

**DULAS Solar Direct Drive
VC200SDD-B Refrigerator
User's Manual**

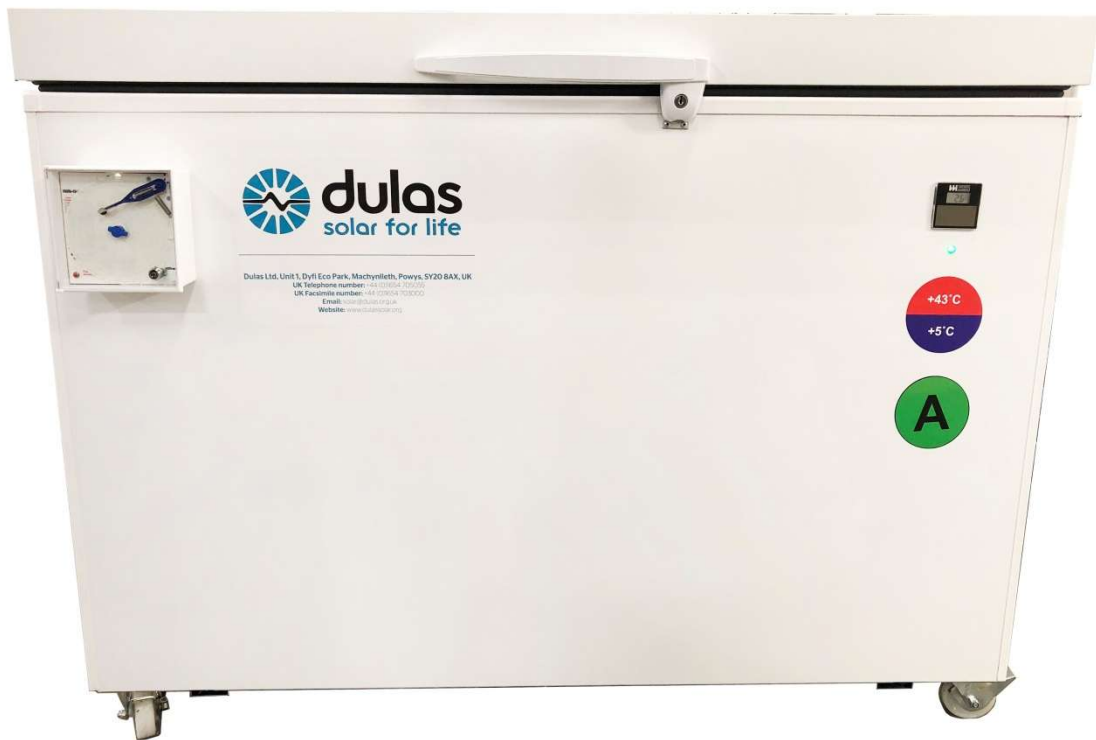


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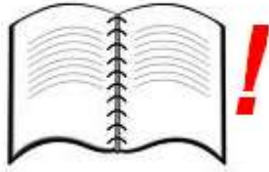
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1. Components Checklist

DESCRIPTION	QUANTITY
REFRIGERATOR	
VC200SDD-B Refrigerator Cabinet	1
Refrigerator Baskets	6
Refrigerator Key	2
Chart Recorder	1
SOLAR ARRAY	
250W min Solar Modules	2
20m Pre-terminated Solar Cable (+ve & -ve)	1 pair
Solar Connector – Branch Plug	1
Solar Connector – Branch Socket	1
Earthing Kit (incl. Earth Rod, 25m Earth Cable & Earth Clamp)	1
MOUNTING SYSTEM (see page 14 for references A to G)	
(A) End Clamp 34-42mm Set	4
(B) Mid Clamp 28-42mm Set	2
(C) Front fixed leg	2
(D) C-Rail 47-3 – 1530mm	2
(E) C-Rail 47-3 - 750mm	2
(F) Rear adjustable leg	2
(G) Rail connector set 47	2
Coachscrews, Rawbolts, Washers	2 packs
Screws	1 pack
Wall Plugs	1 pack
Cable Ties	1 pack
Cable Tie Bases	1 pack
Silicon Sealant	1

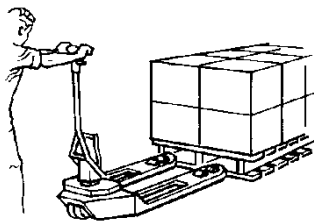
2. Safety Instructions



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.



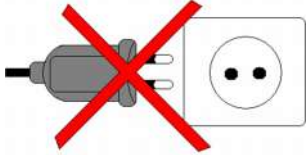
Safe working - Please observe safe working at height practices when installing the solar array.



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 VC200SDD-B bloodbank refrigerator. With over 30 years of engineering experience in the production of solar powered vaccine and bloodbank refrigerators, Dulas is considered one of the market leaders in this field.

The VC200SDD 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 renown Dulas quality and reliability that have always kept your vaccines and blood safe, but in a simpler and more efficient package.

How does solar direct drive work?

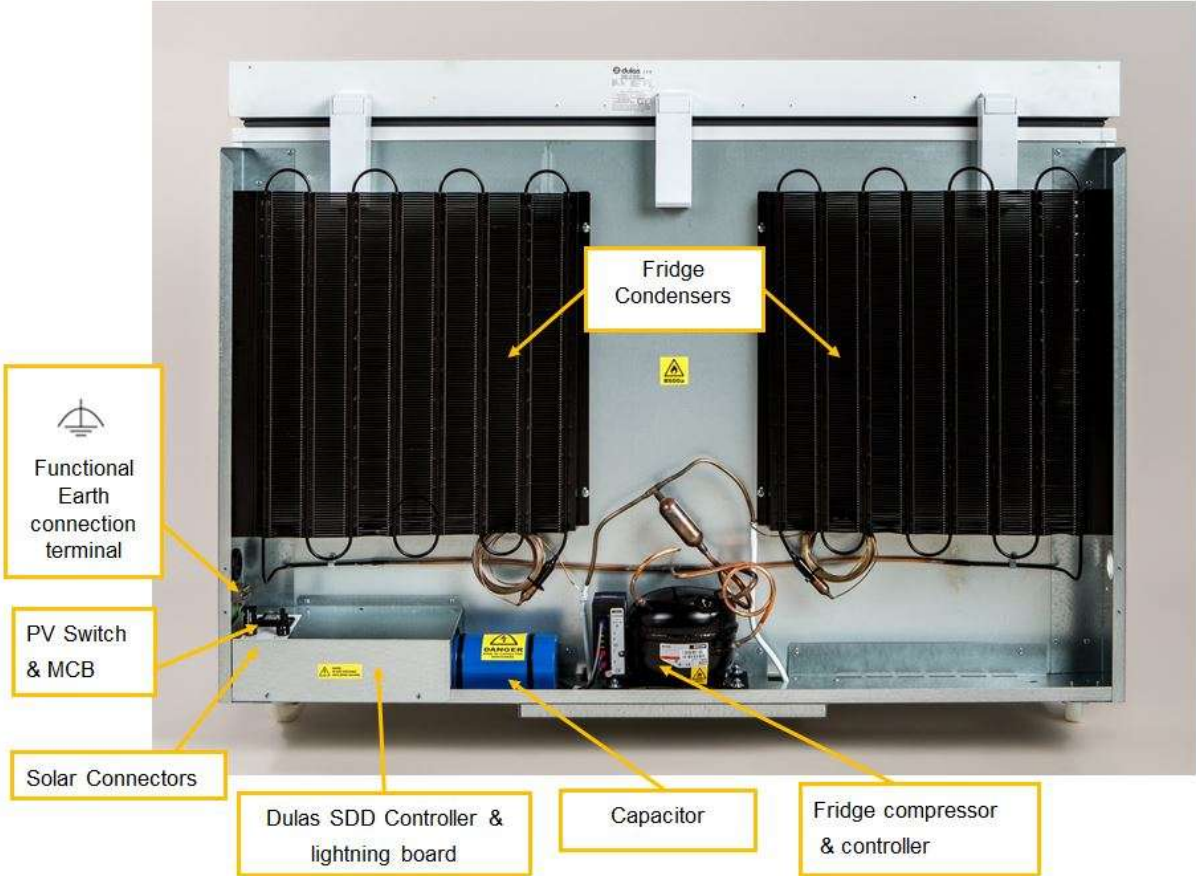
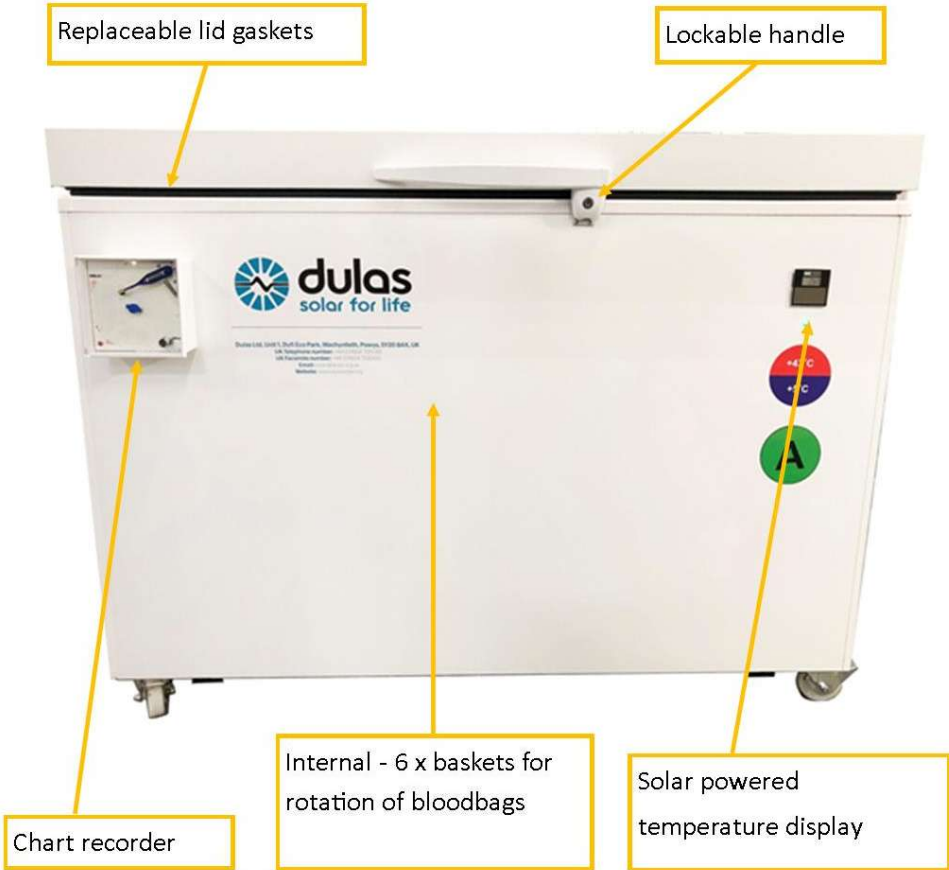
When the sun shines the solar panels generate electricity which directly drives the refrigerators compressor, cooling down the refrigerator and its contents. As a result the compressor only operates during the day. To maintain the temperature at night or when the sun is not shining the refrigerator has a phase change lining. This interior lining holds the exact temperatures required for safe vaccine or blood 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 or blood safe for prolonged periods without any sunshine, the refrigerator must be allowed time to charge it's cold store. Under normal sunlight conditions (8 hours/day of solar irradiance $>200\text{W}/\text{m}^2$) the refrigerator will take approximately 7 days to fully charge the cold store and be ready for vaccine or blood storage.

Recommended solar array

The VC200SDD has been designed to meet the World Health Organisation's 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 +5C and +43C. For use in such Hot Zone environments it should be powered by a minimum 400 peak Watt (Wp) solar array with an open circuit voltage (VOC) not exceeding 45Vdc.

4. Refrigerator Components



5. Material Safety Information

THE REFRIGERATOR

The Dulas VC200SDD-B 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) - paraffins, 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) 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.
- 4) 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.
- 5) 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.



- 6) Ensure that all baskets are in position and the refrigerator lid is firmly closed.
- 7) Check that all cables are securely supported so that they will not be pulled loose if the refrigerator is moved for cleaning.
- 8) 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 VC200SDD-B refrigerator has a single compartment specifically for the storage of blood, see Section 4. The refrigerator 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 compartment that drop below freezing and thus no danger of freezing.

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 blood 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.

The best time to add blood packs

The best time to cool fresh packs of blood is as early in the morning as possible to allow the fridge to use as much direct solar energy as possible.

Amount of blood to be added per day

The fridge has been tested to cool 24 x 280ml packs of blood from 37 °C to 6 °C in less than 11 hours. This is fine occasionally, but to ensure correct operation of the fridge on the cloudiest days limit 4 packs per day should be added.

Temperature excursions above 6 °C

The VC200 is a PQS approved fridge for vaccine storage which have safe storage temperature of 2°C to 8 °C. In cloudy conditions, or when fresh blood packs have been added there is likely to be occasional short term increases above 6 °C overnight. In periods of cloudy weather these can be minimised by reducing the amount of fresh blood packs added, ensuring the PV array is kept clean, and minimising the lid opening time as much as possible.

9. 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 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.

10. User Training

The end user of the VC200SDD should be instructed in the simple processes outlined below and also those in Section 22. 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 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, 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.
- Do not keep food or drink in the refrigerator.

11. 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

Every 6 months:

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

12. VC200SDD-B System Layout





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