REGAL

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REV. G

TITLE SyMAX-i 56 / Platinum e 56 – Customer Product Definition

FIRST MADE FOR: CHACR ECM NEMA 56FR

REVISION SHEET

Rev Level	Name	Date	Comment
A	Paul Lin	7/9/13	Initial Draft
B	Zach Stauffer	9/5/13	Model Number Nomenclature Updated
C	Zach Stauffer	11/14/13	Updated Mechanical Construction Options, UL File details, and Available Rating Points
D	Zach Stauffer	12/3/13	Initial Customer Release Document
E	Zach Stauffer	3/3/14	Add 56HZ min overall length, Chged Frame Material to Mount Style in Nomenclature
F	Zach Stauffer	1/12/15	UL current ratings, inrush current ratings, bearing grease updated, daisy chain details, fault output circuit functionality
G	Zach Stauffer	9/22/15	Added open/vent details/ratings, updated misc items
H	Luis Morales	2/9/16	Added IEC specification compliance details, discrete speed control details, and update connection section picture

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SyMAX-i 56 / Platinum e 56 ECM PRODUCT SPECIFICATION

1.0 General Description

1.1 Model/Part # Designations

1.1.1 Model Number: E56Y23TRAXXXXP

E = UL Prefix, 56 = NEMA or IEC Frame, Y = Electrical Type, 2 = Input Voltage, 3 = Input Voltage Phase, T = Enclosure Type, R = Mount Style, A = Motor Type, Letter, XXXX = serialized number, P = Rev.

1.1.2 UL Prefix

Prefix Letter	*Designation*
E	Electronically Protected

1.1.3 Electrical Type

Construction Letter	*Description*
Y	Interior Permanent Magnet

1.1.4 Input Voltage

Voltage Number	*Designation*
2	208-230V, 230V
4	460V

1.1.5 Input Voltage Phase

Phase Number	*Phases*
2	Three

1.1.6 Enclosure Type

Enclosure Letter	*Description*
N	TENV
T	TEAO
V	Open Vented

1.1.7 Mount Style

Mount Letter	*Description*
R	Spl
B	Base (56)
H	Base (56H)
T	Base (143T)
Z	Base (180)
C	C-Face
F	Full Round
D	56C/Base (56)

1.1.8 Motor Type

Type Letter	*Description*
A	Control OSE, VSU
C	Control SE, VSU
H	Control OSE, Horiz
M	Control SE, Horiz
D	Control OSE, VSD
B	Control SE, VSD

1.2 Type – Permanent magnet, brushless AC, 3-phase motor with sinusoidal drive for 3-phase user voltage input. Unit is total enclosed, requires airflow over the motor (TEAO), and is made for regulated speed or regulated torque direct-drive applications.

1.3 Rating – Horsepower rating is per NEMA MG1-10.33, service factor 1.0 for continuous duty at rate ambient

1.4 Frame – NEMA 56 frame; 6.5” diameter

1.5 Estimated Length / Max RPM / Max Torque Combinations – Length excludes shaft and clamp screw extensions. Additional length variation may be introduced by end bracket and or mounting selection (56HZ mount adds 2.5”).

HP	Max. Length	RPM	Max Torque (in-lbs)
1.0	10.45” +/- 0.03”	900-1150	70.0
1.5	10.70” +/- 0.03”	900-1150	105.0
2.0	11.45” +/- 0.03”	900-1150	142.5
2.1	11.95” +/- 0.03”	900-1150	161.1
1.0	9.95” +/- 0.03”	1600-1800	35.0
1.5	10.20” +/- 0.03”	1600-1800	54.0
2.0	10.70” +/- 0.03”	1600-1800	72.1
3.0	11.45” +/- 0.03”	1600-1800	105.0

1.6 Mounting – Motor can be designed to mount in each different shaft orientations (shaft down, shaft up, horizontal, etc.). Shaft down versus shaft up orientations require different mechanical bearing construction systems. It is recommended that the lead exit is in the 6 o'clock position and proper drip loops applied whenever possible.

1.6.1 Customer provided belly band or basket style mount

1.6.2 Welded base options for NEMA 56/56H, 143T/145T, or 182/182T/184/184T constructions

1.7 Loading – All applications need to be tested to ensure NEMA class F temperature limit are not exceeded.

1.7.1 TEAO design units are designed to operate with a direct drive fan load only.

1.7.2 Open vented design units are designed to operate direct drive or belt drive application.

1.8 Start Up - During start up, motor current is slowly applied to motor windings. This provides a controlled smooth start up. Motor/fan will attain a speed of 300rpm in 15 seconds maximum with a single sided confidence limit of 90%.

1.9 Shaft

1.9.1 Diameter – Available but not limited to shaft diameters include: 1/2", 5/8 ", 3/4", and 7/8"

1.9.2 Extension

1.9.2.1 Single extension

1.9.2.2 Length – 1.50" to 5.0" in 0.125" increments and all NEMA 48/56/140FR options

1.9.3 Features

1.9.3.1 Flat

1.9.3.1.1 Single Flat: 1.25" to 4.5" long flat in 0.05" increments with a 0.16" flat depth. Flat length must be at least 0.5" shorter than the shaft extension length. Transition between shaft diameter and flat does not necessarily provide a positive stop.

1.9.3.1.2 Double Flat: Two flats of equal length separated by 90 deg; Same dimension requirements as the single flat

1.9.3.2 Keyed

1.9.3.2.1 Keyed Only: 1.25" to 4.5" long keyway in 0.05" increments with a 0.19"x0.19"x1.38" key; Keyway must be at least 0.5" shorter than the shaft extension length

1.9.3.2.2 Keyed with Flat: Keyed shaft with single flat separated by 90 deg; Same keyed requirements in 1.8.3.2.1 and flat requirements in 1.8.3.1.1

1.10 Bearing System – Ball Bearings 6205

1.10.1 Protection – Two Seals (Full Contact)

1.10.2 Grease – Grease type varies based on application ambient

1.10.2.1 ≤40C Ambients – Shell Oil Aeroshell 7

1.10.2.2 ≥40C Ambients – Polyrex EM

1.11 Rotation – Factory default is CCW viewing opposite drive end of motor. User can set rotation of primary speed in the terminal box; remaining speeds (if applicable) are factory set base on primary speed rotation. Rotation direction for each speed can also be configured via the ECM Toolbox™.

1.12 Estimated Product Weight – Based on full round designs without internal fans. Actual weight will vary based on mechanical features and electrical design required by application.

HP	RPM - @ UL Rating	Approximate Weight
1.0	900-1150	21.0 lbs
1.5	900-1150	25.0 lbs
2.0	900-1150	34.5 lbs
2.1	900-1150	35.0 lbs
1.0	1600-1800	19.0 lbs
1.5	1600-1800	23.0 lbs
2.0	1600-1800	25.0 lbs
3.0	1600-1800	32.0 lbs

2.0 Electrical Characteristics

2.1 Line Voltage – Alternate line voltage ratings and ranges available upon request with alternate designs.

Available Nominal Input Voltage Ratings	Min. Voltage	Max. Voltage
460V, 3 phase	414V	506V
230V, 3 phase	207V	253V

2.2 Frequency – Product will operate on 60Hz or 50Hz without an impact on performance

2.3 Input Current (Reference Standard UL Nameplate Ratings) – Actual performance could vary based on end product design to meet customer performance requirements.

HP	Nominal Voltage	Input Current
1.0	460V, 3 phase	1.5A
1.5	460V, 3 phase	1.9A
2.0	460V, 3 phase	2.4A
2.1	460V, 3 phase	2.5A
3.0	460V, 3 phase	3.8A
1.0	230V, 3 phase	2.8A
1.5	230V, 3 phase	3.9A
2.0	230V, 3 phase	4.8A
2.2	230V, 3 phase	5.2A
3.0	230V, 3 phase	7.1A

2.4 Inrush Current – The inrush current will decay to zero in approximately 50 milliseconds. Any switching device between the AC source and the motor must be sized properly to handle the inrush current.

Nominal Voltage	Max. Inrush Current per Motor
230V, 3 phase	18.7A
460V, 3 phase	37.4A

2.5 Rated Power Output – The horsepower/shaft wattage is rated at nominal line voltage and 60 deg C. Motor output horsepower will vary proportionally based on actual line voltage applied. Basic ratings (HP, Torque, and Speed) are as defined in the table in Section 1.5.

2.6 Full Load Efficiency (Reference) – Minimum product efficiency will vary based upon desired product outputs.

HP	RPM	REF EFF %
1.0	850-1150	83-86
1.5	850-1150	85-88
2.0	850-1150	85-88
2.1	850-1150	85-88
1.0	1600-1800	81-84
1.5	1600-1800	83-86
2.0	1600-1800	83-86
3.0	1600-1800	85-88

2.7 Power Factor – The power factor is ≥80% (at full load rating point) and is similar to a leading power factor.

2.8 Speed Range –

2.8.1 Turn on RPM: The product minimum turn-on speed is 250rpm. This is the initial speed the motor will being operating at upon demand.

2.8.2 Minimum Operation RPM: The minimum operating speed allowed is 225 RPM. This speed can be obtained by reducing demand slightly after the initial “Turn on RPM” has been achieved.

2.8.3 Maximum Operation RPM: Maximum rpm available in a given design as a default is set to the unit rating point.

2.9 Fault Output Indicator (460V) – The 460V product includes an indicator for standard motor and application related fault conditions. If a fault is detected an electronic contact closure is activated. When a fault condition is removed or cleared, the electronic contact opens (clears) after 30 seconds. Normal operating conditions will result in an open contact. The contact indicator is designed to work with a customer indicator circuit.

2.9.1 Indicator Interface Circuitry: The FAULT feature of the SyMAX-i/Platinum e can be used with a variety of customer supplied fault indicator circuits such as LEDs or relays. See Figure X for an example circuit. The FAULT input is an open collector input capable of sinking up to 50mA of continuous current. Any external circuits that are connected to the FAULT input must limit the current to 50mA or less and must apply a positive DC voltage no more than 48VDC to the FAULT pin. Circuit grounds of externally powered circuits that use the FAULT input should be connected to the COM pin (pin 5) on the SyMAX-i/Platinum e connector.

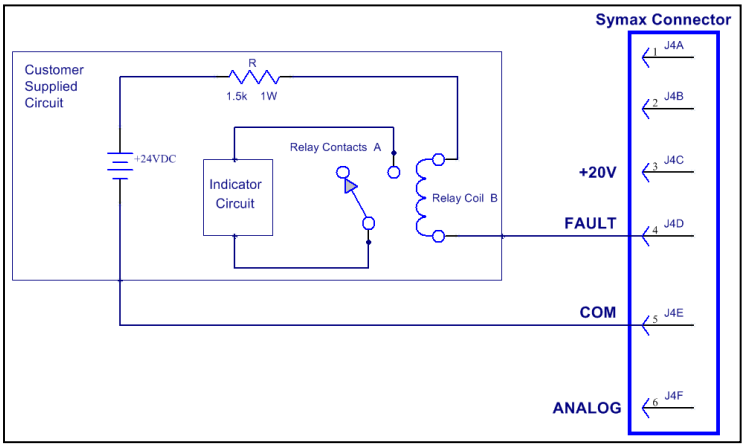


Figure X *- Example fault indicator circuit using the FAULT input as a current sink for a customer-supplied 24V relay.*

2.9.2 Trigger faults: Fault triggers include over current, excessive control bus voltage, under voltage, under speed (<nominal speed in 30s), loss of phase, no load, and all other UL faults.

2.10 Overload – Product is “electronically protected” per the guidelines outlined in UL 60730.

2.10.1 Locked Rotor Operation: The control detects a locked shaft and will shut down for a time period of up to 120s duration to avoid over temperature of the design. The unit will automatically attempt to restart after each shut down until the shaft.

2.10.2 No Load Trip Operation: The control detects an unloaded condition which is a function of RPMs above nameplate and/or very low current. When such a condition is detected, the control will stop spinning the motor for 2 minutes and then automatically attempt to restart. Once a proper load is achieved, the unit will operate during the next start attempt.

2.10.3 Loss of Phase Operation: The control detects a loss of any single input phase power. Default functionality during this detection is to reduce power output of the unit to avoid over temperature and potential control damage. This can result in loss of rpm if the unit demanded load exceeds the adjusted power capability of the unit in the loss of phase condition. A secondary functionality is available where the unit will shut down for 2 minutes after each loss of phase detection and will automatically attempt to restart until the lost phase is restored.

2.11 Agency – Product is qualified to cURus using UL standards (60730, 1004-3/4/7, and 1446) for totally enclosed air over, fan applications or for open/vented continuous duty applications (blowers/belt drive). The OEM shall do a thermal evaluation for each model design on a Regal supplied thermocoupled sample in the desired application. This is required to ensure each product maintains UL acceptable limits and to add OEM specific models to the base Regal agency file numbers shown below.

2.11.1 UL File Number (Motor): E306123 Volume 6

2.11.2 UL File Number (Control): E338178 Volume 1 section 11

2.11.3 UL File Number (Insulation): E306343 Volume 1

2.11.4 IEC Standards Compliance

2.11.4.1 IEC 60034-1: 2010
2.11.4.2 IEC 60034-11: 2004
2.11.4.3 EN 6100-6-4: 2007
2.11.4.4 EN 6100-6-2: 2005
2.11.4.5 EN 6100-3-2: 2006
2.11.4.6 EN 6100-3-3: 2008
2.11.4.7 IEC 6100-4-3
2.11.4.8 IEC 6100-4-4
2.11.4.9 IEC 6100-4-5
2.11.4.10 IEC 6100-4-6
2.11.4.11 IEC 6100-4-8
2.11.4.12 IEC 6100-4-2
2.11.4.13 IEC 6100-4-11

2.12 Electrical Noise Compliance – Product meets IEC 61000 for noise suppression (Class A) and immunity (Level 4).

2.13 Grounding - Product is designed to comply with applicable safety standards. Proper installation includes that the product be connected to earth ground. This connection is also required for proper electrical noise suppression. The ground connection is provided through proper customer external wiring to control internal ground connection found within the control wiring enclosure. Proper wire gage must be used for the ground based on UL requirements.

2.14 Insulation System – NEMA/UL Class F motor insulation system.

2.15 Hipot – Product is tested by RBC with a DC Hipot applied from all AC line voltage input terminals to the control housing and any low voltage input terminals (if present). The hipot DC voltage is set as per the following: $\sqrt{2}$ * (1000 + (2 * Line Voltage)) for a 1 minute hipot or 1.2 * $\sqrt{2}$ * (1000 + (2 * Line Voltage)) for a 1 second hipot. Additionally the voltage ramp up time should be set for 5 seconds to avoid y-capacitor nuisance tripping before full hipot voltage potential is reached and the test started. Leakage current limit is set at 0.750 mA.

2.16 Starting – Product has a gradual ramp up to desired speed. It will achieve 200 RPM min. within 4 sec. of power being applied at 25 deg. Celsius and under nameplate conditions. Starting is robust to windmilling (externally driven rotation) up to 350 RPM at 25 deg. Celsius under nameplate conditions.

2.17 Operating Modes

2.17.1 Speed Regulation – Regulated speed is the primary operating mode of the product. At operating points across the operation range with unit input voltage within the min. and max. values as defined in Section 2.1, the motor will operate at set speed point +/- 2%.

2.17.2 Torque Regulation – This is a non-standard mode of operation for this product, but may be required for some applications and is optionally available. In the regulated torque operating mode, at operating points across the operation range with unit input voltage within the min. and max. values as defined in Section 2.1, the motor will operate at the set torque point +/- 2%.

2.18 Performance – Max. torque for a given model will be available at nominal voltage for rated speeds, per Section 1.5. At speeds above the rated speed, the available torque may be cut back to maintain UL temperature limits.

3.0 Environmental Characteristics

3.1 Application Environment – Product is designed for indoor or outdoor use.

3.2 Temperature Range

3.2.1 Non-Operating – -40 deg. Celsius to +85 deg. Celsius

3.2.2 Operating – -40 deg. Celsius to +60 deg. Celsius

3.3 Humidity – 5% to 100%, condensing

3.4 Moisture – Product is designed to a minimum of IP54 per IEC 60529 requirements.

4.0 Operational Characteristics

4.1 Installation – Product is to only be installed using approved mounting as defined in Section 1.6. Product must be mounted such that air is flowing over the motor during operation for any IP54/totally enclosed design. The OEM should do a thermal evaluation for new applications with a RBC supplied thermocoupled sample. It is recommended to position the connections downward when possible and to create proper drip loops with the motor leads.

4.2 Operation Control (connection diagrams shown in section 4.5)

4.2.1 Discrete – A discrete product operates simply by the user applying line voltage to the product. The product will then operate at the pre-set operating point (factory configured or user programmed with the ECM Toolbox™). An operating point is as defined in Section 2.17.

4.2.1.1 Single Operating Point – Product operation is achieved by applying line voltage between the L1, L2 and L3 terminals on the product.

4.2.1.2 Multi Operating Point – Product can have up to 9 discrete operating points if 24V AC is used as an input signal. Primary operation (Spd0) is achieved by applying line voltage between the L1, L2 and L3 terminals on the product with no signals on X1/X2. There are 8 secondary operating points that are obtained through application of full or half wave form signals on the X1 and X2 terminals found on the 6 position terminal block. Shown below is the mapping array of the applied signals to outputted discrete speeds.

If 24 DC is used, 4 discrete operating points will be available (Spd0, Spd2, Spd6 and Spd8).

24Vac Signal Input

Location	X2	X1
SpdX	**Signal**	**Signal**
Spd0	0	0
Spd1	0	HW
Spd2	0	FW
Spd3	HW	0
Spd4	HW	HW
Spd5	HW	FW
Spd6	FW	0
Spd7	FW	HW
Spd8	FW	FW

24Vdc Signal Input

Location	X2	X1
SpdX	**Signal**	**Signal**
Spd0	0	0
Spd2	0	FW
Spd6	FW	0
Spd8	FW	FW

4.2.2 Variable (0-10Vdc) – A variable product requires the user to continuously supply line voltage between the L1 L2 and L3 terminals. The product is then "turned on" by applying a low voltage DC signal, ranging between 0Vdc and 10Vdc, between the positive (AN) and common (COM) signal terminals. The default control method is 0-10Vdc where 0V is off and 10V is full operation. The operating point magnitude is a linear relationship with the DC signal applied. Upon request the operating point magnitude may be proportional or inversely proportional to the DC signal (i.e. 0Vdc may be off or 100% of the operating range). There is a 1Vdc threshold for the "turn on/turn off" transition point or 2V turn on and 1.3V turn off threshold .

4.2.3 Variable (1-5Vdc or 4-20mA) – A variable product requires the user to continuously supply line voltage between the L1 L2 and L3 terminals. The product is then "turned on" by applying a low voltage DC signal, ranging between 1Vdc and 5Vdc(4 – 20mA), between the positive (AN) and common (COM) signal terminals. The defulat control method is 4-20mA where 4mA is off and 20mA is full operation. The operating point magnitude is a linear relationship with the DC signal applied. The operating point magnitude may be proportional or inversely proportional to the DC signal (i.e. 0Vdc may be off or 100% of the operating range). There is a 1Vdc threshold for the "turn on/turn off" transition point.

4.2.4 Variable (Inverted 0-10V/4-20mA) – An alternate control method of inverted 0-10V or 4-20mA can be added within the software such that using either of the connection methods listed under the 0-10V or 4-20mA sections along with an additional connection made from +20V output terminal to the X2 terminal of the 6 position terminal block will invert the default operation scaling.

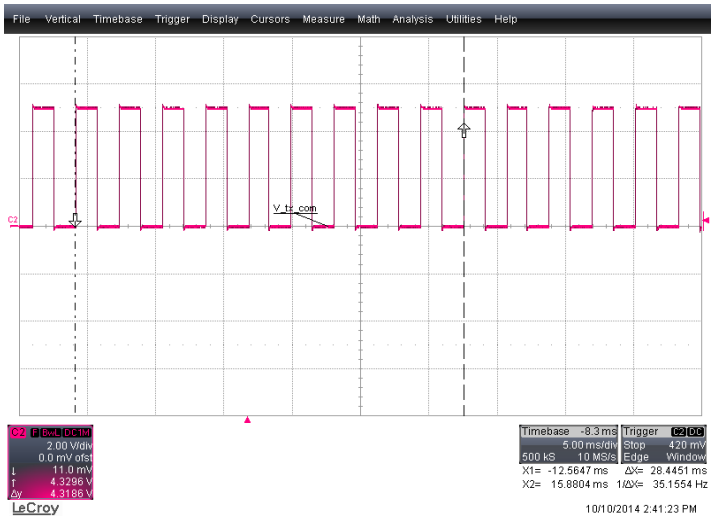
4.2.5 Enable/disable switch for Variable – The 10V or 20Vdc is applied to X1 input terminal to "turn on" enable variable control mode. This will be model dependent and available per request.

4.2.6 Variable (PWM) – Another alternate control method is duty cycle input (PWM) control. The PWM signal must be a DC pulse signal of amplitude range 10-30Vdc and a frequency range of 40-200Hz to be recognized as an acceptable input. Operation is such that 0% duty cycle is off and 100% duty cycle is full operation. The PWM signal should be applied with +V DC line attached to the X2/PWM terminal on the 3 position terminal block and DC common line attached to the COM of the same 3 position terminal block. Additionally the PWM/X2 switch (switch 4) must be set for PWM operation instead of X2 operation. Alternately, the +V DC line can be attached to the Rx

terminal of the 3-pin connector with DC common attached to the COM terminal of that same connector.

4.2.7 Shaft Rotation Adjustment Switch – Default motor rotation and switch location are set to be CCW (viewed from opposite shaft end), but it is possible to change the rotation of the motor from CCW to CW by toggling the switch # 2 label as CCW CW in figure 2. Rotation changes should only be made with power removed from the unit. Motor direction change will not be implemented until positional switch is toggled and power has been removed and then reapplied to the unit.

4.2.8 Speed Output – An additional control function can be provided to output a signal indicating the current motor speed. The signal can be obtained across TX and COM. Note that for a clean signal, a pull-up resistor is needed on Tx. The speed is directly related to the frequency of the signal. One period is considered as 9 repetitions of the waveform. This frequency is then multiplied by 30 to give the motor speed. In the example below, the frequency of 9 repetitions is 35.1554Hz. Multiplying by 30 gives a speed of approximately 1055rpm. This test was performed by applying 5V across a 12kohm resistor and Tx to COM (Circuit COM).



4.2.9 +20V and +10V output voltage sources have a combined max output current of 60mA. (230V Models)

4.2.10 +20V output voltage source has a max output current of 60mA (460V Models)

4.3 BlaKBox™ – BlaKBox™ is internal product memory that stores key operational history that can still be read after most forms of electronic failure. This information is to help RBC perform more accurate failure analysis and continue to improve the quality and reliability of it products. At a minimum the data is recorded in intervals of every 8 minutes and the last 32 minutes of data available in memory. Data recorded includes the last known operating performance and the product "vital signs."

4.4 Programmability – The product will be factory configured for operating mode, as defined in Section 2.17, and type of operation, as defined in Section 4.2 upon availability of ECM Toolbox™ software for the product and with the use of a License Agreement, ECM programming Module 8794700ETG01, and product specific programming cables 87947xxxx, the user will be able to program parameters for the product. The parameters that can be programmed are dependent on the products operating mode.

4.4.1 Discrete Mode Programming – Discrete operating mode product can be reprogrammed to change the magnitude for each operating point. The product can also be programmed as to how many operating points it has; within the guidelines defined in Section 4.2.1. Operating point magnitude is restricted as per Section 2.9.

4.4.2 Variable Mode Programming – Variable operating mode product can be reprogrammed to change direction of rotation, set the range of operation (within bounds of Section 2.9), and set whether 0Vdc is the off state or the peak operating state. Users can also change variable operating mode product to discrete operating mode product.

4.4.3 Factory Programming – After a user creates model specific program files with the ECM Toolbox™, the files can be loaded into the ECM Factory Programmer™ tool to facilitate rapid reprogramming, and optional labeling, of large quantities of product.

4.5 Connections – All connections to the product will be made via faston terminals or other plug in style interface on a terminal block internal to the motor enclosure and accessed through a cover on the end shield of the product. At a minimum, all models with have L1, L2, L3 and ground terminal connections. Specific low voltage control connections should be made as directed in section 4.2.

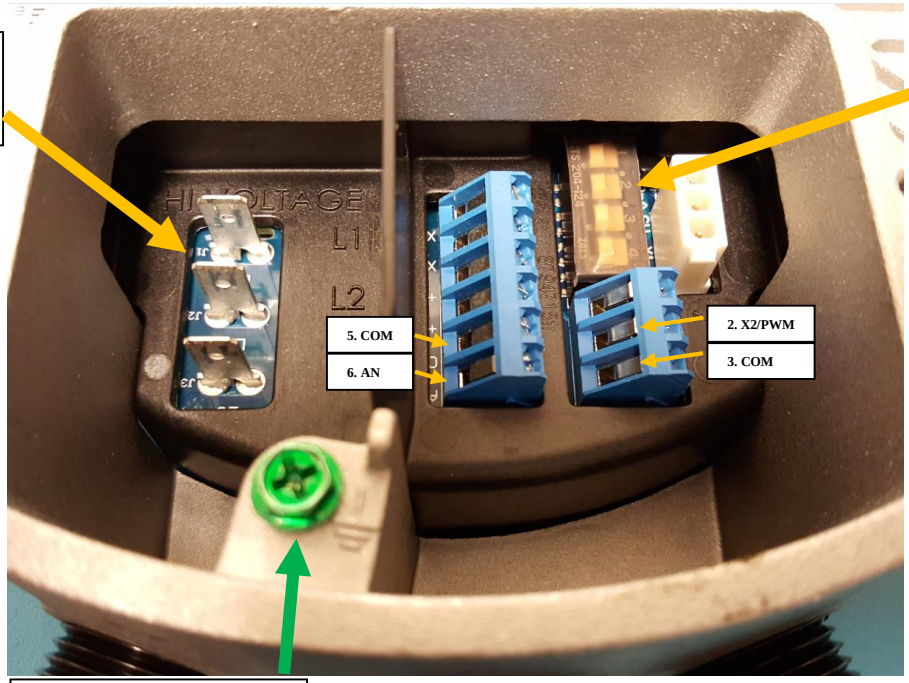


Figure 1 – Connections for signal and power leads

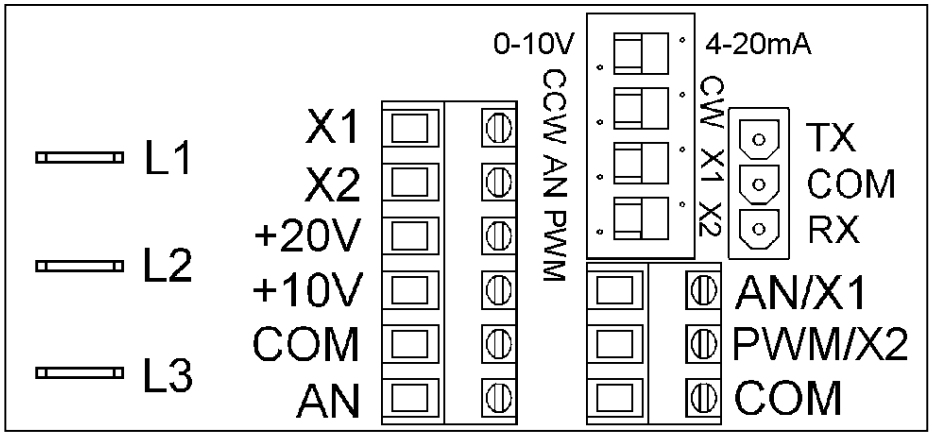
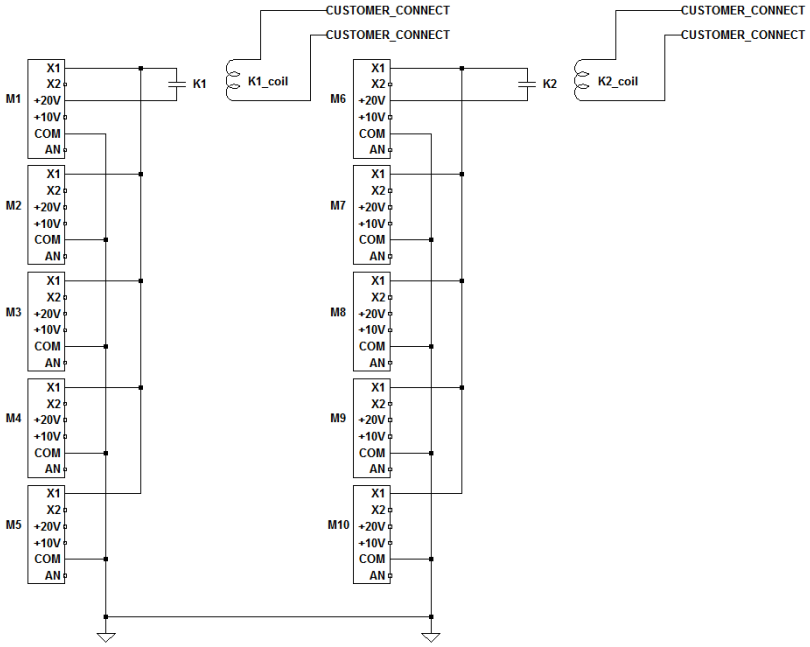
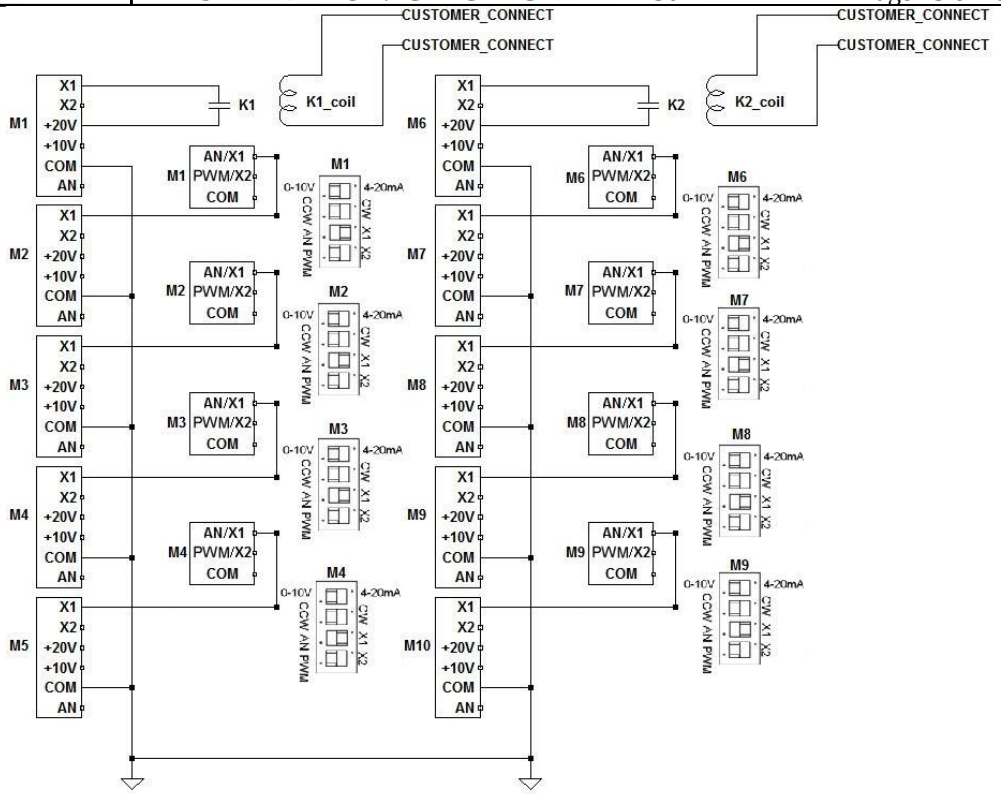


Figure 2 – Connection label supplied on cover plate (+10V output terminal is a Fault output terminal on the 460V design)

4.6 Daisy Chain Connections – Units can be daisy chained together in a number of different configurations. Below are two connection schemes for using the +20Vdc output of the control and a customer provided relay to enable/disable all units via 20Vdc application to X1 with enable/disable functionality activated. For this particular control/connection method no more than 5 units should be connected in series.




CUSTOMER_CONNECT
CUSTOMER_CONNECT
K1
K1_coil
K2
K2_coil
X1
X2
+20V
+10V
COM
AN
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
AN/X1
PWM/X2
COM
0-10V
4-20mA
CCW AN PWM
CW X1 X2

4.7 Appendix