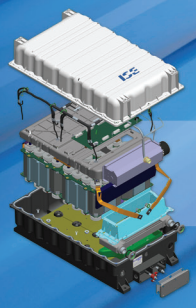
Innovative Solutions for Energy™



ISE CORP PROVIDES THE SMART CHOICE FOR HEAVY-DUTY ENERGY STORAGE SYSTEMS

DEEP EXPERIENCE COMBINED WITH REAL-WORLD SUCCESS

ENERGY STORAGE SYSTEMS

BUILT FOR HEAVY-DUTY APPLICATIONS

Across the globe, industries of every kind are looking for the most reliable and comprehensive energy storage solutions available. One example is the fast-growing hybrid vehicle market where manufacturers are moving from engine-dominant hybrids to battery-dominant, plug-in, and zero-emission (all-electric) propulsion methods. In response to this growing demand for battery-based energy storage, ISE delivers a complete line of scalable, modular Energy Storage Systems capable of powering a variety of heavy-duty applications.

GET TO MARKET FASTER

With ISE Energy Storage Systems, you benefit from advanced, proven technology expertise that ensures you get to market faster. We have invested years of research and testing to understand the significant nuances of making the right energy storage system work with the desired cell chemistry. Because of this deep expertise, we can work with any cell chemistry and you avoid the ramp-up time that is often required by less mature energy storage system providers. ISE has the experience and engineering know-how to deliver the power you need to the application of your choice.

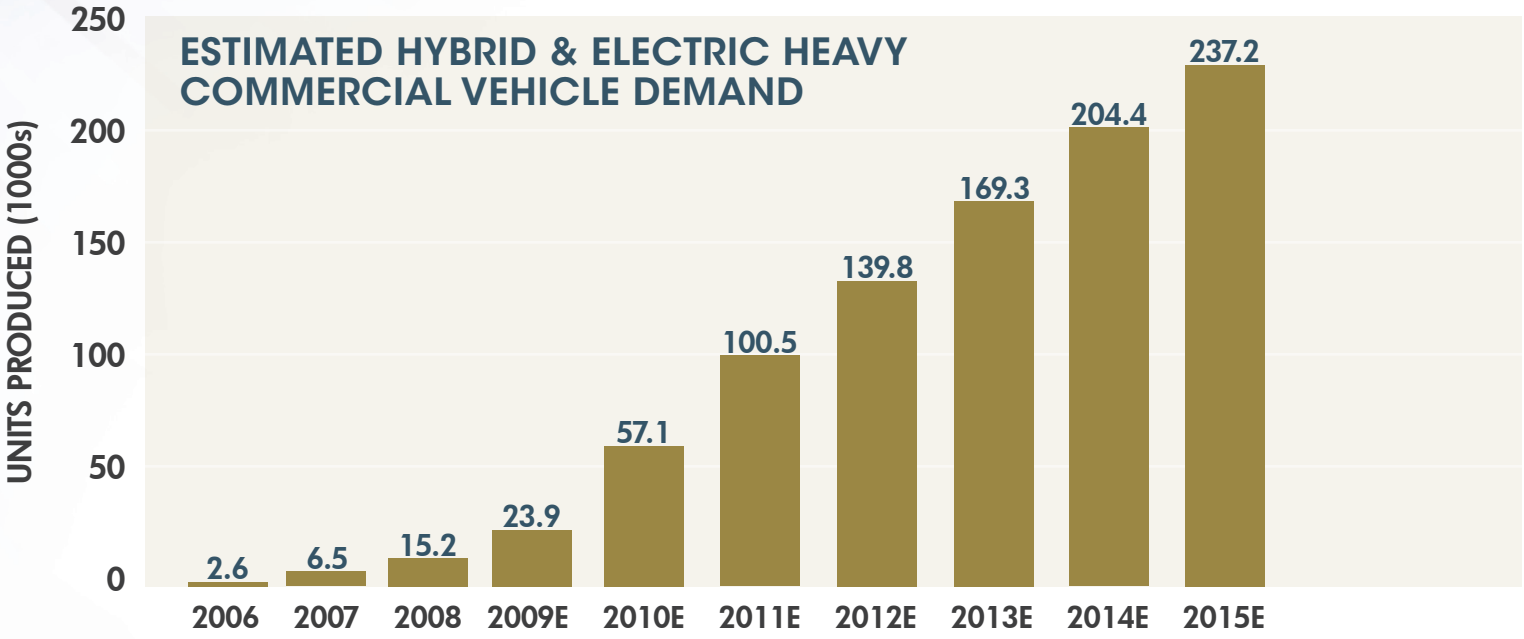
KEY ADVANTAGES

Today, ISE's high quality Energy Storage Systems are successfully at work on a large scale in the heavy-duty hybrid vehicle arena. Our cost-effective, production-ready products offer a range of features and benefits, including:

- Modular and scalable
- Reliable and safe
- High power, high duty cycles
- Environmentally sealed
- Compact form factor
- Extensive bench and field testing
- ISE 9001 certified company
- Strong commitment to quality

A PROVEN TRACK RECORD IN ENERGY STORAGE

ISE Energy Storage Systems are used successfully today in over 300 hybrid transit buses across the world. As emissions regulations tighten, the number of hybrid units in the North American transit bus market is expected to grow at a compound annual growth rate of 49% from 2002 to 2015. Because the key component in a hybrid system is energy storage, this data heralds a fertile market for the industry.



ISE stands ready to serve the need as increased adoption of heavy-duty hybrid vehicles increases. This example of growth in the transportation sector echoes a set of demands for energy storage that a variety of industries are facing. These demands include:

- The need for greater electrical supply stability
- Reduced operating costs
- Lower opportunity cost when buying from the grid

"The modular architecture of ISE's energy storage systems makes our solutions highly configurable. This flexibility enables OEMs to adapt to market demands as cell technology advances."

– **Rob Del Core**, *Director of Business Development, Energy Storage Systems*

SUPPLYING HEAVY-DUTY POWER

ISE Energy Storage Systems deliver the heavy-duty power used in hundreds of hybrid transit buses across the world today. To fully grasp what we mean by "heavy-duty," let's explore the vast differences in energy requirements between automotive and transit applications. Transit buses are:

- Approximately 10 times heavier
- Encounter more starts and stops per day during operation
- Deliver more peak power
- Require higher operating voltage and currents
- See more energy throughput
- Encounter more charge/discharge cycles.

COMPARING ENERGY STORAGE REQUIREMENTS: AUTOMOTIVE & HEAVY-DUTY TRANSIT

MEASUREMENT	PASSENGER CAR	TRANSIT BUS
Typical vehicle curb weight	3,500 pounds	40,000 pounds
Battery (B)/Ultracapacitor (U) ESS capacity	~ 1.5 kWh	B: 15 kWh / U: 1.0 kWh
Vehicle to ESS weight ratio	20	30
Start-stops per day	30	750
Energy per cycle	100 Wh	500 Wh
ESS peak power	30 kW	200 kW
Typical ESS voltage/current	273 VDC/110A	600 VDC/333A
Energy throughput per day	3 kWh	375 kWh
Daily equivalent full ESS cycles	1	B: ~ 15 / U: ~ 200
Lifetime equivalent full ESS cycles	3,600	B: 50,000 / U: 700,000

Performance numbers are estimates derived from actual fleet data, assuming 300 days of operation a year for 12 years.

ISE Energy Storage Systems (ESS) meet this challenge with technology that is built from the ground up to handle a range of charge and discharge cycles over the typical operating life of a heavy-duty vehicle. The ability to deliver this amount of power and flexibility according to unique application specifications is a differentiating feature of ISE Energy Storage Systems. While many providers can simply provide an energy system, ISE provides a system that may be quickly integrated into nearly any application.

"ISE is moving the transportation industry one step closer to zero emissions with a new hybrid-energy paradigm that calls for smaller engines and increased energy storage."

– **Rick Sander**, *ISE President and CEO*

MEETING THE HEAVY-DUTY CHALLENGE IN TRANSIT

ISE has invested over eight years of engineering research, development, and testing to produce a complete line of heavy-duty energy storage solutions designed to accommodate a range of duty cycles. Today, we provide the key component in drive systems that power hybrid-electric mass transportation vehicles. In fact, it is the ISE energy storage component within these hybrid vehicles that makes the vehicle a *hybrid.*

REAL-WORLD APPLICATIONS FOR ENERGY STORAGE

Since ISE began developing energy storage systems, we have witnessed the steady increase in demand for cost-effective, efficient, and environmentally friendly sources of energy for heavy-duty applications. While many companies have focused on light-duty applications, such as those required in the automobile market, ISE has continued to amass an extensive body of intellectual property (IP) in the area of heavy-duty energy storage. This established set of IP is being leveraged today in the mass transit industry and is ready to power a much wider range of applications, including:

- Heavy-duty trucking
- Mining
- Rail
- Forklifts and material handling
- Cranes and elevators
- Backup power for data centers or telecom transmission sites
- Renewable energy including solar and wind farms
- Smart grid energy/power management
- Utility-scale energy storage for ancillary services like frequency regulation and peak shaving

ISE'S COMPLETE LINE OF ENERGY STORAGE SYSTEMS

ISE Energy Storage Systems include a range of products that may be customized to meet a variety of requirements. Our reliable, safe, and cost-effective offerings are designed to meet your heavy-duty power needs. We can also combine our products to produce energy storage systems in a range of voltages (110 to 660 VDC) and capacities (0.1 to 41 kWh).

THE ISE LINE OF ENERGY STORAGE SYSTEMS INCLUDES:

PRODUCT	DESCRIPTION
ISE Ultracapacitor Module	The ISE Ultra-E™ ultracapacitor-based energy storage module offers high-density durability and reliability, is lightweight and scalable, and can help you reduce manufacturing and maintenance costs.
ISE Lithium-Ion Power Module	The Li-ion (Power) energy storage system features lithium ion battery modules, optimized for high charge and discharge rates.
ISE Blended Energy Flex Pack	ISE's Blended Energy Flex Pack offers the flexibility to combine Ultracapacitor-based and Lithium-Ion-based energy systems for a superior blended high-power/high-energy system.
ISE Master Control Module	ISE's proprietary control/contactor box serves as a controller and gateway for one or more energy storage modules (up to 6). Allows easy integration with the host application's control and electrical systems.

ADVANTAGES OF OUR FLEXIBLE CONFIGURATION ARCHITECTURE

- Modular cassette design makes ISE Energy Storage modules "cell agnostic"
- Allows for upgrades as new cells become available
- Provides customers a route to more energy-dense Energy Storage
- Simplifies manufacturing, testing, and maintenance

"Common-mode interference (noise) in heavy-duty applications is unique. Because of ISE's significant experience with these specific EMC/EMI issues, our systems are designed to handle these challenges."

– **Peter Paris**, *Director of Electrical Engineering*

ISE ULTRACAPACITOR MODULE *110V, 0.1 kWh*

High-power ultracapacitor-based technology supports quick charging, discharging, and acceleration for applications such as transit buses.

MECHANICAL

L x W x H (mm)	778 x 482 x 303
Weight (Kg)	51
Cooling	Liquid

MODULE SPECIFICATIONS

ELECTRICAL

Rated voltage	110 VDC
Recommended max voltage	120 VDC
Surge voltage	129 VDC
Isolation voltage	2500 V
Rated continuous current	150 A
Rated peak current	400 A
Leakage current	< 5 mA
Cells in module	48
Ultracapacitors	Maxwell Boostcap 3000P
Cycles	1 million (50% DoD)

ENERGY & PERFORMANCE

Capacitance	62 F
Total energy stored nominal	105 Wh (2.3 V/cell)
Total energy stored peak	125 Wh (2.5 V/cell)
Rated power	40 kW
DC ESR	16 mOhms

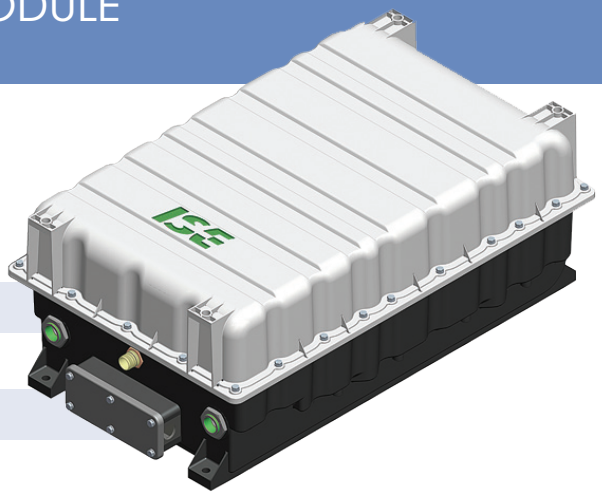
ENVIRONMENTAL

Storage temperature	-40º C to 70º C
Operating ambient temperature	-40º C to 50º C
Vibration	SAE J2380 & J2464
IP rating	IP67, IP6K9K
IEC rating	IEC 529 (Type 5)

ISE LITHIUM-ION BATTERY POWER MODULE

2.4 kWh, 110V Li-Ion

Lithium battery-based technology supports the high energy needs of many heavy-duty applications.



MECHANICAL

L x W x H (mm)	778 x 482 x 366
Weight (Kg)	87
Cooling	Liquid

MODULE SPECIFICATIONS (CONFIGURATIONS A/B)

ELECTRICAL

Nominal voltage	A: 110 VDC/B: 220 VDC
Max voltage	A: 134 VDC/B: 268 VDC
Isolation voltage	2500 V
Rated continuous current	A: 132 A/B: 66 A
Rated peak current (10 second pulse)	A: 400 A/B: 200 A
Leakage current	< 10% SOC/month
Cells in module	96
Cycles	25,000 (100% DoD)
End of life	80% capacity
Cell	Altairnano 11Ah

ENERGY & PERFORMANCE

Nominal capacity	2.4 kWh
Power (continuous)	13 kW
Power (peak)	42 kW
DC ESR (BOL)	72 mOhms or 288 mOhms

ENVIRONMENTAL

Storage temperature	-40º C to 55º C
Operating ambient temperature	-40º C to 55º C
Vibration	SAE J2380 & J2464
IP rating	IP67, IP6K9K
IEC rating	IEC 529 (Type 5)

ISE LITHIUM-ION POWER – 3-MODULE SYSTEM (CONNECTED IN SERIES)

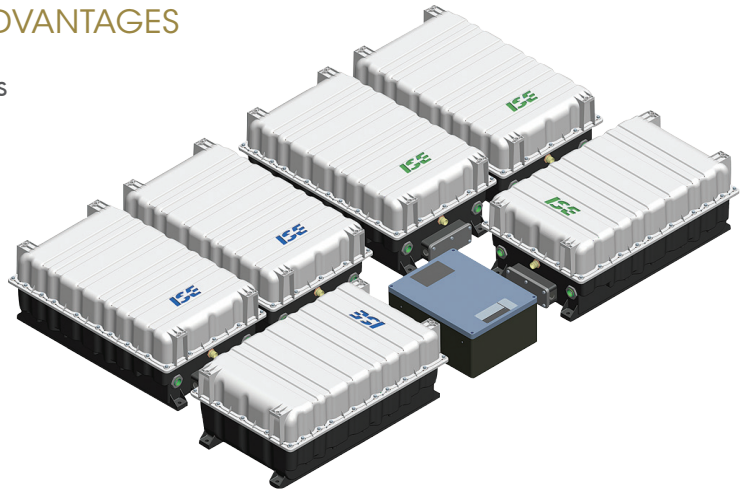
Rated system voltage	330 VDC
Rated system power	40 kW
Peak system power	127 kW
Rated continuous current	132 A
Rated peak current (10 second pulse)	200 A
Nominal capacity	7 kWh

ISE BLENDED ENERGY FLEX PACK *(Future Production)*

ISE's Blended Energy Flex Pack offers you the flexibility to combine Ultracapacitor-based and Lithium-Ion-based energy systems for a superior blended high-power/high-energy system. Our flexible configuration architecture supports variable kilowatts depending on your application. This architecture melds with our extensive body of intellectual property (IP) in the area of heavy-duty energy storage to give you the added benefit of faster deployment and ease of customization.

KEY ISE BLENDED ENERGY FLEX PACK ADVANTAGES

- Enables the coupling of energy storage systems
- Extends battery life
- Reduces cost
- Increases Energy Storage efficiency
- Reduces weight and volume



ISE MASTER CONTROL MODULE

The ISE Master Control Module is the brain of the Energy Storage System. A 32-bit microcontroller handles all communication and power management for the energy storage module. The Master Control Module contains pre-charge circuitry, main contactors, a 500A-rated current sensor, high voltage/isolation measurement, and a CAN J1939 user interface. Combined with ISE's modular pack design, the Master Control Module allows easy system integration and scalability.

MODULE SPECIFICATIONS

L x W x H (mm)	419 x 313 x 182
Weight (Kg)	16.5
Communication interface	CAN J1939

REASONS TO CHOOSE ISE ENERGY STORAGE SYSTEMS

When you choose an ISE Energy Storage System, you benefit from our years of development and production in mastering the way energy cells work in unique power applications. This advantage eases integration and streamlines the process of combining two unique configurations.

With ISE, you benefit from the flexibility of application-specific cell selection, individual cell management, and active cooling in extending life. And, our advanced technology ensures that your systems remain thermally stable.

ADDITIONAL BENEFITS INCLUDE:

TOTAL COST OF OWNERSHIP – ISE Energy Storage Systems are cell-agnostic to provide you with the lowest total cost of ownership. Our deep expertise in managing cell chemistry streamlines integration so you can get to market faster.

THERMAL MANAGEMENT – Ultracapacitors and batteries generate kW of energy that equates to heat which can degrade cells. As the ISE Cooling Loop actively cools, performance is maximized and the lifetime of each cell is increased.

SIMPLIFIED MAINTENANCE – ISE Energy Storage systems are designed to allow for the replacement of drained cells.

CHARGER READY INTERFACE – ISE systems are compatible with commercially available chargers designed for 600V systems.

PERFORMANCE – ISE systems include sufficient margin for dynamic, high duty cycle applications.

PACKAGING – ISE understands the challenges of packaging complex electric drive systems in heavy-duty applications. Because of this, we have optimized the cooling ports, HV terminations, and LV electrical connections in all ISE Energy Storage Systems.

ISE's foundation of solid engineering in the transit industry provides the proven track record that ensures our energy storage solutions are ready to be integrated into the most demanding applications.

ABOUT ISE CORP

ISE Corp is a leading developer, manufacturer and distributor of heavy-duty hybrid-electric drive systems based on a core set of proprietary technologies focused on three critical subsystems: energy storage, controls software, and power electronics. ISE specializes in series hybrid-electric and all-electric/zero-emission technologies, and offers industry-leading energy storage systems and hybrid system components.

Over the past 10 years, ISE has sold over 300 hybrid-electric drive systems that have demonstrated reliability and performance in more than 13 million miles of fleet operation. Established in 1995, ISE is headquartered in San Diego, California. The company's history of innovation and technological leadership has resulted in the design and development of systems and components that deliver superior operating performance.

ISE's family of advanced energy products includes hybrid drive systems powered by gasoline, CNG, zero-emission/fuel cell, all-electric, and diesel fuels as well as a complete line of heavy-duty, modular energy storage systems.

ISE Corp is an ISO 9001 certified company and is committed to Continuous Process Improvement in the areas of reliability, product cost reductions, and customer satisfaction.

ISE Corp is a wholly owned subsidiary of ISE Limited (TSX:ISE).

MEET THE POWER OF ISE

Call us today to discuss options for your fleet. You can also find out more at **www.isecorp.com**.

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