

INSTRUCTION MANUAL

 elastimold®

# MVR molded vacuum reclosers





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# Table of contents

<b>004</b>	<b>Introduction</b>
<b>006</b>	<b>Ordering information</b>
<b>007</b>	<b>Ratings and specifications</b>
<b>008</b>	<b>Elastimold® MVR single-phase and three-phase instruction manual</b>
<b>017</b>	<b>Outline drawings</b>
<b>035</b>	<b>Schematic drawings</b>
<b>039</b>	<b>Elastimold® MVR test data summary</b>

# Introduction

## Elastimold® MVR molded vacuum reclosers

Thank you for your purchase of the Elastimold molded vacuum recloser (MVR). This state-of-the-art recloser incorporates several design features that will assure you of many years of reliable, trouble-free service.

### Description of operation

The single-phase Elastimold MVR is controlled and operated by the SEL® 351RS Kestrel control via a 10/14-pin interconnecting cable. The three-phase Elastimold MVR can be controlled either directly with the SEL 651Rx2 control via a 32-pin interconnecting cable or by a SEL 351R or 351R Falcon control via a 14-pin cable connected to an MVR power module, which then connects to the recloser. This manual will cover the set-up and installation of your new Elastimold MVR recloser. For information on SEL controls and their operation, please refer to their respective manuals.

SEL is a registered trademark of Schweitzer Engineering Laboratories, Inc.

### Features and innovations include:

- A lightweight, maintenance-free\*, fully modular design allowing individual pole replacement or shed replacement in the event of external damage
- Specially formulated molded EPDM main body with overlapping silicone sheds for improved dielectric, weatherability and UV performance
- Integral CT and resistive load-side voltage sensors with option to add source-side resistive voltage sensors
- Electrically linked operation so single-phase trip provides three-phase lockout with mechanically linked manual trip mechanism
- Highly visible position indicator
- Fully solid-dielectric design incorporating unique diaphragm technology to isolate high voltage from the grounded housing
- State-of-the-art magnetic actuator mechanism

\* The Elastimold molded vacuum reclosers are considered maintenance-free because they contain no oil or gas to monitor or maintain.

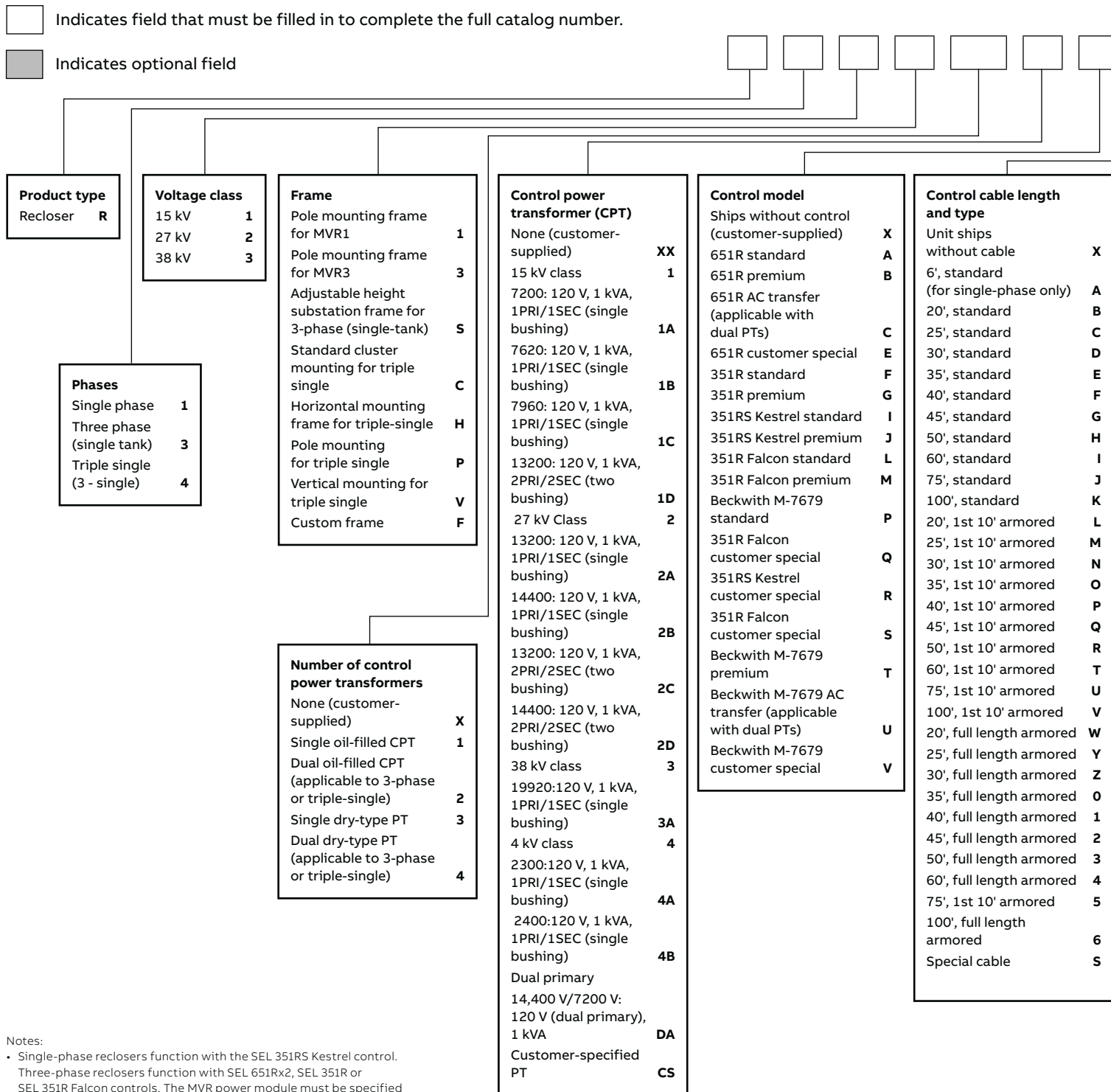


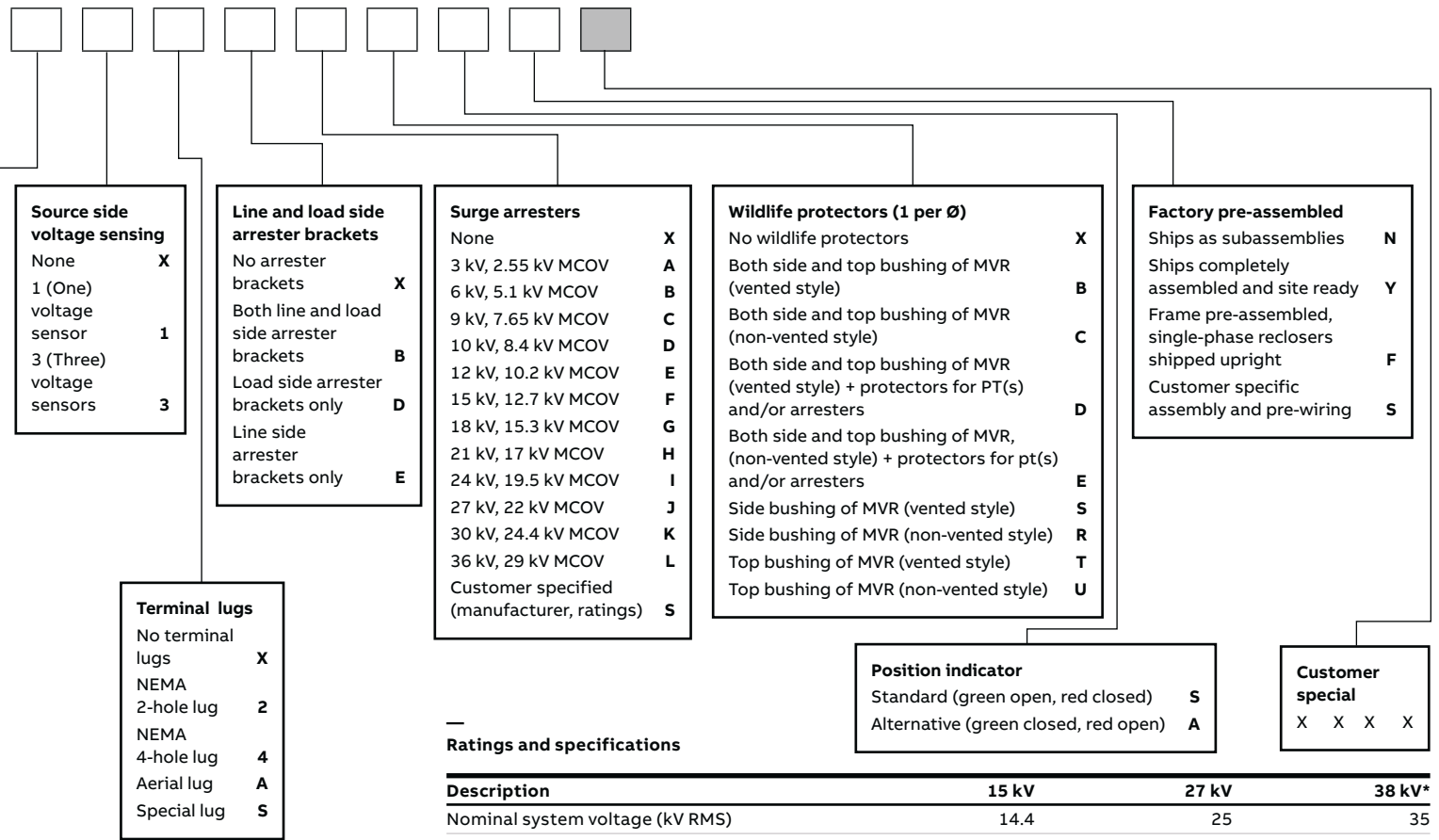


## Ordering information/ratings and specifications

### Molded vacuum recloser catalog numbering system

The following diagram shows how to construct a catalog number for a molded vacuum recloser:





### Ratings and specifications

Description	15 kV	27 kV	38 kV*
Nominal system voltage (kV RMS)	14.4	25	35
Rated maximum voltage (kV RMS)	17.1	29.3	38
Nominal frequency (Hz)	50 or 60	50 or 60	50 or 60
Phase spacing on 3-phase units (inches)	15.5	15.5	15.5
Bil (kV)	150	150	170
Power frequency withstand – dry (kV)	50	60	70
Power frequency withstand – wet (kV)	45	50	60
Continuous current (a rms)	800	800	800
Eight-hour overload current (A RMS)	960	960	960
CT ratio	1000/500:1	1000/500:1	1000/500:1
Interrupting current (kA RMS symmetrical)	12.5	12.5	12.5
Making current (kA asymmetrical peak)	32.5	32.5	32.5
Creepage distances – inches (line to ground)	41.5	41.5	51
Arc-extinction medium	Vacuum	Vacuum	Vacuum
Insulation medium	EPDM/silicone rubber	EPDM/silicone rubber	EPDM/silicone rubber
Mechanical operations	10,000	10,000	10,000
Normal operating temperatures	-10 °C to 45 °C	-10 °C to 45 °C	-10 °C to 45 °C
Normal operating conditions voltage sensor accuracy (load/line)	±3%/1%	±3%/1%	±3%/1%
Extreme operating temperatures	-40 °C to 65 °C	-40 °C to 65 °C	-40 °C to 65 °C
Extreme operating conditions voltage sensor accuracy (load/line)	5%/1%	5%/1%	5%/1%
CT accuracy	Class 1	Class 1	Class 1
Weight (single-phase/three-phase)	57/208 lbs.	57/208 lbs.	58/211 lbs.

### Notes:

1. Use with the 351R or 351R Falcon control requires connection via MVR power module. The power module is connected to the recloser via a 6 ft. 32-pin cable.
2. Voltage sensors require 8 V AC, 1M LEA inputs.

\* Single-phase 38 kV units are rated for use on grounded systems only. Three-phase 38 kV units can be used for single-phase tripping on grounded systems only. For ungrounded systems, three-phase tripping is required.

## Instruction manual

### Safety instructions

The following are general caution and warning statements that apply to this equipment. Additional statements related to specific tasks and procedures are located throughout this manual.

#### **WARNING**

Refers to hazards or unsafe practices which could result in death, severe personal injury or significant equipment damage.

#### **CAUTION**

Refers to hazards or unsafe practices which could result in damage to equipment or in personal injury.

#### **WARNING**

Before installing, operating, maintaining or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury or equipment damage.

#### **WARNING**

Hazardous voltage. Contact with high voltage will cause serious personal injury or death. Follow all locally approved safety procedures when working around high-voltage lines and equipment

#### **WARNING**

Hazardous voltage. Do not rely on the contact position indicator to determine that the line has been de-energized. Always establish a visible disconnect and establish person grounds when performing de-energized line work. Failure to follow proper safety practices can result in contact with high voltage, which can cause death or severe personal injury.

#### **WARNING**

Hazardous voltage. Recloser and control must be solidly grounded. Improper grounding can result in contact with high voltage, which will cause severe personal injury or death and equipment damage. Disconnecting the control cable when the recloser is energized could result in high voltage on the pins if the recloser tank is not grounded as specified.

#### **WARNING**

When testing at high voltage, the MVR and high-voltage test equipment should be in a test cage or similar protective area to prevent accidental contact with the high-voltage parts. All equipment needs to be solidly grounded. Failure to comply can result in death, severe personal injury and equipment damage

#### **CAUTION**

All MVRs are sealed and leak tested prior to shipment to prevent moisture ingress. Do not open the lower cover as it is possible that the MVR will not reseat when the cover is closed. While the diaphragm will keep moisture from ever entering the high-voltage chamber, excessive moisture ingress could cause damage to the magnetic actuator mechanism and misoperation.

#### **CAUTION**

Do not remove and replace the side terminal in the field. The MVR incorporates a unique diaphragm technology that fully encapsulates the high-voltage chamber in the MVR. The side terminal must be vented during installation and then sealed to prevent pressure build-up against the diaphragm during the installation process. Improper installation may cause equipment damage and possible personal injury.



Rotating the terminal connector without properly loosening the connector will apply excessive force on the terminal stud and could damage the interrupter assembly.



Follow approved safety practices when lifting and mounting the MVR. Use lifting rings on three-phase units and lift smoothly, limiting shifting to avoid damage. Do not lift three-phase MVRs by the side terminals as damage could result.



The complete recloser system, including control, requires routine inspection and maintenance if damage is found to ensure proper operation. If it is not maintained, it may fail to operate properly. Improper operation may cause equipment damage and possible personal injury



Do not energize the recloser for service until all control settings have been properly programmed and verified. Refer to the appropriate SEL control manual for programming procedures. Failure to comply may result in control and recloser misoperation.

**Additional information:** These instructions are not intended to cover all details or variations in the equipment, procedures or processes described. Nor are they designed to provide directions for meeting every possible contingency during installation, operation or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your local ABB representative.

## Instruction manual

### Acceptance and initial inspection

Each MVR is shipped in the closed position from the factory.

Upon arrival, uncrate the unit (refer to Crate removal and visual inspection section). Check the unit does not have missing parts and it is in the closed position. Also check the unit for any damage that may have occurred during shipping. Should any damage be found, file a claim with the shipping carrier and contact the factory or your local ABB representative.

### Crate removal and visual inspection

Packaging may differ depending on the units being shipped. Carefully remove the MVR from its packaging. In the case of units shipped in crates, remove the outer crate top by removing the screws or bolts attaching it to the skid. Then unbolt the recloser from the skid. It is then possible to lift the unit directly off the skid with a hoist. Take care when opening packaging not to nick or cut the EPDM/silicone insulation on the MVR.

After uncrating, visually inspect the MVR for any shipping damage, including the insulation, bushings, trip lever, mounting frame, etc. If damage has occurred, please file a claim with the shipping carrier immediately and contact your local ABB representative. Do not attempt to install the equipment with damages or missing parts.

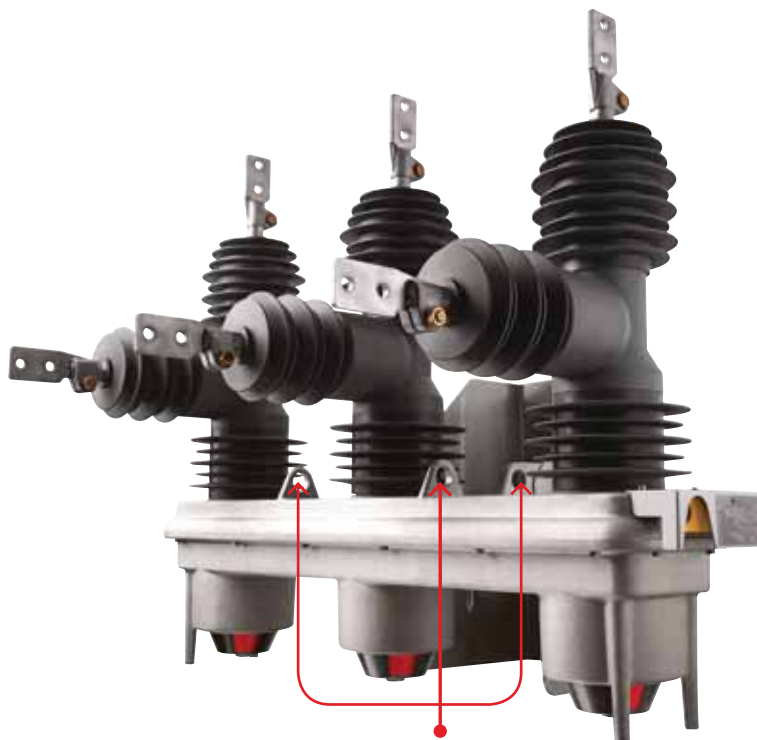
### Lifting

Single-phase units can be lifted and moved by hand or by fastening a loop around the main body. Three-phase units must be lifted using the lifting rings.

Follow all approved safety practices when making hitches and lifting the equipment. Lift the MVR smoothly by using the four lifting rings on the recloser as shown. Do not allow the unit to shift. Be careful that the lifting sling exerts no forces on the side terminals or on the individual poles.

#### CAUTION

Follow approved safety practices when lifting and mounting the MVR. Use lifting rings on three-phase units and lift smoothly, limiting shifting to avoid damage. Do not lift three-phase MVRs by the side terminals as damage could result.

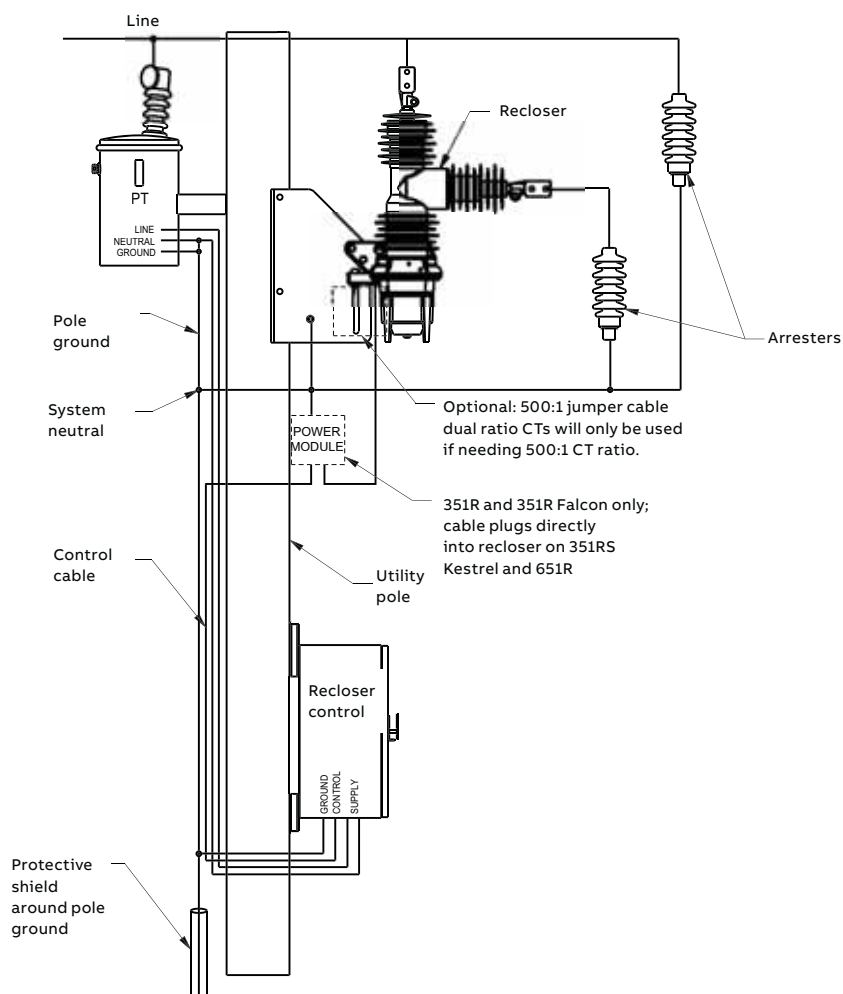


Four lifting ring detail

Lifting rings

## Instruction manual

### Typical installation detail



### Set-up

Set-up and testing of the recloser can be performed at maintenance facilities, test laboratories or directly in the field once appropriate control supply voltage is made available. Connect the recloser to the appropriate control:

- Single-phase units — the MVR should be connected to the SEL 351RS Kestrel control via a 10/14-pin interconnecting cable
- SEL 651Rx2 control — the MVR should be connected to the control via a 32-pin interconnecting cable
- SEL 351R or 351R Falcon control — the 14-pin cable should be connected to the MVR power module, and the 6-ft. 32-pin cable should be used to connect the power module to the MVR\*

The recloser receives the necessary signal to open and close from the control circuitry. The control is powered from an external supply voltage but is also supplied with a battery backup system that is fully charged from the factory. The battery backup system, located in the control cabinet, is shipped in the “off” or disconnected position. For information on how to connect the battery, please refer to the appropriate SEL control manual.

The figure at left shows a typical recloser, control and power supply interconnection layout.

\*Note: MVRs originally purchased for use with the SEL 351R or 351R Falcon controls are designed to be easily upgradable for use with the SEL 651R control. Please contact your local ABB representative for instructions.

### **⚠ WARNING ⚠**

Before installing, operating, maintaining or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury or equipment damage.



## Instruction manual

### Mounting

Note: Use extreme care in handling the recloser so that no force is exerted on the side terminals or on the individual poles as damage may result.

- **Single-phase units:** Attach the mounting bracket to the pole or structure using a  $\frac{3}{4}$ " lag or thru bolt (customer supplied). Hoist the MVR by creating a sling around the main body and the side terminal on the recloser, and lower it into the mounting bracket. Orient as desired and then lock in place by torquing the two  $\frac{3}{8}$ "-16 set screws to 20 ft.-lbs. The single-phase recloser can be oriented from 0 to 180 degrees as shown below.
- **Three-phase units:** Hoist the MVR by creating a sling that uses the lifting rings provided on the recloser. Mount the recloser on the pole or structure using two  $\frac{3}{4}$ " lag or thru bolts (customer supplied) as specified on the product drawings shown from pages 25–34. With the SEL 351R or 351R Falcon control, mount the power module onto the pole below the recloser, as shown at right. With the SEL 651R control, no power module is needed and the 32-pin cable should be plugged directly into the recloser.

### High-voltage terminations

The terminal connectors supplied with each recloser are aluminum alloy with standard NEMA two-hole drilling and the bolts/nuts are silicon bronze. The electrical connection at the terminal pad must be treated with Alcoa No. 2 joint compound or equivalent. Each terminal should be wire brushed through the compound to improve the connection.

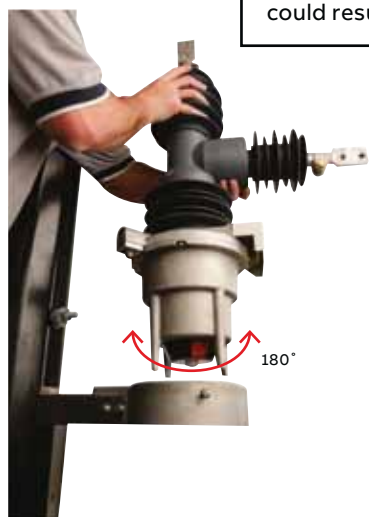
If the terminal pad is rotated, the connector bolt(s) must be loosened before turning the pad. Retighten the bolt(s) to 35 ft.-lbs. after repositioning.

#### CAUTION

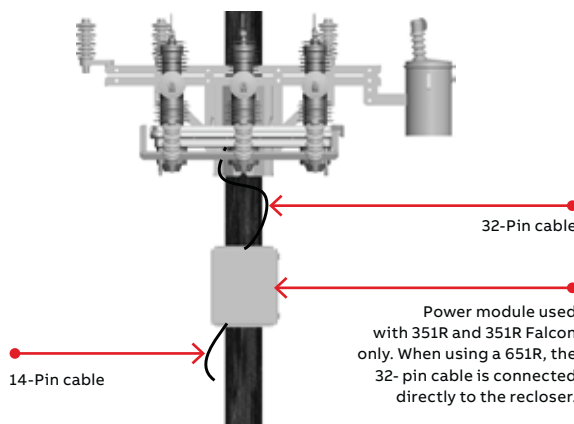
Rotating the terminal connector without properly loosening the connector will apply excessive force on the terminal stud and could damage the interrupter assembly.

#### CAUTION

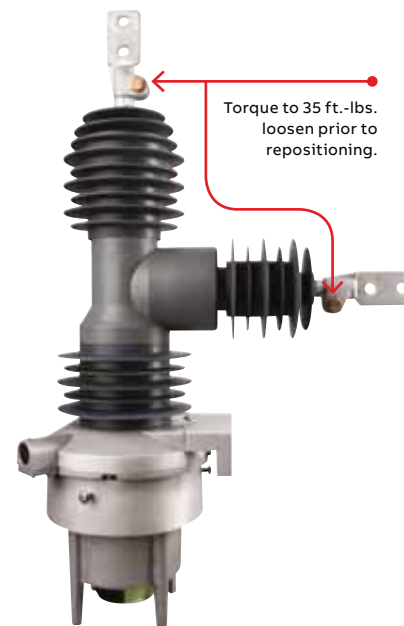
Follow approved safety practices when lifting and mounting the MVR. Use lifting rings on three-phase units and lift smoothly, limiting shifting to avoid damage. Do not lift three-phase MVRs by the side terminals as damage could result.



Single-phase orientations



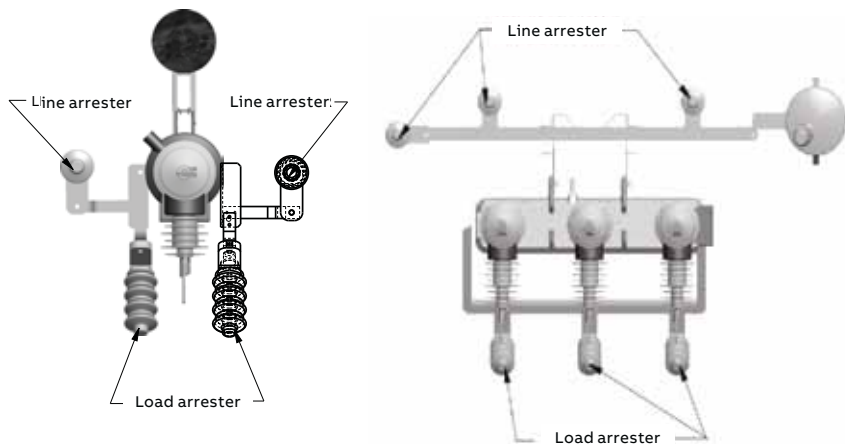
Three-phase mounting



High-voltage terminal connectors



## Instruction manual



Single-phase surge arrester mounting

Three-phase surge arrester mounting

### Surge arrester mounting

Each single-phase recloser mounting ring has a provision for mounting an optional bracket on either side of the recloser to support two customer-supplied arresters (one line-side and one load-side). Refer to the supplied recloser drawings for specific installation dimensions. Alternate configurations are shown at left.

Three-phase reclosers have provisions for mounting an optional front bracket to support three load-side, customer-provided surge arresters. A rear mounting bracket for three additional line-side arresters is also available as an option as well as an option to mount multiple transformers. Refer to the supplied recloser drawings for specific installation dimensions. See example at left.

Since arresters are designed to provide lightning overvoltage protection, they should be mounted as close as practical to the recloser if the standard arrester brackets are not used.

### Control wiring

Control power must meet the requirements stated on the drawings supplied with the recloser control. Please refer to the appropriate SEL control manual. Each recloser and control cabinet assembly comes with standard interconnection cables that are keyed at each end to assure proper installation. Please see figures at left for descriptions of the receptacle pins.

 651Rx2	A – CT AØ	M – VNEUTRAL	Z – trip AØ
	B – CT BØ	N – VLINE AØ	a – not used
	C – CT CØ	P – VLINE BØ	b – not used
	D – CT neutral	R – VLINE CØ	c – not used
	E – not used	S – VNEUTRAL	d – not used
	F – 12VDC	T – not used	e – not used
	G – GND	U – monitored trip AØ (52a)	f – close BØ
	H – not used	V – monitored trip BØ (52a)	g – trip BØ
	J – VLOAD AØ	W – monitored trip CØ (52a)	h – close CØ
	K – VLOAD BØ	X – monitored manual trip (69)	j – trip CØ
	L – VLOAD CØ	Y – CLOSE AØ	
 351R	A – 24VDC	H – CT BØ	
	B – monitored trip PT	J – CT CØ	
	C – trip	K – CT neutral	
	D – monitored trip PT	L – not used	
	E – close	M – GND	
	F – monitored close PT	N – cap healthy status (optional)	
	G – CT AØ	P – cap healthy status (optional)	
 351RS Kestrel	A – monitored trip (52A)	F – not used	
	B – monitored manual trip (69)	G – GND	
	C – CT	H – 12VDC	
	D – CT neutral	J – trip	
	E – not used	K – close	

## Instruction manual

### Grounding

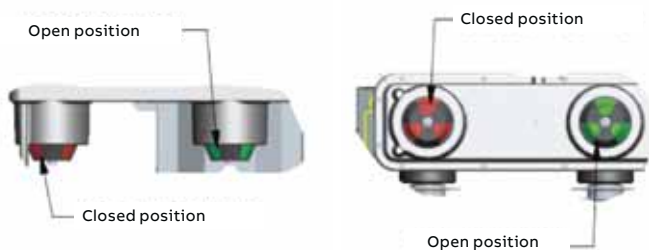
To ensure the maximum amount of protection for internal control components during possible power surge events, the recloser and control cabinet need to be solidly grounded together. The recloser ground conductor must be connected to the supplied #10–2 AWG ground lug located on the recloser's frame base. All separate grounds should be connected to the main ground wire. All connections to the SEL control (including the control cable, which contains a ground) must be routed in close proximity to and parallel to the main ground paths and should be approximately equal in length. When using a power module with a 351R or 351R Falcon, the power module box must also be grounded. See Set-up on page 11 for a visual representation.

### ⚠ WARNING ⚠

Hazardous voltage. Recloser and control must be solidly grounded. Improper grounding can result in contact with high voltage, which will cause severe personal injury or death and equipment damage. Disconnecting the control cable when the recloser is energized could result in high voltage on the pins if the recloser tank is not grounded as specified.

### Voltage sensor set-up

All Elastimold MVRs come with pre-calibrated, load-side resistive voltage sensors that are capable of measuring amplitude and phase angle with an accuracy of  $\pm 3\%$  under normal operating conditions ( $-10\text{ }^{\circ}\text{C}$  to  $45\text{ }^{\circ}\text{C}$ ) and  $\pm 5\%$  at extreme conditions ( $-40\text{ }^{\circ}\text{C}$  to  $65\text{ }^{\circ}\text{C}$ ).



Individual pole position indicator (side view)

Individual pole position indicator (bottom view)

For 3-phase MVRs, optional pre-calibrated line-side resistive voltage sensors are also available and are capable of measuring the voltage with a higher accuracy of 1%. All sensors require an 8 V AC, 1M LEA voltage sensor input on the SEL 651Rx2 control. Refer to the Elastimold source side voltage sensor (ESSVS) installation instructions for mounting details. The ESSVS are not used with the SEL 351R, 351R Falcon or 351RS Kestrel controls.

### Electronic operation test

Using the controller, open and close the MVR electrically by pressing the marked open and close buttons. Confirm that the selected button is in agreement with the position indicator on the control panel as well as the recloser position indicator. The recloser position indicator is located on the bottom of the recloser as shown below. MVRs are designed to operate with a total circuit resistance of 6.5–7.5 ohms across the TRIP/CLOSE pins on the SEL control interface.

### ⚠ CAUTION ⚠

Do not energize the recloser for service until all control settings have been properly programmed and verified. Refer to the appropriate SEL control manual for programming procedures. Failure to comply may result in control and recloser misoperation.

### ⚠ WARNING ⚠

Hazardous voltage. Do not rely on the contact position indicator to determine that the line has been de-energized. Always establish a visible disconnect and establish grounds when performing de-energized line work. Failure to follow proper safety practices can result in contact with high voltage, which can cause death or severe personal injury.

## Instruction manual

### Manual trip lever test

With the switch closed, pull down the yellow trip lever as shown in center photo below and verify that the recloser opens. The position indicators located on the bottom of the recloser will be GREEN for OPEN. The manual trip lever will remain in the down position until returned to the up position. When in the down TRIPPED position, the manual trip will block all close operations until it is manually restored to the up NORMAL position. When using the standard SEL 651Rx2, the control standard settings will also send a signal to open when the manual trip handle is pulled. The recloser can be closed once the manual trip handle has been restored to the normal position by pressing the close button on the control.

### Vacuum interrupter tests

Every recloser is quality checked and tested before leaving the factory to assure it meets all design specifications. In order to verify proper operating condition after shipment and before installation, two tests should be performed to evaluate the vacuum contacts. These tests should be performed across each module separately and can be performed again, as desired, throughout the life of the recloser.

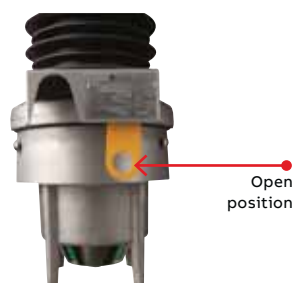


### WARNING

When testing at high voltage, the MVR and high-voltage test equipment should be in a test cage or similar protective area to prevent accidental contact with the high-voltage parts. All equipment needs to be solidly grounded. Failure to comply can result in death, severe personal injury and equipment damage.



Manual trip lever – closed position



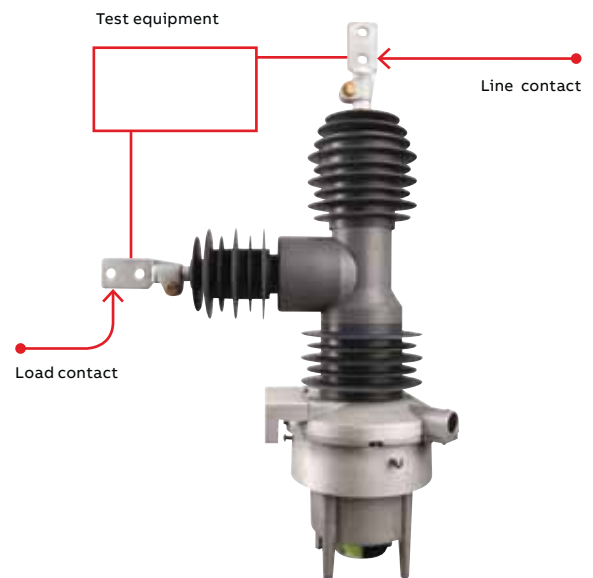
Manual trip lever – open position

### 1. AC high potential test:

Loss of vacuum results in complete breakdown across open vacuum contacts at voltages below 30 kV RMS. Only AC high potential testing is meaningful. With the recloser in the OPEN position, apply 30 kV RMS across each individual contact for 15 seconds. To avoid possible generation of X-rays, do not apply more than 30 kV RMS. During the high potential testing, self-extinguishing, momentary breakdowns lasting only a few seconds may occur. These breakdowns are not significant but can result in false indication of vacuum loss if the test set uses a high-speed overload relay or breaker. During normal operation with the recloser in service, loss of vacuum or a defective module may be indicated by excessive AM radio noise with the recloser open or by measuring a difference in surface temperatures (differential of more than 5 °C temperature rise above normal ambient) between poles on the same recloser. When loss of vacuum occurs, contact resistance will typically increase.

### 2. Contact resistance test:

With the recloser in the CLOSED position, measure the resistance across each module. Resistance values should be less than 200 micro-ohms. If higher resistance values are measured, contact your local ABB representative.



Test cable set-up details

## Instruction manual

### Operation

The recloser receives the necessary signal to open and close from the control circuitry. For specific information concerning the operation of the control and how to change settings, please refer the appropriate SEL control manual.

**CT and voltage sensor:** When using standard SEL settings files, the CT ratio will already be preset to 1000:1 and the voltage sensors will come pre-calibrated (used on the 651Rx2 only). If standard settings files are not used or another CT ratio is desired, the CT input in the SEL control will need to be adjusted to the desired ratio. All voltage sensors require an 8 V AC 1M LEA input and are pre-calibrated to a ratio of 10 kV on the line to 1 V AC into the SEL control.

**Reclose sequence:** For specific information on how to adjust settings and curves, please refer to the appropriate SEL control manual. Note that certain SEL controls limit the number of reclose sequences when AC or battery is not present. Please consult Schweitzer Engineering Laboratories.

**351R power module:** For specifications, please refer to the power module box installation and operation instructions.

### Maintenance

The Elastimold MVR is designed to be maintenance-free under normal operating conditions, and the EPDM/silicone insulation is not prone to the cracking or chipping that sometimes occurs with porcelain or epoxy insulators. However, should damage occur as a result of an external event, in most cases it is possible to replace the damaged components due to the modular design of the recloser. Both the top and bottom silicone sheds, as well as the side terminal, can be removed and replaced if damaged by external arcing, a knife cut, etc. If damage extends to the main body of the pole, the pole in each phase can be replaced individually. If damage occurs, please contact ABB customer service. If it becomes necessary to clean the main body or sheds, recommended cleaning agents are soap and warm water or isopropyl alcohol.

Refer to: [www.abb.com](http://www.abb.com) for full warranty terms.

#### CAUTION

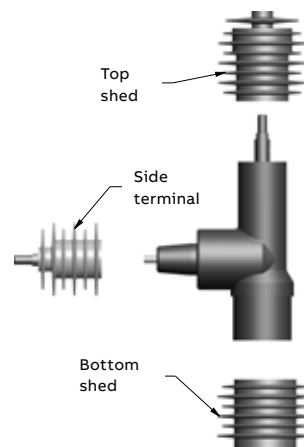
The complete recloser system, including control, requires routine inspection and maintenance if damage is found to ensure proper operation. If it is not maintained, it may fail to operate properly. Improper operation may cause equipment damage and possible personal injury.

#### CAUTION

All MVRs are sealed and leak tested prior to shipment to prevent moisture ingress. Do not open the lower cover as it is possible that the MVR will not reseal when the cover is closed. While the diaphragm will keep moisture from ever entering the high-voltage chamber, excessive moisture ingress could cause damage to the magnetic actuator mechanism and misoperation.

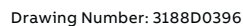
#### CAUTION

Do not remove and replace the side terminal in the field. The MVR incorporates a unique diaphragm technology that fully encapsulates the high-voltage chamber in the MVR. The side terminal must be vented during installation and then sealed to prevent pressure build-up against the diaphragm during the installation process. Improper installation may cause equipment damage and possible personal injury.



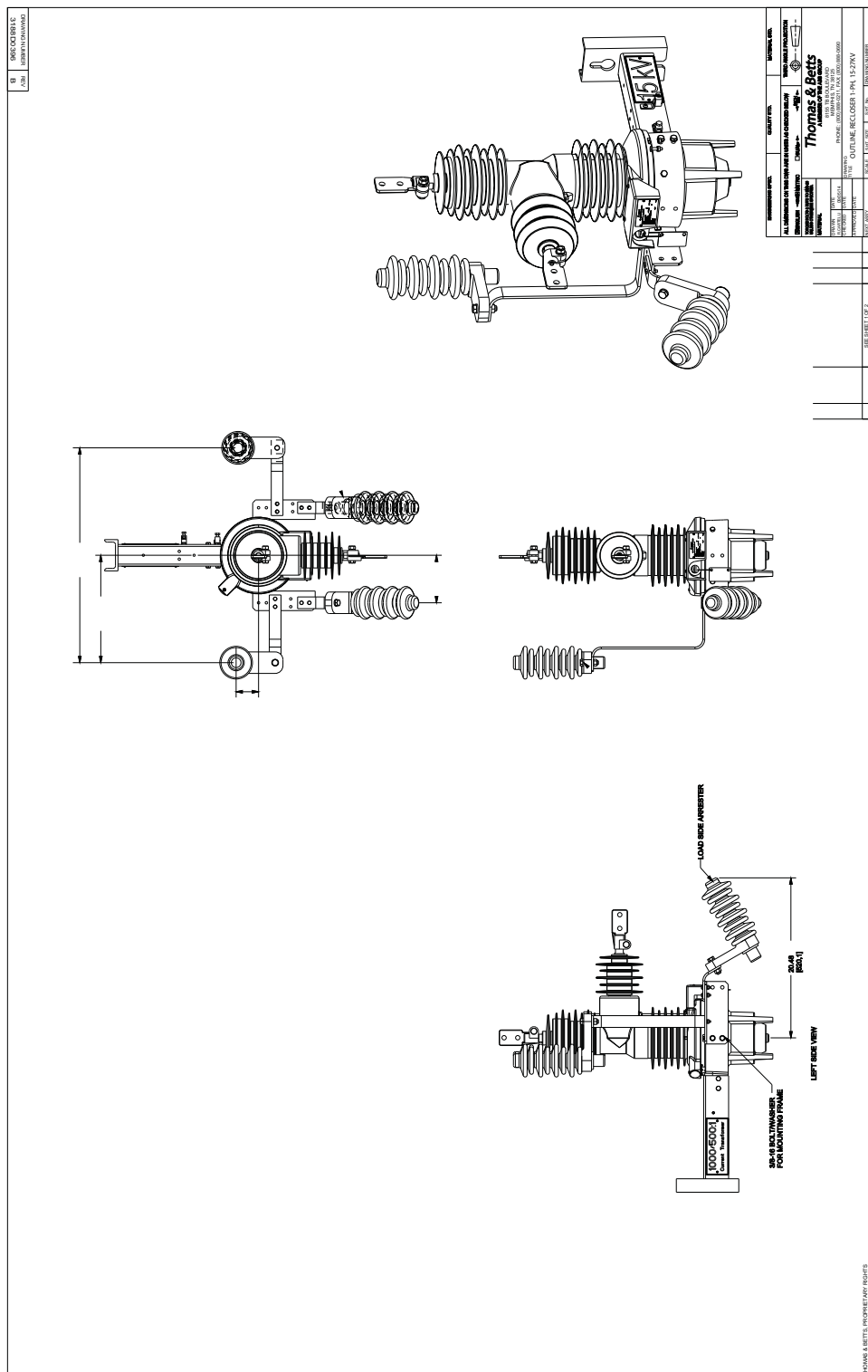
Standard pole replacement details

Single-phase 15/27 kV

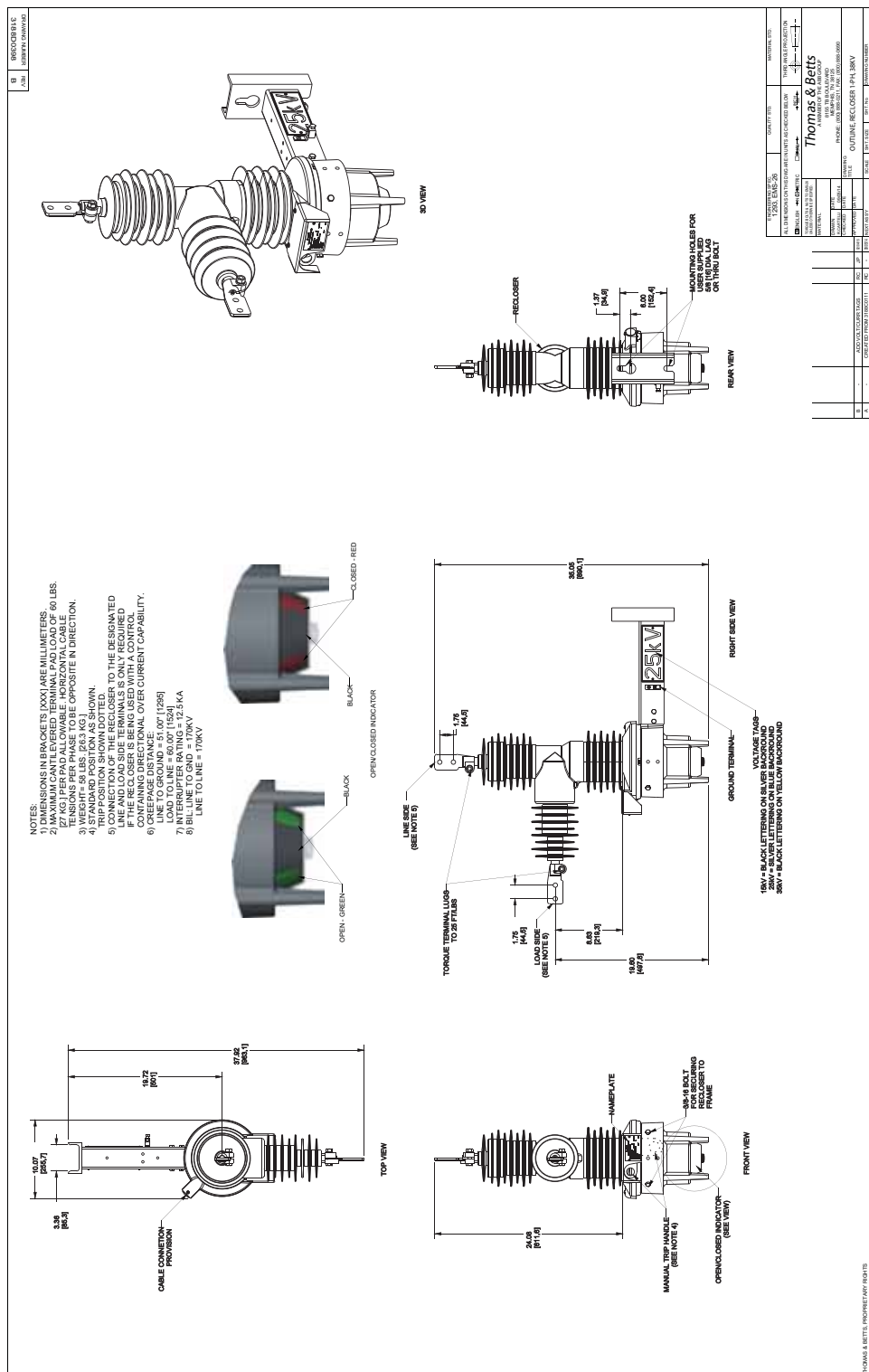


## Outline drawings

Single-phase 15/27 kV

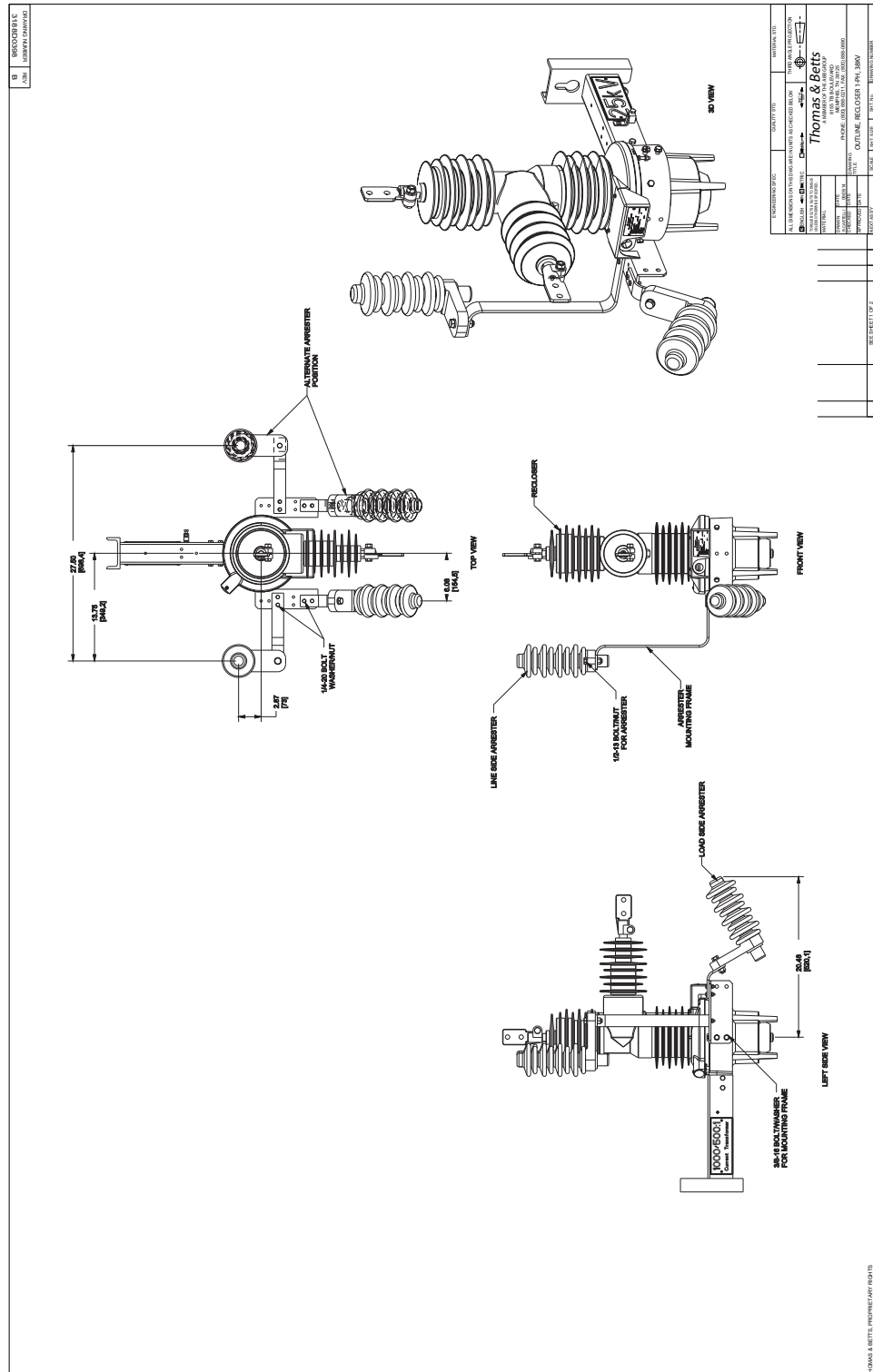


Single-phase 38 kV



## Outline drawings

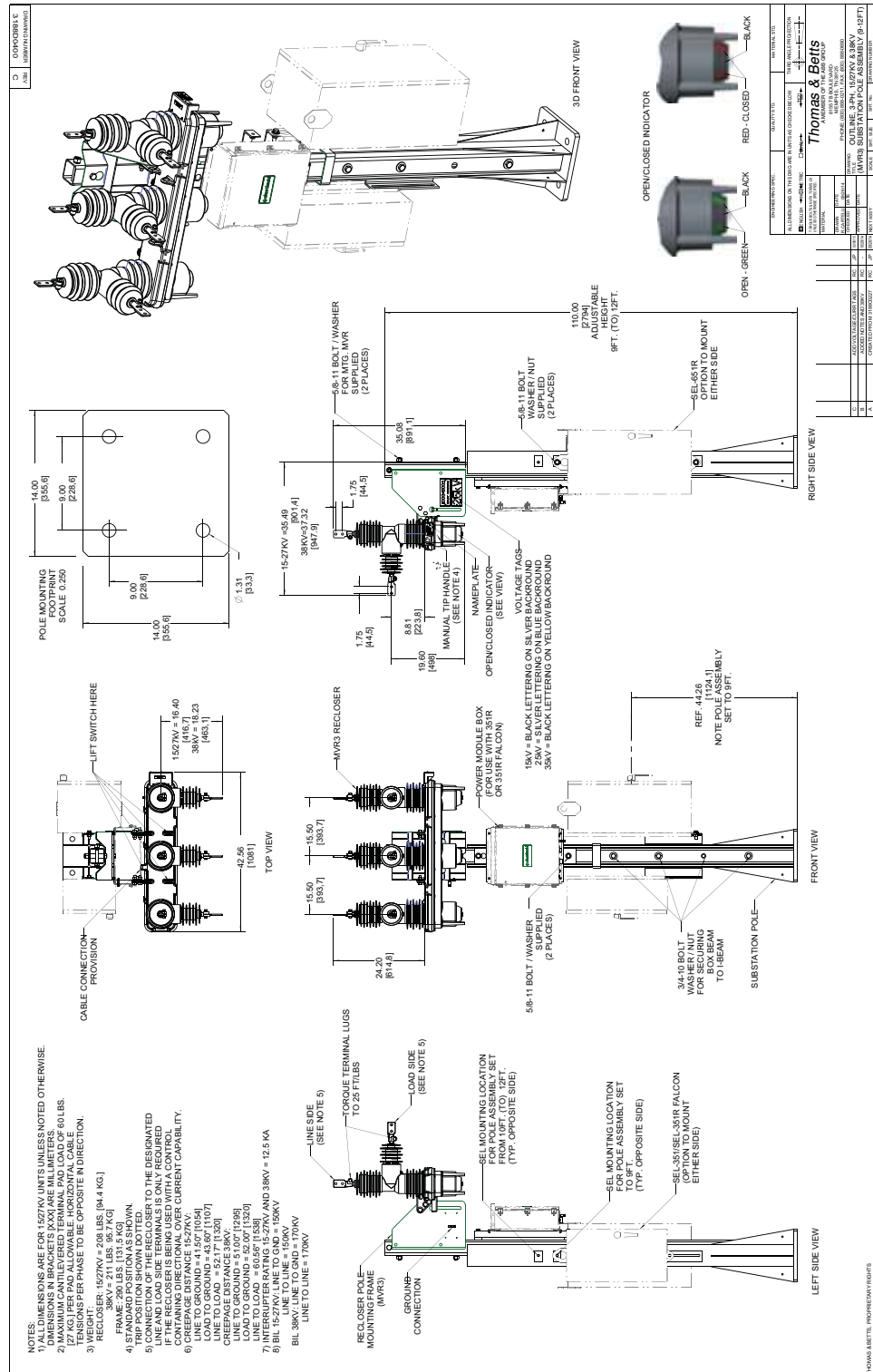
Single-phase 38 kV





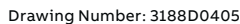
# Outline drawings

## Three-phase substation pole assembly

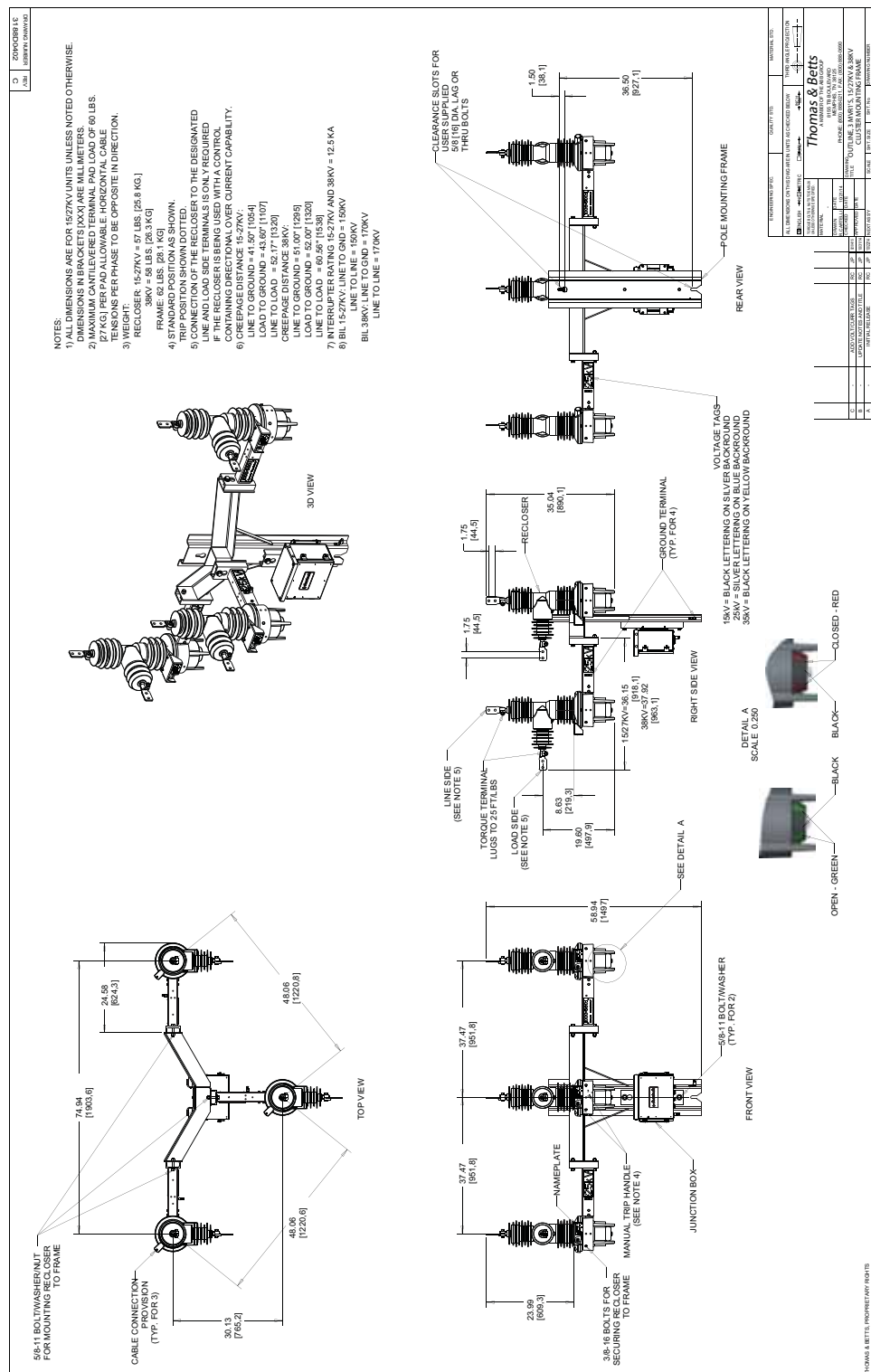


Drawing Number: 3188D0400

### Triple single vertical mounting frame

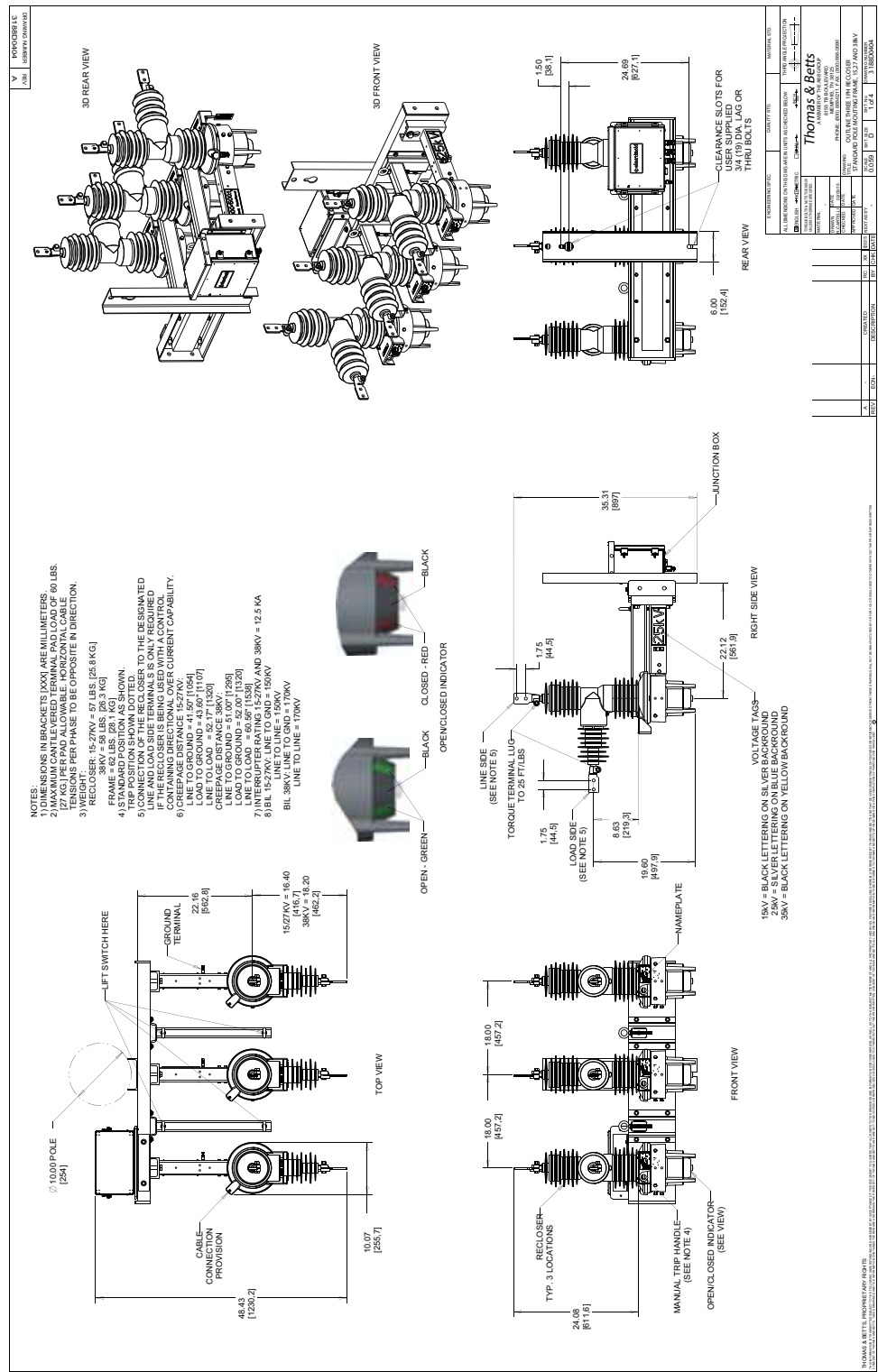


### Triple single cluster mounting frame

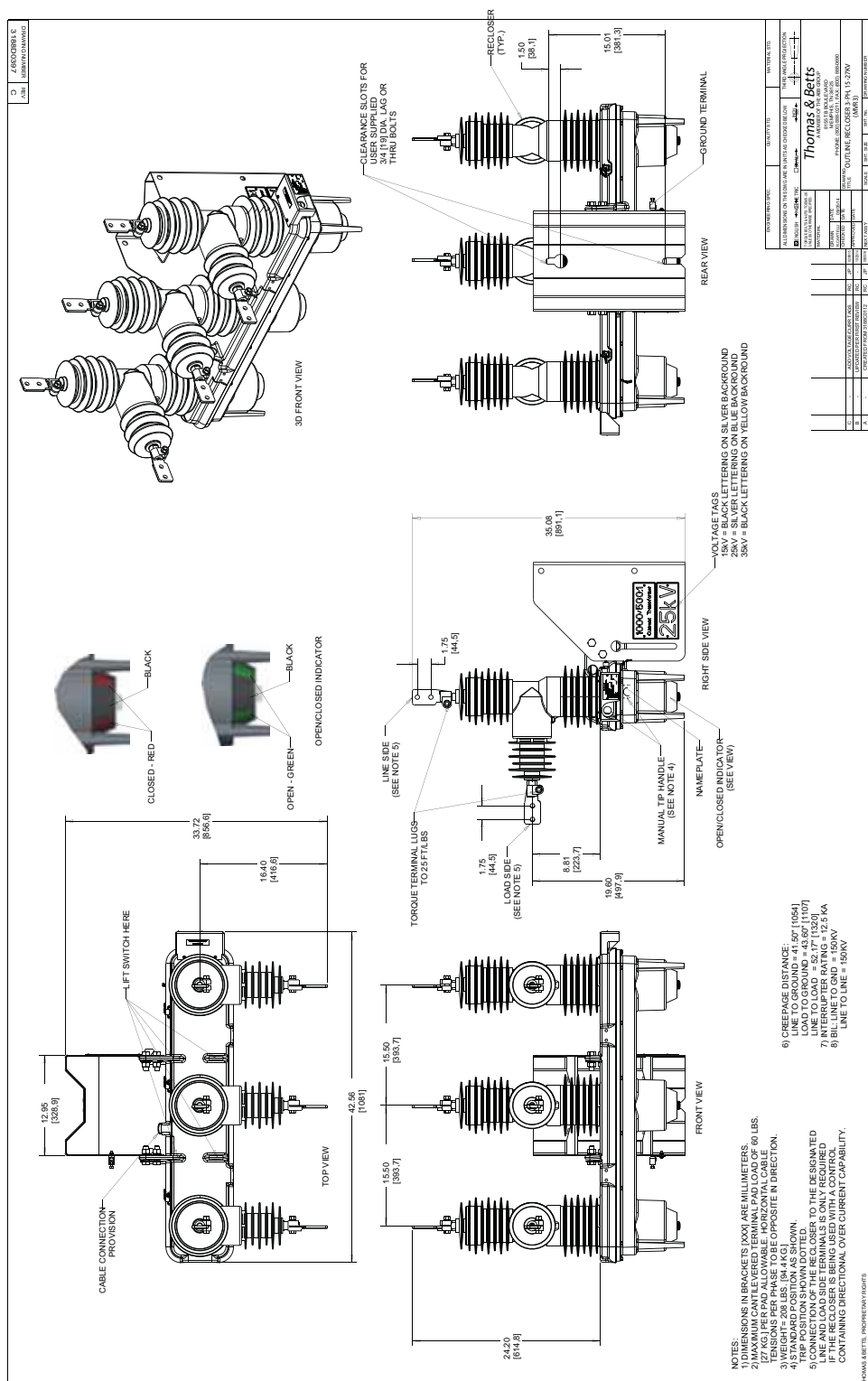


Outline drawings

Triple single pole mounting frame



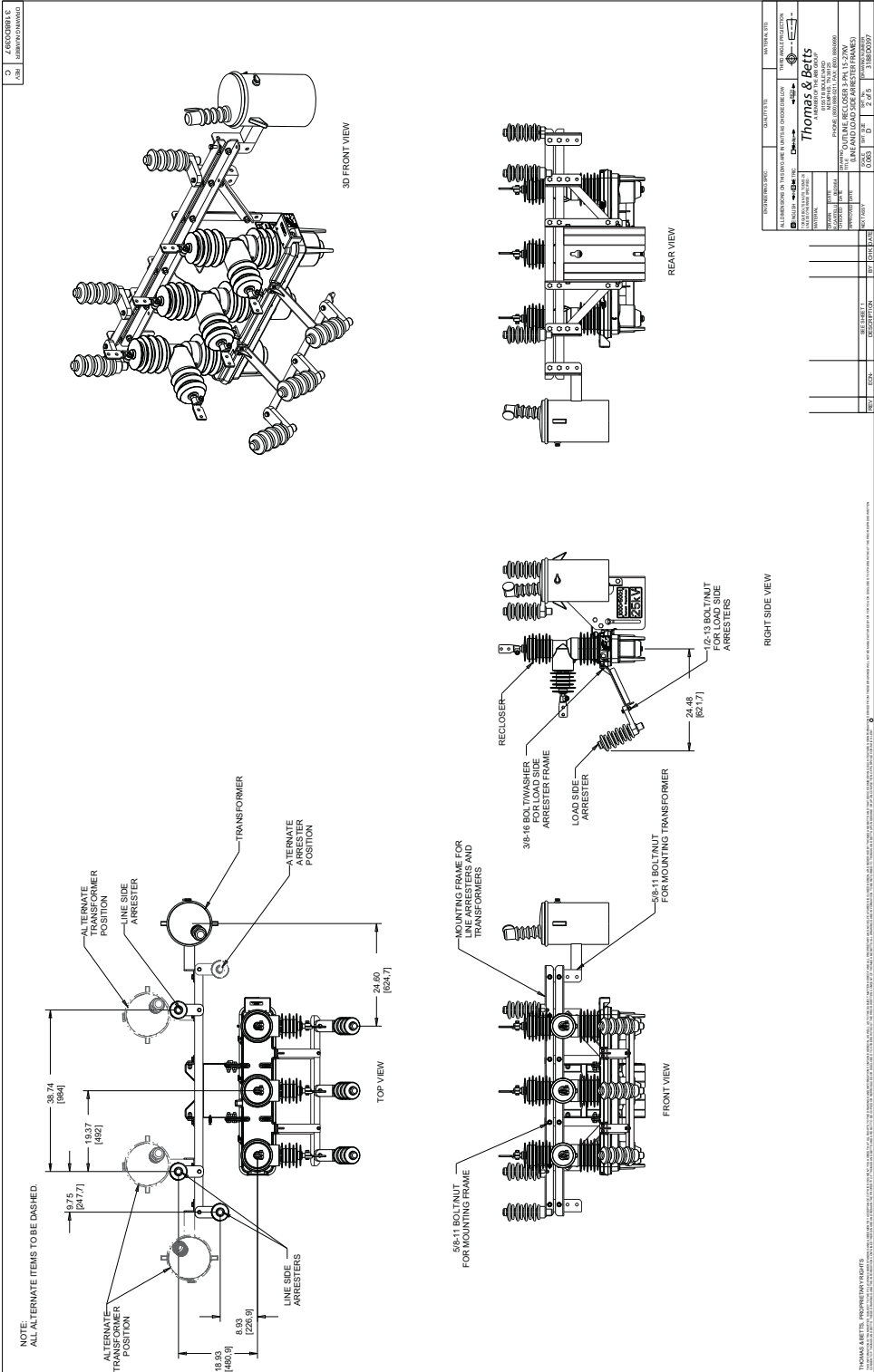
Three-phase 15/27 kV



Drawing Number: 3188D0397

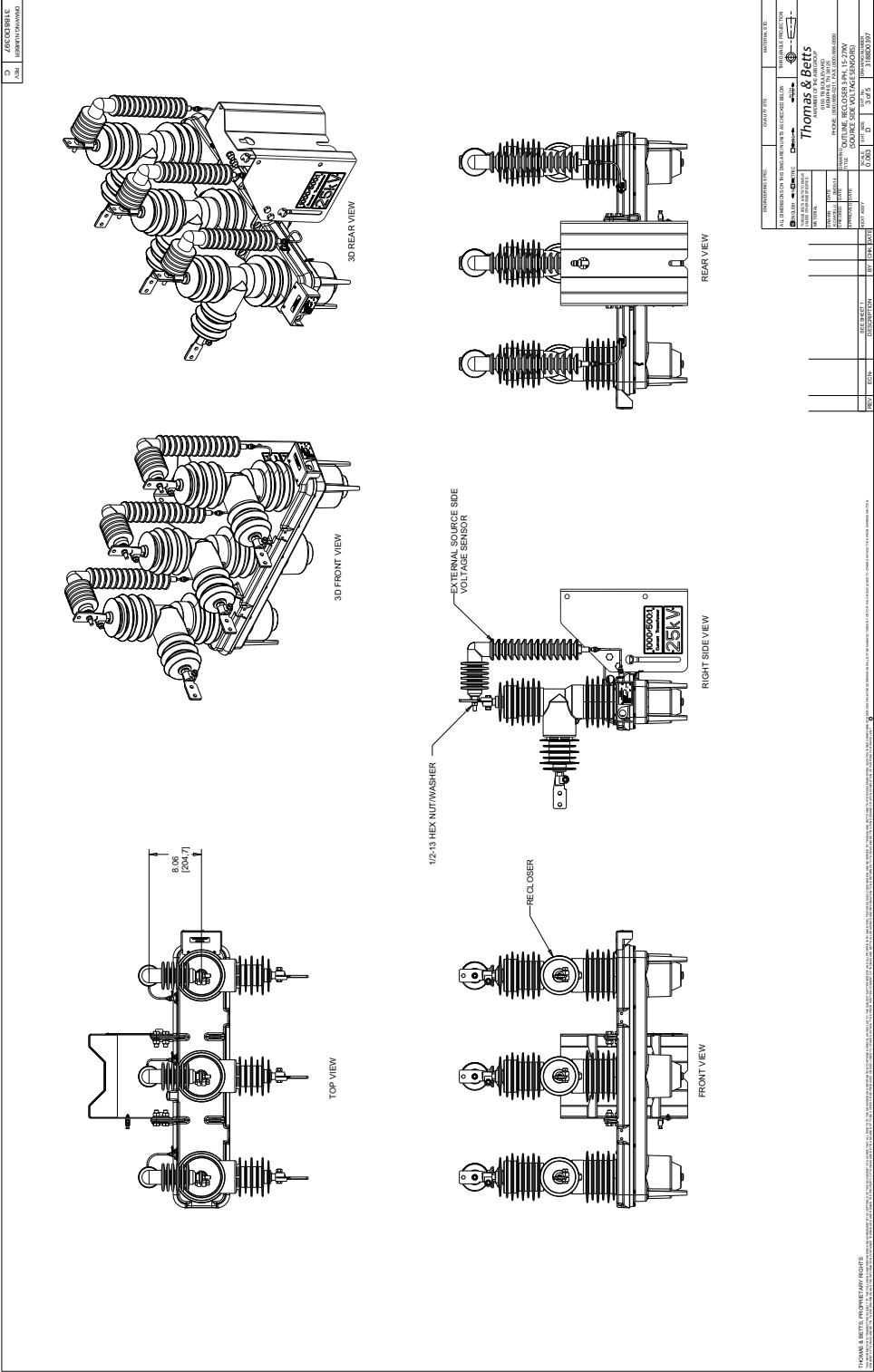
Outline drawings

Three-phase 15/27 kV

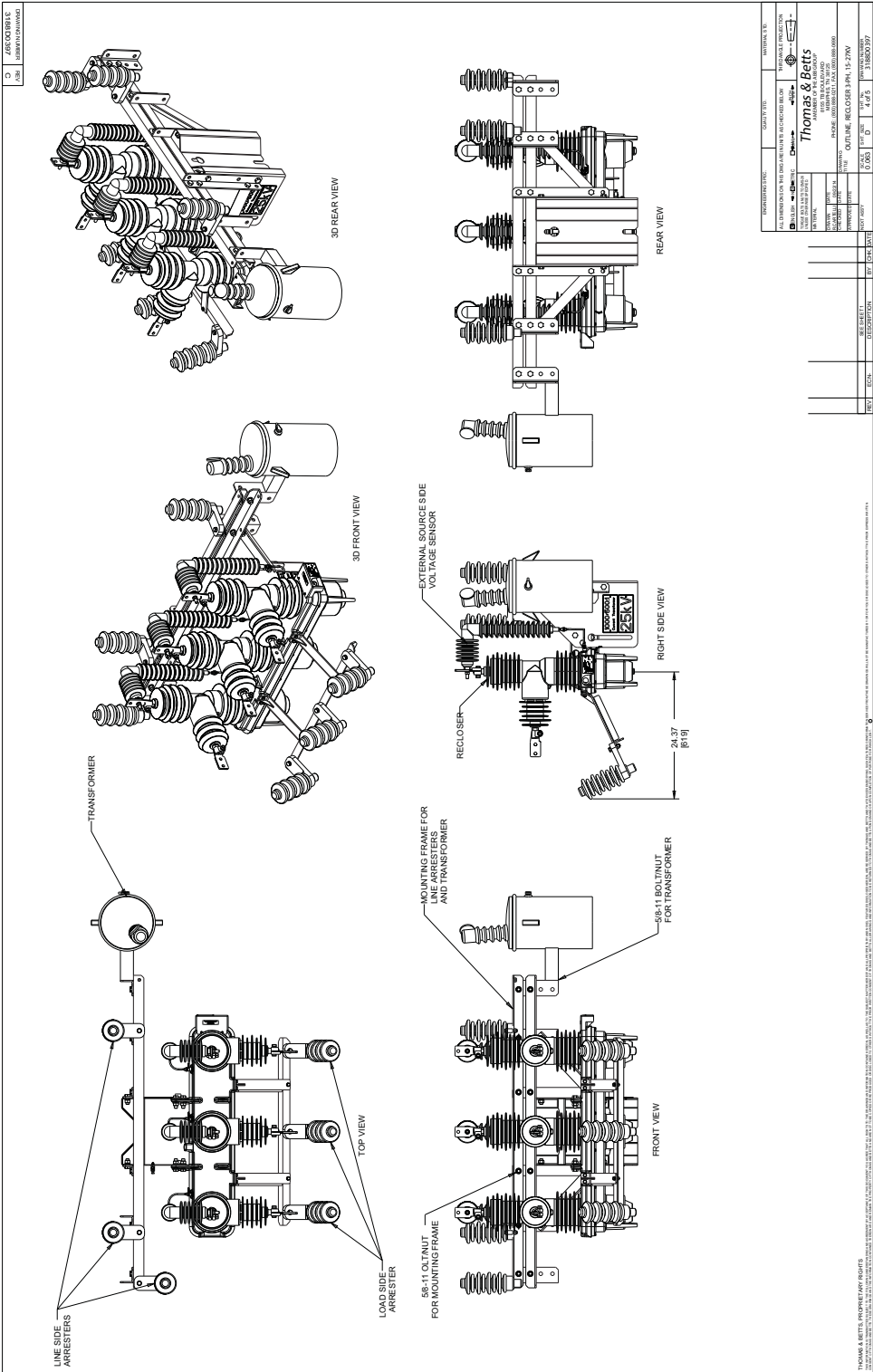


Outline drawings

Three-phase 15/27 kV

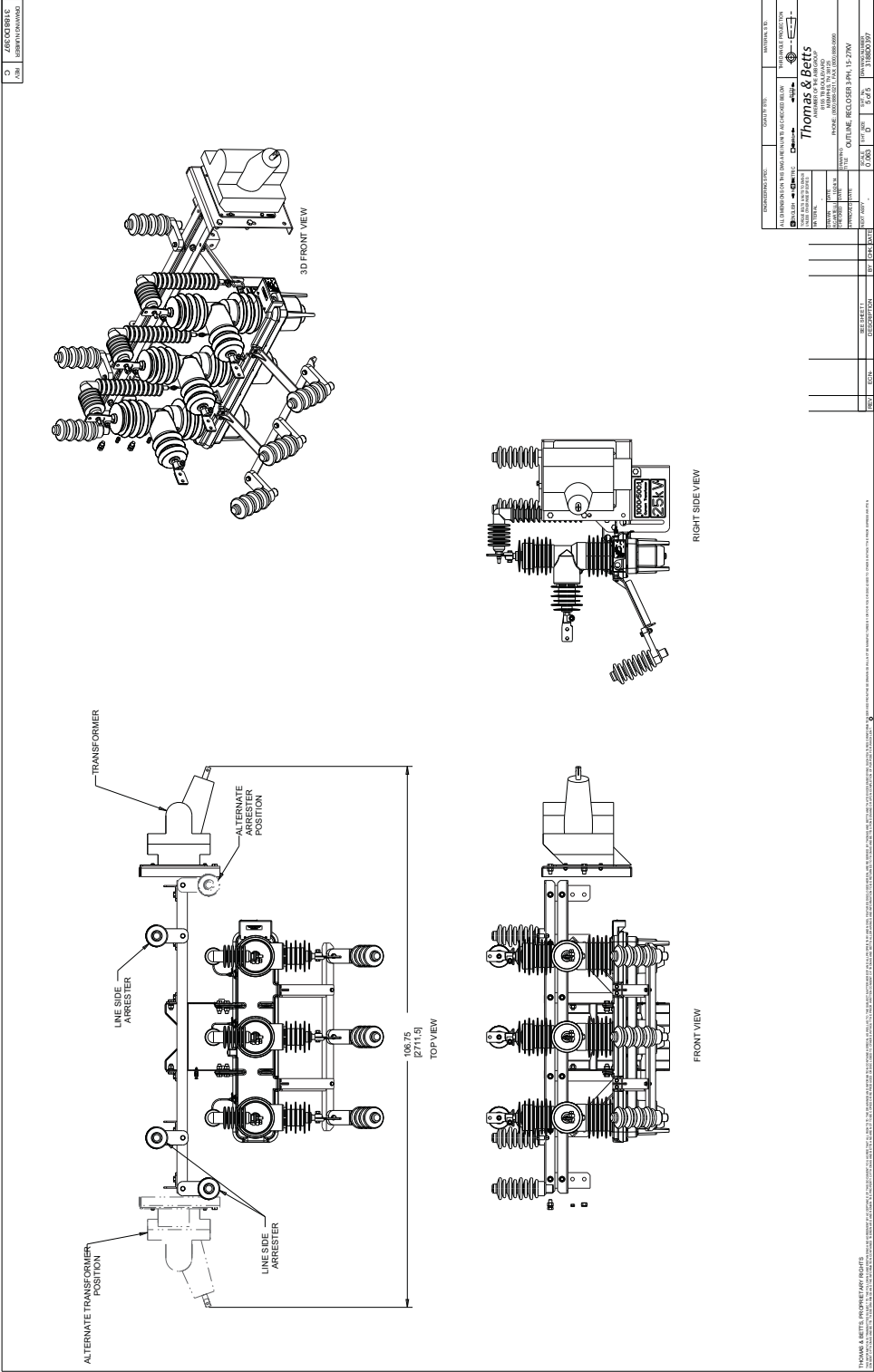


Outline drawings  
Three-phase 15/27 kV



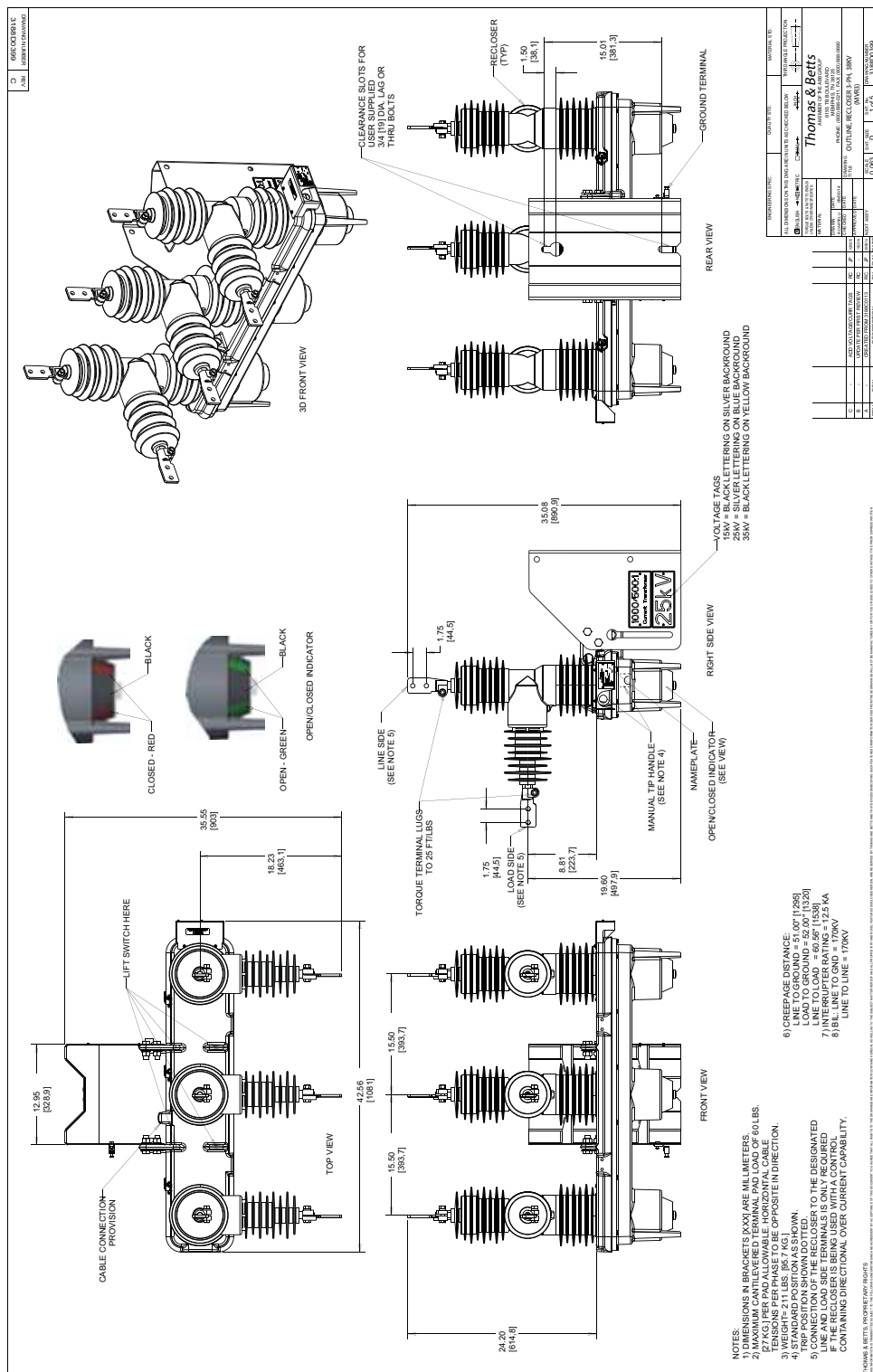


Outline drawings  
Three-phase 15/27 kV



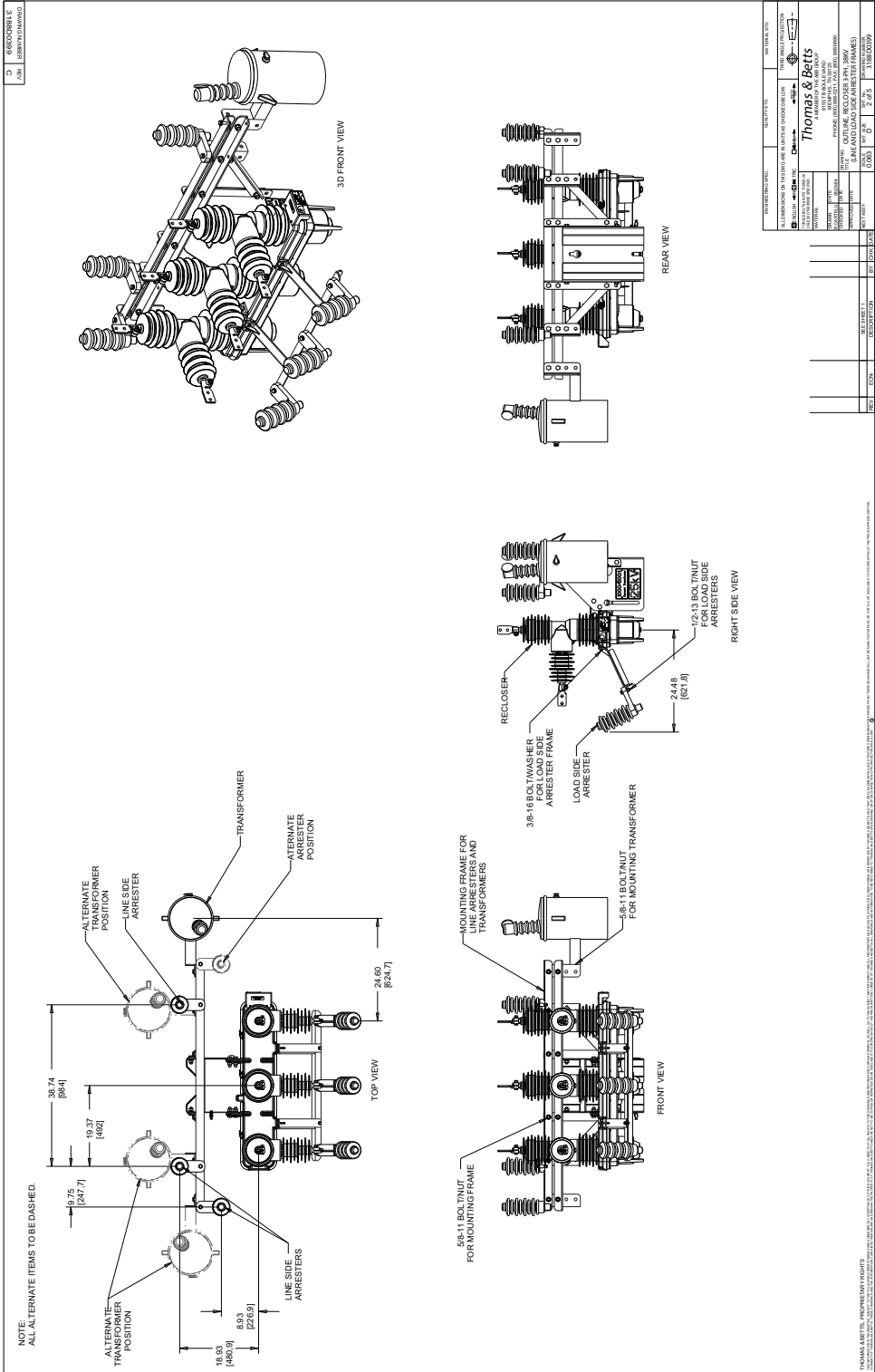
## Outline drawings

### Three-phase 38 kV



Outline drawings

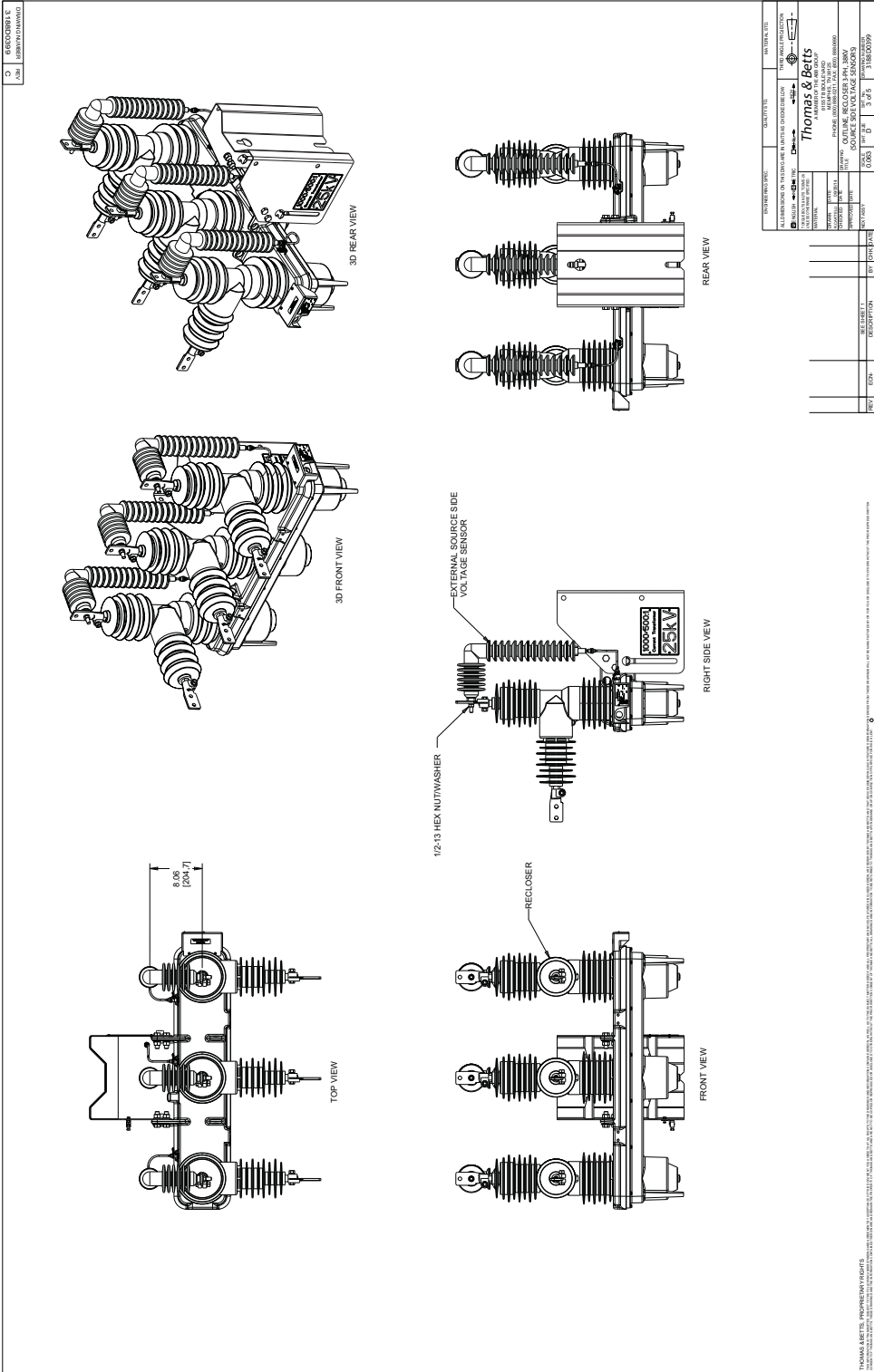
Three-phase 38 kV



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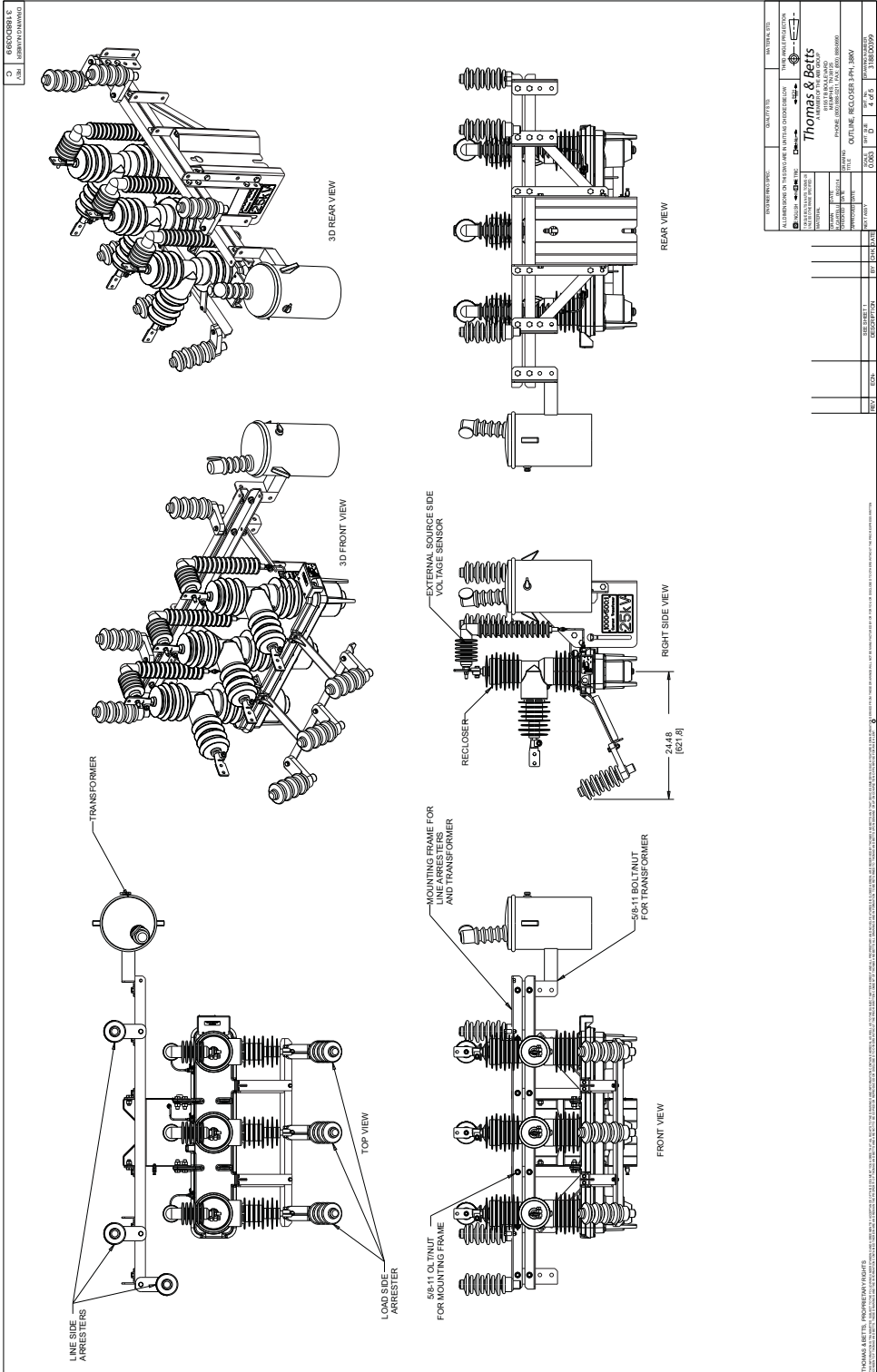
Outline drawings

Three-phase 38 kV



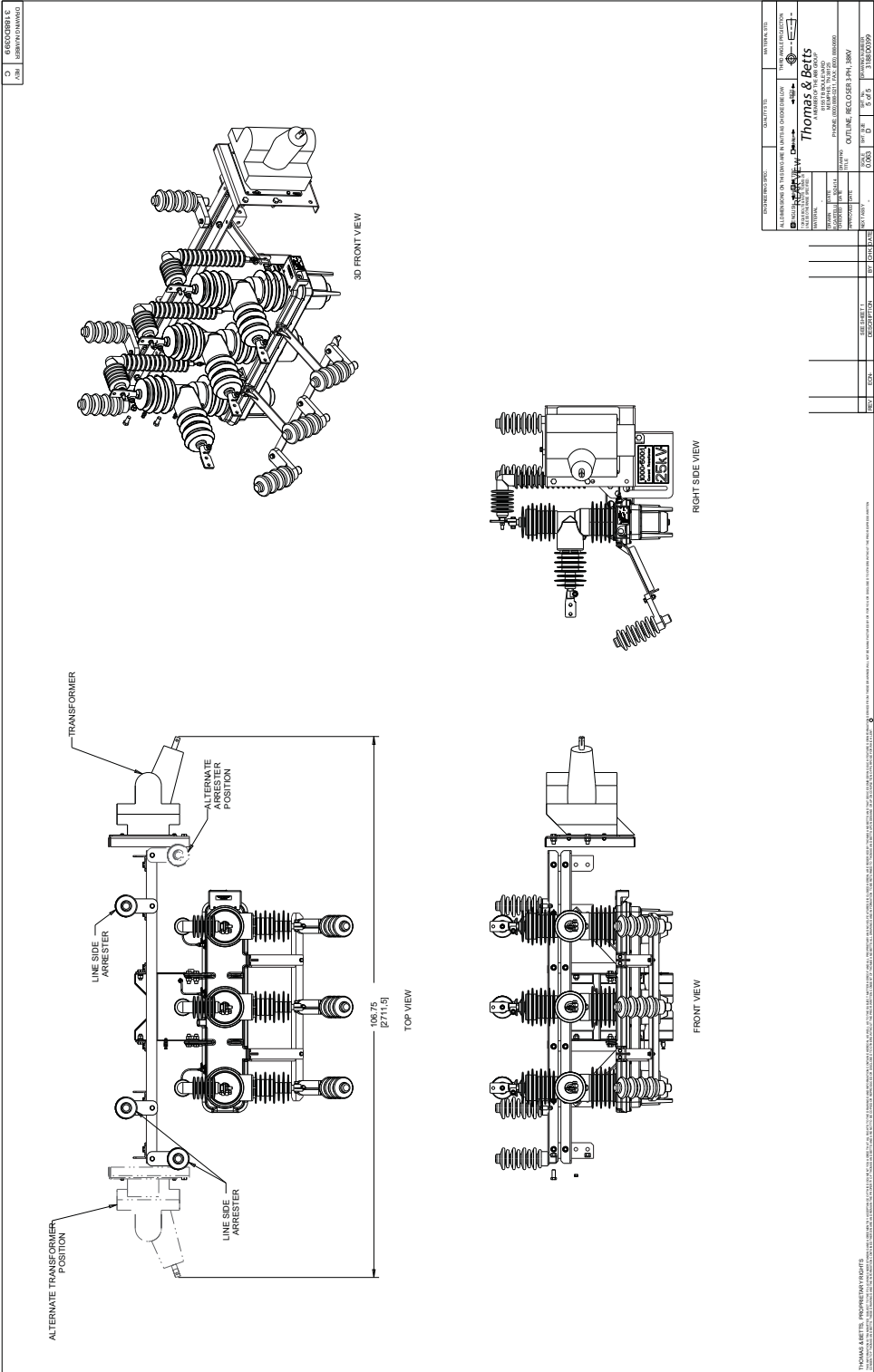
## Outline drawings

Three-phase 38 kV



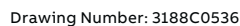
Outline drawings

Three-phase 38 kV

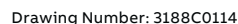


Drawing Number: 3188D0399

Single-phase 15/27/38 kV



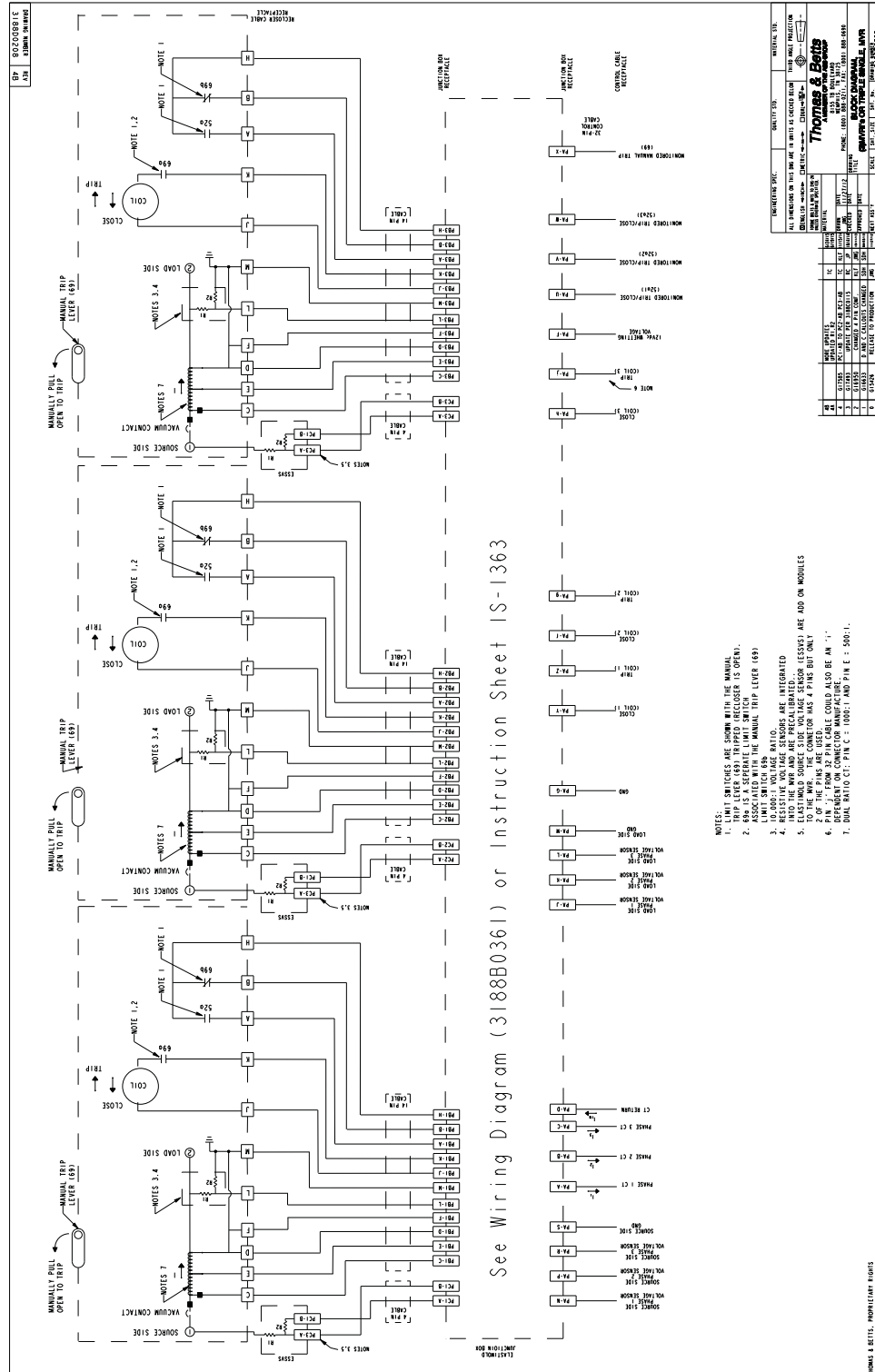
Three-phase 15/27/38 kV



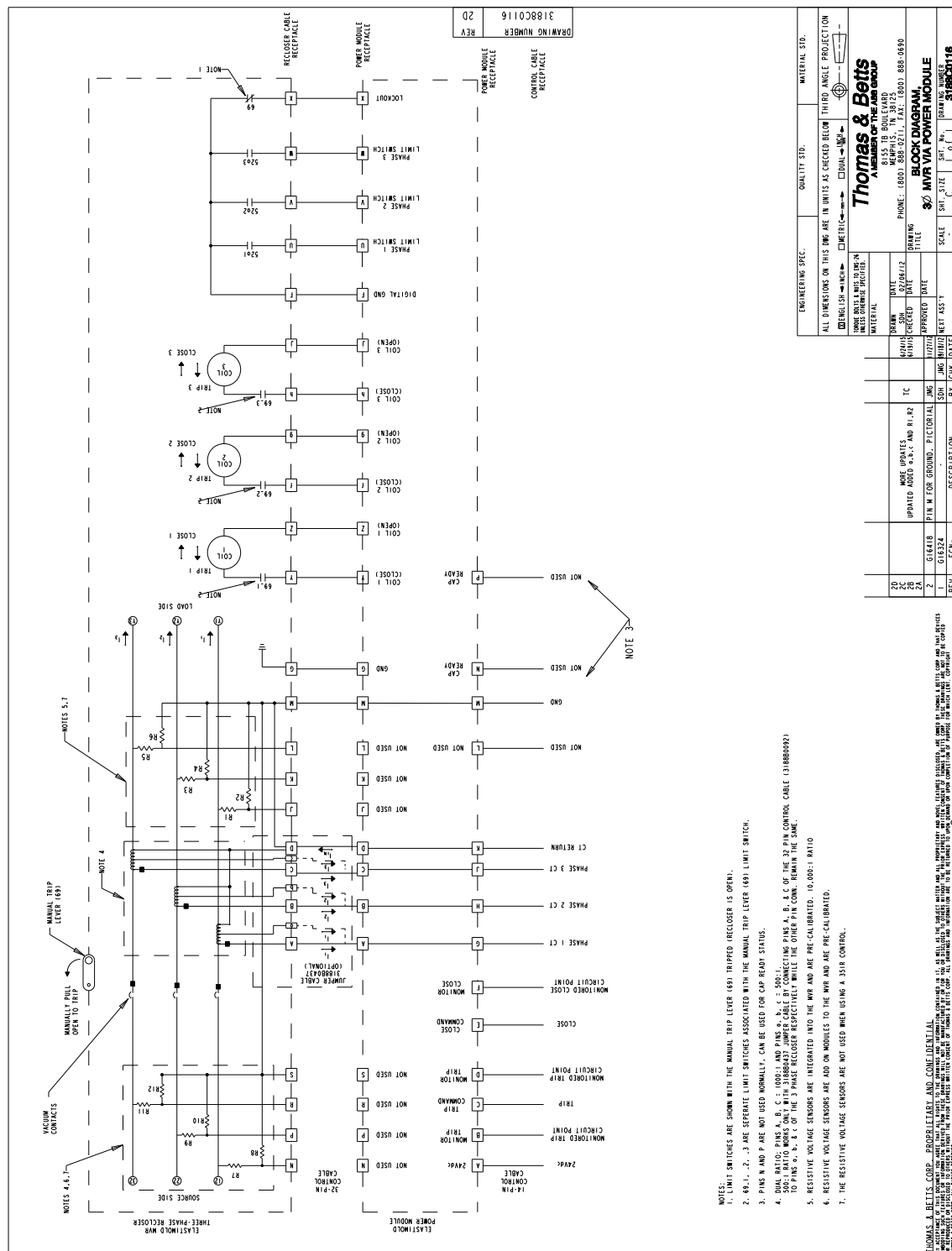


# Schematic drawings

Triple single 15/27/38 kV



Power module (for use with SEL 351R)



## Elastimold MVR test data summary



Elastimold MVRs are tested under the requirements of ANSI C37.60-2003.

**15 kV and 27 kV MVRs** are certified as single-phase devices and are capable of single-phase tripping on all grounded and ungrounded circuits within their respective rated maximum voltages (17.1 kV for 15 kV units and 29.3 kV for 27 kV units).

**38 kV MVRs** are certified for use as a single-phase device capable of single-phase tripping on grounded circuits and as a three-phase device capable of three-phase tripping only on ungrounded circuits.

The table below highlights the testing covered in Elastimold Test Report # 372-17-12010.

### Test report 372-17-12010

C37.60-2003 Standard clause & description	15 kV MVR compliance	27 kV MVR compliance	38 kV MVR compliance
6.2 Insulation (dielectric) tests	●	●	●
6.3 Switching tests	●	●	●
6.4 Making current capability	●	●	●
6.5 Operating duty tests	●	●	●
6.6 Minimum tripping current tests	●	●	●
6.7 Partial discharge (corona) tests	●	●	●
6.10 Temperature rise tests	●	●	●
6.11 Time-current tests	●	●	●
6.12 Mechanical duty tests	●	●	●
6.13 Surge withstand capability (SWC) tests	●	●	●
Other testing UV/weathering tests	●	●	●
Other testing IEC 62217 – salt fog spray test (1,000 hrs.)	●	●	●



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