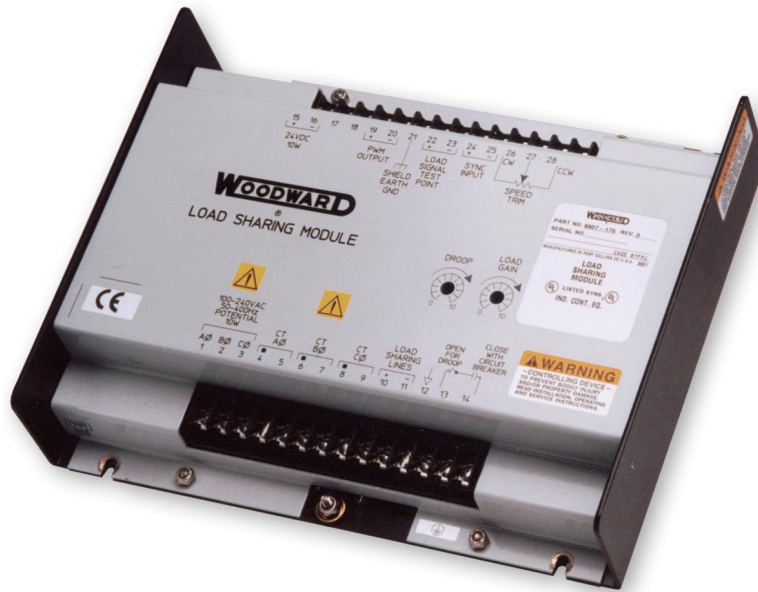


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**Product Manual 02035
(Revision E, 04/2024)
Original Instructions**



Load Sharing Module

**0.5–4.5 Vdc Output
9907-252**

Installation and Operation Manual

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Load Sharing Module

Chapter 1. General Information

Introduction

The Woodward Load Sharing Module is made for use with engines equipped with speed controls that accept a 0–5 Vdc speed setting. The Load Sharing Module allows use of Woodward power generation accessories and allows load sharing between engines equipped with speed controls that are not manufactured by Woodward and engines controlled with Woodward electronic controls, or controls using other Woodward load sharing modules.

Description

The Load Sharing Module provides isochronous and droop load-sharing capability for engines in generator set applications. Additional equipment in the control system can include the Woodward SPM-A Synchronizer, Import/Export Control, Automatic Generator Loading Control, and Automatic Power Transfer and Loading Control.

Figure 1-1 shows a typical system using a Load Sharing Module.

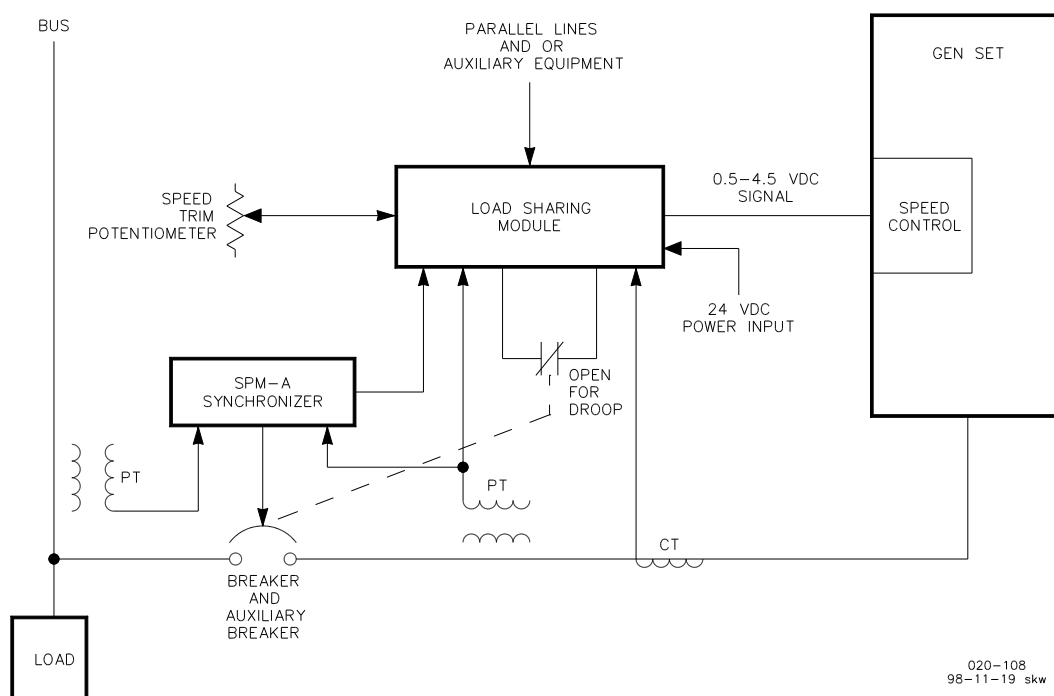


Figure 1-1. Typical System Using a Load Sharing Module

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Load Sharing Module

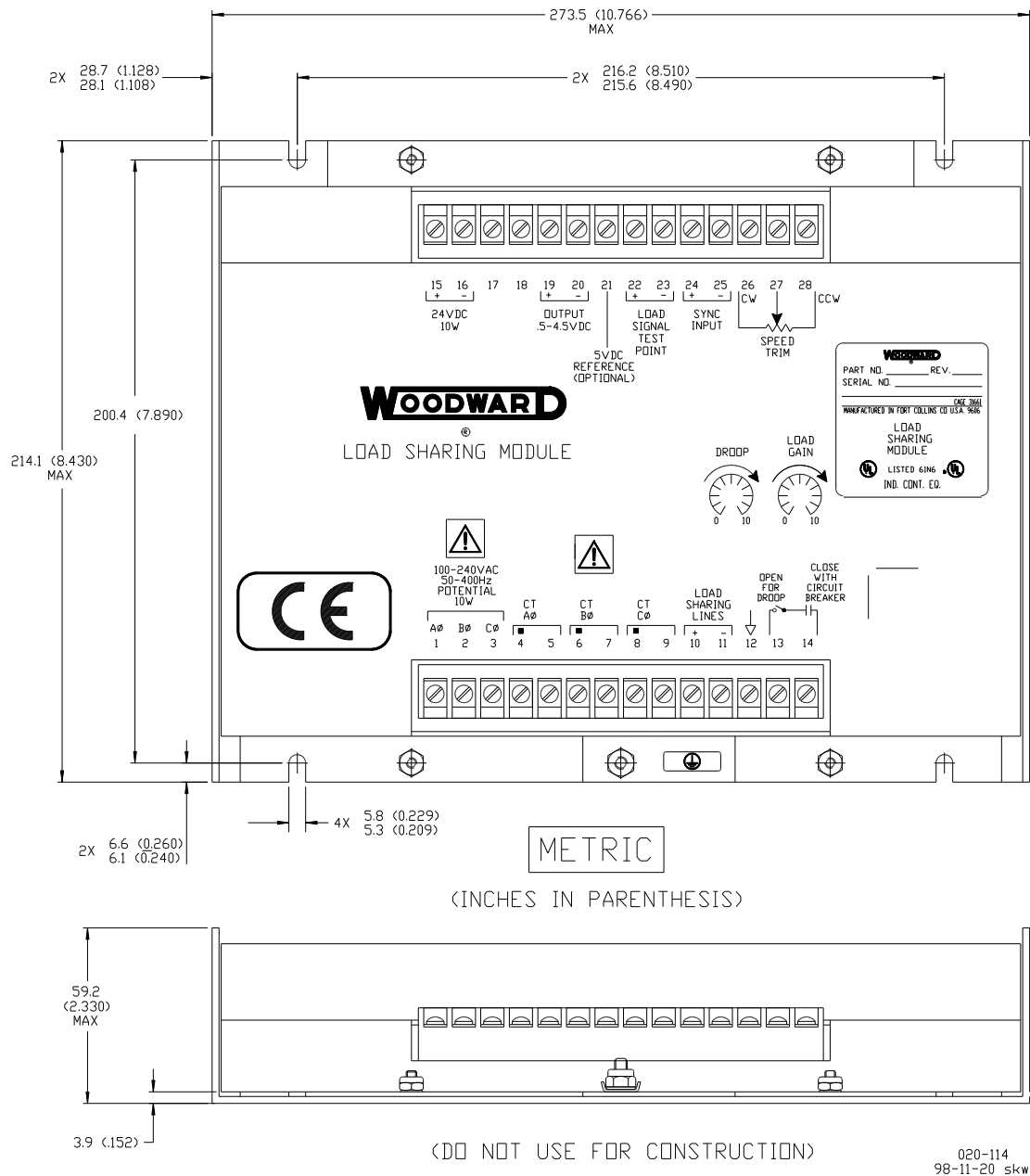


Figure 1-2. Outline Drawing of Load Sharing Module

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Load Sharing Module

Chapter 2. Installation

Introduction

This section contains general installation instructions for the Load Sharing Module. Environmental precautions and location considerations are included to determine the best location for the Load Sharing Module. Additional information includes unpacking instructions, electrical connections, and an installation check-out procedure.

Unpacking

Before handling the Load Sharing Module, read page ii, Electrostatic Discharge Awareness. Be careful when unpacking the Load Sharing Module. Check the unit for signs of damage such as bent or dented panels, scratches, and loose or broken parts. Notify the shipper of any damage.

Location Considerations

Consider these requirements when selecting the mounting location:

- Adequate ventilation for cooling
- Space for servicing and repair
- Protection from direct exposure to water or to a condensation-prone environment
- Protection from high-voltage or high-current devices, or devices which produce electromagnetic interference
- Protection from excessive vibration
- An ambient operating temperature range of -40 to $+70$ °C (-40 to $+158$ °F)

Do not mount the Load Sharing Module on the engine.

Figure 1-2 is an outline drawing of the Load Sharing Module. Install the unit as close as practical to the electronic engine control, but *not* on the engine itself. It may be installed in any position.

To maintain compliance with CE and UKCA marking requirements, the European Union Low Voltage Directive requires that the Load Sharing Module (LSM) be mounted in an IP43 enclosure as defined in EN60529. Access to the Load Sharing Module must be restricted to qualified personnel.

General Wiring Requirements



The circled ground symbol identifies the Protective Earth Terminal. This terminal must be connected directly to protective earth using a grounding conductor at least as large as those used on terminals 1 through 9. The insulation of the grounding conductor must be of green and yellow color.



This symbol identifies functional or EMC earth. This terminal is to be used for cable shield connections only. It is not to be used as a protective earth terminal.

External wiring connections and shielding requirements for a typical installation are shown in the plant wiring diagram, Figure 1-4. These wiring connections and shielding requirements are explained in more detail in this chapter.

To maintain compliance with CE and UKCA marking requirements, the Low Voltage Directive requires that the Load Sharing Module must only be connected to Class III equipment.

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Load Sharing Module

Chapter 4. Theory of Operation

Introduction

This chapter describes the operation of the Load Sharing Module and its internal circuits. Figure 1-3 is a block diagram of the circuits in the module.

The Load Sharing Module senses the power output of a generator and provides a 0.5–4.5 Vdc signal to the speed control to adjust the power output of the engine-generator set to match the reference power level. The Load Sharing Module can also produce a droop condition (instead of isochronous load-sharing), making it possible to connect the generator set in parallel with either a generator set which is running isochronously, or with an infinite bus.

Power Supply

The internal power supply generates a regulated dc voltage for the operation of the circuits in the Load Sharing Module. The power supply gets its power from the engine 24 Vdc power source. To prevent damage to the unit that uses an alternator or battery charging device, make sure the charging device is turned off before disconnecting or connecting the 24 Vdc supply to the unit.

Power Sensor

Generator load is measured by the power-sensor circuit of the Load Sharing Module. The power-sensor circuit senses current amplitude and produces a load signal proportional to the current amplitude times the power factor. The potential input comes from potential transformers (PTs) and the current input comes from the current transformers (CTs). The circuit uses these two inputs to generate a load signal which is then filtered and sent to the controller circuit. The load signal voltage of each generator set will be proportional to the percentage of rated load on the generator set.

Ammeters and voltmeters may be driven with the same PT and CT wires.

Load Comparator Circuit

In the load comparator circuit, the load signal voltage is balanced with the other generator sets in the system via the load sharing lines. The comparator circuit of each Load Sharing Module includes a load gain potentiometer to adjust each generator set's load signal so that the load signal voltage of each is the same at full load. This compensates for varying CT ratios or different generator set sizes. The load sharing voltage will be one-half the measured voltage of the load signal test point.

Speed Trim Circuit

A speed-trim potentiometer can be added to the Load Sharing Module to permit remote adjustment of the load or frequency of the generator. The speed trim is normally used for manual synchronization of a generator set with an existing bus or to change the load demand when in droop mode.

Isochronous Load Sharing

Each comparator circuit compares the load signal voltage for its generator set to two times the voltage on the load sharing lines and produces an error voltage proportional to the difference. This error voltage is used to generate a pulse width modulated signal which is output to the speed control. This output biases the speed loop of the speed control until the load signal voltage is equal to that of other generators on the load sharing lines.

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Load Sharing Module

Appendix. LSM Control Specifications

POWER SUPPLY	18–32 Vdc, approximately 5 W. Protected against undervoltage, overvoltage to +80 Vdc, reverse voltage to –32 Vdc.
INPUTS	
3-phase PT Inputs	100–240 Vac line-to-line, 50–400 Hz. PT input burden is 1.6 W per phase at 240 Vac, 0.4 W per phase at 120 Vac.
3-phase CT Inputs	3–7 Arms at full load, CT input burden at full load is 0.1 VA per phase.
Load Sharing Input	0–3 Vdc into 25 k Ω impedance in isochronous mode, open circuit in droop mode.
Sync Input	Compatible with optional Woodward SPM-A Synchronizer, 0.75% speed change* per volt input.
Speed Trim	$\pm 7.5\%$ speed change* with an external 10 k Ω potentiometer.
Droop Switch	The external droop switch is to be wired in series with the auxiliary circuit breaker contact between terminals 13 and 14. Droop mode is selected when either the droop switch or the auxiliary circuit breaker is open.
5 Vdc Reference	Optional external reference used to set output offset and clamp voltages. 10 k Ω input impedance.
OUTPUTS	
Load Signal	DC signal proportional to total real current measured by the Load Sharing Module. Load Gain adjustable over minimum range of 0.86 to 2.0 Vdc/Arms.
Analog Output	DC output, internally limited to +0.5 Vdc min, +4.5 Vdc max. Zero error output = $+2.50 \pm 0.05$ Vdc. 2 k Ω output impedance.
ADJUSTMENTS	
Droop	Provides 0 to 11% speed reduction* between no load and full load conditions.
Load Gain	Provides adjustment of the load on an individual generator when two or more generators are paralleled. Adjusts specified full load condition from 3 to 7 Arms.
ENVIRONMENTAL	
Operating Temperature	–40 to +70 °C (–40 to +158 °F).
Salt Fog	Tested at 5% NaCl, 35 °C, 48 hrs wet, 48 hrs dry.
Humidity	Tested at 95% RH, 65 °C, non-condensing, 5 cycles at 24 hr/cycle.
Vibration	Swept sine: 4 G, 5 mm, 5–2000 Hz, 3 hr min/axis, including four 30-minute dwells at resonant frequencies.
Shock	40 G, 11 ms sawtooth pulse.
Installation / Overvoltage Category	Category III.
Air Quality	Pollution Degree 2.
DIMENSIONS	
Linear (maximum)	Length: 273.6 mm (10.77 in) Width: 214.1 mm (8.43 in) Height: 59.2 mm (2.33 in)
Weight	1397 g (49.3 oz) approximate.

(*) When used with a speed control having a gain of 5% speed change/volt



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