Title
Energy Device High Level Design

Document No.:	**MYIED09-HLD-0001**	Issue:	**A**

☒ APPROVED DOCUMENT

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Change History

Date	Revision	Description	Prepared By:
03/04/2009	A	Draft WIP	T. Marsh

LIST OF FIGURES

1.0 LEGAL

2.0 OVERVIEW

2.1 Introduction

My Intelligent Energy (MYIE) is seeking a manufacturer for its in-building power (AC) control package.

The products are to be used to control AC appliances in any building, with some feedback provided via a central unit in regard of power usage, energy usage, the attendant cost, and CO2 output.

The product set comprises two products; a basic system and expert system.

The basic system provides fundamental core functionality for the home user who only requires a simple control system with some feedback information. This is comprised of the controller and slaves.

The expert system extends the basic system to provide appliance scheduling, Ethernet connectivity with HTTP management and the ability to control more variables.

In each case, each system is specified with mandatory requirements. Optional requirements are also provided, and it is expected that these are costed in addition to a base level development/sampling cost, so the effect of more advanced functionality can be clearly assessed.

2.2 Design philosophy

Where possible, the design is to conform to industry standards and RFCs, and be designed with a view to providing either now, or via a cost effective and simple upgrade path in the future, compatibility with:

- Google PowerMeter
- Utility companies (AMR/PLC capable, now, or in the future)

The devices are intended to be:

- Scalable through the home
- Extremely robust [IP66 – less by negotiation as specified in following sections]
- Highly efficient in and of themselves
- Highly recyclable
- Low carbon input (use recycled plastics etc where possible)
- Designed for long life

2.3 Scope of Work for Manufacturer

The scope of work as it applies to the manufacturer is to provide the following services:

- IC/circuit design, supply and manufacture
- Housing and peripheral design, supply and manufacture
- System testing (this will also be tested by us)

2.4 Cost

We are seeking to minimize the cost so that the cost of uptake for the consumer is very low.

If the expert system can be designed and manufactured at a cost that is not prohibitive, we may choose to only develop that system.

3.0 BASIC SYSTEM

3.1 Introduction

The basic system comprises a controller and slaves (wall units).

The controller is able to command the slave GPO devices to turn on or off, controlled by the user at the central controller.

This is achieved via the use of toggle switches on each slave, forcing it into a pool.

The pool range should be 1-5 (1-10 is an option if not a large increase in costs). This effectively consigns the device to one of 5 device types.

The user is able to then pool different devices within these 5 pools. This number of pools should be adequate for the home or SOHO user.

3.2 Slave Functionality

The slave provides capability for the controller to turn the power to the connected devices off.

Optionally, we require pricing for slave display of kWh, $, CO2 and W.

3.3 Controller Functionality

There should be a wireless remote control (on/off capability only) and there must be a central control panel.

The basic LCD on the control panel must be capable of, at a minimum:

- Displaying current total connected device kWh, $, CO2, W
- Usage for kWh, $, CO2, W for the past hour, day, week, month, year, historical (through a simple up/down button) via a usage graph and Amount To Date (TTD) total for that metric
- Turning device pools on and off

It is therefore a requirement that the user be able to input a kWh tariff according to their local utility, both for a peak and offpeak rate.

As an option, it would be desirable to be able to display:

- Per device-pool usage in terms of current, hour, day, week, month, year kWh/$/CO2/W and Amount To Date (TTD) total for that metric

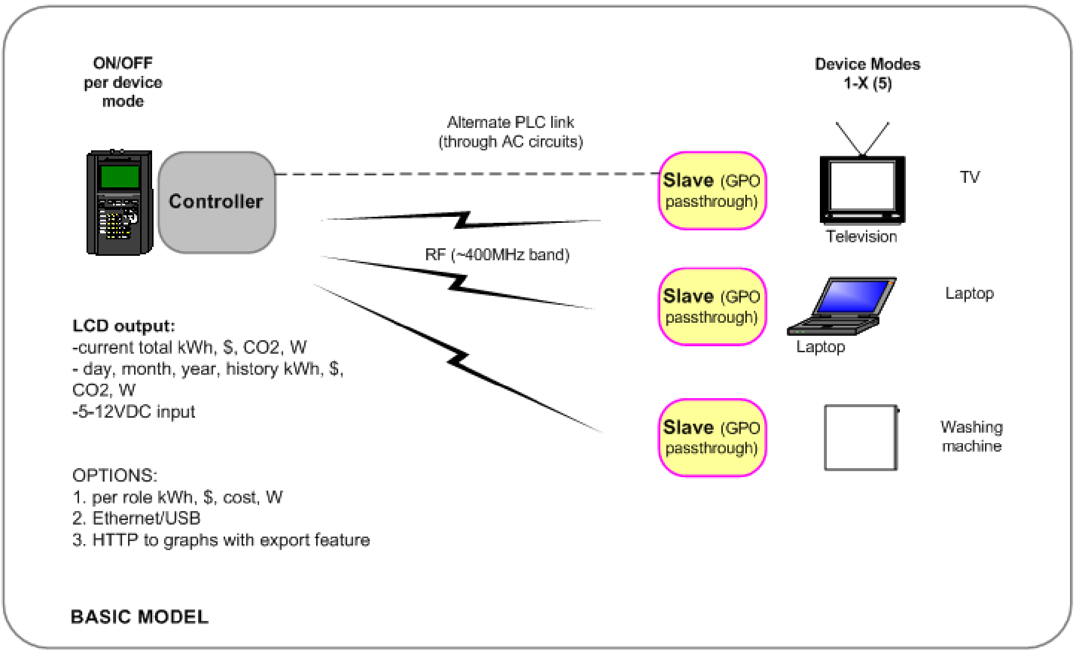

Figure 1 Basic System

3.4 Communications

The entire system shall communicate via RF signaling in 400Mhz or other band.

It would be highly desirable (if cost-efficient) to use instead of, or in addition, PLC communications to achieve data transmission via the in-building mains power wiring. This should be costed as an option according to Table 1.

If this achievable, a switch will be needed to choose RF or PLC communications.

Optionally, the control device should include

- Ethernet IEEE802.3E
- USB 1.1/2
- 802.11b/g
- Zigbee standard Zigbee 1.0+
- IEEE 802.15.4

3.5 Interfaces

At a minimum the device must include an interface for 5-12VDC input for a power pack.

Optionally, the device should include:

- Input so that the control panel can monitor the mains fusebox
- Ethernet RJ45
- USB 1.1/2

3.6 Power

The slaves shall be powered inline from the GPO outlet. Optionally surge protection is desirable.

The controller must have a 5-12VDC power pack (cost permitting – 12VDC if a static power level is more cost effective).

3.7 Environmentals

The device should be IP64 and be capable of operating in ambient temperatures of –10 to +65 degrees Celsius. This can be negotiated downward to around –10 to 55 deg C if more cost effective.

The mean time between failure should be at least 43,800 hours for each system (slave, controller).

3.8 Management

The device management is intended to be very simple – there is to be none, beyond managing device pools and power tariffs.

As an option it is a requirement that an indication of cost for HTTP management over an Ethernet or USB interface to allow the user to browse the data as usage graphs, as well as being able to download them as jpegs.

3.9 Form Factor

The slaves should look like the device pictured below.

Notably, we have included an option for an LCD or LED output on the slave showing the current kWh, $, CO2 output on that outlet. The tariffs and CO2 rates should be passed from the central control panel. This output must be able to be turned on and off.

The expected form factor of the remote control is also shown (albeit with 4 device pools instead of 5).

We have not specified the form factor or layout of the controller as seek the manufacturer's guidance on layout according to their industry knowledge.

We seek costs on 10A and 15A slaves.

Figure 2 Example GPO Slave

4.0 EXPERT SYSTEM

4.1 Introduction

The expert system comprises a controller and remote slaves.

All functionality from the basic system is maintained, with the extended functionality as described below being added.

4.2 Slave Functionality

The slaves are exactly the same as the basic model, with the exception that they must now support the extended controller functionality such as scheduling. This should be the same firmware but inactive in the basic system scenario.

4.3 Controller Functionality

The expert controller is exactly the same as the basic controller, except extended functionality as briefly described below is added:

- Slave scheduling per device pool (on, off, repeat y/n, cycle time on/off) – via tactile buttons
- HTTP management
- Ethernet connectivity via RJ45/CAT-6e to facilitate http management
- Graph downloading (format pdf, jpg, csv)

The LCD on the control panel must be capable of, at a minimum:

- Displaying current total connected device kWh, $, CO2, W
- Turning device pools on and off
- Usage for kWh, $, CO2, W for the past hour, day, week, month, year, historical (through a simple up/down button) via a usage graph and Amount To Date (TTD) total for that metric
- Per device-pool usage in terms of current, hour, day, week, month, year kWh/$/CO2/W and Amount To Date (TTD) total for that metric

It is therefore a requirement that the user be able to input a kWh tariff according to their local utility, both for a peak and offpeak rate.

As an option, it would be desirable to be able to control the devices via a touch panel (similar to iPhone touch screen) with sliders to control scheduling and reporting.

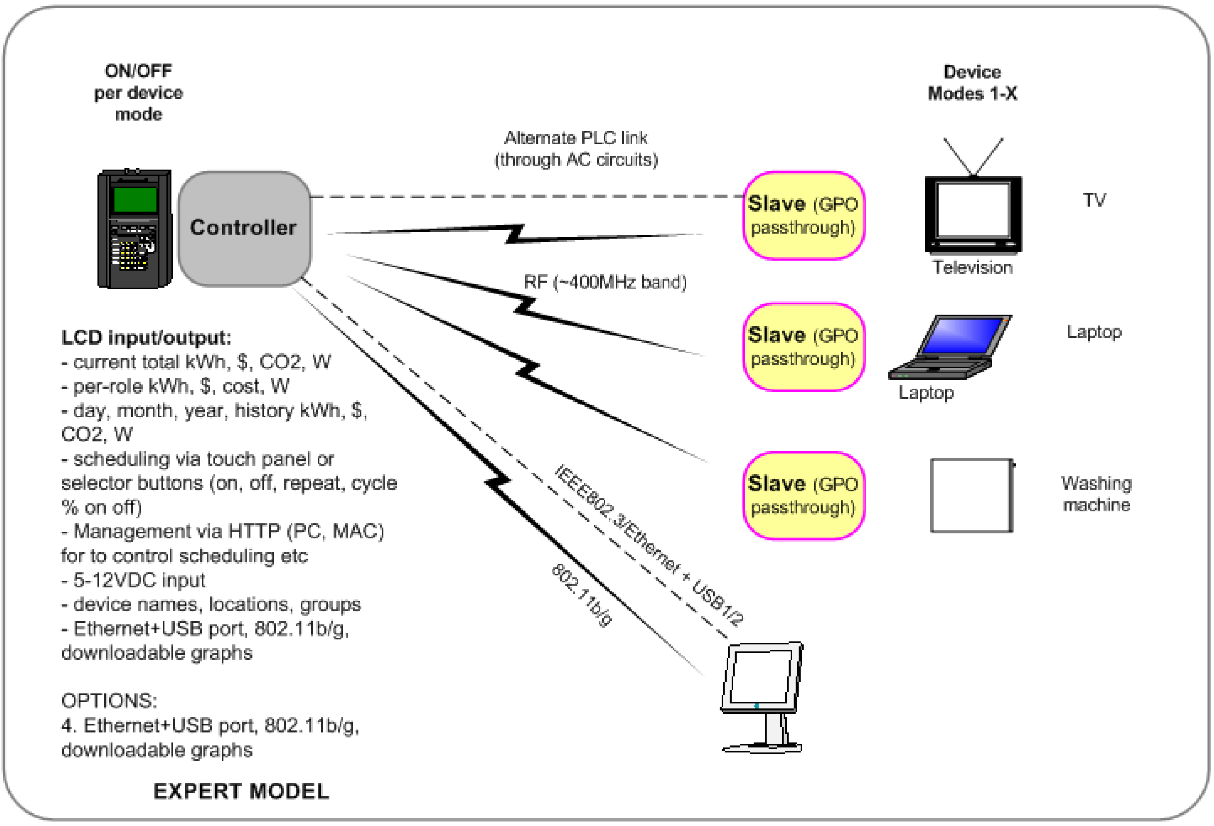

Figure 3 Expert System

4.4 Communications

The system shall communicate via RF signaling in 400MHz band.

It would be highly desirable (if cost-efficient) to use instead of, or in addition, PLC communications to achieve data transmission via the in-building mains power wiring. This should be costed as an option according to table XX.

If this achievable, a switch will be needed to choose RF or PLC communications.

Mandatorily, the device shall support:

- Ethernet IEEE802.3E
- USB 1.1/2
- 802.11b/g
- Zigbee standard Zigbee 1.0+
- IEEE 802.15.4

4.5 Interfaces

At a minimum the device must include an interface for 5-12VDC input for a power pack.

Mandatorily, the device must include:

- Ethernet RJ45
- USB 1.1/2

Optionally, the device should include:

- Input so that the control panel can monitor the mains fusebox

4.6 Power

The slaves shall be powered inline from the GPO outlet. Optionally surge protection is desirable.

The controller must have a 5-12VDC power pack (cost permitting – 12VDC if a static power level is more cost effective).

4.7 Environmentals

The device should be IP64 and be capable of operating in ambient temperatures of –10 to +65 degrees Celsius. This is able to be negotiated downward to around –10 to 55 if more cost effective.

The mean time between failure should be at least 43,800 hours for each system (slave, controller).

4.8 Management

The device management is to be achieved via HTTP management over an Ethernet or USB interface to allow the user to browse the data as usage graphs, as well as being able to download them as jpegs/csvs/pdfs.

4.9 Form Factor

The slaves should look like the device pictured below.

Notably, we have included an option for an LCD or LED output on the slave showing the current kWh, $, CO2 output on that outlet. The tariffs and CO2 rates should be passed from the central control panel. This output must be able to be turned on and off.

The expected form factor of the remote control is also shown (albeit with 4 device pools instead of 5).

We have not specified the form factor or layout of the controller as seek the manufacturer's guidance on layout according to their industry knowledge.

We seek costs on 10A and 15A slaves.

Figure 4 Example Slave Unit

5.0 REQUIREMENTS

5.1 Slave Unit

Table 1 Mandatory Slave Requirements

Metric	Rating	Requirement Type	Comment
Device Pool switch	1-5	M	Increase to 10 if cost not prohibitive
Device Operational Control	On/Off	M	Remote (signaled), physical (switch on device)
Power Interface	100-250VAC, 50-60HZ	M	Costing should be provided for other country power form factor e.g. EU, JP, US, GB
Communications	400MHz band	M	PLC as an option, RF band can be different
Data Storage	CF	M	No lost data on power loss – if this needs to be a different type of memory, that is ok
Data capacity	100MB	M	Negotiable (capacity), data should not be lost in the event of power outage
Data overflow	Oldest data overwritten	M	
Current	10A	M	
IP rating	IP64	M	IP63 or IP54/53 by negotiation
Housing colour	PMS360	M	TBC – white is ok if cheaper
Sustainability Requirements			
The device should be manufactured from post-consumer plastic where practicable (if this greatly increases the cost, indicate how much).		M	
The device should have a minimal carbon input footprint.		M	
The device should be recyclable as much as possible.		M	

Table 2 Slave Cost - Core Functionality

Item	Cost, USD	Comments
Development and Sample		
Production 1-1000		
Production 1001-5000		
Production 5001-10000		
Production 10000+		
Re-production subsequent runs		

Table 3 Slave Requirement Options

Metric	Rating	Requirement Type	Comment	Cost
Communications	PLC	O	PLC as an option	
Communications	Zigbee	O	Zigbee 1.0 option	
Current	15A	O		
Output LCD/LED, including: -On/off -Current kWh -Related usage cost -related usage CO2 -related usage W		O		
Output LCD/LED control	On/off	O		

5.2 Basic Controller

Table 4 Basic Controller Mandatory Requirements

Metric	Rating	Requirement Type	Comment
Device Pool switch	1-5	M	Increase to 10 if cost not prohibitive
Output LCD/LED, including -Current, Historical (hour, day, month, year, history) kWh -Related usage cost -related usage CO2 -related usage W Total, per group		M	
Configurable Parameters	KWh $ tarrif, peak and off-peak	M	
Remote slave Operational Control	On/Off	M	Remote (signaled), physical (switch on device)
Power	12VDC via powerpack	M	Costing should be provided for other country power form factor e.g. EU, JP, US, GB
DC powerpack	110-250VAC 50-60HZ	M	
Communications	400MHz band	M	Other RF band ok, PLC, Zigbee as an option
Data Storage	CF	M	No lost data on power loss – if this needs to be a different type of memory, that is ok
Data capacity	4GB	M	Negotiable (capacity), data should not be lost in the event of power outage
Data overflow	Oldest data overwritten	M	
Current	Manufacturer specified		
IP rating	IP64	M	IP63 or IP54/53 by negotiation
Sustainability Requirements			
The device should be manufactured from post-consumer plastic where practicable (if this greatly increases the cost, indicate how much).	M		
The device should have a minimal carbon input footprint.	M		
The device should be recyclable as much as possible.	M		

Table 5 Controller Cost - Core Functionality

Item	Cost, USD	Comments
Development and Sample		
Production 1-1000		
Production 1001-5000		
Production 5001-10000		
Production 10000+		
Re-production subsequent runs		

Table 6 Basic Controller Options

Metric	Rating	Requirement Type	Comment
Controller mgmt via HTTP		O	
Data download (http)	Downloadable graphs/data via PDF, CSV, JPEG	O	
Communications	Ethernet IEEE802.3E	O	
Communications	USB 1.1/2	O	
Communications	802.11b/g	O	
Communications	Zigbee standard Zigbee 1.0+	O	
Communications	IEEE 802.15.4	O	
Physical interface	USB1.1/2, RJ45, VDC input	O	
Sustainability Requirements			
The device should be manufactured from post-consumer plastic where practicable (if this greatly increases the cost, indicate how much).		M	
The device should have a minimal carbon input footprint.		M	
The device should be recyclable as much as possible.		M	

5.3 Expert Controller

Table 7 Expert Controller Mandatory Requirements

Metric	Rating	Requirement Type	Comment
Device Pool switch	1-5	M	Increase to 10 if cost not prohibitive
Output LCD/LED, including -Current, Historical (hour, day, month, year, history) kWh -Related usage cost -related usage CO2 -related usage W		M	
Configurable Parameters	KWh $ tarrif, peak and off-peak	M	
Slave Management	Table of connected slaves	M	

	Slave groups Slave/group scheduling http over either or all PLC, Ethernet, Zigbee		
Slave, Total Reporting	Total & Per slave power/$/CO2/kWh usage Per group usage	M	
Data download (http)	Downloadable graphs/data via PDF, CSV, JPEG	M	
Device Operational Control	On/Off	M	Remote (signaled), physical (switch on device)
Power	12VDC via powerpack	M	Costing should be provided for other country power form factor e.g. EU, JP, US, GB
DC powerpack	110-250VAC 50-60HZ	M	
Communications	400MHz band	M	Other RF band ok, PLC, Zigbee as an option
Communications	Ethernet IEEE802.3E	M	
Communications	USB 1.1/2	M	
Communications	802.11b/g	M	
Communications	Zigbee standard Zigbee 1.0+	M	
Communications	IEEE 802.15.4	M	
Physical interface	USB1.1/2, RJ45, VDC input	M	
Data Storage	CF	M	No lost data on power loss – if this needs to be a different type of memory, that is ok
Data capacity	4GB	M	Negotiable (capacity), data should not be lost in the event of power outage
Data overflow	Oldest data overwritten	M	
Current	Manufacturer specified		
IP rating	IP64	M	IP63 or IP54/53 by negotiation
Sustainability Requirements			
The device should be manufactured from post-consumer plastic where practicable (if this greatly		M	

increases the cost, indicate how much).	
The device should have a minimal carbon input footprint.	M
The device should be recyclable as much as possible.	M

Table 8 Expert Controller Cost - Core Functionality

Item	Cost, USD	Comments
Development and Sample		
Production 1-1000		
Production 1001-5000		
Production 5001-10000		
Production 10000+		
Re-production subsequent runs		

6.0 Appendices