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List of Abbreviations:

Abbreviation	Description
DB	Distribution Box / Distribution Board.
PV	Photo Voltaic / Photovoltaic System.
SOC	State of Charge of the batteries.
ICC	Inverter Control Centre.
SSR	Solid State Relay.
USB	Universal Serial Bus.
DIN	DIN (Deutsches Institut für Normung) metal rail of a standard type widely used for mounting circuit breakers and industrial control equipment.
Pi	Raspberry Pi hardware.
OS	Operating system.
SD Card	Secure Digital Storage Card.
Dry Contact	Dry contact means no energy is supplied to the contacts (completely passive and isolated).
Genset	A combination of diesel/fossil fuel driven engine and electric generator.
CT	Current Transformer. Unit used to monitor current flow via induction process.

Partners and approved suppliers:

	ICC Software	info@iccsoftware.co.za	www.iccsoftware.co.za
	Centurion Solar	info@centurionsolar.co.za	www.centurionsolar.co.za

Relay and Home Automation DB:

Background:

Whilst dealing with users from all walks of life in the Solar/PV arena, and the fact that more and more users have moved over to Solar energy either partial or fully it has become apparent that there are numerous shortcomings and/or requirements that could enhance the use of these said systems in a more efficient way.

The relay option to control “heavy loads” was specifically developed and incorporated into ICC to enable the user to switch “heavy loads” on or off based on SOC of the battery. There was a requirement as well to enable the user to switch these loads under certain time conditions as well. The advantage of time switching is that a user can for example switch on one or more “heavy loads” during specific time slots of the day to ensure that maximum use is made of the available solar. The SOC option was also added as some users would rather prefer the PV charge the batteries as first priority, and as soon as a set SOC is met, the relay can be switched and thus “loading” the system to ensure maximum possible solar production. On the lower end the relay will disconnect the “heavy loads” again as soon as the SOC fall below a set number to ensure that enough battery power is conserved to run normal loads for the required times.

All three relays in the system are controlled individually from the ICC Home Automation tab, and every individual load circuit can be named in ICC, and controlled by either time, SOC, or Grid Availability.

System Components:

1. **The Relay Distribution box**, also referred to under the Home Automation tab in ICC is made up of the following:
 - a. 18U White Plastic Distribution Box with Smokey lid including Earth & Neutral bar. (Wall mount unit).
 - b. Control board for communication between ICC and Solid State Relays. (SSR).
 - c. 63A DIN Miniature Isolator 400V.
 - d. Three 32A DIN Miniature Circuit Breakers:
 - e. Three 50A DIN Solid State Relays. (SSR).
 - f. USB A-B Communication Cable.
2. **Control Board:**
 - a. The Control Board interfaces between ICC and the Solid State Relays to trigger relays as per settings in ICC Home Automation Tab, as well as monitor those relays and relay state information to ICC.
 - b. The Control Board communicates with ICC Pi via Standard USB A-B cable. (USB Socket situated on the side of the DB Unit.
 - i. Pro's:
 1. Easy to interface.
 2. Cheaper option for communication.
 - ii. Cons:
 1. Limitation on the distance from the Pi ICC unit.
 2. Limitation on the distance from the Main feed DB/Inverter Main DB.
3. **63A DIN Miniature Isolator 400V.**
 - a. This is the main DB Isolator to break all current flow to all three relays in the event of a system malfunction or other related overload.
4. **32A DIN Miniature Circuit Breakers:** (Three in total).
 - a. The main function of these 32A breakers are to protect the 50A relays and also functions as current overload for each individual circuit.

5. 50A Solid State Relays. (SSR) (Three in total).

- Each SSR operates independently from each other and are individually protected by the 32A breakers as mentioned in 4a above.
- Each relay are controlled by its corresponding setting as per Home Automation tab in ICC.

Additional Safety features:

- The **Control Board** within the **Relay Distribution box** monitors for a heartbeat communication command from ICC at all times. Should the heartbeat stop from ICC the relays will go into the "Off" state within 5 minutes of the last heartbeat received. This is done in order to protect the batteries and related systems from overloading the system should ICC stop communication.
 - ICC communication failure can result from various causes listed but not limited to below:
 - ICC Stop or hang for any reason.
 - Pi hang due to hardware or OS error.
 - SD Card corruption.
 - Power failure to Pi.

Home Automation Tab under Settings in ICC:

The screenshot displays the ICC Home Automation settings interface. At the top, it shows the ICC logo, a 'Stop' button, 'RunTime 24:35:27', 'PI: 43.5°C', and a 'Change To Battery' button. The main navigation bar includes 'Dashboard', 'Dashboard 2', 'Inverter Values', 'Grid Trends', 'Load Trends', 'PV Trends', 'Battery Trends', 'Hour Totals', 'Threads Info', 'Totals', 'Settings', and 'Info Logs'. The 'Home Automation' tab is selected, showing settings for three relays:

Relay Name	Status	Use Time Control	Use SOC Control	Use Grid Availability	ON Value	OFF Value
Pool Pump	OFF	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	08:00	16:00
Geyser	OFF	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14:30	16:00
Drier	OFF	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	00:00	00:00

Each relay configuration also includes a 'Relay Control' button, a 'Manual Override' button, and numerical input fields for 'ON Value' and 'OFF Value' with up/down arrows.

Future enhancements and changes:

1. In the next release of the *Relay Distribution box*, we will have the option to communicate wirelessly to the Pi ICC system.
 - a. Pro's:
 - i. Extended range achieved between Pi ICC unit and Relay DB.
 - ii. Extended range achieved between Monitoring system and Main feed DB/Inverter DB.
 - b. Cons:
 - i. More expensive than USB protocol.
 - ii. Limitation in general home for communication of 50m to 75m.
 - c. This option has been developed and is in testing at the moment, once all tests have conformed to acceptable standards incorporation into the bigger system will be implemented.
2. It is also envisioned and currently in testing phase that the next release of the *Relay Distribution box*, will have the following options:
 - a. One "Dry Contact" configurable for Start/Stop of Genset.
 - i. Some considerations in this regard still outstanding is to be able to configure the Genset signal from ICC to accommodate different requirements from various manufacturers.
 - ii. There are also the variable from standard two wire relay contact with signal, to three wire interface with independent start and stop signals.
 - iii. There then need to be a separate tab added to ICC/Home Automation for Genset control for the Generator Start/Stop Assistant.
 - b. One to three CT inputs to be used for monitoring identified load lines.
 - i. This will be done by "Clip-On" CT clamps, and although it is envisioned that the Relay Distribution box Control Board will host three CT Inputs, the CT Clamps can be implemented individually.