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CAN BUS specification

AK	F	28.09.2010	<p>Following telegrams added</p> <p>0x297 Set Fundamental Frequency of Induction Generator</p> <p>0x298 Set Fundamental Phase Voltages (Modulation Index)</p> <p>0x299 Set Rate of Change of Fundamental Frequency</p>
AK	G	20.10.2010	<p>0x208 Byte 2, bit 3 - Induction Generator Mode has been Added</p> <p>0x29A Set Modulation index to Synchronous frequency Point 1</p> <p>0x29B Set Modulation index to Synchronous frequency Point 2</p> <p>0x29C Set Modulation index to Synchronous frequency Point 3</p>
AK	H	24.11.2010	<p>Renamed Point 1 to Point 0, Point 2 to Point 1, and Point 3 to Point 1</p> <p>Renamed Set Fundamental Phase Voltages (Modulation Index) to Set Fundamental RMS Voltage</p> <p>0x083 added Induction Generator Mode feedback signal</p> <p>Telegrams 0x297,0x298,0x299 values has been changed to unipolar</p> <p>Source terminal voltage preset for source side</p>
AK	I	04.01.2011	<p>Accuracy of the following telegrams has been increased from 1 decimal point to 3 decimal points</p> <p>0x202, 0x203, 0x291, 0x292, 0x293, 0x294, 0x295, 0x296</p> <p>For telegrams (induction generator) 0x29A,0x29B,0x29C name for Set modulation index has been changed to Set generator RMS voltage, representation of the value has also been updated.</p> <p>0x111Serial number resolution changed to 32 bits</p> <p>0x209 increased accuracy to 1 decimal point</p> <p>0x21B Rotor speed increased</p>

			accuracy to 1 decimal point 0x305 Turbine speed removed Telegrams 0x280-28F removed from table Telegrams: source/network settings
WDD	J	03/02/2011	Added 0x406 for Shetland analogue output box.
AK DJM	K	9.02.2011 24.02.2011 07.03.2011	Set source over frequency limit (over speed) Telegram 0x080 Loss Off Source error added Added accumulated total power 0x0405 Added operating time in days and hours 0x407
AK DJM DJM	L	20.04.2011 27.04.2011	Added bit2 in telegram 0x21A for error reset Added bit23 to NET status 0x082 for 'power ready'
WD	M	26.05.2011	Added 0x408 for network V_d and V_q telegram
AK	N	03.06.2011	0x221 Measured speed of the Induction/PMG motor (speed feedback)
AK	O	06.07.2011	Telegrams 0x210-0x213 has been modified to accommodate two threshold levels for G59-2, for over/under voltage and frequency. Telegram 0x222-0x225 are for the time of the G59-2 parameters above. Telegrams 0x216 has been modified resolution of RoCoF has been changed. Same applies to Telegram 0x120 Byte 3and4 and telegram 0x121 Telegram 0x81 has been modified added error SurgeVoltage

			Modifications in 0x208 byte 2 bits 4,5,6.
AK	P	09.11.2011	Modifications in 0x21A byte Bit 3 Active braking command 0x085 – Bit 3 – External stop Bit 4 – External active braking command 0x297 – added speed demand byte 3&4 0x299 – added rate of change of speed byte 3&4 ID 0x208 – added byte 2 bit 7 Motor Start-up
DJM	Q	21/11/11	User Interface Digital IO 0x084 Status Removed byte1:bits 0-2 Removed byte2:bits 0-7 0x086 Control (new message) Relay control byte1:bits 0-3 DO control byte3:bits 0-2 DI control byte4:bits 0-7 ID 0x080 byte4 bit 0 DC-Link pre-charge error was added ID 0x208 byte3 bit 0 DC Overcurrent protection was added ID 0x087 added warning register
AK/JWR		19.01.2012	ID 0x222 0x223 0x224 0x225 Update under and over trip range and resolution
JWR		27.01.2012	ID 0x226 number of active parallel inverters
AK		31.01.2012	
AK	R	03.07.2012	Added telegram 0x30A to send Generator Ke factor Added value to the telegram 0x226 for percentage voltage limiter
JWR		04.07.2012	Removed messages 0x113 and 0x114

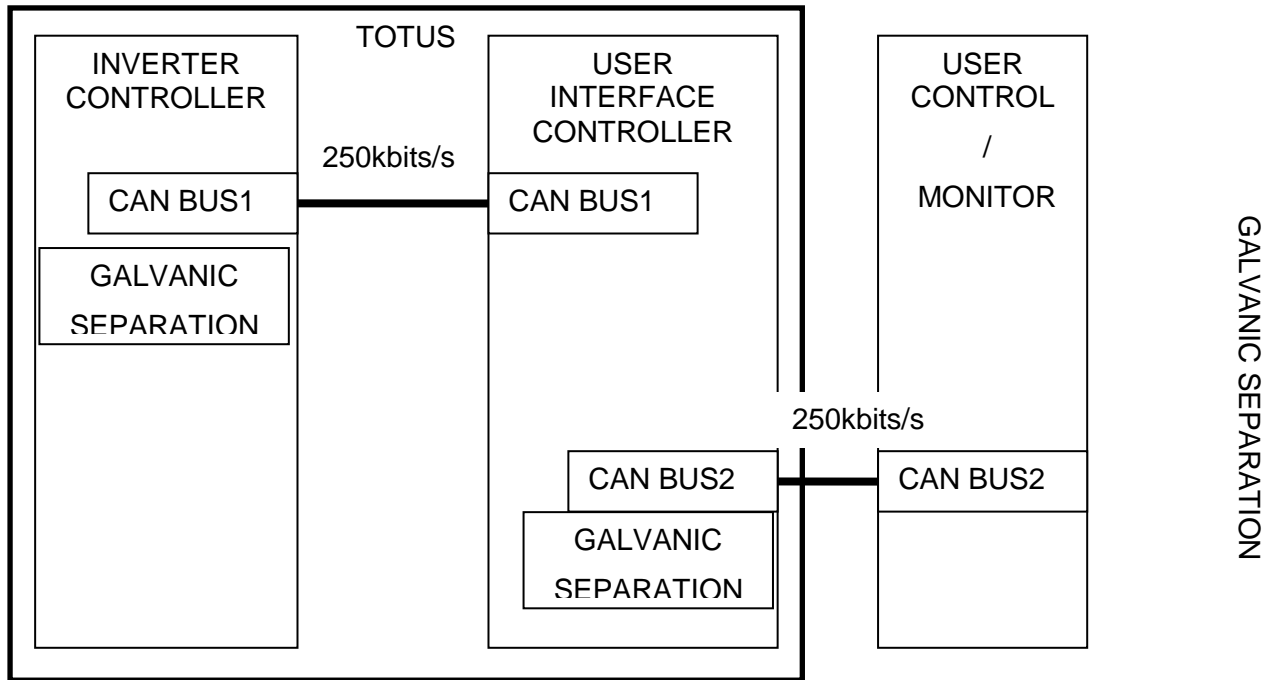
			Reserve messages 0x000, 0x27F, 0x37F, 0x47F, 0x57F Added turbine rotation reversed to warning register ID 0x87 byte 1 bit 1
JWR	S	26.09.2012	Added power limiting indicator to warning register ID 0x87 byte 1 bit 2

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1 CAN BUS specification

1.1 CAN bus topology



2 CAN-BUS protocol

CAN-bus telegrams structure:

ID	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
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where:

ID – telegram identifier,

Byte1-8, - are data information. This gives total 64 bit information contained in a single telegram.

CAN bus telegram data length is fixed to 4 bytes:

ID	Byte1	Byte2	Byte3	Byte4
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If variable takes only 2 bytes 2 bytes are free.

Normal CAN-bus protocol will be used, which defines ID as 11 bit. In normal CAN-bus protocol there is 2048 possible identifiers.

CAN-bus protocol baud rate is 250kbits/s.

Telegram time interval is 50ms

In data resolution (.) means artificial decimal point which is created by multiplying original value by 10^x where x is number of 0 after the (.)

Example for variable which resolution is 0-6553(.)5

10.5 should be converted to 105

2.1 Telegrams.

	Telegrams: Internal parameters settings	Units	ID
0	Reserved		0x000
1	Source current controller P gain		0x001
2	Source current controller I gain		0x002
3	Network choke current controller P gain		0x003
4	Network choke current controller I gain		0x004
5	Network choke current controller D gain		0x005
6	Network choke current controller D filter time constant		0x006
7	Network current controller P gain		0x007
8	Network current controller I gain		0x008
9	Network current controller D gain		0x009
10	Network current controller D filter time constant		0x00A

	Telegrams: Digital signals	Units	ID
1	Error source inverter		0x080
2	Error network inverter		0x081
3	Status network inverter		0x082
4	Status source inverter		0x083
5	User interface control		0x084

	Telegrams: Analog out for network inverter	Units	ID
1	Network L-N RMS voltage for phase U	V	0x100
	Network L-N RMS voltage for phase V	V	
2	Network L-N RMS voltage for phase W	V	0x101
	Network RMS current for phase U	A	
3	Network RMS current for phase V	A	0x102
	Network RMS current for phase W	A	
4	Network active power	kW	0x103
	Network reactive power	kVAr	
5	Network apparent power	kVA	0x104
	Network frequency	Hz	
6	Network power factor		0x105
7	Total energy yield kWhs	kWh	0x106
8	Total kWhsls (since last start)	kWh	0x107
9	Monthly energy yield	kWh	0x108
10	Current annual energy yield	kWh	0x109
11	Network's set maximum RMS current (feedback what value has been set)	A	0x10A
12	Total time	h	0x10B
13	Time since last start	h	0x10C
14	IGBTs bridge temperature	°C	0x10D
15	Utility meter reading	kWh	0x10E
16	Analog input 1	V	0x10F
	Analog input 2	V	
17	Analog input 3	V	0x110
	Analog input 4	V	
18	Serial number		0x111
19	Software version inverter controller		0x112
20	Time to service	days	0x115
21	Demanded source speed	rpm	0x116
22	Capacitor L-N RMS voltage for phase U	V	0x117
	Capacitor L-N RMS voltage for phase V	V	
23	Capacitor L-N RMS voltage for phase W	V	0x118
24	Vector Shift U	°	0x119
	Vector Shift V		

25	Vector Shift W	°	0x120
	ROCOF U	Hz/s	
26	ROCOF V	Hz/s	0x121
	ROCOF W	Hz/s	
27	Software version user controller		0x122

	Telegrams: source/network settings	Units	ID
1	Set network maximum RMS current	A	0x200
2	Set source maximum RMS current	A	0x201
3	Set source demanded active power (iQ)	kVAr	0x202
4	Set source demanded reactive power (iD)	kW	0x203
5	Set alternator number of poles		0x204
6	Set turbine over speed	rpm	0x205
7	Set turbine cut in speed	rpm	0x206
8	Set turbine cut in voltage	V	0x207
9	Set operating mode		0x208
10	Minimum engine speed	rpm	0x209
	Maximum engine speed	rpm	
11	Set genset characteristic power point 1	kW	0x20A
	Set genset characteristic speed point 1	rpm	
12	Set genset characteristic power point 2	kW	0x20B
	Set genset characteristic speed point 2	rpm	
13	Set genset characteristic power point 3	kW	0x20C
	Set genset characteristic speed point 3	rpm	
14	Set genset characteristic power point 4	kW	0x20D
	Set genset characteristic speed point 4	rpm	
15	Set utility meter start value	kWh	0x20E
	Set service interval (for harsh environment)	days	
16	Service engineer name	4 letters	0x20F
17	Set network over voltage (L-N) [V]	V	0x210
18	Set network under voltage (L-N) [V]	V	0x211
19	Set network over frequency	Hz	0x212
20	Set network under frequency	Hz	0x213
21	Set network nominal frequency	Hz	0x214
22	Set network voltage frequency	Hz	0x215
23	Set Rate Of Change Of Frequency (ROCOF) trip	Hz/s	0x216
24	Set vector shift trip	°	0x217
25	Set time	hh.mm.ss	0x218
26	Set date	dd.mm.yyyy	0x219
27	Control (start – stop) register		0x21A

144	Set source maximum RMS terminal voltage (point where field weakening starts)		0x290
145	Set source demanded active power (iQ)	kVAr	0x291
146	Set source demanded reactive power (iD)	kW	0x292
147	Set network active power limit	kW	0x293
148	Set network reactive power limit	kVAr	0x294
149	Set source active power limit	kW	0x295
150	Set source reactive power limit	kVAr	0x296
151	Set Fundamental Frequency of Induction Generator	Hz	0x297
	Set Demanded speed of Generator	rpm	
152	Set Fundamental Phase Voltages (Modulation Index)		0x298
153	Set Rate of Change of Fundamental Frequency	Hz/s	0x299
	Set Rate of Change of Speed	rpm/s	
154	Set Modulation index to Synchronous frequency Point 0		0x29A
155	Set Modulation index to Synchronous frequency Point 1		0x29B
156	Set Modulation index to Synchronous frequency Point 2		0x29C
157	Reserved		0x27F
158	Reserved		0x2FF

	Telegrams: Analog out for source inverter	Units	ID
1	Source L-N RMS voltage for phase R	V	0x300
	Source L-N RMS voltage for phase S	V	
2	Source L-N RMS voltage for phase T	V	0x301
	Source RMS current for phase R	A	
3	Source RMS current for phase S	A	0x302
	Source RMS current for phase T	A	
4	Source active power	kW	0x303
	Source reactive power	kVAr	
5	Source apparent power	kVA	0x304
	Source frequency	Hz	

6	Source power factor		0x305
	Turbine speed	Rpm	
7	Wind speed	m/s	0x306
	DC-link voltage [V]	V	
8	DC-link voltage TOP [V]	V	0x307
	DC-link voltage BOTTOM[V]	V	
9	IGBTs bridge temperature	°C	0x308
10	Source's set maximum RMS current (feedback what value has been set)	A	0x309
11	Generator Ke factor (peak phase voltage/gen frequency)	V/Hz	0x30A
12	Reserved		0x37F

	Telegrams: Analogue out for user interface	Units	ID
1	User ADC Ch1		0x400
	User ADC Ch2		
2	User ADC Ch3		0x401
	User ADC Ch4		
3	Countdown timer		0x402
4	Modem state		0x403
5	Latest hour average speed		0x404
	Latest hour average temperature		
6	Energy accumulative		0x405
7	CAN Communicating with Shetland CAN/Analog box		0x406
	0→5V current power output		
9	Network V_q & V_d demand		0x408

10	Reserved		0x47F
11	Reserved		0x57F

Digital

- 1) Indicators
 - a) PLL locked
 - b) Network contactor status
 - c) Source contactor status
 - d) Wireless status

3 Telegrams details

3.1 Telegrams: internal parameters settings

ID 0x001	Description		Resolution
Byte 1	Source current controller P gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x002	Description		Resolution
Byte 1	Source current controller I gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x003	Description		Resolution
Byte 1	Network choke current controller P gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x004	Description		Resolution
Byte 1	Network current controller I gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x005	Description		Resolution
Byte 1	Network current controller D gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x006	Description		Resolution
Byte 1	Network choke current controller D filter time constant	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x007	Description		Resolution
Byte 1	Network current controller P gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x008	Description		Resolution
Byte 1	Network current controller I gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x009	Description		Resolution
Byte 1	Network current controller D gain	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x00A	Description		Resolution
Byte 1	Network current controller D filter time constant	LO	Floating point
Byte 2			
Byte 3			
Byte 4		HI	

3.2 Telegrams: Digital signals out

<i>Errors source inverter</i>	
<i>ID 0x080</i>	<i>Byte 1</i>
Bit 0	<i>Driver phase U error</i>
Bit 1	<i>Driver phase V error</i>
Bit 2	<i>Driver phase W error</i>
Bit 3	IGBT over temp
Bit 4	Over current U
Bit 5	Over current V
Bit 6	Over current W
Bit 7	Contactor error
<i>Byte 2</i>	
Bit 0	Inverter overloaded
Bit 1	Phase sequence error
Bit 2	Frequency out of limits
Bit 3	Voltage out of limits
Bit 4	DC-link over voltage Top
Bit 5	DC-link over voltage Bottom
Bit 6	DC link under voltage
Bit 7	Terminal voltage present
<i>Byte 3</i>	
Bit 0	Over frequency
Bit 1	Under frequency
Bit 2	Over voltage phase R
Bit 3	Over voltage phase S
Bit 4	Over voltage phase T
Bit 5	Under voltage phase R
Bit 6	Under voltage phase S
Bit 7	Under voltage phase T
<i>Byte 4</i>	
Bit 0	DC-LINK pre-charge
Bit 1	Loss of Source
Bit 2	PLL Error
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

Errors network inverter	
ID 0x081	Byte 1
Bit 0	Driver phase U error
Bit 1	Driver phase V error
Bit 2	Driver phase W error
Bit 3	IGBT over temp
Bit 4	Over current U
Bit 5	Over current V
Bit 6	Over current W
Bit 7	Contactor error
	Byte 2
Bit 0	Inverter overloaded
Bit 1	Phase sequence error
Bit 2	Frequency out of limits
Bit 3	Voltage out of limits
Bit 4	Terminal voltage present (islanding mode)
Bit 5	SurgeVoltage
Bit 6	
Bit 7	
	Byte 3
Bit 0	Over frequency
Bit 1	Under frequency
Bit 2	Over voltage phase U
Bit 3	Over voltage phase V
Bit 4	Over voltage phase W
Bit 5	Under voltage phase U
Bit 6	Under voltage phase V
Bit 7	Under voltage phase W
	Byte 4
Bit 0	ROCOF error
Bit 1	Vector shift error
Bit 2	PLL error
Bit 3	DCCurrentLimit
Bit 4	
Bit 5	
Bit 6	
Bit 7	

Status network inverter	
ID 0x082	Byte 1 (network)
Bit 0	PLL locked
Bit 1	Network contactor status open/closed
Bit 2	Bypass Contactor status open/close
Bit 3	Pre-charge contactor status open/close
Bit 4	Detected 50Hz
Bit 5	Detected 60Hz
Bit 6	Detected 400Hz
Bit 7	Detected 110V
Byte 2	
Bit 0	Detected 220V
Bit 1	Detected 230V
Bit 2	Detected 240V
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
Byte 3	
Bit 0	Command
Bit 1	Command
Bit 2	Command
Bit 3	Command
Bit 4	Voltage control mode synchronised
Bit 5	Current control mode
Bit 6	Voltage control mode not synchronised
Bit 7	Power ready
Byte 4	
Bit 0	System status (Started/Stopped) "1" – system is generating; "0" – system is stopped
Bit 1	Nominal Voltage settings received
Bit 2	Nominal Frequency settings received
Bit 3	Operating Mode settings received
Bit 4	Loss of Mains Settings received
Bit 5	Islanding mode
Bit 6	Network mode
Bit 7	Parallel mode (rings)

Status source inverter	
ID 0x083	Byte 1
Bit 0	PLL locked
Bit 1	Source contactor status open/closed
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 2
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 3
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 4
Bit 0	Filed weakening mode feedback signal (1- ON, 0-OFF)
Bit 1	Induction Generator Mode feedback signal (1- ON, 0-OFF)
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

User interface Digital IO Status	
ID 0x084	Byte 1
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 2
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 3
Bit 0	Digital output 1
Bit 1	Digital output 2
Bit 2	Digital output 3
Bit 3	Digital output 4
Bit 4	Digital output 5
Bit 5	Digital output 6
Bit 6	Digital output 7
Bit 7	Digital output 8
	Byte 4
Bit 0	Digital input 1
Bit 1	Digital input 2
Bit 2	Digital input 3
Bit 3	Digital input 4
Bit 4	Digital input 5
Bit 5	Digital input 6
Bit 6	Digital input 7
Bit 7	Digital input 8

User interface Control	
ID 0x085	Byte 1
Bit 0	Command: Reset to factory settings
Bit 1	Command: Reset to user interface and inverter controllers
Bit 2	Command: Manual power and control override
Bit 3	Command: External/(forced) stop 0- no stop; 1- forced stop
Bit 4	Command: External active braking command ; 0-no brake ; 1- active braking
Bit 5	
Bit 6	
Bit 7	
	Byte 2
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 3
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 4
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

User interface Digital IO Control	
ID 0x086	Byte 1
Bit 0	Relay 1
Bit 1	Relay 2
Bit 2	Relay 3
Bit 3	Relay 4
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 2
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 3
Bit 0	Digital output 1
Bit 1	Digital output 2
Bit 2	Digital output 3
Bit 3	Digital output 4
Bit 4	Digital output 5
Bit 5	Digital output 6
Bit 6	Digital output 7
Bit 7	Digital output 8
	Byte 4
Bit 0	Digital input 1
Bit 1	Digital input 2
Bit 2	Digital input 3
Bit 3	Digital input 4
Bit 4	Digital input 5
Bit 5	Digital input 6
Bit 6	Digital input 7
Bit 7	Digital input 8

Warning register	
ID 0x087	Byte 1
Bit 0	Over Speed
Bit 1	Turbine rotation reversed
Bit 2	Power limiting
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 2
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 3
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	
	Byte 4
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

3.3 Telegrams: Analog out for network inverter

ID 0x100	Description		Resolution/Range
Byte 1	Network L-N RMS voltage for phase U	LO	0-6553(.)5 V
Byte 2		HI	
Byte 3	Network L-N RMS voltage for phase V	LO	0-6553(.)5 V
Byte 4		HI	

ID 0x101	Description		Resolution/Range
Byte 1	Network L-N RMS voltage for phase W	LO	0-6553(.)5 V
Byte 2		HI	
Byte 3	Network L-N RMS current for phase U	LO	0-6553(.)5 A
Byte 4		HI	

ID 0x102	Description		Resolution/Range
Byte 1	Network L-N RMS current for phase V	LO	0-6553(.)5 A
Byte 2		HI	
Byte 3	Network L-N RMS current for phase W	LO	0-6553(.)5 A
Byte 4		HI	

ID 0x103	Description		Resolution/Range
Byte 1	Network active power	LO	+3276(.)7 kW
Byte 2		HI	
Byte 3	Network reactive power	LO	+3276(.)7 kVAr
Byte 4		HI	

ID 0x104	Description		Resolution/Range
Byte 1	Network apparent power	LO	0-6553(.)5 kVA
Byte 2		HI	
Byte 3	Network frequency	LO	0-655(.)35 Hz
Byte 4		HI	

ID 0x105	Description		Resolution/Range
Byte 1	Network power factor	LO	+3276(.)7
Byte 2		HI	

ID 0x106	Description		Resolution/Range
Byte 1	Total energy yield	LO	TBD
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x107	Description		Resolution/Range	
Byte 1	Daily energy yield	LO	+214748364(.)7 kWh	
Byte 2		HI		-214748364(.)8 kWh
Byte 3		LO		
Byte 4				

ID 0x108	Description		Resolution/Range
Byte 1	Monthly energy yield	LO	0-6553(.)5 kWh
Byte 2			

ID 0x109	Description		Resolution/Range
Byte 1	Annual energy yield	LO	TBD
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x10A	Description		Resolution/Range
Byte 1	Network's set maximum current	LO	0-6553(.)5 A
Byte 2		HI	

ID 0x10B	Description		Resolution/Range
Byte 1	Total time	LO	TBD
Byte 2			
Byte 3			

Byte 4		<i>HI</i>	
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<i>ID 0x10C</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Time since last start	<i>LO</i>	<i>TBD</i>
Byte 2			
Byte 3			
Byte 4		<i>HI</i>	

<i>ID 0x10D</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	IGBTs bridge temperature	<i>LO</i>	<i>+327(.)67 °C</i>
Byte 2		<i>HI</i>	<i>-327(.)68 °C</i>

<i>ID 0x10E</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Utility meter reading	<i>LO</i>	<i>TBD</i>
Byte 2			
Byte 3			
Byte 4		<i>HI</i>	

<i>ID 0x10F</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Analog input 1	<i>LO</i>	<i>-10(.)000 +10(.)000</i>
Byte 2		<i>HI</i>	
Byte 3	Analog input 2	<i>LO</i>	<i>-10(.)000 +10(.)000</i>
Byte 4		<i>HI</i>	

<i>ID 0x110</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Analog input 3	<i>LO</i>	<i>-10(.)000 +10(.)000</i>
Byte 2		<i>HI</i>	
Byte 3	Analog input 4	<i>LO</i>	<i>-10(.)000 +10(.)000</i>
Byte 4		<i>HI</i>	

ID 0x111	Description		Resolution/Range
Byte 1	Serial number	LO	Unsigned long
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x112	Description		Resolution/Range
Byte 1	Software version inverter controller (TMS)	LO	Unsigned long SC001-00500Rev1.09 Gives 1 500 01 09
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x113	Description		Resolution/Range
Byte 1	Hours in binary coded decimal	LO	0 – 24 h
Byte 2		HI	
Byte 3	Minutes in binary coded decimal	LO	0-60mins
Byte 4		HI	
Byte 5	Seconds in binary coded decimal	LO	0-60secs
Byte 6		HI	
Byte 7		LO	
Byte 8		HI	

ID 0x114	Description		Resolution/Range
Byte 1	Date in binary coded decimal	LO	0-31
Byte 2		HI	
Byte 3	Month in binary coded decimal	LO	0-12
Byte 4		HI	
Byte 5	Century in binary coded decimal	LO	20-21
Byte 6		HI	
Byte 7	Year in binary coded decimal	LO	0-99
Byte 8		HI	

ID 0x114	Description		Resolution/Range
Byte 1	Date	LO	TBD
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x115	Description		Resolution/Range
Byte 1	Time to service	LO	0-65535 h
Byte 2		HI	

ID 0x116	Description		Resolution/Range
Byte 1	Demanded source speed	LO	0-65535
Byte 2		HI	

ID 0x117	Description		Resolution/Range
Byte 1	Network L-N capacitor RMS voltage for phase U	LO	0-6553(.).5 V
Byte 2		HI	
Byte 3	Network L-N capacitor RMS voltage for phase V	LO	0-6553(.).5 V
Byte 4		HI	

ID 0x118	Description		Resolution/Range
Byte 1	Network L-N capacitor RMS voltage for phase W	LO	0-6553(.).5 V
Byte 2		HI	
Byte 3		LO	
Byte 4		HI	

ID 0x119	Description		Resolution/Range
Byte 1	Vector shift U	LO	+327(.).67 deg
Byte 2		HI	-327(.).68 deg
Byte 3	Vector shift V	LO	+327(.).67 deg
Byte 4		HI	-327(.).68 deg

ID 0x120	Description		Resolution/Range
Byte 1	Vector shift W	LO	+327(.)67 deg
Byte 2		HI	-327(.)68 deg
Byte 3	ROCOF U	LO	+32(.)767 Hz/s
Byte 4		HI	-32(.)768 Hz/s

ID 0x121	Description		Resolution/Range
Byte 1	ROCOF V	LO	+32(.)767 Hz/s
Byte 2		HI	-32(.)768 Hz/s
Byte 3	ROCOF W	LO	+32(.)767 Hz/s
Byte 4		HI	-32(.)768 Hz/s

ID 0x122	Description		Resolution/Range
Byte 1	Software version user controller (dsPic)	LO	Unsigned long SC001-00500Rev1.09 Gives 1 500 01 09
Byte 2			
Byte 3			
Byte 4		HI	

3.4 Telegrams: Source/Network settings

ID 0x200	Description		Resolution/Range
Byte 1	Set network maximum RMS current	LO	0-6553(.).5 A
Byte 2		HI	

ID 0x201	Description		Resolution/Range
Byte 1	Set source/alternator maximum current	LO	0-6553(.).5 A
Byte 2		HI	

ID 0x202	Description		Resolution/Range
Byte 1	Set source demanded active power (iQ)	LO	+2147483(.).647 kW -2147483(.).648 kW
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x203	Description		Resolution/Range
Byte 1	Set source demanded reactive power (iD)	LO	+2147483(.).647 kVAr -2147483(.).648 kVAr
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x204	Description		Resolution/Range
Byte 1	Set alternator number of poles	LO	Integer 0-1000
Byte 2		HI	

ID 0x205	Description		Resolution/Range
Byte 1	Set turbine over speed	LO	Integer 0-1000(.).0 rpm
Byte 2		HI	

ID 0x206	Description		Resolution/Range
Byte 1	Set turbine cut in speed	LO	Integer 0-1000(.).0 rpm

Byte 2		<i>HI</i>	
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<i>ID 0x207</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Set turbine cut in voltage	<i>LO</i>	<i>0-6553(.5) V</i>
Byte 2		<i>HI</i>	

<i>ID 0x208</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Set operating mode Bit 0 – Network mode Bit 1 – Islanding mode Bit 2 – Parallel mode (islanded) Bit 3 – Bit 4 - Bit 5 Bit 6 Bit 7		
Byte 2	Bit 0 – Parallel mode cable connected Unit is master Bit 1 - Parallel mode cable connected Unit is slave Bit 2 – Field weakening On/Off (“1” is ON “0” is OFF) Bit 3 – Induction Generator mode(if not enable PMG mode Bit 4 - Ind.Gen. Power Control Bit 5- Ind.Gen. Frequency Control (Modulation index set by modulation index v target freq according to the lookup table (Gaia)) Bit 6 – Induction Gen Speed Signal ON Bit 7 - Motor start-up		
Byte 3	Bit 0 -DC Overcurrent Protection (1 is ON, 0 is OFF)		
Byte 4			

<i>ID 0x209</i>	<i>Description</i>		<i>Resolution/Range</i>
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Byte 1	Set minimum source speed	<i>LO</i>	<i>Integer 0-6553(.).5 rpm</i>
Byte 2		<i>HI</i>	
Byte 3	Set maximum source speed	<i>LO</i>	<i>Integer 0-6553(.).5 rpm</i>
Byte 4		<i>HI</i>	

<i>ID 0x20F</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Service engineer	<i>LO</i>	<i>4 letters</i>
Byte 2			
Byte 3			
Byte 4		<i>HI</i>	

<i>ID 0x210</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Set network over voltage ST1 (L-N)	<i>LO</i>	<i>0-6553(.).5 V</i>
Byte 2	Threshold level 1	<i>HI</i>	
Byte 3	Set network over voltage ST2 (L-N)	<i>LO</i>	<i>0-6553(.).5 V</i>
Byte 4	Threshold level 2	<i>HI</i>	

<i>ID 0x211</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Set network under voltage ST1(L-N)	<i>LO</i>	<i>0-6553(.).5 V</i>
Byte 2	Threshold level 1	<i>HI</i>	
Byte 3	Set network under voltage ST2(L-N)	<i>LO</i>	<i>0-6553(.).5 V</i>
Byte 4	Threshold level 2	<i>HI</i>	

<i>ID 0x212</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Set network over frequency ST1 [Hz]	<i>LO</i>	<i>0-655(.).35 Hz</i>
Byte 2	Threshold level 1	<i>HI</i>	
Byte 3	Set network over frequency ST2 [Hz]	<i>LO</i>	<i>0-655(.).35 Hz</i>
Byte 4	Threshold level 2	<i>HI</i>	

<i>ID 0x213</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Set network under freq ST1 [Hz]	<i>LO</i>	<i>0-655(.).35 Hz</i>
Byte 2	Threshold level 1	<i>HI</i>	

Byte 3	Set network under freq ST2 [Hz]	LO	0-655(.)35 Hz
Byte 4		HI	

ID 0x214	Description		Resolution/Range
Byte 1	Set network nominal frequency [Hz]	LO	0-655(.)35 Hz
Byte 2		HI	

ID 0x215	Description		Resolution/Range
Byte 1	Set network nominal voltage [V]	LO	0-6553(.)5 Hz
Byte 2		HI	

ID 0x216	Description		Resolution/Range
Byte 1	Set Rate Of Change Of Frequency (ROCOF) trip	LO	0-65(.)535 Hz/s
Byte 2		HI	

ID 0x217	Description		Resolution/Range
Byte 1	Set vector shift trip	LO	0-655(.)35 °
Byte 2		HI	

ID 0x218	Description		Resolution/Range
Byte 1	Set time	LO	TBD
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x219	Description		Resolution/Range
Byte 1	Set date	LO	TBD
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x21A	Description		Resolution/Range
Byte 1	Bit 0 – Start generating request Bit 1 – Stop Generating request Bit 2 – Reset/reboot DSP Bit 3 – Internal Active Braking Command ; 0- no brake 1- active braking Bit 4 - Bit 5 Bit 6 Bit 7		
Byte 2			
Byte 3			
Byte 4			

ID 0x21B	Description		Resolution/Range
Byte 1	Rotor Speed	LO	0-6553(.5) rpm
Byte 2		HI	

ID 0x21C	Description		Resolution/Range
Byte 1	Serial Number	LO	
Byte 2		HI	

ID 0x21D	Description		Resolution/Range
Byte 1	Modem status	LO	
Byte 2		HI	

ID 0x21E	Description		Resolution/Range
Byte 1	Debug	LO	
Byte 2		HI	

ID 0x21F	Description		Resolution/Range
Byte 1	Debug	LO	
Byte 2		HI	

ID 0x220	Description		Resolution/Range
Byte 1	Set source over frequency limit (over speed) [Hz]	LO	0-6553(.).5 Hz
Byte 2		HI	

ID 0x221	Description		Resolution/Range
Byte 1	Measured speed of the Induction/PMG motor (speed feedback)	LO	0-6553(.).5 Hz
Byte 2		HI	

ID 0x222	Description		Resolution/Range
Byte 1	Time to trip for Over Voltage Trip setting 1 OV_ST1	LO	0-1000 [10ms]
Byte 2		HI	
Byte 3	Time to trip for Over Voltage Trip setting 2 OV_ST2	LO	0-1000 [10ms]
Byte 4		HI	

ID 0x223	Description		Resolution/Range
Byte 1	Time to trip for Under Voltage Trip setting 1 UV_ST1	LO	0-20000 [10ms]
Byte 2		HI	
Byte 3	Time to trip for Under Voltage Trip setting 2 UV_ST2	LO	0-20000 [10ms]
Byte 4		HI	

ID 0x224	Description		Resolution/Range
Byte 1	Time to trip for Over Frequency Trip setting 1 OF_ST1	LO	0-1000 [10ms]
Byte 2		HI	
Byte 3	Time to trip for Over Frequency Trip setting 2 OF_ST2	LO	0-1000 [10ms]
Byte 4		HI	

ID 0x225	Description		Resolution/Range
Byte 1	Time to trip for Under Frequency Trip setting 1 UF_ST1	LO	0-1000 [10ms]
Byte 2		HI	
Byte 3	Time to trip for Under Frequency Trip setting 2 UF_ST2	LO	0-1000 [10ms]
Byte 4		HI	

ID 0x226	Description		Resolution/Range
Byte 1	Number of active parallel inverters	LO	1-65535
Byte 2		HI	
Byte 3	Voltage limiter margin as a percentage below OV_ST1 setting (1% below default)	LO	0-6553(.).5 V
Byte 4		HI	

ID 0x290	Description		Resolution/Range
Byte 1	Set source maximum RMS terminal voltage	LO	0-6553(.).5 V
Byte 2		HI	

ID 0x291	Description		Resolution/Range
Byte 1	Set network demanded active power (iQ)	LO	+2147483(.).647 kW -2147483(.).648 kW
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x292	Description		Resolution/Range
Byte 1	Set network demanded reactive power (iD)	LO	+2147483(.).647 kVAr -2147483(.).648 kVAr
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x293	Description		Resolution/Range
Byte 1	Set network active power limit	LO	+2147483(.).647 kW

Byte 2			-2147483(.)648 kW
Byte 3			
Byte 4		HI	

ID 0x294	Description		Resolution/Range
Byte 1	Set network reactive power limit	LO	+2147483(.)647 kVAr -2147483(.)648 kVAr
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x295	Description		Resolution/Range
Byte 1	Set source active power limit	LO	+2147483(.)647 kW -2147483(.)648 kW
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x296	Description		Resolution/Range
Byte 1	Set source reactive power limit	LO	+2147483(.)647 kVAr -2147483(.)648 kVAr
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x297	Description		Resolution/Range
Byte 1	Set Demanded Frequency of Induction Generator	LO	0-655(.)35 Hz
Byte 2		HI	
Byte 3	Set Demanded speed of Generator	LO	0-6553(.)5 rpm
Byte 4		HI	

ID 0x298	Description		Resolution/Range
Byte 1	Set Demanded Phase RMS Voltages (Modulation Index)	LO	0-6(.)5535 V
Byte 2		HI	

Byte 3	Reserved	LO	
Byte 4		HI	

ID 0x299	Description		Resolution/Range
Byte 1	Set Rate of Change of Fundamental Frequency	LO	0-655(.)35 Hz/s
Byte 2		HI	
Byte 3	Set Rate of Change of Speed	LO	0-100(.)1 rpm/s
Byte 4		HI	

ID 0x29A	Description		Resolution/Range
Byte 1	Set Synchronous frequency Point 0	LO	0-655(.)35 Hz
Byte 2		HI	
Byte 3	Set generator RMS voltage Point 0	LO	0-6553(.)5 V
Byte 4		HI	

ID 0x29B	Description		Resolution/Range
Byte 1	Set Synchronous frequency Point 1	LO	0-655(.)35 Hz
Byte 2		HI	
Byte 3	Set generator RMS voltage Point 1	LO	0-6553(.)5 V
Byte 4		HI	

ID 0x29C	Description		Resolution/Range
Byte 1	Set Synchronous frequency Point 2	LO	0-655(.)35 Hz
Byte 2		HI	
Byte 3	Set generator RMS voltage Point 2	LO	0-6553(.)5 V
Byte 4		HI	

3.5 Telegrams: Analog out for source inverter

ID 0x300	Description		Resolution/Range
Byte 1	Source L-N RMS voltage phase R	LO	0-6553(.)5 V
Byte 2		HI	
Byte 3	Source L-N RMS voltage phase S	LO	0-6553(.)5 V

Byte 4		<i>HI</i>	
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<i>ID 0x301</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Source L-N RMS voltage phase T	<i>LO</i>	<i>0-6553(.5 V</i>
Byte 2		<i>HI</i>	
Byte 3	Source line RMS current phase R	<i>LO</i>	<i>0-6553(.5 A</i>
Byte 4		<i>HI</i>	

<i>ID 0x302</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Source line RMS current phase S	<i>LO</i>	<i>0-6553(.5 A</i>
Byte 2		<i>HI</i>	
Byte 3	Source line RMS current phase T	<i>LO</i>	<i>0-6553(.5 A</i>
Byte 4		<i>HI</i>	

<i>ID 0x303</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Source active power	<i>LO</i>	<i>+3276(.7 kW</i> <i>-3276(.8 kW</i>
Byte 2		<i>HI</i>	
Byte 3	Source reactive power	<i>LO</i>	<i>+3276(.7 kVAr</i> <i>-3276(.8 kVAr</i>
Byte 4		<i>HI</i>	

<i>ID 0x304</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Source apparent power	<i>LO</i>	<i>0-6553(.5 kVA</i>
Byte 2		<i>HI</i>	
Byte 3	Source frequency	<i>LO</i>	<i>0-655(.35 Hz</i>
Byte 4		<i>HI</i>	

<i>ID 0x305</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Source power factor	<i>LO</i>	<i>+3276(.7</i> <i>-3276(.8</i>
Byte 2		<i>HI</i>	
Byte 3		<i>LO</i>	
Byte 4		<i>HI</i>	

<i>ID 0x306</i>	<i>Description</i>		<i>Resolution/Range</i>
Byte 1	Wind speed	<i>LO</i>	<i>0-6553(.5 m/s</i>
Byte 2		<i>HI</i>	
Byte 3	DC-link voltage	<i>LO</i>	<i>0-6553(.5 V</i>
Byte 4		<i>HI</i>	

ID 0x307	Description		Resolution/Range
Byte 1	DC-link voltage TOP	LO	0-6553(.).5 V
Byte 2		HI	
Byte 3	DC-link voltage BOTTOM	LO	0-6553(.).5 V
Byte 4		HI	

ID 0x308	Description		Resolution/Range
Byte 1	IGBTs bridge temperature	LO	+3276(.).7 °C
Byte 2		HI	-3276(.).8 °C

ID 0x309	Description		Resolution/Range
Byte 1	Source's set maximum RMS current (feedback what value has been set)	LO	0-6553(.).5 A
Byte 2		HI	
Byte 3	spare	LO	
Byte 4		HI	

ID 0x30A	Description		Resolution/Range
Byte 1	Ke of the generator	LO	0-6553(.).5 V/Hz
Byte 2		HI	
Byte 3	spare	LO	
Byte 4		HI	

3.6 Telegrams: Analogue out for user interface

ID 0x400	Description		Resolution/Range
Byte 1	User ADC Ch1	LO	-10V to 10V
Byte 2		HI	
Byte 3	User ADC Ch2	LO	-10V to 10V
Byte 4		HI	

Byte 4	User ADC Ch3	<i>LO</i>	-10V to 10V
Byte 4		<i>HI</i>	
Byte 4	User ADC Ch4	<i>LO</i>	-10V to 10V
Byte 4		<i>HI</i>	

ID 0x405	Description		Resolution/Range
Byte 1	Energy accumulated	<i>LO</i>	+214748364(.)7 kWhrs -214748364(.)8 kWhrs
Byte 2			
Byte 3			
Byte 4		<i>HI</i>	

ID 0x406	Description		Resolution/Range
Byte 1	CAN to Analogue Converter	<i>LO</i>	O/P 1
Byte 2			O/P 2
Byte 3			O/P 3
Byte 4		<i>HI</i>	

ID 0x407	Description		Resolution/Range
Byte 1	Operating time in hrs	<i>LO</i>	0-6553(.)5 hrs
Byte 2		<i>HI</i>	
Byte 3	Operating time in days	<i>LO</i>	0-6553(.)5 days
Byte 4		<i>HI</i>	

ID 0x408	Description		Resolution/Range
Byte 1	Network V _q demand	<i>LO</i>	0-6553(.)5 V
Byte 2		<i>HI</i>	
Byte 3	Network V _d demand	<i>LO</i>	0-6553(.)5 V
Byte 4		<i>HI</i>	

4 Reference tables

ID	Byte1	Byte2	Byte3	Byte4
0x201				

ID 0x201	Byte 1
Bit 0	
Bit 1	
Bit 2	
Bit 3	
Bit 4	
Bit 5	
Bit 6	
Bit 7	

ID 0x004	Description		Resolution/Range
Byte 1		LO	TBD
Byte 2			
Byte 3			
Byte 4		HI	

ID 0x400	Description		Resolution/Range
Byte 1		LO	
Byte 2		HI	
Byte 3		LO	
Byte 4		HI	
Byte 4		LO	
Byte 4		HI	
Byte 4		LO	
Byte 4		HI	

