THREE-PHASE INVERTER MANAGEMENT WITH MODBUS RTU

AAS1100IMB08_H

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1. INTRODUCTION

This report contains some documentation about all Ingecon Sun Three-phase family. The following information explains on one hand how to get information of the inverter and on the other hand how to manage the inverter using the MODBUS RTU protocol.

2. INPUT REGISTERS

Relevant data in each 3-phase Ingecon Sun is identified as a 16 bit **Input Registers** in the 30001 Modbus Range, accessible with Function 0x04. Note that 0x30001 range is a Modbus naming convention, and in practice register 0x30001 register is addressed at 0, and so on.

INPUT REGISTER QWERY:

--	Inverter Address[1 .. 247]
0x04	Read Input Registers
0x00	Address of 1st register (HI byte)
0x00	Address of 1st register (LO byte)
0x00	Number of registers to read (HI byte)
0x7B	Number of registers to read (LO byte)
--	Cyclic redundancy code (HI byte)
--	Cyclic redundancy code (LO byte)

MODBUS ADDRESS	DESCRIPTION	DATA TYPE	UNIT	DATA TYPE	SCALING
30001	Total AC Energy. 30001 and 30002 registers are the High and Low parts, respectively, of the 32 bit variable that stores, in kWh, the total value of produced energy over its lifecycle.	INT32	kWh	IR (READ)	x1
30003	Hours up and running 30003 and 30004 registers are the High and Low parts, respectively, of the 32 bit variable that stores the number of hours that the inverter has been running.	UINT32	hour	IR (READ)	x1
30005	Number of connections to grid (High)	UINT32	pu	IR (READ)	N/A
30007	Inverter alarms (high) Not used	UINT16	bitwise	IR (READ)	N/A
30008	Inverter alarms (low)	UINT16	bitwise	IR (READ)	N/A
	-. ALARMA_FRED (0x0001): Grid frequency outside limits.				
	-. ALARMA_VRED (0x0002): Grid voltage outside limits.				
	-. ALARMA_PI_ANA (0x0004): Current PI saturation.				
	-. ALARMA_RESET_WD (0x0008): inverter reset by Watch Dog				
	-. ALARMA_IRED_EFICAZ (0x0010): Excessive RMS grid current				
	-. ALARMA_TEMPERATURA (0x0020): Max. Temperature reached.				

	-. ALARMA_LEC_ADC (0x0040): A/D converters reading error				
	-. ALARMA_IRED_INSTA (0x0080): AC overcurrent				
	-. ALARMA_PROT_AC (0x0100): AC protections				
	-. ALARMA_PROT_DC (0x0200): DC protections				
	-. ALARMA_PARO_AISL_DC (0x0400): DC Isolation Failure.				
	-. ALARMA_FRAMA (0x0800): Failure in power electronics				
	-. ALARMA_PARO_MANUAL (0x1000): Manual stop				
	-. ALARMA_CONFIG (0x2000): Change in configuration				
	-. ALARMA_VIN (0x4000): Excessive input voltage				
	-. ALARMA_VPV_MED_MIN (0x8000): Minimim input voltage reached				
	-. ALARMA_FALLO_HW_DC (0x0240): DC HW failure				
	-. ALARMA_BLOQUEO COMMS (0x1200): Blocked by Modbus command				
	-. ALARMA_ERROR_FATAL (0x7FFF): Fatal error ocurred				
30009	Vdc: DC input voltage, in Volts	UINT16	Volts	IR (READ)	x1
30010	Idc: Average input current estimation. In Amps	UINT16	Amperes	IR (READ)	x1
30011	Vac1: Grid RMS Voltage, phase 1, in Volts	UINT16	Volts	IR (READ)	x1
30012	Vac2: Grid RMS Voltage, phase 2, in Volts	UINT16	Volts	IR (READ)	X1
30013	Vac3: Grid RMS Voltage, phase 3, in Volts	UINT16	Volts	IR (READ)	X1
30014	Iac1: Grid RMS Current, phase 1, in Amps	UINT16	Amperes	IR (READ)	X1
30015	Iac2: Grid RMS Current, phase 2, in Amps	UINT16	Amperes	IR (READ)	X1
30016	Iac3: Grid RMS Current, phase 3, in Amps	UINT16	Amperes	IR (READ)	X1
30017	Cos(phi) : in thousandths (phi, delay angle between AC voltage and current)	INT16	º	IR (READ)	x1000
30018	Sign of sin(j). 1 and -1 are for positive and negative values, respectively.	INT16	pu	IR (READ)	N/A
30019	Active Power: Alternating output power generated by the INGECON-SUN, in tens of Watt.	INT16	Watts	IR (READ)	x10
30020	Grid frequency, in hundredths of Hz	UINT16	Hz	IR (READ)	x100
30021	Current year.	UINT16	yy	IR (READ)	x1
30022	Current month	UINT16	mm	IR (READ)	x1
30023	Current day	UINT16	dd	IR (READ)	x1
30024	Current hour	UINT16	hh	IR (READ)	x1
30025	Current minute	UINT16	mm	IR (READ)	x1
30026	Current sec	UINT16	ss	IR (READ)	x1
30027	Sun position (tenths of degree)	UINT16	degree	IR (READ)	x10
30028	Suntracker 1, mode	UINT16	pu	IR (READ)	N/A
30029	Suntracker 1, motor state	UINT16	pu	IR (READ)	N/A

30030	Suntracker 1, motor position (tenths of degree)	UINT16	degree	IR (READ)	x10
30031	Suntracker 1, motor position command (tenths of degree)	UINT16	degree	IR (READ)	x10
30032	Suntracker 1, alarms	UINT16	bitwise	IR (READ)	N/A
30033	Suntracker 1, automatic tracking offset (tenths of degree)	UINT16	degree	IR (READ)	x10
30034	Suntracker 1, automatic step (tenths of degree)	UINT16	degree	IR (READ)	x10
30035	Suntracker 2, mode	UINT16	bitwise	IR (READ)	N/A
30036	Suntracker 2, motor state	UINT16	bitwise	IR (READ)	N/A
30037	Suntracker 2, motor position (tenths of degree)	UINT16	degree	IR (READ)	x10
30038	Suntracker 2, motor position command (tenths of degree)	UINT16	degree	IR (READ)	x10
30039	Suntracker 2, alarms	UINT16	bitwise	IR (READ)	N/A
30040	Suntracker 2, automatic tracking offset (tenths of degree)	UINT16	degree	IR (READ)	x10
30041	Suntracker 2, automatic step (tenths of degree)	UINT16	degree	IR (READ)	x10
30042	Analog Input 1	UINT16	config	IR (READ)	x1
30043	Analog Input 2	UINT16	config	IR (READ)	x1
30044	Analog Input 3	UINT16	config	IR (READ)	x1
30045	Analog Input 4	UINT16	config	IR (READ)	x1
30046	Analog Input 5 – PT100 nº 1	UINT16	config	IR (READ)	x1
30047	Analog Input 6 – PT100 nº 2. Analog Inputs 1 to 6 contain values between 0 and 4095 (12 bit AD converters), samples provided if optional Analog Inputs card (ref. AAP0016) is installed. Read 0 if not installed. 1 to 4 are general purpose inputs, 5 and 6 are designed for PT100 temperature probes.	UINT16	config	IR (READ)	x1
30048 to 30058	Reserved	UINT16		IR (READ)	
30054	Tracker alarms (see point 2.2)	UINT16	bitwise	IR (READ)	N/A
30055-30058	Reserved.	UINT16		IR (READ)	
30059	Energy Resetable Counter 30059 and 30060 registers represent the High and Low parts, respectively, of the 32 bit resettable variable that stores, in kWh, the value of produced energy since last reset.	INT32	kWh	IR (READ)	x1
30061	Hours up and running	UINT32	hour	IR (READ)	x1
30063	Number of connections to grid	UINT32	pu	IR (READ)	x1
30065	Instantaneous inverter alarms. 30065-30066: Inverter alarms codes are the same than in the parameters 30007-30008.	UINT32	bitwise	IR (READ)	x1

30067	Inverter alarms mainteined. 30067-30068: Inverter alarm codes are the same than in the parameter instantaneous inverter alarms.	UINT32	bitwise	IR (READ)	x1
30069	Reactive Power: Reactive output power generated by the INGECON-SUN, in tens of VAr.	INT16	VAr	IR (READ)	x10
30070	Zpos (solar field impedance, POS-EARTH, in kOhm)	UINT16	Ohm	IR (READ)	x1000
30071	Zneg (solar field impedance, POS-EARTH, in kOhm)	UINT16	Ohm	IR (READ)	x1000
30072	Power electronics temperatura, in degrees Celsius	INT16	ºC	IR (READ)	x1
30073	Control electronics temperature, in degrees Celsius	INT16	ºC	IR (READ)	x1
30074	Inverter state:	UINT16	bitwise	IR (READ)	N/A
30075	VpvN: Voltage NEGATIVE- EARTH, in Volts	UINT16	Volts	IR (READ)	x1
30076	VpvP: Voltage POSITIVE – EARTH, in Volts	UINT16	Volts	IR (READ)	x1
30077	Nominal power, in tens of Watt	UINT16	W	IR (READ)	x10
30078	Pos. Last Stop reason (0 to 4) This variable indicates which of the last 5 stop reason is the newest.	UINT16	pu	IR (READ)	N/A
30079	Year stop reason 0	UINT16	year	IR (READ)	x1
30080	Month stop reason 0	INT16	month	IR (READ)	x1
30081	Day stop reason 0	UINT16	day	IR (READ)	x1
30082	Hour stop reason 0	UINT16	hour	IR (READ)	x1
30083	Minute stop reason 0	UINT16	minute	IR (READ)	x1
30084	Stop reason 0	UINT16	pu	IR (READ)	x1
30085	Year Stop reason 1	UINT16	year	IR (READ)	x1
30086	Month Stop reason 1	UINT16	month	IR (READ)	x1
30087	Day Stop reason 1	UINT16	day	IR (READ)	x1
30088	Hour Stop reason 1	UINT16	hour	IR (READ)	x1
30089	Minute Stop reason 1	UINT16	minute	IR (READ)	x1
30090	Stop reason 1 (Defined before)	INT16	pu	IR (READ)	x1
30091	Year stop reason 2	UINT16	year	IR (READ)	x1
30092	Month stop reason 2	UINT16	month	IR (READ)	x1
30093	Day stop reason 2	UINT16	day	IR (READ)	x1
30094	Hour stop reason 2	INT16	hour	IR (READ)	x1
30095	Minute Stop reason 2	INT16	minute	IR (READ)	x1
30096	Stop reason 2 (Defined before)	UINT32	pu	IR (READ)	x1
30097	Year stop reason 3	UINT16	year	IR (READ)	x1
30098	Month stop reason 3	UINT16	month	IR (READ)	x1
30099	Day stop reason 3	UINT32	day	IR (READ)	x1
30100	Hour stop reason 3	UINT16	hour	IR (READ)	x1
30101	Minute stop reason 3	UINT16	minute	IR (READ)	x1
30102	Stop reason 3 (Defined before)	INT16	pu	IR (READ)	x1
30103	Year stop reason 4	INT16	year	IR (READ)	x1

30104	Month stop reason 4	INT16	month	IR (READ)	x1
30105	Day stop reason 4	UINT16	day	IR (READ)	x1
30106	Hour stop reason 4	INT16	hour	IR (READ)	x1
30107	Minute stop reason 4	INT16	minute	IR (READ)	x1
30108	Stop reason 4 (Defined before)	UINT16	pu	IR (READ)	x1
30109	Remaining time to connect, in seconds	UINT16	V	IR (READ)	x1
30110	Total time to connect, in seconds	UINT16	V	IR (READ)	x1
30111	Inverter state (Same as 30074 register)	UINT16	bitwise	IR (READ)	x1
30112	Cos(Phi) : in thousandths (phi, delay angle between AC voltage and current) (Same as 30017)	INT16	º	IR (READ)	x1000
30113	Sign of sin(j). 0 and 1 are for positive and negative values, respectively. (Same as 30018)	INT16	pu	IR (READ)	N/A
30114	Active Power: Alternating output power generated by the INGECON-SUN, in tens of Watt. (Same as 30019)	INT16	Watts	IR (READ)	x10
30115	Reactive Power: Reactive output power generated by the INGECON-SUN, in tens of VAr. (Same as 30069)	INT16	Var	IR (READ)	x10
30116	1000V Kit usage Counter (not in use)	UINT16	pu	IR (READ)	x1
30117	Power reduction register	UINT16	bitwise	IR (READ)	x1
	This registers shows the cause of the power reduction:				
	- Bit 0: Power limitation on (The inverter is not injecting all the available solar power).				
	- Bit 1: Modbus power reduction on.				
	- Bit 2: Max frequency power reduction on.				
	- Bit 3: Grid fault power reduction on.				
	- Bit 4: High Vdc power reduction on.				
	- Bit 5: High temperature power reduction on.				
	- Bit 6: Power reduction due to high Vac				
	- Bit 7: Power reduction due to high temp on PCB				
	- Bit 8: Reactive consign ON				
	- Bit 9: Power reduction dut to min Vdc reached				
	- Bit 10: Power reduction due a Fan is stopped (fixed limitation to 20%)				
30118	RedPotencia. Value of % of reduction	UINT16	%	IR (READ)	$x2^{15}$
30119	Total Dc Energy. 30119 and 30120 registers are the High and Low parts, respectively, of the 32 bit variable that stores, in kWh, the total value of produced energy over its lifecycle.	INT32	A	IR (READ)	x1
30121	Partial Dc Energy. 30121 and 30122 registers are the High and Low parts, respectively, of the 32 bit variable that stores, in kWh, the total value of produced energy since last reset.	INT32	V	IR (READ)	x1
30123	Display FW Version	UINT16	(ASCII)	IR (READ)	x1

30124	Smart grounding system State; SMARTCAN_GND_INIT_STE = 0, SMARTCAN_GND_STANDBY_STE = 1, SMARTCAN_GND_TESTING_STE = 2, SMARTCAN_GND_GROUNDED_STE = 3, SMARTCAN_GND_FLOATFORCLOSE_STE = 4, SMARTCAN_GND_ALARM_STE = 5	UINT16	(ASCII)	IR (READ)	x1
30125	Smart grounding system Alarm #define AL_CODE_NONE 0x0000 #define AL_CODE_FIELD_FLOATING 0x0001 #define AL_CODE_AUTOTEST_ERROR 0x0002 #define AL_CODE_FIELD_UNBALANCED 0x0004 #define AL_CODE_DISCHARGING_ERROR 0x0008 #define AL_CODE_GROUNDED_POLE_ERROR 0x0010 #define AL_CODE_ISOLATION_FAULT 0x0020 #define AL_CODE_FUSE_FAULT 0x0040 #define AL_CODE_ADC1_ERROR 0x0080 #define AL_CODE_RESISTORS_COOLING 0x0100 #define AL_CODE_HIGH_DISCHARGE_ENERGY 0x0200 #define AL_CODE_DISCHARGE_SC_FUSE 0x0400 #define AL_CODE_HIGH_FREQ_INST_CURRENT 0x0800 #define AL_CODE_HIGH_FREQ_TEMP_CURRENT 0x1000 #define AL_CODE_FATAL_ERROR 0x8000 #define AL_CODE_FACTORY_TEST 0x7FFF ;	UINT16	(ASCII)	IR (READ)	x1
30126	Smart grounding system Average current in mA div 10	UINT16	mA	IR (READ)	x10
30127	Smart grounding system RMS current in mA div 10;	UINT16	mA	IR (READ)	x10

2.1 Inverter alarm list

The alarms on the 30066 register are associated to the stop reasons on 30084 register. The interpretation of these alarms is explained in the following table.

Alarm		Stop reason	Description
0x0000		Ninguno	No alarms, the equipment should connect if it has enough power
0x0001	ALARMA_FRED	MOTIVO_PARO_FRED	Grid frequency out of range (49-51Hz)
0x0002	ALARMA_VRED	MOTIVO_PARO_VRED	Grid voltaje out of range (195V-253V)
0x0004	ALARMA_PI_ANA	MOTIVO_PARO_PI_ANA_SAT MOTIVO_PARO_PI_ANA_SAT	The current measure is much lower than the current checkpoint in that branch The initial PI in the integrator of the capture current does not work properly.
0x0008	ALARMA_RESET	MOTIVO_PARO_RESET_WD	Indicates that the invertir has been reset by Watch-Dog, failure in inverter's Firmware.
0x0010	ALARMA_BLOCKED	MOTIVO_PARO_TEMPERATURA	Inverter blocked due high running over 80ºC temperature
0x0020	ALARMA_TEMPERATURA	MOTIVO_PARO_TEMPERATURA MOTIVO_PARO_TEMP_AUX	The power electronic temperatura is greater than 80 ºC. The temperature auxiliary sensor has detected an alarm.
0x0040	ALARMA_LEC_ADC	MOTIVO_PARO_ERROR_LEC_ADC MOTIVO_PARO_LATENCIA_ADC	Reading level in the ADC higher than normal in an input not expected. Intern error of the analogic digital converter
0x0080	ALARMA_IRED_INSTAN	MOTIVO_PARO_MAX_IAC_INST	Instantaneous current value out of range
0x0100	ALARMA_PROT_AC	MOTIVO_PARO_VARISTORES MOTIVO_PARO_CONTACTOR MOTIVO_PARO_PROT_AC MOTIVO_PARO_MAGNETO	AAS0043 AC varistor error The state of the contactor is not correct attending the inverter state. Error in the AC protections, dischargers, fuses… Error in the three phase input thermomagnetic (in big equipments)
0x0200	ALARMA_PROT_DC	MOTIVO_PARO_FUS_DC	DC input fuses melt or DC dischargers.
0x0400	ALARMA_AISL_DC	MOTIVO_PARO_AISL_DC	Isolation failure in the solar field or in the inverter interior
		MOTIVO_PARO_VARISTORES	DC varistors error
0x0800	ALARMA_FRAMA	MOTIVO_PARO_FRAMA1 MOTIVO_PARO_FRAMA2 MOTIVO_PARO_FRAMA3	Failure in the branch 1 of the power electronics Failure in the branch 2 of the power electronics Failure in the branch 3 of the power electronics
0x1000	ALARMA_PARO_MANUAL	MOTIVO_PARO_PARO_MANUAL	Manual Stop due to emergency push button, by display or communication
0x2000	ALARMA_CONFIG	MOTIVO_PARO_CONFIGURACION MOTIVO_PARO_CARGA_FIRMWARE	Stop due to Firmware modification. Stop due to Firmware load.
0x4000	ALARMA_VIN	MOTIVO_PARO_VIN	DC input input high voltage
0x8000	ALARMA_VPV_MED_MIN	MOTIVO_PARO_BAJA_VPV_MED	Stop because of low voltage in the input. The inverter controls this voltage, for this reason, this should never happen.

2.2 Tracker Alarms

On the 30032 registers suntracker alarms are stored. If the firmware is AAS1020 or AAS1040 these alarms have to be interpreted as TRACKER alarms :

0x01	Pulses	Too much time without pulses from encoder
0x02	Reference	Tracker lost reference
0x04	Limit switch	Limit switch pushed
0x08	Wind alarm	Too much wind detected
0x10	Pressure alarm	Oil pressure alarm

For the rest of FW inverter this alarmas indicates information related to the behavior of the inverter. In this case the value in shown in register 30054:

0x0001	Inverter limits its power because PvsV algoritm
0x0002	Inverter limits its power because high temperature in electronic board (C.I.)
0x0004	Inverter limits its power because the fan doesn´t start (condition before Fan check error)
0x0008	Inverter stops due the detection of Fans (Fan check error)
0x0010	Inverter has detected an OVRT (over voltage ride through)
0x0020	DCSwitch is set in manual mode
0x0040	Q consigna ON
0x0080	Warning of CAN failure in grounding smart card
0x0100	Inverter is the master of MS system (only for MS inverters)
0x0200	Inverter has working permission into the MS system as a slave (only in MS inverters)
0x0400	Vdc ref. is controlled by the Master (MS system) / Vdc reference is limited by the Vdc CAN average (Mppt system)
0x0800	Inverter limits its power because of Modbus order.
0x1000	Inverter limits its power because of high frequency.
0x2000	Inverter limits its power after a grid voltage failure.
0x4000	Inverter has detected a LVRT (low voltage ride through)
0x8000	Inverter has reduced Pac due to hi Vdc voltage or low Vdc voltage (CalcVinMinGridCycle)

2.3 Stop Reasons

1	MOTIVO_PARO_VIN
2	MOTIVO_PARO_FRED
3	MOTIVO_PARO_VRED
4	MOTIVO_PARO_VARISTORES
5	MOTIVO_PARO_AISL_DC
6	MOTIVO_PARO_IAC_EFICAZ
7	MOTIVO_PARO_TEMPERATURA

8	MOTIVO_PARO_01
9	MOTIVO_PARO_CONFIGURACION
10	MOTIVO_PARO_MANUAL
11	MOTIVO_PARO_BAJA_VPV_MED
12	MOTIVO_PARO_HW_DESCX2
13	MOTIVO_PARO_FRAMA3
14	MOTIVO_PARO_MAX_IAC_INST
15	MOTIVO_PARO_CARGA_FIRMWARE
16	MOTIVO_PARO_03
17	MOTIVO_PARO_04
18	MOTIVO_PARO_ERROR_LEC_ADC
19	MOTIVO_PARO_CONSUMO_POTENCIA
20	MOTIVO_PARO_FUS_DC
21	MOTIVO_PARO_TEMP_AUX
22	MOTIVO_PARO_DES_AC
23	MOTIVO_PARO_MAGNETO
24	MOTIVO_PARO_CONTACTOR
25	MOTIVO_PARO_RESET_WD
26	MOTIVO_PARO_PI_ANA_SAT
27	MOTIVO_PARO_LATENCIA_ADC
28	MOTIVO_PARO_ERROR_FATAL
29	MOTIVO_PARO_FRAMA1
30	MOTIVO_PARO_FRAMA2

3. INVERTER COMMANDS (PRESET HOLDING REGISTERS)

The function used to send commands to the inveter is the 0x10 frame. Some different commands can be sent by these frames:

- Active power can be adjusted.
- Reactive power can be adjusted.
- Inverter can be stopped/started
- Frequency limits can be changed
- Active and Reactive power can be adjusted

The frame will have following structure using the standard function 0x10 (table 1). Values in red will be selected depending on the desired command.

Table 1: Frame structure

Address	--	Slave Address [1 .. 247]
Function	0x10	Inverter command function
Starting Address Hi	0x03	Dirección de primer registro (byte alto)
Starting Address Lo	0xE8	Dirección de primer registro (byte bajo)
Number of Registers Hi	0x00	Número de registros (byte alto)
Number of Registers Lo	0x02	Número de registros (byte bajo)
Byte Count	0x04	Número de octetos para valores
Data Hi	--	Valor del *Vinstart* (byte alto)
Data Lo	--	Valor del *Vinstart* (byte bajo)
Data Hi	--	Valor del *Tinstart* (byte alto)
Data Lo	--	Valor del *Tinstart* (byte bajo)
Error Check (CRC) - Hi	--	Código redundancia cíclica (byte alto)
Error Check (CRC) - Lo	--	Código redundancia cíclica (byte bajo)

How to complete the values on red of the table 1 is explaine on the table 2. Each command has a number which will be introduced at Command Hi and Command Lo fields. If a command needs any data value it will be introduced at Data Hi and Data Lo field. If it is no necessary zeros are to be introduced at these fields.

Modbus Register	Flash Ad (P)	Description	MIN	MAX	TYPE
41001		Command code	0	17	RW
41002		Command Data 1	-32766	32767	RW
41003		Command Data 2 (function 0x11)	-32766	32767	RW

Table 2:Command / Data table for Query:

Command number	Command	Data parameter	Data parameter limits
0 (0x00)	No command	(not used)	(not used)
1 (0x01)	Change phi tangent target	New phi tangent reference in Int16*	Max: 0.48 (15870) Min: -0.48 (-15870)
3 (0x03)	Change power reduction target	Inverter Power in Uint16 **	Max: 100% (32767) Min: 0% (0)
5 (0x05)	Stop inverter	(not used)	Max: 254 Min: 1
6 (0x06)	Start Inverter	(not used)	Max: 254 Min: 1
9 (0x09)	Change reactive power ref	React. power in (VAr/10)	Nominal power of the inveter div 10
11 (0x0B)	Disable reactive power ref***	(not used)	(not used)
12 (0x0C)	Enable restrictive frequency limits****	1: Restrictive limits ON 0: Restrictive limits OFF	Max: 1 Min: 0
13 (0x0D)	Inject reactive power without DC source (See AAS1100IMB09 document)	React. power in (KVAr/10)	Nominal power of the inverter div 10
14 (0x0E)	Stop reactive power injection without DC source (jump to normal operation) (See AAS1100IMB09 document)	(not used)	(not used)
15 (0x0F)	End of Q at night (stop inverter jump	(not used)	(not used)

	to wait state) (See AAS1100IMB09 document)		
17 (0x11)	Change power reduction target and reactive power ref	Inverter Power in Uint16 **	Max: 100% (32767) Min: 0% (0)
		React. power in INT16	Max: 100% (32767) Min: -100% (-32767)

***Int16 bit phi tangent: 32767 is equal to 1, -32767 I equal to -1. (Tan*32767)

****Uint16 Inverter power: 100% of max power: 32767. 0% of max power: 0 (%/100*32767) The maximum reduction is chosen, 0%, the inverter stops with “manual stop” alarm.

*** It changes to 0 the reactive power reference if previously is set to a given value

****Restrictive limits are 49,5Hz/50,5Hz. Non restrictive limits are 47,5Hz/51,5Hz. According to the CEI 0-21 regulation

Reactive Control works as a Generator. When the inverter is commanded with a positive tangent target, injected current will be delayed from voltage.

Otherwise, if tangent target is negative, injected current will be before the voltage.

4. PRACTICAL EXAMPLES

To stop the inverter number 2 using commands the following frames have to be sent and received.

02 10 03 E8 00 01 02 00 05 CRCHi CRCLow

02	Modbus Adress
10	Function
03	Start Adress Hi (03 E8 = 1000)
E8	Start Adreess Low
00	Number of register Hi
01	Number of register Low
02	Number of total bytes
00	Command data Hi
05	Command data Low = 5 = STOP INVERTER
CRCHi	
CRCLow	

To set the reactive power injection to 30kVAr to inverter number 14 following frames have to be sent and received

0E 10 03 E8 00 02 04 00 09 0B B8 CRCHi CRCLow

0E	Modbus Adress (14)
10	Function
03	Start Adress Hi (03 E8 = 1000)
E8	Start Adreess Low
00	Number of register Hi
02	Number of register Low
04	Number of total bytes
00	Register 1 Hi: Command data Hi
09	Register 1 Low: Command data Low = 9 = CHANGE REACTIVE POWER
0B	Register 1 Hi: Command data Hi = 0B B8 = 3000 = 30 kVAr
B8	Register 1 Low: Command data Low
CRCHi	
CRCLow	