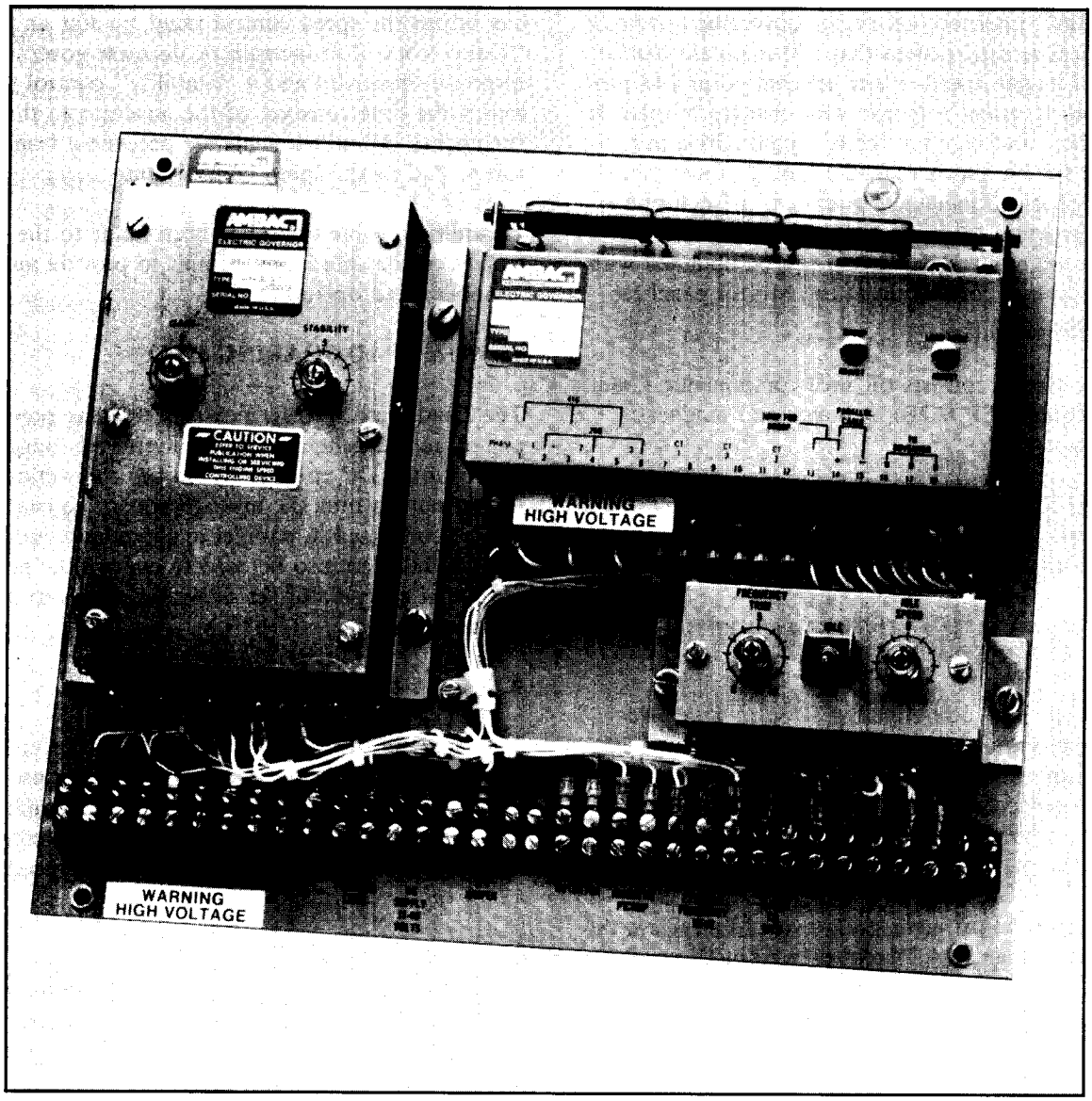
Load Sharing Panel



SYSTEM INTRODUCTION

The AMBAC International engine governing system is an electrical sensing system that will maintain precise control of engine speed at any selected point and provides rapid transient response with changes in load. It is all electric and requires neither engine drive nor hydraulic system and is ruggedly built to resist vibration and physical damage. The system is isochronous and will provide steady state speed stability of less than plus or minus ¼%. Droop can be obtained with a simple jumper connection at the control panel terminal block.

The basic system consists of three components: Load Sharing Panel (LSP 672B), actuator and magnetic speed sensor.

The LSP 672B Load Sharing Panel consists of three components: Speed Control Unit (CU 673C-17), Load Sharing Unit (LS 671A), and Idle/Run Kit (KT 6722A).

CU 673C-17 SPEED CONTROL UNIT

The speed control unit contains all solid state electronic circuits which sense speed from a magnetic speed sensor or other suitable signal source. A controlled output current is provided by the speed control unit to a proportional electric actuator for throttle control. The performance is isochronous.

Three integral adjustments are provided to achieve the desired performance. A "Frequency Adjust" which can adjust the speed control range by 30:1 and "Gain" control to increase or decrease governor response sensitivity and a "Stability" control to match the time constant of the governor to that of the engine. All adjustments are accessible from the top or end of the speed control unit.

In addition, a provision has been made to the electronics of the speed control unit to provide remote variable speed operation.

LS 671A LOAD SHARING UNIT

The Load Sharing Unit measures the true power output of an AC generator and converts this output to a proportional DC voltage. By proper connections of the outputs, a multiple arrangement of generator sets can be connected in parallel to share load equally. The module can also be used to control the power output of a generator set delivering power to an infinite bus.

KT 6722A IDLE/RUN KIT

The Idle/Run Kit permits an engine to be run at either idle speed or operating speed by the use of an integral selector switch. Idle speed is adjustable by a control on the top cover. A frequency trim control is included on the top cover to trim engine speed.

SPECIFICATIONS

LSP 672B LOAD SHARING PANEL PERFORMANCE CHARACTERISTICS

-Steady-state Stability ..... ±0.25% or better
-Frequency Range (Operating) ..... 300-10K Hz continuous
-Frequency Range (Idle) ..... 600 to 3500 Hz.
-Speed Drift With Temperature ..... Less than ±1%

LOAD SHARING

-Signal Inputs ..... 190 to 480 volt (nominal)(2 ranges)
AC line to line at 50/60 Hz.
5 amp current transformers, 12.5 VA.
-Load Sharing ..... Adjustable to within ±2% between sets
-Droop ..... Adjustable up to 10%

POWER INPUT

-Magnetic Speed Sensor Signal ..... 1.0-30 volts rms
-Supply ..... 12, 24, or 32 VDC
-Polarity ..... Negative Ground (Case isolated)
-Power Consumption (DC) ..... Max. of 4 amp at 12 volts, 2 amp at 24 volts
-Power Consumption (AC) ..... Voltage Input - Less than 5 watts
Current Input - 37.5 watts

-Line-to-Line Voltage .....

HZ	LOW RANGE		HIGH RANGE	
	Min	Max	Min	Max
*50	70	104	140	208
*60	85	130	170	260
50	140	208	280	417
60	170	260	340	500
400	170	260	340	500

*Low range input voltages can be accepted as long as CT secondary current is limited to 3 amps at maximum rated load. If higher voltages must be used, external PT's can be added. The transformer burden capability is insignificant.

ENVIRONMENTAL

-Temperature Range ..... −55° to + 85°C (−65° to + 185°F)
-Relative Humidity ..... up to 100%
-Case ..... Fungus proof and corrosion resistant

PHYSICAL

-Dimensions ..... See Figure 1
-Weight ..... 5.0 kgs (11.0 lbs)
-Mounting ..... Any position (See Installation Page 5)

RELIABILITY

-Tested 100%
-Vibration ..... All printed circuit boards are conformally coated on both sides

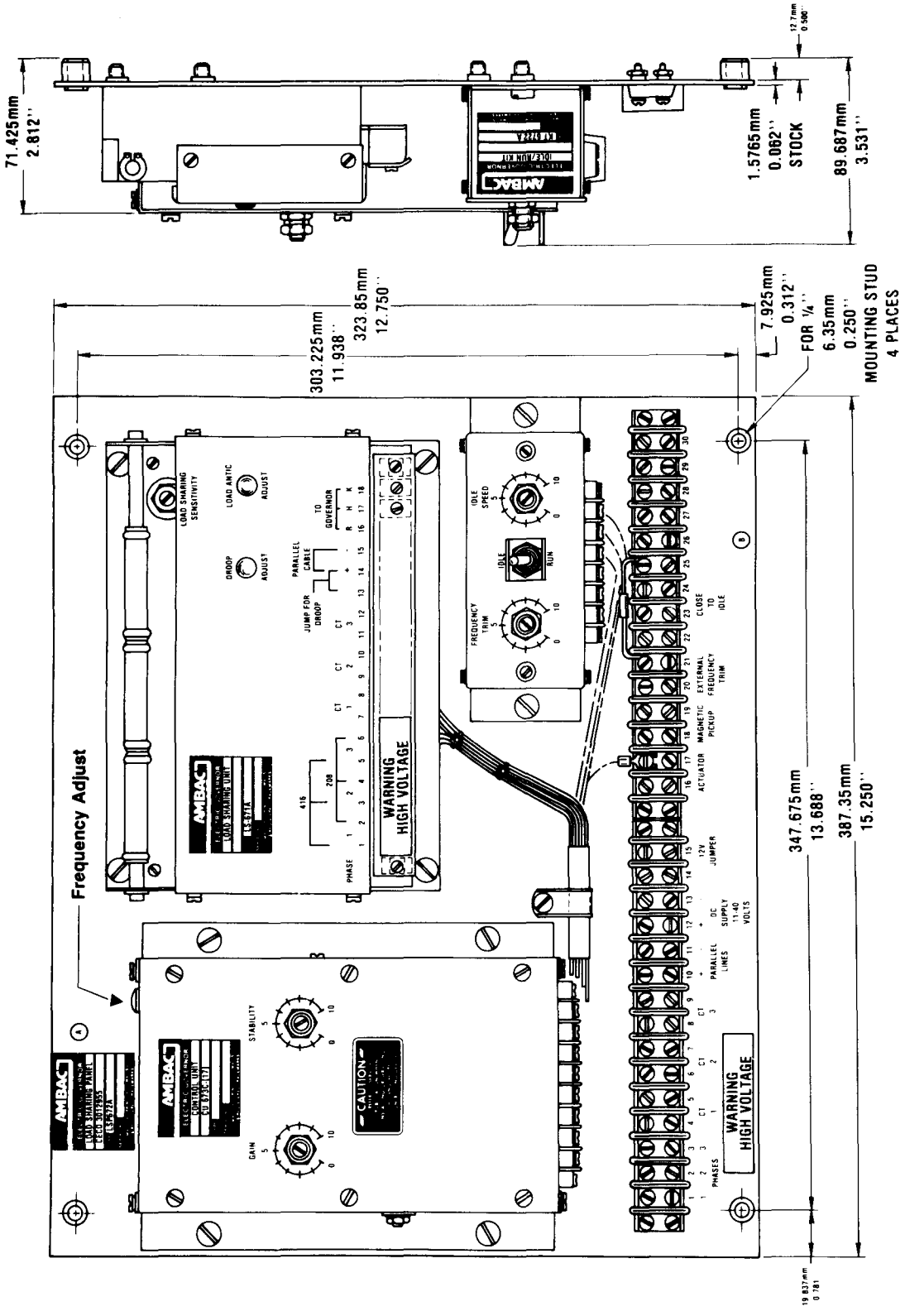


Figure 1. LSP 672B load sharing panel dimensions

SYSTEM DESCRIPTION

LOAD SHARING PANEL

The control panel accepts connections from the battery supply, actuator, magnetic speed sensor and generator set to achieve precise load sharing of paralleled engines. All the control panel components are pre-wired for ease of installation, and a common 30 position terminal trip is provided to accept all connections from accessories and other generator set control panels.

The control panel consists of these three components:

SPEED CONTROL UNIT (CU 673C-17)

The speed control unit is designed to operate on 12, 24 or 32 VDC systems. For 12 volt operation, one jumper connection is added externally. For 12 volt operation, the speed control unit will operate from 11 to 18 volts. In the 24-32 volt connection, the speed control unit will operate from 15 to 40 volts.

The speed control unit compares the engine high frequency speed signal with the frequency of the reference speed signal with the frequency of the reference oscillator signal. Frequency variations of these two signals cause the unit to adjust the current in the actuator, thus metering the fuel flowing through the valve to control the engine at a predetermined speed. The speed control unit is fail-safe in respect to loss of magnetic speed sensor signal as the actuator will position the metering valve to drain rail fuel to tank if the speed sensor voltage falls below 0.5 volt RMS.

The speed control unit has an operating speed adjustment and two performance adjustments—gain and stability. Remotely closing the contacts at terminals 23 and 24 will cause the engine to idle.

IDLE/RUN KIT (KT 6722A)

The idle/run module permits an engine to be run at either idle speed or rated speed by the use of an integral selector switch. Adjustments of idle speed is provided. During idle operation a small amount of droop is introduced in the governor to insure stable operation. The module also includes a speed trim control for precise speed adjustment.

LOAD SHARING UNIT (LS 671A)

A single engine generator set operating on an isolated load may run well isochronously. Thus, under all load conditions, the steady state frequency of the generator is the same. The only deviations from this steady state frequency are caused momentarily by sudden load changes or transients. However, if two or more engine generator sets are used to supply power to parallel to a single load, the two generators are forced to run at exactly the same speed and in phase with each other. When two or more generators are connected in parallel and supplying a common load, any tendency of one unit to get out of phase with the other is resisted by the magnetic forces (synchronizing torques) within the generators as if they were connected together with a chain drive.

If each of the two engines in parallel were controlled by an isochronous governor, each would try to force its speed to be the same as its reference. Although two isochronous governors could be set to nearly the same frequency, it is not possible for their references to be exactly the same. Under these circumstances the two engines must run at some average speed. The first engine whose governor reference is at a slightly higher frequency will try to increase its power generation. On the other hand, the second engine with its governor set slightly below the average speed will keep decreasing throttle in order to slow down. The net result is that in a short time, the first engine will be dropping off as much as it can until its generator begins acting as a motor which will drive the second engine.

This module takes the voltage and current of each of the three phases of the generator and develops a DC voltage proportional to true power. The voltages of the several sets are averaged and the voltage difference between the average power and the actual power of each set is sent to the reference point of each speed control unit. Thus, if a given engine generator set tends to generate at a power level different from its proportionate share, a correction voltage is sent to its governor reference to correct its power. Since there is as much positive as negative correction, the overall system remains isochronous. This system is very accurate and is independent of actuator and throttle characteristics. However, it can be applied only where each set has as its principal load, a single generator.

POWER SOURCE

The source voltage is 12, 24 or 32 VDC.

> CAUTION
> DO NOT CONNECT THE SPEED CONTROL UNIT TO A BATTERY CHARGER.

Most engines will have a 24 volt battery supply. The circuits are isolated from the case. The maximum input current at 24 volts is approximately 2 amps.

REMOTE SPEED TRIM CONTROLS (Optional)

Should remote minor adjustment of speed be desired, provisions have been made for the inclusion of a 5 K-ohm potentiometer. It is connected to terminals 20, 21, and 22.

AUTOMATIC SYNCHRONIZERS (CU 6714D or SYN 671) (Optional)

Should automatic synchronizing of the engine generators be required, provisions have been made for the inclusion of a synchronizer.

When synchronizing engine generator sets to an infinite bus or other engine generator sets, proper voltage, frequency and phasing must be observed.

The function of the synchronizer is to sense the speed and phase of its engine drive generator and to adjust this speed and phase to match the phase of the main bus. When the generator frequency and phase are matched to the bus, the internal relay contacts in the synchronizer are automatically closed to initiate load contractor closure. The synchronizer is fast; typical speed and phase adjustment can be obtained in 3 seconds from a near speed condition.

Request publication EG 70-8 or EG 70-8A for the CU 6714D or SYN 671 synchronizers respectively.

SYSTEM INSTALLATION

LOAD SHARING PANEL

> CAUTION
> THE ENGINE SHOULD BE EQUIPPED WITH AN INDEPENDENT OVERSPEED SHUTDOWN MECHANISM TO PREVENT RUNAWAY WHICH CAN CAUSE EQUIPMENT DAMAGE OR PERSONNEL INJURY.

The load sharing panel may be mounted in any position where vibration and temperature extremes are minimal. The control panel will provide excellent control at temperatures from −55°C to 85°C (−65°F to 185°F). The power resistors on the load sharing module will develop some heat which must be dissipated.

The three panel components are pre-wired into the top row of the 30-position terminal strip.

> CAUTION
> HIGH VOLTAGE IS PRESENT ON THE TERMINAL STRIP ONCE WIRING IS COMPLETED.

All connections from the other components such as battery, actuator, magnetic speed sensor, parallel cable, and connections from the generator (alternator) must be made to the lower row of the terminal screws on the 30-position terminal strip (see wiring diagram, Figure 3, or Figure 4 or by using Table A as a guide).

LOAD SHARING PANEL TERMINALS		
*1, 2, 3	Voltage connections phase A, B, C respectively	Caution: High Voltage present when in operation
*(5,4) (7,6) (9,8)	C.T. secondary, 5 amp. max.	Caution: Accidental open circuits on CT's cause high voltage
10	Parallel line (+)	
11	Parallel line (−)	
12	Battery (+)	
13	Battery (−)	
15	Connects to terminal 12 for 12 VDC operation only	
16, 17	Actuator	See actuator publication for proper wiring of actuator connector
18, 19	Magnetic pickup	Shield connected to terminal 18
20, 21, 22	Remote speed trim potentiometer (optional)	See Figure 3. Shield connected to terminal 22.
23, 24	Jumper for idle mode	
27, 28	Jumper for droop mode	

*Proper phasing must be observed, refer to Figure 3 or Figure 4.

Table A
Wiring chart for LSP 672B load sharing panel

Panel mounted load sharing modules are pre-wired for 416V (high range) service. To operate on low range service (208V), relocate terminal wires on load sharing module (LS 671A) from 1, 3 and 5 to 2, 4 and 6. Do not move any wires on the 30-position panel barrier strip. If other voltages must be used, external transformers will be required.

SPEED TRIM POTENTIOMETER (Optional)

Connections of a 5 K-ohm potentiometer to the load sharing panel can be made as shown in Figure 3.

AUTOMATIC SYNCHRONIZER (Optional)

Connections for an automatic synchronizer can be made as shown in Table B for CU 6714D or Table C for the SYN 671A synchronizer.

Wire sizes are as follows:

Terminals

1, 2, 3	High voltage, low current min 600 V cable
4-9, 12, 13, 16, 17	#18 gauge wire minimum
all other	#22 gauge wire minimum

SYNCHRONIZER TERMINALS	
1	Slave input (Phase A of generator side of main circuit breaker)
2	Master input (Phase A of main bus side of main circuit breaker)
3, 4	Internal relay contacts (N.O.) for main contactor closure (Internal relay contacts used to close main circuit breaker when generator set is synchronized.)
5	Auxiliary N.C. main circuit breaker contact to terminal 16 of load sharing panel
6	Auxiliary N.C. main circuit breaker contact to terminal 26 of load sharing panel
8	Battery supply positive (Terminal 12 of load sharing panel)
9	Connect jumper to terminal 8 of synchronizer for 12 volt operation
10	Battery supply negative (Terminal 13 of load sharing panel)
11	Temporarily jumper to terminal 10 of synchronizer during synchronizer adjustment period.

Table B
Wiring chart for CU 6714D automatic synchronizer

SYNCHRONIZER TERMINALS	
1	Master input (Phase A or main bus side of main circuit breaker)
2	Master input (Phase B or main bus side of main circuit breaker)
3	Slave input (Phase A of generator side of main circuit breaker)
4	Slave input (Phase B of generator side of main circuit breaker)
5	AC enable signal
6	DC output signal (digital signal)
7	DC output signal (analog signal)
8	Synchronizer diable signal
9	Battery supply (positive)
10	Battery supply (negative)
11	Relay disable (place temporary jumper from Terminal 10 to 11 to prevent breaker closure during synchronizer adjustment period)
12	DC enable signal
13, 14	Internal relay contacts (N.O.) for main contactor closure. (Internal relay contacts used to close mian circuit breaker when generator set is synchronized)
15	Dead Bus feature (connect jumper from Terminals 15 to 16 to disable dead bus feature)
16	Dead bus disable

Table C
Wiring chart for SYN 671A automatic synchronizer

SYSTEM ADJUSTMENTS

PRELIMINARY CONTROL PANEL ADJUSTMENTS

The speed control unit (CU 673C-17) has been adjusted at the factory for starting conditions and will control the engine at approximately 450 RPM. If it is desirable to reset the speed control unit, turn the "Freq. Adjust" on the end plate. This will provide control of the engine to any desired speed.

1. Set the gain control at 2.5 on the scale of the speed control unit (CU 673C-17).
2. Set the stability control at midrange (5) on the scale of the speed control unit (CU 673C-17).
3. Set the frequency trim control to midrange position on the idle/run module (KT 6722A).
4. Set the idle/run switch to "run" on the idle/run module (KT 6722A).
5. Increase speed setting of the fuel pump governor by rotating lever to its maximum high idle position. Lock the throttle lever on the fuel pump in this wide open position (maximum CW).
6. Apply DC power to the engine governing system through the wiring connections at the terminal block by closing a switch in the battery circuit.

CAUTION
DO NOT CONNECT TO A BATTERY CHARGER.

7. Momentarily connect the insulated nut on the side of the speed control unit (CU 673C-17) with a jumper wire to battery negative. This should cause the actuator valve to snap to the full fuel position. If not, check for wiring defects in the actuator or battery wiring.
8. Set the sensitivity control on load sharing unit to the full CW position (LS 671A).
9. Set the load anticipation adjustment full CW (LS 671A).

STARTING THE ENGINE INITIALLY

CAUTION
THE ENGINE SHOULD BE EQUIPPED WITH AN INDEPENDENT OVERSPEED SHUTDOWN MECHANISM TO PREVENT RUNAWAY WHICH CAN CAUSE EQUIPMENT DAMAGE OR PERSONNEL INJURY.

During cranking, but before the engine starts, the actuator will snap to full fuel position. Once started, the engine will be controlled at low idle by the speed control unit.

Raise the engine speed to the desired operating speed by turning the frequency adjust control, located under the end plate of the speed control unit (CU 673C-17), in a CW direction, usually about four turns. Final precise speed adjustment is made by using the "frequency trim" control on the idle/run module (KT 6722A). If the governor becomes unstable, stability can be recovered by turning the gain and stability adjustments on the speed control unit CCW. Place the idle/run switch at "idle" position. The idle speed may now be adjusted to the desired RPM by turning the idle speed control CW.

ENGINE PERFORMANCE ADJUSTMENTS

Once the engine is at operating speed, the stability and gain adjustments can be made as follows:

1. At no load, turn the gain adjustment on the speed control unit CW until the system becomes unstable. Then back-off slightly CCW (one major division) beyond the point where stability returns.
2. Turn the stability control CW until instability results. Then back-off slightly CCW (one major division) beyond the point where stability returns. Tap the throttle to be sure the system is truly stable. If system is slightly unstable, turn gain CCW. Recheck stability by tapping.
3. Load may now be applied to the engine. If necessary, repeat steps 1 and 2 above until optimum performance is obtained. Normally, the critical point for gain and stability adjustment is at no load.

   CW adjustment of the gain control shortens the response time after a load change. CCW adjustment causes more sluggish action.

   CW adjustment of the stability control shortens the recovery time after a load change. CCW adjustment lengthens the recovery time.

The optimum adjustment of both controls is in the maximum CW position where the best response and stability are obtained under all operating conditions. It is well to back off slightly from that position to allow for changing conditions that may affect the dynamic response of the engine. If stability problems are encountered, see "Troubleshooting".

4. Final Trimming of the Governor.

If a load bank and a recorder are available, use them to make traces per Figure 2.

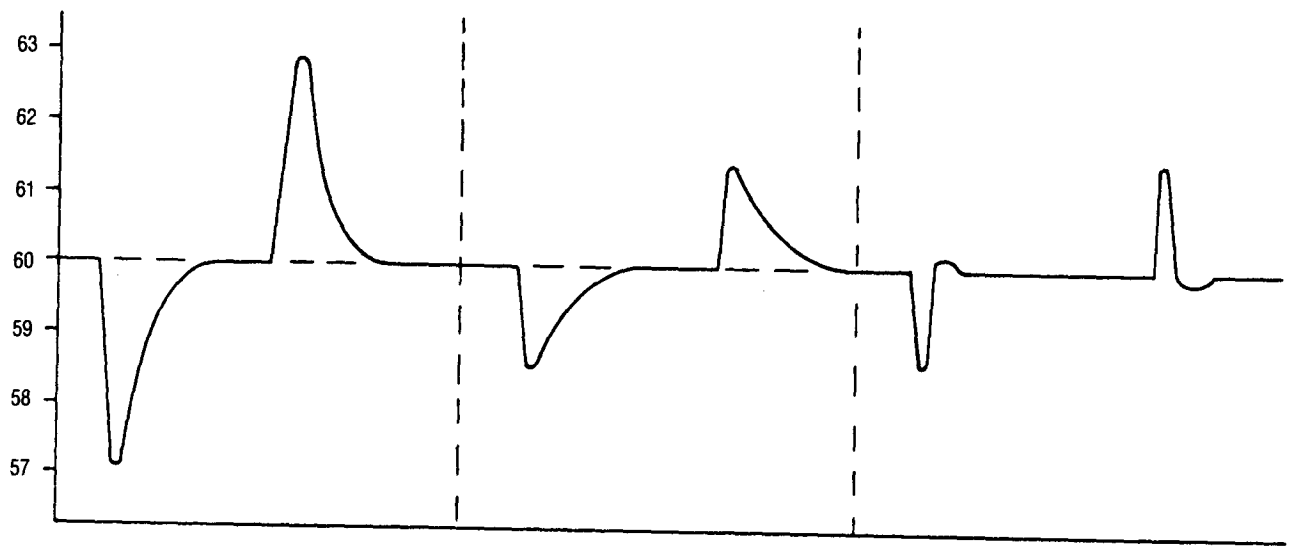


Figure 2. Typical performance chart

LOAD SHARING CHECKS AND ADJUSTMENTS

Before proceeding with load sharing adjustments, all engine generator set governors should be adjusted to the desired speed and trimmed with the external or load sharing panel frequency trim control.

1. Check load sharing unit for proper current transformer phasing and polarity by measuring with a DC voltmeter on the load sharing panel the voltage across the parallel cable on terminals 10 (+) and 11 (−) with a load applied to the generator. A voltage of about +8 VDC will represent full load with 5 amps CT input. Instrument polarity must be observed. Then, momentarily short the individual CT connections with the load sharing panel (4 to 5, 6 to 7, 8 to 9) one at a time with an insulated lead. The parallel cable voltage will fall by about ⅓ for each individual shorting of a CT. If a voltage rise occurs instead of a voltage drop, this indicates improper CT phasing and/or voltage connections which must be corrected. Make sure power is off before making corrections.

   NOTE: During CT phasing, the parallel cable voltage output can also be measured conveniently at test points on the LS 671A load sharing module. The red post (+) is on the right next to the load sharing sensitivity adjustment.
2. Generator sets may now be synchronized manually with the speed trim control or with an automatic synchronizer. Once synchronized, the generator sets can be paralleled.
3. At no load adjust the external load sharing panel frequency trim control for zero real power. Adjust the voltage regulator to trim the reactive current to zero.
4. Apply a constant load (preferrably 100%). If instability occurs, see "Troubleshooting".
5. Check the power output of each generator set. The engine carrying the least load can be adjusted by turning that engine's load sharing sensitivity adjustment CCW until the load is balanced.

LOAD ANTICIPATION ADJUSTMENT

The load sharing modules (LS 671A) have a load anticipation circuit to improve transient responses. This function is factory set at zero sensitivity (full CW). Load anticipation should be adjusted while the engines are parallel.

Carefully turn the control CCW while occasionally poking the valve of the actuator with about 50% load applied to the engine. Instability may result if the control is advanced too far. Usually a ¼ turn CCW will be close to optimum.

DROOP ADJUSTMENT

When paralleling with an infinite bus, droop is often used. Adjustable droop with load is obtainable by connecting terminals 27 and 28 by placing either a jumper or a switch between these terminals. An internal control is provided for droop adjustment and is located under the dot plug on the cover of the LS 671A. Adjust the droop control to the desired droop level by CW rotation of droop adjustment. The droop is linear and may be set at any level. The parallel cable must be disconnected during droop operation.

CAUTION
WHEN THE SET IS IN OPERATION, HIGH VOLTAGE IS PRESENT ON TERMINALS.

AUTOMATIC ELECTRONIC SYNCHRONIZER ADJUSTMENTS (Optional)

Once the section on installation, operation and wiring have been completed, terminal 6 of the CU 6714D synchronizer may be connected. Then turn the phase sensitivity control of the synchronizer full CW. This will prevent terminals 3 and 4 from closing. Start the engine(s) and turn the synchronizer "on". The synchronizer will now synchronize the system but will not close the circuit breaker (terminals 3 and 4 will remain open). Adjust the gain control CW until instability results, then back off the gain control until stability is restored. Tap the engine throttle to be sure the system is stable and the response is fast. If instability or response is not as good as desired, refer to the section below on stability. Once the synchronizer gain has been adjusted, the phase error should be within 6°. Further CCW adjustment will result in wide window and shorter synchronizing times. When satisfactory, lock both cover adjustments. If SYN 671A synchronizer is being used consult Section EG 70-8A.

A phase error adjustment is located behind the rear end cover on the near left side (to the right of the stability control as viewed from the rear end). This control is factory adjusted for phase error of less than 6°. If a small phase error is desired, this control may be adjusted for minimum obtainable error.

When the phase angle difference is reduced to a minimum by the synchronizer, the phase detection circuit will close the internal relay (terminals 3 and 4). The phase angle difference can be adjusted by the breaker closure angle control (located on the cover). CW rotation of this control will reduce the phase error window to near zero. All synchronizers are factory set for 6° window. CCW rotation can increase this window to 30°.

Contact closure (terminals 3 and 4) indicates that the synchronizer is holding the speed and phase of the governor so that the line contactor may be closed either manually or automatically. Oil pressure and voltage regulator sensing devices may be added in series with the internal relay contacts (terminals 3 and 4) to insure proper conditions before paralleling the generators.

At the same time the generators are paralleled, the synchronizer must be disconnected from the control panel by the opening of the NC main circuit auxiliary contacts, since the speed is held by the bus. When the synchronizer is disconnected from terminals 16 and 26 of the control panel, speed control reverts to normal operation.

STABILITY

If optimum engine stability cannot be obtained or if it is difficult to stabilize the system, use the internal stability adjustment. The stability adjustment is located behind the dot button on the rear end plate and is the nearest adjustment to the side of the synchronizer case. A CW adjustment will reduce the time constant.

TROUBLESHOOTING

GOVERNOR INOPERATIVE

While cranking, measure the voltage from ground (#13 of terminal strip) to the speed control unit terminals (CU 673C-17) in sequence as indicated below (terminals F, G, H and T are ground terminals located on the speed control unit):

STEP	TERMINALS	NORMAL VALUE	PROBABLE CAUSE OF NON-NORMAL READING
1	S	1.0 VAC-RMS minimum while cranking	1. Defective magnetic speed sensor. 2. Gap too large between speed sensor and gear teeth. 3. Improper or defective wiring to the speed sensor.
2	K	10.1 ± 0.20 VDC while energized (Internal regulated DC supply)	1. DC power not connected or low battery voltage. 2. Speed trim control shorted, ground or miswired. 3. Wiring error. 4. Defective speed control unit.
3	L	Above 5.1 VDC while cranking. (Inverse speed error signal.) Above 5.1 volts is under speed signal. Below 5.1 volts is over speed signal. On speed will indicate a steady 5.1 volts.	1. Frequency adjust set too low. Turn CW. 2. Defective speed control unit.
4	N	8.5 to 9.5 VDC while cranking. (Proportional actuator voltage.)	1. Defective speed control unit. 2. Battery voltage may be too low while cranking.
5	B	2.5 VDC maximum while cranking. (Transistor voltage.)	1. Output transistor open (defective speed control unit). 2. Defective actuator. 3. Error in wiring to actuator.

OTHER TROUBLESHOOTING TESTS

STEP	SYMPTOM	TEST	PROBABLE TROUBLE
1	Engine overspeeds	Determine voltage on terminal "L". Should be less than 5.1 VDC.	1. Frequency set too high. Turn frequency adjust CCW. 2. Defective speed control unit.
2	Engine overspeeds	Measure the voltage across the insulated nut located on the side of the control unit. Should be more than 2.5 VDC.	1. Output transistor shorted. (Defective speed control unit.) 2. Wiring to actuator incorrect.
3	Throttle does not move	Measure battery voltage at the battery while cranking. Must be at least 75% of nominal battery voltage.	1. Insufficient battery voltage. Put a momentary connection from terminal "B" on the control unit to ground (terminal "G") while cranking. 2. Replace with battery of higher amp hour rating.
4	Throttle does not move	Ground the insulated nut located on the side of the speed control unit, except on CU 673C-10 speed control units. Throttle should move to full open position.	1. Wiring to actuator or battery incorrect. 2. Actuator or linkage bound. 3. Defective actuator.

ERRATIC OR UNSTABLE GOVERNING

A. **Insufficient Magnetic Speed Sensor Signal**
Although the speed control unit will govern well on 1.0 volts RMS signal if it is a clean sine wave, a signal from the magnetic speed sensor of 3 volts RMS at full speed will eliminate any possibility of missed or extra pulses. This signal is measured across terminals 19 and 18 (terminal 18 is internally grounded). Signal strength must not exceed 30 volts RMS.

B. **Electrical Noise or Unwanted Droop**
If noisy electrical devices are present, such as magnetos, solid state ignition systems, battery chargers or regulators which emit radio frequency interference (RFI), unstable governing or droop may be noticed. The speed control unit has internal filters which provide some protection from radio frequency interference. Excessive levels of RFI must be treated separately. A metal shield placed around the emitting source will help. Placing the governor harness and speed control unit as far away as possible from the emitting source will help. Shielded cable is recommended. Ground one end of shield only at terminal 18 of the Load Sharing Panel.

Raise the magnetic speed sensor voltage by reducing the gap between the speed sensor and the ring gear. A gap of 0.030" will provide a strong signal, 30 volts RMS maximum. If noise is still present, a capacitor (1,000 ufd, 15 volts) may be connected across terminal 20 (+) and terminal 22 (−) to reduce external interference coming from the DC power supply. The best solution is usually to relocated the panel to a position where less noise is experienced.

C. **Low Frequency Instability**
When low frequency instability or surge (0.5 to 3 Hz.) is experienced, a simple jumper wire connection can be installed between terminals "H" and "M" on the CU 673C-17 speed control unit. This will increase the engine dead time filter compensation and tend to eliminate low frequency instability or surge.

D. **High Frequency Instability**
When rapid instability or surge (about 8 Hz.) occurs, remove the jumper between terminals "M" and "H." Then a jumper connection can be made between terminals "M" and "N". This will decrease delay compensation and tend to eliminate the instability. For slight instability problems place a 5.1K ohm (1/4 W) resistor from terminals M to N.

E. **Unsatisfactory Engine Performance**
When poor transient performance is caused by the speed control unit gain adjustment being at or near its lowest point, a 6.2K ohm (1/4 W) resistor can be applied between terminals L and P. This will expand the range of the gain control.

NOTE: Do not install both M to H and M to N jumper connection—no improvement in performance will result.

F. **Other Instability**

Fuel system problems can cause instability. If air is suspected in the fuel line, use a sight glass to check for bubbles at the fuel pump inlet.

G. **Reverse Power Condition**

Recheck phasing of voltage and current transformers per instructions on Page 9.

H. **Erratic Load Sharing**

Check the generators' voltage regulators to verify equal voltages from each. Generator voltage mismatch causes harmonic content which can be the cause of erratic load sharing. Excessive (>0.1 ohm) or unequal resistance at connections to current transformers can cause erratic load sharing.

LOAD SHARING LS 671A TROUBLESHOOTING

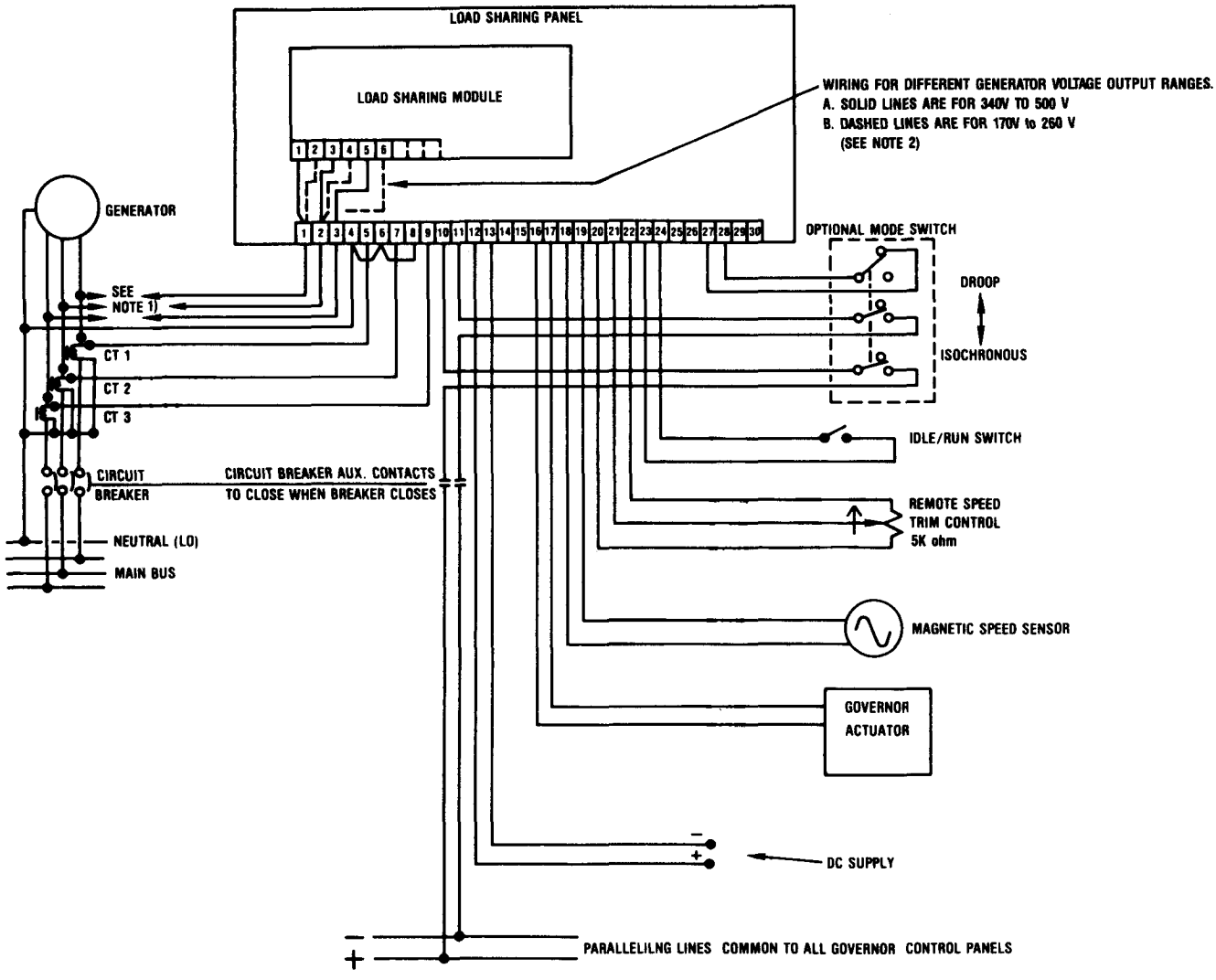
Inoperative or erratic (measure the following voltages under single unit isochronous operation at load, preferably 100%). The terminals at which the voltages are to be measured are the 18 terminals on the load sharing unit (shown in Figure 1). Do not attempt to measure at the 30-position terminal block.)

STEP	LOAD SHARING *TERMINALS	NORMAL VALUE	PROBABLE CAUSE OF NON-NORMAL READING
1	1 to 3 3 to 5 5 to 1	340-500 VAC (at 60 Hz.) line voltage CAUTION: HIGH VOLTAGE	1. Improper wiring of terminals 1, 3 or 5 to generator
1a	2 to 4 4 to 6 6 to 2	170-260 VAC (at 60 Hz.) line voltage CAUTION: HIGH VOLTAGE	1. Improper wiring of terminals 2, 4 or 6 to generator
2	7 to 8 9 to 10 11 to 12	Up to 2.5 VAC (Voltage across the burden resistors (0.5 ohm) proportional to line currents	1. Current transformers open circuited, short circuited or miswired to load sharing panel
3	14 to 15	0 to approx. 8 VDC proportional to load, 14 positive, 15 negative	1. Improper phasing of AC inputs. 2. Connected voltage inputs to high voltage range (terminals 1,3,5) rather than low voltage range (terminals 2,4,6). 3. Excessive resistance (>0.1 ohm) at connections to current transformers. 4. Improper C.T. ratios.
3a	14 to 15	Short 7-8 will reduce the voltage at 14-15 about 30%	1. Incorrect phasing of current transformers 2. Defective load-sharing unit
3b	14 to 15	Short 9-10 will reduce the voltage at 14-15 about 30%	1. Incorrect phasing of current transformers 2. Defective load-sharing unit
3c	14 to 15	Short 11-12 will reduce the voltage at 14-15 about 30%	1. Incorrect phasing of current transformers 2. Defective load-sharing unit
4	16 to 17	With no load on engine 5.1 VDC ±0.2 volt 16 (+), 17 (−)	1. Terminal 26 improperly wired at the 30-position terminal block

IDLE/RUN MODULE (KT 6722A) TROUBLESHOOTING

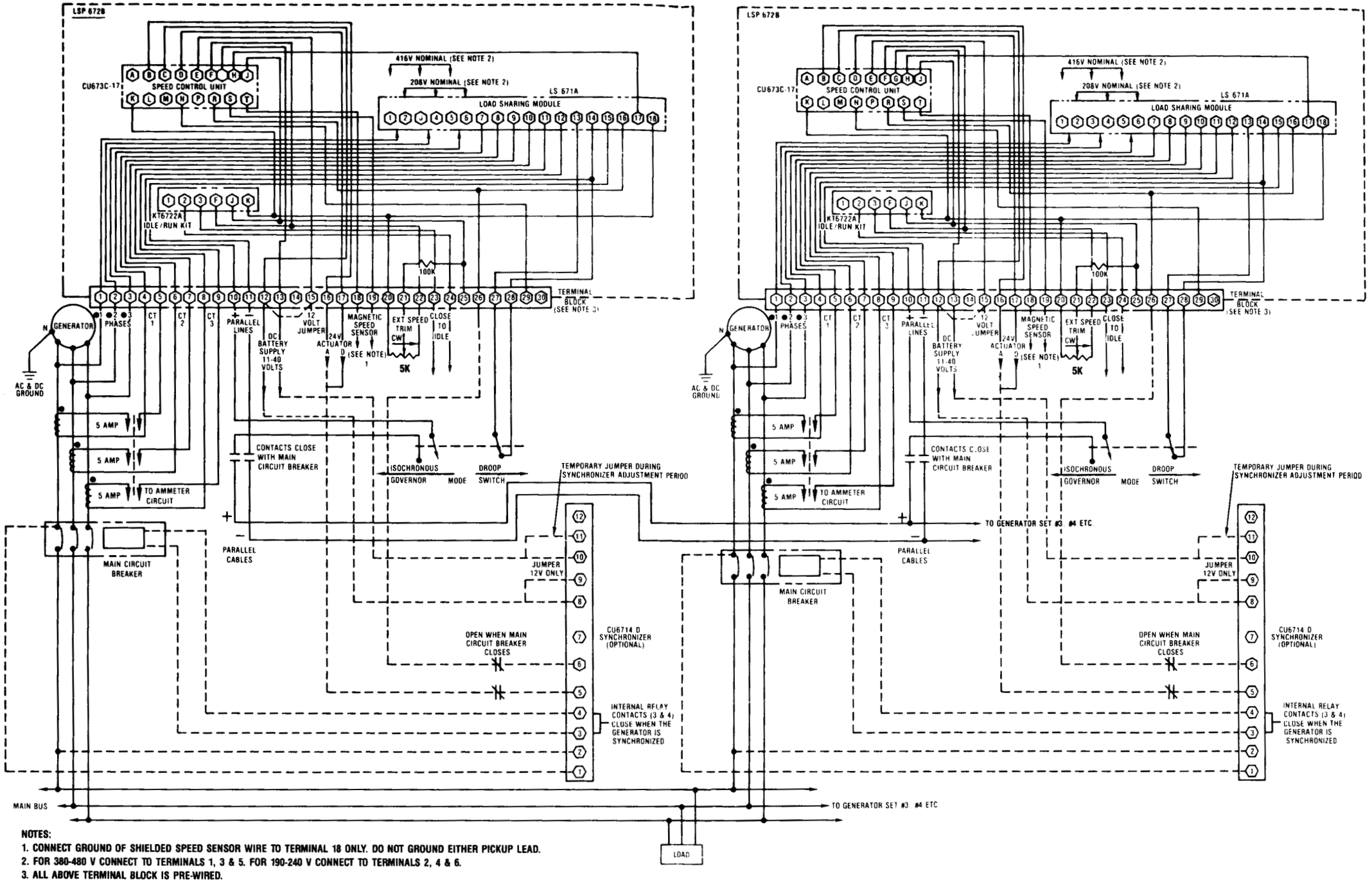
Inoperative. (Measure the following voltages at the 6 terminal strip on the idle/run module).

STEP	IDLE/RUN TERMINALS	NORMAL VALUE	PROBABLE CAUSE OF NON-NORMAL READING
1	K to F (−)	10.1 ± 0.2 VDC	1. Improper wiring or problem associated with the control unit. See Troubleshooting of Speed Control Unit
2	J to F (−)	8 ± 1 VDC at idle speeds	1. Improper wiring of idle/run kit 2. Defective control in idle/run kit
3	J to F (−)	5 ± 1 VDC at operating speed	1. Improper wiring of idle/run kit 2. Defective control in idle/run kit



NOTES:
1. PHASING OF THE VOLTAGE AND CURRENT SENSING INPUTS TO THE GOVERNOR CONTROL PANEL IS CRITICAL FOR CORRECT OPERATION.
2. CONNECT TERMINALS 1, 2, & 3 ON THE LOAD SHARING PANEL TO TERMINALS 1, 3 & 5 OF THE LOAD SHARING MODULE FOR HIGH VOLTAGE RANGE OR TO TERMINALS 2, 4 & 6 OF THE LOAD SHARING MODULE FOR LOW VOLTAGE RANGE. (SEE TABLE ON PAGE 2)

Figure 3 Multi-Engine Load Sharing System LSP 672B



NOTES:

1. CONNECT GROUND OF SHIELDED SPEED SENSOR WIRE TO TERMINAL 18 ONLY. DO NOT GROUND EITHER PICKUP LEAD.
2. FOR 380-480 V CONNECT TO TERMINALS 1, 3 & 5. FOR 190-240 V CONNECT TO TERMINALS 2, 4 & 6.
3. ALL ABOVE TERMINAL BLOCK IS PRE-WIRED.

COMMENT

A DEAD BUS RELAY MAY BE REQUIRED TO ALLOW THE FIRST UNIT THAT REACHES OPERATING SPEED TO PARALLEL TO THE MAINS AUTOMATICALLY WHEN A SYNCHRONIZER IS USED.

Figure 4
Wiring Diagram