



February, 2003

Polyphonic ring signals T300, P800, T310, T610

Preface

1. Purpose of this document

The Developers' Guidelines for Polyphonic ring signals is designed to give the reader an understanding of how high quality, polyphonic sound is supported in Sony Ericsson phones. To be able to support polyphonic sound, a synthesizer is built into the phone. The polyphony of a sound generator refers to its ability to play more than one note at a time. In Sony Ericsson phones, polyphonic sound follows the Musical Instrument Digital Interface (MIDI) standard. MIDI files are significantly smaller than digital audio files (.wav, .aiff, etc.), which makes polyphonic ring signals suitable to download, store, edit and share with other users via WAP, MMS, Bluetooth wireless technology or Infrared.

People who can benefit from this document are:

- Music designers
- Music arrangers
- Software developers
- Content providers
- Publishers
- Operators and service providers
- Business decision-makers

It is assumed that the reader has a basic understanding of ring signals and sound in mobile phones and of mobile network technology. For music developers, valuable prerequisite knowledge includes Musical Instrument Digital Interface (MIDI) standard and synthesizer programming.

More information, useful for music developers and producers, service and application developers, is published on the Sony Ericsson Developer World. The site at <http://www.SonyEricsson.com/developer> contains up-to-date information about technologies, products and tools.

2. Document conventions

In this document the following terminology is used:

3GPP™

Third Generation Partnership Project.

DRM

Digital Rights Management; controlling copying and distribution of contents, with respect to intellectual property rights.

EMS

Enhanced Message Service. Allows the user to add simple pixel pictures and animations, sounds and melodies to a text message. The EMS 3GPP™ standard also includes text formatting.

FM synthesis

Frequency Modulation (FM) synthesis. The audible frequencies are created by a modulating signal (the modulator), that controls the amplitude of another signal (the carrier).

Forward lock

A solution for DRM, which disables the user from forwarding of content that is the property of the designer, composer or publisher, or subject to licensing and royalty agreements.

GM, GM1, GM2, GM Lite

General MIDI Level1, Level2, Lite. These are covered by the MIDI standard and its extensions.

MIDI

Musical Instrument Digital Interface, a protocol for music description in binary form.

MMS

Multimedia Messaging Service. Defined and specified by 3GPP™ as a standard for third generation implementation, MMS completes the potential of messaging. Sending digital postcards and PowerPoint-style presentations is expected to be among the most popular user applications of MMS.

RMF

Rich Music Format™. A new type of sound file for transforming music and sound on digital and wireless devices, such as mobile phones and PDAs.

SMF

Standard MIDI File format. This is the common way to store MIDI protocol messages in memory. In addition to the native MIDI protocol, the Standard MIDI File format includes also time-stamped events for playback in the proper sequence.

SP-MIDI

Scalable Polyphony MIDI. SP-MIDI makes a polyphonic ring signal sound good in the recipient's mobile phone, even if the support for polyphony is different on different phones.

Timbre

Tone quality, loosely referred to as an instrument.

Voice

A note rendered at a given moment. In polyphonic sound, several voices are rendered simultaneously.

WAP

Wireless Application Protocol. Handheld devices, low bandwidth, binary coded, a deck/card metaphor to specify a service.

Wavetable synthesis

The audible sounds are created by combining and playing sound segments from a "table" of digitized natural sound, stored in the synthesizer.

3. Document history

Change history		
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2002-12-04	Version R2A	Phone model P800 added
2003-01-21	Version PC2	Phone models T310 and T610 added
2003-01-27	Version PC3	Tips list added for T310
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Contents

1. Purpose of this document	2
2. Document conventions.....	2
3. Document history	4
Technical overview and architecture	7
4. The MIDI world	8
4.1. Protocol.....	8
4.2. Standard MIDI files	8
4.3. Sony Ericsson supported MIDI formats.....	8
4.4. Scalable Polyphony MIDI (SP-MIDI)	8
Application Development	9
5. MIDI in Sony Ericsson phones	10
5.1. Sound generation.....	10
User interface and use cases	11
6. Using MIDI in Sony Ericsson phones.....	12
6.1. MIDI sounds played as ring signals	12
6.2. MIDI played in the sound browser and in applications	12
6.3. MIDI file sizes	13
7. Distribution	13
7.1. Forward lock	13
Technical specifications/ Additional information.....	14
8. Links and references.....	15
8.1. Documents.....	15
8.2. Links.....	15
8.3. Trademarks and acknowledgments	15
Appendix.....	16
9. Sony Ericsson T300/302.....	17
9.1. Technical characteristics: polyphonic ring signals	17
9.2. Sound generation and hardware	18
9.3. Frequency range	18
9.4. Tone map for T300/T302	20
9.5. Percussion map	22
9.6. Tips!.....	23
10. Sony Ericsson P800/P802.....	24
10.1. Technical characteristics: polyphonic ring signals	24
10.2. Scalable Polyphony MIDI (SP-MIDI)	25
10.3. Sound generation.....	25
10.4. Mini-BAE MIDI Implementation for P800/P802	25
10.5. Creating RMF Content for P800/P802.....	27
10.6. Creating MIDI Content for P800/P802.....	27
10.7. Frequency range	27
10.8. Tone map and Percussion map.....	29
11. Sony Ericsson T310/T312	34
11.1. Technical characteristics: polyphonic ring signals	34
11.2. Sound generation and hardware	35
11.3. Frequency range	35
11.4. Tone map for T310/T312	37
11.5. Percussion map	39

11.6.	Tips!.....	40
12.	Sony Ericsson T610/T618	41
12.1.	Technical characteristics: polyphonic ring signals	41
12.2.	Sound generation and hardware	42
12.3.	Frequency range	42
12.4.	Tone map in T610/T618.....	44
12.5.	Percussion map	46
12.6.	Tips!.....	47

Technical overview and architecture

4. The MIDI world

MIDI (Musical Instrument Digital Interface) is a specification for a communications protocol principally used to control electronic musical instruments. Since the middle of the eighties, MIDI is a well-known standard for many musicians, composers, music arrangers and producers.

There are actually two components to the MIDI format used in mobile phones:

- The communications protocol (language),
- A distribution format called Standard MIDI Files.

4.1. Protocol

The MIDI protocol is an entire music description language in binary form. Each word describing an action of musical performance is assigned a specific binary code. MIDI was designed for keyboards, so many of the actions are percussion oriented. To sound a note in MIDI language, you send a "Note On" message, and then assign that note a "velocity", which determines how loud it plays. Other MIDI messages include selecting which instrument to play, mixing and panning sounds, and controlling various aspects of electronic musical instruments.

4.2. Standard MIDI files

When MIDI messages are stored on disks, they are commonly saved in the Standard MIDI file format, in which the events are also time-stamped for play-back in the proper sequence. Music delivered by MIDI files is the most common use of MIDI today.

4.3. Sony Ericsson supported MIDI formats

Sony Ericsson fully supports playback of the SMF0 and SMF1 formats. Sony Ericsson products support the MIDI 1.0 detailed specification. The standards for these formats are described in the Complete MIDI 1.0 Detailed Specification, found at <http://www.midi.org/>

4.4. Scalable Polyphony MIDI (SP-MIDI)

Sony Ericsson supports Scalable Polyphony MIDI (SP-MIDI), which is based on the General MIDI format and mainly developed for ring signals for mobile phones. SP-MIDI makes a polyphonic ring signal sound good in the recipient's mobile phone, even if the support for polyphony is different on different phones. Generally speaking, SP-MIDI takes care of scaling down the number of voices used, depending on the capacities of the device. Even if the recipient's phone only handles 8 voices polyphony, the support for SP-MIDI makes it possible for the melody to play well on this phone also. Initial recommendations for using SP-MIDI in 3GPP™ applications are discussed in a document, titled Scalable Polyphony MIDI Device 5-24 Note Profile for 3GPP™, found at <http://www.midi.org/>

Application Development

5. MIDI in Sony Ericsson phones

There are two ways of implementing a synthesizer in the mobile phone.

- Hardware implementation: Using a separate synthesizer chip in the phone.
- Software implementation: Including a software program and data in the processor of the mobile phone.

A hardware solution is used to render sounds. It does not take up any memory in the processor in the mobile phone. In addition, software programs in the phone control the MIDI files and make sure they fit into the synthesizer chip. It is possible to modify the dynamics, and it is possible to make the sound escalate, start quietly and grow louder.

With a software solution, no extra power is used, and the solution does not take up any extra space on the printed circuit card. An advantage with using a software synthesiser is that it provides support for other audio file formats, such as RMF that may give an even richer sound experience.

5.1. Sound generation

There are a number of different technologies or algorithms used to create sounds in music synthesizers. These are two widely used techniques.

- Frequency Modulation (FM) synthesis: The audible frequencies are created by a modulating signal (the modulator), that controls the amplitude of another signal (the carrier).
- Wavetable synthesis: The audible sounds are created by combining and playing sound segments from a “table” of digitized natural sound, stored in the synthesizer.

The Wavetable sounds have been sampled from real instruments.

The FM sounds are synthetically generated, which means that they are not as precise, and instrument-like as the Wavetable sounds.

User interface and use cases

6. Using MIDI in Sony Ericsson phones

The outstanding quality of MIDI sound makes it useful for ring signals, melody samples for browsing and as effect sounds or ambient sounds in games and other applications. However, the phone handles MIDI sounds differently depending on how it is used.

Note that all MIDI sounds should end with the End Of Track signal (hex FF 2F 00). Otherwise the terminal has to scan the MIDI chip until the sound is finished, which might affect the performance.

6.1. MIDI sounds played as ring signals

When designing ring signals, it is useful to consider the following characteristics:

- Ring signals are always played through the speaker. This is true even if a portable handsfree or an FM radio handsfree is connected and in use.
- When a ring signal is initiated, the phone is designed to start playing it at a low volume, gradually increasing it, over 2 to 3 seconds, to the preferred volume. This is to avoid the risk that a ring signal accidentally plays at full volume, while the user is holding the phone to the ear.
- In a ring signal, it is recommended to avoid moments of silence followed by a signal of high amplitude. Otherwise, the user could be led into believing that the call has been answered, placing the phone by the ear.
- A ring signal should be kept short, preferably shorter than 5 seconds. Note that if the ring signal is too short, the user might not hear it if the ring signal is set to escalating.

6.2. MIDI played in the sound browser and in applications

MIDI sounds can be used as melody samples for browsing and as effect sounds or ambient sounds in games and other applications. In these cases, the following characteristics apply:

- When using the sound browser, or playing MIDI sounds in games and other applications, the sound is played through connected accessories, such as a portable handsfree or an FM radio handsfree.
- The delay from starting the sound until you can hear it is almost unnoticeable. However, for sound effects, where even a slight delay would degrade the user experience, it is recommended to keep the MIDI file size smaller than the size of the buffer in the phone.
To eliminate any risk of interruption while the sound is played, it is recommended to keep the MIDI file size even smaller than the size of the buffer on the MIDI chip.
- A MIDI sound cannot be played from resource, if the MIDI file size is larger than the size of the buffer in the phone. If larger, the MIDI sound must be played from a file.

For specifications and buffer sizes, See “Technical characteristics related to polyphonic ring signals” on page 16.

6.3. MIDI file sizes

MIDI files are stored in the file system of the phone, and the number of MIDI sounds and melodies is limited only by the available memory. The following files are typical melodies, which may be included in Sony Ericsson products.

MIDI file name	Duration	MIDI file size
Beethoven5	41.27 seconds	11200 bytes
Carmen	53.25 seconds	24300 bytes
NYC	42.06 seconds	6500 bytes
Samba	31.29 seconds	12400 bytes

7. Distribution

Users are able to receive or download polyphonic ring signals in much the same way as other file types. This means that the methods of distribution include WAP, MMS, and directly connected to a PC or another phone via Infrared or Bluetooth wireless technology (if available). The small size of MIDI files compared to audio files, enables a short transfer time and the possibility to store a large number of melodies in the phone.

7.1. Forward lock

To prevent users from forwarding copyrighted or otherwise restricted material, Sony Ericsson mobile phones support a technology to forward lock polyphonic ring signals. If the forward lock attribute is set, the user of the phone cannot forward or edit the file. However, the user can play, store and remove the file in the phone.

Some sound files may have an attribute set which makes them possible to use only in a certain application, for example a game. In this case, the user cannot access the file via the file system in the phone.

Users cannot lock or unlock the forward lock attribute, of a file stored in the phone.

**Technical
specifications/
Additional information**

8. Links and references

8.1. Documents

- The Sony Ericsson T300/302 User's Guide available from <http://www.SonyEricsson.com>
- The Sony Ericsson T300/302 FAQ available from <http://www.SonyEricsson.com>
- The Sony Ericsson T300/302 White Paper available from <http://www.SonyEricsson.com/developer>
- Polyphonic ring signals, T300/302 White Paper available from <http://www.SonyEricsson.com/developer>
- Polyphonic ring signals, P800 White Paper available from <http://www.SonyEricsson.com/developer>
- Polyphonic ring signals, T310 White Paper available from <http://www.SonyEricsson.com/developer>
- Polyphonic ring signals, T610 White Paper available from <http://www.SonyEricsson.com/developer>
- Complete MIDI 1.0 Detailed Specification available from <http://www.midi.org>
- Scalable Polyphony MIDI Device 5-24 Note Profile for 3GPP™ available from <http://www.midi.org>
- Beatnik Audio Engine™ White Paper available from <http://www.beatnik.com>
- Beatnik miniBAE™ datasheet available from <http://www.beatnik.com>

8.2. Links

- <http://www.SonyEricsson.com>
- <http://www.midi.org>
- <http://www.ericsson.com>
- <http://www.oki.com>
- <http://www.3gpp.org>
- <http://www.gprsworld.com>
- <http://www.beatnik.com>

8.3. Trademarks and acknowledgments

- Oki is a registered trademark of Oki Electric Industry Co. Ltd
- 3GPP is a registered trademark of the Third Generation Partnership Project.
- miniBAE is a registered trademark of Beatnik, Inc.
- RMF is a registered trademark of Beatnik, Inc.

Appendix

9. Sony Ericsson T300/302

The T300/302 is made for entertaining multimedia applications like imaging, messaging and gaming. Triple-band GSM/GPRS, colour screen, polyphonic ring signals, SMS, EMS, and MMS together deliver a complete messaging phone. The T300 can be further personalized with the exchangeable fronts, and the 24-tone polyphonic feature that makes the ring signals sound like real songs.



9.1. Technical characteristics: polyphonic ring signals

This is a selection of characteristics for the T300/T302, which is related to the use of polyphonic ring signals. For a complete listing, see technical documentation for the Sony Ericsson T300/T302.

Feature		Support in Sony Ericsson T300/302
Dimensions		106 x 48 x 21 mm
File system		Yes. A total of 1.0 megabyte are available for storing objects, such as pictures, sounds and themes.
Forward lock		Yes. The user cannot set or release forward lock.
Graphic display		Full graphic LCD height 80 x width 101 pixels. 256 colours, 34 x 28 mm (30.3 x 24 mm used)
MIDI	Hardware chip	Oki™ LSI ML2860 sound generator
	Number of timbres	128 over five octaves
	Number of voices	24
	Buffer size on MIDI chip	128 bytes
	Buffer size in phone	480 bytes
Ring signals	Total storage capacity	Limited by the memory
	Number of pre-existing ring signals	14

Feature		Support in Sony Ericsson T300/302
	Polyphonic ring signals	Yes, MIDI 1.0 detailed specification. SMF0 and SMF1.
	Possibility to download	Yes, storage capacity only limited by the memory
	Possibility to compose	Yes, iMelody only. Storage capacity only limited by the memory
Ring signal exchange		Yes, via EMS, MMS and Infrared, unless forward lock applies.
Sound browser		Yes. Gives the user access to sounds stored in the phone, unless locked to an application (game).
Sound handling		Yes, eMelody, iMelody, MIDI (polyphonic) and AMR
Sound recorder		Yes, total recording time only limited by the memory. The voice recordings cannot be used as ring signals.
Weight (including battery)		101 g

9.2. Sound generation and hardware

In Sony Ericsson T300/302, the Wavetable synthesis is used. This consists of sampled natural sounds, for example instruments, which are converted back into analog sound signals for playback. This gives a much higher quality and a more natural sound than the FM synthesis. Especially the treble is more distinguished. In addition, the so called "Touch correct" feature makes dynamic compression possible. This equalizes the amplitude of the instruments included in the MIDI file, which greatly improves the sound quality, especially in melodies with big differences in amplitude.

The hardware solution in the Sony Ericsson T300/302 is based on the Oki™ LSI ML2860 sound generator. It can reproduce 128 different timbres over a range of five octaves, including up to 24 polyphonic sounds and 16 timbres simultaneously.

9.3. Frequency range

The supported frequencies for polyphonic ring signals, in the Sony Ericsson T300/302, range from approximately 300 Hz and beyond 15000 Hz. This is equivalent to an FM stereo radio, which means excellent sound quality.

9.3.1. Output as a function of frequency

In electric devices designed to reproduce sound, the output-to-signal ratio varies as a function of the frequency of the signal. Of course, this also applies to a mobile phone playing ring signals. The following diagram indicates the output of sound as a function of frequency in the Sony Ericsson T300/302.

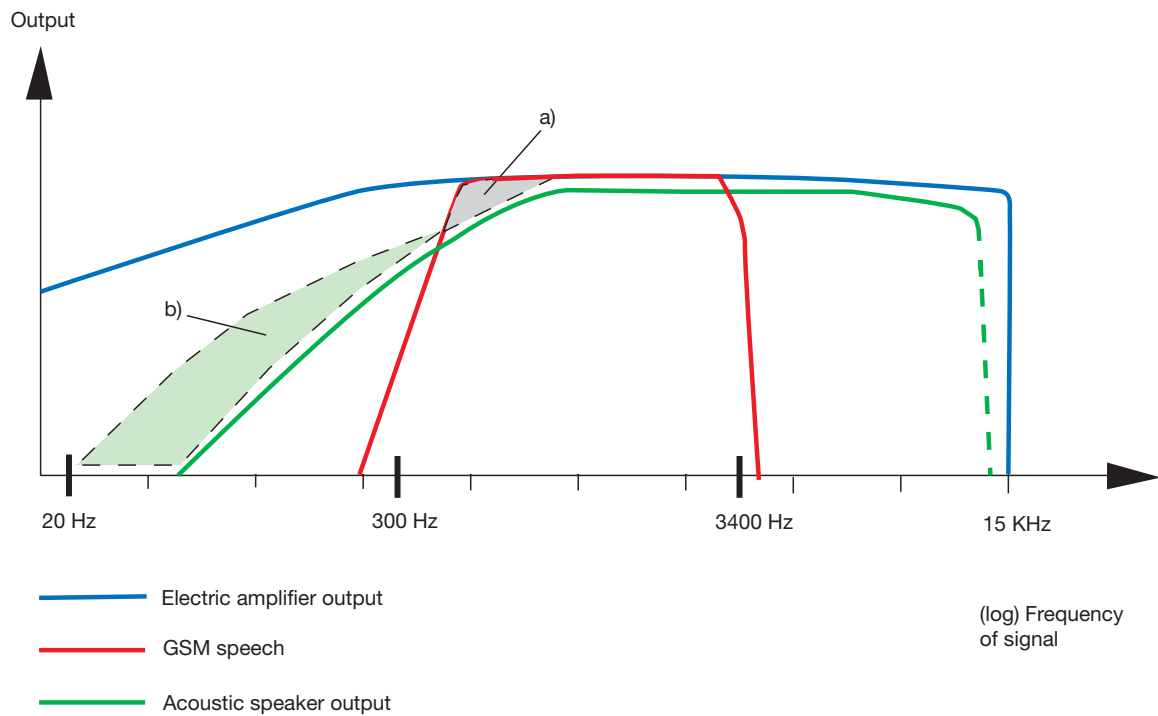


Figure 1. Sound output (approximate) as a function of signal frequency in Sony Ericsson T300/T302. Note that the diagram only gives indications, and does not provide any exact values.

- Electric amplifier output - The capacity of the electric amplifier.
- GSM speech - The typical range for speech in GSM, as experienced through the speaker.
- Acoustic speaker output - This is the output when playing ring signals, as experienced through the speaker.

a) The output of low frequencies is better in GSM speech, partly because speech is usually heard with the speaker close to the ear. Also, equalizing methods are used to adjust speech frequencies.

b) The output of low frequencies is somewhat increased when using a portable handsfree.

Note that the output curve falls rapidly below 500 Hz. If the phone is forced to produce sound at low frequencies, there is a high risk of distortion, resulting in inferior sound quality.

9.4. Tone map for T300/T302

The tone map in Sony Ericsson T300/302 is according to General MIDI (GM) Tone Map. This table lists the instruments, and also the polyphony to produce the instrument.

GM	Poly	GM Tone map	GM	Poly	GM Tone map
0	1	Acoustic Grand Piano	65	1	Alto Sax
1	1	Bright Acoustic Piano	66	1	Tenor Sax
2	2	Electric Grand Piano	67	1	Baritone Sax
3	2	Honkey-tonk Piano	68	1	Oboe
4	1	Electric Piano 1	69	1	English Horn
5	1	Electric Piano 2	70	1	Bassoon
6	1	Harpsichord	71	1	Clarinet
7	1	Clavi	72	1	Piccolo
8	1	Celesta	73	1	Flute
9	1	Glockenspiel	74	1	Recorder
10	2	Music Box	75	1	Pan Flute
11	1	Vibraphone	76	2	Blown Bottle
12	1	Marimba	77	2	Shakuhachi
13	1	Xylophone	78	1	Whistle
14	1	Tubular Bells	79	1	Ocarina
15	2	Dulcimer	80	2	Lead 1 (square)
16	2	Drawbar Organ	81	2	Lead 2 (sawtooth)
17	2	Percussive Organ	82	2	Lead 3 (calliope)
18	2	Rock Organ	83	2	Lead 4 (chiff)
19	2	Church Organ	84	2	Lead 5 (charang)
20	1	Reed Organ	85	2	Lead 6 (voice)
21	2	Accordion	86	2	Lead 7 (fifths)
22	1	Harmonica	87	2	Lead 8 (bass + lead)
23	2	Tango Accordion	88	2	Pad 1 (new age)
24	1	Acoustic Guitar (nylon)	89	2	Pad 2 (warm)
25	1	Acoustic guitar (steel)	90	2	Pad 3 (polysynth)
26	1	Electric Guitar (Jazz)	91	2	Pad 4 (choir)
27	1	Electric Guitar (clean)	92	2	Pad 5 (bowed)
28	1	Electric Guitar (muted)	93	2	Pad 6 (metallic)
29	1	Overdriven Guitar	94	2	Pad 7 (halo)
30	1	Distortion Guitar	95	2	Pad 8 (sweep)

GM	Poly	GM Tone map	GM	Poly	GM Tone map
31	1	Guitar Harmonics	96	2	Fx1 (rain)
32	1	Acoustic Bass	97	2	Fx2 (soundtrack)
33	1	Electric Bass (finger)	98	2	Fx3 (crystal)
34	1	Electric Bass (pick)	99	2	Fx4 (atmosphere)
35	1	Fretless Bass	100	2	Fx5 (brightness)
36	1	Slap Bass 1	101	2	Fx6 (goblins)
37	1	Slap Bass 2	102	2	Fx7 (echoes)
38	1	Synth Bass 1	103	2	Fx8 (sci-fi)
39	1	Synth Bass 2	104	1	Sitar
40	1	Violin	105	1	Banjo
41	1	Viola	106	1	Shamisen
42	1	Cello	107	1	Koto
43	1	Contrabass	108	1	Kalimba
44	1	Tremolo Strings	109	2	Bag pipe
45	1	Pizziano Strings	110	2	Fiddle
46	1	Orchestral Harp	111	1	Shanai
47	1	Timpani	112	1	Tinkle Bell
48	1	String Ensemble 1	113	1	Agogo
49	1	String Ensemble 2	114	2	Steel Drums
50	1	Synth String 1	115	1	Woodblock
51	2	Synth String 2	116	1	Taiko Drum
52	1	Choir Aahs	117	1	Melodic Tom
53	1	Voice Oohs	118	2	Synth Drum
54	2	Synth Voice	119	1	Reverse Cymbal
55	2	Orchestra Hit	120	1	Guitar Fret Noise
56	1	Trumpet	121	1	Breath Noise
57	1	Trombone	122	2	Seashore
58	1	Tuba	123	1	Bird Tweet
59	1	Muted Trumpet	124	1	Telephone Ring
60	2	French Horn	125	1	Helicopter
61	1	Brass Section	126	2	Applause
62	2	Synth Brass 1	127	1	Gunshot
63	2	Synth Brass 2			

9.5. Percussion map

The percussion map in Sony Ericsson T300/302 is according to the General MIDI (GM) Percussion Map.

No.	Percussion name	No.	Percussion name
35	Acoustic Bass Drum	59	Ride Cymbal 2
36	Bass Drum 1	60	Hi Bongo
37	Side Stick	61	Low Bongo
38	Acoustic Snare	62	Mute Hi Conga
39	Hand Clap	63	Open Hi Conga
40	Electric Snare	64	Low Conga
41	Low floor Tom	65	High Timbale
42	Closed Hi-Hat	66	Low Timbale
43	High Floor Tom	67	High Agogo
44	Pedal Hi-Hat	68	Low Agogo
45	Low tom	69	Cabasa
46	Open Hi-Hat	70	Maracas
47	Low-Mid Tom	71	Short Whistle
48	Hi-Mid Tom	72	Long Whistle
49	Crash Cymbal 1	73	Short Guiro
50	High Tom	74	Long Guiro
51	Ride Cymbal 1	75	Clavas
52	Chinese Cymbal	76	Hi Wood Block
53	Ride Bell	77	Low Wood Block
54	Tambourine	78	Mute Cuica
55	Splash Cymbal 1	79	Open Cuica
56	Cowbell	80	Ride Cymbal2
57	Crash Cymbal 2	81	Hi Bongo
58	Vibraslap		

9.6. Tips!

- The MIDI file should have the SMF0 format (Standard Midi File 0), which demands less parsing work.
- At start of playback there is a 0.1 second long delay before the sound path is completely powered up.
- Avoid all unnecessary data in the MIDI file, i.e. all non-musical data which takes up memory space. E.g. track name, copy right, song title, etc.
- Always start a sound as soon as possible (after 0.1 second) and end a song as quick as possible to avoid unnecessary silence before and after the music.
- The MIDI file should not be shorter than 6-7 seconds due to that the maximum escalation time is 3 seconds. (This is not applicable to system sounds, Melody composer sounds and game sounds, since the in-built escalation is then turned off)
- The data buffer for the synthesizer is 128 bytes. If music data is equal or less than than 128 bytes no interrupts will be generated, this saves processor work.
- The increasing ring lasts for 18 seconds. I.e. it takes 18 seconds for the phone to reach the maximum ring signal level (level 6). (If the melody starts over before 18 seconds have passed, the melody is raised one level at every re-start)
- Long silent pauses are dangerous. The user might pick up the phone and put it to his ear.

10. Sony Ericsson P800/P802

The P800/P802 is a full-featured mobile phone having full integration with the other functions of the device, including third party applications. It includes applications like imaging, messaging and gaming. Triple-band GSM/GPRS, large 4096 colour touch screen, polyphonic ring signals, SMS, EMS, and MMS together deliver a complete messaging phone. The Memory stick makes it possible to transfer files from the P800/P802 to other compatible products. The P800 can be further personalized with images, and the 16-tone polyphonic feature that makes the ring signals sound like real songs.



10.1. Technical characteristics: polyphonic ring signals

This is a selection of characteristics for the P800/P802 that are related to the use of polyphonic ring signals. For a complete listing, see technical documentation for the Sony Ericsson P800/P802.

Feature	Support in Sony Ericsson P800/P802
File system and memory	12 megabyte available for storage of audio, images, contacts, messages, add-on applications etc. (P800) (P802: 9 megabyte, dictionary not activated). Support for Memory Stick
Processor	ARM 9
MIDI SW	Beatnik MiniBAE 1.6
Number of timbres	60 (aliased over 128 instruments) over five octaves
Number of voices	16
Total storage capacity of ring signals	Limited by the memory
Number of pre-existing ring signals	30
Polyphonic ring signals	Yes, MIDI 1.0 detailed specification. SMF0 and SMF1.
Possibility to download ring signals	Yes, storage capacity only limited by the memory

Feature	Support in Sony Ericsson P800/P802
Possibility to compose ring signals	No
Ring signal exchange	Via MMS, Bluetooth and Infrared
Sound browser	Gives the user access to sounds stored in the phone, unless locked to an application (game).
Sound handling	iMelody, MIDI (polyphonic), AMR, RMF and MP3.
Sound recorder	Total recording time only limited by the memory. The sound recordings can be used as ring signals.

10.2. Scalable Polyphony MIDI (SP-MIDI)

Sony Ericsson P800/P802 will play Scalable Polyphony MIDI (SP-MIDI) files, but uses Beatnik's mini-BAE voice prioritization scheme and not the prioritization specified in the SP-MIDI data.

10.3. Sound generation

In Sony Ericsson P800/P802, the Wavetable synthesis is used. This consists of sampled natural sounds, for example instruments, which are converted back into analog sound signals for playback. This gives a much higher quality and a more natural sound than the FM synthesis. Especially the treble is more distinguished.

10.4. Mini-BAE MIDI Implementation for P800/P802

Model: Beatnik Mini-BAE, Software Wavetable Synthesizer

Version: Mini-BAE

	Function	Transmitted	Recognized	Remarks
Basic Channel	Default	x	1-16	
	Changed	x	1-16	
Mode	Default	x	Mode 3	Unchangeable
	Messages	x	x	
	Altered	*****		
Note Number		x	0-127	
	True Voice	*****	0-127	
Velocity	Note on	x	O	
	Note off	x	x	
After Touch	Keys	x	x	

	Function	Transmitted	Recognized	Remarks
	Channels	x	x	
Pitch Bend	Pitch Bend	x	*1, *2	Resolution 12 bit
Change Control	0	x	*1, *2	Bank Select (MSB Only)
	1	x	*1, *2	Modulation
	6	x	*1, *2	Data Entry
	7	x	*1, *2	Volume
	10	x	*1, *2	Panpot
	11	x	*1, *2	Expression
	64	x	*1, *2	Hold1 (Sustain)
	85, 86, 87	x	*1, *2	Beatnik Looping & Muting (from files only)
	98, 99	x	*1, *2	NRPN (LSB, MSB)
	100, 101	x	*1, *2	RPN (LSB, MSB)
	121	x	*1, *2	Reset All Controllers
	123	x	0	All Notes Off
Program Change		x	*1	
	True Number	*****	0-127	
System Exclusive		x	x	
System Common	Song Position	x	x	
	Song Select	x	x	
	Tune Request	x	x	
System Real Time	Clock	x	x	
	Commands	x	x	
Aux. Messages	Local On/Off	x	x	

	Function	Transmitted	Recognized	Remarks
	All Notes Off	x	O (123)	
	Active Sensing	x	x	
	System Reset	x	x	
Notes	*1 O x can be selectable O : Yes x : No			
	*2 See BAESong_SetController() function for details on Beatnik's response to Controllers.			
Mode 1: OMNI ON, POLY Mode 2: OMNI ON, MONO Mode 3: OMNI OFF, POLY Mode 4: OMNI OFF, MONO				

10.5. Creating RMF Content for P800/P802

There are several advantages to composing music in the RMF format: File size, high sound quality, custom samples, and security are among them. Because RMF allows a composer to use both the built-in instrument bank in the device and his or her own custom instruments, the resulting song will be very small in size, yet still sound very distinctive. Custom instruments can range anywhere from a short square wave, to a drum loop, to a vocal sample.

Composers can use the Beatnik Editor to create RMF content – http://www.beatnik.com/developers/editor_dev.html

When composing RMF content for the P800/P802, it is important to keep a few limitations in mind. The P800/P802 supports up to 16 polyphonic voices, an output sampling rate of 22 kHz, and single channel (mono) output.

The Editor displays a song's polyphony in real time, and it is easy to turn channels on and off to see where most of the voices are used. To compress samples, use only the IMA 4:1 compression option; the P800/P802 does not support MPEG-compressed samples in RMF. Keep in mind that custom samples are stored in memory when the RMF is playing, so they shouldn't be excessively large. By configuring the Editor's output settings according to those of the P800/P802, and by monitoring the polyphony level, a composer can get a very good idea of what his or her composition will sound like on the P800/P802.

10.6. Creating MIDI Content for P800/P802

When composing MIDI content for the P800/P802, it is important to keep P800/P802 characteristics in mind:

- P800/P802 supports up to 16 polyphonic voices, an output-sampling rate of 22 kHz (which means 11 kHz audio), and single channel (mono) output.
- P800/P802 supports a General MIDI instrument set but the instrument bank doubles (or re-aliases) some of the sounds.

10.7. Frequency range

The supported frequencies for polyphonic ring signals, in the Sony Ericsson P800/P802, range from approximately 300 Hz and beyond 11000 Hz. This is almost equivalent to an FM stereo radio, which means excellent sound quality.

10.7.1. Output as a function of frequency

In electric devices designed to reproduce sound, the output-to-signal ratio varies as a function of the frequency of the signal. Of course, this also applies to a mobile phone playing ring signals. The following diagram indicates the output of sound as a function of frequency in the Sony Ericsson P800/P802.

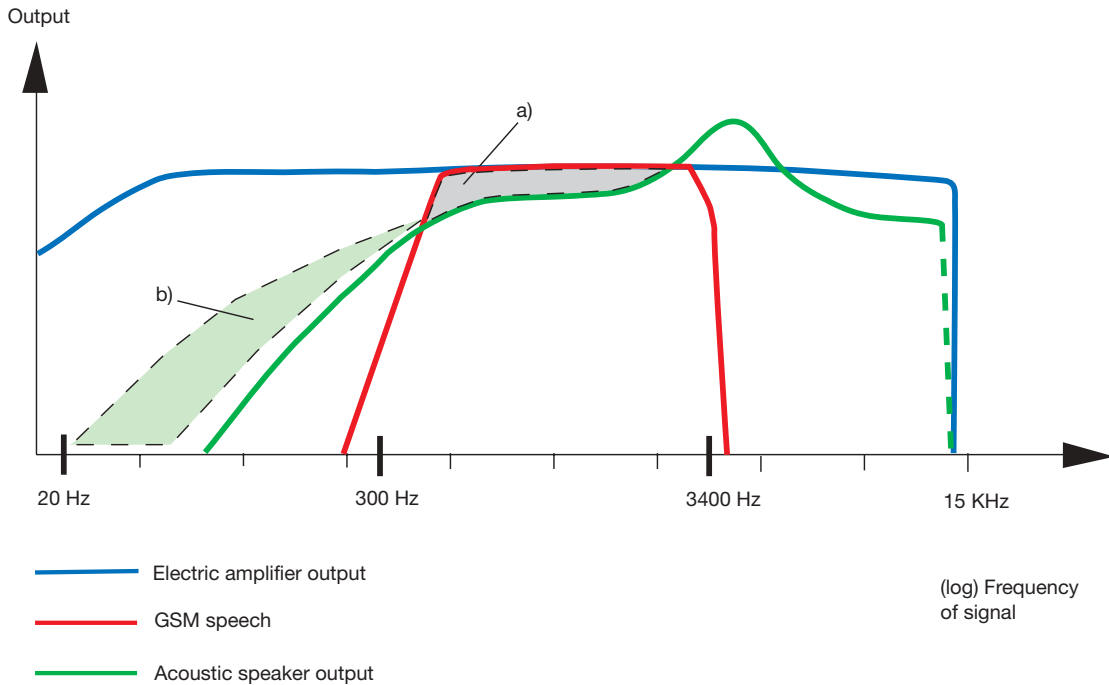


Figure 2. Sound output (approximate) as a function of signal frequency in Sony Ericsson P800/P802. Note that the diagram only gives indications, and does not provide any exact values.

- Electric amplifier output - The capacity of the electric amplifier.
- GSM speech - The typical range for speech in GSM, as experienced through the speaker.
- Acoustic speaker output - This is the output when playing ring signals, as experienced through the speaker.

a) The output of low frequencies is better in GSM speech, partly because speech is usually heard with the speaker close to the ear. Also, equalizing methods are used to adjust speech frequencies.

b) The output of low frequencies is somewhat increased when using a portable handsfree.

Note that the output curve falls rapidly below 500 Hz. If the phone is forced to produce sound at low frequencies, there is a high risk of distortion, resulting in inferior sound quality.

10.8. Tone map and Percussion map

The tone map (Melodic Bank) and the percussion map (Percussion Bank) in Sony Ericsson P800/P802 are according to General MIDI (GM) Maps. This table lists the instruments, and also the polyphony to produce the instrument.

Please note: Aliased instruments are in *italics*.

Melodic Bank			Percussion Bank	
	Instrument Name	# of samples	Key	Instrument Name
0	Piano	5	C-1	EMPTY
1	<i>Piano</i>		C#-1	EMPTY
2	<i>Piano</i>		D-1	EMPTY
3	<i>Piano</i>		D#-1	EMPTY
4	Rhodes	3	E-1	EMPTY
5	<i>Rhodes</i>		F-1	EMPTY
6	<i>Clavinet</i>		F#-1	EMPTY
7	Clavinet	4	G-1	EMPTY
8	<i>Rhodes</i>		G#-1	EMPTY
9	Bell	1	A-1	EMPTY
10	<i>Bell</i>		A#-1	EMPTY
11	Vibraphone	1	B-1	EMPTY
12	Marimba	1	C0	EMPTY
13	<i>Marimba</i>		C#0	EMPTY
14	<i>Bell</i>		D0	EMPTY
15	<i>Rock Organ</i>		D#0	EMPTY
16	Rock Organ	3	E0	EMPTY
17	Perc Organ	4	F0	EMPTY
18	<i>Rock Organ</i>		F#0	EMPTY
19	Church Organ	4	G0	EMPTY
20	<i>Accordion</i>		G#0	EMPTY
21	Accordion	2	A0	EMPTY
22	<i>Accordion</i>		A#0	EMPTY
23	<i>Accordion</i>		B0	EMPTY

Melodic Bank			Percussion Bank	
24	Acoustic Guitar	4	C1	EMPTY
25	<i>Acoustic Guitar</i>		C#1	EMPTY
26	Jazz Guitar	4	D1	EMPTY
27	<i>Jazz Guitar</i>		D#1	EMPTY
28	Mute Guitar	5	E1	EMPTY
29	Electric Guitar	5	F1	EMPTY
30	<i>Electric Guitar</i>		F#1	EMPTY
31	<i>Electric Guitar</i>		G1	EMPTY
32	<i>Finger Bass</i>		G#1	EMPTY
33	Finger Bass	3	A1	EMPTY
34	<i>Finger Bass</i>		A#1	EMPTY
35	Fretless Bass	3	B1	Kick 2
36	<i>Finger Bass</i>		C2	Kick 1
37	<i>Finger Bass</i>		C#2	Cross Stick
38	Synth Bass 1	3	D2	Acoustic Snare
39	Synth Bass 2	3	D#2	Handclap
40	Solo String	3	E2	Acoustic Snare 2
41	<i>Solo String</i>		F2	Tom Floor
42	<i>Solo String</i>		F#2	Closed Hi Hat
43	<i>Solo String</i>		G2	Tom Low
44	<i>Solo String</i>		G#2	Foot Hat
45	Pizzicato Strings	3	A2	Tom Low Mid
46	Harp	4	A#2	Open Hi Hat
47	Timpani	1	B2	Tom Mid
48	Strings	2	C3	Tom Hi
49	Slow Strings	2	C#3	Crash Cymbal
50	Synth Strings	2	D3	Tom Very Hi
51	<i>Synth Strings</i>		D#3	Ride Cymbal 1
52	Choir Aah	1	E3	<i>Crash Cymbal 2</i>

Melodic Bank		
53	<i>Choir Aah</i>	
54	<i>Choir Aah</i>	
55	Orch Hit	2
56	Solo Brass	4
57	<i>Solo Brass</i>	
58	<i>Solo Brass</i>	
59	<i>Solo Brass</i>	
60	French Horn	1
61	Brass Section	4
62	<i>Brass Section</i>	
63	<i>Brass Section</i>	
64	<i>Saxes</i>	
65	<i>Saxes</i>	
66	Saxes	4
67	<i>Saxes</i>	
68	<i>Oboe</i>	
69	Oboe	2
70	<i>Oboe</i>	
71	Clarinet	2
72	<i>Flutes</i>	
73	Flutes	2
74	<i>Flutes</i>	
75	<i>Flutes</i>	
76	<i>Flutes</i>	
77	<i>Flutes</i>	
78	<i>Ocarina</i>	
79	Ocarina	1
80	<i>Sawlead</i>	
81	Sawlead	3

Percussion Bank	
F3	Ride Bell
F#3	Tambourine
G3	<i>Ride Cymbal 1</i>
G#3	Agogo
A3	Crash Cymbal 2
A#3	<i>Ride Cymbal 1</i>
B3	<i>Ride Cymbal 2</i>
C4	Hi Bongo
C#4	Low Bongo
D4	Hi Bongo
D#4	Open Hi Conga
E4	Open Low Conga
F4	Timbale
F#4	<i>Timbale</i>
G4	<i>Agogo</i>
G#4	<i>Agogo</i>
A4	Cabasa
A#4	Maracas
B4	<i>Agogo</i>
C5	<i>Agogo</i>
C#5	<i>Maracas</i>
D5	<i>Cabasa</i>
D#5	Claves
E5	<i>Woodblock</i>
F5	<i>Woodblock</i>
F#5	<i>Open Lo Conga</i>
G5	<i>Open Lo Conga</i>
G#5	Mute Triangle
A5	Open Triangle

Melodic Bank			Percussion Bank	
82	<i>Flutes</i>		A#5	Shaker
83	<i>Brightness</i>		B5	<i>Tambourine</i>
84	Charang	5	C6	<i>Agogo</i>
85	<i>Choir Aah</i>		C#6	<i>Claves</i>
86	<i>Saw lead</i>		D6	<i>Open Lo Conga</i>
87	<i>Saw lead</i>		D#6	<i>Open Lo Conga</i>
88	<i>Synth Strings</i>		E6	EMPTY
89	Warm Pad	1	F6	EMPTY
90	<i>Strings</i>		F#6	EMPTY
91	<i>Choir Aah</i>		G6	EMPTY
92	<i>Sweep Pad</i>		G#6	EMPTY
93	<i>Sweep Pad</i>		A6	EMPTY
94	<i>Sweep Pad</i>		A#6	EMPTY
95	Sweep Pad	3	B6	EMPTY
96	<i>Brightness</i>		C7	EMPTY
97	<i>Brightness</i>		C#7	EMPTY
98	<i>Bell</i>		D7	EMPTY
99	<i>Brightness</i>		D#7	EMPTY
100	Brightness	1	E7	EMPTY
101	<i>Sweep Pad</i>		F7	EMPTY
102	Echo Drops	1	F#7	EMPTY
103	<i>Synth Strings</i>		G7	EMPTY
104	<i>Banjo</i>		G#7	EMPTY
105	Banjo	1	A7	EMPTY
106	<i>Banjo</i>		A#7	EMPTY
107	<i>Banjo</i>		B7	EMPTY
108	<i>Marimba</i>		C8	EMPTY
109	<i>Saxes</i>		C#8	EMPTY
110	<i>Solo String</i>		D8	EMPTY

Melodic Bank			Percussion Bank	
111	<i>Oboe</i>		D#8	EMPTY
112	<i>Bell</i>		E8	EMPTY
113	Agogo	1	F8	EMPTY
114	<i>Marimba</i>		F#8	EMPTY
115	Woodblock	1	G8	EMPTY
116	<i>Melodic Toms</i>		G#8	EMPTY
117	Melodic Toms	1	A8	EMPTY
118	<i>Reverse Cymbal</i>		A#8	EMPTY
119	Reverse Cymbal	1	B8	EMPTY
120	Guitar Fret Noise	1	C9	EMPTY
121	<i>Brightness</i>		C#9	EMPTY
122	Seashore (noise)	1	D9	EMPTY
123	Bird	1	D#9	EMPTY
124	<i>Flutes</i>		E9	EMPTY
125	<i>Seashore (noise)</i>		F9	EMPTY
126	Applause (noise)	1	F#9	EMPTY
127	Gunshot	1	G9	EMPTY

11. Sony Ericsson T310/T312

The Sony Ericsson T310/T312 is designed for entertainment and imaging, with features that are bursting with fun for consumers, and it's a revenue winner for network operators. The T310/T312 marketing focus is on mobile gaming, imaging and messaging.

It has all EMS and picture messaging (text messaging with pictures and sounds), e-mail and MMS (Multimedia messaging), and a snap-on camera as a core accessory.



11.1. Technical characteristics: polyphonic ring signals

This is a selection of characteristics for the T310/T312, which is related to the use of polyphonic ring signals. For a complete listing, see technical documentation for the Sony Ericsson T310/T312.

Feature		Support in Sony Ericsson T310/T312
Dimensions		104 x 49 x 20 mm
File system		Yes. A total of 1.0 megabytes are available for storing objects, such as pictures, sounds and themes.
Forward lock		Yes. The user cannot set or release forward lock.
Graphic display		Full graphic LCD height 80 x width 101 pixels. 256 colours, 34 x 28 mm (30.3 x 24 mm used)
MIDI	Hardware chip	Oki™ LSI ML2860 sound generator
	Number of timbres	128 over five octaves
	Number of voices	32
	Buffer size on MIDI chip	128 bytes
	Buffer size in phone	480 bytes

Feature		Support in Sony Ericsson T310/T312
Ring signals	Total storage capacity	Limited by the memory
	Number of pre-existing ring signals	14
	Polyphonic ring signals	Yes, MIDI 1.0 detailed specification. SMF0 and SMF1.
	Possibility to download	Yes, storage capacity only limited by the memory
	Possibility to compose	Yes, iMelody only. Storage capacity only limited by the memory
Ring signal exchange		Yes, via EMS, MMS and Infrared, unless forward lock applies.
Sound browser		Yes. Gives the user access to sounds stored in the phone, unless locked to an application (game).
Sound handling		Yes, eMelody, iMelody, MIDI (polyphonic) and AMR
Sound recorder		Yes, total recording time only limited by the memory. The sound recordings cannot be used as ring
Weight (including battery)		97 g

11.2. Sound generation and hardware

In Sony Ericsson T310/T312, the Wavetable synthesis is used. This consists of sampled natural sounds, for example instruments, which are converted back into analog sound signals for playback. This gives a much higher quality and a more natural sound than the FM synthesis. Especially the treble is more distinguished. In addition, the so called "Touch correct" feature makes dynamic compression possible. This equalizes the amplitude of the instruments included in the MIDI file, which greatly improves the sound quality, especially in melodies with big differences in amplitude.

The hardware solution in the Sony Ericsson T310/T312 is based on the Oki™ LSI ML2860 sound generator. It can reproduce 128 different timbres over a range of five octaves, including up to 32 polyphonic sounds and 16 timbres simultaneously.

11.3. Frequency range

The supported frequencies for polyphonic ring signals, in the Sony Ericsson T310/T312, range from approximately 300 Hz and beyond 15000 Hz. This is equivalent to an FM stereo radio, which means excellent sound quality.

11.3.1. Output as a function of frequency

In electric devices designed to reproduce sound, the output-to-signal ratio varies as a function of the frequency of the signal. Of course, this also applies to a mobile phone playing ring signals. The following diagram indicates the output of sound as a function of frequency in the Sony Ericsson T310/T312.

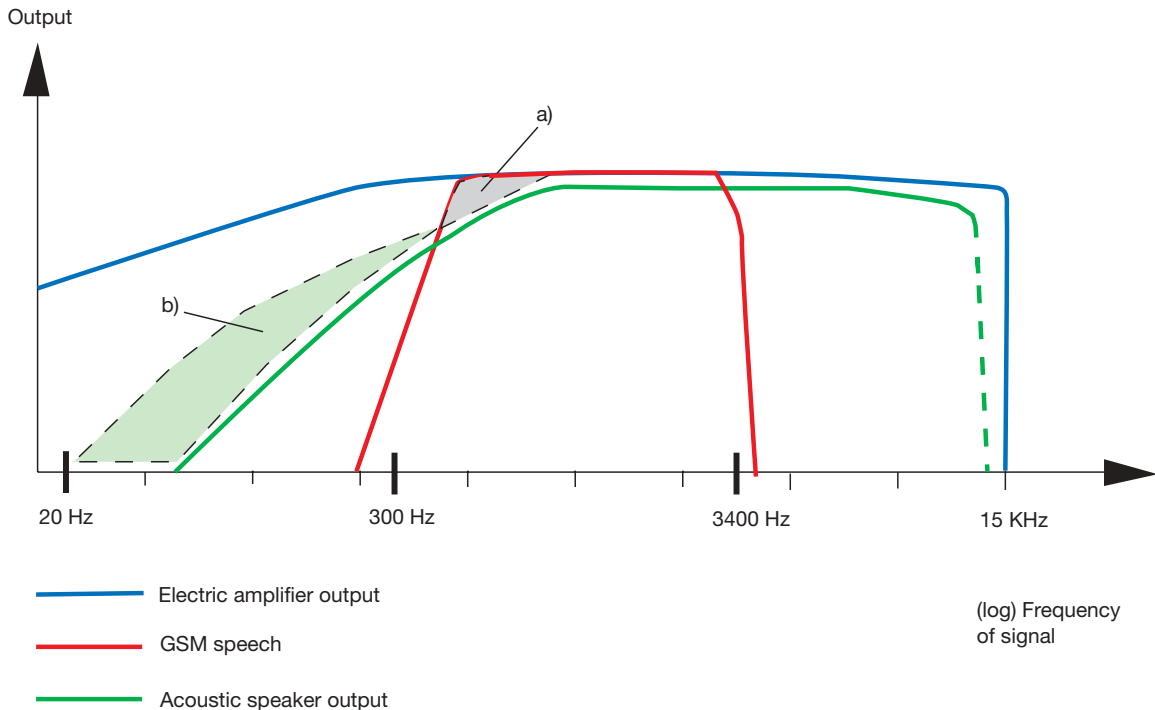


Figure 1. Sound output (approximate) as a function of signal frequency in Sony Ericsson T310/T312. Note that the diagram only gives indications, and does not provide any exact values.

- Electric amplifier output - The capacity of the electric amplifier.
- GSM speech - The typical range for speech in GSM, as experienced through the speaker.
- Acoustic speaker output - This is the output when playing ring signals, as experienced through the speaker.

a) The output of low frequencies is better in GSM speech, partly because speech is usually heard with the speaker close to the ear. Also, equalizing methods are used to adjust speech frequencies.

b) The output of low frequencies is somewhat increased when using a portable handsfree.

Note that the output curve falls rapidly below 500 Hz. If the phone is forced to produce sound at low frequencies, there is a high risk of distortion, resulting in inferior sound quality.

11.4. Tone map for T310/T312

The tone map in Sony Ericsson T310/T312 is according to General MIDI (GM) Tone Map. This table lists the instruments, and also the polyphony to produce the instrument.

GM	Poly	GM Tone map	GM	Poly	GM Tone map
0	1	Acoustic Grand Piano	65	1	Alto Sax
1	1	Bright Acoustic Piano	66	1	Tenor Sax
2	2	Electric Grand Piano	67	1	Baritone Sax
3	2	Honkey-tonk Piano	68	1	Oboe
4	1	Electric Piano 1	69	1	English Horn
5	1	Electric Piano 2	70	1	Bassoon
6	1	Harpsichord	71	1	Clarinet
7	1	Clavi	72	1	Piccolo
8	1	Celesta	73	1	Flute
9	1	Glockenspiel	74	1	Recorder
10	2	Music Box	75	1	Pan Flute
11	1	Vibraphone	76	2	Blown Bottle
12	1	Marimba	77	2	Shakuhachi
13	1	Xylophone	78	1	Whistle
14	1	Tubular Bells	79	1	Ocarina
15	2	Dulcimer	80	2	Lead 1 (square)
16	2	Drawbar Organ	81	2	Lead 2 (sawtooth)
17	2	Percussive Organ	82	2	Lead 3 (calliope)
18	2	Rock Organ	83	2	Lead 4 (chiff)
19	2	Church Organ	84	2	Lead 5 (charang)
20	1	Reed Organ	85	2	Lead 6 (voice)
21	2	Accordion	86	2	Lead 7 (fifths)
22	1	Harmonica	87	2	Lead 8 (bass + lead)
23	2	Tango Accordion	88	2	Pad 1 (new age)
24	1	Acoustic Guitar (nylon)	89	2	Pad 2 (warm)
25	1	Acoustic guitar (steel)	90	2	Pad 3 (polysynth)
26	1	Electric Guitar (Jazz)	91	2	Pad 4 (choir)

GM	Poly	GM Tone map	GM	Poly	GM Tone map
27	1	Electric Guitar (clean)	92	2	Pad 5 (bowed)
28	1	Electric Guitar (muted)	93	2	Pad 6 (metallic)
29	1	Overdriven Guitar	94	2	Pad 7 (halo)
30	1	Distortion Guitar	95	2	Pad 8 (sweep)
31	1	Guitar Harmonics	96	2	Fx1 (rain)
32	1	Acoustic Bass	97	2	Fx2 (soundtrack)
33	1	Electric Bass (finger)	98	2	Fx3 (crystal)
34	1	Electric Bass (pick)	99	2	Fx4 (atmosphere)
35	1	Fretless Bass	100	2	Fx5 (brightness)
36	1	Slap Bass 1	101	2	Fx6 (goblins)
37	1	Slap Bass 2	102	2	Fx7 (echoes)
38	1	Synth Bass 1	103	2	Fx8 (sci-fi)
39	1	Synth Bass 2	104	1	Sitar
40	1	Violin	105	1	Banjo
41	1	Viola	106	1	Shamisen
42	1	Cello	107	1	Koto
43	1	Contrabass	108	1	Kalimba
44	1	Tremolo Strings	109	2	Bag pipe
45	1	Pizziano Strings	110	2	Fiddle
46	1	Orchestral Harp	111	1	Shanai
47	1	Timpani	112	1	Tinkle Bell
48	1	String Emsemble 1	113	1	Agogo
49	1	String Emsamble 2	114	2	Steel Drums
50	1	Synth String 1	115	1	Woodblock
51	2	Synth String 2	116	1	Taiko Drum
52	1	Choir Aahs	117	1	Melodic Tom
53	1	Voice Oohs	118	2	Synth Drum
54	2	Synth Voice	119	1	Reverse Cymbal
55	2	Orchestra Hit	120	1	Guitar Fret Noice

GM	Poly	GM Tone map	GM	Poly	GM Tone map
56	1	Trumpet	121	1	Breath Noise
57	1	Trombone	122	2	Seashore
58	1	Tuba	123	1	Bird Tweet
59	1	Muted Trumpet	124	1	Telephone Ring
60	2	French Horn	125	1	Helicopter
61	1	Brass Section	126	2	Applause
62	2	Synth Brass 1	127	1	Gunshot
63	2	Synth Brass 2			

11.5. Percussion map

The percussion map in Sony Ericsson T310/T312 is according to the General MIDI (GM) Percussion Map.

No.	Percussion name	No.	Percussion name
35	Acoustic Bass Drum	59	Ride Cymbal2
36	Bass Drum 1	60	Hi Bongo
37	Side Stick	61	Low Bongo
38	Acoustic Snare	62	Mute Hi Conga
39	Hand Clap	63	Open Hi Conga
40	Electric Snare	64	Low Conga
41	Low floor Tom	65	High Timbale
42	Closed Hi-Hat	66	Low Timbale
43	High Floor Tom	67	High Agogo
44	Pedal Hi-Hat	68	Low Agogo
45	Low tom	69	Cabasa
46	Open Hi-Hat	70	Maracas
47	Low-Mid Tom	71	Short Whistle
48	Hi-Mid Tom	72	Long Whistle
49	Crash Cymbal 1	73	Short Guiro
50	High Tom	74	Long Guiro

No.	Percussion name	No.	Percussion name
51	Ride Cymbal 1	75	Clavas
52	Chinese Cymbal	76	Hi Wood Block
53	Ride Bell	77	Low Wood Block
54	Tambourine	78	Mute Cuica
55	Splash Cymba 1	79	Open Cuica
56	Cowbell	80	Ride Cymbal2
57	Crash Cymba 2	81	Hi Bongo
58	Vibraslap		

11.6. Tips!

- The MIDI file should have the SMF0 format (Standard Midi File 0), which demands less parsing work.
- At start of playback there is a 0.1 second long delay before the sound path is completely powered up.
- Avoid all unnecessary data in the MIDI file, i.e. all non-musical data which takes up memory space. E.g. track name, copy right, song title, etc.
- Always start a sound as soon as possible (after 0.1 second) and end a song as quick as possible to avoid unnecessary silence before and after the music.
- The MIDI file should not be shorter than 6-7 seconds due to that the maximum escalation time is 3 seconds. (This is not applicable to system sounds, Melody composer sounds and game sounds, since the in-built escalation is then turned off)
- The data buffer for the synthesizer is 128 bytes. If music data is equal or less than than 128 bytes no interrupts will be generated, this saves processor work.
- The increasing ring lasts for 18 seconds. I.e. it takes 18 seconds for the phone to reach the maximum ring signal level (level 6). (If the melody starts over before 18 seconds have passed, the melody is raised one level at every re-start)
- Long silent pauses are dangerous. The user might pick up the phone and put it to his ear.

12. Sony Ericsson T610/T618

The T610/T618 includes multimedia applications like imaging, messaging and gaming. Triple-band GSM/GPRS, colour screen, polyphonic ring signals, SMS, EMS, MMS and Java together deliver a complete messaging and gaming phone. The T610/T618 can be further personalized with the 32-tone polyphonic feature that makes the ring signals sound like real music.



12.1. Technical characteristics: polyphonic ring signals

This is a selection of characteristics for the T610/T618, that are related to the use of polyphonic ring signals. For a complete listing, see technical documentation for the Sony Ericsson T610/T618.

Feature		Support in Sony Ericsson T610/T618
Dimensions		102 x 44 x 19 mm
File system		Yes. A total of 2.0 megabytes are available for storing objects, such as pictures, sounds and themes.
Forward lock		Yes. The user cannot set or release forward lock.
Graphic display		Full graphic LCD width 128 x height 160 pixels. 65k colour display.
MIDI	Hardware chip	Oki™ LSI ML2860 sound generator
	Number of timbres	128 over five octaves
	Number of voices	32
	Buffer size on MIDI chip	128 bytes
	Buffer size in phone	480 bytes
Ring signals	Total storage capacity	Limited by the memory

Feature		Support in Sony Ericsson T610/T618
	Number of pre-existing ring signals	14
	Polyphonic ring signals	Yes, MIDI 1.0 detailed specification. SMF0 and SMF1.
	Possibility to download	Yes, storage capacity only limited by the memory.
	Possibility to compose	Yes. Storage capacity only limited by the memory.
Ring signal exchange		Yes, via EMS, MMS, Bluetooth and Infrared, unless forward lock applies.
Sound browser		Yes. Gives the user access to sounds stored in the phone, unless locked to an application (game).
Sound handling		Yes, eMelody, iMelody, MIDI (polyphonic) and AMR.
Sound recorder		Yes, total recording time only limited by the memory. The sound recordings cannot be used as ring signals.
MIDI Composer		Yes. This is where the polyphonic ring signals are created.
Weight (including battery)		Ca 100 g

12.2. Sound generation and hardware

In Sony Ericsson T610/T618, the Wavetable synthesis is used. This consists of sampled natural sounds, for example instruments, which are converted back into analogue sound signals for playback. This gives a much higher quality and a more natural sound than the FM synthesis. Especially the treble is more distinguished. In addition, the so called "Touch correct" feature makes dynamic compression possible. This equalizes the amplitude of the instruments included in the MIDI file, which greatly improves the sound quality, especially in melodies with big differences in amplitude.

The hardware solution in the Sony Ericsson T610/T618 is based on the Oki™ LSI ML2860 sound generator. It can reproduce 128 different timbres over a range of five octaves, including up to 32 polyphonic sounds and 16 timbres simultaneously.

12.3. Frequency range

The supported frequencies for polyphonic ring signals, in the Sony Ericsson T610/T618, range from approximately 300 Hz and beyond 15000 Hz. This is equivalent to an FM stereo radio, which means excellent sound quality.

12.3.1. Output as a function of frequency

In electric devices designed to reproduce sound, the output-to-signal ratio varies as a function of the frequency of the signal. Of course, this also applies to a mobile phone playing ring signals. The following diagram indicates the output of sound as a function of frequency in the Sony Ericsson T610/T618.

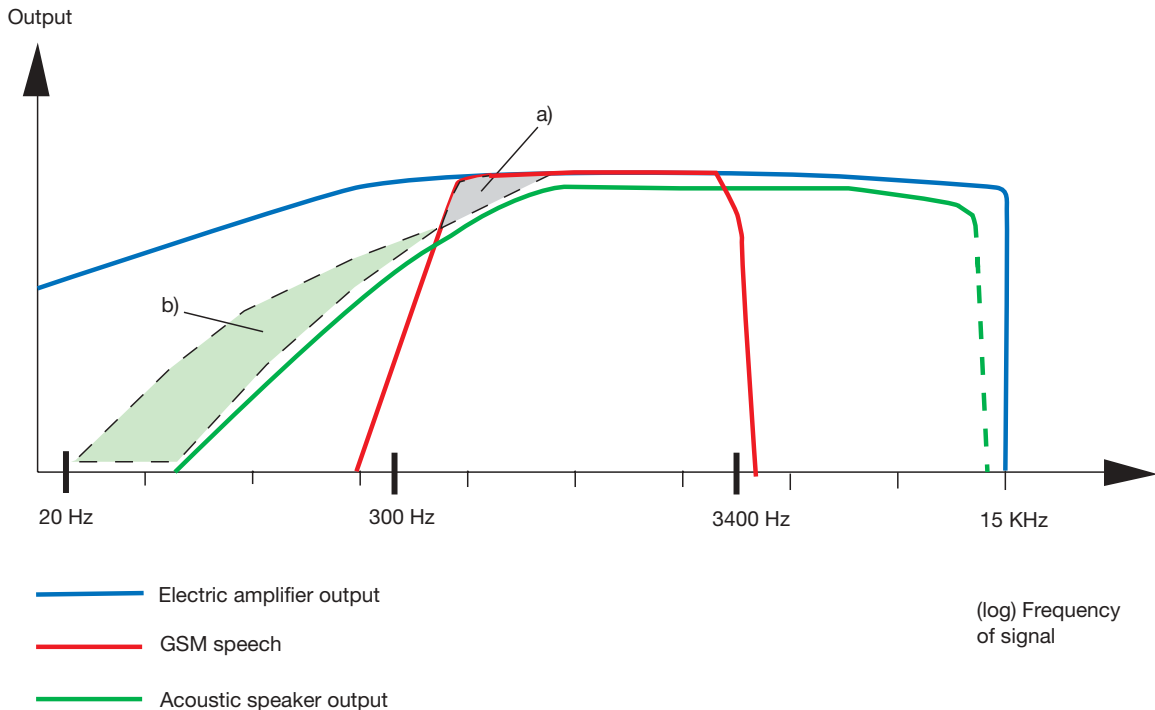


Figure 1. Sound output (approximate) as a function of signal frequency in Sony Ericsson T300/T302. Note that the diagram only gives indications, and does not provide any exact values.

- Electric amplifier output - The capacity of the electric amplifier.
- GSM speech - The typical range for speech in GSM, as experienced through the speaker.
- Acoustic speaker output - This is the output when playing ring signals, as experienced through the speaker.

a) The output of low frequencies is better in GSM speech, partly because speech is usually heard with the speaker close to the ear. Also, equalizing methods are used to adjust speech frequencies.

b) The output of low frequencies is somewhat increased when using a portable handsfree.

Note that the output curve falls rapidly below 500 Hz. If the phone is forced to produce sound at low frequencies, there is a high risk of distortion, resulting in inferior sound quality.

12.4. Tone map in T610/T618

The tone map in Sony Ericsson T610/T618 is according to General MIDI (GM) Tone Map. This table lists the instruments, and also the polyphony to produce the instrument.

GM	Poly	GM Tone map	GM	Poly	GM Tone map
0	1	Acoustic Grand Piano	65	1	Alto Sax
1	1	Bright Acoustic Piano	66	1	Tenor Sax
2	2	Electric Grand Piano	67	1	Baritone Sax
3	2	Honkey-tonk Piano	68	1	Oboe
4	1	Electric Piano 1	69	1	English Horn
5	1	Electric Piano 2	70	1	Bassoon
6	1	Harpsichord	71	1	Clarinet
7	1	Clavi	72	1	Piccolo
8	1	Celesta	73	1	Flute
9	1	Glockenspiel	74	1	Recorder
10	2	Music Box	75	1	Pan Flute
11	1	Vibraphone	76	2	Blown Bottle
12	1	Marimba	77	2	Shakuhachi
13	1	Xylophone	78	1	Whistle
14	1	Tubular Bells	79	1	Ocarina
15	2	Dulcimer	80	2	Lead 1 (square)
16	2	Drawbar Organ	81	2	Lead 2 (sawtooth)
17	2	Percussive Organ	82	2	Lead 3 (calliope)
18	2	Rock Organ	83	2	Lead 4 (chiff)
19	2	Church Organ	84	2	Lead 5 (charang)
20	1	Reed Organ	85	2	Lead 6 (voice)
21	2	Accordion	86	2	Lead 7 (fifths)
22	1	Harmonica	87	2	Lead 8 (bass + lead)
23	2	Tango Accordion	88	2	Pad 1 (new age)
24	1	Acoustic Guitar (nylon)	89	2	Pad 2 (warm)
25	1	Acoustic guitar (steel)	90	2	Pad 3 (polysynth)

GM	Poly	GM Tone map	GM	Poly	GM Tone map
26	1	Electric Guitar (Jazz)	91	2	Pad 4 (choir)
27	1	Electric Guitar (clean)	92	2	Pad 5 (bowed)
28	1	Electric Guitar (muted)	93	2	Pad 6 (metallic)
29	1	Overdriven Guitar	94	2	Pad 7 (halo)
30	1	Distortion Guitar	95	2	Pad 8 (sweep)
31	1	Guitar Harmonics	96	2	Fx1 (rain)
32	1	Acoustic Bass	97	2	Fx2 (soundtrack)
33	1	Electric Bass (finger)	98	2	Fx3 (crystal)
34	1	Electric Bass (pick)	99	2	Fx4 (atmosphere)
35	1	Fretless Bass	100	2	Fx5 (brightness)
36	1	Slap Bass 1	101	2	Fx6 (goblins)
37	1	Slap Bass 2	102	2	Fx7 (echoes)
38	1	Synth Bass 1	103	2	Fx8 (sci-fi)
39	1	Synth Bass 2	104	1	Sitar
40	1	Violin	105	1	Banjo
41	1	Viola	106	1	Shamisen
42	1	Cello	107	1	Koto
43	1	Contrabass	108	1	Kalimba
44	1	Tremolo Strings	109	2	Bag pipe
45	1	Pizziano Strings	110	2	Fiddle
46	1	Orchestral Harp	111	1	Shanai
47	1	Timpani	112	1	Tinkle Bell
48	1	String Emsemble 1	113	1	Agogo
49	1	String Emsamble 2	114	2	Steel Drums
50	1	Synth String 1	115	1	Woodblock
51	2	Synth String 2	116	1	Taiko Drum
52	1	Choir Aahs	117	1	Melodic Tom
53	1	Voice Oohs	118	2	Synth Drum
54	2	Synth Voice	119	1	Reverse Cymbal

GM	Poly	GM Tone map	GM	Poly	GM Tone map
55	2	Orchestra Hit	120	1	Guitar Fret Noise
56	1	Trumpet	121	1	Breath Noise
57	1	Trombone	122	2	Seashore
58	1	Tuba	123	1	Bird Tweet
59	1	Muted Trumpet	124	1	Telephone Ring
60	2	French Horn	125	1	Helicopter
61	1	Brass Section	126	2	Applause
62	2	Synth Brass 1	127	1	Gunshot
63	2	Synth Brass 2			

12.5. Percussion map

The percussion map in Sony Ericsson T610/T618 is according to the General MIDI (GM) Percussion Map.

No.	Percussion name	No.	Percussion name
35	Acoustic Bass Drum	59	Ride Cymbal2
36	Bass Drum 1	60	Hi Bongo
37	Side Stick	61	Low Bongo
38	Acoustic Snare	62	Mute Hi Conga
39	Hand Clap	63	Open Hi Conga
40	Electric Snare	64	Low Conga
41	Low floor Tom	65	High Timbale
42	Closed Hi-Hat	66	Low Timbale
43	High Floor Tom	67	High Agogo
44	Pedal Hi-Hat	68	Low Agogo
45	Low tom	69	Cabasa
46	Open Hi-Hat	70	Maracas
47	Low-Mid Tom	71	Short Whistle
48	Hi-Mid Tom	72	Long Whistle
49	Crash Cymbal 1	73	Short Guiro

No.	Percussion name	No.	Percussion name
50	High Tom	74	Long Guiro
51	Ride Cymbal 1	75	Clavas
52	Chinese Cymbal	76	Hi Wood Block
53	Ride Bell	77	Low Wood Block
54	Tambourine	78	Mute Cuica
55	Splash Cymba 1	79	Open Cuica
56	Cowbell	80	Ride Cymbal2
57	Crash Cymba 2	81	Hi Bongo
58	Vibraslap		

12.6. Tips!

- The MIDI file should have the SMF0 format (Standard Midi File 0), which demands less parsing work.
- Avoid all unnecessary data in the MIDI file, i.e. all non-musical data which takes up memory space. E.g. track name, copy right, song title, etc.
- Always start a sound as soon as possible (after 0.1 second) and end a song as quick as possible to avoid unnecessary silence before and after the music.
- The MIDI file should not be shorter than 6-7 seconds due to that the maximum escalation time is 3 seconds. (This is not applicable to system sounds, Melody composer sounds and game sounds, since the in-built escalation is then turned off)
- The data buffer for the synthesizer is 128 bytes. If music data is equal or less than than 128 bytes no interrupts will be generated, this saves processor work.
- The increasing ring lasts for 18 seconds. I.e. it takes 18 seconds for the phone to reach the maximum ring signal level (level 6). (If the melody starts over before 18 seconds have passed, the melody is raised one level at every re-start)
- Long silent pauses are dangerous. The user might pick up the phone and put it to his ear.

Index

- Appendix P800/P802, 24
 - Frequency range, 27
 - MIDI content, 27
 - MiniBAE MIDI implementation, 25
 - Percussion map, 29
 - RMF content, 27
 - Sound generation, 25
 - Technical characteristics, 24
 - Tone map, 29
- Appendix T300/T302, 17
 - Frequency range, 18
 - Percussion map, 22
 - Sound generation, 18
 - Technical characteristics, 17
 - Tips, 23
 - Tone map, 20
- Appendix T310/T312, 34
 - Frequency range, 35
 - Percussion map, 39
 - Sound generation, 35
 - Technical characteristics, 34
 - Tips, 40
 - Tone map, 37
- Appendix T610/T618, 41
 - Frequency range, 42
 - Percussion map, 46
 - Sound generation, 42
 - Technical characteristics, 41
 - Tips, 47
 - Tone map, 44
- Forward lock, 13
- Frequency Modulation synthesis, 10
- Links, 15
- MIDI, 8
 - file sizes, 13
 - in Sony Ericsson phones, 10
 - Protocol, 8
 - Scalable Polyphony, 8
 - Supported formats, 8
 - using MIDI, 12
- Percussion Map, 22, 39, 46
- References, 15
- Table, 20, 37, 44
- Tone Map, 20, 37, 44
- Trademarks, 15
- Wavetable synthesis, 10