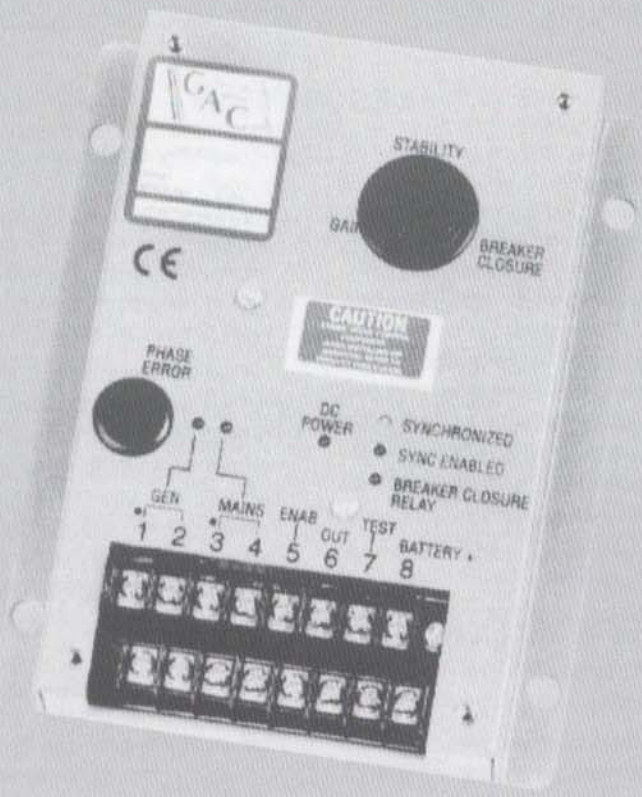
GOVERNORS AMERICA CORP.

ENGINE GOVERNING SYSTEMS

SYC6714



SYNCHRONIZER

MEMBER EGSA Electrical Generating Systems Association

CE

GOVERNORS AMERICA CORP. • 720 Silver St. • Agawam, MA 01001-2907, USA

SYC6714 SYNCRHONIZER

PRODUCT TECHNICAL INFORMATION

PTI 4030

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INTRODUCTION

When paralleling a synchronous generator to a main bus consisting of other generators or the utility, both the phase and voltage levels of each power system must be matched. The SYC6714 is an accessory module which adjusts the speed governor to obtain an equal phase relationship between the oncoming generator and the main bus. A "SYNC CHECK" function is provided which can activate a relay to connect the generator to the main bus. The typical time for synchronization is usually less than 3 seconds when the generator sets are at rated speed with optimum governor performance settings.

DESCRIPTION

The synchronizer monitors the phase and frequency of its generator and the main bus. These two AC signals are electrically isolated from each other and from the governor speed control unit. A phase comparison of the two AC signals is made and a corrective analog DC signal is generated. This correction signal adjusts the governor speed setting until the electrical phase error between the generator and the main bus is eliminated. With the two AC signals and the enabling signal at Terminal 5, the synchronization process will commence. Any phase error that results may be trimmed out by using the internal "Phase Error Adjustment". When the enable signal at Terminal 5 is removed, the synchronizer will assume a neutral output.

A wide range of AC input voltages and wave shapes can be accepted by the synchronizer. Isolation between input signals allows each generator to be isolated from each other until the actual paralleling occurs. If the generator output voltage exceeds the specified input limits of the SYC6714, isolation transformers of proper ratio will be required.

A measurement of the phase relationship between the two AC inputs is continuously available as an analog voltage at Terminal 11. A level of approximately 5.1 V indicates an in-phase condition. The synchronizer's dynamic control circuits include graduated **GAIN** and **STABILITY** adjustments. These controls are used to obtain optimum synchronization times and stable performance. The **GAIN** adjusts the sensitivity of the synchronizer output to the governor. A clockwise adjustment increases the sensitivity of the system. The **STABILITY** adjusts the time rate of response of the synchronizer output. Both controls operate independently, are easily optimized, and are similar in function to the gain and stability adjustments on GAC speed control units.

A separate internal Breaker Closure/Sync Check circuit has its own variable phase angle window for controlling the breaker closure. Window phase angle may be adjusted between near 0 degrees up to about 25 degrees. Clockwise rotation of the graduated **BREAKER CLOSURE ANGLE** adjustment reduces the window to near 0, inhibiting breaker closure. The phase angle must stay within the phase angle window for at least 1/2 second for synchronization to occur. If during this time the phase angle momentarily exceeds the breaker closure setting, the time period of 1/2 second must be repeated. System stability is very important during this critical time period.

Once synchronization is complete and the units are paralleled, the synchronizer should be reset to its neutral output and disabled position. The wiring diagram (Figure 2) shows a switching method that resets the unit by disconnecting the synchronizer output from the governor and opening the reset line at Terminal 5. Disconnection of the Mains input signal (Terminal 3 and 4) also causes the synchronizer to reset. The synchronizer now assumes a neutral position with Terminal 6 holding a constant output voltage of 5.1 Volts.

Synchronizer operation may be checked/tested without activating the breaker closure relay by connecting a jumper or a switch between Terminals 7 and 10. With this jumper in place, the synchronizer functions normally except the breaker closure relay will not close. The green LED indicator that signifies when the generator is synchronized will operate during this test.

Dead Bus Operation

If the mains input is missing, the synchronizer will not attempt to synchronize the system. A separate system may be used to close this oncoming generator onto the bus which will provide a reference to which the others may synchronize.

Voltage Matching and Monitoring

GAC offers a separate module, the VMA100, which when used combines all the voltage monitoring functions and adjustment functions. In combination with the SYC6714, a comprehensive system results. See GAC publication PIB4090 for details of this addition function.

SPECIFICATIONS

GENERATOR AND MAIN BUS AC INPUTS

Sensitivity	50 VRMS - 500 VRMS (line-to-line or line-neutral)
Frequency	50 or 60 HZ Nom. (400Hz, special order)
Isolation	1000 V min.
Burden	less than 2.5 VA

BATTERY/DC POWER SUPPLY REQUIREMENTS (Terminals 8 - 10)

Low Voltage Range (Terminals 8 and 9 connected)	10 - 16V DC
High Voltage Range	14 - 40V DC
Current Required	less than 200 ma

PERFORMANCE (WITH ESD SERIES)

Capture Range	+4% based on 3250 Hz
Output Voltage	See Note 1 ..... 3 - 7V DC
Breaker Closure Window Size	1° - 25°
Relay Contact Rating (N.O. or N.C.)	10 A @ 28 VDC
Phase Error Adjustment Range	±10° typical
LED's - Synchronization Indicator	Green LED
Mains	Red LED
Generator	Red LED
DC supply	Red LED
Synchronizer Enabled	Red LED
Relay Closure	Red LED

ENVIRONMENTAL*

Temperature Range	-40° F to +180° F (-40° C to +85° C)
Humidity	up to 100%
Vibration	5g (20-200 Hz)
Case	Corrosion resistant and fungus proof IP22 with terminal cover in place

**Circuit boards are fully coated and sealed with a heavy conformal coating.*

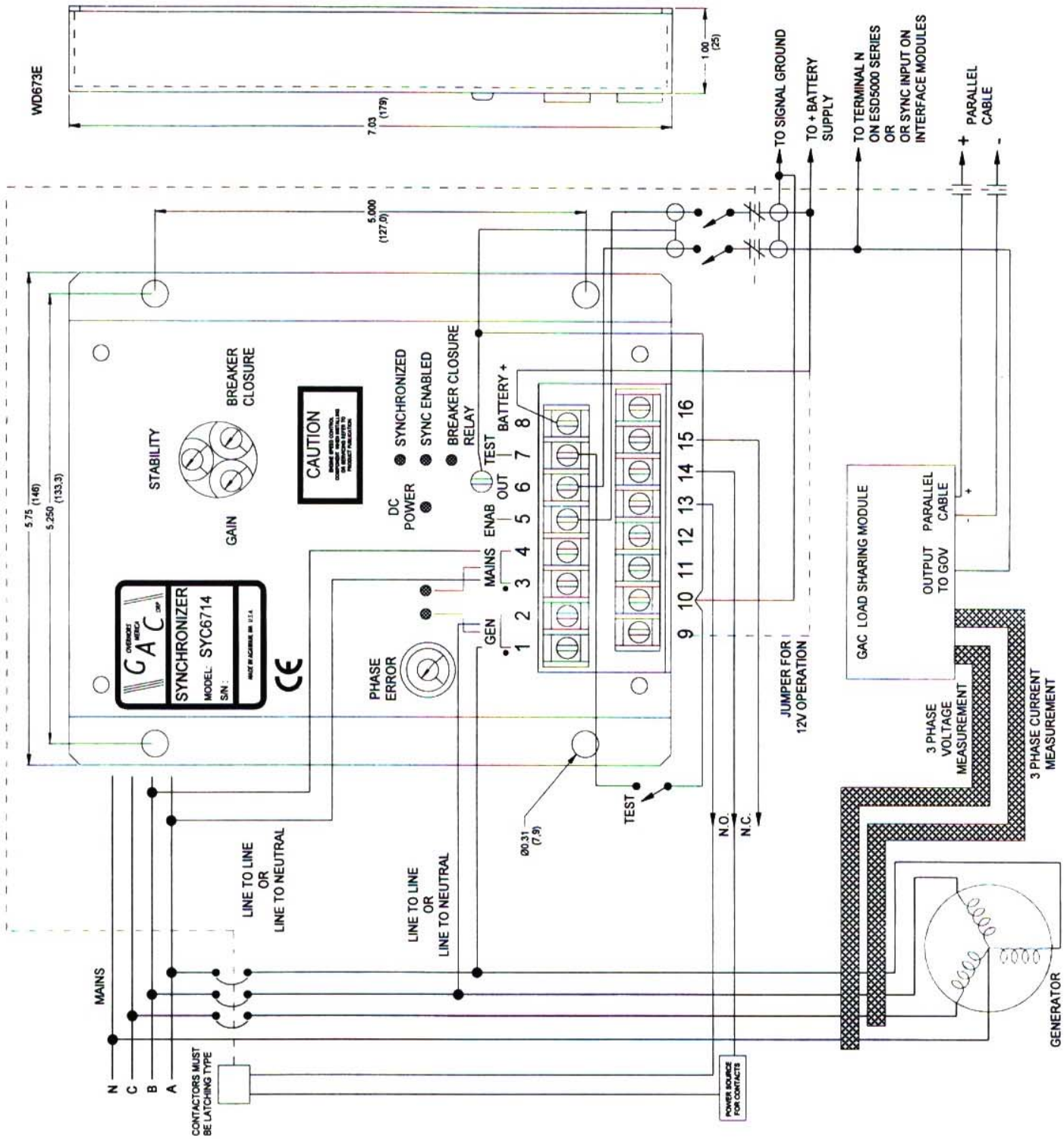
PHYSICAL

Dimensions	See outline, Figure 1
Weight	1.5 lb. (0.68 kg.)
Mounting	Any position, vertical preferred

This unit is compatible with GOVERNORS AMERICA CORP. speed controls, interface modules, as well as electronic governor systems from various other manufacturers. The synchronizer is available with touch proof terminals (SYC6714T) or terminal cover AIS674 can be used.

Note 1: The sign of Terminal 6's voltage output is such that a voltage increase is intended to decrease engine speed. If the mains and the generator voltage connections are exchanged, the output sign at Terminal 6 is reversed. This configuration may be useful if applying the SYC6714 to competitive governors.

SYC6714 WIRING



INSTALLATION

The synchronizer was designed with the same rugged construction as all GAC electronic products and may be mounted in a control cabinet with other equipment. Care should be taken to limit exposure of the unit to extreme temperatures. If water or condensation may come in contact with the synchronizer, mount it vertically to prevent accumulation inside the unit.

CAUTION

HIGH VOLTAGE AC may be present at TERMINALS 1 - 4

Deenergize and Check Voltages before Servicing.

Connecting cables carry low currents and special size wire is not required. The connection between the speed control unit and synchronizer Terminal 6 is sensitive and must be shielded over its entire length. The shield should be connected at one end only where other shields are grounded at the case, or at Terminal 10.

Note: The phasing of the mains and the generator signals is such that when synchronized, Terminals 1 and 3 are in phase. (See phasing dots on case.)

Since the SYC6714 is a CE (Community Europe) approved unit, certain installation requirements must be met to maintain EMC capability. The unit must be securely mounted to a metal ground plane, shielded cables must be used where shown in the wiring diagram, and a ground strap must be connected from Terminal 10 to the case as shown in the wiring diagram. When installed according to these procedures, the synchronizer will have excellent resistance to external fields. Refer to the CE certification in PIB 4030 for more details.

ADJUSTMENTS

The governing system must be in good working order, stable, and adjusted correctly for the synchronizer to properly operate in the system. Holding phase tightly can only be accomplished with a quality governor system.

A. When the synchronizer is connected as per the wiring diagram, add a jumper between Terminals 7 and 10 or disconnect the relay wires at Terminals 13 and 14 or 14 and 15. This allows the generator to be synchronized to the mains without paralleling being allowed to occur .

B. Check to confirm that the generator's governed frequency is within 0.1 Hz of the mains (or other generator). Close the connections between the synchronizer and the governor. The SYC6714 will immediately attempt to synchronize the system. The synchronizer is factory set to near optimum settings and large increments of adjustment are not usually required.

C. Adjust the **GAIN** as far CW as possible without causing instability in the system. Set the **GAIN** one division CCW from the point where instability occurs.

D. Unsynchronize the system by disconnecting Terminals 5 and 6, or momentarily moving the engine throttle. Reinstate the synchronizer and observe the speed and stability of the synchronization with a synchroscope or phase meter. Readjust the **GAIN** if necessary.

E. Once the Gain is optimized, adjust the **STABILITY** for a fast and smooth synchronization. A more CCW setting will result in a slower (more damped) but smoother response. Adjust for the desired performance.

F. The **PHASE ERROR** adjustment can now be used to set the synchronizer for exact zero phase error. Verify this on a synchroscope, as a measurement of near zero AC Volts, or a null in AC voltage between Terminals 1 and 3 when the mains and generator voltages are equal.

G. Set the breaker closure angle by first turning the **BREAKER CLOSURE ANGLE** fully CW (zero degree phase angle window). The relay should open. Turn the control CCW until the relay closes again, and continue CCW one additional division. Approximate phase angle window values from the following table may also be used for setting the breaker closure angle.

BREAKER CLOSURE ANGLE ADJUSTMENT

Adjustment Setting	Breaker Closure Angle
100	0°
70	6°
50	12°
20	18°
0	25°

H. Remove the jumper between Terminals 7 and 10 and/or reconnect the relay contact connections at Terminals 13 and 14 or 14 and 15. Synchronizing and paralleling of the system may now be accomplished.

I. For a final check, start the engine and synchronize the system to insure that all adjustments are optimal. If certain characteristics are unsatisfactory, consult the troubleshooting guide.

TROUBLESHOOTING

If the system fails to operate or synchronize properly, make the following measurements. (+) (-) refers to meter polarity.

MEASUREMENT

1. Measure the battery voltage between Terminals 8(+) and 10(-). It should be 12 or 24V DC nominal.
2. Note the Red "DC Power" LED. Measure the internal 10V DC supply between Terminals 12(+) and 10(-). It should be 9.6 - 10.4V DC.
3. Note the Red "Generator" LED. Measure the AC voltage between Terminals 1 and 2. It should be 50 - 500V AC.
4. Note the Red "Mains" LED. Measure the AC voltage between Terminals 3 and 4. It must be the same as in Step 3.
5. Note the Red "Enable" LED. Check (On/Off) switch and auxiliary contacts (see wiring diagram). Measure the DC voltage between Terminals 5 (+) and 10 (-). It must be greater than 8V DC.
6. Check the DC voltage between Terminals 7 (+) and 10 (-). This should be 10V DC when in phase. Check the test switch position. It must be open to synchronize.
7. Also check the enable signal from the voltage matching unit if used.
8. Measure the internal Phase Error Voltage. between Terminals 11 (+) and 10(-). These readings should be as follows:

   If in phase, 5.1V DC

   If less than 5.1 V, the generator frequency is higher than the mains frequency. Decrease the governor speed until the system is synchronized.

   If greater than 5.1 V, the generator frequency is lower than the mains frequency. Increase the governor speed until the system is synchronized.
9. Measure the synchronizers output analog voltage between Terminals 6 (+) and 10(-). If the generator frequency is lower than the mains, this voltage should be lower than 5.1V DC and vice versa. Adjust the governor speed until 5.1V DC is measured between Terminals 6 and 10.
10. If the green "Synchronized" LED does not light, the breaker closure angle may be set too narrow. Adjust the breaker angle control CCW until the green LED lights.
11. If the green "Synchronized" LED lights continuously but the internal breaker closure relay fails to close, go to step 6 (relay inhibited).
12. If the unit synchronizes but does not close the breaker, check that the N.O. contacts at Terminals 13 & 14 have closed. If not, the synchronizer is defective.

Failure to synchronize or slow synchronization

1. This problem is usually caused by the governor performance not being tightly controlled. The governor performance must be excellent to obtain fast, consistent synchronization. Controlling the phase of a generator is a more demanding operation than basic speed control. Review and optimize the governor system before attempting to service the synchronizer. Other issues may lie within the engine and how well it is operating.
2. Severe harmonic distortion of the AC wave forms from power converters can disturb the synchronizer. If the wave form has more than 10% distortion, or other wave form issues are suspected, contact GAC for an external AC filter recommendation.

GOVERNORS AMERICA CORP.

720 Silver Street • Agawam, MA 01001-2907, USA • TEL **(413) 786-5600**
FAX **(413) 786-5666**

e-mail: info@governors-america.com
Internet: www.governors-america.com