

## Save Energy with Intelligence

### INTELLIGENT Opvarmning.

Har du solpaneler eller en vind eller vand turbine? Nu kan du varme dit vand gratis.

Den intelligente Immersion Model I2 er en lille elektronisk enhed til dit hjem.

Der i stedet for at eksportere din overskydende strøm til el nettet, afleder den elektricitet fra en Micro generator, såsom solcelleanlæg eller vind/vand turbine til en varmvandsbeholder eller anden varmekilde. Den smarte software regulerer varmelegemet med strøm til konstant at matche husets belastning og PV generation, hvilket giver maksimal effekt i varmelegemet og minimal strøm til el-nettet. Det reagerer på ændringer i husstandens efterspørgsel eller generation i de sekunder den genererer, så den altid matcher, hvad huset gør. Den er fuldautomatisk og kræver ingen ejer justering eller interaktion. Signallamper på apparatet fortæller dig, hvad det gør, og hvor meget Strøm, der passerer til belastningen og gitteret. Termostaten i din vandbeholder holder vandet på den rette temperatur.

Da denne enhed regulerer strømmen til varmelegemet vil du ikke importere el til opvarmning eller eksportere, når den ikke er påkrævet. Enheden har en nyttig overstyring at tænde varmelegemet fuldt i en kort periode ved hjælp af Grid power, så hvis dit varme vand har behov for et hurtig boost på en kedelig dag er dette muligt.

Typisk kan du generere nok varmt vand til en familie på 3-4 personer i et halvt år og bidrage til det i vinterhalvåret også, hvorved der spares en stor del af den normale brændstof, du bruger til at opvarme dit vand med. Du sparer yderligere ved at dreje din kedel og dens pilot lys slukkes helt for sommeren. Du kan også bruge enheden til at varme

dit håndklædevarmer eller gulvvarme op.

Mange er blevet installeret allerede, og vi har haft stor succes og er meget pålidelige. Der er ingen dele, der viser mekaniske fejl. Nu er Intelligent Immersion Ltd i stand til at tilbyde disse enheder til Elektrikere og mikroproduktion installatører.

Det er nemt at installere, behøver kun to tråde, der forbinder ind i din "Dybkoegers" (Varmtvandsbeholder) kredsløb og der er ingen ændringer i de vigtigste hus installationer. En sensor clipses på en af de hoved ledninger nær tavlen eller din forbruger enhed. Det bruger din eksisterende 3kW dybkoeger som sidder i næsten alle varmtvandsbeholdere, så der ingen udgift er eller nødvendighed for udskiftning.

Typisk tilbagebetalingstid i UK er 2-3 år, hvis du normalt bruger gas, vand varme, eller 1-2 år, hvis du har olie, LPG eller alm. elektrisk vandopvarmning. For de dyrere brændstoffer en typisk britiske familie hus med en 4kW PV-system kunne spare 2000 DKK af dit årlige vand varmeregningen.



## Save Energy with Intelligence

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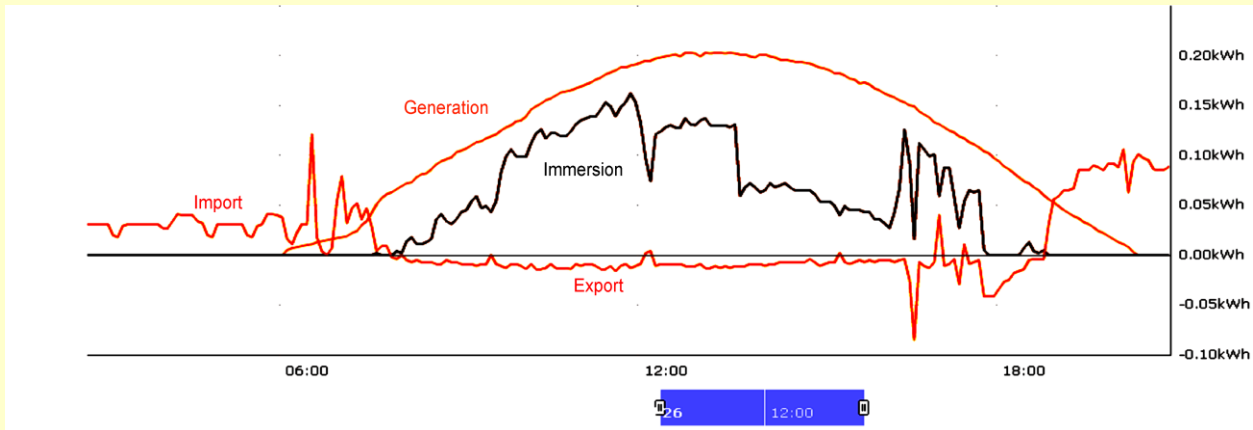


Save Energy with Intelligence

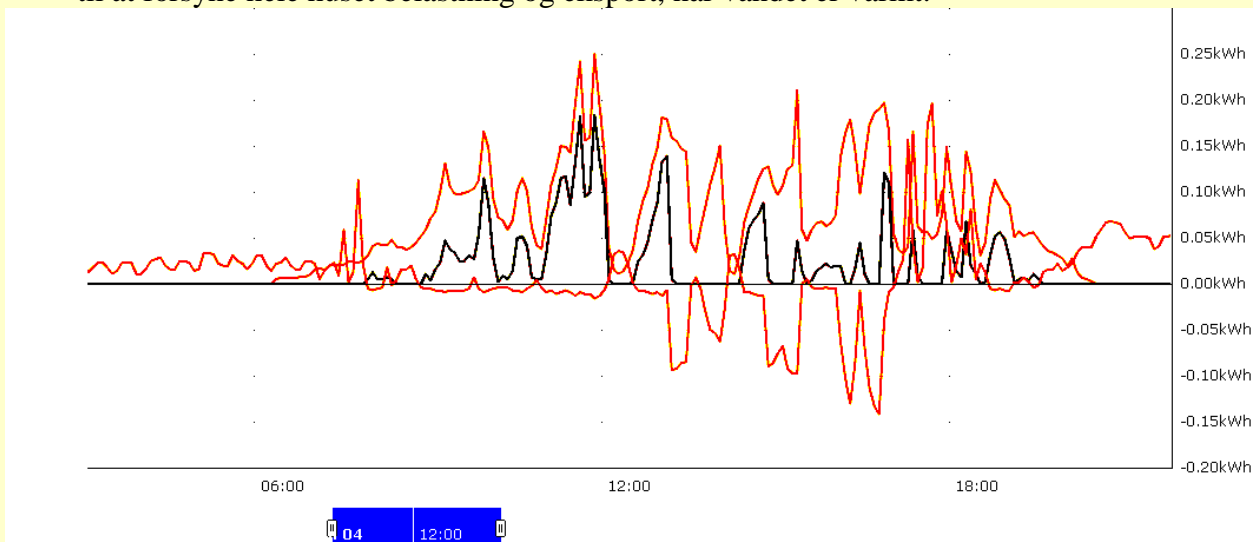
### HVORDAN DET PERFORMER?

Disse daglige grafer er taget fra en I2 installation i London i sommeren med en 3kW solcellesystem. Den lodrette akse er kWh i en 5 minutters periode.

I den første graf eksport kontrolleres til en lav værdi, indtil termostaten kobler ud ved 4:00. Omkring halvdelen af generation går ind i fordybelse, en lille mængde er eksporteret og resten feeds huset belastning.



I den anden graf vandet har nået denne temperatur med 12,30 da der er mindre brugt vand. For resten af den dag termostaten cykler til at holde vandet varmt. Trods skyerne går forbi, hvilket gør den generation variabel op til 12,30 for I2 hurtige processor meget præcist styrer eksport til en stabil minimum og udøver derved hver gang termostaten skærer i igen. Den har kun importerer strøm, når solen er for svagt til at forsyne hele huset belastning og eksport, når vandet er varmt.



980kWh blev leveret i denne fordybelse i et år. Med de mere almindelige 4kW solcelleanlæg ville det have været omkring 1500kWh.

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### SPECIFICATION

Parameter	Data	Notes
Voltage range	210-250VAC, 50+/-2 Hz	
Load rating	3.5kW max resistive	2 - 3kW belastning anbefales. Må ikke spore så præcist med en lavere belastning. Brug ikke induktive (fx til motoren) eller kapacitive belastninger
Terminals	DIN terminals for 2.5 or 4mm <sup>2</sup> cable Small terminal strip for current sensor	One 3 core cable to MCB One 3 core to load Sensor to near consumer unit or DNO meter
Cable entry points	Two 20mm diameter holes in end wall of enclosure	Suitable for connection to conduit, fitting cable glands or using without extras
Turn on threshold	40W of export to grid	Default value can be altered down to zero (applies to version 2.3 software and above). This sheet assumes the default is set
Quiescent power	0.5W	
Power consumption in unit	0.5W + 0.5% of load power	
Efficiency (% input power transferred to hot water)	>99% (for power more than 500W)	Gas and oil boilers are around 50 - 70% for short water heating cycles
Case	Cast aluminium	
Thermal rise of case at 2kW	<15C	In free air
Time to stabilise load power after an instantaneous step in generation or house load - 200W step	<2 sec for 200W step <5 sec for 2000W step	Much faster with software version 2.4
Temperature range - operating	0 to 40C	Assumes a free flow of cooling air around unit
Temperature range - storage	-30 to 70C	
Humidity	Non condensing	
Dust and water protection	IP50	Semi sealed. Keep away from dripping water, not for outdoor use.
Sensor	One clip-on current sensor around incoming mains supply	
Sensor cable length	2 m	Can be extended up to 20m
Front panel controls	Switch for load off, automatic operation, load fully on, one hour top up	Can override permanently or set a one hour top up at full load power
Indicators	LEDs for power level to load,	

## Save Energy with Intelligence

	import power level, export power level	
Enclosure size	220 x 145 x 55mm	
Weight	900g	
External wiring	2.5 or 4mm <sup>2</sup> twin and earth recommended	Must be earthed
Mounting	3 holes in back plate for screws. Mount in free air. Any orientation allowed.	Recommended to mount near consumer unit
Protection	15A and 1A fuses Surge suppressor EMC filter	
EMC and Approvals	CE marked EMC and Low Voltage Directives 2004/108/EC and 2006/95/EC BS EN 61000-6-1 Generic Immunity BS EN 61000-6-3 Generic Emissions BS EN 61000-4-3 Immunity to radiated emissions BS EN 61000-4-14 Flicker	For UK/EU use only  Does not use Burst Firing to control power so no risk of causing owner's and neighbours' lights to flicker
Warranty	3 year return to base	Made in UK
Expected life	20 years	No moving parts apart from occasionally used switch
Expected MTBF	>200,000 hours	
Supplied with	Current sensor Operating manual Installation manual	
<b>Vejledende ydelse med et 4kW solcelleanlæg i London (Note 1)</b>		
Vejledende årlige input til dypekoger	1200-1700kWh	Antager en 4 personers husstand. Realistisk maksimum er omkring 2000kWh
Maximum daily input to immersion heater	15kWhr in summer	Can be up to 20kWh if house load is very low
Payback time with gas or Economy 7 water heating	2-3 years	Not including installation cost
Payback time with oil/LPG/full rate electricity water heating	1-2 years	Not including installation cost

Note 1: Performance og payback tider er ikke garanteret. Fordi hvert hus er anderledes i sin mængde af solskin, størrelse af PV system, brug af varmt vand og elektricitet, osv. vi kan kun give vejledende tal. Vi kan dog sige, at I2 ydeevne er lige så god eller bedre end nogen anden proportional viderestilling controller øjeblikket er til rådighed, og meget bedre end nogen, at kun skifte belastningen helt tændt og slukket.

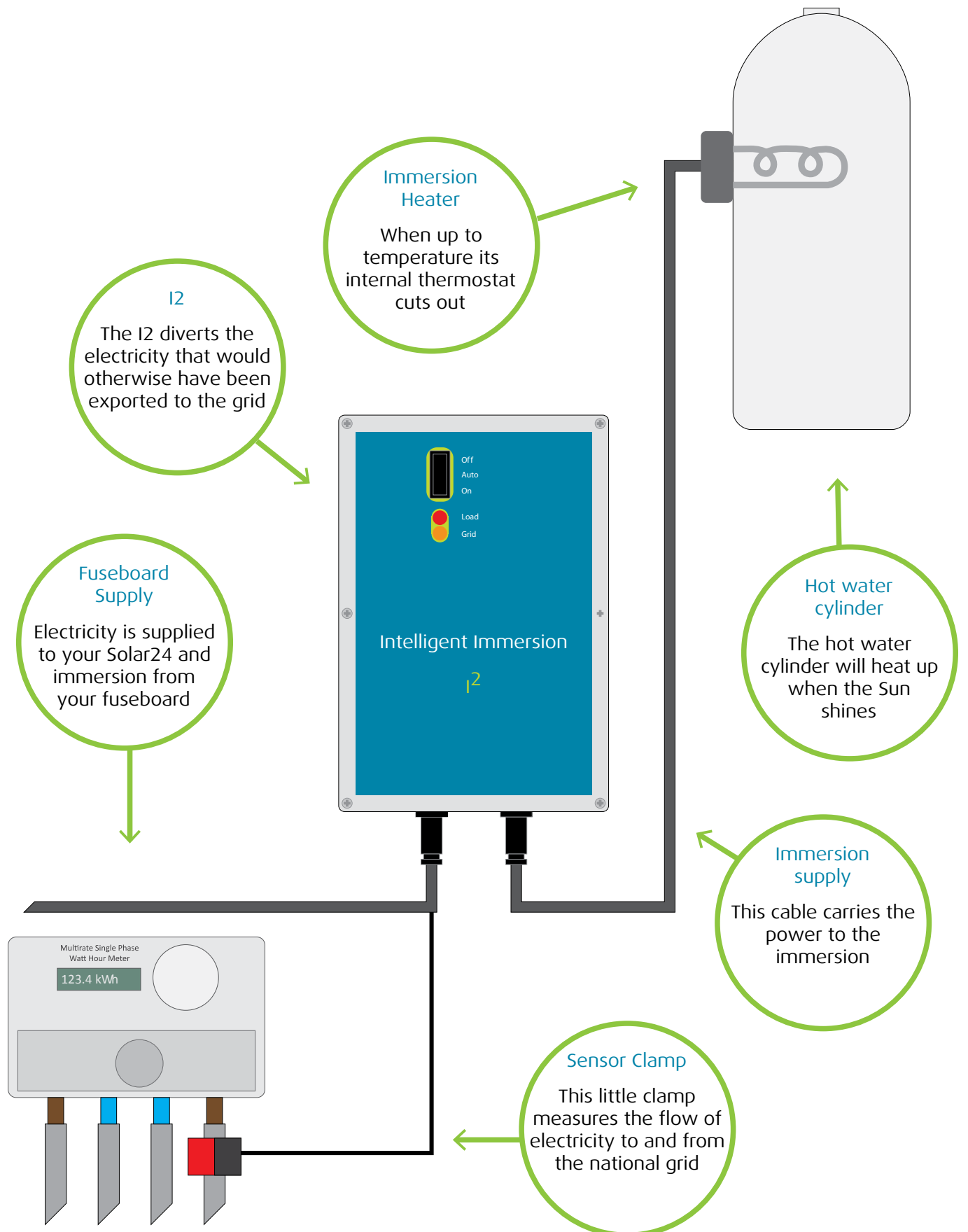
# Intelligent Immersion

i2

User Guide

# How the system works

The I2 is a simple device that enables you to capture all of the energy generated by your solar panels.



# Instructions

## Use of buttons

### 'Auto'

The switch should usually be left in the 'Auto' position.

### 'Off'

Use 'Off' when hot water is not needed for more than a couple of days (e.g. when you are going on holiday). Better still, turn it off at the isolator – this will save the standby power consumed by the I2, although this is less than 1 watt. Be green!

### 'On'

If you need a hot water top-up, e.g. on a cloudy day, use the 'On' position. This overrides the normal dimming action of the 'Auto' position and increases the import of electricity. If you have Economy 7 or similar electricity you should arrange the top ups during cheap rate times.

### 1-hour mode

Flipping the switch from 'Auto' to 'On' for more than 1 second, then back to 'Auto', starts a timed 1 hour period of fully 'On'. It can be cancelled by turning to 'Off' for more than one second. Just turning it from 'On' to 'Auto' will not cancel the one hour period.

## Routine checks

From time to time, check that the Solar24 is working correctly. When there is a good amount of sun and there are no large house loads on, check that that the red light is on and that the amber light is very slowly blinking. This shows that the immersion is being powered and export is low. When the amber light starts flashing quickly with the red light on, the water has finished heating and power to the immersion cuts out or you are generating at least 3kW more than your house load.

## Health and safety

For protection against harmful bacteria you must heat your whole cylinder up to 55-60C at least weekly just like in a normal hot water heating system (set your thermostat to 60C and check it is accurate.). Seek independent advice for further information.


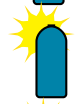

it is normal I2 to become slightly warm, but if it gets too hot just turn the system off at the isolator and give us a ring.

## Energy conservation

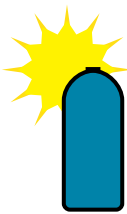
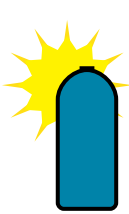
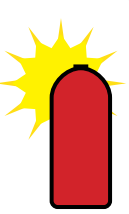
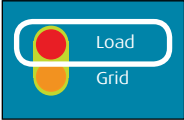



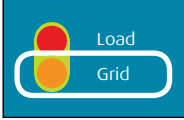



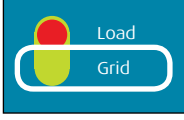







If necessary, set your boiler to come on in the evening or I2 via its 'On' switch. Unless you use most of the hot water immediately it is generally better not to put your boiler on in the morning. This means that there will be plenty of cool water to be heated up by solar electricity throughout the day. A well insulated cylinder should retain enough heat from evening to morning to run a few showers in the morning.

## What the lights on the on the box mean

The Solar24 has two lights: a red load light, and a flashing green/amber grid light. Here's a guide to how they behave depending on whether:

-  the water is not fully heated and the house demand exceeds the solar electricity supply
-  the water is not fully heated and the solar supply exceeds house demand
-  the water is fully heated so the solar supply exceeds the house demand and the immersion thermostat has cut out

The speed at which the grid lights flash depends on the amount of electricity being imported or exported.

			
		 <b>Dim/bright</b>	
		 <b>Export</b>	 <b>Export</b>
	 <b>Import</b>		
			







## [Intelligent Immersion model I2 - Installation Manual](#)

### **Safety Warnings**

*It is the responsibility of the buyer/installer/end user to ensure that the I2 is fit for use in the intended installation and is safely installed by suitable qualified and experienced personnel. Ensure the installation complies with IEE wiring regulations. Ensure all mains supplies including the microgeneration system are turned off before wiring the I2.*

*Make sure the lid is screwed on before mains voltage is applied as lethal mains voltages are present inside the enclosure. The enclosure must be earthed via the supplied earth terminals.*

*For loads of other than 3.0 +/-0.5kW rating these notes are not fully applicable. These notes assume the load is an immersion heater; other types of load are possible but these notes do not apply and the installer must ensure it is safe to use the intended load. A solar PV microgenerator is assumed here but the notes can be adapted for grid tied wind or water turbine generation. These notes only apply in the European Union and the I2 only has approvals for use in the EU.*

### **Materials needed**

To install the I2 you only need, in addition to what is supplied with the unit, a few standard electricians' items such as:

- Cable ties to secure cables
- Twin and earth cable
- Screws for mountings
- Optionally 20mm conduit or cable glands

Tools needed are screwdrivers and wire strippers.

### **Mounting the unit**

Mount the I2 on a non flammable surface using the screw holes in the back face. It can be orientated any way round but putting the face that the ratings label is on vertical ensures the best cooling. Make sure the customer can reach it easily to use the switch and indicators. Ensure the current transformer (CT) cable can reach to where it will be clipped. Make sure there is no readily flammable materials near the cable exits as say failure to tighten the wiring in the terminal block could cause a heat build up, thus you need to be sure it can not burn any materials in that area.

Do not install it outdoors and keep it away from dripping water and condensation.

The unit gives out a small amount of heat so must be mounted in a place where a free flow of air occurs, the air is less than 40C (lower for increased reliability) and no adjacent object radiates or convects heat. Leave 50mm gaps all around the box for cool air to circulate; on the face with the ratings label the gap should be at least 75mm. Airing cupboards and lofts are not recommended as they may be too hot. We can not give definitive guidance for all situations but as a rule of thumb any enclosed space less than 0.5m<sup>3</sup> in volume or that is well insulated would need some ventilation holes with total area more than 1000mm<sup>2</sup> at bottom and 1000mm<sup>2</sup> at top to allow cool air to flow up through the space. The important point is that the space must not heat up to more than 40C due to the unit's own heat or other heating sources.

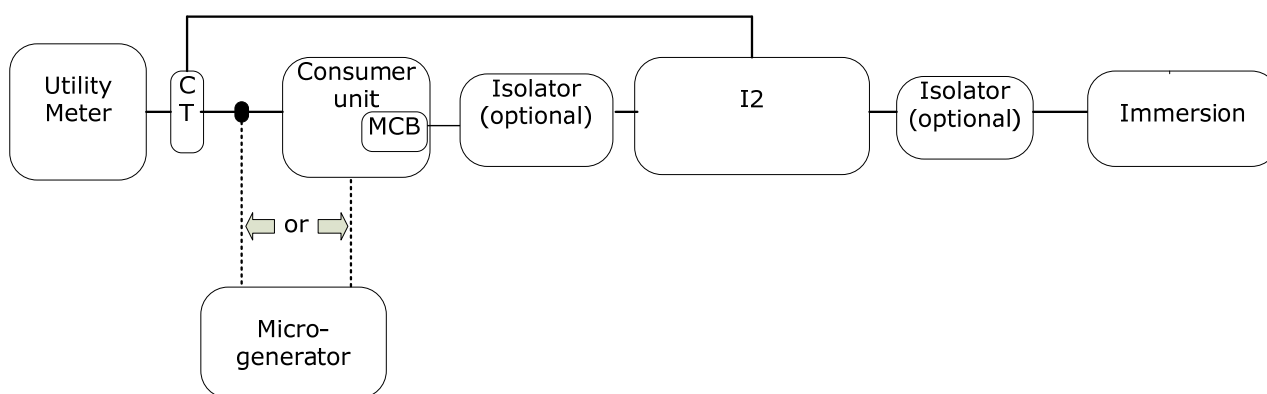
Thus small cupboards around consumer units may need ventilation holes added. Airing cupboards may be too hot unless the hot water cylinder is very well lagged.

If mounted in a cold area like a garage protect it from below zero temperatures e.g., by placing a cupboard around it.

Very slight buzzing from the unit when the sun is quite bright is normal. It is the EMC filter doing its job properly. Ensure it is not mounted in a position where this slight noise may affect the customer. Consumer unit cupboards should be OK but the unit should not be mounted in a living space like a sitting room unless inside a cupboard that masks the noise.

### Wiring the unit

The I2 should be inserted into the mains circuit between the consumer unit immersion MCB and the load as per the User Guide and the diagram below. The best place to mount it is near the consumer unit as it is usually easy to access the cable to the immersion at this position and simply move it from the consumer unit MCB to the terminals marked "load" inside the I2. Run a short length of new 3 core cable from the I2 "in/supply" terminals to the MCB.



Use solid core cable between the I2 and the MCB suitable for >16amps, such as at least 2.5mm<sup>2</sup> twin and earth. Follow IEE wiring standards. Between the I2 and the load 2.5mm<sup>2</sup> or 4mm<sup>2</sup> twin and earth may be needed for a 3kW load. The terminals accept up to 4mm<sup>2</sup>.

The I2 should be wired to a 13amp fused spur or protected by a 16amp MCB to protect the wire between the supply and the I2. An internal fuse protects the I2 itself.

Do not use flexible cable for the mains connections.

Ensure there is no fraying of cables against the holes in the enclosure. Use the supplied blanking plugs to make grommets or wrap the wires with insulating tape to cushion the wires from the enclosure. Or commonly available (thread size 20mm) plastic glands can be fitted into the two cable entry points or 20mm conduit can be used. Double check the connections inside the I2, especially the earth connections.

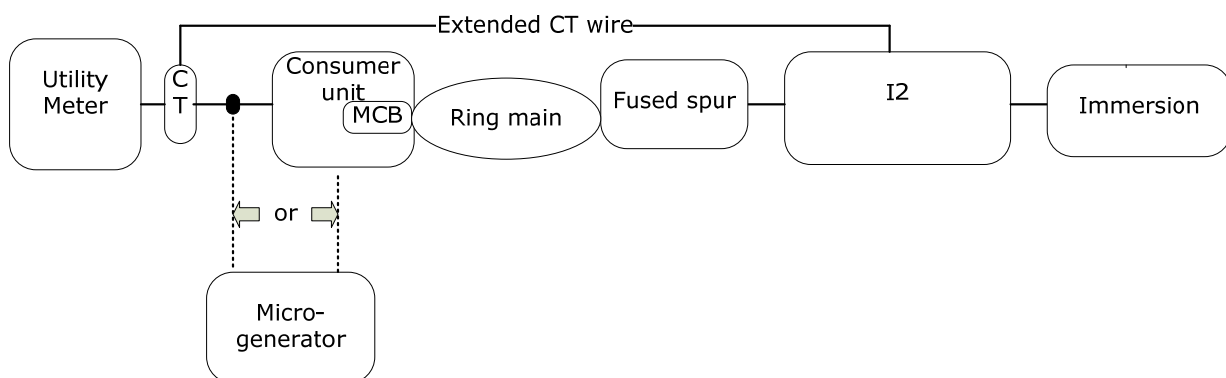
**Use cable ties to secure both mains and CT cables to ensure that the cables can not be pulled out of their terminals** by tugs on external cabling. Ensure there are no loose strands of wire sticking out of the terminals and clear out any wire clippings left inside the box, especially any lying on or under the PCB. For touch protection check the relay's transparent cover is clipped over its terminals; it only fits one way round.

All items in the circuit using electronics or motors between the I2 and the load, including time clocks, must be disconnected or they could be damaged by the I2's modulated mains output. Volt free contacts of time clocks, relays, contactors, etc. and fuses and isolators are allowed.

### Alternative installations

If removing these items is not possible or the immersion is on a ring main shared by other appliances an alternative installation where the I2 is put near the load instead of near the consumer unit is possible. Use a fused spur at the immersion position for the I2 and extend the current transformer sensor (CT) wire to run back to the consumer unit as in the diagram below. The extended cable should be run at least 200mm away from any mains cable carrying the I2 supply or load current. The performance of the I2 in terms of its ability to minimise export may be slightly degraded if more than 20m of extension is used, due to cable resistance and interference pickup in the cable. However it should still operate successfully with longer extensions up to 50m.

Extension cable should be shielded CAT5 or 6 network cable (use one of the twisted pairs only) or shielded single twisted pair cable such as microphone cable. Ensure the polarity of the CT is maintained. The shield must be connected to the earth terminal on the PCB with a short wire that is spaced from any mains wiring. Do not connect the shield to any earth or other connection at the CT end.



Clip the CT around the main incoming live wire in or near the consumer unit or near the main meter (not the PV meter) so it records **total house current**. Pressing the tab on the CT with a medium sized flat screwdriver makes it easier to release the catch. Only clip around a single wire. It does not matter if the wire is not centrally placed in the CT. The normal current in this wire must not exceed 100A. It must be **on the grid side** of where the microgenerator feed into the house wiring (e.g. might be at a Henley

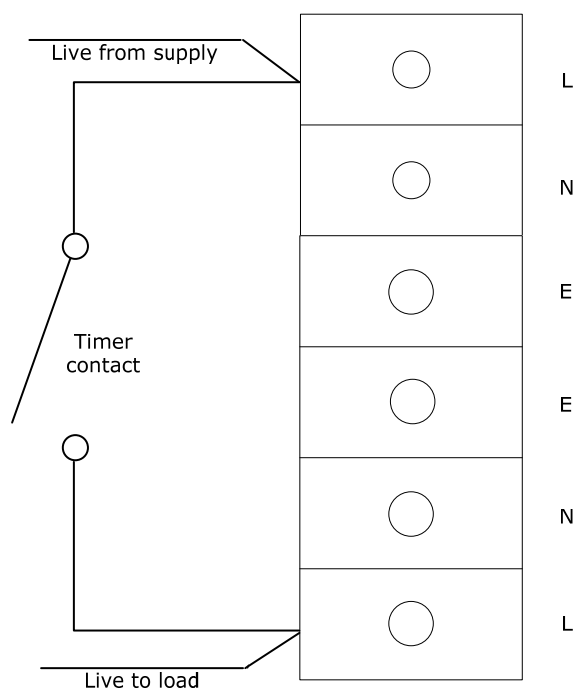
block or in the consumer unit) as per above diagrams. Or use the neutral wire and point the arrow towards the consumer unit. Make sure the CT is clipped tightly shut as the split ferrite cores inside it must touch each other.

### Get the most from your system

Any immersion thermostat in the circuit must be a modern one with both thermostat and overheat safety cut-out as per BSEN60335-2-73. The increased immersion running time that the I2 may cause makes it very important to have a safe modern thermostat with full boiling protection. Immersions older than around 7 years will not comply and even some more modern ones may not have the right thermostat fitted. Old elements should ideally be changed whilst the contractor is present as they may not last long with the increased usage. Especially in hard water areas old elements can be quite degraded.

To heat more water consider fitting as long an element as will fit, particularly if it is a  $> 3\text{kW}$  PV and /or a large hot water cylinder (HWC). Also consider a larger hot water cylinder if it needs replacing anyway. To account for the fact that not all days are sunny it is useful to have at least twice the water capacity used each day. 200-250litres is a useful sized HWC for 4kW PV systems. A standard foam clad cylinder does not have enough insulation so add a jacket or even two jackets.

In installations which use Economy 7 for water heating the customer may wish to carry on using Economy 7 for topping up the heat. To do this wire the I2 in parallel with the switched terminals from the Economy 7 timer, e.g. with switched terminals across live supply and load terminals as per the figure below. When the switch closes the I2 will be powered up but not controlling the load. Its indicator lights may not provide meaningful information in this mode. Normal automatic operation resumes when the switch contact opens. There are now dual sources of supply to the load so any isolator should cut the feed to both the immersion timer contact and the I2. Do not power the timer clock itself from the I2's output.



The unit consumes some harmonic current from the supply. Do not install many units in one street or estate as the additional harmonic current may be more than the electricity supplier (DNO) allows on one substation transformer.

## Testing

Turn off the microgeneration system or perform these first 2 paragraphs when there is no generation. Connect the load and make sure the water temperature is lower than the load's internal thermostat setting or else it won't draw any current.

Check the switch is in centre (auto) position. Turn on the isolator and the yellow LED should start at half brightness, dimming in a few seconds down to off. If it brightens up the CT is mounted the wrong way round; reverse it or the CT wires in the terminal block.

Turn on the PV system and on a bright day where there is enough sun to export electricity the red grid LED should blink from on and off very slowly indicating a small export (less than once per approx 30 secs, see Note 1). The yellow LED will brighten up as the sun brightens (as long as house load is constant). Turn on a kettle or other multikilowatt load and the yellow light will dim or go out. Failure to change may indicate that the CT is not correctly connected or not clipped shut.

Optional. With a true RMS energy meter (Note 2), clip it around the same cable as the CT and check that the power recorded on the meter is in the 0-300W control range. It may regularly change slightly and the yellow LED brightness alter a little even if the PV and house load is steady; this is normal as the relay is switching between two of its many discrete power levels.

For the first few days turn the I2 off at an external isolation switch overnight and when the customer is out. This is a protection against the wiring being faulty or the immersion thermostat not correctly cutting out when the set temperature is reached. Once confidence is gained leave the isolator on.

It is also possible to partially test the unit "on the bench" if you wish. Connect a normal 13amp plugtop and lead to the input terminals, making sure the earth is connected. Do not connect a load or clip the CT to anything. Check the switch is in centre (auto) position. Turn on the mains and the yellow LED should start at half brightness, possibly slowly dimming down to off or up to full brightness. Try the switch in On and Off positions to check the yellow LED goes fully on and off respectively. The grid lights will rarely come on and only flash slowly.

## Calibration

Calibration is not required.

## Operation

See the User Guide. Additional notes:

The yellow LED indicates that the relay is trying to power the load rather than being a real measure of power delivered. Thus if the thermostat cuts out the immersion this LED may still be lit even though no power is being delivered to the immersion. It will be delivering power if the filter (the large silver coloured item inside the box) is

buzzing slightly but lack of buzzing does not necessarily mean that no power is being delivered.

The backup water heating needs to be carefully set. Generally set it to come on only in the evening after the sun has almost gone down or use the I2 override. Morning top ups should be avoided unless most of the hot water is definitely used immediately. As with most solar hot water heating systems customers need to get into a mentality of accepting that occasionally the cylinder will be less than fully hot, as attempting to always have it hot leaves little cool water to heat up by the sun. Tops ups should therefore be as short as possible. A well insulated cylinder should retain enough heat from evening to morning to run a few showers in the morning.

### **Fault finding**

Repeat the first three paragraphs of the Testing section above if a fault is suspected. No lights showing at all (for say over one minute as normally there are periods when none show) may indicate a fault such as:-

Loss of mains input. Check external wiring and fuses/MCB.

Main fuse failure, mounted in lid of the enclosure. Short circuits in the load or its wiring will blow this fuse but the MCB may not trip at the same time. This 15 or 16amp fuse must be replaced by the same fast acting fuse type or else the I2's relay will not be fully protected against failure if a short occurs.

Loose wiring. Tighten up the terminal block screws after checking that the terminals have not become damaged by sparking.

The immersion has failed. Immersion elements can have a short life with hard water if the wrong sort of element is used.

Loss of CT input. Check wiring and make sure clamp is clipped shut. It may buzz loudly if open.

For any other failures consult the supplier.

Tighten up the screws holding the box to the wall and the filter and lid to the box if the buzzing from the filter becomes unusually loud.

Although the unit complies with relevant electrical interference regulations slight radio interference in the form of buzzing may be noticed on Medium and Long Wave when the immersion is being powered if a radio is very close. Try moving the radio away from the I2 and its mains wiring, or plug it into a different ring main if mains powered.

### **Notes**

#### Note 1

The I2's red/green grid LED can not blink more rapidly than once per two seconds. Any significantly higher rate is not particularly recommended for epileptic sufferers. Thus any export or import greater than about 7 kW will all deliver a blink rate of once per two seconds. One on/off cycle represents about 4Wh.

This cap does not affect the I2's control functions which operate separately from LED blinking.

### Note 2

Not all meters can correctly record the non sine wave (but legal) current waveform that the proportional action of the I2 produces. A good quality power meter is needed. Measurements of true RMS current and RMS voltage multiplied together will be very inaccurate.

A better way to check if the I2 is really causing any import may be to watch the main house meter. It should ignore exports (although some wheel style meters are of doubtful performance here), so any readings made when the I2 is running represents a true import. Note that if the meter has a pulse light this may flash on both export and import even if the meter digits only count the import.

Remember that there will be an import whenever the microgenerated electricity is inadequate for the house load. Also the I2 takes a few seconds to react to any large change in PV or house current and stabilise, so for up to 5 seconds there could be a very slight import but it will be negligible compared with the kWhr of export saved.

### **Support**

For any clarifications please email [info@intelligent-immersion.co.uk](mailto:info@intelligent-immersion.co.uk)  
We pride ourselves for our comprehensive and helpful technical support.  
Website [www.intelligent-immersion.co.uk](http://www.intelligent-immersion.co.uk)

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