

Hybrid Power Management Unit (HPMU), 1500 LIC

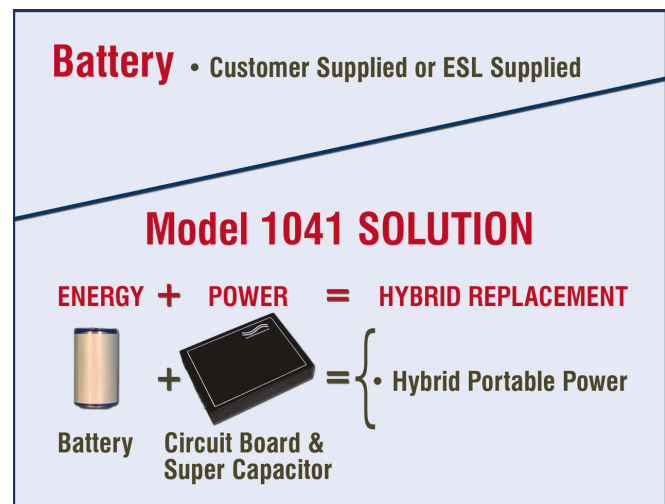
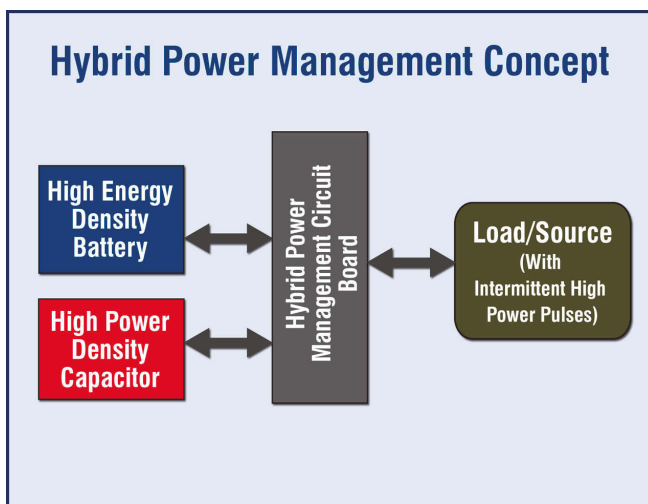
INTRODUCTION

The Model 1041 Hybrid Power Management Unit combines the strength of a high-power capacitor and a high energy battery. A power management board integrates the two energy-storage devices and provides the user with a light-weight, high performance, and safe power source. This hybrid technology greatly benefits pulsed power load systems that are typically supported by "battery-only" systems. Battery technologies are inherently energy dense systems with limited power capability. Where energy transfer to the load is equal, primary and secondary chemistries have shown reduced performance when subjected to pulsed loading as compared to operation at low constant rates. Primary chemistries exhibit reduced discharge time or usable capacity while secondary chemistries suffer from both reduced usable capacity as well as reduced cycle life. The hybrid technology pairs the energy dense battery system with the power dense ESL Hybrid Power Management Unit (HPMU) to improve overall system performance. The HPMU contains ESL's hybrid power management circuitry and a high-power Super Capacitor (SCap) element. The HPMU enables the battery system to operate at a reduced rate supporting the baseline load and the recharge of the SCap while the SCap is utilized to support peak pulse requirements of the load. The result is improved lifetime, reduced battery heating, and extended cycle life of the battery system.



HPMU FEATURES:

- Supports 12V nominal battery systems and provides 12V or 24V output
- Nominal load pulse support for 60 seconds @ 100W. Contains a 1500F Lithium Ion Capacitor (LiC).
- Supports bidirectional operation allowing pulsed power into and out of HPMU system.
- Hybrid technology scalable in terms of peak power and pulse duration support to suit customer needs.
- Non-Lithium Super Capacitor options available if required.
- Compatible with wide variety of COTS and custom battery systems.
- Reusable to support the lifetime operation of many primary and secondary type battery systems.
- Custom systems are available to meet specific peak power and pulse duration requirements.



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Application to Portable Systems and Devices

The Model 1041 Hybrid Power Management Unit is particularly applicable to portable communication devices. When battery power alone cannot meet power requirements, the batteries are stressed beyond their limits. The hybrid power unit allows batteries to operate at lower current level so that the operation can be achieved and the battery life is extended. Once the batteries are exhausted, they can be replaced, while the hybrid unit can be used again, repeatedly. The hybrid unit contains a 1500F LiC. The battery is sold separately allowing use of a customer supplied battery. Time extensions will vary with power requirements. Custom systems are available to meet specific power extension requirements.

Military Communications and Other Applications

Currently, extensive work has been done supporting military communications load profiles such as SATCOM (1min @ 100W, 9min @ 12W) and SINCGARS (1min @ 20W, 9min @ 6W). Additionally, the HPMU has been integrated into unmanned underwater vehicles hybridizing the thruster load used for station keeping or depth control which experiences pulsed loading on the order of 100W to 150W. Further applications with larger systems upwards of 250kW which use the lithium ion capacitors in a different hybrid architecture to provide load leveling support have been successfully completed.

Additional Capabilities and Uses

Existing system design supports nominal 12V battery systems as input with 12V or 24V output support. 60s @ 100W possible over full LiC voltage range. Higher power is possible over shorter pulse widths (shorter LiC operating voltage range). Supports bidirectional operation in which the system is able to regulate the battery during pulsed power loads and also when absorbing pulsed power from external sources. Note the hybrid technology is scalable to accommodate different sized systems in terms of energy and power required. The nominal 100W system provides the opportunity for hybridizing the intended battery chemistry/technology in a subscale setting for performance evaluation before moving to the full-sized system.

Electrical Specifications

- **Input:**
Voltage: 12V (Range: 10V – 17V)
Current: 2.0A (10A MAX)
- **Output:**
Voltage: 12V or 24V Operation
Current: 10A MAX
- **Power**
100W Nominal
Higher Power Possible at Shorter Durations (See Figure 1 & 2)
- **Energy Storage**
1500F Lithium Ion Capacitor (Super Capacitor)

Mechanical Specifications

- **Weight:**
0.45kg (1lb)
- **Dimensions:**
125mm X 110mm X 35mm (4.92in X 4.33in X 1.38in)

Connectivity

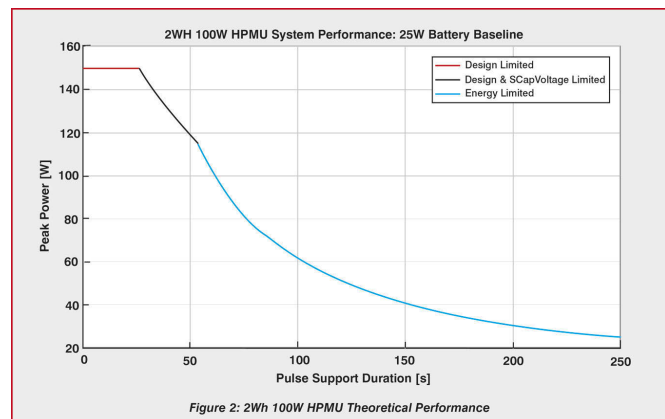
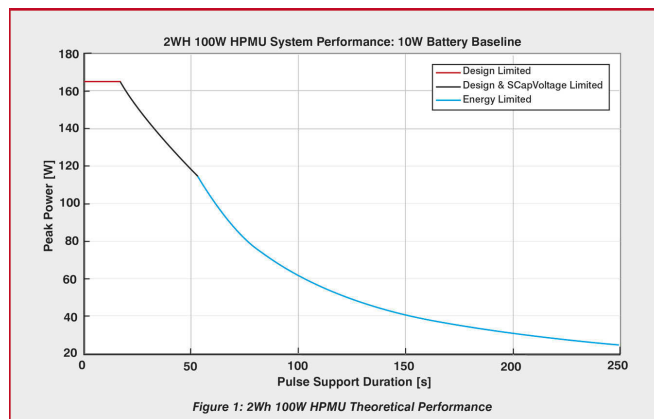
- **Power Interface**
Connector: SC-C-179495 (BB2590 Female Connector)
Cabling: HPMU Battery to Load Cable (Parallel) (ESL PN: 989960)
HPMU Battery to Load Cable (Single) (ESL PN: 989959)

Serial Communications

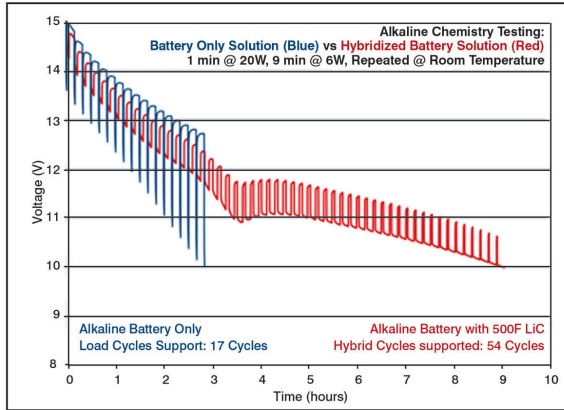
- Connector: Micro DB-9
- **Cabling**
HPMU Serial Communications Cable (ESL PN: 989881)

User Interface

- **Switches**
Load Connect
12V/24V Operation
HPMU Enable
- **LED Indicators**
Green LED – Operating Mode Indicator
Red LED – Data Logging Status

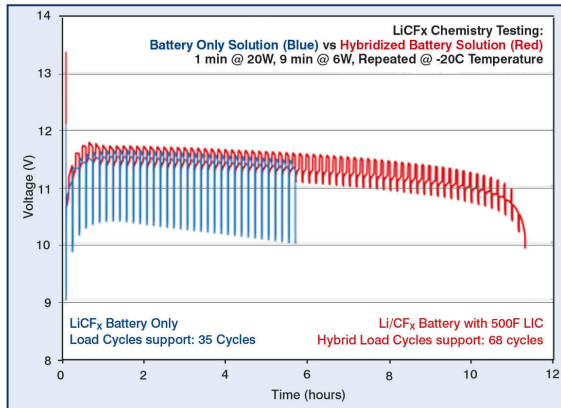


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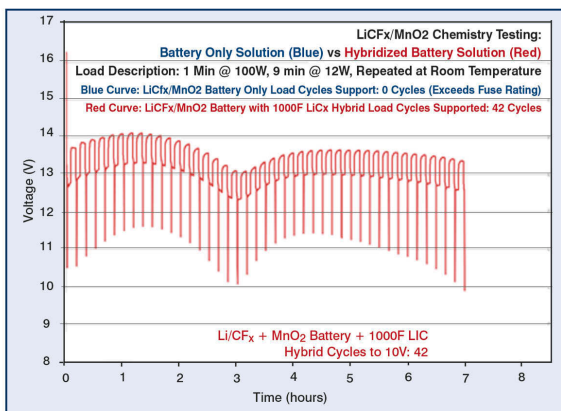
Alkaline Chemistry Test

- Battery Only solution (Blue) versus Hybridized Battery Solution (RED).
- 1 min @20W, 9 min @ 6W, Repeated @ Room Temperature
- Alkaline Battery Only Load Cycles Support 17 Cycles.
- Alkaline Battery with 500F LiC Hybrid Cycles supported 54 Cycles.



LiCFx Chemistry Test

- Battery Only solution (Blue) versus Hybridized Battery Solution (RED).
- 1 min @20W, 9 min @ 6W, Repeated @ -20C Temperature
- LiCFx Battery Only Load Cycles Support 35 Cycles.
- LiCFx Battery with 600F LiC Hybrid Cycles supported 68 Cycles.



LiCFx/MnO2 Chemistry Test

- Battery Only solution (Blue) versus Hybridized Battery Solution (RED).
- Load Description: 1 min @ 100W, 9 min @ 12 W, Repeated at room temperature
- Blue Curve: LiCFx/MnO2 Battery only load cycles support 0 (Exceeds Fuse Rating)
- Red Curve: LiCFx/MnO2 Battery with 1000F LiCx Hybrid Load Cycles Supported: 42 Cycles.