

DULAS Solar Direct Drive VC60SDD-1 Refrigerator & Freezer User Manual



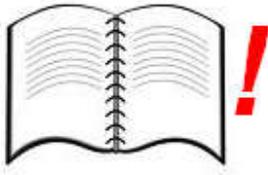
Table of Contents

1. COMPONENTS CHECKLIST	3
2. SAFETY INSTRUCTIONS	4
3. YOUR DULAS SOLAR DIRECT DRIVE REFRIGERATOR	6
4. REFRIGERATOR COMPONENTS	7
5. MATERIAL SAFETY INFORMATION	8
6. END OF LIFE & PRODUCT RECYCLING	9
7. REFRIGERATOR INSTALLATION	11
8. REFRIGERATOR LOADING	12
9. FREEZER OPERATION	13
10. GREEN COMPRESSOR STATUS LED LIGHT	14
11. USER TRAINING	15
12. MAINTENANCE TASKS	16
13. SPARE PARTS	16
14. VC60SDD-1 SYSTEM LAYOUT	17

1. Components Checklist

DESCRIPTION	QUANTITY
REFRIGERATOR	
VC60SDD-1 Refrigerator Cabinet	1
Refrigerator Baskets	4
Refrigerator Key	2
SOLAR ARRAY	
250W minimum solar modules	3
20m pre-terminated solar cable (+ve & -ve)	1 pair
Solar Connector – Branch Plug	2
Solar Connector – Branch Socket	2
Earthing Kit (incl. Earth Rod, 25m Earth Cable & Earth Clamp)	1
MOUNTING SYSTEM (see page 14 for references A to G)	
(A) End Clamp 34-43mm Set	4
(B) Mid Clamp 28-42mm Set	4
(C) Front fixed leg	3
(D) C-Rail 47-3 – 1530mm	4
(E) C-Rail 47-3 - 750mm (<i>not used with VC60SDD-1 system</i>)	0
(F) Rear adjustable leg	3
(G) Rail connector set 47	2
Coachscrews, Rawlbolts, Washers	3 packs
Screws	1 pack
Wall Plugs	1 pack
Cable Ties	1 pack
Cable Tie Bases	1 pack
Silicon Sealant	1

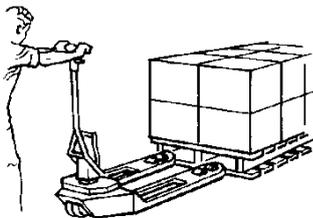
2. Safety Instructions



Read the Manual - please read all instructions completely before installing. Installation and system servicing should only be carried out by a qualified and competent engineer. Work performed by persons with insufficient technical knowledge may adversely affect the performance of the unit or cause physical injury or damage to the equipment.



The refrigerator is not to be used by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction. Children must be supervised not to play with the appliance. This refrigerator is for professional use only. It is not designed for household use.



Refrigerator and power system are heavy - please observe good manual handling procedures when moving the refrigerator and solar power system. Only use suitable transport equipment.



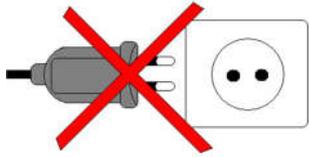
Safe working - Please observe safe working at height practices when installing the solar array.



Live electrical components – solar modules are live when exposed to sunlight. Isolate the array (using the PV isolator on the back of the refrigerator) before disconnecting any components.



Electrical danger – under fault conditions high electrical currents can occur. Never bypass a circuit breaker and always replace with the same type and rating.



DC power only - this refrigerator is designed for operation with the solar power system supplied. Do not connect the refrigerator to other power supplies.

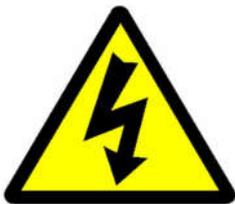


Dangerous substances - this refrigerator contains substances that are not biodegradable and can cause harm, please ensure that all components of the refrigerator are disposed of correctly, see page 8 for more information. Do not damage the internal side panels of the compartment.



Keep Dry – This refrigerator is for indoor use only. Do not expose it to rain.

WARNING: This unit's cooling system contains flammable refrigerant. Due to this fact, the following information is particularly important:



Warning: Do not damage the refrigeration circuit. Ensure that sharp or pointed objects do not come into contact with the refrigeration circuit.

Warning: Do not use mechanical devices or other means to accelerate the defrosting process, other than those recommended by the manufacturer.



Warning: Keep ventilation openings, in the appliance enclosure or in the built-in structure, clear of obstruction.

Warning: Do not use electrical equipment inside the appliance.

Warning: Do not store explosive substances such as aerosol cans with a flammable propellant inside this appliance.

3. Your Dulas Solar Direct Drive Refrigerator

Congratulations on choosing the Dulas VC60SDD-1 vaccine refrigerator and water pack freezer. With over 30 years of engineering experience in the production of solar powered vaccine refrigerators, Dulas is considered one of the market leaders in this field.

The VC60SDD-1 is Dulas' latest innovation in solar refrigeration. Using our new solar direct drive technology we have replaced the traditional battery energy store with a ground breaking phase change solution. With this new technology we can offer the same renowned Dulas quality and reliability that have always kept your vaccines safe, but in a simpler and more efficient package.

How does solar direct drive work?

When the sun shines the solar panels generate electricity which directly drives the refrigerators compressor, cooling down the refrigerator and its contents. As a result the compressor only operates during the day. To maintain the temperature at night or when the sun is not shining the refrigerator has a phase change lining. This interior lining holds the exact temperatures required for safe vaccine storage and acts as a "cold store", storing energy that keeps the temperatures stable all day and night.

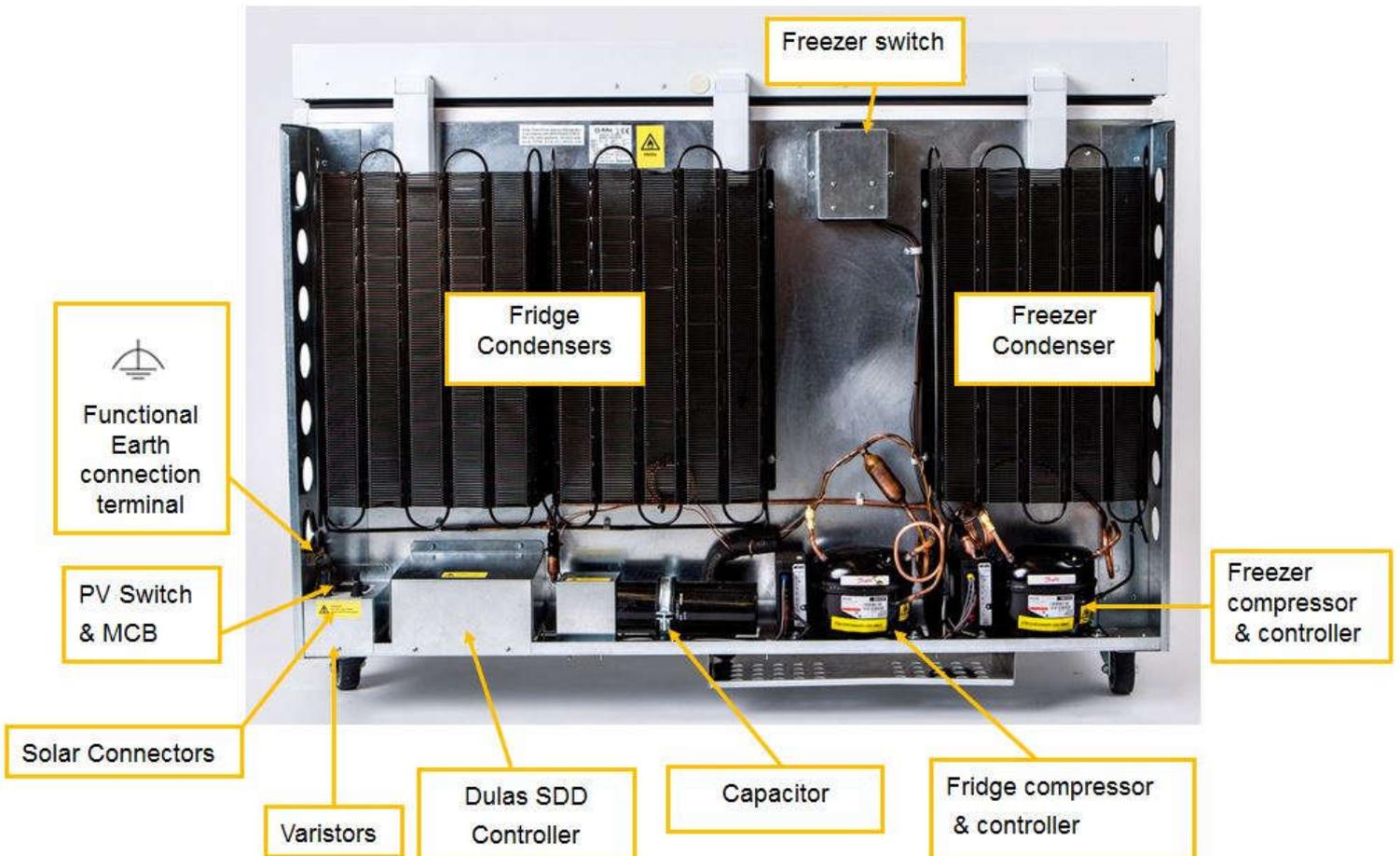
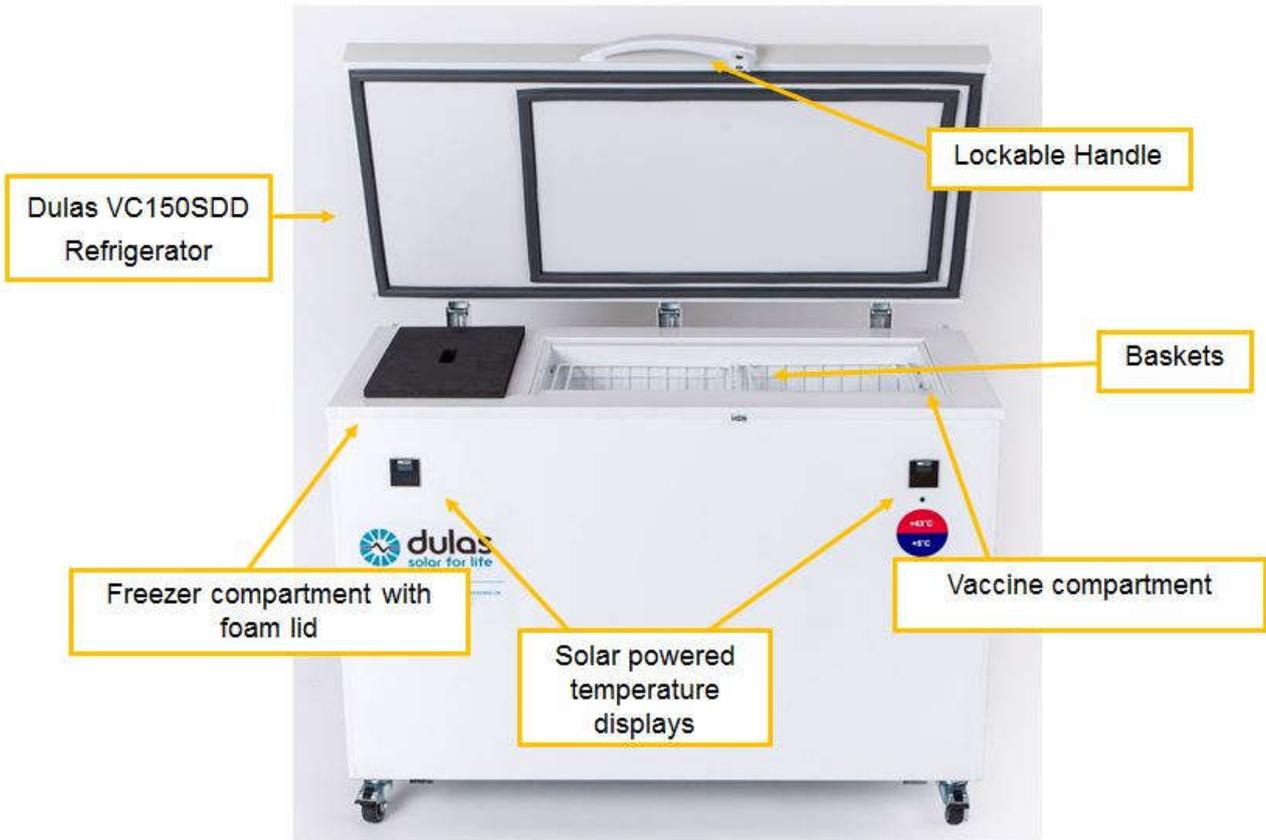
In order to store sufficient energy to keep vaccines safe for prolonged periods without any sunshine, the refrigerator must be allowed time to charge its cold store. Under normal sunlight conditions (8 hours/day of solar irradiance $>200\text{W/m}^2$) the refrigerator will take approximately 7 days to fully charge the cold store and be ready for vaccine storage.

In the VC60SDD-1 the freezer compartment is secondary to the vaccine compartment. It has its own separate refrigeration circuit and we prioritise the operation of the vaccine compartment. The freezer only runs when there is enough solar energy to power first the fridge compressor and then the freezer. This means that in periods of very low sunshine you may not be able to freeze water packs.

Recommended solar array

The VC60SDD-1 has been designed to meet the World Health Organisations Performance, Quality & Safety (PQS) standards. The refrigerator has been independently tested to the PQS standard WHO/PQS/E03/RF05 and is a Hot zone rated appliance with an ambient operating temperature range of between $+5\text{C}$ and $+43\text{C}$. For use in such Hot Zone environments it should be powered by a minimum 600W solar array with a Voc not exceeding 45Vdc.

4. Refrigerator Components



5. Material Safety Information

THE REFRIGERATOR

The Dulas VC60SDD-1 conforms to the European directive 2002/95/EC on hazardous substances and does not contain the following elements: lead, cadmium, mercury, hexavalent chrome, PBB or PBDE.

The absence of ozone destroying materials is in accordance with EC 1005/2009 (CFC-free)

It is compliant with European Standards (CE) EN60335-1:2010 & EN60335-2-24:2010.

R600a refrigerant – Isobutane, is highly flammable when mixed with air. Do not inhale, ingest, and avoid contact to skin. Ensure that any work carried out on the refrigeration circuit is done by a competent refrigeration engineer.

THE PHASE CHANGE MATERIAL (PCM)

The refrigerator contains an organic phase change material (PCM) that provides the energy store for the refrigerator. This PCM material is a paraffin wax that is liquid at room temperature and is stored in large tanks secured inside the walls of the refrigerator. In normal use the user will never be aware of its presence. This PCM is classified under regulation (EC) No 1272/2008 as a category 1 aspiration hazard and is classified under regulation 67/548/EWG, 1999/45/EG as having the potential to cause physical harm (R65 & R66). At normal ambient temperatures this product will be unlikely to present an inhalation hazard because of its low volatility. At high temperature aerosol/mist can cause an irritation of the respiratory tract.



H304 May be fatal if swallowed and enters airways.

P301 + P310 IF SWALLOWED: Immediately call a POISON CENTRE or physician.



P331 DO NOT induce vomiting.

R65: Harmful: may cause lung damage if swallowed.

R65: Repeated exposure may cause skin dryness or cracking.

In the event of a PCM spillage:

- Wear suitable protective clothing, gloves and safety glasses when clearing up spillages.
- Use an absorbent substance such as sand to contain any escaping material.
- Do not allow to enter drains / surface waters / groundwater. In case of the leakage of a large amount inform the responsible authorities.

6. End of Life & Product Recycling

PACKAGING

The packaging is made from recyclable / reusable materials and should be brought to an official recycling centre. The materials used are:

- Heat treated (HT) timber, certified by UK Forestry Commission (ISPM No. 15 Mark)
- Corrugated cardboard / Cardboard
- Polyethylene plastic
- Moulded polystyrene parts
- Steel reinforcing straps

WARNING – Keep packaging away from children - danger of suffocation from plastic!

WORN OUT REFRIGERATOR

The refrigerator still contains valuable materials and is not to be disposed of in the normal household waste.

- Ensure that the cooling circuit of the worn out device is not damaged when being transported.
- Information on the coolant used is on the type plate on the back of the refrigerator.
- The walls of the refrigerator contain an organic phase change material that can be harmful and must be disposed of safely. Please contact Dulas for advice.
- Worn out devices must be professionally disposed of in accordance with local regulations and legislation.

Potentially hazardous components / materials are:

- Refrigerant gas (R600a)
- Phase change material (PCM) - paraffin, normal C5-20
- Electrolytic capacitor
- Electronic components
 - SDD controller
 - Compressor controller
 - Refrigerator compartment temperature display

Disposal of Phase Change Material (PCM)

The PCM used in the Dulas refrigerator has a very long life and does not degrade through use. At the end of the refrigerators useful life the PCM should be either recycled or disposed of in accordance with applicable regional, national and local laws and regulations. Contact your local waste disposal authority for advice. The product can be incinerated in accordance with local regulations. In the EU it has a Waste Disposal Code (EWC): *13 08 99 oil waste not otherwise specified*.

SOLAR POWER SUPPLY

Do not dispose of this equipment with normal domestic waste!

To comply with the European Directive 2002/96/EC on Waste Electrical and Electronic Equipment and its implementation as national law, electrical equipment that has reached the end of its life must be collected separately and returned to an approved recycling facility. Any device that you no longer require must be returned to our agent, or find out about the approved collection and recycling facilities in your area.

Ignoring this European Directive may have potentially adverse effects on the environment and your health!

Solar modules contain materials that can be recovered and reused in either new PV modules or other new products. Industrial recycling processes exist for both thin-film and silicon modules. Materials such as glass, aluminium, as well as a variety of semiconductor materials, are valuable when recovered.

7. Refrigerator Installation

DO NOT position the refrigerator in direct sunlight or next to any heat sources. Make sure the refrigerator is positioned to provide good ventilation and ease of access for maintenance. Ventilation is particularly important for the condensers and compressors.

- 1) Position the refrigerator on a level surface; wipe all internal and external surfaces with a clean cloth.
- 2) Check the PV isolator at the back of the cabinet is in the "0" position.
- 3) Check the freezer switch on the back left of the cabinet is in the "0" position
- 4) Plug the solar connectors into the refrigerator. Check that there is sufficient slack in the cable to allow access to the back of the refrigerator.
- 5) Turn the PV isolator on by switching it to "1". Within 1 minute the compressor will start if there is sufficient sunlight (solar irradiance of $>125\text{W/m}^2$). You will be able to hear the compressor operating and feel the condensers getting warm.



- 6) Turn the freezer switch to "1". Within 1 minute the second compressor will start if there is sufficient sunlight (solar irradiance of $>250\text{W/m}^2$). You will be able to hear the compressor operating and feel the condensers getting warm.
- 7) Check that the refrigerator compartment temperature display on the front of the cabinet is operating. If there is insufficient natural light shine a torch on the display for a few seconds.
- 8) Ensure that all baskets are in position and the refrigerator lid is firmly closed.
- 9) Check that all cables are securely supported so that they will not be pulled loose if the refrigerator is moved for cleaning.

- 10) Roll the refrigerator into its final position and apply the brakes on the castors to secure it.

8. Refrigerator Loading

IN ORDER TO KEEP INTERNAL TEMPERATURES OPTIMISED AND MINIMISE ENERGY CONSUMPTION, ONLY OPEN THE LID WHEN STRICTLY NECESSARY.

The VC60SDD-1 refrigerator has two refrigerated compartments. The large one is specifically for the storage of vaccines and the smaller one with the fan is the freezer, see Section 4. The vaccine compartment is designed to maintain a stable temperature between +2°C and +8°C across an ambient temperature range from +5°C to +43°C. There are no points within the vaccine compartment that drop below freezing and thus no danger of freezing vaccines.

The refrigerator contains stacking baskets designed to make stock management easier and encourage air circulation within the compartment.

Do not remove these baskets and do not store vaccines outside of these baskets.

The wire baskets encourage the circulation of air by maintaining a small gap between the basket and the cabinet wall. Good air circulation will help the refrigerator to maintain an even temperature throughout the compartment. In order to save energy, try to keep the lid open for as short a time as possible.

Stock management

- Allocate a certain space for each different type of vaccine, so that they may be located rapidly.
- Check the vaccine labels and adhere to any special requirements.
- Always use before expiry date (store older vaccines on top).
- Store the most frequently used vaccines in the top baskets for easy access.

WARNING: ALWAYS FOLLOW THESE VACCINE STORAGE GUIDELINES

9. Freezer operation

The VC60SDD-1 freezer is a highly efficient freezer designed specifically for freezing water packs for vaccine distribution. It has a fan to maximise the cooling power and is able to rapidly freeze up to 2.4kg of water each day.

The refrigeration circuit of a solar direct drive freezer only runs during the day time when there is enough sunshine. The VC60SDD-1 is designed to prioritise keeping the vaccine compartment cold over the freezing of water packs. The freezer only turns on when there is enough solar energy to run first the fridge compressor and then the freezer. In low sunshine conditions it is normal for only the fridge to keep running.

To freeze water packs simply place the required number of water packs in the freezer at the beginning of the day and by the end of the day they will be frozen. The freezer is well enough insulated that the water packs will remain frozen overnight.

The VC60SDD-1 can be used to build up a store of up to 23 x 0.6L water packs allowing multiple outreach trips to take place in a short time. Simply add 2.4kg of water packs each day until the desired amount of ice has been accumulated.

Freezing capacity per day	
Water pack volume	Qty = 2.4kg
0.3L	8
0.4L	6
0.6L	4

The VC60SDD-1 has an intelligent controller that automatically ensures the operation of the freezer never endangers the safe storage of the vaccines in the fridge. There is also an on / off switch on the back of the cabinet.

There is no need to turn the freezer off unless for maintenance.

There is no risk of damage to the system by freezing too many water packs.

Tips to maximise the freezing power of the VC60SDD-1:

- Allow the freezer to run for 2 or 3 days before starting to freeze water packs.
- Use the foam lid: make sure it is always replaced securely.
- Use the basket provided in the freezer: this is designed to allow air to flow around the water packs and ensures rapid freezing
- If there is a build-up of ice on the cabinet walls, turn the freezer off for a day until it has melted. **Keep the lid closed during defrosting!**
- If water builds up in the bottom of the freezer there is a drain plug on the side.

10. Green compressor status LED light

The green LED light on the front of the refrigerator illuminates to indicate that the compressor is operating. The compressor will run if the refrigerator temperature is above about 4 degrees and there is sufficient solar power.

Normal operation

The the refrigerator warms up slightly overnight. It is usual for the compressor to start running shortly after sunrise. It will run continuously for a few hours to cool the refrigerator. After this time the compressor will begin cycling on and off to maintain the correct internal temperature. This will continue until the sun sets at the end of the day. At night there is no power to the refrigerator and so the compressor will not run nor will the LED light operate.

11. User Training

The end user of the VC60SDD-1 should be instructed in the simple processes outlined below and also those in Section 12. It should be stressed that these tasks are essential to ensure correct and reliable operation of the refrigerator.

Caution: failure to follow these instructions may lead to system failure and vaccine wastage.

If you have a problem, please contact your appointed engineer.

When turning on for the first time or when the refrigerator has been turned off for more than 3 days:

- Connect the solar panels and allow the refrigerator to run for at least 7 days.
- Before loading with vaccines, ensure that the temperature display on the front of the refrigerator reads +4.5°C or less by 4pm in the afternoon.

Daily Routine

- Keep the lid closed, open only when required and lock after use.
- Store the most frequently used vaccines in the top baskets for easy access.
- Do not keep food or drink in the refrigerator.

Vaccine Storage:

- Only store vaccines in the refrigerator.
- Use the baskets provided: Do not store vaccines outside the baskets.
- Always store vaccine in its original packaging.
- Always keep the same type of vaccine together and store your vaccine neatly.
- Always use old vaccines before new ones; before use make sure the vaccine has not expired.

Freezer operation:

- Designed to make 2.4kg of ice each day. Freezing more may be possible when very sunny.
- Use the foam lid, always replace it securely.
- Use the basket provided.
- Defrost the freezer if ice builds up on the walls (switch on the back to turn it off)

12. Maintenance Tasks

Every morning and afternoon:

- Check the temperature
- Fill in the daily record sheet

On the first day of every week:

- Wipe away any moisture build up around cabinet lid
- Clean the solar array

On the first day of every month:

- Clean the refrigerator, condensers and compressors and drain any water from the bottom of the cabinet using the inbuilt drain
- Check the solar array is not shaded between 7am and 5pm
- Defrost the freezer if there is a build-up of ice on the walls of the compartment

Every 6 months:

- Check all mechanical fixings and electrical connections (including the array)

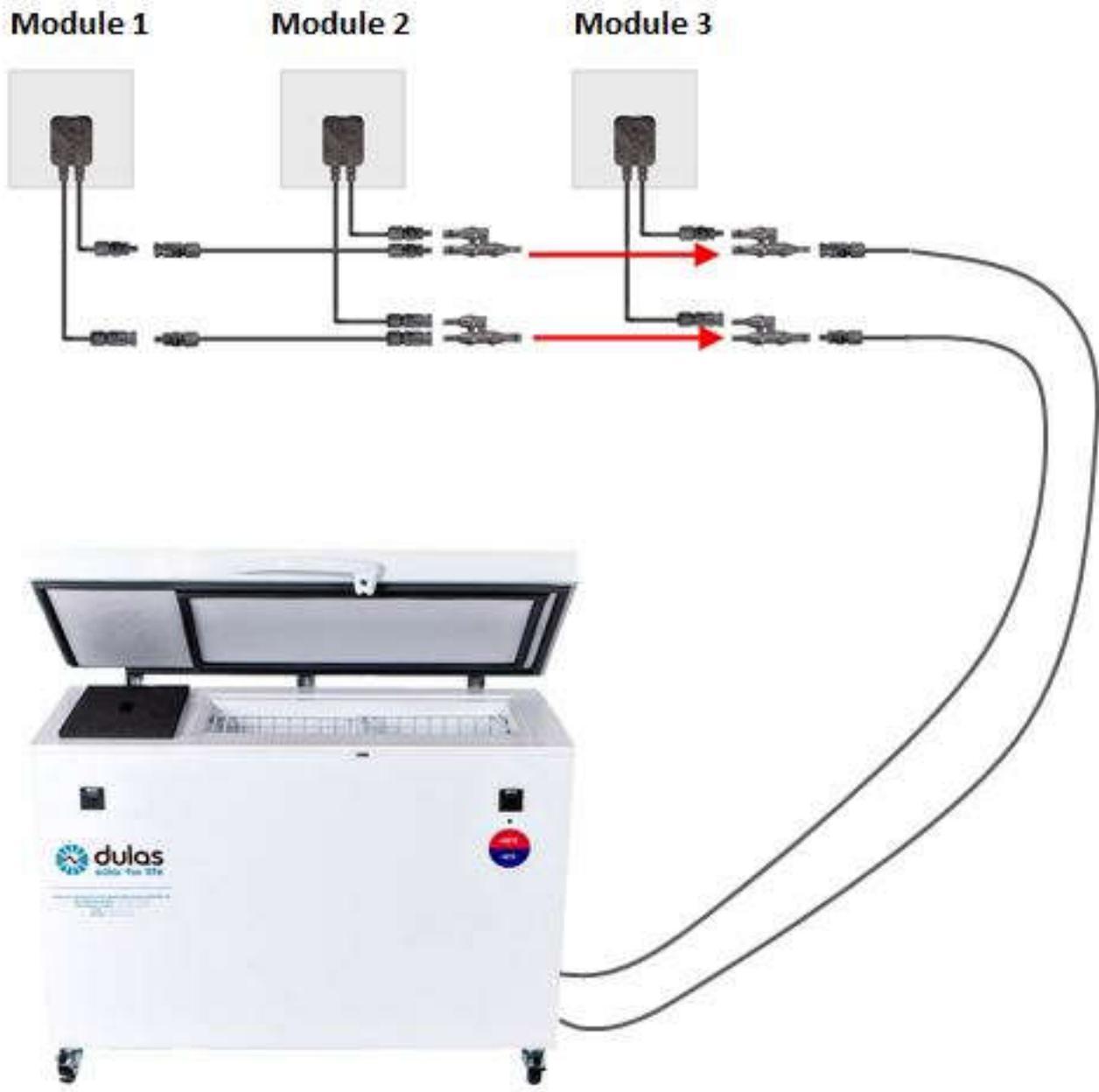
13. Spare parts

Listed below are the most likely spare parts required by the VC60SDD-1 over the course of its lifetime. It is recommended that one set of these spares is purchased for every 10 refrigerators.

Qty	Description
1	Dulas SDD controller
3	Temp probe
1	Freezer fan
1	Compressor controller
1	MCB fridge / freezer
1	Freezer on/off switch

Any other parts required can be obtained by contacting Dulas on the details at the end of this manual.

14. VC60SDD-1 System Layout





For more information contact:

DULAS Ltd, Dyfi Eco Park, Machynlleth, Powys, SY20 8AX, UK

tel: +44(0)1654 705055 fax: +44(0)1654 703000

email: solar@dulas.org.uk

website: www.dulassolar.org