KAPower KSM Starting Module
With Programmable Logic Controller

INSTALLATION - OPERATION
MANUAL Rev. D

KBI/Kold-Ban International, Ltd.
8390 Pingree Road, Lake In The Hills, Illinois 60156-9637 U.S.A.
(800) 527-8278, (847) 658-8561, Fax (847) 658-9280, www.koldban.com
ATA VMRS - T44 KLDBN

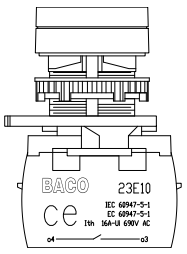
PARTS LIST:

1. KSM PLC module.
2. Double Pole Single Throw (DPST) push button switch.
3. Wiring harness. (Not Shown)
4. Terminal grease. (Not Shown)
5. Protective boots. (Not Shown)

ITEMS NEEDED FOR INSTALLATION:

1. Battery cables, 4/0 cable is recommended.
2. Terminals for battery cable.
3. Torque wrench with ¾ inch socket.
4. 16 gauge wire for harnesses.

1.



2.

SAFETY AWARENESS

SAFETY AWARENESS SYMBOLS are inserted in this manual to alert you to possible SAFETY HAZARDS. Whenever you see these symbols:

WARNING or CAUTION heed their instructions!

SAFETY AWARENESS SYMBOLS AND MEANINGS:

WARNING

THIS WARNING SYMBOL IDENTIFIES SPECIAL INSTRUCTIONS OR PROCEDURES, WHICH, IF NOT CORRECTLY FOLLOWED, COULD RESULT IN PERSONAL INJURY.

CAUTION

THIS CAUTION SYMBOL IDENTIFIES SPECIAL INSTRUCTIONS OR PROCEDURES, WHICH, IF NOT STRICTLY OBSERVED, COULD RESULT IN DAMAGE TO OR DESTRUCTION OF EQUIPMENT.

WARNING

Capacitors assembled into the KAPower module contain an electrolyte, which represents a potassium hydroxide solution. Requirements to the KAPower modules operation shall be observed to avoid electrolyte leakage! Electrolyte may cause chemical burn if spilled onto unprotected skin. If the KAPower module or individual capacitors are destroyed due to accidental physical impact, it is necessary to take actions preventing electrolyte from spilling onto unprotected skin of attending personnel.

KAPower module is a product of high electric power.

Never short circuit KAPower module terminals! It may be followed by burning or igniting of combustible materials adjacent to the point of short circuit. In case of accidental short-circuit-ing of the KAPower module or individual capacitors it is necessary to disconnect the KAPower module immediately from the electric circuit taking relevant safety measures.

CAUTION

Noncompliance with the requirements set forth in this Manual may result in KAPower module failure. Such requirements shall be reviewed prior to and observed in the course of KAPower module operation and installation.

The KAPower module is polarity sensitive. Polarity shall be strictly observed when connecting the KAPower module!

Note: KAPower ***is not*** a high-voltage device. It simply supplies the same voltage that it was charged up to. Treat it with the same respect you would give to a fully charged battery.

TABLE OF CONTENTS:

Notes:

INTRODUCTION:

KSM is a prepackaged KAPower enclosure assembly allowing for the ease of installation and operation of your KAPower system. The KSM enclosure consists of a KAPower module, a contactor, a PLC Module, a fuse, cables, conductors and connectors. The cover of the KSM enclosure can be removed by unscrewing and removing the ten (10) fasteners found on the top and sides of the enclosure. The cover should only be removed for servicing or troubleshooting.

KAPower is designed as an auxiliary power source to be installed in parallel with your cranking batteries. It derives its power from your batteries or engine charging system and discharges this power when needed. KAPower is intended for supplying electric power to various loads operated in high pulse power (engine cranking) modes. KAPower will enhance and provide for reliable cranking and starting of internal combustion engines.

KAPower:

•Stores Cranking Voltage Until Needed
•Long Service Life – Upwards of a Million Cycles
•Performance Virtually Unaffected by Temperatures
•Increases the Life of Batteries
•Requires NO Maintenance
•Safe & Easy to Install

KAPower Description:

The KAPower module is a polarity sensitive device. Polarity should be strictly observed when connecting the KAPower module into any circuit.

KAPower Module:

The KAPower module represents an internal bank of 10 or 20 capacitors series-connected to each other. Positive (+) and negative (-) terminals with threaded connections are located under the plastic cover of the module.

Electrochemical Capacitor:

Electrochemical capacitor represents a device capable of storing and delivering electric power due mainly to the existing capacitance of the double electric layer, which is formed by the capacitor's negative electrodes being in contact with electrolyte. The capacitor consists of negative and positive electrodes with terminals, separator, electrolyte, shell and a valve.

INTRODUCTION (CONTINUED):

Electrodes:

Negative electrodes are made of activated carbon material, positive ones are nickel hydroxide electrodes. The design of the electrodes provides for a high charge/discharge rate.

Electrolyte:

Aqueous solution of potassium hydroxide having a density of 0.042 - 0.0455 ounces per cubic inch (1.2 - 1.3 grams per cubic centimeter), is used as the electrolyte. The concentration of the potassium hydroxide is 30% (30 grams per 100 grams of electrolyte solution).

KAPower design:

1. Provides for a slight Faradaic process that creates high power and high-energy performance characteristics virtually unaffected by cold temperatures.
2. Provides for extremely low self-discharge rates, which enable extended periods of storage or non-use while providing sufficient power for engine starting.
3. Allows for a self-balancing effect of the voltage between the individual cells within the device without using electronic circuitry.
4. Provides safe, efficient and effective operation without elaborate internal controls.

Leakage Currents are diminished as voltage declines, eventually becoming almost nonexistent. Leakage Current declines as the temperature declines and rises as the temperature rises.

CAUTION

1. KAPower modules can be kept at the specified minimum voltage for a short period.
2. Short-Term discharge of the module down to zero voltage is possible; however, it should be stored at a voltage not less than the Minimum Voltage specified in the table.
3. Operating temperature is dependent not only on the ambient temperature, but also on the module operating mode. High charge/discharge cycle frequency and high charge/discharge currents produce higher internal temperatures. To insure guaranteed cycle life of the capacitor module, internal cell temperatures should not exceed 131ºF (55ºC). Module operation at temperatures above 131ºF (55ºC) may result in a reduction of the module's capacitance and delivered energy. See temperature vs. voltage table next page.

KAPower OPERATING VOLTAGES:

Module Voltage	12 Volt	24 Volt
Operating Voltage Window	4-14.5 Volts	8-29 Volts
Minimum Voltage	4 Volts	8 Volts
Maximum Voltage	16 Volts	32 Volts
Operating Temperature Range	-40° to 131°F (-40° to 55°C)	
Storage Temperature	-76° to 158°F (-60° to 70°C)	

Table 1

The complete specifications for the modules you will be using are identified on the engineering drawing supplied with the module in the original KSM package.

TEMPERATURE VS. VOLTAGE:

This chart identifies the maximum voltage the capacitor can be operated at with respect to capacitor internal temperature.

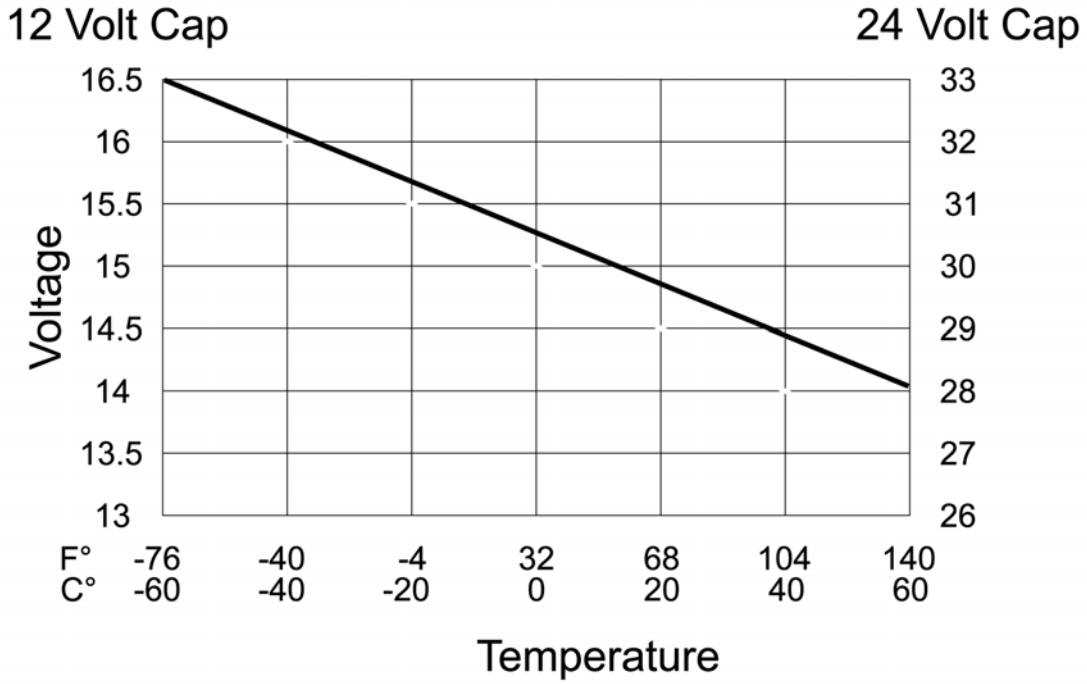


Table 2

INSTALLATION:

WARNING

The KAPower KSM Module is a product of high electric power. Avoid shorting module terminals! A brief, short circuit will not cause product failure, however, it may result in burning or igniting of combustible materials adjacent to the point of short circuit.

Before installation, familiarize yourself with the specifications of your KAPower KSM module. Insure that you have the proper device for your application.

IMPORTANT!

Remember that Electrical Resistance in the circuit created is the consumer of the electrical energy in your KAPower Module. Keep the resistance to an absolute minimum. Short, heavy cables and good, clean cable connections are essential!

CAUTION

When selecting a location for installation, make sure that the KAPower KSM module will clear any lids and other movable parts. Install the KAPower KSM module as close to the engine's cranking motor as possible. Avoid locations that are subject to extreme heat, humidity, road dirt, ice and snow. The KAPower KSM module must be mounted in an upright position (with its cover up). Prevent the external case of the KAPower KSM module from physical impacts.

CAUTION

The KAPower module must be installed with the module in the upright position (↑).

Visually inspect the external case prior to mounting the module. Make sure that no traces of physical impacts or electrolyte leaks are present on the external case of the KAPower KSM module.

WARNING

DO NOT open the external plastic case cover of the KAPower module located within the KSM enclosure.

DO NOT short circuit terminals.

ELECTRICAL CABLE SELECTION:

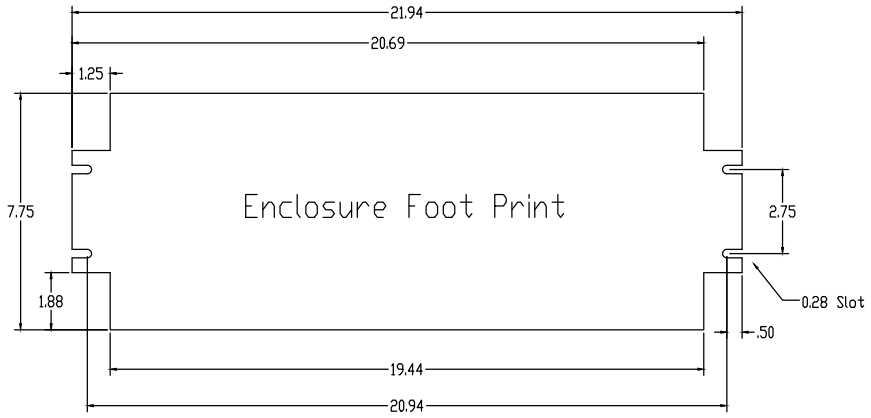
1. Electrical resistance in the circuit you create is a significant consumer of the power available in the KAPower device. For optimal performance the load resistance (entire load) and the internal resistance of the capacitor module should be matched as closely as possible.
2. Use the heaviest gauge cable available. It is recommended that 4/0 cable be used.
3. Keep cable length to an absolute minimum. The circuit resistance increases with cable length.
4. Insure that the cable termination connections (terminals) are properly crimped and/or soldered to the cables.
5. The quality of the cable connections from the KSM to the vehicle or equipment is critical. Make sure to provide good, clean, robust cable interface connections.
6. The closer the KSM is located to the engine's cranking motor, the shorter the cable lengths are, the shortest overall length of the entire heavy current circuit, the better the performance will be with your KSM.
7. The 4 Pin Deutsch connector has been supplied with a mating connector. Be sure to follow proper wire schemes as identified in the diagrams.
8. The supplied DPST switch will either be replacing an existing push-button engine-start switch or will be in addition to the existing key-start switch, depending on how your vehicle or equipment is currently setup, started. Locate and install the DPST switch in a convenient location relative to the key switch if there is no existing push-button start switch to replace.

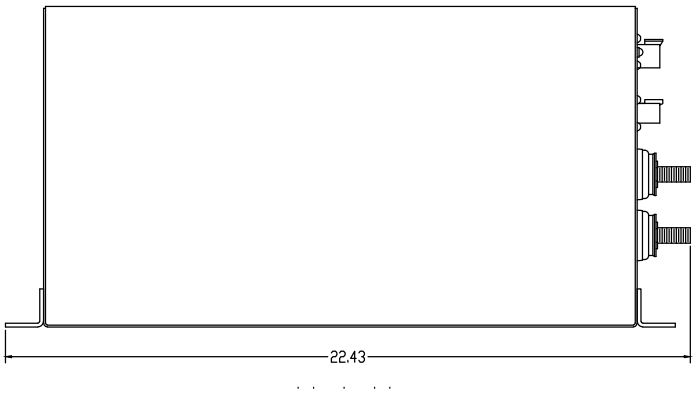
MOUNTING THE KSM UNIT:

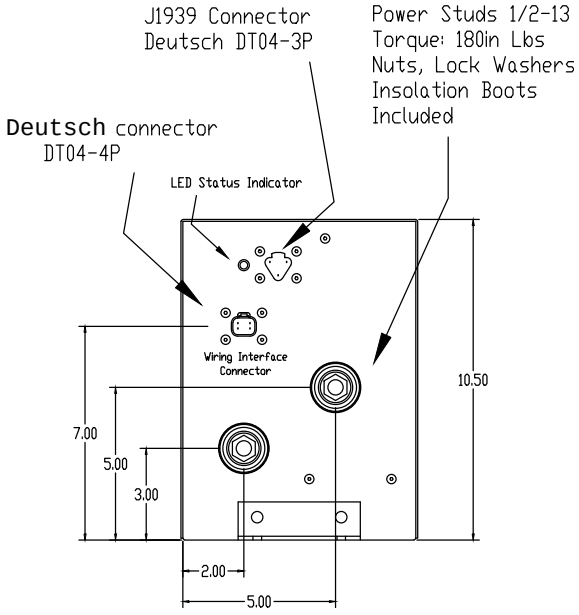
Using the dimensions shown below, use four (4) ¼" bolts, nuts & lock washers (not supplied) to mount the KSM unit to vehicle or equipment chassis**.**

CAUTION

When selecting a location for installation, make sure that the KSM module and cables will clear any hoods, lids, covers and other movable vehicle or equipment parts. Install the KSM module as close to the engine's cranking motor as possible. Avoid locations that are subject to extreme heat, humidity, road dirt, ice and snow. The KSM module must be mounted in an upright position (with its cover up). Take care to prevent the external case of the KSM module from receiving any physical impacts.

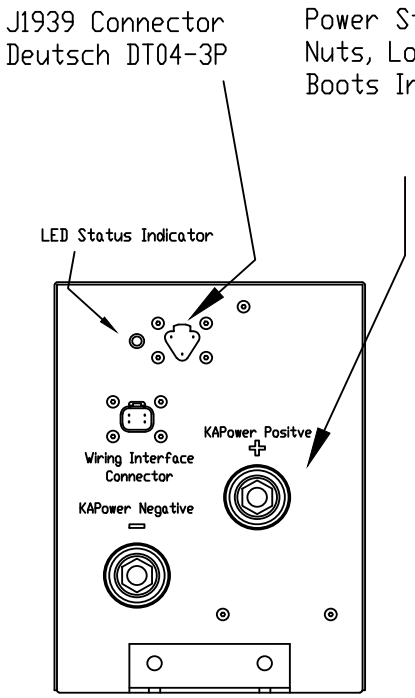






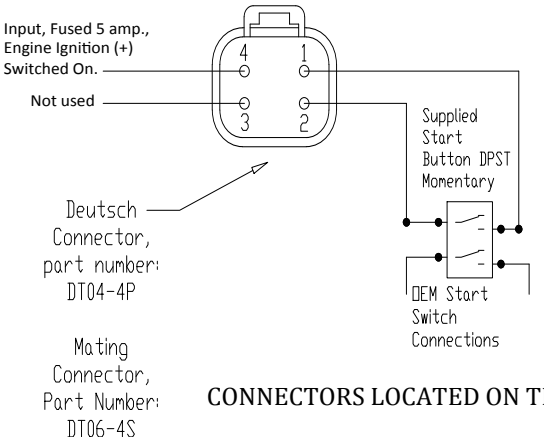
GENERAL WIRING INSTALLATION PROCEDURE:

CAUTION KSM Power Stud Nuts should be torqued to 180 Inch Pounds.

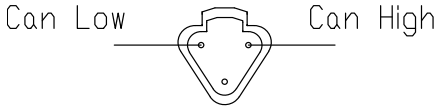


END-FACEPLATE OF THE
KSM ENCLOSURE.

Wire Interface Connector Pin-Out



J1939 Connector Pin-Out



Deutsch Connector
DT04-3P

CONNECTORS LOCATED ON THE END-FACEPLATE OF THE KSM ENCLOSURE.

GENERAL WIRING INSTALLATION PROCEDURE: (CONTINUED)

Theory of Operation, explaining how the KSM module works:

Once installed and wired properly, the LED on the End-Faceplate of the KSM will be illuminated whenever the KSM contactor relay is closed. When the LED is illuminated, the contactor is closed; the KAPower Module is running parallel with the vehicle or equipment batteries and electrical system.

When the DPST switch is depressed you are closing the contactor inside the KSM enclosure, using power from the KAPower module, regardless of the state of charge of the vehicle or equipment's batteries. When depressing the DPST switch you are also engaging the cranking motor circuit. This is done by wiring and using the recommended electrical circuit, displayed on the schematic (page 14). By doing so, you have tapped into the OEM (Original Equipment Manufacture) electrical circuit allowing both the KSM and the OEM cranking motor circuit to be engaged, simultaneously. Once the engine starts, the Programmable Logic Controller (PLC) inside the KSM monitors the condition of the KAPower Module and will close or open the Contactor Relay inside the KSM, based on the preprogrammed parameters inside the PLC. When the engine is stopped, the equipment is turned off, the contactor opens and the KAPower module remains isolated, waiting for the next engine-starting event, the pressing down of the DPST switch.

The PLC preprogrammed functions:

The PLC has been preprogrammed to monitor and control the state-of-charge of the KAPower capacitor module based on temperature, voltage & time. Once a voltage signal is received at pin four (4) of the Wiring Interface Connector the PLC "wakes-up" and will determine when and how long to keep the contactor closed. Remember, anytime the LED Status Indicator is illuminated the contactor is closed. In a typical engine-starting event you will see the LED illuminate during engine cranking and then go out for several seconds after the engine has started. The LED will then illuminate again and could remain illuminated for several seconds based on the condition of the KAPower module. The LED may even begin to "cycle" depending on the vehicle or system voltage during the recharging events.

The J1939 connector is used for programing the PLC and for communications between the KSM and the equipment being operated. Optional, Contact KBI for details.

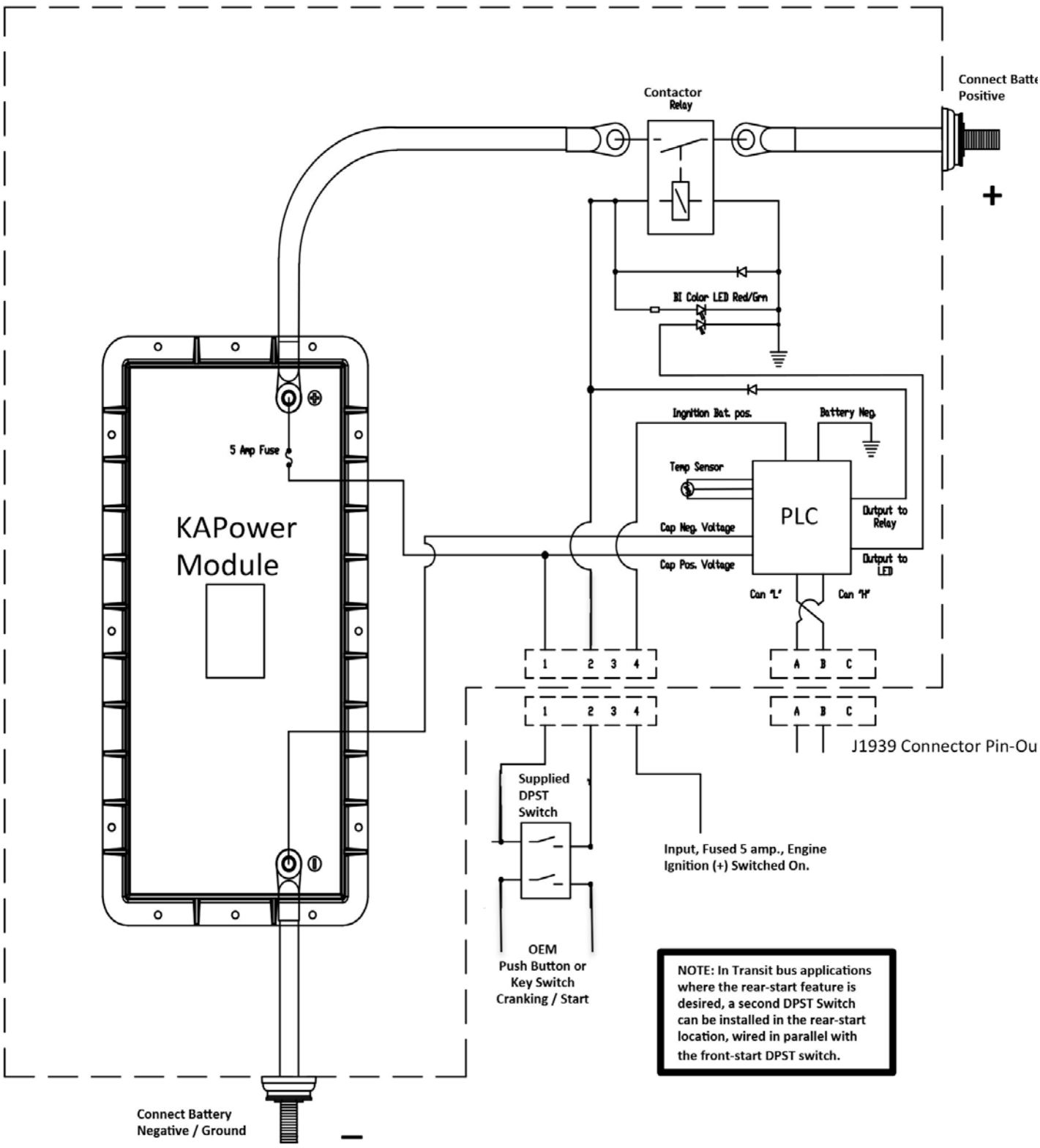
GENERAL WIRING INSTALLATION PROCEDURE: (CONTINUED)

1. Before attaching any cables, slide included supplied protective boots onto the cables. The first cable shall be connected to the "+" terminal of the KSM and then connected to the "+" terminal of the battery.
2. Slide included protective boot onto the "-" cable. This second cable shall be connected to the "-" clamp or terminal of the battery and then connected to the "-" terminal of the KSM module.
3. As based on page 11 & 14 create and wire the harnesses to the Deutsch connector. The KSM Deutsch connector has been provided with mating connector that has pigtail wire leads tagged & identified in order to facilitate installation.
4. For the PLC input, pin four (4) of the wire interface connector, you must find a 5 Amp. power source from the vehicle, "key-on" ignition source that is live (+) only when the engine is cranking and running. Install a five (5)-amp fuse in this circuit as close to the power source as possible.
5. Wire DPST and find & wire the appropriate PLC input (pin 4) as based and depicted on the diagram & schematic pages 11 & 14. You will not be connecting any wiring to the J1939 Connector. *The J1939 connector is used for programing the PLC and for communications between the KSM and the equipment being operated (optional). Contact KBI for details.*
6. Apply provided protective grease on KSM **+** & **-** terminals.
7. Attach provided protective boots to terminals on KSM module.
8. Wiring is complete and the unit is now ready to operate.

CAUTION

After the installation and wiring are complete, whenever the DPST switch is depressed the KSM positive **+** and negative – terminals will be live. Do not short-circuit the terminals.

KSM Enclosure



OPERATION:

CAUTION

Do not bypass the PLC functionality. Charge voltage and temperature shall not exceed the Maximum Voltage and Temperature as specified in Table 1 & 2 (see page 7). It is important to MONITOR the voltage when charging the KAPower module to its Maximum Voltage Vs. Temperature. Failure to do so may result in premature module failure.

Using the system:

- Make sure you have properly installed the KSM module before activation.
- Simply push and hold down the DPST switch to engage the KAPower KSM system until the engine starts.
- By using power from the KAPower capacitor, the KSM contactor will close and stay closed whenever the DPST switch is depressed. The DPST switch should also be engaging the vehicle or equipment's OEM cranking motor circuit.
- Whenever the KSM KAPower contactor is closed, the LED on the End-Faceplate should be illuminated.
- The engine should begin to crank-over with power being supplied from both the KSM capacitor module and the standard batteries.
- Once the engine starts and the DPST switch is released, the KSM internal PLC module should be active, keeping the contactor closed when required, allowing the KAPower module to recharge.
- **NOTE: If the vehicle or equipment's batteries where completely discharged ("dead") you may need to keep the DPST switch depressed until the vehicle's electrical (charging) system has become active. The "dead" batteries, on their own, may not support all of the engine's electrical power requirements to keep it running. In this case, keep the DPST switch depressed until you are sure the vehicle's charging system is active. The KAPower module *will* have enough power to keep the engine running until the engine's charging system becomes active.**
- When the engine stops and the vehicle or equipment is turned off the KSM contactor should open, keeping the fully charged KAPower module in reserve for the next engine-starting event.

TROUBLESHOOTING
AND
MAINTENANCE:

Maintenance of the KAPower module within the KSM enclosure shall not be required provided that the operating conditions are proper and that the requirements specified in this Manual are observed.

- The LED located on the End-Faceplate of the KSM indicates the active condition of the KSM module. See page 11. If the LED is not illuminated when the expected, insure all wiring and connections are in accordance with the instructions within this manual. Make sure to check the integrity of the DPST and the PLC active high (Engine Ignition **+** Switched On) input wiring harness you created.
- If the wiring and harnesses are in good order continue troubleshooting by unplugging the Deutsch connector on the End-Faceplate of the KSM, giving you access to the pin terminals on the KSM connector. Refer to pages 11 & 14.
- Check the fuse and contactor relay within the KSM module. In order to service or replace any of these components you will have to remove the cover of the KSM enclosure. Reference page 5.
- The bi-color (red/green) LED is an indicator for how the KSM is functioning. The green side of the LED is connected parallel with the contactor. The red side is connected to an output on the PLC as shown in the schematic depicted on page 14. The PLC monitors the capacitor voltage during and after the recharge cycle. If the Cap voltage drops to below an acceptable level in the first 5 minutes after the recharge, the red LED will flash, indicating a fault. If at any time while the PLC is powered up and the internal fuse blows or the cap voltage level drops below 4 volts the red LED will flash.

To check KSM Internal 5 Amp Fuse:

- Using a voltmeter check voltage at Pin #1 of the Deutsch four-pin connector and the KSM negative (**-**) ground Power Stud terminal. If voltage is present the fuse is "good". The voltage reading is the actual KAPower module voltage and should be at least 10 volts in order to activate the contactor.
- Jump pins 1 and 2 on the four-pin connector, the contactor should activate. If not remove cover and check for faulty contactor or internal wiring.
- The PLC Module is a sealed unit. It cannot be serviced. If additional troubleshooting is required contact KBI.

STORAGE:

CAUTION

The KAPower modules shall be charged up to the Maximum Voltage per specifications prior to storage.

The total duration of the KAPower modules storage time shall not exceed five years during it's service life.

The KAPower modules shall be stored within enclosed heated or unheated premises outfitted with a natural ventilation system in regions having moderate or cold weather conditions. Climate control systems are not required. The required storage temperature range is -76º to 158ºF (-60º to 70ºC).

TRANSPORTATION:

The KAPower KSM modules can be shipped in approved corrugated cardboard, wooden, or plastic containers. For more information on transportation contact KBI. KAPower KSM modules shall be transported in normal upright working position and cases shall bear relevant marking specifying this requirement.

LIMITED WARRANTY

The KAPower module itself is guaranteed against defects in material and workmanship for three (3) years from date of purchase. The KAPower is a sealed unit. If the KAPower does not operate properly, it must be returned to the factory, prepaid, for replacement. If factory inspection determines the product to be defective under the terms of this warranty, it will be replaced without charge. All other KSM components are guaranteed against defects in material and workmanship for one (1) year from the date of purchase.

Failure due to accident, abuse, neglect, use other than in the intended application specified in this manual, improper installation or maintenance, mishandling, and repairs or attempted repairs which have been made by others, are not covered under the terms of this warranty.

Kold-Ban International, Ltd. shall not be liable for loss of use of the KAPower KSM or other incidental or consequential costs, expenses or damages incurred by the purchaser or user.

This warranty does not include labor for repair or replacement.

Kold-Ban International, Ltd.

8390 Pingree Road

Lake In The Hills, IL 60156-9637

(847) 658-8561 (800) 527-8278

Options:

1) SAE J1939 / CAN bus

2) Remote State of Charge Indicator

3) Custom Configurations Available

Nickel Carbon Advantages

HIGH POWER CRANKING — Supplies current 2 - 3 times greater than a battery only system during the critical seconds of cranking motor engagement.

ANTI-IDLE REGULATIONS — Greatly increases performance and reliability when complying with ever increasing emissions laws.

LONG SHELF LIFE — Virtually unlimited shelf life. Low self-discharge allows high power starts even after months of storage.

ASYMMETRIC NICKEL CARBON — Means more energy compared to symmetric Supercapacitors due to the intrinsic two-fold increase in capacitance.

SIMPLE DESIGN — No danger of overcharging. Requires no sophisticated electronic controls or switching equipment. No voltage balancing is required as in symmetrical Supercapacitors.

CONSTANT LIFE PERFORMANCE — Virtually unaffected by temperatures. Maintains starting performance for over one million cycles and increases life of existing batteries.

WEIGHT REDUCTION — Lead-Acid batteries can be removed. As a result weight reduction can be achieved while increasing cranking power.

KAPower Starting Module

	12 Volt Specifications		24 Volt Specifications	
	KSM0120012	KSM0200012	KSM030024	KSM050024
Electrical Characteristics				
Operating Voltage Window	4 – 14.5 V	4 – 14.5 V	8 – 29 V	8 – 29 V
Maximum Voltage *	16 V	16 V	32 V	32 V
Minimum Voltage **	4 V	4 V	8 V	8 V
Internal Resistance	0.002 Ohm	0.002 Ohm	0.006 Ohm	0.006 Ohm
Pulse Cranking Amps (PCA) 1.5s	2462	2909	1455	1778
Capacitance	1200 F	2000 F	300 F	500 F
Energy Stored Within Operating Voltage Window	110 kJ	190 kJ	110 kJ	190 kJ
Energy Stored Within a Specified Voltage Window of 6.5 – 13 Volts	70kJ	120kJ	70kJ	120kJ
Maximum Power ***	18 kW	18 kW	24 kW	24 kW
Leakage Current at 14.4 V	20 mA	30 mA	10 mA	15 mA
Operating Conditions				
Operating Temperature Range ****	-58°– 122° F -50° – 50° C	-58°– 122° F -50° – 50° C	-58°– 122° F -50° – 50° C	-58°– 122° F -50° – 50° C
Storage Temperature	-76° – 158° F -60° – 70° C	-76° – 158° F -60° – 70° C	-76° – 158° F -60° – 70° C	-76° – 158° F -60° – 70° C
Cycle Life ****	~1,000,000	~1,000,000	~1,000,000	~1,000,000
Dimensions and Weight				
Length	19.62”	19.62“	19.62”	19.62“
Width	8”	8“	8”	8“
Height	10.5”	10.5”	10.5”	10.5”
Weight	63 lbs	75 lbs	63 lbs	75 lbs

made in USA

ISO 9001:2008 REGISTERED

For Use Under One Or More Of The Following Patents.
6,242,887 6,362,595
6,819,010 6,871,625
6,888,266 6,988,475
6,988,476 7,134,415
7,198,016

Kold-Ban International, Ltd., 8390 Pingree Rd., Lake In The Hills, IL 60156
800-527-8278 or 847-658-8561 **www.koldban.com**

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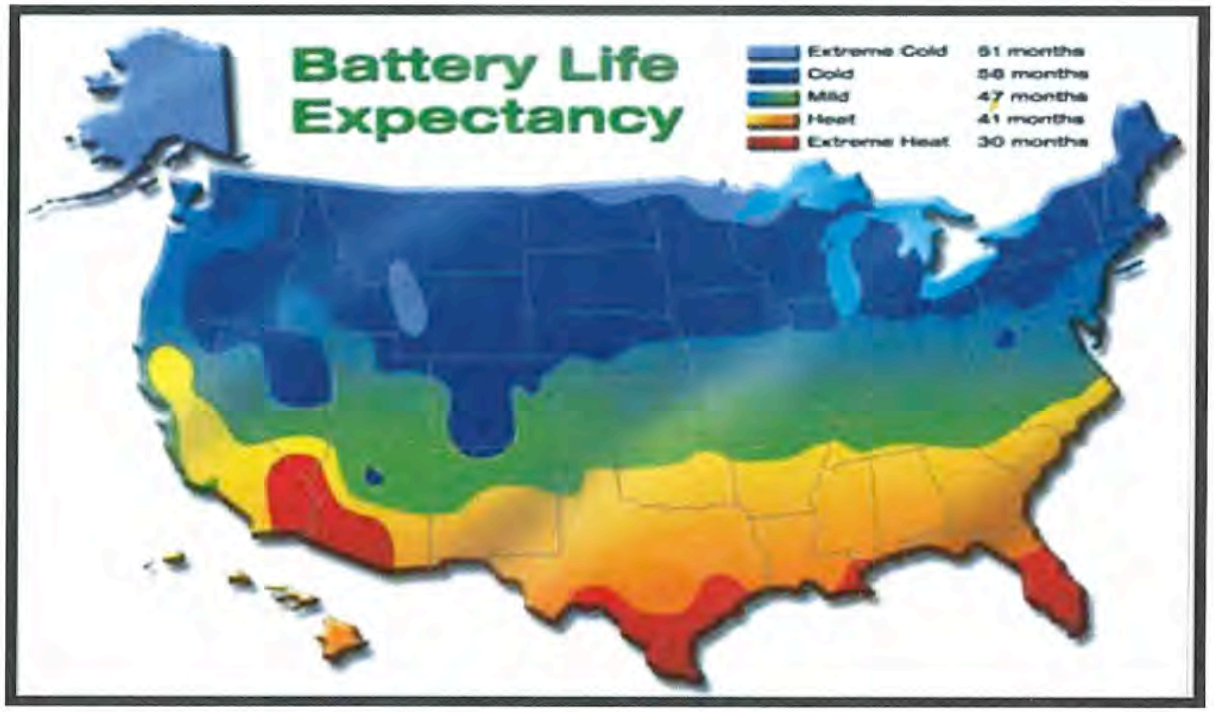
12. WHAT ARE THE COMMON CAUSES OF PREMATURE BATTERY FAILURES?

Normally, premature battery failures are caused by one or more of the failures listed below. Prior to 1980, plate or grid shorts were the most common failure. Since then the manufacturers have significantly improved the life expectancy by using improved separators, plate alloys to reduce corrosion, and heat shields. By relocating sealed AGM and Gel Cell batteries to the passenger compartment (or trunk), also has considerably **decreased** premature battery failures. Batteries that have been in use for longer periods of time will typically fail from multiple causes. **All batteries will fail at some point in time.**



[Source: Interstate Batteries]

12.1. **Water Loss! (Car) and Sulfation! (Deep Cycle)**

12.2. **Water Loss! (Car) and Sulfation! (Deep Cycle)**

12.3. **Water Loss! (Car) and Sulfation! (Deep Cycle)**

12.4. For Car batteries, high under hood **heat** or overcharging causes a loss of water (which account for over **50%** of the failures); accelerated positive grid corrosion and growth; increased self discharge; or plate-to-strap shorts.

12.5. Sulfation from water loss, undercharging, excessive temperatures or prolonged periods of non-use account for approximately 85% of the Deep Cycle battery failures. (Please see Section 16.) Data Power Monitoring Corp. reports that 90% of the Deep Cycle VRLA battery failures are due to the battery itself.

12.6. Deep discharges, such as leaving your lights on.

12.7. Misapplication, for example, using a starting battery in a deep cycle application, a motive Deep Cycle battery instead of a stationary for a UPS, an under sized battery (or battery bank) that causes discharges greater than the battery was designed for or a mismatch to the charging system.

12.8. Excessive vibration due to a loose hold down clamp.

12.9. Calcium or magnesium sulfation from using **tap** or reverse osmosis water.

12.10. Freezing a discharged battery.

12.11. Undercharging which reduces capacity due to incomplete conversion of sulfate back to lead which causes plate, cracked grids and cell shorts.

12.12. Old age (positive plate shedding).

12.13. Fast recharging at rates greater than C/4 (amp hour capacity/four hours).

12.14. Temperatures above 80° F (26.7° C), especially above 100° F (37.8° C) causing VRLA battery "thermal runaway".