GTI SERVICE NOTE

GTI 127 **January 23, 2018**

GW5 Watt Transducer Troubleshooting Guide

This guide is intended to assist the service technician with determining the cause of various problems with the installed Flex-Core watt transducer. When troubleshooting, please read and follow the warnings contained in the section labeled "WARNINGS".

WARNINGS:

- Never work on a live circuit. Short the secondary leads of current transformers that are not connected to transducers, meters, relays, or other proper load.
- **NEVER LEAVE A CURRENT TRANSFORMER SECONDARY OPEN IF IT IS INSTALLED ON A LINE.**
- Never install a fuse in a CT secondary circuit!
- Make certain the transducer is rated for the voltage and current for the circuit. Call the factory if you have any questions.
- Use #14 or heavier gage wire for current transformer circuits.
- If you are using both potential and current transformers on voltages higher than 600 volts, ground the secondary lead (X2 lead) to a solid earth ground. Call the factory for assistance.
- Keep signal wires separate from supply lines.
- Self-powered transducers have limited voltage ranges. Please refer to the specification sheet or call the factory.
- Check with the factory before using alternative wiring schemes.

Sections in this Guide

1. Read the General Information section.
2. Read the section that fits the model of watt transducer you are using:
   - **GW5 3 Phase, Two-Element**
   - **GW5 3 Phase, Three-Element**
3. If you have one of the three problems listed below, read that section:
   - **No Output**
   - **Low Output**
   - **Reverse Output**
4. Things that are not problems but that one needs to know:
   — The How To's:
   - Calculating full-scale power when using a transducer with current and/or voltage (potential) transformers. See Section Labeled How To's
   - What type of signal cable should be used?
   - Limitation on current transformer leads.

General information

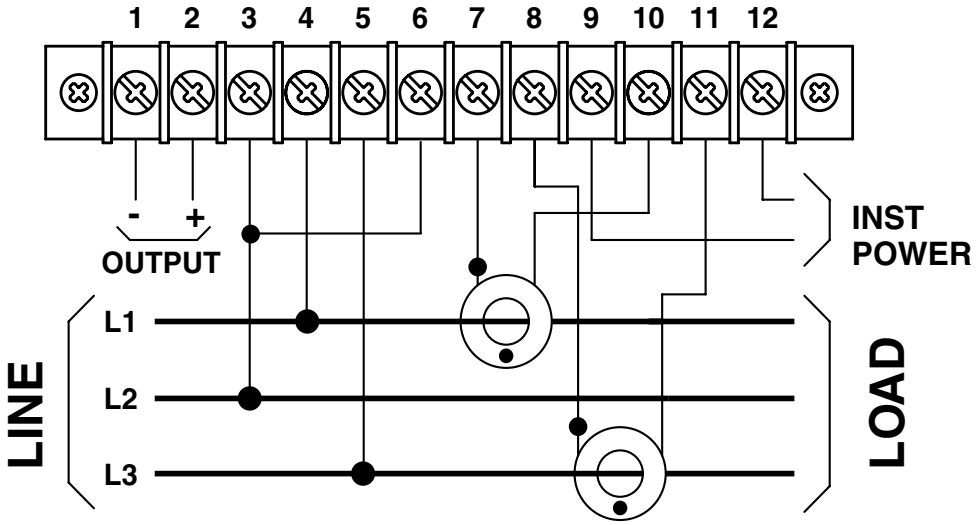
- Watt transducers are both phase and polarity sensitive. Incorrect phasing or incorrect positioning of current transformers (CTs) and/or voltage transformers (PTs) will cause the transducer to register incorrectly.
- The transducer must measure both voltage and current as delivered to the load being measured.
- The number of elements refers to the number of multipliers in the watt transducer.
    - 1 element for single-phase, two-wire connections.
    - 2 elements for single-phase, three-wire and for three-phase, three-wire connections.
    - 3 elements for three-phase, four-wire connections.
- Most watt transducers require Instrument power. This may be a separate AC source (230VAC, 115VAC) or it may be taken from the lines monitored. Models vary. Check the model number that you have.
- Watt transducers with analog outputs are easy to check by measuring the analog signal.
- It cannot be emphasized enough — Check and double check wiring for correctness. **Phasing and polarity must be correct.**

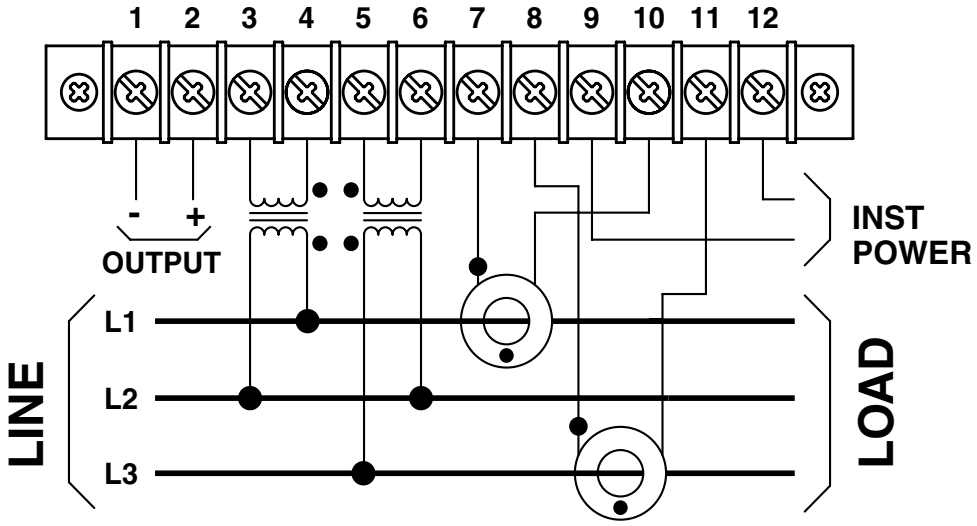
The following pages give instructions for wiring and inspection of the exactness of wiring connections.

GW5 Three-Phase, Two-Element

- Connect L1 CT to terminals 7 & 10 with the X1 lead on terminal 7 and the H1 or dot on the body of the transformer facing the line or source.
- Connect the L1 voltage to terminal 4.
- Connect the L3 CT to terminals 8 & 11 with the X1 lead on terminal 8 and the H1 or dot on the body of the transformer facing the line or source.
- Connect the L3 voltage to terminal 5.
- Connect the L2 or neutral (if single-phase, three-wire) conductor to terminals 3 and 6.
- The L1 CT connected to terminals 7 & 10 must be on the same line that is connected to terminal 4.
- The L3 CT connected to terminals 8 & 11 must be on the same line that is connected to terminal 5.
- The analog signal is on terminals 1 & 2. Terminal 2 should be positive.

  If terminal 2 is negative, verify that the polarity dot or the H1 on the CT faces the line or source. Also verify that the X1 leads go to terminal 7 for L1 and terminal 8 for L3.





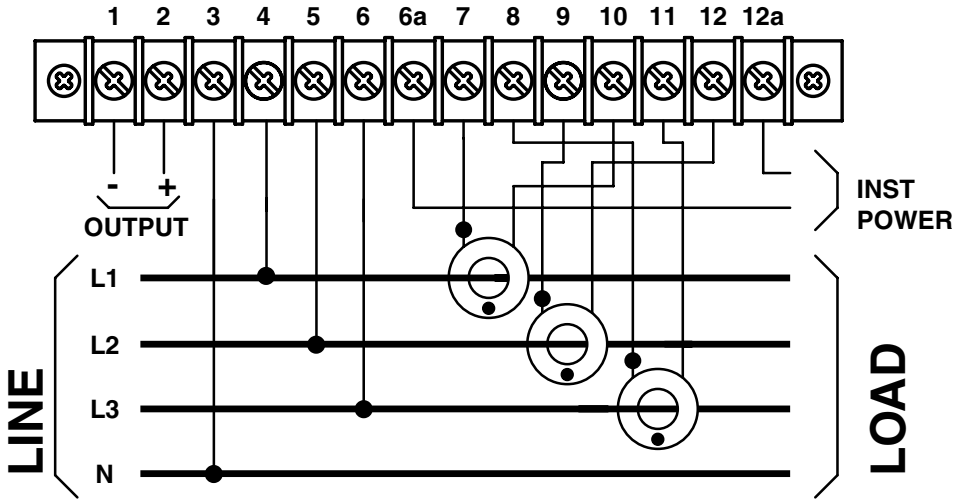
GW5 Three-Phase, Three-Element

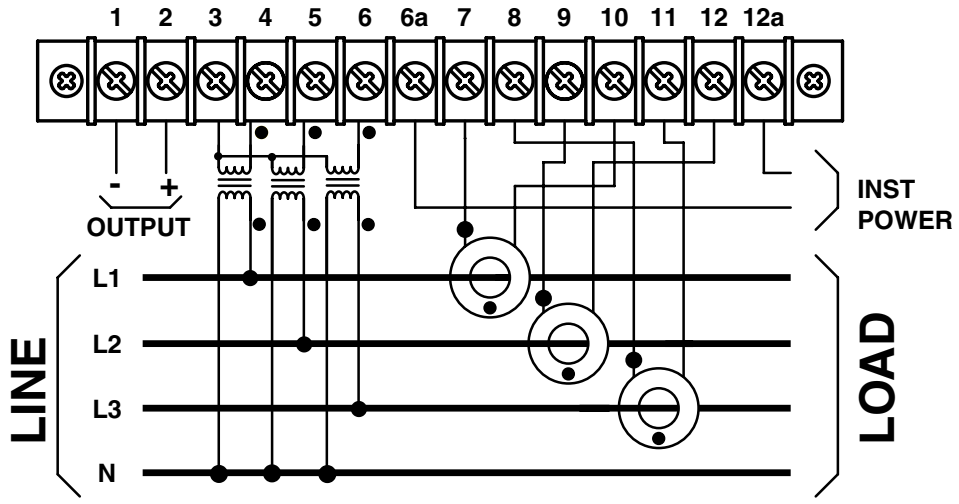
- Connect the L1 CT to terminals 7 & 10 with the X1 lead on
- Connect the L2 CT to terminals 9 & 12 with the X1 lead on terminal 9.
  Caution: Note that the L2 CT connects to 9 & 12 and not 8 & 11. This is a common error.
- Connect the L3 CT to terminals 8 & 11 with the X1 lead on terminal 8.
- Connect L1 voltage to terminal 4.
- Connect L2 voltage to terminal 5.
- Connect L3 voltage to terminal 6.
- Connect the neutral to terminal 3. This must be connected if the transducer has output option A, C, CX5, or EG.
- The L1 CT must be on the same line that is connected to terminal 4.
- The L2 CT must be on the same line that is connected to terminal 5.
- The L3 CT must be on the same line that is connected to terminal 6.
- The analog signal is on terminals 1 and 2. Terminal 2 should be positive.
- If 2 is negative, check to ensure that the polarity dots or the H1's on all the current transformers are facing the line or source. Also check that the white or X1 leads go to 7, 9, & 8 for L1, L2, and L3 current transformers. If PTs are used, make certain that the H1 leads go to L1, L2, and L3 and that the X1 leads go to terminals 4, 5, & 6 respectively on the transducer.
- If there is no analog output or pulse output and the transducer has output option B, D, X5 or E check for 120 volts AC instrument power on terminals 6A & 12A. For self-powered models the line voltage must be within the following range limits:

Nominal Input Rating	Range for GW5	Range for GH
120 volts (150 volt models)	85 to 135 volts	85 to 135 volts
240 volts (300 volt models)	85 to 135 volts	85 to 135 volts
480 volts (600 volt models)	85 to 135 volts	85 to 135 volts

- If the analog output is +1/3 of what it should be, check for a reversed current transformer.
- If the analog output is -1/3 0f what it should be, check for two reversed current transformers.

****The biggest cause of confusion for the 3-element GW5 transducers is the order of connections for the current transformers.**


1 2 3 4 5 6 6a 7 8 9 10 11 12 12a
- +
OUTPUT
INST
POWER
L1
L2
L3
N
LINE
LOAD


1 2 3 4 5 6 6a 7 8 9 10 11 12 12a
- +
OUTPUT
INST
POWER
L1
L2
L3
N
LINE
LOAD

No Output

- Instrument power? If this is a transducer requiring separate instrument power, is power applied? Output options B, D, E, and X5 all require instrument power of 120 volts except -22 or -52 models — these require 220 or 240 volts.
- If the output is 4 to 20mA DC and there is 0-output and instrument power is supplied — check the polarity of the current transformers. They may be reversed.
- If the transducer is a two-element model, check the current transformers. One may be reversed. The two elements may be canceling each other.
- Check the meter of instrument with which you are reading the output of the transducer. Is it working properly?
- **Warning — never open the secondary leads of current transformers when primary current exists.**

  Very bad things can happen! Death, explosion, shock . . .

Low Output

SINGLE ELEMENT

- Not much can go wrong. If the load is inductive, a motor load for example, low power factor is likely the cause.
- Check the analog output directly with a DC meter. Look out for the milliampere readings. Often the fuse is blown on multi-meters.

  This causes the meter to read the open circuit voltage rather than current. Our technicians prefer to use a load resistor and read the voltage drop across the resistor. Use a 250-ohm resistor for 4 to 20mA DC outputs.

  With a 250-ohm resistor across a 4 to 20 mADC output the digital meter should read 1 to 5 volts DC.

TWO ELEMENT

- Check the single element reasons first.
- The most common problem is that one of the current transformers is reversed.
- The second most common problem is that the voltage connections do not agree with the current transformers — a phasing problem.

  Make certain that all voltage taps agree with the current transformers.

THREE ELEMENT

- Check the single element reasons first.
- If the reading is 1/3 of what it should be, one of the current transformers is on backwards.
- Make certain that the voltage taps agree with the current transformers.

Reversed Output (Analog)

TWO ELEMENT

- If the output is at the expected level but reversed in polarity, reverse both current transformers.
- If the output is just slightly negative, one of the current transformers may be reversed or the phasing of the voltage connections is incorrect.
- If the output is negative when a motor is lightly loaded but goes positive when the motor is fully loaded, one of the current transformers may be reversed or the voltage is incorrectly connected.

THREE ELEMENT

- If the output is at the expected level but reversed in polarity, reverse all three current transformers.
- If the output is 1/3 the expected level and reversed in polarity, two of the current transformers are reversed.
- The three-element transducer is easy to check:
    1. Disconnect two of the voltage leads leaving the neutral and one phase connected.
    2. With a load the transducer should produce a positive analog output.
    3. If the output is positive, confirm that the remaining voltage lead attached is on the same line as the current transformer for that phase. If the output is negative, reverse the current transformer for that phase.
    4. Reconnect the second voltage lead. The output should increase. Check for agreement between the CT and voltage connection. If the output decreases, reverse the CT for that phase.
    5. Reconnect the third voltage lead., the output should increase. If it decreases, reverse the CT for that phase.

THINGS TO KNOW: CURRENT TRANSFORMERS

CURRENT TRANSFORMER LEAD LENGTH

- The best rule of thumb for current transformer lead length is:
  Keep the lead as short as possible.
- Current transformers cannot withstand much loading on the secondary. This load is typically expressed in VA or volt-amperes.
- Transducers that require a current input from current transformers are likewise rated. The sum of the VA loads (burdens) on a current transformer must be less than the rating on that current transformer.
- Use the chart below as a general rule for a single load on a current transformer. If more than one load is on the transformer, divide the distance by the number of loads.

Primary Current	10 AWG Wire	12 AWG Wire	14 AWG Wire
100 amps	20 feet	15 feet	10 feet
200 to 400 amps	40 feet	30 feet	20 feet
600 amps, or more	80 feet	60 feet	40 feet

CURRENT TRANSFORMER MARKINGS

- A current transformer body is marked with an H1 or a dot on one face and an H2 on the opposite face. The H1 or dot on the body of the current transformer should face the line or source of the voltage.
- The secondary leads or terminals are labeled X1 and X2. The X1 corresponds to the polarity of the H1 or dot on the body of the current transformer. On all OSI current transformers, the white lead is X1.
- **Remember: Loads on current transformer secondaries are connected in series.**

THINGS TO KNOW: SIGNAL LEAD LENGTH

- Keep signal lead lengths as short as practical.

What are practical lengths?

- For voltage signals — 10's of feet.
- For 4 to 20 mADC signals — 1000's of feet.
- Recommend using a signal cable that consists of a shielded, twisted pair of # 22 or 24 wire.
- Ground the shield at the receiving end only.Do not connect the shield at the transducer can.

Noisy Environment?

- Shorten lead length.
- Ground the shield at the receiving end.
- Ground the case.
- Use a load resistor at the receiving end of voltage signals. Try a 10,000-ohm resistor.
- Consult factory if problem continues.

HOW TO'S

HOW TO CALCULATE THE FULL SCALE POWER OF A TRANSDUCER WHEN CTS AND VTS ARE USED.

- Find the full-scale calibration on the label of the watt transducer.
- If only a CT is being used, multiply the full scale rating by the CT ratio.
- If both a CT and VT are being used, multiply the full scale rating by both the CT and VT ratios.
- Example 1: A GW5-004A has a full scale rating of 1000 watts. It is being used with 1000/5 current transformers.

  Multiply 1000 watts by 1000/5 or 1000 X 200 = 200,000 watts.
- Example 2: A GW5-004A has a full scale rating of 1000 watts. It is being used with 300/5 current transformers and 4200/120 voltage transformers.

  Multiply 1000 watts by 300/5 and 4200/120 or 1000 X 60 X 35 = 2,100,000 watts

This guide was edited from a troubleshooting guide created by Ohio Semitronics Inc. It has been modified for the troubleshooting of the GW5 watt transducers.