Horario para descarga de batería

Horario 1: Desactivado

Horario 2: Desactivado

4.2.3 Registros para Control directo (Fixed Setpoint / Override)

Start Address	Modbus Register		Description	Type	Unit	Min	Max	Category
40	40041		PV: Setpoint	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
41	40042		Battery: Setpoint	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
42	40043		reserved					
70	40071		PV: Setpoint R	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
71	40072		PV: Setpoint S	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
72	40073		PV: Setpoint T	int16	%	0	100	3 - SETPOINT: PV INVERTER (%)
73	40074		Battery: Setpoint R	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
74	40075		Battery: Setpoint S	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
75	40076		Battery: Setpoint T	int16	%	-100	100	4 - SETPOINT: BATT INVERTER (%)
76	40077		reserved					
77	40078		reserved					
78	40079		reserved					
79	40080		Available Power R	int32	W			6 - AVAILABLE: REV CHARGE
81	40082		Available Power S	int32	W			6 - AVAILABLE: REV CHARGE
83	40084		Available Power T	int32	W			6 - AVAILABLE: REV CHARGE

200	40201		PV Setpoint mode	enum [decimal]				3 - SETPOINT: PV INVERTER
			• 0 : Percentage					3 - SETPOINT: PV INVERTER
			• 1 : Watts					3 - SETPOINT: PV INVERTER
201	40202		Battery Setpoint mode	enum [decimal]				4 - SETPOINT: BATT INVERTER
			• 0 : Percentage					4 - SETPOINT: BATT INVERTER
			• 1 : Watts					4 - SETPOINT: BATT INVERTER
202	40203		PV: Active Power	int32	W	0		3 - SETPOINT: PV INVERTER (W)
204	40205		Battery: Setpoint	int32	W			4 - SETPOINT: BATT INVERTER (W)

206	40207		PV: Active Power R	int32	W	0		3 - SETPOINT: PV INVERTER (W)
208	40209		PV: Active Power S	int32	W	0		3 - SETPOINT: PV INVERTER (W)
210	40211		PV: Active Power T	int32	W	0		3 - SETPOINT: PV INVERTER (W)
212	40213		Battery: Setpoint R	int32	W			4 - SETPOINT: BATT INVERTER (W)
214	40215		Battery: Setpoint S	int32	W			4 - SETPOINT: BATT INVERTER (W)
216	40217		Battery: Setpoint T	int32	W			4 - SETPOINT: BATT INVERTER (W)

Nota:

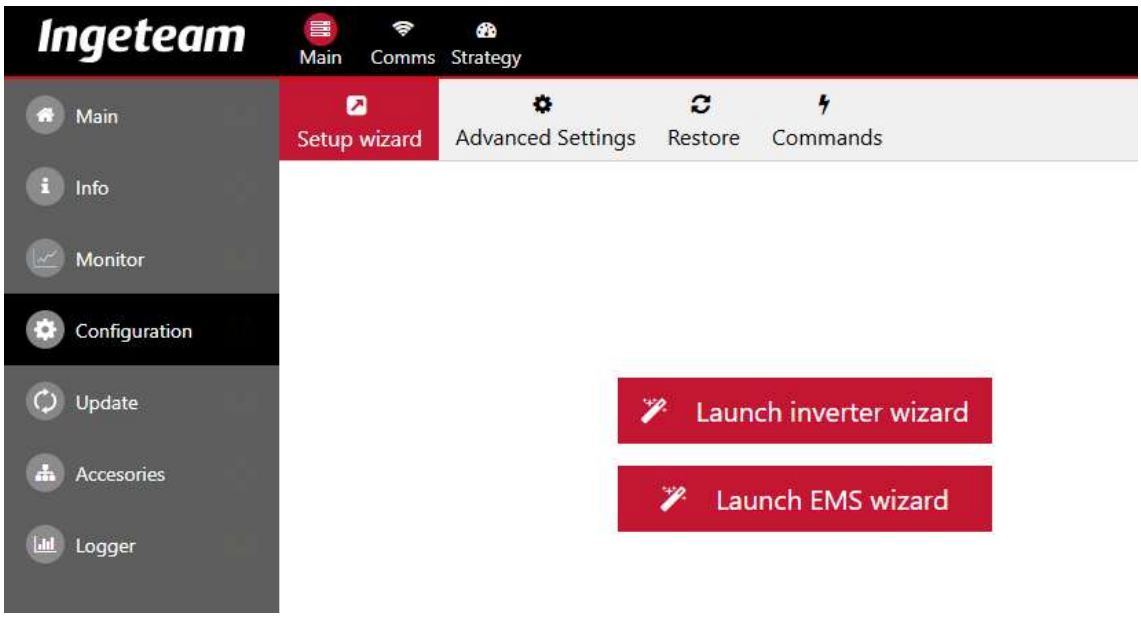
- Los porcentajes a enviar como setpoint son sobre la potencia nominal del equipo. Por ejemplo, en el caso del ISS 100TL la potencia nominal de carga es 60kW y la de descarga 100kW. Un 50% de carga equivaldría a 30kW, así como un 50% de descarga equivaldría a 50kW.
- Batería: Setpoint > 0 -> Descarga
- Batería: Setpoint < 0 -> Carga
- Batería: Setpoint = 0 -> No Carga / No Descarga

5 Puesta en marcha de la instalación y del INGECON SUN® EMS

El primer paso consiste en realizar la puesta en marcha y configuración de todos los dispositivos de la instalación (inversores fotovoltaicos, inversores de almacenamiento, vatímetros, etc...), además del INGECON SUN® EMS mediante su wizard inicial.

5.1 Ejecutar el Wizard de puesta de inversor

En cada inversor de la instalación, ejecutar el Wizard de puesta en marcha. En este paso se realiza la configuración como regulación, frecuencia y Voltaje AC nominal (V), modo de operación de cada inversor.

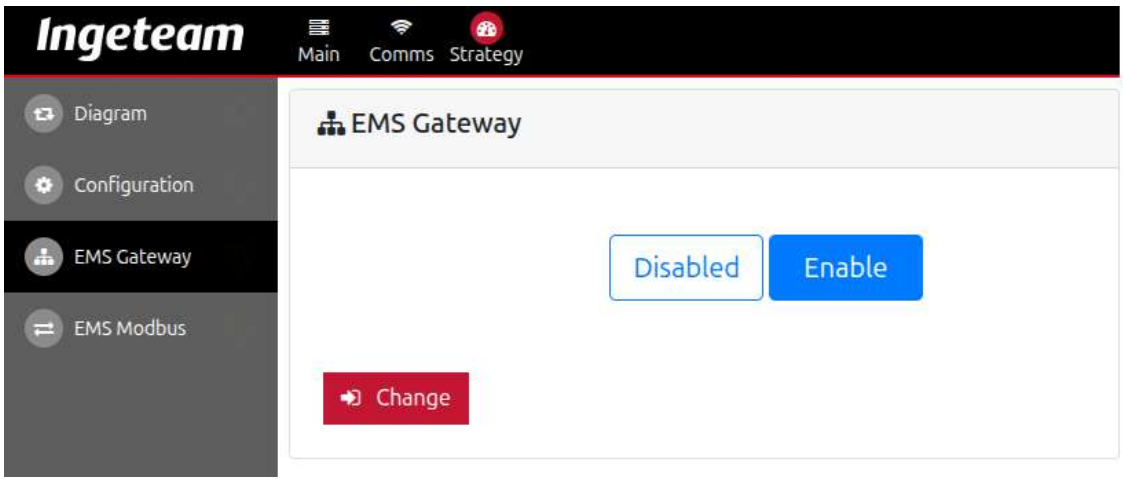


5.2 Ejecutar el Wizard de EMS

En el inversor maestro EMS, ejecutar el Wizard de EMS para registrar todos los dispositivos de la instalación. Este paso se utiliza para registrar todos los dispositivos (inversores fotovoltaicos, inversores de almacenamiento, vatímetros y cargador de vehículo eléctrico) serán controlados por el INGECON SUN® EMS.

6 Habilitar INGECON SUN® EMS Gateway

Una vez hayamos realizado todos los pasos y tengamos la instalación en marcha y controlada bajo el INGECON SUN® EMS, procedemos a habilitar el INGECON SUN® EMS Gateway. Para ello, en el inversor maestro EMS, el usuario debe ir a *Estrategia* > *EMS Gateway* y seleccionar la opción *Enable* que se muestra a continuación.



Una vez que la opción Modbus está activa, el INGECON SUN® EMS se puede controlar a través de Modbus TCP.

7 Ejemplos de Control

A continuación, presentamos unos ejemplos de control a través del INGECON SUN® EMS Gateway.

El tipo de control a realizará dependerá de los dispositivos que tengamos en nuestra instalación (inversores solares, inversores almacenamiento, cargador vehículo eléctrico, etc…).

7.1 Control dinámico (Strategy Dynamic)

En este modo el INGECON SUN® EMS controla los dispositivos de la instalación conforme a la estrategia de control definida por Ingeteam. Mediante los registros definidos en el apartado 4.2.2 el controlador externo podrá modificar de manera dinámica parámetros como Grid target, horarios de carga y descarga de baterías, etc…

7.1.1.1 Operación mediante Modbus

e) Inicio de Control

Escribir el modo de operación (Holding Registers)

- Escribir 0x0000 en el Holding Register 40001, para el modo *Strategy dynamic*

f) Leer la información de estado

Leer los Holding registers descritos en el apartado 4.1 en función de tipo de instalación, monofásica o trifásica, y la información de estado.

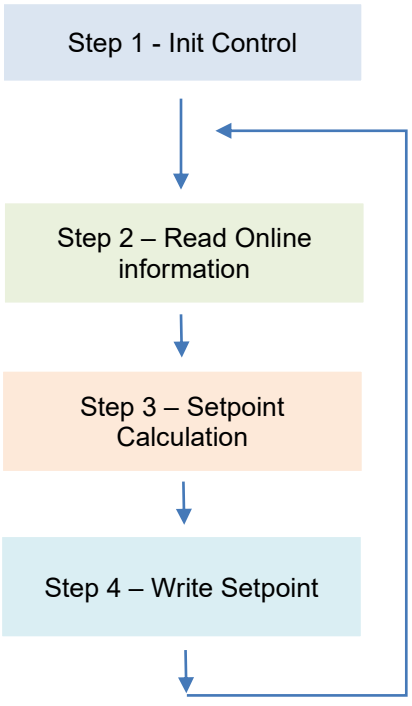
g) Decidir el parámetro a modificar

El algoritmo del controlador externo decide sobre qué parámetro debe actuar.

h) Escribir el parámetro a modificar (Holding Registers)

Escribir en la zona modbus correspondiente descrita en el apartado 4.2.2.

7.1.1.2 Diagrama de Control



7.2 Control directo (Fixed Setpoint / Override)

Este modo de control debe usarse cuando el controlador externo va a controlar directamente la instalación mediante sus algoritmos y estrategias de control. En este modo, el INGECON SUN® EMS Gateway actúa como una pasarela entre el controlador externo y los dispositivos definidos en la instalación (inversores, vatímetros, etc…), de modos que, el INGECON SUN® EMS Gateway se encarga de transcribir la consigna general del controlador externo a los dispositivos de la instalación.

Mediante los registros definidos en el apartado 4.2.3 el controlador externo podrá enviar consignas de generación fotovoltaica, consignas de carga y descarga a las baterías, etc…

7.2.1 Control directo de la generación fotovoltaica

7.2.1.1 Operación mediante Modbus

f) Inicio de Control

Escribir el modo de operación (Holding Registers)

- Escribir 0x0005 en el Holding Register 40001, para el modo *Fixed point*
- Escribir 0x0006 en el Holding Register 40001, para el modo *Override*

Escribir el tipo de consigna (Holding Registers)

- Escribir 0x0000 en el Holding Register 40201, para consigna en %
- Escribir 0x0001 en el Holding Register 40001, para consigna en W

g) Leer la información de estado

- Para control monofásico

Start Address	Modbus Register	Description	Type	Unit	Category
4	30005	PV: Active Power generation	int32	W	Phase R
16	30017	PV: Total available power	uint32	W	Phase R
40	30041	Grid: Active Power	int32	W	Phase S
56	30057	PV: Total available power	uint32	W	Phase S
80	30081	Grid: Active Power	int32	W	Phase T
96	30097	PV: Total available power	uint32	W	Phase T

- Para control trifásico

Start Address	Modbus Register	Description	Type	Unit	Category
204	30205	PV: Active Power generation	int32	W	Triphasic
216	30217	PV: Total available power	uint32	W	Triphasic

- Para información de estado de la instalación

Start Address	Modbus Register	Description	Type	Unit	Category
300	30301	Alarms	flags		Plant
		Not used	Bit 0		Plant
		Not used	Bit 1		Plant
		PV inverter lost between 10:00 and	Bit 2		Plant

		15:00			
301	30302	Status	flags		Plant
		Not used	Bit 0		Plant
		Not used	Bit 1		Plant
		PV inverter lost	Bit 2		Plant
		Not used	Bit 3		Plant
		PV inverter with alarms	Bit 4		Plant

h) Calcular la consigna fotovoltaica

Calcular el setpoint fotovoltaico en función de los registros 30017, 30057 y 30097 para control monofásico y 30217 para control trifásico.

Por ejemplo, si hay 4 inversores trifásicos INEGCON SUN 3Play de 110kW:

- Reg: 30217: Fotovoltaico: Potencia total disponible = 440.000 W

Consigna en %

Si el controlador externo requiere:

- 330.000 W, el setpoint será 75 (75 %) en el registro 40041
- 220.000 W, el setpoint será 50 (50 %) en el registro 40041

Consigna en W

Si el controlador externo requiere:

- 330.000 W, el setpoint será 330.000 en el registro 40203
- 220.000 W, el setpoint será 220.000 en el registro 40203

i) Escribir la consigna fotovoltaica (Holding Registers)

Consigna en %

- Para control monofásico

Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
70	40071	PV: Active Power R			int32	3 - SETPOINT: PV INVERTER (%)
71	40072	PV: Active Power S			int32	3 - SETPOINT: PV INVERTER (%)
72	40073	PV: Active Power T			int32	3 - SETPOINT: PV INVERTER (%)

- Para control trifásico

Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
40	40041	PV: Active Power			int32	3 - SETPOINT: PV INVERTER (%)

Consigna en W

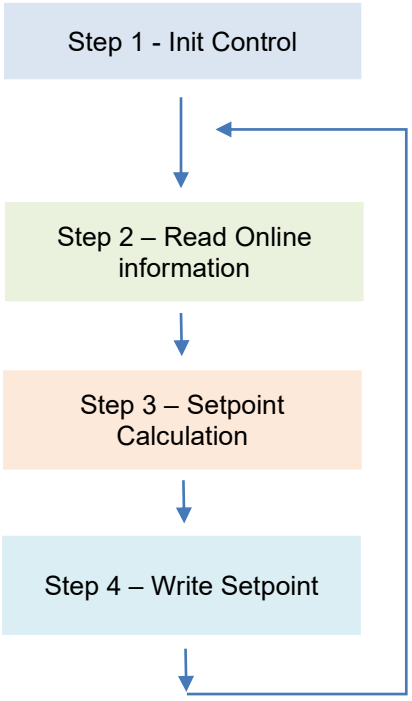
- Para control monofásico

Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
206	40207	PV: Active Power R			int32	3 - SETPOINT: PV INVERTER (W)
207	40208	PV: Active Power S			int32	3 - SETPOINT: PV INVERTER (W)
208	40209	PV: Active Power T			int32	3 - SETPOINT: PV INVERTER (W)

- Para control trifásico

Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
202	40203	PV: Active Power			int32	3 - SETPOINT: PV INVERTER (W)

7.2.1.2 Diagrama de Control



7.2.2 Control directo sobre el almacenamiento

7.2.2.1 Operación mediante Modbus

e) Inicio de Control

Escribir el modo de operación (Holding Registers)

- Escribir 0x0009 en el Holding Register 40001, para el modo *Fixed point*
- Escribir 0x000A en el Holding Register 40001, para el modo *Override*

Escribir el tipo de consigna (Holding Registers)

- Escribir 0x0000 en el Holding Register 40201, para consigna en %
- Escribir 0x0001 en el Holding Register 40001, para consigna en W

Escribir los valores de SOC (Holding Registers)

Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
106	40107	SOC Minimum	0	100	short	9 - BATTERY SOC LEVELS
107	40108	SOC Maximum	0	100	short	9 - BATTERY SOC LEVELS
108	40109	SOC Recovery	0	100	short	9 - BATTERY SOC LEVELS

f) Leer la información de estado

- Para control trifásico

Start Address	Modbus Register	Description	Type	Unit	Category
208	30209	Battery: Active Power discharge	int32	W	Triphasic
210	30211	reserved			
212	30213	Battery: Charge Power	int32	W	Triphasic
214	30215	Battery: SOC	uint16	%	Triphasic
215	30216	Battery: Voltage	uint16	V	Triphasic
216	30217	Not used			
218	30219	Battery: Total available power discharge	uint32	W	Triphasic
220	30221	Not used			
222	30221	Battery: Total available power charge	uint32	W	Triphasic

- Para información de estado de la instalación

Start Address	Modbus Register	Description	Type	Unit	Category
300	30301	Alarms	flags		Plant
		Not used	bit 0		
		Battery inverter lost for more than 15 minutes	bit 1		
		Not used	bit 2		
301	30302	Status	flags		Plant
		Not used	bit 0		
		Battery inverter lost	bit 1		
		Not used	bit 2		
		Battery inverter with alarms	bit 3		
		Not used	bit 4		

g) Calcular la consigna de batería

Calcular el setpoint de carga/descarga según los registros de entrada 30219 o 30221.

Por ejemplo, si hay cuatro inversores de batería INEGCON SUN 3Play de 100kW

- Reg: 30219: Batería: Potencia total disponible de descarga = 400.000 W
- Reg: 30221: Batería: Potencia total disponible de carga = 240.000 W

Consigna en %

Si el controlador externo requiere:

- descarga a 300.000 W, el valor de consigna será 75 (75 %) en el registro 40042.
- descarga a 200.000 W, el valor de consigna será 50 (50 %) en el registro 40042.
- carga a 200.000 W, el valor de consigna será -50 (-50 %) en el registro 40042.
- carga a 300.000 W (más de 240.000 W), el valor de consigna será -75 (-75 %) en el registro 40042, pero el sistema estará limitado al 60 %.

Consigna en W

Si el controlador externo requiere:

- descarga a 300.000 W, el valor de consigna será 300.000 en el registro 40205.
- descarga a 200.000 W, el valor de consigna será 200.000 en el registro 40205.
- carga a 200.000 W, el valor de consigna será -300.000 en el registro 40205.

h) Escribir la consigna de almacenamiento (Holding Registers)

Consigna en %

- Para control trifásico

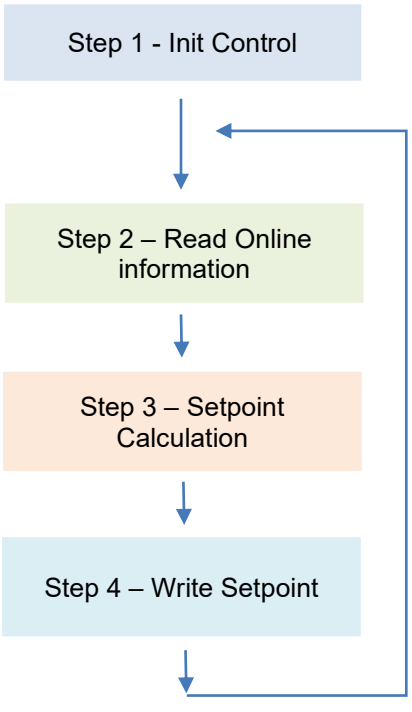
Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
41	40042	Battery: Setpoint	-100	100	int16	4 - SETPOINT: BATT INVERTER (%)

Consigna en W

- Para control trifásico

Start Address	Modbus Register	Description	Min Value	Max Value	Type	Category
204	40205	Battery: Setpoint			int32	4 - SETPOINT: BATT INVERTER (W)

7.2.2.2 Diagrama de Control



7.2.3 Control directo de la generación fotovoltaica y almacenamiento

En este modo de operación debemos seguir los pasos descritos en los puntos anteriores indicando en inicio el control de ambos tipos de dispositivos.

7.2.3.1 Operación mediante Modbus

j) Inicio de Control

Escribir el modo de operación (Holding Registers)

- Escribir 0x000D en el Holding Register 40001, para el modo *Fixed point*
- Escribir 0x000E en el Holding Register 40001, para el modo *Override*