

## Application Note #1239: GP4000 Series COM Port Grounding Information

### Introduction

This document will discuss performance issues with communication using the COM2 ports on the GP4000 series, the possible causes, and available countermeasures.

**Note:** Throughout this document, you will see text formatted like [this<sup>n</sup>](#). These are hyperlinked web pages that will provide additional information regarding the associated topic. The 'n' superscript ( <sup>n</sup> ) will be the citation source number. Refer to the **Appendix A: Works Cited** section for more information.

### Acronyms

Throughout this document, there are several acronyms that will be used. To ensure that the information included in this document is clear and concise, explanations and/or background information for any acronyms used are listed below:

- CE: [CE Marking](#) <sup>[1]</sup>
- EMC: [Electromagnetic Compatibility](#) <sup>[2]</sup>
- EMI: [Electromagnetic Interference](#) <sup>[3]</sup>
- ESD: [Electrostatic Discharge](#) <sup>[4]</sup>
- FG: [Frame \(Chassis\) Ground](#) <sup>[5]</sup>
- GND: [Ground \(Earth Ground\)](#) <sup>[6]</sup>
- GPD: [Ground Potential Differences](#) <sup>[7]</sup>
- HBM: [Human Body Model](#) <sup>[8]</sup>
- IC: [Integrated Circuit](#) <sup>[9]</sup>
- SG: [Signal Ground](#) <sup>[5]</sup>
- SELV: [Safety Extra Low Voltage](#) <sup>[10]</sup>
- STP: [Shielded Twisted Pair](#) <sup>[11]</sup>
- UTP: [Unshielded Twisted Pair](#) <sup>[12]</sup>

**Note:** In this document, "GP" refers to the Pro-face GP4000 series HMIs, unless otherwise stated.

### A Note About COM1 Ports

While this application note discusses the COM2 port specifically, the information in this document can also apply to the COM1 port of the GP4000 series HMIs. The reason that the focus is on the COM2 port is because there is a greater chance of this type of communication failure occurring on the COM2 port than the COM1 port. This is because the COM1 port is configured for RS-232 communication, which is typically used for "short-range" (50ft. or less) communication between devices. The COM2 port is configured for RS-422/485, which is used for longer range communication (RS-422: 4,900 ft. max; RS-485: 4,000ft. max) between devices. Therefore, due to the possible causes of this particular communication error (see below), the COM2 port has a higher chance of encountering these issues.

## Background

The performance issues stem from external surges and/or static electrical charges that affect the COM port IC on the I/O control board installed in the GPs. The IC static electrical charge immunity is 15kV, but high electrical surges (caused by lightning strikes, brownouts, electrical spikes from external machinery, etc.) can cause the COM port IC to overload and burn out which causes communication failure.

In addition, the same failure can be caused by improper wiring of the COM port. In one case, a customer connected a GP4000 HMI to a Siemens S7-300 via the GP's COM2 port. The customer built the cable themselves, with the PLC +24V and -24V power outputs connected to the signal lines (Tx & Rx) of the GP's COM2 port. This resulted in the COM2 IC to eventually burn out, causing a communication failure.

## GP4000 Series COM2 & FG Connection Notes

- The GP4000 series has EMC/EMI performance that satisfies CE requirements and international standards.
- The GP4000 series FG & SG connection design improves the EMC/EMI performance under the recommended applications. However, this performance can vary based on the specific installation.
- The COM2 port is not isolated (unless otherwise stated in the GP4000 series hardware manual).
- The SG line connects internally to the FG of the power connection (see Figure 1).
- The COM2 port provides an ESD protection of the HBM for electrical surges.
- The COM2 IC can be damaged by a surge, noise, or a GPD beyond the tolerated limit.

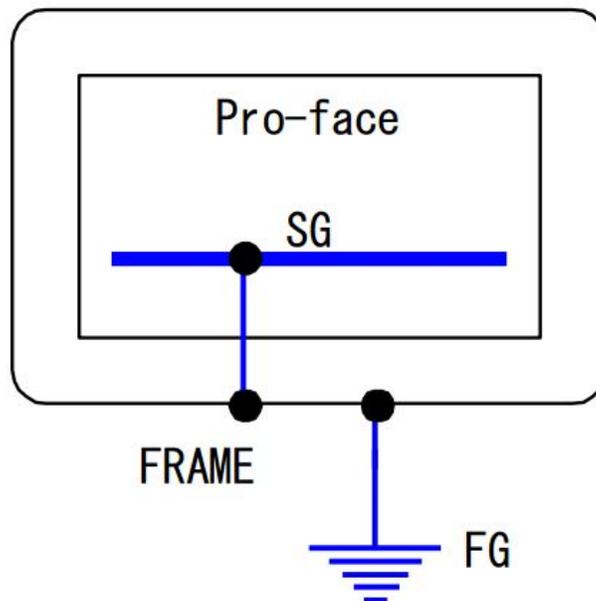


Figure 1: SG & FG connection.

## GP4000 Hardware Manual Notification

The GP4000 series hardware manual includes the following notification regarding the FG & SG connections:

GP4000 Series Hardware Manual

## Specifications of Serial Interface COM2

### Introduction

**NOTE:** For instructions on how to connect to other devices, always refer to the “GP-Pro EX Device/PLC Connection Manual”.

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the GP unit.

**⚡ ⚠ DANGER**

**ELECTRIC SHOCK**

When using the SG terminal to connect an external device to the panel:

- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #5 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #5 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

**Failure to follow these instructions will result in death or serious injury.**

Figure 2: COM port non-isolation warning.

What is meant by the phrase “a short-circuit loop” is a [Ground Loop](#)<sup>[13]</sup>. However, without additional equipment it will be extremely difficult to connect the GP4000 series HMI without making a ground loop.

## Communication Error Possible Causes

Some of the possible causes for (non-hardware failure) communication errors include:

- Electromagnetic induction noise
- A decline in the voltage margin caused by the GND electric potential difference.
- Noise caused by a ground loop between the SG & FG.

## COM2 Port Failure Possible Causes

Some of the possible causes of COM2 port failure include:

- An electric potential difference in the ground(s) in regards to interconnected equipment.
- An electric potential difference caused by surges from connected devices.
- An excessive surge of noise from an externally-connected device which causes electromagnetic induction on the communication cable.
- Static electricity introduced on a signal line of the COM2 port.
- A power spike caused by lightning strikes, power grid failure, etc.

In order to resolve or reduce the COM2 port failures, it may be necessary to resolve the GPD that is causing reduced durability & consistency of the COM2 port.

## Countermeasures

The possible countermeasures available to help remedy/prevent COM2 communication or hardware failures include:

1. Using a single FG.
2. Using an open FG.
3. Migrating from serial to Ethernet communication.
4. Migrate to a GP4000 series HMI with an isolated COM port.
5. Install an Isolation Unit cable adapter.

### #1. Using a single FG (*Figure 3*)

- FG connection points are gathered in a single location and uses the largest gauge wire as possible.
- Minimizes GPD.
- If grounding resistance becomes too low however, there is a chance that the opposite effect takes place where noise current flow increases.
- Every installation requires a connection which loses the GPD between the interconnected equipment.
- The GPD apply noise via the SG of the communication cabling.

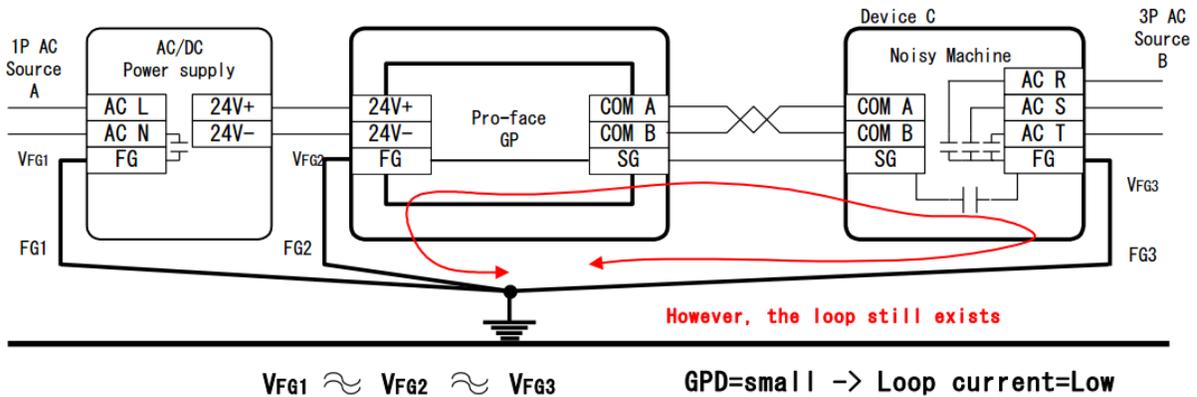


Figure 3: Single-point FG connection

## #2. Using an open FG (Figure 4)

- This option is only applicable to 24VDC models using an exclusive (i.e., the only device connected to the power supply), with a SELV output.
- The noise from the DC power connection is minimal.
- The GP has an all-resin (non-metallic) housing.
- The GP is not connected to the enclosure electrically. Meaning:
  - o The grounding screw terminal on the GP is not connected to enclosure at any point.
  - o The GP is installed in the enclosure via the provided mounting clips, which use a resin (non-metallic) tab to make contact with the GP. Although the tightening screws are metal, they do not (under normal conditions) come into contact with the GP.
- The enclosure is composed of metal and is not electrically charged.
- **CONCERN:** While the issue may be resolved, this configuration may not meet EMC/EMI specifications.

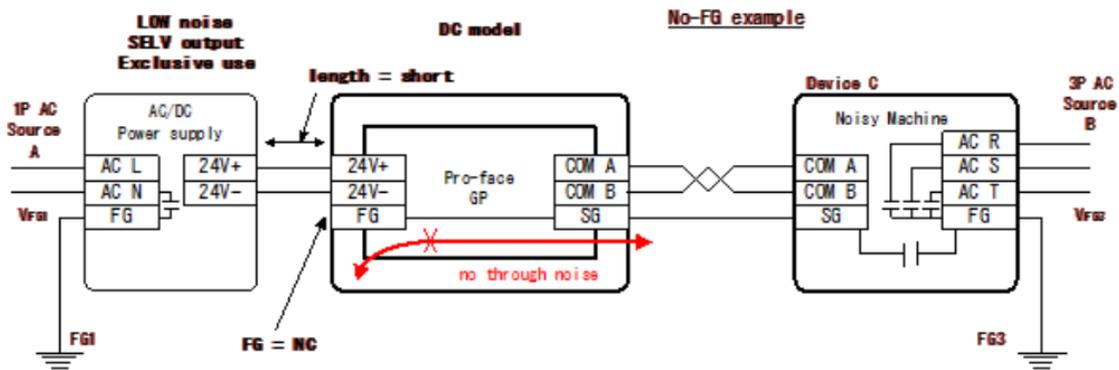


Figure 4: Open FG connection

### #3. Migrating from serial to Ethernet communication (Figure 5)

- Only the Ethernet (LAN) and power supply connections are used. No other connections are made to the GP.
- A ground loop does not occur if a UTP cable **without** shielding or a single-side STP cable is used.
- This provides **optical isolation**<sup>[14]</sup> for the communication connection and can prevent the issues/failures described above.

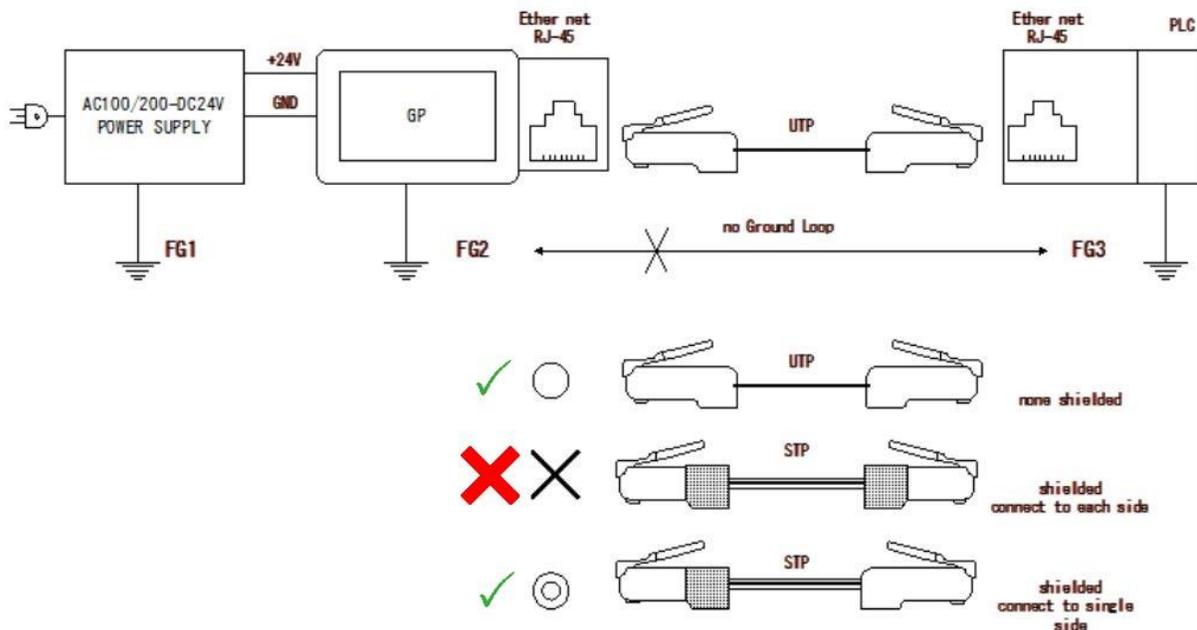


Figure 5: Ethernet Communication Connection

### #4. Migrate to a GP4000 series HMI with an isolated COM port

- This option has the best chance to resolve and prevent ground loops.
- The COM port is isolated on the following models, any model **not** listed **DOES NOT** have an isolated COM port.
  - o GP4203T (COM1)
  - o GP4303T
  - o GP4503T
  - o GP4603T
- The disadvantages are:
  - o The above models are RS-485 only.
  - o May be more expensive than currently used product.
  - o Will have to replace hardware and

## #5. Install an Isolation Unit cable adapter (Figure 6)

- This is the best option for existing hardware that cannot or will not be replaced.
- Prevents/eliminates ground loops.
- Is not influenced by GPD.
- No common
- Disadvantages:
  - o Additional cost for isolation unit.
- There are several commercially available isolation units available (Figure 6)
  - o Pro-face CA3-ISO232-01 – RS232C to RS422 isolation converter for 9pin=VCC port.
  - o Unconfirmed/untested:
    - MOXA
    - Black-Box
    - CommFront
    - SerialComm
    - NetworkSupply (Japan)
    - LINEEYE (Japan)

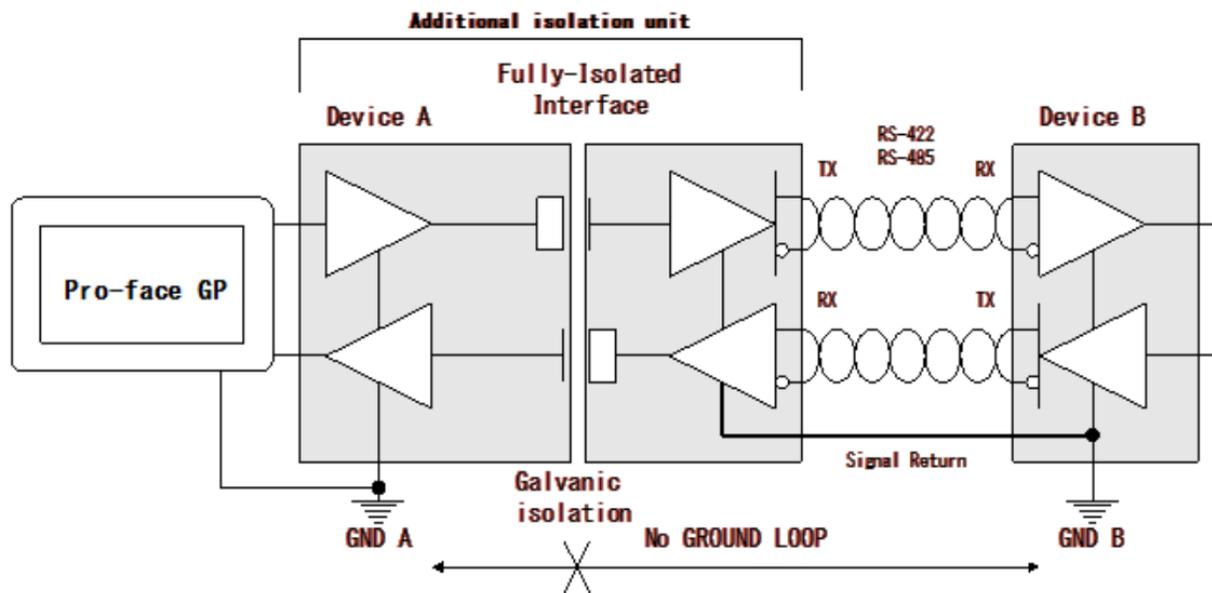


Figure 6: Isolation Unit Adapters & Diagram

## Appendix A: Works Cited

Below is a list of the web pages referenced in this application note (in order of appearance).

- [1] "CE Marking," Wikipedia, 22 July 2016. [Online].  
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- [5] "Signal Ground Versus Chassis Ground," NovAtel, [Online].  
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- [14] "Optical isolator," Wikipedia, 7 May 2016. [Online].  
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For technical support email: [support@profaceamerica.com](mailto:support@profaceamerica.com) or call: 800.289.9266.

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