

# Connecting a BBC micro to a Television

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## **1. Introduction**

The standard (and best) visual display unit for the BBC micro is an RGB colour monitor. These were usually supplied by Microvitec and can be driven directly from the BBC's RGB port. However, if you do not have access to a monitor then a television must be used instead. This is a simple solution but does not always give a satisfactory quality of display.

However, modern televisions typically have a number of input ports and these offer several new opportunities to the BBC user. This document therefore sets out to explain the various methods by which television sets can be interfaced with a BBC micro.

The author does not have an electronics background and has therefore tried to explain things in simple (and hopefully accurate) terms.

## 2. BBC display hardware

A circuit diagram of the BBC B's display hardware is given on page 504 of the User Guide.

At the top left of the diagram it can be seen that the data is originally supplied along three lines - Red, Green and Blue. These are fed directly to the RGB output port along with 5v and 0v power lines and a "Sync" signal. The red, green and blue signals are TTL, which means that they are either on (5v) or off (0v). Consequently, the machine can output just eight colours: black, white, red, green, blue, yellow, magenta and cyan. More modern machines such as the Archimedes are able to produce more colours because they output an analogue value for each of the basic colours.

In the centre of the diagram the red, green and blue signals are superimposed to produce a single "luminance" value. This is termed "composite video" and is effectively a black and white signal. It can, however, have a "colour burst" (chrominance) component added to it to give a colour output, and the method for doing this is explained in section 6.

Alternatively, the chrominance signal can be fed out of the BBC separately and used along with the luminance signal to provide an "S-video" output (section 5.4).

The composite video signal is processed further to produce an equivalent which is modulated to radio frequency (RF) by the UM1233 TV modulator. This unit feeds the TV port.

Hence the BBC micro can output the same picture via three ports:

RGB	Red, Green and Blue digital signals to drive a monitor
Video out	PAL Composite video in black and white (colour if modified)
TV	RF signals

Additionally, by taking the chrominance and luminance signals out separately it can be made to produce S-video, although there is no port for this.

Since all television sets have an aerial socket it follows that the TV port is the automatic choice for connecting a BBC micro to a television. However, this simple solution may not always be successful, because of the way in which the BBC's display circuitry works. Since the signal has to pass through so many processing stages (RGB -> PAL composite video -> RF) there are many opportunities for signal degradation to occur. The RGB output is therefore likely to be much better than the RF output, especially on old machines.

### 3. BBC display ports

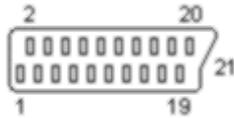
The ports at the back of the BBC are as follows from left to right:

#### 3.1. TV

This is a socket for connecting to a coaxial aerial lead. It has only one signal-carrying pin along with a screened outer shield.

#### 3.2. Video out

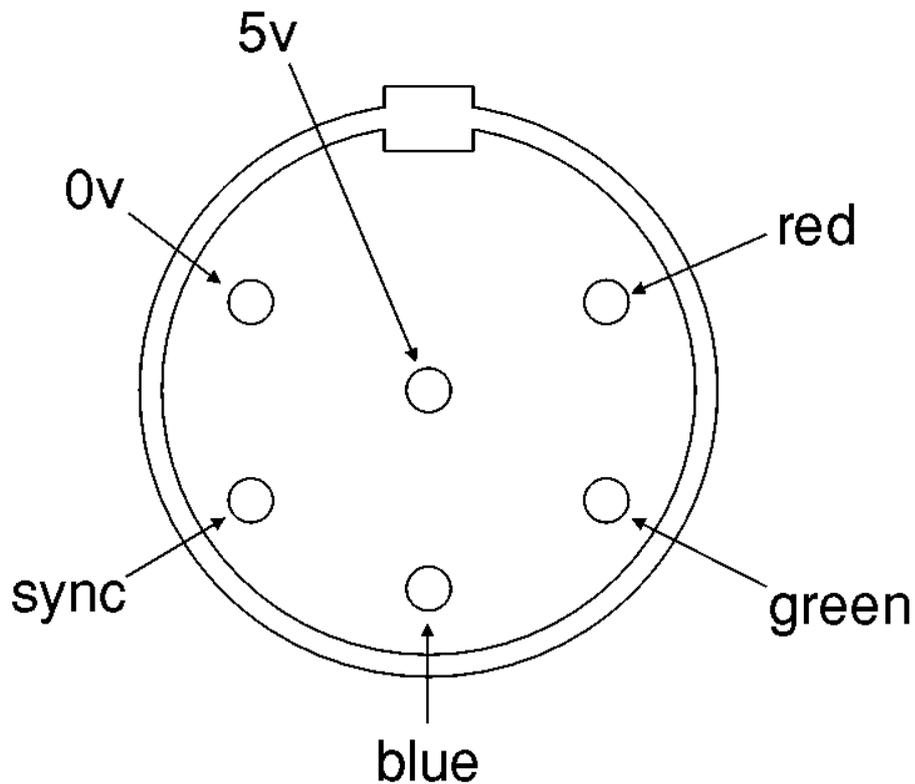
This is a BNC socket carrying the composite video signal. Again, there is only one



signal-carrying pin, together with a shield.

#### 3.3. RGB

This is a 6 pin, 240 degree DIN socket. The pins are laid out as shown:



## **4. Sockets typically found on television sets**

### **4.1. Aerial**

The aerial socket accepts co-axial plugs feeding RF signals. There is only one signal-carrying pin (at the centre), with the surrounding metal element being connected to the screening cable which is held at earth potential.

### **4.2. SCART sockets**

The SCART (or Peritel) socket is a feature of modern televisions which is intended to allow easy connection of external video sources such as video recorders, satellite receivers, and games consoles. Older (or cheaper) televisions may have one SCART socket whereas more recent models often have two.

If two SCART sockets are fitted then they may not both offer the same functionality. All SCART sockets can accept composite video (monochrome or colour), but some can also accept RGB signals. To identify the capabilities of the SCART sockets on your television it will be necessary to read the manual or contact the supplier.

If two SCART sockets are fitted then typically only one will be RGB-capable. This socket could be used for either a games console (outputting RGB) or a video recorder (outputting composite video). A non-RGB capable socket could only accept a video recorder.

### **4.3. Video in socket**

The video in socket is normally found on the front of the television and is a “phono” type connector. It carries composite video signals.

If no video in connector is present on the television then there is likely to be one on the video.

### **4.4. S-VHS socket**

Often found on the front of modern sets, the S-VHS socket is a 4-pin mini-DIN connector and is intended for use with camcorders. It carries ‘S-video’ signals - these are effectively the chrominance and luminance elements of composite video but carried on separate pins to reduce interference. The quality of S-video is therefore better than that of composite video.

## 5. Connecting a BBC micro to a television

By studying sections 3 and 4 above it is possible to deduce that there are four ways to connect a BBC micro to a television:

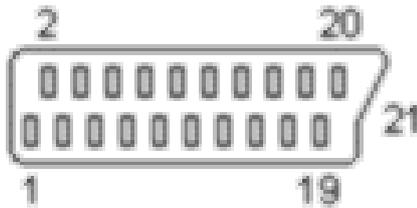
1. TV socket to aerial socket (PAL)
2. RGB socket to SCART socket (RGB)
3. Video out socket to 'video in' socket (Composite video)
4. Video out socket plus chrominance signal to S-VHS socket (S-video)

These are described in sections 5.1 to 5.4 below. In the case of option 3, the default picture displayed would be monochrome but it is possible to produce colour output if the motherboard alteration described in section 6 is carried out. Option 4 also requires part of the same modification to be carried out.

### 5.1. TV socket to aerial socket

This is the standard arrangement, and can be achieved with an off-the-shelf cable.

### 5.2. RGB socket to SCART socket



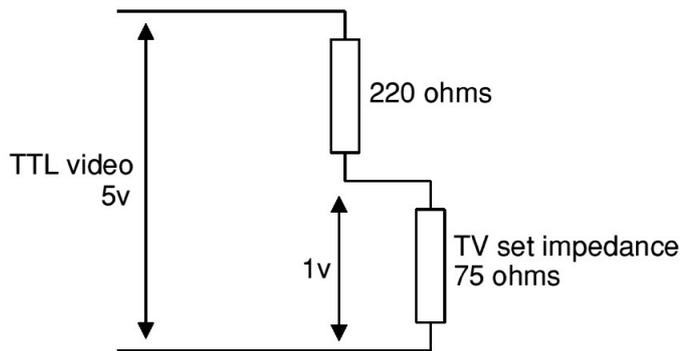
View on SCART plug (onto pins from outside)

A standard cable cannot be purchased to make this connection and therefore one must be made up. The following items are required:

1. 4 off 220 ohm resistors
2. 1 off 270 ohm resistor
3. 1 off SCART plug
4. 1 off 6 pin DIN plug

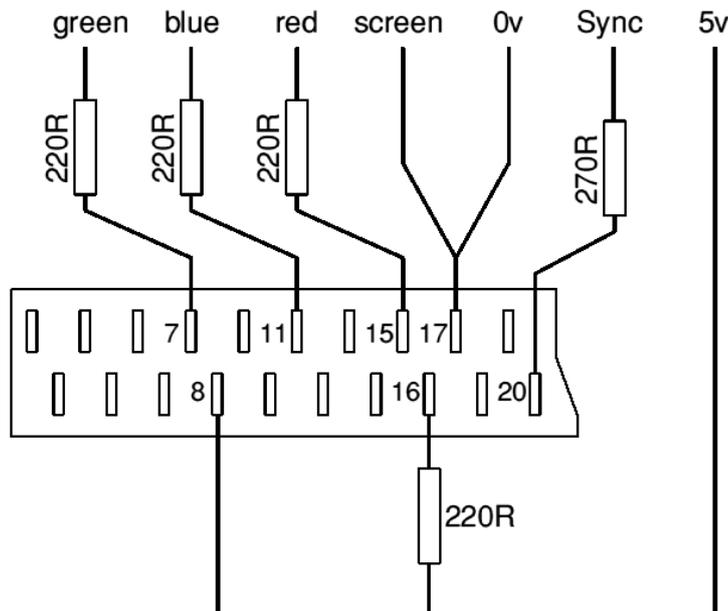
6 way screened cable of the length required, of 0.7/2 gauge. (NB: if the cable is to be used with a TV set in a lounge, it may be wise to ensure a generous length of cable.)

The resistors are needed because whilst the SCART inputs are required to be 1v peak to peak, the BBC micro outputs 5v peak to peak. The resistors form a potential divider with the internal impedance of the TV set itself, reducing the voltage delivered to the SCART socket, as shown in the diagram overleaf:



At the DIN plug end the cores of the screened cable should be soldered directly to the six pins, using a logical choice of colours for Red, Green, Blue, 5v, 0v and Sync. In addition, several strands of screening wire should be twisted together, tinned and soldered to the 0v pin, the rest can be cut back neatly. At this stage it is important to remember to slide the DIN plug sleeve and the SCART plug sleeve onto the cable, so they are not forgotten later.

The SCART plug has plenty of room inside for resistors. The legs of these should be trimmed back to a suitable length (approx. 8mm) and they should be soldered onto the pins shown in the diagram below. Having done this, the resistors should be aligned so that they fit neatly within the SCART plug and the cores of the cable cut to lengths which match up with them. The cores should then be soldered onto the resistors/pins as appropriate, again ensuring that the screening wires are soldered to the 0v pin (pin 17).



After continuity testing both plugs can be closed up ready for use.

### 5.3. Video out socket to SCART socket

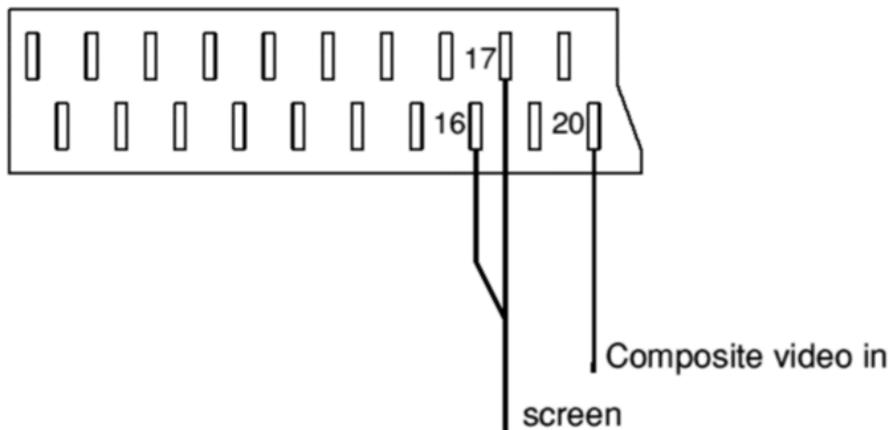
The composite video signal from the Video Out port on the BBC micro can be connected to the Composite Video pins of a SCART plug and used to give a picture on a TV set.

This will be subject to the normal limitations of composite video, namely:

- As standard, a black and white picture will be generated
- With modifications to the motherboard (as detailed in Section 6) a colour picture can be produced but this may suffer from blurring where blocks of colour meet.

With these limitations in mind it may be better to try option 5.4 and use S-video which does not suffer from blurring.

The connections to the SCART plug would be as follows for this option. It should be noted that this has not been tested and hence cannot be guaranteed to work.



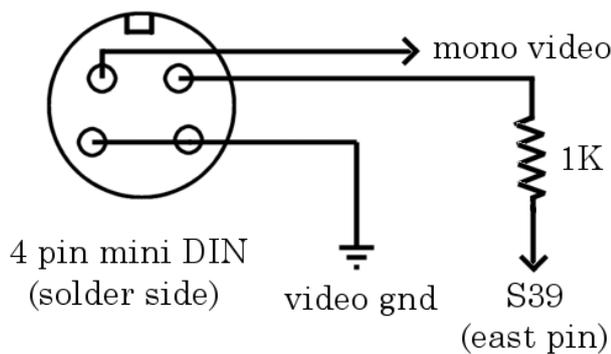
#### 5.4. Video out socket to S-Video socket

This option takes advantage of the S-video sockets which are commonly found on the front of modern TV sets.

S-Video is basically the same as composite video but with the luminance and chrominance signals separated out. This gives a better picture which does not suffer from the blurring which occurs when the BBC's composite video output is modified to give colour.

To use S-video, the chrominance signal must be located on the motherboard. Section 6 describes which components have to be added to condition the signal but in order to use S-video the actual link to the video circuits must not be made. Instead the chrominance signal should be fed separately to the mini DIN plug.

On a standard BBC B the signal is to be found on the East solder point of link S39. To this a 1kOhm resistor should be added. The overall arrangement should thus be as follows:



BBC Model B - S-Video Output

The monochrome wire and video ground signals should be connected respectively to the signal and screen pins of the existing video out socket.

Ready-made cables with a mini-DIN plug at each end can be bought from electronics shops. These can easily be adapted to suit this application by cutting off the plug at one end, soldering the 1k resistor onto link 39 and soldering the ends of the cable to the appropriate positions.

Alternatively, for a neater solution the existing BNC "video out" port can be removed and replaced with a mini DIN socket. These are available from Maplin as part JX08. The pins of the socket should be wired as shown in the figure and a standard S-video cable used to connect the BBC to the TV.

## **6. Converting motherboards to output colour composite video signals**

As standard, all BBCs output monochrome composite video signals (luminance), but it is possible to modify the motherboard to supply the missing chrominance signal. The modification is quite easy to perform.

### **6.1. BBC Micro issue 1, 2 and 3 motherboards**

A 470 picofarad capacitor must be fitted between the emitter (marked 'e') of Q9 and the base of Q7 (the central leg).

### **6.2. BBC Micro issue 4 and 7 motherboards**

Link 39 must be made. This can be found next to the modulator in the far right hand corner of the PCB.

### **6.3. BBC Micro model B+**

Link S26 should be made.

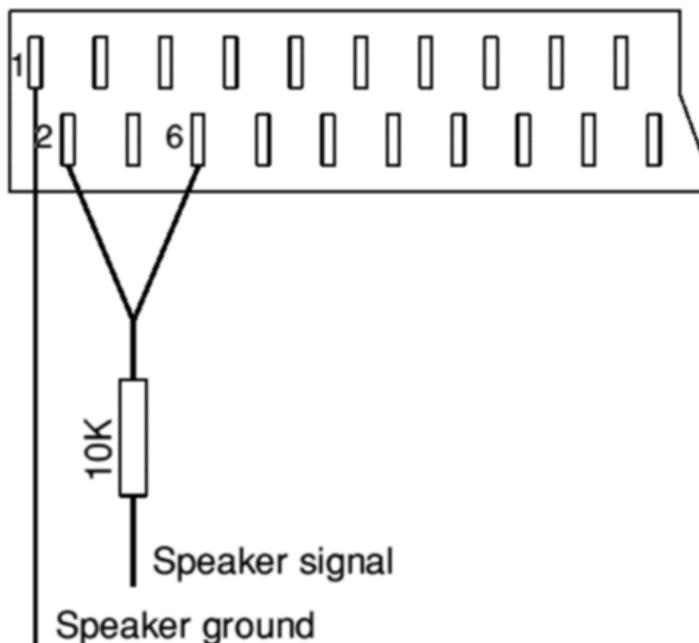
### **6.4. Master 128 issue 1 motherboards**

A 470 picofarad capacitor should be connected between the east leg of R137 and the east leg of R153. These are located to the east of the modulator.

## 7. Feeding sound into the TV's SCART socket

SCART sockets have a sound input as well as a picture input, and this can be driven quite easily by the BBC micro. The resulting sound quality will be much improved since the television's speakers will be used in place of the very small speaker in the BBC. The disadvantage is a slightly untidy wire arrangement and the fact that the BBC's internal speaker becomes disabled.

The SCART socket has an 0v pin for sound plus a left and right hand input. Because the BBC outputs mono sound only, the two stereo inputs must be linked. In addition, a 10kOhm resistor must be used to attenuate the sound signals to a level acceptable to the TV. The wiring within the SCART plug is thus as shown:



A thin two-core cable must be used to connect these two inputs to the BBC. There is no advantage to using spare cores within the RGB cable itself since the wires have to lead to a different destination in the BBC.

The input to the speaker can be found on the motherboard by tracing the red and black wires which lead to the speaker. The speaker wire must be unplugged and tucked to one side, revealing the two pins which stick up from the motherboard. The signal should be on the left hand pin with ground on the right, but it would be wise to check this with a multimeter.

A replacement plug is needed to go onto the motherboard pins, and from here a two-core cable should be routed out through the cooling holes in the back of the case and up to the SCART plug.

## **8. Disclaimer**

The information contained in this document is believed to be correct.

However, no responsibility can be accepted for damage caused to computers, TV sets or persons as a result of following this advice.