Kinetix 6000 Multi-axis Servo Drives

Catalog Numbers 2094-ACxx-Mxx-S, 2094-BCxx-Mxx-S, 2094-AMxx-S, 2094-BMxx-S, 2094-ACxx-Mxx, 2094-BCxx-Mxx, 2094-AMxx, 2094-BMxx, 2094-BSP2, 2094-PRF, 2094-SEPM-B24-S

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual

Original Instructions

Catalog Number Explanation

Kinetix 6000 (Bulletin 2094) drive catalog numbers and descriptions are listed in the following tables.

IMPORTANT Throughout this publication, when the IAM or AM module catalog number is followed by *-x*, for example 2094-BMP5-*x*, the variable (*x*) indicates that the drive module may or may not include the safe torque-off feature.

Table 3 - Kinetix 6000 Drive Catalog Numbers

Integrated Axis Modules (230V)	Cat. No. (with safe torque-off feature)	Cat. No. (without safe torque-off feature)
Kinetix 6000, IAM, 200V-class, 3 kW converter, 5 A inverter	2094-AC05-MP5-S	2094-AC05-MP5
Kinetix 6000, IAM, 200V-class, 3 kW converter, 9 A inverter	2094-AC05-M01-S	2094-AC05-M01
Kinetix 6000, IAM, 200V-class, 6 kW converter, 15 A inverter	2094-AC09-M02-S	2094-AC09-M02
Kinetix 6000, IAM, 200V-class, 11 kW converter, 24 A inverter	2094-AC16-M03-S	2094-AC16-M03
Kinetix 6000, IAM, 200V-class, 23 kW converter, 49 A inverter	2094-AC32-M05-S	2094-AC32-M05
Integrated Axis Modules (460V)		
Kinetix 6000, IAM, 400V-class, 6 kW converter, 4 A inverter	2094-BC01-MP5-S (1)	2094-BC01-MP5
Kinetix 6000, IAM, 400V-class, 6 kW converter, 9 A inverter	2094-BC01-M01-S (1)	2094-BC01-M01
Kinetix 6000, IAM, 400V-class, 15 kW converter, 15 A inverter	2094-BC02-M02-S (1)	2094-BC02-M02
Kinetix 6000, IAM, 400V-class, 28 kW converter, 30 A inverter	2094-BC04-M03-S (1)	2094-BC04-M03
Kinetix 6000, IAM, 400V-class, 45 kW converter, 49 A inverter	2094-BC07-M05-S (2)	2094-BC07-M05
Axis Modules (230V)		
Kinetix 6000, AM, 200V-class, 5 A	2094-AMP5-S	2094-AMP5
Kinetix 6000, AM, 200V-class, 9 A	2094-AM01-S	2094-AM01
Kinetix 6000, AM, 200V-class, 15 A	2094-AM02-S	2094-AM02
Kinetix 6000, AM, 200V-class, 24 A	2094-AM03-S	2094-AM03
Kinetix 6000, AM, 200V-class, 49 A	2094-AM05-S	2094-AM05
Axis Modules (460V)		
Kinetix 6000, AM, 400V-class, 4 A	2094-BMP5-S (1)	2094-BMP5
Kinetix 6000, AM, 400V-class, 9 A	2094-BM01-S (1)	2094-BM01
Kinetix 6000, AM, 400V-class, 15 A	2094-BM02-S (1)	2094-BM02
Kinetix 6000, AM, 400V-class, 30 A	2094-BM03-S (1)	2094-BM03
Kinetix 6000, AM, 400V-class, 49 A	2094-BM05-S (2)	2094-BM05

(1) You can configure the peak inverter current rating of this 460V (series B and later) IAM or AM module for 250% of continuous inverter current.
(2) You can configure the peak inverter current rating of this 460V (series B and later) IAM or AM module for 200% of continuous inverter current. Refer to Peak Enhancement Specifications on page 59, for more information on drive performance in the peak-enhanced mode.

Table 4 - Kinetix 6000 Drive Component Catalog Numbers

Drive Components	Cat. No.
Integrated power interface (IPIM) module, 400V-class, 15 kW, 24 A (rms)	2094-SEPM-B24-S
Kinetix 6000 shunt module, 200/400V-class, 200 W	2094-BSP2
Kinetix 6000 slot-filler module, 200/400V-class	2094-PRF

- Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a grounded 360° clamp termination.
- Use high-frequency (HF) bonding techniques to connect the modules, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, to better understand the concept of electrical noise reduction.

Transformer Selection

The IAM module does not require an isolation transformer for three-phase input power. However, a transformer can be required to match the voltage requirements of the controller to the available service.

To size a transformer for the main AC power inputs, refer to the Kinetix 6000 power specifications in the Kinetix 3, 300, 350, 2000, 6000, 6200, 6500, 7000 Servo Drives Specifications, publication KNX-TD005.

IMPORTANT If using an autotransformer, make sure that the phase to neutral/ground voltages do not exceed the input voltage ratings of the drive.

IMPORTANT Use a form factor of 1.5 for three-phase power (where form factor is used to compensate for transformer, drive module, and motor losses, and to account for utilization in the intermittent operating area of the torque speed curve).

For example, to size a transformer to the voltage requirements of a 2094-BC01-M01-S integrated axis module:
2094-BC01-M01-S = 6 kW continuous x 1.5 = 9.0 KVA transformer

AC Line Filter Selection

These AC line filters are available for your servo drive input power.

Table 7 - Kinetix 6000 (three-phase) AC Line Filter Selection

Drive Cat. No.	Voltage	Current A @ 50 °C (122 °F)	Weight, approx kg (lb)	AC Line Filter Cat. No.
2094-AC05-MP5-S	500V AC 50/60 Hz	30	2.7 (5.9)	2090-XXLF-X330B
2094-AC05-M01-S				
2094-AC09-M02-S				
2094-AC16-M03-S		75	5.2 (11.4)	2090-XXLF-375
2094-AC32-M05-S		100	9.5 (20.9)	2090-XXLF-3100
2094-BC01-MP5-S	500V AC 50/60 Hz	30	2.7 (5.9)	2090-XXLF-X330B
2094-BC01-M01-S				
2094-BC02-M02-S				
2094-BC04-M03-S		75	5.2 (11.4)	2090-XXLF-375B
2094-BC07-M05-S		100	9.5 (20.9)	2090-XXLF-3100

Refer to the Kinetix Motion Accessories Specifications Technical Data, publication KNX-TD004, for additional AC line filter specifications.

Circuit Breaker/Fuse Options

The 2094-*xCxx*-M*xx*-S and 2094-*x*M*xx*-S drive modules, and the Kinetix 6000M integrated drive-motor system (2094-SEPM-B24-S IPIM module and MDF-SB*xxxxx* IDM units) use internal solid-state motor short-circuit protection and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 200,000 A (fuses) and 65,000 A (circuit breakers).

Table 8 - Control and DC-bus Circuit Protection Specifications

IAM Module Cat. No.	Control Input Power		DC-bus Power		
	Bussmann Fuse (1)	Allen-Bradley® Circuit Breaker (2) (non-UL)	Bussmann Fuse	Mersen Fuse (3)	
2094-AC05-MP5-S	FNQ-R-10 (10 A)	1492-SPM2D060	N/A	A50P20-1	
2094-AC05-M01-S					
2094-AC09-M02-S			FWH-35B	A50P35-4	
2094-AC16-M03-S		1492-SPM2D200	FWH-60B	A50P60-4	
2094-AC32-M05-S			FWH-125B	A50P125-4	
2094-BC01-MP5-S	FNQ-R-10 (10 A) or FNQ-R-7.5 (7.5 A)	1492-SPM2D060 or 1492-SPM1D150	FWJ-20A14F	DCT20-2	HSJ20
2094-BC01-M01-S					
2094-BC02-M02-S			FWJ-40A	A70QS40-4	HSJ40
2094-BC04-M03-S			FWJ-70A	A70QS70-4	HSJ70
2094-BC07-M05-S			FWJ-125A	A70QS125-4	HSJ125

(1) Use FNQ-R-7.5 circuit breaker for higher single -cycle inrush current capability. This is recommended when the continuous control-power current exceeds 3.0 A.
(2) Use 1492-SPM1D150 circuit breaker for higher single -cycle inrush current capability. This is recommended when the continuous control-power current exceeds 3.0 A.
(3) Mersen fuses were formerly known as Ferraz Shawmut.

Input Power Circuit Protection (LIM)

The 2094-AL09 and 2094-BL02 line interface modules (LIM) contain supplementary protection devices and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 5000 A. When these modules are used, protection on the line side of the LIM module is required. Fuses must be class J or CC only.

The 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S-C*x* LIM modules contain branch circuit rated devices suitable for use on a circuit capable of delivering up to 65,000 A (400V-class) or 100,000 A (200V-class).

Refer to the Line Interface Module Installation Instructions, publication 2094-IN005, for power specifications and more information on using the LIM module.

Refer to Input Power Circuit Protection (without LIM) on page 23 when your drive system does not include the LIM module.

Input Power Circuit Protection (without LIM)

The fuses and Allen-Bradley circuit breakers shown in Table 9 are recommended for use with 2094-*xCxx*-M*xx*-S IAM modules when the line interface module (LIM) is not used.

IMPORTANT LIM Modules (catalog numbers 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S-C*x*) provide branch circuit protection to the IAM module. Follow all applicable NEC and local codes.

Table 9 - Input Power Circuit Protection Specifications

Kinetix 6000 Drives		UL Applications				IEC (non-UL) Applications			
IAM Module Cat. No.	Drive Voltage (three-phase) nom	Fuses (Bussmann) Cat. No.	Miniature CB Cat. No.	Motor Protection CB, Self-protected CMC Cat. No.	Molded Case CB Cat. No.	Miniature CB Cat. No.		Motor Protection CB Cat. No.	Molded Case CB Cat. No.
2094-AC05-MP5-S	230V	KTK-R-20 (20 A) Class CC	1489-M3D300	140M-F8E-C16	–	1492-SPM3D300	1489-M3D300	140M-F8E-C16	–
2094-AC05-M01-S	230V	KTK-R-20 (20 A) Class CC		140M-F8E-C16				140M-F8E-C16	
2094-AC09-M02-S	230V	KTK-R-30 (30 A) Class CC	–	140M-F8E-C20		1492-SPM3D400	–	140M-F8E-C20	
2094-AC16-M03-S	230V	LPJ-45SP (45 A) Class J		–	140G-G6C3-C50	–		–	140G-G6C3-C50
2094-AC32-M05-S	230V	LPJ-80SP (80 A) Class J			140G-G6C3-C90				140G-G6C3-C90
2094-BC01-MP5-S	360…480V	KTK-R-20 (20 A) Class CC	1489-M3D300	140M-F8E-C32	–	1492-SPM3D300	1489-M3D300	140M-F8E-C32	–
2094-BC01-M01-S	360…480V	KTK-R-20 (20 A) Class CC		140M-F8E-C32				140M-F8E-C32	
2094-BC02-M02-S	360…480V	KTK-R-30 (30 A) Class CC	–	140M-F8E-C45		1492-SPM3D400	–	140M-F8E-C45	
2094-BC04-M03-S	360…480V	LPJ-45SP (45 A) Class J		–	140G-G6C3-C50	–		–	140G-G6C3-C50
2094-BC07-M05-S	360…480V	LPJ-80SP (80 A) Class J			140G-G6C3-C90				140G-G6C3-C90

Refer to the Kinetix 3, 300, 350, 2000, 6000, 6200, 6500, 7000 Servo Drives Specifications, publication KNX-TD005, for additional power specifications for your IAM module.

Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Bulletin 2094 drive system. The example system consists of these components:

- 6-axis Bulletin 2094 servo drive system
- Line Interface Module (LIM)
- ControlLogix® chassis and modules (controller)

Size the Bulletin 2094 servo drive and LIM module and use the results to predict the amount of heat dissipated into the enclosure. You also need heat dissipation data from other equipment inside the enclosure (such as the ControlLogix controller). Once the total amount of heat dissipation (in watts) is known, you can calculate the minimum enclosure size.

Table 10 - Bulletin 2094 System Heat Dissipation Example

Enclosure Component	Description		Loading (1)	Heat Dissipation (1) watts
2094-BC02-M02-*x*	Integrated axis module (IAM), 400/460V	15 kW (converter section)	20%	44
		15 A (inverter section)	40%	72
2094-BM02-*x*	Axis module (AM), 400/460V, 15 A		60%	93
2094-BM02-*x*	Axis module (AM), 400/460V, 15 A		60%	93
2094-BM01-*x*	Axis module (AM), 400/460V, 9 A		40%	73
2094-BM01-*x*	Axis module (AM), 400/460V, 9 A		40%	73
2094-BM01-*x*	Axis module (AM), 400/460V, 9 A		20%	57
2094-BL25S	Line interface module (LIM), 400/460V, 25 A; 24V DC 20 A		100%	43

In this example, the enclosure must have an exterior surface of 6.66 m^2. If any portion of the enclosure is not able to transfer heat, do not include that portion in the calculation.

Because the minimum cabinet depth to house the 460V drive (selected for this example) is 302 mm (11.9 in.), then the cabinet needs to be approximately 2500 mm (high) x 950 mm (wide) x 302 mm (deep).

$2 \times (0.3 \times 0.95) + 2 \times (0.3 \times 2.5) + 2 \times (0.95 \times 2.5) = 6.82\ m^2$

Because this cabinet size is considerably larger than what is necessary to house the system components, consider some means of cooling in a smaller cabinet to be more efficient. Contact your cabinet manufacturer for options available to cool your cabinet.

Table 12 - Power Dissipation Specifications

Bulletin 2094 Drive Modules (1)	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
IAM (converter) module (2)					
2094-AC05-MP5-S	8	11	15	19	24
2094-AC05-M01-S	9	12	16	20	25
2094-AC09-M02-S	14	20	28	36	46
2094-AC16-M03-S	19	30	43	58	74
2094-AC32-M05-S	41	68	100	136	176
2094-BC01-MP5-S	18	21	25	29	34
2094-BC01-M01-S					33
2094-BC02-M02-S	36	44	54	64	75
2094-BC04-M03-S	50	67	87	110	135
2094-BC07-M05-S	71	101	137	179	226
IAM (inverter) module or AM module (2)					
2094-AC05-MP5-S or 2094-AMP5-S	28	32	37	41	46
2094-AC05-M01-S or 2094-AM01-S	31	38	46	54	62
2094-AC09-M02-S or 2094-AM02-S	34	45	57	70	84
2094-AC16-M03-S or 2094-AM03-S	48	68	91	116	144
2094-AC32-M05-S or 2094-AM05-S	104	156	212	274	342
2094-BC01-MP5-S or 2094-BMP5-S	46	54	61	69	77
2094-BC01-M01-S or 2094-BM01-S	57	73	90	108	126
2094-BC02-M02-S or 2094-BM02-S	53	72	93	116	142
2094-BC04-M03-S or 2094-BM03-S	94	130	169	211	255
2094-BC07-M05-S or 2094-BM05-S	121	183	252	326	407
Shunt module - 2094-BSP2	68	121	174	227	280
IPIM module - 2094-SEPM-B24-S	To calculate power dissipation for IPIM modules on your 2094 power rail, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.				

(1) Power dissipation for the Bulletin 2094 control modules, catalog numbers 2094-SE02F-M00-Sx and 2094-EN02D-M01-Sx, is included in the IAM and AM power module specifications.
(2) Internal shunt power is not included in the calculations and must be added based on utilization.

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Bulletin 2094 system components.

IMPORTANT Mount the module in an upright position. Do not mount the module on its side.