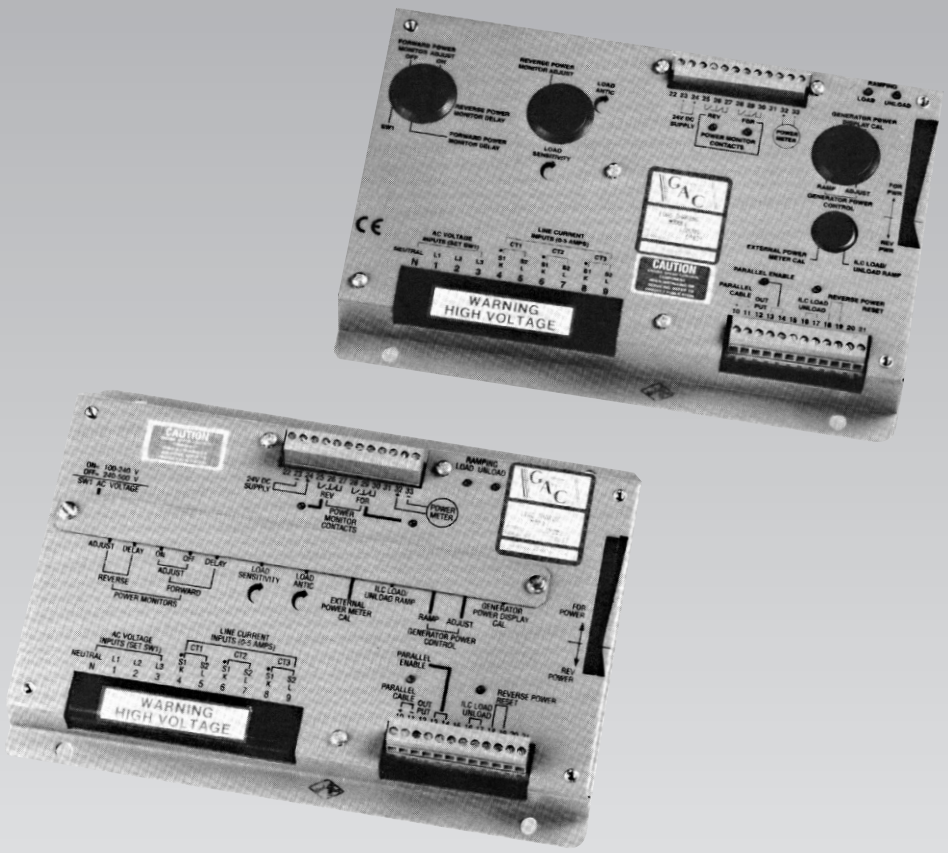
GOVERNORS AMERICA CORP.

ENGINE GOVERNING SYSTEMS

LSM200 SERIES



LOAD SHARING MODULE

MEMBER

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

LSM200 SERIES LOAD SHARING MODULE

PRODUCT TECHNICAL INFORMATION

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MPC

INTRODUCTION

The LSM200 Series controls are multi-function load sharing and power control module accessories. They are intended to be used with Governors America Corp. speed control units on generator set applications requiring isochronous paralleling and /or mains power control. Isochronous load sharing is its primary function. The LSM200 Series controls have the following capabilities:

- Isochronous Load Sharing (0% Droop)
- Reverse Power Monitoring
- Forward Power Monitoring
- Load Anticipation
- Automatic Power Ramping of its oncoming generator
- Generator Power Ramping to the mains
- Internal bar graph power measurement display
- Power measurement with an external display

Note: The LSM200 Series is presently available in two models, the LSM201 and the LSM201N. The LSM201 is the latest and current model that meets all the specifications and functions described in this publication and is CE approved. The LSM201N is functionally the same but lacks the extra filtering for CE approval. The LSM201 is supplied unless specified otherwise.

DESCRIPTION

Load Sharing Mode

Engine generator sets with isochronous governors maintain the requested speed very precisely. If synchronous generators are electrically paralleled to increase the total generated power capability, a system to apportion the load is required. Even the finest electric governors will have minor frequency differences among units to be paralleled, which would cause power variations. In this case, one generator set would continuously increase the power it produces, while the other sets would decrease the power they produce. This condition eventually leads to motorizing one or more generator/ engines. The load sharing system continuously adjusts the governor speed settings so that no average power difference exists. The generators are locked together through electrical synchronizing torques. They act as though they are tightly connected through a gear drive.

The load sharing module measures the power that the generator supplies to the main bus. Voltage inputs accept two ranges of three phase voltage. This covers most all applications (see table in the specifications). In the design of poly- phase generators, the presence of a third harmonic is possible. This odd order harmonic may cause errors in load sharing systems. To minimize this error and to improve the load sharing, a terminal is provided to connect to the neutral of a Wye configuration generator.

The line current measurements are usually taken from current transformers existing in the equipment such as those used for ammeter circuits.

Internal power measurement circuits develop a D.C. load signal across the parallel cable proportional to the AC power measured. The magnitude and sensitivity of the load sharing is adjustable through the LOAD SENSITIVITY control in the module. Test points TP1 (+) and TP2 (-) adjacent to this control are used to measure the polarity and magnitude of the proportional power signal. This measurement is very important when initially installing a system and these test points may also be used in troubleshooting the system.

The parallel cable is the interconnection between each generator set. Across this cable, each generator sends its load signal to a common point when the parallel cable's circuit breaker contacts are closed. With all the parallel cables connected, a current flows in the cable that is proportional to any imbalance of load between the generators. The individual load sharing modules detect this imbalance, and a correction signal is sent to each governor to minimize the differences.

Automatic soft loading is a standard feature in the LSM200 Series modules. The oncoming generator set presets its load sharing to zero power until the parallel enable signal is given, then the unit ramps to equalize the loads of all common generator sets. Soft unloading can be commanded via the ILC (Individual Load Control) terminals from service.

The load anticipation feature (Load Pulse) provides a signal that is a derivative function of the load. This load anticipation signal will make the governors more responsive to transient loads on the generator.

Forward and Reverse Power Monitors are provided for convenience and protection in the load sharing module. When a reverse power condition is sensed by the internal AC power measuring circuits, the internal relay contacts are closed.

The forward power monitor has both “ON” and “OFF” set points, which may be adjusted independently. The internal relay can be used to signal different load points.

Power Control Mode

Automatic power ramping is a function provided in the LSM200 Series units. Each time the generator is put on-line or taken off-line, the power can be ramped for a smooth transition.

Mains Power control is also within the capability of this unit. With a slight reconnection, the unit can request its generator to supply a specific power level to the mains. This function can be controlled from local or remote locations. The power transitions are normally ramped up and down but may be made faster for rapid response.

The LSM200 Series of units additionally can be made part of a larger control system to manage a total power system.

Hence this unit can be commanded by other GAC accessories to control the power from a group of engine generators.

SPECIFICATIONS

PERFORMANCE

Load Sharing	Adjustable to within +/- 2% between sets
Operating Modes	Isochronous and droop paralleling and main power control
Reverse Power Monitor Trip Point	Adjustable from -2 to -20%
Reverse Power Delay (Inverse Time Delay)	Adjustable from 0.5 to 15 seconds
Forward Power Monitor Trip Point	"ON" trip point adjustable from 20-100% "OFF" trip point adjustable from 0-80%
Forward Power Delay	Adjustable from 0.4 to 30 Seconds
Power Output Signal	0 to -1 VDC represents reverse power 0 to +6 VDC represents forward power
Forward and Reverse Power Relay Contact Rating	Form C, 10 Amp 290 VA
Parallel Cable Relay Contact Rating	Gold Clad, 1.25 A 60 VA Max.

All Performance specifications are based on 5 amps from the current transformer secondary at full load on the generator.

POWER INPUTS

3 phase AC Voltage signals	Two selectable ranges accommodate 100-500 VAC Line to Line Isolated from battery minus by 5000 VDC Isolated from case by 1000 VDC
3 phase AC Line Currents	0-5 Amps with 1.25 VA requirement Isolated from case by 1000 VDC Common WYE connection to battery ground permitted.
DC Supply	17-32 VDC (Transient and Reverse voltage protected)

Note: Battery (-) On All Sets Must Be Connected Together In Common . . . . . 12 VDC units available on request.

Polarity	Negative ground case isolated.
Power Consumption-Battery Supply	160 ma
AC Phase Voltage Inputs	2.5 ma
External Power Meter (Voltage Output)	10 ma max. current

ENVIRONMENTAL

Operating Temperature Range	-40º to +80ºC (-40º to +175ºF)
Humidity	up to 95% Corrosion Resistance and Fungus proof. All surfaces treated. Circuit boards coated with heavy build of silicon coating on all sides.

PHYSICAL

Dimensions	See Diagrams 1 & 2
Weight	2.4 lbs. (1.09 Kg)

RELIABILITY

Testing	All units 100% functionally tested.
Vibration	5G @ 20-100 Hz

INSTALLATION

The LSM200 Series Module is typically mounted in the generator set control cabinet with the other dedicated control equipment. It is best to locate the load sharing, synchronizer, and speed control all together if possible since the interconnection cable lengths are minimized

WIRING

Terminal N must be connected to the neutral of the generator. When connected, the neutral is still isolated from battery minus but may be connected to battery minus if necessary. Electrical connections are illustrated in the wiring diagrams. Choice of a proper wire size is dependent on the maximum current expected at specific terminals of the load sharing module. Large gauge wire should be used for CT Terminals 4 to 9 as the current can reach a maximum of 5 Amps. Long wires with high resistance can add to the burden of the CT Shielded wire is recommended for sensitive control terminals, see wiring diagrams.

FUNCTIONAL DESCRIPTIONS

3 Phase Power Measurement

The power measured by the LSM200 Series unit is the real power portion of the generator. This is based on the measurement of just the real power portion of the CT current in comparison to the phase of the generator voltage. A new all electronic method of power measurement is used as opposed to the transformer and diode switching system traditionally used. This method provides higher accuracy and increased reliability.

3 Phase AC Voltage Inputs

The generator's 3 phase voltages are measured at L1, L2 and L3 (Terminals 1 through 3). Terminal N must be connected to the generator neutral. The AC voltage inputs are isolated from the battery circuits for over 5000 Volts.

CAUTION:
HIGH VOLTAGE PRESENT AT TERMINALS N & 1-3.
Terminal strip cover must be in place
when in operation.

The LSM200 Series has two AC voltage ranges, Low and High. The appropriate voltage range must be selected to match the connections of the generator. This is accomplished with the dip switch located in the adjustment window. The voltage ranges are wide and overlap significantly

Selecting the Operating Voltage Range
Low AC Voltage Range 100 - 280 VAC SW1 (ON)
High AC Voltage Range 240 - 500 VAC SW1 (OFF)

3 Phase Line Current Inputs

Generator line currents are measured with external 5 Amp current transformers. Connect the CTs with the phasing dot/start at Terminals 4, 6, and 8 as shown in the wiring diagram. The CT circuits are also isolated from battery minus so that they may have one side connected to the battery minus if required for the application. The Volt Amp burden of the LSM200 Series on the current transformers is very small (1.25 VA each).

DC Supply Voltage Input

Battery power, 24 VDC, must be applied to the unit at Terminals 24 (+) and 23 (-). The voltage must be in the range of 17 to 32 VDC for proper operation. Connections to the battery supply must come from connections at the governor control unit (see wiring diagram) or ground loops can result in improper operation. The total current consumption is less than 160 ma. 12 VDC units are available as a special order.
Note: In compliance with industry standards, all battery negatives should be commonly connected.

Various Other Signal Inputs

The LSM200 Series units have a great deal of inputs for signaling each function of the unit. All the inputs have some form of protection built in for misconnection. If the cable attached to these terminals must be shielded, the shield connections are shown in the wiring diagram. GAC expects that most applications will not require additional considerations, since some applications can experience significant differences in field strengths of interfering signals, all cables may require shielding and further precautions. See the CE EMC specifications for more details in PIB4100 literature.

Parallel Cable Function and Its Internal Relay

The load sharing system is based on a concept where each individual load sharing unit communicates with other units through an analog bus signal. The parallel cable interconnection system is the method by which each load sharing unit sends its own signal to an external common node. Any difference in parallel cable voltage sent from one unit to the other causes an unbalanced current to circulate in the cable. The load sharing unit senses the imbalance in both parallel cables and thus cancels common mode signals. However, the battery minus (-) of all generators must be connected together to limit high common mode signals. This indicates an unbalanced load condition. Each load sharing unit takes action to control its governor to minimize this imbalance. The imbalance can be lower than 2% when the system is adjusted properly.

The parallel cable voltage is proportional to the load on the generator. The voltage ranges from 0 - 7.5V DC for a 0 - 5 Amp change in CT current (real power). The internal parallel cable signal, before the sensitivity adjustment, can be measured at the two internal test posts, TP1 (+) and TP2 (–) These posts are located near to the LOAD SENSITIVITY adjustment. See Diagram 1 and 2 for test post locations.

All parallel cables are permanently hard wired together (+ to + and - to -). When a generator is off-line, its parallel cable must be disconnected from the rest of the units. Each LSM200 Series unit has its own internal relay to make this disconnect and reconnection. The parallel cable relay is closed when Terminals 13 and 14 are connected together. A slave relay or contacts on the generator's main circuit breaker normally operate this connection when the generators main contactor is closed. The PARALLEL ENABLE LED will light when this occurs, indicating that the internal parallel cable circuit is connected to the other units (Terminals 10 & 11.)

Analog Power Output Signal, Internal and External Metering Systems

Provided the AC voltage on the sets remains constant, the DC signal at Terminals 32 and 33 is a good indicator of the real power output from the generator. This signal is based on the load sharing power measurement system and is proportional to the real power component (forward and reverse) of the line currents.

The voltage signal that appears at Terminals 32 (+) and 33(–) may be adjusted with the EXTERNAL POWER METER CALIBRATION adjustment, and has a range of approximately -1 to 5V DC. These voltages are proportional to the CT currents. An output of 5V will indicate 5 Amps CT current (forward power) and -1 volt will indicate 1 Amp CT current (reverse power). Terminal 32's maximum current consumption, should be limited to 10 ma.

The Internal Power Meter / Bar graph displays the generator power as detailed above in the external power meter operation. The bar graph can be calibrated for generator power. The display will normally display the zero power output position, or the third dot. After full power has been applied to the generator, adjust the generator POWER DISPLAY CAL for a full-scale reading. Be sure that the adjustment is made by moving CW from the zero position.

Paralleling with Other GAC Load Sharing Modules

The LSM200 Series may be used with other types of GAC load sharing modules, where an external mains auxiliary parallel cable relay already exists. Simply connect Terminals 13 and 14 together permanently, closing the internal parallel cable relay and treat the parallel cable as in the older units with external Series contacts.

Note: The smooth ramping function during paralleling will not be available under these circumstances.

Reverse Power Monitor

Since the LSM200 Series monitors the forward power output of the generator, it also can accurately measure the reverse power portion as well. The reverse power relay will signal if the generator's power has gone negative. If negative power exists above a small level, the generator must be removed from service.

The set point is adjustable between 2% and 20% based on a 5 Amp CT rating at 100% power. An adjustment of "0" is the most sensitive point. The "100" adjustment position is about 20% reverse power, the highest setting.

Note: It is important to note that the reverse power monitor circuit must have a jumper wire or a reverse power reset switch across Terminals 18 and 19.

Latching and non-latching operation of the Reverse Power monitor relay signal can be obtained. All units are factory set to the non-latching configuration. When a reverse power condition above the set point takes place, the reverse power relay will activate. When the reverse power condition reduces or disappears, the monitor automatically resets itself.

If a latching condition of the reverse power monitor is desired, see Pages 9 and 10 for details.

The reverse power monitor also has a time delay adjustment. The time delay is an inverse function where the higher the reverse power the shorter the delay in the monitor's operation. This feature is intended to provide faster response should a major reverse power condition take place. This time delay should be set to the shortest delay (maximum CCW) unless a long delay is required.

CAUTION: Care should be used in setting this adjustment so that an excessive delay does not damage the generator.

A set of isolated 10 Amp Form "C" NO and NC relay contacts are provided at Terminals 25, 26, and 27 to operate the external protection mechanisms that remove the generator from service once a reverse power condition has occurred. An LED on the unit signals the reverse power monitor relay's condition.

Forward Power Monitor

The forward power monitor can signal two levels of power output from the generator. The two trip points are the ON point where power is increasing and exceeds the monitors high limit set point, and the OFF point when the power is falling below the monitors lower load limit set point.

The ON setting adjustment range is from 20-100% power which corresponds to a 0-80 on the adjustment scale.

The OFF adjustment range is from 0-80% power which corresponds to 0-100 on the adjustment scale. If the maximum CT currents are less than 5 Amps, the adjustment range will exceed the power levels described above.

The monitor also includes a DELAY adjustment. In the full CCW position (0) the delay is very short, about 0.4 seconds. In the full CW position (100), the delay is about 30 seconds.

An internal relay with 10 Amp Form C contacts NO and NC is included at Terminals 28, 29, and 30 along with an LED to signal the monitor relay status.

Forward Power Monitor Programmability

The settings are externally programmable with an analog signal. See Page 10 for details.

ILC (Individual Load Control) and Load Ramping

Individual generator control is one of the functions of the LSM200 Series units. Loading and Unloading the generator is easily accomplished by opening and closing a switch at Terminals 16 and 17. Two LEDs (LOAD and UNLOAD) indicate the status for the operator.

Typical operation is as follows. When a group of engines are operating together in a load sharing mode, and one engine needs to be removed from service, the ILC unload switch is closed (Terminals 16 & 17). The selected generator will start to reduce power until it gives up all its load and is held at zero power at which time it can be removed from service by opening its generator circuit breaker. The speed at which the unit reduces its load is controlled by the ILC LOAD / UNLOAD RAMP adjustment. This control adjusts the unloading rate, and thus the smoothness, at which the load transition occurs. The generator can be held at zero power indefinitely. If the ILC switch is opened, the generator will increase its load and smoothly ramp back up to normal power.

Once a generator is removed from service, the ILC switch must be opened so that the system will smoothly parallel and accept load when the generator is put back into service. When reparalleling a generator set (I LC open), the LSM201 will match the existing parallel cable voltage with its own so that a smooth connection is made (zero voltage difference). The load control will then ramp to equal load sharing. See details in Load Sharing Mode (Page 1).

Load Anticipation Function

The LSM200 Series units include a load anticipation function that is used to improve the governor response to loads applied to parallel generators. The basic transient response of the system is improved because the electrical load is measured directly by the LSM. This load actually occurs before the speed changes and thus the response delays are reduced. The internal LOAD ANTICIPATION adjustment allows the operator to adjust the magnitude of the response to the load change that is presented to the governor. A CW adjustment increases the magnitude of the compensation. Transient reductions of 10 - 30% are possible if the capability of the engine is not limiting the system. Optimize this adjustment with repetitive load steps.

Droop Operation

The LSM200 Series units operate as isochronous systems and thus no internal provision has been made for droop operation. If droop operation is required, apply a fixed resistance across the parallel cable. A resistance of 1 Meg ohm will provide a very small amount of droop <1 %. Lower values of resistance (10K) will provide increased levels of droop. If droop is used, the automatic smooth load / unload and ILC functions will not operate.

Output Signals to the Governor

Terminal 12 signals the governor to change generator power (speed change). It has a nominal output of 5.0 VDC with respect to the signal ground point (Terminal 23) unless the unit is calling for a speed change. Refer to the speed control's publication for the appropriate load sharing input terminal (AUX) on the speed control to which Terminal 12 (output) and Terminal 23 (signal ground) should be connected. See the wiring diagram for typical connections.

Signal Ground Connections

The ground or battery minus connection, Terminal 23, is a signal ground connection and is important. This terminal must be connected to the speed control's signal ground terminal. See the speed control's publication for details.

Mains Power Control

The generator power control feature is intended to be used when the generator is supplying power to the infinite main bus (exporting power). See the wiring diagrams. In this mode, a temporary connection is made across the parallel cable at Terminals 10 and 11. After synchronizing and paralleling to the mains, the parallel enable switch (Terminals 13 & 14) must be closed when the main generator circuit breaker is closed.

The GENERATOR POWER CONTROL Adjustment can then be turned CW toward 100. This will cause the generator to start supplying power to the mains. The generator power output is a function of how far the ADJUST control is turned CW and how high the load sensitivity control is adjusted. Once this setting is made, the power output can be reduced to zero with a switch connection between Terminals 15 and 16. The power setting can also be set externally with a simple potentiometer and a switch that applies a voltage to Terminal 15. (See insert on wiring diagrams).

This power control function can be ramped for smooth operation. Adjustment of the RAMP control towards 100 will slow down the load pickup time. The load up and load down times are about the same. For fast response, temporarily connect Terminals 20 & 21.

Power Ramp Defeat - Optional

When in parallel with the mains under power control, if the mains fails the LSM200 Series load sharing module must revert to isochronous load sharing quickly. The connection across the parallel cable (Terminals 10 and 11) must be opened and the mains load sharing reduced to zero quickly (Terminals 15 to 16 connection). Defeating the mains ramp can be accomplished by a connection from Terminal 20 to 21. See wiring diagram insert.

If the generator power control function is not used, adjust the RAMP and ADJUST to their 0 settings.

Diagram 1. Load Sharing Module LSM201

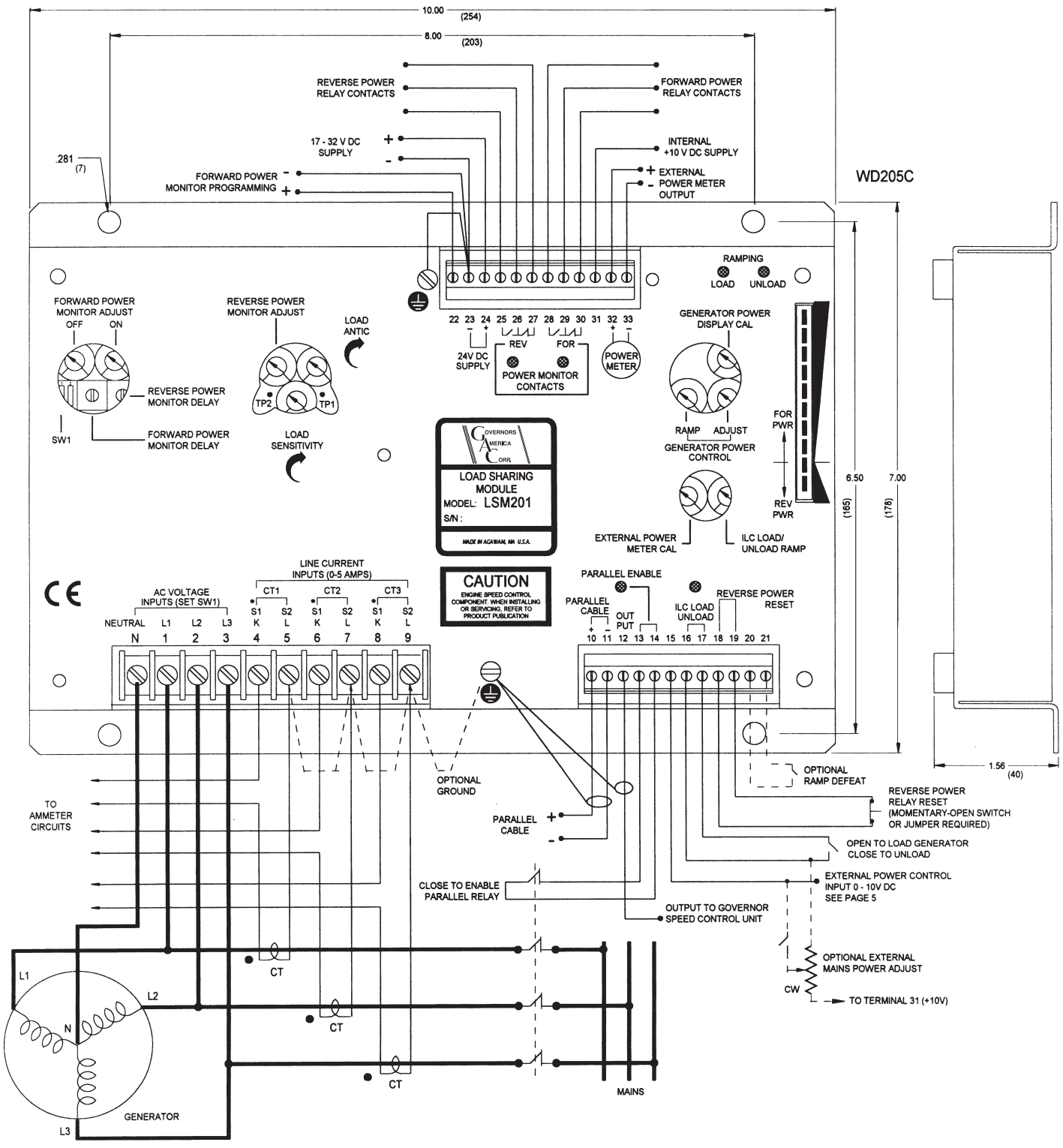
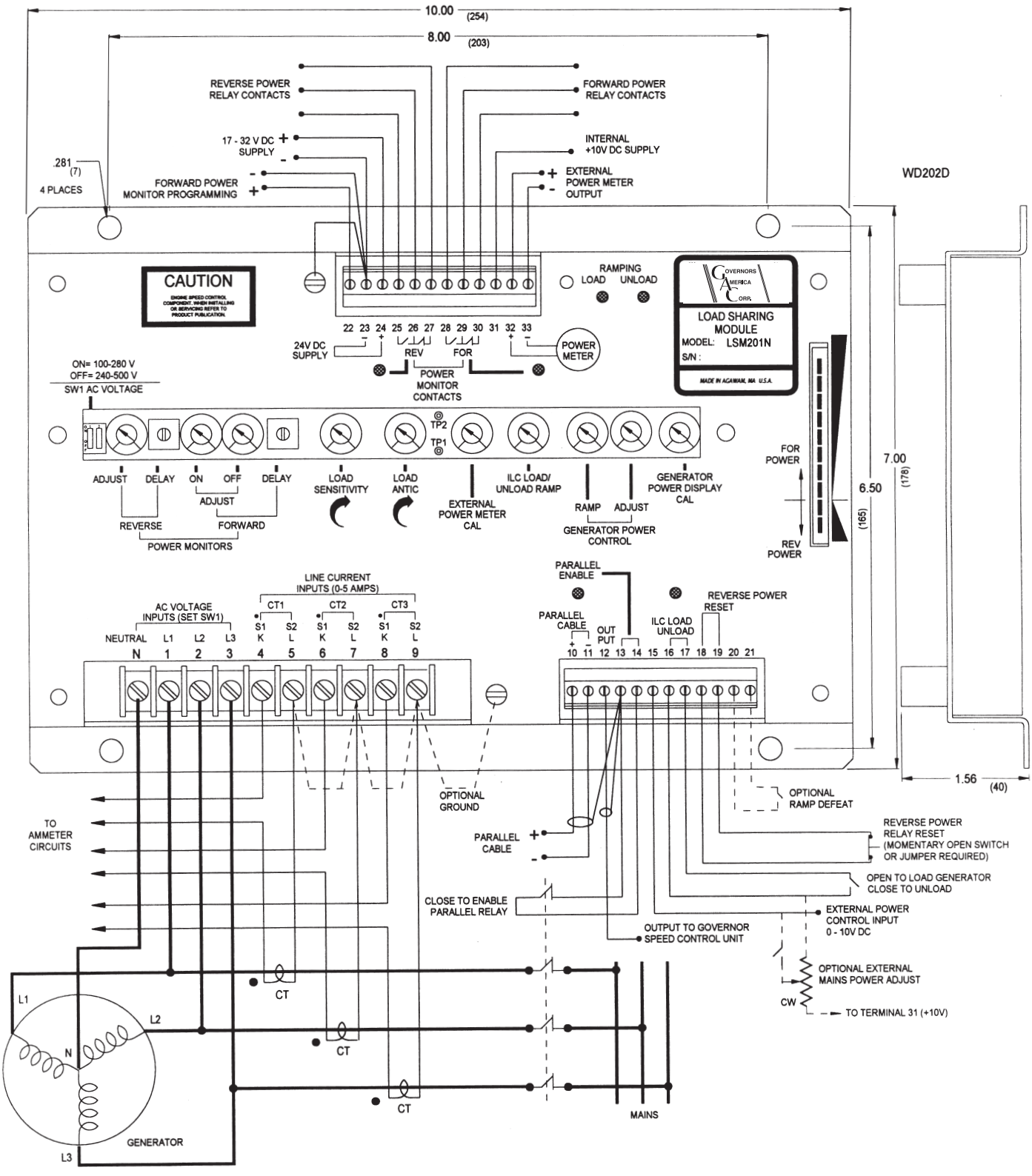


Diagram 2. Load Sharing Module LSM201N



ISOCHRONOUS PARALLELING AND LOAD SHARING OPERATION

Refer to the appropriate wiring Diagram 1 or 2.
Note: The Reverse Power reset jumper or switch must be in place at Terminals 18 & 19 for this monitor to function.

Factory Preset Adjustments

Once the LSM200 Series is connected into the system per the appropriate wiring diagram, the following pre-checks must be made.

ADJUSTMENT	POSITION	SETTING
Reverse Power	10	Appx 5%
Reverse Power Delay	Full CCW	Fastest
Forward Power "On"	80	100%
Forward Power "Off"	100	0%
Forward Power Delay	Full CCW	Fastest
Load Sensitivity	100	Most Sensitive
Load Anticipation	0	0
External Power Meter Cal	100	Max. Range
ILC Load Ramp	20	Appx 4 Sec.
Generator Power Ramp	0	0
Generator Power Adjust	0	0
Generator Power Display Cal	50	5 Amps = Full scale

DO NOT adjust the Internal Bias Reference or the Internal Offset Balance adjustment.

Measure the following voltages at these Terminals in this order with DC power applied to the unit.

Terminal	Voltage Measurement	Value
31(+) to 23 (-)	Internal Power Supply	10.6+/- 0.2 VDC
12 (+) to 23 (-)	Output to Governor	5.0 +/- 0.1 VDC

CAUTION
LETHAL HIGH VOLTAGE is present at Terminals 1, 2 & 3
Do not disconnect the CT wiring (Terminals 4, 5, 6, 7, 8, 9) when the generator is operating.

Apply AC voltages to unit (run engine at no load)

TPI1 (+) to TP2 (-)	Generator Power Signal	0 +/- 0.2 VDC
32 (+) to 33 (-)	Internal Power Meter	0 +/- 0.2 VDC

Current Transformer Phasing

With a DC meter across TP1 (+) and TP2 (-), apply a small amount of load to the generator and note the voltage reading and polarity. With a large gauge jumper wire, short out each CT signal (Terminals 4 to 5, 6 to 7, 8 to 9) one at a time. If the short is of low resistance, a 1/3 drop in voltage at the test points will be measured. If the drop is not near 1/3 or the voltage increases, the CT / AC line voltage phasing is improper and must be corrected in the wiring.

Load Sharing Adjustment

When proper phasing has been confirmed, the generators can then be synchronized and paralleled. With the system paralleled and operating with no load, adjust each governor's speed trim for zero real power as indicated on each generator set's wattmeter. Reactive currents can be trimmed out with the generator set voltage regulators (AVR). With no load still on the engine, adjust the AVR's AC voltage setting so that the AC ammeters read as low as possible. This should ideally be very low or zero AC current.

The system should be stable and no significant power from either generator should be indicated. If the system does not seem stable, adjust each of the LOAD SENSITIVITY controls CCW about 1/3 of a turn or until the system is stable. If the sensitivity is set below 40%, refer to troubleshooting section which is located on Page 11.

Electrical load can now be applied to the system.

All generator sets in the system should be sharing the systems load nearly proportionally. The generator set carrying the least amount of load should be adjusted to accept more of the total system load. Turn the LOAD SENSITIVITY control adjustment CCW on this unit to increase its load contribution.

Load Anticipation Adjustment

The LOAD ANTICIPATION adjustment is factory set to zero sensitivity. To improve the genset's transient response, gradually advance the adjustment CW to about 50% while the generator sets are in parallel. The transient response improvement can be observed when the engine load is changed. An optimum setting requires a speed recorder to minimize the transient in both magnitude and duration. Instability may result if the adjustment is advanced too far CW.

Reverse Power Adjustment

With the reset switch or jumper across Terminals 18 and 19, the reverse power monitor can be calibrated. To obtain reverse power on a generator may be difficult. An alternate method is to simulate reverse power by reversing all the CTs temporarily when the unit is in single unit operation.

CAUTION: Do not disconnect the CTs while the engine is running.

With the CTs still reversed, adjust the monitor's setting from 20 to 100 and the DELAY to fastest (full CCW). Apply a small amount of load representing the trip point of the reverse power monitor, approximately 10%. Turn the REVERSE POWER MONITOR adjustment from 100 slowly toward 0 until the monitor turns on. Remove the generator load. The monitor should turn OFF (reset). Recheck the setting by applying the 10% load again.

The Reverse Power Delay may now be set by turning this adjustment CW. The minimum delay necessary should be used, otherwise leave this setting to full CCW (minimum delay).

Note: The delays are of the inverse time type. See previous description for details.

CAUTION: Care should be used in setting the Reverse Power Delay so excessive delay does not damage the generator or switch gear.

Be sure to reinstate the CT connections to their proper polarity before attempting parallel operation.

A set of 10 amp Form C NO and NC relay contacts are provided at Terminals 25, 26, and 27 to operate the external protection mechanisms that remove the generator from service once a reverse power condition occurs. The reverse power LED on the cover indicates the reverse power monitor relay condition.

If a latching condition for the reverse power monitor is desired, posts E1 and E2 on the circuit board must be connected together. These posts are located on the circuit board just above and to the right of the AC Voltage Selector DIP Switch. (On the LSM201N module, these posts are located on the circuit board just above the AC Voltage Selector DIP Switch.) Solder a jumper wire across these posts without damaging the circuit board. When a reverse power condition occurs, the internal relay will activate and latch. To reset the relay, open the external Reverse Power Relay switch connected between Terminals 18 and 19.

Forward Power Monitor Adjustment

Always set the ON point first with the delay set to minimum delay. The ON setting range is from 20 - 100% power which corresponds to 0 - 80 on the adjustment scale. With the ON adjustment at a setting of 80, adjust the generator load for a desired trip point, i.e. 90% load. Turn the ON adjustment CCW until the monitor turns on with 90% load applied.

The OFF adjustment range is from 0 - 80% and corresponds to 0 - 100 on the adjustment scale. With the OFF adjustment at a setting of 0, adjust the generator load for a desired reset point, i.e. 20% load. Adjust the OFF adjustment CW until the monitor resets to OFF with the load reduced to 20%.

The monitor's DELAY setting may now be adjusted. The Full CCW position offers minimum delay (about 0.4 seconds) and the Full CW position offers a delay of about 30 seconds. These are inverse time delays as in the reverse power circuits.

Programmability

Once these settings have been set for the ON and OFF adjustment, they can be externally programmed with an analog DC signal at Terminal 22. If this terminal is connected to signal ground, it will lower the set point of the monitors approximately 20%. Raising the voltage at Terminal 22 above the nominal 3 Volts will increase the set points to a level higher than the internal settings. Consult factory for details.

An internal 10 Amp relay with Form C contacts NO and NC are included at Terminals 28, 29, and 30 along with an LED to indicate the monitors' relay condition.

Power Meter Operation

The analog power output voltage signal is a good measure of engine power when the AC voltage from the generator is considered to be constant. The external power meter can be any analog or digital meter with a relatively high input impedance (>10K Ohms) that is within the voltage range of the unit. The (+) signal output is at Terminal 32 and the reference is at Terminal 33(-). Terminal 33 is referenced at a voltage of 2.OV DC above battery minus.

The maximum range of voltage is -2 to +5 VDC across these two terminals. The bipolar output allows reverse power as well as forward power to be detected. The EXTERNAL POWER METER CAL adjustment allows this signal to be adjusted for lower levels to match the external instruments. CCW adjustment reduces the voltage range.

The internal bar graph is taken from the same voltage source. The bar graph can be calibrated for generator power output. The third dot is zero power output and the 10th dot is 100% output. After full power has been applied to the generator, adjust the GENERATOR POWER DISPLAY CAL for a full scale reading. Be sure the adjustment is made by turning the adjustment CW from the zero position.

EMI CONSIDERATIONS

The LSM200 Series has been tested and conforms to the requirements for CE regulations (see Declaration of Conformity in PIB4100). In any installation, EMI considerations should be made. Proper installation is mandatory for the equipment. Refer to the declaration and the wiring diagram for proper usage.

TROUBLESHOOTING

Preliminary Voltage Checks

Measure the following voltages and record the readings. Begin to perform these voltage checks, under the following conditions:

No AC power applied to the unit
Terminals 13 to 14 open
Terminals 16 to 17 open
Terminals 18 to 19 closed

TESTING OF THE LOAD SHARING FUNCTION

1.0 Measure the battery power output. 24 VDC at terminals 24(+) and 23(-) [12 VDC for -12 versions]

2.0 Measure the internal 10 VDC supply at terminals 31 (+) to 23(-).10.6 VDC +/-0.2 V

3.0 Measure the output at Terminals 12(+) and 23(-). 5.0 VDC +/-0.1 V

4.0 All LED's except the "Load" should be "OFF"

5.0 Apply the AC Voltage to the phase voltage inputs (N, 1, 2, 3)

6.0 Measure the power meters output Terminals 32(+) to 33(-). 0 VDC +/-0.1 V
Terminals 33(+) to 23(-).2.0 VDC +/-0.2 V

7.0 Measure the test points TP1 (+) and TP2 (-) Parallel Cable Differential Voltage. 0 VDC +/-0. 1 V
Note: If this voltage is greater than 0. 1 VDC then consult the Bias and Offset voltage adjustment procedures at the end.

8.0 Apply full power to the Generator Set (or as high as possible). In isolated mode, measure the Test Points TP1 and TP2 and note the polarity and magnitude of the voltage. For a unity power factor condition, and a CT current level of 5 Amps in all phases the test points should read between 6.0 and 7.0 VDC with TP1 being positive. If not, then check the CT and Voltage phasing as described on page 9.

9.0 With full CT current (generator set in isolated mode) applied, check the parallel cable output voltage at terminals 10(+) and 11 (-). With a meter connected from 10 to 11 short terminals 13 and 14 to close the internal relay. Note the parallel enable LED should light. The voltage output at terminals 10 and 11 should be adjustable via the LOAD SENSITIVITY adjustment from 0 up to the maximum as stated in step 8. Failure to obtain the above readings, look for an open generator neutral connection, missing AC current or AC voltage signal or SWI voltage range switch set improperly.

10.0 To confirm that the Load Sharing portion is controlling the governor, temporarily connect a jumper across terminals 10 to 11 and short terminals 13 to 14. Apply load to the engine. The speed of the engine should fall (droop) as more load is applied to the engine. Remove engine load and the temporary jumpers. Load sharing function is normal.

INSTABILITY OR IRREGULARITY OF LOAD CONTROL

If the load sharing is unstable then follow the steps below:

1.0 Check to see that the battery minus on all generators are connected together.

2.0 Insure the shielded cables are connected at one end, at load sharing module as shown in the proper wiring diagram.

3.0 Check to see that the case ground and the battery minus are at the same potential. See EMC/CE information in this publication.

4.0 Reduce ALL load sharing sensitivity controls until the system is stable. Do not go below 25 on the sensitivity adjustment or load sharing will be poor.

5.0 If still unstable, reduce the Gain in the speed control unit slightly

6.0 Check the stability of the Automatic Voltage Regulator, including the reactive current compensation.

7.0 Cut the internal jumper across post E5 to E6. (Lower Load Sharing Loop Gain).

8.0 Connect a 22 mfd, 10 VDC capacitor from terminals 12(+) to 13(-). (Slows Load Sharing Function).

INDIVIDUAL LOAD CONTROL (ILC)

If the ILC does not unload to zero power.

1.0 With ILC in unload position, measure the voltage at the test points TP1 to TP2 to determine if the LSM is sensing zero power internally This voltage should fall to about 0.2 VDC.

2.0 Condition which can prevent unloading to zero power is the AVR (Automatic Voltage Regulator) droop/cross current compensation does not track and allow the sets to have different power levels (load on the generator set is highly reactive).

3.0 Improper speed setting of the governor on one or more governors.

4.0 Adjust the ILC ramp time to a longer time.

INTERNAL BIAS REFERENCE AND OFFSET BALANCE ADJUSTMENTS

These two adjustments are factory set and normally never require readjustment. To check the settings follow the procedure below. The internal bias reference adjustment sets the 5 VDC reference for the parallel cable. In order to set this voltage apply DC and AC voltages to the LSM200 Series unit. DO NOT apply any CT currents (Generator Load). Close the parallel cable relay (Terminals 13 to 14). Measure the voltage from terminal 10 to terminal 13 and adjust the Reference (located just above the "Power Display Cal") for 5.00 VDC. With the load sensitivity set to 100, measure the parallel cable voltage from terminals 10 to 11 and adjust the offset Balance adjustment to 0.00 VDC.

LOCATION OF	**LSM201**	**LSM201N**
Internal Bias Adjustment	Above Generator Power Control-Ramp Adjustment	Above Generator Power Display Cal Adjustment
Offset Balance Adjustment	Above & left of Load Antic (load anticipation) Adjustment	Above Load Antic (load anticipation) Adjustment

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