

CONSTRUCTION GUIDELINE**HAZELTINE MODEL 2778 TRANSMITTER INSTALLATION
TYPE "O3"**

Type "O3": Transmitters are installed outside of NP.

For Reference Only***See NTP-123 for New Installations*****1. Hazeltine Equipment Description**

The new Hazeltine transmitter (Model 2778) is known within Seattle City Light as Next Generation model and also as a Type "O3" transmitter. It is microprocessor controlled. The transmission frequency, CT ratio, ID number and all of the alarm features are selected by programming with a laptop computer in conjunction with the frequency select plug. This transmitter uses an interface cable, which is different from older Types "O1" or "O2". From the outside, it has the same physical appearance as the Type "O1" or "O2", however.

1.1 Transmitter

The transmitter provides status information for eight switches or contacts, three load current inputs, three phase voltages and two analog inputs. This status is transmitted by coded power line carrier signals over the network feeders to the substation receiver. Unique identification and frequency selection for each transmitter is provided by the plug-in program board and the power plug. Data for the load current is from current transformers (CT's) installed on the network protector's main current transformer secondary leads. The unit, when properly connected to the interface cable, is submersible.

1.2 Current Transformer Assembly (CT's)

The Hazeltine Model 2358 CT is used to monitor the load currents on each phase of the network transformer from inside the transformer's network protector. The Hazeltine Model 2358 CT is installed on the leads from the main network protector CT's. The Model 2358 is internally protected for open circuits under load.

1.3 Frequency Selection and ID Number

The coding of the transmitter for both identification (ID No.) and frequency selection is programmed into the on board microprocessor per the instructions in Section 4 of this Construction Guideline.

- 1.3.1 Frequency selection is by site survey from the manufacturer and one frequency is assigned to all transformers on that feeder. Network Engineering maintains the current frequency that is assigned to each feeder and it will be included on the installation drawing. There are four frequencies available for use. Each frequency is associated with a color for ease of frequency identification as shown below:

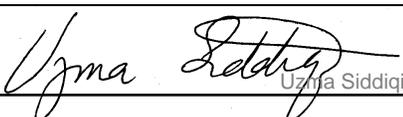
Transmission Frequency kHz	Associated Color
45 kHz	red
50 kHz	blue
55 kHz	green
62 kHz	yellow

- 1.3.2 The ID number is assigned by Network Engineering. Crews will need to call Network Engineering when they are ready to install the transmitter.

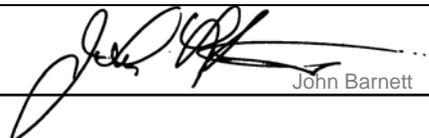
STANDARDS COORDINATOR

STANDARDS SUPERVISOR

UNIT DIRECTOR



Uzma Siddiqi



John Barnett



John Nierenberg

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Table 1.1, Wiring Details

Pin No.	Name	Wire Designation	Wire Source
DIGITAL CONNECTOR (J1)			
2	A FLAG	GREEN	MAIN CABLE
24	A RTN	YELLOW/BLACK	MAIN CABLE
10	P or B FLAG	WHITE/BLUE	MAIN CABLE
25	P or B RTN	WHITE/YELLOW	MAIN CABLE
13	G FLAG	WHITE/BLACK/GREEN	MAIN CABLE
30	G RTN	WHITE/BLACK/RED	MAIN CABLE
14	H FLAG	WHITE/BLACK/BLUE	MAIN CABLE
31	H RTN	WHITE/BLACK/GRAY	MAIN CABLE
5	I B PHASE	YELLOW	MAIN CABLE
6	I C PHASE	ORANGE	MAIN CABLE
7	I A PHASE	WHITE	MAIN CABLE
11	CT RTN	WHITE/BLACK	MAIN CABLE
1	C FLAG	WHITE ON ORANGE	TAGGED AUX CABLE
26	C RTN	BLACK ON ORANGE	TAGGED AUX CABLE
3	D FLAG	WHITE ON YELLOW	TAGGED AUX CABLE
27	D RTN	BLACK ON YELLOW	TAGGED AUX CABLE
4	E FLAG	WHITE ON GREEN	TAGGED AUX CABLE
28	E RTN	BLACK ON GREEN	TAGGED AUX CABLE
19	F FLAG	WHITE ON RED	TAGGED AUX CABLE
29	F RTN	BLACK ON RED	TAGGED AUX CABLE
15	ANALOG 1 IN	WHITE ON VIOLET	TAGGED AUX CABLE
37	ANALOG 1 REF	RED ON VIOLET	TAGGED AUX CABLE
34	ANALOG 1 RTN	BLACK ON VIOLET	TAGGED AUX CABLE
8	ANALOG 2 IN	WHITE ON BLUE	P5-1
21	ANALOG 2 REF	RED ON BLUE	P5-2
35	ANALOG 2 RTN	BLACK ON BLUE	P5-3
used for internal analog 2 sensor	ANALOG 2 IN	WHITE/ORANGE	J5-1 (MAIN CABLE)
	ANALOG 2 REF	WHITE/RED	J5-2 (MAIN CABLE)
	ANALOG 2 RTN	WHITE/GRAY	J5-3 (MAIN CABLE)
used for internal analog 2 sensor	ANALOG 2 IN	J4-1	WHITE ON BLUE TAGGED AUX CABLE
	ANALOG 2 REF	J4-2	RED ON BLUE TAGGED AUX CABLE
	ANALOG 2 RTN	J4-3	BLACK ON BLUE TAGGED AUX CABLE
16	+5 VDC	WHITE/RED/ORANGE	MAIN CABLE
36	COMM RTN	WHITE/BLACK/BROWN	MAIN CABLE
18	RX	WHITE/BROWN	MAIN CABLE
17	TX	WHITE/VIOLET	MAIN CABLE
POWER CONNECTOR (J2)			
1	55 kHz OUT	GREEN	P1
2	50 kHz OUT	BLUE	P2
3	45 kHz OUT	RED	P3
4	62 kHz OUT	YELLOW	P4
5	C PHASE VOLTAGE SENSE	BLACK/YELLOW	MAIN CABLE
6	AC RETURN	GRAY	MAIN CABLE
7	A PHASE VOLTAGE SENSE	BLACK/RED	MAIN CABLE
8	AC POWER & B PHASE VOLTAGE SENSE	BLACK	MAIN CABLE
OUTPUT WIRE (J3)			
1	OUTPUT	RED	MAIN CABLE (J3)

1.4 Interface Cable

The interface cable assembly is supplied with two connectors and a rubber boot molded onto one end, six sealed two-wire rubber-covered cables, and a cable with a pressure seal containing loose wires at the opposite end. The rubber boot end is attached to the monitor transmitter. The six sealed two-wire rubber-covered cables are attached to switches outside the network protector as directed on the transformer installation drawing. The cable with the pressure seal containing loose wires is routed through the network protector case and attached inside the network protector (see Table 1.1 and Figure 2.1).

2. Hazeltine Equipment Installation**2.1 Transmitter**

Two transmitter mounting straps are provided. Clamp the transmitter to the support rack (Stock No. 687725) using the two mounting straps. Locate the mounting straps 10 inches apart.

2.2 Current Transformers (Three Required)

Install the Hazeltine Model 2358 CT on the non-polarized side of each phase of the network protector relaying CT's ("X" side).

2.3 Interface Cable

2.3.1 Connect the transmitter to the interface cable. The rubber boot end of the interface cable is attached to the transmitter by connecting the electrical plugs per Table 1.1 and Figure 2.1 in the following order:

- A. Connect the digital connector to the digital receptacle (J1 to P1).
- B. Connect the analog 2 connector (P5), located on the back of the digital connector (J1), to the appropriate internal or external analog 2 receptacle (J4 or J5), as required.
- C. Connect the frequency select plug (output wire - J3) to the back of the frequency select receptacle (power connector - J2). This J3 plug is to be installed to either P1, P2, P3, or P4 (green, blue, red, or yellow wires) as identified by the color code of the selected frequency.
- D. Install the frequency select receptacle to the back of the transmitter until it locks into place (J2 to P2).
- E. Slide the boot down over the transmitter housing as far as possible. Slide the boot clamp up over the boot and locate it squarely on the transmitter housing (no sideways twist). Tighten the boot clamp securely and mount the transmitter with the straps in the mounting brackets.
- F. Near the connector and boot end, six two-wire rubber-covered cables "break out" and can be routed separately to switch sensors located on the exterior of the transformer. Use switch terminals that are normally open (closed on detected abnormal condition) and seal the connections to make them waterproof. Of the six cables, three cables have the following color-coded sleeves and are used as follows:

Color	Flag Assignment	Connected to:
orange	"C" sensor	hermometer on transformer
yellow	"D" sensor	unused
green	"E" sensor	oil level gage on transformer

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- G. If the transformer has a dial-type thermometer with alarm contacts, connect leads from the Hazeltine's orange cable to the alarm contacts. Seal the connections to make them waterproof.
- H. If the transformer has a dial-type oil level gage with alarm contacts, connect leads from the Hazeltine's green cable to the alarm contacts. Seal the connections to make them waterproof.

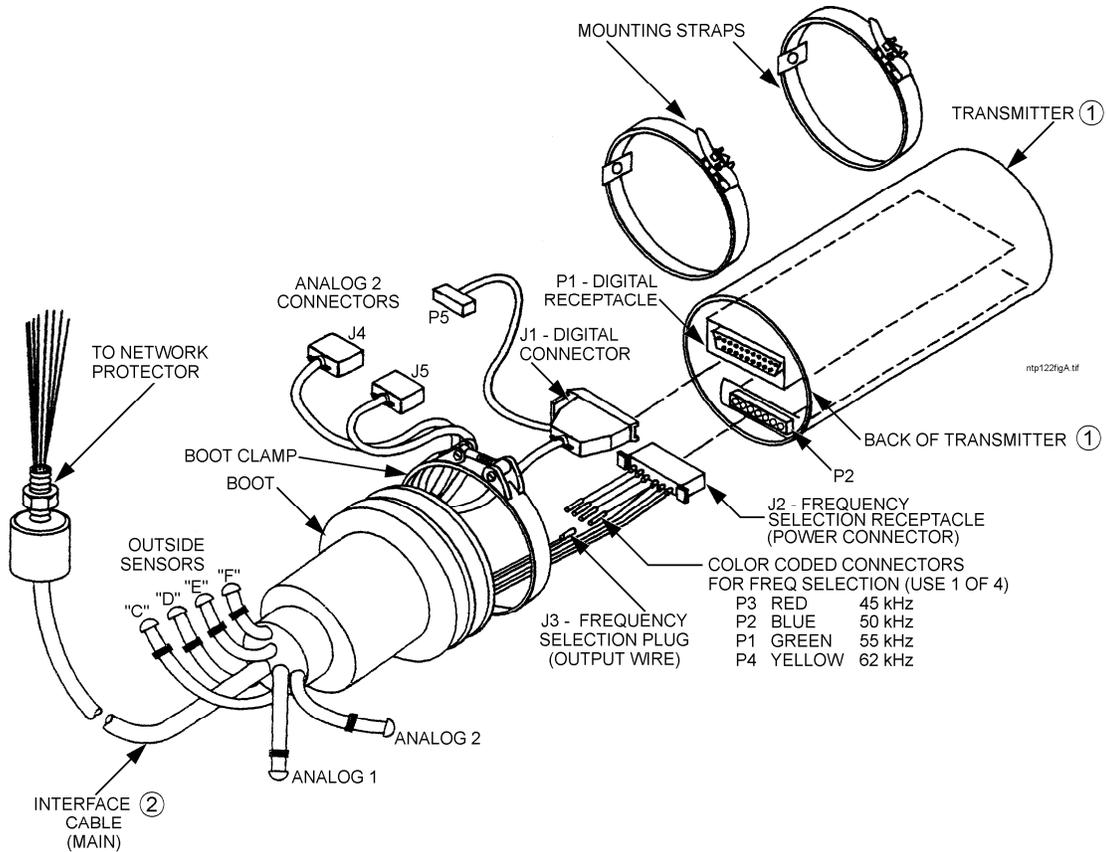


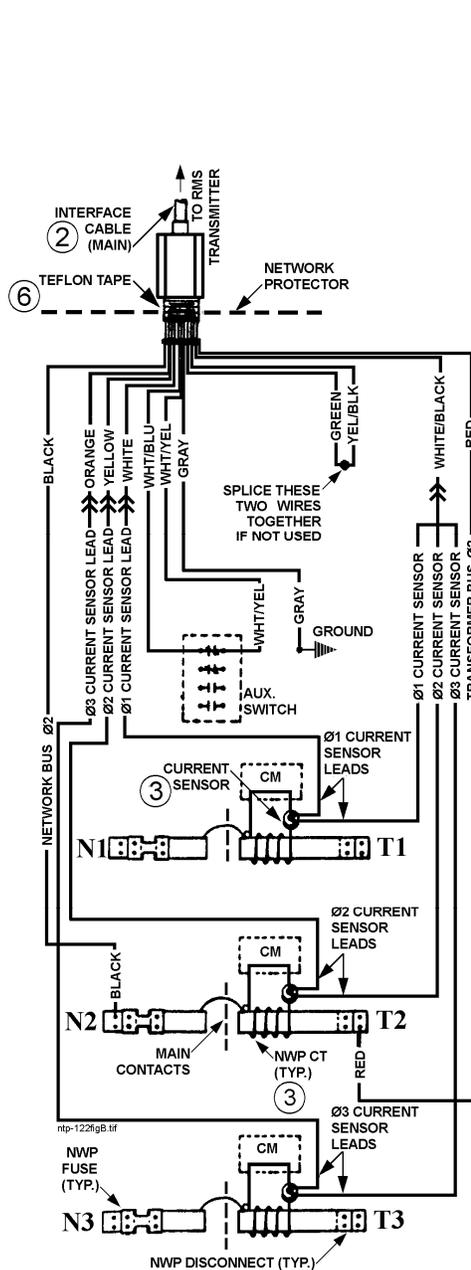
Figure 2.1, Transmitter, Frequency Selector Plugs, and Interface Cable Assembly

Table 2.1, Hazeltine Material List, Refers to Figure 2.1

Item No.	Description	Stock No.	Quantity
1	Transmitter, Remote, Model 2778, type "O3"	687701	1 each
2	Interface Cable (Main)	687717	1 each
3	Load Current Sensor, CT	687720	3 each
4	Support Rack	687725	1 each
5	Autotransformer, for 480V transformers	687730	1 each
6	Teflon Tape	736690	1 roll

2.3.2 Connect the interface cable to the network protector per Figure 2.1 and the following instructions:

- A. On all pre-1960 Westinghouse network protectors, installation of a microswitch, mounted on the left-hand arc-shoot barriers, is required to obtain a non-used switch position for Wht/Blu and Wht/Yel wires (see Figure 2.1).
- B. The loose wires must be passed through an opening in the network protector casing tapped for a 1/2-inch NPT so that the seal is maintained properly. The 17 color-coded wires entering the network protector are connected as follows (see Figure 2.3):



Black	Input power lead plus X2 phase voltage sense. Connect as directly as possible to the Phase 2 bus on the network side of the network protector (125V nominal). On 277/480V applications, connect to terminal No. 2 or black lead of the autotransformer (see Figure 4.1).
Black/ Yellow	X3 phase voltage sense. Connect as directly as possible to the phase X3 on the Network side of network protector. For installation on 277/480 transformers, connect wire to the 125-volt tap on the network autotransformer (not the heavy duty ones).
Black/Red	X1 phase voltage sense. Connect as directly as possible to the phase X1 on the Network side of network protector. For installation on 277/480 transformers, connect wire to the 125-volt tap on the network autotransformer (not the heavy duty ones).
Gray	Ground wire. Connect solidly to a good ground. On 277/480V applications, connect to terminal No. 3 or gray lead of the autotransformer and to a good ground (see Figure 4).
Red	Output lead. Connect as directly as possible to the Phase 2 bus on the transformer side (not the network side) of the network protector (125V or 277V).
Green, Yel/Blk	Connect these wires to the A sensor. If the A sensor is not installed, these two wires must be shorted together and taped securely.
Wht/Blu, Wht/Yel	Connect these wires to the B or P sensor, which is the unused auxiliary contacts on the network protector circuit breaker (either color to either connection). The connection to the auxiliary contacts must be such that the contacts are open when the network protector is closed, and closed when the network protector is open. For pre-1960 Westinghouse, use the microswitch installed in paragraph 2.3.2.A. This will cause report flag "B" when the protector is open.
Wht/Blk/Grn, Wht/Blk/Red	Wires for the G sensor. Currently unused. Short together and Tape off securely.
Wht/Blk/Blu, Wht/Blk/Gry	Wires for the H sensor. Currently unused. Short together and Tape off securely.
White	Splice and carefully tape this wire to one of the wires extending from the current transformer assembly for Phase 1.
Yellow	Same as above for Phase 2.
Orange	Same as above for Phase 3.
White/Black	Splice and carefully tape the remaining wire from each of the load current sensor assemblies to this wire.

Figure 2.2
Some of the Color-Coded Wire Connections

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Table 2.2 Material List, Refers to Figure 2.2

Item No.	Description	Stock No.	Quantity
2	Interface Cable (Main)	687717	1 each
3	Load Current Sensor, CT	687720	3 each
6	Teflon Tape	736690	1 roll

- C. Installation of an autotransformer is required when converting from 277/480V to 125/216V. The autotransformer is connected between the network side Phase 2 and the ground (see Figure 2).
- D. Outside NP sensors are Digital's (C, D, E, F) and also Analog's 1 and 2. Currently, only sensors "C" and "E" are being installed. In future, we will use more of the outside NP sensors for sending in alarms.

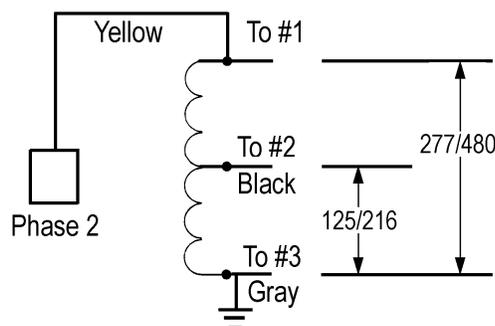


Figure 2.3 - Autotransformer Wire Connection
(Required for 480/277V Applications)

Table 2.3 Material List, Refers to Figure 2.3

Item No.	Description	Stock No.	Quantity
5	Autotransformer, for 480V Transformers	687730	1 each

3. Test Equipment

After the interface cable has been installed, it should be checked with a cable installation tester.

4. Programing the Hazeltine Model 2778 Transmitter, Type "O3"

Connect transmitter, computer, and cables. See Figure 4.

4.1 Start Program

Double click on shortcut to Xmt_pgmr.exe to start the program.

NOTE: YOU MAY TAB, POINT AND CLICK, OR HIT RETURN TO NEXT WINDOW.

4.2 Main Menu

In order to proceed to the transmitters main menu, you must first enter the following information in capital letters.

VAULT NO.	VS1234 TM3355 V 9853	:ENTER VAULT NAME BY NOMENCLATURE. :ENTERED IN THE FIRST LINE IN START MENU. :ALL ENTRIES MUST START AND CONTAIN A :"VS", "TM" or "V ". :VS, SUBMERSIBLE PROTECTOR. :TM, MANHOLE PROTECTOR. :V , OPEN PROTECTOR DRY INSTALLATION.
FEEDER NO.	1371	:ENTER NETWORK AND FEEDER NUMBER. :ENTERED IN SECOND LINE IN THE START MENU. :ANY ALPHA/NUMERIC ENTRY ACCEPTABLE.
PORT ON PC.		:ENTER THE PC COMM. PORT "1" or "2", IN THIRD :LINE IN THE START MENU.
QUIT		:TO QUIT CLICK OR TAB TO THIS WINDOW. :ENTER OR CLICK TO EXIT.
MAIN MENU:		CLICK OR ENTER TO PROCEED TO NEXT MENU.

NOTE: YOU MAY TAB OR POINT AND CLICK TO NEXT WINDOW.

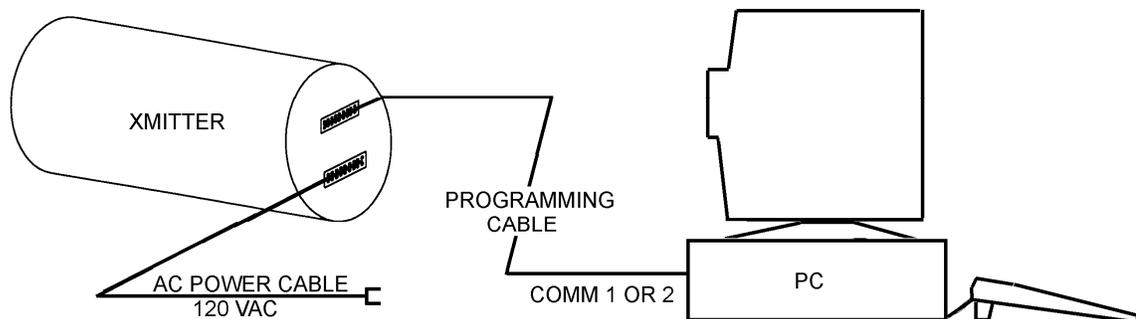


Figure 4.1, Connect Transmitter, PC, and Cables as Shown

EACH WINDOW FROM HERE ON HAS ITS OWN HELP MENU WHEN YOU ACTIVATE THE WINDOW.

4.3 ID Number:

In main menu, click or enter where pointer is located in "ID No." Control window. Now the ID help window is visible. The cursor is now set to first number in ID number window with the original ID number. Use delete key to remove old ID and then enter new ID number. Any invalid entries will be error flagged and automatically removed. Then click or tab to send or cancel. Click or enter on send and new ID will be programmed and verified into/from transmitter. The new ID located in ID control window.

NOTE: Click or enter on cancel and the old ID will remain in transmitter with old ID located in ID window.

Example:

ID No.	1 TO 1023	:* Transmitter ID, Replaces program card * Old feature implemented by using program card.
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4.4 Frequency:

To program frequency, click or enter on "frequency". Then enter the transmitter frequency red, blue, green, or yellow by typing in the lower left-hand box or clicking on the arrow selecting the required frequency.

To exit or program a new transmitter location, click or enter on that control window.

Example:

FREQ. R, B, G, Y :* Transmitter freq., Replaces program card

* Old feature implemented by using program card.

4.5 Output File:

Transmitter programmer output file "Log1" is created when you exit and save. The file is placed on your hard drive in the Trs_Con directory as Log1. To view this file using Windows Explorer, rename file to Log1.txt.

Example:

12-12-1996 14:14:32 :Date & Time Transmitter Was Programmed.

:This Is Inputted From The PC Date & Time

Vault Number - Tm1234

Feeder Number - 17m83

Id No. - 1000

(Call Network Engineering for the ID number.)

4.6 Examples of MODEL 2778 Settings:

CT Mult. - 120

(Call Network Engineering for the correct value.)

Current Thresh High - 120

Voltage Thresh High - 135

Voltage Thresh Low - 110

Analog1 Thresh - 100

Analog2 Thresh - 100

THIS FREQUENCY LINE IS VALID.

Transmit Frequency - BLUE

(Call Network Engineering for the correct frequency)

Flag Switches

Flag A Active On OPEN

Flag B Active On CLOSE

Flag C Active On CLOSE

Flag D Active On CLOSE

Flag E Active On CLOSE

Flag F Active On CLOSE

Flag B Off

Flag C ON

Flag D Off

Flag E ON

Flag F Off

Current Alarm ON

Over Voltage Alarm ON

Under Voltage Alarm ON

Analog1 Alarm OFF

Analog2 Alarm OFF

Pump Alarm ON

ALARM SENSE

Analog1 Thresh OVER

Analog2 Thresh OVER

ALARM ENABLES

Flag A Off

5. Analog Temperature Sensor, Digitalgrid Model DG-500 (Stock No. 012122)

Install vault temperature sensors anytime a new transformer or new transmitter is added in the field.

Operating temperature of sensors: -10°C to $+125^{\circ}\text{C}$

The sensors may be installed on either the analog 1 input or the analog 2 input.

To be consistent, select analog 1 for vault temperature and analog 2 for inside protector temperature.

Table 5.1, Temperature Sensor Wiring Details

Sensor Wire Color	Harness Wire Source
<i>External Mount of Sensor Using ANALOG 1 Input</i>	
RED	Red Wire on Violet , Tagged Aux Cable
PURPLE	White Wire on Violet , Tagged Aux Cable
BLACK	Black Wire on Violet , Tagged Aux Cable
<i>External Mount of Sensor Using ANALOG 2 Input</i>	
RED	Red Wire on Blue , Tagged Aux Cable
PURPLE	White Wire on Blue , Tagged Aux Cable
BLACK	Black Wire on Blue , Tagged Aux Cable
<i>Mounting Inside Network Protector of Sensor Using ANALOG 2 Input</i>	
RED	White / Red
PURPLE	White / Orange
BLACK	White / Gray

5.1 Set Up

Install the AC power plug (J2) to transmitter (P2).

Connect programming cable to the transmitter (P1).

Run transmitter programming software from PC per Appendix A, as referenced in operating handbook. Reference the following sections, pages A3 and A4.

5.2 Transmitter Programing

The information below is based on factory settings. Contact Network Engineering for new threshold values.

ALARM

Analog 1: thresh: 100 :Threshold temperature level for input 1

Analog 1: thresh: AE :Alarm Enable, set to on or off.

ALARM

Analog 2: thresh: 100 :Threshold temperature level for input 2

Analog 2: thresh: AE :Alarm Enable, set to on or off.

ANALOG 1 Threshold: Alarm will occur over or under a set threshold, over/under

ANALOG 2 Threshold: Alarm will occur over or under a set threshold, over/under

Program "analog 1 or 2" with the "thresh" number to convert to temperature sensor in degrees C output from the transmitter to get an alarm from the receiver. **Set "thresh" number to alarm at 40 degrees C for vault temperature. Assign analog 1 unless specified by a Network engineer.**

Disconnect programming cable from transmitter (P1).

6. Location of Analog Temperature Sensor for Ambient Temperature

Install one analog sensor for every new transformer, per the following details. Existing transformers may be retrofitted per engineering job orders.

6.1. For all of the street transformer vaults:

The analog temperature sensor may be placed **above** the network protector, near the heat sensor location. Connect the sensor to the transmitter's analog 1 alarm. See Figure 6.1. In the year 2005 and beyond, new NTP may be developed to enhance temperature readings for single transformer vaults (i.e., terminating the signal wire between the network protector fuse and the vault bus bars.).

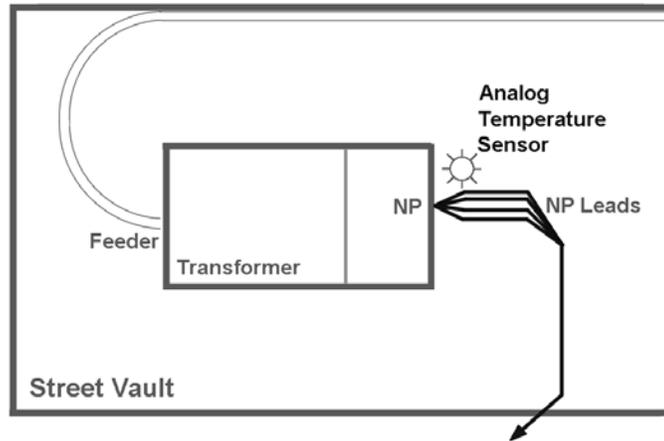


Figure 6.1, Street Transformer Vaults

6.2 For New In-Building Vaults with Only One Transformer:

The analog temperature sensor may be placed **above** the network protector, near the heat sensor location. Connect the sensor to the transmitter's analog 1 alarm. See Figure 6.2. In the year 2005 and beyond, new NTP may be developed to enhance temperature readings for single transformer vaults.

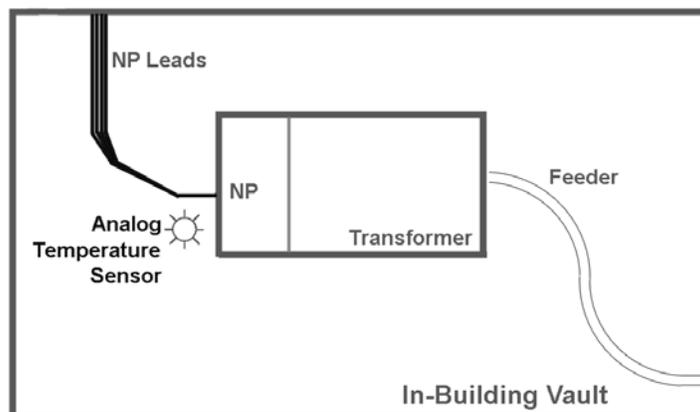


Figure 6.2, New, In-Building Vault - One Transformer

6.3 For In-Building Vault with Two or More Transformers:

Select any **two** transformers for the temperature sensor installation location. Place the temperature sensor **above** the network protector, near the heat sensor location. Connect the sensor to the transmitter's analog 1 alarm. See Figure 6.3.

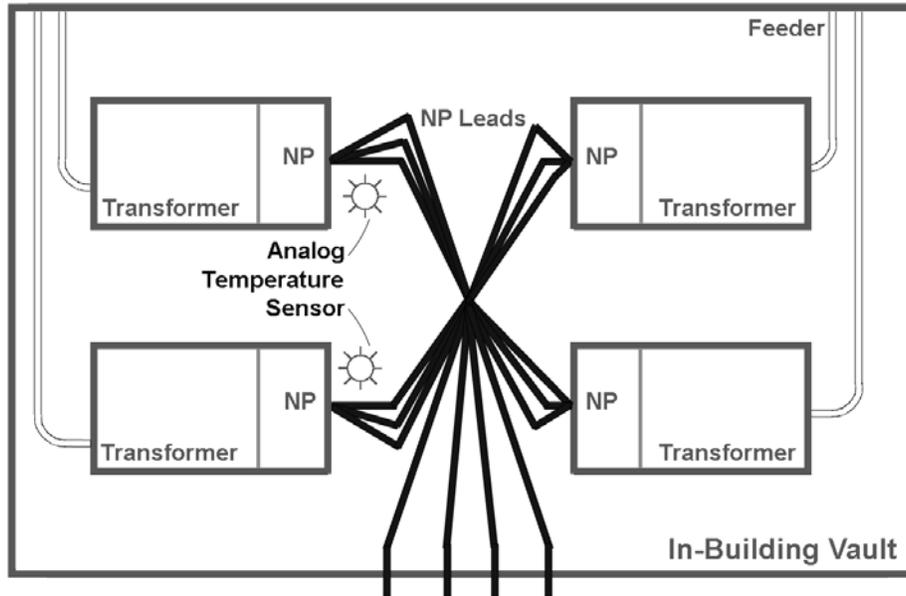


Figure 6.3, In-Building Vault - More than One Transformer

7. Float Sensors

Stock Recommendations have been sent for new float sensors. Please contact Network Engineering for locations that may need float sensors. A probable installation point is at the bottom of the primary switch chamber (outside of the transformer).