Thank you for purchasing the TOF module. Installation requires soldering skills and common hand tools.

Ameritron Amplifiers

This module is directly compatible with all Ameritron amplifiers. The module has to be ordered by Ameritron amplifier model. There are a few internal components that make each module amplifier specific. Mounting instructions are available at https://www.w8ji.com/TOF1.htm

Generic Amplifiers

This module will install in any amplifier that employs a grid shunt and negative meter terminal going to ground. With an amplifier configured this way, and with an 11-16 volt positive supply, this is a direct install. The only possible changes are a scaling resistor for the warning indicator. This scaling resistor could be replaced with a potentiometer. The scaling resistor, R6 on the board, can be 400-10,000 ohms but is typically around 5000 ohms. The only thing R6 does is set the warning light trip point.

A few current meters read current through a meter movement directly, and do not use a shunt. Most current meters, as strange as it seems, actually measure voltage across a low resistance current shunt. The shunt develops a certain voltage for a given current through the shunt, and the meter measures that voltage.

If your amplifier has a floating grid current meter, or a direct current reading of fairly low current, the TOF will still work. It will require a floating 12Vdc supply of a few milliamperes.

How it Works (all amplifiers)

Better than anything else, maximum peak grid current tells us if our amplifiers are being overdriven or mistuned. During normal voice or CW operation conventional metering circuits do not allow measurement of the most critical parameter, grid current.

Conventional grid current metering circuits require a steady, full-power, carrier to show actual grid current. Knowing if amplifier's drive and loading are safe requires a steady carrier, even when using a tuning-pulser system. Without using a steady sometimes lengthy carrier to check grid current meter readings, the operator has no idea exactly how the amplifier is running! We never really know the actual grid current when operating SSB voice or other amplitude changing modes.

This module does three basic things:

1.) Provides a running visual on the meter of peak grid current

2.) Gives a warning light indicating potential non-linearity and splatter when allowable peak current is reached

3.) Disables the amplifier if peak grid becomes unsafe

Operation In a properly functioning amplifier:

- The ***plate tuning capacitor*** should be set for ***maximum grid current and maximum output power*****.** Both will occur at the same time**.**
- The ***load control*** should be set for ***the proper peak operating value*** of grid current at full expected drive. This is the grid current just below when the red light flashes

Regardless of mode, the TOF system displays the short-term ***peak*** of RMS grid current without ***requiring a carrier***. Grid current RMS peak value are stored in the TOF and forwarded to the amplifier metering system. The amplifier grid meter thus indicates the short-term grid current peaks. This peak current, when excessive, promotes tank circuit damage and/or intermodulation distortion (splatter).

A bright red warning light illuminates the instant maximum allowable grid current is reached. It illuminates even when unsafe peaks are reached for very brief times. An occasional flash on voice peaks is generally OK. A steady red warning, or anything more than an occasional flash, means the load control should be opened more or the drive power reduced. (Occasional leading edge warning light flashes are OK; they are a normal unavoidable result of ALC overshoot in some modern radios.)

If excessive exciter drive power is saturating the tube, opening the loading control will ***not*** bring peaks back in line. The warning light will continue to flash red almost constantly, and the loading control will act "mushy". Grid current will not sharply vary with load setting when drive is too high for tube emission. If advancing the LOAD does not bring grid current in line, drive must be reduced.

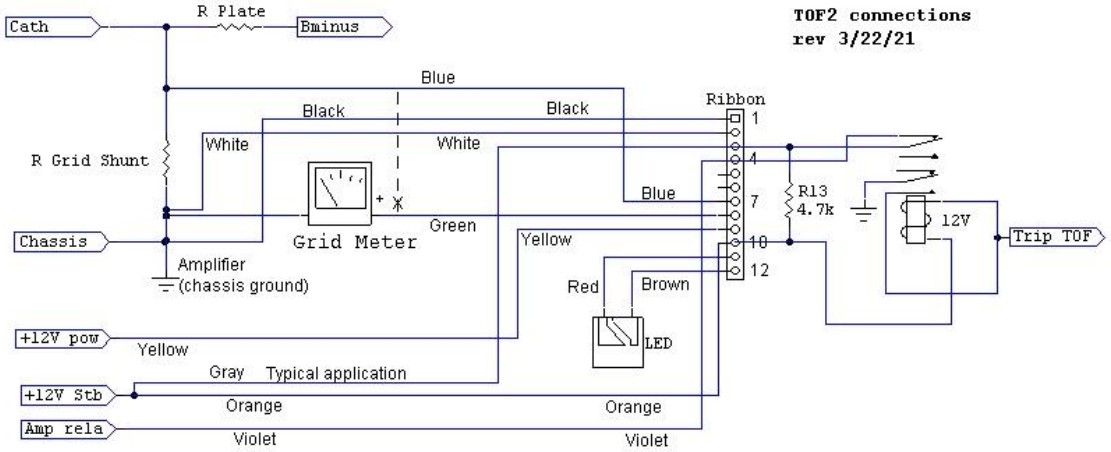
If you have any suggestions, corrections, or questions, please contact me at w8ji@w8ji.com. (This circuit and the operation of the circuit are protected by a pending patent.)

Ribbon Wire Function by Color

1.) **Black** is power ground. It must go to the 12V power negative polarity chassis ground
2.) **White** is M- out. It should normally go directly to the main chassis on a supplied lug
3.) **Gray** is the overload relay common through a 4.7K internal resistor. It can go to the LED amplifier's T/R relay coil feed in some amplifiers. ***In almost all cases it is connected to Orange***
4.) **Violet** is the overload relay normally closed contact. It supplies direct (no resistor) voltage to the TR relay
5.) Not normally used. Overload relay normal open contact
6.) No wire Meter floating – in. Normally not used. This is for specific special applications
7.) **Blue** Meter + from shunt in amplifier to the TOF. This is the TOF meter input (This is an "open the wire" insertion point with 8)
8.) **Green** Meter + to meter + terminal
9.) **Yellow** to +12-16 Vdc supply
10.) **Orange** to standby switch switched relay lead **(in almost all cases common with #3 Gray)**

11.) **Red** current limited LED +
12.) **Brown** ground can be used for LED - ground.

REV 3/22/21



1 Blk: Ground
2 Wht: Grid Meter - out
3 Gry: Trip relay common
4 Vio A: NC Trip relay
5 Vio B: NO Trip relay
6 Special use only
7 Blu: Grid Meter + input
8 Grn: Grid meter + output
9 Yel: TOF +power 12 to 15volts
10 Org: From standby switch 12V
11 Red: LED
12 Brn: GND

The original positive grid meter wire is interrupted and the TOF inserted. The blue TOF connects to the old meter + wire. The Green TOF wire connects to the meter +. This routes the meter's + wire through the TOF, in on the TOF's Blue and out on the TOF's Green to the meter.

The Orange wire (10) is a +12V latch hold wire for overload. Remove voltage to reset.

The gray wire is the amp relay coil pass through high current common. It normally connects for high current relays. It can be floated for current limited like some AL811H's if you wish to remove the external LED series feed resistor.

The violet is the amp relay normally closed pass through. It opens on overload.

TOF kit

Thank you for purchasing the TOF kit for your amplifier. Instructions are at:

http://www.w8ji.com/TOF1.htm

Please email me at tom@ctrengineeringinc.com with any errors, suggestions, questions, or comments.

Some hints.

1.) the TOF requires one continuous +10 to +15Vdc voltage source. This is the **Yellow** wire

2.) TOF power ground is the **Black** wire, it has to be a reasonably good ground. We supply a lug to fit below a power supply board spacer in Ameritron amps. Keep this lead as reasonably short as possible.

3.) meter ground is the **White** wire. This normally should go parallel with the black.

4.) grid meter positive wire is unsoldered or cut and goes to the TOF Blue wire

5.) the TOF Green wire then goes to the meter

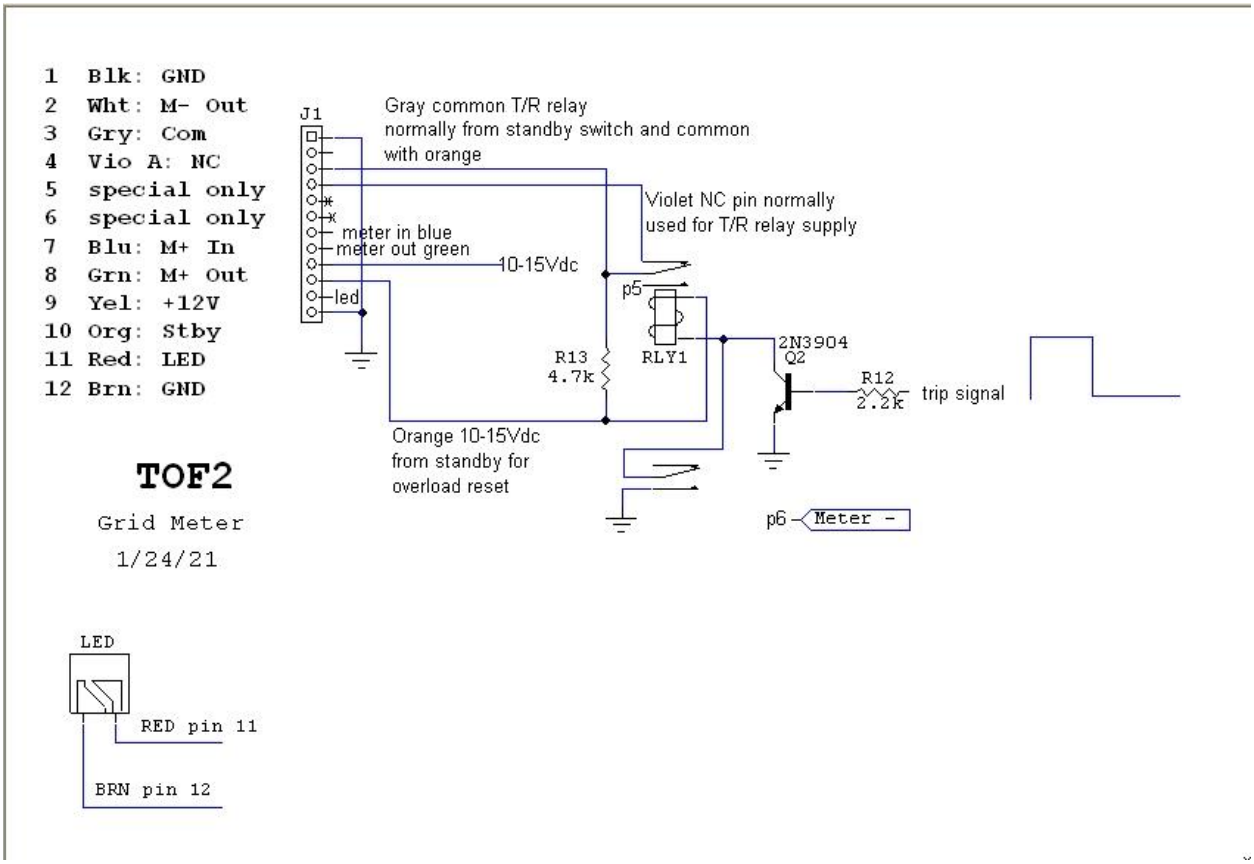
The remaining wires all deal with overload.

6.) The Orange wire is the latch and reset wire. It allows latching when at +10-15 Vdc. It resets when low

7.) The Gray wire is one of the pass-through contacts for amplifier relay voltage. It almost always goes to the standby switch common with Orange. Gray can be removed to limit the violet wire current in special applications, such as removing the "hanging" ***<u>series connected</u>*** 4.7K on some LED's. It is almost always connected to Orange.

8.) The Violet wire is the normally closed "trip" wire. It normally goes out to the amplifier relay

9.) ***With <u>the newer</u> Ameritron "two-relay" low current control lines***, the transmit LED is in series with the relay activation line. The violet would go to the LED, which then goes to the relay circuit. The orange would go to the standby switch. If you want to remove the "hanging" resistor in ***series*** with the LED, just leave the gray wire cut free and run the violet directly to the LED+ terminal in the amplifier.



Connections

June 24, 2022 Rev 2B

Note:

It is okay to shorten wires to the length needed if you pull back the wires to separate as in instructions. The ground wires should not be needlessly long to the chassis grounding lug. It is best to ground to the chassis.

Red is LED positive that is current limited by a resistor inside the TOF

Brown is LED ground that simply goes to the chassis ground via the black wire

Orange has to be a 12-15 volt positive switched lead. This lead feeds the TOF trip relay coil and the latching. When you interrupt voltage to this lead (if the overload is gone) the TOF resets. Not connecting this wire disables the overload because it prevents the relay from tripping. The maximum current here is about 50 mA when the internal relay trips and latches. **The orange and gray normally just tie together and are treated as one wire**.

Yellow has to be continuous 12-15Vdc positive at fairly low current, typically less than $1/10^{th}$ ampere. Most of the current is consumed by a Zener diode regulator/protection circuit so the current varies with supply voltage.

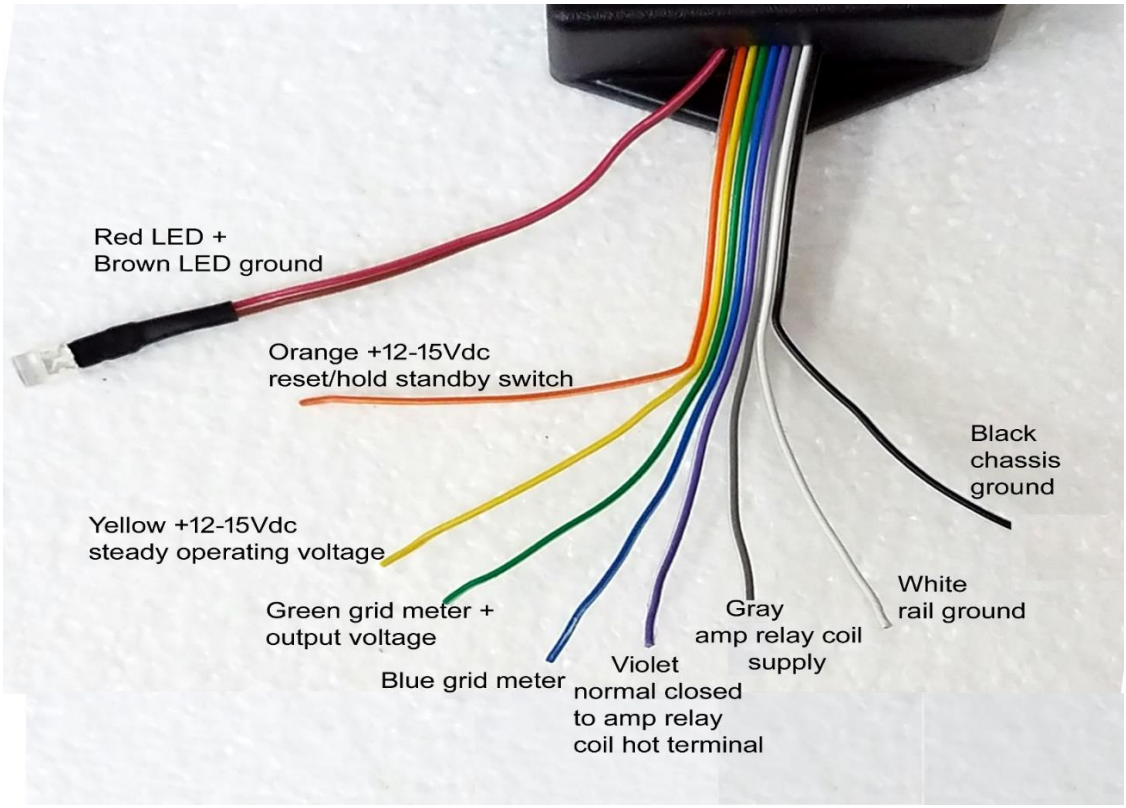
Green is the grid meter positive lead. There can be a very small meaningless off-zero voltage caused by ground loops and noise. This does not affect anything. This lead is RF bypassed and protected. It connects to the grid meter voltage source, normally the grid meter shunt. This is designed for a POSITIVE grid meter source that is referenced to the chassis. There are ways around this restriction by floating the voltage supply from ground if your amp has a non-chassis meter feed system, like an SB200 Heath.

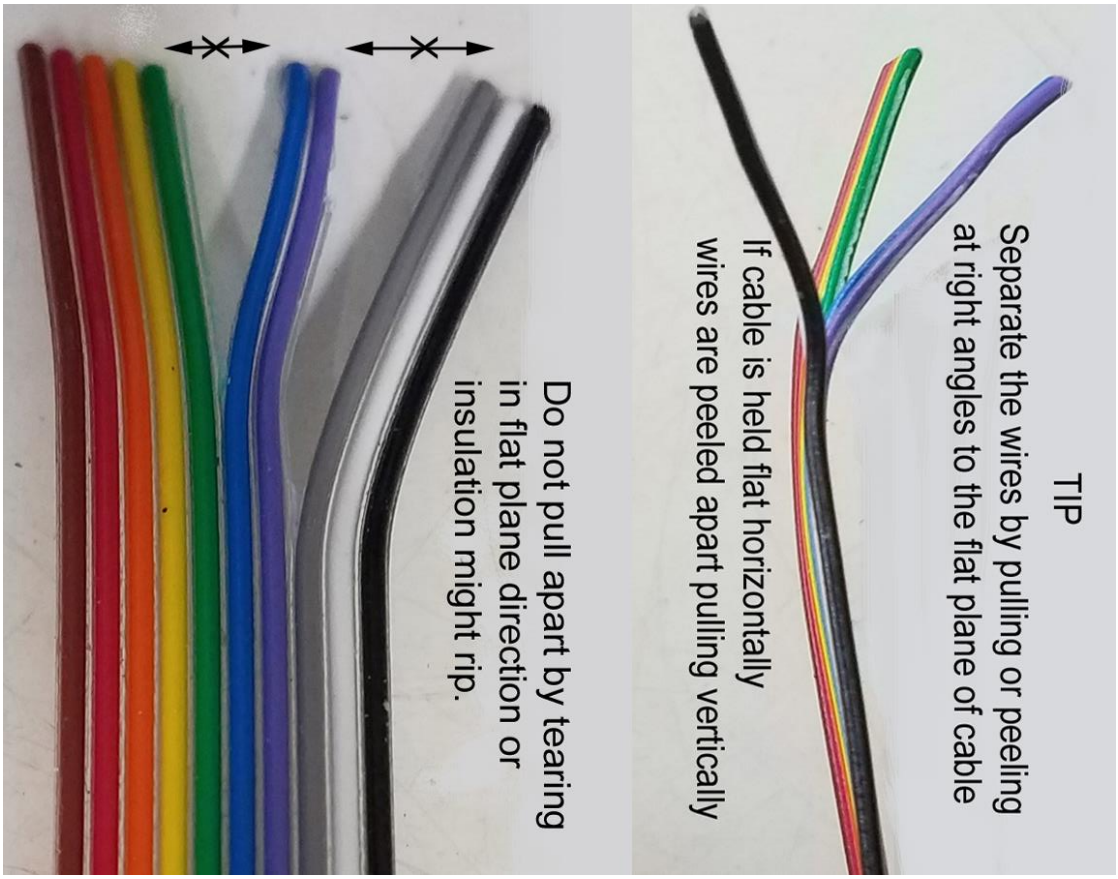
Blue goes to the grid meter positive. The resistance of this path will affect the shunt voltage where the overload light and relay trips.

Violet is the normally closed relay contact used to run the amplifier relay circuit. It can be more than 12 volts but less than 30 volts, it is just a relay contact. It normally goes to the lead leaving the standby switch and going to the relay system with amplifiers using 12V relays.

Gray connects to the supply that runs the amplifier relay. It is the relay common contact in the TOF. The relay inside the TOF interrupts the path to the Violet. There is a 4.7k resistor in the TOF tying the gray loosely to the Orange. ***The gray normally parallels the orange and goes to the amplifier 12V from standby switch.***

White and Black normally connect as short and direct as possible to the chassis. They are the grounds. The white is directly to op-amp ground bus on the TOF board, while the black is the main grounding bus in the TOF. Almost always they are tied together to amplifier chassis. It is best to connect them to a RF and dc offset zero voltage point, which is almost always the chassis.


Red LED +
Brown LED ground
Orange +12-15Vdc
reset/hold standby switch
Yellow +12-15Vdc
steady operating voltage
Green grid meter +
output voltage
Blue grid meter
Violet
normal closed
to amp relay
coil hot terminal
Gray
amp relay coil
supply
White
rail ground
Black
chassis
ground


Do not pull apart by tearing
in flat plane direction or
insulation might rip.
TIP
Separate the wires by pulling or peeling
at right angles to the flat plane of cable
If cable is held flat horizontally
wires are peeled apart pulling vertically

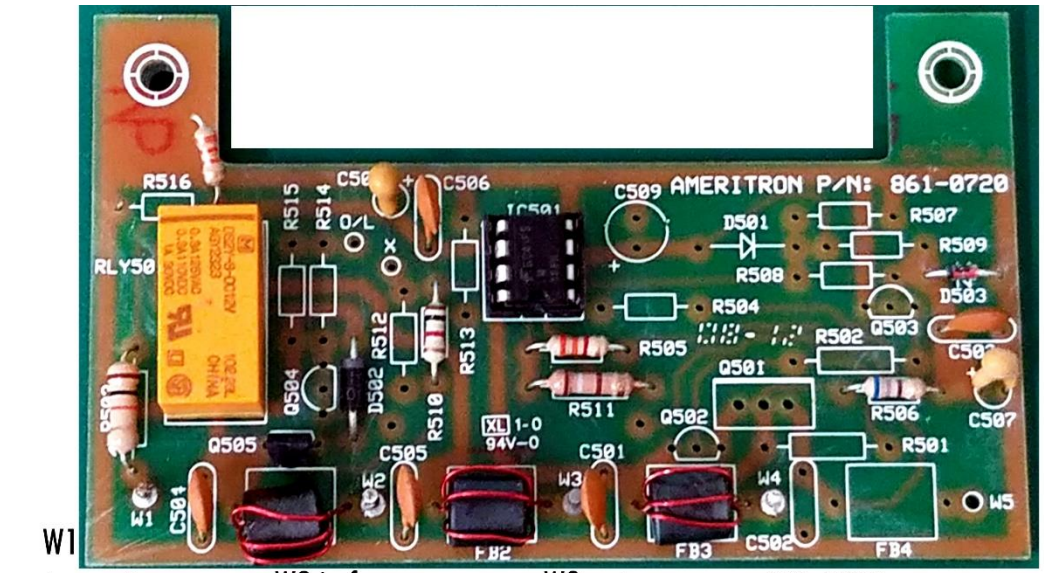
TOF in AL80B and AL1500 style amplifiers

(including the AL80B, AL572, AL1500, AL800, and AL800H series with GOP or Timer/Overload Boards)

Warnings:

1.) Amplifiers using indirectly heated tubes with delay timed warm-up must retain the Ameritron board! Overload functions are moved to the TOF system. The timer must be retained.

2.) Ameritron either has not watched transformer designs on 12Vdc windings or has changed the voltages. Some amplifiers will have more than 15Vdc on the 12Vdc control lines. Some IC chips and other parts were designed around a nominal 12Vdc supply. Amplifiers with significantly more than 15Vdc on the 12V bus may have premature relay or semiconductor failure. The safest way to verify this voltage is to measure either a 12Vdc rear panel jack if present, or "snake" a temporary 12V sample wire, like a clip lead, out of the cabinet to allow safe measurement with the cover laid in place. The meter lights or standby switch is a good pick point.



1.) Terminal Pad W5, if the board is fully populated, is the time delayed 12Vdc control output. If used, it must be left alone.

2.) Terminal Pad W4 is the 12Vdc supply. To conform with design limits, it must not ever be much more than 15Vdc. The connection point for W4 can be used to feed the TOF yellow wire, which is the TOF 12Vdc continuous power feed.

3.) Terminal Pad W3 is the protected 12Vdc output to the antenna relay system. This becomes the violet wire connection on the TOF system.

4.) Terminal Pad W2 is the standby switched +12Vdc input to the boards. This provides a reset connection, as well as standby switching of the relay system. This wire, when 12Vdc is removed, resets the latched overload relay in these boards. This connection would become the gray and orange wire feeds.

Note that some amplifiers have a 4.7k resistor in series with the LED. Some amplifiers use a resistor shunting the TX LED. Ameritron does not always document changes in schematics. Unfortunately, we must look to see if a 22-ohm to 33-ohm resistor in parallel with the LED. If there is, the TOF gray and orange wires must both be used. If there is a 4.7K in series with the LED at the standby switch, you eliminate that resistor and do **not** use the gray TOF wire. The gray wire is not connected, and an internal 4.7K becomes in circuit to the violet wire.

5.) The peak reading meter and grid current trip sensing wire is the BLUE TOF wire. This wire can go to where W1 on the original Ameritron GOP or Timer/Overload board connection point, or simply interrupt the positive terminal wire to the grid current meter. The BLUE goes to the meter source, not to the meter terminal.

6.) The GREEN TOF wire becomes the wire that connects to the grid meter positive terminal.