LDS03A Outdoor Open/Close Door Sensor Manual

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<th>Description</th>
<th>Date</th>
</tr>
</thead>
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<tr>
<td>1.0</td>
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1. Introduction

1.1 What is LDS03A Open/Close Door Sensor

The Dragino LDS03A is an Open/Close LoRaWAN Door Sensor. It detects door open/close status and uplinks to IoT server via LoRaWAN network. User can see the door status, open duration, open counts in the IoT Server.

LDS03A is powered by a 8500mAh Li-SOCI2 battery. It can be used for up to 10 years.

The LDS03A will send periodically data every 2 hours as well as for each door open/close action. It also counts the door open times and calculates the last door open duration. Users can also disable the uplink for each open/close event, instead, LDS03A can count each open event and uplink periodically.

LDS03A has a Datalog feature, it will record the open/close event and the user can retrieve the history from LoRaWAN.

LDS03A has the open alarm feature, user can set this feature so the device will send an alarm if the door has been open for a certain time.

LDS03A is designed for outdoor use. It has a weatherproof enclosure and industrial level battery to work in low to high temperatures.
Each LDS03A is pre-load with a set of unique keys for LoRaWAN registration, register these keys to LoRaWAN server and it will auto-connect after power on.

*Battery life depends on how often to send data, please see battery analyzer.*
1.2 Features

✓ LoRaWAN v1.0.3 Class A protocol.
✓ Door Open/Close detect
✓ Door open/close statistics
✓ 8500mAh industrial battery (non-rechargeable)
✓ AT Commands to change parameters
✓ Uplink on periodically and open/close event
✓ Datalog feature
✓ Remote configure parameters via LoRa Downlink
✓ Firmware upgradable via program port
✓ Wall Mountable
✓ Outdoor Use

1.3 Storage & Operation Temperature

-40°C to +85°C

1.4 Applications
1.5 Mechanical

LD503A Outdoor Open/Close Door Sensor
1.6 Pin Definitions and Switch

1.6.1 Pin Definition
The device is pre-configured to connect to a door sensor. The other pins are not used. If user wants to know more about other pins, please refer to the user manual of LSN50v2 at:

1.6.2 Jumper JP2(Power ON/OFF)
Power on Device when putting this jumper.

1.6.3 BOOT MODE / SW1
1) ISP: upgrade mode, device won't have any signal in this mode. but ready for upgrade firmware. LED won't work. Firmware won’t run.
2) Flash: work mode, the device starts to work and send out console output for further debug

1.6.4 Reset Button
Press to reboot the device.

1.6.5 LED
It will flash:
1) Boot the device in flash mode
2) Send an uplink packet
2. **Operation Mode**

2.1 **How it works?**

Each LDS03A is shipped with a worldwide unique set of OTAA keys. To use LDS03A in a LoRaWAN network, user needs to input the OTAA keys in the LoRaWAN network server. So LDS03A can join the LoRaWAN network and start to transmit sensor data.

2.2 **Example to use for LoRaWAN network**

This section shows an example of how to join the TTN V3 LoRaWAN IoT server. Usages with other LoRaWAN IoT servers are similar.

**LDS03A User Case**

In this user case, the LDS03A is installed on the door edge to detect the open/close event and send the status to the LoRaWAN server. The LDS03A will uplink different types of messages to the LoRaWAN server. See [Uplink payload](#) for detail.

Assume the LG308 is already set to connect to the TTN V3 network. We need to add the LDS03A device in TTN V3:

**Step 1**: Create a device in TTN V3 with the OTAA keys from LDS03A.

Each LDS03A is shipped with a sticker with the default device EUI as below:
Users can enter these keys in the LoRaWAN Server portal. Below is the TTN V3 screenshot:

Add APP EUI in the application.
Register end device

From The LoRaWAN Device Repository  Manually

Preparation

Activation mode *
- Over the air activation (OTAA)
- Activation by personalization (ABP)
- Multicast
- Do not configure activation

LoRaWAN version *
Select...

Network Server address
eu1.cloud.thethings.network

Application Server address
eu1.cloud.thethings.network

External Join Server
Add APP KEY and DEV EUI

**Step 2**: Power on LDS03A
Put the jumper to power on LDS03A and it will auto-join to the TTN V3 network. After join success, it will start to upload sensor data to TTN V3 and the user can see it in the panel.

2.3 Uplink Payload

Uplink payloads have two types:

- **Open/Close Status**: Use FPORT=2
- **Other control commands**: Use other FPORT fields.

The application server should parse the correct value based on FPORT settings.

2.3.1 Device Status, FPORT=5

Include device configure status. Once LDS03A joined the network, it will uplink this message to the server. After that, LDS03A will uplink Device Status every 12 hours.

Users can also use the downlink command(0x26 01) to ask LDS03A to resend this uplink. This uplink payload also includes the DeviceTimeReq to get time.

<table>
<thead>
<tr>
<th>Device Status (FPORT=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (bytes)</td>
</tr>
<tr>
<td>Value</td>
</tr>
</tbody>
</table>

Example parse in TTNv3
➢ **Sensor Model**: For LDS03A, this value is 0x0A
➢ **Firmware Version**: 0x0100, Means: v1.0.0 version
➢ **Frequency Band**:
  * 0x01: EU868
  * 0x02: US915
  * 0x03: IN865
  * 0x04: AU915
  * 0x05: KZ865
  * 0x06: RU864
  * 0x07: AS923
  * 0x08: AS923-1
  * 0x09: AS923-2
  * 0x0a: AS923-3
  * 0x0b: CN470
  * 0x0c: EU433
  * 0x0d: KR920
  * 0x0e: MA869

➢ **Sub-Band**:  
  ✓ AU915 and US915: value 0x00 ~ 0x08  
  ✓ CN470: value 0x0B ~ 0x0C  
  ✓ Other Bands: Always 0x00

➢ **Battery Info**:  
  Check the battery voltage.  
  Ex1: 0x0B45 = 2885mV  
  Ex2: 0x0B49 = 2889mV

### 2.3.2 Sensor Configuration, FPORT=4
LDS03A will only send this command after getting the downlink command (0x26 02) from the server.

<table>
<thead>
<tr>
<th>Size (bytes)</th>
<th>3</th>
<th>1</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>TDC (unit: sec)</td>
<td>Disalarm</td>
<td>Keep status</td>
<td>Keep time (unit: min)</td>
</tr>
</tbody>
</table>

LDS03A Outdoor Open/Close Door Sensor
2.3.3 Real-Time Open/Close Status, Uplink FPORT=2
LDS03A will send this uplink after Device Status once join the LoRaWAN network successfully. And LDS03A will:

a) periodically send this uplink every 2 hours, this interval can be changed.
b) There is an Open/Close event.

Uplink Payload totals 11 bytes.

Real-Time Open/Close Status, FPORT=2

<table>
<thead>
<tr>
<th>Size (bytes)</th>
<th>1</th>
<th>3</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Status &amp; Alarm</td>
<td>Total open door events</td>
<td>The last door open duration (unit: min)</td>
<td>Unix TimeStamp</td>
</tr>
</tbody>
</table>

Status & Alarm field

<table>
<thead>
<tr>
<th>Size (bit)</th>
<th>6</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Reserve</td>
<td>Enable/disable Timeout Alarm</td>
<td>Status</td>
</tr>
<tr>
<td></td>
<td>0: No Alarm; 1: Alarm</td>
<td>0: Close, 1: Open</td>
<td></td>
</tr>
</tbody>
</table>

2.3.4 Historical Door Open/Close Event, FPORT=3
LDS03A stores sensor values and users can retrieve these history values via the downlink command.

The historical payload includes one or multiples entries and every entry has the same payload as Real-Time open/close status.
Each data entry is 11 bytes and has the same structure as Real-Time open/close status, to save airtime and battery, LDS03A will send max bytes according to the current DR and Frequency bands.

For example, in the US915 band, the max payload for different DR is:

a) DR0: max is 11 bytes so one entry of data
b) DR1: max is 53 bytes so devices will upload 4 entries of data (total 44 bytes)
c) DR2: total payload includes 11 entries of data
d) DR3: total payload includes 22 entries of data.

If LDS03A doesn’t have any data in the polling time. It will uplink 11 bytes of 0

**Downlink:**
0x31 61 8E 57 40 61 8E 81 70 05

**Uplink:**
00 00 00 00 00 00 00 61 8E 5F 8F 01 00 00 01 00 00 00 61 8E 5F D2 00 00 00 01 00 00 02 61 8E 60 64 01 00 00 02 00 00 02 61 8E 60 75 00 00 00 02 00 00 01 61 8E 60 C6 00 00 00 02 00 00 01 61 8E 7B A7 01 00 00 03 00 00 01 61 8E 7F 38 00 00 00 03 00 00 02 61 8E 7F CE 01 00 00 04 00 00 02 61 8E 81 1B 00 00 00 04 00 00 00 61 8E 81 50

**Parsed Value:**

[ALARM, DOOR_OPEN_STATUS, DOOR_OPEN_TIMES,LAST_DOOR_OPEN_DURATION, TIME]

[FALSE,CLOSE,0,0,2021-11-12 12:35:27],
[FALSE,OPEN,1,0,2021-11-12 12:36:34],
[FALSE,CLOSE,1,2,2021-11-12 12:39:00],
[FALSE,OPEN,2,2,2021-11-12 12:39:17],
[FALSE,CLOSE,2,1,2021-11-12 12:40:38],
[FALSE,CLOSE,2,1,2021-11-12 14:35:19],
[FALSE,OPEN,3,1,2021-11-12 14:50:32],
[FALSE,CLOSE,3,2,2021-11-12 14:53:02],
[FALSE,OPEN,4,2,2021-11-12 14:58:35],
[FALSE,CLOSE,4,0,2021-11-12 14:59:28],
2.4 Datalog Feature

When a user wants to retrieve sensor value, he can send a poll command from the IoT platform to ask the sensor to send value in the required time slot.

2.4.1 Unix TimeStamp

LDS03A use Unix TimeStamp format based on

<table>
<thead>
<tr>
<th>Size (bytes)</th>
<th>Payload</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>DeviceTimeAns</td>
</tr>
<tr>
<td></td>
<td>32-bit unsigned integer : Seconds since epoch*</td>
</tr>
<tr>
<td>1</td>
<td>8bits unsigned integer: fractional-second in 1/8 second steps</td>
</tr>
</tbody>
</table>

Figure 10: DeviceTimeAns payload format

Users can get this time from the link: [https://www.epochconverter.com/](https://www.epochconverter.com/)

Below is the converter example

So, we can use AT+TIMESTAMP=1611889405 or downlink 3060137afd00 to set the current time 2021 – Jan -- 29 Friday 03:03:25

2.4.2 Set Device Time

There are two ways to set the device’s time:

1. Through LoRaWAN MAC Command (Default settings)

Users need to set SYNCMOD=1 to enable sync time via the MAC command.

Once LDS03A Joined the LoRaWAN network, it will send the MAC command (DeviceTimeReq) and the server will reply with (DeviceTimeAns) to send the current time to LDS03A. If LDS03A fails to get the time from the server, LDS03A will use the internal time and wait for the next time request [via Device Status (FPORT=5)].

Note: LoRaWAN Server needs to support LoRaWAN v1.0.3 (MAC v1.0.3) or higher to support this MAC command feature.

LDS03A Outdoor Open/Close Door Sensor
2. Manually Set Time
Users need to set SYNCMOD=0 to manual time, otherwise, the user set time will be overwritten by the time set by the server.

2.4.3 Poll sensor value
Users can poll sensor values based on timestamps. Below is the downlink command.

<table>
<thead>
<tr>
<th>Downlink Command to poll Open/Close status (0x31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1byte</td>
</tr>
<tr>
<td>31</td>
</tr>
</tbody>
</table>

Timestamp start and Timestamp end use Unix TimeStamp format as mentioned above. Devices will reply with all data logs during this period, using the uplink interval.

For example, downlink command 31 618E5740 618E8170 05 is to check 2021/11/12 12:00:00 to 2021/11/12 15:00:00's data
Uplink Internal =5s, means LDS03A will send one packet every 5s. range 5~255s.

2.4.4 Decoder in TTN V3

Please check the decoder from this link:
2.5 Show data on Datacake

Datacake IoT platform provides a human-friendly interface to show the sensor data, once we have sensor data in TTN V3, we can use Datacake to connect to TTN V3 and see the data in Datacake. Below are the steps:

**Step 1:** Link TTNv3 to Datacake
[https://docs.datacake.de/lorawan/lns/thethingsindustries#create-integration-on-tti](https://docs.datacake.de/lorawan/lns/thethingsindustries#create-integration-on-tti)

**Step 2:** Configure LDS03A in Datacake
LDS03A Outdoor Open/Close Door Sensor
3. **Configure LDS03A via AT Command or LoRaWAN Downlink**

Use can configure LDS03A via AT Command or LoRaWAN Downlink.

- **AT Command Connection:** See [FAQ](http://wiki.dragino.com/index.php?title=Main_Page#Use_Note_for_Server).
- **LoRaWAN Downlink instruction for different platforms:**

There are two kinds of commands to configure LDS03A, they are:

- **General Commands.**
  - These commands are to configure:
    - General system settings like uplink interval.
    - LoRaWAN protocol & radio related command.
  - They are the same for all Dragino Devices which support DLWS-005 LoRaWAN Stack *(Note**).
  - These commands can be found on the wiki:

- **Commands special design for LDS03A**
  - These commands are only valid for LDS03A, as below:

### 3.1 Set Transmit Interval Time

Feature: Change LoRaWAN End Node Transmit Interval.

**AT Command: AT+TDC**

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+TDC?</td>
<td>Show current transmit Interval</td>
<td>30000 OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the interval is 30000ms = 30s</td>
</tr>
<tr>
<td>AT+TDC=60000</td>
<td>Set Transmit Interval</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set transmit interval to 60000ms = 60 seconds</td>
</tr>
</tbody>
</table>

**Downlink Command: 0x01**

Format: Command Code (0x01) followed by 3 bytes time value.

If the downlink payload=0100003C, it means set the END Node’s Transmit Interval to 0x00003C=60(S), while type code is 01.

- Example 1: Downlink Payload: 0100001E // Set Transmit Interval (TDC) = 30 seconds
- Example 2: Downlink Payload: 0100003C // Set Transmit Interval (TDC) = 60 seconds
3.2 Set Password

Feature: Set device password, max 9 digits

**AT Command: AT+PWORD**

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+PWORD=?</td>
<td>Show password</td>
<td>123456</td>
</tr>
<tr>
<td>AT+PWORD=999999</td>
<td>Set password</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Downlink Command:**

No downlink command for this feature.

3.3 Quit AT Command

Feature: Quit AT Command mode, so user needs to input the password again before using AT Commands.

**AT Command: AT+DISAT**

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+DISAT</td>
<td>Quit AT Commands mode</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Downlink Command:**

No downlink command for this feature.

3.4 Enable / Disable Alarm

Feature: Enable/Disable Alarm for door open/close. Default value 0.

**AT Command:**

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+DISALARM=1</td>
<td>End node will only send packets in TDC time.</td>
<td>OK</td>
</tr>
<tr>
<td>AT+DISALARM=0</td>
<td>End node will send packets in TDC time or status change for door sensor</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Downlink Command:**

- 0xA7 01 //Same As AT+DISALARM=1
- 0xA7 00 // Same As AT+DISALARM=0
3.5 Clear count

Feature: Clear current door open.

**AT Command:**

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+CLRC</td>
<td>Clear the count of door open events.</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Downlink Command:**

0xA6 01 // Same As AT+ CLRC

3.6 Set system time

Feature: Set system time, Unix format. [See here for format detail.]

**AT Command:**

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+TIMESTAMP=1611104352</td>
<td>Set System time to 2021-01-20 00:59:12</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Downlink Command:**

0x306007806000 // Set timestamp to 0x(6007806000), Same as AT+TIMESTAMP=1611104352

3.7 Set Time Sync Mode

Feature: Enable/Disable Sync system time via LoRaWAN MAC Command (DeviceTimeReq), LoRaWAN server must support v1.0.3 protocol to reply to this command.

SYNCMOD is set to 1 by default. If user wants to set a different time from the LoRaWAN server, the user needs to set this to 0.
### AT Command:

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+SYNCMOD=1</td>
<td>Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq) The default is zero time zone.</td>
<td>OK</td>
</tr>
<tr>
<td>AT+SYNCMOD=1,8</td>
<td>Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq) Set to East eight-time zone.</td>
<td>OK</td>
</tr>
<tr>
<td>AT+SYNCMOD=1,-12</td>
<td>Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq) Set to West Twelve Time Zone.</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Downlink Command:**

- 0x28 01 // Same As AT+SYNCMOD=1
- 0x28 01 08 // Same As AT+SYNCMOD=1,8
- 0x28 01 F4 // Same As AT+SYNCMOD=1,-12
- 0x28 00 // Same As AT+SYNCMOD=0

### 3.8 Alarm Base on Timeout

LDS03A can monitor the timeout for a status change, this feature can be used to monitor some events such as door opening too long etc.

User configures this feature by using:

**AT Command** to configure:

- AT+TTRIG=1,30 → When the status change from close to open, and device keeps in open status for more than 30 seconds. LDS03A will send an uplink packet, the Alarm bit (the second bit of 1st byte of payload) on this uplink packet is set to 1.
- AT+TTTRIG=0,0 → Default Value, disable timeout Alarm.

**Downlink Command** to configure:

Command: 0xA9 aa bb cc

- A9: Command Type Code
- aa: status to be monitored
- bb cc: timeout.

If user send 0xA9 01 00 1E: equal to AT+TTRIG=1,30
Or
0xA9 00 00 00: Equal to AT+TTRIG=0,0. Disable timeout Alarm.
3.9 Clear Flash Record

Feature: Clear flash storage for data log feature.

AT Command: AT+CLRDTA

<table>
<thead>
<tr>
<th>Command Example</th>
<th>Function</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+CLRDTA</td>
<td>Clear flash storage for data log feature.</td>
<td>Clear all stored sensor data... OK</td>
</tr>
</tbody>
</table>

Downlink Command:

- Example: 0xA301 //Same as AT+CLRDTA
4. Battery & how to replace

4.1 Battery Type

LDS03A is equipped with a **8500mAh ER18505 Li-SOCI2 battery**. The battery is an un-rechargeable battery with a low discharge rate targeting 8~10 years of use. This type of battery is commonly used in IoT targets for long-term running, such as water meters.

The discharge curve is not linear so can’t simply use percentage to show the battery level. Below is the battery performance.

1. Typical discharge profile at +20°C (Typical value)

![Battery Performance Graph](image)

Minimum Working Voltage for the LDS03A:

LDS03A: 2.45v ~ 3.6v

4.2 Replace Battery

Any battery with a range of 2.45 ~ 3.6v can be a replacement. We recommend using Li-SOCI2 Battery. And make sure the positive and negative pins match.

4.3 Power Consumption Analyze

Dragino Battery-powered products are all running in Low Power mode. We have an updated battery calculator which base on the measurement of the real device. Users can use this calculator to check the battery life and calculate the battery life if want to use different transmit intervals.
Instruction to use as below:

Step 1: Downlink the up-to-date DRAGINO_BatteryLife_Prediction_Table.xlsx from: https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Battery_Analyze/

Step 2: Open it and choose
- Product Model
- Uplink Interval
- Working Mode

And the battery life expectation in different cases will be shown on the right.

The battery-related documents are as below:
- Battery Dimension,
- Lithium-Thionyl Chloride Battery datasheet,
- Lithium-ion Battery-Capacitor datasheet, Tech Spec

4.3.1 Battery Note
The Li-SICO battery is designed for small current / long period applications. It is not good to use a high current, short period transmit method. The recommended minimum period for use of this battery is 5 minutes. If you use a shorter period to transmit LoRa, then the battery life may be decreased.
4.3.2 Replace the battery

You can change the battery in the LDS03A. The type of battery is not limited as long as the output is between 3v to 3.6v.

The default battery pack of LDS03A includes an ER18505 plus super capacitor. If user can’t find this pack locally, they can find ER18505 or equivalence, which will also work in most cases. The SPC can enlarge the battery life for high-frequency use (update period below 5 minutes)
5. FAQ

5.1 How to use AT Command to configure LDS03A

LDS03A UART connection photo

In the PC, you need to set the serial baud rate to 9600 to access the serial console for LSN50. LSN50 will output system info once power on as below:

![Serial Console Output]

There must be a new line after each command
5.2 How to upgrade the firmware?

A new firmware might be available for:
✓ Support new features
✓ For bug fix
✓ Change LoRaWAN bands.

Instruction for how to upgrade:

Firmware location:

5.3 How to change the LoRa Frequency Bands/Region?

Users can follow the introduction for how to upgrade image. When downloading the images, choose the required image file for download.

6. Trouble Shooting
7. **Order Info**

Part Number: **LDS03A-XX**

- **XX**: The default frequency band
  - ✓ **AS923**: LoRaWAN AS923 band
  - ✓ **AU915**: LoRaWAN AU915 band
  - ✓ **EU433**: LoRaWAN EU433 band
  - ✓ **EU868**: LoRaWAN EU868 band
  - ✓ **KR920**: LoRaWAN KR920 band
  - ✓ **US915**: LoRaWAN US915 band
  - ✓ **IN865**: LoRaWAN IN865 band
  - ✓ **CN470**: LoRaWAN CN470 band

8. **Packing Info**

**Package Includes:**

- ✓ LDS03A Open/Close Sensor x 1

9. **Support**

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- Provide as much information as possible regarding your inquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to

  support@dragino.com

10. **FCC Warning**

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