Monitoring Generators Start Signal Wiring Integrity

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INTRODUCTION

Emergency backup generators perform a critical function in ensuringpower is always available to loads, regardless of the availability of utilitypower. If the emergency backup system is compromised, it may not respond appropriately in case of an emergency. One potential failure point within the system is the start signal wiring that runs between the generator and the transfer equipment.

The National Electrical Code (NEC) introduced new language beginningin 2017 related to monitoring the start signal between an emergency (standby) generator and transfer (switching) equipment connected to theutility. This language was added to assure that the standby generator will start if the wiring between the generator and the transfer equipment is compromised. Prior to these code changes, damaged, corroded, or unconnected start signal wiring may not have been found until the emergency occurred and the generator did not start as a result.

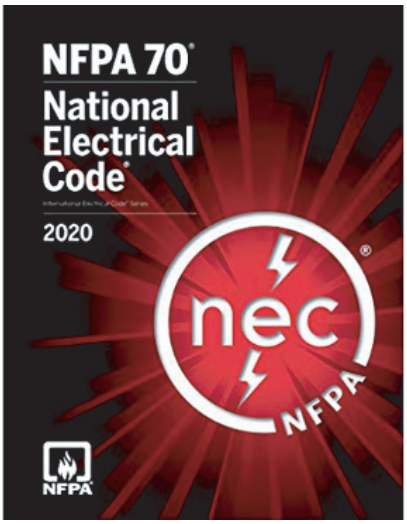
While NEC dictates when a system must comply, applications that do not fall under either article can still benefit from start signal monitoring.

NEC

ADOPTION OF 2017 AND 2020 CODES

Before we begin, it is important to note that states adopt and enforce requirements based on NEC. The adoption of the 2017 and 2020 codes can vary from state to state, and from county to county. As a result, site requirements depend on the authority having jurisdiction (AHJ). Often the AHJ for a site is a federal, state, or local inspector (e.g., electrical inspector or fire marshal). The language related to start signal monitoring was added to Article 695: Fire Pumps and Article 700: Emergency Systems. Both articles focus on applications where the powered load is essential to life safety, underlying the importance of an emergency generator providing power in case of a utility failure.

NEC ARTICLES 695 AND 700



NEC Article 695 is written around fire pumps which maintain water supply to building sprinkler systems and are designed to operate when a building fire is detected. The intent is that the fire pump has power no matter how the system is powered (utility or generator) so the water supply is continuously available. NEC Article 700 is written for emergency systems, of which a standby generator meets this definition. This article describes the legally required capabilities of emergency systems to maintain life safety equipment.

NEC 695.14 (F) AND 700.10 (D) (3)

Both NEC 695.14 (F) and 700.10 (D) (3) added language to monitor start signal wiring integrity. Both article sections relate to generator control wiring methods, and in 2017 the codes stated that control conductors installed between the transfer equipment and the standby emergency generator shall be kept separate from all other wiring and that the wiring should be continuously monitored. Clarification was added in 2020 to state that the monitoring was for broken, disconnected, or shorted start signal wiring. It further stated that a “loss of integrity” in the wiring should default to starting the generators to assure power is available to life safety equipment.

ARTICLE 700.10 (D) (1–3) OCCUPANCY REQUIREMENTS

In 2020, Article 700.10 (D) (1–3) added occupancy requirements to clarify when emergency systems must meet the criteria. One or more of the following occupancy scenarios must exist: buildings that have assembly space for 1000 or more people, education facilities with more than 300 people, or the building is above 23 meters (75 feet) in height. If any one of these is true for the site, the code applies.

NEC 2020 Language for Monitoring Control Wiring

695.14 (F) GENERATOR CONTROL WIRING METHODS

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or short wires. Loss integrity shall start the generator(s).

700.10 (D) (3) Generator Control Wiring

Control conductors installed between the fire pump power transfer switch and the standby generator supplying the fire pump during normal power loss shall be kept entirely independent of all other wiring. The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or short wires. Loss integrity shall start the generator(s).

700.10 (D) (1–3) Fire Protection

Emergency systems shall meet the additional requirements in (D) (1) through (D) (3) in the following occupancies:

1. Assembly occupancies for not less than 1,000 persons
2. Building above 23 m (75 ft) in height
3. Educational occupancies with more than 300 occupants

START SIGNAL WIRING

MONITORING TRANSFER EQUIPMENT

The transfer equipment is monitoring the availability of utility power and a start signal is connected between the transfer equipment and the generator. On the transfer equipment side, the start signal is connected to a normally closed (NC) contact and on the generator side, it is connected to a two-wire input on the controller. *Figure 1* shows a typical setup.

The NC contact is energized to remain open when utility is present. When a loss of power occurs, the transfer equipment closes the contact to signal to the generator controller to start. Since the start signal is open when utility is present, if the connection between the transfer equipment and generator becomes broken or disconnected, the issue is not detected. Likewise, if the signal is shorted, the generator will see that as a closed contact signal and start but does not have a way to detect it is due to an issue with the start signal wiring.

Figure 1

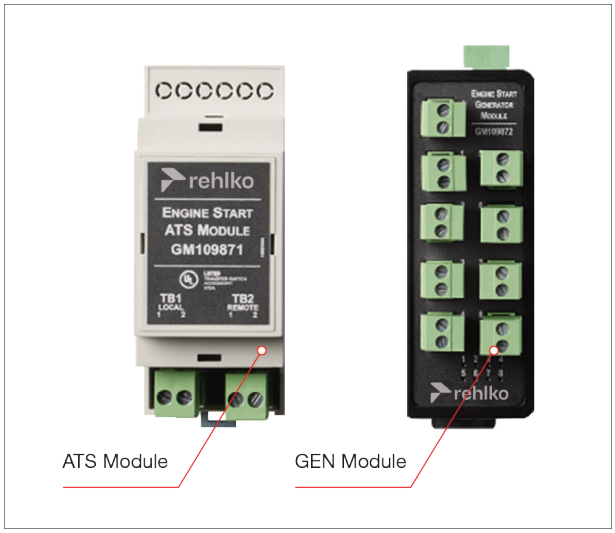
Traditional Start Signal Wiring Between Transfer Equipment and Generator

MONITORING START SIGNAL INTEGRITY

HOW IT WORKS

In a basic system, monitoring consists of two modules. One module is installed in the transfer equipment (e.g., automatic transfer switch [ATS], paralleling switchgear, or other transfer system controller device). A second module is installed on the generator. Location of installation in each piece of equipment will vary; however, the concepts are the same. *Figure 2* shows Rehlko's ATS module and generator (GEN) module components.

Figure 2 – Module Components



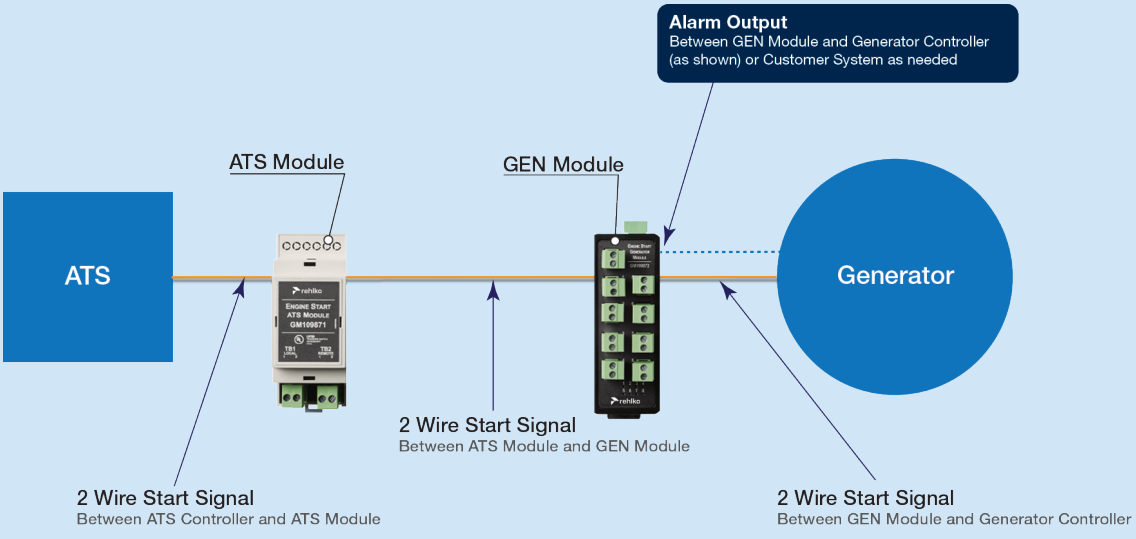
START SIGNAL WIRING

The start signal wiring is two wires (one for positive and the other for negative) sized appropriately for the distance between the transfer equipment and the generator. The two modules are now connected in–line between the generator and transfer equipment. The GEN module requires power from the generator starting battery. An ATS module is required for each transfer equipment device and does not require a battery power connection.

In Rehlko's UL–listed solution, each GEN module has the capacity to connect with up to 8 transfer devices. Therefore, in a system of one generator and 16 transfer switches, two GEN modules will be installed at the generator and one ATS module would be installed in each ATS for a total of 16 ATS modules installed. In addition to the start signal monitoring, the GEN module also has the capability for an alarm output to the generator controller or another annunciation point for the customer. *Figure 3* shows a basic system of a generator, an ATS, and the connections.

A visual annunciator is included for each ATS connection on the GEN module so the system status can quickly and easily be assessed. An LED light illuminates to show the following colors and corresponding system status per channel. See *Figure 3*.

Figure 3 – Module Wiring



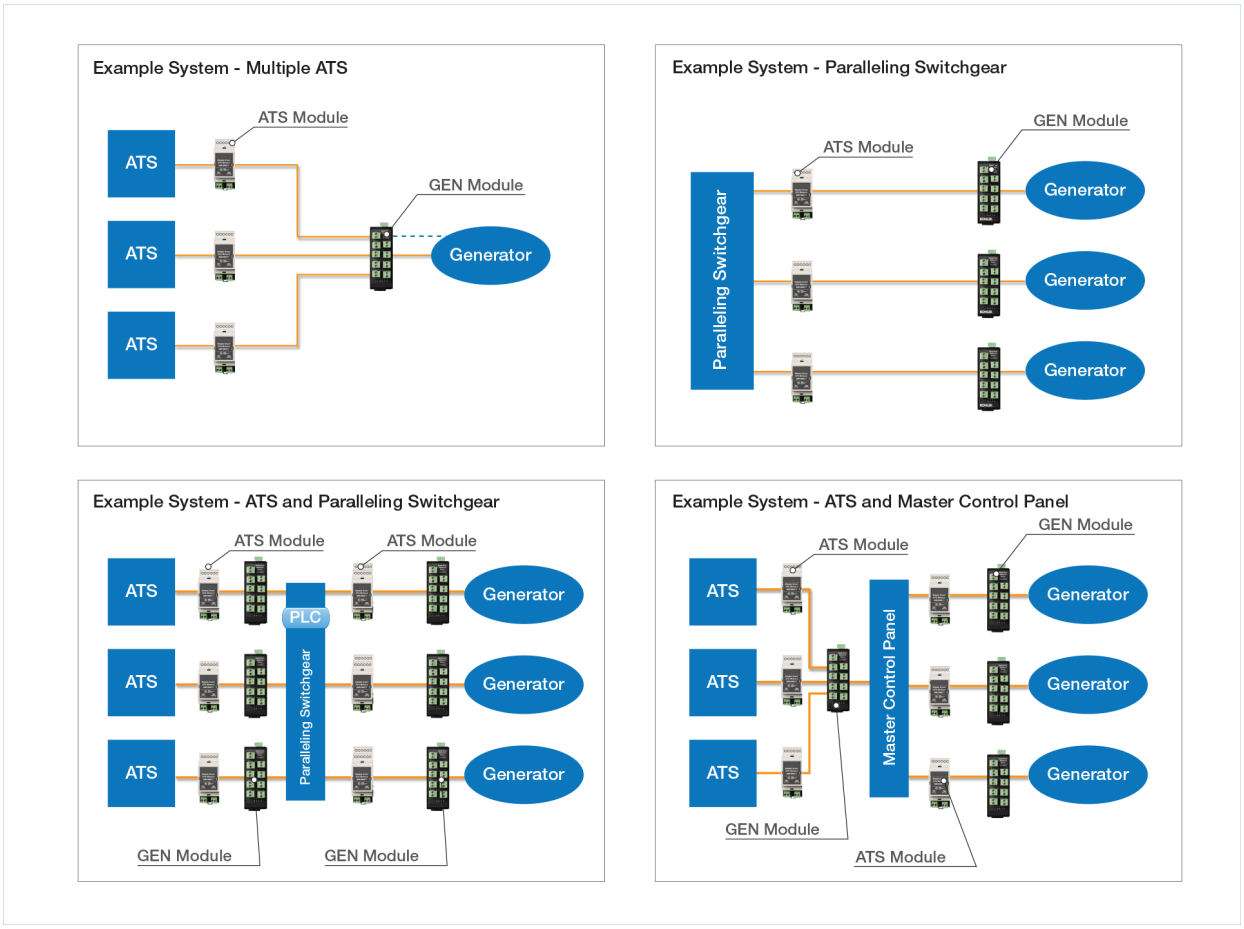
WIRING CONFIGURATIONS

EXAMPLES OF RECEIVER AND TRANSMITTER

Figure 4 shows four examples of wiring configurations. Note that the GEN module is used as the receiver and the ATS module is used as the transmitter. The monitoring of the signal requires both modules as a set between the transfer equipment and each generator. The GEN and ATS modules are designed to mount on DIN rails within their respective equipment.

Figure 4

Additional System Wiring Configurations

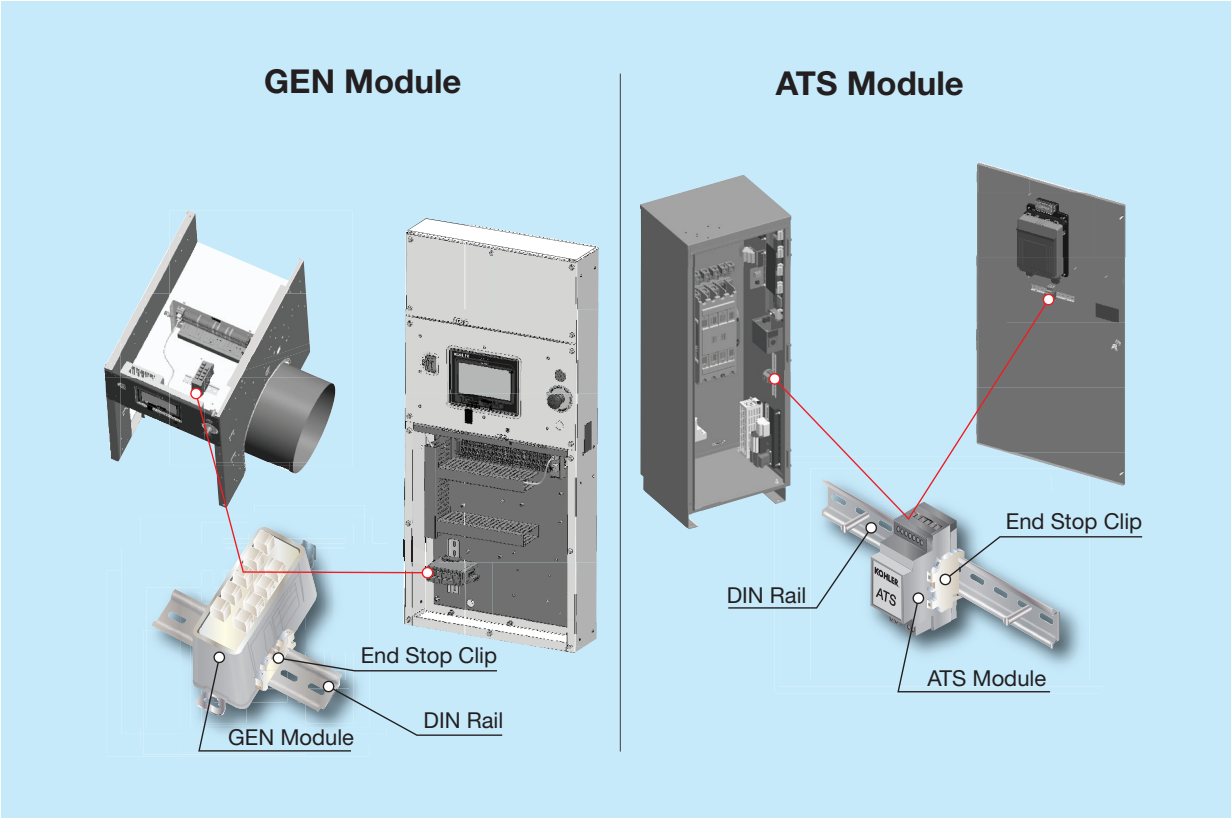


EXAMPLES OF RECEIVER AND TRANSMITTER

See *Figure 5* for examples of mounting locations that make them easy to install where they are protected from the environment.

Figure 5

Installing the Modules



REHLKO ADVANTAGES

CONTINUOUS MONITORING

The Rehlko® start signal monitoring system continuously monitors the start signal to detect immediately when an issue occurs. With the ability to detect eight individual transfer inputs, the source of the issue can be quickly identified and corrected.

EASY TO INSTALL

The system is easy to install and can be added to existing power systems already installed at a site. The system takes advantage of the traditional outputs and inputs available on equipment and does not require any additional wires or inputs on the generator controller. By using the normally closed contact, the system retains the fail-safe operation provided by a normally closed contact in the transfer equipment.

ALARM SYSTEM BRINGS AWARENESS

An added benefit with the Rehlko solution is the ability to use the alarm output of the GEN module to annunciate the issue and bring awareness. While a loss of signal integrity will start the generator, it is essential that a person know of the signal issue so it can be fixed.

TOTAL SYSTEM INTEGRATION

Rehlko can provide total system integration with this start signal monitoring solution to complement a full range of generators, controls, automatic transfer switches, and paralleling switchgear. You can rest assured that all system components will work together.

SUMMARY

The recent NEC requirements for monitoring start signal integrity were made to assure emergency backup reliability—especially for life safety needs. Rehlko has a long-standing history of providing reliable power for more than a century.

Be sure to work with your local Rehlko distributor or dealer to equip your system with the start signal monitoring system for additional reliability in healthcare, high-rise buildings with fire pumps, educational facilities, and many other applications.

ABOUT THE AUTHOR

Nicole Dierksheide is the Global Category Director – Large Power. She has broad experience over her 25-plus year career that spans from engineering subsystems on locomotives to marketing test and measurement equipment. She has been with Rehlko since 2011, focused on offering energy resilient solutions. Nicole holds a degree in electrical engineering from the University of Arizona and uses her technical expertise to work with customers on finding the optimal solutions for their needs. She is a sustainability champion at Rehlko and passionate about driving greener actions both at work and in her personal life.

ABOUT POWER SYSTEMS

Power Systems, Rehlko's largest division, delivers worldwide energy solutions designed to ensure resilience for mission-critical applications of all sizes. Building on more than a century of expertise and dedication, the company offers complete power systems, including industrial backup generators (HVO, diesel, gaseous), enclosures, hydrogen fuel cells systems, automatic transfer switches, switchgear, monitoring controls, genuine parts and end-to-end services. As a global company with service partners in every country, Power Systems provides reliable, cutting-edge technology to keep industries and businesses running. www.powersystems.rehlko.com

ABOUT REHLKO

A global leader in energy resilience, Rehlko delivers innovative energy solutions critical to sustain and improve life across home energy, industrial energy systems, and powertrain technologies, by delivering control, resilience and innovation. Leveraging the strength of its portfolio of businesses – Power Systems, Home Energy, Uninterruptible Power, Clarke Energy, Heila Technologies, Curtis Instruments, and Engines, and more than a century of industry leadership, Rehlko builds resilience where and when the grid cannot, and goes beyond functional, individual recovery to create better lives and communities, and a more durable and reliable energy future.

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