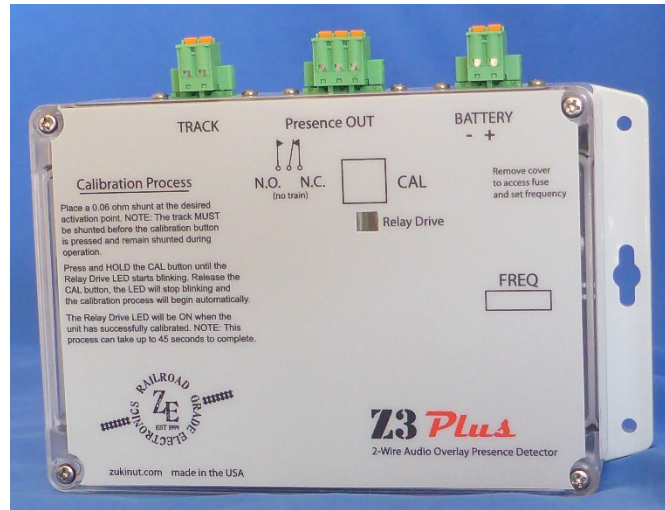


# Z3-Plus 2-Wire Audio Overlay Presence Detector Manual

## Revision A6, July 2020



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## Z3-Plus Overview

The Z3-Plus is a non-vital 2-Wire audio overlay track circuit operating on 9 to 24VDC and is field configurable for the following track drive frequencies: 8.2K, 10K, 11.5K, 13.2K, 15K, 17.5K, 20K, 26KHz. This track circuit provides a sinusoidal output under all track load conditions minimizing possible harmonic interaction with other audio equipment on the track. The unit also provides consistent activation point independent of operating battery. Digital receiver circuitry provides for precise receiver operation. The unit is calibrated by simply dropping a shunt at the activation point and pushing the cal button. Additionally, a non-vital loss of shunt timer is provided to further optimize consistent performance. An LED has been provided to allow a visual indication of the Z3-Plus relay drive.

## Theory of Operation

See Figure 1. The Z3-Plus is an audio overlay track circuit. This means the system transmits AC energy in the audio band into the track, rail to rail. Since the output is an AC waveform, multiple systems operating on different frequencies can be used on the same track section at the same time or overlaying of systems. This includes DC track circuit commonly used for signaling applications. The Z3-Plus is a two wire system meaning it “looks” equally in both directions from its feed point. (Typically 500ft in both directions in good ballast)

When a train approaches the Z3-Plus circuit a complete electrical circuit is created through one rail, the train axle and the other rail resulting in a rising output current as the train moves toward the feed point. The Z3-Plus receiver front end employs a frequency selective current to voltage converter that monitors this rising current and converts it to a rising voltage. When this voltage reaches a level equal to or greater than the desired activation point, the relay drive is activated. The relay drive will remain on as long as the input voltage is equal to or greater than the activation point voltage. The activation point voltage is set by the calibration procedure in which a 0.06 ohm shunt is placed on the track at the desired activation point and the CAL button is pressed for 3 seconds or more. At this time the Z3-Plus clears the previous set point and begins turning its receiver gain up until the set point equals the input voltage. This value is then stored in non volatile memory. A non-vital Loss Of Shunt (LOS) timer is built in to prevent “chatter” in the relay drive in the event of poor train shunting. I.e. Light, short trains such as Amtrak.

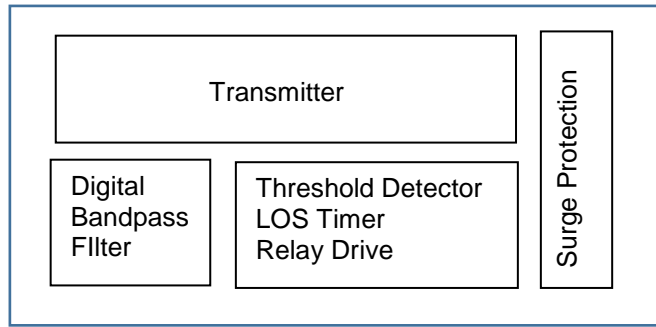


Figure 1.

As noted above, the Z3-Plus responds to track loading that pulls enough current out of the transmitter to equal or surpass the desired activation point voltage. This condition is usually due only to the load associated by train axles. However, the circuit created by the conductive nature of the dirt, rocks, ties and rails can also create a load sufficient to activate the Z3-Plus. Figure 2 depicts a simplified track circuit model. Note the resistance rail to rail and the earth ground connection. This symbolically represents the conductive elements naturally occurring in the roadbed. The impedance values of this circuit are specified in ohms per 1000 ft of track and go down as the ballast gets wet (rain) and go up as the ballast dries or freezes. Road bed composed of wood ties with poor drainage and/or aged ballast are generally low ballast circuits. In most cases the Z3-Plus activation point will move out and not cause an operational problem. If the ballast resistance value goes too low, a stuck ON condition could occur requiring a re-calibration. However, it is strongly recommended that the installation and track circuit be inspected for trouble before initiating the re-calibration.

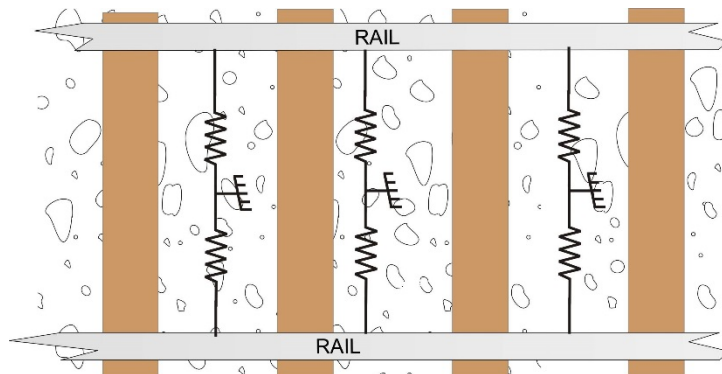


Figure 2.

# Installation and Application Guidelines

1. The Z3-Plus includes secondary surge protection but, like all signal products, requires primary protection. Ze recommends air gap arrestors and equalizers. Locate these devices at the point of entry of the equipment house. Good earth ground is essential.
2. Always check battery. 9-24VDC
3. If a polarized relay is used or has a snubber diode across its coil, polarity MUST be observed.
4. When troubleshooting always ask “what has changed?”
5. Obtain track & Time authority. Always place the track shunt at the desired pick point BEFORE pressing the CAL button. Ideally the shunt should be a 0.06 ohm unit. After calibration move the shunt out approximately 10ft to ensure correct activation point.
6. After track side calibration procedures have been successfully completed, place a temporary shunt at the track wires on the unit in the case and verify that the signal system goes to stop. Once verified remove the temporary shunt.
7. If the unit will not calibrate, watch the relay drive LED for approx 45 seconds. If it blinks this means the Z3-Plus has turned its receiver gain to the maximum setting and cannot see the track shunt. Look for open circuits between the Z3-Plus and the shunt on the track. I.e. track wires, bond wires etc
8. The Z3-Plus will look equally in both directions. If one side of the circuit has insulated joints the Z3-Plus will operate, however, the activation distance will not be the same. In general, track circuit equipment cannot see past insulated joints.
9. Audio overlay systems like the Z3-Plus will not work with wide band shunts in their track circuit range.
10. If relay drive is stuck ON look for short circuits between the Z3-Plus and the desired pick point.
11. The greater the distance between the Z3-Plus and track connections, the greater the affects ballast will have on the Z3-Plus performance.
12. Presence output is a dry contact configuration Form –C dry contact, 225mA max current. (N.C. contact with no train presence)
13. In good track ballast conditions a Z3-Plus circuit can travel up to 500ft in each direction. Rotating operating frequencies to avoid interference with other equipment is recommended.
14. The higher the operating frequency the shorter the track circuit.
15. Paint a stripe on the side of the rail at the desired pick point at each end of the circuit to provide a visual troubleshooting aid.
16. High series inductance in the track leads, commonly found in primary surge protection assemblies can shorten the usable detection range of the Z3 Plus.

# Z3-Plus Frequency Configuration

The Z3-Plus is capable of outputting the following track drive frequencies: 8.2K, 10K, 11.5K, 13.2K, 15K, 17.5K, 20K, 26KHz. These track frequencies can be configured in the field without need of specialized tools. Figure 3 below, details the switch and TAP setting required to configure the unit for each frequency. Figures 4 and 5 provide examples of the setting for 26KHz and 8.2KHz.

**Note:** Perform the calibration procedure after changing the track frequency.

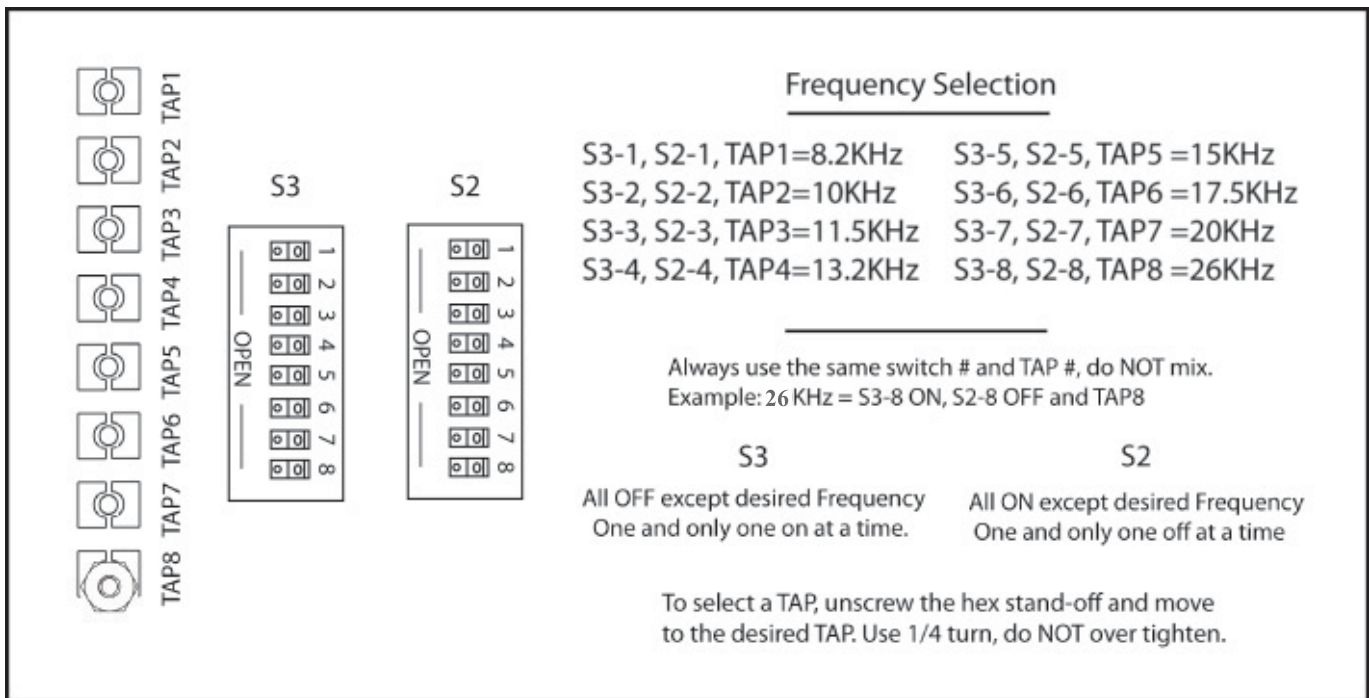


Figure 3

### Z3-Plus Configured for 26KHz

TAP 1-8

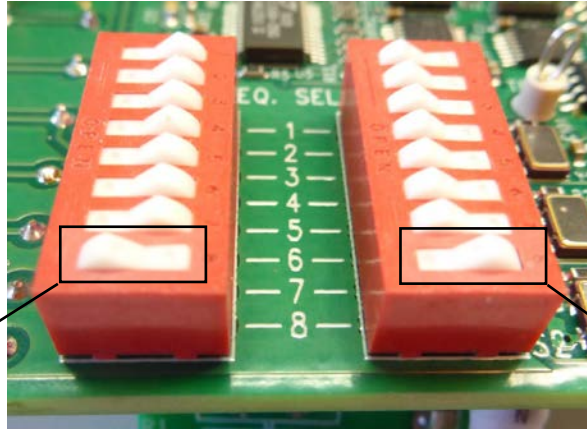
Switch 3

Switch 2



All Switches of S3  
OFF except SW3-8

SW3-8 ON



All Switches of S2  
ON except SW2-8

SW2-8 ON

Figure 4

### Z3-Plus Configured for 8.2KHz

TAP 1-8

Switch 3

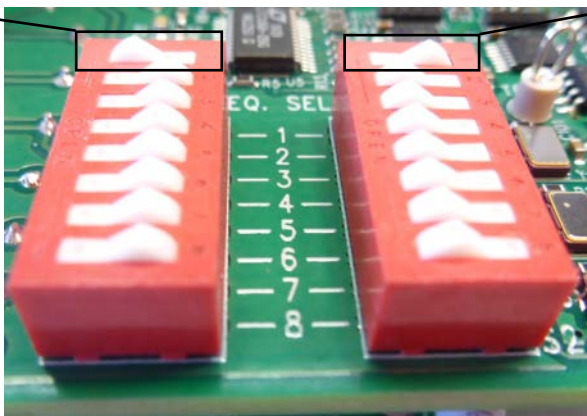
Switch 2



Stand-Off on TAP1  
(1/4 turn to tighten)

All Switches of S3  
OFF except SW3-1

SW3-1 ON

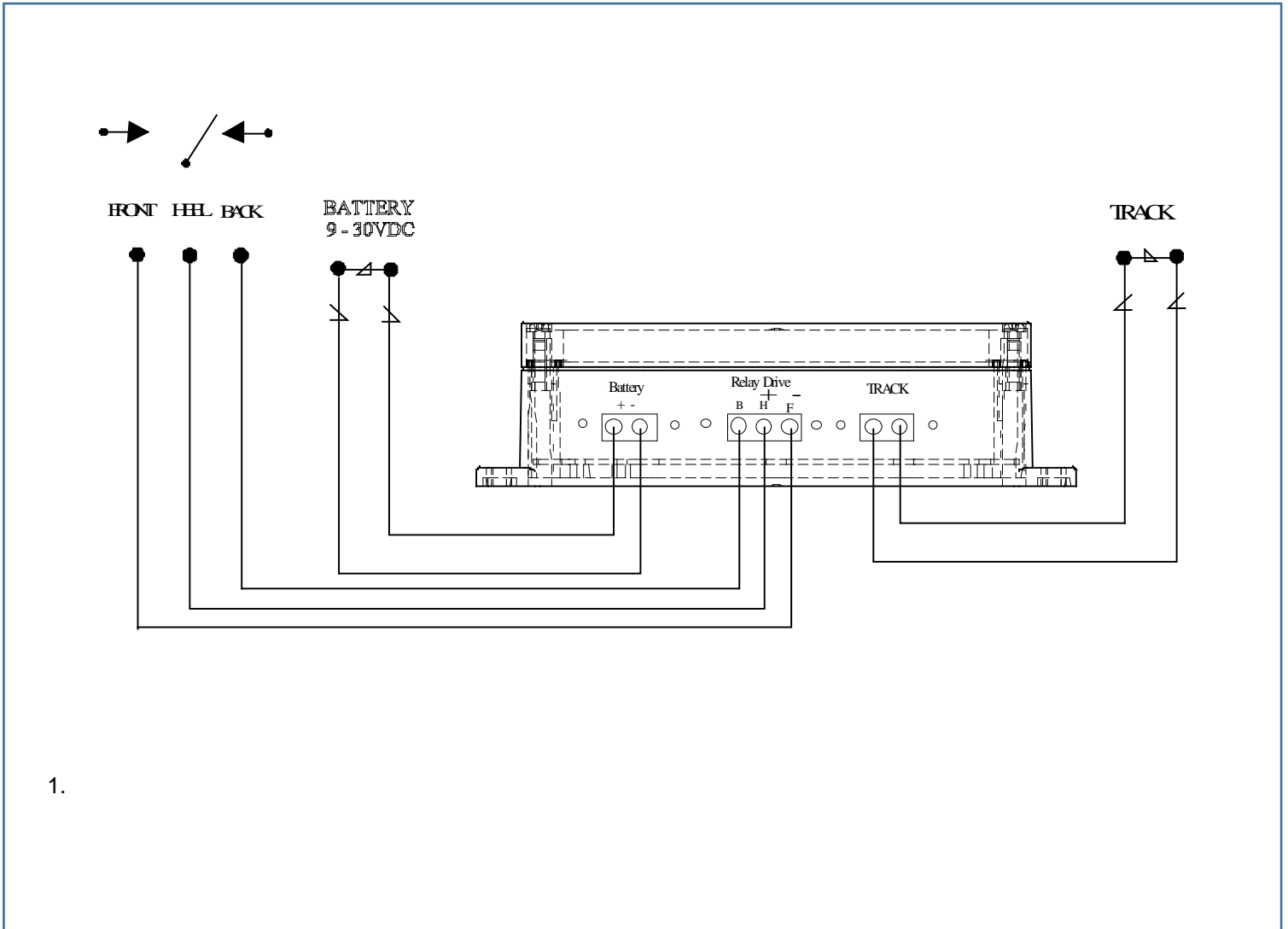


SW2-1 ON

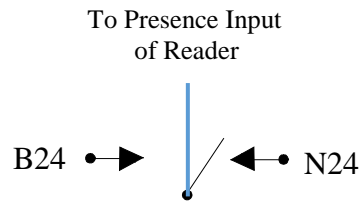
All Switches of S2  
ON except SW2-1

Figure 5

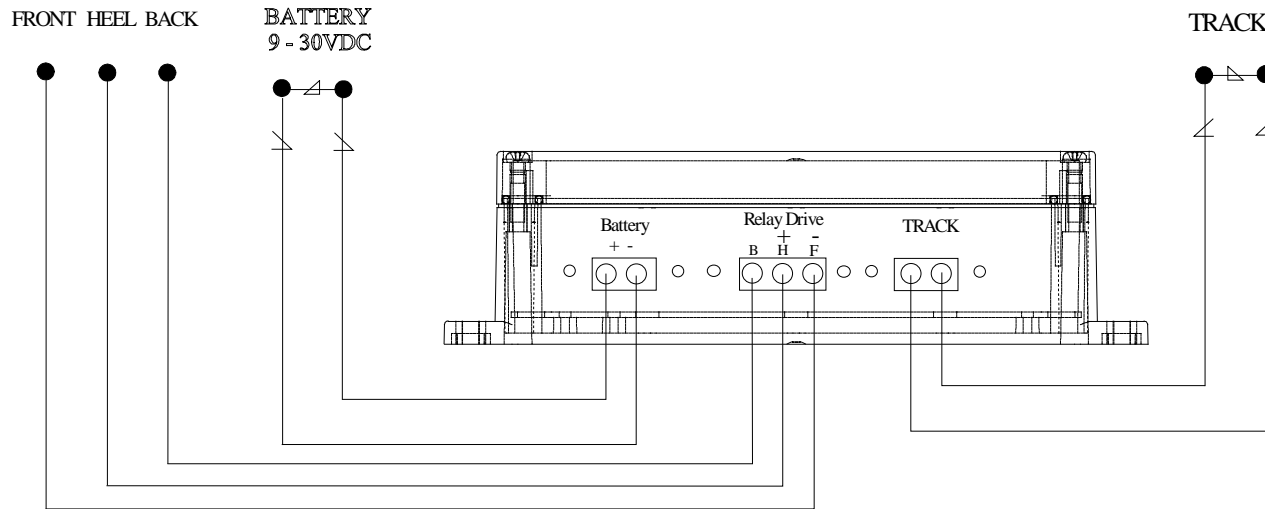
# Z3-Plus typical wiring



# High Impedance AEI Inputs



Some types of AEI readers have high impedance inputs that can be susceptible to ambient electrical noise. The result of this sensitivity can be false indication of presence (stuck ON). To eliminate this potential, use the N.C. contact of the Z3-Plus output to terminate the reader input to N24 when there is no train presence.



1. 9 – 30 VDC input battery.
2. Primary Surge protection & ground rod required. Zukinut Enterprises recommends air gap equalizers and arrestors.
3. Relay Drive output, Dry contact Form C, 225mA Max.
4. Track wire to be #6 twisted.
5. Unit foot print of 8" x 5.75" x 3".



## Z3-Plus Calibration Procedure

1. Obtain track & Time authority.
2. Place a  $0.06\Omega$  track shunt at the desired activation point.
3. Press and HOLD the CAL button until the relay drive LED starts blinking. Release the CAL button, the LED will stop blinking and the calibration process will begin automatically.
4. The relay drive LED will be ON when the unit has successfully calibrated.
5. Remove the track shunt.
6. After track side calibration procedures have been successfully completed, place a temporary shunt at the track wires on the unit in the case and verify that the signal system goes to stop. Once verified remove the temporary shunt.

**Note:** After completing the calibration steps above, it is recommended that the track shunt be placed  $\pm 10$ ft from the calibration point to ensure proper operation.

**Note:** This process can take up to 45 seconds to complete.

**Note:** If the relay drive LED blinks 3 times in rapid succession, this indicates a failure to calibrate and that there is an open circuit.

**Note:** The track must be shunted before the calibration button is pressed and remain shunted during the calibration procedure.

**Note:** If the track drive frequency is changed it is necessary to re-calibrate the track circuit.

# Zukinut Warranty and Repair Policy

1. Unless otherwise specified, Zukinut Enterprises, Ze, railroad products are covered by a 1 year warranty from the date of the original purchase. Ze liability is limited solely to the repair or replacement of Ze product and only in the case of a defect in materials or workmanship in said product. Ze reserves the right to decline warranty coverage if, in the opinion of Ze, the product has been modified or misused. Ze will not be held responsible for damage or loss to property or persons incurred while using Ze products.

2. All defective material must have a "Returned Material Authorization" number clearly marked on the packaged material returned. An RMA number can be obtained by submitting a support ticket via the customer service portal on zukinut.com.

3. All defective material returned must be packaged to avoid shipping or handling damage. Material received by Zukinut that evidences shipping or handling damage will be considered out of warranty and customer will be notified that out of warranty repair fees will be incurred as outlined below.

4. It is strongly recommended that material returned for warranty or repair include as much detail as possible as to the specific nature of the failure. In addition, it is recommended that information showing a contact phone or email address of the equipment user also be included.

5. Defective material returned that is out of warranty will be repaired under the Zukinut policy outlined below:

a. A flat rate charge of \$400.00 will be assessed for each out of warranty device returned for repair. This charge will cover the following:

- Update to current hardware and software levels
- Full factory test
- 5 day system test

b. Out of warranty material returned that Zukinut considers not repairable or that the customer decides not to repair will be scrapped.

c. If a repaired item fails to perform upon initial installation due to defect in material or Ze Workmanship, secondary repair will be performed at no charge. In the event of such please indicate so on the RMA request. Warranty of either type, new or repair, may be void, if in the opinion of Ze, the failure is the result of improper Installation, improper application or damage due to improper handling of the product.

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