

SECTION 9 - REGEN RESISTOR SELECTION

9.1 DELTAMAX DRIVER REGENERATION CAPACITIES

The DeltaMax motor and driver have the ability to act as a brake for a rotating load. This condition typically occurs during the deceleration of the load or when the system is stopping a vertical load such as an elevator or lift. In both cases, the driver may have to absorb the mechanical and potential energy in the system. The driver must absorb the energy if the energy in the load exceeds to mechanical losses in the system.

The driver has 3 ways to absorb the energy from the load.

- Store the energy by charging the internal main DC bus capacitors (E_C)
- Use the energy internally to power the driver control circuitry (P_D)
- Dissipate the energy using a regeneration resistor (P_R)

The Delta driver energy absorption capacities are as shown in **Table 9.1**.

DRIVER SIZE	INTERNAL REGEN CAPACITY (P_R)	INTERNAL POWER CONSUMPTION (P_D)	CHARGING CAPACITY (E_C)
DMAX-1.5/RB	0 W	13	17
DMAX-1.5/RA	0 W	13	17
DMAX-4.25/RB	0 W	13	17
DMAX-4.25/RA	0 W	13	17
DMAX-8.5/RA	0 W	24	17
DMAX-8.5/RB	0 W	17	17
DMAX-17.5/RA	0 W	37	22
DMAX-35/RA	80 W	80	38
DMAX-50/RA	80 W	100	54
DMAX-70/RA	100 W	200	94
DMAX-115/RA	180 W	300	188

Table 9.1 - Energy Absorption Capabilities

The DeltaMax drivers are equipped with internal circuitry to detect a rise in the main DC power bus indicating energy absorption. If the DC power bus reaches approximately 400 VDC, the regeneration circuit is turned on to prevent the main DC power bus from rising to 420 VDC which will result in an over voltage alarm AL-02.

9.2 SELECTION OF REGENERATION RESISTOR

The amount of energy stored in the moving components of the system must be calculated and compared to the energy absorption capacity of the driver to determine if an external regeneration resistor is required.

The stored energy is of two basic types, kinetic energy in the form of a moving mass and potential energy of a mass being held against gravity.

$$E_k = 0.5 * (J_M + J_L) * (2 * \pi * N / 60)^2$$

$$E_P = (2 * \pi * N * T_g * t_b / 60)$$

Calculate the system losses in the motor, driver and friction.

$$E_L = (P_M + P_D + (\pi * N * T_f / 60)) * t_a$$

Calculate the regeneration power.

$$P_R = (E_k + E_P - E_L - E_C) / t_c$$

If regeneration power P_R is greater than 0.0, a regeneration resistor will be needed to prevent the main DC power bus from generating an over voltage alarm AL-02.

Where:

- E_k = Net kinetic energy Joules
 - E_P = Net Potential energy Joules
 - E_L = Energy loss due to friction Joules
 - E_C = Driver charging capacity Joules (See [Table 9.1](#))
 - J_M = Motor rotor inertia $kg\cdot m^2$
 - J_L = Load inertia $kg\cdot m^2$
 - N = Motor speed in RPM
 - P_M = Motor loss watts (10% of motor rating)
 - P_D = Driver internal power consumption watts (See [Table 9.1](#))
 - T_f = System friction torque N-m
 - T_g = Net torque to hold up load against gravity N-m
 - P_R = Regen power watts (See [Table 9.1](#))
 - t_a = Deceleration time
 - t_b = Move time
 - t_c = Cycle time
- } See [Figure 9.1](#)

* The above equations are reasonable approximations.

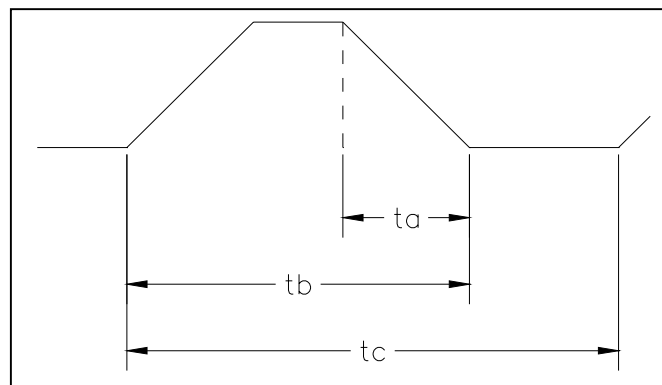


Figure 9.1

9.2 SELECTION OF REGENERATION RESISTOR (cont'd)

DeltaMax Drivers DMAX-1.5 through DMAX-17.5 does not contain an internal regeneration resistor. If a regeneration resistor is required, an external resistor with a power rating of at least P_R watts must be connected.

DeltaMax Drivers DMAX-35 through DMAX-115 contains internal regeneration resistors. If the internal regeneration resistor capacity is greater than P_R watts, no external resistor is needed. If the internal resistor is not large enough, an external resistor with a power rating of at least P_R watts must be connected. If an external regeneration resistor is needed, parameters UP-30 and UP-31 must be set to the values of the external resistor.

The external resistor specifications are shown in **Table 9.2**.

DRIVER SIZE	RESISTANCE	MAX WATTAGE	WIRE GAUGE
DMAX-1.5/RA	30~100 Ohms	300 W	14 AWG 1.25 mm ²
DMAX-1.5/RB	30~100 Ohms	300 W	14 AWG 1.25 mm ²
DMAX-4.25/RA	30~100 Ohms	300 W	14 AWG 1.25 mm ²
DMAX-4.25/RB	30~100 Ohms	300 W	14 AWG 1.25 mm ²
DMAX-8.5/RA	30~100 Ohms	300 W	14 AWG 1.25 mm ²
DMAX-8.5/RB	30~100 Ohms	300 W	14 AWG 1.25 mm ²
DMAX-17.5/RA	30~70 Ohms	400 W	14 AWG 1.25 mm ²
DMAX-35/RA	12.5~25 Ohms	2.4 KW	12 AWG 3.5 mm ²
DMAX-50/RA	12.5~25 Ohms	3 KW	12 AWG 3.5 mm ²
DMAX-70/RA	10~15 Ohms	5.5 KW	10 AWG 5.5 mm ²
DMAX-115/RA	6~15 Ohms	11 KW	8 AWG 16 mm ²

Table 9.2 - External Resistor Specifications

Figures 9.2 and 9.3 shows how to connect an external regeneration resistor to the DeltaMax drivers.

9.2 SELECTION OF REGENERATION RESISTOR (cont'd)

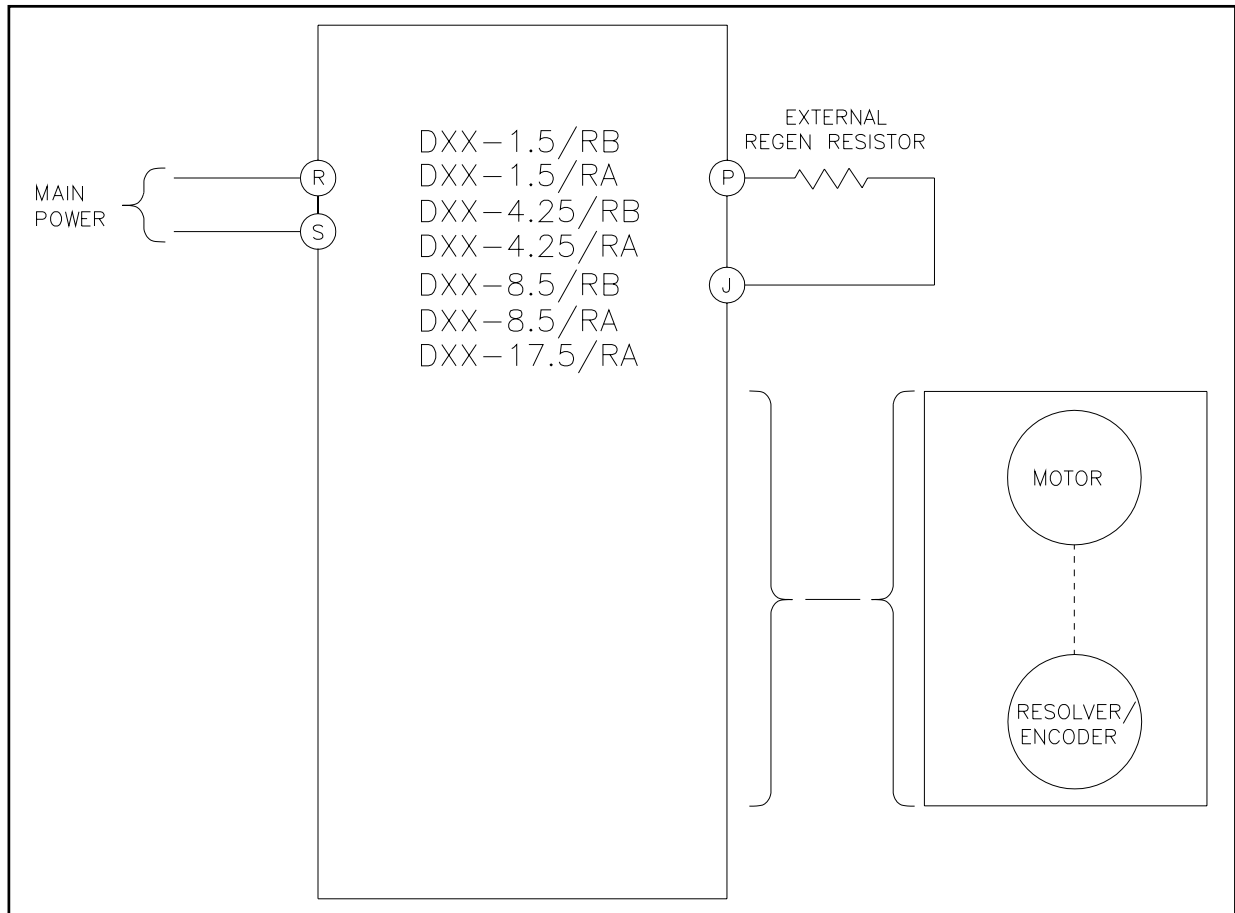


Figure 9.2 - Connection of an External Regen Resistor for DeltaMax Driver Sizes DMAX-1.5 Through DMAX-17.5

9.2 SELECTION OF REGENERATION RESISTOR (cont'd)

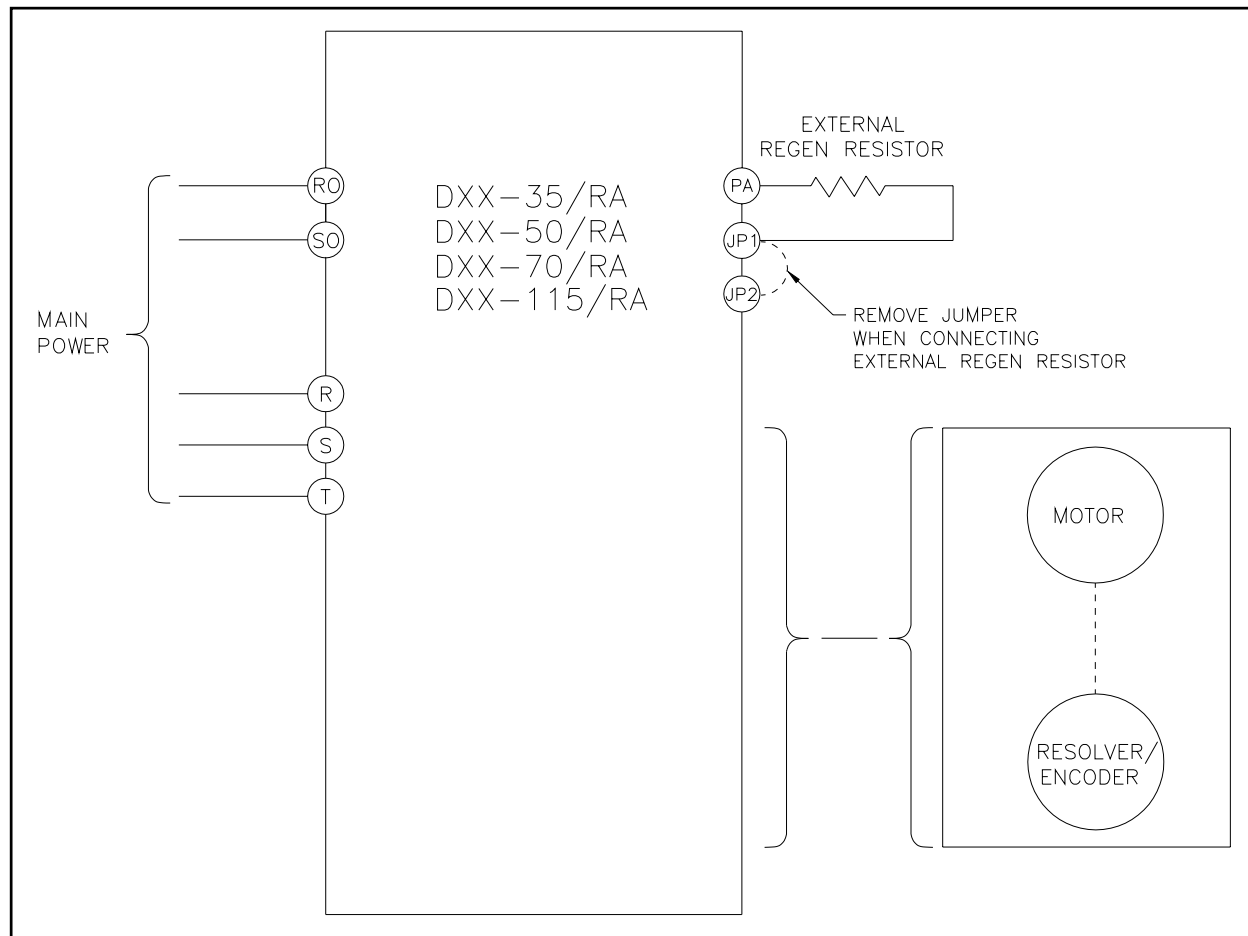


Figure 9.3 - Connection of an External Regen Resistor for DeltaMax Driver Sizes DMAX-35 and Larger

The regeneration resistor is subjected to severe peak power loads during regeneration. The driver switches the regeneration resistor across the DC power bus using PWM techniques to regulate the DC power bus voltage during regeneration dumping. When the driver's switch is on the regeneration resistor is subjected to the following peak power:

$$\text{PEAK POWER} = (400 \text{ VDC})^2 / \text{RESISTOR VALUE in ohms}$$

Be sure to select a regeneration resistor that can sustain the required peak power and continuous power ratings.

9.3 STANDARD REGENERATION RESISTOR PACKAGES

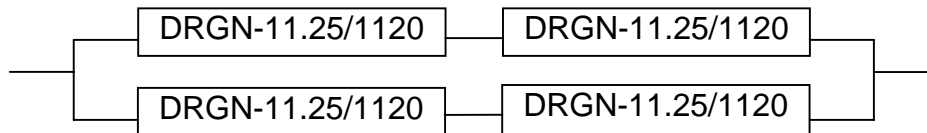
In general, wound metal ribbon resistors are recommended for this type of application. IIS offers a complete line of enclosed panel mounted regen resistor units to complement the DeltaMax driver. Various combinations of series and parallel connections are allowed to provide adequate regen resistor capacity.

IIS P/N	Description
MFS30A300J*	30 Ohm 30 Watts
RGH200-30*	30 Ohm 200 Watts
DRGN-20/400*	20 Ohm 400 Watts
DRGN-45/420	45 Ohm 420 Watts
DRGN-22.5/655	22.5 Ohm 655 Watts
DRGN-15/880	15 Ohm 880 Watts
DRGN-11.25/1120	11.25 Ohm 1120 Watts

*Not UL/CE approved

EXAMPLE CALCULATION:

If 4 KW of regen were needed on a DMAX-115 driver, four (4) DRGN-11.25/1120 units could be connected as follows to yield 11.25 Ohms at 4480 Watts.



DRAWING NUMBER

- MFS30A300J
- RGH200-30
- DRGN-20/400
- DRGN-45/420
- DRGN-45/420-2
- DRGN-22.5/655
- DRGN-15/880
- DRGN-11.25/1120

DESCRIPTION

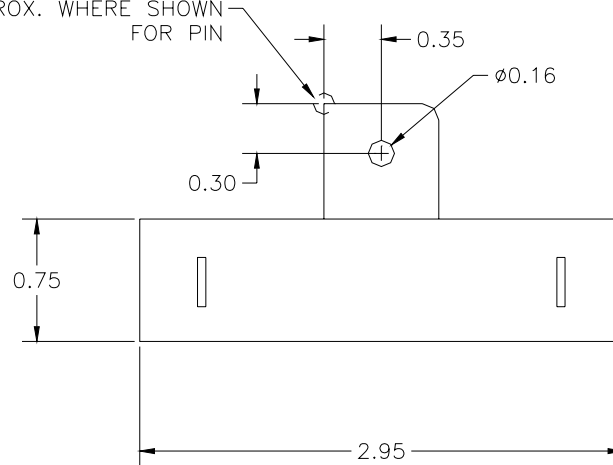
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- Regen Resistor
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- Regen Resistor
- Regen Resistor
- Regen Resistor

NOTES:

- 1.) THIS RESISTOR IS NOT UL OR CE APPROVED.
- 2.) RESISTOR MUST BE SECURELY MOUNTED ON LARGE HEATSINK SUCH AS ENCLOSURE WALL OR BACKPANEL.

SPECIFICATIONS	
RESISTANCE:	30 Ohms
CONTINUOUS POWER:	30 Watts
MAXIMUM VOLTAGE:	VDC
MAXIMUM PULSE CURRENT:	15 A
MAXIMUM RMS CURRENT:	1 A
DUTY CYCLE	6 %

DRILL $\phi 0.13$ HOLE ON MOUNTING
PANEL APPROX. WHERE SHOWN
FOR PIN



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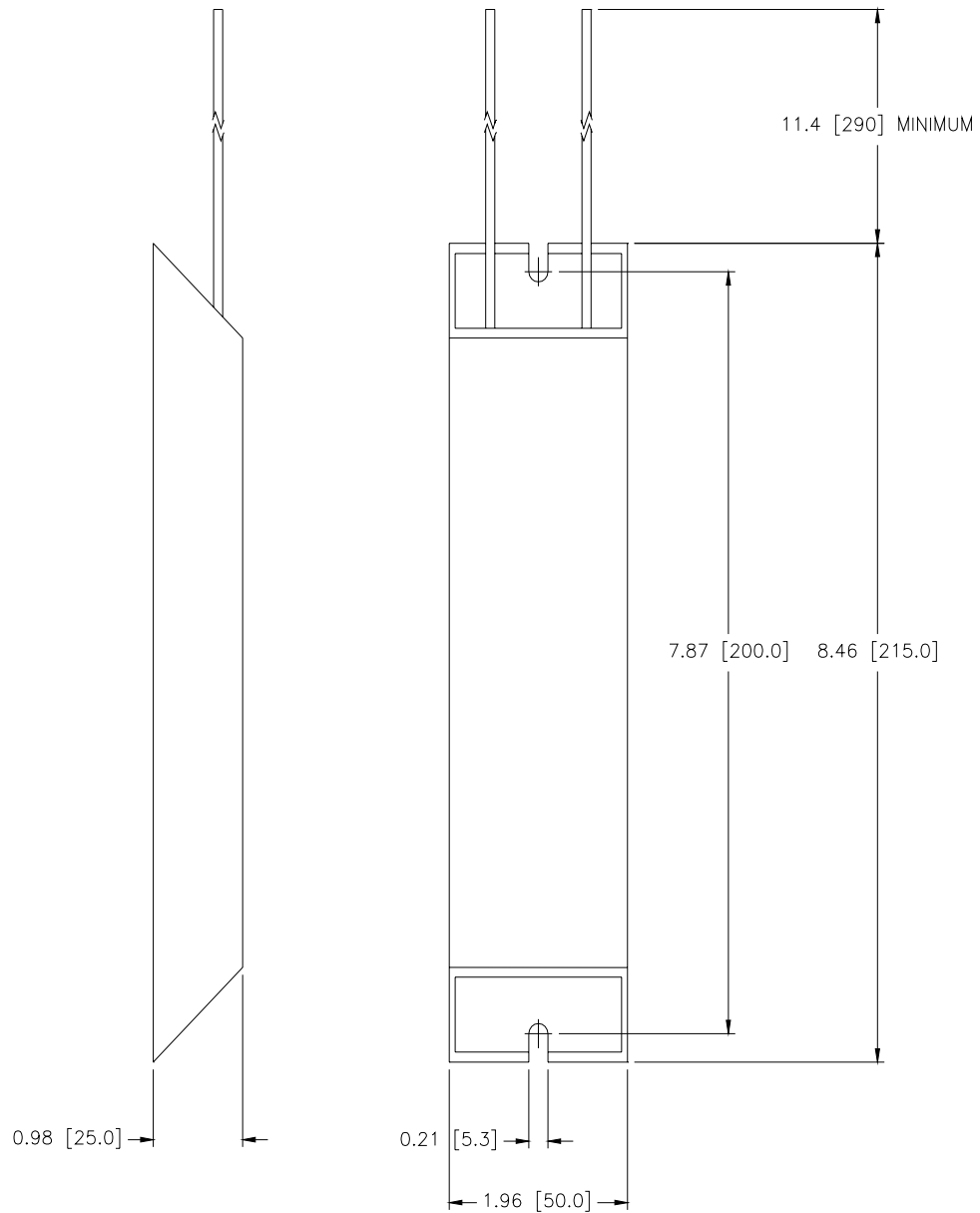
TITLE
RESISTOR, 30 OHM, 30W

DRAWING NUMBER
MFS30A300J

NOTES:

- 1.) RESISTOR MUST BE MOUNTED ON A FLAT SURFACE AT LEAST 12" X 12" IN FREE AIR TO MEET THE 200 WATT POWER DISSIPATION.
- 2.) THIS RESISTOR IS NOT UL OR CE APPROVED.

SPECIFICATIONS	
RESISTANCE:	30 Ohms
CONTINUOUS POWER:	200 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	14.0 A
MAXIMUM RMS CURRENT:	5.0 A
DUTY CYCLE	50%



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TITLE
REGEN RESISTOR

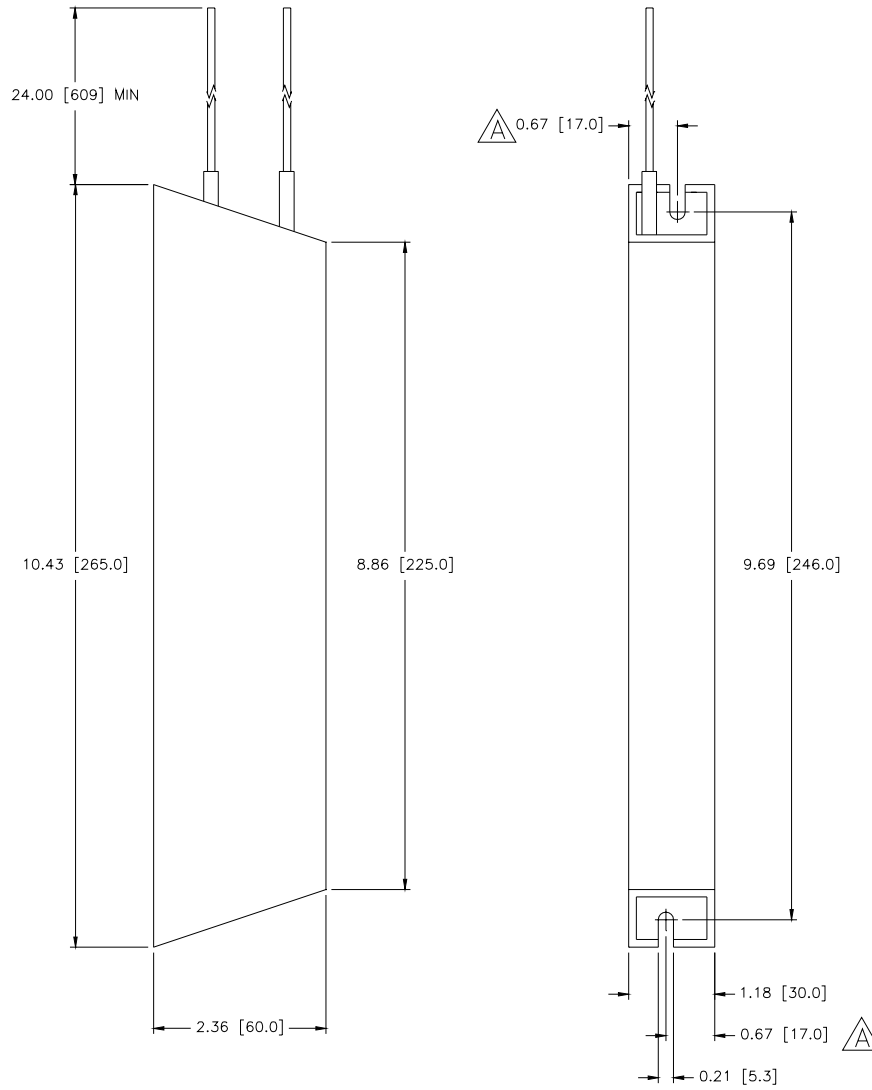
DRAWING NUMBER
RGH200-30

NOTES:

- 1.) RESISTOR MUST BE MOUNTED ON A FLAT SURFACE AT LEAST 12" X 12" IN FREE AIR TO MEET THE 200 WATT POWER DISSIPATION.
- 2.) THIS RESISTOR IS NOT UL OR CE APPROVED.
- 3.) RESISTOR MUST BE SECURELY MOUNTED ON LARGE HEATSINK SUCH AS ENCLOSURE WALL OR BACKPANEL.

SPECIFICATIONS

RESISTANCE:	20 Ohms
CONTINUOUS POWER:	400 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	22 A
MAXIMUM RMS CURRENT:	4.5 A
DUTY CYCLE	15 %



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TITLE

REGAN RESISTOR

DRAWING NUMBER

DRGN-20/400

DIMENSIONS ARE INCHES [mm]

TOLERANCES X.XX±0.01

X.XXX±0.005

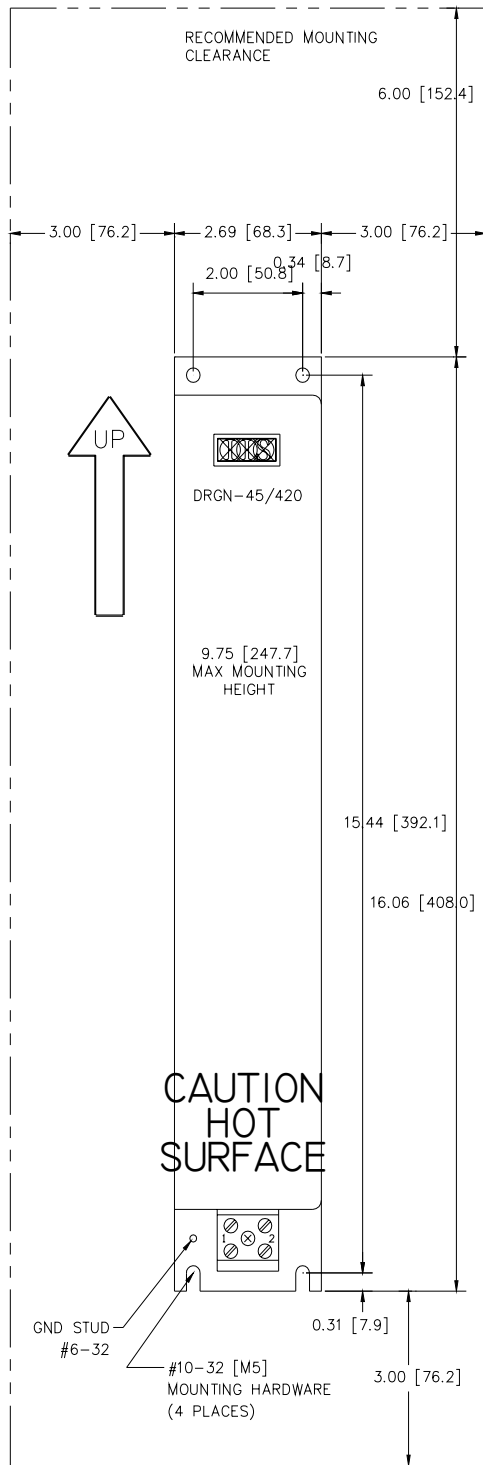
± 5°

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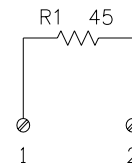
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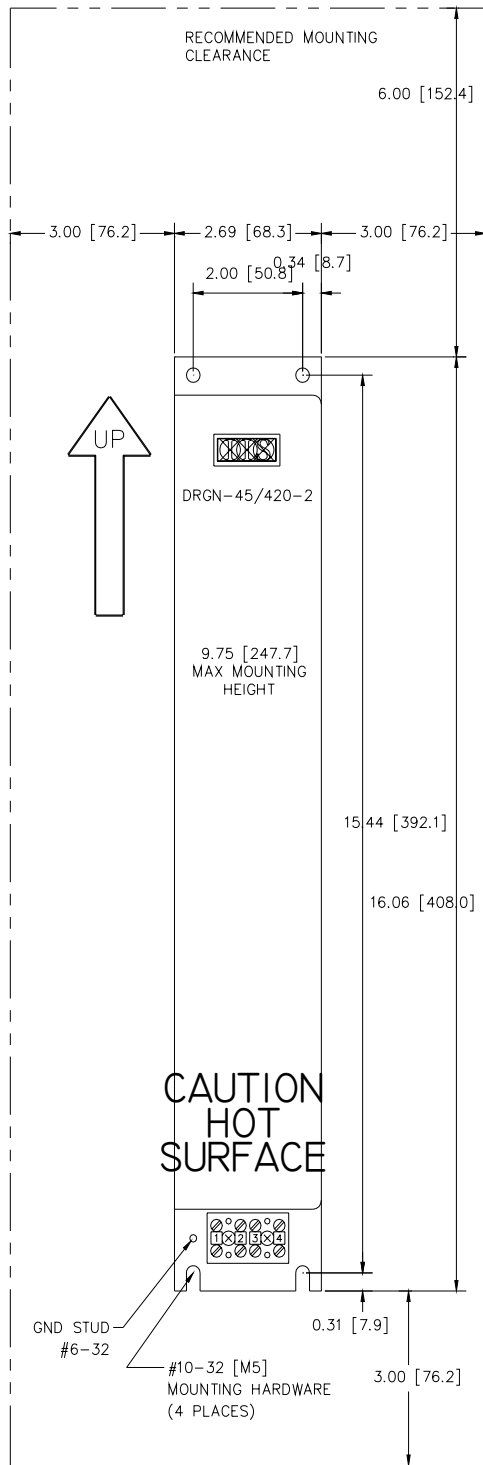
SPECIFICATIONS	
RESISTANCE:	45 Ohms
CONTINUOUS POWER:	420 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	9.5 A
MAXIMUM RMS CURRENT:	3.1 A
DUTY CYCLE	15%



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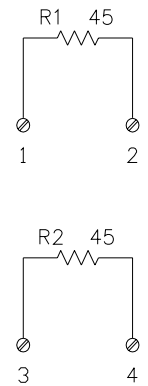
TITLE
REGEN RESISTOR

DRAWING NUMBER
DRGN-45/420



SPECIFICATIONS	
RESISTANCE:	45 Ohms
CONTINUOUS POWER:	420 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	9.5 A
MAXIMUM RMS CURRENT:	3.1 A
DUTY CYCLE	15%

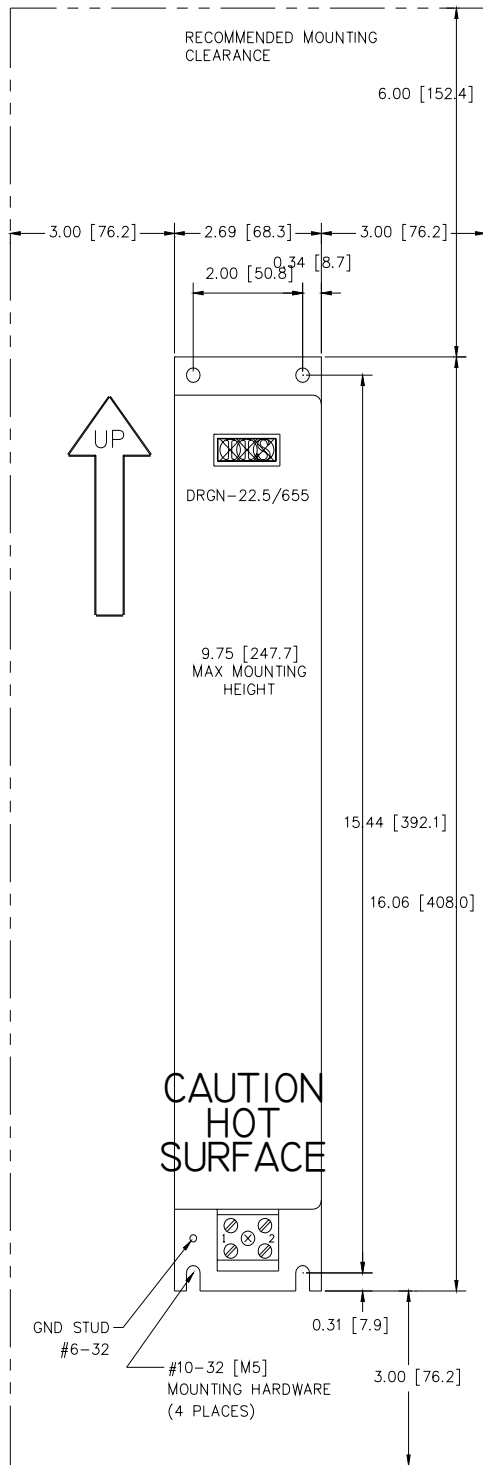
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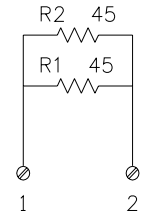
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TITLE
REGEN RESISTOR

DRAWING NUMBER
DRGN-45/420-2



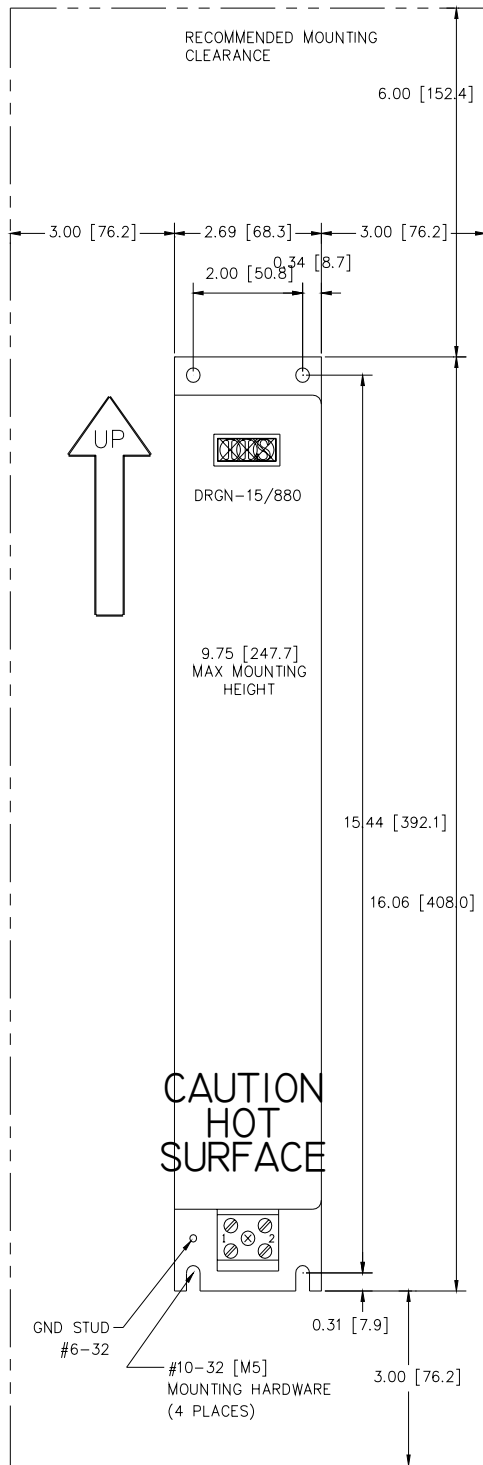
SPECIFICATIONS	
RESISTANCE:	22.5 Ohms
CONTINUOUS POWER:	655 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	18.9 A
MAXIMUM RMS CURRENT:	5.4 A
DUTY CYCLE:	15%



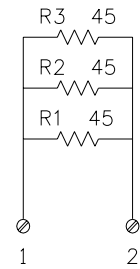
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TITLE
REGEN RESISTOR

DRAWING NUMBER
DRGN-22.5/655



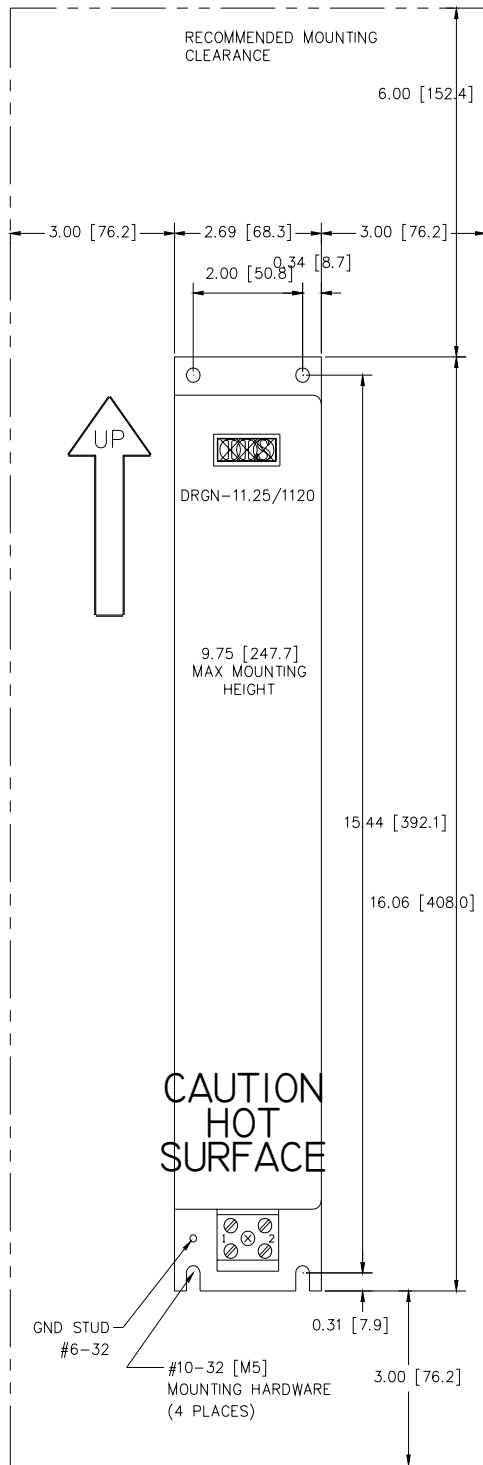
SPECIFICATIONS	
RESISTANCE:	15 Ohms
CONTINUOUS POWER:	880 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	28.4 A
MAXIMUM RMS CURRENT:	7.6 A
DUTY CYCLE	15%



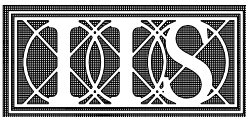
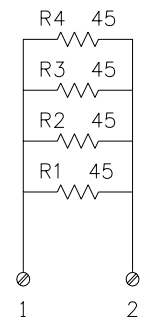
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TITLE
REGEN RESISTOR

DRAWING NUMBER
DRGN-15/880



SPECIFICATIONS	
RESISTANCE:	11.25 Ohms
CONTINUOUS POWER:	1120 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	38.7 A
MAXIMUM RMS CURRENT:	10 A
DUTY CYCLE	15%



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TITLE
REGEN RESISTOR

DRAWING NUMBER
DRGN-11.25/1120