SYC6714
Synchronizer

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1 OVERVIEW

The GAC SYC6714 accessory module adjusts a speed control unit to obtain an equal AC phase relationship between the generator and the main bus (mains). When paralleling a synchronous generator to a main bus, generators, or utility.

The SYC6714 provides the SYNC CHECK function which activates a relay to connect the generator to the main bus. Typically this takes less than 3 seconds when the generator sets are at rated speed and using optimum speed controller performance settings.

The GAC SYC6714 is a CE (Community Europe) approved unit the installation requirements must be met to maintain EMC capabilities.

2 SPECIFICATIONS

GENERATOR AND MAIN BUS AC INPUT	
Sensitivity	50 V RMS - 500 V RMS (line-to-line or line neutral)
Frequency	50 or 60 Hz nominal
Isolation	1000 V minimum
Burden	less than 2.5 V A
BATTERY/DC POWER SUPPLY REQUIREMENTS (TERMINALS 8-10)	
Low Voltage Range (Terminals 8 & 9 connected)	10 - 16 V DC
High Voltage Range	14 - 40 V DC
Current Required	less than 200 mA
PERFORMANCE (WITH ESD SERIES)	
Capture Range	+4% based on 3250 Hz
Output Voltage	3 - 7 V DC
Breaker Closure Window Angle	1 ° - 25 °
Relay Contact Rating (N.O. or N.C.)	10 A @ 28 V DC
Phase Error Adjust Range	+/- 10° typical

ENVIRONMENTAL	
Temperature Range	-40 to +180° F [-40 to +85°C]
Humidity	up to 100 %
Vibration	5g (20 – 200 Hz)
Case	Corrosion resistant and fungus proof IP22 with terminal cover in place
PHYSICAL	
Dimensions	5.72 [146] x 7.03 [179] x 1 in [25]
Weight	1.5 lb [0.68 kg]
Mounting	any position, vertical preferred

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3 INSTALLATION

The SYC6714 can be mounted in a cabinet with other equipment. Limit exposure of the unit to extreme temperatures. Mount the SYC6714 vertically if exposed to moisture or wetness to prevent accumulation inside the unit.

The governor system must be in good working order and adjusted correctly for the synchronizer to properly operate in the system. The SYC6714 is factory set to near optimum settings, therefore, large increment adjustments are not normally needed.

An overspeed shutdown device, independent of the governor system, should be used to prevent loss of engine control which may cause personal injury or equipment damage.

Do not rely exclusively on the governor system electric actuator to prevent overspeed. A secondary shut-off device, such as a fuel solenoid must be used.

Since the SYC6714 is a CE (Community Europe) approved unit, if used as a CE unit, all GAC installation requirements including the following CE specific, must be met to maintain EMC capabilities. (see Declaration of Conformity to EC Directives)

1. The synchronizer must be mounted against a metal ground plate with four bolts which make positive electrical connections between the case and the back plane, or backing plate PL128, available from GAC, must be installed.
2. All cable shields on connections to the synchronizer must be connected to the case at the screw on the case as shown on Wiring diagram.
3. The battery minus connection to Terminal 10 must be jumpered to the case as shown in the Wiring diagram.
4. The installer must refer to the Wiring Diagram for proper electrical connections.

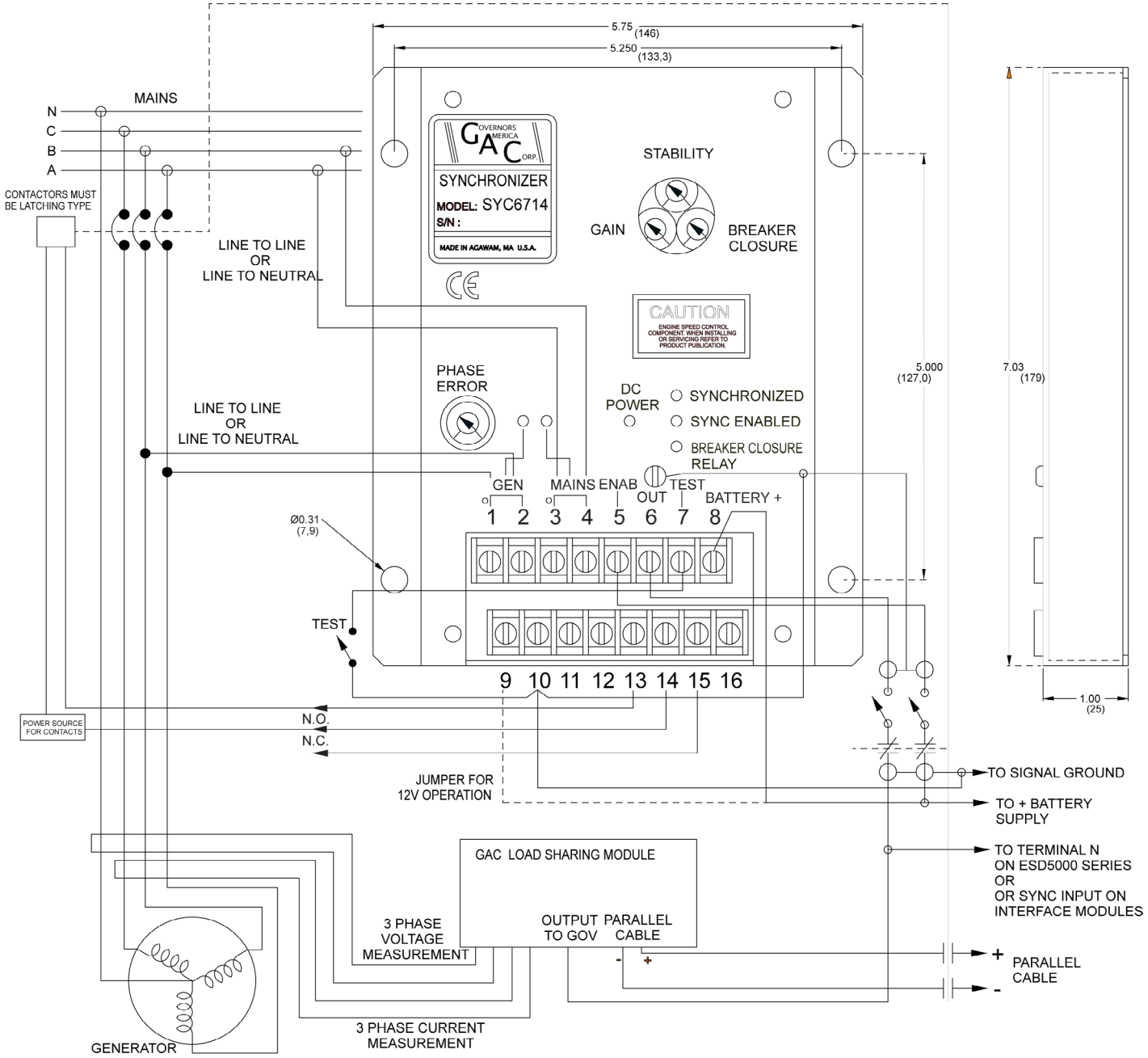
4 WIRING AND DIMENSIONS

Typical electrical connections are shown in the Wiring diagram below. Connecting cables carry low current and do not require special sized wire. The connection between the speed controller and the synchronizer Terminal 6 is sensitive and must be shielded for its entire length. The shield must be connected at one end only and must be terminated to the case.

Phasing of main power (MAINS) and the generator signals occurs when Terminals 1 and 3 are in phase.

Paralleling out-of-phase generators may cause equipment damage.

High AC Voltage may be present at Terminals 1 thru 4. De-energize and check voltages before use.



5 SETUP AND SYNCHRONIZATION

A measurement of the phase relationship between the two AC inputs is continuously available as an analog voltage at Terminal 11, where 5.1 V indicates phase condition. The SYC6714 controls include GAIN, Stability, to adjust synchronization and performance.

- GAIN adjusts the sensitivity of the synchronization to the speed controller, where CW rotation increases the sensitivity.
- STABILITY adjusts the rate of response time of the synchronizers output.
- BREAKER CLOSURE ANGLE provides a Sync Check circuit with its own variable phase angle window for controlling breaker closure, Window phase angle may be adjusted between 0 ° and 25 °.

INITIAL ADJUSTMENT

After connecting your system as detailed in the Wiring diagram, adjust synchronizer performance. This mode allows for the generator set to synchronize to the mains without paralleling occurring.

1. Add a jumper or remove relay wires at one of the following locations:
   - Add a jumper between Terminals 7 and 10

   OR

   - disconnect the relay wires at Terminals 13 and 14 or Terminals 14 and 15
2. Confirm the generators governed frequency is set within 0.1 Hz of the mains or other generator.
3. Close the connections between the synchronizer and the speed controller.
4. Trim the speed controller setting so that the generator frequency is within 0.1 Hz of the mains (or other generator) frequency.
5. Note the status of the LEDs on the SYC1674. The MAINS, GEN, and DC POWER LEDs should show RED.
6. Close the connections between the synchronizer and the speed controller.
7. Close the switch connected from Terminals 5 and 6 between the governing system and the SYC6714.
8. Close auxiliary contacts [Parallel Cable +/-] .
9. The RED SYNC ENABLED LED should illuminate and the SYC6714 will attempt to synchronize.

ADJUSTING AND OPTIMIZING GAIN

On the SYC6714, adjust GAIN by turning GAIN Adjustment. as far clockwise (CW) as possible without causing instability in the system, then turn the GAIN adjustment one division counterclockwise (CCW). When the system is unstable, the main breaker is inhibited from closing.

To optimize GAIN, desynchronize the system by opening the switch between Terminals 5 and 6 or momentarily move the engine throttle. Reinstate the synchronizer and observe the speed and stability of the synchronization with a synchronizer or a phase meter. Readjust GAIN as necessary.

ADJUSTING STABILITY

If necessary, adjust STABILITY for fast, smooth synchronization without instability. A CCW setting will result in a slower (more damped) but smoother response.

ADJUSTING PHASE ERROR

Set the PHASE ERROR ADJUSTMENT for exact zero phase error. Verify this on a synchroscope, as a measurement of near zero AC voltage or a null in AC voltage between Terminals 1 and 3 when the mains and generator voltage are equal.

BREAKER CLOSURE ANGLE

Rotate the BREAKER CLOSURE ANGLE adjustment clockwise to reduce the window to near 0, inhibiting the breaker closure. The phase angle must stay within the angle setting for at least .5 s for synchronization to occur; system stability is very important during this time or the setting will need to be set again until the angle is saved.

To make further adjustment, with the system operating and synchronized, set the breaker closure angle to 0 (fully CW). Adjust BREAKER CLOSURE CCW until the BREAKER CLOSURE RELAY LED lights. The relay should open. Turn the adjustment CCW one additional division. The following approximate phase angle window values may 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°

LED

The following LED view is considered nominal for a working system.

LED	LABEL	NOMINAL SETTING	FUNCTION
1	SYNCHRONIZED	Green	Generator voltage present
2	MAINS	Red	Mains voltage present
3	GEN	Red	Synchronizer enabled
4	DC POWER	Red	Internal voltage supply present
5	SYNC ENABLED	Red	Relay energized
6	BREAKER CLOSURE RELAY	Red	Mains and generator synchronized

RE-ENABLE BREAKER CONTROL FUNCTION

Re-enable the break control function by removing the jumper wire between Terminals 7 and 10 and /or reconnect the relay wire between Terminals 13 and 14 or Terminals 14 and 15. Synchronization and paralleling may now be performed.

For a final check, start the engine and synchronize the system to ensure that all adjustments are optimized.

NOTE If performance is unsatisfactory, consult the trouble shooting section.

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 the oncoming generator onto the bus which will provide a reference to which others may synchronize.

VOLTAGE MATCHING AND MONITORING

GAC offers additional modules for support.

The VMA100, when combined with the SCY6714 combines all the voltage monitoring functions and adjustment functions.

OBTAINING NEUTRAL OUTPUT

Once synchronization is complete, and the units are parallel, the synchronizer should be reset to its neutral output and placed in the disabled position.

Use one of the following to set the synchronizer in a neutral output, ready for its next use:

- Following the wiring diagram review the switching method that resets the unit by disconnecting the synchronizer output from the speed controller and opening the reset line at Terminal 5.

OR

- Disconnect the MAINS (Terminals 3 and 4) to reset the synchronizer. The synchronizer now assumes a neutral position with Terminal 6 holding a constant output voltage of 5.1 V.

6 TROUBLESHOOTING

The following troubleshooting steps are helpful if initial setup is not working as desired. Please contact your GAC representative with any questions.

SYSTEM FAILS TO OPERATE or SYNCHRONIZES POORLY	
STEP	**CHECKS**
1.	Measure the battery voltage between Terminals 8 (+) and 10 (-) . It should be 12 or 24 V DC nominal.
2.	Note the RED DC POWER LED. Measure the internal 10 V DC supply between Terminals 12 (+) and 10 (-). It should be 9.6 – 10.4 V DC.
3.	Note the RED GEN LED. Measure the AC Voltage between Terminals 1 and 2. It should be 50 - 500 V AC.
4.	Note the RED MAINS LED. Measure the AC Voltage between Terminals 3 and 4. It should be 50 - 500 V AC
5.	Note the RED SYNC ENABLE LED. Check (ON/OFF) switch (at Terminals 5 and 6) and auxiliary contacts (Parallel Cable +/-). Measure the DC voltage between Terminals 5 (+) and 10 (-). It must be greater than 8 V DC. (See Wiring Diagram)
6.	Check the DC voltage between Terminals 7 (+) and 10 (-). This should be 10 V DC when in phase. Check the Test switch position. It must be opened 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 reading should be as follows: • If in phase, 5.1 V DC • If less than 5.1 V DC, the generator frequency is higher than the mains frequency. Decrease the speed controller speed until the system is synchronized. • If greater than 5.1 V DC, the generator frequency is lower than the mains frequency. Increase the speed controller 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 mains, the voltage should be lower than 5.1 V DC and visa versa. Adjust the speed controller speed until 5.1 V 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 back to step 6 (relay inhibited).
12.	If the unit synchronizes but does not close the breaker, check that the normally open contacts at Terminal 13 and 14 have closed. If not, the synchronizer is defective.
FAILURE TO SYNCHRONIZE or SLOW SYNCHRONIZATION	
1.	The problem is usually caused by the governor system performance not being tightly controlled. The governor system performance must be excellent to obtain fast, consistent synchronization. Controlling the phase of the 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 from the 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.