User's Guide for the

LX
Brushless Servo Drives

Amplifier Models
LX-400, LX-700, LX-1100

Motor Models
DX-208, DX-316, DX-340
DX-455, DX-490, DX-4120

User's Guide
for the

LX Series
Brushless Analog Servo Drives

LX400, LX-700, LX-1100

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1
Introduction

1.1 Features of the LX Drives

- Uses 96-264 VAC 50/60 Hz, single or 3Ø, direct on-line power source
- 1 KW to 3 KW output power range
- 10 lb.-in. to 100 lb.-in. (1.13 NM to 11.3 NM) matching motor series
- Resolver feedback tolerates shock and high temperature
- Encoder simulation output for external position controller interface
- Personality module to maintain axis adjustments
- Sinusoidal commutation for smooth motion
- Velocity or torque mode of control
- Limit switch inputs
- Diagnostic LEDs
- Integral power supply minimizes external wiring
- Backup logic supply input
- Integral brake available on motors
- Waterproof and connectorized motors available
- Bus power sharing capability

Description

The LX Series of brushless servo drives is the latest in analog amplifier design from Emerson EMC. The wide input voltage range and compact dimensions make it one of the most versatile amplifiers available.

There are three amplifiers in the LX Series; the LX-400 (4.0 amps of continuous output current), the LX-700 (7.0 amps of continuous output current) and the LX-1100 (10.9 amps of continuous output current). All three amplifiers have the same physical dimensions.

Each LX Amplifier is matched with the proven reliable DX Brushless Servo motors. When correctly matched, the LX Amplifier and DX Motor combinations offer continuous torque output ratings of from 10 to 100 lb.-in.

The amplifiers incorporate pulse width modulated (PWM) design to provide efficient power conversion. Sine wave commutation of the motor results in smooth rotation across the full range of speed.

All LX Amplifiers are designed with their own power supply, heat sink, shunt resistor and fan (when needed). This allows for simple installation and expansion.

LX Amplifiers can be easily adjusted to operate with a variety of motors and controllers. A personality module attached to the amplifier retains all adjustments. If an amplifier needs to be replaced, the personality module can be removed and attached to a new amplifier, thus alleviating the re-adjustment process.

Troubleshooting is aided through the use of status LEDs located on the front panel of the amplifiers. The LEDs continually keep the operator informed of the status of the amplifier at all times. In addition to the LED indications, fault conditions such as resolver fault and motor over temperature are announced as a contact signal output which can be monitored by a host controller.

Input power voltage can range from 96 to 264 VAC 50/60 Hz without jumper or switch selection. A 230 VAC 50/60 Hz, 3Ø supply will deliver the maximum output power.

Optimum performance from a servo system is accomplished by carefully matching the motor and amplifier. Emerson EMC's DX Series of servo motors has been engineered to compliment the LX servo amplifier, providing unparalleled reliability and performance.

The DX Motors are available in a number of configurations including connectorized or waterproof (IP65) versions. Most motors are also available with a mechanical holding brake.

NEMA motor face dimensions are available in addition to the metric dimensions on four motor models to greatly simplify mounting to many standard reducers.

DXE-208 NEMA 23 compatible
DXE-316 NEMA 34 compatible
DXE-455 NEMA 56C
DXE-490 NEMA 143TC
DXE-4120 NEMA 143TC

The signal and power connections are conveniently located on the drive front panel to simplify wiring in multi-axis applications.

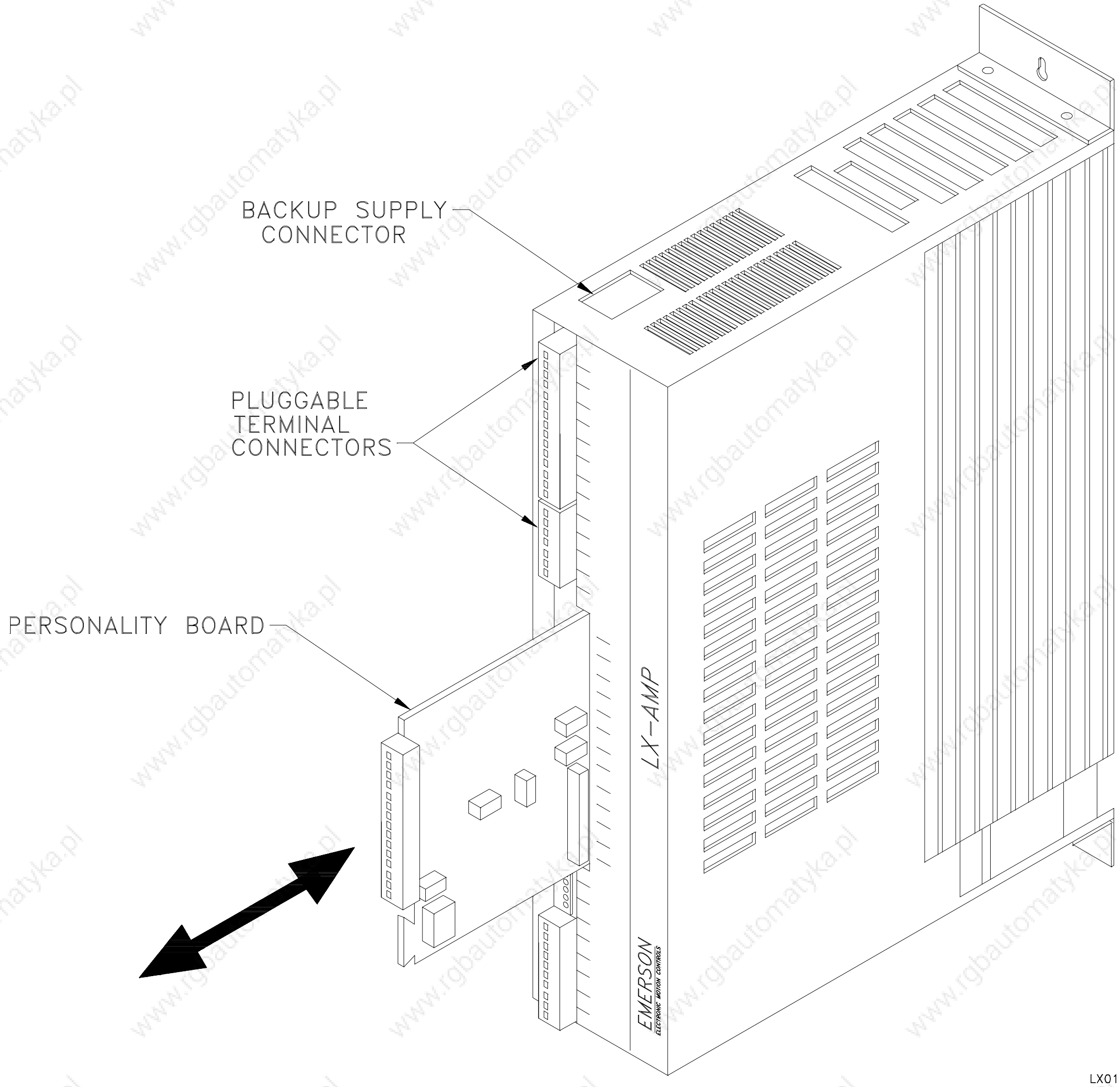


Figure 1.1 LX Drive, overall layout

1.2 System Components

A complete LX package is made up of an LX amplifier, a DX motor and the appropriate motor and resolver cables connected as shown in Figure 1.2. Cables are available from Emerson for both the connectorized and non-connectorized motors. EMC designed cables are recommended because they have been specially designed for the LX amplifiers and will minimize installation problems. Table 1-A shows the available cables and their application. For more information see Chapter 2.

Table 1-A – Motor Cabling

Motor Type	Motor Model	Motor Cable	Resolver Cable
Waterproof Motors	DXM/E-3xxW, 4xxW	HPS-XXX (shielded) 250036-00(non-shielded)	250224-09
Connectorized Motors	DXM/E-3xxC, -455C	ECM-XXX	LCF-XXX
	DXM/E-490C, -4120	ECL-XXX	LCF-XXX
	DXM/E-208	LCS-XXX	
All cabling is PVC, rated for 105° C. (XXX) is length in feet, consult an Emerson EMC application engineer for cabling requirements over 100 ft.			

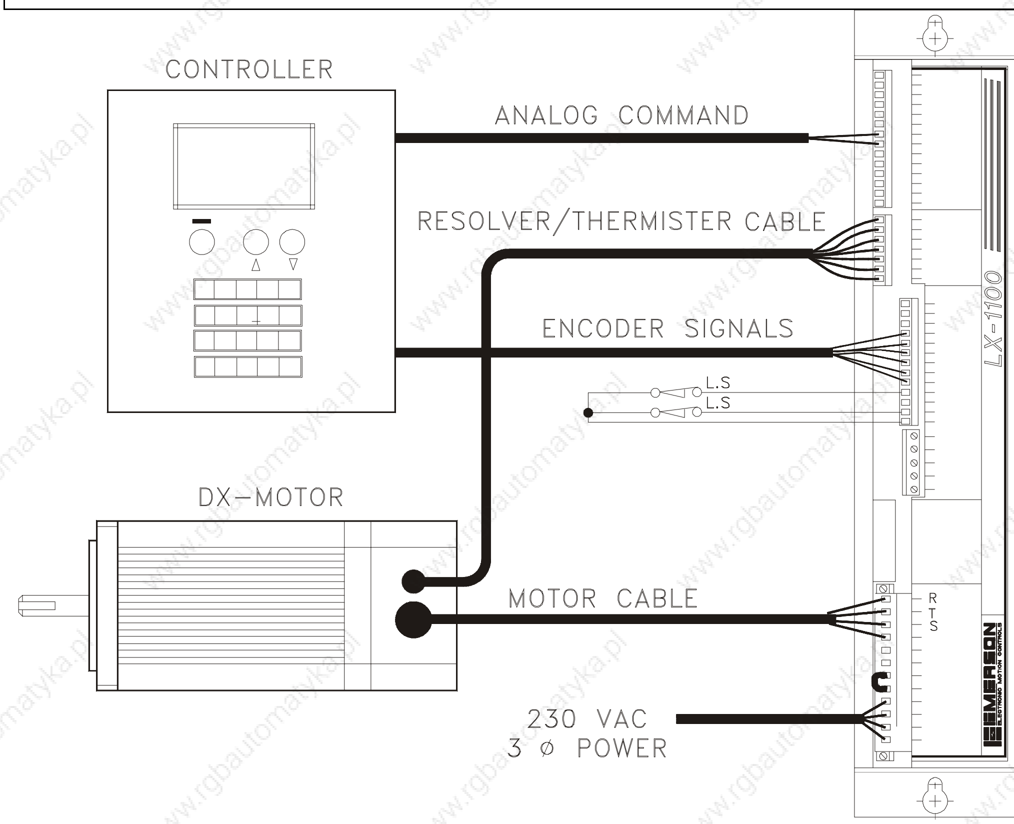


Figure 1.2 Typical LX component configuration

1.2.1 User Adjustments and Options

The amplifiers each have a personality module that is used to set up the drive for the application as required. The drive features which are customized by the user on the personality board include:

- Continuous Current limit value
- Maximum Speed Range (3000 / 6000 rpm)
- Motor pole selection
- Calibration adjustments
- Limit Switch enable and polarity
- Encoder output resolution

The Limit switch inputs and Emulates encoder outputs are standard on the LX, however these features can be deleted when purchasing quantities of drives to further reduce costs. See your Emerson Sales Representative for further details.

1.3 Basic Function and Operation

The amplifier is designed to operate in either a velocity command or current (torque) mode with an analog ±10 volt command. The velocity command input is a true differential input while the current command input is a single ended input that doubles as the current demand output. This signal can be used as a master output in torque helper applications as well as a test point for detecting the actual motor current required in an application. For details about the current command mode see the “Special Applications” section 6.

1.3.1 Feedback Signals

Speed and position feedback signals are accurately derived from the position information coming from the resolver mounted on the motor shaft.

The derived tachometer signal is used by the amplifiers speed control circuitry and is available as an analog signal output on the connection strip. This tachometer output provides analog voltage proportional to the shaft speed with a range of ± 10V equal to ± 3000 / 6000 rpm.

Emulated encoder outputs with zero markers are provided on the standard LX amplifier for use with position controllers.

1.3.2 Control Loops

The LX drive uses two high performance control loops (current and velocity) to control the speed and torque of the motor. The “current loop” controls the current flowing into the motor by comparing the current flowing in the motor to the current command from the reference signal and correcting it to maintain the commanded current. The current command can come from either an external controller or directly from the LX amplifiers speed loop. The velocity loop controls the motor velocity by comparing the actual velocity of the motor to the velocity commanded by the drive and adjusting the current command as needed to maintain the commanded velocity.

Velocity Loop

In the velocity loop circuit the error signal is processed by a P.I.D. (Proportional, Integral and Derivative). The output of the P.I.D. filter is the current reference signal also available for test on terminal 2 of the front connector. The voltage on this point is ± 10 VDC. At ± 10V the drive generates the maximum current in the designated direction.

All the adjustments shown on the block diagram in Figure 1-3. Zero offset, proportional gain, response, accel/decel ramp gradient and full scale speed are located on the personality board and the potentiometers are accessible from the front panel.

Current Loop and Limiting

The current error signal is generated comparing the output of the current limiting stage with the actual current in the motor. The current error signal is computed to generate the PWM signals driving the IGBT final stage. In the block diagram in Figure 1-3, the IGBT devices are shown as switches.

Current Limiting

In the current loop circuit there is a current limiting circuit referred to as *Ixt*, which continuously monitors the current commanded and delivered into the motor.

> ***The Ixt limiting circuit is not operational in the current command mode. See Chapter 6 for details on implementing current command mode.***

This limiting circuit estimates the heating of the motor by continuously monitoring the amount of current in the motor and the length of time this current has been flowing. The limiting value is determined by the setting of dip switches on the personality board. If the current requested exceeds the value set by the dip switches, the *Ixt* control circuit will determine how long the commanded peak current will be allowed before limiting the delivered current to the dip switch value. This current limiting is not a fault condition but rather an *Ixt* current fold back limiting and is so indicated by the High Irms LED and High Irms output. When the drive is in the Ixt limit status, the RED led (HIGH Irms) lights and terminal 12 becomes open circuit. Once current fold back is engaged the drive will continue in the limited current condition until the current commanded is reduced below the dip switch level for length of time sufficient to reset the *Ixt* limiting circuitry. The amount of time allowed above the continuous level before *Ixt* limiting varies is dependent on the percent of RMS current the drive has been running. Peak current availability is also dependent on the level of current demand below and the amount of time below the dip switch level. In addition to the current foldback limiting, the LX amplifiers also have short circuit protection. This prevents destruction of the amplifiers due to short circuits either from a short that is applied while in operation or from a short circuit in effect at power ON.

1.4 Diagnostics and Fault Handling

A number of diagnostic and fault detection circuits are incorporated in the LX amplifier to protect the drive. Some faults like over voltage, under voltage and amplifier or motor over temperature reset when the fault is cleared. Other faults such as short- circuit at the motor output terminals and/or resolver fault need to be reset by cycling power. *Ixt* trip is not a fault condition, it simply folds back the current command to the DIP switch setting until the demand is reduced.

The Ixt trip is not operational in the current command mode. See Section 6 (Special Applications) for details.

Table 1-B

Condition	Display	Drive OK	Reset Action Required
Motor over temperature	LED on	Drive OK - contact open Drive OK - LED off	Auto reset on temp drop
Amp overtemp >95° C	LED on		Auto reset on temp drop
Over voltage			Auto reset on return to normal voltage
Under voltage			Auto reset on return to normal voltage
Output short ckt			Cycle power
Resolver fault	LED on		Cycle power
High Irms	LED on	Drive OK - on contact closed	Not a fault. Indicates current limiting action.
Backup Logic Supply active mode		Drive OK – contact opens for about 2 seconds then closes. LED follows contact action.	Re-application of AC Line power

1.5 Power Section

On the main board, the high current and the signal sections are optically isolated. Looking at the block diagram (Figure 1-3) the main functions of the drive can be identified. The power stage DC bus is supplied by the AC line input to the drive and the internal diode bridge rectifier followed by a set of filtering capacitors. The internal SMPS (Switching Mode Power Supply) operates off the power DC bus to generate all the voltages necessary to supply the low power and control electronics.

To dissipate the energy generated by the motor during high gradient deceleration rates and continuous regeneration against a load, the braking circuit shunts the excess current generated by the motor through the internal shunt (braking) resistor. The yellow LED lights when the shunt circuit is active. If the power capacity of the internal braking resistor is insufficient for heavy cycles, an external braking resistor with greater power should be added and the internal resistor disconnected. See the "Special Applications" in Chapter 6 for more information.

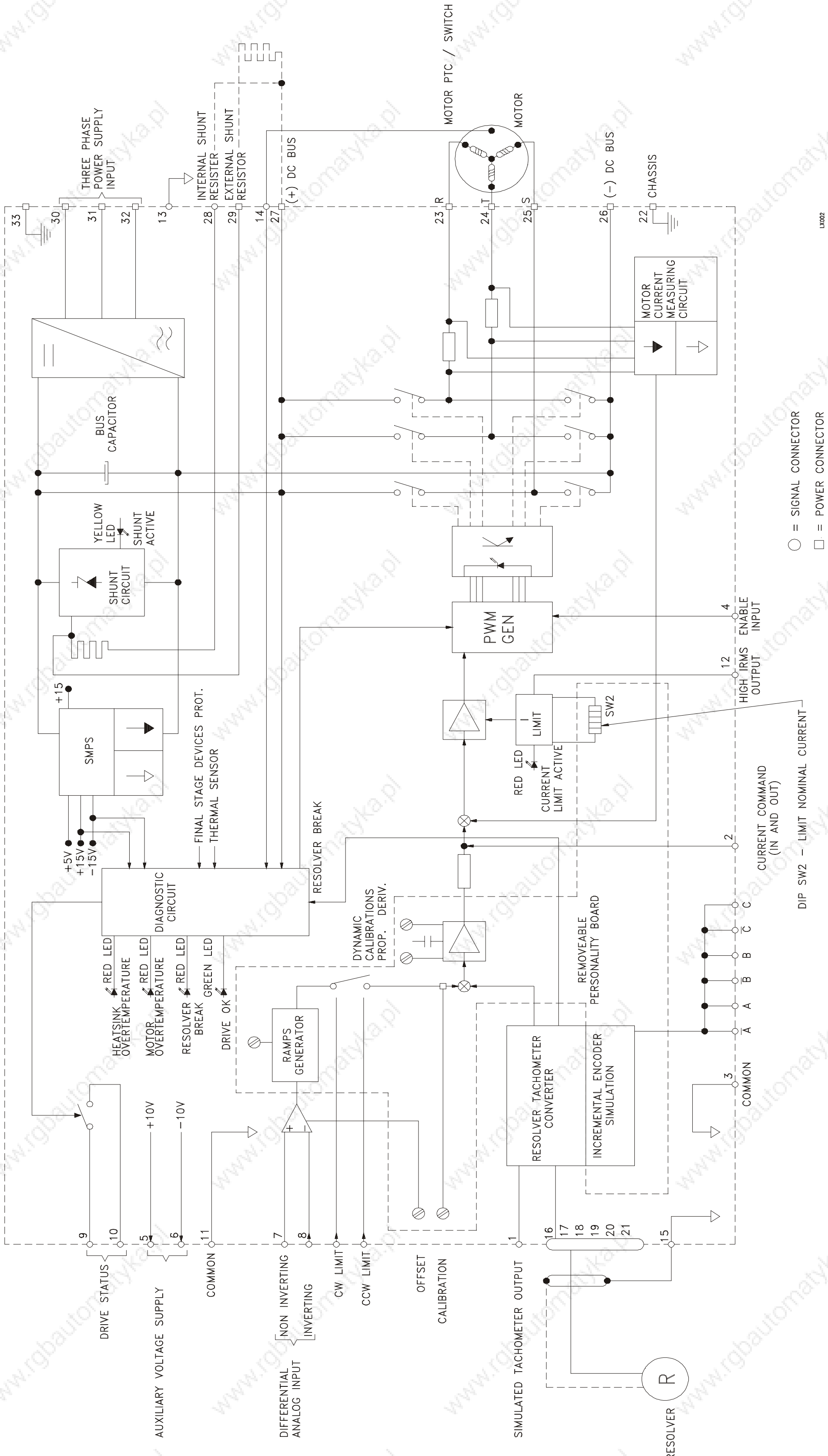


Figure 1-3 Block Diagram

2
INSTALLATION -- MECHANICAL

2.1 Installation
The following installation requirements, methods and procedures are provided to assure reliable and trouble free installation of your Emerson MC LX Drive.

The methods and procedures are outlined on the following pages and include site requirements, safety considerations, power and fusing requirements, wire and transformer sizing, noise suppression, and I/O wiring.

2.2 Safety Considerations
The installer/user is responsible for incorporating appropriate safety features into the equipment to prevent injury to personnel or damage to equipment.

The installer/user has the responsibility to comply with the safety requirements of the system. This includes installing the system with an appropriate master interlock switch for emergency shut down and using the proper wire and transformer sizes (if necessary) to fit the system. This section will provide you with the information to complete a trouble free installation.

WARNING!

The user is responsible for providing emergency interlock switches that will remove AC power from the system any time the equipment is not running, or when the emergency stop is activated. This is to eliminate the possibility of electrocution or unwanted movement of the motor. The safety ground connections should only be disconnected for servicing and only after <u>all</u> AC power has been removed.

2.3 Selecting an Enclosure
The LX drive is designed for the industrial environment. However, no sophisticated electronic system can tolerate certain atmospheric contaminants such as moisture, oils, conductive dust, chemical contaminates and metallic particles. Therefore, if the drive is going to be subjected to this type of environment it must be mounted vertically in a NEMA type 12 enclosure.

Proper ventilation and filtering must also be provided. If the equipment environment is above 50° C, cooling is mandatory. The amount of cooling depends on the size of the enclosure, the thermal transfer of the enclosure to the ambient air and the amount of power being dissipated inside the enclosure. Your enclosure supplier can assist you in properly selecting an enclosure for your application.

2.4 Amplifier Mounting

The LX drives must be mounted in a vertical orientation to insure the best air flow between the cooling fins of the heatsink. Mounting above other drives or any heat producing equipment may result in overheating.

The mounting brackets are attached to the LX drive heatsink by self tapping screws and thus are well grounded to the amplifier chassis. There are two ways to mount the drive depending on the placement of the mounting brackets. The physical dimensions of all the LX amplifiers are identical. See Figure 2-1 for mounting information.

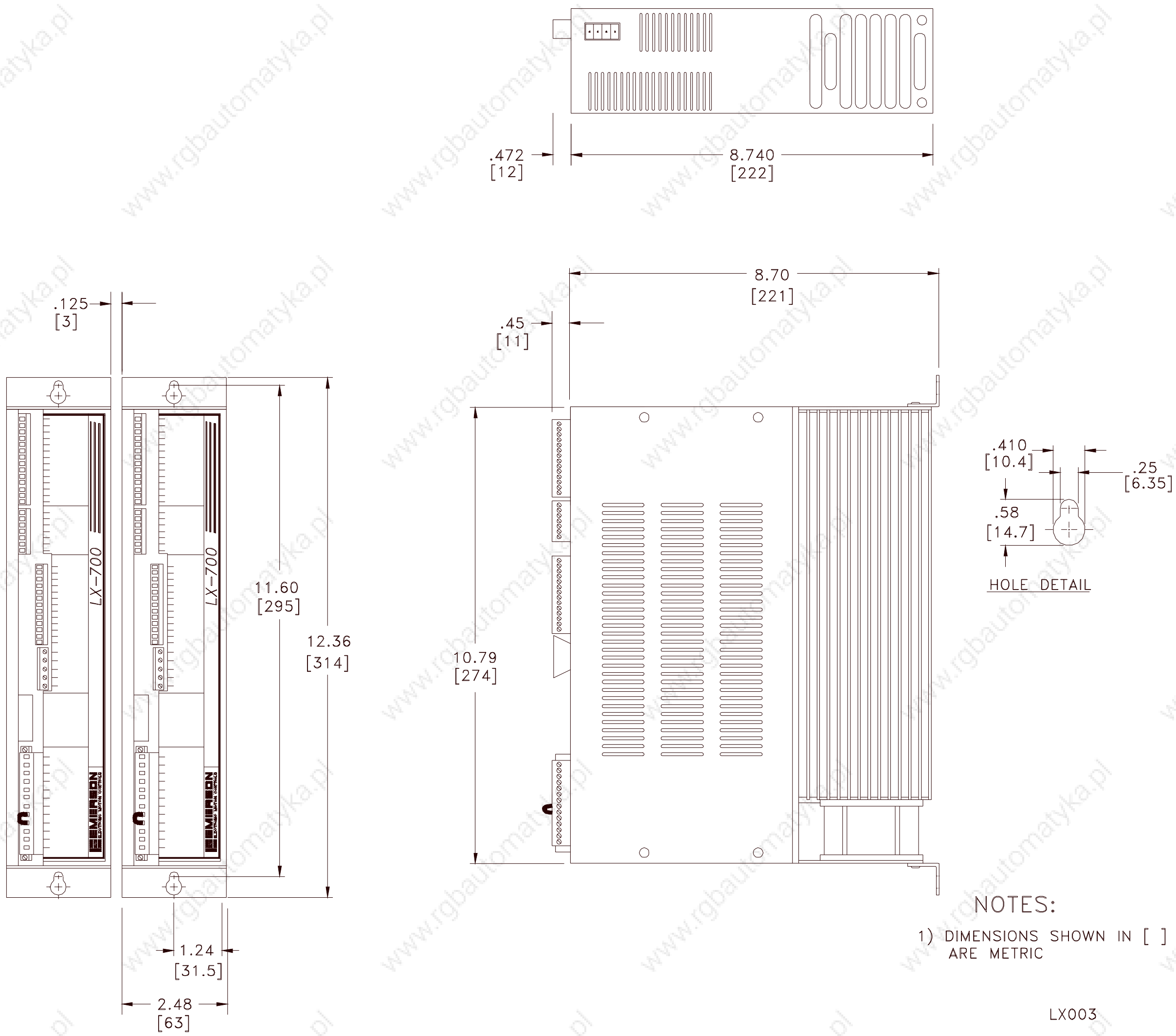


Figure 2.1 Amplifier Mounting Information

2.5 Motor Installation

2.5.1 Motor Mounting

To provide good mechanical alignment, the mounting surface of the motor face plate is held perpendicular to the motor shaft to within 0.005 inches. Projecting above the plane of the mounting surface is a close tolerance circular pilot boss. Matching the pilot boss with a pilot hole in the mounting structure facilitates interchanging the motor and minimizes the need for mechanical adjustments. The mounting surface is fitted with four holes equally spaced on a bolt circle pattern.

The mounting panel must be stiff enough so it does not deflect significantly when radial loads are applied to the motor shaft. The mounting panel should also have good thermal conductivity especially if peak performance is demanded of the motor.

WARNING!

Mechanical shock to the motor case or shaft (e.g., from striking or dropping) must be avoided to prevent damage to the motor. Possible results from striking or dropping include: Misalignment of the resolver; damage to armature bearings; cracking of the motor case; unbonding or demagnetization of the permanent magnets. Any of these would render the motor unserviceable.

2.5.2 Conduit Installation

The following procedure must be followed to assure a waterproof motor installation will be water-tight.

- Remove the rear cover from the motor and install the supplied “O” ring into the groove of the cover.
- Wrap the threads of the NPT conduit fitting with at least 2 layers of Teflon[1] tape.
- Install the fitting into the motor threads and tighten at least 1 turn after hand tightening. Do not over torque.
- Make the motor wire connections as necessary. DO NOT TIN THE WIRES. Tinning will compromise the long term integrity of the connection.
- Apply a high temperature (100° C.; 212° F.) rated grease (Lubriko ACZ or equivalent) to the “O” ring.
- Install the rear motor cover by tapping it into place taking care not to damage the “O” ring.
- Secure the cover with the four screws provided.

2.5.3 Load Coupling

A flexible coupling MUST be used between the motor shaft and the load to minimize mechanical stress due to radial loads, axial loads and/or misalignment. Radial and axial loading cannot exceed specified values. See Table 2-1.

[1] *Teflon is a registered trademark of the Dupont Corporation*.

Table 2-1 – Load Coupling

Motor	Maximum Radial Load (lbf) **	Maximum Axial Load (lbf)
DXM/E-208 *	20	15
DXM/E-3XX	20	15
DXM/E-4XXX	100	50
* M-(XXX) = Metric E-(XXX) = English ** Maximum Radial Load is rated at 1 inch from the motor face		

2.5.4 Gear Reducer Oil

It is strongly suggested that a synthetic oil is used in the gear reducer or rotary tables. This will reduce the amount of friction in the mechanism and, in turn, reduce the amount of current it takes to drive the motor.

3
INSTALLATION -- ELECTRICAL

3.1 Wiring

Wiring of any industrial equipment should be done with some consideration for future troubleshooting and repair. It is a good idea that wiring be either color coded and/or tagged with industrial wire tabs.

3.1.1 Interlocking

The user is responsible for emergency interlock switches. Any master interlock should be wired to shut down AC power to all parts of the system. Your system should be designed such that power is disconnected from the output loads any time the equipment is not running or when the emergency stop is activated.

3.1.2 EMI/RFI Interference

If there is sensitive electronic equipment (digital computer, test equipment, etc.) operating on the same AC power line as the Drive, additional EMI/RFI filtering may be required to reduce the effects of conducted AC line noise.

3.1.3 Shielding Suggestions

Effects of electrical noise on the electronic equipment are greatly reduced when the techniques outlined below are closely followed.

- Do not run low power control signals and high power wiring in the same raceway.
- If mixing wires cannot be avoided, then the low voltage control input and output wiring must be shielded. The shield for these wires should be connected to ground only at the source end of the signals.
- Do not connect both ends of a shielded cable to ground unless specified by the manufacturer to do so. This may cause a ground loop condition which could cause erratic equipment behavior and may be very difficult to locate.
- All the wires in the system must be kept as short as possible.

3.2 Magnetic Coil Noise

In the case of DC coils, a diode is installed across the coil in a direction that will cause the voltage transient to be dissipated through the diode.

Figure 3.1 DC Coil Suppression

In the case of AC coils, a capacitor and resistor are installed across the coil to suppress the unwanted transients.

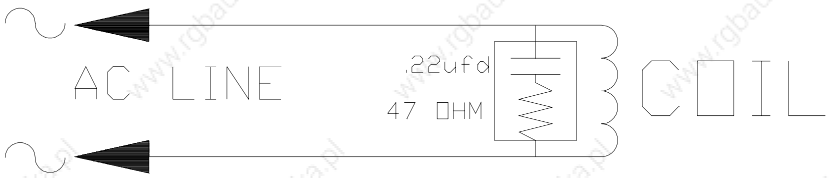


Figure 3.2 AC Coil Suppression

3.3 Grounding

The GND terminal of the drive is bonded to the frame and the mounting tabs. There are two acceptable methods for connecting the grounds of the enclosure and other electrical equipment to the Earth ground. Figure 3.3 shows the ideal grounding method providing a grounding point isolated from the enclosure and ground all the electrical equipment to this one point. From there, a grounding wire with good conductivity will be run to the enclosure cabinet ground point. The machine ground wire and earth ground supply wire are connected to this enclosure ground point. This method provides maximum isolation of the control and servo grounds from the machine and other sources of ground imbalances and noise. In most cases however, a single point enclosure ground can be used as shown in Figure 3.5.

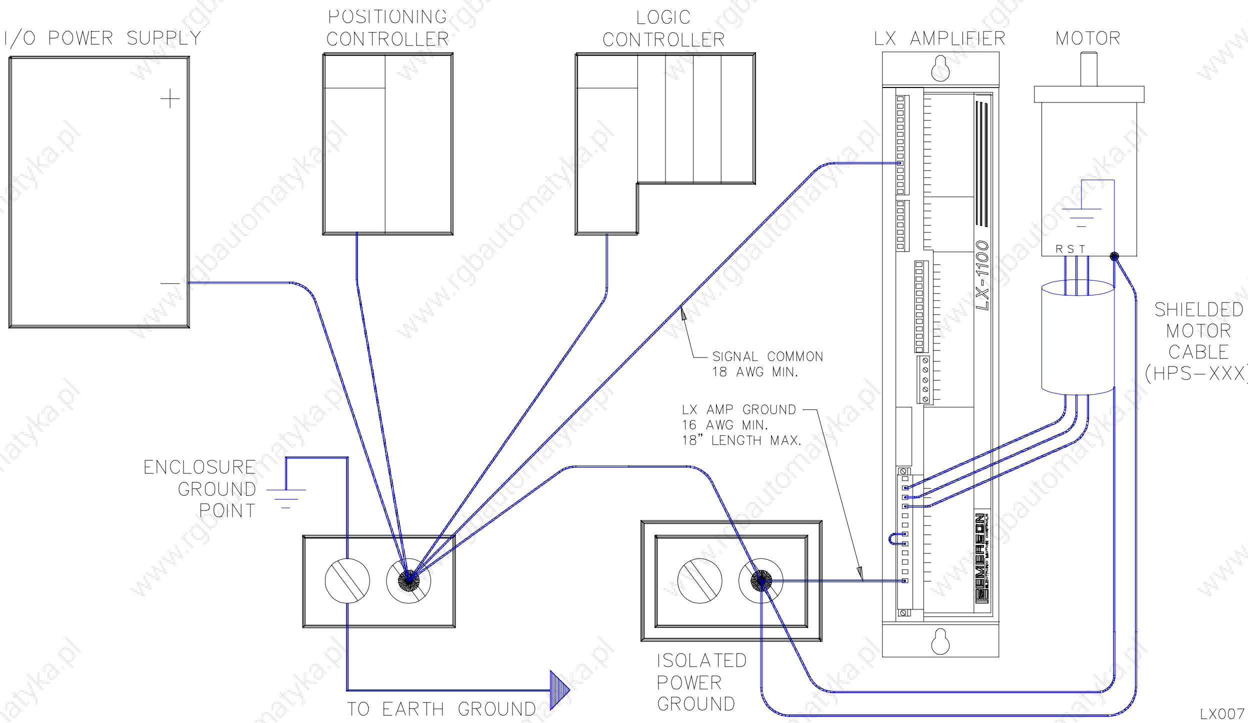


Figure 3.3 Ideal grounding example, schematic

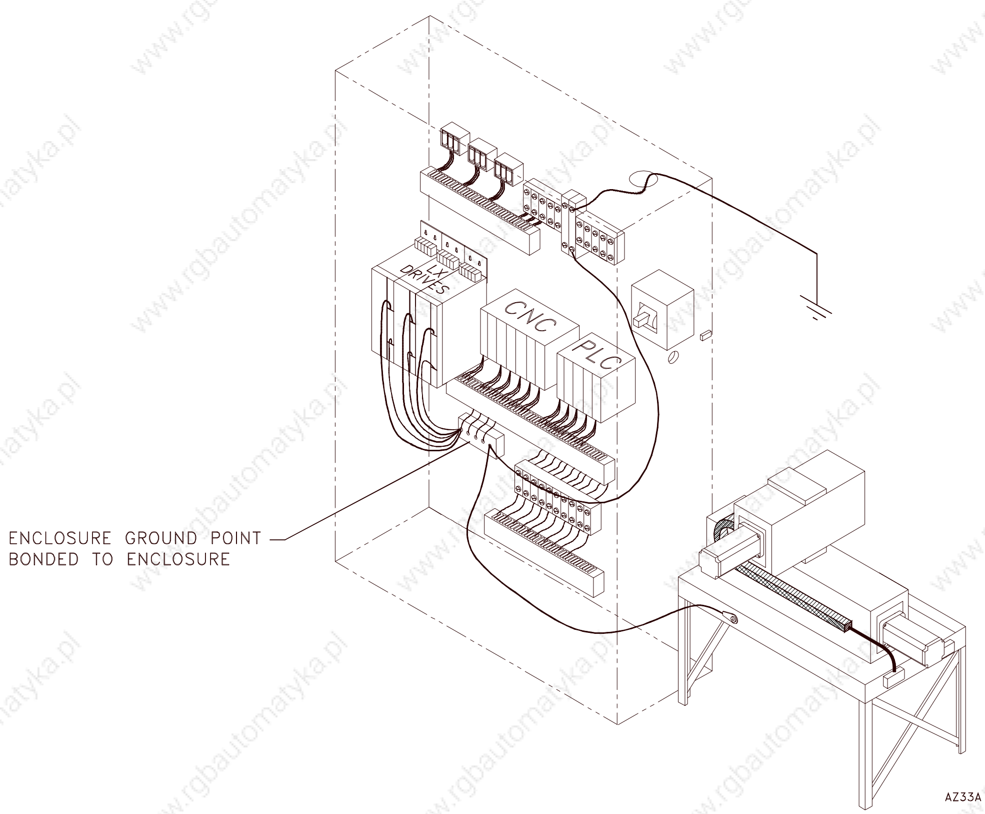


Figure 3.4 Ideal grounding example, pictorial

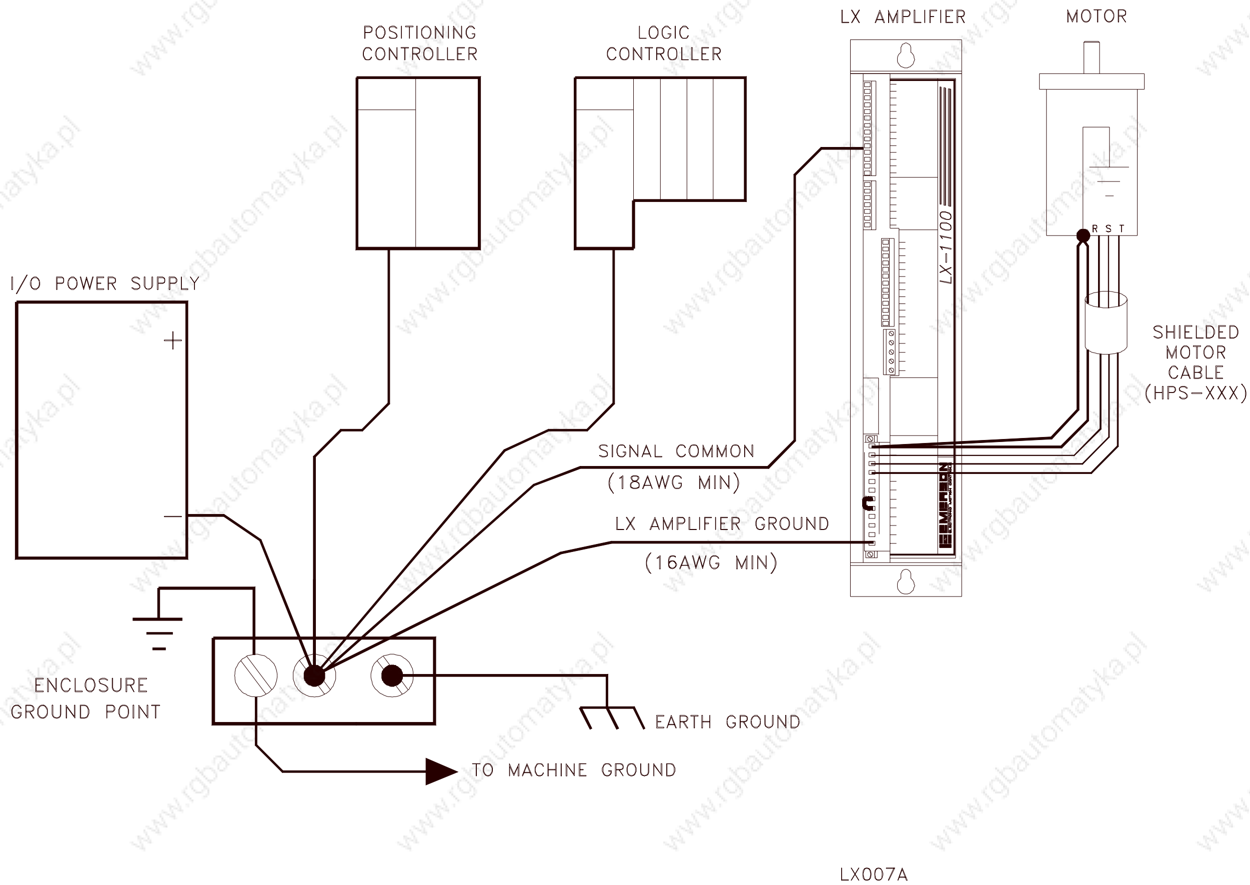


Figure 3.5 Acceptable grounding example

3.4 AC Input

The drives are designed to operate on a 50/60 Hz, three phase AC power line. The AC voltage of this power line must be within the specified range of 96-264 VAC. If at any time the input line voltage falls below 96 VAC the drive will drop out the Drive OK output contact and will disable the output bridge.

3.4.1 Single Phase Power

The LX drives will deliver maximum performance when operating on three phase, however, 96 to 264 volt, 1Ø can be used with a derating factor.

Note: Consult Emerson EMC customer service if 1Ø power supply is used.

Table 3-A – Power Wiring and Fusing

Model	MINIMUM WIRE SIZE AWG	[1]FUSE RATING AMPS
LX-400	20	5
LX-700	18	8
LX-1100	16	12

[1] *Recommended fuse type is a LOW PEAK delayed action type fuse such as Bus brand type LPN fuse. A standard rated delayed action or dual element fuse such as Bus brand FRN may be used in lieu of the Low peak type fuse when availability dictates but the level of drive protection afforded by the LPN fuse is better. In the case of a short circuit in the drive, there will be fewer failed drive components if a low peak fuse is used because it will blow before the currents reach a high level.*

3.4.2 Transformer Power Supply

One 3Ø transformer may be used to supply more than one drive. The secondary winding should be set up to supply the sum of the nominal current of the motors connected. The transformer secondary must be a delta configuration or a WYE configuration with a full current grounded neutral connection due to the harmonics induced when supplying power to a rectified power supply. The type of primary winding is immaterial.

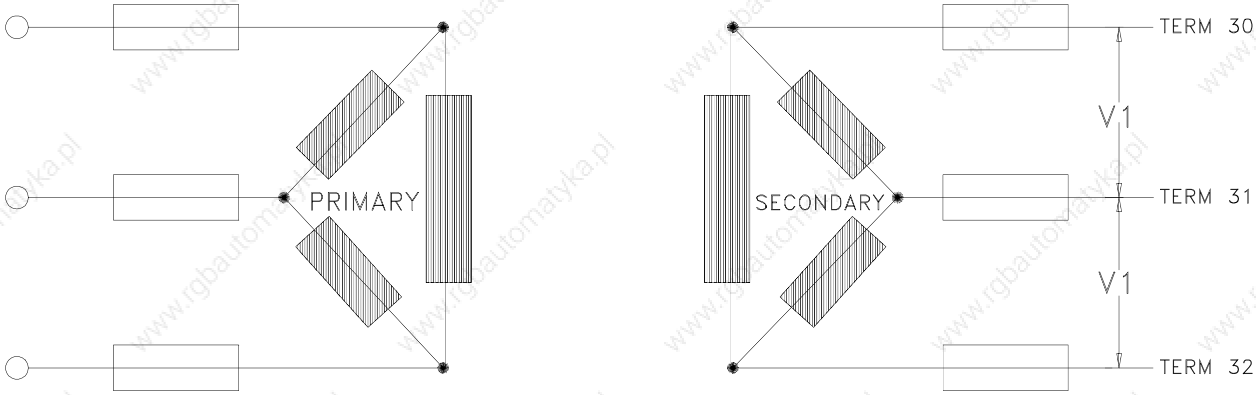


Figure 3.6 Power supply example

The following formula can be used for transformer sizing. For each secondary winding, the power in VA is:

Ps - (Paz * 1.5) * 1.73 / √ (n+2)

where:

Paz = (Vm1*Cm1 + Vm2* Cm2 + ... + Vmn*Cmn)

Vm = motor max speed in rad/sec (RPM/9.55)

Cm = nominal motor torque in Nm(lb-in/8.85)

1.73/√(n+2) = corrective factor when using more than one drive supplied in parallel with n= number of drives.

The overall transformer power in VA is:

Pt = Ps1 + Ps2 .... + Psn

where:

Ps1 = power of secondary winding 1

Ps2 = power of secondary winding 2

Psn = power of secondary winding n

3.4.3 Transformer Fusing

The secondary of the transformer must have fuses installed in each of the legs. The current for each fuse is:

Ampere = 0.8 transformer VA rating / RMS secondary voltage

If more than one drive is connected to the same secondary winding, each drive must have it's own set of fuses as shown in Figure 3-6.

See Table 3-A for the recommended fuse size and type.

3.4.4 External Disconnect

The following two circuits are given as Emerson EMC recommended disconnect / transformer / fusing examples.

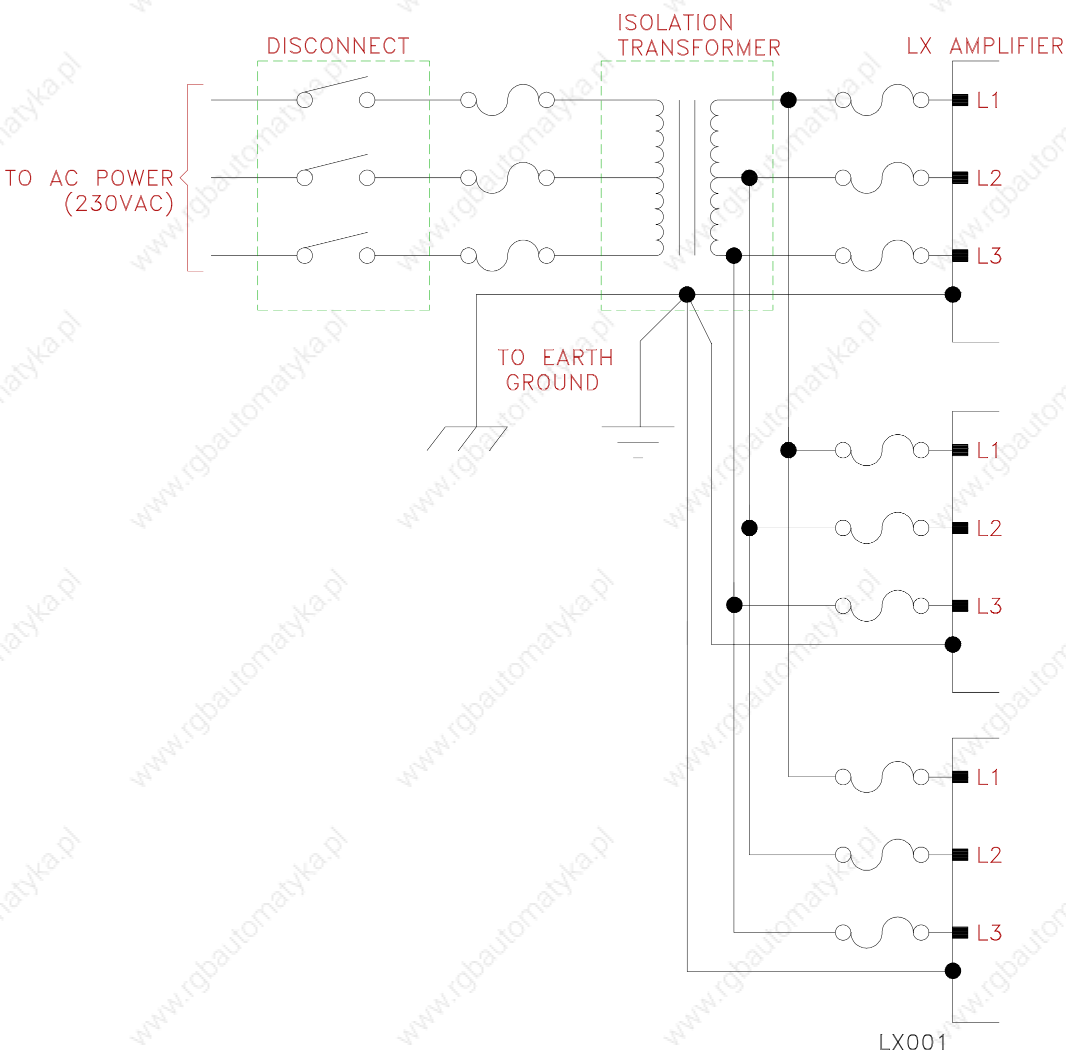


Figure 3.7 Typical disconnect with transformer

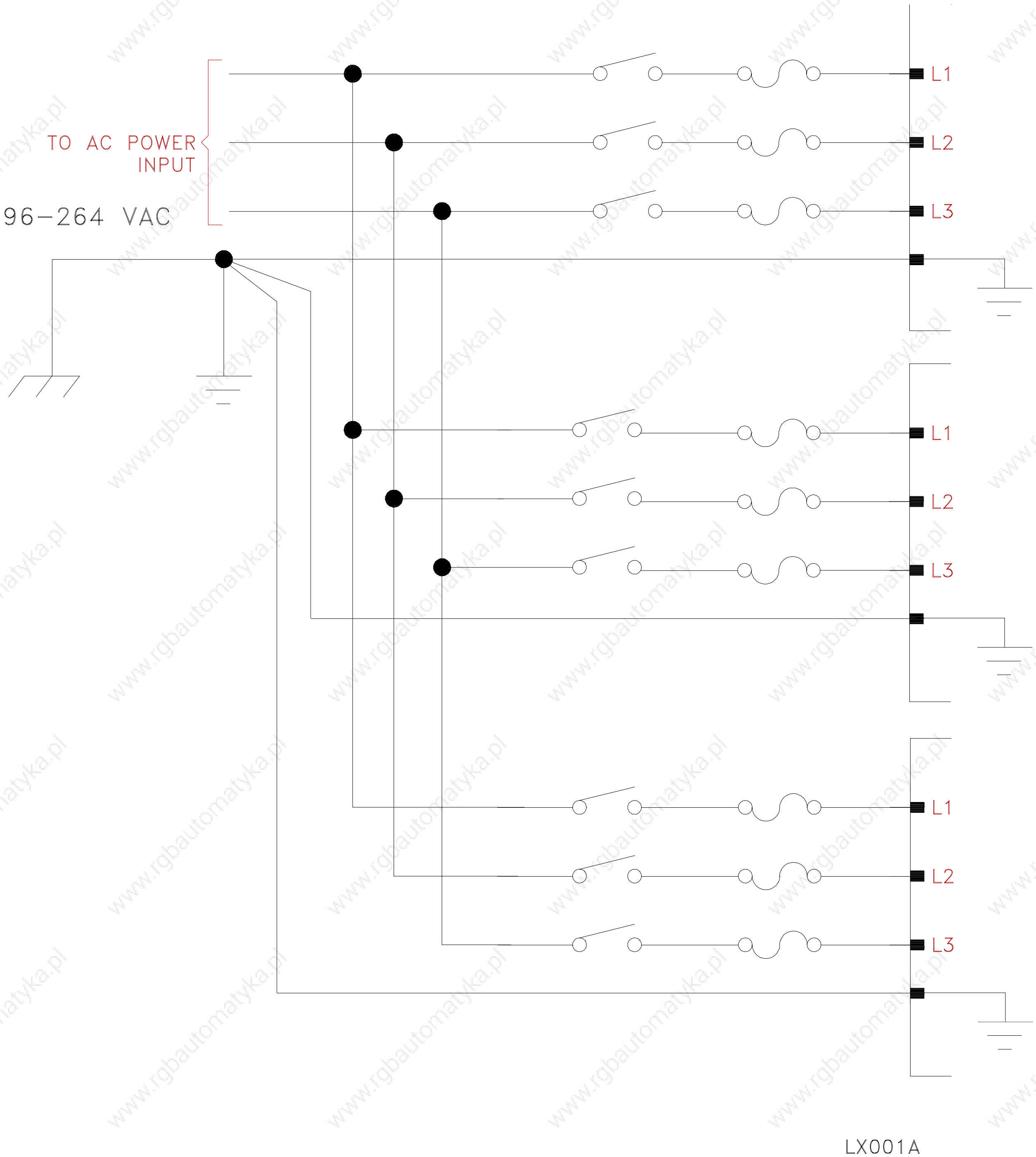


Figure 3.8 Typical disconnect without transformer

3.5 Motor Connections

DX motors are available in two different styles for most models; waterproof designated by a W in the motor model number, and connectorized, designated by a C in the motor model number. The waterproof type has been designed to meet IP65 waterproofing standards. Cable entries are made through American National Standard Tapered Pipe Threads (NPT) conduit holes. The connectorized type of motors come equipped with one or two MS style multi-pin connectors. See Table 3-B for motor connector options.

Table 3-B – Motor Connector Options

DX MOTOR MODEL	WITH MS STYLE CONNECTORS	WITH NPT HOLES
DX-208	YES (ONE)	N/A
DX-316	YES (TWO)	YES
DX-340	YES (TWO)	YES
DX-455	YES (TWO)	YES
DX-490	YES (TWO)	YES
DX-4120	YES (TWO)	YES

Note: Motors equipped with MS style connectors meet IP65 waterproofing standards. However, the mating cables and connectors do not. If waterproofing is required, motors with NPT conduit holes should be ordered.

3.5.1 Motor Thermal Protection

In each of the motors there is at least one level of thermal protection. Every motor model has three 150° C thermal switches mounted directly within the motor windings. The contacts are connected in series and are available via the motor connections for controller sensing of motor temperature. The Waterproof motors also include a second thermal switch which is electrically in series with the three winding sensors and is mounted in the area of the user wiring terminal strips. This second thermal switch is set to a lower temperature (80° C) to protect the lower temperature type PVC insulated wiring that may be used for the motor connections. This lower temperature thermal switch may be shunted out of the circuit by a jumper on the connection board when the higher temperature connection wiring is used. All motor wiring supplied by Emerson EMC is rated for at least 105° C., so the low temperature switch can be jumpered out. The contacts remain closed as long as the temperature stays within operating range. When the temperature exceeds the specification, the contacts will open. These contacts are generally connected to the servo amplifier which shuts the amplifier off to protect the motor from damage. The thermal switch contact ratings are 30VDC, 500 milliamps.

3.5.2 Waterproof Motor Connections

The waterproof motors are provided with NPT (National Pipe Tapered Threads) for easy connection to waterproof conduit fittings. The motor power wiring can be either a cable assembly or discrete wires. Shielded motor power cables are highly recommended for best system performance and for minimum EMI radiation from the high frequency switching of the amplifier. Emerson EMC has shielded power cable available in bulk under part number HPS-XXX (XXX is the length in feet). If a shielded motor power cable is used, the shield should be connected to ground at both ends of the cable. If discrete motor power wires are used, the power wires should be twisted or braided together but not twisted with the ground wire. All wiring must be done with industrial grade insulated stranded wire capable of withstanding the environmental conditions of the application. See Table 3-C for recommended motor power and ground wire gauge sizes.

3.5.3 Resolver Wiring

The resolver cable must be comprised of twisted and shielded pair with an overall braided shield. The resolver cable conductors should be 18 to 24 gauge. The use of larger gauge wire will prematurely fatigue the terminals and make installation difficult. Emerson EMC has resolver cabling available in bulk for ease of installation (PN 250224-09). The resolver shield should be connected only at the controller (excitation) end of the cable.

Table 3-C – Power wire recommendations

Motor	Minimum Wire Size	Recommended Wire Type
DX-208	20 AWG	300V, 105° C
DX-316	20 AWG	300V, 105° C
DX-340	18 AWG	300V, 105° C
DX-455	18 AWG	300V, 105° C
DX-490	16 AWG	300V, 105° C
DX-4120	16 AWG	300V, 105° C

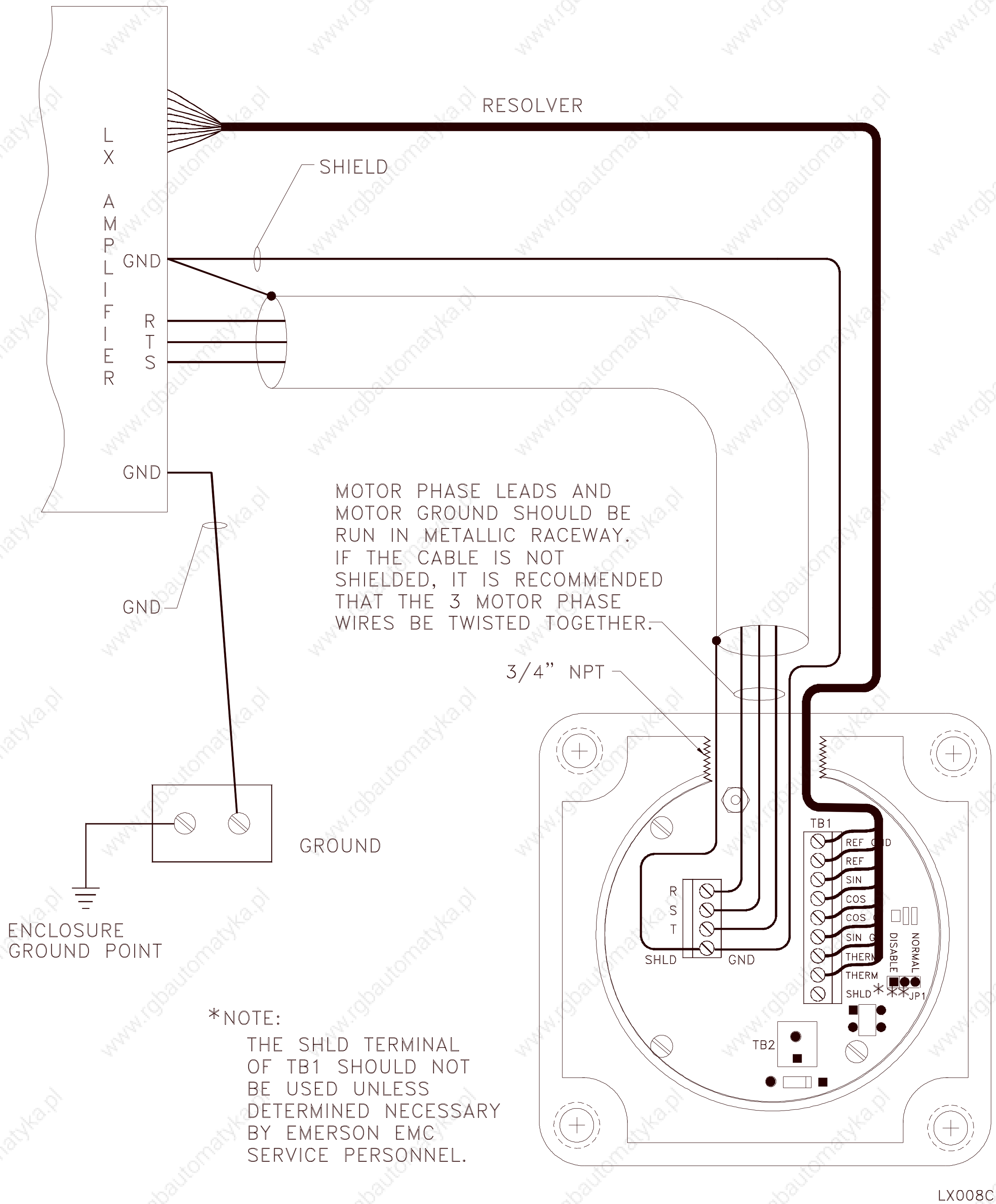


Figure 3.9 DXM-3XXW motor wiring

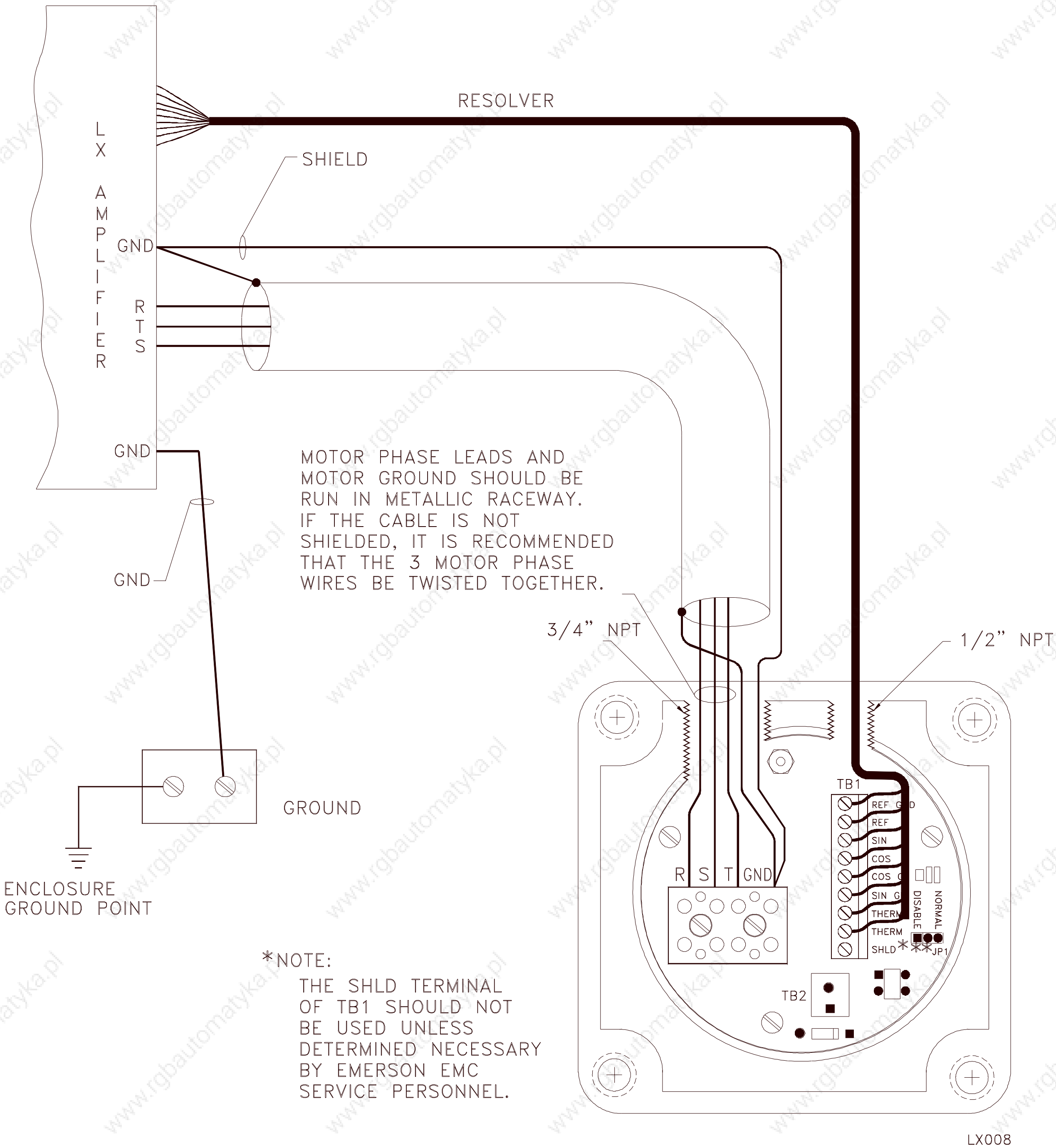


Figure 3.10 DXM-4XX(X)W motor wiring

3.5.4 Connectorized Motor Wiring

Connectorized motors are equipped with two military style connectors for easy connection and disconnect. This is especially useful for equipment that is disassembled an reassembled many times. All the motor models except for the DX- 208 motor have two connectors. One makes the motor power and ground connections and the other makes the resolver and thermal switch connections. The connectors are different to eliminate the possibility of incorrect connections. The LCF-XXX feedback cable makes the resolver / thermal switch connection. The ECM- XXX and ECS-XXX cables make the motor power, ground and brake connections (if required). The DX-208 motor is very small and so is supplied with one integrated connector. The LCS-XXX cable includes all the wiring for the DX-208 motor. The DX-208 motor is not available with a brake so no brake wiring is included in the cable. The following figures show the wiring diagrams for the ECM-XXX, ECL-XXX, LCS-XXX and LCF-XXX cables.

Table 3-D – Motor Cabling

Motor Type	Motor Model	Motor Cable	Resolver Cable
Waterproof Motors	DXM/E-3xxW, 4xxW	HPS-XXX (shielded) 250036-00(non-shielded)	250224-09
Connectorized Motors	DXM/E-3xxC, -455C	ECM-XXX	LCF-XXX
	DXM/E-490C, -4120	ECL-XXX	LCF-XXX
	DXM/E-208	LCS-XXX	
All cabling is PVC, rated for 105° C. (XXX) is length in feet, consult an Emerson EMC application engineer for cabling requirements over 100 ft.			

Cable Notes:

1. *Applications that require LCS or LCF cables longer than 100 ft. should be discussed with Emerson EMC's Applications department.*

2. *As a general rule, the minimum cable bend radius is ten times the cable outer diameter.*

3. *Motors with MS style connectors should be mounted with the connectors pointing downward. This provides added protection against dust and water damage.*

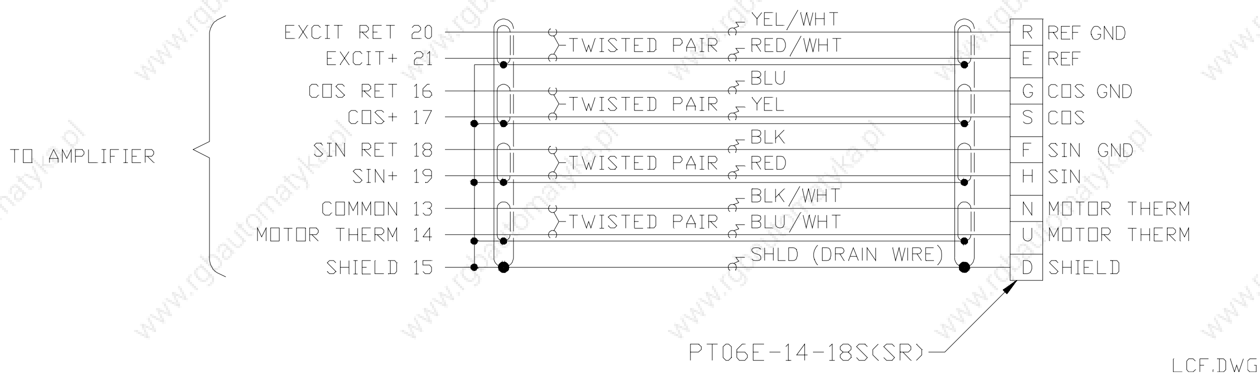


Figure 3.11 LCF-XXX Cable Wiring Diagram

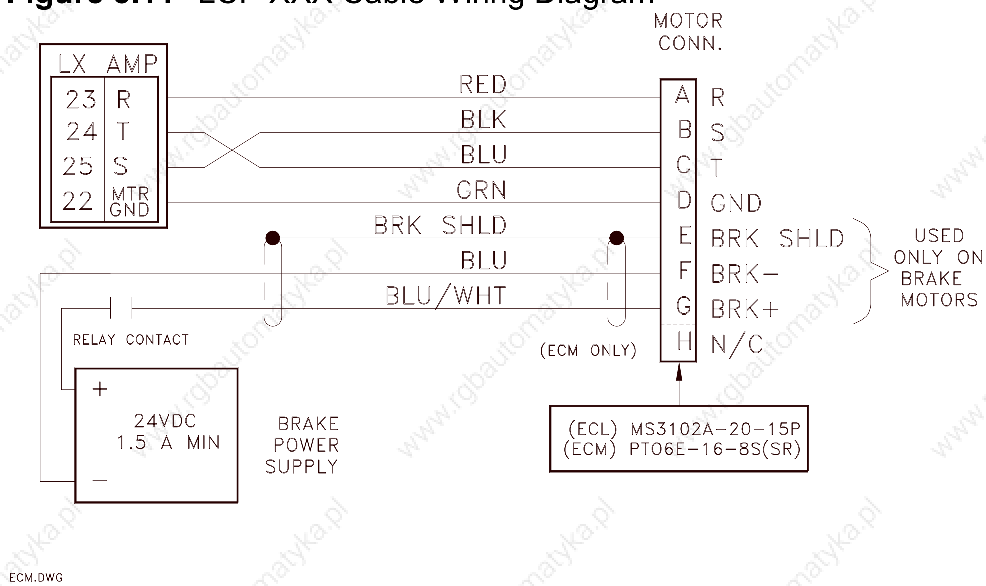


Figure 3.12 ECM/ECL-XXX Cable Wiring Diagram

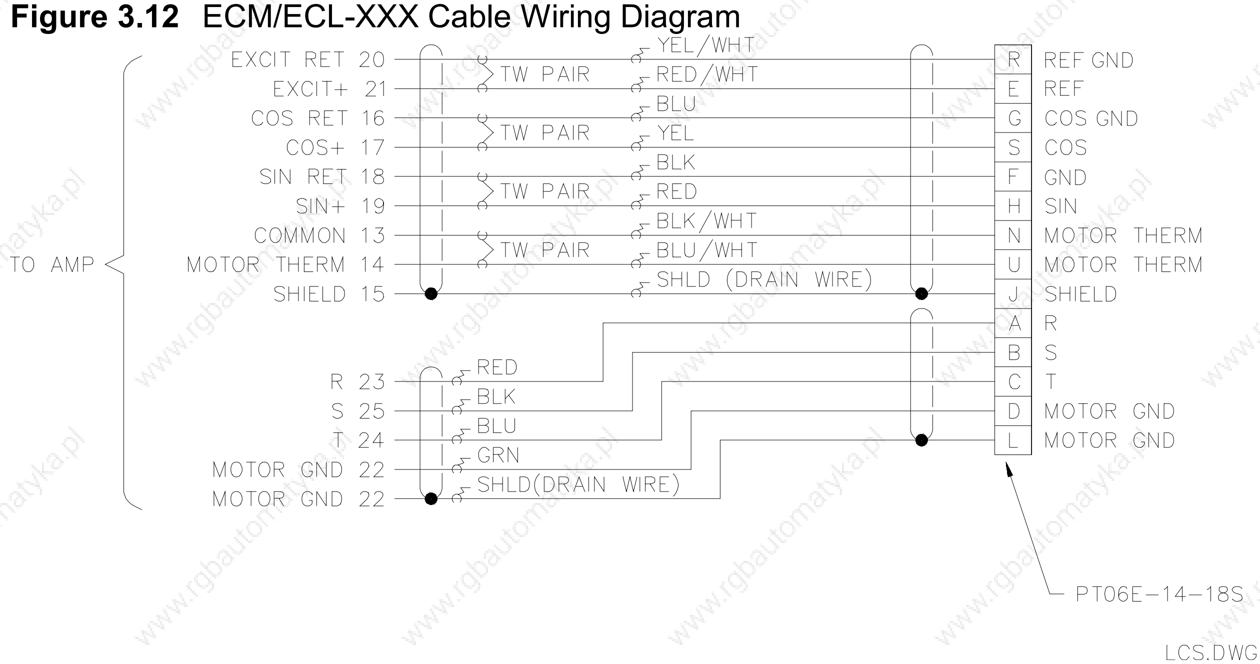


Figure 3.13 LCS-XXX Cable Wiring Diagram

3.6 Brake Motors

Brake motors are intended for applications where there is a load on the motor that must be immovable with the power off. This is usually the case with vertical loads whether or not they are counterbalanced. The motor brake will apply braking force with no power applied to the brake connections and will disengage when the correct voltage is applied to the motor brake terminals. See Figures 3-14, 3-15, 3-16 for connections to brake motors of either waterproof or connectorized type.

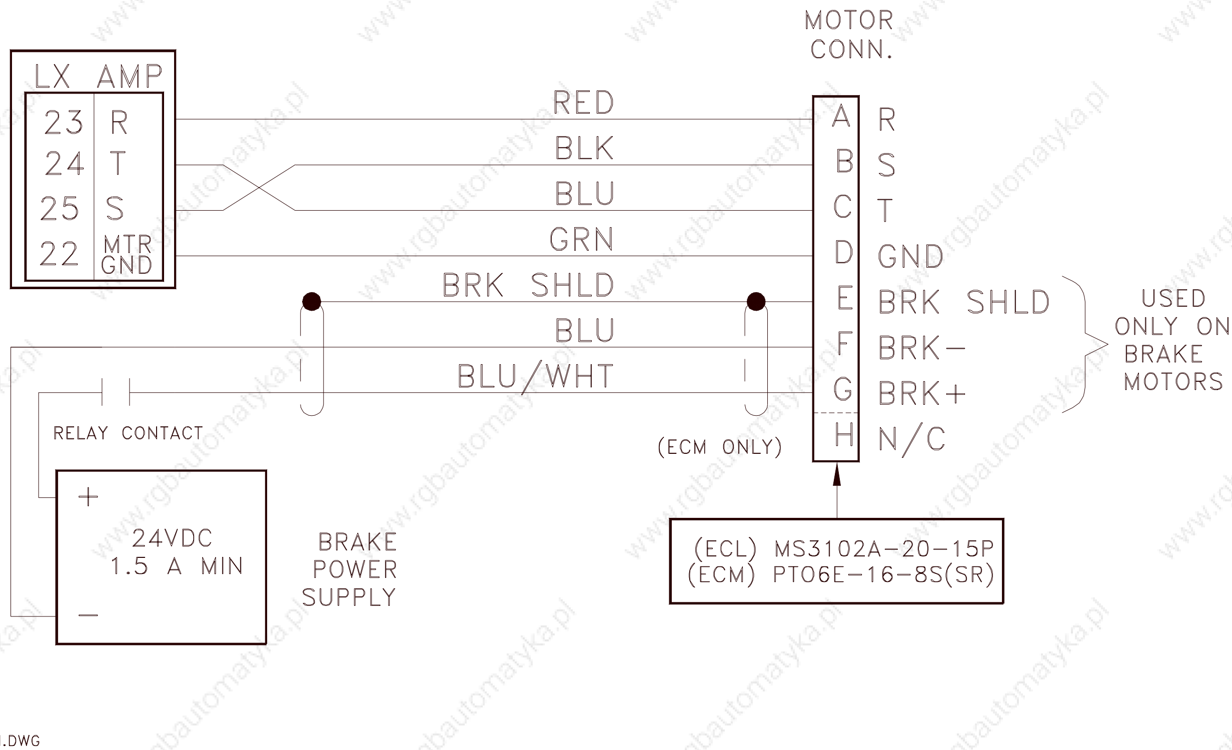


Figure 3.14 Connectorized Motor Brake Connection

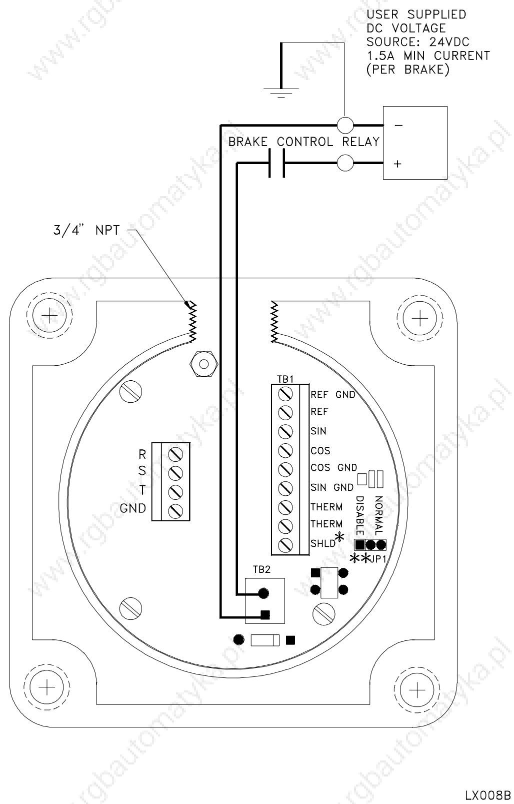


Figure 3.15 DXM-3XXW Motor Brake Connection

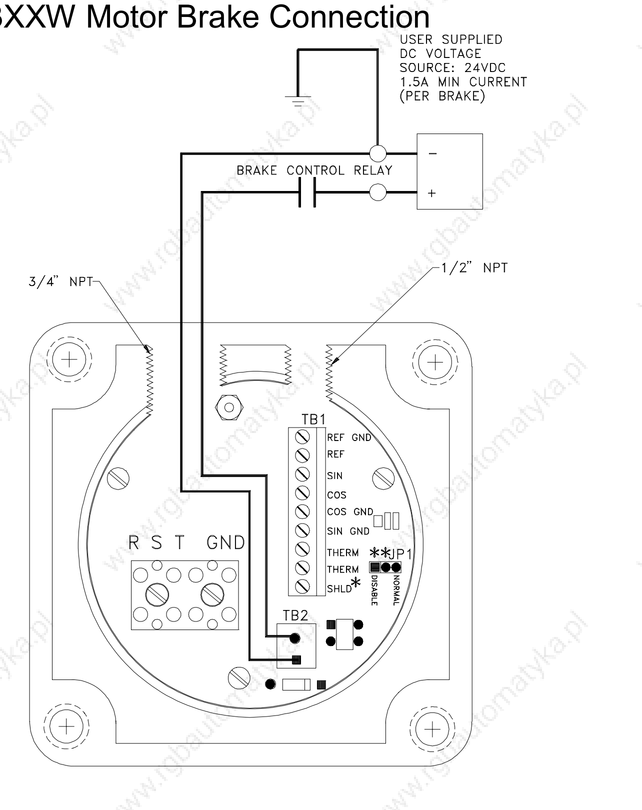


Figure 3.16 DXM-4XX(X)W Motor Brake Connection

Table 3-E – Amplifier Connections – Signal Connector

Conn#	Signal	Signal Description
1	TACH	Simulated tachometer output signal derived from resolver with a range from -10V to +10V with a full scale of 3000 or 6000 RPM selected through SW1/1.
2	CUR CMD	The command signal is a DC signal in the range -10V to +10V proportional to the requested current value. When ±10V is applied the drive generates peak current. A positive signal with respect to common (pin 3) will produce a counterclockwise shaft rotation. A negative signal with respect to common will produce a clockwise shaft rotation. Shaft rotation direction is viewed from the front of the motor.
3	COMMON	Signal common. <u>This terminal is not internally connected to the Earth ground on the power connector.</u>
4	ENABLE	Drive enable input. 1 (10 to 30VDC) = drive enable. O or open circuit = drive disable (10 K W input impedance). The drive should be disabled for a few seconds after applying power and should be disabled before removing power. This way, the drive will power up in a stable fashion.
5	+10V	Voltage reference output +10V (max load 10mA)
6	-10V	Voltage reference output -10V (max load 10mA)
7	SPEED CMD (+)	Non inverting input for speed command signal. Positive signal will produce CW motion as seen when facing the motor shaft.
8	SPEED CMD (-)	Inverting input for speed command signal. Positive signal will produce CCW motion as seen when facing the motor shaft.
9	DRIVE OK	See pin 10 description.
10	DRIVE OK	Terminal pins 9 and 10 are internally connected through a contact when the green LED lights and the drive is running. If a fault is active, the contact is open. The contact drive capability is 5A 30V DC. If an LX drive is connected to the back up supply, when the main supply falls, the "Drive OK" green LED goes off for about 2 seconds then lights again. The DRIVE OK contacts follow the green LED operation. In back up status the drive is disabled, the green LED is ON and the DRIVE OK contacts are closed.
11	COMMON	Signal common. <u>This terminal is not internally connected to the Earth ground on the power connector.</u>
12	HIGH Irms	This pin is normally at zero volts being pulled down to logic common through an open collector transistor in the amplifier. When the red High IRMS led lights during current limiting, this terminal becomes an open circuit. The maximum voltage rating is 47V. The current drive capability at logic 0 (grounded) is 100 mA.
13	COMMON	Signal common. <u>This terminal is not internally connected to the Earth ground on the power connector.</u>
14	MOTOR THERM	The terminal pin is normally connected to the motor thermal sensor. Link with terminal 13 if not used (default).

Table 3-F – Resolver Connector

Conn #	Signal	Signal Description
15	SHIELD	Resolver cable shield. <u>Do not connect anything else to this terminal. It is electrically connected to logic common but has a dedicated trace on the circuit board to minimize noise interference and maximize shielding.</u>
16	COS RET	Cosine low signal coming from the resolver.
17	COS +	Cosine high signal coming from the resolver.
18	SINE RET	Sine low signal coming from the resolver.
19	SINE +	Sine high signal coming from the resolver.
20	EXCIT RET	Resolver excitation low signal.
21	EXCIT +	Resolver excitation high signal.

Table 3-G – Personality Board Connector

<table>
<tr><th>Conn #</th><th>Signal</th><th colspan="2">Signal Description</th></tr>
<tr><td>34</td><td>COMMON</td><td colspan="2">Logic common. <u>This terminal is not internally connected to the Earth ground on the power connector.</u></td></tr>
<tr><td>35</td><td>DR. OUT</td><td colspan="2">CW / CCW direction signal +15v = CW, 0v = CCW</td></tr>
<tr><td>36</td><td>PULSE OUT</td><td colspan="2">2048 PPR 0v to +15V</td></tr>
<tr><td>37</td><td>A’</td><td rowspan="4">Encoder Simulation Channels 128, 256, 512, 1024 lines/rev 1</td><td rowspan="6">5 volt, 20 milliamps RS422 output drivers</td></tr>
<tr><td>38</td><td>A</td></tr>
<tr><td>39</td><td>B’</td></tr>
<tr><td>40</td><td>B</td></tr>
<tr><td>41</td><td>Z’</td><td>Zero marker channel - 1 / rev 1[1]</td></tr>
<tr><td>42</td><td>Z</td><td>Zero marker channel - 1 / rev 1[1]</td></tr>
<tr><td>43</td><td>CCW L.S.</td><td colspan="2">CCW limit switch input 10 to 30 volt. See DIP Switches for N.O. or N.C. polarity.</td></tr>
<tr><td>44</td><td>COMMON</td><td colspan="2">Common for N.O. CW limit switch. <u>This terminal is not internally connected to the Earth ground on the power connector.</u></td></tr>
<tr><td>45</td><td>CW L.S.</td><td colspan="2">CW limit switch input
10 to 30 volt. See DIP Switches for N.O. or N.O. polarity.</td></tr>
<tr><td>46</td><td>COMMON</td><td colspan="2">Common for N.O. CCW limit switch. <u>This terminal is not internally connected to the Earth ground on the power connector.</u></td></tr>
</table>

1 The phase shift between channel A and B is 90° and the Z pulse is phased with the A pulse. Max driving capability is 20 mA and each output can drive up to 10 line receiver devices with a maximum total cable length of up to 5000 feet (1200 meters). If the encoder signal receiver is not terminated for RS422 signals, a termination resistor must be installed across each complementary signal pair to net 220W to 330W total resistance. These resistors must be installed at the point furthest from the signal source. The termination resistance would be installed between the signal and common (ov).

Table 3-H – Power Connector

Conn #	Signal	Signal Description
22	MOTOR GND	Chassis ground motor side. Connected internally to the Earth ground terminal.
23	MOTOR PHASE R	Motor power phase R.
24	MOTOR PHASE T	Motor power phase T.
25	MOTOR PHASE S	Motor power phase S.
26	-DC BUS	High power negative DC voltage.
27	+ DC BUS	High power positive DC voltage.
28	INT SHUNT	This terminal pin is linked with terminal pin #27 to enable the internal brake resistor (default). If an external shunt is required, disconnect this internal shunt resistor by removing the link between terminals 27 and 28. See the "Special Applications" section.
29	EXT SHUNT	This terminal is used to drive an external brake resistor instead of the internal one. The external brake resistor will be connected between this terminal pin and pin#27. If an external shunt is required, disconnect this internal shunt resistor by removing the link between terminals 27 and 28. See Chapter 6.
30	AC LINE 1	Phase 1 of the AC line.
31	AC LINE 2	Phase 2 of the AC line.
32	AC LINE 3	Phase 3 of the AC line.
33	EARTH GND	Chassis ground power supply side. This is not connected to the logic side common. It is connected to the amplifier frame.

4
CONFIGURATION

4.1 Configuration Options

Drive configurations choices are made via the DIP switches mounted on a removable personality board. Note that the OFF positions are all towards the connector on the front of the personality board. The DIP switches control the following functions:

- SW1/1 Full scale speed selection 3000 RPM / 6000 RPM
- SW2 Nominal current limiting
- SW3 Motor poles selection
- SW1/2 [1]Limit switch enable
- SW4 [1]Simulated encoder resolution selection
- SW5 [1]Limit switch polarity

> ***NOTE: The personality boards for different size LX Amplifiers are not identical.***

** A select resistor soldered into a header on the personality board is installed at the factory which sets the gain windows for the range of motors normally used on that amplifier.*

Table 4-A – Standard Personality Board R22 Values

AMPLIFIERS	MOTORS	R22 RESISTOR VALUE
LX-400	DX-208	10 K Ω
	DX-316	
LX-700	DX-340	47 K Ω2[2]
	DX-455	82 K Ω
LX-1100	DX-490	82 K Ω
	DX-4120	

[1] These functions can be deleted on special ordered; reduced cost drives.

[2] Standard R22 value in the LX-700 is 82KΩ. A 47KΩ resistor and instructions for installation are included with each LX-700 amplifier in the case of a DX-340 motor application.

4.2 Standard Motor Configurations

The LX amplifiers can be easily configured for DX motors supplied by Emerson EMC by using the settings in the following table.

Table 4-B – Settings for DX Motors **OFF=0 ON=1**

(Tabel 4-B – Rev. 01/13/95j)

LX AMP	MOTOR	R22 Ω	# POLES	SW 3/1,2		MOTOR CURRENT AMPS	SW 2/1-/4			
				3/1	3/2		2/1	2/2	2/3	2/4
400	DX-208	10K	4	1	0	2.16	0	0	0	0
	DX-316	10K	6	0	1	2.97	0	1	1	0
700	DX-340	47K	6	0	1	6.14	1	0	1	0
	DX-455	82K	6	0	1	7.32	1	1	1	1
1100	DX-490	82K	6	0	1	10.99	1	1	1	1
	DX-4120	82K	6	0	1	10.99	1	1	1	1

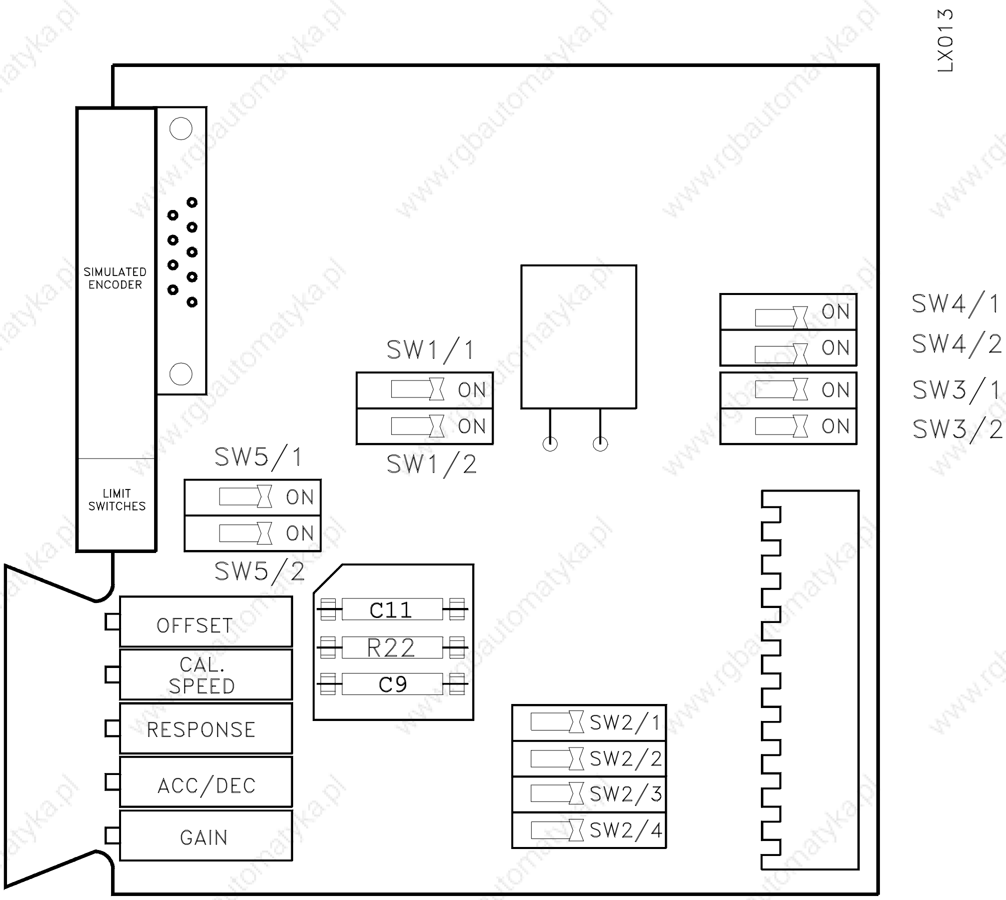


Figure 4.1 Personality Board Dip Switch Locations

4.3 Function Selections

This section covers the various optional functions and their selection.

4.3.1 Limit Switch Enable

OFF = function DISABLED (default) (0)
ON = function ENABLED (1)

SW1/2 enables the limit switch stop function. This function is normally used on limited travel linear slide axes for over travel limit protection. When the CW limit is activated the velocity command in that direction is clamped immediately to zero speed and will not allow any more motion in that direction. The motor will be commanded to decelerate at full amplifier capacity without any deceleration ramps even if a ramp has been set into the accel/decel potentiometer. Motion in the opposite direction of the activated switch will not be impeded i.e., CCW motion is not impeded with the CW limit activated and vice versa. The position is not locked and the motor may drift + or - depending on the Offset adjustment. The motor is not disabled but has full torque capability and is holding zero speed. If the holding limit switch is released while a speed command is applied, the motor will accelerate to the commanded speed at full torque with no ramping even if a ramp has been set into the Acc/Dec potentiometer.

4.3.2 Limit Switch Polarity

With the limit switch function enabled, the activating logic is determined by DIP switches SW5/1 and /2 allowing a choice between normally-open or normally-closed limit switches.

SW5/1

ON = N.O limit switch application.
CCW rotation is disabled with a 0V (amplifier common) signal on terminal #43 (CCW LIM. SW.). CCW rotation is enabled with terminal #43 open.

OFF = N.C. limit switch application
CCW rotation is disabled with terminal #43 open (CCW LIM. SW.).
CCW rotation is enabled with a +1 to +30 volt signal applied.

SW5/2

ON = N.O. limit switch application.
CW rotation is disabled with an 0V (amplifier common) signal on terminal #45 (CW LIM. SW.). CW rotation is enabled with terminal #45 open.

OFF = N.C. limit switch application.
CW rotation is disabled with terminal #45 open (CW LIM. SW.).
CW rotation is enabled with a +1 to +30 volt signal applied.

4.3.3 Simulated Encoder Resolution

SW4 sets the simulated encoder resolution according to the following table. The default position is 512 lines per revolution.

Table 4-C – Encoder Step/Revolution **OFF = 0 ON = 1**

SW4/1	SW4/2	ENCODER STEP/REVOLUTION
0	0	1024
0	1	512
1	0	256
1	1	128

4.4 Configuration Tables

This section covers the adjustments that are necessary when using a motor not covered under the DX motor setup chart in Section 4.2.

4.4.1 Full Scale Speed

SW1/1 sets the full scale speed to match the control loop to the motor rated maximum speed.

ON = 3000 RPM (default)
OFF = 6000 RPM

4.4.2 Motor Poles Selection
Switch SW3 sets the number of motor poles. The default setting is for a 6 pole motor.

Table 4-D – Motor Poles Selection **OFF = 0 ON = 1**

(Table 4-D – Rev. 01/13/95j)

SW3/1	SW3/2	MOTOR POLES
0	0	8
0	1	6
1	0	4
1	1	2

4.4.3 Continuous Current Adjustment
When continuous current of the motor is less than the continuous current of the drive, it is possible to reduce the drive continuous current using the four SW2 switches with the following logic.

Identify the required current level in Table 16 related to the LX drive model you are using. Set the relevant SW2/ 1, 2, 3, 4 ON or OFF configuration.

Table 4-E – Nominal Current Adjustment **OFF = 0 ON = 1**

(Table 4-E – Rev. 01/13/95j)

SW2/1	SW2/2	SW2/3	SW2/4	LX-400 AMPS RMS	LX-700 AMPS RMS	LX-1100 AMPS RMS
0	0	0	0	2.16	3.78	5.67
0	0	0	1	2.30	4.02	6.02
0	0	1	0	2.43	4.25	6.38
0	0	1	1	2.57	4.49	6.73
0	1	0	0	2.70	4.73	7.09
0	1	0	1	2.84	4.96	7.44
0	1	1	0	2.97	5.20	7.80
0	1	1	1	3.11	5.43	8.15
1	0	0	0	3.24	5.67	8.51
1	0	0	1	3.38	5.91	8.86
1	0	1	0	3.51	6.14	9.21
1	0	1	1	3.65	6.38	9.57
1	1	0	0	3.78	6.62	9.92
1	1	0	1	3.92	6.85	10.28
1	1	1	0	4.05	7.09	10.63
1	1	1	1	4.19	7.32	10.99

5
START UP / CALIBRATION

This chapter will cover the steps necessary to correctly adjust an LX drive. In some cases the most accurate adjustment requires some test equipment such as an oscilloscope, tachometer or a voltmeter. The type of test equipment required is dependent on the type of controller that is employed and the level of calibration accuracy required for the application.

5.1 Drive Calibrations

- ZERO OFFSET — Allows adjusting for input voltage offsets in the speed command signal at zero speed (± 130 mV) to eliminate drift.
- CAL SPEED — Adjusts the full scale speed command sensitivity. At fully CCW the max speed will be achieved at 13 VDC command. At fully CW the max speed will be achieved at 7 VDC command. The speed range is set by dip switch SW1/1 - 3000/6000 RPM.
- RESPONSE — Adjusts the derivative action. Turn CW to reduce the overshoot and increase the PID filter derivative action. Too high an adjustment will result in a high frequency oscillation on the motor shaft and the possibility of overheating the motor. Too high a setting will increase settling time to speed changes. Too low a setting will result in slow response to load changes and overshoot during quick speed changes.
- ACC/DEC — Sets the motor acceleration/deceleration gradient. The range of adjustment allows ramping to max. speed in 0-1 sec. with a ± 10 volt signal applied. Normal servo application requires full CCW adjustment (zero ramping time).
- GAIN — Proportional velocity gain control. Turn CW to increase the PID filter proportional action. Too high an adjustment will cause a medium frequency vibration on the motor shaft and possibility of overheating a motor.

NOTE: THE PERSONALITY BOARDS FOR THE DIFFERENT SIZE LX AMPLIFIERS ARE NOT ALL IDENTICAL[1]

[1]A select resistor soldered into a header on the personality board is installed at the factory which sets the gain windows for the range of motors normally used on that amplifier.

Table 5-A Personality Board R22 Selections

AMPLIFIERS	NITIRS	R22 RESISTOR VALUE
LX-400	DX-208	10 K Ω
	DX-316	
LX-700	DX-340	47 K Ω**
	DX-455	82 K Ω
LX-1100	DX-490 DX-4120	82 K Ω

***Standard R22 value in the LX-700 is 82 K Ω. The amplifier is shipped with a 47 K Ω resistor and instructions for installation in the case of a DX-340 motor application.*

5.1.1 Zero Offset Adjust

The zero offset is factory set. The following instructions allow you to recalibrate the offset when the LX is connected to a controller.

<u>Open loop mode</u>

The following instructions have to be executed with the position control in open loop or the controller could interfere with the setting. If the controller cannot be set up in an open loop configuration follow the instructions as described in Closed loop mode.

- Set up the controller to operate in open position loop mode. This will allow the motor to rotate if there is an offset in the command signal.
- Adjust the command output signal offset before connecting to the LX drive.
- Connect the nulled command signal to terminals 7 and 8.
- Check that the limit switches are not engaged.
- Enable the drive and adjust the ZERO OFFSET potentiometer to stop the motor.
- Restore the original operation mode of the controller.

<u>Closed loop mode</u>

The easiest method of setting the Offset with a closed position loop is to monitor the position controller analog command output with a voltmeter and adjust the Offset until the voltage reads Zero ± 5 millivolts. If the position loop following error is visible on the controller screen. With no command adjust the Offset until the following error is minimized.

5.1.2. Cal. Speed Adjustment

This adjusts the command voltage input levels so they match the controllers output levels. In other words, if the controller puts out 8.5 volts for a 3000 rpm command, the drive must be adjusted to deliver 3000 rpm with an 8.5 volt command. The adjustment range is from 75% to 140% of the DIP switch (SW1/1 setting) 3000 / 6000 rpm. The adjustment procedure for the Cal. Speed is as follows:

Perform the Offset adjustment

If the position controller **can be** set up in an open position loop mode do so now and follow step 1 through 5 to complete the calibration.

If the position controller **cannot** be set up in an open loop mode follow steps a. through f.

Cal. Speed adjustment in open loop mode.

1. Apply 10% of the max command to pins 7 and 8.

2. Verify correct speed.
   If the controller allows viewing the actual motor speed then monitor it and adjust the Cal. Speed pot until the correct speed is observed ±5%. If the controller doesn't allow viewing the motor speed then use a tacho-meter on the motor shaft or use the drive's tach output signal. See Table 3-E.

3. Apply 25% of the max command and verify the speed per the above.

4. Continue increasing the command signal level in 25% increments and verifying / adjusting Cal Speed until 100% command signal is achieved.

5. Follow the above procedure in the opposite motor direction to verify there is no signal offset. Check for velocity offset. A difference of up to 5% between CW & CCW is acceptable. Any more than 5% difference may indicate a resolver phasing shift or a tachometer problem. The system will run but not at optimum performance.

Cal. Speed Adjustment with closed position loop controller.

a. Adjust the position controller loop gain to a value below normal. This will allow more accurate adjustment of the Cal. Speed setting.

b. Apply 10% of the max command to pins 7 and 8.

c. Verify correct speed.
   If the controller allows viewing the following error, then monitor the following error and adjust the Cal. Speed port until the correct amount of error is observed. If the controller is designed with feed forward command, this error should be near zero.

d. Apply 25% of the max command and verify the speed per the above.

e. Continue increasing the command signal level in 25% increments and verifying / adjusting Cal Speed until 100% speed command is achieved .

f. Follow the above procedure in the opposite motor direction to check for velocity offset.

5.1.3 Dynamic Calibration with Oscilloscope

The LX drives leave the factory with a default calibration. To most accurately adjust this setting for your load you will need a low frequency function generator with an output level between -3.5V and 3.5V and a dual trace storage oscilloscope. Remove the controller signal cable from terminals 7 and 8. Connect the function generator output to terminals 7 and 8 and set it per the following:

- Square wave
- Amplitude ± 2V (approximately 600 to 1200 rpm)
- Frequency 0.2 Hz (2.5 seconds each direction)
- The oscilloscope power cord must be grounded to the exact same point that the amplifiers are grounded or a very inaccurate signal may be displayed
- Connect oscilloscope Channel A to terminal 1 (simulated tach signal)
- Connect oscilloscope Channel B to terminal 2 (current demand)
- Oscilloscope probes have to be grounded on terminal 11 of LX
- Connect the oscilloscope external trigger input to the function generator output
- Set oscilloscope for 1mV / div and for 20 mS / div scan time

WARNING! ***To avoid over travel interference on an axis with limited travel, the stroke can be limited by either increasing the frequency of the function generator or decreasing the amplitude. The minimum signal amplitude that will allow a good calibration is 100mV pk to pk.***

Refer to the following trace drawings to make the correct adjustments.

Start with the Gain adjustment and the Response pot fully CCW. The trace will probably look like Figure 5.1. Turn the Gain CW until most of the instability is gone and the Tach trace looks like Figure 5.2. Now turn the Response CW until the trace looks like Figure 5.3. If the Response is turned too far CW the trace will look similar to Figure 5.4. This completes the oscilloscope calibration procedure.

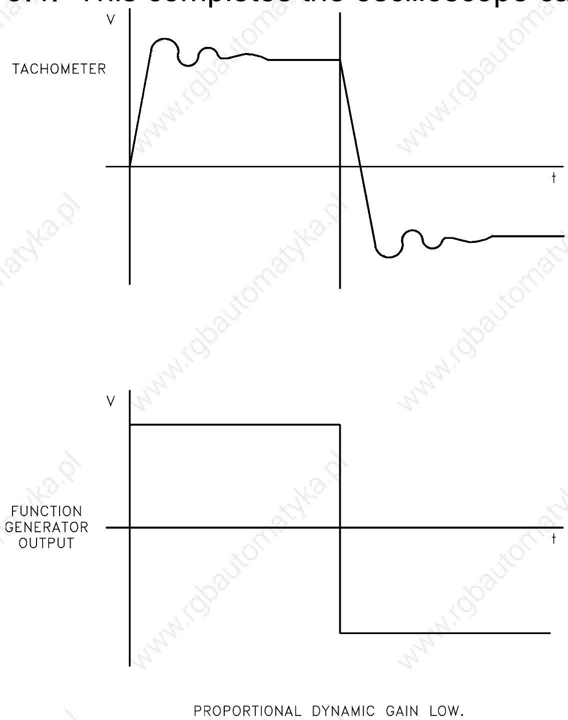


Figure 5.1 Gain set too low.

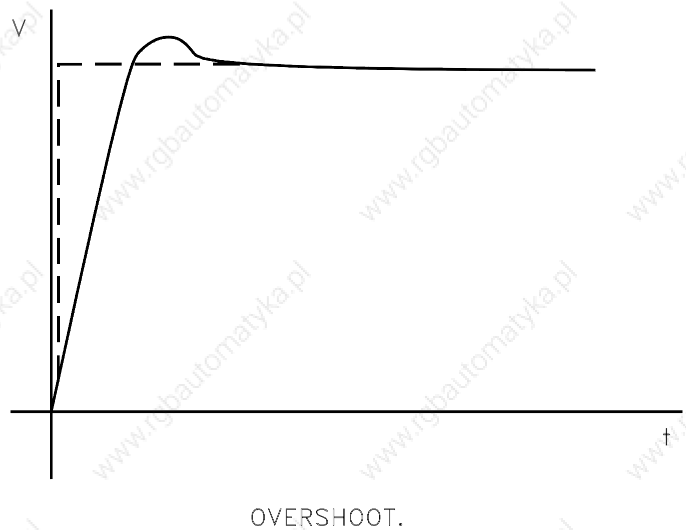


Figure 5.2 Gain set correctly, Response not set.

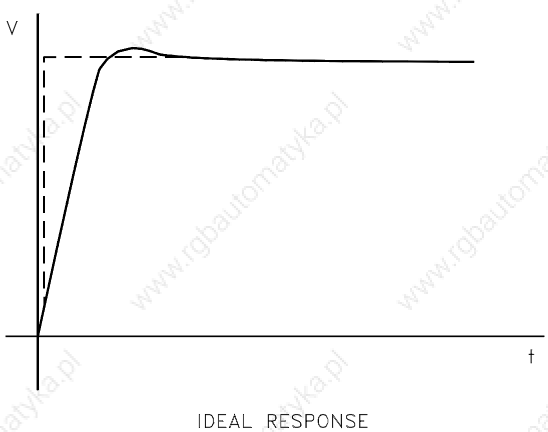


Figure 5.3 Ideal gain setting.

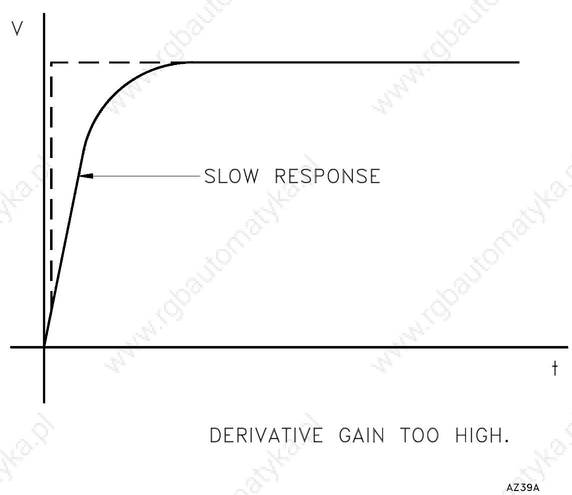


Figure 5.4 Response adjusted too high.

5.1.4 Dynamic Calibration without Oscilloscope

An acceptable calibration can normally be obtained by setting the calibration potentiometers in the following fashion.

CAUTION!

THE FOLLOWING ADJUSTMENT PROCESS WILL CAUSE HIGH FREQUENCY MOTOR INSTABILITY AND OSCILLATION FOR A SHORT PERIOD OF TIME. VERIFY THAT THE LOAD WON'T BE DAMAGED BY THIS MOTION.

Set the Acc/Dec pot to fully CCW. This completely eliminates the ramping.

Set the Response and Gain Pots to fully CCW.

Apply power to the amplifier.

Monitor the motor shaft rotation. Adjust the Offset pot until the motor shaft stops rotating.

CAREFULLY!

Adjust the gain potentiometer CW until the motor just starts to buzz then quickly turn it CCW until it stops buzzing, then turn it CCW (1) more turn.

CAREFULLY!

Adjust the response potentiometer CW until the motor just starts to buzz then quickly turn it CCW until it stops buzzing, then turn it CCW (2) more turns.

6
SPECIAL APPLICATIONS

6.1 External Shunt Resistor

LX drives leave the factory with the internal shunt resistor enabled through an externally wired jumper between terminal pins 27 and 28. If the power rating of the internal shunt resistor is insufficient for heavy cycles an external shunt resistor with greater power capacity should be added.

The internal shunt resistor capacity on all LX drives is 150 watts.

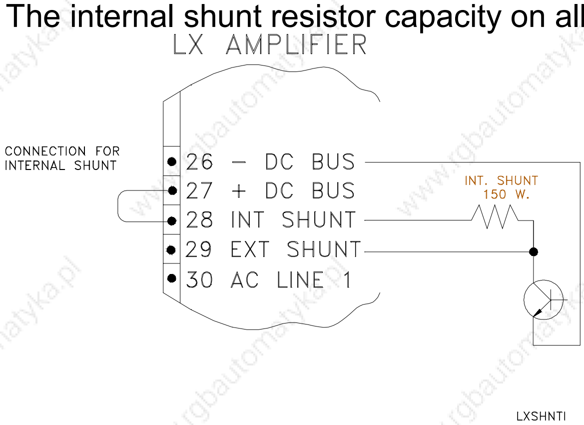


Figure 6.1 Internal shunt connection (default).

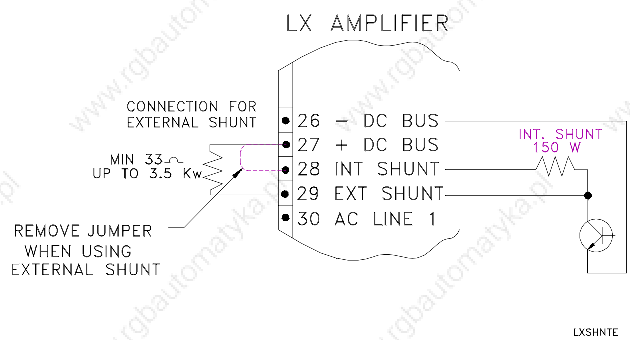


Figure 6.2 External shunt connection

To use an external shunt resistor:

1. Remove jumper between terminals 27 and 28.
2. Connect the external shunt resistor between terminals 27 and 29.

WARNING:

To avoid damaging the shunt driving circuit when using an external shunt resistor:

- ***Remove the Internal Shunt jumper from the connection strip***
- ***Do not use a resistor value less than 33 Ω***

6.2 Current Command Mode

LX drives can be operated in torque mode or current command mode using terminal pin 2 (CUR CMD) as an input for the current command signal. The command signal range is ±10V. Terminal pin 2 is a bi-directional terminal with an input impedance of 20 kΩ . Output impedance of the device driving the CUR CMD input must be 50W or less (standard operating amp output). It serves as both an input for the current command when operating in current command mode and an output for the current demand signal generated by the speed loop when operating in velocity command mode.

When operating in current command, the *Ixt* limit circuit is not operational but the motor current is still monitored. The High Irms output will go open circuit when the *Ixt* limit has been reached and the High Irms LED will illuminate. The system controller must monitor the High Irms output and reduce the current command when the voltage at that point is high (not grounded to logic common)

> *Note: When operating an LX drive in torque mode, terminal pins 7 and 8 must remain unconnected.*

WARNING: NO AUTOMATIC CURRENT LIMITATION IS PERFORMED IN CURRENT COMMAND MODE. It is the responsibility of the system designer to implement current limitation by monitoring the high Irms output.

6.2.1 Torque Helper Application

Torque helper applications can be easily implemented by interconnecting the drives to share the same torque command from a master drive. To implement this, connect the terminal pin 2 of the Lead drive (running in velocity mode) to the terminal pin 2 of the Helper drive(s) (no connections to pins 7 & 8). This way the same current command is being used by all the drives. Terminal pin 2 is a bi-directional terminal with an input impedance of 20 kΩ.

6.3 Back Up Logic Supply

The connector on the top side of the drive provides a connection for an external multi voltage power supply to maintain the encoder logic signals while the main power is removed.

Note: If an LX drive is connected to the back up supply, when the main supply falls below 96 VAC, the "Drive OK" green LED goes off for about 2 seconds then lights again. The drive status relays follows the green LED operation. In back up status, the drive disabled, the green LED is ON and the drive status relay contact is closed.

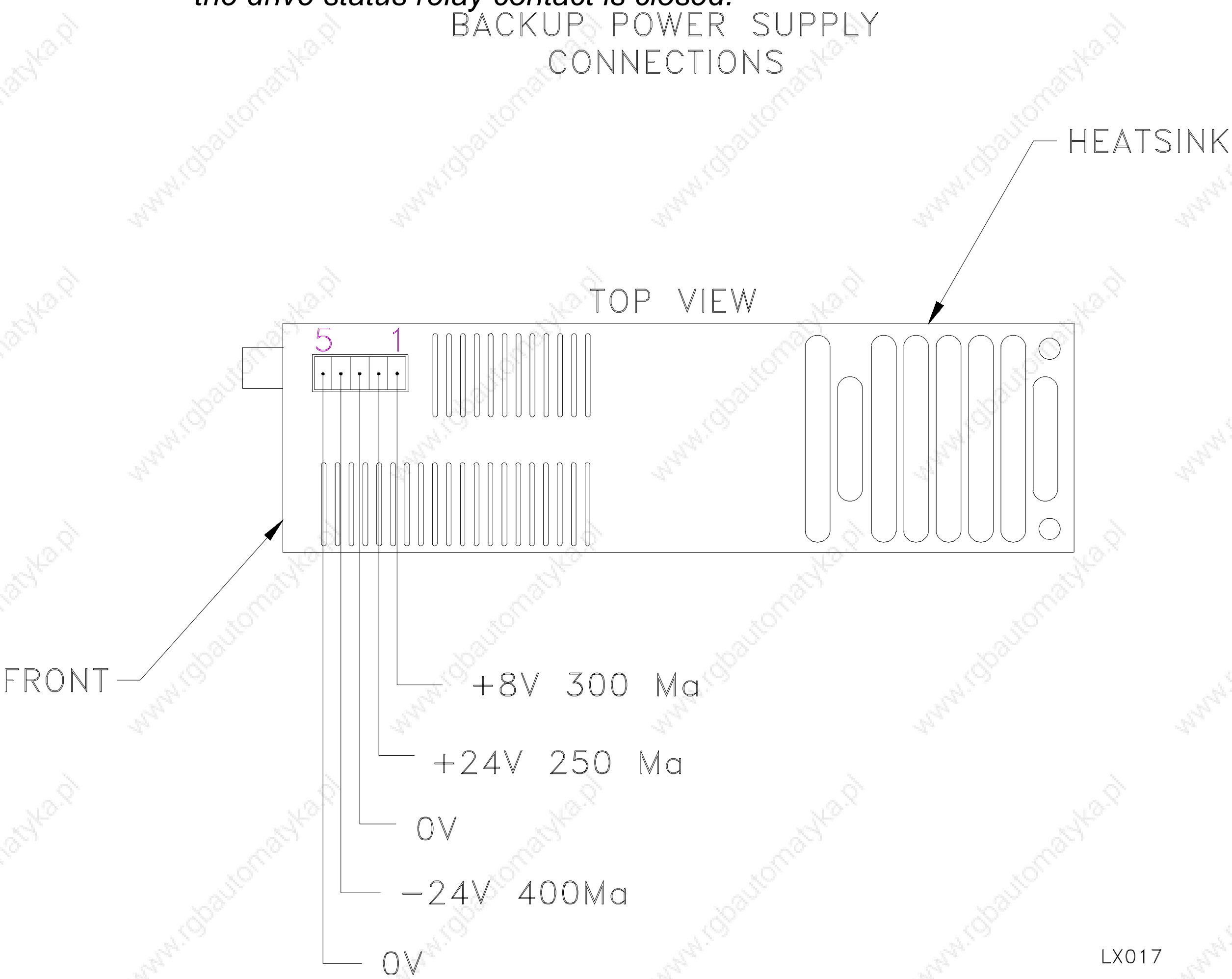


Figure 6.3 LX back up logic supply connection

7
DIAGNOSTICS

7.1 Diagnostics and Fault Handling

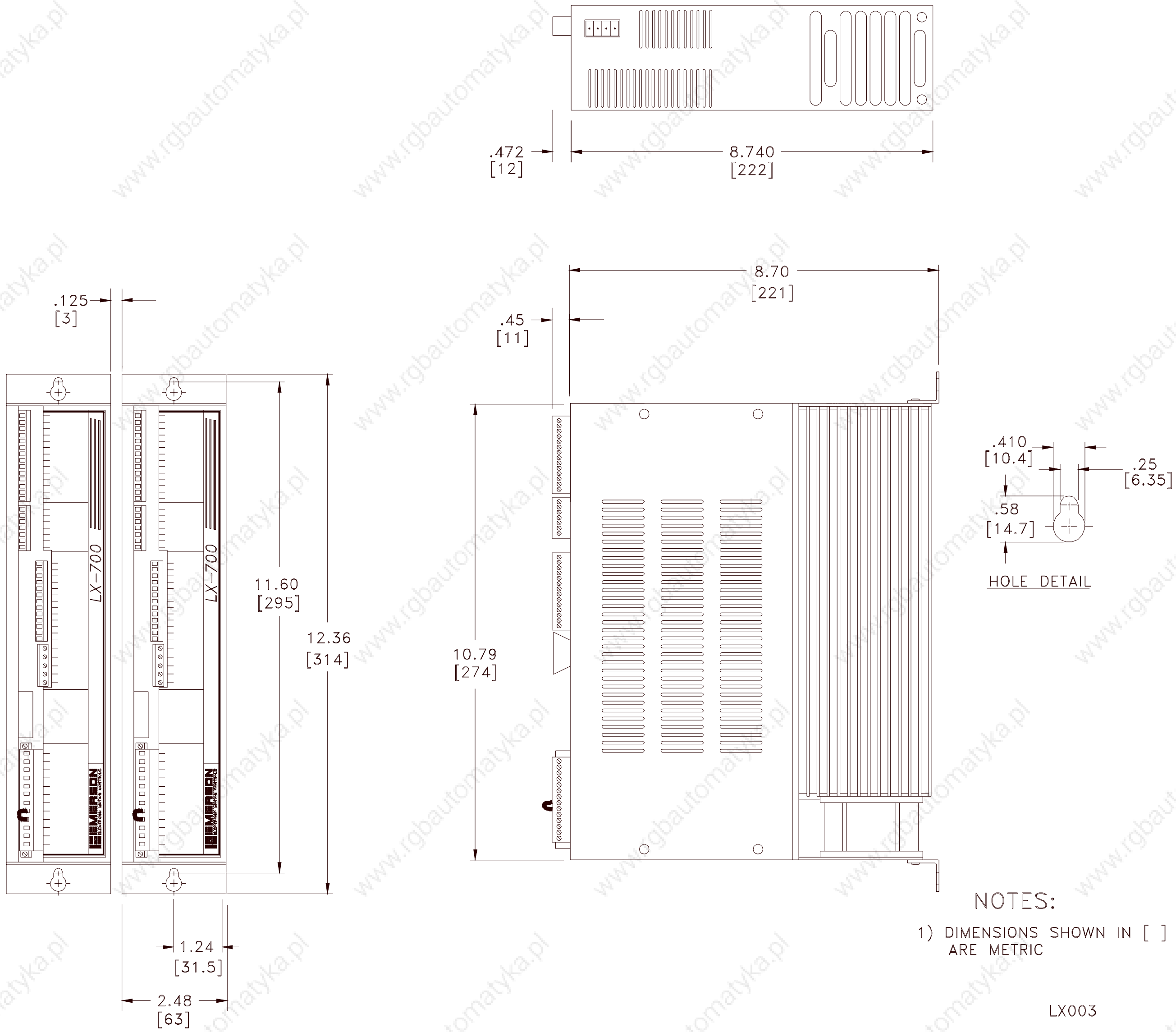
A number of diagnostic and fault detection circuits are incorporated in the LX amplifier to protect the drive. Some faults like over "voltage", "under voltage" and "amplifier or motor over temperature" reset when the fault is cleared. Other faults such as "short-circuit at the motor output terminals and/or resolver fault" need to be reset by cycling power. Ixt trip is not a fault condition, it simply folds back the current command to the DIP switch setting until the demand is reduced.

The Ixt trip is not operational in the current command mode. See Section 6 (Special applications) for details.

Table 7-A

CONDITION	DISPLAY	DRIVE OK	RESET ACTION REQUIRED
Motor Over temperature	LED on	Drive OK contact open Drive OK LED off	Auto reset on Temp drop
Amp Overtemp >95°C	LED on		Auto reset on Temp drop
Over voltage			Auto reset on return to normal voltage
Under voltage			Auto reset on return to normal voltage
Output short Ckt			Cycle power
Resolver Fault	LED on		Cycle power
High Irms	LED on	Drive OK on, contact closed	Not a fault. Indicates current limiting action.
Backup Logic Supply active mode		Drive OK contact opens for about 2 seconds then closes. LED follows contact action.	Re-application of AC Line power

A
SPECIFICATIONS



A.1 LX Amplifier Mechanical Diagram

B. Amplifier Electrical Specifications

B.1 Amplifier Overview

	UNITS	LX-400	LX-700	LX-1100
Input power	KVA	1.5	2.5	3.75
Input current	Amps	4.5	7.5	11.2
Continuous output current	Amps	4.0	7.0	10.9
Maximum output current	Amps	8.0	14.0	22.0
Input voltage	Single of 3∅ 96 to 264 VAC, 47/63 Hz			

Supply voltage

96V to 264VAC nominal RMS voltage direct on the main line or through a line transformer.

Output current specification tolerance

± 10% of I max

Max voltage output of the amplifier between phases R,S,T

Supply voltage -10 VAC rms

Internal braking resistor capacity

33 Ω 150 Ω

External shunt resistor drive capacity

33 Ω 3300 watts

Analog command input

± 10V (10 kΩ input impedance)

Error amplifier temperature drift

1.3 uV/°C

Working temperature

-10 °C to +50 °C

B.2 User Adjustments

All adjustments are on the personality board

- Offset null
- Full scale speed
- Response
- Acc/Dec
- Gain

B.3 Diagnostic Annunciation

- N.O. relay contact output for drive O.K. monitoring
- Green LED for drive O.K. monitoring
- Red LED for resolver fault monitoring
- Red LED for heatsink over temperature
- Red LED for motor over temperature
- Red LED illuminates when *Ixt* current limiting is active
- Yellow LED illuminates when shunt circuit activates

B.4 Functions Enabled via Dip Switches

- Nominal current limiting
- Motor poles selection
- Speed scale selection
- [1]Limit switch enabling and polarity 1
- [1]Simulated encoder resolution

B.5 Protection and Diagnostics

- Resolver fault
- Current limiting to protect motor
- Drive O.K indication (LED and contact)
- Output short circuit   Phase to phase or Grnd)
- Over temperature   95 °C on the heatsink
- [2]Under voltage 2   135 Vdc on the DC bus
- Over voltage   416 Vdc on the DC bus

The shunt circuit is automatically disabled when the input line power is lost while the DC bus voltage not zero.

B.6 Personality Board Options

The standard LX amplifier contains the personality board with all options which include the encoder and pulse / direction outputs along with the limit switch inputs. A reduced cost version of the LX is available in quantity purchases which does not include these connections or features.

[1] *These are available as 'delete options' at a reduced cost.*

[2] *When under voltage is tripped, the optional external logic supply is automatically invoked. See Chapter 6.*

C. Combined Motor / Amplifier Characteristics

AMP MODEL	MOTOR MODEL	CONT. TORQUE lb–in (Nm)	PEAK TORQUE lb- in (Nm)	POWER HP (kW)	INERTIA lb-in-sec^2 (gm^2)	MAX SPEED RPM	MOTOR WT. Lb (kg)
LX-400	DXM/E-208	10	32	.60	.00010	5000	4.0
		(1.13)	(3.62)	(.45)	(.0113)		(1.81)
	DXM/E-316	18	42	.76	.00052	4000	8.3
		(2.00)	(4.7)	(.57)	(.059)		(3.8)
LX-700	DXM/E-340	40	115	1.50	.0014	3000	14.6
		(4.5)	(13.0)	(1.10)	(.158)		(6.6)
	DXM/E-455	60	125	2.14	.0026	3000	19.8
		(6.80)	(14.1)	(1.60)	(.294)		(9.0)
LX-1100	DXM/E-490	80	160	3.00	.0051	3000	37.0
		(9.0)	(18.1)	(2.20)	(.577)		(16.8)
	DXM/E-4120	100	200	2.90	.0074	3000	38.0
		(11.3)	(22.6)	(2.10)	(.837)		(17.3)

C.1 Torque Speed Curves for LX Amplifiers / DX Motors

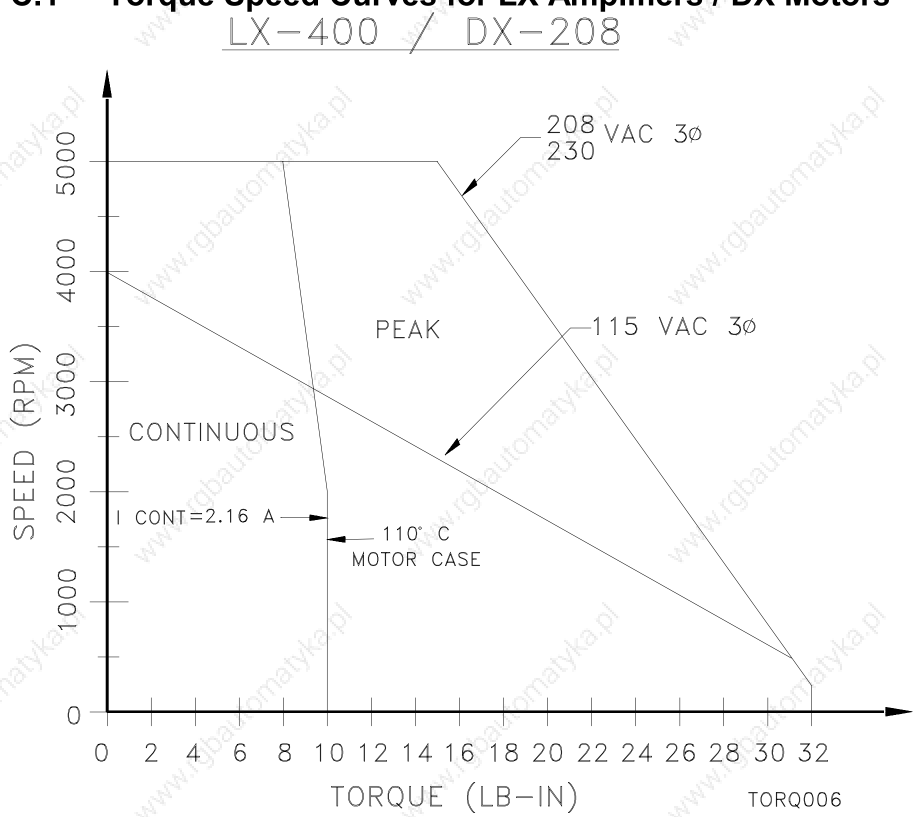


Figure C.1 LX-400 / DX-208 torque speed curve.

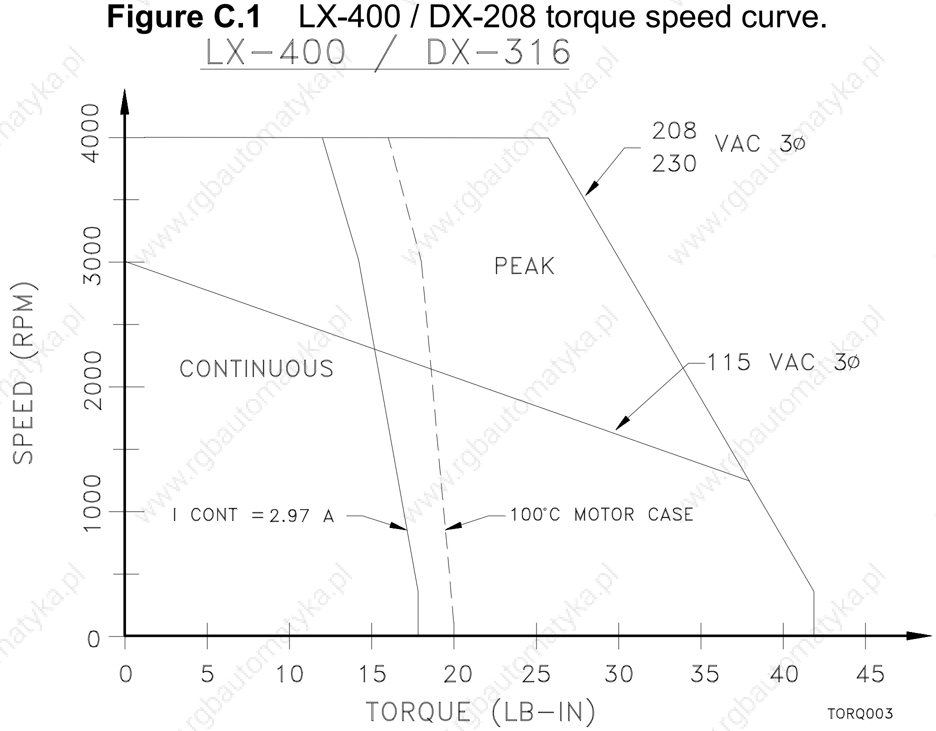


Figure C.2 LX-400 / DX-316 torque speed curve.

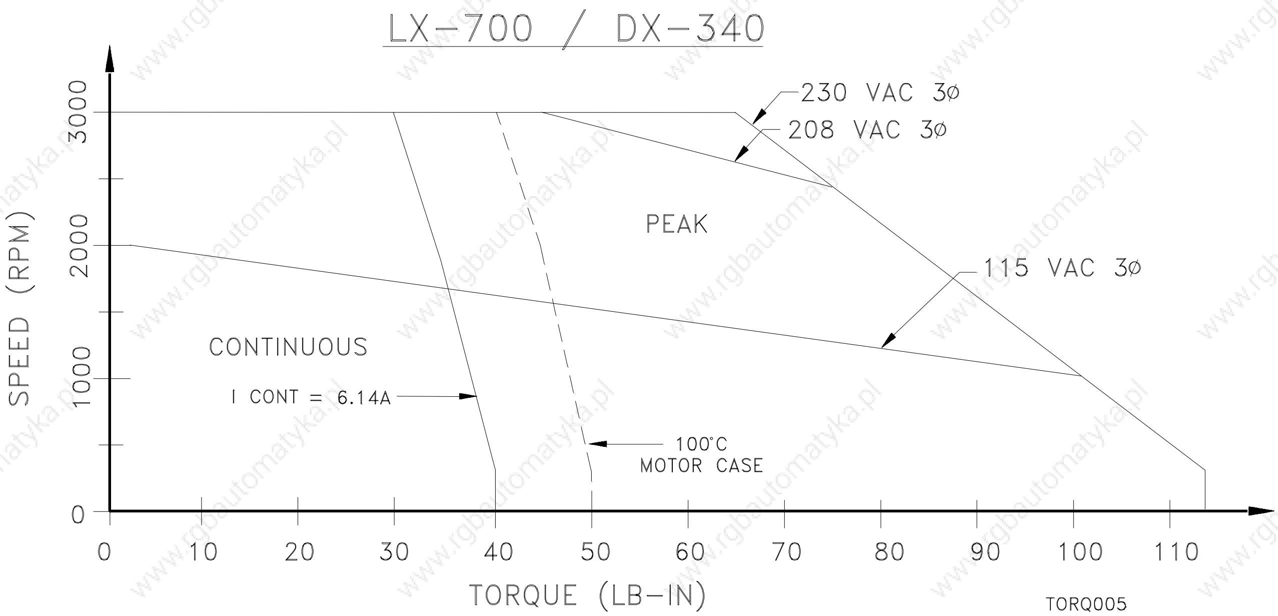


Figure C.3 LX-700 / DX-340 torque speed curve.

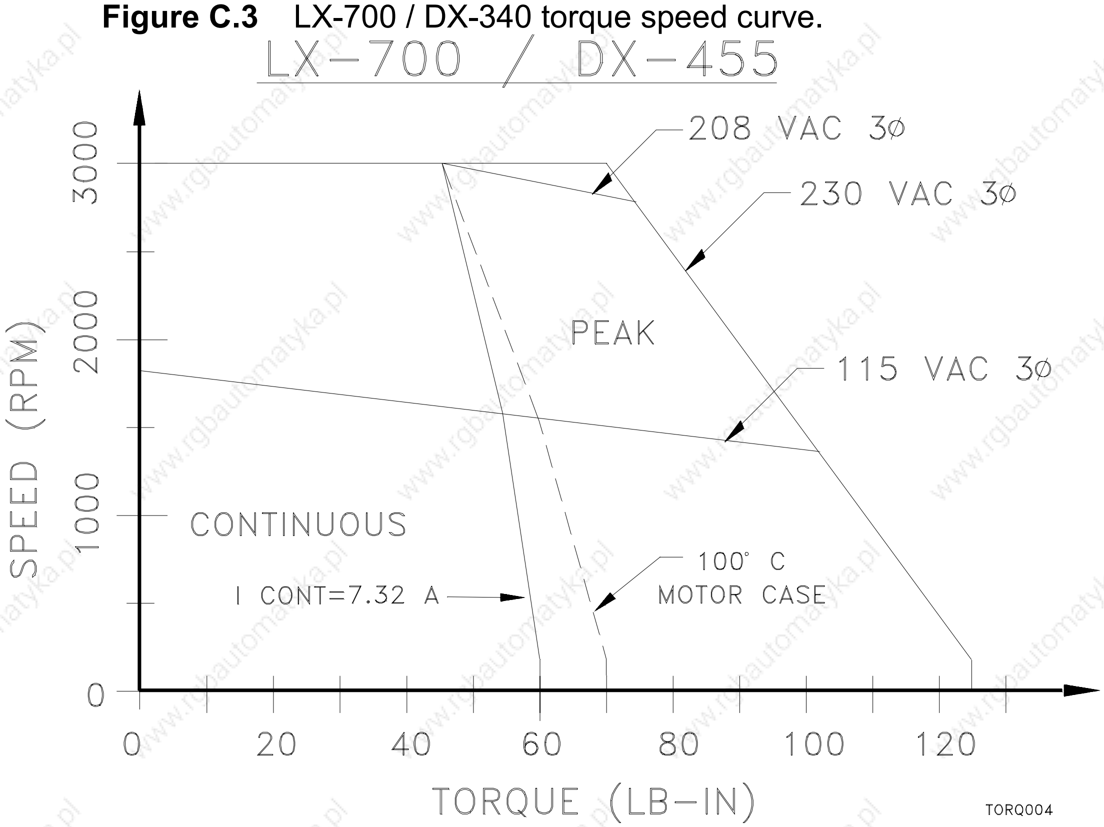


Figure C.4 LX-700 / DX-455 torque speed curve.

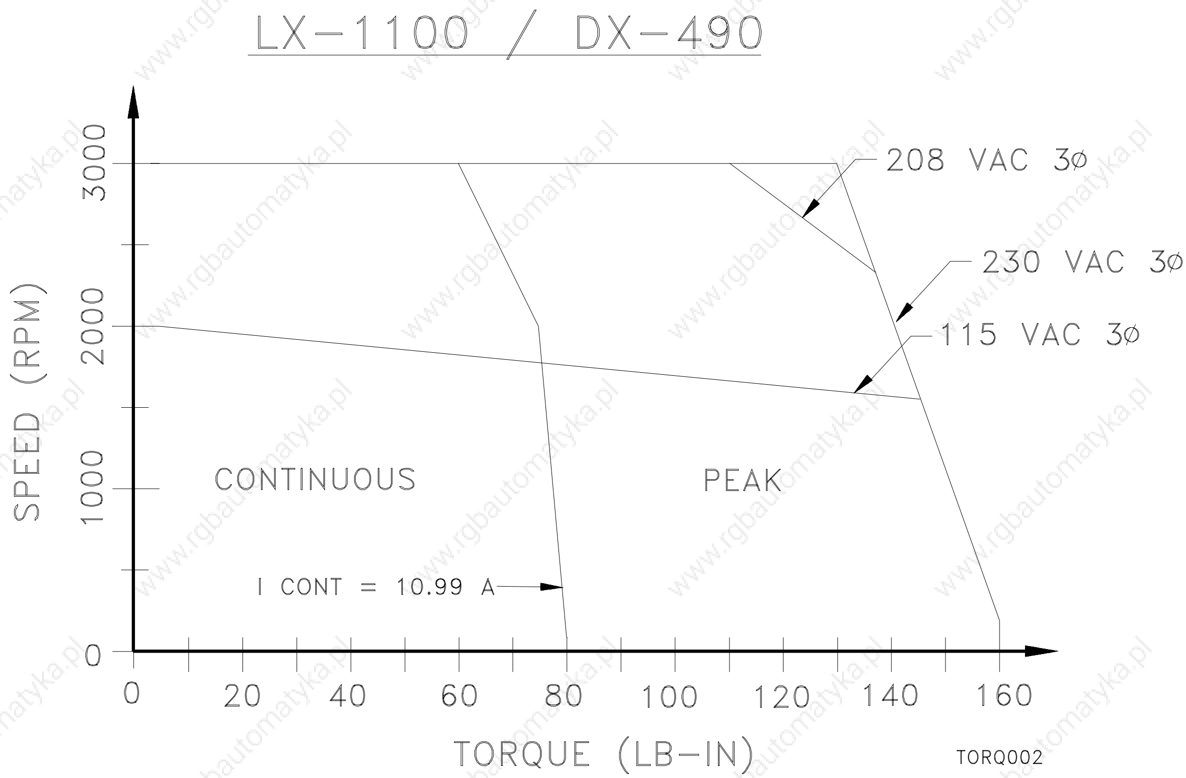


Figure C.5 LX-1100 / DX-490 torque speed curve.

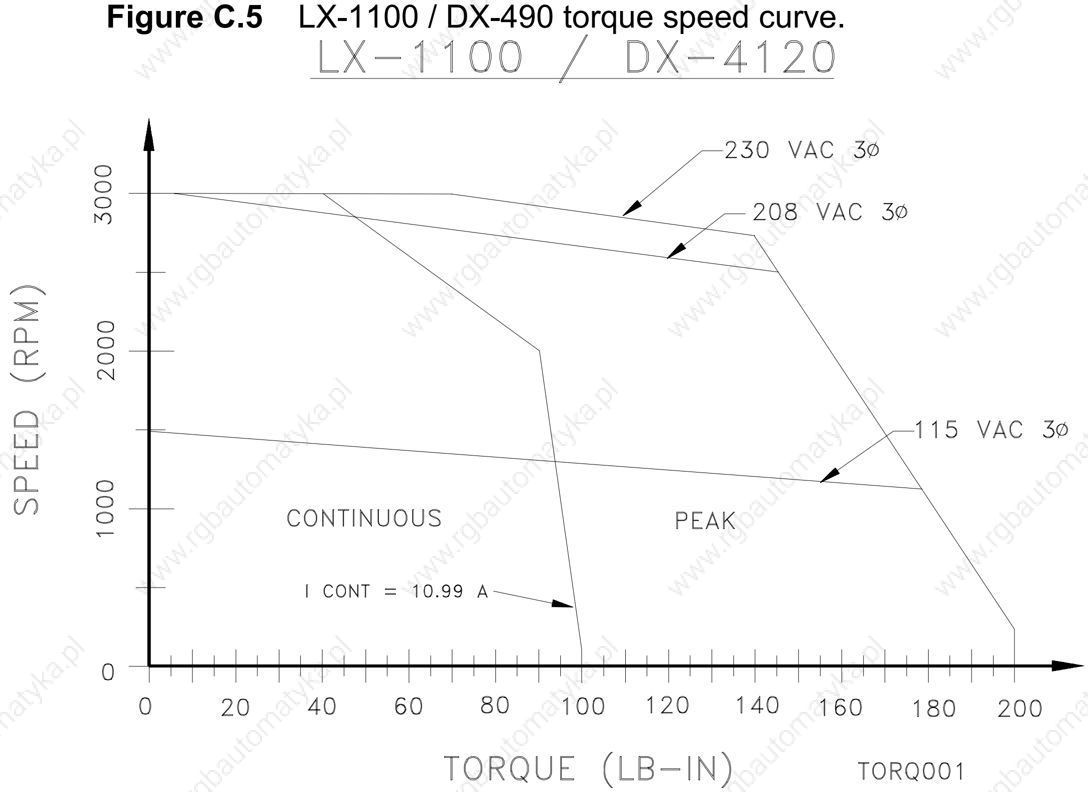


Figure C.6 LX-1100 / DX-4120 torque speed curve.

D. DX Motor Specifications and Diagrams

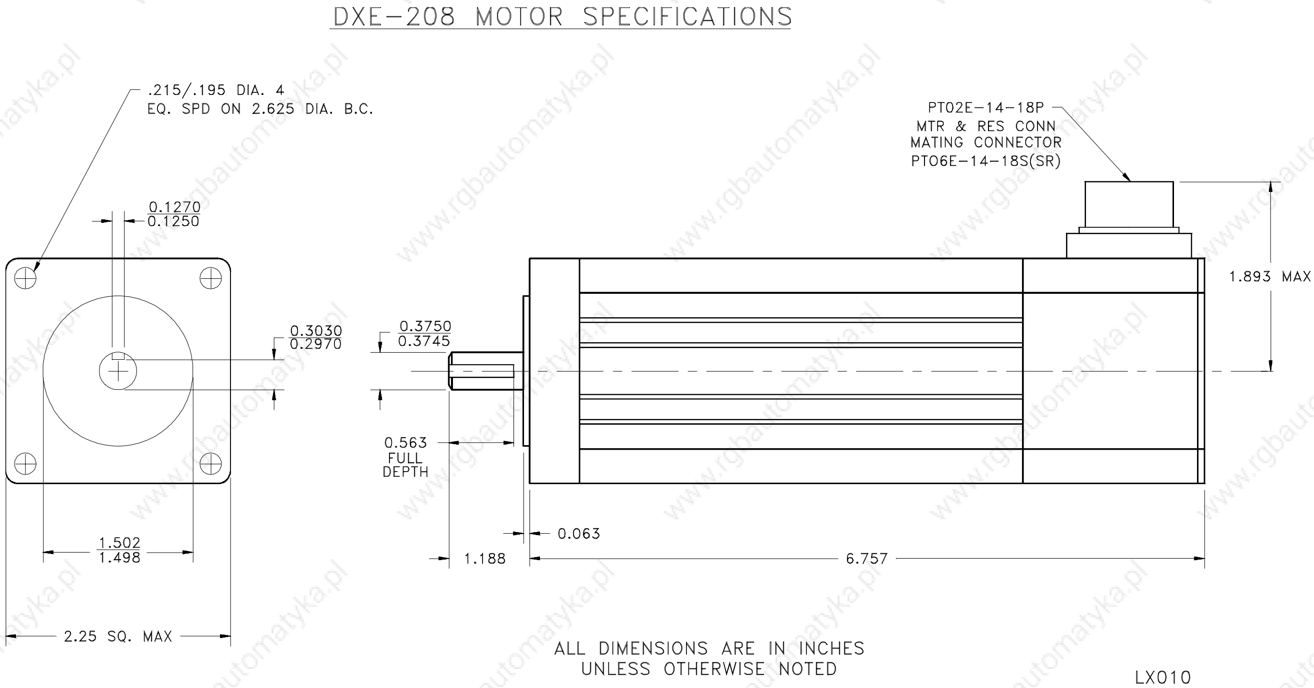


Figure D.1 DXE-208 Motor.

ROTOR INERTIA	**CONT. STALL TORQUE**	**PEAK TORQUE**	**MAX CONT OPER SPEED**	**Kt**	**PEAK CURRENT**	**LENGTH A**	**AXIAL SHAFT LOADING**	**RADIAL SHAFT LOADING**	**WEIGHT**
Lb-in-sec^2 (kg-cm^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	in	lbs	lbs	Lb/kg
0.0001 (0.113)	10	32	5000	4.1	8.0	6.757	15	20	4 / 1.9

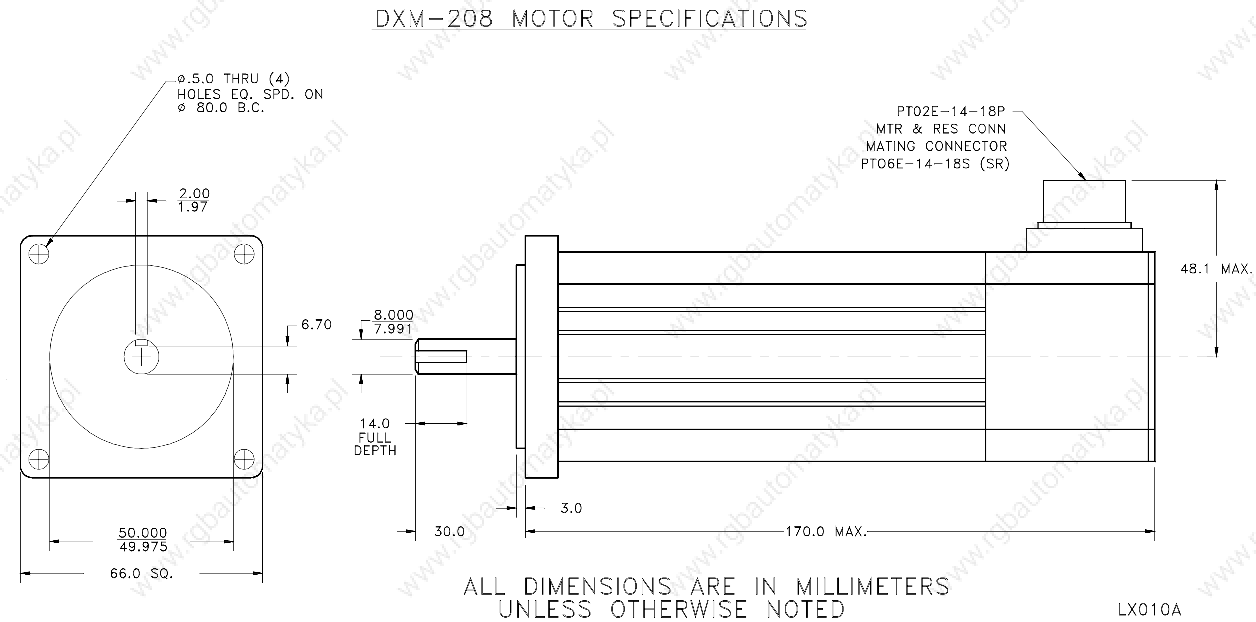


Figure D.2 DXM-208 Motor.

ROTOR INERTIA	**CONT. STALL TORQUE**	**PEAK TORQUE**	**MAX CONT OPER SPEED**	**Kt**	**PEAK CURRENT**	**LENGTH A**	**AXIAL SHAFT LOADING**	**RADIAL SHAFT LOADING**	**WEIGHT**
Lb-in-sec^2 (kg-cm^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	mm	lbs	lbs	Lb/kg
0.0001 (0.113)	10	32	5000	4.1	8.0	170	15	20	4 / 1.9

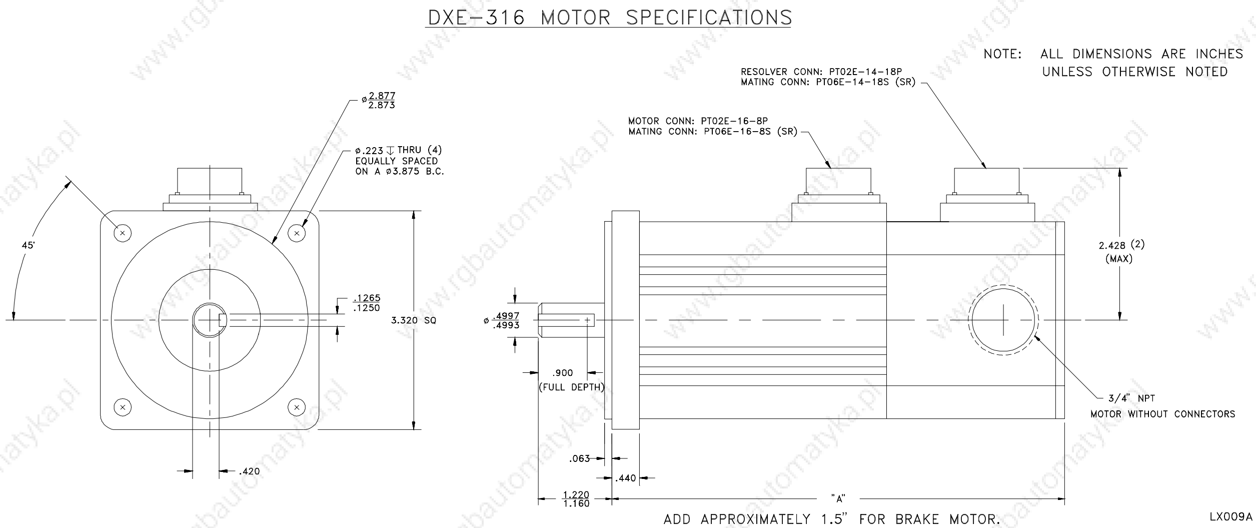


Figure D.3 DXE-316 Motor.

ROTOR INERTIA	CONT. STALL TORQUE	PEAK TORQUE	MAX CONT OPER SPEED	Kt	PEAK CURRENT	LENGTH A	AXIAL SHAFT LOADING	RADIAL SHAFT LOADING	WEIGHT
lb-in-sec^2 (kg-cm^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	in	lbs	lbs	Lb/kg
0.0052 (0.558)	20	72	4000	5.5	13	8.75 / 7.24	15	20	8.3 / 3.8

Holding Torque lb-in	Voltage Volts	Current Amps	Engage Time	Disengage Time	Added Inertia lb-in-sec^2	Added Length in	Added Weight lb/kg
60	24	.52 ±10%	100 ms max off	250 ms max on	0.00015	1.5	2.4/1.1

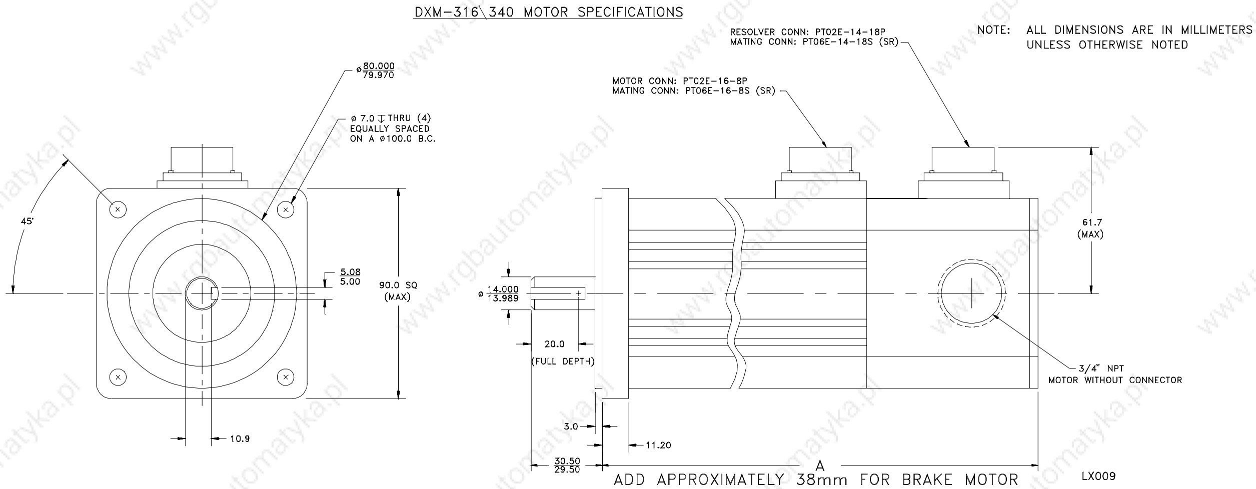


Figure D.4 DXM-316/340 Motor.

ROTOR INERTIA	CONT. STALL TORQUE	PEAK TORQUE	MAX CONT OPER SPEED	Kt	PEAK CURRENT	LENGTH A	AXIAL SHAFT LOADING	RADIAL SHAFT LOADING	WEIGHT
lb-in-sec^2 (kg-cm^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	Mm NPT/CONN	lbs	lbs	Lb/kg
DXM-316									
0.0052 (0.558)	20	72	4000	5.5	13	223/184	15	20	8.3/3.8
DXM-340									
0.0014 (1.31)	50	180	3000	8.3	21.7	301/260	15	20	14.6/6.7

Holding Torque lb-in	Voltage Volts	Current Amps	Engage Time	Disengage Time	Added Inertia lb-in-sec^2	Added Length mm	Added Weight lb/kg
60	24	.52 ±10%	100 ms max off	250 ms max on	0.00015	38	2.4/1.1

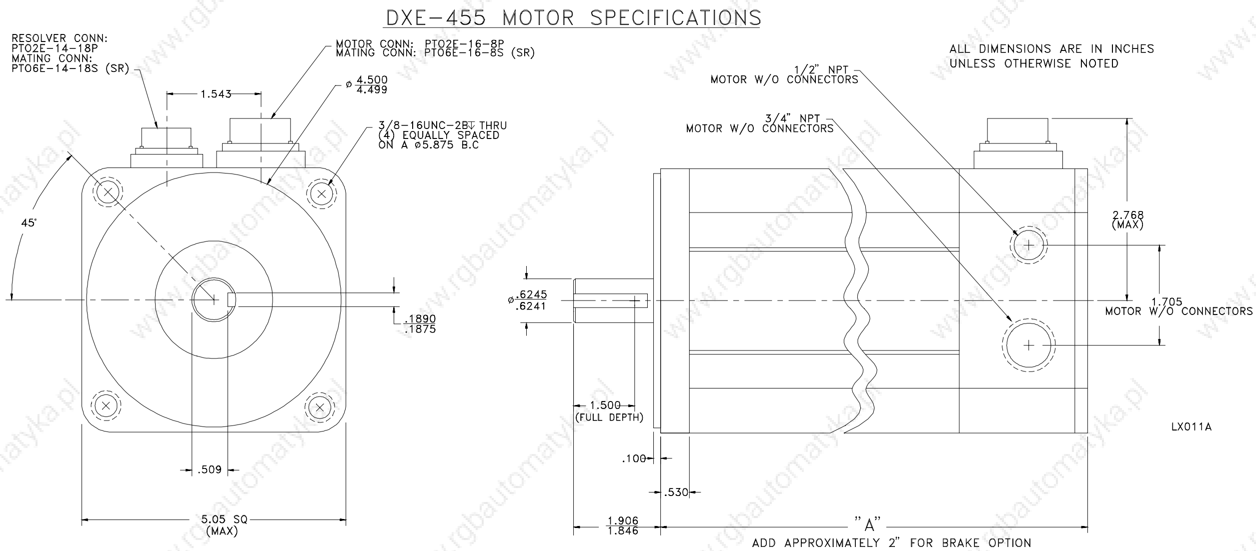


Figure D.5 DXE-455 Motor.

ROTOR INERTIA	CONT. STALL TORQUE	PEAK TORQUE	MAX CONT OPER SPEED	Kt	PEAK CURRENT	LENGTH A	AXIAL SHAFT LOADING	RADIAL SHAFT LOADING	WEIGHT
lb-in-sec^2 (kg-cm^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	In NPT/CONN	lbs	lbs	Lb/kg
0.0026 (2.94)	70	245	3000	8.8	27.8	10.3/8.6	50	100	19.8/9.0

Holding Torque lb-in	Voltage Volts	Current Amps	Engage Time	Disengage Time	Added Inertia lb-in-sec^2	Added Length in	Added Weight lb/kg
240	24	.88 ±10%	100 ms max off	250 ms max on	0.0009	2	5.8/2.6

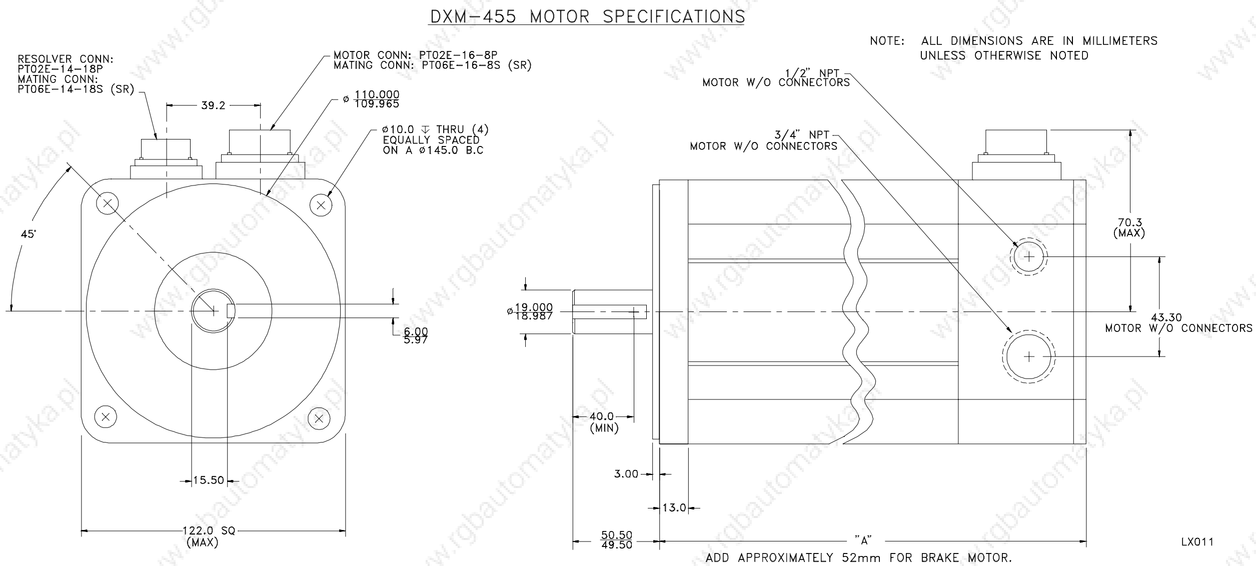


Figure D.6 DXM-455 Motor.

ROTOR INERTIA	CONT. STALL TORQUE	PEAK TORQUE	MAX CONT OPER SPEED	Kt	PEAK CURRENT	LENGTH A	AXIAL SHAFT LOADING	RADIAL SHAFT LOADING	WEIGHT
lb-in-sec^2 (kg-cm^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	mm NPT/CONN	lbs	lbs	Lb/kg
0.0026 (2.94)	70	245	3000	8.8	27.8	262/216	50	100	19.8/9.0

Holding Torque lb-in	Voltage Volts	Current Amps	Engage Time	Disengage Time	Added Inertia lb-in-sec^2	Added Length mm	Added Weight lb/kg
240	24	.88 ±10%	100 ms max off	250 ms max on	0.0009	52	5.8/2.6

DXE-490, 4120 MOTOR SPECIFICATIONS

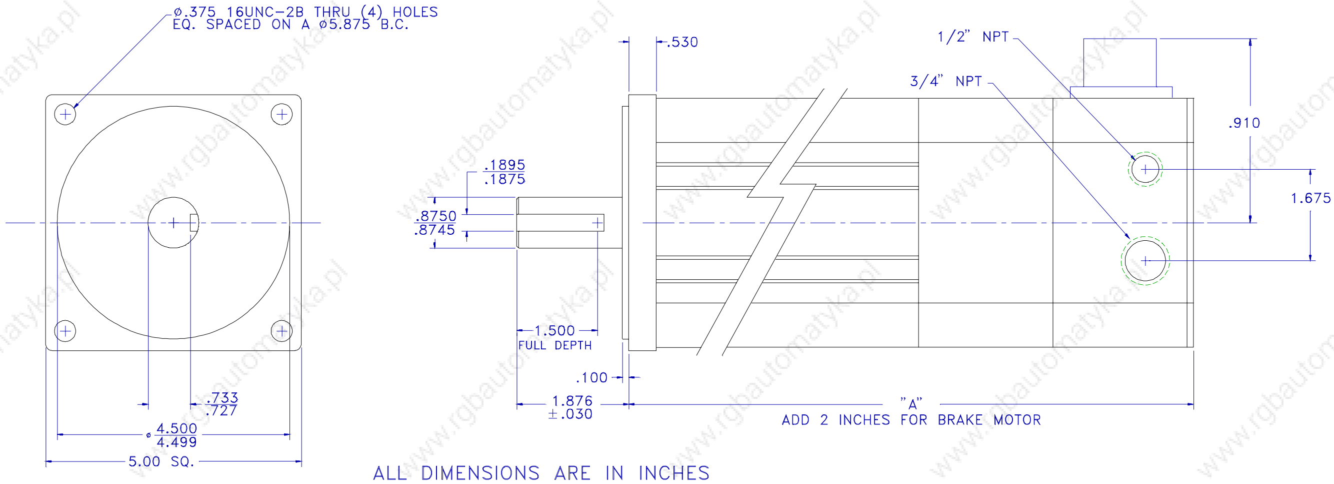


Figure D.7 DXE-490 / 4120 Motor.

ROTOR INERTIA	**CONT. STALL TORQUE**	**PEAK TORQUE**	**MAX CONT OPER SPEED**	**Kt**	**PEAK CURRENT**	**LENGTH A**	**AXIAL SHAFT LOADING**	**RADIAL SHAFT LOADING**	**WEIGHT**
lb-in-sec^2 (kg-m^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	In NPT/CONN	lbs	lbs	Lb/kg
				DXE-490					
0.0051 (0.00058)	90	315	3000	8.6	36.6	12.8/11.1	50	100	27.5/ 11.6
				DXE-4120					
0.0074 (0.00084)	120	420	3000	10.5	40.0	15.3/13.6	50	100	38/17.2

Holding Torque lb-in	**Voltage Volts**	**Current Amps**	**Engage Time**	**Disengage Time**	**Added Inertia lb-in-sec^2**	**Added Length in**	**Added Weight lb/kg**
240	24	.88 ±10%	100 ms max off	250 ms max on	0.0009	2	5.8/2.6

DXM-490, 4120 MOTOR SPECIFICATIONS

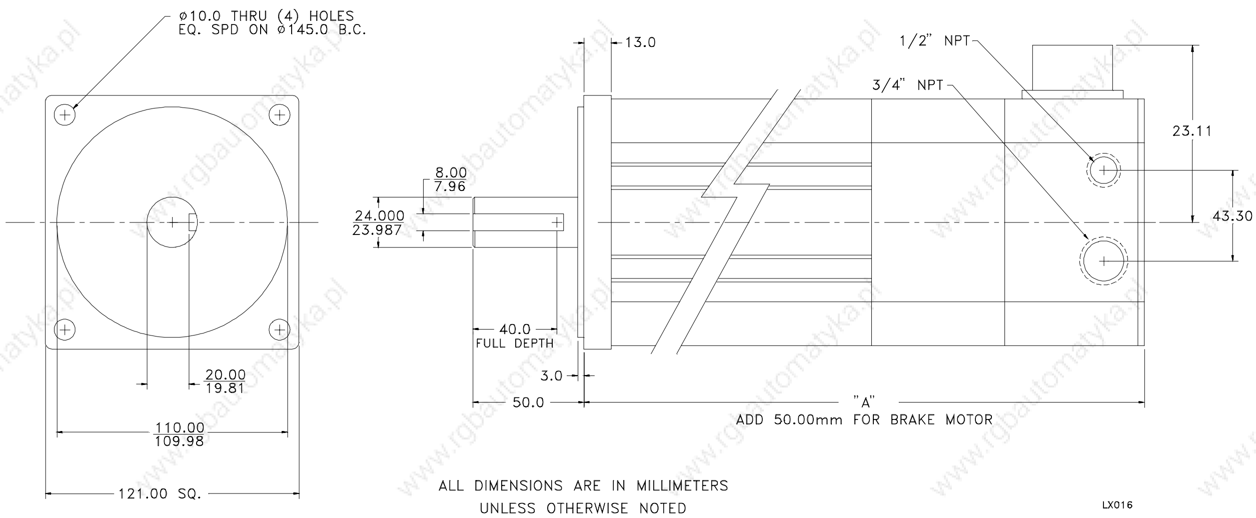


Figure D.8 DXM-490 / 4120 Motor.

ROTOR INERTIA	CONT. STALL TORQUE	PEAK TORQUE	MAX CONT OPER SPEED	Kt	PEAK CURRENT	LENGTH A	AXIAL SHAFT LOADING	RADIAL SHAFT LOADING	WEIGHT
lb-in-sec^2 (kg-m^2)	lb-in	lb-in	rpm	Lb-in/amp	Amps RMS	In NPT/CONN	lbs	lbs	Lb/kg
DXM-490									
0.0051 (0.00058)	90	315	3000	8.6	36.6	12.8/11.1	50	100	27.5/ 11.6
DXM-4120									
0.0074 (0.00084)	120	420	3000	10.5	40.0	15.3/13.6	50	100	38/17.2

Holding Torque lb-in	Voltage Volts	Current Amps	Engage Time	Disengage Time	Added Inertia lb-in-sec^2	Added Length mm	Added Weight lb/kg
240	24	.88 ±10%	100 ms max off	250 ms max on	0.0009	50	5.8/2.6

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