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Product Overview

This self-contained device is ready to use. It can be easily attached to the rear surface of most Storm keypads to provide connectivity and communication with USB compatible host systems. Factory configured for standard numeric data entry, this versatile device can also be user programmed to output any supported USB code; making the 450 Series encoder the ideal keypad interface for most applications.

Features

- Generic keyboard (HID) device – no additional drivers needed
- Factory configured to encode telephone or calculator format numeric keypads
- Output code table can be customised using Storm's USB Configuration Utility
- Host PC can use the supplied API to control the encoder functions in an application.
- Integrated power supply for keypad illumination
- 450i version provides additional brightness control for keypad illumination
- 450i version features a piezo sounder for optional key press confirmation or application driven status signal
- Simple connection via a USB Mini-B socket
- Compact, self contained form factor
- Compatible with most Storm 4, 12 and 16 key format keypads
(including Storm 700, 720, 1000, 2000, 3000, GFX and PLX product series)

Product Range and Accessories

| Part Number | Description |
|-------------|---|
| 4500-10 | 450i Encoder with Buzzer and Illumination Control |
| 4500-00 | 450 Encoder |
| 4500-01 | USB Cable 1 metre - type A to angled mini B |

Note :

These part numbers are for on line ordering directly from Storm Interface.
When bought through broadline distribution they have an additional suffix to allow for distributor specific labelling/marketing requirements e.g.

| | |
|----------|--------------------------|
| 4500-102 | 450i Encoder with Buzzer |
|----------|--------------------------|

Downloads

| | |
|----------------|------------------------------------|
| 4500-SW01 | USB Configuration Utility |
| 450i-LIT-01 | Product Brochure |
| 450-xx-08KT | Installation Sheet |
| 450 USB Manual | Engineering Manual (this document) |

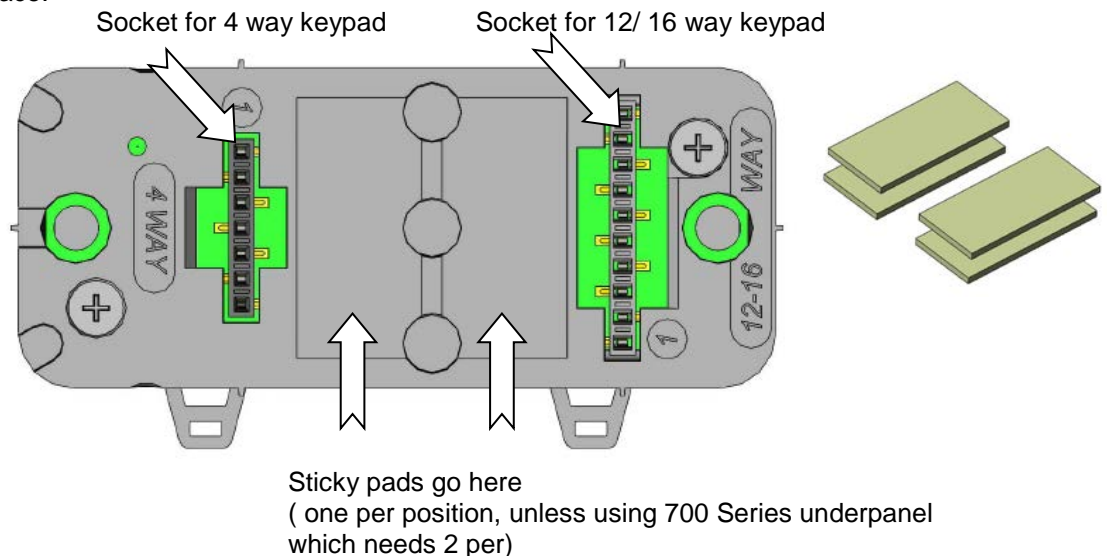
Quickstart Guide

Before starting make sure that you have :

- The encoder
- A compatible Storm keypad.
- A USB mini-B cable between your keypad and the host computer.
- A panel with the correct cutout for your keypad
- A copy of the configuration utility if you want to customise the configuration

Installation

- Ensure your computer is powered up before connecting the encoder.
- Note that there are two different sockets for the keypad connection, depends if a 4 way or 12/16 way keypad is being used. Make sure that the correct socket is used before using the sticky pads to fix the encoder in place.



- Push the encoder onto the keypad pins ; make sure the pad sticks down
- Plug in the mini B USB cable on the side of the encoder

One Time Only Initialisation

This initialisation process must be completed the first time you turn it on. The encoder has to recognise the keypad, and you have to select the layout that matches the keypad layout.

- PRESS AND HOLD** the bottom right hand key on the keypad – this tells the encoder which keypad is connected
 - Connect the encoder cable to the pc
 - RELEASE KEY IF** you want function key (4 way) / telephone layout (12/16 way) code table
- or
- KEEP THE KEY PRESSED FOR 10 SEC IF** you want cursor (4 way) / calculator (12/16 way) code table

Now check that you are getting the correct characters on screen. If you need to reconfigure the encoder you can change the code table (or reset to a pre-loaded code table) with the USB Configuration Utility from www.storm-interface.com

F.A.Q's

| | |
|--|---|
| Does this encoder need a special driver ? | No – it works with the standard USB keyboard driver |
| Does the utility work on any pc ? | At present it does not run on Linux or Mac os The utility requires Windows XP or later |
| What's the USB connection ? | Mini-B socket |
| Do I need to use the sticky pads ? | These are included to retain the encoder in service |
| What custom USB codes can I assign ? | See the code tables on page 11 |
| What do I do if I have wrongly initialised the product ? | Download & use the config utility to reset the defaults |
| Why is the socket longer than the pinstrip on my keypad? | The end pins power the 720 illuminated keypads. |
| Can I control this from a host application ? | Yes – the commands are listed in the API reference |

Ratings & Performance

| | |
|--------------------------|---|
| Operational temperature | -20°C to +60°C |
| Storage temperature | -20°C to +70°C |
| Humidity | 10% to 90% non-condensing |
| Vibration and shock | ETSI 300 019 5M3 |
| Operating voltage | 5V +/- 5% (USB) |
| Operating current | 20mA (excluding keypad illumination current) |
| Safety | EU Low Voltage Directive |
| EMC: | Emissions and Immunity: FCC part 15 class A EN55022, EN55024 ESD: Up to +/- 15kV air discharge, +/- 7.5kV contact discharge |
| EU RoHS | |
| WEEE Directive compliant | |

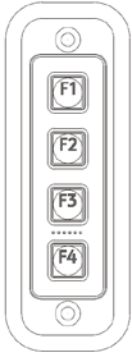
Compatible Products

| | 4 Key | 12 Key | 16 Key | Note | |
|------------------|-------------------------------------|---|-------------------------------------|--|--|
| 700 Series | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Use additional sticky pads for underpanel fixing of 700 Series | |
| 720 Series | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | |
| 1000 Series | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 720 and 720 illuminated keypads are supported | |
| PLX Series | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | |
| 2000 Series | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | |
| GFX | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | |
| 3000 Series | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | |
| 3000 Illuminator | | | | | Illumination not supported on this model |
| GFX Illuminator | | | | | Illumination not supported on this model |
| | Use the 7 way socket for 4 key pad | Use the 10 way socket for 12/16 key pad | | | |

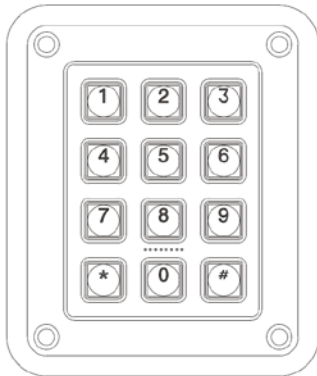
Keypad Layouts

Keypad Layouts

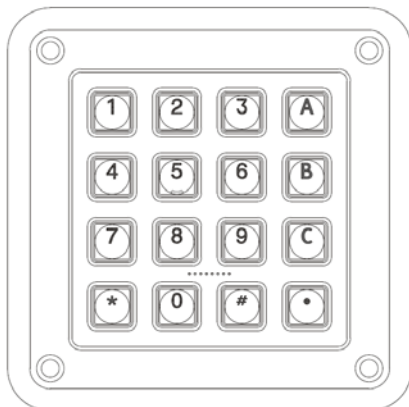
Default Code Table (US English)



4-Way Function



12-Way Telephone



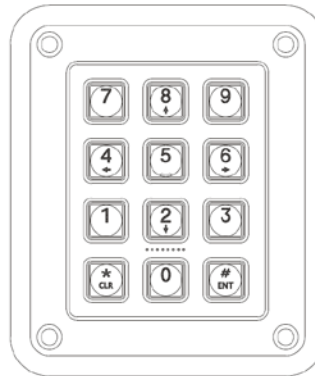
16-Way Telephone

Keypad Layouts

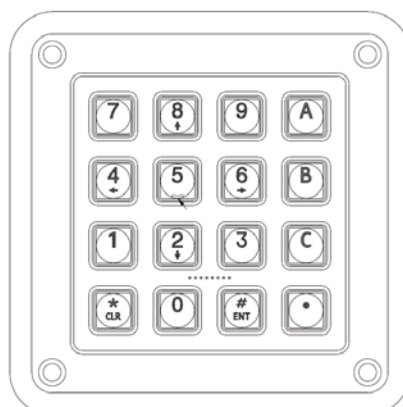
Alternate Code Table (US English)



4-Way Cursor



12-Way Calculator



16-Way Calculator

Default Code Tables (remember host set to UK English gives £ instead of #)

| Row | Column | 4 way codes Function (hex) | 12 way code Telephone(hex) | 16 way code Telephone(hex) |
|-----|--------|-------------------------------|-------------------------------|-------------------------------|
| A | 1 | F1 (3A) | 1 (1E) | 1 (1E) |
| B | 1 | F2 (3B) | 4 (21) | 4 (21) |
| C | 1 | F3 (3C) | 7 (24) | 7 (24) |
| D | 1 | F4 (3D) | * (E1, 25) | * (E1, 25) |
| A | 2 | - | 2 (1F) | 2 (1F) |
| B | 2 | - | 5 (22) | 5 (22) |
| C | 2 | - | 8 (25) | 8 (25) |
| D | 2 | - | 0 (27) | 0 (27) |
| A | 3 | - | 3 (20) | 3 (20) |
| B | 3 | - | 6 (23) | 6 (23) |
| C | 3 | - | 9 (26) | 9 (26) |
| D | 3 | - | # (E1, 20) | # (E1, 20) |
| A | 4 | - | - | A (04) |
| B | 4 | - | - | B (05) |
| C | 4 | - | - | C (06) |
| D | 4 | - | - | . (37) |

Alternate Code Table

(to get the arrow keys on a 12/16 way keypad then switch NumLock off)

| Row | Column | 4 way code Cursor (hex) | 12 way code Calculator (hex) | 16 way code Calculator (hex) | Output for 12/16 way with NumLock off |
|-----|--------|----------------------------|---------------------------------|---------------------------------|---|
| A | 1 | ↑ (52) | 7 (5F) | 7 (5F) | HOME |
| B | 1 | ← (50) | 4 (5C) | 4 (5C) | ← |
| C | 1 | → (4F) | 1 (59) | 1 (59) | END |
| D | 1 | ↓ (51) | * (E1, 25) | * (E1, 25) | * |
| A | 2 | - | 8 (60) | 8 (60) | ↑ |
| B | 2 | - | 5 (5D) | 5 (5D) | |
| C | 2 | - | 2 (5A) | 2 (5A) | ↓ |
| D | 2 | - | 0 (62) | 0 (62) | |
| A | 3 | - | 9 (61) | 9 (61) | PgUp |
| B | 3 | - | 6 (5E) | 6 (5E) | → |
| C | 3 | - | 3 (5B) | 3 (5B) | PgDn |
| D | 3 | - | # (E1, 20) | # (E1, 20) | # |
| A | 4 | - | - | A (04) | A |
| B | 4 | - | - | B (05) | B |
| C | 4 | - | - | C (06) | C |
| D | 4 | - | - | . (37) | . |

Configuration Utility

To customise the output codes just download and install the Configuration Utility from www.storm-interface.com
This lets you do the following :-

| | |
|------------------------------|---|
| Scan the encoder in order to | Confirm the encoder is connected Show which version of firmware is installed Show which keypad is set (4, 12 or 16 key) Show which code table is selected (default, alternate or customised) |
|------------------------------|---|

| | |
|----------|--|
| And also | Change the keypad setting Change the selected code table Change the buzzer volume (450i only) Change the brightness on illuminated keypads (450i only) Self test the encoder |
|----------|--|

| | |
|---------------------------|---|
| For re-legendable keypads | Customise the code table by assigning a USB code to each key Add a modifier in front of each USB code Save this configuration Export or Import configuration files |
|---------------------------|---|

| | |
|--------------------------|--|
| For maintenance purposes | Update the encoder firmware if a new version is released Restore all settings to original factory defaults. |
|--------------------------|--|

API

To allow a host application to control the USB encoder the available commands are listed in the API Documentation. Free download from www.storm-interface.com

Configuration Utility User Guide

Download from www.storm-interface.com and install on a Windows PC with XP or later

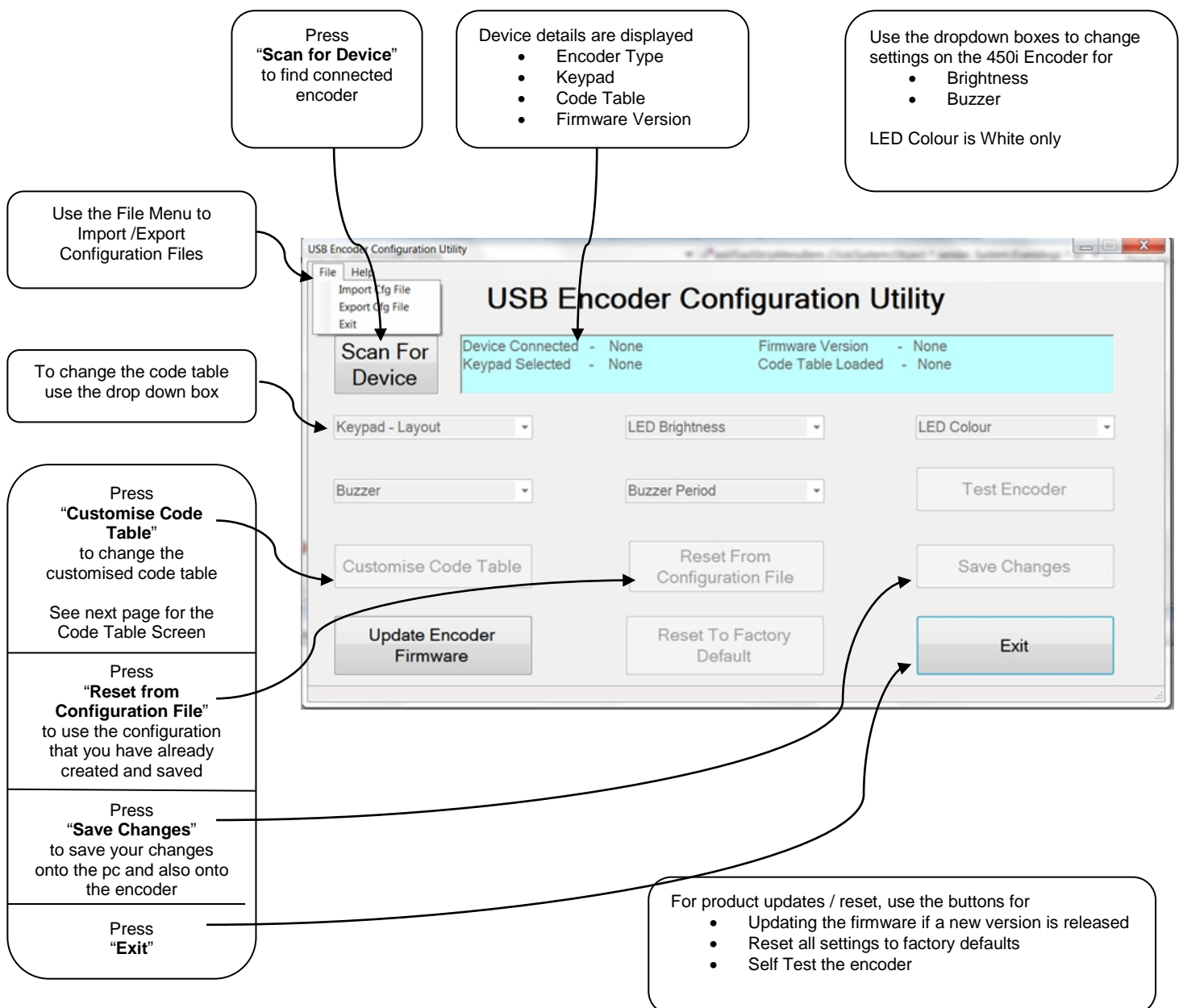
Run the application.

Plug in the encoder + keypad.

Scan the encoder. The configuration will be displayed as below on the home screen.

If you have a standard layout keypad then the output from the default code table will correspond to the keypad
 If you have a keypad designed to allow customisation of keytop graphics then you need to assign a code to each key.

The configuration file is saved to the pc and to the encoder when the **Save Changes** button is pressed.



Configuration Utility User Guide

Customising the Code Table

The utility displays a screen that shows for each key

- Which USB code is assigned
- Which modifier (if any) is applied to the USB code.

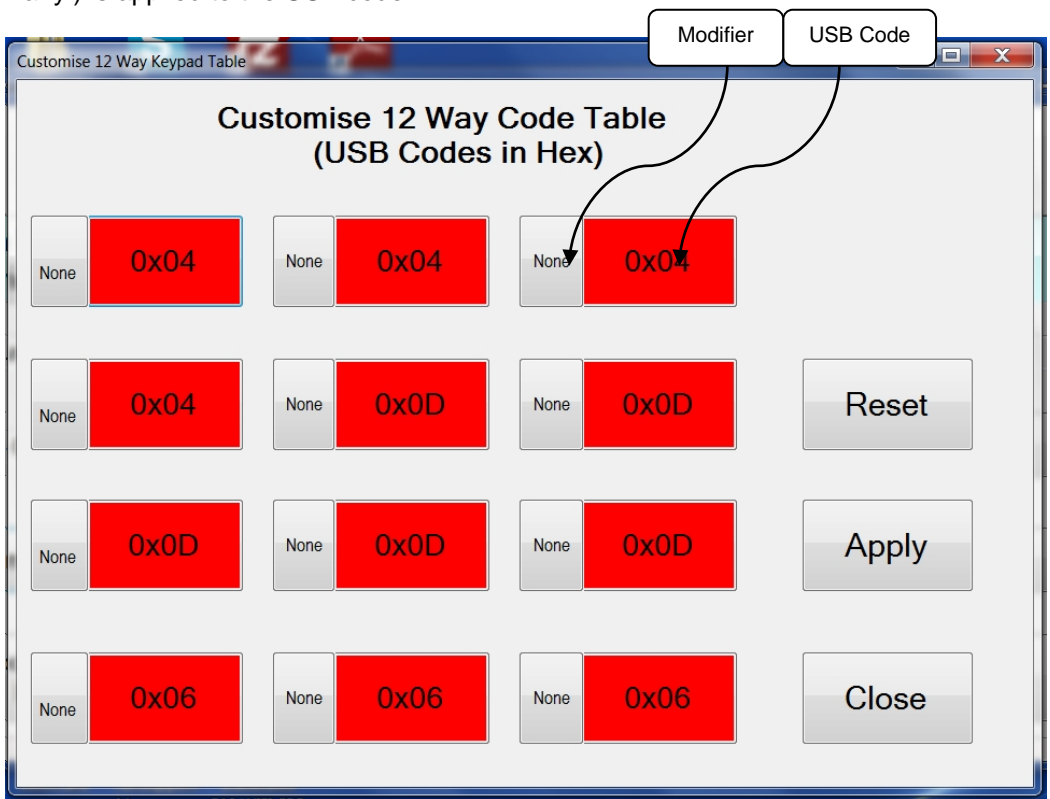
Click on each position and select a USB code from the drop down list.

Add a modifier for each position if required.

Press **“Apply”** to reserve your changes. *This does not save the changes at this stage.*

Press **“Close”** to return to the home screen

“Reset” reloads the default code table



The full list of USB Codes is shown on the following pages.

USB Codes that have been checked in Word are shown in the relevant column, for example :

| | | Un-shifted | Shifted |
|------|------|------------|---------|
| Code | 0x04 | gives | a A |

Where the same USB code gives a different character dependent on the host language setting then this is shown in the relevant language column.

The actual function of the USB code is determined by the application; not all codes have a function in every application.

Full Code Table Reference

450 Series USB Encoder with Firmware
Revision 8v04
Using Generic HID Keyboard Driver

When customising the code table on the encoder
you can place a modifier in front of the USB Code

e.g. E1 , 34 will give you @

| | | | | Any Language differences (using Word) | | | | | | | |
|--------------------|--------------------|-------------------------------|------|---|---------|--------------|---------|----------|--------|--------|---------|
| | | | | English U.K. (if different to U.S.) | | English U.S. | | | French | German | Spanish |
| USB Usage ID (Dec) | USB Usage ID (Hex) | Usage Name | Note | Un-shifted | Shifted | Un-shifted | Shifted | Num lock | | | |
| 00 | 00 | Reserved (no event indicated) | 9 | | | | | | | | |
| 01 | 01 | Keyboard Error Roll Over | 9 | | | | | | | | |
| 02 | 02 | Keyboard POST Fail | 9 | | | | | | | | |
| 03 | 03 | Keyboard Error Undefined | 9 | | | | | | | | |
| 04 | 04 | Keyboard a and A | 4 | | | a | A | | | | |
| 05 | 05 | Keyboard b and B | | | | b | B | | | | |
| 06 | 06 | Keyboard c and C | 4 | | | c | C | | | | |
| 07 | 07 | Keyboard d and D | | | | d | D | | | | |
| 08 | 08 | Keyboard e and E | | | | e | E | | | | |
| 09 | 09 | Keyboard f and F | | | | f | F | | | | |
| 10 | 0A | Keyboard g and G | | | | g | G | | | | |
| 11 | 0B | Keyboard h and H | | | | h | H | | | | |
| 12 | 0C | Keyboard i and I | | | | i | I | | | | |
| 13 | 0D | Keyboard j and J | | | | j | J | | | | |
| 14 | 0E | Keyboard k and K | | | | k | K | | | | |
| 15 | 0F | Keyboard l and L | | | | l | L | | | | |
| 16 | 10 | Keyboard m and M | 4 | | | m | M | | | | |
| 17 | 11 | Keyboard n and N | | | | n | N | | | | |
| 18 | 12 | Keyboard o and O | 4 | | | o | O | | | | |
| 19 | 13 | Keyboard p and P | 4 | | | p | P | | | | |
| 20 | 14 | Keyboard q and Q | 4 | | | q | Q | | | | |
| 21 | 15 | Keyboard r and R | | | | r | R | | | | |
| 22 | 16 | Keyboard s and S | 4 | | | s | S | | | | |
| 23 | 17 | Keyboard t and T | | | | t | T | | | | |
| 24 | 18 | Keyboard u and U | | | | u | U | | | | |
| 25 | 19 | Keyboard v and V | | | | v | V | | | | |
| 26 | 1A | Keyboard w and W | 4 | | | w | W | | | | |
| 27 | 1B | Keyboard x and X | 4 | | | x | X | | | | |
| 28 | 1C | Keyboard y and Y | 4 | | | y | Y | | | | |
| 29 | 1D | Keyboard z and Z | 4 | | | z | Z | | | | |
| 30 | 1E | Keyboard 1 and ! | 4 | | | 1 | ! | | | | |
| 31 | 1F | Keyboard 2 and @ | 4 | 2 | " | 2 | @ | | | | |
| 32 | 20 | Keyboard 3 and # | 4 | 3 | £ | 3 | # | | | | |
| 33 | 21 | Keyboard 4 and \$ | 4 | | | 4 | \$ | | | | |
| 34 | 22 | Keyboard 5 and % | 4 | | | 5 | % | | | | |
| 35 | 23 | Keyboard 6 and ^ | 4 | | | 6 | ^ | | | | |
| 36 | 24 | Keyboard 7 and & | 4 | | | 7 | & | | | | |
| 37 | 25 | Keyboard 8 and * | 4 | | | 8 | * | | | | |
| 38 | 26 | Keyboard 9 and (| 4 | | | 9 | (| | | | |



450 Series USB Encoder with Firmware Revision 8v04
Using Generic HID Keyboard Driver

When customising the code table on the encoder you can place a modifier in front of the USB Code

e.g. E1 , 34 will give you @

| Any Language differences (using Word) | | | | | | | | | | |
|---|--------------------|---------------------------------|------|------------|---------|------------|---------------------|----------|--|--|
| English U.K. (if different to U.S.) | | English U.S. | | | French | German | Spanish | | | |
| USB Usage ID (Dec) | USB Usage ID (Hex) | Usage Name | Note | Un-shifted | Shifted | Un-shifted | Shifted | Num lock | | |
| 39 | 27 | Keyboard 0 and) | | | | 0 |) | | | |
| 40 | 28 | Keyboard Return (ENTER) | 5 | | | | | | | |
| 41 | 29 | Keyboard ESCAPE | | | | | | | | |
| 42 | 2A | Keyboard DELETE (Backspace) | 13 | | | | | | | |
| 43 | 2B | Keyboard Tab | | | | | | | | |
| 44 | 2C | Keyboard Spacebar | | | | | | | | |
| 45 | 2D | Keyboard - and (underscore)4 | 4 | | | - | _ | | | |
| 46 | 2E | Keyboard = and + | 4 | | | = | + | | | |
| 47 | 2F | Keyboard [and { | 4 | | | [| { | | | |
| 48 | 30 | Keyboard] and } | 4 | | |] | } | | | |
| 49 | 31 | Keyboard \ and | | | | \ | | | | |
| 50 | 32 | Keyboard Non-US # and ~ | 2 | # | ~ | \ | | | | |
| 51 | 33 | Keyboard ; and : | 4 | | | ; | : | | | |
| 52 | 34 | Keyboard ' and " | 4 | ' | @ | ' | " | | | |
| 53 | 35 | Keyboard Grave Accent and Tilde | 4 | | | ` | ~ | | | |
| 54 | 36 | Keyboard , and < | 4 | | | , | < | | | |
| 55 | 37 | Keyboard . and > | 4 | | | . | > | | | |
| 56 | 38 | Keyboard / and ? | 4 | | | / | ? | | | |
| 57 | 39 | Keyboard Caps Lock11 | 11 | | | | | | | |
| 58 | 3A | Keyboard F1 | | | | F1 | | | | |
| 59 | 3B | Keyboard F2 | | | | F2 | | | | |
| 60 | 3C | Keyboard F3 | | | | F3 | | | | |
| 61 | 3D | Keyboard F4 | | | | F4 | | | | |
| 62 | 3E | Keyboard F5 | | | | F5 | | | | |
| 63 | 3F | Keyboard F6 | | | | F6 | | | | |
| 64 | 40 | Keyboard F7 | | | | F7 | | | | |
| 65 | 41 | Keyboard F8 | | | | F8 | | | | |
| 66 | 42 | Keyboard F9 | | | | F9 | | | | |
| 67 | 43 | Keyboard F10 | | | | F10 | | | | |
| 68 | 44 | Keyboard F11 | | | | F11 | | | | |
| 69 | 45 | Keyboard F12 | | | | F12 | | | | |
| 70 | 46 | Keyboard PrintScreen | 1 | | | | | | | |
| 71 | 47 | Keyboard Scroll Lock | 11 | | | | | | | |
| 72 | 48 | Keyboard Pause | 1 | | | | | | | |
| 73 | 49 | Keyboard Insert | 1 | | | | | | | |
| 74 | 4A | Keyboard Home | 1 | | | Home | Select line of text | | | |
| 75 | 4B | Keyboard PageUp | 1 | | | PgUp | Select text above | | | |
| 76 | 4C | Keyboard Delete Forward | 1,14 | | | Delete | Select text forward | | | |



450 Series USB Encoder with Firmware Revision 8v04
Using Generic HID Keyboard Driver

When customising the code table on the encoder you can place a modifier in front of the USB Code

e.g. E1 , 34 will give you @

| Any Language differences (using Word) | | | | | | | | | |
|---------------------------------------|--------------------|---------------------------|------|--------------|---------|-----------------|---------------------|----------|---------|
| | | | | English U.S. | | | French | German | Spanish |
| English U.K. (if different to U.S.) | | | | | | | | | |
| USB Usage ID (Dec) | USB Usage ID (Hex) | Usage Name | Note | Un-shifted | Shifted | Un-shifted | Shifted | Num lock | |
| 77 | 4D | Keyboard End | 1 | | | End | Select to end | | |
| 78 | 4E | Keyboard PageDown | 1 | | | PgDn | Select to page down | | |
| 79 | 4F | Keyboard RightArrow | 1 | | | Goes right | Select to right | | |
| 80 | 50 | Keyboard LeftArrow | 1 | | | Goes left | Select to left | | |
| 81 | 51 | Keyboard DownArrow | 1 | | | Goes down | Select line down | | |
| 82 | 52 | Keyboard UpArrow | 1 | | | Goes up | Select line up | | |
| 83 | 53 | Keypad Num Lock and Clear | 11 | | | Toggles Numlock | | | |
| 84 | 54 | Keypad / | 1 | | | / | | | |
| 85 | 55 | Keypad * | | | | * | | | |
| 86 | 56 | Keypad - | | | | - | | | |
| 87 | 57 | Keypad + | | | | + | | | |
| 88 | 58 | Keypad ENTER | | | | Enter | | | |
| 89 | 59 | Keypad 1 and End | | | | End | | 1 | |
| 90 | 5A | Keypad 2 and Down Arrow | | | | Down arrow | | 2 | |
| 91 | 5B | Keypad 3 and PageDn | | | | Page down | | 3 | |
| 92 | 5C | Keypad 4 and Left Arrow | | | | Left arrow | | 4 | |
| 93 | 5D | Keypad 5 | | | | | | 5 | |
| 94 | 5E | Keypad 6 and Right Arrow | | | | Right arrow | | 6 | |
| 95 | 5F | Keypad 7 and Home | | | | Home | | 7 | |
| 96 | 60 | Keypad 8 and Up Arrow | | | | Up arrow | | 8 | |
| 97 | 61 | Keypad 9 and PageUp | | | | Page up | | 9 | |
| 98 | 62 | Keypad 0 and Insert | | | | | | 0 | |
| 99 | 63 | Keypad . and Delete | | | | . | | . | |
| 100 | 64 | Keyboard Non-US \ and | 3,6 | | | \ | | | |
| 101 | 65 | Keyboard Application | 12 | | | | | | |
| 102 | 66 | Keyboard Power | 9 | | | | | | |
| 103 | 67 | Keypad = | | | | = | on Mac O/S only | | |
| 104 | 68 | Keyboard F13 | | | | | | | |
| 105 | 69 | Keyboard F14 | | | | | | | |
| 106 | 6A | Keyboard F15 | | | | | | | |
| 107 | 6B | Keyboard F16 | | | | | | | |
| 108 | 6C | Keyboard F17 | | | | | | | |
| 109 | 6D | Keyboard F18 | | | | | | | |
| 110 | 6E | Keyboard F19 | | | | | | | |
| 111 | 6F | Keyboard F20 | | | | | | | |



450 Series USB Encoder with Firmware Revision 8v04
Using Generic HID Keyboard Driver

When customising the code table on the encoder you can place a modifier in front of the USB Code

e.g. E1 , 34 will give you @

Any Language differences (using Word)

| | | | | | | |
|---|--------------|---------|----------|--------|--------|---------|
| English U.K. (if different to U.S.) | English U.S. | | | French | German | Spanish |
| | Un-shifted | Shifted | Num lock | | | |

| USB Usage ID (Dec) | USB Usage ID (Hex) | Usage Name | Note | Any Language differences (using Word) | | | French | German | Spanish |
|--------------------|--------------------|------------------------------|------|---------------------------------------|---------|----------|--------|--------|---------|
| | | | | Un-shifted | Shifted | Num lock | | | |
| 112 | 70 | Keyboard F21 | | | | | | | |
| 113 | 71 | Keyboard F22 | | | | | | | |
| 114 | 72 | Keyboard F23 | | | | | | | |
| 115 | 73 | Keyboard F24 | | | | | | | |
| 116 | 74 | Keyboard Execute | | | | | | | |
| 117 | 75 | Keyboard Help | | | | | | | |
| 118 | 76 | Keyboard Menu | | | | | | | |
| 119 | 77 | Keyboard Select | | | | | | | |
| 120 | 78 | Keyboard Stop | | | | | | | |
| 121 | 79 | Keyboard Again | | | | | | | |
| 122 | 7A | Keyboard Undo | | | | | | | |
| 123 | 7B | Keyboard Cut | | | | | | | |
| 124 | 7C | Keyboard Copy | | | | | | | |
| 125 | 7D | Keyboard Paste | | | | | | | |
| 126 | 7E | Keyboard Find | | | | | | | |
| 127 | 7F | Keyboard Mute | | | | | | | |
| 128 | 80 | Keyboard Volume Up | | | | | | | |
| 129 | 81 | Keyboard Volume Down | | | | | | | |
| 130 | 82 | Keyboard Locking Caps Lock | 12 | | | | | | |
| 131 | 83 | Keyboard Locking Num Lock | 12 | | | | | | |
| 132 | 84 | Keyboard Locking Scroll Lock | 12 | | | | | | |
| 133 | 85 | Keypad Comma | 27 | | | | | | |
| 134 | 86 | Keypad Equal Sign | 29 | | | | | | |
| 135 | 87 | Keyboard International115 | | | | | | | |
| 136 | 88 | Keyboard International216 | | | | | | | |
| 137 | 89 | Keyboard International317 | | | | | | | |
| 138 | 8A | Keyboard International418 | | | | | | | |
| 139 | 8B | Keyboard International519 | | | | | | | |
| 140 | 8C | Keyboard International620 | | | | | | | |
| 141 | 8D | Keyboard International721 | | | | | | | |
| 142 | 8E | Keyboard International822 | | | | | | | |
| 143 | 8F | Keyboard International922 | | | | | | | |



450 Series USB Encoder with Firmware Revision 8v04
Using Generic HID Keyboard Driver

When customising the code table on the encoder you can place a modifier in front of the USB Code

e.g. E1 , 34 will give you @

| Any Language differences (using Word) | | | | | | | | | |
|---------------------------------------|--------------------|---|-------|------------|---------|------------|---------|----------|---------|
| | | English U.S. | | | | | French | German | Spanish |
| | | English U.K. (if different to U.S.) | | | | | | | |
| USB Usage ID (Dec) | USB Usage ID (Hex) | Usage Name | Note | Un-shifted | Shifted | Un-shifted | Shifted | Num lock | |
| 144 | 90 | Keyboard LANG125 | | | | | | | |
| 145 | 91 | Keyboard LANG226 | | | | | | | |
| 146 | 92 | Keyboard LANG330 | | | | | | | |
| 147 | 93 | Keyboard LANG431 | | | | | | | |
| 148 | 94 | Keyboard LANG532 | | | | | | | |
| 149 | 95 | Keyboard LANG68 | | | | | | | |
| 150 | 96 | Keyboard LANG78 | | | | | | | |
| 151 | 97 | Keyboard LANG88 | | | | | | | |
| 152 | 98 | Keyboard LANG98 | | | | | | | |
| 153 | 99 | Keyboard Alternate Erase7 | | | | | | | |
| 154 | 9A | Keyboard SysReq/Attention1 | | | | | | | |
| 155 | 9B | Keyboard Cancel | | | | | | | |
| 156 | 9C | Keyboard Clear | | | | | | | |
| 157 | 9D | Keyboard Prior | | | | | | | |
| 158 | 9E | Keyboard Return | | | | | | | |
| 159 | 9F | Keyboard Separator | | | | | | | |
| 160 | A0 | Keyboard Out | | | | | | | |
| 161 | A1 | Keyboard Oper | | | | | | | |
| 162 | A2 | Keyboard Clear/Again | | | | | | | |
| 163 | A3 | Keyboard CrSel/Props | | | | | | | |
| 164 | A4 | Keyboard ExSel | | | | | | | |
| 224 | E0 | Keyboard LeftControl | | | | | | | |
| 225 | E1 | Keyboard LeftShift | | | | | | | |
| 226 | E2 | Keyboard LeftAlt | | | | | | | |
| 227 | E3 | Keyboard Left GUI | 10,23 | | | | | | |
| 228 | E4 | Keyboard RightControl | | | | | | | |
| 229 | E5 | Keyboard RightShift | | | | | | | |
| 230 | E6 | Keyboard RightAlt | | | | | | | |
| 231 | E7 | Keyboard Right GUI | 10,24 | | | | | | |

Notes on the Code Tables 1-15, 20-34

1 Usage of keys is not modified by the state of the Control, Alt, Shift or Num Lock keys. That is, a key does not send extra codes to compensate for the state of any Control, Alt, Shift or Num Lock keys.

2 Typical language mappings: US: \ | Belg: fÊ`@' FrCa: <|> Dan: @f* Dutch: <|> Fren:*fÊ Ger: #
Nor:,* Span: }C Swed: ,* Swiss: \$ @' UK: #~. @f Ital: u@~ La

3 Typical language mappings: Belg:<|> FrCa:@á @>@a@ Dan:} | Fren:<|> Ger:<|> Ital:<|> LatAm:<|> Nor:<|>
Span:<|> Swed:<|> Swiss:<|> UK:\ | Brazil: \ |.

4 Typically remapped for other languages in the host system.

5 Keyboard Enter and Keypad Enter generate different Usage codes.

6 Typically near the Left-Shift key in AT-102 implementations.

7 Example, Erase-Eaze. key.

8 Reserved for language-specific functions, such as Front End Processors and Input Method Editors.

9 Reserved for typical keyboard status or keyboard errors. Sent as a member of the keyboard array. Not a physical key.

10 Windows key for Windows 95, and @gCompose. @h

11 Implemented as a non-locking key; sent as member of an array.

12 Implemented as a locking key; sent as a toggle button. Available for legacy support; however, most systems should use the non-locking version of this key.

13 Backs up the cursor one position, deleting a character as it goes.

14 Deletes one character without changing position.

15-20 See additional foot notes in the USB spec

21 Toggle double-byte/single-byte mode

22 Undefined, available for other front end language processors

23 Windowing environment key, examples are Microsoft left win key, mac left apple key, sun left meta key

24 Windowing environment key, example are microdoft wight win key, macintosh right apple key, sun right meta key

Product Dimensions

| | | |
|----------------|---------------------------------------|----------|
| Overall dims | 77mm x 39mm x 25mm, | 30 grams |
| Packed dims | 124mm x 52mm x 40mm, | 50 grams |
| Included parts | Qty 4 sticky pads, Installation sheet | |

Cables

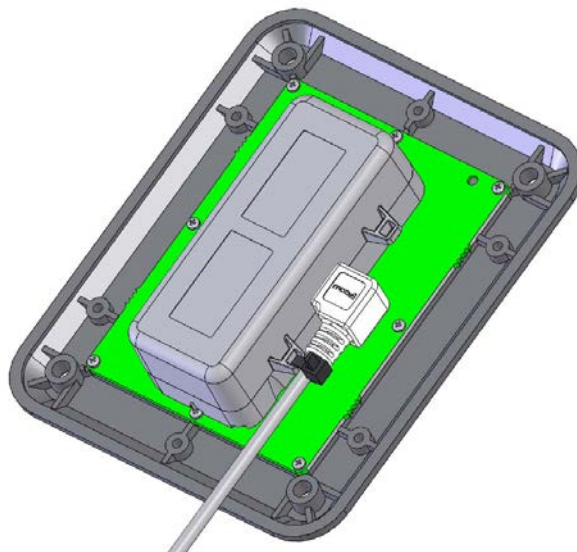
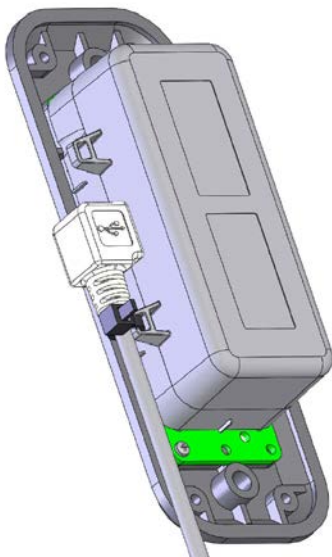
Depending on your installation you may require either a straight or an angled cable, with latching mini B USB connector. If you use an angled cable then you will be able to secure the cable to the encoder as below.



Encoder on 4 way keypad
With Startech cable USB2HABM3RA

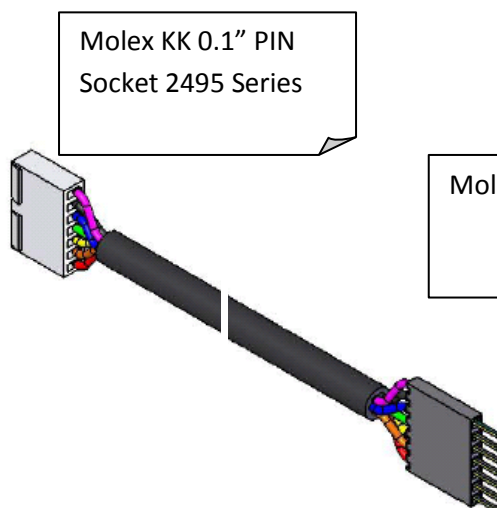


Encoder on 12 way keypad
Startech USB2HABM3LA
(order pn 4500-01 from Storm)



If you wish to have the encoder remote from the keypad then you will need an interconnection cable as below

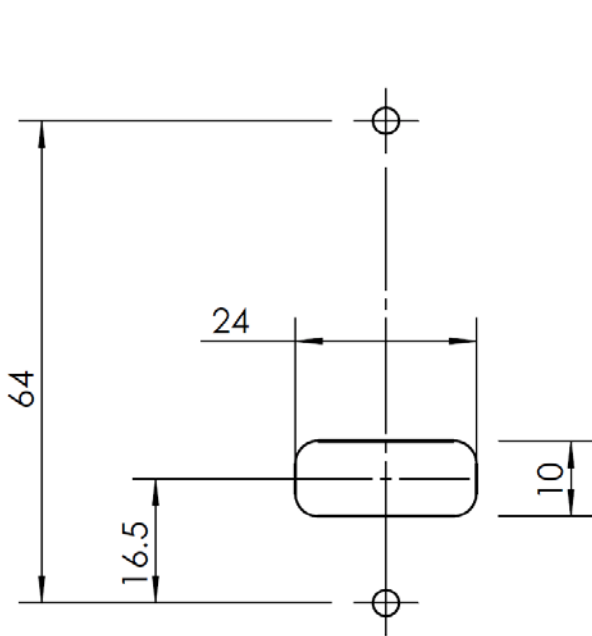
| Encoder 4 W | to | 4 w keypad | Illuminated version |
|-------------|----|------------|---------------------|
| PIN | | PIN | PIN |
| 1 | | | 1 |
| 2 | | 1 | 2 |
| 3 | | 2 | 3 |
| 4 | | 3 | 4 |
| 5 | | 4 | 5 |
| 6 | | 5 | 6 |
| 7 | | | 7 |



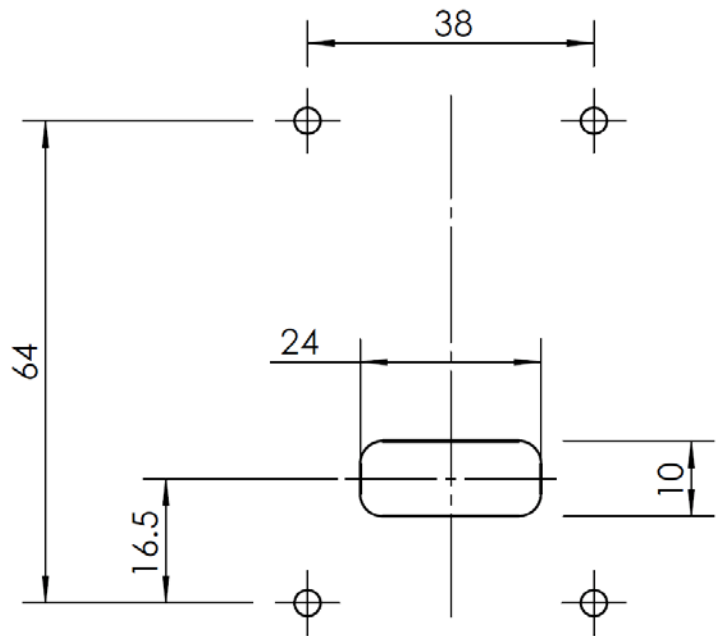
| Encoder 12/16 | to | 12/16 keypad | Illuminated version |
|---------------|----|--------------|---------------------|
| PIN | | PIN | PIN |
| 1 | | | 1 |
| 2 | | 1 | 2 |
| 3 | | 2 | 3 |
| 4 | | 3 | 4 |
| 5 | | 4 | 5 |
| 6 | | 5 | 6 |
| 7 | | 6 | 7 |
| 8 | | 7 | 8 |
| 9 | | 8 | 9 |
| 10 | | | 10 |

Panel Cutout Drawings

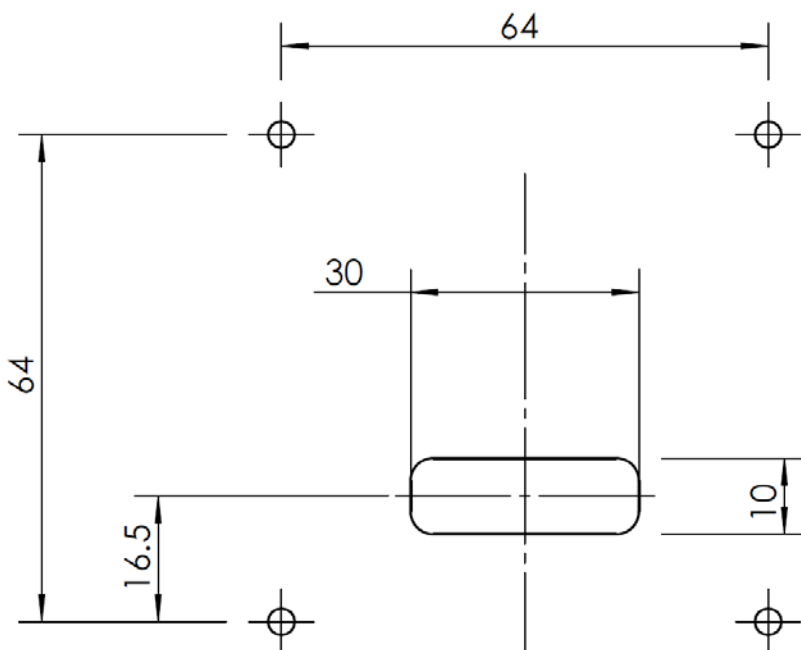
Surface Fixing of Keypads : 700 Series. 720 Series Both products use the same panel cutout detail.



4 WAY PANEL FRONT MOUNTED



12 WAY PANEL FRONT MOUNTED



16 WAY PANEL FRONT MOUNTED

PANEL DETAILS FOR
700 AND 720 SERIES
FRONT FIXING

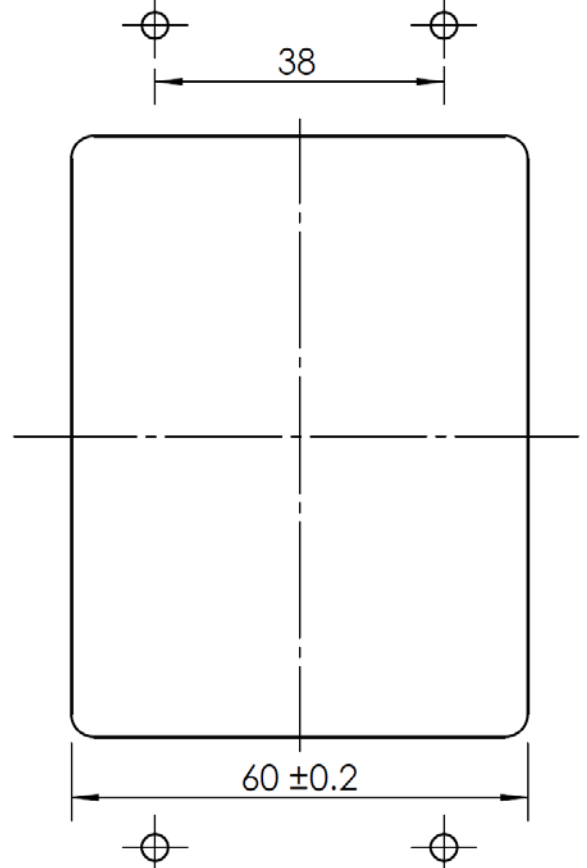
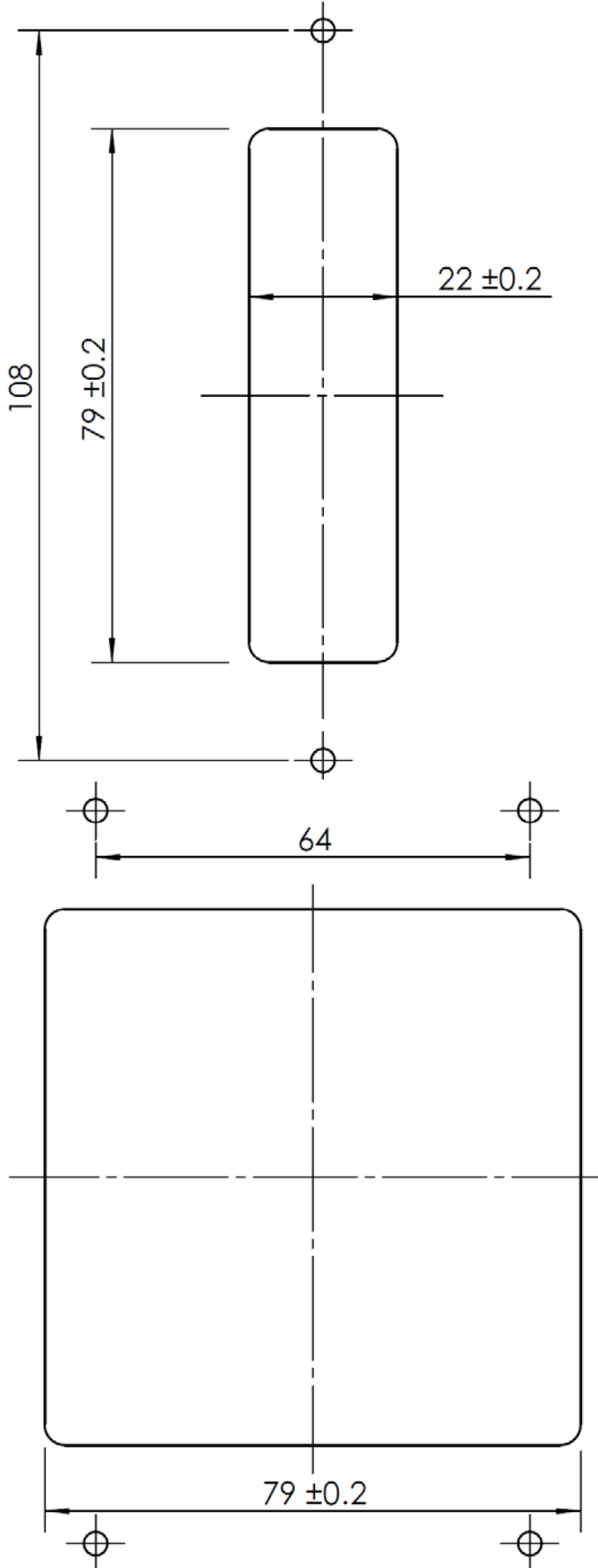
ALL DIMS IN MM
R3 IN CORNERS

CLEARANCE HOLES
DIAMETER 3.5 FOR STUDS

Panel Cutout Drawings

Underpanel Fixing of Keypads :

700 Series. (4 way uses fix kit 7004CL0, 12/16 way uses fix kit 7012CL0)
720 Series (uses fixing kit pn 7204CL0, 12/16 way uses fix kit 7212CL0)



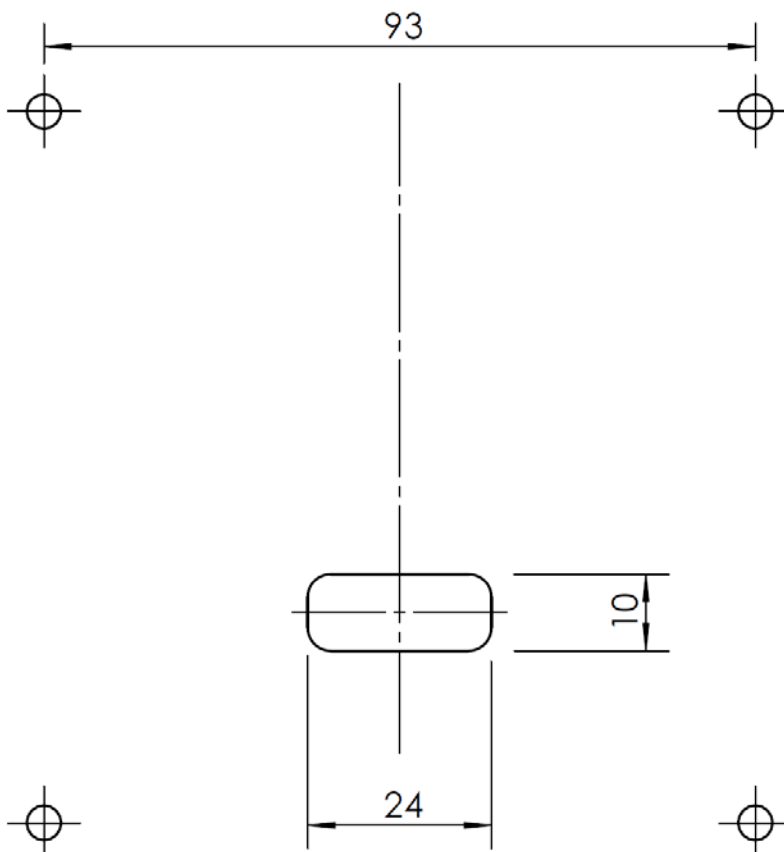
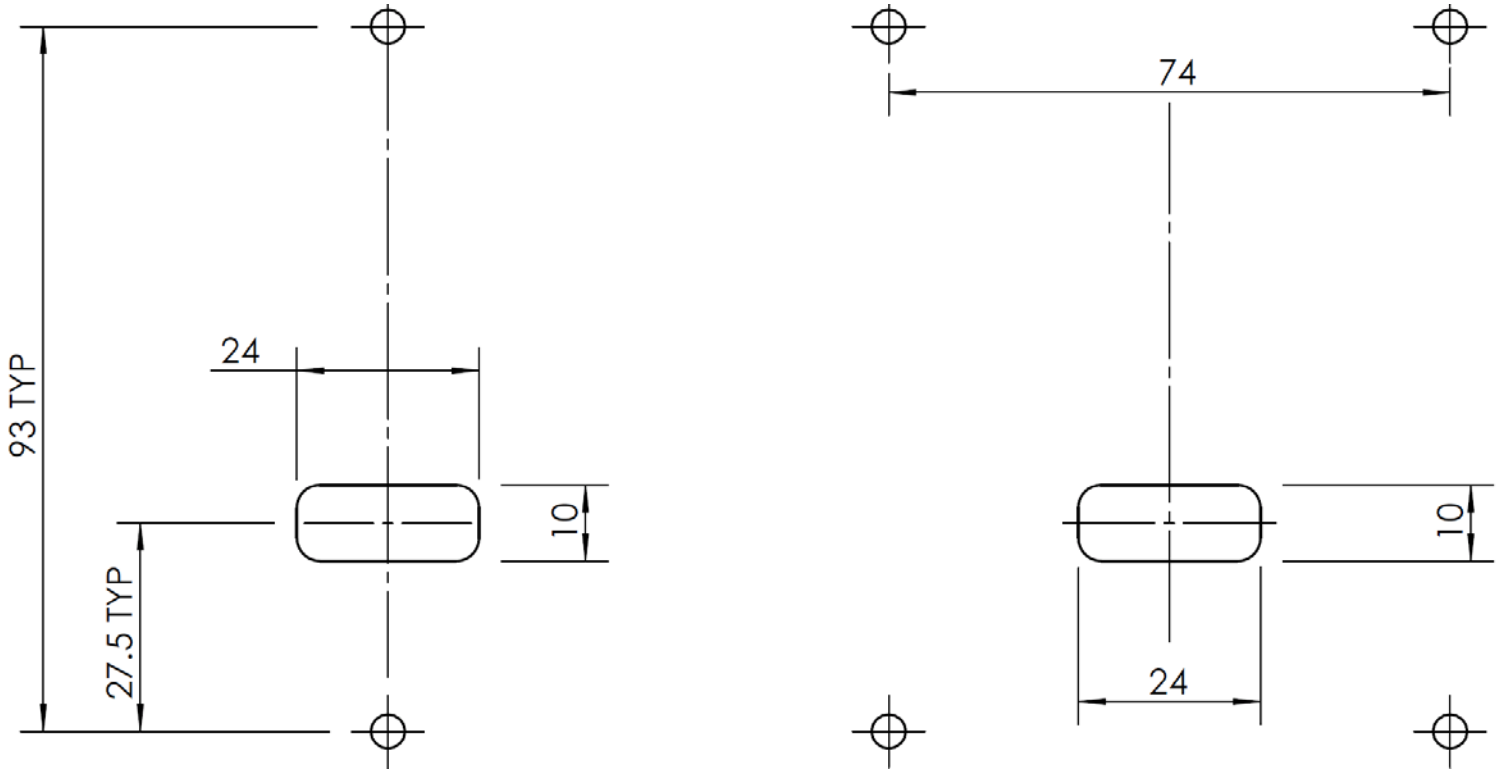
PANEL DETAILS FOR
700 AND 720 SERIES
UNDERPANEL FIXING

4, 12 AND 16 WAY
KEYPADS
MAKE SURE TO USE THE
CORRECT FIXING CLIPS
FOR PRODUCT

ALL DIMS IN MM
R3 IN CORNERS
M3 STUDS OR SIMILAR

Panel Cutout Drawings

Surface Fixing of Keypads : 1000 Series, 2000 Series, PLX Series



PANEL DETAILS FOR
1000 AND 200 SERIES
FRONT FIXING

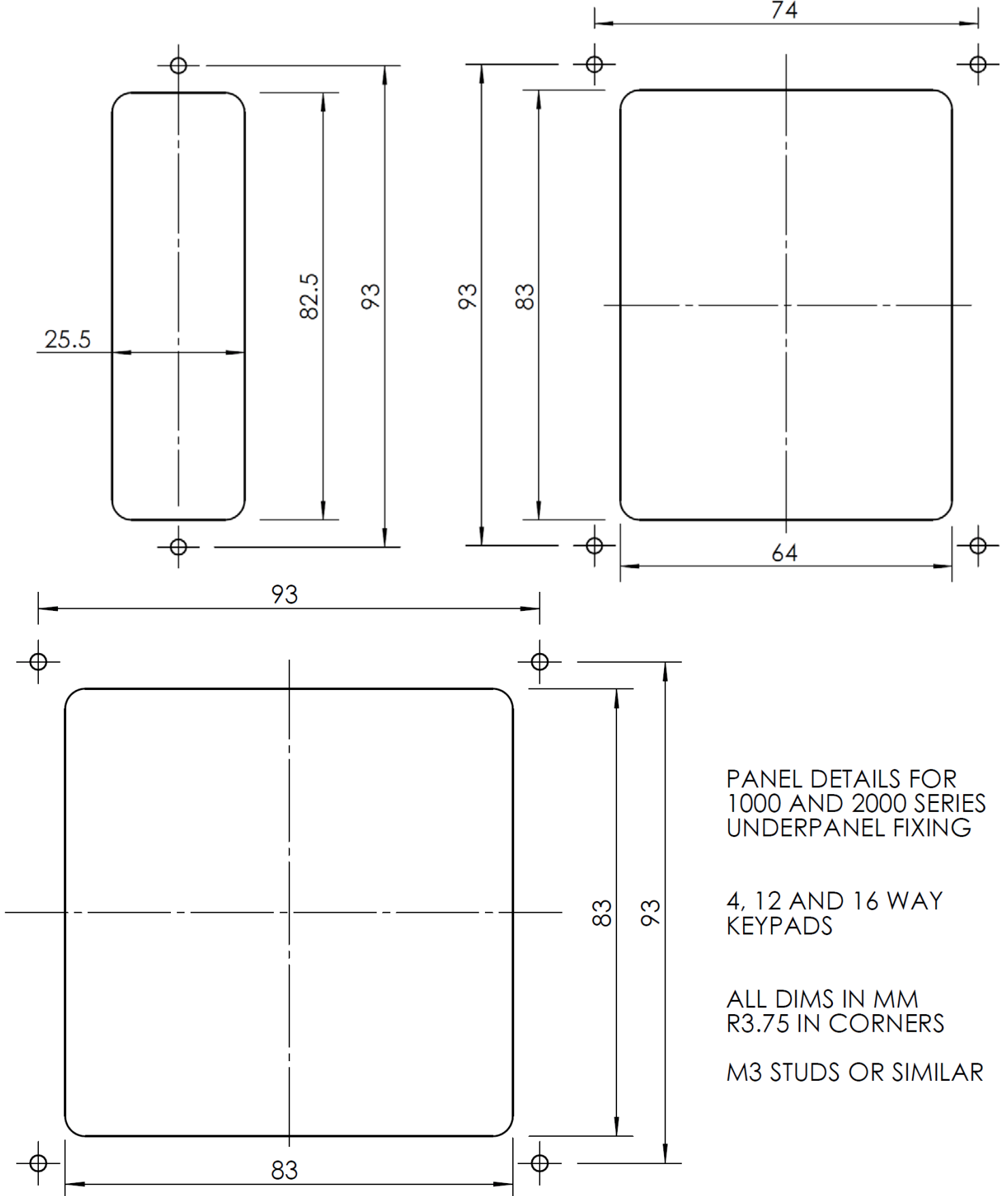
4, 12 AND 16 WAY
KEYPADS

ALL DIMS IN MM
R3 IN CORNERS

CLEARANCE HOLES
DIAMETER 4.5

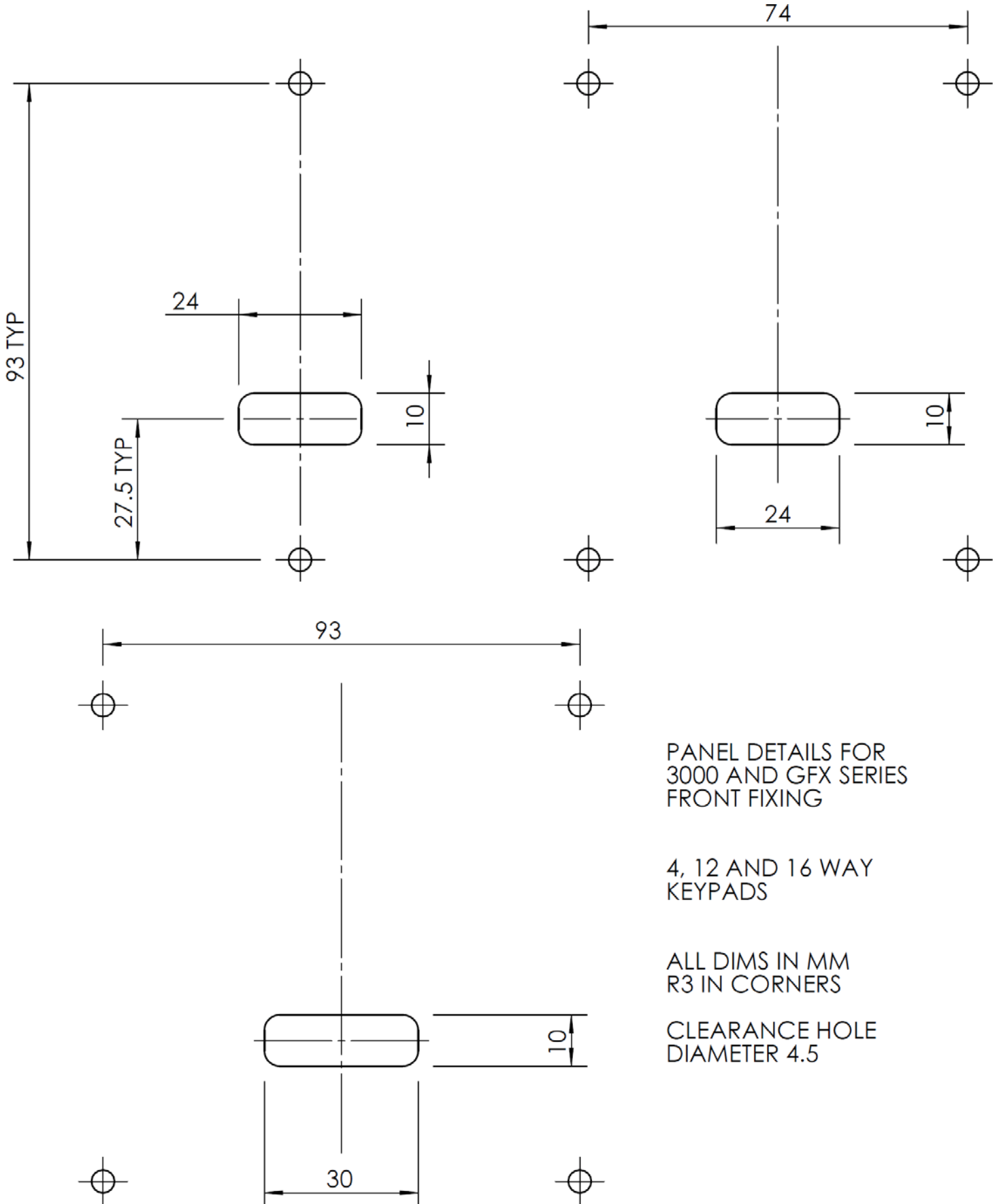
Panel Cutout Drawings

Underpanel Fixing of Keypads : 1000 Series, 2000 Series, PLX Series. Use M3 CD weld studs or similar



Panel Cutout Drawings

Surface Fixing of Keypads : 3000 Series, GFX Series



PANEL DETAILS FOR
3000 AND GFX SERIES
FRONT FIXING

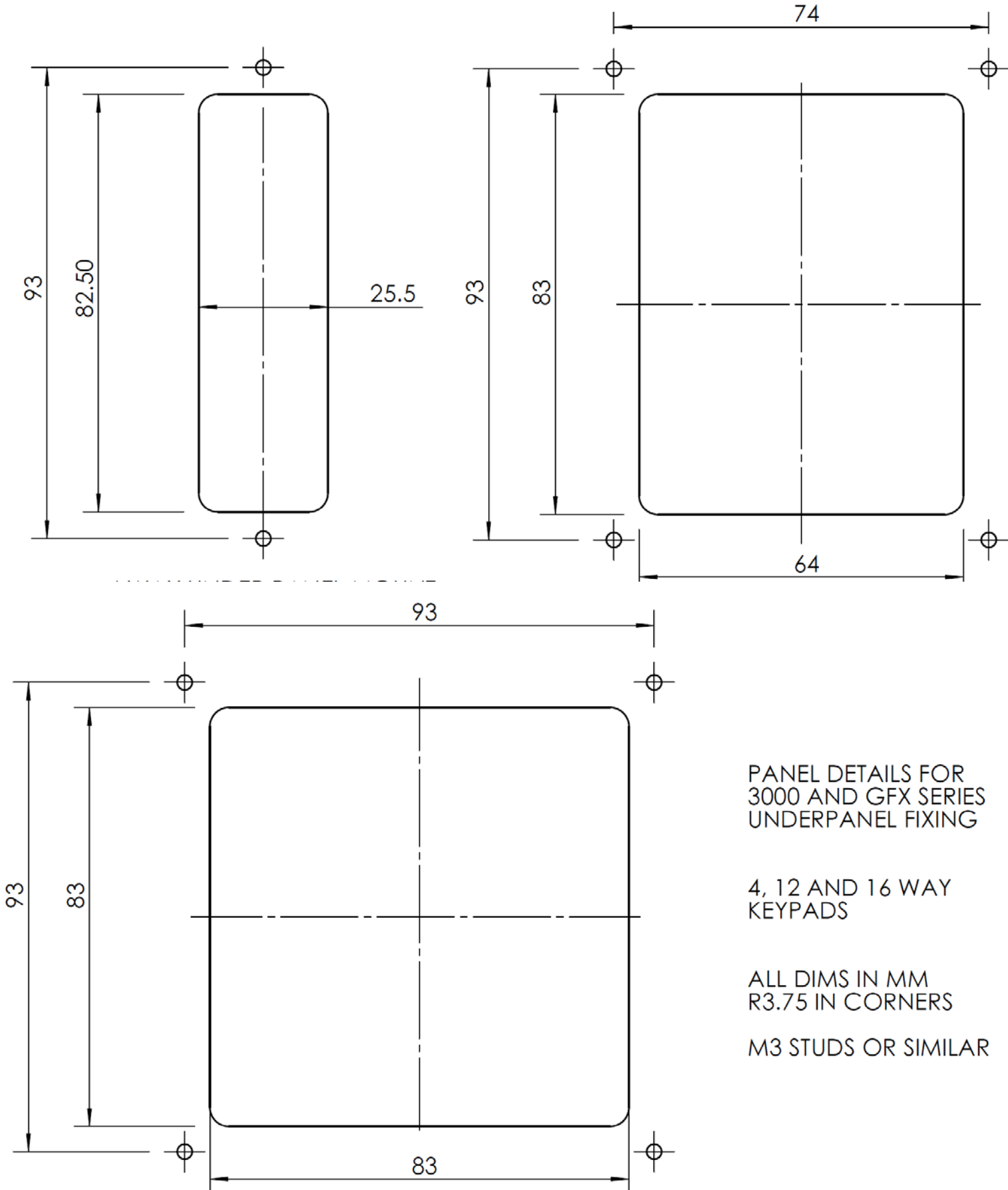
4, 12 AND 16 WAY
KEYPADS

ALL DIMS IN MM
R3 IN CORNERS

CLEARANCE HOLE
DIAMETER 4.5

Panel Cutout Drawings

Underpanel Fixing of Keypads : 3000 Series, GFX Series,





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Change History

| USB Configuration Utility | Date | Version | Details |
|---------------------------|-----------|---------|---|
| 4500-SW01 | 1 Aug 13 | 2.1 | First Release |
| | 20 Aug 13 | 3.0 | Increased size of modifier button + Increased size of Select Code Combo box. |
| | 12 Nov 13 | 4.0 | Update in line with 8v04 release |
| | | | |
| | | | |
| | | | |

| USB Encoder Software | Date | Version | Details |
|----------------------|-----------|---------|---------------------------------|
| | 1 Aug 13 | 8v02 | First Release |
| | 20 Aug 13 | 8v03 | Disable USB stack serialisation |
| | 12 Nov 13 | 8v04 | Improve Brightness Control. |
| | | | |

| Engineering Manual | Date | Version | Details |
|--------------------|------------|---------|---|
| | 1 Aug 13 | 1.0 | First Release |
| | 12 Aug 13 | 1.02 | p7 Alternative Code table : Outputs with Numlock clarified. Also changed in French version p11-14. Checked some USB codes in the full tables. Removed Insulation Breakdown spec (error) |
| | 1 Oct 2013 | 1.03 | Add section about the API |
| | 12 Nov 13 | 1.05 | Software update to 8v04 |
| | 2 Nov 15 | 1.1 | API added, plus addition of LED & buzzer control in API command set. |

| API Documentation | Date | Version | Details |
|-------------------|------------|--|---------------|
| | 1 Oct 2013 | 1.0 | First Release |
| | 2 Nov 15 | API Doc merged with Engineering Manual | |
| | | | |
| | | | |



API

| | Page |
|--|------|
| Device Communications & Message Format | 27 |
| List of Messages and Error Code Definitions | 28 |
| <i>Messages from Host to Encoder</i> | |
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| 02 LED Brightness Adjust led brightness. | 30 |
| 04 Key Press Buzzer Enable/Disable buzzer. | 31 |
| 05 Load New code table Load new code table | 32 |
| 06 Buzzer Duration Change buzzer duration..... | 33 |
| 07 Keypad Type Select layout table | 34 |
| 08 Self Test Start/end a self test | 35 |
| 09 Write to default Encoder writes configuration data from ram to flash. | 36 |
| 10 Reset to factory default Reset device back to factory default | 37 |
| 12 Load Firmware Sets the encoder to detect the device loader for firmware loading ... | 38 |
| 13 Status Buzzer Sounds the buzzer for x period. | 39 |
| <i>Keyboard Report Encoder to Host</i> | |
| 01 Key Press Code sends key code back to HOST when a key is pressed on keypad | 40 |

USB Encoder Device Communications

The encoder uses the ASCII/binary Message format described below.

Every message that is sent from a host should be acknowledged with the control byte ACK (0x06).

A retransmission should be initiated if an NAK (0x15) is received or if nothing is received.

When encoder transmits a key press code to host, it will only send ASCII code. No acknowledgement is required.

Message Format

| | Message Field | Type | Length | Description |
|---|---------------|------|--------|---|
| 1 | STX | C | 1 | Control character Start of Text = 0x02 |
| 2 | Message ID | H | 2 | Defines the type of message and format of the data field |
| 3 | Data Length | H | 2 | Hexadecimal value represented in ASCII defines the number of bytes in the data field. '00' to 'FF'. Maximum data field size is 256 bytes. |
| 4 | Data Field | S | var | In binary format |
| 5 | ETX | C | 1 | Control character ETX = 0x03 |
| 6 | LRC | C | 1 | Longitudinal Redundancy Check Digit, calculated on all previous data including STX |

Message Format Example – enable the buzzer on key press

| | STX | ID | DATA LENGTH | DATA FIELD | ETX | LRC |
|-----|------|----|-------------|------------|------|------------|
| HEX | 0x02 | 04 | 1 | 1 | 0x03 | calculated |

The full message is always as per the format above. For clarity only the **ID** and the **Data Field** are shown in the message definitions on pages 4 – 14.

Character Types Used

| | |
|---|--|
| A | Alpha character, 'A'-'Z' and 'a' - 'z' |
| C | Control character one byte in length. |
| H | Hexadecimal characters, '0'-'9', 'A'-'F' |
| N | Numeric character, '0'-'9' |
| S | Special characters, entire character set 0x00 - 0xFF |

Message Definitions

The messages are listed below; each one is fully detailed on the following pages.

| ID. | Data | Message | Description |
|-----|------|--------------------------|---|
| 01 | | Device Status Request | Host To USB Encoder – Output the firmware version and all currently selected parameters |
| 02 | lb | LED Brightness | Host To USB Encoder – adjust led brightness. (default: 0) |
| 03 | | Reserved | |
| 04 | bof | Key Press Buzzer On/Off | Host To USB Encoder - Enable/Disable buzzer. (Default: Enable) |
| 05 | lt | Load New code table | Host To USB Encoder – Load new code table |
| 06 | bp | Change Buzzer Duration | Host To USB Encoder – change the buzzer period duration |
| 07 | kt | Keypad Type | Host To USB Encoder – Select layout table 0 – Function key – 4way (default) 1 – Arrow Key - 4 way 2 – Customised 4way, 3 – Telephone – 12way, 4 – Calculator – 12way , 5 – Customised – 12way, 6 – Telephone – 16way, 7 – Calculator – 16way , 8 – Customised – 16way |
| 08 | st | Self Test | Host To USB – The encoder start/end a self test |
| 09 | | Save Configuration | Host To USB Encoder – Encoder writes configuration data from ram to flash. |
| 10 | | Reset to factory default | Host To USB Encoder – Reset device back to factory default |
| 11 | | Reserved | |
| 12 | | Load Firmware | Host To USB Encoder – Sets the encoder to detect the device loader for firmware loading |
| 13 | sb | Status Buzzer | Host to USB encoder – Sounds the buzzer for x period. X is passed in value (0 -9) |
| | | | |

Error Code

Every response message contains one of the following error codes:

| | |
|----|-----------------------------------|
| 00 | No error |
| 01 | Command not recognized |
| 02 | Command not support at this stage |
| 03 | Parameter not supported |
| 04 | Hardware fault |

Device ID

Following table shows the possible values for the device ID field:

| | |
|----|-------------------------------|
| 00 | Keymat Technology USB Encoder |
|----|-------------------------------|

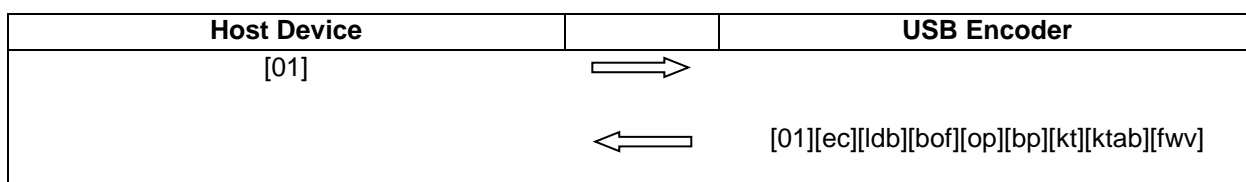
Device Status (01)

Host sends this message to USB encoder to request the status of the encoder.

USB Encoder Status Response

USB Encoder sends this message to Host in response to the Device Status message.

| | Data Field | Type | Length | Description |
|------|------------------|------|----------|---|
| ec | Error Code | H | 2 | |
| ldb | LED Brightness | N | 1 | Value (0 – 9) |
| | reserved | N | 1 | |
| bof | Buzzer | N | 1 | 0 – OFF, 1 – ON |
| op | Option | N | 1 | 0x01 – LEDs, 0x02 – Buzzer, Rest is reserved for future use. |
| bp | Buzzer on period | N | 1 | Value (0 – 9) |
| kt | Keypad Type | N | 1 | 0 – Function key – (default) 4 way 1 – Arrow Key 4 way 2 – Customised 4 way 3 – Telephone 12 way 4 – Calculator 12 way 5 – Customised 12 way 6 – Telephone 16 way 7 – Calculator 16 way 8 – Customised 16 way |
| ktab | Keypcode table | H | Up to 32 | Layout selected table – data could be for 4 way or 12/16 way |
| fwv | Firmware Version | A,N | 20 | Left justified, if Firmware Version is less than 20 then just add enough spaces after the Firmware Version until this field is completed, for instance, “123456” becomes: “123456 “ |



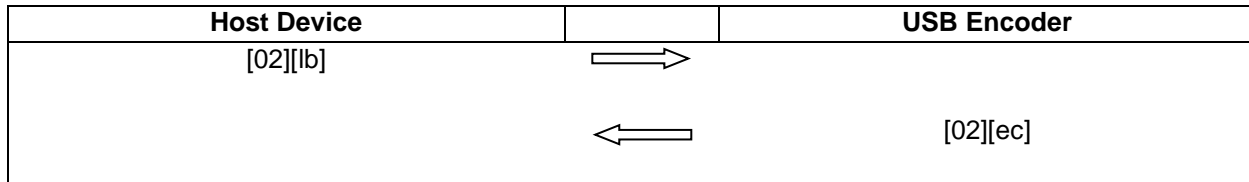
LED Brightness Command (02)

Host sends this message to control brightness of LEDs

| | Data Field | Type | Length | Description |
|----|----------------|------|--------|-------------|
| lb | LED brightness | N | 1 | 0 - 9 |

LED Brightness Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



Note: LED brightness of 0 value indicates LEDs are off

LED brightness of 9 value indicates full brightness

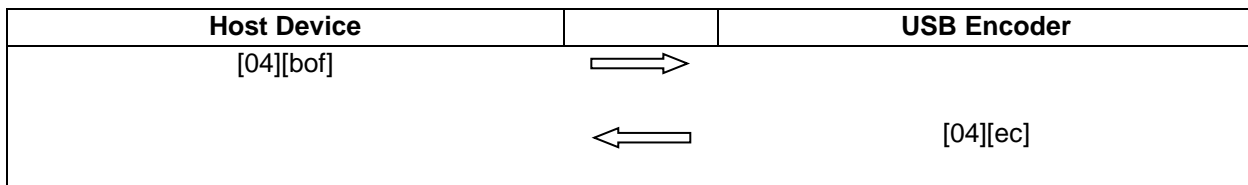
Buzzer On / Off Command (04)

Host sends this message to enable/disable buzzer on key presses

| | Data Field | Type | Length | Description |
|-----|------------|------|--------|---------------------|
| bof | Buzzer | N | 1 | 0-Disable, 1-Enable |

Buzzer Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



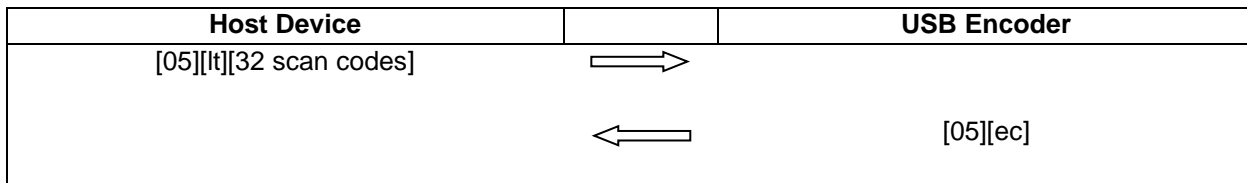
Load New Key Code Table Command (05)

Host sends this message to Load New Code Table

| | Data Field | Type | Length | Description |
|----|---------------------|------|-----------|--|
| lt | Load New Code Table | H | Always 32 | Key Code Table: 8 for 4W, 24 for 12W, or 32 for 16W |

Load New Table Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



Note: Length is always 32, for example for 4 way, it requires 8 codes and this will be the first 8 bytes, subsequent 24 bytes will be ignored by the encoder.

Format of table is as follows:

<modifier for key 1><code for Key 1><modifier for key 2><Code for Key 2>.....etc

The code table is specified in the user manual together with the modifier code. For example to program the following for 4 way :

Key 1 – A

Key 2 – a

Key 3 – 9

Key 4 - !

```
<0xE1><0x04><0x00><0x04><0x00><0x26><0xE5><0x1E>< 0x00><0x00>< 0x00><0x00>< 0x00><0x00><
0x00><0x00>< 0x00><0x00>< 0x00><0x00>< 0x00><0x00>< 0x00><0x00>< 0x00><0x00>< 0x00><0x00><
0x00><0x00>< 0x00><0x00>
```

Note: 32 bytes must be sent, for unused key code pad the values with 0x00.

Note: For shift modifiers there is a left and right modifiers value defined. So we can use 0xE1 – Left Shift and 0xE5 – Right shift. Similarly there is left and right Alt

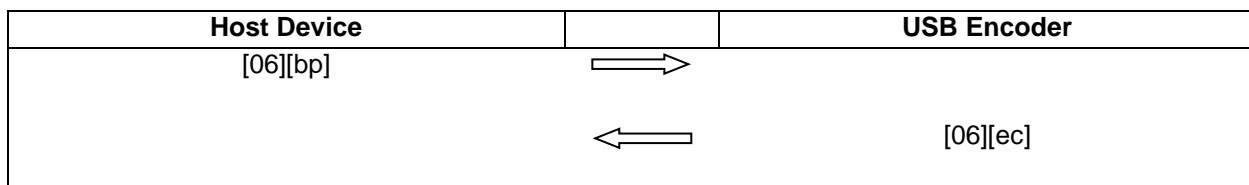
Buzzer Duration Command (06)

Host sends this message to change the duration of the buzzer period (when a key is pressed)

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| bp | Duration | N | 1 | Value 0 - 9 |

Buzzer Duration Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



Buzzer value increments in 0.25s. For example 1 = 0.25s, 2 – 0.5s, 3 – 0.75s, 4 – 1.0s etc.,

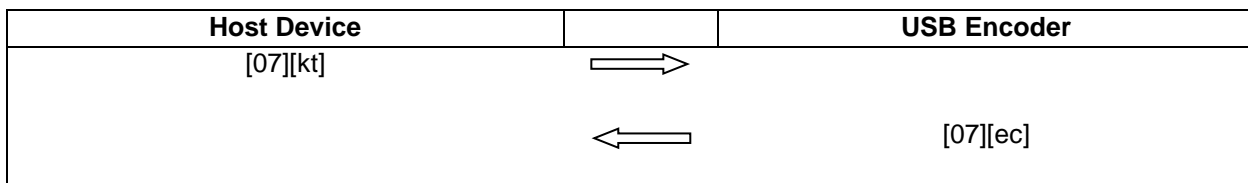
Keypad Type Command (07)

Host sends this message to set keypad type

| | Data Field | Type | Length | Description |
|----|-------------|------|--------|---|
| kt | Keypad Type | N | 1 | 0 – Function key – (default) 4 way 1 – Arrow Key 4 way 2 – Customised 4 way 3 – Telephone 12 way 4 – Calculator 12 way 5 – Customised 12 way 6 – Telephone 16 way 7 – Calculator 16 way 8 – Customised 16 way |

Keypad Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



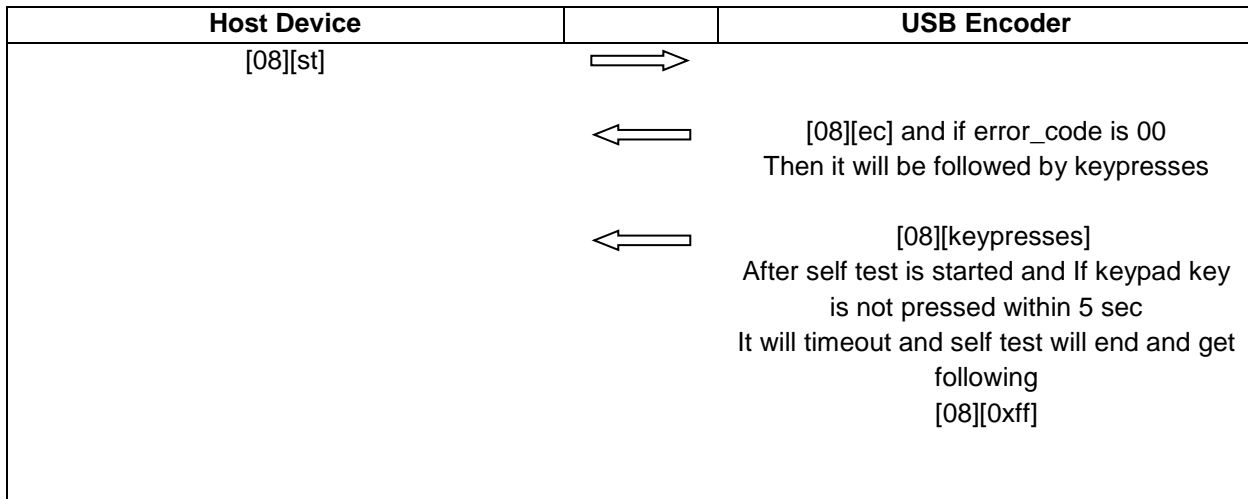
Self Test Command (08)

Host sends this command to request the USB Encoder to start/end a self test of the encoder.

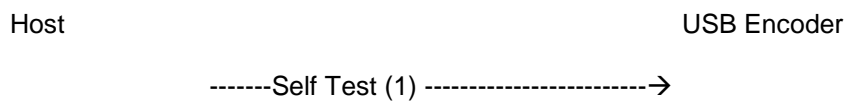
| | Data Field | Type | Length | Description |
|----|------------|------|--------|--------------------------------------|
| st | Self test | N | 1 | 1 – start self test 2– end self test |

Self Test Start/End Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



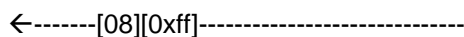
The self test command is used to test the key presses on keypad.



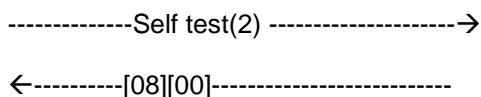
This command disables the USB encoder USB devices, so if any keys are pressed the key codes are sent to Host over the HID datapipe channel as shown above. So if user presses key button 1.



If no key is presses for 5 sec then the command ends



The host can stop the self test command by issuing



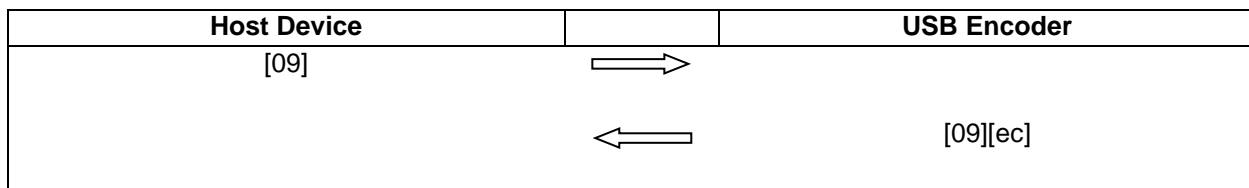
Write Config Data To Flash command (09)

Host sends this command to request the USB Encoder to write the configuration data from RAM to FLASH.

This command has no data associated with it.

RAM to FLASH Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



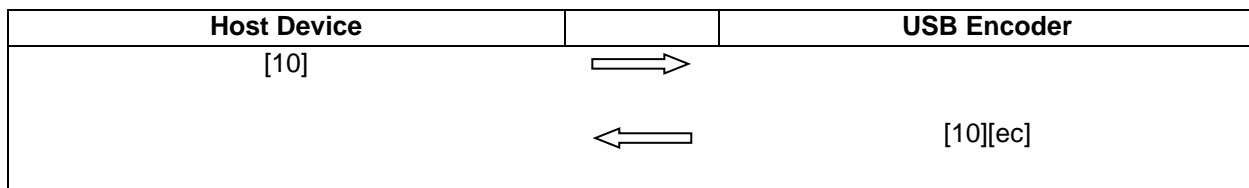
Reset To Factory Default command (10)

Host sends this command to request the USB Encoder to reset parameters back to factory default.

This command has no data associated with it.

Reset To Factory Default Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



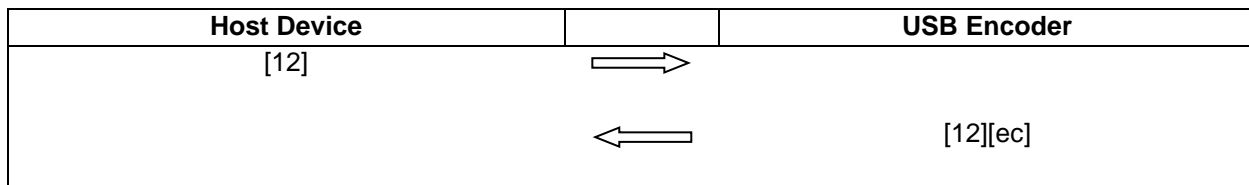
Enable BSL Command (12)

Host sends this command to request the USB Encoder to start downloader.

This command has no data associated with it.

Enable BSL Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



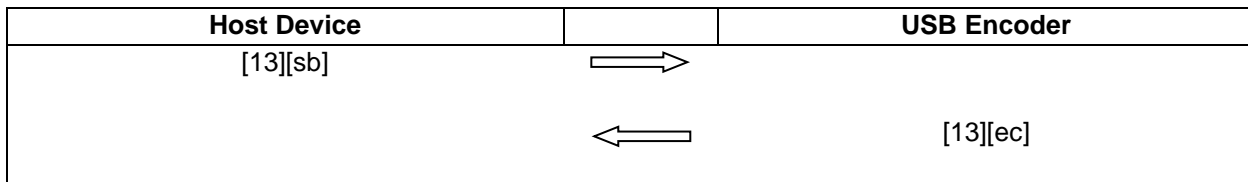
Status Buzzer Command (13)

Host sends this message to sound the buzzer for specified duration

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| sb | Duration | N | 1 | Value 0 - 9 |

Status Buzzer Command Response

| | Data Field | Type | Length | Description |
|----|------------|------|--------|-------------|
| ec | Error Code | H | 2 | |



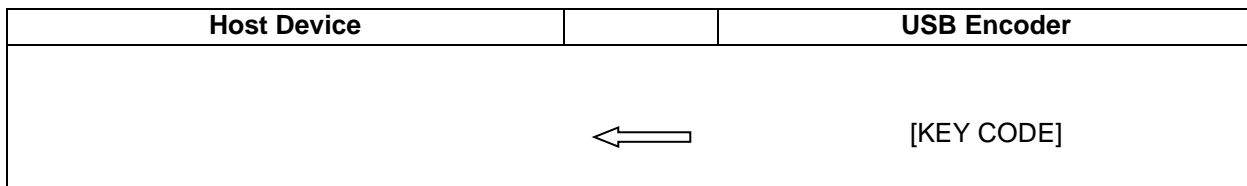
Key Press Code

Each time a key is pressed on keypad the USB encoder sends the keyboard report back to HOST.

When the key is released the USB Encoder sends 00000000 back to the HOST.

Keypress Code Type Report

| | Data Field | Type | Length | Description |
|---|----------------|------|--------|--|
| 1 | Key Press Code | A | 1 | Sends appropriate key code to host when keypad key is pressed. |



Keyboard Report

HID Keyboard Report Format

| | BIT7 | BIT6 | BIT5 | BIT4 | BIT3 | BIT2 | BIT1 | BIT0 |
|--------------|------------------|------------------|------------------|-------------|-------------|-------------|-------------|-------------|
| <i>Byte0</i> | <i>Right GUI</i> | <i>Right Alt</i> | <i>Right Sft</i> | Right Ctrl | Left GUI | Left Alt | Left Shift | Left Ctrl |
| <i>Byte1</i> | <i>Reserved</i> | | | | | | | |
| <i>Byte2</i> | Key_array[0] | | | | | | | |
| <i>Byte3</i> | Key_array[1] | | | | | | | |
| <i>Byte4</i> | Key_array[2] | | | | | | | |
| <i>Byte5</i> | Key_array[3] | | | | | | | |
| <i>Byte6</i> | Key_array[4] | | | | | | | |
| <i>Byte7</i> | Key_array[5] | | | | | | | |

For example if user has a 4 way keypad connected to encoder and configured for Arrow key. If the user now presses the top key, which is “up arrow” and USB code of 52. Then keyboard report sent to host would be:

Byte 0 – 0
 Byte 1 – 0
 Byte 2 – 52
 Byte 3 – 0
 Byte 4 – 0
 Byte 5 – 0
 Byte 6 – 0
 Byte 7 – 0

Now if the user customizes the top key to be “R SHIFT” (modifier) and USB code for “a” (04). If the user presses the top key, then the keyboard report sent to host would be:

Byte 0 – 20 This is Right Shift modifier.
 Byte 1 – 0
 Byte 2 – 52
 Byte 3 – 0
 Byte 4 – 0
 Byte 5 – 0
 Byte 6 – 0
 Byte 7 – 0



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