BeFREE 20

15.0" Touchcomputer with InterCom

TECHNICAL OVERVIEW

Description and Application

BeFREE20_TO_1_3.doc

Version 1.3 (hardware version 2.0)

November 18, 2019

TIPRO

TABLE OF CONTENTS

A. GENERAL INFORMATION

The **BeFREE 20** (BF 20) is a member of the modular **FREE** (also referred to as FREE/FREE+/BeFREE) product family, integrating a 15.0" touchmonitor, a computer and an intercom device. It is compatible and combinable with all existing **FREE** modules. The touchmonitor comprises a high-brightness, ultra-wide viewing angle TFT LCD and 5-wire resistive touchscreen. The computer is based on a main-board with Intel quad-core Celeron processor (**J1900**) and a solid state disk. Thanks to low-power components and the corresponding electronic and thermal design the BeFREE 20 is completely silent and without moving parts.

The Intercom section consists of a goose-neck microphone, illuminated PTT key, stereo loudspeakers, two volume control knobs, two VU-meters. Its primary audio interface is USB via two independent Audio Codecs, but it is also connected to the analogue sound card of the embedded computer as well as to the externally available connectors. This triple interface results in up to eight listening (output) channels and four parallel recording (input) channels. Status of the PTT key is reported via HID Keyboard and/or HID Telephony interface.

A.1. Highlights

FEATURES

- ♦ space-saving integration of a fanless touchcomputer and an intercom
- ♦ modular – combinable with other **FREE** modules into multifunctional terminals
- ♦ low-profile horizontal design
- ♦ silent and reliable - no moving parts, industrial grade components, Ethernet redundancy, redundant internal audio and controller interfaces
- ♦ extensive connectivity (LAN, USB, COM, external display, digital inputs)
- ♦ analogue audio connectivity (Line-In, Line-Out, Mic-In, Intercom-In, Intercom-Out)
- ♦ cable management – hidden and secured, but accessible
- ♦ built-in Tipro controller enables:
    - ➢ modularity and programmability
    - ➢ energy saving modes
    - ➢ touchscreen disable/enable control
    - ➢ brightness adjustment
    - ➢ 6 programmable keys
    - ➢ two programmable digital inputs (e.g. for an external PTT switch/pedal)
- ♦ stereo loudspeakers (2 x 2W) with two separate volume control encoders

- ♦ additional low-frequency loudspeaker (1 x 3W) with programmable equalizer
- ♦ total 7 W output power generates sound pressure level (SPL) of approximately 96 dB at 1.0 m distance, what is approximately 35 times louder than average conversation
- ♦ goose-neck microphone with illuminated PTT key
- ♦ dual three-colour bar-graph display
- ♦ five mechanical keys for brightness control, volume adjustment and other functions
- ♦ several LED indicators (power, SSD, microphone, touchscreen ...)
- ♦ optional Inclination Mechanism (VESA 75)

APPLICATIONS

- ♦ operator/dispatcher terminals/consoles for command and control centres in:
    - ➢ transport and traffic control (railways, air traffic …)
    - ➢ public safety (police, fire brigades, ambulance …)
    - ➢ utilities (electricity, gas ...)
    - ➢ building/facility management systems (airports, banks, industrial plants …)
- ♦ trading and banking consoles
- ♦ multifunctional control panels

A.2. Technical Characteristics

ELECTRICAL

- ♦ **power supply**: $12 V \pm 5\%$ (from an external AC/DC adapter)
- ♦ **power consumption**:

Operating Mode	Typical	Maximal
OFF (power saving)	0.2W	TBD
SLEEP (Windows standby)	3.0W	TBD
IDLE	18.0W	TBD
ACTIVE	23.0W	34.0W

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 20 (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 5.0".

- ♦ **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

TIPRO

> ➢ **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, COM, VGA … (see Chapter B.5 for details)

MECHANICAL

- ♦ **casing**: plastic ABS, black (C15) colour with matte black (C25) top part
- ♦ **gross dimensions** (with side-covers): 440 x 342 x 111 (W x D x H) [mm]
- ♦ **goose-neck microphone length/height**: 350±50mm
- ♦ **weight**: 6.1 kg (approximately)
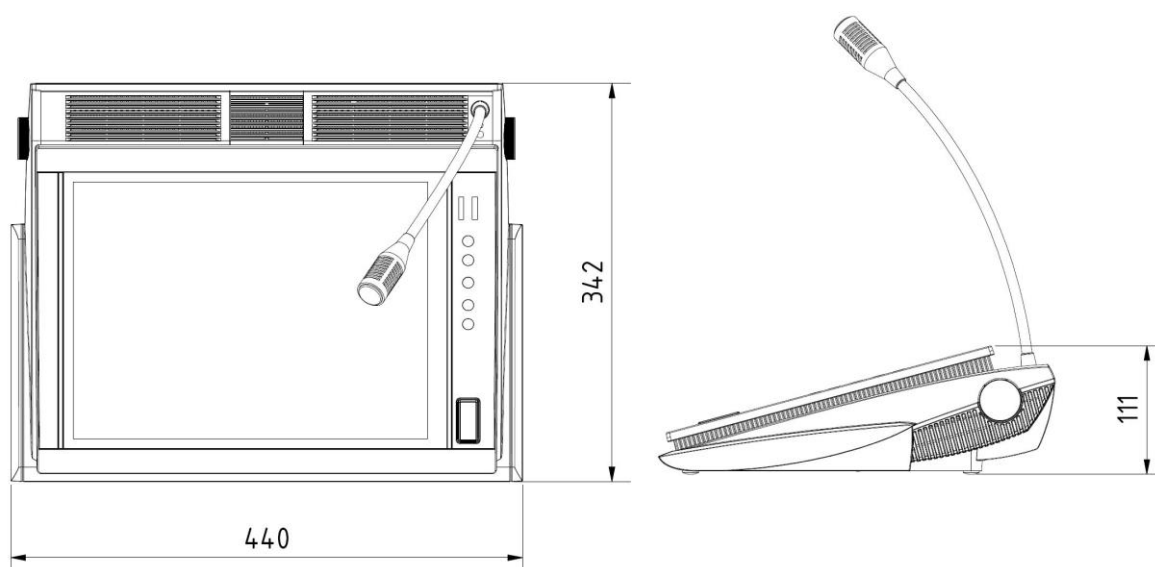- ♦ **protection (sealing) grade**: IP 20 (according to EN 60529)

Figure A.1   Physical Dimensions

ENVIRONMENTAL

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

EMBEDDED COMPUTER

- ♦ **Processor (SoC)**
  - ➢ Intel Celeron J1900 2.0 GHz (2.42 GHz burst frequency)

♦ **Chipset**
  ➢ Northbridge functionality integrated in the SoC
  ➢ Southbridge functionality integrated in the SoC

♦ **System Memory**
  ➢ 4GB DDR3L - 1333

♦ **Video**
  ➢ graphic processor integrated in the SoC
  ➢ dual independent display support
  ➢ resolution: up to 2560 x 1600

♦ **Dual Ethernet**:
  ➢ 2 x Intel I211, 10/100/1000 Base-TX

♦ **Audio**
  ➢ Analogue Line In, Line Out and Mic-In (internally connected to Intercom and/or externally available – see Chapter B.5)

♦ **Mass Storage**
  ➢ **type:** Solid State Disk
  ➢ **technology**: Multi-Level Cell (MLC) NAND
  ➢ **interface**: SATA II - 3 Gb/s
  ➢ **form factor**: 2.5"
  ➢ **capacity**: ≥ 120 GB

DISPLAY
  ♦ **type**: TFT LCD
  ♦ **size**: 15.0" diagonal
  ♦ **aspect ratio**: 4:3
  ♦ **native resolution**: 1024×768 (XGA)
  ♦ **luminance/ brightness** (typical): ≥ 400 cd/m^2
  ♦ **contrast ratio** (typical): $\geq 500{:}1$
  ♦ **backlight lifetime** (typical): $\geq 50{,}000$ hours

TIPRO

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 10^6 touches in one location

AUDIO SECTION (INTERCOM)

- ♦ **Loudspeakers (Left and Right)**
  - ➢ 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

- ♦ **Loudspeaker (Central)**
  - ➢ type: dynamic
  - ➢ rated power: 4 W
  - ➢ output sound pressure level (SPL): 79 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: 7 W (2 x 2 x 1 W + 1 x 3 W)

- ♦ **USB Audio Codecs**
  - ➢ model: Texas Instruments PCM 2902C (Codec **A**) & PCM 2900C (Codec **B**)
  - ➢ 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

- ♦ **Push To Talk Key** (two key-switches in parallel)
  - ➢ model: Cherry MX
  - ➢ key travel: 3.6 mm to 4.0 mm 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)

- ♦ **Control Keys**
  - ➢ model: Diptronic DTS
  - ➢ key travel (typical): 0.3 mm
  - ➢ actuating force (typical): 255 cN
  - ➢ lifetime (minimal): 0.5 million operations

B. INTEGRAL PARTS AND FUNCTIONALITY

BeFREE 20 represents an integration of a touchmonitor (display with touchscreen), a computer, an intercom and a controller.

Central Speaker — Microphone
Left Speaker
Left Encoder — Right Speaker
ON/OFF Key — Microphone LED
LED Indicators — Right Encoder
— Bar-Graph Displays
Touchscreen — Control Keys
Display — PTT Key

Figure B.1   Operator Interface of BeFREE 20

B.1. Operator Interface

The **Stripe** (see Figure B.2 below) is an ergonomically designed vertical area along the right-hand side of the display. It comprises a number of visual indicators and mechanical keys (short-travel) to provide the operator with a quick insight and immediate access to important controls. The most prominent position is assigned to the PTT key, which consists of two long-travel mechanical key-switches and a large actuator with dimmable background illumination. Several additional LED indicators (see Figure B.3) are located in a Stripe extension on the left-hand side of the display.
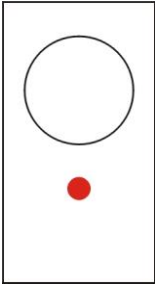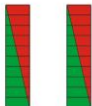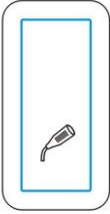
Microphone LED	Illuminated (red) while the microphone is active (enabled).

Bar-Graph Displays	Green: loudspeakers volume level
	Red: VU-meter (actual signal level at the loudspeakers and the microphone)
	Orange: display brightness level
Volume UP Key	Press to increase volume of left and right speakers.
Volume DOWN Key	Press to decrease volume of left and right speakers.
Home / Touch Disable Key	Long press disables touchscreen. Short press (re)enables touchscreen.
Brightness UP Key	Press to increase brightness of the display and all visual indicators.
Brightness DOWN Key	Press to decrease brightness of the display and all visual indicators.
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.2   The Stripe (Keys & Indicators)

	Power	Blue	Short blink: OFF (power saving mode)
			Long blink: SLEEP (standby)
			Continuous: ACTIVE (operating)
	Disk	Blue	Blinking indicates read/write activity of SSD
	Touchscreen	Red	Illuminated when touchscreen is disabled
	Warning	Red	Illuminated when an error has been detected

Figure B.3   LED Indicators

B.2. Touchmonitor

The touchmonitor comprises a high-brightness, ultra-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.

Brightness of the LCD and all visual indicators on the Stripe (Bar-Graph Displays, LED Indicators and PTT Key backlight) is adjustable by Brightness UP and DOWN keys. Home / TouchDisable key can be used to temporarily disable touchscreen for cleaning purposes.

B.3. Embedded Computer

BeFREE 20 incorporates an industrial grade single-board computer, which operates the embedded touchmonitor and provides for an extensive connectivity to enable various external peripherals to be used along (see Chapter B.5 for more details). It is internally connected to the Tipro Controller (via USB and COM 4) as well as with the Audio Section / Subsystem (via USB and Analogue Line-In / Line-Out signals).

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 via a heat-pipe to an internal heat-sink, without a fan. As a result the BeFREE 20 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 and Right Speaker are physically/electrically realized as two loudspeakers in parallel to double the output volume. The Central Speaker, along with associated hardware equalizer, emphasizes lower frequencies in order to improve naturalness and intelligibility of the reproduced speech.

Internal signal processing includes analogue-to-digital and digital-to-analogue conversion (block "USB AUDIO CODEC" which comprises two USB Codec chips), 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). USB and analogue signals can be mixed, resulting in up to eight listening / output audio channels (4 stereo signals) and four parallel recording / input channels (USB and analogue). The Echo-Cancellation circuitry is optional (see Chapter D.3 for more details).
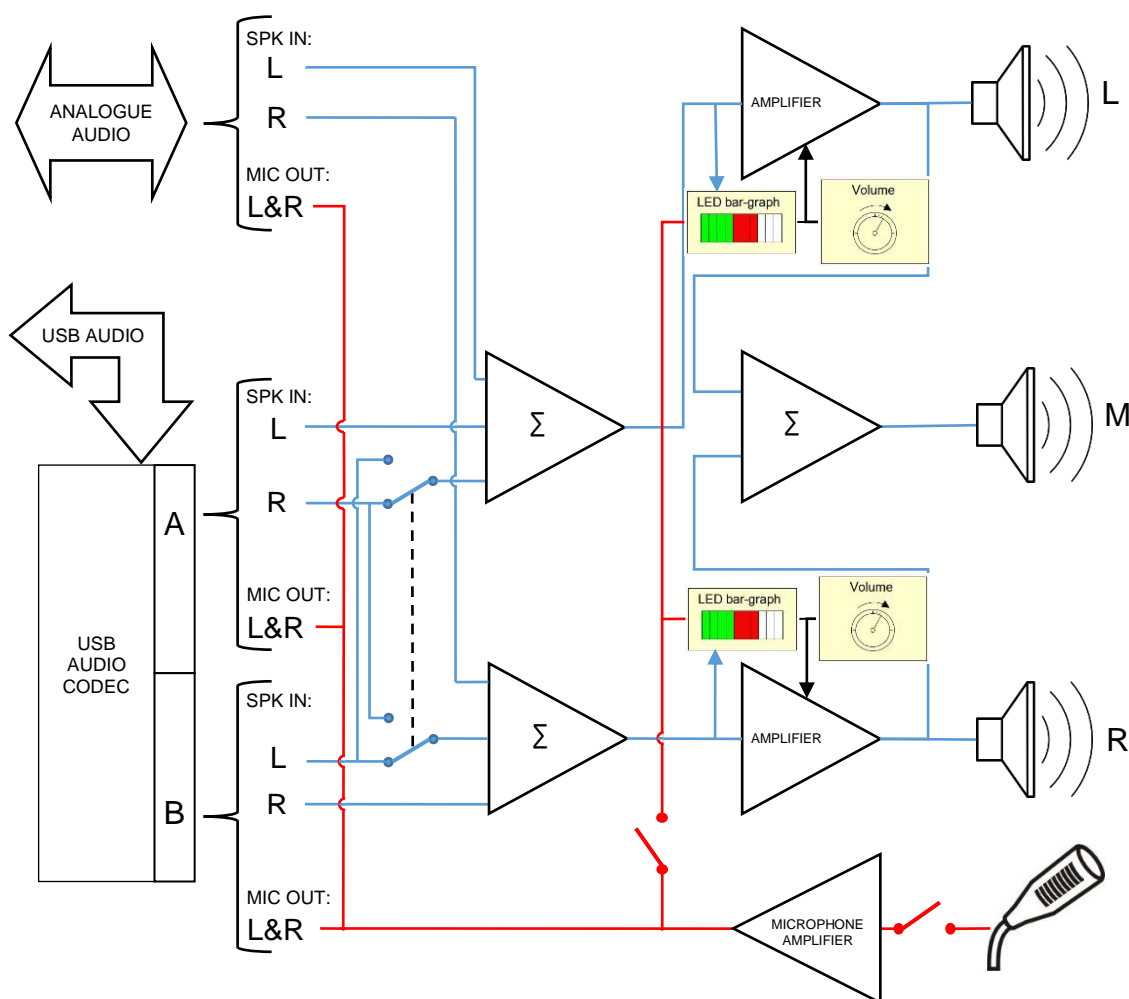
Figure B.4   Audio Section (Intercom)

Analogue audio signals to and from the Intercom can be connected to the analogue sound card of the embedded computer or alternatively to the externally available connectors (see Chapter B.5 for more details). The connection diagram is shown in Figure B.5 below. The analogue sound card can be completely disconnected from the Intercom section and made available for external analogue audio devices via connectors in the connector plate shown in Figure B.6.
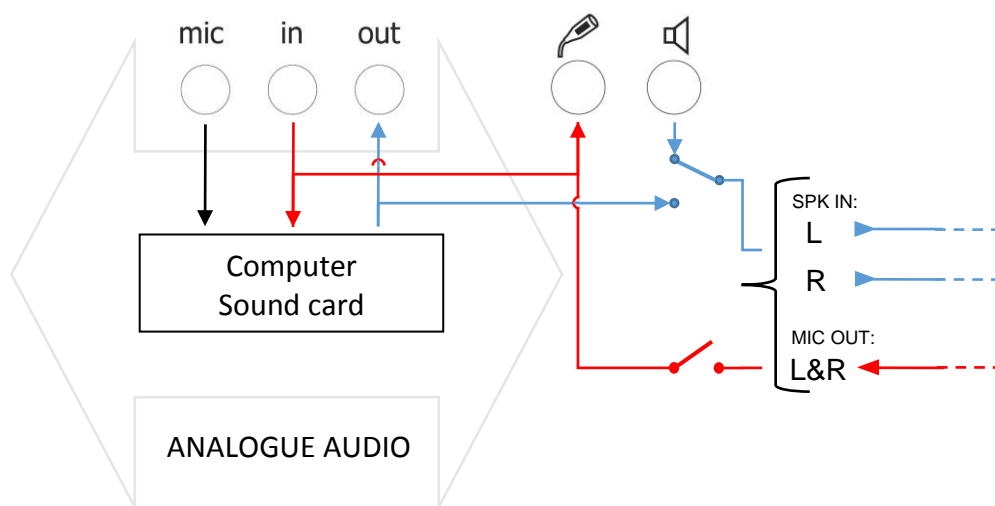
Figure B.5   Analogue Audio Detail

B.4.1. Microphone Amplifier

This is a logarithmic audio amplifier with programmable gain, noise gating threshold and compression ratio. 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.

A linear regime of the amplifier is a special option which might be activated in full-duplex operation where acoustic echo is to be cancelled using application software (rather than optionally integrated hardware echo-canceller – see Chapter D.3).

B.4.2. Left and Right Speaker Amplifiers

These are linear audio power amplifiers with programmable gain, each driving its own speaker (Left and Right Speaker in Figure B.4). The gain of each amplifier (i.e. volume level of the respective speaker) can be adjusted by the user in normal operation via the respective incremental encoder at the respective side of the module (Left and Right Encoder in Figure B.1). The selected level is immediately displayed at the respective bar-graph display in green colour (20 volume levels + mute). Each amplifier can deliver up to 2 W (2 x 1 W) of electric power to its speaker.

By default, the left speaker is driven by the sum of left output of USB Codec A and left output of USB Codec B, while the right speaker is driven by the sum of right output of Codec A and right output of Codec B (so-called **Stereo Mode**). Alternatively, each Codec can drive its own speaker, i.e. Codec A to left speaker, Codec B to right speaker (so-called **Mono Mode**). In either of the modes the analogue Line Out signals from the computer sound card can be optionally added to the summing amplifiers, Line Out Left to left amplifier, Line Out Right to right amplifier.

B.4.3. Central Speaker Amplifier

This is a linear audio power amplifier with programmable gain and cut-off frequency, so it effectively acts as a programmable low-pass filter (which is a kind of an equalizer) capable to boost lower frequencies (typically below 300 Hz) and improve naturalness of the reproduced speech. It drives the Central Speaker by the "equalized" sum of signals to the Left and to the Right Speaker. The amplifier can deliver up to 3 W of electric power to the Central Speaker.

B.4.4. Bar-Graph Displays

Each of the two bar-graph displays comprises 10 three-colour (red, green and orange) LEDs. By default they constantly operate as VU meters in red colour, showing actual levels of the respective speaker signals and the level of the microphone signal. Optionally, the microphone signal can be disconnected from the VU meters.

If a rotation of an incremental encoder has been detected the respective bar-graph automatically displays the gain of the respective amplifier in green colour. Volume UP and DOWN keys can also be used to adjust the current volume settings, but simultaneously for both speakers.

If a press of Brightness UP or DOWN key has been detected both bar-graphs simultaneously display the current brightness setting of the LCD and all visual indicators in orange colour.

B.4.5. Incremental Encoders

These (Left and Right Encoder in Figure B.1) are endless digital potentiometers used for immediate volume control of the Left and the Right Speaker respectively. Each 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 corresponding Bar-Graph display in green colour.

B.5. External Connectors

Numerous connections for external devices are available at the Connector Plate (see Figure B.6) from underneath the module. Most of them are standard interfaces (USB, LAN, COM, VGA …) intended for users to apply freely.
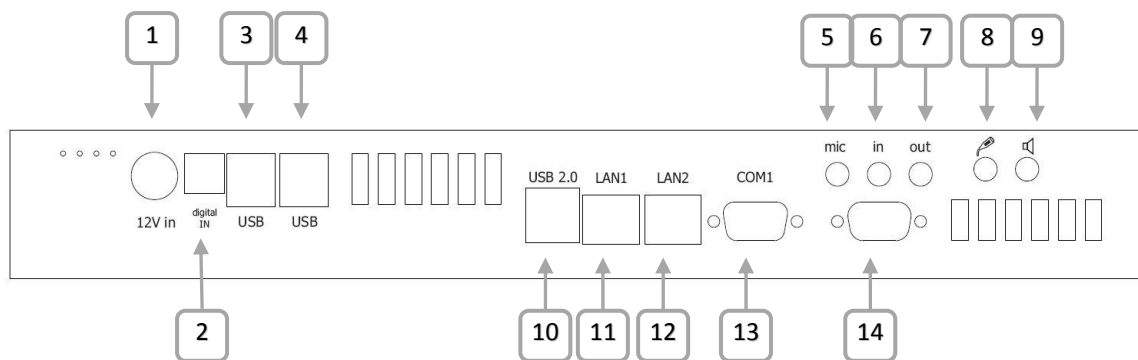
#	Designator	Type	Note
1	12V Input	Mini Power DIN	reserved
2	Digital Input	RJ 4P/4C socket	see Chapter B.5.1
3	Dual USB	2 × USB type – A	full-speed, 500 mA
4	Dual USB	2 × USB type – A	full-speed, 500 mA
5	Mic-In	Stereo jack 3.5 mm	input to analogue sound card
6	Line-In	Stereo jack 3.5 mm	input to analogue sound card
7	Line-Out	Stereo jack 3.5 mm	output from analogue sound card
8	Intercom Line-Out	Stereo jack 3.5 mm	microphone amplifier output
9	Intercom Line-In	Stereo jack 3.5 mm	loudspeaker amplifier input
10	Dual USB	2 × USB type – A	high-speed, 500 mA
11	LAN 1	RJ 8P/8C (RJ 45)	1 Gb Ethernet
12	LAN 2	RJ 8P/8C (RJ 45)	1 Gb Ethernet
13	COM 1	DSUB-9 male	RS232 serial port
14	VGA	DSUB-15 female	analogue RGB output

Figure B.6   Connector Plate

B.5.1. External Digital Inputs

Two inputs (refer to Figure B.7 for the connector and signal description) are provided for detection of external digital (ON/OFF) signals to be transformed into programmable

key events, equivalent to, for instance, PushToTalk key on the Stripe. Typical device to be connected to is an external PushToTalk switch/pedal.

One of the inputs (A) is galvanically isolated (via opto-coupler) and is therefore intended for an external ground-referenced signal, such as a digital output of another electronic device. The other input (B) is to be used for an external "floating" signal, such as contacts of a mechanical/magnetic key/switch (see Figure B.8).
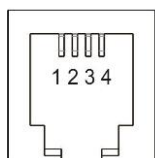
Pin #	Signal
1	A– (GND)
2	A+ (RxD)
3	B+ (TxD)
4	B– (GND)

Figure B.7   Digital Inputs Connector

Port	Internal circuitry	Suggested external circuitry
A		
B		

Figure B.8   Applying Digital Inputs

These inputs have an alternative function (direct access to the Tipro controller from an external computer via serial RS232 port, as per Figure B.7) which is intended for

installation and maintenance purposes. More details can be found in the Chapter C.1 as well as in the Reference [10].

B.5.2. External Analogue Inputs and Outputs

Mic-In, Line-In and Line-Out are standard PC audio inputs/outputs available at 3.5 mm stereo jacks for external audio devices, such as headsets, active loudspeakers or microphones. In this case the internal analogue sound card should be disconnected from the Intercom section via ChangeMe software (see Figure B.5 for more details).

Intercom Line-Out signal is actually the output of the internal microphone amplifier at the standard line level (0 dBu) which can be connected to an external recording device, for instance. Its output impedance is $10\,k\Omega$ in series with $1\,\mu F$.

Intercom Line-In signal is an auxiliary stereo analogue input to the internal speaker amplifiers. Expected signal level is 0 dBu. Its input impedance is $100\,k\Omega$ in series with $0.1\,\mu F$.

C. OPERATION

C.1. Configuring BeFREE 20

The BeFREE 20 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 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. display brightness, 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.

BeFREE 20 can be programmed/configured externally, from another computer. That computer needs to operate under Windows with ChangeMe utility installed and have one serial COM port available. The BeFREE 20 may operate under any operating system or not have it installed at all. This feature is obviously useful in cases when the BeFREE 20 runs a non-Windows operating system, but it is also applicable in all Windows cases where ChangeMe utility is not installed (e.g. to prevent uncontrolled modifications of the settings). The cable required for programming can be ordered from Tipro (Ordering Code TM-CGR) or rather easily made. The Reference [10] describes the procedure in detail.

C.2. Applying BeFREE 20

The BeFREE 20 is typically used together with other **FREE** add-on modules, combined in various compositions/configurations. An example with Handset modules is shown in Figure C.1 below, along with its schematic representation in Figure C.2.

TIPRO

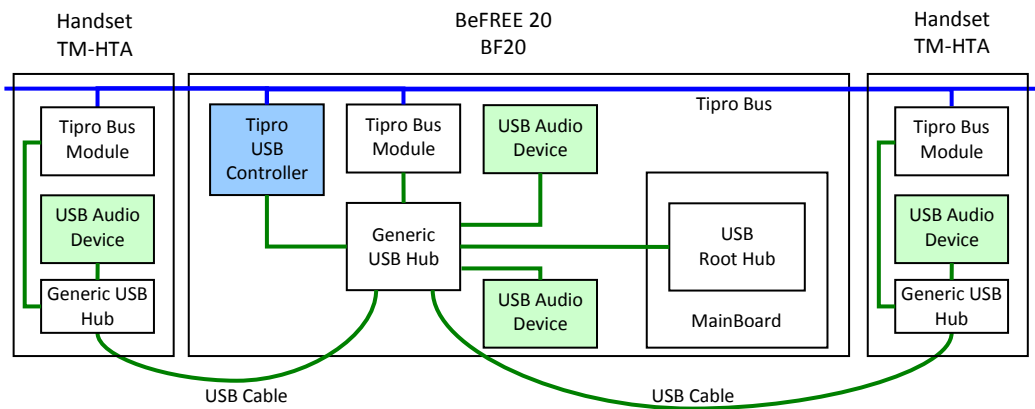**Figure C.1   Example BeFREE 20 Configuration**

Figure C.2   Example BeFREE 20 Configuration – Schematic Representation

D. OPTIONS

D.1. Inclination Mechanism

BeFREE 20 can be fitted with an Inclination Mechanism (also referred to as Angle Adjustment Mechanism). Normally, the display surface of BeFREE 20 is inclined for 15^0 against the horizontal plane. The mechanism enables gradual adjustment of the angle from approximately 30^0 to 70^0.

Figure D.1   BeFREE 20 with Inclination Mechanism (VESA 75)

D.2. HID Telephony Interface

Actual status (pressed/released) of the PTT key and Line Keys 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 the Reference [8] ("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 20. See reference [9] ("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 the sum of signals at the left and the right speaker. Optionally, the reference might be taken from either of the speakers.

D.4. Goose-Neck Microphone

By default, the goose-neck microphone is an integral part of the BeFREE 20, but it can be optionally omitted. See Chapter E.1 for details on the respective Ordering Code.

E. ORDERING CODES

E.1. BeFREE 20

```
      1      2      3   4      5  6  7          8          9
    B F    20   -   J  D 2  -  R  U  0   -   C15C25   -   x x x
```

1 – Module Type

   BF – **B**eFREE (touchcomputer) module

2 – Model

   20 : Integrated Intercom, 15.0" LCD

3 – Embedded Computer

   J : Intel Celeron J1900 @ 2.0 GHz with 4 GB RAM

4 – Version & Connectivity

   D2 : Fanless version with audio features ("**D**ispatcher")

5 – Touchscreen Technology

   R : ELO **R**esistive (zero-bezel)

6 – Integrated Intercom Option

   U : **U**SB Speakerbox functionality
   C : USB Speakerbox functionality with Echo-**C**ancellation Circuitry
   V : USB Speakerbox functionality without goose-neck microphone

7 – Reserved

   0 : none

8 – Housing Colour

   C15C25 : black (C15) with black matte (C25) top part of the housing
   This part of the code is not mandatory if the colour is C15C25, what is a
   default.

9 – Custom Version

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

Note 1:

BeFREE 20 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. For installations where AC/DC adapter needs to be placed further away (more than about 1m) from the BeFREEE 20 Tipro offers the DC power extension cable (Ordering Code TM-CPH) which is 1.5 m long.

TIPRO

E.2. Inclination Mechanism

<div align="center">

1   2   3   4   5

T M - S   U   A - C 1 5 - x x x

</div>

1 – Accessory Type

   S – Mechanical **S**upport mechanism (Inclination Mechanism)

2 – Mechanism Type

   U : **U**niversal

3 – Adapter Type

   A : **A**ll BeFREEs (except for BeFRE 15)

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 10" – Technical Overview
3. "HANDSET" – Technical Overview
4. "SPEAKERBOX" – Technical Overview
5. "ChangeMe" – User's Manual
6. "HID API" - Reference Manual
7. "Modularity Demystified" – "Dispatching Hints & Tips" White Paper – Issue No. 001
8. "Hook & PTT in Software" – "Dispatching Hints & Tips" White Paper – Issue No. 004
9. "HID Telephony Interface" – "Dispatching Hints & Tips" White Paper – Issue No. 005
10. "BeFREE 10/20/22 External Programming" – "Dispatching Hints & Tips" - Issue No. 006

G. NOTICES

G.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.

G.2. Copyright Notice