*Technical Manual*

**Creating Media for the
Motorola T725 Handset**

Version 1.1

**MOTOROLA**
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# Table of Contents

# Overview

Welcome to the *Creating Media for the Motorola T725 Handset* guide. This guide contains all the information you need to get started developing pictures, animation, and sounds for the Motorola T725 handset.

The Motorola T725 handset guide covers these areas:

- Display information like size, color depth, and more

- Graphic support information

- Sound support information

This document assumes you familiar with creating different media using the appropriate tools. This guide does not cover the tools required to create pictures, animations, sounds, or messages. Instead, it concentrates on the features and limitations of the device when working with media.

## Document History

| Version | Date | Author | Comments |
|---|---|---|---|
| Draft (1.0) | May 9, 2003 | MOT LMR | First draft |
| Draft (1.0) | Jun 9, 2003 | MW MDP | Second draft |
| Draft (1.0) | Jun 19, 2003 | MW MDP | Third draft |
| 1.1 | December 17, 2003 | Motocoder | Baseline |

# Glossary

Here are definitions of common terms used in this manual:

| Term | Definition |
| --- | --- |
| AMR | Adaptive Multi Rate |
| EMS | Enhanced Messaging Service |
| GIF | Graphics Interchange Format |
| iMelody | Infrared Data Association (IrDA) standard for the textual representation of a ring tone. |
| MIDI | Musical Instrument Digital Interface |
| MIDI Patch | One of the channels in a MIDI device, defined by the general MIDI standard |
| Pixel | One picture element on the display |
| PNG | Portable Network Graphics |
| WAP | Wireless Application Protocol |
| WAV | Windows Audio Volume |
| WBMP | Wireless Bitmap |

# References

The following references provide information related to developing media for this device:

| Organization | URL |
| --- | --- |
| 3GPP | `www.3gpp.org` |
| Infrared Data Association | `www.irda.org` |
| MIDI Manufacturers Association | `www.midi.org` |
| Motorola Developer Program | `www.motocoder.com` |
| WAP Forum | `www.wapforum.org` |
| World Wide Web Consortium | `www.w3.org` |
| Moving Pictures Experts Group | `mpeg.telecomitalialab.com` |

# Display

This chapter describes the display characteristics for the Motorola T725 handset.

| T725 |
|---|
|  |

## Display Info

The physical internal display characteristics of the Motorola T725 handset are the following:

| Item | Description |
|---|---|
| Screen resolution | 120w x 160h pixels |
| Screen dimensions | 28 x 38 mm viewing area |
| Pixel pitch | .237mm pitch, square |
| Color depth | 16 bits |
| Maximum Colors | Up to 65535 colors |
| Text area | 7 lines |

# Graphics

This chapter describes the graphic environment available in the Motorola T725 handset. It includes information on picture and animation formats, size restrictions, pre-defined media, and more. Use it as a reference when creating pictures or animations that support your products.

In general, file size is limited by available memory. All media (wallpaper, screensavers, ring tones, and themes), whether pre-loaded on the device or downloaded by the user, share the same storage area. The available memory for downloaded files will vary based on the media that is pre-loaded into the device, and that will vary from region to region and from carrier to carrier. We recommend keeping all media files as small as possible to ensure the consumer has the ability to download and use a variety of files to enhance the user experience.

## Supported Picture Formats

The Motorola T725 handset supports these graphic and animation formats:

| Type | Description |
| --- | --- |
| EMS 5.0 Bitmaps | Enhanced Messaging Service bitmap |
| GIF 87a | Graphics Interchange Format, a standard file format for lossless compression of still images. It is used to display static images. This is the preferred format for pictures. |
| GIF 89a | The GIF 89a standard is a superset of the GIF 87a specification. It allows a sequence of GIF images to be displayed in succession that generates an animation. |
| JPEG | Joint Photography Expert Group standard. JPEG is designed for compressing either full-color or gray-scale images of natural, real-world scenes, not line art or lettering. |
| PNG | Portable Network Graphics (PNG) is an extensible file format for the lossless, portable, well-compressed storage of raster images.<br><br>NOTE: Only available from J2ME applications. |

| Type | Description |
|------|-------------|
| WBMP | Wireless Bitmap format described in the WAP specifications. It is an optimized bitmap format intended for use in portable devices with smaller screens and limited display capabilities. |

# Picture Support

The Motorola T725 handset supports these EMS picture sizes:

| Type | Description |
|------|-------------|
| Small | Color, 16 x 16 pixels |
| Large | Color, 32 x 32 pixels |
| Variable | Color, 8, 16, 32, or 64 pixels |
| Maximum size | 125 x 125 |

# Animation Support

The Motorola T725 handset supports use of these animation settings:

| Type | Description |
|------|-------------|
| Small | Color, 8 x 8 pixels |
| Large | Color, 16 x 16 pixels |
| Frames | 4 frames maximum (EMS animations only) |
| Rate | 500 ms |
| Loop | Continuous |

# Screensaver Support

The Motorola T725 handset supports screensavers. **Screensavers** are animated or static images selected by the user that are shown full screen when the phone has been inactive for a time.

The recommended format for a screen saver is animated GIF (GIF 89a). Other file types are also supported including: static GIF (GIF 87a), WBMP, and EMS 5.0 bitmaps.

Screen savers are displayed using the entire screen. In the event an image is larger or smaller than the display, the following rules are followed:

- **Image too small**–image is scaled up to fit the display, maintaining the same aspect ratio, and centered on the display.

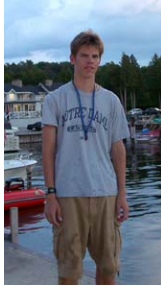- **Image too large**–image is scaled down to fit the display while maintaining the same aspect ratio.



| Image scaled to fit on the display while maintaining the original aspect ratio. | Original Image | Image scaled to fill the display while maintaining the original aspect ratio. |
|---|---|---|

**Figure 1.**     **How large screensaver images are displayed on the screen**

**Note:** By default, bars may appear on the left/right or top/bottom of the image to fill the display

If the screensaver is an animation, it plays for one minute and then halts at the first animation frame. This first frame, or key frame, then remains on the screen. Please note when creating the animation, the first frame must be a key frame.

# Wallpaper Support

Wallpaper images are static images that appear on the idle screen in full color and on other screens at a lower saturation to avoid obscuring screen details. Wallpaper images can be tiled or centered as selected by the user; centered is the default setting.

The recommended format for wallpaper images is a static GIF (GIF87a) file. Other file types that can be used as wallpaper image are JPEG, WBMP and EMS 5.0 bitmaps.

| | | |
|---|---|---|
| Wallpaper image. (example only) | Wallpaper images appear behind all screen elements on the idle screen. | Wallpaper images appear behind all screen elements on the menu screen. |

**Figure 2.** **How wallpaper is displayed on the idle screen and main menu screen.**

The user has the following options for wallpaper:

- **Center** – the image is resized to fit on the screen while keeping the aspect ratio.

- **Fit-to-screen** – the image is resized to fill the screen while keeping the original aspect ratio (refer to Figure 2).

If the user selects an animated GIF image, the first frame of the animated GIF becomes the wallpaper image. It's important that the colors of the wallpaper image allow the text displayed on the screen to remain legible.

# Theme Support

The Motorola T725 handset supports themes. A **theme** is a combination wallpaper, screensaver, and ring tone data set that enables users to customize their experience on the handset. Theme components are grouped together and downloaded to the handset as a bundle.

**NOTE**: The filenames used for screensavers, wallpapers, and ring tones used to create a theme files are limited to 32 characters each (excluding the dot and extension). The Media Manager automatically truncates longer filenames (while retaining the extension) when it creates the theme file. Duplicate filenames are renamed by the phone to ensure they are unique. However, it is recommended you use unique filenames for each media element.

For more information on creating theme bundles, see the documentation that accompanies the Media Manager tools.

**NOTE**: Some wireless networks limit the maximum size of a Theme download to 100 KB. Developers are encouraged to keep their themes to this size or less. This size must also include header information, which can be up to 500 bytes in size.

# Sound

This chapter describes the sound environment available in the Motorola T725 handset. It includes information on sound formats, pre-defined melodies and ring tones, and more. Use it as a reference when creating sounds for your products.

In general, file size is limited by available memory. All media (wallpaper, screensavers, ring tones, and themes), whether pre-loaded on the device or downloaded by the user, share the same storage area. The available memory for downloaded files will vary based on the media that is pre-loaded into the device, and that will vary from region to region and from carrier to carrier. We recommend keeping all media files as small as possible to ensure the consumer has the ability to download and use a variety of files to enhance the user experience.

## Supported Sound Formats

The Motorola T725 handset supports these sound formats:

| Type | Description |
| --- | --- |
| AMR | Adaptive Multi-Rate is a speech codec that provides high speech quality under a wide range of transmission conditions. |
| iMelody | iMelody is the Infrared Data Association (IrDA) standard for the textual representation of a ring tone that can be used to transfer melodies between devices. |
| MIDI | The Motorola T725 handset is fully MIDI 1.0 compliant, and supports any data format described in *The Complete MIDI 1.0 Detailed Specification*, including:<br><br>  − MIDI, Type 0<br>  − MIDI, Type 1<br>  − Scalable Polyphonic MIDI (SP-MIDI) |
| WAV | Windows Audio Volume (WAV) is a digitized audio file format that stores sounds as waveforms. Supported only in J2ME applications running on the device. |
| MP3 | The MP3 format provides the coding of audio for digital storage. |

# Sound Support

The Motorola T725 handset support use of these sound settings:

| Type | Description |
| --- | --- |
| Recommended Size | 9Kb |
| Duration | 20 ms (minimum duration for a single note) |

## Pre-Defined EMS Sounds

The Motorola T725 handset supports these standard pre-defined EMS ring tones, which the user can enclose in an EMS text message or set as a ring indicator.

| Number | Sound |
| --- | --- |
| 0 | Chimes high |
| 1 | Chimes low |
| 2 | Ding |
| 3 | TaDa |
| 4 | Notify |
| 5 | Drum |
| 6 | Claps |
| 7 | Fanfare |
| 8 | Chord high |
| 9 | Chord low |

# Ring Tone Support

Ring tones should not exceed 30 seconds because most voice mail systems pick up after four rings (16-25 seconds depending on the system).

Due to this length suggestion and the fact that Motorola T725 handset's synthesizer has a maximum polyphony of 24 notes, ring tone length should never exceed 9Kb.

# MIDI Support

The Musical Instrument Digital Interface (MIDI) enables people to use multimedia computers and electronic musical instruments to create, enjoy and learn about music.

The MIDI protocol is a music description language in which every word describes an action of musical performance. Each action is stored as a binary word and when combined, stored as MIDI files. These files can then be replayed by any electronic device that can read the MIDI file and recreate the performance using its available sound system. Unlike recorded sound files like MP3, WAV, or AIFF, MIDI files are extremely compact and completely editable, making them ideal for small mobile devices.

## MIDI Key Mapping

The Motorola T725 handset supports all 128 general MIDI instruments and the standard drum kit, but due to frequency limitations, not all MIDI notes are supported for all patches. The following table describes what the valid key ranges are for T725.

| Patch Number | Patch Names | Valid MIDI Note Numbers |
|---|---|---|
| 0 | Acoustic Grand Piano | 21-96 |
| 1 | Bright Acoustic Piano | 21-96 |
| 2 | Electric Grand Piano | 21-96 |
| 3 | Honky-tonk Piano | 21-96 |
| 4 | Electric Piano 1 | 28-96 |
| 5 | Electric Piano 2 | 28-96 |
| 6 | Harpsichord | 24-89 |
| 7 | Clavinet | 24-84 |
| 8 | Celesta | 48-96 |
| 9 | Glockenspiel | 65-96 |
| 10 | Music Box | 48-84 |
| 11 | Vibraphone | 53-89 |
| 12 | Marimba | 48-96 |
| 13 | Xylophone | 60-96 |
| 14 | Tubular Bells | 48-96 |
| 15 | Dulcimer | 48-84 |
| 16 | Drawbar Organ | 36-96 |
| 17 | Percussive Organ | 36-96 |

Sound

| Patch Number | Patch Names | Valid MIDI Note Numbers |
|:---:|:---|:---:|
| 18 | Rock Organ | 36-96 |
| 19 | Church Organ | 21-96 |
| 20 | Reed Organ | 36-96 |
| 21 | Accordion | 53-89 |
| 22 | Harmonica | 60-84 |
| 23 | Tango Accordion | 53-89 |
| 24 | Acoustic Guitar (nylon) | 40-86 |
| 25 | Acoustic Guitar (steel) | 40-86 |
| 26 | Electric Guitar (jazz) | 40-86 |
| 27 | Electric Guitar (clean) | 40-86 |
| 28 | Electric Guitar (muted) | 40-86 |
| 29 | Overdriven Guitar | 36-86 |
| 30 | Distortion Guitar | 36-91 |
| 31 | Guitar Harmonics | 36-86 |
| 32 | Acoustic Bass | 28-72 |
| 33 | Electric Bass (finger) | 28-60 |
| 34 | Electric Bass (pick) | 28-60 |
| 35 | Fretless Bass | 24-72 |
| 36 | Slap Bass 1 | 28-60 |
| 37 | Slap Bass 2 | 28-60 |
| 38 | Synth Bass 1 | 28-60 |
| 39 | Synth Bass 2 | 28-60 |
| 40 | Violin | 48-96 |
| 41 | Viola | 48-84 |
| 42 | Cello | 36-72 |
| 43 | Contrabass | 28-55 |
| 44 | Tremolo Strings | 28-91 |
| 45 | Pizzicato Strings | 28-96 |
| 46 | Orchestral Harp | 21-96 |
| 47 | Timpani | 36-84 |
| 48 | String Ensemble 1 | 28-91 |
| 49 | String Ensemble 2 | 28-96 |

| Patch Number | Patch Names | Valid MIDI Note Numbers |
|---|---|---|
| 50 | Synth Strings 1 | 36-91 |
| 51 | Synth Strings 2 | 36-91 |
| 52 | Choir Aahs | 48-84 |
| 53 | Voice Oohs | 48-84 |
| 54 | Synth Voice | 48-96 |
| 55 | Orchestra Hit | 36-84 |
| 56 | Trumpet | 58-94 |
| 57 | Trombone | 34-75 |
| 58 | Tuba | 29-55 |
| 59 | Muted Trumpet | 58-82 |
| 60 | French Horn | 41-77 |
| 61 | Brass Section | 36-91 |
| 62 | Synth Brass 1 | 36-91 |
| 63 | Synth Brass 2 | 36-91 |
| 64 | Soprano Sax | 54-87 |
| 65 | Alto Sax | 47-80 |
| 66 | Tenor Sax | 42-76 |
| 67 | Baritone Sax | 36-68 |
| 68 | Oboe | 58-91 |
| 69 | English Horn | 52-81 |
| 70 | Bassoon | 34-72 |
| 71 | Clarinet | 50-91 |
| 72 | Piccolo | 74-96 |
| 73 | Flute | 60-96 |
| 74 | Recorder | 60-96 |
| 75 | Pan Flute | 60-96 |
| 76 | Blown Bottle | 60-96 |
| 77 | Shakuhachi | 55-84 |
| 78 | Whistle | 60-96 |
| 79 | Ocarina | 60-96 |
| 80 | Lead 1 (square) | 24-96 |
| 81 | Lead 2 (sawtooth) | 24-96 |

Sound

| Patch Number | Patch Names | Valid MIDI Note Numbers |
|---|---|---|
| 82 | Lead 3 (calliope) | 36-96 |
| 83 | Lead 4 (chiff) | 36-96 |
| 84 | Lead 5 (charang) | 24-96 |
| 85 | Lead 6 (voice) | 36-96 |
| 86 | Lead 7 (fifths) | 36-96 |
| 87 | Lead 8 (bass+lead | 24-59 |
| 88 | Pad 1 (new age) | 36-91 |
| 89 | Pad 2 (warm) | 36-96 |
| 90 | Pad 3 (polysynth) | 36-96 |
| 91 | Pad 4 (choir) | 36-96 |
| 92 | Pad 5 (bowed) | 36-96 |
| 93 | Pad 6 (metallic) | 36-96 |
| 94 | Pad 7 (halo) | 36-96 |
| 95 | Pad 8 (sweep) | 36-96 |
| 96 | FX 1 (rain) | 36-96 |
| 97 | FX 2 (soundtrack) | 36-96 |
| 98 | FX 3 (crystal) | 36-96 |
| 99 | FX 4 (atmosphere) | 24-96 |
| 100 | FX 5 (brightness) | 24-96 |
| 101 | FX 6 (goblins) | 36-96 |
| 102 | FX 7 (echoes) | 36-96 |
| 103 | FX 8 (sci-fi) | 36-96 |
| 104 | Sitar | 48-77 |
| 105 | Banjo | 48-84 |
| 106 | Shamisen | 50-79 |
| 107 | Koto | 55-84 |
| 108 | Kalimba | 48-79 |
| 109 | Bagpipe | 36-77 |
| 110 | Fiddle | 48-96 |
| 111 | Shanai | 48-72 |
| 112 | Tinkle Bell | 72-91 |
| 113 | Agogo | 60-72 |

| Patch Number | Patch Names | Valid MIDI Note Numbers |
|---|---|---|
| 114 | Steel Drums | 52-84 |
| 115 | Woodblock | 60-72 |
| 116 | Tailo Drum | 60-72 |
| 117 | Melodic Drum | 48-84 |
| 118 | Synth Drum | 48-84 |
| 119 | Reverse Cymbal | 60-72 |
| 120 | Guitar Fret Noise | 60-72 |
| 121 | Breath Noise | 60-72 |
| 122 | Seashore | 60-72 |
| 123 | Bird Tweet | 60-72 |
| 124 | Telephone Ring | 60-72 |
| 125 | Helicopter | 60-72 |
| 126 | Applause | 60-72 |
| 127 | Gunshot | 60-72 |
| none | Drums | 35-81 |

# MIDI Audio Guidelines

The following are suggested guidelines to maximize sound quality while reducing the overall file size of a MIDI Ring Tone file for use with the T725 handset.

**Tip 1: Use MIDI's running status feature**

In the MIDI standard, a key-on or a key-off event will use at most three bytes each. However, when several key events occur on the same MIDI-channel, the running status feature can be used. In principle, running status means that the first byte of, say, a key-on event is omitted. In addition, the key-on event having a velocity of zero is equivalent to the key-off event. Thus, combining running status with key-on events that have zero velocity reduces the number of bytes needed to encode all key events.

EXAMPLE:

Without using the running status, features, the sequence

```
91 2E 23 8E, 91 2B 50 8E, 81 2E 64 00, 81 2B 64 00
```

represents "Key 2E ON" Velocity 23 MIDI Ch 1", "Key 2B ON Velocity 50 MIDI Ch 1", "Key 2E OFF Velocity 64 MIDI Ch 1", "Key 2B OFF Velocity 64 MIDI Ch 1". Using the running status feature reduces the sequence to:

```
91 2E 23 8E, 2B 50 8E, 2E 00 00, 2B 00 00,
```

That is, the command byte is omitted and velocity zero is used for key off.

**Tip 2: Use Standard MIDI File (SMF) type 1**

The MIDI content can be stored in a Standard MIDI File (SMF) of type 0 or type 1. In a type 0 SMF, the file format uses one header chunk with one-track chunk. In a type 1 SMF, the format uses one header chunk with several track chunks. SMF type 2 should not be used.

In general, it is more efficient to store the MIDI data as a type 1 file. The increased efficiency is achieved because each track contains only one MIDI channel and one instrument (This is often the case). The running status feature can be applied on each individual track, thereby reducing the track size. To further reduce the size of the file, use one track per used MIDI channel. That is, if a temple/conductor track exists, merge it with the first instrument track. Remove all unnecessary meta-events such as the "track name" and "lyric" meta-events.

To summarize, the following measures can be taken in order to reduce the SMF:

1.  Use SMF type 1 (Or verify that a type 1 file is smaller than a type 0 file and use the smallest file).

2.  Use running status.

3.  One and only one instrument per track. Try not to change channels.

4.  Do not change tempo in the middle of the music. That is, set the tempo once.

5.  Use beat, instead of SMPTE, to set the tempo.

6.  Do not use Copyright Text Fields.

7.  Limit the use of continuous controller information such as pitch-bend and volume.

8.  Turn off the options below:

    -   Sequence Number - MIDI sequence ids

    -   Text - embedded text for any optional fields

    -   Sequence / Track Name

    -   Instrument Name

    -   Lyric

    -   Marker - for synchronization purposes

    -   Cue Point

    -   Midi Channel Presix - associate channels with all events following

    -   Sequencer-Specific settings

Items one through three above optimize the encoding of the notes, while items four to eight optimize the overall melody. The above measures provide an SMF file that is ready-made for compression. However, prior to compression, the composer/content author can add a few values for key velocity, thereby increasing the redundancy of the file.

**Tip 3: Consider the Frequency Response**

Even though the MIDI synthesizer is sampled at 22 KHz, the polyphonic speaker's frequency response is not as wide. Try to keep the majority of melodic information below 6000 Hz.

**NOTE**: The use of MIDI notes below 800Hz may cause a decrease in volume when playing the note. Always test your audio on an actual device to ensure the accuracy of the sound you want to produce.

# MP3 Audio Guidelines

MP3 (MPEG Audio Layer 3) is an audio compression technology that is part of the MPEG-1 and MPEG-2 specifications. Developed in Germany in 1991 by the Fraunhofer Institute, MP3 uses perceptual audio coding to compress CD-quality sound by a factor of 12, while providing almost the same fidelity.  Because MP3 audio is digitized, not synthesized, reproduction (disregarding speaker quality) is identical on all devices.  Therefore MP3 ring tones provide a near-CD quality audio experience for listeners as opposed to their MIDI counterparts which differ greatly from device to device.

The following recommendations should be used when designing MP3 audio clips for use in the phone:

**Technical Specifications for MP3:**

➢ Bit Rate:  65kbps max

➢ Recommended File Size:  100K

➢ Maximum Duration (NW dependent):  16-30 secs

# Available Sound Properties

The following table describes the available MP3 encoding properties on the T725 Platform.

| File Type | Sampling Frequency | Bit Depth | Mono/Stereo | Bit-rate (kbps) |
|-----------|--------------------|-----------|-------------|-----------------|
| MP3 | 44.1kHz | 16 | Mono | 64 |
| MP3 | 24kHz | 16 | Stereo | 40 |
| MP3 | 24kHz | 16 | Mono | 40 |
| MP3 | 16kHz | 16 | Stereo | 40 |
| MP3 | 16kHz | 16 | Mono | 32 |

*Overall bit-rate cannot exceed 64 kbps. Any MP3s encoded higher than 64 kbps will not play on the device.

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**Note:** There is no stereo speaker support for the Motorola T725. Stereo ring tones will be played in mono. If the handset supports a stereo file and a stereo headset is attached, the file will be played in stereo.

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Depending of frequency content of the material the recommended properties for MP3 ring tones are:

| | | | | |
|------|---------|----|------|----|
| MP3  | 44.1kHz | 16 | Mono | 64 |
| MP3  | 24kHz   | 16 | Mono | 40 |

## Design Guidelines

Since ring tones need to be at a consistent audible level, compressing the original content to reduce the peak-to-average ratio is necessary.  After the audio is compressed it is advisable to re-normalize the audio to 0db before saving the compressed MP3 file.

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**Note:** Ring tones are generally between 15-20 seconds in length.  Based on the recommended bit rates that would yield a file size between 75-150K per tone.  It is advisable to keep file size beneath 100K to allow the end-user to download multiple tones, but there is no file size limit except for total free memory available on the device.

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## MotoMixer

The Motorola MotoMixer feature allows users to mix a repeating "base track" directly on the Motorola T725 using the MotoMixer application. The base track consists of four parts: three content-specified instruments and a drum. Four variations are provided for each part in the base track file. Selecting one of the four variations for each of the parts at a specific point in time creates the mix. The mix created by the user can be saved in a file referred to as the "mix file" and can be recalled later to be used as a ringtone or sent to another mobile phone using SMS or email. The initial release of the Motorola T725 will not support mobile originated messages containing MIDI files.

The four variations defined for each part are referred to as "Variation A," Variation B," Variation A with effect," and "Variation B with effect." The user interface for the MotoMixer editor allows the user to modify three settings for each part: instrument on/off, which enables or disables the part entirely; variation A/B, which selects the variation played; and effect on/off, which enables and disables the effect. There are five valid combinations of these three settings: part turned off (muted) and the four variations listed at the beginning of this paragraph. The MotoMixer editor starts with all four parts muted as shown below.
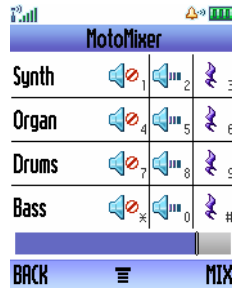
Changes made to the mix by the user will take effect only on 16$^{th}$ note boundaries. If a base track was written in 4/4 time (four quarter notes per measure), there would be 16 equally-spaced "sequence points" in the measure where changes by the user would take effect.

When played, the base track file is looped. Initial revisions of the MotoMixer feature will loop the base track four times. Future revisions may allow the number of loops to be configurable (with a default value of four) by the user on a per-mix file basis.

# Base Track File Format

MotoMixer base tracks are required to be standard MIDI files stored in format 0 (i.e. data for all channels is stored in a single track). Base track files can be any length and be written any time and any key signature. MotoMixer base tracks should be saved with a .bas file extension.

# Channels

The four variations for each part in the base track file are stored as separate channels. The mapping between part and variation and channel number is shown in the table below.

| Part | Variation | MIDI Channel |
|---|---|---|
| Instrument 1 | Variation A | 1 |
| | Variation B | 2 |
| | Variation A with effect | 3 |
| | Variation B with effect | 4 |
| Instrument 2 | Variation A | 5 |
| | Variation B | 6 |
| | Variation A with effect | 7 |
| | Variation B with effect | 8 |
| Drums | Variation A | 9 |
| | Variation B | 10 |
| | Variation A with effect | 11 |

| Part | Variation | MIDI Channel |
|------|-----------|--------------|
| | Variation B with effect | 12 |
| Instrument 3 | Variation A | 13 |
| | Variation B | 14 |
| | Variation A with effect | 15 |
| | Variation B with effect | 16 |

# Instruments

The MotoMixer feature supports use of all 128 General MIDI instruments. Please note that not all phones are able to distinctly represent all of these instruments (e.g. all General MIDI piano-like instruments may be represented by a single piano sound – Acoustic Grand Piano may sound like Electric Piano 2). The Motorola T725 handset supports the full instrument set with very limited re-mapping. The General MIDI Percussion Map will be used for the drum part, so no instrument should be specified for the variations of the drum part.

In the MotoMixer editor, the parts are named by the General MIDI instrument used by the first note of the "Variation A" variation of the part. That is, if the first note in "Variation A" for a part is played with the "Whistle" instrument, the part is labeled in the user interface as "Whistle". The different variations for a part can be implemented using different General MIDI instruments, but the part name displayed to the user will never change. The drum part will always be named "Drums" regardless of the drum sounds used in the part.

The results of changing instrument mapping for a variation in the middle of the variation are unpredictable and should be avoided.

Base tracks may use up to four different drum instruments from the General MIDI Percussion Map. For example, a base track may decide to use drum instruments 36, 40, 42, and 45 (Bass Drum 1, Electric Snare, Closed Hi Hat, and Low Tom). No additional drum instruments can be used. If other drum instruments are used, only the first four that are specified in the base track will be heard. This applies across all variations of the drum part – only the four selected drum instruments can be used in the entire base track.

# Tempo

The tempo of the base track must be specified at a time 0 of the base track file. Tempo is specified in microseconds per quarter note in a standard MIDI "Set Tempo" meta-event. If the tempo is not set in the MIDI file, or is not set at time 0, the tempo will default to 500,000 microseconds per quarter note (120 beats per minute). Tempo changes in the middle of the base track file will be ignored.

The MotoMixer user interface provides the user with an option to adjust the tempo of the base track. This user-specified tempo is saved as part of the mix file. The user is allowed

to adjust the tempo on a scale of 0-7. Setting 3 is the default value and will be equal to the tempo specified in the base track file. Setting 0 is approximately equal to half of the default temp. Setting 7 is more than double the default tempo.

## Restrictions

The implementation of the MotoMixer feature uses a MIDI Text Event containing the text "\!" (backslash exclamation mark) in the form:

FF 01 02 5C 21

Base tracks will not contain text events matching this format. Text events that contain other text can be included at any point in the base track file.

In addition, files should be created to allow for a maximum polyphony of 16 simultaneous notes when all tracks and effects are active.

## Design Recommendations

Individual instruments' variations should be varied greatly to allow for an easily discernable difference between variation 1 and 2. This can be accomplished by using different rhythmic, harmonic, and melodic structures. One possible recommendation is to use a more basic structure for variation 1 and a more complex one for variation two (steady rhythm vs. syncopation).  There must be an easily recognizable differentiation between each of the variations.

With regards to variations with effect, these tracks can be used in a multitude of ways. One possibility is to use the effect track to add harmony to a melody of an associated track.  Additionally, the effect track can be used to add musical substance such as arpeggiations or figured basses. Lastly, the effect track can be used to add delay effects such as echo by copying all musical events and pasting them at a short (1/32) offset. Overall, the effect track should be used to add rhythmic, harmonic, or acoustical depth to the associated variation track.

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