BEI SENSORS

WIRELESS INDUSTRIAL SENSOR INTERFACE

Swift comm
wireless industrial sensor interface

A SECURE ROBUST WIRELESS INTERFACE WITH BUILT-IN RELIABILITY NEEDED FOR REAL-TIME INDUSTRIAL CONTROL

BEI SENSORS

The BEI SwiftComm wireless industrial sensor interface ushers in a new era of wireless industrial control. Now the machine designer is free to install sensor equipment without the expense and constraints of a hard-wired system. Encoder installations in difficult applications like cranes, rotating tables or mobile applications, are greatly simplified.

The SwiftComm system includes the transmitter-receiver pair, which communicates using a point-to-point frequency-hopping 2.4 GHz RF protocol. Because of its flexible input/output electronics, it can interface with many different industrial sensors and control systems. Simply connect the SwiftComm transmitter to the sensor and the SwiftComm receiver to your control system and apply power. That's it! No complicated cabling required.

SwiftComm's proprietary radio protocols include a broad security code range, data encryption, handshaking, interference recovery, and error checking that together provides a secure and robust wireless interface system. Ruggedness and flexibility are further enhanced with SwiftComm's NEMA 4 weatherproof enclosures, panel mounting options, antenna choices and wide-range DC power inputs. SwiftComm is available with an incremental or SSI output, or with an optional explosion proof transmitter housing (pictured above).

A Wireless Interface for Real-Time Industrial Control

Until now, the only option available to connect encoders to controllers or PLCs has been by hard wiring. This approach has served the system designer well in many applications. However, there are times where the cabling to the sensor is expensive to install, cumbersome, or creates a maintenance problem. This is most evident when the encoder needs to move over large distances or is mounted to a rotating or mobile device.

Motion control applications require position and speed feedback in real time and as a continuous stream of data. Until now, wireless systems have been unable to work with these applications due to high latency and signal interference. With most typical wireless systems, if packet information is lost, the protocol requests for the information to be resent. This approach however slows down the flow of information from transmitter to receiver, and adds an indeterminate amount of time delay to when the information is received. Add to this an undefined amount of time required to process packets over a network protocol, such as Zigbee or Bluetooth, the resultant latency would seriously degrade time sensitive data. Another even bigger threat is random interference that can destroy whole packets of information. All these factors have made wireless systems for control unsuccessful…until now.

SwiftComm was designed from the ground up specifically to meet the demands of industrial motion control applications. It provides an extremely robust wireless signal in real time over a secure network. SwiftComm is also equipped with several fail-safes to deal with signal interference.

Applications

SwiftComm is suitable for use in a wide variety of industrial applications. However, certain conditions allow the user to receive the most benefit from SwiftComm. In applications where long, expensive cable lengths are needed, SwiftComm can provide a very cost effective alternative to hard wiring. If cabling of any length is damaged often in a system and needs constant replacement, SwiftComm can be a viable solution. SwiftComm is ideal for use in applications with a clear line-of-sight between the transmitter and receiver. Although SwiftComm can work around some obstructions, the best performance will be achieved where the radios have a clear line-of-sight. SwiftComm is a very robust and reliable wireless interface system, and will work in many different kinds of industrial applications. Here are just a few examples:

- Crane & Hoist
- Drawbridge
- Drawworks
- Dam Control
- Irrigation
- Mining
- Printing Press
- Factory Automation

SWIFTCOMM'S UNIQUE ADVANTAGES

Robust Signal

BEI's SwiftComm operates on the 2.4 GHz ISM radio band and uses Adaptive Frequency Hopping Protocol (AFH). This helps avoid data interruptions due to frequency interference. If a particular radio channel encounters interference, SwiftComm seamlessly hops to another open channel. This technology decreases the susceptibility to interference thereby increasing overall reliability. The SwiftComm hopping algorithm uses 77 ISM channels in a pseudo-random sequence. To enhance RF link reliability even more, when SwiftComm detects interference on a channel, that channel is dropped from the hop sequence and SwiftComm will avoid using that channel in the future. If the available channels list ever becomes exhausted, previous dropped channels are retested to see if they are clear.

SwiftComm's patent pending technology can even overcome data loss due to link interruption. Internally and transparent to the user, SwiftComm keeps track of the encoder's output signal. If SwiftComm encounters packet loss from temporary link interruption, it fills in the encoder's output information based on the historical data trend. It then processes this information in place of the lost packet. SwiftComm corrects for any accumulated error and seamlessly sends the corrected data to the controller. So, even in environments where occasional packets are lost, SwiftComm will transmit a continuous stream of data to the control system.

Real Time Control

It is critical in any motion control application to have minimum lag time in signal transmission. Delays in data to the controller can cause major problems. SwiftComm is one of the fastest wireless sensor interfaces available. Data is relayed between the transmitter and receiver every 600 microseconds (µs). Because SwiftComm is a point-to-point configuration, there is minimal latency.

Secure Transmission

SwiftComm provides a very secure system for your data to travel wirelessly. The transmitter and receiver each have a 40-bit hard coded security code. These codes are programmed at the factory and give the system a range of over 500 billion possible unique codes. BEI has developed its own proprietary protocol for SwiftComm, which is not available to the public. Additionally, the data is transmitted with a high-level encryption algorithm and pseudo-random frequency hopping. This provides additional levels of data security to assure that your data is protected.

Long Range

Because motion control applications can vary widely, SwiftComm was designed with a 50 mW radio. This provides SwiftComm with reliable long-range communication. In most open situations, a reliable link distance of up to 1,000 feet is possible. Inside buildings, a reliable link distance on the order of 300 feet can be expected.

SETUP AND OPERATION

Basic Setup

The SwiftComm Transmitter and Receiver modules operate as a pair, known as Point-To-Point communication. Each pair shares a unique security code, which is hard-coded at the factory and is not user selectable. The full security code is not revealed on the modules' labels and is stored by BEI. This is one of the many layers of security provided by the SwiftComm architecture. If a replacement module is needed, then the module's serial number needs to be provided to BEI in order to match the pair's security code.

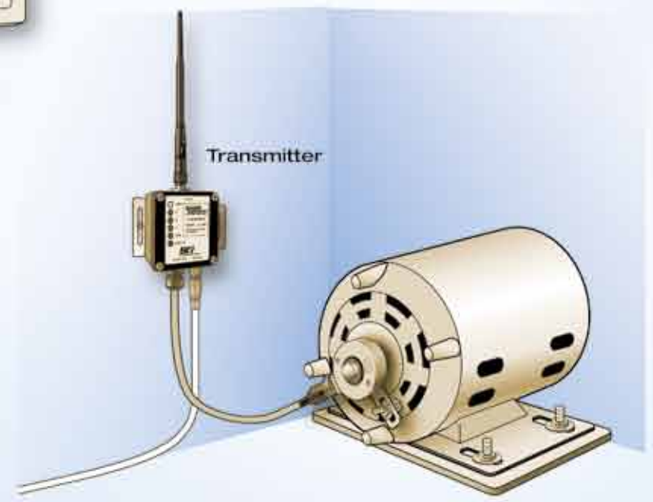
The basic configuration of the SwiftComm system begins with connecting the Transmitter module to the encoder and connecting the Receiver module to the control equipment. The Transmitter sends the encoder signal wirelessly to the Receiver module, which then passes this signal on to the controller. Even though the encoder data travels one direction from Transmitter to Receiver, additional information is exchanged between modules bi-directionally to keep the modules in sync, maintain a quality RF link and to issue Built-in-Test (B.I.T.) commands.

Mounting

The SwiftComm modules have several mounting options. Each module has two 1/4-20 UNC tapped holes on the back of enclosure for mounting to flat surfaces. In addition, mounting ears are available with front mount screws. For DIN rail mounting, a DIN rail kit is available.

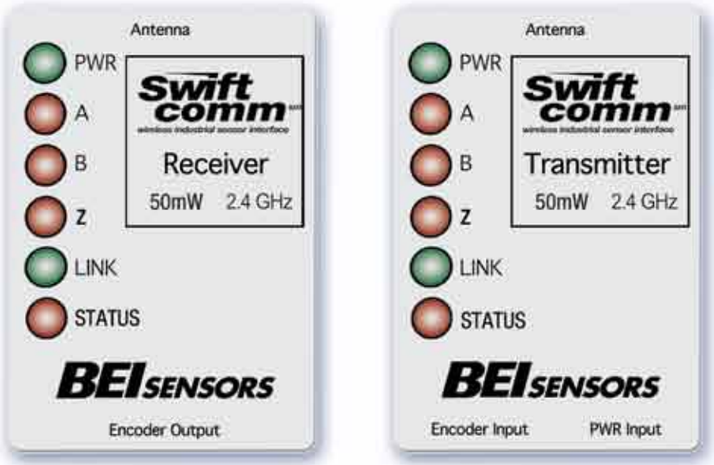
The transmitter and receiver should be installed so that their antennas have a clear line of sight with each other.

SwiftComm has a reliable range of up to 300 ft. indoors, and up to 1,000 ft. outdoors.



FRONT PANEL INDICATORS

SwiftComm Transmitter and Receiver Modules has a set of six front panel indicators that show internal operation and RF status.



*Incremental Version shown. Available in Incremental or SSI versions

LABEL	COLOR	DESCRIPTION
POWER	GREEN	ON Indicates input power is supplied to the Module
A	RED	Indicates quadrature Phase A status
B	RED	Indicates quadrature Phase B status
Z	RED	Indicates index status
LINK	GREEN	ON Indicates SwiftComm Modules have established a reliable RF link. OFF Indicates the RF link has been lost and an B.I.T. signal is active
STATUS	RED	Blinks ON each time RF packets are lost. Rate of blinking indicates relative quality of the RF link. Useful when setting up antennas and troubleshooting interference problems.

The LINK and STATUS lights indicate the quality of RF connection between the modules. On startup, both Transmitter and Receiver modules search their assigned RF spectrum for another module with the same address. When the modules locate each other, they exchange frequency hopping sequence and other housekeeping information. Once finished with this exchange, the LINK light is turned on.

From that point on, the Transmitter sends the data from the encoder as a packet over the RF connection to the Receiver. The Receiver reconstructs the encoder's signal from the received packet and informs the Transmitter of a successful packet exchange. This series of events repeats each 600 microseconds.

ANTENNAS

Requirements

SwiftComm is licensed for use with a 5.5 dBi gain dipole (rubber ducky) with a reverse polarity TNC connector. These antennas are mounted directly to the mating connectors on the SwiftComm modules and are supplied with each Transmitter and Receiver module.

For reliable radio transmission, a secure and obstruction-free antenna location is required. If the SwiftComm module itself can be located away from metal obstructions, like steel beams and plates, then the supplied antenna can be attached directly to the module's RF Port. Make sure the transmit and receive antennas have the same orientation, either vertical or horizontal (vertical orientation will provide better performance). If the module is mounted in a metal enclosure or located near metal obstructions, an FCC-approved BEI antenna extension accessory must be used, providing more flexible antenna mounting options. This accessory includes a 10-foot coax cable and ground plane mounting bracket.

To install the antenna extension, first secure the ground plane mounting bracket as high up as possible and away from metallic obstructions. Secure the coax cable to the bracket, attaching it to the RF Port. Then secure the other end of the coax cable to the SwiftComm module, attaching the cable connector to the module's RF Port. Attach the antenna to the antenna connector at the ground plane mounting bracket. Make sure the transmit and receive antennas have the same orientation (either vertical or horizontal).

ESD Protection

The antenna inputs on the SwiftComm modules are equipped with Transient Voltage Suppression (TVS) diodes. This is normally adequate to protect the RF circuitry from static discharges and mild lightning induced transients. However, if the antenna is to be used outdoors where lightning is a much bigger threat, a lightning arrestor such as an Altelicon AL-RTPRTJB-9SPL is recommended. The arrestor is placed in-line with the antenna cable, and grounded to a high integrity earth ground.

Important FCC Note: Only the 5.5 dBi gain dipole antenna, optional BEI antenna extension accessory and optional lightning arrestor are allowed for use with the SwiftComm modules. All other antenna types and configurations are prohibited by the FCC license rules. Consult the factory to discuss your application requirements.

GROUNDING

SwiftComm transmitters and receivers are constructed with the case connected to circuit common (0 V). Input signals are optically isolated to provide exceptional noise immunity and significantly reduce susceptibility to ground loop effects.

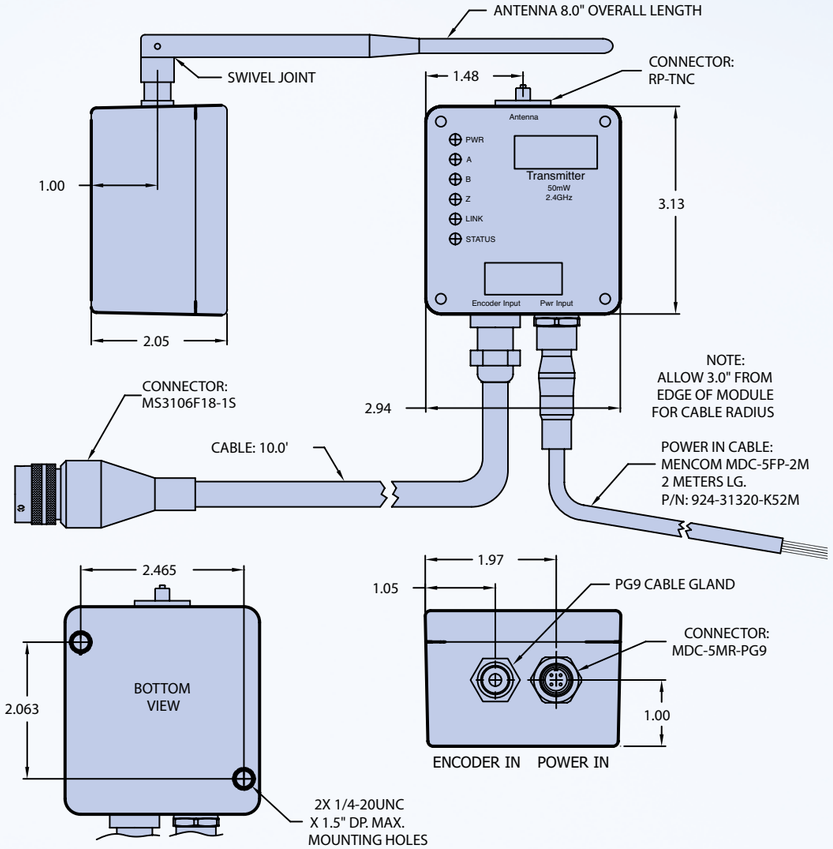
If the transmitter or receiver are mounted to a metal cabinet or support structure, it is recommended that an insulator be added so that the case is not electrically connected to Earth ground.

SIGNAL AND POWER CONNECTIONS

Electrical power and signal connections are located on the end of the SwiftComm modules, opposite the antenna connector. The modules are powered by a power supply with a minimum of 5 VDC. The transmitter draws approximately 200mA, and the encoder approximately 100mA. The encoder output logic needs to be consistent with the transmitter input logic (5V, 12-15V or 24V logic). The receiver draws approximately 200mA. The receiver output logic type and levels should be selected consistent with the input requirements of the PLC or computer receiving the signals.

Logic choices are 5 to 28V, a 5V regulated logic output (RS-422 and TTL compatible) with a 5 to 28 VDC supply, and an NPN open collector output. All outputs are differential, with each channel capable of sourcing or sinking 50 mA. If single-ended outputs are needed, simply do not connect the complementary signals (float them). Never connect any outputs directly to power, circuit common, or another output, as this will cause an over-current in the driver and likely lead to a thermal shutdown in the output stage.

SWIFTCOMM TRANSMITTER MODULE



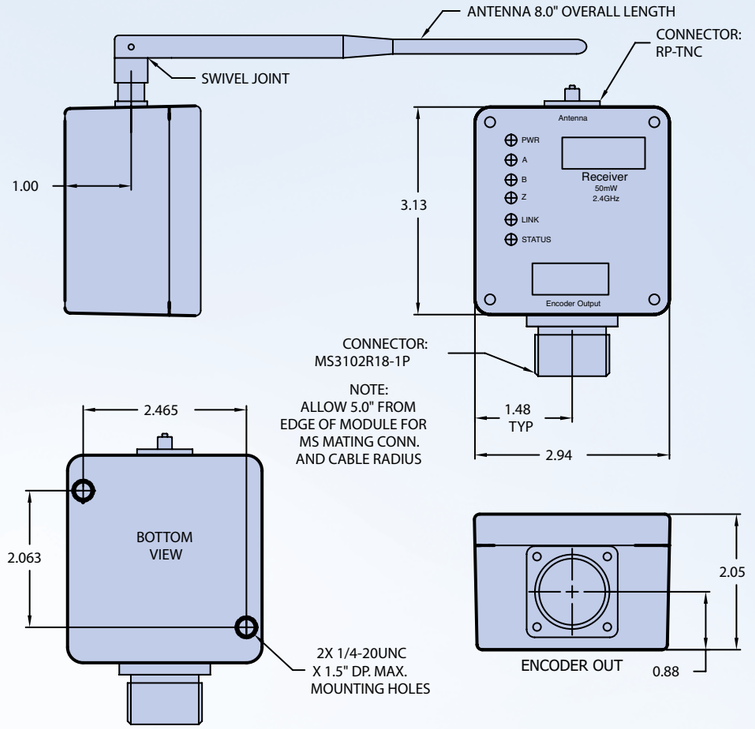
The SwiftComm Transmitter Module has two connector plugs: a 5-pin connector for power input, B.I.T output and chassis ground; and a 3-meter cable with a 10-pin MS connector attached to the end.

Transmitter: Pwr Input & BIT Output (5 Pin Connector)		
Pin	**Function**	**Color**
1	+V (Supply Voltage)	BRN
2	B.I.T Output*	WHT
3	0V (Circuit Common)	BLU
4	——	BLK
5	Case Ground	GRY

*If transmission is interrupted for longer than 0.13 seconds the status of this pin will change from LO to HI. B.I.T. is HI at +V level.

Transmitter: Encoder Input (MS3106F18-1S or 10 ft pigtail)			
Pin	**Color (Pigtail)**	**Incremental Function**	**SSI Function**
A	Yellow	A	DATA
B	Blue	B	CLOCK
C	Orange	Z	——
D	——	+V (Supply to Encoder)	+V
E	Black	——	——
F	——	0V (Supply to Encoder)	0V (Supply to Encoder)
G	Wh/Yellow	Case Gnd	——
H	Wh/Blue	A/	DATA
I	Wh/Orange	B/	CLOCK
J		Z/	——

SWIFTCOMM RECEIVER MODULE



The SwiftComm Receiver Module has an MS connector that provides the same output signals as a standard BEI encoder.

Input power can be from 5 to 28 VDC. Output signals (specified at time of ordering) can be 5 VDC or V in. The B.I.T output signals indicate the RF Link Status.

Case ground is connected to earth ground. Circuit ground is electrically isolated from the case ground. Both of these grounds are typically connected together at the power supply.

Receiver Pinouts: Encoder Output (MS3102R18-1P)		
Pin	**Incremental Function**	**SSI Function**
A	A	DATA
B	B	CLOCK
C	Z	——
D	+V (Supply Voltage)	+V
E	B.I.T Output*	B.I.T Output*
F	0V (Circuit Common)	0V (Circuit Common)
G	Case Gnd	——
H	A/	DATA
I	B/	CLOCK
J	Z/	——

*If transmission is interrupted for longer than 0.13 seconds the status of this pin will change from LO to HI. B.I.T. is HI at +V level.

SECURITY CODE

SwiftComm radios are paired in a point-to-point configuration. Encoder data is sent from the Transmitter module to the Receiver module, where the data is passed on to the user's equipment. Because of this architecture, only one Transmitter and one Receiver can share the same security code. Over 500 billion unique security codes are available, assuring no address will ever be repeated. Additionally, all radio pairs are programmed with their security code at the factory and are not publicly available, which provides enhanced security of each pair.

ENCRYPTION AND DATA SECURITY

Data security was highly considered in the design of the SwiftComm architecture. SwiftComm deploys three layers of protection to the data.

1. The radios use a pseudo-random adaptive frequency hopping sequence, changing frequency every 600 uS. This random hopping helps prevent unauthorized monitoring of the data stream.

2. The data sequence being transmitted between the SwiftComm radios is proprietary, unlike common radio protocols such as Wi-Fi, Zigbee or BlueTooth. These publicly known protocols are susceptible to outside monitoring. SwiftComm's protocol further enhances the security of the data while being transmitted wirelessly.

3. SwiftComm uses a 40-bit encryption algorithm for an additional layer of data protection from external monitoring.

TROUBLESHOOTING

Most troubleshooting can be accomplished by observing the state of SwiftComm's front panel lighted indicators. Following is a description of the indicator lights and how to utilize them for troubleshooting:

POWER: This indicator will turn on (green), if power between 5 and 28 VDC is being provided to the module. If this indicator is off, check the power supply connections.

A, B, Z: These indicators turn on and off as the encoder's quadrature signals change state. While slowly turning the encoder, observe if the A, B and Z indicators toggle on and off in a pattern. If these indicators don't respond, check the wiring to the encoder. A differential encoder signal is required as an input to the module.

LINK: If a SwiftComm transmitter and receiver with the same security code establishes radio contact with each other, then the LINK indicator will turn on (green). The LINK indicator will turn off if continuous radio contact is lost for more than 0.13 seconds (about 200 packets). The B.I.T output follows the state of the LINK indicator. Generally, the LINK indicator turns off for three reasons.

1. The RF signal is too weak. This can happen if the radios are too far apart, or there is some obstruction, such as a building, between the radios. Try reorienting the radios to avoid obstructions and/or locating them closer together. Orient the antennas so they are both vertical or horizontal. In a factory setting, Swiftcomm can typically transmit reliably up to approximately 300 feet. In an outdoor setting, that distance can increase to 1,000 feet. Contact the factory to discuss your specific application environment.

2. The antenna is broken or not attached correctly. The antenna should be securely tightened to the RF connector on both SwiftComm modules. Also, inspect the coax wire inside the swivel base of the antenna to make sure it is not frayed or broken.

3. A source of RF interference exists. Turn off different equipment in the vicinity to see if the interference decreases, such as Programmable Logic Controllers (PLC) and variable frequency drives (VFD). If interference subsides when equipment is turned off, try moving the source of interference or the SwiftComm modules to another location. Also check that equipment covers and doors are secured and the equipment is properly grounded to earth ground.

STATUS: Every 600 uS, the Transmitter sends a packet to the Receiver with the current encoder data. The STATUS indicator "flashes" each time an acknowledgment packet is lost. The more packets lost, the more the STATUS indicator flashes. This makes the STATUS indicator a good measure of signal quality. Normally you would see about 1 or 2 flashes per second. This indicates over a 99% packet success rate. This feature can be used during initial set-up to optimize the location of the antennas, investigate intervening obstructions and minimizing sources of interference.

SWIFTCOMM FAQs

I need a continuous, reliable encoder signal. What happens if the wireless signal is interrupted and loses packets of data?

SwiftComm was designed specifically for critical motion control applications. Its use of an Adaptive Frequency Hopping Protocol (AFH) helps avoid data interruptions due to frequency interference. If a particular radio channel encounters interference, SwiftComm seamlessly hops to another open channel. This technology decreases the susceptibility to interference, increasing overall reliability.

Of course, in the real world, signal interference cannot be avoided in all cases. Because of this, SwiftComm uses patent pending technology that can overcome data loss due to link interruption. Internally and transparent to the user, SwiftComm keeps track of the encoder's output signal. If SwiftComm encounters packet loss from temporary link interruption, it fills in the encoder's output information based on the historical data trend. It then processes this information in place of the lost packet. When a valid packet of information is received, SwiftComm determines any accumulated error and corrects the quadrature signal to the controller. So even in environments where occasional packets are lost, SwiftComm will transmit a seamless stream of data to the control system.

I'm concerned with the security of my data being transmitted wirelessly. Will SwiftComm protect my data?

Yes. SwiftComm provides a very secure system for your data to travel wirelessly. The transmitter and receiver each have a 40-bit hard coded security code. These codes are programmed at the factory and give the system a range of over 500 billion possible unique codes. BEI has developed its own proprietary protocol for SwiftComm, which is not available to the public. Additionally, the data is transmitted with a high-level encryption algorithm and pseudo-random frequency hopping. This provides additional levels of data security to assure that your data is protected.

What type of encoder can SwiftComm interface with?

SwiftComm can interface with any quadrature incremental or SSI absolute encoder with differential outputs.

I have an application using a high-speed encoder. What kind of latency will I experience with SwiftComm?

It is critical in any motion control applications to have minimum lag time in signal transmission. Delays in data to the controller can cause major problems. SwiftComm is one of the fastest wireless sensor interfaces available. Data is relayed between the transmitter and receiver every 600 microseconds (µs). Because SwiftComm is a point-to-point configuration, there is little inherent latency, typically about 1mS.

I have an outdoor application and my encoder cables continually need replacement due to this harsh environment. Is SwiftComm an option for me?

Absolutely. The SwiftComm transmitter and receiver are both encased in NEMA 4 cast aluminum enclosures. They are also powder coated with a gasketed cover. This gives them excellent protection from windblown dust and rain, splashing water and the formation of ice on the enclosures.

What is the maximum distance I can transmit my encoder data wirelessly with SwiftComm?

Like all wireless systems, the maximum transmission distance depends on the environment where the transmitter and receiver are being installed. On a factory floor, where there is high electrical noise and metal obstructions, we typically see reliable communications up to 300 feet. Outdoors, with line-of-sight and relatively few sources of interference, this increases to over 1,000 feet.

Can multiple SwiftComm pairs operate in the same area without interfering with each other?

Yes. Each pair shares a unique security code which ensures they will not interfere with other SwiftComm pairs in the area. These codes are programmed at the factory and give the system a range of over 500 billion possible unique codes. Additionally, SwiftComm utilizes Adaptive Frequency Hopping (AFH) protocol. If a radio band is being used by one SwiftComm pair, the other SwiftComm pair seamlessly hops to another open channel. This helps avoid data interruptions due to frequency interference.

United States FCC ID: VSR-SWIFTCOMM11

Canadian IC: 7445A-SWIFTCOMM11

Licensed in US and Canada only

To satisfy RF exposure requirements, this device and its antenna must operate with a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This device has been designed to operate with an antenna having a maximum gain of 5.5dBi. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than the required for successful communication.

swift comm

wireless industrial sensor interface

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BEI SENSORS

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