CASCADIA MOTION
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Setting up the PM/RM Controller to run with Yasa Motor

Revision 0.9

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1. Setup

This document describes setting up the Yasa motor for use with the Cascadia Motion PM/PM Family of inverters.

Motor Name	Motor Type Number With KTY84/130	Motor Type Number with PT1000
Yasa 750	37	7
Yasa 400	45	8

Program the EEPROM motor type parameter to reflect the motor that is being used.

Please contact Yasa for the proper motor phase connections between the motor and the inverter. If the phases are not connected properly it will cause the motor to not spin.

The Yasa motors use a SIN/COS encoder instead of a resolver. The use of the encoder requires a special version of the PM/RM Family controller. Please contact Cascadia Motion for more information. The controller **MUST** be ordered with the -SP option (e.g. PM100DX-SP). The -SP provides the SIN/COS encoder interface instead of the resolver interface. Once this -SP modification has been made the inverter can not be used with a resolver.

The SIN/COS Encoder connections are as follows:

Encoder Wire Color	Signal	PM100 /PM150 Pin	PM250 Pin	RM100 Pin	RM300 Pin	CM200 /CM350 Pin
Red	XDCR_PWR (5V) SIN COS	J2-1 J2-11 J2-4	J1-P J1-C J1-E	23 19 18	M-14 M-3 M-4	K3
Green	/SIN	J2-18	J1-D	31	M-2	H1
Brown	/COS	J2-12	J1-F	30	M-8	J1
Black	GND/AGND	J2-3	J1-J	35	M-13	K4
Shield	Shield	J2-19	J1-T	29	M-7	G1

* Note that XDCR_PWR, SIN, and COS must be connected together except for CM200/CM350.

The stator temperature sensor (KTY 84/130 type) should be connected to the AIN2 input. A pull-up resistor (1.00K 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.

On new models of the Yasa motor the temperature sensors have been changed to be PT1000 RTDs. Connect the stator core temperature sensor to the RTD1 input. The stator winding temperature can be connected to the RTD2 input. Only RTD1 will be used to determine the "motor temperature" as read by the parameter Motor Temperature. Since only RTD1 is used for the Motor Temperature then the de-rating algorithm will only apply to RTD1. RTD2 can still be monitored through the RMS GUI or through CAN.

Yasa Pin	Yasa Wire Color	Function	PM100/PM150 Pin
A	Brown	Stator Core 1/PT1000	J1-5 (RTD1)
B	Red	Stator Core 1/PT1000	J1-19 (AGND)
C	Black	Stator Coil 1/ PT1000	J1-6 (RTD2)
D	Orange	Stator Coil 1/PT1000	J1-17 (AGND)

*** For PM250 use the equivalent pins on that inverter, refer to the hardware manual.

Yasa Pin	Yasa Wire Color	Function	RM100 Pin	RM300 Pin
A	Brown	Stator Core 1/PT1000	32 (RTD1+)	M-5 (RTD1+)
B	Red	Stator Core 1/PT1000	20 (RTD1-)	M-9 (RTD1-)
C	Black	Stator Coil 1/ PT1000	21 (RTD2+)	M-10 (RTD2+)
D	Orange	Stator Coil 1/PT1000	22 (RTD2-)	M-11 (RTD2-)

The Yasa motor has provisions for a rotor temperature sensor that produces an analog output voltage. This sensor can be connected to AIN4 (or any unused analog input). The sensor voltage can be read from the CAN message that shows the voltage for the analog inputs. The voltage to temperature scaling is Temperature = 80 x Voltage – 90 (Temperature is in degrees Celsius and Voltage is in volts).

Yasa Pin	Yasa Wire Color	Function	PM100/PM150 Pin
A	Red	+5V / XDCR_PWR	J1-14
B	Black	Ground / AGND	J1-15
C	Brown	SCL	n/c
D	Green	SDA/Output PWM Temp	n/c
E	Yellow	Output Analog Temp/AIN4	J1-3
n/a	Orange	Not used	n/c
n/a	Bare Wire	Drain/Shield	n/c

*** For PM250 use the equivalent pins on that inverter, refer to the hardware manual.

Yasa Pin	Yasa Wire Color	Function	RM100 Pin	RM300 Pin
A	Red	+5V / XDCR_PWR	23	M-14
B	Black	Ground / AGND	35	M-13
C	Brown	SCL	n/c	n/c
D	Green	SDA/Output PWM Temp	n/c	n/c
E	Yellow	Output Analog Temp/AIN2	3	M-12
n/a	Orange	Not used	n/c	n/c
n/a	Bare Wire	Drain/Shield	n/c	n/c

- Note for RM100 AIN2 is selected as AIN4 is not available. If AIN2 is not available then AIN1 or AIN3 could be used.
- Note for RM300 AIN2 is selected as it is available on the M connector. If AIN2 is not available then AIN1 or AIN3 could be used from the I/O connector.

2. Setting the 'Motor Type'

The firmware can 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 Software User's Manual for more information on programming EEPROM parameters.

Model	Motor Type With KTY84/130	Motor Type With PT1000
Yasa 750	37	7
Yasa 400	45	8

Use the above table to help guide which motor type number value must be used based on the particular Yasa motor that it is being operated.

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. Yasa would need to provide more information on the maximum allowable 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 the motor supplier and the battery pack voltage used.
Motor_Torque_Limit_EEPROM_(Nm)_x_10	This sets the maximum torque command.
Regen_Torque_Limit_EEPROM_(Nm)_x_10	This sets the maximum regen torque command.

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2.1 Recommended Settings for Parameters

The table below shows the 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 Cascadia Motion for more information

Yasa Motor	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.*
Yasa 750 Type 7 and 37	PM100DX RM100DX	320	*	495	250	3,250	1,100	824
	PM100DXR PM150DX			636	250	3,250	1,100	1059
	PM100DZ RM100DZ	650		283	250	3,250	2,200	471
	PM150DZ			425	250	3,250	2,200	708
	PM150DZR			566	250	3,250	2,200	942
	PM250DZ RM300DZ			636	250	3,250	2,200	1059
Yasa 400 Yasa P400 Type 8 and 45	PM100DX RM100DX	320	*	495	200	8,000	2,000	359
	PM100DXR PM150DX			636	200	8,000	2,000	462
	PM100DZ RM100DZ	650		283	200	8,000	3,500	205
	PM150DZ			425	200	8,000	3,500	309
	PM150DZR			566	200	8,000	3,500	411
	PM250DZ RM300DZ			636	200	8,000	3,500	462

* Do not change the Veh_Flux level from the default that is set when the motor type is changed.
** When operating the motor at no-load during testing it is recommended that the ID Limit be set to zero to disable field weakening. Field weakening on an unloaded motor can cause the speed to increase without control.

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Revision History

Version	Description of Versions / Changes	Responsible Party	Date
0.1	Initial version	Chris Brune	4/30/2012
0.2	Added Yasa 400 motor	Chris Brune	8/03/2012
0.3	Added ability to have a setup that is PT1000 (RTD1) for the motor temperature input.	Chris Brune	2/5/2015
0.4	Corrected mistake in SIN/COS encoder signal table	Chris Brune	3/6/2015
0.5	Updated the parameter table to include different inverter setups.	Chris Brune	6/3/2016
0.6	Added more detail on motor temperature connections to inverter.	Chris Brune	6/18/2019
0.7	Added information about the RM100 and RM300.	Chris Brune	12/2/2019
0.8	Added additional detail about the encoder connections for the RM100 and RM300.	Chris Brune	1/15/2020
0.9	Added additional detail about the encoder connections for CM200 and CM350.	Andrew Louie	8/30/2021