



8420,8421 MEMORY HILOGGER

User's Guide

(Concerning Noise Countermeasures)

1. Mechanism of Noise Introduction into Thermocouple Temperature Measurements

● What are the sources of noise?

Within a factory, power is provided by large current flows at 50/60Hz. The main loads are primarily L loads, such as motors and solenoids; in addition, large current pulses are produced by capacitor input-type switching power supplies for equipment such as inverters and high-frequency induction furnaces. Basic wave component leak current, harmonic wave current, and other types of noise become mixed into the flow from each ground point to ground lines.

● What are the paths of noise propagation?

- * Common mode voltage introduced between the ground points of the equipment being tested and the tester leaks to the input signal lines
- * AC magnetic fields produced by current in power lines couple into loops in the input signal lines
- * Coupling due to electrostatic capacitance between input signal lines and power supply lines

● What is common mode noise?

Noise that is generated between ground and the "+" and "-" input terminals of the tester

● What is normal mode noise?

Inter-line noise that is generated between the "+" and "-" input terminals of the tester

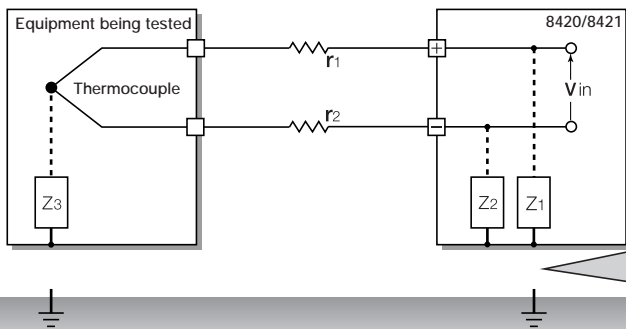


Fig. 1 Example of Connections Where Noise Can Affect Measurements

When using a thermocouple to measure temperature, noise can affect measurements unless both the equipment being tested and the tester are grounded. Although there is no problem if the tester is running on battery power, the tester must be connected to ground if an AC adapter is being used.

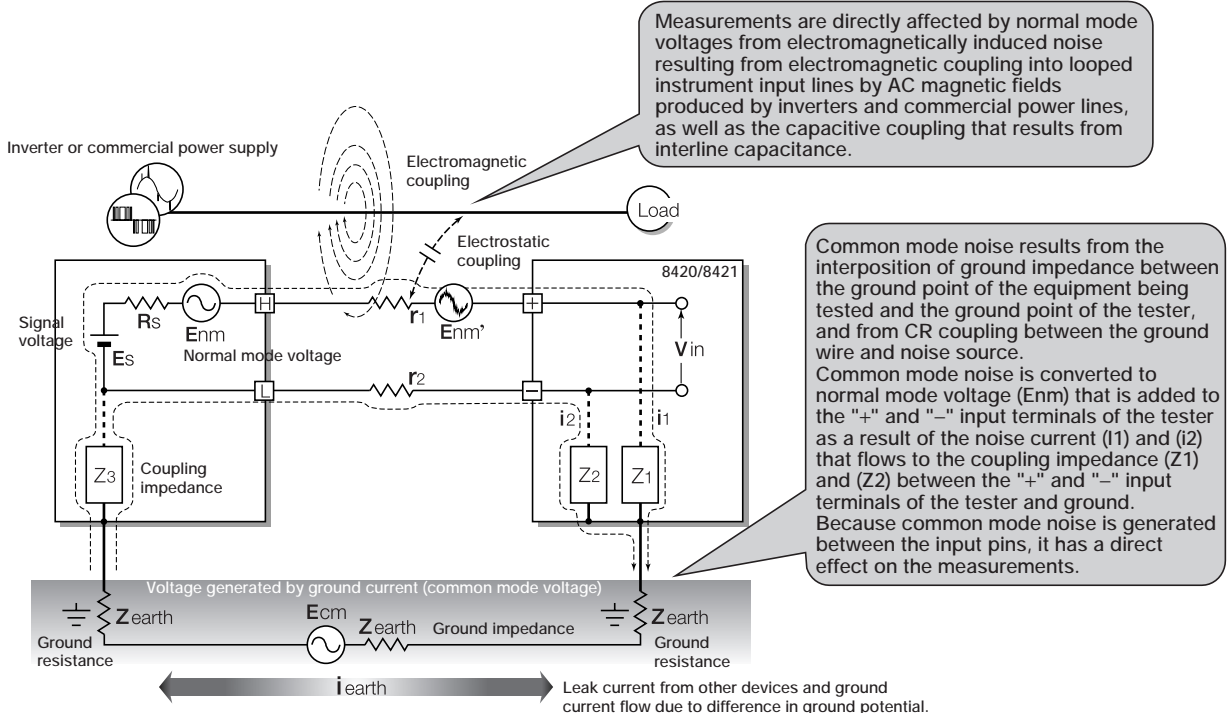


Fig. 2 Equivalent Circuit of Noise Introduction Path

Measurements are directly affected by normal mode voltages from electromagnetically induced noise resulting from electromagnetic coupling into looped instrument input lines by AC magnetic fields produced by inverters and commercial power lines, as well as the capacitive coupling that results from interline capacitance.

Common mode noise results from the interposition of ground impedance between the ground point of the equipment being tested and the ground point of the tester, and from CR coupling between the ground wire and noise source. Common mode noise is converted to normal mode voltage (E_{nm}) that is added to the "+" and "-" input terminals of the tester as a result of the noise current (I_1) and (I_2) that flows to the coupling impedance (Z_1) and (Z_2) between the "+" and "-" input terminals of the tester and ground. Because common mode noise is generated between the input pins, it has a direct effect on the measurements.

2. The Importance of Equipment Grounding

● Ground the tester (8420/8421) securely

The 8420 and 8421 can both be powered through an AC adapter. The tester is designed so that the chassis is grounded when the three-prong power cord from the adapter is plugged directly into a grounded, three-prong receptacle.

If a three-prong-to-two-prong adapter must be used on the AC adapter power cord and therefore the tester is not grounded, the tester can still be grounded by connecting a grounded wire to the GND terminal (a pushbutton terminal) located on the side of the 8420/8421.

● Securely ground the chassis of the equipment being tested.

Securely connect the chassis of the equipment being tested to a good ground.

● Connecting the chassis GND on the signal side to the tester chassis

When connecting the chassis ground of the 8420/8421 to the chassis ground of the equipment being tested and then to ground, use a wire that is as short and as thick as possible to bring both pieces of equipment to equal potential.

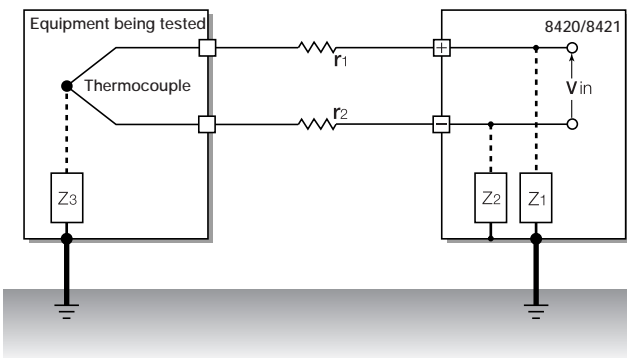
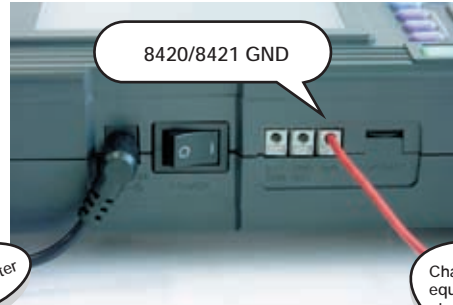
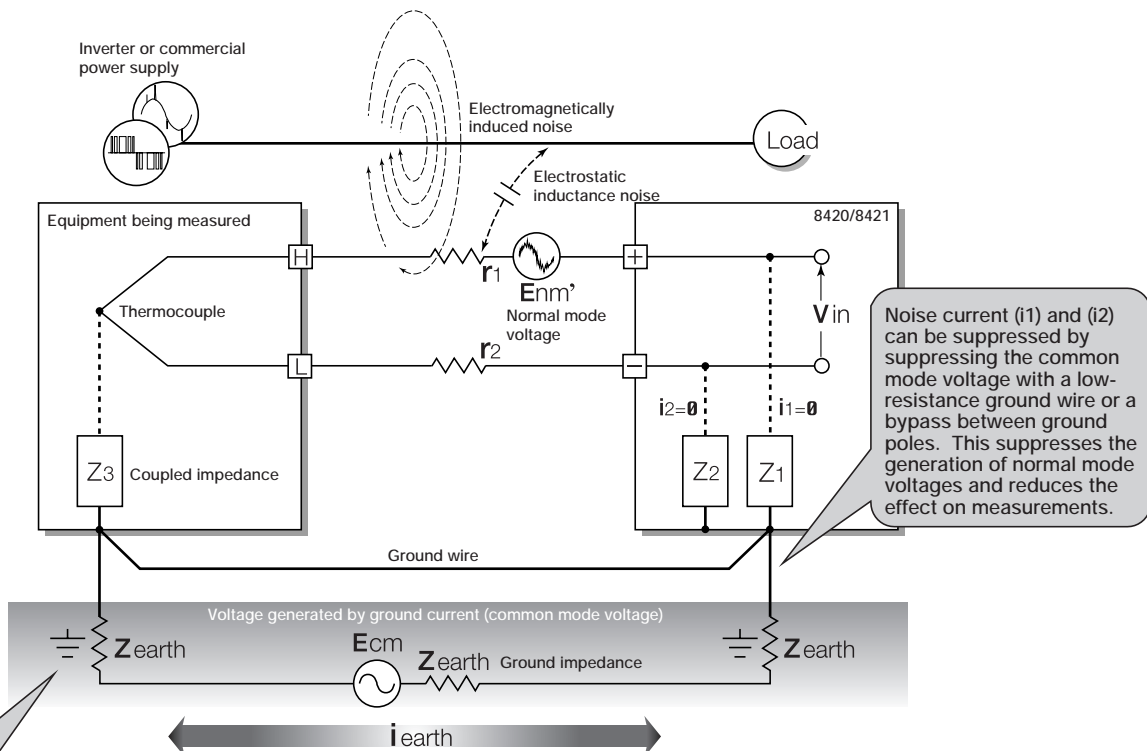


Fig. 3 Grounding Both the Equipment Being Tested and the Tester



● Running the tester (8420/8421) on battery power

When the tester is being powered by batteries and the AC adapter is not connected, the ground current loop is eliminated, making it possible to reduce the effects of common mode noise. For measurements of short duration, powering the 8420/8421 with batteries is an effective method for eliminating noise.



Noise current (i_1) and (i_2) can be suppressed by suppressing the common mode voltage with a low-resistance ground wire or a bypass between ground poles. This suppresses the generation of normal mode voltages and reduces the effect on measurements.

Connect the chassis GND on the signal side to a good ground with a sufficiently low ground resistance. If there is still a large amount of noise, it may be possible to reduce the effects of common mode voltage by connecting a bypass ground wire to the GND terminal on the tester.

Fig. 4 Common Mode Noise Countermeasures

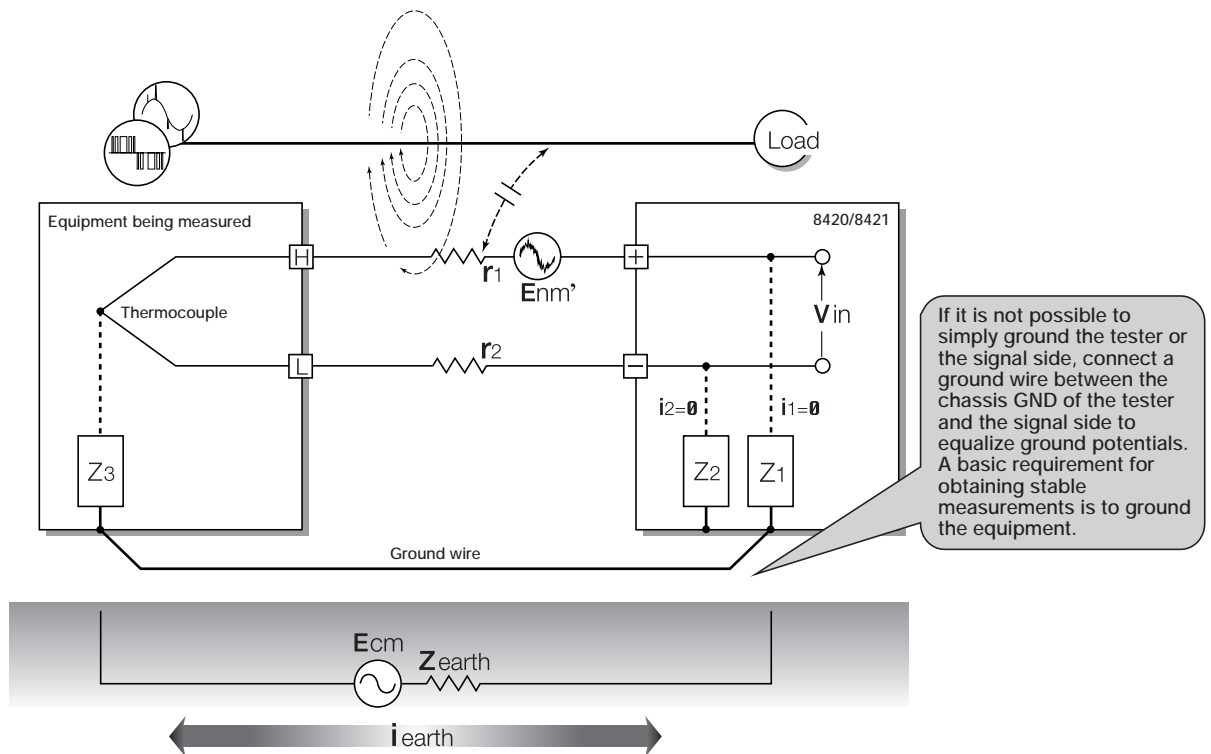


Fig. 5 Common Mode Noise Countermeasures

3. Blocking Noise from External Sources

● **Keep signal lines away from noise sources**

Keep input signal lines (of the thermocouple) away from wiring that is a noise source (such as power lines, etc.), and make any permanent installation with as much separation as possible; for example, by running wires through a separate duct.

● **Use shielded twisted pair wiring**

It is effective to use shielded twisted pairs for the input signal lines (of the thermocouple). Twisted pairs are effective for preventing electromagnetic induction, and shielded wires are effective for preventing electrostatic induction.

The shielded wires should basically be grounded on the signal source side. If it is not possible to connect the signal source to ground, connect it to the chassis GND on the 8420/8421. Note that doing so has no effect if the 8420/8421 is not itself connected to ground through the three-prong power cord, etc. Shielded twisted pair wires for the thermocouple can be obtained from thermocouple manufacturers, such as Asahi Sangyo Corporation (Japan).

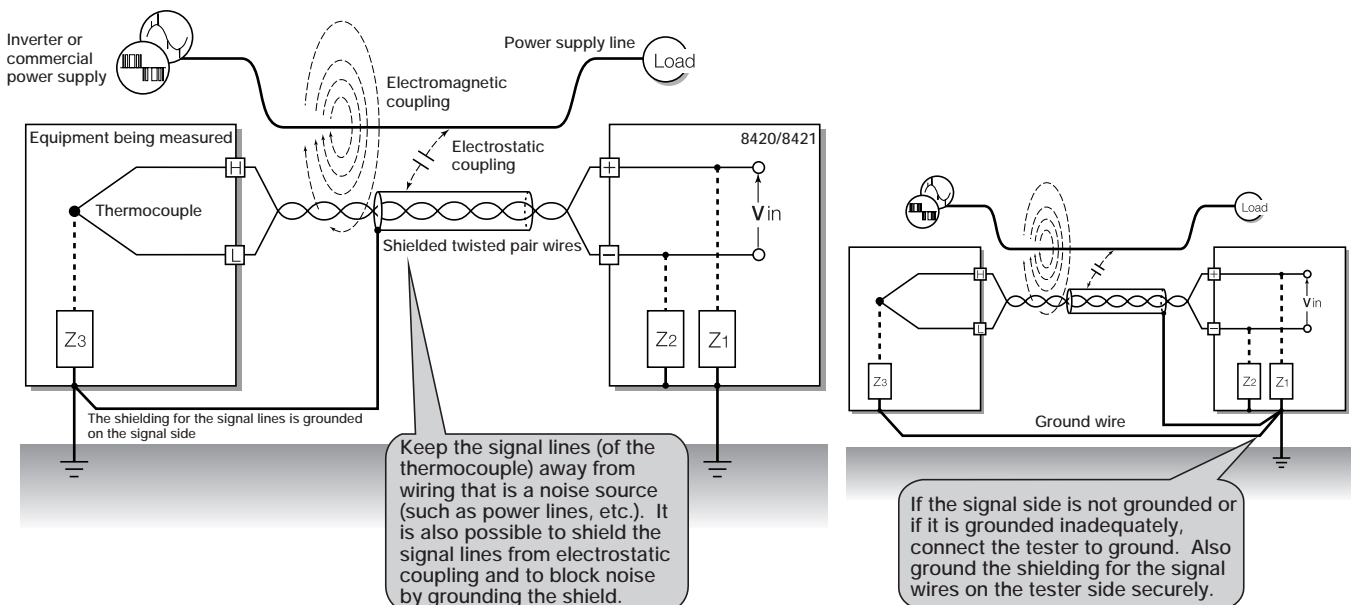


Fig. 6 Normal Mode Noise Countermeasures

● Insulation from noise sources
(temperature measurement by thermocouple)

Because each input terminal and the circuit GND (the chassis) are insulated from each other by a Photo-MOS relay, and the input system consists of a differential amp, the 8420/8421 is designed with an extremely high circuit ground coupling impedance $Z1$ and $Z2$. Therefore, although it is possible to take measurements by directly applying the thermocouple to a conductor with electric potential, in a situation where noise has a large effect it is effective to insulate the thermocouple by wrapping it with heat-resistant tape, or to use an ungrounded thermocouple and insulate the input line.

4. Applying a low-pass filter in the input stage

● Using the tester's built-in equalization processing and filter functions

The filter functions of the 8420/8421 include equalization within a recording interval and the ability to set a hard filter. Equalization within a recording interval refers to data addition equalization processing every 100ms. The hard filter is a low-pass filter with a cutoff frequency of 1.5Hz. Because this filter is applied after each channel in the circuit configuration has been scanned, it is best if the recording interval setting is longer than one minute.

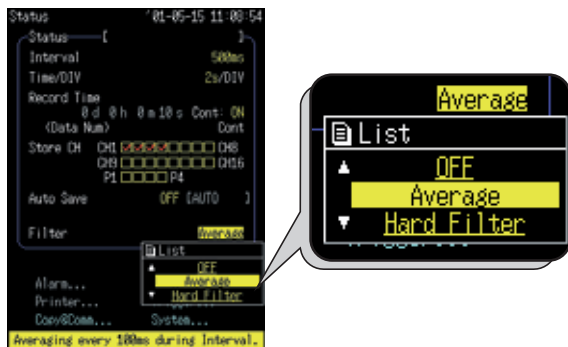


Fig. 7 8420/8421 Setting Screen

● Inserting a capacitor in the signal line

When noise affects the signal source directly or when measuring high-frequency pulses, it is effective to insert a capacitor between the "+" and "-" input terminals so that the noise does not enter the 8420/8421. When inserting a capacitor, use one with a rated voltage that is equal to or exceeds the input voltage. When a capacitor is inserted between the "+" and "-" input terminals, there are no restrictions on the recording interval because the filter is applied before the channel scan operation.

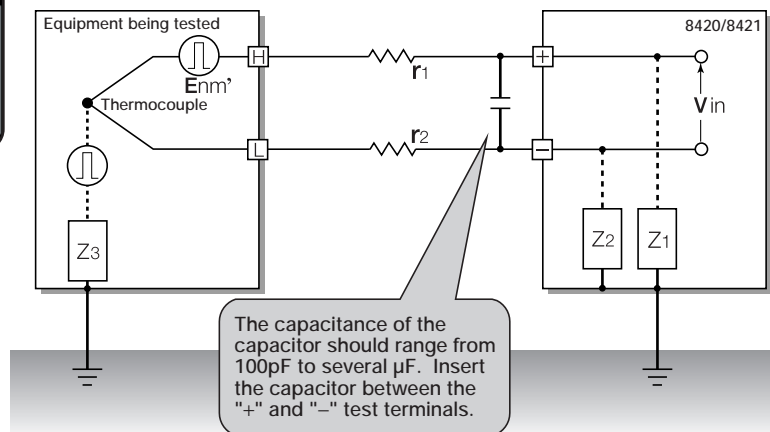


Fig. 8 Effective for Eliminating Pulse Noise



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HIOKI E. E. CORPORATION

HEAD OFFICE :
81 Koizumi, Ueda, Nagano, 386-1192, Japan
TEL +81-268-28-0562 / FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp

HIOKI USA CORPORATION :
6 Corporate Drive, Cranbury, NJ 08512 USA
TEL +1-609-409-9109 / FAX +1-609-409-9108
E-mail: hioki@hiokiusa.com

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