Operations Manual

Model NT11 & NT11-E

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Manual Contents

Glossary

d.c.	Direct Current
DIL	Dual In-Line
led	Light Emitting Diode
Megger	Meg Ohmmeter
msec	millisecond
pk-pk	Peak to Peak
uH	Micro henry
uF	Micro farad

Description – NT11 and NT11-E

Northstar Controls LLC single channel NT11 and single channel with extend & delay timing NT11-E quality products of the latest design to provide consistent response times, and superior noise immunity for reliable operation.

The NT11 and NT11-E have four operating frequencies controlled by front panel DIP switches to help eliminate crosstalk between loops connected to different detectors. Tuning is fast and automatic with correct power applied or pressing the reset. With power applied the detector will tune to the loop and continuously track and adjust to environmental drifts. Presence time is consistent and substantially independent of vehicle type.

Front panel indicators (LED's) include Detect (DET) which is Red solid during current detect and flashing to indicate extension or delay operation. Additionally the DET indicator will flash with a particular sequence when the detector is in the fault condition. The Fault (FLT) will be solid yellow to indicate a current fault and will flash a sequence to indicate a previous fault condition. The fault type sequence is one flash and one space is for an open, two flashes and one space is for a short and three flashes and a space indicate a greater than 25% inductance change. The NT11 and NT11-E are fail-safe detectors so in fault they will provide a constant output until the fault is cleared.

Characteristics – NT11 and NT11-E

- Operating mode: **Presence** = 15 minutes (Short), 120 minutes (Long), **Pulse** = 125ms +/- 25ms.

- Pulse paralysis: When used in pulse mode, a pulse paralysis time of two seconds is incorporated to prevent multiple pulses being produced when a vehicle remains over the loop for an extended period.

- Sensitivity: 16 levels of sensitivity are available, selected by front panel DIP switches. Medium sensitivity is used for most applications, this is a setting of seven or eight. Always use the lowest sensitivity setting that detects the desired vehicles.

- Frequency: Four separate frequency setting are controlled by front panel DIP switches. Frequency range is 15 to 150 KHz. Always reset the detector after changing settings.

- Timing options (E model only): Output signal may be extended from 0 to 15.75 seconds in .25 second increments and delayed from 0 to 63 seconds in 1 second increments. Both functions are activated by front panel DIP switches. *Delay timing function may be inhibited by a 120VAC signal (reference Neutral) applied to Pin J of the connector.

- Reset: Channel may be reset by pressing the reset button or by temporarily selecting another sensitivity or mode setting then returning to the desired value.

- Outputs: Relay or Optically isolated Solid State. Solid State output rating maximum voltage 47V, ON voltage <1.5V at 50ma. Relay output rating 10A, 277VAC, 24VDC. Output is fail-safe (assumes detect condition on power failure).

- Power: 115VAC +/- 20%,1W.

- Tuning: Automatically tunes to proper loop and lead-in with application of power.

- Inductance range: 20µH to 2000µH with a Q factor greater than 5.

- Temperature range: -40 C to +80 C.

- Lead-in length: Up to 5000 ft. with proper lead-in and loop.

- Lightning and transient protection: Loop inputs will withstand discharge of 2000V from a 10µF capacitor across the loop connections or from either loop input to ground. Protection exceeds NEMA specification.

- Mechanical: Dimensions are 5.5" D x 5.5" H x 2" W excluding connector.

- Weight: 1 lb.

- Indicators: Front panel indicators include, Detect – Red, solid during detect and flashing to indicate extend or delay operation. Fault – Yellow, solid for current or flashing for historical fault. Fault sequence is related to type of fault sensed.
  1 blink and 1 space = Open
  2 blinks and 1 space = Short
  3 blinks and 1 space = 25% inductance change

Installation

Please use safe operating practices at all times to avoid electrical shock hazards that may be present in the cabinet.

- Select presence or pulse, if presence then select long or short.

- Set frequency and sensitivity switches to the desired positions for the application. Set sensitivity to the medium range (7 or 8) and work from there.

- If crosstalk is experienced with an adjacent detector, change the frequency to allow for the maximum frequency separation between the detector units.

- With power applied and switch settings in the desired positions, press the reset button.

- Observe the detection of vehicles by watching the front panel detect LED.

Loop installation:

The Northstar NT11 and NT11-E detectors will operate with loop and lead-in's whose total inductance is between 20µH and 2000µH. Loops with a perimeter less than 30 feet should have at least three turns, between 30 feet and 120 feet should have two turns and over 120 feet should have one turn of wire.

Loop and lead-in should be proper loop wire, #12 or #14 AWG, lead-in should be twisted at least seven twists per foot. Shielded lead-in's are not essential but are recommended especially on longer runs. Loop and lead-in should have an insulation resistance to ground greater than 50MΩ measured at 500V and a series resistance of less than 10Ω.

Loop size and location are a function of application and are dictated by experience. Northstar detectors will handle a wide range of loop and lead-in systems.

Adjustments – NT11 and NT11-E

Sensitivity: Four front panel DIP switches provide for 16 sensitivity settings.

Setting	Level dL/L	Setting	Level dL/L	Setting	Level dL/L
15	.01%	10	.06%	5	.32%
14	.015%	9	.08%	4	.48%
13	.02%	8	.12%	3	.64%
12	.03%	7	.16%	2	.96%
11	.04%	6	.24%	1	1.28%
				0	2.56%

* see chart on page 6 for DIP positions

Frequency: Two front panel DIP switches provide for 4 frequency settings.

- F2+F1 = High
- F2+F0 = Medium High
- F1+F0 = Medium Low
- F0+F0 = Low

Adjustments Continued – NT11 and NT11-E

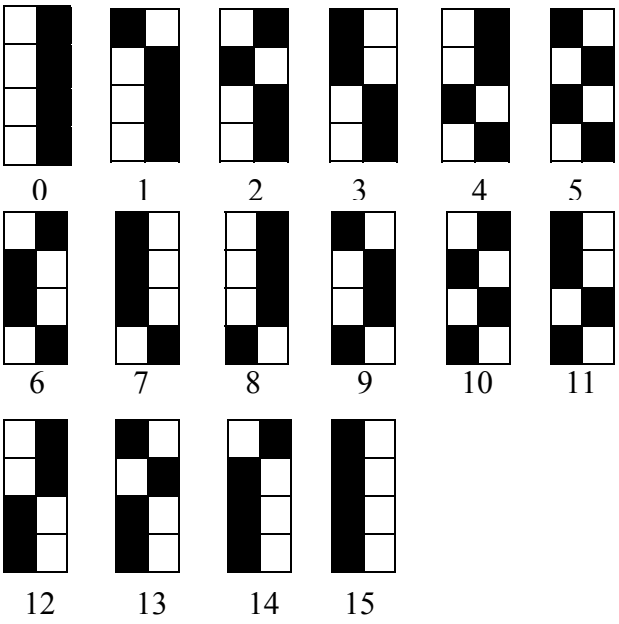
F0F0 = Low

F1F0 = Med Low

F2F0 = Med High

F1F2 = High

Setting 0 = 2.56%
Setting 1 = 1.28%
Setting 2 = .96%
Setting 3 = .64%
Setting 4 = .48%
Setting 5 = .32%
Setting 6 = .24%
Setting 7 = .16%
Setting 8 = .12%
Setting 9 = .08%
Setting 10 = .06%
Setting 11 = .04%
Setting 12 = .03%
Setting 13 = .02%
Setting 14 = .015%
Setting 15 = .01%



Sensitivity DIP switch positions (shaded area).

Connections – 10 pin MS 3102-A-18-P mating with MS3106-A-18-1S.

Pin #	Function	Color
C	Power (+)	Black
A	Power (-)	White
H	Chassis Ground	Green
B	Relay Common	Yellow
F	Relay N.O.	Blue
G	Relay N.C.	Red
D	Loop	Gray
E	Loop	Brown
I	Spare	White/Black
J	120VAC Timer Override	White/Red

* **Note:** The above connection is shown with correct power supplied and no vehicle present.

Theory of Operation

Systems Description

The Northstar Controls NT11 and NT11-E sensor unit consists of the following major circuit elements: The loop oscillator, the digital period measurement circuit, the microcontroller, the front panel switches and indicators and the output circuits

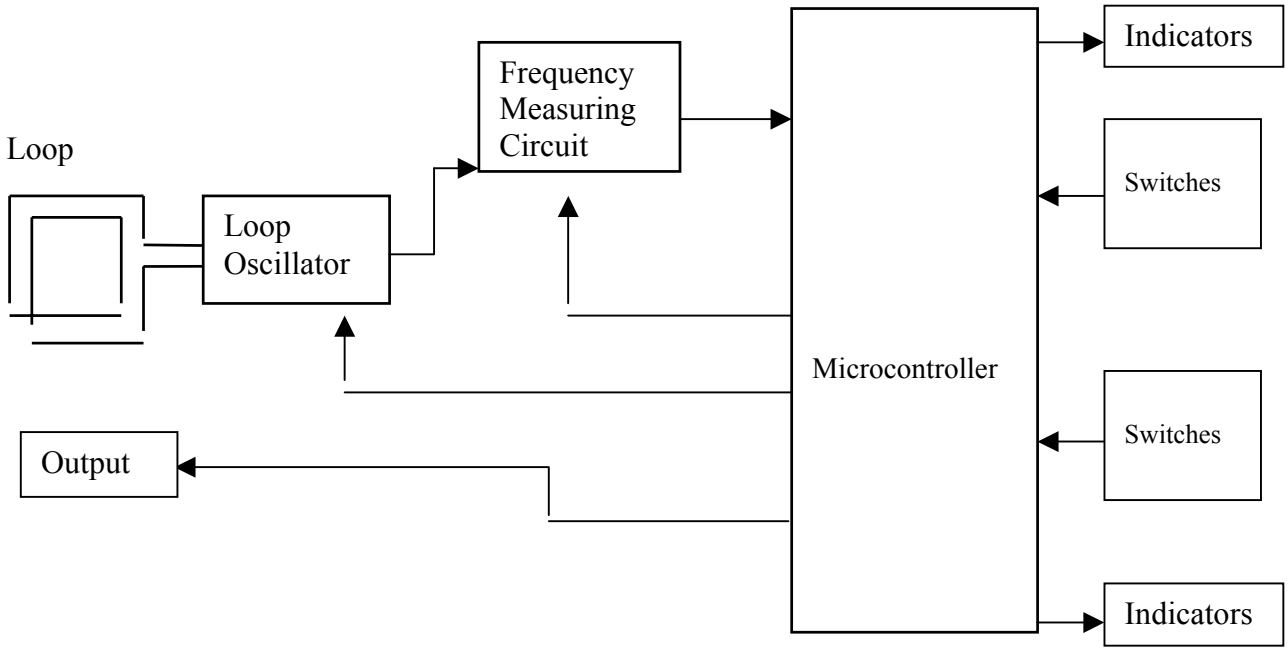
The loop oscillator, when connected to a suitable road loop / lead-in combination, establishes an oscillating signal the frequency of which is directly related to the inductance of the loop and lead-in. When a vehicle enters the detection zone surrounding the loop, the inductance of the loop changes causing the frequency of the oscillating signal to change and providing a means to determine the presence of the vehicle. Transient protection elements are incorporated within the oscillator to prevent large transients from causing damage to the oscillator or other electronics.

Frequency switches accessible from the front panel allow the operating frequency of the oscillator to be modified to prevent mutual interference between oscillators associated with different sensor boards connected to adjacent loops.

When a channel is energized, a sample of the frequency is taken and compared to a stored reference. Sensitivity switches accessible from the front panel allow the adjustment of sensitivity which determines the amount of change in frequency that is required between the current sample and the reference to result in a detect call being made.

The detection call output for each sensor is made by means of a relay which is set to conduct to indicate a vehicle detection. Front panel led indicators also indicate a vehicle detection and also when the inductance of the road loop exceeds the operating range.

Block Diagram of NT11/NT11-E Loop Sensor Unit



Detailed Description of Operation

When power is applied to the sensor unit, the microcontroller first checks the condition of the front panel switches to determine that the channel is enabled, what sensitivity level is set and what operational mode is required. Then the loop oscillator is activated to obtain a sample of the loop frequency.

When the loop oscillator is activated the combination of the inductance of the road loop and the added capacitance within the oscillator circuitry produces a resonant frequency. The oscillating signal in the road loop sets up an alternating magnetic field surrounding the loop itself. When the conductive metal in a vehicle enters the magnetic field it acts in a similar manner to a shorted turn and the effective inductance of the loop is reduced thus increasing the resonant frequency.

Frequency modification switches at the front panel allow the oscillator frequency to be modified when multiple loops and multiple sensor units are operated close to each other. This prevents interference or crosstalk from occurring between loops connected to different sensor units. A loop transformer within the oscillator circuitry isolates the road loop from the internal circuitry of the sensor improving its resistance to external surges induced in the road loop and also allowing the sensor to operate with loops that are shorted to ground.

The sinusoidal oscillations are fed through a squaring circuit to produce a square wave which is suitable for the digital frequency measurement circuitry. The loop oscillator frequency is measured by counting the number of oscillations from a stable crystal oscillator source which occur over a predetermined number of loop oscillator cycles. This is known as period measurement and defines the frequency of the loop oscillator to a very fine resolution. A combination of the loop frequency and the selected sensitivity is used to determine the number of cycles over which to perform the period measurement.

Once a stable oscillator condition has been established the sample is stored as a reference against which subsequent samples will be compared. Small, slow changes in the oscillator frequency due to environmental drift are programmed out allowing the direct comparison of fast changes due to the entry of a vehicle in the detection zone. Once a period shift exceeding the detection threshold set by the sensitivity level occurs, the output and detect indicator for that channel are activated. The Operational mode that was set on the front panel switches will determine whether a single 125 millisecond output pulse is issued (pulse mode) or whether the output signal remains until the oscillator frequency returns below the detection threshold indicating the exit of the vehicle from the detection zone (Presence mode).

If the loop oscillator frequency exceeds the operating range of the sensor unit, as might happen when the road loop connection is open or short circuited then a fault condition is signaled by the detect output entering the fail-safe condition, the fault led lighting solid yellow and the detect led indicators flashing. If the oscillator frequency should then return to within the operating range, the detect output and led indicator will return to their normal operating state while the yellow Event indicator will continue to flash indicating that a historical fault has occurred. The flash sequence indicates the type of fault that was sensed. A single flash followed by a pause indicates an open circuit loop or. A double flash followed by a pause indicates a shorted loop or too small a loop inductance. A triple flash followed by a pause indicates a greater than 25% change in loop inductance.