Open DC Grid Project

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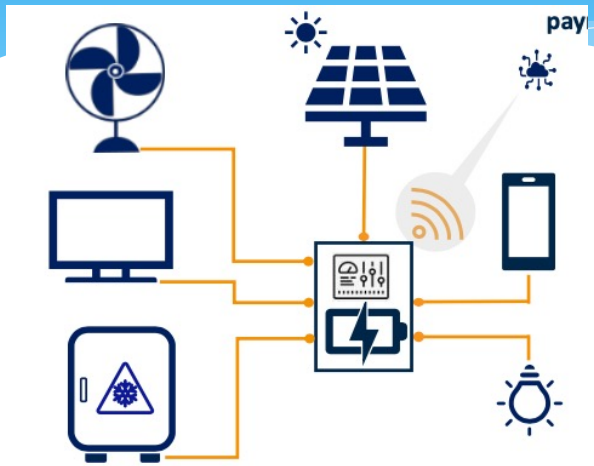
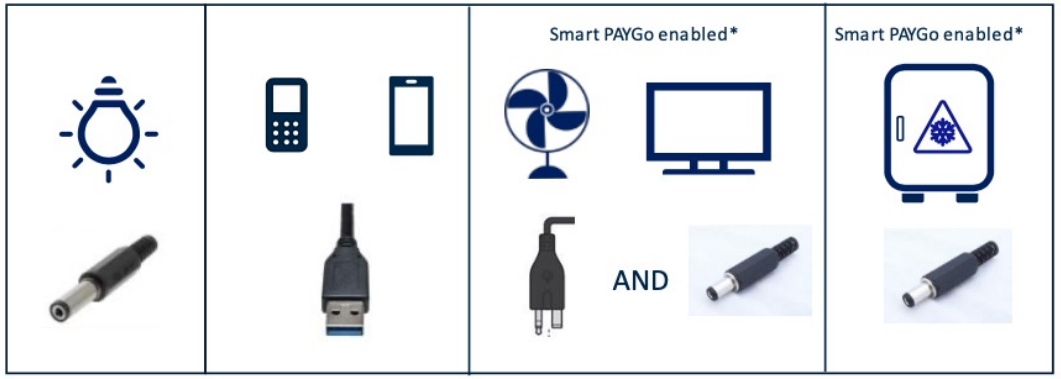
James Gula - jlgula@papugh.com
Martin Jäger – martin@libre.solar
Chris Moller – chris.moller@evonet.com

Agenda

* GOGLA Connect Initiative
* Related Standards / Industry Developments

Connect Initiative - Introduction





* Recommendations for 12V SHS-appliance interconnect
* Intended for SHS kits up to 350W
* Appliances and loads up to 100W (actually 10V * 8A delivered)
* Intended for home use excluding high power like agriculture
* Supports both smart (managed) and basic (unmanaged) appliances

Connect Initiative - References

* Connect Initiative is a “guideline” not a standard
* Consistent with though not formally compliant with:
  * IEC/TS 62257-9-5 Recommendations for small renewable energy and hybrid systems for rural electrification - Selection of portable PV lanterns
  * IEC/TS 62257-9-8 Renewable energy and hybrid systems for rural electrification - Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W
  * Verasol Quality Standards and testing protocols

Connect – Interoperability Stack

4a	PAYGo Activation (lock/unlock)	Digital Handshake
Nexus Channel (secured): Manages secure PAYGo *pairing* and *activation* of appliances based on commands from software platform.		

4b	Load management	Data feedback
Nexus Channel Core (not secured): Enables load management (sharing limited battery energy), data feedback (to view performance or faults) and other functions.		

3. Communications protocol
Open PAYGo Link: A communication channel on which Nexus Channel can 'speak' between SHS Kit and Appliance.

2. Electrical Characteristics
The voltage current, etc. ranges to ensure compatibility.

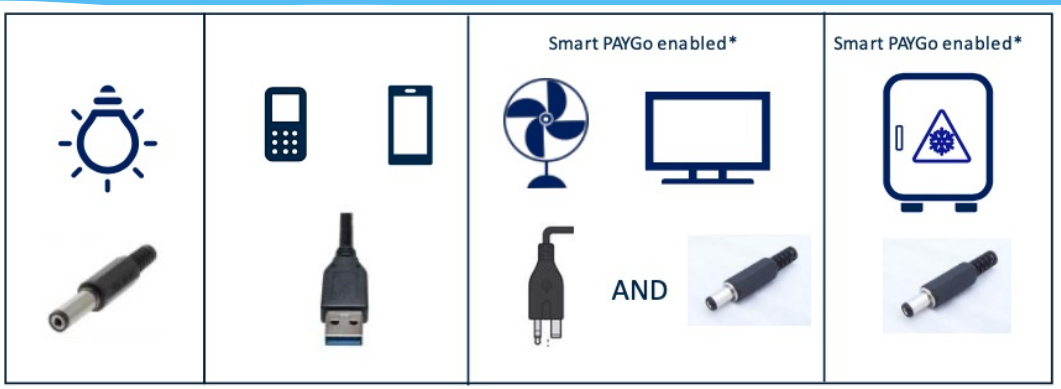
1. Connector
The physical connector (plug and socket) that joins the SHS Kit and appliance.

Using Nexus Channel with OpenPAYGo Link is like agreeing that we will speak English and talk on the telephone.

Connect – Not in Scope

* What should be communicated to an independent testing agency
* The Testing and Sampling regime
* Environmental requirements
* The effectiveness, energy efficiency or safety of appliances
* Durability, sustainability, repairability
* USB and smartphone charging (beyond highlighting the issue)
* Protocols for smart loads (a future Connect Affiliates document)
* Conducted and radiated electrical noise
* Appliance ride-through time
* Anything relating to solar panels or SHS inputs

Connect - Ports



* B3.5 – a basic power port capable of delivering up to 3.5amps
* S3.5 – a smart power port capable of delivering up to 3.5amps,
* B8 – a basic power port capable of delivering up to 8amps
* S8 – a smart power port capable of delivering up to 8amps
* USB Type A
* USB-C (option)

Connect – Voltage Range

* Voltage as measured at SHS port: 10.5 V – 15 V
* Voltage as observed at appliance: 10 V – 15 V (IR drop)
* Maximum voltage issues:
  * Below 16V specified by ISO 16750
  * Below >15 V necessary for lead-acid equalization/desulphation
* Minimum voltage issues:
  * Output down to 9V permitted with visual indication
  * No clear definition about appliance behavior at low voltage

Connect – Voltage Transients

* Transient limits are not specified
  * Reference is made to potential over-voltage situations
  * There is a brief mention about stability but no clear constraints
* Voltage drop-outs are described as out-of-scope
* No provision is included for noise constraints

Connect – Current Limits

* Guidelines define 3.5 A and 8 A circuit limits
* Beyond that much handwaving...
  * Ports may be labelled as delivering less than the limit
  * The system may have overall limits
* Overload protection
  * There are recommendations on how to limit current
  * In-rush issues are described
  * A specific formula is offered similar to fuse ratings
  * Protection may be to groups of ports

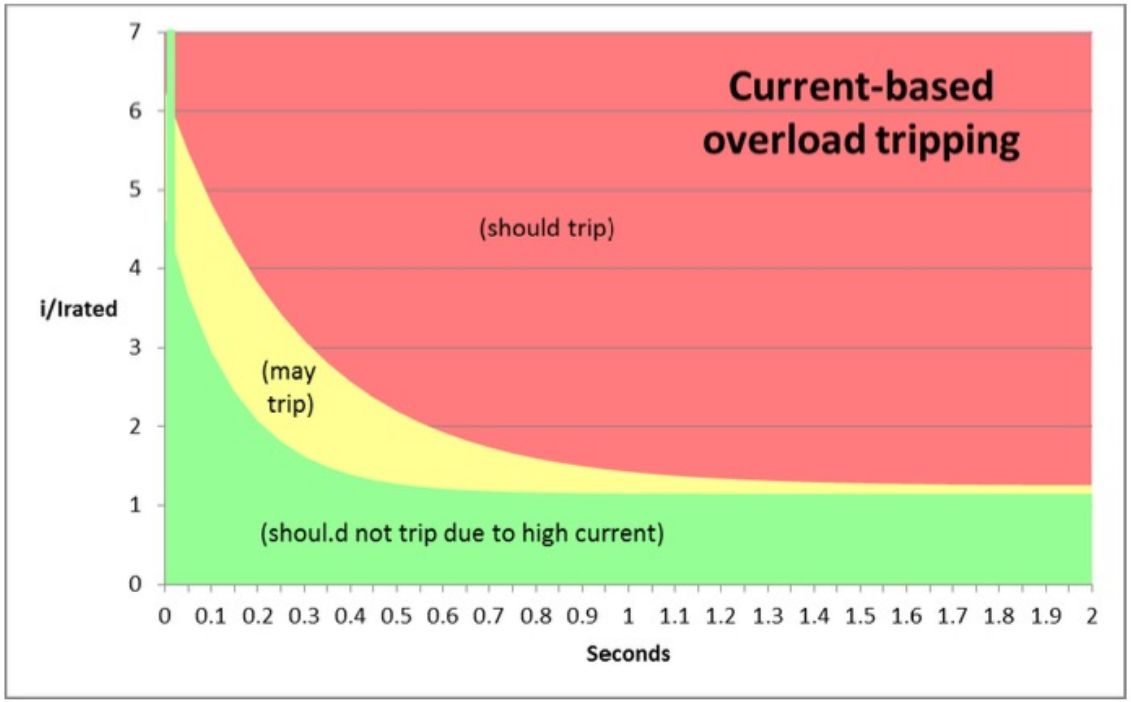
Connect – Current Overloads

Must trip:

$$i_{port} > (I_{pk}\, e^{-(t/T_1)} + 1.25\, I_{rated})$$

Must not trip:

$$i_{port} < (0.7 I_{pk}\, e^{-(t/T_2)} + 1.15\, I_{rated})$$



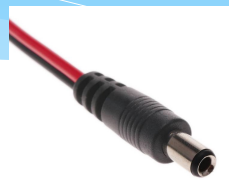
Connect – Fault Conditions

* Output port protection
  * Connection to external power source must not apply current to battery
  * Applies if SHS is on or off
* Reverse polarity protection
  * External power source must clamp at negative 1.0 V
  * A fuse is recommended to limit reverse currents

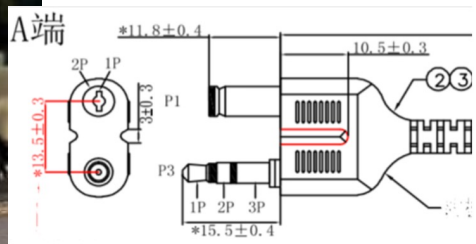
Connect – Status Indicators

* Status indicators are recommended but no specifics
* Status conditions indicated:
  * Low voltage state
  * Current overload
  * Stored energy depleted or nearly depleted
  * Battery failure
  * Equipment over-heating

Connect – SHS Power Sockets



* B3.5 barrel 5.5 mm OD , 2.5 mm ID (5525)
* S3.5 adds parallel audio jack:
* B8 and S8 (7406)
  * 7.4 mm OD, 5 mm ID
  * 0.6 mm center pin

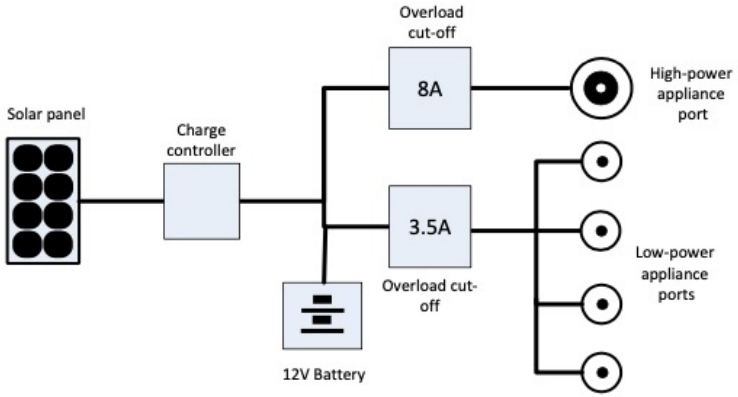


Connect – SHS Socket Labelling

B3.5:

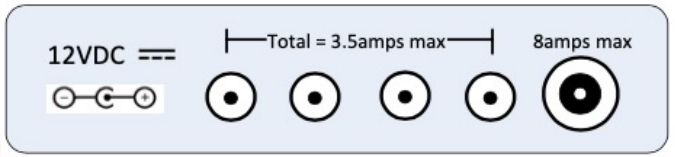
B8:

S8:



[SHS 2]

This should be labelled as follows:



[SHS 2]

Connect – Appliance Requirements

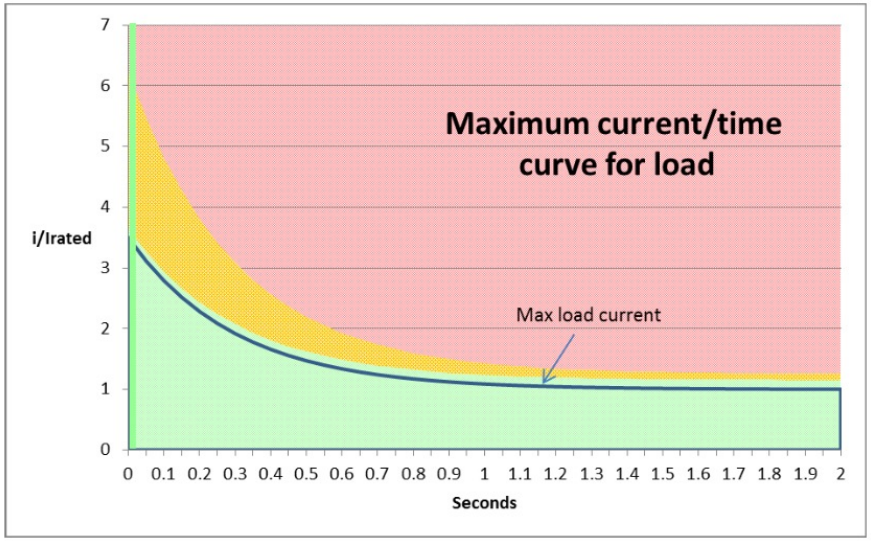
* Voltage limits 15 V – 10 V – permits 0.5 V IR drop
* May operate down to 9 V – Low voltage mode
* Power consumption should be labeled in Amps
* Galvanic isolation recommended for appliances with other ports
* Provision for in-rush:

$$i_{load} < (I_{rated}\,(1 + 4e^{-(t/T)}) \qquad \text{(e1)}$$

$$t < 8 * 10^{-5}\ secs \qquad \text{(e2)}$$

…where the symbols have the following meanings:

i_{load}:	The load current measured at appliance
I_{rated}:	The published rated maximum steady-state load current for the appliance (from the ratings plate or Technical Specification)
t:	The time in seconds since the current exceeded the rated value – ***note that this is not necessarily the time since power was first applied.***
T:	Time-constant in seconds. A guideline value of 0.3secs is given.



Connect – Test Recommendations

* Tests are defined for various voltage/ current conditions
* Some overlap with existing Verasol tests
* Some overlap with existing ISO-16750 testing
  * Missing tests like slow voltage rise, frequency sweep..

Connect – Vendor Feedback

from: Consultation Feedback

* Would like to lock appliances but worried about expense...
  * High costs of 3-pin connectors, 3-wire cables, PCBs
* Worried about loss of control over customers
* Concerned that OEM suppliers would fear competition
* Good project – "perfect manifestation of our values and visions.."
* Would like to take to IEC and IEEE...
* Wants more voltages: 3.7, 5, 7.4, 24, 48, AC mains
* More power... 350W input, only 100W output
* Want standardization of PV side as well...
* Wants to use twisted pair with combined comms
* Would like to use USB-C, micro-USB for smaller size
* Wants 10A – 25A using Anderson-like connectors

Related Standards / Industry Developments

* LFEnergy ?
* OwnTech – Open Digital Power?
* P2030.10.1 ?
* TMS ?
* GOGLA: The Connect Initiative
* OpenPAYGO Link ?
* Angaza Nexus Channel / Nexus Channel Core ?
* Open Connectivity Foundation / IoTivity -?

Next Meeting / Feedback

* Next Meeting
  * 12 July – 1400 UTC
  * Zoom – Meeting ID 87518284403 password: opendcgrid
* Sharing Portals
  * Web site: https://open-dc-grid.org/
  * GitHub: https://github.com/open-dc-grid