Z1203B
Active Antenna Power Coupler/DC Injector

Assembly and Operation Manual



Revised 25 December 2010

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Model Z1203B Active Antenna Power Coupler

Revised 25 December 2010

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Warranty

This warranty is effective as of the date of first consumer purchase.

What is covered: During the ninety (90) days after date of purchase, Clifton Laboratories will correct any defects in the Z1203B due to defective parts or workmanship (if purchased as an assembled unit) free of charge (post-paid). You must send the unit at your expense to Clifton Laboratories, but we will pay return shipping. Clifton Laboratories' warranty does not extend to defects caused by your incorrect assembly or use of unauthorized parts or materials or construction practices.

What is not covered: If the Z1203B is purchased as a kit, this warranty does not cover correction of assembly errors or misalignment; repair of damage caused by misuse, negligence, or builder modifications; or any performance malfunctions involving non-Clifton Laboratories accessory equipment. *The use of acid-core solder, water-soluble flux solder, or any corrosive or conductive flux or solvent will void this warranty in its entirety.* Whether purchased as an assembled unit or as a kit, also not covered is reimbursement for loss of use, inconvenience, customer assembly or alignment time, or cost of unauthorized service.

Limitation of incidental or consequential damages: This warranty does not extend to non-Clifton Laboratories equipment or components used in conjunction with our products. *Any such repair or replacement is the responsibility of the customer. Clifton Laboratories will not be liable for any special, indirect, incidental or consequential damages, including but not limited to any loss of business or profits.*

Under no circumstances is Clifton Laboratories liable for damage to your equipment connected to the Z1203B resulting from use of the Z1203B, whether in accordance with the instructions in this Manual or otherwise.

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Safety Information

The Z1203B operates with an external transformer providing a source of current limited and overload protected AC power. The Z1203B converts the AC power to an adjustable DC power supply of 10 to 24 Volts. The Z1203B's purpose is to couple this DC voltage to an active antenna over a coaxial cable. By design, therefore, one side of the Z1203B has +12V on it. If inadvertently connected to a receiver or similar device, excess current may flow and damage the receiver or other device. It is the user's responsibility to ensure that the Z1203B is properly connected to the remote active antenna and the receiver.

The Z1203B has no replaceable fuses; rather a self-resetting polyfuse limits short circuit current to approximately 400 mA.

Part of the Z1203B's safety design is overload protection in the supplied external transformer. DO NOT substitute a transformer without these essential safety measures.

The Z1203B is designed to be used only with receive-type power levels. It should not be used to inject DC voltage into a transmitting system. *Transmit power levels may damage the Z1203B or equipment connected to it, or both.*

The Z1203B has an adjustable voltage output that must be set to match the requirements of the connected equipment. Excessive voltage output may damage connected equipment.

Although the Z1203B has several protective features, these are intended to reduce, not prevent, damage from catastrophic events, such as nearby lightning damage. The user always remains responsible for following good engineering practices with respect to antenna design, installation, lightning protection and grounding. Clifton Laboratories recommends that remote antennas be disconnected from the Z1203B except when actually in use and that under no circumstances should the Z1203B be connected to a remote antenna or preamplifier or used when there is a possibility of nearby lightning.

General Information and Specifications

Description

The Z1203B Active Antenna Power Coupler provides a way to couple or inject DC power into a coaxial cable so as to power remote devices, such as Clifton Laboratories' Z1501 series Active Antennas.



The Z1203B has two RF connections:

- ACTIVE ANTENNA—the port to be connected to the device requiring remote power. This port has the RF signal from the active antenna plus DC power on it when the output is enabled. The shell is connected to the enclosure and hence the ground stud. (BNC connector)
- RECEIVER—the port to be connected to the receiver. This port has RF signal and no DC voltage. It is isolated from the enclosure and ground. (BNC connector)

In addition, the Z1203B has power input and control connectors and a ground stud:

- DC IN—a standard 5.5/2.1 mm coaxial power connector. AC power is supplied to the Z1203B through this connection. Although the rear panel is marked "18V" in fact, up to 24 V AC (rms) may be used. A maximum of 400 mA may be sourced to the remote device.
- TX PWR CTRL—the Z1203B's DC output to the remote active antenna or preamplifier can be turned on/off through this port, a standard RCA "phono" connector. Jumper JP1 on the printed circuit board selects between two control modes:
    - Mode 1: Ground on the TX PWR CTRL port enables the output; +12V on the control port disables the output. To bypass the control feature and enable the output at all times, select Mode 1and make no connection to the control connector.
    - Mode 2: +12V on the TX PWR CTRL port enables the DC voltage output; ground on the control port disables the output.
- Ground Stud: A 4-40 threaded connector with thumb nut for station ground.



A bi-color front panel LED indicates the Z1203B's status:

Green: AC power is supplied to the Z1203B and DC voltage is being sourced to the active antenna port.

Yellow: AC power is supplied to the Z1203B but the device has been put into "safe" mode via the TX PWR CTRL port, whereby the voltage supplied to the active antenna port is reduced to 1V or less. A Clifton Laboratories Z1501 series active antenna disconnects the whip input from the whip amplifier under these conditions and hence is protected—to a reasonable degree—against nearby high power transmitters.

There is no power on/off switch.

The Z1203B includes a current measuring shunt allowing the current draw of the remote equipment to be determined.

The last page of this manual has a condensed instruction sheet.

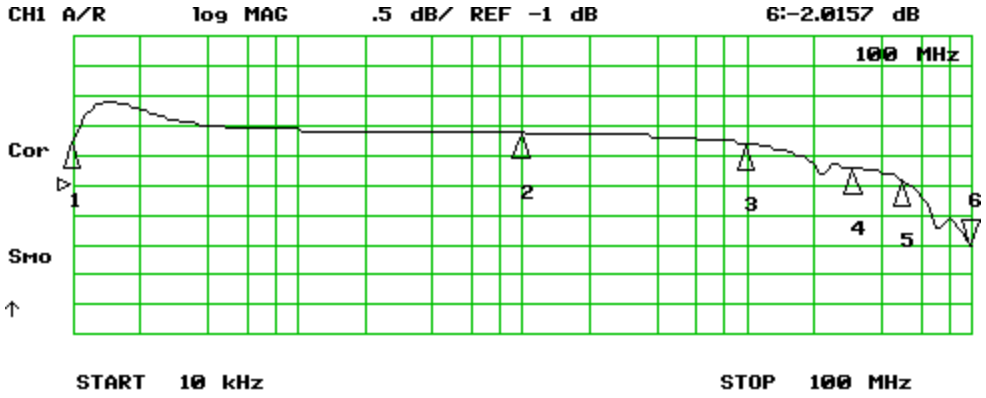
Specifications

Parameter	Value
Dimensions	(Width, Depth, Height) Approx. 3.75" x 4.5" x 1.62 inches, (95mm x 115mm x 42mm) powder coated, silk screened steel enclosure, excluding extensions for BNC connectors, DC power connector, feet and LED. Weight approx. 8 ounces (225 grams).
AC Input	Overload limited external transformer, depending on maximum desired DC output, transformer supplied may range from 16V RMS to 24V RMS. Any transformer used must in internally protected against short circuit, over-current and over-temperature conditions. 50 or 60 Hz supply may be used with a suitable transformer.
DC Output	Regulated and adjustable. Typically 10V to 24V range (negative to ground; positive on coaxial center conductor) with 24V RMS transformer input. With lower voltage transformers, the maximum output voltage may be less. Maximum output current to active antenna port is 400 mA.
Maximum RF Power	The Z1203B is designed to be used with typical receiver power levels and should not be used to inject DC voltage into a transmitting circuit.
Frequency Range	20 KHz – 30 MHz; usable to 10 KHz - 100 MHz
Insertion Loss	1.0 dB typical over range 10 KHz – 30 MHz; not to exceed 2 dB over this frequency range.
Protective Measures	Gas trap on active antenna input; reverse voltage protection; automatic resetting overload fuse and over-voltage MOV.

Typical Insertion Loss versus Frequency

The figure below shows the measured composite insertion loss for a Z1203B DC Power Coupler and Z1501D Active Antenna over the frequency range 10 KHz to 100 MHz (log frequency horizontal axis). Due to component tolerance and assembly practices, this performance should be regarded as typical, not guaranteed. The plot scale is 0.5 dB/division with the center horizontal graticule line (identified with the ▷ symbol at the left) indicating -1.5 dB.

The "N Stimulus val" data at the bottom of the plot identifies the data markers, their associated frequency and the insertion loss at that frequency.



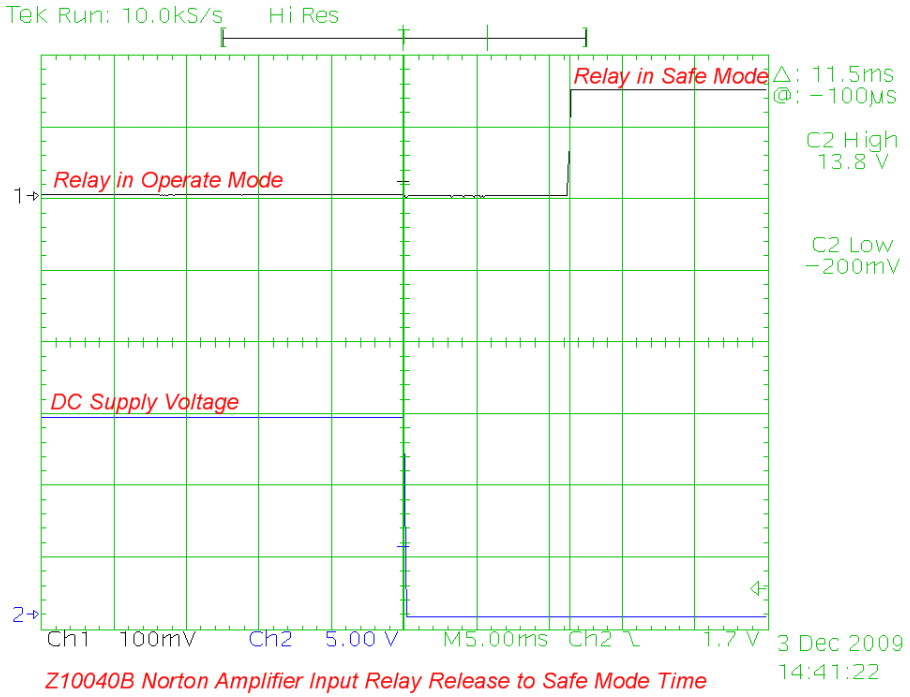
N	STIMULUS	val
1	10 kHz	-.2338 dB
2	1 MHz	-.1249 dB
3	10 MHz	-.2975 dB
4	30 MHz	-.7127 dB
5	50 MHz	-.9248 dB
6	100 MHz	-2.0157 dB

Improvement in Relay Switching Time with Active Pull Down

The Z1203B is equipped with "Active Pull Down" which shunts a low value resistance across the Active Antenna port when the TX PWR CTRL input is in disable mode. (The resistance is connected after the RF isolation circuitry so it only shunts DC.) Active pull down discharges filter and bypass capacitors in the remote device faster than simply switching the DC source into high impedance disconnect mode. For remote devices with an input disconnect relay (such as Clifton Laboratories Z10040B and Z10042A Norton amplifiers and its Z1501D Active Antenna) the faster the DC supply voltage bleeds down, the shorter the time required for the remote device to switch to "safe" mode where the input is disconnected. Safe mode is intended to prevent damage due to strong RF signals when the remote device is used in conjunction with transmitting equipment, such as a typical amateur radio installation.

To demonstrate the improvement the time required to switch the remote device relay into "safe" or disconnect mode, Clifton Laboratories Z10040B Norton Amplifier is used as an example.

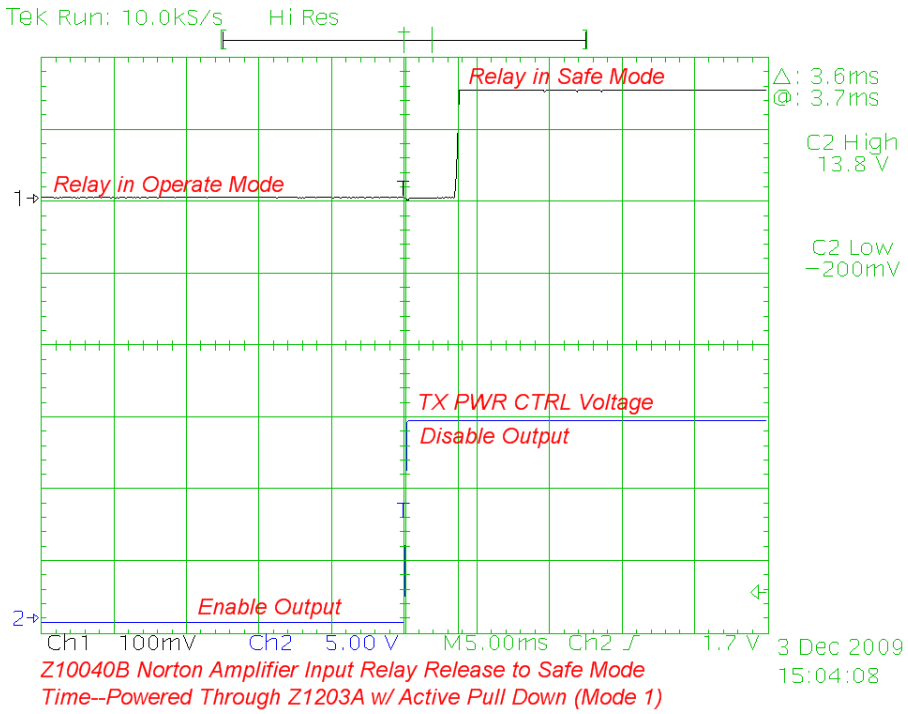
The oscilloscope capture below shows that if power is simply removed from the Z10040B Norton Amplifier, approximately 11.5 milliseconds elapses between power removal and the protective input relay switching to safe mode. This measurement is taken with a diode isolated DC power supply to simulate the effect of a regulator providing isolation to reverse current flow.



Z10040B Norton Amplifier Input Relay Release to Safe Mode Time

When the Z10040B is powered through a Z1203B (configured for Mode 1 control in this example, although the same results hold for Mode 2 as well), the relay is placed into safe mode 3.6 ms after the disable command is asserted on the Z1203B's TX PWR CTRL line. The Z1203B's active pull

down feature thus provides a significant improvement in the time required to switch to safe mode over simply removing DC voltage from the Z10040B.



Installation and Use

Receiver Level Only – Not for Transmitting Power Levels

It is critical to remember that the Z1203B is intended to operate with receive signal levels and should, under no circumstances, be connected to a transmitter or a transceiver's output. Transmitting into the Z1203B will cause damage that is not covered under the warranty and may also damage any remote equipment to which it is connected.

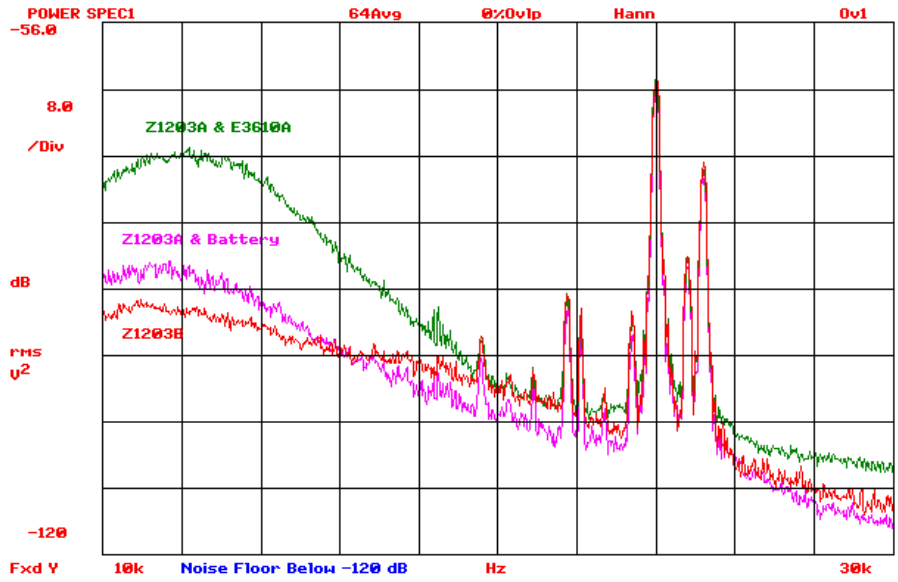
Power Supply Quality

The Z1203B incorporates features to suppress noise from the AC power mains from being coupled into the active antenna and receiver ports.

The plot below shows the measured noise floor of a Z1501D active antenna located at Clifton Laboratories for three test conditions over the frequency range 10-30 KHz, where mains coupled noise is difficult to suppress:

- Z1203A coupler with an HP/Agilent E3610A laboratory grade bench power supply
- Z1203A coupler with a 12V gel-cell battery
- Z1203B coupler with transformer

The Z1203B coupler with transformer power compares very favorably with a battery power supply. (The battery supply should induce no noise and hence should be the quietest source; the difference between the Z1203A/Battery and Z1203B noise plots is due to changes in the local noise environment between plots.)



Common Mode Choke

In many cases, noise from computers, switching power supplies and other electronic devices can be picked up in the radio room and carried over the coaxial cable braid to the active antenna, where it couples into the active antenna input. A common mode choke installed near the active antenna can be beneficial in reducing this type of noise. For more details, consult the Z1501D Active Antenna manual.

Floating Receiver Output

The Z1203B's Receiver Output port is "floating" and is isolated from ground with a 10 KHz – 100 MHz transformer. This prevents ground loops and noise current from the receiver from being coupled into the active antenna system via a common mode path over the active antenna coaxial cable shield's outer surface.

Grounding, Disconnecting and Lightning



Although the Z1203B has protective measures incorporated in its design, a nearby lightning strike, let alone a direct hit, will cause damage to the Z1203B and equipment to which it may be connected. You should take the following safety precautions:

1. Do not operate the Z1203B when there is a risk of lightning. Disconnect the remote active antenna or remote preamplifier cable from the Z1203B.
2. When not actually using the Z1203B, disconnect the remote active antenna or remote preamplifier cable from the Z1203B.

Do you need Remote Power Control?

Before using the Z1203B, decide whether you will use the remote power control feature. Remote power control enables the Z1203B to remove DC voltage from the remote active antenna or amplifier when a control signal from a transceiver or transmitter is applied. If the active antenna has relay disconnect upon power off features (as does Clifton Laboratory's Z1501D Active Antenna and its Z10040B and Z10042A Norton amplifiers), removing DC voltage places the remote device in "safe" mode reducing the chance of damage due to strong RF signals that might be induced by a nearby transmitter. The guidelines for deciding whether remote power control is necessary are:

You do not need remote power control if:

- If you are a shortwave listener and do not transmit.
- If you are an amateur radio operator but use low power (10 watts or less)
- If you are an amateur radio operator transmitting > 10 watts up to 1.5 KW output if your active antenna is located sufficiently far from your transmitting antennas. Sufficiently far is difficult to define categorically, but separation between the active antenna and the transmitting antenna of 150 feet (45 meters) or more is usually adequate.

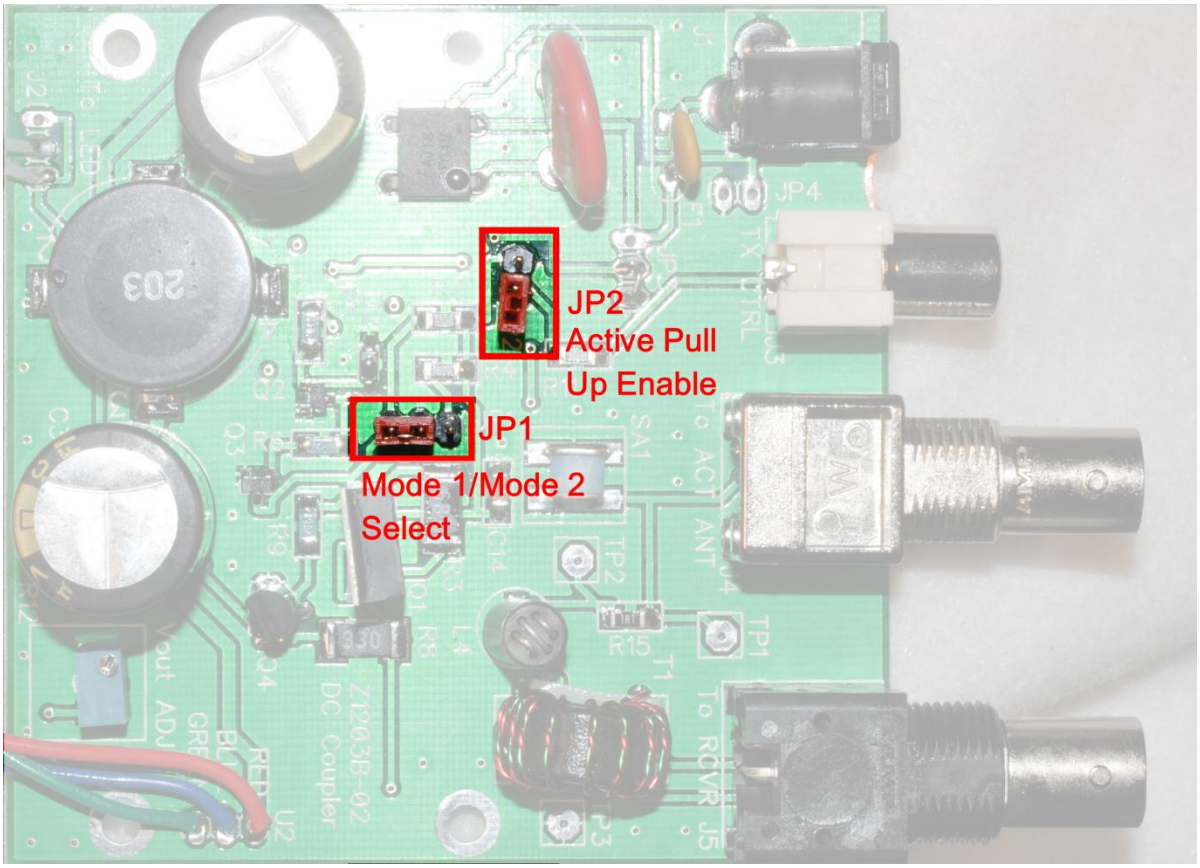
You should consider using remote power control if your installation does not meet one of these three categories. In this case, the choice of Mode 1 or Mode 2 will be determined by the control voltage available from your transceiver.

If you do not need to use remote power control, set jumper JP1 for Mode 1. JP2 should be disabled. No connection need be made to the TX PWR CTRL port to place the Z1203B into continuous DC power enable.

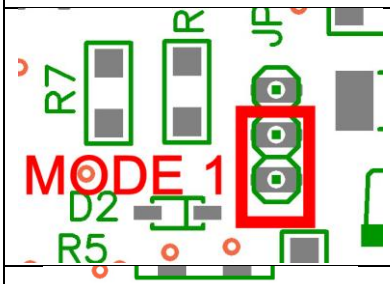
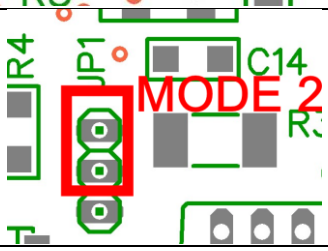
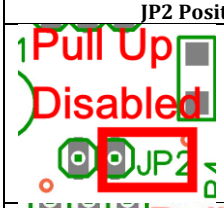
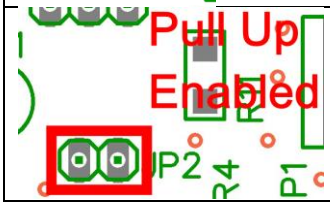
Setting the Mode Jumpers

Remote power control configured by moving a jumper (JP1) on the Z1203B's printed circuit board to one of two positions, Mode 1 and Mode 2. In Mode 2, jumper JP2 permits enabling a 10K "pull up" resistor. Both jumper settings are easily reconfigurable if your plans change.

If necessary, remote the four sheet metal screws securing the Z1203B's enclosure top to access the printed circuit board. Jumper JP1 is located near the PCB's center adjacent to the large power tab transistor Q1. Jumper JP2 is located nearer the back of the printed circuit board.



Movable "shunts" are provided for both JP1 and JP2. To remove the shunt, pull it up with long nose pliers. JP1's shunt may be placed in either of two positions to select Mode 1 or Mode 2, as detailed in the illustration and table below. If the pull up feature is not used, JP2's shunt may be stored by slipping it onto one one of JP2's pins.

TX PWR CTRL Operating Modes.			
JP1 Position	**TX PWR CTRL**	**AA Output?**	**Comments**
	No Connection	Yes	Use Mode 1: if remote control is not desired or where the transceiver provides +13.8V on transmit.
	Low Voltage/Short Circuit	Yes	
	+13.8V	No	
	No Connection	No	Use Mode 2 where the transceiver provides ground on transmit. 10K pull-up may be needed. See JP2
	Low Voltage/Short Circuit	No	
	+13.8V	Yes	
JP2 Position			
	10K Pull up is not enabled. Jumper is in storage position		Disengage JP2 unless needed.
	10K Pull up is engaged.		Use with **Mode 2** when pull up is required.

Note Regarding Pull Up Voltage

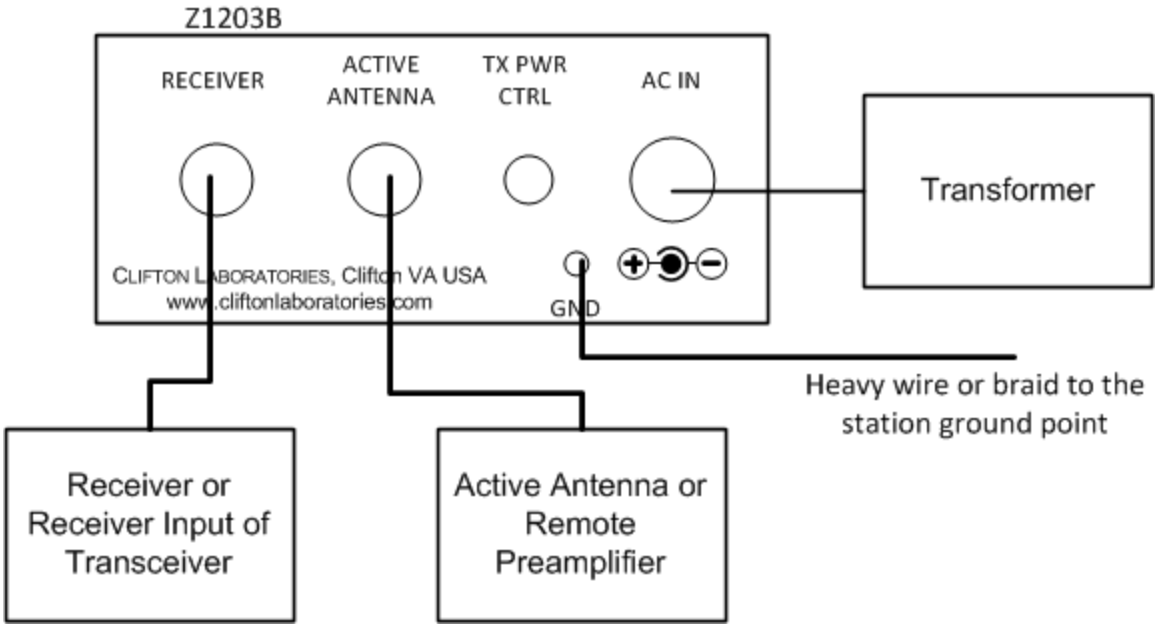
The pull up voltage is derived from the Z1203B's regulated voltage. If set at 24V DC, for example, the pull up will elevate the TX CTRL port to +24V. This may or may not be a concern in any particular configuration involving connecting the TX CTRL port to other equipment. The pull up resistor, R11 is 10K ohms, and hence the short circuit current at the TX CTRL port is limited to 2.4 mA under the worst case condition where the Z1203B's voltage is set to 24V.

Connection where Remote Power Control is not used

The figure below shows the typical connection when remote power control is not used. In this configuration, Mode 1 is selected. No connection need be made to the Z1203B's TX PWR CTRL connector, as Mode 1 defaults to continuous DC voltage output for an open circuit on the TX PWR CTRL connector.

When operating with Mode 1, jumper JP2 should be set to the disengaged position, with the red jumper block stored by pushing it onto one pin only.

Of course, if the Z1203B is to be used with a transceiver, it must be connected to the transceiver's auxiliary receiver input port, never to the transmitting antenna connector!



Connection Where Remote Power Control is used

It is not possible to provide detailed connection instructions for all the possible connection arrangements involved in using Remote Power Control. A few guidelines and an example should be sufficient to explain the concept.

Almost all transceivers have a keying output, usually used to control an external amplifier. When the transceiver is placed into transmit mode, the keying output changes state. The most commonly used keying outputs, and the associated Z1203B modes are:

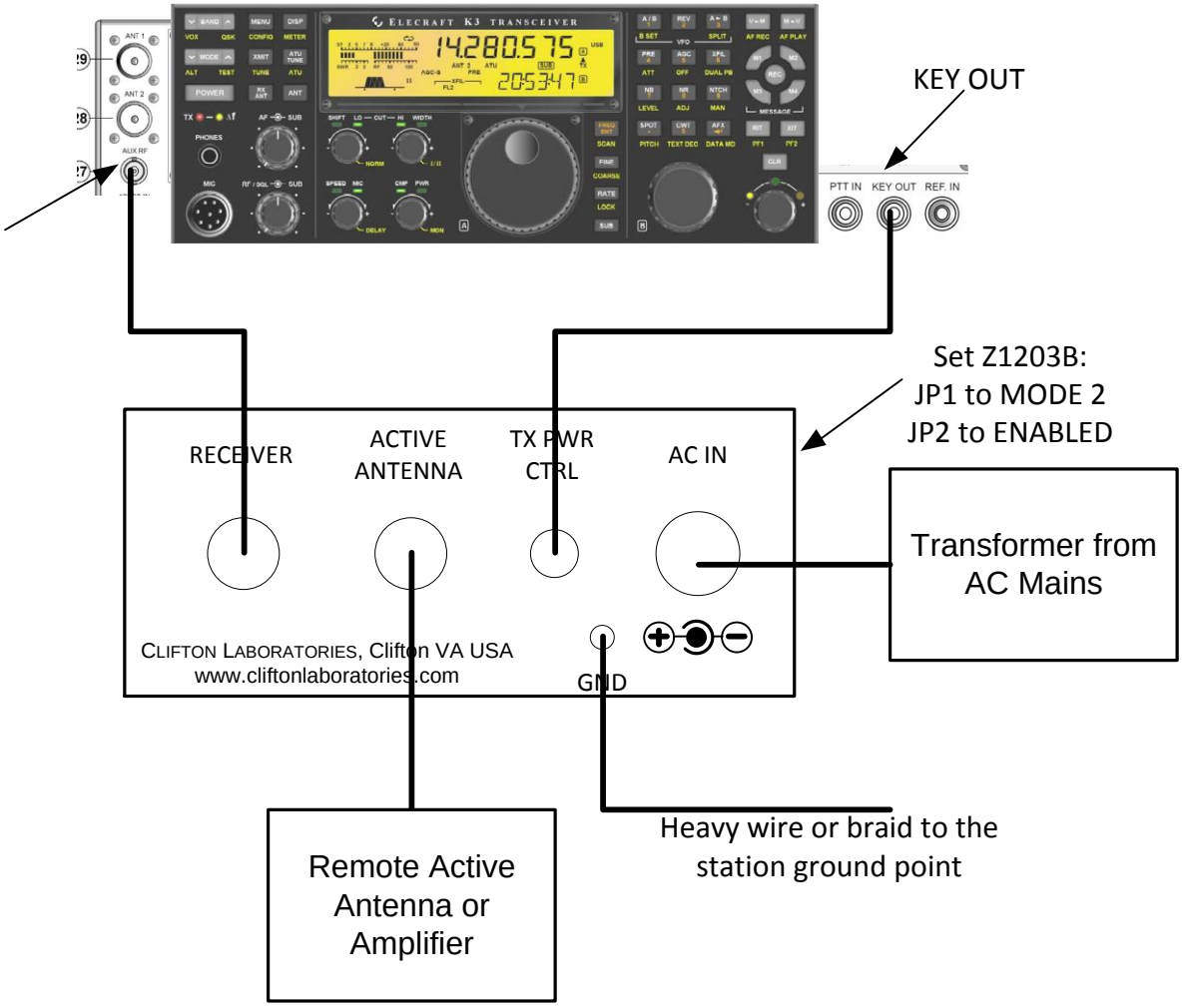
Transceiver Action when in Transmit Mode	**Transceiver Action when in Receive Mode**	**Z1203B Mode Jumper to be Used**	**Comments**
Outputs a +12V control signal	Open circuit or ground	Mode 1	
Takes a control line to ground	+12V	Mode 2	
Takes a control line to ground	Open circuit, not affirmatively asserted at +13.8V	Mode 2	Enable jumper JP2 to provide pull up during receive.

When in Mode 1, the Z1203B's output is enabled by either grounding or open circuiting the TX PWR CTRL line and disabled by a positive voltage near the 13.8 V supply level. If the transceiver provides ground on transmit and +13.8V on receive, it may be directly connected to the Z1203B's TX PWR CTRL line.

However, some transceivers do not affirmatively assert +13.8V on the control line during receive. Rather, the control line is held near ground on transmit and allowed to disconnect or float upon receive. In this case, the Z1203B's internal 10K ohm pull-up resistor should be enabled.

Typical Setup with Remote Power Control

The figure below shows how an Elecraft K3 transceiver might be used with the Z1203B and remote power control.



Several points of interest should be noted:

- The K3 has (optionally) an Auxiliary RF Input that connects to the K3's receiver circuit. It does not have transmitted power upon it and hence is well suited for connection to the Z1203B's RECEIVER port.
- The K3's KEY OUT control line goes low when the K3 is in transmit state and hence calls for the Z1203B to be used in Mode 1. However, the K3 does not include a pull-up resistor on the KEY OUT control line. Rather, the KEY OUT line floats during receiver, so the Z1203B's internal 10K pull-up resistor must be enabled by JP2 to ensure the Z1203B enters operate mode when the K3 is in receive.

Control Voltage Levels



Control voltages applied to the TX PWR CTRL input should be as close as possible to 0 volts and the DC supply voltage, nominally 13.8 V. With intermediate voltages, it is possible to place Q1, the

series transistor switch, into linear mode with a resulting risk of excess power dissipation. Certain intermediate voltages also might partially forward bias Q1 but not disable Q4, the active pull down, with consequential overheating and damage to R8.

Safe limits for the low control voltage are 0 to 0.6 volts and for the high control voltage DC supply voltage to DC supply voltage – 0.6 volts.

Assembly

Appendix B contains a complete parts list for the Z1203B. Before commencing construction, please check the parts list against the parts provided.

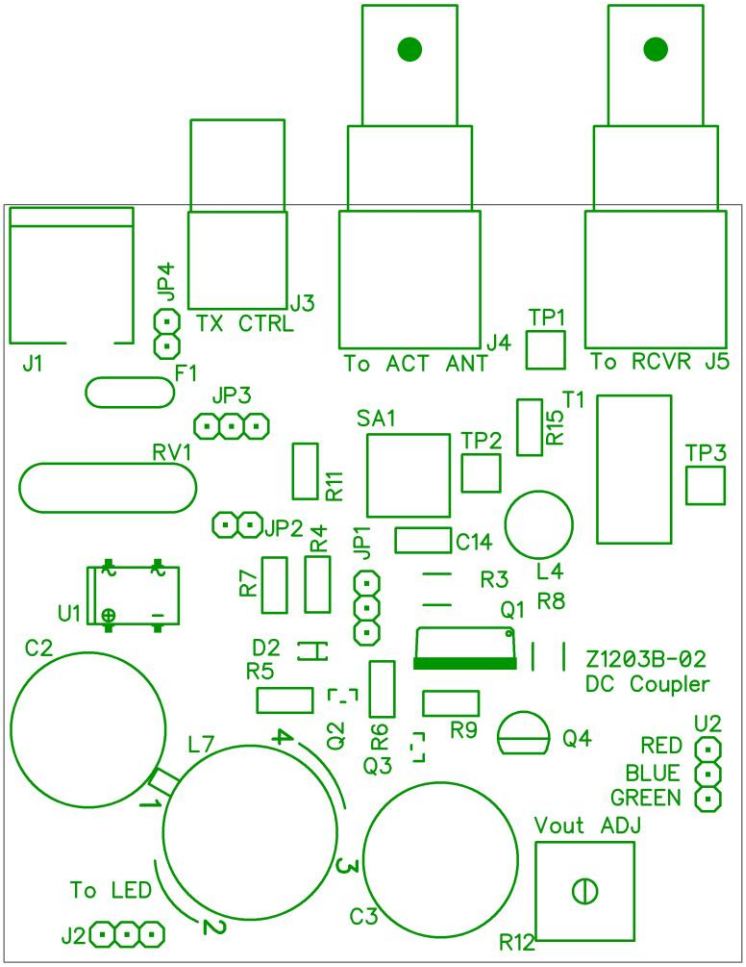
A note on how component values are identified in this manual

This document follows the international practice of using the value multiplier to indicate the decimal point. Thus, a 1.0µF capacitor is identified as 1µ0 and a 10,000 ohm resistor is identified as 10K0.

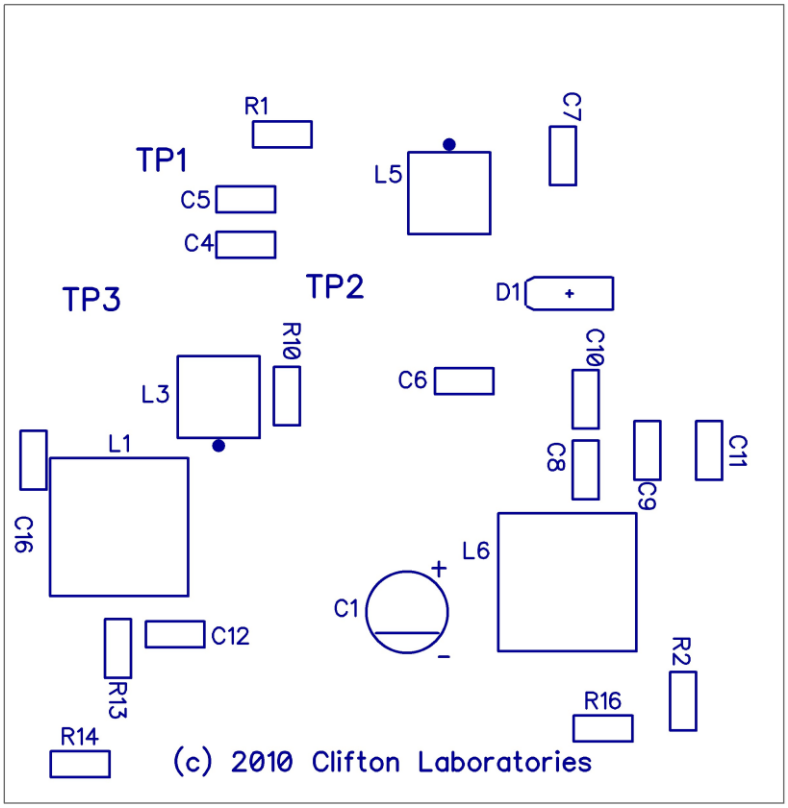
PCB Parts Location

Although the Z1203B PCB is silk screened, it's useful to have a larger view of component location.

TOP Board Surface



BOTTOM Board Surface



DC

Version Applicability



This manual applies to Z1203B's with printed circuit board revision 02.

Assembly Order

The Z1203B is a simple kit and the order of assembly is not critical. However, following the order provided below will simplify the construction.

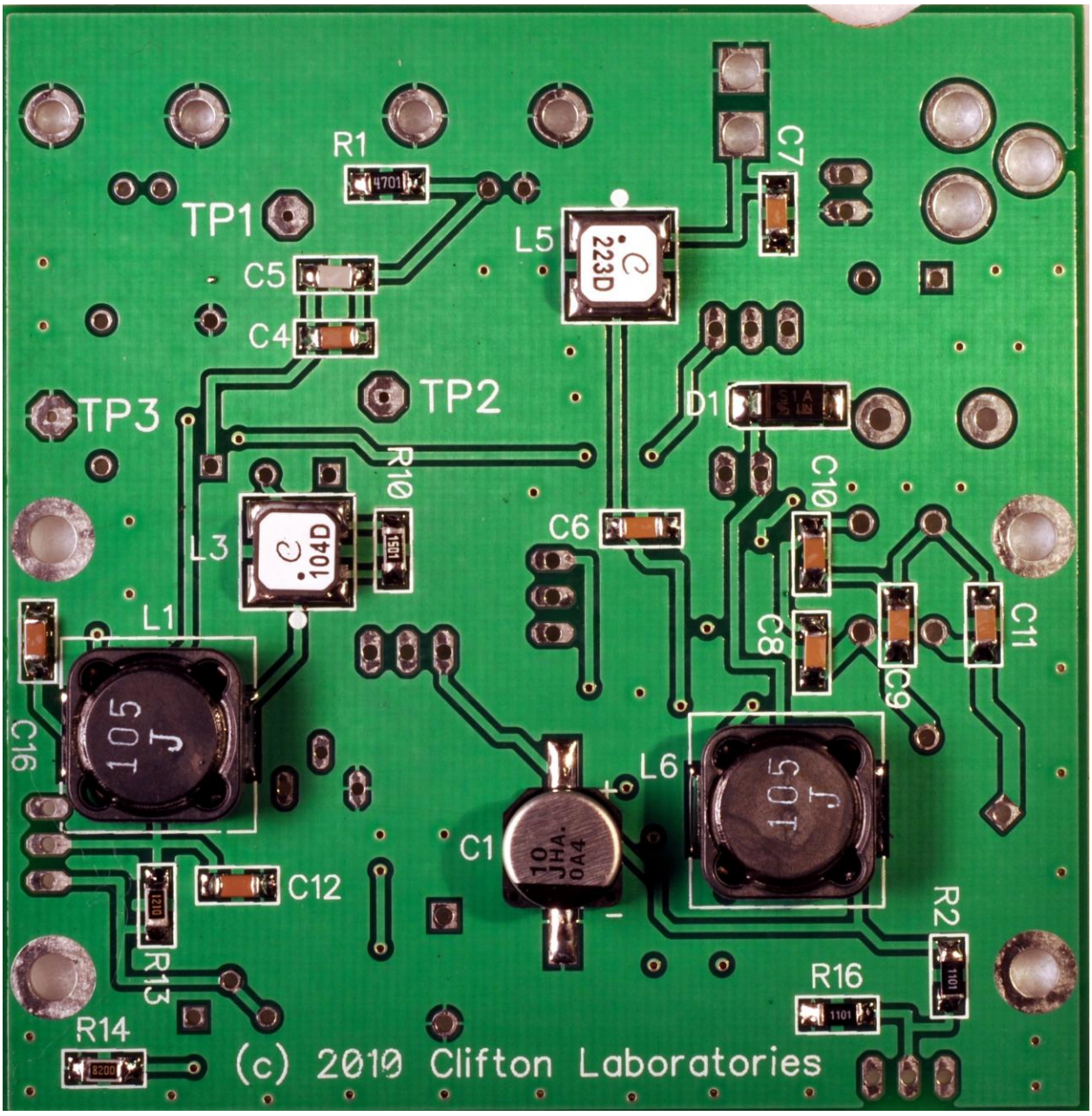
The assembly order is bottom surface, and then the top surface.

The photograph below shows an assembled PCB bottom surface. (Top components have not yet been installed in this photograph.)

NOTE FOR OPERATION ABOVE 15V DC.

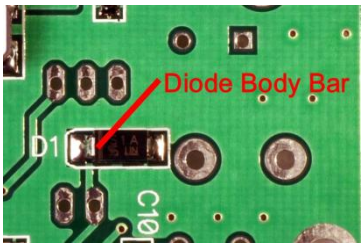
Resistors R2 and R16 must be selected according to the table below.

DC Voltage	R2 & R16
15V and below	1K1
>15V	2K2



Printed Circuit Board Assembly Bottom Surface

- ❑ Install D1, a type S1A diode, marked S1A. The diode body has a bar or ridge on one end. This end is installed on the pad identified by the silk screen angled end.



- ❑ Install C6, 0u1 capacitor, no marking
- ❑ Install C8, 0u1 capacitor, no marking

- ❑ Install C9, 0u1 capacitor, no marking
- ❑ Install C10, 0u1 capacitor, no marking
- ❑ Install C11, 0u1 capacitor, no marking
- ❑ Install C7, 0u1 capacitor, no marking
- ❑ Install C12, 1u0 capacitor, no marking
- ❑ Install C16, 1u0 capacitor, no marking
- ❑ Install C4, 1u0 capacitor, no marking
- ❑ Install C5, 1000p capacitor, no marking
- ❑ Install R13, 121 ohms, 1% marked 1210
- ❑ Install R14, 820 ohms, 1% marked 8200

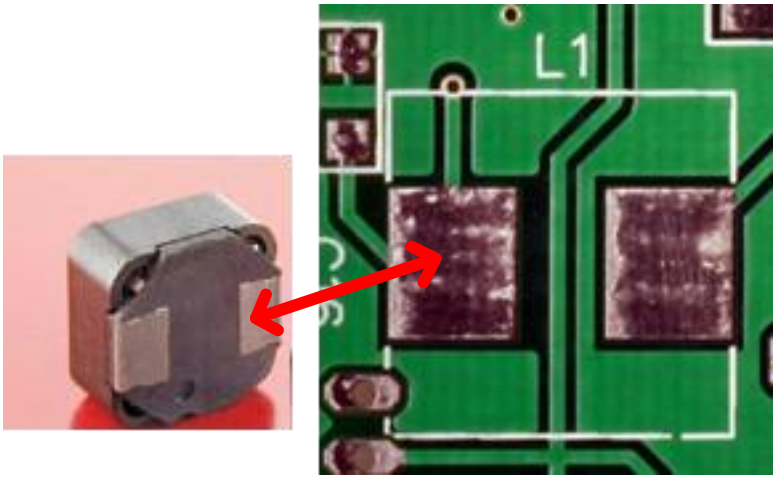
NOTE FOR OPERATION ABOVE 15V DC.

Resistors R2 and R16 must be selected based upon the desired DC regulated voltage according to the table below.

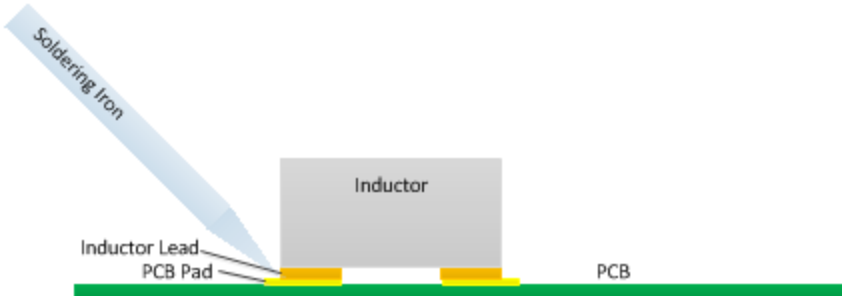
DC Voltage	R2 & R16
15V and below	1K1
>15V	2K2

- ❑ Install R2. 1100 ohms, 1% marked 1101 or 2200 ohms, marked 2201 as per table above
- ❑ Install R16, 1100 ohms, 1% marked 1101 or 2200 ohms, marked 2201 as per table above
- ❑ Install R10, 1500 ohms, 1% marked 1501
- ❑ Install R1, 4700 ohms, 1% marked 4701

L1 and L6 are 1mH surface mount inductors, marked 105J with two flush tabs on the bottom surface that align with the PCB pads.

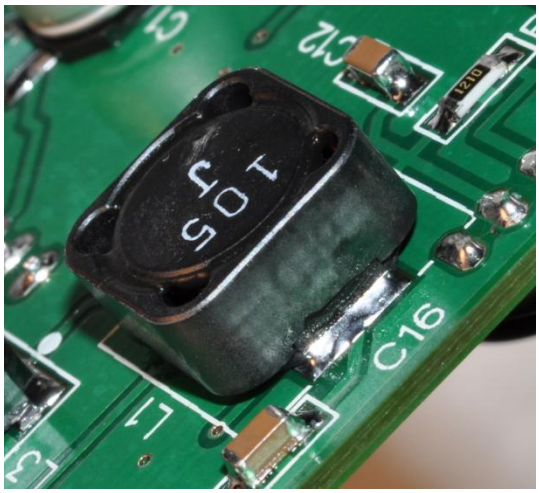


To install L1 and L6 use the following procedure:



1. If possible, apply a small amount of electronic grade rosin flux to the two PCB pads. Flux makes soldering these parts much easier.
2. Place the inductor on the pads, carefully aligning it. The PCB's pads will extend only a small distance from the inductor body and leads.
3. Charge the soldering iron tip with solder.
4. Hold the inductor in place and solder one lead, holding the soldering iron at approximately 45 degrees to the PCB surface. Move the soldering iron along the pad length to develop a small fillet of solder between the lead and pad.
5. Solder the second pad using a similar technique, but applying solder to the joint.
6. Go back and add solder to the first pad.

When installed, a solder fillet should run along the full length of each inductor tab.

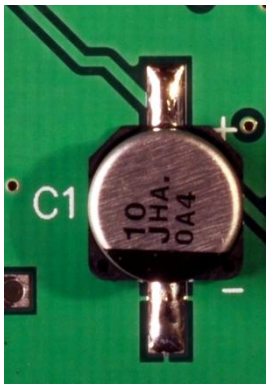


Using the above procedure, install L6, 1m0 inductor, marked 105J

❑

❑ Using the above procedure, install L1, 1m0 inductor, marked 105J

❑ Install C1, 10u/63V electrolytic capacitor.



⚠ C1 is polarized, with the negative lead identified by a black stripe on the body. The pad identified by the black stripe must be soldered to the negative (-) pad.

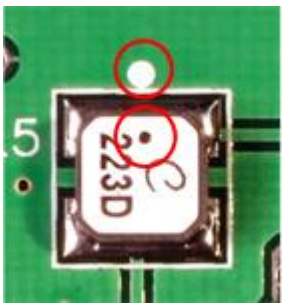
To install C1, use the following procedure:

1. If possible, apply a small amount of electronic grade rosin flux to the two PCB pads. Flux makes soldering these parts much easier.
2. Place C1 on the pads, carefully aligning it.

3. Charge the soldering iron tip with solder.
4. Solder the positive (+) lead in place by touching the iron to the lead and pad. (This works best when flux is applied to the pad).
5. Solder the negative lead to the negative pad.
6. Return to the positive lead and apply additional solder as necessary.

❑ L5 and L3 are installed using the same procedure as described for L1 and L6. However, L5 and L3 are smaller and the PCB pads are larger, so the installation will be easier.

L3 and L5 have a small orientation dot on the body. Orient the inductors so that this dot matchs the silk screen dot as shown in the photograph.



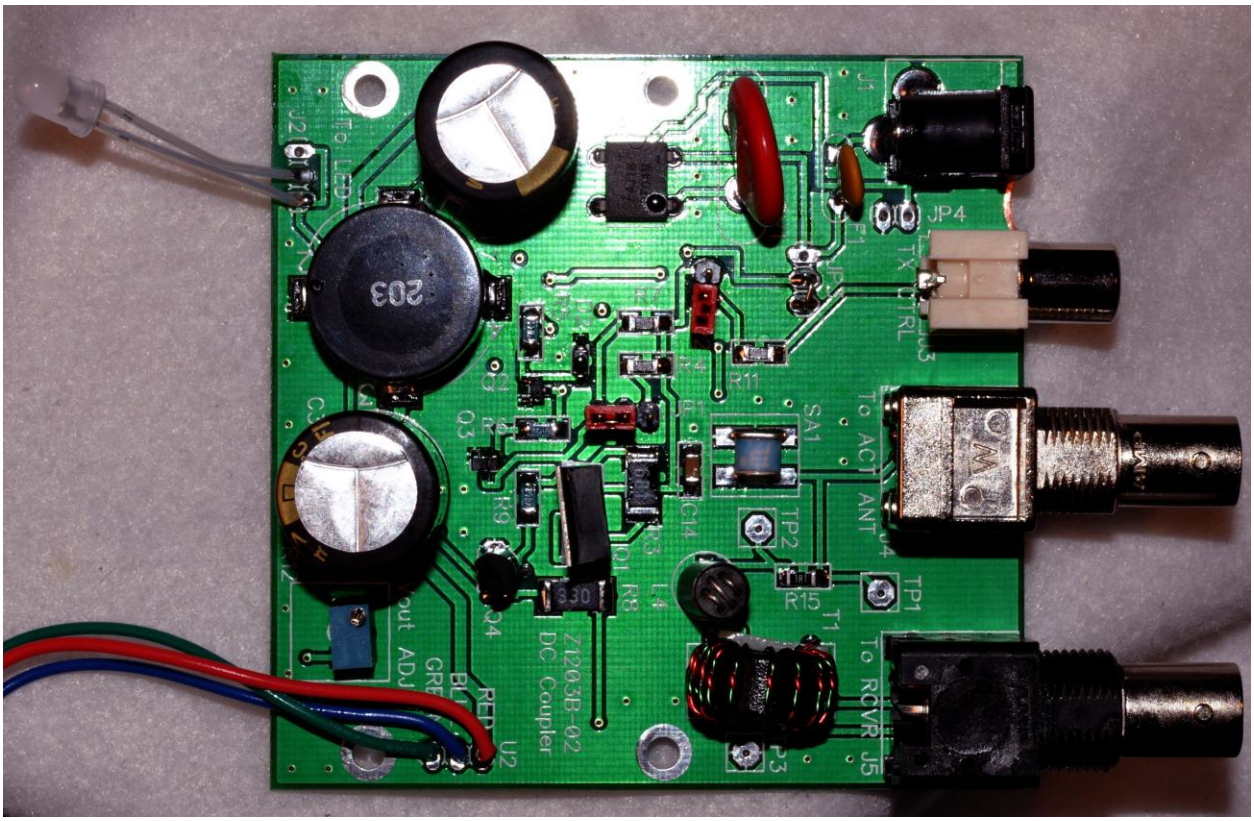
❑ Using the procedure described above, install L5, 22u, marked 223D.

❑ Using the procedure described above, install L3,100u, marked 104D.

This completes installation of all bottom surface components. You should check your board against the bottom surface photograph for possible assembly errors or missing parts.

Printed Circuit Board Assembly Top Surface

The photograph below shows an assembled PCB top surface.



Q1 and Q2 are physically small NPN transistors. To install Q1 and Q2, use the following procedure:

1. If possible, apply a small amount of electronic grade rosin flux to the PCB pads. Flux makes soldering these parts much easier.
2. Charge the soldering iron tip with solder.
3. Using angled tweezers or a similar tool, place the transistor on the pads, carefully aligning it.
4. Holding the transistor in place with the angled tweezers, touch the soldering iron tip to one pad. Sufficient solder should be transferred to hold the part in place.
5. Solder the other pads.
6. Return to the first pad, adding additional solder if necessary.

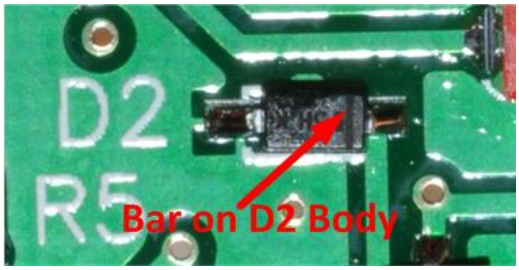
- ❑ Using the above procedure, install Q1, a KST4401 NPN transistor marked 2X
- ❑ Using the above procedure, install Q2, a KST4401 NPN transistor marked 2X

Diode D2 is another small part and the same procedure used to install Q1 and Q2 should be used for it.

D2 has a polarity mark consisting of a small bar molded into the body. It can best be seen if illuminated at an angle.

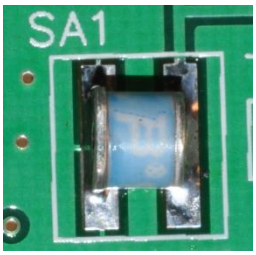
When installing D2, orient the bar as indicated in the illustrations.





- ❑ Using the above procedure, install D2, a 1N4148 (or similar) diode.
- ❑ Install R5, 27K, 1% resistor, marked 2702
- ❑ Install R6, 27K, 1% resistor, marked 2702
- ❑ Install R9, 27K, 1% resistor, marked 2702
- ❑ Install R4, 10K, 1% resistor, marked 1002
- ❑ Install R7, 10K, 1% resistor, marked 1002
- ❑ Install R11, 10K, 1% resistor, marked 1002
- ❑ Install C14, 0u1 capacitor, no marking
- ❑ Install R3, 680 ohm, 5% resistor, 1 watt marked 681
- ❑ Install R8, 33 ohm, 5% resistor, 1 watt marked 330
- ❑ Install R15, 1.00 ohm, 1% resistor, marked 1R00

SA1 is a plasma "gas trap" over voltage arrestor. It is not polarized and may be installed in either orientation.



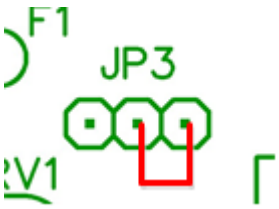
SA1 is best installed by holding it in place with angled tweezers while a fillet of solder is applied to one pad. Allow SA1 to cool and solder the second pad building up a fillet of solder.

- ❑ Using the procedure described above, install SA1

The two instructions below require removing sections from the header pin strip. Note that the header strip has indentations between each pin. The strip may be cut with standard wire cutters at the indentation points. Or, the strip may be held with pliers at the indentation and the strip broken.

When installing JP1 and JP2, it is convenient to slip the red jumper block over the pins to serve as a holding point.

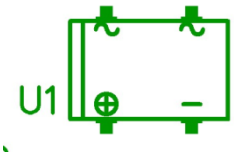
- ❑ Cut or break a 3 pin section from the header pin strip. Install at JP1
- ❑ Cut or break a 2 pin section from the header pin strip. Install at JP2
- ❑ Using the length of #24 tinned copper wire, install a wire jumper at JP3 between pins 2 and 3 as illustrated.



- ❑ JP4 is not used.
- ❑ Install F1, a 400mA PTC "polyfuse" at F1. Marked 040x. (Check both sides of F1 for this marking.)

❑ Install RV1, a MOV over-voltage protector, marked P39Z6

❑ Install U1, a DIP packaged bridge rectifier. U1's marking may vary depending on the particular part rating provided with the kit.

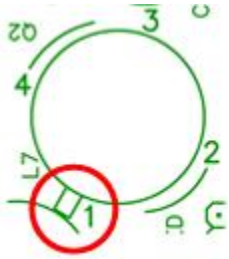


U1's body may have a notch or bar at one end or it may have markings similar to those on the silk screen, indicating AC input (~) and DC output (+) and -.

Orient U1 to match the silk screen. A notch or bar at one end matches the double line in the silk screen, or if AC and DC symbols are molded in the case, match them to the silk screen.

❑ Install L7, a 20mH common mode choke. L7 is marked 203 and has a small ridge molded into the case, adjacent to pin 1.





Orient L7 so that its ridge matches the silk screen ridge.

Use a technique similar to that described for L1 and L6 when installing L7. Since L7 has lead wires wrapped around plastic projections, it may not be possible to obtain a smooth solder fillet.

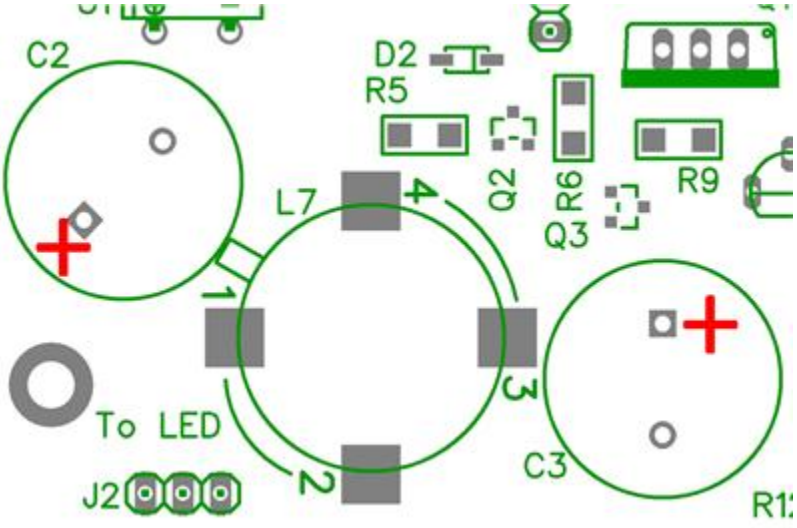
C2 and C3 are 820uF/50V electrolytic capacitors and are polarized. The negative lead is identified in two ways:

- The capacitor body is marked with a gold stripe with centered minus (-) symbol
- It is the shorter of the two leads

Conversely, the positive lead is:

- The longer of the two leads

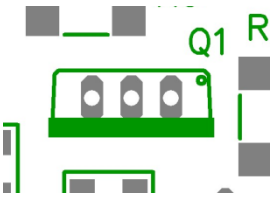
❑ Install C2 and C3.
The silk screen does not indicate polarity. To orient C2 and C3 note that the POSITIVE (longer) lead is inserted in the hole with a SQUARE pad. The illustration at the right shows the correct polarity.

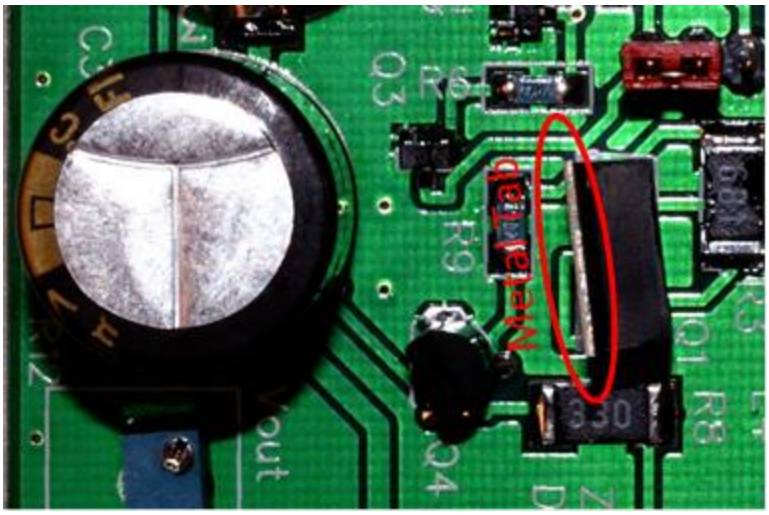


❑ Install R12, a 1K multi-turn trim pot, identified as 102.

❑ Install Q1, a TIP30C, 100V PNP transistor.

Orient Q1 so that the metal tab is on the side marked by the solid bar on the silk screen. When properly installed, Q1's metal tab will be on the side nearest C3 as illustrated in the photograph.



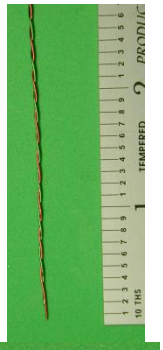


❑ Install Q4 (2N7000 MOSFET transistor). When installing Q4, follow the orientation shown on the PCB silk screen. The 2N7000 is a MOSFET transistor and normal anti-static procedures should be used when handling and installing Q4.

❑ Install L4, the multi-turn ferrite bead. Space L4's bottom winding approximately 1/8" (3mm) above the PCB surface.

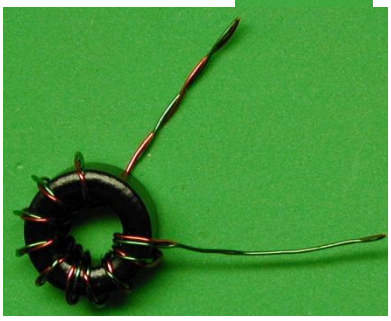
❑ Install a length of double sided foam tape at T1. Leave the protective paper in place until T1 is ready for installation. Carefully position the tape to avoid obstructing the four connection pads.

❑ Locate the No. 26 AWG magnet wire. One length of green insulated wire is provided and one of red insulated wire. Each wire is approximately 16 inches (400 mm) long.



Twist the red and green wires together with approximately 75 to 80 turns. (A variable speed drill, running slow speed, speeds up the twisting process.)

The end nearest the drill may be twisted more tightly than the far end. If so, cut an inch (25mm) or so from the most tightly twisted end.



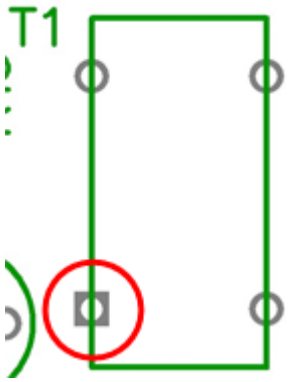
Wind the twisted wire 14 turns onto the ferrite core.

As a reminder, a turn is counted when the wire passes through the hole in the core.

Start by inserting the cut end approximately one inch (25 mm) through the core. Thread the end through and wind 14 turns. Space the turns so that the windings are roughly evenly spaced and occupy approximately 75% of the core perimeter (270 degrees if you prefer to think in those terms).

Congratulations. You have completed winding T1, a bifilar broadband transformer.

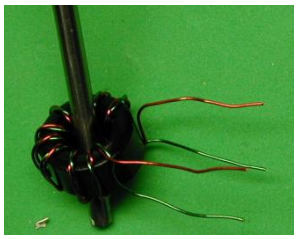
❑ Locate the PCB and look at the silk screen outline for T1. It has four pads, comprised of three round pads and one square pad, oriented as shown in the drawing.



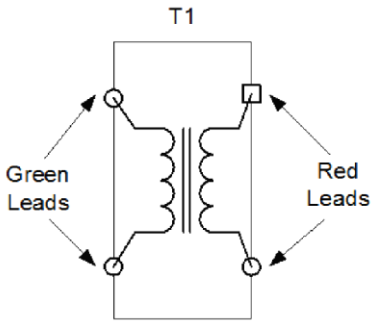
The green wires connect to the two round pads on one side and the red wires connect to the one square and one round pad on the opposite side.

Un-twist the wire extensions so that you have four separated wires. Remove the insulation and tin the four wires. The red and green wire supplied is "solderable" and the insulation will melt if heated with a blob of molten solder. This heating and tinning must be done before the transformer is installed in the PCB.

The wire leads should be formed as illustrated in the photo.



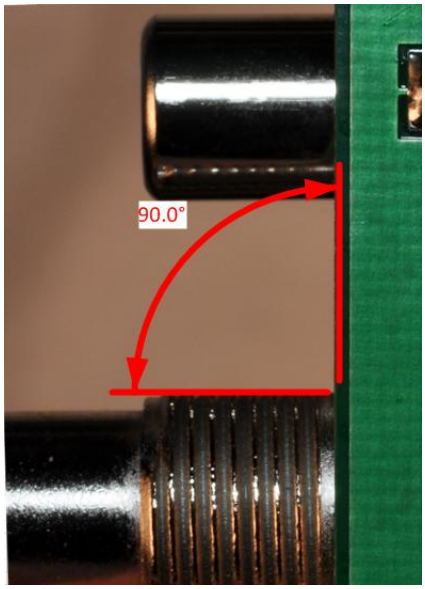
Remove the protective tape from the foam tape and install the transformer at T1 following the orientation shown in the drawing.



A common error in installing T1 is that the insulation is not fully removed from the wire due to insufficient heating.

Inspect the leads and, if necessary, bend the leads so that any bare conductor does not touch the transformer core or other leads.

The next four steps involve installing connectors J1, J3, J4 and J5. These connectors fit through holes in the Z1203B's rear panel and must be aligned to the printed circuit board or else the connectors may not fit through the rear panel holes. There is some room for movement when the connectors are placed into the PCB holes before soldering, so do not depend upon the mounting holes for accurate alignment.



The four connectors will be properly oriented if the connector body is aligned with their associated silk screens and if the end of the connector is parallel to the end of the printed circuit board. The connector shell will then be 90 degrees to the PCB edge.

The two BNC connectors are not identical. One has a plastic body (J5) and one a metal body (J4).

- ❑ Locate the plastic body BNC connector and install it at J5, being careful to orient it to match the silk screen outline. Solder the two signal leads and the two mounting pins to the PCB.

- ❑ Locate the metal body BNC connector and install it at J4, being careful to orient it to match the silk screen outline. Solder the two signal leads. Soldering the two mounting pins may be difficult as the metal body drains heat away from the pins. One trick is to use two soldering irons. Make a sloppy joint with one iron and then apply two soldering irons to reflow the solder. A touch of liquid or paste rosin flux will aid in making a smooth fillet around J4's mounting pins.

- ❑ Install J3, an RCA connector. Before soldering, align the connector to match the silk screen outline and also verify that the connector body is parallel to the PCB in the vertical plane. Tack one lead to the PCB and check the connector body alignment, adjusting as necessary. Solder the remaining lead and the tacked lead. Fill the holes with solder as the pads provide mechanical support for J3.

- ❑ Install J1, a 5.5/2/1 mm coaxial power connector. J1 has the most opportunity for mis-alignment of all the Z1203B's connectors. When properly aligned, J1's end will be flush with the PCB edge.

  Tack one lead to the PCB and check the connector body alignment, adjusting as necessary. Solder the remaining leads and the tacked lead. Fill the holes with solder as the pads provide mechanical support for J1.

- ❑ Trial fit the PCB into the enclosure. Slide the PCB into place and temporarily install four mounting screws (4-40 x ¼ inch). No not use lockwashers. Verify that all connectors fit their associated mounting holes. Slip the transformer power plug into J1 (do not connect the power transformer to the AC mains for this test – this is just a mechanical fit verification) and verify that the plug can be fully inserted. Locate the RCA connector and verify that it can be fully inserted into J3.

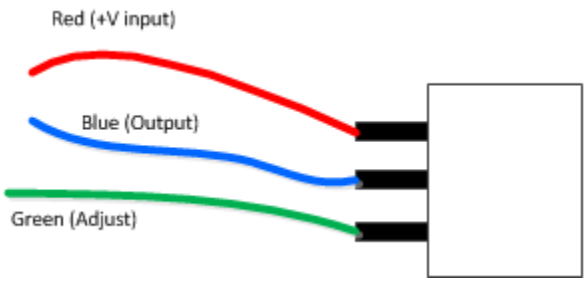
  If any connectors do not fit and align, rework until it does.

  When proper connector alignment is verified, remove the mounting screws and remove the board from the enclosure.

  U2, an LM317-style voltage regulator mounts off the PCB and is connected by a wiring harness to the PCB. The Z1203B's LM317 has an insulated body and does not require separate mica or other insulating pad.

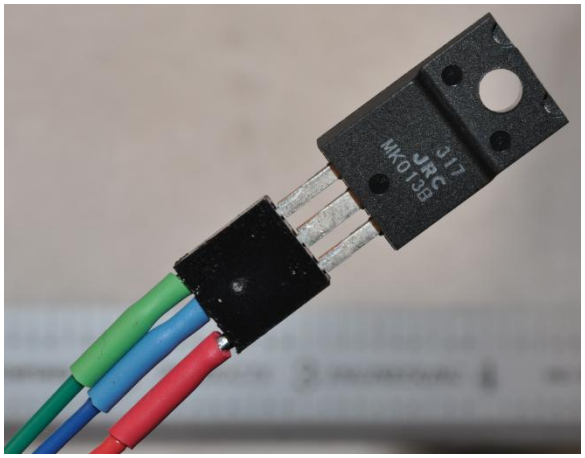
- ❑ Cut 3.5 inch (90mm) lengths of red, blue and green wire. Strip insulation 1/8th inch (3mm) from both ends of the three wires and tin.

❑ Tin the pins on the 3-pin header socket and solder one end of each of the three wires to the header socket following the order in the illustration.



Cut short lengths (½ inch or 12mm) red, blue and green heat shrink tubing and slip over the associated color wire until flush against the connector shell. Apply heat to shrink in place.

❑ Slide the 3-pin header socket onto the LM317's pins. This may be a tight fit. The socket will likely be slightly beyond the thick portion of the LM317's pins. Cut a small amount off the LM317 pins so that when the socket is slid into place the socket body reaches the thick portion of the pin. Trimming the pin length by 1/16th inch (1.5mm) is approximately correct.



Note the socket orientation. With the tab down, (so that U2's part number is facing up) looking into the pins, the red wire is on U2's right side as shown in the photograph.

❑ Solder the other end of the wiring harness to the printed circuit board's U2 pads.

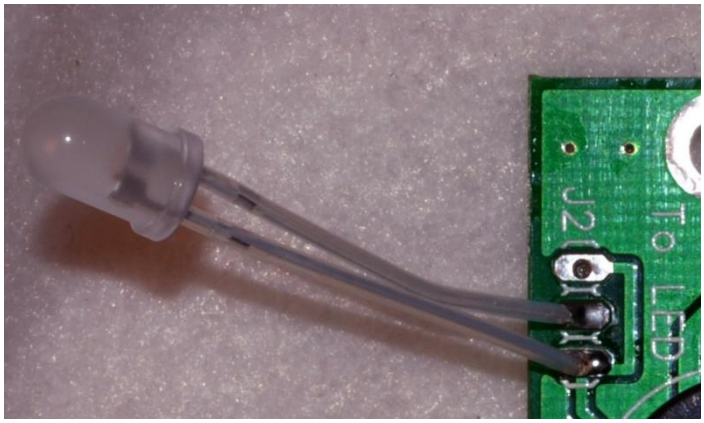
U2 pads are silk screen identified with the color wire to be installed in each position.

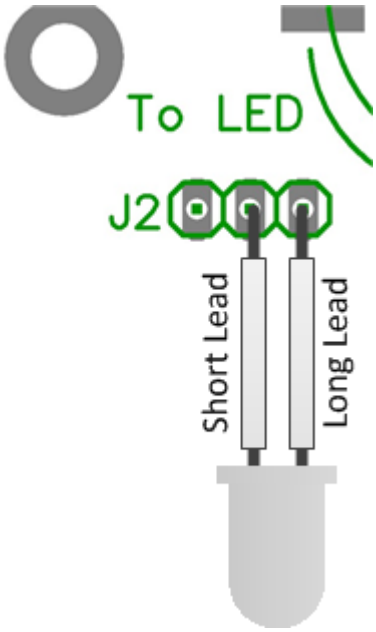


❑ Locate the bi-color (green and yellow) LED. Note that one lead is slightly longer than the other.

Cut lengths of Teflon tubing so that approximately 1/8th inch (3mm) of lead extends beyond the tubing when slipped over the LED leads. Push the tubing flush against the LED body when installing the tubing.

Install the LED at J2. The short lead connects to the J2's center pad and the long lead to the outside pad furthest from the J2 legend.





This completes the printed circuit board assembly.

Initial PCB Checkout

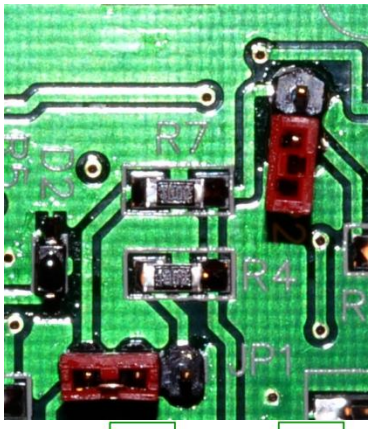
☞ The following resistance readings are taken with an HP 3468A digital multi-meter. Most of the resistance readings in the table below are influenced by the voltage the DMM uses and also the scale selected. Different DMMs will use different test voltages on ohms scale and the resistance values measured may depart significantly from the values in the table below. Hence the table should be regarded as only a rough guide to verification.

In particular, the HP 3486A has low voltage ohms and does not forward bias diode junctions. This is not the case with all ohmmeters and may cause significant differences in resistance readings.

Many soldering or component selection errors will cause gross departure from the table values. For example, shorting a pad to ground (difficult with a solder masked board, but still not impossible) will reveal itself as a near zero ohms reading.

Unless otherwise indicated, the resistance readings are taken with the negative DMM probe connected to ground. (This means the ohmmeter lead used for measurements is positive with respect to ground.)

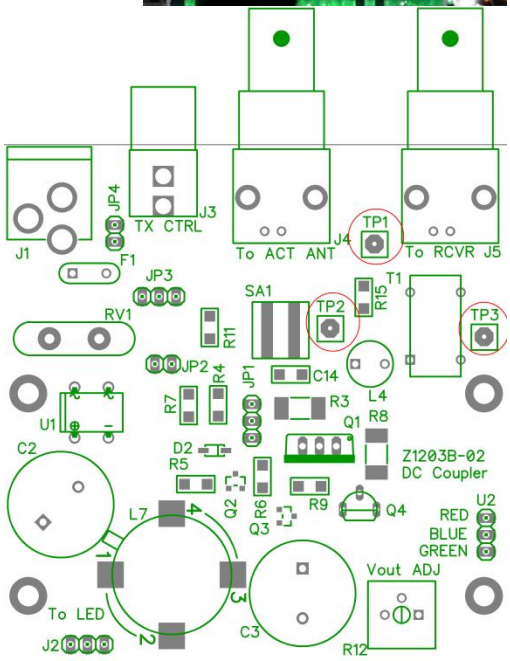
❑ Before taking ohmmeter measurements, install jumpers at JP1 and JP2 to enable Mode 1, no pull up, as illustrated in the photo.



JP1 has the jumper plug over the two pins nearest Q1, the large TO-220 power transistor.

JP2 is open. To avoid misplacing the jumper plug, install it on one pin of JP2, with the other side of the jumper plug unconnected.

Some measurements reference TP1, TP2 and TP3. These are silk screened onto the board (both top and bottom) and are highlighted in the illustration.



❑

Note: Ground can be picked up at TP3 or the J4's shell (J4 is the metal body BNC).

Connector	Pin (to ground unless otherwise noted)	Resistance	Comments
J1	center	7.3 M Ohms	Should be high impedance, exact value will depend on ohmmeter open circuit voltage.
J3	center	488K	Assumes ohmmeter does not develop sufficient voltage to forward bias Q2's B-E junction.
J4	center	4.5K	Dominated by 4.7K bleeder resistor to ground.
J5	Shell and center	Infinity	J5 shell and center float (via T1) with respect to ground.
TP1 & TP2		4.5K	Should match J4, center reading.
U2	red	5M	Depends upon U2 parameters as well as ohmmeter open circuit voltage.
U2	blue	650	Depends upon R12 setting
U2	green	670	Depends upon R12 setting

Power-On Initial Tests

❑ Before mounting the assembled PCB in the enclosure, power-on tests should be conducted.

With the jumper settings as described for the ohmmeter checks, plug the transformer into the AC mains socket and connect the transformer output to the Z1203B board J1 connector. There should be no connections to J3, J4 or J5.

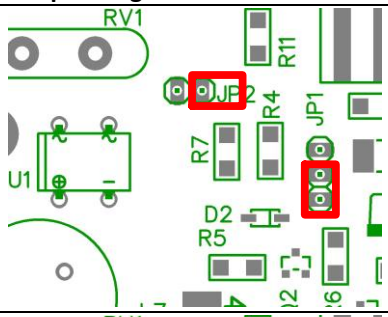
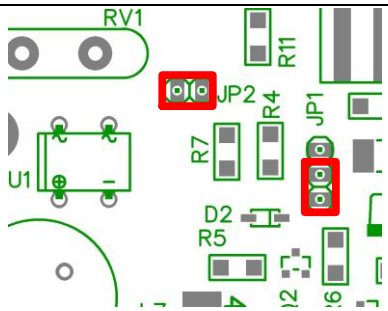
❑ The LED should illuminate, green. If the LED does not illuminate or if it is yellow, remove power and check your work.

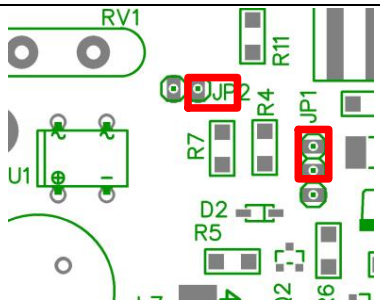
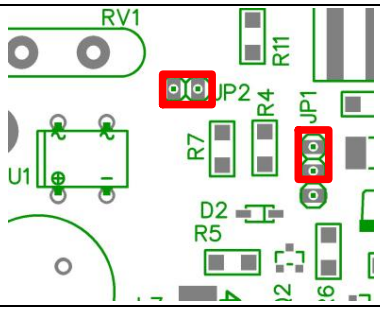
❑ Measure the DC voltage between TP3 (ground) and TP1 (positive). It should be between 9 and 25 volts. (These are approximate values). Adjust R12 while observing the output voltage. It should be adjustable up and down within this range.

For the tests to be conducted, adjust R12 to set the voltage measured at TP1 to 13.8V (between 13.5 and 14.0 is OK).

If you have an oscilloscope, set it to AC mode and view the AC voltage at TP1. It should be essentially 0. (You will see a few millivolts noise in most cases due to probe pickup.)

❑ Verify operation of TX CTRL using the internal jumpers. (Power can be left on during these tests.)

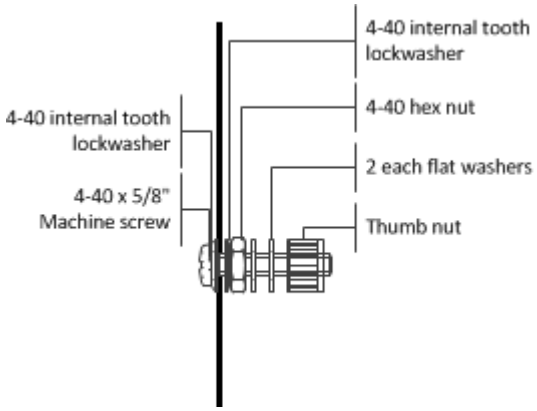
JP1	JP2	LED Color	Voltage at TP1	Jumper Diagram
Mode 1	Open	Green	+13.8V	
Mode 1	Closed	Yellow	< 0.25V	

Mode 2	Open	Yellow	+13.8V	
Mode 2	Closed	Green	< 1.2V	

Final Assembly

If the functional tests above are satisfactory, proceed to final assembly and adjustment.

❑ Install the ground post hardware. Use a 4-40 x 5/8" machine screw, two 4-40 internal tooth lockwashers, one 4-40 hex nut, two 4-40 flat washers and a 4-40 thumb nut as illustrated.

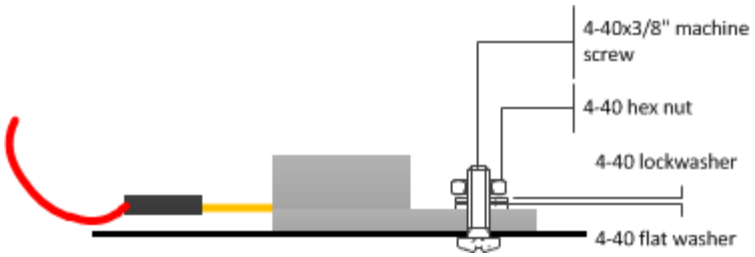


It is necessary to fully tighten the 4-40 hex nut so that the lockwashers penetrate the enclosure paint. It may be necessary to scrape away paint from the enclosure's inside rear surface around the ground hole to ensure a better connection to the hardware.

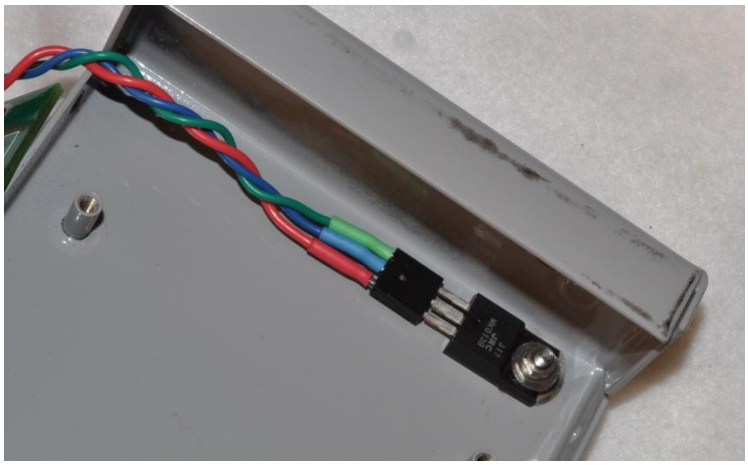


❑ Although it is not electrically necessary, the LM317 wire harness will look better if it is twisted to keep the wires together.

❑ Using a 4-40x3/8: machine screw, a 4-40 flat washer, a 4-40 lockwasher and a 4-40 hex nut, mount the LM317 using the mounting hole near the LED.



Orient the LM317 and wiring harness as in the photograph.



❑ Install the PCB into the enclosure with 4-40 hardware (4-40x1/4" machine screws and 4-40 lockwashers). It's easiest to install the board by angling the front end up at about a 45 degree angle and slipping the BNC connectors into holes. Then lower the board whilst sliding it to the enclosure rear.

❑ Install the LED retaining clip, flange to the outside. Slide the LED into the clip and push until the clip snaps in place around the LED. A small screwdriver or the end of needle nose pliers may be required to push the LED into place.

❑ Install the BNC hardware (lockwasher and retaining nut). A 9/16" deep reach socket is the best tool to use for this purpose. <u>Do not over tighten these nuts as you may break the solder connections.</u>

Final Adjustment Before Installing Cover and Measuring Current

❑ The final voltage adjustment (R12) can now be made.
As a safety measure, before connecting the active antenna to the Z1203B, adjust R12 to set the output voltage at TP2 (measured with nothing connected to J4, the active antenna port) at the voltage level recommended for the equipment powered by the Z1203B.

Connect the active antenna or other equipment to J4, the active antenna port. Adjust R12 to provide the recommended voltage, measured between TP2 (positive) and TP3 (ground.)

To measure the current supplied through J4, measure the voltage drop across the 1.00 ohm, 1% shunt resistor, R15. To accomplish this, using an accurate voltmeter measure the voltage between TP1 (negative lead) and TP2 (positive lead).

This measurement provides the voltage drop across the 1.00 ohm shunt. The current

supplied through J4 in mA, therefore, is equal to the voltage measured between TP2 and TP1 in millivolts.

Sample calculation:

Voltage between TP2 and TP1 is 0.125 volts. The current supplied is thus 0.125 ampere or 125 mA.

Note: The current shunt is upstream from the 4.7K discharge resistor and hence for maximum accuracy an adjustment is required:

$$I_{corrected} = \frac{V_{TP2-TP1}}{1.00} - \frac{V_{TP1}}{4700}$$

Where:
$I_{corrected}$ is the true current delivered to the device connected to JP4.
V_{TP2}-V_{TP2} is the voltage measured between TP2 and TP1 in volts
V_{TP1} is the voltage measured at TP1 to ground (TP3 is a convienent ground point)

In many cases, the second term may be disregarded. At 14V DC, for example, the discharge resistor error is 3 mA.

- ❑ If necessary, move jumper blocks on JP1 and JP2 to match the desired mode of operation.
- ❑ Attach adhesive "bumpers" to the four corners of the enclosure lower section.
- ❑ Attach the enclosure cover with four black self-tap sheet metal screws.

This completes construction of the Z1203B.

- ❑ Disconnect both power supplies and change JP1 to Mode 2. Set the variable supply to 0 V. Reconnect both power supplies. The voltmeter should read 1 V or less. Quickly increase the variable DC supply to 12V. The voltmeter should indicate approximately 0.4 to 0.5 volts below the DC power supply, i.e., 13.4 to 13.3 V if the supply voltage is 13.8 V.

Theory of Operation

A complete schematic of the Z1203B appears at Appendix A and should be used to follow this Theory of Operation discussion.

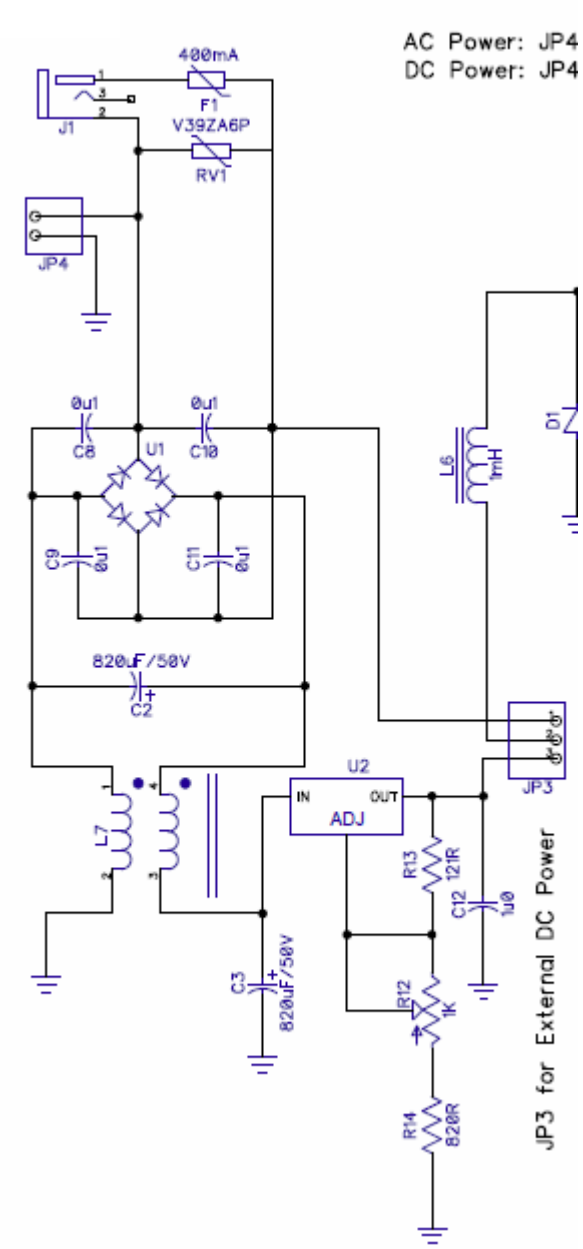
In order to inject DC voltage into a transmission line also carrying RF signal, the Z1203B accomplishes two essential tasks:

- Prevents the DC power source from appearing as low impedance at RF frequencies; and
- Prevents the DC voltage from appearing on the signal output (receiver) port.

The Z1203B also adds several useful features:

- Provides a low noise, regulated DC voltage source, independent of any other station power supply;
- Provides an isolated (floating ground) signal output to break any potential ground loop between the receiver and the remote antenna system;
- Protects from over-voltage on both the AC supply line and the remote antenna system feedline;
- Protects against over current;
- Remotely controls the DC supply feed to the remote antenna system, including an active pull down circuit; and
- Provides a convenient method of measuring the current supplied to the remote device.
- Indicates voltage output status with a two-color LED.

AC power from an external “wall wart” type transformer enters through J1. Over-current protection is provided by F1, a 400 mA “polyfuse” or positive temperature coefficient (PTC) thermistor. In the event that more than 400 mA current is drawn, F1’s temperature increases as does its resistance. While the fault condition continues, F1 stays in a high temperature, high resistance state, thereby protecting the power source from overload. When the short circuit is cleared, F1 reverts to normal operation.



Excessive supply voltage is clamped by RV1, a metal oxide varistor (MOV) with a threshold voltage of 25V RMS. The AC is full wave rectified with U1, a monolithic quad power diode device and filtered with C2, an 820uF/50V electrolytic capacitor. Capacitors C8 through C11 slow switching times in the bridge diodes, reducing switching noise that otherwise might be coupled into the active antenna through the power feed.

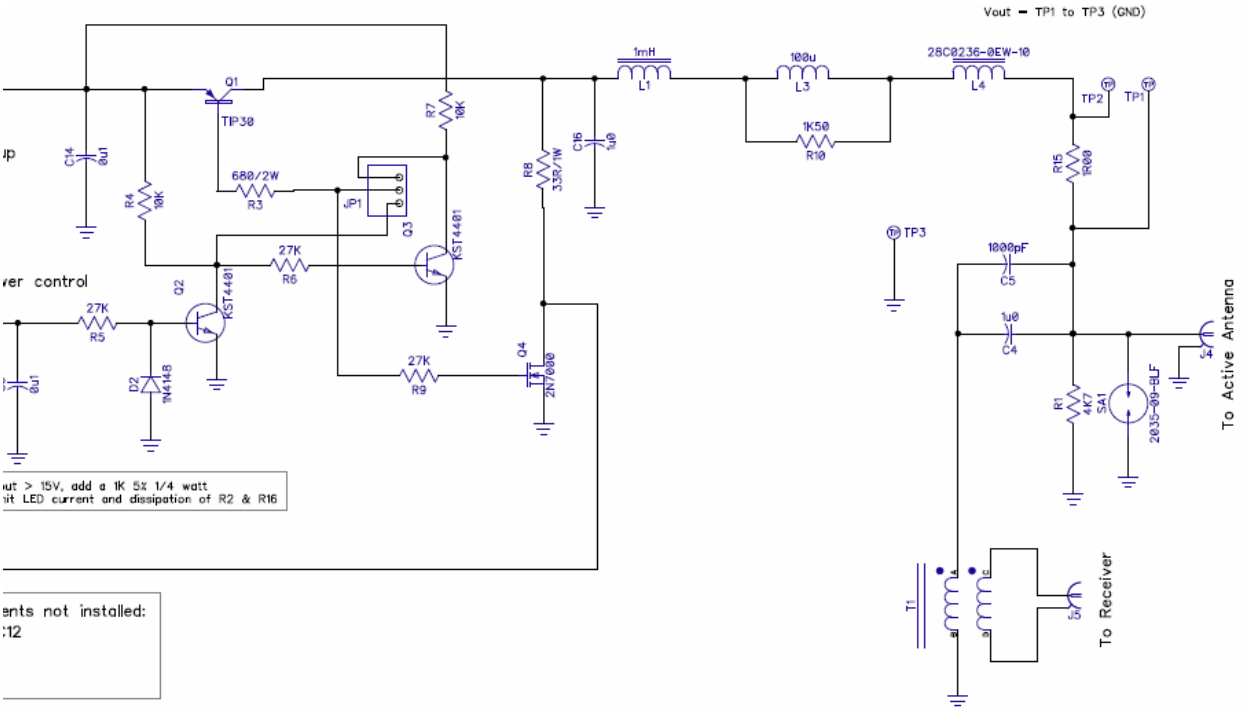
The rectified and filtered DC (both positive and negative sides) pass through L7, a 20mH common mode choke. L7 suppresses high frequency noise that might be coupled from the AC mains into the Z1203B through the input transformer.

C3 provides additional ripple filtering is provided after the common mode choke.

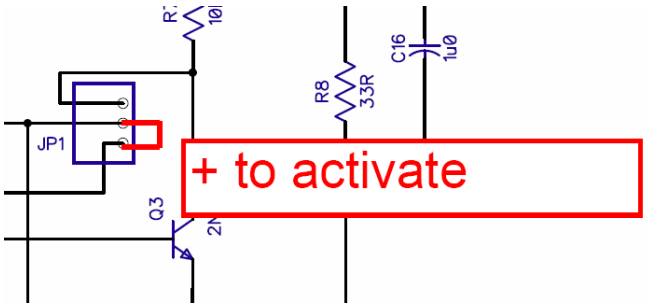
U2 is an LM317 family voltage regulator and provides a regulated and smoothed DC output, adjustable over the range of approximately 10V to 24V. R12 is a multi-turn trim pot used to adjust the output voltage.

Broadband output noise from U2 is further suppressed by the low pass filter comprising C12, L6 and further capacitors (C1 and C14) not reproduced in this schematic fragment.

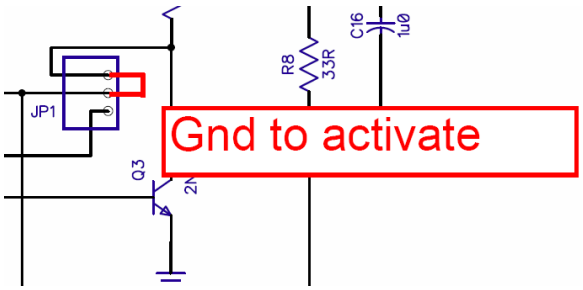
Jumpers JP3 and JP4 provide a method to bypass the rectifier and ripple filter stages and feed the Z1203B with an external DC supply. This feature is reserved for future use. Under normal AC power operation, JP3 is jumped between pins 2 and 3 and JP4 is unused.



Filtered and regulated DC power is supplied to the active antenna output through the series combination of Q1, L1, L3 and L4.



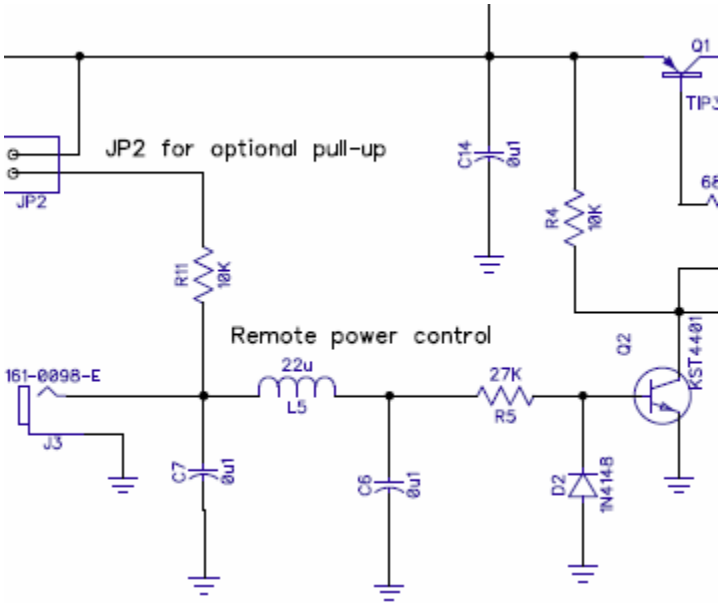
Q1, a TIP30 PNP power transistor, enables and disables DC voltage on the remote antenna port. Holding Q1's base near ground places it into saturated conduction and enables DC voltage on the output port. Conversely, if Q1's base is near the supply voltage, it is cut off and the output port DC voltage drops to near zero. Q1's base is controlled by Q2 and Q3, as determined by the position jumper JP1 is placed in and the voltage level appearing at J3, the remote control port.



When JP1 is placed in the lower position, as reflected in the schematic fragment at the right, a positive voltage > 6V at J3 causes Q2 to turn on and pulls Q1's base voltage to near zero, thereby placing Q1 into conduction and applying voltage to the Z1203B's output port. Bringing J3's voltage to ground level turns Q2 off and increases Q1's base voltage to near 12V thereby placing it into cutoff and removing the output voltage.

When JP1 is placed in the upper position, as reflected in the schematic fragment at the right, Q1's base connection is shifted to Q3 which inverts Q2's output. Hence Q1's action is reversed; a ground at J3 places Q1 into conduction and +12V at J3 places Q1 into cutoff and removes DC from the output.

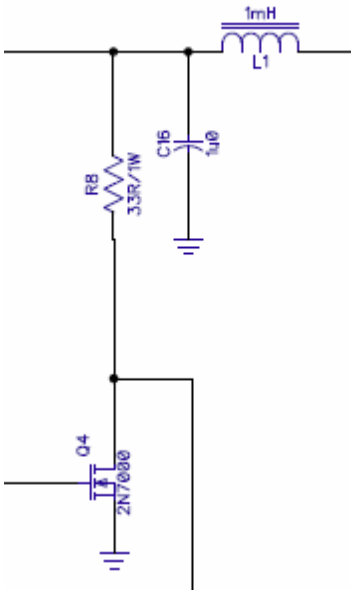
The remote control input, J3, has RF filtering to reduce the possible effect of nearby transmitted signals. C6, C7 and L5 form a Π-section low pass filter. R5 and D2 protect Q2 against reverse voltage and over-voltage that might be inadvertently applied at J3.



Jumper JP2 provides an option setting for an internal 10K pull up resistor.

Clifton Laboratories's Z10040B and Z10042A Norton amplifiers and Z1501D active antenna have input relays that disconnect their inputs when power is removed. This feature has two purposes:

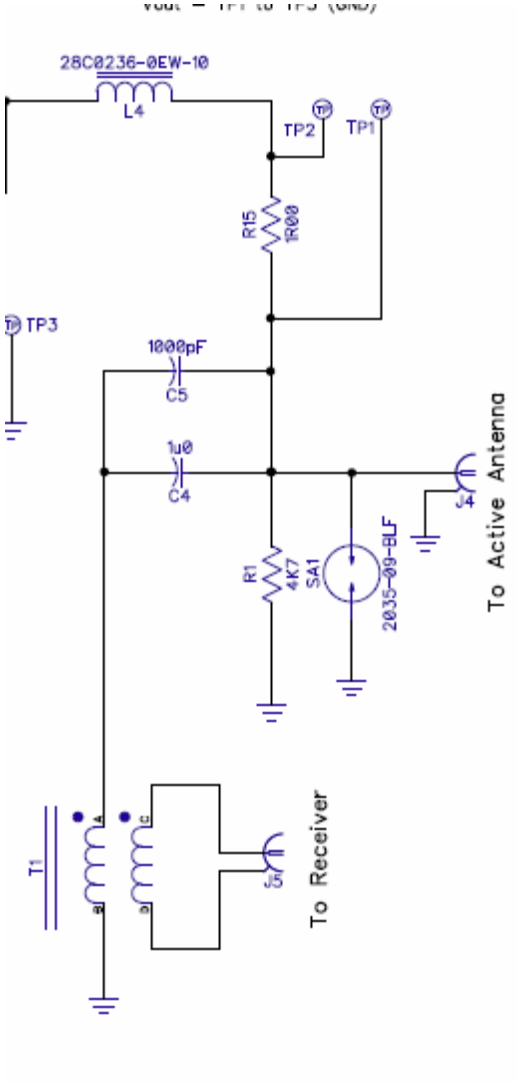
- Protection when the device is not being used; and
- When used in conjunction with amateur radio equipment, disconnection during transmit reduces the chances of damage due to transmitted power being coupled into the device.



The Z1203B's remote disable feature facilitates immediate disconnection when transmitting. The remote disable input can be connected to a transceiver at a point where a suitable control voltage appears during transmit. The control voltage may be +12V during transmit or ground during transmit.

Q4, a 2N7000 MOSFET, provides active pull down of the DC output voltage when Q1 is placed into the deactivated state. The purpose of active pull down is to shorten the time a remote antenna is powered up via its internal filtering capacitor(s) when DC power is removed. Since both the Z10040B and Z1501C have internal filter capacitors in the 10 – 33 uF range, it takes a few milliseconds for the voltage to decay to the point where the input disconnect relays are in the safe position. This time can be improved upon if a low value resistance is shunted across the transmission line immediately upon Q1 assuming a high impedance (off) state. Q4's gate is driven from the same voltage source as is Q1's base, so when Q1 is on, Q4 is off and vice versa. R8, 33R, limits discharge current to a safe level.

To isolate the DC supply from the RF signal and prevent the DC source from appearing as a short circuit to RF, three series inductors, L1, L3 and L4 are used. Cascading multiple inductors minimizes problems with self-resonance and with inadvertently creating an unwanted series-resonant notch trap created by the choke and its bypass capacitor. This is particularly troublesome when very broadband performance is desired, as inductors suitable in one part of the frequency range can be problematic at higher or lower frequencies. L4 is a multi-turn ferrite inductor which has broadband isolation characteristics and is useful above 5 MHz. R10, 1K5, is a "Q-spoiling" resistor that dampens an otherwise objectionable notch in the frequency response caused by L3-L1-C16.



C4 and C5 provide a DC block between the receiver port and the active antenna port, permitting DC voltage to be imposed on the active antenna port without causing damage to the attached receiver. Two parallel capacitors, C4 (1u0) and C5 (1000p), with widely spaced values are used to avoid component parasitic resonance effects at higher frequencies. R1, 4K7, provides a DC drain to ground, should a small amount of leakage voltage appear across C4 and C5, and also provides a safe path to ground for turn-on and turn-off transients. Spark gap SA1 (90 volt) provides protection against gross over-voltage conditions on the remote antenna connection.

R15 is a 1.00 ohm, 1% resistor in series with the DC feed to the active antenna port. Measuring the voltage drop across R15 (TP2 and TP1) permits determining the current drawn by the remove device.

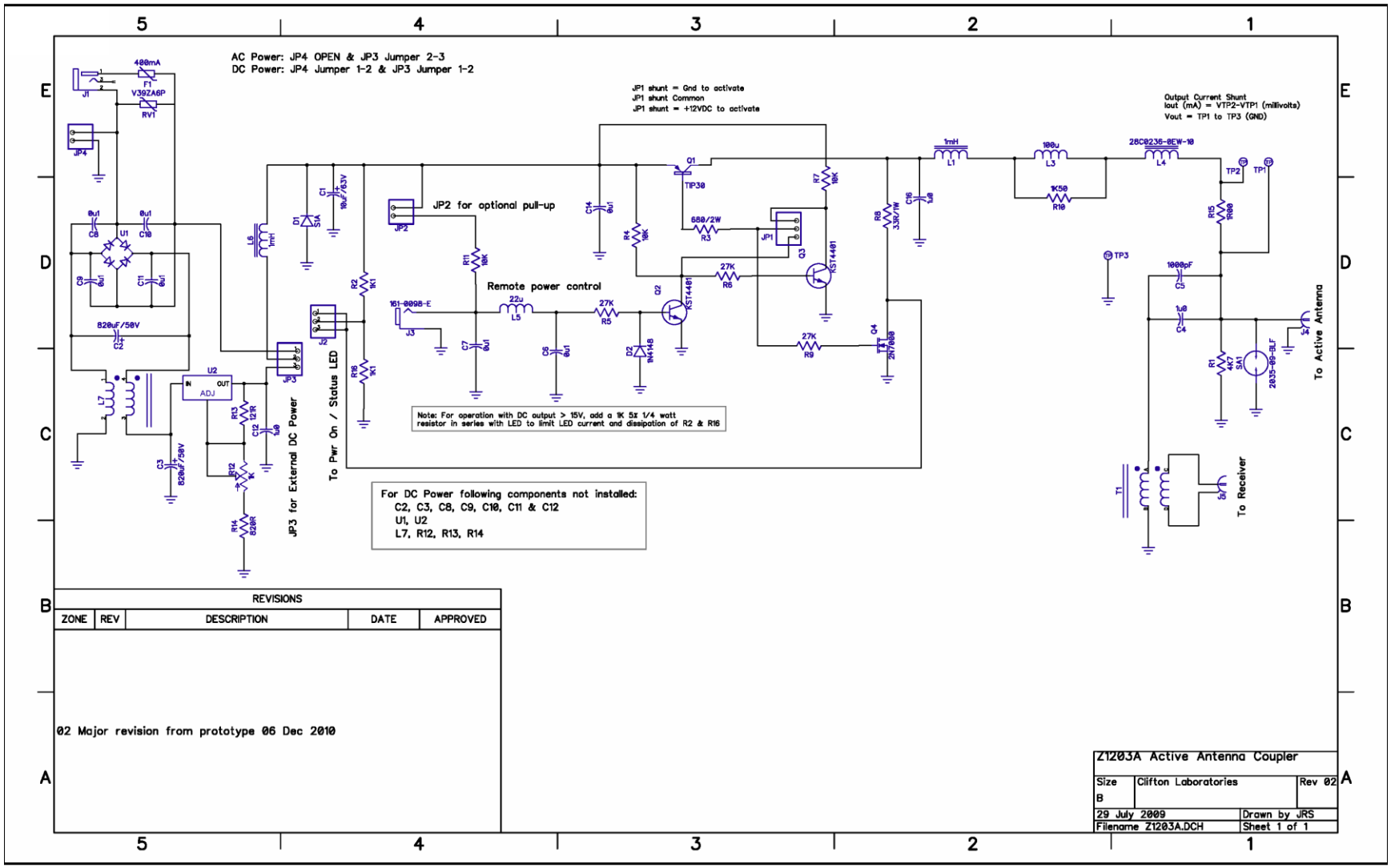
T1 is a broadband, bifilar wound transformer that provides an isolated (floating) output to the receiver. Floating the receiver output reduces the noise that may otherwise be coupled onto the active antenna feed line from the receiver and its connection to the AC power mains.

LED D3 is a bi-color LED. One side is held at approximately one-half DC supply and the other side is connected to Q4 drain. When the Z1203B is actively supply power to the remove device, Q4's drain is at supply voltage and hence current flows through D3 and R16, causing D3 to illuminate green. When the Z1203B is in "safe" mode, Q4's drain is at a low voltage state and current through D3 reverses direction, flowing through R2. This activates the yellow LED.



Although the Z1203B has several protective features, these are intended to reduce, not prevent, damage from catastrophic events, such as nearby lightning damage. The user always remains responsible for following good engineering practices with respect to antenna design, installation, lightning protection and grounding. Clifton Laboratories recommends that remote antennas be disconnected from the Z1203B except when actually in use and that under no circumstances should the Z1203B be connected to a remote antenna or preamplifier or used when there is a possibility of nearby lightning.

Appendix A Schematic

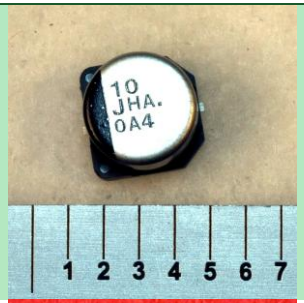
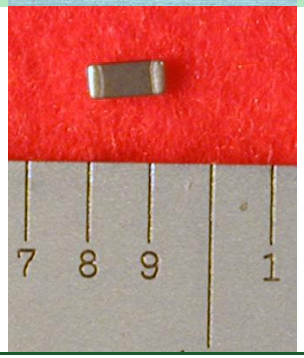


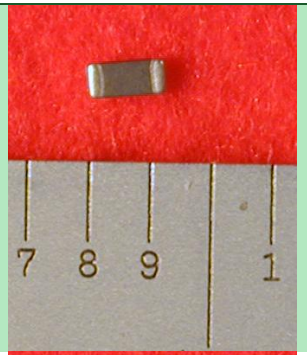
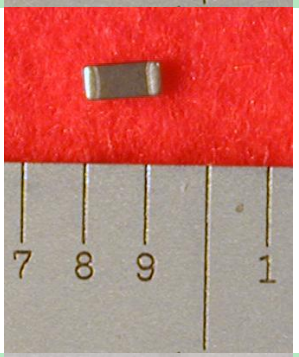
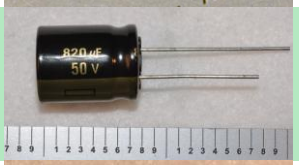
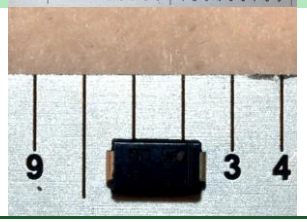
Appendix B Parts List

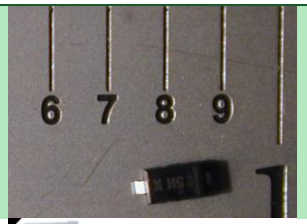
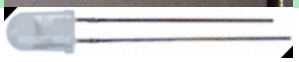
A note on how component values are identified in this manual

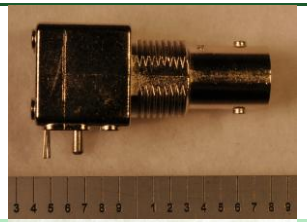
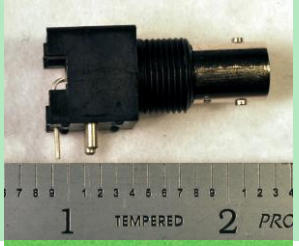
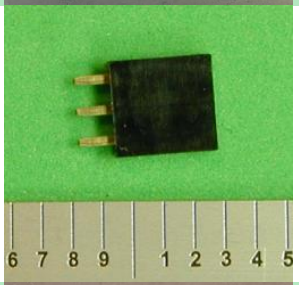
This document follows the international practice of using the value multiplier to indicate the decimal point. Thus, a 1.0µF capacitor is identified as 1µ0 and a 10,000 ohm resistor is identified as 10K0.

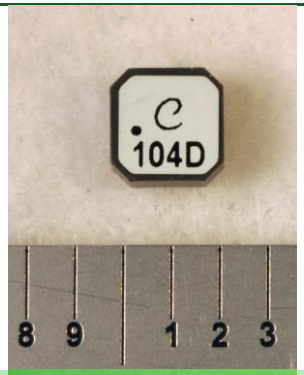
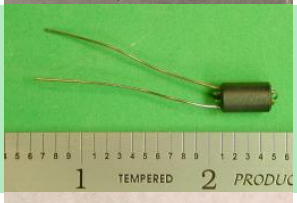
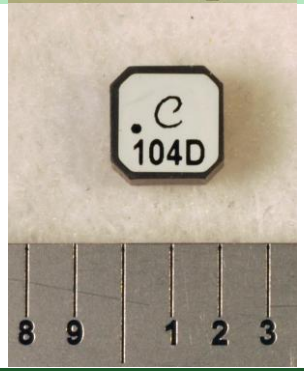
Before starting your build, please take a moment and inventory the parts provided against the list below. The ruler is marked in inches and tenths. (25.4 mm equals one inch.)

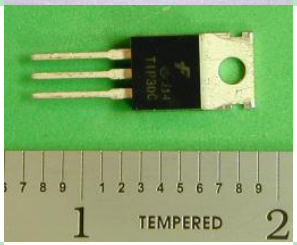
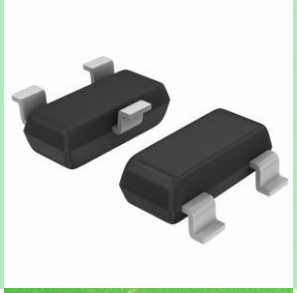
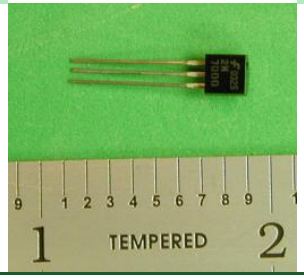
Component ID	Value	Description	Quantity	Marking	Photo
C1	10uF	10UF 63V ELECT EB RADIAL	1	10	
C6, C7, C8, C9, C10, C11 & C14	0u1	Ceramic X7R 1206 size	7	None	

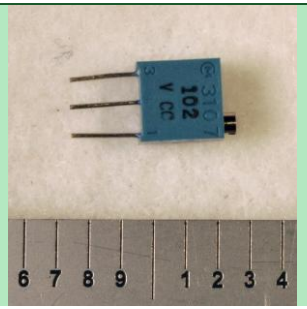
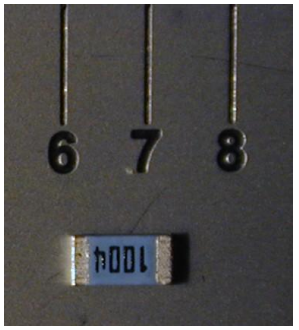
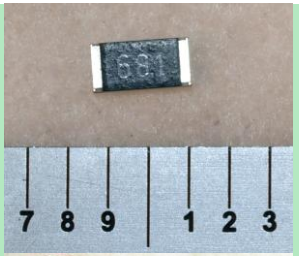
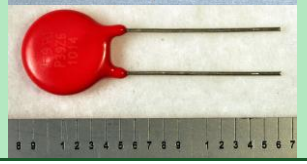
Component ID	Value	Description	Quantity	Marking	Photo
C4, C12 & C16	1u0	50volts 1uF Z5U 1206 size	3	None	
C5	1000pF	1000pF 50V C0G, 1206 size	1	None	
C2 & C3	820u/50V	820uF, 50V through hole electrolytic capacitor	2	820uF 50V	
D1	S1A	S1A surface mount silicon diode, 1A, 50V	1	S1A	

Component ID	Value	Description	Quantity	Marking	Photo
D2	1N4148	1N4148 Silicon signal diode surface mount	1	Varies	
D3	MC20413	Green/Yellow bicolor LED T1-¾ lens	1	None	
F1	400mA	400mA polyfuse	1	040X (may differ slightly depending upon supplier)	
J1		5.1/2.1mm coaxial power jack, PCB mount	1	None	
J3		RCA jack, PCB mount	1	None	

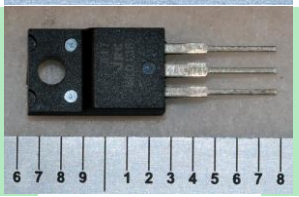
Component ID	Value	Description	Quantity	Marking	Photo
J4		BNC jack, PCB mount metal body	1	None	
J5		BNC jack, PCB mount plastic body	1	None	
None		3x1 0.1" pin header socket (F)	1	None	
L1 & L6	1mH	1 mH surface mount RF Choke high current	2	105J	

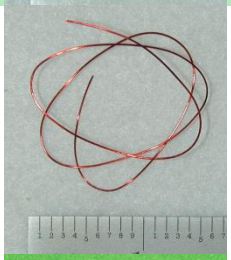
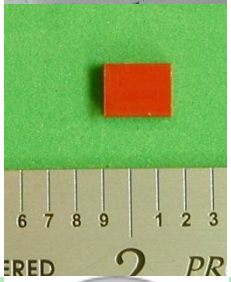
Component ID	Value	Description	Quantity	Marking	Photo
L3	100u	Surface mount, high current 100uH RF choke	1	104D	
L4		multi-turn ferrite bead	1	None	
L5	22u	Surface mount, high current 22uH RF choke (photo is of L3, which is physically identical with L5, except for marking)	1	223D	

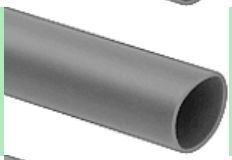
Component ID	Value	Description	Quantity	Marking	Photo
L7	20mH	20mH high current common mode choke, surface mount	1	203	
Q1	TIP30C	Bipolar Transistor 1A 100V 30W PNP	1	TIP30C	
Q2, Q3	KST4401	Bipolar Transistor NPN Transistor General Purpose surface mount Note: These are very small parts (SOT-23) and can easily be lost if removed from the cut tape.	2	2X	
Q4	2N7000	MOSFET N-Channel 60V 200mA	1	2N7000	

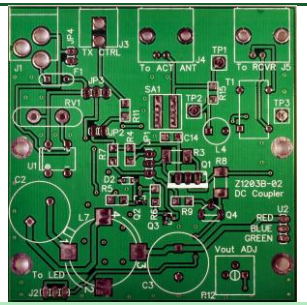
Component ID	Value	Description	Quantity	Marking	Photo
R12	1K	1K multi-turn trim pot	1	102	
R1	4K7	1/4 watt 1% thick film surface mount resistor, 1206 size	1	4701	
R2, R16	1K1 (<15)		2	1101	
R2, R16	2K2 (for >15V)		2	2201	
R13	121R		1	1210	
R4, R7, R11	10K		3	1004	
R5, R6, R9	27K		3	2702	
R14	820R		1	8200	
R15	1R00		1	1R00	
R10	1K50		1	1501	
R3	680R	1 watt, 5% thick film surface mount resistor, 2512 size	1	681	
R8	33R		1	330	
RV1	V39ZA6P	14mm MOV, 24V nominal threshold	1	P39Z6	

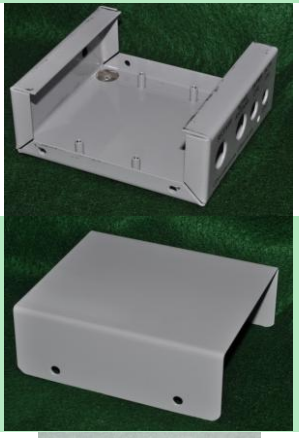
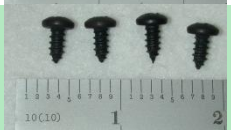
Component ID	Value	Description	Quantity	Marking	Photo
SA1	90V	Gas Discharge Tube 90V surface mount (color and markings may vary depending on supplier)	1		
T1 Core		Ferrite core for T1, 0.5" OD Nominal	1	None	

Component ID	Value	Description	Quantity	Marking	Photo
U1	DF04M (exact part supplied depends on availability)	EDIP packaged, monolithic bridge rectifier, 1A and 100V PIV minimum	1	DF04M (will vary depending upon ratings of part supplied)	
U2	NJM317F	LM317 type adjustable regulator, plastic package not requiring insulator	1	317 JRC	
JP1 & JP2	0.1" pin header	Male 0.1" x 1 header pin strip	5	None	
		Lockwasher for J4 & J5, ½" ID	2	None	

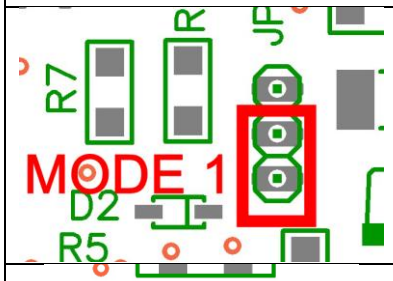
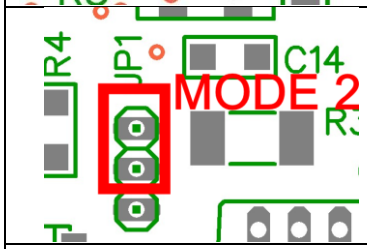
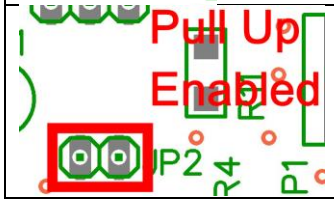
Component ID	Value	Description	Quantity	Marking	Photo
		Jam nut for J4 & J5, 1/2 -28 UNEF thread	2	None	
		LED MOUNTING CLIP	1		
		16" Solderable magnet wire #26 AWG red	1	None	
		16" Solderable magnet wire #26 AWG green	1	None	
	JP1 & JP2	SHUNT, RED 0.1" x 2 position	2	None	
		4-40 brass thumb nut	1	None	

Component ID	Value	Description	Quantity	Marking	Photo
		4-40 x 5/8" Philips pan head 18-8 SS machine screw	1	None	
		4-40 internal tooth lock washer 18-8 SS	2	None	
		4-40 flat washer 18-8 SS 0.125" ID 0.313" OD	3	None	
		4-40 hex nut, ¼" across flats	2	None	
		Heat shrink tubing red, 1/8" ID before shrinking ½"	1	None	
		Heat shrink tubing green, 1/8" ID before shrinking ½"	1	None	
		Heat shrink tubing blue, 1/8" ID before shrinking ½"	1	None	

Component ID	Value	Description	Quantity	Marking	Photo
		Printed circuit board	1	Z1203B	
		#24 Teflon sleeving, approx. 3”	1		None
		4-40 x 1/4" Philips pan head 18-8 SS machine screw	4		
		4-40 x 3/8" Philips pan head 18-8 SS machine screw	1		
		4-40 split (spring) 18-8 SS lock washer	5		
		#24 stranded wire, red insulation for U2 wiring harness approx. 4”			None
		#24 stranded wire, blue insulation for U2 wiring harness approx. 4”			None
		#24 stranded wire, green insulation for U2 wiring harness approx. 4”			None

Component ID	Value	Description	Quantity	Marking	Photo
		#24 solid, tinned copper wire for JP3 jumper, approx. 1”			None
		Enclosure, punched steel powder coated / silk screened and accessories, consisting of:			
		Lower enclosure half	1	Z1203 DC Power Coupler	
		Upper enclosure half	1	None	
		Adhesive plastic bumpers 0.5” x 0.5” x 0.25”	4	None	
		Sheet metal screws #8x3/8”, black w/ Philips head	4	None	
		Double sided adhesive foam tape, ¼” wide, approx. 1”	1	None	None

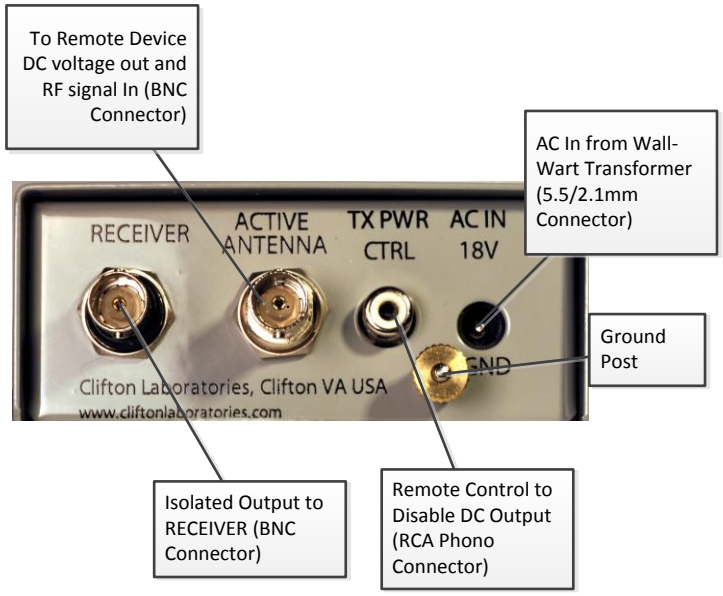
Z1203B Condensed Operating Instructions

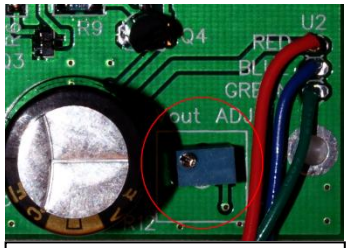
TX PWR CTRL Operating Modes.			
JP1 Position	**TX PWR CTRL**	**AA Output?**	**Comments**
	No Connection	Yes	Use Mode 1: if remote control is not desired or where the transceiver provides +13.8V on transmit.
	Low Voltage/Short Circuit	Yes	
	+13.8V	No	
	No Connection	No	Use Mode 2 where the transceiver provides ground on transmit. 10K pull-up may be needed. See JP2
	Low Voltage/Short Circuit	No	
	+13.8V	Yes	
JP2 Position			
	10K Pull up is not enabled. Jumper is in storage position		Disengage JP2 unless needed.
	10K Pull up is engaged.		Use with **Mode 2** when pull up is required.

NOTE FOR OPERATION ABOVE 15V DC.

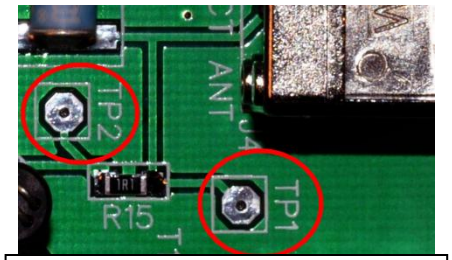
DC Voltage	R2 & R16
15V and below	1K1
>15V	2K2







R12 Adjustment for DC output voltage



To determine remote device current, measure voltage across 1 ohm shunt between TP2 & TP1