1391B-ES AC Servo Controller
User Manual

Introduction

This publication provides updated information for the 1391B-ES Instruction Manual (1391ES-5.0, dated October, 1992). Please place this publication with your manual for future reference.

Page 1-3

The following material is new and should be added at the end of "Controller Description."

The 1391-EST45 combines all of the features of the 1391B-ESAA45 with the addition of 300% peak current capability. The controller can be ordered with A Quad B encoder feedback and is available in the 45A size only.

Page 1-4

The following is updated Option/Modification information.

- Anti-Backlash
  Provisions to use the 1388 Anti-Backlash module (1388-XA) are available.

- Linear Accel/Decel
  Linear accel/decel can be set using the CR-APG-001 Control Module. This module provides a manually generated trapezoidal velocity profile for up to four preset speeds. A single acceleration/deceleration rate can be set for all speeds.

Page 2-1

The Controller Specifications shown on the following page have been updated to include the 1391-EST45.

<u>Specific Ratings – 1391B- . . .</u>	<u>ESAA15</u>	<u>ESAA22</u>	<u>ESAA45</u>	<u>EST45</u>
Nominal Bus Output Voltage	300V DC	300V DC	300V DC	300V DC
Continuous Current (RMS)	15A	22.5A	45A	45A
Peak Current (RMS)	30A	45A	90A	135A
Continuous Power Output	5.0 kW	7.5 kW	15.0 kW	15.0 kW
Peak Power Output	10.0 kW	15.0 kW	30.0 kW	45.0 kW
Input Circuit Breaker Rating	17A RMS	26A RMS	38A RMS	38A RMS
Circuit Breaker Interrupt Rating (Symmetrical Amperes)	1300A	1300A	1300A	1300A
Unit Weight in lbs. (kg)	22 (9.97)	28 (12.69)	34 (15.40)	37 (16.78)

<u>All Controller Ratings</u>

Static Gain (A/RMS)	1.5 x Rated Motor Current / rpm
Form Factor	1.03 or less
Speed Regulation change	0.05% (max.) of maximum motor speed with 95% load
Peak Current Limit Adjust 1391B-ES continuous drive	20 to 300% of Rated Motor Current (to 2 times rating, maximum)
1391-EST45 continuous drive	20 to 300% of Rated Motor Current (to 3 times rating maximum or 135A.
	Note: Peak current time varies with RMS current history.
IT current.	(current-time) history is used to determine available peak current
for 130 ms	For example: With 30A "soak," 300% peak is available or more with lower soak.
Controller Efficiency (Minimum at Rated Load)	85%
Modulation Frequency	2500 Hz ±10%
Drift (Referred to Tach)	0.07 rpm /Degrees C. Maximum
Ambient Temperature	0 to 60° C (32 to 140° F)
Storage Temperature	0 to 65° C (32 to 149° F)
Input Voltage (from Transformer)	Power: 230V AC, Three-Phase, 50/60 Hz ±3 Hz Control: 36V AC CT, Single-Phase
Relative Humidity	5 to 95% Non-Condensing
Deadband	Zero
Altitude	1000 meters (3300 feet)
Integral Fan Output	50 CFM (Unloaded)
Max. RMS Short Circuit Current (Symmetrical Amperes)	1300A
Transformer Input Tolerance	+10%, –15%

Specifications are for reference only and are subject to change without notice.

Page 3-3 through 3-7   Several catalog number descriptions have been clarified. Descriptions for the 1391-EST controller and Planetary Gearbox have been added.

Bulletin 1391B-ES Controller

1391B – ES A A 45 – xxx

First Position	Second Position	Third Position	Fourth Position	Fifth Position	Sixth Position
Bulletin Number	Speed Capability	Type and Construction	Nominal Output Voltage	Current Rating	Options (if required)

Code	Description	Letter	Description	Letter	Description	Letter	Description	Number	Description	Description
1391B	Standard 1391B	Blank	Standard 1391B	A	Open Frame, Internal Heat Sink	A	230V AC, Three-Phase	15	15A RMS Cont./ 30A Peak	Three character field assigned to special modifications. Contact your local Allen-Bradley Sales Representative for further information.
		ES	Extended Speed Range					22	22.5A RMS Cont./ 45A Peak	
								45	45A RMS Cont./ 90A Peak	

Code	Description
A13	Zero Current Option (see Appendix D)

Bulletin 1391-EST Controller

1391 – EST 45 – AQB

First Position	Second Position	Third Position	Fourth Position
Bulletin Number	Speed Capability	Current Rating	Options (if required)

Code	Description	Letter	Description	Number	Description	Description
1391	Standard EST	EST	Extended Speed & Peak Torque Range	45	45A RMS Cont./ 135A Peak	Three character field assigned to special modifications. Contact your local Allen-Bradley Sales Representative for further information.

Code	Description
AQB	A Quad Encoder Output

Accessory Modules

1388 – X B

Bulletin No.	Module	Accessory

Description	Code	Description	Code	Description
1388	X	Accessory Module for 1391	A	Anti-Backlash Module w/mounting assembly
			B [1]	Accel/Decel Board w/mounting rack
CR-APG	Blank		C [1]	Velocity Reference Board w/mounting rack
			001	Linear Accel/Decel Board w/power supply & 4 preset speeds

[1] A combination of the 1388-XB and XC is supplied by the CR-APG-001.

External Shunt Regulator Resistor

1391 – MOD – SR22A

	Bulletin Number	Type		Description	
		Code	Description	Code	Description
		MOD	Modification Kit	SR22A	Shunt Regulator Resistor for 22.5A Controller
				SR45A	Shunt Regulator Resistor for 45A Controller

1326AB Servomotor

1326   A   B – A   3   E – 11 – A4

First Position Bulletin Number	Second Position Type		Third Position Design	Fourth Position Series		Fifth Position Motor Length		Sixth Position Max. Operating Speed			Seventh Position Mounting & Shaft Description		Eighth Position Standard Options
	Letter	Description	Description	Description		Description		Code	1391B-ES	Rated	Code	Description	
	A	AC Servomotor PM Type	Factory use only	Sequentially lettered to designate frame diameters.		Sequentially numbered to indicate stack length within a given frame size.		B	2000	1600	11	Inch Combination Face/ Flange with Keyway	
								C	3000	2000	21	NEMA/IEC Metric Flange with Keyway	
								E	4000	3000			
								G	6000	5000			

		Code	Description			Code	Description
		A	4.25" (108 mm)			A4	72 lb.-in. (8.1 N-m) Holding Brake w/90V DC Coil.
		B	5.88" (149 mm)			A5	120 lb.-in. (13.6 N-m) Holding Brake w/90V DC Coil.
		C	7.63" (194 mm)			A7	400 lb.-in. (45.2 N-m) Holding Brake w/90V DC Coil.
						K4	72 lb.-in. (8.1 N-m) Holding Brake w/24V DC Coil.
						K5	120 lb.-in. (13.6 N-m) Holding Brake w/24V DC Coil.
						K7	400 lb.-in. (45.2 N-m) Holding Brake w/24V DC Coil.

Planetary Gearbox

1326AB – PG   A   05   12   21
B   B

First Position Bulletin Number	Second Position Type		Third Position Used on 1326AB Motor Series		Fourth Position Gear Ratio (Motor Shaft:Output Shaft)		Fifth Position Options		Sixth Position Adapter	
	Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
	PG	Straight Planetary Gearbox	A	Series A	03		Blank	No Options	21	Metric
	RP	Right Angle Planetary Gearbox	B	Series B	05	3:1	LB	Low Backlash Option		
			C	Series C	10	5:1				
					15	10:1				
					20	15:1				
					30	20:1				
					50	30:1				
					100	50:1				
						100:1				

Power and Feedback Cables

1326	–	C	P	A B	T	15

First Position	Second Position	Third Position	Fourth Position	Fifth Position	Sixth Position
Bulletin Number	Type	Function	Motor Size Used On	Power Track Cable	Cable Length

Letter	Description	Letter	Description	Letter	Description	Code	Type	Letter	Description	Code	Description
Blank	Standard Cable	C	Connector & Cable Assembly	P	Power Connection	AB C	Series A & B (except 1326AB-B4) Series C & 1326AB-B4	T	All Series, used for high flex applications	K	Connector Kit (No Cable)
				F	Commutation & Feedback Connection	U	1326AB-B4	Blank	Standard Cable	15	15' (4.6m)
				E V	845H/T Encoder All 4.25" (108 mm) Resolver Packages					30	30' (9.1m)
										50	50' (15.2m)
										100	100' (30.4m)
										150	150' (45.7m)
										200	200' (61m)
										250	250' (76.2m)
										300	300' (91.4m)

Page 5-3   In Figure 5.1, a cable specification has been added to Note 1. Note 2 has been clarified.

[1] Recommended Wire – Belden #9728 or equivalent. Maximum distance between the A Quad B Board and the position controller is 40 feet (12.2 meters) using a 5 volt signal. For distances up to 300 feet (91 meters), 18 AWG (0.8 mm^2) wire (Belden 9388 or equivalent) and an 8 to 15V DC power supply must be used.

[2] For proper operation when interconnecting to IMC Classic products (i.e. IMC 110, 12x), the B and B (NOT) signals must be reversed.

Page 5-4   **External Shunt Regulator Resistor** (TB5, Terminals 8, 9, 10)

The following sentence supplements the current material.

Bus voltage can be monitored on terminals 9 (+) and 7 (–) of TB5.

Page 5-8   Scaling information for the 1326AB-A1G motor has been added.

Table 5.C
Typical Scaling for 1326 AC Servomotors

Motor Catalog Number[2]	I_C (A)	S1 Switch Setting[1]		
		1391B-ESAA1	**1391B-ESAA2**	**1391B-ESAA4**
1326AB-A1G	4.5	5 4	2 3	5

Page 5-10

The S2 switch setting for the 1326AB-A1G motor has been added.

Table 5.E
S2-2 Switch Positions

Motor Catalog Number[1]	S2-2 Switch Setting
1326AB-A1G	ON

Page 5-12

The following information has been clarified for use with IMC Classic products.

When using the A Quad B option with Allen-Bradley IMC motion controllers, the AMP parameters will be set according to the line count selected. In general, one parameter must be justified when using this device.

Important: For all IMC Classic products (IMC 110, 12x) the normal line counts per cycle of the encoder must be divided by two since the controller will see two markers per cycle.

Example (using an IMC 12x Controller)
With switch S3 set to 1024 lines per revolution (S3-2 OFF, S3-1 ON), the lines per cycle of the position feedback device (located in the Feedback Parameters File) must be 2048.

$$1024 \times 4 = 4096 / 2 = 2048$$

(Quadrature)

Lines/Revolution

2
Markers/Revolution
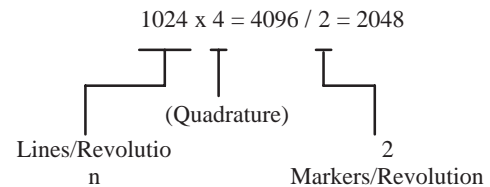
Page 6-5   Encoder (A Quad B Board) Wiring

The following information supplements the current material.

For proper operation when interconnecting to IMC products, the B and B (NOT) signals must be reversed.

Applications that interface the 1391B-ES with an IMC Classic Controller (IMC 110, 120, 121, 123) require a relay to sequence the encoder power supply during a controller shutdown.

Without this power supply relay, erroneous counts could be received by the IMC Classic Controller when AC power is cycled to the 1391B-ES, but not the IMC controller. When power is removed to the 1391B-ES, the AQB Board will not have control voltage. However, the board will still receive the encoder voltage (+5V DC or +8-15V DC) from the IMC Classic Controller. As the 1391B-ES power is cycled, it will briefly output a stream of encoder pulses which will be interpreted as movement of the servomotor by the IMC Classic Controller.

It is recommended that a normally open (N.O.) contact from an external relay be wired in series with the encoder voltage going to the 1391B-ES from the IMC Classic Controller. The relay coil must be wired into the control circuit. When power is not applied to the 1391B-ES, a Quadrature Fault will occur in the controller, forcing a re-homing and calibration of the controller.

Page 7-4   The following error example should be added to step 15.

$$\text{Following Error} = \frac{\text{Velocity}}{\text{Gain}} = \frac{100 \text{ ipm}}{1 \text{ ipm/ml}} = 100 \text{ ml}$$

Page 7-6   Linear Accel/Decel Control Module

The following information is new and explains manual controller operation with the Linear Accel/Decel Control Module (CR-APG-001). This module provides adjustable acceleration/deceleration control for the 1391B-ES. Up to four remote or local preset speeds are available.
The 1391B-ES can be manually operated with controlled trapezoidal motion profiles when the module is installed and the following steps are performed.

o 1.   Perform the Start-Up Procedure presented earlier in this chapter.

o 2.   Remove all system power.

o 3.   Install and interconnect the Linear Accel/Decel Control Module as shown in Figure 7.3. Refer to Figure 7.4 for dimension information.

o 4. Set all of the Speed pots (SPD 1-SPD 4 or remote pots) to the maximum clockwise position (speed minimum). Set the front panel Accel and Decel pots to the maximum counterclockwise position (minimum accel/decel time).

    Important: All potentiometers on the module are 15 turn, bi-directional. The Local Speed pots are setup such that counterclockwise rotation will increase output and clockwise rotation will decrease output. Counterclockwise rotation of the Accel/Decel pots will decrease time, while clockwise rotation will increase time.

o 5. Apply 115V AC to terminals 1 & 2 of J3. Using a voltmeter, verify that this voltage is present. Also verify that +10V DC is present between terminals 9 (+) and 2 (–) of J1. The "ON/OFF" LED located on the front of the module will be illuminated.

o 6. Select Remote or Local speed control.

    To select Remote Speed

    a) Connect an external, 1k ohm, 1/2 watt speed potentiometer as shown in Figure 7.3.

    b) Energize the R/L 1 input (terminals 3 & 4 of J2) with either 24V DC or 115V AC.

    c) Energize the speed select input, SEL 1 (terminals 1 & 2 of J2) with the same voltage used in the previous step. The front panel "R/L 1" LED will illuminate.

    d) Repeat steps *a* through *c* for any of the other three preset speeds.

    Important: If more than one speed is selected at the same time, the resulting speed for the velocity profile will not be predictable.

    To select Local Speed

    e) Energize the speed select input, SEL 1 (terminals 1 & 2 of J2) with either 24V DC or 115V AC. The front panel "SEL 1" LED will illuminate.

    f) Repeat the above step for any of the other three preset speeds.

    Important: If more than one speed is selected at the same time, the resulting speed for the velocity profile will not be predictable.

    Important: In the following steps, the local speed control (SPD 1) will be used. If your application utilizes remote speed pots, the remote pot should be substituted for SPD 1.

o 7. Connect a voltmeter between terminals 11 (+) and 10 (–) of J1. While monitoring the meter, turn the speed pot (SPD 1 or remote) counterclockwise until the output voltage is approximately +10V DC. Toggle the FWD/REV switch. The voltage measured should change in polarity.

If the polarity does not change, recheck the wiring and connections of the FWD/REV relay and switch.

Important: Changing direction with the speed input follows the accel/decel times set on the module.

o 8. Move the meter leads to controller terminals 1 (–) & 2 (+) of TB2. The meter should indicate a voltage of approximately +10V DC.

o 9. Rotate the Accel and Decel pots (located on the module front panel) approximately 7 turns.

o 10. De-energize the SEL 1 input (terminals 1 & 2 of J2) and note the time needed for the meter voltage to reach zero (minimum) volts. Energize the SEL 1 input and note the time needed for the voltage to reach +10V DC (maximum).

o 11. Adjust the Accel/Decel pots for desired ramp times (approximate range is 0.25 to 6.5 seconds) by repeating step 10. The final ramp time will be set during final system calibration. Rotate the speed pot fully clockwise for minimum speed. Remove the SEL1 input.

> ⚠ **ATTENTION:** To protect against rapid accel/decel commands from the module and possible machine damage or personal injury, the "Bypass" input (terminals 19 & 20 of J2) <u>must</u> <u>not</u> be energized. Applying 24V DC or 115V AC to this input will remove the Accel/Decel pot settings from the circuit, causing the output to immediately ramp to +10V DC or zero volts.

o 12. The output of the module is controlled by the "Deadman" input at terminals 10 & 11 of J1. Applying 24V DC or 115V AC to this input will cause the module to operate. The front panel "Dedman" LED will be off. When this input is de-energized, the module output will be connected to logic ground, thus disabling output. At this point the "Dedman" LED will illuminate.

Energize the "Deadman" input with 24V DC or 115V AC.

⚠ **ATTENTION:** During subsequent steps, the servomotor may begin to rotate and cause incorrect machine movement when the controller is enabled. Be prepared to remove power by opening (MCB) or the branch circuit disconnect device if this occurs. This movement may be due to a wiring error or system component malfunction and must be corrected before proceeding with this procedure. Damage to machine system components can occur due to uncontrolled machine movements.

o 13. Apply power to the controller and module. Initiate a Start command by selecting speed input, SEL1. Command a speed through the speed pot, SPD 1 that represents approximately 10% of maximum speed (i.e. 1V DC).

The motor should rotate slowly under control (following the speed pot). If the motor is uncontrollable or rotates incorrectly, de-energize SEL 1. Remove all power and check wiring.

If the controller current limit function is used – slowly adjust the Current Limit potentiometer (R148) to the desired setting after the motor is stable. Refer to Chapter 5 for more information on the this potentiometer.

If the application requires reverse direction, use the FWD/REV toggle switch to check operation in the reverse direction.

o 14. With a zero velocity command from the module, use the controller Offset pot (R1) to set zero motor speed. Refer to Chapter 5 for more information on this adjustment.

Important: The motor may begin to move slowly after a period of time (several minutes) even though the Offset pot is set to zero.

o 15. Rotate the speed pot (SPD 1) fully counterclockwise. Adjust the Velocity Command Scale pot (R132) to give the desired motor speed.

o 16. Check the accel/decel rate settings at speeds selected for the application. Refer to steps 10 & 11.

o 17. If applicable, repeat steps 6-16 for any of the other three preset speeds
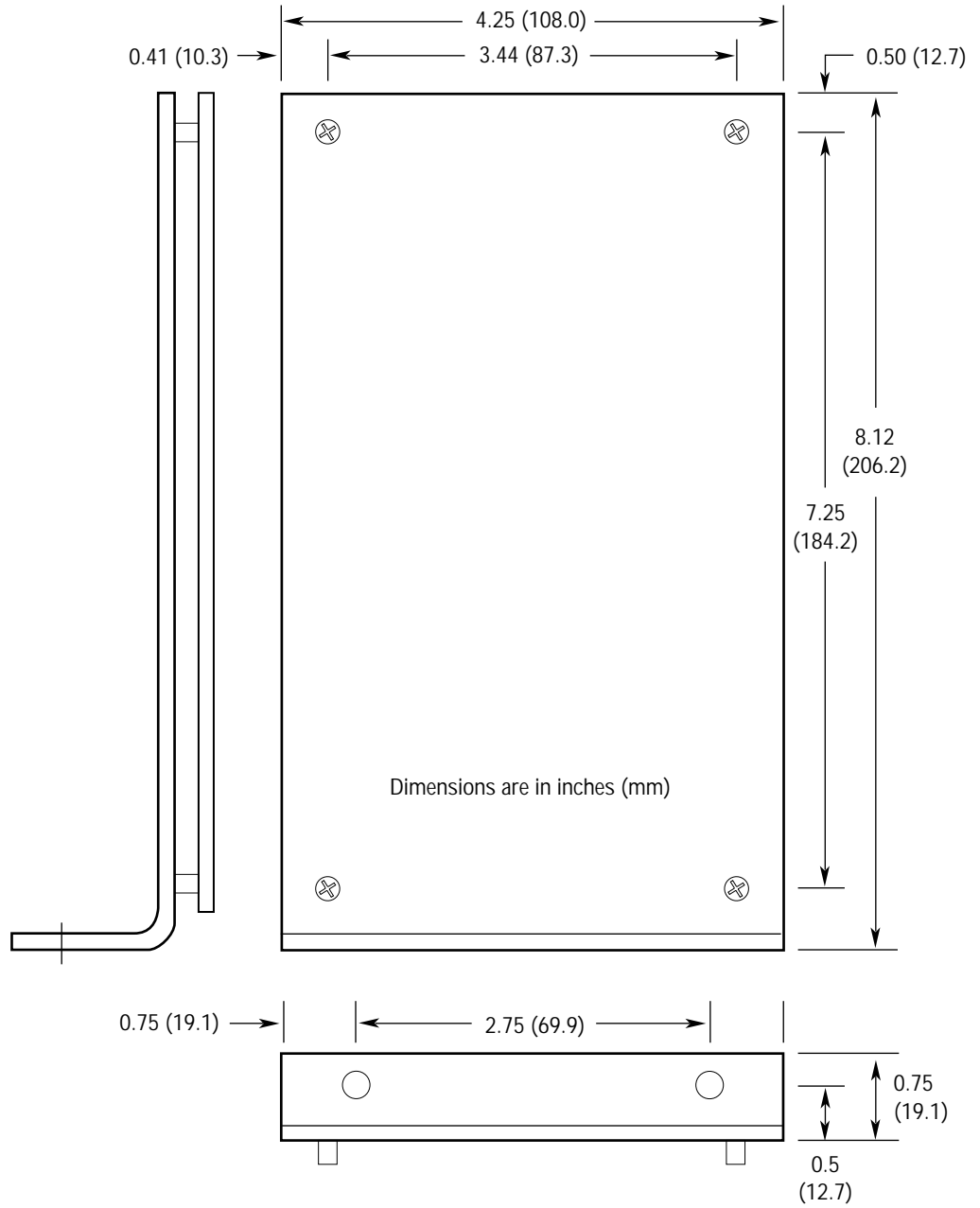
Figure 7.3
Linear Accel/Decel Control Module Wiring
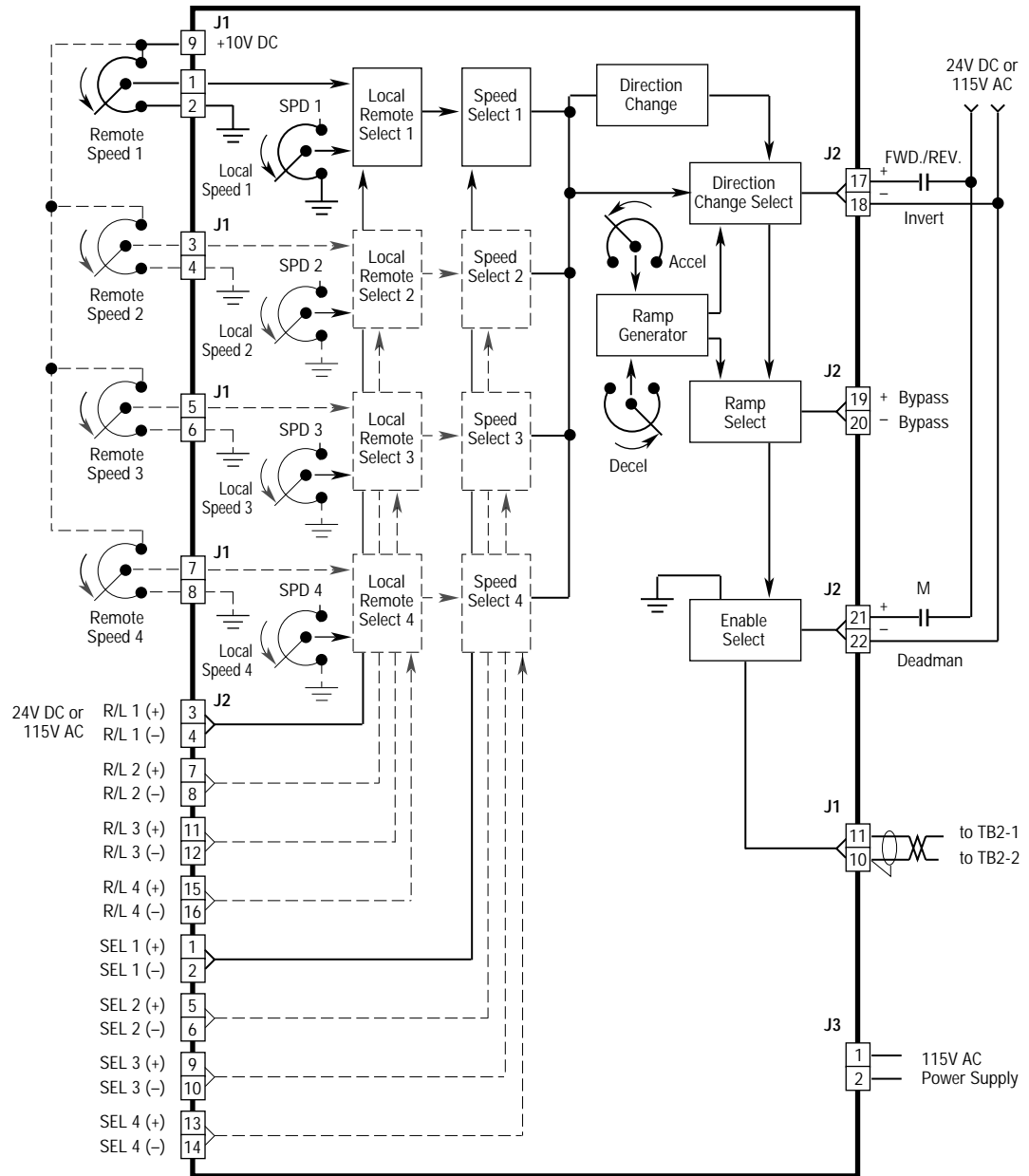
TYPICAL CONTROL CIRCUIT
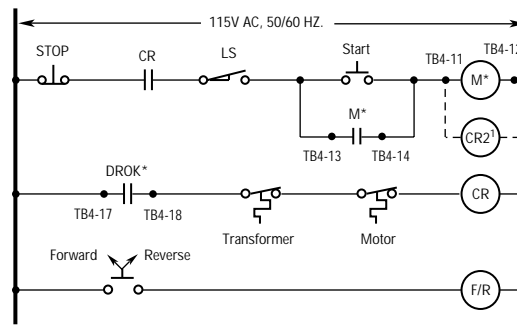
* Indicates component located in controller
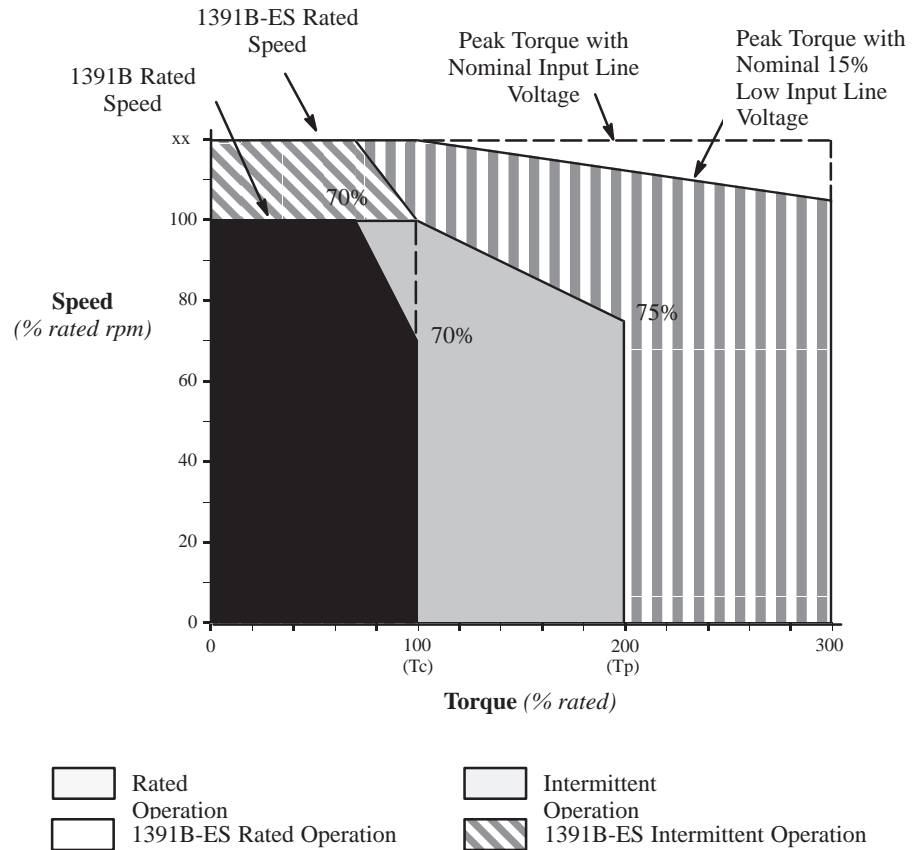[1] Required only with IMC 110, 120, 121 AND 123 controllers

Figure 7.4
Linear Accel/Decel Control Module Dimensions

4.25 (108.0)

0.41 (10.3)

3.44 (87.3)

0.50 (12.7)

8.12 (206.2)

7.25 (184.2)

Dimensions are in inches (mm)

0.75 (19.1)

2.75 (69.9)

0.75 (19.1)

0.5 (12.7)

Page 8-1

The Speed-Torque Curve shown in Figure 8.1 has been updated to 300% rated torque.

Figure 8.1
Typical Bulletin 1326 Speed-Torque Curve

Page 8-3

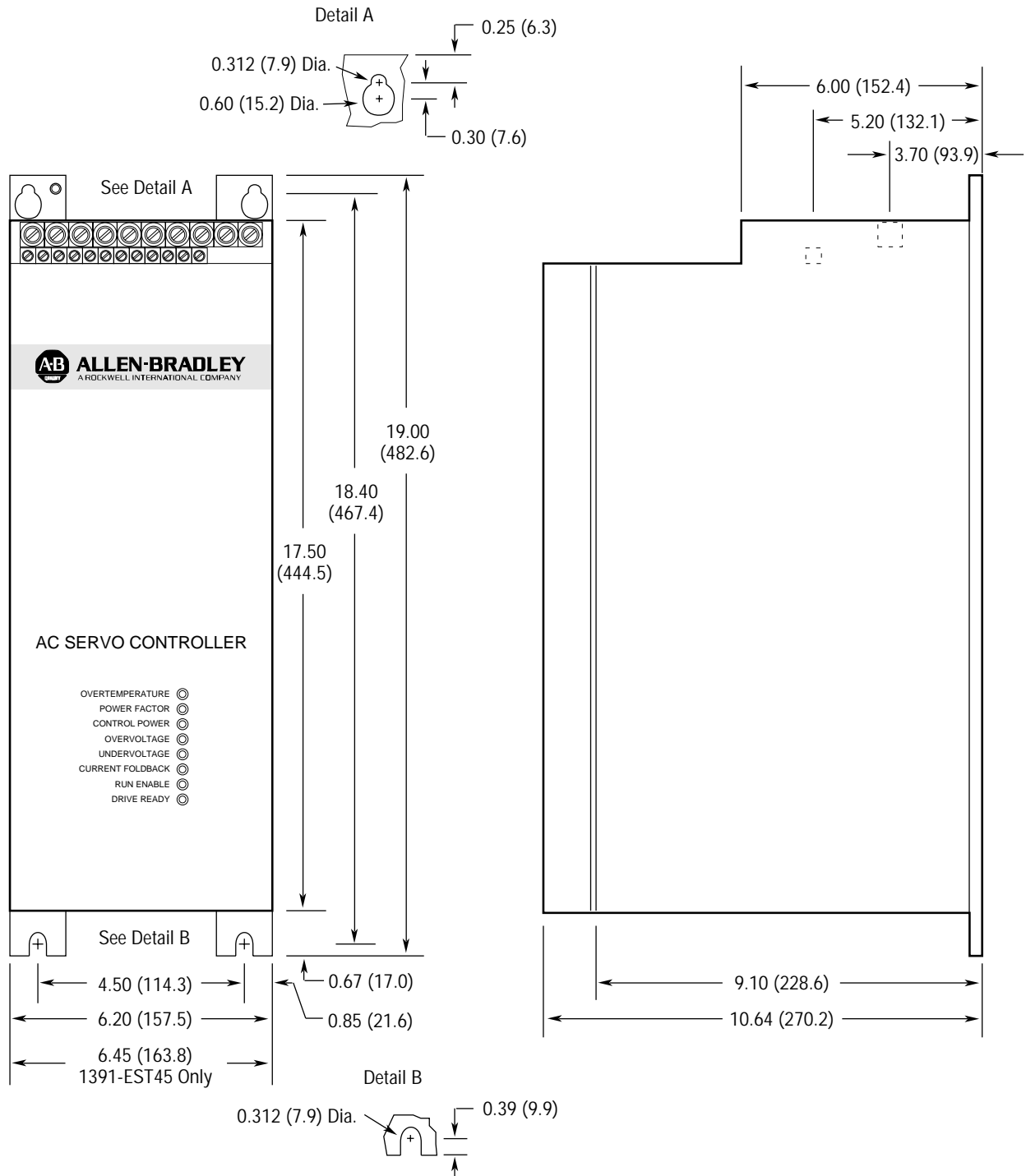Speed comparisons with the 1391-EST drive have been added to Table 8.A.

Table 8.A
1391/1391B-ES /1391-EST Speed Comparison

Continuous Stall Torque (tb.-in./ N-m)	Peak Stall Torque (lb.-in./ N-m)	Rated Speed (rpm)	Motor Catalog Number	Servo Amplifier Catalog Number	Amperes at Continuous Torque	Rotor Inertia (lb.-in.-s²/kg-m²)	Rated Output (kW)
		4000					
	630/71.2	4000	1326AB-C2E			0.14/0.015	6.9
210/23.7				1391-EST45	33.2		
	852/96.3	3000	1326AB-C3E			0.22/0.024	10.0
310/35.0				1391-EST45	49.1		
	1217/137.5	2000	1326AB-C4C			0.29/0.032	9.3
420/47.4				1391-EST45	46.6		
	1260/142.4		1326AB-C4B			0.29/0.032	7.5
420/47.4				1391-EST45	38.2		

Page A-1

A dimension has been added to cover the 1391-EST45 controller.

Figure A.1
1391B-ES/1391-EST Dimensions
Dimensions are in inches and millimeters

Detail A

0.25 (6.3)

0.312 (7.9) Dia.

0.60 (15.2) Dia.

0.30 (7.6)

6.00 (152.4)

5.20 (132.1)

3.70 (93.9)

See Detail A

ALLEN-BRADLEY
A ROCKWELL INTERNATIONAL COMPANY

19.00
(482.6)

18.40
(467.4)

17.50
(444.5)

AC SERVO CONTROLLER

OVERTEMPERATURE
POWER FACTOR
CONTROL POWER
OVERVOLTAGE
UNDERVOLTAGE
CURRENT FOLDBACK
RUN ENABLE
DRIVE READY

See Detail B

4.50 (114.3)

6.20 (157.5)

6.45 (163.8)
1391-EST45 Only

0.67 (17.0)

0.85 (21.6)

9.10 (228.6)

10.64 (270.2)

Detail B

0.312 (7.9) Dia.

0.39 (9.9)

Notes:
1. Dimensions are in inches (millimeters)
1. Mounting slots and keyholes will accept 1/4-20 (7 mm) hardware.
2. A minimum spacing of 0.312" (7.9 mm) is required between adjacent controllers – 1" (25.4 mm) is recommended.

Page A-2

"NT" has been added to the catalog numbers shown and "Europa" style terminal blocks have been incorporated into the transfomer design.

Figure A.2
1391 Isolation Transformer Dimensions
Dimensions are in inches and (millimeters)
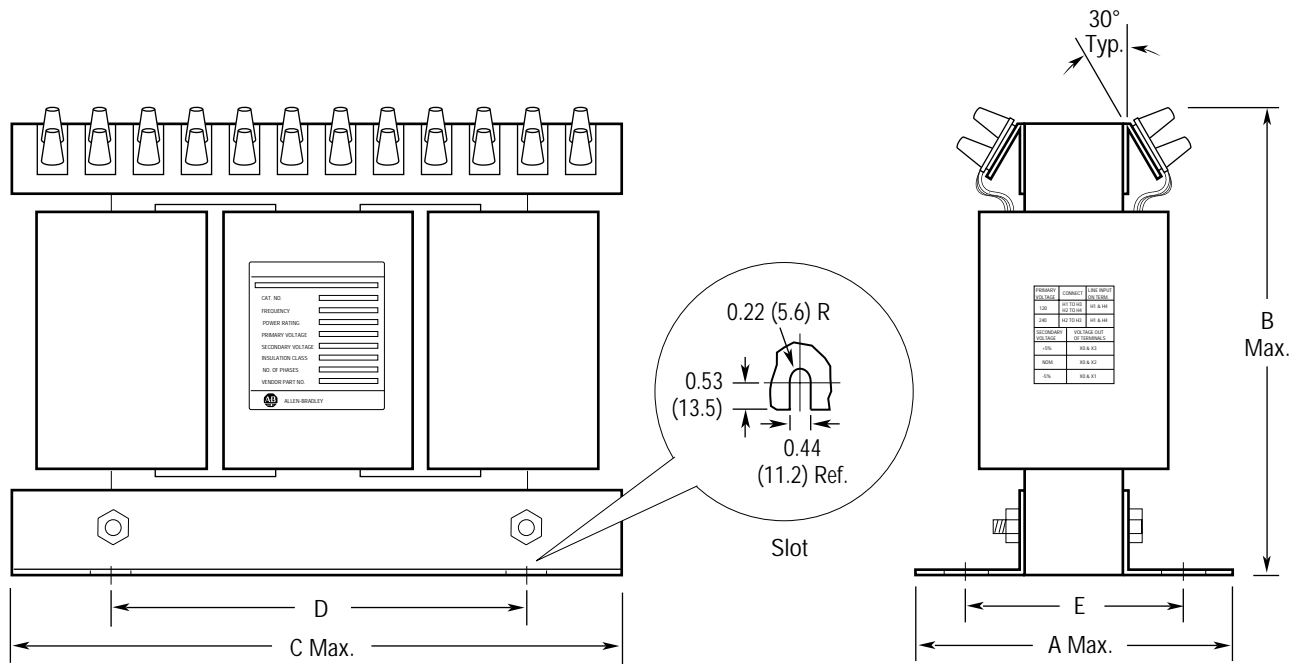
Catalog Number	kVA	A	B	C	D	E	Weight
1391-T015DT	1.5	9.00 (228)	10.00 (254)	13.00 (330)	5.00 (127)	3.10 (79)	27 (12.2)
1391-T015ET/NT		9.00 (228)	10.00 (254)	13.00 (330)	5.00 (127)	3.50 (89)	40 (18.2)
1391-T025DT	2.5	11.00 (279)	11.00 (279)	14.00 (356)	6.00 (152)	3.30 (84)	42 (19.0)
		11.00 (279)	11.00 (279)	14.00 (356)	6.00 (152)	4.00 (102)	60 (27.2)
1391-T025ET/NT	3.5	11.00 (279)	11.00 (279)	14.00 (356)	6.00 (152)	4.50 (114)	60 (27.2)
		11.00 (279)	11.00 (279)	14.00 (356)	6.00 (152)	4.50 (114)	85 (38.6)
1391-T035DT	5.0	11.00 (279)	11.00 (279)	14.00 (356)	6.00 (152)	5.25 (133)	75 (34.0)
1391-T035ET/NT		11.00 (279)	11.00 (279)	14.00 (356)	6.00 (152)	6.00 (152)	100 (45.4)
1391-T050DT	10.0	12.00 (305)	12.50 (317)	16.00 (406)	8.00 (203)	5.85 (149)	112 (50.8)
1391-T050ET/NT		12.00 (305)	12.50 (317)	16.00 (406)	8.00 (203)	5.85 (149)	140 (63.6)
	15.0	13.00 (330)	14.00 (356)	17.50 (444)	9.50 (241)	6.00 (152)	150 (68.0)
1391-T100DT		13.00 (330)	14.00 (356)	17.50 (444)	9.50 (241)	6.00 (152)	200 (90.9)
1391-T100ET/NT							
1391-T150DT							
1391-T150ET/NT							

Page A-3

The following items are included with the NEMA Type 1 Enclosure.

Qty.	Description
2	Steel Mounting Channels
4	3/8-16 x 1.0 HHCS Screw
4	3/8-16 x 1.5 HHCS Screw
8	3/8 Flat Washer
8	3/8 Split Lock Washer
8	3/8-16 Hex Nuts

Appendix B

The following changes have been made to the interconnect diagrams in Appendix B. The diagrams on the following pages have been renumbered.

Figure	Diagram	Description of Change
B.1 Control Circuit.	Interconnect	Note added to C.T. of transformer. CR2 added to
resolver.		Note added to "M" Contact table. Capacitor added to
B.2, B.3	IMC	New diagrams. CR2 and M contact added.
B.4	8400	Removed.
B.5	8600	Removed.
B.6 have been	MAX/CONTROL	New diagram. Notes and terminal block designations
		clarified. M contact added.
	IMC-S/20x	New diagram.
	IMC-S/21x	New diagram.
	IMC-S/23x	New diagram.
	IMC-201	New diagram.
	IMC 110	New diagram.
	9/Series	New information.

Note 10 has been added.

Notes:

1) Power Wiring unless Noted:

   15A   12 AWG (3.3 mm^2) min. 75C min.
   22.5A   10 AWG (5.3 mm^2) min. 75C min.
   45A   8 AWG (8.4 mm^2) min. 75C min.

2) Signal Wiring: 18 AWG (0.8 mm^2) min.

3) Allen-Bradley Supplied Cable:

   8 AWG (8.4 mm^2) Motor   126473
   12 AWG (3.3 mm^2) Motor   126474
   Resolver   116190

4) Customer Supplied Resolver Cable:

Belden 9873 or equivalent, 20 AWG (0.5 mm^2), 30 pf/ft (97.5 pf/m) max. capacitance
   between conductors.

5) Terminate shield on source end only.

6) Do not make connections to unused pins on the resolver connector.

7) F3 provided on 15 & 22.5a units only. 15A=KLM-10, 22.5A=FNQ 6 1/4 series B only.

8) S2-1 ON for 1.2V/krpm, S2-1 OFF for 2.0V/krpm

9) Current Feedback Scaling: See Chapter 5

10) On all Series D controllers (verify with controller nameplate) the secondary center tap
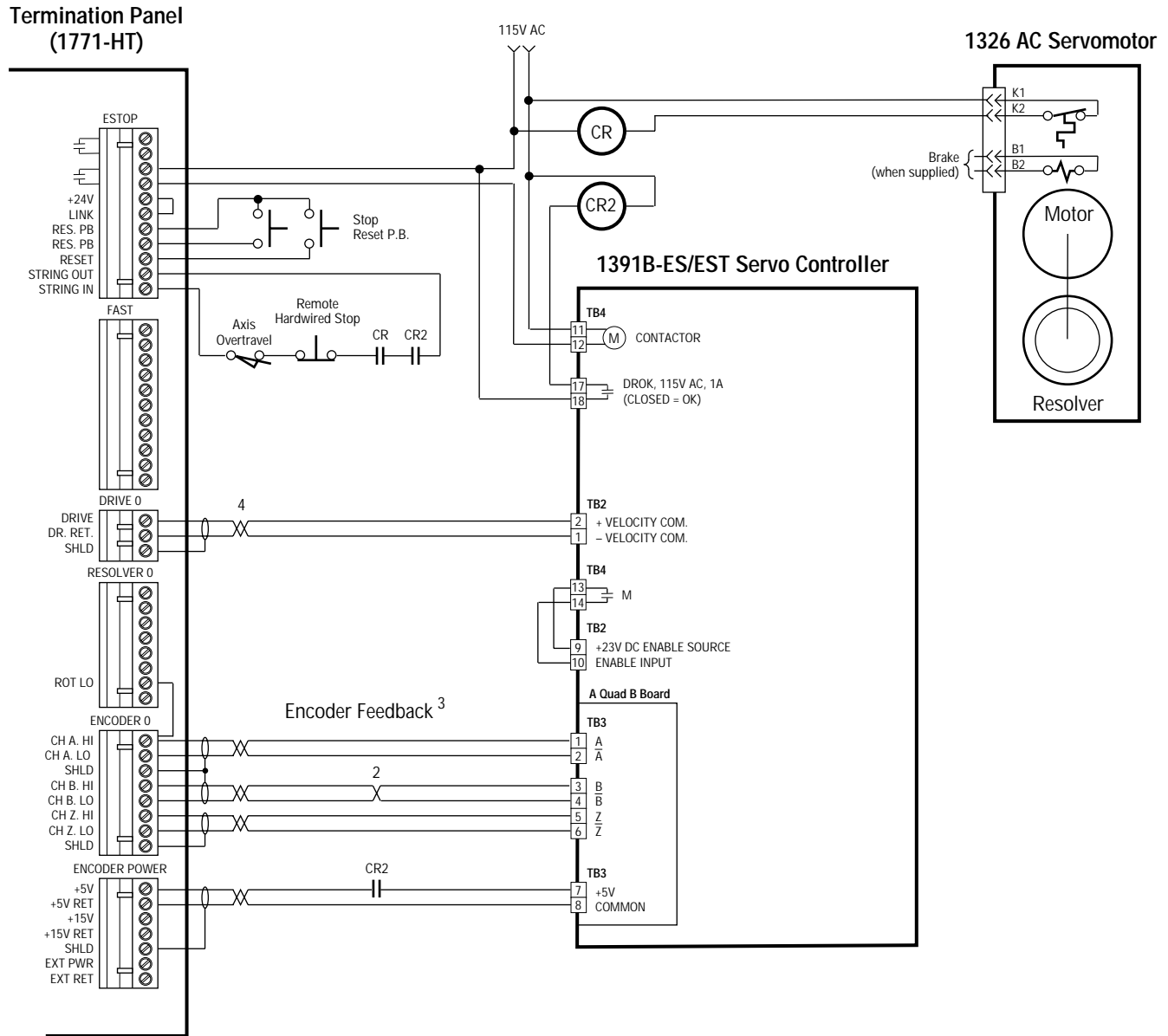   <u>must not</u> be grounded. Grounding this will cause damage to the controller.

Figure B.1
1391B-ES/1391-EST Interconnect Diagram

Figure B.2
Typical IMC 110 Interconnect Diagram
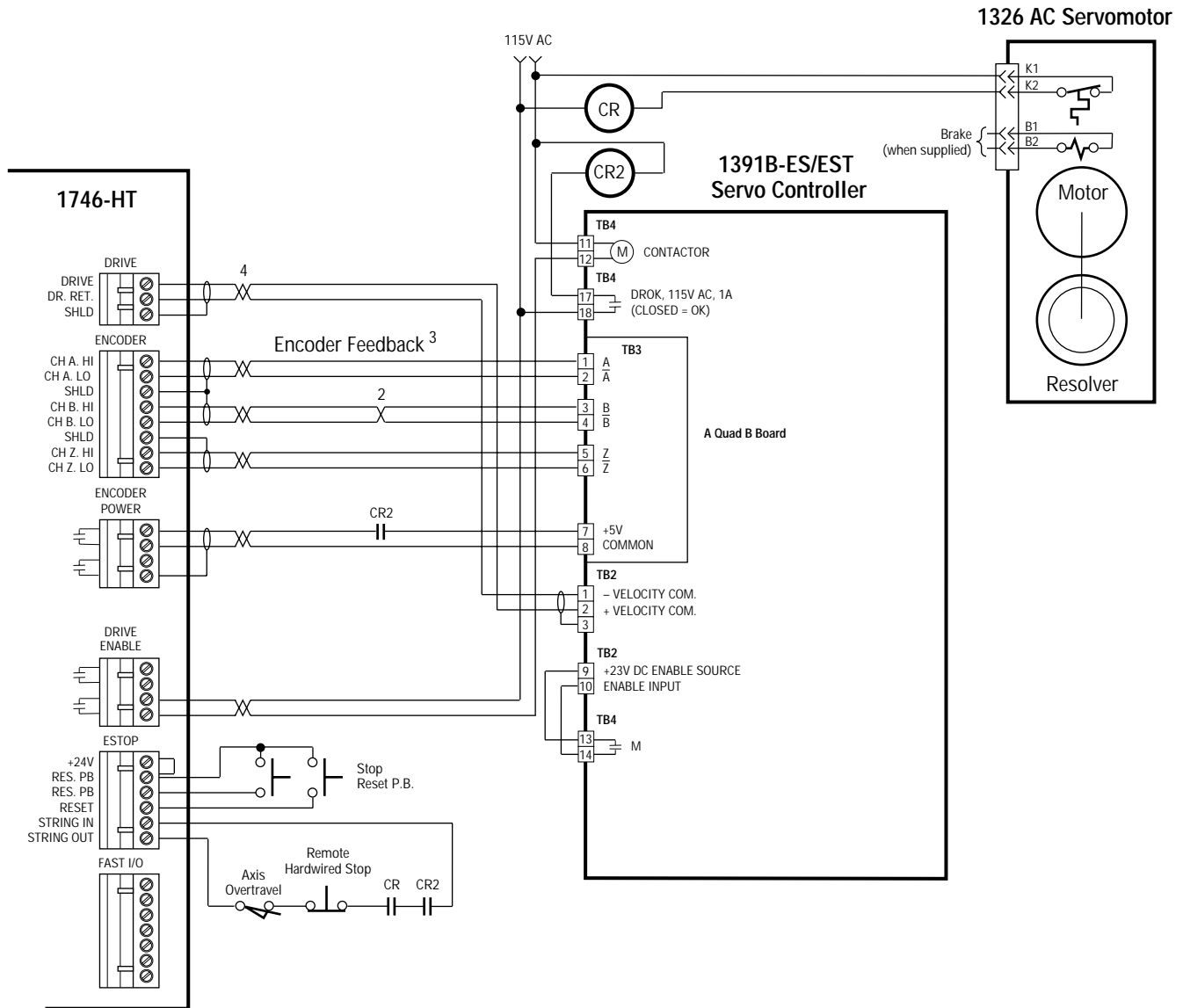
[1] Refer to the 1391B-ES Interconnect Drawing for further details.

[2] B and B (NOT) are interchanged.

[3] Use Belden brand #9504 or equivalent twisted pair, shielded cable, 40 feet (12.2 meters) maximum. Shields grounded at controller only.

[4] Use Belden brand #8760 or equivalent shielded cable.
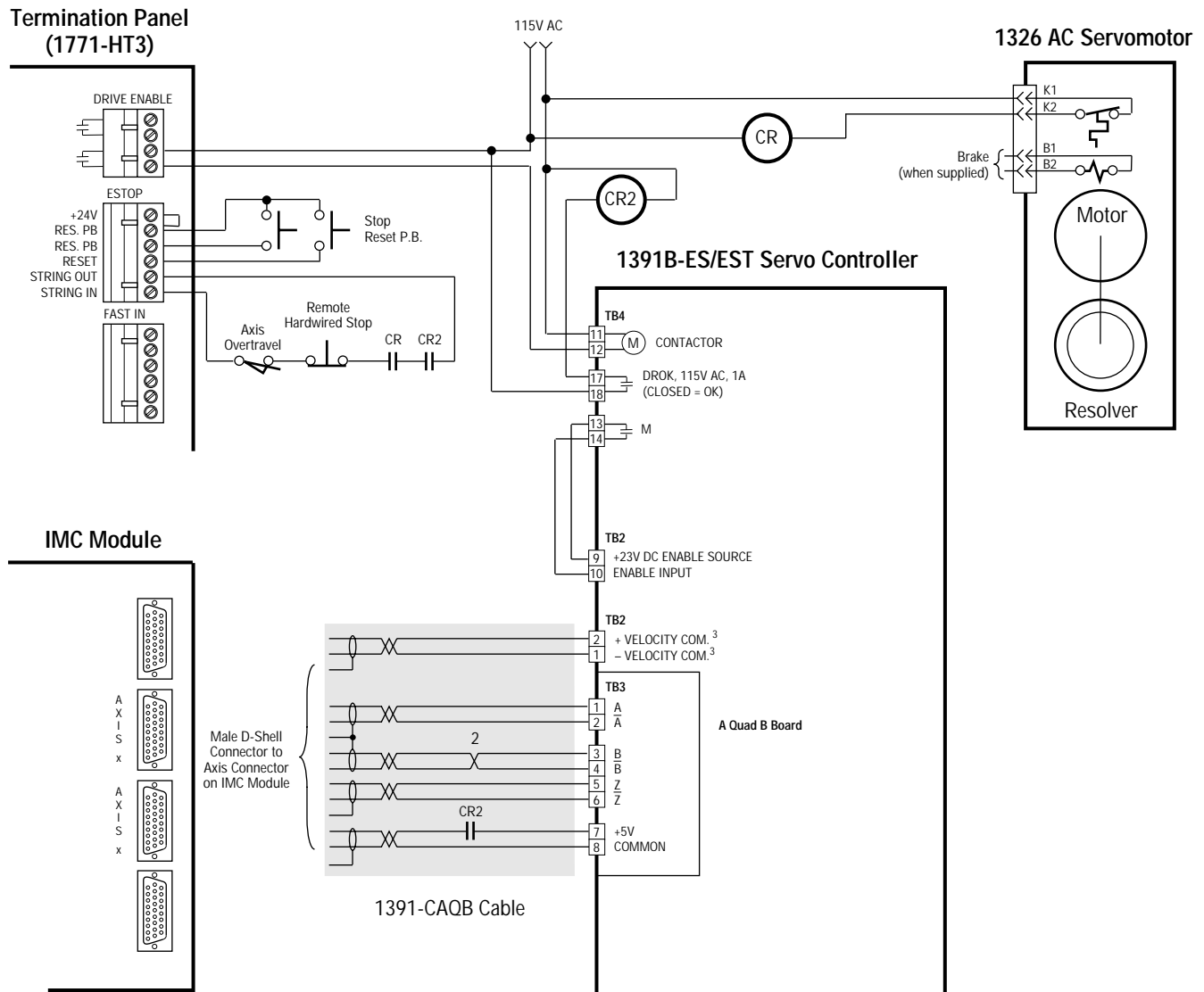
Figure B.3
Typical IMC 120 Interconnect Diagram [1]

Termination Panel
(1771-HT)

115V AC

1326 AC Servomotor

ESTOP

+24V
LINK
RES. PB
RES. PB
RESET
STRING OUT
STRING IN

CR

CR2

K1
K2
B1
B2

Brake
(when supplied)

Motor

Resolver

Stop
Reset P.B.

FAST

Axis
Overtravel

Remote
Hardwired Stop

CR   CR2

1391B-ES/EST Servo Controller

TB4
11
12   M   CONTACTOR

17
18   DROK, 115V AC, 1A
(CLOSED = OK)

DRIVE 0

DRIVE
DR. RET.
SHLD

4

TB2
2   + VELOCITY COM.
1   – VELOCITY COM.

RESOLVER 0

ROT LO

TB4
13
14   M

TB2
9   +23V DC ENABLE SOURCE
10   ENABLE INPUT

A Quad B Board

Encoder Feedback [3]

ENCODER 0

CH A. HI
CH A. LO
SHLD
CH B. HI
CH B. LO
CH Z. HI
CH Z. LO
SHLD

2

TB3
1   A
2    $\overline{A}$
3   B
4    $\overline{B}$
5   Z
6    $\overline{Z}$

ENCODER POWER

+5V
+5V RET
+15V
+15V RET
SHLD
EXT PWR
EXT RET

CR2

TB3
7   +5V
8   COMMON

---

[1] Refer to the 1391B-ES Interconnect Drawing for further details.

[2] B and B (NOT) are interchanged.

[3] Use Belden brand #9504 or equivalent twisted pair, shielded cable, 40 feet (12.2 meters) maximum. Shields grounded at controller only.

[4] Use Belden brand #8760 or equivalent shielded cable.

Figure B.4
Typical IMC 121, 123 and 123CR Interconnect Diagram [1]

Termination Panel (1771-HT3)

DRIVE ENABLE

ESTOP
+24V
RES. PB
RES. PB
RESET
STRING OUT
STRING IN
FAST IN

Stop
Reset P.B.

Axis
Overtravel

Remote
Hardwired Stop

CR   CR2

115V AC

CR

CR2

1391B-ES/EST Servo Controller

TB4
11
12   M   CONTACTOR

17   DROK, 115V AC, 1A
18   (CLOSED = OK)

13   M
14

TB2
9   +23V DC ENABLE SOURCE
10   ENABLE INPUT

TB2
2   + VELOCITY COM. [3]
1   − VELOCITY COM. [3]

TB3
1   A
2   Ā
3   B
4   B̄
5   Z
6   Z̄
7   +5V
8   COMMON

A Quad B Board

1326 AC Servomotor

K1
K2

B1
B2

Brake
(when supplied)

Motor

Resolver

IMC Module

AXIS x

AXIS x

Male D-Shell
Connector to
Axis Connector
on IMC Module

2

CR2

1391-CAQB Cable

---

[1] Refer to the 1391B-ES Interconnect Drawing for further details.

[2] B and B (NOT) are interchanged.

[3] If the drive is to be operated as a torque block from an IMC 121 or 123, command wires should be connected to TB2-15, 16 & 17.

Figure B.5
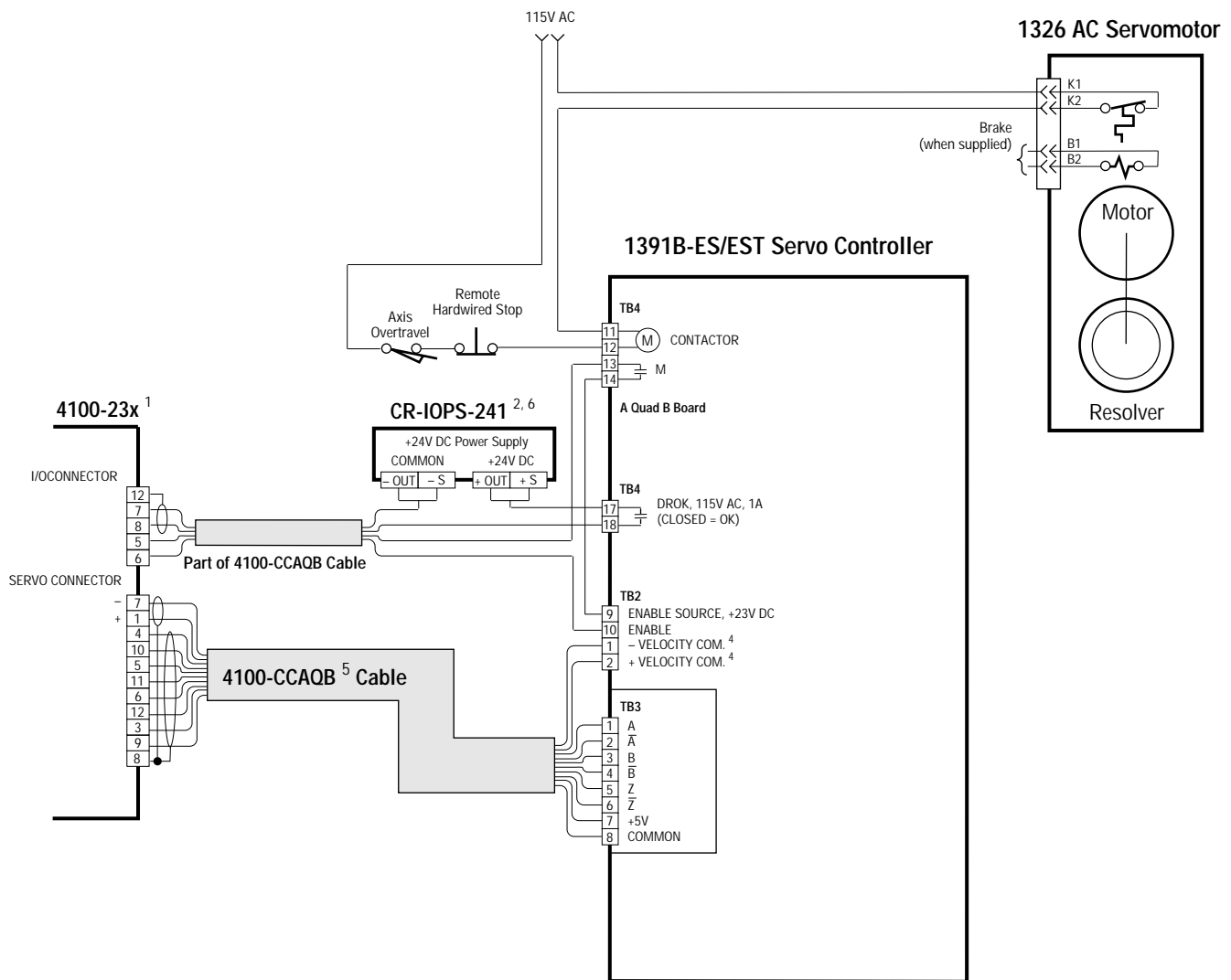Typical MAX/CONTROL Interconnect Diagram

---
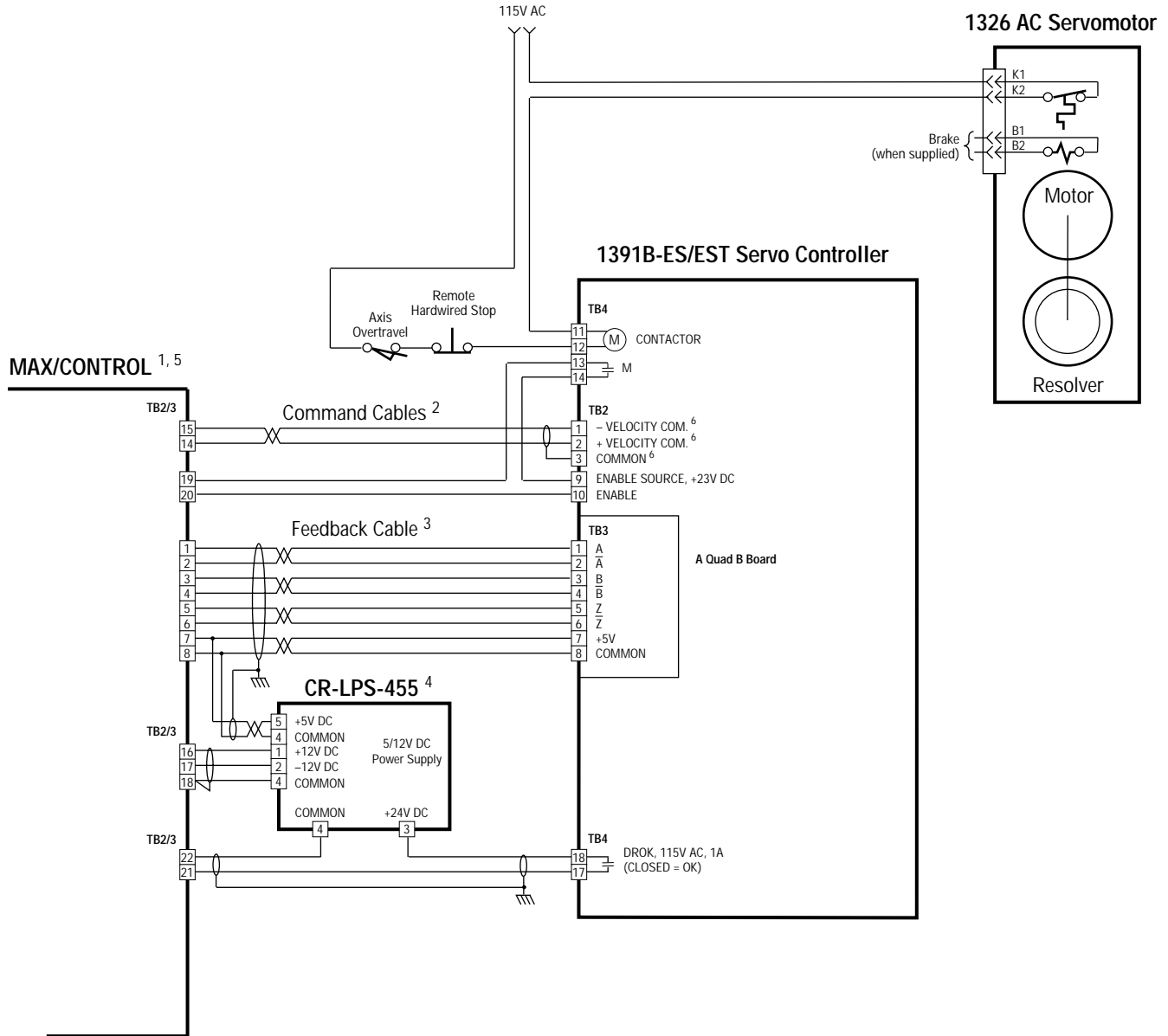
[1]   Refer to the MAX/CONTROL Installation and Setup Manual (999-051) and the 1391B-ES Interconnect Drawing for further details.

[2]   Use Belden brand #8760 or equivalent shielded cable.

[3]   Use Belden brand #9504 or equivalent twisted pair, shielded cable, 40 feet (12.2 meters) maximum. Shields grounded at controller only.

[4]   Use Belden brand #9533 or equivalent shielded cable.

[5]   X-axis connections are shown – Y-axis connections (TB3) are identical.

[6]   If the drive is to be operated as a torque block, command wires should be connected to 1391B-ES TB2-15, 16 & 17.

Figure B.6
Typical IMC-S/20x Interconnect Diagram
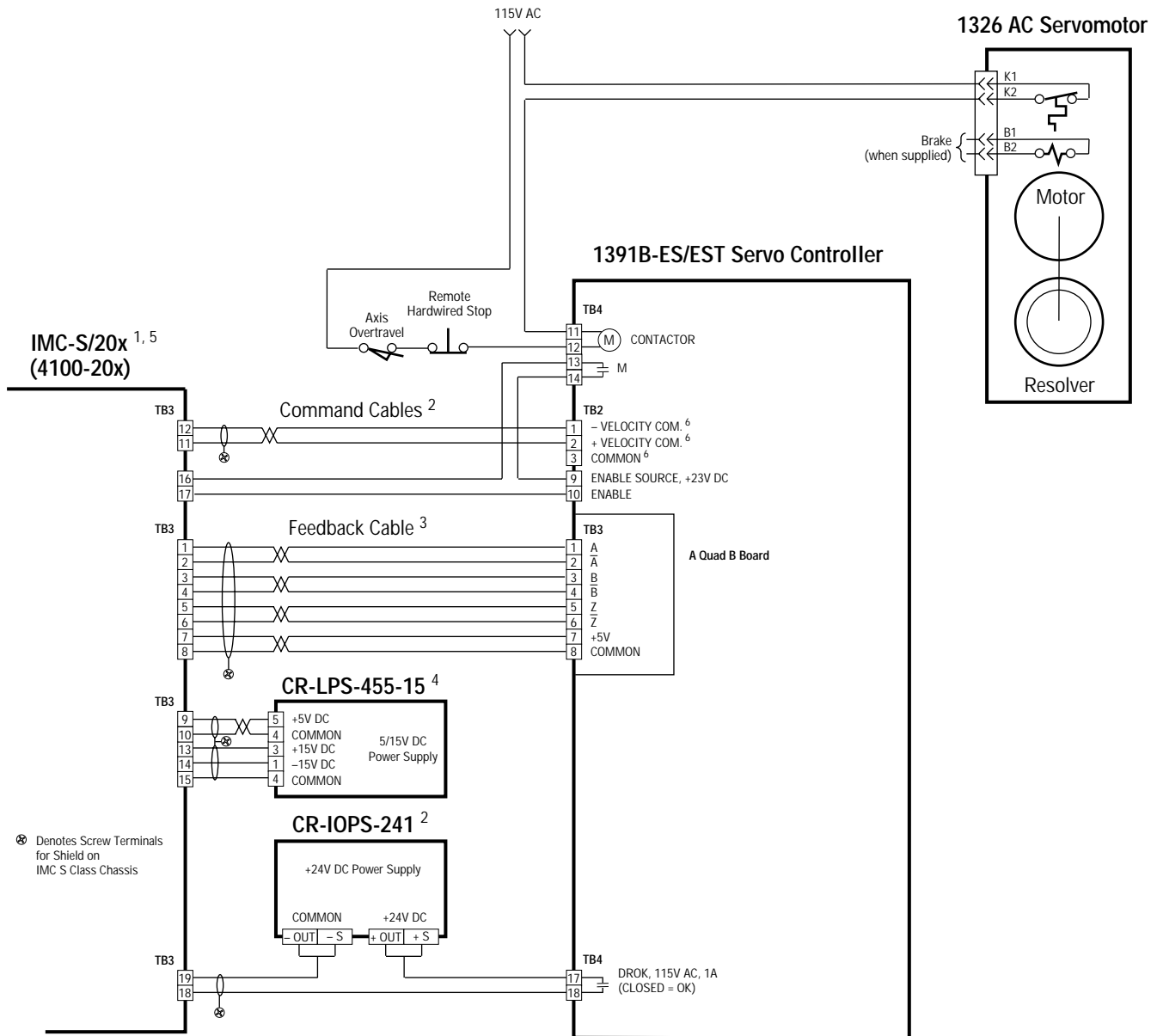
[1] Refer to the IMC-S/20x Installation and Setup Manual (999-105) and the 1391B-ES Interconnect Drawing for further details.

[2] Use Belden brand #8760 or equivalent shielded cable.

[3] Use Belden brand #9504 or equivalent twisted pair, shielded cable, 40 feet (12.2 meters) maximum. Shields grounded at controller only.

[4] Use Belden brand #9533 or equivalent shielded cable.

[5] Axis 0 (TB3) connections are shown – Axis 1, 2, 3 connections are identical (use TB5 for Axis 1, TB4 for Axis 2, and TB6 for Axis 3).

[6] If the drive is to be operated as a torque block, command wires should be connected to 1391B-ES TB2-15, 16 & 17.

Figure B.7
Typical IMC-S/21x Interconnect Diagram
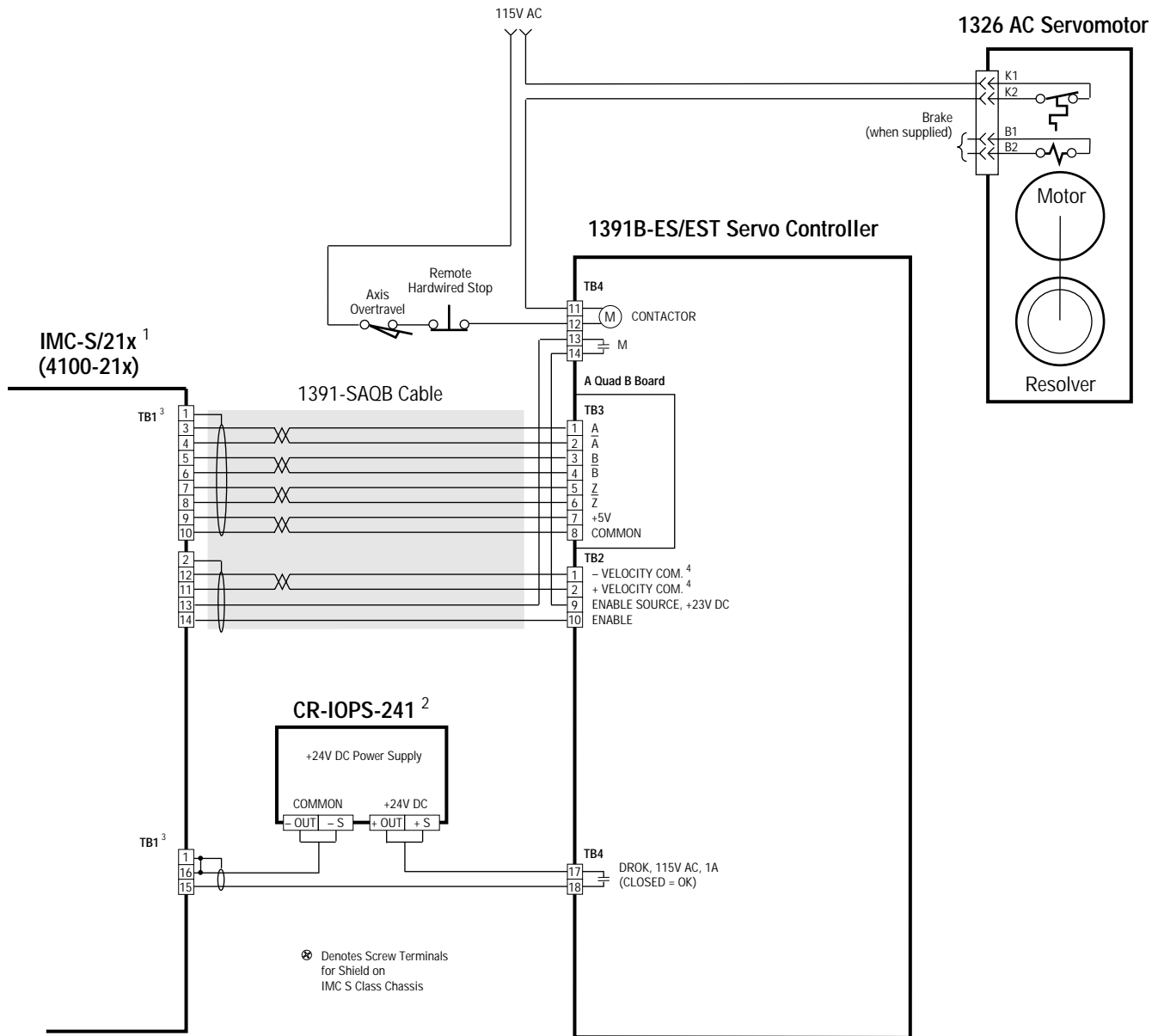
[1] Refer to the IMC-S/21x Installation and Setup Manual (999-103) and the 1391B-ES Interconnect Drawing for further details.

[2] Use Belden brand #8760 or equivalent shielded cable.

[3] Axis 0 connections (TB1) are shown – Axis 1, 2, 3 connections are identical (use TB3 for Axis 1, TB4 for Axis 2 and TB5 for Axis 3).

[4] If the drive is to be operated as a torque block, command wires should be connected to 1391B-ES TB2-15, 16 & 17.

Figure B.8
Typical IMC-S/23x Interconnect Diagram

[1] Refer to the IMC-S/23x Installation and Setup Manual and the 1391B-ES Interconnect Drawing for further details.

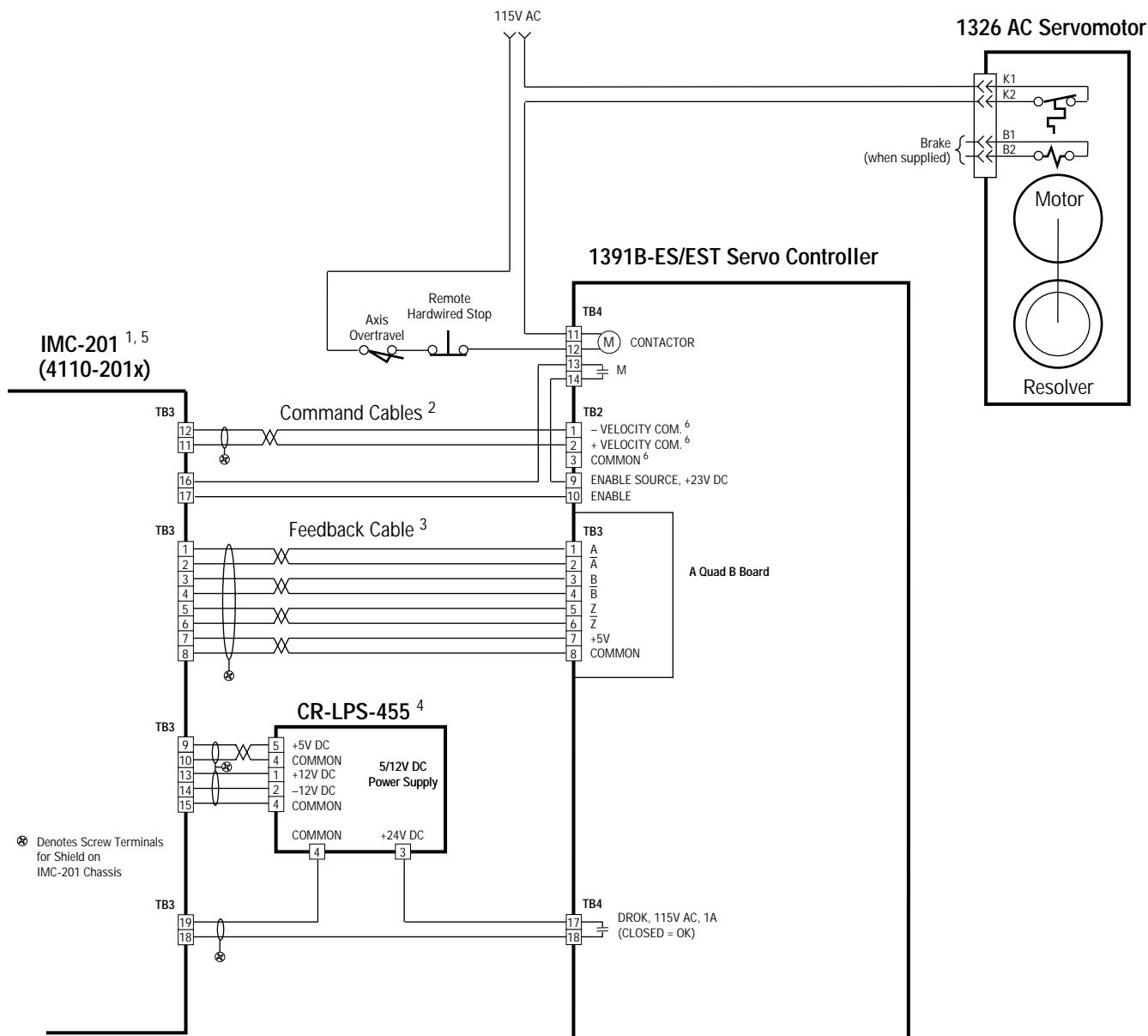[2] Use Belden brand #8760 or equivalent shielded cable.

[3] Axis 0 connections are shown – Axis 1, 2, 3 connections are identical.

[4] If the drive is to be operated as a torque block, command wires should be connected to 1391B-ES TB2-15, 16 & 17.

[5] 4100-CCAQB cable assembly is a combination of the 4100-CCSxxF (servo and AQB) and 4100-CCAxxF (enable, I/O, fault). 4100-CCAQB can only be used on 1391C-HB, 1391B-ES and 1391-DES controllers.

[6] Separate from the 24V DC I/O power supply.

Figure B.9
Typical IMC-201 Interconnect Diagram

[1] Refer to the IMC-201 Installation and Setup Manual (999-108) and the 1391B-ES Interconnect Drawing for further details.

[2] Use Belden brand #8760 or equivalent shielded cable.

[3] Use Belden brand #9504 or equivalent twisted pair, shielded cable, 40 feet (12.2 meters) maximum. Shields grounded at controller only.

[4] Use Belden brand #9533 or equivalent shielded cable.

[5] X Axis (TB3) connections are shown – secondary feedback (TB5) connections are identical to the TB3 connections.

[6] If the drive is to be operated as a torque block, command wires should be connected to 1391B-ES TB2-15, 16 & 17.

Figure B.10
9/ Series Interconnect Diagram

For detailed 9/Series interconnect information, please refer to the
following publications:

Controller	Publication
9/240	9/240 Integration Manual, publication 8520-4.1
9/230, 9/260, 290	9/230, 9/260 or 9/290 Integration Manual, publication 8520-6.2

Page C-2   Outer shield has been added to the following cable information.

1326-CEUxx Encoder Feedback Cable

Pair	Wire Color	Gauge (AWG)	Connector Pin
1	Black	22	H
	White	22	A
2	Black	22	F
	Red	22	D
3	Black	22	J
	Orange	22	C
4	Black	22	I
	Blue	22	B
5	Black	22	F
	Green	22	E
Outer Shield (Drain)			G

Page C-3   The table heading for the 1391-CAQB Cable has been clarified.

Cable, D-Shell			Connection on 1391B-ES Controller	
Terminal Number	Wire Color	Signal	Terminal	Location

Page D-1

Connection of a variable DC supply was described incorrectly. In addition, the last paragraph has been clarified. Please refer to the corrected information below

It is possible to connect a variable 8.0V DC voltage supply to TB2-18 (+) and 20 (–). Varying the voltage at TB2-18 will modify the current limit of the controller as set by selector switch S1 (this rating will not exceed 200% of the controller current rating).

Available current is proportional to the applied voltage as shown in the table below.

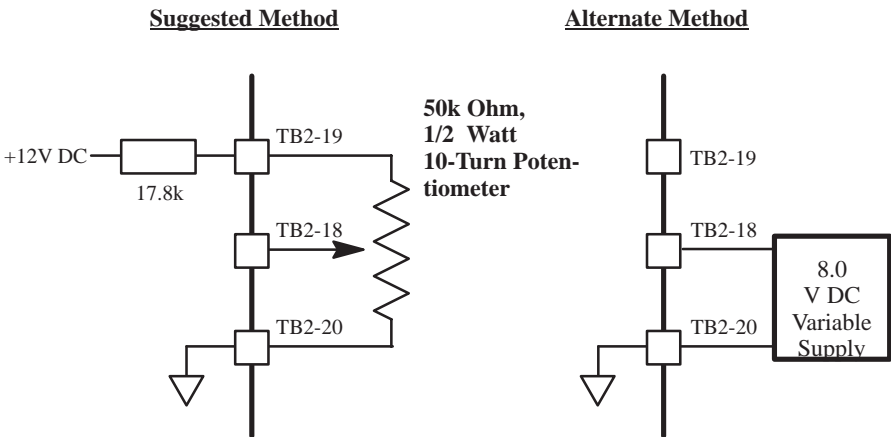| Voltage at TB2-18, 20	Peak Current [3] Percentage
0V DC or Open Circuit	300% [1]
3.0V DC	200%
5.6V DC	100%
8.0V DC [2]	0%

[1] 300% torque of the S1 setting or 200% of drive rating, whichever is less.

[2] Short between TB2-18 and 19 will also give zero current.

[3] Approximate, check TP21 for an exact amount.

The Zero Current option approximates, but may not exactly produce zero current and torque due to tolerances inherent in the drive and components. Offset torque may approach 10% of motor rated torque.

Figure D.1
Option Connection

Notes