

DL381S

service manual

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Chapter One About Maintenance

1.1 Safety precautions

1.1.1 Power supply

When maintenance personnel are repairing DVD players, he should pay special attention to the power board with 220V AC and 330V DC which will cause hurt and damage to persons!

1.1.2 Precautions for antistatic

Movement and friction will both bring static electricity which causes serious damages to integrated IC. Though static charge is little, when a limited quantity of electric charge is added to large-scale integrated IC, as the capacitance is very small in the meantime, now the integrated IC is very much easy to be struck through by static electricity or the performance will decrease. Thus static electricity prevention is of extraordinary importance. The following are several measures to prevent static electricity:

1. Use a piece of electric conduction metal with the length of about 2 metres to insert into the earth, and Fetch the lead wire from the top of the surplus metal and connect to the required static electricity device. The length and depth of the metal embedded under the earth should be determined according to the wettability of the local soil. For humid places, it may be shorter, and longer and deeper for dry places. If possible, it can be distributed and layed in terms of “#” shape.
2. On operating table-board, the antistatic table cushion should be covered and grounded.
3. All devices and equipments should be placed on the antistatic table cushion and grounded.
4. Maintenance personnel should wear antistatic wrist ring which should be grounded.
5. Places around the operating position should also be covered with electric conduction cushion or Painted with antistatic paint.

1.1.3 Precautions for laser head

1. Do not stare at laser head directly, for laser emission will occur when laser head is working, which will Hurt your eyes!
2. Do not use wiping water or alcohol to clean laser head, and you may use cotton swab.

1.1.4 About placement position

1. Never place DVD player in positions with high temperature and humidity.
2. Avoid placing near high magnetic fields, such as loudspeaker or magnet.
3. Positions for placement should be stable and secure.

1.2 Maintenance method

1.2.1 Visualized method

Directly view whether abnormalities of collision, lack of element, joint welding, shedding welding, rosin joint, copper foil turning up, lead wire disconnection and elements burning up among pins of elements appear. Check power supply of the machine and then use hands to touch the casing of part of elements and check whether they are hot to judge the trouble spot. You should pay more attention when using this method to check in high voltage parts.

1.2.2 Electric resistance method

Set the multimeter in resistance position and test whether the numerical value of resistance of each point in the circuit has difference from the normal value to judge the trouble spot. But in the circuit the tested numerical value of resistance is not accurate, and the tested numerical value of integrated IC's pins can only be used for reference, so the elements should be broken down for test.

1.2.3 Voltage method

Voltage method is relatively convenient, quick and accurate. Set the multimeter in voltage position and test power supply voltage of the player and voltage of a certain point to judge the trouble spot according to the tested voltage variation.

1.2.4 Current method

Set the multimeter in current position and test current of the player of a certain point to judge the trouble spot. But when testing in current method, the multimeter should be series connected in the circuit, which makes this method too trivial and troublesome, so it is less frequently used in reality.

1.2.5 Cutting method

Cutting method should be combined with electric resistance method and voltage method to use. This method is mainly used in phenomena of short circuit and current leakage of the circuit. When cutting the input terminal voltage of a certain level, if voltage of the player rises again, it means that the trouble lies in this level.

1.2.6 Element substitution method

When some elements cannot be judged good or bad, substitution method may be adopted directly.

1.2.7 Comparison method

A same good PC board is usually used to test the correct voltage and waveform. Compared these data with those tested through fault PC board, the cause of troubles may be found.

Through the above maintenance method, theoretical knowledge and maintenance experience, all difficulties and troubles will be readily solved.

1.3 Required device for maintenance

- ◆ Digital oscillograph ($\geq 100\text{MHz}$)
- ◆ TV set
- ◆ SMD rework station
- ◆ Multimeter
- ◆ Soldering iron
- ◆ Pointed-nose pincers
- ◆ Cutting nippers
- ◆ Forceps
- ◆ Electric screw driver
- ◆ Terminal connecting cord
- ◆ Headphone
- ◆ Microphone

Chapter Three Principle or Servicing

Section One Principle of the Player

3.1.1 Block diagram of the player

DL381S is composed of decode circuit, servo circuit, audio circuit, video circuit and power circuit.

The block diagram of the player is shown as in the following figure 3.1.1.1:

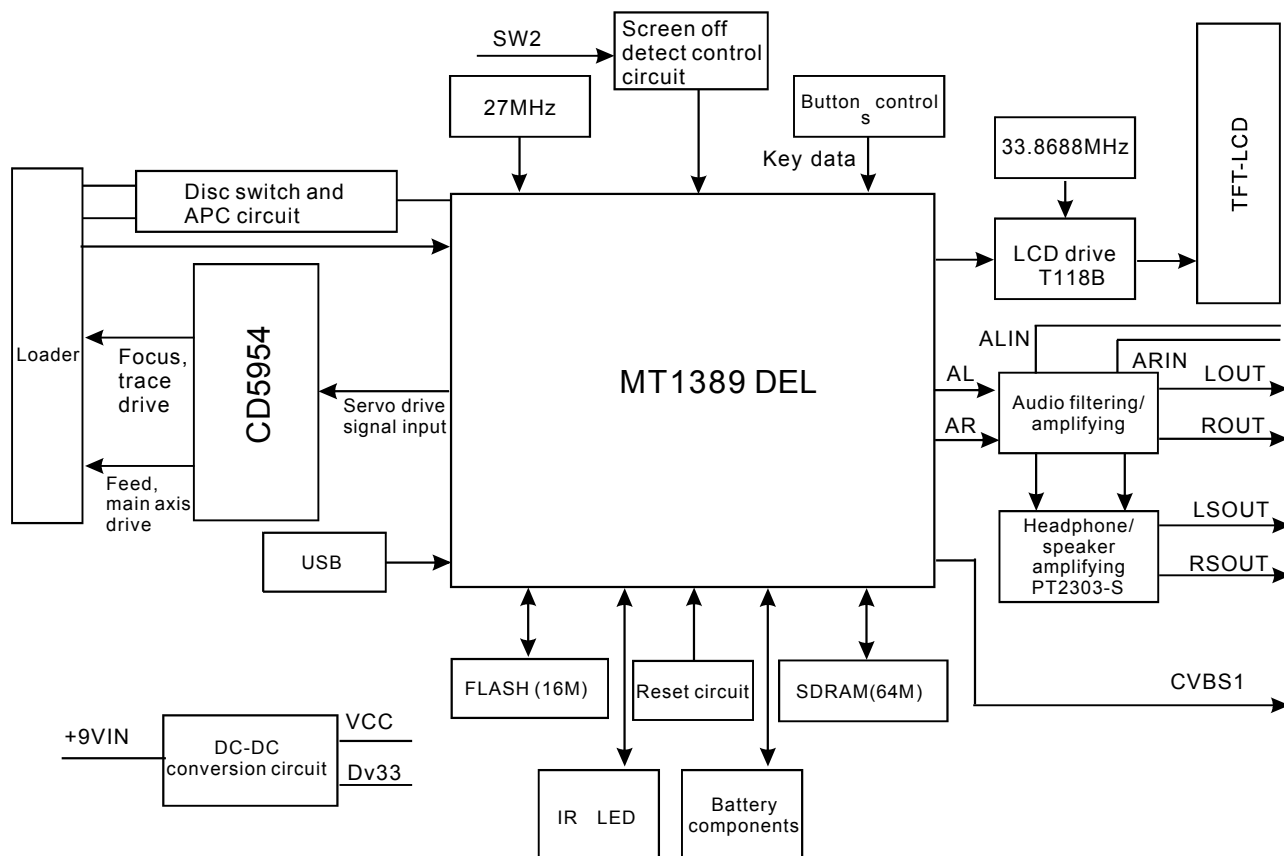


Figure 3.1.1.1 Block diagram of the player

3.1.2 PCB composition block diagram of the player

PCB composition diagram of the player is shown as in the following figure 3.1.2.1:

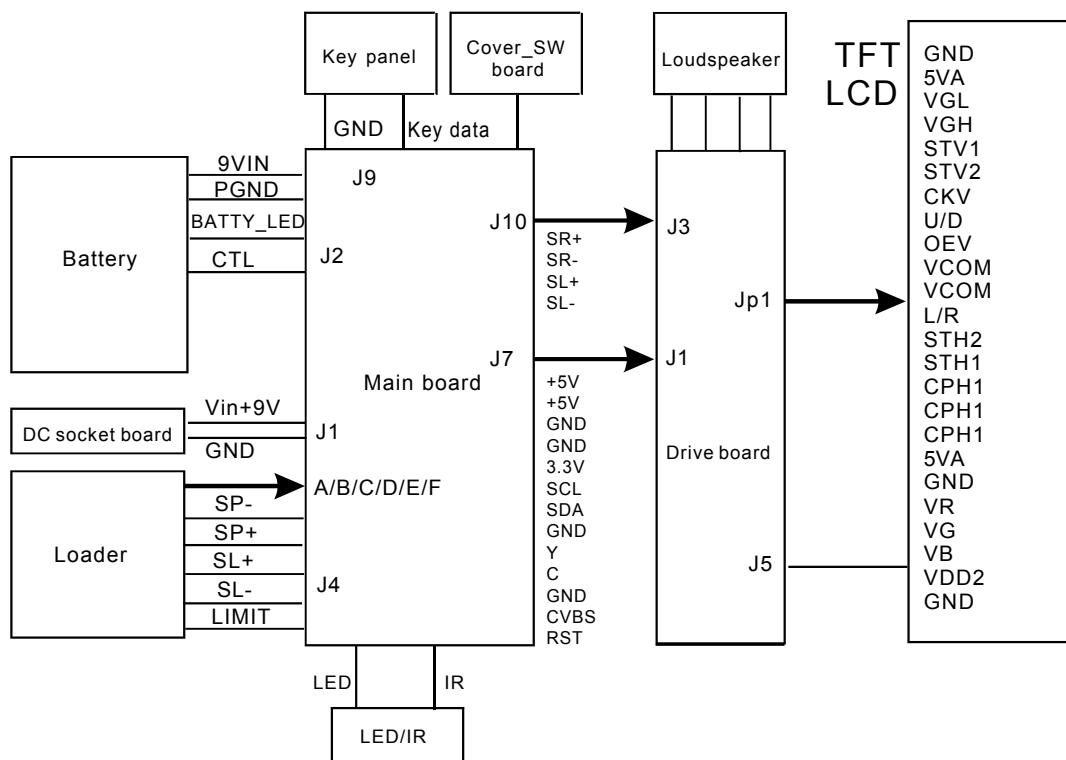


Figure 3.1.2.1 PCB composition figure of the player

3.1.3 Function introduction to IC of the player

Function introduction to IC of the player is shown as in the following figure:

PCB board	Location	IC model	Function
Drive board	U3	UTC3414	VCOM signal amplifying
	U1	T118B	Video coding LCD drive
Decode board	U8	JRC4558	Audio amplifying (operational amplifier)
	U3	LD 1117-1.8	Voltage regulating IC
	U6	HY57V641620ET	64M SDRAM
	U5	MT1389DE-L	Decode chip
	U4	CD5954	Servo drive
	U10	PT2303-S	Headphone amplifying
	U7	29LV160BE	16M FLASH
	U1 U2	TD1410	DC-DC conversion
	U11	SPM9435	Power control

Section Two Unit Circuit Principle

3.2.1 Servo processing circuit

1. DL381S adopts SANYO 850 loader and MTK decode solution (MT1389DEL+FLASH (16M)+SDRAM (64M)). The servo circuit is composed of front end signal processing, digital signal processing IC MT1389DEL and drive circuit CD5954, in which MT1389DE is also the main composition of decode circuit.

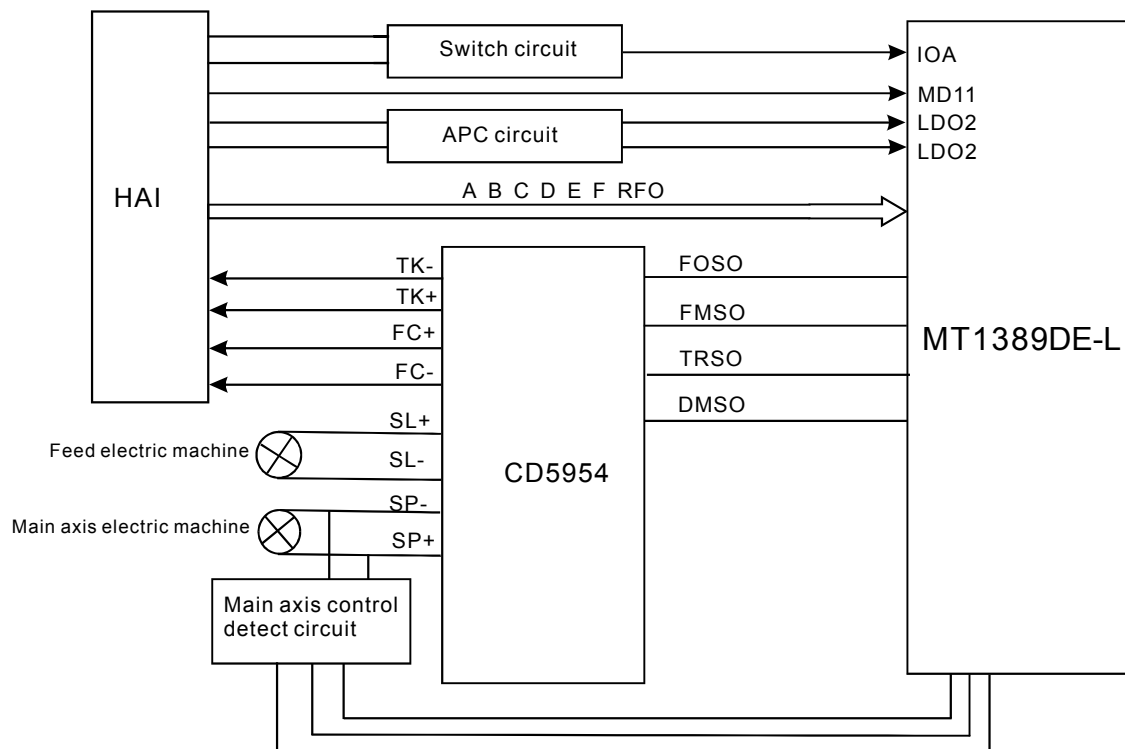


Figure 3.2.2.1 Servo processing circuit block diagram

2. Working principle: after power on or turning off door (door detect switch SW4), loader laser head begins to reset, focus and main axis begin to rotate, laser head begins to identify disc information to judge the disc is CD or DVD to facilitate to make the corresponding acts. At the same time, Mt1389 also adjusts laser output power through laser power control circuit. When loader reads disc information, after photoelectric conversion, A, B, C, D, E, F signals are formed to give to Mt1389 (DVD has A, B, C, D signals only) and Therefore signal and the input from pin 1~6 of MT1389. After MT1389 internal pre-amplifying processing, now signal are divided into two parts inside MT1389:

After being processed by digital servo signal circuit inside MT1389, one part of signal form corresponding servo control signals and output FOO, TRO, DMO, FMO digital servo control signals from pin 25, pin 24, pin 20, pin 21 of Mt1389 respectively, then change into analog servo control signal FOSO, TRSO, DMSO, FMSO through integration circuit composed by resistor capacitor, and send to driver circuit BA5954 for amplification to bring along focus coil, trace coil, main axis electric machine and feed electric machine after drive amplification. Among these, focus and trace servo are used to correct objective position accurately; feed servo is used to bring along laser head to make radial large-scale move which belongs to the preliminary adjustment to pick-up position; and main axis servo is used to control main axis electric machine to make it read signals in means of constant linear velocity and bring along disc to rotate. After processing of amplification by VGA voltage control amplifier and equalization frequency compensation inside MT1389, another part of signals are changed into digital signals through internal A/D converter. When loader is reading CD/VCD signals, these signals are conducted EFM demodulation inside MT1389, after CIRC (Cross-Interleaved Reed-Solomon Code) error correction is finished inside, it outputs to rear state for audio/video decoding; when loader is reading DVD signals, these signals are conducted ESM demodulation inside MT1389, and then sent to latter stage for decoding after finishing RSPC error correction inside. Compared with general DVD players, this machine has no disc in/out circuit and manual opening method is adopted. When pin 26 of MT1389E is high level, system recognises that the door has been opened, when it is low level, the machine recognizes that the door has been closed.

3. Loader signals introduction is shown as follows:

Pin	Name	Signal flow direction	DVD disc	CD disc	No disc	Function description
1	F-	Input loader	2.52	2.34	0.46	Focus error signal is added to two sides of pick-up focus coil
2	F+	Input loader	2.49	2.49	0.93	
3	T+	Input loader	2.53	2.51	0.94	Trace error signal is added to two sides of pick-up trace coil
4	T-	Input loader	2.58	2.51	0.93	
5	C	Input MT1389	2.2	2.25	2.04	Disc data signal
6	D	Input MT1389	2.2	3.2	2.04	Disc data signal
7	IOA	Input MT1389	0.01	3.2	3.21	Disc identification signal, CD is 3.3V, DVD is 0V
8	RF	Input MT1389	2.21	2.53	1.28	The sum of disc data signal
9	A	Input MT1389	2.17	2.22	2.04	Disc data signal
10	B	Input MT1389	2.19	2.27	2.04	Disc data signal
11	F	Input MT1389	2.07	2.44	2.03	Supplementary signal used in trace
12	GND	Ground	0.01	0.01	0	Grounding
13	V20	Input loader	2.04	2.06	2.03	Reference voltage

14	Vcc	Input loader	5.04	5.04	5.02	Supply voltage for loader
15	E	Input MT1389	2.06	2.45	2.03	Disc data signal
16	Blanking	hanging in air	0.01	0	0	unused
17	VR-CD	Input loader	0.21	0.01	0	Through the handling inside loader, make sure MD11 is 180mV when reading CD
18	VR-DVD	Input loader	0.01	0.2	0	Through the handling inside loader, make sure MD11 is 180mV when reading DVD
19	LD-CD	Input loader	0.09	2.1	0	CD laser power control signal
20	MDII	Input MT1389	0.21	0.2	0	CD and DVD laser power monitoring signal
21	AVCC	Input loader	5.04	5.04	5.02	High frequency overlapping signal produces laser with different wave length inside loader
22	Blanking	unused	0.01	0.1	0	
23	LD-DVD	Input loader	2.21	0.1	0	DVD laser power control signal
24	GND	unused	0.01	0.01	0	Grounding

Note: 1. When reading DVD, there are only A, B, C, D signals.

2. When reading CD, there are A, B, C, D, E, F signals.

3. $RFO=A+B+C+D$.

4. Focus error signal= $(A+C)-(B+D)$ Trace error signal= $E-F$.

3.2.2 CD/DVD switch circuit

1. CD/DVD switch circuit is shown as in the following figure 3.2.2.1:

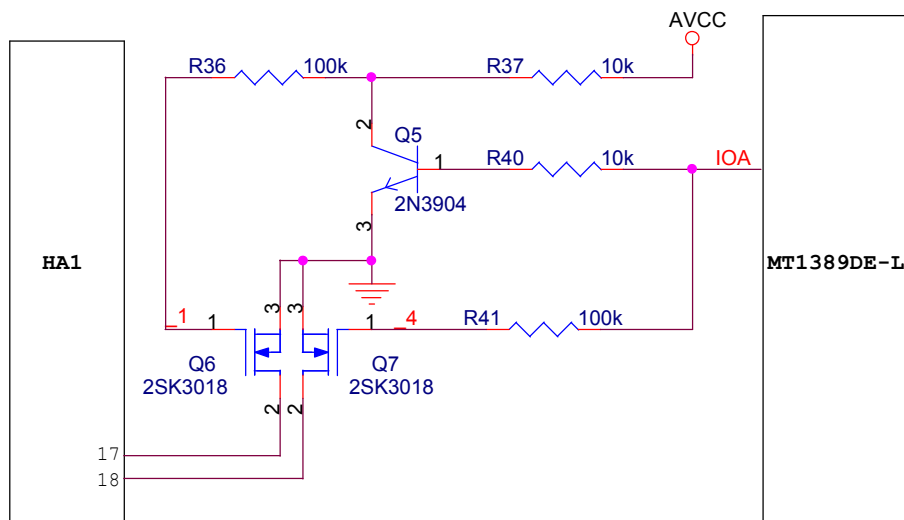


Figure 3.2.2.1 CD/DVD switch circuit

3.2.3 Laser power control circuit

When reading VCD disc, laser power becomes weak, voltage of MDII pin decreases; when voltage of MT1389 decreases, voltage of pin 19 of HA1 increases to reach the function of boost laser power; when laser power is too strong, voltage of MDII pin increases to make voltage of MT1389 increase and voltage of pin 19 of HA1 decrease to reach the purpose of lowering laser power to form an automatic power control circuit. When reading DVD disc, pin 16 is detect signal input pin, pin 17 is drive control output pin and the working principle is the same with that when playing VCD disc.

3.2.4 Main axis control circuit

1. Main axis control circuit is shown as in the following figure 3.2.4.1:

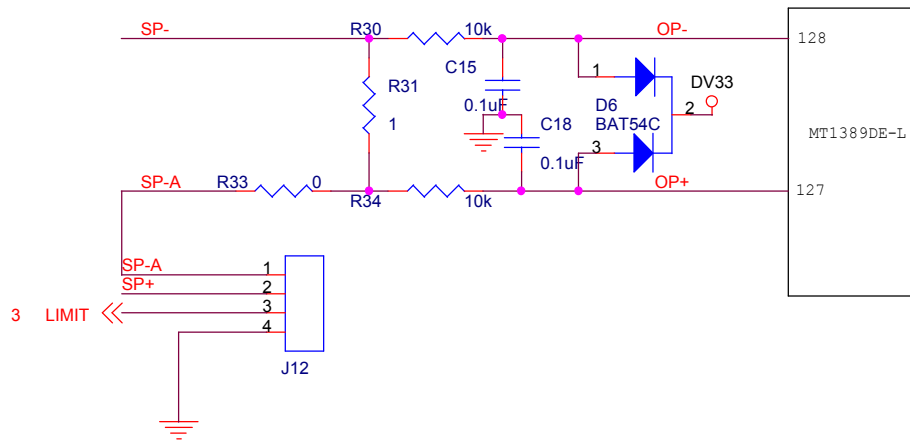


Figure 3.2.4.1 Main axis control circuit diagram

2. Working principle: MT1389E has a comparator composed of operational amplifier inside. When door is opened, disc is always rotating, so a braking signal is required to make main axis electric machine stop rotating immediately to realize the purpose that disc can stop rotating during a short period after door is opened. In the course of playing, if “OPEN” button is pressed, main axis drive signal disappears, but main axis electric machine is still in rotating state because of inertia function. The induced voltage achieved by induced electromotive force produced by electric machine running on sampling resistor, after sampling through resistor R30, R31, R34 input to pin 127, 128 of MT1389, after Mt1389 amplifying processing inside, and D/A conversion and relevant processing inside Mt1389, an instant electric machine reverse braking signal is outputted to make main axis electric machine speed down. This machine is manual open/close means, so disc is still rotating after door is opened but it will stop very soon.

3.2.5 DC-DC switch circuit

1. DC-DC switch circuit is shown as in the following figure 3.2.5.1:

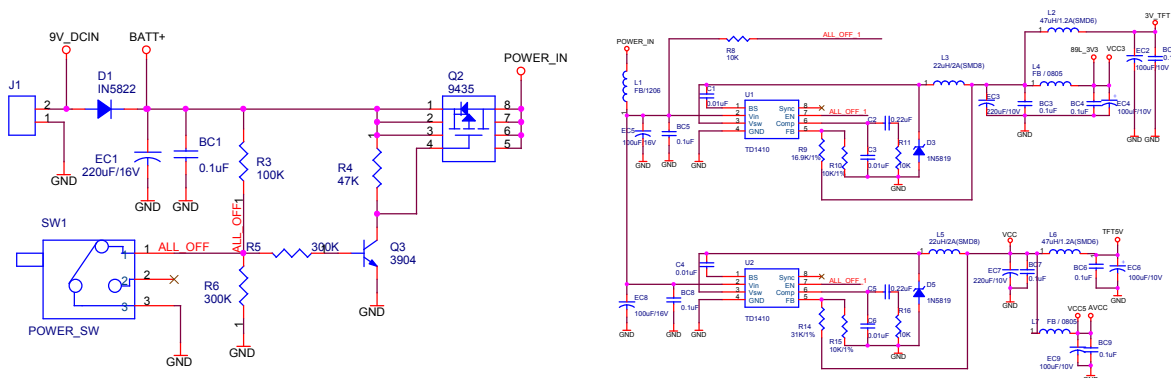


Figure 3.2.5.1 DC-DC switch circuit diagram

2. Working principle: when switch is closed, pin 4 of Q2(APM9435) is high level, Q2 is cut off, power-in has no power output, DC-DC circuit has no function, machine is in power off state, but after SW1 is disconnected, pin 4 is low level, DC-DC circuit begins to work. Take VCC for instance, we give explanation to voltage regulating of circuit: DC-DC circuit begins to oscillate, its working frequency is in 380khz, Sw pin outputs on/off signal. When VSW is high level, MOS pipe is on, +9V power reaches L5 EC7 through MOS pipe to save energy for inductor and charge capacitor, D5 freewheeling diode, when MOS pipe is cut off, L discharges energy and its induced electromotive force makes diode on, at the same time EC7 discharges the load with current direction unchanged to form a series connection switch voltage regulating circuit. When output voltage is on high side, it has the following changes: VCC increases — COMP increases VSW on/off frequency turns low —VCC decreases. When voltage is on low side, the course is opposite to that of increase. (VCC3 circuit principle is the same with that of VCC)

3.2.6 Audio output circuit

1. Audio output circuit block diagram is shown as in the following figure 3.2.7.1:

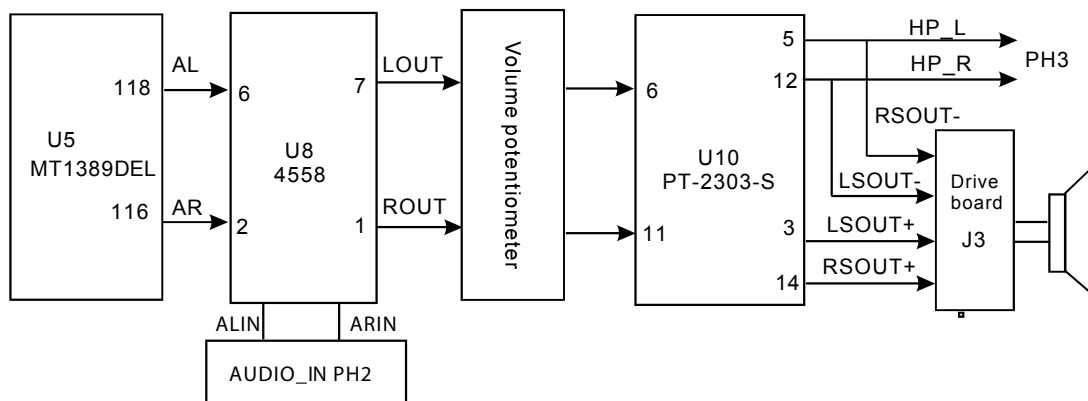


Figure 3.2.6.1 Audio output circuit block diagram

2. Working principle: signal read out by disc, through audio and video decoding, converse audio signal in MT1389DE built-in DAC circuit to analog audio signal and output left and right channel analog signals from pin 118, 116 of MT1389E, through EC33, EC29 coupled to pin 6, 2 of U8 and then output from pin 1, 7 of U8 through being filtering and amplifying by the active filter composed of U8 and send to audio output terminal and headphone amplifying output circuit.

(1) Headphone amplifying output circuit

As shown in the figure 3.2.7.2, after volume adjustment of the audio signals outputted from U8 through VRJ8, input from pin 6, 11 of U10 respectively; audio signals after being amplified output from pin 5, 12 of U10 to headphone socket for perform converse between headphone and speaker.

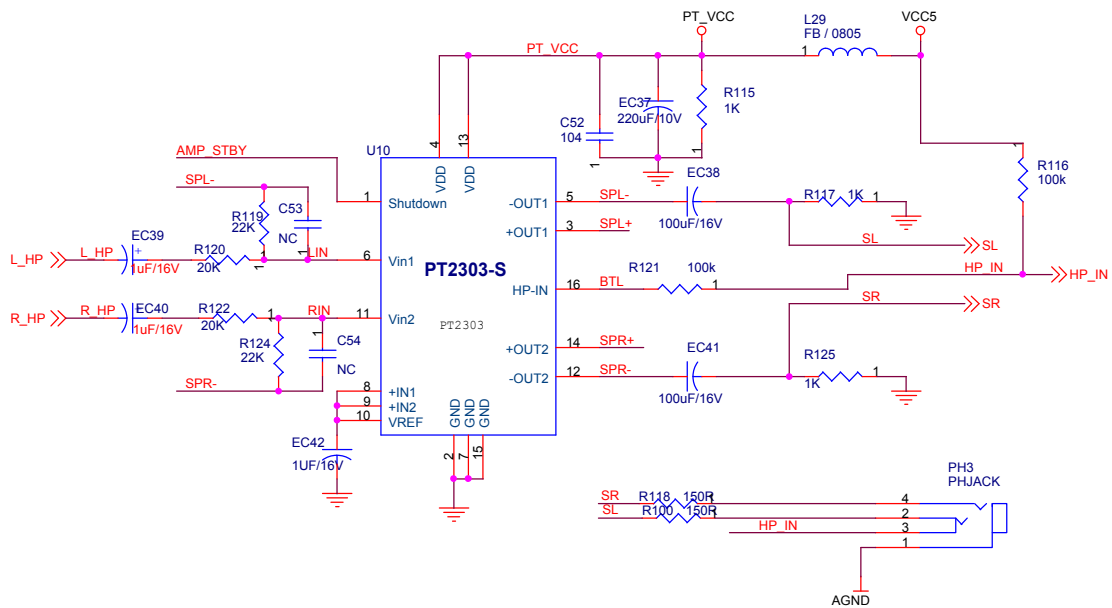


Figure 3.2.6.2 Headphone amplifying output circuit diagram

(2) Output mode switch in headphone and speaker

PT-2303S drive speaker adopts bridge connection. That drives headphone is single ending working mode and its switch between them is fulfilled by HP-IN pin. As shown in the figure 3.2.7.2, when headphone is inserted into a jack, a $4V \sim VDD/2$ voltage is added to HP-IN, which may cut off internal operational amplifying module Amp2A and Amp2B to make the load connected by bridge invalid. Now IC lies in single ending working mode and speaker has no sound output. When no headphone is connected to jack, partial pressure resistance of R116, R117 makes the voltage supplied to pin HP-IN (pin 16) close to 50mV, drive Amp2A and Amp2B are in working state to make 2303-S work in bridge mode and transmit to speaker through drive board to make speaker has sound output.

3.2.7 Screen off detect control circuit

1. Screen off detect control circuit is shown as in the following figure 3.2.7.1:

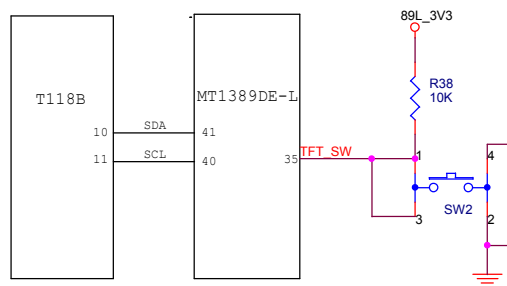


Figure 3.2.7.1 Screen off detect control circuit

2. Working principle: when switch is off, pin 35 of MT1389 detects level, pin 40/41 outputs control signal to make T118B has not voltage output; when switch is disconnected, voltage of T118B has output and lighten back lighe. (when switch is in panel position, screen close is off, screen open is disconnected).

3.2.8 Video coding and LCD – TFT drive circuit

1. Video coding and LCD – TFT drive circuit block diagram is shown as in the following figure 3.2.8.1:

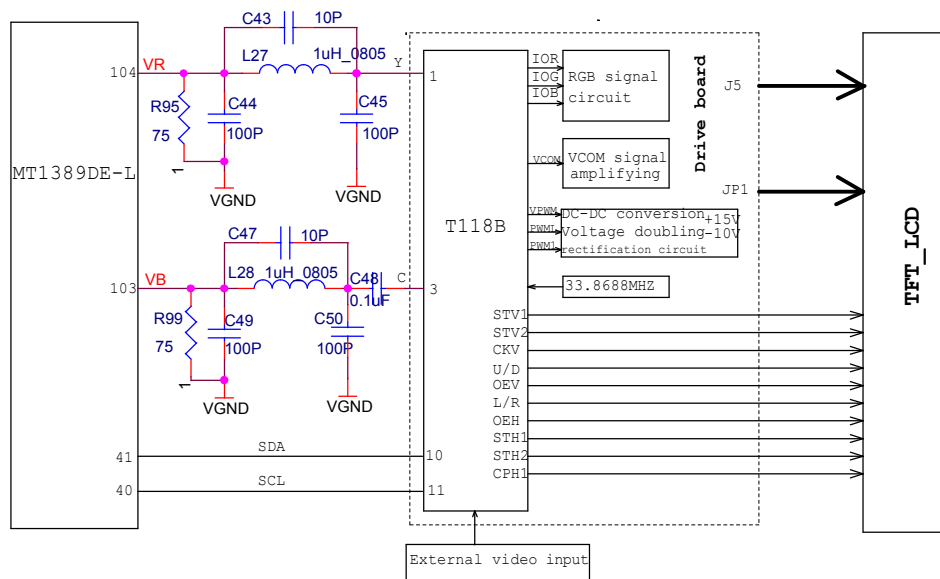


Figure 3.2.8.1 Video coding and LCD – TFT drive circuit block diagram

2. Working principle: decode chip outputs video (Y/C) signal through filter inputs to T118B for coding in the means of data in parallel (8 bit), and restore digital signal to 3 base colour signal through internal DAC circuit and are outputted by pin 40, 41, 42 and sent to a amplifying circuit composed of single triode. Shown as in the figure 3.2.9.2, converse small current signal of RGB into voltage output means to drive LCD screen to display.

VCOM signal amplifying circuit: VCOM, after U3 UTC3414 amplifying, outputs from pin 6, 7 to display screen and is used as the colourful filtering plate of display screen.

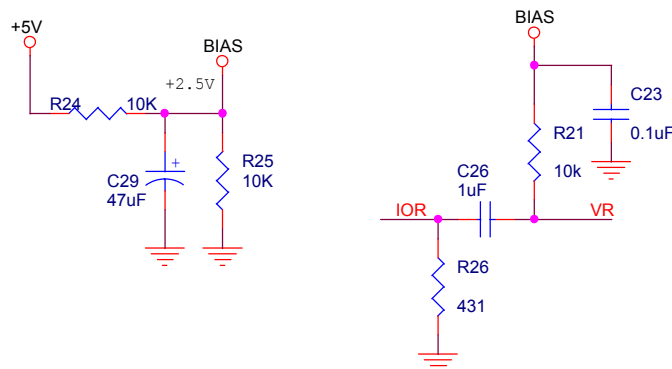


Figure 3.2.8.2 Amplifying circuit

3. Voltage doubling circuit

Working of display drive circuit requires high voltage, so +5V voltage is voltage doubled, shown as in the following figure 3.2.8.3:

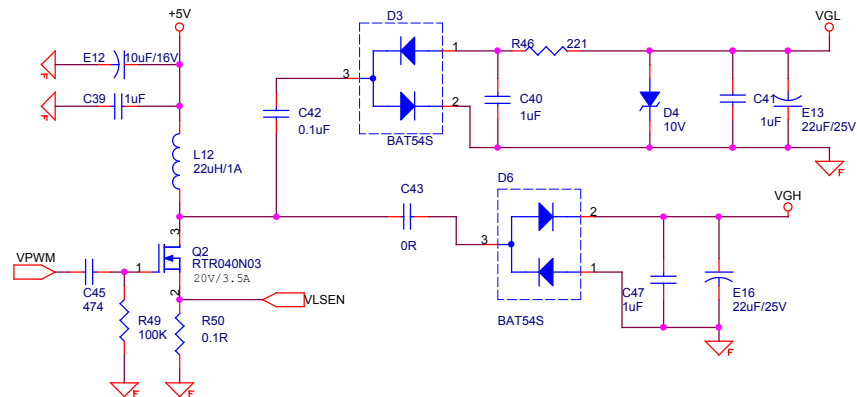


Figure 3.2.8.3 Voltage doubling rectification circuit

+5V power, through Q2, L12 is transmitted to the two groups of voltage doubling rectification circuit composed of D3,D6 to perform rectification to power sent from pin 53 of U1. When VPWM input is negative half circle, about -14V voltage is formed in pin 1 of D3, -10 VGL voltage outputted after D4 voltage regulating is provided to VCOM signal amplifying circuit and display screen. When VPWM input is positive half circle, the voltage doubling rectification circuit composed by D6, C47 and then output VGH(+15V) DC power to provide for display screen. +15V is outputted by JP1 to display screen.

4. Function introduction to display screen pin is shown as in the following table:

Pin	Symbol	I/O	description
1	GND	-	Ground
2	VCC	P	Power line for logic
3	VGL	P	Gate driver negative voltage
4	VGH	P	Gate driver positive voltage
5	STVR	I/O	Gate driver START PULSE 1
6	STVL	I/O	Gate driver START PULSE 2

7	CKV	I	Gate driver scanning clock
8	U/D	I	Up/Down scanning change
9	OEV	I	Gate driver output enable
10	Vcom	I	HORIZONTAL SYNCHRONIZATION SIGNAL(Voltage applied to color filter substrate)
11	Vcom	I	Voltage applied to color filter substrate
12	L/R	I	Right / Left scanning change
13	MOD	I	Sampling mode change (H: Simultaneous, L: Sequential)
14	OEH	I	LATCH PULSE FOR COLUMN DRIVER
15	STHL	I/O	Source scanning start signal 2
16	STHR	I/O	Source scanning start signal 1
17	CPH3	I	INPUT DATA CLOCK
18	CPH2	I	INPUT DATA CLOCK
19	CPH1	I	INPUT DATA CLOCK
20	Vcc	P	Power line for logic
21	GND	P	Ground
22	VR	I	Red video signal
23	VG	I	Green video signal
24	VB	I	Blue video signal
25	AVdd	P	Power
26	AVss	P	Ground

5. Scanning mode selection is shown as in the following table:

Scan control input setup		Start up pulse I/O state				Scan mode
U/D	L/R	STVR	STVL	STHR	STHL	
GND	Vcc	O	I	O	I	Up→down Left→right
Vcc	GND	I	O	I	O	Down→up Right→left
GND	GND	O	I	I	O	Up→down Right→left
Vcc	Vcc	I	O	O	I	Up→down Left→right

3.2.9 Charge circuit and protection circuit

1. Battery: Lithium-ion polymer chargeable battery always follows the method of constant current firstly and then constant voltage, and then charge in constant voltage state.

2. Lithium battery protection part (this PCB board will not be serviced inside battery components) is divided into three types: A) Over-voltage protection, that is charge protection; B) Under voltage protection, that is discharge protection; C) Current protection (short circuit protection included). The protection delay and delay time of the above 3 items are different, from 1 second to 0.1 second and to 10ms with delay adjustable. Two lithium batteries protection, no matter over voltage protection or under voltage protection, they are the relationship of “or”. Only one of the two cores has the condition, the protection is available, which requires that the two cores of a group of battery are balanced on the whole, or else the whole capacity will be severely damaged (when in over voltage protection, the core of high voltage causes over voltage protection firstly; when in under voltage protection, the core of low voltage causes protection firstly).

3. Working principle: when external power adapter is adopted to supply power, power arrives at 9V_DCIN pin through socket board and is divided into two ways: A) arrive at decode board directly through D1; B) if battery has installed, it will charge with 750MA. current at the same time.

3.2.10 Decode circuit

1. Decode circuit block diagram is shown as in the following figure 3.2.10.1:

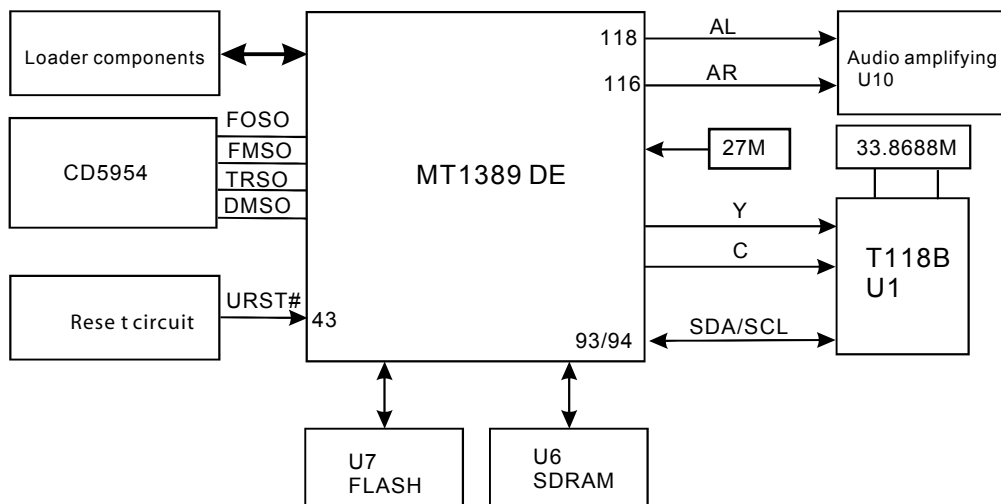


Figure 3.2.10.1 Decode circuit block diagram

2. Working principle:

(1) Power: MT1389 is with two groups of power supply: one group achieves 1.8V voltage after LM1117MP-1.8(U3) voltage regulating to supply for the logic circuit inside IC; the other group achieves 3.3V voltage after DC-DC conversion . At the same time, FLASH and SDRAM must also meet the requirements of power.

(2) System clock: clock signal is an important factor of machine's working, that whether there is clock signal or whether it is normal will affect the normal working of the player. This machine adopts external clock (27M) that inputs to pin 9, 10 of MT1389, clock is produced by Y1 and its peripheral circuit.

(3) Data communication

1) Communication of Mt1389 and SDRAM: the communication of MT1389 and SDRAM is mainly to temporarily save the large quantities of data after MT1389 decoding to prepare for saving at any time. Shown as in the figure, DMA0DMA10 is address signal, DQ0DQ15 is data signal, DCLK is synchronous clock, DCKE is enabled end, CS is chip selection signal, WE is write enabled signal, RAS and CAS are row and line gating signals.

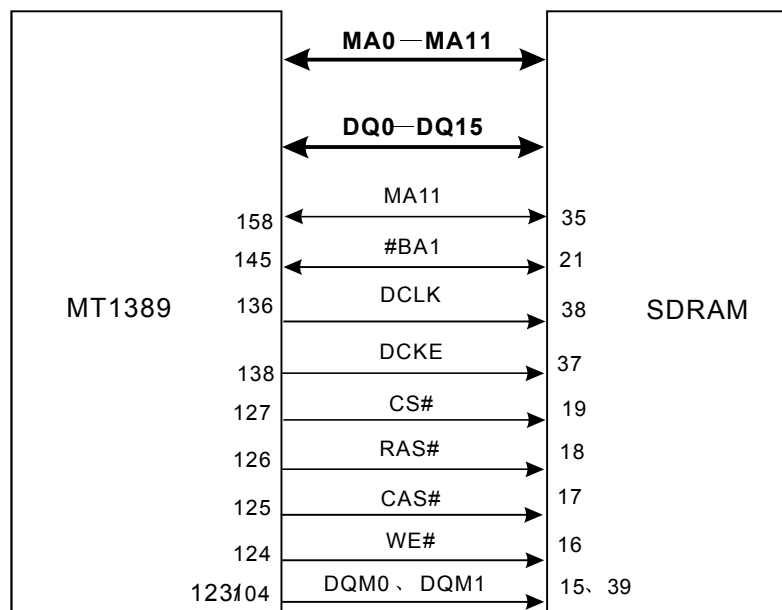


Figure 3.2.10.2 Communication block diagram of MT1389 and SDRAM

2) Communication of MT1389 and FLASH

The communication of Mt1389 and FLASH is mainly to call the program and working directions saved inside FLASH when power on. Shown as in the figure, CS is chip selection. DO is serial data output. DI is serial Data input, CK is serial clock.

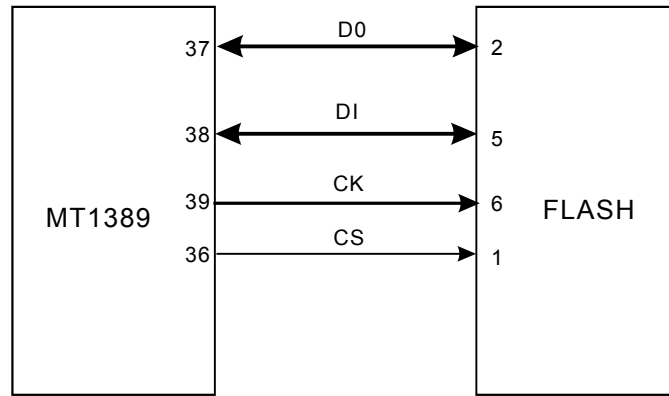


Figure 3.2.10.3 Communication block diagram of Mt1389 and FLASH

3. Audio, video output

(1) Video: MT1389 integrates video encoder inside, so analog video signals can output from Mt1389 inside directly;

Pin 104 output Y, and pin 103 output C.

(2) Audio: Mt1389 integrates D/A conversion inside, so analog audio signal output from MT1389 inside directly, and digital signal may also output directly and be converted by the externally connected D/A conversion IC, which is also with optical output function. DL381S adopts analog audio output and the output signals are as follows:

◆ P119: ASL

◆ P118: AL

◆ P116: AR

◆ P115: ASR

This machine only uses two channels of AL and AR and no other channels.

3.2.11 Reset circuit

1. Reset circuit is shown as in the following figure 3.2.11.1:

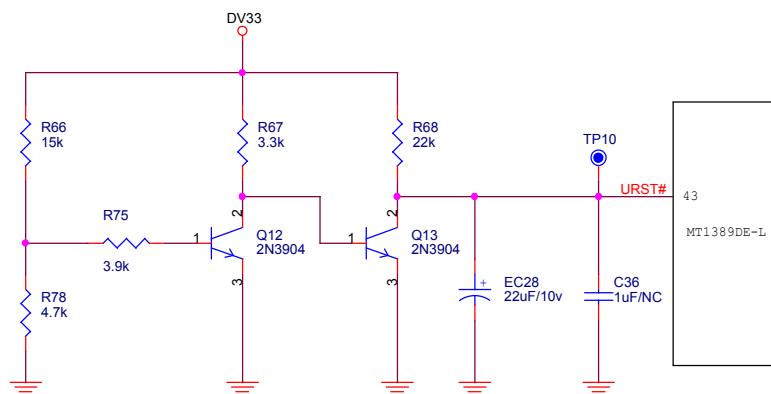


Figure 3.2.11.1 Reset circuit diagram

2. Working principle: after power on, DV33 charges TC28 through R68. Voltage on two ends of capacitor cannot change suddenly, so positive voltage of EC28 increases gradually and its increase time is related with R68/EC28. When machine is working normally, this voltage is the same with power voltage on the whole. After this circuit performs reset to decode chip pin 43, After machine power off, the electric charge saved in EC28 discharges through Q13 to ensure the reliable reset after power on next time.

3.2.12 Mute circuit

1. Mute circuit is shown as in the following figure 3.2.12.1:

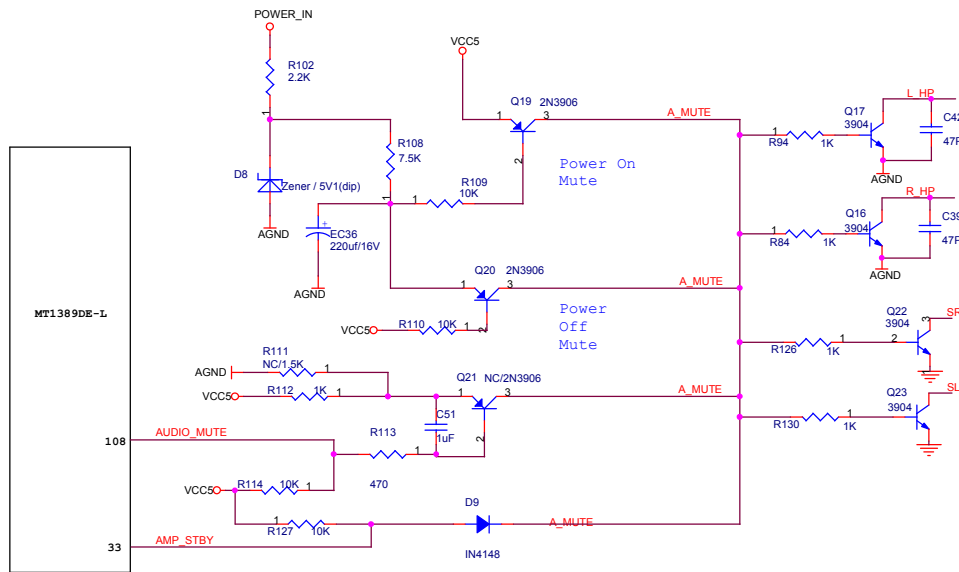
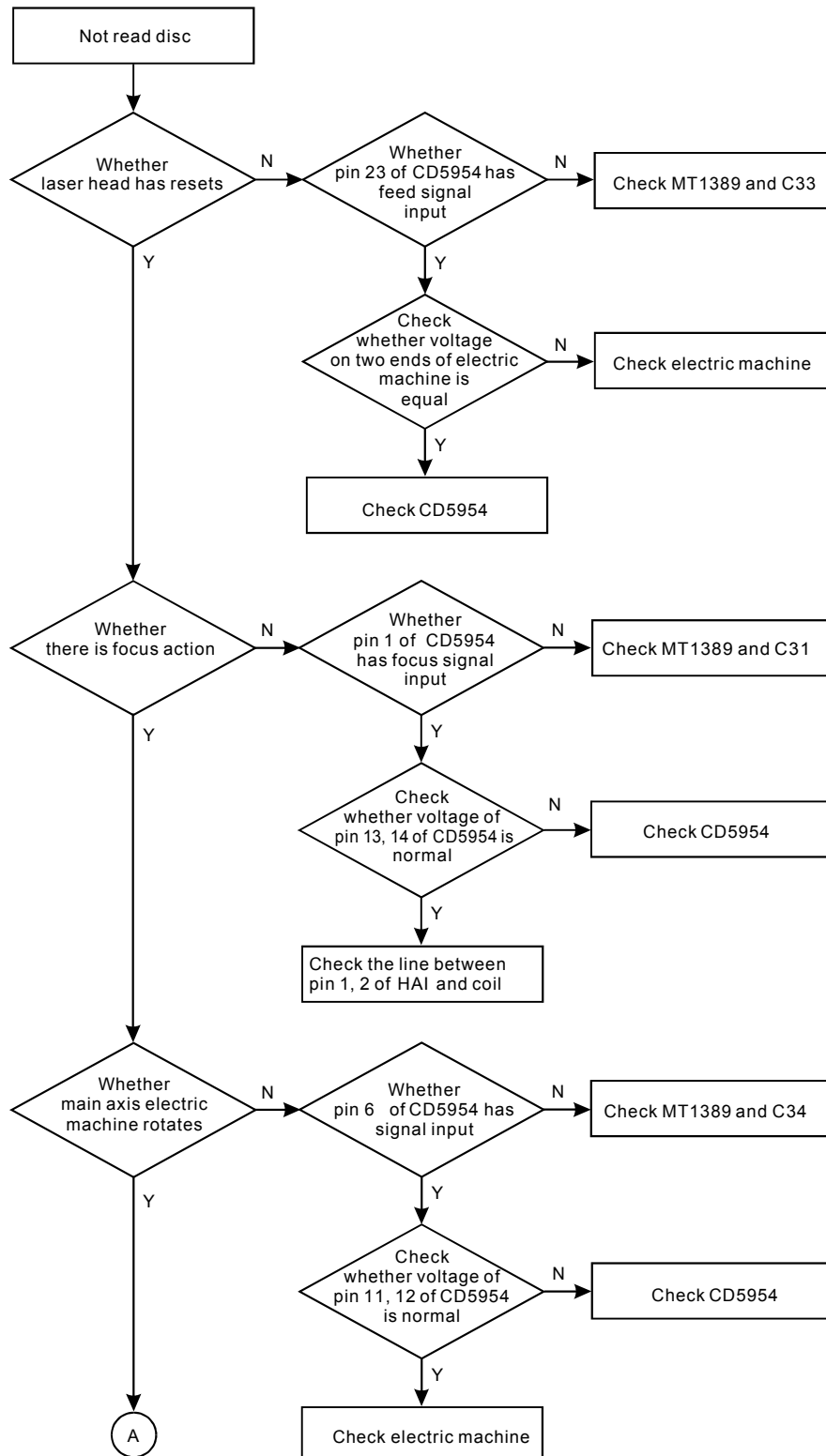


Figure 3.2.12.1 Mute circuit diagram

2. Working principle: after power on, +9V arrives at the base electrode of Q16, Q17, Q22, Q23 through CE of Q19 to make triode saturated on, audio signal output and headphone output are short circuited to ground to remove noise that produces when power on. After machine resets and begins to read disc, pin 33 of Mt1389 outputs a high level to make pin MUTE change from high level to low level, Q16, Q17, Q22, Q23 are cut off because the base electrode is low level, audio signal can output normally.

3.3.1 Troubleshooting flow chart

1. Troubleshooting flow chart for “Not read disc” is shown as in the following figure 3.3.1.1:



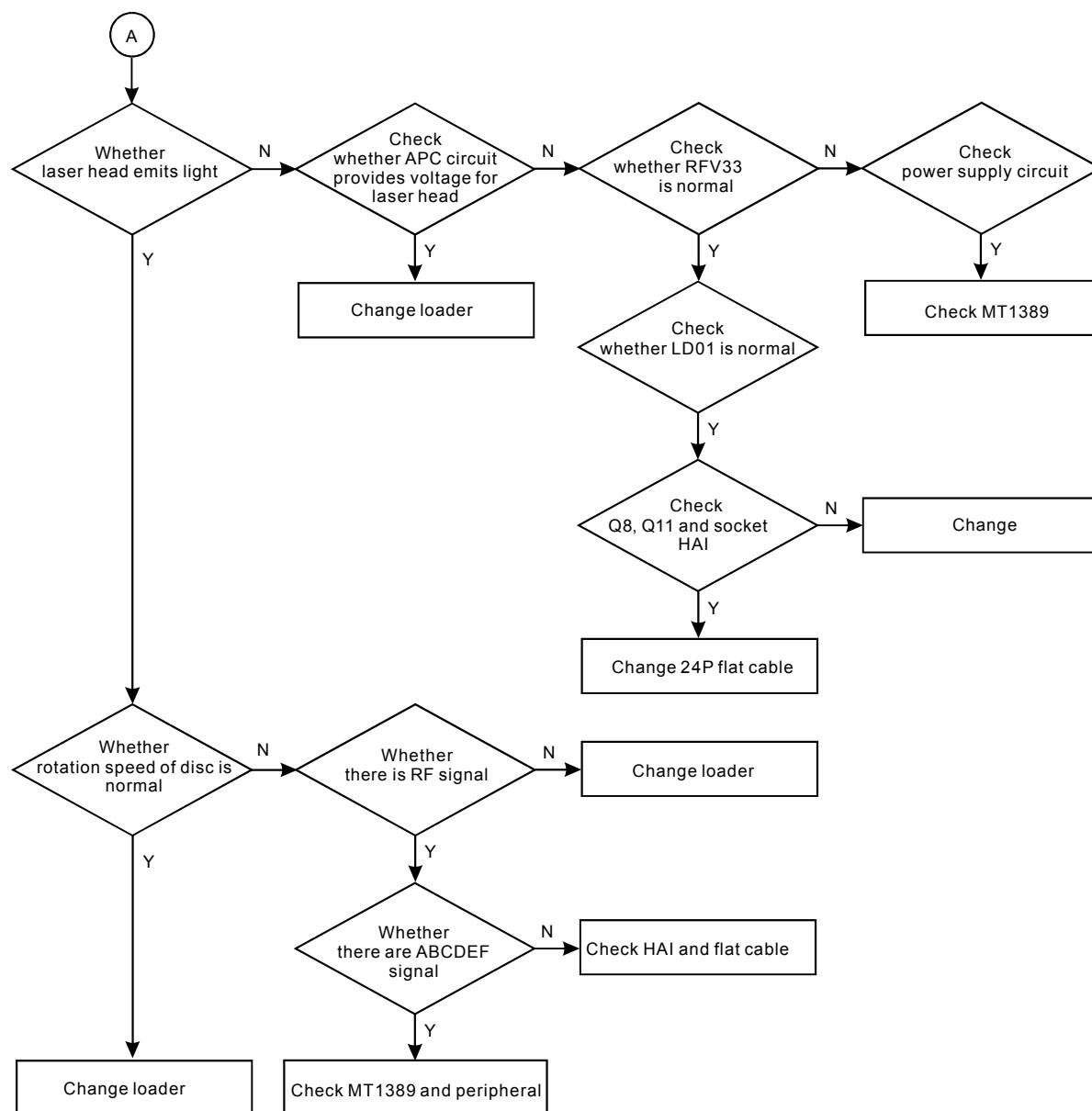
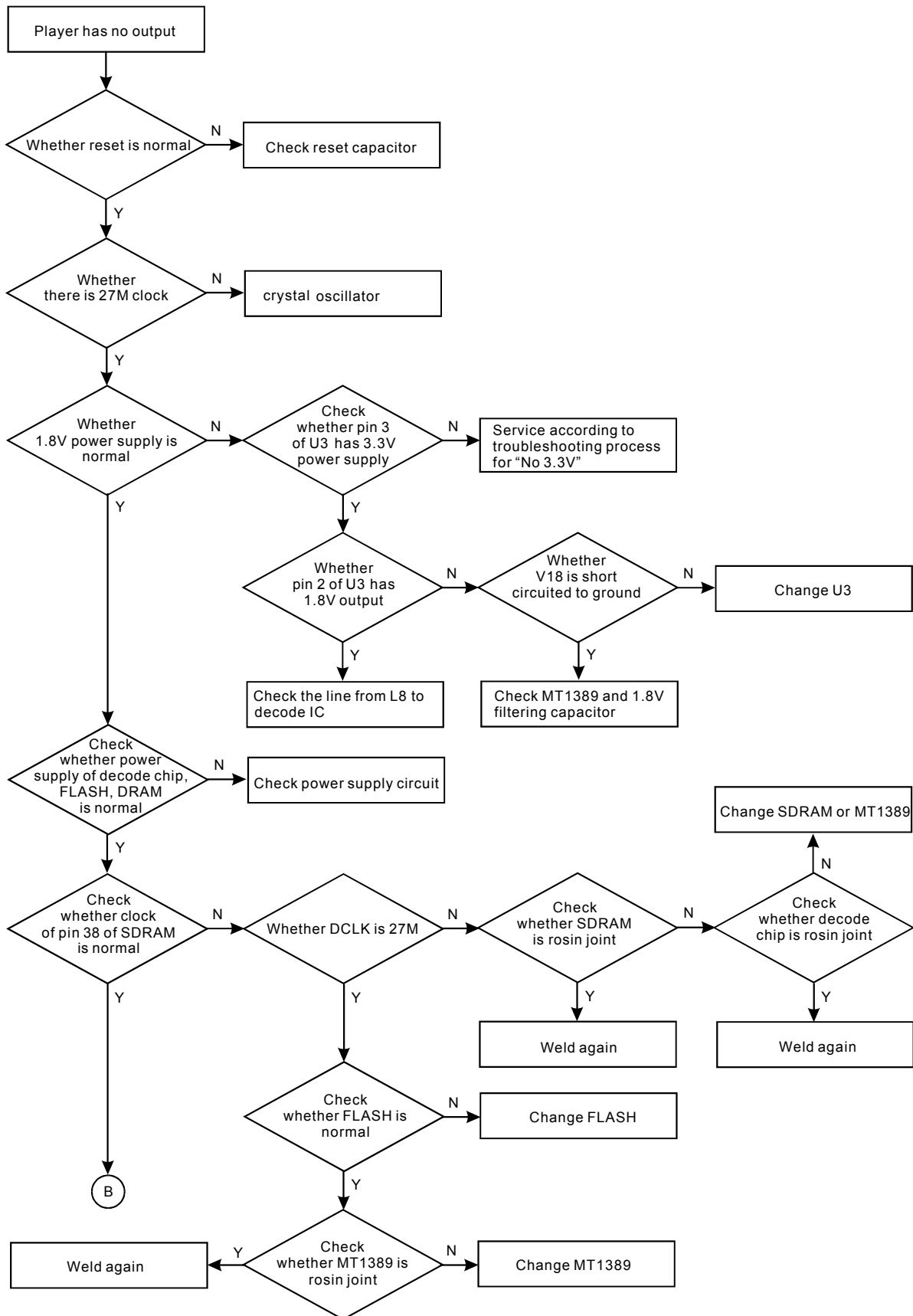


Figure 3.3.1.1 Troubleshooting flow chart for “Not read disc”

2. Troubleshooting flow chart for “Player has no output” is shown as in the following figure 3.3.1.2:



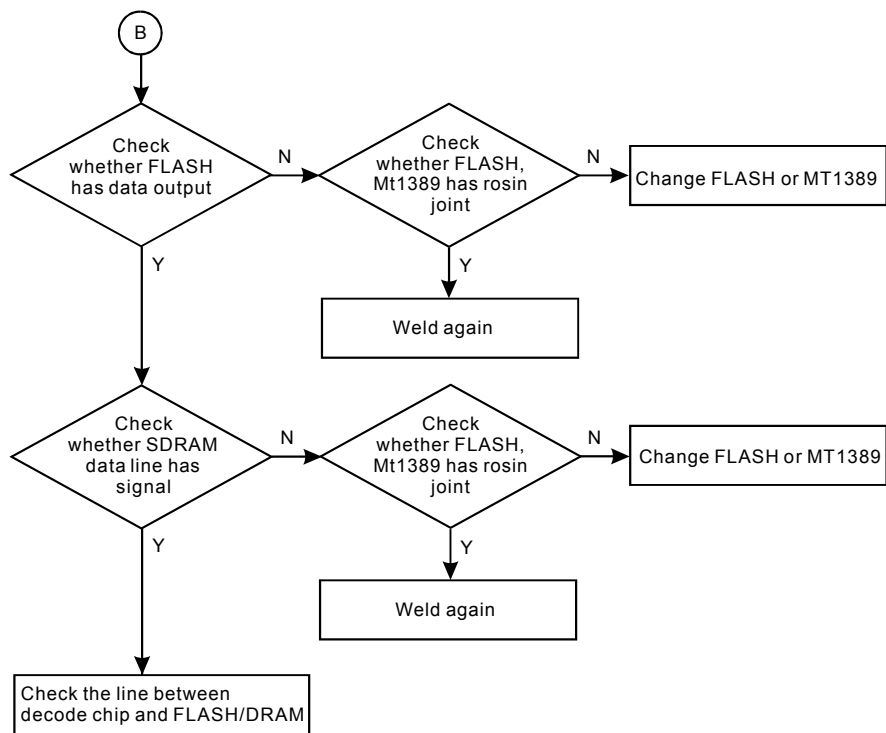


Figure 3.3.1.2 Troubleshooting flow chart for "Player has no output"

3. Troubleshooting flow chart for “No VCC voltage” is shown as in the following figure 3.3.1.3:

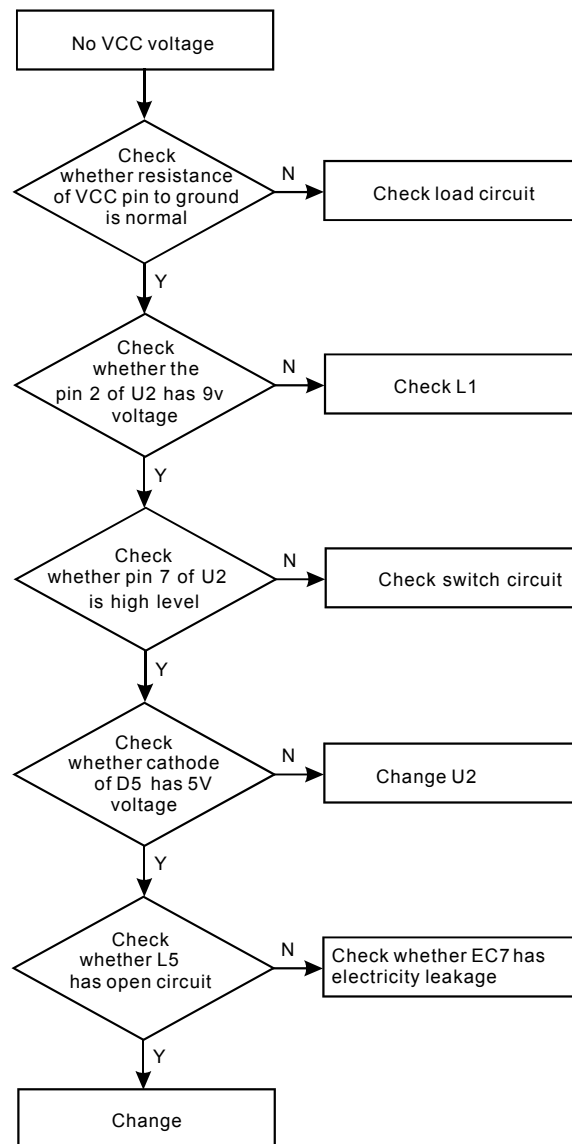


Figure 3.3.1.3 Troubleshooting flow chart for “No VCC voltage”

4. Troubleshooting flow chart for “No DV33V voltage” is shown as in the following figure 3.3.1.4:

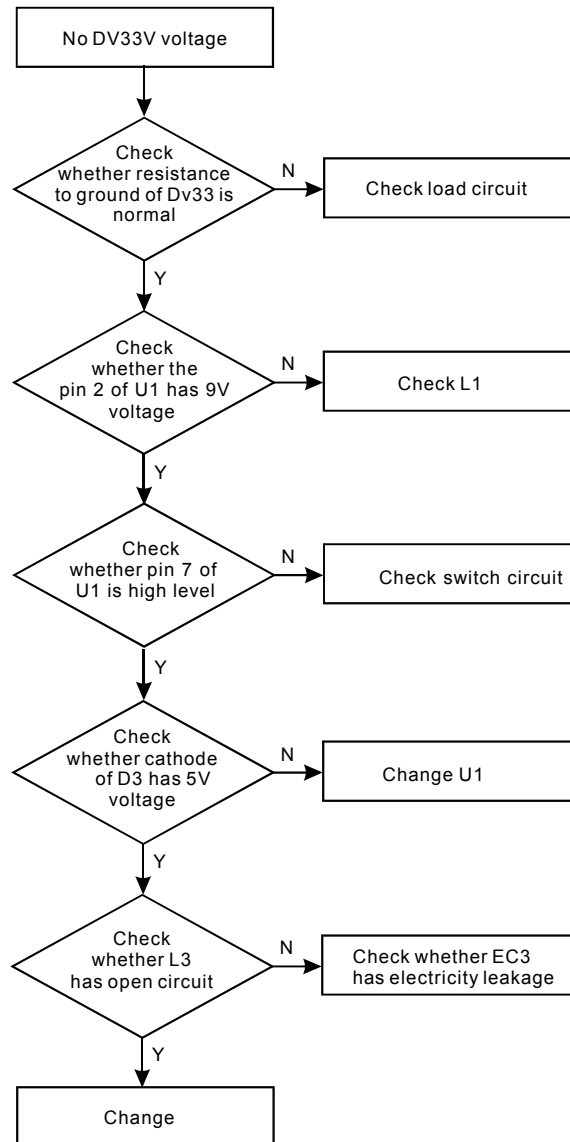


Figure 3.3.1.4 Troubleshooting flow chart for “No DV33V voltage”

5. Troubleshooting flow chart for “No VCC, DV33V voltage” is shown as in the following figure 3.3.1.5:

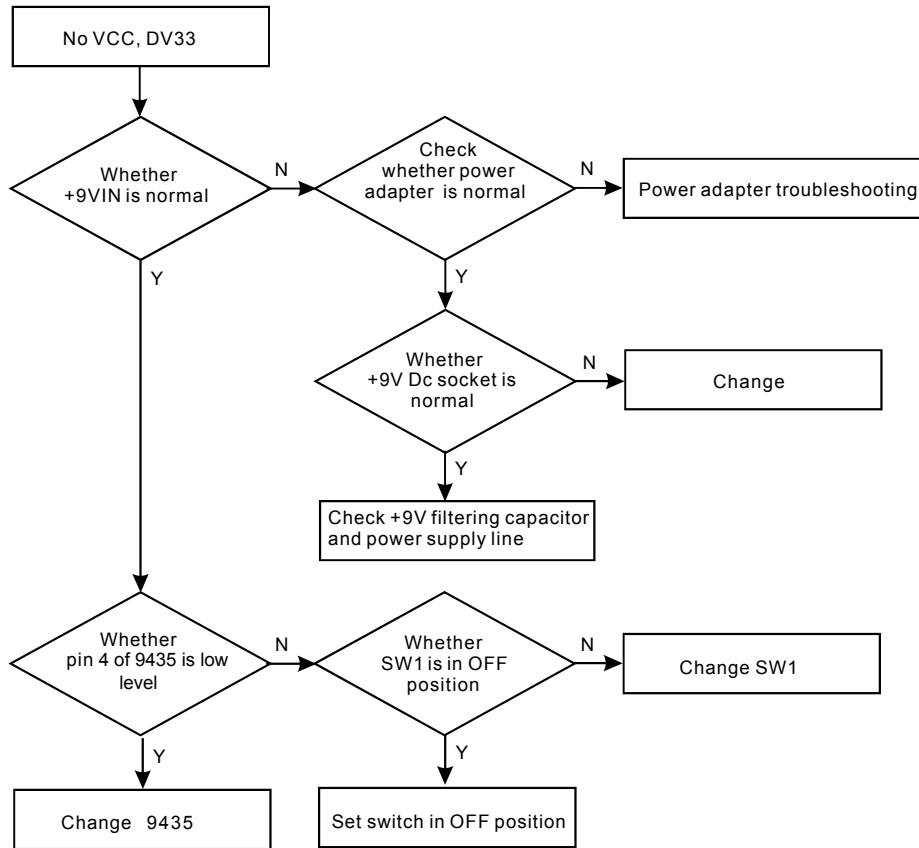


Figure 3.3.1.5 Troubleshooting flow chart for “No VCC, DV33V voltage”

6. Troubleshooting flow chart for “Audio has no output” is shown as in the following figure 3.3.1.6:

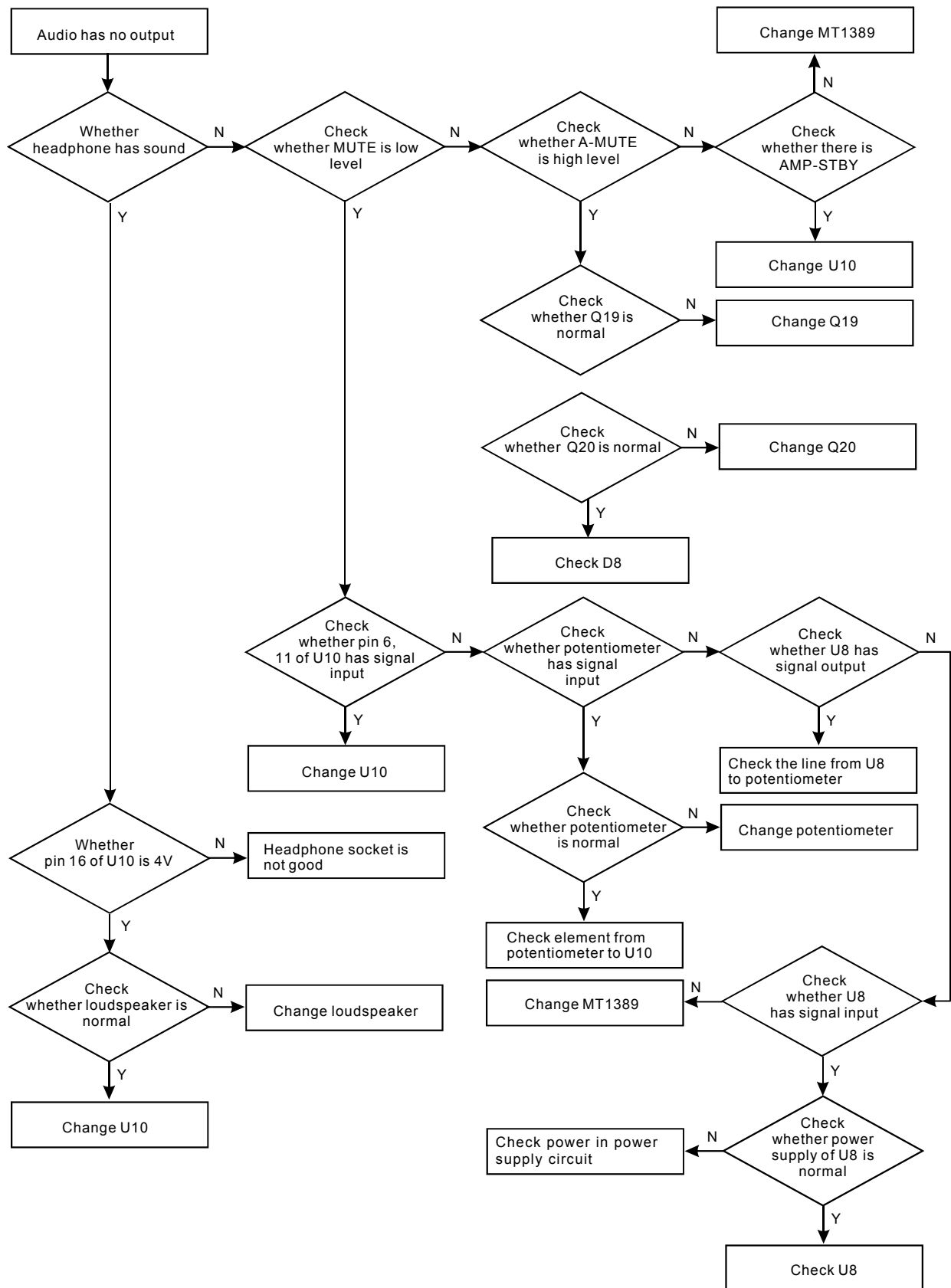
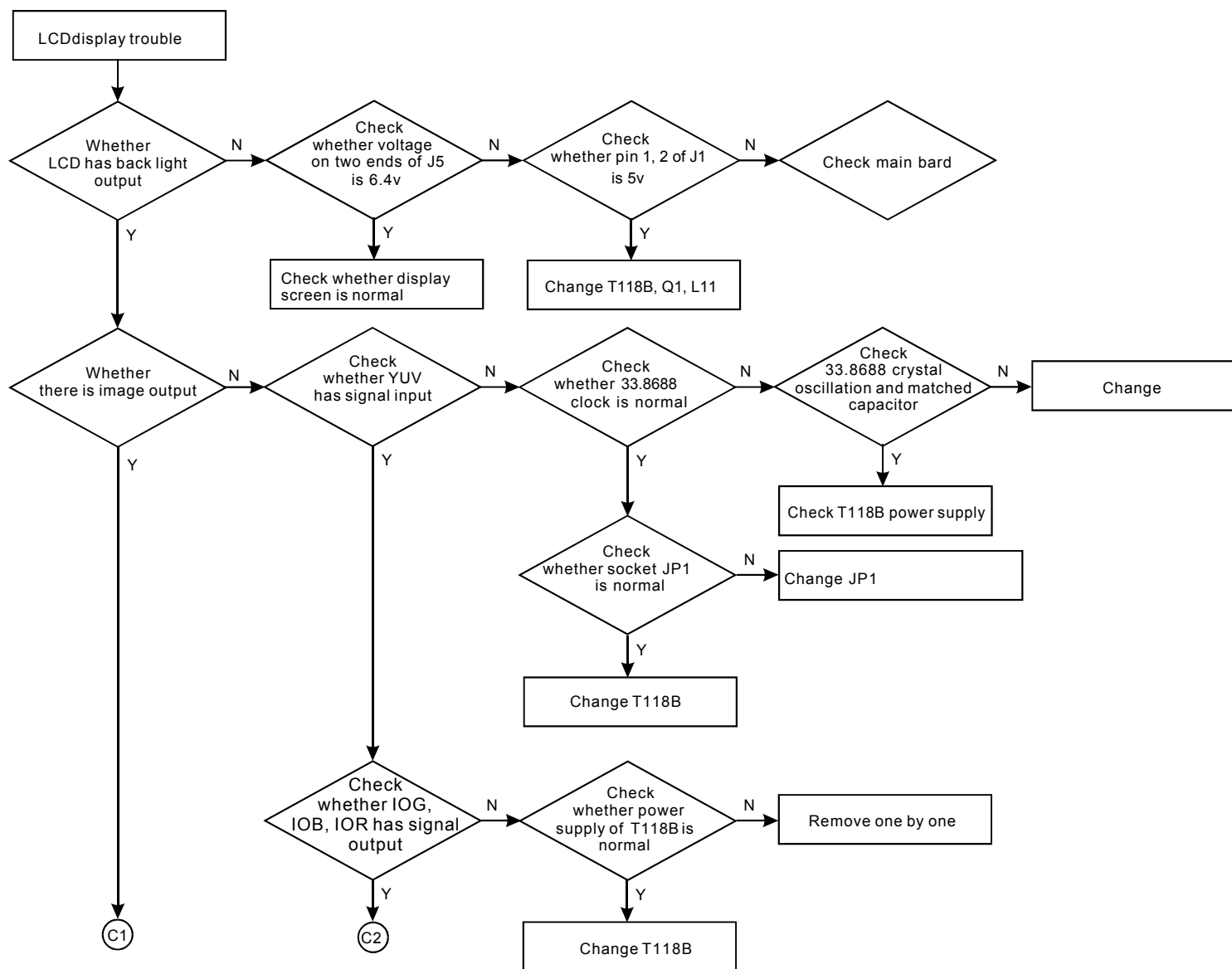


Figure 3.3.1.6 Troubleshooting flow chart for “No audio output”

7. Troubleshooting flow chart for “LCD display trouble” is shown as in the following figure 3.3.1.7:



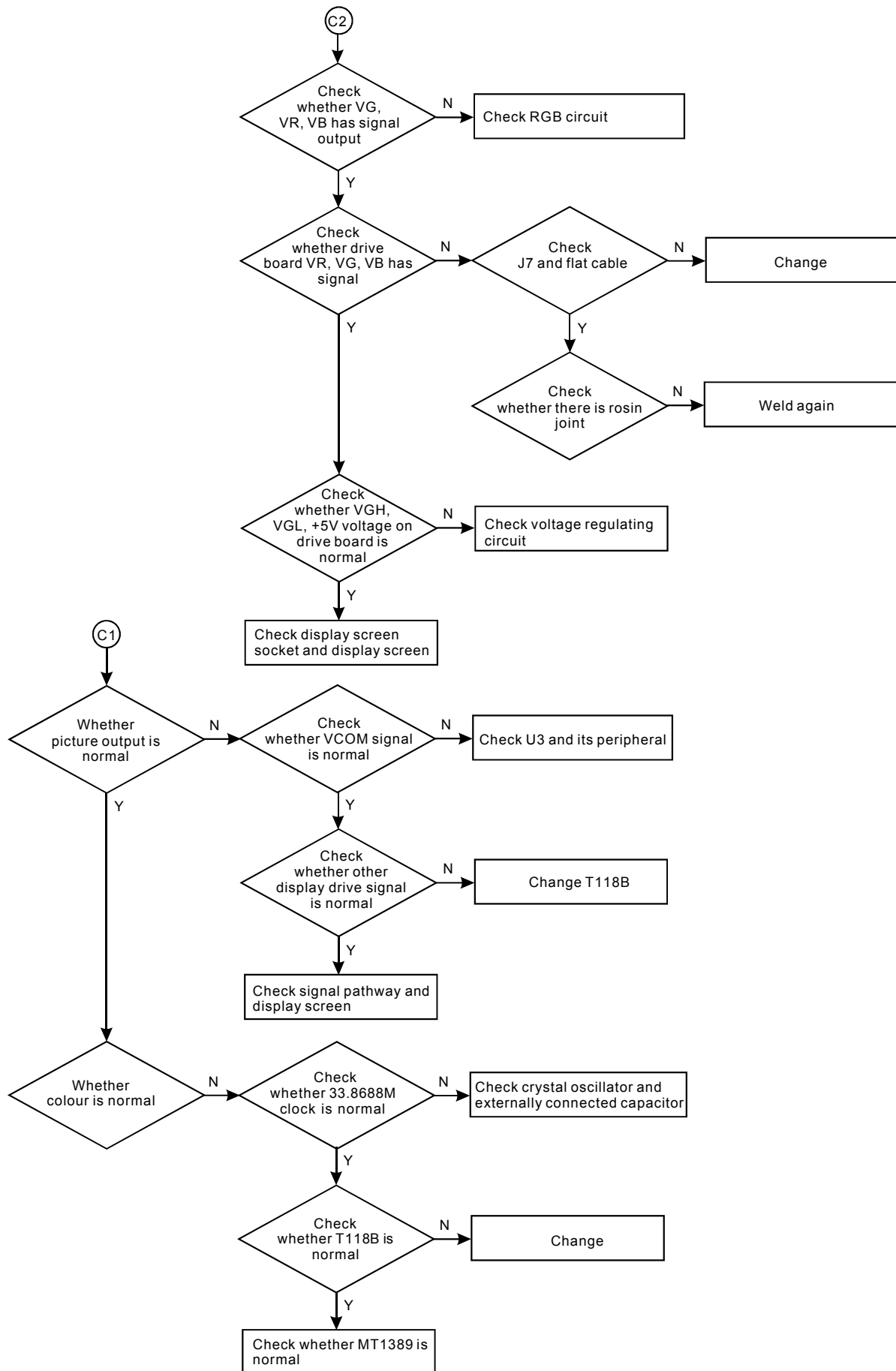


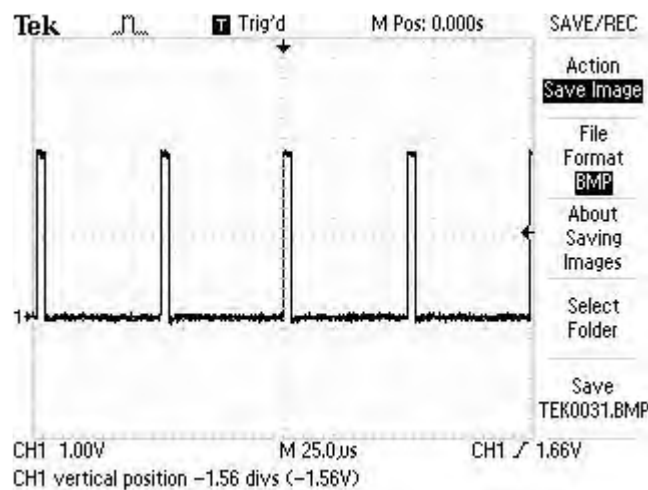
Figure 3.3.1.7 Troubleshooting flow chart for “LCD display trouble”

Section Four Servicing Parameters

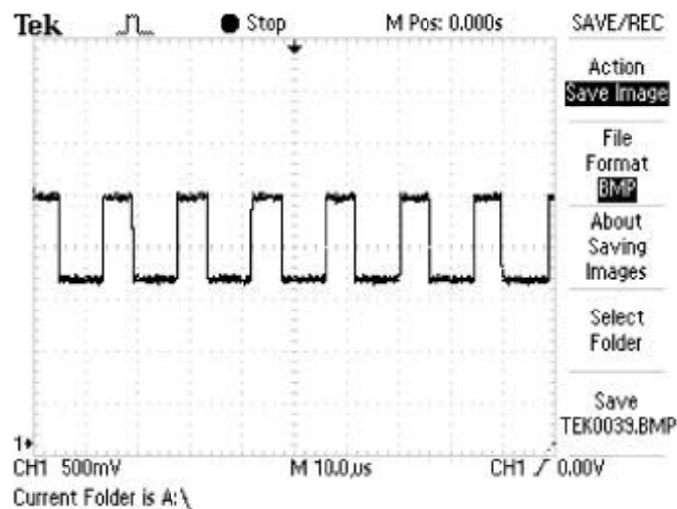
3.4.1 Signal waveform diagram

This section collects signal waveform diagram of audio, video and each unit circuit with the purpose to help servicing personnel to judge where trouble lies in accurately and quickly to improve servicing skills. For the difference of oscillograph's type, model and tuner, a certain difference may exist, so the servicing personnel are expected to pay more attention to check in daily operation.

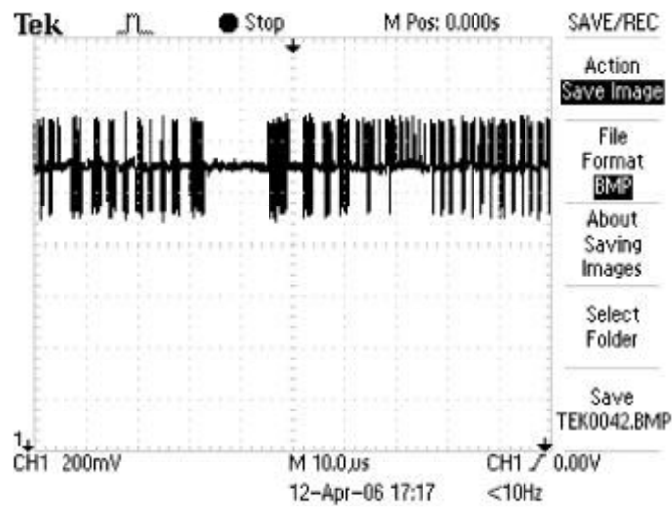
1. Waveform diagram of pin 7 CKV of JP1



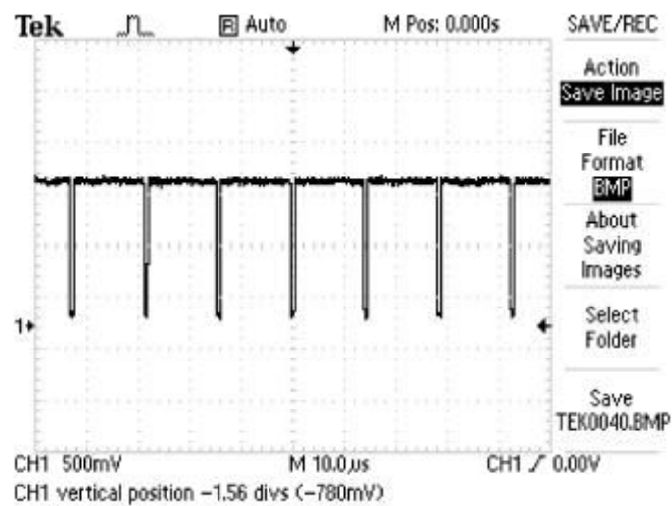
2. Waveform diagram of main axis drive DMO outputted by decode chip



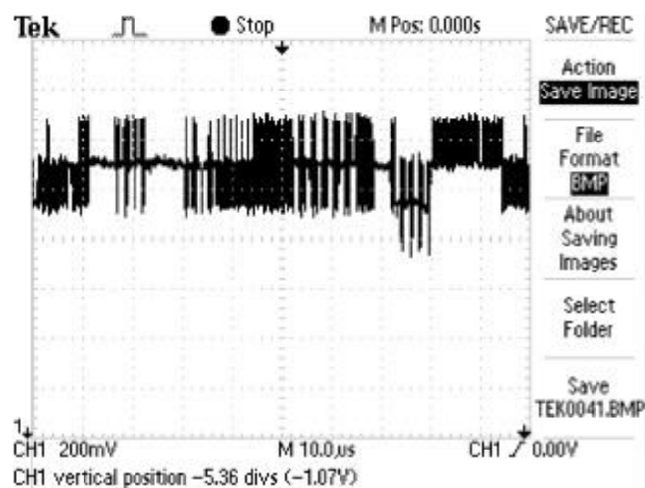
3. Waveform diagram of FO outputted by decode chip



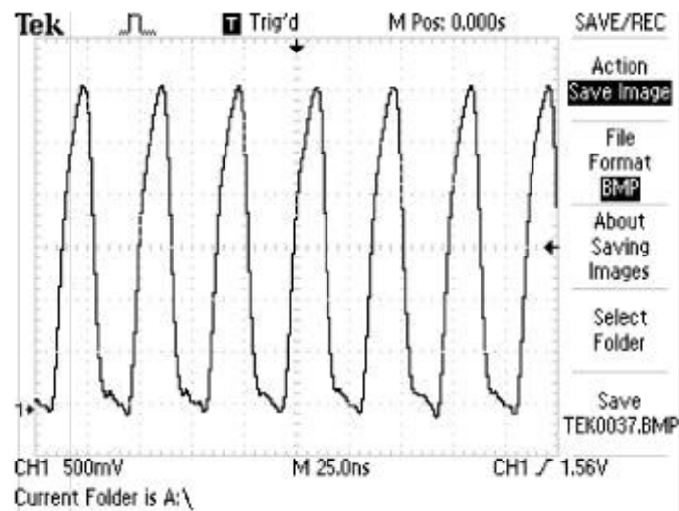
4. Waveform diagram of FM outputted by decode chip



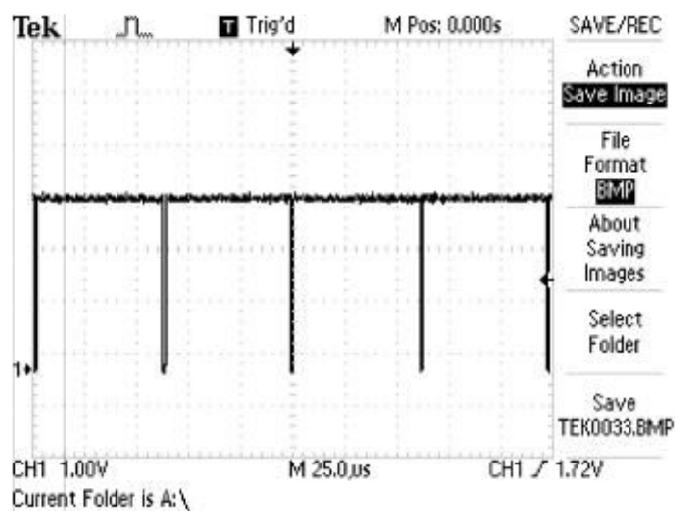
5. Waveform diagram of TR outputted by decode chip



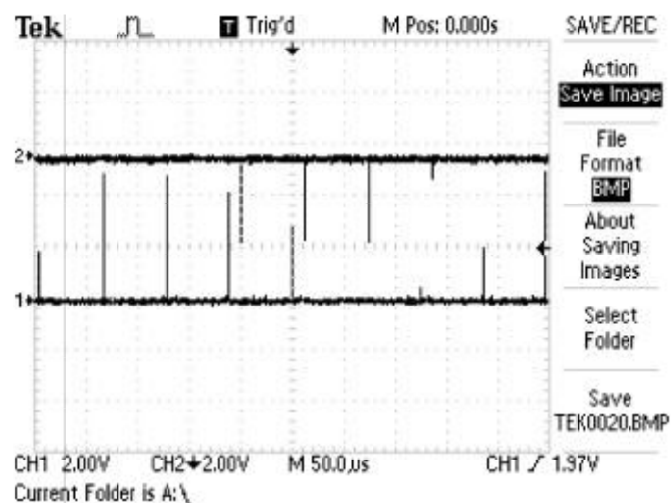
6. Waveform diagram of CLK of pin 66 of MT1389



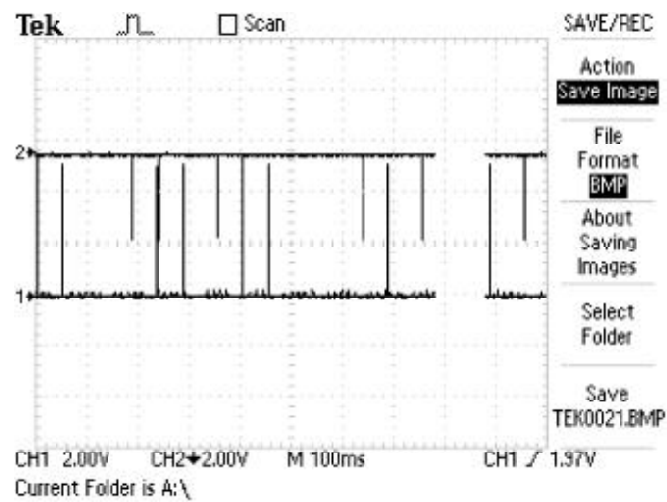
7. Waveform diagram of OEH of pin 14 of JP1



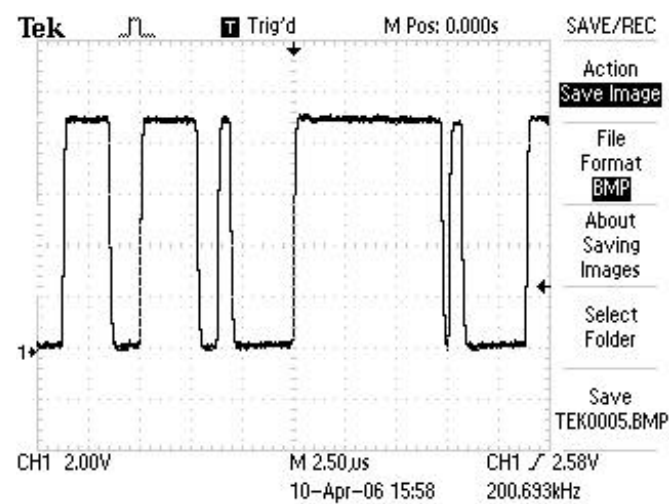
8. Waveform diagram of STHL, STHR of pin 15, 16 of JP1



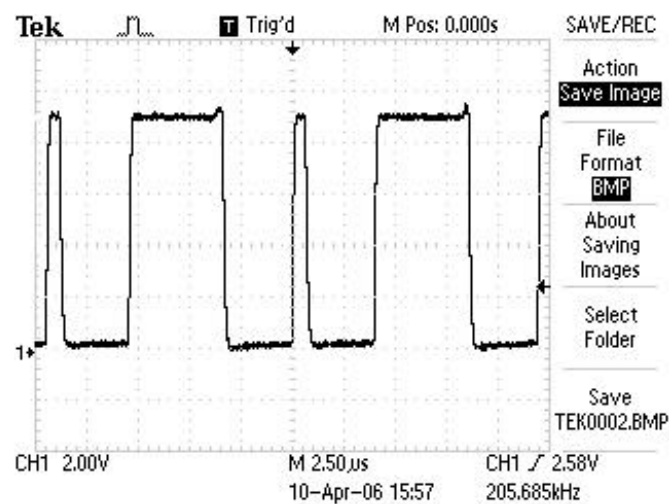
9. Waveform diagram of pin 5, 6 STVR,STVL of JP1



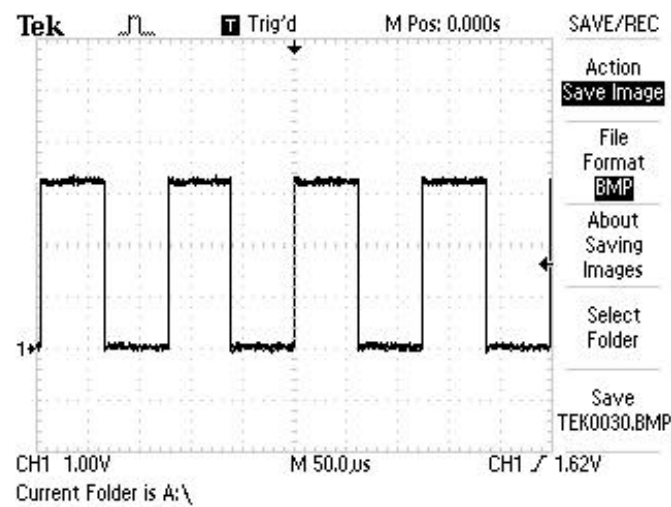
10. Waveform diagram of pin 3 VSW of U1 TD1410



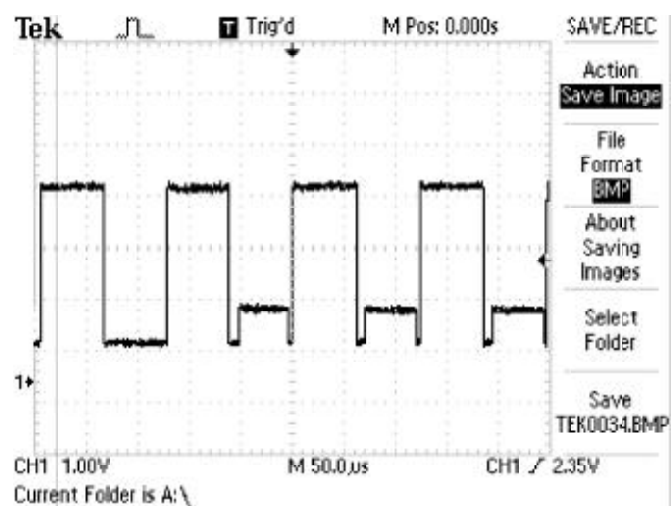
11. Waveform diagram of pin 3 VSW of U2 TD1410



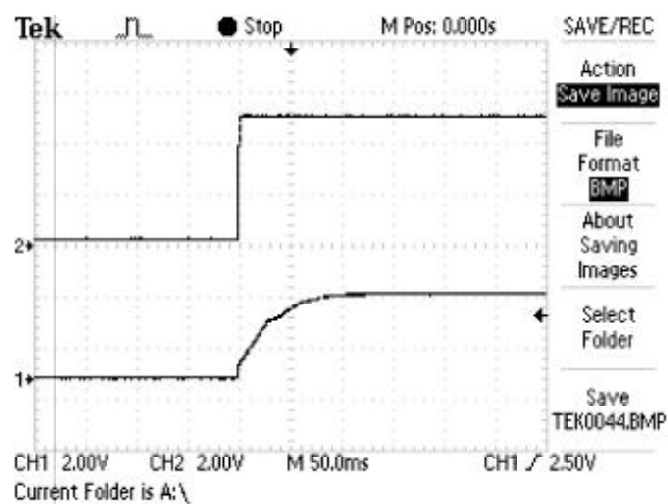
12. Waveform diagram of pin 10, 11 VCOMO of JP1



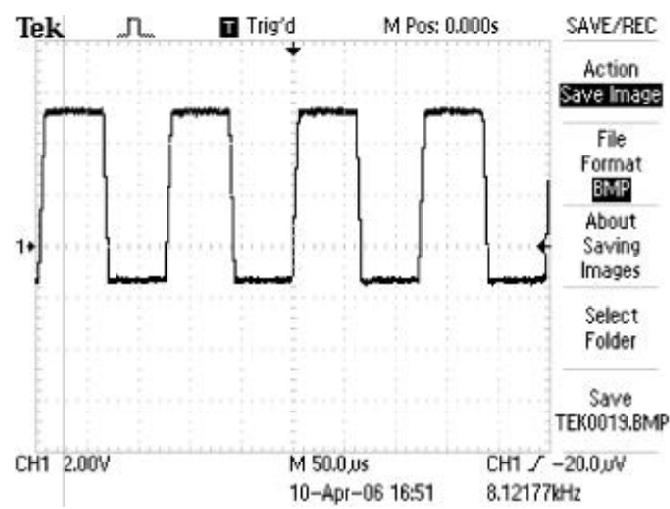
13. Waveform diagram of pin 22 VR of JP1



14. URST waveform diagram



15. Waveform diagram of pin 6 U3 VCOM



Section Five Function Introduction to IC

3.5.1 function introduction to MT1389DE

1 General Description

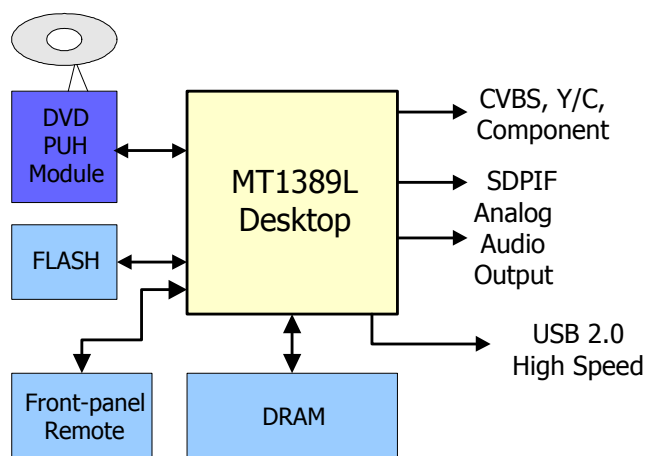
MediaTek MT1389L is a cost-effective DVD system-on-chip (SOC) which incorporates advanced features like MPEG-4 video decoder, high quality TV encoder and state-of-art de-interlace processing. The MT1389L enables consumer electronics manufacturers to build high quality, USB2.0, MS/SD/MMC reader, feature-rich DVD players, portable DVD players or any other home entertainment audio/video devices.

World-Leading Technology: Based on MediaTek's world-leading DVD player SOC architecture, the MT1389L is the New generation of the DVD player SOC. It integrates the MediaTek 3rd generation front-end digital RF amplifier and the Servo/MPEG AV decoder.

Rich Feature for High Valued Product: To enrich the feature of DVD player, the MT1389 equips a simplified MPEG-4 advanced simple profile (ASP) video decoder to fully support the DivX¹ Home Theater profile. It makes the MT1389-based DVD player be capable of playback MPEG-4 content which become more and more popular.

Incredible Audio/Video Quality: The progressive scan of the MT1389L utilized advanced motion-adaptive de-interlace algorithm to achieve the best movie/video playback. It also supports a 3:2 pull down algorithm to give the best film effect. The 108MHz/12-bit video DAC provides users a whole new viewing experience. Built-in 6ch audio DACs and 2ch audio ADCs could give the variable function solutions.

High Performance Memory Storage Device: As the core of Portable DVD players need more capability to support current multimedia contents. The MT1389L provides the interface for the 3-in-1 card reader, which supports Memory-Stick, Secure Digital Memory Card, and MultiMediaCard, to connect with the mainstream digital camera FLASH cards. For the USB application, we adopt **USB2.0 High speed** specification to reach rich-contents transference. **USB 2.0 High speed** will support for high-speed devices. **USB 2.0 High Speed** is suitable for high-performance devices such as high-density storage devices. In addition, **USB 2.0 High Speed** supports old USB 1.0/1.1 software and peripherals, offering impressive and even better compatibility to customers



DVD Player System Diagram Using MT1389L

Key Features

- RF/Servo/MPEG Integration
- DivX Home Theater Level MPEG4 ASP Video decoder
- Support Nero-Digital
- Support DivX Ultra
- High Performance Audio Processor
- Progressive Scan
- 108MHz/12-bit, 4 CH TV Encoder
- Internal 6CH Audio DAC
- Internal 2CH Audio ADC
- USB2.0 High Speed (Host/Device)
- 3-in-1 MS/SD/MMC reader

Applications

Standard DVD Players

2 Key Features

- RF/Servo/MPEG Integration
- Embedded 6ch Audio DAC
- Embedded 2ch Audio ADC for Karaoke
- High Performance Audio Processor
- High Performance Progressive Video Processor
- Support Nero-Digital
- Support DivX Ultra
- High Quality 108MHz/12-bit, 4 CH TV Encoder
- USB 2.0 High-Speed

3 Applications

- Standard DVD Players
- DVD Players Home Theater Application
- Portable DVD Players
- TV/DVD Combo Systems

4 General Feature lists

■ Super Integration DVD player single chip

- High performance analog RF amplifier
- Servo controller and data channel processing
- MPEG-1/MPEG-2/JPEG video
- Dolby AC-3/DTS Decoder
- Unified memory architecture
- Versatile video scaling & quality enhancement
- OSD & Sub-picture
- Built-in clock generator
- Built-in high quality TV encoder
- Built-in progressive video processor
- Audio effect post-processor
- Built-in 5.1-ch Audio DAC
- Built-in 2-ch Audio ADC for Karaoke
- USB 2.0 High-Speed
- MS/SD/MMC 3-in-1 card reader

■ Speed Performance on Servo/Channel

Decoding

- DVD-ROM up to 4XS
- CD-ROM up to 24XS

■ Channel Data Processor

- Digital data slicer for small jitter capability
- Built-in high performance data PLL for channel data demodulation
- EFM/EFM+ data demodulation
- Enhanced channel data frame sync protection & DVD-ROM sector sync protection

■ Servo Control and Spindle Motor Control

- Programmable frequency error gain and phase error gain of spindle PLL to control spindle motor on CLV and CAV mode
- Built-in ADCs and DACs for digital servo control
- Provide 2 general PWM
- Tray control can be PWM output or digital output

■ Embedded Micro controller

- Built-in 8032 micro controller
- Built-in internal 373 and 8-bit programmable lower address port
- 1024-bytes on-chip RAM

- Up to 2M bytes FLASH-programming interface
- Supports 5/3.3-Volt. FLASH interface
- Supports power-down mode
- Supports additional serial port

■ DVD-ROM/CD-ROM Decoding Logic

- High-speed ECC logic capable of correcting one error per each P-codeword or Q-codeword
- Automatic sector Mode and Form detection
- Automatic sector Header verification
- Decoder Error Notification Interrupt that signals various decoder errors
- Provide error correction acceleration

■ Buffer Memory Controller

- Supports 16Mb/32Mb/64Mb SDRAM
- Supports 16-bit SDRAM data bus
- Provides the self-refresh mode SDRAM
- Block-based sector addressing

■ Video Decode

- Decodes MPEG1 video and MPEG2 main level, main profile video (720/480 and 720x576)
- Decodes MPEG-4 Advanced Simple Profile
- Support DivX 3.11/4.x/5.x Home Theater Profile
- Support Nero-Digital
- Support DivX Ultra
- Smooth digest view function with I, P and B picture decoding
- Baseline, extended-sequential and progressive JPEG image decoding
- Support CD-G titles

■ Video/OSD/SPU/HLI Processor

- Arbitrary ratio vertical/horizontal scaling of video, from 0.25X to 256X
- 65535/256/16/4/2-color bitmap format OSD,
- 256/16 color RLC format OSD
- Automatic scrolling of OSD image

■ Audio Effect Processing

- Dolby Digital (AC-3)/EX decoding
- DTS/DTS-ES decoding
- MPEG-1 layer 1/layer 2 audio decoding

- High Definition Compatible Digital (HDCD)
- Windows Media Audio (WMA)
- Dolby ProLogic II
- Concurrent multi-channel and downmix out
- IEC 60958/61937 output
 - PCM / bit stream / mute mode
 - Custom IEC latency up to 2 frames
- Pink noise and white noise generator
- Karaoke functions
 - Microphone echo
 - Microphone tone control
 - Vocal mute/vocal assistant
 - Key shift up to +/- 8 keys
 - Chorus/Flanger/Harmony/Reverb
- Channel equalizer
- 3D surround processing include virtual surround and speaker separation

■ TV Encoder

- Four 108MHz/12bit DACs
- Support NTSC, PAL-BDGHINM, PAL-60
- Support 525p, 625p progressive TV format
- Automatically turn off unconnected channels
- Support PC monitor (VGA)
- Support Macrovision 7.1 L1, Macrovision 525P and 625P
- CGMS-A/WSS
- Closed Caption

■ Progressive Scan Video

- Automatic detect film or video source
- 3:2 pull down source detection
- Advanced Motion adaptive de-interlace
- Minimum external memory requirement

■ External Interface

- USB2.0 High Speed (Host/Device)
- Memory-Stick, Secure Digital Memory Card, and MultiMediaCard Interface

■ Outline

- 128-pin LQFP package
- 3.3/1.8-Volt. Dual operating voltages

5 Pin Definitions

Abbreviations:

- SR: Slew Rate
- PU: Pull Up
- PD: Pull Down
- SMT: Schmitt Trigger
- 4mA~16mA: Output buffer driving strength.

Pin	Main	Alt.	Type	Description
Analog Interface (66)				
125	RFIP		Analog Input	AC coupled DVD RF signal input RFIP
126	RFIN	OPOUT	Analog Input	AC coupled DVD RF signal input RFIN
127	RFG	OPINP	Analog Input	Main beam, RF AC input path
128	RFH	OPINN	Analog Input	Main beam, RF AC input path
1	RFA		Analog Input	RF main beam input A
2	RFB		Analog Input	RF main beam input B
3	RFC		Analog Input	RF main beam input C
4	RFD		Analog Input	RF main beam input D
5	RFE		Analog Input	RF sub beam input E
6	RFF		Analog Input	RF sub beam input E
7	AVDD18_2		Analog power	Analog 1.8V power
8	AVDD33_1		Analog Power	Analog 3.3V power
9	XTALI		Input	27MHz crystal input
10	XTALO		Output	27MHz crystal output
11	AGND33		Analog Ground	Analog Ground
12	V20		Analog output	Reference voltage 2.0V
13	V14		Analog output	Reference voltage 1.4V
14	REXT		Analog Input	Current reference input. It generates reference current for RF path. Connect an external 15K resistor to this pin and AVSS
15	MDI1		Analog Input	Laser power monitor input

Pin	Main	Alt.	Type	Description
16	MDI2		Analog Input	Laser power monitor input
17	LDO1		Analog Output	Laser driver output
18	LDO2		Analog Output	Laser driver output
19	AVDD33_2		Analog Power	Analog 3.3V power
20	DMO		Analog Output	Disk motor control output. PWM output
21	FMO		Analog Output	Feed motor control. PWM output
22	TRAY_OPEN		Analog Output	Tray PWM output/Tray open output
23	TRAY_CLOSE		Analog Output	Tray PWM output/Tray close output
24	TRO		Analog Output	Tracking servo output. PDM output of tracking servo compensator
25	FOO		Analog Output	Focus servo output. PDM output of focus servo compensator
26	FG	GPIO2	Analog	1) Motor Hall sensor input 2) GPIO
27	USB_DP		Analog Inout	USB port DPLUS analog pin
28	USB_DM		Analog Inout	USB port DMINUS analog pin
29	VDD33_USB		USB Power	USB Power pin 3.3V
30	VSS33_USB		USB Ground	USB ground pin
31	PAD_VRT		Analog Inout	USB generating reference current
32	VDD18_USB		USB Power	USB Power pin 1.8V
95	DACVDDC		Power	3.3V power pin for video DAC circuitry
96	VREF		Analog	Bandgap reference voltage
97	FS		Analog	Full scale adjustment (suggest to use 560 ohm)
98	DACVSSC		Ground	Ground pin for video DAC circuitry
99	CVBS		Analog	Analog composite output
100	DACVDDB		Power	3.3V power pin for video DAC circuitry
101	DACVDDA		Power	3.3V power pin for video DAC circuitry
102	Y/G		Analog	Green, Y, SY, or CVBS
103	B/CB/PB		Analog	Blue, CB/PB, or SC

Pin	Main	Alt.	Type	Description
104	R/CR/PR		Analog	Red, CR/PR, CVBS, or SY
105	AADVSS		Ground	Ground pin for 2ch audio ADC circuitry
106	AKIN2		Analog	1) Audio ADC input 2 2) MS_CLK set B 3) MCDATA 4) Audio Mute 5) HSYN/VSYN output 6) C5 7) GPIO
107	ADVCM		Analog	1) 2ch audio ADC reference voltageC 2) C6 3) GPIO
108	AKIN1		Analog	1) Audio ADC input 1 2) MS_D0 set B 3) Audio Mute 4) HSYN/VSYN output 5) C7 6) GPIO
109	AADVDD		Power	3.3V power pin for 2ch audio ADC circuitry
110	APLLVDD3		Power	3.3V Power pin for audio clock circuitry
111	APLLCAP		Analog InOut	APLL external capacitance connection
112	ADACVSS2		Ground	Ground pin for audio DAC circuitry
113	ADACVSS1		Ground	Ground pin for audio DAC circuitry
114	ARF / LFE	GPIO	Analog Output	1) Audio DAC sub-woofer channel output 2) While internal audio DAC not used: a. ACLK b. GPIO
115	ARS	GPIO	Analog Output	1) Audio DAC right Surround channel output 2) While internal audio DAC not used: a. ABCK b. GPIO

Pin	Main	Alt.	Type	Description
116	AR	GPIO	Analog Output	1) Audio DAC right channel output 2) While internal audio DAC not used: a. SDATA2 b. GPIO c. RXD2
117	AVCM		Analog	Audio DAC reference voltage
118	AL	GPIO	Analog Output	1) Audio DAC left channel output 2) While internal audio DAC not used: a. SDATA1 b. GPIO c. RXD1
119	ALS	GPIO	Analog Output	1) Audio DAC left Surround channel output 2) While internal audio DAC not used: a. ALRCK b. GPIO
120	ALF /CENTER	GPIO	Analog Output	1) Audio DAC center channel output 2) While internal audio DAC not used: a. ASDATA0 b. GPIO
121	ADACVDD1		Analog Power	3.3V power pin for audio DAC circuitry
122	ADACVDD2		Analog Power	3.3V power pin for audio DAC circuitry
123	AVDD18_1		Analog Power	Analog 1.8V power
124	AGND18		Analog Ground	Analog Ground
General Power/Ground (7)				
54, 90	DVDD18		Power	1.8V power pin for internal digital circuitry
79	DVSS18		Ground	1.8V Ground pin for internal digital circuitry
50, 68,84	DVDD33		Power	3.3V power pin for internal digital circuitry
60	DVSS		Ground	3.3V Ground pin for internal digital circuitry
Micro Controller , Flash Interface and GPIO(12)				
33	GPIO3	INT#	InOut 8mA, SR PD, SMT	1) General purpose IO 3 2) Microcontroller external interrupt 1
34	GPIO4		InOut 4mA, PD	General purpose IO 4

Pin	Main	Alt.	Type	Description
35	GPIO6		InOut 4mA, PD	General purpose IO 6
36	SF_CS_		InOut 8mA, SR PU, SMT	Serial Flash Chip Select
37	SF_DO		InOut 8mA, SR PD, SMT	Serial Flash Dout
38	SF_DI		InOut 8mA, SR PU, SMT	Serial Flash Din
39	SF_CK		InOut 8mA, SR PD, SMT	Serial Flash Clock
40	UP1_6	SCL	InOut 4mA, SR PU, SMT	1) Microcontroller port 1-6 2) I ² C clock pin
41	UP1_7	SDA	InOut 4mA, SR PU, SMT	1) Microcontroller port 1-7 2) I ² C data pin
42	ICE		Input PD, SMT	Microcontroller ICE mode enable
43	PRST#		Input PU, SMT	Power on reset input, active low
44	IR		Input SMT	IR control signal input
Dram Interface (37) (Sorted by position)				
45	RD0		InOut, 4mA	DRAM data 0

Pin	Main	Alt.	Type	Description
46	RD1		InOut 4mA	DRAM data 1
47	RD2		InOut 4mA	DRAM data 2
48	RD3		InOut 4mA	DRAM data 3
49	RD4		InOut 4mA	DRAM data 4
51	RD5		InOut 4mA	DRAM data 5
52	RD6		InOut 4mA	DRAM data 6
53	RD7		InOut 4mA	DRAM data 7
55	DQM0		InOut 4mA, PD	Data mask 0
56	RD15		InOut 4mA	DRAM data 15
57	RD14		InOut 4mA	DRAM data 14
58	RD13		InOut 4mA	DRAM data 13
59	RD12		InOut 4mA	DRAM data 12
61	RD11		InOut 4mA	DRAM data 11
62	RD10		InOut 4mA	DRAM data 10
63	RD9		InOut 4mA	DRAM data 9
64	RD8		InOut 4mA	DRAM data 8

Pin	Main	Alt.	Type	Description
65	DQM1		InOut 4mA, PD	Data mask 1
66	RCLK		InOut 4mA, PD	Dram clock
67	RA11		InOut 4mA, PD	DRAM address bit 11
69	RA9		InOut 4mA, PD	DRAM address 9
70	RA8		InOut 4mA, PD	DRAM address 8
71	RA7		InOut 4mA, PD	DRAM address 7
72	RA6		InOut 4mA, PD	DRAM address 6
73	RA5		InOut 4mA, PD	DRAM address 5
74	RA4		InOut 4mA, PD	DRAM address 4
75	RWE#		Output 4mA, PD	DRAM Write enable, active low
76	CAS#		Output 4mA, PD	DRAM column address strobe, active low
77	RAS#		Output 4mA, PD	DRAM row address strobe, active low
78	BA0		InOut 4mA, PD	DRAM bank address 0
80	BA1		InOut 4mA, PD	DRAM bank address 1
81	RA10		InOut 4mA, PD	DRAM address 10

Pin	Main	Alt.	Type	Description
82	RA0		InOut 4mA, PD	DRAM address 0
83	RA1		InOut 4mA, PD	DRAM address 1
85	RA2		InOut 4mA, PD	DRAM address 2
86	RA3		InOut 4mA, PD	DRAM address 3
87	GPIO7	CKE	InOut 4mA, PD	1) GPIO 7 2) Dram Clock Enable 3) MS_CLK set A 4) Audio Mute 5) HSYN/VSYN input 6) C0
GPIO (6)				
88	GPIO8		InOut 4mA, PD	1) GPIO8 2) MS_BS set A 3) SD_CLK set A 4) ASDATA2 5) ACLK 6) Audio Mute 7) HSYN/VSYN input 8) C1
89	GPIO9		InOut 4mA, PU	1) GPIO9 2) MS_D0 set A 3) SD_CMD set A 4) ASDATA1 5) ABCK 6) C2 7) RXD1

Pin	Main	Alt.	Type	Description
91	GPIO10		InOut 4mA, PD	1) GPIO10 2) SD_CLK set B 3) SD_D0 set A 4) ASDATA0 5) ALRCK 6) HSYN/VSYN output 7) C3 8) TXD1
92	GPIO11		InOut 4mA, PD	1) GPIO11 2) SD_CMD set B 3) MS_BS set B 4) Audio Mute 5) HSYN/VSYN output 6) C4
93	SPDIF	GPIO12	InOut 2mA, PD	1) SPDIF output 2) GPIO12
94	GPIO13		InOut 4mA, PD	1) GPIO13 2) SD_D0 set B 3) ALRCK 4) Audio Mute 5) YUVCLK

Note:

1. The Main column is the main function, Alt. means alternative function.
2. The multi-function GPIO pins are set to green characters.

3.5.2 function introduction to T118B

1. General Description

The T118B is a highly integrated All-in-one Visual Processor that provides major cost saving solution for the portable applications. T118B has built-in high performance dual ADCs (support YCbCr), TCON, Triple DACs, Scaling Machine with sophisticated upscaling and downscaling algorithms.

The Innovative integrated “Frame-Buffer-Less” De-interlacer can significantly reduce system cost. The T118B also integrates On Screen Display engine with 3K-words of font RAM and built-in 1K-words of font ROM. The device can interface to an external micro-controller through 2-wire serial bus interface.

2. Applications

1. 1.8-inch to 10-inch portable DVD or in-car TV
2. Progressive CRT TV

3 Pin Description

Table 1-1 Pin Description

Symbol	Pin #	Type	Description
Power Supplies			
VDD18	8,26	PWR	+1.8V digital core power supply
VDD33	22,36	PWR	+3.3V digital output power supply,
VD5A	38	PWR	+5.0V analog power supply
VD33ADC1 VD33ADC2	63	PWR	+3.3V analog power supply for ADC
VD33DAC VD33PWM	47	PWR	+3.3V analog power supply for DAC
GND	7,21,27,37	GND	Digital ground
VS18PLL	48	GND	Analog ground for PLL
VS33ADC1 VS33ADC2	64	GND	Analog ground for ADC
VS33DAC	39	GND	Analog ground for DAC
VS33PWM	62	GND	Analog ground for backlight inverter
Output Interface Signals			
RSET	43	AO	DAC reference current adjustment
VBFG	44	AO	Voltage reference output
IOR	42	AO	Channel R current output
IOG	41	AO	Channel G current output
IOB	40	AO	Channel B current output
CPH1	25	DO	Output data clock
CPH2/sD0	28	DO	Output data clock/the bit 0 of serial interfaced panel
CPH3/sD1	29	DO	Output data clock/the bit 1 of serial interfaced panel
VSO/STH1	23	DO	Vertical synchronization output signal.
HSO/POL	20	DO	Horizontal synchronization output signal.
DEN/STH2	24	DO	Horizontal data enable
Timing Controller Interface Signals			
UD	19	DO	Vertical Up/Down control
RL	18	DO	Horizontal Right/Left control
Q1H/sD2	30	DO	Source Driver Q1H/the bit 2 of serial interfaced panel
LP/sD3	31	DO	Latch pulse for source driver/the bit 3 of serial interfaced panel
GCLK/sD4	32	DO	Gate driver clock/the bit 4 of serial interfaced panel
GOE/sD5	33	DO	Gate driver output enable/the bit 5 of serial interfaced panel
STV1/sD6	34	DO	Gate Driver start pulse/the bit 6 of serial interfaced panel
STV2/sD7	35	DO	Gate Driver start pulse/the bit 7 of serial interfaced panel
VCOMAMP	45	DO	Analog VCOM amplitude
VCOMDC	46	DO	Analog VCOM DC offset
2-wire serial bus Interface Signals			
SCL	11	DI	2-wire serial bus clock. Power down does not affect SCL.
SDA/IICA3	10	I/O	2-wire serial bus data. Power down does not affect SDA.
Configuration interface Signals			
CPUINT	12	I/O	Internal Interrupt.
RSTB	9	DI	Whole chip reset. (Internal Pull-up)

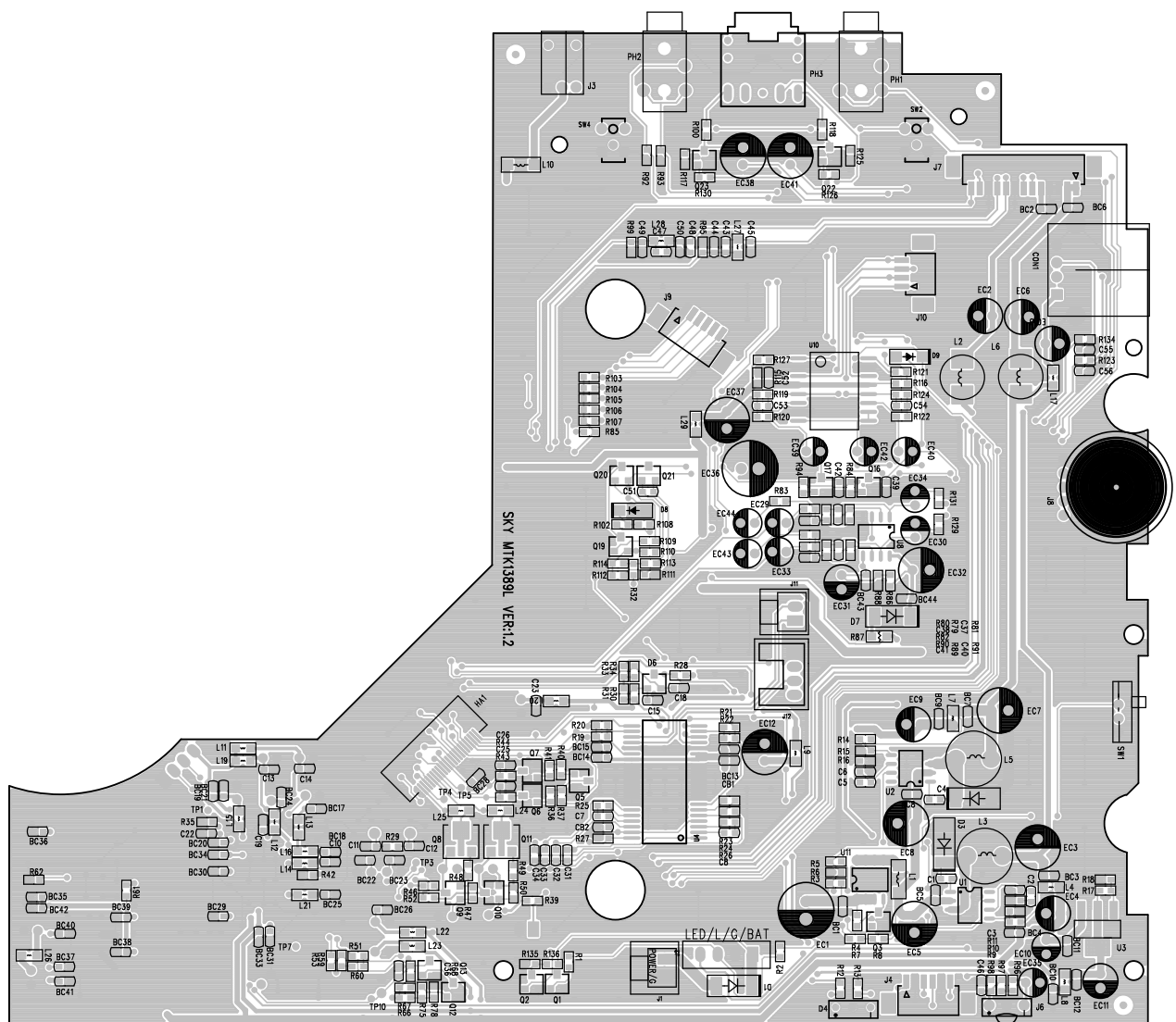
Symbol	Pin #	Type	Description
ADC Interface			
AY1	1	AI	Analog input 1 of input channel 2
AY0	2	AI	Analog input 0 of input channel 2
ACR1	3	AI	Analog input 1 of input channel 1
ACR0	4	AI	Analog input 0 of input channel 1
ACB1	5	AI	Analog input 1 of input channel 3
ACB0	6	AI	Analog input 0 of input channel 3
PLL Reference Clock			
XTALI	13	DI	Output PLL reference clock input
XTALO	14	DO	Output PLL reference clock output
XCLK2MC	15	DO	Buffered XTALI for external microprocessor.
Power Management Interface Signals			
PWM1	16	DO	Pulse Width Modulation for volume/backlight control.
PWM2	17	DO	Pulse Width Modulation for volume/backlight control.
VEA	49	AO	Error amplifier output
CSS	50	AO	Soft start pin
VFB	51	AI	Feedback of Lamp current
CEXT	52	AO	Switching frequency of DC-DC converter
VPWM	53	AO	PWM output, connect to external N-channel power MOSFET
VEAL	54	AO	Error Amplifier output
VFBL	55	AI	Feedback of Lamp current
VPWML	56	AO	PWM output, drive NMOSFET switch
CSSL	57	AO	Soft start pin
CEXTL	58	AO	Switching frequency of Inverter
VIsenL	59	AI	Current sense
VIsen	60	AI	Current sense
NC	61	N/A	

Chapter Cinque

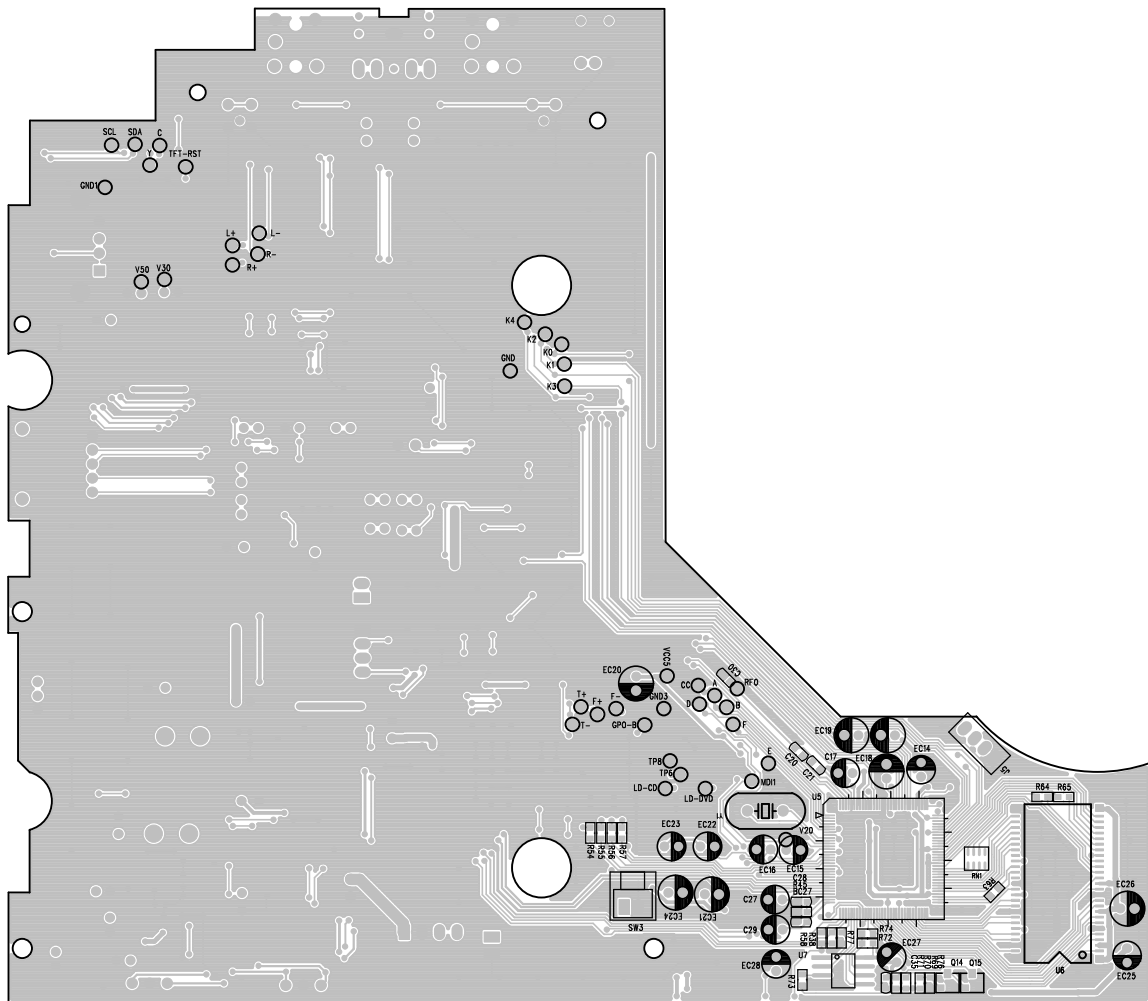
PCB board & Circuit diagram

Section One PCB board

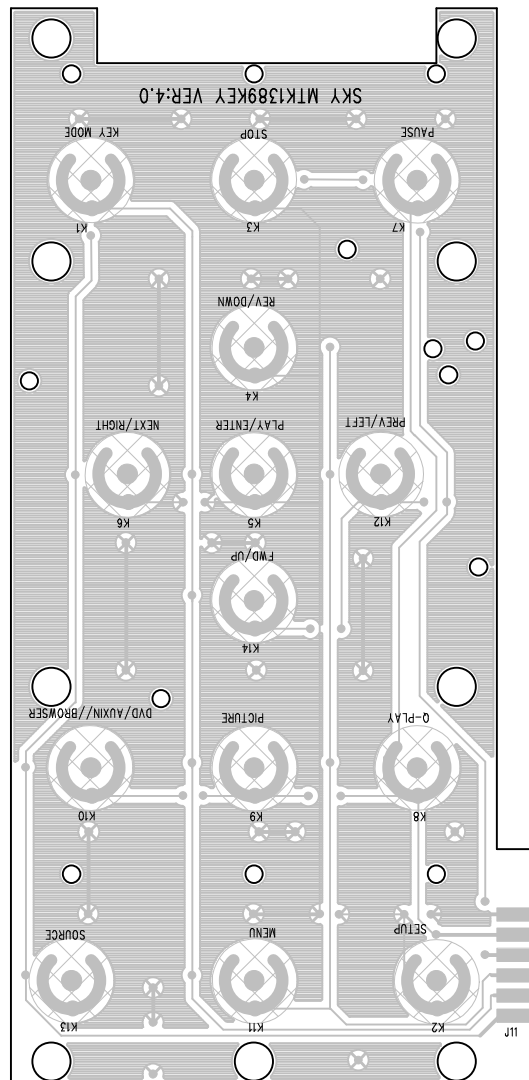
5.1.1 Bottom layer of DECODE Board



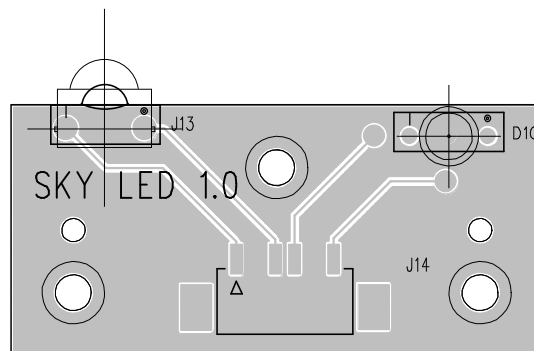
5.1.2 Bottom layer of DECODE Board



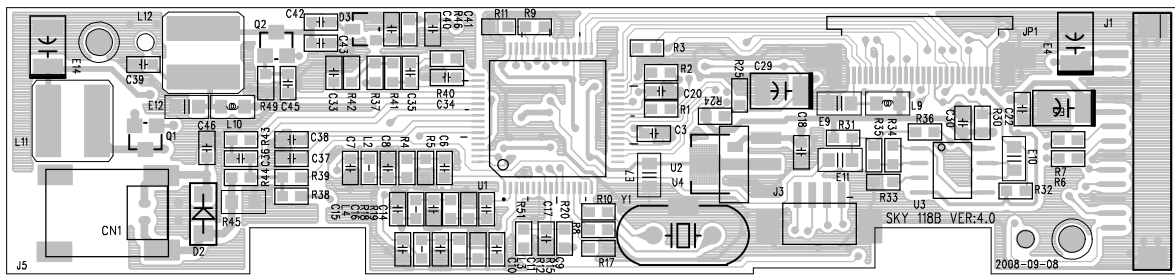
5.1.3 Surface layer of KEY SCAN Board



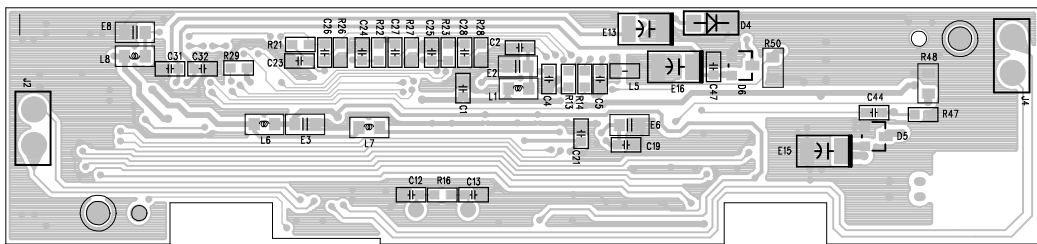
5.1.4 Surface layer of LED/IR Board

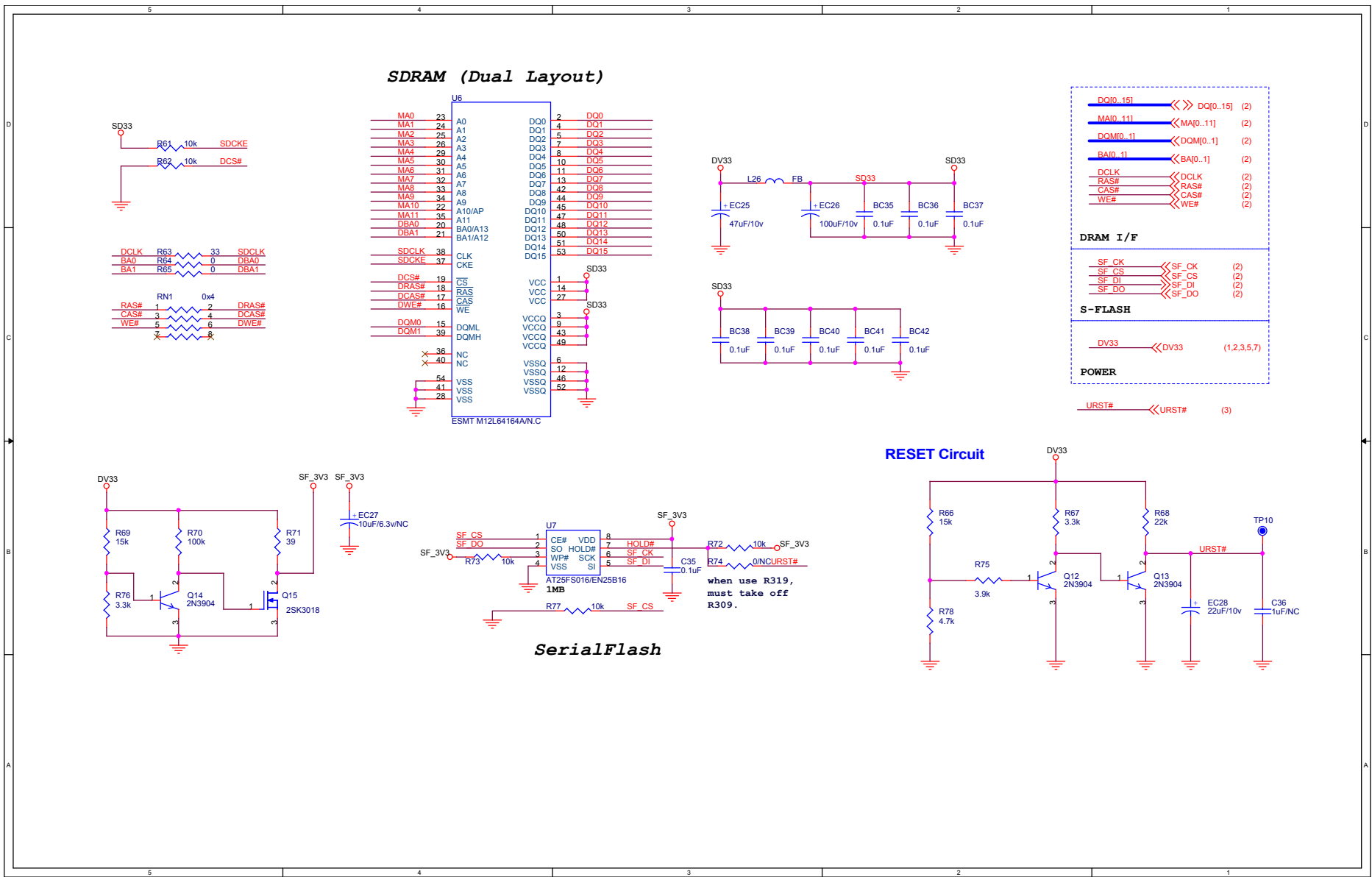


5.1.5 Surface layer of Drive Board

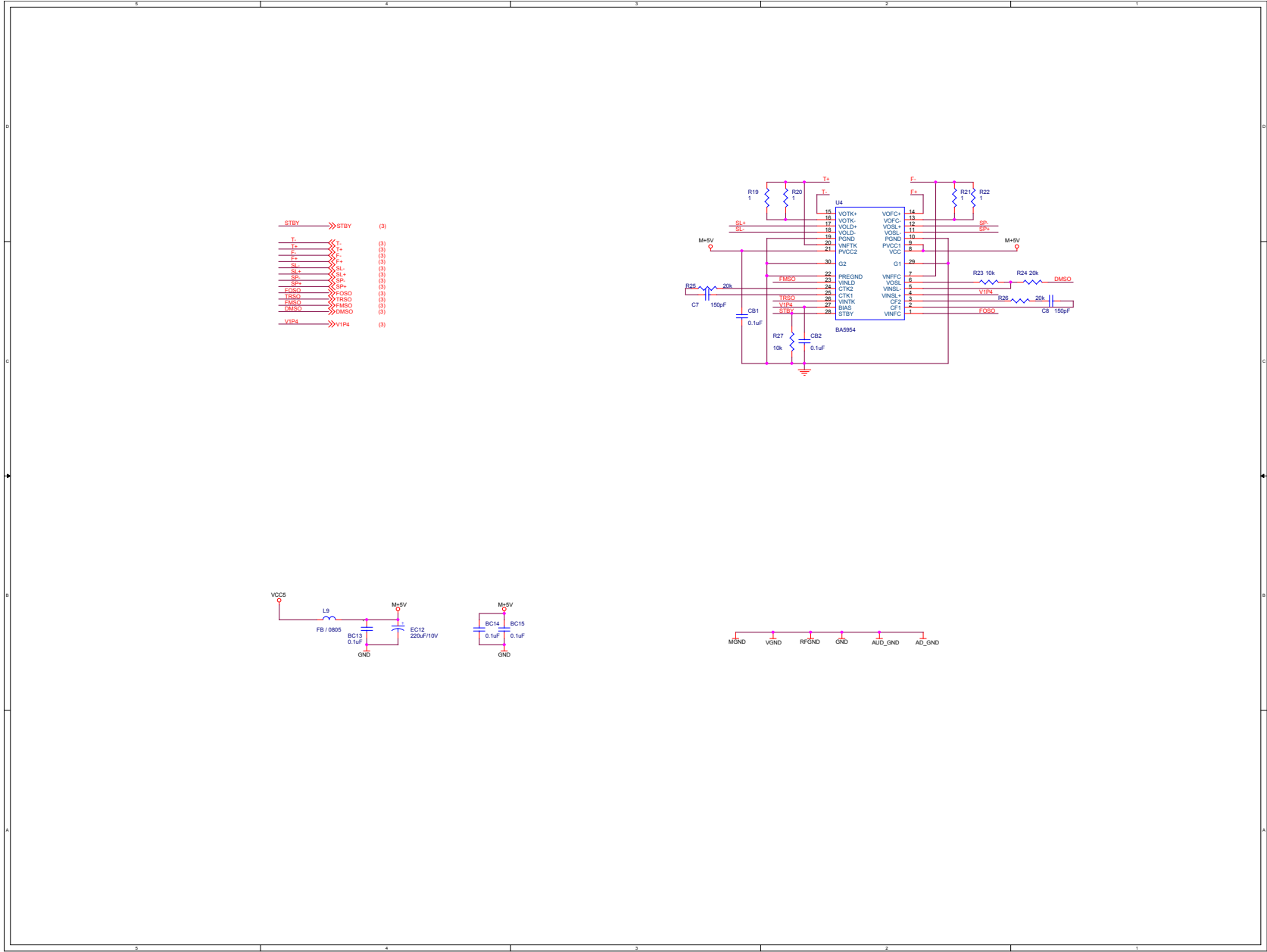


5.1.6 Bottom layer of Drive Board

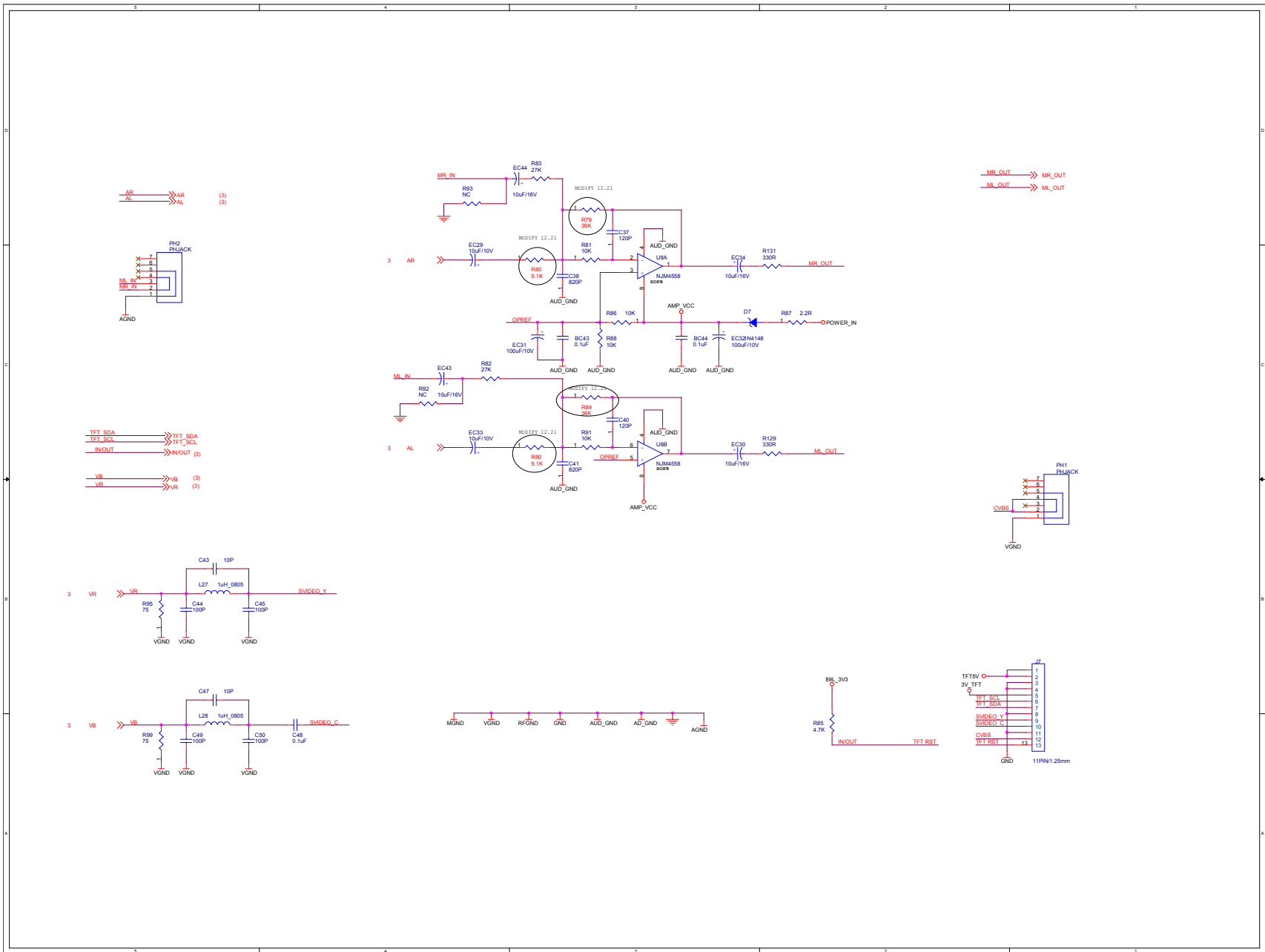




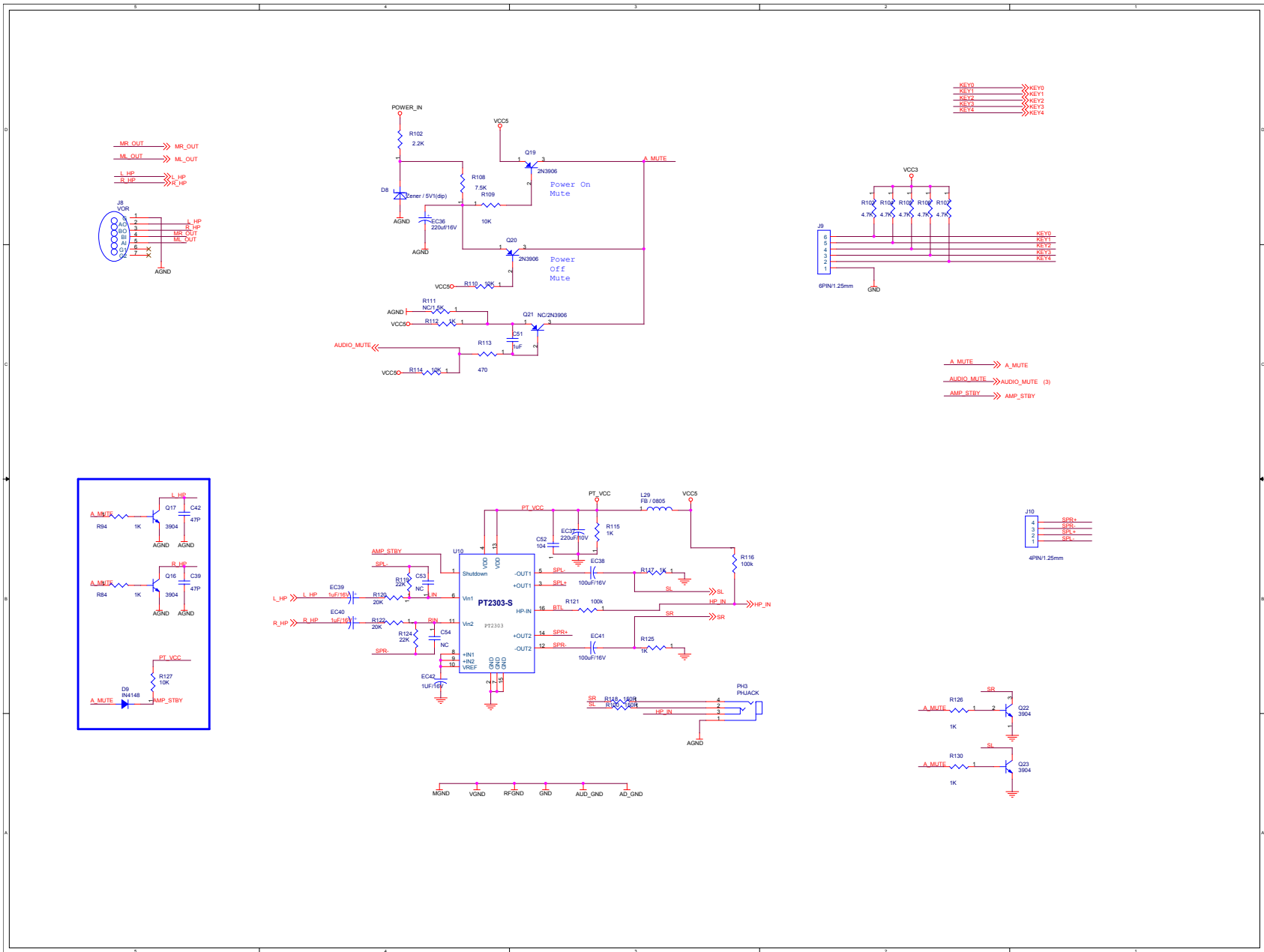
5.2.3 DECODE Board 3



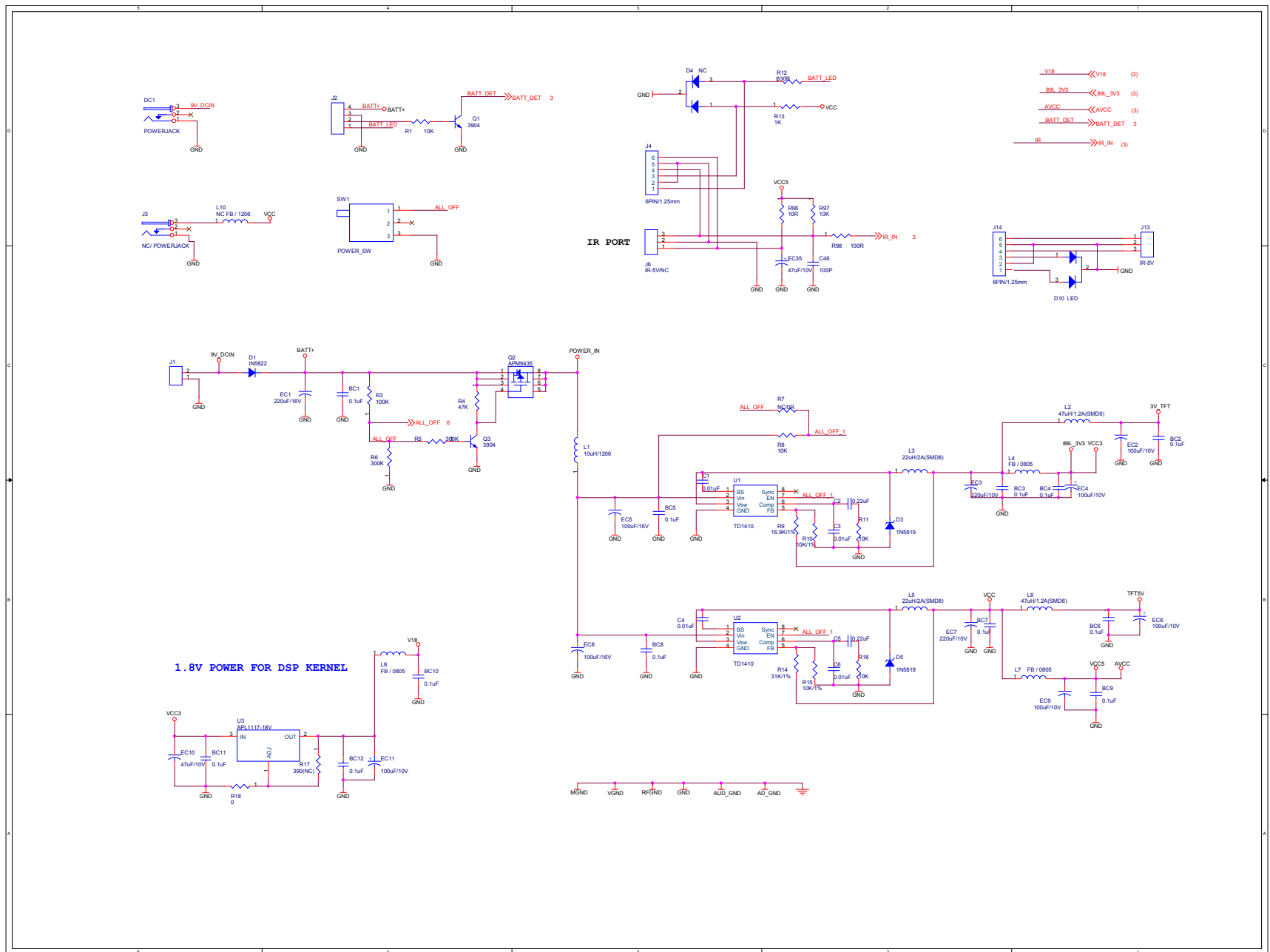
5.2.4 DECODE Board 4



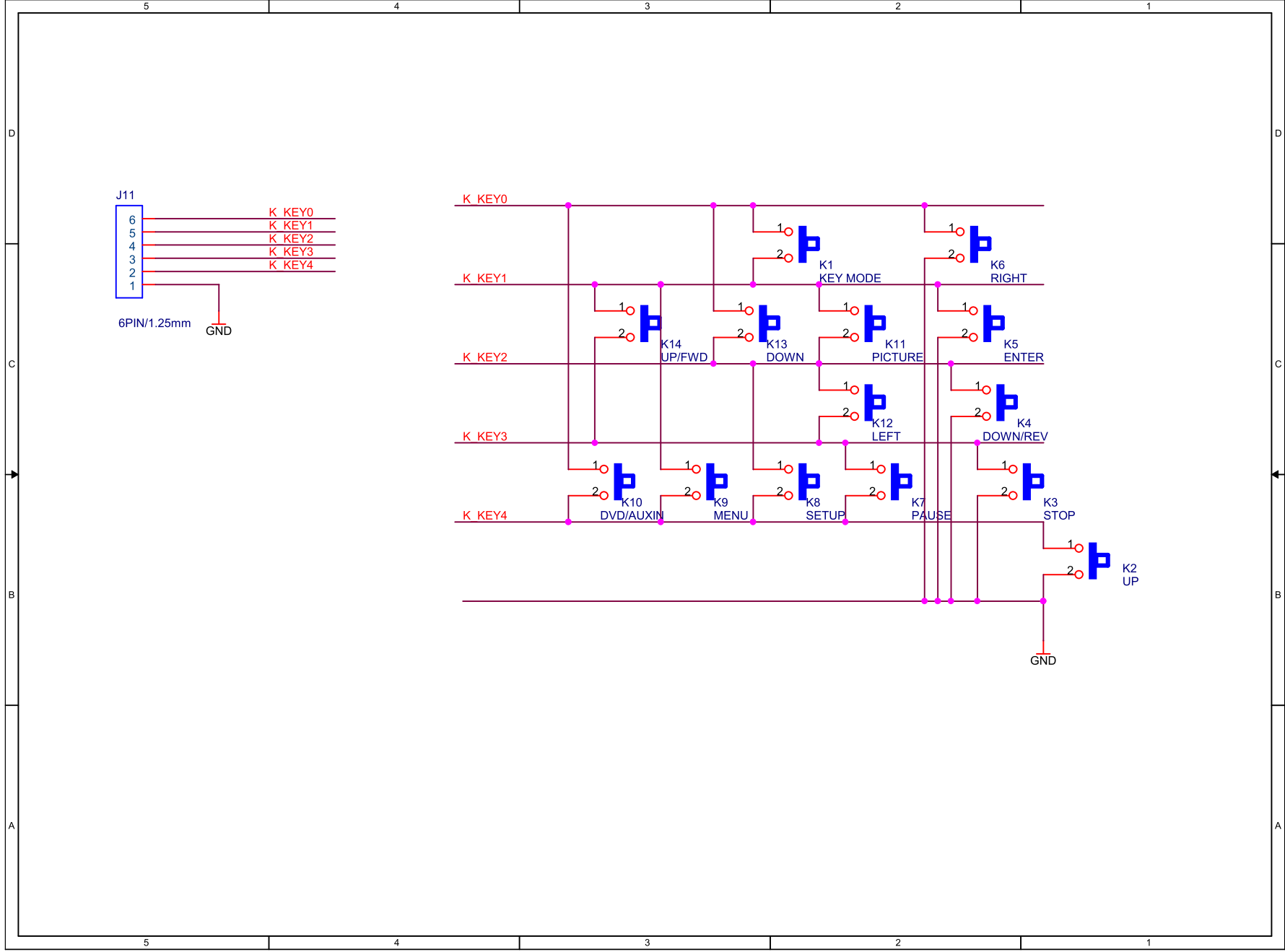
5.2.5 DECODE Board 5



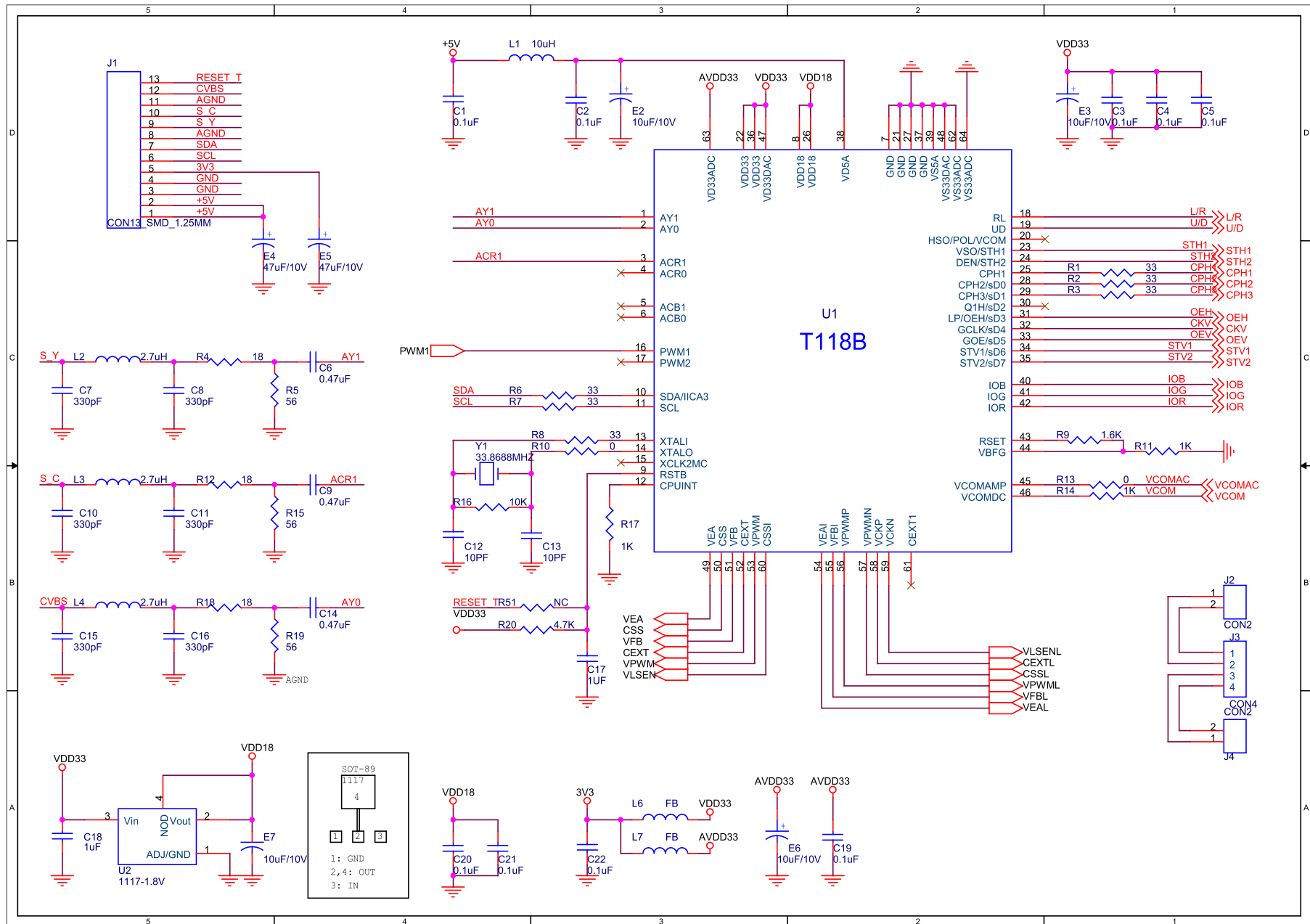
5.2.6 DECODE Board



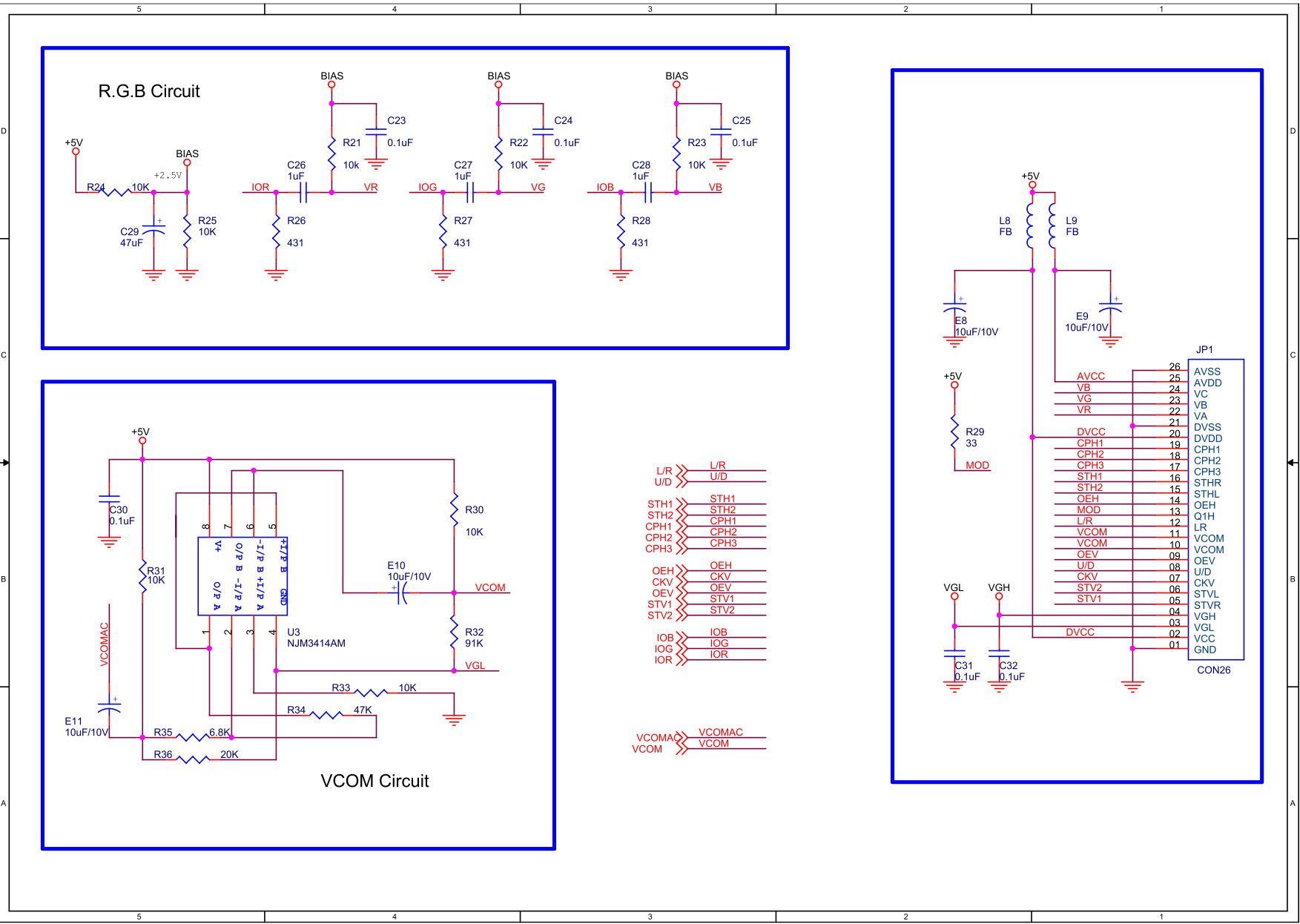
5.2.7 Key Board



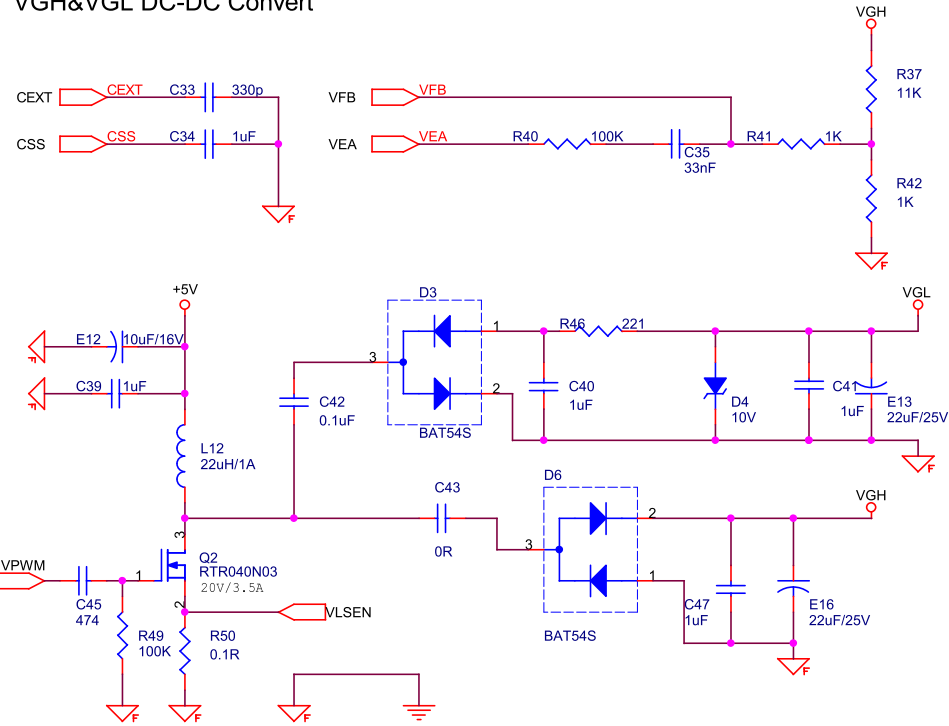
5.2.8 Drive Board



5.2.9 Battery charge Board



VGH&VGL DC-DC Convert



LED DC-DC Convert

