VIDEO PROCESSING CIRCUIT

A VIDEO AMPLIFIER WITH AGC & ADJUSTABLE BLACK LEVEL CLAMP.

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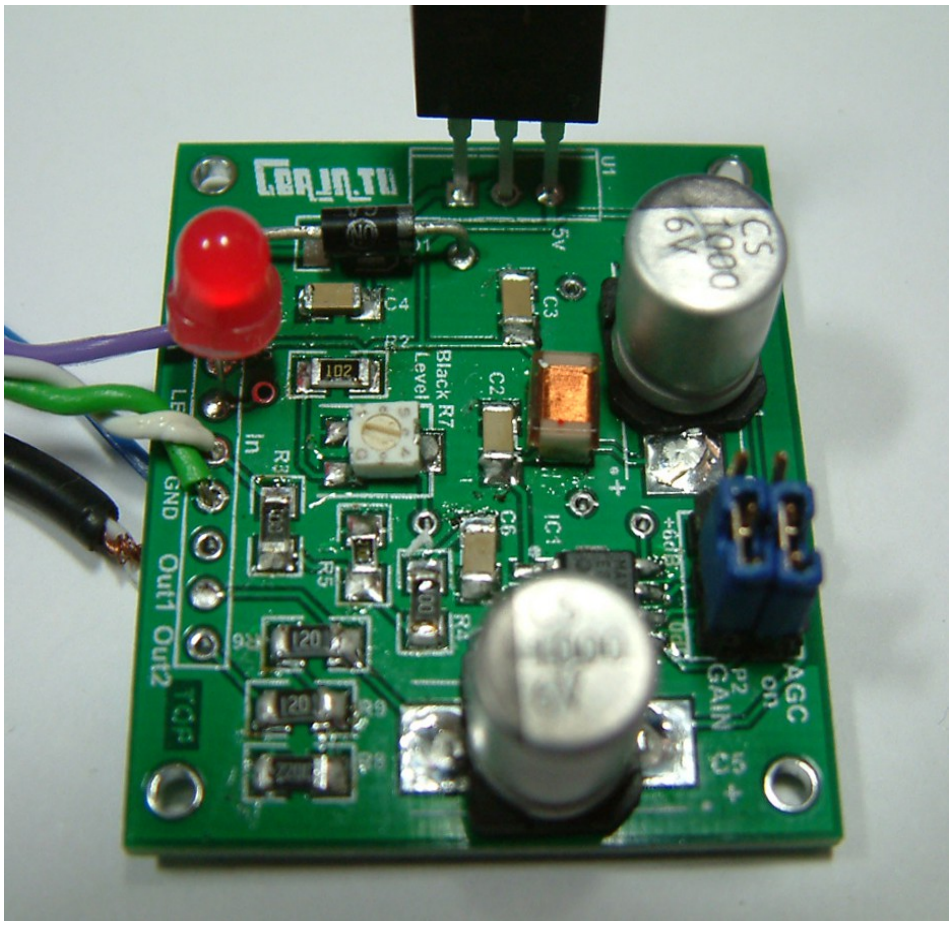

Board size: 35mm x 40mm (approx:1.5"x1.25")

Ideal for both analogue or digital modulators, especially those not having any auto input level control, this video AGC circuit will enable levels from different sources to be stabilised and consistent. It will give a good quality video waveform and will avoid problems often encountered where captions are overlaid. If you put in a badly distorted video waveform it will not sort it out and make it perfect. It is not a Timebase Corrector. However it does mean that inputs to video switchers or modulators etc would not now need an input potentiometer in an attempt to control a video feed level to 1v pk with the usual mismatch occurring as the potentiometer moves away from 75 ohms. Three of these boards have now been incorporated into the local ATV repeater GB3SQ one on each video input and the three corresponding video input controls have been removed.

Using the low-cost MAX7452 it is a complete front-end video-signal conditioner and is designed to improve the quality of standard-definition video signals. The device restores the DC level of the video input, corrects for amplitude errors up to ±6dB, detects and indicates fault conditions, and filters out-of-band noise. The device integrates an input video clamp, automatic gain control (AGC), loss-of-sync (LOS) detector, and an out-of-band noise/low-pass filter. It also incorporates a user-selectable buffer gain (0 or +6dB) and an AGC disable function. The black level is clamped to an adjustable reference voltage. The circuit operates by measuring the sync size against the preset level and adjusts the waveform to the correct size. When a low-level input signal, say 0.5v pk, is presented it steps the video level up until it is correct. Careful adjustment of R7 improves the settling point and smoothness of the transition.

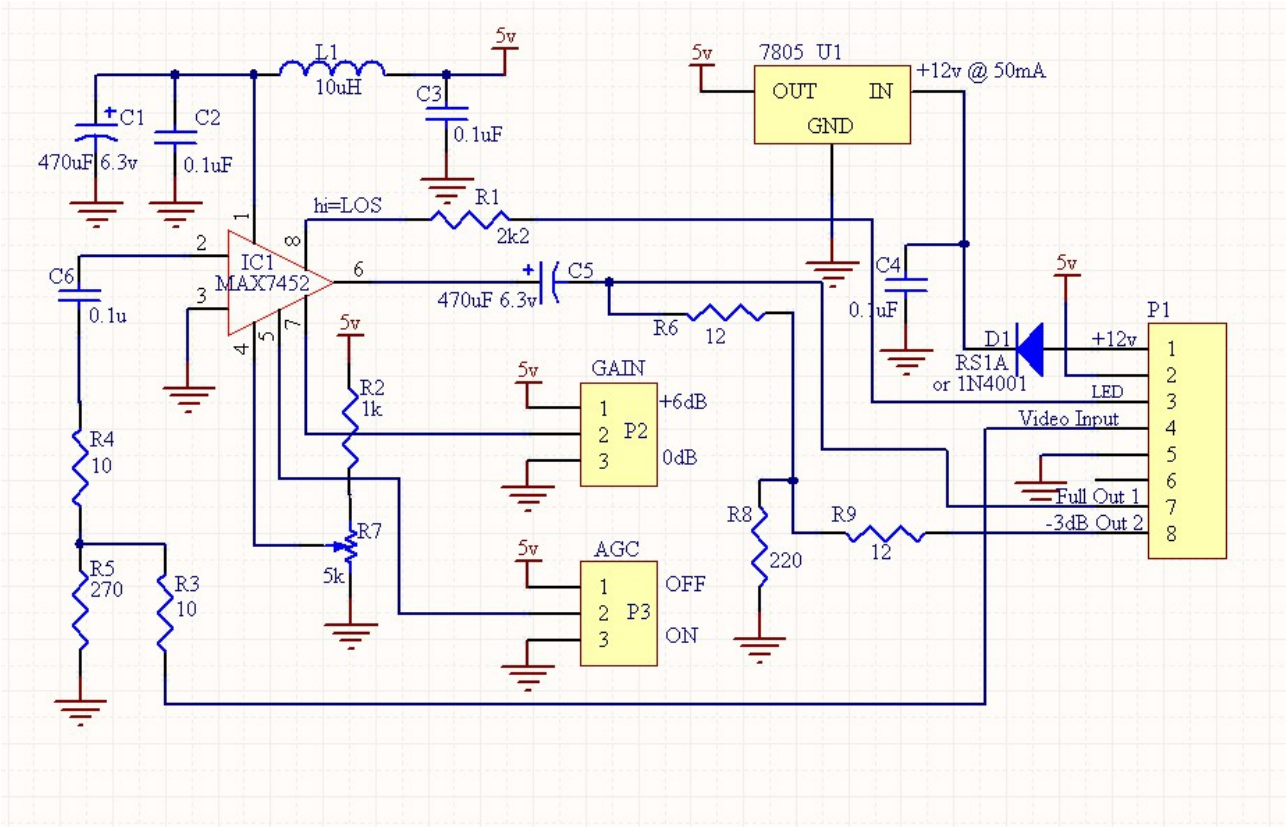

Figure 1. Circuit Diagram

The circuit diagram.
The 5v line at about 30mA – 40mA is supplied via a regulator U1. Input voltage can be from 10 to 14v. If more than 14v is likely to be applied, a heat sink might be advisable on the 7805. D1 is a polarity protection diode and gives a useful voltage drop into the regulator. Any AC ripple present on the DC input is filtered by D1,C4.
Further filtering is provided by components C1,C2,C3 and L1. L1 is not a critical value and can be any value from 5uH to 100uH SMD. It should be kept to a small physical size due to space considerations.

The video input on Pin 4 of P1 is run through R4 and C6 into pin 2 of the IC. R3,R4 and R5 are for an optional 2.5dB 75 ohm attenuator which although not needed for regular 1v pk video waveforms but can be useful when taking video from a high level source(>2v pk). R3,R4 could be links with R2 left as a single 75 ohms for input matching, the design seems quite happy to operate over a wide range of input feeds with various impedances.

R7 is the black level bias point control. Set initially to midway or about 2v. Adjust it using an input video signal to give smooth operation on a range of different video sources.

If you are intending to use the 'No Video' LED option via R1 you will need to decide whether to have a LOS light or a 'valid signal' light. See later OPTIONS section.
This feature could be more useful in a switcher where several different sources are being handled. Each input could have its own video processor board with a light to indicate a valid input.

The output amplifier exits on P1 pin 8 and is dc blocked by C5 for feeding up to two 75 Ω loads, one attenuated to 3dB. The capacitor is a precaution, a 75 ohm resistor could be used in its place if you are sure of the circumstances in which the output will be used and are happy with the standing DC on the output.

P3 and P4 are the preset options connectors. I suggest using a 3 pin open header and using shorting links such as those found on PC motherboards. Alternatively P3 and P4 connections could be run out to front panel SPST switches.
Using links on P3 the output level can either be 0dB, i.e. output equal to the input signal (assuming AGC is settled or disabled) or +6dB (double the input signal).
Here are the various combinations that the links can give.

AGC(P4)	GAIN(P3)	OUTPUT
0	0	$1V_{P-P}$ fixed
0	1	$2V_{P-P}$ fixed
1	0	$V_{OUT} = V_{IN}$
1	1	$V_{OUT} = 2V_{IN}$

TABLE 1 (0=0v 1=+5v)

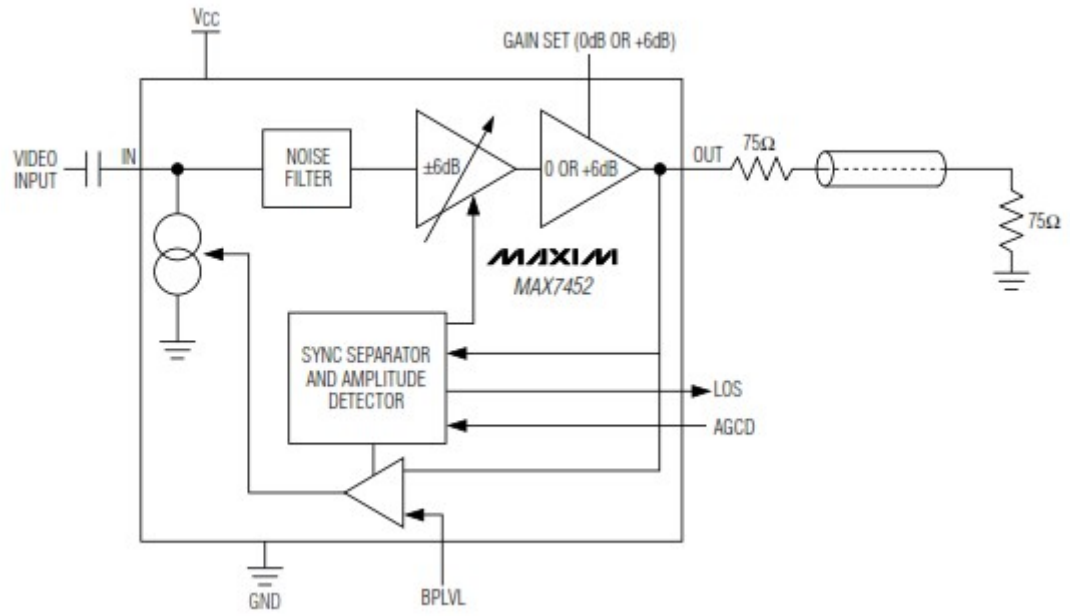

Figure 2 Internal functions

As shown in Figure 2, the device includes a 2nd-order low-pass filter intended to reject out-of-band noise. There is also an automatic video gain control (AGC), which automatically adjusts the gain to ensure the sync amplitude is normalized to a standard video level; an AGC disable function; and an output driver that drives a standard 150Ω video load (75Ω x2) with a full 2V pk.
The clamp and the AGC work concurrently. Interaction between the two different control loops is eliminated by the large difference in time constants. The time constant of the clamp settles within 100 lines, while the AGC loop is digitally stepped so that it settles between 1000–64,000 lines. The AGC control works independently of the gain setting of the output buffer. The overall gain is the multiplication of the AGC gain and the output buffer gain. The maximum overall

gain is +12dB and the minimum gain is -6dB.

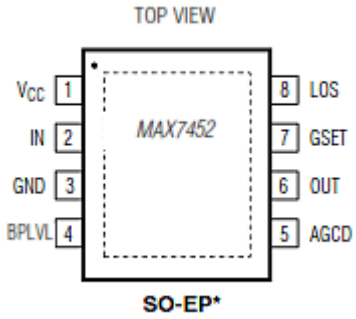

Figure 3 Pinouts

Back-Porch Clamp
The MAX7452 features a back- porch clamp to set the output blanking level. The devices sense the voltage during back porch and feed back into a control system. The control system provides the appropriate DC-level shift to clamp the output to ground to a voltage set by BPLVL (pin 4). This restores the DC level for further video processing such as on-screen display (OSD) insertion and analog-to-digital conversion. The back- porch clamp to ground also eliminates the need for large value output-coupling capacitors that can introduce unwanted line-time distortion (tilt). This can also reduce board space. The feedback network and the on-chip capacitors introduce a finite settling time after power-up or after any dramatic shift in input voltage.

Automatic Gain Control (AGC)
The device has an integrated automatic gain-control circuit to ensure the sync amplitude is normalized to the standard level, thus normalizing the overall amplitude to a standard level. The accuracy of the normalized amplitude assumes the ratio of active video to sync amplitude is correct in the input video signal. The gain is adjusted automatically by detecting and comparing the amplitude of the sync pulse to a fixed internal reference. If the sync amplitude is less than this value, the overall gain is increased until the sync amplitude is equal to this reference. However, if the sync amplitude is high, the overall gain is reduced accordingly. Disable the AGC loop by taking AGCD high. When installing the board into a system, it is important to note that the AGC can mask termination problems. On initial setting up, disable the AGC and verify that the terminations are correct, and then enable the AGC for proper operation.

Output Buffer :
The output buffer of the MAX7452 is designed to drive either standard video loads or high-impedance loads, independent of the buffer gain. Logic levels on GSET (P3) and AGCD (P4) set the gain of the device. Refer to Table 1 for the different gain-settings.

Noise Filter:
The MAX7452 features a simple 2nd- order low pass filter to reject out-of-band noise that may be introduced by long cable connection between the camera/video source and the switching matrix.

LOS Detector :
The LOS detector outputs a logic high when the sync is not present (loss of video signal) for at least 15 horizontal lines on the input. This can be used to indicate a fault condition of the camera or cable. In most uses this LED is superfluous and can be omitted though provision for the resistor (R1) and P1 pin 3 to the diode have been made on the pcb. Normally the LED would be to ground but an alternative arrangement could be to have the LED lit whilst there is a valid signal input and going off when there is a LOS. This change would be simple as in OPTION B in this diagram..

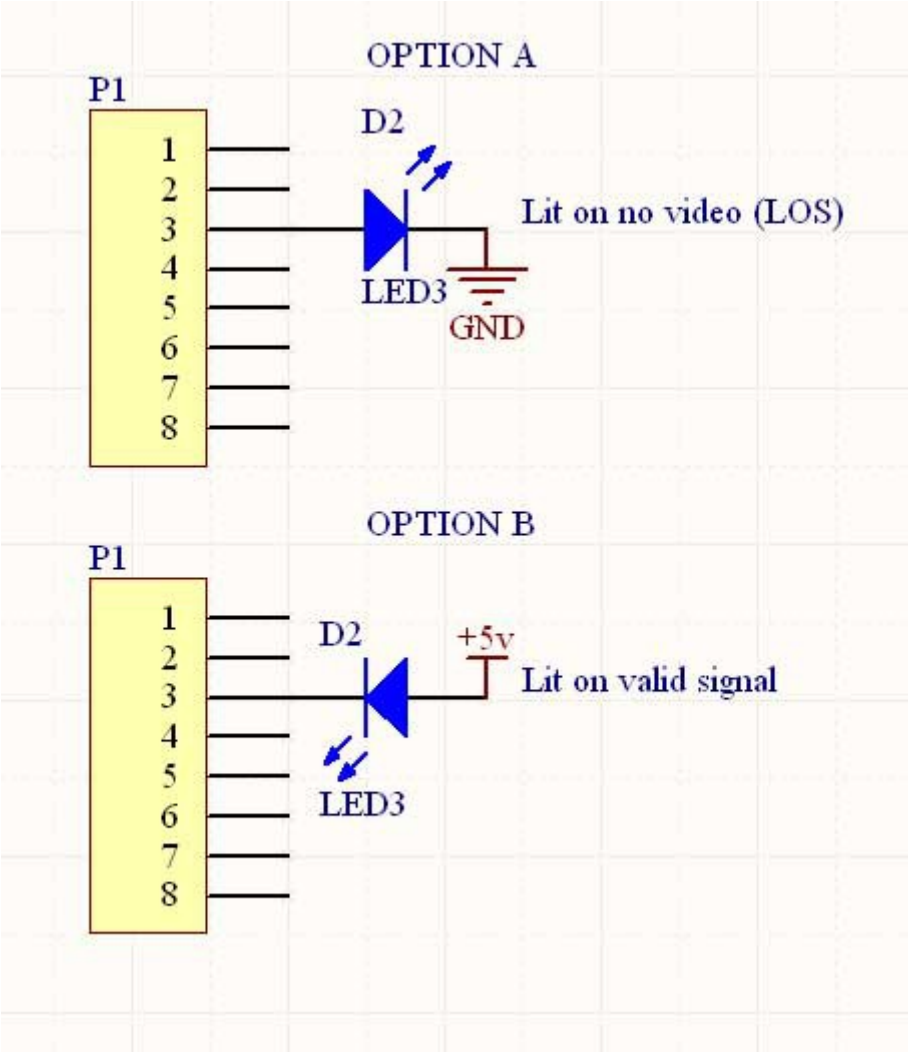

Figure 4 Alternative LED wiring

This diode still comes from Pin3 of P1 but goes to +5v instead of to ground. Please note the diode is reversed polarity.

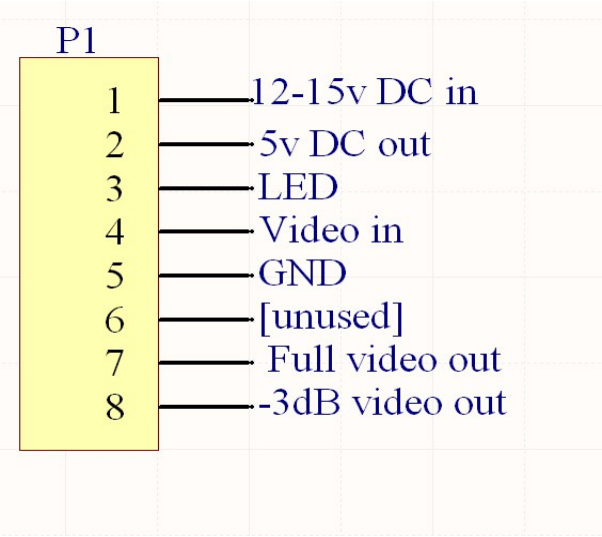

Figure 5 CONNECTIONS

Building the project.

There are no real difficulties , the SMD IC being the part needing most care in soldering, have some solder wick handy to clear any accidental solder bridges. Use a small tipped

soldering iron and thin gauge solder. The metal tab underneath the MAX7452 needs to be grounded but more for heat dissipation than any electrical reason. I suggest just a fine wipe of solder on the tag, not enough to raise its height as this will make it difficult to solder the eight pins, just sufficient to allow a good contact with the ground connection when pressed down.
Start building by fitting the IC using a single end pin, pin1 which is the pin at the side with the bevelled edge and a rather feeble dot. Fit R1 (underside) then electrolytic C5 adjacent to IC. Then add the other components at will.

The IC printing should be upright when pin1 is at the bottom. Pin 1 should adjoin the dot on the overlay. Get the other seven pins aligned before soldering them, then solder a single end pin to hold the device in place opposite the first one and check again that all pins are aligned before soldering them all in. Keep a firm pressure down onto the body of the IC to ensure all pins are flush to the board,this will also ensure a good thermal connection to the printed board. Once all eight pins are soldered, place a soldering iron tip on the exposed copper at the edge of the IC to allow the heat to

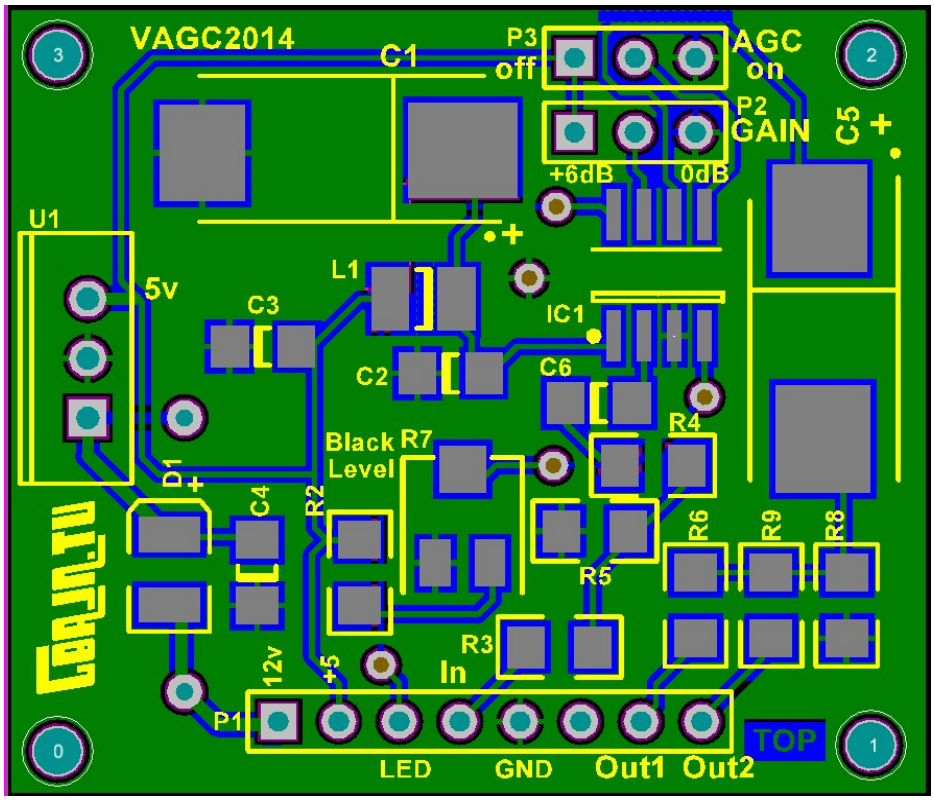

Figure 6 Component overlay Top side.

flow underneath the IC and then apply a little solder. Do the same at the other end of the IC. Electrically it seems happy to run with the pad not connected to ground, so it is mainly for heat dissipation, running at 30mA without an LED the IC runs cool. I believe the tab was incorporated for the dual-supply versions that seem to run quite a lot warmer. I have run the +5 volt version we are using here for many days with a 'valid signal ON' LED with no heat problems despite the ground tab being unsoldered.
Headers are optional, wiring directly into the board is fine but P2 and P3 need to be either wired out to switches or have pins fitted to enable links. An example is shown in the photos herewith.
D1 can be any 1A diode of over 25v rating. Extra holes at each end of D1 have been provided for using wire-ended devices such as the 1N4001 if preferred to the SMD.

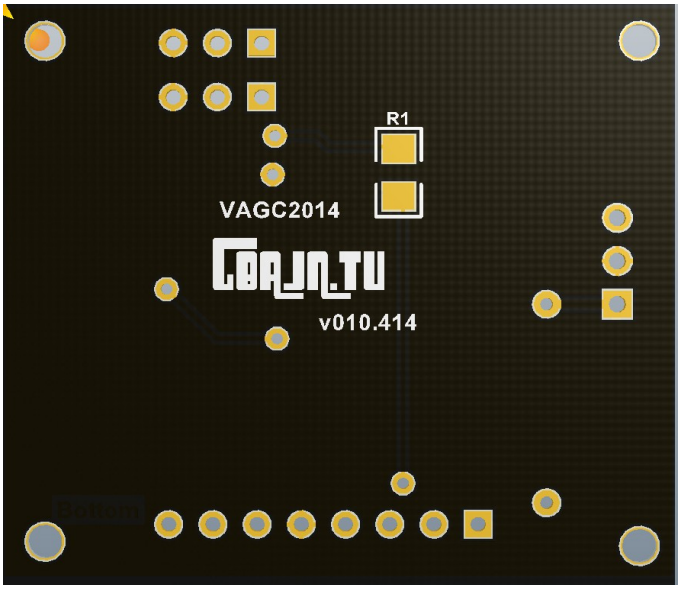

Figure 7 Component overlay Bottom side.

BILL OF MATERIALS:

Description		Quantity	Example Part Numbers	
Regulator 7805		1	U1	RS 516-4799
Cap Alum 470mfd 6.3v	SMD 7mmx6mm	2	C1, C5	RS 7110952
Capacitor 0.1uF	C1206	4	C2, C3, C4, C6	RS 723-6704
Diode RS1A	RS1A	1	D1	RS 710-3096
Header 8 way*	2.5mm	1	P1	
Header 3 way	2.5mm	2	P2,P3	RS 712-1804
Inductor 4uH/100uH	1210	1	L1	RS 725-5042
LED	Any LED	1	D2	
MAX7452(SMD)	SOP8	1	IC1	RS 732-6977
Resistor 2k2	1206	1	R1	
Resistor 270 R	1206	1	R2	
Resistor 75 R	1206	3	R5,R6,R9	
Resistor 10 R	1206	2	R3,R4	
Preset 5k 4mm SMD	4MM	1	R7	RS 691-7492
Resistor 150 R	1206	1	R8	

*Starred items are optional

The correct RS part number for R7 (5k 4mm trimmer pot) is 177-346 or Farnell 152-0632

CONSTRUCTIONAL NOTES:

If you run the IC with either or both links missing there will be no video output. For an initial setting, with 0dB gain and AGC on, adjust R7 Black Level preset for 1.3v on the slider. Make final adjustment to suit a wide range of video sources.

If you wish to use the alternative 4mm preset with protruding legs shown above, it can be adapted

by folding the legs underneath the body before soldering into place. There are also several 3mm SMD versions of the pots, they will also fit onto the solder pads.

Please check at my website www.g8ajn.tv under PROJECTS menu for any updates and for details of purchasing these inexpensive commercially manufactured PCBs.