



Malfar Mechanical Inc.

144 Woodstream Boulevard, Woodbridge, Ontario L4L 7Y3
Tel: (905) 850-1242 - Fax: (905) 850-2630 - www.malfar.ca

Submittal

21-03 — FORESTSIDE ESTATES

Subject : VFDs for Make-Up Air Units

To Vince Staffieri
Royal Pine Homes
3550 Langstaff Road
Suite 200
Woodbridge, ON L4L 9G3
Phone No: 416-213-7181
Mobile: 647-287-4136
Fax No: 905-856-6543
vince@royalpinehomes.com

Number : 3
Spec Section No : 20 05 10
Submittal Number: 3
Date Sent : 3/8/2021
Type : Original Submittal
Method Sent : Email
Reason For Sending : For Approval
Status : Pending

Return To Gaurav Sharma
Malfar Mechanical Inc.
144 Woodstream Blvd.
Woodbridge, ON L4L 7Y3
Phone No: 905-850-1242
Fax No: 905-850-2630
gauravs@malfar.ca

Copy To

Details

none

Notes

Please return submitted items by **3/22/2021**.

Signed By:

Gaurav Sharma
Project Coordinator

UNITED ENGINEERING INC.

PROFESSIONAL CONSULTING ENGINEERS

THIS SHOP DRAWING IS:

- ☒ REVIEWED
- ☐ REVIEWED AS MODIFIED
- ☐ REVISE AND RESUBMIT
- ☐ SUBMIT HYDRO FOR APPROVAL

The review of these shop drawings is for general design only and shall not relieve the contractor from conforming to the contract drawings and specifications.

All dimensions and sizes shall be checked

DATE:

Apr. 6, 2021

CHECKED BY:

MECH.

ELEC.

L. Matthews

Dated: 3/8/2021



Submittal

To: Malfar Mechanical Date: 2021-02-26

Attn: Ajay Baghel

Project Name: Forestside Estates - Brampton

Danfoss Sales Office: Kildonan Energy Products

Kildonan Job # PRJ21-23656

Submittal for: Record
X Approval

Approved By: _____

Released For: _____

Manufacturing and Shipment: _____

Hold For Release: _____

Approved: _____

Approved as Noted: _____

Disapproved: _____

Explanation for Disapproval: _____

Explanation: Submittal for VFD's

Please Return Drawings to:



Kildonan Energy Products
195 Clayton Drive, Unit 8 & 9
Markham, On, L3R 7P3

Attn: **Arash Ahmadi**

aahmadi@kildonanenergy.com

VFD's



VFD's								
Qty.	Tag Numbers	HP	Frame Size NEMA1	VLT Model	Voltage	Amps	Mechanical Drawing #	Electrical Drawing #
2	MUA-1,2	5	A2/3	FC102P4K0T6	575	6.1	176U8485	174U3338
2	MUA-3,4	7.5	A2/3	FC102P5K5T6	575	9	176U8484	174U3338

Included

- On Site Commissioning
- Embedded BACnet Communication Protocol (MS/TP)
- 5% Dual Input DC-Link Reactors for Harmonic Supression
- Integrated Rotary Disconnect Switch
- Drive Input Fuses
- 3 Contactor Bypass
- NEMA 1 Enclosure
- Standard 18 Month Warranty - Parts & Labour
- Real Time Clock with Battery Back-Up
- Installation
- Loose 30amp Disconnect switch fro MUA-1/2 included
- Loose 60amp Disconnect switch for MUA-3/4 included

ELECTRO-MECHANICALLY CONTROLLED BYPASS (EMB) FEATURES

General Features

All optional features shall be built, mounted and tested by Danfoss. The factory warranty will apply to the entire assembly as shipped. All options will carry a UL / C-UL Enclosed Industrial Control Panel label. All optional devices will be factory tested as assembly.

Bypass Power Features

- *Three Contactor bypass* will be provided that allows operation of the motor via line power in the event of a failure of the VFD. Motor control selection shall be through either a VFD output contactor or a bypass contactor that is interlocked to ensure that both contactors are not energized simultaneously.
- *Main input disconnect* will be provided that removes power from both the bypass and VFD.
- *VFD-only, fast acting input fuses* will be provided.
- *Mechanical Overload protection* will be supplied for bypass mode (Electronic Thermal Overloads are provided in the VFD).
 - Adjustable current setting for complete motor protection when operating on line power.
 - Overload protection shall include phase loss and phase imbalance protection.
- *A third contactor*, the drive input contactor, will be supplied. This allows powering of the VFD with the motor off or operating in bypass mode for testing, programming and troubleshooting purposes.

Bypass Interface and Control Features

- *Bypass or VFD selection shall be via a DRIVE – OFF –BYPASS selector switch.*
- A BYPASS pilot light will illuminate when operating in bypass mode.
- Units that include an optional drive input contactor shall include a fourth switch position; TEST. This shall allow the ability to supply power to the drive for testing purposes while running the motor in bypass.
- Selection of Bypass or VFD operation will be by any one of the following: Manually via the selector switch or automatic bypass operation based on VFD programming.
- Bypass package will include an *External Safety* interlock that will disable motor operation in either bypass or VFD mode when open.
- **EMB2** control package will be provided. There shall be complete *Common Start/Stop command* when operating in either Bypass or VFD mode. Also a Run Permissive circuit allowing for the connection of the VFD directly to a damper and end switch common to both VFD and Bypass. An Automatic bypass feature is selectable, allowing automatic switch to bypass in the event of a VFD fault.
- **Additional Protective features**

In addition to the power and operational protective features listed above, each bypass will include the following:

- Low voltage contactor operation shall be maintained to 70% of the package's nominally rated voltage. This will ensure VFD operation on low voltage conditions that would otherwise be interrupted due to contactor dropout.

The VFD shall be able to operate the motor at a reduced load with the loss of any one of the three phases of power. Contactors shall remain closed regardless of which phase is lost. This will ensure VFD operation on single-phase conditions that would otherwise be interrupted due to contactor dropout.



WARRANTY

The VLT HVAC Drive packages for this project carry an 18-month on-site warranty from the date of shipment. This warranty includes parts, labor, travel, and expenses.

STARTUP

Danfoss authorized service technician will perform a professional startup service.

DRIVE FEATURES – OPERATOR INTERFACE

The VLT®HVAC Drive

The VLT HVAC Drive Series is a microprocessor-based, high frequency IGBT-based, PWM AC drive with control functions and software designed solely for the unique needs of HVAC systems. The VLT HVAC Drive uses state-of-the-art Voltage Vector Control to supply full rated motor voltage at rated load and frequency, full motor performance without derating, high efficiency for both drive and motor, and a nearly perfect output sine wave. The diode-bridge rectifier and DC-link reactor provide a high displacement power factor at all speeds and loads and minimize power line harmonics. The VLT HVAC Drive utilizes a common user interface for all units.

Fully Graphic, Multilingual Display

The VLT HVAC Drive uses a large, bright, backlit graphic display to provide complete drive information at a glance. The logical arrangement of all elements simplifies the setup, operation and monitoring of the drive. Choose from 25 different items to display, including input reference, motor current, hours run, output frequency, horsepower, kW or kWh. Or select from custom units, such as GPM or HP and calibrate the maximum value to the maximum frequency of the unit. After programming one drive, the keypad can be used to transfer the same settings to all other drives. Drive can run without the keypad in place to assure tamper-proof operation. Drive status is shown even with the keypad removed.

LED Indication

Three LEDs are provided on the VLT HVAC Drive for indication of power applied, warning and fault. Upon power up, all LEDs will briefly light as a lamp test.

Alarm – Will flash red when the drive has registered a fault condition which has caused the drive to shut down.

Warning – Will flash yellow to indicate a situation exists that exceeds the normal drive/system parameters, and if that condition continues, a trip may be imminent.

On – Will glow green to indicate that the VFD is connected to AC power (line voltage is present).

Operating Keys

Hand On – Starts the drive regardless of remote start/stop contact (assuming safety interlock is closed). The speed of the drive will generally be controlled manually via the keypad "+" and "-" buttons.

Off – Shuts the drive down regardless of other commands.

Auto/On – The drive will start and stop via the external contact closure (building automation time clock). The speed is generally controlled via the building automation signal (4 to 20 mA, 0 to 10 V DC, etc.).

Reset – Will reset any trip level fault (not trip lock) if the drive is not set for infinite automatic fault resets.

Directional Keys

Right / Left / Up / Down arrows – Used as the electronic potentiometer to manually control the speed in the Hand/Start mode. All four keys are active during operation as well as programming. They provide the ability to move the cursor around the display, or sequence through display values.

Programming Keys

Status – Used to display operational data and status.

Cancel – Used to cancel the last programming command so the change is not carried out.

OK – Used to confirm that the last programming change should be saved to memory.

Back – Used to exit present display or menu to the previous display or menu.

Quick Menu – Used for programming the VLT HVAC Drive for the most typical applications.

Main Menu – Used to access all parameters for programming. It can switch directly from this mode to quick menu.

Alarm Menu – Used to access all fault and warning data.

Info Key – Accesses an on-board manual that gives detailed explanation of a parameter.

PROGRAM OPTIONS

Application-Specific Software

The VLT HVAC Drive was designed specifically for the HVAC market. This specialization has allowed Danfoss to factory program and configure the VLT HVAC Drive to make it ready to use, out of the box. This eliminates the time-consuming and often confusing job of selecting the correct parameters in the field. For the advanced user, the parameters are logically grouped, making modifications simple. Customized text fields are available to show user-specific data. Four independent setups are available for unmatched flexibility.

Menu Structure

Quick Setup Menu – Contains the 14 required setup parameters to easily start the application.

HVAC Application Menu – Easy access to the most relevant parameters for each of the most common HVAC applications.

Personal Menu – Contains up to 20 user-selectable parameters for customized access.

Changes Made Menu – Provides easy access to previously modified parameters

Keypad Features

- Hot-pluggable with upload and download capabilities
- On-screen scroll bars and graphs
- Up to five separate meters displayed simultaneously
- Two-level password protection
- Plain language alarms and warnings
- Remote keypad mounting kits available

USB Connectivity

The VLT HVAC Drive can be remotely commissioned and monitored through a standard USB connection and MCT 10 PC software.

Agency listing:

All drives and option packages are factory built and carry UL and C–UL listings.

All drives and option packages are built in ISO 9000 and 14001 certified facilities.

DRIVE FEATURES – MOTOR AND DRIVE INTERACTION

Constant-Torque Start

The VLT HVAC Drive's constant-torque start mode provides full torque to accelerate different loads until the drive reaches the setpoint. Breakaway current can be set up to 160% for up to 0.5 seconds for starting high friction loads.

Current Limit Circuit

Adjustable from 0 to 110% of the VLT HVAC Drive's rated current (factory set at 110%). If during acceleration the current required to accelerate the load exceeds the current limit, the VLT HVAC Drive will stop accelerating until the motor current is reduced to normal levels, at which time the load will continue to accelerate at the rate set by the acceleration time.

Three-Phase Output Current Measurement

The VLT HVAC Drive's software measures output current on all three phases. Phase grounding is detected instantly. Output contactors may be repeatedly used with no damage to the drive. Multiple motors may be run from one drive.

Advanced Motor Protection

The VLT HVAC Drive features integrated electronic, thermal motor protection. The VFD calculates the motor temperature based on current, frequency, and time. This system allows for changing cooling conditions as speed and load vary. The drive can predict motor overheating and reports a % of thermal load.

Motor Preheat Circuit

This preheat function can be activated to avoid condensation on the motor windings when it is stopped.

Stall Protection

The VLT HVAC Drive provides protection against a stalled motor. When activated, this function can provide a warning or a fault condition caused by excessive motor current at low speeds.

DRIVE FEATURES

DC-Link Reactor

A dual, 5% DC-link reactor on the positive and negative rails of the DC bus is standard equipment on the VLT HVAC Drive. This reactor reduces the level of harmonics reflected back into the building power system without causing a voltage loss at the drive's input and reducing efficiency as an external AC line reactor would. This reactor also improves input power factor. The reactor is non-saturating (linear) to provide full harmonic filtering throughout the entire load range. In performance, the DC-link reactor is equivalent to a 5% AC line reactor.

Power Line Protection

Power line voltage surge protection is provided by means of input Metal Oxide Varistors (MOVs). This protects the diodes in the VLT HVAC Drive's 3-phase full wave diode bridge. The DC-link reactor also acts to reduce input current caused by power line disturbances.

Sleep Mode

Automatically stops the drive when speed drops below set "sleep" level for specified time. Automatically restarts when speed command exceeds set "wake" level. Saves energy and reduces wear on driven equipment.

Run Permissive Circuit

Ability to accept a "system ready" signal assures that dampers or other auxiliary equipment are in the proper state for drive operation. This feature also provides the ability for the drive to send a "start signal applied" signal to the system to notify the auxiliary equipment of the drive's request to start.

Firefighter's Override Mode

Overrides all other commands to provide desired operation. Ignores most alarms including overload, overcurrent, overtemperature, and phase loss. When used with bypass, selectable to run from drive, from bypass, or switch from drive to bypass in the event of a drive failure.

Acceleration / Deceleration Rates

The VLT HVAC Drive can provide four individually controlled sets of acceleration/deceleration rates each from 1 to 3600 seconds. The shape of these curves may be automatically contoured to prevent tripping.

Enclosure

The VLT HVAC NEMA 1 drive is recognized by UL for installation in air handling compartments.

Auto Restarts

The VLT HVAC Drive can be automatically restarted up to 20 times or infinitely at 0 to 600 second intervals. If the application causes the drive to trip more than the number of trials set, the drive will stop operating and display the fault on the display screen. A manual reset will be required by means of the reset key, a digital input, or EIA-485 command. In cases of severe trips, as a safety feature, the drive's input power may have to be cycled to restart a fault.

Carrier Frequency

By using IGBTs, the VLT HVAC Drive can employ high switching frequencies, so the motor current is practically sinusoidal. Audible motor noise can also be minimized by adjusting the switching frequency. These frequencies can be set or adjust themselves automatically to fit the application.

Input Power

The VLT HVAC Drive is equipped with an automatic sustained power or phase loss circuit. The VLT HVAC Drive will provide a full rated output with an input voltage as low as 90% of the nominal. The drive will continue to operate with reduced output with an input voltage as low as 164 volts for 208/230 volt units, 313 volts for 460 volt units, and 394 volts for 600 volt units.

Automatic Motor Adaptation (AMA)

Knowing motor stator resistance, the drive automatically optimizes performance and efficiency. The motor does not have to be run or decoupled from the load for the AMA setup to be performed.

Automated Frequency Avoidance / Critical Frequency Lockouts

For applications where it may be necessary to avoid specific frequencies due to mechanical resonance problems in the driven equipment, the VLT HVAC Drive, with its Critical Frequency Lockout Function, makes it possible to set up to four different frequency ranges which will be avoided during operation of the drive. This feature can be programmed by simply activating the feature and pushing OK at the top and bottom points that you wish to avoid.

- Each critical frequency setting can avoid a frequency band which is from 1 to 100 Hz wide. If the reference signal defines that the VLT HVAC Drive is to operate within this critical frequency range, the critical frequency lockout function will keep the drive operating continuously within this range.
- When the frequency reference signal rises above the critical frequency maximum limit, the VLT HVAC Drive will allow the motor to accelerate through the critical frequency at the rate set by the acceleration rate.

Automatic Energy Optimization Circuitry

The Automatic Energy Optimization (AEO) function adapts the output of the drive to the specific motor and load connected. This circuit optimizes the system efficiency as system loads change. The AEO function regulates the output voltage on the basis of the reactive current and the effective current. A savings of 3 to 10% in power consumption can be obtained with this function.

Preset Speeds

The VLT HVAC Drive allows for a maximum of 16 programmable preset speeds to be selected from the digital inputs.

Energy Monitoring

Real energy savings are always available without the additional expense of external equipment.

Real-Time Clock

Adds sophisticated performance to basic control schemes for increased comfort and energy savings.

Automatic High Ambient Derate

If the ambient temperature exceeds the normal limit, the drive can be set to warn of its overtemperature and continue to run, keeping the HVAC system functional. To control its temperature, the drive will reduce the output carrier frequency and then, if necessary, reduce the output current.

Preventive Maintenance Scheduling

The VLT HVAC Drive can monitor system usage and notify the operator when preventive maintenance is required.

Intelligent HVAC Controller

Four auto-tuning PIDs control the drive and up to three other devices, eliminating external controllers and reducing cost.

- **Proportional:** The proportional gain dictates the rate at which the deviation between actual and desired feedback signal is corrected. The higher the gain, the faster the response, but too high a gain can cause hunting and a large overshoot.
- **Integral Time:** The integral time continually compares the feedback value with the desired setpoint over time to make sure the setpoint is reached. The greater the integral time, the longer it takes to actually achieve the setpoint, but improves the system stability.
- **Derivative:** The derivative function monitors the rate at which the feedback is closing on the desired setpoint and slows the rate of approach to prevent overshooting. This function allows rapid accurate system control.

Built-in Communications

The VLT HVAC Drive is fully equipped for serial communication (EIA-485). Up to 31 drives can be connected to one serial bus up to 5,000 feet long.

Communicates directly with *Johnson Controls Metasys (N2)*, *Siemens Building Technologies System 600 (FLN)*, and *Modbus RTU* systems with no hardware changes or additional costs.

Broken Belt, Loss of Load

A minimum motor current value can be set to indicate the motor is not using any more current than to run at idle. This can be used to indicate a broken belt or coupler. This feature can also be used to detect when a motor is disconnected from the drive.

SPECIFICATIONS

Drive Input Power

Input voltage, 3 phase.....	200–240, or 380–460, or 525–600 VAC
Input voltage range for full output	Nominal $\pm 10\%$
Undervoltage trip point.....	164, 313 VAC, or 394 VAC
Overvoltage trip point.....	299, 538, or 690 (792 for 100 HP and above) VAC
Input frequency	50 or 60 Hz, ± 2 Hz
Displacement Power factor	0.98 or greater at all speeds and loads

Drive Output Power

Output frequency	Selectable 0 to 120 Hz
Motor voltages	200, 208, 220, 230; 380, 400, 415, 440, 460; 550 or 575 VAC
Continuous output current	100% rated current
Output current limit setting.....	Adjustable to 110% of drive rating
Current limit timer	0 to 60 seconds or infinite
Adjustable maximum speed	From minimum speed setting to 120 Hz
Adjustable minimum speed	From maximum speed setting to 0 Hz
Acceleration time	To 3,600 seconds to base speed
Deceleration time	To 3,600 seconds from base speed
Breakaway torque time	0.0 to 0.5 seconds (1.6 times motor nameplate current)
Start voltage.....	0 to 10%
DC braking time	0 to 60 seconds
DC braking start.....	0 to maximum frequency
DC braking current.....	0 to 50% of rated motor current

Environmental limits:

Efficiency.....	97% or greater at full load and nominal motor speed
Ambient operating temperature	14°F to 113°F (–10°C to 45°C) frames A2–C2; 14°F to 104°F (–10°C to 40°C) frames D1–E1
Humidity	< 95%, non-condensing
Altitude: maximum without derating.....	3,300 ft. (1,000 m)
Drive and options enclosure(s)	NEMA/UL Type 1

Software

Lost speed reference action	Selectable to go to a preset speed, go to maximum speed, stay at last speed, stop, turn off, or stop and trip
Time delay for lost speed reference action.....	1 to 99 seconds
Adjustable auto restart time delay.....	0 to 600 seconds
Automatic restart attempts.....	0 to 20 or infinite
Automatic restart time delay	0 to 600 seconds between each attempt
Relay ON delay and relay OFF delay.....	0 to 600 seconds
Maximum number of preset speeds	16
Maximum number of frequency stepovers	4
Maximum stepover width	100 Hz
Maximum number of accel rates	4
Maximum number of decel rates	4
Delayed Start	0 to 120 seconds

Protections:

Low frequency and high frequency warnings.....	0 to 120 Hz
Low current and high current warnings.....	0 to maximum current
Low reference and high reference warnings.....	-999,999 to 999,999
Low feedback and high feedback warnings.....	-999,999 to 999,999
Ground fault	Protected
Motor stall	Protected
Motor overtemperature	Protected (Predictive motor temperature)
Motor Condensation.....	Protected (Motor pre-heat circuit)
Pump No-Flow	Protected
Pump end-of-curve	Protected
Dry pump	Protected
Short-cycle	Protected
Motor overload	Protected (Programmable action)
Vibration protection	Protected (Programming automated)

Control Connections

Follower signal, analog input	2; selectable voltage or current, direct and inverse acting
Programmable digital inputs	6 (2 can be used as digital outputs)
Programmable analog outputs.....	1; 0/4 to 20 mA
Programmable relay outputs.....	2 standard Form C 240 V AC, 2 A; 1 or 3 additional optional
Auxiliary voltage	+24 V DC, maximum 200 mA

Control Optional

MCB 101 General Purpose I/O	3 DI, 2 DO, 2 AI (voltage), and 1 AO (current)
MCB 105 Relay Card	3 standard Form C 240 V AC, 2 A
MCB 107 24V DC Supply	Allows external 24 V DC power to be connected to the VLT HVAC Drive
MCB 109 Analog I/O	3 AO(voltage), 3 AI(voltage or PT1000 or NI1000), Battery backup
MCB 110 Battery backup	Battery backup for real-time clock

4

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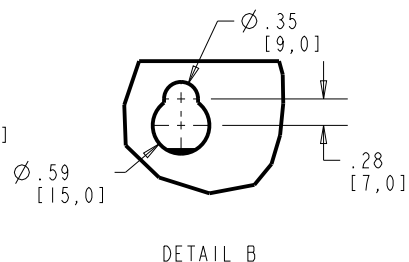
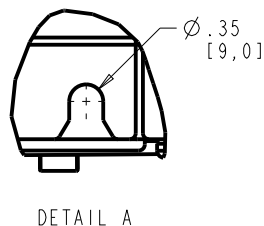
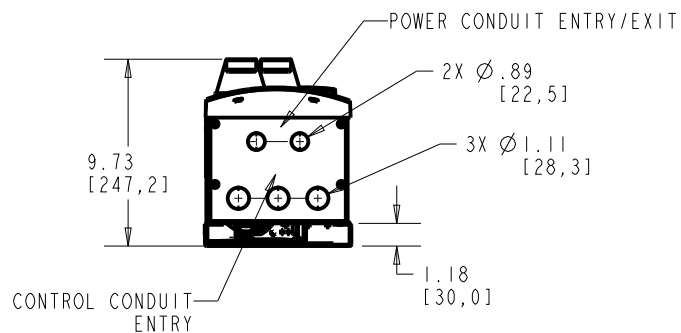
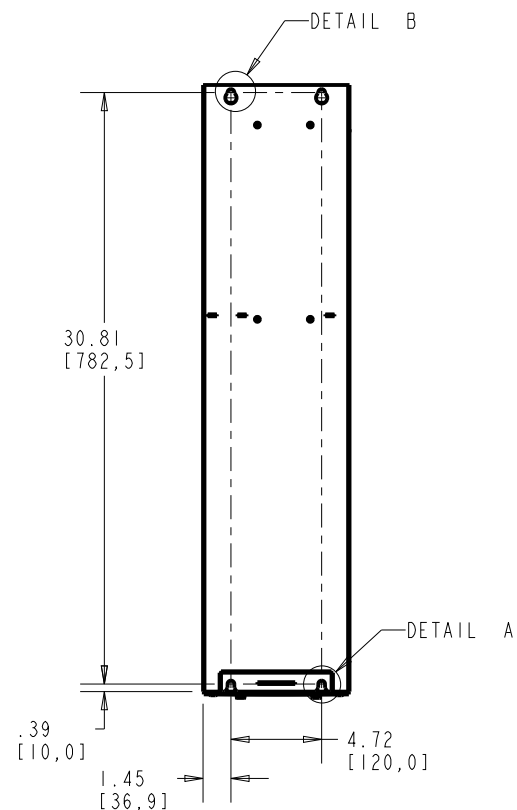
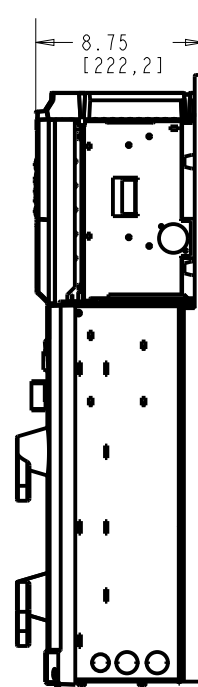
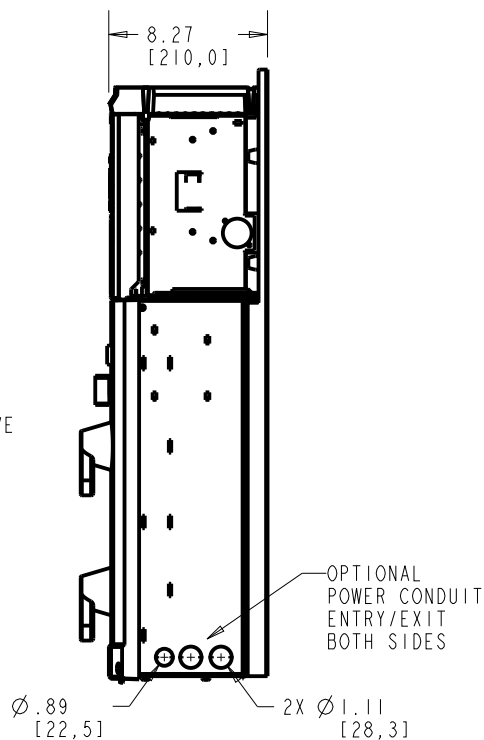
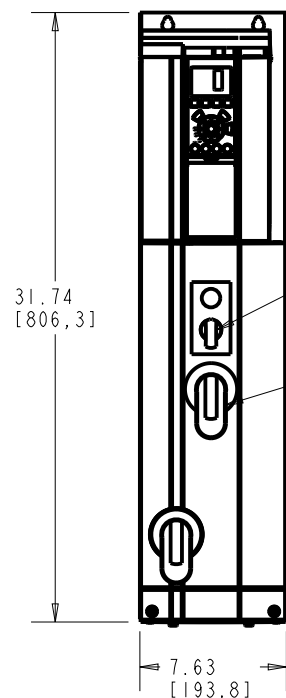
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B

B

A

A

DEPTH WITHOUT
OPTION A OR BDEPTH WITH
OPTION A OR B

CLEARANCE REQUIREMENT FOR AIR FLOW COOLING:

THE UNIT MUST BE INSTALLED VERTICALLY WITH THE
MINIMUM CLEARANCE OF 3.94" [100.0mm] ON THE BOTTOM
AND 1.50" [38.1mm] ON EITHER SIDE FOR UNIT COOLING.

UNIT APPROXIMATE WEIGHT: 35 Lbs [16 Kg]

FRAME SIZE A2 AND A3		
VOLTAGE	HP	KW
208/230	0.5-5	1.1-3.7
460/600	0.5-10	1.1-7.5

- NOTICE -

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LATEST E.C.N. NO.:

SPI0032

E.C.N. PRO-E ENTRY BY/DATE:

SAK 04/30/10

PRO-E ENTRY BY/DATE:

MG 3/02/07

DESIGNED BY/DATE:

MG 3/02/07

APPROVAL:

PLOT SCALE:

NONE

CHECKED BY/DATE:

MFG. APPROVAL BY/DATE:

ENG. APPROVAL BY/DATE:

PRO-E FILE:

APU_A2-A3_MAIN_T2-T3

DANFOSS DRIVES
4401 N. BELL SCHOOL RD. LOVES PARK, ILLINOIS 61111 USA
(815) 638-8800 FAX (815) 638-8000

TITLE:

DWG, REF, SUBMITTAL, A2-A3-TIER 2

SHEET:

1

OF:

1

DRAWING NO.:

176U8485

REV.:

A

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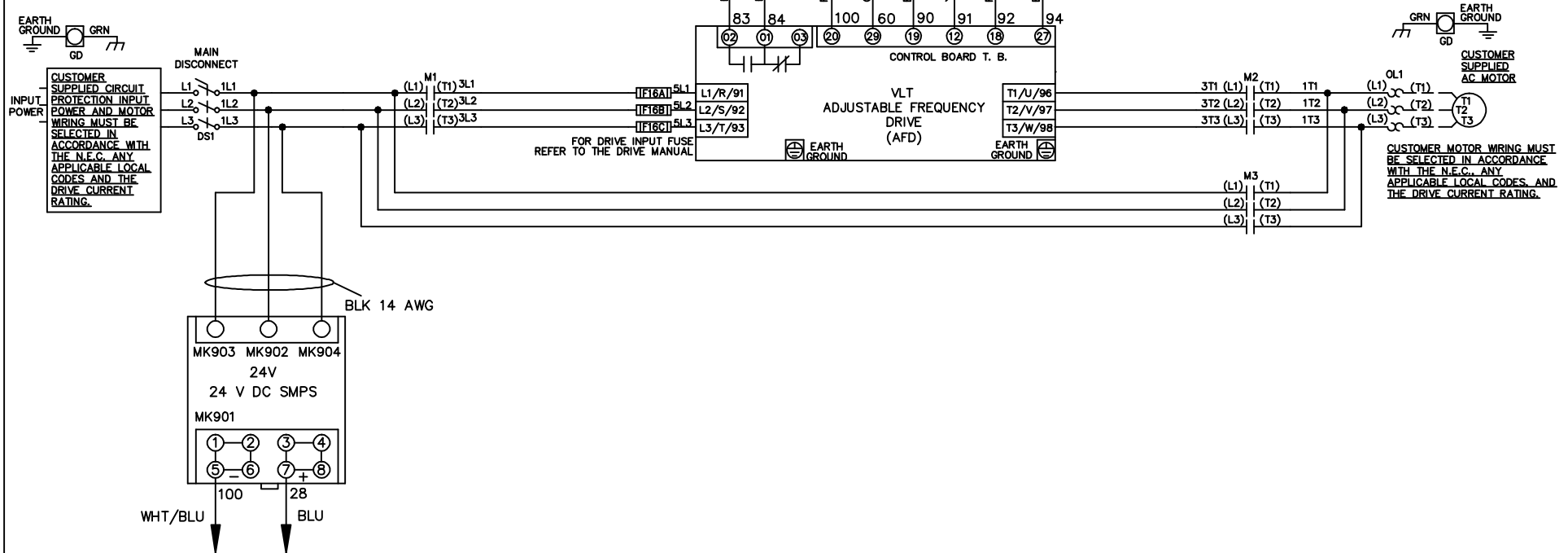
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1

WIRE COLOR SCHEME
 BLACK - LINE VOLTAGE
 RED - AC CONTROL
 WHITE - AC GROUNDED
 BLUE - DC CONTROL
 GREEN - CHASSIS GROUND

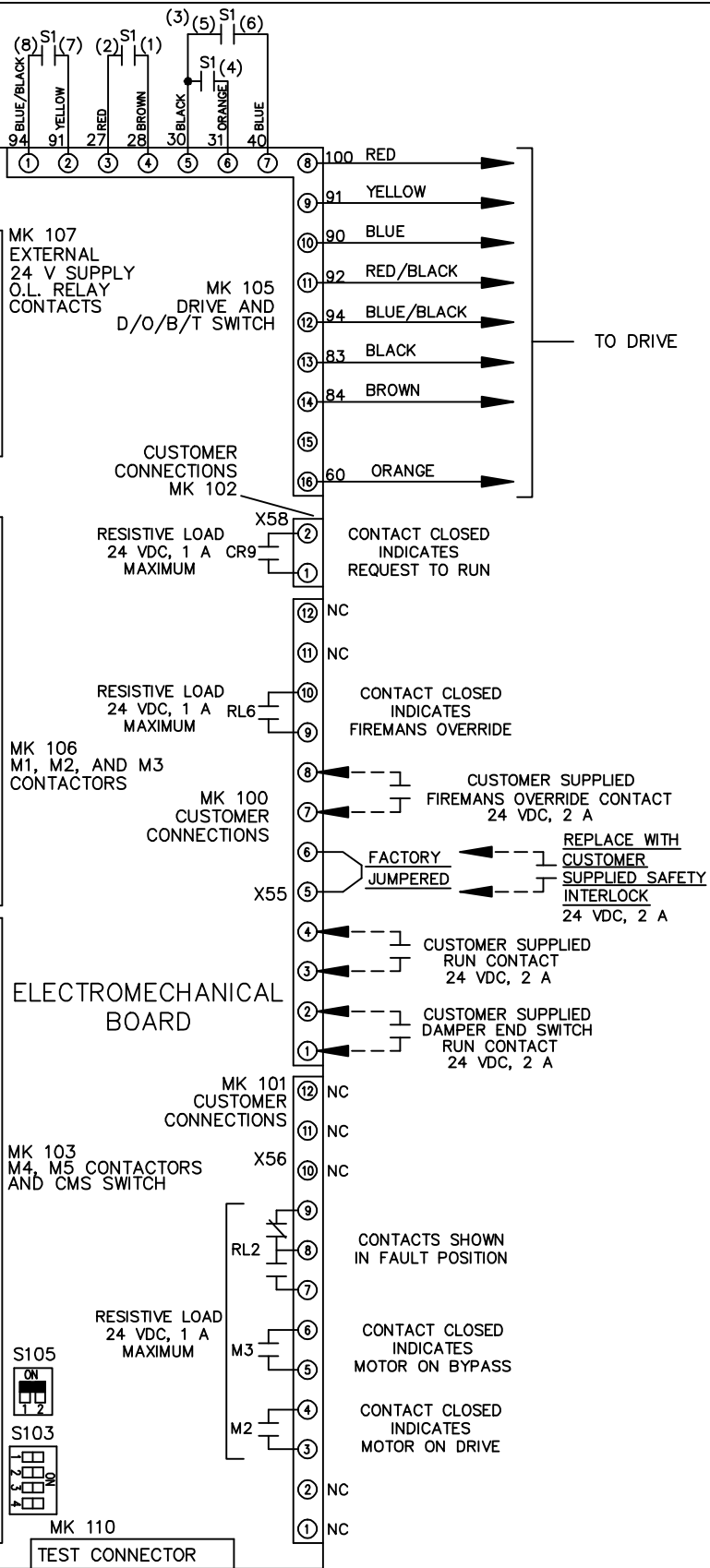
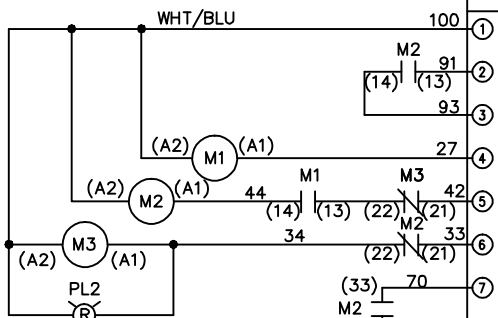
* ALL CONTROL WIRES ARE BLUE EXCEPT WHERE NOTED.

TO ELECTROMECHANICAL
 RELAY BOARD

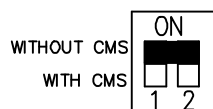


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				APR	MODEL VLT		PAGE 1 OF 2	SIZE A	DWG NO.	174U3338
REV	ECN	DATE								

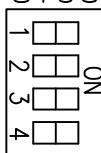
CONTACT SEQUENCE CHART FOR S1	
POSITION	CONTACT
1-2	DRIVE
3-4	OFF
5-6	BYPASS
7-8	TEST



FACTORY SETTING



S103



CUSTOMER SETTING
AUTOMATIC BYPASS TIME SELECT
ONLY # 1 ON 30 SECONDS
ONLY # 2 ON 60 SEC.
ONLY # 3 ON 300 SEC
ALL ON 15 SEC.
ALL OFF NO AUTO BYPASS

REV	ECN	DATE	NOTICE	DRN	JNW	APR	MODEL	VLT	PAGE	2	OF	2	SIZE	A	DWG	NO.	174U3338
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Dancross

Enclosed

Disconnect Switches

DISCONNECT SWITCHES



Mersen enclosed disconnect switches are designed to meet customer's requirements for compact and durable individual disconnecting means. Both fusible and non-fusible versions are available in a variety of enclosure types resulting in one of the largest available ranges in the industry. The enclosed disconnect switch range offers safety, ease of installation, space savings and operational convenience to end-users.

Mersen features NEMA style, Type 4X non-metallic and stainless steel enclosures that are extremely durable and provide the ultimate protection for harsh environments and conditions. These rugged enclosure types are often used in areas where "wash down" applications are required.

APPLICATIONS:

- Load break switching
- Separate disconnect means within sight of all motor loads to comply with NEC® Article 430
- Circuit isolation
- Service entrance ratings available
- Food processing
- Conveyor systems
- Harsh industrial environments

RATINGS:

Fusible

- **Volts:** 600VAC
- **Amps:** 30 to 800A

Non-Fusible

- **Volts:** 600VAC
- **Amps:** 16 to 1200A
- **Volts:** 600VDC
- **Amps:** 100 to 400A

HIGHLIGHTS:

- Suitable for use as motor disconnect
- Meets OSHA lockout/tagout requirements
- NEMA rated enclosures
- Knockouts provided
- Easy screw mounting
- Selector or pistol handles in black or red/yellow
- Clear ON/OFF indication

APPROVALS:

- UL 508A
- UL 508
- UL 98
- CSA
- IEC versions available



PART NUMBERING GUIDELINE (EXAMPLE)

ED	FS	30	3	R	S	0	-
Enclosure Type	Switch Type	Amp Rating	Number of Poles	Color of handle: R = Red/yellow B = Black	Type of handle: S = Selector P = Pistol	Auxiliary contacts: See chart below	Other options

Switch Type		Part Numbers	Auxiliary Contact Suffix				
			0	1	2	3	4
FS	UL 508 Non-Fused	M163 to M803	None	1 NO	1 NC	1 NO + NC	1 NO + NO
FC or SC	UL 98 Non-Fused	M30U to M1200U	None	1 NO	1 NC	1 NO + NC	1 NO + NO
FB	UL 98 Fused	MxxC, J, L	None	1 NO	1 NC	1 NO + NC	1 NO + NO

OTHER OPTIONS

Please consult factory for availability and suffix for any other options including:

- Neutral blocks (N)
- If terminal shrouds are necessary, add a "T" to the end of the part number.
- Special Request
 - Pilot lights
 - Push buttons
 - 2 or 3 position selector switches

ALL ENCLOSED SWITCHES ARE PROVIDED WITH A STANDARD INTEGRAL GROUND LUG

Box type	Switch type	Ground lug wire size
NEMA/UL	16 – 60A	{2} #4 – #14
NEMA/UL	80 – 125A	{2} 1/0 – #14
NEMA/UL	200 – 400A	{2} 600kcmil – #2
NEMA/UL	600A & above	Consult Factory

Note: EDFs 40A, 60A & 80A use grounding stud

ENCLOSURE APPLICATION INFORMATION

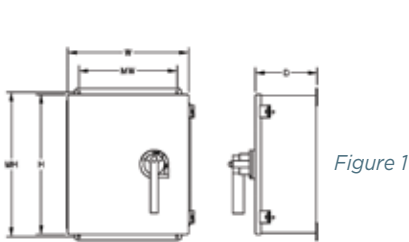
Enclosure Type		Intended Use and Description
NEMA	1	Indoor use primarily to provide a degree of protection against contact with the enclosed equipment and against a limited amount of falling dirt.
NEMA	3R	Intended for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.
NEMA	12	Intended for indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping non-corrosive liquids.
NEMA	4	Intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation.
NEMA	4X	Intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, wind blown dust and rain, splashing water, hose-directed water, and damage from ice formation.
IEC	IP65	Total protection against dust and protected against water jets from any hosed direction.

NEMA ENCLOSURE 3 Pole, 600V 30-1200A, Non-fused			1	3R	12	4	4X Stainless	4X Non-Metallic
	Ampere Rating (A)	Catalog Numbers						
UL 588 2 x 30 amp 2 x 60 Amp	16	Special compact polycarbonate enclosures						EJM16BS0S
	30	Special compact polycarbonate enclosures						EJM30BS0
	60	Special compact polycarbonate enclosures						EJM60BS0
	16	EAFS163RS0	EFFS163RS0	ECFS163RS0	EHFS163RS0	EBFS163RS0	EDFS163RS0	
	25	EAFS253RS0	EFFS253RS0	ECFS253RS0	EHFS253RS0	EBFS253RS0	EDFS253RS0	
	30	EAFS303RS0	EFFS303RS0	ECFS303RS0	EHFS303RS0	EBFS303RS0	EDFS303RS0	
	40	Special hinged cover, SS					EBFS403RS0-H	
	40	EAFS403RS0	EFFS403RS0	ECFS403RS0	EHFS403RS0	EBFS403RS0	EDFS403RS0	
	60	EAFS603RP0	EFFS603RP0	ECFS603RP0	EHFS603RP0	EBFS603RP0	EDFS603RP0	
	80	EAFS803RP0	EFFS803RP0	ECFS803RP0	EHFS803RP0	EBFS803RP0	EGFS803RP0	
UL 98	30	EAFS303RP0	EFFS303RP0	ECFS303RP0	EHFS303RP0	EBFS303RP0	EGFS303RP0	
	60	EAFS603RP0	EFFS603RP0	ECFS603RP0	EHFS603RP0	EBFS603RP0	EGFS603RP0	
	100 50	EAFS1003RP0	EFFS1003RP0	ECFS1003RP0	EHFS1003RP0	EBFS1003RP0	EGFS1003RP0	
	200	EAFS2003RP0	EFFS2003RP0	ECFS2003RP0	EHFS2003RP0	EBFS2003RP0	EGFS2003RP0	
	400	EAFS4003RP0	EFFS4003RP0	ECFS4003RP0	EHFS4003RP0	EBFS4003RP0	EGFS4003RP0	
	600	EAFS6003RP0	EFFS6003RP0	ECFS6003RP0	EHFS6003RP0	EBFS6003RP0	EGFS6003RP0	
	800	EAFS8003RP0	EFFS8003RP0	ECFS8003RP0	EHFS8003RP0	EBFS8003RP0	EGFS8003RP0	
	1000	EAFS10003RP0	EFFS10003RP0	ECFS10003RP0	EHFS10003RP0	EBFS10003RP0	EGFS10003RP0	
	1200	EAFS12003RP0	EFFS12003RP0	ECFS12003RP0	EHFS12003RP0	EBFS12003RP0	EGFS12003RP0	
	NEMA ENCLOSURE 3 Pole, 600V 30-800A, Fused			1	3R	12	4	4X Stainless
	Ampere Rating (A)	Fuse Type	Catalog Numbers					
UL 98	30, compact	CC	EAFBCC303RP0	EFFBCC303RP0	ECFBCC303RP0	EHFBCC303RP0	EBFBCC303RP0	EGFBCC303RP0
	30	J	EAFBX303RP0	EFFBX303RP0	ECFBX303RP0	EHFBX303RP0	EBFBX303RP0	EGFBX303RP0
	60	J	EAFBX603RP0	EFFBX603RP0	ECFBX603RP0	EHFBX603RP0	EBFBX603RP0	EGFBX603RP0
	100	J	EAFBX1003RP0	EFFBX1003RP0	ECFBX1003RP0	EHFBX1003RP0	EBFBX1003RP0	EGFBX1003RP0
	200	J	EAFBX2003RP0	EFFBX2003RP0	ECFBX2003RP0	EHFBX2003RP0	EBFBX2003RP0	EGFBX2003RP0
	400	J	EAFBJ4003RP0	EFFBJ4003RP0	ECFBJ4003RP0	EHFBJ4003RP0	EBFBJ4003RP0	EGFBJ4003RP0
	600	J	EAFBJ6003RP0	EFFBJ6003RP0	ECFBJ6003RP0	EHFBJ6003RP0	EBFBJ6003RP0	EGFBJ6003RP0
	800	L	EAFBL8003RP0	EFFBL8003RP0	ECFBL8003RP0	EHFBL8003RP0	EBFBL8003RP0	EGFBL8003RP0

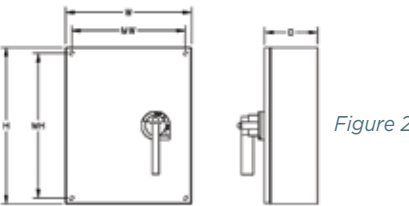
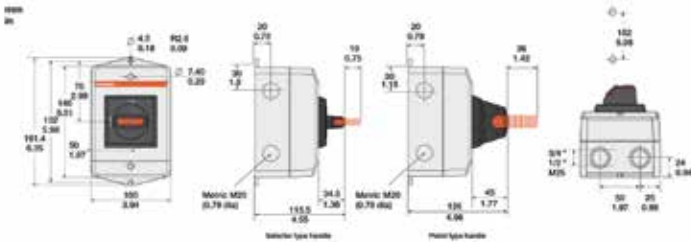
Notes: Each of the above enclosed switches are listed having a red/yellow handle. Simply replace the "RS" or "RP" with a "BS" or "BP" to receive with a black handle. The non-metallic enclosures are comprised of "ED" polycarbonate and "EG" polyester fiberglass.

Switch Rating	Enclosure Type	H height (in)	W width (in)	D depth (in)	MH mounting height (in)	MW mounting width (in)	Shipping Weight (lbs)	Figure No.
16-40A (M163-M403) UL508	1	8	8	6	5	7	10	2
	3R	8	8	6	9	3	11	1
	12	8	6	6	8.75	4	7	1
	4	5.91	5.91	4.72	5.2	3.35	7	2
	4X Stainless	5.91	5.91	4.72	5.2	3.35	7	2
	4X Non-Metallic	7	5	5	6.18	4.21	2	2
60A (M633) UL508	1	8	8	6	5	7	10	2
	3R	8	8	6	9	3	10	1
	12	8	6	6	8.75	4	7	1
	4	7.87	5.91	4.72	7.17	3.35	7	2
	4X Stainless	7.87	5.91	4.72	7.17	3.35	7	2
	4X Non-Metallic	7	5	5	6.18	4.21	4	2
80A (M803) UL508	1	10	8	6	7	7	10.6	2
	3R	10	8	6	11	3	11.1	1
	12	10	8	6	10.75	6	12.3	1
	4	9.84	7.87	5.91	9.13	5.31	9.8	2
	4X Stainless	9.84	7.87	5.91	9.13	5.31	9.8	2
	4X Non-Metallic	11.3	9.31	5.43	10.75	6	6	1
100A (M100U3) UL98	1	10	8	6	7	7	10.6	2
	3R	10	8	6	11	3	11.1	1
	12	10	8	6	10.75	6	12.3	1
	4	10	8	6	10.75	6	11.8	1
	4X Stainless	9.84	7.87	5.91	9.13	5.31	9.8	2
	4X Non-Metallic	11.31	9.31	5.43	10.75	6.02	7.6	1

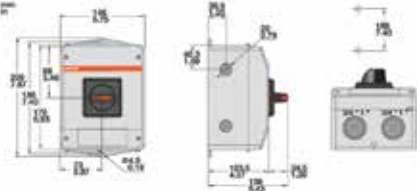
DIMENSIONS (IN / MM)



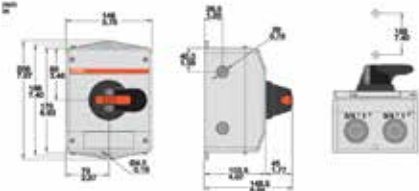
EJM16BS0S & EJM30BSx (enclosure size 1)



EJM60BSx (enclosure size 2)



EJM60BPx (enclosure size 2)



Switch Rating	Enclosure Type	H height (in)	W width (in)	D depth (in)	MH mounting height (in)	MW mounting width (in)	Shipping Weight (lbs)	Figure No.
30A (M30U3) UL98	1	8	8	6	5	5	9.3	2
	3R	8	8	6	9	3	10.2	1
	12	7.87	5.91	4.72	5.2	3.35	7.6	1
	4	7.87	5.91	4.72	5.2	3.35	7.6	1
	4X Stainless	9.844	7.87	5.91	9.13	5.31	10.1	2
	4X Non-Metallic	9.3	7.31	4.96	8.74	4.01	6.2	1
60A (M60U3) UL98	1	12	12	6	9	11	16	2
	3R	12	10	6	13	3	17.6	1
	12	12	12	6	12.75	10	21.6	1
	4	12	12	6	12.75	10	21.9	1
	4X Stainless	11.81	9.84	5.91	11.1	7.28	17.4	2
	4X Non-Metallic	13.3	11.29	7.1	12.75	8.01	12.9	1
200A (M200U3) UL98	1	30	20	8.62	27.5	15	68.6	2
	3R	30	14	8	31	13	88.6	1
	12	30	20	8	28.5	18.5	70.1	2
	4	30	20	8	28.5	18.5	70.1	2
	4X Stainless	30	20	10	28.5	18.5	71	1
	4X Non-Metallic	32.87	25	11.81	34.72	22.91	59.3	1

Note: Dimensions are subject to change! Please consult factory for verification.

Switch Rating	Enclosure Type	H height (in)	W width (in)	D depth (in)	MH mounting height (in)	MW mounting width (in)	Shipping Weight (lbs)	Figure No.
30A (M30CC12) UL 98	1	8	8	6	5	7	9.4	2
	3R	8	8	6	9	3	10.3	1
	12	9.84	7.87	5.91	9.13	5.31	10.8	1
	4	9.84	7.87	5.91	9.13	5.31	10.8	1
	4X Stainless	9.84	7.87	5.91	9.13	5.31	11.3	2
	4X Non-Metallic	11.31	9.31	6.93	10.75	6.02	9.7	1
30A (M30J30) UL 98	1	12	12	8	9	11	18.3	2
	3R	12	12	10	13	3	23.2	1
	12	12	10	8	12.75	8	14.4	1
	4	13.78	11.81	7.87	13.07	9.25	22.4	2
	4X Stainless	13.78	11.81	7.87	13.07	9.25	24.3	2
	4X Non-Metallic	11.31	9.31	6.93	10.75	6.02	9.7	1
60A (M60J30) UL 98	1	12	12	8	9	11	18.2	2
	3R	12	12	10	13	5	23.1	1
	12	12	10	8	12.75	8	14.6	1
	4	13.78	11.81	7.87	13.07	9.25	24.2	2
	4X Stainless	13.78	11.81	7.87	13.07	9.25	24.2	2
	4X Non-Metallic	15.32	13.3	8.19	14.75	10	17.5	1
100A (M100J30) UL 98	1	20	16	8.62	17.88	11	35.2	2
	3R	18	18	10	19	13	41.3	1
	12	20	16	8	21.24	10	35.2	1
	4	20	16	8	18.5	14.5	39	2
	4X Stainless	20	16	8	18.5	14.5	38.1	2
	4X Non-Metallic	19.31	17.31	9.58	18.74	12	25.6	1
200A (M200J30) UL 98	1	24	20	8.62	21.96	12.76	56.6	2
	3R	24	24	10	25	13	61.2	1
	12	24	20	8	25.24	14	51	1
	4	24	20	8	22.5	18.5	49.5	2
	4X Stainless	24	20	8	22.5	18.5	50.5	2
	4X Non-Metallic	28.94	21	10.63	30.79	18.97	46.3	1

Note: Dimensions are subject to change! Please consult factory for verification.