

BeFREE 07

7” Touchcomputer with InterCom and Handset



TECHNICAL OVERVIEW

Description and Application

BeFREE07_TO_1_0.docx

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[**TIPRO**]

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A. GENERAL INFORMATION

The **BeFREE 07** (BF 07) is a member of the modular **FREE** (also referred to as FREE/FREE+/BeFREE) product family, integrating a 7" touchmonitor, a computer, an intercom device and a Handset. The touchmonitor comprises a wide-screen, wide viewing angle TFT LCD and 5-wire resistive touchscreen. The computer is based on a main-board with Intel dual-core Celeron processor (**N3350**) and a solid state disk. Thanks to low-power components and the corresponding electronic and thermal design the BeFREE 07 is completely silent and without moving parts.

The Intercom section consists of a goose-neck microphone, illuminated PTT key, stereo loudspeakers, volume control knob and VU-meter. Its audio interface is USB. Status of the PTT key is reported via HID Keyboard and/or HID Telephony interface. The same is applicable to the 6 line keys under the touchscreen.

The Handset shares the same audio codec as the Intercom and –by default- has priority: When the Handset is picked up, the audio is automatically routed to the handset and the Intercom is disabled.

A.1. Highlights

FEATURES

- ◆ space-saving integration of a fanless touchcomputer, an intercom and a handset
- ◆ modular – combinable with other **FREE** modules into multifunctional terminals
- ◆ low-profile horizontal design
- ◆ silent and reliable - no moving parts, industrial grade components.
- ◆ cable management – hidden and secured, but accessible
- ◆ built-in Tipro controller enables:
 - modularity and programmability
 - touchscreen disable/enable control
 - six programmable keys
 - optional dailpad on Handset
- ◆ stereo loudspeakers (2 x 2W) with volume control encoder
- ◆ total 4 W output power
- ◆ goose-neck microphone with illuminated PTT key
- ◆ three-colour bar-graph display
- ◆ mechanical key-switch inside the encoder for bar-graph control
- ◆ several LED indicators (power, SSD, microphone, speakers, handset status, touchscreen ...)

- ◆ optional Inclination Mechanism (VESA 75)
- ◆ optional Dialpad for the Handset
- ◆ optional Echo-canceller

A.2. Technical Characteristics

ELECTRICAL

- ◆ **power supply:** 12V ± 5% (from an external AC/DC adapter)
- ◆ **power consumption:**

Operating Mode	Typical	Maximal
OFF (power saving)	1.0 W	TBD
SLEEP (Windows standby)	1.0 W	TBD
IDLE	9.0 W	TBD
ACTIVE	16.5 W	24.0W

Note 1: Values in the table above are temporary approximations of typical consumption, obtained by measurements at the 12 V power input of the BeFREE 07 (LCD at full brightness) without any additional Tipro modules and without any other peripherals connected. Terminology for Operating Modes is taken from “ENERGY STAR Program Requirements for Computers: Version 7.1”.

- ◆ **internal interface and power connectors** (to provide for modularity):
 - **left-hand side Tipro Bus connector:** 6-pin Micro-MaTch header (male) at the end of a 6-wire ribbon cable
 - **right-hand side Tipro Bus connector:** 6-pin Micro-MaTch header (male) at the end of a 6-wire ribbon cable
- ◆ **external interface and power connectors** (to provide for external expansions):
 - **standard computer interfaces:** LAN, USB, HDMI (see Chapter B.6 for details)

MECHANICAL

- ◆ **casing:** plastic ABS, black (C15) colour
- ◆ **gross dimensions** (with side-covers): 332 x 278 x 113 (W x D x H) [mm]
- ◆ **goose-neck microphone length/height:** 350±50mm
- ◆ **weight:** 3.4 kg (approximately)
- ◆ **protection (sealing) grade:** IP 20 (according to EN 60529)

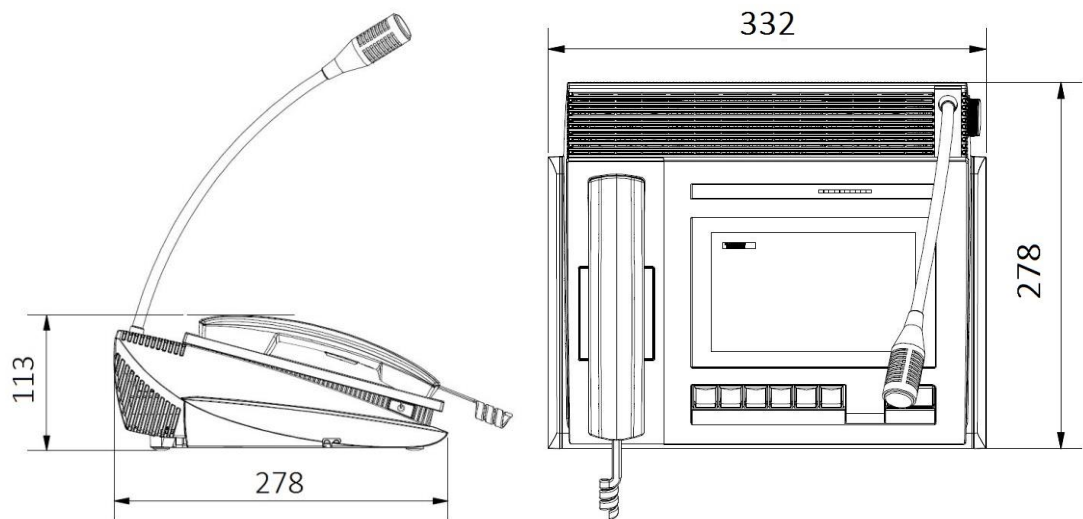


Figure A.1 Physical Dimensions

ENVIRONMENTAL

- ◆ **operating ambient temperature range:** +5°C to +35°C
- ◆ **storage ambient temperature range:** -10°C to 50°C
- ◆ **relative humidity range:** 20% to 80% (non-condensing)

EMBEDDED COMPUTER

- ◆ **Processor (SoC)**
 - Intel Celeron N3350 1.1 GHz (2.40 GHz burst frequency)
- ◆ **Chipset**
 - Northbridge functionality integrated in the SoC
 - Southbridge functionality integrated in the SoC
- ◆ **System Memory**
 - 4GB DDR3L - 1866 (default)
- ◆ **Video**
 - graphic processor integrated in the SoC
 - dual independent display support
 - resolution: up to 3840 x 2160
- ◆ **Ethernet:**
 - Intel® Gigabit Ethernet i210AT
- ◆ **Mass Storage**
 - **type:** Solid State Disk
 - **technology:** Multi-Level Cell (MLC) NAND
 - **interface:** SATA II - 3 Gb/s
 - **form factor:** mSATA
 - **capacity:** 32 GB (default)

DISPLAY

- ◆ **type:** TFT LCD
- ◆ **size:** 7" diagonal
- ◆ **aspect ratio:** 15:9
- ◆ **native resolution:** 800 × 480
- ◆ **luminance/ brightness (typical):** ≥ 400 cd/m²
- ◆ **contrast ratio (typical):** ≥ 500:1
- ◆ **backlight lifetime (typical):** ≥ 35,000 hours

TOUCHSCREEN

- ◆ **technology:** 5-wire resistive (ELO)
- ◆ **positional accuracy:** 2.03 mm (standard deviation of error)
- ◆ **positional accuracy:** ± 4.572 mm (maximum error)
- ◆ **touch activation force:** < 113 g (typically)
- ◆ **controller resolution:** 4096 x 4096 touch points
- ◆ **light transmission:** 80 ± 5 % (at 550 nm wavelength)
- ◆ **lifetime:** 35 x 10⁶ touches in one location

AUDIO SECTION (INTERCOM)

- ◆ **Loudspeakers (Left / Voice and Right / Alert)**
 - two in parallel within the left output
 - two in parallel within the right output
 - type: dynamic
 - rated power: 3 W
 - output sound pressure level (SPL): 78 dB ± 3 dB @ 1 W @ 1 kHz @ 1.0 m distance
- ◆ **Goose-neck Microphone**
 - type: electret condenser, unidirectional
 - max input: 120 dB SPL
- ◆ **Analogue Amplifiers**
 - designed to meet wide-band IP telephony standards
 - frequency pass-band: (100 Hz - 8 kHz) TYP
 - output power: 4 W (2 x 2 x 1 W)
- ◆ **USB Audio Codec**
 - model: Texas Instruments PCM 2902C
 - USB Interface: full-speed, USB 2.0 compliant, certified by USB-IF
 - resolution: 16-bit Delta-Sigma ADC and DAC
 - sampling rates (ADC): 8, 11.025, 16, 22.05, 32, 44.1, 48 kHz
 - sampling rates (DAC): 32, 44.1, 48 kHz
 - recommended data format: **16-bit** (rather than 8-bit), **stereo** (rather than mono)

MECHANICAL KEYS AND REED SWITCHES

- ◆ **Handsfree Push To Talk Key** (two key-switches in parallel) **and 6 Line Keys**
 - model: Cherry MX
 - key travel: 3.6mm to 4.0mm total, (2 ± 0.6) mm pretravel
 - actuating force: (60 ± 20) cN
 - reliability (Mean Cycles To Failure): MCTF = 1 billion (10^9) press/release cycles (50 million is guaranteed minimum)
- ◆ **Keycaps of Line Keys** (user replaceable)
 - construction: separate body and cover (allows for paper key legends)
 - size: single (by default) or double (as an option)
 - keycap bodies: CN15 black colour
 - keycap covers: transparent
- ◆ **Handset PTT/ PTM key (two keyswitches in parallel)**
 - model: Cherry ML
 - key travel: 2.5 mm to 3.0mm total
 - actuating force: (45 ± 20) cN
 - reliability (Mean Cycles To Failure): MCTF = 1 billion (10^9) press/release cycles (20 million is guaranteed minimum)
- ◆ **Hook switch (reed switch)**
 - reliability (Mean Cycles To Failure): MCTF = 500 million (5×10^8) switching cycles (20 million is guaranteed minimum)
- ◆ **OPTIONAL: Dailpad - keyswitch**
 - model: Cherry ML
 - key travel: 2.5 mm to 3.0mm total
 - actuating force: (45 ± 20) cN
 - reliability (Mean Cycles To Failure): MCTF = 1 billion (10^9) press/release cycles (20 million is guaranteed minimum)
- ◆ **keycaps**
 - construction: separate body and cover
 - size: single
 - keycap bodies: CN15 black colour
 - key legends: printed on the keycap bodies
 - keycap covers: transparent
 - user-customizable key legends/pictograms (to be printed on a thin paper and put underneath the keycap covers)

B. INTEGRAL PARTS AND FUNCTIONALITY

BeFREE 07 represents an integration of a touchmonitor (display with touchscreen), a computer, an intercom, a handset and a controller.



Figure B.1 Operator Interface of BeFREE07

B.1. Operator Interface

The **Stripe** (see Figure B.2 below) is an ergonomically designed horizontal area along the top side of the display. It comprises a number of visual indicators to provide the operator with a quick insight.

The **Line Keys** (see Figure B.3) consist of six mechanical keys (long-travel) aligned below the display. Key content is programmable. Using double keycaps the Line Keys can be reconfigured into 3 double keys or a combination of single and double keys as per user preferences. Users can make their own paper legends and apply them.

The most prominent position is assigned to the PTT key, which consists of two long-travel mechanical key-switches and a large actuator with background illumination.









	Power	Blue / Red	OFF: No power supply connected Red: OFF (standby) Blue Continuous: ACTIVE (operating)
	Disk	Blue	Blinking indicates read/write activity of SSD
	Touchscreen	Red	Illuminated when touchscreen is disabled
	Bar-Graph Display		Green: loudspeakers volume level Red: VU-meter (actual signal level at the loudspeakers and the microphone) Orange: Handset speaker volume
	Handset LED	Green /Red	Handset Hook and Mute status; configurable. Default: OFF: Handset on hook Red: Handset off hook Green: Handset off hook and Handset microphone muted
	Microphone LED	Red	Illuminated (red) while the handsfree microphone is active (enabled).

Figure B.2 The Stripe (Indicators)



	6 x Line Key	Programmable key
	PTT (Push To Talk) Key	By default PTT, but can be set to PTM (Push To Mute) or any other key event. Blue backlight can be programmed to blink or turn ON/OFF upon press/release.

Figure B.3 Line Keys and PTT Key

B.2. Touchmonitor

The touchmonitor comprises a high-brightness, wide viewing angle TFT LCD and a touchscreen. The display is connected to the embedded computer via LVDS interface. The touchscreen is operated by the respective controller with USB interface to the embedded computer.

B.3. Embedded Computer

BeFREE 07 incorporates an industrial grade single-board computer, which operates the embedded touchmonitor and provides for connectivity to enable various external peripherals to be used along (see Chapter B.6 for more details). It is internally connected to the Tipro Controller (via USB) as well as with the Audio Section / Subsystem (via USB).

The computer is based on Intel's integrated circuits, what enables a wide-range of operating systems to be applied. A solid state disk is used as a mass storage device. The heat generated by integrated circuits is transferred to an internal heat-sink, without a fan. As a result the BeFREE 07 is completely silent in operation, without moving parts.

B.4. Intercom (Audio Section)

The functional block diagram of the audio section is shown in Figure B.4 below. Left (Voice) and Right (Alert) Speaker are physically/electrically realized as two loudspeakers in parallel to double the output volume.

Internal signal processing includes analogue-to-digital and digital-to-analogue conversion (block "USB AUDIO CODEC"), conditioning (amplification, attenuation, filtering ...), sensing and switching. The complete processing is programmable via ChangeMe software and can be dynamically modified during the operation in so-called On-Line operating mode (using HID API). The Echo-Cancellation circuitry is optional (see Chapter D.3 for more details).

B.4.1. Audio Switching

By default the audio input and outputs are routed to the Intercom / Handsfree Speakers and Gooseneck microphone.

When the handset is lifted off-hook, the audio channels automatically switch to the handset. It can be configured if both channels switch; Left and Right, or just Left / Voice.

This default behaviour of switching when the handset is lifted can be modified in ChangeMe.

Switching can also be controlled by the Application Software using Tipro's HID API. See reference [7] (“HID API Reference Manual”) for more details.

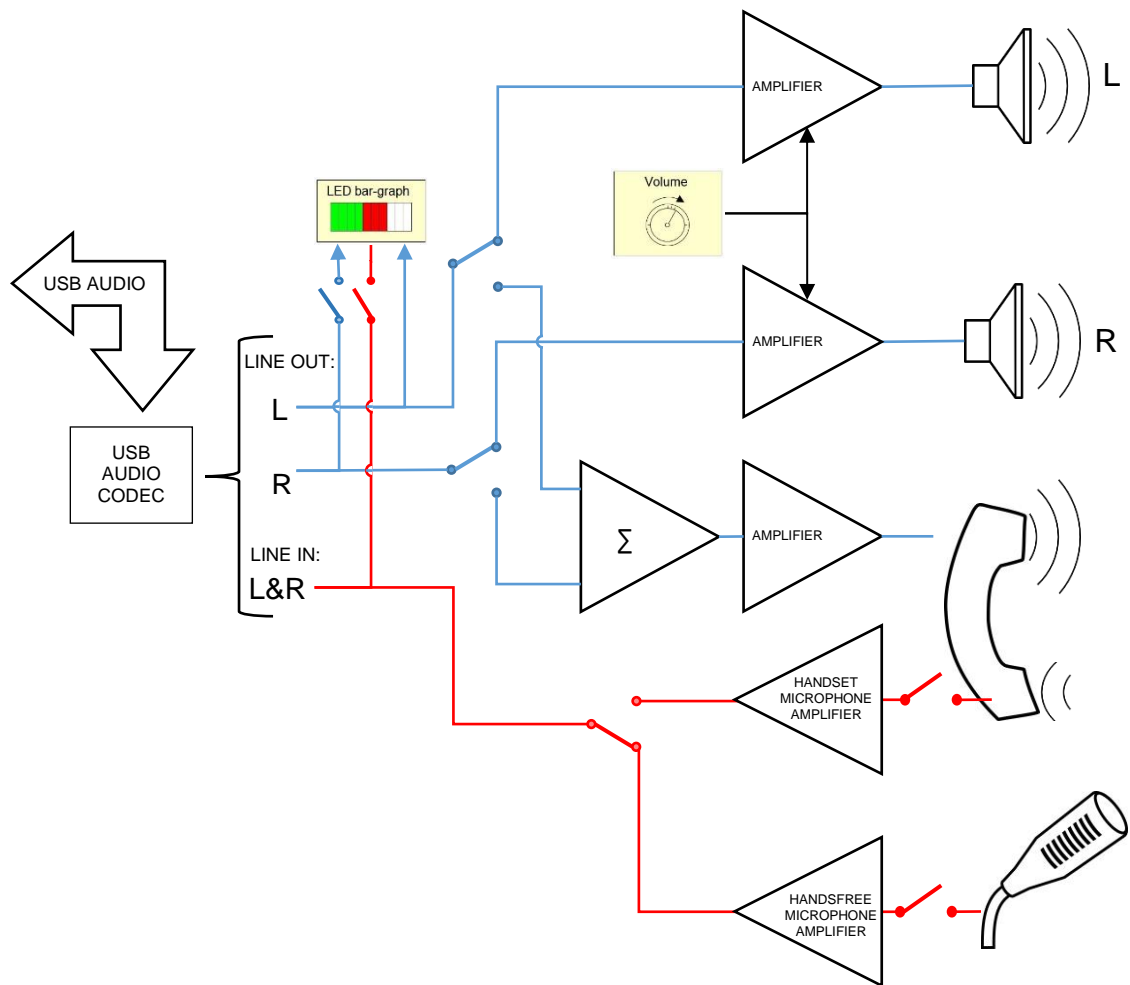


Figure B.4 Audio Section

B.4.2. Handsfree Microphone Amplifier

This is a logarithmic audio amplifier with programmable gain, noise gating threshold and compression ratio. The noise gating feature enables ambient noise to be suppressed. All sounds below the threshold are removed inside the amplifier, so with higher threshold the microphone needs to be used closer to the mouth and speech needs to be louder to get through the amplifier. The compression feature enables compression of the output signal dynamics in order to minimize the difference between soft/low and loud speech. The amplifier is also capable of limiting extremely loud speech thus preventing distortion and popping. The overall gain can be even lower than one (i.e. attenuation) as well as equal to

zero (i.e. totally muted input). Also the range of the goose-neck microphone can be adjusted.

B.4.3. Hands-Free Speaker Amplifier

This is a linear audio power amplifier with programmable gain that drives the Voice (Left) Speaker. The gain of this amplifier (i.e. volume of the Voice Speaker) can be adjusted by the user in normal operation via the incremental encoder (i.e. endless digital potentiometer) at the rear right-hand side of the module. The selected level is immediately displayed at the bar-graph display in green colour (20 volume levels + mute). The amplifier can deliver up to 2 W (2 x 1 W) of electric power to the Voice Speaker.

B.4.4. Alarm/Alert Amplifier

This is a linear audio power amplifier with programmable gain that drives the Alert (Right) Speaker. The gain of this amplifier is normally equal to the gain of the Hands-Free amplifier, but it can also have a separate response characteristic to the position of the incremental encoder. This way, for instance, the Alert Speaker can be held at a constant volume level while increasing/decreasing volume level at the Voice Speaker. The amplifier is capable of delivering up to 2 W (2 x 1 W) of electric power to the Alert Speaker.

It is also possible to obtain completely independent volume adjustments of the Alert Speaker (see Chapter B.4.6).

B.4.5. Bar-Graph Display

It comprises 10 dual-colour (red / green) LEDs. By default it constantly operates as VU meter in red colour, showing actual level of the left output signal and the level of the microphone signal. Optionally, the microphone signal can be disconnected from the VU meter. It is also possible to add the right output signal, so the VU meter displays the sum of left and right outputs.

If a rotation of the incremental encoder has been detected it automatically displays the gain of the Hands-Free Amplifier in green colour.

If the Handset speaker volume is changed, e.g. by key press, the volume is shown in orange.

B.4.6. Incremental Encoder

This is an endless digital potentiometer used for immediate volume control of the Voice and Alert Speakers. It has 24 detents per revolution. Every single detent changes the volume for one step up or down, but only every second one is represented by one LED in the Bar-Graph display in green colour.

B.5. Handset

B.5.1. Handset Microphone Amplifier

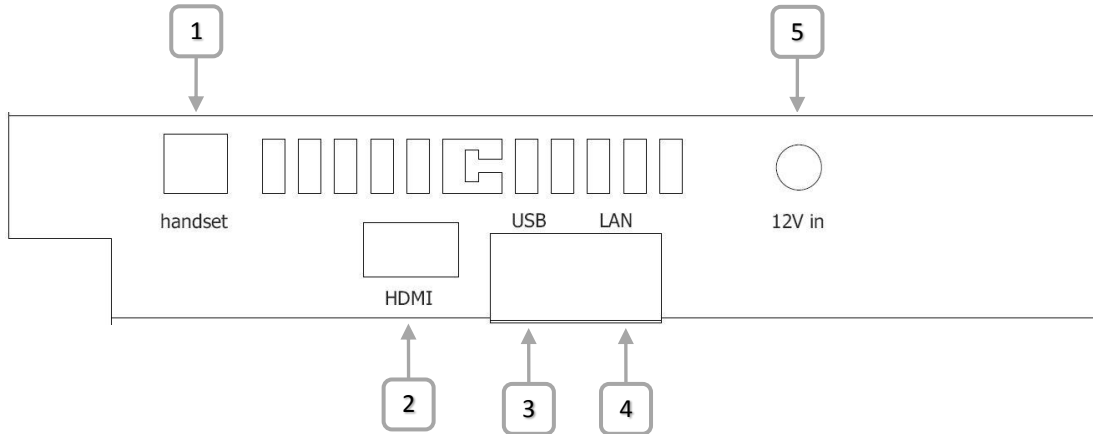
The microphone amplifier is a logarithmic audio amplifier with programmable gain, noise gate threshold and compression ratio. The noise gating feature enables ambient noise to be suppressed. All sounds below the threshold are removed inside the amplifier, so with a higher threshold the microphone needs to be used closer to the mouth and speech needs to be louder to get through the amplifier. The compression feature enables compression of the output signal dynamics in order to minimize the difference between soft/low and loud speech. The amplifier is also capable of limiting extremely loud speech thus preventing distortion and popping. The overall gain can be even lower than one (i.e. attenuation) as well as equal to zero (i.e. totally muted input).

B.5.2. Handset Loudspeaker Amplifier

The loudspeaker amplifier is a linear audio amplifier with differential output, programmable gain and limiting circuitry to prevent an acoustic shock. It drives the loudspeaker inside the handset with a signal which is a composition of the output signal (USB audio data stream received from the computer and converted by Digital-to-Analogue Converter inside the USB Codec chip) and a part of the microphone signal (so-called side-tone).

B.6. External Connectors

Connections for external devices are available at the Connector Plate (see Figure B.5) from underneath the module. Most of them are standard interfaces (USB, LAN, HDMI) intended for users to apply freely.



#	Designator	Type	Note
1	HANDSET	RJ 6P/6C socket	reserved
2	HDMI	HDMI type-A female	External Display
3	DUAL USB	2 × USB type – A	Super Speed
4	LAN	RJ 8P/8C (RJ 45)	1 Gb Ethernet
5	12V Input	DC power conn. 5.5mm OD / 2.1mm ID	reserved

Figure B.5 Connector Plate

C. OPERATION

C.1. Configuring BeFREE 07

The BeFREE 07 is a rather complex device with a number of programmable settings/parameters provided for users to configure in accordance to the particular application. To enable that feature Tipro supplies the respective programming utility (**ChangeMe**) which operates only under Windows operating systems. It assists users to define their own set of parameters, save them into a file (for possible replication in the future) and program into non-volatile memory of the Tipro controller for permanent storage.

It is also possible to dynamically modify certain settings (e.g. LED indicators, touchscreen disable/enable for cleaning purposes ...) from the application software. For that purpose Tipro provides the respective Windows API (**HID API**) and the associated documentation.

D. OPTIONS

D.1. Inclination Mechanism

BeFREE 07 can be fitted with an Inclination Mechanism (also referred to as Angle Adjustment Mechanism). Normally, the display surface of BeFREE 07 is inclined for 15° against the horizontal plane. The mechanism enables gradual adjustment of the angle from approximately 30° to 70° .

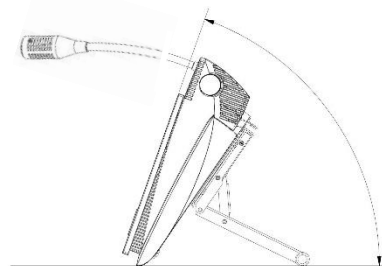


Figure D.1 BeFREE 07 with Inclination Mechanism (VESA 75)

D.2. HID Telephony Interface

Actual status (pressed/released) of the PTT key is normally reported as a programmable sequence of keystrokes generated by a standard USB keyboard, this way emulating a generic HID Keyboard Device. An example of the application can be found in Reference [9] (“Hook and PTT in Software”).

Additionally or alternatively, the PTT and Line Keys status can be reported via HID Telephony Interface, which is an integral part of the BeFREE 07. See reference [10] (“HID Telephony Interface”) for more details.

D.3. Echo-Cancellation Circuitry

Acoustic echo is a physical phenomenon inherent to hands-free devices (such as Intercom) in full-duplex mode, so it needs to be suppressed and/or cancelled. This is normally implemented in the application software through the specific signal processing routines. Alternatively, it can be achieved in the hardware using a digital signal processor. Basic properties of the optional (see Chapter E.1 for details on the respective Ordering Code) Echo-Cancellation circuitry are listed below.

- ◆ **performance:** full-duplex
- ◆ **sampling rate:** 16 kHz
- ◆ **acoustic echo-cancellation:** ≥ 40 dB
- ◆ **latency:** ≤ 10 ms

Reference signal for the canceller is taken from the Voice Speaker. Optionally, the reference can be signal at the Alert Speaker as well as the sum of signals at both speakers.

D.4. Optional Intergated Dialpad

The handset can optionally incorporate a Dial-Pad with 12 mechanical keys to provide for more ergonomic dialling. The keys are programmable in the same way as the PTT key and the Hook switch.

D.5. Goose-Neck Microphone

By default, the goose-neck microphone is an integral part of the BeFREE 07, but it can be optionally omitted. See Chapter E.1 for details on the respective Ordering Code.

E. ORDERING CODES

E.1. BeFREE 07

1 2 3 4 5 6 7 8 9 10 11 12
BF 07 - NC B - R U A - 0 0 0 - C15 - xxx

1 – Module Type

BF – BeFREE (touchcomputer) module

2 – Model

07 : Integrated Intercom, Handset, 7” LCD

3 – Embedded Computer

NC : Compact board, Dual Core Celeron N3350

4 – Version & Connectivity

B : 4 GB RAM; 32 GB SSD (default)

C : 8 GB RAM; 32 GB SSD

E : 4 GB RAM; 64 GB SSD

F : 8 GB RAM; 64 GB SSD

5 – Touchscreen Technology

R : ELO Resistive (zero-bezel)

6 – Integrated Audio Options

U : USB Speakerbox functionality

C : USB Speakerbox functionality with Echo-Cancellation Circuitry

V : USB Speakerbox functionality without goose-neck microphone

7 – Integrated Handset

A : Handset shares USB audio codec with Intercom

8 – Integrated Options

0 : Reserved

9 – Integrated Options - Dialpad

0 : without Dialpad

K : with integrated Dialpad

10 – Integrated Options

0 : Reserved

11 – Housing Colour

C15 : black (C15) This part of the code is not mandatory if the colour is C15, what is a default.

12 – Custom Version

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

Note 1: BeFREE 07 requires 12V_{DC} power supply to operate (see Chapter A.2). The respective AC/DC adapter is included in the packaging, along with the EU power cord.

E.2. Inclination Mechanism

1 2 3 4 5
TM - S U A - C15 - xxx

1 – Accessory Type

S – Mechanical Support mechanism (Inclination Mechanism)

2 – Mechanism Type

U : Universal

3 – Adapter Type

A : All BeFREES

4 – Colour

C15 : black

This part of the code is not mandatory if the colour is C15, what is a default.

5 – Custom Version

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

F. REFERENCES

1. “BeFREE 22” – Technical Overview
2. “BeFREE 20” – Technical Overview
3. “BeFREE 10” – Technical Overview
4. “HANDSET” – Technical Overview
5. “SPEAKERBOX” – Technical Overview
6. “ChangeMe” – User’s Manual
7. “HID API” - Reference Manual
8. “Modularity Demystified” – “Dispatching Hints & Tips” White Paper – Issue No. 001
9. “Hook & PTT in Software” – “Dispatching Hints & Tips” White Paper – Issue No. 004
10. “HID Telephony Interface” – “Dispatching Hints & Tips” White Paper – Issue No. 005

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