MFJ

Super Battery Booster

Model MFJ-4418

INSTRUCTION MANUAL

CAUTION: Read All Instructions Before Operating Equipment

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INTRODUCTION & FEATURES

INTRODUCTION

The MFJ-4418 Super Battery Booster is designed with the serious mobile operator in mind. In the mobile environment low battery voltage can cause output signal distortion, output power problems and even transceiver resetting. This low voltage occurs in two ways. First – even low resistance wiring can result in noticeable voltage drop. And second when you turn off your vehicle or remove a typical battery from the charger, the battery voltage can drop from the nominal 13.8 volts to 12 volts after a short period of time. With this in mind the MFJ-4418 Super Battery Booster corrects all of these problems. With its high efficiency boost regulator circuitry, it will maintain the desired 13.8 volts at up to 25 amps ICAS from voltages as low as 9 volts.

The MFJ-4418 has been redesigned to make the device more robust with heavy duty transistors and rectifiers, improved switch mode transformer, and larger heatsinks on vital components. The EMI filters on the input and output of the MFJ-4418 are designed to reduce noise to a minimum so radio reception while boosting is normally no problem.

FEATURES

Choice of Input and Output Connections: No need to fumble around looking for connectors. The MFJ-4418 gives you a choice of Anderson PowerPole™ connectors or 5-way binding posts on the input and output.

Software Managed Adjustments: The user, through MFJ software, can adjust the output voltage, measure load current, set minimum voltage levels, over-current trip levels, ignition control, and other functions.

Adjustable Output Voltage: User adjustable output voltage. Factory set at 13.8 volts this voltage is adjustable anywhere from 12 to 13.8 volts.

Selectable Minimum Input Voltage: You have the choice of the minimum input voltage the MFJ-4418 will operate on. Set from the factory at 11.5 volts you can select 9.5 to 13 volts. This keeps you from possibly over discharging your battery and damaging it.

Audio Alert Feature: When enable instantly alerts you when the input voltage drops below the preset level.

External Boost Enable: A DE-9 input port with 4 inputs that are used to externally enable the MFJ-4418. Two inputs when grounded enable the unit and two inputs when taken high (10 to 12V) will enable the unit.

Remote Jack: Allows sampling of the Input Voltage and the Output Voltage. Also allows for control of the Boost Switch and has an active low output for the Low voltage alarm. Direct connection to the MFJ-4416RC Remote Unit.

RUGGED CONSTRUCTION - Attractive all-metal cabinet and conservative component selections ensure solid performance for years to come. Fully covered by MFJ's "No Matter What" one year limited warranty.

TYPICAL SPECIFICATIONS

Output Current…………………..……25 Amps ICAS 30A peak.

Output Voltage …………………………13.8 Volts at 9.5-13.8 volts input.

Before attempting to operate your MFJ-4418, please read the manual thoroughly. It contains important details about setting up your unit to obtain the best performance.

EASY START INSTRUCTIONS

1. Prepare input and the output cables for the MFJ-4418. It is recommended to use #12 or larger wire for both the input and output cables. MFJ has cables available for the output side for use with most HF and VHF/UHF radios.

2. Prior to connecting the radio and battery, plug the input and the output cables in to the MFJ-4418 and ensure the polarity is correct.

3. Plug the output of the MFJ-4418 into your radio and then attach the input to your battery.

4. You are now ready to operate. If not using external switching, depress the enable switch.

NOTE: The MFJ-4418 is not designed to boost the voltage of a 6V electrical system up to 13V and will not run on a positive ground system. It will also not reduce the voltage of a 24 volt system to 13V.

SYSTEM CONTROLS AND INDICATORS

Top Inputs and Outputs:

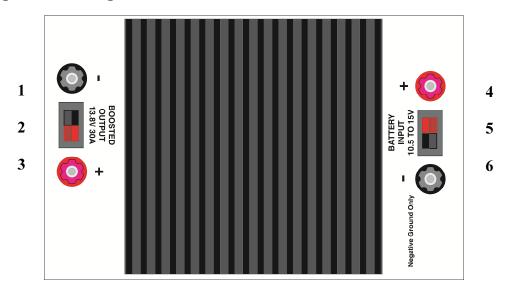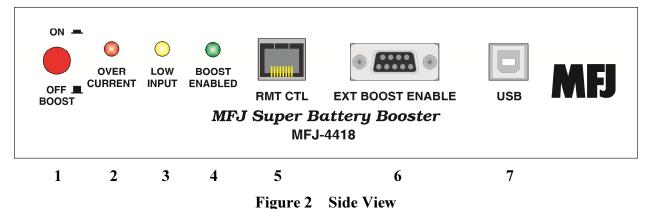**Figure 1   Top View**

1. 5-Way High Power Binding Post Negative Input.
2. Anderson PowerPole™ Input.
3. 5-Way High Power Binding Post Positive Input.
4. 5-Way High Power Binding Post Positive Output.
5. Anderson PowerPole™ Output.
6. 5-Way High Power Binding Post Negative Output.

Controls and Indicators:

Figure 2   Side View

1. **Boost On/Remote**: This switch enables the Battery Boost function when in and when out enables the Remote Boost Enable feature.

2. **Over Current LED**: Lights when over current sense is tripped.

3. **Low Input LED**: Lights when input is below the preset minimum input voltage.

4. **Boost Enable LED**: This LED is illuminated when the Switching Regulator is enabled.

5. **Remote Control**: This Jack allows the MFJ-4416BRC Remote Control and metering unit to be attached to the MFJ-4418. This allows remote monitoring of the Input Voltage and Output Voltage. It also allows Remote Enabling and Audible alarm of the MFJ-4418. Perfect for remote placement of the MFJ-4418.

6. **External Boost Enable**: This connector allows remote enabling of the booster from an ignition switched line, the radio amp key line, or other remote devices

7. **USB**: The port to connect a computer for setting up the MFJ-4418 and monitoring the MFJ-4418 functions.

Not shown on the back side there is a ground lug available for chassis grounding.

CONNECTION AND OPERATION

Mounting

Place the MFJ-4418 in a dry, out of the way place, where air can circulate over the heatsink. Do not mount it in a location where it can get wet. Place it in a location where the case can be grounded with short ground leads.

DC Power Connection:

The MFJ-4418 is designed to boost voltages as low as 9.5V up to 13.8V at up to 30A peak. At high currents the voltage drop from even large gauge wires can be appreciable for even short runs. It is recommended to use a large gauge wire (such as #8 or #10) to reduce the voltage drop. Connect the wire to the battery or other high current terminal on the vehicle for best results. Connection to the lighter jack or a smaller fuse block is not recommended because of the smaller

gauge wires used in the automotive wiring harnesses. A fuse in the positive line near the battery is recommended to protect the wiring from accidental shorts circuits. Connect the radio to the MFJ-4418 using the wiring harness from the radio manufacturer. MFJ carries a number of cables that can be used for this purpose. See page 16 for model numbers.
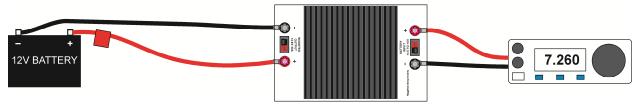

Figure 3   DC Wiring

Terminal connections to and from the MFJ-4418 can use the 30A Anderson PowerPole terminals, crimp lugs, banana plugs or wires straight to the 5 way binding posts. Follow the connector manufacturers' instructions for attaching the terminal lugs. Make sure the lugs are tightly crimped to insure they do not pull loose. If the binding posts are used place ring lugs or spade lugs on the wire and make sure the binding posts are tightened down so the lug will not pull off the post. Wires that connect to the binding posts directly are not recommended because they can pull loose easily.

Remote and External Control Connections:

External Control: The MFJ-4418 can be enabled externally through the "EXTERNAL BOOST ENABLE" connector allowing the unit to be enabled a number of ways including the ignition line and the radio amplifier key line. There are a total of 4 control lines. Two will enable the MFJ-4418 when grounded and two will enable the MFJ-4418 when tied to a 4 to 13V source.

Connecting either pin 1 or 2 to the amplifier key line of the radio if it has one will set up the MFJ-4418 to enable only when transmitting. This will help reduce any noise that may be generated by the switching boost circuit while receiving. See your radio manual for the proper connections to the radio.

Connecting either pin 3 or pin 4 of the external control connector to an accessory line will allow the booster to be enabled when the vehicle is turned on or when it is set in accessory on the ignition switch. This will help reduce the current drain on the battery when the vehicle is off.

Not all radios are set up to be able to key the MFJ-4418. In those cases the boost button will have to be set to ON or programmed for "Enable on input at low limit". There is no RF sense built into the MFJ-4418.

LINEAR
KEY Line

Figure 4   External Enable to Amp Key Line

Remote Control: The optional Remote Control MFJ-4416BRC can be used to monitor and control the MFJ-4418 allowing the MFJ-4418 to be mounted in an out of the way place in the vehicle. The connection is a normal CAT-5 cable that plugs into the MFJ-4416BRC and the MFJ-4418 REMOTE CONTROL RJ-45 Jack.

Programmable Internal Control: The programmable "Enable on input at low limit" function will set up the MFJ-4418 to boost only when needed with the programmable settings. With the "Enable on input at low limit" check box checked the MFJ-4418 will boost whenever the voltage has dropped below the "ENABLE LOW LIMIT" setting and will quit boosting when the "Enable High Limit" is obtained. This setting is handy to reduce any noise from the switching circuit when the MFJ-4418 is not needed to boost the voltage. See "Programming the MFJ-4418" section. This mode does not require any connections to the radio and does not require the Boost Enable switch to be pushed in. Any external connections or the Boost Enable switch will override this function.
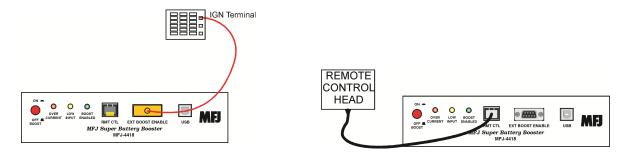
Figure 5   Ignition Connection and Remote Control Connection

EXTERNAL BOOST CONNECTOR	
DE-9 Pin	Function
1	GROUND TO ENABLE pulled to +5V with internal 1.6K pull-up resistor.
2	GROUND TO ENABLE pulled to +5V with internal 1.6K pull-up resistor.
3	HIGH TO ENABLE any voltage between 4 and 15V
4	HIGH TO ENABLE any voltage between 4 and 15V
5	13V DC OUTPUT resettable fuse limited to 100mA (boosted)
6 to 9	GROUND

Figure 6   External Boost Wiring Chart

REMOTE CONTROL CONNECTOR	
RJ-45 Pin	Function
1	INPUT VOLTAGE, resettable fuse limited to 100mA (unboosted)
3	ENABLE SIGNAL, ground to enable.
5	LOW VOLTAGE ALARM SIGNAL, ground indicates alarm condition.
7	OUTPUT VOLTAGE, resettable fuse limited to 100mA (boosted)
2, 4, 6, 8	GROUND

Figure 7   Remote Control Wiring Chart
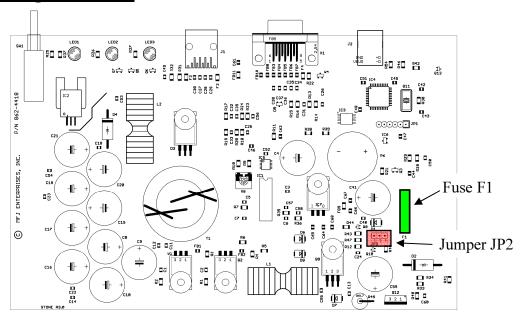
Internal Settings and Fuses

Figure 8   Board Parts Locations

JP2: The jumper is accessible by removing the bottom cover. Set the jumper for **UNSWITCHED** (jumper 1 to 2, default) or **IGNITION SENSE** (jumper 2 to 3). "Unswitched" powers the microcontroller from the battery input and the "Ignition Sense" from the ignition sense line.

F1 Fuse: The fuse is accessible by removing the bottom cover. This fuse is a 30A automotive blade type. Do not use a fuse of a higher current rating.

Operation:

Once wired in the MFJ-4418 will boost the incoming voltage to 13.8V when enabled for any voltage between the minimum voltage and 13.8V. If the incoming voltage is above what the output voltage is set to the output voltage will rise to the incoming voltage minus about a half volt. When the MFJ-4418 is not energized the input voltage is passed to the output connectors and has about a half volt drop due to the internal rectifiers.

There are protective diodes that protect the input and output from exceeding 18V or being reverse wired.

The MFJ-4418 is not designed to boost the voltage of a 6V electrical system up to 13V and will not run on a positive ground system. It will also not reduce the voltage of a 24V or higher system to 13V.

Programming the MFJ-4418

The Power Booster Manager is a PC program capable of running on Windows XP, 7 and later operating systems. It is not designed to run on Apple computers. The software and drivers are available on the MFJ Enterprises web site.

1. Program Installation

    a. Windows 7 and XP

        i. DO NOT plug into the USB port on the MFJ-4418 until you install the driver as Windows will install a generic serial USB driver which is not compatible. To install the drivers unzip and run the MFJ-4418 Driver Installer.exe. The program will place the drivers in the correct directory for use.

        ii. If you accidentally install the wrong driver go to the Control Panel's "Device Manager" window and find the device under "Ports (Com and LPT)" or "Other Devices". On the Driver tab select update driver. Then select the proper driver which came with the manager program and update it.

    b. Windows 10

        i. The default USB driver used by Windows 10 will work with the MFJ-4418. There is no need to run the MFJ-4418 Driver Installer program.

        ii. You can do a driver update by going to the Control Panel's "Device Manager" window and find the device under "Ports (Com and LPT)" and on the Driver tab select update driver and search on the internet. The more recent Microchip driver will be installed.

    c. Unzip and run the MFJ-4418 Battery Booster Manager Installer.exe program to install the MFJ-4418 Battery Booster Manager Program. The installer will place an icon on the desktop to run the program.

    d. Apply power to the MFJ-4418 and plug in the USB cable between the unit and the computer. The computer should find and use the drivers to communicate with the MFJ-4418. Use the "Ports (Com and LPT)" selection in the Device Manager on the Control Panel and make note of the COM port number. If the COM Port is 10 or higher then change the number to something 9 or lower in the Ports Settings tab Advanced section. The Battery Booster Program will not handle COM Ports over COM9.
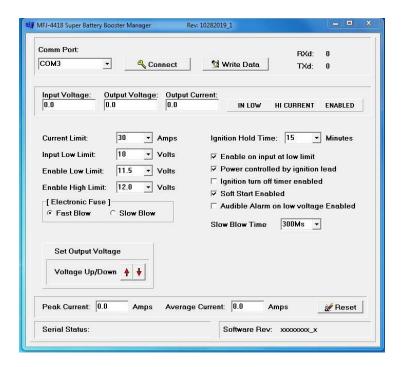
2. The Manager window is described below:

Figure 9   Battery Booster Manager Window

a. **Comm Port**: This pull down box allows you to set the COM port used with the USB connection.

b. **Connect Button**: This button connects and disconnects from the MFJ-4418. The button label changes following the role the button plays.

c. **Write Data Button**: This button writes any changes made to the EEPROM on the 4418 making them permanent. If you forget to write the data the MFJ-4418 will automatically save it when the USB connection is closed. It is a good idea to write the data when the changes are made because of the power is interrupted prior to closing the USB port the changes will be lost.

d. **Input Voltage, Output Voltage and Output Current**: These displays are updated every ½ second and display in volts and amps.

e. **IN LOW** indicator: If the input voltage falls below the value set in the "Input Low Limit" setting the supply will stop providing boost voltage and this indicator will turn red.

f. **HI CURRENT Indicator**: If the output current exceed the "Current Limit" setting or exceeds 35 amps the boost supply will turn off all output voltage. The

high current indicator will turn red and the supply will be locked out until the boost enable signals are all in the non-boost state or the power is cycled.

g. **ENABLED Indicator**: When the boost supply is enabled by any of the enable signals this indicator will turn green.

h. **CURRENT LIMIT**: This pull down box allows the current limit to be set from 5 to 30 Amps in 1 amp steps. This control works with the Electronic Fuse setting and Slow blow time to select the current protection provided.

i. **INPUT LOW LIMIT**: This pull down box allows setting the absolute low level of the input voltage from 9.5 to 13.0 volts in ½ volt steps. This limit is a hard stop limit and the supply will turn off all output when the input is below this value for more than 1/3 of a second.

j. **ENABLE LOW LIMIT**: This pull down box work in conjunction with the "Enable on input at low limit" Check Box. This setting allows the input voltage level to turn on the boost supply automatically when the input voltage falls below this value. This setting can be from 10.5 to 13.0 volts in ½ volt steps. This is a latching enable signal that will be cleared when the input voltage exceeds the value set in the "Enable High Limit" setting. This hysteresis minimizes cycling caused when the battery or other source is partially discharged and has higher output impedance. Make sure the Enable High Limit is greater than the Enable Low Limit.

k. **ENABLE HIGH LIMIT:** The limit where the MFJ-4418 will shut off the boost supply when the input is above this setting. Used in conjunction with the "**Enable on input at low limit**" Check Box. Make sure the "Enable High Limit" is greater than the "Enable Low Limit".

l. **Electronic Fuse**: This selects either fast or slow blow operation. In fast blow the delay time is 1/10 second and in slow blow the delay time is adjustable by the "Slow Blow Time" pull down box.

m. **Enable on input at low limit**: This setting allows the input voltage level to turn on the boost supply automatically when the input voltage falls below the" Enable Low Limit" value and off when the voltage exceeds the "Enable High Limit".

n. **Power Controlled By Ignition Lead**: This checkbox enables the Ignition lead sense functions.

o. **Ignition Hold Time**: This setting works with the "Ignition Turn Off Timer" and "Power controlled by ignition lead" checkboxes. When the power is controlled by the ignition lead and the "Ignition Turn Off Timer" checkbox is checked this setting controls the hold on time after the ignition is turned off. This allows you to complete a QSO without the fear of leaving the radio on as the MFJ-4418 will turn off the output voltage at the end of this time unless the ignition is again turned on.

p. **Soft Start Enabled**: Allow the power supply to pulse width control the charge into the output capacitors minimizing the surge currents.

q. **Audible Alarm On Low Voltage Enabled**: Enables internal audible alarm on low input voltage. The alarm always sounds on high current. When this is enabled and power is removed from the MFJ-4418 the alarm may sound till the capacitors discharge.

r. **Set Output Voltage**: Allows the output voltage to be adjusted up and down.

s. **Peak Current Display**: This value is the peak current seen during the supply operation. This value is volatile and will be zeroed when the power supply input voltage is removed or the "Reset" button in pressed.

t. **Average Current Display**: This value is the average current delivery by the supply. This value is volatile and will be zeroed when the power supply input voltage is removed or the "Reset" button in pressed.

u. **Reset Button**: This button clears the "Peak Current Display" and "Average Current Display". It does not reset any other functions.
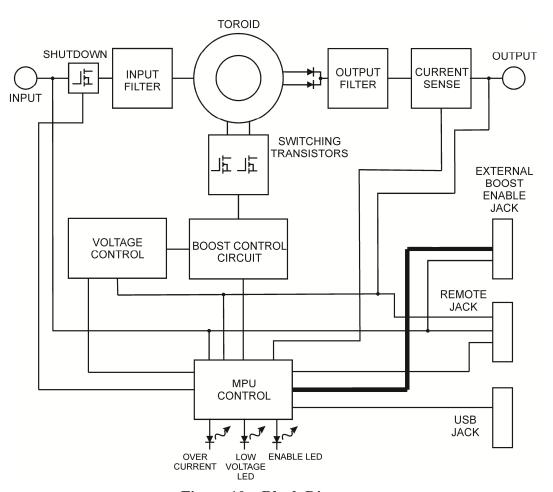
THEORY OF OPERATION

Figure 10   Block Diagram

Input Filtering: The input filter consists of C13 which provides EMI filtering followed by L1, C12 and C11 which are a low pass filter at the alternator which range. C8, C9 and C10 provide low ESR energy storage which helps to suppress input noise while providing energy during input low voltage transient periods. Diode D1 and capacitors C3 and C4 provide additional filtering and energy storage feeding the SMPS controller IC1. The additional energy storage is isolated from any transient load causing a voltage drop on the input protecting IC1 from resets and gaps in the boost function. Diode D2 is a transient suppressor diode and acts to protect the unit against transient voltages greater than 15 Volts.

SMPS controller: IC1 is a packaged SMPS controller with built in voltage reference. This is a constant frequency pulse width modulated regulator with built in driver for the MOSFET gates. The switching frequency is set to 50Khz. The controller is enabled or disabled by the soft start control input. This input is grounded to disable the SMPS boost supply. An open collector of Q8 and series resistor R44 provide the control function. Feedback from the output voltage is provided by the voltage divider consisting of R9, electronic pot IC5, and R10. This feedback is compared against the voltage reference to adjust the pulse width and resulting voltage output. The voltage reference is supplied to the analog control section for voltage level decision making.

MOSFET drivers and transformer: A push pull configuration using two FDP56N06 MOSFETs drives the transformer T1. T1 uses two tapped windings allowing the input voltage to be placed in series with the SMPS output voltage. The turns ratio is 1.57:1 in series with the DC input voltage results in a boost of 1.57 over the input voltage. The tapped points on the two windings are fed to the common cathode rectifier pair D3. Using MOSFET Q1 as an example for both the Q1 and Q2 circuitry. The gate circuit consists of R6, R3 and FB1. R6 and FB1 minimize ringing and parasitic oscillations while R3 is a base drain that discharges the gate to substrate capacity while the unit is not powered. The storage of energy in the gate capacity as a result of residual energy from previous operation or static can allow both transistors to attempt to conduct during the next power up cycle before the control IC takes control of the gate usually destroying one or both MOSFETs.

Output Filtering: The output filter consists of toroid inductor L2 with capacitors C14 through C22 that act as a low pass filter and energy storage bank. The total energy storage is 23,500 UF distributed over 5 capacitors to minimize ESR. Capacitor C22 is located close to the output and serves as an EMI suppressor. Diode D4 is a 15 volt transient suppressor diode and protects the unit from transient seen on the output terminals.

Over-voltage Protection: The microprocessor monitors the output voltage and when the voltage exceeds the programmed set voltage the input PMOS transistor Q9 is turned off turning off power to the remainder of the MFJ-4418.

Microprocessor Control: The CPU is the brains of the MFJ-4418 and controls most aspects of the operation.

The MFJ-4418 has direct control over the power feed and unlike the MFJ-4416 booster it can turn off the output voltage under CPU control. This allows the MFJ-4418 to provide both operational shutoff of the attached radio and shutoff in a failure mode to protect both the MFJ-4418 and the radio. The operational power control mode is based on the use of the ignition lead and power will be switched on and off by this lead. In addition a hold on timer can allow the MFJ-4418 to provide power for a programmable period of time post the ignition turn off. This

allows the attached radio to operate with the ignition off without the concern of forgetting to turn it off resulting in a dead battery. The failure modes detected and used for power shutoff are low input voltage below the programmable point, high output current above the programmable limit and high output voltage above 15Volts.

The MFJ-4418 provides soft start and this is activated on power up or when the ignition lead senses +12V. The software waits 500 milliseconds for the supply to stabilize and then switches on MOSFET Q12 which provides current limited charging of the filter capacitors. This limits the inrush currents to 50Amps. After 200 milliseconds the main power MOSFET is activated. This operation is universal to all power on modes. If the "Soft Start" checkbox is used the above process is started followed by pulse width modulation of the power switch minimizing the average charging current so the supply can start into a load without a significant current transient sent back to the source.

The CPU monitors and integrates the input voltage and uses the resulting level for two functions. The boost enable is allowed if the input voltage is above the programmable "Input Low Limit". The input voltage maybe utilized to turn on the voltage boost by enabling this function. When the input voltage falls below the programmable "Enable Low Limit" the boost will be enabled and when the input voltage exceeds the "Enable High Limit" the boost will be disabled. Having a guard band between the two voltages minimizes the possibility of cycling on and off when the battery gets low and its terminal impedance increases.

The CPU monitors the output voltage and verifies it is with the tolerance of the programmed output voltage. This is also the high output voltage check and if 15 Volts is exceeded the CPU will shut down the power and boost function protecting the attached radio and the MFJ-4418 from internal or external voltage faults. If this fault occurs the supply is locked out till the power is removed. The high current led will blink indicating a high voltage fault occurred.

The CPU monitors for overcurrent and will shut down the power and boost function should the output current exceed the programmable value. The high current LED will be illuminated and the supply locked out until the enable signal is removed.

The boost enable can be initiated by low input voltage, positive keying inputs, negative keying inputs, boost switch mounted on the MFJ-4418, boost switch mounted on the remote or by grounding pin 7 of X1. The CPU will check to see if the input voltage is OK and there is no failure lock out before enabling the boost and will check for input voltage or failure during boost operating disabling it if required.

The CPU provides a USB driver to communicate with the Power Booster Manager software package and receives data through this connection to the manager.

IN CASE OF DIFFICULTY

Low Voltage Disconnect trips under high demand conditions

This can be caused by 2 things. First ensure your battery is charged. A discharged battery will recover voltage under low current conditions, but once current is drawn it will immediately drop below the cutout voltage. Second, ensure the wiring on the input side of the unit is adequate for the current being drawn and the lengths of the cable run.

Enable LED fails to illuminate.

Ensure that you are either feeding one of the enable lines from the radio amplifier key line into the unit or the Enable/Disable switch is depressed.

When programmed for "Enable on Low input" where the level is above the low limit and has been above the Enable on High limit to turn off the boost function. This would be normal. If it does not try to boost when below the Enable Low Limit and above the Input Low Limit check the programming to insure the programming is correct.

Minimum Battery Voltage

According to battery manufacturers vehicle batteries are normally considered drained at 11.6V with no load. Under load the voltage will be a little lower. Below about 9-10V the voltage will drop fast with any load. The battery life may suffer and the vehicle may not start when the battery is that low.
http://www.eetimes.com/author.asp?section_id=36&doc_id=1320644

Noise Reduction

Although every effort was made to reduce switching noise RF noise is a possibility. To reduce noise to a minimum ground the case of the MFJ-4418 to the automotive chassis with as short of a wire or grounding braid as possible. Clamp on ferrite beads can be used on the input and out power leads to further reduce noise. 1 or 2 turns through the bead will help.

TECHNICAL ASSISTANCE

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or is your problem is not solved by reading the manual, you may call MFJ Technical Service at 662-323-0549 or the MFJ Factory at 662-323-5869. You will be best helped if you have your unit, manual and all information on your station handy so you can answer any questions the technician may ask.

You can also send questions by mail to:

MFJ Enterprises, Inc.
300 Industrial Park Road
Starkville, MS 39759

by Facsimile (FAX) to 662-323-6551

or by email to techinfo@mfjenterprises.com.

Send a complete description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station.

Available Accessories:

MFJ-4416BRC Remote Control
MFJ-5262 CAT5E cable

Radio Power Cables:

MFJ-5112, MFJ-5112M   Yaesu, Kenwood, Icom VHF/UHF
MFJ-5535, MFJ-5535M   Yaesu, Kenwood, Icom HF
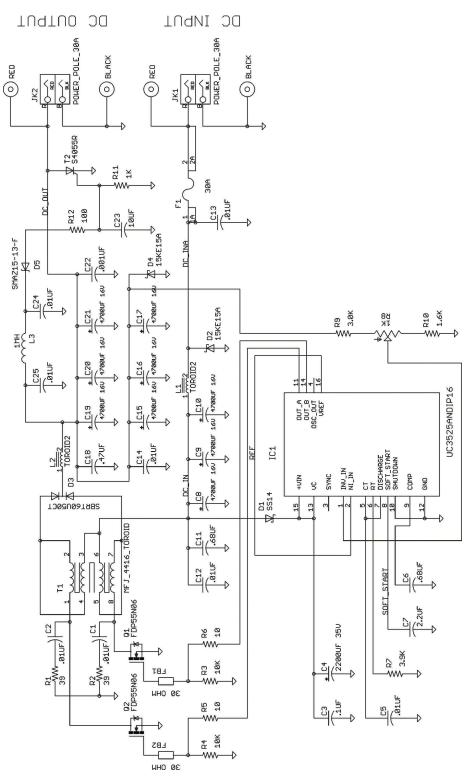MFJ-5538, MFJ-5538M   Yaesu 4 pin HF
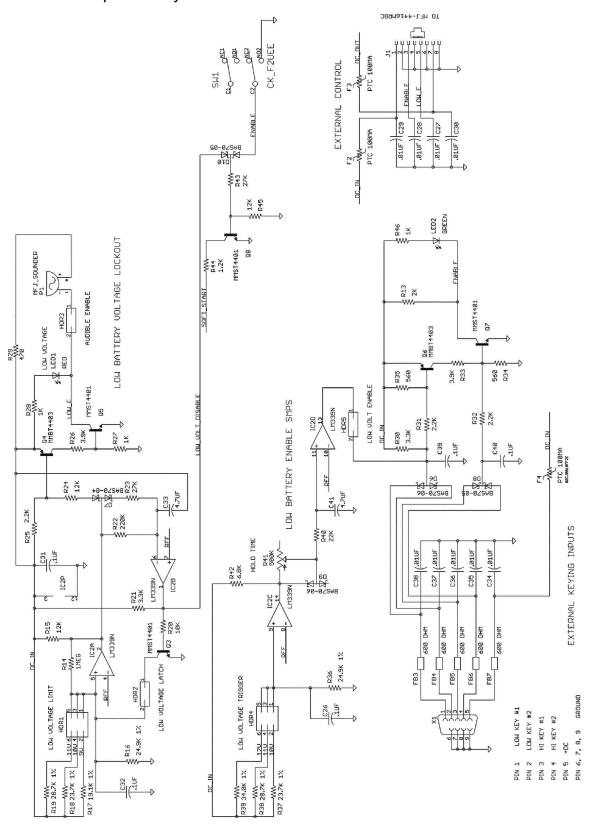
Schematics

Figure 11   SMPS Section Schematic

Figure 12   Control Section Schematic

FULL 12-MONTH WARRANTY

MFJ Enterprises, Inc. warrants to the original owner of this product, if manufactured by MFJ Enterprises, Inc. and purchased from an authorized dealer or directly from MFJ Enterprises, Inc. to be free from defects in material and workmanship for a period of 12 months from date of purchase provided the following terms of this warranty are satisfied.

1. The purchaser must retain the dated proof-of-purchase (bill of sale, canceled check, credit card or money order receipt, etc.) describing the product to establish the validity of the warranty claim and submit the original or machine reproduction of such proof of purchase to MFJ Enterprises, Inc. at the time of warranty service. MFJ Enterprises, Inc. shall have the discretion to deny warranty without dated proof-of-purchase. Any evidence of alteration, erasure, of forgery shall be cause to void any and all warranty terms immediately.

2. MFJ Enterprises, Inc. agrees to repair or replace at MFJ's option without charge to the original owner any defective product provided the product is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashiers check, or money order. This is good on all products except antennas and software to cover postage and handling for return from in warranty service. We also take MasterCard, Visa, American Express, and Discover credit cards. Postage and handling may vary according to the weight of the product in question. You should specify what type of delivery service you wish. We can send by UPS, U.S. Postal service or Fedex. MFJ doesn't guarantee delivery by US Postal Service.

3. MFJ Enterprises, Inc. will supply replacement parts free of charge for any MFJ product under warranty upon request, provided the following terms are satisfied. MFJ must receive the original parts you wish to replace, your proof-of-purchase, and a personal check, cashiers check or money order must be provided to cover postage and handling. Postage and handling may vary according to the weight of the product in question. We also take MasterCard, Visa, American Express and Discover credit cards.

4. This warranty is **NOT** void for owners who attempt to repair defective units. Technical consultation is available by calling (662) 323-5869.

5. This warranty does not apply to kits sold by or manufactured by MFJ Enterprises, Inc.

6. Wired and tested PC board products are covered by this warranty provided **only the wired and tested PC board product is returned.** Wired and tested PC boards installed in the owner's cabinet or connected to switches, jacks, or cables, etc. sent to MFJ Enterprises, Inc. will be returned at the owner's expense un-repaired.

7. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to person or property by the use of any MFJ products.

8. **Out-of-Warranty Service:** MFJ Enterprises, Inc. will repair any out-of-warranty product provided the unit is shipped prepaid. All repaired units will be shipped COD to the owner. Repair charges will be added to the COD fee unless other arrangements are made.

9. This warranty is given in lieu of any other warranty expressed or implied.

10. MFJ Enterprises, Inc. reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes upon any of the products previously manufactured.

11. All MFJ products to be serviced in-warranty or out-of-warranty should be addressed to **MFJ Enterprises, Inc., 300 Industrial Park Rd, Starkville, Mississippi 39759, USA** and must be accompanied by a letter describing the problem in detail along with a copy of your dated proof-of-purchase and a telephone number.

12. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.