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General description

The SC14CVMDECT SF is a member of the Cordless Module family with integrated radio transceiver and baseband processor in a single package. It is designed for hosted and embedded cordless voice and data applications in the DECT frequency band. Its simple to use API commands allow easy setup of a wireless link between two or more nodes.

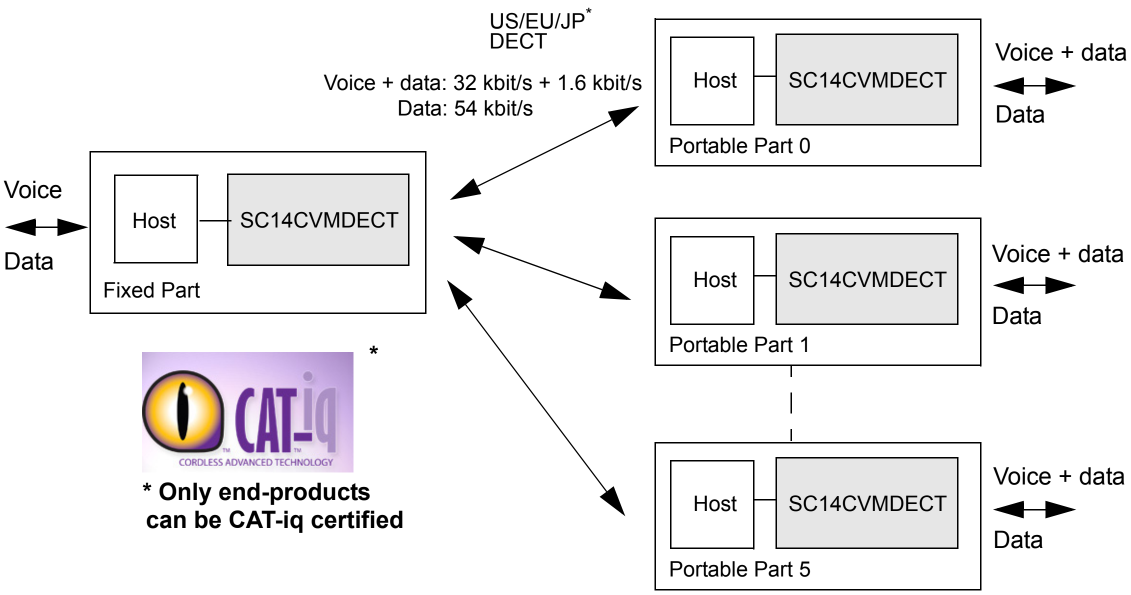
Features

- Supports EU-DECT (CAT-iq V2.0, v3.0 partly), DECT6.0 for North America and Japan DECT
- ETSI (EU-DECT) and FCC (DECT 6.0) certified
- J-DECT pre-certified
- ETSI 300 444 (DECT GAP) compliant
- Up to 64 Portable Parts or ULE devices registered per Fixed Part
- UART interface to external host
- Controllable via API command set
- Supports voice and data
- RF range: 1870 MHz to 1930 MHz
- Receiver sensitivity < -93 dBm
- Transmit power
  - EU: 23 dBm: 1881 MHz - 1897 MHz
  - USA: 20 dBm: 1921 MHz - 1928 MHz
  - JP: 23 dBm: 1895 MHz - 1903 MHz
- Antenna embedded, supports external antennas
- Contains both PP and FP functionality
- Program memory available for custom software
- Supports both internal and external (hosted) applications
- Power supply voltage: 2.1 V to 3.45 V
- Supports NiMH and Alkaline batteries
- Small form factor (19.6 mm x 18.0 mm x 2.7 mm)
- Operating temperature range: -40 °C to +85 °C

Applications

- Cordless intercom
- Cordless baby monitor
- Wireless data applications up to 54 kbit/s
- FP supports ULE sensors and actuators

System diagram



*** Only end-products can be CAT-iq certified**

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1.0 Connection diagram

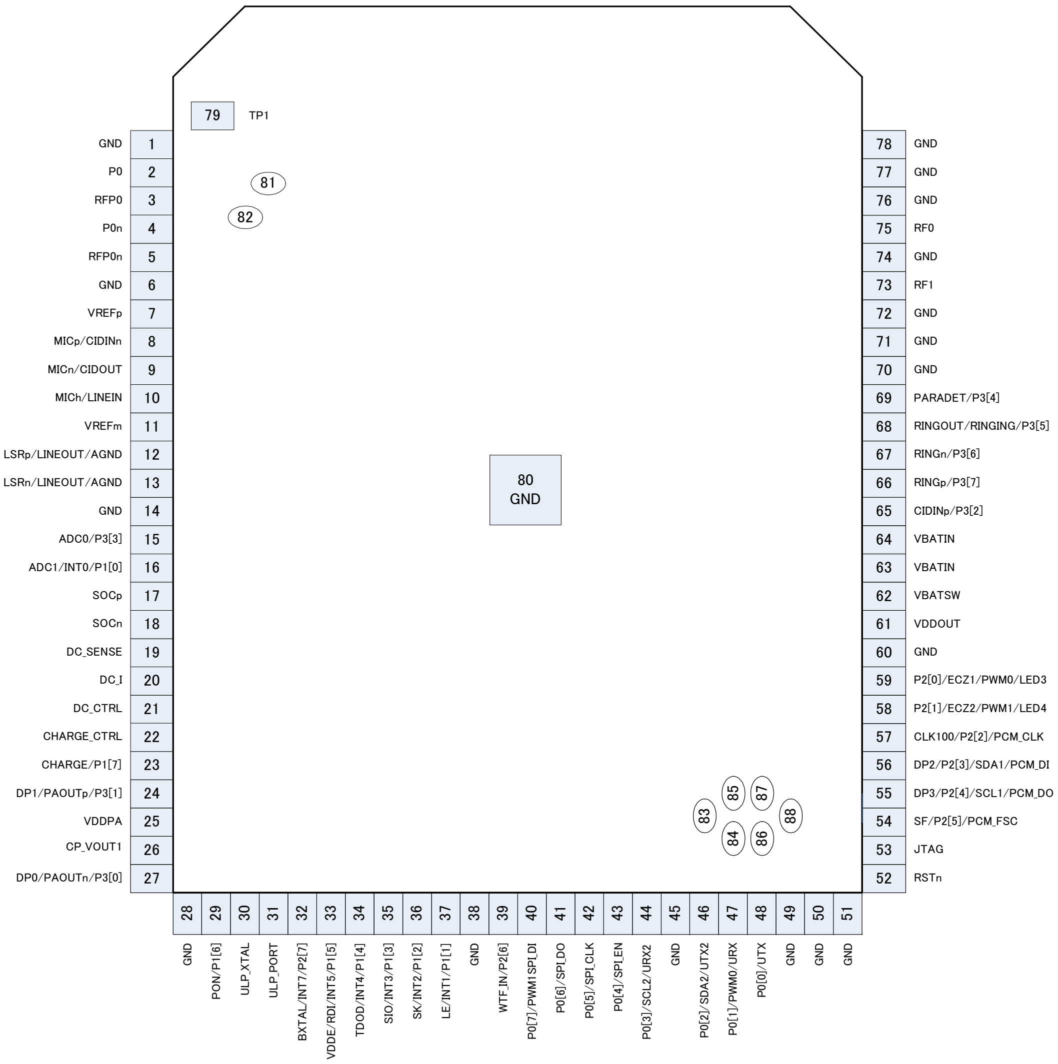

Figure 1: Connection diagram (top view, leads face down)

Table 1: Ordering information

Part number	Package	Size (mm)	Shipment form	Pack quantity
SC14CVMDECT SF01T (Note 2)	MOD88	18 x 19.6	Tray	60 (Note 1)
SC14CVMDECT SF02T (Note 3)	MOD88	18 x 19.6	Tray	60 (Note 1)

Note 1: MOQ = 600 pcs.
Note 2: Up to 6 PPs can be registered.
Note 3: Up to 64 PPs can be registered.

1.1 PIN DESCRIPTION

Table 2: Pin description

Pin	Module Pin name (Note 4)	In/ Out	Iout Drive (mA)	Reset State (Note 5)	Description
1	GND	-	-	-	Ground
2	P0	O	8	Hi-Z	Control port for FAD. See 4.13
3	RFP0	O	8	Hi-Z	Control port for FAD. See 4.13
4	P0n	O	8	Hi-Z	Control port for FAD. See 4.13
5	RFP0n	O	8	Hi-Z	Control port for FAD. See 4.13
6	GND	-	-	-	Ground
7	VREFp	O	-	I	Positive microphone supply voltage
8	MICp	I	-	I	Positive microphone input
9	MICn	I	-	I	Negative handset microphone input
10	MICh	I	-	I	Headset microphone input with fixed input protection
11	VREFm	-	-	-	Negative microphone reference (star point), connect to GND.
12	LSRp	O	-	O	Positive loudspeaker output
13	LSRn	O	-	O	Negative loudspeaker output
14	GND	-	-	-	Ground
15	P3[3]	IO	8	I	I/O Port
16	P1[0]	IO	2	I-PU	I/O Port
17	SOCp	I	-	I	Battery state of charge positive input. Connect to GND if not used. See 4.9
18	SOCn	I	-	I	Battery state of charge negative input. Star point connected to the SOC resistor. Connect to GND if not used. See 4.9
19	DC_SENSE	I		I	Voltage sense input. Connect to GND if not used.
20	DC_I	I		I	Current sense input of DC/DC converter. Connect to GND if not used
21	DC_CTRL	O	2	O-0	Switching clock for the DC/DC converter.
22	CHARGE_CTRL	O	1	O-0	Charge control pin. Leave unconnected if not used. See 4.9
23	CHARGE	I	-	I-PD (270k fixed pull-down)	Charger connected indication. Switches on the device if voltage > 1.5 V. Must be connected to charger via resistor R > (Vcharger_max-3 V)/10 mA (round to next largest value in range). See 4.9
24	PAOUTp	IO	500	O-0 (5k fixed pull-down)	CLASSD loudspeaker positive outputs
25	VDDPA	I	-	-	CLASSD Audio Amplifier supply voltage up to 3.45 V. GND or leave unconnected if CLASSD Audio Amplifier is not used.
26	CP_VOUT1	O	-	I	Charge Pump Output 1. A capacitor of 1 μF to GND is internally connected to this pin.
27	PAOUTn	IO	500	O-0 (5k fixed pull-down)	CLASSD loudspeaker positive output
28	GND	-	-	-	Ground

Table 2: Pin description (Continued)

Pin	Module Pin name (Note 4)	In/ Out	Iout Drive (mA)	Reset State (Note 5)	Description
29	PON	I	-	I (270k fixed pull-down)	Power on, Switches on the device if Voltage > 1.5 V. May be directly connected to VBAT, also with Li-Ion batteries. After startup the software takes over then PON pin to keep the device on after which the PON pin may be released.
30	ULP_XTAL	I	-	I	32.768 kHz XTAL clock input. Connect to GND if not used. **(Note 6)**
31	ULP_PORT	I	-	I	Ultra Low Power Port Pin. Connect to GND if not used. **(Note 6)**
32	P2[7]	IO	8	I-PU	I/O port
33	P1[5]	IO	8	O-1	I/O Port
34	P1[4]	IO	1/2	I-PD	I/O port
35	P1[3]	IO	1/2	I-PD	I/O Port
36	P1[2]	IO	2	I-PD	I/O Port
37	P1[1]	IO	2	I-PU	I/O Port
38	GND	-	-	-	Ground
39	P2[6]	IO	2	I-PU	I/O port
40	P0[7] / SPI_DI	IO	8	I-PU	I/O Port SPI Data Input
41	P0[6] / SPI_DO	IO	8	I-PU	I/O Port SPI Data Out
42	P0[5] / SPI_CLK	IO	8	I-PU	I/O Port SPI Clock
43	P0[4] / SPI_EN	IO	8	I-PU	I/O port SPI_EN: Active low.
44	P0[3] / SCL2 / URX2	IO	8	I-PU	I/O port Access bus clock, UART Serial In.
45	GND	-	-	-	Ground
46	P0[2] / SDA2 / UTX2	IO	8	I-PU	I/O port Access bus data, UART Serial Out.
47	P0[1] / URX	IO	8	I-PD (10k)	I/O port UART Serial In
48	P0[0] / UTX	O	8	I-PU	I/O Port UART Serial Out
49	GND	-	-	-	Ground
50	GND	-	-	-	Ground
51	GND	-	-	-	Ground
52	RSTn	I	1	I-PU (200k)	Active low Reset input with Schmitt-trigger input, open-drain output. Input may not exceed 2.0 V. An internal capacitor of 47 nF is mounted on this pin.
53	JTAG	IO	8	I-PU (1k)	JTAG-SDI+; one wire Debug interface with open-drain.
54	P2[5]/PCM_FSC	IO	8	I-PU	I/O Port PCM_FSC: PCM Frame Sync
55	P2[4]/SCL1/ PCM_DO	IO	8	I-PU	I/O port SCL1; I2C clock PCM_DO: PCM Data output

Table 2: Pin description (Continued)

Pin	Module Pin name (Note 4)	In/ Out	Iout Drive (mA)	Reset State (Note 5)	Description
56	P2[3]/SDA1 / PCM_DI	IO	8	I-PU	I/O Port SDA1: I2C Data PCM_DI: PCM Data input
57	P2[2]/PCM_CLK	I/O	8	I-PD	I/O Port PCM_CLK: PCM clock input/output
58	P2[1] / PWM1 / LED4	IO	8	I	I/O Port PWM1: Pulse Width Modulation output LED4: 2.5 mA/5 mA LED current sink
59	P2[0]/ PWM0 / LED3	IO	8	I	I/O Port PWM0: - LED3: 2.5 mA/5 mA LED current sink
60	GND	-	-	-	Ground
61	VDDOUT	-	-	-	Test purpose only. Must be left unconnected.
62	VBATSW				Test purpose only. Must be left unconnected.
63	VBATIN	I	-	-	Main supply voltage < 3.45 V.
64	VBATIN	I	-	-	Main supply voltage < 3.45 V.
65	P3[2]	IO	8	I	I/O Port
66	P3[7]	IO	4	I	I/O Port
67	P3[6]	IO	4	I	I/O Port
68	P3[5]	IO	4	I	I/O Port
69	P3[4]	IO	8	I	I/O Port
70	GND	-	-	-	Ground
71	GND	-	-	-	Ground
72	GND	-	-	-	Ground
73	RF1	-	-	-	RF signal for external antenna. See 4.13
74	GND	-	-	-	Ground
75	RF0	-	-	-	RF signal for external antenna. See 4.13
76	GND	-	-	-	Ground
77	GND	-	-	-	Ground
78	GND	-	-	-	Ground
79	TP1	-	-	-	Tuning point for internal antenna. Follow instructions of Section 8.5.
80	GND	-	-	-	Ground
81-88	TP2 to TP9	NC			Must be left unconnected. See section 8.3.2 and Figure 36.

Note 4: "NC" means: leave unconnected.
"GND" means internally connected to the module ground plane. Every GND pin should be connected to the main PCB.ground plane.

Note 5: All digital inputs have Schmitt trigger inputs. After reset all I/Os are set to input and all pull-up or pull-down resistors are enabled unless otherwise specified.
PU = Pull-up resistor enabled, PD = Pull-down resistor enabled, I = input,
O = output, Hi-Z = high impedance, 1 = logic HIGH level, 0 = logic LOW level
Refer also to Px_DIR_REGs for INPUT/OUTPUT and Pull-up/Pull-down configurations

Note 6: All ULP pins use snap-back devices as ESD protection, which (when triggered) have a holding voltage below the typical battery voltage. This means that the snap-back device of a ULP pin may remain conductive, when triggered while the pin is directly connected to the battery voltage. If any of the ULP pins are directly or indirectly electrically accessible on the outside of the application, system level ESD precautions must be taken to ensure that the snap-back device is not triggered while in active mode, to prevent the chip from being damaged.

2.0 Introduction

2.1 SCOPE

The SC14CVMDECT SF is a programmable DECT module for voice and data services. The internal software stack receives commands and data from the application, for instance to set up a link to other modules. The application software can be implemented on the module itself or on an external host processor. The internal FLASH provides user space where custom applications can be located.

The module converts analog signals to a digital stream, compresses/decompresses them according to the DECT standards and transmits/receives them over the air interface. The DECT protocol stack in each module supports both PP and FP functionality.

The embedded software running on the internal microcontroller (CR16) supports all protocol layers up to the network layer. The module can be controlled by software running on the internal controller as well as from an external controller via the UART.

2.2 REFERENCES

1. CVM FP API Documentation package.
2. CVM PP API Documentation package.
3. Athena Eclipse User Manual, v1.02, Dialog Semiconductor, Cordless Software and Tools.
4. SC14CVMDECT EEPROM (VES) map for PP (NatalieV3PpCvm Eeprom_vXXXX.html).
5. AN-D-174, SC14480 Battery Management; using the State of Charge function, Application Note, Dialog Semiconductor.
6. AN-D-212, SC14CVMDECT_SFxx_DB External Antenna Design and Leveraging Modular Approval, Application Note, Dialog Semiconductor.
7. AN-D-222, SC14CVMDECT production pairing, Application Note, Dialog Semiconductor.

2.3 GLOSSARY AND DEFINITIONS

AFE	Analog Front End
API	Application Programming Interface
Baby monitor	Same as intercom but optionally voice activated
CAT-iq	Cordless Advanced Technology, Internet and Quality
CODEC	COder and DECoder
CoLA	Co-Located Application
Conference	Same as intercom, but including an external party
CRC	Cyclic Redundancy Check
CVM	Cordless Voice Module
DECT	Digital Enhanced Cordless Telephone
DSP	Digital Signal Processor
EMC	Equipment Manufacturer's Code
ESD	ElectroStatic Discharge
FAD	Fast Antenna Diversity
FP	Fixed Part
GAP	Generic Access Profile (DECT)
GFSK	Gaussian Frequency Shift Keying
HPM	High Power Mode
Inband tones	Tones played by the application itself and not from external e.g. line.
Intercom	Internal call between FP and PP(s)
IPEI	International Portable Equipment Identity (ETSI EN 300 175-6)
IWU	InterWorking Unit (ETSI EN 300 175-1)
LCD	Liquid Crystal Display
LDO	Low Drop Out (regulator)
LDR	Low Data Rate
LPM	Low Power Mode
MCU	Micro Controller Unit
MMI	Man Machine Interface (keypad, LCD, buzzer, microphone, earpiece, etc.)
NTP	Normal Transmitted Power
PAEC	Perceptual Acoustic Echo Canceller
PC	Personal Computer, IBM compatible
PCB	Printed Circuit Board
PP	Portable Part
PSTN	Public Switched Telephone Network
RF	Radio Frequency
RFPI	Radio Fixed Part Identity (ETSI EN 300 175-6)
RLR	Receive Loudness Rating
RSSI	Radio Signal Strength Indication (ETSI EN 300 175-1)
Sidetone	Feedback of microphone signal to earpiece
SLR	Sending Loudness Rating
SPI	Serial Peripheral Interface Bus
UART	Universal Asynchronous Receiver and Transmitter
ULE	Ultra Low Energy
VAD	Voice Activity Detection
VES	Virtual EEPROM Storage
Walkie Talkie	Call between two PPs without an FP

3.0 Cordless Voice Module functions

This section describes the key functions and features supported by the SC14CVMDECT SF as shown in Figure 2.

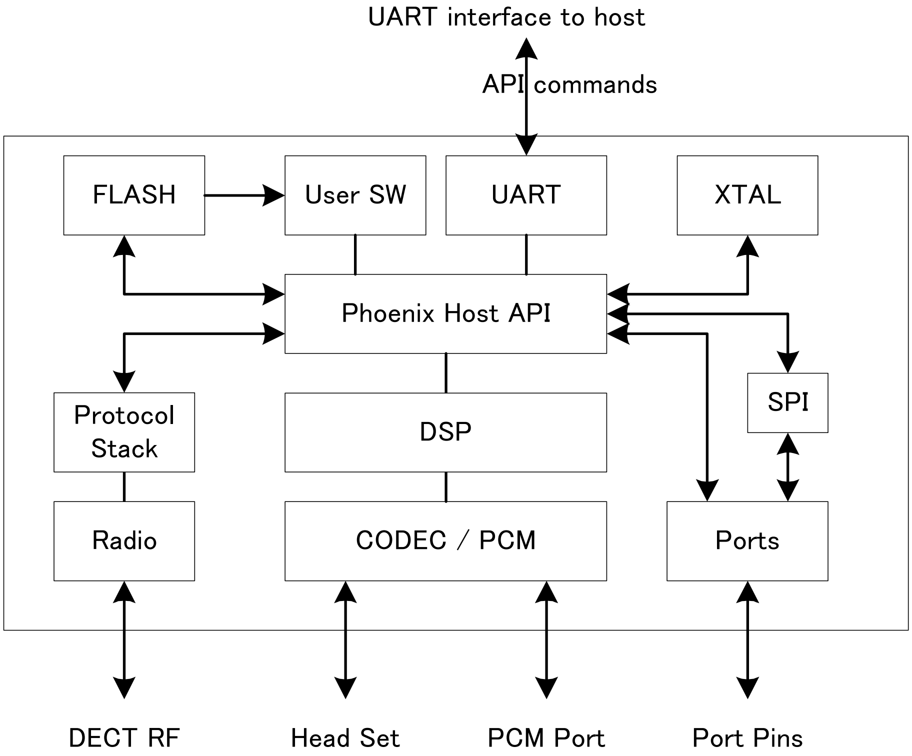

Figure 2: SC14CVMDECT SF functional overview

3.1 MODULE HARDWARE

The SC14CVMDECT SF internal hardware consists of:

- An internal microprocessor is running from FLASH and handles the API call coming from UART or embedded user software.
- A 4 kB VES (Virtual EEPROM Storage) used by the protocol stack and for user variables.
- A DSP for the audio signal processing like ADPCM voice compression towards the CODEC.
- A CODEC converts the analog signals to digital signals and vise versa.
- Input/Output ports which can be toggled high/low as an output or a high/low digital level can be read as an input.
- A 20.736 MHz XTAL. This crystal is automatically tuned by the PP module software for optimal radio performance.
- Voltage regulators convert the external supply voltage (VBAT) to stable supply voltages for the core and the I/Os.
- A DECT radio transceiver with a built-in antenna circuit. The antenna itself is integrated into the module, relieving the product designer from RF expertise.
- A full duplex UART for communication with an optional host processor.

3.2 SOFTWARE CONTROL

The application software is written by the customer and has to manage the call control and also the MMI functions. The supported API software includes the Network layer that is defined in figure 1 of the EN300 175-3 document, which describes the DECT protocol stack. Detailed functions and data flows, including some example sequences, can be found in document reference [1] for FP and [2] for PP.

The default configuration of the SC14CVMDECT SF module software is: US DECT, FP and CoLA enabled.

3.3 DECT PROTOCOL STACK

The SC14CVMDECT SF internal protocol stack is based on the ETSI DECT specifications and is compliant with ETSI 300 444 (GAP).

The product supports up to 6 DECT GAP compliant PP units to one FP station.

3.4 PORTABLE PART CONFIGURATION

A Portable Part configuration with SC14CVMDECT SF requires additional external parts as shown in Figure 3.

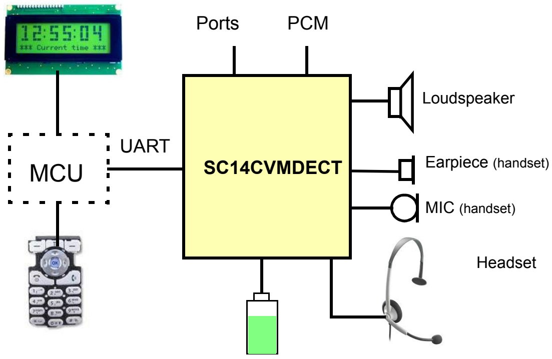

Figure 3: PP configuration

Table 3 provides an overview of the supported interfaces for a portable part.

Table 3: PP support overview

Item	Supported	Remark
Battery management	Yes	Supported by API
Keypad	No	On external MCU
Display	No	On external MCU
I/O Ports	Yes	All digital I/O port pins can be controlled by API
PCM interface	Yes	1x 16 bits serial I/O, PCM_FSC 8 kHz/16 kHz
UART	Yes	115.2 kbit/s, used for API-commands
Headset detection	Yes	Supported by API
LSR (Earpiece, headset)	Yes	Connected to LSRp and/or LSRn supports single-end and differential **(Note 7)**
MIC (Earpiece, headset, handsfree)	Yes	Connected to MICp and/or MICn and/or MICh supports single-ended and differential **(Note 7)**
Handsfree speaker	Yes	Connected to PAOUTp/n **(Note 7)**
Radio	Yes	Integrated single antenna and support for external antenna(s)

Note 7: AFE setting is configurable, refer to document [2].

3.5 FIXED PART CONFIGURATION

A Fixed Part configuration with SC14CVMDECT SF requires additional external parts as shown in Figure 4.

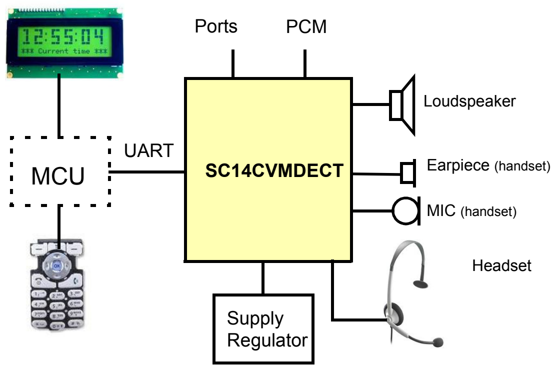

Figure 4: FP configuration

Table 4 provides the overview of required and available interfaces for a basic or a feature rich cordless FP with the SC14CVMDECT SF.

Table 4: FP support overview

Item	Supported	Remark
Supply Regulator	No	Use external 3.3 V LDO
Keypad	No	On external MCU
Display	No	On external MCU
I/O Ports	Yes	All digital I/O port pins can be controlled via API
PCM interface	Yes	4x 16 bits serial I/O, PCM_FSC 8 kHz/16 kHz
UART	Yes	115.2 kbit/s, used for API-commands
Headset detection	No	Not supported by API
LSR (Earpiece, headset)	Yes	Connected to LSRp and/or LSRn supports single-end and differential **(Note 8)**
MIC (Earpiece, headset, handsfree)	Yes	Connected to MICp and/or MICn and/or MICh supports single-end and differential **(Note 8)**
Handsfree speaker	Yes	Connected to PAOUTp/n **(Note 8)**
PSTN Line interface	No	Not supported by API
Radio	Yes	Integrated single antenna and support for external antenna(s)

Note 8: AFE setting is configurable, refer to document [1].

3.6 VOICE COMMUNICATION

An FP supports up to 64 registered PPs, where 4 of these PPs can be in a call at the same time. Multiple simultaneous calls are supported. Supported voice codec is G.726 (32 kbit/s ADPCM) and G.722 (64 kbit/s ADPCM). See Figure 5.

3.7 LIGHT DATA APPLICATION

The SC14CVMDECT SF supports Low Data Rate (LDR) transmission up to 1.6 kbit/s with IWU to IWU messaging. The LDR can be used in combination with voice communication. See Figure 5.

3.8 LU10 DATA APPLICATION

The SC14CVMDECT SF supports CAT-iq LU10 data transmission up to 54 kbit/s. Since LU10 data communication uses the B-Field it cannot be used in combination with voice communication. See Figure 6.

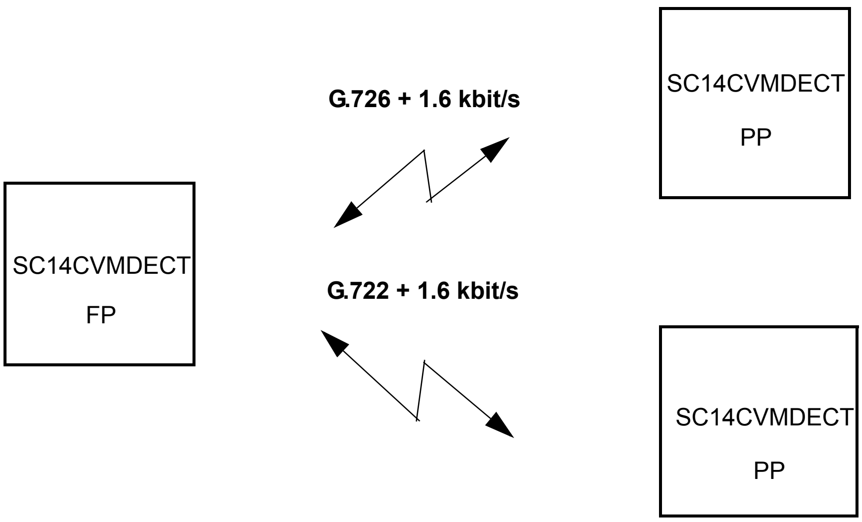

Figure 5: Voice and LDR data communication

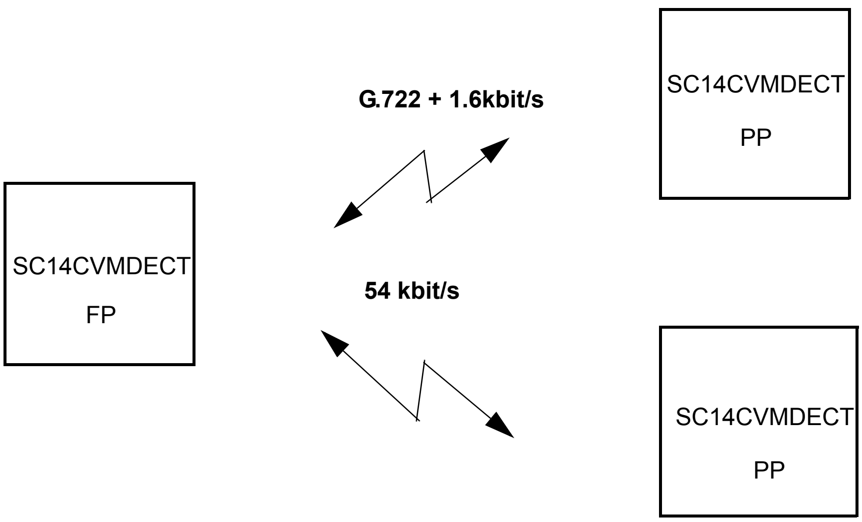

Figure 6: LU10 data application

3.9 GENERAL FEATURES

Table 5: Supported general features

Functionality (Note 9)	PP support	FP support	Remark
Call handling			
Conferencing	-	Yes	Call between FP and 4x PP
Intercom	Yes	Yes	Call between FP and 4x PP
Walkie Talkie mode	Yes	-	Call between PP and PP without FP
Baby monitor	Yes	-	Voice Activated PP. See document reference [2]
Voice over PCM interface	Yes	Yes	μ-law (64 kbit/s), A-law (64 kbit/s), G.726 ADPCM (32 kbit/s), G.722 ADPCM (64 kbit/s), Linear (128 kbit/s)
Call transfer	Yes	Yes	Transfer call between PPs on FP
Page call	Yes	Yes	FP pages all PPs (PP locator)
Protocol			
Manual registration	Yes	Yes	
Wire registration	Yes	Yes	See document reference [7]
Number of CVM PP registrations per FP	-	Yes	1 to 6 for SF01
			1 to 64 for SF02 **(Note 10)**
Number of ULE PP registrations per FP	-	Yes	1 to 180 for SF01
			1 to 64 for SF02 **(Note 10)**
Audio and tone			
Microphone mute	Yes	Yes	
Tone generation	Yes	No	Melody generator with 7 polyphonic tones
Audio Volume control	Yes	Yes	
Tone Volume control	Yes	No	
Headset support	Yes	Yes	
Handsfree/Speakerphone	Yes	No	
General			
Real time clock	Yes	Yes	Accuracy depending directly on crystal
Real time clock synchronization	Yes	Yes	All PP clocks are kept in synchronization with the FP
SW EEPROM (VES) Storage	Yes	Yes	Internal on module
Battery Charge Management	Yes	No	
PSTN line interface support	-	No	PSTN software on request
I/O port support	Yes	Yes	
Port Interrupt support	No	No	
Automatic headset detection	Yes	No	
Low speed data	Yes	Yes	1.6 kbit/s
LU10 data channel	Yes	Yes	54 kbit/s **(Note 11)**
CAT-iq up to version 2.0, 3.0	Yes	Yes	

Note 9: These features can be supported by combined API commands in user software.
Note 10: The number of PP registrations includes both CVMDECT PP and ULE PP devices.
Note 11: SF02 supports one channel LU10 simultaneously.

4.0 Functional description

4.1 UART INTERFACE

The UART is normally used for API commands, but can also be used for software upgrades and debugging.

The UART is a full duplex UART with frame type:

1 start bit,
8 data bits (LSB first),
1 stop bit,
no parity,
up to 115.2 kBd.

The UART hardware interface uses only TX/RX (see Figure 7).

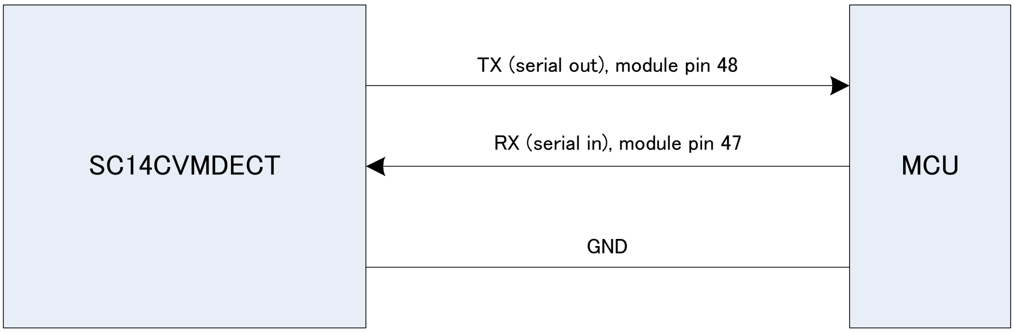

Figure 7: UART hardware configuration

Caution: All UART signals are 1.8 V, input max. 3.45 V (see Table 18, Table 21 and Table 22). An external V.24 line driver must be provided if the UART port of the module is connected to a standard V.24 device (±12 V). Connecting the module without a driver may damage the module.

4.2 VES (VIRTUAL EEPROM STORAGE)

4.2.1 VES layout

The SC14CVMDECT SF PP and FP include a 4 kB VES which is divided into two areas (see Table 6).

Table 6: VES map

VES space	Size	Usage
SC14CVMDECT SF	3.6 kB	Used for RF, audio, battery, tone setup, data base, etc.
User	0.4 kB	Can be used for MMI applications such as User information.

VES is supported as virtual EEPROM with the internal FLASH.

A detailed overview of the VES parameters can be found in document reference [4].

Some parts of the VES parameters are read into the SC14CVMDECT SF during the start up and other parts are used by the SC14CVMDECT SF software during execution.

The VES parameters are divided into two types:

- Factory type
- Normal type

The “factory” type is specific for the SC14CVMDECT SF and should only be set by production. The “factory” type parameters are either adjustments used by the baseband or the radio interface, or are used to set up the SC14CVMDECT SF into special modes. The “factory” type parameters will only be modified by changing the factory programmed default value. See document reference [4].

The “normal” VES parameters can be reset to their default values via software.

4.2.2 VES access by MCU

The host is able to read or modify the VES parameters or limited free VES areas via API command.

4.3 AUDIO CONFIGURATIONS

The SC14CVMDECT SF audio supports standard DECT audio qualities. The audio gain and volume parameters are placed in the VES. The DECT gains can be adjusted to meet the TBR38 and TBR10 audio level requirements by using the SC14CVMDECT SF application reference design. For other line and acoustic designs it is required to adjust and tune the audio setup.

4.3.1 Audio connection

The SC14CVMDECT SF PP audio connections are shown in Figure 8. Refer to "Example application diagram" on page 49 for detailed component values.

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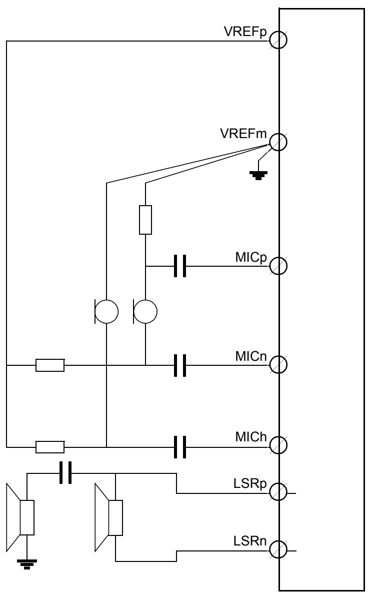

Figure 8: Audio connections

Earpiece or small loudspeaker connection

The earpiece loudspeaker can be connected either differentially or single-ended. Dynamic loudspeakers with an impedance of 30 Ω can be connected, as well as ceramic loudspeakers equivalent to 600 Ω and 30 µF. Refer to Table 28 for a detailed specification or the earpiece loudspeakers.

The earpiece is connected to the LSRp and LSRn pins.

Microphone connection

The microphone can be connected either single-ended via MICp or differentially to MICp and MICn.

Headset connection

The headset microphone must be connected to the MICh pin. The headset earpiece is connected to the LSRp.

Microphone supply connection

For active microphones a voltage source with high supply voltage rejection ratio is provided on supply pins VREFp/VREFm. Filtering of internal and external reference voltages is provided by an internal capacitor. No external capacitor shall be connected to pin VREFp. To avoid audible switching noise it is important that the ground supply signals are directly "star point" connected to the VREFm and **not** via a common ground plane. From this VREFm star point, one connection is made to the common ground plane.

Loudspeaker connection

For the handsfree operation a 4 Ω loudspeaker must be connected to the PAOUTp and PAOUTn pins as shown in Figure 9. The VDDPA is the supply pin.

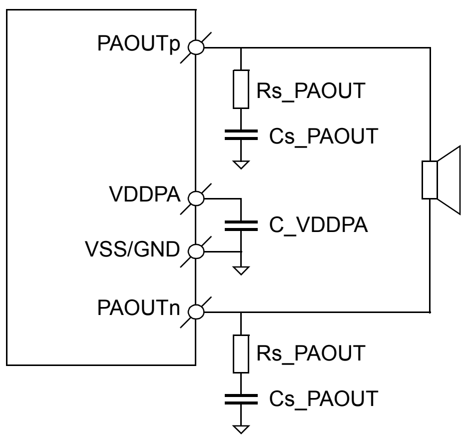

Figure 9: Loudspeaker connection

Refer to Table 31 for a detailed specification of the external components around the loudspeaker. These components are necessary to guarantee the lifetime of the module.

4.4 AUDIO ROUTING

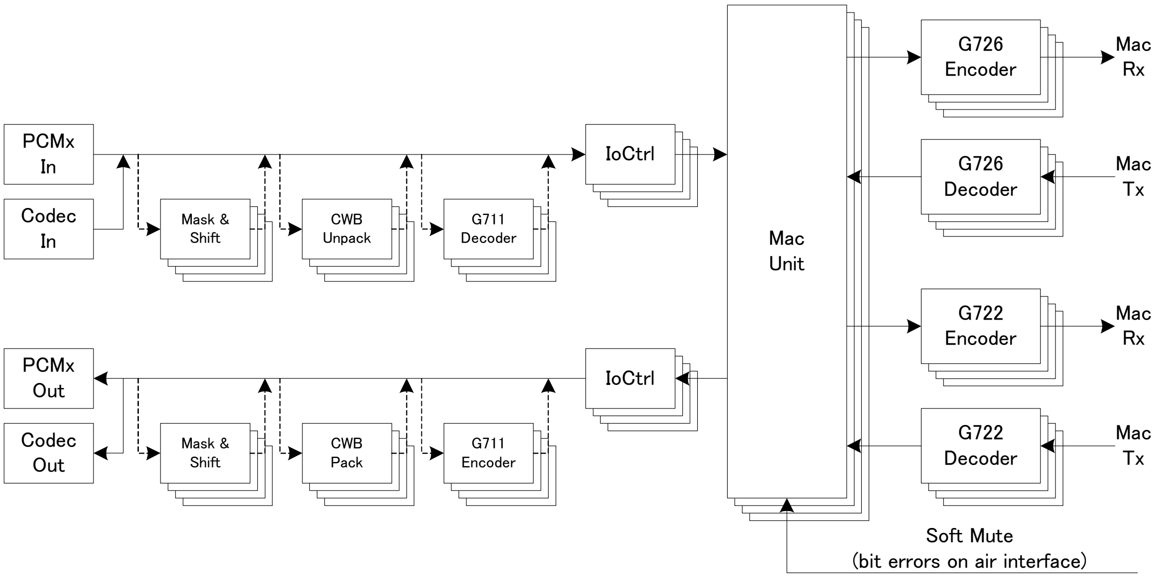

Figure 10: FP audio routing

4.4.1 FP audio routing

Figure 10 shows the audio routing for an FP. Input and output signals are supported both for the internal codec and the PCM, and the Air interface supports G.726 (32 kbit/s ADPCM) and G.722 (64 kbit/s ADPCM). The internal software supports up to 4 audio channels simultaneously. Supported sample rates are 8 kHz and 16 kHz.

FP does not support acoustic or line echo cancellation.

4.4.2 FP audio level adjustment

The internal codec audio levels can be controlled with the parameters MicGain and LsrGain.

The MicGain range is 0 to 30 dB in steps of 2 dB and a value of -128 will mute the input signal, default is 0 dB.

The LsrGain range is +2 dB to -12 dB in steps of 2 dB, default is +2 dB. See document reference[1].

4.4.3 PP audio routing

Figure 11 and Figure 12 show the different audio routing modes of a PP. Figure 11 shows an overall audio routing and Figure 12 shows the detailed audio routing for the speakerphone of PP (FP does not support speakerphone).

4.4.4 PP audio codec adjustment

The audio codec settings for the loudspeaker and microphone must be pre-configured in the VES for each mode. The VES parameter fields for

Audio.Earp.xxx
Audio.Heads.xxx
Audio.SpkPh.xxx

have a default value and maybe fine-tuned for the application. See document reference [4].

4.4.5 General audio adjustment

For each audio mode, the receive (RLR) and transmit (SLR) audio paths must be adjusted. RLR and SLR are adjusted in the registers in the VES for each audio state; see document reference [4]. Figure 13 shows this image.

4.4.6 PP volume

The PP supports 6 volume steps, which are VES configurable through parameter fields Audio.Earp.Vol.xxx, the Audio.Heads.Vol.xxx and Audio.SpkPh.Vol.xxx. The volume steps must be set initially in the VES during production; see document reference [4].

4.4.7 PP audio equalization

To enable adjustments of the frequency response the PP contains four programmable filters: 2 in RX direction and 2 in TX direction (see Figure 11).

By default these filters are loaded with bypass coefficients. These can be modified by loading new coefficients via API commands.

Equalizer filters are part of the audio routes for all audio modes and are placed as shown in Figure 11.

For a detailed description of the filter functionality refer to the API documentation; see document reference [2].

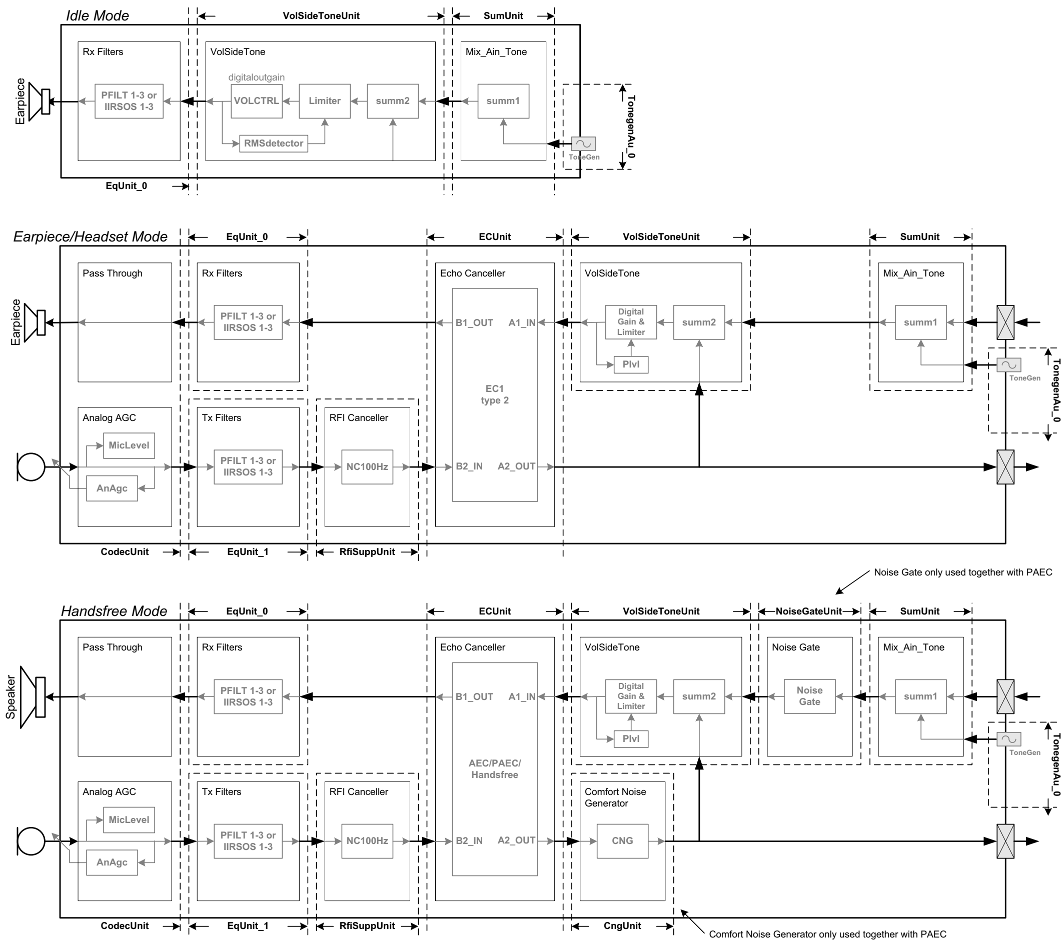

Figure 11: PP audio routing

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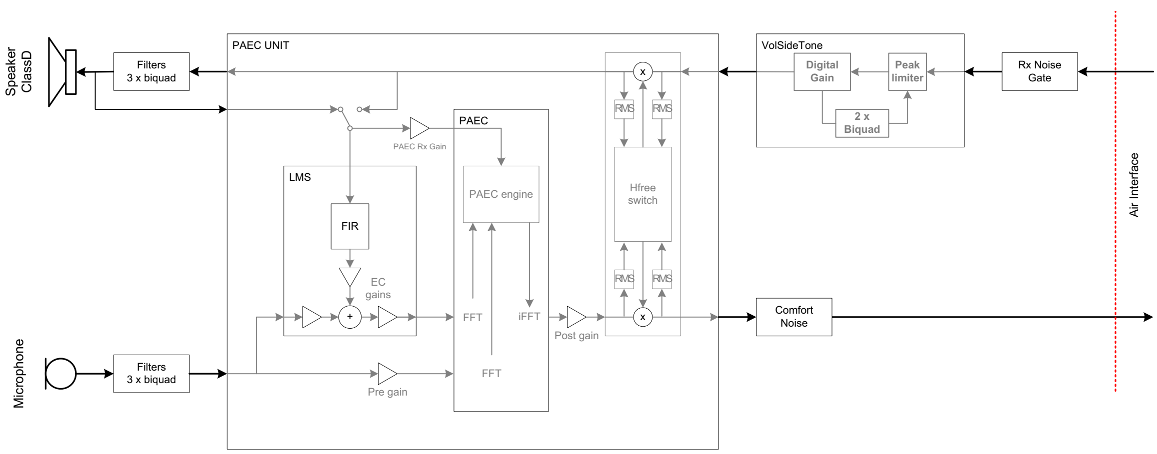

Figure 12: Extended speakerphone for PP

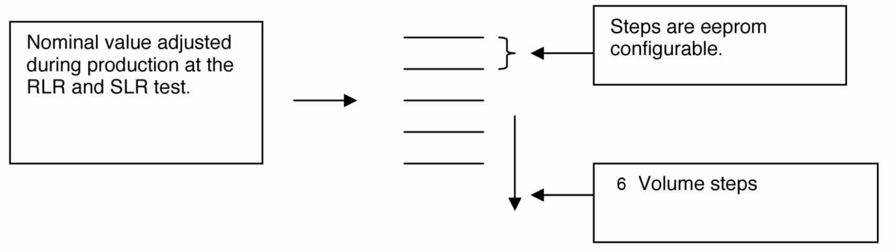

Figure 13: Handset volume configuration

4.5 PP AUDIO MODES

The PP audio handling consists of four audio states (see Figure 14). In these states the audio subsystem is configured for a certain audio mode:

1. Idle mode (not relevant for microphone configuration)
2. Earpiece mode (Handset speaker)
3. Handsfree or Speakerphone mode
4. Headset mode

Selection between the modes is done via API calls; see document reference [2].

The Alert state is for tone playing and is entered automatically when tones are played using the API calls. The Alert state can originate from idle, earpiece, handsfree or headset mode.

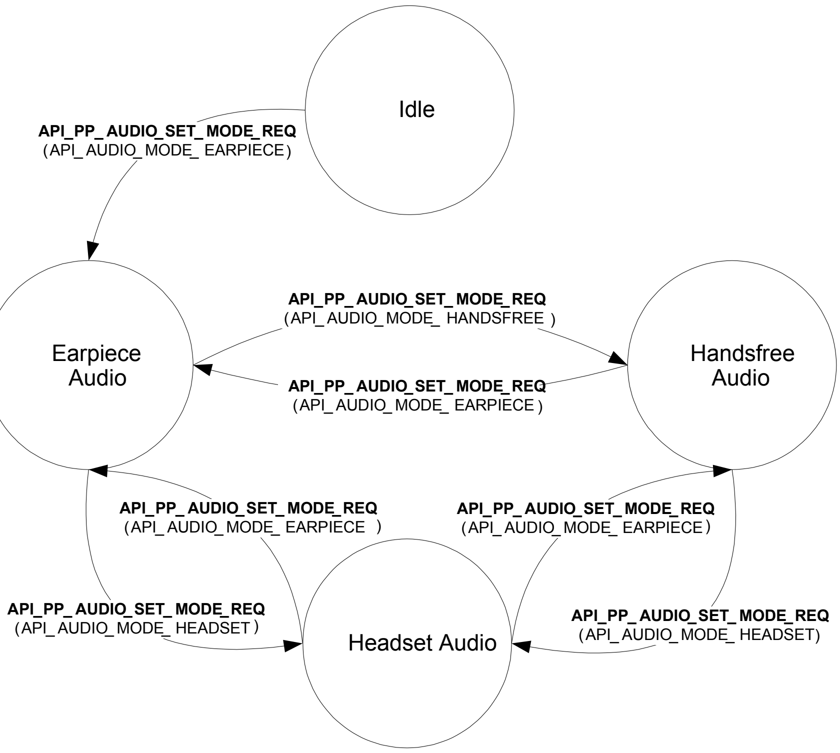

Figure 14: PP audio modes

4.5.1 Power management

To minimize the current consumption the PP will shut down all codec amplifiers in Idle mode. This means that all reference voltages in the analog front-end will be disabled. This feature can be disabled in the VES if the reference voltages for some reasons are needed in Idle mode.

4.5.2 Earpiece mode

In Earpiece mode (Handset speaker) an artificial sidetone is generated. The level of the sidetone can be adjusted and setup in the VES through parameter fields Audio.Earp.Vol.Elementx, SideToneGain and Audio.Heads. Elementx.SideToneGain. In Earpiece mode it is possible to adjust the volume in the Earpiece via API calls. In Earpiece mode the PP audio is routed as shown in Figure 11.

4.5.3 Alert mode

The Alert mode is for generating tones and melodies on the Speakerphone loudspeaker. In Alert mode it is possible to adjust the volume in the speaker via API calls. Inband tones will be affected by the volume adjustments, since the volume control takes place after tones are added to the signal. Figure 11 shows the Audio flow.

4.6 CALL HANDLING

4.6.1 FP to PP call

When the FP initializes a call to a PP, a radio connection is set up to all PP applications to make it possible for the PP application software to indicate that there is an incoming call.

It is possible to configure the ringing indication using broadcast to make all 64 PPs ringing.

4.6.2 PP to FP call

When the MMI software signals the PP to establish a call, the PP opens the radio connection to the FP.

4.6.3 Intercom

Figure 15 shows the audio routing of an internal call between PP1 and PP2. In the FP no transcoding takes place.

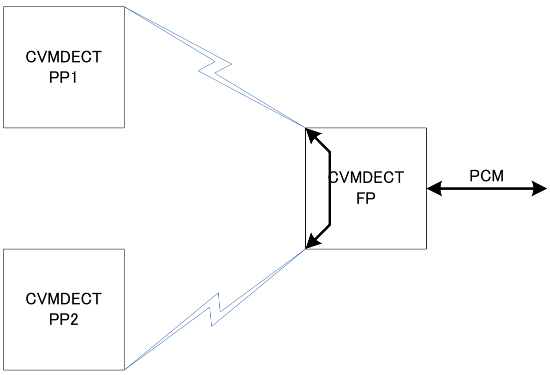

Figure 15: Intercom connection

4.6.4 Conference

Figure 16 shows the audio routing of a 9-party conference call.

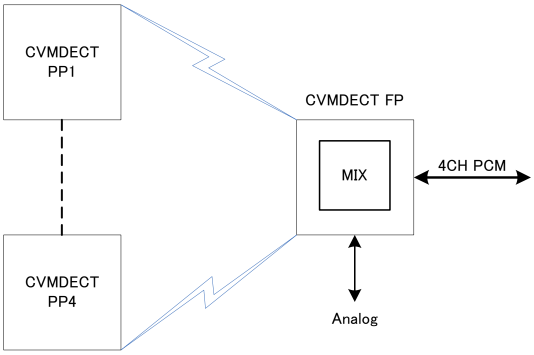

Figure 16: Conference connection

4.6.5 Page call

The Page call is an FP functionality used to locate the registered PPs. FP paging does not establish a normal audio connection and is terminated when answered by the PP.

4.7 TONE/MELODY HANDLING

The tone component handles the generation of various tones in the device. Both tones/melodies in a PP configuration are supported.

The main features of the tone component are:

- Ringer tones and melodies (7-tone polyphonic)
- Alert tones (key sound, error tones, confirmation tones, etc.)
- Inband tones (dial tone, net-congestion tone, busy tone, etc.)
- Single tone generation

4.8 DATE AND REAL-TIME CLOCK

The FP has a real-time clock feature, which (when activated) broadcasts the date and time of day to the PPs. Activation of the date and real-time clock is done by setting the date and time via the PP.

The clock supports hours, minutes and date. The date supports leap years. Daylight saving time is not supported and must be handled by the MMI application.

The PP clock is synchronized with the FP every time a broadcast is received. If the PP goes out-of-lock, the PP itself calculates the clock time until the PP is again within the range of the FP. The updated clock time can be read locally via the MMI software.

To adjust the clock in the FP, a service connection can be set up via commands from the PP.

The clock can also be read and set directly from an external microprocessor or through the MMI software on the FP.

The real-time clock accuracy depends directly on the SC14CVMDECT SF crystal.

When the SC14CVMDECT SF is configured as a PP, the clock has the same accuracy as the FP clock. When the PP synchronises with an FP, the PP crystal is synchronized with the FP crystal and the PP clock will change accordingly.

The accuracy is expected to be within 1 minute for up to 6 weeks without being locked to an FP.

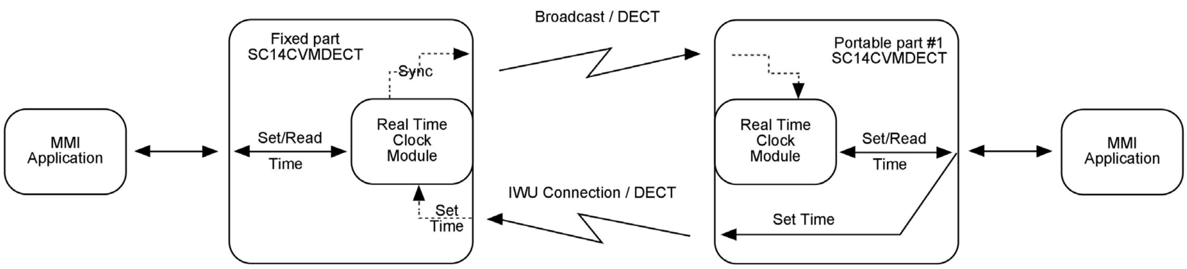

Figure 17: Clock synchronization

4.9 BATTERY MANAGEMENT

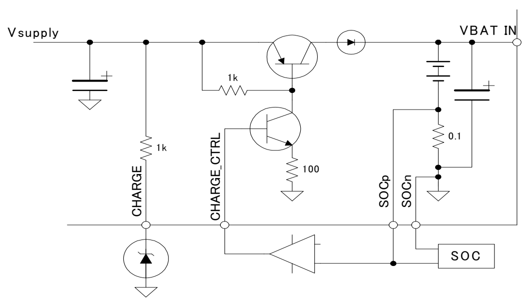

Figure 18: Handset (PP) application with 2x NiMH

Figure 18 shows a handset application with NiMH. SOC (State Of Charge) is used to measure the amount of charge in the rechargeable batteries.

Figure 19 shows an FP application. The FP uses an external LDO, so the SOC pins are not used and can be connected to GND.

The PP API supports battery management to calculate the battery capacity and to indicate charge status. Refer to API document [2].

The SOC circuit is used to very accurately determine the amount of charge in rechargeable batteries as well as the discharge state of Alkaline batteries. This information is essential for the battery charging algorithm and necessary for battery status indication to the user. Battery status information is supported by the API. Detailed information can be found in AN-D-174 (Battery Management) [5].

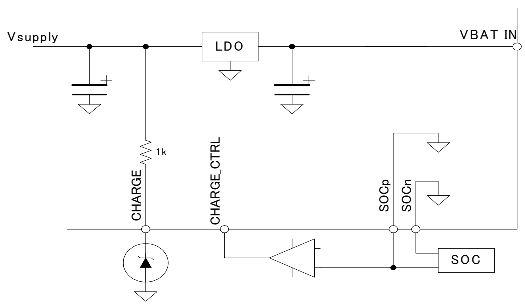

Figure 19: Base station (FP) application

Pin CHARGE_CTRL is driven high when either the “sensed voltage on the VBAT pin” is lower than the voltage setting or “sensed current via SOCp” is lower than the current setting. Pin CHARGE_CTRL can drive up to 500 μA as source current (see Table 32). Detailed setting information can be found in document [4] under “Battery settings”.

4.10 PROTOCOL STACK

The protocol stack handles the RF interface, the MAC-, DLC-, NWK-layer and encryption according to the DECT standard EN300 175 1-9.

4.10.1 DECT TBR22

The SC14CVMDECT SF supports the DECT GAP standard according to EN300 444. For TBR22 type approval (optional) switching off the authentication and encryption is required, which can be done with the VES parameter Tbr_22.

4.10.2 Out-of-Range handling

When the PP goes in-range or out-of-range a signal is sent from the PP to the MMI software indicating whether the PP is in-lock or is out-of-lock with the FP.

4.10.3 Preamble antenna diversity

To optimise the audio quality caused by rapidly changing radio paths (fading), the SC14CVMDECT SF supports preamble antenna diversity. The preamble diversity algorithm uses RSSI measurements to judge the radio signal strength on both antennas and, as a result, the choice of the best performing antenna is determined. This antenna will then be used for the receive slot and the next transmit slot.

The preamble antenna diversity is supported with two antennas. The preamble diversity can be controlled by VES. See document reference [4] and section 4.13 for more information about antenna diversity.

4.10.4 Broadcasting messages

Messages consisting of up to 19 bytes can be broadcasted from FP to all registered PPs. Broadcasting does not require an active connection. Broadcasting does not use retransmission, therefore broadcasting is not secured. If the real time clock is enabled this data is also broadcasted to all PPs.

4.10.5 IWU to IWU messaging

The protocol in the SC14CVMDECT SF module is made according to the DECT/GAP standard as defined in EN 300 175 and EN 300 444.

The DECT standard defines an EMC code (see EN 300 175-5, chapter 7.7.23.). This code is unique for a DECT product and must be programmed by the DECT manufacturer to the correct manufacturer code.

The EMC code must be the same for SC14CVMDECT SF based product families when using the IWU to IWU messaging.

If the Dialog default EMC VES value is changed the IWU to IWU messaging may not operate correctly.

IWU data is transferred in a FA format frame; see chapter 6.1 in EN 300 175-4. This frame has an information field of maximum 63 bytes of which maximum 52 bytes can be used for IWU data. With the SC14CVMDECT SF it is only possible to send 5 frames in a row without pause. The following frame must be an acknowledge-frame to secure that the internal buffers within the SC14CVMDECT SF are emptied.

The FA frame is segmented in 5 byte fragments and transferred over the air-interface in the A-field. The 2-bytes CRC is used to determine if the data is received correctly. If the data is not received correctly this is signalled back to the transmitter by the Q2 bit, and the data is retransmitted.

The FA frame has a 2 bytes checksum, used to determine if the complete packet is received correctly. If A checksum error is signalled back to the transmitter and the complete packet is retransmitted. The packet will be retransmitted until it is received correctly, or until the link is closed.

More transmitted packets will be received in the same order as they were transmitted. The application must handle flow control, if needed.

4.11 REGISTRATION

The PP and the FP must be paired using a procedure called Registration. Without Registration, the PP will be out-of-lock and will not be able to establish a link to an FP and therefore not be able to make a call. The registration uses the unique product identities and secures the PP and FP to allow no cross-communication.

The PP can be de-registered from an FP either via the FP or PP MMI Software using the command interface. It is also possible to deregister a PP from another registered PP.

It is possible to pair a PP and FP during the production.

4.11.1 Handling product identities

To secure that the FP and PPs do not make cross-communications a unique ID must be entered into the VES of an FP or PP. For the DECT version the ID for the FP is named RFPI and for the PP the ID is named IPEI. These numbers are factory settings.

After a successful registration, the IPEI is stored in the FP and the RFPI is stored in the PP. In this way the two parts are known to each other and are allowed to make connections. The registration data are automatically stored in VES of the FP and PP while making the registration.

It is possible to register the same PP to 2 FPs, but it can only be used in one FP at the same time.

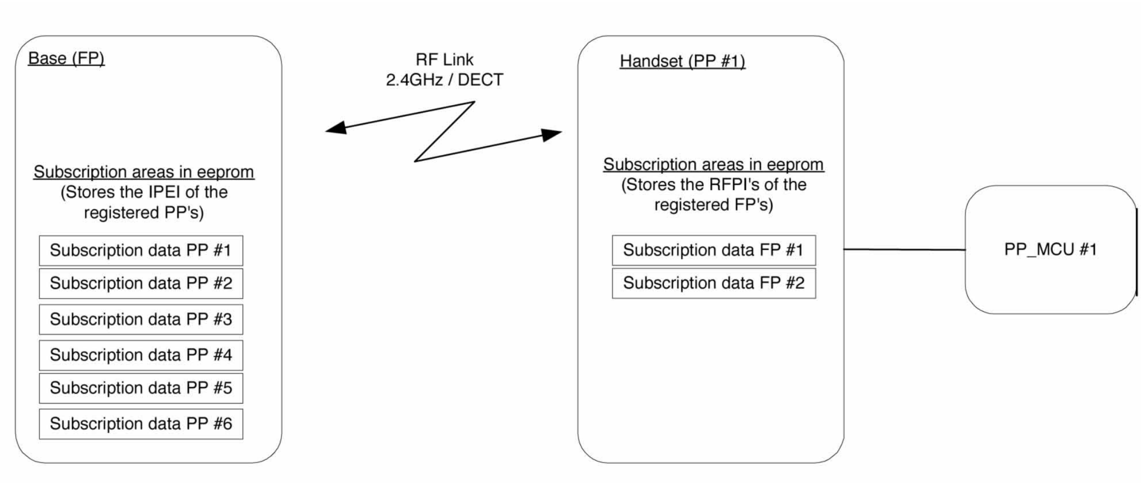

Figure 20: Handling product identities

4.11.2 Deregistration

There are two ways of deregistering a PP from an FP:

- Remote FP and PP deregistration
  The correct way to deregister a PP from an FP is to deregister it remotely in the FP. If this is done over a service connection from the PP to the FP, the FP actually performs the deregistration and then it is automatically signalled to the PP which in turn will drop out-of-lock. Using this method it is also possible to deregister other PPs registered to the FP from one PP.
- Removing all registrations at once from the FP (e.g. in case the original PPs are lost).

4.12 PCM INTERFACE

The PCM supports the following modes:

- SLAVE mode clock sync. In this mode the clock of the module will be adjusted to follow the PCM provided by the external PCM master clock. All audio samples are kept if the provided PCM clock accuracy is +/- 5 ppm, which is a DECT radio requirement.
- SLAVE no clock sync. In this mode the clock of the module is not synchronized. This means audio sample will be discarded in case the master PCM clock is faster than the clock of the module or samples will be repeated in case the master PCM clock is slower.
- MASTER mode. The FP is master on PCM interface and therefore provides PCM clock and PCM_FSC to an external device.

4.12.1 PCM Interface for FP

The SC14CVMDECT SF supports PCM interface functionality to connect to an external audio source/destination.

The different PCM interface modes and timings are shown in Figure 21 to Figure 26. Refer to document [1] for detailed information.

4.12.2 PCM_FSC frequency

The PCM interface supports the following options:

- 8 kHz
- 16 kHz

4.12.3 Length of PCM_FSC

The PCM interface supports the following options:

- 1: The length of PCM_FSC pulse is equal to 1 data bit.
- 8: The length of PCM_FSC pulse is equal to 8 data bits.
- 16: The length of PCM_FSC pulse is equal to 16 data bits.
- 32: The length of PCM_FSC pulse is equal to 32 data bits.

4.12.4 Start position of FSC

The PCM interface supports the following options:

- The FSC pulse starts 1 data bit before the MSB bit of the PCM channel 0 data.
- The FSC pulse starts at the same time as the MSB bit of the PCM channel 0 data.

4.12.5 PCM clock frequency

The PCM interface supports the following options in master mode:

- 1.152 MHz
- 2.304 MHz
- 4.608 MHz
- 1.536 MHz

4.12.6 PCM data mode

The PCM interface supports the following PCM data formats:

- Linear PCM, 8 kHz sample rate. Used for narrowband calls (G.726).
- Linear PCM, 16 kHz sample rate. Used for wideband calls (G.722).
- G.711 – A-law, 8 kHz sample rate. Used for narrowband calls (G.726).
- G.711 – μ-law, 8 kHz sample rate. Used for narrowband calls (G.726).
- Compressed wideband using A-law, 16 kHz sample rate. The 16 bit PCM data is encoded as two 8 bit audio samples if 8 kHz frame sync is used. Used for wideband calls (G.722).
- Compressed wideband using μ-law, 16 kHz sample rate. The 16 bit PCM data is encoded as two 8 bit audio samples if 8 kHz frame sync is used. Used for wideband calls (G.722).

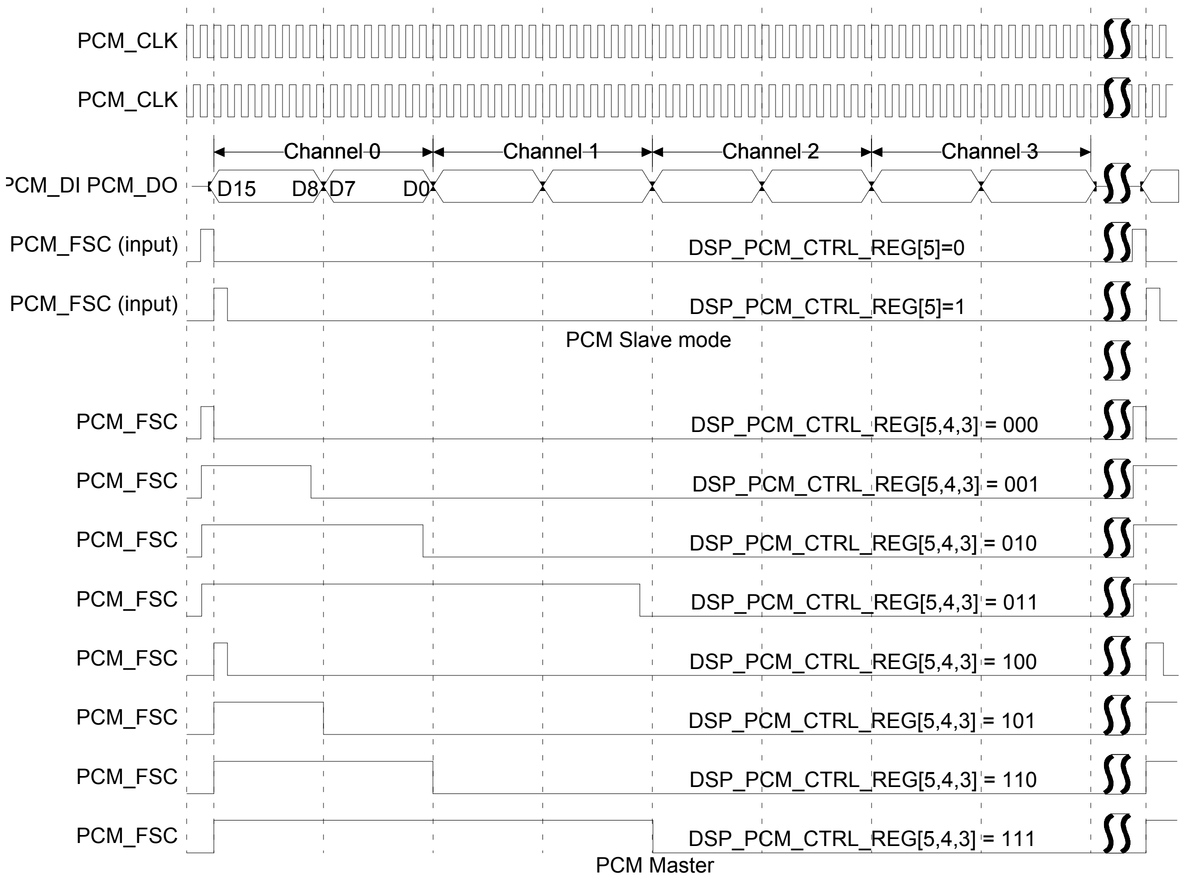

Figure 21: PCM interface formats

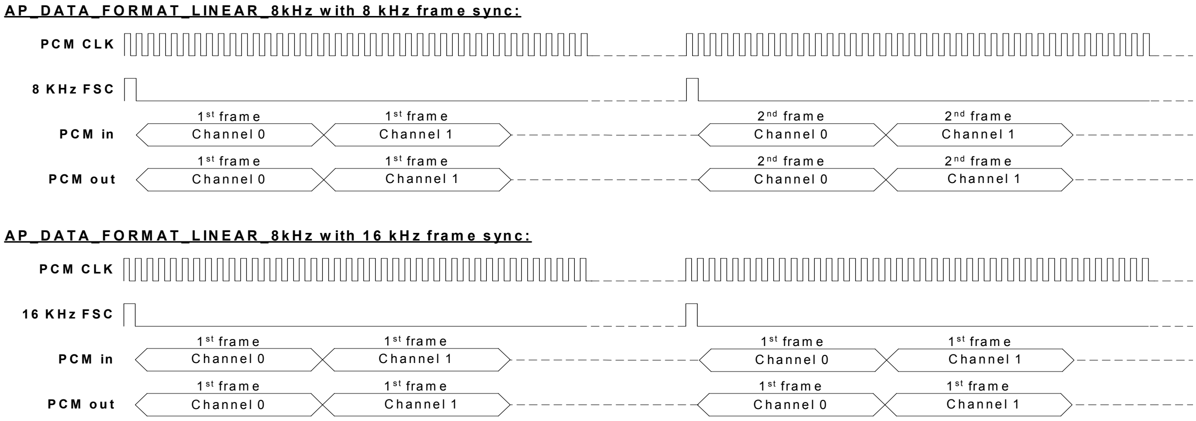

Figure 22: PCM bus with linear PCM, 8 kHz sample rate

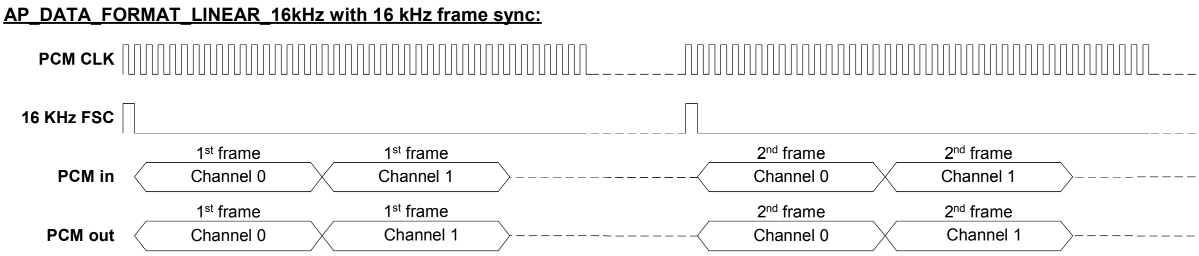

Figure 23: PCM bus with linear PCM, 16 kHz sample rate

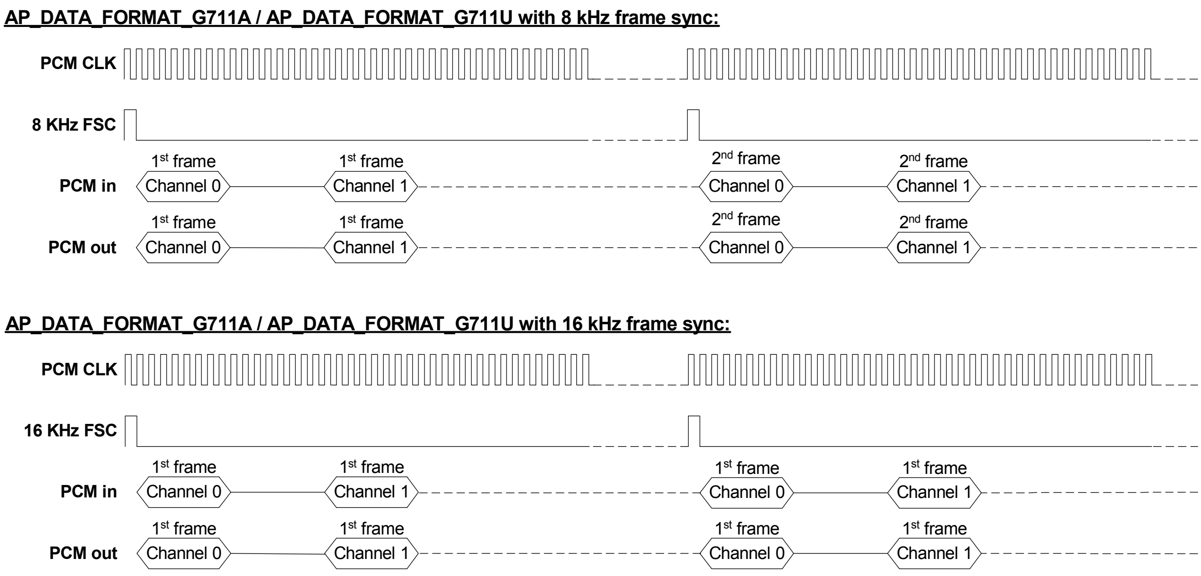

Figure 24: PCM bus with G.711 – A-law/μ-law, 8 kHz sample rate

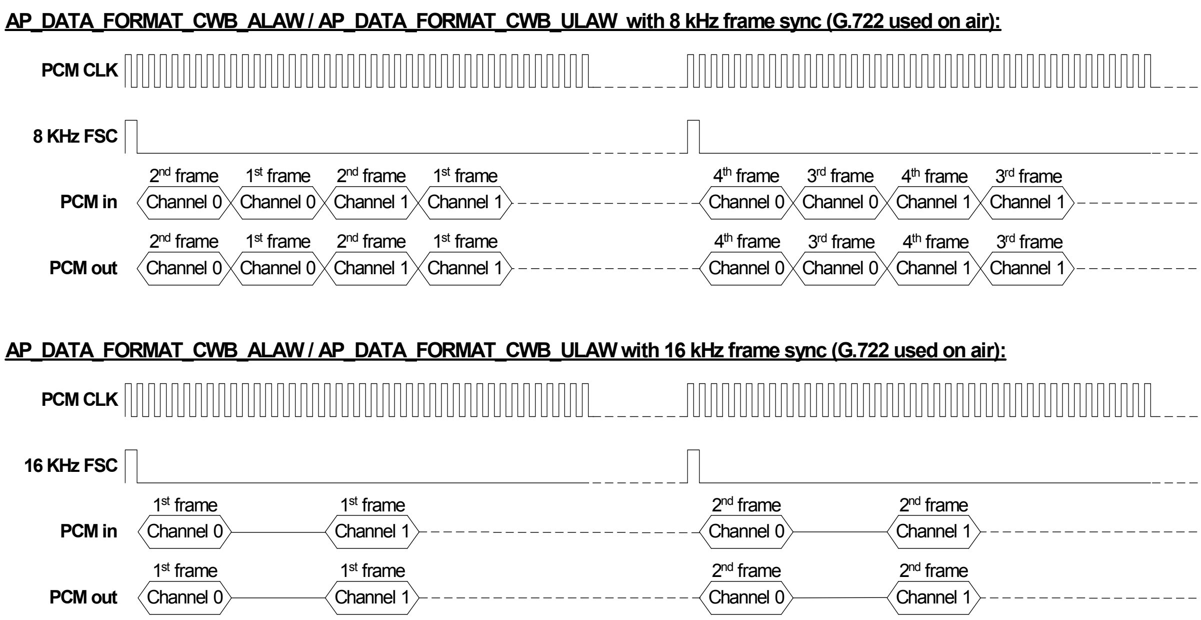

Figure 25: PCM bus with compressed wideband using A-law/ μ-law, G722 used on air interface

