

Slow-Scan ATV with a PC

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Foreword:-

This is a circuit which enables a PC (AT or faster) to receive SSTV on hf, vhf or uhf. The computer should have a VGA graphics card and a VGA mono or colour monitor. A former EGA or CGA graphics card is not good enough because we need to display at least 16 grey levels for fair picture quality.

The advantages of this circuit are:-

- Simple hardware and adjustment.
- Simple connection to the receiver.
- Uses the Centronics printer port
- Enables the many radio amateurs who own a PC to use SSTV.

SSTV was developed by radio amateur, who originally used monochrome cameras with modified deflection to send and radar cathode - ray tubes to display the images. Nowadays it is possible to follow the transmissions comfortably and easily because the computer's built-in frame store enables flicker-free pictures to be displayed (see the pictures). The more commercial "FAX" cannot be received with this circuit. However, despite the substantial advances in computer technology in recent years, it is necessary to use a small interface because the computers are still too slow to manage this facility.

Explanation of the circuit.

The purpose of the hardware is to digitise the received audio so that the computer can understand it (zero and five volts TTL). I.C.'s U3A and U3B (TL084 or LM324) amplify the audio from the speaker. This is sufficient to create a zero - 5 volt TTL format. It must now be converted to binary form.

With every negative-going edge of the TTL pulses, the I.C.'s U4A and U4B create short needle-pulses. Then follows a circuit originally described by DL2RZ. He digitised the picture into 16 grey levels by using 4 bits (i.e. four wires) and detected the sync. tone with separate, analogue circuitry. But there is no need for this analogue sync. recognition if five wires are used (i.e. to digitise 5 bits). By using five bits the resolution is good enough to cover the whole frequency range i.e. from sync (1200) to black (1500) up to white (2300). Thus the computer will be able to recognise the sync. without any further hardware. The addition of this extra wire is quite simple. Two monostables, U2A and U2B, are started by the pulses coming from U4B.

However, U2B is used as an oscillator. The pulses created in U2A and U2B will be counted by U1A and U1B for as long as monostable U2A is enabled. U2A resetting will stop the counters. When U2A is adjusted for a cycle of 0.42 msec (i.e. the lowest countable frequency of 1200 Hz) the osc. U2B should deliver 32 pulses.

The IC U5 is used as a digital 5-bit memory and will store the result up to the next incoming cycle. U7 converts the binary information to decimal and the 16 LED's display the result. Higher tones create low numbers and v.v. Normally it would be necessary to use an IC to deal with this inversion - however, if a computer is used, the software does it.

So. If 1200 Hz (sync) is fed in, the left LED will light; if 2300Hz (white), the right LED lights and so on for the range of LED's in between. The converter creates 32 steps on 5 wires; the computer sees these 5 bits and is able to measure out the range from 2300 - 1200 = 1100Hz. This means 32 steps of 34.375 Hz. The LED's show 16 steps using 4 wires; this represents steps of 68.75 Hz which is good enough for tuning the radio.

This circuit has been tested and, because it only needs two adjustments - the period of U2A and the frequency of U2B - is ideal for SSTV beginners. To keep the hardware simple the PLL which synchronises the clock of the computer with the real-time-clock of the pictures has been left out, so the pixel-uncertainty which is therefore created at the beginning of each line simply has to be tolerated. Naturally, those who want to have a PLL can easily install one.

Connection to the computer

This is made via the standard Centronics Printer port and printer cable. Simply use the standard 36-pin plug, available from any computer shop. If you don't want to keep having to switch the cable between printer and SSTV hardware it is recommended you buy a second Centronics card for LPT2.

This may seem confusing as the normal function of Centronics is to send data, not receive it. Don't forget that a printer receives and sends certain data to a computer eg. the "error", "acknowledge", "busy", "paper end" and "select" info.

Simply read the address HEX 378 (LPT1) or HEX 278 (LPT2) with the weights 8, 64, 128, 32 and 16 which correspond to the above information.

The programme has to read the info. from each of these five wires very quickly and calculate it to grey levels before displaying it on the VGA screen. That's the reason why a fast computer is needed, even when some experts in machine-language can do it with a slow machine as well.

There are many modes for the VGA graphics on an IBM or compatible, but at the moment only the mode 13h is important for radio amateurs. This is the only mode which is addressable world-wide with a resolution from 320*200 in 256 colours or 16 grey levels. Only in this mode is it certain that, wherever they are, the readers will be able to use the programmes successfully.

It should be noted that an expensive colour CRT is not necessary as a simple grey-level CRT can do the job just as well, provided it is a VGA monochrome. It is not possible to use the former TTL CRT's eg. Hercules, as they display only a black or white with no grey levels.

The software

There are many computer languages for the PC but the only useful ones are those which are quick enough and enable access to the frame-store. BASIC is not good enough, but PASCAL or C++ can do it quite well.

The last problem is the different computer clock-rates. We are involved with a real-time problem - a need to display every SSTV line within 60 milliseconds (ie. 128 pixels on a line) or within 120 milliseconds (ie. 256 pixels on a line). The computer, therefore, should not run slower or faster otherwise a part of the picture will be lost. Thus the need for a clock-measurement on your computer which is facilitated by executing a special programme that fixes the clock-rate on the disc. This has to be done before starting the main programme. The author is able to send you a floppy disc for a fee of #10 where all these problems are solved. You will get the source-code and ready-compiled programmes to receive and store transmissions in black and white with 8 and 32 seconds duration. A pcb is also available; further info. on request.

Usage

A small 5 volt 40mA power supply will be needed; alternatively, use four size AA nicads (1.25v each) High speed CMOS IC are recommended, which need very little power.

Either the loudspeaker connection or the audio line can be used. When tuning for a SSTV signal, watch the 16 LED's. When the 1200Hz LED flickers rhythmically with 16Hz or 8Hz, you are properly tuned in and can expect pictures. With a little experience you will soon hear the difference between the 8 and 32 second mode, as well as the differences in the FAX tones, which is signified by the long duration of transmissions (sometimes as long as 5 minutes). In SSTV mode the duration is much shorter, giving a better security against QRM.

Every Sunday you will find SSTV stations, especially on the 20 metre band. All radio amateurs not using SSTV are asked to avoid working on 14.230 MHz and maintain a reasonable distance to this QRG, otherwise the pictures may be disrupted. The pictures shown here are records of the contest in March 1992 in the 8 second mode with 128*128 pixels.

I wish you a good reception of SSTV pictures.