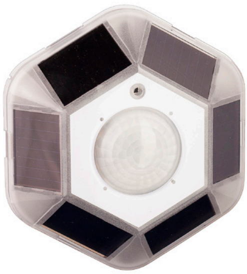
IoT Ceiling Sensor

MOS-MT

Programming Guide



Echoflex intends this document, whether printed or electronic, to be read in its entirety.

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Introduction

This guide covers the IoT ceiling sensor, model number MOS-MT. The IoT sensor is a self-powered wireless sensor offering occupant detection, light level, temperature and sound level monitoring for the collection and sharing of data for Internet of Things applications.

Facility operations use the IoT sensor data via gateways or interfaces to track occupancy levels and environment mapping for building-use optimization. Areas not being used can be placed into set-back mode to conserve energy.

The sensor is powered using solar energy harvesting from natural and artificial light sources.

This guide contains information to allow linking of the sensor to a receiver and technical details for programming to interpret the MOS-MT transmissions.

The guide assumes the reader has some familiarity with EnOcean telegrams or messages. Contact EnOcean to learn more about the DolphinAPI and EnOcean Radio Protocol (ERP) at enocean.com

This guide is available for free download from Echoflex Solutions website: www.echoflexsolutions.com

Overview

The MOS-MT sensor monitors occupancy, light level, temperature and sound level in interior spaces. The sensor is powered by solar energy from natural or artificial light sources. The solar energy is transformed into electrical energy which is then stored providing a continuous power source for the sensor. Powered by six solar cells, the sensor can operate without battery in darkness for over 4 days. The sensor will operate even with a brief exposure to light, however for best results the sensor should be mounted in a location with exposure for 2.5 hours of natural or artificial light (minimum of 500 lux or 46 foot-candles) on a daily basis.

The sensor must be within range of any receiving gateway or interface. The MOS-MT and gateway/interface should be installed within 80’ (24m) of each other. For applications exceeding 80’ (24m) range, telegram repeaters may be needed to extend reception range.

Radio Communications

The MOS-MT is a wireless device transmitting an EnOcean generic profile telegram. The telegram includes:

Parameter	Measured value
Ambient Light Level	0-4095 lux
Current Produced from Solar Panels	1 - 100 µA
Space Temperature	0.0 - +40.0 °C
Occupancy/Vacancy State via PIR Detection	(1) occupied (0) unoccupied
Ambient Sound Level	40 - 80 dB spl
Battery Voltage	0 - 5.5 VDC
Super-Capacitor Voltage	0 - 5.5 VDC

Data Communication Protocol

The MOS-MT transmits data using the EnOcean Generic Profile.

Note: *Refer to the EnOcean Alliance documents referencing Generic Profiles for further detailed information on this protocol.*

The MOS-MT Generic Profile has the following channels.

Channels used in the MOS-MT Profile					
Ch. #	**Type**	**Min**	**Max**	**Unit**	**Resolution (bits)**
0	Light	0	10000	Lux	12
1	Current -Solar	1	100	µA	8
2	Temperature	0.0	+40.0	°C	10
3	Occupancy State	0	1	(1) occupied (0) unoccupied	1
4	Sound	40	80	dB spl	8
5	Battery Voltage	0	5.5	VDC	8
6	Super Cap Voltage	0	5.5	VDC	8

Teach-In Message

The MOS-MT must be linked with a receiver or gateway via a teach-in process before its data messages can be properly interpreted. When the link button is pressed on the MOS-MT the following GP teach-in message is transmitted.

Note: *Refer to the EnOcean DolphinAPI User Manual and EnOcean Radio Protocol Specification documents for more information on these fields and process of assembling the messages.*

Teach-in Request Telegram Header			
Manufacturer ID	**Data Direction**	**Purpose**	**Not used**
11 bit	1 bit	2 bits	2 bits
00000000100=Echoflex	0=unidirectional 1=bidirectional	00=teach-in 01=teach-in deletion 10=teach-in or deletion of teach-in 11= not used	

Following the header, each of the channels are defined. The channel definition for each is 5 bytes long and follows the structure as shown below.

Channel Definition - "Data"							
Channel Type	Signal type	Value type	Resolution	Engineering Minimum	Scaling minimum	Engineering maximum	Scaling maximum
2 bits	8 bits	2 bits	4 bits	8 bits	4 bits	8 bits	4 bits

Channel 0 – Light

assembled bit stream: 0x43 D8 00 16 43

Channel type – 0b01 (Data Channel)

Signal type – 0b00001111 (Luminance intensity - Lux)

Value type – 0b01 (Current Value)

Resolution – 0b1000 (12 bit)

Engineering Minimum – 0b00000000 (0)

Scaling Minimum – 0b0001 (1)

Engineering Maximum – 0b01100100 (100)

Scaling Maximum – 0b0011 (100)

Channel 1 – Current (solar)

assembled bit stream: 0x41 96 00 C6 4C

Channel type – 0b01 (Data Channel)

Signal type – 0b00000110 (Current - Amps)

Value type – 0b01 (Current Value)

Resolution – 0b0110 (8 bit)

Engineering Minimum – 0b00000000 (0)

Scaling Minimum – 0b1100 (0.000001)

Engineering Maximum – 0b01100100 (100)

Scaling Maximum – 0b1100 (0.000001)

Channel 2 – Temperature

assembled bit stream: 0x46 17 00 12 81

Channel type – 0b01 (Data Channel)

Signal type – 0b00011000 (Temperature)

Value type – 0b01 (Current Value)

Resolution – 0b0111 (10 bit)

Engineering Minimum – 0b00000000 (0)

Scaling Minimum – 0b0001 (1)

Engineering Maximum – 0b00101000 (40)

Scaling Maximum – 0b0001 (1)

Channel 3 – Occupancy

assembled bit stream: 0x82 5

Channel type – 0b10 (Flag Channel)

Signal type – 0b00001001 (Occupancy Flag)

Value type – 0b01 (Current Value)

Channel 4 – Sound

assembled bit stream: 0x47 D6 00 16 41

Channel type – 0b01 (Data Channel)

Signal type – 0b00011111(Sound)

Value type – 0b01 (Current Value)

Resolution – 0b0110 (8 bit)

Engineering Minimum – 0b00000000 (0)

Scaling Minimum – 0b0001 (1)

Engineering Maximum – 0b01100100 (100)

Scaling Maximum – 0b0001 (1)

Channel 5 - Battery Voltage

assembled bit stream: 0x47 16 00 1F F1

Channel type – 0b01 (Data Channel)

Signal type – 0b00011100 (Voltage)

Value type – 0b01 (Current Value)

Resolution – 0b0110 (8 bit)

Engineering Minimum – 0b00000000 (0)

Scaling Minimum – 0b0001 (1)

Engineering Maximum – 0b11111111 (255)

Scaling Maximum – 0b0001 (1)

Channel 6 - Super Cap Voltage

assembled bit stream: 0x47 16 00 1F F1

Channel type – 0b01 (Data Channel)

Signal type – 0b00011100 (Voltage)

Value type – 0b01 (Current Value)

Resolution – 0b0110 (8 bit)

Engineering Minimum – 0b00000000 (0)

Scaling Minimum – 0b0001 (1)

Engineering Maximum – 0b11111111 (255)

Scaling Maximum – 0b0001 (1)

Data Message

The sensor always transmits a complete Generic Profile data message with a length of 6 bytes. Selective data messages are not supported at this time. The payload contains the data for each channel compacted together in a byte stream.

- The first 12 bits contain the scaled value of the light measurement
- The next 10 bits contain the scaled value of the temperature measurement
- The next 2 bits contain the occupancy flag (1 – occupied, 0 – vacant)
- The next 8 bits contain the scaled value of the sound measurement
- The next 8 bits contain scaled value of the battery voltage
- The next 8 bits contain scaled value of the super capacitor voltage

The scaled values transmitted by the device can be converted to their real values using the formula given in Figure 3.

x= actual value	
X_{min} = actual engineering minimum	X_{max} = actual engineering maximum
Eng_{min} = scaled engineering minimum	Eng_{max} = scaled engineering maximum
F_{min} = scaling factor minimum	F_{max} = scaling factor maximum
n = quantized value	N = number of steps (bit range)

$$Eng_{min} = \frac{X_{min}}{F_{min}} \qquad Eng_{max} = \frac{X_{max}}{F_{max}}$$

$$n = N \times \frac{x - X_{min}}{X_{max} - X_{min}} \qquad x = \frac{n}{N} \times (X_{max} - X_{min}) + X_{min}$$

Appendix A: Data Message Example

Transmitted data message = 0x03 4A F0 CD 2F CA

Light Measurement

Scaled value = 0b000000110100 (52)

X = (52/4096) * (10000 – 0) + 0

X = 126.95 LUX

Solar Measurement (uAmps)

Scaled value = 0b00001111 (15)

X = (15/255) * (100 - 0) + 0

X = 5.88 uA

Temperature Measurement

Scaled value = 0b1010111100 (700)

X = (700/1024) * (40 – 0) + 0

X = 27.34°C

Occupancy Measurement

Scaled value = 0b0

0 – Vacant

1 – Occupied

Sound Measurement

Scaled value = 0b01100110 (102)

X = (102/255) * (100 – 0) + 0

X = 40dB

Battery Measurement

Scaled value = 0b10010111(151)

X = (151/255) * (5.5 – 0) + 0

X = 3.26V

Super Capacitor Measurement

Scaled value = 0b11100101(229)

X = (229/255) * (5.5 – 0) + 0

X = 4.94V

Appendix B: Teach-In Message Example

1st telegram	00 90 43 D8 00 16 43 41 96 00 C6 4C 46 17 00 12 81 82 54 7D 60 01 64 14 71 60 09 37 90 04 31
2nd telegram	00 58 00 5F C5 00 58 00 5F C4

Note: *This message is transmitted across two telegrams as a chained message as the payload is too long to be transmitted in a single telegram.*

The R-ORG of the teach in request is 0xB0. The R-ROF CDM (chained message) is 0x40.

The chained telegrams will be:

0x40, 0x80, 0x00, 0x2E, 0xB0, 0x00, 0x90, 0x43, 0xD8, 0x00, 0x16, 0x43, 0x41, 0x96, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80

0x40, 0x81, 0xC6, 0x4C, 0x46, 0x17, 0x00, 0x12, 0x81, 0x82, 0x54, 0x7D, 0x60, 0x01, 0x64, 0x00, 0x00, 0x00, 0x00, 0x80

0x40, 0x82, 0x14, 0x71, 0x60, 0x09, 0x37, 0x94, 0x71, 0x60, 0x09, 0x37, 0x90, 0x04, 0x31, 0x00, 0x00, 0x00, 0x00, 0x80

0x40, 0x83, 0x00, 0x58, 0x00, 0x5F, 0xC5, 0x00, 0x58, 0x00, 0x5F, 0xC4, 0x00, 0x00, 0x00, 0x00, 0x80

The first two bytes contains the teach-in request header as shown in the table on page 3. This indicates that the message is a unidirectional teach-in or deletion message with an Echoflex Manufacturer ID

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