



ZONGE ZTEM GEOPHYSICAL TRANSMITTER MANUAL

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ZTEM-30



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Revision: A
Release Date: 03-May-2022

1.0 INTRODUCTION

This manual provides information necessary to operate the ZTEM geophysical transmitter and to keep it in proper operating condition.

 **This equipment operates at lethal voltages. Only trained, qualified personnel should operate, maintain, or service it.**

 **CAUTION: Refer To Appendix C for first time operation. Click [here](#) to go to Appendix C.**

2.0 SPECIFICATIONS

NOTE: Specifications are subject to change without notice.

2.1 Mechanical

Case size: 24.6 x 20.3 x 25.9 cm (9.7 x 9.8 x 10.2 inches)

Weight: 6.6kg, 14.5 lbs.

2.2 Electrical

Logic Power

- Logic supply: 9 to 140V
- Peak current draw: 1.6A
- Average current @ 12V: <1ampere

Input Power

- Touch Proof SurLok Plus™ Connectors
- 11 to 600 volts

Transmitter control by:

- Six pin military connector for transmitter controller.
- Recommended transmitter controller: Zonge XMT-G, GDP or ZEN
- 3 - 14mA current drive (15mA absolute maximum)
- Optical isolation

Output

- Peak current: 30 Amperes unregulated
- 11 to ~600 volts
- over-current shutdown (set for ~33 A)
- IGBT current switch
- Power removed from transmitter output during fault conditions

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Transmitter frequency:

- DC to 128 Hz time domain
- DC to 8196 Hz frequency domain

Current monitor

- 4mm Sheathed Banana Jack
- isolated output
- 10mV/Ampere

2.2.1 Environmental

- Operating temperature: -40° to +55°C (-40° to +130°F)
- Operating humidity: 0 to 90%, non-condensing

2.2.2 Output Monitor Jacks

- Jacks are 4mm Safety Banana Jacks with a 1,000V CAT II/600V CAT IV rating.
- Isolated output current monitor 10mV/ampere

NOTE: When using this output there is no need to use an isolation amplifier (ZCM-10) to measure the output current. This output is isolated and compatible with the ZEN receiver.

- Isolated output voltage monitor 10mV/Volt. (Future option not yet available)

3.0 SurLok Connector Instructions

 **This connector is not suitable for live disconnection. Do not attempt to remove the connector whilst transmitting.**

To mate the plug to the receptacle, push the plug vertically into the receptacle until you hear or feel a "click" to indicate that the plug and receptacle mated well.

To remove the plug from the receptacle, push the release button and pull the plug vertically from the receptacle. Do not deviate from the axis of the plug and receptacle, as damage to either the plug, the receptacle, or both may occur.

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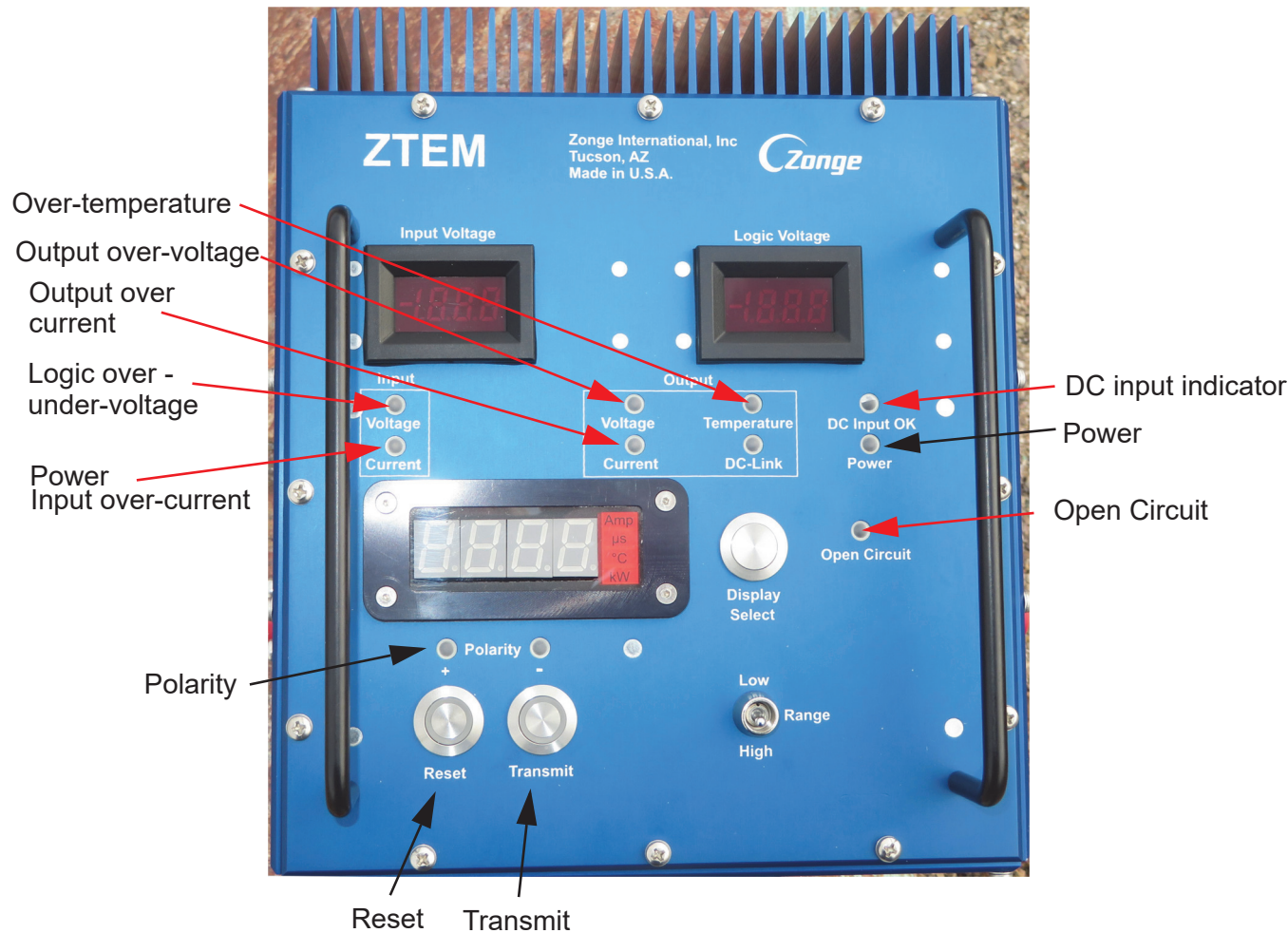


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4.0 PANEL OVERVIEW

4.1 ZTEM CONTROL PANEL



Fault LEDs are indicated with **RED** arrows. Status are indicated with **BLACK** arrows.

To test the LEDs, remove logic power and reconnect after ten seconds. This will cause all LEDs to turn on.

4.1.1 CONTROL PANEL LED DESCRIPTION

TRANSMIT SWITCH LED - This indicates that the ZTEM is transmitting and that high voltage is present on the output. It will go off when a fault or reset occurs and the output voltage will be disabled.

SUPPLY OVERVOLTAGE - This indicates that the voltage level on the high-voltage supply to the output switch has exceeded 600 volts. This fault is detected to protect the components in the transmitter.

OUTPUT OVERVOLTAGE - This indicates that the voltage level on the output has exceeded 600 volts. This can indicate that a largely inductive load is present on the output. The purpose of this fault is to protect the IGBT output stage from damage.

INPUT VOLTAGE - This indicates that the voltage level from the logic supply exceeded 150 volts or was less than 10 volts and must be adjusted back into the proper range.

OPEN CIRCUIT - This indicates that the output circuit is open and the ZTEM is trying to transmit into a very large or infinite load.

INPUT OVERCURRENT - This indicates that too much current has been requested from the supply generator. The detection level is ~33 amperes for the ZTEM30.

OUTPUT OVERCURRENT - This indicates an over-current condition in one of the output IGBT modules. If this LED will not reset it indicates a shorted output or that an IGBT module has been damaged. The over-current detection level is set at the desaturation level of the IGBTs. It is not adjustable.

OVERTEMP - This indicates that a temperature of 85°C has been reached on the IGBT heatsink. Stop transmitting and allow ZTEM to cool.

4.1.2 CONTROL PANEL SWITCH DESCRIPTION

RESET: (LED will indicate for two seconds when switch is pressed)

- May be used to clear the LED lamp test when power is connected.
- May be used to reset the ZTEM after a fault.

TRANSMIT: (LED indicates the output is active)

- May be used to start transmission. Press RESET and then, during the next two seconds, press TRANSMIT. If TRANSMIT is not pressed during the two second window, transmission will not start.

DISPLAY SELECT SWITCH:

Switches the meter display between Current, Decay Time, and Heat Sink Temperature.

This switch selects the following meter functions:

- **OUTPUT CURRENT** - the output current in amperes.
- **DECAY TIME** - the approximate time in microseconds for transmitter to turn off into a loop. It is recommended that an isolated oscilloscope be used if accurate times are required.
- **TEMPERATURE** - the heat sink temperature in degrees Celsius.

RANGE SWITCH - This switch changes the output current measurement range.

4.2 HIGH VOLTAGE OUTPUT PANEL

4.2.1 High Voltage Output Connectors

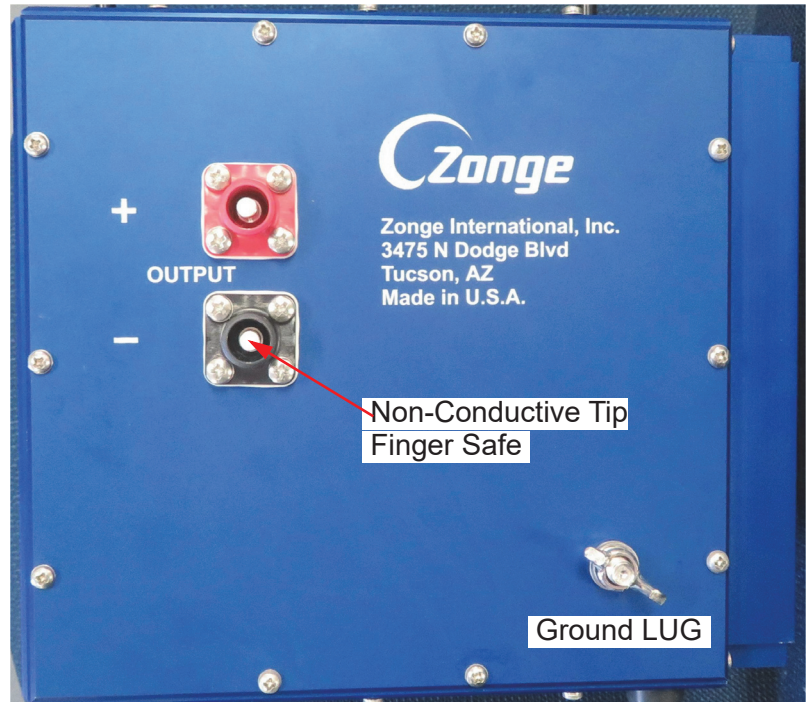
The output panel has two high-voltage, high current SurLok output connectors.

The male contact elements are protected by a non-conductive tip which makes physical contact with the current carrying element impossible.

Press the SurLok plug onto the connector.

To remove the SurLok connector, press down on the lever and pull the connector off.

To avoid the safety and reliability issues, the connection to the output must be made with the supplied connectors. It is also recommended that UL 3239 high voltage wire be used for the first 15 to 20 feet from the transmitter.



4.2.2 High Voltage Output Connector Disassembly

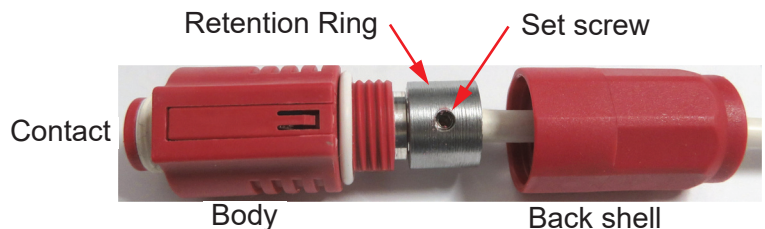
Over time it will become necessary to replace the wire in the SurLok connectors.

First remove the back shell.

Remove the set-screw and wire. Use the 2mm ball end hex screwdriver hex wrench in the accessories kit.

Crimp a ferrule on the replacement wire using the HSC8-6-6 crimping tool in the accessories kit.

Reverse the procedure to put the connector back together.



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4.3 XMT PANEL

XMT Input - The transmitter control input is on the front panel. When the ZTEM is running, and the XMT input has a good signal, then the Period and Duty LEDs will turn on. This is a good way to insure that the ZTEM has a good signal for operation. If the LEDs do not turn on, then the controller or the cable may be bad.

Current Sense - This is an isolated monitor for the output current. The output is 10mV/ampere.

Voltage Sense - This option is not yet available, but is included for future capability.



4.4 POWER INPUT PANEL

The DC INPUT provides the power for driving the output load. This power can be supplied from multiple truck batteries in series or from a DC supply.

The Logic Power input is intended to be connected to a NTEM-BAT battery to supply the internal logic and operating power. It may also be connected to any DC supply voltage from 10.8 to 140 volts.



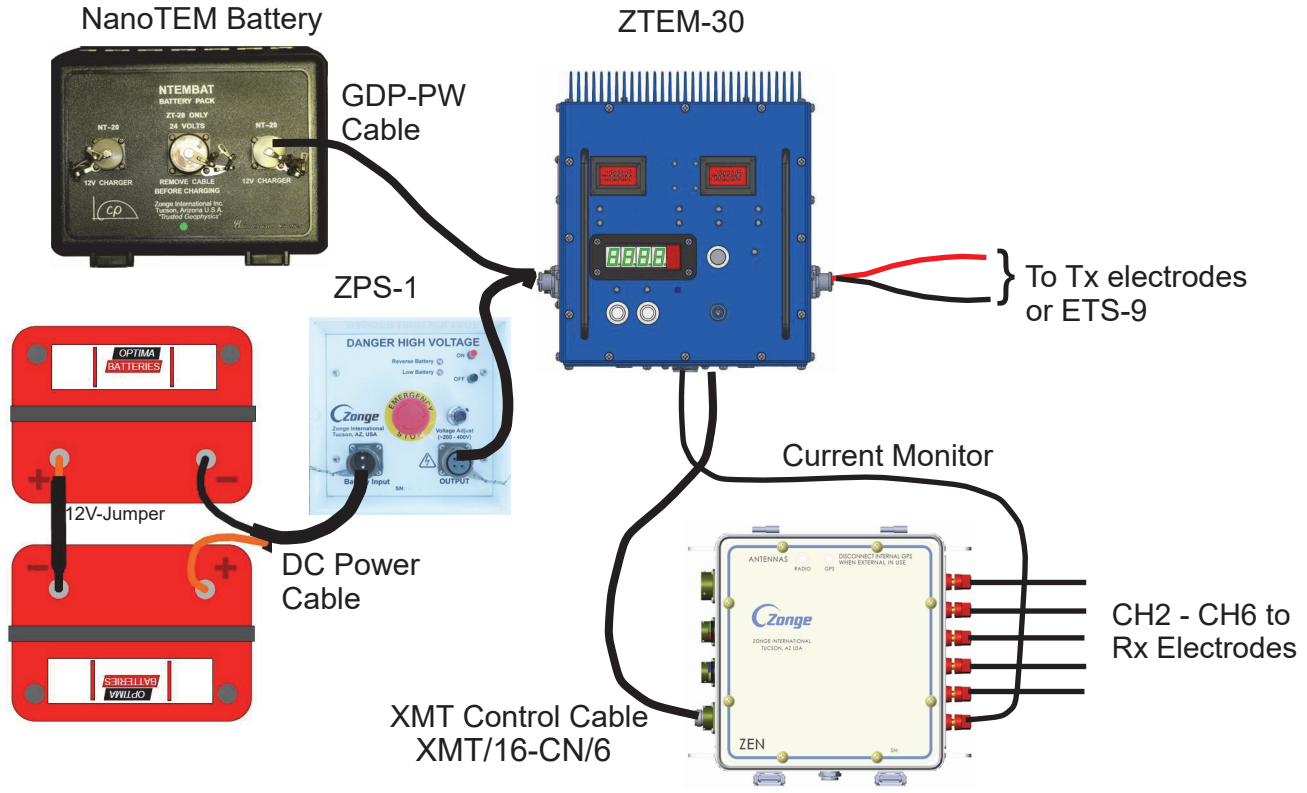
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5.3 CONNECTIONS DIAGRAM GROUNDED DIPOLE



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6.0 APPENDIX A - TROUBLESHOOTING

 **This equipment operates at lethal voltages. Only trained, qualified personnel should operate, maintain, or service it.**

6.1 XMT Input Test

The ZTEM has two LEDs next to the XMT input which can be used to determine if the controller or control cable is bad. With the XMT, GDP, or ZEN set to 1Hz 50% duty cycle the Period and Duty LEDs should cycle.

If they are not cycling, then either the cable is bad or the controller is bad. Try a different cable and then a different controller.



A less common problem would be power to the XMT input board. If power is indicated on the control panel, this is unlikely.

Problem	Possible Cause	Possible Solution
Logic Supply Meter indicates a negative voltage	The logic power is connected in reverse (backwards)	Correct the logic power connection so that the display reads a positive value.
Input Voltage fault LED is ON	Logic input voltage is below 9 volts or above 140 volts.	Correct the input voltage.
No LEDs are on when power is connected	Internal Fuse Blown	Replace fuse
	Power is connected reversed	Correct logic power connection.
Voltage Status LED is ON after RESET.	Battery voltage is too low or too high.	Charge battery. Check battery cable connections.
DC Input OK is On Input Voltage meter indicates less than ten volts or more than 600 volts	Input Voltage is below 10 volts	Recharge batteries or increase DC supply to greater than 10 volts.
	Input Voltage is above 600 volts	Decrease input voltage

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Problem	Possible Cause	Possible Solution
DC Input OK LED is on Input Voltage meter indicates negative voltage	Input voltage is reversed or backwards.	Correct polarity of DC input
Output Current LED ON and can't be cleared by reset.	Shorted IGBT	Replace IGBT
	IGBT driver failure	Replace IGBT drivers. They come in pairs.

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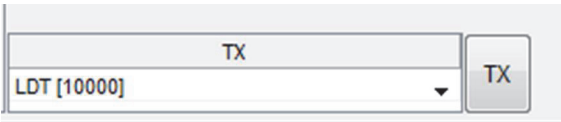


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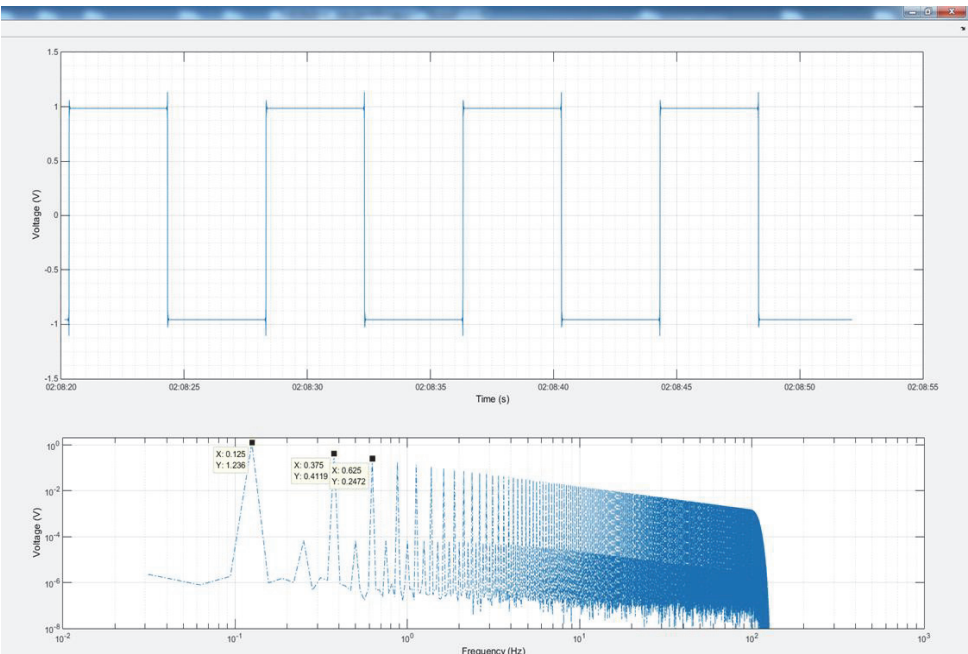
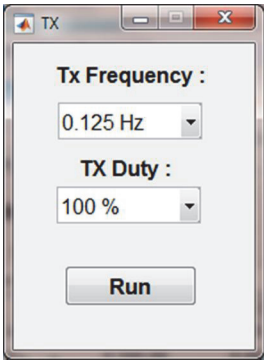
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7.0 APPENDIX B: ZEN Control of Period and Duty Cycle

To control the transmitter with ZenACQ5, you'll need to click on the "TX" button situated in the Task section. This will open a TX window,



The **Run/Stop** button will start/stop the transmitter at the defined Frequency and Duty. It is then possible to check the signal using the **STREAMING** window.

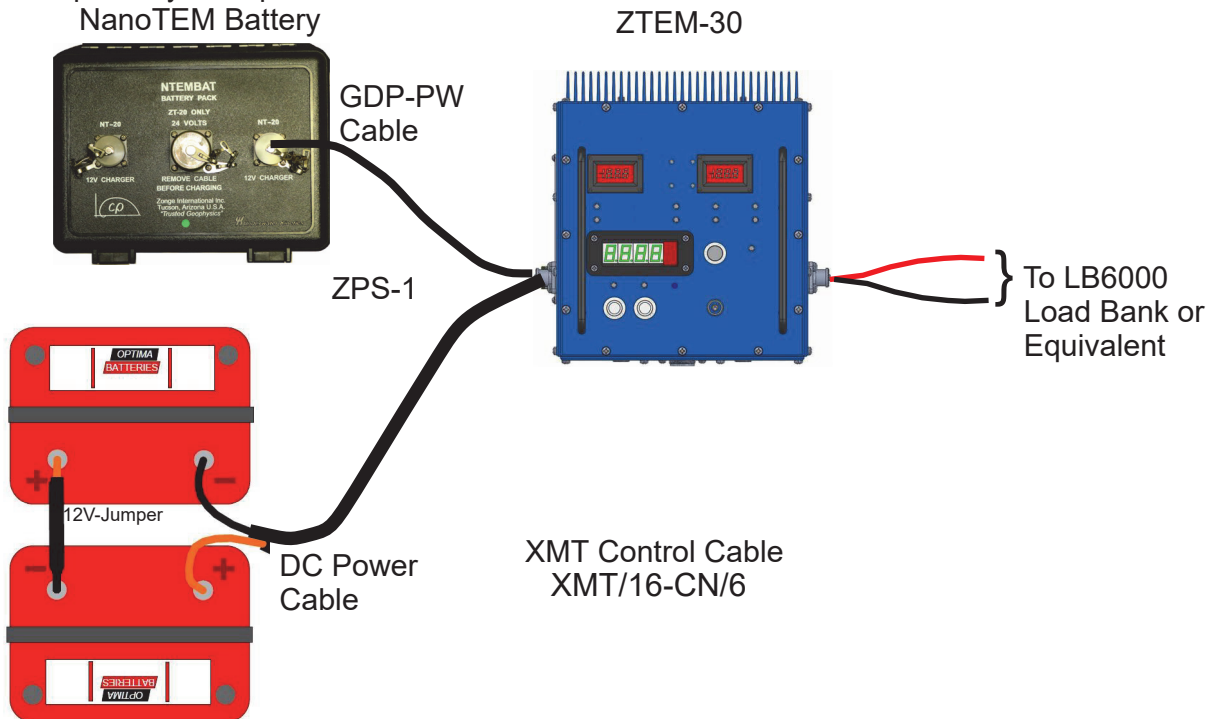


8.0 APPENDIX C - FIRST TIME OPERATION

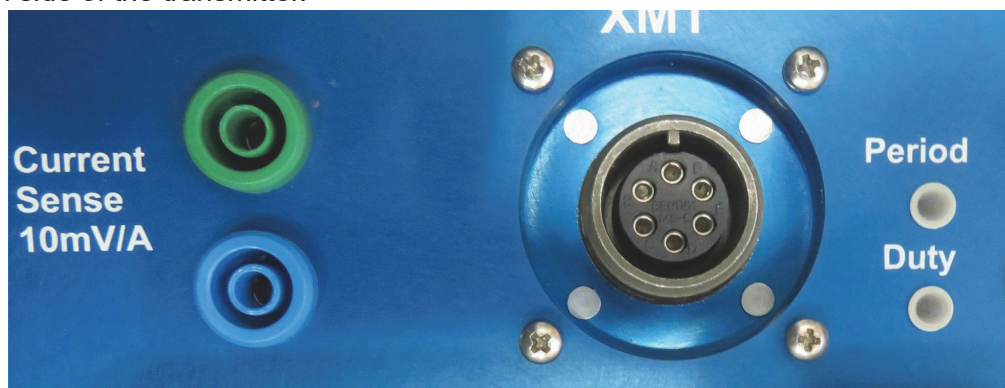
8.1 Inspection

Inspect the ZTEM on arrival for any damage that may have occurred during shipment. Remove the ZTEM from its shipping case and inspect for damage. If damage has occurred, it should be reported to the shipper and to Zonge immediately and corrected before operation is attempted.

8.2 Preparatory Set-up



1. Connect a 27 ohm resistive load (use Zonge Model LB6000 or a 25 to 27 ohm resistor with a rating of 30 watts or more.) to the red and black output jacks on the transmitter.
2. Connect two 12V batteries or a 24 volt power supply to the power input.
3. Connect a battery powered or line isolated oscilloscope to the CURRENT SENSE output jacks on the fan side of the transmitter.



Set up the oscilloscope as follows:

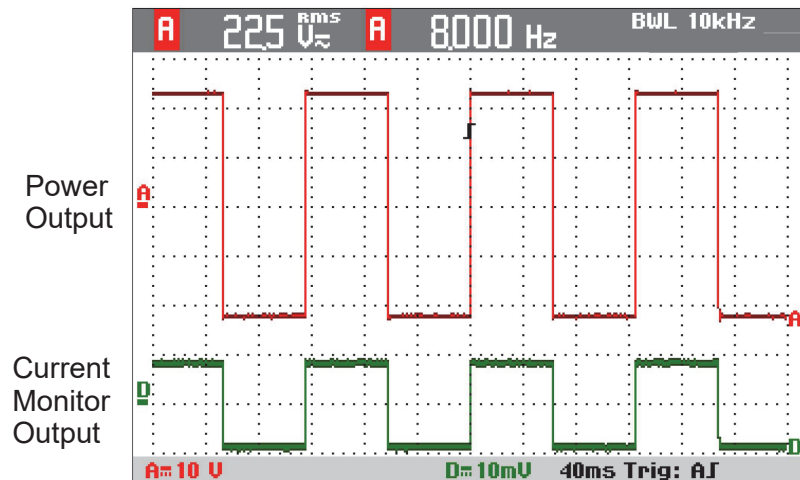
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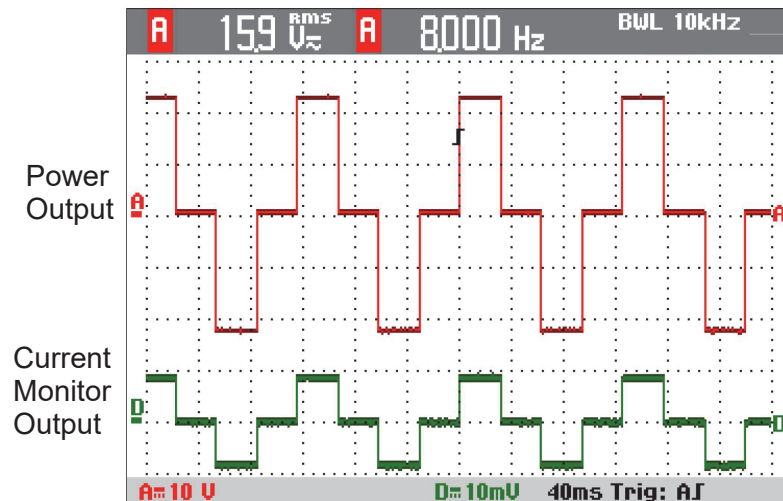
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- 0.5 m sec/division
 - 0.5 volts/division
4. Connect a Zonge transmitter controller (XMT-32, GDP or ZEN) and set the frequency to 8 Hz and frequency domain.
 5. Connect the NTEM-BAT to the ZTEM using the GDP-PW cable
 6. The green power LED should now be on. All LEDs should light with the automatic LED test. Press the RESET button. All fault indicator LEDs should turn off.
 7. Put the RANGE switch in the high position.
 8. Press the RESET button, and then immediately press the TRANSMIT button.
 9. The FREQUENCY/TIME DOMAIN switch on the transmitter controller can be toggled between either position. Refer to the oscilloscope traces.



8 Hz Frequency Domain



8 Hz Time Domain (50% duty cycle)

10. If the transmitter fails to operate properly, contact Zonge for corrective action.

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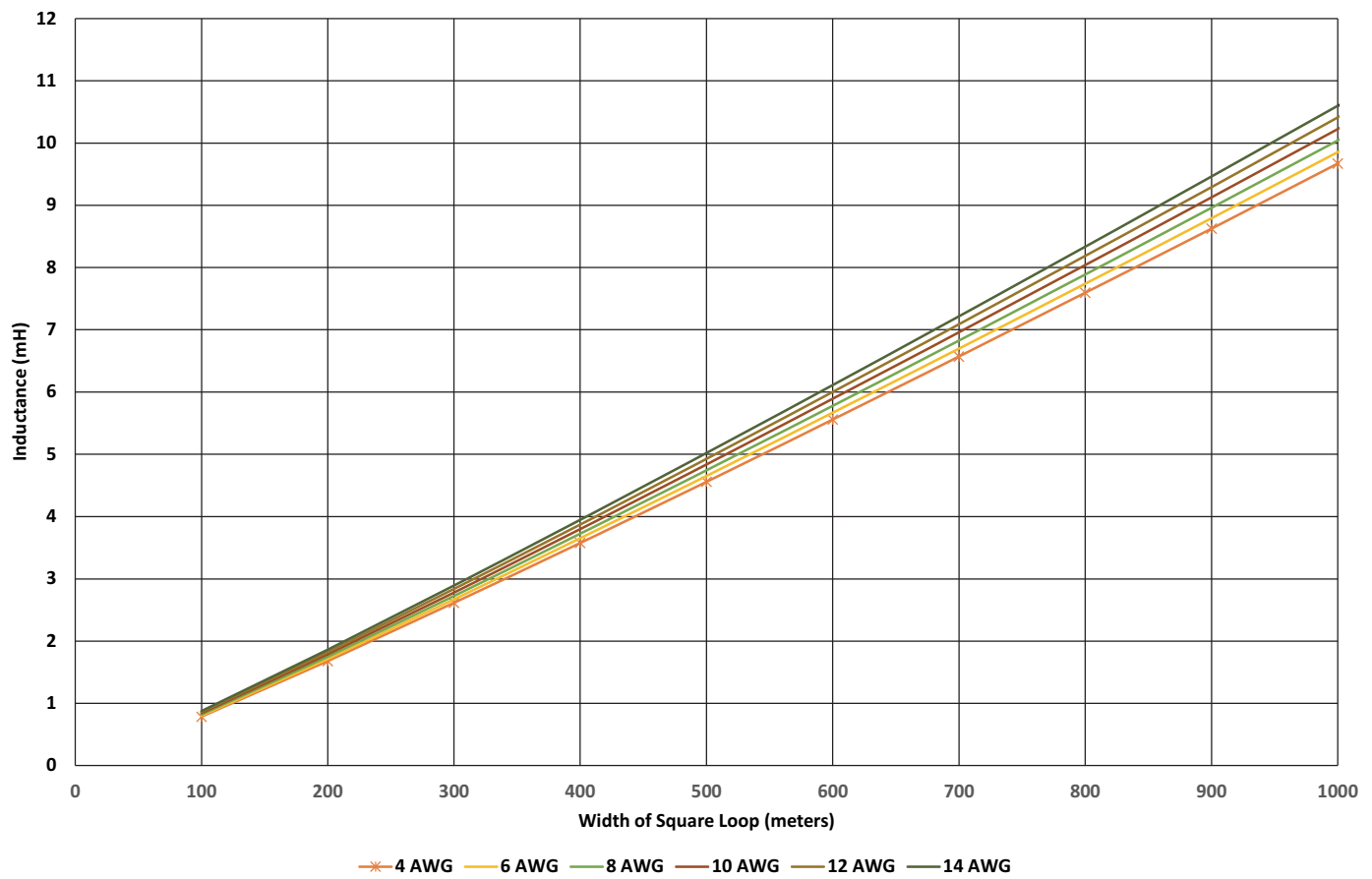


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9.0 APPENDIX D - USEFUL TABLES

9.1 Inductance versus Loop Width for 4 AWG to 14 AWG



9.2 Calculation of required main power voltage.

The ZTEM uses IGBTs for the output switch. The voltage drop on the IGBTs must be taken into account, dependent on the output current: approximately 2.6 volts at 10 amperes, 3.0 volts at 20 amperes, and 3.2 volts at 30 amperes, when operating at 25°C. This voltage drop increases with junction temperature of the IGBTs. The required voltage is $V_{main} \geq V_{(igbt\ loss)} + I \cdot R$, where I is the desired current, and R is the total resistance of the loop plus any lead-in wire.

External Supply Voltage Required for Transmitter Output of 10 amperes.

AWG gauge	Ohms per km	Loop Side, meters									
		100	200	300	400	500	600	700	800	900	1000
4 AWG	0.815	-	-	12.4	15.6	18.9	22.2	25.4	28.7	31.9	35.2
5 AWG	1.028	-	-	14.9	19.0	23.2	27.3	31.4	35.5	39.6	43.7
6 AWG	1.296	-	13.0	18.2	23.3	28.5	33.7	38.9	44.1	49.3	54.4
7 AWG	1.634	-	15.7	22.2	28.7	35.3	41.8	48.4	54.9	61.4	68.0
8 AWG	2.060	10.8	19.1	27.3	35.6	43.8	52.1	60.3	68.5	76.8	85.0
9 AWG	2.598	13.0	23.4	33.8	44.2	54.6	65.0	75.3	85.7	96.1	106.5
10 AWG	3.276	15.7	28.8	41.9	55.0	68.1	81.2	94.3	107.4	-	-
11 AWG	4.133	19.1	35.7	52.2	68.7	85.3	101.8	118.3	-	-	-
12 AWG	5.209	23.4	44.3	65.1	85.9	106.8	-	-	-	-	-
13 AWG	6.570	28.9	55.2	81.4	107.7	-	-	-	-	-	-
14 AWG	8.282	35.7	68.9	102.0	-	-	-	-	-	-	-

External Supply Voltage Required for Transmitter Output of 20 amperes.

AWG gauge	Ohms per km	Loop Side, meters									
		100	200	300	400	500	600	700	800	900	1000
4 AWG	0.815	-	16.0	22.6	29.1	35.6	42.1	48.6	55.2	61.7	68.2
5 AWG	1.028	11.2	19.4	27.7	35.9	44.1	52.3	60.5	68.8	77.0	85.2
6 AWG	1.296	13.4	23.7	34.1	44.5	54.8	65.2	75.6	85.9	96.3	106.7
7 AWG	1.634	16.1	29.1	42.2	55.3	68.4	81.4	94.5	107.6	-	-
8 AWG	2.060	19.5	36.0	52.5	68.9	85.4	101.9	118.4	-	-	-
9 AWG	2.598	23.8	44.6	65.4	86.1	106.9	-	-	-	-	-
10 AWG	3.276	29.2	55.4	81.6	107.8	-	-	-	-	-	-
11 AWG	4.133	36.1	69.1	102.2	-	-	-	-	-	-	-
12 AWG	5.209	44.7	86.3	-	-	-	-	-	-	-	-
13 AWG	6.570	55.6	108.1	-	-	-	-	-	-	-	-
14 AWG	8.282	69.3	-	-	-	-	-	-	-	-	-

External Supply Voltage Required for Transmitter Output of 30 amperes.

AWG gauge	Ohms per km	Loop Side, meters									
		100	200	300	400	500	600	700	800	900	1000
4 AWG	0.815	13.4	23.2	32.9	42.7	52.5	62.3	72.1	81.8	91.6	101.4
5 AWG	1.028	15.9	28.3	40.6	52.9	65.3	77.6	89.9	102.3	114.6	-
6 AWG	1.296	19.2	34.7	50.3	65.8	81.4	96.9	112.5	-	-	-
7 AWG	1.634	23.2	42.8	62.4	82.0	101.6	-	-	-	-	-
8 AWG	2.060	28.3	53.1	77.8	102.5	-	-	-	-	-	-
9 AWG	2.598	34.8	66.0	97.1	-	-	-	-	-	-	-
10 AWG	3.276	42.9	82.2	-	-	-	-	-	-	-	-
11 AWG	4.133	53.2	102.8	-	-	-	-	-	-	-	-
12 AWG	5.209	66.1	-	-	-	-	-	-	-	-	-
13 AWG	6.570	82.4	-	-	-	-	-	-	-	-	-
14 AWG	8.282	103.0	-	-	-	-	-	-	-	-	-

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Revision Record Sheet

Revision	Release Date	Description of Change
A	03-May-2022	Initial Release

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