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)	• 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	• 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

Sensor Modes

mode	application	description
B (event)	count stations; advance detection	• 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 *ON* and *OFF* detection events using pre-configured detection parameters

• 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	• non-replaceable primary Li-SOCl$_2$ 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	• designed for in-pavement mounting • NEMA Type 6P enclosure • IP68 ingress protection
operating temp	-40ºF to 176ºF/-40ºC to +85ºC

Compliance

safety	2006/95/EC
EMC	• 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.

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