



KSM

KAPower Starting Module

INSTALLATION – OPERATION MANUAL
Gen 3 (12 Volts or 24 Volts)



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



SAFETY INFORMATION

WARNING and CAUTION symbols are used in this document to alert the reader of possible safety hazards. The reader is responsible for reading and following these alerts.



WARNING indicates a hazardous situation which, if not avoided, will result in death or serious injury.



CAUTION indicates a hazardous situation which, if not avoided, could result in equipment damage and/or equipment failure.

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Patent information can be found at: http://www.koldban.com/about_KBi_s/1.htm



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1.0 PARTS LIST

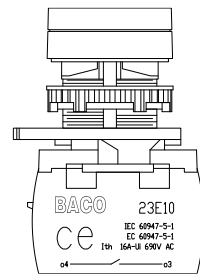
1. KSM Enclosure (See Figure 1)
2. Double Pole Single Throw (DPST) switch (See Figure 1)
3. Wiring harness (Not Shown)
4. Terminal grease (Not Shown)
5. Protective boots (Not Shown)

2.0 ITEMS NEEDED FOR INSTALLATION

1. Battery cables (See Section 4.1 for cable recommendations)
2. Terminals for battery cable
3. Torque wrench with $\frac{3}{4}$ inch socket, or $\frac{11}{16}$ th depending on KSM model
4. Minimum 16-gauge wire for harnesses



KSM Enclosure



DPST Switch

Figure 1: Parts List Items



3.0 INTRODUCTION

The KSM enclosure houses a KAPower module, contactor, PLC Module (Programable Logic Controller), circuit breaker, 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 at the direction of KBI.

KAPower is designed as an auxiliary power source to be installed in parallel with cranking batteries. It derives its power from batteries or an 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. This capability may allow for removal of half or most existing starting batteries.



The KAPower module can produce a significant electric charge. KAPower is not a high voltage device. It supplies the same amount of voltage as its charge. A charged module should be treated as a fully charged battery.



Do not short circuit KAPower module terminals. Burning or igniting of combustible materials adjacent to the point of short circuit may result from a short circuit. Do not place any conductive objects or materials across terminal posts. In case of accidental short-circuiting of the KAPower module, or individual capacitors, immediately mitigate short by removing the object causing short.



Noncompliance with the requirements set forth in this manual may result in KAPower module failure. Such requirements shall be reviewed and followed in the course of KAPower module operation and installation.



3.1 KAPower Advantages

- 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 and Easy to Install

3.2 KAPower Basic Description

The KAPower module is an energy storage device. KAPower is a high-power device with low energy density. The cranking or discharge periods will be short, but powerful (typically less than 30 seconds), with the time to full recharge rated in tens of seconds. Recharging can be accomplished from virtually any 12-volt or 24-volt DC electrical power source. Cycling, charge, and discharge events will not wear out the device. The Cycle Duty is rated in hundreds of thousands of cycles, approaching one million cycles.

3.3 The KAPower Module

The KAPower module, which is housed within the KSM enclosure, represents an internal bank of 6, 10, or 12 capacitor cells series-connected to each other.

3.4 Electrochemical Double-Layer Capacitor (EDLC)

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

4.0 INSTALLATION

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

Before installation, review the KAPower KSM module specifications. Ensure that the proper device for the specific application is being used. (See Table 1.)



Table 1: Specifications

Specifications				
	12V 6 Cell Unit	12V 10 Cell Unit	24V 10 Cell Unit	24V 12 Cell Unit
Electrical Characteristics				
Operating Voltage Window	7 – 14.5V	7 – 14.5V	12 – 29V	12 – 29V
Maximum Voltage	18V	18V	30V	33V
Minimum Voltage	0V	0V	0V	0V
Internal Resistance	0.0011 ohms	0.0008 ohms	0.0019 ohms	0.0022 ohms
Capacitance	525 F	1250 F	315 F	263 F
Energy Stored within Operating Voltage Window	42.3 kJ	101.6 kJ	122.4 kJ	102 kJ
Energy Stored at Max Voltage	85.1 kJ	141.8 kJ	141.8 kJ	142.9 kJ
Maximum Power	47 kW	112 kW	112 kW	94 kW
Leakage Current at Max Voltage	4.5 mA	4.5 mA	4.5 mA	4.5 mA
Operating Conditions				
Operating Temperature Range	-40° – 149°F (-40° – 65°C)	-40° – 149°F (-40° – 65°C)	-40° – 149°F (-40° – 65°C)	-40° – 149°F (-40° – 65°C)
Cycle Life	>1,000,000	>1,000,000	>1,000,000	>1,000,000
Dimensions and Weight				
Length x Width x Height	14.79" x 7.75" x 8"	19.44" x 7.75" x 8"	19.44" x 7.75" x 8"	19.44" x 7.75" x 8"
Weight	22 lb.	32.5 lb.	32.5 lb.	34.5 lb.



The KAPower KSM 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.



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



CAUTION

Electrical resistance in a circuit is the consumer of the electrical energy. When installing a KAPower Module, keep resistance to a minimum. Short, heavy cables, and clean cable connections are essential to reducing the amount of resistance in a circuit.

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 starting batteries or starter as possible. Avoid locations that are subject to extreme heat, humidity, dripping water (under air conditioning units, for example), road dirt, ice, and snow. Prevent the external case of the KAPower KSM module from physical impacts.

4.1 Electrical Cable Selection

1. Electrical resistance in a circuit is a significant consumer of the power available in the KAPower device. Create and keep the integrity of the circuit to the highest possible standards. Use high strand count cable that is abrasion resistant.
2. Use the heaviest gauge cable available. For 24-volt (and 10 cell units), use at least 2/0, with 4/0 being recommended. A six cell, 12-volt unit may use 4 gauge to 2/0 cables.
3. Keep cable length to an absolute minimum. The circuit resistance increases with cable length.
4. Ensure that the cable termination connections (terminals) are properly crimped, and ensure that the holes in ring terminals match the size of the studs over which they are placed.
5. The quality of the cable connections from the KSM to the vehicle's battery/starter circuit, or equipment, is critical. Make sure to provide good, clean, robust cable interface connections. The cables between the KSM module and the battery are cranking motor conductors, and therefore are typically not equipped with a fuse or circuit breaker. If a short circuit occurs, the cable will overheat, and it may catch fire, or ignite nearby combustible materials. Therefore, make certain the cable is well-secured, at least every 18-inches, and protected from damage and chafe.
6. The 4 Pin Deutsch connector has been supplied with a mating connector. Be sure to follow proper wire schemes as identified in the diagrams.
7. The supplied DPST switch will be installed in addition to or paralleling the existing key-start switch. Locate and install the DPST switch in a convenient location relative to the key switch.



4.2 Mounting the KSM Unit

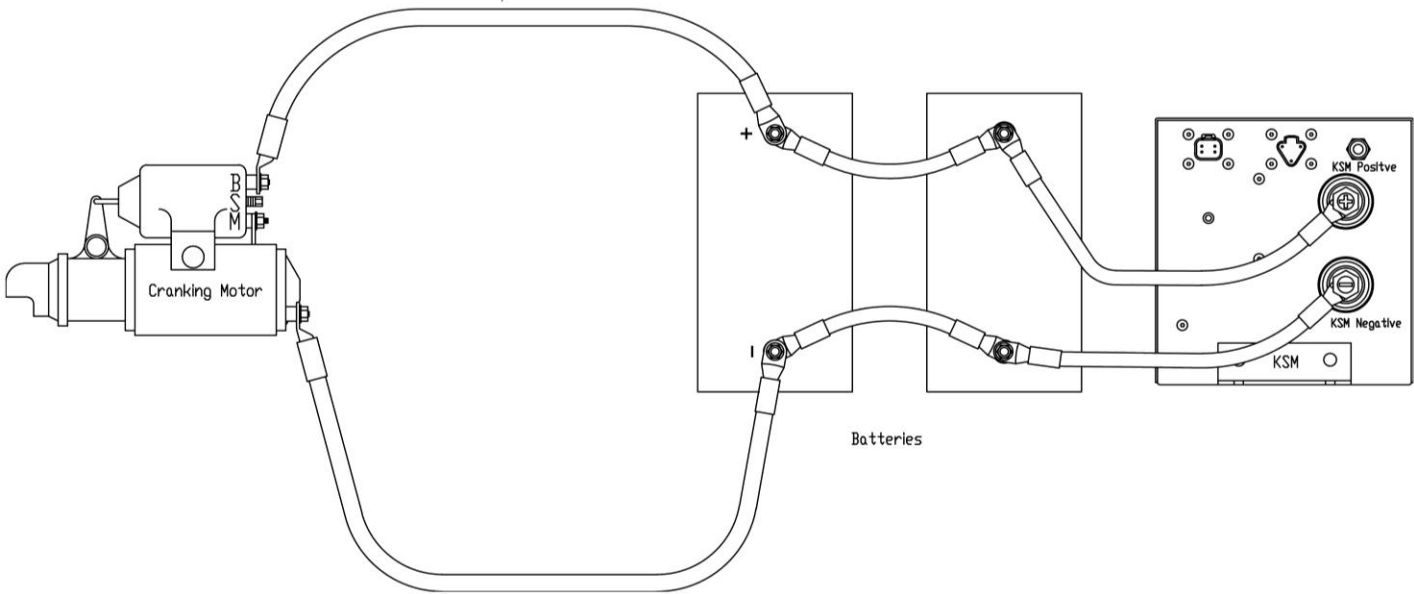
Using the dimensions shown in Figures 3, and 4, use four (4) ¼" bolts, nuts, and lock washers (not supplied) to mount the KSM unit to vehicle, vessel, or equipment chassis. If mounting on a solid bulkhead or other location without backside access, other fasteners such as suitably-sized tapping screws can be used.

CAUTION

When selecting a location for installation, make sure that the KSM module and cables will clear any hoods, hatches, lids, covers, and other movable vehicle, vessel or equipment parts. Avoid locations that are subject to extreme heat, dripping water, humidity, road dirt, ice, and snow. While the KSM unit may be mounted in any position or orientation, do not mount it directly over batteries, or under ventilation systems through which water might drip. The internal components of the KSM are IP67 rated, but the KSM itself is not IP rated. Take care to prevent the external case of the KSM module from receiving any physical impacts.



Notes:
4/0 Cable Recommended
2/0 For 6-Cell KSM
Any Battery Selector Switch Can Remain In Place



4/0 Cable Recommended
2/0 For 6-Cell KSM

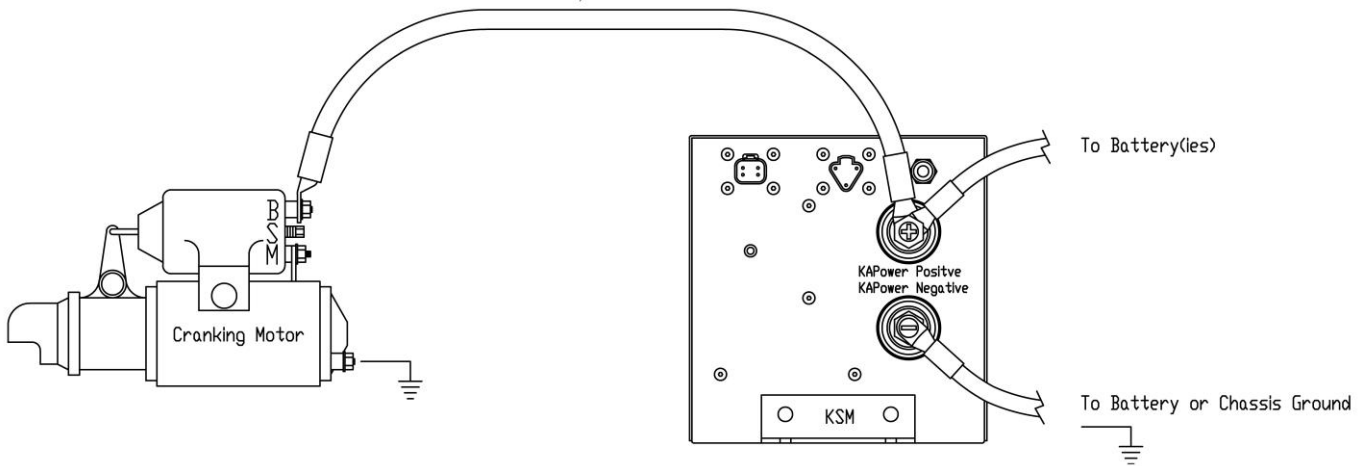


Figure 2: Typical Cable Installations



Material:
Shell; 16ga SS 304 2B
Cover; 18ga SS 304 2B

Weight:
Approx 21.5lb

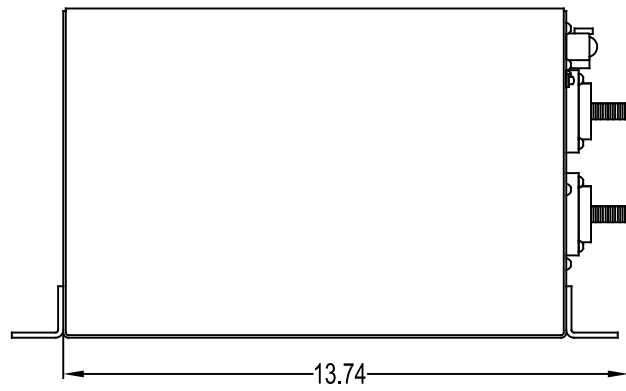
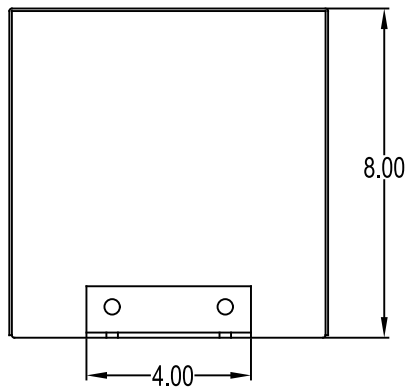
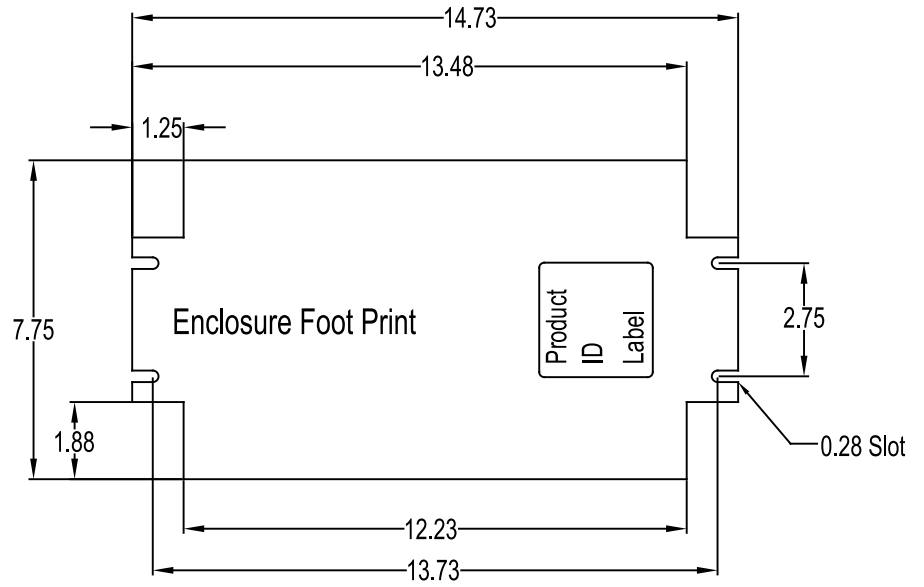


Figure 3: Six (6) Cell KSM



Material:
Shell; 16ga SS 304 2B
Cover; 18ga SS 304 2B

Weight:
Approx 32.5lb

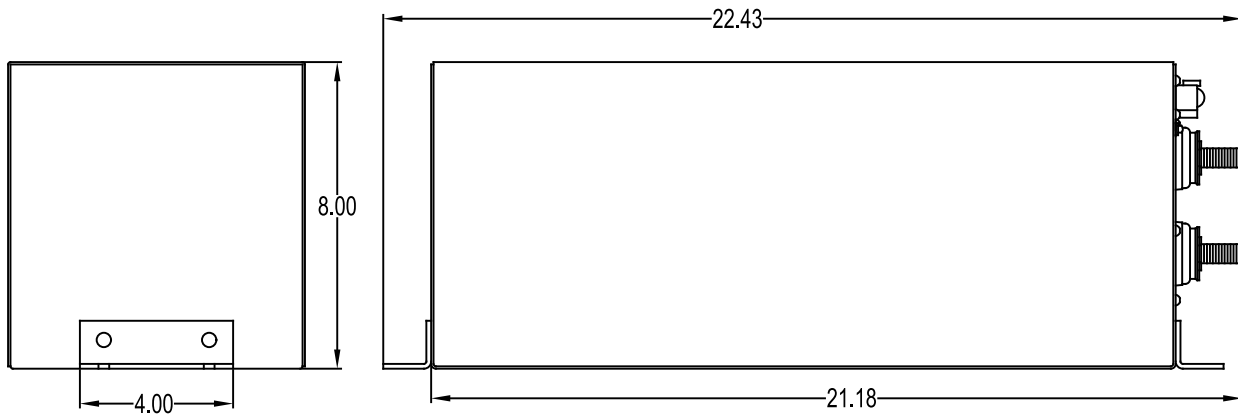
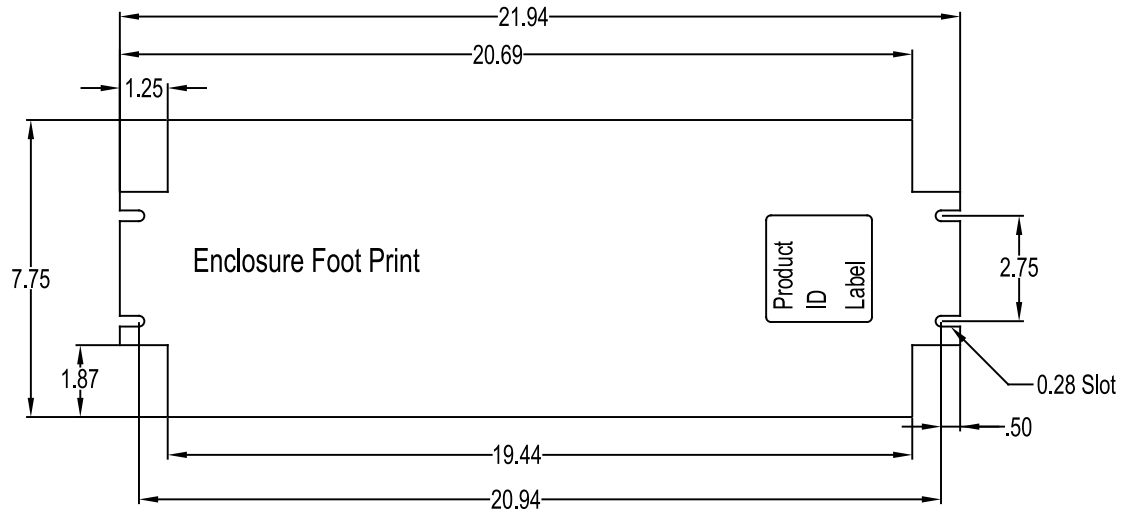


Figure 4: Ten (10) and Twelve (12) Cell KSM



Theory of Operation, Explaining how the KSM Module Works:

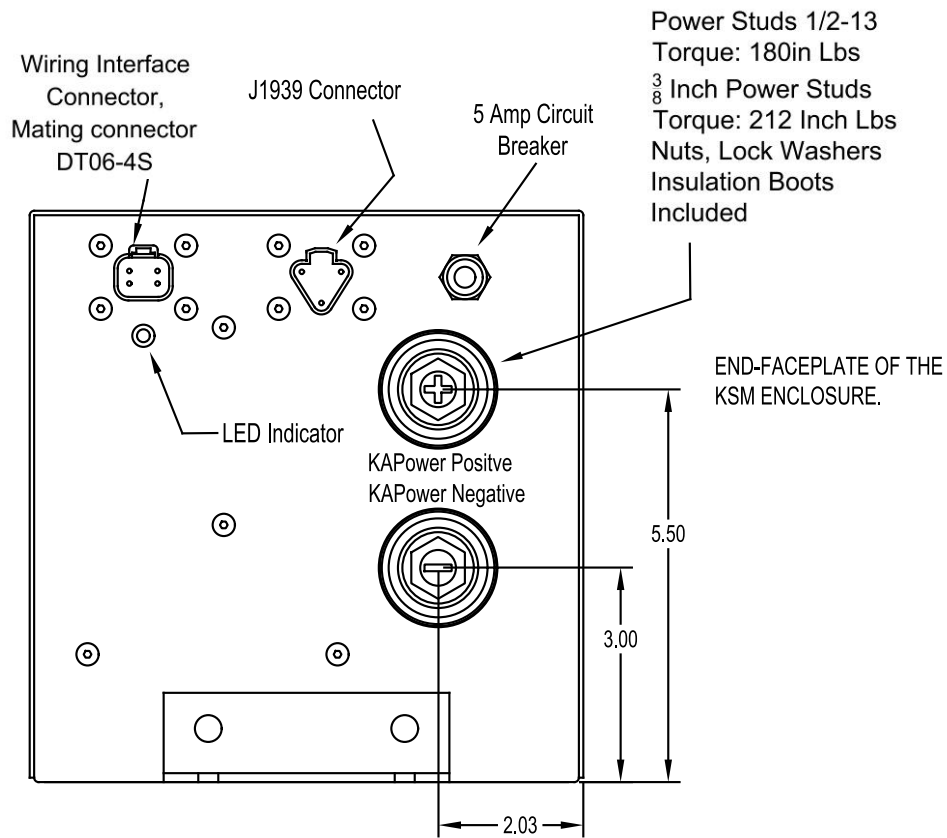
Once installed and wired properly, the LED on the end-faceplate of the KSM will be illuminated green whenever the KSM contactor relay is closed. When the LED is illuminated, the contactor is closed; the KAPower Module is running parallel with the vehicle, or the equipment batteries and electrical system.

Pressing the DPST switch closes 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. Pressing the DPST switch also engages the cranking motor circuit, just as if the key switch to the crank/start position had been turned, or the vehicle's or vessel's start button (if so equipped) had been pressed. The DPST switch is wired in parallel with the existing starting system. This is done by wiring and using the recommended electrical circuit, displayed on the schematics in Figure 5 (page 14), or Figure 6 (page 16). This creates a parallel circuit with the OEM (Original Equipment Manufacturer) 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, when the DPST switch is pressed.

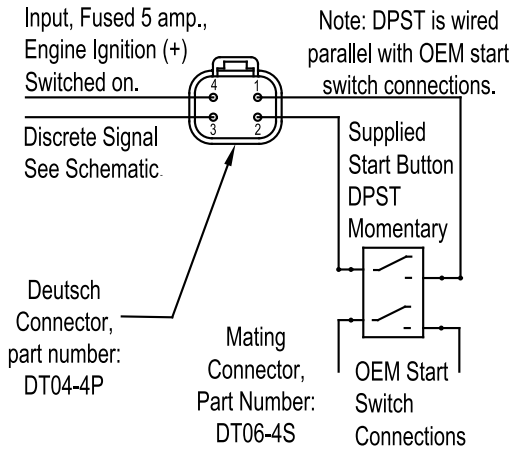
The PLC Pre-programmed Functions:

The PLC has been preprogrammed to monitor and control the state-of-charge of the KAPower capacitor module based on temperature, voltage, and 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. Anytime the LED Status Indicator is illuminated, the contactor is closed. In a typical engine-starting event, the LED will 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/vessel, or system voltage during the recharging events.

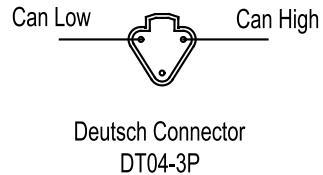
The J1939 connector is used for KBI factory programming only. Contact KBI for details.



Wire Interface Connector Pin-Out



J1939 Connector Pin-Out



The J1939 connector is used for KBI factory programming only. Contact KBI for details.

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

NOTE: The J1939 connector is used for KBI factory programming only. Contact KBI for details.

Figure 5: General Wiring Installation



4.3 Wiring Installation Procedure

1. Before attaching the large battery cables to the KSM posts, slide included protective boots onto the cables. The first cable shall be connected to the positive (+) terminal of the KSM, and then connected to the positive (+) terminal of the battery, or starter.
2. Slide included protective boot onto the negative (-) cable. This second cable shall be connected to the negative (-) clamp, or terminal of the battery, engine, or chassis ground and then connected to the negative (-) terminal of the KSM module.
3. As based on Figure 5, Figure 6, or Figure 7 create and wire the harnesses to the Deutsch connector. The KSM Deutsch connector has been provided with a mating connector that has pigtail wire leads tagged and identified in order to facilitate installation.
4. For the PLC input, pin four (4) of the wire interface connector, find a 5-amp power source from the vehicle, or vessel “key-on” ignition source that is live positive (+) **only**, when the ignition switch is on, and is capable of delivering up to 5 amps. This can often be sourced at the engine. Install a 5-amp fuse in this circuit within 7-inches of the power source. Use care not to disturb or compromise the engine’s own wiring harness, or connections.

NOTE: The PLC inside the KSM needs power (approximately 2.5 amps) from a source, such as a key switch, that provides power only when the vehicle or boat is in operation. Consider this additional 2.5 amps of power and how it may influence the source. This new circuit should be protected with a 5-amp fuse or circuit breaker per ABYC standards in marine applications.

5. Wire the DPST switch, and find and wire the appropriate PLC input (pin 4) as based and depicted on Figure 5, Figure 6, or Figure 7. Do not connect any wiring to the J1939 Connector. *The J1939 CAN-Bus is used for KBI Factory programming only. Contact KBI for details.*
6. Apply provided protective grease on KSM positive (+) and negative (-) terminals.
7. Attach provided protective boots to terminals on KSM module.
8. To monitor the KSM state of charge, order and install the KBI Voltmeter wire-harness, and connector accessory kit, KBI part number 302809. See page 36. The meter used may be digital, or analogue; however, it **must** be activated only with a momentary ON switch or button. Permanently wiring a voltmeter to the KSM will accelerate the depletion of its charge.
9. Wiring is complete and the unit is now ready to operate.



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

Capacitor Enclosure

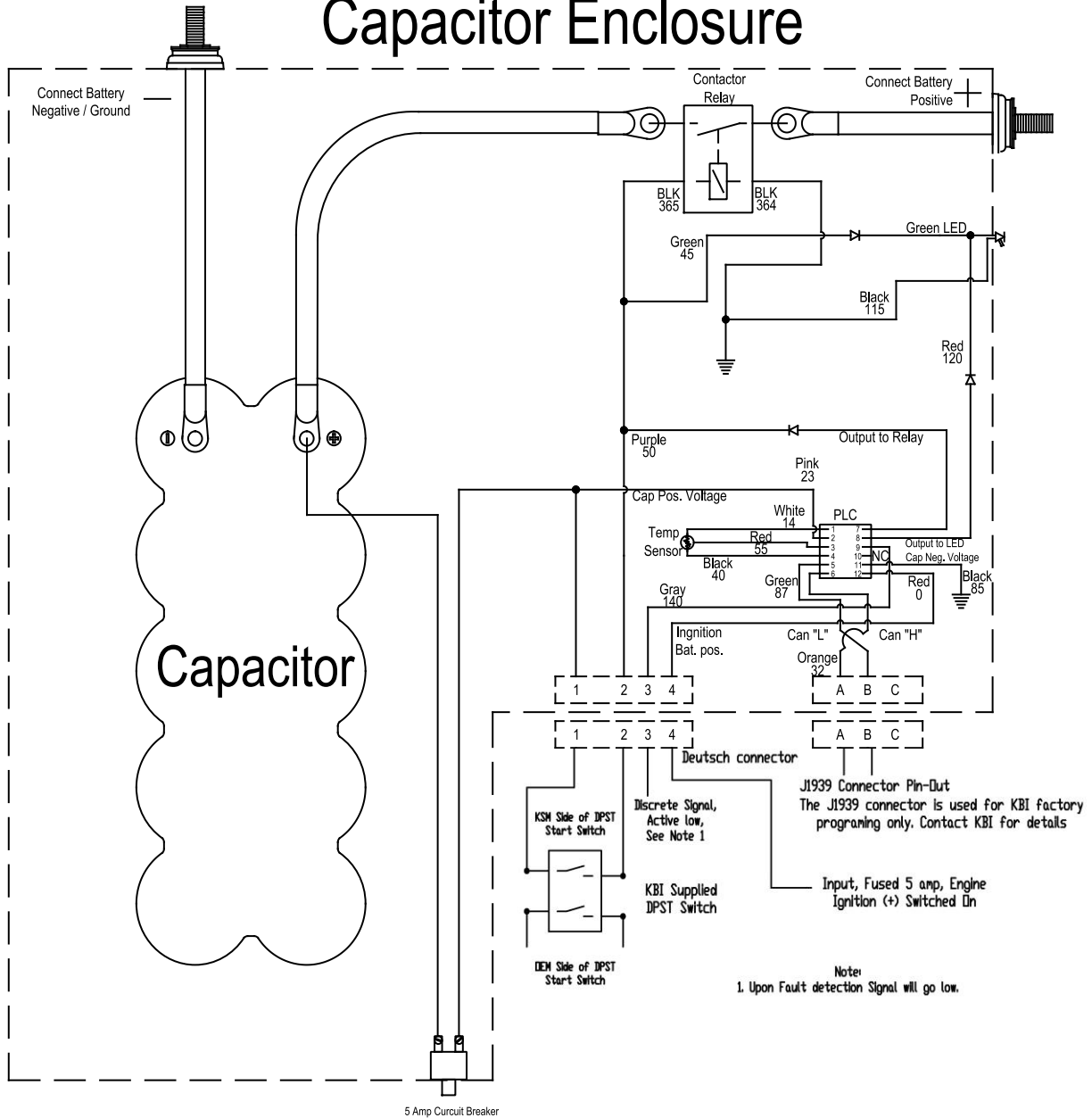


Figure 6: Standard KSM Schematic

NOTE: In Transit bus applications where the rear-start feature is desired, a second DPST Switch can be installed in the rear-start location, wired in parallel with the front DPST switch.



5.0 OPERATION

CAUTION

Do not attempt to bypass the PLC functionality. Charge voltage and temperature shall not exceed the Maximum Voltage and Temperature as specified in Table 1. It is important to MONITOR the voltage when charging the KAPower module to its Maximum Voltage. This is the main purpose and function of the PLC. If the voltage exceeds these ranges, contact KBI for further troubleshooting instructions. Failure to adhere to these specifications will result in premature module failure.

1. Before activation, confirm, using the wiring diagrams on Figure 2 (page 10), and figure 5 (page 14), that the KSM module has been properly installed.
2. Turn the vehicle/equipment key switch to the ON position, then push and hold down the DPST switch to engage the KAPower KSM system until the engine starts.
3. By using power from the KAPower capacitor, the KSM contactor will close and stay closed whenever the DPST switch is pressed. The DPST switch is designed to engage the vehicle, vessel, or equipment's OEM cranking motor circuit.
4. Whenever the KSM KAPower contactor is closed, the LED on the End-Faceplate should be illuminated green.
5. The engine should begin to crank-over with power being supplied from both the KSM capacitor module and the standard battery(ies).
6. Once the engine starts and the DPST switch is released, the KSM internal PLC module will be active, keeping the contactor closed when required, allowing the KAPower module to recharge.

NOTE: If the vehicle, or equipment's batteries are completely discharged (if the battery is dead), it may be necessary to keep the DPST switch, or emergency start switch pressed until the vehicle's electrical (charging/alternator) system has become active. The dead batteries, on their own, may not support all the engine's electrical power requirements to keep it running. In this case, keep the DPST switch pressed down until the vehicle's or vessel's charging system is active. This can be noted by watching the engine's volt or amp meter. The KAPower module will have enough power to keep the engine running until the engine's charging system becomes active.



CAUTION NOTE: *This can only be done if the engine is equipped with automatic starter disengagement. If the starter remains engaged while the start button is pressed, after the engine has started, the starter may be damaged, in which case this procedure cannot be used.*

7. When the engine stops and the vehicle, or equipment is turned off, the KSM contactor will open, keeping the fully charged KAPower module in reserve for the next engine-starting event.

6.0 TROUBLESHOOTING AND MAINTENANCE

Maintenance of the KAPower module within the KSM enclosure is not required provided that the operating conditions are proper, and that the requirements specified in this manual are observed.

NOTE: During scheduled maintenance you can disconnect the 4-pin deutsch connector from the KSM faceplate then start the engine using only the vehicle's or vessel's own key switch or start button. Doing so will prevent the KSM from coming on-line, thereby allowing the condition of the starting battery to be tested.

1. The LED located on the End-Faceplate of the KSM indicates the active condition of the KSM module. See Figure 5 for location of this light. If the LED is not illuminated when expected (see Section 4.3, Theory of Operation), ensure that all wiring and connections are in accordance with the instructions within this manual. Check the integrity of the DPST switch, and the power supply to the PLC (sourced from the engine ignition switched when ON) wiring harness you created.
2. This LED is also an indicator for how the KSM is functioning. The LED is connected in parallel with the contactor, and is also connected to an output on the PLC as shown in the Figure 6 and Figure 7. The PLC monitors the capacitor voltage during, and after, the recharge cycle. If the capacitor voltage drops below an acceptable level in the first 5 minutes after the recharge, the LED will flash, indicating a fault. If at any time while the PLC is powered up and the KSM Circuit Breaker trips or the capacitor voltage level drops below 6-volts (on a 12-volt unit) or 12-volts (on a 24-volt unit), the LED will flash in a sequence that indicates the fault, see Table 2.



Table 2: LED Flash Sequence

Priority	Name	Flash Rate
1	Capacitor Over Temperature	2
5	Temperature Sensor Error	3
4	Contactors Over Current Error	4
2	Low Capacitor Voltage Error	6
3	Rapid Voltage Decay after Recharge	7

6.1 To Check KSM Internal Circuit

1. If the wiring and harnesses are in good order, continue troubleshooting by unplugging the Deutsch connector on the end-faceplate of the KSM, providing access to the pin terminals on the KSM connector. Refer Figure 5, Figure 6, and Figure 7.
2. With the circuit breaker reset, use a voltmeter to check voltage at Pin #1 of the Deutsch four-pin connector and the KSM negative (–) ground power stud terminal. If voltage is present, the circuit is good. The voltage reading is the actual KAPower module voltage, and should be at least 12-volts for the 24-volt models and 6-volts for the 12-volt models in order to activate the contactor.
3. Jump pins 1 and 2 on the four-pin connector, the contactor should activate and make a “clunk” sound. If not, contact KBI for assistance.
4. If experiencing problems check the integrity of the vehicle or vessel side of the wiring harness for issues such as shorts, corrosion, chafing, or bad connections and components.
5. Check the circuit breaker and contactor relay connections within the KSM module. In order to service or replace any of these components, remove the cover of the KSM enclosure, with the assistance of KBI.
6. The PLC Module is a sealed unit. It cannot be serviced. If additional troubleshooting is required, contact KBI.



7.0 STORAGE

CAUTION

When not installed 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 -76° to 185°F (-60° to 85°C).

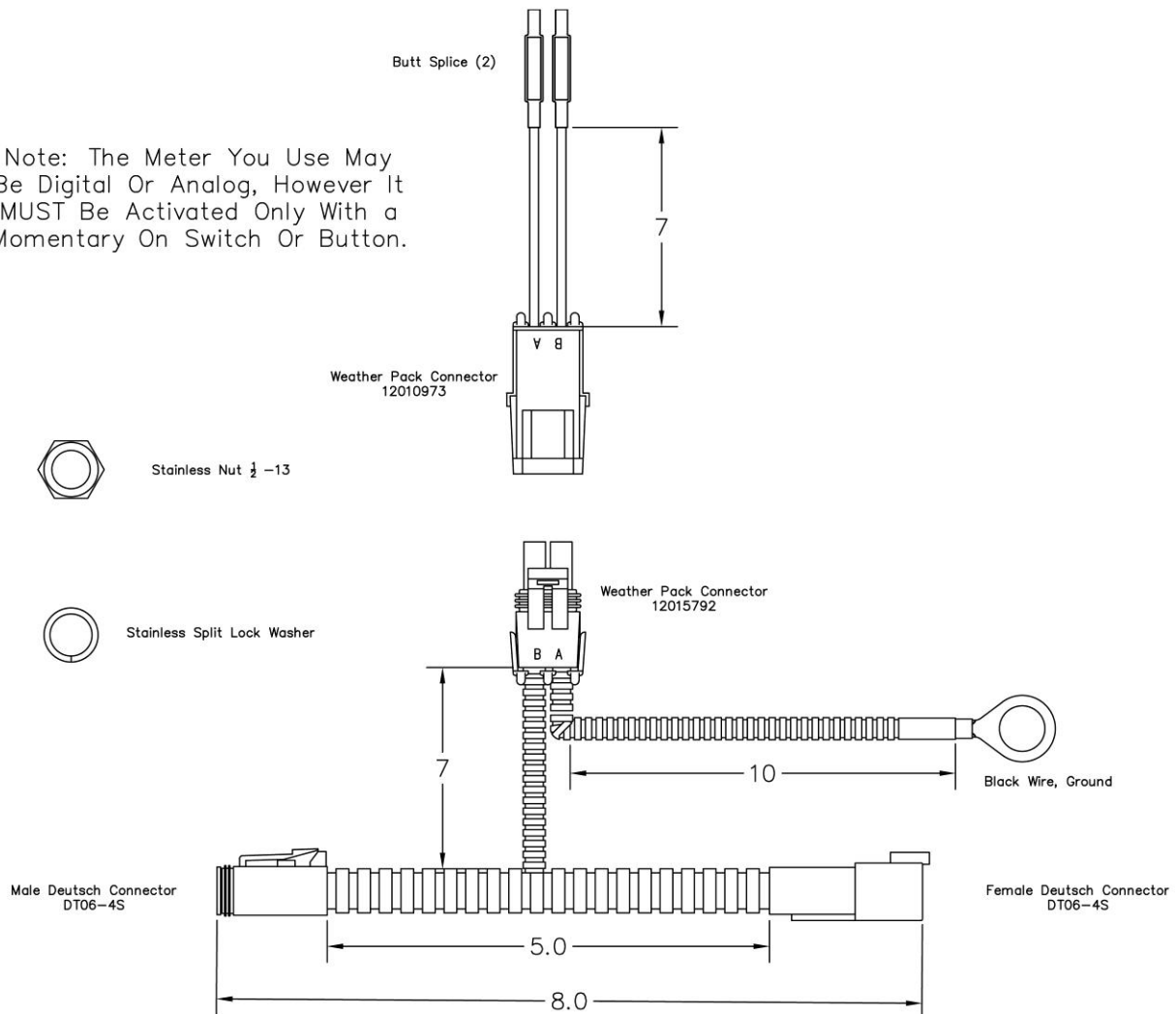
8.0 TRANSPORTATION

The KAPower KSM modules can be shipped in approved corrugated cardboard, wooden, or plastic containers. For more information on transportation, contact KBI.



9.0 OPTIONAL VOLTMETER HARNESS

Note: The Meter You Use May Be Digital Or Analog, However It MUST Be Activated Only With a Momentary On Switch Or Button.



Using this harness with a voltmeter will allow checking of capacitor voltage. The Male end of the harness plugs into KSM faceplate. The female end will receive the connector from the vehicle, or vessel. Connect the eyelet over the existing ground connection on the negative post of the KSM. A voltmeter can then be installed at the butt splices coming from the Weather Pack connector.

Note: Not all KSM models can use external voltmeter, contact KBI for details.



10.0 LIMITED WARRANTY

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

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
www.koldban.com**

NOTE: Not all scenarios and installation methods are covered in this document. If your application does not match any identified in this document, please contact KBI for assistance.