

Downlink Description

For Ultrasonic Wireless Sensors of the Series WILSEN.sonic

WS-UC*-F406-B41-*-02-*

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General Notes

What is a downlink channel?

In a LoRaWAN network, the downlink channel is usually the remote access option of a LoRa network server to devices registered in the network. Parameter values and settings in the device can be queried or changed via the downlink channel.

What are the requirements for device access via the downlink channel?

- The LoRaWAN network service provider must support the LoRaWAN "Downlink" function.
- The device to be accessed is a WILSEN device with firmware version 2.3.10 or higher.
- The downlink channel is enabled in the WILSEN device (factory default).

When are WILSEN devices ready to receive downlink messages?

The WILSEN devices are LoRa class A devices. This means that they are not permanently ready to receive downlink messages. Downlink messages can only be received within a short time interval after each uplink message of these devices. Therefore, downlink messages are queued for a specific device on the LoRa network server. Then, when it reports to the LoRa network server with an uplink message, the downlink messages are sent to that device.
The transmission of downlink messages is thus possible in the same interval in which the device transmits its measured values to the LoRa network server via uplink message.

Which commands are supported by the WILSEN device for downlink messages?

In general, the WILSEN device supports all commands and parameters that are also accessible to the user via the app. Only the LoRaWAN communication parameters (DevEUI, AppEUI and AppKey) cannot be changed via downlink.
An overview of the corresponding command codes and parameter values for downlink messages can be found in the following of this document.
Details on the individual parameters can be found in the relevant manual for your WILSEN device. You can download this from the product detail page via www.pepperl-fuchs.com.

How do I verify that the downlink message was received and processed correctly by the WILSEN device?

By default, the WILSEN devices are configured to send an acknowledgement message to the LoRa network server in response to received downlink messages. The content of this acknowledge message consists either of the requested parameter values and/or reflects back the received, newly set parameter values. Invalid commands and commands with invalid parameter values are missing in the confirmation message. In this way, it is very easy for the user to verify whether the message has arrived and whether all contained commands could be executed / processed by the WILSEN device.
In case of an already very heavy load on the LoRaWAN network, the sending of the confirmation message can be disabled in the WILSEN devices. In this case, the user does not receive any direct confirmation of the reception of the downlink message. If parameter values such as measurement or transmission intervals have been changed, this is nevertheless indirectly noticeable via uplink messages now coming in this new interval.

Note

Be aware of and comply with the applicable rules and limits for downlink messages for your LoRaWAN network. For details, contact your gateway manufacturer or LoRa network server provider.

Country-specific restrictions on the permitted transmission time ("Air time") for downlink messages must be observed!
As with the maximum permissible transmission time ("Air time") of 1% per hour per LoRaWAN device for uplink messages, there are also country-specific time restrictions for the transmission of downlink messages per LoRaWAN gateway. Compliance with the legally regulated maximum permissible transmission time ("air time") for downlink messages per gateway is usually ensured directly at gateway level. However, the limits and rules set vary depending on the gateway manufacturer and are sometimes stricter than the legal requirements.
Furthermore, the LoRa network server provider may also set further, sometimes stricter rules and specifications for this.

General Structure of a LoRaWAN Downlink Payload

The general structure of a LoRaWAN downlink payload always consists of the 3 parts:

- **Length**: Indicates the information how many subsequent bytes belong to this command.
- **ID**: Identifies the command to be executed or the parameter to be changed.
- **Value**: Contains the value associated with this parameter/command, if such a value is required for the corresponding command.

This structure is repeated for each command or parameter. Several commands can be packed into one downlink payload and thus sent to the WILSEN device in one downlink message. The total length of the downlink payload must not exceed 51 bytes.

Example

The hex value sequence 03F30101 refers to the command "Set message type to 'confirmed'".
The hex value sequence 04F3030C00 refers to the command "Set the spreading factor to 'SF12'".

Combined to a downlink payload the hex value sequence 03F3010104F3030C00 results. This is transmitted to the WILSEN device with only one downlink message.

Procedure for sending a downlink message to a WILSEN device

Note
Make sure that the downlink channel is enabled in the WILSEN device (factory default). The check is possible using the WILSEN app on a mobile device.

Follow the steps below to transmit a downlink message to a WILSEN device in your LoRaWAN network:

1. Check with the help of the WILSEN app that the "downlink channel" is enabled.
2. Establish a connection to the corresponding WILSEN device via Bluetooth.
3. After the connection has been established, switch to the "LoRaWAN configuration" menu and check the "Downlink channel" parameter. This has to be switched on.

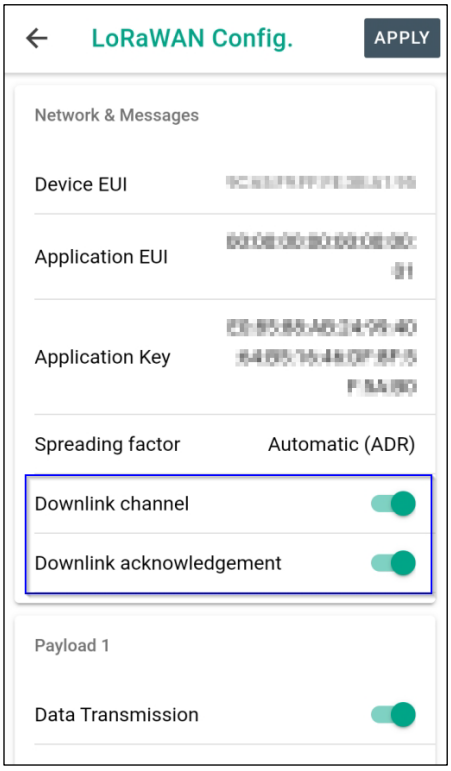


Fig. 1 WILSEN App

Note
We also recommend having the "Downlink acknowledgement" switched on. The confirmation message provided by the WILSEN device makes it easy to verify that the downlink command has been received and processed correctly.

4. Compose the content of your downlink message depending on what is to be queried or changed in the WILSEN device.

Note
For this purpose, Pepperl+Fuchs provides the free web service "LoRaWAN Downlink Support" at https://wilsen-services.pepperl-fuchs.com/. The use and options of this web service are described in detail in chapter "Using the Pepperl+Fuchs "LoRaWAN Downlink Support" Web Service".
Alternatively, you can also compose the downlink message manually yourself. The information required for this can be found in the two chapters "General Structure of a LoRaWAN Downlink Payload" and "Available Commands and Parameters".

5. Select the device(s) in your LoRa network that should receive this message.
6. Queue the generated downlink message.

Note
For details on the procedure, refer to the support documents of your LoRaWAN network provider. For some LoRaWAN network providers, the Pepperl+Fuchs "LoRaWAN Downlink Support" web service also offers corresponding support. For details, refer to chapter "Using the Pepperl+Fuchs "LoRaWAN Downlink Support" Web Service".

➔ The downlink message is now automatically transmitted to the respective device via the LoRa network server the next time it reports with an uplink message.

Using the Pepperl+Fuchs "LoRaWAN Downlink Support" Web Service

The use of the "LoRaWAN Downlink Support" web service provided free of charge by Pepperl+Fuchs at https://wilsen-services.pepperl-fuchs.com/ is suitable for occasional or spontaneous use of the downlink feature.

If the automatic generation and sending of downlink messages is to be permanently integrated into an application environment, you will find the necessary information in the chapters:

- „General Structure of a LoRaWAN Downlink Payload“
- „Available Commands and Parameters“

The "LoRaWAN Downlink Support" web service includes the following functions:

- Easy compilation of the downlink message by directly selecting the desired commands.
- Copy the created message for subsequent pasting and sending via the downlink send function of your LoRa network server.
- Alternatively, send the downlink message directly from the tool. Currently supported platforms are "TheThingsNetwork (TTN)" and "ChirpStack (in version 3 and 4)".
- Payload decoder for decoding the confirmation message transmitted by the WILSEN in response to the downlink message.

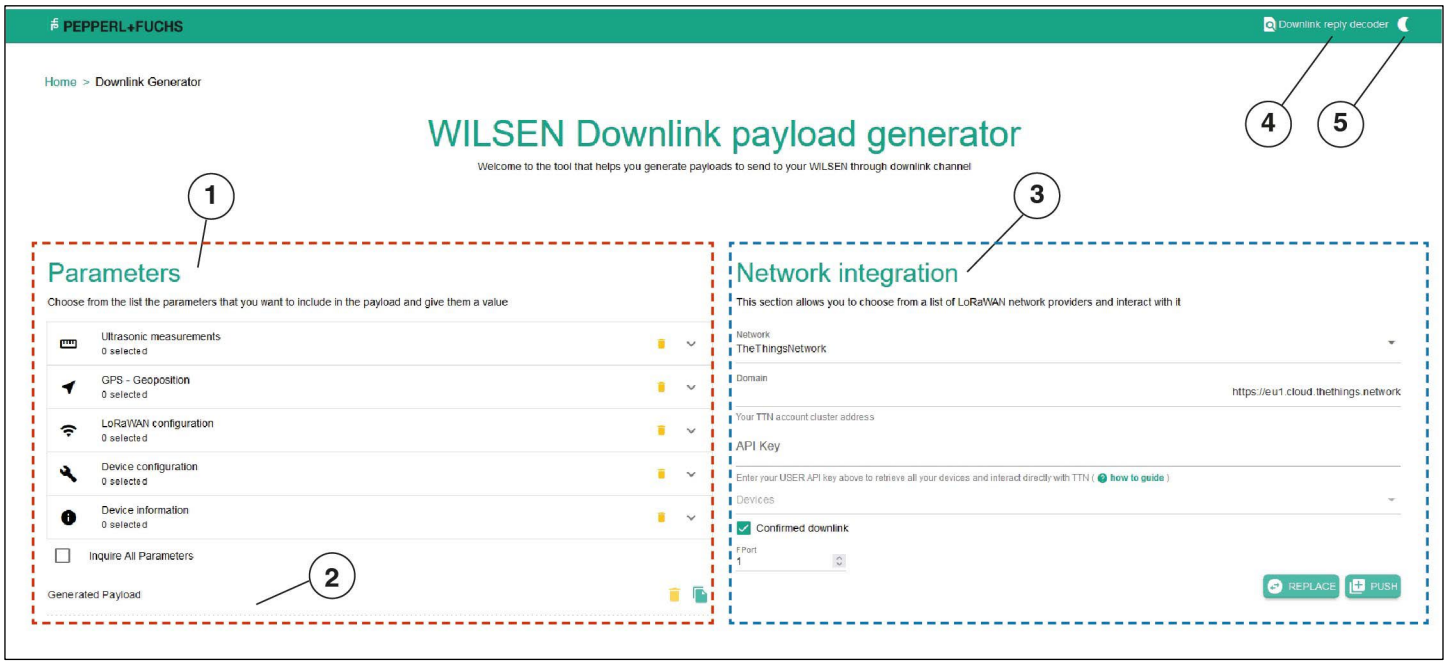


Fig. 2 "LoRaWAN Downlink Support“ Web Service

No.	Short Description	Explanation
1	Composing the downlink message	Here you compose your downlink message by selecting the desired parameters. The structure of the menu corresponds to the menu in the WILSEN app and contains all sensor parameters that can be controlled or queried via downlink. Descriptions of the parameters can be found in the manual for your WILSEN device. Clicking opens the relevant menu branch. Ticking the desired parameter and - if necessary - entering the desired value, will add this command to the downlink message. Clicking the dustbin icon deselects all parameters selected in this menu branch and removes them from the downlink message.
2	Created downlink payload is available for copying here	When your compilation is complete, click the icon to copy the compiled downlink message to your computer's cache. You can then paste it into the downlink send function of your LoRa network server and send it to the desired devices using that function.
3	Direct sending of the downlink message from the web service	As an alternative to sending via the downlink send function of your LoRa network server, you can also send directly from the "LoRaWAN Downlink Support" web service. Currently the platforms "TheThingsNetwork" and "Chirpstack (V3 or V4)" are supported; in the future, more platforms may be added. 1. First, select the LoRa network platform you are using from the “Network” list. 2. Then enter the necessary information for the respective platform, e.g. domain and API key. **Note** Creating the API Key for remote access to your LoRa network platform varies from platform to platform. Therefore a specific link behind (how to guide) explains you how to create the API Key for the selected platform. 3. After entering all the relevant data for the network, all the devices in your network that can be accessed are displayed under "Devices". 4. From this list, select the device or devices that are to receive the compiled downlink message. 5. Finally press the "Push" button. PUSH ➔ This submits the message to your LoRa network server and places it in its queue to be sent to the selected device(s). If you want to replace any queued downlink messages for a specific device, submit the message to be sent to the LoRa network server using the "Replace" button REPLACE instead of "Push".
4	Downlink Reply Decoder	This function helps you to easily decode the confirmation message transmitted by your WILSEN device in response to your downlink message. Just open this function and enter the received reply message by copy & paste. Finally click on “DECODE”. Afterwards the content of the reply message is displayed in plain text.
5	Light Mode / Dark Mode	Via this switch, you select the appearance of the “LoRaWAN Downlink Support“ web service to either light mode or dark mode.

Available Commands and Parameters

In order to be able to permanently integrate the automatic generation and/or the sending of specific downlink messages into your application environment, you will find detailed payload information here.

Also note the further information provided in the chapter "General Structure of a LoRaWAN Downlink Payload".

In the following tables, you will find the necessary hexadecimal values for "Length", "ID" and "Value" of all available commands, structured by command groups.

Ultrasonic Sensor Configuration

Command / Parameter	Length [hex]	ID [hex]	Value [hex]
Query of all Ultrasonic Parameters	02	F400	
Sound beam width	03	F401	- FE (small) - FD (medium) - FC (wide) - 37 (user-defined)
Query: „Sound beam width“	02	F401	
User-defined burst length	03	F402	- 05 (normal) - 03 (short) - 10 (very short)
Query: „User-defined burst length“	02	F402	
User-defined transmitting power	03	F403	- 3F (high) - 28 (medium) - 0C (low)
Query: „User-defined transmitting power“	02	F403	
User-defined sensitivity	03	F404	- 3F (maximum) - 33 (very high) - 30 (high) - 26 (medium) - 1B (low) - 0F (minimum)
Query: „User-defined sensitivity“	02	F404	
Distance value for „Full (100%)“ [mm]	04	F405	**Note:** Parameter only available for WILSEN.sonic.level devices! UCC2500: 0096 (150 = min.) .. 09C4 (2500 = max.) UCC4000: 00FA (250 = min.) .. 0FA0 (4000 = max.) UC7000: 01F4 (500 = min.) .. 1B58 (7000 = max.)
Query: Distance value for „Full (100%)“	02	F405	**Note:** Parameter only available for WILSEN.sonic.level devices!
Distance value for „Empty (0%)“ [mm]	04	F406	**Note:** Parameter only available for WILSEN.sonic.level devices! UCC2500: 0096 (150 = min.) .. 09C4 (2500 = max.) UCC4000: 00FA (250 = min.) .. 0FA0 (4000 = max.)

			UC7000: 01F4 (500 = min.) .. 1B58 (7000 = max.)
Query: Distance value for „Empty (0%)“	02	F406	**Note:** Parameter only available for WILSEN.sonic.level devices!
Event-driven transmission	03	F410	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher! - 00 (disabled) - 01 (enabled)
Query: “Event-driven transmission”	02	F410	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher!
Monitoring interval [s]	06	F411	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher! - 00000014 (20 s) - 0000001E (30 s) - 0000003C (1 min) - 00000078 (2 min) - 0000012C (5 min) - 00000258 (10 min) - 00000384 (15 min) - 00000708 (30 min) - 00000E10 (1 h) - 00001C20 (2 h) - 00002A30 (3 h) - 00003840 (4 h) - 00004650 (5 h) - 00005460 (6 h) - 00007080 (8 h) - 0000A8C0 (12 h) - 0000FD20 (18 h) - 00015180 (24 h)
Query: “Monitoring interval“	02	F411	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher!
Limit distance	04	F413	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher! UCC2500: 0096 (150 = min.) .. 09C4 (2500 = max.) UCC4000: 00FA (250 = min.) .. 0FA0 (4000 = max.) UC7000: 01F4 (500 = min.) .. 1B58 (7000 = max.)
Query: “Limit distance”	02	F413	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher!

Trigger event	03	F412	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher! - 01 (Limit transition) - 02 (Below limit) - 03 (Above limit)
Query: “Trigger event”	02	F412	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher!
Message type	03	F414	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher! - 00 (unconfirmed) - 01 (confirmed)
Query: „Message type“	02	F414	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher!
Number of transmissions	03	F415	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher! - 01 (1) - 03 (3)
Query: „Number of transmissions“	02	F415	**Note:** Parameter only available for WILSEN.sonic.level devices with firmware version 2.5.12 and higher!
Water body level measurement	03	F40E	**Note:** Parameter only available for WILSEN.sonic.distance devices with firmware version 2.5 and higher! - 01 (enabled) - 00 (disabled)
Query: „Water body level measurement“	02	F40E	**Note:** Parameter only available for WILSEN.sonic.distance devices with firmware version 2.5 and higher!
Distance to water body ground [mm]	04	F40F	**Note:** Parameter only available for WILSEN.sonic.distance devices with firmware version 2.5 and higher! UCC2500: 0096 (150 = min.) .. C350 (50000 = max.) UCC4000: 00FA (250 = min.) .. C350 (50000 = max.) UC7000: 01F4 (500 = min.) .. C350 (50000 = max.)
Query: „Distance to water body ground [mm]“	02	F40F	**Note:** Parameter only available for WILSEN.sonic.distance devices with firmware version 2.5 and higher!
Measurement sequence	03	F407	- 01 (enabled) - 00 (disabled)

Query: „Measurement sequence“	02	F407	
Evaluation method	03	F408	- 01 (Average value)
Query: „Evaluation method“	02	F408	
Measurements per seq.	03	F409	- 02 (2) - 03 (3) - 04 (4) - 05 (5) - 06 (6) - 07 (7) - 08 (8) - 09 (9) - 0A (10)
Query: „Measurements per seq.“	02	F409	
At intervals of [ms]	04	F40A	- 0064 (100 ms) - 03E8 (1 s) - 2710 (10 s) - EA60 (1 min)
Query: „At intervals of“	02	F40A	
Application filter	03	F40B	**Note:** Parameter only available for WILSEN.sonic.level devices! - 01 (enabled) - 00 (disabled)
Query: „Application filter“	02	F40B	**Note:** Parameter only available for WILSEN.sonic.level devices!
Post-processing filter	03	F40C	**Note:** Parameter only available for WILSEN.sonic.level devices! - 01 (Container filling)
Query: „Post-processing filter“	02	F40C	**Note:** Parameter only available for WILSEN.sonic.level devices!
Additional measurements	03	F40D	**Note:** Parameter only available for WILSEN.sonic.level devices! - 01 (1) - 02 (2) - 03 (3) - 04 (4) - 05 (5) - 06 (6) - 07 (7) - 08 (8) - 09 (9) - 0A (10)
Query: „Additional measurements“	02	F40D	**Note:** Parameter only available for WILSEN.sonic.level devices!

GPS Configuration

Command / Parameter	Length [hex]	ID [hex]	Value [hex]
Query of all GPS Parameters	02	F200	
GPS acquisition	03	F201	- 01 (enabled) - 00 (disabled)
Query: „GPS acquisition“	02	F201	
GPS accuracy	03	F204	**Note:** Parameter only available in firmware version 2.5 and higher! - 01 (Eco mode) - 02 (Precision mode)
Query: „GPS accuracy“	02	F204	**Note:** Parameter only available in firmware version 2.5 and higher!
Acquisition interval [s]	06	F202	- 00000708 (30 min) - 00000E10 (1 h) - 00001C20 (2 h) - 00002A30 (3 h) - 00003840 (4 h) - 00005460 (6 h) - 00007080 (8 h) - 0000A8C0 (12 h) - 0000FD20 (18 h) - 00015180 (24 h)
Query: „Acquisition interval“	02	F202	
Message type	03	F205	**Note:** Parameter only available in firmware version 2.5 and higher! - 00 (unconfirmed) - 01 (confirmed)
Query: „Message type“	02	F205	**Note:** Parameter only available in firmware version 2.5 and higher!
Number of transmissions	03	F206	**Note:** Parameter only available in firmware version 2.5 and higher! - 01 (1) - 03 (3)
Query: „Number of transmissions“	02	F206	**Note:** Parameter only available in firmware version 2.5 and higher!
Next acquisition [s]	06	F203	- 0000003C (1 min) - 0000012C (5 min) - 00000258 (10 min)
Query: „Next acquisition“	02	F203	

LoRaWAN Configuration

Command / Parameter	Length [hex]	ID [hex]	Value [hex]
Query of all LoRaWAN Parameters	02	F300	
Spreading factor	04	F303	- FFFF (Automatic - ADR) - 07FF (7 – fixed) - 08FF (8 – fixed) - 09FF (9 – fixed) - 0AFF (10 – fixed) - 0BFF (11 – fixed) - 0CFF (12 – fixed)
Query: „Spreading factor“	02	F303	
Downlink channel	03	F307	- 00 (disabled) - 01 (enabled) **Note:** If the downlink channel is deactivated, the sensor will no longer accept and process downlink messages from that moment on. The sensor can therefore no longer be reached via downlink. The downlink channel can only be reactivated on site via the WILSEN app and the Bluetooth interface.
Query: „Downlink channel“	02	F307	
Downlink acknowledge	03	F308	- 00 (disabled) - 01 (enabled)
Query: „Downlink acknowledge“	02	F308	
Data transmission	03	F304	- 01 (enabled) - 00 (disabled)
Query: „Data transmission“	02	F304	
Transmission interval [s]	06	F305	- 0000012C (5 min, available from FW version 2.5.12 and higher) - 00000258 (10 min) - 00000384 (15 min, available from FW version 2.5 and higher) - 00000708 (30 min) - 00000E10 (1 h) - 00001C20 (2 h) - 00002A30 (3 h) - 00003840 (4 h) - 00005460 (6 h) - 00007080 (8 h) - 0000A8C0 (12 h) - 0000FD20 (18 h) - 00015180 (24 h)
Query: „Transmission interval“	02	F305	
Message type	03	F301	- 00 (unconfirmed) - 01 (confirmed) **Note:** The message type selected here applies to the transmission of “Payload 1” and “Payload 3”.
Query: „Message type“	02	F301	

Number of transmissions	03	F302	- 01 (1) - 03 (3) **Note:** The number of transmissions selected here applies to the transmission of “Payload 1” and “Payload 3”.
Query: „Number of transmissions“	02	F302	
Next transmission [s]	06	F306	- 0000003C (1 min) - 0000012C (5 min) - 00000258 (10 min)
Query: „Next transmission“	02	F306	

Device Configuration

Command / Parameter	Length [hex]	ID [hex]	Value [hex]
Query of all Device Config. Parameters	02	F100	
Bluetooth	03	F101	- 01 (enabled) - 00 (disabled)
Query: „Bluetooth“	02	F101	
Device name	12	F102	- 16 Bytes Text
Query: „Device name“	02	F102	
Reset counters	02	F103	
Reset to factory defaults (incl. password)	02	F104	
Change password	22	F105	SHA-256 hash value derived from password string

Note

For the calculation of the SHA-256 hash value there are available several hash generators in the internet. Here is the example for the standard password `00000000` [string] and the corresponding SHA-256 hash value [hex]:
SHA-256(`00000000`) = 7E071FD9B023ED8F18458A73613A0834F6220BD5CC50357BA3493C6040A9EA8C

Device Information

Command / Parameter	Length [hex]	ID [hex]	Value [hex]
Query of all Device Information	02	F500	
Query: „Part number“	02	F501	
Query: „Hardware revision“	02	F502	
Query: „Firmware revision“	02	F503	
Query: „Serial number“	02	2A25	