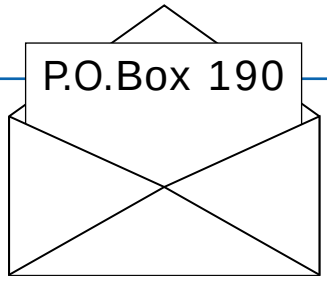


We can only answer questions or remarks of general interest to our readers, concerning projects not older than two years and published in *Elektor Electronics*. In view of the amount of post and email received, it is not possible to answer all correspondence, and we are unable to respond to individual wishes and requests for modifications to, or additional information about, *Elektor Electronics* projects.

How much current from the USB?

Dear Sir — in the article 'USB Audio-DAC' (December 2000), you state on page 45 that the current consumption of the circuit (60 mA), is such that it was not considered appropriate to power it from the USB port, which has a maximum spec of 100 mA in this respect. According to information I have available, a USB device may draw up to 500 mA. For example, the Canon CanoScan N650U gets its complete power requirement of 2.5 watts (500 mA x 5 V) from a USB port. This works just fine, even if an additional USB camera is connected. I would therefore be interested to know where you got the 100 mA spec from?
M. Radde (by email)

The specification '100 mA' is the current a USB port is always capable of supplying. During initialisation, a higher current is allowed. Once initialised, a USB device requiring more current may draw more current after reporting its requirement to the operating system. The limit of an USB port is 500 mA, and no further devices may be powered once this current is reached.
Depending on their current requirement, USB devices fall into one of three classes:
1. low bus powered
2. high bus powered
3. self powered

Devices from the first two classes draw all necessary current from the USB port. Self powered devices, on the other hand, have an internal power supply and require little or no power from the USB. A unit load of 100 mA has been defined for the USB. Devices from the first class (low bus powered) are only allowed to draw one unit, i.e., 100 mA. The same goes for high bus powered devices (class 2) when in the pre-configuration state. Up to 5 load units are allowed in class 2 devices when configured.
The amount of current an USB device is allowed to draw from a port depends on five factors:
A. Device status
– power-on: max. 1 load unit
– configured: 1 load unit (100 mA) for low-power devices, or up to 5 load units (500 mA) for high power devices provided they have been allowed to do so by the OS
– suspended: not exceeding 500 mA including current through pull-up to D+ or D–.

B. Hub type used to connect the device. Up to 500 mA allowed using a hub with internal power supply. If the hub is bus powered, this is reduced to 100 mA. A hub is a PC is normally considered self-powered, while a hub in a portable device is bus powered. When a device draws to much current, it may happen that the USB goes along by supplying more current than is strictly allowed. None the less, it is recommended to provide for an internal power supply.
C. Configured and running: current consumption should not exceed the level reported by the device (by means of the enumeration in the configuration descriptor) during the configuration phase.

The same restrictions in respect of current demand apply to devices with an internal powered supply (self powered). Good separation is essential between the USB and the external power supply. In the event of the internal supply failing, the device may not present a heavier load the USB than 'promised' during configuration (i.e., not more than one load unit of 100 mA when configured as self-powered or low power bus powered).

CD Recording Quality

Dear Editor — roughly a year ago you had an article in Elektor Electronics about CDs that were supposedly recorded with overdriven signals. An oscilloscope was used to look at the output signal of a CD player playing Jean Michel Jarre's 'Oxygen 7-13'. It was clear that the peaks of the waveform were flat where the signal was greater than what could be reproduced by the CD. This is also known as clipping.
Using an oscilloscope in this way can't really tell us how much the CD player affects the signal quality. Between the CD and oscilloscope will be an oversampling digital filter, a digital-to-analogue converter and finally an analogue filter. The most accurate way to check a CD is to extract the track digitally and store it as a WAV file. This will be an exact digital copy of the CD, assuming there were no read errors. The creation of the WAV file shouldn't be a problem since it is a function that is found in most current CD 'rippers'. A computer program can then be used to analyse the contents of this WAV file.
A WAV file consists of a header followed by the thousands of samples that make up the digitised sound. The 16-bit format used on CDs gives these samples a range from -32768 to 32767. In order to have a closer look at these WAV files I have written a program that can analyse them. As the first step, the program creates a histogram of the WAV file. This counts how often each sample value occurs in the WAV file, and gives a display as shown in Figure 1.
The values near zero occur most often; the more you go to the extremes of –32768 and 32767, the less often they occur. If there was any clipping at the recording stage, all strong signals will be rounded to the extremes of -32768 and 32767, which results in two peaks at the ends of the histogram. This way you can see if there is any clipping present and at what level (it is possible

CORRECTIONS&UPDATES

Free Downloads now supplied as zip files

Having obtained a licence to distribute .zip files via the Free Downloads section of the Elektor Electronics website, we are pleased to announce that all previously supplied .exe self-extracting archive files have been replaced by .zip equivalents. The program needed to unpack these files is called Winzip and may be downloaded free of charge from http://www.winzip.com.

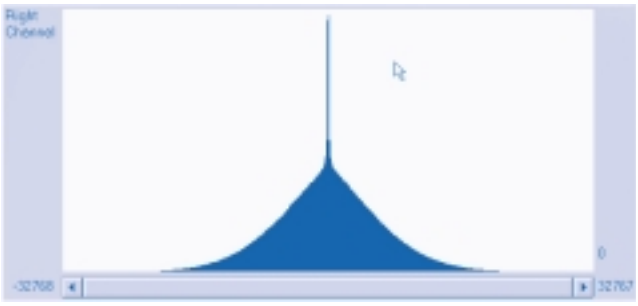
MCS BASIC-52 V1.3

On page 22 of the article, the sentence 'The PROG commands are also redundant, so they have been deleted' should read 'The FPROG commands…'

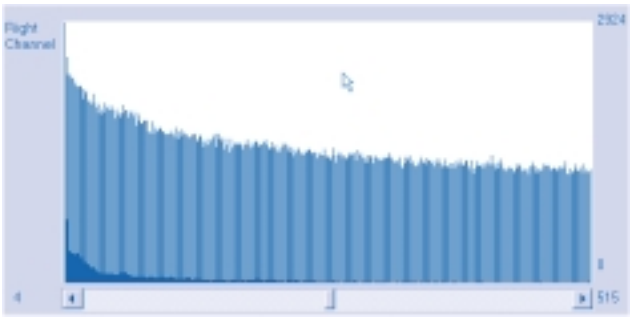
MIDI Lights & Slide Control

The SAB80C535 used in this project may is not easily obtainable and may be replaced by the more commonly available and fully compatible type SAB80C515-N.

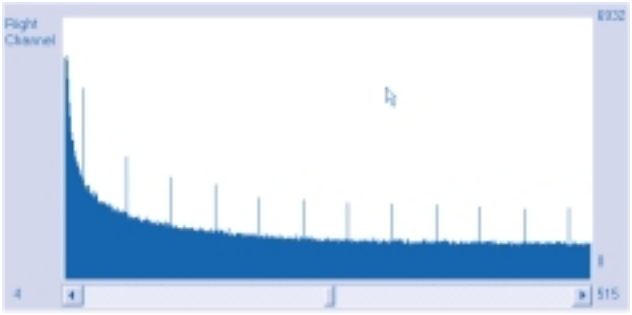
1



2



3



for it to occur at different values than -32768 and 32767, due to badly set up A/D converters).
Next, the program displays the actual waveform stored in the WAV file. This window has a search facility that searches for clipping values, as determined by the previous histogram function.
I have used this program to analyse the track "...Baby One More Time" by Britney Spears, from her CD "...baby one more time". It was obvious that there was a lot of clipping in this track, but the display returned by the histogram was the most surprising.
This is shown in Figure 2. It contains the number of occurrences in the WAV file for samples with values from 4 to 515. After every two values that occur over a 1000 times, there follows a value that rarely or never occurs at all. You could only get such a histogram when a 16-bit recording is re-recorded after amplification by a factor of 1.5. Samples with values of 1, 2, 3, 4, 5, 6, 7 etc. are multiplied by 1.5 to give 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5 etc. These values then have to be rounded to integers before being written to the CD. This gives the result 2, 3, 5, 6, 8, 9, 11 etc. You'll see that every third value is missing from this series of numbers. By looking at the waveform where clipping occurs, it is possible to deduce by how much the recording of the CD was overdriven. I estimate this to be a factor of about 1.5.

From this I conclude that the original mix, which was recorded perfectly, was remixed with an amplification of 1.5, causing clipping in the new recording.
The track "Gloria, lonely boy" on the CD "Metamorphose" by Jean Michel Jarre was then analysed, in order to see if his latest CD had signs of clipping. Here too it seemed that the recording was overdriven. But once more it was the histogram that returned some fascinating information (Figure 3).
The smallest and largest samples found in the recording were -32022 and 32021 respectively (0.977 of the maximum range). These were also the levels at which clipping occurred. From the histogram it can be seen that every fortieth value is twice as large as its neighbours are. From these observations you can conclude that this CD is a remix of an original CD recording. The samples have been multiplied by 0.977 before being converted back into CD format.
This raises the question why this meaningless conversion was carried out on the recording. The only reason I can think of is that the remix was made to hide the fact that the recording was overdriven. Anybody who uses an oscilloscope to look for clipping would set the trigger level at the largest possible signal level, about 99.9% of the maximum signal possible. The remix would cause the signal to remain below this level so the oscilloscope would never trigger and the clipping would remain undetected. The person making the remix would have known that clipping occurred and was determined to hide this fact. The correct procedure would have been to make a slightly softer remix from the master tape and avoid any clipping that way.
The record industry is currently promoting the new Super Audio CD (SACD), which has an improved quality. They would be better off stopping the messing around with the recordings. These fudges also sound bad in SACD format and making careful recordings in CD format will result in bigger improvements than the change to SACD format.
A. Kappert, Netherlands

We've said it before and we'll say it again: We think that the price of a CD is high enough to expect the best quality recordings. Initiatives such as these by quality conscious music lovers should therefore be applauded.
Mr. Kappert has been kind enough to make his analyser program available to Elektor Electronics readers free of charge. The program can be downloaded from our website at www.elektor-electronics.co.uk. It can be found as 'CD-analyser' on the Free Downloads page, May 2001 items.