

FREE

Modular Programmable Keyboards



TECHNICAL OVERVIEW

Description and Application

FREE_TO_01.doc

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[**TIPRO®**]

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A. GENERAL INFORMATION

The FREE family comprises a range of **Keyboard Modules** in different sizes and matrix arrangements. Modules can be freely combined into different compositions, referred to as **Configurations**. Each configuration must incorporate one Tipro **Controller**. The controller provides interface (**USB** by default) to the host system (computer) and acts as a master of the Tipro Bus which electrically interconnects the modules. Selected keyboard modules can be complemented with so-called **Special Function Modules** that are divided into the following three groups: **Card Readers**, **Identifications Modules** and **Pointing Devices**. All FREE modules can also be combined with FREE+ touchmonitors and BeFREE touchcomputers.

A.1. Highlights

FEATURES

- ◆ modular and programmable
- ◆ wide range of keyboard modules in different sizes and matrix arrangements
- ◆ mechanical keys (Cherry MX or Omron B3F)
- ◆ ergonomic tactile feedback for frequent/intensive typing
- ◆ a selection of special function add-on modules
- ◆ various keycap sizes and colours
- ◆ customizable key inscriptions (pad printing) and contents/codes
- ◆ optional PS/2 + RS232 controller interface for legacy applications
- ◆ black (C15) or light grey (C10) housing colour
- ◆ robust and durable

APPLICATIONS

- ◆ Point of Sale keyboards (retail, hospitality, toll collection ...)

CONCEPT AND MODULARITY

- ◆ one (1) Controller and up to fourteen (14) Modules in a Configuration
- ◆ combinable with FREE+ and BeFREE modules
- ◆ open-standard interfaces
- ◆ supported by generic HID keyboard/mouse drivers
- ◆ versatile and upgradeable

PROGRAMMABILITY

- ◆ each key can be programmed with up to four (4) different contents (layers)

- ◆ enable/disable function for individual keys and key combinations
- ◆ different access levels protected by passwords (see Reference [2])
- ◆ all settings permanently stored in internal non-volatile memory of the controller

A.2. Technical Characteristics

ELECTRICAL

- ◆ **power supply:** 5V±5% (from primary USB interface)
- ◆ **current consumption:** depends on configuration
 - 80 mA_{TYP} (one keyboard module with integrated USB controller)
 - 15 mA_{TYP} (each additional module)

ENVIRONMENTAL

- ◆ **operating ambient temperature range:** 0°C to +40°C
- ◆ **storage ambient temperature range:** -10° C to +50°C
- ◆ **relative humidity range:** 20% to 80% (non-condensing)

A.3. Ordering Codes

Ordering codes of FREE configurations (combinations of at least one module and a controller) comprise the following fields/ letters:

1	2	3	4	5	6	7	8	9
T	M	C	-	K	R	I	P	M
C	-	K	R	I	P	M	C	V
-	C	15	-	x	x	x	-	x

The letters printed in boldface are mandatory. Others (positions 2, 3 and 4) are specified only if the respective modules are integrated into the configuration.

- 1** – Keyboard Module(s)
- 2** – Magnetic Card Reader(s)
- 3** – Identification Module
- 4** – Pointing Device
- 5** – Controller (**M**aster)
- 6** – Cable
- 7** – Various (e.g. side-covers)
- 8** – Housing Colour (**C15** black or **C10** light grey)
- 9** – Custom Version

Besides the ordering code for a configuration, each module can also be represented by its own ordering code. These ordering codes are described in the respective chapters below.

B. MODULES

B.1. Keyboard Modules

Keyboard modules exist in four different sizes: 32, 64, 96 and 128 keys. Keys are normally arranged into matrices with eight (8) rows (see Figure B.1). All keys are furnished with single keycaps and transparent keycap covers.

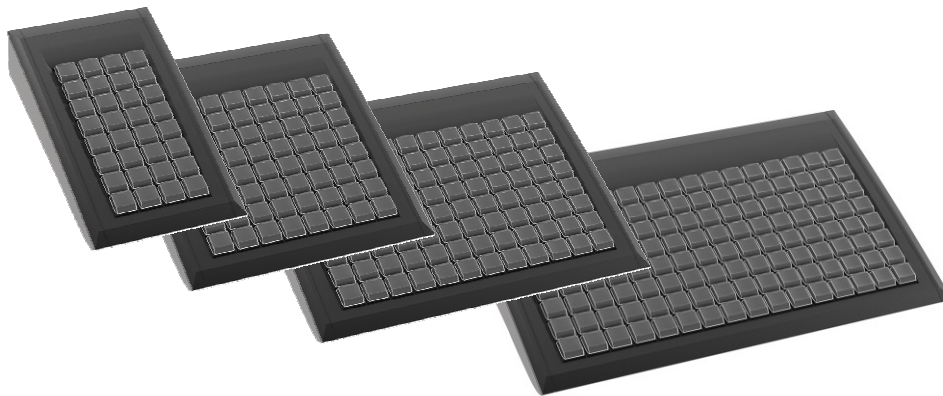


Figure B.1 Keyboard Modules with XY Matrix Layout (KMX)

A special key arrangement with a staggered Qwerty layout (in the lower five rows) is possible in the largest model (see Figure B.2). Standard layouts are German (DE) and US English (US). Other national/country layouts are available upon request.



Figure B.2 Keyboard Module with Qwerty Layout (KMQ)

Keyboard modules can be combined together into configurations, but only one of them shall incorporate the USB controller. All these keyboard modules utilize Cherry MX mechanical keyswitches with the long travel and an ergonomic force feedback suitable for

a frequent typing. Keycaps are available in different sizes (single, double horizontal, double vertical, quadruple) and colours.

The largest model (128 keys) exists also in a special variant (see Figure B.3) with a double protective membrane (lower for the keys, upper for the label sheet).



Figure B.3 Keyboard Module with Protective Membrane (KBX)

It utilizes Omron B3F mechanical keyswitches with the short travel and a high force feedback convenient for a typing through the membranes. This module is suitable for applications where easy cleaning or fast label exchange is required.

B.1.1. Factory Built-in Options

All keyboard modules with MX keys (KMX and KMQ) can optionally integrate an 8-position keylock (see Figure B.4 on the left) and/or a full-size touchpad (see Figure B.4 on the right) instead of 3x4 keys.



Figure B.4 Factory Built-In Options for Keyboard Modules

Technical details on the keylock and the touchpad can be found in the respective chapters further in the document.

B.1.2. Technical Characteristics

ELECTRICAL

- ◆ **power supply:** $5V \pm 5\%$ (from Tipro controller via Tipro bus)
- ◆ **power consumption:** $15 \text{ mA}_{\text{TYP}}$
- ◆ **control interface:** TIPRO bus
- ◆ **interface connectors:**
 - **left-hand side Tipro bus connector:** 6-pin Micro-MaTch header (male) at the end of a 100 mm long ribbon cable
 - **right-hand side Tipro bus connector:** 6-pin Micro-MaTch receptacle (female) on the PCB

MECHANICAL

- ◆ **casing:** plastic ABS
- ◆ **dimensions and weight:** see Figure B.5 and Table B.6
- ◆ **protection (sealing) grade:** IP 30 (according to EN 60529)

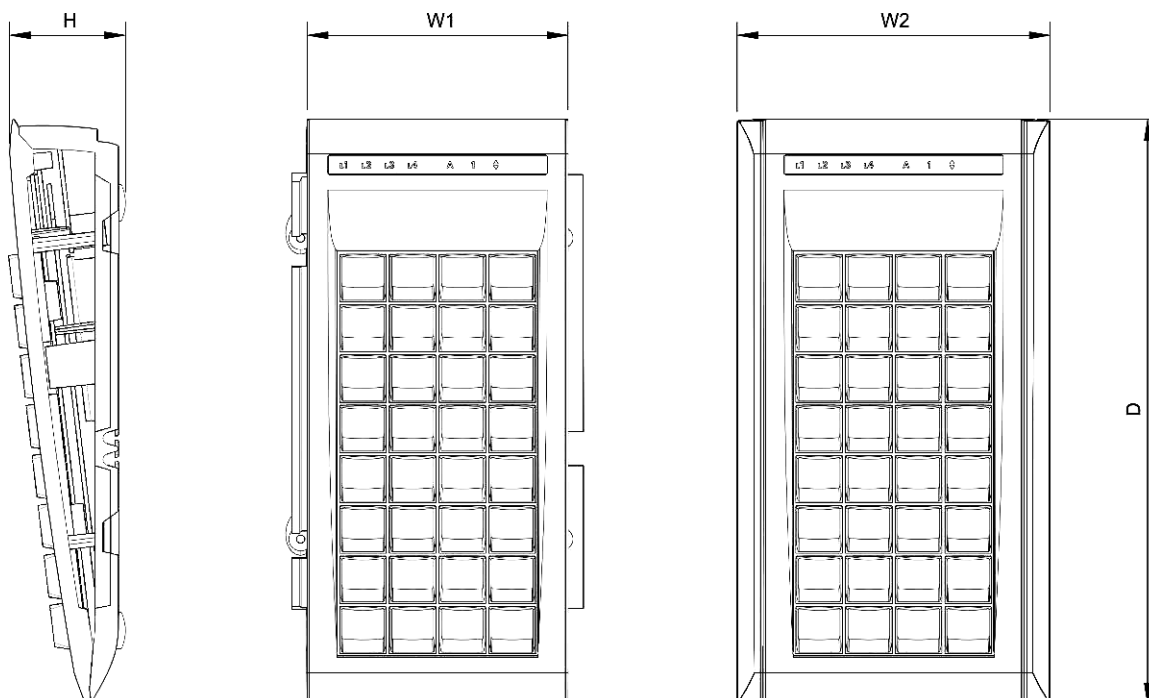


Figure B.5 Keyboard Modules – Physical Dimensions

Module	Number of Keys	Net Dimensions (W1×D×H) [mm]	Gross Dimensions (W2×D×H) [mm]	Net Weight [g]
TM-KMX-032A	32	100 × 222 × 44	120 × 222 × 44	350
TM-KMX-064A	64	176 × 222 × 44	196 × 222 × 44	650
TM-KMX-096A	96	252 × 222 × 44	272 × 222 × 44	900
TM-KMX-128A	128	328 × 222 × 44	348 × 222 × 44	1200
TM-KMQ-128A	119	328 × 222 × 44	348 × 222 × 44	1200

Table B.6 Keyboard Modules – Physical Dimensions

Each side cover adds approximately 10 mm to the width and 30 g to the weight of a module.

MECHANICAL KEYS (KMX & KMQ Modules)

◆ **keyswitch**

- model: Cherry MX
- actuation: linear
- key travel: 3.6mm to 4.0mm total, (2 ± 0.6) mm pre-travel
- actuating force: (60 ± 20) cN
- reliability (Mean Cycles To Failure): MCTF = 1 billion (10⁹) press/release cycles (50 million is guaranteed minimum)

◆ **keycaps**

- construction: separate body and cover
- size: single
- keycap bodies: CN15 black (if housing colour is black)
- keycap bodies: CN14 dark grey (if the housing colour is light grey)
- keycap covers: transparent

MECHANICAL KEYS (KBX Module)

◆ **keyswitch**

- model: Omron B3F-4005
- key travel: 0.3 ^{+0,2}/_{-0,1} mm
- lifetime: 1 million (10⁶) operations (minimal)
- Actuating force: 255 ± 69 cN

B.1.3. Ordering Codes

B.1.3.1. Keyboard Modules

1
2
3
4
5
6
7
8
 T M - K M X - 128 A - US - C15 - xxx

1 – Type

K – Keyboard Module

2 – Keyswitch Type

M : long-travel keyswitches (Cherry MX)

B : short-travel keyswitches (Omron B3F)

3 – Matrix Arrangement

X : xy matrix

Q : staggered qwerty layout (5 lower rows)

4 – Housing Size

032 – 32 keys

064 – 64 keys

096 – 96 keys

128 – 128 keys

5 – Module Type (Interface & Factory Built-in Options)

A : standard Tipro bus module

K: integrated 8-position keylock

T : integrated touchpad (instead of 3x4 keys)

6 – National / Country Alphanumeric Layout (used only with KMQ-128A module)

US – US English

DE – German

Other national / country layouts are available upon request.

6 – National / Country Numeric Layout (used only with KMX-032A module)

US – US English

DE – German

TEL – Telephony

Other national / country layouts are available upon request.

7 – Housing Colour

C15 – black

C10 – light grey

8 – Custom Version

Three-digit number reserved for product customizations. It is omitted in case of standard version.

B.1.3.2. Stand-Alone Versions (Configurations)

1 2 3 4 5 8 9
 T M C - K M C V - C 1 5 - x x x

1 – C – Configuration – Complete Device

2 – K – Keyboard Module (e.g. TM-KMX-128A)

3 – M – Integrated Controller (**M**aster) Module

4 – C – Interface Cable(s) Included

5 – V – Side Covers (End Caps) Included

6 – Housing Colour

C15 – black

C10 – light grey

7 – Custom version

Three-digit number reserved for product customizations. It is omitted in case of standard version.

B.2. Magnetic Card Readers

The card reader module retrieves information from a magnetic stripe card that is swiped through the reader. It reads all cards according to ISO7811 standard. Each track on the stripe can be identified through a programmable header and terminator. Besides that, there are two other programmable event descriptions for identifying successful/failed readings.



Figure B.7 Magnetic Stripe Card Reader

B.2.1. Technical Characteristics

ELECTRICAL

- ◆ **power supply:** $5V \pm 5\%$ (from Tipro controller via Tipro bus)
- ◆ **power consumption:** $15 \text{ mA}_{\text{TYP}}$

- ◆ **control interface:** TIPRO bus
- ◆ **interface connectors:**
 - **left-hand side Tipro bus connector:** 6-pin Micro-MaTch header (male) at the end of a 100 mm long ribbon cable
 - **right-hand side Tipro bus connector:** 6-pin Micro-MaTch receptacle (female) on the PCB

MECHANICAL

- ◆ **casing:** plastic ABS
- ◆ **net dimensions:** 54 x 222 x 52 (WxDxH) [mm]
- ◆ **weight:** 180 g (approximately)
- ◆ **protection (sealing) grade:** IP 20 (according to EN 60529)

MAGNETIC CARD READER

- ◆ **conformance standard:** ISO7811
- ◆ **card feeding speed:** 5 – 150 cm/s
- ◆ **card thickness range:** 0.18 mm – 0.84 mm
- ◆ **head operating life:** 1×10^6 with ISO7810/7811 conformed cards (typically)
- ◆ **stripe media coercivity range:** Lo-Co and Hi-Co

B.2.2. Ordering Codes

1
2
3
4
5
 T M - R C A - C 1 5 - x x x

1 – Type

R – Magnetic Card Reader

2 – Reader Type

A : ISO Tracks 1+2

C : ISO Tracks 1+2+3

3 – Module Type

A : Standard Module

4 – Housing Colour

C15 – black

C10 – light grey

5 – Custom Version

Three-digit number reserved for product customizations. It is omitted in case of standard version.

B.3. Identification Modules

Identification modules are intended for user identification. Two different types exist: the Keylock and the iButton Reader, both in the housing which can be connected only to the rightmost position in a configuration.



Figure B.8 Identification Modules

Two additional short travel keys are fully programmable and can be used for instance as LOG ON/LOG OFF keys.

The iButton reader incorporates a magnetized socket to firmly hold the iButton. When an iButton is placed in the socket, the reader sends its unique 64-bit registration number, preceded with a programmable header and followed by a programmable terminator. Upon the iButton removal the reader sends another programmable header-terminator pair. The reader is delivered with one DS 1990A iButton in an angled plastic fob.

The Keylock sends out a programmable code whenever the lock position is changed. The lock has 8 positions (S, 0-6), two of them (0 and 1) being key-removable. The module is delivered with a set of 7 different keys that have access to different positions.

B.3.1. Technical Characteristics

ELECTRICAL

- ◆ **power supply:** $5V \pm 5\%$ (from Tipro controller via Tipro bus)
- ◆ **power consumption:** $15 \text{ mA}_{\text{TYP}}$
- ◆ **control interface:** TIPRO bus
- ◆ **interface connectors:**
 - **left-hand side Tipro bus connector:** 6-pin Micro-MaTch header (male) at the end of a 100 mm long ribbon cable

MECHANICAL

- ◆ **casing:** plastic ABS

- ◆ **net dimensions:** 62×222×42 (W×D×H) [mm]
- ◆ **weight:** 120 g (approximately)

KEYLOCK

- ◆ **number of lock positions:** 8
- ◆ **step angle** (between the lock positions): 45° and 30°
- ◆ **number of key-removable lock positions:** 2
- ◆ **number of different keys in the set:** 7
- ◆ **lock operating life:** 25×10³ cycles

Key	if inserted in the lock position 0	if inserted in lock position 1
T	0, S	1
R	0, 1	0, 1
REG	0, 1, 2	0, 1, 2
X	0, 1, 2, 3	0, 1, 2, 3
P	0, 1, 2, 3, 4	0, 1, 2, 3, 4
S	0, 1, 2, 3, 4, 5, S	0, 1, 2, 3, 4, 5, S
MA	0, 1, 2, 3, 4, 5, 6, S	0, 1, 2, 3, 4, 5, 6, S

Table B.9 Keylock – Key Access Range

iBUTTON READER

- ◆ **socket operating life:** 1×10⁶ insertions/withdrawals
- ◆ **supported iButtons:** DS 1990A, DS 1992L, DS 1993L

B.3.2. Ordering Codes

1
2
3
4
5
 T M - I K A - C15 - xxx

1 – Type

I – Identification Module

2 – Device Type

K : Keylock

B : iButton Reader

3 – Module Type

A : Standard Module

4 – Housing Colour

C15 – black

C10 – light grey

5 – Custom Version

B.4. Pointing Devices

A trackball or touchpad can be used as an alternative for the classic mouse. The trackball is built into a housing which can be connected only to the rightmost position in a configuration. The touchpad can be integrated in a keyboard module instead of 12 keys (3 rows of 4 columns). This is a factory built-in option.

Both pointing devices emulate the mouse and require no specific drivers for operation.



Figure B.10 Pointing Devices

B.4.1. Technical Characteristics

ELECTRICAL

- ◆ **Interface:** USB
- ◆ **power supply:** $5V \pm 5\%$ (from Tipro controller via USB hub)
- ◆ **power consumption:**
 - Trackball : $26 \text{ mA}_{\text{TYP}}$
 - Touchpad : $11 \text{ mA}_{\text{TYP}}$
- ◆ **control interface:** USB
- ◆ **interface connectors:**
 - Trackball : USB A male at end of a cable to the Tipro Controller
 - Touchpad : internal USB cable to the Tipro Controller

MECHANICAL

- ◆ **trackball**
 - **casing:** plastic ABS
 - **net dimensions:** $62 \times 222 \times 42$ (W×D×H) [mm]
 - **weight:** 120 g (approximately)

◆ **touchpad**

- **casing:** plastic ABS
- **dimensions** (built into keyboard): 3 rows, 4 columns

TRACKBALL

- ◆ **size:** Ø16 mm
- ◆ **resolution:** 800 counts per revolution
- ◆ **lifetime:** 5×10^6 rotations
- ◆ **casing:** plastic ABS
- ◆ **ball material:** Phenolic (metal core)

TOUCHPAD

- ◆ **resolution:** 40 counts/mm
- ◆ **sample rate:** 100 samples/s
- ◆ **lifetime:** 1×10^7 strokes (500 km)

B.4.2. Ordering Codes

1
2
3
4
5
 T M - P B U - C 1 5 - x x x

1 – Type

P – Pointing Device

2 – Device Type

B : 16 mm trackBall

3 – Interface

U : USB

4 – Housing Colour

C15 – black

C10 – light grey

5 – Custom Version

Three-digit number reserved for product customizations. It is omitted in case of standard version.

The touchpad is a built-in option for keyboards. The ordering code can be found in the keyboard chapter.

B.5. Controller

The Tipro Controller is an integral part of any configuration. Each configuration requires one Controller. The controller provides USB interface to the host system (computer) and acts as a master of the Tipro Bus which electrically interconnects the modules. Therefore it acts as a communication bridge between the modules and the host system.

For legacy applications a controller with PS/2 and RS232 interface is also available upon request.

FEAUTURES

- ◆ integrated bus-powered USB hub with two downstream ports
- ◆ supported by generic drivers
- ◆ all keys freely programmable with enable/disable function
- ◆ implemented “Protect” function provides several access levels (security)
- ◆ programmable with ChangMe software
- ◆ status LEDs
 - Caps Lock
 - Num Lock
 - Scroll Lock
- ◆ four LEDs (L1 to L4) for layer indication

B.5.1. Technical Characteristics

ELECTRICAL

- ◆ **power supply:** $5V \pm 5\%$ (from USB upstream port)
- ◆ **power consumption:** 65 mA_{TYP}
- ◆ **primary interface:** USB
- ◆ **external interface connectors**
 - 1 x USB B receptacle (female) towards host
 - 2 x USB A receptacle (female) for downstream ports
 - 1 x Mini-DIN 5 female for external Tipro Bus Modules
- ◆ **inward communication interface:** Tipro Bus
- ◆ **internal interface connector:** 6-pin header (male)

MECHANICAL

- ◆ **dimensions:** integrated into keyboard module
- ◆ **weight:** 30 g (approximately)

CONTROLLER EEPROM:

- ◆ **capacity** : 64kB
- ◆ **endurance** : 1 million write/erase cycles
- ◆ **data retention** : 100 years

B.6. Side Covers

Left and Right Side Cover (also referred to as End Caps) are needed to close a configuration on the respective sides. They are automatically included when ordering a configuration, but not when a module is ordered.

MECHANICAL:

- ◆ **casing**: plastic ABS
- ◆ **colour**: black (C15) or light grey (C10)
- ◆ **net dimensions**: 10×222×42 (W×D×H) [mm]
- ◆ **weight**: 30 g (approximately)

B.7. Interface Cable

The necessary cable is included in the configuration. It is normally a USB cable. In case of legacy applications with PS/2+RS232 controller the configuration is furnished with the appropriate cable.

USB CABLE

- ◆ **length**: 2.5 m
- ◆ **controller side connector**: USB B plug (male)
- ◆ **host side connector**: USB A plug (male)

C. REFERENCES

1. “ChangeMe” – User’s Manual
2. “Protect Function” – Application Note

D. NOTICES

D.1. Disclaimer

Information furnished by Tipro is believed to be accurate and reliable. However, Tipro makes no representations or warranties regarding the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice.

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