

## SPECIAL PURPOSE MOTOR PROGRAM OVERVIEW

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The Sigma FSP or Flexible ServoPack, expands the range of servo applications suitable for Yaskawa controls, by allowing the Yaskawa FSP amplifier to run non-Yaskawa motors. This feature is an important step in allowing Yaskawa to offer a solution in severe food-grade washdown applications, hazardous environments that require explosion proof servomotors, and applications that benefit from integrated mechatronic actuators.

In order to meet our customer's expectations of a robust, well-documented servo system, Yaskawa requires that servo combinations are part of a test program. The benefit is that torque-speed and amp-motor connection diagrams are readily available for application support and service. Yaskawa has accomplished this by partnering with select servomotor manufacturers to provide documented servo combinations. These combinations will be supported by all Yaskawa Electric America Technical Support Engineers and Application Engineers.

### **Combinations available for download:**

[www.yaskawa.com/FSP/SPM](http://www.yaskawa.com/FSP/SPM) <sup>\*1</sup>

Each combination includes a Motor-Data File and a Data Sheet. The Motor-Data File can be downloaded from the Web site, imported into the FlexWorks software and used in a FlexWorks Project. The Data Sheet will show torque-speed curves and connection diagrams as well as which motor options apply to the Motor-Data File.

### **Customer Specified Combinations**

Yaskawa will work with customers who would like to run a motor that is not part of a test program, provided that the customer will test the combination on their machine and approve the test results and allow Yaskawa to document the connection diagram and Motor-Data File. These combinations, which are approved by the customer, are only for sale to the approving customer or their preferred Yaskawa distributor or an end-customer with a service requirement. These combinations may, after further testing, become part of the list of publicly accessible combinations.

<sup>\*1</sup> Actual URL is:

[http://www.yaskawa.com/site/DMServo.nsf/\(DocID\)/TKUR-6WMJSN/\\$FILE/Yaskawa%20Special%20Purpose%20Motors.pdf](http://www.yaskawa.com/site/DMServo.nsf/(DocID)/TKUR-6WMJSN/$FILE/Yaskawa%20Special%20Purpose%20Motors.pdf)

To start this process the following is required:

- Place a purchase order for a Motor-Data File Fee. \$750 List One Time Charge.
- Place an order for an FSP amplifier to run the motor with the designation "prototype" on the order and ship to YEA Applications Engineering.
- Ship the prototype motor and cables to Yaskawa YEA Applications Engineering Note the feedback cable may need to be modified at YEA and may not be usable after the process.
- Provide the remaining information in section 1-8 of this document.

Yaskawa will:

- Conduct a no-load operational check of the combination.
- Create the motor data file based on the information provided.
- These deliverables will be finished three weeks after all components and information are made available to the Yaskawa designated engineer.
- After the testing at the customer site is approved by the customer, Yaskawa will provide a customer specific part number (example is FSP-10AMC-Y125 ). The Yxxx is termed a Y-mod. All subsequent orders should be for the amplifier with Y-mod. Yaskawa will burn the motor data parameters at the factory. Each Y-mod amplifier has a \$100 list adder.

The Customer will:

- Test the motor and amplifier on their machine under full worst-case load conditions and approve the combination by signing the Yaskawa Customer Application Specific SPM engineering drawing. See Appendix A for a template of that drawing.

NOTE - If the prototype motor is not suitable to ship to Yaskawa, alternative arrangements should be made with the Yaskawa representative for a no-load operational check and development of the motor-data file on site. Only a Yaskawa designated engineer is allowed to make a motor data file and the travel to the customer's facility needs to be worked out with the Yaskawa representative. Normal service rates may apply.

Guidelines for suitable motors:

- 1) Synchronous permanent magnet brushless AC rotary servomotors. Motors wound (or optimized) for sinusoidal (not trapezoidal) commutation. Consult the factory for non-Yaskawa linear motors.
  
- 2) Incremental Encoder Feedback, A/B quadrature feedback up to 1.6 MHz (post quadrature). See figure 2 below for the FSP feedback terminal layout. The motor's encoder resolution (pulses/rev) and the amplifier's maximum encoder frequency will determine the maximum speed of the motor.
  - Max speed =  $96 * 10^6 / (X \text{ motor pulses/rev post quad})$ .
  - Equation details are:  $\text{Max Speed} = (1,600,000 \text{ pulses/sec}) * (60 \text{ sec/min}) / (X \text{ pulses/rev}) = \text{rpm}$ .This limitation affects line C in figure 1.
  
- 3) The amplifier's DC bus voltage and the Ke of the motor will determine the maximum speed of the motor (in addition to #2 above).
  - For 230 VAC powered systems, the max speed =  $325 \text{ volts} / \text{Ke (volts/rpm)}$ .
  - For 480 VAC powered systems, the max speed =  $679 \text{ volts} / \text{Ke (volts/rpm)}$ .
  - For 110 VAC powered systems, the max speed =  $156 \text{ volts} / \text{Ke (volts/rpm)}$ .
  - DC Bus Voltage = AC supply voltage \* 1.414.This limitation affects line C in figure 1.
  
- 4) The Rated Continuous Current of the motor is often a primary factor in selecting an amplifier, since this current multiplied by the Kt of the motor determines the available torque.
  - Continuous torque available =  $\text{Kt} * \text{Rated Continuous Current}$ . Be sure to use units of Amps rms, not zero to peak amps, Amps (0-p).  $\text{Amps (rms)} = \text{Amps (0-p)} / 1.414$ .
  - For 230 VAC powered systems, the maximum continuous current available is offered in the FSP-30AMH amplifier, which is 28 Amps (rms).
  - For 480 VAC powered systems, the maximum continuous current available is offered in the FSP-50DMH amplifier, which is 16.6 Amps (rms).
  - For 110 VAC powered systems, the maximum continuous current available is offered in the FSP-02BMH amplifier, which is 3.0 Amps (rms).

The rated continuous current of the motor and Kt affect line A in figure 1 below. See Table 1 for more current ratings. Yaskawa recommends selecting an amplifier with a continuous current rating, that is within the range of 2:1 and 1:2 of the motor's continuous current rating.

5) The Rated Peak Current of the motor multiplied by the Kt of the motor will determine the amount of peak torque available. Peak torque available = Kt \* Rated Peak Current. Be sure to use units of Amps rms, not zero to peak amps, Amps (0-p). Amps (rms) = Amps (0-p) / 1.414.

- For 230 VAC powered systems, the maximum peak current available is offered in the FSP-30AMH amplifier, which is 56 Amps (rms).
- For 480 VAC powered systems, the maximum peak current available is offered in the FSP-50DMH amplifier, which is 40.5 Amps (rms).
- For 110 VAC powered systems, the maximum peak current available is offered in the FSP-02BMH amplifier, which is 9.0 Amps (rms).

The rated peak current of the motor and Kt affect line B in figure 1 below. See Table 1 for more current ratings. The maximum time allowed to deliver peak torque is dependent on the motor's thermal-overload curve (or thermal overload limit switch) or the amplifier's peak current time. The FSP amplifiers can deliver peak current for up to three seconds.

Table 1. FSP amplifier current ratings

Amplifier	Nominal Supply Voltage VAC	Supply Voltage Phase	Bus Voltage VDC	Continuous Output Current Amps (rms)	Peak Output Current Amps (rms)
FSP-01BMH	110	1	156	2.4	7.2
FSP-02BMH	110	1	156	3.0	9
FSP-01AMH	230	1	325	0.9	2.8
FSP-02AMH	230	1	325	2.1	6.5
FSP-04AMH	230	1	325	2.8	8.5
FSP-08AMH-S	230	1	325	5.7	13.9
FSP-10AMH	230	3	325	7.6	17
FSP-15AMH-S	230	1	325	11.6	28
FSP-20AMH	230	3	325	18.5	42
FSP-30AMH	230	3	325	24.8	56
FSP-05DMH	480	3	679	1.9	5.5
FSP-10DMH	480	3	679	3.5	8.5
FSP-15DMH	480	3	679	5.4	14
FSP-20DMH	480	3	679	8.4	20
FSP-30DMH	480	3	679	11.9	28
FSP-50DMH	480	3	679	16.5	40.5

Figure 1. Torque vs. Speed Curve

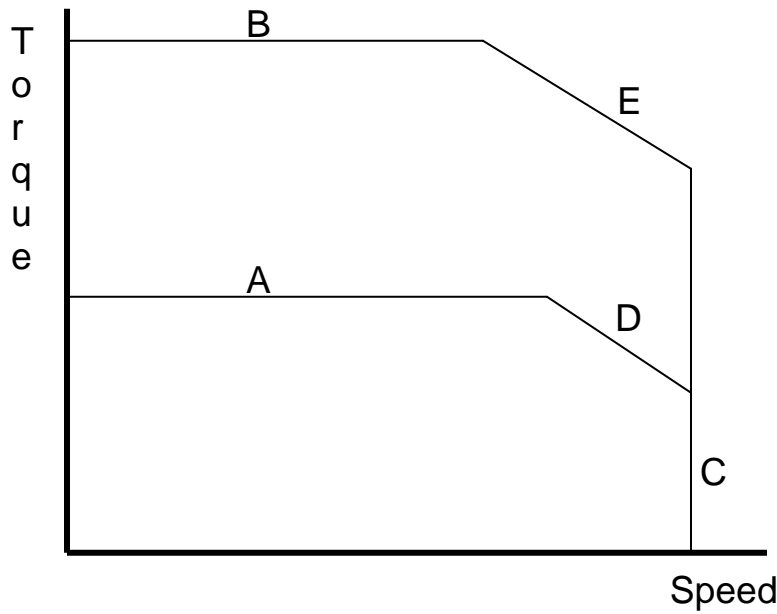


Figure 2. FSP Feedback Terminal Layout

**■ CN2 Connector with Commutation Sensors Terminal Layout for Hall Effect FSP Amplifiers (models FSP-□□□MH)**

1	PPG0V	PG GND	2	PPG0V	PG GND	11	SPG0V	GND	12	BAT+	Battery + input
3	PPG0V	PG GND	4	PPG5V	PG +5V	13	BAT-	Battery - input	14	PC	PG C-phase
5	PPG5V	PG +5V	6	PPG5V	PG +5V	15	/PC	PG /C-phase	16	PA	PG A-phase
7	/UIN	U – Phase Hall Effect	8	NC*	—	17	/PA	PG /A-phase	18	PB	PG B-phase
9	/VIN	V – Phase Hall Effect	10	SPG5V	+5V	19	/PB	PG /B-phase	20	/WIN	W – Phase Hall Effect

Note: NC\* – Leave contact open.

YEA requests the following information from the customer prior to the delivery of the prototype FSP Amplifier with Y-mod.

**REQUIRED**

- 1. **CUSTOMER INFORMATION** (form included, p.4).
- 2. Completed **MOTOR CHARACTERISTICS** sheet (form included, p.5).  
(Obtainable from the motor manufacturer)
- 3. Motor manufacturer's **OVERLOAD CURVE** (form included, p.6).  
(Obtainable from the motor manufacturer)
- 4. Power & Feedback **CONNECTORS** or **CABLES** (with flying leads).  
(Manufacturer usually includes this with motor in shipment)
- 5. **WIRING DIAGRAMS** of motor connectors or cables.  
This includes diagrams of the Wiring pin-outs.  
(Obtainable from the motor manufacturer)
- 6. **SERVO MOTOR** hardware.
- 7. **APPLICATION INFORMATION** (form included, p.7).

**OPTIONAL**

- 8. Motor manufacturer's **SPEED VS. TORQUE CURVE**.

<p><b>Ship all of the above items to:</b> ATTN: Servo Application Engineering Sigma FSP SPM Program Yaskawa Electric America 2121 Norman Dr. S. Waukegan, IL 60085</p>
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**Complete at least the first 5 fields** (Company, Address, City, state, zip, Contact, Phone).  
If submitting items at different times, attach this sheet as a cover sheet for each submission.  
If submitting all items at once, attach this sheet as a cover sheet.

## 1. CUSTOMER INFORMATION **(REQUIRED)**

\* Company \_\_\_\_\_

\* Address \_\_\_\_\_

\* City, state, zip \_\_\_\_\_

Contact name

Contact e-mail

\* 1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

Contact phone number

\* 1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

Fax number \_\_\_\_\_

Web page \_\_\_\_\_

\* Required

Complete ALL fields in Rotary Motor or Linear Motor, depending on the type of motor being submitted. If using your own units, cross out the units shown and write in your own units. This information can be obtained from the manufacturer of your motor.

## 2. MOTOR CHARACTERISTICS (REQUIRED)

### ROTARY MOTOR

- |   |                                   |   |                                   |
|---|-----------------------------------|---|-----------------------------------|
| 1. Encoder format                         | <input type="checkbox"/> A quad B | <input type="checkbox"/> Yaskawa Serial | <input type="checkbox"/> Resolver |
| 2. Encoder resolution                     | _____                             | [counts / rev]                          | (post-quadrature)                 |
| 3. Rated speed                            | _____                             | [rpm]                                   |                                   |
| 4. Maximum speed                          | _____                             | [rpm]                                   |                                   |
| 5. Overspeed detect level                 | _____                             | [%]                                     | (% of maximum speed)              |
| 6. Number of pole-pairs                   | _____                             | [pairs]                                 |                                   |
| 7. Rated torque                           | _____                             | [Nm]                                    |                                   |
| 8. Peak torque                            | _____                             | [Nm]                                    |                                   |
| 9. Rated current                          | _____                             | [Amps <sub>rms</sub> ]                  |                                   |
| 10. Peak current                          | _____                             | [Amps <sub>0-peak</sub> ]               |                                   |
| 11. Back EMF constant<br>between 2 phases | _____                             | [V <sub>rms</sub> / rpm]                |                                   |
| 12. Motor inertia                         | _____                             | [Kg · cm <sup>2</sup> ]                 |                                   |
| 13. Resistance between 2 phases           | _____                             | [Ω]                                     |                                   |
| 14. Inductance between 2 phases           | _____                             | [mH]                                    |                                   |

### LINEAR MOTOR

- |   |       |                           |                      |
|---|-------|---------------------------|----------------------|
| 1. Magnetic pitch                         | _____ | [mm]                      | (North to South)     |
| 2. Linear scale pitch                     | _____ | [μm]                      |                      |
| 3. Counts per scale pitch                 | _____ | [counts / scale pitch]    |                      |
| 4. Rated speed                            | _____ | [m / sec]                 |                      |
| 5. Maximum speed                          | _____ | [m / sec]                 |                      |
| 6. Overspeed detect level                 | _____ | [%]                       | (% of maximum speed) |
| 7. Rated force                            | _____ | [N]                       |                      |
| 8. Peak force                             | _____ | [N]                       |                      |
| 9. Rated current                          | _____ | [Amps <sub>rms</sub> ]    |                      |
| 10. Peak current                          | _____ | [Amps <sub>0-peak</sub> ] |                      |
| 11. Back EMF constant<br>between 2 phases | _____ | [V <sub>rms</sub> / rpm]  |                      |
| 12. Moving mass                           | _____ | [Kg]                      | (without load)       |
| 13. Resistance between 2 phases           | _____ | [Ω]                       |                      |
| 14. Inductance between 2 phases           | _____ | [mH]                      |                      |

Submit manufacturer's overload curve OR complete all fields. If none of this information is obtainable, provide the insulation temperature at 100% torque, as well as the insulation rating.

### 3. OVERLOAD CURVE (REQUIRED)

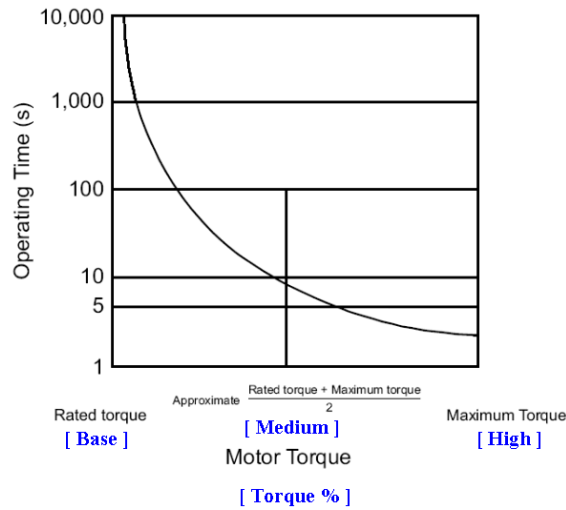
- A. Submit manufacturer's overload curve.  
 OR  
 B. The following fields may be completed:

**Overload curve points:**

Threshold	Time[sec]	Torque[%]
Base	Infinite	
Medium		
High		

Example of an overload curve:

Note: **Base** value is slightly larger than the Rated torque.  
**High** value is slightly less than the Maximum torque.



Threshold	Time[sec]	Torque[%]
Base	Infinite	115
Medium	10	200
High	3	250

IF NEITHER OF THE ABOVE:

- C. Provide insulation temperature at 100% torque: \_\_\_\_\_  
 Provide insulation rating (max temp): \_\_\_\_\_

Provide the information. For values, provide the value and units of the value.

## 7. APPLICATION INFORMATION (REQUIRED)

Machine information:

Machine or Application Name \_\_\_\_\_

**The remaining Application Information is OPTIONAL**

Machine information:

Axis Name \_\_\_\_\_

Calculated requirements:

	<u>VALUE</u>	[	UNITS	]
Continuous torque	_____	[		]
Peak torque	_____	[		]
Average speed	_____	[		]
Maximum speed	_____	[		]

Refer to the *motor sizing applications* found here:

<http://www.yaskawa.com/site/webfaqmotion.nsf/SearchV/86256ED000686FC986256D670056EFAE?OpenDocument>

# Appendix A. Template of Yaskawa Customer Application Specific SPM

This document is a reference. Yaskawa will re-send this for customer signing after Yaskawa's tests are completed.



	1	2	3	4	5	6	7	8	9	10	11																								
YASKAWA CUSTOMER/APPLICATION SPECIFIC SPECIAL PURPOSE MOTOR						DATA REQUIRED FOR YASKAWA TO SUPPORT CUSTOMER'S APPLICATION																													
A	Rotary Servo Combination Drawing TEMPLATE				ENCODER CABLE COLOR / NUMBER	ENCODER MATING CONNECTOR PIN #	Amp Model # _____																												
B	FSP	PPG0V	1	_____	_____																														
		PPG0V	2	_____	_____																														
		PPG0V	3	_____	_____																														
		PPG5V	4	_____	_____																														
		PPG5V	5	_____	_____																														
		PPG5V	6	_____	_____																														
		NC**	7	_____	_____																														
		PS	8	_____	_____																														
		/PS	9	_____	_____																														
		SPG5V	10	_____	_____																														
C	C N 2	SPG0V	11	_____	_____																														
		BAT+	12	_____	_____																														
		BAT-	13	_____	_____																														
		PC	14	_____	_____																														
		/PC	15	_____	_____																														
		PA	16	_____	_____																														
		/PA	17	_____	_____																														
		PB	18	_____	_____																														
		/PB	19	_____	_____																														
		NC**	20	_____	_____																														
E	P O W E R	U-Phase	U	_____	_____	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="6">Machine / Application Name _____</td> </tr> <tr> <td colspan="6">Axis Name (If Applicable)* _____</td> </tr> <tr> <td colspan="6">Y-mod Number _____</td> </tr> <tr> <td colspan="6">Motor Data File Name _____</td> </tr> </table>						Machine / Application Name _____						Axis Name (If Applicable)* _____						Y-mod Number _____						Motor Data File Name _____					
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Motor Data File Name _____																																			
	V-Phase	V	_____	_____																															
	W-Phase	W	_____	_____																															
	Ground	G	_____	_____																															
F	Data Used for Motor Data File				POWER CABLE COLOR / NUMBER	POWER MATING CONNECTOR PIN #																													
G			Value / Units																																
		Encoder resolution	_____	Published / Calculated																															
		Rated speed	_____	Published / Calculated																															
		Maximum speed	_____	Published / Calculated																															
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		Rated current	_____	Published / Calculated																															
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		** Leave contact open																																	
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				SHEET: 1/2																															

	1	2	3	4	5	6	7	8	9	10	11										
DATA REQUIRED FOR SUCCESSFUL APPLICATION PERFORMANCE BASED ON CRITICAL MOTOR AND AMPLIFIER PARAMETERS																					
A	<b>Yaskawa Recommendations:</b> Check speed vs torque curve Check overload curve Check overspeed Check temperature limit Check noise Check encoder signal					<b>Application Data*</b>															
B								Value	Units	Example											
						Worst-case load		_____	_____	10	Kg										
						Worst-case move profile for RMS torque	Accel	_____	_____	100	in/sec <sup>2</sup>										
							Traverse	_____	_____	50	in/sec										
	Decel	_____	_____	0.5	seconds																
			_____	_____	1	seconds															
C	<b>Servomotor Overload Protection*</b>					<b>Yaskawa cannot guarantee the amplifier's protection of servomotor overload for combinations tested on a machine.</b>  <b>Additional Precautions by Customer:</b>  ___ 1] Customer has checked that the case or winding temperature is below the motor manufacturer's recommendation.  ___ 2] Motor thermal switch integrated in system by the customer.  ___ 3] Motor data has been de-rated to application requirements by the customer.  Rated current _____ % de-rated      Rated speed _____ % de-rated Rated torque _____ % de-rated      Max speed _____ % de-rated Peak current _____ % de-rated Peak torque _____ % de-rated															
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G																					
H	<b>Baseline/Benchmark Data containing:</b> <ul style="list-style-type: none"> <li>● Max application speed</li> <li>● Max application torque</li> <li>● RMS application torque</li> </ul> <b>Attachments*:</b> <ul style="list-style-type: none"> <li>● FlexWorks speed &amp; torque vs. time graph</li> <li>● FlexWorks project file</li> </ul> * This data is not required					<b>Describe Mechanical Transmission</b>		<b>Example:</b> Servomotor drives load through 5 rev per inch ballscrew. OR Servomotor drives 2" diameter timing belt pulley through a 5:1 reduction gearbox. Load is attached to timing belt.													
						<b>Company Name:</b> _____ <b>Customer Name:</b> _____ <b>Title Position:</b> _____ <b>Engineering Location:</b> _____ <b>Intended Final Location*:</b> _____ <b>Preferred Yaskawa Distributor*:</b> _____				A SIGNED DRAWING INDICATES THE COMBINATION HAS BEEN TESTED ON THE CUSTOMER'S MACHINE AND THE DESCRIBED AMPLIFIER-MOTOR COMBINATION PROVIDES THE PERFORMANCE, MOTOR PROTECTION, AND SAFETY REQUIRED FOR THE APPLICATION.  <b>CUSTOMER SIGNATURE:</b> _____ _____											
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