

INSTALLATION GUIDE

for the Siemens Solar Industries

M55 / M75 / M65 / M20

M45 / M40 / M35

Solar Electric Modules

PLEASE READ THIS GUIDE COMPLETELY BEFORE INSTALLING OR USING THE MODULES

INTRODUCTION

This Guide contains application information, and safety information with which you should be familiar before using your Siemens Solar Industries photovoltaic (solar electric) modules. Your Siemens Solar Industries distributor or dealer can provide additional sizing and system design information, if necessary.

The information in this Guide is based on Siemens Solar's knowledge and experience and is believed to be reliable; but such information and suggestions do not constitute a warranty, expressed or implied. Siemens Solar Industries reserves the right to make changes to the product, specifications, or to the Guide without prior notice.

CAUTION: *Photovoltaic modules produce electricity when sunlight or other light sources illuminate the front face. The voltage from a single module is not considered a shock hazard, but if modules are connected in series to increase voltage, the shock hazard increases.*

General Information

These Siemens Solar Industries modules utilize high efficiency, single crystal silicon cells which are laminated to tempered glass with EVA. The cells are antireflective coated for improved efficiency. The laminated package is supported by a metal frame. The wiring method provided for each module does not require the use of special cable assemblies. All the modules are equipped with junction covers into which interconnect wiring is installed, except the M20, which is equipped for interconnection with a two-conductor cable.

Disclaimer of Liability

Since the use of this Guide and the conditions or methods of installation, operation, use and maintenance of the module are beyond Siemens Solar Industries' control, Siemens Solar does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance. No responsibility is assumed by

Siemens Solar Industries for any infringement of patents or other rights of third parties which may result from use of the module. No license is granted by implication or otherwise under any patent or patent rights.

APPLICATION

M55, M45, M75 and M40

The M55 and M45 have 36 cells in series and are well suited for all solar electric applications, including battery charging in hot climates, direct connection to a DC motor, and operation with a peak power tracking controller.

The M75 and M40, with 33 cells in series, are designed as battery charging solar electric modules for all but the hottest climates where the extra voltage of the M55 or M45 may be needed. The M75 and M40 may also be used for direct connection in selected DC motor applications. A regulator is needed when the M55, M45, M75 or M40 are used to charge a battery.

M20, M65 and M35

These self-regulating modules are designed for direct battery connection. They are intended to meet the needs of those who require electrical power for many applications, particularly lighting, appliances, and other equipment in remote homes, or on recreational vehicles and boats. While the M20 is intended for 12 volt systems only, the M65 and M35 are rated for use in high voltage systems.

Each of these modules has 30 cells in series. They are self-regulating when used to charge batteries of the proper capacity because their electrical characteristics are an excellent match to the charging requirements of a lead acid battery. For more information, see the section titled 'Self Regulation.'

Power

The current output for these modules as shown in the *Specifications* are for industry standard conditions. These conditions may not be frequently observed in actual practice. A more common condition, for example, is an irradiance of 800 W/M² and 42°C cell temperature.

Under these conditions, a clean module charging a battery can be expected to produce current as follows:

M55 - 2.6 Amp
M45 - 2.4 Amp
M75 - 2.5 Amp
M40 - 2.1 Amp
M65 - 2.3 Amp
M35 - 2.0 Amp
M20 - 1.1 Amp

It should be emphasized that the performance of these or any other solar electric module is dependent on local conditions, and even approximate performance estimation requires measurement of solar irradiance and module operating temperature.

WARNING

General Module Safety

All instructions should be read and understood before attempting to install, wire, operate, and maintain the photovoltaic module. Retain this instruction booklet for future reference. The word "module" as used in this booklet refers to one or more photovoltaic modules.

Avoid electrical hazards when installing, wiring, operating, and maintaining the module.

- ▶ A photovoltaic module generates DC electricity when exposed to sunlight or other light sources.
- ▶ Cover module face completely with opaque material to halt production of electricity when installing or working with module or wiring.
- ▶ When modules are connected in series, voltages are additive. When they are connected in parallel, amperages are additive. Consequently, a system assembled from photovoltaic modules can produce high voltages and amperages which constitute an increased hazard.
- ▶ Do not touch terminals while module is exposed to light. Provide suitable guards to prevent contact with 30 VDC or greater. As an added precaution, use properly insulated tools only.
- ▶ Contact with electrically active parts of the module such as terminals can result in burns, sparks, and lethal shock whether the module is connected or disconnected.

Follow Permit, Installation, and Inspection Requirements

- ▶ Before installing module, contact appropriate authorities to determine permit, installation, and inspection requirements which should be followed. This should be done not only for installations in conjunction with buildings, but also for marine and motor vehicle applications, for which additional requirements may apply.

- ▶ Ground module frames for all systems of any voltage.
- ▶ If not otherwise specified, it is recommended that requirements of U.S. National Electrical Code be followed.
- ▶ For roof mounted modules, special designs may be required to help provide proper installation. Both roof design and module installation design have an effect on the fire resistance of the building. Improper installation may contribute to hazards in the event of fire.

Installation and Operation

- ▶ Module installation and operation should be performed by qualified personnel only. Children should not be allowed near the solar electric installation.
- ▶ Use module for its intended use only. Follow all module manufacturer's instructions. Do not disassemble the module, or remove any part installed by the manufacturer.
- ▶ Do not drop module or allow objects to fall on module. Do not stand or step on module.
- ▶ Do not wear jewelry when working with photovoltaic module.
- ▶ Do not concentrate sunlight on module.
- ▶ **If batteries are used with a module, follow all safety precautions of battery manufacturer.** Some batteries can release flammable hydrogen gas. Do not produce sparks when working in locations where flammable gases or vapors exist. Do not overcharge battery. Do not expose batteries to heat sources such as open flames, lighted matches, and cigarettes. Shield skin and eyes (with goggles) from battery acid. Flush thoroughly with water if eyes, skin or clothing come in contact with acid. Place battery in well ventilated area and on racks or floors that do not react with acid.
- ▶ Since sparks may be produced, do not install module where flammable gases or vapors are present.

SPECIFICATIONS

	MODEL M55	MODEL M45	MODEL M75	MODEL M40	MODEL M65	MODEL M35	MODEL M20
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ELECTRICAL CHARACTERISTICS:

Max. Power, Watts	53 Wp	48 Wp	48 Wp	40 Wp	43 Wp	37 Wp	20 Wp
Open Circuit Voltage (Voc)	21.7	21.6	19.8	19.5	18.0	18.0	18.0
Short Circuit Current (Isc)	3.35	3.2	3.35	3.0	3.32	3.0	1.60
Voltage at Load	17.4	17.3	15.9	15.7	14.6	14.5	14.5
Amperage at Load	3.05	2.78	3.02	2.55	2.95	2.56	1.38

NOTES: 1. Rated electrical characteristics are within 10% of measured values at Standard Test Conditions of: 1000 W/m², 25°C cell temperature and solar spectral irradiance per ASTM E 892.

2. Under normal conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on UL Listed modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes, and size of controls connected to the module output. Refer to Section 690-8 of the National Electric Code for an additional multiplying factor of 1.25 which may be applicable.

PHYSICAL CHARACTERISTICS:

No. Cells in Series	36	36	33	33	30	30	30
Cell Size	.....		4.05" (102.9 mm) Sq.		.....		1/2 of 4.05" cell
Module	- Length:	50.9" (1293 mm)	48" (1219 mm)		42.6" (1083 mm)		22.4" (569 mm)
	- Width:	.....		13" (330 mm) .....		.....
	- Depth:	.....		1.4" (36 mm) .....		.....
Weight	12.6 lb (5.7 kg)	11.6 lb (5.2 kg)		10.5 lb (4.8 kg)		5.6 lb (2.5 kg)	
Mounting Holes:	Across Length of Module	49.8" (1265 mm)	46.9" (1191 mm)		41.5" (1054 mm)		21.3" (541 mm)
	Inner Set	.....		25.3" (643 mm)		None	
Across the Width of Module	.....		11.3" (287 mm) .....		.....		.....
Diameter	.....		0.26" (6.6 mm) .....		.....		.....
Wiring Provisions	.....		2 Junction Covers .....		.....		18 AWG, 2-conductor cable attached
Maximum System Open Circuit Voltage	.....		600V .....		.....		20V
Factory Installed Bypass Diodes	Yes	Yes	Yes	Yes	Yes	Yes	No

and does not cover marine or vehicle applications, where additional requirements may apply.

4. Observe the requirements described by Note 2 under Electrical Specifications, page 3.

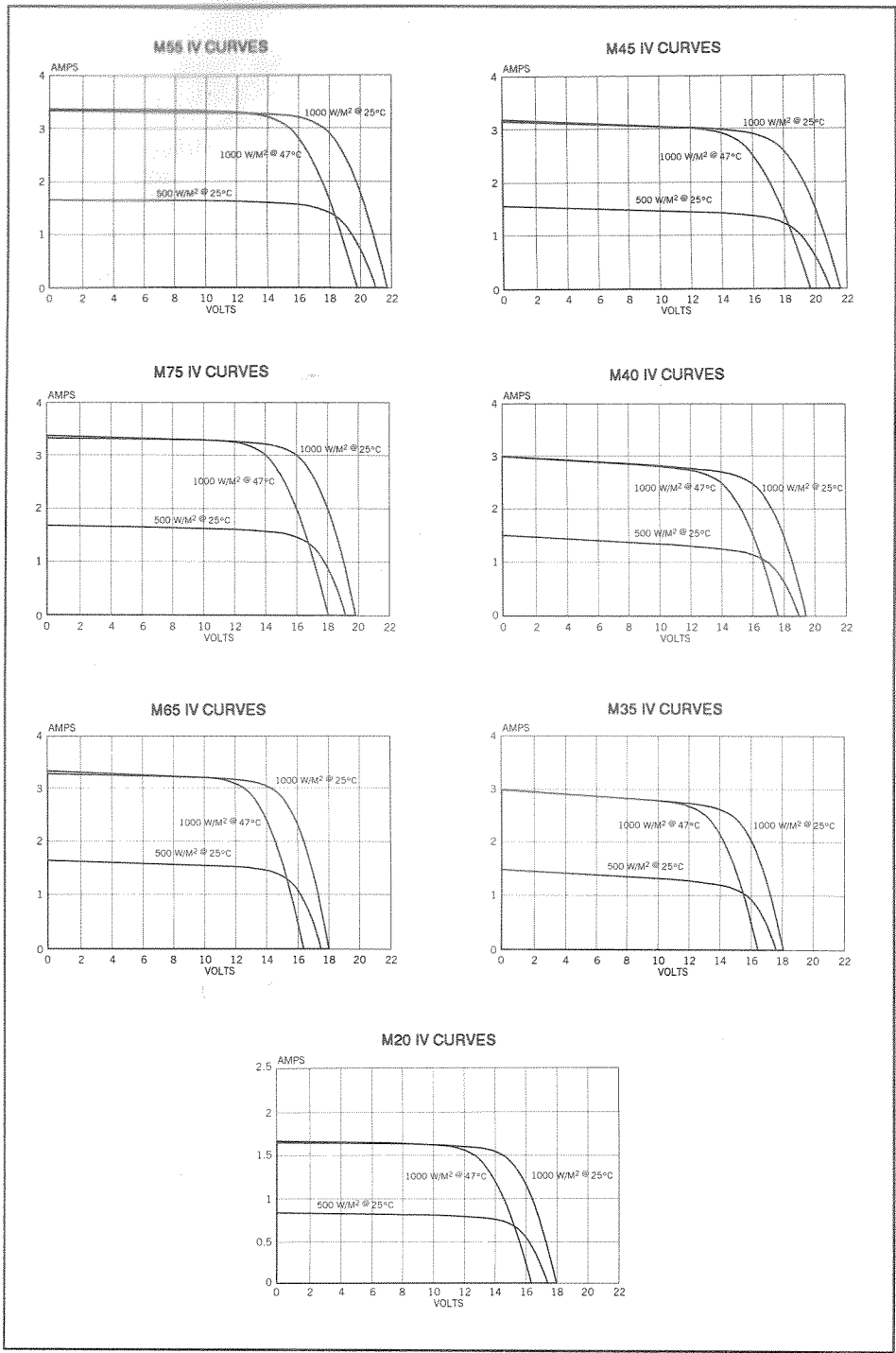
INSTALLATION

Siemens Solar Industries modules are shipped in boxes specially designed to protect them during transit. It is recommended that they remain packed in these boxes until time of installation.

CAUTION: Never leave a module unsupported or unsecured. If a module should fall, the glass can break. A module with broken glass cannot be repaired and must not be used.

Module should be firmly fixed in place in a manner suitable to withstand all expected loads, including wind and snow loads. Modules should be mounted with the orientation and tilt angle required for optimum yearly performance as determined by the sizing analysis. The location should be selected to prevent even partial shading from 9:00 a.m. to 3:00 p.m. (Solar time) on the shortest day of the year.

Designs that concentrate sunlight can produce uneven illumination across the face of the module, an effect which is similar to shading. Thus, concentrating sunlight on these modules is not recommended.



Underwriters Laboratory Listing Information

Note: The M20 module is not UL Listed.

To satisfy the conditions of the UL Listing when these modules are installed in a system, be sure to:

1. Use the strain relief clips as discussed under wiring (Reference Figure 5).
2. Use only stranded or solid copper single conductor type UF cable, rated sunlight resistant, for module and array interconnection wiring, which is exposed to weather.
3. Mount members using the standoff or rack methods when installing on a building. The module Listing does not cover modules mounted integral with the roof or wall of the building,

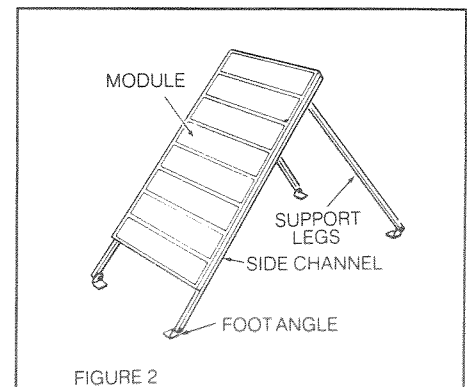


FIGURE 2

The frame of each module has eight 1/4" diameter mounting holes; except for the M20, which has four mounting holes. These are used to secure the modules to Siemens Solar Standard Support Structures, or other equivalent supporting hardware. A typical ground mount structure is shown in Figure 2.

When mounted at the corner holes, these modules will withstand static loads of over 50 PSF. When heavy ice or snow loads are expected, mount the modules using the closer spaced holes. When so mounted, the modules will withstand loads of 125 PSF (static). Note: PSF=Pounds Per Sq.Ft.

NOTE: Clearance between the module frame and the mounting surface may be required to prevent the junction cover from touching the surface, and is recommended to allow cooling air to circulate around the back of the module.

If modules are to be mounted to the roof or wall of a building, the following methods are recommended.

► **Standoff:** Use of a mounting method whereby the modules are supported parallel to the building surface is required only to prevent wiring damage, or to provide for cooling air circulation around the back of the module.

CAUTION

For modules with factory installed bypass diodes, including M55, M45, M35, M75 and M40:

If these modules are incorrectly connected to a battery, the bypass diodes and junction covers may be damaged. Observe correct polarity:

- Positive wire from module to battery positive terminal.
- Negative wire from module to battery negative terminal

► **Rack:** Use of a supporting frame to mount modules at correct tilt angles.

These modules are not specifically designed for integral mounting with the roof structure. Both building and module installation design have an effect on the fire resistance of the building. Improper installation may contribute to hazards in the event of fire.

WIRING

General

All wiring should be done in accordance with applicable codes. Wiring should be protected to help ensure personnel safety and to prevent its damage. Wiring connections should be mechanically and electrically sound.

Module Wiring (except M20)

There are two weather protected terminal covers on each module, one for positive terminations and one for negative terminations. Access to the terminal cover is obtained by using a screwdriver to disengage a sliding latch as indicated in Figure 3. The screwdriver is moved sideways to do this. Do not twist the screwdriver.

Shipped with each module are the frame ground screw and washer, and strain relief clips. These parts must be used for a proper installation.

Each terminal has provision for attaching two wires, which can range from 8 to 14 AWG in size. Use of wire lugs is not required or recommended.

To install wires, first strip insulation back 5/8" (16 mm). For 8 AWG type UF wire, it may be necessary to strip wire back 3/4" (19 mm). Do not lubricate wire. Insert stripped wire through foam seal and under terminal screw slider. Tighten screw securely using a screwdriver of the proper size (Figure 4).

Both large and small sizes of strain relief clips are provided. For all sizes of wire, press a large strain relief clip in place as shown in Figure 5. Use a screwdriver to seat the clips. When they are installed, verify that the wire insulation has been slightly deformed by the clip.

Upon completion of wiring, the terminal cover is set in place and secured with the sliding latch. The special design of the cover eliminates the need for a gasket.

All modules connected in series should be of the same model number. However, modules of different model numbers may be connected in parallel.

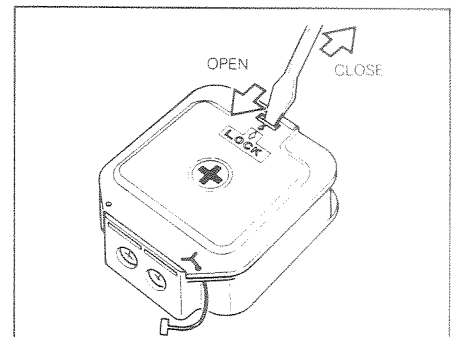


FIGURE 3

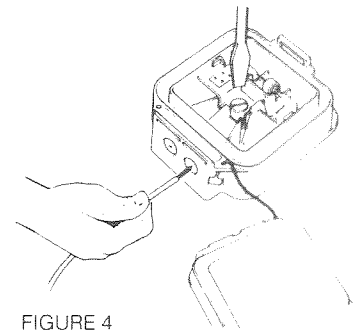


FIGURE 4

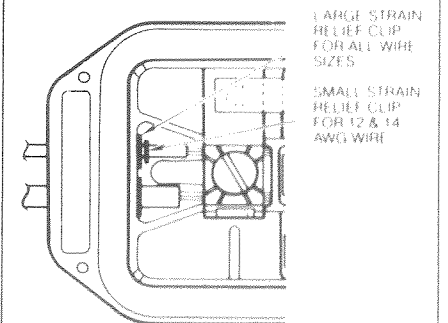


FIGURE 5

Module Wiring - M20

The M20 is provided with a two-conductor 18 AWG cable that is color coded red for positive connection and grey or black for negative connection. Reversed battery connections should not damage the module, but will result in battery discharging.

Array Wiring

The term 'array' is used to describe the assembly of several modules on a support structure with associated wiring.

Use copper wire which is sunlight resistant and is insulated to withstand the maximum possible system open circuit voltage. Type UF cable meets these requirements. Array output wiring should be taken to a junction box at the array. From that point, we recommend that conduit be used to enclose wiring to controller and loads. Check your local codes for requirements.

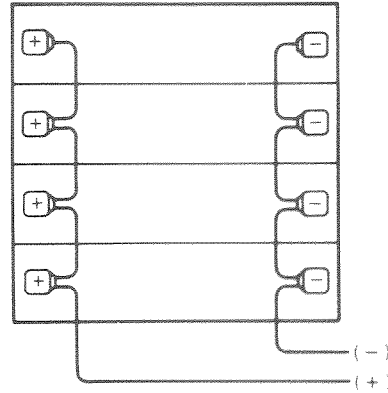
Earth Ground Wiring

It is desirable to ground the frames of all modules and arrays. Each module has a hole in the side frame for installation of a self-tapping screw. This screw and a cup washer are included with each module. To install ground wire, first install screw with cup washer partially into hole. If wire is insulated, strip insulation back approximately 5/8" (16 mm) from the end of the wire and wrap wire around screw between its head and the cup washer. Tighten screw. The cup washer may be omitted if the wire is provided with a lug. The ground wire should also be attached to the support structure.

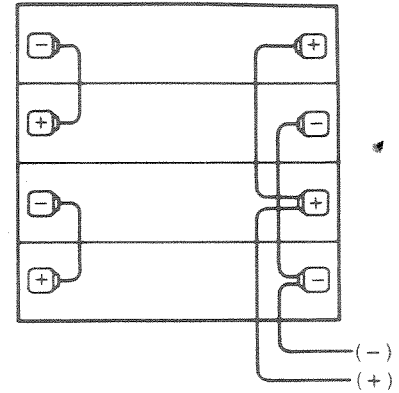
Wiring Schematics

The following array wiring drawings show examples of several wiring configurations. Your Siemens Solar dealer or distributor can assist in determining the exact number of modules in series and parallel for your location.

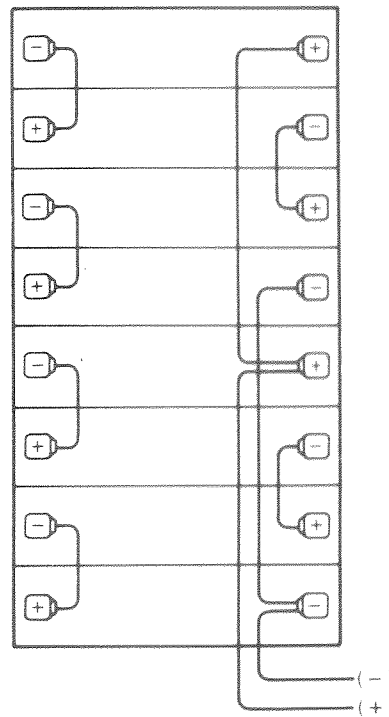
Note: Illustrations not to scale.



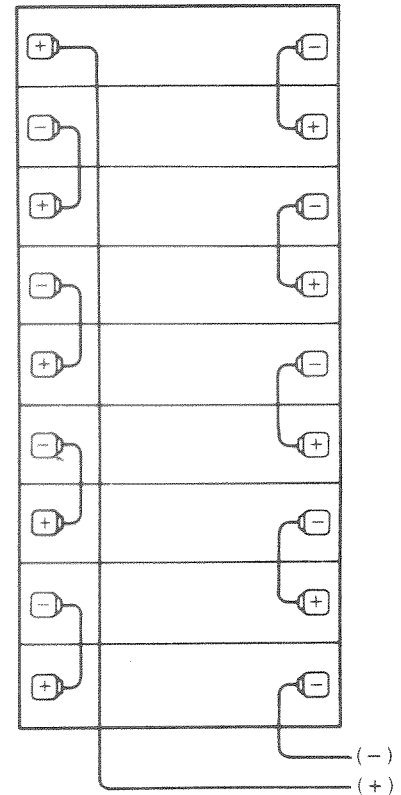
12 Volt Wiring
4 Modules wired in parallel



24 Volt Wiring
Two 2-module series strings
connected in parallel



48 Volt Wiring
Two 4-module series strings,
connected in parallel



120 Volt Wiring
Single series string

SELF-REGULATION

This information applies to the M65, M35 and M20 modules only.

In operation, the charging current provided to the battery by these modules decreases as battery voltage increases; thus, a battery at a low state of charge will accept more charging current than one which is at or near a full state of charge. If the system is used during the day, the charging current will automatically and continuously adjust to replace the energy used.

To obtain the benefit of self-regulation:

1. Use proper minimum battery size. For the M65 and M20 modules, this is as follows:

One 60 Amp-Hour Battery For Each M20 Module

One 100 Amp-Hour Battery For Each M65 or M35 Module

2. Install the modules and batteries so that the air temperatures around them are similar; within 20°F (11°C).
3. Use the system regularly. The current from an M65, M35 or M20 module to a fully charged battery may overcharge the battery if the system is not used for an extended time. The amount of this overcharge may result in undesirable consumption of electrolyte, but should not damage the battery.

If it is not possible to meet these requirements, it will be necessary to use a charge regulator.

DIODES

BLOCKING DIODES

Use of blocking diodes can prevent partial loss of array output. For example, if one of several parallel module strings is shaded, reverse circuit flow may occur. Use of blocking diodes is recommended.

BYPASS DIODES

Shading of individual cells and modules in series strings can cause a reverse voltage across the cell or module. Because current is forced through the shaded area by other series modules, undesirable heating can occur. Use of a diode to bypass the shaded area can minimize both heating and reduction of array current.

M55, M45, M65, M35, M75, M40

Each of these modules is provided with bypass diodes at the factory.

- ▶ For 12V systems (1 module), the factory installed diodes provide proper circuit protection without the need for additional diodes.
- ▶ For 24V and above (2 or more modules in series), the simplest arrangement is to connect modules as individual series strings, and then parallel these strings to obtain the required array current. If this is done, additional bypass diodes are not required.
- ▶ If, however, it is necessary to parallel modules within series strings, proceed as follows:

Connect modules in parallel with internal bypass diodes intact and place one large external diode around the parallel group. This diode should have the capacity to conduct the total current of the parallel group. Each external bypass diode should be properly derated and provided with a heat sink, if necessary. The external diode is required because the small internal diodes may not share current flow equally with this wiring arrangement.

M20

The M20 is not equipped with bypass diodes because it is intended for 12 volt service only, where these are not required.

MAINTENANCE

The maintenance requirements for all the modules are minimal. If the module becomes dirty, use water and a soft cloth or sponge to clean the glass. A mild non-abrasive detergent may be used on persistent contaminants. Make a semi-annual inspection of all connections for cleanliness, tightness, and absence of damage. Fix any problems found.

If a battery is used and has removable caps, check and correct electrolyte level, preferably once a month. For lead acid batteries (the most common type), add only distilled or deionized water. Never add acid. Follow the battery manufacturer's instructions.

A voltmeter is highly recommended for verifying that the system is operating properly and for checking system components, if necessary. A good quality expanded scale voltmeter can be wired into the system. If a hand-held voltmeter is used, a digital readout type is recommended.

Siemens Solar Industries provides a complete range of support services for its customers worldwide. These include training seminars and energy consultations.

The regional offices listed below can provide additional information.

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(including United States and
Canada)**

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Telex: 62874 BEX HX
Fax: 852-5-754-227

LIMITED WARRANTY
(Please keep for your records.)

**M-SERIES Glass Front Solar
Electric (Photovoltaic) Modules**

Limited Warranty - One Year

Siemens Solar Industries warrants the module to be free from defects in materials and workmanship under normal application, installation, use and service conditions for twelve (12) months from date of sale to the original consumer purchaser. Siemens Solar Industries will, at its option, either repair or replace the product, or refund the purchase price, if it becomes inoperable due to a defect in material or workmanship during the twelve (12) month period of this warranty.

**Limited Warranty - Ten Year
Extended Term**

For ten (10) years from the date of sale of modules to the original consumer purchaser, Siemens Solar Industries will replace the lost power of modules that exhibit a power output less than 90% of the rated power specified at time of delivery by Siemens Solar, provided that such lost power is determined by Siemens Solar to be due to defects in material or workmanship. Siemens Solar Industries will replace such lost power by either providing to buyer additional modules to make up the total wattage lost, or by repairing or replacing the modules, at its option.

**What is Not Covered
By The Warranty**

This warranty does not apply to any module which in Siemens Solar's judgment has been subject to misuse, neglect or accident or which has been damaged through abuse, alteration, improper installation or application, or negligence in use, storage, transportation or handling, or repaired by anyone other than Siemens Solar. The warranty

does not cover any transportation costs for return of module or for reshipment of any repaired or replaced module, or cost associated with installation, removal or reinstallation of modules.

Warranty Limitations

Siemens Solar Industries shall have no responsibility for damage to persons or property or other loss or injury resulting from a defect in the module or from improper use or installation. Under no circumstances will Siemens Solar be liable for any incidental or consequential damage. Any warranties implied by law, including those of merchantability and fitness for a particular purpose are limited in duration to the twelve months after date of original purchase. Siemens Solar's maximum liability under any warranty is in lieu of all other warranties express or implied.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR THE EXCLUSION OR LIMITATION OF INCIDENTAL DAMAGES, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

Obtaining Warranty Performance

Fill out and return the Warranty Registration Card, if supplied with the module, within thirty (30) days after purchase. Failing to return the card will not affect your rights under the warranty so long as you can establish the date on which you purchased the module.

If you feel you have a claim under this warranty, first contact the dealer who sold you the module or any authorized Siemens Solar distributor. Check local telephone listings for location. The dealer or distributor will give advice on handling the claim. If further assistance is required, write Siemens Solar for instructions.

The return of any modules will not be accepted by the factory unless prior written authorization has been given by Siemens Solar.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

**Siemens Solar Industries
Warranty Service Department**
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Camarillo, CA 93011-6032

Siemens Solar Industries

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