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Setting up the PM Controller to run with Emrax Motor

Revision 0.2



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Revision History

Version	Description of Versions / Changes	Responsible Party	Date
0.1	Initial version	Chris Brune	1/18/2012
0.2	Added new Emrax model, 228 medium voltage. Clarified existing data	Chris Brune	11/25/2014

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1. Setup

This document describes setting up the Emrax motor manufactured by Enstroj d.o.o. (www.enstroj.si). Enstroj makes several different sizes motors in both liquid cooled and air cooled variations.

The Emrax motor must be configured to come with a resolver. As of this writing the motor is offered with a 1X (2 pole) resolver. If the motor comes with a different type of resolver please contact RMS before attempting to use. The software is only configured to work with a 1X resolver. The software is not configured to use the RM44AC sin/cos encoder (or any other RLS product). It is possible to use the RM44AC but it requires a special version of the PM controller as well as different software, contact RMS for more information.

The Emrax motor family comes in 3 different motor winding configurations depending on the intended operating voltage.

	RMS Motor Type	Max. Motor Current	Recommended RMS Controllers
Emrax 207 Medium Voltage	n/c	320Arms	PM100DX
Emrax 207 High Voltage	n/c	200Arms	PM100DX, PM100DZ
Emrax 228 Medium Voltage	82	320Arms	PM100DX
Emrax 228 High Voltage	40	240Arms	PM100DX, PM100DZ, PM150DZ
Emrax 268 Medium Voltage	n/c	350Arms	PM100DX
Emrax 268 High Voltage	n/c	240Arms	PM100DX, PM100DZ, PM150DZ

n/c – not completed as of the date of this document.

To set the PM controller to run the Emrax motor set the EEPROM parameter Motor Type per the above table. Review the table in Section 2.1 for additional parameters that should be verified.

There are three phase terminals on the Emrax motor. They are not labeled, but do have different color heat shrink on them. These need to be connected to the motor controller as follows. Do not change this order as it will cause the motor to not spin.



Color	PM100 Terminals
Red	A
Black	B
Blue	C

The resolver connections are as follows:

Color	10p Delphi	PM100
Red/Wht	B	J2-17
Yel/Wht	A	J2-3
Red	C	J2-11
Blk	E	J2-18
Yel	D	J2-4
Blue	F	J2-12

The 10 pin Delphi connector pins are given only as a reference as this is what was used on the RMS dyno for testing.

The temperature sensor should be connected to the AIN2 input. A pull-up resistor (3.01K 1%) must be added between AIN2 and XDCR_PWR.

Signal	Connects to
AIN2	One end of sensor and one end of pull-up resistor
AGND	Other end of sensor
XDCR_PWR	Other end of pull-up resistor.

2. Setting the 'Motor Type'

The PM family firmware has the ability to drive several different motor types. The user must tell the controller what type of motor it is to be used with. This is done via the Motor_Type_EEPROM parameter. Refer to the Programming EEPROM Parameters using GUI manual for more information on programming EEPROM parameters.

Model	Motor Type
Emrax 228 Medium Voltage	82
Emrax 228 High Voltage	40



When you set the motor type via the GUI it will automatically adjust some default parameters. However, there are several additional parameters that should be reviewed and adjusted if desired.

EEPROM Parameter	Description
Veh_Flux_EEPROM_(Wb)_x_1000	This is the back EMF (flux) constant for the motor. It will automatically default to the correct value when the motor type is changed. There is no need to change this.
IQ_Limit_EEPROM_(Amps)_x_10	This parameter sets the maximum value of the torque producing current that can be commanded. The amount of allowable current is dependent on the motor type and the controller type. The current is set in peak Amps times 10. For example, $300 A_{rms} = 4250$.
ID_Limit_EEPROM_(Amps)_x_10	This parameter sets the maximum amount of field weakening current.
Mtr_OverTemp_Limit_EEPROM_(C)_x_10	This parameter sets the motor over-temperature fault limit. It is set in degrees C times 10. Thus for 150°C it would be set to 1500. It would be wise to set this parameter so that if a cooling system failure occurs it would fault immediately.
Motor_Overspeed_EEPROM_(RPM)	This parameter sets the speed at which an over-speed fault will be generated. It should be set based on the needs of the vehicle system for over-speed protection.
Max_Speed_EEPROM_(RPM)	This parameter sets the maximum speed that the controller will command.
Break_Speed_EEPROM_(RPM)	The Break Speed is the speed at which the torque capability of the motor starts to decrease due to lack of voltage from the motor controller. This value should be set based on information from either RMS or Remy on the performance of the motor with the particular battery voltage being used.
Motor_Torque_Limit_EEPROM_(Nm)_x_10	This sets the maximum torque command when operating in VSM mode.
Regen_Torque_Limit_EEPROM_(Nm)_x_10	This sets the maximum regen torque command when operating in VSM mode.

After setting all of the parameters it is necessary for the Resolver to be calibrated. The calibration must be performed on each motor, it will vary from motor to motor. Please refer to the Resolver Calibration manual for more information on how to perform the resolver calibration.



2.1 Recommended Settings for Parameters

The table below shows the RMS recommended settings for the parameters that are motor specific. There are many factors that may influence a decision to deviate from these settings. If there are questions about setting please contact RMS for more information

Motor Type	Inverter	Battery	Vehicle Flux	IQ Limit	ID Limit	Motor Over-speed	Break Speed	Torque Limit (Motor/Regen)
		Volts	Weber	A (pk)	A (pk)	RPM	RPM	N.m.
207 Medium Voltage Type n/c	PM100DX	360	*	425	425	5,500	TBD	160
207 High Voltage Type n/c	PM100DZ	450	*	283	TBD	5,500	TBD	160
	PM100DX	360		283	TBD			160
228 Medium Voltage Type 82	PM100DX	360	*	453	221	4,500	4,000	240
228 High Voltage Type 40	PM100DZ PM150DZ	400	*	339	150	4,500	4,000	240
	PM100DX	360		339	150			
268 Medium Voltage Type n/c	PM100DX	320	*	495	220	4,500	TBD	500
268 High Voltage Type n/c	PM100DZ PM150DZ	600	*	339	143	4,500	TBD	500
	PM100DX	360						

* Do not change the Veh_Flux level from the default that is set when the motor type is changed.