OXOBUTTON 1
Documentation 🗎

Firmware explained

Application / EPD modes

The current firmware provides three different application / EPD modes. These modes determine how the images in the memory are displayed.
An application mode can be selected via Device Manager mobile app or LoRa downlink.

In **mode 0** all images in the memory are shown. If there's only one image in the memory, every button can trigger an uplink. If there are more then one image in the memory, a carousel menu is displayed. A specific image can then be selected by pressing the corresponding arrow button(s). An uplink can be sent by pressing the corresponding check mark button(s)

In **mode 1** only selected images from the memory are shown. If there are more then one image selected, a carousel menu is displayed. The image selection can be configured via Device Manager mobile app or LoRa downlink.

In **mode 2** only one image is shown at a time and will be toggled with a second image when a button is pressed. The two images can be configured via Device Manager mobile app or LoRa downlink.

BLE mode
The BLE mode can either be entered by pressing the small BLE button within the case (V1 & V2) or by pressing and holding all 4 buttons together for 6 seconds (V2).

In the BLE mode, a BLE icon is shown on the EPD and the device starts advertising. It can now be connected with the Device Manager mobile app.

The BLE mode can be left again by pressing any button.

Recommended batteries
Not all batteries handle the required currents of a LoRa transmission very well. We tested several different brands and can recommend the two following battery types:

CR2032 from Energizer
CR2032 from muRata

Other batteries work as well but may be drained faster.

Uplink message
Every wakeup event can trigger an uplink message. Such a wakeup event can be one of the following:

– Button press
– Accelerometer interrupt
– Heartbeat timeout

An uplink message always has the same byte structure and only the uplink bytes are changing.

Uplink message bytes

30	05	00	00	08	02	64	18	FF	20	FF	D2	10	11
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8	byte9	byte10	byte11	byte12	byte13

byte0:	Uplink ID (0x30)
byte1:	Button clicked number (0… 9) Oxobutton Q: 1-4 Button 1 to 4 5 Button 1 & 2 6 Button 2 & 3 7 Button 3 & 4 8 Button 1 & 4 9 More than 2 buttons * Oxobutton T: 1 Button 1 2 Button 2 3 Button 1 & 2
byte2:	Heartbeat timeout occured (0 or 1)
byte3:	Accelerometer interrupt event (0… 6)
byte4:	Image code H byte
byte5:	Image code L byte
byte6:	Battery level in % (0… 100)
byte7:	Signed temperature in °C (+/- 2°C; Should be calibrated via backend)
byte8:	Signed 14bit accelerometer value X axis H byte **
byte9:	Signed 14bit accelerometer value X axis L byte **
byte10:	Signed 14bit accelerometer value Y axis H byte **
byte11:	Signed 14bit accelerometer value Y axis L byte **
byte12:	Signed 14bit accelerometer value Z axis H byte **
byte13:	Signed 14bit accelerometer value Z axis L byte **
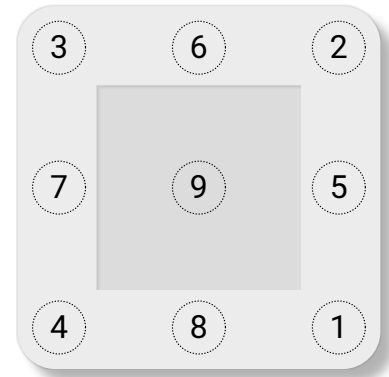
* Note the errata entry regarding the case when all 4 buttons are pressed
** The accelerometer is configured to measure 14bit values within +/-2G. This means that the accelerometer values will be within -8'192… 8'191 and that the value +/-4096 represents +/-1G (9.81m/s2)

Downlink messages

There are 4 different downlink messages that can be used to configure the behavior of the device:

(0xB0) Configure LoRa parameters
(0xB1) Configure periphery
(0xB2) Select image(s)
(0xB3) Configure user text

Each downlink message comes with an ID and a defined or configurable length.
It is also possible to link multiple downlink messages together, but make sure to keep it below 50 bytes per downlink message.

Configure LoRa parameters downlink message bytes

B0	00	02	03	01	01	00	00	0C	00	07
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8	byte9	byte10

byte0:	Downlink ID (0xB0)
byte1:	ADR (0 or 1)
byte2:	DR (0… 5 respectively SF12… SF7) If ADR is enabled, the configured DR will be ignored
byte3:	Send trials (1… 10) When an uplink fails, it automatically sends further uplinks (with the next DR) according to the configured send trials. Each send trial takes up to 7 seconds.
byte4:	Join trials (1… 3) When a join fails, it automatically tries to join again (with the next DR) according to the configured join trials. The first join trial takes up to 10 seconds, the second up to 40 seconds and the third up to 130 seconds.
byte5:	Port (1… 223)
byte6:	Confirmed or unconfirmed messages (0 or 1)
byte7:	Heartbeat interval in x*15min high byte (0… 65535)
byte8:	Heartbeat interval in x*15min low byte (0… 65535)
byte9:	LoRa interval in seconds high byte (5… 65535)
byte10:	LoRa interval in seconds low byte (5… 65535) The LoRa interval represents the delay before a new image can be selected or a new uplink can be sent (minimum is 5s; LEDs may blink red in this time).

Configure periphery downlink message bytes

B1	29	00	0F	00	01
byte0	byte1	byte2	byte3	byte4	byte5

byte0:	Downlink ID (0xB1)
byte1:	Piezo byte (0bxxxx'yyzz)
	Piezo modes (xxxx):
	0 OFF
	1 1 tone
	2 2 tones
	3 2 tones (2*dur1)
	4 2 tones (4*dur1)
	5 2 tones (2*dur2)
	6 2 tones (4*dur2)
	7 2 tones (2*dur1 & 2*dur2)
	8 2 tones (4*dur1 & 4*dur2)
	Piezo frequ. tone2 (yy): 0 (500Hz), 1 (1kHz), 2 (2kHz), 3 (4kHz)
	Piezo frequ. tone1 (zz): 0 (500Hz), 1 (1kHz), 2 (2kHz), 3 (4kHz)
byte2:	Reserved (0x00)
byte3:	LED EN bits (0b0000'wxyz): (w) = LED4, (x) = LED3, (y) = LED2, (z) = LED1
byte4:	Accel modes:
	0 OFF
	1 Movement detection (slow moving)
	2 Movement detection (fast moving)
	3 Movement detection (shaking)
	4 Free fall detection (~3 to 12.5cm)
	5 Free fall detection (~28 to 50cm)
	6 Free fall detection (~78 to 113cm)
byte5:	Show hourglass:
	0 OFF
	1 ON

Select images downlink message bytes

B2	01	02	00	1D	00	1E	…
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7

byte0:	Downlink ID (0xB2)
byte1:	EPD modes:
	0 Show all images in the memory
	1 Show only selected images
	2 Toggle two images
byte2:	Number of following image codes (0... 8)
byte3:	Image code 1 H byte
byte4:	Image code 1 L byte
byte5:	Image code 2 H byte
byte6:	Image code 2 L byte
byte7:	... more images

Configure user text downlink message bytes

B3	08	58	18	00	0B	48	65	…
byte0	byte1	byte2	byte3	byte4	byte5	byte6	byte7	byte8

byte0:	Downlink ID (0xB3)
byte1:	X position (0… 199)
byte2:	Y position (0… 199)
byte3:	Font size (8, 12*, 16, 20*, 24)
byte4:	Text states: 0 0° 1 0° inverted 2 90° 3 90° inverted 4 180° ** 5 180° inverted ** 6 270° ** 7 270° inverted **
byte5:	Number of following ASCII characters (0… 44)
byte6:	First ASCII character
byte7:	Second ASCII character
byte8:	…

* Note the errata entry regarding rotated text with font 12 or 20
** FW version 2.1.3 or above

Change Log

FW version 2.1.4
This version fixes the bug when invalid ASCII characters are drawn (see errata for details).

– Bugfix: Crash when drawing invalid characters
– Handling of the '\r' (0x0D) character

FW version 2.1.3
This version fixes some bugs (see errata for details) and improves the user text handling.

– Bugfix: When all buttons are pushed the uplink byte is 0 but should be 9
– Bugfix: Crash when drawing rotated user text with font 12 or 20
– Improved user text handling and added new rotations (0°, 90°, 180°, 270°)
– BLE mode can now also be entered when BLE button is pushed during startup

FW version 2.1.2
This is the first released firmware version with the new features for the Oxobutton Q and T.

Errata

Wrong value when all 4 buttons are pushed

Affects
Q-Buttons firmware version 2.1.2.

Description
When all 4 buttons are pushed, the expected uplink button byte should be 9 but is 0.

Workaround
To still make sure that the generated uplink was triggered by all 4 buttons and not by a heartbeat or accelerometer interrupt, check that all three bytes are 0.

For example:
0x 30 **09 00 00** ... (3 buttons were pushed)
0x 30 **00 01 00** ... (heartbeat timeout occurred)
0x 30 **00 00 05** ... (free fall detected)
0x 30 **00 00 00** ... (**4 buttons were pushed**)

Fix
Update device firmware to V2.1.3 or above.

FW crash when a rotated text is drawn with font 12 or 20

Affects
Q- & T-Buttons firmware version 2.1.2.

Description
When a downlink to configure user text with the font 12 or 20 and a text state bigger than 1 (rotated) is sent, the firmware will crash / reset when drawing text on the EPD. Since the text is also drawn during the startup process, the firmware keeps crashing / resetting (leading to a blinking e-paper display) until the battery is empty.

Workaround
Use a font that is dividable by 8 if you want to rotate your text.
If your device is already in the "blinking e-paper display" state, please contact us.

Fix
Update device firmware to V2.1.3 or above.

FW crash when drawing invalid characters (e.g. '\r')

Affects
Q- & T-Buttons firmware version 2.1.3 and below.

Description
When a downlink to configure user text with an invalid ASCII character (less than 32 or bigger than 126 and not 10) is sent, the firmware will crash / reset when drawing text on the EPD.

Workaround
There's no workaround. Make sure to only use valid ASCII characters:
Starting from space ' ' (32 = 0x20) to '~' (126 = 0x7E) and '\n' (10 = 0x0A).

Fix
Update device firmware to V2.1.4 or above.