

FlexMag Flush and Deep Sensors

The Sensys Networks VDS240 Wireless Vehicle Detection System uses wireless magneto-resistive sensors to detect the presence and movement of vehicles. The sensors – installed in holes cored in the roadway and covered with epoxy – transmit detection data in real-time via low-power radio technology to a nearby Sensys Networks gateway. Vehicle detections are further relayed to a traffic signal controller, remote traffic management center, or other system.

The FlexMag Flush and Deep sensor developed by Sensys Networks utilizes the next generation of RF chipsets and circuitry. The FlexMag Flush sensors are installed flush with the roadway surface in plastic shells. The plastic shells enable the removal and replacement of sensors during roadway milling operations. Plastic shells are optional and are ordered separately. The FlexMag Deep sensors are installed without plastic shells at depth of up to 4.25 inches (10.8 cm) from the roadway surface to the top of the sensor. Sensors installed at these depths do not have to be removed and replaced during most roadway milling operations.

In typical traffic management applications, a sensor is placed in the middle of a traffic lane to detect the presence and passage of vehicles. Vehicle speeds and length are measured by two sensors installed in the same lane with the exact distance between them configured in software. The recommended distance between sensors depends on the range of expected speeds to be measured: for typical freeway applications, a separation of 20 to 24 feet (6.1 to 7.3 meters) is recommended; for typical arterial applications, a separation of 10 to 12 feet (3.1 to 3.7 meters) is preferred.

Advanced Magnetometer-Based Vehicle Detection.

The state-of-the-art magneto-resistive sensing devices in each wireless sensor measure the x-, y-, and z-axis components of the Earth's magnetic field at a 128 Hz sampling rate. As vehicles come within range, changes in the x, y, or z axes of the measured magnetic field become apparent. When no vehicles are present, sensors continually measure the background magnetic field to estimate a reference. Each sensor automatically self-calibrates to the local environment, and to any long-term variations of the local magnetic field, by allowing this reference value to change over time.

Types of FlexMag Flush and Deep Sensors:

VSN240-F-2A

- Flush-mount or deep-mount wireless sensor for in-pavement installation
- For all freeway, arterial, and signal control applications

VSN240-T-2A

- Flush-mount or deep-mount wireless sensor for in-pavement installation
- For signal control applications only

VSN240-CS-2

- Clear Shell for FlexMag Sensors



Functions / Features

Lower power consumption

3-axis magnetometer for vehicle detection

- 128 Hz sampling rate
- Count and presence detection modes
- Modes for bicycle and motorcycle detection

Flush mount or up to 4.25" (10.8 cm) depth (to top of sensor) in-pavement installation with no wires or lead-in cabling

Fast and simple installation

- Installs in less than 10 minutes in small hole using a hammer or core drill
 - Hole 4" (10 cm) diameter; a maximum of 6.5" (16.5 cm) deep
 - Covered with fast-drying epoxy
- Minimal lane closure time
- No saw cuts

Expected 10 year battery life

- Rugged mechanical design
- Auto-calibration

Reliable 2-way radio communications with gateway

- Uniquely addressable and configurable
- Firmware can be upgraded over-the-air

Readily deployed where other systems cannot be used

- Split roadways
- High water tables
- Damaged pavement

Ability to enable temperature reporting

Functional Specifications

detection technique	3-axis magnetic field sensing
sampling rate	128 Hz
programmable vehicle detection parameters (mode B only)	<ul style="list-style-type: none"> • Z-axis detect threshold (mG) • Z-axis undetect threshold (mG) • X-axis undetect threshold (mG) • onset filter (ms) • holdover (ms) • auto-recalibration timeout (secs)
over-the-air protocol	Sensys Networks NanoPower (SNP) protocol (TDMA)
physical layer protocol	IEEE 802.15.4 PHY
modulation	Direct Sequence Spread Spectrum Offset Quadrature Phase-Shift Keying (DSSS O-QPSK)
transmit/receive bit rate	250 kbps
frequency band	2405 to 2480 MHz (ISM unlicensed band)
frequency channels	16
channel bandwidth	2 MHz
antenna type	microstrip patch antenna (mounted below top surface of sensor)
antenna field of view	±60° (azimuth & elevation)
nominal output power	+3 dBm
spurious emissions	<ul style="list-style-type: none"> • 30 - 1000 MHz: < -36 dBm • 1 - 12.75 GHz: < -30 dBm • 1.8 - 1.9 GHz: < -47 dBm • 5.15 - 5.3 GHz: < -47 dBm
typical receive sensitivity	-101 dBm (PER = 1%)
saturation (max input level)	≥ 10 dBm

Compliance

safety	2006/95/EC
EMC	<ul style="list-style-type: none"> • FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. • CE0678 • 2004/108/EC • IC: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. • IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Sensor Modes

mode	application	description
B (event)	count stations; advance detection	<ul style="list-style-type: none"> • sends timestamped ON and OFF detection events using configurable detection parameters • not supported by VSN240-T-2A
E (idle)	status reporting	disables magnetometer and sends sensor hardware and software version information
STOPBAR-# (presence detection)	stop bar detection; ramp management	sends timestamped <i>ON</i> and <i>OFF</i> detection events using pre-configured detection parameters
<ul style="list-style-type: none"> • 16 different stop bar detection modes can be selected • recommended stop bar detection modes for specific applications: 		
	STOPBAR-0	bicycles/scooters
	STOPBAR-2	motorcycles
	STOPBAR-5	passenger vehicles (normal recalibration)
	STOPBAR-7	passenger vehicles (fast recalibration)
	STOPBAR-14	light rail

Power, Physical, & Environment

power supply	<ul style="list-style-type: none"> • non-replaceable primary Li-SOCl₂ 3.6v battery • 8.5 Ah (nominal capacity)
dimensions	2.9" x 2.9" x 2.2" (7.4 cm x 7.4 cm x 5.6 cm)
weight	• 0.53 lbs/0.238 kg (with shell)
environmental	<ul style="list-style-type: none"> • designed for in-pavement mounting • NEMA Type 6P enclosure • IP68 ingress protection
operating temp	-40°F to 176°F / -40°C to +85°C

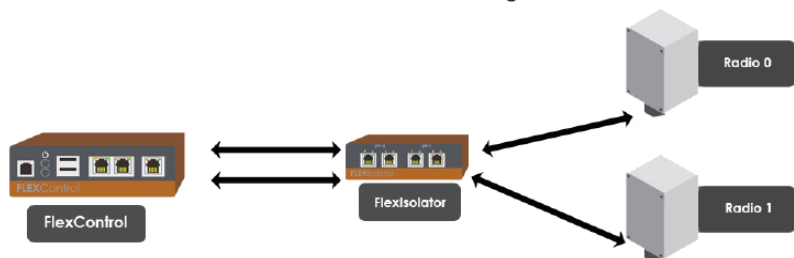
Local Distributor

Flexisolator

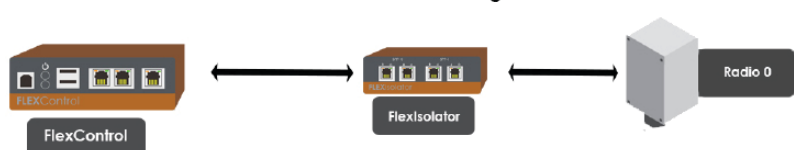
The Sensys Networks Flexisolator module provides both safety and length extension for the FlexControl[†] to Radio wired interface. The Flexisolator provides two independent isolator ports, one for each Radio connection.

A typical FlexControl system consists of one FlexControl and two Radios with one Flexisolator. The system can also consist of a Flexisolator and a Radio.

FlexControl with Two Radios Configuration



FlexControl with One Radio Configuration



Flexisolator

A Flexisolator isolates and protects signals from the FlexControl to the Radio and provides up to 2,000 feet (610 meters) of 24 AWG CAT5 cable communication for the FlexControl to and from the Radio using RS-422 drivers.

The Flexisolator serves three purposes:

1. Equipment protection from electrical surges.
Surge protection prevents unwanted electrical surge currents, for example from lightning, to enter the controller cabinet and destroy electronic circuitry.
2. Protection from electrical shock.
Ground isolation prevents dangerous voltages in a cable from shorting onto the ground or power supply in the cabinet.
3. Length extension.
The power supply voltage on the CAT5 between the FlexControl and the Radio is normally 5 V which allows only limited connection length. To increase the connection length the Flexisolator boosts this voltage to 15 V.

[†]Applicable also to the Access Point Controller Card (APCC)



Functions / Features

Safety Assurance

- Provides surge protection up to 12 A
- Provides electrical isolation up to 2,500 Vrms

Increases connection length between FlexControl and Radio

Power and Activity indicators for both Local (i.e. FlexControl) and Remote (i.e. Radio) connections

Two types of ground terminations

Mounts in traffic cabinet with DIN mount or bracket mount

Flexisolator Front Panel

SPP-0 and SPP-1	RJ45 ports for Radio connections
Remote ↓	Activity LED for SPP ports: off (not receiving data); blinking (receiving data from Radio)
Remote ⏻	Power LED for Radio: on (+ 15 V on); off (no power)
Local ↑	Activity LED for SPP ports: off (not transmitting data); blinking (transmitting data to Radio)
Local ⏻	Power LED for Flexisolator: on (+ 5 V on); off (no power)

Flexisolator Back Panel

	Both Phoenix and screw (# 8) grounding lugs (only connect one).
--	---

Power, Physical, & Environmental

output voltage	15 VDC unregulated 2 W
power consumption	600 mW per Radio
dimensions	4.3" x 3.5" x 1.2" (10.9 cm x 8.8 cm x 3 cm) without mount
weight	7.8 oz (221.5 g) without mount
operating temp	industrial -40°C to 85°C
surge protection	<ul style="list-style-type: none"> • IEC 61000-4-2 (ESD) ±15 kV (air), ±8 kV (contact) • IEC 61000-4-4 (EFT) 40 A (5/50 ns) • IEC 61000-4-5 (Lightning) 12 A (8/20 µs)
electrical isolation	2500 Vrms
connection length extension	up to 2,000 ft (610 m)
mounting	DIN or bracket mount

Available Product

Order Code	Description
FLEX-ISOL-M	FlexIsolator module (2 port): Provides surge protection, electrical isolation, and CAT5 cable length extension (DIN and bracket mounting kit included).

Compliance



safety	2006/95/EC
EMC	<ul style="list-style-type: none"> • FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. • 2004/108/EC • IC: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. • IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

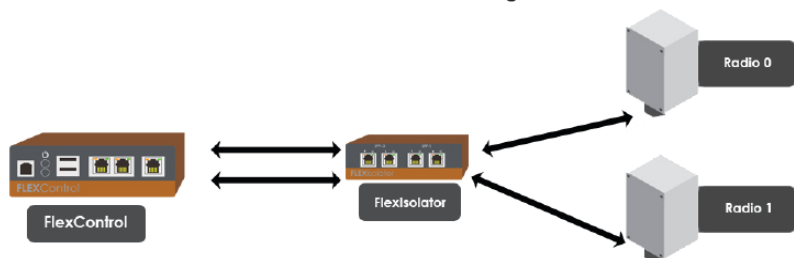
Local Distributor

Flexisolator

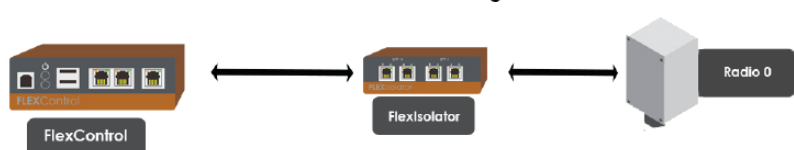
The Sensys Networks Flexisolator module provides both safety and length extension for the FlexControl[†] to Radio wired interface. The Flexisolator provides two independent isolator ports, one for each Radio connection.

A typical FlexControl system consists of one FlexControl and two Radios with one Flexisolator. The system can also consist of a Flexisolator and a Radio.

FlexControl with Two Radios Configuration



FlexControl with One Radio Configuration



Flexisolator

A Flexisolator isolates and protects signals from the FlexControl to the Radio and provides up to 2,000 feet (610 meters) of 24 AWG CAT5 cable communication for the FlexControl to and from the Radio using RS-422 drivers.

The Flexisolator serves three purposes:

1. Equipment protection from electrical surges.
Surge protection prevents unwanted electrical surge currents, for example from lightning, to enter the controller cabinet and destroy electronic circuitry.
2. Protection from electrical shock.
Ground isolation prevents dangerous voltages in a cable from shorting onto the ground or power supply in the cabinet.
3. Length extension.
The power supply voltage on the CAT5 between the FlexControl and the Radio is normally 5 V which allows only limited connection length. To increase the connection length the Flexisolator boosts this voltage to 15 V.

[†]Applicable also to the Access Point Controller Card (APCC)



Functions / Features

Safety Assurance

- Provides surge protection up to 12 A
- Provides electrical isolation up to 2,500 Vrms

Increases connection length between FlexControl and Radio

Power and Activity indicators for both Local (i.e. FlexControl) and Remote (i.e. Radio) connections

Two types of ground terminations

Mounts in traffic cabinet with DIN mount or bracket mount

Flexisolator Front Panel

SPP-0 and SPP-1	RJ45 ports for Radio connections
Remote ↓	Activity LED for SPP ports: off (not receiving data); blinking (receiving data from Radio)
Remote ⏻	Power LED for Radio: on (+ 15 V on); off (no power)
Local ↑	Activity LED for SPP ports: off (not transmitting data); blinking (transmitting data to Radio)
Local ⏻	Power LED for Flexisolator: on (+ 5 V on); off (no power)

Flexisolator Back Panel

	Both Phoenix and screw (# 8) grounding lugs (only connect one).
--	---

Power, Physical, & Environmental

output voltage	15 VDC unregulated 2 W
power consumption	600 mW per Radio
dimensions	4.3" x 3.5" x 1.2" (10.9 cm x 8.8 cm x 3 cm) without mount
weight	7.8 oz (221.5 g) without mount
operating temp	industrial -40°C to 85°C
surge protection	<ul style="list-style-type: none"> • IEC 61000-4-2 (ESD) ±15 kV (air), ±8 kV (contact) • IEC 61000-4-4 (EFT) 40 A (5/50 ns) • IEC 61000-4-5 (Lightning) 12 A (8/20 µs)
electrical isolation	2500 Vrms
connection length extension	up to 2,000 ft (610 m)
mounting	DIN or bracket mount

Available Product

Order Code	Description
FLEX-ISOL-M	FlexIsolator module (2 port): Provides surge protection, electrical isolation, and CAT5 cable length extension (DIN and bracket mounting kit included).

Compliance



safety	2006/95/EC
EMC	<ul style="list-style-type: none"> • FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. • 2004/108/EC • IC: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. • IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Local Distributor

FlexConnect

Sensys Networks FlexConnect is a stand-alone unit that provides an SDLC interface to TS2 controllers* for Gateways (FlexControl Module, FlexControl Card (i.e., APCC), FlexAP). FlexConnect replaces the functionality of the EX cards. This reduces system costs and the need for additional card slots for expansion cards and multiple racks in controller cabinets.

FlexConnect connects to the EX port on the FlexControl Module or FlexControl Card (i.e., APCC) or the CC card (for the FlexAP). FlexConnect conforms to the Port 1 interface communications and indicator requirements specified in the NEMA TS2-2003 standard. FlexConnect is powered through the 9-28VDC barrel connector, the EX port (recommended), or the USB port. The front panel display shows the channel status of the 64 channels arranged as four racks of 16 channels each. Racks can be independently enabled or disabled via a push button. TrafficDOT is used to configure the channels and download firmware updates.



Functions / Features

Directly connects a FlexControl Module, FlexControl Card (i.e., APCC) or CC card to a TS2 controller via the SDLC link

- Eliminates the need for EX cards and additional card slots in the cabinet.
- Adheres to NEMA Standard TS2-2003 requirements: 8.6.1, 8.6.2.

FlexConnect is programmable via TrafficDOT

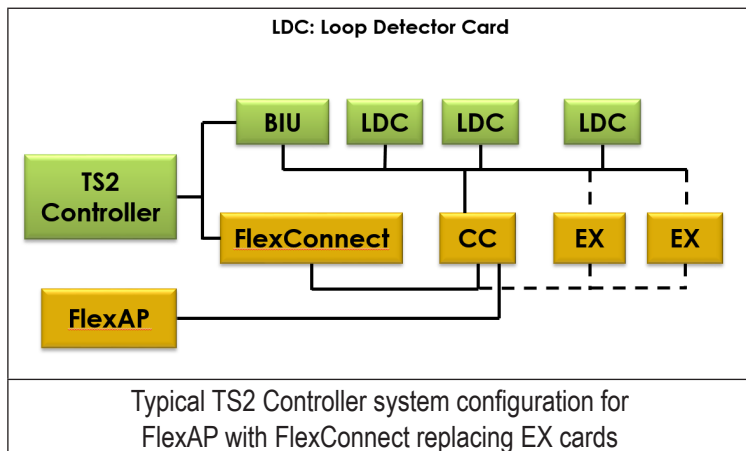
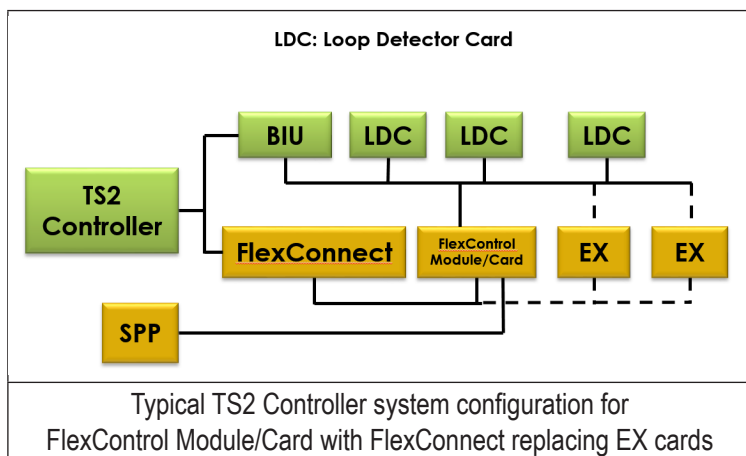
- Utilizes the same configuration interface as CC and EX cards.
- All current CC and EX card configuration options are supported.
- FlexConnect supports a total of 64 channels.

Simple installation

- Mounts in traffic cabinet with DIN mount or bracket mount. Mounting kit supplied with module.

Software Compatibility

- FlexControl Module or FlexAP firmware v3.0.0 or later.
- FlexControl Card (i.e., APCC) firmware v2.10.3 or later.
- TrafficDOT software v2.12.2 or later.



* And other controllers that support Port 1 SDLC connections

Front Panel

power LED indicator	for unit power
TX LED indicators	for SDLC and EX port connections
Link LED indicators	for SDLC and EX port connections
channel LED display	rack number indicator and 16 channel status states: call, no call, recall, disabled
push button	for rack number selection and rack enable/ disable
USB B connector	USB port connection to FlexControl Module/Card for SDLC monitor data and debug data and power

Back Panel

power connector	to cabinet power adapter or terminal blocks
DB15 connector	SDLC link to TS2 controller
RJ45 connector	connection to EX port






Power, Physical, & Environmental

input voltage	<ul style="list-style-type: none"> 9-28 VDC (24 VDC nominal): 5.5 mm x 2.1 mm barrel power connector, or 5 VDC nominal USB port 9-28VDC EX port (recommended)
power consumption	less than 300 mW
dimensions	4.3" x 3.5" x 1.2" (10.9 cm x 8.8 cm x 3 cm) without mount
weight	7.8 oz (221.1 g) without mount
operating temp	industrial -40°C to 80°C
mounting	DIN or cabinet mount

Available Products

Order Code	Description
FLEX-CONN-M	FlexConnect (DIN and bracket mounting kit included).
FLEX-CONN-ACC-1	FlexConnect TS2 Y-Cable (0.5'/3'): Splitter cable to connect FLEX-CONN-M to used SDLC port.
FLEX-CONN-ACC-2	FlexConnect Power Cord (6'): Cord to connect FlexConnect with cabinet power terminal blocks.
FLEX-CONN-ACC-3	FlexConnect Power Supply (60W, 12V): Industrial rated cabinet power adapter with cords (6' AC/4' DC).
FLEX-CONN-ACC-4	FlexConnect TS2 Straight Cable (3'): Through cable to connect FLEX-CONN-M to spare SDLC port.
FLEX-CONN-ACC-5	FlexConnect 2070 Y-Cable (0.8'/4'): Splitter cable to connect FLEX-CONN-M to C12S P1 port.
FLEX-CONN-ACC-6	FlexConnect 2070 Straight Cable (6'): Through cable to connect to FLEX-CONN-M to C12S P1 port.



CHANNEL LED Display Legend		
Display	Meaning	TS2 Diag Response
	channel disabled	watchdog failure
	no call	none
	call	none
	recall due to all sensors in fault	open circuit
	recall due to some sensors in fault	excessive inductance

Compliance

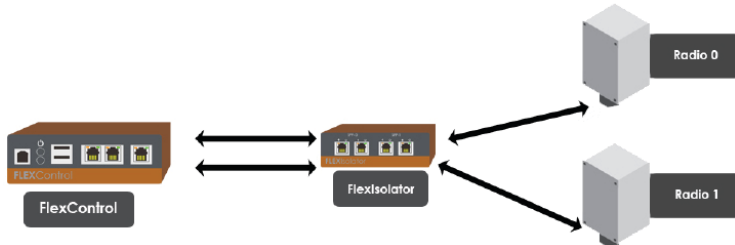
safety	2006/95/EC
EMC	<ul style="list-style-type: none"> FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. 2004/108/EC IC: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Local Distributor

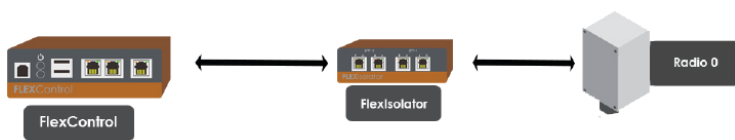
Radio

The **Sensys Networks Serial Port Protocol (SPP) Radio** is a low powered radio that maintains two-way wireless links to an installation's sensors and repeaters. The Radio establishes overall time synchronization, transmits configuration commands and message acknowledgements, and receives data from the sensors. The Radio then relays the sensor detection data to the FlexControl[†] over a CAT5 cable.

FlexControl with Two Radios Configuration



FlexControl with One Radio Configuration



A typical FlexControl system consists of one FlexControl and two Radios with one FlexIsolator. The system can also consist of a FlexIsolator and a Radio.

Functions / Features

Sensys Networks radio communications

- To/from Sensys Networks sensors
- To/from Sensys Networks repeaters

Radio signal quality measurements

- Receive Signal Strength Indicator (RSSI, in dBm)
- Link Quality Index (LQI, figure of merit)

Simple installation

- Any roadside location that provides adequate signal coverage to sensors/repeaters
- No special requirements regarding setback, relative angle of the sun, or mounting stability
- Mounted on pole using a Sensys Networks mounting kit

Low power consumption

- Receives power through the FlexControl in the traffic cabinet

No calibration or adjustment required

[†] Applicable also to the Access Point Controller Card (APCC)



Functional Specifications

interfaces	RS-422 full duplex to FlexControl via RJ45 connector
over-the-air protocol	Sensys NanoPower (SNP) protocol (TDMA)
physical layer protocol	IEEE 802.15.4 PHY
modulation	Direct Sequence Spread Spectrum Offset Quadrature Phase-Shift Keying (DSSS O-QPSK)
transmit/receive bit rate	250 kbps
frequency band	2405 to 2483.5 MHz (ISM unlicensed band)
frequency channels	16
channel bandwidth	2.8 MHz (20 dB)
antenna type	ceramic patch antenna (+5 dBi)
antenna field of view	±60° (azimuth & elevation)
nominal output power	+3 dBm
spurious emissions	<ul style="list-style-type: none"> • 30 - 1000 MHz: < -36 dBm • 1 - 12.75 GHz: < -30 dBm • 1.8 - 1.9 GHz: < -44 dBm • 5.15 - 5.3 GHz: < -47 dBm
typical receive sensitivity	-101 dBm (PER ≤ 1%)
saturation (max input level)	≥ 10 dBm

Power, Physical, & Environmental

power consumption	less than 150 mW
input voltage	4.5 V up to 28 V
dimensions	4.7" x 3.5" x 2.4" (12 cm x 9 cm x 6 cm)
weight	14.1 oz (400 g)
operating temp	industrial -40°C to 85°C
enclosure rating	NEMA 4X

Available Product

Order Code	Description
APCC-SPP	Radio (SPP Digital Radio)
KIT-MTG	Mounting kit

Compliance



safety	2006/95/EC
EMC	<ul style="list-style-type: none"> • FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. • 2004/108/EC • IC: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference that may cause undesired operation of the device. • IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Local Distributor

FlexRepeat Solar

The Sensys Networks Repeater. In cases where installed Sensys Networks wireless sensors are out of range of the nearest access point, one or more Sensys Networks repeaters can be used to provide a two-way relay between the out of range sensors and the access point. A repeater is pole mounted by the roadside and is positioned so that both the sensors and the tandem repeater or access point are within view and within range.

The Sensys Networks FlexRepeat Solar is a single pole-mounted unit with a 10+ year life that eliminates any battery replacement for the effective life of the wireless sensor networking system thereby lowering ongoing maintenance costs. This version of the solar repeater represents significant advantages over the previous model, as the FlexRepeat Solar is housed in a robust enclosure that provides IP67 protection. The solar panels are mounted on two sides of the enclosure cover to allow increased exposure to sunlight during the sun's trajectory over the course of a day seasonally.

The FlexRepeat Solar has a connector for an external antenna for greater flexibility in providing a two-way relay between sensors and the access point.

The FlexRepeat Solar has three different power sources: (i) the solar panels used when there is sunlight, (ii) a rechargeable battery that is charged by the solar panels and used when there is no sunlight, and (iii) a lithium battery as backup where there might be extended periods of low sunlight. The multiple power sources provide a reliable mechanism to provide power for the repeater for at least 10 years.

Antenna options. The optional external antenna connects to the FlexRepeat Solar via a coaxial cable. The external antenna allows the repeater to be aimed in two directions simultaneously utilizing a pole located between the sensor and access point.

Three types of external antenna are supported: (i) the FLEX-ANT-1 with the same RF coverage as the internal antenna, (ii) the FLEX-ANT-2 with Long-Range RF coverage, and (iii) the FLEX-ANT-OMNI with omni-directional coverage.

The FlexRepeat Solar can also operate without an external antenna.



Features and Functions

Relay of radio communications

- To/from wireless sensors (downlink)
- To/from access point (uplink)
- To/from another repeater (uplink or downlink)

Extension of range and coverage of the access point

- Tandem operation – one repeater and its supported sensors can communicate with another repeater and then to the access point
- Maximum single-hop range of ~2000 feet (610 meters) from supporting access point or repeater with a Long Range external antenna
- Maximum single-hop range of ~300 feet (91 meters) from sensors with Long Range external antenna

Fully wireless operation – no cable connections

Radio signal quality measurements (of each link to wireless sensors or tandem repeater)

- Receive Signal Strength Indicator (RSSI, in dBm)
- Link Quality Index (LQI, figure of merit 40-99)

Enclosure

- Provides IP67 protection

Simple installation

- Any roadside location that provides adequate height and line of sight to sensors and the access point or repeater
- External connector and indicator to activate unit

No calibration or adjustment required

Firmware upgrades over-the-air from access point

Functional Specifications

interfaces	<ul style="list-style-type: none"> to/from sensors via 802.15.4 PHY radio to/from repeaters via 802.15.4 PHY radio to/from access point via 802.15.4 PHY radio
over-the-air protocol	Sensys Networks NanoPower (SNP) protocol (TDMA)
physical layer protocol	IEEE 802.15.4 PHY
modulation	Direct Sequence Spread Spectrum Offset Quadrature Phase-Shift Keying (DSSS O-QPSK)
transmit/receive bit rate	250 kbps
frequency band	2400 to 2483.5 MHz (ISM unlicensed band)
frequency channels	16
channel bandwidth	2 MHz
internal antenna type	microstrip patch antenna (behind front face panel)
internal antenna field of view	±60° (azimuth & elevation)
nominal output power	+3 dBm
spurious emissions	<ul style="list-style-type: none"> 30 - 1000 MHz: < -36 dBm 1 - 12.75 GHz: < -30 dBm 1.8 - 1.9 GHz: < -47 dBm 5.15 - 5.3 GHz: < -47 dBm
typical receive sensitivity	-101 dBm (PER ≤ 1%)
saturation (max input level)	≥ 10 dBm

Power, Physical, & Environmental

power supply	<ul style="list-style-type: none"> Solar panels (2): 100 mm x 35 mm, 0.33 W each Rechargeable battery: Lithium ion 18650 with protection, 3.6 V, nominal capacity 2.2 Ah Backup battery: Li-SOCl₂ 3.6 V primary battery pack, nominal capacity 57 Ah
recommended system replacement	<ul style="list-style-type: none"> every 10 years
dimensions	<ul style="list-style-type: none"> FLEX-RPT3-SLR-E: 9.5" x 5.59" x 4.32" (24.13 cm x 14.19 cm x 10.97 cm) FLEX-ANT-1: 5.65" x 3.54" x 4.80" (14.4 cm x 9 cm x 12.2 cm) FLEX-ANT-2: 9.5" x 9.5" x 4.38" (24.10 cm x 24.10 cm x 11.10 cm) FLEX-ANT-OMNI: 6.5" x 3.5" x 3.5" (16.51 cm x 8.9 cm x 8.9 cm)
weight	<ul style="list-style-type: none"> FLEX-RPT3-SLR-E: 2.2 lb (1 kg) FLEX-ANT-1: 0.94 lb (0.43 kg) FLEX-ANT-2: 2.2 lb (1 kg) FLEX-ANT-OMNI: .14 lb (0.06 kg)
environmental	<ul style="list-style-type: none"> designed for weatherproof, outdoor operation IP67 ingress protection
operating temp	-40°F to +176°F / -40°C to +80°C

Available Products

Order Codes	Description
FLEX-RPT3-SLR-E	FlexRepeat Solar
FLEX-ANT-1	Standard External Antenna
FLEX-ANT-2	Long-Range External Antenna
FLEX-ANT-OMNI	Omni-Directional External Antenna

Compliance



safety	• 2014/35/EU
RF	• 2014/53/EU
EMC	• 2014/30/EU
	<ul style="list-style-type: none"> FCC: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. IC: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. IC : Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

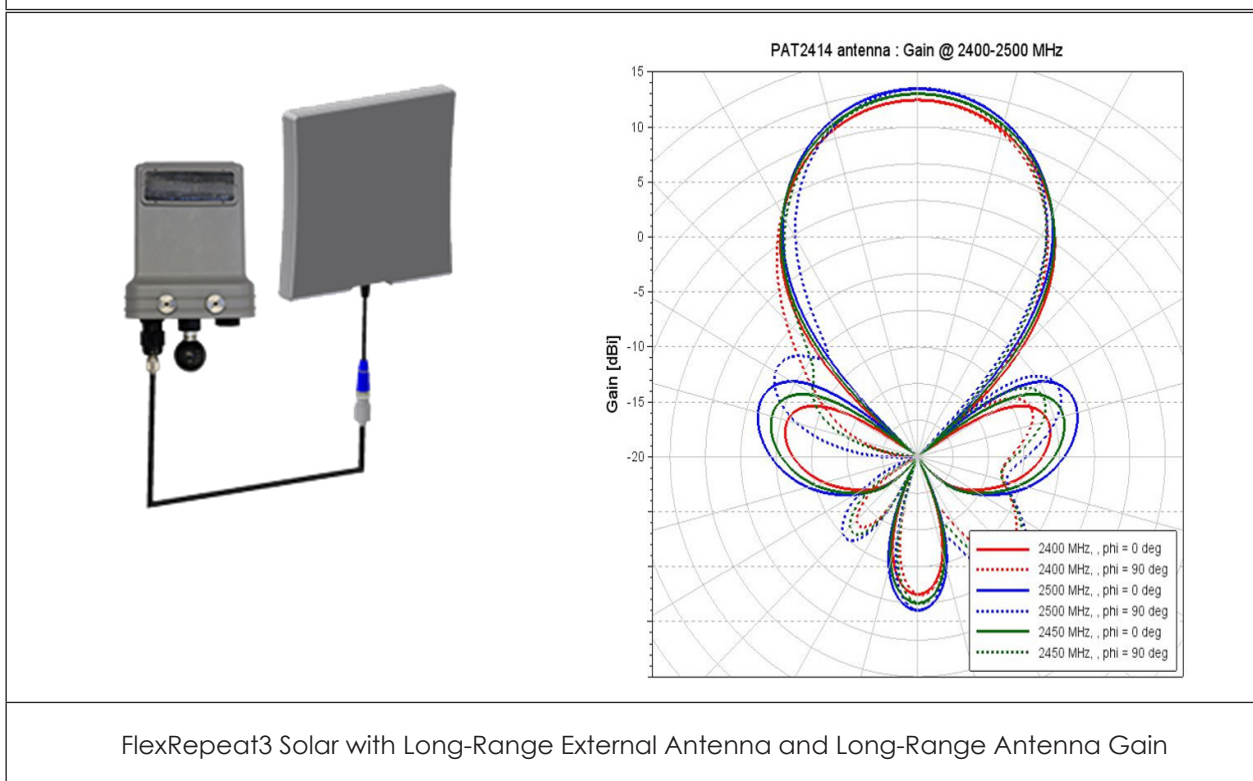
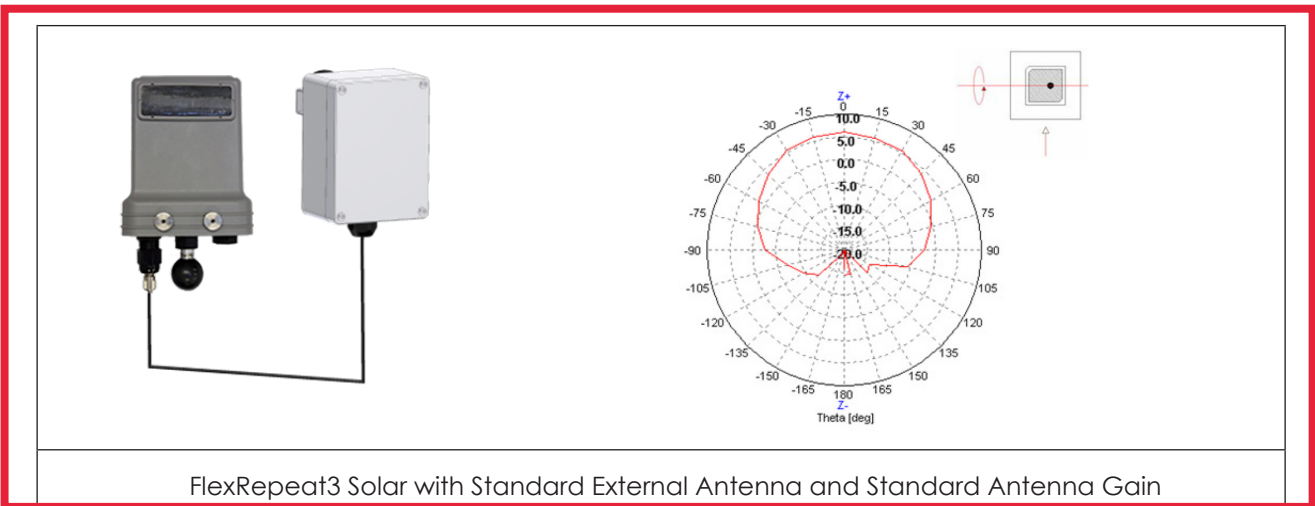
Local Distributor

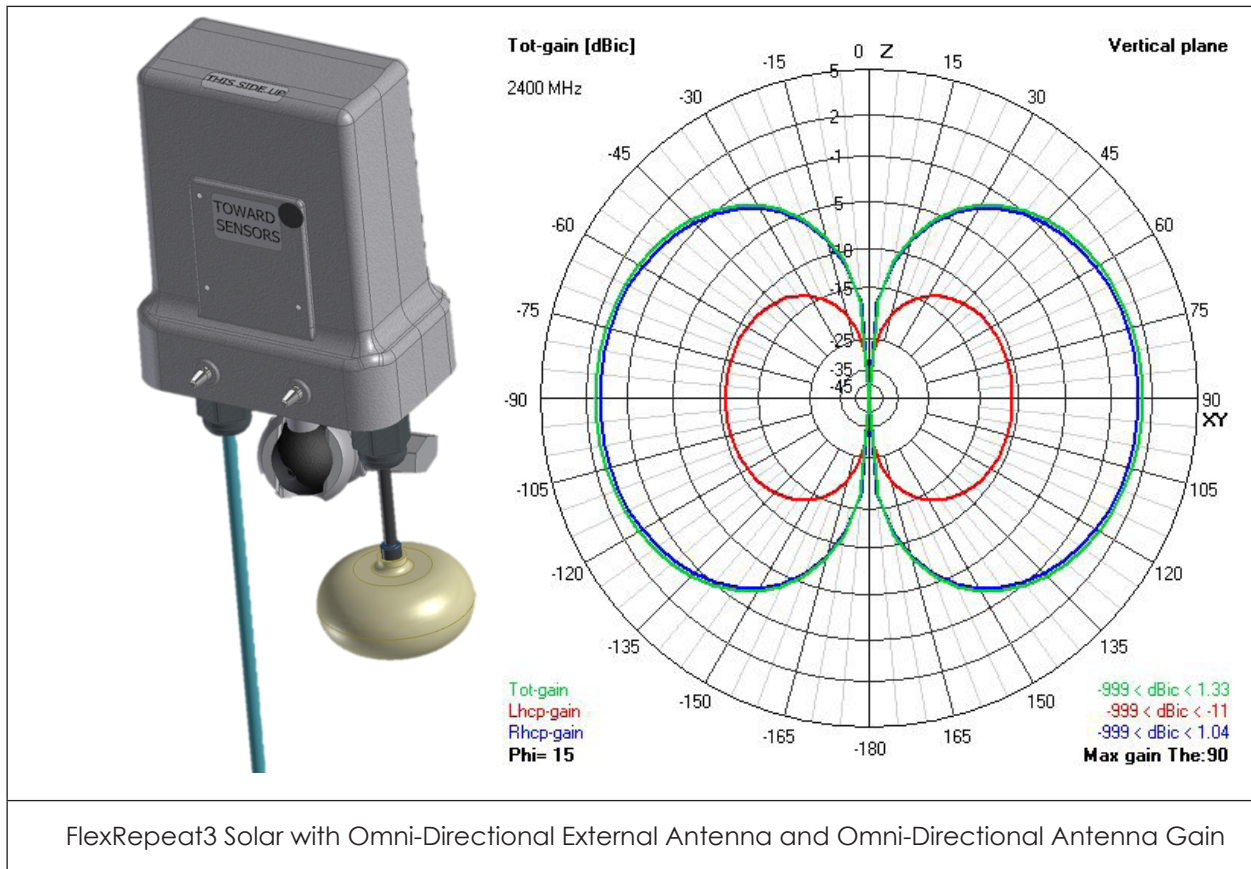
External Antennas

The **Sensys Networks External Antennas** provide additional range and coverage when using Flex Repeaters or FlexNodes. Flex Repeaters or FlexNodes have a connector for an external antenna to provide for greater flexibility in providing connections to sensors and FlexAPs, Radios (SPP), or other Repeaters.

Antenna options. The optional external antenna connects to a Flex Repeater or FlexNodes via a coaxial cable. Three types of external antennas are supported: (i) the FLEX-ANT-1 with the same RF coverage as the internal antenna, (ii) the FLEX-ANT-2 with Long-Range RF coverage, and (iii) the FLEX-ANT-OMNI with omni-directional coverage.

The family of Flex Repeaters or FlexNodes can operate without an external antenna.





Available Products

Order Codes	Description	Mounting Kit (MTG-KIT)
FLEX-ANT-1	Standard External Antenna	Required
FLEX-ANT-2	Long-Range External Antenna	Required
FLEX-ANT-OMNI	Omni-Directional External Antenna	Not needed

Local Distributor

Electrical, Physical, & Environmental

frequency range	<ul style="list-style-type: none"> • 2.4 - 2.5 GHz
polarization	<ul style="list-style-type: none"> • FLEX-ANT-1: RHCP • FLEX-ANT-2: Horizontal • FLEX-ANT-OMNI: RHCP
gain	<ul style="list-style-type: none"> • FLEX-ANT-1: 5.5 dBi • FLEX-ANT-2: 14 dBi • FLEX-ANT-OMNI: 0 dBi
beam width	<ul style="list-style-type: none"> • FLEX-ANT-1: $\pm 60^\circ$ (horizontal and vertical) • FLEX-ANT-2: $\pm 38^\circ$ (horizontal and vertical) • FLEX-ANT-OMNI: 360° (horizontal), $\pm 30^\circ - 150^\circ$ (vertical)
front to back ratio	<ul style="list-style-type: none"> • FLEX-ANT-1: >15 dB • FLEX-ANT-2: >19 dB • FLEX-ANT-OMNI: 0 dB
dimensions	<ul style="list-style-type: none"> • FLEX-ANT-1: 5.65" x 3.54" x 4.80" (14.4 cm x 9 cm x 12.2 cm) • FLEX-ANT-2: 9.5" x 9.5" x 4.38" (24.10 cm x 24.10 cm x 11.10 cm) • FLEX-ANT-OMNI: 6.5" x 3.5" x 3.5" (16.51 cm x 8.9 cm x 8.9 cm)
weight	<ul style="list-style-type: none"> • FLEX-ANT-1: 0.94 lb (0.43 kg) • FLEX-ANT-2: 2.2 lb (1 kg) • FLEX-ANT-OMNI: .14 lb (0.06 kg)
environmental	<ul style="list-style-type: none"> • designed for weatherproof, outdoor operation
operating temp	-40°F to +176°F / -40°C to +80°C
RoHS compliant	<ul style="list-style-type: none"> • Yes

Compliance Impact

The External Antennas do not impact the compliance of the Flex Repeater or FlexNode products.	
EMC	<ul style="list-style-type: none"> • FCC: FLEX-RP-B-LL-2, FLEX-RPT3-SLR, FLEX-NODE-LPDC • IC: FLEX-RP-B-LL-2, FLEX-RPT3-SLR, FLEX-NODE-LPDC • 2004/108/EC FLEX-RP-B-LL-2 • 2014/30/EC FLEX-RPT3-SLR-E, FLEX-NODE-LPDC-E • CE0678 FLEX-RP-B-LL-2
RF	<ul style="list-style-type: none"> • 2014/53/EC FLEX-RPT3-SLR-E, FLEX-NODE-LPDC-E
safety	<ul style="list-style-type: none"> • 2006/95/EC FLEX-RP-B-LL-2 • 2014/35/EC FLEX-NODE-LPDC-E

Local Distributor