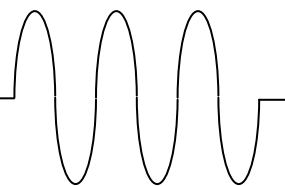


# MATRIX<sup>®</sup> FILTER

SERIES D

208-240 Volts, 60HZ

## USER MANUAL



PART NO. INSTR -027

REL. 120628

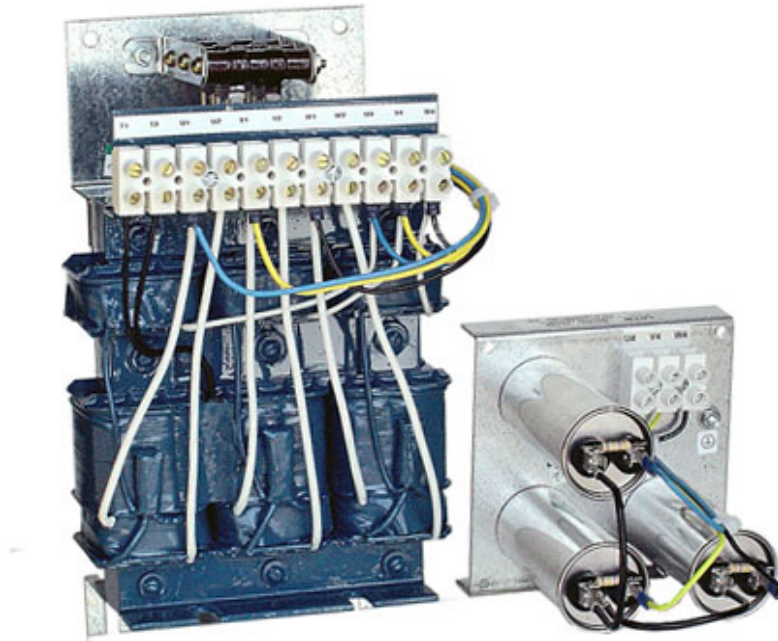
REV. 006

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## IMPORTANT USER INFORMATION

### NOTICE

The MTE Corporation Matrix® Filter is designed for harmonic mitigation of six pulse inverter drives supplying variable torque loads in a wide variety of applications. The suitability of this filter for a specific application must therefore be determined by the customer. In no event will MTE Corporation assume responsibility or liability for any direct or consequential damages resulting from the use or application of this filter. Nor will MTE Corporation assume patent liability with respect to the use of information, circuits or equipment described in this instruction manual. The series D Matrix Filter uses patented Harmonics Mitigating Reactor (HMR) technology to limit full load current distortion to less than 5% THID.



**MDP0011A**

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## IMPORTANT SAFETY INFORMATION



### WARNING

**ONLY A QUALIFIED ELECTRICIAN CAN CARRY OUT THE ELECTRICAL INSTALLATION OF THIS FILTER**



### WARNING

High voltage is used in the operation of this filter. Use Extreme caution to avoid contact with high voltage when operating, installing or repairing this filter.

**INJURY OR DEATH MAY RESULT IF SAFETY PRECAUTIONS ARE NOT OBSERVED.**

After removing power, allow at least five minutes to elapse and verify that the capacitors have discharged to a safe level before contacting internal components. Connect a DC voltmeter across the capacitor terminals. Start with the meter on the highest scale and progressively switch to a lower scale as the indicated voltage falls below the maximum value of the scale used.



### WARNING

The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the filter should be examined and replaced if damaged.

**IMPORTANT SAFETY INFORMATION, CONT.****WARNING**

An upstream disconnect/protection device must be used as required by the National Electrical Code (NEC) or governing authority.

**WARNING**

Even if the upstream disconnect/protection device is open, the drive down stream of the filter may feed back high voltage to the filter. The drive safety instructions must be followed.

**INJURY OR DEATH MAY RESULT IF SAFETY PRECAUTIONS ARE NOT OBSERVED****WARNING**

The filter must be grounded with a grounding conductor connected to all grounding terminals.

**WARNING**

Only spare parts obtained from MTE Corporation or an authorized MTE distributor can be used.

**WARNING**

***Loose or improperly secured connections may damage or degrade filter performance. Visually inspect and secure all electrical connections before loading the filter.***

## Introduction

This manual was specifically developed to assist in the installation, interconnection and operation of the MTE Corporation "Series D" Matrix Filter.

This manual is intended for use by personnel experienced in the operation and maintenance of electronic drives. Because of the high voltages required by the filter and drive and the potential dangers presented by rotating machinery, it is essential that all personnel involved in the operation and maintenance of this filter know and practice the necessary safety precautions for this type of equipment. Personnel should read and understand the instructions contained in this manual before installing, operating or servicing the filter and the drive to which the filter is connected.

### **Upon Receipt of this Filter:**

The MTE Matrix Filter has been subjected to demanding factory tests before shipment. Carefully inspect the shipping container for damage that may have occurred in transit. Then unpack the filter and carefully inspect for any signs of damage. Save the shipping container for future transport of the filter.

**In the event of damage, please contact and file a claim with the freight carrier involved immediately.**

If the equipment is not going to be put into service upon receipt, cover and store the filter in a clean, dry location. After storage, ensure that the equipment is dry and that no condensation has accumulated on the internal components of the filter before applying power.

### **Repair/Exchange Procedure**

MTE Corporation requires a Returned Material Authorization Number before it can accept any filters that qualify for return or repair. If problems or questions arise during installation, setup, or operation of the filter, please call the Director of Corporate Quality for assistance at:

Phone: 262-946-2800

FAX: 262-253-8222

## PART NUMBER CODES

	<b>MD</b>	<b>X</b>	—	—	<b>X</b>	—	—
Matrix Series <u>D</u>							
TYPE							
P Panel mounts G General Purpose NEMA 2 W Weather NEMA 3R							
CURRENT RATING							
0006 is 6 Amps 0240 is 240 Amps							
VOLTAGE FREQUENCY CODE							
A 208-240 Volts 60 HZ C 385-415 volts 50 Hz D 480 volts 60 Hz E 600 volts 60- Hz							
<b>BLANK for Options shows none selected</b>							
ENCLOSURE OPTIONS							
0 – None 1 – 3R / White paint 2 – 3R / Stainless / White paint 3 – Standard grey / rodent screen 4 – 3R / white paint / rodent screen 5 – 3R / Stainless / White / rodent screen							
CONTACTOR OPTIONS							
00 – None 02 – Contactor for capacitor Removal 09 – Adjustable Contactor capacitor removal 12 – Contactor for capacitor Removal / Transformer power 10 – Bypass contactor 11 – Bypass contactor / Transformer power 13 – Bypass contactor / Contactor for capacitor Removal / Transformer power							

## Specifications:

### Service Conditions

Load: 6 pulse variable torque rectifier only

Input voltage: 208-240 VAC +/- 10%, 60  $\pm$  0.75 Hz, 3 phase

Input voltage line unbalance: 1% maximum

Maximum source impedance: 6.00%

Minimum source impedance: 1.5%

Service Factor: 1.00

Overload: 150 % for 1 minute duration with 10% output voltage reduction of nominal of voltage.

Ambient Temperature (Operating)

Enclosed Filters:	-40 to +40 degrees C
Open Panel Filters:	-40 to +50 degrees C
Storage Temperature:	-40 to +90 degrees C

Altitude: 0 to 3300 Feet above sea level. Refer to figure 4 for altitude de-rating.

Relative Humidity: 0 to 95% non-condensing

### Agency Approvals

UL and cUL listed to UL508 Type MX and CSA-C22.2 No 14-95  
File E180243 (3 – 1000 HP, 120VAC through 600 VAC  
50, 50/60, 60 Hz Three Phase

#### **Notes (SCCR):**

1. The Short Circuit Current Rating (SCCR) is not required under Exception No.1 of UL508A SB4.2.1 effective 4/25/06. This exception also applies to all the Contactor Options (002, 009, 012, and similar), where the Contactors are separated from the Main Power path by exempt components (such as Reactors) of sufficient Impedance, which is assured in case of the Reactors that are integral components of our Filter.
2. The SCCR of Matrix Harmonic Filters with the Bypass Options (010, 011, 013, and similar) is determined by the rating of the Bypass Contactor, if the Contactor is supplied by MTE. These Options use Eaton (Cutler-Hammer) Freedom Series Contactors. The Contactors are UL certified as IEC Type 2, and have the SCCR of 100,000 Amps, when protected by appropriate Current Limiting Fuses (or Fast Acting Breaker of similar characteristics), such upstream branch protection devices being supplied and installed by Others. Customer's election to substitute their own Contactor for MTE's Standard, renders such Contactor separate from the Filter and thus has no impact on the Filter Rating Exemption Status.

### Performance

Total Harmonic Current Distortion:

Five Percent Filter: 5% MAX at FULL LOAD

Standby Current:

Without Optional Capacitor Contactor: 70% of the full load capacitor current listed in Table 3

With Optional Capacitor Contactor: Refer to Drive User's Manual



## Ratings

### Watts loss

Table 1

Maximum Output Amps RMS	Efficiency (Typical) (%)	Power Dissipation @ Rated Current (Typical) (Watts)
6	95.4	99
8	95.8	121
11	96.4	144
14	96.6	169
21	97.2	214
27	97.4	254
34	97.7	286
44	97.9	338
52	98.0	373
66	98.2	439
83	98.3	506
103	98.4	591
128	98.6	664
165	98.7	763
208	98.8	905
240	98.8	997

**Regulation table**  
**Table 2**

FILTER VOLTAGE REGULATION		208 VAC	240 VAC
MAXIMUM OUTPUT VOLTAGE AT NO LOAD	RMS PEAK	218 308	251 355
MINIMUM OUTPUT VOLTAGE AT FULL LOAD	RMS PEAK	200 282	230 324
*MAXIMUM PCC VOLTAGE WITH 6% SOURCE IMPEDANCE	RMS PEAK	212 300	245 346

Note: PCC is the point of common coupling with the power distribution system

**Capacitor Currents**  
Table 3

<b>Capacitor Current at Full Load</b>	
<b>Filter Current Rating Amps Rms</b>	<b>Capacitor Current (Typical) Amps RMS</b>
6	2.3
8	3.1
11	4.2
14	5.4
21	8.1
27	10.4
34	13.1
44	16.9
52	20.0
66	25.4
83	31.4
103	39.6
128	49.2
165	63.4
208	79.9
240	92.2

## Over Temperature Switch Ratings

Table 6

<b><i>NC Switch</i></b> opens at 180 Deg. +/- 5 deg C		
<b>Current Amps</b>	<b>Voltage</b>	<b>Contact Load</b>
6	120 AC	Resistive Loads
3	120 AC	Inductive Loads
3	240 AC	Resistive Loads
2.5	240 AC	Inductive Loads
8	12 VDC	Resistive Loads
4	24 VDC	Resistive Loads

## Open Style Component Dimensions

Amps rating	Catalog Part Number	Weight Lbs.	HMR Size Inches	HMR Ref. Figure	Capacitor assemblies size Inches	Capacitor Ref. Figure
6	MDP0006A	26	11.3"H x 6"W x 5.6"D	<a href="#">Figure 5</a>	5.6"H x 5.6"W x 9.3"D	<a href="#">Figure 10</a>
8	MDP0008A	28	11.3"H x 6"W x 5.6"D	<a href="#">Figure 5</a>	5.6"H x 5.6"W x 9.3"D	<a href="#">Figure 10</a>
11	MDP0011A	33	11.3"H x 6"W x 6.2"D	<a href="#">Figure 5</a>	5.6"H x 5.6"W x 7.3"D	<a href="#">Figure 10</a>
14	MDP0014A	39	11.3"H x 6"W x 6.3"D	<a href="#">Figure 5</a>	5.6"H x 5.6"W x 8.2"D	<a href="#">Figure 10</a>
21	MDP0021A	48	12.4"H x 7.2"W x 5.7"D	<a href="#">Figure 5</a>	5.6"H x 5.6"W x 9.3"D	<a href="#">Figure 10</a>
27	MDP0027A	63	12.4"H x 7.3"W x 6.3"D	<a href="#">Figure 5</a>	8"H x 9.1"W x 12"D	<a href="#">Figure 11</a>
34	MDP0034A	74	15.8"H x 9"W x 6.5"D	<a href="#">Figure 5</a>	8"H x 9.1"W x 12"D	<a href="#">Figure 11</a>
44	MDP0044A	84	15.8"H x 9"W x 7"D	<a href="#">Figure 5</a>	8"H x 9.1"W x 12"D	<a href="#">Figure 11</a>
52	MDP0052A	119	15.8"H x 9"W x 7"D	<a href="#">Figure 5</a>	5.6"H x 5.6"W x 9.3"D	<a href="#">Figure 10</a>
66	MDP0066A	150	15.8"H x 9"W x 7.5"D	<a href="#">Figure 5</a>	8"H x 9.1"W x 12"D	<a href="#">Figure 11</a>
83	MDP0083A	169	15.8"H x 9"W x 8"D	<a href="#">Figure 5</a>	8"H x 9.1"W x 12"D	<a href="#">Figure 11</a>
103	MDP0103A	172	16.5"H x 12.3"W x 9.6"D	<a href="#">Figure 6</a>	8"H x 9.1"W x 12"D	<a href="#">Figure 11</a>
128	MDP0128A	209	16.5"H x 12.3"W x 10.2"D	<a href="#">Figure 6</a>	12"H x 9.1"W x 12"D	<a href="#">Figure 12</a>
165	MDP0165A	265	16.5"H x 12.3"W x 11.3"D	<a href="#">Figure 6</a>	12"H x 9.1"W x 12"D	<a href="#">Figure 12</a>
208	MDP0208A	276	16.5"H x 12.3"W x 11"D	<a href="#">Figure 6</a>	15"H x 9.1"W x 12"D	<a href="#">Figure 13</a>
240	MDP0240A	282	23"H x 15.3"W x 11.3"D	<a href="#">Figure 7</a>	15"H x 9.1"W x 12"D	<a href="#">Figure 13</a>

See following assembly pages for drawing details.

## Enclosed Unit Size and Weights

Table 5

Filter Amps	NEMA 2	Enclosure	Weight	NEMA 3R	Enclosure	Weight	Figure
6	MDG0006A	CAB-12C2	76	MDW0006A	CAB-12C3	86	<a href="#">Figure 14</a>
8	MDG0008A	CAB-12C2	79	MDW0008A	CAB-12C3	89	<a href="#">Figure 14</a>
11	MDG0011A	CAB-12C2	83	MDW0011A	CAB-12C3	93	<a href="#">Figure 14</a>
14	MDG0014A	CAB-12C2	89	MDW0014A	CAB-12C3	99	<a href="#">Figure 14</a>
21	MDG0021A	CAB-12C2	100	MDW0021A	CAB-12C3	110	<a href="#">Figure 14</a>
27	MDG0027A	CAB-17C2	115	MDW0027A	CAB-17C3	125	<a href="#">Figure 15</a>
34	MDG0034A	CAB-17C2	126	MDW0034A	CAB-17C3	136	<a href="#">Figure 15</a>
44	MDG0044A	CAB-17C2	138	MDW0044A	CAB-17C3	148	<a href="#">Figure 15</a>
52	MDG0052A	CAB-17C2	190	MDW0052A	CAB-17C3	199	<a href="#">Figure 15</a>
66	MDG0066A	CAB-17C2	219	MDW0066A	CAB-17C3	228	<a href="#">Figure 15</a>
83	MDG0083A	CAB-17C2	241	MDW0083A	CAB-17C3	250	<a href="#">Figure 15</a>
103	MDG0103A	CAB-17C2	244	MDW0103A	CAB-17C3	253	<a href="#">Figure 15</a>
128	MDG0128A	CAB-26C2	385	MDW0128A	CAB-26C3	406	<a href="#">Figure 16</a>
165	MDG0165A	CAB-26C2	441	MDW0165A	CAB-26C3	462	<a href="#">Figure 16</a>
208	MDG0208A	CAB-26C2	461	MDW0208A	CAB-26C3	482	<a href="#">Figure 16</a>
240	MDG0240A	CAB-26C2	467	MDW0240A	CAB-26C3	488	<a href="#">Figure 16</a>

**Note:** Weight is shown in pounds

## Performance Data

Figure 1

### Load effect on THID

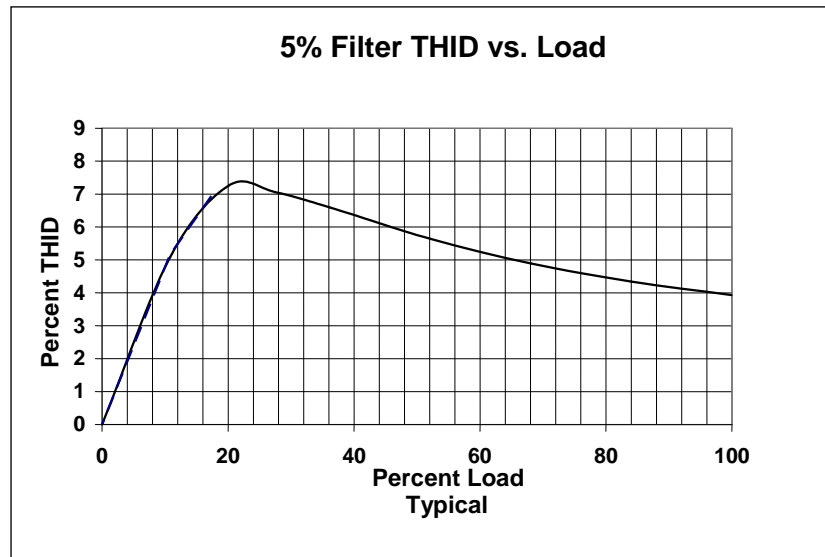


Figure 2

### Harmonic Spectrum 100% Load

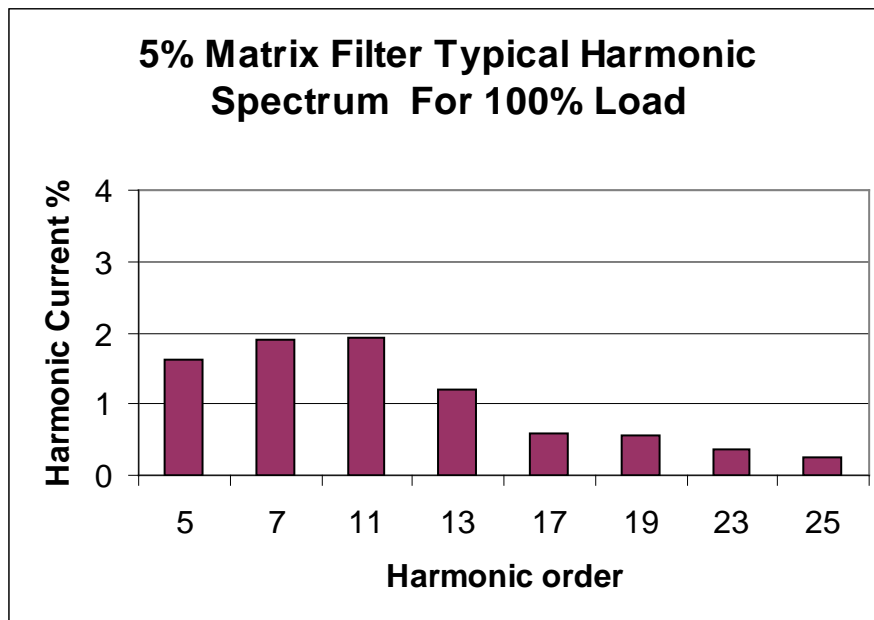
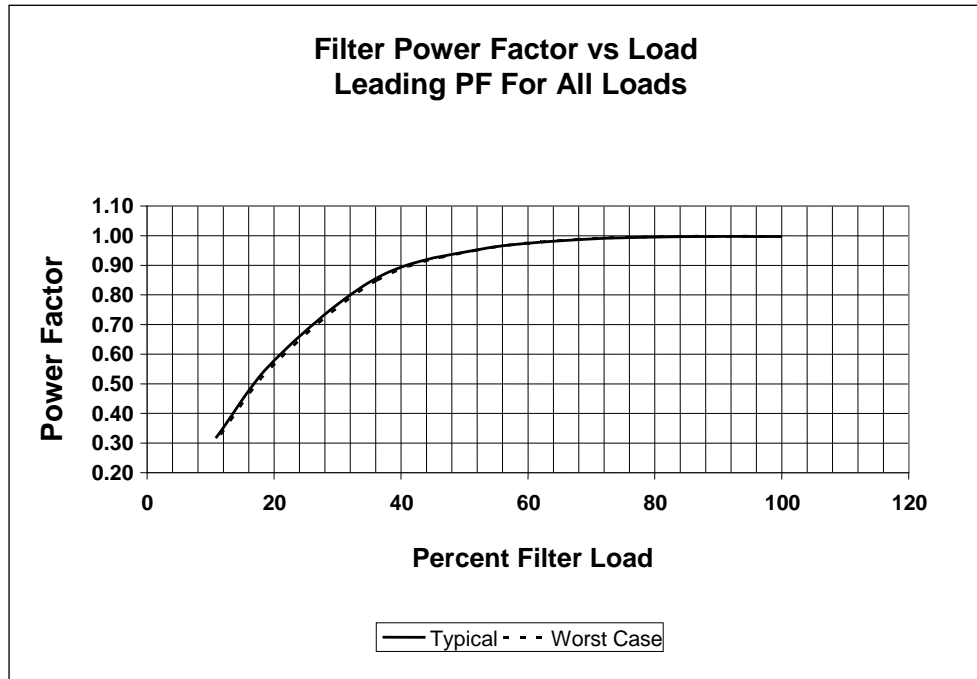


Figure 3  
**Power Factor**



## Performance with Unbalanced Line Voltage (Typical)

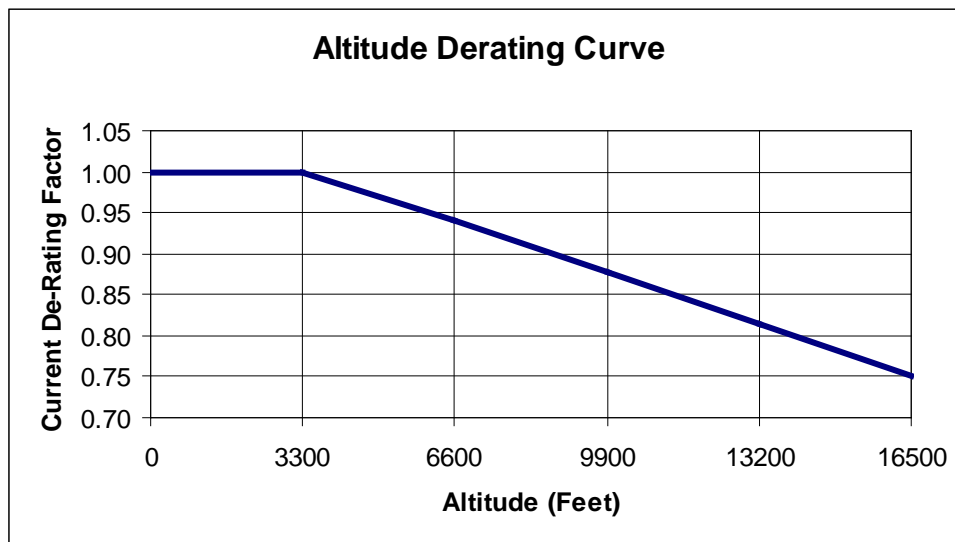
Table 7

All Components at Nominal Values and Worse Case Service Conditions	
100% Load	
Nominal THID	3.93%
1% Unbalance	4.06%
2% Unbalance	4.47%
3% Unbalance	5.10%
30% Load	
Nominal THID	7.06%
1% Unbalance	7.45%
2% Unbalance	8.21%
3% Unbalance	10.46%



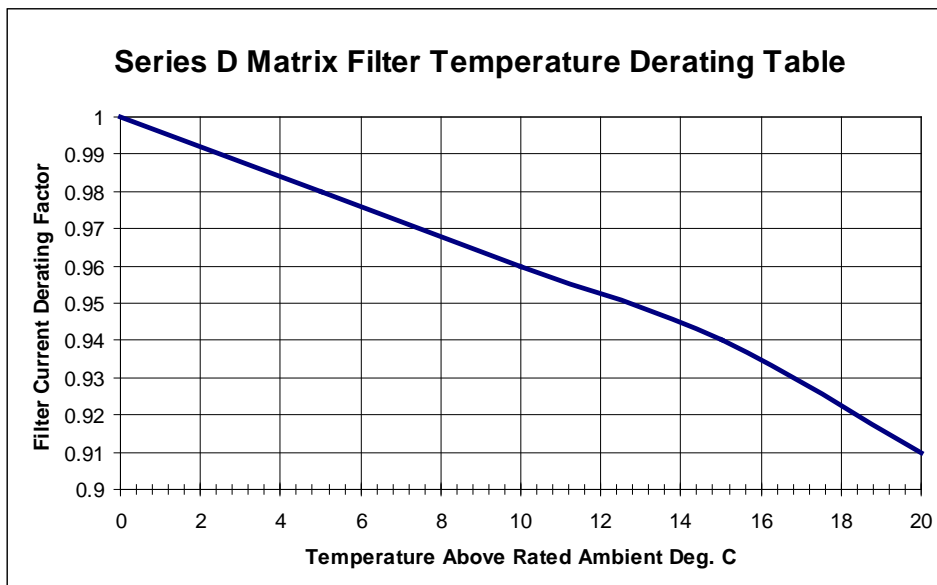
## Altitude Derating Curve

Figure 4



## Temperature Derating Curve

Figure 4A



**Note:** Contact factory if Ambient is 20 °C above temperature rating.  
 See or click [Specifications](#) for temperature ratings

## INSTALLATION INSTRUCTIONS

Matrix Filters are supplied in the following mechanical configurations:

Panel mounted assemblies

Floor mounted general purpose NEMA 2, & 3R cabinets,

Select a well-ventilated, dust-free area away from direct sunlight, rain or moisture. Do not install in or near a corrosive environment. Avoid locations where the filter would be subjected to excessive vibrations.

Panel mounted filters are designed for mounting in the vertical plane within the customer's enclosure. Panel mount units are made up of a Harmonic Mitigating Reactor (HMR) and one or more capacitor panel assemblies referred to as cap-panels on drawings and diagrams.

Mount the Harmonic Mitigating Reactor in a location where the ambient temperature does not exceed 50 degrees C. Allow a minimum side clearance of four (4) inches and a vertical clearance of six (6) inches for proper heat dissipation and access.



### WARNING

**Do not install capacitor assembly above/near resistors and Harmonic Mitigating Reactor. Premature or catastrophic failure may occur.**

The capacitor assembly must be located in the lowest temperature regions of the enclosure - generally toward the bottom and away from high temperature components.



Figure's 5 - 17 contain outline drawings for the various ratings and show mounting orientation with bolt patterns.

Include the power dissipation of the filter along with all the other components located in the enclosure to determine the internal temperature rise and cooling requirements of the enclosure.

General purpose NEMA 2, and 3R enclosed filters are designed for floor mounting in the vertical plane in an environment suitable for the enclosure type. Do not install in or near a corrosive environment. Avoid locations where the filter would be subjected to excessive vibrations. Allow a minimum side and back clearance of eight (8) inches and front clearance of thirty-six (36) inches for proper heat dissipation and access.

Refer to Article 430 Table 430.91 of the National Electrical code for the selection of the appropriate enclosure Type Number for your application.

## HMR Bolt Hole Mounting Patterns

Table 8

Part Number	Lbs	Overall Size	Rear Mount Centerline	Base Mount Centerline	Mounting Holes	Figure
MDP0006A	26	11.3"H x 6"W x 5.6"D	10.25"A x 5"B	3"C x 2.5"E	0.281 DIA	<a href="#">Figure 5</a>
MDP0008A	28	11.3"H x 6"W x 5.6"D	10.25"A x 5"B	3"C x 2.5"E	0.281 DIA	<a href="#">Figure 5</a>
MDP0011A	33	11.3"H x 6"W x 6.2"D	10.25"A x 5"B	3"C x 2.5"E	0.281 DIA	<a href="#">Figure 5</a>
MDP0014A	39	11.3"H x 6"W x 6.3"D	10.25"A x 5"B	3"C x 2.5"E	0.281 DIA	<a href="#">Figure 5</a>
MDP0021A	48	12.4"H x 7.2"W x 5.7"D	11.38"A x 5"B	3"C x 2.38"E	0.281 DIA	<a href="#">Figure 5</a>
MDP0027A	63	12.4"H x 7.3"W x 6.3"D	11.38"A x 5"B	3"C x 2.88"E	0.281 DIA	<a href="#">Figure 5</a>
MDP0034A	74	15.8"H x 9"W x 6.5"D	14.25"A x 6"B	4.26"C x 3.2"E	0.358 DIA	<a href="#">Figure 5</a>
MDP0044A	84	15.8"H x 9"W x 7"D	14.25"A x 6"B	4.26"C x 3.75"E	0.358 DIA	<a href="#">Figure 5</a>
MDP0052A	119	15.8"H x 9"W x 7"D	14.25"A x 6"B	4.26"C x 3.75"E	0.358 DIA	<a href="#">Figure 5</a>
MDP0066A	150	15.8"H x 9"W x 7.5"D	14.25"A x 6"B	4.26"C x 4.25"E	0.358 DIA	<a href="#">Figure 5</a>
MDP0083A	169	15.8"H x 9"W x 8"D	14.25"A x 6"B	4.26"C x 4.75"E	0.358 DIA	<a href="#">Figure 5</a>
MDP0103A	172	16.5"H x 12.3"W x 9.6"D	12.24"A x 11"B	6.5"C x 11"E	0.413 DIA	<a href="#">Figure 6</a>
MDP0128A	209	16.5"H x 12.3"W x 10.2"D	12.14"A x 11"B	6.5"C x 11"E	0.413 DIA	<a href="#">Figure 6</a>
MDP0165A	265	16.5"H x 12.3"W x 11.3"D	12.15"A x 11"B	6.5"C x 11"E	0.413 DIA	<a href="#">Figure 6</a>
MDP0208A	276	16.5"H x 12.3"W x 11"D	12.21"A x 11"B	6.5"C x 11"E	0.413 DIA	<a href="#">Figure 6</a>
MDP0240A	282	23"H x 15.3"W x 11.3"D	17.83"A x 14"B	8"C x 14"E	0.413 DIA	<a href="#">Figure 7</a>

*Use the above table and referenced figures to establish suitable reactor mounting.*

**Cap-panel Bolt Hole Mounting Patterns**  
**Table 9**

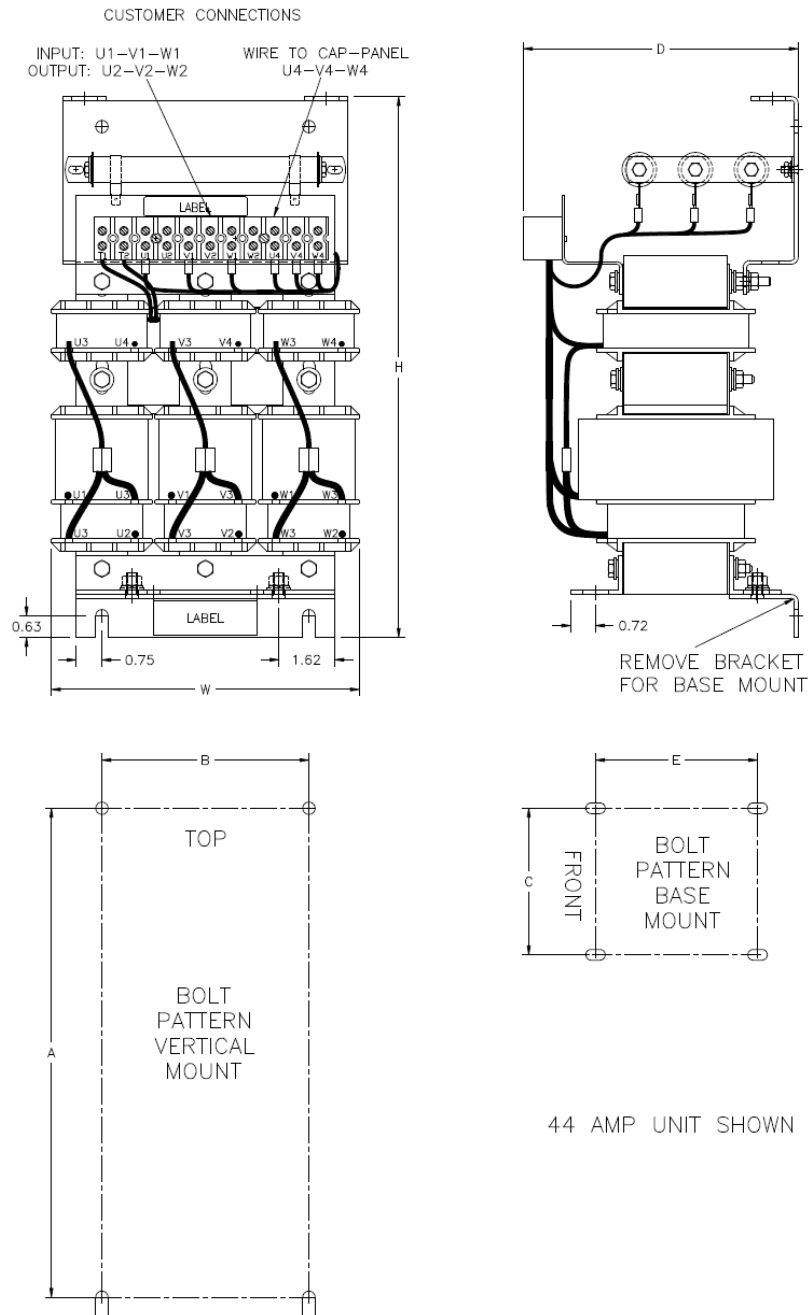
Part Number	CAP P.N.	Cap-panel Weight Lbs.	Overall Size	Rear Mount Centerline	Mounting Holes	Figure
MDP0006A	202	3.75	5.6"H x 5.6"W x 9.3"D	5.06"A x 5.06"B	0.218	<a href="#">Figure 10</a>
MDP0008A	294	3.75	5.6"H x 5.6"W x 9.3"D	5.06"A x 5.06"B	0.218	<a href="#">Figure 10</a>
MDP0011A	204	3.75	5.6"H x 5.6"W x 7.3"D	5.06"A x 5.06"B	0.218	<a href="#">Figure 10</a>
MDP0014A	295	3.75	5.6"H x 5.6"W x 8.2"D	5.06"A x 5.06"B	0.218	<a href="#">Figure 10</a>
MDP0021A	522	3.75	5.6"H x 5.6"W x 9.3"D	5.06"A x 5.06"B	0.218	<a href="#">Figure 10</a>
MDP0027A	271	7.5	8"H x 9.1"W x 12"D	7.25"A x 4.5"B	0.218	<a href="#">Figure 11</a>
MDP0034A	266	7.5	8"H x 9.1"W x 12"D	7.25"A x 4.5"B	0.218	<a href="#">Figure 11</a>
MDP0044A	308	7.5	8"H x 9.1"W x 12"D	7.25"A x 4.5"B	0.218	<a href="#">Figure 11</a>
MDP0052A	530	3.75	5.6"H x 5.6"W x 9.3"D	5.06"A x 5.06"B	0.218	<a href="#">Figure 10</a>
MDP0066A	267	7.5	8"H x 9.1"W x 12"D	7.25"A x 4.5"B	0.218	<a href="#">Figure 11</a>
MDP0083A	272	7.5	8"H x 9.1"W x 12"D	7.25"A x 4.5"B	0.218	<a href="#">Figure 11</a>
MDP0103A	268	7.5	8"H x 9.1"W x 12"D	7.25"A x 4.5"B	0.218	<a href="#">Figure 11</a>
MDP0128A	270	11.25	12"H x 9.1"W x 12"D	11.25"A x 4.5"B	0.218	<a href="#">Figure 12</a>
MDP0165A	523	11.25	12"H x 9.1"W x 12"D	11.25"A x 4.5"B	0.218	<a href="#">Figure 12</a>
MDP0208A	300	15	15"H x 9.1"W x 12"D	14.25"A x 4.5"B	0.218	<a href="#">Figure 13</a>
MDP0240A	301	15	15"H x 9.1"W x 12"D	14.25"A x 4.5"B	0.218	<a href="#">Figure 13</a>

*Use the above table and referenced figures to establish suitable Cap-panel mounting*

## HMR MOUNTING & TERMINAL LOCATIONS

### HMR 6 - 83 Amps

**Filters No Longer Ship  
With Resistors**

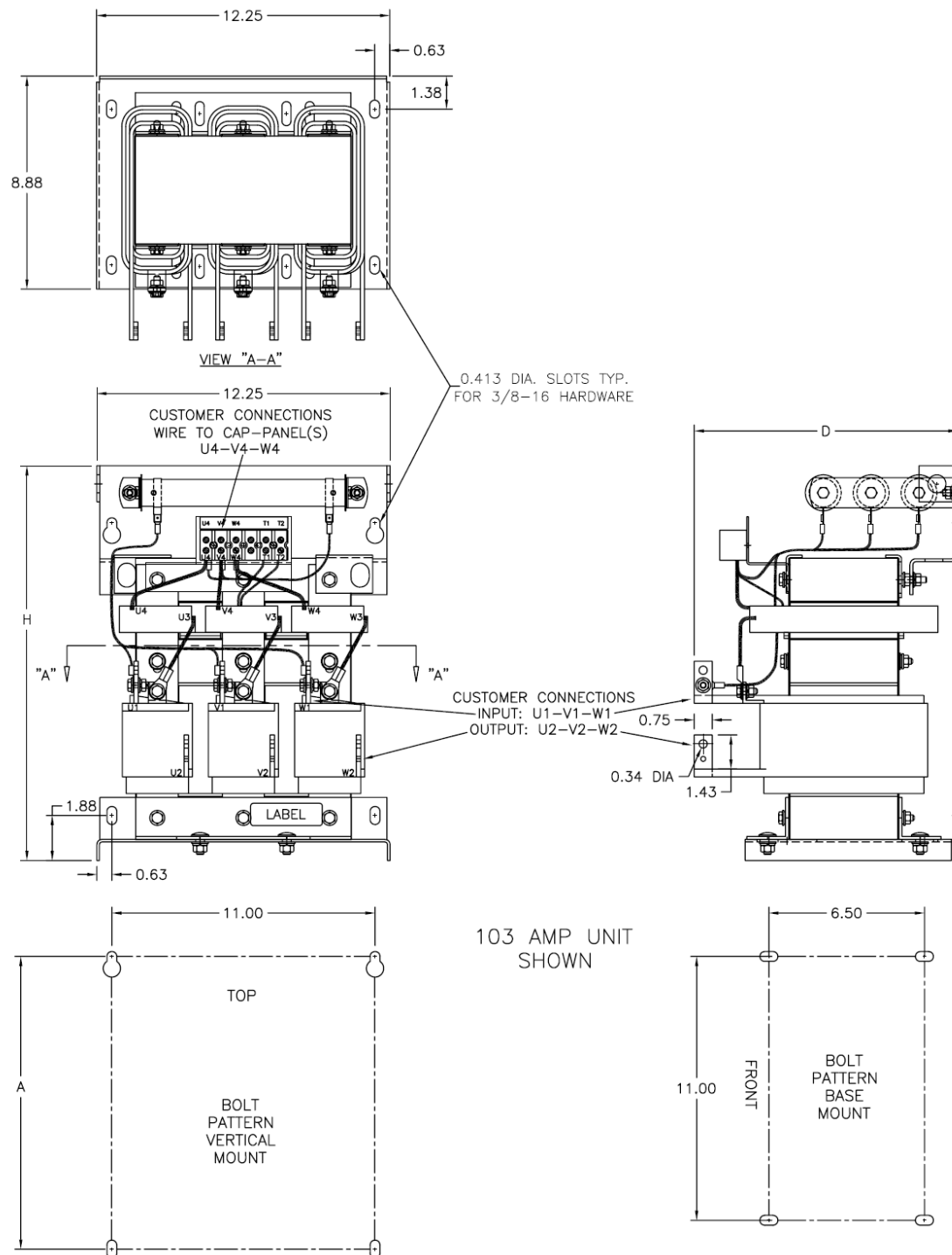


**Figure 5 6 - 83 AMP**

## HMR MOUNTING & TERMINAL LOCATIONS

### HMR 103 - 208 Amp

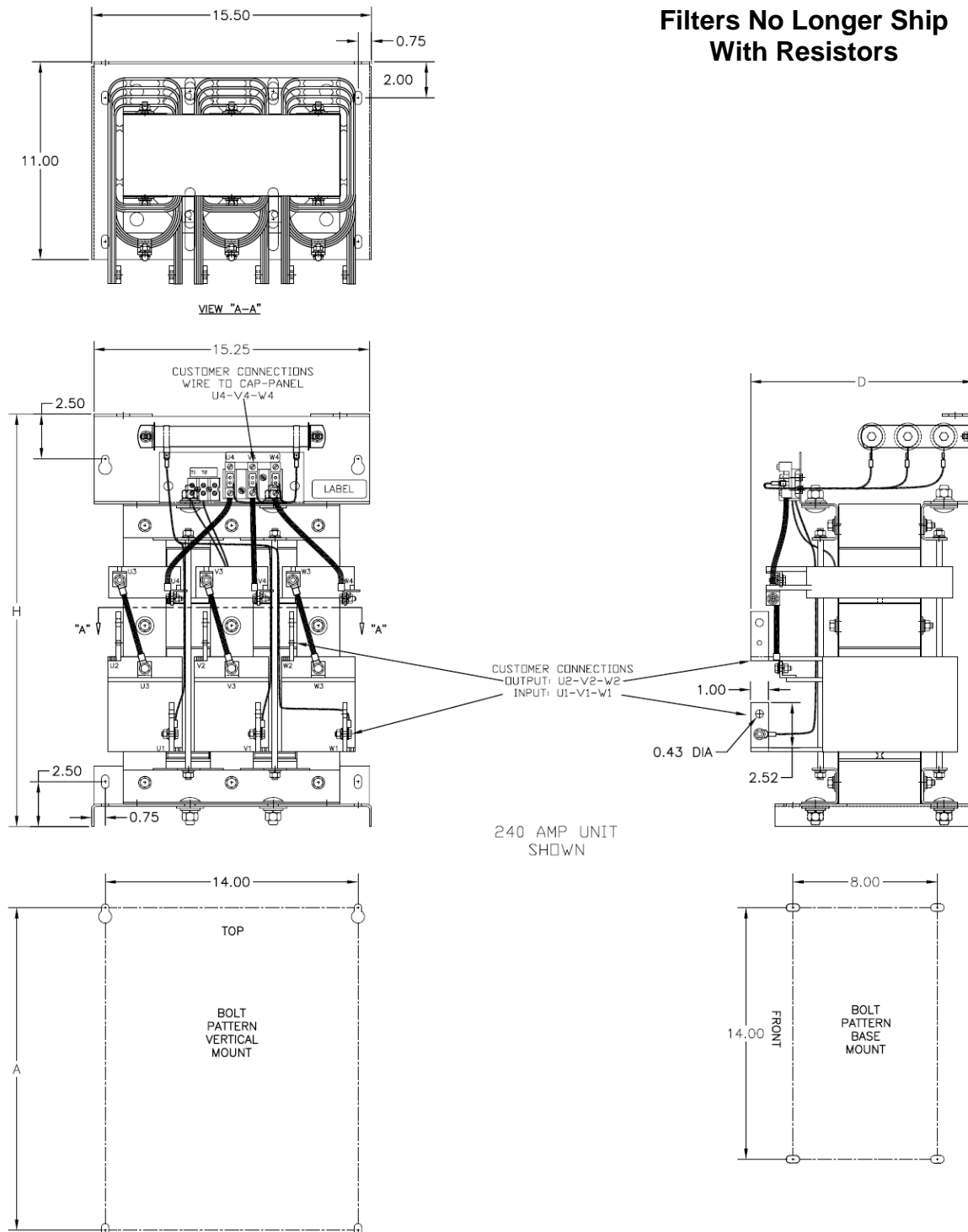
**Filters No Longer Ship  
With Resistors**



**Figure 6 103 – 208 AMP**

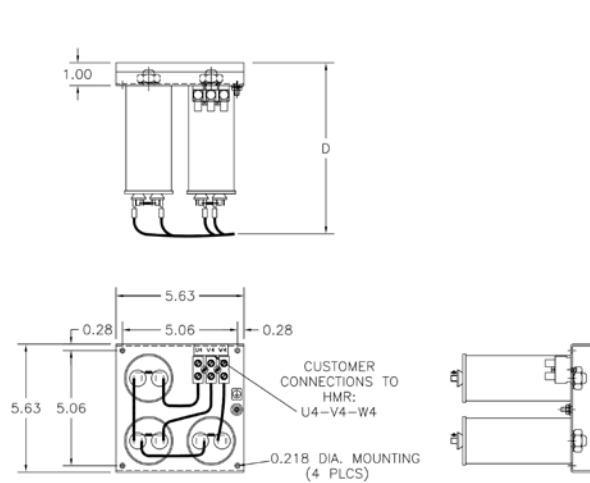
## HMR MOUNTING & TERMINAL LOCATIONS

### HMR 240 Amp

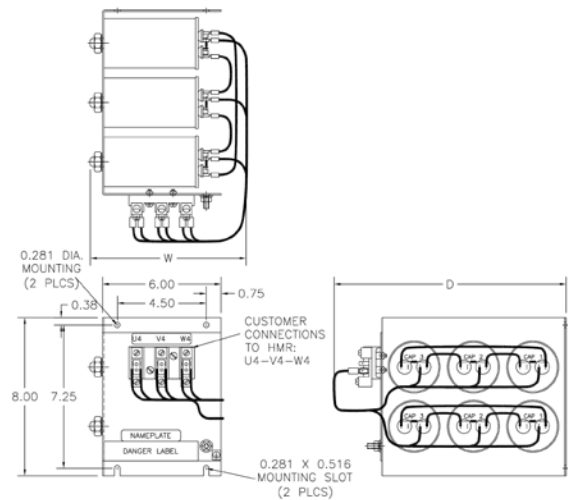


**Figure 7 240 AMP**

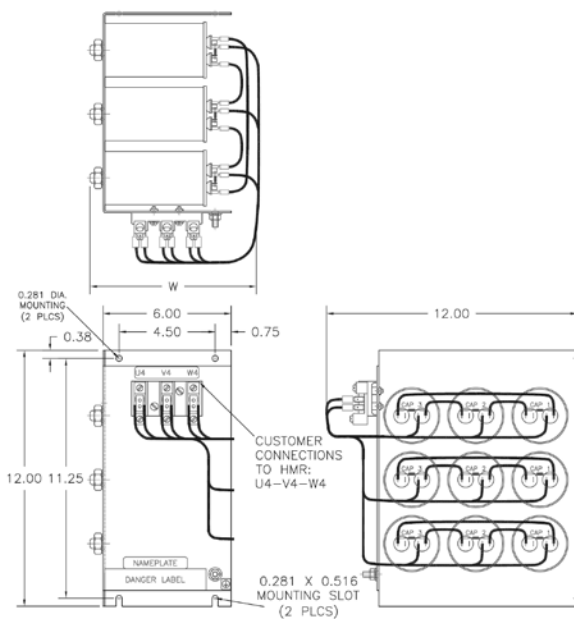
## CAP-ASSEMBLY MOUNTING & TERMINAL LOCATIONS



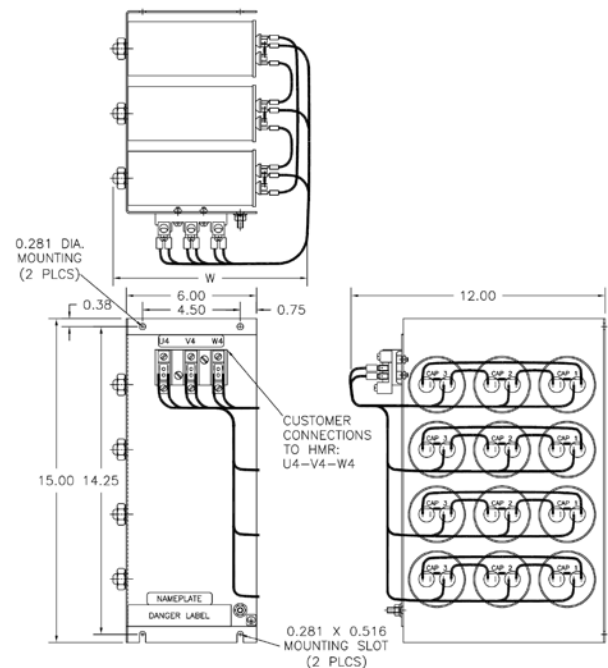
**Figure 10 3 Caps**



**Figure 11 6 Caps**



**Figure 12 9 Caps**

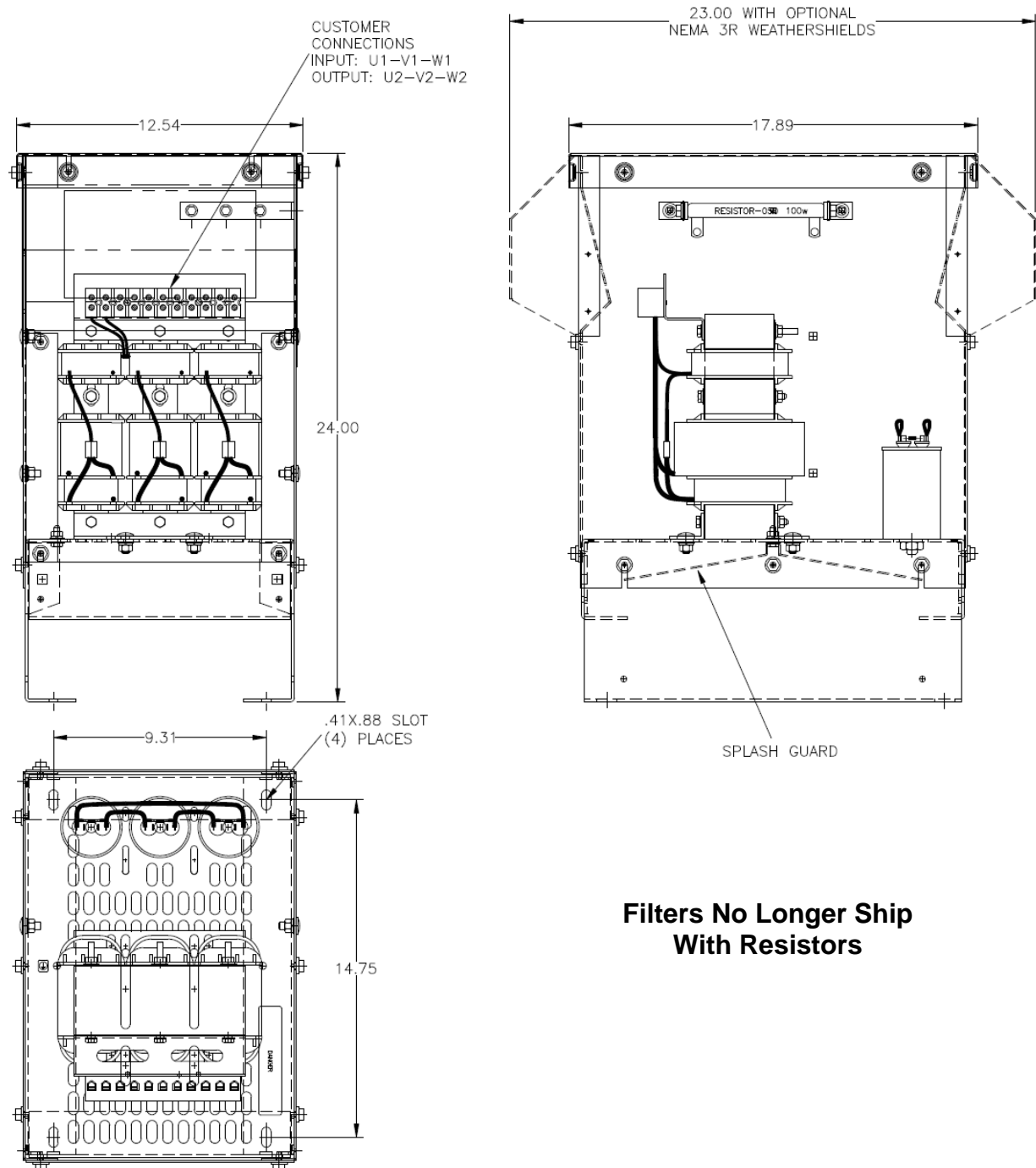


**Figure 13 12 Caps**



## ENCLOSED UNIT INTERNAL DETAILS & TERMINAL LOCATIONS

### CAB-12C 6-21 AMPS



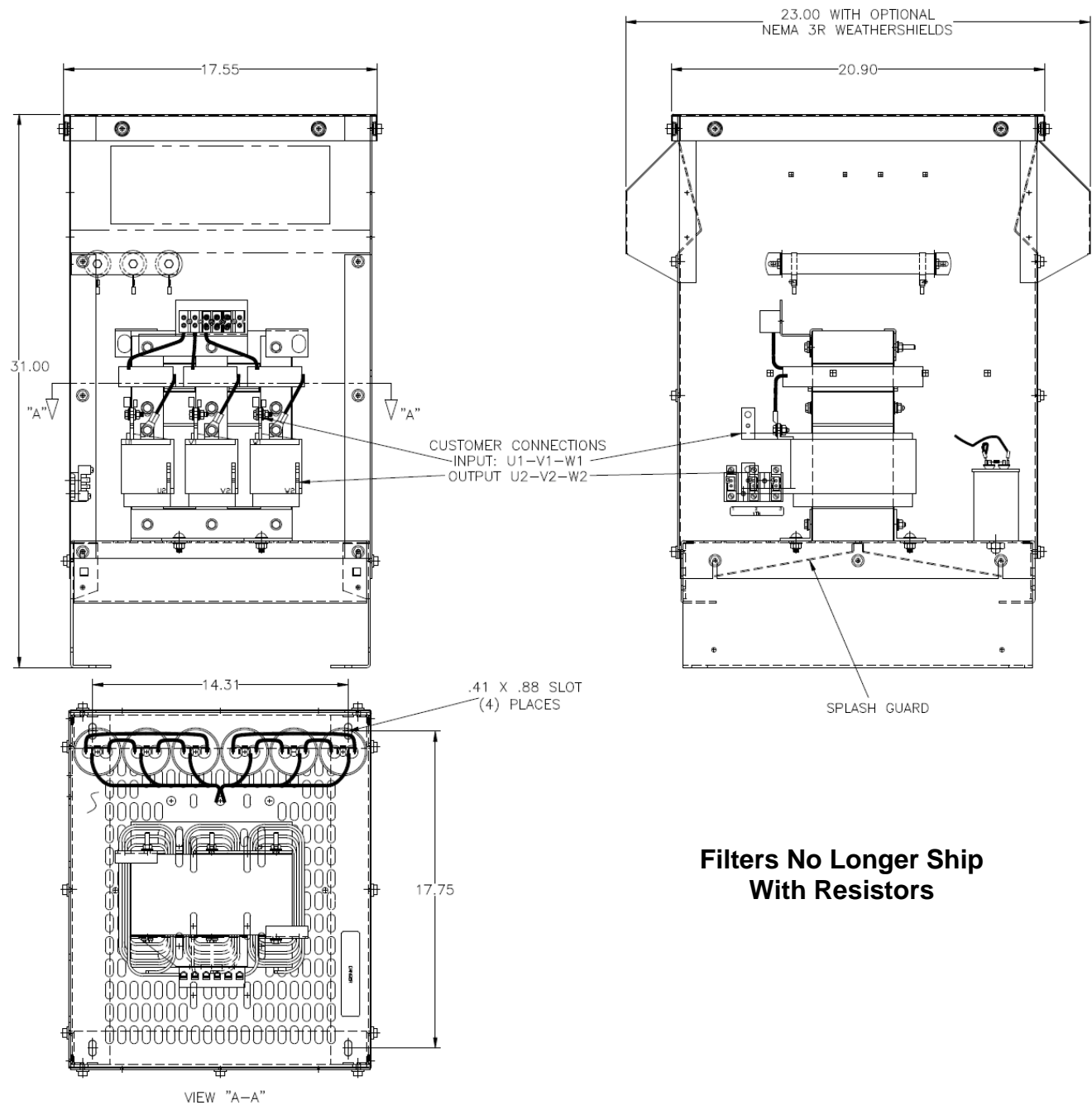
**Filters No Longer Ship  
With Resistors**

**Figure 14 6 - 21 AMP**

Refer to the MTE website, [www.mtecorp.com](http://www.mtecorp.com), for Detailed Specifications  
Capacitor placement shown for illustrative purposes only

## ENCLOSED UNIT INTERNAL DETAILS & TERMINAL LOCATIONS

### CAB-17C 27-103 AMPS

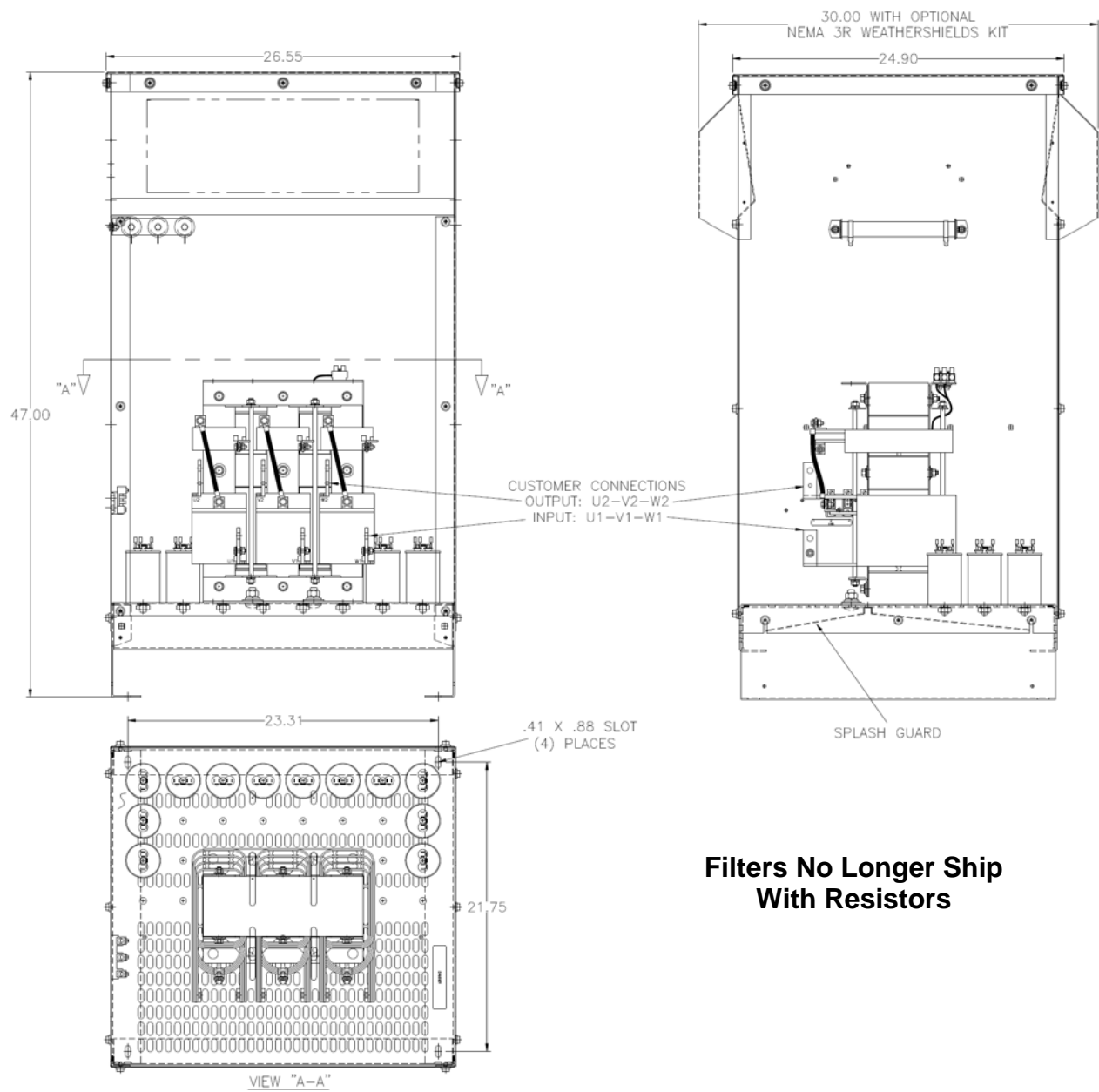


**Figure 15 27-103 AMP**

Refer to the MTE website, [www.mtecorp.com](http://www.mtecorp.com), for Detailed Specifications  
Capacitor placement shown for illustrative purposes only

## ENCLOSED UNIT INTERNAL DETAILS & TERMINAL LOCATIONS

### CAB-26C 128-240 AMPS



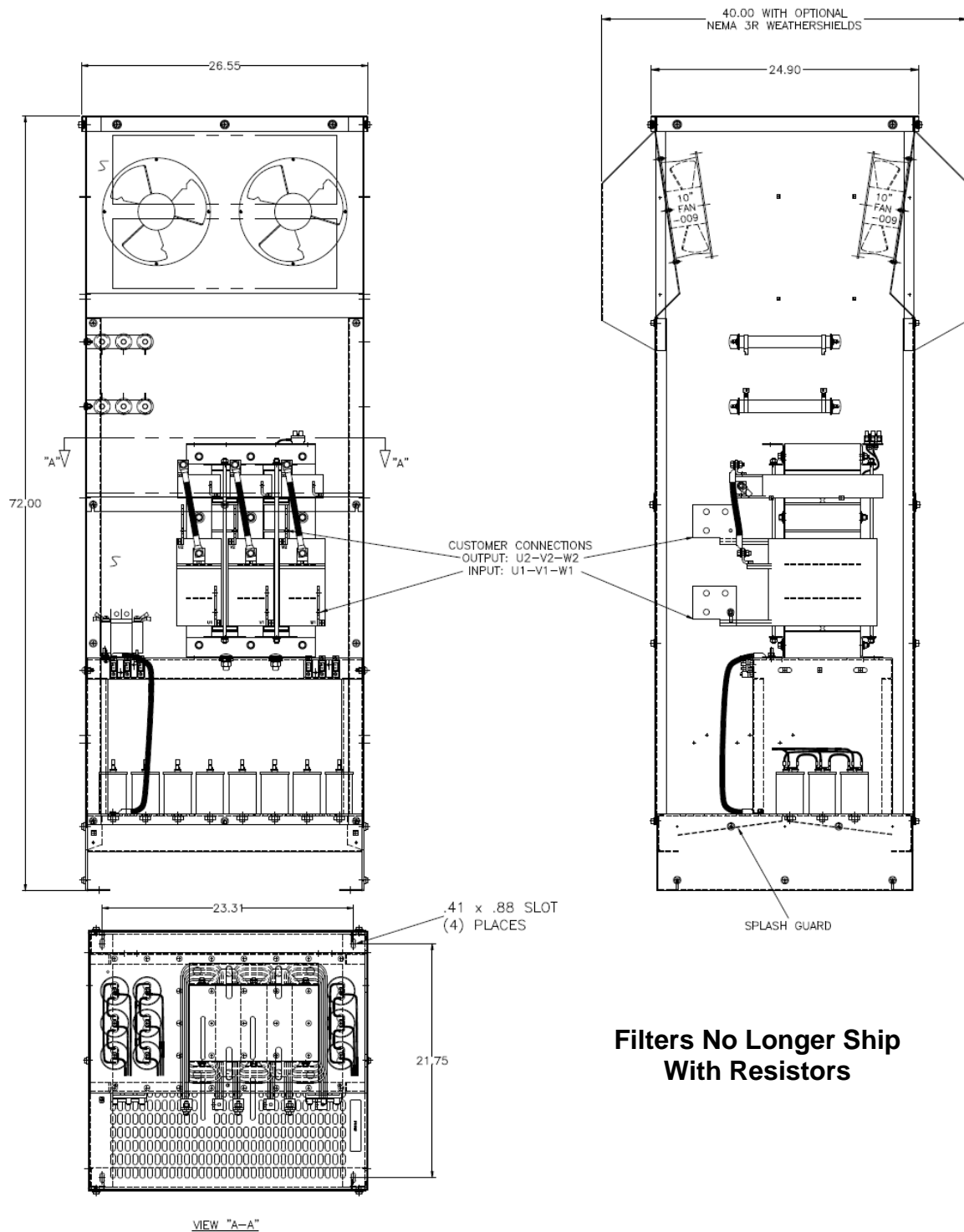
**Filters No Longer Ship  
With Resistors**

**Figure 16 128-240 AMP**

Refer to the MTE website, [www.mtecorp.com](http://www.mtecorp.com), for Detailed Specifications  
Capacitor placement shown for illustrative purposes only

## ENCLOSED UNIT INTERNAL DETAILS & TERMINAL LOCATIONS

### CAB-26D 208-240 AMPS contactor options



**Figure 17 208-240 AMP**

Refer to the MTE website, [www.mtecorp.com](http://www.mtecorp.com), for Detailed Specifications  
Capacitor placement shown for illustrative purposes only

## Power Wiring Connection



### WARNING

**Input and output power wiring to the filter should be performed by authorized personnel in accordance with the NEC and all local electrical codes and regulations. Cable lugs and mounting hardware are provided by the customer.**

Verify that the power source to which the filter is to be connected is in agreement with the nameplate data on the filter. A fused disconnect switch or circuit breaker should be installed between the filter and its source of power in accordance with the requirements of the NEC and all local electrical codes and regulations. Refer to the drive user manual for selection of the correct fuse rating and class.

The filter is suitable for use on a circuit capable of delivering not more than 100K RMS symmetrical amperes at 480 volts maximum when protected by type J, T or RK1 class fuses or a circuit breaker having an interrupting rating not less than 100K RMS symmetrical amperes, 480 volts maximum.

For panel mounted filter applications interconnection between the filter, its power source the cap-panels and the drive is shown in Figure 24. Table 10 lists the wire range and terminal torque requirements as a function of filter current ratings. Use table 10 for selecting conductors that interconnect the HMR and capacitor assemblies. Filters that use multiple cap-panels share total cap current shown on table 3.

Refer to the drive user manual for instructions on interconnecting the drive and motor and the correct start-up procedures for the drive.

The filter is designed for use with copper conductors with a minimum temperature rating of 75 degrees C.

For filters supplied in general purpose NEMA, 2 & 3R cabinets, interconnection between the filter, its power source, and the drive is shown in Figure 25. Refer to Figures 5 to 7 for the location of input, output, ground, and over temperature switch terminals. Table 10 lists the wire range and terminal torque requirements as a function of filter current ratings. Refer to the drive user manual for instructions on interconnecting the drive and motor and the correct start-up procedures for the drive.

### Wiring checks

Using Figure 27 visually check the wired components for wiring errors then with a multi meter check phase to phase isolation using the 100 K ohm range. The multi meter will read the parallel equivalent of the bleeder resistors after the capacitors initially charge. All phase to phase resistance values should be the same.



### WARNING

**Any extremely low or high resistance readings indicate a mis-wire and may result in damage to filter components if not corrected.**

### Check for the following faults:

- Resistors wired phase to phase
- Capacitor shorted
- Capacitor bus not connected
- Capacitor bus to chassis short
- Paralleling wiring errors

## **Power Wiring Connection, Cont.**

### **Grounding and Ground Fault Protection**

The filter must always be grounded with a grounding conductor connected to all ground terminals.

Due to high leakage currents associated with variable frequency drives, ground fault protective devices do not necessarily operate correctly when placed ahead of a Matrix Filter feeding a drive. When using this type of device, its function should be tested in the actual installation.

### **Over Temperature Switch**

The temperature switch is provided to annunciate adverse filter heating. Damage to the filter or drive may be avoided by interlocking this switch to shut down the drive or illuminate a service light; see figures 24 and 25 for connection diagrams. Read the vendor drive manual for details in using interlock inputs.

## Input and Output Terminal Specifications

Table 10

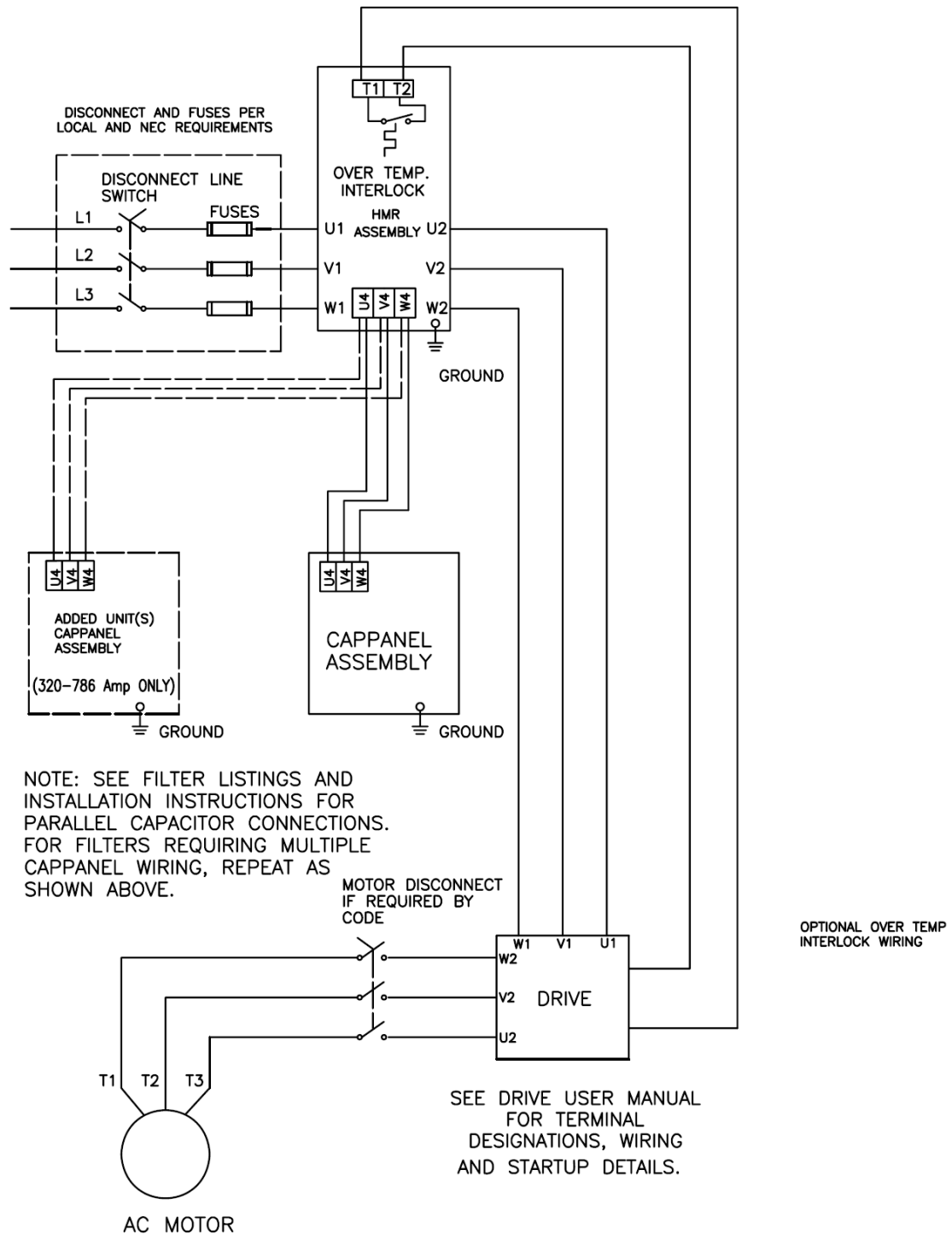
Filter Rating (Amps)	HMR Terminals			Cappanel Terminals U4-V4-W4		
	Input /Output Power U1-V1-W1 / U2-V2-W2		U4-V4-W4 interconnect cappanel	CAPPANEL Part Number	Minimum Interconnect Wire Gauge (AWG)	Terminal Torque (in-lbs.)
	Wire Range (AWG)	Terminal Torque (in-lbs.)	Terminal Torque (in-lbs.)			
6	14 – 4	16	16	202	14	16
8	14 – 4	16	16	294	14	16
11	14 – 4	16	16	204	14	16
14	14 – 4	16	16	295	14	16
21	14 – 4	16	16	522	14	16
27	14 – 4	16	16	271	14	35
34	14 – 4	16	16	266	14	35
44	14 – 4	16	16	308	12	35
52	14 – 4	16	16	530	12	16
66	Flat copper tab	N/A	16	267	10	35
83	Flat copper tab	N/A	16	272	8	40
103	Flat copper tab	N/A	16	268	8	40
128	Flat copper tab	N/A	16	270	8	40
165	Flat copper tab	N/A	16	523	6	45
208	Flat copper tab	N/A	50	300	4	45
240	Flat copper tab	N/A	50	301	2	50

**Note:** Cappanel interconnect wiring specification according to UL508 75° C Table.

**Note:** To prevent flexing or bending of the coil windings attached to MHR Flat copper terminal tabs, use two wrenches to tighten customer provided cable mounting hardware.

## Open Panel Unit Interconnection Diagram

Figure 24



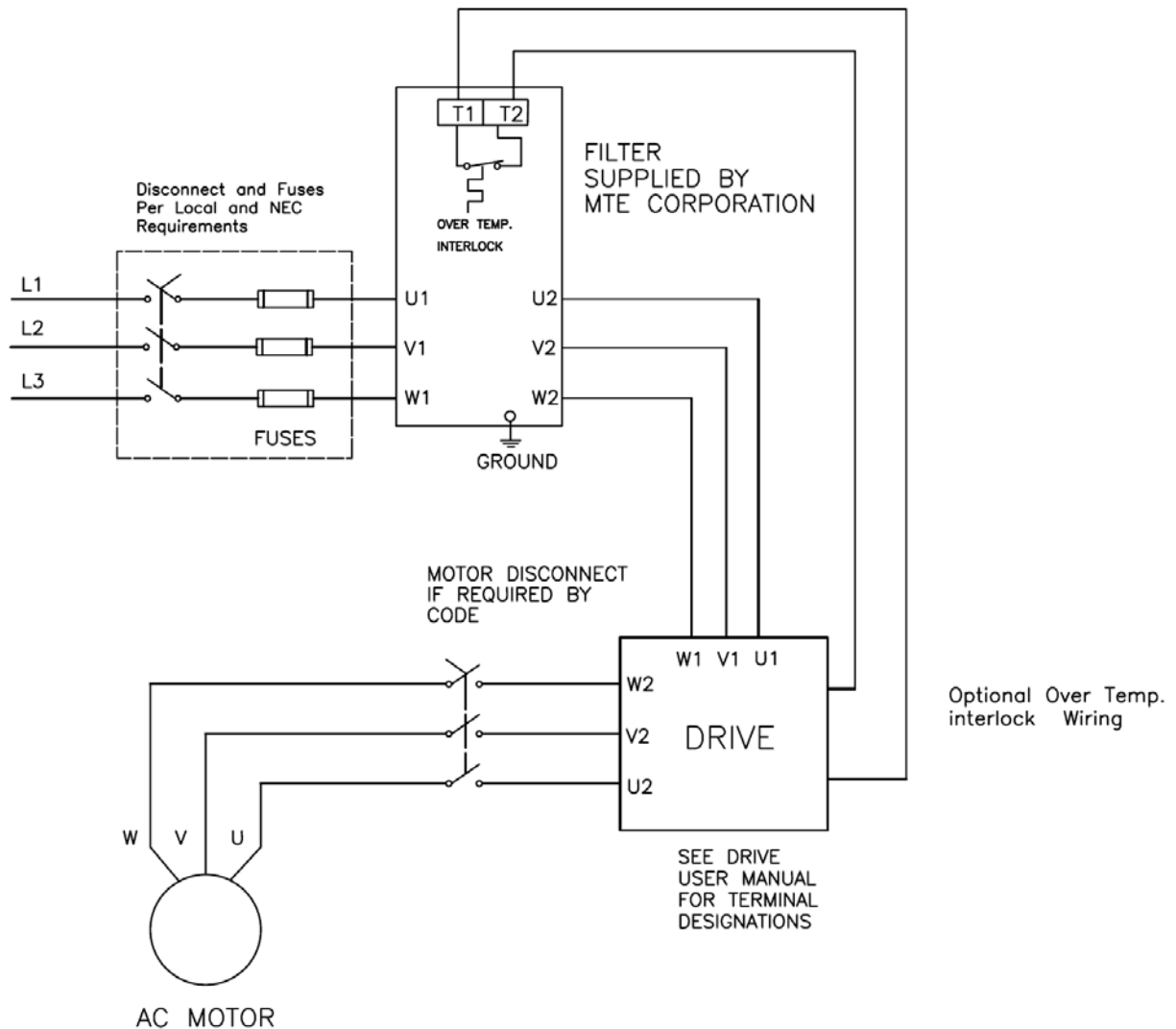
**Note:** all 208-240 filters use only one cappanel assembly



## Enclosed Unit interconnection Diagram

Figure 25

### Matrix Filter Series D



## FILTER DESCRIPTION

The MTE Matrix Filter is a low pass filter containing proprietary technology, which makes it particularly useful for harmonic mitigation of adjustable speed drives. Figure 21 shows a block diagram of the filter. Three phase AC power is connected to the Harmonic Mitigating reactor HMR section which contains patented circuitry which inhibits oscillation of the filter with the AC power system. Shunt resistors and capacitor panels make up the rest of the filter. Because of the capacitor bank the filter operates with leading power factor at light loads, but unlike trap filters the MTE Matrix Filter does not produce significant voltage rise at the point of common coupling with the power system.

Matrix Filters are suitable for use with AC and DC drives and they can be used in both regenerative and non-regenerative applications when properly selected. For AC regenerative drives application consult the factory.

Filters for variable torque AC drives rated 7.5 HP and above should be selected for a filter output current rating greater than or equal to the motor current rating. If the motor current rating is not available, use the NEC motor current rating.

Filters for variable torque AC drives rated 2 – 5 HP should be selected for a filter output current rating greater than or equal to 105% of the motor current rating. If the motor current rating is not available, select on the basis of 105% of the NEC motor current rating.

Filters for variable torque AC drives rated less than 1.5 HP should be selected for an output current rating greater than or equal to 110% of the motor current rating or 110% OF the NEC motor current rating.

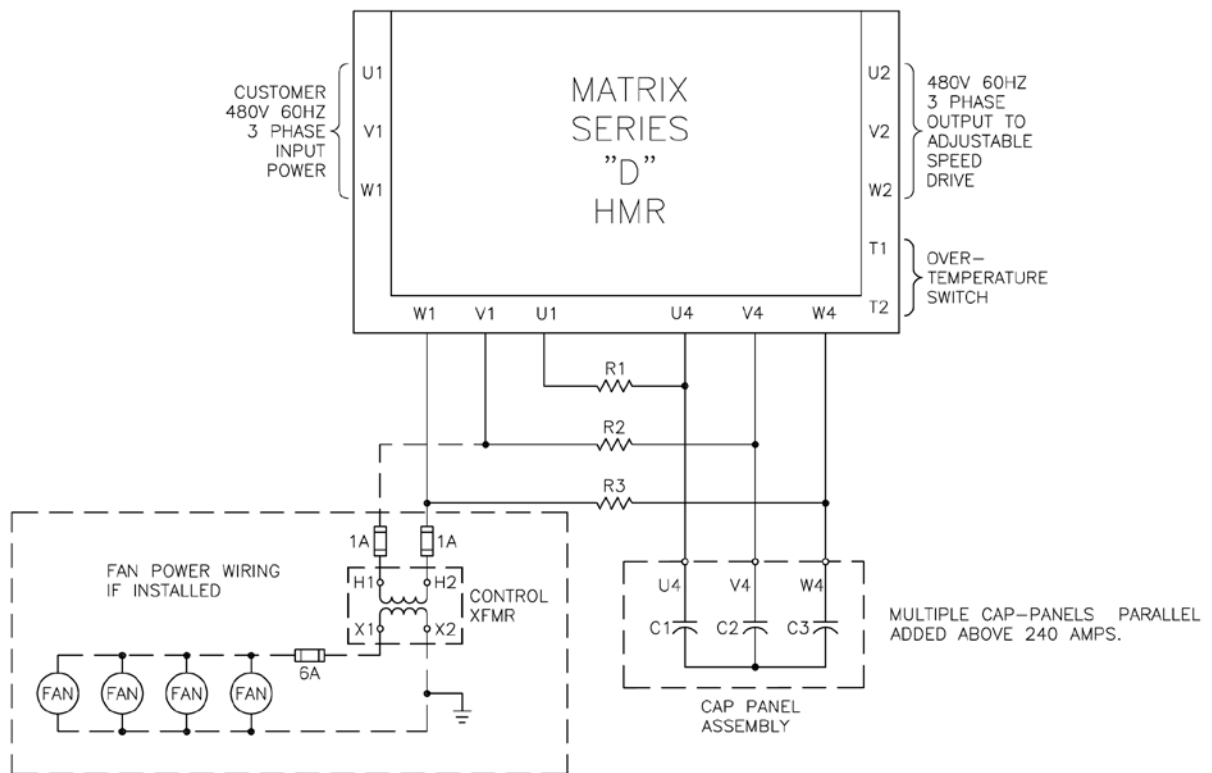
For constant torque, AC and DC drive applications operating from six pulse rectifier front ends selected a filter current rating according to application engineering note “Matrix Filter Operation in Constant Torque Applications with Six Pulse Rectifiers” or consult MTE engineering. For phase controlled DC drive applications, select filter current rating per application note “Matrix Filter with Phase Controlled DC Drivers”.

Where a single filter is used to feed multiple drives, the output current rating of the filter should be selected to equal the total current rating of the individual drives when calculated according to the instructions above.

Because the filter supplies harmonic currents required by the drive, linear loads (such as space heaters, incandescent lighting and AC motors operated across the line) should not be connected to the output of the filter.

## Block Diagram

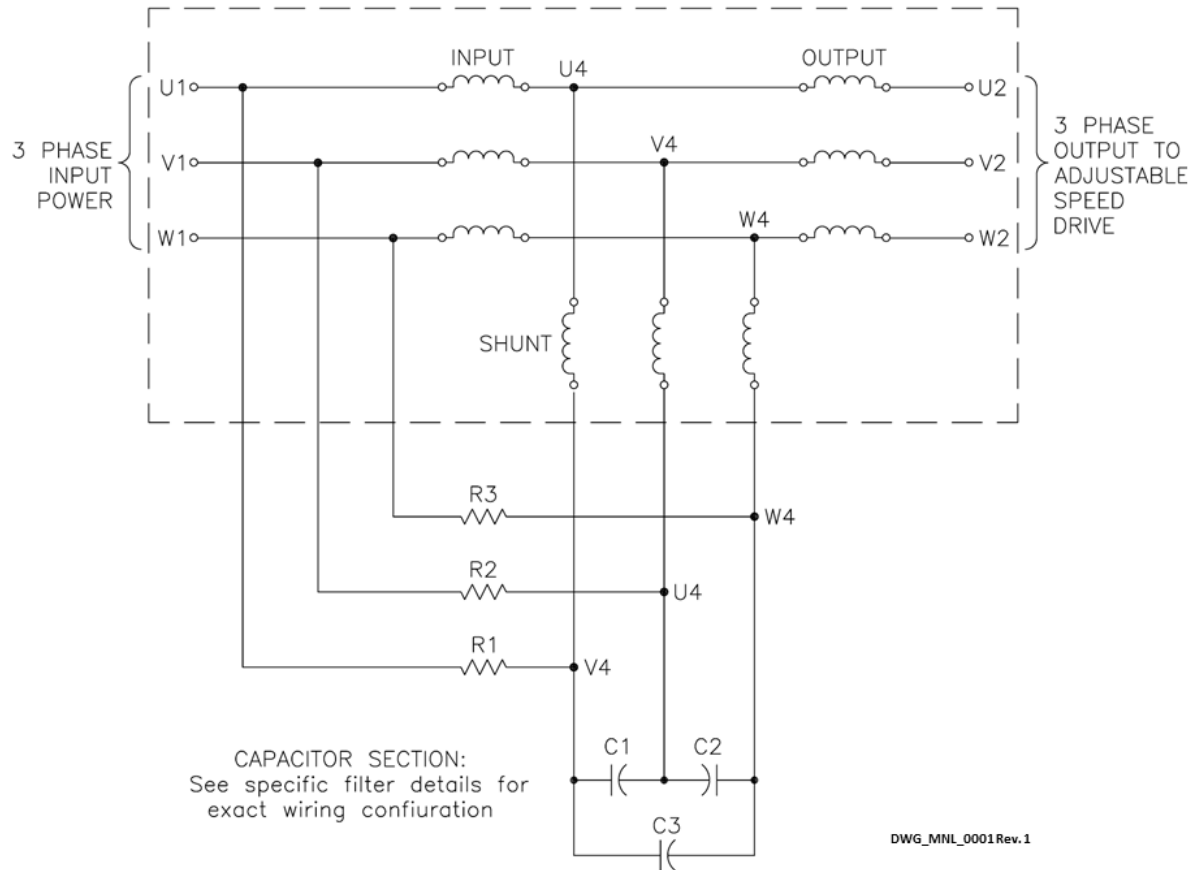
Figure 26



**Note:** Connect 208 or 240 volt power as indicated above in place of 480 V 60Hz.

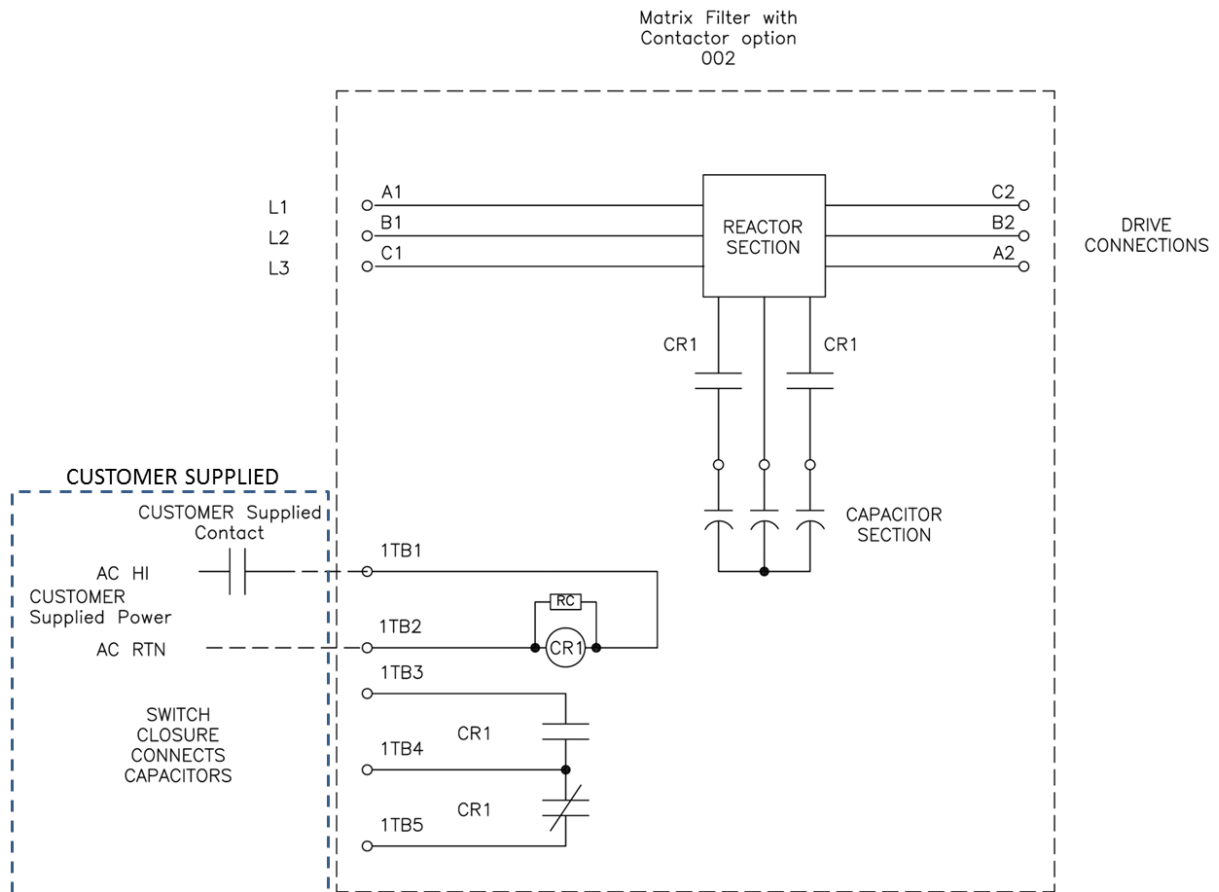
## Matrix D Basic Schematic Diagram

Figure 27



Contactor Options  
Option -002  
Capacitor Contactor

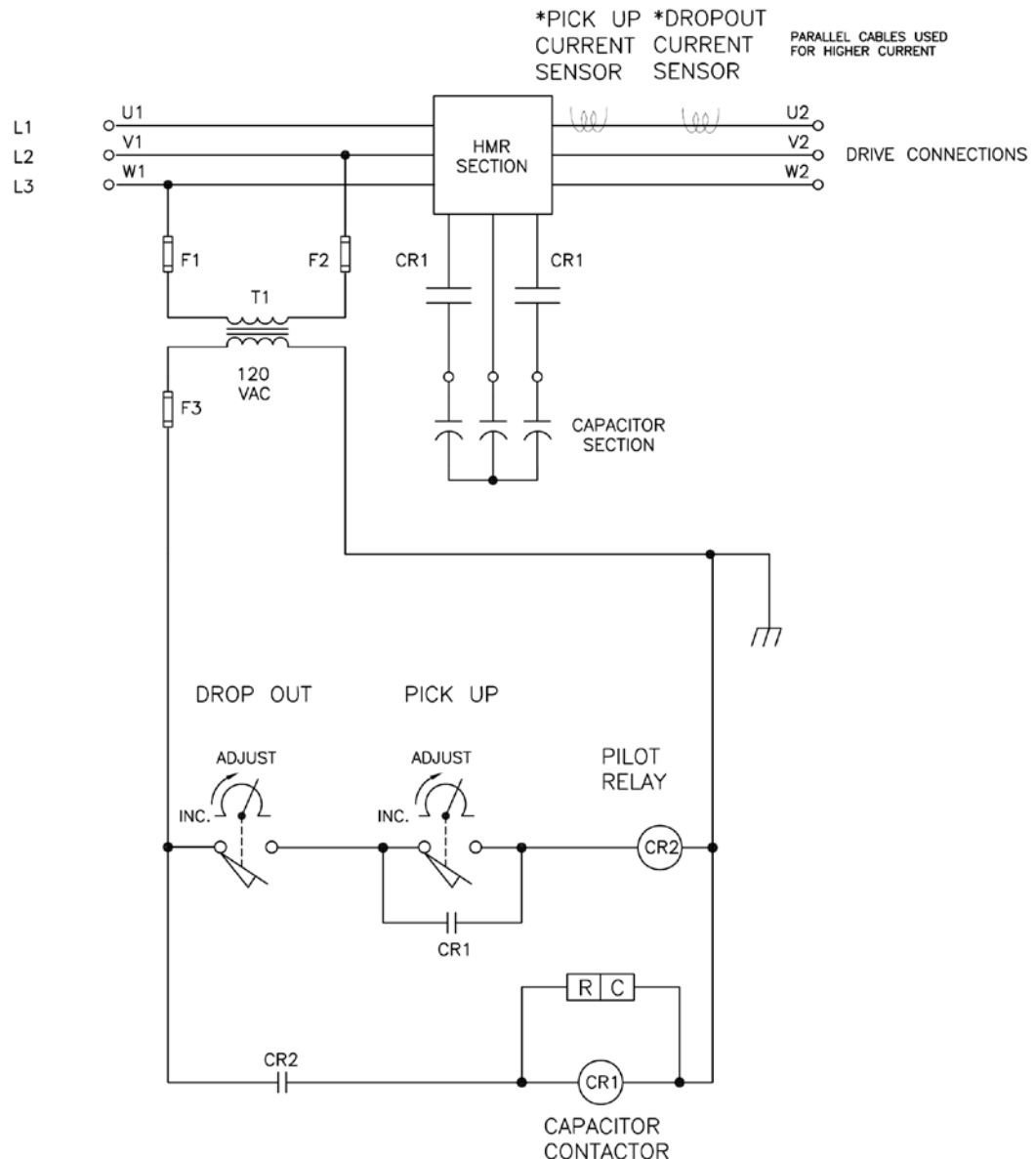
This option provides a contactor to disconnect the filter capacitor bank when the drive is not running. The contactor is supplied with NO/NC auxiliary contacts. The contactor coil and auxiliary contacts are wired to a customer terminal block. See page 39 for contactor coil switching characteristics. This option is provided pre-wired complete for enclosed filters and as loose parts for open panel filters.



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The above contactor option diagram is provided to help understand the circuit function and does not reflect actual circuit wiring.

This option provides a contactor to disconnect the filter capacitor bank based on the motor load current. Two current operated switches provide independent adjustment of the pickup and drop current levels. The switches are preset at the factory for pick up at 35% and drop out at 20% of the filter output current rating. The switches are each field adjustable over a 0 – 100% current range. This option is only available for enclosed filters and may include a larger cabinet to accommodate the contactor and parts associated with this option.

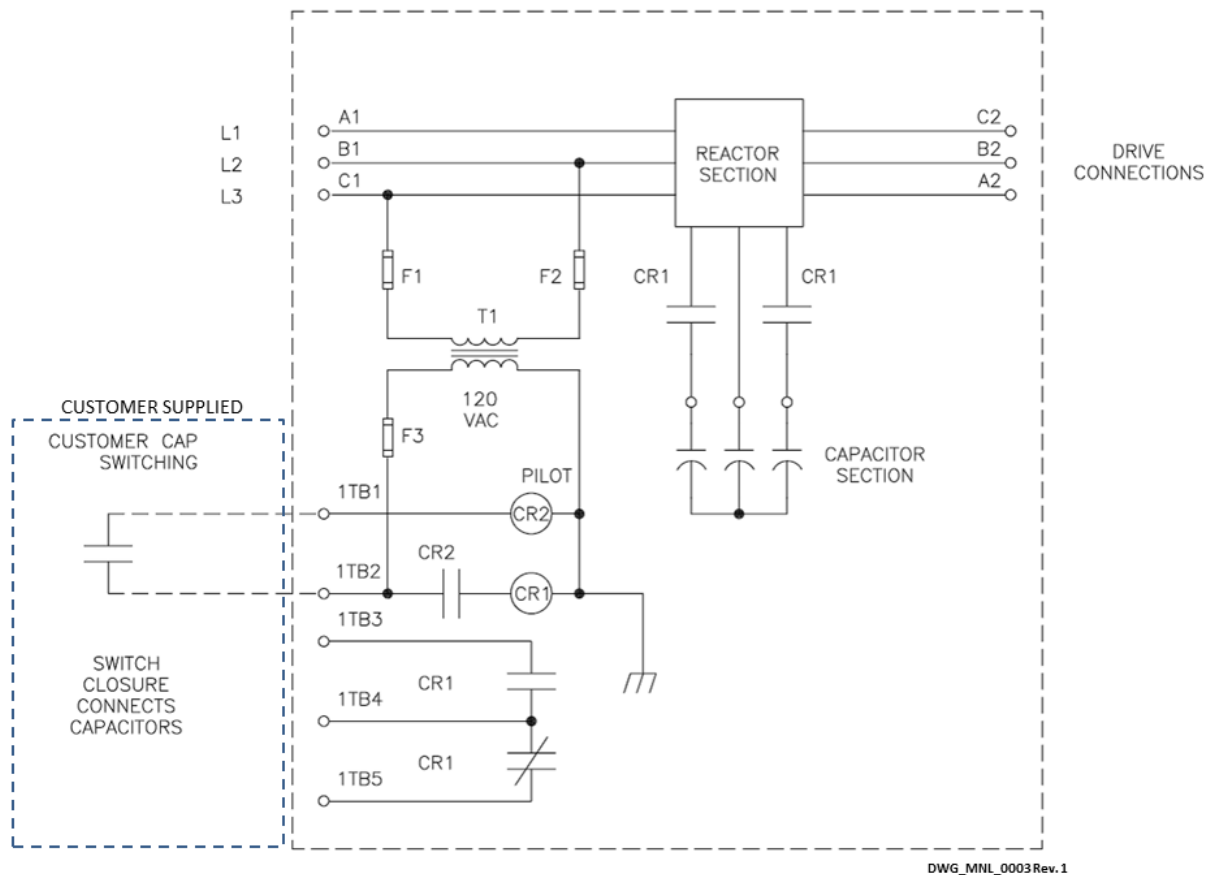


**The above contactor option diagram is provided to help understand the circuit function and does not reflect actual circuit wiring.**

Option -012

Capacitor contactor with control transformer

This option provides a control transformer to power the capacitor contactor. The contractor is provided with NO/NC auxiliary contacts. For filter ratings 165 amps and above a pilot relay is also provided to limit inrush current below 0.60 amps. Connections are wired to a customer terminal block. This option is only available for enclosed filters and may include a larger cabinet to accommodate the contactor and parts associated with this option.



The above contactor option diagram is provided to help understand the circuit function and does not reflect actual circuit wiring.

## Option -010

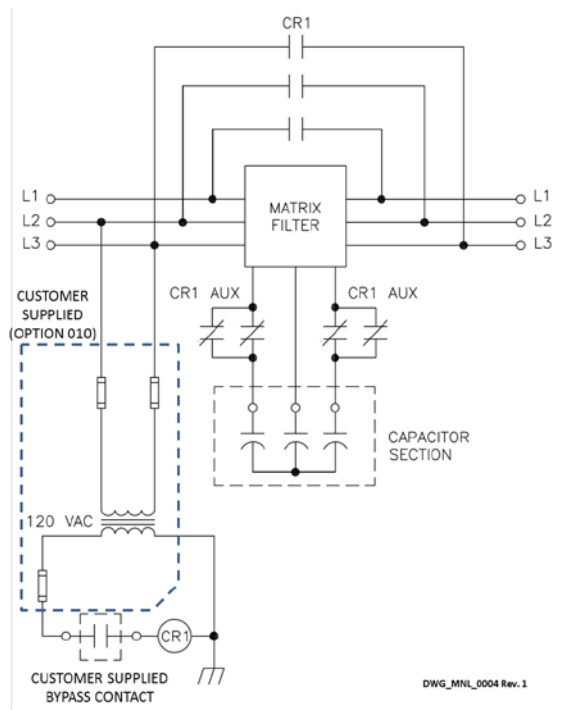
### Filter Bypass

The filter bypass option is designed to provide filter bypass for drives that have an integrated bypass option as typically found in HVAC applications. Filter bypass is initiated by a contact closure when the motor is switched to operate directly from the AC line instead of the drive. See page 42 for contactor coil switching characteristics. A 120VAC control power source is required. This option is only available for enclosed filters and may include a larger cabinet to accommodate the contactor and parts associated with this option.

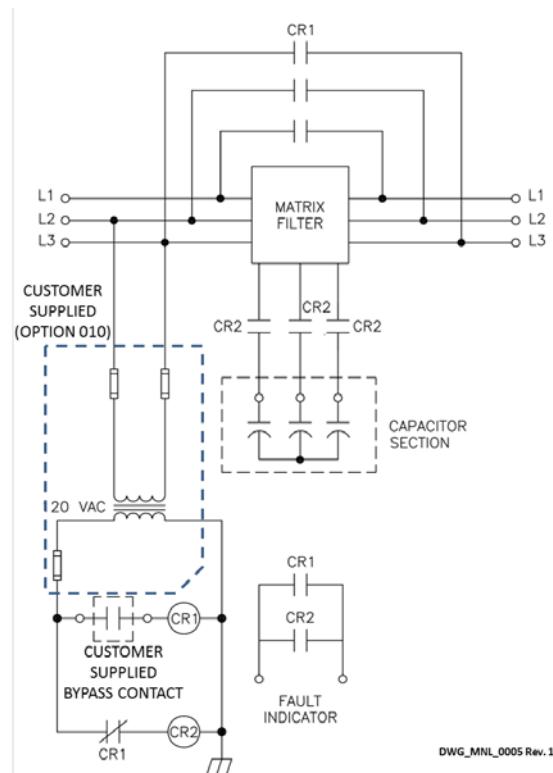
## Option -011

### Filter Bypass with transformer

The filter bypass option is designed to provide filter bypass for drives that have an integrated bypass option as typically found in HVAC applications. Filter bypass is initiated by a contact closure when the motor is switched to operate directly from the AC line instead of the drive. A control transformer provides 120 VAC power for contactor operation.. See page 42 for contactor coil switching characteristics. This option is only available for enclosed filters and include a larger cabinet to accommodate the contactor and parts associated with this option.



Filters rated 44 Amps and below



Filters rated 55 Amps and above

**The above contactor option diagram is provided to help understand the circuit function and does not reflect actual circuit wiring.**

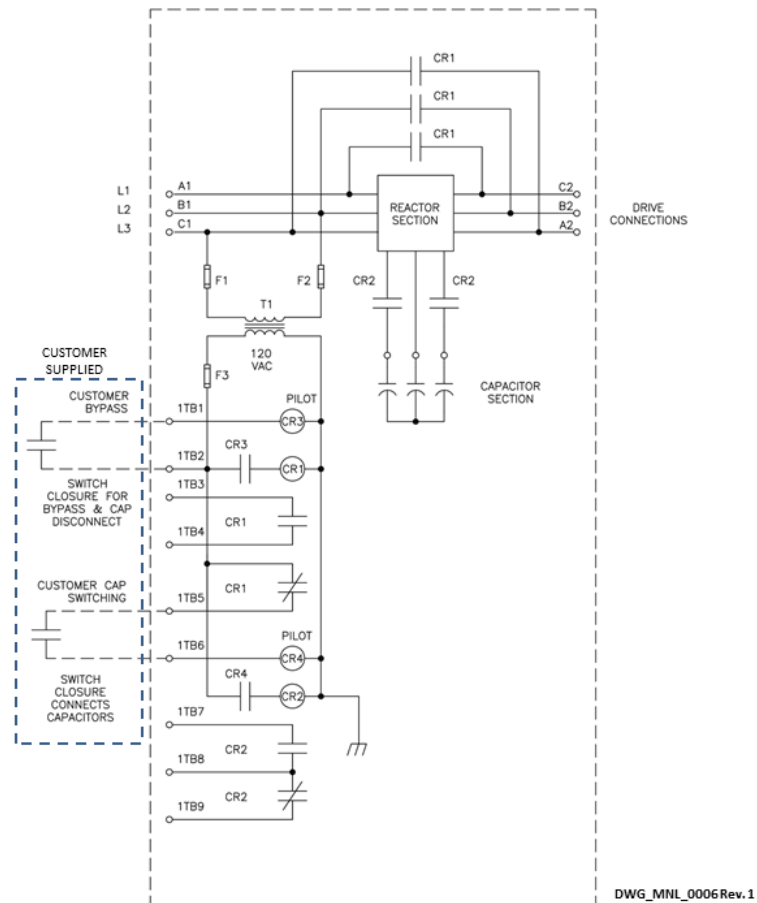


Option -013

Filter bypass and capacitor contactor with control transformer

This option provides a 120 VAC control transformer to power the capacitor and bypass contactors. Contactors are provided with NO/NC auxiliary contacts. For filter ratings 44 amps and above pilot relays are also provided to limit inrush currents below 0.60 amps. A jumper selection provides single contact switching for normal bypass control with capacitor removal. Connections are wired to a customer terminal block.

This option is only available for enclosed filters and may include a larger cabinet to accommodate the contactor and parts associated with this option.



The above contactor option diagram is provided to help understand the circuit function and does not reflect actual circuit wiring.

## MTE BY-PASS option 010, 011 and 013



# Warning!!!

**Equipment damage may result from activation of the bypass contactor during motor operation. Ensure the motor is at rest before switching the bypass control contactor!**

Purpose: Provide compatible hardware to integrate a system motor bypass when used in conjunction with a drive which supports the bypass function as required for HVAC and control applications.

- 1.) To switch out the Matrix Filter and connect utility power to the Matrix output terminals to support a motor bypass initiated from the control contact of the drive.
- 2.) During the bypass mode, remove the effect of Matrix Filter capacitor loading on drive utility branch circuits

### Design:

For low current Matrix Filters a single contactor CR1 provides the dual function switching to accomplish bypassing the Matrix Filter and removal of the filter's capacitors. For higher current filters a second powered contactor CR2 connects the capacitors to the filter circuit. See the schematic drawings that show these circuits.

### Function description:

- 1.) (Matrix Filter mode): The bypass coil CR1 is de-energized: the Matrix Filter provides normal harmonic attenuation of the VFD distorted power. For the dual contactor systems the capacitor contactor CR2 must be powered to get maximum THID reduction.
- 2.) With 120 VAC 60 Hz on CR1 from the customer supplied contact selection:  
A three phase connection is made across the Matrix Filter input to the corresponding output terminals. At the same time CR1 auxiliary contacts or the second CR2 contactor remove the capacitors from the filter circuit.

## Contactor coil switching currents

**Table 11**

### Options 002, 010 & 011

The following table indicates the 120 VAC 60 Hz current required to switch and hold the various size contactors used in Matrix Filter capacitor switching and bypass options. This data is provided to select the proper switch rating to remotely control the contactor.

Contactor Currents for 120 VAC 60 Hz coils.

Matrix filter current Rating AMPS	Capacitor Contactor Option 002 AMPS (Maximum)		Filter Bypass Options 010 & 011 AMPS (Maximum)	
	<b>INRUSH</b>	<b>SEALED</b>	<b>INRUSH</b>	<b>SEALED</b>
6	0.62	0.048	1.25	0.090
8	0.62	0.048	1.25	0.090
11	0.62	0.048	1.25	0.090
14	0.62	0.048	1.25	0.090
21	0.62	0.048	1.25	0.090
27	0.62	0.048	1.25	0.090
34	0.62	0.048	1.25	0.090
44	0.62	0.048	1.55	0.112
52	0.62	0.048	2.33	0.352
66	0.62	0.048	3.5	0.30
83	0.62	0.048	3.5	0.30
103	0.62	0.048	2.04	0.74
128	0.54	0.064	2.34	0.95
165	1.70	0.30	3.78	1.73
208	2.88	0.25	4.76	0.286
240	1.42	0.026	3.5	0.062

## STARTUP

### Safety Precautions

Before startup, observe the following warnings and instructions:



Internal components of the filter are at line potential when the filter is connected to the utility. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it.



After disconnecting the utility power, wait at least 5 minutes before doing any work on the filter connections. After removing power, allow at least five minutes to elapse and verify that the capacitors have discharged to a safe level before contacting internal components. Connect a DC voltmeter across the capacitor terminals. Start with the meter on the highest scale and progressively switch to a lower scale as the indicated voltage falls below the maximum value of the scale used.

### Sequence of Operation

1. Read and follow safety precautions.
2. After installation, ensure that:
  - All filter ground terminals are connected to ground.
  - Power wiring to the utility, drive and motor is in accordance with the power wiring connection diagrams shown in installation instructions section. Use the guidelines of table 10 for power and cap-panel wire gauges.

3. Check that moisture has not condensed on the filter components. If moisture is present, do not proceed with startup until the moisture has been removed.
4. Disconnect the filter output from the drive.
5. Connect the filter to the utility.



**Use extreme caution to avoid contact with line voltage when checking for power. INJURY OR DEATH MAY RESULT IF SAFETY PRECAUTIONS ARE NOT OBSERVED.**

6. Confirm that line voltage is present at the input terminals (U, V1, W1) of the filter.
7. Confirm that line voltage is present at the output terminals (U2, V2, W2) of the filter.
8. Disconnect the filter from the utility.
9. Connect the filter output to the drive.
10. Refer to the drive user manual for the drive startup procedure. Observe all safety instructions in the drive user manual.



**INJURY OR DEATH MAY RESULT IF THE DRIVE SAFETY PRECAUTIONS ARE NOT OBSERVED.**



Damage to equipment may occur if the drive startup procedures are not observed.

## TROUBLESHOOTING



When properly installed, this equipment has been designed to provide maximum safety for operating personnel. However, hazardous voltages exist within the confines of the enclosure. Servicing should therefore be performed by qualified personnel only and in accordance with OSHA Regulations.

To aid in troubleshooting, a block diagram is shown in Figure 21 and a list of potential problems and solutions are listed below.



High voltage is used in the operation of this filter. Use Extreme caution to avoid contact with high voltage when operating, installing or repairing this filter. **INJURY OR DEATH MAY RESULT IF SAFETY PRECAUTIONS ARE NOT OBSERVED.**

After removing power, allow at least five minutes to elapse and verify that the capacitors have discharged to a safe level before contacting internal components. Connect a DC voltmeter across the capacitor terminals. Start with the meter on the highest scale and progressively switch to a lower scale as the indicated voltage falls below the maximum value of the scale used.

## Troubleshooting, Cont.

### MTE Matrix Filter Field Checks

1. Read and understand the voltage appropriate MTE Matrix user manual. These manuals may be downloaded from the [www.mtecorp.com](http://www.mtecorp.com) web site. Locate figures and drawings for your particular filter and identify the terminals locations.
2. Disconnect all power and remove input power wiring from U1, V1, W1 terminals.
3. Remove VFD drive power connections from filter terminals U2, V2, W2 and any contactor or temperature switch wiring. (For filters having control transformers: remove power fuses on top of transformer.)
4. Visually inspect filter terminals and wiring lugs for signs of heat and corrosion. **Contact factory if any wires appear to be missing or cut!**
5. Inspect the U4, V4, W4 capacitor interconnect terminals and wiring.
6. Visually inspect all capacitors for signs of case deformation bowing of the top, leaking oil or terminal damage. Note the CAP- # and date code of any damaged capacitors.
7. Using a multi meter set to read 100K ohms check:
  - a. Phase to phase U1-V1-W1-U1 (mechanically activate contactor if present) after reactor and caps charge reading should be about 40K (total equivalent breeder resistance value) and should be the same for each phase. Open circuit or very low readings indicate a problem.
  - b. Phase to chassis U1- case, V1-case, W1- case; low readings indicate a ground fault problem.
8. Ensure the "disconnect" is safe then wire the utility power to U1, V1, W1.
9. Apply power and verify that proper output voltage is present on U2, V2, and W2.
10. Using a clamp on amp meter read the filter input current:
  - a. Readings will be 0.7 of the capacitor current listed in table 3 for the listed filter current in the user manual (mechanically activate the contactor if the filter is equipped with one). Readings should be the same (+/- 5%) for all phase currents; **contact the factory if currents are out of tolerance!**
  - b. Open contactor readings will show zero current for all phases.
11. Disconnect filter power and wire the VFD to U2, V2, and W2 as well as any control wiring to the filter contactor or temperature switch. Replace any control transformer fuses. Follow the drive power startup guidelines in the drive manufactures user manual.

<b>PROBLEM:</b>	<b>Line voltage is not present at the filter output terminals.</b>
<b>Possible cause:</b>	Power to the filter is turned off.
<b>Solution:</b>	Turn power on.
<b>Possible cause:</b>	One or more external line fuses are blown.
<b>Solution:</b>	Verify the continuity of line fuses in all phases. Replace as necessary.

<b>PROBLEM:</b>	<b>Full Load Harmonic current distortion exceeds 5% on one or more phases at full load.</b>
<b>Possible cause:</b>	The capacitor assembly has not been connected.
<b>Solution:</b>	Check interconnection of capacitor assembly with HMR (Figure 19 & 20).
<b>Possible cause:</b>	A capacitor has failed.
<b>Solution:</b>	Inspect the tops of all capacitors for bowing. Replace failed capacitors.
<b>Possible cause:</b>	Source impedance is less than 1.5%.
<b>Solution</b>	Add a minimum 1.5% impedance line reactor to the filter input
<b>Possible cause:</b>	Input source voltage harmonic distortion.
<b>Solution</b>	Identify equipment causing harmonic voltage distortion and add filters as required or accept elevated THVD
<b>Possible cause:</b>	Line voltage unbalance exceeds 1%.
<b>Solution:</b>	Balance input line voltage to 1% or less.

<b>PROBLEM:</b>	<b>Filter output voltage is not within specification</b>
<b>Possible cause:</b>	Filter input voltage is not within specification.
<b>Solution:</b>	Check the AC input line voltage and verify that it is within tolerance. Refer to the filter service conditions and performance specifications for tolerances.
<b>Possible cause:</b>	Source impedance is out of tolerance.
<b>Solution:</b>	Verify that the source impedance is within tolerance. Refer to the filter service conditions and performance specifications for tolerances.
<b>Possible cause:</b>	One or more Capacitors is damaged
<b>Solution:</b>	Visually check capacitor top for distortion or doming check for shorts or open caps.
<b>Possible cause:</b>	Drive set up parameters do not allow for input filter
<b>Solution:</b>	Consult drive manufacturer to update setup to accommodate input filter
<b>Possible cause:</b>	Input voltage subject to extreme transients such as switching between two voltage sources. Drive faults on over or under voltage.
<b>Solution:</b>	Source switching is not recommended without proper phase synchronizing or allowing reasonable time delay before transfer to new source.



Matrix Filter Series D 208-240V 60Hz User Manual			INSTR-027
Responsibility: Product Lines Manager Approved By: Wayne Walcott ISO Section: 7.2.3			
Revision	Date	Revision History	
081020	10/20/08	New document written by Wayne Walcott per ECN 6065	
110302	03/02/11	Updated Table 10, Fax number, and MTE logo. Added hyperlinks to tables. Added Warning Symbols. Added cappanel warning text. Fixed numerous spelling and grammar errors.	
110419	04/19/11	Updated table 10,cappanel listing	
004	06/08/11	Modified Revision scheme to match Avante	
005	05/01/12	Cosmetic change to Figure 27. Updated drawings for contactor options 002, 010, 011, 012 and 013 to clarify customer supplied components.	
006	06/28/12	By LB. Updated logo. Added “No Resistors” note to drawings.	