“Dream holiday”

Vice snapshot with Vice palette

Made with the GIMP from a photo
and converted to C64 160x200
Multicolor Mode Bitmap
by Stefano Tognon
in 2004

“The big of small”
...

Free Software Group

SciTools Understand 7
version 1.00
9 January 2004

SIDin Contents

General Index

Editorials

Stefano Tognon <ice00@libero.it>

Hi, again.

As you can see there is no a Marble Madness article. But I think that if you downloaded the new HVSC update you will enjoy a rip it contains. However I have not yet finish my rip, but now there is no pleasure to finish as we can listen to the available rip.

So this time I will present another engine from the inside: Modules tune by Ivan Del Duca.
I choose this tune primary as I like it and secondary as this is probably made with the first music engine written by an Italian programmer.

The second article is about a very tiny sid: 256 bytes for a fantastic sound!

Well, why not making a competition about writing very small sid? A mix about programming and sid composition...

Finally I like to remember to all the sid people around that if you want to contribute to this magazine with article it's very simple: write something about your sid music activity and it will be a pleasure to make it available for all.

Bye
S.T.

News

Some various news of players, programs , competitions and hardware:

- CGSC v1.11
- SIDPlayer 4.4
- SID PC64 Winamp plugin v2.0
- Sidplay2/w
- HVSC 5.7
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CGSC v1.11

Version 1.11 of the Compute's Gazette Sid Collection was released on 8 May 2004.

The collection now contains 5913 MUS files, 1314 STR files and 1567 WDS files.

Download the update from http://www.c64music.co.uk

SIDPlayer 4.4

Released on 8 May 2004 the new version of Christian Bauer SIDPlayer (BeOS, Linux).

It this version it is fixed a problem with the wrong replay routine being called when the IRQ vector was changed. Mastercomposer tunes (and probably others) not play correctly.

Download the player from here: http://www.uni-mainz.de/~bauec002/SPMain.html

SID PC64 Winamp plugin v2.0

SID PC64 is a Winamp plugin which plays .sid files on real C64 through a PC64 cable (http://sta.c64.org/pc64.html) developed by Jakub 'Prezes' Wozniakowski.

Features and limitations:

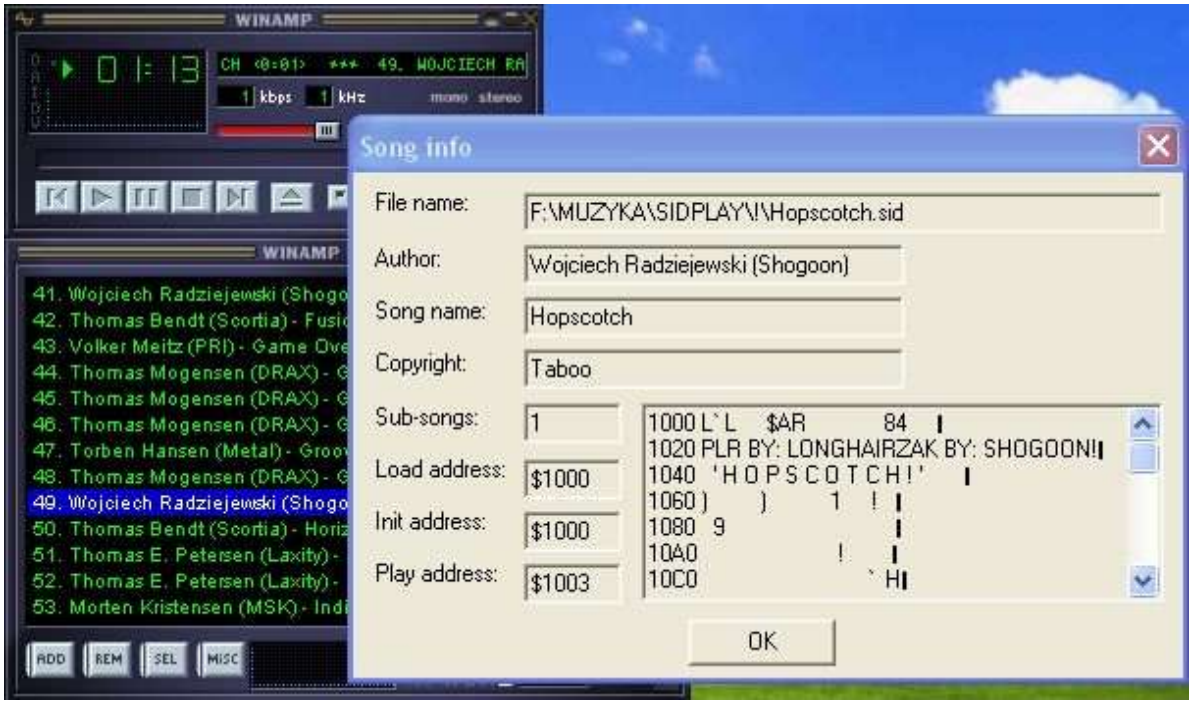
- Multispeed songs are supported
- Tunes which use samples are not supported
- Change playing sub-tune number moving Winamp's position bar (if disabled there is only one sub-song)
- The whole song must be transfered to C64 before playing, it can take few seconds - rasters on borders (c64), progress window (pc)
- Plugin and c64 can hang from time to time - not all tunes have been tested. This piece of player's code taken from HVSC will not work:

```
                LDA #$00
                STA kapusta
                JSR $1000
kapusta         NOP
                ...
```

- Player on C64 is $6a bytes long (including IRQ and simple transfer routines) so don't say it's lame ;-)
- Plugin was tested on Windows XP professional and Windows 2003 Server using Winamp 2.91, AMD Duron 1800

Version 2.0 (released on 16 may 2004) features:

- Windows XP/2000/2003 compatible
- detailed song info
- selectable parallel (LPT) port
- custom playing time
- inproved stability
- transfer progress window



Sidplay2/w

A new version of sidplay2/w was released on 27 May. These are the notable changes this time:

- support for multi-subtune BASIC tunes (libsidplay2)
- sprite stealing emulated (libsidplay2)
- p00 support (libsidplay2)
- stereo mus to sid conversion (libsidplay2)
- corrected instruction overlapping (libsidplay2)
- CPU Debug improvements - same memory model, progress meter, option to enter power-on delay value

Download it from http://www.gsldata.se/c64/spw/

HVSC 5.7

HVSC Update #39 was released on 27 May an is available at www.hvsc.c64.org

After this update, the collection should contain 27,087 SID files!

This update features (all approximates):

- 1946 new SIDs
- 275 fixed/better rips
- 3 fixes of PlaySID/Sidplay1 specific SIDs
- 12 repeats/bad rips eliminated
- 230 SID credit fixes
- 470 SID model infos
- 41 tunes moved out of /DEMOS to their composers' directories
- 11 tunes from /DEMOS/UNKNOWN identified :-) (1 goes back due to bad credits)
- 14 tunes moved out of /GAMES to their composers' directories

We're once more proud to present another monster update, consisting of overall over 2100 SID tunes, 275 of those being fixes. With this release we also finally managed to completely unload our huge queue of unreleased tunes to the public. There are still a couple of problem tunes left which we'll hopefully manage to fix for the next HVSC update, but basically that's all all there is.

We've got the music compo entries from the following parties in this pack:

Breakpoint 2004, Sidwine 3, Floppy 2004, Forever 5 and 7D4

Further there are a lot of real, unmodified BASIC rips in this update:

They are basically RSID tunes, hence they need Sidplay2 or a real C64.
To make them easier to spot we have added _BASIC to the filename.

Another bunch of classical tunes from the first minute have been added to HVSC:

- Peter Weighill's Master Composer collection /DEMOS/UNKNOWN/Master_Composer/
- the Master Composer example tunes, most likely done by the author of the program, Paul Kleimeyer.
- the Brøderbund Music Shop tunes, uncredited, but with high likeliness also composed by the maker of the tool, Don Wilson.

Main Artists featured in this update:

- DRAX
- Jan Albartus
- Dwayne Bakewell & Kent Patfield (Pearl)
- Kristian Røstøen
- Cosowi
- Jeroen Breebart
- Kordiaukis
- Sad
- Taxim
- Yip
- Amadeus/Attic/Meka
- Richard Bayliss
- Bzyk
- Cycleburner
- Jeff
- Mitch & Dane
- Shapie
- Agemixer
- Compod
- Glenn Rune Gallefoss
- Comer
- Hein Holt
- Klax
- Replay
- Surgeon

NEW Artists featured in this update:

- Android
- Tonal Teapot
- David Bain
- Debby Cruz
- Ewen Gillies
- Krwiak
- Mr. Wig
- Sam/SCCS
- Steven Judd (Wyndex)
- Steffen Wagner
- Don Williams
- Commodore (BASIC classics)
- 4wd-soft
- Benno
- Freeze/The Force
- David Green
- Lio
- Stephan Parth (Nata)
- Speedcracker
- Tinnitus (Asterion & Trompkins)
- Nick Williams
- Paul Kleimeyer
- Amadeus/Slash
- Black Dove
- G-Fellow
- Gummibeer
- Alexander Kern (Mac)
- Rashka
- TheFatman
- Oskar Törnros
- Yoshi

There are a couple of things worth mentioning in this update:

- The latest release of Sidplay2 not only contains some generic emulation improvements, but it also introduces the possibility to play back real BASIC tunes without the need to painfully convert them to machine code, which often resulted in rather doubtful playback quality. We ripped and re-ripped quite a lot of BASIC tunes for this update, most of which now reside in the /Commodore directory. There are the classic example tunes of the C64 users manual, some example tunes from "the bible", the C64 Programmer's Reference Guide. Also take a peek into the /GAMES dir of this update, there are a couple of classic BASIC tunes too, such as Sword of Fargoal, Telengard or the 1983 Stack Computer Services BASIC games! To make them easy to spot we added a _BASIC suffix to all the filenames.

- After several requests, both from inside and outside the HVSC team, we decided to integrate Peter Weighill's old Master Composer Collection into HVSC. Many of these tunes bear a lot of nostalgic value, so it would be a shame not to have them. Be aware that due to a bug in the libsidplay1 libraries they might sometimes lock up your sidplay1-based player. They work fine on Sidplay2 and on a real C64, though.

- The HVSC crew got a new member: We all want to welcome back Wilfred Bos, the author of the fabulous ACID64 Player for users with hardware based SID cards such as the Hardsid or the Catweasel. Wilfred was a HVSC member of the first hour, but had to quit four years ago due to real life priorities. Welcome back, Wilfred!

- While talking about Wilfred, he just recently released a new version of ACID Player, upgrading the version number to 2.0. New features:
    - Cycle based emulation of 6510 CPU, 6526 CIA and 6569 VIC-II chip
    - Cycle based playback of SID data

- Support for sample playback of RSID and C64 Program files
- Support for playing PRG and PC64 files
- Simulation of space bar and joystick fire buttons to skip intros
- Support for restoring screen size
- Added 6510 CPU performance indicator
- Support for skipping silents of beginning of tunes
- Better resetting of SID chip
- Faster voice bar animation
- Fix for frequency adjustment to avoid warble sounds in some tunes
- Many other improvements

Download it here: http://www.acid64.com

Asterion Sid-Tracker v1.1

Released 31 May 2004 the new version of Tinnitus editor.

major improvements:

- vibrating portamento implemented
- vibrating arpegio implemented (experimental)
- independent detune level for each instrument
- multispeed up to 4x
- pulse step programming
- 11-bit filter step programmng
- various bugs removed
- heavily refined packer

Download from http://tinnitus.prv.pl

reSID 0.16

On 11 June reSID 0.16 was released.

reSID is the sid emulation library developed by Dag Lem.

This release fixes a few bugs, most notably a one cycle error in the ADSR delay bug emulation. This error only affected fast sampling.

Resampling is necessary to achieve the ultimate sound quality in SID emulation. In collaboration with Laurent Ganier, the resampling code has been highly optimized and streamlined for vectorizing compilers. High quality resampling can now be run in real time on off-the-shelf hardware. With vectorizing compilers (e.g. Intel's icc) real time resampling can be achieved even on somewhat older hardware.

For the full changelog and source code download reSID 0.16 at:

ftp://ftp.funet.fi/pub/cbm/crossplatform/emulators/resid/resid-0.16.tar.gz

Sidplay2 + ReSID 0.16

On 15 June, Simon White had released the new version of libsidplay2 library modified for taking use of the new reSID 0.16 library and the changes made in the May released of sidplay2/w.

Download all the stuff from http://www.gsldata.se/c64/spw/ and http://sourceforge.net/projects/sidplay2

2010 SID COMPO V1

Ended on 1 July 2004 the 2010 SID COMPO music competition organized by Rolemusic on www.2010compo2010.tk

Here the result:

1.	Hein Design/Vision	Chill Addiction	7.16
2.	Richard	High Speed	6.64
3.	Surgeon/Vulture Design	NICE DREAM	6.58
4.	hukka	Leego II	5.77
5.	maktone / fairlight	mr freshness	5.66
6.	Raf/Samar/Vulture design	God is a girl	4.92
7.	Thomas Wurgler (AKA Trez	Happy Day	4.79
8.	Anders Carlsson (Zapac)	Theme 1:22	4.64

Libsidplay1 1.36.59

On 17 August 2004 was released an update to libsidplay1 (a low-cpu consuming sid emulation library) that fix security bug in debian.

Download from http://www.geocities.com/SiliconValley/Lakes/5147/sidplay/linux.html

SIDPLAY for Mac OS X 3.3

This sidplayer for Mac OS X was released on 17 August 2004.

New to this version:

- Updated to latest libsidplay2 and reSID components
- Integrated HardSID support courtesy of Teli Sandor and Hard Software
- Redesigned the user interface using a separate info window
- Fixed visual glitches on Panther
- Added mixer panel with mute and solo controls
- Improved filter adjustment panel with options to add and remove filter spline points
- Added automatic download of composer photos from http://composers.c64.org/
- Added feature to play a random tune from the HVSC collection
- Added dock menu
- Improved search in playlists
- Updated to PSID64 0.6
- Fixed various major and minor bugs

Download from http://www.sidmusic.org/sidplay/mac/

CGSC v1.12

Version 1.12 of the Compute's Gazette Sid Collection was released on 21 August 2004.

The collection now contains 5998 MUS files, 1314 STR files and 1567 WDS files.

Download the update from http://www.c64music.co.uk

HVSC 5.8

HVSC Update #40 was released on 27 September an is available at www.hvsc.c64.org

After this update, the collection should contain 27,653 SID files!

This update features (all approximates):

```
563 new SIDs
724 fixed/better rips
  2 fixes of PlaySID/Sidplay1 specific SIDs
 10 repeats/bad rips eliminated
323 SID credit fixes
152 SID model/clock infos
 27 tunes moved out of /DEMOS to their composers' directories
 15 tunes from /DEMOS/UNKNOWN identified  :-)
    (and two go back due to bad credits)
 12 tunes moved out of /GAMES to their composers' directories
    (and one goes back due to bad credits)
```

Main Composers featured in this update:
(Artists marked with NEW! are either completely new to the HVSC or they get their own directory in this update)

```
Deek                              James Hilthy  (NEW!)
Kathy and Kidd Clark (NEW!)       Henning Rokling
John Vanderaart                   Agemixer
Alien                             Richard Bayliss
Glenn Rune Gallefoss              Ciaran
CMP (NEW!)                        ELA
G-Fellow                          Harmony Productions
Hein Holt                         John Keding
Sascha Zeidler (Linus) (NEW!)     Lordnikon
Maktone                           Murdock
Nadira                            Ne7 (NEW!)
Richard Nygaard (NEW!)            Puterman
Reed (NEW!)                       Scortia
Tango                             Jeremy Thorne (NEW!)
Asterion                          Zeus
```

So what is new about this update?

- We've got the music compo entries from the following parties in this pack:
  LCP 04, North Party 9, Assembly 04, Primary Star 04 and Solskogen 04

- The mega hyped Turrican 3 soundtrack is of course also in this update, check out /VARIOUS/S-Z/Sonic/Turrican_3.sid. And head over to www.smash-designs.de and drop a mail to AEG and express your interest in Katakis 2, which, if all goes well, will be coproduced by ye ole master Manfred Trenz again!

- This update contains about 500 multi speed fixes. Due to an incorrect assumption regarding the

number of cycles per frame (the C64 has $4CC7 and not $4CF9 cycles per frame, due to running at 50.125Hz instead of 50Hz) most of the multi speed tunes that you will find in HVSC were played a little slower than intended after converting them to play via the CIA timer.

Also we removed some completely unnecessary cycle eating $DC0E writes, which caused a larger slowdown than the mere $22 cycles difference mentioned above.

Although a 0.2% speed difference may not sound much in audible terms, some tunes do require very precise timing to get the instruments to sound correct, and so we felt it would be best to fix them all in one big effort in this update.

Do note that we haven't fixed all the old game tunes yet, as some native CIA timed tunes were indeed made to be played at exactly 50 Hz instead of 50.125 Hz and those will be fixed as necessary.

- We divided the update in a /fix and /new section. This makes it easier for us to keep track of the update during its creation and it's at the same time more convenient for you to listen through the update pack, so you can avoid the fixes and concentrate on the new tunes only (we assume that's your prime reason you update your collection regularly, to get new SIDs to listen to). :-)
  Of course, listening to the /fix section might be interesting to some of you as well, as it almost exclusively contains multispeed tunes! :-)

Catweasel MK4

Announced in July 2004, the new Catweasel MK4 pci card will be released as soon as some delay due to hardware components will be resolved.

Improvements to the SID audio part in this new card:

- **DC-DC converter eliminates noise**. On the Catweasel MK3, it was possible that noises from 3D-graphics cards or high-speed harddrives were coupled into the 12V-power supply of the SID audio part. This cannot happen any more on the Catweasel MK4, because a DC-DC converter is an insuperable obstacle for such noises.

- **Cycle-exact control**. In addition to the known programming that's compatible with the Catweasel MK3, the MK4 has a sophisticated script-language for SID control. This lets the programmer define the exact time for data to be written to the SID chips. To make sample playback sound exactly like on a real C64, the data rate to the SID chip must be kept at a constant rate. This is accomplished with a Fifo memory that is big enough to maintain the datarate even under high processor load conditions.

- **Digiboost for new SID versions**. As opposed to the 'classic SID' 6581, the newer SID-chips 8580 and 6582 cannot playback samples any more. This option, which is also called 'the fourth voice', is replaced by two sigma-delta converters on the Catweasel MK4, so the fourth channel is also audible with the newer SID versions. Since the filter properties and the sound of mixed waveforms of all SID versions have their supporters, this should make the decision for the right chip a little easier.

- **Filter capacitors selectable**. Commodore has defined three different capacitor values for the filters of the SIDs during the years that this chip has been produced. The result was that the same chip sounded differently if used in different computers. To bring the sound as close as possible to what you are used to, the filter capacitors can be chosen with a few jumpers.

- **Precise clocking**. The Catweasel MK3 used the commodore-chip 8701 to recreate the exact same clock. Since our stock of this chip is empty with the Catweasel MK3 being sold out, we have cloned it on the main logic chip of the Catweasel MK4: The exact base frequency is generated with crystals that have been made especially for us. By division and multiplication according to the specifications of the C64 schematics from 1982, we managed to replace the 8701, which is not made any more. Even the slight difference between PAL and NTSC computers is software-selectable!

- **Two SIDs for stereo sound**. You'll have twice the SID pleasure after installing a second SID chip. Every SID has it's own selection of filter capacitors, and SIDs of all versions can be mixed.

Technology improvements:

- **compatible with 3.3V and 5V PCI slots**. Even though PC boards with 3.3V PCI slots are not yet widely available, the Catweasel is prepared for it. The roadmap of the PCI special interest group plans to abandon 5V PCI slots within forseeable time, and the Catweasel is perfectly suited for that date. Local generation of the 3.3V power also ensures proper function on early PCI motherboards that do not comply to the ATX standard.

- **Two DMA interfaces.** In addition to processor-based data transfer, the Catweasel MK4 can exchange data with the main system through two low-speed DMA channels: The first goes throught he PCI slot, and it has a capacity of about 8K per second and direction. The second uses the direct connection to the onboard-floppy controller, and the speed is up to 100K per second.

- **Low power consumption**. The Catweasel MK4 makes use of the latest FPGA technology with 2.5V core voltage. This reduces the power consumption of the new controller to a fraction of what the Catweasel MK3 used. This also reduces heat generation a lot.

- **Re-configurable logic**. The FPGA on the Catweasel MK4 is completely re-configurable by the drivers. This means that a hardware update can be done through the internet! Should we find a disk format that cannot be handled with the current hardware, the core of the Catweasel can be 're-wired' to address the problem. The controller doesn't even have to be taken out of the computer for ths update!

- **Drivers for many operating systems.** The Catweasel MK4 is delivered with drivers for Linux, Windows 98(se)/ME/XP/2000, Amiga OS4, and for Mac OS X at a later date.

Other improvement not related to sid:

- Kylwalda built in
- Support for auto-eject drives
- Hard-sectored disks supported
- Dual-ported memory
- More flexible read- and write operations
- Extensive timer-functions
- All events can trigger an interrupt (IRQ)
- Amiga mice supported in hardware
- Every signal can be programmed as output
- Compatible with CD32 pads

More information from http://www.jschoenfeld.de/news/news_e.htm

XSidplay 1.6.5.2

Released in October 2004 the new version of the linux sid player:

- fix Qt-mt detection
- fix streampos arithmetic cast in File.cpp
- fix tab order in filter dialog
- load config from global /etc/xsidplay.ini
- fix underquoted automake definitions

The player is available at: http://www.geocities.com/SiliconValley/Lakes/5147

The SID Compo IV

The c64.sk music competition was taken from 22.november to 5.december 2004

There were 32 competing tunes plus 2 bonus tunes. Here the result, more info at the www.c64.sk site:

Place	PTS	Song Name / Author	ID
1	500	Natural Cause of Death / Thomas Mogensen (DRAX)	10
2	492	Natural Cause of Life / Alexander Rotzsch (Fanta/Oxyron/Plush)	31
3	467	Crush / Stellan Andersson (Dane/Booze Design)	24
4	457	Level Kamil Wolnikowski / (Jammer/EXON/MSL/Samar)	12
5	456	Vinyl Headz / Michal Hoffmann (Dat Nigga Randall / Ghettomuzik)	14
6	439	Unleas The F. Fury / Lasse rni (Cadaver/CoverBitOps	21
7	438	Sherona Red / Hein Holt (Hein/Focus)	6
8	424	Focus On Food / Ronny Engmann (Dalezy)	15
9	423	Flight of Serpent Dragon / Rafal Kazimierski (Asterion)	11
10	417	Mutator / Mark Thomas Ross (MTR1975)	3
11	395	The Battle Of [illegible] / Maciej Stankiewicz (Trompkins/Tinnitus)	17
12	394	Are you satisfied ? (prw) / Marcin Kubica (Booker/Amorphis/Onslaught	32
13	394	Garden of the Black Rose part 4 / Krzysztof Malczewski (Phobos/Samar	4
14	387	Second Steps / Aleksi Eeben (aeb/Carillon)	7
15	387	Marvel / Gerard Hultink (GH/Toondichters)	20
16	385	Sunday Weirdness / Marc van den Bovenkamp (No-XS/World Wide Expressive)	29
17	375	Path Of Pain / Daniel M. Gartke (Turtle / The Demented)	25
18	375	Cosy Brains Pulsating / Mark Waldaukat (Heinmukk/Salva Mea)	19
19	354	Your Average Giallo / Sascha Zeidler (Linus)	16
20	339	Sidcompo IV / Martin Nordell (Maktone/Fairlight)	2
21	326	Nicca Pop / Anders Carlsson (Zapac)	13
22	312	Bonuslevel! / Tony Cav (Ferrara / phObos team)	8
23	306	Lost Again / Richard Bayliss (Richard / The New Dimension)	1
24	303	TRYITON1x2&4-first48sec / Przemek Mroczkowski (Surgeon/Vulture Design)	26
25	298	FarOff CyberSpace (short) / Robert D fler (LordNikon)	9
26	291	Depleted Uranium / Linus Akerlund (Puterman/Fairlight)	18
27	286	Mididrums / Jaymz Julian (A Life in Hell)	27
28	267	Riffing On The Edge / Andrew Lemon (ne7/Creators/Napalm/Rebels)	22
29	252	COMPOSEED $c0de/ Rafal Szyja (Raf/Samar/Vulture)	30
30	229	ChipSlip / Marcus Jansson (CMP)	28
31	194	Into The Sunset / Oliver VieBrooks (Six of Dloc)	5
32	188	Distoken Disinterpretor / Langel Janson L. Bookbinder Esq. IX	23

SIDBrowser V2.4

SIDBrowser is the Windows program that let your life to be more easy with sid:

- Browse easy in HVSC
- Define favourite paths
- See picture of musician (if available)
- Play subtune by button
- Read background-information of SID tune information list (STIL)
- Multilingual: Czech, English, German, Italian, Japanese, Polish

- Quick Search for filename, copyright, songlength, words inside STIL
- Show while browsing filelist sorted by Year
- Read documents of HVSC easy
- Browse inside Top100 of HVSC
- Create Play-List and edit them easy
- Toggle between 5 playlists, to create your own Bestest Best of Best ;-)
- Create SIDList (Mega-playlist)
- Import Playlists from sidplay (.spl), winamp (.m3u)
- Export Playlists to sidplay (.spl, Format 2)
- Listen Playlists random (shuffle)and repeat
- History of listened SIDs
- Get and put playlists online. Exchange them with your friends all the world!
- Chat with other SIDians ;-)
- Minimizable to Tray
- Taskbutton scrolls information about actual playing SID

The new version was released 2 January 2005 with this new features:

- little history-bug fixed
- photos updated
- updated splashscreen
- some values updated
- new Document for reading: Songlength-Database-Readme
- Language files updated a little bit
- include the new songlength-database 5.8 for HVSC 5.8

Download from http://www.sidbrowser.com

Dustbin (Stefano Palmonari) Interview!

by Stefano Tognon

This time you can read an interview with Stefano Palmonari that occurs with some emails in December.

Hello, Stefano,
Can you introduce yourself to the readers: something about you and your real life.

Hi everybody! My name is Stefano Palmonari, I'm 31 years old and I was known in the scene as Dustbin. I started composing computer music at 15 without any specific musical knowledge: just a lot of Rob Hubbard's tunes recorded on a tape... And tons of Jeroen Tel's tunes played 24:7 :-) so I learned some tricks just listening to the musics... I was very lucky too, 'cause I met a guy from F4CG in Ferrara, wich I was born, that gave me some music editors like, for example, Future Composer. I started typing shit in it until I was able to produce something "ear-able":-))
Actually I sing in a Queen-Tribute band, I'm married and I have a daughter:
she's 2 years old and she already likes music of every kind: from Mozart to Coal Chamber...!

You are one of the few Italian sid composers that worked into a game company that produce games in '90. Can you speak about those (old) days?

Well... Italian musicians were talented (ie: Ivan Del Duca, Paolo Galimberti, Gianluca Gaiba, Nicola Tomljianovic...) and graphic artists too... Italian coders were quite good but not at the same level as Dan Phillips :-)) ... The only impressive Italian coders I remember are Paolo Galimberti and Andrea Pompili. Anyway, the main problem were the Software Houses themselves... They wanted talented people but they didn't wanted to pay them... :-|
Talking about those good old days, I remember a lot of hours passed on the C64 learning to use the editors. I was 17 and you can't imagine how happy I was when I finished my first shitty-tune done in Rockmonitor :-) That shitty tune was sent to Simulmondo, more or less as a joke, but they called me to work for them... So I did.
90's were, computerically speaking, AMAZING...

You have compose music for Amiga, PC, and even for Game Boy: what are the difference about composing music for the Sid chip and the other architectures?

Everybody knows that .mod format was introduced with the Amiga but in some way we can consider Rockmonitor, on the glorious C64, as an ancestral of it.
The SID chip allows you to manage just 3 channels and you have to practice a lot on it to gain a balance between technique, full control of the tracks and musical skill!
On the Game Boy I did 3-tracks midi files (Rayman), testing it with a proprietary player: that was quite easy, 'cause the midi editor and my Roland makes the difference. On the C64, using the good old editors, we have to think in hex and write something like

```
SND.01
DUR.0c
C-5
SND.02
C-4
DUR.18
F#4
...
```

Then we have to handle the arpeggio table, filter table, wave table... Every C64 editor, or at least

the editors I used, works keeping in mind the amount of memory, not a user friendly interface. I think the differences in composing music, between the platforms, are related to the interface... With PC-trackers you have a full control of every single note, at tick resolution. You can find some trackers for the GB, too, but the best seems to be Musicbox, a commercial product. In my opinion it's very difficult to use due to the hardware used: a real GB :-)) In order to compose in a "reasonable" way on the GB you have to use a pc-tracker in audio-emulation, like Paragon 5 Tracker.
Well, I found quite easy to compose on the Amiga/PC but tremendously difficult to compose with the C64. I found Renoise, on the PC, a fantastic editor/tracker... I hope they'll add a realtime sid-emulation plug-in/VST... something like that :-))

I know that you are not a musician/composer, but your Sid music I'm listening now is what I call fantastic music! Maybe you can tell as how this is possible (some sid people could learn something from your experience).

Oh... Thank you! But maybe "Fantastic" is too much. Anyway, I think the best feature invented is the arpeggio... You can use it "chopped" for funky tunes. I have to say one other thing: none of the workstations I used, neither a soundcard, gives you that typical WARM lead sound... Maybe just a minimoog! The SID chip is unique, and every SID chip is unique (someone said "filters" ? :-)
Here's a good snare ripped from zakazazam by Glenn Rune Gallefoss:

```
wavetable 81 41 40 80 80
arptable  CE AE AC CA DE
```

This data works fine with Sadotracker... :-) (You can break it and shake it and re-compose it but... I think first Rob Hubbard music routines were studied well :-))
C64 produces some of the best sounds I ever heard...
Anyway, as I said, in my humble opinion, there are something to keep in mind when you compose on the SID:

- SID has just 3 channels (+1, when available :-) , you can try to do miracles but only if...
- ... you reach a good balance between technique and the channels available.
- Learn to use PERFECTLY one or two editors... don't waste your time trying to learn all the editors around
- Listen to the best .sid around and try to remake it with your ears only (That's what I did 10 years ago!! With the difference I didn't have .sid files like today but just tapes live-recorded from TV :-) (no audio out).

At this point a question that I already know the answer :-) : can we listen again to a your new composition for the C64 (hint: LSS2)?

hehe, yes! :-) Thanks to you, the coder, I did some jingles for Little Sara Sisters 2 :-))) Nothing special, but it was very exciting to type the good old commands in the pattern editor :-))

A technical question: what do you find the actual editor/tracker compared with the ones you use 12 years ago? Some years are passed, the SID chip is the same, but what about the tools?

I find Cybertracker and Odintracker user friendly and it's fantastic to see they've been developed in this years, after the death (just for the market!) of the C64.
Anyway, for some nostalgic reasons, but technical also, my preference goes to Sadotracker: the essential features are fully present and I don't have to remember a lot of keys to type and activate something.

Now some quick final (standard) questions:
Real machine vs emulator: what do you think of?

Although the C64 is 99% emulated I will not sell my real C64 for any amount of money (I've already sold one of my two C64's but I won't sell the last one).
Above all the SID chip is critical to emulate: it's almost impossible to emulate it perfectly. They reached good results but emulating filters, for example, requires a lot of CPU and it doesn't work fine. This speaking about technical facts.
Emulation is fantastic because, personally, I re-discovered forgotten feelings when I played with Gyruss, for example... Or Cybernoid... That was the first Tel's tune I've listened to... And it's still beautiful.

6581 vs 8580 chip: any (musical) preference?

6581, without doubts. The new 8580 was not good compared to the old 6581!
Sounds incredible but I think so.

What is the worst sid that you compose and the better one?

The worst one was the title music of Big Game Fishing... On the other hand, I think my best work was did for Basket Play Off.

Who are your best sid authors?

What the hell... :-) Rob Hubbard, who invented the profession, Jeroen Tel, whose technical skill was, and still is, incredible (he was already musician at age 0) and Martin Galway. These three persons has changed the story of the C64. Jeroen Tel is my music hero, but Rob Hubbard is the best and many musicians (and music-routines coders, too) have to say "thanx" to him.

What are the best sids ever in your opinion?

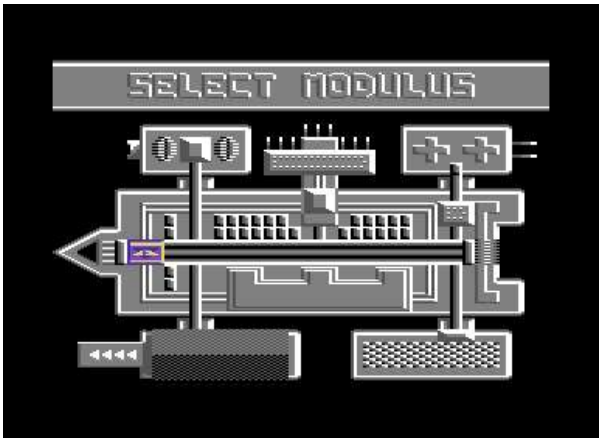
Hard question to answer... I think Sanxion's tape loader music...
Then Cybernoid's title track and, last but not least, Wizball's soundtrack...
I think Wizball is the best game ever made on the C64.

Finally, many thanks for the time you give for this interview, and now you can say any things you want that the people will read from you!

Thank you very much for interviewing me!
Well, first of all excuse my spaghetti-english, sooner or later I'll improve it :-)))
My dream is to turn back child at age 13 when my parents brought to me my first C64.
Then start again with all the things I did (maybe with some minor changes :-))

Inside Modules

by Stefano Tognon <ice00@libero.it>



Modules is one of the game programmed by Italian people in the '80 and in particular Ivan Del Duca has wrote his own music engine for creating his music.

Ivan has declared in some Italian interview that he was not a true musician (he is a game coder, even today), but that he probably wrote the first Italian music engine around, instead of used the one's that were available.

I would like to see how the engine works, and I choose to analyze Modules because I like the music of this game.

Structure

The player use some common structures:

- Tracks
- Patterns
- Music commands

A track is composed by a sequence of patterns to executes. There are 3 tables of tracks: one for each voices.

An entry in the track has this structure:

- high address of pattern to execute
- low address of pattern to execute
- max index in pattern to execute (FF=max, can be terminate by instruction)
- number of times to repeat the given pattern

This means that we have an 16 bit address of the pattern to execute, the max number of instruction in the pattern to execute (a FF values means that will be a special instruction into the pattern that will end the pattern execution) and the number of times this pattern will be repeated.

Some examples:

```
track1:
  .byte >pat00, <pat00, $3D, $02
  .byte >pat01, <pat01, $51, $00
  .byte >pat03, <pat03, $FF, $00
```

Here *pat00* will be executed for $3D instructions and it will be repeated 3 times, then *pat01* will be executed 1 time for $51 instructions and finally *pat03* will be executed 1 time until the instruction flow reach the instruction that terminate the pattern.

Instrument

This engine handles 16 instruments (even if it could be possible to use up to 256 if we extend the tables of attributes). In fact an instrument is built by 9 parameters putted into 9 tables of 16 entries.

Let we analyze one instrument definition:

- Attack-Decay of the voice
- Sustain-Release of the voice
- Low value of wave (for rectangular waveform)
- High value of wave (for rectangular waveform)
- Control of voice when it is on
- Control of voice when it is off (e.g. release)
- Hight byte of filter cut frequency
- Filter resonance
- Filter mode

As we can see, one instrument has very limited capability: ADSR, Wave duty cycle (fixed) and control values for the voice (two types). This means that all the effects that the player can reproduce are not associated with the instrument, with one exception: the filter.

In fact, the last 3 bytes of the instrument definition are for controlling the filter of the voice, by selecting the type of filter and resonance/cut frequency (however dynamically change onto filter are to be performed with instruction in the pattern)

Pattern

The instructions used into the patterns are quite complicated, as they use low address pointer as an instruction (so, the code cannot be relocated easily).

But let we see how the instructions are made, by looking at the program (in pseudocode)

- Read a pattern value
- If it is 0, then the next value is a note duration
- If it is negative (e.g with value from $80 to $FF) it is a command
- Else it is a note; After a note, we read another value:
    - If it is above $9F this is a note duration
    - Else it is another note and the duration is like the previous used one

As you can see this is not a so clear code, as note duration need even special command (0 byte) for be used correctly.

A declared note is an index for frequency values: a table of 12 frequencies is used (one octave) and the others are calculated each times by manipulating that little table. The note is so made in this manner:
octave-note

Where octave is the octave to use (from 0 to 7) and note goes from 1 to C.

Valid note duration values are from $A0 to $E0: this is an index that is used for read the real

duration from a table of duration. This table is of 16bit, so we can have very-very long sound.

Finally, we must see the commands available. Remember that a value of a command is the low pointer of the memory location that contains the code. The high value of the pointer is fixed.

Value	*Command*
$80	End of pattern
$83	Set control for release
$86	Set a new instrument
$89	Set the volume
$8C	Portamento add
$8F	Portamento down
$92	Stop effect
$95	Copy sid register values
$98	Not used
$9B	Various action: vibrato, gosub, return, play note

- The command $80 will terminate the pattern. Remember that the pattern can be terminate by the length that is given into the track, or by this command.

- $83 will make the release of the envelope (gate=0). The value used is the one declared into the instrument table.

- $86 is the command for changing the instrument. It has two parameters:
    1. The instrument number to use
    2. A flag: <> 0 means to reload the filter parameters, otherwise currents will be used

- $89 sets the volume, and so it has only one parameter:
    1. The volume (from $0 to $F) to use

- $8C and $8F will perform the portamento up and down, so it has those parameters:
    1. Frequency step to add/sub
    2. Delay between an add/sub

- $92 is a command that stop all effects that are being done to this voice.

- $95 is a command that is to be used for copy the values of sid registers. It has two parameters:
    1. Offset of source sid register
    2. Offset of destination sid register

  You can, for example, use this for copying the oscillator 3 value to one other register for putting a random value in it.

- $9B is a command that performs many actions, according to the first parameter, so now we will see all the cases.

Values	*Command*
$9B $02 indType limit step delay(speed)	This command is for making effect like vibrato. There is the *limit* that will invert the adding sequence to became descendant. *Step* is the amount of value to add/subtract. *Delay* is the ticks between two add/sub, and so it is the speed. Finally *indType* is an index to a table of effect to use: 0: Manage actual filter cut frequency high value 1: Manage the wave high value of a voice 2: Manage the frequency high value of a voice (vibrato)
$9B $03	Return instruction: the flow of execution is passed back to the caller
$9B $05 note	This instruction will put *note* as output frequency. No action is taken about duration of this note.
$9B val	Gosub intruction: the flow of execution is passed to the pattern that has $C9 as high address and *val* as low address

As I have commented a lot the first patterns into the code, you can see how those commands are used directly by looking into the code.

Code

Here the reverse engineering source code of the player. Note that all he right remain to Ivan.

```
;PSID file version 2
;Load Address: 0
;Init Address: c57b
;Play Address: cfe8
;name:      Modulus
;author:    Ivan Del Duca
;copyright: 1988 System
;songs: 1 (startsong: 1)
 processor 6502
 .org $C000

      ldx  #$00
      stx  vTemp

loopNext:
      lda  disVoice,x           ; voice 1 disable?
      bne  nextVoice

      lda  flagMus,x            ; is to process music flow?
      beq  nextVoice

      dec  flagMus,x            ; no more to process
      stx  vIndex               ; voice index
      jsr  processMusic

nextVoice:
      inc  vTemp                ; next voice
      ldx  vTemp
      cpx  #$03
      bne  loopNext

      jsr  makeDurEffect
      lda  disMusic             ; is to disable music?
```

```
      bne  disPlayer
      rts

vTemp:                          ; voice temp index
  .byte $03

disPlayer:
      jsr  disablePlayer
      lda  #$00
      sta  actFiltCut
      rts

processMusic:
      lda  maxIndex,x           ; max index of pattern to execute
      cmp  patIndex,x           ; actual pattern index
      beq  readTrack

makePatFlow:
      jsr  setPatAddr
      lda  patIndex,x           ; actual pattern index
      inc  patIndex,x           ; actual pattern index
      tay
      lda  ($14),y              ; read from pattern
      beq  jmpSetDuration
      bmi  execInstr            ; is an instruction?
      tay                       ; it's a packet note
      jsr  makeControlOff

setFreq:
      jsr  setFrequency         ; set frequency of this note
      lda  relDelay,x           ; delay to reload
      sta  actDelay,x           ; actual delay
      jsr  makeControlOn

setDuration:
      jsr  readNextValue        ; read note duration
      cmp  #$9F
      bcs  readDuration
      jsr  goBackPIndex         ; go back with index
      lda  packDuration,x       ; use previous pack duration

readDuration:
      sta  packDuration,x
      sec
      sbc  #$A0
      tay
      lda  durationHiTab,y
      sta  durationHi,x
      lda  durationTab,y
      sta  duration,x
      rts

jmpSetDuration:
      jmp  setDuration

execInstr:
      sta  instAddr
      jmp  (instAddr)           ; execute the instruction

;================================
; Read next attern value
; in case it reads a new pattern
; from track
;================================
readNextValue:
      lda  maxIndex,x           ; max index of pattern to execute
      cmp  patIndex,x           ; actual pattern index
      beq  readTrack

      jsr  setPatAddr
      lda  patIndex,x           ; actual pattern index
      inc  patIndex,x           ; actual pattern index
      tay
      lda  ($14),y
      rts

readTrack:
      lda  trackIndex,x         ; actual track index
      tay
      cpx  #$00
      beq  readTrack1
      cpx  #$01
      beq  readTrack2

readTrack3:
      jsr  testForRepeat
      lda  track3,y
      sta  hiPatAddr,x
      iny
```

```
      lda  track3,Y
      sta  loPatAddr,x
      iny
      lda  track3,y
      sta  maxIndex,x            ; max index of pattern to execute
      lda  #$00                  ; reset pattern index
      sta  patIndex,x            ; actual pattern index
      jsr  readNRepeat3
      sty  trackIndex+2          ; actual track index
      jmp  makePatFlow

readTrack2:
      jsr  testForRepeat
      lda  track2,y
      sta  hiPatAddr,x
      iny
      lda  track2,y
      sta  loPatAddr,x
      iny
      lda  track2,y
      sta  maxIndex,x            ; max index of pattern to execute
      lda  #$00                  ; reset pattern index
      sta  patIndex,x            ; actual pattern index
      jsr  readNRepeat2
      sty  trackIndex+1          ; actual track index
      jmp  makePatFlow

readTrack1:
      jsr  testForRepeat
      lda  track1,y
      sta  hiPatAddr,x
      iny
      lda  track1,y
      sta  loPatAddr,x
      iny
      lda  track1,y
      sta  maxIndex,x            ; max index of pattern to execute
      lda  #$00                  ; reset pattern index
      sta  patIndex,x            ; actual pattern index
      iny
      lda  track1,y
      sta  nRepeat,x             ; number ot times to repeat
      iny
      sty  trackIndex            ; actual track index
      jmp  makePatFlow

;================================
; Set pattern index address
;================================
setPatAddr:
      lda  loPatAddr,x
      sta  $14
      lda  hiPatAddr,x
      sta  $15
      rts

;================================
; Make the voice control off
;================================
makeControlOff:
      lda  vCntOff,x
      jsr  indexToOffset
      sta  $D404,x               ; Voice 1: Control registers
      ldx  vIndex                ; voice index
      rts

;================================
; Make the voice control on
;================================
makeControlOn:
      lda  vCntOn,x
      jsr  indexToOffset
      sta  $D404,x               ; Voice 1: Control registers
      ldx  vIndex                ; voice index
      rts

;================================
; go back pattern index
;================================
goBackPIndex:
      dec  patIndex,x            ; actual pattern index
      rts

;================================
; set instrument to use
;================================
setInstrument:
      jsr  readNextValue
      tay                        ; instrument number
```

```
setInstrumentY:
      jsr  indexToOffset
      lda  tbAD,y
      sta  $D405,x               ; Generator 1: Attack/Decay

      lda  tbSR,y
      sta  $D406,x               ; Generator 1: Sustain/Release

      lda  tbWLo,y
      sta  $D402,x               ; Voice 1: Wave form pulsation amplitude (lo byte)

      lda  tbWHi,y
      sta  $D403,x               ; Voice 1: Wave form pulsation amplitude (hi byte)

      ldx  vIndex                ; voice index
      sta  waveHi,x
      sta  waveHiRel,x

      lda  tbCntOn,y             ; voice control (on)
      sta  vCntOn,x

      lda  tbCntOff,y            ; voice control (off)
      sta  vCntOff,x

      tya
      sta  actInstr,x            ; actual instrument number

modCode:
      sty  temp
      jsr  readNextValue         ; filter flag state (<>0=reload filter paramethers)
      bne  reloadFilter
      lda  bitWiseTab,x
      eor  #$FF
      and  actFiltRes
      sta  actFiltRes
      sta  $D417                 ; Filter resonance control/voice input control
      cpx  #$00
      bne  noResAFC

      lda  #$00                  ; reset for voice 0
      sta  actFiltCut
noResAFC:
      jmp  jmpProcessMusic

reloadFilter:
      ldy  temp

reloadFilterY:
      lda  filtCutFH,y
      sta  $D416                 ; Filter cut frequency: hi byte
      cpx  #$00
      bne  skipActFC
      sta  actFiltCut

skipActFC:
      sta  actFiltCutFH
      lda  actFiltRes
      and  #$0F
      ora  filterResCtr,y
      sta  actFiltRes
      lda  actFiltVol
      and  #$0F
      ora  filterMode,y
      sta  actFiltVol
      sta  $D418                 ; Select volume and filter mode
      lda  bitWiseTab,x
      ora  actFiltRes
      sta  actFiltRes
      sta  $D417                 ; Filter resonance control/voice input control
      jmp  jmpProcessMusic

;================================
; Disable the passed x voices
;================================
disableVoice:
      lda  #$01
      sta  disVoice,x            ; disable this voice
      rts

;================================
; Set the volume of voices
;================================
setVolume:
      jsr  readNextValue         ; read the volume
      sta  temp
      lda  actFiltVol
      and  #$F0
      ora  temp
```

```
      sta  actFiltVol
      sta  $D418                ; Select volume and filter mode
      jmp  jmpProcessMusic

;================================
; Change control of voice for
; release phase
;================================
makeRelease:
      jsr  makeControlOff
      jmp  jmpProcessMusic

;================================
; portamento up effect (can be used
; also for vibrato in conjuction
; with portamento down)
; par1: freq. step to add
; par2: delay to reload
;================================
portUp:
      jsr  readNextValue        ; freq. step to add
      sta  freqStep,x
      jsr  readNextValue        ; delay to apply
      sta  relDelay,x           ; delay to reload
      sta  actDelay,x           ; actual delay
      inx
      txa
      dex
      ldy  #$01                 ; freq. add
      jsr  onEffect
      jmp  jmpProcessMusic

;================================
; portamento down effect (can be used
; also for vibrato in conjuction
; with portamento up)
; par1: freq. step to sub
; par2: delay to reload
;================================
portDown:
      jsr  readNextValue        ; freq. step to sub
      sta  freqStep,x
      jsr  readNextValue
      sta  relDelay,x           ; delay to reload
      sta  actDelay,x           ; actual delay
      ldy  #$02                 ; freq. sub
      jsr  onEffect
      jmp  jmpProcessMusic

;================================
; Stop effect in the passed x voice
;================================
stopEffect:
      lda  #$00
      sta  flagEff,x            ; flag effect for each voices
      lda  flagEff
      bne  goProcessMusic
      lda  flagEff+1
      bne  goProcessMusic
      lda  flagEff+2
      bne  goProcessMusic

      lda  #$00
      sta  abilEffect           ; stop all effects

goProcessMusic:
      jmp  jmpProcessMusic

;================================
; copy a sid register to another
; par1: SID index source
; par2: SID index destination
;================================
sidCopy:
      jsr  readNextValue
      sta  fromIndex,x
      jsr  readNextValue
      sta  toIndex,x
      ldy  #$03
      jsr  onEffect
      jmp  jmpProcessMusic

;================================
; 02 indType limit step delay(speed)
; 03
; 05 packet_note
; <>
;================================
varyAction:
```

```
      jsr  readNextValue
      cmp  #$02
      beq  setVibLikeEf
      cmp  #$03                 ; return (restore state)
      beq  jmpInstReturn
      cmp  #$05                 ; set packet note
      beq  setPacketNote
      jmp  instGosub            ; gosub (store state)

jmpInstReturn:
      jmp  instReturn

setPacketNote:
      jsr  readNextValue        ; read packet note
      tay
      jmp  setFreq

setVibLikeEf:
      jsr  readNextValue        ; index type
      sta  indType,x
      jsr  readNextValue        ; limit value
      sta  limit,x
      lsr
      lsr
      sta  lowLimit,x
      lda  #$00
      sta  currValue,x
      jsr  readNextValue        ; read the step
      sta  step,x
      jsr  readNextValue        ; read delay (speed)
      sta  delayRelod,x
      sta  delay,x
      ldy  #$05                 ; vibrato like effect
      jsr  onEffect
      jmp  jmpProcessMusic

;================================
; Performe a gosub instruction
;================================
instGosub:
      sta  temp                 ; low address of gosub routine
      lda  loPatAddr,x
      sta  storedLoPatAddr
      lda  hiPatAddr,x
      sta  storedHiPatAddr
      lda  temp
      sta  loPatAddr,x          ; set low address
      lda  patIndex,x           ; actual pattern index
      sta  storedPatIndex
      lda  maxIndex,x           ; max index of pattern to execute
      sta  storedMaxIndex
      lda  actInstr             ; act instrument voice 1
      sta  storedInstr
      lda  #$C9
      sta  hiPatAddr,x          ; set high address
      lda  #$00
      sta  patIndex,x           ; actual pattern index
      lda  #$FF
      sta  maxIndex,x           ; max index of pattern to execute
      jsr  setPatAddr
      jmp  jmpProcessMusic

;================================
; Performe a return instruction
;================================
instReturn:
      lda  storedLoPatAddr
      sta  loPatAddr,x
      lda  storedHiPatAddr
      sta  hiPatAddr,x
      lda  storedPatIndex
      sta  patIndex,x           ; actual pattern index
      lda  storedMaxIndex
      sta  maxIndex,x           ; max index of pattern to execute
      jsr  setPatAddr
      ldy  storedInstr
      lda  #$60
      sta  modCode              ; put rts
      jsr  setInstrumentY       ; set only instrument paremeter
      lda  #$8C                 ; put sty absolute
      sta  modCode
      lda  actFiltCut           ; actual filter cut frequency
      bne  toReload
      jmp  jmpProcessMusic

toReload:
      jmp  reloadFilterY

;================================
```

```
; Test for repeat the current pattern
;================================
testForRepeat:
      lda  cRepeat,x            ; repeat counter
      cmp  nRepeat,x            ; number of times to repeat
      bne  incTestRepeat
      rts

incTestRepeat:
      inc  cRepeat,x            ; inc repeat counter
      lda  cRepeat,x            ; repeat counter
      cmp  nRepeat,x            ; number of times to repeat
      beq  noRepeat

      dey                       ; go back to previous row in track
      dey
      dey
      dey
      rts

noRepeat:
      lda  #$00
      sta  cRepeat,x            ; reset repeat counter
      rts

;================================
; Read the number of time to
; repeat for track 3
;================================
readNRepeat3:
      iny
      lda  track3,y
      sta  nRepeat,x            ; number of times to repeat
      iny
      rts

;================================
; Read the number of time to
; repeat for track 2
;================================
readNRepeat2:
      iny
      lda  track2,y
      sta  nRepeat,x            ; number of times to repeat
      iny
      rts

;================================
; Set the frequency of note
; Y=packet note: octave/note
;================================
setFrequency:
      tya
      tax
      and  #$0F                 ; take the note
      tay
      dey
      lda  freqTableHi,y
      sta  actFreqHigh
      lda  freqTableLo,y
      sta  actFreqLow
      txa
      and  #$F0                 ; take the octave of the note
      lsr
      lsr
      lsr
      lsr
      tay                       ; octave
      cpy  #$00
      beq  freqOk

calcFreq:
      lsr  actFreqHigh
      ror  actFreqLow
      dey
      bne  calcFreq
freqOk:
      jsr  indexToOffset
      lda  actFreqLow
      sta  $D400,x              ; Voice 1: Frequency control (lo byte)
      ldx  vIndex               ; voice index
      sta  actFreqLo,x
      jsr  indexToOffset
      lda  actFreqHigh
      sta  $D401,x              ; Voice 1: Frequency control (hi byte)
      ldx  vIndex               ; voice index
      sta  actFreqHi,x
      lda  #$00
      sta  currValue,x
```

```
      lda  waveHiRel,x          ; wave high to reload
      sta  waveHi,X
      rts

jmpProcessMusic:
      lda  vIndex               ; voice index
      jmp  processMusic

;================================
; Convert voice index to sid offset
;================================
indexToOffset:
      sta  temp
      ldx  vIndex               ; voice index
      lda  vOffset,x            ; read voice offset of sid
      tax
      lda  temp
      rts

onEffect:
      inx
      txa
      dex
      sta  flagEff,x            ; store voice+1
      tya
      sta  freqEffect,x         ; store frequency effect
      sta  abilEffect           ; abilitate all effects
      rts

;================================
; activate effects
;================================
activateEffects:
      lda  flagEff
      beq  testV2
      lda  #$00
      sta  vIndex               ; voice index
      jsr  makeEffect

testV2:
      lda  flagEff+1
      beq  testV3
      lda  #$01
      sta  vIndex               ; voice index
      jsr  makeEffect

testV3:
      lda  flagEff+2
      beq  skipEff
      lda  #$02
      sta  vIndex               ; voice index
      jsr  makeEffect
skipEff:
      rts

;================================
; Make freq. effect
;================================
makeEffect:
      ldx  vIndex               ; voice index
      lda  freqEffect,x
      cmp  #$01                 ; freq. add
      beq  addFreq
      cmp  #$02                 ; freq. sub
      beq  subFreq
      cmp  #$03                 ; sid copy
      beq  efSidCopy
      cmp  #$05                 ; vibrato like effect (even for wave and filter)
      beq  jsrDecDelay
      rts

efSidCopy:
      jsr  sidCopyEffect
      rts

jsrDecDelay:
      jsr  decDelay
      rts

addFreq:
      lda  actDelay,x           ; actual delay
      bne  decADelay
      clc
      lda  actFreqLo,x
      adc  freqStep,x
      sta  actFreqLo,x
      jsr  indexToOffset
      sta  $D400,x              ; Voice 1: Frequency control (lo byte)
```

```
      ldx  vIndex               ; voice index
      lda  actFreqHi,x
      adc  #$00
      sta  actFreqHi,x
      jsr  indexToOffset
      sta  $D401,x              ; Voice 1: Frequency control (hi byte)

      ldx  vIndex               ; voice index
      lda  relDelay,x           ; delay to reload
      sta  actDelay,x           ; actual delay
      rts

decADelay:
      dec  actDelay,x           ; dec actual delay
      rts

subFreq:
      lda  actDelay,x           ; actual delay
      bne  decSDelay

      sec
      lda  actFreqLo,x
      sbc  freqStep,x
      sta  actFreqLo,x
      jsr  indexToOffset
      sta  $D400,x              ; Voice 1: Frequency control (lo byte)

      ldx  vIndex               ; voice index
      lda  actFreqHi,x
      sbc  #$00
      sta  actFreqHi,x
      jsr  indexToOffset
      sta  $D401,x              ; Voice 1: Frequency control (hi byte)

      ldx  vIndex               ; voice index
      lda  relDelay,x           ; delay to reload
      sta  actDelay,x           ; actual delay
      rts

decSDelay:
      dec  actDelay,x           ; dec actual delay
      rts

;================================
; copy sid register values effect
;================================
sidCopyEffect:
      lda  fromIndex,x
      tay
      lda  $D400,y              ; Voice 1: Frequency control (lo byte)
      tay
      lda  toIndex,x
      tax
      tya
      sta  $D400,x              ; Voice 1: Frequency control (lo byte)
      ldx  vIndex               ; voice index
      rts

decDelay:
      dec  delay,x
      beq  delayIs0
      rts

delayIs0:
      lda  delayRelod,x
      sta  delay,x              ; reload the delay
      jsr  setAddrForEff
      lda  lowLimit,x
      sta  temp
      lda  currValue,x
      cmp  temp
      bcc  effectAdd
      jsr  incByLowlimit

      cmp  temp
      bcc  effectSub
      jsr  incByLowlimit
      cmp  temp
      bcc  effectSub
      jmp  effectAdd

;================================
; set the address for effect
;================================
setAddrForEff:
      lda  indType,x            ; index type of effect
      tax
      lda  loIndType,x
      sta  $8C
```

```
      lda  hiIndType,x
      sta  $8B
      lda  #$D4
      sta  $67
      lda  sidIntType,x
      sta  $66
      ldx  vIndex               ; voice index
      rts

effectAdd:
      ldy  #$00
      jsr  adapt2ForVoice
      lda  ($8B),y              ; read actual value for the effect
      clc
      adc  step,x
      sta  ($8B),y              ; store the new value
      jsr  adaptForVoice
      sta  ($66),y              ; put sid effect
      ldx  vIndex               ; voice index
      jmp  testLimit

effectSub:
      ldy  #$00
      jsr  adapt2ForVoice
      lda  ($8B),y
      sec
      sbc  step,x
      sta  ($8B),y
      jsr  adaptForVoice
      sta  ($66),y              ; put sid effect
      ldx  vIndex               ; voice index
      jmp  testLimit

;================================
; Test limit for curr value and
; reset if necessary
;================================
testLimit:
      inc  currValue,x
      lda  currValue,x
      cmp  limit,x
      bne  skipResetCV
      lda  #$00
      sta  currValue,x
skipResetCV:
      rts

loIndType:
  .byte >actFiltCutFH, >waveHi, >freqHi

hiIndType:
  .byte <actFiltCutFH, <waveHi, <freqHi

sidIntType:                     ;  filter cut f high, wave high, freq. hi
  .byte $16, $03, $01

;================================
; Adapt the register for the voice
;================================
adaptForVoice:
      sta  temp
      lda  $66
      cmp  #$16                 ; this is a value not depending of voice
      beq  skipAsFix            ; so skip
      lda  vOffset,x            ; read offset for the voice
      tay
skipAsFix:
      lda  temp
      rts

;================================
; Adapt2 the register for the voice
;================================
adapt2ForVoice:
      lda  $66
      cmp  #$16                 ; this is a value not depending of voice
      beq  skipAsFix2           ; so skip
      ldy  vIndex               ; voice index
skipAsFix2:
      rts

;================================
; Increment temp by low limit
;================================
incByLowlimit:
      lda  temp
      clc
      adc  lowLimit,x
      sta  temp
```

```
      lda  currValue,x
      rts

;================================
; Make note duration and effects
;================================
makeDurEffect:
      ldx  #$00

testDVoice:
      lda  disVoice,x            ; is voice disable?
      bne  nextVoice_

      dec  duration,x            ; dec low of note duration
      bne  nextVoice_
      dec  durationHi,x          ; dec high of note duration
      lda  durationHi,x
      cmp  #$FF
      bne  nextVoice_

      lda  #$01                  ; music flow is to process
      sta  flagMus,x

nextVoice_:
      inx
      cpx  #$03
      bne  testDVoice

      lda  abilEffect            ; abilitate effects
      beq  skipAbil
      jsr  activateEffects
skipAbil:
      lda  disVoice
      beq  skipDisable
      lda  disVoice+1
      beq  skipDisable
      lda  disVoice+2
      beq  skipDisable

      lda  #$01
      sta  disMusic              ; disable music

skipDisable:
      rts

;================================
; Init music
;================================
initMusic:
      lda  #$00
      ldx  #$00

repClear:
      sta  disVoice,x
      inx
      cpx  #$5F
      bne  repClear

      lda  #$01
      sta  flagMus
      sta  flagMus+1
      sta  flagMus+2
      sta  bitWiseTab
      lda  #$C6
      sta  instAddr+1
      lda  #$07
      sta  vOffset+1
      lda  #$0E
      sta  vOffset+2
      lda  #$02
      sta  bitWiseTab+1
      lda  #$04
      sta  bitWiseTab+2
      rts

;================================
; disable the player
;================================
disablePlayer:
      lda  #$60                  ; put rts
      sta  $C000
      rts

;C5B5
  .byte $C0, $60, $00, $00
  .byte $FF, $FF, $FF, $FB
  .byte $00, $00, $02, $FF
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF
```

```
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF
  .byte $FF, $FF, $FF, $FF

actFreqHigh:
  .byte $54

actFreqLow:
  .byte $7D

freqTableLo:
  .byte $1E, $18, $8B, $7E
  .byte $FA, $06, $AC, $F3
  .byte $E6, $8F, $F8, $2E

freqTableHi:
  .byte $86, $8E, $96, $9F
  .byte $A8, $B3, $BD, $C8
  .byte $D4, $E1, $EE, $FD

durationHiTab:                  ; table of not duration (high value)
  .byte $03, $01, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $02, $01, $00, $00
  .byte $00, $00, $00, $00

durationTab:                    ; table of note duration
  .byte $C0, $E0, $F0, $A0
  .byte $78, $60, $50, $45
  .byte $3C, $35, $30, $2C
  .byte $28, $25, $22, $20
  .byte $1E, $1C, $1B, $19
  .byte $18, $17, $16, $15
  .byte $14, $13, $13, $12
  .byte $11, $11, $10, $0F
  .byte $0F, $0F, $0E, $0E
  .byte $0D, $0D, $0D, $0C
  .byte $0C, $0C, $0B, $0B
  .byte $0B, $0B, $0A, $0A
  .byte $0A, $08, $06, $05
  .byte $04, $03, $02, $01
  .byte $D0, $68, $B4, $5A
  .byte $2D, $A4, $D2, $69

  .byte $FF

 .org $C680
      JMP  disableVoice         ; 80: end of pattern
      JMP  makeRelease          ; 83: set control for release
      JMP  setInstrument        ; 86: set a new instrument
      JMP  setVolume            ; 89: set the volume
      JMP  portUp               ; 8C: portamento add
      JMP  portDown             ; 8F: portamento down
      JMP  stopEffect           ; 92: stop effect
      JMP  sidCopy              ; 95: copy sid register values
      JMP  $0000                ; 98: not used
      JMP  varyAction           ; 9B: various action: vibrato, gosub, return, play note

  .byte $00, $00

disVoice:                       ; 1=disable voice
  .byte $00, $00, $00

flagMus:                        ; 1=process music flow
  .byte $00, $00, $00

vIndex:                         ; voice index
  .byte $02

disMusic:
  .byte $00

maxIndex:                       ; max index of pattern to execute
```

```
  .byte $3D, $F5, $0E

patIndex:                       ; actual pattern index
  .byte $3A, $13, $0E

durationHi:                     ; high part of duration of note
  .byte $00, $00, $00

duration:                       ; duration of note
  .byte $08, $80, $80

vCntOn:                         ; voice control on
  .byte $11, $85, $41

vOffset:                        ; voice offset
  .byte $00, $07, $0E

instAddr:                       ; instruction address to execute
  .byte $9B, $C6

  .byte $00

nRepeat:                        ; number of imes to repeat
  .byte  $02, $00, $02

temp:
  .byte $48

trackIndex:                     ; actual track index
  .byte $04, $04, $04

loPatAddr:                      ; low pattern index
  .byte $00, $00, $00

hiPatAddr:                      ; high pattern index
  .byte $CA, $CB, $CC

actFiltVol:                     ; actual filter and volume of sid
  .byte $3F

bitWiseTab:                     ; a table for bitwise operation
  .byte $01, $02, $04

actFiltRes:                     ; actual filter res
  .byte $F2

freqStep:
  .byte $00, $00, $00

relDelay:                       ; delay to reload
  .byte $00, $00, $00

actDelay:                       ; actual delay
  .byte $00, $00, $00

flagEff:                        ; flag effect for each voices
 .byte $01, $02, $03

freqEffect:
  .byte $05, $05, $05

abilEffect:                     ; flag for abilitate effects
  .byte $05

freqHi:
actFreqHi:                      ; actual frequency high value
   byte $54, $3F, $05

actFreqLo:                      ; actual value of frequency low
  .byte $7D, $4B, $47
;C6E5
  .byte $00, $00, $00

cRepeat:                        ; repeat counter
  .byte $00, $00, $00

actInstr:                       ; actual insrument number
  .byte $00, $02, $01

fromIndex:                      ; sid index for from
  .byte $00, $00, $00

toIndex:                        ; sid index for to
  .byte $00, $00, $00

actFiltCutFH:
  .byte $48, $00, $00

storedLoPatAddr:
```

```
  .byte $00

storedHiPatAddr:
  .byte $00

storedPatIndex:
  .byte $00

storedMaxIndex:
  .byte $00

storedInstr:
 .byte $00

actFiltCut:                     ; actual filter cut frequency
  .byte $00

packDuration:                   ; pack duration
  .byte $A8, $A0, $A0

tbAD:                           ; attack decay table
  .byte $2A, $58, $82, $0C
  .byte $FA, $08, $09, $0C
  .byte $08, $08, $09, $0C
  .byte $3A, $09, $09, $00

tbSR:                           ; sustain release table
  .byte $3C, $5C, $50, $00
  .byte $00, $00, $4C, $50
  .byte $00, $50, $00, $5A
  .byte $4A, $00, $00, $00

tbWLo:                          ; wave low table
  .byte $0A, $7A, $00, $7A
  .byte $7A, $00, $7A, $00
  .byte $00, $50, $00, $40
  .byte $00, $00, $00, $00

tbWHi:                          ; wave high table
  .byte $06, $07, $00, $07
  .byte $08, $08, $08, $0C
  .byte $00, $08, $00, $08
  .byte $00, $00, $00, $00

tbCntOn:                        ; control voice (on) table
  .byte $11, $41, $85, $41
  .byte $41, $15, $41, $15
  .byte $11, $41, $11, $15
  .byte $81, $81, $11, $00

tbCntOff:                       ; control voice (off) table
  .byte $10, $40, $84, $40
  .byte $40, $14, $40, $14
  .byte $10, $40, $10, $14
  .byte $80, $80, $10, $00

filtCutFH:                      ; filter cut frequency high byte table (one values for each
instrument)
  .byte $80, $30, $70, $90
  .byte $5D, $00, $A0, $00
  .byte $00, $00, $00, $80
  .byte $90, $00, $00, $00

filterResCtr:                   ; filter resonance control table for the instrument
  .byte $F0, $F0, $F0, $F0
  .byte $F0, $00, $F0, $00
  .byte $00, $00, $00, $F0
  .byte $F0, $00, $00, $00

filterMode:                     ; filter mode (type) table for the instrument
  .byte $10, $10, $30, $30
  .byte $30, $00, $10, $00
  .byte $00, $00, $00, $10
  .byte $10, $00, $00, $00

;C790
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

currValue:                      ; current value for effect
  .byte $00, $68, $13

delay:
```

```
  .byte $02, $08, $08

vCntOff:                          ; voice control off
  .byte $10, $84, $40

waveHi:
  .byte $06, $00, $04

indType:                          ; index type of effect
  .byte $02, $00, $01

step:
  .byte $01, $01, $01

limit:                            ; limit value
  .byte $04, $80, $20

delayRelod:
  .byte $06, $08, $0A

lowLimit:                         ; low limit value
  .byte $01, $20, $08

waveHiRel:                        ; wave high to reload
  .byte $06, $00, $07

  .byte $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

; track format:
; high address of pattern to execute
; low address of pattern to execute
; max index in pattern to execute (FF=max, can be terminate by instruction)
; number of times to repeat the given pattern

track1:
  .byte >pat00, <pat00, $3D, $02
  .byte >pat00, <pat00, $51, $00
  .byte >pat01, <pat01, $0A, $04
  .byte >pat02, <pat02, $16, $08
  .byte >pat03, <pat03, $10, $16
  .byte >pat03, <pat03, $FF, $00
  .byte >pat0b, <pat0b, $FF, $00
  .byte >pat0c, <pat0c, $FF, $00
  .byte >pat0d, <pat0d, $FF, $00
  .byte >pat0e, <pat0e, $FF, $00
  .byte >pat0f, <pat0f, $FF, $00
  .byte >pat10, <pat10, $FF, $00
  .byte >pat11, <pat11, $FF, $00
  .byte >pat12, <pat12, $FF, $00
  .byte >pat13, <pat13, $FF, $00
  .byte >pat14, <pat14, $FF, $00
  .byte >pat15, <pat15, $FF, $00
  .byte >pat16, <pat16, $FF, $00
  .byte >pat17, <pat17, $FF, $00
  .byte >pat18, <pat18, $FF, $00
  .byte >pat26, <pat26, $FF, $00
  .byte >pat37, <pat37, $FF, $00
  .byte >pat27, <pat27, $FF, $00
  .byte $00, $00, $00, $00

track2:
  .byte >pat05, <pat05, $F5, $00
  .byte >pat0a, <pat0a, $5B, $00
  .byte >pat04, <pat04, $FF, $00
  .byte >pat19, <pat19, $FF, $00
  .byte >pat1a, <pat1a, $FF, $00
  .byte >pat1b, <pat1b, $FF, $00
  .byte >pat1c, <pat1c, $FF, $00
  .byte >pat1d, <pat1d, $FF, $00
  .byte >pat1e, <pat1e, $FF, $00
  .byte >pat1f, <pat1f, $FF, $00
  .byte >pat20, <pat20, $FF, $00
  .byte >pat21, <pat21, $FF, $00
  .byte >pat22, <pat22, $FF, $00
  .byte >pat23, <pat23, $FF, $00
  .byte >pat24, <pat24, $FF, $00
  .byte >pat25, <pat25, $FF, $00
```

```
;C8A0
track3:
  .byte >pat06, <pat06, $0E, $02
  .byte >pat06, <pat06, $3C, $00
  .byte >pat07, <pat07, $24, $05
  .byte >pat08, <pat08, $39, $05
  .byte >pat07, <pat07, $24, $02
  .byte >pat09, <pat09, $FF, $00
  .byte >pat28, <pat28, $FF, $00
  .byte >pat29, <pat29, $FF, $00
  .byte >pat2a, <pat2a, $FF, $00
  .byte >pat2b, <pat2b, $FF, $00
  .byte >pat2c, <pat2c, $FF, $00
  .byte >pat2d, <pat2d, $FF, $00
  .byte >pat2e, <pat2e, $FF, $00
  .byte >pat2f, <pat2f, $FF, $00
  .byte >pat30, <pat30, $FF, $00
  .byte >pat31, <pat31, $FF, $00
  .byte >pat32, <pat32, $FF, $00
  .byte >pat33, <pat33, $FF, $00
  .byte >pat34, <pat34, $FF, $00
  .byte >pat35, <pat35, $FF, $00
  .byte >pat36, <pat36, $FF, $00

;C8F4
  .byte $00, $00, $00, $00
  .byte >pat36, <pat36, $FF, $00
  .byte $00, $00, $00, $00


;C900
pat38:
  .byte $86, $0D, $00           ; set instrument
  .byte $23, $D5
  .byte $9B, $05, $23           ; play note
  .byte $86, $0E, $00           ; set instrument
  .byte $9B, $05, $5A           ; play note
  .byte $D6
  .byte $9B, $05, $5A           ; play note
  .byte $86, $0D, $00           ; set instrument
  .byte $9B, $05, $23
  .byte $D5
  .byte $9B, $05, $23           ; play note
  .byte $86, $0E, $00           ; set instrument
  .byte $9B, $05, $5A           ; play note
  .byte $D6
  .byte $9B, $05, $5A           ; play note
  .byte $86, $0F, $00           ; set instrument
  .byte $00, $D0
  .byte $9B, $03                ; restore state
  .byte $00
  .byte $00, $00

;C930
pat39:
  .byte $86, $0D, $00           ; set instrument
  .byte $26, $D5
  .byte $9B, $05, $23           ; play note
  .byte $86, $0E, $00           ; set instrument
  .byte $9B, $05, $5A           ; play note
  .byte $D6
  .byte $9B, $05, $5A           ; play note
  .byte $86, $0D, $00           ; set instrument
  .byte $9B, $05, $26           ; play note
  .byte $D5
  .byte $9B, $05, $23           ; play note
  .byte $86, $0E, $00           ; set instrument
  .byte $9B, $05, $5A           ; play note
  .byte $D6
  .byte $9B, $05, $5A           ; play note
  .byte $86, $0F, $00           ; set instrument
  .byte $00, $D0
  .byte $9B, $03                ; restore state

  .byte $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
```

```
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
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  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat00:
;CA00
  .byte $86, $00, $00             ; set instrument
  .byte $9B, $02, $02, $04, $01, $06
  .byte $83                       ; set control for release
  .byte $83                       ; set control for release
  .byte $2A
  .byte      $A8                  ; note duration
  .byte      $15, $11, $13
  .byte $2A, $15, $11, $13
  .byte $2A, $15, $11, $13
  .byte $2A, $15, $11, $13
  .byte $26, $15, $11, $13
  .byte $26, $15, $11, $13
  .byte $26, $15, $11, $13
  .byte $26, $15, $11, $13
  .byte $25, $15, $11, $13
  .byte $25, $15, $11, $13
  .byte $25, $15, $11, $13
  .byte $25, $15, $11, $13
  .byte $A8                       ; note duration
  .byte $2A
  .byte $83                       ; set control for release
  .byte $00, $D8                  ; note duration
  .byte $00, $DA                  ; note duration
  .byte $00, $A0                  ; note duration
  .byte $00, $A0                  ; note duration

pat01:
;CA47
  .byte $00, $A8                  ; note duration
  .byte $9B, <pat39               ; gosub instruction
  .byte $00, $DB                  ; note duration
  .byte $9B, <pat39               ; gosub instruction
  .byte $9B, <pat38               ; gosub instruction
  .byte $92                       ; stop effect
  .byte $92                       ; stop effect

pat02:
;CA53
  .byte $86, $05, $00             ; set instrument
  .byte $9B, $02, $02, $04, $01, $06
  .byte $1A, $B0, $18             ; note + note duration + note
  .byte $9B, <pat39               ; gosub instruction
  .byte $1A, $A8                  ; note + note duration
  .byte $00, $B0                  ; note duration
  .byte $9B, <pat39               ; gosub instruction
  .byte $9B, <pat38               ; gosub instruction

pat03:
;CA69
  .byte $86, $05, $00             ; set instrument
  .byte $1A, $B0, $18             ; note + note duration + note
  .byte $9B, <pat39
  .byte $1A, $A8                  ; note + note duration
  .byte $9B, <pat38               ; gosub instruction
  .byte $9B, <pat39               ; gosub instruction
  .byte $9B, <pat38               ; gosub instruction
  .byte $86, $06, $00             ; set instrument
  .byte $3A, $A1                  ; note + note duration
  .byte $83                       ; set control for release
```

```
  .byte $9B, $05, $36           ; play note
  .byte $9B, $05, $4A           ; play note
  .byte $9B, $05, $46           ; play note
  .byte $3A, $A2                ; note + note duration
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
;CA8C
  .byte $80, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
;CAB8
  .byte $16, $26, $21, $26
  .byte $28, $11, $16, $26
  .byte $C0, $80, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat04:
;CAE0
  .byte $86, $02, $01           ; set instrument
  .byte $9B, $02, $00, $80, $01, $08
  .byte $25, $A0                ; note + note duration
  .byte $9B, $05, $21           ; play note
  .byte $9B, $05, $2A           ; play note
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern
;CAF4
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat05:
;CB00
  .byte $89, $0F                ; set volume
  .byte $86, $02, $01           ; set instrument
  .byte $9B, $02, $00, $80, $01, $08
  .byte $25, $A0                ; note + note duration
  .byte $9B, $05, $21           ; play note
  .byte $9B, $05, $2C           ; play note
  .byte $83                     ; set control for release
  .byte $86, $03, $01           ; set instrument
  .byte $9B, $02, $01, $20, $01, $01
  .byte $31, $A1, $4A
  .byte $A8, $3A, $A4, $38
  .byte $A8, $35, $A2, $46
  .byte $A1, $4A, $A8, $48
  .byte $31, $4A, $A2, $4A
  .byte $A8, $45, $A1, $41
  .byte $C0, $43, $45, $43
  .byte $45, $46, $48, $46
  .byte $48, $4A, $4C, $4A
  .byte $4C, $31, $33, $35
  .byte $33, $35, $36, $38
  .byte $3A, $38, $3A, $A4
  .byte $00, $B0                ; note duration
  .byte $4A, $A1                ; note + note duration
;CB50
  .byte $86, $02, $01           ; set instrument
  .byte $9B, $02, $00, $40, $01, $08
  .byte $83                     ; set control for release
  .byte $83                     ; set control for release
  .byte $25, $A1                ; note + note duration
  .byte $9B, $05, $21           ; play note
  .byte $A0
  .byte $9B, $05, $2C           ; play note
  .byte $A0
  .byte $9B, $05, $25           ; play note
  .byte $A0
  .byte $9B, $05, $2C           ; play note
  .byte $9B, $05, $11           ; play note
  .byte $9B, $02, $02, $04, $01, $04
  .byte $86, $03, $00           ; set instrument
  .byte $2A, $A2, $23, $A8
  .byte $21, $25, $A4, $2A
  .byte $A4, $26, $D9, $00
```

```
  .byte $A2, $2A, $A4, $25
  .byte $A8, $11, $B0, $2C
  .byte $2A, $A4, $21, $A8
  .byte $11, $B0, $2C, $2A
  .byte $A2, $11, $B0, $2C
  .byte $11, $2C, $11, $2C
  .byte $28, $26, $2A, $A4
  .byte $11, $B0, $15, $1A
  .byte $A2, $2A, $A8, $25
  .byte $A8, $21, $C0, $15
  .byte $21, $16, $21, $18
  .byte $21, $1A, $21, $01
  .byte $A8, $01, $C0, $1A
  .byte $01, $18, $01, $16
  .byte $01, $15, $01, $13
  .byte $01, $11, $DA, $2A
  .byte $A8, $13, $B0, $2A
  .byte $15, $2A, $18, $2A
  .byte $A4, $25, $C0, $23
  .byte $21, $23, $25, $28
  .byte $2A, $B0, $11, $13
  .byte $15, $18, $1A, $A0
  .byte $00, $B0                ; note duration
  .byte $86, $01, $00           ; set instrument
  .byte $11, $A4, $11
  .byte $A8, $2A, $25, $B0
  .byte $21, $A8, $11, $B0
  .byte $2A, $25, $2A, $11
  .byte $2A, $25, $23, $21
  .byte $A4
  .byte $80                     ; end of pattern

  .byte $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat06:
;CC00
  .byte $86, $01, $00           ; set instrument
  .byte $9B, $02, $01, $20, $01, $0A
  .byte $5A, $A0, $56
  .byte $55, $A0, $5A, $A8
  .byte $83                     ; set control for release
  .byte $00, $D8
  .byte $86, $04, $00           ; set instrument
  .byte $00
  .byte $DA

pat07:
;CC18
  .byte $4A, $A8, $3A, $B0
  .byte $4A, $DB, $3A, $A8
  .byte $4A, $A8, $3A, $B0
  .byte $4A, $DB, $3A, $A8
  .byte $83                     ; set control for release
  .byte $86, $01, $00           ; set instrument
  .byte $46, $A8, $36, $B0
  .byte $46, $DB, $36, $A8
  .byte $46, $A8, $36, $B0
  .byte $46, $DB, $36, $A8

pat08:
;CC3C
  .byte $4A, $A8, $3A, $C0
  .byte $3A, $38, $B0, $31
  .byte $4A, $3A, $C0, $4A
  .byte $3A, $4A, $4A, $A8
  .byte $3A, $C0, $3A, $38
  .byte $B0, $31, $4A, $3A
  .byte $C0, $4A, $3A, $4A
  .byte $46, $A8, $36, $C0
  .byte $36, $31, $B0, $4A
  .byte $46, $36, $C0, $46
  .byte $36, $46, $46, $A8
  .byte $36, $C0, $36, $31
  .byte $B0, $4A, $46, $36
  .byte $C0, $46, $36, $46
  .byte $C0

pat09:
;CC75
  .byte $5A, $A2
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

  .byte $00, $00
  .byte $00, $80, $00, $00
  .byte $00, $00, $00, $00
```

```
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat0a:
;CCA0
  .byte $2A, $B0, $2C, $C0
  .byte $11, $13, $15, $1A
  .byte $B0, $01, $03, $05
  .byte $08, $A8
  .byte $86, $07, $00           ; set instrument
  .byte $0A, $A0
  .byte $86, $03, $01           ; set instrument
  .byte $9B, $02, $01, $20, $01, $01
  .byte $1A, $A4, $15, $B0
  .byte $18, $A4, $2A, $15
  .byte $B0, $18, $1A, $A4
  .byte $15, $A8, $11, $A4
  .byte $01, $A8, $1A, $A4
  .byte $13, $B0, $11, $A8
  .byte $1A, $B0, $15, $A8
  .byte $2A, $C0, $2B, $2C
  .byte $11, $12, $13, $14
  .byte $15, $16, $17, $18
  .byte $19, $1A, $A4, $18
  .byte $A8, $15, $13, $B0
  .byte $11, $A8, $2A, $B0
  .byte $25, $2A, $A8, $25
  .byte $B0, $21, $25, $A8
  .byte $2A, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

  .byte $00, $00, $00, $00

pat0b:
;CD00
  .byte $89, $0F                ; set the volume
  .byte $86, $08, $00           ; set instrument
  .byte $2A, $D5, $1A
  .byte $11, $01
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat0c:
;CD0C
  .byte $89, $0F                ; set the volume
  .byte $86, $07, $00           ; set instrument
  .byte $8F, $FF, $01
  .byte $31, $C0
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat0d:
;CD19
  .byte $89, $0F                ; set the volume
  .byte $86, $09, $00           ; set instrument
  .byte $8C, $80                ; portamento add
  .byte $01, $41, $B4
  .byte $92                     ; stop effect
  .byte $00, $B0
  .byte $8F, $80                ; portamento down
  .byte $01, $00, $B4
  .byte $92                     ; stop effect
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat0e:
;CD2E
  .byte $89, $0F                ; set the volume
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $31, $A8, $83
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat0f:
;CD3E
  .byte $89, $0F                ; set the volume
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $33, $A8
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
```

```
  .byte $80                     ; end of pattern

pat10:
;CD4E
  .byte $89, $0F                ; set the volume
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $35, $A8
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat11:
;CD5E
  .byte $89, $0F                ; set the volume
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $36, $A8
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat12:
;CD6E
  .byte $89, $0F                ; set the volume
  .byte $86, $0A, $00           ; set instrument
  .byte $9B, $02, $02, $10, $01, $03
  .byte $21, $B0
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat13:
;CD7E
  .byte $89, $0F                ; set the volume
  .byte $86, $0A, $00           ; set instrument
  .byte $2A
  .byte $D3, $1A, $2A, $26
  .byte $2A, $1A
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat14:
;CD8C
  .byte $89, $0F                ; set the volume
  .byte $86, $08, $00           ; set instrument
  .byte $11, $D0, $1A
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat15:
;CD96
  .byte $89, $0F                ; set the volume
  .byte $9B, $02, $02, $10, $05, $02
  .byte $86, $05, $00           ; set instrument
  .byte $21, $C0, $25
  .byte $2A
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat16:
;CDA8
  .byte $89, $0A                ; set the volume
  .byte $86, $0B, $00           ; set instrument
  .byte $21, $A2
  .byte $9B, $05, $21
  .byte $A8
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat17:
;CDB6
  .byte $89, $0F                ; set the volume
  .byte $86, $0C, $00           ; set instrument
  .byte $9B, $02, $02, $08, $0A, $01
  .byte $21, $DB
  .byte $83                     ; set control for release
  .byte $00, $A4
  .byte $86, $0F, $00           ; set instrument
  .byte $80                     ; end of pattern

pat18:
;CDCA
  .byte $89, $0F                ; set the volume
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $3A, $C0, $35
```

```
  .byte $33, $3A, $35, $33
  .byte $3A, $35, $33, $3A
  .byte $B0, $3A
  .byte $83                     ; set control for release
  .byte $00
  .byte $A8
  .byte $80                     ; end of pattern

  .byte $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat19:
;CE00
  .byte $86, $08, $00           ; set instrument
  .byte $21
  .byte $D5, $11, $25, $15
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat1a:
;CE0A
  .byte $86, $03                ; set the volume
  .byte $00, $41, $C0
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat1b:
;CE11
  .byte $86, $02, $00           ; set instrument
  .byte $8C, $80, $01
  .byte $41
  .byte $B4
  .byte $92                     ; stop effect
  .byte $00, $B0
  .byte $8F, $80, $01
  .byte $00
  .byte $B4
  .byte $92                     ; stop effect
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat1c:
;CE24
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $31, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat1d:
;CE31
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $33, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat1e:
;CE3E
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $35
  .byte $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat1f:
;CE4B
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $36, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat20:
;CE58
  .byte $86, $05, $00           ; set instrument
  .byte $11
  .byte $C0, $15
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat21:
;CE60
```

```
  .byte $86, $0A, $00           ; set instrument
  .byte $9B, $02, $02, $10, $05, $02
  .byte $21, $B0
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat22:
;CE6D
  .byte $86, $08, $00           ; set instrument
  .byte $21, $D0, $2A
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat23:
;CE75
  .byte $86, $05, $00           ; set instrument
  .byte $11, $B0, $00, $C0
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat24:
;CE7E
  .byte $86, $0B, $00           ; set instrument
  .byte $9B, $02, $02, $08, $03, $04
  .byte $11
  .byte $A2
  .byte $9B, $05, $11           ; play note
  .byte $A8
  .byte $83                     ; set control for release
  .byte $00, $B0
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat25:
  .byte $86, $0C, $00           ; set instrument
  .byte $9B, $02, $02, $10, $0A, $02
  .byte $21
  .byte $DB
  .byte $83                     ; set control for release
  .byte $00, $A4
  .byte $86, $0F, $00           ; set instrument
  .byte $80                     ; end of pattern

pat26:
CEA4
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $20, $01, $05
  .byte $2A, $C0, $25
  .byte $23, $2A, $25, $23
  .byte $2A, $25, $23, $2A
  .byte $B0, $2A
  .byte $83                     ; set control for release
  .byte $00
  .byte $A8
  .byte $80                     ; end of pattern

pat27:
;CEBE
  .byte $86, $00, $00           ; set instrument
  .byte $9B, $02, $02, $04, $01, $04
  .byte $2A
  .byte $A8, $21, $B0, $25
  .byte $A4, $25, $A8, $21
  .byte $B0, $3A, $A8
  .byte $83                     ; set control for release
  .byte $00, $A2
  .byte $80                     ; end of pattern
  .byte $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $11, $21, $11
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern
  .byte $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00

pat28:
;CF00
  .byte $86, $08, $00           ; set instrument
  .byte $21
  .byte $D5, $11, $25, $15
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern
```

```
pat29:
;CF0A
  .byte $86, $08, $00           ; set instrument
  .byte $25, $C0
  .byte $80                     ; end of pattern

pat2a:
;CF10
  .byte $86, $07, $00           ; set instrument
  .byte $9B, $02, $02, $04, $0A, $04
  .byte $31, $AA, $00
  .byte $B0
  .byte $83                     ; set control for release
  .byte $80
  .byte $00                     ; end of pattern

pat2b:
;CF20
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $31, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat2c:
;CF2D
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $33, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat2d:
;CF3A
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $35
  .byte $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat2e:
;CF47
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $01, $10, $01, $05
  .byte $36, $A8
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat2f:
;CF54
  .byte $86, $0A, $00           ; set instrument
  .byte $9B, $02, $02, $04, $0A, $02
  .byte $21, $B0
  .byte $83                     ; set control for release
  .byte $92                     ; stop effect
  .byte $80                     ; end of pattern

pat30:
;CF62
  .byte $86, $05, $00           ; set instrument
  .byte $35, $D0, $31
  .byte $4A
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat31:
;CF6B
  .byte $86, $05, $00           ; set instrument
  .byte $11, $D3
  .byte $01, $1A, $0A
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat32:
  .byte $86, $05, $00           ; set instrument
  .byte $9B, $02, $02, $10, $05, $02
  .byte $21, $B0, $2A, $C0
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat33:
;CF84
  .byte $86, $03, $00           ; set instrument
  .byte $8C                     ; portamento add
  .byte $10, $00, $21, $A2
  .byte $92                     ; stop effect
  .byte $00, $A8
  .byte $83                     ; set control for release
```

```
  .byte $80                     ; end of pattern

pat34:
;CF91
  .byte $86, $0B, $00           ; set instrument
  .byte $95, $1B, $0F           ; put osc3 to freq. hi
  .byte $83
  .byte $83                     ; set control for release
  .byte $83                     ; set control for release
  .byte $51, $DB
  .byte $83                     ; set control for release
  .byte $00, $A4
  .byte $86, $0F, $00           ; set instrument
  .byte $80                     ; end of pattern

pat35:
;CFA3
  .byte $86, $03, $00           ; set instrument
  .byte $9B, $02, $00, $40, $05, $02
  .byte $83                     ; set control for release
  .byte $5A, $B0, $51, $C0
  .byte $58, $B0, $51, $C0
  .byte $5A, $B0, $55, $C0
  .byte $5A, $B0, $5A
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern

pat36:
;CFBE
  .byte $86, $00, $00           ; set instrument
  .byte $95, $1C, $16           ; put asdr3 to filter freq hi
  .byte $4A, $A8, $41, $A8
  .byte $5A, $A4, $4A, $B0
  .byte $3A
  .byte $83                     ; set control for release
  .byte $00, $A2
  .byte $80                     ; end of pattern
  .byte $00, $00, $00
  .byte $00, $00, $00, $00

pat37:
;CFD8
  .byte $89, $0F                ; set volume
  .byte $86, $00, $00           ; set instrument
  .byte $2A, $A8, $21
  .byte $B0, $25, $A2
  .byte $83                     ; set control for release
  .byte $80                     ; end of pattern
  .byte $00, $00, $00

playMusic:
      jsr  $C000
      jsr  $C000
      rts

  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00, $00, $00, $00
  .byte $00
```

Conclusion

The engine is not so powerful compared to some player of the same year, but probably only the features needed by Ivan were implemented into the player.

However we know that wonderful sid music can be produced even with simple player (look at “Lazy Jones” in SIDin #2) and so I think that with this player, Modulus is resulted very-very good.

xxlarge

by Stefano Tognon <ice00@libero.it>

xxlarge is a tune created by Ninja/theDream is less than 256 byte. Before reading this article, goes to download and listen to it! (http://noname.c64.org/csdb/release/?id=14337)

The tune is a cover of Jeff's “X large” and you will note that it is played a little slower that the original.

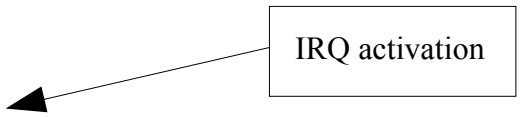
Now I think you are wondering how music and code can be fitted in so little space, as Jeff original is large about 800 bytes!

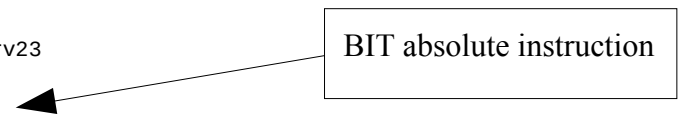
Here I go to analyze the code to show how this can be made and finally I hope that one of you would like to take the challenge to produce a 256/512b tune (but this will be explained later).

Code

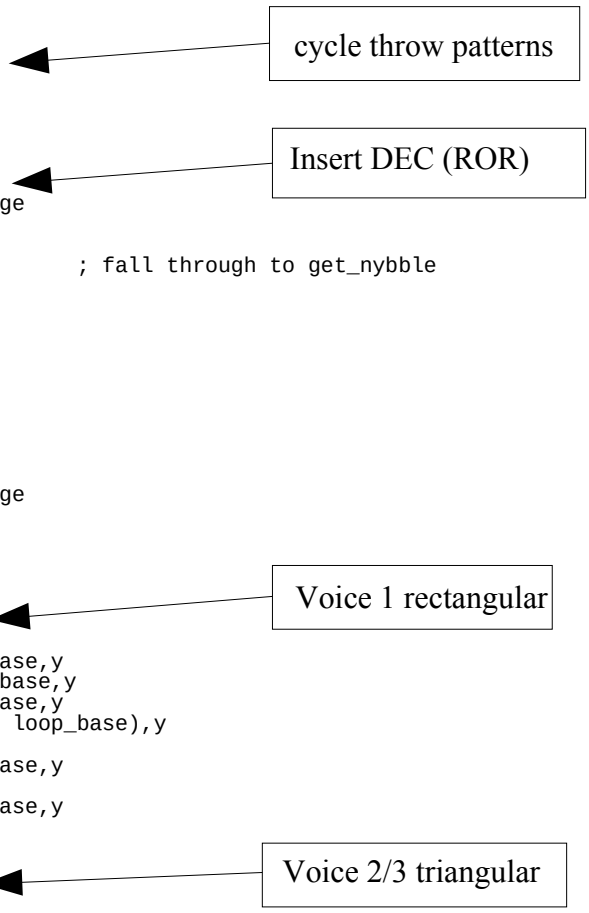
Here the complete code that were released together with the music.

```
              include standard.c64

mus_pnt          =  $17      ; $16
mus_filtercnt    = $39      ; $05 (basic line lo)
mus_v1pos        = $3b
mus_v2pos        = mus_v1pos+7
mus_v3pos        = mus_v1pos+14
pattern_idx      = $3d      ; $0b
mus_bufferv23    = $b3      ; $03
mus_pulsecnt     = $cd      ; Cursor Blink Cnt :)


              org $0801

              adr $080c, $05
              byt $97,"789,8"             ; POKE

pattern_list:         ; $08 = 8
                      byt pattern3, pattern2
                      byt pattern3, pattern2
                      byt pattern1, pattern1
                      byt pattern5, pattern4

pulse_tab:            ; $14 = 20
                      byt $07,$47,$87,$B7,$08,$38,$88,$B8
                      byt $09,$39,$89,$49,$09,$B8,$88,$38
                      byt $08,$B7,$87,$37

SR_tab:               ; 3 + 2*6 = 15
              byt $d7
filter_cut:           byt $60,$78,$90,$a8,$c0,$DB
              byt $77
filter_res:           byt $01,$41,$71,$a1,$e1,$1f
              byt $38

mus_irq:
                  ldx mus_pulsecnt
                  lda pulse_tab - 1,x
                  STA $D403
                  STA $D402
                  asl
                  bpl mus_exit

                  LDA mus_bufferv23
                  STA mus_v3pos
                  LDA mus_v2pos
                  STA mus_bufferv23
                  LDA mus_v1pos
                  STA mus_v2pos
                  byt $2c
mus_filterchange:                     ; c=0
                  ror mus_filtercnt   ; inc <-> ror
```





```
                ldy mus_filtercnt
                LDA filter_res,y
                STA $D418 - 5,y
                STA $D417
get_nybble:
                lda mus_pnt
                inc mus_pnt
                lsr
                tax
                lda patterns,x
                bne do_note

                dec pattern_idx
                lda pattern_idx
                lsr
                and #7
                tax
                lda #$66<<1
                ror
                sta mus_filterchange
                lda pattern_list,x
                sta mus_pnt
                txa                     ; fall through to get_nybble
do_note:
                bcs mus_getlo
                lsr
                lsr
                lsr
                lsr
mus_getlo:
                and #$0f
                STA mus_v1pos
                asl
                beq mus_filterchange
                adc filter_cut,y
                STA $D416

loop_base     = $100 - 3*7
                ldy #loop_base
                lda #$41
mus_l1:
                sta $d404 - loop_base,y
                lda SR_tab - loop_base,y
                sta $d406 - loop_base,y
                ldx lo(mus_v1pos - loop_base),y
                LDA notes_lo - 2,X
                STA $D400 - loop_base,y
                LDA notes_hi - 2,X
                STA $D401 - loop_base,y
                tya
                adc #7
                tay
                lda #$11
                bcc mus_l1
mus_exit:
               if 0
                 lda mus_filtercnt
                 sta $0400
                 lda mus_pnt
                 sta $0402
                 lda pattern_idx
                 and #15
                 ldx mus_pulsecnt
                 sta $0404,x
               endif
                jmp $ea31


notes_lo:           ; $0e = 14
                    byt $5a,$ce,$c1,$b4,$9c,$09,$d0,$82
                    byt $68,$88,$af,$39,$13,$a1
notes_hi:           ; $0e = 14
                    byt $04,$05,$07,$08,$0b,$0d,$0d,$0f
                    byt $11,$13,$14,$17,$1a,$1b

patterns      = *
pattern3      = (* - patterns) * 2        ; $0b = 11
pattern5      = pattern3 + 6
                    byt $03*$10+$05,$06*$10+$07,$00*$10+$08
                    byt $03*$10+$0a,$06*$10+$00,$0d*$10+$03,$0c*$10+$0b
                    byt $06*$10+$09,$03*$10+$0a
                    byt 0
pattern1      = (* - patterns) * 2        ; $0a = 10
                    byt $02*$10+$00,$05*$10+$04,$02*$10+$00,$05*$10+$02
                    byt $0a*$10+$05,$00*$10+$09,$02*$10+$05,$0a*$10+$05
                    byt $04*$10+$02,$0a*$10+$02
                    byt 0
pattern2      = (* - patterns) * 2        ; $09 = 9
                    byt $02*$10+$05,$07*$10+$0b,$0c*$10+$02,$0d*$10+$05
```



```
                        byt $0f*$10+$02,$0e*$10+$0c,$05*$10+$0b,$02*$10+$0a
                        byt 0
pattern4        = (* - patterns) * 2        ; $0a = 10
                        byt $02*$10+$05,$00*$10+$04,$02*$10+$00,$05*$10+$02
                        byt 0
pattern_end     = (* - patterns) * 2

                        byt "NINJA"

                end $0801
```

Analysis

One of the first things that a player must do is to add a IRQ handler after it has initialize the engine. The IRQ has to call the player routine at each programmed interval (like by CIA or VIC).

This is a task that require many bytes, but we have to use the less we can, so look at this heavy optimized peaces of code:

- The player did not initialize itself, or in other words, it did not use an init routine, as all that is needed is done inside the play routine (and with variables already initialized).
- The IRQ initialization use the BASIC instruction: POKE 789,8

The last is a very optimized way to initialize IRQ.

The address 788/789 contains the Hardware Interrupt vector that standard Kernal IRQ routine will give control during an IRQ call. It is very common to change this address to assign an self made IRQ routine. In this case, the high byte of the IRQ routine is assigned to 08.

What this means? Simple, as normally the IRQ vector is at $EA31, with this instruction it will be located to $0831. In other words, the IRQ routine *mus_irq* must be starting at $0831 and we don't need anymore BASIC instructions to go away. If you look at the source, before the $0831 address, we have lot of bytes used by the player for patterns and tables.

Before going into further analysis of the source we have to say that the player as these features:

- The player use a track for the music: *pattern_list*
- The track is composed by a sequences of patterns
- Each pattern contains sequence of note and filter command (packed in one byte)
- All 3 voices are used
- The player has a wave and filter table for dynamic effects onto the voices

In depth

Now we start to look at the end of the source from *loop_base = $100 – 3*7*

This is a cycle that:

- Initialize voice control register to rectangular for voice 1 and triangular for voice 2 and 3
- Set the Sustain/Release of each voice
- Set the high/low byte of frequency for the current note to play

All is similar to *sta $d404 – loop_base,y* with *y* equals to *loop_base* at beginning and then it is increased by 7 (for next voices), so we have:
$D404 -loop_base + loop_base = $D404

The loop will end when adding 7 to *y* will make the carry positive, and as *y* starts from $100-3*7, this will occurs after we finish to pass the 3° voice.

As we see, voice 1 is rectangular, so it must be set his wave pulse values. This is done at the beginning of the routine. High and low value of wave are the same, but values are taken from a table, so they are not fixed. The nice idea for saving space, is to use the value in *$cd* as index for the table. This is the values used for making the cursor blinking animation by the Kernal. Its value goes from $14 to $1.

The high bit of the wave value read from the table is then used for skipping or not the rest of the player: this give some delay in calling the player.

What is missing into the player is that it not set the Attack/Decay value of each voices: according to Ninja there where no more space to add this features.

Now goes to see from *get_nibble*: here current pointer to music notes (*mus_pnt*) is incremented and then a pattern value is read using the pointer. A 0 values means that the pattern is ended and so the *pattern_idx* is decremented and a new pattern is taken from the track (*mus_pnt* is also initialized to the right place. Note that *pattern_idx* is always decremented as the track is composed by 8 patterns, only the 3 lower bits are used.

Each pattern values are composed by two nibbles: each nibble has this meaning:

- $00 change mus_filtercnt
- $01 not used
- $02-$0f notes index (from tables)

So, goes to the *mus_filterchange* label: before this there is a BIT instruction (opcode $2C): this means that each time the player is executed, no action is taken to the *current mus_filtercnt*, and so the same value from table is putted to the filter.

Instead, as soon as a nibble is zero, (look after *mus_getlo*) the flow is passed to the *mus_filterchange* position and so the current filter position is changed.

In fact at *mus_filterchange* we can have these instructions:

- inc *mus_filtercnt*
- ror *mus_filtercnt*

and so filter index table is incremented and decremented (ror is shorted than dec, but according to Ninja it is still good enough).

The instructions that made *inc* to *ror* are:

```
lda  #$66<<1
ror
sta  mus_filterchange
```

If Carry is 0 a $66 (ror) is putted into *mus_filterchange*, while if Carry is 1, $E6 (inc) is putted.

Finally, each patterns are played twice, so during the first time the filter table is incremented, in the second it is decremented.

In the source if you made compile the “if 0” statement, you will have a look of how *mus_filtercn* behaves.

Conclusion

I hope that you have found interesting the analysis of this wonderful peace of code, so why not try yourself?

Well, this is why I'm near to organize the “Tiny Sid Competition”: see what coder/musician are able to produce with less space.

“Tiny Sid Competition” will be executed from 15 January 2005 to 21 April 2005 instead of the “SidWine compo” (sorry, but SidWine compo take me too many months to organize, so I go for something less time consuming this year).

Allowed sizes will be:

- 256 bytes
- 512 bytes

Maybe a size of 1K could be another chance if required, but I think that 1KB are big enough, even if it could be interesting too.

Allowed will be all tunes that fit in that categories as prg executable (e.g. they must be runnable with run after loading) and they can be even cover/remix of existing tunes (cover with less byte is hard in every case).

Reverse engineering source code (or better original source) may be allowed by the author to be published in an article like this in SIDin.

I don't know how many people could be interesting in such compo, but if we did not try...

Check: http://digilander.iol.it/ice00/tsid/tinysid

Finally I like to thank Ninja for allowing me to write this article about his work and to have give some in-depth description of the engine.

Sin 7 end