

**Adjustment of SPM-A Synchronizer to
Lean-burn, Spark-ignited Gas Engines**



General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.



Revisions

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.



Translated Publications

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Warnings and Notices

Important Definitions



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

WARNING

**Overspeed /
Overtemperature /
Overpressure**

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

WARNING

**Personal Protective
Equipment**

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- Eye Protection
- Hearing Protection
- Hard Hat
- Gloves
- Safety Boots
- Respirator

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

WARNING

**Automotive
Applications**

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE**Battery Charging
Device**

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE**Electrostatic
Precautions**

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).
- Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.
- Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual **82715**, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
 - Do not touch any part of the PCB except the edges.
 - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
 - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Decreasing Match-Up Window Size (Time) to Shorten Automatic Synchronization Delay on Unstable, Lean-Burn, Spark-Ignited Gas Engines

It sometimes takes an excessive amount of time for an SPM-A automatic synchronizer to parallel two lean-burn gas engines together or to parallel the local bus to the utility bus.

Synchronizing times can be significantly shortened by reducing the dwell time (match-up time) setting controlled by a dip switch on the printed-circuit board inside the synchronizer case.

Dwell time is set for 1/2 second at the factory. This means that the phase angle must remain in the control's synchronizing window for 1/2 second before a synchronize order will be issued by the SPM-A.

This time can be reduced to 1/4 or 1/8 of a second to allow the synchronizer to become more easily satisfied if the engine-generator phase is moving into and out of the phase-matching window due to engine misfiring and rough idle.

The change in phase window length is made necessary by the inherent engine instability on *some* lean-burn gas engines. The phase window should be set for the maximum amount of time possible to minimize transient current when the breaker closes.



WARNING

Reducing the dwell time may cause higher transient currents when the breaker closes. This could damage the generator, the breakers, or cause personal injury.

Another method of improving synchronization on engine/governor systems that are very sensitive at high idle is to reduce the SPM-A gain. This is normally accomplished by turning the gain adjust potentiometer on the SPM-A counterclockwise. In some cases of poor system dynamics on lean-burn gas engines, the gain may still be too high, even with the gain potentiometer full ccw.

In these cases we recommend additional gain reduction by adding a series resistance between terminal 22 on the SPM-A and the \pm connection on the 2301A Load Sharing and Speed Control or Generator Load Sensor.

Dwell Time Adjustment Procedure

The dwell time, often referred to as match-up time, is factory set at 1/2 second. To set the dwell time for one of the other settings (1/8, 1/4 or 1 second) perform the following procedure:

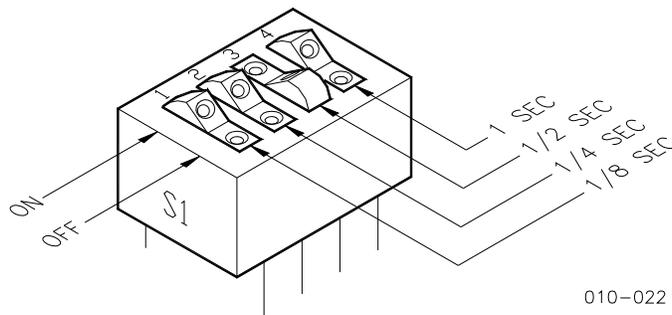
1. Turn off the power and all voltage inputs to the synchronizer.
2. Remove the four elastic hex nuts securing the synchronizer cover. Remove the cover.

NOTICE

To prevent damage to the components of the synchronizer, do not touch any part of the circuit board unless adequately grounded against static discharge. Follow instructions provided in Woodward manuals 82715 and 82384.

IMPORTANT

To minimize circuit breaker stress it is best to use the longest possible dwell time that still gives acceptable synchronizing times. Try Synchronizing at the 1/2 second dwell time before trying the 1/4 second or 1/8 second settings.



010-022

Dwell-Time Setting Switches

3. Set the dwell time using the four-position gang switch located in the upper left corner of the circuit board. The settings are as follows:

Dwell Time Seconds	Switch 1	Switch 2	Switch 3	Switch 4
One-eighth Seconds (1/8)	ON	Off	Off	Off
One-quarter Seconds (1/4)	Off	ON	Off	Off
One-half Second (1/2)	Off	Off	ON	Off
One Second (1)	Off	Off	Off	ON

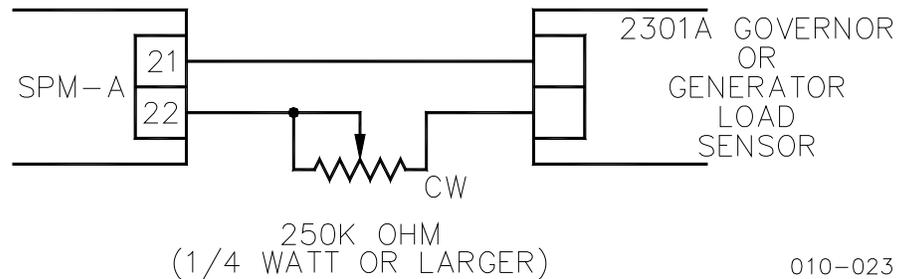
4. Replace the cover and secure with the four elastic hex nuts.

Synchronizer Gain Reduction Procedure

If the governor response to the synchronizer output signal is too sensitive, even with the SPM-A gain adjustment potentiometer fully ccw, and if the actuator-to-carburetor linkage is optimized and non-linear (see manual 25014 and the appropriate governor manual), it may be necessary to reduce the electrical signal between the SPM-A and the governor or load sensor. This will, in effect, add additional gain adjustment to the SPM-A.

To add gain adjustment:

1. Turn off the power and all voltage inputs to the synchronizer, or turn the synchronizer mode switch (terminals 10–13) to the OFF position.
2. Temporarily wire in a 250 k Ω , at least 1/4 W potentiometer as shown.



010-023

Using a Potentiometer to Reduce Gain in an SPM-A

3. Turn the SPM-A gain potentiometer back to the mid position, turn the externally wired potentiometer full cw, and turn the stability adjustment to mid position.
4. Turn the synchronizer switch to the check position (terminal 11 closed to terminal 13) and start the engine.
5. Adjust the externally added potentiometer slowly ccw until gain is reduced to an acceptable level and the synchronizer begins to hold the synchroscope within the phase window at 12 o'clock. Switch from CHECK to OFF to CHECK several times and fine tune the SPM-A gain and stability adjustments of optimal synchronizing with minimal overshoot.
6. Shut down the engine. If desired, the external potentiometer can be carefully removed, resistance measured, and replaced with an appropriate fixed resistor of the nearest value. It may be necessary, after replacement, to again fine tune the synchronizer's Gain and Stability as in step 5.

Unloaded steady-state dynamics of some lean-burn gas engines are so poor that the best the synchronizer can do is close the breaker as the synchroscope passes through the acceptable phase window. In these cases, all sections of the fuel system should be looked at and optimized for maximum steady-state performance.

Parts of the fuel system which can Affect stability include, but are not limited to:

- Actuator to carburetor linkage
- Carburetor adjustments
- Carburetor selection
- Carburetor bearings
- Air/Fuel ratio control
- Gas supply and differential pressures
- Actuator selection
- Spark plugs
- Ignition system
- Ignition timing
- Waste gate settings
- Governor settings
- Fuel Quality

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Please reference publication **01301**.



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