LITERATURE

VARIABLE THRESHOLD NEUTRAL ISOLATOR

DAIRYLAND
ELECTRICAL INDUSTRIES
ALWAYS RUGGED. ALWAYS RELIABLE.

INTRODUCTION

The Variable Threshold Neutral Isolator (VTNI) is a solid-state, lightning- and fault-rated switching device that prevents power utility neutral-to-earth voltage from appearing on the customer's secondary neutral, to minimize utility contribution to animal contact voltage, typically at dairy facilities.

This utility pole mounted device is installed near the distribution transformer, between the primary neutral of the utility system and the secondary neutral of the customer service, as depicted in Figure 1. It acts as a closed tie switch between the primary and secondary neutrals under abnormal overvoltage conditions, and as an open switch under normal conditions. This product meets the requirement of the National Electric Safety Code (NESC) Rule 97D2, which allows for primary to secondary neutral isolation.

Note: The Dairyland model VTNI is not authorized for use in solving nuisance shock to persons at swimming pools or similar human health situations where structure to ground voltage is present. Instead, proper bonding and grounding techniques need to be applied to solve such problems.

HOW THE VARIABLE THRESHOLD NEUTRAL ISOLATOR FUNCTIONS

Dairyland Electrical Industries' Variable Threshold Neutral Isolator (VTNI) is normally open, voltage triggered switch which performs two key functions.

Function 1: Isolation of the customer's neutral/grounding system under normal operating conditions

When properly installed, the VTNI is an open switch connected between the power utility primary neutral/grounding system and the customer's secondary neutral/grounding system. This effectively isolates these two systems, thereby preventing utility contribution to neutral-to-earth voltage on the customer's service. The VTNI is the functional equivalent of an isolation transformer for providing this function.

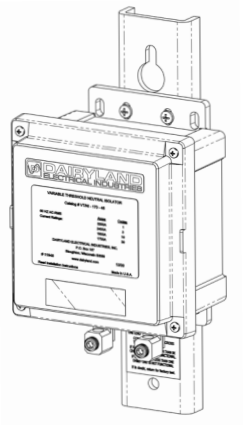
Function 2: Reconnection of neutrals/grounding systems during overvoltage conditions

In addition to providing isolation, another main function of the VTNI is to reconnect the two neutrals/grounding systems any time the voltage difference between them attempts to exceed a predetermined value for a predetermined time.

Reconnection of the neutrals is important to prevent unsafe voltage from developing between the two grounding systems and to enable the power utility's over-current protection to function properly in the event of a primary-to-secondary failure of the distribution transformer.

The Variable Threshold Neutral Isolator was designed to prevent transient over-voltages from causing the isolating device to transition to its "shorted mode" unless the transient lasts beyond a predetermined time—as illustrated in Figure 3.

This characteristic effectively increases the switching threshold voltage for short duration over-voltage events, preventing nuisance conduction, yet retains a lower threshold voltage for 60 Hz steady-state conditions.



VTNI

Variable Threshold Neutral Isolator

FEATURES OF THE VTNI

Energy Requirements

None. This device does not use or require energy. It is totally autonomous.

Number of Operations

Virtually unlimited under maximum 60 Hz current ratings—provided operations are not immediately repetitive.

Automatic Reset

Following an overvoltage event which causes the isolator to transition to its "shorted mode," the device automatically reverts to its voltage blocking (i.e. switch open) mode whenever the current through the terminals goes through zero.

Fail-Safe

Should the neutral isolator be exposed to current in excess of rating so that failure would result, failure will normally occur in the shorted mode, thereby permanently reconnecting the primary and secondary neutrals to maintain safety bonding. Due to this possibility, it is suggested that the utility recommend a suitable voltage monitoring device to the customer and assist in its installation.

Field Testing

VTNI's can readily be tested to verify operability using a standard DC ohmmeter:

- If R (ohmmeter) > 5,000 ohms between terminals, the unit is likely functional.
- If R (ohmmeter) < 1 ohm, unit is not functional, contact factory for repair.

If the unit is installed, remove one conductor before conducting this test. If there is any question on whether a unit is functional, contact Dairyland.

Terminals

The VTNI has two identical terminals; each will accommodate #8 through 1/0 copper ground conductor.

Neutral Connection

The primary and secondary neutral can be connected to either terminal. The isolator is completely bi-directional.

Enclosure

The VTNI is cased in a light gray non-conducting, non-corrosive, polycarbonate enclosure which is waterproof and moisture proof. The enclosure is pre-assembled to a non-metallic bracket suitable for mounting on a wood utility pole. Corrosion resistant lag bolts and washers are provided for mounting.

Weight

7 Pounds (3.2 kg)

Serial Number

All Variable Threshold Neutral Isolators have a unique serial number, located on the name plate.

Compliance

The VTNI complies with the National Electrical Safety Code (NESC) Rule 97D2 and with the REA rule and with 7 CFR 1724.52 – "Permitted deviations from RUS construction standards." In addition, the VTNI complies with the 1996 requirements of the Wisconsin Public Service Commission for an isolating device that will also block transient over-voltage as illustrated in Figure 3. Individual state electrical codes may modify and supercede NESC 97D2, altering such aspects as the ground rod spacing. Reference your state's electrical codes.

Other Considerations

Other utilities serving the location where the VTNI is to be installed may have a parallel interconnection between the power company primary neutral and the customer secondary neutral, thereby bypassing the isolator. Therefore, all utilities should be consulted when installing a VTNI to assure the desired isolation between the neutrals is obtained. Telephone and cable TV companies are prime examples of utilities which must be contacted.

Some farms have a second power utility service entering the facility which must also have neutral isolation applied, as effectively this is in parallel with the first service.

The Neutral Isolator is not allowed to be used on the secondary side. It is intended for primary-to-secondary isolation only. It is to be installed and maintained by the local power utility as its use and application comes under the National Electric Safety Code (NESC).

Ratings for VTNI-170-45		
60 Hz AC-RMS Rating		
Amperes	Cycles	i^2t Rating
3200	1	170×10^3
2400	3	288×10^3
1900	10	602×10^3
1700	30	1445×10^3
Lightning Surge Current (8 x 20 microsecond waveform)		
30,000 Amperes crest		
60 Hz Voltage Rating		
For use on 15kV, 25kV or 35kV Class Distribution Systems		
Switching Threshold Voltage		
Reference Figures 2 & 3 of VTNI Technical Literature		
Operating Temperature		
-40°F to +140°F (-40°C to +60°C)		

OPERATION UNDER 60 Hz CONDITIONS

Figure 2 shows the peak or absolute voltage at which the Variable Threshold Neutral Isolator (VTNI) transitions to the shorted mode when AC power frequency (50 or 60 Hz) is impressed across the isolator terminals. The transition to the shorted mode starts at 45 VAC peak and increases as the external voltage increases. The "Prospective Peak AC Voltage Impressed Across Isolator Terminals" on the horizontal axis in Figure 2 refers to the peak AC voltage that the external system may attempt to impress across the isolator terminals. As the voltage from the external system is increased, the voltage at which the VTNI transitions to its shorted mode is also increased as illustrated.

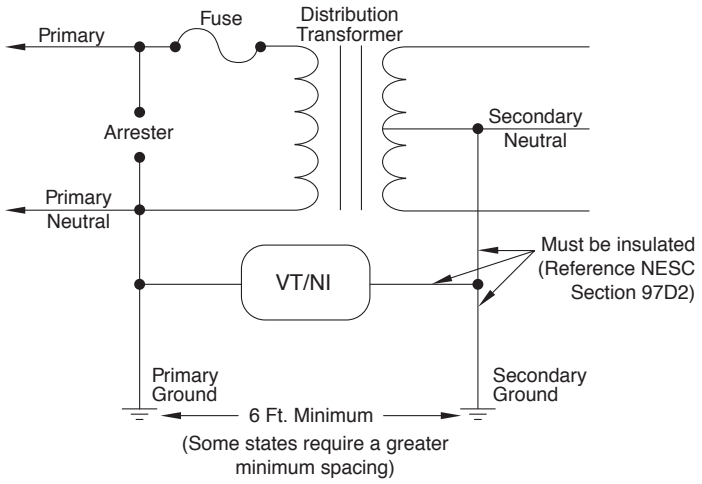
For example, if the prospective peak voltage is 100 volts, the isolator switching threshold voltage increases from 45 volts to 62 volts. In other words, though the system attempts to impress 100 volts, the VTNI limits the peak voltage to 62 volts. This characteristic results from modifying the original neutral isolator design in order to block transient over-voltages as illustrated in Figure 3.

OPERATION UNDER TRANSIENT CONDITIONS

When fast rising voltage (e.g., such as from lightning, an electric fence, etc.) is applied across the isolator terminals, transition to the shorted mode is delayed as illustrated in Figure 3. For example, a voltage transient of 200 microseconds in duration would need to have a magnitude of over 200 volts before the isolator would transition to its “shorted” (i.e. non-blocking) mode. Similarly, a voltage transient of 100 microseconds in duration would have to exceed about 310 volts, and a 1.5 microsecond transient, more than about 530 volts. This characteristic enables the isolator to effectively block short duration transients while maximizing safety for longer duration over-voltage events.

This characteristic, combined with a 60Hz switching threshold voltage of 45 volts peak, increases the range of overvoltage conditions for which the isolator will maintain isolation without sacrificing safety. After the transient event is over, the isolator automatically reverts to its normal, or voltage blocking, mode.

Figure 1: Schematic of VT/NI Installation



Note: Remove bond between secondary neutral and transformer tank.

Figure 2: Switching Threshold Voltage @ 60 Hz

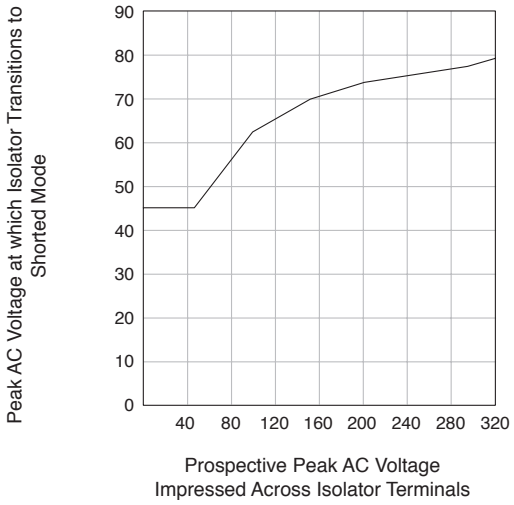


Figure 3: Triggering Characteristics Under Transient Conditions