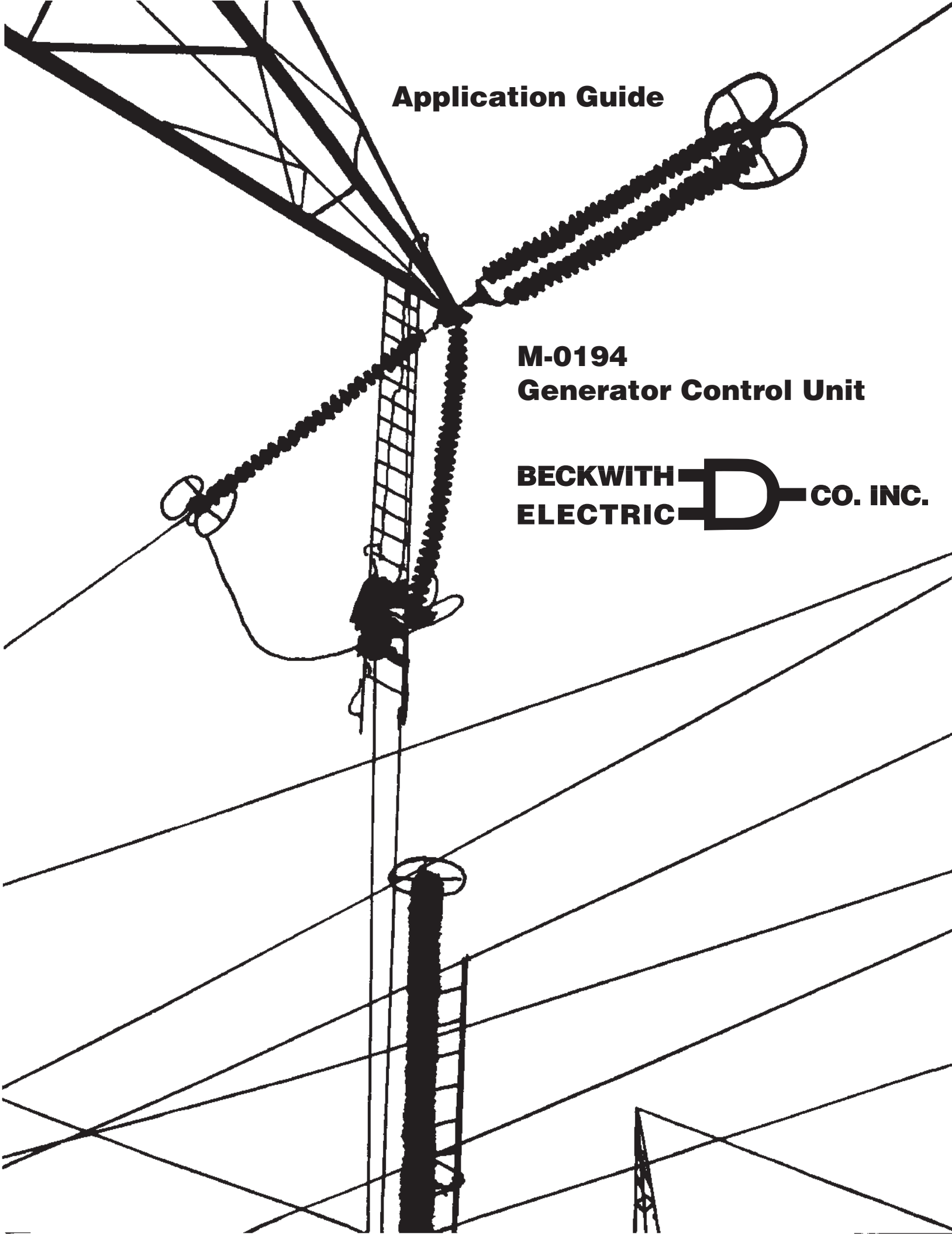
Application Guide



M-0194
Generator Control Unit

BECKWITH ELECTRIC CO. INC.

BECKWITH ELECTRIC CO. INC.

SYNCROCLOSER® LINE

Generator Control Unit M-0194

- **Matches Generator Speed And Voltage To System**
- **Works In Conjunction With M-0193B Syncrocloser® Unit To Close Breaker At Zero Degrees Phase Angle Error**
- **Adjustable Jog Durations, proportional to error, for Voltage and Speed control.**
- **Time Between Jogs adjustments bring the generator to a matched condition in minimum time and eliminate overshoot and hunting.**
- **Kicker Pulse brings phase angle around through zero if speed is matched but synchronism has not yet occurred. Adjustable pulse duration compensates for the sensitivity of the governor.**

Industry Leader Since 1969
Made in the USA

Inputs

Power: 120 V ac ±10%, 60 Hz ±5 Hz or optional 50 Hz ±5 Hz, 10 VA maximum burden. Will withstand 150 V ac maximum continuous, 200 V ac for 1 sec.

Interconnector Cable (Included): Provides logic inputs by connecting M-0194 Generator Control Unit to M-0193B Syncrocloser® Unit. Length of cable is approximately three feet.

Speed Control

Speed Matching Range of Operation: 30 to 85 Hz

TIME BETWEEN JOGS: available in two ranges: 1 to 15 sec. or 2 to 30 sec.

JOG DURATION: proportional to error. Proportional Jog Duration is 1 to 10 sec. per Hz of frequency mismatch; linear for ΔF of 0.015 Hz to 1.5 Hz of mismatch.

KICKER PULSE: A generator raise speed jog is produced if the speed matcher does not operate in the time set on the **KICKER PULSE DURATION** dial. The kicker pulse duration is adjustable from 0.1 to 2.4 seconds at a kicker pulse rate of one pulse per 6 to 120 seconds.

Voltage Control

Voltage Matching Range of Operation: 30-200 V ac

TIME BETWEEN JOGS, available in two ranges: 1 to 15 sec. or 2 to 30 sec.

JOG DURATION, proportional to error. Proportional Jog Duration: 0.1 to 1.0 sec. per volt of mismatch; linear from 1 to 20 V of mismatch.

OUTPUT RELAY CONTACTS

Raise Voltage Jog	Raise Speed Jog
Lower Voltage Jog	Lower Speed Jog

Contact Rating

Dry output contacts rated to make and carry 20 A up to 250 V dc, or to interrupt 0.9 A, 120 V dc inductive load or 0.4 A, 250 V dc inductive load. Open contacts will withstand 1500 V ac for one minute. Contacts to ground will withstand 1500 V ac for one minute.

LED Indicators

SENDING RAISE SPEED
SENDING RAISE VOLTAGE
BUS FREQUENCY HIGH
SENDING LOWER SPEED
SENDING LOWER VOLTAGE
GENERATOR FREQUENCY HIGH

Accuracy

Jog times and Kicker Pulse Duration will be within ±20% of setting.

Mounting Options

Horizontal mounting is standard; vertical mounting or vertical General Electric GTL14B Retrofit Panel mounting are available as options.

Generator Control Unit Cover Kit

The M-0194 Generator Control Unit includes a transparent cover with associated mounting bracket to cover the dials and prevent accidental resetting.

Transient Protection

Input and output circuits are protected against system transients. The M-0194 will pass all requirements of ANSI/IEEE C37.90.1-1989 defining oscillatory surge withstand capability. All inputs and outputs will withstand 1500 V ac to chassis or instrument ground for one minute. Voltage inputs are electrically isolated from each other, from other circuits, and from ground.

Environmental

Temperature Range: Stated accuracies are maintained from –40° to +80°C.

Humidity: Stated accuracies are maintained under 95% relative humidity (non-condensing).

Fungus Resistance: A conformal printed circuit board coating inhibits fungus growth.

Physical

Size: 19" wide x 3-1/2" high x 14" deep (48.3 cm x 8.9 cm x 35.6 cm)

Horizontal mounting requires two rack units space in a standard 19" rack.

Approximate Weight: 15 lbs (6.8 kg)

Approximate Shipping Weight: 23 lbs (10.4 kg)

Warranty

The M-0194 Generator Control Unit is covered by a five year warranty from date of shipment.

Specification is subject to change without notice.

BECKWITH ELECTRIC CO., INC.
6190 - 118th Avenue North • Largo, Florida 33773-3724 U.S.A.
PHONE (727) 544-2326 • FAX (727) 546-0121
marketing@beckwithelectric.com
www.beckwithelectric.com
ISO 9001:2008

800-0194-SP-00MC5 11/16

WARNING

DANGEROUS VOLTAGES, capable of causing death or serious injury, are present on the external terminals and inside the equipment. Use extreme caution and follow all safety rules when handling, testing or adjusting the equipment. However, these internal voltage levels are no greater than the voltages applied to the external terminals.

DANGER! HIGH VOLTAGE

– This sign warns that the area is connected to a dangerous high voltage, and you must never touch it.

PERSONNEL SAFETY PRECAUTIONS

The following general rules and other specific warnings throughout the manual must be followed during application, test or repair of this equipment. Failure to do so will violate standards for safety in the design, manufacture, and intended use of the product. Qualified personnel should be the only ones who operate and maintain this equipment. Beckwith Electric Co., Inc. assumes no liability for the customer's failure to comply with these requirements.

– This sign means that you should refer to the corresponding section of the operation manual for important information before proceeding.

Always Ground the Equipment

To avoid possible shock hazard, the chassis must be connected to an electrical ground. When servicing equipment in a test area, the Protective Earth Terminal must be attached to a separate ground securely by use of a tool, since it is not grounded by external connectors.

Do NOT operate in an explosive environment

Do not operate this equipment in the presence of flammable or explosive gases or fumes. To do so would risk a possible fire or explosion.

Keep away from live circuits

Operating personnel must not remove the cover or expose the printed circuit board while power is applied. In no case may components be replaced with power applied. In some instances, dangerous voltages may exist even when power is disconnected. To avoid electrical shock, always disconnect power and discharge circuits before working on the unit.

Exercise care during installation, operation, & maintenance procedures

The equipment described in this manual contains voltages high enough to cause serious injury or death. Only qualified personnel should install, operate, test, and maintain this equipment. Be sure that all personnel safety procedures are carefully followed. Exercise due care when operating or servicing alone.

Do not modify equipment

Do not perform any unauthorized modifications on this instrument. Return of the unit to a Beckwith Electric repair facility is preferred. If authorized modifications are to be attempted, be sure to follow replacement procedures carefully to assure that safety features are maintained.

PRODUCT CAUTIONS

Before attempting any test, calibration, or maintenance procedure, personnel must be completely familiar with the particular circuitry of this unit, and have an adequate understanding of field effect devices. If a component is found to be defective, always follow replacement procedures carefully to that assure safety features are maintained. Always replace components with those of equal or better quality as shown in the Parts List of the Instruction Book.

Avoid static charge

This unit contains MOS circuitry, which can be damaged by improper test or rework procedures. Care should be taken to avoid static charge on work surfaces and service personnel.

Use caution when measuring resistances

Any attempt to measure resistances between points on the printed circuit board, unless otherwise noted in the Instruction Book, is likely to cause damage to the unit.

TABLE OF CONTENTS

M-0194 GENERATOR CONTROL UNIT
Application Guide

In our efforts to provide accurate and informative technical literature, suggestions to improve the clarity or to correct errors will receive immediate attention. Please contact the Marketing Services Department, specifying the publication and page number.

Printed in USA

800-0194-AG-01 11/16

This Page Left Intentionally Blank

INTRODUCTION

DESCRIPTION

The M-0194 Generator Control Unit provides speed and voltage "jog" controls to bring a generator within proper conditions of matching voltage and frequency prior to closing a breaker into a bus energized by an electric power network. The unit derives its logic inputs from an M-0193B Syncrocloser® Unit through an interconnector cable; the power input is connected directly to the M-0194.

The associated M-0193B is an automatic synchronizer that includes, as an option, a compatibility package for the Generator Control Unit. The option has a connector for the M-0194 Connector Cable and provides control signals required to detect frequency and voltage. Refer to the M-0193B Application Guide for further information on this unit.

For enhanced security against an out-of-phase closing, a Beckwith Electric M-0188A or M-0359 Syncrocloser Check Relay may be used in conjunction with the M-0193B and M-0194. Figure 6 shows a typical interconnection diagram. Refer to the corresponding Sync-Check Relay Application Guide for details specific to the applied unit.

Before a generator breaker can be closed, the generator voltage and speed must be adjusted to match the voltage and frequency of the power network on the other side of the breaker. This is called the bus and will generally be a physical bus at a substation located at the generating plant. The bus voltage and frequency may vary sufficiently that it will be necessary for the generator to follow the changes and to seek a matching condition at which the associated automatic synchronizer will permit closing the breaker.

The phase of the generator must match that of the bus; however, this is not controlled directly. Rather, the system depends on a small residual frequency difference to rotate the phase angle to zero before closing the breaker. A kicker pulse assures that such a minimum difference will exist.

The speed of response to voltage control impulses tends to be similar for various machines. However, the speed of response to speed control impulses varies fundamentally with the type and size of the machine. For example, hydro machines with long penstocks respond slower than others, due to the inertia of the water flowing in the penstock.

The M-0194 may be adjusted to match characteristics of individual generators to minimize the time to convergence of speed and voltage conditions which will permit synchronizing. Convergence time is minimized due to two unique functions:

1. The **TIME BETWEEN JOGS** dials for **SPEED CONTROL** and **VOLTAGE CONTROL** can be set on the M-0194 to match machine characteristics and can be set independently of slip rate or other unrelated variables.

2. With proportional control, the duration of the control jog is a function of the error. This allows compensation for a wide range of governor sensitivities.

■ **NOTE**: Values for the 50 Hz Operating Frequency option are shown in brackets.

PROPORTIONAL CONTROL

For proportional control, the **VOLTAGE CONTROL** and **SPEED CONTROL** jog durations are proportional to error as the generator reaches the proper conditions. This means that with wider divergences, maximum jog durations are produced to assure rapid convergence. As the error decreases, jog length is shortened proportionately, in order to bring the unit to the proper condition. The proportional control for both the voltage and speed matching produces contact closures (i.e., raise speed, lower voltage, etc.) for a length of time (T_J) as shown in Figure 1. The output contact will close for the proportional T_J seconds and open for T_{BJ} (time between jogs). The proportionality constant is adjustable to assure the fastest possible convergence to the synchronizing condition without extensive hunting.

PROPORTIONAL CONTROL OPERATION

Proportional control for either voltage or speed matching produces contact closures that are used to adjust the generator speed and voltage to within the limits set by the front panel dials on the M-0193B Syncrocloser Unit. The Proportional Control adjusts jog duration T_J as the voltage or frequency difference changes, as given in the following equations.

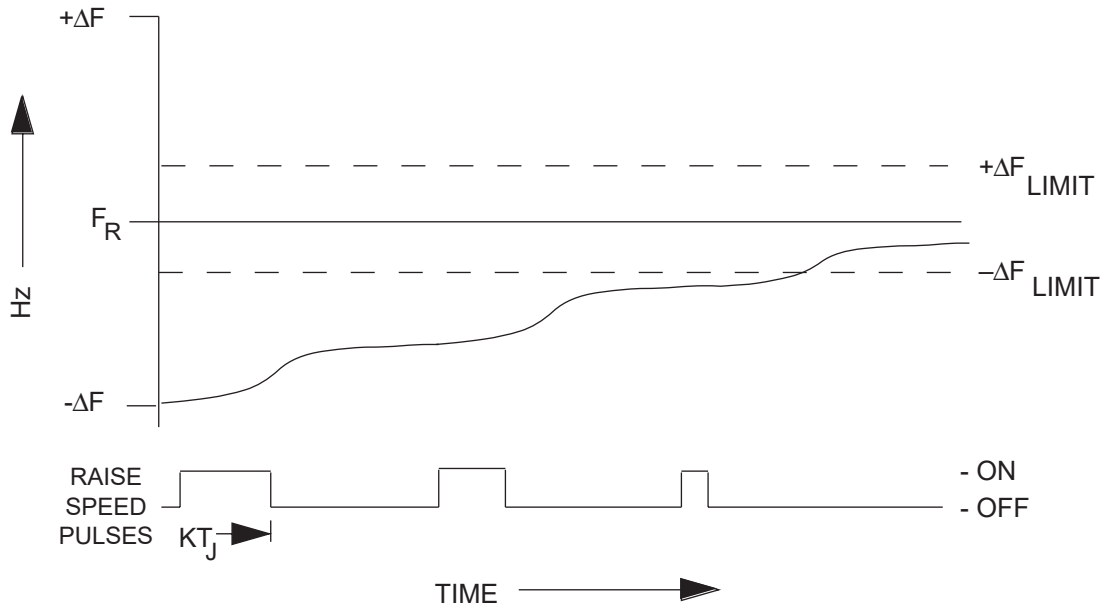


FIGURE 1 Proportional Pulse Width Control, With Fixed Time Between Jogs

Voltage Control: $T_J = (K_v)\ (\Delta V)$

Speed Control: $T_J = (K_f)\ (\Delta F)$

Where:

ΔV = the voltage difference across the breaker to be closed.

ΔF = the frequency difference (slip frequency) across the breaker for ranges of ΔF equal to 0.015 Hz to 1.5 Hz.

K_v = the setting of the M-0194 **VOLTAGE CONTROL JOG DURATION** dial.

K_f = the setting of the M-0194 **SPEED CONTROL JOG DURATION** dial.

Figures 2 and 3 show the speed and voltage jog duration T_J versus frequency and voltage difference. The bus frequency must be 60 [50] Hz ±0.5 Hz and the generator frequency from 30 to 85 Hz for proper operation of the speed matcher. The voltage matcher will operate properly for bus voltages from 90 to 140 V rms. If the bus voltage is outside of this range, the M-0194 may operate properly, but the M-0193B will not close the breaker since the **UPPER VOLTAGE** or **LOWER VOLTAGE LIMIT** settings on the M-0193B have been exceeded. The data of Figures 2 and 3 assume that the voltage and frequency do not change during the jog.

The proportional control allows the voltage and speed to match rapidly without extensive hunting or overshooting. The **JOG DURATION** dials can be set so that the first jog is long enough to bring the generator voltage or frequency to within the limits set on the M-0193B. If further jogs are required, the duration will be reduced to ensure no overshooting or hunting takes place. If the voltage or speed changes during the control jog, the M-0194 will reduce the jog width accordingly.

■ **NOTE**: With proportional voltage control operation, the Raise and Lower Voltage relays will not close if the generator voltage exceeds the **LOWER** or **UPPER VOLTAGE LIMIT** settings on the M-0193B, even if ΔV is still outside the limit setting.

CHANGE OF DIRECTION OF DELTA FREQUENCY

Other speed match controllers use a circuit that requires that the phase angle pass through zero before a change in sign of the frequency difference is recognized. With a very slowly moving angle, the time could be very short or very long, depending on the angle and direction of rotation of the scope at the time the frequency difference changed direction.

The M-0194 uses a circuit that works correctly at any phase angle and has a fixed time of operation of somewhat under 3 sec. It is necessary for the time to be this long to avoid erratic operation due to the inevitable phase jitter on the line voltage. The circuit is capable of correct operation with a frequency difference as low as 0.005 Hz.

The other controllers mentioned could require up to a complete revolution of the scope or 2.5 hours to detect the change in sign, if indeed the unit would operate at all with such a small frequency difference. This time would occur if the sign changed just as the angle was approaching zero and then reversed, so that a complete revolution was required to reach zero again.

It is possible, in testing the M-0194, to create a raise or lower pulse and have this continue in the wrong direction for up to 3 sec. under ideal laboratory conditions. It is most unlikely for this to happen in practice, however, since it is the nature of proportional control for the corrective pulse to occur followed by a reaction time for the speed to approach a value closer to synchronous speed. To ensure this proper operation, it is suggested that the time between pulses (T_{BJ}) be set to 3 sec. or more.

Should the unusual laboratory condition occur in the field, the consequences would be of little importance. At the start of any such raise or lower pulse, conditions are most likely to be within the synchronizing window of voltage and frequency. The portion of the pulse in the “wrong” direction will then merely act as a kicker pulse to help the angle come around to zero.

In an even more unlikely situation, which can be created in a laboratory, the breaker could close during a corrective pulse. In that case, external relays are expected to transfer control of the speed and field to other equipment, thereby ending the pulse existing at the time of the breaker closing.

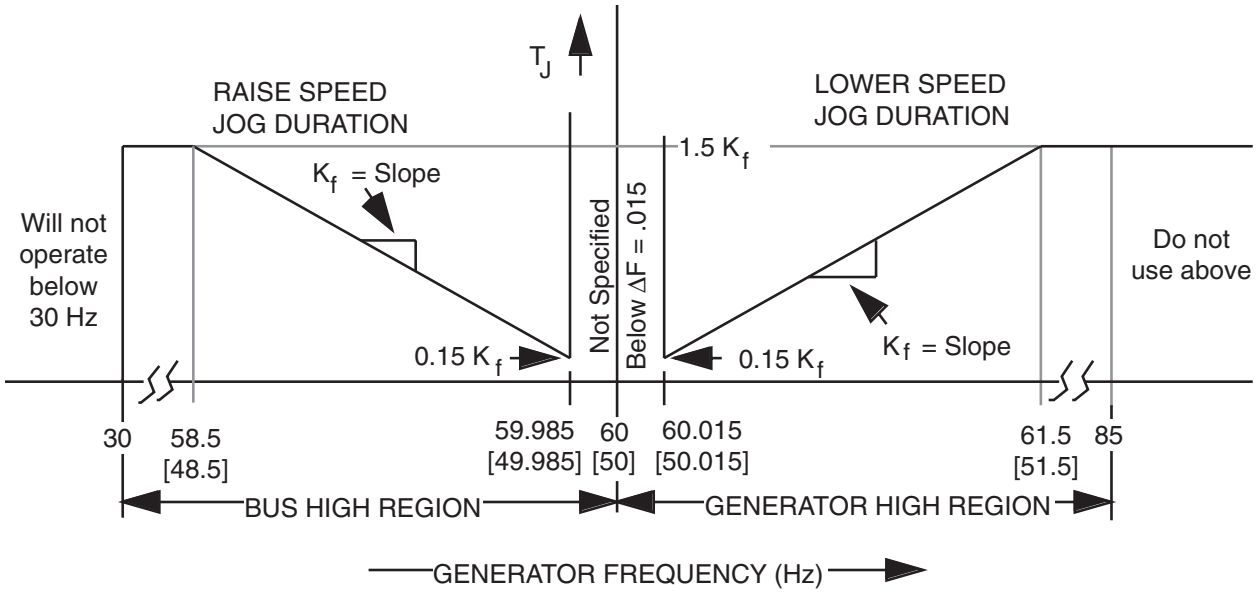


FIGURE 2 Proportional Speed Jog Duration Diagram

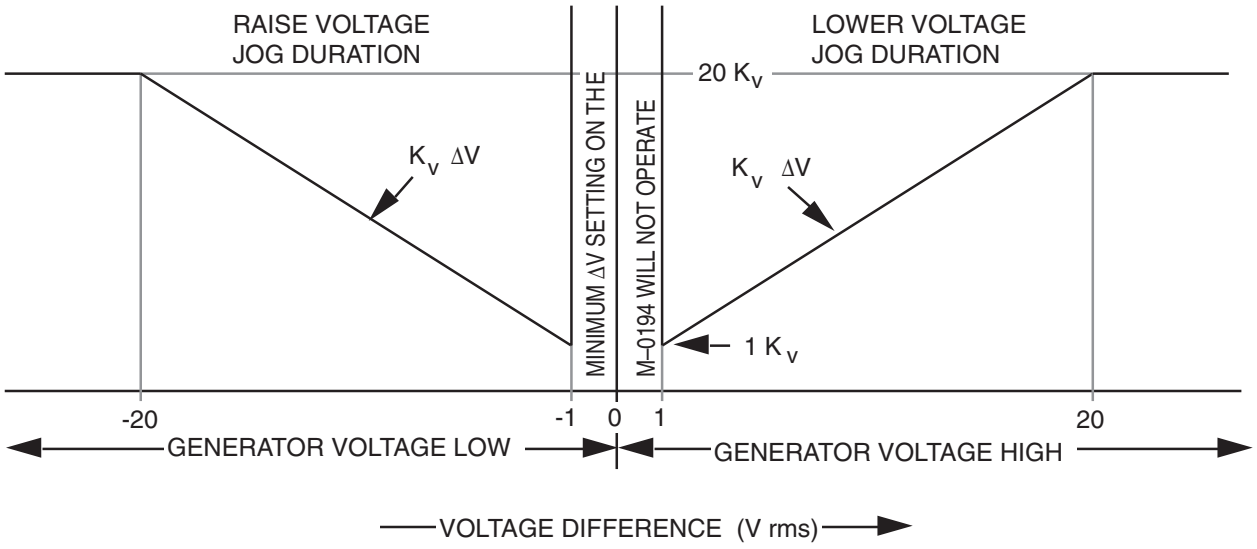
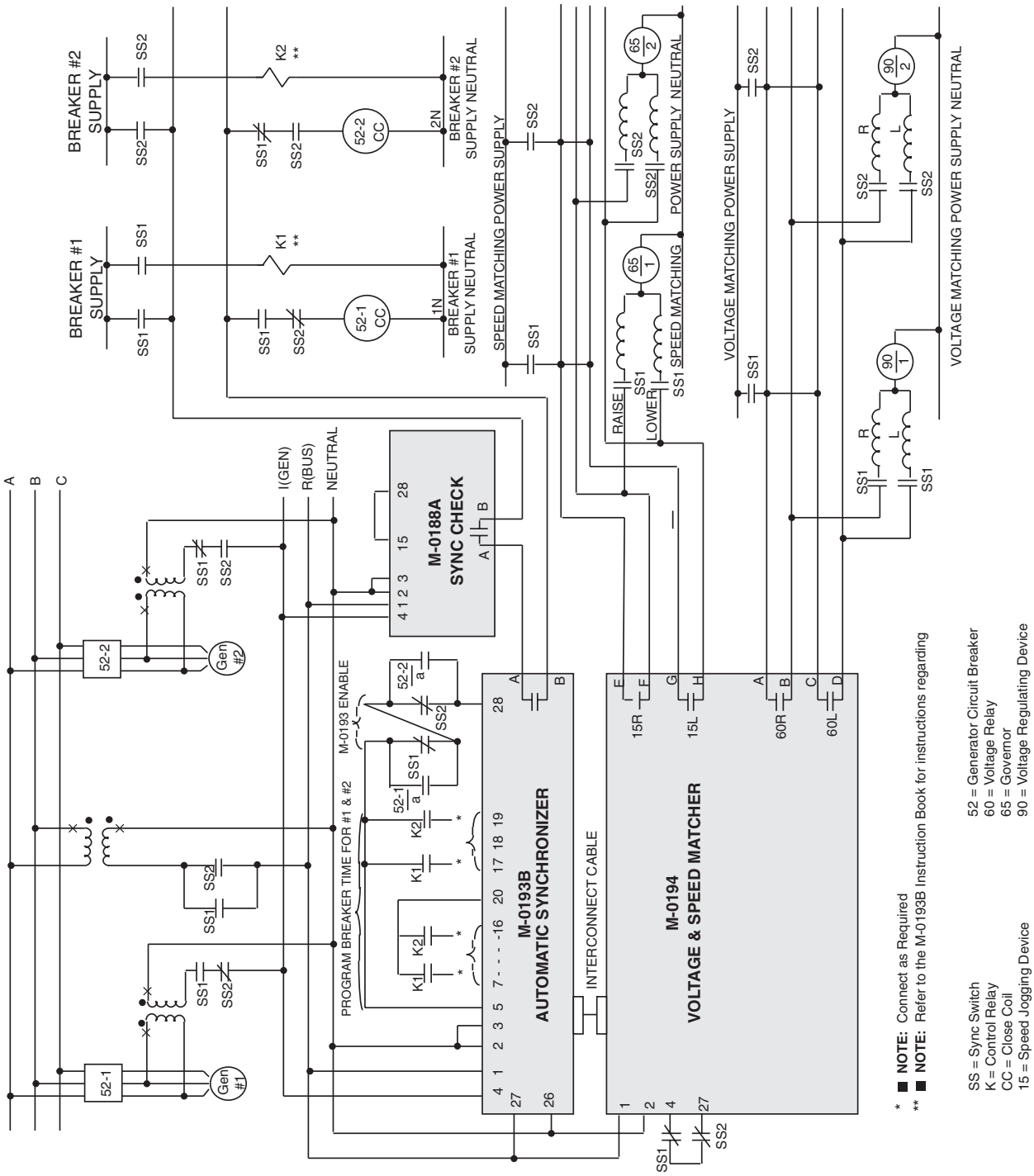


FIGURE 3 Proportional Voltage Jog Duration Diagram

This discussion merely illustrates the care with which Beckwith Electric studies the operation of its product under all possible conditions, regardless of the probability of the condition happening. The information gained from laboratory tests is then used to reduce the chance of an unacceptable event occurring.

TYPICAL APPLICATION

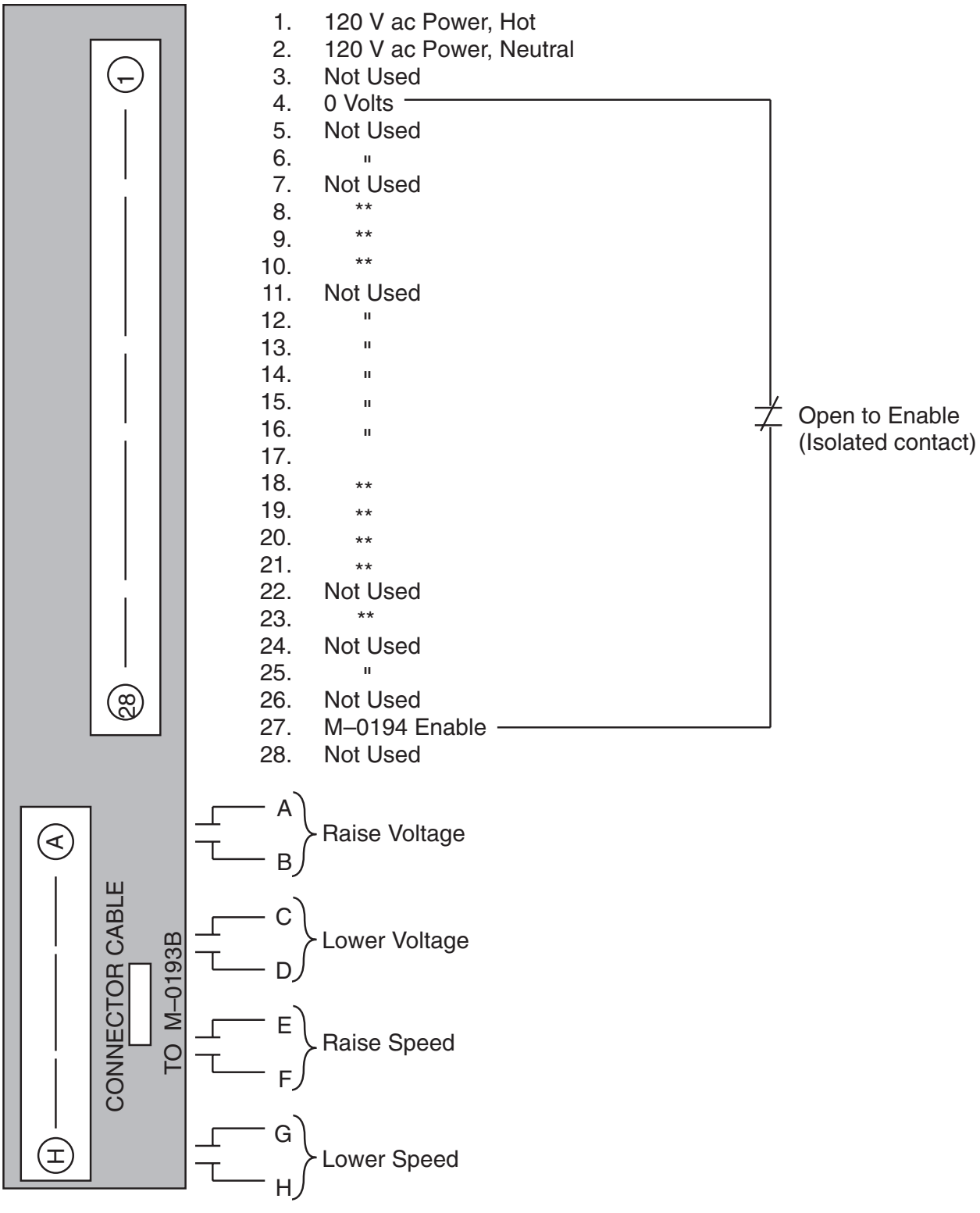
A typical application diagram for the M-0193B/M-0194 Synchronizing System is shown in Figure 4. This system can be expanded to any number of generators by duplicating the contact arrangements for generators 1 and 2 as shown. Multiplexing using multiple keyed sync switches, or through selector relays indexed by a Programmable Logic Controller or Distributed Control System are also applicable for multiple generator installations. The synchronizing breakers can have widely varying closing times and will operate properly by making the appropriate closing time connections to terminals 5 through 20 on the M-0193B. The M-0188A Syncrocloser® Check Relay provides enhanced security by ensuring that the phase angle is within limits when the M-0193B contact closes. Refer to the M-0188A Application Guide for details on the unit.



* ■ **NOTE:** Connect as Required
** ■ **NOTE:** Refer to the M-0193B Instruction Book for instructions regarding

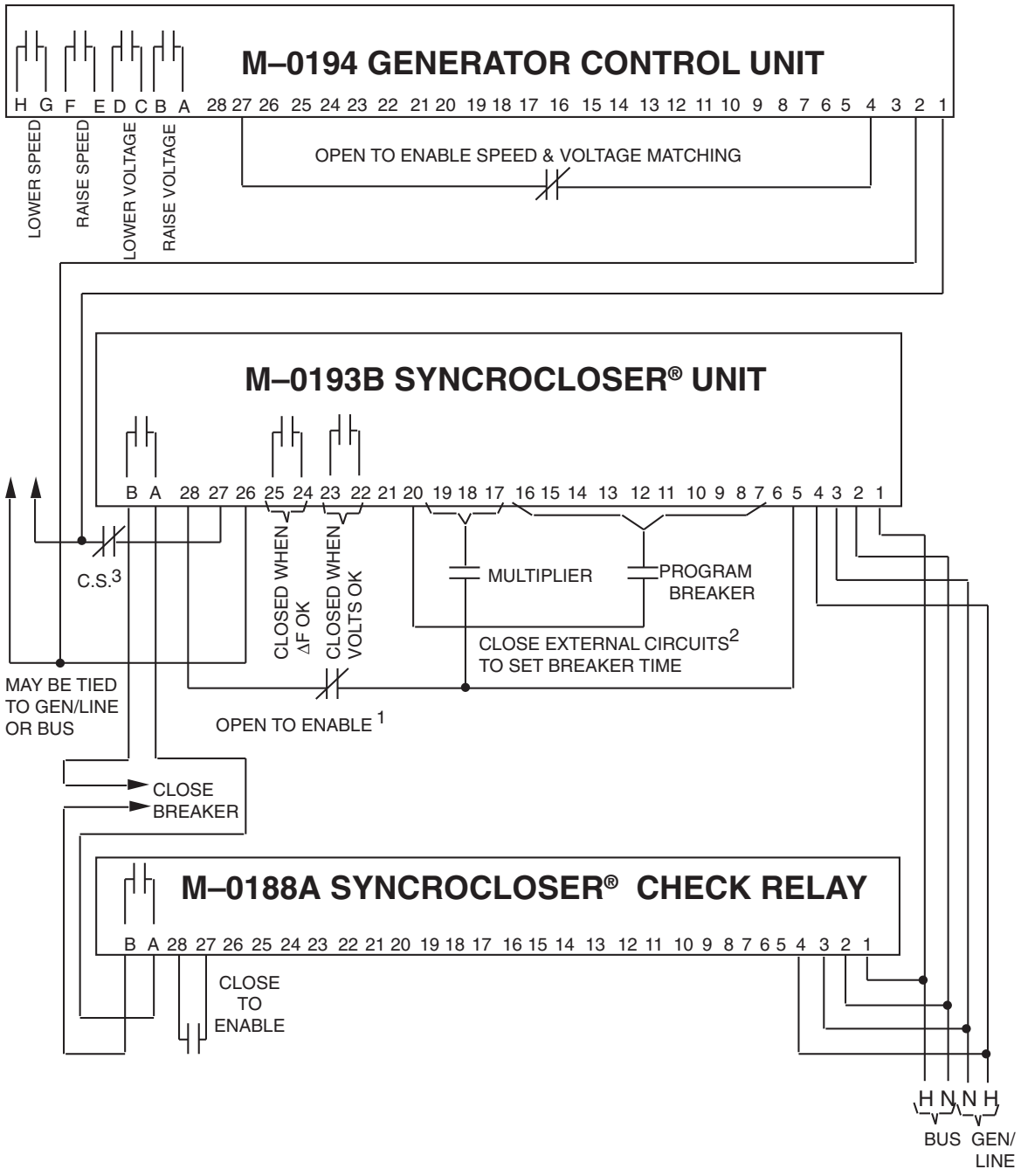
SS = Sync Switch
K = Control Relay
CC = Close Coil
15 = Speed Jogging Device
52 = Generator Circuit Breaker
60 = Voltage Relay
65 = Governor
90 = Voltage Regulating Device

FIGURE 4 Synchronizing System Typical Application



***Future use*

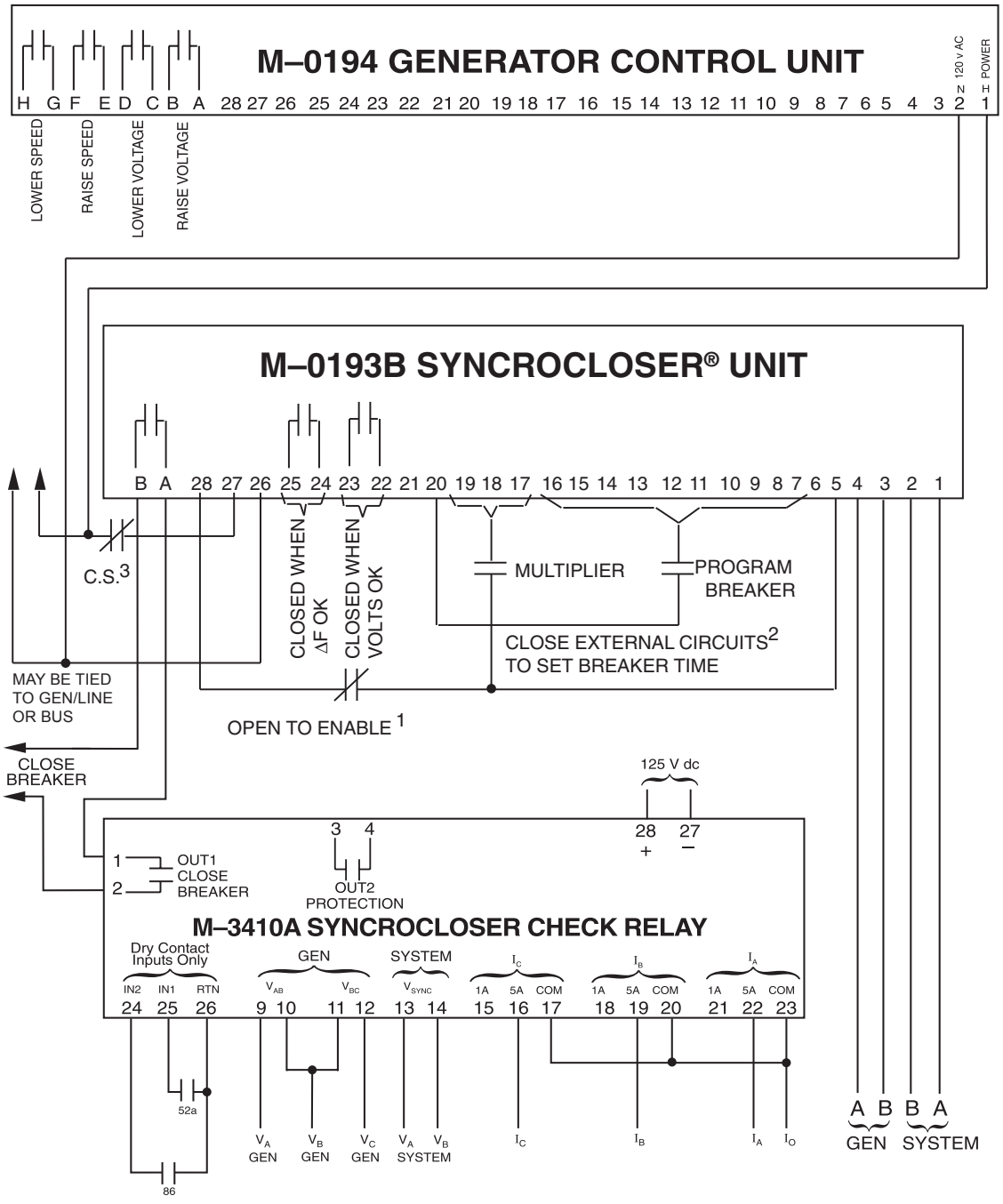
FIGURE 5 External Connections



■ **NOTES:**

1. Terminals 5 and 28 are also used for the Operator Window Option, in which case a momentary closed contact enables breaker close.
2. When making connections to the rear of the unit to program the breaker closing time, 20 ms must be added to the actual breaker closing time. This additional time is the average pickup time of the M-0193B output relay. For example, if the average closing time for the controlled circuit breaker is 100 ms, the M-0193B should be programmed for 120 ms.
3. Control Switch — This switch must be opened for 10 sec. after each M-0193B operation to reset the Anti-Pump option, unless the unit is ordered without the option.

FIGURE 6 Syncrocloser® Interconnections



■ **NOTES:**

1. Terminals 5 and 28 are also used for the Operator Window Option, in which case a momentary closed contact enables breaker close.
2. When making connections to the rear of the unit to program the breaker closing time, 20 ms must be added to the actual breaker closing time. This additional time is the average pickup time of the M-0193B output relay. For example, if the average closing time for the controlled circuit breaker is 100 ms, the M-0193B should be programmed for 120 ms.
3. Control Switch — This switch must be opened for 10 sec. after each M-0193B operation to reset the Anti-Pump option, unless the unit is ordered without the option.

FIGURE 6A Syncrocloser® Interconnections (with M-3410A)

ADJUSTMENT

TIME BETWEEN JOGS (SPEED AND VOLTAGE)

These dials are set at a constant time relative to the response time of the generator control. In order to avoid hunting, it is necessary to wait until the effect of one jog is essentially complete before giving another.

The time between jogs T_{BJ} (output contact open) is independently set for both speed and voltage using the **TIME BETWEEN JOGS** dials. These two periods should be adjusted for the generator controls at the particular installation to be long enough to allow the effect of the previous contact closure to be completed. Once set, T_{BJ} is fixed and will not change as the voltage or frequency difference changes.

The **TIME BETWEEN JOGS** dials can be set at two to three times the system time constant, if this constant is known. The following procedure is suggested if the data is not readily available. Data must be taken with the generator disconnected from the system. Insert one control jog of a given, known time duration. Observe the time required for the frequency or voltage to move 90% of the way to the final value after the jog. Set the appropriate **TIME BETWEEN JOGS** dial to a value greater than or equal to this value.

Typically, there will be a difference in the response time to a voltage and frequency jog. Therefore, separate measurements must be taken for the **SPEED** and **VOLTAGE** dial settings.

For example: Apply a 0.1 sec. speed jog and observe the time required for the frequency change to be 90% complete. That is, if the jog caused the frequency to change from 59.0 [49.9] to 60.0 [50.0] Hz, record the time required for the frequency to reach 59.9 [49.9] Hz. If this time was 10 sec., then the **TIME BETWEEN JOGS** for **SPEED** should be set at 10 sec. or greater.

JOG DURATION (SPEED AND VOLTAGE)

The jog durations T_J (output contact closed) are set by the **JOG DURATION** dials on the M-0194 front panel. The speed and voltage jogs are independently set by the appropriate dials.

The **JOG DURATION** dials set the proportionality constants for the speed and voltage matching. The **VOLTAGE CONTROL JOG DURATION** dial setting is the constant K_v. The **SPEED CONTROL JOG DURATION** dial setting is the constant K_f. The jog width is related to the voltage or frequency difference as shown in Figures 2 and 3.

Setting the SPEED CONTROL JOG DURATION Dial

In order to make adjustments for the proportional control, it is necessary to have data on the machine response to a jog of a given length. A procedure such as the following is suggested if data is not already available. Data must be taken with the generator disconnected from the system. Insert a speed control jog of a given, known time duration. Record the change in frequency due to the known length control jog. Calculate Hz/sec. total response to the jog. Set the **JOG DURATION** dial to the reciprocal of the Hz/sec. value obtained experimentally.

For example:

If a single 0.2 sec. raise speed jog causes the speed to increase 0.1 Hz, then:

$$\frac{\Delta F}{T} = \frac{0.1 \text{ Hz}}{0.2 \text{ sec.}} = 0.5 \text{ Hz/sec.}$$

Therefore, set the **SPEED CONTROL JOG DURATION** dial to:

$$K_f = \frac{1}{0.5 \text{ Hz/sec.}} = 2 \text{ sec./Hz}$$

Setting the VOLTAGE CONTROL JOG DURATION Dial

Repeat the above procedure for a given, known voltage control jog and set the **VOLTAGE CONTROL JOG DURATION** dial accordingly.

KICKER PULSE RATE

A condition may exist in which the bus frequency, for a time, does not change and in which the generator has been brought to a nearly perfect speed match, but at a phase angle far from zero. The kicker pulse will raise the generator frequency slightly, causing the phase to rotate towards zero and create the condition whereby the M-0193B will close the breaker.

The kicker pulse timer begins timing at the instant each jog is completed (contacts open) and is therefore set longer than the time between jogs. The kicker pulse rate dial is typically set to three times the time between speed jogs setting.

Setting the KICKER PULSE DURATION Dial

A variable dial on the front panel can be set from 0.1 to 1.5 sec., depending on the response of the machine. The kicker pulse length should be adjusted to increase the speed of the generator by approximately one-half of the **ΔF LIMIT** setting on the M-0193B. This will minimize the synchronizing time of the operation if the frequency and voltage conditions are met, but the phase angle has not passed through 0°.

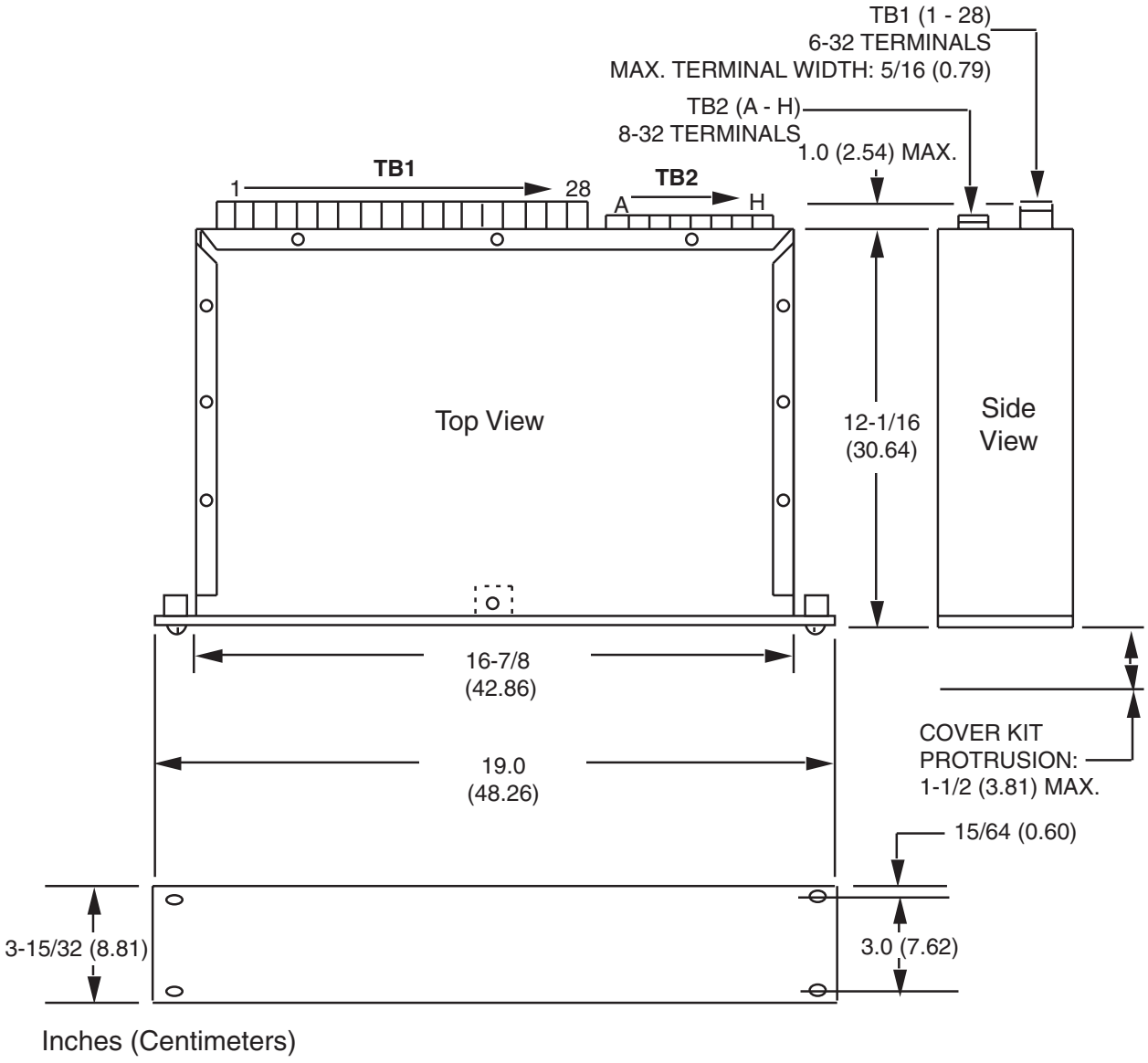


FIGURE 7 Outline Dimensions for all Syncrocloser® Equipment Chassis

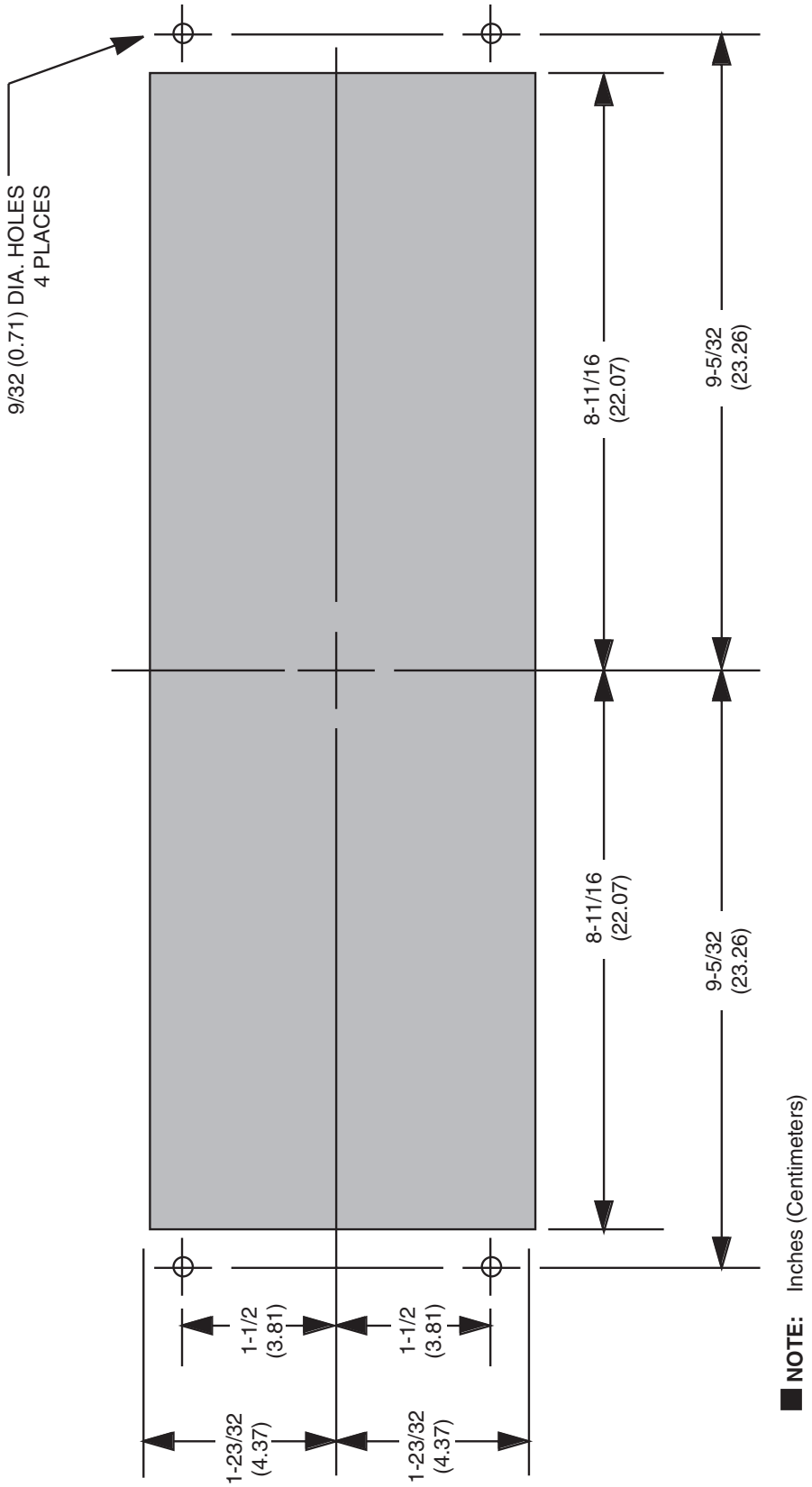
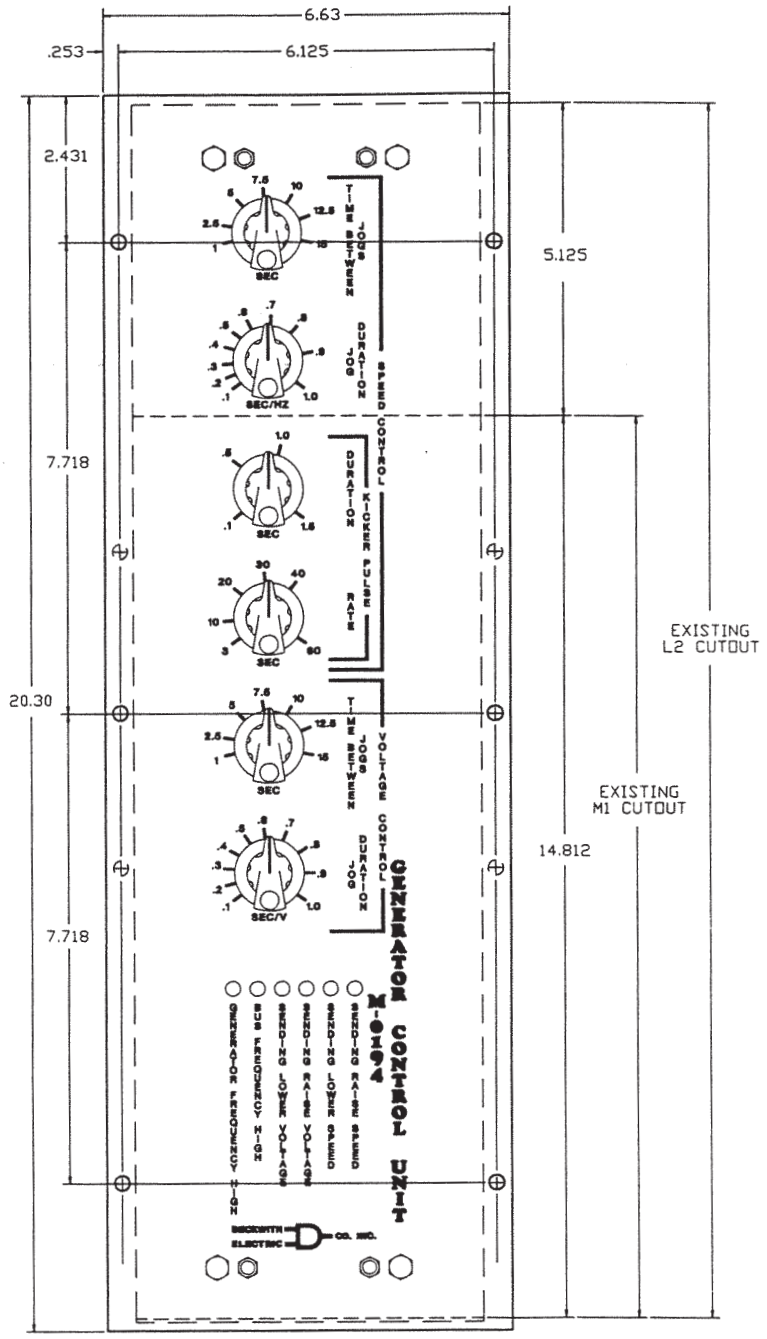


FIGURE 8 Panel Mounting Dimensions



NOTE:

IF CUTOUT FOR REPLACEMENT PANEL IS FOR AN M1 TYPE CASE, LOCATE REPLACEMENT PANEL AT BOTTOM SET OF HOLES, ENLARGE CUTOUT HEIGHT 5.125", AND DRILL (4) NEW HOLES AT DIMENSIONS SPECIFIED.

IF CUTOUT FOR REPLACEMENT PANEL IS FOR AN L2 TYPE CASE, NO ADDITIONAL CUTTING IS REQUIRED.

FIGURE 9 Panel Mounting Dimensions for General Electric GTL14B Retrofit Panel

MAINTENANCE

Due to the extremely sophisticated nature of the circuitry in the M-0194, field repair is not recommended. All units are fully calibrated at the factory prior to shipment; there is no need to re-calibrate a unit prior to initial installation. Calibration is only required after a component is replaced. In the event that a unit does not operate properly, it should be established that the problem is caused by malfunction of a Beckwith Electric unit and not caused by an external fault or wiring error. Once this is assured, the entire unit should be returned to Beckwith Electric. Pack the unit carefully (in the original carton if possible), assuring that there is adequate packing material to protect the contents.

■ **NOTE**: Any equipment returned for repair must be sent with transportation charges prepaid. The equipment must remain the property of the user. The warranty is void if the value of the unit is invoiced to Beckwith Electric at the time of return or if the unit is returned with transportation charges collect.

If under warranty, units will be repaired rapidly and returned at no cost and with return transportation paid if the fault is found to be due to workmanship or failure of material. If a unit is under warranty and express shipment for return of the repaired unit is requested, shipping charges will be billed at the current rate. If the fault is due to abuse or misuse, or if the unit is out of warranty, a modest charge will be made. Repair can normally be expected to take three weeks, plus shipping time. If faster service is required, it should be requested at the time of return.

■ **NOTE**: Units returned with only a blown fuse are not covered by warranty and a nominal repair charge will be made for replacement of the fuse. Please check the fuses before returning the M-0194 for repair in order to avoid unnecessary repair charges.

To help in analyzing the problem, a complete description of the malfunction and conditions leading to the failure should be included with the unit.

However, if you choose to repair the unit, it is necessary to be completely familiar with the circuitry involved, and have an adequate understanding of field effect devices. Be sure to carefully read the **WARNING** page at the beginning of this manual.

▲ **CAUTION**: This unit contains sensitive MOS circuitry that can be damaged by improper repair procedures. Work stations used for repair should be static-free and procedures for handling MOS circuitry should be followed. In addition, any attempt to measure resistances between points on the printed circuit board may cause damage to the unit.

It is suggested that first a visual inspection be made for any component that does not appear normal or appears to have overheated. Analysis of the circuit will then often lead to the cause of the failure and components that need to be replaced.

If no obvious problems exist, it is suggested that the **TEST** and **CALIBRATION PROCEDURES** be followed until a portion of a circuit is detected which does not perform as expected or until a calibration point is found which will not meet requirements. These procedures should lead to a determination of the defective component.

This Page Left Intentionally Blank

Legal Information

Patent

The units described in this manual are covered by U.S. Patents, with other patents pending.

Buyer shall hold harmless and indemnify the Seller, its directors, officers, agents, and employees from any and all costs and expense, damage or loss, resulting from any alleged infringementof United States Letters Patent or rights accruing thereform or trademarks, whether federal, state, or common law, arising from the Seller's compliance with Buyer's designs, specifications, or instructions.

Warranty

Seller hereby warrants that the goods which are the subject matter of this contract will be manufactured in a good workmanlike manner and all materials used herein will be new and reasonably suitable for the equipment. Seller warrants that if, during a period of five years from date of shipment of the equipment, the equipment rendered shall be found by the Buyer to be faulty or shall fail to peform in accordance with Seller's specifications of the product, Seller shall at his expense correct the same, provided, however, that Buyers shall ship the equipment prepaid to Seller's facility. The Seller's responsibility hereunder shall be limited to replacement value of the equipment furnished under this contract.

Seller makes no warranties expressed or implied other than those set out above. Seller specifically excludes the implied warranties of merchantibility and fitness for a particular purpose. There are no warranties which extend beyond the description contained herein. In no event shall Seller be liable for consequential, exemplary, or punitive damages of whatever nature.

Any equipment returned for repair must be sent with transportation charges prepaid. The equipment must remain the property of the Buyer. The aforementioned warranties are void if the value of the unit is invoiced to the Seller at the time of return.

Indemnification

The Seller shall not be liable for any property damages whatsoever or for any loss or damage arising out of, connected with, or resulting from this contract, or from the performance or breach thereof, or from all services covered by or furnished under this contract.

In no event shall the Seller be liable for special, incidental, exemplary, or consequential damages, including but not limited to, loss of profits or revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of purchased power, cost of substitute equipment, facilities or services, downtime costs, or claims or damages of customers or employees of the Buyer for such damages, regardless of whether said claim or damages is based on contract, warranty, tort including negligence, or otherwise.

Under no circumstances shall the Seller be liable for any personal injury whatsoever.

It is agreed that when the equipment furnished hereunder are to be used or performed in connection with any nuclear installation, facility, or activity, Seller shall have no liability for any nuclear damage, personal injury, property damage, or nuclear contamination to any property located at or near the site of the nuclear facility. Buyer agrees to indemnify and hold harmless the Seller against any and all liability associated therewith whatsoever whether based on contract, tort, or otherwise. Nuclear installation or facility means any nuclear reactor and includes the site on which any of the foregoing is located, all operations conducted on such site, and all premises used for such operations.

Notice:

Any illustrations and descriptions by Beckwith Electric Co., Inc. are for the sole purpose of identification.

The drawings and/or specifications enclosed herein are the proprietary property of Beckwith Electric Co., Inc., and are issued in strict confidence; therefore, shall not be used as a basis of reproduction of the apparatus described therein without written permission of Beckwith Electric Co., Inc.

No illustration or description contained herein shall be construed as an express warranty of affirmation, promise, description, or sample, and any and all such express warranties are specifically excluded nor shall such illustration or description imply a warranty that the product is merchantable or fit for a particular purpose. There shall be no warranties which extend beyond those contained in the Beckwith Electric Co., Inc. terms of sale.

This Page Left Intentionally Blank

BECKWITH ELECTRIC CO., INC.
6190 - 118th Avenue North • Largo, Florida 33773-3724 U.S.A.
PHONE (727) 544-2326 • FAX (727) 546-0121
marketing@beckwithelectric.com
www.beckwithelectric.com
ISO 9001:2008

800-0194-AG-01 11/16
Printed in USA