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M2, M5, M10 and M20 VARIAC® Autotransformers

with DURATRAK Coating Process

(U.S. Patent No. 2,949,592)

GENERAL INSTRUCTIONS

1.1 LINE VOLTAGE AND FREQUENCY. The M series Variac® autotransformers are designed for use at frequencies between 350 and 1200 cycles per second (cps) on 120-volt lines. Operation at frequencies below 350 cps is permissible if the line input voltage does not exceed $120 \times \frac{f}{350}$, where f is the lower frequency. Under no circumstances should the input voltage exceed 125 volts for the overvoltage connection (147 volts across the complete winding), since, above this value, the voltage across the brush will be excessive.

Variac autotransformers cannot be operated on direct current. Any attempt to do so will result in a burned-out unit.

1.2 FUSES AND LINE CAPACITY. Protect your unit by placing a fusing device of proper rating between terminal 3 and the load. The input line capacity must be adequate for the Variac autotransformer, its load, additional loads that may be required, and a margin for slight overload. Because these transformers are iron-cored devices using high-performance core material, normal inrush surges up to 10 times the rated current of the unit may be encountered when the unit is first connected to the line. Fuses must be selected with this in mind.

Slow-blow (thermal delay) fuses or magnetic or thermal time-current integrating breakers are preferable to the quick-blow fuse, for the input line and the load circuits. Such devices as Klixon and Heinemann circuit breakers are particularly useful where the load is subject to high inrush.

The short-term overload curve, Figure 1, shows what your autotransformer will stand under initial surge conditions, as in motor starting, incandescent lamp lighting, etc. At no time should the unit be called upon to furnish a current in excess of ten times its rated current.

1.3 LOADS. Variac autotransformers are adaptable to any load that is subject to control by voltage variation. As a rule, induction motors cannot thus be smoothly controlled. However, dc motors (with rectifiers), universal motors (with or without rectifiers), capacitor motors with fan loads, heaters, lights, and many other devices are suitable for such control.

The overvoltage connection should be avoided where the load may be damaged by the higher-than-line voltage available. When the overvoltage connection is omitted, with a fixed, known load, maximum current may be drawn at line voltage. Since losses (which vary with brush setting) are at a minimum near line and zero voltages, higher current can be drawn at these settings without exceeding normal temperature ratings. This higher (maximum) current is of such value that, as the brush setting is reduced below line voltage, with a constant-impedance load, the current fall-off with decreasing output voltage keeps the current within safe limits. To find the impedance in ohms of the minimum ohmic load, divide line volts by maximum amperes. The power rating of this load in watts is the product of line volts and maximum amperes.

For continuous operation, the rated current of the transformer should not be exceeded. Derate the unit in accordance with Figure 2 for ambient temperatures above 50 C.

Figure 1. Overload limits for line-voltage connection.

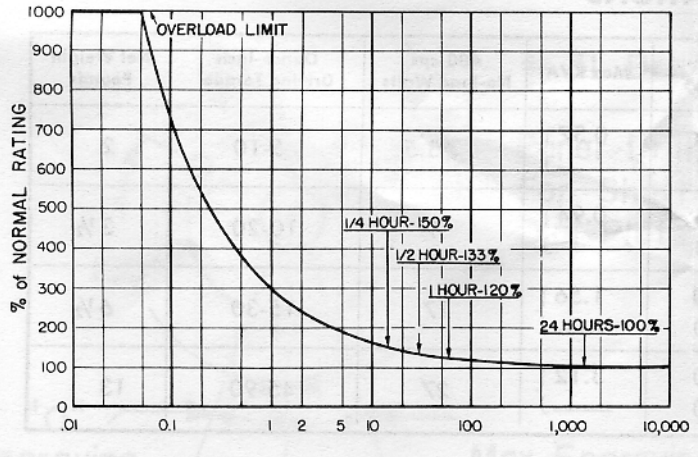
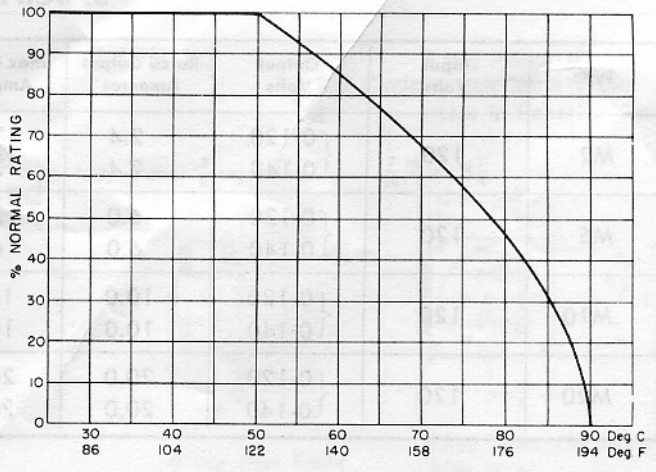


Figure 2. Temperature derating curve.



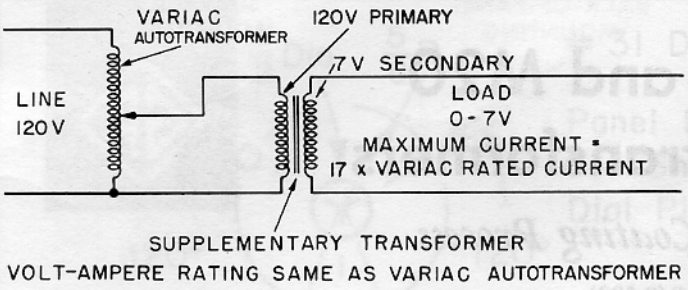


Figure 3. Supplementary low-voltage transformer useful for applications such as control of vacuum-tube heaters.

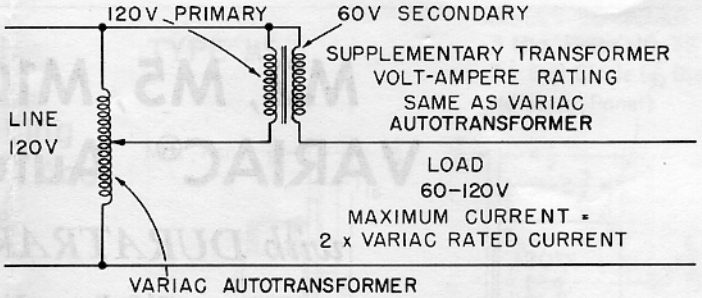


Figure 4. Supplementary 2:1 transformer useful for applications such as control of resistance furnaces.

When a load requires regulation over a limited range only, a supplementary, fixed, step-down transformer gives more satisfactory and economical operation. This practice results in:

a. an increase in current rating in the ratio of line voltage to operating range.

b. finer adjustment, since the operating range is spread out over the entire winding.

c. longer unit life, as the brush traverses the entire winding rather than a limited arc.

Typical examples are illustrated in Figures 3 and 4.

1.4 SWITCHING. To avoid dangerous surges, always set the pointer to zero before switching in the load circuit.

1.5 MAINTENANCE.

WARNING

Always disconnect the Variac autotransformer from *both* sides of the line before attempting any maintenance work.

1.5.1 Brush Track. The contact surface is stabilized by the patented *Duratrak* process. If cleaning becomes necessary use only a soft cloth and a safe solvent such as alcohol or "white" (non-leaded) gasoline. Do not use abrasives; their action may destroy the stabilized surface.

1.5.2 Brushes. Normally, brushes will last indefinitely. Rapid brush wear is an almost certain sign of overload, although the presence of an abrasive dust can accelerate wear of both brush and brush track. Brush extension is limited to prevent contact between the metal brush shell and the winding. Operation of the brush beyond its extension limit results in arcing, indicated by a voltage drop under load. Replace brushes before this limit is reached.

The Type M2 uses the General Radio Company Type VB1 brush assembly; the Type M5, the Type VB2 assembly. To replace either assembly, rotate the top plate to clear the retaining pins. Proper brush insertion is indicated by a click, or detent action, as the long axis of the top plate is aligned with the retaining pins.

The Type M10 uses the General Radio Company Type VBT10 brush assembly; the Type M20, the Type VBT8 assembly. To replace either assembly, remove the two screws that secure the assembly to the radiator.

The "pigtail(s)" on the new assembly must be securely fastened under the mounting screws.

Newly installed or reinstalled brushes must be correctly seated for proper operation. With power off, a few swings of the brush over the abrasive side of a piece of crocus cloth resting on the brush track will effectively mate brush and track. Remove the crocus cloth and blow or brush loose carbon from the brush track before applying power.

1.6 SERVICE. If, for any reason, you feel that your unit does not operate properly, write to our Service Department, giving operating details, circuit diagram, input and output voltages and current, and load type and rating.

When returning a unit for repair, or for any other reason, please write to our Service Department first, requesting shipping instructions. State the type number and the date of purchase. Pack the unit carefully. Returned units often suffer more damage in shipment than in service.

SPECIFICATIONS

Type	Input Volts	Output Volts	Rated Output Amperes	Max Output Amperes	Max KVA	400-cps No-load Watts	Ounce-Inch Driving Torque	Net Weight Pounds
M2	120	0-120 0-140	2.4 2.4	3.1 2.4	0.37 —	3.5	5-10	2
M5	120	0-120 0-140	6.0 6.0	7.8 6.0	0.94 —	9	10-20	3½
M10	120	0-120 0-140	10.0 10.0	13.0 10.0	1.56 —	17	15-30	6½
M20	120	0-120 0-140	20.0 20.0	26.0 20.0	3.12 —	27	45-90	13

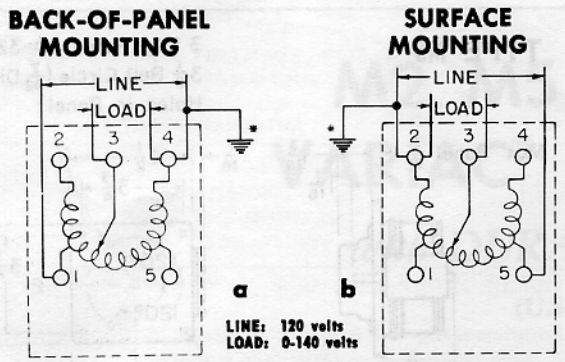


Figure 5. Recommended overvoltage connections

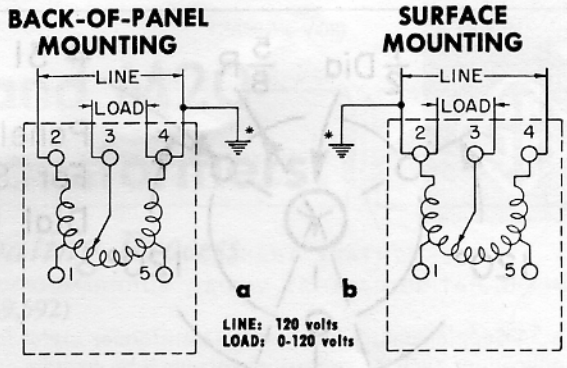


Figure 6. Recommended line-voltage connections

* If ground is necessary, common line-load terminal must connect to ground side of line

MOUNTING

2.1 GENERAL. The basic Type M2, M5, M10, and M20 Variac autotransformers are uncased units for back-of-panel mounting, with combination screw and solder-lug terminals provided.

Connection diagrams, for clockwise increase of voltage, are given in Figure 5a for overvoltage (0-140 v) operation and in Figure 6a for line-voltage (0-120 v) operation.

Type M models can also be operated on top of a table or other surface, with the shaft extending up from the brush radiator. Connection diagrams, for clockwise increase of voltage, are given in Figure 5b for overvoltage (0-140 v) operation and in Figure 6b for line-voltage (0-120 v) operation.

2.2 THREE-HOLE MOUNTING. The dimensions given in Figure 7 can be used to lay out three unit mounting holes, three dial-plate mounting holes, and the shaft-clearance hole. The mounting-screw heads must be flush or subflush with the panel surface to avoid interference with the dial plate.

2.3 FOUR-HOLE MOUNTING. The dimensions given in Figure 7 can be used to lay out four unit mounting holes, three dial-plate mounting holes, and the shaft-clearance hole. The four mounting screws do not require countersinking or counterboring, since there is sufficient clearance for the dial plate. Be sure the base is flat against the panel. Do not overtighten any of the mounting screws, as this may distort or tip the base.

2.4 GENERAL MOUNTING INFORMATION. Excellent heat-transfer characteristics exist between the coil and base and between the base and panel. A marked reduction in operating temperature can be realized if there is good thermal contact (tight parallel mounting) between the base and a metal mounting panel of any substantial area. It is recommended that the unit be installed where adequate ventilation is available, and well away from hot instruments. In mounting the reversible dial plate, use the scale that conforms to the load voltage range of the selected wiring connections. To adapt shaft projection for various panel thicknesses, loosen the two setscrews in the radiator hub, move the shaft as required, and retighten the set screws. With standard shafts, the maximum panel thickness for the Type M2 or M5 is $\frac{3}{8}$"; for the Type M10 or M20, it is $\frac{1}{2}$". Longer shafts are available at slight extra charge, and should be used on thicker panels. The opposite end of the shaft should project not less than $\frac{3}{16}$" from the radiator hub to allow adequate overinsulation distance between hub and shaft core. The pointer should be at zero with full counterclockwise rotation.

2.5 WIRING. Wiring circuits are shown in Figures 5 and 6. When making connections, avoid loose "whiskers" and keep wiring free from contact with working parts.

Figure 7. Mounting Dimensions

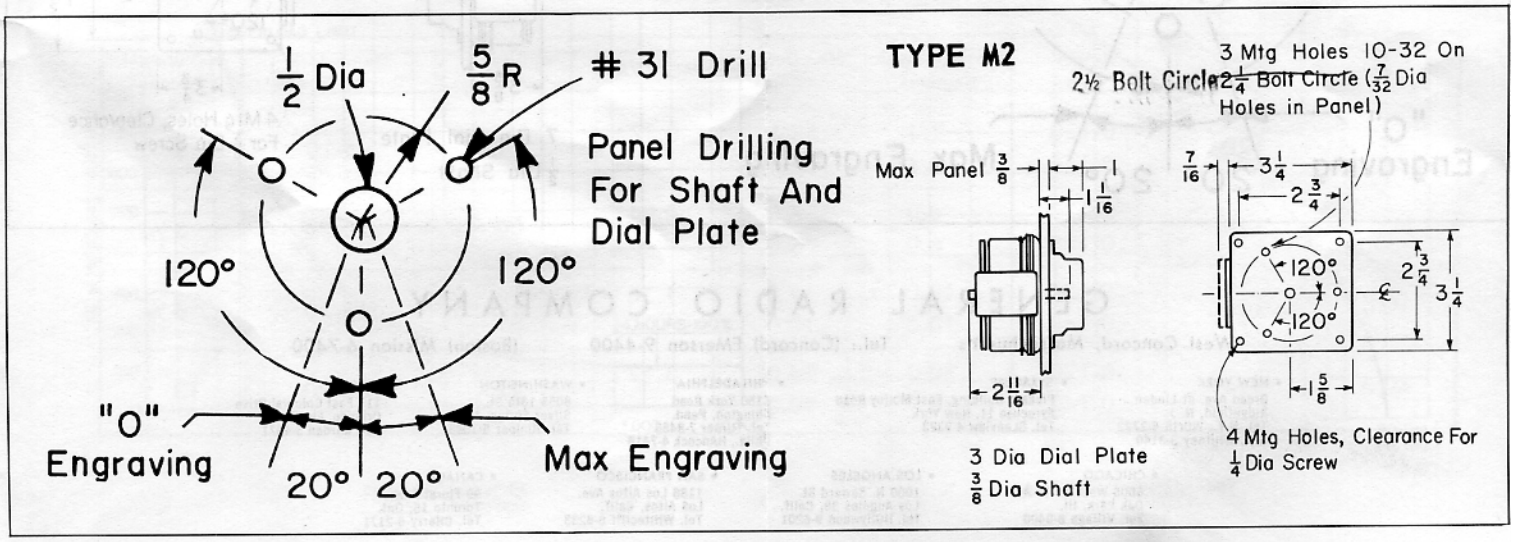
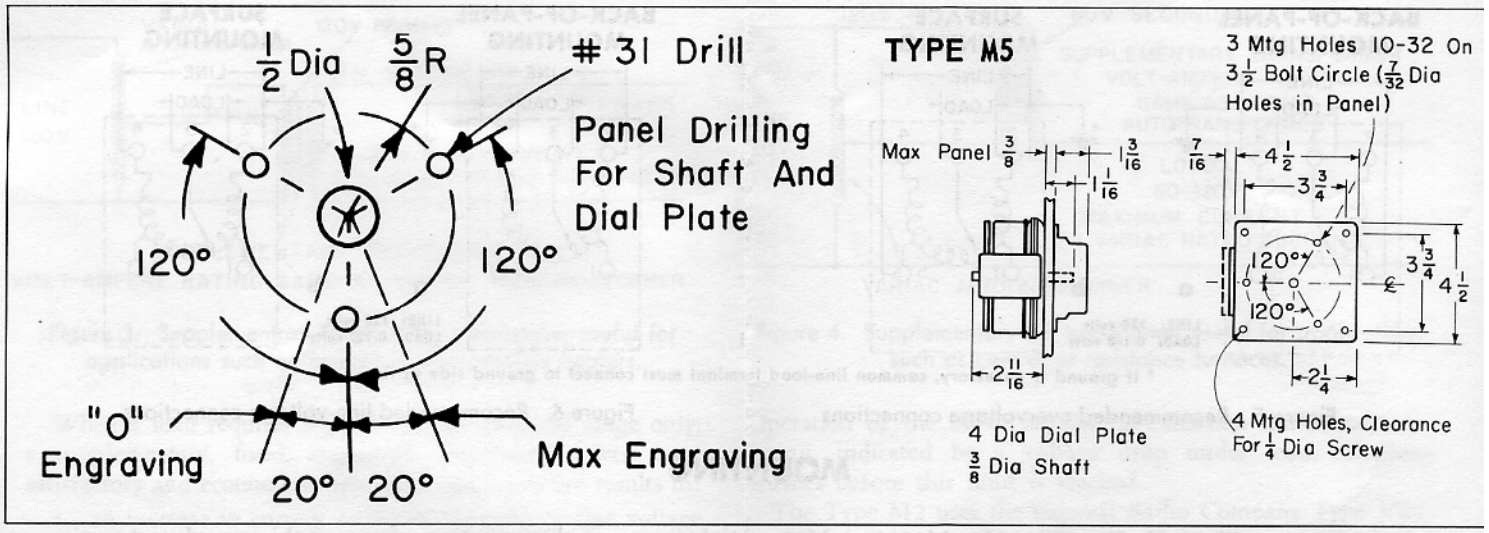
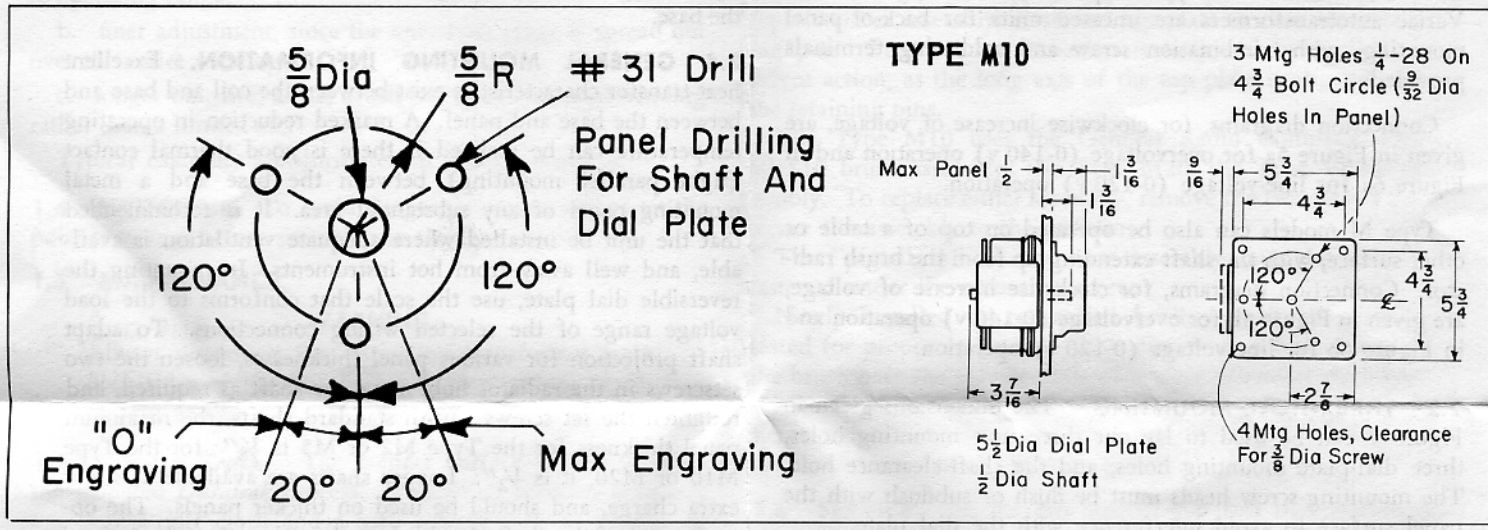
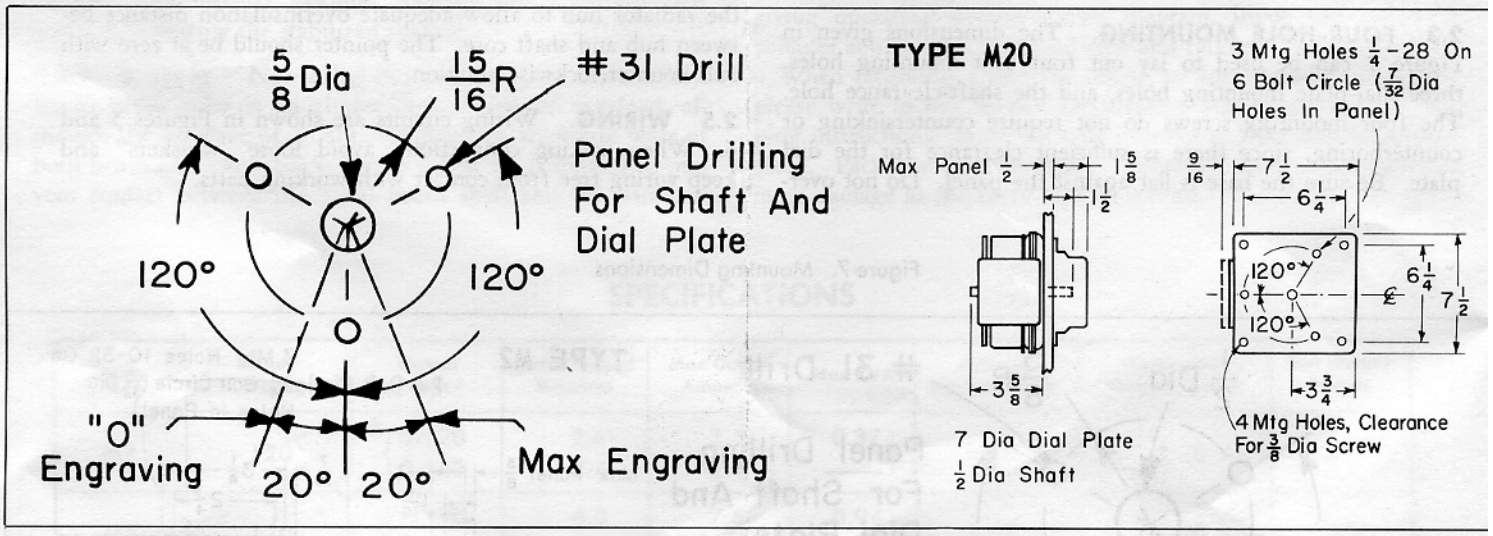


Figure 7. Mounting Dimensions (Cont.)







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