PM100 Inverter/Controller CAN Bus Messages

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CAN Message:

CAN ID	Data Byte 0	Data Byte 1	Data Byte 2	Data Byte 3	Data Byte 4	Data Byte 5	Data Byte 6	Data Byte 7

Message Type	Details/Example
Broadcast Message	**CAN ID: 0x0A0 – 0x0AF** (Each CAN ID is the "address" to specific content) • PM100 Inverter Broadcasts messages with the given CAN IDs, so we can choose a CAN ID to filter/read
Command Message	**CAN ID: 0x0C0** • We send CAN messages to the PM100 with this CAN ID. The Inverter will know it is a command message
Parameter Message - Set EEPROM parameters - (Will not use CAN to set these up)	**CAN ID: 0x0C1** → Use to send message to controller **CAN ID: 0x0C2** → Response from controller

Address	Frequency	Content	CAN Active Messages (Low Word)
0x0A0	Slow/10 Hz	Temperatures #1	0x0001
0x0A1	Slow/10 Hz	Temperatures #2	0x0002
0x0A2	Slow/10 Hz	Temperatures #3	0x0004
0x0A3	Fast/100 Hz	Analog Inputs Voltages	0x0008
0x0A4	Fast/100 Hz	Digital Input Status	0x0010
0x0A5	Fast/100 Hz	Motor Position Information	0x0020
0x0A6	Fast/100 Hz	Current Information	0x0040
0x0A7	Fast/100 Hz	Voltage Information	0x0080
0x0A8	Fast/100 Hz	Flux Information	0x0100
0x0A9	Slow/10 Hz	Internal Voltages	0x0200
0x0AA	Fast/100 Hz	Internal States	0x0400
0x0AB	Fast/100 Hz	Fault Codes	0x0800
0x0AC	Fast/100 Hz	Torque & Timer Information	0x1000
0x0AD	Fast/100 Hz	Modulation Index & Flux Weakening Output Information	0x2000
0x0AE	Slow/10 Hz	Firmware Information	0x4000
0x0AF	100 Hz (fixed)	Diagnostic Data	0x8000

Byte.Bit	Name	Format	Description
0,1	Torque Command	Torque	Torque command used when in torque mode.
2,3	Speed Command	Angular Velocity	Speed command used when in speed mode.
4	Direction Command	Boolean	0 = "Reverse" 1 = "Forward" See section 2.3.2.2 for further definition of direction.
5.0	Inverter Enable	Boolean	0 = Inverter Off, 1 = Inverter On
5.1	Inverter Discharge[8]	Boolean	0 = Disable Discharge, 1 = Enable Discharge
5.2	Speed Mode Enable	Boolean	0 = Do not over-ride mode 1 = If controller is in torque mode then controller will change to speed mode. This is a mode over-ride bit that will change the mode from torque to speed only. It does not change the mode from speed to torque. See manual Using Speed Mode for more information.
6,7	Commanded Torque Limit	Torque	If set to 0, the default torque limits sets in the EEPROM parameters are used. If set to a positive number then the Motor and Regen Torque limits are set to the torque value sent.

Quick Examples: (Arduino Code + Sending CAN PM100 Messages)

Arduino Serial CAN Bus Code:

```
unsigned char dta[8] = {1, 2, 3, 4, 5, 10, 11, 12};     //data
can.send(0x0C0, 0, 0, 8, dta);       //send(unsigned long id, byte ext, byte rtrBit, byte len, const byte *buf);
can.recv(&id, dta)
```

Example: Commanding Torque of Motor (From PM100 CAN Manual):

Message Type	CAN ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Description
Rxd	0xAA	4	0	9	0	**0**	0	**128**	0	Torque mode Is active. Lockout is enabled.
Txd	0xC0	0	0	0	0	0	**0**	0	0	Send out inverter disable command to release lockout. **Note** that lockout will not disable if the inverter is faulted. This command should have been set up to be transmitted at a rate sufficient to prevent the CAN Timeout fault. To prevent a fault at startup start sending before the inverter is powered up.
Txd	0xC0	**100**	**0**	x [9]	x	**1**	**1**	0	0	Enable the inverter with a torque command of +10 Nm in forward direction.
Txd	0xC0	**200**	**0**	x	x	1	1	0	0	Set the torque to +20 Nm (motoring) in forward direction.
Txd	0xC0	**156**	**255**	x	x	1	1	0	0	Set the torque to -10 Nm (regenerative) in forward direction.
Txd	0xC0	X	x	x	x	1	**0**	0	0	Disable the inverter before changing the direction. If the direction is changed without disabling the inverter first. The inverter will be automatically disabled as a safety precaution.
Txd	0xC0	**100**	**0**	x	x	**0**	**1**	0	0	Set the command to +10 Nm (motoring) in reverse direction.

Command Messages:

"When in CAN mode the Command messages should be sent to the controller before the inverter is powered on. If they are not then the Command message Lost fault will have to be cleared up on power up."

1. **Torque Command:** ***Sent as a value in N.m. times 10***

For the message sequence example described below, following assumptions hold true:

GUI EEPROM Parameter	Default Value	Description
Inv_Cmd_Mode_EEPROM(CAN=0_VSM=1)	0	CAN mode
Run_Mode_EEPROM(Trq=0_Spd=1)	0	Torque mode
CAN_ID_Offset_EEPROM	0xA0	Default CAN ID offset
CAN_TimeOut_(/3ms)_EEPROM	333	1 second timeout period

a. { 0, 0, 0, 0, 0, 0, 0, 0}
b. Torque Value = Byte 1, Byte 0 (High, Low Byte) (BUT SENT AS LOW, HIGH) LITTLE-ENDIAN!!!
    1. {00000000 00000000} = 0 (So send data: 0, 0)
    2. {00000000 01100100} = 100 (So send data: 100, 0)
    3. Negative Torque values are represented using ***Binary Signed 2's Complement***
    4. {11111111 10011100} = -100 (So send data: 156, 255)

Torque Value (N.m) Send byte value as N.m x 10	CAN ID	Byte 0 Torque (Nm) (**Low** Byte)	Byte 1 Torque (Nm) (**High** Byte)	Byte 2 Speed (Angular Velocity) (RPM) (**Low** Byte)	Byte 3 Speed (Angular Velocity) (RPM) (**High** Byte)	Byte 4 Direction Command (Boolean) (0 = Reverse/Clockwise 1 = Forward/Counter-Clockwise)	Byte 5 Inverter Enable / Discharge / Speed Mode Enable	Byte 6 Commanded Torque Limit	Byte 7 Commanded Torque Limit
+10	**0x0C0**	100	0	0	0	1	1	0	0
+20	**0x0C0**	200	0	0	0	1	1	0	0
-10	**0x0C0**	156	255	0	0	1	1	0	0
+30	**0x0C0**	44	1	0	0	1	1	0	0
+45	**0x0C0**	194	1	0	0	1	1	0	0
+25.5	**0x0C0**	255	0	0	0	1	1	0	0
+25.6	**0x0C0**	0	1	0	0	1	1	0	0
+25.7	**0x0C0**	1	1	0	0	1	1	0	0

c. Ex:
d. {100, 0, 0, 0, 1, 1, 0, 0} -> Torque = 10N.m, Forward Direction
e. {200, 0, 0, 0, 1, 1, 0, 0} -> Torque = 20N.m, Forward Direction
f. {156, 255, 0, 0, 1, 1, 0, 0} -> Torque = -10N.m, Forward Direction (Decelerate)
g. {44, 1, 0, 0, 1, 1, 0, 0} -> Torque = 30N.m, Forward Direction
h. {194, 1, 0, 0, 1, 1, 0, 0} -> Torque = 45N.m, Forward Direction

2. **Speed Command:** ***Sent as RPM value***
    a. Speed Value = Byte 3, Byte 2 (High, Low) (But sent as LOW, HIGH) LITTLE-ENDIAN!!!
        1. *(I don't think you can send NEGATIVE RPM?)*
        2. {00000000 00000000} = 0 (So send data: 0, 0)

Speed Value (RPM) Send as RPM Value	CAN ID	Byte 0 Torque (Nm) (**Low** Byte)	Byte 1 Torque (Nm) (**High** Byte)	Byte 2 Speed (Angular Velocity) (RPM) (**Low** Byte)	Byte 3 Speed (Angular Velocity) (RPM) (**High** Byte)	Byte 4 Direction Command (Boolean) (0 = Reverse/Clockwise 1 = Forward/Counter-Clockwise)	Byte 5 Inverter Enable / Discharge / Speed Mode Enable	Byte 6 Commanded Torque Limit	Byte 7 Commanded Torque Limit
500	**0x0C0**	0	0	244	1	1	1	0	0
100	**0x0C0**	0	0	100	0	1	1	0	0
50	**0x0C0**	0	0	50	0	1	1	0	0
250	**0x0C0**	0	0	250	0	1	1	0	0
260	**0x0C0**	0	0	4	1	1	1	0	0
256	**0x0C0**	0	0	0	1	1	1	0	0
255	**0x0C0**	0	0	255	0	1	1	0	0

a. Ex:
b. {0, 0, 244, 1, 1, 1, 0, 0} -> Speed = 500RPM, Forward Direction
c. {0, 0, 100, 0, 1, 1, 0, 0} -> Speed = 100RPM, Forward Direction
d. {0, 0, 50, 0, 1, 1, 0, 0} -> Speed = 50RPM, Forward Direction
e. {0, 0, 250, 0, 1, 1, 0, 0} -> Speed = 250RPM, Forward Direction
f. {0, 0, 4, 1, 1, 1, 0, 0} -> Speed = 260RPM, Forward Direction

Broadcast Messages:

0 = CAN Messages broadcast disabled
1 = CAN Message broadcast enabled

"A parameter 'CAN Active Messages Lo Word' with parameter address 148 is defined to enable/disable individual CAN Broadcast Messages"
As an example, in order to **disable Temperature #1, #2 and #3 messages** in the above table, the parameter command message should be configured as follows:

Data Byte 7 (Low Byte)	Data Byte 6 (Low Byte)	Data Byte 5 (High Byte)	Data Byte 4 (Low Byte)	Data Byte 3	Data Byte 2	Data Byte 1	Data Byte 0
CAN Active Messages High Word		CAN Active Messages Low Word		Reserved	R/W Command	Parameter Address	
255 (0xFF)	255 (0xFF)	255 (0xFF)	248 (0xF8)	0	1	0	148

Data Byte 4							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Voltage Information	Current Information	Motor Position Information	Digital Input Status	Analog Input Voltages	Temperature #3	Temperature #2	Temperature #1

Data Byte 5							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diag Data	Firmware Information	Modulation Index & Flux Weakening Output Information	Torque & Timer Information	Fault Codes	Internal States	Internal Voltages	Flux Information

Data Byte 6 controls the following messages but user should not disable any of these messages:

Data Byte 6							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BMS Command Message	Slave Mode Command Message	Not used	Not used	Not used	Not used	Not used	Not used

Data Byte 7 controls the following messages but user should not disable any of these messages:

Data Byte 7							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
CAN Command Message	Parameter Command Message	Parameter Response Message	U2C RX Message	U2C TX Message	OBD2 Response	OBD2 Specific Query	OBD2 General Query

Data Byte 0	Data Byte 1	Data Byte 2	Data Byte 3	Data Byte 4 (Low Byte)	Data Byte 5 (High Byte)	Data Byte 6 (Low Byte)	Data Byte 7 (High Byte)
Parameter Address		R/W Command (Read/Write?)	Reserved	CAN Active Messages Low Word		CAN Active Messages High Word	
Ex 1: Disable Temperature #1, #2 and #3 Messages							
148	0	1	0	248 (0xF8)		255 (0xFF)	
148	0	1	0	1 1 1 1 1 0 0 0		1 1 1 1 1 1 1 1	

- What CAN ID do we send these messages to???? 0? Doesn't matter?

Broadcast Message Definitions:

These are the message formats that we receive from the PM100
So if we want to read a specific parameter value, we look for CAN Message with the appropriate CAN ID

All types of broadcasted messages:

Address	Frequency	Content	CAN Active Messages (Low Word)
0x0A0	Slow/10 Hz	Temperatures #1	0x0001
0x0A1	Slow/10 Hz	Temperatures #2	0x0002
0x0A2	Slow/10 Hz	Temperatures #3	0x0004
0x0A3	Fast/100 Hz	Analog Inputs Voltages	0x0008
0x0A4	Fast/100 Hz	Digital Input Status	0x0010
0x0A5	Fast/100 Hz	Motor Position Information	0x0020
0x0A6	Fast/100 Hz	Current Information	0x0040
0x0A7	Fast/100 Hz	Voltage Information	0x0080
0x0A8	Fast/100 Hz	Flux Information	0x0100
0x0A9	Slow/10 Hz	Internal Voltages	0x0200
0x0AA	Fast/100 Hz	Internal States	0x0400
0x0AB	Fast/100 Hz	Fault Codes	0x0800
0x0AC	Fast/100 Hz	Torque & Timer Information	0x1000
0x0AD	Fast/100 Hz	Modulation Index & Flux Weakening Output Information	0x2000
0x0AE	Slow/10 Hz	Firmware Information	0x4000
0x0AF	100 Hz (fixed)	Diagnostic Data	0x8000

0x0A0 – Temperatures #1

Byte #	Name	Format	Description
0,1	Module A Temperature	Temperature	Temperature of IGBT Module, Phase A
2,3	Module B Temperature	Temperature	Temperature of IGBT Module, Phase B
4,5	Module C Temperature	Temperature	Temperature of IGBT Module, Phase C
6,7	Gate Driver Board Temperature	Temperature	Temperature of Gate Driver Board

0x0A1 – Temperatures #2

Byte #	Name	Format	Description
0,1	Control Board Temperature	Temperature	Temperature of Control Board.
2,3	RTD #1 Temperature	Temperature	Temperature read from RTD input #1
4,5	RTD #2 Temperature	Temperature	Temperature read from RTD Input #2
6,7	RTD #3 Temperature	Temperature	Temperature read from RTD Input #3, Gen 2 only.

0x0A2 – Temperatures #3 & Torque Shudder

Byte #	Name	Format	Description
0,1	RTD #4 Temperature	Temperature	Temperature read from RTD Input #4, Gen 2 only
2,3	RTD #5 Temperature	Temperature	Temperature read from RTD Input #5, Gen 2 only
4,5	Motor Temperature	Temperature	Filtered temperature value from the motor temperature sensor.
6,7	Torque Shudder	Torque	A value of torque used in shudder compensation.

0x0A3 – Analog Input Voltages (for firmware version 1995 and after)

Bit #	Name	Format	Description
0 – 9	Analog Input #1	Low Voltage	Voltage on Analog Input #1
10 – 19	Analog Input #2	Low Voltage	Voltage on Analog Input #2
20 – 29	Analog Input #3	Low Voltage	Voltage on Analog Input #3
32 – 41	Analog Input #4	Low Voltage	Voltage on Analog Input #4
42 – 51	Analog Input #5	Low Voltage	Voltage on Analog Input #5
52 – 61	Analog Input #6	Low Voltage	Voltage on Analog Input #6

0x0A4 – Digital Input Status

Byte #	Name	Format	Description
0	Digital Input #1	Boolean	Status of Digital Input #1, Forward switch
1	Digital Input #2	Boolean	Status of Digital Input #2, Reverse switch
2	Digital Input #3	Boolean	Status of Digital Input #3, Brake switch
3	Digital Input #4	Boolean	Status of Digital Input #4, REGEN Disable Switch
4	Digital Input #5	Boolean	Status of Digital Input #5, Ignition switch
5	Digital Input #6	Boolean	Status of Digital Input #6, Start switch
6	Digital Input #7	Boolean	Status of Digital Input #7, Valet Mode
7	Digital Input #8	Boolean	Status of Digital Input #8

0x0A5 – Motor Position Information

Byte #	Name	Format	Description
0,1	Motor Angle (Electrical)	Angle	The electrical angle of the motor as read by the encoder or resolver.
2,3	Motor Speed	Angular velocity	The measured speed of the motor
4,5	Electrical Output Frequency	Frequency	The actual electrical frequency of the inverter.
6,7	Delta Resolver Filtered	Angle	This is used in calibration of resolver angle adjustment. The range of this parameter is ±180°. Values between 180° and 360° are shown as negative angle. For example, 270° is equal to -90°, and 190° is equal to -170°.

0x0A6 – Current Information

Byte #	Name	Format	Description
0,1	Phase A Current	Current	The measured value of Phase A current.
2,3	Phase B Current	Current	The measured value of Phase B current
4,5	Phase C Current	Current	The measured value of Phase C current
6,7	DC Bus Current	Current	The calculated DC Bus current.

0x0A7 – Voltage Information

Byte #	Name	Format	Description
0,1	DC Bus Voltage	High Voltage	The actual measured value of the DC bus voltage.
2,3	Output Voltage	High Voltage	The calculated value of the output voltage, in peak line-neutral volts.
4,5	VAB_Vd_Voltage	High Voltage	Measured value of the voltage between Phase A and Phase B (VAB) when the inverter is disabled. Vd voltage when the inverter is enabled.
6,7	VBC_Vq_Voltage	High Voltage	Measured value of the voltage between Phase B and Phase C (VBC) when the inverter is disabled. Vq voltage when the inverter is enabled.

0xA8 – Flux Information

Byte #	Name	Format	Description
0,1	Flux command	Flux	The commanded flux
2,3	Flux feedback	Flux	The estimated flux
4,5	Id feedback	Current	D-axis current feedback
6,7	Iq feedback	Current	Q-axis current feedback

0x0A9 – Internal Voltages

Byte #	Name	Format	Description
0,1	1.5V Reference voltage	Low Voltage	One of the low voltage references
2,3	2.5V Reference voltage	Low Voltage	One of the low voltage references
4,5	5.0V Reference voltage	Low Voltage	One of the low voltage references
6,7	12V System voltage	Low Voltage	One of the low voltage references

0x0AA – Internal States

Byte #	Name	Format	Description
0,1	VSM State	Internal	0 = VSM Start State 1 = Pre-charge Init State 2 = Pre-charge Active State 3 = Pre-charge Complete State 4 = VSM Wait State 5 = VSM Ready State 6 = Motor Running State 7 = Blink Fault Code State 14 = Shutdown in Process – in key switch mode 1, user has turned the key switch to off position. 15 = Recycle Power State – user must recycle power when the unit is in this state.
2	Inverter State	Internal	0 = Power on State 1 = Stop State 2 = Open Loop State 3 = Closed Loop State 4 = Wait State 5, 6, 7 = *Internal states* 8 = Idle Run State 9 = Idle Stop State 10,11,12 = *Internal states*
3	Relay State	Internal	Bit 0: Relay 1 Status (1 = active) Bit 1: Relay 2 Status Bit 2: Relay 3 Status Bit 3: Relay 4 Status Bit 4: Relay 5 Status Bit 5: Relay 6 Status
4 – Bit0	Inverter Run Mode	Internal	0 = Torque Mode 1 = Speed Mode
4 – Bits5-7	Inverter Active Discharge State	Internal	Current Inverter Active Discharge State: 000 (0) = Discharge Disabled 001 (1) = Discharge Enabled, waiting 010 (2) = Performing Speed Check 011 (3) = Discharge Actively occurring 100 (4) = Discharge Completed All other states are reserved for future use.
5	Inverter Command Mode	Internal	0 = CAN Mode 1 = VSM Mode When in CAN Mode the inverter takes commands from the CAN messages. When in VSM Mode the inverter takes messages from the Vehicle State Machine which is operated from the various input and outputs of the inverter.
6 - Bit0	Inverter Enable State	Internal	0 = Inverter is disabled 1 = Inverter is enabled
6 – Bit7	Inverter Enable Lockout	Internal	0 = Inverter can be enabled 1 = Inverter cannot be enabled This feature is added so that the inverter cannot be accidentally enabled. This feature requires that before sending out an Inverter Enable command, the user must send out a Inverter Disable command. Once the inverter sees a Disable command, the lockout is removed and controller can receive the Inverter Enable command.
7 – Bit0	Direction Command	Internal	1 = Forward 0 = Reverse, if inverter is enabled Stopped, if inverter is disabled
7 – Bit1	BMS Active	Internal	0 = BMS Message is not being received 1 = BMS Message is being received
7 – Bit2	BMS Limiting Torque	Internal	0 = Torque is not being limited by the BMS. 1 = Torque is being limited by the BMS.

0x0AB – Fault Codes

Byte #	Name	Format	Description
0,1	POST Fault Lo	Internal	Each bit represents a fault
2,3	POST Fault Hi	Internal	Each bit represents a fault
4,5	Run Fault Lo	Internal	Each bit represents a fault
6,7	Run Fault Hi	Internal	Each bit represents a fault

0x0AC – Torque & Timer Information

Byte #	Name	Format	Description
0,1	Commanded Torque	Torque	The commanded torque.
2,3	Torque Feedback	Torque	The estimated motor torque based on motor parameters and feedbacks.
4,5,6,7	Power on Timer	(Counts x .003) sec	This timer is updated every 3 msec. This timer will roll-over in approximately 5 months.

0x0AD – Modulation Index & Flux Weakening Output Information

Byte #	Name	Format	Description
0,1	Modulation Index	Per-unit Value	This is the modulation index. The scale factor is x100. To get the actual modulation index divide the value by 100.
2,3	Flux Weakening Output	Current	This is the current output of the flux regulator.
4,5	Id command	Current	The commanded D-axis current
6,7	Iq command	Current	The commanded Q-axis current

0x0AE – Firmware Information

Byte #	Name	Format	Description
0,1	EEPROM Version / Project Code	NA	This is an EEPROM version that is assigned to each project. For factory use only!
2,3	Software Version	NA	This is the software version with major and minor release values.
4,5	Date Code (mmdd)	NA	This is the portion of date code that displays month and date information in *mmdd* format.
6,7	Date Code (yyyy)	NA	This is the portion of date code that displays year information in *yyyy* format.

0x0AF – Diagnostic Data

Byte #	Name	Format	Description
Please refer to the manual, “Download Diagnostic Data” for details.			

Broadcast Messages – Overview/High Level

PM100 Broadcasted Messages									
Message Type	CAN ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Temperatures #1	0X0A0	Module A Temperature - Temperature of IGBT Module, Phase A		Module B Temperature - Temperature of IGBT Module, Phase B		Module C Temperature - Temperature of IGBT Module, Phase C		Gate Driver Board Temperature - Temperature of Gate Driver Board	
Temperatures #2	0X0A1	Control Board Temperature - Temperature of Control Board		RTD #1 Temperature - Temperature read from RTD input #1		RTD #2 Temperature - Temperature read from RTD Input #2		RTD #3 Temperature - Temperature read from RTD Input #3, Gen 2 only	
Temperatures #3 & Torque Shudder	0X0A2	RTD #4 Temperature - Temperature read from RTD Input #4, Gen 2 only		RTD #5 Temperature - Temperature read from RTD Input #5, Gen 2 only		Motor Temperature - Filtered temperature value from the motor temperature sensor		Torque Shudder - A value of torque used in shudder compensation	
Analog Input Voltages	0X0A3	Bit 0-9 (Analog Input #1) Bit 10-19 (Analog Input #2)		Bit 20-29 (Analog Input #3) Bit 32-41 (Analog Input #4)		Bit 42-51 (Analog Input #5)		Bit 52-61 (Analog Input #6)	
Digital Input Status	0X0A4	Status of Digital Input #1, Forward switch	Status of Digital Input #2, Reverse switch	Status of Digital Input #3, Brake switch	Status of Digital Input #4, REGEN Disable Switch	Status of Digital Input #5, Ignition switch	Status of Digital Input #6, Start switch	Status of Digital Input #7, Valet Mode	Status of Digital Input #8
Motor Position Information	0X0A5	Motor Angle (Electrical) - The electrical angle of the motor as read by the encoder or resolver.		Motor Speed		Electrical Output Frequency - The actual electrical frequency of the inverter		Delta Resolver Filtered - This is used in calibration of resolver angle adjustment. The range of this parameter is ±180°. Values between 180° and 360° are shown as negative angle. For example, 270° is equal to -90°, and 190° is equal to -170°	
Current Information	0X0A6	Phase A Current		Phase B Current		Phase C Current		DC Bus Current	
Voltage Information	0X0A7	DC Bus Voltage		Output Voltage		VAB_Vd_Voltage - Measured value of the voltage between Phase A and Phase B (VAB) when the inverter is disabled. Vd voltage when the inverter is enabled		VBC_Vq_Voltage - Measured value of the voltage between Phase B and Phase C (VBC) when the inverter is disabled. Vq voltage when the inverter is enabled	
Flux Information	0X0A8	Flux command - The commanded flux		Flux feedback - The estimated flux		Id feedback - D-axis current feedback		Iq feedback - Q-axis current feedback	
Internal Voltages	0X0A9	1.5V Reference voltage		2.5V Reference voltage		5.0V Reference voltage		12V System voltage	
Internal States	0X0AA	**VSM State**		**Inverter State**	Relay State	Bit 5-7 - Inverter Active Discharge State	Bit 0 - Inverter Run Mode	Inverter Command Mode	Bit 7 - Inverter Enable Lockout	Bit 0 - Inverter Enable State	Bit 2 - BMS Limiting Torque	Bit 1 - BMS Active	Bit 0 - Direction Command
Fault Codes	0X0AB	POST Fault Lo		POST Fault Hi		Run Fault Lo			Run Fault Hi				
Torque & Timer Information	0X0AC	Commanded Torque		Torque Feedback - The estimated motor torque based on motor parameters and feedbacks		Power on Timer - This timer is updated every 3 msec. This timer will roll-over in approximately 5 months							
Modulation Index & Flux Weakening Output Information	0X0AD	Modulation Index - This is the modulation index. The scale factor is x100. To get the actual modulation index divide the value by 100		Flux Weakening Output - This is the current output of the flux regulator		Id command - The commanded D-axis current			Iq command - The commanded Q-axis current				
Firmware Information	0X0AE												
Diagnostic Data	0X0AF												

PM100 Essential CAN Bus Messages:

1. Command:
    a. ***Torque** Message*:
        i. CAN ID= 0X0C0, {100, 0, 0, 0, 1, 1, 0, 0} -> Torque = 10N.m, Forward Direction
        ii. CAN ID= 0X0C0, {194, 1, 0, 0, 1, 1, 0, 0} -> Torque = 45N.m, Forward Direction
    b. ***Speed** Message*:
        i. CAN ID= 0X0C0, {0, 0, 244, 1, 1, 1, 0, 0} -> Speed = 500RPM, Forward Direction
        ii. CAN ID= 0X0C0, {0, 0, 100, 0, 1, 1, 0, 0} -> Speed = 100RPM, Forward Direction

2. Broadcast:
    a. Read ***Internal State*** status from Inverter:
        i. CAN ID=0X0AA, { 0, 0, 0, 0, 0, 0, 0, 0 } →First 2 Data Bytes = VSM State
            i. 0 = VSM Start State
            ii. 1 = Pre-charge Init State
            iii. 2 = Pre-charge Active State
            iv. 3 = Pre-charge Complete State
            v. 4 = VSM Wait State
            vi. 5 = VSM Ready State
            vii. 6 = Motor Running State
            viii. 7 = Blink Fault Code State
            ix. 14 = Shutdown in Process – in key switch mode 1, user has turned the key switch to off position.
            x. 15 = Recycle Power State – user must recycle power when the unit is in this state
    b. *Read **Fault Codes** from Inverter*:
        i. CAN ID=0X0AB, {0, 0, 0, 0, 0, 0, 0, 0} → Each Bit represents a Fault

    c. ***Disable Broadcast Messages*** (All are Enabled by default)
        i. {148, 0, 1, 0, 248, 255, 255, 255} →148 = Parameter Address
        ii. WHAT CAN ID DO WE SEND TO???