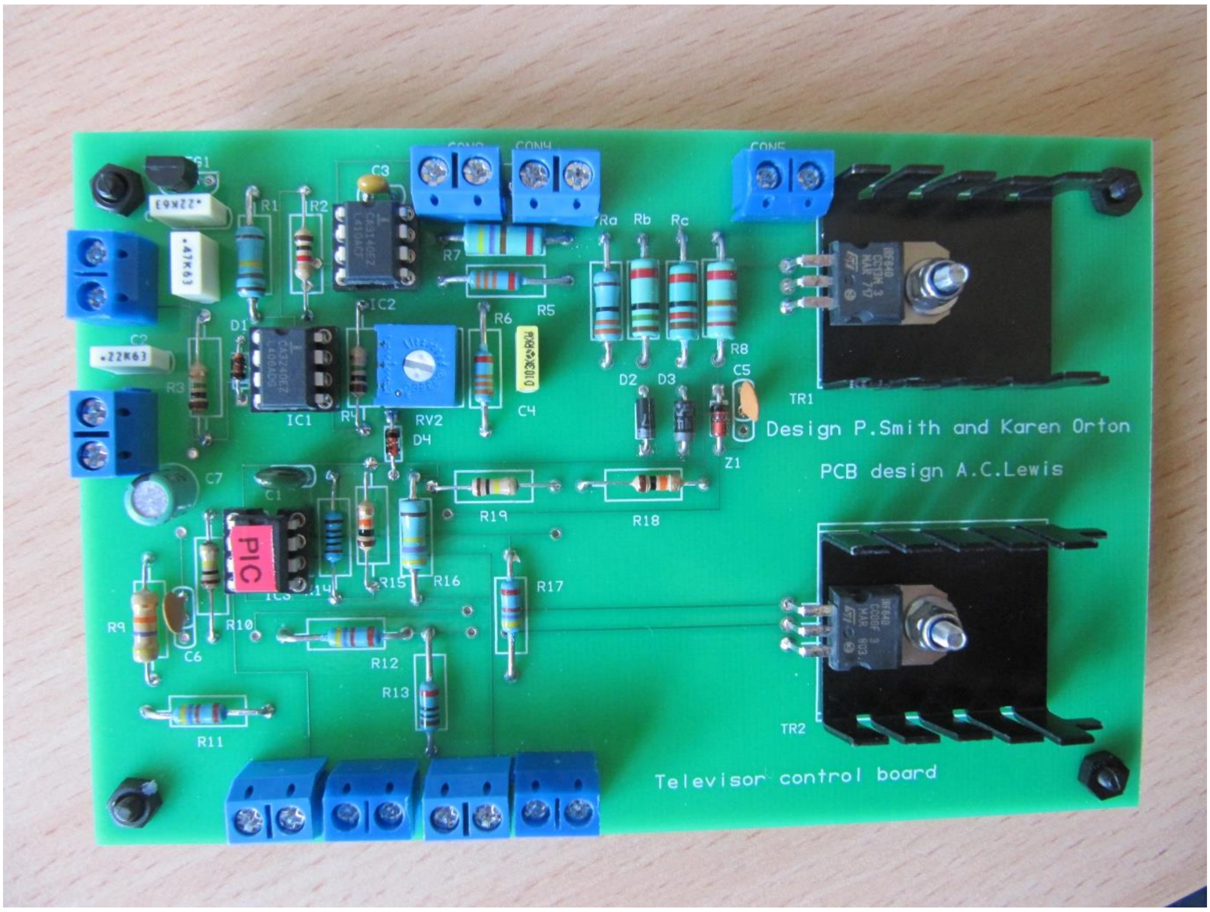
Control Board for Club Televisor project



This board is intended to be used on the new laser-cut televisor designed by James Sheehan. The main objective is to produce a unit with a defined motor available from the club shop or eBay and the standard 12-inch manila disc. The base unit along with motor support assembly, lightbox and viewer box are laser cut and could be produced locally. A standard 50mm magnifying glass is used in the viewer box. An ordinary two-inch loudspeaker and cheap audio amplifier are also required for the NBTV audio channel.

The design of the PCB minimises external wiring by providing point to point connection to peripheral components. The board will accept both .5Watt (Electrosil TR5) and .25Watt (Electrosil TR4) size resistors as well as capacitors with .1 or .2 inch spacing where space allows.

The design is a combination of the efforts of two stalwarts of the NBTV fraternity. Peter Smiths LED driver and synch signal separator board has faithfully been replicated and integrated with Karen Orton's PIC microcontroller motor drive circuitry. This is particularly suited to lightweight disc monitors where algorithms within the PIC software slowly advance or retard individual video frames until correct framing is obtained. Due to the unusual use of the 4046-phase comparator circuitry in the standard design certain manufacturers devices were deemed unsuitable for this application. Suitable tested devices can be purchased from the club shop along with hex code or eight pin programmed PIC for this project.

Most significantly, it uses the same covered synchronisation hole method of frame reference as the existing club arrangement. A theory of operation document has been created for those interested in this new controller's inner workings.

An accurate emulation of the 4046 ensures operation that is almost indistinguishable from the 4046-based one: on switch on the disk twitches (moves so far then defeats itself with the injection of an opto pulse); the disk spins up to speed on arrival of synchronisation pulses; and it makes that same familiar grinding noise as it approaches lock. Finally, you are greeted with rolling images that stop when the correctly framed image moves into view. The controller can roll the images in either direction thus minimising time to frame lock. Mean time to lock is around six seconds while the maximum time to frame lock is a little over twelve seconds. Missing pulse insertion ensures quiet operation.

The controller does have a couple of idiosyncrasies: It is apt to overshoot by one line when rolling the images downward but quickly realises its mistake and rolls the images back up a line. No attempt was made to correct this as it is harmless and quite amusing. Secondly, there is a degree of dithering of the image when perfect lock is achieved.

This latter is quite definitely down to the finite time needed by the PIC to process pulses. When synchronisation pulses and opto fork pulses arrive simultaneously then it is a matter of chance which gets serviced first. This leads to phase jitter which finds its way onto the image. The situation is easily remedied however by adjusting the manual speed potentiometer so that the pulses separate in time, thus ending the contention. It is only necessary to separate the pulses by a few percent of a line in order to obtain a steady lock.

Consequently there is no significant increase in the noise level of the system when using this trick. Note that a similar issue with the 4046 in response to simultaneous pulses is almost certainly due to the 4046's use of asynchronous logic and is therefore unconnected with the effect described here.

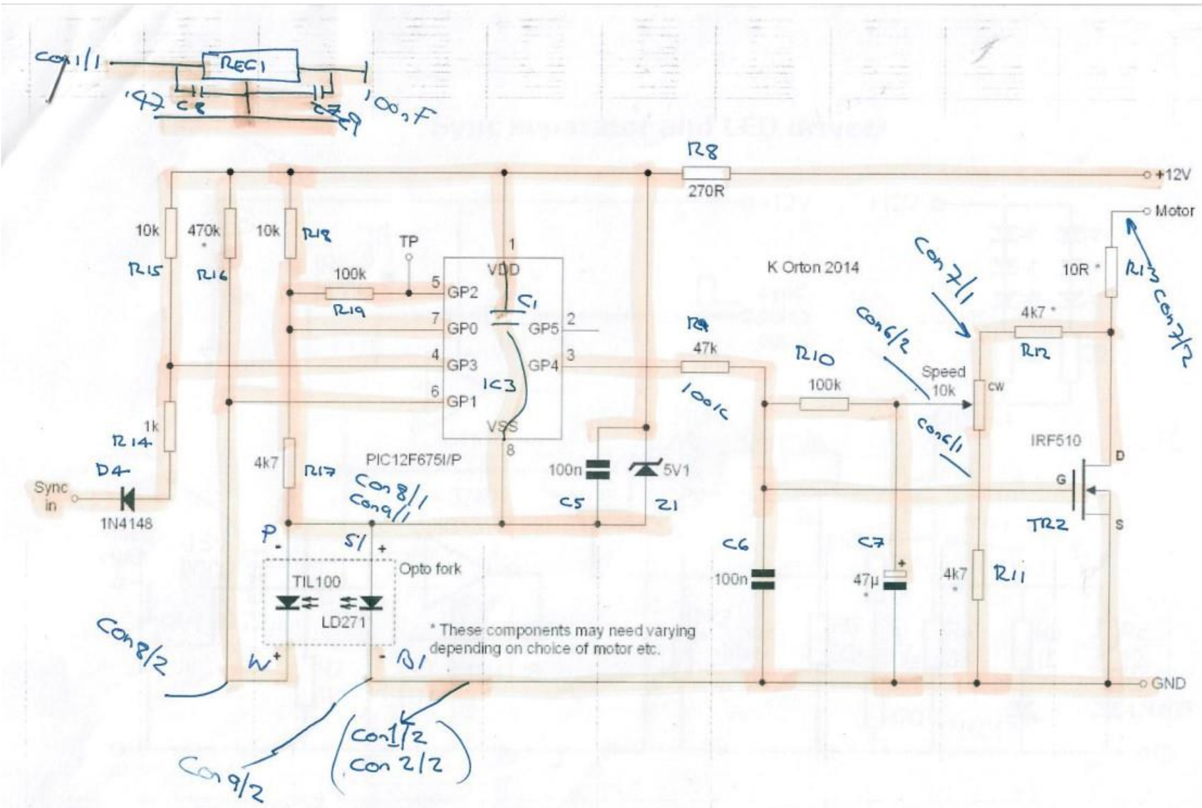
A stress test of the controller confirmed reliable but noisy lock to synchronisation pulse streams that were as much as twenty percent too fast or too slow. A much quieter lock was achieved with pulse streams that were within ten percent of NBTVA standard rate. The noise associated with wildly out-of-spec frame rates is the result of the fixed time periods used in the PIC4046's algorithm, the main consequence being inserted missing pulses that are either way too early or way too late. Such mis-timed pulses cause periodic spikes on the motor current however, they do not cause the controller to lose lock.

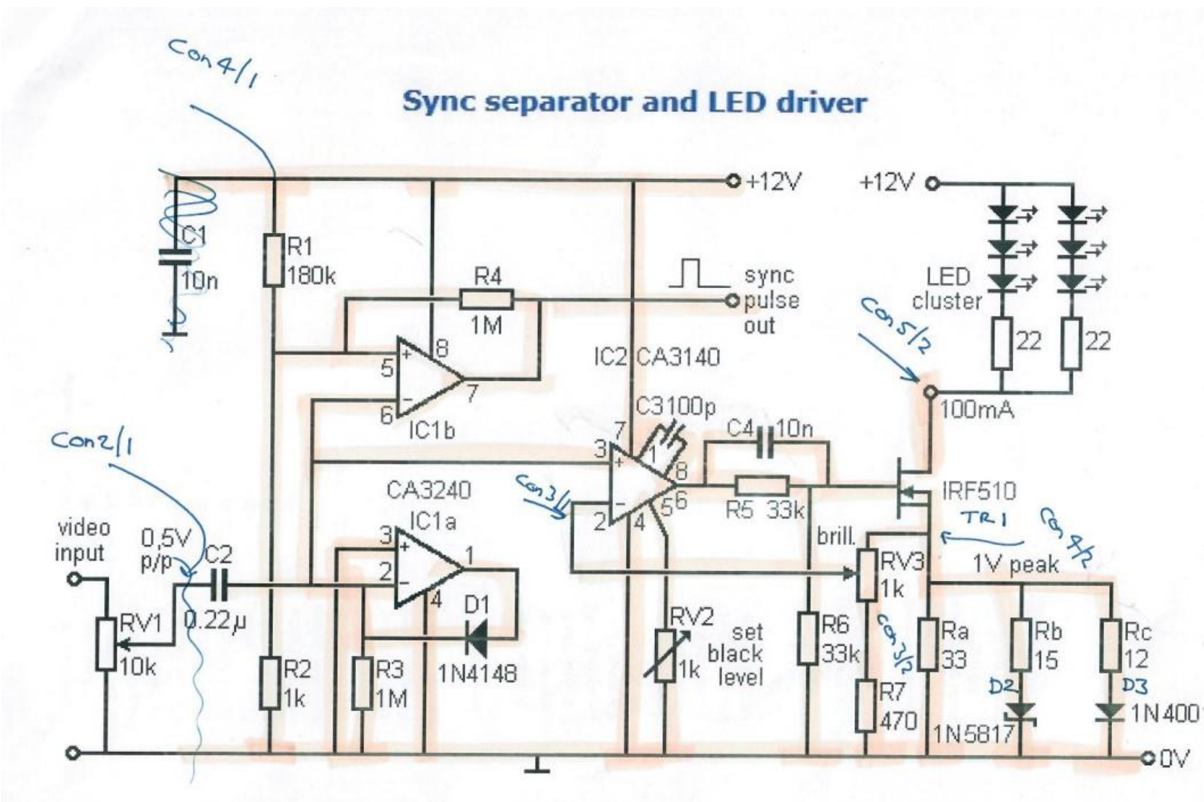
The circuit is unremarkable, save for the use of the infra-red LED to 'jack up' the PIC's power rails. This ensures that the PIC power rails are more symmetrically disposed around the FET's gate voltage. The output from the PIC is, like the 4046, a three-state output which can drive high, drive low, or go passive (high impedance). The PIC has a reduced output swing as compared to the 4046 (5V as opposed to 12V) - hence the reduction in value of the resistor feeding the gate of the FET (47k as opposed 100k). An on-chip comparator is brought out to some PIC pins and used with positive feedback to clean up the opto fork signal. The cleaned-up signal is available for probing on the test point post (TP). Peter Smith's FET driver stage, including damping and manual speed control, is used unaltered in Karen's controller as it cannot be improved upon.

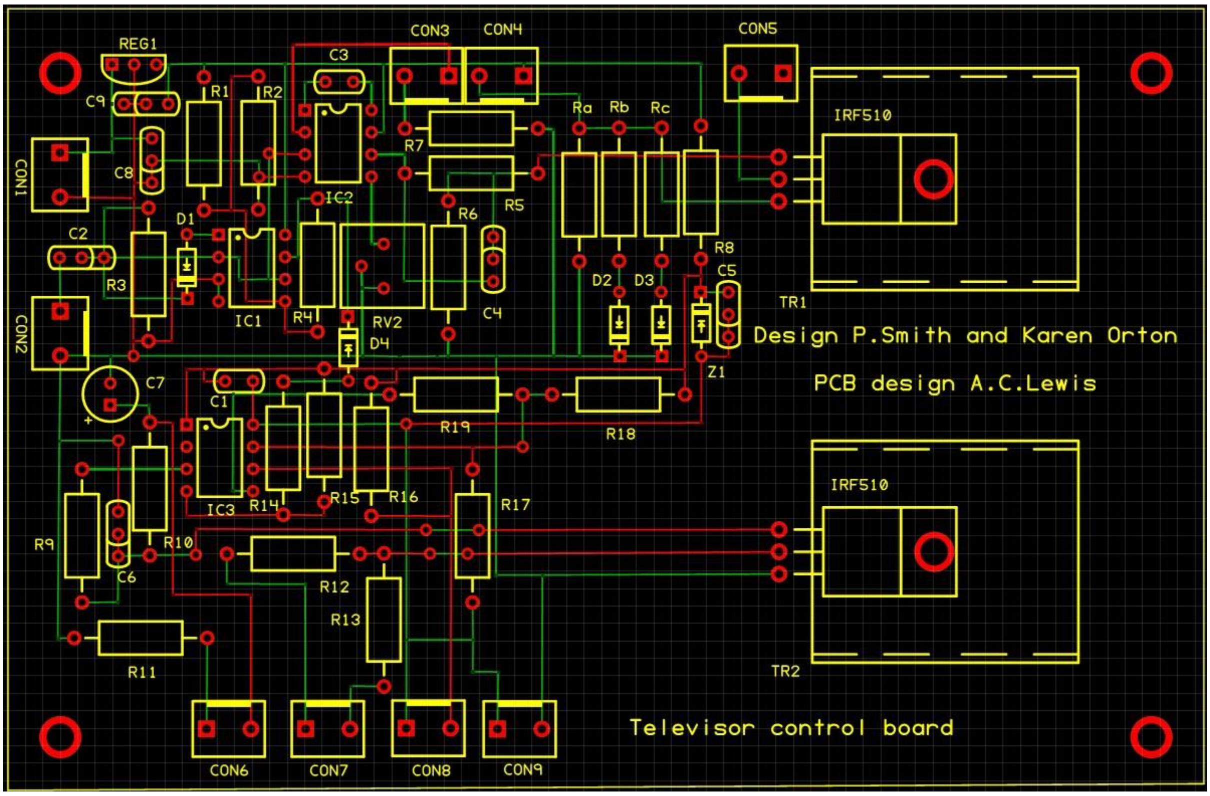
Testing is fairly simple. With the unit connected to all peripheral circuitry apply the nominal 12-volt dc supply to the board with all ICs removed. Verify the supply rails are correct on all devices including the 5 Volts on PIC (IC3). Power down and replace devices and apply power again. With a suitable NBTV signal connected verify the disk spins-up and, with the motor speed pot adjustment confirm the picture remains stable. Should the picture frame not be able to be centred vertically reduce the value of either R11 or R12 to allow equidistance control of the picture frame. If the picture does not sit horizontally in the viewing window, then the position of blanked hole on the discs synchronising holes requires repositioning. With adjustment of external potentiometers RV1 (Input level), RV3 (brilliance) and on board RV2 (set black level) optimise picture settings.

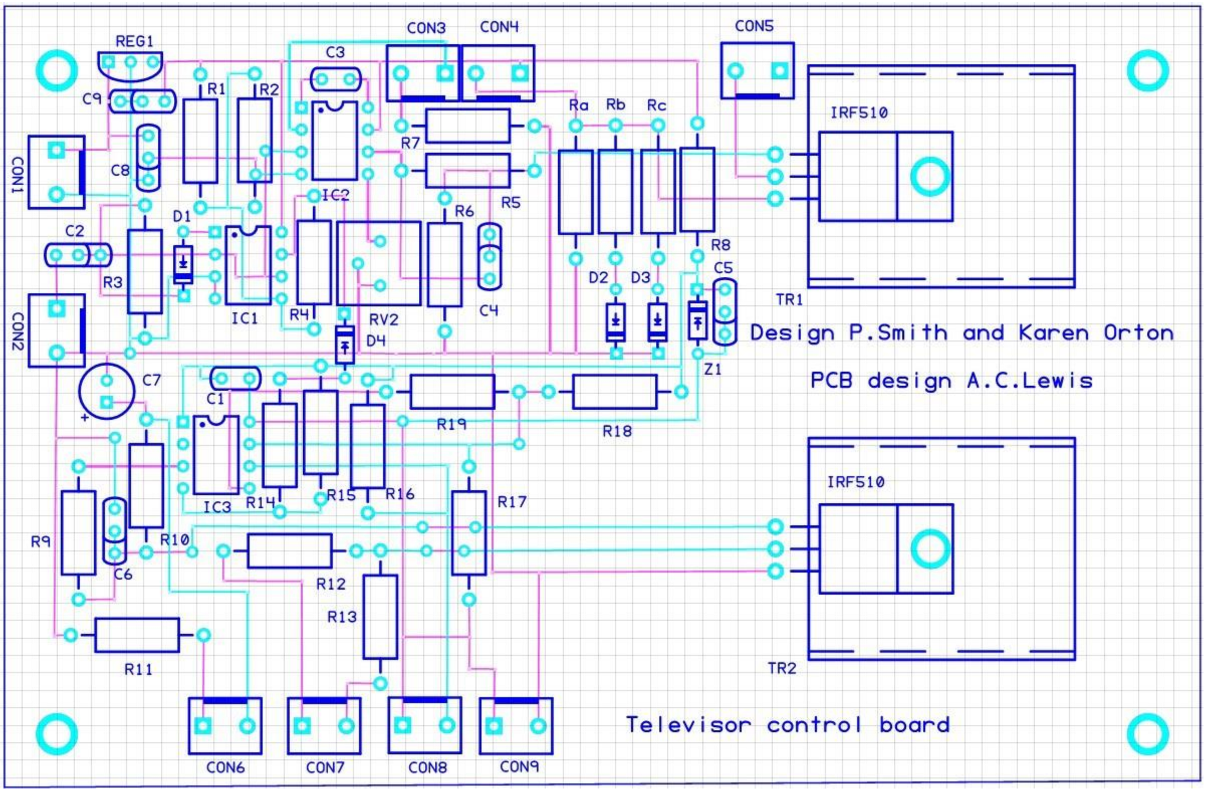
Component	Circuit reference	Quantity
180K resistor	R1	1
1K resistor	R2, R14	2
1Meg Ohm resistor	R3, R4	2
33K Ohm resistor	R5, R6	2
470 Ohm Resistor	R7	1
33 Ohm Resistor	Ra	1
15 Ohm Resistor	Rb	1
12 Ohm Resistor	Rc	1
270 Ohm resistor	R8	1
47K Ohm resistor	R9	1
100K Ohm resistor	R10 R19	2
4K7 Ohm resistor	R11, R12, R17	3
10 Ohm resistor	R13	1
10K Ohm resistor	R15,18	2
470K Ohm resistor	R16	1
Preset Pot 1K	RV2	1
Capacitor 10nF	C1, C4	2
Capacitor .22uF	C2	1
Capacitor 100pF	C3	1
Capacitor 100nF	C5, C6, C9	3
Capacitor 47uF	C7	1
Capacitor 470nF	C8	1
Diode 1N4148	D1, D4	2
Diode 1N5417	D2	1
Diode 1N4001	D3	1
Zener diode 5V1	Z1	1
MOSFET IRF510	TR1,2	2
12 Volt regulator	REG1	1
CA3240	IC1	1
CA3140	IC2	1
Pre-programmed PIC12F675I/P	IC3	1
Printed circuit board		1
M3 10mm long screw		2
M3 standoff insulator		4
M3 nuts	TR1,2 spacers	6
8 pin turned pin IC socket	IC1 to 3	3
2-way PCB connector	Con 1 to 9	9
M3 plane washers	TR1,2 spacers	6
M3 crinkle washers	TR1,2 spacers	6
Heatsinks	TR1,2	2

Connector	Function
Con 1/1	Nominal positive 12 to 30 Volt dc supply
Con 1/2	Ground
Con 2/1	NBTV input signal
Con 2/2	Ground
Con 3/1	External brilliance pot RV3 wiper
Con 3/2	External brilliance pot RV3 ACW
Con 4/1	Regulated 12 Volt output
Con 4/2	External brilliance pot CW
Con 5/1	No connection
Con 5/2	To LED cluster
Con 6/1	Speed setting pot ACW
Con 6/2	Speed setting pot wiper
Con 7/1	Speed setting pot CW
Con 7/2	To motor
Con 8/1	TIL100 anode
Con 8/2	TIL100 cathode
Con 9/1	LD271 anode
Con 9/2	LD271 cathode
	Please note square PCB land
	denotes connection one




Sync separator and LED driver
Con 4/1
+12V
+12V
C1
10n
R1
180k
R4
1M
sync
pulse
out
LED
cluster
Con 5/2
22
22
IC2 CA3140
100mA
IC1b
C3100p
C4 10n
Con 2/1
CA3240
IC1a
Con 3/1
R5 33k
IRF510
TR1
Con 9/2
brill.
RV3
1k
1V peak
video
input
0.5V
p/p
C2
0.22µ
RV1
10k
D1
1N4148
RV2
1k
set
black
level
R6
33k
Con 7/2
Ra
33
Rb
15
Rc
12
R2
1k
R3
1M
R7
470
D2
1N5817
D3
1N400
0V


REG1
C3
CON3
CON4
CON5
C9
R1
R2
IRF510
CON1
C8
R7
Ra
Rb
Rc
IC2
R5
R6
D1
C2
R3
R8
C5
D2
D3
CON2
IC1
R4
RV2
C4
TR1
D4
Design P.Smith and Karen Orton
Z1
C7
C1
PCB design A.C.Lewis
R19
R18
IC3
R14
R15
R16
R17
IRF510
R9
R10
C6
R12
R13
R11
TR2
Televisor control board
CON6
CON7
CON8
CON9


REG1
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C3
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CON3
CON4
CON5
R7
R5
R6
Ra
Rb
Rc
R8
IRF510
TR1
D1
C2
R3
IC1
R4
RV2
D4
C4
D2
D3
C5
Z1
CON2
Design P.Smith and Karen Orton
PCB design A.C.Lewis
C7
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IC3
R14
R15
R16
R19
R18
R17
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R10
C6
R12
R13
R11
TR2
CON6
CON7
CON8
CON9
Televisor control board