

A close-up photograph of a television circuit board, likely an IDTV (Integrated Digital Television) board. The board is green with various electronic components. A large, dark integrated circuit (IC) is the central focus, with numerous gold-plated pins visible along its edges. To the left of the IC, there are several smaller components, including capacitors and resistors, labeled with white text: 'C108', 'C107', 'C113', 'C112', and 'U5'. The background is blurred, showing other parts of the board and some lighting artifacts.

MB140R IDTV SERVICE MANUAL

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IMPORTANT

Before removing the rear cover from the TV for servicing, make sure that no cables are fixated to the cover. Release the cables from their clamps and disconnect (if any). Failure to do so may damage the wires and/or other components of the TV.

1. INTRODUCTION

17MB140R main board is driven by MStar SOC. This IC is a single chip iDTV solution that supports channel decoding, MPEG decoding, and media-center functionality enabled by a high performance AV CODEC and CPU.

Key features include:

- Combo Front-End Demodulator
- A multi standart A/V format decoder
- Mstar high performance video processor
- Home theatre sound processor
- Embedded memory for optimized BOM cost
- Multiple HDMI 1.4 compliant ports with ARC support
- One MHL 2.1 compliant port
- Transport-Stream input for extended DTV system
- Support for mini LVDS tconless cell

Supported peripherals are:

- 1 RF input VHF I, VHF III, UHF
- 1 Satellite input
- 2 HDMI input (2side)
- 1 Common interface(Common)
- 1 Coax S/PDIF output
- 1 Headphone(Common)
- 1 USB(Common)

2. T/T2/C/A TUNER (U15)

Description:

The Si2151 is Silicon Labs' sixth-generation hybrid TV tuner supporting all worldwide terrestrial and cable TV standards. Requiring no external balun, SAW filters, wirewound inductors or LNAs, the Si2151 offers the lowest-cost BOM for a hybrid TV tuner. Also included are an integrated power-on reset circuit and an option for single power supply operation. As with prior-generation Silicon Labs TV tuners, the Si2151 maintains very high linearity and low noise to deliver superior picture quality and a higher number of received stations when compared to other silicon tuners. The Si2151 offers increased immunity to WiFi and LTE interference, eliminating the need for external filtering. For the best performance with next-generation digital TV standards, such as DVB-T2/C2, the Si2151 delivers industry-leading phase noise performance.

Features:

- Worldwide hybrid TV tuner
 - Analog TV: NTSC, PAL/SECAM
 - Digital TV: ATSC/QAM, DVB-T2/T/C2/C, ISDB-T/C, DTMB
 - 1.7 MHz, 6MHz, 7MHz, 8MHz and 10MHz channel bandwidths
 - 42-1002 MHz frequency range
- Industry-leading margin to A/74, NorDig, DTG, ARIB, EN55020, OpenCable™, DTMB
- Lowest BOM for a hybrid TV tuner
 - No balun, SAW filters, or external inductors required
 - Increased ESD protection on 4pins
- Best-in-class real-world reception
 - Lowest phase noise
 - High Wi-Fi and LTE immunity
- Low power consumption
 - 3.3 V and 1.8 V power supplies
 - Integrated 1.8 V LDO for 3.3 V single-supply operation
- Integrated power-on reset circuit
- Standard CMOS process
- 3x3 mm, 24-pin QFN package
- RoHS compliant

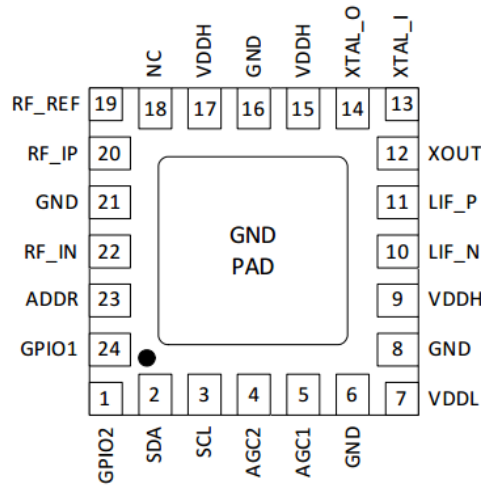


Figure 3: Pin Description

Pin Number(s)	Name	I/O
1*	GPIO2	I/O
2	SDA	I/O
3	SCL	I
4*	AGC2	I
5*	AGC1	I
6	GND	S
7	VDDL	S
8	GND	S
9	VDDH	S
10	LIF_N	O
11*	LIF_P	O
12	XOUT	O
13	XTAL_I	I
14	XTAL_O	O
15	VDDH	S
16	GND	S
17	VDDH	S
18*	NC	NC
19	RF_REF	O
20	RF_IP	I
21	GND	S
22	RF_IN	I
23	ADDR	I
24*	GPIO1	I/O

***Note:** Pin should be left floating if unused.

Table 1: Pin Functions

3. S/S2 TUNER & DEMODULATOR (U16)

Description:

The M88TS2022 is a single-chip, direct-conversion tuner for digital satellite receiver applications. It offers the industry's most integrated solution to a satellite tuner function, simplifying the front-end designs. The device also provides an RF bypass output for driving a second tuner module.

This device incorporates the following functional blocks on a single chip: an LNA, quadrature down-converting mixers, a low phase noise and fast locking frequency synthesizer with on-chip loop filters, a DC offset cancellation loop with integrated loop filters, self calibrated programmable baseband channel filters, an integrated RF AGC loop, and crystal oscillators with an integrated auxiliary clock output.

As a result of integrating all the blocks, the M88TS2022 has the least number of pins compared with other conventional solutions, and requires the least external components. In typical applications, the M88TS2022 requires only one crystal, one bypass capacitor, one matching network, and a few external resistors. The device also has the industry's smallest latency, as it uses a fast locking PLL and a fast settling DC offset cancellation architecture.

The M88TS2022 can be configured via a 2-wire serial bus. The chip is available in a 28-pin QFN package.

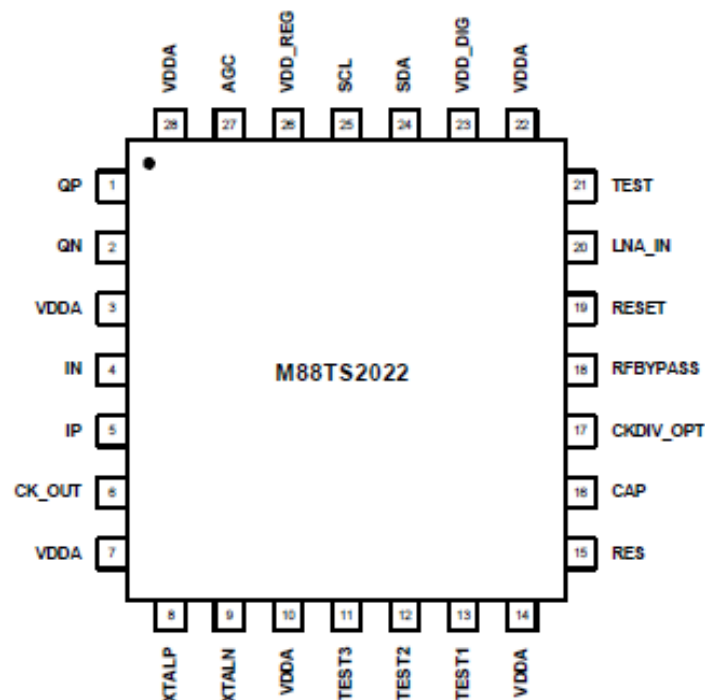


Figure 4: Pin Description

Features:

- Single-Chip tuner
- Compliant with DVB-S2 and ABS-S standards
- Support PSK(PSK and 16 PSK)
- Direct-conversion from L band to baseband
- Symbol rate 1 to 45 Msymbol/s
- Integrated VCOs and PLL, with on-chip inductors varactors and loop filter
- Integrated RF AGC for optimal performance
- Integrated baseband DC offset cancellation removes external loop filters
- Excellent immunity to strong adjacent undersired channels
- Integrated clock driver provides auxiliary divided clocks output for other devices
- Selectable RF bypass
- Support sleep mode
- 2-wire serial bus with 3.3V compatible logic levels
- Power supply +3.3V
- 28 pin QFN package
- RoSH compliant

4. AUDIO AMPLIFIER STAGE

A. MAIN AMPLIFIER (U6)

Description:

The AD52050 is a high-efficiency stereo Class-D audio amplifier with an adjustable power limit function. It operates from a 4.5V–14.4V supply and delivers 15W per channel into a 4Ω speaker at 12V supply with 10% THD+N. It features output DC detection to prevent speaker damage and auto-recovery from short circuit and over-temperature conditions. The adjustable power limit allows users to set a voltage rail lower than half of 5.5V to control current, and the amplifier ensures superior EMC performance for filter-free applications.

Features:

- Single supply voltage: 4.5V ~ 14.4V for loudspeaker driver.
- Built-in LDO output: 5.5V for other components.
- **Loudspeaker power from 12V supply:**
- BTL Mode: 8W/CH into 8Ω @ 1% THD+N.
- BTL Mode: 10W/CH into 6Ω @ <1% THD+N.

- BTL Mode: 12W/CH into 4Ω @ <1% THD+N.
- PBTL Mode: 16W/CH into 4Ω @ 1% THD+N.
- **Loudspeaker power from 12V supply :**
- BTL Mode: 10W/CH into 8Ω @ 10% THD+N.
- BTL Mode: 13W/CH into 6Ω @ 10% THD+N.
- BTL Mode: 15W/CH into 4Ω @ 10% THD+N.
- PBTL Mode: 20W/CH into 4Ω @ 10% THD+N.
- 93% efficient Class-D operation eliminates the need for a heat sink.
- Differential inputs.
- Internal oscillator.
- Short-circuit protection with auto-recovery option.
- Under-voltage detection.
- Over-voltage protection.
- Pop noise and click noise reduction.
- Adjustable power limit function for speaker protection.
- Output DC detection for speaker protection.
- Over-temperature protection with auto-recovery feature.

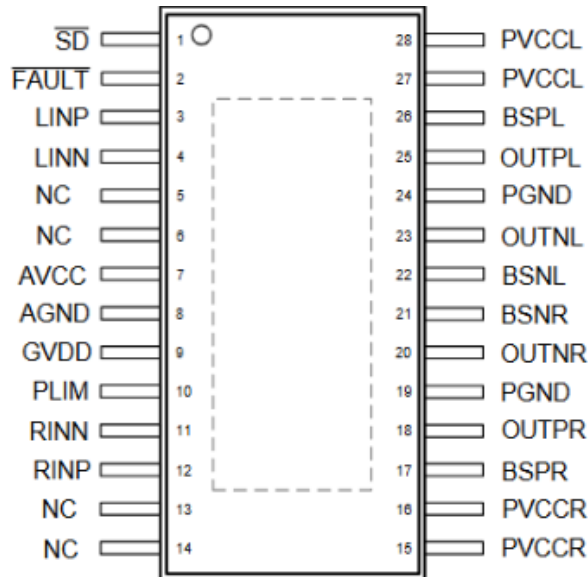


Figure 5: Pin Description

5. POWER STAGE

Power socket is used for taking voltages which are 12V_stby. These voltage are produced in power card. Also socket is used for giving dimming, backlight and stand-by signals with power card. It is shown in figure.

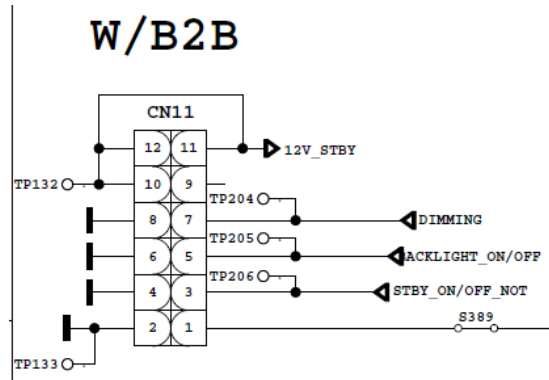


Figure 7: Power socket and power options

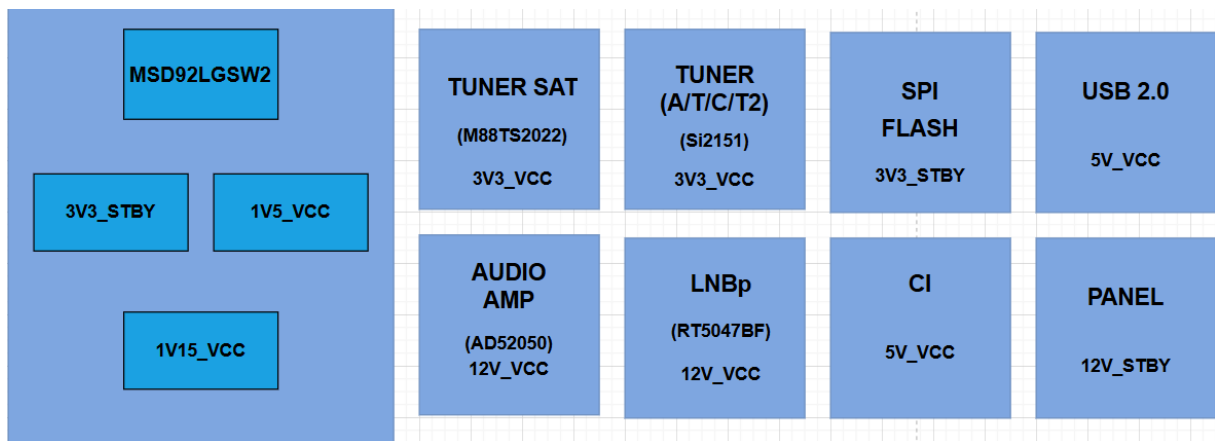


Figure 8: Power Block Diagram-1

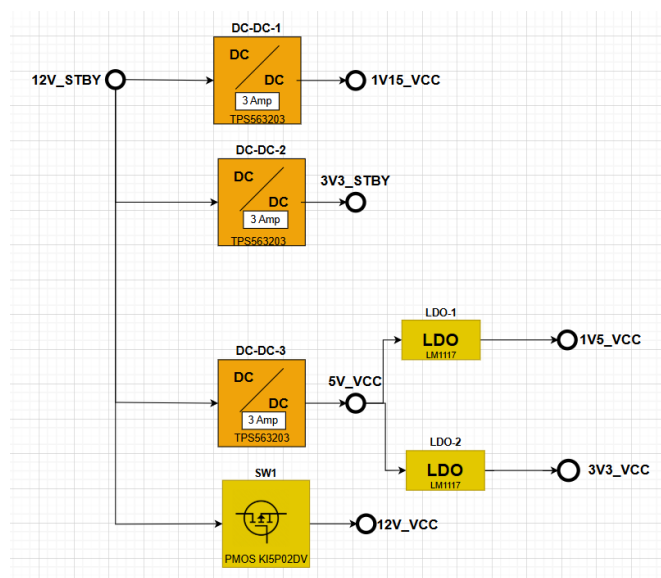


Figure 9: Power Block Diagram-2

List of the components are:

- TPS563203 (DC/DC) → U18,U19,U28
- LM1117 (LDO)→ U8,U27
- KI5P02DV (PMOS) → Q18

A. TPS563201 (U18,U19,U28)

Description:

The TPS563201 and TPS563208 are simple, easy-touse, 3A synchronous step-down converters in SOT-23 package.

The devices are designed to operate with minimum external component counts and also designed to achieve low standby current.

These switch mode power supply (SMPS) devices employ D-CAP2 control scheme providing a fast transient response and supporting both low equivalent series resistance (ESR) output capacitors such as specialty polymer and ultra-low ESR ceramic capacitors with no external compensation components.

The TPS563201 operates in pulse skip mode, which maintains high efficiency during light load operation. The TPS563201 and TPS563208 are available in a 6-pin 1.6mm × 2.9mm SOT (DDC) package, and specified from a –40°C to 125°C junction temperature.

Features:

- TPS563201 and TPS563208 3A converter integrated 95mΩ and 57mΩ FETs
- D-CAP2™ control scheme with fast transient response
- Input voltage range: 4.5V to 17V
- Output voltage range: 0.76V to 7V
- Pulse-skip mode (TPS563201) or continuous current mode (TPS563208)
- 580kHz switching frequency
- Low shutdown current less than 20μA
- 2% feedback voltage accuracy (25°C)
- Startup from prebiased output voltage
- Cycle-by-cycle overcurrent limit
- Hiccup-mode overcurrent protection
- Non-latch UVP and TSD protections
- Fixed soft start: 1.0ms

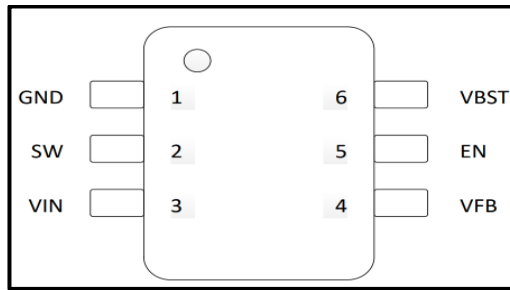


Figure 9: Pin Assignment

PIN		TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
GND	1	—	Ground pin Source terminal of low-side power NFET as well as the ground terminal for controller circuit. Connect sensitive VFB to this GND at a single point.
SW	2	O	Switch node connection between high-side NFET and low-side NFET.
VIN	3	I	Input voltage supply pin. The drain terminal of high-side power NFET.
VFB	4	I	Converter feedback input. Connect to output voltage with feedback resistor divider.
EN	5	I	Enable input control. Active high and must be pulled up to enable the device.
VBST	6	O	Supply input for the high-side NFET gate drive circuit. Connect 0.1 μ F capacitor between VBST and SW pins.

Table 4: Pin Functions

$T_J = -40^{\circ}\text{C}$ to 125°C , $V_{IN} = 12\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY CURRENT						
I _{VIN}	Operating – non-switching supply current	V _{IN} current, EN = 5 V, V _{FB} = 0.9 V	TPS563201	120	200	μA
			TPS563208	350	500	
I _{VINSDN}	Shutdown supply current	V _{IN} current, EN = 0 V		8	20	μA
LOGIC THRESHOLD						
V _{ENH}	EN high-level input voltage		1.6			V
V _{ENL}	EN low-level input voltage			0.8		V
R _{EN}	EN pin resistance to GND	V _{EN} = 1.5 V	600	1500	2400	kΩ
I _{EN}	EN pulldown current	V _{EN} = 1.5 V		1		μA
V _{FB} VOLTAGE AND DISCHARGE RESISTANCE						
V _{FBTH}	V _{FB} threshold voltage ⁽¹⁾	V _O = 1.05 V, I _O = 10 mA, Eco-mode operation		774		mV
	V _{FB} threshold voltage	V _O = 1.05 V, continuous mode operation	749	768	787	mV
I _{VFB}	V _{FB} input current	V _{FB} = 0.8 V		0	±0.1	μA
MOSFET						
R _{DS(on)h}	High-side switch resistance	T _A = 25°C, V _{BST} – SW = 5 V		95		mΩ
R _{DS(on)l}	Low-side switch resistance	T _A = 25°C		57		mΩ
CURRENT LIMIT						
I _{ocl}	Current limit	DC current, V _{OUT} = 1.05 V, L ₁ = 1.5 μH	3.3	4.2	5.1	A
THERMAL SHUTDOWN						
T _{SDN}	Thermal shutdown threshold ⁽¹⁾	Shutdown temperature		172		°C
		Hysteresis		37		
ON-TIME TIMER CONTROL						
t _{OFF(MIN)}	Minimum off time	V _{FB} = 0.5 V		220	310	ns
SOFT START						
T _{ss}	Soft-start time	Internal soft-start time		1.0		ms
FREQUENCY						
F _{sw}	Switching frequency	V _{IN} = 12 V, V _O = 3.3 V, I _O = 1 A		580		kHz
OUTPUT UNDERVOLTAGE AND OVERVOLTAGE PROTECTION						
V _{UVP}	Output UVP threshold	Hiccup detect (H > L)		65%		
T _{HICCUP_WAIT}	Hiccup on time			1.2		ms
T _{HICCUP_RE}	Hiccup time before restart			10		ms
UVLO						
UVLO	UVLO threshold	Wake up VIN voltage		3.8	4.3	V
		Shutdown VIN voltage	3.3	3.4		
		Hysteresis VIN voltage		0.4		

Table 5: Electrical Characteristics

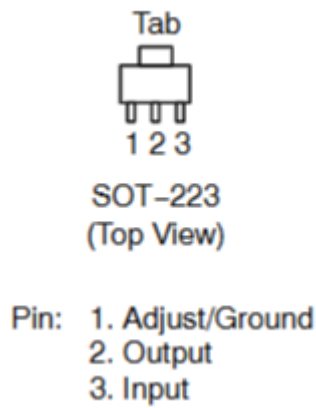
B. LM1117 (U8,U27)

Description:

The LM1117 is a low dropout voltage regulator with a dropout of 1.2 V at 800 mA of load current. The LM1117 is available in an adjustable version, which can set the output voltage from 1.25 to 13.8 V with only two external resistors. In addition, it is available in five fixed voltages, 1.8 V, 2.5 V, 3.3 V, and 5 V. The LM1117 offers current limiting and thermal shutdown. Its circuit is trimmed to assure output voltage accuracy to within $\pm 1\%$.

Features:

- Available in 1.8 V, 2.5 V, 3.3 V, 5.0 V, and Adjustable Versions
- Space-Saving SOT-223 Package•Current Limiting and Thermal Protection
- Output Current 800 mA
- Line Regulation 0.2% (Maximum)
- Load Regulation 0.4% (Maximum)
- Temperature Range: 0°C to 125°C

**Figure 10:** Pin Configuration

Rating	Symbol	Value	Unit
Input Voltage (Note 1)	V_{in}	20	V
Output Short Circuit Duration (Notes 2 and 3)	–	Infinite	–
Power Dissipation and Thermal Characteristics Case 318H (SOT-223) Power Dissipation (Note 2) Thermal Resistance, Junction-to-Ambient, Minimum Size Pad Thermal Resistance, Junction-to-Case	P_D $R_{\theta JA}$ $R_{\theta JC}$	Internally Limited 160 15	W °C/W °C/W
Maximum Die Junction Temperature Range	T_J	–55 to 150	°C
Storage Temperature Range	T_{stg}	–65 to 150	°C
Operating Ambient Temperature Range	T_A	0 to +125	°C

Table 6: Maximum Ratings

Characteristic	Symbol	Min	Typ	Max	Unit
Reference Voltage, Adjustable Output Devices ($V_{in}-V_{out} = 2.0\text{ V}$, $I_{out} = 10\text{ mA}$, $T_A = 25^\circ\text{C}$) ($V_{in}-V_{out} = 1.4\text{ V}$ to 10 V , $I_{out} = 10\text{ mA}$ to 800 mA) (Note 4)	V_{ref}	1.238 1.225	1.25 –	1.262 1.270	V
Output Voltage, Fixed Output Devices 1.8 V ($V_{in} = 3.8\text{ V}$, $I_{out} = 10\text{ mA}$, $T_A = 25^\circ\text{C}$) ($V_{in} = 3.2\text{ V}$ to 11.8 V , $I_{out} = 0\text{ mA}$ to 800 mA) (Note 4) 2.5 V ($V_{in} = 4.5\text{ V}$, $I_{out} = 10\text{ mA}$, $T_A = 25^\circ\text{C}$) ($V_{in} = 3.9\text{ V}$ to 10 V , $I_{out} = 0\text{ mA}$ to 800 mA) (Note 4) 3.3 V ($V_{in} = 5.3\text{ V}$, $I_{out} = 10\text{ mA}$, $T_A = 25^\circ\text{C}$) ($V_{in} = 4.75\text{ V}$ to 10 V , $I_{out} = 0\text{ mA}$ to 800 mA) (Note 4) 5.0 V ($V_{in} = 7.0\text{ V}$, $I_{out} = 10\text{ mA}$, $T_A = 25^\circ\text{C}$) ($V_{in} = 6.5\text{ V}$ to 12 V , $I_{out} = 0\text{ mA}$ to 800 mA) (Note 4)	V_{out}	1.782 1.755 2.475 2.450 3.267 3.235 4.950 4.900	1.800 – 2.500 – 3.300 – 5.000 –	1.818 1.845 2.525 2.550 3.333 3.365 5.050 5.100	V
Line Regulation (Note 5) Adjustable ($V_{in} = 2.75\text{ V}$ to 16.25 V , $I_{out} = 10\text{ mA}$)	Reg_{line}	–	0.04	0.1	%
1.8 V ($V_{in} = 3.2\text{ V}$ to 11.8 V , $I_{out} = 0\text{ mA}$) 2.5 V ($V_{in} = 3.9\text{ V}$ to 10 V , $I_{out} = 0\text{ mA}$) 3.3 V ($V_{in} = 4.75\text{ V}$ to 15 V , $I_{out} = 0\text{ mA}$) 5.0 V ($V_{in} = 6.5\text{ V}$ to 15 V , $I_{out} = 0\text{ mA}$)		– – – –	0.4 0.5 0.8 0.9	1.0 2.5 4.5 6.0	mV
Load Regulation (Note 5) Adjustable ($I_{out} = 10\text{ mA}$ to 800 mA , $V_{in} = 4.25\text{ V}$)	Reg_{load}	–	0.2	0.4	%
1.8 V ($I_{out} = 0\text{ mA}$ to 800 mA , $V_{in} = 3.2\text{ V}$) 2.5 V ($I_{out} = 0\text{ mA}$ to 800 mA , $V_{in} = 3.9\text{ V}$) 3.3 V ($I_{out} = 0\text{ mA}$ to 800 mA , $V_{in} = 4.75\text{ V}$) 5.0 V ($I_{out} = 0\text{ mA}$ to 800 mA , $V_{in} = 6.5\text{ V}$)		– – – –	2.6 3.3 4.3 6.7	6.0 7.5 10 15	mV
Dropout Voltage (Measured at $V_{out} = 100\text{ mV}$) ($I_{out} = 100\text{ mA}$) ($I_{out} = 500\text{ mA}$) ($I_{out} = 800\text{ mA}$)	$V_{in}-V_{out}$	– – –	0.95 1.01 1.07	1.10 1.15 1.20	V
Output Current Limit ($V_{in}-V_{out} = 5.0\text{ V}$, $T_A = 25^\circ\text{C}$, Note 6)	I_{out}	1000	1500	2200	mA
Minimum Required Load Current for Regulation, Adjustable Output Devices ($V_{in} = 15\text{ V}$)	$I_{L(min)}$	–	0.8	5.0	mA
Quiescent Current 1.8 V ($V_{in} = 11.8\text{ V}$) 2.5 V ($V_{in} = 10\text{ V}$) 3.3 V ($V_{in} = 15\text{ V}$) 5.0 V ($V_{in} = 15\text{ V}$)	I_Q	– – – –	4.2 5.2 6.0 6.0	10 10 10 10	mA
Thermal Regulation ($T_A = 25^\circ\text{C}$, 30 ms Pulse)		–	0.01	0.1	%/W
Ripple Rejection ($V_{in}-V_{out} = 6.4\text{ V}$, $I_{out} = 500\text{ mA}$, 10 V _{pp} 120 Hz Sinewave) Adjustable 1.8 V 2.5 V 3.3 V 5.0 V	RR	67 66 62 60 57	73 70 68 64 61	– – – – –	dB
Adjustment Pin Current ($V_{in} = 11.25\text{ V}$, $I_{out} = 800\text{ mA}$)	I_{adj}	–	52	120	μA
Adjust Pin Current Change ($V_{in}-V_{out} = 1.4\text{ V}$ to 10 V , $I_{out} = 10\text{ mA}$ to 800 mA)	ΔI_{adj}	–	0.4	5.0	μA
Temperature Stability	S_T	–	0.5	–	%
Long Term Stability ($T_A = 25^\circ\text{C}$, 1000 Hrs End Point Measurement)	S_L	–	0.3	–	%
RMS Output Noise ($f = 10\text{ Hz}$ to 10 kHz)	N	–	0.003	–	%V _{out}

Table 7: Electrical Characteristics

C. KI5P02DV (P-CHANNEL MOSFET) (Q18)

Description:

The KI5P02DV is a P-Channel MOSFET with a -20V drain-to-source voltage rating and a -5A drain current capacity. It features a gate threshold voltage of -2V to -4V and low on-resistance for efficient power switching. Commonly used in power regulation, load switching, and DC-DC converters, it provides high-speed switching and operates reliably across a wide temperature range.

Features:

- V_{ds} (Drain-Source Voltage): -20V
- I_d (Drain Current): -4.6A
- $R_{ds(on)}$ (On-Resistance):
 $R_{ds(on)} < 40m\Omega$ at $V_{gs} = -4.5V$
 $R_{ds(on)} < 70m\Omega$ at $V_{gs} = -2.5V$
- Low Input/Output Leakage: Minimizes current leakage, improving efficiency.

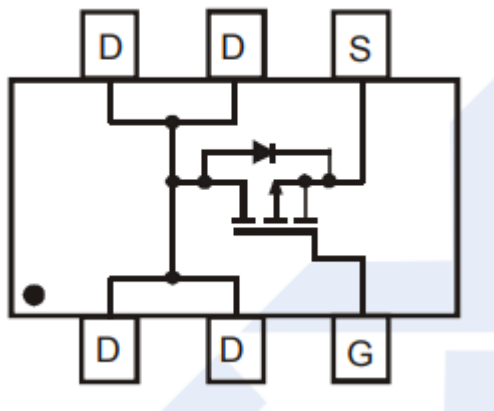


Figure 11: Pin Configuration

Parameter	Symbol	Rating	Unit
Drain-Source Voltage	V_{DS}	-20	V
Gate-Source Voltage	V_{GS}	± 12	
Continuous Drain Current $T_a = 25^\circ\text{C}$ $T_a = 70^\circ\text{C}$	I_D	-4.6	A
		-3.7	
Pulsed Drain Current	I_{DM}	-18	
Power Dissipation	P_D	1.25	W
Thermal Resistance.Junction- to-Ambient	R_{thJA}	100	$^\circ\text{C/W}$
Junction Temperature	T_J	150	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-55 to 150	

Table 8: Absolute Maximum Ratings

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	V_{DS}	$I_D = -250 \mu A$, $V_{GS} = 0V$	-20			V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -20V$, $V_{GS} = 0V$			-1	μA
Gate-Body leakage current	I_{GSS}	$V_{DS} = 0V$, $V_{GS} = \pm 12V$			± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = -250 \mu A$	-0.6		-1.2	V
Static Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = -4.5V$, $I_D = -4.6A$			40	m Ω
		$V_{GS} = -2.5V$, $I_D = -3.8A$			70	
On state drain current	$I_{D(on)}$	$V_{GS} = -4.5V$, $V_{DS} = -5V$	-15			A
Forward Transconductance	g_{FS}	$V_{DS} = -10V$, $I_D = -4.6A$		9		S
Input Capacitance	C_{iss}	$V_{GS} = 0V$, $V_{DS} = -15V$, $f = 1MHz$		820		pF
Output Capacitance	C_{oss}			200		
Reverse Transfer Capacitance	C_{rss}			160		
Gate resistance	R_g	$V_{GS} = 0V$, $V_{DS} = 0V$, $f = 1MHz$		2.5		Ω
Total Gate Charge	Q_g	$V_{GS} = -4.5V$, $V_{DS} = -10V$, $I_D = -4.5A$		10.1		nC
Gate Source Charge	Q_{gs}			1.5		
Gate Drain Charge	Q_{gd}			4.3		
Turn-On DelayTime	$t_{d(on)}$	$V_{DS} = -10V$, $V_{GS} = -4.5V$, $I_D = -1A$, $R_G = 6\Omega$		4.4		ns
Turn-On Rise Time	t_r			9.9		
Turn-Off DelayTime	$t_{d(off)}$			28		
Turn-Off Fall Time	t_f			23.4		
Maximum Body-Diode Continuous Current	I_S				-1.7	A
Diode Forward Voltage	V_{SD}	$I_S = -2.1A$, $V_{GS} = 0V$	-0.5		-1.4	V

Table 9: Electrical Characteristics

6. MICROCONTROLLER

A. MSTAR MSD92LGSW2 (U24)

Description:

MSD92LGSW2 is a highly integrated TV SoC solution for DVB-C/DVB-T/DVB-T2/ISDB-T/DVB-S/DVB-S2 digital television platform. Integrating latest advanced technologies, MSD92LGSW2 provides the most cost-efficient solution for multimedia TV application with creative and attractive features.

In order to achieve the lowest BOM cost in a multi-media TV platform, MSD92LGSW2 integrates DVB-C/DVB-T/DVB-T2/ISDB-T/DVB-S/DVB-S2 demodulators, TV/multi-media all-purpose AV decoder, VIF demodulator, and advanced Sound/Video processors into a single device. This not only reduces the overall BOM significantly, but also facilitates the design of originally-complicated TV systems for developers. In addition, the memory-embedded solution provided by MSD92LGSW2 can reduce the excessive work of memory interface routing on board and the risk of memory performance degradation while powering cost-down in the total system.

The powerful multimedia A/V decoder inside MSD92LGSW2 is hosted with a dedicated hardware video codec engine to secure fast and stable video streaming playback. Moreover, MSD92LGSW2 is equipped with a DSP specifically designated for audio application, including digital audio format decoding and advanced sound effects, and a high performance MIPS34Kf to manipulate all possible routines and house-keeping activities. With extendable USB 2.0 interface, an MSD92LGSW2 based system can turn into a high quality media-center in a simple manner.

The MSD92LGSW2 supports the latest MHL technology, which allows user to stream audio and full HD video from mobile devices to televisions. Power management and low-power design of MSD92LGSW2 make it possible to charge MHL devices even in standby mode. The MHL/HDMI dual-purpose port on MSD92LGSW2 will enable charging if MHL devices are automatically detected.

For average users, the MSD92LGSW2 provides multi-standard analog TV support with adaptive 3D video decoding and VBI data extraction. The built-in audio decoder is capable of decoding FM, AM, NICAM, A2, BTSC and sound standards. The MSD92LGSW2 also supplies all the necessary A/V inputs and outputs to complete a receiver design including HDMI receivers and component video ADCs. All input selection multiplexers for video and audio are integrated, including full SCART support with CVBS output. The equipped MStar High Performance Video Processor is the latest masterpiece of MStar technologies, providing excellent video and picture quality in Full-HD and large-scale display system. The MSD92LGSW2 also supports an ultra low power standby mode to meet the latest energy legislative requirements without any additional hardware.

Features:

MSD92LGSW2 is a highly integrated single chip solution for digital DVB-C/DVB-T/DVB-T2/ISDB-T/DVB-S/DVB-S2 TV system. Key features include:

1. DVB-C/DVB-T/DVB-T2/ISDB-T/DVB-S/DVB-S2 and Analog TV Front-End Demodulator
2. Multi-Standard A/V Decoder
3. MStar High Performance Video Processor
4. Home Theater Sound Processor
5. Embedded Memory for optimized BOM cost
6. Multiple HDMI 1.4 Compliant Ports with ARC Support
7. One MHL 2.1 Compliant Port
8. Transport-Stream Input for Extended DTV System

■ High Performance Micro-processor

- MIPS34Kf with 32KB/32KB I/D cache
- Supports Hardware floating point unit

■ HEVC/H.265 Video Decoder

- Supports HEVC/H.265 video decoding
- Supports Main/Main-10 profile, level 4.1, high tier
- Supports 8-bit/10-bit color depth
- Supports resolution up to 1920x1080@60fps
- Supports max bitrate upto 50 Mbps

■ AVC/H.264 Video Decoder

- ITU-T H.264, ISO/IEC 14496-10 (main and high profile up to level 4.2) video decoding
- Supports resolution up to 1920x1080@60fps
- Supports bitrate up to 62.5Mbps, the upper limit of level 4.2
- Supports resolutions for all DVB, ATSC, HDTV, DVD and VCD
- Supports SVAE 2ES (for Dual Decode)
- Supports MVC 3D decoding upto 1080p@30fps

■ MPEG-2 Video Decoder

- ISO/IEC 11172-2 MPEG-1 video format decoding
- ISO/IEC 13818-2 MPEG-2 video MP@HL and HD level
- Supports resolution up to HDTV (1080p, 1080i, 720p) and SDTV

■ MPEG-4 Video Decoder

- ISO/IEC 14496-2 MPEG-4 ASP video decoding up to HD level
- Supports resolutions up to HDTV (1080p@30fps)
- Supports DivX Home Theater & HD profiles
- Supports FLV version1 video format decoding

■ AVS/AVS+ Video Decoder^{Optional}

- Supports Broadcasting profile, level 6.0.1.08,60 (AVS+)
- Supports Jizhun profile, level 6.0
- Supports bitrate up to 50Mbps
- Supports resolution up to 1920x1080@30fps

■ RealMedia Video Decoder^{Optional}

- Supports RV8, RV9, RV10 decoders
- Supports file formats with RM and RMVB
- Supports maximum resolution up to 1080p@30fps
- Supports Picture Re-sampling
- Supports in-loop de-block for B-frame

■ Hardware JPEG Decoder

- Supports upto 640x480@30fps
- Supports formats: 422/411/420/444/422T
- Supports scaling down ratios: 1/2x1/2, 1/4x1/4, 1/8x1/8
- Supports both color and grayscale pictures
- Supports sequential mode, single scan
- Supports programmable Region of Interest (ROI)
- Following the file header scan the hardware decoder fully handles the decode process

■ VC-1 Video Decoder^{Optional}

- Supports SMPTE-421M (WMV video) decoding up to MH@HL
- Supports SMPTE-421M (VC1 video) decoding up to AP@L3 (2048x1024p30)

■ NTSC/PAL/SECAM Video Decoder

- Supports NTSC-M, NTSC-J, NTSC-4.43, PAL (B, D, G, H, M, N, I, Nc), and SECAM standards
- Automatic standard detection
- Motion adaptive 3D comb filter
- One configurable CVBS & Y/C S-video input
- Supports Teletext, Closed Caption (analog CC 608/ analog CC 708/digital CC 608/digital CC 708), and V-chip and SCTE

■ Multi-Standard TV Sound Processor

- Supports BTSC/A2 demodulation
- Supports NICAM/FM/AM demodulation
- Supports MTS Mode Mono/Stereo/SAP in BTSC mode
- Supports Mono/Stereo/Dual in A2/NICAM mode
- Built-in audio sampling rate conversion (SRC)
- Audio processing for loudspeaker channel, including volume, balance, mute, tone, EQ, virtual stereo/surround and treble/bass controls
- Advanced sound processing options available, for example: Dolby¹, DTS²
- Supports digital audio format decoding:
 - MPEG-1, MPEG-2 (Layer I/II), MP3, Dolby Digital (AC-3) ^{Optional}, AAC-LC, HE-AAC, WMA and supports Dolby Digital Plus ^{Optional}
- Supports Audio Description
- Supports programmable delay for audio/video synchronization

■ Audio Interface

- Two L/R audio line-inputs and two mono Mic. Inputs
- One L/R outputs for main speakers, monitor output, and SCART output
- Supports stereo headphone driver
- I2S digital audio output
- S/PDIF digital audio output
- Supports HDMI receiver ARC function

■ Analog RGB Compliant Input Ports

- Three analog ports support up to 1080P
- Supports PC RGB input up to SXGA@75Hz
- Supports HDTV RGB/YPbPr/YCbCr
- Supports Composite Sync and SOG Sync-on-Green
- Automatic color calibration

■ Analogue RGB Auto-Configuration & Detection

- Auto input signal format and mode detection
- Auto-tuning function including phasing, positioning, offset, gain, and jitter detection
- Sync Detection for H/V Sync

■ DVI/HDCP/HDMI Compliant Input Ports

- Three HDMI/DVI Input ports
- HDMI 1.4a Compliant
- HDCP 1.4 Compliant
- 225MHz @ 1080P 60Hz input with 12-bit Deep-color support
- Supports CEC
- Supports HDMI 3D format input
- Supports UHD 30Hz down-scaling
- Supports HDMI ARC
- Single link DVI 1.0 compliant
- Robust receiver with excellent long-cable support
- Embedded HDCP key

■ HDMI/MHL Dual-Purpose Port

- MHL 2.1 Compliant
- MHL/HDMI Auto-detection
- Supports MHL charging in normal/standby mode

■ MStar High Performance Video Processor

- Video Processing Engine
 - Supports up to FHD@60p
 - 10-/12-bit Internal Data Processing
 - Dual-Engine Architecture supporting PIP/PBP
 - Arbitrary Frame Rate Conversion
- Video Care Technology
 - Video Line Broken Artifact Detection and Removal
- Fully Programmable Multi-Function Scaling Engine
 - High-Tap Filters with Programmable Parameter
 - An advanced Zoom Algorithm providing Aliasing/Ringing Suppression
 - Nonlinear Video Scaling supports various modes including Panorama
 - Supports Dynamic Scaling for RM, VC-1 Optional
 - Fully Programmable Zoom Ratios for Up/Down Scaling
 - Independent Horizontal and Vertical Zoom
- Deinterlacer
 - Motion Compensated Video Deinterlacing with Motion Object Stabilizer
 - Motion Adaptive Deinterlacer
 - Edge-Oriented Deinterlacer with Edge Smoothing and Artifact Removal
 - Automatic 3:2/2:2/M:N Pull-Down Detection and Recovery
- MStar Genuine 3D
 - Supports Mandatory 3D Format
- Motion Frame Rate Conversion
 - Supports Frame Repeat Frame Rate Conversion
- Backlight Technology
 - Content Adaptive LCD Backlight Control
- Response Time Compensation
 - Supports Overdrive Technology

■ MStar Professional PQ Engine

- UltraClear
 - MPEG Artifact Removal
 - ◇ Adaptive Block Noise Reduction
 - ◇ Mosquito Noise Reduction
 - UltraClear Noise Reduction
 - ◇ 3D Motion-Estimation Temporal Filtering
 - 3D Noise Reduction
 - ◇ 3D Temporal Noise Reduction for Lousy Air/Cable Input
 - ◇ Cross-Color Suppression Technology
 - ◇ Supports Hanging Dot Search & Removal
- S-Powers
 - Video Enhancement Processor
 - ◇ Advanced 3D Independent Multi-Band Control Sharpness Technology
 - ◇ Advanced Chroma Transient Improvement
 - ◇ Content Adaptive Contrast Enhancement with Chroma Compensated
 - Super Resolution
 - ◇ Local Detail Enhancement
 - ◇ Multi-Directional Jagged Compensation Technology
- MACE
 - MStar Advanced Color Engine (MACE)
 - ◇ 3D Independent and Accurate Multi-Adaptive Color Manager
 - ◇ Color Stain Removal Technology
 - Standard Color Format and Processing
 - ◇ Fully programmable Input/Output CSC
 - ◇ BT601, BT709, BT2020 (CL/NCL)
 - ◇ xvYCC601, xvYCC709
 - ◇ Fully Programmable 12-bit RGB Gamma

- Gamut Mapping
 - ✧ Nonlinear/Linear RGB Domain Gamut Mapping
 - ✧ Supports 2D Gamut Mapping
 - ✧ The 3rd Generation 3D Gamut Mapping Engine
- **Output Interface**
 - Single/Dual link 8/10-bit LVDS output
 - Supports panel resolution up to Full HD 1920x1080@ 60Hz (LVDS 2ch)
 - Supports TCON: miniLVDS 2ch interface, panel resolution up to Full HD @ 60Hz
 - Supports TCON:EPI interface, panel resolution up to Full HD @ 60Hz
 - Supports programmable timing controller
 - Supports dithering options
 - Spread spectrum output frequency for EMI suppression
 - Supports 60Hz 3D polarized panel (line interleave)
 - Supports Cinema output mode
- **CVBS Video Outputs**
 - Supports CVBS bypass output
- **2D Graphics Engine**
 - Hardware Graphics Engine for responsive interactive applications
 - Supports point draw, line draw, rectangle draw/fill and text draw
 - Supports BitBlt, stretch BitBlt, italic BitBlt, Mirror BitBlt and rotate BitBlt
 - Supports alpha-blending operation
 - Supports source/destination color key and alpha key
 - Supports dither
 - Supports color space conversion and format transformation
 - Raster Operation (ROP)
 - Supports DFB and Porter-Duff operation
- **VIF**
 - Compliant with NTSC M/N, PAL B, G/H, I, D/K, SECAM L/L' standards
 - Support low IF architecture
 - Audio/Video internal dual-path processor
 - Locking range improvement
- **DVB-C Demodulator**
 - Compliant with ITU J.83 Annex A/C DVB-C (EN 300 429)
 - Supports 1-7.2 M Baud symbol rate
 - Automatic blind channel scan (constellation and symbol rate)
 - Supports LIF interfaces
 - IIS performance improvement
- **DVB-T Demodulator**
 - Compliant with DVB-T (ETSI EN 300 744)
 - NORDIG 2.2.2, D-book 7.0 compliant
 - Accept low IF inputs in 6, 7, 8MHz channel bandwidths
 - Supports all guard intervals (1/32 to 1/4)
 - Supports all constellations (QPSK, 16-QAM, 64-QAM)
 - Ultra fast automatic blind UHF/VHF channel scan
 - Optimized for SFN channels with pre/post-cursive echoes inside/outside the guard
 - Phase-Noise suppression
 - Impulse-Noise suppression
 - All digital demodulation and timing recovery loops for tracking frequency and clock offset
 - Automatic co-channel and adjacent channel interference suppression
 - CNR performance improvement
 - Outside-GI performance improvement

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
3.3V Supply Voltages	V _{VDD_33}	3.14		3.46	V
1.5V Supply Voltages	V _{VDD_15}	1.43		1.57	V
Core Supply Voltages	V _{VDD_core}	1.067	1.1	1.133	V
Ambient Operating Temperature	T _A	0		70	°C
Junction Temperature	T _J			125	°C

Table 9: Recommended Operating Conditions

7. PMIC STAGE

A. ANX6861 (BOE)

FEATURES

- 8V to 16.5V input supply
- Current-mode boost regulator
 - 500k/750kHz selectable frequency
 - Integrated 20V/3.5A 100mΩ FET
 - Fast transient response to pulsed load
 - High efficiency up to 90%
 - Adjustable soft-start
 - Adjustable current limit for over current protection
 - Adjustable high-accuracy output voltage
 - Over voltage protection
- Current-mode buck regulator
 - Integrated 20V/3.2A 100mΩ FET
 - Fast transient response
 - Internal compensation
 - High efficiency
 - Internal 3ms soft-start
 - Adjustable high-accuracy output voltage
- VGH positive charge pump controller
- VGL negative charge pump controller
- High voltage LDO for gamma reference
 - Adjustable high-accuracy output voltage
 - Low drop-out voltage at 60mA output current (0.25V)
- Integrated high performance operational amplifier
 - ±200mA output short-circuit current
 - 45V/μs fast slew rate
- Reset Function
- GPM controller
 - Adjustable falling time
 - Adjustable turn-on delay
- External gate control for AVDD sequencing
- Thermal shutdown
- Thin 7x7 mm 48-lead WQFN package

DESCRIPTION

The ANX6861 is an integrated power supply solution optimized for large thin-film transistor (TFT) liquid crystal display (LCD) TV panels which generates all voltage rails for the TFT LCD bias (AVDD, VGH, VGL, VCOM) and also a buck regulator for system logic supply. It is especially designed for 12V input. For better display quality control, the device also provides Gate-Pulse-Modulation block and high accuracy Gamma voltage reference for driver IC.

The boost regulator provides TFT source driver AVDD voltage. The integrated N-channel FET operates at a fixed frequency of 500k/750kHz which has a current limit up to 3.5A and can support output voltages up to 20V.

The buck regulator supplies system logic power with a current limit of 3.2A, it includes an internal power MOSFET and fixed-frequency operation allowing the use of small inductors and capacitors. Both boost and buck regulators feature internal soft-start function to limit inrush current and use current mode control to perform fast load transient response. The buck regulator is compensated internally and the boost regulator is compensated by an external RC network.

The gate-on and gate-off charge pumps provide TFT-LCD gate drivers regulated gate-on and gate-off supplies. Both outputs can be adjusted by external resistive voltage dividers. Internal soft-start function is also included.

The integrated operational amplifier is typically used for LCD VCOM driving, it features fast slew rate, wide bandwidth, and rail-to-rail output which can sink or source up to 200mA.

The GPM is a flicker compensation circuit to reduce the coupling effect of gate lines; the gate-shaping timing is controlled by the timing-controller to modulate the Gate-On voltage, VGHM.

The high voltage Gamma reference ensures a stable voltage to generate the Gamma correction voltages.

The ANX6861 is available in a thin 48-pin 7x7 mm WQFN green package.

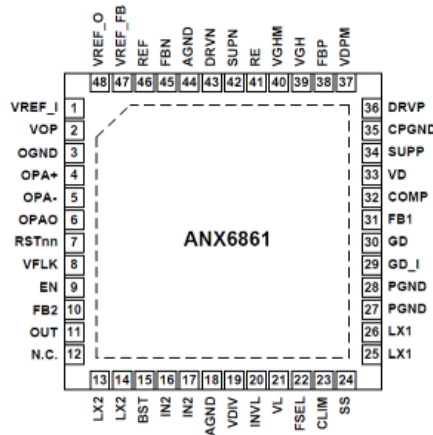


Figure 12: Pin description

8.3V 128M-BIT SERIAL FLASH MEMORY WITH DUAL/QUAD SPI & QPI

A. W25Q128JV-DTR (128M-BIT) SPI FLASH (U14)

Description:

The W25Q128JV (128M-bit) Serial Flash memory provides a storage solution for systems with limited space, pins, and power. The 25Q series offers flexibility and performance beyond ordinary Serial Flash devices, ideal for code shadowing to RAM, executing code directly from Dual/Quad SPI (XIP), and storing voice, text, and data.

It operates on a single 2.7V to 3.6V power supply with as low as 1μA current consumption in power-down mode. The W25Q128JV has an array organized into 65,536 programmable pages of 256 bytes each, with erasure in sectors or blocks.

It supports SPI, Dual/Quad I/O SPI, and QPI interfaces, with clock speeds up to 133MHz, allowing for faster read rates with Dual and Quad I/O. The Continuous Read Mode enables efficient memory access for true XIP operation. Additionally, it features a Hold pin, Write Protect pin, programmable write protection, and supports a 64-bit Unique Serial Number along with security registers.

Features:

- Memory Size: 128M-bit (16M-byte)
- SPI Modes: Standard SPI, Dual SPI, Quad SPI, QPI
- Performance:
 - Up to 133MHz SPI (266/532MHz Dual/Quad SPI)
 - 66MB/s continuous data rate
 - 100K program-erase cycles per sector
 - 20+ years data retention
- Power Efficiency:

2.7V to 3.6V supply

<1 μ A power-down

-40°C to +85°C operating range

- Architecture: 4KB sectors, program/erase suspend and resume
- Security: Write-protect, OTP, sector/block protection, 64-bit unique ID, SFDP register, 3x256-byte security registers
- Packaging Options: 8-pin SOIC, 8-pad WSON, 16-pin SOIC (with /RESET), 24-ball TFBGA
- Target Use: High-performance, low-power applications with flexible security and efficient memory management.

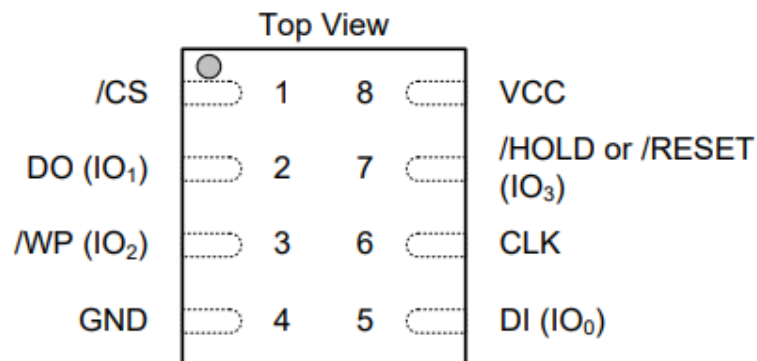


Figure 13: Pin configuration

PIN NO.	PIN NAME	I/O	FUNCTION
1	/CS	I	Chip Select Input
2	DO (IO1)	I/O	Data Output (Data Input Output 1) ⁽¹⁾
3	/WP (IO2)	I/O	Write Protect Input (Data Input Output 2) ⁽²⁾
4	GND		Ground
5	DI (IO0)	I/O	Data Input (Data Input Output 0) ⁽¹⁾
6	CLK	I	Serial Clock Input
7	/HOLD or /RESET (IO3)	I/O	Hold or Reset Input (Data Input Output 3) ⁽²⁾
8	VCC		Power Supply

Table 10: Pin description

9.USB INTERFACE

Mstar IC has one input port for USB.

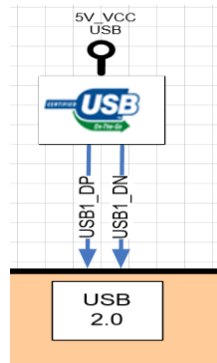


Figure 14: USB Block Diagram

10.CI INTERFACE

17MB140R Digital CI ve Smart Card Interface Block diagram:

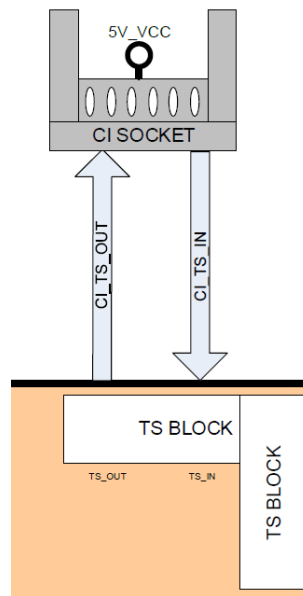


Figure 15: CI interface

11.SOFTWARE UPDATE

A. MAIN SW UPDATE

In MB140R project, please follow software update procedure:

1. mb140_en.bin and usb_auto_update_G9.txt files should be copied directly inside of a flash memory (not in a folder).
2. Insert flash memory to the TV when TV is powered off.
3. While pushing the OK button in remote control, power on and wait. TV will power-up itself.
4. If First Time Installation screen comes, it means software update procedure is successful.
- 5.

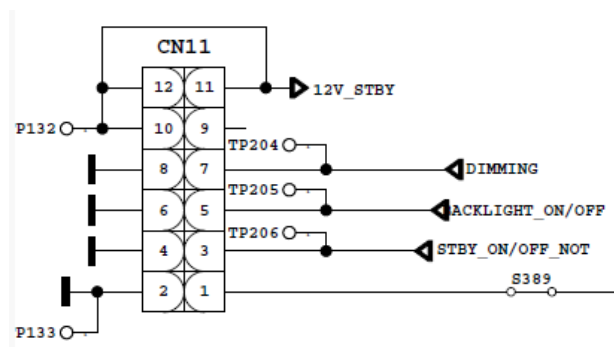
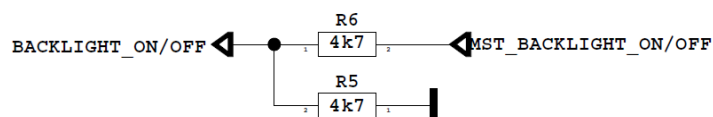
12.TROUBLESHOOTING

A. NO BACKLIGHT PROBLEM

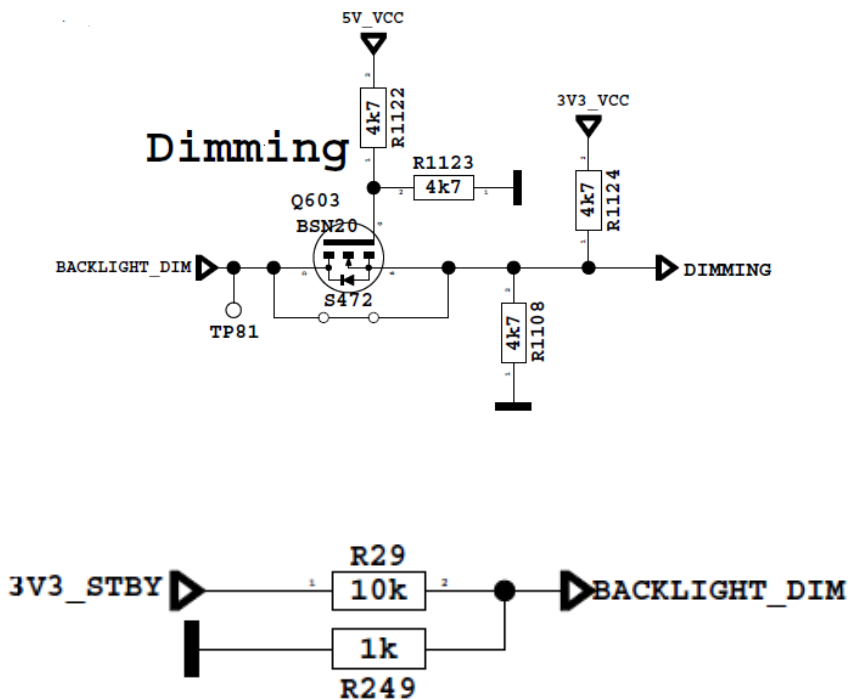
Problem: If TV is working, led is normal and there is no picture and backlight on the panel.

Possible causes: Backlight pin, dimming pin, backlight supply, stby on/off pin

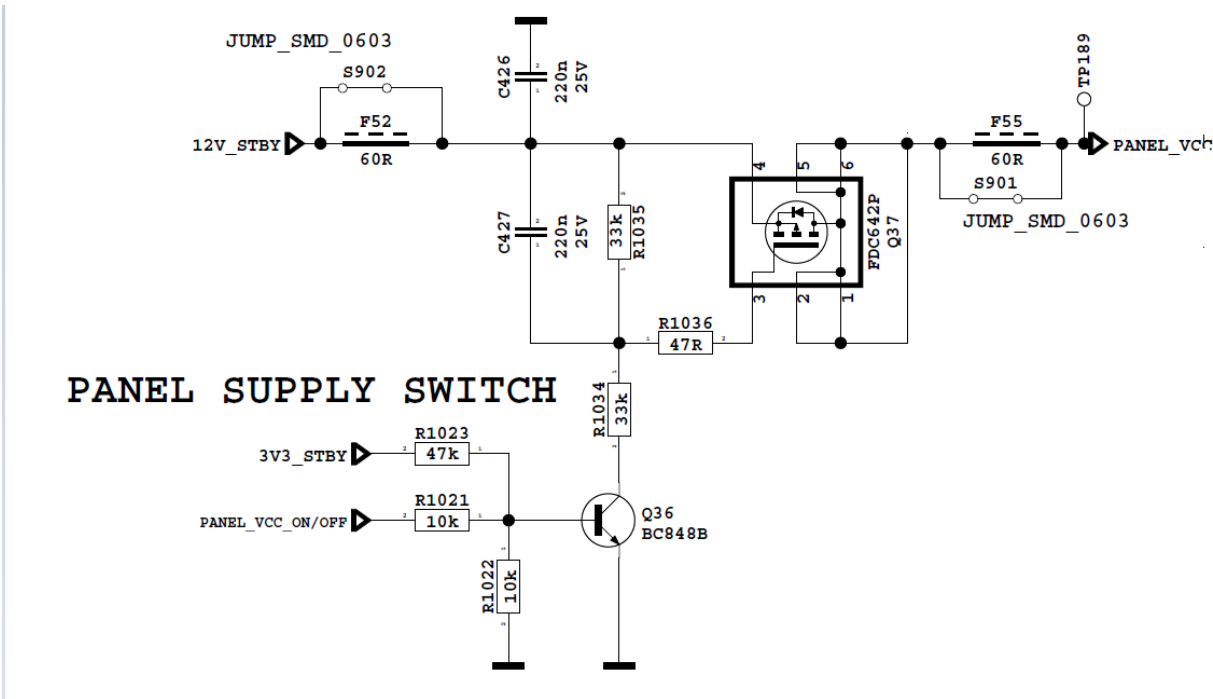
BACKLIGHT_ON/OFF pin should be high when the backlight is ON. BACKLIGHT_ON/OFF must be low when the backlight is OFF. If it is a problem, please check this pin and the panel cables. Also it can be tested in TP205 in main board.



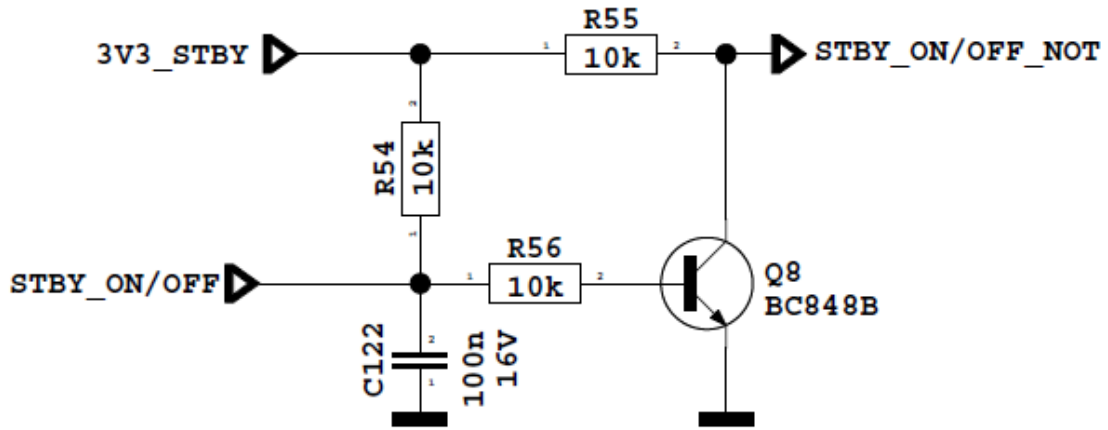
Dimming pin should be high or square wave in open position. If it is low, please check TP81 for Mstar side and panel or power cables, connectors.



Backlight power supply should be in panel specs. Please check Q37, shown below; also it can be checked TP189.



STBY_ON/OFF_NOT should be low for TV on condition, please check Q8's collector.

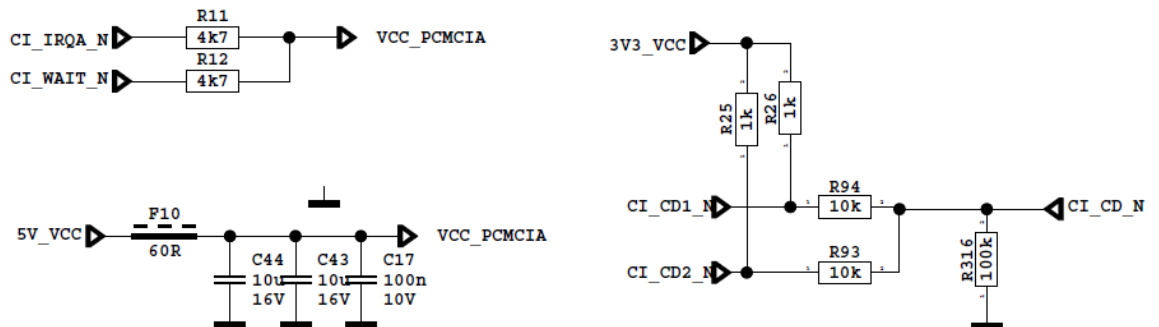


B. CI MODULE PROBLEM

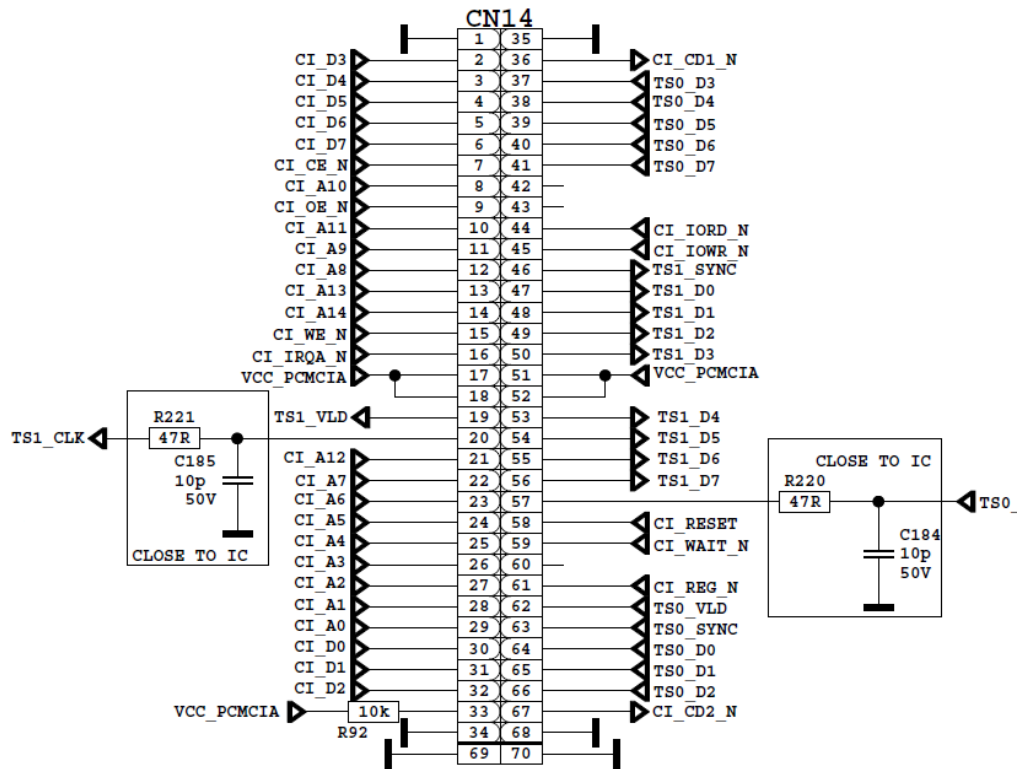
Problem: CI is not working when CI module inserted.

Possible causes: Supply, supply control pin, detects pins, mechanical positions of pins.

- CI supply should be 5V when CI module inserted. If it is not 5V please check VCC_PCMCIA, this pin should be low.



- Please check mechanical position of CI module. Is it inserted properly or not?
- Detect ports should be low. If it is not low please check CI connector pins, CI module pins.



C. STAYING IN STAND-BY MODE

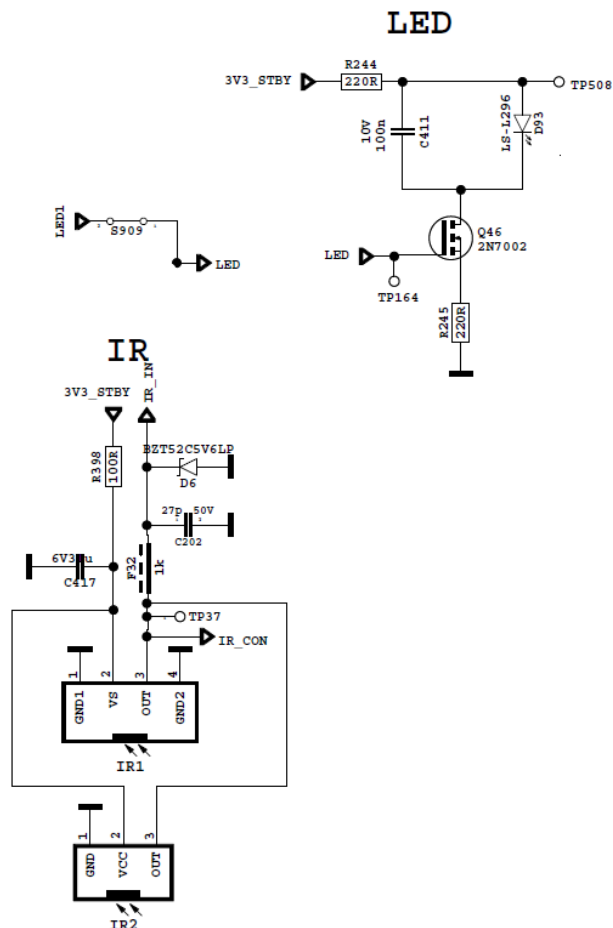
Problem: Staying in stand-by mode, no other operation.

This problem indicates a short on Vcc voltages. Protect pin should be logic high while normal operation. When there is a short circuit protect pin will be logic low. If you detect logic low on protect pin, unplug the TV set and control voltage points with a multimeter to find the shorted voltage to ground.

D. IR PROBLEM

Problem: LED or IR not working

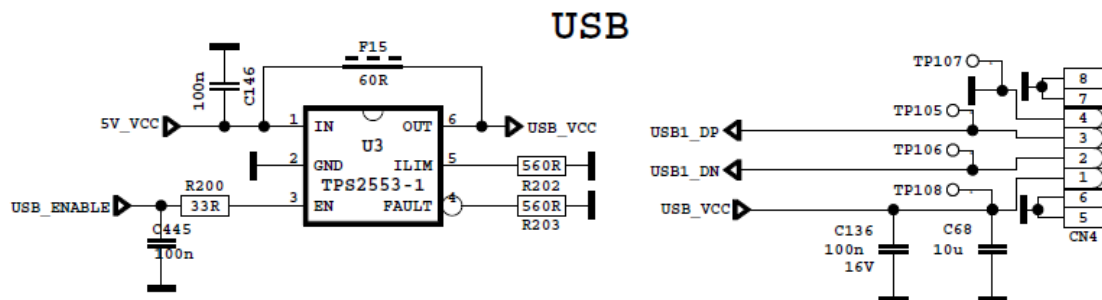
Check LED card supply on MB140R chasis.



E. USB PROBLEMS

Problem: USB is not working or no USB Detection.

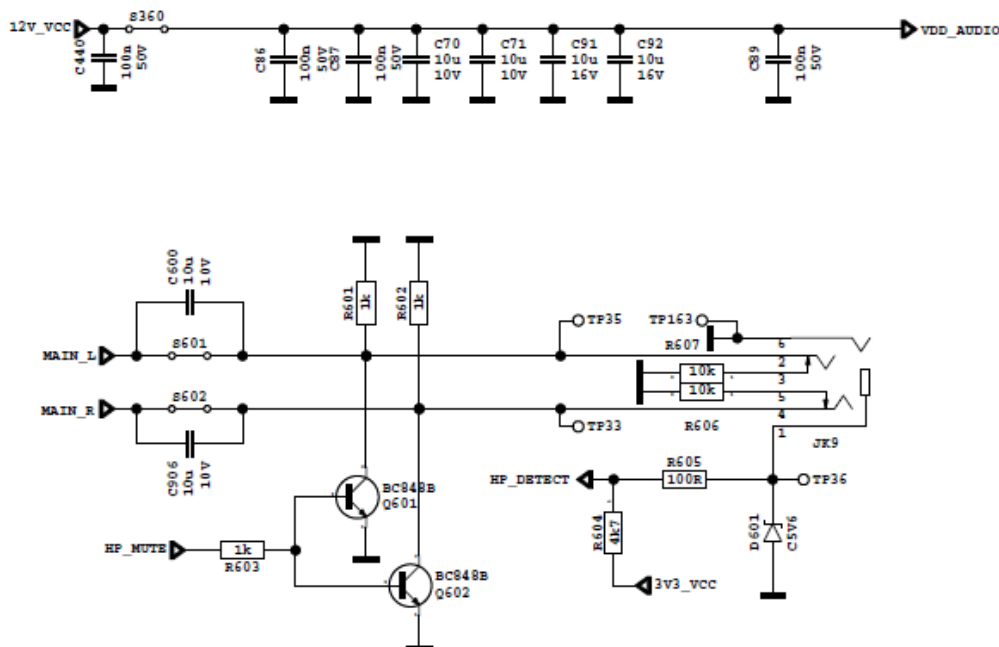
Check USB Supply, It should be nearly 5V. Also USB Enable should be logic high.



F. NO SOUND PROBLEM

Problem: No audio at main TV speaker outputs.

Check supply voltages of 12V_VCC and VDD_AUDIO with a voltage-meter. There may be a problem in headphone connector or headphone detect circuit (when headphone is connected, speakers are automatically muted). Measure voltage at HP_DETECT pin, it should be 3.3V.



G. STANDBY ON/OFF PROBLEM

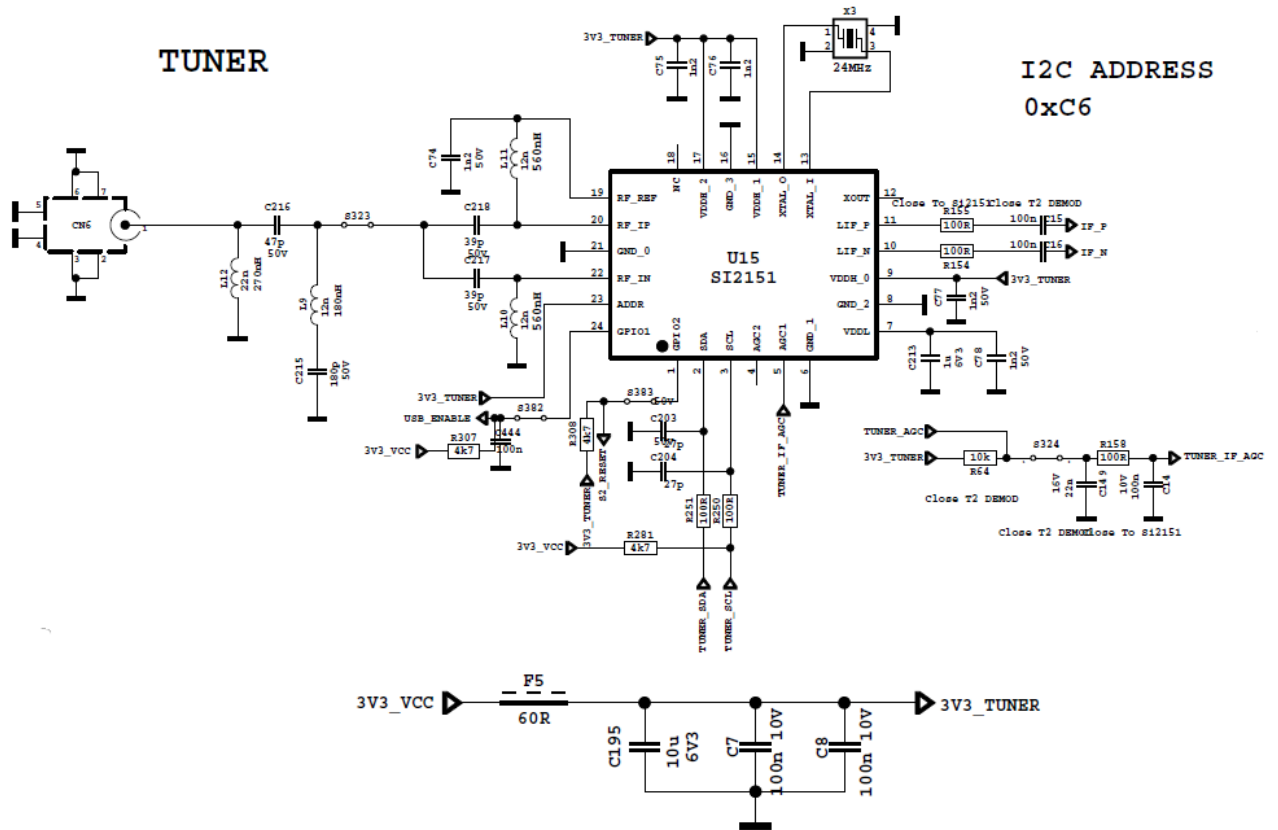
Problem: Device can not boot, TV hangs in standby mode.

There may be a problem about power supply. Check main supplies with a voltage-meter. Also there may be a problem about SW. Try to update TV with latest SW. Additionally it is good to check SW printouts via Teraterm. These printouts may give a clue about the problem. You can use Scart-1 for terraterm connection.

H. NO SIGNAL PROBLEM

Problem: No signal in DVB-T/T2/C mode.

Check tuner supply voltage; 3V3_TUNER. Check tuner options are correctly set in Service menu. Check AGC voltage at TUNER_IF_AGC pin of tuner.



Problem: No signal or Low signal in DVB-S/S2 mode.

Check signal cables and LNB voltage, if there is no problem, check TS2022 supply voltage.

If it is OK, then measure the voltage from the PIN20 of U16.

If the PIN20 voltage is equal to 0V, please check I2C waveforms and software. If the PIN20 voltage is lower than 1V(e.g: 0.8V or 0.3V), change the U16 with a new part.

13.SERVICE MENU SETTINGS

In order to reach service menu, first Press “MENU” buton, then write “4725” by using remote controller.

You can see the service menu main screen below. You can check SW releases by using this menu. In addition, you can make changes on video, audio etc. by using video settings, audio settings titles.

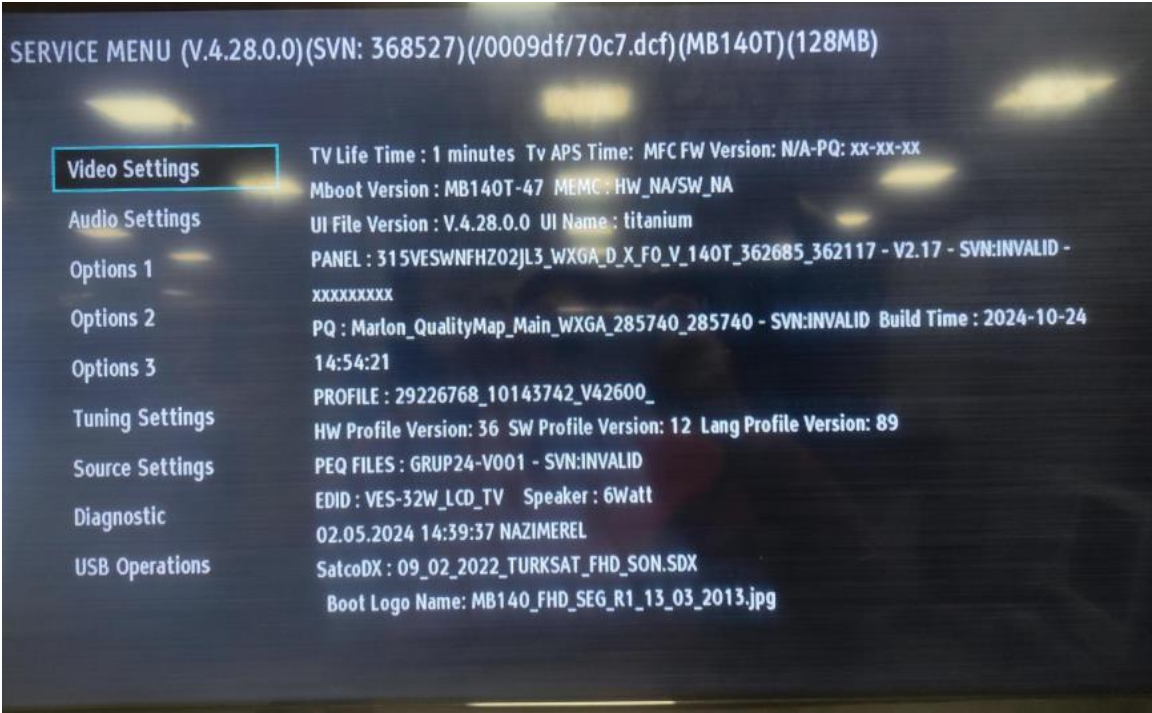


Figure 16: Service Menu Main Screen

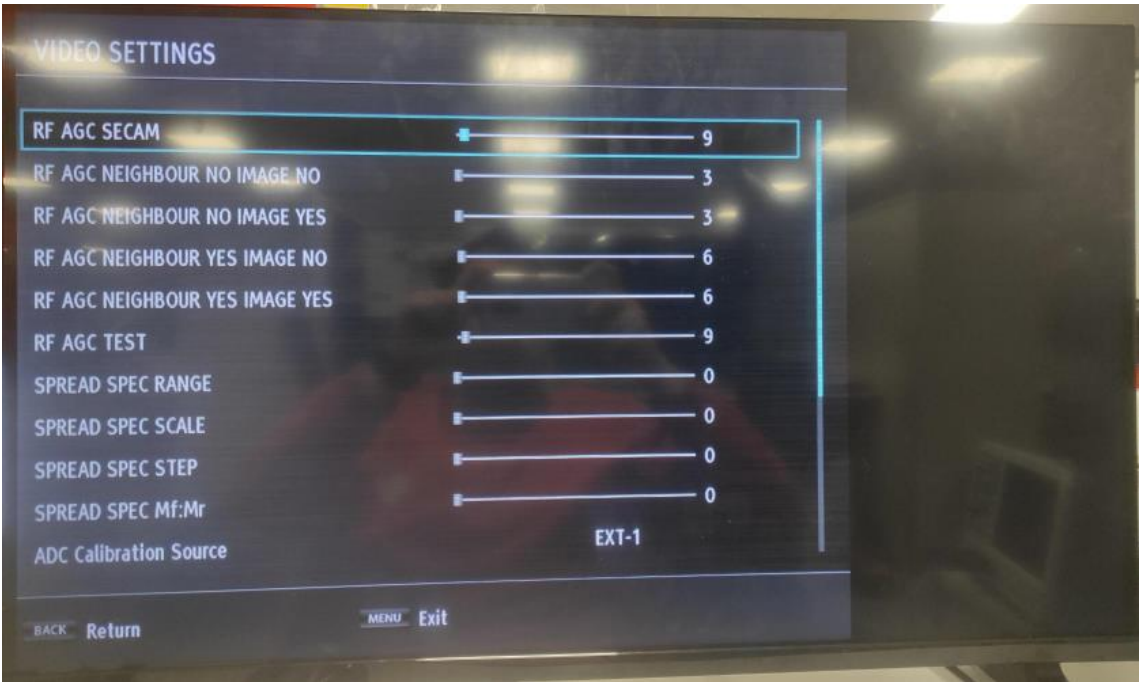


Figure 17: Video Settings

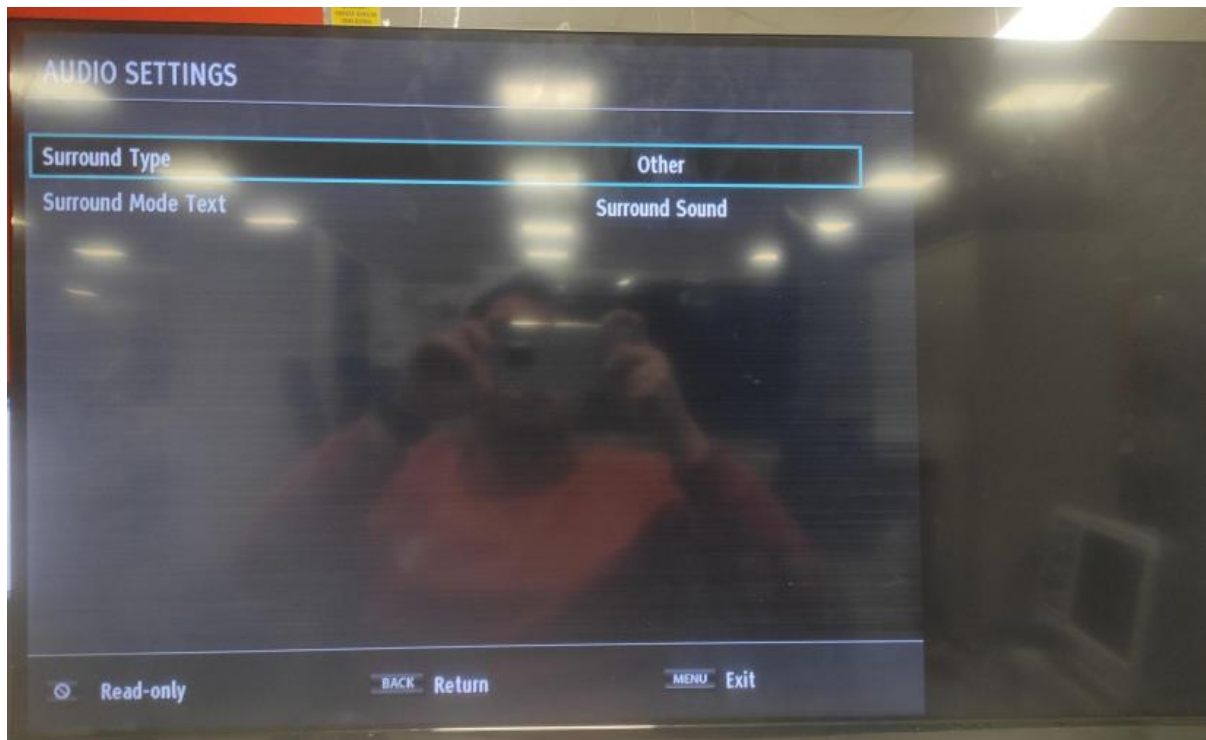


Figure 18: Audio Settings

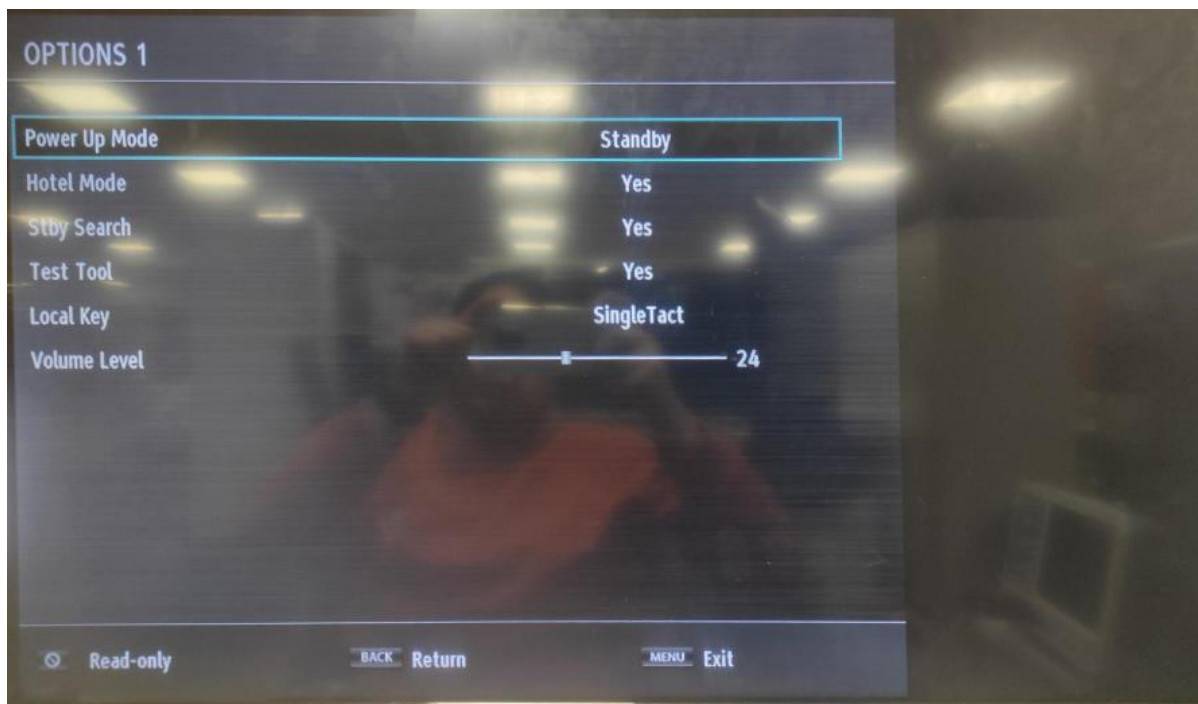


Figure 19: Options-1 Menu

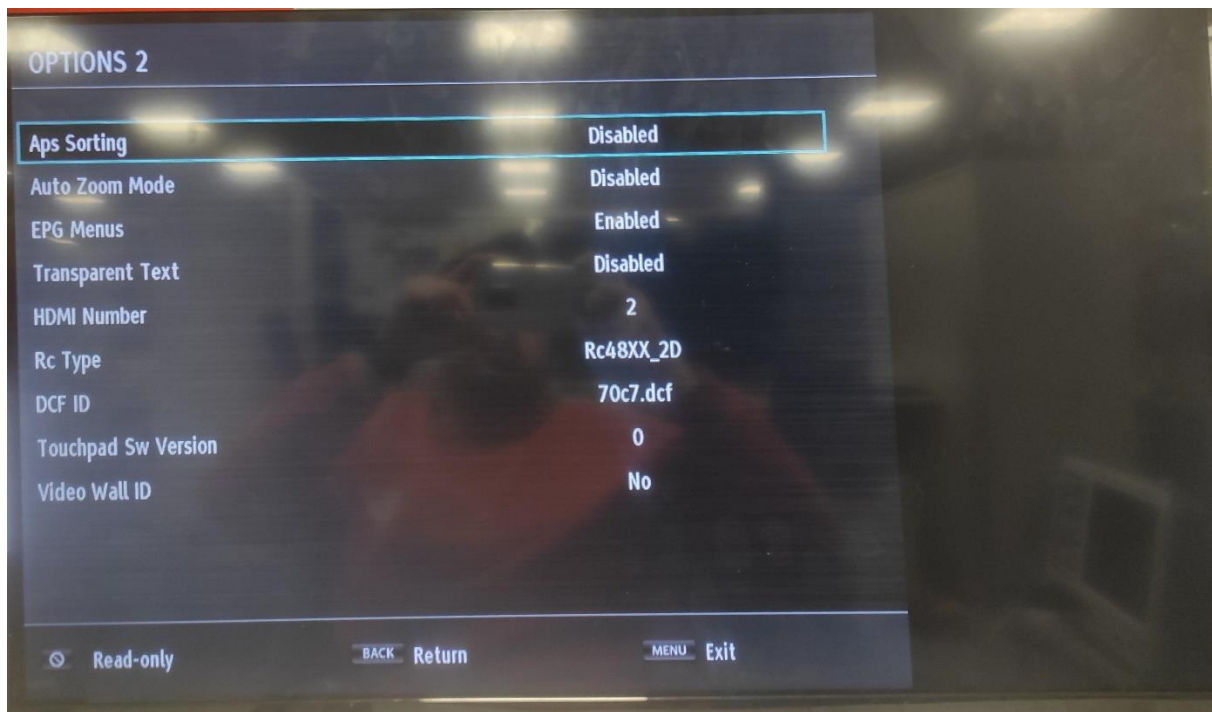


Figure 20: Options-2 Menu

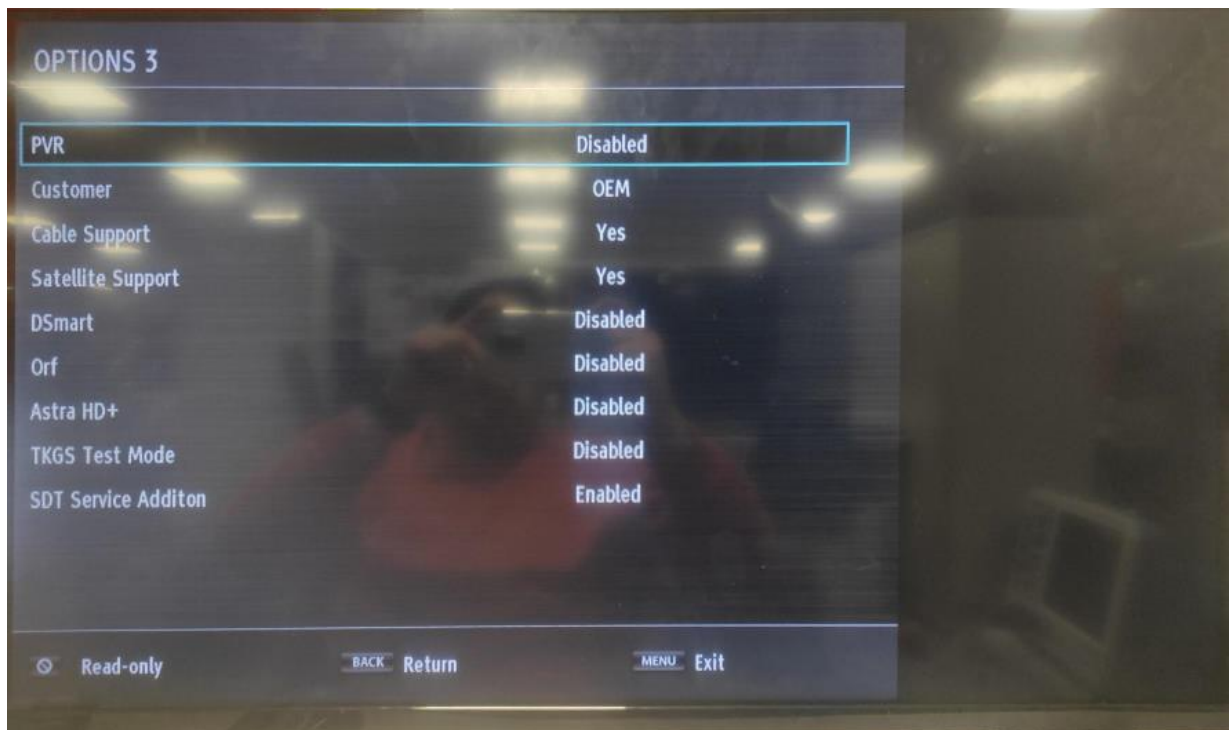


Figure 21: Options-3 Menu

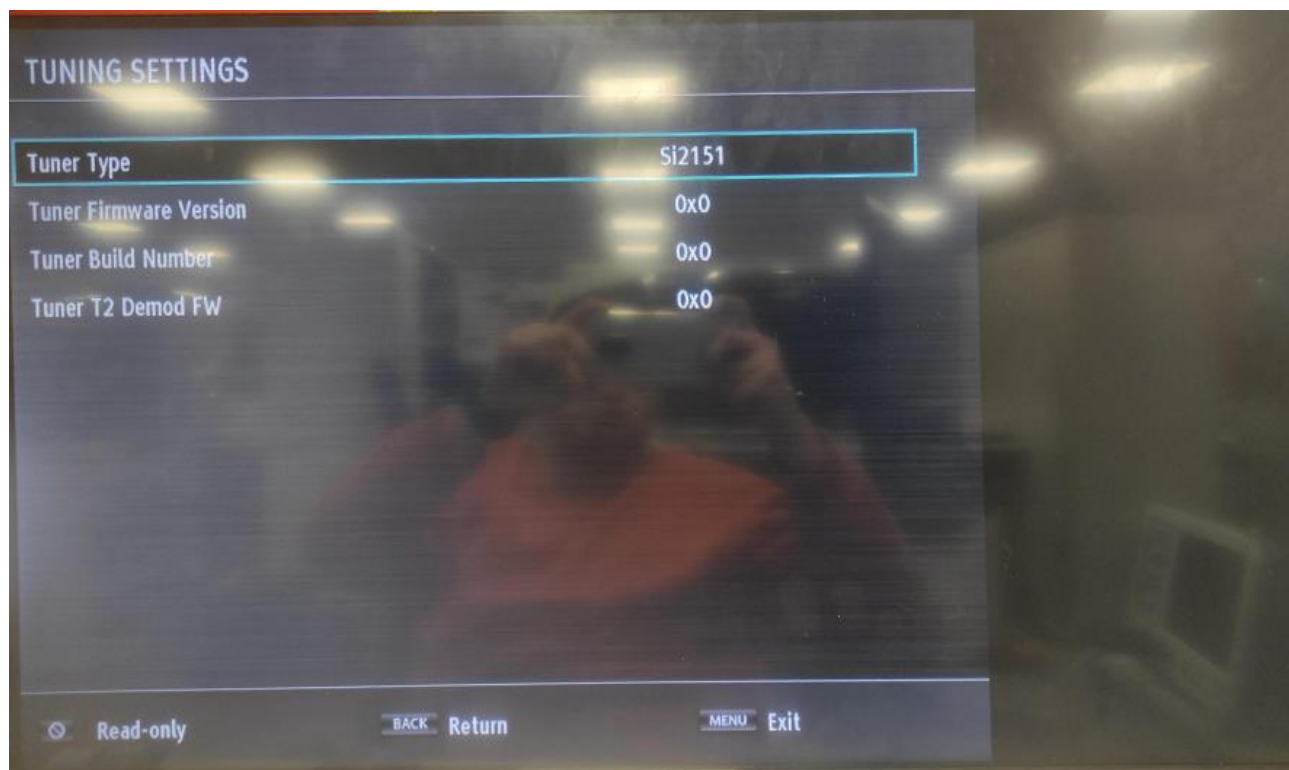


Figure 22: Tuner Settings Menu

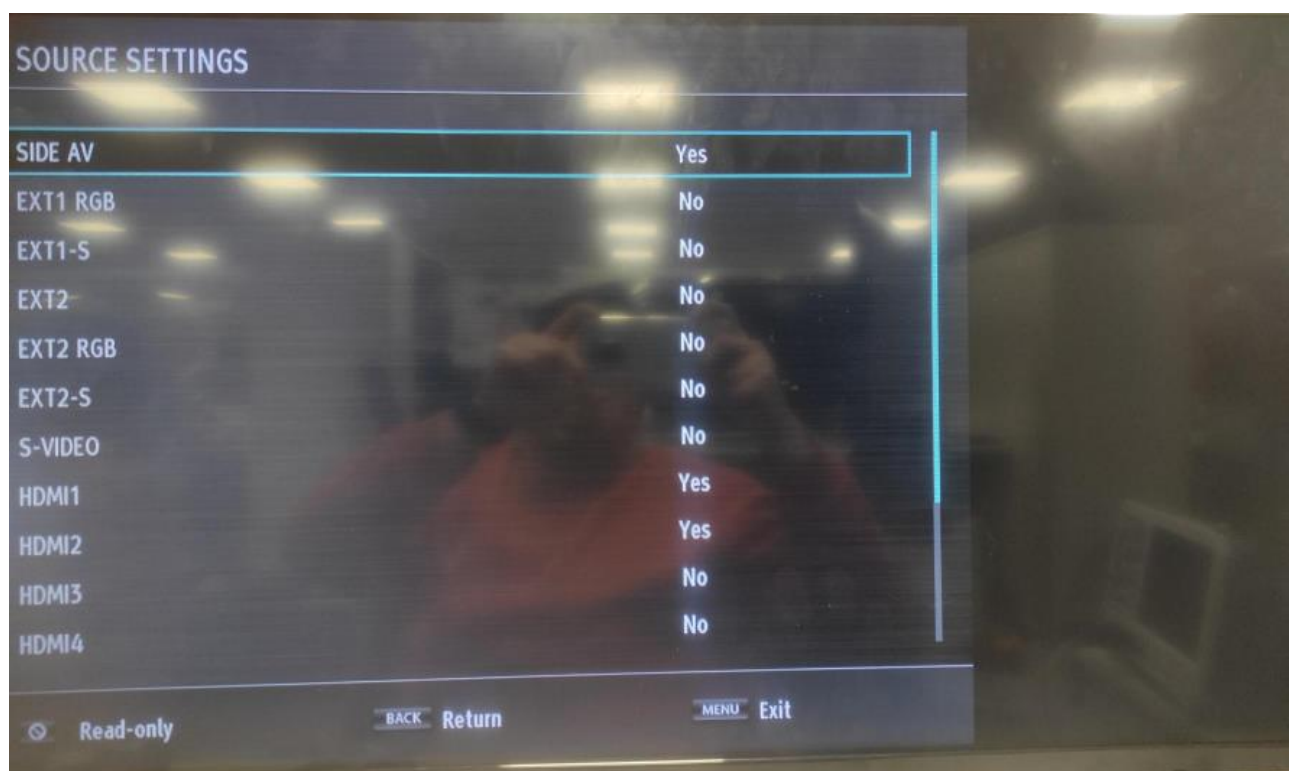


Figure 23: Source Settings Menu

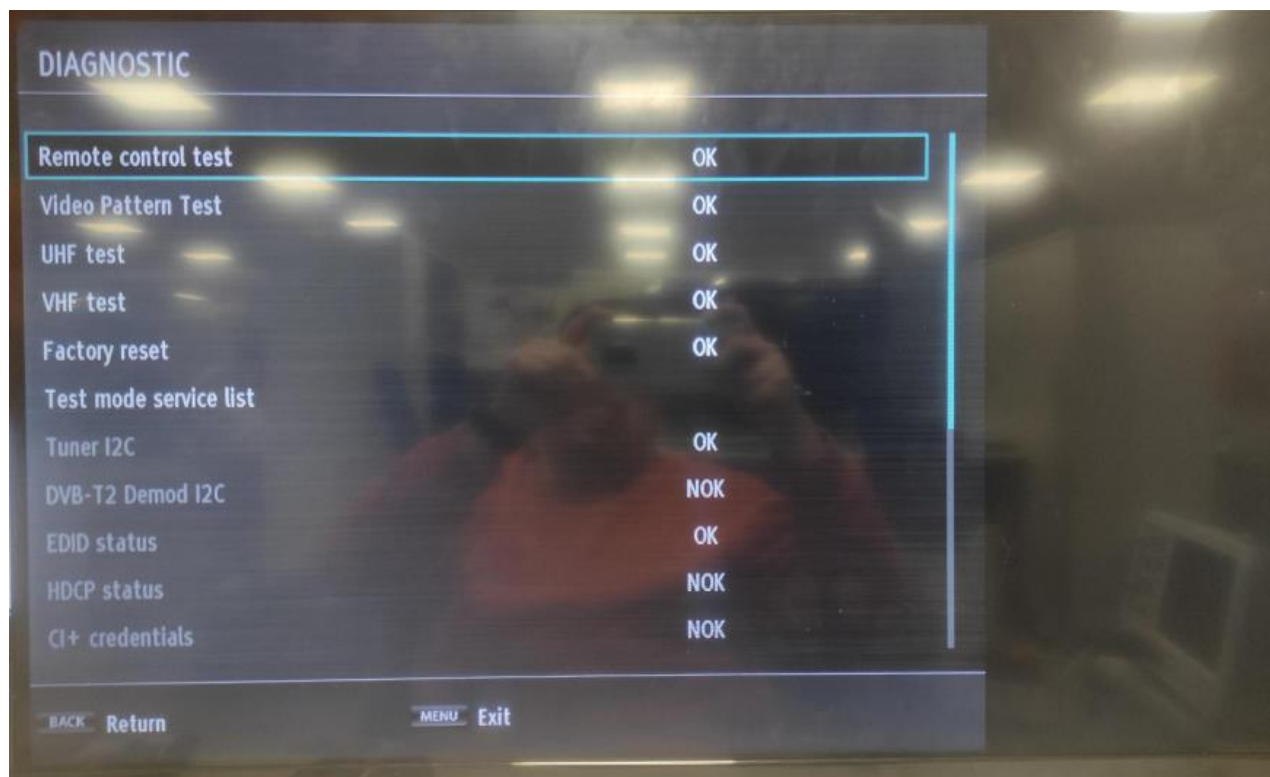
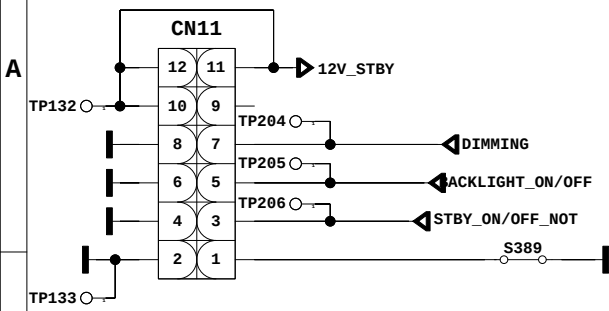
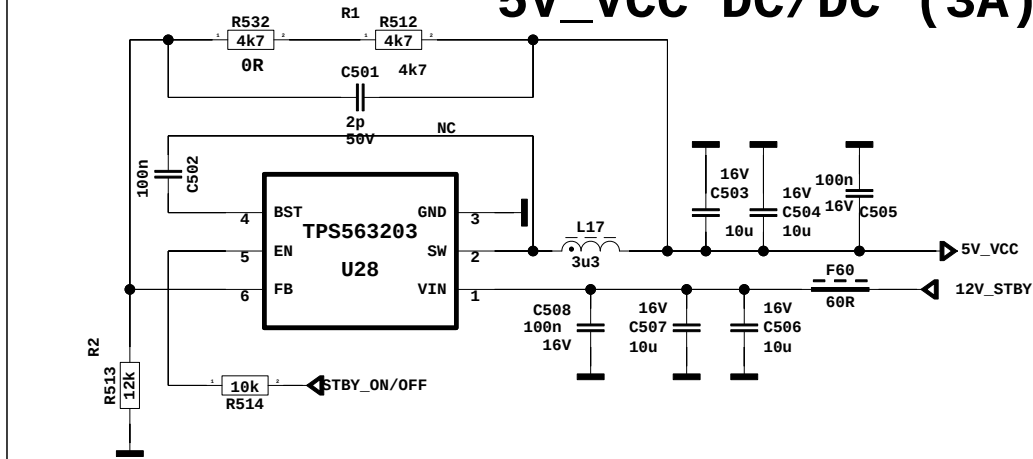


Figure 24: Diagnostic M

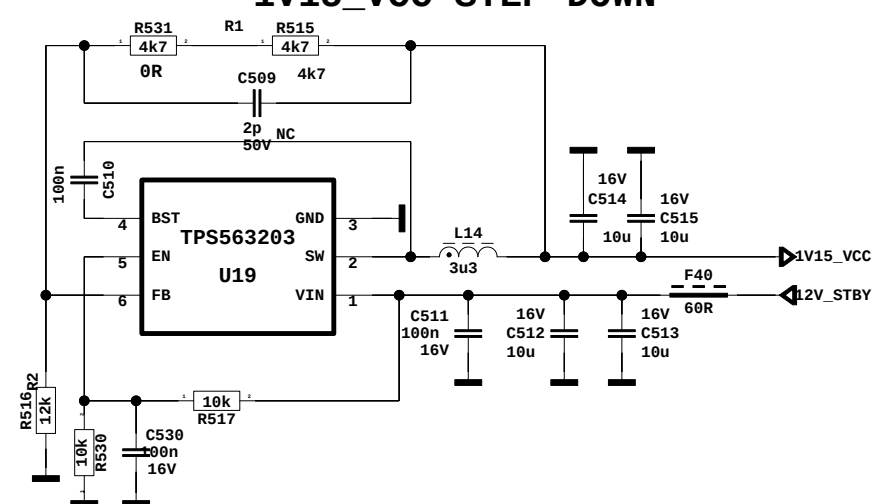
W/B2B



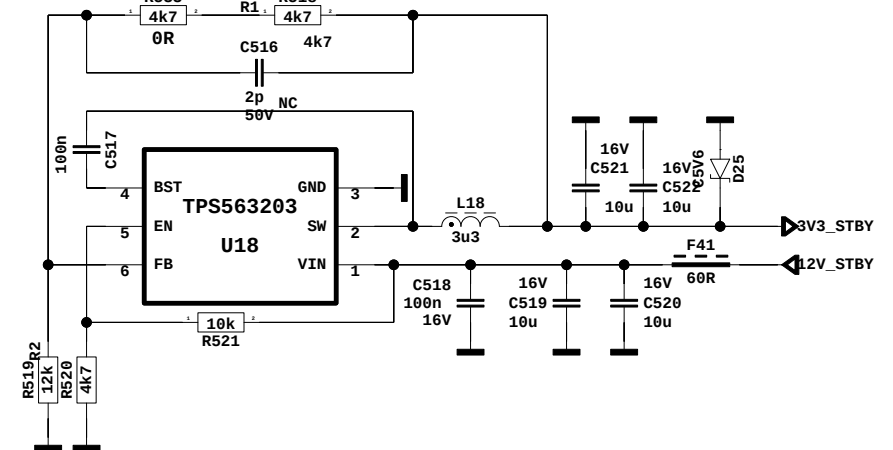
5V_VCC DC/DC (3A)



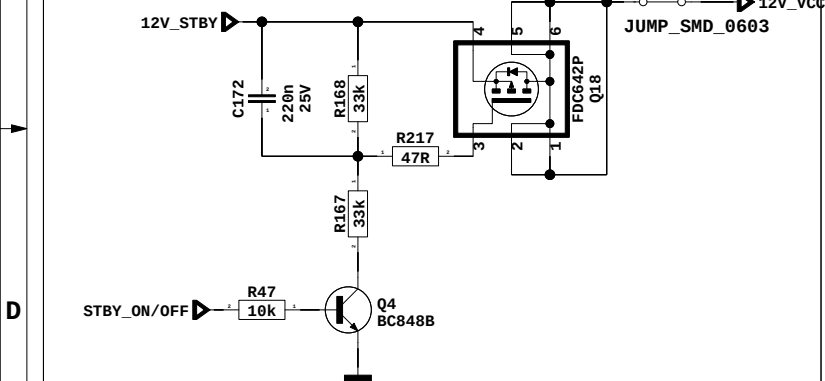
1V15_VCC STEP-DOWN



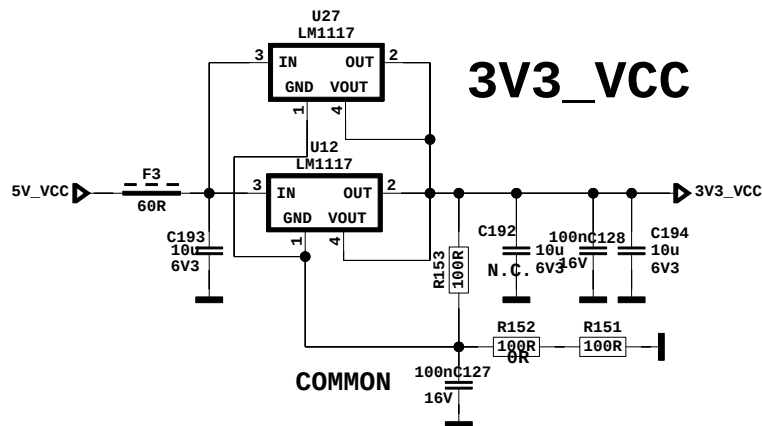
3V3_STBY DC/DC (3A)



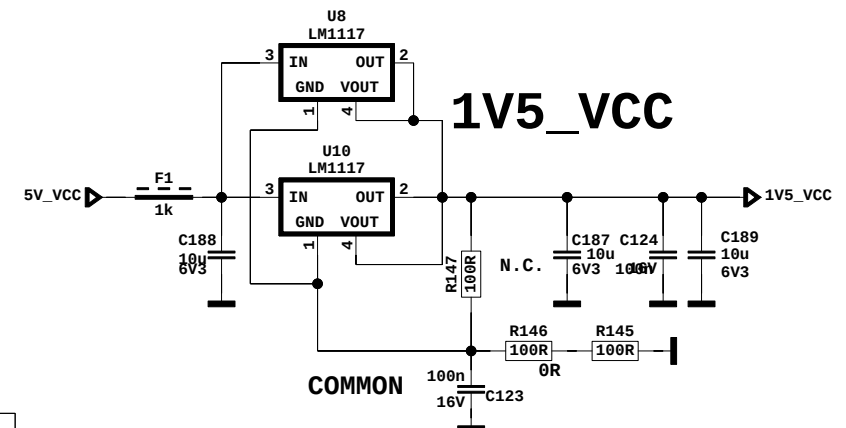
12V_VCC SWITCH



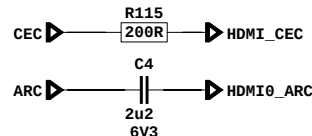
3V3_VCC



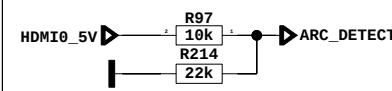
1V5_VCC



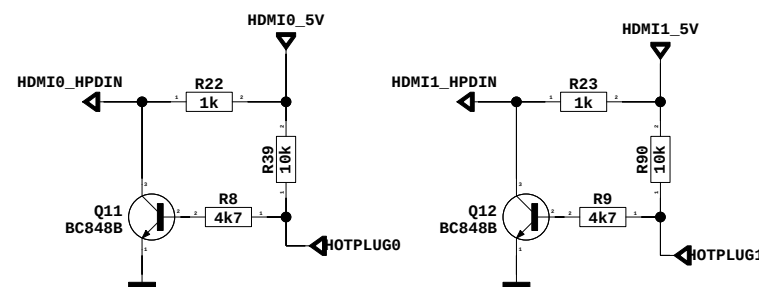
CEC & ARC



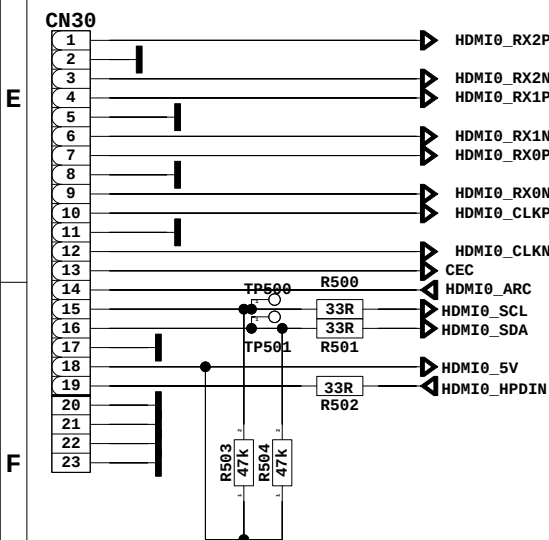
ARC DETECT



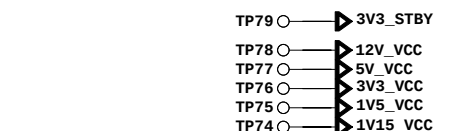
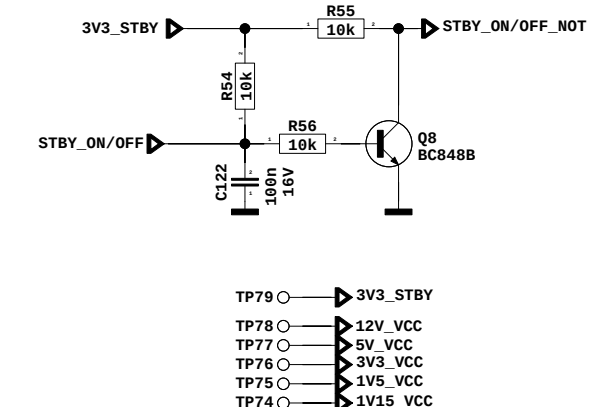
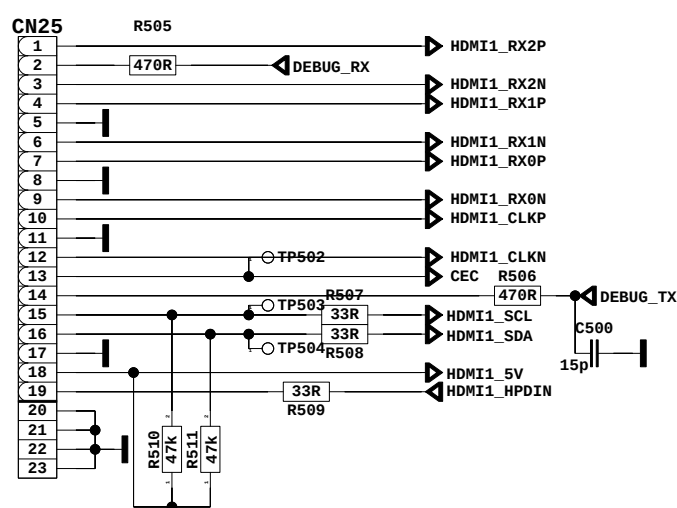
HOTPLUG



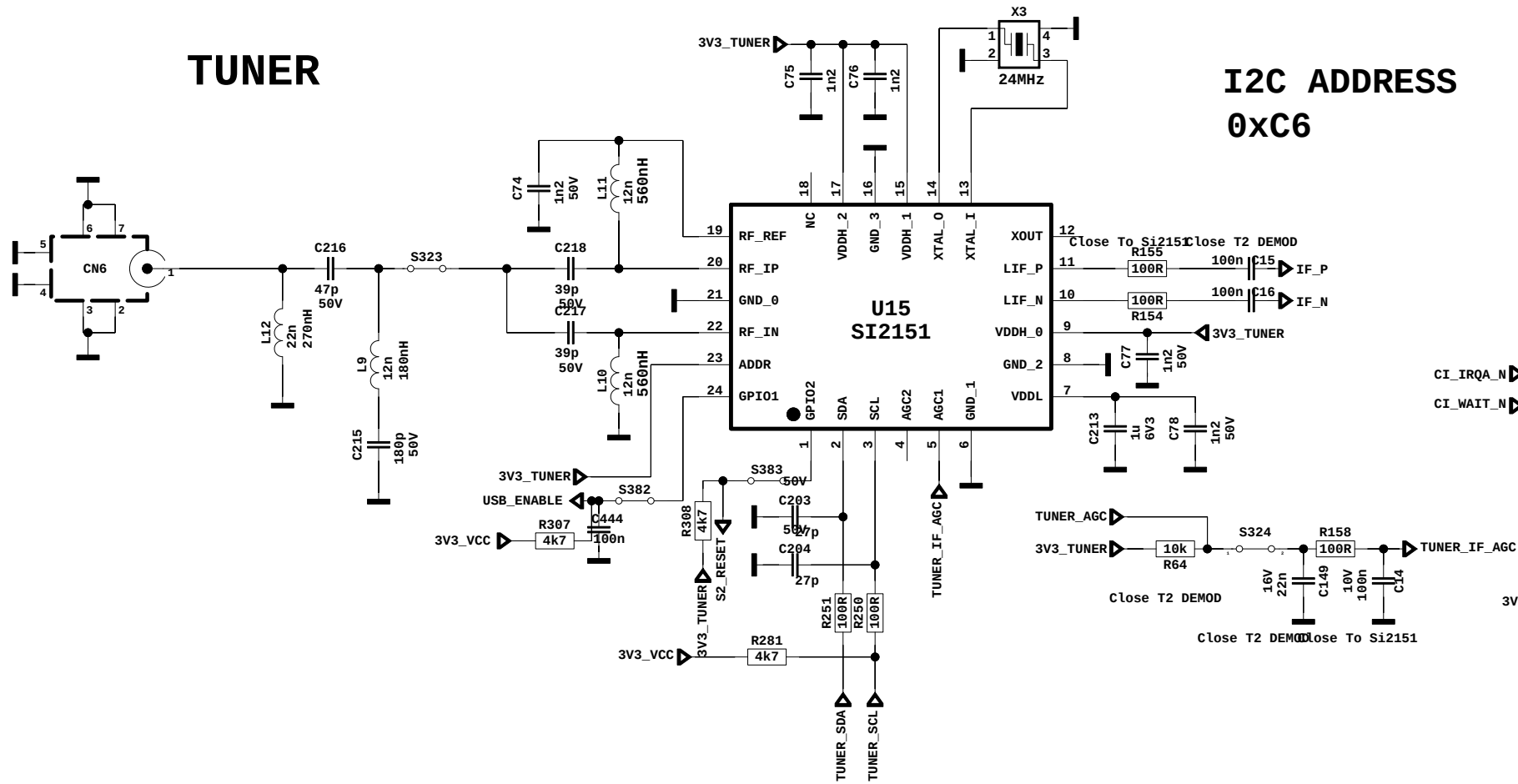
HDMI2 (SIDE-W/ARC)



HDMI1 (SIDE)

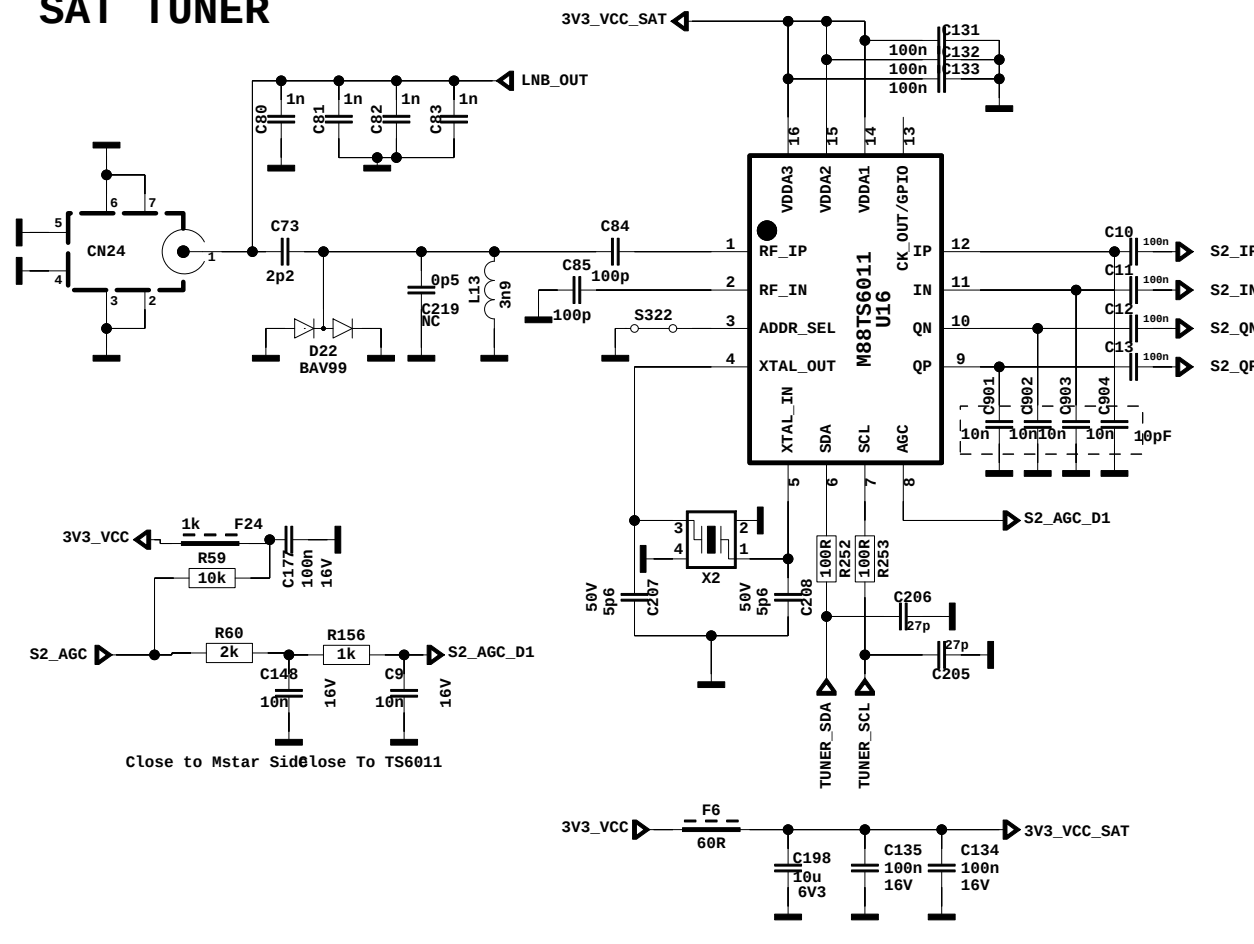


TUNER

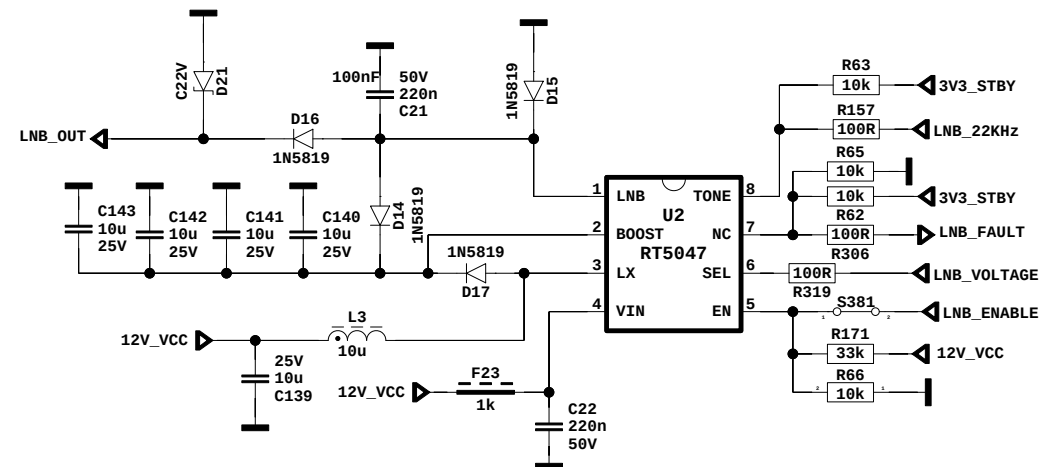


I2C ADDRESS
0xC6

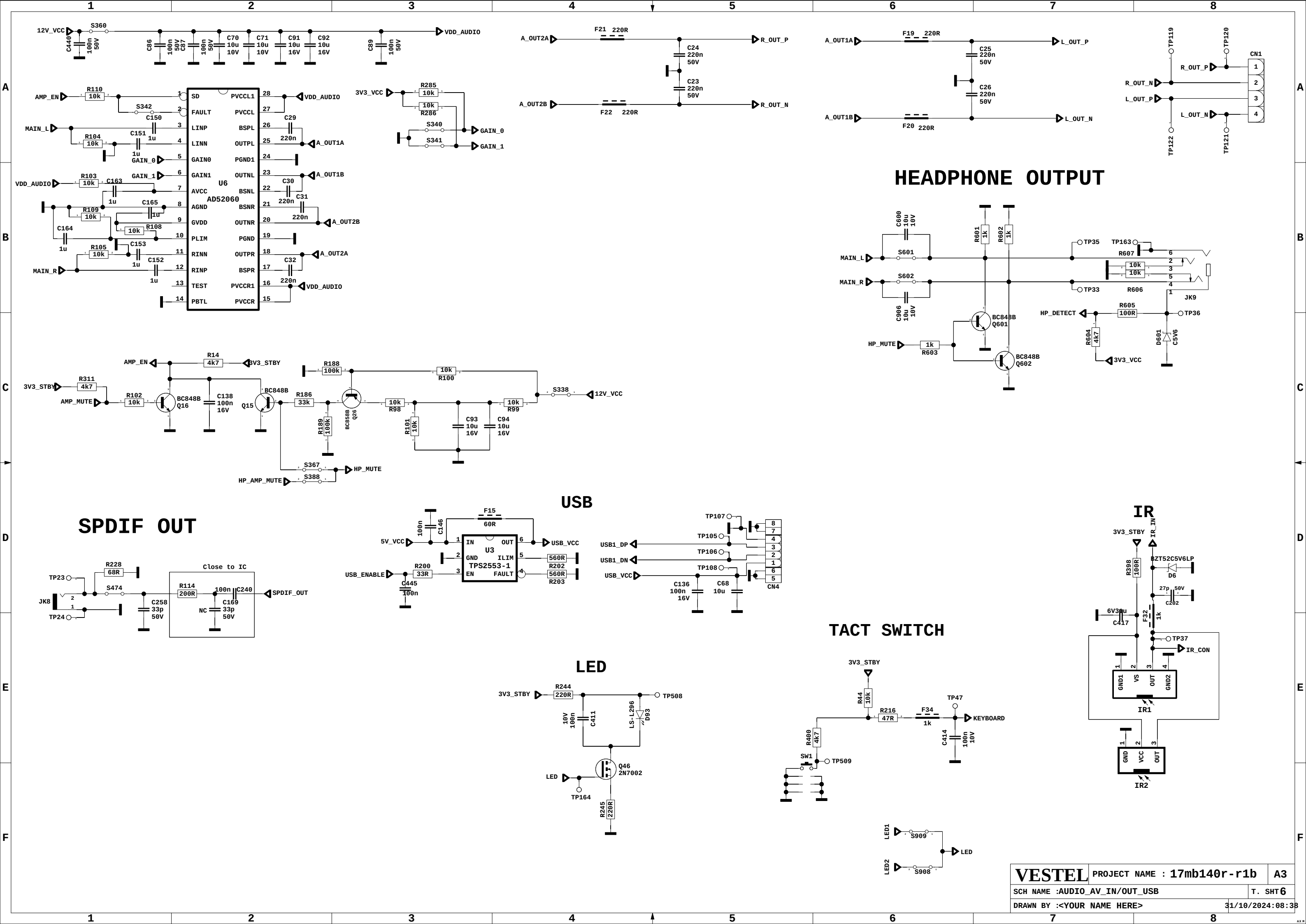
SAT TUNER

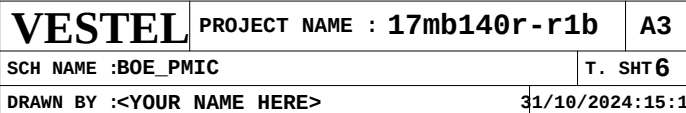


LNBP

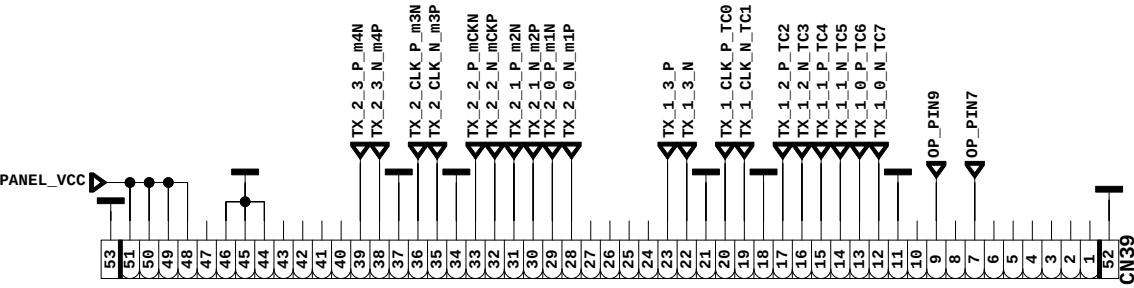


	LNBP_VOLTAGE	LNBP_EN
HIGH	18V	ENABLE
LOW	13V	DISABLE

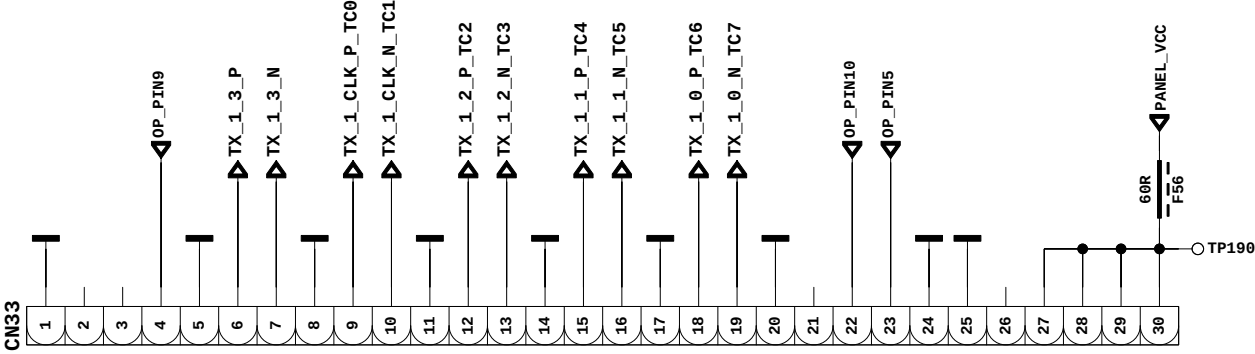




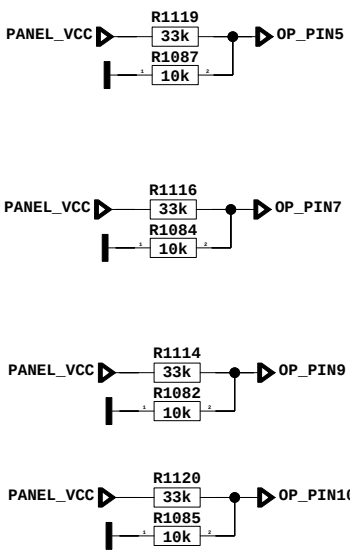
51 PIN FHD



WXGA FFC



OPTIONS TABLE



PANEL SUPPLY SWITCH

