
A Low Cost Caption Generator

Revised 13th August 2010

Preface

This is a revision of an article first published in CQ – TV in 2004, the Pace satellite receivers referenced are now long obsolete but fortunately the Mitsubishi OSD chip is still available in sufficient quantity for this design to be viable as a kit.

By Steve Drury, G6ALU

Those ATV enthusiasts who like myself don't have a deep pocket might find this title generator of interest. If like me you use the family camcorder, you would have found how unfriendly the built in titling facility is. Another failing is the inability to control the text position, normally displayed across the centre of the viewing area.

I believe I have presented a functional and cost effective solution in this article, instead of using keys to scroll through the available characters I have incorporated a PC (AT type) keyboard interface.

Features

- Superimposed or full screen text
- Coloured background when in full screen mode
- Internal sync when no video input present
- Text entered via directly connected PC type keyboard
- 8 Pages of text stored in eeprom (no backup batteries)
- Push button for changing viewed page when keyboard isn't connected
- Video bypass switch
- 8-15V supply @ 80ma (plus keyboard power)

Readers will previously have seen an article in CQ-TV relating to the OSD chip type STV5730A. This unit doesn't use one! Constructors will need to find

an abandoned Pace satellite receiver, from which the OSD chip type M50555-001SP and 17.734MHz crystal will be required. Hopefully there are a few left that haven't been skipped!

The chip used here, made by Mitsubishi, has a limited but still useful character set. Notable omissions are the question mark (?) and currency signs. There are several exclamation marks available but all have another character following, the one I have chosen to use is an exclamation mark and dot (!.).

A solution using this chip is more complex in comparison to that used by the STV5730A, all the extra components are however inexpensive and probably in the junk box.

Circuit Description

As previously mentioned the main device is the Mitsubishi OSD chip, a 24LC16 eeprom memory device stores the pages of text with a PIC micro taking control of the system.

The M50555 requires a 2V P-P video signal; this is generated from the input signal by Q1 and Q3 in the classic video amp combination, gain being set by R2 and R7. Q2 is a clamp transistor, sync tip clamping is used with a clamp pulse obtained from the sync separator circuit. The output of the OSD chip is presented to emitter follower Q7, this signal doesn't require amplifying as it's already at 2V P-P. L1, C16 and C17 are the timing components for the "dot" oscillator, the values of which can be varied to change the text display width. The "F5" key can remove any horizontal text offset. The chrominance circuit requires an oscillator frequency of 17.734475MHz, this is provided by XTAL1 and its load capacitors C21 and C22. If a no colour symptom is observed then these capacitors may be adjusted in value to trim the chrominance frequency. This wasn't required in the prototypes.

The sync separator is built around Q4 and Q5, this circuit was chosen in place of the normal LM1881 type on cost grounds, although it was met with some

scepticism it has performed very well giving good clean sync with most video sources. Positive going sync derived from Q5 collector is supplied to the clamp circuit and signal detector. Signal present detection is required so the micro knows when to switch to internal sync generation. Positive pulses are detected by D1 with a time constant set by C11, R20 and applied to port Ra0 of the micro.

The micro-controller "talks" to the eeprom via the I2C bus, Scl on port Ra3 and Sda on Ra2. The OSD chip is addressed by a standard 3 wire bus consisting of chip select (active low) Rb3, clock Rb1 and data Rb2. Sw2, the page advance switch is applied to port Rb5 using pull ups internal to the micro. Not implemented on the PCB is a facility to initialise the whole eeprom, this can be accomplished by powering up whilst port Rb6 (pin 12) is grounded with a 100 Ohm resistor. It was thought unnecessary to include this circuitry as pressing the home key whilst in edit mode may initialise each page separately. R16, R17, R24 and R25 are all pull up resistors and not critical in value. R23 and C14 are the oscillator components, the values used set a frequency of about 4MHz. Note that when a PIC16F628A is used these components can be left out as the internal oscillator option is utilised.

A bypass switch is included (Sw1) so video can pass straight through when power is removed or to allow comparisons to be made.

The power supply simply consists of a 5V regulator and decoupling capacitors C3, C7, C9 and C10. A forward biased diode (D2) has been incorporated to prevent any nasty accidents.

Construction

Most components are easily available, the exception being IC4 the OSD chip and its crystal, these can be removed from a now redundant Pace satellite receiver. Models to look out for are the PRD800/900, MSS500/1000 and all the "badged" variants. The clamp transistor Q2 can also be obtained from a PRD800/900 (also available from

Farnell Ltd). If using electrolytic capacitors removed from the same, don't use any from around the power supply area.... they are unlikely to be any good!

The PIC program is available on the CQ-TV web site; suitable versions for PIC16F84 and PIC16F628 devices are ready for download. If the constructor doesn't have programming facilities a ready-programmed device is available from myself.

Many of the components can be substituted for ones of nearby values, avoid making substitutions which will significantly change bias conditions. Note that voltage ratings haven't been given for the capacitors, all except C7 have 5V maximum across them. C7 should be rated appropriately for the supply voltage used (16V rating would be OK).

A double-sided PCB has been used to make a compact unit, all components except the Video and power sockets are directly mounted to this. As the OSD chip doesn't use a 0.1" pin spacing (actually 1.77mm) utilising strip-board won't be easy. The PCB hasn't been designed to fit any specific case but for UK builders Maplin type LF08J is a good choice having ample room for fixing the video and power sockets at the rear. Use the bare PCB to mark the case for drilling; the PCB needs to be positioned with the DIN socket touching the inside of the case. A large clearance hole may be required to allow the keyboard plug to mate correctly with this socket.

A mounting screw should pass through the hole in IC1 tab and into the case, a metal case will aid heat sinking of the regulator. Note that there can be a considerable difference in power consumption between keyboards, 100ma is common for an old keyboard whereas Ima has been measured with one recently purchased.

If making your own PCB, download the CAD files from the CQ-TV web site. These may then be loaded into Easy-PC and printed on a transparency so a PCB can be made using the photo-reproduction technique. A demonstration version of Easy-PC is available from www.numberone.com, this demo version will allow printing and modifying of the board but won't allow changes to be saved.

As many components need ground connections soldering on the topside of the board, fit those with difficult access first. You will notice that completely hidden ground pads - under electrolytics for instance, need not be soldered as they are connected on the

underside. There is one link on the topside that also requires through connections. If there is enough interest I will have made double sided plated through boards, please email me if you have an interest.

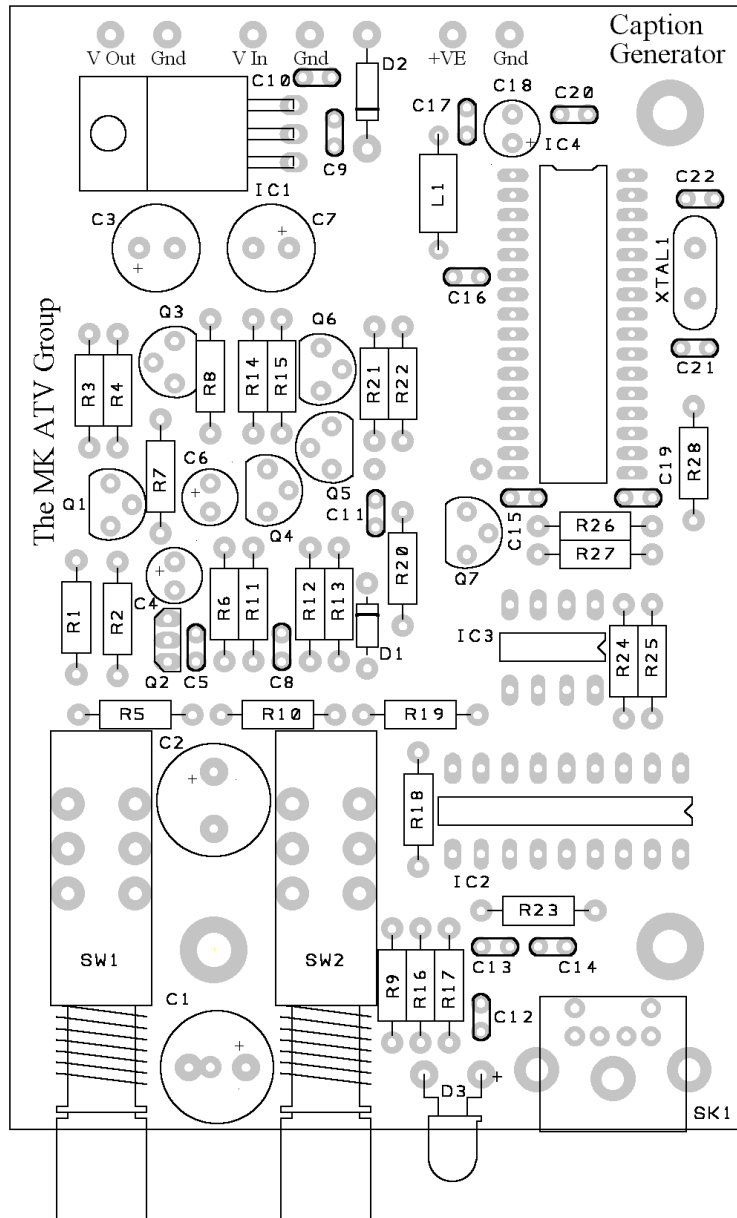
Component Reference	Value	Quantity
C15, C19, C8	1000pF	3
C1	1000uF	1
C10, C12, C13, C20, C9	100nF	5
C11	10nF	1
C18, C6	1uF	2
C4	10uF	1
C2	100uF	1
C3, C7	220uF	2
C14	Not Fitted	0
C16	27pF	1
C17	33pF	1
C21, C22	47pF	2
C5	470pF	1
R6, R10, R14, R16, R17, R21, R22, R24, R25	10K	9
R11	100K	1
R2, R7, R18, R27	100R	4
R4, R13, R15	1K	3
R1	1K2	1
R3	1K8	1
R8	220R	1
R12	2K2	1
R28	2K7	1
R20	390K	1
R26	3K9	1
R9	470R	1
R23	Not Fitted	0
R19	75R	1
R5	82R	1
L1	15uH	1
XTAL1	17.735MHz	1
D1	1N4148	1
D2	1N4001	1
D3	Red LED	1
Q1, Q4	BC548	2
Q3, Q5, Q6, Q7	BC558	4
Q2	ZVN3306	1
IC1	7805	1
IC2	PIC16F628A	1
IC3	24LC16	1
IC4	M50555-001SP	1
SK1	Mini 6 pin DIN	1
SW1, SW2	2 Pole 2 way latching - remove latch from SW2	2
Switch knobs		2
PCB		1

Keyboard functions	
F1	Help screen
F2	Select background colour
F3	Screen mode, full-screen or superimpose
F4	Not used
F5	Text horizontal position
F6	Text vertical position
F7	Text border type
F8	Border mode, allows different borders between lines 1, 2-9 and 10
F9	Horizontal size line 1
F10	Vertical size line 1
F11	Horizontal size lines 2-10
F12	Vertical size lines 2-10
Esc	Toggles between edit and view modes
Home	Clears current screen to defaults
Arrow buttons	Allows navigation around screen
Page Up / Page Down	Increment or decrement viewed page
Shift & space	Writes a special space character, seen as a space on a normal screen but as a black box in some background modes
Alpha-numeric keys	All keys have their normal function but remember the limitations of the character set!

Testing

Once the board is fully constructed connect the output to a monitor and apply power.

After initialising itself the micro checks for valid data in the eeprom, if invalid (previously unused in the character



PCB Overlay

generator) the micro loads in default values. Eeprom initialisation takes between 10 – 20 seconds, during this period the picture is likely to be blank and if connected the keyboard won't function. When initialisation has finished the screen will turn blue, connect a keyboard, an input signal and carry out a functional test. Note that the firmware will “hang” if an eeprom isn't fitted.

In Use

Text can only be changed whilst in the edit mode (entered by pressing Esc), whilst in this mode spaces are indicated by a ° symbol, the character at the current cursor position will flash. Shift space characters appear blank. If

enlarged characters are used ensure that none appear off the screen edge, these may cause sync disturbance.

Conclusion

I hope anybody constructing this unit gets the same satisfaction I have from designing it. Note that for those wishing to program their own PIC micros (types 16C84/F84 and PIC16F628) the source code is on the CQ-TV web site. The data sheet for the OSD chip and any updates can be found on my web site at www.radio-kits.co.uk.

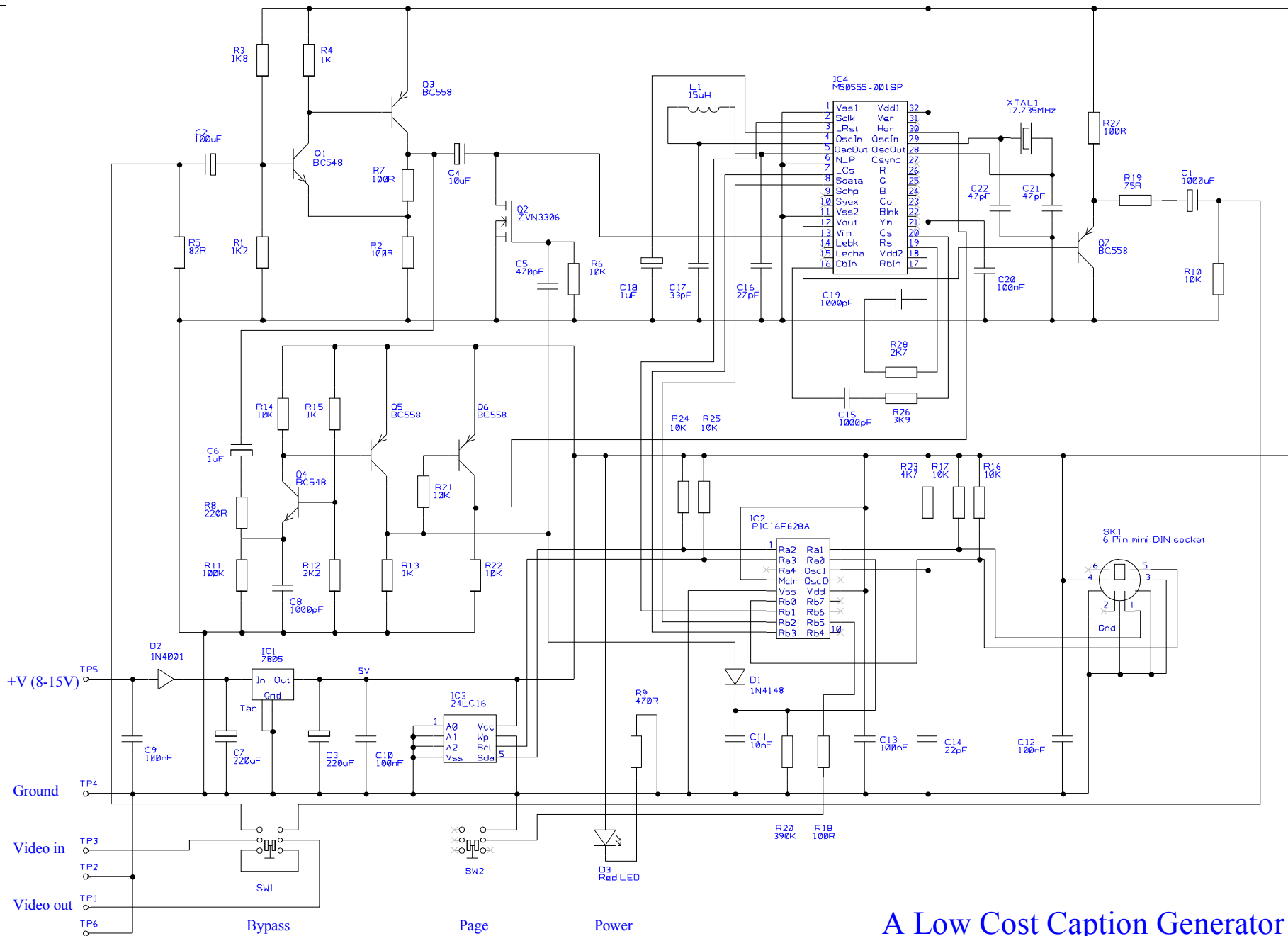
Should there be sufficient interest I will have made professionally produced PCBs with plated through holes, silk

screen etc. Please contact me by email to register your interest. My email address is g6alu@tiscali.co.uk.

Thanks

I must thank Calvin - M1EPM and Carl - M0HJX for their suggestions and input.

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