LI-12

USER MANUAL

version 1.0
November 2002

The LI-12.

The LI-12 visualizes the electrical energy yield of a solar energy system. The LI-12 consists of a measuring unit that measures the delivered power and total energy and a display. The display shows the total energy that is delivered by the solar system in kWh, the avoided greenhouse gas emission in CO_2 and the actual power in Watts.

Installation and operation of the LI-12.

1) Install 3 batteries in the display (3 'penlight', AA-size cells). The battery holder shows how the batteries must be placed: make sure that they are place in the right way.

2) Place the measuring unit between the plug of the solar energy system and the mains outlet. After a while (a few minutes maximum) the display will show the measured values.

3) Select the desired display function by pressing the button on the front of the display unit. When you press the button you will see stripes on the display. The stripes point at the value that will be shown on the display (either Watts, kg CO_2 or kWh). Each time you press and release the button, the next display function is selected. The display can also show all three measured values in a fixed sequence. This mode is indicated with stripes on the display at all three lines.

During normal operation, the stripes are shown approximately every 10 seconds so that there can be no misunderstanding about the value that is being displayed.

Watt, kWh and CO_2 emission.

A solar energy PV system generates electrical energy. The PV panels convert solar radiation into electrical current. The current that is generated by solar panels is so-called DC, direct current, the same type of current that comes from a car battery. An inverter converts the DC current into AC (alternating current). This is the type of current that comes from your mains outlet. The inverter feeds the converted energy from the PV panels into the grid. The energy that is generated by the PV system therefore does not have to generated by the power plant.

Electrical appliances consume electrical power. Electrical power is measured in Watts. The power requirement is indicated on a appliance and it is a value in Watts. A vacuum cleaner may use approximately 1000 Watts, a refrigerator approximately 50 Watts. Your solar energy cells generate a specific number of Watts at a specific amount of solar radiation. More sun, more Watts.

How much energy an appliance consumes or how much energy your PV system generates depends on how long it uses or generates the rated power in Watts.

Electrical energy is expressed in Watt-hour. The consumed electrical energy is the consumed power in Watts times the time during which this power was consumed. 1 Watt-hour is a use of 1 Watt during 1 hour, or 2 Watts during half an hour, or half a Watt during 2 hours, etc

Usually the electricity consumption is expressed in kilo-Watt-hour (kWh). 1 kWh = 1000 Wh, that is 1000 Watts during an hour. Larger amounts of electrical energy are expressed in Mega-Watt-hours (MWh). 1 MWh = 1000 kWh = 1000000 Wh.

If your PV system generates approximately 250 Watts on a sunny day, you will notice that the kWh value of the LI-12 reads one kWh extra after an hour. This is because 250 Watt x 4 hours = 1000 Wh = 1kWh.

In winter, there is very little solar radiation, and the kWh counter will increase very slowly.

A rule of thumb is that the PV system should deliver approximately 80 kWh per square meter per year (northern European countries). This depends of course on the orientation of the panels and local circumstances (shadow from trees for example decreases the yield).

Because your PV system generates electrical energy, there is less energy production required in the power plant. A power plant produces approximately 0,566 kg CO_2 per kWh. So every kWh generated by your PV system precludes emission of 0,566 kg CO_2 in the air! This is called the avoided emission.

For more information, the internet is very good source. You can find sites that will give you an estimate as to what you may expect from your system at your location.

Maintenance

Clean the LI-12 display exclusively with a damp, not moist, cloth. The housing does not like cleaners with chlorides. Keep the measuring unit dry at all times. The measuring unit may only be cleaned when disconnected. Never use moist when cleaning the measuring unit.

More about wireless.

The wireless communication works as follows.

At regular intervals, the display transmits a request for measured values. The measuring unit receives the request and in respond transmits the values of the measurements it has made. (You can follow this process by watching the lamp at the bottom of the measuring unit. Each time the measuring unit transmits data, the lamp toggles.)

A so called license free frequency band is used for the data communication. This implies that there may be other devices using the same frequency. If two devices try to use the same band at the same time, they will jam each other's signal. This does not damage the devices, it merely inhibits the normal data communication. If the connection is jammed for some time the display will show stripes instead of the measured values. The display will recover as soon as the band is free again.

The quality of the connection depends on local circumstances. Predicting the quality of the link in specific circumstances is impossible. If the link between display and measuring unit is very weak, you will notice that the measured values will disappear from the display irregularly, say a few times per day for a few minutes. If it happens often you can try to reposition the measuring unit or the display. Once a good link is established, it will stay like that. If after some time the link seems to weaken, there may have been a new wireless device installed in the vicinity. The quality of the link also depends on the health of the batteries. The batteries will keep the display working for a very long time, but at the end of their lifetime the communication link will weaken. If in doubt about the batteries, replace them to see if this improves the situation.

The display and measuring unit have an address. The display broadcasts its address when requesting the measuring unit for data. The measuring unit will normally only respond to the address it is set to. The measuring unit can be configured so that it will respond to all requests. This way multiple displays can show information from just one measuring unit. If several LI-12's are used in the same building, they can jam each other's signal. This has been foreseen and the software makes sure that the devices will work together smoothly.

Measured values are stored in the measuring unit, not in the display. This means that information is not lost when the batteries of the display are changed or the display is off for some other reason. The measuring unit also retains the measured totals when the power is off.

When and how must I set the address.

If you notice that the link is weak (the measured values are replaced by stripes for several minutes, several times per day), you can try to change the address. You can try any other address than the one in use.

If you use several LI-12's in each other's vicinity, you must make sure that the addresses of all systems are different. You can determine what address is set by looking at the switches at the back of the display and measuring unit. The meaning of the position of the switches is shown in the tables below.

The setting of the measuring unit and accompanying display must be the same. It is possible to have the measuring unit respond to all displays. All displays will show the same value. There is a switch position also that resets the totals to zero.

This is how the switches look:

YOU MUST DISCONNECT THE MEASURING UNIT BEFORE YOU MAKE CHANGES TO THE SWITCHES

There are 6 switches, numbered from 1 through 6. A switch can be on (ON) or off. The picture shows all switches in the ON position. The switches can be operated with a pen. Slide the white notch in the desired direction. The meaning of the switch settings is as follows:

Switches in the display unit:

Meaning of the position of the switches in the display unit.						
1	**2**	**3**	**4**	**5**	**6**	**Meaning/effect**
off	off	Off	off	on	off	No meaning, not used.
on	off	Off	off	on	off	display address 1
off	on	off	off	on	off	display address 2
on	on	off	off	on	off	display address 3
off	off	on	off	on	off	display address 4
on	off	on	off	on	off	display address 5
off	on	on	off	on	off	display address 6
on	on	on	off	on	off	display address 7
off	off	off	on	on	off	display address 8
on	off	off	on	on	off	display address 9
off	on	off	on	on	off	display address 10
on	on	off	on	on	off	display address 11
off	off	on	on	on	off	display address 12
on	off	on	on	on	off	display address 13
off	on	on	on	on	off	display address 14
on	on	on	on	on	off	display address 15
off	off	off	off	on	on	display address 16
on	off	off	off	on	on	display address 17
off	on	off	off	on	on	display address 18
on	on	off	off	on	on	display address 19
off	off	on	off	on	on	display address 20
on	off	on	off	on	on	display address 21
off	on	on	off	on	on	display address 22
on	on	on	off	on	on	display address 23
off	off	off	on	on	on	display address 24
on	off	off	on	on	on	display address 25
off	on	off	on	on	on	display address 26
on	on	off	on	on	on	display address 27
off	off	on	on	on	on	display address 28
on	off	on	on	on	on	display address 29
off	on	on	on	on	on	display address 30
on	on	on	on	on	on	Display self test. All segments of the display are switched on and off in a regular pattern.

Meaning of the switches on the measuring unit:

Meaning of the switches in the measuring unit.						
1	**2**	**3**	**4**	**5**	**6**	**meaning / effect**
Off	off	off	off	on	off	Respond to all displays, regardless their address.
On	off	off	off	on	off	respond to display with address 1
Off	on	off	off	on	off	respond to display with address 2
On	on	off	off	on	off	respond to display with address 3
Off	off	on	off	on	off	respond to display with address 4
On	off	on	off	on	off	respond to display with address 5
Off	on	on	off	on	off	respond to display with address 6
On	on	on	off	on	off	respond to display with address 7
Off	off	off	on	on	off	respond to display with address 8
On	off	off	on	on	off	respond to display with address 9
Off	on	off	on	on	off	respond to display with address 10
On	on	off	on	on	off	respond to display with address 11
Off	off	on	on	on	off	respond to display with address 12
On	off	on	on	on	off	respond to display with address 13
Off	on	on	on	on	off	respond to display with address 14
On	on	on	on	on	off	respond to display with address 15
Off	off	off	off	on	on	respond to display with address 16
on	off	off	off	on	on	respond to display with address 17
off	on	off	off	on	on	respond to display with address 18
on	on	off	off	on	on	respond to display with address 19
off	off	on	off	on	on	respond to display with address 20
on	off	on	off	on	on	respond to display with address 21
off	on	on	off	on	on	respond to display with address 22
on	on	on	off	on	on	respond to display with address 23
off	off	off	on	on	on	respond to display with address 24
on	off	off	on	on	on	respond to display with address 25
off	on	off	on	on	on	respond to display with address 26
on	on	off	on	on	on	respond to display with address 27
off	off	on	on	on	on	respond to display with address 28
on	off	on	on	on	on	respond to display with address 29
off	on	on	on	on	on	respond to display with address 30
on	on	on	on	on	on	***Reset totals to zero when powered.*** ATTENTION! The totals are reset to zero and can not be recovered.

Technical specifications.

Display:

Type	4 characters LCD, 12mm high
Watt display	max. 9999W. Resolution 1W.
kWh display	max. 9999.999 kWh Only the four most significant numbers are shown.
CO_2 display	max. 9999.999 kg Only the four most significant numbers are shown.
Dimensions	Width 80 mm Height 128 mm Depth 43 mm
Weight	Approx. 260 gr. incl. batteries
Ambient conditions	Storage –20 … 60 ^{o}C For indoor use only! 5 … 40 ^{o}C, RH 80% max. at 31 ^{o}C, altitude 2000 m. max.

Measuring unit:

Max. current	10 A BE CAREFUL! The measuring unit does not have a fuse. It may be connected only to a fused power outlet with a fuse of 16A max.
Mains voltage	230 VAC +/- 10%, 50 Hz.
Power consumption	< 2 Watt
Measuring range	0 … 2400 W
Dimensions	Width 70 mm Length 110 mm Height 55 mm
Weight	Approx. 220 gr.
Protection class	IP20 IK0
Ambient conditions	Staorage –20 … 60 ^{o}C For indoor use only! 5 … 40 ^{o}C, RH 80% max. atj 31 ^{o}C, altitude 2000 m. max.
Accuracy	2% +/- 8 W

Transmitter/receiver in display and measuring:

Max. power	< 10mW
Duty cycle	< 50ms / 10 sec. (error free link) < 50ms / sec. (jammed link)
Frequency	433.92MHz (channel 1) 434.33MHz (channel 2)
Frequency deviation	+/- 15kHz max.
Modulation	FSK
Range	Approx. 50m. max., depending on the local circumstances, see manual
Addresses	2 channels with 30 addresses each

WARRANTY AND LIABILITY

Leiderdorp Instruments garantees that this product has been thoroughly tested to ensure that it meets it published specifications. Leiderdorp Instruments does not assume liability for consequential damages as a result of the product's use, or liability exceeding the original selling price of the equipment. In addition, there is no assumption of liability as a consequence of any such events under the terms of the warranty in the following:
- Improper environment, temperature extremes, electrical power surges or failure, or other misuses or negligence.
- Adjustment or repair by personnel not authorized by Leiderdorp Instruments.
- Improper installation or use or failure to follow installation and operating instructions.
- Forces beyond the control of Leiderdorp Instruments, including but not limited to an act of war, insurrection, civil disturbances, natural disasters, labor disputes, or government regulations.
- This warranty is only applicable to the units sold by retailers authorized by Leiderdorp Instruments to sell these products.

CE DECLARATION

In accordance with the EC guidelines as listed below, we declare:

Leiderdorp Instruments
Splinterlon 152
NL-2352 SM Leiderdorp
The Netherlands

within our responsibility, that the product:
Type: 021201
Name: LI-12
to which this declaration applies, is in conformity with the following guidelines:

LOW VOLTAGE 73/23/EEC
EN60335-:1994+ Safety of household and similar electrical appliances
EN60335-A1:1996+ Part 1: General requirements

EN60335-A11:1995+	EN60335-A12:1996+
EN60335-A13:1998+	EN60335-A14:1998
EN60335-:1991+	EN60335-:1994, modified

EMC GUIDELINE 89/336/EEC

Immunity	EN-62000-6-2
Emission	EN-50081/1

Leiderdorp Instruments
Splinterlon 152
NL-2352 SM Leiderdorp
The Netherlands

Signed by: J.H.Liefting
Function: DGA
Place: Leiderdorp
Date: 1-11-2002

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