Aurora Inverter Series

- Communication Protocol -

Rel. 4.2 10/09/08

Modifications

Rel 4.2:

- New parameters (M/Q factors for calibration) added for String-Comb

Rel 4.1:

- New product types added to command "Version reading"

Rel 4.0:

- New product types added to command "Version reading"

Rel 3.9:

- Command "Read parameters" for String-Comb inserted
- Broadcast command "Read field-number" for String-Comb inserted
- New setting parameters ("tolerances" and "enabling flags" for string currents comparison) added for String-Comb

Rel 3.8:

- Command "Statistics variable read/write" for50 Kw Module inserted
- New measure values added for String-Comb
- New setting parameters ("weights" for string current comparison) added for String-Comb

Rel 3.7:

- 50 Kw Module Protocol modified
- Command "Last four alarms" implemented also on 50 Kw Module

Rel 3.6:

- String-Comb change RS485 baud-rate command inserted
- String-Comb setting parameter command updated

Rel 3.5:

- String-Comb monitor command inserted
- 50Kw Module Protocol Inserted

Rel 3.4:

- 3G74 – state codes modified

Rel 3.3:

- 3G74 (Communication Interface for three-phase systems) Commands inserted.
- Command 58 modified

Rel 3.2:

- Var. 125 corrected

Rel 3.1:

- Command 58 coding completed.
- Command 202: read result inseterted

Rel. 3.0: Junction Box Commands inserted

Communication Protocol between Host and Supervisor Microprocessor

The communication between Host and processor works via a Serial Interface RS485 or RS232 (*see User Manuals for details)*.

Configuration parameters in both cases are:

- 19200 baud (default value)
- 1 stop bit
- no parity

The communication protocol uses fixed length transmission messages (8Bytes + 2Bytes for Checksum) structured as follows:

0	1	2	3	4	5	6	7	8	9
Address	**Command**	B_2	B_3	B_4	B_5	B_6	B_7	CRC_L	CRC_H

The structure of the answer has also fixed length (6 Bytes + 2 Bytes for Checksum) :

0	1	2	3	4	5	6	7
Transmission State	**Global State**	B_2	B_3	B_4	B_5	CRC_L	CRC_H

Transmission State:

Coded as follows:

0 = Everything is OK.
51 = Command is not implemented
52 = Variable does not exist
53 = Variable value is out of range
54 = EEprom not accessible
55 = Not Toggled Service Mode
56 = Can not send the command to internal micro
57 = Command not Executed
58 = The variable is not available, retry

Global State:

It shows the state of the addressed device, the details are specified in the description of the commands.

Description of commands:

50) **State** request: Ask the state of the system modules:

0	1	2	3	4	5	6	7	8	9
Address	**50**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Tr. State	Global State	Inverter State	DC/DC Channel 1 State	DC/DC Channel 2 State	Alarm State	CRC_L	CRC_H

State Codes:

Global State		**DcDc State**		**Inverter State**	
0	Sending Parameters	**0**	DcDc OFF	**0**	Stand By
1	Wait Sun/Grid	**1**	Ramp Start	**1**	Checking Grid
2	Checking Grid	**2**	MPPT	**2**	Run
3	Measuring Riso	**3**	*Not Used*	**3**	Bulk OV
4	DcDc Start	**4**	Input OC	**4**	Out OC
5	Inverter Start	**5**	Input UV	**5**	IGBT Sat
6	Run	**6**	Input OV	**6**	Bulk UV
7	Recovery	**7**	Input Low	**7**	Degauss Error
8	Pause	**8**	No Parameters	**8**	No Parameters
9	Ground Fault	**9**	Bulk OV	**9**	Bulk Low
10	OTH Fault	**10**	Communication Error	**10**	Grid OV
11	Address Setting	**11**	Ramp Fail	**11**	Communication Error
12	Self Test	**12**	Internal Error	**12**	Degaussing
13	Self Test Fail	**13**	Input mode Error	**13**	Starting
14	Sensor Test + Meas.Riso	**14**	Ground Fault	**14**	Bulk Cap Fail
15	Leak Fault	**15**	Inverter Fail	**15**	Leak Fail
16	Waiting for manual reset	**16**	DcDc IGBT Sat	**16**	DcDc Fail
17	Internal Error E026	**17**	DcDc ILEAK Fail	**17**	Ileak Sensor Fail
18	Internal Error E027	**18**	DcDc Grid Fail	**18**	SelfTest: relay inverter
19	Internal Error E028	**19**	DcDc Comm. Error	**19**	SelfTest: wait for sensor test
20	Internal Error E029			**20**	SelfTest: test relay DcDc + sensor
21	Internal Error E030			**21**	SelfTest: relay inverter fail
22	Sending Wind Table			**22**	SelfTest timeout fail
23	Failed Sending table			**23**	SelfTest: relay DcDc fail
24	UTH Fault			**24**	Self Test 1
25	Remote OFF			**25**	Waiting self test start
26	Interlock Fail			**26**	Dc Injection
27	Executing Autotest			**27**	Self Test 2
30	Waiting Sun			**28**	Self Test 3
31	Temperature Fault			**29**	Self Test 4
32	Fan Staucked			**30**	Internal Error
33	Int. Com. Fault			**31**	Internal Error
34	Slave Insertion			**40**	Forbidden State
35	DC Switch Open			**41**	Input UC
36	TRAS Switch Open			**42**	Zero Power

37	MASTER Exclusion			**43**	Grid Not Present
38	Auto Exclusion			**44**	Waiting Start
98	Erasing Internal EEprom			**45**	MPPT
99	Erasing External EEprom			**46**	Grid Fail
100	Counting EEprom			**47**	Input OC
101	Freeze				

Alarm State					
Value	Description	Code	Value	Description	Code
0	No Alarm		**32**	Grid OV	W004
1	Sun Low	W001	**33**	Grid UV	W005
2	Input OC	E001	**34**	Grid OF	W006
3	Input UV	W002	**35**	Grid UF	W007
4	Input OV	E002	**36**	Z grid Hi	W008
5	Sun Low	W001	**37**	Internal error	E024
6	No Parameters	E003	**38**	Riso Low	E025
7	Bulk OV	E004	**39**	Vref Error	E026
8	Comm.Error	E005	**40**	Error Meas V	E027
9	Output OC	E006	**41**	Error Meas F	E028
10	IGBT Sat	E007	**42**	Error Meas Z	E029
11	Bulk UV	W011	**43**	Error Meas Ileak	E030
12	Internal error	E009	**44**	Error Read V	E031
13	Grid Fail	W003	**45**	Error Read I	E032
14	Bulk Low	E010	**46**	Table fail	W009
15	Ramp Fail	E011	**47**	Fan Fail	W010
16	Dc/Dc Fail	E012	**48**	UTH	E033
17	Wrong Mode	E013	**49**	Interlock fail	E034
18	Ground Fault	---	**50**	Remote Off	E035
19	Over Temp.	E014	**51**	Vout Avg errror	E036
20	Bulk Cap Fail	E015	**52**	Battery low	W012
21	Inverter Fail	E016	**53**	Clk fail	W013
22	Start Timeout	E017	**54**	Input UC	E037
23	Ground Fault	E018	**55**	Zero Power	W014
24	Degauss error	---	**56**	Fan Stucked	E038
25	Ileak sens.fail	E019	**57**	DC Switch Open	E039
26	DcDc Fail	E012	**58**	Tras Switch Open	E040
27	Self Test Error 1	E020	**59**	AC Switch Open	E041
28	Self Test Error 2	E021	**60**	Bulk UV	E042
29	Self Test Error 3	E019	**61**	Autoexclusion	E043
30	Self Test Error 4	E022	**62**	Grid df/dt	W015
31	DC inj error	E023	**63**	Den switch Open	W016
			64	Jbox fail	W017

Remark: Alarm *Codes* (e.g. E001..) are shown only on Aurora Display. The Alarm State values are returned by serial communication

52) P/N Reading (Aurora inverters)

0	1	2	3	4	5	6	7	8	9
Address	**52**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Char.6	Char.5	Char.4	Char.3	Char.2	Char.1	CRC_L	CRC_H

Characters to be interpreted as ASCII code.
Char. 6 = Most significant P/N digit
Char. 1 = Least significant P/N digit

Remark: in this case no information transmission and global state is returned.

58) Version Reading (Indoor/Outdoor, Europe/America, available only for FW version 1.0.9 and following)

0	1	2	3	4	5	6	7	8	9
Address	**58**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Trans. State	Global State	Par1	Par2	Par3	Par4	CRC_L	CRC_H

Par 1		**Indoor/Outdoor and type**
	'i'	Aurora 2 kW indoor
	'o'	Aurora 2 kW outdoor
	'I'	Aurora 3.6 kW indoor
	'O'	Aurora 3.0-3.6 kW outdoor
	'5'	Aurora 5.0 kW outdoor
	'6'	Aurora 6 kW outdoor
	'P'	3-phase interface (3G74)
	'C'	Aurora 50kW module
	'4'	Aurora 4.2kW new
	'3'	Aurora 3.6kW new
	'2'	Aurora 3.3kW new
	'1'	Aurora 3.0kW new
	'D'	Aurora 12.0kW
	'X'	Aurora 10.0kW
Par 2		**Grid Standard**
	'A'	UL1741
	'E'	VDE0126
	'S'	DR 1663/2000
	'I'	ENEL DK 5950
	'U'	UK G83
	'K'	AS 4777
Par 3		**Trafo/Non Trafo**
	'N'	Transformerless Version
	'T'	Transformer Version
Par 4		**Wind/PV**
	'W'	Wind version
	'N'	PV version

59) Measure request to the DSP (Voltage,Current etc.. etc..)

0	1	2	3	4	5	6	7	8	9
Address	**59**	Type	Global	-	-	-	-	CRC_L	CRC_H

Global: if 1 requires the Global Measurements (Only For a Master)
if 0 requires the Module Measurements (Master and Slave)
The * in the table below list the variable to which apply the global requirement

1	Grid Voltage*	For three-phases systems is the mean
2	Grid Current*	For three-phases systems is the mean
3	Grid Power*	For three-phases systems is the mean
4	Frequency	For three-phases systems is the mean
5	Vbulk	For Inverter with more Bulk is the sum
6	Ileak (Dc/Dc)	
7	Ileak (Inverter)	
8	Pin1*	Pin for single channel module
9	Pin2	
21	Inverter Temperature	
22	Booster Temperature	
23	Input 1 Voltage	Input Voltage for single channel module
24	- - -	
25	Input 1 Current*	Input Current for single channel module
26	Input 2 Voltage	
27	Input 2 Current	
28	Grid Voltage (Dc/Dc)	
29	Grid Frequency (Dc/Dc)	
30	Isolation Resistance (Riso)	
31	Vbulk (Dc/Dc)	
32	Average Grid Voltage (VgridAvg)	
33	VbulkMid	
34	Power Peak	
35	Power Peak Today	
36	Grid Voltage neutral	
37	Wind Generator Frequency	
38	Grid Voltage neutral-phase	
39	Grid Current phase r	
40	Grid Current phase s	
41	Grid Current phase t	
42	Frequency phase r	
43	Frequency phase s	
44	Frequency phase t	
45	Vbulk +	
46	Vbulk -	
47	Supervisor Temperature	
48	Alim. Temperature	
49	Heat Sink Temperature	
50	Temperature 1	
51	Temperature 2	
52	Temperature 3	
53	Fan 1 Speed	
54	Fan 2 Speed	
55	Fan 3 Speed	
56	Fan 4 Speed	
57	Fan 5 Speed	
58	Power Saturation limit (Der.)	
59	Riferimento Anello Bulk	
60	Vpanel micro	
61	Grid Voltage phase r	
62	Grid Voltage phase s	
63	Grid Voltage phase t	

Answer:

Trans. State	Global State	Val_3	Val_2	Val_1	Val_0	CRC_L	CRC_H

The 4 bytes Val_3 ... Val_0 compose a float value. In order to rebuild the original float value it is necessary to put in sequence the 4 bytes and to read it according to the ANSI standard:

31	30 ... 23	22 ... 0
S	Exponent	Mantissa

The value is:

$$(-1)^s * 2^{(Exponent-127)} * 1.Mantissa.$$

The value is expressed in the following measurement units:

Voltages	V
Currents	A
Powers	W
Temperatures	°C

63) Serial Number reading (Aurora inverters)

0	1	2	3	4	5	6	7	8	9
Address	**63**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Char.6	Char.5	Char.4	Char.3	Char.2	Char.1	CRC_L	CRC_H

Characters to be interpreted as ASCII code.
Char. 6 = Most significant S/N digit
Char. 1 = Least significant S/N digit

Remark: in this case no information transmission and global state is returned.

65) Manufacturing Week and Year reading (Aurora inverters)

0	1	2	3	4	5	6	7	8	9
Address	**65**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Tr. State	Global State	Week2	Week1	Year2	Year1	CRC_L	CRC_H

Bytes to be interpreted as ASCII code.
Wk2 = Most significant week digit
Wk1 = Least significant week digit
Yr2 = Most significant year digit
Yr1 = Least significant year digit

67) Flags or switch reading (Aurora Central only)

0	1	2	3	4	5	6	7	8	9
Address	**67**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Tr. State	Global State	Flag 1	Flag 2	Switch1	Switch2	CRC_L	CRC_H

Flag1,Flag2 are two bytes which codify the flag status in each bits as il table below

Flag 1	bit 0	**Master/Slave**	0 = Slave 1 = Master
	bit 1	**Parameter EE status**	0 = Not OK 1 = OK
	bit 2	**Statistics EE status**	0 = Not OK 1 = OK
	bit 3	**Clock Problem flag**	0 = No Problem 1 = Problem
	bit 4	Reserved	
	bit 5	Reserved	
	bit 6	Reserved	
	bit 4	Reserved	
Flag 2	bit 0	Reserved	

	bit 1	Reserved	
	bit 2	Reserved	
	bit 3	Reserved	
	bit 4	Reserved	
	bit 5	Reserved	
	bit 6	Reserved	
	bit 7	Reserved	

Switch1,Switch2 are two bytes which codes the switches status in each bits as il table below

Switch 1	bit 0	**Remote ON/OFF**	0 = Open 1 = Closed
	bit 1	**DC switch**	0 = Open 1 = Closed
	bit 2	**TRAS switch**	0 = Open 1 = Closed
	bit 3	**DEN switch**	0 = Closed 1 = Open
	bit 4	Reserved	
	bit 5	Reserved	
	bit 6	Reserved	
	bit 4	Reserved	
Switch 2	bit 0	Reserved	
	bit 1	Reserved	
	bit 2	Reserved	
	bit 3	Reserved	
	bit 4	Reserved	

	bit 5	Reserved	
	bit 6	Reserved	
	bit 7	Reserved	

68) Cumulated Float Energy Readings (Aurora Central only)

0	1	2	3	4	5	6	7	8	9
Address	**68**	Var	Ndays_h	Ndays_l	Global	-	-	CRC_L	CRC_H

Var.: Variable to read
Ndays_h and Ndays_l are, respectively the high and low part of the number of Days we want to show the cumulated energy (maximum 366).
Global: 0 module energy (Master or Slave)
1 global energy (Master)

1	Current day Energy
2	Current week Energy
3	Current Month Energy
4	Current Year Energy
5	Last Ndays day Energy
6	Total Energy
7	Partial Energy

Answer:

Trans. State	Global State	Val_3	Val_2	Val_1	Val_0	CRC_L	CRC_H

The 4 bytes Val_3 ... Val_0 compose a float value. In order to rebuild the original float value it is necessary to put in sequence the 4 bytes and to read it according to the ANSI standard:

31	30 … 23	22 … 0
S	Exponent	Mantissa

The value is:

$$(-1)^s * 2^{(Exponent-127)} * 1.Mantissa.$$

The value is expressed in the measurement units specified in the table of command 60

70) **Time/Date** reading

The time and the date are stored in a 4-byte variable which provides the number of past second since midnight of January 1, 2000. From this variable it is possible to rebuild the time and date (with the accuracy of 1 second).

0	1	2	3	4	5	6	7	8	9
Address	**70**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Tr. State	Global State	Time3	Time2	Time1	Time0	CRC_L	CRC_H

This value is coded as follows:

$$NumSeconds = Time3 * 2^{24} + Time2 * 2^{16} + Time1 * 2^{8} + Time0$$

72) Firmware release reading

0	1	2	3	4	5	6	7	8	9
Address	**72**	Var	-	-	-	-	-	CRC_L	CRC_H

Var	**Meaning**
1	Micro A release
2	Micro B release
...	Micro ... release
N	Micro Z release

Note: For Aurora grid-tied inverters you will read always the MCU firmware version (field **var** is not interpreted)

Answer:

Tr. State	GlobalState	Rel3	Rel2	Rel1	Rel0	CRC_L	CRC_H

The four bytes are ASCII-coded, and must be read as follows:
Release = Rel3.Rel2.Rel1.Rel0

78) **Cumulated energy** readings **(Aurora grid-tied inverters only)**

0	1	2	3	4	5	6	7	8	9
Address	**78**	Par	-	-	-	-	-	CRC_L	CRC_H

If Par =

0) Daily Energy
1) Weekly Energy
2) *Not used*
3) Month Energy (Energy from the first day of current calendar month)
4) Year Energy (Energy from the first day of current calendar year)
5) Total Energy (total lifetime)
6) Partial Energy (cumulated since reset)

Answer:

Tr. State	Global State	En3	En2	En1	En0	CRC_L	CRC_H

En3..En0: energy value according with selected period, expressed in Wh.

Energy values are coded as follows:

$$En(Par) = En3 * 2^{24} + En2 * 2^{16} + En1 * 2^{8} + En0$$

85) Baud rate setting on serial lines

0	1	2	3	4	5	6	7	8	9
Address	**85**	BaudCode	Serial-line	-	-	-	-	CRC_L	CRC_H

Serial-line: 1 (external line), 2, ..., 255

The serial-line field is reserved to **Aurora Central** modules.
Remember that the code **"1"** refers always to the external communication line (ex. for monitoring system connection)

Baud code:
0 19200 bps
1 9600 bps
2 4800 bps
3 2400 bps

86) Last four alarms

0	1	2	3	4	5	6	7	8	9
Address	**86**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Tr.State	Global State	AL1	AL2	AL3	AL4	CRC_L	CRC_H

This command returns the codes of the last four alarms, in form of a FIFO queue from the first (AL1) to the last one (AL4).
When this command is used the queue is emptied (the four values are set to zero).
Alarm code are described in command 50.

101) System info reading (Aurora Central only)

0	1	2	3	4	5	6	7	8	9
Address	**101**	var	-	-	-	-	-	CRC_L	CRC_H

var	meaning	val	meaning
1	Transformer type	0	no transformer
		1	50 Kw Transformer
		2	100 Kw Transformer
		3	200 Kw Transformer
		4	300 Kw Transformer
2	50Kw Modules Number	1:6	Number of 50Kw modules in the system that have the same transformer

Answer:

Tr.State	Global State	val	-	-	-	CRC_L	CRC_H

103) Junction Box Monitoring status (Aurora Central only)

0	1	2	3	4	5	6	7	8	9
Address	**103**	CF	RN	NJT	JAL	JAH		CRC_L	CRC_H

Answer:

Trasm. State	CF	RN	NJT	JAL	JAH	CRC_L	CRC_H

CF = Control Flag = 1 The Module is managing the Junction boxes
= 0 The Module is not managing the Junction boxes

RN = Rack Number

NJT = Total number of Junction boxes the Module must manage. (The maximum is 12).

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
JAL								JAH							

JA = JAH * 2^8 + JAL = Active junction boxes coded bit x bit as follow:

JAL - bit0 = 0 Junction number 1 (Inner Rs-485 address 2) is not active
1 Junction number 1 (Inner Rs-485 address 2) is active

JAL – bit1 = 0 Junction number 2 (Inner Rs-485 address 3) is not active
1 Junction number 2 (Inner Rs-485 address 3) is active

JAL – bit2 = 0 Junction number 3 (Inner Rs-485 address 4) is not active
1 Junction number 3 (Inner Rs-485 address 4) is active

JAL – bit3 = 0 Junction number 4 (Inner Rs-485 address 5) is not active
1 Junction number 4 (Inner Rs-485 address 5) is active

JAL – bit4 = 0 Junction number 5 (Inner Rs-485 address 6) is not active
1 Junction number 5 (Inner Rs-485 address 6) is active

JAL – bit5 = 0 Junction number 6 (Inner Rs-485 address 7) is not active
1 Junction number 6 (Inner Rs-485 address 7) is active

JAL – bit6 = 0 Junction number 7 (Inner Rs-485 address 8) is not active
1 Junction number 7 (Inner Rs-485 address 8) is active

JAL – bit7 = 0 Junction number 8 (Inner Rs-485 address 9) is not active
1 Junction number 8 (Inner Rs-485 address 9) is active

JAH – bit0 = 0 Junction number 9 (Inner Rs-485 address 10) is not active

1 Junction number 9 (Inner Rs-485 address 10) is active

JAH – bit1 = 0 Junction number 10 (Inner Rs-485 address 11) is not active
1 Junction number 10 (Inner Rs-485 address 11) is active

JAH – bit2 = 0 Junction number 11 (Inner Rs-485 address 12) is not active
1 Junction number 11 (Inner Rs-485 address 12) is active

JAH – bit3 = 0 Junction number 12 (Inner Rs-485 address 13) is not active
1 Junction number 12 (Inner Rs-485 address 13) is active

105) System P/N Reading (Aurora Central only)

0	1	2	3	4	5	6	7	8	9
Address	**105**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Char.6	Char.5	Char.4	Char.3	Char.2	Char.1	CRC_L	CRC_H

Characters to be interpreted as ASCII code.
Char. 6 = Most significant P/N digit
Char. 1 = Least significant P/N digit

Remark: in this case no information transmission and global state is returned.

107) System Serial Number reading (Aurora Central only)

0	1	2	3	4	5	6	7	8	9
Address	**107**	-	-	-	-	-	-	CRC_L	CRC_H

Answer:

Char.6	Char.5	Char.4	Char.3	Char.2	Char.1	CRC_L	CRC_H

Characters to be interpreted as ASCII code.
Char. 6 = Most significant S/N digit
Char. 1 = Least significant S/N digit

Remark: in this case no information transmission and global state is returned.

200) Junction Box – State Request

0	1	2	3	4	5	6	7	8	9
Address	**200**	**NJ**						CRC_L	CRC_H

Answer:

Trasm. state	**Jbox State**	Fuses State 2	Fuses State 1	Fuses State 0 / String-Currents State 1	String-Currents State 0	CRC_L	CRC_H

NJ: Junction Box Number

JBox State: coded as follows:

Jbox State Bit (0-7)	Meaning
0	(0: All fuses OK – 1: Burnt fuse on Jbox)
1	(0: OK – 1: Jbox Overtemperature)
2	(0: OK – 1: Jbox Overvoltage)
3	(0: OK – 1: Unbalanced string current)
4	(0: OK – 1: Jbox Overcurrent)
5	(0: OK -1:Power Off)
6	(0: OK-1 No communication)
7	(0: OK – 1: Jbox not calibrated)

Fuses State / String-Currents State:

F10	F20	F9	F19	F8	F18	F7	F17	F6	F16	F5	F15	F4	F14	F3	F13
FS2								FS1							

F2	F12	F1	F11	-	-	C9	C8	C7	C6	C5	C4	C3	C2	C1	C0
FS0 / CS1								CS0							

Fx	=	1	Fuse OK
	=-	0	Fuse Burnt
Cx	=	0	String Current OK
	=-	1	String Current Unbalanced

201) Junction Box – Val Request

0	1	2	3	4	5	6	7	8	9
Address	**201**	**NJ**	Par					CRC_L	CRC_H

Answer:

Trasm. state	**Par**	FVal3	FVal2	FVal1	FVal0	CRC_L	CRC_H

NJ: Junction Box Number

FVal3…FVal0 Float Value

Par coded as follows:

Par	Meaning	Measure Unit
0	Current I_0	A
1	Current I_1	A
2	Current I_2	A
3	Current I_3	A
4	Current I_4	A
5	Current I_5	A
6	Current I_6	A
7	Current I_7	A
8	Current I_8	A
9	Current I_9	A
10	Tint	°C
11	Global Parallel Voltage	V
12	Analog In. 1	-
13	Analog In. 2	-
14	Analog In. 3	-
15	Analog In. 4	-
16	Global String Current	A

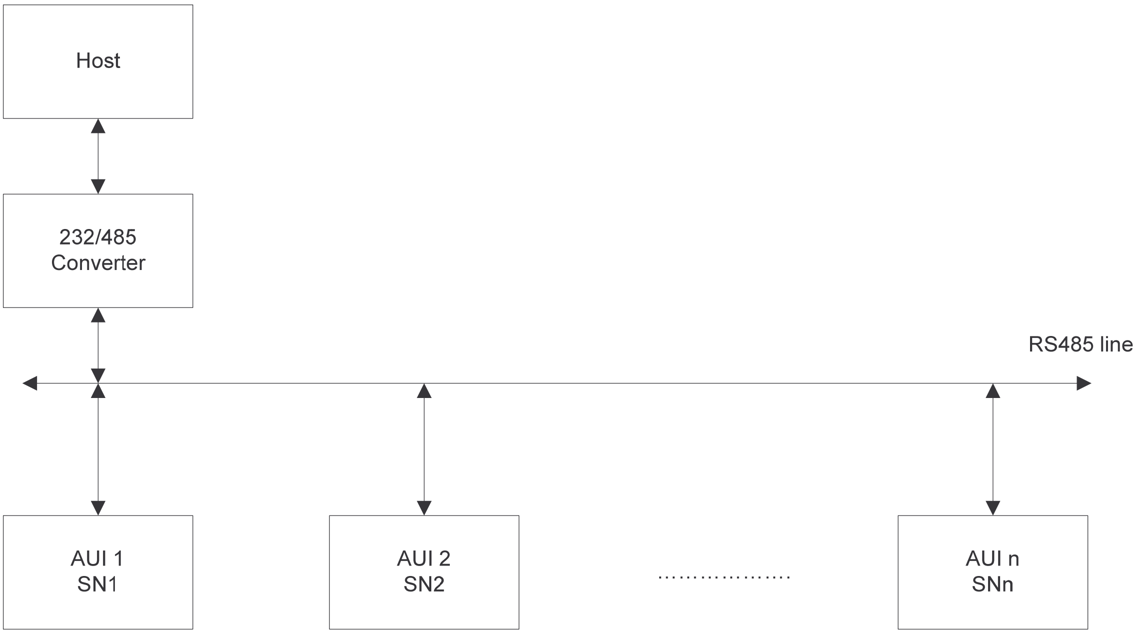
Aurora PV Inverter

- Self Addressing -

Introduction

In this section we are going to describe how a collection of Aurora can be addressed automatically using a set of broadcast commands. This feature is available only for RS485 line and not for the PLM, due to the different communication protocol and hardware implementation.

In the following picture it has been represented a typical Aurora Rs-485 line



At first power-up, all the units have the same default address, so they are unable to communicate with the host until a unique address is given to each one of them. Thus, we need to perform a simple addressing procedure before the ordinary communication tasks are started.
The only thing that differentiates the units, by the software point of view, is the serial number; so this is the feature to be used to address every single unit.
A set of broadcast commands was implemented, in order to recognize the unaddressed units and to assign (or delete) the unique address on the line, and they are based on the serial number.

With **broadcast** command, we mean a command that is a directed to every unit that is physically connected to the line; potentially, every inverter should answer to a broadcast command. If more than one inverter answer at the same time to a broadcast command, the host may receive a message with a wrong checksum. We can still take advantage of this, because we can restrict the broadcast message depending from the units'serial number. In other words, we can think of a command directed not to every inverter, but just to a subset of them. If the host transmits a command of that kind and it does not obtain any answer, it means that the subset is empty; otherwise, if an answer is obtained, it means that the subset is populated. With some iterative restrictions of the subset we will be able to identify a single inverter, and then we can assign an address to be used during ordinary communication. Such commands were implemented on Aurora communication protocol, and they are described in the following pages.

Command 254 Check subset

Check if any Aurora inverter connected to the line has its serial number is included in the specified interval.

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
254	SN_U_2	SN_U_1	SN_U_0	SN_D_2	SN_D_1	SN_D_0	-	CRCH	CRCL

Where SN_U = Upper interval limit (3-byte)
SN_D = Lower interval limit (3-byte)

If a unit's serial number is included in the interval, the unit answers as follows:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*
0	SN_2	SN_1	SN_0	-	-	CRCH	CRCL

Command 253 Assign address

Given a unit with a known serial number SN, it is possible to assign an address to it as follows:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
253	SN_2	SN_1	SN_0	NewAddr	-	-	-	CRCH	CRCL

Answer:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*
0	Res	-	-	-	-	CRCH	CRCL

If Res = 0 Assignment OK
Res = 0 Assignment Fail

NOTE: When a unit is addressed, it does not answer neither to command 254 nor command 253.

Command 252 Delete Address

Using this command it is possible to delete previously assigned address

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
252	Par	-	-	-	-	-	-	CRCH	CRCL

If Par = 1 Delete Address

Answer:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*
0	-	-	-	-	-	CRCH	CRCL

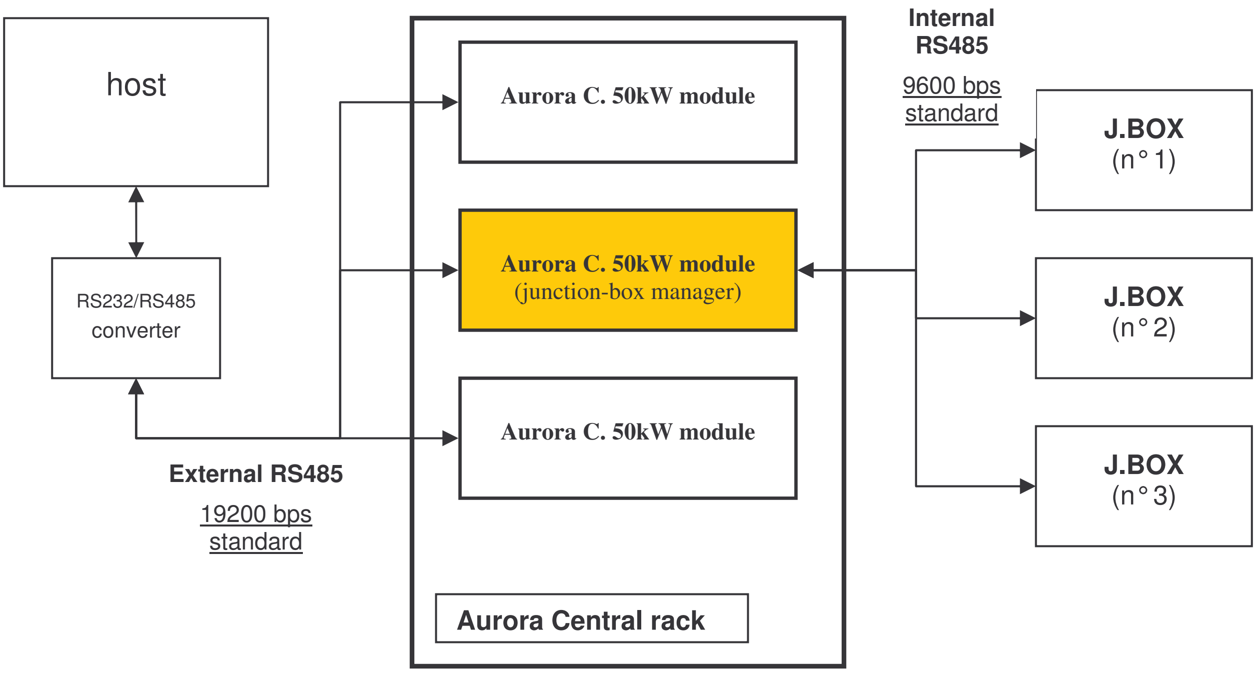
Aurora Junction Box

- Communication Protocol -

Introduction

In this section we are going to describe how to address and communicate with junction-boxes connected to a rack of **Aurora Central** modules.
Junction-boxes are connected to a single module of a rack through a dedicated "internal" Rs-485 line. An external host (local PC, monitoring system) communicates with Aurora Central modules via the "external" Rs-485 line.

In the following picture it has been represented a typical system of host/rack and rack/junction-boxes Rs-485 connections:



First of all, the host system has to scan the rack modules in order to identify which one is managing junction-boxes (see command **103** in Aurora PV Inverters communication protocol).

Then each junction-box is identified and "internally" addressed by a number called **"NJ"** (junction-box number).

When the host system wants to address a single junction-box, it simply launches a command to manager module (with its Rs-485 address) and writes the number of j. box on the "NJ" field – remember that at the moment only the commands 200, 201 and 212 (state, values, SN, PN reading) are available for host communication.

In the following table is represented a typical command sent to a junction-box manager module:

0	1	2	3	4	5	6	7	8	9
Manager Address	**Command**	**NJ field**						CRC_L	CRC_H

200) Junction Box – State Request (Also available through 50 Kw. module)

0	1	2	3	4	5	6	7	8	9
Address	**200**	**NJ**						CRC_L	CRC_H

Answer:

Trasm. state	**Jbox State**	Fuses State 2	Fuses State 1	Fuses State 0 / String-Currents State 1	String-Currents State 0	CRC_L	CRC_H

NJ: Junction Box Number

JBox State: coded as follows:

Jbox State Bit (0-7)	**Meaning**
0	(0: All fuses OK – 1: Burnt fuse on Jbox)
1	(0: OK – 1: Jbox Overtemperature)
2	(0: OK – 1: Jbox Overvoltage)
3	(0: OK – 1: Unbalanced string current)
4	(0: OK – 1: Jbox Overcurrent)
5-6	no meaning
7	(0: OK – 1: Jbox not calibrated)

Fuses State / String-Currents State:

F10	F20	F9	F19	F8	F18	F7	F17	F6	F16	F5	F15	F4	F14	F3	F13
FS2								FS1							

F2	F12	F1	F11	-	-	C9	C8	C7	C6	C5	C4	C3	C2	C1	C0
FS0 / CS1								CS0							

Fx = 1 Fuse OK
=- 0 Fuse Burnt

Cx = 0 String Current OK
=- 1 String Current Unbalanced

201) Junction Box – Val Request (Also available through 50 Kw. module)

0	1	2	3	4	5	6	7	8	9
Address	**201**	**NJ**	Par					CRC_L	CRC_H

Answer:

Trasm. state	**Par**	FVal3	FVal2	FVal1	FVal0	CRC_L	CRC_H

NJ: Junction Box Number

FVal3…FVal0 Float Value

Par coded as follows:

Par	Meaning	Measure Unit
0	Current I_0	A
1	Current I_1	A
2	Current I_2	A
3	Current I_3	A
4	Current I_4	A
5	Current I_5	A
6	Current I_6	A
7	Current I_7	A
8	Current I_8	A
9	Current I_9	A
10	Tint	°C
11	Global Parallel Voltage	V
12	Analog In. 1	-
13	Analog In. 2	-
14	Analog In. 3	-
15	Analog In. 4	-
16	Global String Current	A
17	Numeric Mean String Current	A
18	Weighted mean string current	A
19	Max current for "unbalanced string current" alarm	A
20	Min current for "unbalanced string current" alarm	A

Checksum calculation

The algorithm to compute the checksum to validate the RS485 transmission is the CRC polynomial standardized by CCITT:

Bn=N^16+N^12+N^5+Bn-1

Where N^16 means that N is elevated to the sixteenth power of 2 (i.e. it is shifted left of 16 bit) and where the symbol '+' represents the XOR bit by bit.

Practically, if **New** is the byte to process , **Tmp** is a swap byte and **BccLo** and **BccHi** are the low and high parts of the validation word, the following algorithm must be followed:

A. Initialize BccLo=0xFF, BccHi=0xFF

B. For each byte to transmit or receive repeat the following steps:
   1. New = New XOR BccLo
   2. Tmp=New << 4
   3. New=Tmp XOR New
   4. Tmp=New >> 5
   5. BccLo=BccHi
   6. BccHi= New XOR Tmp
   7. Tmp= New << 3
   8. BccLo= BccLo XOR Tmp
   9. Tmp= New >> 4
   10. BccLo= BccLo Xor Tmp

C. Negate bit by bit BccLo e BccHi : CRC_L=~BccLo CRC_H=~BccHi