LSM672
Load Sharing Modules

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1 OVERVIEW

GAC's LSM672 Series Load Sharing Modules proportionally share the load between two or more generator sets while the system frequency is held constant. As an accessory to the Electronic Governing System, the LSM672 Series measures the true power current through a parallel cable interconnection, continuously controlling the governing system. By using various droop and power-control connections, the Load Sharing Module can parallel and share load with the utility's main bus.

In addition to its primary function of load sharing, a load-anticipation circuit is included to maximize performance in single or parallel engine generator operation. The unit also contains adjustable monitors for forward and reverse power.

- Non-CE
- 24VDC
- Isochronous Load Sharing, Load Anticipation
- Droop
- Forward and Reverse Power Monitoring and Reset Capability
- All electric sensing
- Accurately measures true power
- Load anticipation and droop adjustment
- Small, compact size

LOAD SHARING MODULES

MODEL	DESCRIPTION
LSM672	CE-Compliant / 24 V DC / Isochronous Load Sharing / Load Anticipation / Droop / Forward and Reverse Power Monitoring and Reset Capability
LSM672A-1	Same as LSM672 Except Terminal 25, power output signal with respect to Terminal 16 (Terminal 16 function disabled) Output = 0 to 7 V DC Forward and 0 to -2 V DC Reverse Power. (50, 60 & 400 Hz)
LSM672C	Same as SM672 except AC Voltage input nominally 120 V AC line to line. (50, 60 & 400 Hz)
LSM672N	Non-CE / 24VDC / Isochronous Load Sharing / Load Anticipation / Droop / Forward and Reverse Power Monitoring and Reset Capability
LSM672N-12	Non-CE / 12VDC / Isochronous Load Sharing / Load Anticipation / Droop / Forward and Reverse Power Monitoring and Reset Capability

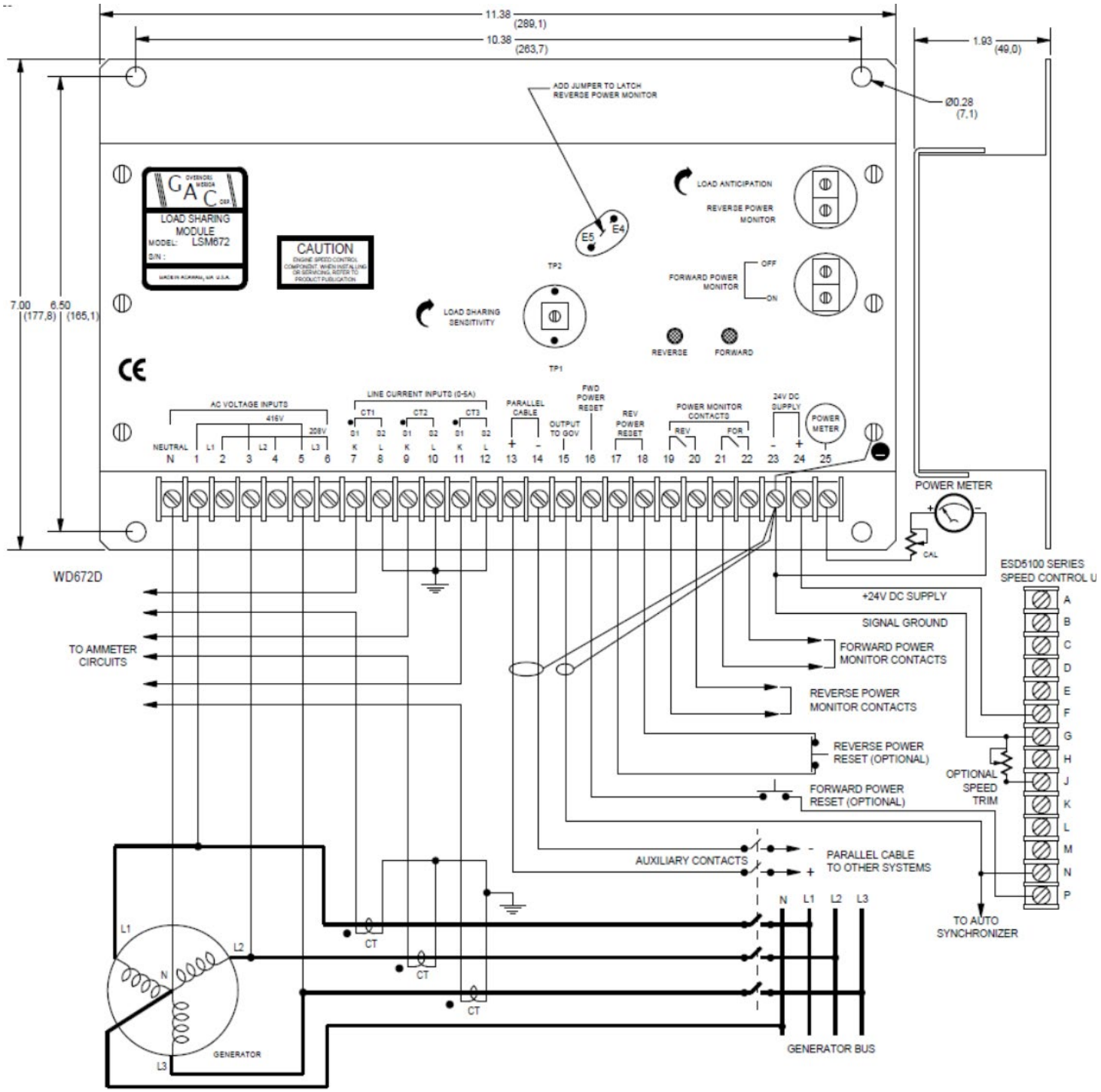
2 SPECIFICATIONS

PERFORMANCE	
Load Sharing	Adjustable to within ± 2 % between gen-sets
Reverse Power Monitor	Adjustable from 0.5 % to 20 % with a 2s inverse time constant.
Forward power Monitor	ON trip point adjustable from 20% - 100% OFF trip point adjustable from 0 - 80%
Power Output Signal	0 to 7.5 V DC representing 0 - 100% load
All specs are based on 5 amps from the current transformer (CT) secondaries at full load unity P.F.	
INPUT / OUTPUT	
Supply	18-36 V DC
Polarity	Negative Ground (case isolated)
Power Consumption	70 mA Typical
Power Output Signal	0 - 7 V based on 5 A CT output
AC Input Signals	208 or 416 Volt nominal line to line and 5 A CT's with a minimum 6.25 VA rating.
Reverse Power Protection	Transient and reverse voltage protected
Line to Line Voltage	See the Line to Line Voltage table

ENVIRONMENTAL	
Ambient Temperature	-40° to 85 °C (-40° to 185 °F)
Relative Humidity	up to 95 %
All Surface Finishes	Fungus Proof and Corrosion Resistant
PHYSICAL	
Dimension	See Section 3, Wiring and Installation
Weight	5.2 lbf (2.36 kgf)
Mounting	Any Position, Vertical Preferred
RELIABILITY	
Vibration	4g, 20-100 Hz
Shock	20 g Peak
Testing	100% Functional Test
COMPLIANCE / STANDARDS	
LSM672N	RoHS
LSM672	CE and RoHS

3 WIRING AND INSTALLATION

The unit is typically mounted in the generator set control cabinet with the other dedicated control equipment. Position the unit so that the natural flow of cooling air is not obstructed. The unit's three large burden resistors will dissipate up to 6.25 watts each.



LINE TO LINE VOLTAGE		
HZ	**LOW RANGE**	**HIGH RANGE**
50	140-250 V AC	260-420 V AC
60	170-260 V AC	340-500 V AC
400	170-260 V AC	340-500 V AC

3 WIRING AND INSTALLATION (CONTINUED)

Electrical connections are illustrated in Diagram 1. Choice of the proper wire size is dependent on the maximum current expected at specific terminals of the load sharing module. Terminals 7-12 can reach a maximum of 5 amps. All others are less than 50 mA, with the exception of the relay contacts which are rated up to 10 Amps.

High Voltage Present at Terminals N & 1-6.
Terminal Strip Cover Must Be In Place When In Operation

TERMINALS 1-6 accept the 3 PHASE VOLTAGE inputs. Selection of the proper 3 terminals is dependent on the generator voltage. See section 2, Specifications, for details.

Do Not Open Circuit CT Connections While the Generator Set is Running, High Voltage Will Be Present.
Ensure To Replace Terminal Block Cover After All Wiring Is Completed.

TERMINALS 7-12 accepts the 3 PHASE CURRENT input from 5 amp current transformers. Series connections can be made from instrument panel CTs providing the VA rating is adequate. The CT burden of the load sharing module is 6.25 VA for each phase. This will add to the burden rate of the panel instruments and wiring on the CTs. Note the common CT connections at Terminals 8,10 and 12. This is required for CE approved applications.

TERMINALS 13 AND 14 are the PARALLEL CABLE connections which link all load sharing modules together. Proper polarity must be observed. If these cables are longer than 3 ft. (1 m) they must be shielded with the shield grounded at Terminal 23. The relay contacts used must be suitable for low current levels, less than 1 ma (Dry contacts).

TERMINAL 15 is the load sharing OUTPUT TERMINAL to the governor system speed control unit. If this cable connection is longer than 3 ft (1 m) it must be shielded. Ground the shield at Terminal 23.

TERMINAL 16 is the FORWARD POWER RESET A momentary connection to a +10 VDC source on the governor speed control using a normally open switch will automatically reset the forward power relay to the OFF condition. Connecting Terminal 16 to battery negative turns on the monitor. The forward power monitor may also have programmed switch points through Terminal 16. Connecting a 1 mΩ resistor between Terminal 16 and battery minus (terminal 23) shifts a 100% ON/ 40% OFF setting down to a 85% ON/ 5% OFF setting. If different programming is required, consult GAC's engineering for assistance.

TERMINALS 17 AND 18 are for a REVERSE POWER RESET momentary switch. The unit is factory shipped with a jumper connected, for automatic reset. This automatic reset will cause the internal relay to remain energized only when the reverse power level is above the reverse power set point.

The reverse power relay can be setup to latch and then be manually reset by an external switch at Terminals 17 to 18 with the following modification. Install a soldered wire link between posts E4 and E5 on the circuit board. The posts are accessible by removing the unit's cover. See section 3, Wiring and Installation, for post positions.

Replace the factory installed jumper between Terminals 17 and 18 with a N.C. momentary switch. The reverse power relay and sensing circuit will reset to the OFF condition when switch is opened.

TERMINALS 19 AND 20 are the REVERSE POWER RELAY OUTPUT TERMINALS. Contacts are N.O. and rated for 10 A (LED lights).

TERMINALS 21 AND 22 are the FORWARD POWER RELAY OUTPUT TERMINALS. Contacts are N.O. and rated for 10 A (LED lights).

TERMINAL 23 is the battery negative connection and is connected to the ground reference terminal at the speed control unit. Do not connect directly to battery minus or a ground loop will be formed.

4 PRE-PARALLELING CHECKS

1. Load Sharing Sensitivity adjustment - Full clockwise (CW) position.
2. Load Anticipation adjustment - 1/4 turn from full counterclockwise (CCW) OFF position.
3. Governor Speed Set point - trim to desired speed setting.
4. CT Phasing check requires DC voltage measurements. Measure across the test posts (TP1 and TP2) observing instrument polarity, TP1, the lower post, is (+). This voltage is directly proportional to unity P.F. load. A voltage of 0 to 7.5 V DC can be expected, depending on load, Load Sharing Sensitivity adjustment, and CT ratios.

Do Not Open Circuit CT Connections While the Generator Set is Running, High Voltage Will Be Present.
Ensure To Replace Terminal Block Cover After All Wiring Is Completed.

With the generator set under load, check the CT phasing momentarily and sequentially short each CT one at a time, with an insulated lead at Terminals 7-8, 9-10, or 11-12. Each time a CT is independently shorted, the voltage reading will be reduced by 1/3. If the voltage change is not 1/3, this very likely indicates improper CT or voltage phasing. Corrections to CT phasing must be performed while the generator set is not running.

5 ADJUSTMENTS

With the generator paralleled to the other generator(s) and with no load on the system, adjust each generators speed setting using the governor speed trim control for zero power as indicated on each generator sets watt meter and proper system frequency (50,60 or 400 Hz). Also, adjust the generators AC voltage regulators setting for zero circulating AC current. Electrical load can now be applied to the system.

LOAD SHARING

All generator sets in the system should be sharing the system load proportionately. The generator set carrying less than its share of the load should be adjusted to accept more of the system load. Move the appropriate LOAD SHARING SENSITIVITY adjustment counterclockwise to increase its contribution of load.

LOAD ANTICIPATION

LOAD ANTICIPATION adjustment is factory set at 1/4 turn from full counterclockwise. To improve transient response, gradually advance the adjustment clockwise while the engine generator sets are in parallel. The transient response improvement can be observed with engine load changes. Instability may result if the adjustment is advanced too far clockwise. A conservative adjustment is suggested.

DROOP

Droop operation may be required under certain circumstances. To obtain droop, disconnect the parallel cable connections from Terminals 13 and 14. Place a jumper between Terminals 13 and 14. Turn the LOAD SHARING SENSITIVITY adjustment clockwise to increase the percentage of droop. Or connect a 100K variable resistor across the open parallel cable terminals 13 and 14. Adjustable droop of about 5% can be obtained. See your actuators installation guide for further information on droop operation.

REVERSE POWER

Reverse Power monitor adjustment is factory set at full clockwise for the highest trip point setting. Adjust the Reverse Power monitor counterclockwise to set the reverse power relay trip point. The range of this adjustment is 0.5% to 20% based on 5 Amp CT secondary output. With the desired level of real or simulated reverse power applied to the generator, set the reverse power relay trip point.

Note: Reversing the polarity connections of each CT and then applying normal electric load simulates a reverse power condition. After adjustment, correctly replace all CT connections.

If a longer inverse time constant is desired, add a 10 mfd capacitor to posts E3 and E4 (+). This doubles the time constant, making it approximately 4 seconds.

FORWARD POWER

The Forward Power Monitor is typically used as an action signal for an additional engine to start when the power demand increases or to signal an engine to shut off when the power demand is reduced.

The Forward Power monitor ON adjustment is factory set full clockwise (>100%). The Forward Power monitor OFF adjustment is factory set full counterclockwise (<20%). The ON adjustment must always precede the OFF adjustment.

1. Slowly raise the engine generator set load to the desired ON forward power relay trip point.
2. Rotate the ON adjustment counterclockwise until the forward power LED lights and the relay energizes.
3. Slowly reduce the engine load to the desired OFF forward power relay trip point.
4. Rotate the OFF adjustment CCW until the forward power LED extinguishes and the relay de-energizes.
5. Adding a 10 mfd capacitor between posts E6 and E7 (+) doubles the inverse time constant to 4 seconds.
6. The referenced load percentages are based on a 5 Amp CT secondary current at full engine load and are approximate.

POWER OUTPUT SIGNAL

A DC signal proportional to the power measured is available at Terminal 25. The voltage range is 0 to 7.5 V DC based on a 0 to 5 A CT current range. The impedance of Terminal 25 is 1 K Ω and Terminal 23 is the ground reference. This output is a voltage based signal. This signal may be used to drive a 0-1 MA meter movement if the meter and a 10 K Ω calibration potentiometer are connected in series between Terminal 25 and 23.

6 SPECIAL APPLICATIONS

In addition to load sharing, the LSM672 is capable of generator power control and main bus power management. Request more information from your GAC representative.

USING THE POWER RAMP CONTROL

The PRC100A Power Ramp Control from GAC can be used to ramp the generator load. Import and/or Export control, or individual generator control can be achieved with the PRC100A to smoothly ramp the generator(s) on or off the main bus.

INTERNAL POST FUNCTIONS

- Post E1 and E2 may be connected with a jumper to convert to the 3.1 V reference used by some competitive governor systems.
- Post E8 allows checking of the 5.1V reference supply.
- Post E9, E10, E11 and E12 are used to invert the signal of the output circuit. The normal configuration is for E9 and E10 to be jumpered and for E11 and E12 to be jumpered.

PEAK SHAVING (LSM672-1)

For peak shaving applications, remove the E9 to E10 and E11 to E12 jumper wires. Install a jumper wire between posts E9 and E11. Install a 42.2 K Ω resistor between posts E10 and E12. The unit is now an LSM672-1. Contact your GAC representative for more information.

REFERENCE ADJUSTMENT CALIBRATION

To adjust and calibrate the internal reference bias, apply DC and AC voltages to the LSM672. At no load, remove Terminal 15 to the speed control unit. Measure Terminals 15 and 23. Adjust this voltage for 5.0 V DC.

7 SYSTEM TROUBLESHOOTING

1. Reconfirm the 3 phase AC Voltages are present and within specification. Also confirm that a neutral connection to the generator has been made.
2. With DC applied to Terminals 23 and 24, measure the units output voltage from terminals 15 and 23. This should be 5.0 V DC ± 0.1 V DC.
3. Measure the parallel cables voltages at No Load.
   - 13 to 14 Nominally 0 VDC ± .05 VDC
   - 13 to 23 Nominally 5.0 VDC
   - 14 to 23 Nominally 5.0 VDC
4. Recheck the CT phasing. Measuring the AC voltage across each CT input will also confirm equal CT currents.
5. If instability is present when the generator sets are in parallel, equally reduce the Load Sharing Sensitivity adjustment of each load sharing module. Rotate the adjustments in small increments counterclockwise on all of the load sharing modules in the system until stability is restored. If the Load Sharing Sensitivity adjustment is reduced to less than 25%, poor load sharing may result. Further check to ensure that the Load Anticipation adjustment is at the factory setting of 1/4 turn from full counterclockwise.
6. If the instability persists, open the parallel cable and add a jumper across the parallel cable connection, Terminals 13 and 14, of each unit. Droop will be present, but the system should be stable. If not, check the generator voltage regulator stability.