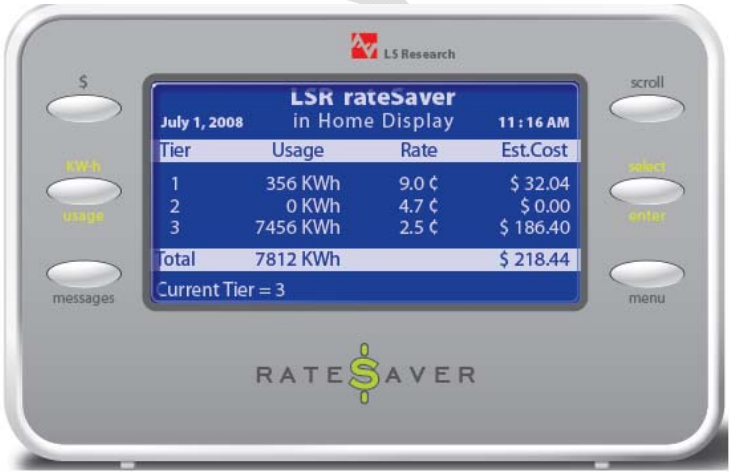
RATE$AVER
In Home Display

Features

- BATTERY OPERATED !
- Zero Power Display
- Smart Energy Profile Approved[1]
- Current Use / Rate / Tier Display
- Messaging / Alarm Display
- Graphical Cost and Usage Summary
- Time-of-Use Display
- Date / Time / Temperature
- Unlimited View Angle
- 100 mW Zigbee Radio
- FCC / CE / IC Certified (pending)[2]
- Simple User Interface
- Internal Buzzer / Alarm
- Optional USB Power / PC Programming Interface
- Internal Magnet – Refrigerator Mount



Ordering Information:

Part Number	RS-SE-24-01

Product Description

The Rate$aver is an In-Home-Display (IHD) device capable of communicating with Smart Energy Profile compliant Energy Service Portals (ESP) within electric meters to display current energy consumption, utility rates, billing history, messages, alarms, temperature and time. The device consists of display technology requiring no power consumption to display graphical images enabling true, wireless battery operation. The device operates on 2 AA batteries and incorporates a 100 mW high performance Zigbee radio.

[1] Pending
[2] Pending

1) Display
   - 128 x 64 Pixel
   - Blue / White Monochrome
   - Zero Power / Persistent Display

2) Buttons
   - Scroll
   - Select / Enter
   - Menu
   - $
   - kW-h usage
   - Messages

3) Beeper
   - Beep Tone #1: on button press – user option to disable
   - Beep Tone #2: on alarm or new high priority unsolicited message – user option to disable
   - Volume – tone #1 low, tone #2 high
   - Frequency: tone #1 = 500 Hz; tone #2 = 2 kHz
   - Duration
     - Tone #1: 100ms
     - Tone #2: 500ms

4) Temperature Sensor
   - Internal Temperature Sensor (Indoor Ambient Temperature Displayed)
   - Range: same as product operating temperature range
   - Accuracy: +/- 2 ºC over specified range, +/-1 ºC at 25 ºC

5) Wireless Protocol
   - Conforms to Zigbee Smart Energy Profile for In Home Display device
   - Supports all mandatory attributes and commands plus additional ones required for the specified screens from the following clusters:
     - Simple Metering
     - Price
     - Message
     - Time
     - Key Establishment
     - Identify
     - Basic

6) Supported Zigbee Cluster attributes and commands:

CLUSTER	Attributes (provided by RateSaver if a server cluster, required from ESP if a client cluster)	Commands Accepted	Commands Generated
Basic Server	ZCL version Application Version Stack Version HW Version Manufacturers Name Model Identifier Date Code Power Source	Reset to Factory Defaults	
Identify Server	Identify Time	Identify Identify Query	Identify Query Response
Key Establishment Client			
Key Establishment Server			
Time Client	Time Time Status Local Time		
Simple Meter Client	Current Summation Delivered Current Tier 1 Summation Del Current Tier 2 Summation Del Current Tier 3 Summation Del Current Tier 4 Summation Del Current Tier 5 Summation Del Current Tier 6 Summation Del Summation Formatting Instantaneous Demand Unit of Measure Metering Device Type Status (Service Disconnect, Leak detect, Power Qual, Power Fail, Tamper Detect, Low Battery, Check Meter) **Others TBD**		
Price Client		Publish Price	Get Current Price Get Scheduled Prices
Message Client		Display Message Cancel Message	Get Last Message Message Confirmation
Manufacturer Specific Client	tbd		

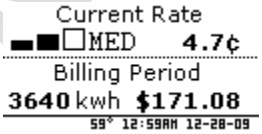
- Mandatory features
  - Join network, pair devices (ZDP bind and unbind), end device announce
  - Factory defaults restore

- Enable Identify Mode by user
- Service Discovery (Match descriptor request)

7) Enclosure
   - Dimensions
     - 100mm x 64mm x 26mm
   - ABS Plastic
   - Non-glare Lens
   - Integrated Magnet for mounting
   - Front Panel Label: customizable Mylar graphical overlay

8) Power supply
   - Power Source
     - 2 AA alkaline batteries
     - USB connector power
   - External Connector (for firmware upgrade)
     - USB Mini-B Receptacle
   - Battery Life: 1 year with 60 second update interval
   - Reverse Battery Protection

9) Test and Programming Interface
   - Firmware Updates: UART interface via mini-B USB connector. External adapter required to convert USB/RS232 to UART level signals (provided by LSR).
   - Test & Debug: via JTAG Interface with access points in battery compartment. Supports both DIP and ZIF connector interface cables (provided by LSR).

10) Screens
   - Screens included as needed for particular customers. Examples include:
     - Current tier, current tier rate, total consumption, total monthly bill, standard header
     - 

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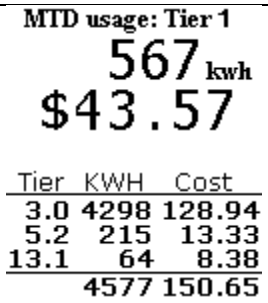
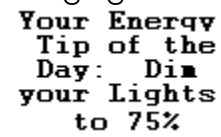
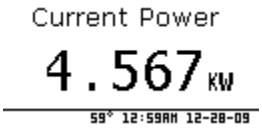
     - Tier breakdown screen: for each tier –horizontal bar graphs or numeric table



- o
- o User Messaging Screen / Alarm Display – inverted colors-.



- o Inst power screen – numeric kWatts and bar



- o User Setup and Initialization
  - Network ID and Channel
  - Join Network button
  - Celsius/Fahrenheit
  - Time Zone
- o Low Power: Screen Display "Replace Battery"

- Screen Operation
  - o Cycle through info screens on SCROLL button press
  - o Poll and refresh current screen on any button press
  - o Go to setup screen on SELECT / MENU button held for 5 seconds.
  - o Automatically switch to message screen when new message received.

11) Information present on all screens (header)

- Date / Time Display
  - o Poll ESP no more than once per 24 hours (per SE spec)
  - o Accuracy within +/-1minute relative to ESP (per SE spec)
- Battery/Power Indicator
  - o V>= 2.0v no battery indication
  - o 1.6v <V<2.0v low battery icon- broken battery
  - o V< 1.6v unit shut down. hollow broken battery icon, no link icon, unit off screen "Replace Battery"
- Indoor temperature
  - o ºC/ºF user selectable
- Wireless link indicator
  - o Cell phone standard 4 bar antenna signal strength graphic

12) Commissioning

- user informs network owner (web login, phone call, handheld tool) provide MAC ID and mfg supplied hashed key Utility commissions ESP to allow join for limited time
- User / Installer press button/sequence to initiate join
- Device indicates to user "joined"

13) Polling
- Poll ESP for updated information needed for current screen:
  - Immediately on screen change or refresh button press
    - Indicate "updating" immediately
    - Draw whole new screen after new info arrives, or timeout
  - Every 60 seconds on the minute
  - Only changed portions of screen redraw

14) Firmware upgrades
- Wired Bootloader – through USB connector
- Wireless Bootloader – must be implemented in ESP or parent router to the display. Requires code to initiate the bootloader in the display and transfer the code image. Also method to read/supply the code image file. LSR to supply example source code and specifications.

15) Regulatory Requirements (pending)
- FCC part 15.247, 15.209
- Industry Canada RSS 210
- CE EN 300 220 1
- C-Tick
- Zigbee SE Profile Certification
- RoHS Compliant

16) Environmental
- Operating temperature
  - 10deg C to 70deg C
- Storage temperature
  - -20deg C to 100deg C
- Relative Humidity – non-condensing
  - <90% for T<40C, <50% T>40C
- Physical shock (consumer level drop test)
  - Test per IEC 60068-2-27 (Shock)
  - 20g peak acceleration in three orthogonal axis
  - Saw tooth pulse shape, 11ms pulse width
- Vibration
  - Test per IEC 60068-2-6 (Sinusoidal Vibration)

  - 5g-peak acceleration
  - 10-150 Hz
  - Five cycles per axis in three orthogonal axis
- ESD
  - Per CE approval limits specified in ETS 301-489 and EN 61000-4-2 testing methods

Absolute Maximum Ratings

Rating	Value	Unit
Power Supply Voltage Input	3.5	Vdc
Voltage on any digital pin	Max 3.6	Vdc
RF Input Power	+10	dBm
Storage Temperature Range	-45 to 125	°C

Note: Under no circumstances exceeding the maximum ratings in Table can be allowed. Such a stress may cause permanent damage to the devices

Operating Conditions

Characteristic	Min	Typ	Max	Unit
Power Supply Voltage (Vdd)	2.1		3.5	V
Input Frequency	2405		2480	MHz
Ambient Temperature Range	10	25	70	°C
Logic Input Low Voltage	0		0.7	V
Logic Input High Voltage	2.8		3.6	V

Radio Electrical Specifications

At 25°C, Vdd = 3.3V for both APEX and APEX LT unless stated otherwise.

General

Parameter	Min	Typ	Max	Unit
RF Frequency Range	2400		2483.5	MHz
RF Data Rate		250		kbps
Microcontroller Operating Frequency		12		MHz
Flash Memory		128		kB
RAM		5		kB

Power Consumption

Parameter	Min	Typ	Max	Unit
Transmit Mode (100mW output)				
Receive Mode				
Standby Mode				

Boost mode is an optional higher performance radio mode that is software selectable to boost receiver sensitivity.

Transmitter

Parameter	Min	Typ	Max	Unit
Nominal Output Power		20		dBm

Programmable Output Power range		32		dB
Error Vector Magnitude		15	35	%

Receiver

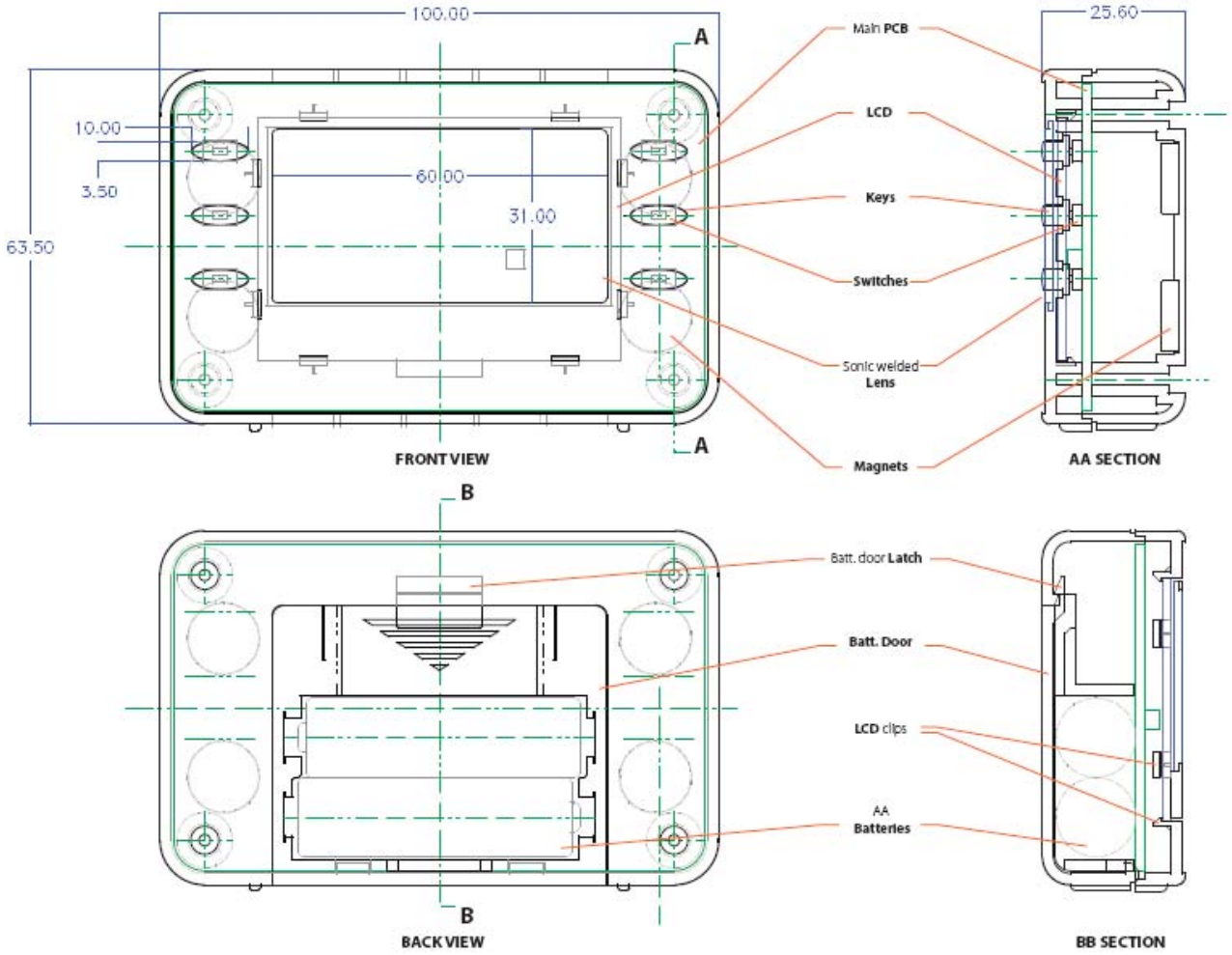
Parameter	Min	Typ	Max	Unit
Receiver Sensitivity (1% PER) – normal mode	-92	-96		dBm
Receiver Sensitivity (1% PER) – boost mode	-93	-97		dBm
Saturation (Maximum Input Level) (1% PER)	0			dBm
802.15.4 Adjacent Channel Rejection				
APEX	35			dB
802.15.4 Alternate Channel Rejection	40			dB
802.11g Rejection (±10 MHz)				
APEX	40			dB

Control DC characteristics

Parameter	Min	Typ	Max	Unit
Logic Input Low	0		0.2VDD	V
Logic Input High	0.8VDD		VDD	V
Logic Output Low	0		0.18VDD	V
Logic Output High	0.82VDD		VDD	V
Output source current			4	mA
Output sink current			4	mA
Output source current			8	mA
Output sink current			8	mA
I/O pin pull-up and pull-down resistor		30		kΩ

Figure 1

Mechanical Drawing



Disclaimer

LS Research, LLC believes the information in this document is correct and accurate at the time of release. However, LS Research, LLC reserves the right to make changes to this product without notice.

Statements

Compliance Statement (Part 15.19)

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Warning (Part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement (Part 15.105 (b))

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF Exposure (OET Bulletin 65)

To comply with FCC's and IC's RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Section 7.1.5 of RSS-GEN

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2) This device must accept any interference received, including interference that may cause undesired operation.