SENNHEISER

GuidePort – EMP

System Manual

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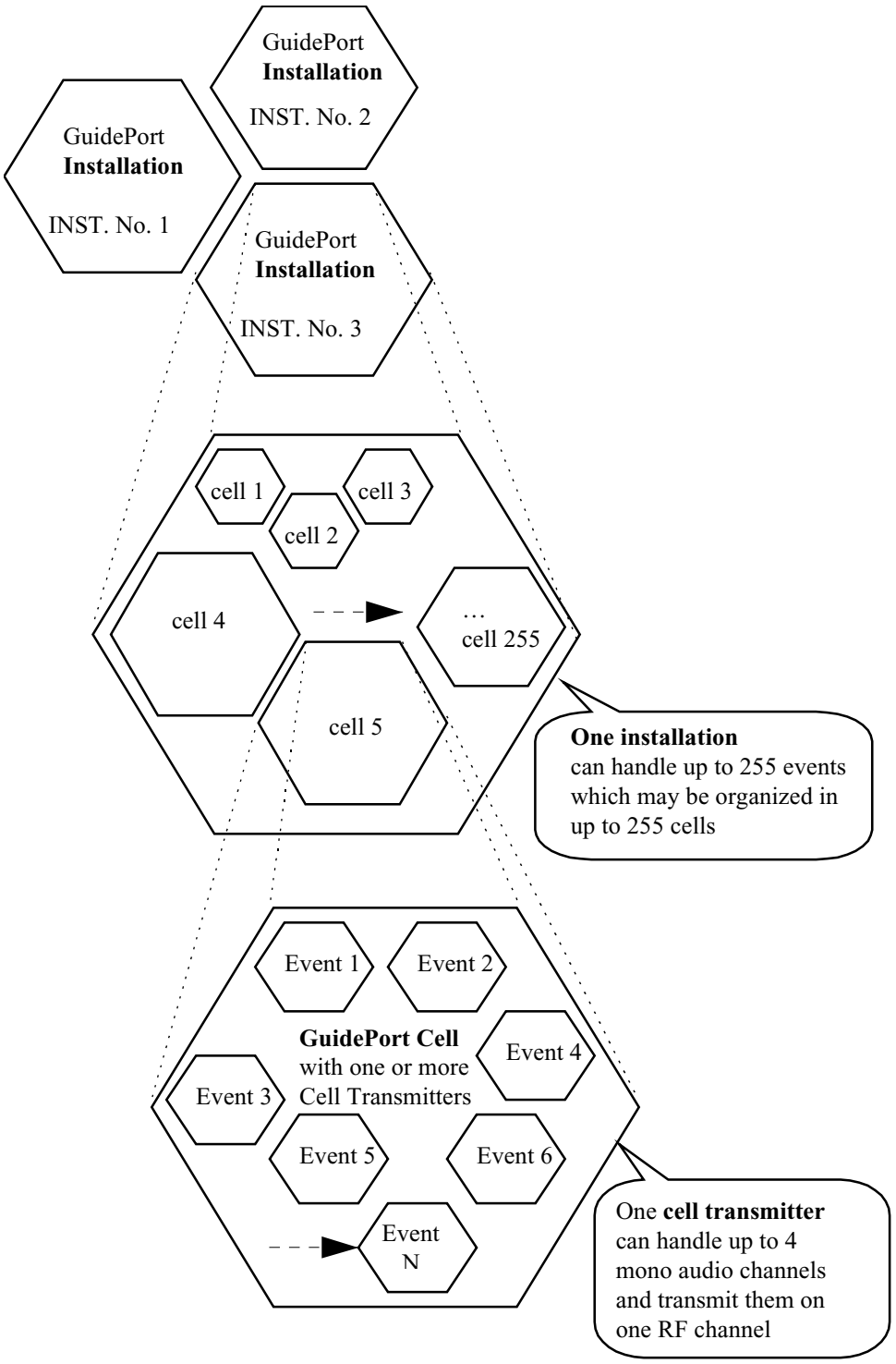
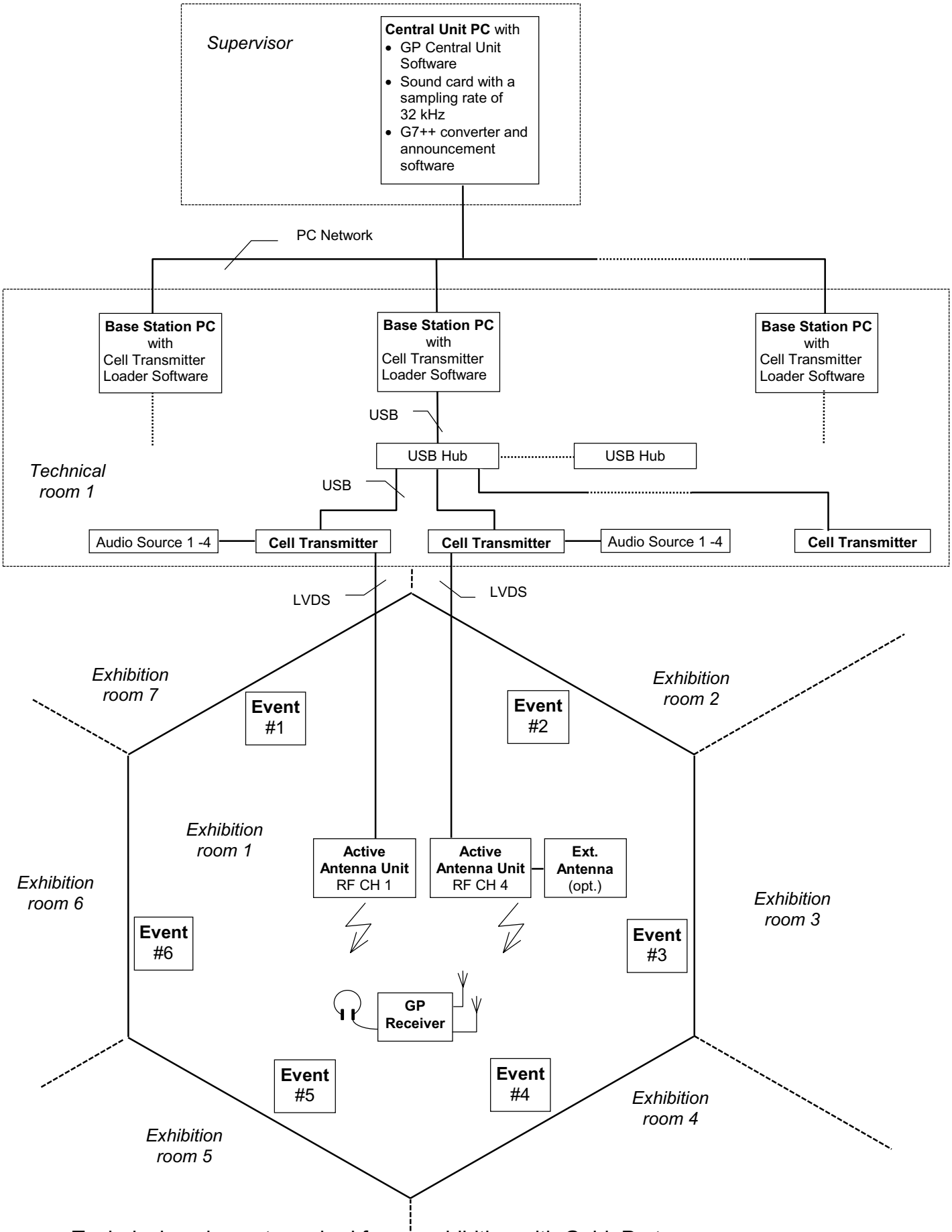
1 GuidePort Wireless Audio Transmission

GuidePort is a local area broadcast system for use in museums, visitor centers and at exhibitions. GuidePort features a characteristic cell structure, the so-called cells being defined areas of information and entertainment. These areas are supplied by **Cell Transmitters** which send digitally coded information via an **Active Antenna Unit** to portable **Receivers**. The transmitted data can be any audio information, for example comments or music. The audio signals are picked up by bodypack receivers which play the audio program directly via headphones. The various audio programs (events) can be triggered automatically by **magnetic field identifiers**.

The diagram on the next page shows GuidePort's system hierarchy. At the top level are the GuidePort installations. Each installation carries a specific code transmitted via RF. Whenever a GuidePort receiver recognizes a new installation code, it will automatically collect the installation-specific control data. This data is mainly the so-called Event Assign Table which defines the receiver's "reactions" to the 255 possible event numbers available in each installation, making the receiver compatible with other separate, independent GuidePort installations.
An installation can be seen as a macro cell. Each installation can be organized in up to 255 cells and contains up to 255 real-time audio events.



GuidePort System Hierarchy



Technical equipment required for an exhibition with GuidePort

2 Hardware Components of the System

2.1 Central Unit PC

The Central Unit PC with its Central Unit Software is at the heart of the GuidePort system. It serves to configure the entire GuidePort installation with its cells, transmitters, events and identifiers. Via a network, the Central Unit PC is connected with all Base Station PCs of the GuidePort installation.

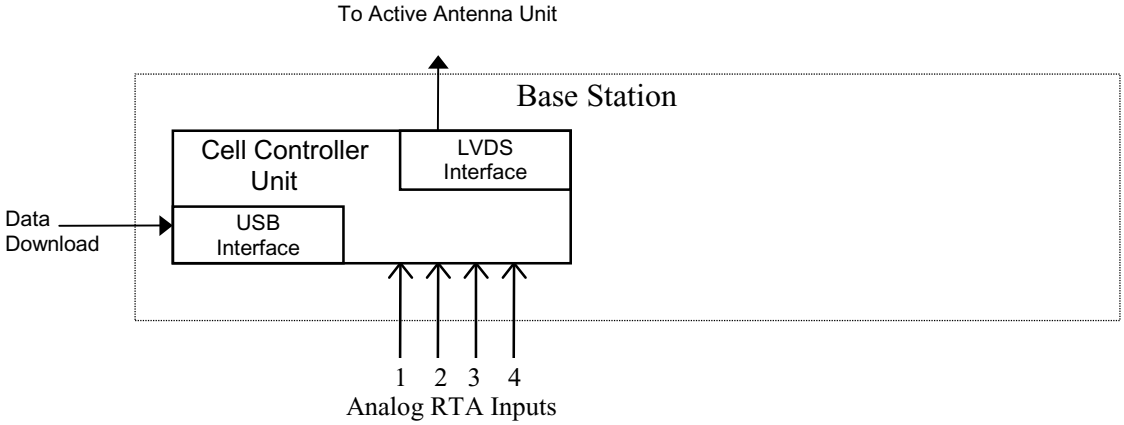
2.2 Base Station PC

The Base Station PC with its Cell Transmitter Loader Software detects the IDs of all Cell Transmitters connected to it via a USB. The Base Station PC will transmit the configuration files created by the Central Unit Software to the Cell Transmitters.

2.3 Cell Transmitter

2.3.1 Description

A Cell Transmitter is a digital unit which picks up prepared MTS data and combines them with installation-specific control tables and the real-time audio information from its four analog audio inputs. Via an LVDS interface, the entire data stream is sent to an Active Antenna Unit where FSK modulation and RF conversion take place. The transmission of the MTS data is done in a cyclic manner. The cable length between the Cell Transmitter and the Active Antenna Unit may amount to up to 150 m, which ensures a convenient installation of the local antennas.

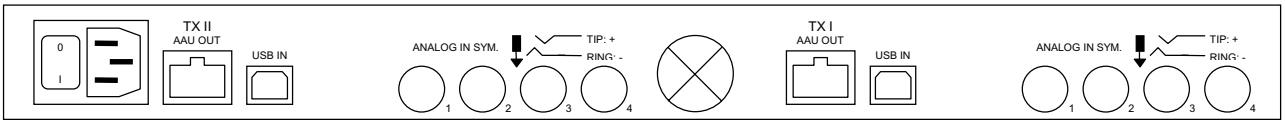


2.3.2 Hardware Interfaces

a) Front panel

Headphone Outputs
Allow you to monitor the audio signals transmitted to the receivers.

b) Rear panel



USB IN:
Input socket for the USB cable from the Base Station PC.

ANALOG IN SYM.:
Inputs for connecting your audio sources to the transmitter. There are four balanced inputs, you can either connect 4 mono sources, 2 mono sources and 1 stereo source or 2 stereo sources. For a stereo audio source, you will need two sockets (left and right channel), please use inputs 1 & 2 and/or 3 & 4. Connect the left audio channel to socket No. 1 or 3, the right audio channel to No. 2 or 4, respectively.

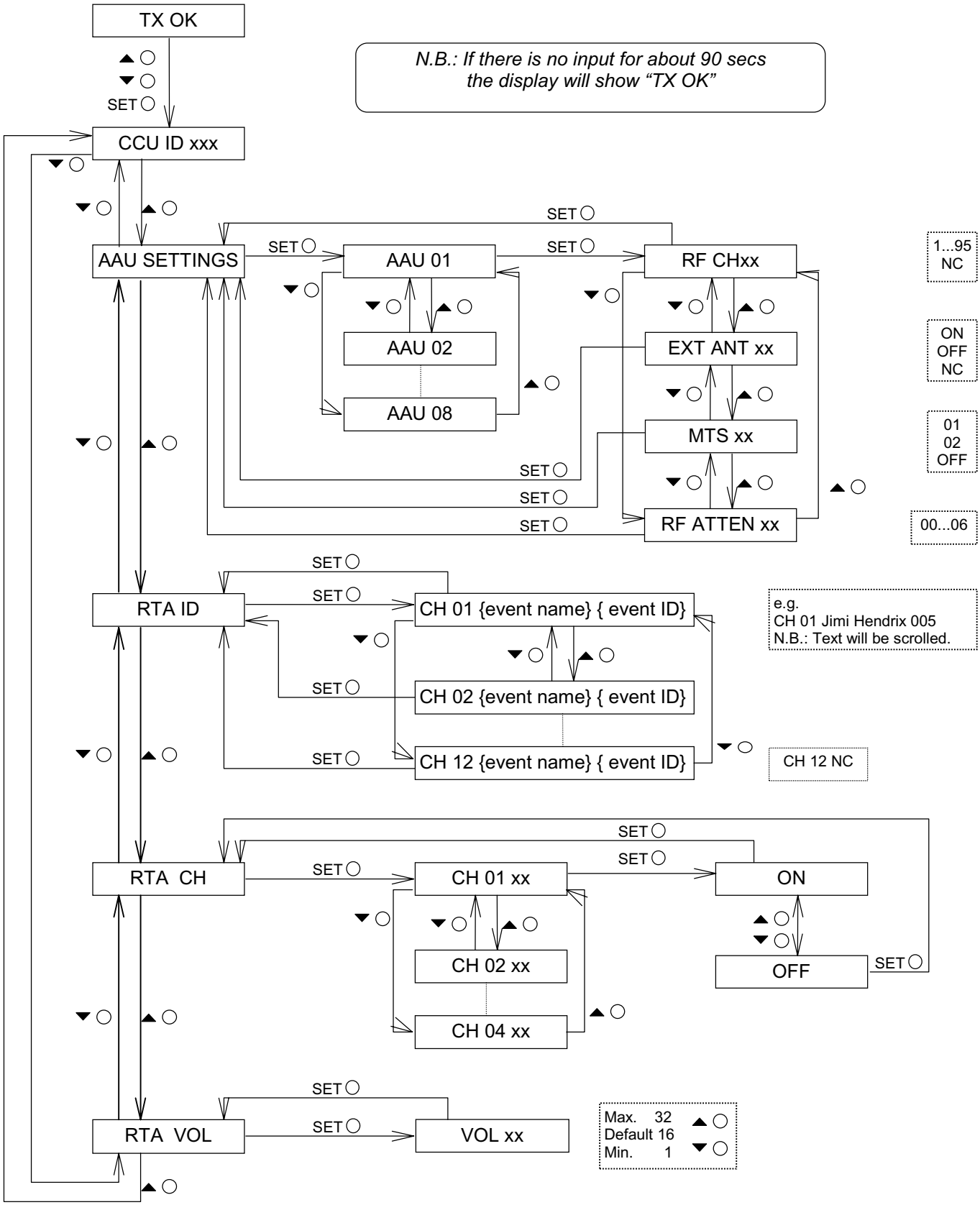
The following table shows how to connect your audio sources to the GuidePort Cell Transmitter:

Number and kind of audio sources	Input No. 1	Input No. 2	Input No. 3	Input No. 4
4 mono (m)	m	m	m	m
2 mono (m), 1 stereo (s)	m	m	s, left	s, right
2 stereo (s)	s, left	s, right	s, left	s, right

AAU OUT
Output for connection of an Active Antenna Unit. Use a shielded, 8-wire twisted pair cable (4 individually twisted pairs) for connection. This cable supplies the Active Antenna Unit with DC and the digital data stream to be transmitted.

2.3.3 User Interface (Display and Controls)

Menu layout of the GuidePort Cell Transmitter:



2.3.4 Technical Data

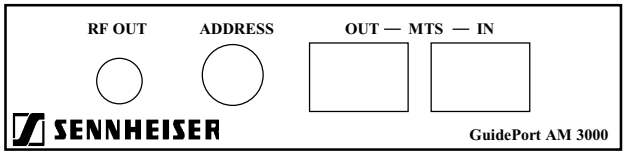
AF IN			
Frequency	40 - 14,000	Hz	
Input level		mV_{rms}	
Impedance	660	Ω	balanced input
Audio sources	4 mono 2 stereo 1 stereo, 2 mono		AF IN 1, 2, 3, 4 AF IN 1&2 (1 = left, 2 = right) 3&4; (3 = left, 4 = right) AF IN 1&2 or 3&4 (stereo); remaining inputs for mono sources
USB IN			
AAU OUT			
DC output	+15	V	
I_{max}	200	mA	
Data rate	1,024	Mbit/s	
Output level	350	mV_{pp}	LVDS standard
Headphone Output			
Output level		mV_{pp}	AF input level 350mV_{rms}
Output impedance	32	Ω	

2.2 Active Antenna Unit

2.2.1 Description

The Active Antenna Unit receives the data stream from the Cell Transmitter via an LVDS interface. The data stream is then FSK modulated onto an RF carrier in the 2.4 GHz ISM Band and transmitted to the GuidePort receivers. Settings for transmission frequency, RF output power and the antenna to be used (internal or external antenna) are controlled by the Cell Transmitter.

2.2.2 Hardware Interfaces



MTS IN
Connects the Active Antenna Unit to the GuidePort Cell Transmitter. The connection cable supplies the Antenna Unit with both DC and the digital data stream to be transmitted. When the associated Cell Transmitter is switched on, it will automatically configure the Antenna Unit.

MTS OUT
For connecting (daisy-chaining) a second Active Antenna Unit. The second Antenna Unit will transmit the same data stream, but on another RF carrier. This feature is not available in this customized version, instead you can connect measuring equipment to MTS OUT.

RF OUT
For connecting an optional, external directional antenna. If you want to use an external antenna, you have to select the “External Antenna” option when configuring the Cell Transmitter with the Central Unit software.

2.2.3 User Interface

ADDRESS
The Active Antenna Unit is automatically configured by the Cell Transmitter when the transmitter is switched on. The default address is No. 1. Presently, other addresses are not supported.

2.2.4 Available RF Channels

The following RF Channels can be chosen when configuring the Active Antenna Unit via the Central Unit Software. The highlighted channels (grey) are preferred channels. Please do not forget a minimum channel spacing of 3 channels within one cell.

RF Ch.	Frequency [MHz]
1	2401.920
2	2402.784
3	2403.648
4	2404.512
5	2405.376
6	2406.240
7	2407.104
8	2407.968
9	2408.832
10	2409.696
11	2410.560
12	2411.424
13	2412.288
14	2413.152
15	2414.016
16	2414.880
17	2415.744
18	2416.608
19	2417.472
20	2418.336
21	2419.200
22	2420.064
23	2420.928
24	2421.792
25	2422.656
26	2423.520
27	2424.384
28	2425.248
29	2426.112
30	2426.976
31	2427.840
32	2428.704
33	2429.568

RF Ch.	Frequency [MHz]
34	2430,432
35	2431,296
36	2432,160
37	2433,024
38	2433,888
39	2434,752
40	2435,616
41	2436,480
42	2437,344
43	2438,208
44	2439,072
45	2439,936
46	2440.800
47	2441.664
48	2442.528
49	2443.392
50	2444.256
51	2445.120
52	2445.984
53	2446.848
54	2447.712
55	2448.576
56	2449.440
57	2450.304
58	2451.168
59	2452.032
60	2452.896
61	2453.760
62	2454.624
63	2455.488
64	2456.352
65	2457.216
66	2458.080

RF Ch.	Frequency [MHz]
67	2458.944
68	2459.808
69	2460.672
70	2461.536
71	2462.400
72	2463.264
73	2464.128
74	2464.992
75	2465.856
76	2466.720
77	2467.584
78	2468.448
79	2469.312
80	2470.176
81	2471.040
82	2471.904
83	2472.768
84	2473.632
85	2474.496
86	2475.360
87	2476.224
88	2477.088
89	2477.952
90	2478.816
91	2479.680
92	2480.544
93	2481.408
94	2482.272

2.2.5 Technical Data

RF transmission frequency range	f	2.4 - 2.4835	GHz	
Max. radiated RF peak power	P	1 0	mW dBm	ERP for North America in compliance with FCC
	P	10 10	mW dBm	ERP for Europe in compliance with ETS 300 440
RF antenna		internal		chip antenna, mounted on board
		external		directional, wall-mounted antenna (opt.)
RF channel bandwidth	f	2.6	MHz	
Total number of RF channels		94		
Transmission range of cell transmitter for quasi error-free reception, no walls	s s	>30 >50	m m	1 mW RF peak power 10 mW RF peak power
Spurious frequencies outside the ISM band				in compliance with ETS/FCC
Modulation type		2-FSK		binary frequency shift keying
Modulation index	μ	0.5 ... 0.7		$\mu = 2^* \Delta f/f_{bit}$
Modulated data rate f_{bit} /channel		1024		kbit/s

2.3 Receiver

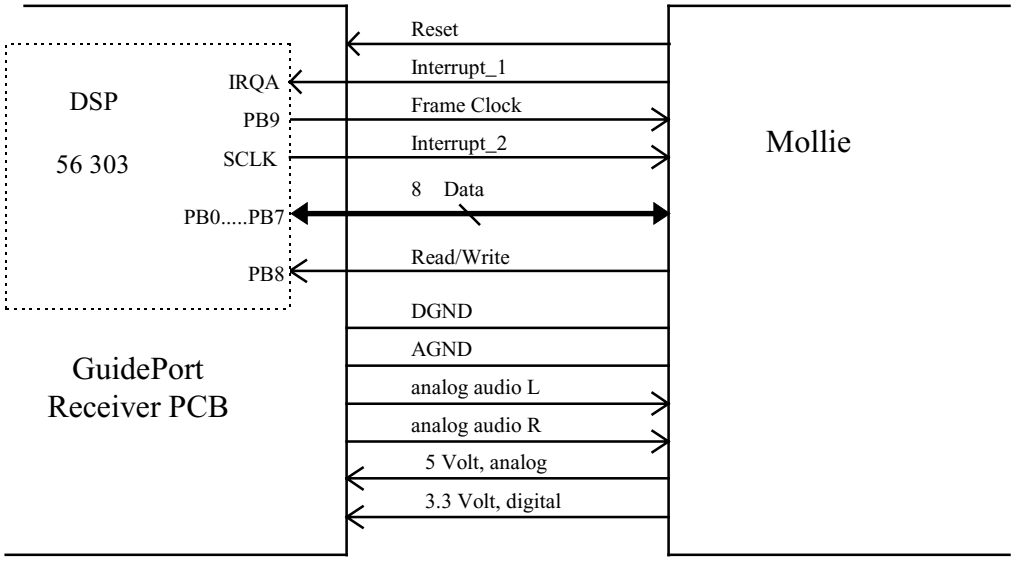
2.3.1 Description

The **GuidePort Receiver** automatically reacts to the magnetic fields created by **Identifier Transmitters** (see 2.4). These Identifiers transmit a number which is related to a certain audio event. When receiving this number, the receiver will transfer the corresponding audio information to the Mollie System. Mollie then decides on the action to be taken, for example to play the audio information. The GuidePort Receiver uses a prestored assignment table for translating the numbers into the correct action.

2.3.2 Mollie Interface

The physical interface consists of:

Function	No. of lines	Direction
Analog:		
Analog audio signals (L, R)	2	from GP receiver to Mollie
3.3 V power line, digital	1	from Mollie to GP receiver
5 V power line, analog	1	from Mollie to GP receiver
Analog ground	1 or more	
Digital:		
Parallel data	8	bi-directional
'Interrupt_1' (Active Low)	1	from Mollie to GP receiver
'Read/Write'	1	from Mollie to GP receiver
'Reset' (Active Low)	1	from Mollie to GP receiver
'Frame Clock'	1	from GP receiver to Mollie
'Interrupt_2'	1	from GP receiver to Mollie
Digital ground	1 or more	



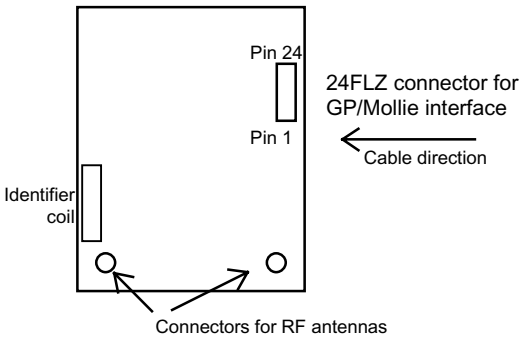
Logical level of all digital lines: according to LVTTL (3.3V)
Interface Connector GP receiver: JST flat multicore cable, type 24FLZ-SM1-TB

Pin Assignment of Interface Connector 24FLZ-SM1-TB:

Pin No.	Function
1	analog ground for audio, from GP receiver
2	left audio channel, from GP receiver
3	analog ground for audio, from GP receiver
4	right audio channel, from GP receiver
5	analog ground for audio, from GP receiver
6	digital ground for digital interface
7	data bus, bit 0, LSB
8	data bus, bit 1
9	data bus, bit 2
10	data bus, bit 3
11	data bus, bit 4
12	data bus, bit 5
13	data bus, bit 6
14	data bus, bit 7, MSB
15	Read/Write
16	Frame Clock
17	Interrupt_2
18	Reset
19	Interrupt_1
20	digital ground for digital interface
21	3.3 volts digital power, from Mollie
22	digital ground from Mollie
23	analog ground from Mollie
24	5 volts analog power from Mollie

Mounting of PCB and Position of Connectors:

It is of the utmost importance to mount the GP receiver board in a vertical position:



'Reset': reset is active when 'low', internal connection on GuidePort receiver PCB: MR of MAX811 (pin 3)

'Interrupt_1 ': Interrupt_1 is active when 'low'. Mollie's read or write procedures always start with the interrupt request. The first interrupt tells the GP receiver that Mollie has put an address word on the bus. During the power on procedure or a Reset from Mollie the line must be in the high ohmic state or 'High'. Interrupt_1 is not allowed if Interrupt_2 is active (low).
Connection on GP receiver: IRQA of DSP56303.

'Read/Write': When Mollie has activated the interrupt and put an address word on the bus, the Read/Write line determines whether Mollie wants to read from or write into the related register. 'High' means 'read', 'Low' means 'write'. Connection on GP receiver: PB 8 of DSP 56 303.

8-bit parallel data: bi-directional data bus
Connection on GP receiver: PB 0.....PB 7 of DSP56303
LSB = PB 0, MSB = PB 7

'Frame Clock': The Frame Clock coming from the GuidePort receiver indicates that the receiver has synchronized with the received bit stream and that real-time audio is available.
'Frame Clock' = low: no synchronization, no audio
'Frame Clock' = high: frame synchronization has taken place, audio is available

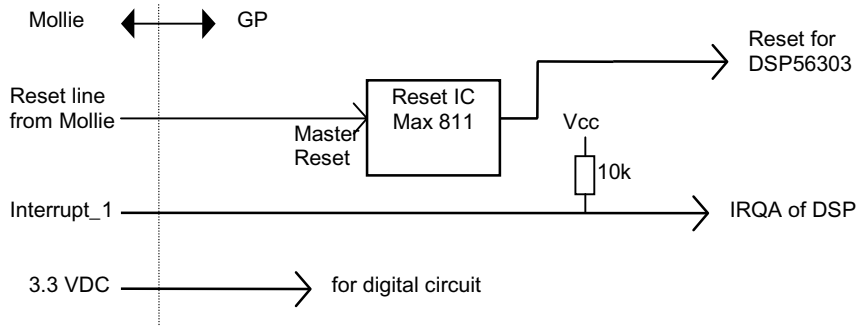
'Interrupt_2': This is an impulse from the GuidePort receiver indicating Mollie that certain conditions have been fulfilled. These conditions are:

Either • there is a change in the identifier number register
and/or • the bit error statistic exceeds the limit defined in the Error Limit register (Bit Error Statistic Register)
and/or • a new GP Message is available(GP Message Register)

During register updating, Interrupt_2 is 'low'. As the time required is very short (≈100ns), the detection of the Interrupt_2 signal should be edge controlled using the positive edge. All above mentioned registers are updated within one write cycle, which means that more than one register may change its content. This makes sense because if there is an old error message in the GP Message Register from the last update, it is now deleted if it is invalid (see also appended flow charts).
Interrupt_2 is not allowed during Mollie's Read/Write routines.

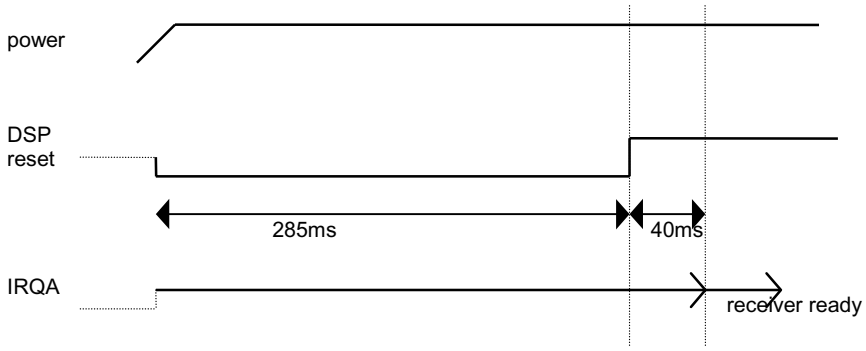
Specification for the Reset Procedure between GuidePort/EMP and Mollie

Simplified hardware diagram:

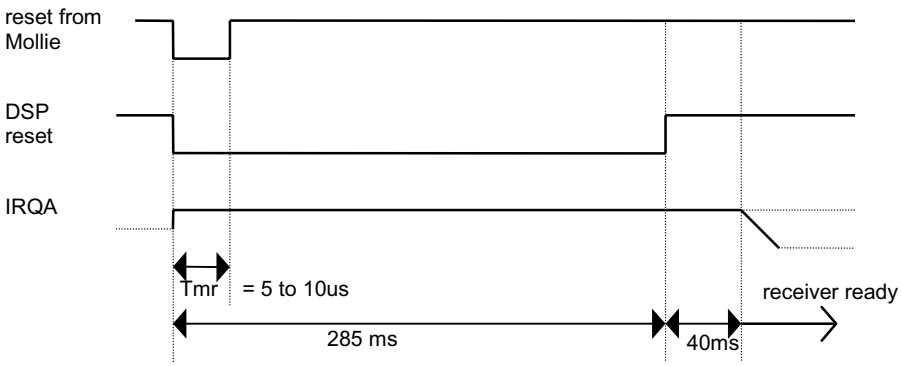


Remark: Other lines of the GP/Mollie interface are not of interest for this subject.

1. Case: Power is switched on
When the 3.3 V power line becomes high the IC Max811 generates a ≈ 280 ms reset impulse.



2. Case: Reset from Mollie (during power on)



2.3.3 Technical Data

RF receiving frequency range	f	2.4 - 2.4835	GHz	
Input sensitivity at antenna input	P	-93	dBm	BER 10^{-3}
RF antenna connector		MMS female		
Input impedance		50	Ω	
Power supply				
Analog Voltage	U	5	V	10% tolerance
Max. current	I	110	mA	
Digital	U	3.3	V	10% tolerance
Max. current	I	120	mA	
AF output				
Headphones	R_L	32	Ω	
Max. AF output level	U_{OUT}		V_{rms}	f_{in} = 1 kHz, U_{in} 350 mV_{rms} at Cell Transmitter, R_L = 32 Ω
Frequency response	f	40 ... 14,000	Hz	

2.4 Identifier Transmitter

2.4.1 Description

The Identifier transmits a binary code, which enables the GuidePort receivers to identify the audio event belonging to it. The identifier transmitter is programmable via a palmtop with the necessary GuidePort software. The parameters to be programmed are identifier number, transmission power, and the times for switching the identifier transmission on and off.

The Identifier is fitted with two LEDs which indicate its operating states (see below).

Functions and Electrical Parameters

- Operation indicator: Time Management will automatically switch the identifier on, the green LED will start flashing for about 30 minutes. Operation will be possible for at least 12 hrs.
- Low battery warning: If the green LED does not flash after switching the identifiers on, the batteries are flat. Please replace.
- Data storage time without batteries ≤ 3 min. (for replacing the batteries)
- Automatic off function: Time Management will switch the transmission off automatically, while the data storage remains on (data integrity). The red LED will light up briefly.
- Time Management: Max. deviation per year: 0.5 h. Time Management is programmed and checked via the IrDa interface.
- Programming interface: IrDa interface, reading and programming of data protocol, clock, RF output power and burst rate.
- RF output power: Programmable via IrDa interface, adjustable in steps of 10% between 10% and 100%
- Possibility of connecting an induction loop via internal screw terminals
- Max. cable length between transmitter and induction loop: 10 m
- Max. burst period of protocol: 1 s or 0.5 s, switchable via IrDa

2.4.2 Technical Data

Transmission frequency	f	127	kHz	
Modulation type		2 - FSK		
FM deviation		4	kHz	
Data rate		8	kbit/s	
Maximum transmission range with internal antenna		3 m		(isotropic pattern)
Maximum area covered by external induction loop		9 sq.m.		
Power supply*				
External DC		7.5 – 15	V	external power supply
4 AA-size batteries		1.5	V	inserted into identifier
Operating time with batteries	≥	3 months		P_{out} = 100%, T_{on} = 8h/day T_{period} = 1s
Programmable parameters				ID code, RF output power, on/off times, int./ext. antenna, burst rate
Setting of ID parameters				via infrared data interface (IrDa) with palmtop
Indoor operating temperature		+10.....+50	°C	

* N.B.: When the identifier is powered by an external DC supply, the battery supply will be automatically cut off. We would recommend to use both external DC and batteries, as this ensures that (a) no data will get lost in case of a mains power failure; (b) you can conveniently program the battery-powered identifiers before they are mounted in their final position and connected to an external DC supply.

3 Software

3.1 Central Unit Software

The Central Unit Software runs on the Central Unit PC. It serves to configure the entire GuidePort installation with its cells, transmitters, events and identifiers.

3.2 Cell Transmitter Loader Software

The Cell Transmitter Loader Software runs on the Base Stations. Via a USB, the software detects the IDs of all Cell Transmitters connected to a Base Station. The Base Station PCs transmit the configuration files – previously created by the Central Unit Software – to the Cell Transmitters.