

# **BRU-200 and BRU-500**

**Brushless Drives  
Instruction Manual**

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**Electro-Craft<sup>®</sup>** *Servo Products*

# **Electro-Craft**

## **BRU-200 and BRU-500 Brushless Drives Instruction Manual**

**P/N 0013-1028-001 Revision B**

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ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL AND OTHER APPLICABLE MANUALS IN THEIR ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

## **WARNING**

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE THE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY.

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## SECTION I - INTRODUCTION

### 1.1 Purpose

This manual describes the Electro-Craft BRU-Series brushless servo drives and spindle drives along with standard Electro-Craft motors recommended for use with the BRU-Series drives. The manual is intended for use by qualified engineers or technicians directly involved in the installation, operation, and field level maintenance of the drives and motors.

### 1.2 Product Description

The BRU-500 is a high performance sinusoidal brushless industrial drive employing a modular package suited to single or multi-axis applications. The drive modules can power S-Series and F-Series permanent magnet synchronous motors as servo drives or I-Series squirrel cage induction motors as spindle drives. All drives share a common power supply to achieve the most economical system package. Figure 1-1 shows the standard BRU-500 components.

The BRU-200 is a high performance sinusoidal brushless industrial drive employing a modular package suited to single or multi-axis applications. The drive modules power S-Series and F-Series permanent magnet synchronous motors. Figure 1-2 shows the standard BRU-200 components.

For single axis positioning applications, the Electro-Craft PRO-Series controller cards are available as PRO-Series Controller Kits to be integrated into the BRU-Series drive module. This eliminates the need for a separate controller package.

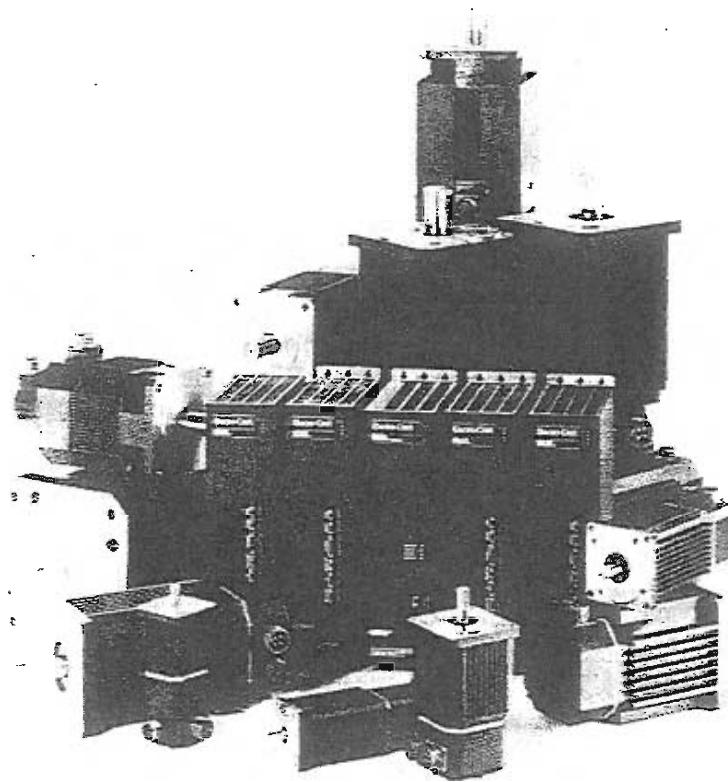
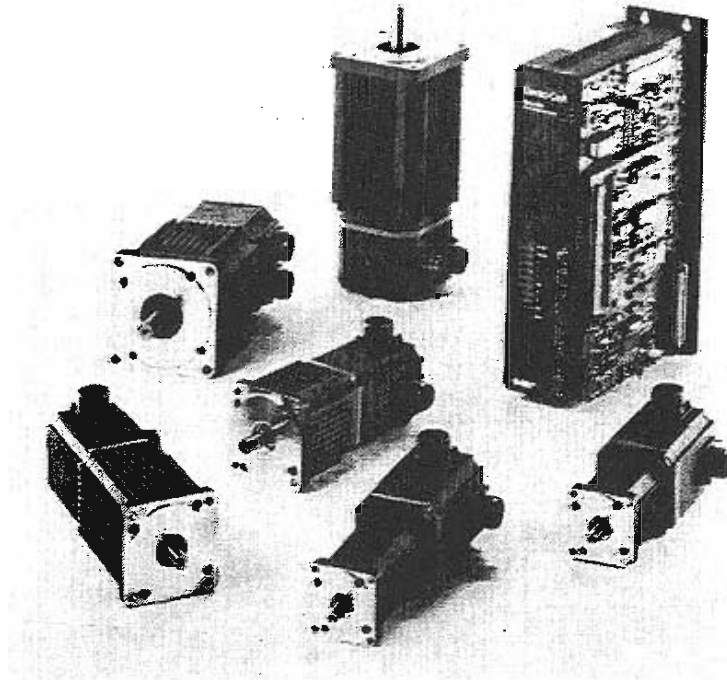


Figure 1-1 BRU-500 Series Servo and Spindle Drives



**Figure 1-2 BRU-200 Series Servo Drives**

A brief description of the BRU-Series major components follows.

#### 1.2.1 Power Supply Modules (BRU-500 Only)

The power supply module (PSM) can supply DC power to as many as six servo or spindle drive modules. The AC voltage input to the PSM is non-isolated or isolated three phase power. The output, which is daisy-chained to the drive modules, is a two wire DC bus. The PSM requires no adjustments, protects itself, provides trouble-shooting diagnostics, and has a built-in solid-state "soft charge" of the DC bus capacitors to reduce AC inrush currents. It also includes a built-in dissipative shunt regulator that provides quick discharge of the DC bus capacitors and doubles as an emergency synchronous motor dynamic brake.

#### 1.2.2 Drive Modules

The drive modules (DM) provide control and power for either S-Series and F-Series permanent magnet synchronous motors or I-Series squirrel cage induction motors (BRU-500 only). The DMs are available in a range of current ratings to best complement the variety of available motors. The DM control circuitry utilizes a 16 bit microprocessor to provide high performance and a simple serial interface from a host computer or user programming terminal to the servo drive.

All set-up and tuning is performed by a personality module (PM) which plugs into the DM. The PM customizes the DM for each specific motor and encoder type. The standard decimal line count encoders are factory-installed on the motors.



A standard RS-232/RS-422 serial interface is used to modify tuning, change limit values, or monitor variables/status in the BRU-Series drive modules. Any changes made through the serial interface can then be stored in the PM. A VT-52 compatible serial terminal is required for the easy-to-use menus. Refer to Section 5.2.3.1 for user terminal requirements. Alternatively, a multi-drop host mode communication protocol is also available for direct connection to computer hosts. Refer to Section 5.2.3.3.

### 1.2.3 Motors and Encoders

A wide range of Electro-Craft S-Series and F-Series permanent magnet synchronous motors and I-Series induction motors are available for use with BRU-Series drives. Each motor includes an internally mounted encoder. The BRU-Series also provides the encoder signals for the position controller to use for the most economical system. Most motors are available with optional spring-set brake, optional shaft oil seals, and/or optional fanpack. The synchronous motors have a rear shaft available for mounting optional feedback devices.

### 1.2.4 Transformers

Multi-tap three phase isolation transformers are available in a variety of power ratings for line voltage matching for the BRU-500. A multi-tap single phase isolation transformer is available for line voltage matching for the BRU-200.

### 1.2.5 Auxiliary Power Supply

An auxiliary power supply module (PSM-AUX) is available to supply DC power to the logic supplies of up to four DMs if the PSM is turned off. The PSM-AUX uses single phase 115 VAC power as the input.

The PSM-AUX option is used if DM logic power must stay on even when the motor supply (the PSM) is turned off. Absolute positioning with PRO-Series controller kits is one example where the PSM-AUX would be used. Another example would be maintaining DM logic power so that the DM serial interface could be used for trouble-shooting and diagnostics. See drawing 9101-0134 in Section X for additional information on use of the PSM-AUX and the optional PSM-AUX isolation transformer.

The auxiliary power supply is built into the BRU-200 drive modules as standard equipment. See drawing 9101-1329 in Section X for additional information.

**SECTION II - SPECIFICATIONS**

**2.1 Drive Module Specifications**

<u>BRU-500 Model</u>	<u>DM-25</u>	<u>DM-50</u>	<u>DM-100</u>	<u>DM-150</u>	<u>DM-150X</u>
Continuous Amps[1]	20	40	50	65	85
Peak Amps[1]	25	50	100	150	150
Bus Voltage	125-375 VDC (325 VDC with 230 VAC input)				
Command Signal Input Range	± 10 VDC (13.3k Ohms impedance)				
Ambient Temp.	32°-122°F (0°-50°C)				
Weight	24.2 lbs (11.0 kg)				

<u>BRU-200 Model</u>	<u>DM-10</u>	<u>DM-20</u>	<u>DM-30</u>
Continuous Amps [1]	5	10	15
Peak Amps [1]	10	20	30
Input Volts	100-240 VAC RMS (Single Phase)		
Internal DC Bus Voltage	141-340 VDC (325 VDC with 230 VAC Input)		
Command Signal Input Range	± 10 VDC (13.3k Ohms impedance)		
Continuous Shunt Power [2]	50 W		
Peak Shunt Power [2]	4.5 kW		
Ambient Temp.	32°-122°F (0°-50°C)		
Weight	15 lbs (6.8 kg)		

[1] peak value of sine wave per phase

[2] DM-30 has provision for optional external shunt resistor that provides 200 W continuous and 6000 W peak shunt power. See drawing 9101-1328 in Section X for additional details.

**2.2 Power Supply Module Specifications (BRU-500 Only)**

<u>BRU-500 Model</u>	<u>PSM-50</u>	<u>PSM-125</u>
Input Volts	88-265 VAC RMS (Three Phase)	
Output Volts	125-375 VDC (325 VDC with 230 VAC Input)	
Continuous Amps (DC)	50	100
Peak Amps (DC)	150	450
Continuous Shunt Power	600 W	1200 W
Peak Shunt Power	20 kW	40 kW
Ambient Temp.	32° -122° F (0° -50° C)	
Weight	26.2 lbs (11.9 kg)	

2.3 S-Series Motor Specifications (TENV) [5]

Model	S-2003	S-2005	S-3007	S-3016	S-4030	S-4050	S-4075	S-6100	S-6200	S-6300	S-8350	S-8500
Stall Torque (lb-in)	2.7	5.0	7.0	20	30	60	90	100	200	325	350	450
(Nm)	0.30	0.56	0.79	2.26	3.39	6.78	10.2	11.3	22.6	36.7	39.5	50.8
Speed (rpm)	6000	6000	5000	5000	4000	4000	3000	3000	3000	3000	2000	2000
Kt (lb-in/A)	1.17	1.17	2.5	2.5	4.4	4.4	6.7	6.0	5.8	6.2	7.6	8.2
(Nm/A)	0.13	0.13	0.28	0.28	0.50	0.50	0.76	0.68	0.66	0.70	0.86	0.92
Ke (V/krpm)	16	16	34	34	60	60	90	82	80	85	104	112
R (ohms)	7.3	2.6	6.6	1.3	2.0	0.8	0.9	0.49	0.18	0.12	0.13	0.10
L (mH)	9.7	4.1	12.0	3.4	9.0	3.3	5.4	4.4	2.2	1.2	2.5	2.4
J (lb-in-s <sup>2</sup> )	0.00007	0.00013	0.00027	0.00072	0.0022	0.0041	0.006	0.012	0.021	0.030	0.056	0.083
(kg-m <sup>2</sup> )	0.00008	0.00015	0.00033	0.00098	0.0025	0.0046	0.0068	0.013	0.024	0.034	0.063	0.094
BRU-500	—	—	DM-25	DM-25	DM-25	DM-50	DM-50	DM-50	DM-100	DM-150	DM-100	DM-150
BRU-200	DM-10	DM-10	DM-10	DM-20	DM-20	DM-30	DM-30	—	—	—	—	—

- [1] maximum continuous operating speed
- [2] peak amps of per phase sine wave
- [3] peak volts of line to line sine wave
- [4] phase to phase
- [5] totally enclosed nonventilated

2.4 F-Series Motor Specifications (TENV) [5]

Model	F-4030	F-4050	F-4075	F-6100	F-6200	F-6300
Stall Torque (Lb-in)	31	61	82	115	175	245
(Nm)	3.5	6.9	9.3	13.0	19.8	27.8
Speed (rpm) <sup>(1)</sup>	4000	4000	3000	3000	3000	3000
K <sub>t</sub> <sup>(2)</sup> (Lb-in/A)	4.8	4.8	6.5	6.3	6.2	6.5
(Nm/A)	0.54	0.54	0.73	0.71	0.70	0.73
K <sub>e</sub> <sup>(3)</sup> (V/krpm)	66	66	89	86	85	89
R <sup>(4)</sup> (ohms)	2.24	0.89	0.98	0.51	0.26	0.16
L <sup>(4)</sup> (mH)	6.8	3.3	3.4	3.3	1.7	1.1
J <sup>(5)</sup> (Lb-in-s <sup>2</sup> )	0.009	0.019	0.029	0.057	0.095	0.144
(kg-m <sup>2</sup> )	0.001	0.0021	0.0032	0.0064	0.0107	0.0162
BRU-500	DM-25	DM-50	DM-50	DM-50	DM-100	DM-100
BRU-200	DM-20	DM-30	DM-30	—	—	—

- [1] maximum continuous operating speed
- [2] peak amps of per phase sine wave
- [3] peak volts of line to line sine wave
- [4] phase to phase
- [5] totally enclosed nonventilated

2.5 I-Series Motor Specifications (BRU-500 Only)

Model	Cont. Power kW/HP	30 Min. Rating kW/HP	Base Speed RPM	Max. Speed RPM	Rotor Inertia Kg-m <sup>2</sup> /Lb-in-s <sup>2</sup>	Weight kg/Lbs	Drive Module
I-5300 TEAO <sub>(1)</sub>	5.5/7.4	7.5/10.0	1500	6000	0.031/ 0.269	70/154	DM-100
I-6600 TEAO <sub>(1)</sub>	11/14.7	15/20	1500	6000	0.073/ 0.643	108/238	DM-150X

- [1] totally enclosed air over (TEAO)



## 2.6 Encoder Specifications

<u>Motor Type</u>	<u>I-Series</u>	<u>S-Series</u>	<u>F-Series</u>
Line Count	1000 [1]	2000 [1]	2000 [1]
Supply	5 VDC	5 VDC (190mA DC max)	5 VDC (245mA DC max)
Line Driver		26LS31	26LS31

[1] standard line count

### CAUTION

THE ENCODERS MOUNTED INSIDE THE S-SERIES AND F-SERIES SYNCHRONOUS MOTORS ARE FACTORY ALIGNED AND MUST NOT BE MOVED OR IMPROPER OPERATION MAY RESULT. HOWEVER, THE ENCODERS MOUNTED ON THE I-SERIES INDUCTION MOTORS MAY BE MECHANICALLY REALIGNED TO ANY ARBITRARY POSITION IF DESIRED.

## 2.7 Transformer Specifications

### BRU-500

Rating(kVA)	3.0	6.0	12.0	18.0
Input	208/230/240/380/460/480 VAC RMS (Three Phase)			
Output	115/230 VAC RMS (Three Phase)			
Ambient Temp.	32° -122° F (0° -50° C)			
Weight	86 lbs (39 kg)	135 lbs (61 kg)	200 lbs (91 kg)	325 lbs (148 kg)

Refer to drawing 9101-0131 and drawing 9101-0132 in Section X for transformer outline drawings and load regulation data.

### BRU-200

Rating(kVA)	3.0
Input	220/230/240/440/460/480 VAC RMS (Single Phase)
Output	115/230 VAC RMS (Single Phase)
Ambient Temp.	32° -122° F (0° -50° C)
Weight	62 lbs (28 kg)

Refer to drawing 9101-1056 and drawing 9101-1057 in Section X for transformer outline drawing and load regulation data.

## 2.8 Maximum Power Losses

<u>Model</u>	<u>Maximum Watts Loss</u>
DM-10	50 + dissipative shunt
DM-20	100 + dissipative shunt
DM-30	150 + dissipative shunt
3 kVA Transformer (1 Phase)	350
DM-25	120
DM-50	180
DM-100	275
DM-150	300
DM-150X	350
PSM-50	110 + dissipative shunt
PSM-125	240 + dissipative shunt
3 kVA transformer (3 Phase)	350
6 kVA transformer (3 Phase)	600
12 kVA transformer (3 Phase)	950
18 kVA transformer (3 Phase)	1200

The maximum power losses are shown to help in sizing a NEMA 12 (or equivalent) enclosure and any required ventilation. Typical power losses are about one-half maximum power losses.

As an additional aid in sizing an enclosure with no active method of heat dissipation, the following approximate equation is used:

$$T = 4.08*(Q/A) + 1.1$$

where T is the temperature difference between inside air and outside ambient (° F), Q is heat generated in enclosure (watts), and A is enclosure surface area (ft<sup>2</sup>). The exterior surface of all six sides of an enclosure is calculated as:

$$A = (2dw + 2dh + 2wh)/144$$

where d (depth), w (width), and h (height) are in inches.

## SECTION III - INSTALLATION

### 3.1 Mounting the Power Supply and Drive Modules

The BRU-500 power supply and drive modules and BRU-200 drive modules are designed for simple installation on a flat surface such as the back wall or plate of an enclosure. The environment in the enclosure must be clean and free of oil mist, coolant mist, conductive particles, and corrosive chemicals. For industrial applications, a NEMA 12 or equivalent enclosure is recommended. The enclosure must also be properly sized (and ventilated if required) to insure that the BRU-500 and BRU-200 maximum ambient temperature is not exceeded.

Drawings 9101-0409 and 9101-0410 illustrates a typical BRU-500 installation showing space requirements between modules for cover removal and around modules for wiring and air flow. The power supply module should be centrally located to minimize the distance between it and the drive modules. It is also recommended that the higher current rating drive modules be located closest to the power supply module.

Drawing 9101-1300 shows the BRU-200 drive module dimensions including space requirements around the drive module for wiring and air flow.

### 3.2 Power Wiring

#### 3.2.1 BRU-500 Power Wiring

#### **WARNING**

**DANGER OF ELECTRICAL SHOCK OR BURN. ONLY QUALIFIED INDIVIDUALS SHOULD WORK ON THIS EQUIPMENT. DISCONNECT ALL POWER BEFORE WORKING ON EQUIPMENT. DANGEROUS VOLTAGES MAY EXIST AFTER POWER IS REMOVED! CHECK DC BUS VOLTAGE OF BRU-500 EACH TIME POWER IS REMOVED BEFORE WORKING ON EQUIPMENT.**

Drawing 9101-0411 illustrates the only required power wiring for a typical four axis installation. The phasing of the three phase input L1, L2, and L3 to the power supply module is arbitrary, but the DC bus + and - polarities must be connected as shown. Also, the phasing of the three phase drive module outputs R, S, and T must conform to the motor R, S, and T leads for proper operation. Connect the earth ground as shown to insure a safe and proper installation.

The DC bus connection wires (substitution not permitted) are provided with each drive module. Selection of transformer, line fuses, and wire gauges is covered in drawing 9101-0411. The optional auxiliary power supply wiring is covered in drawing 9101-0134.



### 3.2.2 BRU-200 Power Wiring

#### WARNING

**DANGER OF ELECTRICAL SHOCK OR BURN. ONLY QUALIFIED INDIVIDUALS SHOULD WORK ON THIS EQUIPMENT. DISCONNECT ALL POWER BEFORE WORKING ON EQUIPMENT. DANGEROUS VOLTAGES MAY EXIST AFTER POWER IS REMOVED!**

Drawing 9101-1329 illustrates the only required power wiring for a typical installation. The phasing of the three phase drive module outputs R, S, and T must conform to the motor R, S, and T leads for proper operation. Connect the earth ground as shown to insure a safe and proper installation.

The AC-AUX auxiliary power input is used if DM logic power must stay on when the motor supply is turned off. Absolute positioning with PRO-Series controller kits is one example where this would be used. Another example would be maintaining DM logic power so that the DM serial interface could be used for trouble-shooting and diagnostics. The auxiliary AC input must be isolated or be the same phase as the main AC power to the drive module or damage can result. If multiple BRU-200 drive modules are used, and AC power is distributed from more than one phase, the AC auxiliary input for each drive must be from the same phase as the main power for that drive. You may not use a single auxiliary AC source for drives on more than one supply phase, even if the auxiliary AC source is isolated. See drawing 9101-1329 for additional information and examples showing use of the AC-AUX power input.

Selection of transformer, line fuses, and wire gauges is covered in drawing 9101-1329.

### 3.3 Motor Mounting and Wiring

Motor outline drawings for the S-Series, F-Series, and I-Series motors are shown in drawings 9101-0129, 9101-0332, and 9101-0130 respectively.

Some motor mounting considerations are as follows:

- 1.) Do not run motor unmounted. Attach all motor cables after motor is mounted.
- 2.) Mount motor with connectors pointing downward to keep liquids flowing away from connectors and use a drip-loop in cables to allow liquids to flow away from connectors.
- 3.) Consider motor case temperature if necessary to safeguard operator and maintenance staff. Maximum case temperature is about 100°C (212°F) for a motor used at continuous rating in a 40°C ambient.

Motor connections are shown in Figure 3-1, Figure 3-2, and Figure 3-3.

### 3.4 External Shunt Mounting and Wiring (BRU-200 Option Only)

The External Shunt is designed to be mounted on a flat surface. The same mounting restrictions apply to the External Shunt as to the BRU-200.

Drawing 9101-1328 shows the External Shunt Resistor dimensions and connection diagram. Note that the jumper between pins 1 and 2 of TB2 on the DM connects the internal shunt resistor when an External Shunt Resistor is not being used.

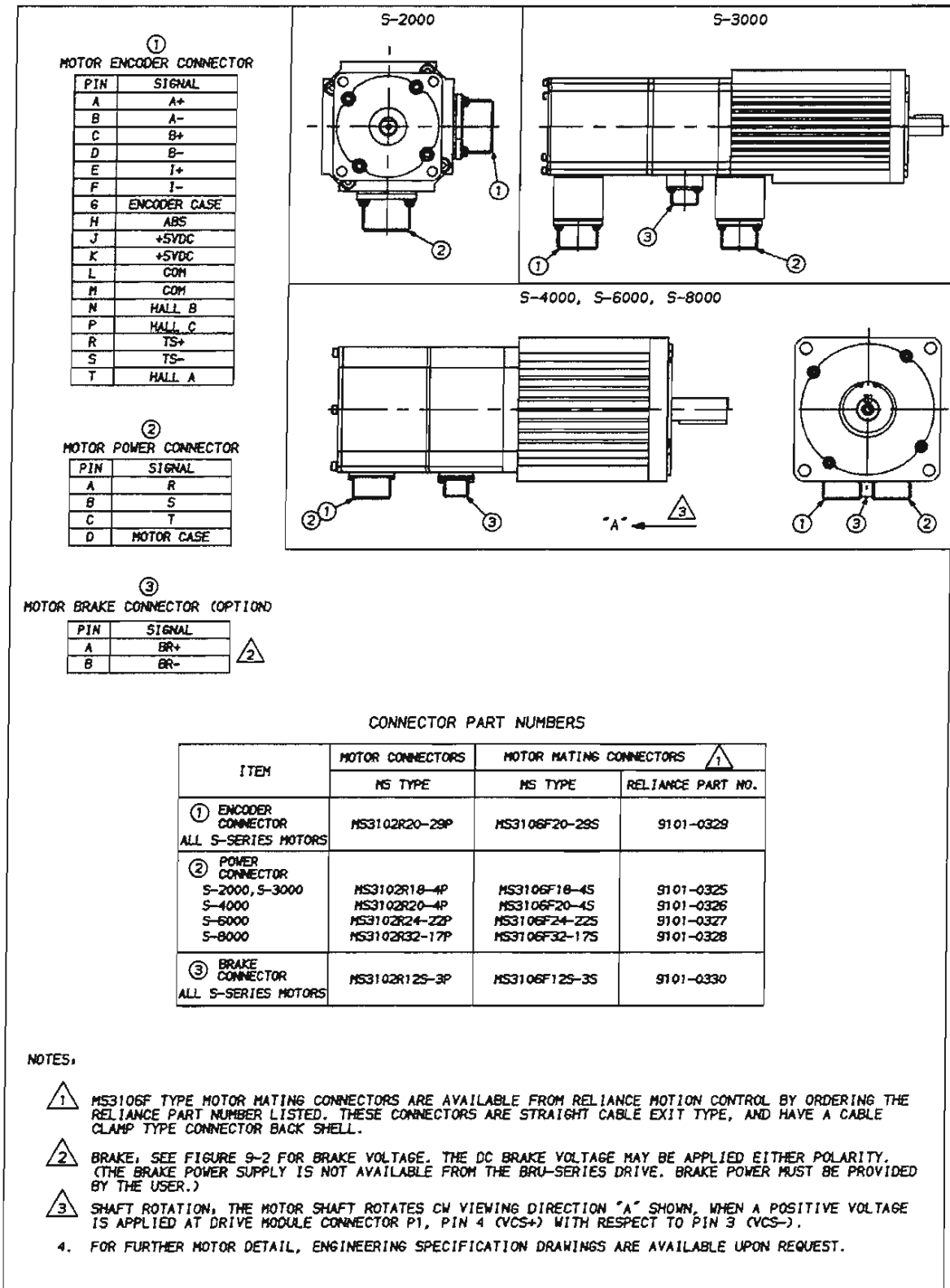


Figure 3-1 S-Series Motor Connections

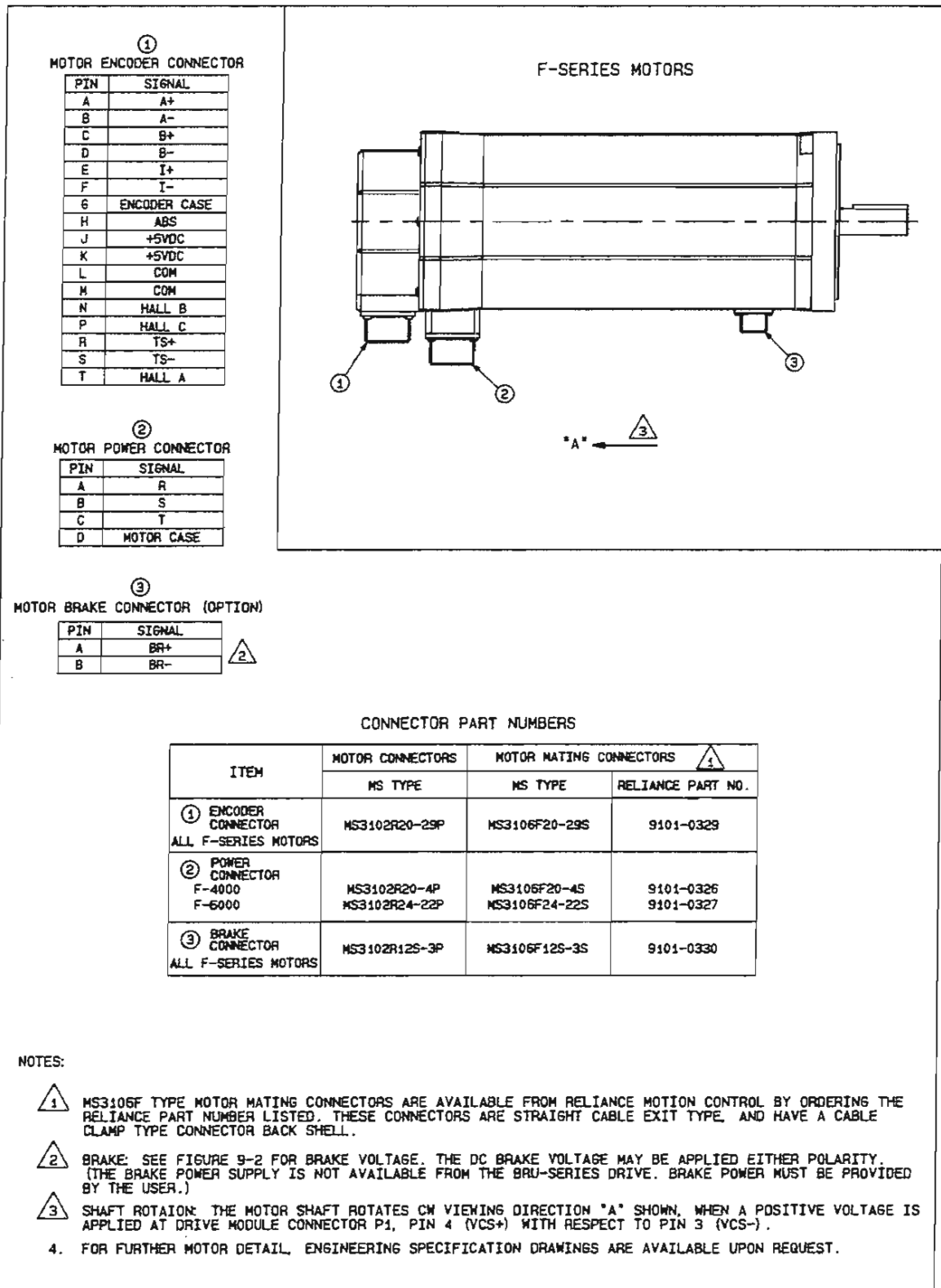


Figure 3-2 F-Series Motor Connections

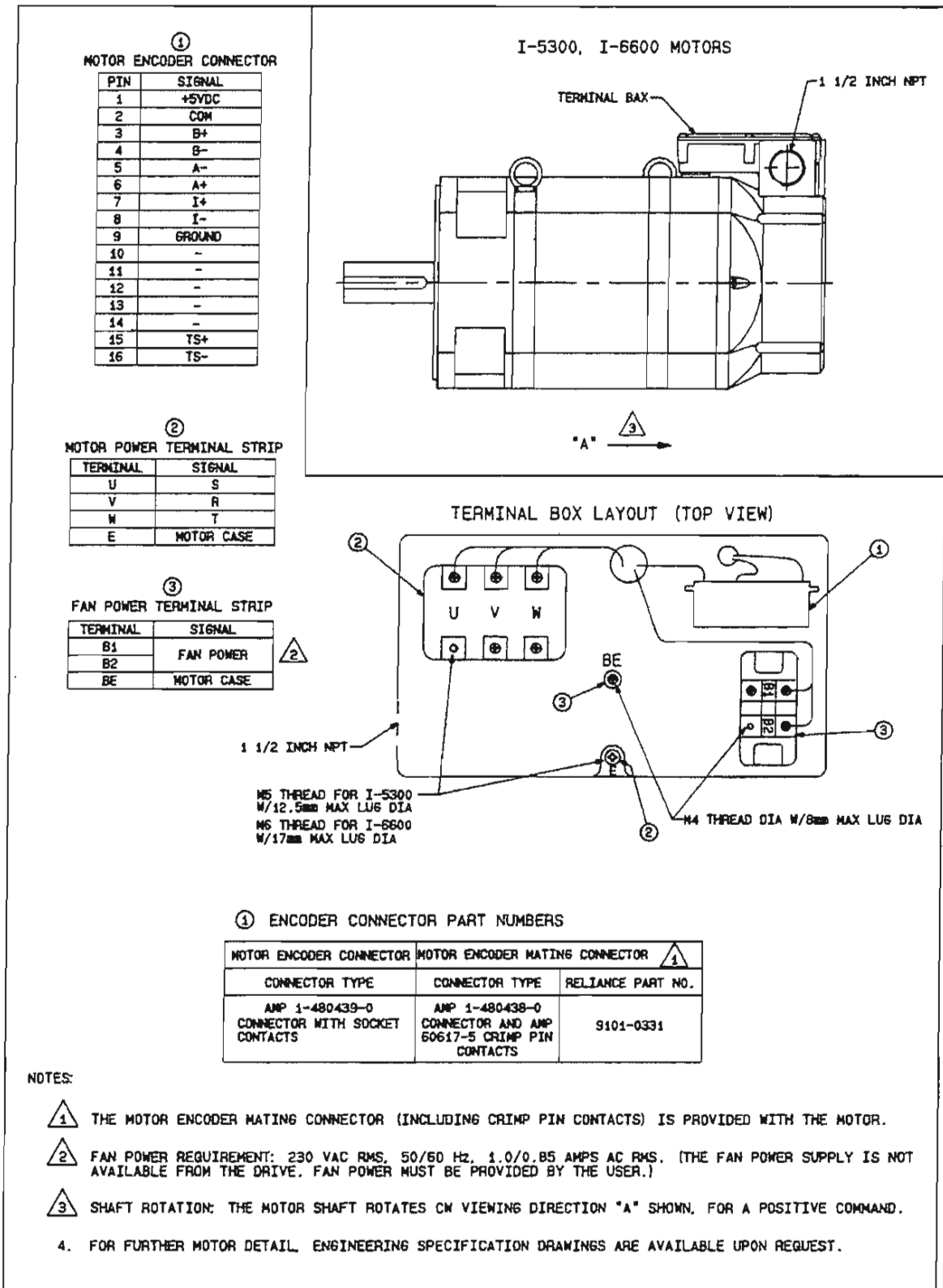


Figure 3-3 I-Series Motor Connections

## SECTION IV - INTERFACE CIRCUITRY

Pin #1 of the interface connectors is indicated on both modules by a white dot on the module covers.

### 4.1 Drive Module Interface Connectors

<u>Connector</u>	<u>Pin #</u>	<u>Signal Name</u>
P6 (Serial)	7	+5 VDC
	6	Shield
	5	RCV-
	4	RCV+ (RS-422 Only)
	3	Common
	2	XMT+ (RS-422 Only)
	1	XMT-
P5 (Monitor)	8	- 15 VDC (Not for external use)
	7	+ 15 VDC (Not for external use)
	6	Shield
	5	Common
	4	External Current Limit Input
	3	Programmable Monitor Output
	2	MVO (Motor Velocity Output)
	1	MCO (Motor Current Output)
P4 (Encoder In)	14	TS - (Motor thermal switch)
	13	TS+ (Motor thermal switch)
	12	Common
	11	+5 VDC
	10	Shield
	9	ABS (Absolute Encoder)
	8	I -
	7	I +
	6	B -
	5	B +
	4	A -
	3	A +
	2	Common
1	+5 VDC	
P3 (Encoder Out)	7	Shield
	6	I -
	5	I +
	4	B -
	3	B +
	2	A -
	1	A +



<u>Connector</u>	<u>Pin #</u>	<u>Signal Name</u>
P2 (I/O).....	10.....	+24 VDC
	9.....	OUT - (Drive running)
	8.....	OUT +
	7.....	+24 VDC Common
	6.....	RST - (Reset)
	5.....	RST +
	4.....	RAC - (Reverse amplifier clamp)
	3.....	RAC +
	2.....	FAC - (Forward amplifier clamp)
	1.....	FAC +
P1 (Controller).....	9.....	Shield
	8.....	+24 VDC
	7.....	SSO - (Drive ready to run)
	6.....	SSO +
	5.....	+24 VDC Common
	4.....	VCS+ (Velocity command signal)
	3.....	VCS -
	2.....	Enable -
1.....	Enable +	

P7 Internal connector for interfacing to any DM option card (such as PRO-Series controller cards and Spindle Orient and Auxiliary Function card). See drawing 9097-1131 for pin-out information.

#### 4.2 Drive Module Interface Signal Specifications

Refer to drawing 9101-0137 for a simplified schematic of the interface circuitry for the DM.

<u>Signal and Connector</u>	<u>Signal Type</u>	<u>Specification</u>
Serial Link.....P6.....	Input/ Output	Refer to Section X drawing 9101-0136
-15 VDC.....P5-8.....	Output.....	NOT FOR EXTERNAL USE
+15 VDC.....P5-7.....		
Shield.....P5-6.....	Shield.....	Connected to chassis ground internal to DM.
Common.....P5-5.....	Common.....	Common return for P5 inputs and outputs. Connected to chassis ground internal to DM.
External Current Limit.....P5-4.....	Input.....	0-10 VDC voltage proportional to zero to peak current of DM. However, current limit cannot be made higher than limit value in PM, only lower.

<u>Signal and Connector</u>	<u>Signal Type</u>	<u>Specification</u>
Programmable.....P5-3 Monitor	Output.....	$\pm$ 0-10 VDC signal representing the output variable which is selected using the serial terminal. See Monitor Information in Section 5.2.3.2.2.
MVO.....P5-2	Output.....	Motor Velocity Output: $\pm$ 10 VDC signal proportional to motor speed. Voltage scaling changes and is the same as the adjustable VCS input scaling selected using the serial terminal.
MCO.....P5-1	Output.....	Motor Current Output: $\pm$ 10 VDC signal proportional to motor current. 10 VDC = DM peak current rating (Example: for DM 20, 10 VDC at MCO = 20 Amps motor current). Output signal is same as logic board test point Imag, and serial terminal monitor output variable I Torq. Signal is + for current applied to drive the motor shaft clockwise facing drive end of motor.
*Encoder In.....P4	Input.....	Power supply and signal connections for motor absolute encoder, incremental encoder and thermostat. All P4 connections to motor are required. See drawing 9101-0140.
Encoder Out.....P3	Output.....	A+, A-, B+, B-, I+, I- incremental encoder signals from the motor are passed thru unbuffered for use by position controller. Signals are TTL compatible. Signal A+ leads signal B+ for clockwise motor shaft rotation facing drive end of motor.
+ 24 VDC.....P2-10	Output.....	$26 \pm 2$ VDC supply available for external use. 0.5 Amp max. output (from P2-10 and P1-8 combined).

## Interface Circuitry

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<u>Signal and Connector</u>	<u>Signal Type</u>	<u>Specification</u>
OUT+ .....P2-8 OUT- .....P2-9	Output.....	Normally open relay contacts that close when the DM is enabled at input pins P1-1, P1-2. The relay opens when the DM is inhibited. Contact rating is 0.3 Amps maximum at 24 VDC.
+24 VDC Com.....P2-7	Common.....	Common return for +24 VDC supply. +24 VDC Com is floating and not connected to chassis ground internal to DM. May be connected to chassis ground of external equipment.
RST+ .....P2-5 RST- .....P2-6	Input.....	Reset: Momentarily connecting and then disconnecting these pins resets any DM fault indications.
*RAC- .....P2-4 *RAC+ .....P2-3	Input.....	Reverse Amplifier Clamp: Connecting these pins allows motion in the reverse direction (CCW motor shaft rotation facing drive end of motor).
*FAC- .....P2-2 *FAC+ .....P2-1	Input.....	Forward Amplifier Clamp: Connecting these pins allows motion in the forward direction (CW motor shaft rotation facing drive end of motor).
Shield.....P1-9	Shield.....	Connected to chassis ground internal to DM.
+24VDC.....P1-8	Output.....	26 ± 2 VDC supply available for external use. 0.5 Amp max. output (from P2-10 and P1-8 combined).
SSO+ .....P1-6 SSO- .....P1-7	Output.....	Normally open relay that closes when the DM is ready to run. The relay opens if there is a DM fault. Contact rating is 0.3 Amps maximum at 24 VDC.

<u>Signal and Connector</u>	<u>Signal Type</u>	<u>Specification</u>
+24VDC Com.....P1-5.....	Common.....	Common return for +24VDC supply. +24VDC Com is floating and not connected to chassis ground internal to DM. May be connected to chassis ground of external equipment.
*VCS+ .....P1-4..... *VCS-.....P1-3	Input.....	$\pm 10$ VDC input command signal range with 13.3k Ohms impedance. Absolute max input signal range is $\pm 12$ VDC. + voltage applied to P1-4 with respect to P1-3 results in CW motor shaft rotation facing drive end of motor.
*Enable+ .....P1-1..... *Enable-.....P1-2	Input.....	Connecting these two pins together enables the DM, otherwise, the DM is disabled.

\* Denotes minimum required connections for DM operation without the PRO-Series controller option.

### 4.3 Power Supply Module Interface Connector (BRU-500 Only)

<u>Connector</u>	<u>Pin #</u>	<u>Signal Name</u>
P1	1 .....	Status-
	2 .....	Status +
	3 .....	PSM Enable-
	4 .....	PSM Enable+

### 4.4 Power Supply Module Interface Signal Specifications (BRU-500 Only)

Refer to drawing 9101-0138 for simplified schematic of interface circuitry.

<u>Signal and Connector</u>	<u>Signal Type</u>	<u>Specification</u>
Status+ .....P1-2 .....	Output.....	-Normally open relay -24 VDC 0.4 A -open relay is PSM fault -closed relay is PSM OK
Status-.....P1-1		
Enable + .....P1-4 .....	Input[1] .....	-Opto-coupler input -1.5k Ohms -16 mA (± 6mA) turn-on current
Enable-.....P1-3		

[1] The PSM Enable input is only functional if jumper W1 is in the proper location (see Figure 5.1).

With the jumper in the enable input activated position, the PSM is enabled if the opto-coupler is turned on. With the opto-coupler off, the PSM DC bus is turned off and the dissipative shunt is turned on to quick discharge the DC bus capacitors and dynamically brake synchronous motors. **IF THE PSM IS DISABLED DURING A POWER-UP, THE DC BUS VOLTAGE WILL BE PRESENT FOR AT LEAST 2 SECONDS BEFORE RETURNING TO A ZERO VOLT CONDITION.** This is to allow time for the DMs to power-up and apply the enable signal to the PSM if the PSM is to remain on.

With the jumper in the enable input deactivated position, the enable input has no effect on the PSM operation and the PSM activates itself when three phase voltage in the proper voltage range is connected to the input. Jumper W1 is in the enable input deactivated position when shipped from Reliance Motion Control.

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## SECTION V - START-UP AND ADJUSTMENTS

### 5.1 Initial Start-Up Procedure

#### 5.1.1 Initial Start-Up Procedure (BRU-500)

#### WARNING

**DANGER OF ELECTRICAL SHOCK OR BURN. ONLY QUALIFIED INDIVIDUALS SHOULD WORK ON THIS EQUIPMENT. DISCONNECT ALL POWER BEFORE WORKING ON EQUIPMENT. DANGEROUS VOLTAGES MAY EXIST AFTER POWER IS REMOVED! CHECK DC BUS VOLTAGE EACH TIME POWER IS REMOVED BEFORE WORKING ON THIS EQUIPMENT.**

- 1.) Measure voltages at L1, L2, and L3 phase to phase to insure incoming power is off. Also observe that green LED is off. Remove PSM cover.
- 2.) Disconnect all three phase input wires attached to L1, L2, and L3. Arrange input wires to safe position for testing of incoming voltage levels.
- 3.) Turn incoming power on and measure phase to phase voltages to insure that they are balanced and in the proper voltage range.
- 4.) If incoming power is the correct voltage then turn power off and reconnect the wires to L1, L2, and L3. Phasing is arbitrary.
- 5.) Disconnect all wires from the PSM DC bus studs marked + and -. Verify that dissipative shunt regulator fuse is OK. Install the PSM cover, then turn on incoming power. Verify that DC bus voltage is in the proper range. Observe that the PSM green LED is on and that all three red LEDs are off. Check that the PSM fans are operating.
- 6.) Disconnect incoming power and observe that the green LED goes off within one second and observe DC bus voltage falling to less than 15 VDC within one second. If so, then the PSM is working properly.
- 7.) Remove PSM cover. Reconnect the DC bus wires to the PSM studs marked + and - insuring that proper polarity is maintained. Install the PSM cover.
- 8.) With incoming power still off, remove all DM covers. Disconnect all motor leads from the DM terminals marked R, S, and T. Verify with an ohmmeter that an open circuit exists between R, S, and T terminals of each DM and earth ground.
- 9.) Verify that each DM has the correct PM installed and that DM jumpers are in the desired locations (see Figure 5-2 for PM location and jumper locations). Install all DM covers. Connect all interface cables to the DMs.
- 10.) Apply incoming power with all DMs inhibited and observe the DM LEDs. The green LED should turn on and remain on while the three red LEDs should turn on for about 1 second and then turn off and remain off. Check that the DM fans are operating. The PSM green LED should turn on and remain on while the three red LEDs should remain off.

- 11.) Connect a serial terminal to DM connector P6. Monitor position feedback and observe that position increases positively when the motor shaft is rotated CW as viewed facing the motor drive end (refer to Section 5.2.3 for serial terminal operation).
- 12.) Remove incoming power and observe that all module LEDs turn off within one second. Measure DC bus to insure voltage is below 15 VDC.
- 13.) It is safest to disconnect the motor(s) from the mechanical load(s) when initially checking out the system. If this is not possible, then take adequate precautions in the event of a fault.
- 14.) Disconnect all interface cables from DMs and remove all DM covers. Connect R, S, T, and G of motor to R, S, T, and GND of DM. Install all DM covers. Connect all interface cables to the proper DM. With each DM inhibited reapply incoming power and observe proper power up diagnostics as indicated by module LEDs.
- 15.) Using the serial terminal or a BRU-Series control station, set a low current limit (25% is a typical value). Apply a small positive voltage (about 0.5V) to the VCS input of each DM. Enable each DM and observe CW rotation of each motor shaft as viewed facing the motor drive end. If motor does not turn CW then check that motor power wires and encoder wires are connected to the DM properly.
- 16.) Inhibit all DMs and turn off input power. Measure DC bus to be sure that it is below 15 VDC.
- 17.) Now that the system installation is verified, return the current limit to a value to suit the application. The final current limit value should be saved in the personality module (see Section 5.2.3.2.3).

### 5.1.2 Initial Start-Up Procedure (BRU-200)

#### **WARNING**

**DANGER OF ELECTRICAL SHOCK OR BURN. ONLY QUALIFIED INDIVIDUALS SHOULD WORK ON THIS EQUIPMENT. DISCONNECT ALL POWER BEFORE WORKING ON EQUIPMENT. DANGEROUS VOLTAGES MAY EXIST AFTER POWER IS REMOVED!**

- 1.) Measure voltage between DM terminals marked L1, L2/N to insure incoming power is off. Also measure voltage between terminals marked L1 AUX, L2/N AUX, if used, to insure power is off. Observe that green LED is off.
- 2.) Disconnect input wires connected to terminals L1, L2/N (and terminals L1 AUX, L2/N AUX, if used). Arrange these wires to safe position for testing of incoming voltage.
- 3.) Turn incoming power on and measure line voltage to insure that it is in the proper voltage range.
- 4.) If incoming power is the correct voltage then turn power off and reconnect the wires to terminals L1, L2/N (and terminals L1 AUX, L2/N AUX, if used).
- 5.) With incoming power still off, disconnect motor leads from DM terminals R, S, and T. Verify with an ohmmeter that the resistance between DM terminals R to GND, S to GND, and T to GND is 100k ohms minimum.

- 6.) Verify that the DM has the correct PM installed and that DM jumpers are in the desired locations (see Figure 5-2 for PM location and jumper locations). Connect all interface cables to the DM.
- 7.) Apply incoming power with the DM inhibited and observe the DM LEDs. The green LED should turn on and remain on while the three red LEDs should turn on for about 1 second and then turn off and remain off. Check that the DM fan is operating by checking that air is coming out of the top of the DM near the mount plate.
- 8.) Connect a serial terminal to DM connector P6. Monitor position feedback and observe that position increases positively when the motor shaft is rotated CW as viewed facing the motor drive end (refer to Section 5.2.3 for serial terminal operation).
- 9.) Remove incoming power and observe that all module LEDs turn off within one second.
- 10.) It is safest to disconnect the motor(s) from the mechanical load(s) when initially checking out the system. If this is not possible, then take adequate precautions in the event of a fault.
- 11.) Connect R, S, T, and G of motor to R, S, T, and GND of the DM. With the DM inhibited reapply incoming power and observe proper power up diagnostics as indicated by module LEDs.
- 12.) Using the serial terminal or a BRU-Series control station, set a low current limit (25% is a typical value). Apply a small positive voltage (about 0.5V) to the VCS input of the DM. Enable the DM and observe CW rotation of the motor shaft as viewed facing the motor drive end. If motor does not turn CW then check that motor power wires and encoder wires are connected to the DM properly.
- 13.) Now that the system installation is verified, return the current limit to a value to suit the application. The final current limit value should be saved in the personality module (see Section 5.2.3.2.3).

## 5.2 Adjustments

### 5.2.1 Power Supply Module Adjustments (BRU-500 Only)

There are no PSM adjustments. The wide input voltage range of 88-265 VAC rms is accommodated automatically and the dissipative shunt regulator automatically tracks the DC bus.

The PSM has one jumper, W1, that is used to activate or deactivate the use of an external PSM enable input. The jumper location and description are shown in Figure 5-1. The PSM is factory configured with the external enable input deactivated. This means that the PSM will supply the DC bus if appropriate input voltages are connected to the PSM input and an external enable input will have no effect on the PSM operation. See Section 4.4 for more information concerning use of jumper W1.

### 5.2.2 Drive Module Adjustments

There are no DM potentiometers to adjust and in most situations the PM (Personality Module) provides all the necessary pre-adjustments so that absolutely no adjustments are required. Refer to Section 9.3 which explains the PM model number and Section 5.4 which covers PM installation. There is also an "automatic tuning" feature which allows the user to set up the BRU-Series system on the machine and have it tune itself. Refer to Section 5.3.1 for information and conditions for using the automatic tuning feature.

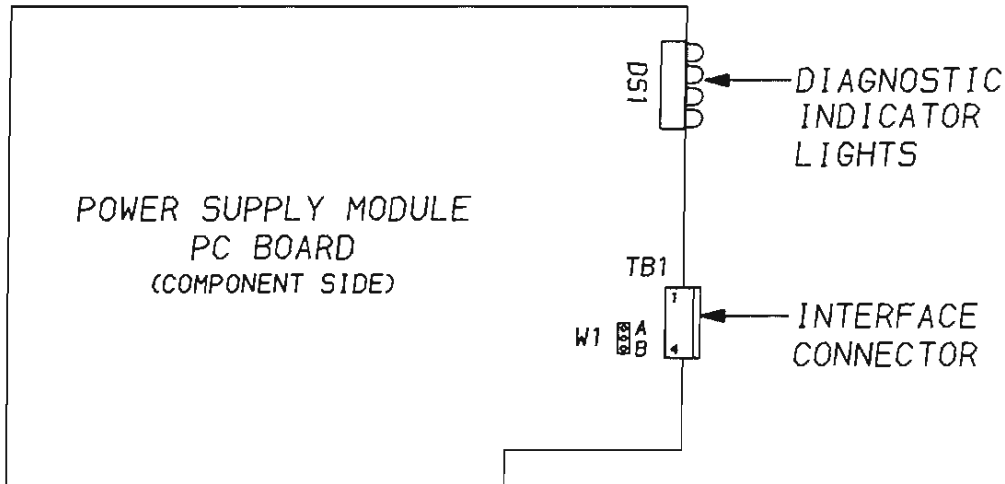
A serial interface is provided to change modes, modify tuning, change limit values, monitor certain variables/status, or obtain more diagnostics information than provided by the LEDs. Refer to Section



5.2.3 for information on using the serial interface. Refer to Section 5.3 for information on tuning the servo drive.

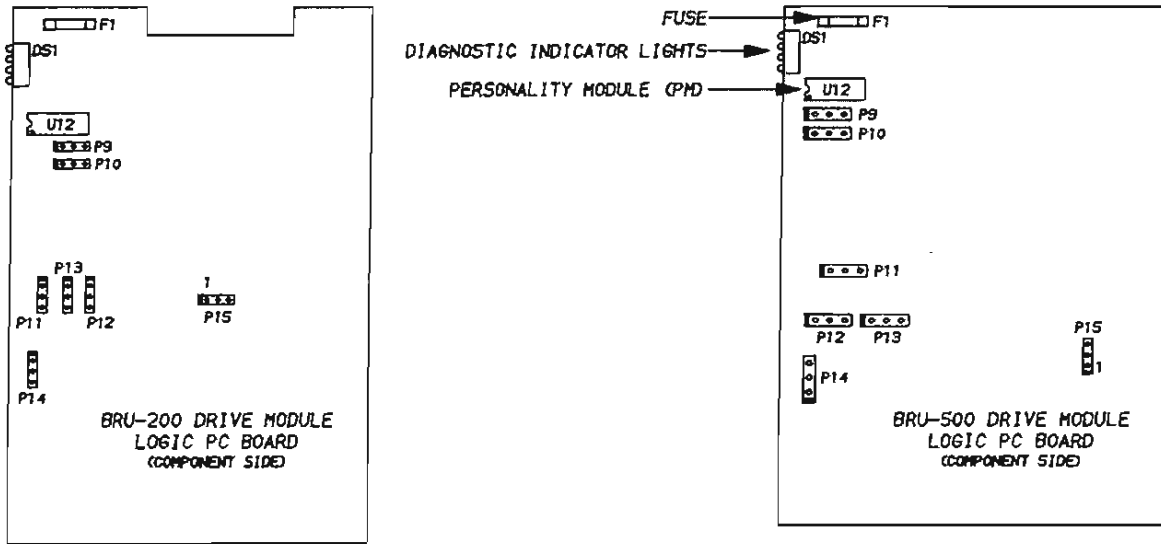
The wide input voltage range of 125-375 VDC for the BRU-500 and 100-240 VAC for the BRU-200 is adjusted for automatically and the dissipative shunt regulator automatically tracks the internal DC bus.

The DM has several jumpers that are shown and described in Figure 5-2. Factory installed locations are indicated. The location of the PM is also indicated.



JUMPER SETTING	SELECTS:
SHORTING JUMPER ACROSS TOP 2 PINS (POSITION A)	EXTERNAL ENABLE INPUT IS SELECTED. EXTERNAL CONNECTION REQUIRED TO CONNECTOR TB1 SIGNALS ENABLE + AND ENABLE -. SEE SECTION 4.4 FOR SIGNAL SPECIFICATION AND DETAILS OF OPERATION BEFORE USING POSITION A.
SHORTING JUMPER ACROSS BOTTOM 2 PINS (POSITION B) (STANDARD SETTING)	EXTERNAL ENABLE INPUT IS DE-ACTIVATED. POWER SUPPLY MODULE IS ENABLED WHENEVER INPUT POWER IS APPLIED AND NO POWER SUPPLY MODULE FAULT CONDITIONS ARE DETECTED.

Figure 5-1 PSM Jumper Locations



	JUMPER ACROSS PINS	SELECTS:
P9	1-2	PM IS RAM OR EPROM
	2-3	PM IS EE PROM
P10	1-2	PM PARAMETERS CAN NOT BE CHANGED
	2-3	PM PARAMETERS CAN BE CHANGED
P11	1-2	RS422 (HOST MODE) SERIAL INPUT AT P6
	2-3	RS232 SERIAL INPUT AT P6
P12	1-2	RS422 (HOST MODE) SERIAL OUTPUT AT P6
	2-3	RS232 SERIAL OUTPUT AT P6
P13	1-2	RS232 SERIAL OUTPUT AT P6
	2-3	RS422 (HOST MODE) SERIAL OUTPUT AT P6
P14	1-2	MOTOR OVERTEMPERATURE SWITCH IS NOT MONITORED
	2-3	MOTOR OVERTEMPERATURE SWITCH IS MONITORED
P15	1-2	INTERNAL TORQUE COMMAND
	2-3	EXTERNAL TORQUE COMMAND

NOTES:

- DENOTES STANDARD JUMPER SETTING.
- SEE SECTION X DRAWING NO. 9101-0136.
- CAUTION: RUNNING MOTOR WITH J14 ACROSS PINS 1-2 WILL NOT PROTECT MOTOR FROM OVERHEATING.
- USED ONLY WHEN SPECIFIED FOR OPTION CARD.

Figure 5-2 DM Jumper and Personality Module Locations

### 5.2.3 Serial Interface Operation

#### 5.2.3.1 User Terminal Requirements

The BRU-Series serial interface is factory configured for RS-232 compatibility, but RS-422 operation is possible by making jumper changes. Refer to Figure 5-2 for jumper locations and configurations. The BRU-Series serial interface is designed to work with the Tandy 102 computer, but should interface to VT-52 compatible terminals with at least an eight line 40 character display. The terminal should be set for full duplex, 8 bit words, no parity, 1 stop bit, with XON/XOFF (software handshake) enabled. Refer to drawing 9101-0136 for serial interface connection details. Appendix A is a step-by-step guide on how to set up the Tandy 102 for operation with the BRU-Series drive. Appendix B contains the communication codes sent to and received from the BRU-Series drive and the user terminal. Appendix C is a step-by-step guide on using an IBM PC terminal and Appendix D covers common communication problems and possible cures.

The default baud rate is stored in the PM (personality module) and is set by the factory to 9600 baud. An autobaud function has been included in the BRU-Series drive to allow terminals with 1200, 2400, 4800, 9600, or 19200 baud to communicate by over-riding the default value. The autobaud function, however, only works during the first second after power is applied, after which the baud rate is set to the default value as stored in the PM. To use the autobaud function, after power is applied and the red LEDs on the drive module turn on, press <Enter> immediately. The Help page should then be displayed on the user terminal as shown in Figure 5-3. The default baud rate may be changed to the baud rate calculated during the autobaud function by turning to the status page by pressing <ESC> and then pressing <S> to save parameters (refer to Section 5.2.3.2.3).

#### 5.2.3.2 Operating the User Terminal

The BRU-Series drive communicates information to the user through 3 pages. The Help Page provides useful information to get the first time user started and shows software release and personality module information. The Status Page indicates the status of the BRU-Series drive, and the Setup Page allows the user to change the tuning parameters for optimal performance. There are four modes of operation: velocity, torque, tune and auto-tune mode. Each of these modes has a Status and Setup page.

##### 5.2.3.2.1 Help Page

If the user terminal is plugged into DM connector P6 when power is applied to the BRU-Series drive, a help message will appear on the terminal screen when power up diagnostics and autobaud have been completed (see Figure 5.3). The Help page shows the software part number (9101-1095-XXX, where XXX refers to the software release number), the personality module identification, and a brief description of how to use the terminal. If the power up diagnostic tests fail, the BRU-Series drive automatically turns to the STATUS page which displays a description of the error (refer to Section 5.2.3.2.2).

From the Help page, you can press the <ESC> key to enter the Status page or press the <P> key to turn to the Setup page. After pressing the <ESC> or <P> key to turn to the Status or Setup page, you will not be able to return to the Help Page except by resetting the BRU-Series drive through the external reset or by cycling power.

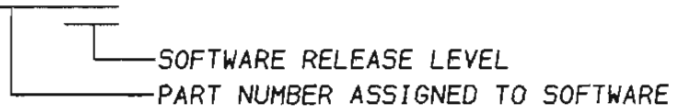
DRIVE SOFTWARE 9101-1095-010  
PERSONALITY MODULE PM020BS4030PH-0 -002

- To enter terminal mode hit ESC key
- <CR> "carriage return" is the same as the <ENTER> or <RETURN> key.
- ESCape key restores previous data when data entry errors occur.

**Figure 5-3 Serial Terminal HELP PAGE**

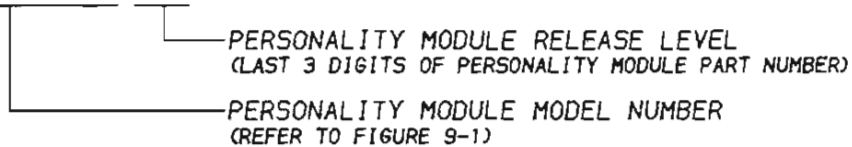
SOFTWARE IDENTIFICATION EXAMPLE

9101-1095-010



PERSONALITY MODULE IDENTIFICATION EXAMPLE

PM025A54030PH-0-002



**Figure 5-4 Software and Personality Module Identification**

5.2.3.2.2 Status Page

The Status Page provides information about the operating status of the BRU-Series drive. The Status screen is divided into five sections - Status information, Monitor information, Copyright notice, Fault information, and Help information.

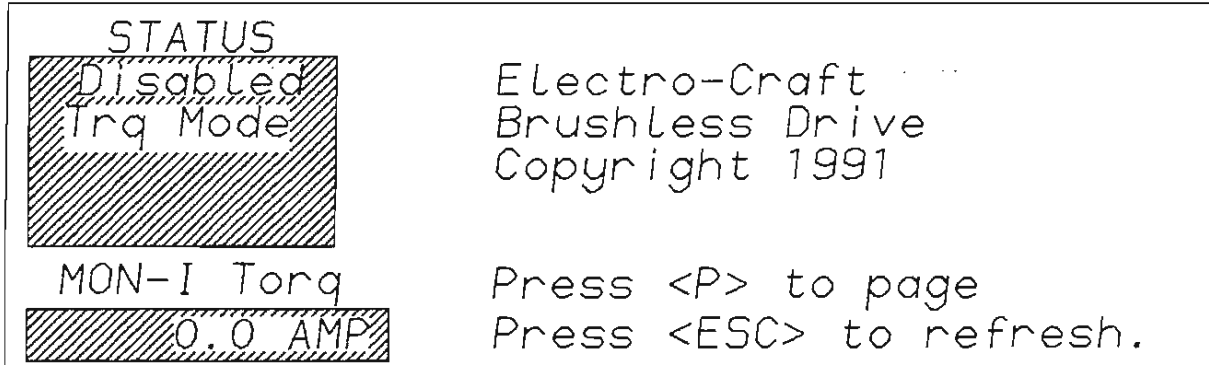


Figure 5-5 Serial Terminal STATUS PAGE

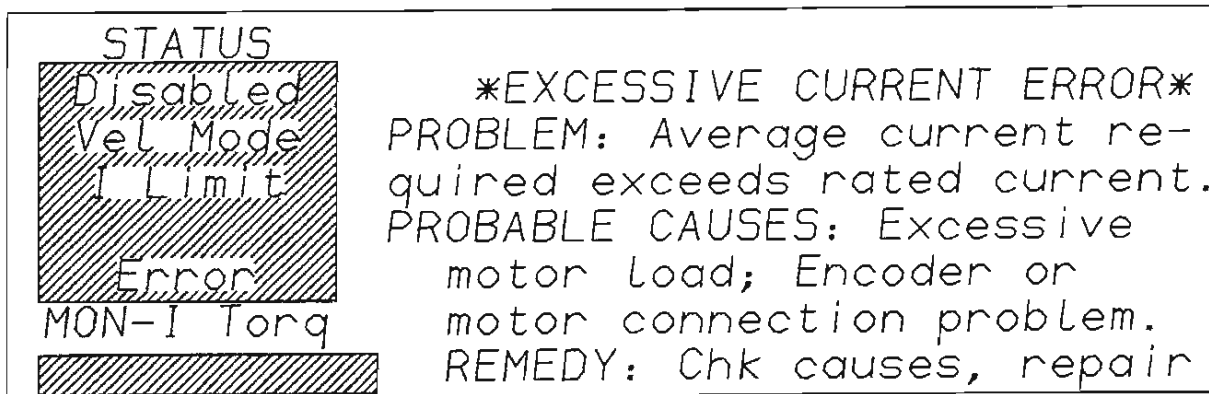


Figure 5-6 Serial Terminal STATUS PAGE After Fault

Status Information

The Status information consists of five lines on the left side of the screen and shows the present status of the BRU-Series drive.

**NOTE:** The reverse video areas (shown as shaded areas in Figure 5-5) are continuously updated by the drive module.

The status information available is as follows:

**Line 1** - displays 'Enabled' if the drive is enabled. Otherwise, 'Disabled' is displayed.

**Line 2** - displays the mode of operation. 'Vel Mode' is displayed if in velocity mode, 'Trq Mode' if in torque mode, 'Tun Mode' if in tune mode and 'A-T Mode' if in auto-tune mode.

**Line 3** - displays current limit status. The BRU-Series drive has been designed to display the 'I Limit' message whenever the drive enters current limit.

**Line 4** - displays 'FAC' and 'RAC' clamp status. FAC is the forward amplifier clamp and RAC is the reverse amplifier clamp. When FAC is enabled (displayed on the screen) the VCS input is clamped internally to 0 when a positive voltage on VCS is detected. This allows only negative velocity commands in velocity mode or only negative torque commands in torque mode. The opposite effect occurs with RAC. When both FAC and RAC are enabled, velocity command is clamped to 0 in velocity mode or torque command is clamped to 0 in torque mode. Both 'FAC' and 'RAC' can be displayed simultaneously.

**Line 5** - displays the 'Error' message when an error has been detected.

### Monitor Information

The monitor information helps in setup and provides a powerful diagnostics tool. The monitor information is selected on the Setup page by changing the monitor variable and is displayed on two lines in the lower left corner of the Status page. The upper line shows the variable which is being monitored and the bottom line shows the value of that variable. The monitor selected on the Setup page is also represented by an analog voltage at the programmable monitor test point or at the monitor output. The variables which can be monitored are:

**ABS Itorq** - Displays the absolute value of commanded torque producing current in units of AMPS.

**I Torq** - Displays the commanded torque producing current in units of AMPS. Note that I Torq is the same as I<sub>mag</sub> for the S-Series and F-Series motors.

**I Ave** - Displays the average value of I Torq in units of AMPS. I Ave prevents the drive from exceeding the current rating. The average value is computed by passing I Torq through a low pass filter. The time constant of the filter is factory set in the personality module. When the average current reaches the rated current of the motor, an excessive current fault will occur.

**Tach** - Displays the velocity of the motor as determined from the encoder feedback in units of RPM. For forward motion, the velocity will be positive and for reverse motion, the velocity will be negative.

**Command** - Displays the value of the VCS command input in units of RPM for velocity mode and AMPS for torque mode. In the tune modes, command will be 0, since the command is internally generated.

**Posn** - Displays the relative motor position in units of ROT or rotations. Posn value will increase for clockwise rotation of the motor shaft, viewed facing the motor drive end. It will decrease for counter-clockwise rotation. For one complete rotation of the motor shaft, the display should indicate a change of one rotation. Note that the display does not show negative rotations, but will change from 0.0 to some large positive number. This occurs due to rollover of the position counter, but after this occurs, continuing to rotate the motor counter-clockwise will cause Posn to decrease.

**I Limit** - Displays the present value of the current limit. The current limit will be set at either the personality current limit (shown on the Setup page) or the external current limit (available at connector P5-4). The current limit is set to the lower of the two values.

Copyright Notice

At the upper right area of the Status page is the copyright notice. If an error occurs, the copyright notice is replaced with the fault information described below.

Fault Information

While the BRU-Series drive is powering up, diagnostic checks are run to check for proper operation of the drive. Also, while the BRU-Series drive is operating, the drive is monitored for fault conditions. If a fault occurs at either time, then the drive is disabled, the red LEDs display the fault code, and a fault message is displayed in the upper right side of the Status page. The fault message includes a description of the fault, some probable causes for the fault, and some possible remedies. Refer to Section 6.3 for a list of the fault messages.

Help Information

At the lower right area of the Status page are two lines which list available keys while in the Status page. They are as follows:

<P> - page command. Turn to Setup page.

<ESC> - refresh the Status Screen.

5.2.3.2.3 Setup Page

The Setup Page is used to modify the BRU-Series drive setup parameters for the specific application. The first 6 lines contain two columns of variables. The last 2 lines provide information about the variable the cursor is beside. The only cursor movement available is up or down. To move the cursor to variables in the right column, press the 'cursor up', <U>, or 'cursor down', <Enter>, keys. The cursor moves down/up one column then moves down/up the next column when pressing the <Enter>/<U> key. Note that the up arrow and down arrow keys will produce this cursor movement on some terminals. Refer to Appendix B for a list of the codes used by the BRU-Series drives.

```

Scale      399.9 RPM/V | P GAIN      100
Offset     0.0000 V   | I GAIN      20
Peak I     24.8 AMP   | D GAIN      0
Overspeed  4599 RPM  | Mode(1):   Velocity
Filter BW  300 Hz    | Monitor-I Torq
U-Cursor Up, <ENTER>-Cursor Down
P-Next Page, R-Reset Setup, S-Save Setup
    
```

**Figure 5-7 Serial Terminal SETUP PAGE (Velocity Mode)**



```
Scale      2.49 AMP/V |
Offset     0.0000 V  |
Peak I     24.8 AMP  |
Overspeed  4599 RPM | Mode(2):   Torque
Filter BW  300 Hz   | Monitor-I Torq

U-Cursor Up, <ENTER>-Cursor Down
P-Next Page, R-Reset Setup, S-Save Setup
```

Figure 5-8 Serial Terminal SETUP PAGE (Torque Mode)

```
Period    1.00 SEC | P GAIN     100
Step Vel   300 RPM | I GAIN     20
Peak I     24.8 AMP | D GAIN     0
Overspeed  4599 RPM | Mode(3):   Tune
Filter BW  300 Hz   | Monitor-I Torq

U-Cursor Up, <ENTER>-Cursor Down
P-Next Page, R-Reset Setup, S-Save Setup
```

Figure 5-9 Serial Terminal SETUP PAGE (Tune Mode)

```
Dist       1.0 REV | P GAIN     100
Max Vel    3000 RPM | I GAIN     20
Step I     8.3 AMP  | D GAIN     0
Overspeed  4599 RPM | Mode(4):   Auto Tune
Filter BW  300 Hz   | Monitor-I Torq

U-Cursor Up, <ENTER>-Cursor Down
P-Next Page, R-Reset Setup, S-Save Setup
```

Figure 5-10 Serial Terminal SETUP PAGE (Auto-Tune Mode)

How to change a variable

The variables are stored in the PM (Personality Module) which is either a nonvolatile RAM or an EEPROM. When new data is entered, the data is **NOT STORED UNTIL THE <S> KEY IS PRESSED**. Thus you can adjust the tuning until satisfied and then save the variables. If not satisfied with the new values, then the previous values can be restored by resetting the drive as long as the <S> key was not pressed. A write protect jumper is available to prevent the variables from being altered. **Make sure the write protect jumper is in the non-write-protect position before powering up the drive if it is going to be tuned (refer to Figure 5-2).** **Under no circumstance, should the write-protect jumper be moved while power is applied. The result could be a damaged personality module.**

To change the value of a variable, move the cursor, using the <U> or <Enter> keys to the location immediately to the left of the variable to be changed and then enter the new value. As the data is being entered, the present data for that variable will be erased off the screen and the new data will be displayed as it is being entered. Press <Enter> to complete the data entry. While entering data for a variable, if you wish to restore the previous value, press the <ESC> key to ignore the present value and restore the previous value.

Available commands

While on the Setup Page, the user has several commands available. They are as follows:

<ESC> - Refresh the Setup screen if not presently changing a variable, or restore previous data if presently changing a variable.

<P> - Turn to the Status Page.

<R> - Reset personality tuning back to the factory settings.

<S> - Save present tuning into the personality.

<U>,up arrow (on Tandy 102) - Move the cursor up.

<ENTER>,dn arrow (on Tandy 102) - Move the cursor down.

<0> to <9>,<.> - Data entry.

<<>,left arrow (on Tandy 102) - decrease the value of the variable. Active only for 'Offset', 'P GAIN', 'I GAIN', and 'D GAIN'.

<>>,right arrow (on Tandy 102) - increase the value of the variable. Active only for 'Offset', 'P GAIN', 'I GAIN', and 'D GAIN'.

User selected variables

Tuning variables for the BRU-Series drive may be modified through the user terminal. The setup screen for each of the four modes is different. Refer to Figures 5-7, 5-8, 5-9, and 5-10.

### CAUTION

#### THE BRU-200 AND BRU-500 RESPOND TO A CHANGE IN THE SETUP PAGE DATA EVEN WHEN ENABLED

The variables available are described as follows:

**Scale** - (velocity and torque mode) For velocity mode, the data entered for Scale is in RPM/V and is used to scale the motor speed for a given voltage at the VCS input. The full scale voltage input at VCS is 10 V. Normally the scaling should be set for full scale RPM/10 to provide the maximum speed resolution. For torque mode, the data entered is in AMP/V and is used to scale the torque producing current for a given voltage at the VCS input. Normally, Scale in torque mode should be set for the drive module peak current/10.

**Period** - (tune mode) The Period variable is used with Step Vel in tune mode to define the output of the internal square-wave function generator. Period refers to the length of time in seconds required to complete one square-wave cycle. Note that the function begins as soon as the drive is enabled, and that the motion of the motor will be centered around the motor position when the drive is enabled.

**Dist** - (auto-tune mode) The Dist variable is used to define the working distance that the servo may move in auto-tune mode to identify the load inertia. The Dist value is intended to be a maximum distance moved in the positive and negative direction around the starting point, however, **due to the open loop control method used and the unknown influences such as gravity, friction, etc., the distance moved can exceed this value. Setting Dist to 0 results in unidirectional motion in the direction of the sign of the Max Vel parameter. Distance is entered in units of motor revolutions.** Refer to Section 5.3.1 for more information on auto-tune.

**Offset** - (velocity and torque mode) For velocity and torque modes, the Offset variable is used to remove offsets from the user input at VCS. This variable is in units of volts and can be a positive or negative value. NOTE: Offset can also be adjusted by potentiometer R107 (BRU-200) or R106B (BRU-500). Refer to Drawing 9101-0139 and 9101-1061.

**Step Vel** - (tune mode) Tune mode disconnects the VCS input from the velocity regulator and internally connects a square-wave function generator which produces step velocity inputs to the velocity regulator. This is used to tune the BRU-Series drive when used in velocity mode. Step Vel is the amplitude of the function generator and is in units of RPM. Step Vel can be either positive or negative. If positive, the initial step velocity will be in the positive direction and if negative, it will be in the negative direction. While in this mode, P GAIN, I GAIN, D GAIN, and Filter BW can be adjusted. Note that when I GAIN is > 0, the motor position will not drift.

**Max Vel** - (auto-tune mode) The Max Vel variable is used to set the maximum speed of the servo motor during auto-tune. If the Dist variable is set to 0 in order to achieve unidirectional motion, the sign of Max Vel determines the direction of rotation. Max Vel is entered in units of RPM. Refer to Section 5.3.1 for information on auto-tune mode.

**Peak I** - (all modes except auto-tune) The Peak I variable is the peak current limit in Amps. It can be over-ridden by the external current limit only if external current limit is at a lower value.

**Step I** - (auto-tune mode) The Step I variable is the peak current setpoint (in Amps) used to accelerate the servo motor during auto-tune. When the Max Vel or half of the Dist values have been reached, the current reverses to accelerate the servo motor in the opposite direction. The value of the current to the motor will be Step I until auto-tune is completed.

**Overspeed** - (all modes) The Overspeed variable is the overspeed trip point in RPM. Exceeding this speed will result in a fault.

**Filter BW** - (velocity, torque and tune mode) Filter BW is the low pass filter which filters the output of the velocity regulator. It reduces the amplitude of the current pulses which can cause excessive noise (rattling sound) in the motor when the P GAIN, I GAIN, and/or D GAIN values are high. Filter BW is entered in Hz.

**P GAIN** - (velocity and tune mode, inactive in torque mode) P GAIN is the proportional gain of the velocity regulator. It is multiplied by the difference between the input velocity command and the motor velocity to produce torque. Larger proportional gains reduce the dynamic following error of the motor velocity to commanded velocity (increases the bandwidth of the velocity regulator).

**I GAIN** - (velocity and tune mode, inactive in torque mode) I GAIN is the integral gain of the velocity regulator. The velocity error is continually added to itself. This sum is multiplied by the integral gain and is used to reduce the steady state error of the motor velocity to commanded velocity. I GAIN is generally used to improve the stiffness of the velocity regulator which reduces the effects of load disturbances. Excessive I GAIN, however, will result in overshoot and possible instability.

**D GAIN** - (velocity and tune mode, inactive in torque mode) D GAIN is the damping gain of the velocity regulator. It is used for two purposes: 1) it can be used to reduce the overshoot caused by high I GAIN; 2) it can be used to minimize torsional resonance between the motor and load.

**Mode** - (all modes) The Mode variable is used to select the desired mode: Velocity, Torque, Tune, or Auto-tune. Velocity mode should be used when the VCS input is a velocity reference. Torque mode should be used when the VCS input is a torque reference. Tune mode is used to provide a square-wave velocity command for tuning the gains for the velocity regulator. Auto-tune automatically tunes the velocity regulator gains. The tune and auto-tune modes are used only to tune the drive for velocity mode operation.

**Monitor** - (all modes) The Monitor variable allows one of 6 variables to be monitored on the monitor output on the Status page, the programmable monitor test point or the programmable monitor output, P5-3. The variables which can be monitored are listed in the monitor information portion of Section 5.2.3.2.2.

### 5.2.3.3 Multi-Drop Host Mode Serial Protocol

The BRU-Series drive has a serial port (P6) that can be configured as RS-232 (short distance interface up to 50 feet) and RS-422 (long distance interface up to 4000 feet). The factory configuration of the drive is RS-232 which provides the terminal mode operation (refer to Section 5.2.3.2) for a human user interface with a VT-52 compatible terminal. Reliance Motion Control has a communication software program called EC COMM that easily configures an IBM compatible computer for VT-52 emulation. The RS-232 terminal mode is the usual way to communicate with the BRU-Series drives.

However, configuring a BRU-Series drive for RS-422 automatically replaces the terminal mode with a host computer communication protocol. In this mode of communication, each BRU-Series drive can be given a unique address and connected (in daisy-chain fashion) on a single serial link. Electro-Craft PRO-Series controllers that support host mode can be placed on the same daisy-chained serial link with the BRU-Series with each device having its own unique address.

For example, the host mode operation of the BRU-Series drives can provide the following functions:

- Save and load the entire personality module (INTEL Hex File Format).
- Real-time read and write of the BRU-Series parameters including PGAIN, IGAIN, SCALE, and OFFSET.
- Real-time diagnostic and status monitor.
- Terminal mode for multiple axes from the host computer.
- Real-time monitor of variables such as average current.

The above would be implemented with the user's host software. The host mode of the BRU-Series drive simply provides a communication protocol (or language) that makes it easy for the host computer to communicate with the BRU-Series drive.

The host mode interface provides a very powerful and flexible communication protocol for use by a host computer. This implies that users will provide the necessary host software to perform the application function. The host mode operation of BRU-Series drives is an option that is not necessary for every application as it will require software to be created for the host computer. The host mode communication protocol is available as a separate document and can be obtained directly from Reliance Motion control and their authorized sales personnel.

### 5.3 Tuning Procedure

The BRU-Series drive has been designed to provide adequate tuning for many applications, that is, all of the necessary tuning information is contained in the personality module. However, for some applications some additional adjustments may be required. Two tuning modes have been included in the BRU-Series drive to help in tuning the system. The first is the auto-tune mode which consists of a "self-tuning" algorithm. Auto-tune mode is designed for applications that require near-optimal performance. To optimize the BRU-Series drive tuning for a specific application, the tune mode can be used. All tuning and adjustments are accomplished via the serial interface (refer to Section 5.2.3.2.3).

#### 5.3.1 Using Auto-Tune Mode

Auto-tune provides a method for tuning the servo drive connected to a machine without any special equipment other than the user terminal. Upon enabling the BRU-Series drive in auto-tune mode, the servo system will move in a rapid back-and-forth motion for 5 seconds and then halt.

#### **WARNING**

**DO NOT ATTEMPT TO USE AUTO-TUNE WITH SYSTEMS WHICH HAVE GRAVITATIONAL AFFECTS. THE BRU-500 AND BRU-200 WILL NOT ATTEMPT TO HOLD INITIAL POSITION.**

Auto-tune implements a simple "self-tuning" algorithm that adjusts the tuning parameters P GAIN and I GAIN by computing the effect of the user's load as applied to the servo motor shaft. This method operates by commanding a constant current to the motor that produces a constant motor torque. The acceleration of the motor is measured and used to compute the gain of the system. Once the actual gain of the system is measured, the values of the tuning parameters P GAIN and I GAIN are adjusted to compensate for the change in gain. Auto-tune mode is selected by moving the cursor to the Mode line on the Setup page of the User interface (refer to Section 5.2.3.2.3). Once selected, enabling the BRU-Series drive starts auto-tune which causes the servo motor to rapidly accelerate and decelerate. After 5 seconds, the current command to the motor is set to zero which should halt motion.

### WARNING

**AT THE COMPLETION OF AUTO-TUNE, VOLTAGE REMAINS APPLIED TO THE MOTOR UNTIL THE BRU-500 OR BRU-200 IS DISABLED.**

Three parameters control the operation of auto-tune mode: Dist, Max Vel, and Step I. The Dist parameter is used to limit the distance moved from the starting position. The maximum value for Dist is 4 motor rotations. Due to the open-loop nature of the auto-tune and the unpredictable affects of gravity, friction, etc., the distance may be exceeded. During auto-tune, exceeding the Dist value will not generate a fault condition. The Max Vel parameter is used to set a maximum velocity during auto-tune. It can be a positive or negative value. If Dist is set to 0, the servo motor will move in one direction with the sign of Max Vel determining the direction. Step I determines the value of motor current used to accelerate and decelerate the motor. The maximum allowed value of Step I is limited to rated current of the motor. These three parameters are set to default values upon entering auto-tune mode which should be sufficient for most loads.

The parameters adjusted by auto-tune are P GAIN, I GAIN, and D GAIN. D GAIN is always set to 0. P GAIN and I GAIN are adjusted proportionally to the change in gain of the system. There are certain conditions where erroneous values are computed for P GAIN and I GAIN. These conditions are as follows:

- 1.) Dist is set too low. This condition results in very rapid reversal of the servo motor rotation and causes it to make a buzzing sound.
- 2.) Max Vel is set too low. This condition results in very rapid reversal of the servo motor rotation and causes it to make a buzzing sound.
- 3.) Step I is set too low. There is no servo motor motion.
- 4.) FAC and/or RAC enabled. This condition can be checked by observing the Status page on the user terminal to see if FAC and/or RAC are displayed. The condition is evidenced by no motion or a halting of the back-and-forth motion.

These conditions will generally result in very high values for P GAIN (999 is maximum) and I GAIN (999 is maximum) which may result in instability when returned to the velocity mode of operation.

The procedure for using auto-tune is as follows:

- 1.) Make sure the system is connected and is operating properly by following the initial start-up procedure in Sec. 5.1.
- 2.) Connect the user terminal to connector P6 on the BRU-Series drive.
- 3.) With the drive disabled, apply power.

- 4.) Press <P> to turn to the SETUP page.
- 5.) Move the cursor to Mode and select auto-tune mode by entering 4 followed by <ENTER>. The terminal screen should appear as shown in Figure 5-10.
- 6.) Adjust Dist, Max Vel, and Step I if required. Note that the default values should provide good results for most systems. The Step I should be reduced if the torque will exceed machine specifications.
- 7.) Turn to the STATUS page by pressing <P> to insure that FAC and RAC are not enabled then return to the SETUP page by pressing <P> again.
- 8.) Enable the BRU-Series drive to start the auto-tune process which will cause the motor to move in a back-and-forth motion.
- 9.) The computed values for P GAIN and I GAIN will appear on the screen after 5 seconds. The BRU-Series drive signals completion by commanding 0 current to the motor and sending a "beep" to the user terminal.
- 10.) Move the cursor to Mode and select velocity mode by entering 1 followed by <ENTER>.
- 11.) Press <S> if the present tuning is to be saved into the personality module. Saving the parameters requires that the write protect jumper J10 is set to the appropriate position (refer to Figure 5-2). **Attempts to move J10 with power applied to the servo drive may result in damaging the personality module.**

### 5.3.2 Using Tune Mode

The tune mode is designed to optimally tune the BRU-Series drive. For most applications, the default tuning values or the results of auto-tune should provide adequate tuning. For applications with particular requirements, tune mode can be used to fine tune the system. A suggested tuning procedure for velocity mode operation is discussed below. This procedure assumes that the system, including the machine the motor is connected to, can tolerate small-signal step velocity changes. There is essentially no tuning required for torque mode; P GAIN, I GAIN, and D GAIN have no effect in torque mode.

The tuning of the velocity regulator is accomplished by changing the variables P GAIN, I GAIN, and D GAIN. The P GAIN is the proportional gain of the velocity regulator. In general, increasing P GAIN reduces the time required to reach the commanded velocity. The I GAIN is the integral gain of the velocity regulator. Integration in the velocity regulator forces the motor velocity to precisely follow the commanded velocity with no error under steady state conditions (no changes in velocity command or load). Increasing I GAIN increases the stiffness, or the ability to reject load disturbances. Increasing I GAIN also, however, increases the amount of velocity overshoot when responding to a step change in velocity. Too much I GAIN can cause the system to go unstable. The D GAIN is the damping gain. It is used to reduce the amount of overshoot caused by the I GAIN term. It can also be used to minimize torsional resonance between the motor and load in some systems. A block diagram of the velocity regulator is shown in Figure 5-11.

To reduce stress on the mechanical components of the machine, the P GAIN, I GAIN and D GAIN should be set as low as possible while still maintaining the desired performance. Recommended steps for tuning the velocity regulator for velocity mode operation are as follows:

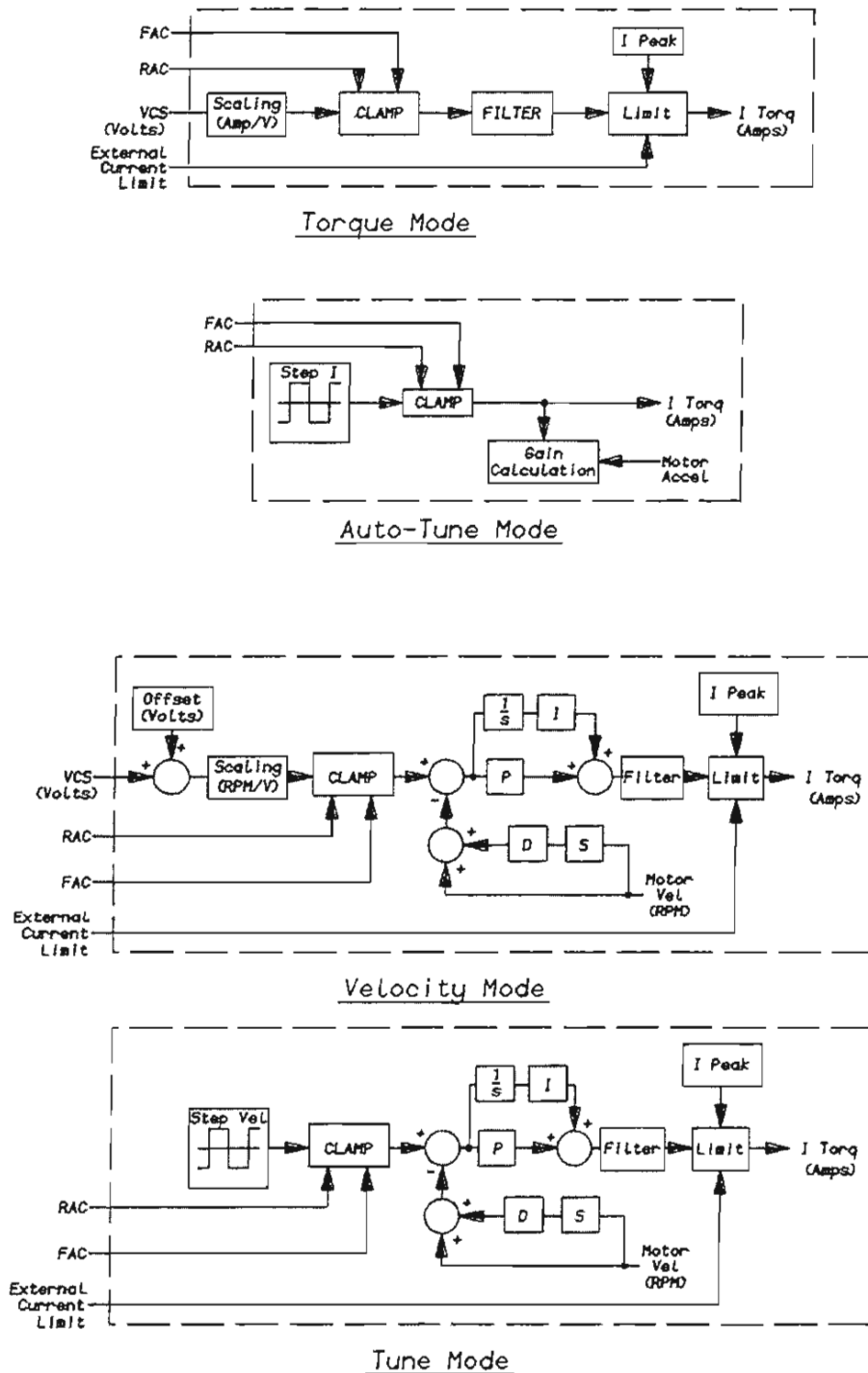


Figure 5-11 Control Block Diagrams of Operating Modes



- 1.) Make sure the system is connected and is operating properly by following the initial start-up procedure in Sec. 5.1.
- 2.) Connect the user terminal to connector P6 on the BRU-Series drive.
- 3.) With the drive disabled, apply power.
- 4.) Press the <ESC> key on the terminal to enter the STATUS page and check that the status indicates 'VEL MODE'. If the servo drive is in 'TRQ MODE' then press the <P> key to turn to the SETUP page. Move the cursor up to the MODE line and type '1' followed by <Enter> to change to VELOCITY MODE, then press <P> to return to the STATUS page. The status should now indicate 'VEL MODE'.
- 5.) Press <P> to page to SETUP page.
- 6.) Move the cursor to SCALE. Set the desired scaling on the velocity command input. While in tune mode it may be helpful to reduce the scaling to a small value such as 50 RPM/V since the scaling of the programmable monitor output (on connector P5-3 or test point MON) is scaled by this value. This will allow full D/A converter resolution over a 500 RPM range.
- 7.) Offset is most easily adjusted with the position controller connected and will therefore be tuned later (refer to step 22).
- 8.) Set the desired Peak I (Peak Current) and the Overspeed trip point.
- 9.) Turn off the Filter BW by setting it to 0.
- 10.) (Optional) Follow steps 5 through 10 for Auto-tune procedure in Section 5.3.1 to provide a near-optimal tuning starting point.
- 11.) Move the cursor again to Mode and select Tune mode. Connect an oscilloscope to the test point MON or to P5 pin 3.
- 12.) Move the cursor to Period and set the desired square wave cycle time. A Period is the time required to complete one cycle of the square wave. The value of Period will depend on the user and the application. Avoid setting Period to a high value which will allow the system to reach the end of travel with the Step Vel value programmed (see step 13). The Period should not need to be set to less than 0.02 seconds.
- 13.) Move the cursor to Step Vel and set the desired step velocity of the internal square wave generator. This value will generally be between 50 and 500 RPM. Note that an excessive step velocity or a low Peak I setting can cause the servo drive to enter current limit. This should be avoided while tuning the BRU-Series drive. You can be sure that the BRU-Series drive is not entering current limit by turning to the Status Page while the BRU-Series drive is enabled and making sure that the I Limit message does not flash during a motor speed reversal. If it does appear, Step Vel must be reduced or Peak I must be increased.
- 14.) Enable the BRU-Series drive and observe the motion of the motor shaft. Ensure that FAC and RAC are not enabled if no motion occurs. Disable the drive and adjust Period and Step Vel if necessary.
- 15.) Change Monitor to Tach by moving the cursor to the monitor line and pressing '3'.
- 16.) Set I GAIN to a low value (no noticeable overshoot) and set D GAIN to 0. While observing the tach at the monitor output with an oscilloscope, increase P GAIN until the desired rise time is obtained.

- 17.) Increase I GAIN until the acceptable limit for the amount of overshoot is reached. The Tach and I Torq signals should look similar to those shown in Figure 5-12.
- 18.) If more stiffness is required, increase I GAIN beyond the desired overshoot. Then increase D GAIN to reduce the overshoot back down to the acceptable limit.
- 19.) After the P GAIN and I GAIN are adjusted, if there is a ringing on the tachometer due to torsional resonance between the motor and load, then increase D GAIN until oscillation is acceptable.
- 20.) Reduce Filter BW until the overshoot begins to increase.
- 21.) To adjust offset, disable the drive and connect the position controller.
- 22.) Set the mode to Velocity mode and enable the system. The position controller should be holding the shaft position still. Read the velocity command input voltage (VCS) at P1 pins 3 to 4 or the VEL CMD test point using a digital voltmeter. NOTE: The velocity offset can also be adjusted by potentiometer R106B (BRU-500) or R107 (BRU-200). Refer to drawings 9101-0139 or 9101-1061.
- 23.) Enter the voltage read for Offset. The velocity command voltage should drop to 0 volts.
- 24.) Press 'S' to save the offset into the personality module.

	P GAIN	I GAIN	D GAIN	Filter BW
To increase bandwidth	Increase			
To increase stiffness	Increase	Increase		
To reduce overshoot	Increase	Reduce		
To reduce rise time	Increase	Increase		
To reduce resonance			Increase	
To reduce motor rattle	Reduce	Reduce	Reduce	Reduce

Table 5-1 Use of Gains to Tune the BRU-Series Drive

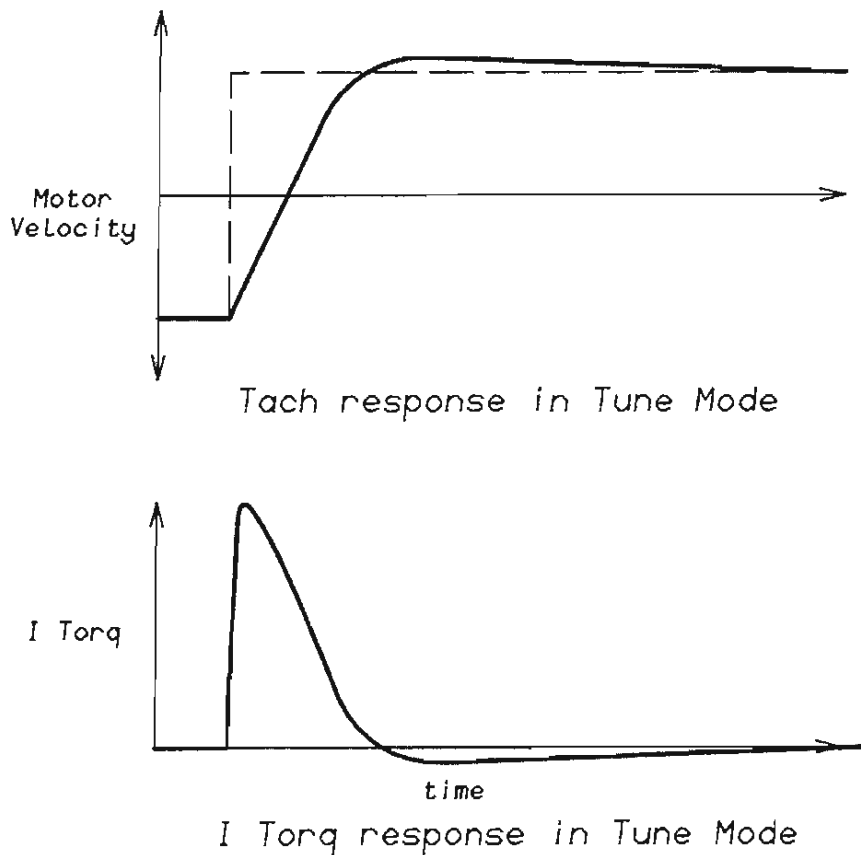


Figure 5-12 Typical Small-Signal Response for Well-Tuned System



## 5.4 Personality Module Installation

### Personality Module (PM) for BRU SERIES Drive Module

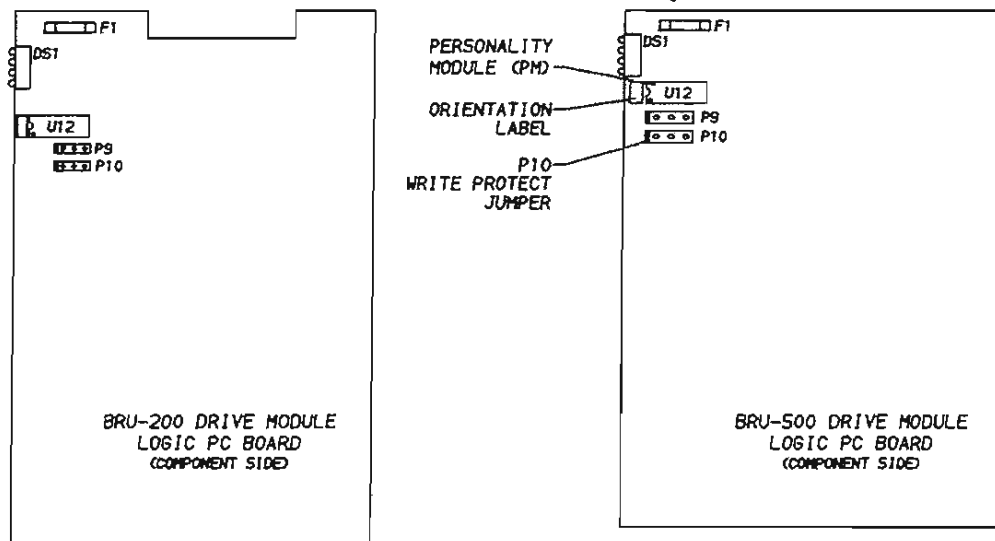
Must be installed prior to operation.

DO NOT INSTALL OR REMOVE WHILE POWER TO DRIVE MODULE IS ON.

STATIC SENSITIVE DEVICE: Wear conductive wrist strap while handling, or touch earth ground before handling.

### INSTALLATION INSTRUCTIONS:

- \* Check that power to Drive Module is OFF.
- \* Remove Drive Module cover (BRU-500 only).
- \* Install Personality Module into the socket marked U12 on the Drive Module Logic board. End of Personality module with colored label on it must be next to colored label on logic board, and colors must match.
- \* Check that jumper P10 is set to position 1-2.  
(unless parameter changes are being made; see below)
- \* Install Drive Module cover (BRU-500 only).



### P10 Write Protect Jumper

- \* Do not move jumper with power on.
- \* Move to position 2-3 (not write protected) only when changing Personality Module parameters using serial terminal.
- \* ALWAYS RETURN to position 1-2 (standard position, write protected) after completing parameter changes.

**Figure 5-13 Personality Module Installation**

## SECTION VI - TROUBLESHOOTING AND MAINTENANCE

### 6.1 Introduction

The BRU-Series drive has been designed to provide troubleshooting aids that help isolate any problems in a "module" of the system. A module may be incoming power, PSM (BRU-500 only), DM, PM, motor and encoder, controller, cables, or mechanical system. BRU-Series drive circuitry is designed to prevent problems in any one module from causing damage to any other module. The cost-effective modular package provides for very simple field replacement. The DM personality module "transfers" all information and adjustment parameters to the replacement module.

BRU-Series drive maintenance is virtually unnecessary. The primary consideration is to insure BRU-Series drive fans are operational and to operate the BRU-Series drive in a properly sized and ventilated NEMA-12 (or equivalent) enclosure with proper fusing.

### 6.2 LED Diagnostic Information

#### 6.2.1 Power Supply Module LEDs (BRU-500 Only)

<u>LED Label</u>	<u>LED Color</u>	<u>Description</u>
PHASE LOSS .....	Red .....	Off = OK On = Loss of one phase of incoming AC power
OVERTEMP .....	Red .....	Off = OK On = Excessive temperature of main heatsink
DISABLED .....	Red .....	Off = Not disabled On = DC bus disabled from external enable input
PSM READY .....	Green.....	Off = No DC bus voltage On = DC bus voltage is present

If the green LED will not come on (and no red LEDs come on or the indicated fault does not exist) and the incoming line voltages are found to be proper then there may be a PSM failure. Replace the PSM with another unit.

#### 6.2.2 Drive Module LEDs

<u>LED Label</u>	<u>LED Color</u>	<u>Description</u>
1 .....	Green.....	Off = Loss of one or more logic supplies or external reset pins connected.  On = Logic supplies OK. LED should turn off within about 1 second at power down. If LED remains on at power down, shunt regulator is not functioning.
2,3,4 .....	Red .....	Off = No fault



<u>LED Label</u>	<u>LED Color</u>	<u>Description</u>
2 .....	Red .....	On = DC bus overvoltage or Heatsink Overtemperature or Logic power supply undervoltage
3 .....	Red .....	On = Short Circuit Overcurrent or Excessive Average Current
4 .....	Red .....	On = Motor Overspeed
3,4 .....	Red .....	On = Motor overtemperature
2,4 .....	Red .....	On = Power-Up Diagnostic Fault, Watchdog timeout (CPU OK)
2,3,4 .....	Blink Red	During power-up, LEDs should turn on for about one second and then turn off. If they remain on and the green LED is on then there is a CPU fault. DM should be replaced.

**NOTE:** While the reset pins (P2-5 and P2-6) are connected, LEDs 2, 3, and 4 will remain on and LED 1 will remain off.

Drawing 9101-0139 (BRU-500) and drawing 9101-1061 (BRU-200) indicates DM test point locations and description of test point signal.

### 6.3 Serial Link Diagnostic Information

In the event of an error occurring in the BRU-Series system, the serial terminal can provide more diagnostic information on the cause of the fault than can be indicated on the LEDs. When a fault is detected, the terminal will automatically switch to the Status page and display a message stating the fault which has been detected, some possible causes for this fault, and some suggestions for corrective action. If the terminal was not connected to the BRU-Series at the time the fault occurred, the terminal may be plugged into connector P6 and pressing <ESC> will display the diagnostic message.

The fault conditions which are displayed by the terminal are:

- 1.) Motor Over Temperature
- 2.) Heat Sink Over Temperature
- 3.) Over Voltage Fault
- 4.) Under Voltage Fault
- 5.) Motor Short Circuit Fault
- 6.) Excessive Current Error
- 7.) Personality Check Error
- 8.) Over Speed Error
- 9.) Reset Error
- 10.) Watch Dog Time-Out Error

Refer to Section 5.2.3.2.2 for more details on the serial link diagnostic information.

## SECTION VII - OPTIONAL ACCESSORIES

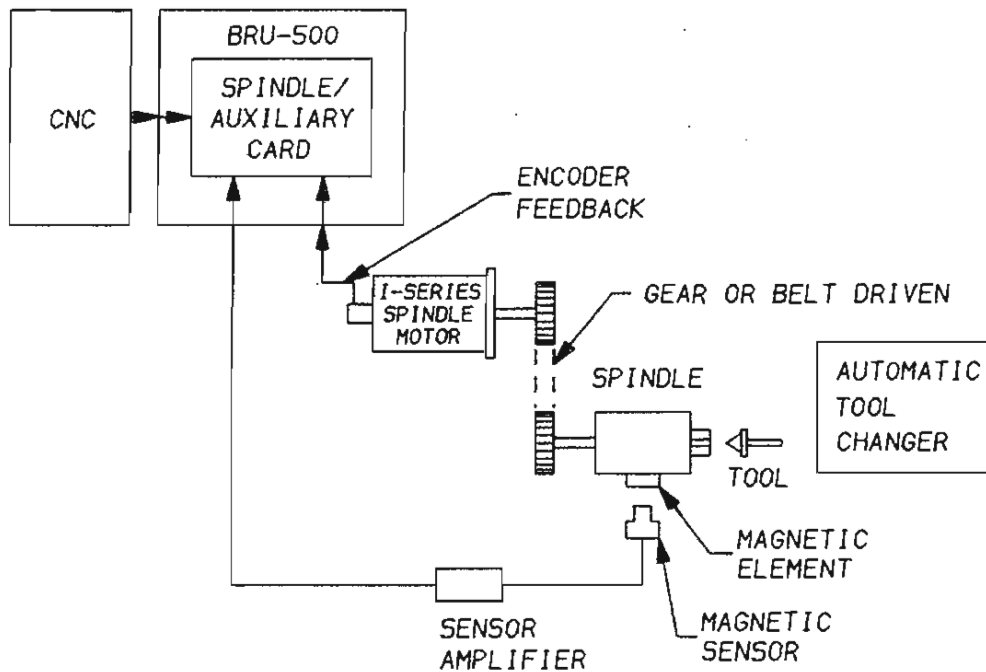
### 7.1 PRO-Series Controller Kit Installation Instructions

The PRO-Series single axis controller products which are available as stand-alone units are also available in kit form for integration into the BRU-Series drive modules. In this cost effective configuration, the PRO-Series controller card shares the BRU-Series power supplies, package, and encoder.

Drawing 9097-1127 (BRU-500) and drawing 9097-1331 (BRU-200) provides installation instructions for mounting the PRO-Series controller card in the standard BRU-Series drives. The standard PRO-Series Instruction Manuals should be used for operating instructions.

### 7.2 Spindle Orient and Auxiliary Function Card Installation Instructions (BRU-500 Only)

The Electro-Craft Spindle Orient and Auxiliary Function Card mounts in the Electro-Craft BRU-500 to provide basic auxiliary functions required for many spindle applications (refer to drawing 9101-0236). Figure 7-1 illustrates the Spindle Orient and Auxiliary Function Card operating with a BRU-500 in a typical machine tool application to provide spindle orient for an automatic tool changer plus additional inputs and outputs used for spindle interface.



**Figure 7-1 Spindle Orient and Auxiliary Function Application (BRU-500 Only)**

The Spindle/Auxiliary Card accepts an analog velocity command input and differential encoder signal feedback. The analog velocity command input and the forward and reverse inputs are used to generate a velocity command for the spindle drive to follow. The rate of change of this velocity command is limited to an acceleration/deceleration time which is user programmable. The Spindle/Auxiliary Card uses the command and feedback information to provide outputs indicating zero speed, up-to-speed, and speed below a programmable threshold. A pulse output is available for externally monitoring the speed of the

spindle motor. The Spindle/Auxiliary Card also provides outputs for system status and inputs for emergency stop and spindle drive enable.

In addition to the functions described above, the Spindle/Auxiliary Card has the capability of implementing a spindle orient function using a customer supplied magnetic position sensor mounted on the spindle. The customer supplied position sensor is a magnetic element mounted on the spindle opposite a sensor head. The position sensor generates two signals during the spindle orient process, a marker signal and a linear signal. The marker signal indicates when the spindle is in the vicinity of the orient position and the linear signal goes through zero volts when the magnetic marker passes the center of the sensor head. The Spindle/Auxiliary Card uses the signals from the sensor to implement a single-point spindle orient, where the orient position is determined by the location of the position sensor magnetic element. The spindle orient routine is initiated by an orient command input and will indicate when the spindle has reached the desired position with an orient complete output.

### 7.3 BRU-Series Control Station

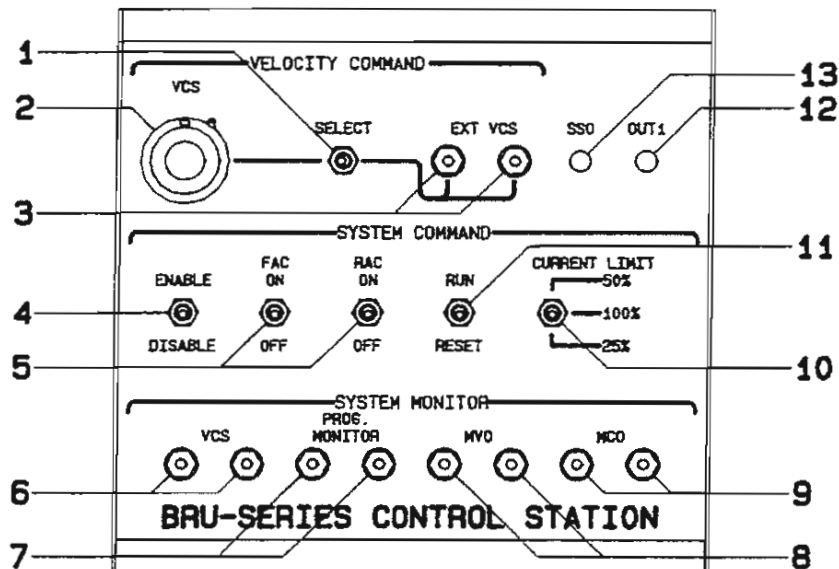


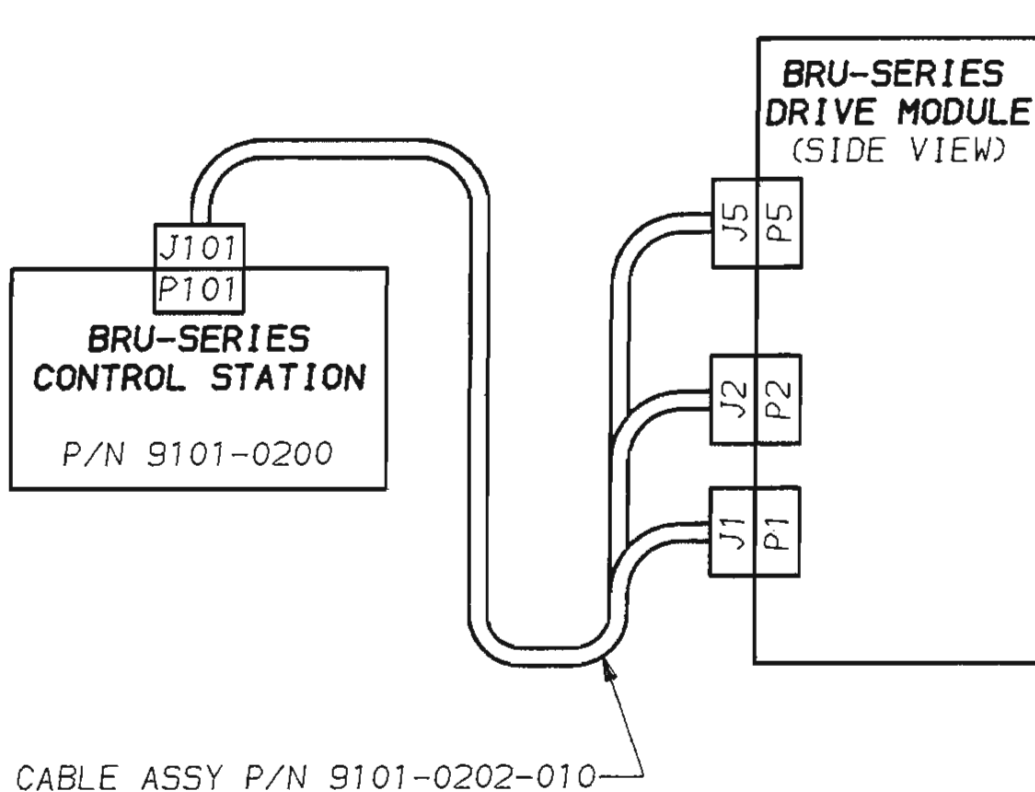
Figure 7-2 BRU-Series Control Station

- 1.) The Select switch selects either the VCS (Velocity Command Signal) from the VCS dial or an external VCS input as the velocity command.
- 2.) The VCS dial supplies a  $\pm 10$  volt command to the Drive Module. Mid-position (dial reading 5.0) is 0 volts.
- 3.) The EXT VCS points are used to connect an external velocity command signal to these points when the VCS dial is not being used and the select switch is in the EXT VCS position.
- 4.) The ENABLE/DISABLE switch is used to either ENABLE or DISABLE Drive Module power to the motor. In the DISABLE position the motor shaft can turn freely (unless held by optional motor brake).
- 5.) The FAC and RAC switches are used to hold motor position. When either the FAC or RAC switch is at the ON position, motor rotation in that direction is clamped to 0 RPM when in velocity mode and motor torque for that polarity is clamped to 0 amps in torque mode. (FAC, RAC = Forward or Reverse Amplifier Clamp)



- 6.) The VCS test points are used to monitor the VCS command to the Drive Module.
- 7.) The programmable monitor test points may be used to monitor the signal selected as the Monitor signal using a serial terminal. Information on the choice of signals that can be output to these test points is shown by moving the cursor to the Monitor line on the serial terminal Setup page.
- 8.) The MVO test points are used to monitor the Motor Velocity Output (tachometer) from the Drive Module.
- 9.) The MCO test points are used to monitor the Motor Current Output (current command) from the Drive Module.
- 10.) The current limit switch sets the peak current limit to 25, 50, or 100% of the Drive Module peak current rating.
- 11.) The RUN/RESET switch is used to reset the Drive Module fault circuits by momentarily setting to RESET and then to RUN.
- 12.) The OUT1 LED is ON when the contacts of the OUT relay are closed in the Drive Module.
- 13.) The SSO LED is OFF when there is either a Drive Module fault or the reset switch is activated.

**NOTE:** The RED test points are + (plus), and the BLACK test points are - (minus). Black test points PROG MONITOR, MVO, MCO, (and VCS when SELECT is set to VCS dial) are connected to signal COMMON on the Drive Module.



**Figure 7-3 BRU-Series Control Station Connection Diagram**

#### **7.4 RS232C/RS422 Converter**

The RS232C/RS422 converter option card mounts in the Electro-Craft BRU-200 and BRU-500 to provide data conversion between RS232C and RS422 standards. This option card is useful when multiple BRU-Series drives are connected together on a daisy-chain serial link using the multi-drop host mode serial protocol. Drawing 9101-0334 shows the board outline and connections.

## SECTION VIII - APPLICATION GUIDELINES

### 8.1 Torque Sharing Operation of BRU-Series Drives

#### 8.1.1 General Description

The BRU-Series drives provide the capability to operate in a torque-sharing mode for applications where multiple motor shafts are rigidly coupled together to drive a common load. The torque sharing configuration may be used with either servo or spindle drives.

The torque sharing mode would typically be used in situations where:

- 1.) A lead screw or shaft is driven from each end;
- 2.) Two or more lead screws must be driven;
- 3.) Drive train torque must be distributed to protect the machine mechanics.

Some of these cases are illustrated in Figure 8-1.

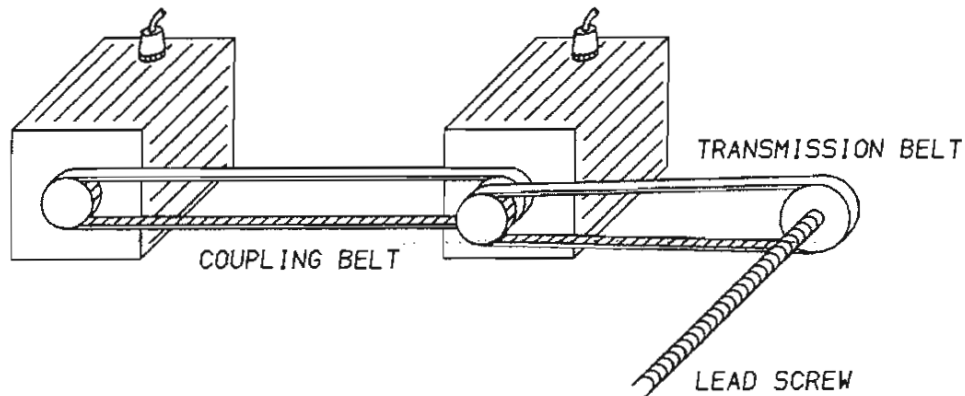
The BRU-Series servo drives provide a flexible microprocessor-based control which allows operation in the torque sharing mode without requiring additional external hardware. All setup and tuning changes can be made using a serial terminal, so there are no components to change and no potentiometers to adjust.

#### 8.1.2 Theory of Operation

The torque sharing mode requires that one drive (designated as the master drive) operates as a velocity controller, and one or more drives (referred to as slave drives) operate as torque controllers. A serial terminal is used to set the mode, scaling, and tuning parameters. Detailed instructions for setup of the drive using the terminal can be found in Section 5.2.3.2.

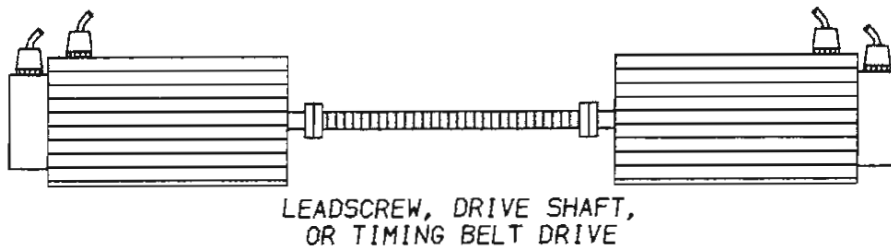
The torque signal (MCO) from the master drive is used as the command for the slave drive. This is a  $\pm 10$  Volt signal, where 10 V corresponds to the peak current of the master drive. For example, if a BRU-500 DM-50 is used as the master drive, a 10 Volt MCO signal corresponds to 50 amps of motor current, and the polarity of the MCO signal determines whether positive or negative torque is produced. The scaling of the MCO output from the master drive is then 5 Amps per Volt (A/V). The command scaling of the slave drive, operating in torque mode, is also in A/V. For equal sharing of the torque, the slave command scaling is set to the same value as the master drive MCO scaling.

**NOTE:** If the master and slave motors have different torque constants (Kt), this must be taken into account when determining the slave command scaling in order to obtain equal torque sharing.



- A.) Torque sharing with motors rotating in same direction

**NOTE:** For proper torque sharing, the coupling belt must have no backlash.



- B.) Torque sharing with motors rotating in opposite directions.

**NOTE:** Shaft connection between master and slave motors must have no windup or backlash.

**Figure 8-1 Examples of Torque Sharing Operation**

#### 8.1.2.1 Multiple Slave Drives

If multiple slave drives are used, the command for the next slave is generated from the MCO of the previous slave. The command scaling for each slave must be set to the proper value as described previously. The SSO relays of all drives should be connected in series with the enable line for safety.

#### 8.1.2.2 Unequal Torque Sharing

Torque sharing in ratios other than unity results if the slave drive command scaling is set to a value different from the master drive MCO scaling. Unequal torque sharing may be obtained by setting the appropriate command scaling for the slave drive. For example, if in the system described previously the slave's command scaling is set to 2.5 A/V rather than 5 A/V, the slave drive will produce 50% of the current that the master drive produces. If the master and slave motors have different torque constants ( $K_t$ ), the command scaling must take this into account to achieve the desired torque sharing ratio.

### 8.1.3 Set-Up Procedure

It is recommended that proper operation of the drive modules and motors is verified before beginning the torque sharing set-up. Offsets in the drives may be adjusted at this time. A drive which is trimmed in the velocity mode will still be correctly adjusted when it is changed to torque mode.

#### 8.1.3.1 Wiring Instructions

The recommended wiring for the master-slave configuration is shown in Figures 8-2 and 8-3. There are two wiring diagrams shown for the two cases illustrated in Figure 8-1. Figure 8-2 shows the wiring for the case where master and slave motors rotate in the same direction, and Figure 8-3 is the wiring for the case when master and slave motors rotate in opposite directions. The wiring for these two cases is different because the polarity of the slave command is reversed in the two situations.

The forward and reverse clamps (FAC and RAC) are not shown in Figures 8-2 and 8-3. If it is desired to connect limit switches or other logic to these inputs, only the FAC and RAC inputs on the master drive should be used. The FAC and RAC inputs on the slave drives should be disabled by connecting FAC+ to FAC- and RAC+ to RAC-.

**NOTE:** It is important that the SSO relay is wired in the enable circuit as shown, so that all drives will be disabled if there is a fault on any one of the drives. Otherwise, dangerous situations can result.

#### 8.1.3.2 Tuning

**NOTE:** The write protect jumper (P10) on the drive should be put in the write-enabled (2-3) position so that after the tuning is complete the values can be saved into the non-volatile memory on the BRU amplifier. It is recommended that after the set up is complete, the jumper be returned to the write-protected position.

All tuning of the master-slave system velocity control is accomplished by the velocity loop parameters of the master drive. The only adjustment required on the slave drives is setting the correct command scaling and adjusting the offset. The command scaling for the slave drives was discussed previously in the Section 8.1.2.

If the offset of the slave drive has already been trimmed, in either velocity or torque mode, there is no need to adjust it again. Once the slave drive is set in the torque mode, the offset adjustment can be accomplished by the following procedure:

- 1.) Set up the slave drive in the torque mode, with the serial terminal connected, and with a command of zero;
- 2.) Set the programmable monitor to look at torque, and enable the drive;
- 3.) The torque displayed on the terminal is the offset in Amps;
- 4.) Calculate the offset in volts by dividing the offset in Amps from step 3 by the command scaling in Amps per Volt and enter the negative of the result into the terminal as offset;
- 5.) Repeat steps 2 and 3 to check that the offset is correct, and then save the results with the 'S' command on the terminal.

The velocity loop of the master drive is tuned as described in the tuning procedure for a standard drive. The velocity loop tuning should be done with all slave drives connected and enabled, because the slave drives will affect the velocity loop response.

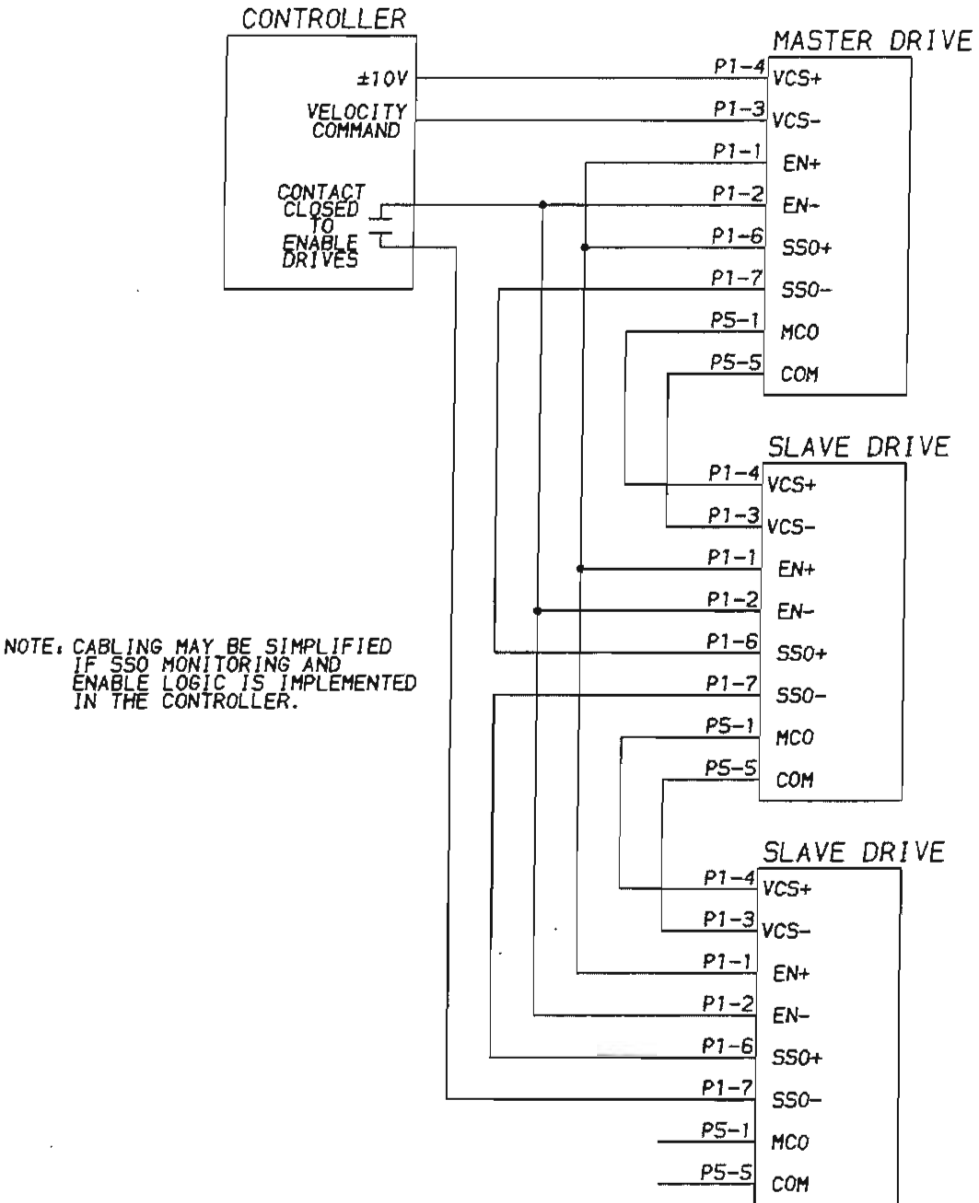


Figure 8-2 Recommended Wiring for Torque Sharing when Motors Rotate in Same Direction

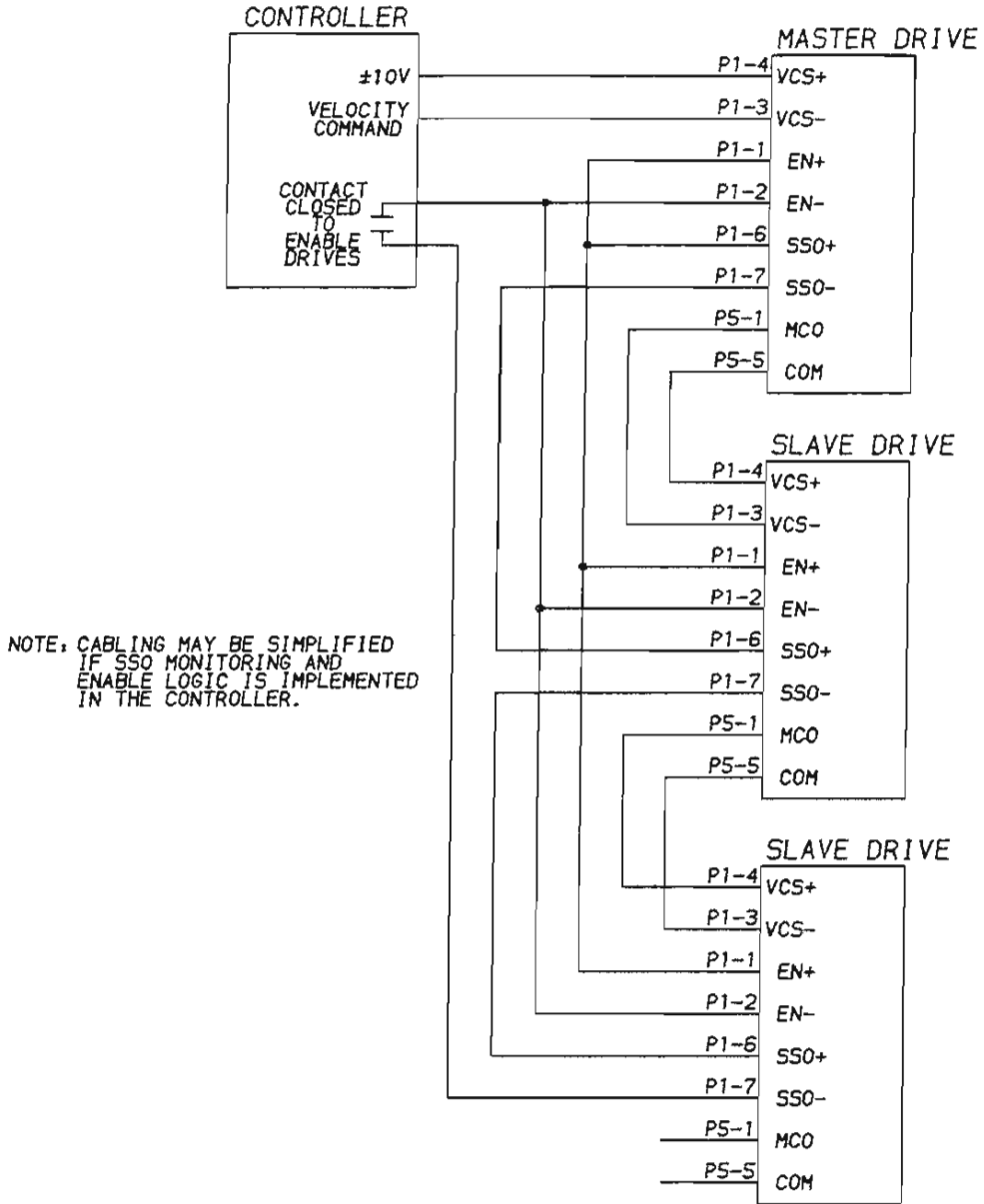


Figure 8-3 Recommended Wiring for Torque Sharing when Slave Motors Rotate Opposite of Master Motor

## SECTION IX - REPLACEMENT PARTS

## 9.1 Power Supply Modules (BRU-500 Only)

<u>Part Number</u>	<u>Description</u>
9101-3000 .....	PSM-50 Power Supply Module
9101-3001 .....	PSM-125 Power Supply Module
9101-0120 .....	PSM-AUX
9101-1076 .....	Fuse, F1, PSM-125, Shunt Fuse (Bussmann KLM-20 or Littelfuse KLK D 20)
9101-0225 .....	Fuse, F1, PSM-50, Shunt Fuse (Bussmann KLM-8 or Littelfuse KLK D 8)
9101-0123 .....	Fuse, F1, PSM-AUX (Bussmann MDX-7 or Littelfuse 313 007)
9101-0111 .....	Connector TB1, PSM, Screw Terminal

## 9.2 Drive Modules

<u>Part Number</u>	<u>Description</u>
9101-1301 .....	DM-10 Drive Module
9101-1302 .....	DM-20 Drive Module
9101-1303 .....	DM-30 Drive Module
9101-0310 .....	DM-25 Drive Module
9101-0311 .....	DM-50 Drive Module
9101-0312 .....	DM-100 Drive Module
9101-0313 .....	DM-150 Drive Module
9101-0314 .....	DM-150X Drive Module
9101-0228 .....	Fuse, Drive Module F1 (for 24 VDC circuits) (Bussmann MDL 1 or Littelfuse 313 001)
9101-0093 .....	Connector Kit, Crimp Type (Mating Connectors for DM P1-P6) Crimp contacts provided with this package are Molex brand, Molex order number 08-55-0102. Use with 22 or 24 gauge stranded wire. Crimp with Molex hand tool, Molex order number 11-01-0037.
9101-0098 .....	DC Bus Connection Kit (Pos, Neg, Gnd Wires - BRU-500 Only)
9101-0200 .....	BRU-SERIES Control Station
9101-0333 .....	RS232C/RS422 Converter Kit



### 9.3 Personality Modules

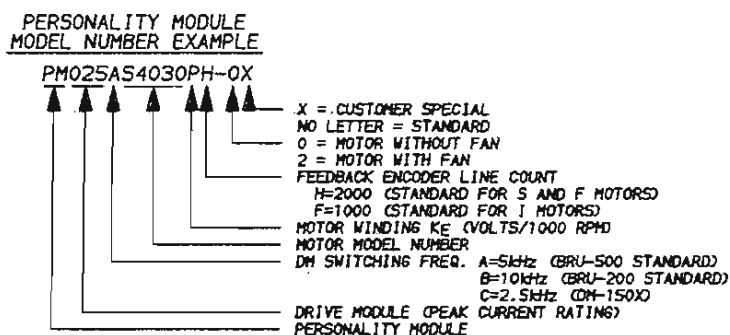


Figure 9-1 Personality Module Model Number Description

### 9.4 Motors

Motors have a model number which is explained in Figure 9-2.

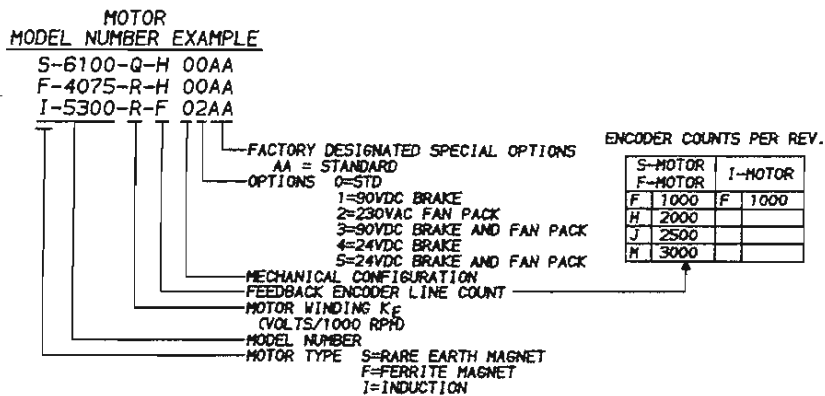


Figure 9-2 Motor Model Number Description

## 9.5 PRO-Series Kits

<u>Part Number</u>	<u>Description</u>
9097-1111.....	PRO-100 Kit
9097-1112.....	PRO-200 Kit
9097-1026-005.....	PRO-200 Handheld Input Terminal with 5 foot cable
9097-1026-505.....	PRO-200 Panel Mount Input Terminal with 5 foot cable
9097-1113.....	PRO-300 Kit
9097-1114.....	PRO-400 Kit
9097-1115.....	PRO-150 Kit
9097-1116.....	PRO-450 Kit
9097-1119.....	Connector Kit, PRO-X00/BRU-Series (Connectors for PRO P1-P6,P8)
9097-1120.....	Connector Kit, PRO-X50/BRU-Series (Connectors for PRO P1-P6, P8)
9097-1094.....	PRO-450 Operator Station

## 9.6 Spindle Orient and Auxiliary Function Card (BRU-500 Only)

<u>Part Number</u>	<u>Description</u>
9097-2000.....	Spindle Orient and Auxiliary Function Card
9097-2009.....	Connector Kit, Spindle Orient/BRU-Series (Connectors for Spindle Orient Card P1- P8)

## 9.7 Cables

<u>Part Number</u>	<u>Description</u>
9101-0145-XXX.....	Drive Module Cable terminated for P1 [2]
9101-0146-XXX.....	Drive Module Cable terminated for P2 [2]
9101-0147-XXX.....	Drive Module Cable terminated for P3 [2]
9101-0149-XXX.....	Drive Module Cable terminated for P4 [2] (S-Series, F-Series, or I-Series motors)
9101-0150-XXX.....	Drive Module Cable terminated for P5 [2]
9101-0161-XXX.....	Drive Module Cable terminated for P6 [2]
9101-0224-XXX.....	9101-0149-XXX Cable with 9101-0329 connector installed on motor end of cable. (S-Series or F-Series motors)
9097-1040-010.....	Cable, DM P6 or PRO P5 to Tandy 102 Terminal (25 pin D)
9097-1108-010.....	Cable, DM P6 or PRO P5 to PC (9 pin D)
9101-0202-010.....	Cable, DM to BRU-SERIES Control Station
9101-0250-XXX.....	BRU-500/S-3000 Power Cable
9101-0251-XXX.....	BRU-500/S-4000/F-4000 Power Cable
9101-0252-XXX.....	BRU-500/S-6000/F-6000 Power Cable
9101-0253-XXX.....	BRU-500/S-8000 Power Cable
9101-1080-XXX.....	BRU-200/S-2000/S-3000 Power Cable
9101-1081-XXX.....	BRU-200/S-4000/F-4000 Power Cable

- [1] Standard cable lengths are 10, 25, 50, and 75 feet. Last three digits denote length of cable in feet.
- [2] Cables noted are terminated on the DM end only. This is to allow cable to be routed through conduit and cut to the length required.

## 9.8 Transformers

<u>Part Number</u>	<u>Description</u>
0020-5091-001.....	3 kVA Three Phase Transformer (BRU-500)
0020-5091-002.....	6 kVA Three Phase Transformer (BRU-500)
0020-5091-003.....	12 kVA Three Phase Transformer (BRU-500)
0020-5091-004.....	18 kVA Three Phase Transformer (BRU-500)
0020-5093.....	PSM-AUX Transformer (BRU-500)
0020-5097.....	3 kVA Single Phase Transformer (BRU-200)

## 9.9 Motor Mating Connectors

<u>Part Number</u>	<u>Description</u>
9101-0325.....	Motor Power Connector Kit, S-2000 and S-3000 Motors (MS3106F18-4S Connector)
9101-0326.....	Motor Power Connector Kit, S-4000, F-4000 Motors (MS3106F20-4S Connector)
9101-0327.....	Motor Power Connector Kit, S-6000, F-6000 Motors (MS3106F24-22S Connector)
9101-0328.....	Motor Power Connector Kit, S-8000 Motor (MS3106F32-17S Connector)
9101-0329.....	Encoder Connector Kit, S-Series, F-Series Motors (MS3106F20-29S Connector)
9101-0330.....	Brake Connector Kit, S-Series, F-Series Motors (MS3106F12S-3S Connector)
9101-0331.....	Encoder Connector Kit, I-5300, I-6600 (AMP 1-480438-0 Connector and AMP 60617-5 Crimp Contacts)

## 9.10 Motor Shaft Seal Kits

0041-5056.....	Shaft Seal Kit, S-2000 Motor (22 mm O. Dia. x 12 mm I. Dia. x 7 mm Wide Seal)
0041-5057.....	Shaft Seal Kit, S-3000 Motor (28 mm O. Dia. x 15 mm I. Dia. x 7 mm Wide Seal)
0041-5058.....	Shaft Seal Kit, S-4000 Motor (47 mm O. Dia. x 20 mm I. Dia. x 7 mm Wide Seal)
0041-5059.....	Shaft Seal Kit, S-6000 Motor (80 mm O. Dia. x 38 mm I. Dia. x 8 mm Wide Seal)
0041-5053-005.....	Shaft Seal Kit, S-8000 Motor (85 mm O. Dia. x 45 mm I. Dia. x 8 mm Wide Seal)
0041-5060.....	Shaft Seal Kit, F-4000 Motor (1.437 inch O. Dia. x .875 inch I. Dia. x .25 inch Wide Seal)
0041-5061.....	Shaft Seal Kit, F-6000 Motor (2.125 inch O. Dia. x 1.438 inch I. Dia. x .31 inch Wide Seal)

## SECTION X - CUSTOMER REFERENCE DRAWINGS

### 10.1 List of Drawings

<u>Drawing Number</u>	<u>Description</u>
9097-1127 .....	Diagram, Installation, PRO-Series Kits/BRU-500
9097-1131 .....	Diagram, Interconnect, BRU/BSA to PRO
9101-0129 .....	Diagram, Outline and Mtg., S-Series Motors
9101-0130 .....	Diagram, Outline and Mtg., I-Series Motors
9101-0131 .....	Diagram, Outline, Transformers, BRU-500
9101-0132 .....	Diagram, Transformer Load Regulation, BRU-500
9101-0134 .....	Diagram, Outline and Connection, PSM-AUX, BRU-500
9101-0136 .....	Diagram, Serial Terminal Connections, PRO P5, BRU P6
9101-0137 .....	Diagram, Interface Connections, BRU-Series
9101-0138 .....	Diagram, PSM, Interface Connections, BRU-500
9101-0139 .....	Diagram, Test Points, DM, BRU-500
9101-0140 .....	Schematic, Cable, DM Connector P4/S Motor/F Motor/I Motor
9101-0142 .....	Schematic, Cables, DM Connectors P1, P2, P3, P5
9101-0233 .....	Diagram, Outline and Mtg., PSM-AUX Transformer
9101-0235 .....	Diagram, DM/Motor/PM Std. Combinations (BRU-500)
9101-0236 .....	Diagram, Installation, Spindle Orient Kit/BRU-500
9101-0239 .....	Diagram, Interface Connection Example, BRU-Series
9101-0332 .....	Diagram, Outline and Mtg., F-Series Motors
9101-0334 .....	Diagram, Connection, RS232C/RS422 Converter
9101-0336 .....	Diagram, Installation, RS-232C/RS422 to BRU-500
9101-0409 .....	Diagram, Outline and Mtg., BRU-500
9101-0410 .....	Diagram, Outline and Mtg., PSM, BRU-500
9101-0411 .....	Diagram, Power Wiring Connection, BRU-500
9101-1053 .....	Diagram, DM/Motor/PM Std. Combinations (BRU-200)
9101-1056 .....	Diagram, Outline, Transformer, BRU-200
9101-1057 .....	Diagram, Transformer Load Regulation, BRU-200
9101-1061 .....	Diagram, Test Points, DM, BRU-200
9101-1140 .....	Schematic, Cable, Motor Power
9101-1300 .....	Diagram, Outline and Mtg., BRU-200
9101-1328 .....	Diagram, Mounting and Connection, External Shunt, BRU-200
9101-1329 .....	Diagram, Power Wiring Connection, BRU-200
9101-1330 .....	Diagram, Installation, RS-232C/RS422 to BRU-200
9101-1331 .....	Diagram, Installation, PRO-Series Kits/BRU-200



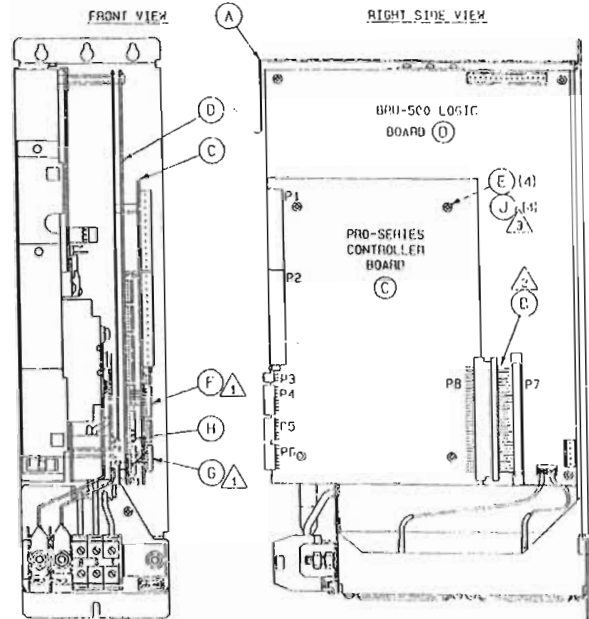
**PRO-SERIES KIT INSTALLATION INSTRUCTIONS**

1. REMOVE COVER (A) FROM DRIVE MODULE. REMOVE NUTS (GTY 2, NOT SHOWN) INSIDE OF COVER (A) AND REMOVE FILLER PANEL (NOT SHOWN) FROM FRONT OF COVER.
2. PLUG RIBBON CABLE (B) INTO CONNECTOR P7 OF BOARD (D) AND INTO CONNECTOR PB OF BOARD (C).
3. FASTEN BOARD (C) TO BOARD (D) USING (4) SCREWS (E) AND (4) LOCK WASHERS (J).
4. PLUG JUMPER CONNECTOR (H) INTO CONNECTOR P2 OF BOARD (D).
5. PLUG 6-WIRE HARNESS (F) INTO CONNECTOR P3 OF BOARD (D) AND INTO CONNECTOR P4 OF BOARD (C).
6. PLUG 2-WIRE HARNESS (G) INTO CONNECTOR P1 OF BOARD (D) AND INTO CONNECTOR PB OF BOARD (C).
7. INSTALL COVER (A).

HATING CONNECTORS ARE PROVIDED IN THE PRO-SERIES KIT FOR CUSTOMER CONNECTION TO PRO-SERIES CONTROLLER BOARD CONNECTORS P1, P2, P3, P5.

HATING CONNECTORS ARE PROVIDED WITH THE BRU-500 FOR CUSTOMER CONNECTION TO BRU-500 LOGIC BOARD CONNECTORS P4, P5, P6.

**BRU-500 DRIVE MODULE WITH PRO-SERIES CONTROLLER OPTION**

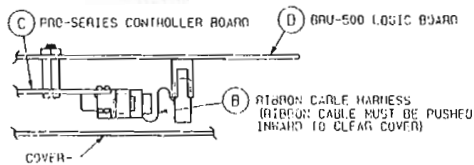


**NOTES**

1. HARNESS (F) AND (G) ARE NOT USED ON BRU-500 PART NO'S. 9101-031X. CONNECTIONS ARE MADE THROUGH RIBBON CABLE (B)

2. RIBBON CABLE HARNESS

**TOP VIEW**



3. LOCK WASHERS (J) ARE USED ON PRO-X50 & PRO-X50H ONLY.

D	20622	J1	CORRECTED TYPO	8-25-93	BC
B-C B-19870, C-19936					
A	19752	DC	RELEASED	8-15-91	DC
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKD
BRU-500 DRIVE MODULE			BY	DATE	CHKD
DIMENSIONS ARE IN INCHES			BY	DATE	CHKD
BREAK ALL EDGES .02 MAX			BY	DATE	CHKD
FILLETS AND ROUNDS .02 R MAX			BY	DATE	CHKD
TOLERANCES UNLESS OTHERWISE SPECIFIED			BY	DATE	CHKD
FRACTIONS $\pm 1/64$			BY	DATE	CHKD
DECIMALS $\pm .001$			BY	DATE	CHKD
ANGLES $\pm 1'$			BY	DATE	CHKD
UNLESS OTHERWISE SPECIFIED			BY	DATE	CHKD
MATERIALS UNLESS OTHERWISE SPECIFIED			BY	DATE	CHKD
FINISHES UNLESS OTHERWISE SPECIFIED			BY	DATE	CHKD
DRAWN BY			DATE	CHKD	
CHECKED BY			DATE	CHKD	
APPROVED BY			DATE	CHKD	
RELIANCE ELECTRIC			9007-1127		
			H/A		1 of 1















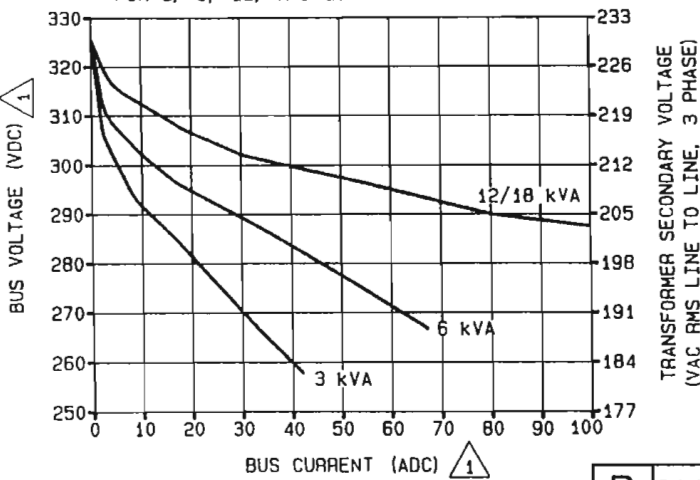
C







3 PHASE TRANSFORMER SECONDARY VOLTAGE  
AND CORRESPONDING DC BUS VOLTAGE,  
VERSUS DC BUS CURRENT  
FOR 3, 6, 12, AND 18 KVA TRANSFORMERS



RELIANCE MOTION CONTROL 3 PHASE TRANSFORMERS	
PART NUMBER	KVA
0020-5091-001	3
0020-5091-002	6
0020-5091-003	12
0020-5091-004	18

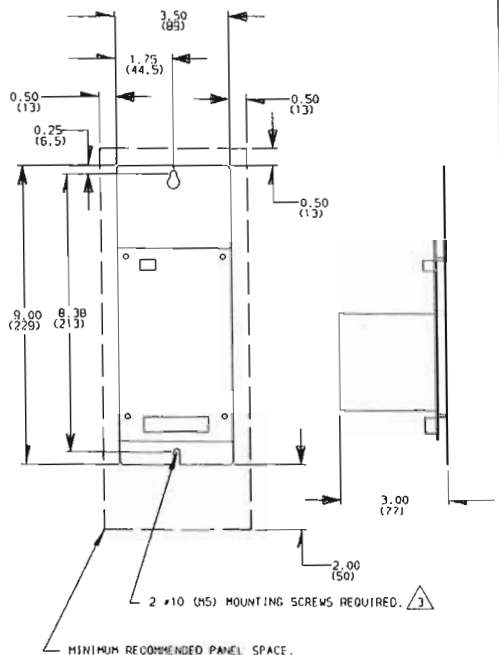
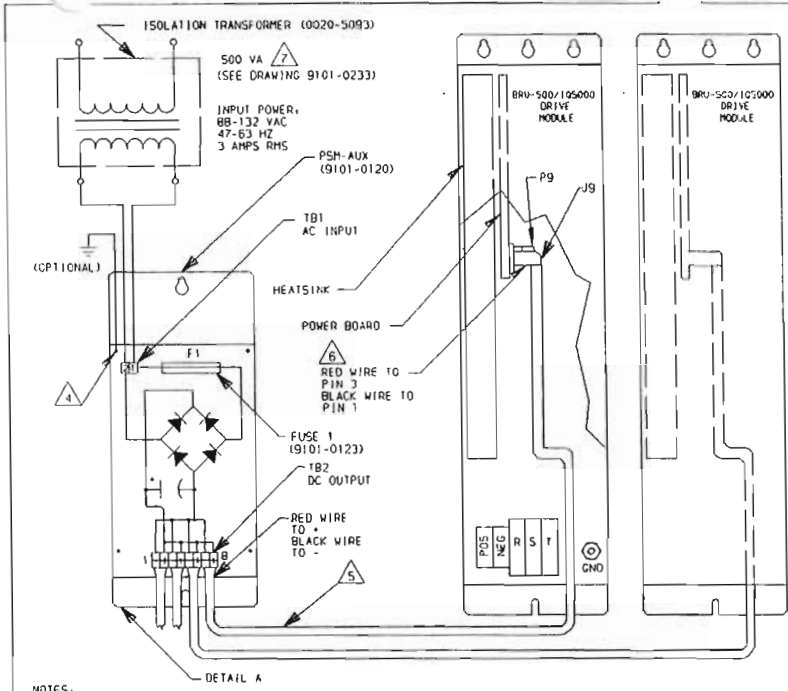
NOTES:

- DC BUS VOLTAGE AND CURRENT IS MEASURED AT POS & NEG OUTPUT TERMINALS OF THE POWER SUPPLY MODULE.
- CURVES SHOW REDUCTION IN TRANSFORMER SECONDARY VOLTAGE AND THE DRIVE MODULE DC BUS VOLTAGE, DUE TO TRANSFORMER INTERNAL LOSSES, AS BUS CURRENT LOAD INCREASES.
- ALL DATA TAKEN WITH TRANSFORMER PRIMARY VOLTAGE HELD TO 480 VAC 3 PHASE LINE TO LINE 60 Hz AND WITH SECONDARY WIRED FOR 230 VAC LINE TO LINE NO LOAD.

D	20625	JL	UPDATE TITLE BLOCK	10-5-93	JC
B-C B-19866, C-19960					
A	16383	BC	RELEASED	8-5-88	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRAWN BY	DATE	DESIGN ENGR
DO NOT SCALE DRAWING			BC	8-5-88	JH
DIMENSIONS ARE IN INCHES			DIAG, XFMR LOAD REG,		
BREAK ALL EDGES .02 MAX			BRU-500/IQ5000		
FILLET AND ROUNDS .02 R MAX			PART NO.		
TOLERANCE ON:			9101-0132		
ANGLES ±1°			SCALE		
FRACTIONS ±1/64"			1:1		
DECIMALS .XX±.020			DWG SIZE		
.XXX±.010			A		
RELIANCE ELECTRIC			SHEET		
			1 of 1		







NOTES:

1. PSM-AUX OUTPUT RATING, 2.0 AMPS DC AT 165 VOLTS DC. MAXIMUM LOAD, QUANTITY 4 BRU-500 OR 105000 DRIVE MODULES.
  2. OUTPUT VOLTAGE VARIES WITH INPUT VOLTAGE (NON-REGULATED OUTPUT).
3. SUGGESTED MOUNTING SCREW HEAD DIAMETER, 0.37 (9.4) MAXIMUM.
4. PC BOARD MOUNTING SCREW IS AVAILABLE FOR OPTIONAL EARTH GROUND CONNECTION. CONNECT USING LUG DESIGNED FOR #6 (M4) MOUNTING SCREW.
5. 4 CABLE ASSEMBLIES 9101-0122-006, ARE PROVIDED WITH EACH PSM-AUX TO PROVIDE AUXILIARY POWER FOR UP TO 4 DRIVE MODULES. EACH CABLE IS 6 FEET (1.8 METERS) LONG.
6. DRIVE MODULE COVER MUST BE REMOVED FOR CONNECTION OF CABLE TO CONNECTOR P9 ON POWER BOARD.
7. **IMPORTANT**  
 INPUT POWER TO THE PSM-AUX MUST BE ISOLATED FROM INPUT POWER TO THE PSM (POWER SUPPLY MODULE). A PSM-AUX ISOLATION TRANSFORMER OR A 3 PHASE ISOLATION TRANSFORMER FOR THE PSM WILL PROVIDE THE REQUIRED ISOLATION. (SEE SH1 2 OF 2)

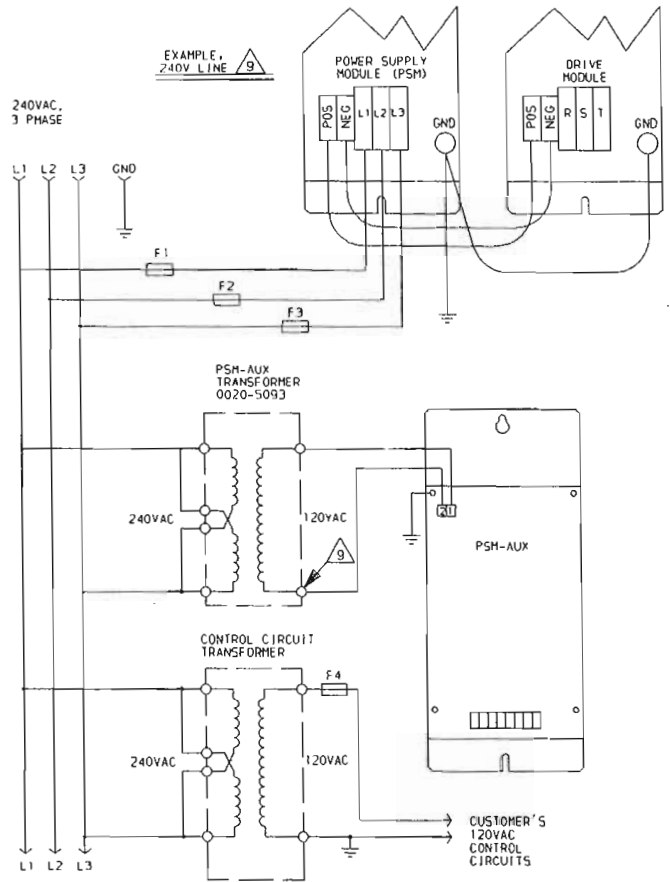
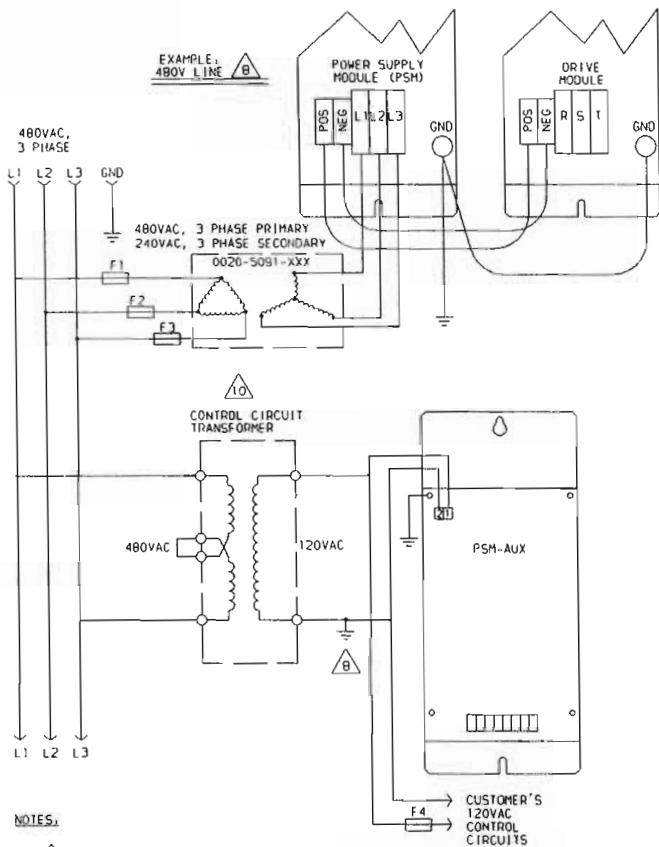
DETAIL A DRAWN AT 1/4 SCALE

DIAGRAM, OUTLINE & CONNECTION,  
 PSM-AUX, BRU-500, 105000  
 DOCUMENT NO. 9101-0134 REV D1

C



SAMPLE INPUT POWER WIRING CONFIGURATIONS, PSM-AUX WITH BRU-500 OR IQ5000



NOTES:

- ⓑ IN THIS EXAMPLE, PSM-AUX INPUT POWER IS CONNECTED TO  $\perp$  AT THE CONTROL CIRCUIT TRANSFORMER SECONDARY. THEREFORE THE PSM INPUT POWER MUST BE ISOLATED FROM  $\perp$  AND FROM THE 480V INPUT LINE. THE THREE PHASE TRANSFORMER PROVIDES THE ISOLATION AND ALSO STEPS DOWN THE VOLTAGE.
- Ⓙ IN THIS EXAMPLE, THE PSM INPUT POWER IS SUPPLIED DIRECTLY FROM THE 3 PHASE LINE. THEREFORE, THE PSM-AUX INPUT POWER MUST BE ISOLATED FROM  $\perp$  AND FROM THE 240V INPUT LINE. IN THIS EXAMPLE THE PSM-AUX TRANSFORMER SECONDARY MUST NOT BE CONNECTED TO  $\perp$ .
- ⓓ SIZE TRANSFORMER FOR 400 VA (PSM-AUX) + CUSTOMER CONTROL CIRCUIT REQUIREMENTS.

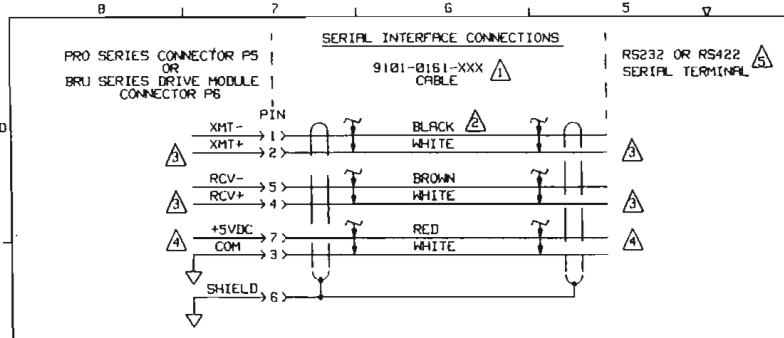
DIAGRAM, OUTLINE & CONNECTION,  
PSM-AUX, BRU-500, IQ5000  
DOCUMENT NO. 9101-0134 REV D1

C

7

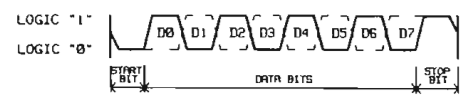
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SERIAL INTERFACE CONNECTIONS



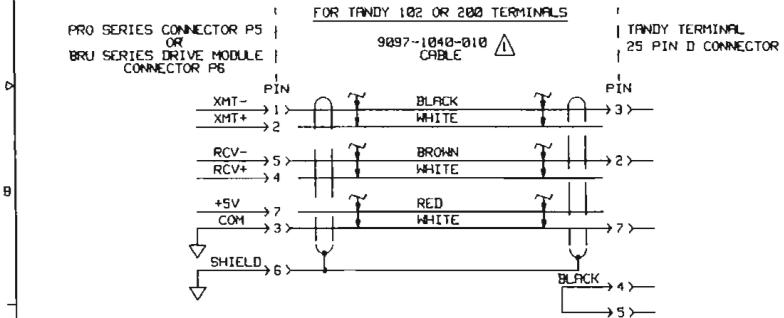
SERIAL COMMUNICATION DETAILS

1. COMMUNICATION TYPE: FULL DUPLEX
2. BAUD RATE: 9600
3. START BITS: 1 BIT
4. STOP BITS: 1 BIT
5. WORD LENGTH: 8 BITS



6. PARITY: NO PARITY, THE BRU/PRO SERIES PRODUCTS DO NOT SET A PARITY BIT OR CHECK INCOMING DATA FOR PARITY.

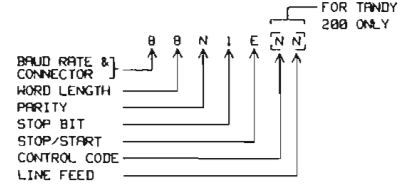
FOR TANDY 102 OR 200 TERMINALS



TANDY 102/200 SETTINGS

SETTINGS MUST BE MADE IN THE TANDY PERSONAL COMPUTER WHEN USING IT AS A SERIAL TERMINAL WITH THE BRU/PRO SERIES PRODUCTS, (REF. TANDY OWNERS MANUAL FOR SETTING COMMUNICATION PARAMETERS).

SET "TELCOM" COMMUNICATION PARAMETERS TO:



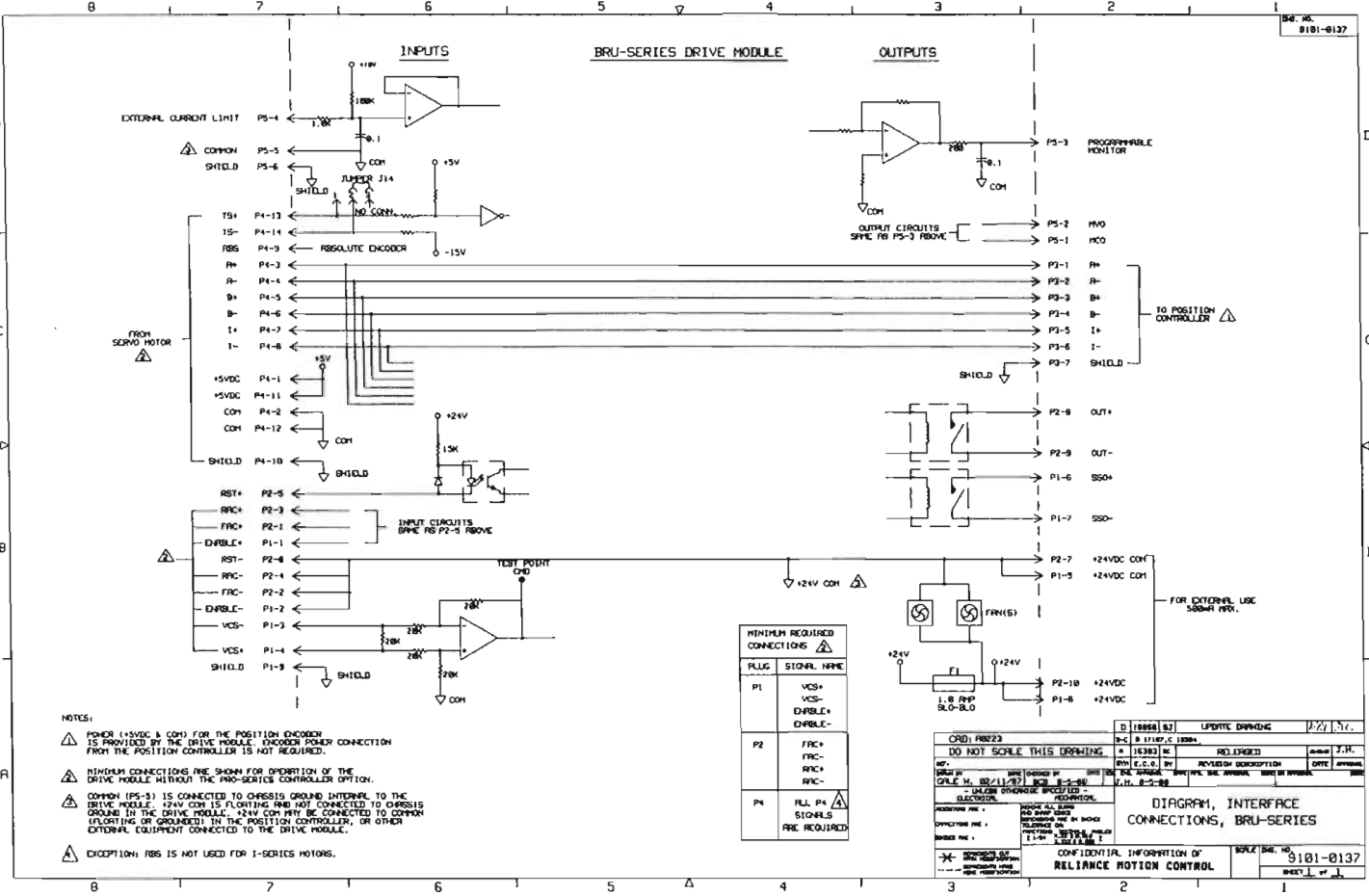
NOTES:

- 9101-0161-XXX IS A GENERAL PURPOSE CABLE FOR CONNECTION TO THE END USER'S SERIAL TERMINAL.
- 9097-1040-010 IS A CABLE TERMINATED AT BOTH ENDS FOR USE WITH TANDY 102 AND TANDY 200 TERMINALS (RS232).
- WIRE COLORS SHOWN ARE FOR CABLE ASSEMBLIES SUPPLIED BY RELIANCE MOTION CONTROL.
- XMT+ AND RCV+ ARE NOT USED FOR RS232 CONNECTION. RS232 USES SINGLE WIRE TRANSMIT AND RECEIVE CONNECTIONS REFERENCED TO COM. RS422 USES XMT+ AND XMT- FOR DIFFERENTIAL (2 WIRE) DATA TRANSMIT. RS422 USES RCV+ AND RCV- FOR DIFFERENTIAL DATA RECEIVE.
- SEE INSTRUCTIONS FOR SERIAL TERMINAL TO DETERMINE IF +5V SUPPLY CONNECTION FROM THE BRU/PRO SERIES PRODUCTS IS NEEDED. DO NOT CONNECT IF SERIAL TERMINAL USED DOES NOT REQUIRE AN EXTERNAL +5V SUPPLY.
- SELECT RS232 OR RS422 VIA JUMPER SELECTION ON THE BRU SERIES LOGIC BOARD OR PRO SERIES CONTROLLER BOARD TO MATCH SERIAL TERMINAL BEING USED.

ORD: 910225	B 119860/SJ	CHG. TITLE BLOCK	1/11/81
DO NOT SCALE THIS DRAWING	RA 119872/BC	REVISIONS	0-11-81
DATE: 2-14-80	DATE: 2-14-80	DATE: 2-14-80	DATE: 2-14-80
ELECTRICAL		DIAGRAM, SERIAL TERMINAL CONNECTIONS PRO P5/BRU P6	
CONFIDENTIAL INFORMATION OF RELIANCE MOTION CONTROL		DATE: 9101-0135	

C



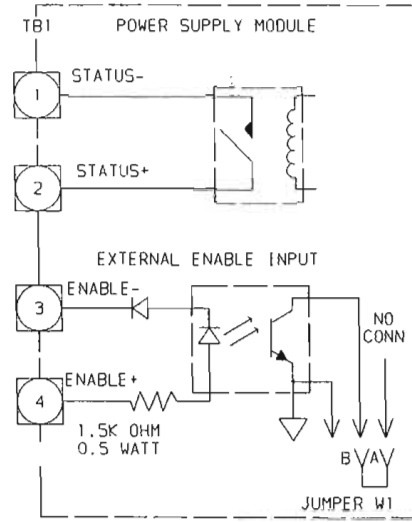
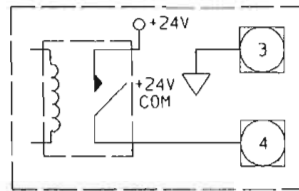
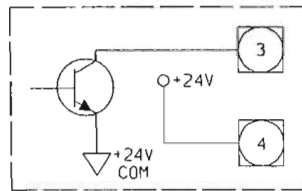
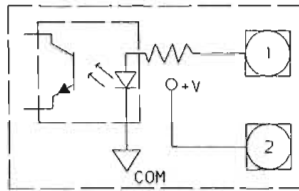
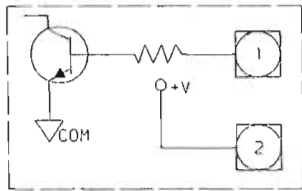


ORD: 9101-0137	DATE: 11/10/87	UPDATE DRAWING	BY: J.H.
DO NOT SCALE THIS DRAWING	SCALE: 1:1	REVISED BY: J.H.	DATE: 11/10/87
<p>DIAGRAM, INTERFACE CONNECTIONS, BRU-SERIES</p> <p>CONFIDENTIAL INFORMATION OF RELIANCE MOTION CONTROL</p> <p>9101-0137</p>			





SAMPLE EXTERNAL CONNECTIONS



NOTES:  
 1. +24V AND +24V COM SUPPLY CONNECTIONS ARE AVAILABLE FROM THE DRIVE MODULE, CONNECTORS P1 OR P2.

D1	A00761	TM	REDRAW	--	--
B-D 19866, 19960, 20625					
A	16383	BC	RELEASED	8-88	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			UNLESS OTHERWISE SPECIFIED	DATE	DATE
DO NOT SCALE DRAWING			GW	2-11-87	JH 8-5-88
DIMENSIONS ARE IN INCHES			DIAGRAM, PSM, INTERFACE		
BREAK ALL EDGES .02 MAX			CONNECTIONS, BRU-500/105000		
FILLETS AND ROUNDS .02 R MAX			TOLERANCE ON:		
ANGLES ±1°			CONFIDENTIAL INFORMATION OF RELIANCE MOTION CONTROL		
FRACTIONS ±1/64"			Edson Electric, Inc. 55314		
DECIMALS ±.010			PART NO. 9101-0138		
.XXX ±.005			RELIANCE ELECTRIC		
			SCALE	DRG SIZE	SHEET
			N/A	8	1 of 1

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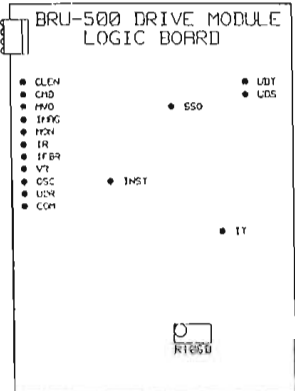
**TEST POINT: DESCRIPTION**

- CLEN (CURRENT LOOP ENABLE): OUTPUT SIGNAL INDICATING DRIVE IS ENABLED. +5VDC = ENABLED, 0 VDC = DISABLED.
- CID (COMMAND): INPUT COMMAND SIGNAL = DIFFERENCE BETWEEN INPUT SIGNALS VCS+ AND VCS-. ANALOG SIGNAL, ±10VDC RANGE.
- COM (COMMON): COMMON REFERENCE FOR TEST POINTS MEASUREMENTS. COMMON (0 VDC) FOR LOGIC CIRCUITS.
- IFBR (CURRENT FEED BACK, R LEG): R LEG MOTOR CURRENT. ANALOG SIGNAL, ± 5.0VDC RANGE. ⚠
- IFNG (CURRENT MAGNITUDE): DETERMINES MAGNITUDE AND POLARITY OF IR, IT. SAME AS OUTPUT SIGNAL INEO (CONNECTOR P5 PIN 1). ANALOG SIGNAL, ±10VDC RANGE.
- INST (INSTRUCTION): INDICATES WHEN MICROPROCESSOR IS READING EPROM. +5VDC = NOT READING EPROM. TOGGLE LOW (0 VDC) WHEN EPROM IS BEING READ.
- IR (CURRENT COMMAND R): R LEG MOTOR CURRENT COMMAND. SIGNAL IS SINE WAVE WHEN MOTOR SHAFT IS TURNING. AMPLITUDE OF SINE WAVE PROPORTIONAL TO COMMAND MOTOR CURRENT. ±10VDC RANGE. ⚠
- IT (CURRENT COMMAND T): T LEG MOTOR CURRENT COMMAND. SAME AS SIGNAL IR BUT SINE WAVE IS SHIFTED 240 DEGREES FROM IR. ⚠
- IPSH (MONITOR): PROGRAMMABLE OUTPUT SIGNAL. OUTPUT IS SELECTABLE USING SERIAL TERMINAL. SAME AS OUTPUT SIGNAL PROGRAMMABLE MONITOR (CONNECTOR P5 PIN 3). ANALOG SIGNAL, ±10VDC RANGE. ⚠
- IMV (MOTOR VELOCITY OUTPUT): VOLTAGE PROPORTIONAL TO MOTOR SPEED. SAME AS OUTPUT SIGNAL IMVO (CONNECTOR P5 PIN 2). ANALOG SIGNAL, ±10VDC RANGE. ⚠
- OSC (OSCILLATOR): TRIANGLE WAVE FOR PWM OUTPUT SWITCHING. NOTE: AMPLITUDE MAY CHANGE AS MOTOR SPEED CHANGES.
- SSO (SYSTEM STATUS OUTPUT): OUTPUT SIGNAL INDICATING DRIVE MODULE STATUS. +5VDC = DRIVE MODULE READY, 0 VDC = FAULT DETECTED. SAME TIMING AS OUTPUT SIGNALS SSO +/- (CONNECTOR P1 PINS 6,7).
- USR (UP/DOWN R): R LEG MOTOR OUTPUT COMMAND SIGNAL. +15VDC = UPPER R LEG POWER DEVICE ON, -15VDC = LOWER R LEG POWER DEVICE ON.
- USZ (UP/DOWN S): S LEG MOTOR OUTPUT COMMAND SIGNAL. +15VDC/-15VDC.
- UST (UP/DOWN T): T LEG MOTOR OUTPUT COMMAND SIGNAL. +15VDC/-15VDC.
- VE (VOLTAGE COMMAND R): R LEG CURRENT LOOP ERROR VOLTAGE. ANALOG SIGNAL, ±12.5VDC RANGE.

**POTENTIOMETER: DESCRIPTION**

RIB50 (VCS OFFSET ADJUST): THIS POTENTIOMETER IS FACTORY ADJUSTED BUT NOT SERIALIZED SO IT CAN BE FIELD ADJUSTED. NOTE: THE OFFSET CAN ALSO BE ADJUSTED DIGITALLY VIA THE SERIAL TERMINAL.

FIG. NO. 9101-0139



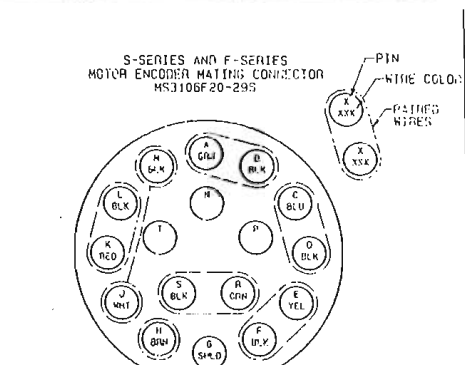
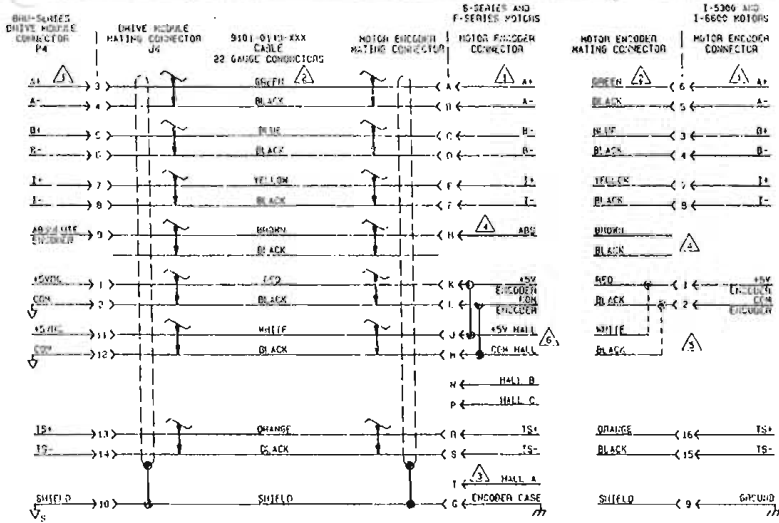
NOTES: ⚠ TEST POINT VOLTAGE SCALING:

SIGNAL	NOTES	DM-25	DM-50	DM-100	DM-150 DM-150A	UNITS
IFBR	5.0VDC=DM PEAK RATING	0.200	0.100	0.050	0.033	VDC/DMC
IMPS						
IR(PEAK)	10.0VDC=DM PEAK RATING	0.4	0.2	0.1	0.067	VDC/DMC
IT(PEAK)						
IMVO	SCALING FOR IMVO DIFFERS WITH DM IS THE SAME AS THE MEASUREMENTS FOR SSO+ AND SSO- MEASURED VIA SERIAL TERMINAL.					VDC

⚠ OUTPUT SIGNALS ABOVE +10 VDC OR BELOW -10VDC ARE CLAMPED TO +10 OR -10 VDC, RESPECTIVELY.

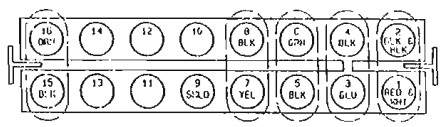
CAD: A0220	C. 20220/TC	REVISED	5/82	BC
DO NOT SCALE THIS DRAWING	B 19866/BJ	CHG TITLE BLOCK	11/84	BC
NO. 1	A 16283/PE	RELEASED	8-1	JH
DATE BY: GALE H. 02/17/87	DATE CHECKED BY: DATE	DES. ENG. APPROVAL	PROV. ENG. APPROVAL	PROJ. ENGR. APPROVAL
DESIGNERS FNC: 1	CONSTRUCTORS FNC: 1	DRAWERS FNC: 1	DIAGRAM, TEST POINTS, DM, BRU-500	
UNLESS OTHERWISE SPECIFIED - ELECTRICAL		RELIANCE MOTION CONTROL		
DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED		SCALE: FIG. NO. 9101-0139		
SHEET #1 OF 1		SHEET #1 OF 1		





CABLE TERMINATION AT MATING CONNECTOR (SOLDER PINS SHOWN)

I-5300 AND I-6600 MOTOR ENCODER MATING CONNECTOR AMP I-40043B-0 CONNECTOR AND AMP 60617-5 CRIMP CONTACTS



CABLE TERMINATION AT MATING CONNECTOR (CRIMP CONTACTS SHOWN)

- NOTES:
- ⚠ WARNING! DO NOT INTERCHANGE ANY CONNECTIONS IN THIS CABLE! INTERCHANGING OF ENCODER SIGNALS FOR DIRECTION PHASING MUST BE DONE ONLY AT THE CUSTOMER'S END OF CABLE 9101-0147-XXX (CABLE FROM DM P3 TO EXTERNAL POSITION CONTROLLER).
  - ⚠ WIRE COLORS SHOWN ARE FOR CABLE ASSEMBLIES SUPPLIED BY RELIANCE MOTION CONTROL.
  - ⚠ SIGNALS HALL A, D, C ARE NOT PROVIDED FROM S-6000, S-8000, I-5300, OR I-6600 MOTORS, AND ARE NOT USED BY DMU-SERIES DRIVE MODULES.
  - ⚠ SIGNAL ABS IS NOT PROVIDED FROM I-5300 OR I-6600 MOTORS, AND IS NOT USED BY DMU-SERIES DRIVE MODULES WHEN USED WITH THESE MOTORS. SIGNAL ABS MUST BE CONNECTED FOR ALL S-SERIES AND F-SERIES MOTORS.
  - ⚠ I-5300, I-6600 MOTORS: WHITE/BLACK WIRE PAIR SHOULD BE CONNECTED TO RED/BLACK WIRE PAIR PRIOR TO TERMINATION AT PINS 1, 2 AS SHOWN, TO LIMIT VOLTAGE DROP OF 5VDC SUPPLY DUE TO LONG CABLE RUNS.
  - ⚠ F-SERIES MOTORS: 15VDC HALL AND COM HALL ARE NOT USED. JUMPERS FROM PINS J-K AND L-M ARE INSTALLED AS SHOWN.

F	20628	JL	CORRECTED TYPO	8-23-93	BC
B-E	B-15500, C-16383, D-17069, E-19866				
A	15390	BC	RELEASED	6-26-87	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKD
UNLESS OTHERWISE SPECIFIED			DESIGNED BY	DATE	
DO NOT SCALE DRAWING			BCR	01-03-87	JH
DIMENSIONS ARE IN INCHES			SCHEM. CABLE S/A		
BREAK ALL EDGES .02 MAX			DM CONNECTOR P4/MOTOR		
FILLETS AND ROUNDS .02 R MAX					
TOLERANCE OR:			MATERIAL SPECIFICATION OF PART NO.		
ANGLES: 11°			MILITARY MOTOR COILING		
FRACTIONS: 11/64"			Eden Prairie, MN 55344		
DECIMALS: .XX1, .020			RELIANCE MOTOR		
.XXX, .010			ELECTRICAL		
			B 101-0140		
			REV. DATE		
			N/A		
			C 1 of 1		

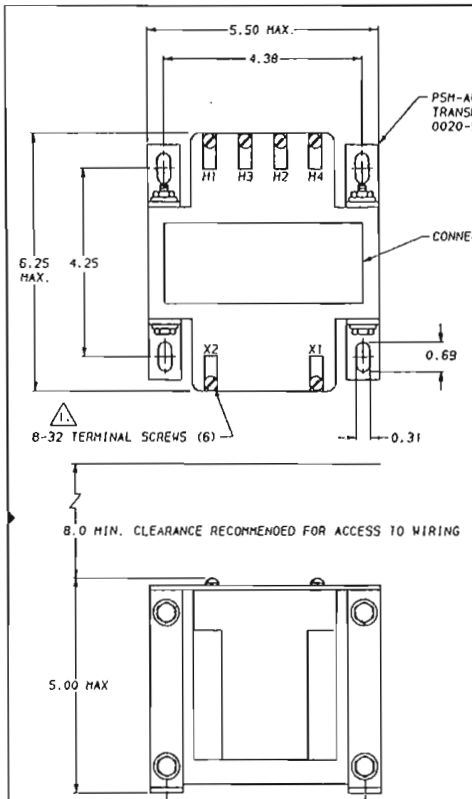
C









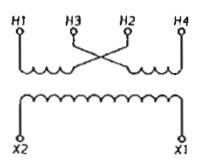


**SPECIFICATIONS:**

OUTPUT POWER @ 50/60Hz  
 110 VAC OUTPUT VOLTAGE  
 50°C MAX. TEMPERATURE RISE ..... 500 VA MIN.

NOMINAL OPERATING VOLTAGES ..... 480 OR 240 INPUT, 120 OUTPUT  
 460 OR 230 INPUT, 115 OUTPUT  
 440 OR 220 INPUT, 110 OUTPUT

**SCHEMATIC SYMBOL**



INPUT (PRIMARY) CONNECTIONS: H1, H4  
 480 VAC INPUT, JUMPER H3 to H2  
 240 VAC INPUT, JUMPER H1 to H3 AND H2 to H4

OUTPUT (SECONDARY) CONNECTIONS: X1, X2  
 120 VAC

**NOTES:**  
 ⚠ RING OR SPADE LUG CONNECTORS (NOT PROVIDED) ARE REQUIRED FOR WIRING CONNECTIONS TO THE TRANSFORMER.

B	19866	SJ	UPDATE TITLE BLOCK	12-20-91	BC
A	16002	PS	RELEASED	4-11-88	BB
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
			PS	4-5-88	JH 4-8-88
UNLESS OTHERWISE SPECIFIED			DATE BY	DATE	DATE
DO NOT SCALE DRAWING			PS	4-5-88	JH 4-8-88
DIMENSIONS ARE IN INCHES			DIAGRAM, OUTLINE & MOUNTING,		
BREAK ALL EDGES .02 MAX			PSM-AUX TRANSFORMER		
FILLETS AND ROUNDS .02 RAD MAX					
TOLERANCE ON:					
ANGLES: 90°					
FRACTIONS: 1/16"			9101-0233		
DECIMALS: 1/10, 0.01			RELIANCE ELECTRIC		
1/32, 0.010			N/A C 1 of 1		

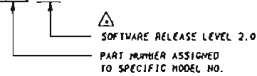


## BRU-500 DRIVE MODULE-MOTOR-PERSONALITY MODULE COMBINATIONS

STANDARD COMBINATIONS				OPTIONAL COMBINATIONS $\Delta$			
DRIVE MODULE MODEL & PART NUMBER	MOTOR		PERSONALITY MODULE		MOTOR MODEL NUMBER	PERSONALITY MODULE MODEL NUMBER	PART NUMBER
	MODEL NUMBER	MODEL NUMBER	MODEL NUMBER	PART NUMBER			
DM-25 9101-0310	S-3007-N-H00AA	PH025A53007NH-0	PH025A53007NH-0	9104-0009-XXX	S-4050-P-H00AA	PH025A54050PH-0	9104-0033-XXX
	S-3016-N-H00AA	PH025A53016NH-0	PH025A53016NH-0	9104-0003-XXX	S-4075-R-H00AA	PH025A54075RH-0	9104-0046-XXX
	S-4030-P-H00AA	PH025A54030PH-0	PH025A54030PH-0	9104-0000-XXX			
	F-4030-Q-H00AA	PH025AF4030QH-0	PH025AF4030QH-0	9104-0095-XXX			
DM-50 9101-0311	S-4050-P-H00AA	PH050A54050PH-0	PH050A54050PH-0	9104-0006-XXX	S-4030-P-H00AA	PH050A54030PH-0	9104-0016-XXX
	S-4075-R-H00AA	PH050A54075RH-0	PH050A54075RH-0	9104-0036-XXX	S-6200-Q-H00AA	PH050A56200QH-0	9104-0014-XXX
	S-6100-Q-H00AA	PH050A56100QH-0	PH050A56100QH-0	9104-0001-XXX			
	F-4050-Q-H00AA	PH050AF4050QH-0	PH050AF4050QH-0	9104-0096-XXX			
	F-4075-R-H00AA	PH050AF4075RH-0	PH050AF4075RH-0	9104-0097-XXX			
	F-6100-R-H00AA	PH050AF6100RH-0	PH050AF6100RH-0	9104-0098-XXX			
DM-100 9101-0312	S-6200-Q-H00AA	PH100A56200QH-0	PH100A56200QH-0	9104-0010-XXX	S-6100-Q-H00AA	PH100A56100QH-0	9104-0039-XXX
	S-8350-S-H00AA	PH100A58350SH-0	PH100A58350SH-0	9104-0011-XXX	S-6300-Q-H00AA	PH100A56300QH-0	9104-0054-XXX
	I-5300-R-F02AA	PH100A15300RF-2	PH100A15300RF-2	9104-0078-XXX	S-8500-S-H00AA	PH100A58500SH-0	9104-0015-XXX
	F-6200-R-H00AA	PH100AF6200RH-0	PH100AF6200RH-0	9104-0099-XXX			
	F-6300-R-H00AA	PH100AF6300RH-0	PH100AF6300RH-0	9104-0100-XXX			
DM-150 9101-0313	S-6300-Q-H00AA	PH150A56300QH-0	PH150A56300QH-0	9104-0051-XXX	S-6200-Q-H00AA	PH150A56200QH-0	9104-0027-XXX
	S-8500-S-H00AA	PH150A58500SH-0	PH150A58500SH-0	9104-0005-XXX	S-8350-S-H00AA	PH150A58350SH-0	9104-0025-XXX
DM-150X 9101-0314							
	I-6600-R-F02AA	PH150C16600RF-2	PH150C16600RF-2	9104-0079-XXX			

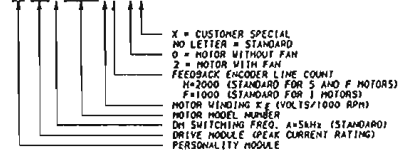
### PERSONALITY MODULE PART NUMBER EXAMPLE

9104-0000-020



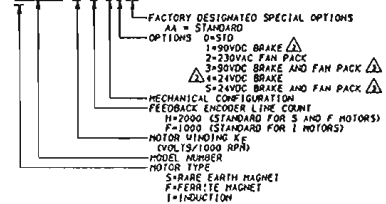
### PERSONALITY MODULE MODEL NUMBER EXAMPLE

PH025A54030PH-0X



### MOTOR MODEL NUMBER EXAMPLE

S-6100-Q-H 00AA  
F-4075-R-H 00AA  
I-5250-R-F 02AA



### NOTES

1. MOTORS WITH AND WITHOUT BRAKE OPTION USE THE SAME PERSONALITY MODULE.
2. USE PERSONALITY MODULE FOR MOTOR WITHOUT BRAKE (-0 SUFFIX PERSONALITY MODULE).
3. USE PERSONALITY MODULE FOR MOTOR WITH FAN (-2 SUFFIX PERSONALITY MODULE).
4. LAST THREE DIGITS OF PERSONALITY MODULE PART NUMBER DENOTE SOFTWARE RELEASE LEVEL, AND WILL BE ADDED BY RELIANCE MOTION CONTROL AT TIME OF SHIPMENT.
5. SALE OF ANY COMBINATION OTHER THAN THOSE LISTED MUST BE APPROVED BY RELIANCE MOTION CONTROL ENGINEERING DEPARTMENT.
6. CONTINUOUS AND PEAK TORQUE RATING OF MOTOR USED IN OPTIONAL COMBINATION MAY BE DIFFERENT THAN SAME MOTOR USED IN STANDARD COMBINATION.

E	19866	BC	ADDED F-MOTOR INFO	22-NOV-79	BC
B-D	B-16383,	C-18394,	D-19666		
A	16162	BC	RELEASED	6-24-88	BC
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRIVEN BY	DATE	DATE
DO NOT SCALE DRAWING			BC	6-24-88	JH 6-24-88
DIMENSIONS ARE IN INCHES			DIAGRAM, DM/MOTOR/PA,		
BREAK ALL EDGES .02 MAX.			STD COMBINATIONS, BRU-500		
FILLETS AND ROUNDS .02 AND MAX					
TOLERANCE .04					
ANGLES .41°					
RADIATIONS .41/64"					
DECIMALS .312, .010					
.3125, .003					
RELIANCE MOTION CONTROL			9101-0235		
ELECTRIC			N/A C 1 of 1		

cccccccccccc

C

SPINDLE ORIENT KIT INSTALLATION INSTRUCTIONS

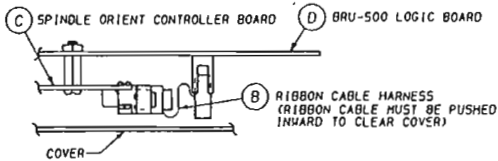
1. REMOVE COVER (A) FROM DRIVE MODULE. REMOVE NUTS (QTY 2, NOT SHOWN) INSIDE OF COVER (A) AND REMOVE FILLER PANEL (NOT SHOWN) FROM FRONT OF COVER.
2. PLUG RIBBON CABLE ASSEMBLY (B) INTO SPINDLE ORIENT BOARD (C), CONNECTOR P8.
3. PLUG OTHER END OF (B) INTO BRU-500 LOGIC BOARD (D), CONNECTOR P7.
4. FASTEN BOARD (C) TO BOARD (D) USING (4) SCREWS (E) AND (4) LOCKWASHERS (F).
5. PLUG 6-WIRE JUMPER HARNESS (G) INTO CONNECTORS P5 OF BOARD (C) AND P3 OF BOARD (D) AS SHOWN.
6. PLUG JUMPER CONNECTOR (H) INTO CONNECTOR P2 OF BOARD (D) AS SHOWN.
7. PLUG 2-WIRE JUMPER HARNESS (I) INTO CONNECTORS P2 OF BOARD (C) AND P1 OF BOARD (D) AS SHOWN.
8. INSTALL COVER (A).

MATING CONNECTORS ARE PROVIDED IN THE SPINDLE ORIENT KIT FOR CUSTOMER CONNECTION TO SPINDLE ORIENT BOARD CONNECTORS P1, P3, P4, P5, P7.

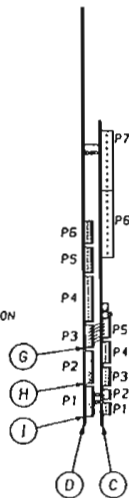
MATING CONNECTORS ARE PROVIDED WITH THE BRU-500 FOR CUSTOMER CONNECTION TO BRU-500 LOGIC BOARD CONNECTORS P4, P5, P6.

NOTES.

▲ RIBBON CABLE HARNESS  
TOP VIEW

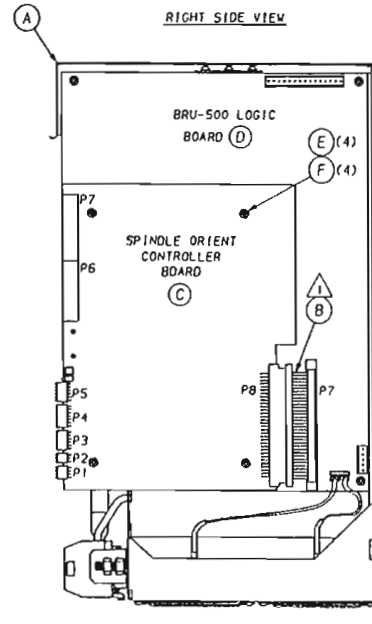


FRONT VIEW



BRU-500 DRIVE MODULE WITH SPINDLE ORIENT CONTROLLER OPTION

RIGHT SIDE VIEW



B	19866	SJ	UPDATE	DWC	12-20-91	BC
A	16338	PS	RELEASED		7-19-88	BCB
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR	
UNLESS OTHERWISE SPECIFIED			PS	6-20-88	DPH	7-19-88
DO NOT SCALE DRAWING			DIAG., INSTALLATION, SPINDLE ORIENT			
DIMENSIONS ARE IN INCHES			KIT/BRU-500 DRIVE MODULE			
BREAK ALL EDGES .02 MAX.			RELIANCE ELECTRIC			
FILLETS AND ROUNDS .02 RAD MAX.			9101-0238			
TOLERANCE ON:			SCALE 100% 1/16" 1/32" 1/64"			
ANGLES, 45°			N/A			
FRACTIONS, 21/64"			C 1 of 1			
DECIMALS, 254.000						
11118.010						

C

✓







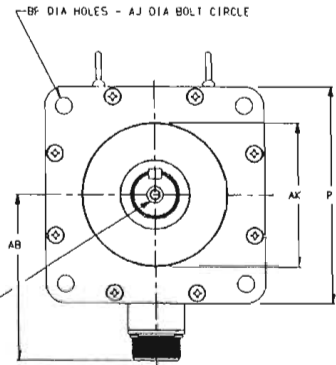
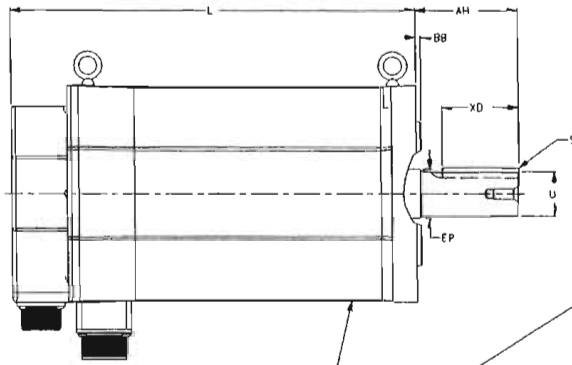
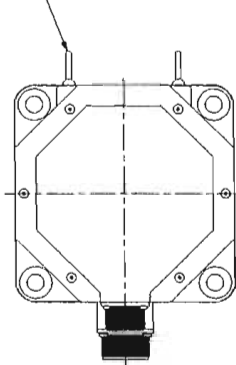
C



F-Series Motor Dimensions

MODEL	AB	AJ	AK	P	U	EP	AH	BB	BF	XD	S	L	with brake
	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.	mm/in.
F4030	102/4.02	145/5.71	110/4.33	127/5.00	19/.75	22.2/.875	50/1.97	3/12	10/.39	40/1.57	8X6/.24X.24	194/7.64	257/10.12
F4050	102/4.02	145/5.71	110/4.33	127/5.00	19/.75	22.2/.875	50/1.97	3/12	10/.39	40/1.57	8X6/.24X.24	272/10.71	335/13.19
F4075	102/4.02	145/5.71	110/4.33	127/5.00	19/.75	22.2/.875	50/1.97	3/12	10/.39	40/1.57	8X6/.24X.24	350/13.78	413/16.26
F6100	131/5.16	200/7.87	114.3/4.50	173/6.81	35/1.38	36.5/1.438	80/3.15	4/16	13.5/.53	60/2.36	10X8/.39X.32	255/10.04	326/12.83
F6200	131/5.16	200/7.87	114.3/4.50	173/6.81	35/1.38	36.5/1.438	80/3.15	4/16	13.5/.53	60/2.36	10X8/.39X.32	320/12.60	390/15.35
F6300	131/5.16	200/7.87	114.3/4.50	173/6.81	35/1.38	36.5/1.438	80/3.15	4/16	13.5/.53	60/2.36	10X8/.39X.32	420/16.53	480/18.79

2 EYE BOLLS INSTALLED ON F-6100, 6200, 6300 MOTORS ONLY.



CONNECTOR FOR BRAKE OPTION THIS AREA

F-4000 MOTORS, M6 X 1mm X 15mm/.59 INCH DEEP THREAD  
 F-6000 MOTORS, M8 X 1.25mm X 20mm/.79 INCH DEEP THREAD

NOTES:

1. MOTORS ARE MANUFACTURED TO MILLIMETER DIMENSIONS SHOWN. INCH DIMENSIONS SHOWN ARE APPROXIMATE CONVERSIONS FROM MILLIMETERS. (EXCEPTION, DIMENSION EP IS MANUFACTURED IN INCHES)

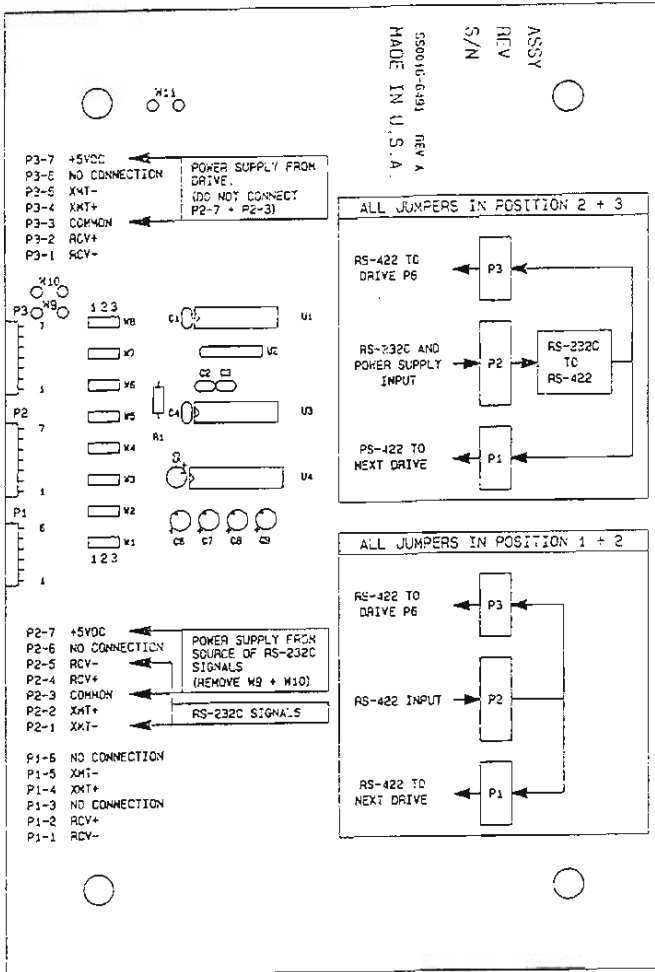
2. FOR FURTHER MOTOR DETAIL, ENGINEERING SPECIFICATION DRAWINGS ARE AVAILABLE UPON REQUEST.

A1	A00759	TM	CHG'D TEXT	--	--
A	19866	BC	RELEASED	11-25-91	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DATE	DATE	DATE
DO NOT SCALE DRAWING			SJ	11-25-91	JH
DIMENSIONS ARE IN INCHES			DIAGRAM, OUTLINE & MOUNTING.		
BREAK ALL EDGES .02 MAX			F-SERIES MOTORS		
FILLETS AND ROUNDS .02 R MAX			CONFIDENTIAL INFORMATION OF PART-TO:		
TOLERANCE ON:			RELIANCE MOTOR CORP.		
ANGLES ±1°			Egan Prairie, MI 55344		
FRACTIONS ±1/64"			9101-0332		
DECIMALS .XX ±.010			SCALE 1:1		
.XXX ±.005			C 1 of 1		

C



DOC. NO. 9101-0334



**NOTE:**

THE RS232C/RS422 CONVERTER IS USEFUL WHEN DAISY-CHAIN CONNECTING MULTIPLE DRIVES TOGETHER AND USING THE MULTI-DROP HOST MODE SERIAL PROTOCOL.

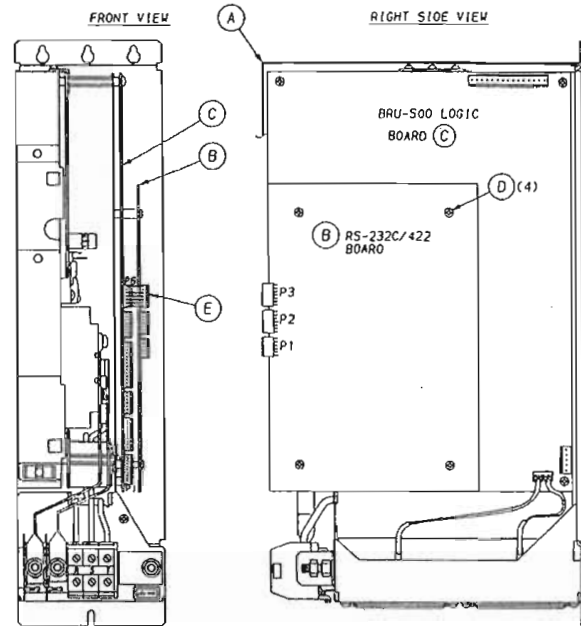
CAD00228		B1	ADP589	BCB	REVISED NOTE	01-16-92	32
DO NOT SCALE THIS DRAWING		A-B		A 13066, B 10760		DATE	APPROVAL
REF:		SYM	C.C.D.	NY	REVISION DESCRIPTION	DATE	APPROVAL
DRAWN BY	CHECKED BY	DATE	DES. ENG.	APPROVAL	DATE	QA	APPROVAL
BCB	11-27-91	12-13-91	BC	GAK	12-13-91		
DIAGRAM CONNECTION, RS232C/RS422 CONVERTER				SCALE: N/A			
CONFIDENTIAL INFORMATION OF RELIANCE MOTION CONTROL				DRAWING NO. 9101-0334			
				SHEET 1 OF 1			



**RS-232C/422 KIT INSTALLATION INSTRUCTIONS**

1. REMOVE COVER (A) FROM DRIVE MODULE. REMOVE NUTS (QTY 2, NOT SHOWN) INSIDE OF COVER (A) AND REMOVE FILLER PANEL (NOT SHOWN) FROM FRONT OF COVER.
  2. FASTEN BOARD (B) TO BOARD (C) USING (4) SCREWS (D).
  3. PLUG 6-WIRE HARNESS (E) INTO CONNECTOR P6 OF BOARD (C) AND INTO CONNECTOR P3 OF BOARD (B).
  4. INSTALL COVER (A).
- MATING CONNECTORS ARE PROVIDED IN THE RS-232C/422 KIT FOR CUSTOMER CONNECTION TO HOST COMPUTER & ADDITIONAL BRU-500 DRIVE MODULES.

**BRU-500 DRIVE MODULE WITH  
RS-232C/422 OPTION**

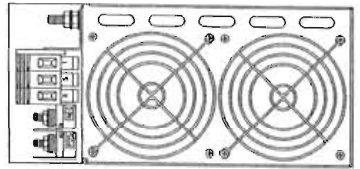
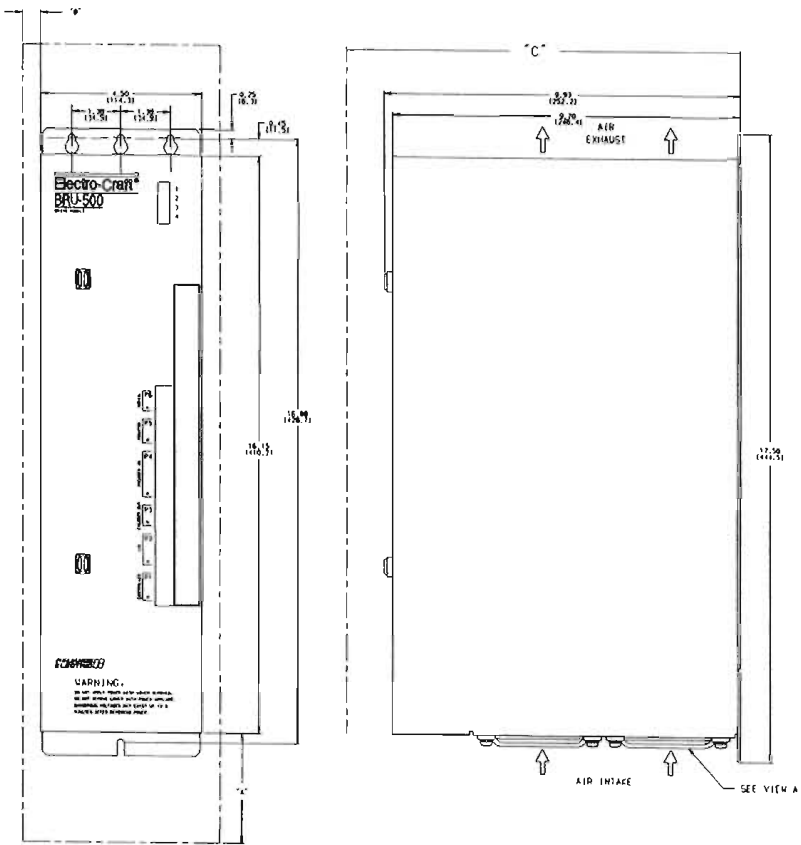


**NOTES.**

1. INSTRUCTIONS FOR CONNECTIONS TO P1 & P2 ARE SILKSCREENED ON THE RS-232C/422 ADAPTOR CARD.

A	19899	SJ	RELEASED	12-19-91	BCB
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
			UNLESS OTHERWISE SPECIFIED	DATE	BY
			DO NOT SCALE DRAWING	SJ 19-DEC-91	GK 12-19-91
			DIMENSIONS ARE IN INCHES	DIAG. INSTALLATION, RS-232C/422	
			BREAK ALL EDGES 02 MAX.	TO BRU-500 DRIVE MODULE	
			FILLETS AND ROUNDS .02 RAD MAX		
			TOLERANCE ON:	PART NO. 9101-0336	
			ANGLES, .01"	REL. JUMP POSITION OPTION	
			FRACTIONS: .01/64"	RELIANCE ELECTRIC	
			DECIMALS: .0010	SCALE	1 of 1
				N/A	C





VIEW A

NOTES:

1. MUST CONFORM TO SPEC. 7058-997B.
2. A = 4.00(102.0) MINIMUM FOR AIRFLOW ABOVE & BELOW UNIT.
- B = 0.50(12.7) MINIMUM FOR AIRFLOW BOTH SIDES OR BETWEEN ADJACENT UNITS.
- C = 11.00(280) CLEARANCE FOR CABLES.

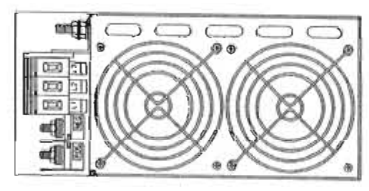
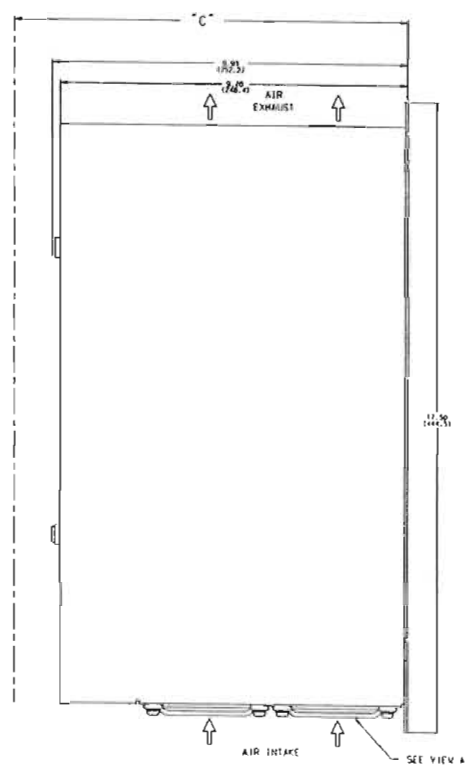
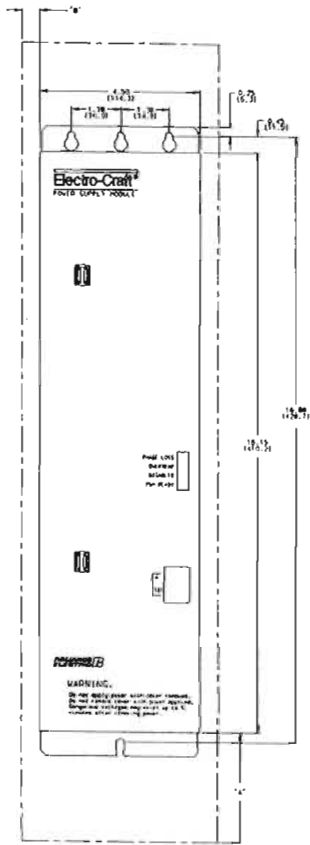
. DXF

A	21170	TM	RELEASED	--	--
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DATE	REVISION ENG	DATE
DO NOT SCALE DRAWING			TM	11-18-94	
DIMENSIONS ARE IN INCHES			DIAGRAM, OUTLINE & MOUNTING		
BREAK ALL EDGES .02 MAX			BRU-500		
FILLETS AND ROUNDS .02 R MAX					
TOLERANCE ON:			PART NO.		
ANGLES ±1°			9101-0409		
FRACTIONS 1/16"			RELIANCE ELECTRIC		
DECIMALS .XX ± .010			SCALE		
.XXX ± .005			1:2		
			UNITS SIZE		
			C		
			1 of 1		



C





- NOTES:
- MUST CONFORM TO SPEC. 7058-9978.
  - "A" = 4.00 (102.0) MINIMUM FOR AIRFLOW ABOVE AND BELOW UNIT.  
"B" = 0.50 (12.7) MINIMUM FOR AIRFLOW BOTH SIDES OR BETWEEN ADJACENT UNITS.  
"C" = 11.00 (280) CLEARANCE FOR CABLES.

.DXF

A	21170	TM	RELEASED	--	--
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DATE	DESIGN ENGR	DATE
DO NOT SCALE DRAWING			TM	11-21-94	
DIMENSIONS ARE IN INCHES			POWER SUPPLY, BRU-500		
BREAK ALL EDGES .02 MAX					
FILLETS AND ROUNDS .02 D MAX					
TOLERANCE ON:			FORMED SURFACES (information of PART NO.)		
ANGLES 11°			FRACTIONS 1/64"		
DECIMALS .XX4 .010			9101-0410		
.XXX4 .005			SCALE 1:2		
RELIANCE ELECTRIC			C 1 of 1		





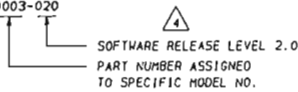
C



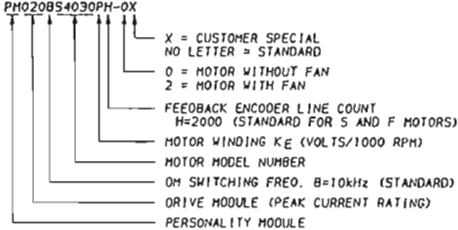
## BRU-200 DRIVE MODULE-MOTOR-PERSONALITY MODULE COMBINATIONS

STANDARD COMBINATIONS				OPTIONAL COMBINATIONS <span style="font-size: small;">(A)</span>		
DRIVE MODULE MODEL & PART NUMBER	MOTOR MODEL NUMBER	PERSONALITY MODULE MODEL NUMBER      PART NUMBER		MOTOR MODEL NUMBER	PERSONALITY MODULE MODEL NUMBER      PART NUMBER	
DM-10 9101-1131	S-2003-K-H00AA	PM010BS2003KH-0	9105-0006-XXX	S-3016-N-H00AA	PM010BS3016NH-0	9105-0001-XXX
	S-2005-K-H00AA	PM010BS2005KH-0	9105-0007-XXX			
	S-3007-N-H00AA	PM010BS3007NH-0	9105-0000-XXX			
DM-20 96101-1132	S-3016-N-H00AA	PM020BS3016NH-0	9105-0002-XXX	S-3007-N-H00AA	PM020BS3007NH-0	9105-0013-XXX
	S-4030-P-H00AA	PM020BS4030PH-0	9105-0003-XXX	S-4050-P-H00AA	PM020BS4050PH-0	9105-0005-XXX
	F-4030-Q-H00AA	PM020BF4030QH-0	9105-0057-XXX			
DM-30 9101-1133	S-4050-P-H00AA	PM030BS4050PH-0	9105-0008-XXX	S-3016-N-H00AA	PM030BS3016NH-0	9105-0015-XXX
	S-4075-R-H00AA	PM030BS4075RH-0	9105-0009-XXX	S-4030-P-H00AA	PM030BS4030PH-0	9105-0012-XXX
	F-4050-Q-H00AA	PM030BF4050QH-0	9105-0058-XXX			
	F-4075-R-H00AA	PM030BF4075RH-0	9105-0059-XXX			

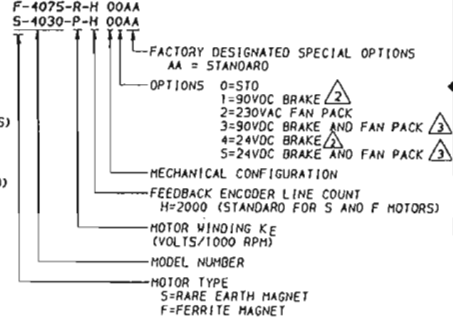
PERSONALITY MODULE  
PART NUMBER EXAMPLE  
9105-0003-020



PERSONALITY MODULE  
MODEL NUMBER EXAMPLE  
PM020BS4030PH-0X



MOTOR  
MODEL NUMBER EXAMPLE  
F-4075-R-H 00AA  
S-4030-P-H 00AA



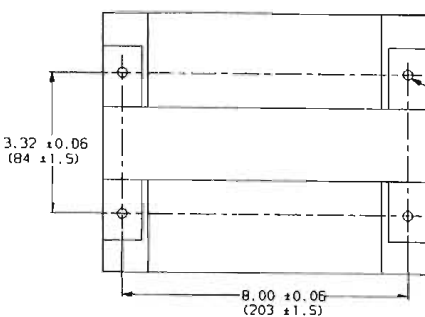
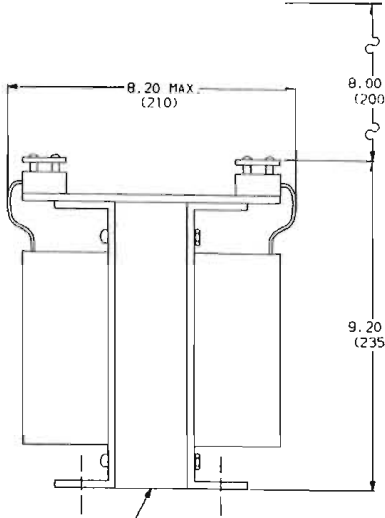
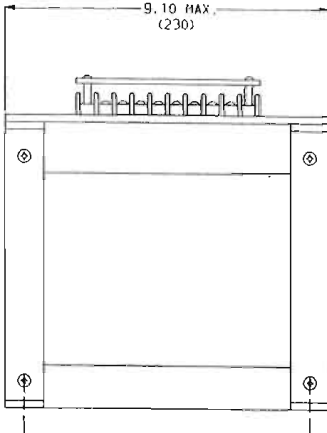
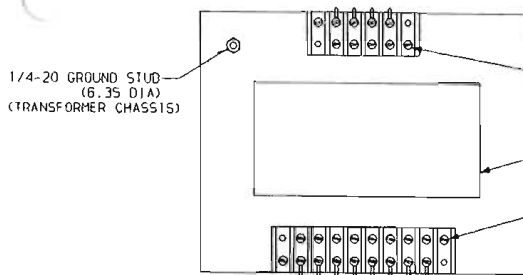
### NOTES.

1. MOTORS WITH AND WITHOUT BRAKE OPTION USE THE SAME PERSONALITY MODULE.
- 2 USE PERSONALITY MODULE FOR MOTOR WITHOUT BRAKE (-0 SUFFIX PERSONALITY MODULE).
- 3 USE PERSONALITY MODULE FOR MOTOR WITH FAN (-2 SUFFIX PERSONALITY MODULE).
- 4 LAST THREE DIGITS OF PERSONALITY MODULE PART NUMBER DENOTE SOFTWARE RELEASE LEVEL, AND WILL BE ADDED BY RELIANCE MOTION CONTROL AT TIME OF SHIPMENT.
5. SALE OF ANY COMBINATION OTHER THAN THOSE LISTED MUST BE APPROVED BY RELIANCE MOTION CONTROL ENGINEERING DEPARTMENT.
- 6 CONTINUOUS AND PEAK TORQUE RATINGS OF MOTOR USED IN OPTIONAL COMBINATION MAY BE DIFFERENT THAN SAME MOTOR USED IN STANDARD COMBINATION.

C	19866	BC	REVISED & REDRAWN	22-NOV-91	BC
B	19646	BC	UPDATED DOCUMENTATION	29-MAY-91	BC
A1	A00282	BC	CHG'D PM MODEL NO.	2-3-89	BC
A	16871	BC	RELEASED	3-NOV-88	BC
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED DRAWN BY DATE DESIGNER DATE					
DO NOT SCALE DRAWINGS BC 3-NOV-88 JH 3-NOV-88					
DIMENSIONS ARE IN INCHES DIAGRAM, DM/MOTOR/PM					
BREAK ALL EDGES .02 MAX. STD COMBINATIONS, BRU-200					
FILLETS AND ROUNDS .02 AND MAX.					
TOLERANCE DIM. REVISION DESCRIPTION PART NO.					
ANGLES: .01" RELIANCE MOTION CONTROL 9101-1053					
FRACTIONS: 21/64" RELIANCE ELECTRIC					
DECIMALS: .001, .020					
.0025, .010					
			REV	APP'D	DATE
			N/A	C	1 of 1

2





NOTES:

1. DIMENSIONS ARE IN INCHES (mm)
2. RING OR SPADE LUG CONNECTORS (NOT PROVIDED) ARE REQUIRED FOR WIRING CONNECTIONS TO TRANSFORMER TERMINAL STRIPS.

3kVA TRANSFORMER  
ELECTRO-CRAFT P/N 0020-5097

B1	A00759	TM	CHG'D TEXT	--	--
B	19866	SJ	UPDATED TITLE BLOCK	12-20-91	BC
A	17320	BC	RELEASED	2-23-89	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRAWN BY	DATE	REVISOR ENG
DO NOT SCALE DRAWING			BC	1-10-89	BB
DIMENSIONS ARE IN INCHES					
BREAK ALL EDGES .02 MAX					
FILLETS AND ROUNDS .02 R MAX					
TOLERANCE ON:			COORDINATE INFORMATION OF PART NO.		
ANGLES ± 1°			RELIANCE MOTOR CONTROL		
FRACTIONS ± 1/64"			Edson Products, Inc. 55344		
DECIMALS .XX ± .010			9101-1056		
.XXX ± .005			SCALE	DOC SIZE	SHEET
			1:1	C	1 of 1



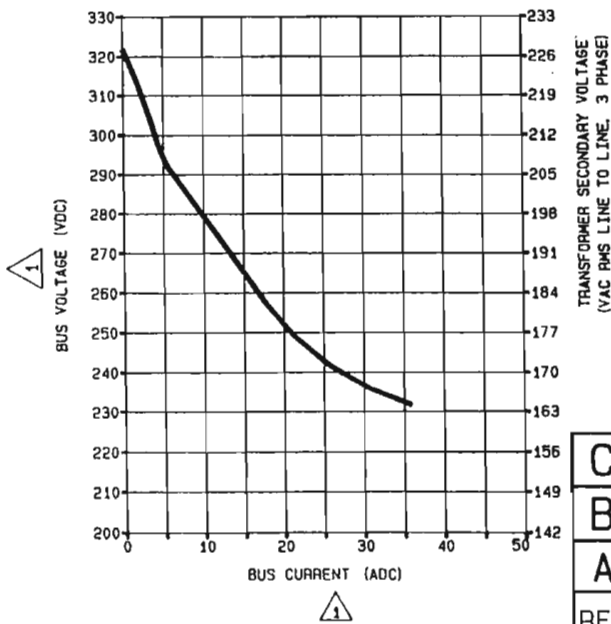
C

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1 PHASE TRANSFORMER SECONDARY VOLTAGE  
AND CORRESPONDING DC BUS VOLTAGE,  
VERSUS DC BUS CURRENT  
3 KVA TRANSFORMER

RELIANCE MOTION CONTROL	
1 PHASE TRANSFORMER	
PART NUMBER	KVA
0020-5097	3



NOTES:

- DC BUS VOLTAGE AND CURRENT IS MEASURED AT MOTOR POWER CIRCUITS INTERNAL TO THE DRIVE MODULE (NOT ACCESSIBLE TO THE USER).
- CURVE SHOWS REDUCTION IN TRANSFORMER SECONDARY VOLTAGE AND DRIVE MODULE INTERNAL DC BUS VOLTAGE, DUE TO TRANSFORMER INTERNAL LOSSES, AS BUS CURRENT LOAD INCREASES.
- ALL DATA TAKEN WITH TRANSFORMER PRIMARY VOLTAGE HELD TO 230 VAC 1 PHASE LINE TO LINE 60 Hz AND WITH SECONDARY WIRED FOR 230 VAC LINE TO LINE NO LOAD.

C	20625	JL	UPDATE TITLE BLOCK	10-5-93	BC
B	19960	BC	BRU-200/IQ2000	2-19-92	BC
A	19866	BC	RELEASED	11-22-91	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR

UNLESS OTHERWISE SPECIFIED  
DO NOT SCALE DRAWING  
DIMENSIONS ARE IN INCHES  
BREAK ALL EDGES .02 MAX  
FILLETS AND ROUNDS .02 R MAX  
TOLERANCE ON:  
ANGLES ±1°  
FRACTIONS, ±1/64"  
DECIMALS, XX±.020  
.XXX±.010

DRAWN BY	DATE	DESIGN ENGR	DATE
BC	11-22-91	JH	11-22-91

DIAG, XFMR LOAD REG,  
BRU-200/IQ2000

Confidential Information of PART NO.

RELIANCE MOTION CONTROL  
Eden Prairie, MN 55344



9101-1057

SCALE	DWG SIZE	SHEET
1:1	A	1 of 1

C

✓

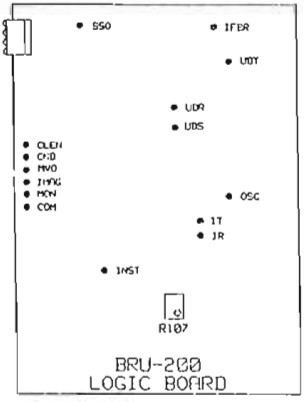


TEST POINT: DESCRIPTION

- CLEN (CURRENT LOOP ENABLE): OUTPUT SIGNAL INDICATING DRIVE IS ENABLED. +5VDC = ENABLED, 0 VDC = DISABLED.
- CID (CURRENT): INPUT COMMAND SIGNAL - DIFFERENCE BETWEEN INPUT SIGNALS VCS+ AND VCS-. ANALOG SIGNAL, ±10VDC RANGE.
- COM (COMMON): COMMON REFERENCE FOR TEST POINTS PERFORMANCES. COMMON (0 VDC) FOR LOGIC CIRCUITS.
- IRM (CURRENT FEED BACK, R LEG): R LEG MOTOR CURRENT. ANALOG SIGNAL, ± 5.0VDC RANGE. ⚠
- IMC (CURRENT MAGNITUDE): DETERMINES MAGNITUDE AND POLARITY OF IR, IT. SAME AS OUTPUT SIGNAL MCO (CONNECTOR PS PIN 1). ANALOG SIGNAL, ±10VDC RANGE.
- IMST (INSTRUCTION): INDICATES WHEN MICROPROCESSOR IS READING ERROR. +5VDC = NOT READING ERROR. Toggles LOW (0 VDC) WHEN ERROR IS BEING READ.
- IR (CURRENT COMMAND R): R LEG MOTOR CURRENT COMMAND. SIGNAL IS SINE WAVE WHEN MOTOR SHFT IS TURNING. AMPLITUDE OF SINE WAVE PROPORTIONAL TO COMMAND MOTOR CURRENT. ±10VDC RANGE. ⚠
- IT (CURRENT COMMAND T): T LEG MOTOR CURRENT COMMAND. SAME AS SIGNAL IR BUT SINE WAVE IS SHIFTED 240 DEGREES FROM IR. ⚠
- MON (MONITOR): PROGRAMMABLE OUTPUT SIGNAL. OUTPUT IS SELECTABLE USING SERIAL TERMINAL. SAME AS OUTPUT SIGNAL PROGRAMMABLE MONITOR (CONNECTOR PS PIN 3). ANALOG SIGNAL, ±10VDC RANGE. ⚠
- MVD (MOTOR VELOCITY OUTPUT): VOLTAGE PROPORTIONAL TO MOTOR SPEED. SAME AS OUTPUT SIGNAL MCO (CONNECTOR PS PIN 2). ANALOG SIGNAL, ±10VDC RANGE. ⚠
- OSC (OSCILLATOR): TRIANGLE WAVE FOR PWM OUTPUT SWITCHING. NOTE: AMPLITUDE MAY CHANGE AS MOTOR SPEED CHANGES.
- SSO (SYSTEM STATUS OUTPUT): OUTPUT SIGNAL INDICATING DRIVE MODULE STATUS. +5VDC = DRIVE MODULE READY. 0 VDC = FAULT DETECTED. SAME TIMING AS OUTPUT SIGNALS SSO +/- (CONNECTOR P1 PINS 5, 7).
- USR (UP/DOWN R): R LEG MOTOR OUTPUT COMMAND SIGNAL. +15VDC = UP/DR R LEG POWER DEVICE ON. -15VDC = DOWN R LEG POWER DEVICE ON.
- USL (UP/DOWN S): S LEG MOTOR OUTPUT COMMAND SIGNAL. +15VDC/-15VDC.
- UST (UP/DOWN T): T LEG MOTOR OUTPUT COMMAND SIGNAL. +15VDC/-15VDC.

POTENTIOMETER DESCRIPTION:

R107 (VCS OFFSET ADJUST): THIS POTENTIOMETER IS FACTORY ADJUSTED BUT NOT SEALED SO IT CAN BE FIELD ADJUSTED. NOTE: THE OFFSET CAN ALSO BE ADJUSTED DIGITALLY VIA THE SERIAL TERMINAL.



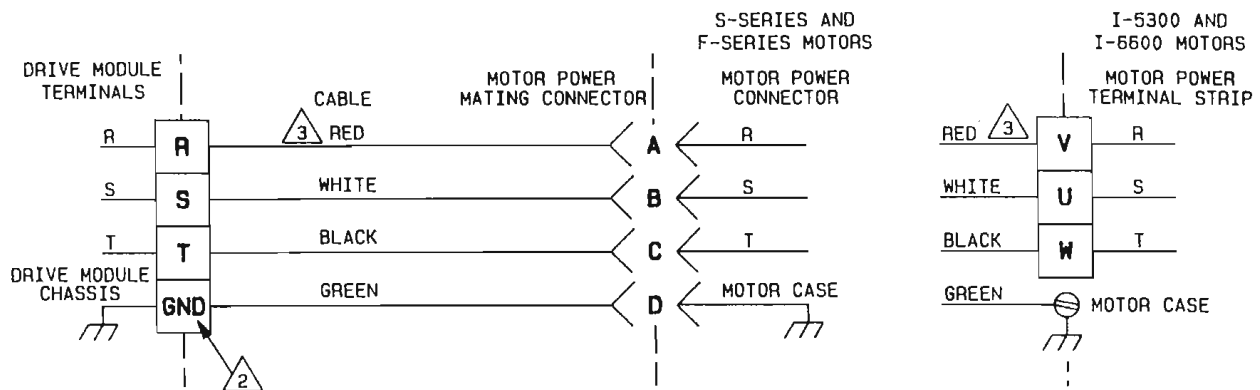
NOTES: ⚠ TEST POINT VOLTAGE SCALING:

SIGNAL	NOTES	PP-10	DM-20	DM-30		
1FBR	5.0VDC-DM PEAK RATING	0.500	0.250	0.100		VDC/DMC
IMC						
IR (PEAK)	10.0VDC-DM PEAK RATING	1.0	0.5	0.333		VDC/DMC
IT (PEAK)						
MVD						VDC

⚠ OUTPUT SIGNALS ABOVE +10 VDC OR BELOW -10VDC ARE CLAMPED TO +10 OR -10 VDC, RESPECTIVELY.

C 19066 BC		REVISED BLDG		3/84	DC
B 19066 5J		CHG TITLE BLOCK		11/81	DC
A1 17327 BC		DOCUMENTATION CHANGE		8/89	WDC
A 17327 BC		RELEASED		2/89	J.H.
BY J.H. 2-22-89		BY J.H. 2-22-89			
DATE 2-22-89		DATE 2-22-89			
DRAWN BY MC 1-10-88		ELECTRICIAN			
REVISIONS ARE 1		SHOW ALL DIMS AND SHARP CORNERS		DIAGRAM, DRIVE MODULE, TEST POINTS, BRU-200	
DIMENSIONS ARE 1		TOLERANCE ON DIMENSIONS ARE IN INCHES		SCALE	
DIMENSIONS ARE 1		FRACTIONS, DECIMALS, INCHES		DWG. NO. 9101-1061	
DIMENSIONS ARE 1		1/4" 1/8" 1/16" 1/32"		SHEET 1 of 1	
DIMENSIONS ARE 1		UNLESS OTHERWISE SPECIFIED		RELIANCE MOTION CONTROL	





C	20625	JL	UPDATE TITLE BLOCK	10-5-93	BC
B	19960	BC	CHG'D NOTE 2	2-19-92	BC
A	19866	BC	RELEASED	11-21-91	JH
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRAWN BY	DATE	DESIGN ENGR
DO NOT SCALE DRAWING			SJ	11-21-91	JH
DIMENSIONS ARE IN INCHES			SCHEM, CABLE, MOTOR POWER		
BREAK ALL EDGES .02 MAX			TOLERANCE ON:		
FILLET AND ROUNDS .02 R MAX			ANGLES ±1°		
FRACTIONS ±1/64"			DECIMALS .XX±.020		
.XXX±.010			Confidential Information of RELIANCE MOTION CONTROL Eden Prairie, MN 55344 <b>RELIANCE ELECTRIC</b>		
			PART NO. 9101-1140		
SCALE		DWG SIZE		SHEET	
1:1		A		1 of 1	

**NOTES:**

1. DO NOT INTERCHANGE ANY CONNECTIONS IN THIS CABLE.



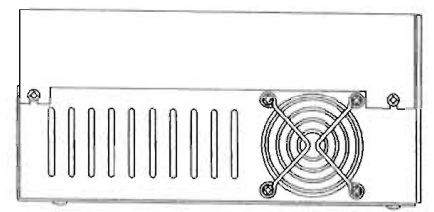
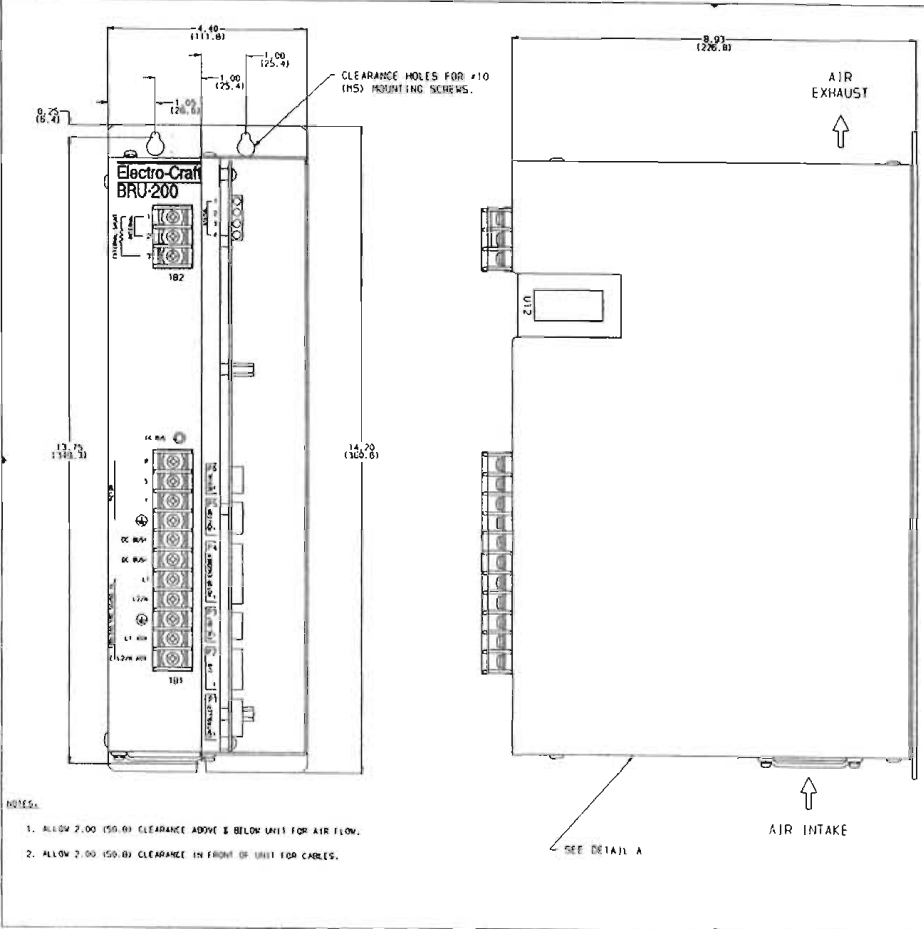
GROUND CONNECTIONS:  
BRU-200 & IQ2000 - SCREW TERMINAL  
BRU-500 & IQ5000 - M6 STUD



WIRE COLORS SHOWN ARE FOR CABLE ASSEMBLIES SUPPLIED BY RELIANCE MOTION CONTROL.

C





DETAIL A  
BOTTOM VIEW

- NOTES:
1. ALLOW 2.00 (50.8) CLEARANCE ABOVE & BELOW UNIT FOR AIR FLOW.
  2. ALLOW 2.00 (50.8) CLEARANCE IN FRONT OF UNIT FOR CABLES.

SEE DETAIL A

.DXF

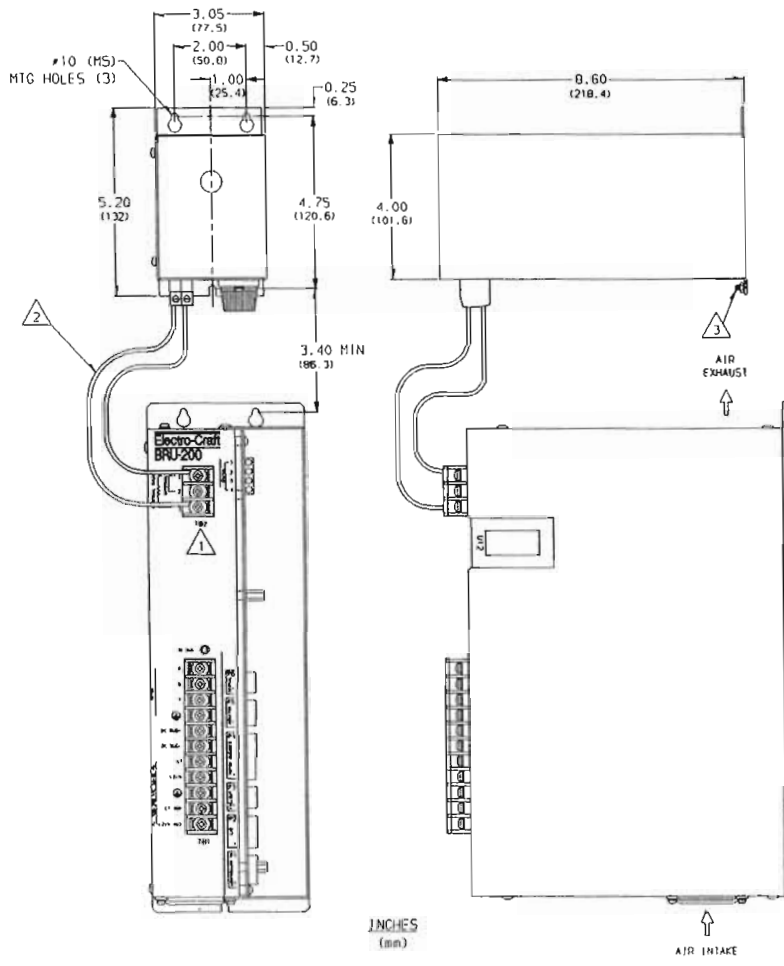
A1	ADDUM	IMPROVED COVER NOTCH			
A	21176TH	RELEASED	11-29-94	BCB	
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
01	001	00000			
02	002	00000	IM 11-29-94	PC 11-29-94	
03	003	00000	DIAG, OUTLINE & POORING		
04	004	00000	GRU-200, PART		
DRAWN BY		DATE		CHKD BY	
DESIGNED BY		DATE		CHKD BY	
CHECKED BY		DATE		CHKD BY	
APPROVED BY		DATE		CHKD BY	
PROJECT NO.		0101-1700			
SHEET NO.		1:1		11 of 11	
SCALE		BELMONT			



C

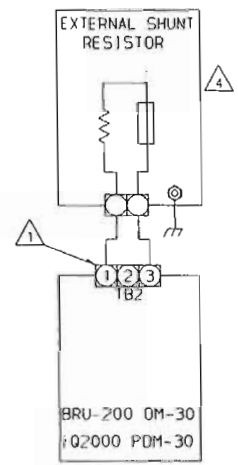
7





**NOTES:**

- 1 FOR INTERNAL SHUNT RESISTOR. JUMPER INSTALLED BETWEEN PINS 1 & 2 OF TB2.
- 2 FOR EXTERNAL SHUNT RESISTOR. REMOVE JUMPER INSTALLED BETWEEN PINS 1 & 2 OF TB2. INSTALL WIRING AS SHOWN.
- 3 36" OF #14 AWG WIRE IS SUPPLIED WITH EXTERNAL SHUNT RESISTOR. CUT TO LENGTH AS REQUIRED.
- 4 #6-32 STUD (NUT AND WASHER SUPPLIED) FOR CUSTOMER GROUNDING.
- 5 200 WATT CONTINUOUS, 6000 WATT PEAK.



CONNECTION DIAGRAM

A	21249	TM	RELEASED	--	--
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRWN BY	DATE	REVISOR/DATE
DO NOT SCALE DRAWING			TM	1-31-95	--
DIMENSIONS ARE IN INCHES			DIAG. MTG & CONN, EXT		
BREAK ALL EDGES .02 MAX			SHUNT, BRU-200/102000		
FILLET AND ROUNDS .02 R MAX			PART NO.		
TOLERANCE ON:			9101-1328		
ANGLES 13°			SCALE		
FRACTIONS: 1/16"			1:2		
DECIMALS: .XX, .010			C		
.XXX+.005			7 of 1		

C

10

7



MOTOR	MOTOR POWER MATING CONNECTOR CONTACT SIZE (GAUGE/mm <sup>2</sup> )	MINIMUM RECOMMENDED POWER WIRE (GAUGE/mm <sup>2</sup> ) (90°C COPPER ONLY)
S-2005	16 AWG/1.2mm <sup>2</sup>	16 AWG/1.5mm <sup>2</sup>
S-3007		
S-3016		
S-4030		
F-4030	12 AWG/3.0mm <sup>2</sup>	14 AWG/2.5mm <sup>2</sup>
S-4050		
F-4050		
S-4075		

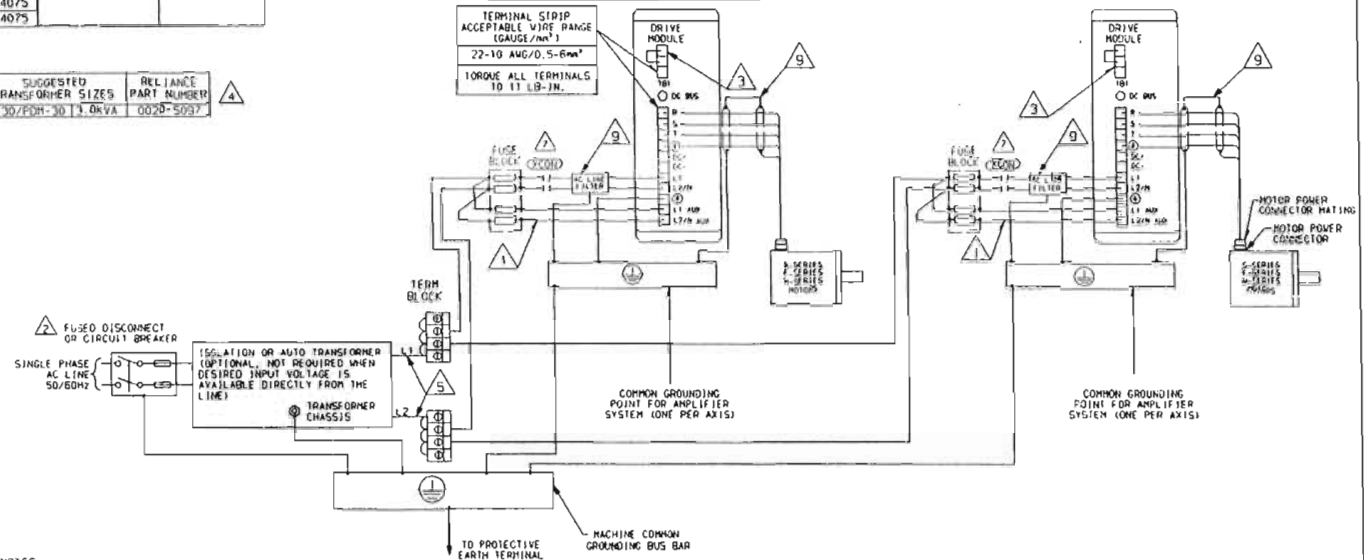
PIN	SIGNAL
A	+
B	-
C	+
D	MOTOR CASE

DRIVE	TERMINAL(S)	RECOMMENDED POWER WIRE (GAUGE/mm <sup>2</sup> ) (90°C COPPER ONLY)
ALL	L1, L2/N	16 AWG/1.5mm <sup>2</sup>
DN-10/PDM-10	L1, L2/N	14 AWG/2.5mm <sup>2</sup>
DN-20/PDM-20	L1, L2/N	14 AWG/2.5mm <sup>2</sup>
DN-30/PDM-30	L1, L2/N	12 AWG/4mm <sup>2</sup>

DRIVE MODULE INPUT CURRENT REQUIREMENT	AMPS AC RMS
L1 AUX, L2/N AUX	1.0 Amps AC @ 115 Volts
L1, L2/N	0.5 Amps AC @ 230 Volts AC
DN-10/PDM-10	10.0 Amps AC
DN-20/PDM-20	15.0 Amps AC
DN-30/PDM-30	20.0 Amps AC

NOTE: SLOW BLOW FUSES ARE REQUIRED TO ALLOW FOR INRUSH CURRENT DURING POWER INITIALIZATION AT THE MAIN AND AUXILIARY TERMINALS. TIME DELAY VERSIONS OF UL CLASS J, CLASS R OR EQUIVALENT FUSES ARE ACCEPTABLE, LOCAL REGULATIONS MUST BE OBSERVED.

SUGGESTED TRANSFORMER SIZES	RELIANCE PART NUMBER
DN-10/PDM-10 1.0kVA	0020-5097



**NOTES**

- 1 MAY BE USED TO KEEP LOGIC SECTION OF DRIVE MODULE SUPPLIES POWERED AFTER MAIN MOTOR SUPPLY IS TURNED OFF AT L1, L2 TERMINALS (EXAMPLE, TO RETAIN DIAGNOSTIC STATUS OF DRIVE MODULE AFTER L1, L2 POWER DOWN). WHEN USING A THREE PHASE SUPPLY CONNECT THE MAIN AND AUXILIARY INPUTS TO THE SAME PHASE.
- 2 A SUPPLY DISCONNECTING DEVICE IS REQUIRED FOR MAINTENANCE & SAFETY. LOCAL REGULATIONS SHOULD BE OBSERVED. IN EUROPE, IF A GROUNDED NEUTRAL IS USED INSTEAD OF L2 OR L2/AUX, ONLY L1 MAY BE SWITCHED OR FUSED.
- 3 JUMPER INSTALLED AT FACTORY FOR INTERNAL SHUNT. SEE DRAWING 9101-1328 FOR TERMINAL WIRING OF EXTERNAL SHUNT OPTION TERMINALS.
- 4 TRANSFORMER SIZES SHOWN ARE FOR MOST APPLICATIONS; APPLICATIONS REQUIRING MAXIMUM PEAK TORQUE AT MAXIMUM MOTOR SPEED MAY REQUIRE A LARGER TRANSFORMER. SECONDARY VOLTAGE MAY DROP (BASED ON TRANSFORMER LOAD REGULATION PERFORMANCE) WHEN THE MOTOR DELIVERS PEAK TORQUE. THIS DROP IN TRANSFORMER VOLTAGE WILL LIMIT MAXIMUM MOTOR SPEED WHILE PEAK TORQUE IS REQUIRED. SEE DRAWING 9101-1057 FOR TRANSFORMER LOAD REGULATION OF RELIANCE MOTION CONTROL TRANSFORMER 0020-5097.
- 5 DRIVE RATED 100-240 VAC RMS, SINGLE PHASE INPUT VOLTAGE (230 VAC STANDARD).
- 6 DO NOT DAISSY CHAIN DRIVE MODULES. MAKE SEPARATE CONNECTIONS DIRECTLY TO THE AC SUPPLY.
- 7 DRIVE ENABLE INPUT MUST BE OPENED WHEN MAIN POWER IS REMOVED AND AUXILIARY POWER IS PRESENT, OR A DRIVE FAULT WILL OCCUR.
- 8 MULTIPLE DRIVE MODULES MAY BE POWERED FROM ONE TRANSFORMER OR OTHER AC SUPPLY SOURCE.
- 9 AC LINE FILTER AND SHIELDED MOTOR CABLE ARE OPTIONAL. TO BE USED FOR IMPROVING THE DRIVE MODULES ELECTROMAGNETIC COMPATIBILITY. THE AUX INPUT HAS AN INTERNAL FILTER. WIRING BETWEEN THE DRIVE MODULE AND FILTER SHOULD BE KEPT AS SHORT AS POSSIBLE. THE COMMON GROUND BUS BAR SHOULD BE AS CLOSE TO THE DRIVE AS POSSIBLE.
- 10 WIRE SIZES ARE MINIMUM RECOMMENDED VALUES. THE REQUIREMENTS OF LOCAL REGULATIONS SHOULD BE OBSERVED.

A	21244	TM	RELEASED		
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRAWN BY	DATE	DESIGN CHECK
DO NOT SCALE DRAWING			TM	1-23-94	
DIMENSIONS ARE IN INCHES			DIAG. POWER WIRING CONNECTIONS,		
BREAK ALL EDGES .02 MAX			BRU-200/102000		
FILLET'S AND ROUNDS .07 P MAX					
TOLERANCE ON:			PART NO.		
ANGLES .1°			9101-1329		
FRACTIONS .1/64"			SCALE		
DECIMALS .XX1 .020			N/A		
.XXX1 .010			SHEET		
			1 of 1		

C

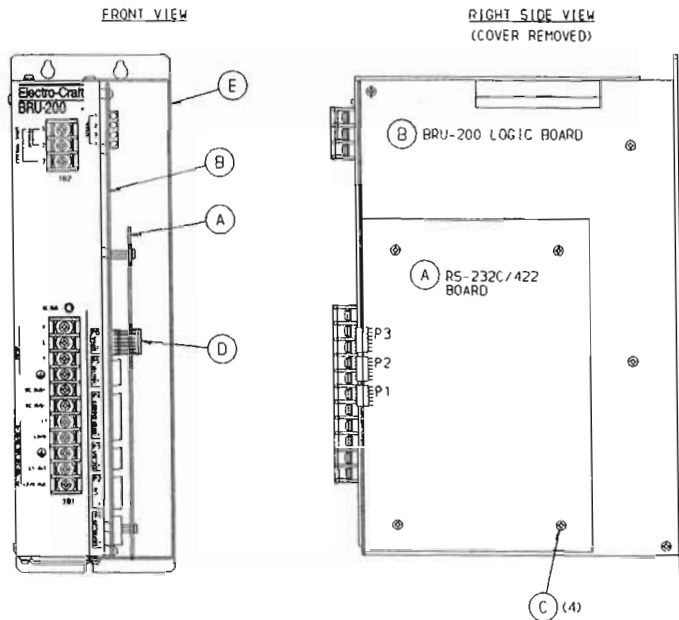


**RS-232C/422 KIT INSTALLATION INSTRUCTIONS**

1. LOOSEN COVER SCREWS AND SLIDE COVER (E) OFF OF UNIT.
2. FASTEN BOARD (A) TO BOARD (B) USING (4) SCREWS (C).
3. PLUG 6-WIRE HARNESS (D) INTO CONNECTOR P6 OF BOARD (B) AND INTO CONNECTOR P3 OF BOARD (B).
4. INSTALL COVER (E)

MATING CONNECTORS ARE PROVIDED IN THE RS232C/422 KIT FOR CUSTOMER CONNECTION TO HOST COMPUTER & ADDITIONAL BRU-200 DRIVE MODULES.

BRU-200 DRIVE MODULE WITH  
RS-232C/422 OPTION



**NOTES:**

1. INSTRUCTIONS FOR CONNECTIONS TO P1 & P2 ARE SILKSCREENED ON THE RS-232C/422 ADAPTOR CARD.

A	--	TM	RELEASED	--	--
REV	ECO	BY	REVISION DESCRIPTION	DATE	CHKR
UNLESS OTHERWISE SPECIFIED			DRAWN BY	DATE	DESIGNER
DO NOT SCALE DRAWING.			TM	2-13-95	
DIMENSIONS ARE IN INCHES			DIAG. INSTALLATION, RS-232C/422		
BREAK ALL EDGES .02 MAX			TO BRU-200 PARJ		
FILLETS AND ROUNDS .02 R MAX			TOLERANCE ON:		
ANGLES ±1°			RELIANCE ELECTRIC		
FRACTIONS ±1/64"			9101-1330		
DECIMALS .001, .020			SCALE: 1:2		
XXX ±.010			DWG. SIZE: C		
			SHEET: 1 OF 1		



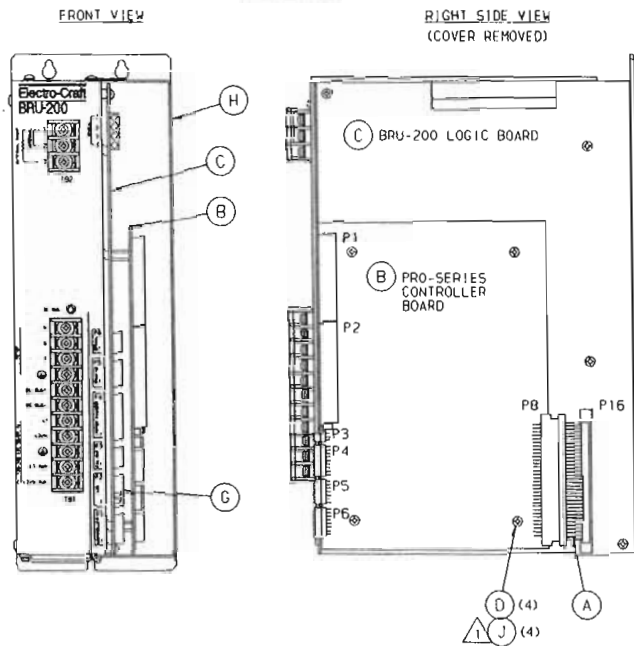
**PRO-SERIES KIT INSTALLATION INSTRUCTIONS**

1. LOOSEN COVER SCREWS AND SLIDE COVER (H) OFF UNIT.
2. PLUG RIBBON CABLE (A) INTO CONNECTOR P16 OF BOARD (C) AND INTO CONNECTOR PB OF BOARD (B).
3. FASTEN BOARD (B) TO BOARD (C) USING (4) SCREWS (D) AND (4) LOCK WASHERS (J).
4. PLUG JUMPER CONNECTOR (G) INTO CONNECTOR P2 OF BOARD (C).
5. INSTALL COVER (H)

MATING CONNECTORS ARE PROVIDED IN THE PRO-SERIES KIT FOR CUSTOMER CONNECTION TO PRO-SERIES CONTROLLER BOARD CONNECTORS P1, P2, P3, P5.

MATING CONNECTORS ARE PROVIDED WITH THE BRU-200 FOR CUSTOMER CONNECTION TO BRU-200 LOGIC BOARD CONNECTORS P4, P5, P6.

**BRU-200 DRIVE MODULE WITH PRO-SERIES CONTROLLER OPTION**



**NOTES:**

⚠ LOCK WASHERS (J) ARE USED ON PRO-X50 & PRO-X50B ONLY.

A	TM	RELEASED		
REV	ECO	BY	REVISION DESCRIPTION	DATE
				CHKR
UNLESS OTHERWISE SPECIFIED		DATE	DATE	DATE
DO NOT SCALE DRAWING		TM	2-12-95	
DIMENSIONS ARE IN INCHES		DIAG, INSTALLATION, PRO-SERIES		
BREAK ALL EDGES .02 MAX		KIT/BRU-200 DRIVE MOD.		
FILLET AND ROUNDS .02 R MAX				
TOLERANCE ON:		PART NO:		
ANGLES ±1°		9101-1331		
FRACTIONS: 1/64"		SCALE (DWG DIA)		
DECIMALS: .XX, .020		1,2 C 1 of 1		
XXX. 010		RELIANCE ELECTRIC		



## APPENDIX A - Getting Started With the Tandy 102 Terminal

The following procedure outlines the steps required to establish BRU-Series drive communications using the Tandy 102. Refer to the Tandy 102 owners manual for switch locations and initial power up instructions.

- 1.) After powering up the Tandy 102, press function key F8 to bring the main menu to the screen.
- 2.) Move the program selector using the arrow keys or the space bar to the "TELCOM" program and press [ENTER]. The telecommunications program will be executed which allows the Tandy 102 to communicate to the BRU-Series drive.
- 3.) The top line of the screen is the status code which indicates the TELCOM communication parameters (for example, "M711D,10 pps"). This code must be changed before the Tandy 102 will talk to the BRU-Series drive. To change the code, press function key F3. The "STAT" prompt will be displayed beside "TELCOM."
- 4.) Type "88N1E" and press [ENTER]. The communications parameters are now set to the required values. For an explanation of this code refer to the Tandy 102 owners manual.
- 5.) Select terminal mode by pressing function key F4.
- 6.) Terminal mode functions are displayed on the bottom line of the screen. The word "FULL" (full duplex) should be displayed above [4]. If "HALF" (half duplex is displayed, press function key F4 to change to "FULL".
- 7.) Connect the RS-232 interface cable (9097-1040-010) between the Tandy 102 and the BRU-Series drive. Press <ESC> and the Tandy is ready to communicate with the BRU-Series drive.

**APPENDIX B - User Terminal Communication Codes**

**ASCII Control Keys Received By BRU-Series drive**

<u>Key</u>	<u>Hex Value</u>
Backspace	08
Carriage Return	0D
XON	11
XOFF	13
ESC	1B

**Other Controls Received By BRU-Series drive**

<u>Key</u>	<u>Hex Value</u>
Up Arrow	1E
Down Arrow	1F
Left Arrow	1D
Right Arrow	1C

**Escape Codes Sent to Terminal By BRU-Series drive**

<u>Escape Code</u>	<u>Hex Value</u>	<u>Description</u>
ESC J	1B,4A	Erase to end of screen
ESC P	1B,50	Turn cursor on
ESC Q	1B,51	Turn cursor off
ESC U	1B,55	Clear system line (Tandy 102)
ESC Y r,c	1B,59,r,c	Position Cursor row, column
ESC p	1B,70	Enter reverse video
ESC q	1B,71	Exit reverse video
ESC H	1B,48	Move cursor (move to top left corner)

**Other Codes Sent to Terminal By BRU-Series drive**

<u>Key</u>	<u>Hex Value</u>
Backspace	08
Linefeed	0A
Carriage Return	0D
Bell	07

## APPENDIX C Getting Started With an IBC PC Terminal

### Communication Using EC COMM

1. Connect cable from the BRU-Series drive serial port (P6) to the PC according to the following pinout:

<u>BRU P6</u>	<u>PC (9 Pin)</u>	<u>PC (25 Pin)</u>
1 XMT.....	2 RXD.....	3 RXD
3 Signal GND.....	5 GND.....	7 GND
5 RCV.....	3 TXD.....	2 TXD

If using RS-422, two additional connections must be made:

2 XMT+ .....	* RXD+ or B .....	* RXD+ or B
4 RCV+ .....	* TXD+ or B.....	* TXD+ or B

\* Correct pin numbers depend on RS-422 board being used

2. Invoke EC COMM--type 'ECC' (for a monochrome monitor, type 'ECC /b')
3. EC COMM will look for a file called ECC.CFG in the current directory to load parameters from; if there is no ECC.CFG file, one will be created and default parameters will be used:

Baud rate:	9600	BRU emulation
Parity:	none	Color monitor
Data bits:	8	Full Duplex
Stop bits	1	No LF after CR
Com1		

Parameters may be changed and then stored using the 'Alt S' command; for example, to save the monochrome monitor setting, use the '/b' command tail shown in 2 above, then press 'Alt S' once in EC COMM--when ECC is invoked again, the screen will be in monochrome rather than color; to return EC COMM to the default parameters, delete the ECC.CFG file.

4. Press 'Alt P' to set the communication parameters:  
BAUD 9600 (or match baud rate of BRU-Series drive)  
PARITY NONE  
DATA BITS 8  
STOP BIT 1  
Select correct COM port  
  
If communicating with a BRU-Series drive, select BRU; if communicating with a PRO-Series Controller, the terminal emulation may be set to either BRU or ANSI
5. Press [ESC] to establish communication
6. Press 'ALT H' for the Help screen
7. Press 'Alt F4' to return to DOS temporarily (DOS shell); once in the DOS shell type 'EXIT' to return to EC COMM
8. To exit EC COMM, press 'Alt X'

## APPENDIX D Communication Problems and Possible Cures

### No Communications Between BRU and Serial Terminal

1. Check jumpers P11-13 for the correct communications mode: RS-232 or RS-422; (factory default setting is RS-232) refer to Figure 5-2 for correct settings.
2. Check baud rate, parity, data, and number of stop bits settings on serial terminal (see Section 5.2.3).
3. Press Ctrl-Q (send XON).
4. If using a Tandy, press Shift-Break (Tandy may be locked up--this will clear it).
5. Make sure that the terminal ground and the BRU-Series ground are referenced to the same point.
6. If using a PC for communication, make sure that the correct COM port is selected.
7. If using a PC with a serial mouse, the mouse driver software may be causing a conflict with the serial port (it may be necessary to disable the mouse driver and then reboot the computer).
8. If using EC COMM, make sure that the BRU emulation mode is selected.

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BRU-200 and BRU-500  
Brushless Drives  
Instruction Manual

**P/N 0013-1028-001 Revision B**

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**MOTION CONTROL**  
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