



**17MB35  
TFT TV  
SERVICE MANUAL**

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# 1. INTRODUCTION

17MB35 Main Board consists of MSTAR concept. This IC is capable of handling Audio processing, video processing, Scaling-Display processing, 3D comb filter, OSD and text processing, 8 bit dual LVDS transmitter.

TV supports PAL, SECAM, NTSC colour standards and multiple transmission standards as B/G, D/K, I/I', and L/L' including German and NICAM stereo.

Sound system output is supplying 2x10W (10%THD) for stereo 8Ω speakers.  
Supported peripherals are:

- 1 RF input VHF1, VHF3, UHF @ 75Ω(Common)
- 1 Side AV (SVHS, CVBS, HP, R/L\_Audio) (Common)
- 2 SCART sockets(Common)
- 1 YPbPr (Common)
- 1 PC input(Optional)
- 4 HDMI 1.3 input(2 HDMI inputs are common, 4 inputs are optional)
- 1 Stereo audio input for PC(Common)
- 1 Line out(Common)
- 1 Subwoofer out(Common)
- 1 S/PDIF output(Common)
- 1 Side S-Video(Optional)
- 1 Headphone(Common)
- 1 Common interface(Optional)
- 1 Digital USB(Opional)
- 1 Analog USB(Opional)
- 1 RS232(Optional)
- 1 Smart card connector(Optional)

## 2. TUNER

A horizontal mounted and Digital Half-Nim tuner is used in the product, which covers 3 Bands(From 48MHz to 862MHz for COFDM, from 45.25MHz to 863.25MHz for CCIR CH). The tuning is available through the digitally controlled I2C bus (PLL). Below you will find info on the Tuner in use.

### 2.1. General description of TDTC-G101D:

The Tuner covers 3 Bands(from 48MHz to 862MHz for COFDM, from 45.25MHz to 863.25MHz for CCIR CH). Band selection and Tuning are performed digitally via the I2C bus.

### 2.2. Features of TDTC-G101D:

- Digital Half-NIM tuner for COFDM
- Covers 3 Bands(From 48MHz to 862MHz for COFDM,

- From 45.25MHz to 863.25MHz for CCIR CH)
- Including IF AGC with SAW Filter
- Bandwidth Switching (7/8 MHz) possible
- DC/DC Converter built in for Tuning Voltage
- Internal(or External) RF AGC, Antenna Power Optional

### 2.3. Pinning:

PIN NAME	PIN No.	PIN Description
Ant PWR	1	+5V (for Active Antenna), Optional
B1	2	+ 5V (for Loop through & DC-DC)
RF AGC	3	N.C
SCL	4	I <sup>2</sup> C Bus for TUNER PLL
SDA	5	I <sup>2</sup> C Bus for TUNER PLL
B2	6	+ 5V (for TU & IF AGC AMP)
Vtu T.P	7	N.C
AS	8	PLL IC Address selection
IF AGC Control	9	IF AGC Control
DIF2	10	Total IF Output2
DIF1	11	Total IF Output1
AIF	12	Tuner IF Output

## 3. AUDIO AMPLIFIER STAGE WITH MP7722

### 3.1. General Description

17MB35 uses a 20W Class D Stereo Single Ended Audio Amplifier for audio. The MP7722 is a stereo 20W Class D Audio Amplifier. It is one of MPS' second generation of fully integrated audio amplifiers which dramatically reduces solution size by integrating the following:

- 180mΩ power MOSFETs
- Startup / Shutdown pop elimination
- Short circuit protection
- Mute / Standby

The MP7722 utilizes a single ended output structure capable of delivering 2 x 20W into 4Ω speakers. MPS Class D Audio Amplifiers exhibit the high fidelity of a Class A/B amplifier at efficiencies greater than 90%. The circuit is based on the MPS' proprietary variable frequency topology that delivers low distortion, fast response time and operates on a single power supply.

### 3.2. Features

- 2 x 20W Output at VDD = 24V into a 4Ω load
- THD+N = 0.06% at 1W, 8Ω
- 93% Efficiency at 20W



- Low Noise (190 $\mu$ V Typical)
- Switching Frequency Up to 1MHz
- 9.5V to 24V Operation from a Single Supply
- Integrated Startup and Shutdown Pop Elimination Circuit
- Thermal and Short Circuit Protection
- Integrated 180m $\Omega$  Switches
- Mute/Standby Modes (Sleep)
- Thermally Enhanced 20-Pin TSSOP Package with Exposed Pad

### 3.3. Applications

- Surround Sound DVD Systems
- Televisions
- Flat Panel Monitors
- Multimedia Computers
- Home Stereo Systems

### 3.4. Absolute Ratings

#### 3.4.1. Electrical Characteristics

$V_{DD} = 24V$ ,  $V_{EN} = 5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Units
<b>Supply Current</b>						
Standby Current		$V_{EN} = 0V$		2	10	$\mu A$
Quiescent Current				3	6	mA
<b>Output Drivers</b>						
SW On Resistance		Sourcing and Sinking		0.18		$\Omega$
Short Circuit Current		Sourcing and Sinking		5.0		A
<b>Inputs</b>						
REF1/2, IN1/2 Input Common Mode Voltage Range			0	$\frac{V_{DD}}{2}$	$V_{DD} - 1.5$	V
REF1/2, IN1/2 Input Current		$V_{PIN} = V_{NIN} = 12V$		1	5	$\mu A$
EN Enable Threshold Voltage		$V_{EN}$ Rising		1.4	2.0	V
		$V_{EN}$ Falling	0.4	1.2		V
EN Enable Input Current		$V_{EN} = 5V$		1		$\mu A$
<b>Thermal Shutdown</b>						
Thermal Shutdown Trip Point		$T_J$ Rising		150		$^\circ C$
Thermal Shutdown Hysteresis				30		$^\circ C$

### 3.4.2. Operating Specifications

Parameters	Symbol	Condition	Min	Typ	Max	Units
Standby Current		$V_{EN} = 0V$		260		$\mu A$
Quiescent Current				23		mA
Power Output		f = 1KHz, THD+N = 10%, 4 $\Omega$ Load		20		W
		f = 1KHz, THD+N = 10%, 8 $\Omega$ Load		10		W
THD+ Noise		$P_{OUT} = 1W$ , f = 1KHz, 4 $\Omega$ Load		0.16		%
		$P_{OUT} = 1W$ , f = 1KHz, 8 $\Omega$ Load		0.06		%
Efficiency		f = 1KHz, $P_{OUT} = 1W$ , 4 $\Omega$ Load		90		%
		f = 1KHz, $P_{OUT} = 1W$ , 8 $\Omega$ Load		95		%
Maximum Power Bandwidth				20		KHz
Dynamic Range				93		dB
Noise Floor		A-Weighted		190		$\mu V$
Power Supply Rejection		f = 1KHz		60		dB

### 3.5. Pinning

Pin #	Name	Description
1, 5, 11, 16	NC	No Connect. Not internally connected
2	REF1	Amplifier 1 Reference. REF1 is the reference point for amplifier 1. Use a resistive voltage divider to set the voltage at REF1 to $V_{DD}/2$ .
3	IN1	Amplifier 1 Input. IN1 is the input for amplifier 1. This is an inverting input.
4	AGND1	Analog Ground 1. Connect AGND1 to AGND2.
6	EN1	Enable Input 1. EN1 must be connected to EN2. Drive high to enable MP7722, drive low to disable.
7	IN2	Amplifier 2 Input. IN2 is the input for amplifier 2. This is an inverting input.
8	REF2	Amplifier 2 Reference. REF2 is the reference point for amplifier 2. Use a resistive voltage divider to set the voltage at REF2 to $V_{DD}/2$ .
9	AGND2	Analog Ground 2. Connect AGND2 to AGND1.
10	EN2	Enable Input 2. EN2 must be connected to EN1. Drive high to enable MP7722, drive low to disable.
12	BS2	High-Side MOSFET Bootstrap Input for Amplifier 2. A capacitor from BS2 to SW2 supplies the gate drive current to the internal high-side MOSFET. Connect a 1 $\mu F$ capacitor from SW2 to BS2.
13	VDD2	Power Supply Input. Bypass VDD2 to PGND2 with a 1 $\mu F$ X7R capacitor (in addition to the main bulk capacitor), placed close to the IC PIN13 and PIN15.
14	SW2	Switched Power Output. SW2 is the output of Amplifier 2. Connect the LC filter to this pin.
15	PGND2	Power Ground for Amplifier 2. Connect PGND2 to PGND1.
17	BS1	High-Side MOSFET Bootstrap Input for Amplifier 1. A capacitor from BS1 to SW1 supplies the gate drive current to the internal high-side MOSFET. Connect a 1 $\mu F$ capacitor from SW1 to BS1. See Figure 1.
18	VDD1	Power Supply Input. Bypass VDD1 to PGND1 with a 1 $\mu F$ X7R capacitor (in addition to the main bulk capacitor), placed close to the IC PIN18 and PIN20.
19	SW1	Switched Power Output. SW1 is the output of Amplifier 1. Connect the LC filter to this pin. See Figure 1.
20	PGND1	Power Ground for Amplifier 1. Connect PGND1 to PGND2. See Figure 1.

## 4. POWER STAGE

The DC voltages required at various parts of the chassis and inverters are provided by a main power supply unit. The power supply generates 33V, 24V, 12V, 5V, 3.3V and 5V, 3.3V stand by mode DC voltages. Power stage which is on-chassis generates 1.26V stand by voltage and 8V, 2.6V, 1.8V and 1V supplies for other different parts of the chassis.

## 5. MICROCONTROLLER (MSTAR)

### 5.1. General Description

The MST6WB7GQ-3 is a high performance and fully integrated IC for multi-function LCD monitor/TV with resolutions up to full HD (1920x1080). It is configured with an integrated triple-ADC/PLL, an integrated DVI/HDCP/HDMI receiver, a multi-standard TV video and audio decoder, two video de-interlacers, two scaling engines, the MStarACE-3 color engine, an on-screen display controller, an 8-bit MCU and a built-in output panel interface. By use of external frame buffer, PIP/POP is provided for multimedia applications. Furthermore, 3-D video decoding and processing are fulfilled for high-quality TV applications. To further reduce system costs, the MST6WB7GQ-3 also integrates intelligent power management control capability for green-mode requirements and spread-spectrum support for EMI management.

### 5.2. General Features

#### LCD TV controller with PIP/POP display functions

- Input supports up to UXGA & 1080P
- Panel supports up to full HD (1920x1080)
- TV decoder with 3-D comb filter
- Multi-standard TV sound demodulator and decoder
- 10-bit triple-ADC for TV and RGB/YPbPr
- 10-bit video data processing
- Integrated DVI/HDCP/HDMI compliant receiver
- High-quality dual scaling engines & dual 3-D video de-interlacers
- 3-D video noise reduction
- Full function PIP/PBP/POP
- MStarACE-3 picture/color processing engine
- Embedded On-Screen Display (OSD) controller engine
- Built-in MCU supports PWM & GPIO
- Built-in dual-link 8/10-bit LVDS transmitter
- 5-volt tolerant inputs
- Low EMI and power saving features
- 296-pin LQFP

#### NTSC/PAL/SECAM Video Decoder

- Supports NTSC M, NTSC-J, NTSC-4.43, PAL (B,D,G,H,M,N,I,Nc), and SECAM
- Automatic TV standard detection
- Motion adaptive 3-D comb filter for NTSC/PAL

- 8 configurable CVBS & Y/C S-video inputs
- Supports Teletext level-1.5, WSS, VPS, Closed-caption, and V-chip
- Macrovision detection
- CVBS video output

### **Video IF for Multi-Standard Analog TV**

- Digital low IF architecture
- Stepped-gain PGA with 26 dB tuning range and 1 dB tuning resolution
- Maximum IF analog gain of 37dB in addition to digital gain
- Programmable TOP to accommodate different tuner gain to optimize noise and linearity performance

### **Multi-Standard TV Sound Decoder**

- Supports BTSC/NICAM/A2/EIA-J demodulation and decoding
- FM stereo & SAP demodulation
- L/Rx4, mono, and SIF audio inputs
- L/Rx3 loudspeaker and line outputs
- Supports sub-woofer output
- Built-in audio output DAC's
- Audio processing for loudspeaker channel, including volume, balance, mute, tone, EQ, and virtual stereo/surround
- Optional advanced surround available (Dolby1, SRS2, BBE3... etc)

### **Digital Audio Interface**

- I2S digital audio input & output
- S/PDIF digital audio input & output
- HDMI audio channel processing capability
- Programmable delay for audio/video synchronization

### **Analog RGB Compliant Input Ports**

- Three analog ports support up to UXGA
- Supports HDTV RGB/YPbPr/YCbCr
- Supports Composite Sync and SOG (Sync-on-Green) separator
- Automatic color calibration

### **DVI/HDCP/HDMI Compliant Input Port**

- Two HDMI input ports with built-in switch
- Supports TMDS clock up to 225MHz @ 1080P 60Hz with 12-bit deep-color resolution
- Single link on-chip DVI 1.0 compliant receiver
- High-bandwidth Digital Content Protection(HDCP) 1.1 compliant receiver

## 6. SiI9185 3:1 HDMI 1.3 Switch

### 6.1. General Description

The SiI9185A is the first generation of TMDS switch device supporting Revision 1.3 of the HDMI Specification (HDMI Consortium; June 2006). With three HDMI inputs and a single output, the SiI9185A provides a low-cost method of adding additional HDMI ports to the latest Digital TVs. New DTVs can easily connect to the many HDMI sources coming on the market, including DVDs, STB, game consoles, PCs, camcorders, and digital still cameras. The SiI9185A is a fully HDMI compliant device providing a simple, lowcost method of retransmitting protected digital audio and video, giving end-users a truly all-digital experience. Built-in backward compatibility with DVI 1.0 allows HDMI systems to connect to any DVI 1.0 source. The SiI9185A provides additional integrated features to help lower system cost and provide enhanced features to the end consumer. To lower system cost, the SiI9185A provides a complete solution for switching sink-side HDMI signals. This includes DDC switching, individual HPD control, and 5V sense. The addition of these features eliminates additional external components, helping to lower cost. For source-side applications, the SiI9185A DDC switching can be bypassed with an external 4-channel I2C-bus switch(e.g., Texas Instruments PCA95445) to allow clock stretching.

### 6.2. Features

- Three-input, single-output HDMI switcher
- Integrated TMDS® receiver and transmitt cores capable of receiving and transmitting 2.25 Gbps:
- Support 60 Hz, 12-bit or 720p/1080i, 120 Hz, 12-bit
- Builcable support even at deep-color resolutions
- Pre-emphasi
- DVI 1.0, HDCP 1.1 and HDM compliant receiver and transmitter
- Uses HDMI-compliant TMDS core recovery and retransmission, unlike TMDS switches, which use high-spee analog switches and degrade TMDS signals
- Built-in Cons support:
- HDM lowers cost for adding CEC support to DTV
- Integra requirements on system microcontrolle speeds design

### 6.3. Absolute Maximum Ratings

Symbol	Parameter	Min	Typ	Max	Units	Note
DVCC18	Digital Core Supply Voltage	-0.5	-	2.5	V	1, 2, 3
AVCC18	TMDS Analog Supply Voltage	-0.3	-	2.5	V	1, 2, 3
AVCC33	TMDS Analog Supply Voltage	-0.3	-	4.0	V	1, 2, 3
V <sub>I</sub>	Input Voltage	-0.3	-	AVCC33+ 0.3	V	1, 2, 4
V <sub>O</sub>	Output Voltage	-0.3	-	AVCC33+ 0.3	V	1, 2
V <sub>5V-Tolerant</sub>	Input Voltage on 5V Tolerant Pins	-0.3	-	5.5	V	4
T <sub>J</sub>	Junction Temperature	-	-	125	°C	-
T <sub>STG</sub>	Storage Temperature	-65	-	150	°C	-

## 6.4. Pinning

### System Switching Pins

Pin Name	Pin #	Type	Dir	Description
DSDA0, DSDA1, DSDA2	30, 50, 70	LVTTL, Schmitt Trigger, 5V Tolerant	Input/ Output	DDC I <sup>2</sup> C Data for respective port. See Note 1.
DSCL0, DSCL1, DSCL2	31, 51, 71	LVTTL, Schmitt Trigger, 5V Tolerant	Input	DDC I <sup>2</sup> C Clock for respective port. See Note 1.
RPWR0, RPWR1, RPWR2	32, 52, 72	LVTTL, 5V Tolerant	Input	5V Port detection input for respective port. Connect to 5V signal from HDMI input connector.
HPD0, HDP1, HPD2	16, 36, 56	LVTTL, 2mA, 5V Tolerant	Output	Hot Plug Detect Output for respective port. Connect to HOTPLUG of HDMI input connector.
HPDIN	76	LVTTL, 5V Tolerant	Input	Hot Plug Detect Input.
TSCL	78	LVTTL, Schmitt Trigger, Open Drain 5V Tolerant	Output	Master DDC I <sup>2</sup> C Clock (Open Drain Output) to HDMI receiver. I <sup>2</sup> C transactions required for HDCP operation are performed over this I <sup>2</sup> C bus. See Note 1.
TSDA	77	LVTTL, Schmitt Trigger, 5V Tolerant	Input/ Output	Master DDC Data (Open drain output.) to HDMI receiver. I <sup>2</sup> C transactions required for HDCP operation are performed over this I <sup>2</sup> C bus. See Note 1.

### Configuration Pins

Pin Name	Pin #	Type	Dir	Description
I2CADDR/ TPWR	79	LVTTL, 4mA, 5V Tolerant	Input/ Output	I <sup>2</sup> C Slave Address input / Transmit Power Sense output pin. When RESET# is low, this pin is used as an input to latch the I <sup>2</sup> C sub-address. The level on this pin is latched when the RESET# pin transitions from low to high. When RESET# is high, this pin is used as the TPWR output, indicating that the selected Rx-port has 5V present. When none of the Rx ports are selected, this signal is low. See page 9 for more information.
I2CSEL/ INT#	35	Schmitt Trigger, Open Drain, 4mA, 5V Tolerant	Input/ Output	I <sup>2</sup> C Selection input / Interrupt output pin. When RESET# is low, this pin is used as an input to latch the External Port Detection signal. The level on this pin is latched when the RESET# pin transitions from low to high. When this pin is low during reset, the external pins EPSEL1/LSCL and EPSEL0/LSDA are used to select the Rx-port as EPSEL[1:0]. When this pin is high during reset, the internal local I <sup>2</sup> C register is used to select the Rx-port. After reset, this pin becomes the Interrupt output. This is an open-drain output and requires an external pull-up. See page 8 for more information.
RSVDL	75		Input	Reserved for use by Silicon Image and must be tied low.

## Control Pins

Pin Name	Pin #	Type	Dir	Description
RESET#	13	LVTTL, Schmitt Trigger. 5V Tolerant	Input	Reset Pin (Active LOW). Certain configuration inputs are latched when RESET# transitions from low to high. See page 8 for more information.
LSCL/ EPSEL1	15	Schmitt 5V Tolerant	Input	Local I <sup>2</sup> C Clock / External Port Select 1. When I2CSEL is high, this becomes the Local I <sup>2</sup> C bus clock pin, LSCL. When I2CSEL is low, this becomes the external port select pin, EPSEL1. True open drain, so does not pull to ground if power not applied. An external pull-up is required. See page 8 for more information.
LSDA/ EPSEL0	14	LVTTL, Schmitt Trigger. Open Drain 5V Tolerant	Input/ Output	Local I <sup>2</sup> C Data / External Port Select 0. When I2CSEL is high, this becomes the Local I <sup>2</sup> C bus data pin, LSDA. When I2CSEL is low, this becomes the external port select pin, EPSEL0. True open drain, so does not pull to ground if power not applied. An external pull-up is required. See page 8 for more information.

## CEC Pins

Pin Name	Pin #	Type	Direction	Description
CEC_A	54	CEC Compliant, 5V Tolerant	Input/ Output	HDMI compliant CEC I/O used to interface to CEC devices. CEC electrically compliant signal. This pin connects to the CEC signal of all HDMI connectors in the system. As an input, the pad acts as a LVTTL Schmitt triggered input and is 5V tolerant. As an output, the pad acts as an NMOS driver with resistive pull-up. This pin has an internal pull-up resistor.
CEC_D	53	LVTTL, Schmitt Trigger 5V Tolerant	Input/ Output	CEC interface to local system. True open-drain. An external pull-up is required. This pin typically connects to the local CPU.

## Power and Ground Pins

Pin Name	Pin #	Type	Description
AVCC33	23, 43, 55, 63	Power	Analog VCC. Connect to 3.3V supply.
AVCC18	6, 17, 29, 37, 49, 57, 69	Power	Analog VCC. Connect to 1.8V supply.
AGND	3, 9, 20, 26, 40, 46, 60, 66, 80	Ground	Analog GND.
DVCC18	33, 73	Power	Digital VCC. Connect to 1.8V supply.
DGND	34, 74	Ground	Digital GND.

## 7. QAM DEMODULATOR – STV0297E

### 7.1. General Description

The STV0297E is a complete single-chip QAM (quadrature amplitude modulation) demodulation and FEC (forward error correction) solution that performs sampled IF to transport stream (MPEG-2 or MPEG-4) block processing of QAM signals. It is intended for the digital transmission of compressed television, sound, and data services over cable. It is fully compliant with ITU-T J83 Annexes A/C or DVB-C specification bitstreams (ETS 300 429, "Digital broadcasting systems for television, sound and data services – Framing structure, channel coding and modulation - Cable Systems"). It can handle square (16, 64, 256-QAM) and non-square (32, 128-QAM) constellations.

Japanese DBS systems require a transport stream multiplex frame (TSMF) layer to carry digital signals over cable systems. When the recovered transport stream is a multiplex frame, the STV0297E post-processes it to extract a single transport stream. Automatic detection of the TSMF layer is provided. The chip integrates an analog-to-digital converter that delivers the required performance to handle up to 256-QAM signals in a direct IF sampling architecture, thus eliminating the need for external downconversion.

## 7.2. Features

- Decodes ITU-T J.83-Annexes A/C and DVB-C bit streams
- Processes Japanese transport stream multiplex frame (TSMF)
- High-performance integrated A/D converter suitable for direct IF architecture in all QAM (quadrature amplitude modulation) modes
- Supports 16, 32, 64, 128 and 256 point constellations
- Small footprint package: (10 x 10 mm<sup>2</sup>)
- Very low power consumption
- Full digital demodulation
- Variable symbol rates
- Front derotator for better low symbol rate performance and relaxed tuner constraints
- Integrated matched filtering
- Robust integrated adaptive pre and post equalizer
- On-chip FEC A/C with ability to bypass individual blocks
- 10 programmable GPIO
- Two AGC outputs suitable for delayed AGC applications (sigma-delta outputs)
- Integrated signal quality monitors, plus lock indicator and interrupt function mapped to GPIO pin
- Improved signal acquisition
- System clock generated on-chip from quartz crystal
- Low frequency crystal operations 4, 16, 25 - 30 MHz
- 4 I2C addresses
- Easy control and monitoring via 2-wire fast I2C bus

## 7.3. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V <sub>DD_1V0</sub>	DC supply voltage	-0.1, +1.1	V
V <sub>DD_2V5</sub>	DC supply voltage	-0.25, +2.75	V
V <sub>DD_3V35</sub>	DC supply voltage	-0.5, +3.63	
V <sub>IN_D</sub>	Voltage on digital input pins	-0.3, V <sub>DD_3V3</sub> + 0.3	V
V <sub>IN_A</sub>	Voltage on analog input pins	0.3, V <sub>DD_2V5</sub> + 0.3	V
T <sub>OPER</sub>	Operating ambient temperature	0, +70	°C
T <sub>STG</sub>	Storage temperature	-40, +150	°C
T <sub>J</sub>	Junction temperature	+125	°C



## 7.4. Pinning

Pad num	Name	Type	Drive	Pad num	Name	Type	Drive
1	GPIO9	digital	2mA	33	GPIO3/SCLT	digital	2mA
2	GPIO8	digital	2mA	34	GPIO2	digital	2mA
3	TDI	digital	2mA	35	GPIO1/AGC1	digital	2mA
4	TDO	digital	2mA	36	GPIO0/AGC2	digital	2mA
5	TRST	digital	2mA	37	VDD	dig. supply	
6	TCK	digital	2mA	38	GND	dig. supply	
7	TMS	digital	2mA	39	VDD_IO_3V3	dig. supply 3.3v	
8	GPIO7/AUX_CLK	digital	2mA	40	GNDAS_AD	analog gnd	
9	N_RESET	digital	2mA	41	INM	analog	
10	VDD	dig. supply		42	INP	analog	
11	GND	dig. supply		43	VCCAISO_D	anal. 2.5v supply	
12	VDD_IO_3V3	dig. supply 3.3v		44	INCM	analog	
13	GPIO6/CS0	digital	2mA	45	REFM	analog	
14	GPIO5/CS1	digital	2mA	46	REFP	analog	
15	SDA	digital	2mA	47	GND_AAD12	analog ground	
16	SCL	digital	2mA	48	VCCA_AD12	analog supply	
17	M_CKOUT	digital	4mA	49	GNDD_AD12	analog ground	
18	M_SYNC	digital	2mA	50	VCCD_AD12	anal. 1.0v supply	
19	M_VALID	digital	4mA	51	GND_APLL	analog ground	
20	M_ERR	digital	2mA	52	VCCA_PLL	anal. 2.5v supply	
21	TS_DATA[0]	digital	4mA	53	GNDD_PLL	analog ground	
22	TS_DATA[1]	digital	2mA	54	VCCD_PLL	anal.1.0v supply	
23	TS_DATA[2]	digital	2mA	55	ZO		
24	TS_DATA[3]	digital	2mA	56	VCCA_OSC	anal. 2.5v supply	
25	VDD	dig. supply		57	A		
26	GND	dig. supply		58	GND_AOSC	analog ground	
27	VDD_IO_3V3	dig. supply 3.3v		59	VBASE		
28	TS_DATA[4]	digital	2mA	60	VDD10REG		
29	TS_DATA[5]	digital	2mA	61	VDD	dig. supply	
30	TS_DATA[6]	digital	2mA	62	GND	dig. supply	
31	TS_DATA[7]	digital	4mA	63	VDD_IO_3V3	dig. supply 3.3v	
32	GPIO4/SDAT	digital	2mA	64	CLK_TST	digital	4mA

## 8. HY5DV281622DT-5 DDR SDRAM 128M

### 8.1. General Description

The Hynix HY5DV281622 is a 134,217,728-bit CMOS Double Data Rate(DDR) Synchronous DRAM, ideally suited for the point-to-point applications which requires high bandwidth. The Hynix 8Mx16 DDR SDRAMs offer fully synchronous operations referenced to both rising and falling edges of the clock. While all addresses and control inputs are latched on the rising edges of the CK (falling edges of the /CK), Data,Data strobes and Write data masks inputs are sampled on both rising and falling edges of it. The data paths are internally pipelined and 2-bit prefetched to achieve very high bandwidth. All input and output voltage levels are compatible with SSTL\_2.

## 8.2. Features

- 3.3V for VDD and 2.5V for VDDQ power supply
- All inputs and outputs are compatible with SSTL\_2 interface
- JEDEC standard 400mil 66pin TSOP-II with 0.65mm pin pitch
- Fully differential clock inputs (CK, /CK) operation
- Double data rate interface
- Source synchronous - data transaction aligned to bidirectional data strobe (DQS)
- x16 device has 2 byte-wide data strobes (LDQS, UDQS) per each x8 I/O
- Data outputs on DQS edges when read (edged DQ) Data inputs on DQS centers when write (centered DQ)
- Data(DQ) and Write masks(DM) latched on the both rising and falling edges of the data strobe
- All addresses and control inputs except Data, Data strobes and Data masks latched on the rising edges of the clock
- Write mask byte controls by LDM and UDM
- Programmable /CAS latency 3 / 4 supported
- Programmable Burst Length 2 / 4 / 8 with both sequential and interleave mode
- Internal 4 bank operations with single pulsed /RAS
- tRAS Lock-Out function supported
- Auto refresh and self refresh supported
- 4096 refresh cycles / 32ms
- Full, Half and Matched Impedance(Weak) strength driver option controlled by EMRS

## 8.3. Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Ambient Temperature	TA	0 ~ 70	°C
Storage Temperature	TSTG	-55 ~ 125	°C
Voltage on Any Pin relative to VSS	VIN, VOUT	-0.5 ~ 3.6	V
Voltage on VDD relative to VSS	VDD	-0.5 ~ 3.6	V
Voltage on VDDQ relative to VSS	VDDQ	-0.5 ~ 3.6	V
Output Short Circuit Current	IOS	50	mA
Power Dissipation	PD	1	W
Soldering Temperature - Time	TSOLDER	260 · 10	°C · sec

## 8.4. Pinning

PIN	TYPE	DESCRIPTION
CK, /CK	Input	Clock: CK and /CK are differential clock inputs. All address and control input signals are sampled on the crossing of the positive edge of CK and negative edge of /CK. Output (read) data is referenced to the crossings of CK and /CK (both directions of crossing).
CKE	Input	Clock Enable: CKE HIGH activates, and CKE LOW deactivates internal clock signals, and device input buffers and output drivers. Taking CKE LOW provides PRECHARGE POWER DOWN and SELF REFRESH operation (all banks idle), or ACTIVE POWER DOWN (row ACTIVE in any bank). CKE is synchronous for POWER DOWN entry and exit, and for SELF REFRESH entry. CKE is asynchronous for SELF REFRESH exit, and for output disable. CKE must be maintained high throughout READ and WRITE accesses. Input buffers, excluding CK, /CK and CKE are disabled during POWER DOWN. Input buffers, excluding CKE are disabled during SELF REFRESH. CKE is an SSTL_2 input, but will detect an LVCMOS LOW level after Vdd is applied.
/CS	Input	Chip Select : Enables or disables all inputs except CK, /CK, CKE, DQS and DM. All commands are masked when CS is registered high. CS provides for external bank selection on systems with multiple banks. CS is considered part of the command code.
BA0, BA1	Input	Bank Address Inputs: BA0 and BA1 define to which bank an ACTIVE, Read, Write or PRECHARGE command is being applied.
A0 ~ A11	Input	Address Inputs: Provide the row address for ACTIVE commands, and the column address and AUTO PRECHARGE bit for READ/WRITE commands, to select one location out of the memory array in the respective bank. A10 is sampled during a precharge command to determine whether the PRECHARGE applies to one bank (A10 LOW) or all banks (A10 HIGH). If only one bank is to be precharged, the bank is selected by BA0, BA1. The address inputs also provide the op code during a MODE REGISTER SET command. BA0 and BA1 define which mode register is loaded during the MODE REGISTER SET command (MRS or EMRS).
/RAS, /CAS, /WE	Input	Command Inputs: /RAS, /CAS and /WE (along with /CS) define the command being entered.
LDM, UDM	Input	Input Data Mask: DM(LDM,UDM) is an input mask signal for write data. Input data is masked when DM is sampled HIGH along with that input data during a WRITE access. DM is sampled on both edges of DQS. Although DM pins are input only, the DM loading matches the DQ and DQS loading. LDM corresponds to the data on DQ0-Q7; UDM corresponds to the data on DQ8-Q15.
LDQS, UDQS	I/O	Data Strobe: Output with read data, input with write data. Edge aligned with read data, centered in write data. Used to capture write data. LDQS corresponds to the data on DQ0-Q7; UDQS corresponds to the data on DQ8-Q15.
DQ0 ~ DQ15	I/O	Data input / output pin : Data Bus
VDD/VSS	Supply	Power supply for internal circuits and input buffers.
VDDQ/VSSQ	Supply	Power supply for output buffers for noise immunity.
VREF	Supply	Reference voltage for inputs for SSTL interface.
NC	NC	No connection.

## 9. IS42S16100C1 SDRAM

### 9.1. General Description

ISSI's 16Mb Synchronous DRAM IS42S16100C1 is organized as a 524,288-word x 16-bit x 2-bank for improved performance. The synchronous DRAMs achieve high-speed data transfer using pipeline architecture. All inputs and outputs signals refer to the rising edge of the clock input.

### 9.2. Features

- Clock frequency: 200, 166, 143 MHz
- Fully synchronous; all signals referenced to a positive clock edge
- Two banks can be operated simultaneously and independently

- Dual internal bank controlled by A11 (bank select)
- Single 3.3V power supply
- LVTTTL interface
- Programmable burst length (1, 2, 4, 8, full page)
- Programmable burst sequence: Sequential/Interleave
- 4096 refresh cycles every 64 ms
- Random column address every clock cycle
- Programmable CAS latency (2, 3 clocks)
- Burst read/write and burst read/single write operations capability
- Burst termination by burst stop and precharge command
- Byte controlled by LDQM and UDQM
- Industrial temperature up to 143 MHz
- Packages 400-mil 50-pin TSOP-II, 60-ball FBGA
- Lead-free package option

### 9.3. Pinning

A0-A11	Address Input
A0-A10	Row Address Input
A11	Bank Select Address
A0-A7	Column Address Input
DQ0 to DQ15	Data DQ
CLK	System Clock Input
CKE	Clock Enable
$\overline{CS}$	Chip Select
$\overline{RAS}$	Row Address Strobe Command

$\overline{CAS}$	Column Address Strobe Command
$\overline{WE}$	Write Enable
LDQM	Lower Bye, Input/Output Mask
UDQM	Upper Bye, Input/Output Mask
VDD	Power
GND	Ground
VDDQ	Power Supply for DQ Pin
GNDQ	Ground for DQ Pin
NC	No Connection

## 10. SAW FILTER

### 10.1. IF Filter for Audio Applications – Epcos K9656M

#### 10.1.1. Standart:

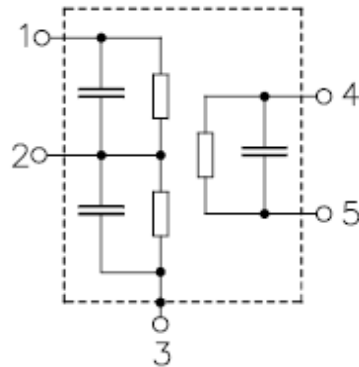
- B/G
- D/K
- I
- L/L'

#### 10.1.2. Features:

- TV IF audio filter with two channels
- Channel 1 (L') with one pass band for sound carriers at 40,40 MHz (L') and 39,75 MHz (L'- NICAM)
- Channel 2 (B/G,D/K,L,I) with one pass band for sound carriers between 32,35 MHz and 33,40 MHz

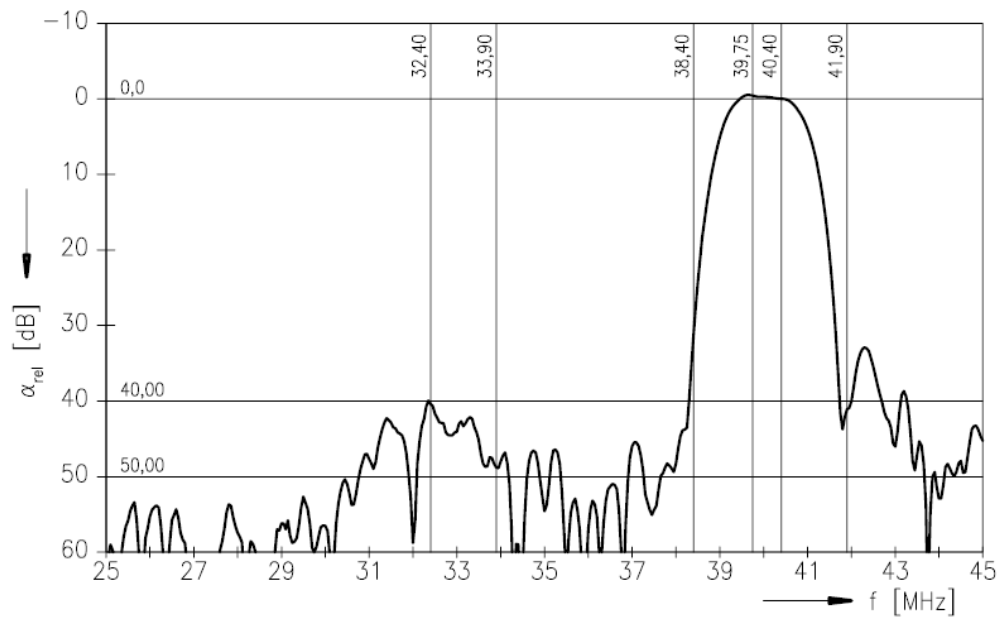
### 10.1.3. Pin configuration:

- 1 Input
- 2 Switching input
- 3 Chip carrier - ground
- 4 Output
- 5 Output

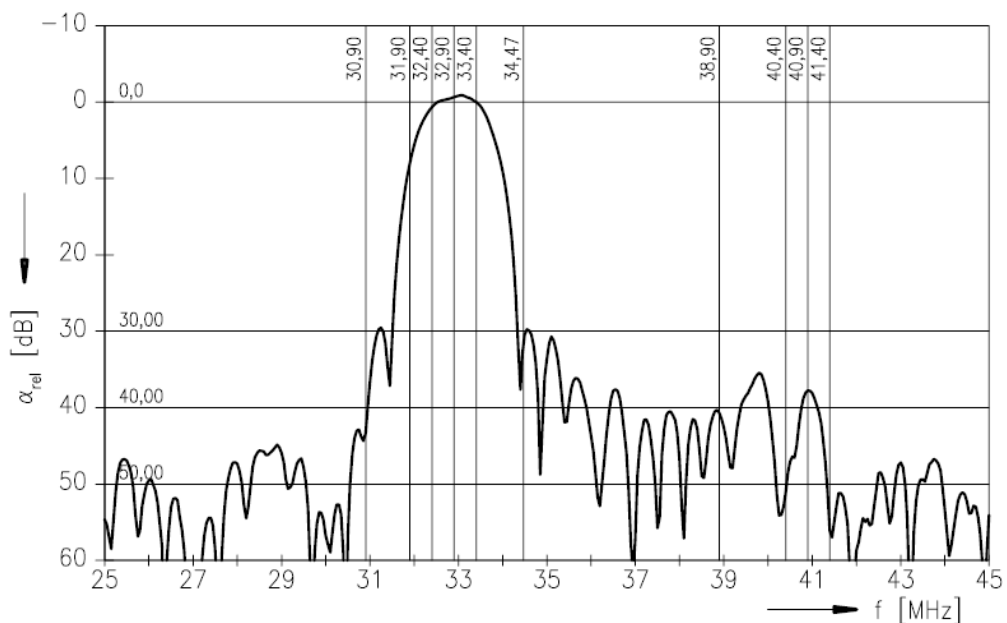


### 10.1.4. Frequency response:

#### Frequency response of channel 1



#### Frequency response of channel 2



## 10.2. IF Filter for Video Applications – Epcos K3958M

### 10.2.1. Standart:

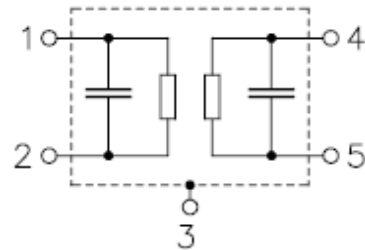
- B/G
- D/K
- I
- L/L'

### 10.2.2. Features:

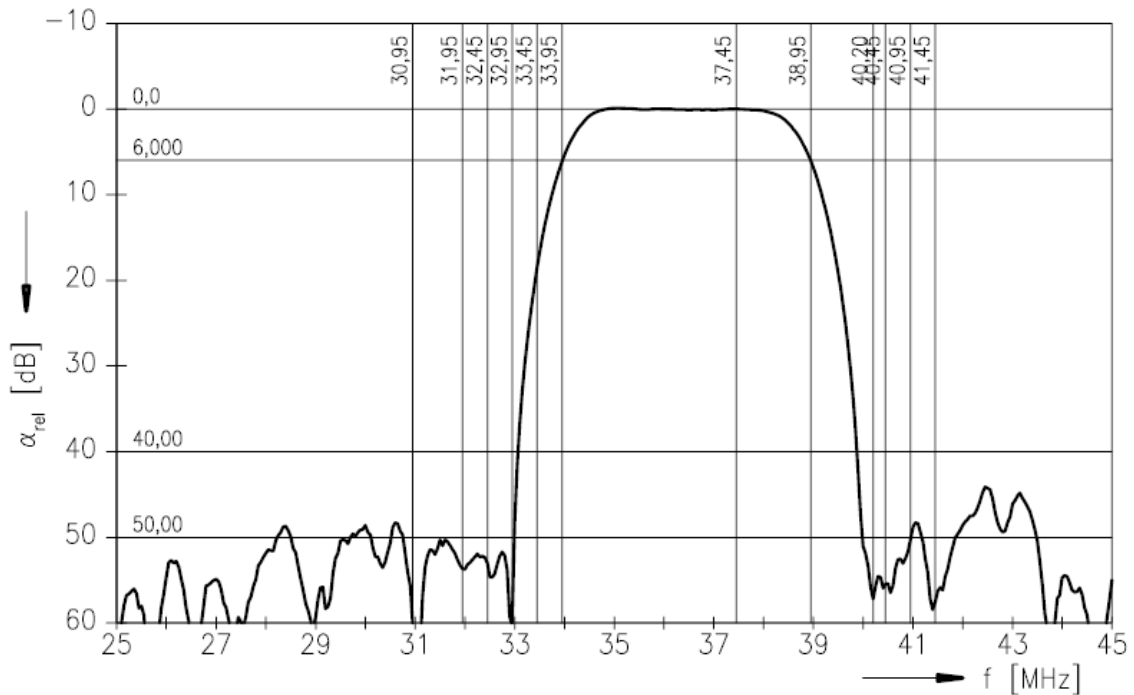
- TV IF filter with Nyquist slopes at 33.90 MHz and 38.90 MHz
- Constant group delay

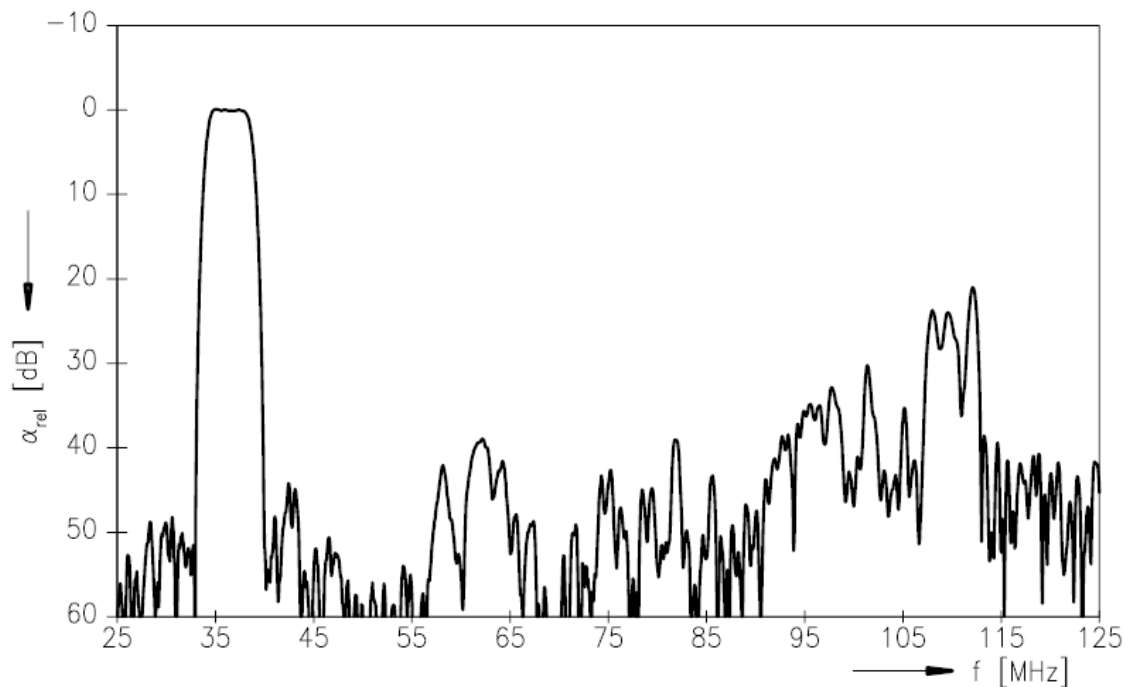
Pin configuration:

- 1 Input
- 2 Input - ground
- 3 Chip - carrier ground
- 4 Output
- 5 Output



### 10.2.3. Frequency response:





## 11. 2048-Bits Serial EEPROM – 24LC02

### 11.1. General Description

The 24LC01/02 is a 1K/2K-bit serial read/write non-volatile memory device using the CMOS floating gate process. Its 1024/2048 bits of memory are organized into 128/256 words and each word is 8 bits. The device is optimized for use in many industrial and commercial applications where low power and low voltage operation are essential. Up to eight HT24LC01/02 devices may be connected to the same two-wire bus. The HT24LC01/02 is guaranteed for 1M erase/write cycles and 40-year data retention.

### 11.2. Features

- Operating voltage: 2.4V~5.5V
- Low power consumption
- Operation: 5mA max.
- Standby: 5mA max.
- Internal organization
- 1K (HT24LC01):128'8
- 2K (HT24LC02): 256'8
- 2-wire serial interface
- Write cycle time: 5ms max.
- Automatic erase-before-write operation
- Partial page write allowed
- 8-byte Page write modes
- Write operation with built-in timer
- Hardware controlled write protection

- 40-year data retention
- 106 erase/write cycles per word
- 8-pin DIP/SOP package
- 8-pin TSSOP (HT24LC02 only)
- Commercial temperature range (0°C to +70°C)

### 11.3. Electrical Specifications

DC Electrical Characteristics ( $V_{CC} = 2.7\sim 5.5V$ ,  $T_a = 25^\circ C$ )

Symbol	Parameter	Conditions	24LC02		Units
			Min	Max	
$I_{CC1}$	Operating Current (Program)	SCL = 100KHz CMOS Input Levels	—	3	mA
$I_{CC2}$	Operating Current (Read)	SCL = 100KHz CMOS Input Levels	—	200	$\mu A$
$I_{SB1}$	Standby Current	SCL=SDA=0V, $V_{CC}=5V$	—	10	$\mu A$
$I_{SB2}$	Standby Current	SCL=SDA=0V, $V_{CC}=3V$	—	1	
$I_{IL}$	Input Leakage	$V_{IN} = 0 V$ to $V_{CC}$	-1	+1	$\mu A$
$I_{OL}$	Output Leakage	$V_{OUT} = 0 V$ to $V_{CC}$	-1	+1	$\mu A$
$V_{IL}$	Input Low Voltage**		-0.1	$V_{CC} \times 0.3$	V
$V_{IH}$	Input High Voltage**		$V_{CC} \times 0.7$	$V_{CC} + 0.2$	V
$V_{OL1}$	Output Low Voltage	IOL = 2.1mA TTL	—	0.4	V
$V_{OL2}$	Output Low Voltage	IOL = 10uA CMOS	—	0.2	V
$V_{LK}$	VCC Lockout Voltage	Programming Command Can Be Executed	Default	—	V

AC Electrical Characteristics ( $V_{CC} = 2.7\sim 5.5V$ )

Parameter	Symbol	24LC02		Units
		Min	Max	
Clock frequency	Fscl	0	100	kHz
Clock high time	Thigh	4000	—	ns
Clock low time	Tlow	4700	—	ns
SDA and SCL rise time**	Tr	—	1000	ns
SDA and SCL fall time**	Tf	—	300	ns
START condition hold time	Thd:Sta	4000	—	ns
START condition setup time	Tsu:Sta	4700	—	ns
Data input hold time	Thd:Dat	0	—	ns
Data input setup time	Tsu:Dat	250	—	ns
STOP condition setup time	Tsu:Sto	4000	—	ns
Output valid from clock	Taa	300	3500	ns
Bus free time **	Tbuf	4700	—	ns
Data out hold time	Tdh	300	—	ns
Write cycle time	Twr	—	10	ms
5V, 25°C, Byte Mode	Endurance**	1M	—	write cycles



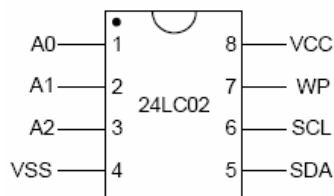
Capacitance TA= 25°C , f=250KHz

Symbol	Parameter	Max	Units
C <sub>OUT</sub>	Output capacitance	5	pF
C <sub>IN</sub>	Input capacitance	5	pF

#### A.C. Conditions of Test

Input Pulse Levels	V <sub>CC</sub> x 0.1 to V <sub>CC</sub> x 0.9
Input Rise and Fall times	10 ns
Input and Output Timming level	V <sub>CC</sub> x 0.5
Output Load	1 TTL Gate and CL = 100pf

#### 11.4. Pinning



PDIP/SOP/TSSOP

A0, A1, A2	Address Inputs
VSS	Ground
SDA	Data I/O
SCL	Clock Input
WP	Write Protect
VCC	Power Input

## 12. 32K Smart Serial EEPROM – 24C32

### 12.1. General Description

The Microchip Technology Inc. 24C32 is a 4K x 8 (32K bit) Serial Electrically Erasable PROM. This device has been developed for advanced, low power applications such as personal communications or data acquisition. The 24C32 features an input cache for fast write loads with a capacity of eight 8-byte pages, or 64 bytes. It also features a fixed 4K-bit block of ultra-high endurance memory for data that changes frequently. The 24C32 is capable of both random and sequential reads up to the 32K boundary. Functional address lines allow up to eight 24C32 devices on the same bus, for up to 256K bits address space. Advanced CMOS technology makes this device ideal for low-power non-volatile code and data applications. The 24C32 is available in the standard 8-pin plastic DIP and 8-pin surface mount SOIC package.

### 12.2. Features

- Voltage operating range: 4.5V to 5.5V
- Peak write current 3 mA at 5.5V
- Maximum read current 150 µA at 5.5V
- Standby current 1 µA typical
- Industry standard two-wire bus protocol, I2C compatible
- Including 100 kHz and 400 kHz modes

- Self-timed write cycle (including auto-erase)
- Power on/off data protection circuitry
- Endurance: 10,000,000 Erase/Write cycles guaranteed for High Endurance Block, 1,000,000 E/W cycles guaranteed for Standard Endurance Block
- 8 byte page, or byte modes available
- 1 page x 8 line input cache (64 bytes) for fast write loads
- Schmitt trigger, filtered inputs for noise suppression
- Output slope control to eliminate ground bounce
- 2 ms typical write cycle time, byte or page
- Up to 8 chips may be connected to the same bus for up to 256K bits total memory
- Electrostatic discharge protection > 4000V
- Data retention > 200 years
- 8-pin PDIP/SOIC packages
- Temperature ranges: Commercial (C): 0°C to +70°C, Industrial (I): -40°C to +85°C

### 11.3 Absolute Maximum Ratings and Electrical Characteristics

V<sub>CC</sub> .....7.0V  
 All inputs and outputs w.r.t. V<sub>SS</sub> ..... -0.6V to V<sub>CC</sub> +1.0V  
 Storage temperature .....-65°C to +150°C  
 Ambient temp. with power applied .....-65°C to +125°C  
 Soldering temperature of leads (10 seconds) ..... +300°C  
 ESD protection on all pins .....≥ 4 kV

#### DC CHARACTERISTICS

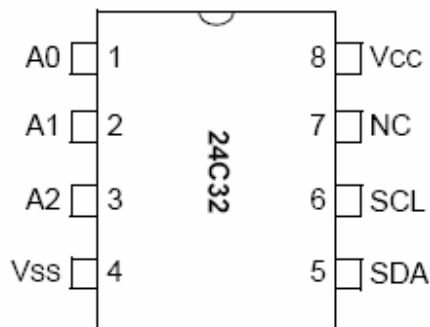
V <sub>CC</sub> = +4.5V to +5.5V Commercial (C): T <sub>amb</sub> = 0°C to +70°C Industrial (I): T <sub>amb</sub> = -40°C to +85°C					
Parameter	Symbol	Min	Max	Units	Conditions
A0, A1, A2, SCL and SDA pins:					
High level input voltage	V <sub>IH</sub>	.7 V <sub>CC</sub>	—	V	(Note) I <sub>OL</sub> = 3.0 mA
Low level input voltage	V <sub>IL</sub>	—	.3 V <sub>CC</sub>	V	
Hysteresis of Schmitt Trigger inputs	V <sub>HYS</sub>	.05 V <sub>CC</sub>	—	V	
Low level output voltage	V <sub>OL</sub>	—	.40	V	
Input leakage current	I <sub>LI</sub>	-10	10	μA	V <sub>IN</sub> = .1V TO V <sub>CC</sub>
Output leakage current	I <sub>LO</sub>	-10	10	μA	V <sub>OUT</sub> = .1V to V <sub>CC</sub>
Pin capacitance (all inputs/outputs)	C <sub>IN</sub> , C <sub>OUT</sub>	—	10	pF	V <sub>CC</sub> = 5.0V (Note) T <sub>amb</sub> = 25°C, F <sub>clk</sub> = 1 MHz
Operating current	I <sub>CC</sub> WRITE	—	3	mA	V <sub>CC</sub> = 5.5V, SCL = 400 kHz V <sub>CC</sub> = 5.5V, SCL = 400 kHz
	I <sub>CC</sub> Read	—	150	μA	
Standby current	I <sub>CCS</sub>	—	5	μA	V <sub>CC</sub> = 5.5V, SCL = SDA = V <sub>CC</sub> A0, A1, A2 = V <sub>SS</sub>

## AC CHARACTERISTICS

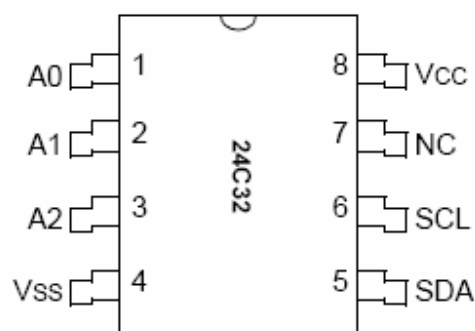
Parameter	Symbol	STD. MODE		FAST MODE		Units	Remarks
		Min	Max	Min	Max		
Clock frequency	FCLK	—	100	—	400	kHz	
Clock high time	T <sub>HIGH</sub>	4000	—	600	—	ns	
Clock low time	T <sub>LOW</sub>	4700	—	1300	—	ns	
SDA and SCL rise time	T <sub>R</sub>	—	1000	—	300	ns	(Note 1)
SDA and SCL fall time	T <sub>F</sub>	—	300	—	300	ns	(Note 1)
START condition hold time	T <sub>HD:STA</sub>	4000	—	600	—	ns	After this period the first clock pulse is generated
START condition setup time	T <sub>SU:STA</sub>	4700	—	600	—	ns	Only relevant for repeated START condition
Data input hold time	T <sub>HD:DAT</sub>	0	—	0	—	ns	
Data input setup time	T <sub>SU:DAT</sub>	250	—	100	—	ns	
STOP condition setup time	T <sub>SU:STO</sub>	4000	—	600	—	ns	
Output valid from clock	T <sub>AA</sub>	—	3500	—	900	ns	(Note 2)
Bus free time	T <sub>BUF</sub>	4700	—	1300	—	ns	Time the bus must be free before a new transmission can start
Output fall time from V <sub>IH</sub> min to V <sub>IL</sub> max	T <sub>oF</sub>	—	250	20 + 0.1 C <sub>B</sub>	250	ns	(Note 1), C <sub>B</sub> ≤ 100 pF
Input filter spike suppression (SDA and SCL pins)	T <sub>SP</sub>	—	50	—	50	ns	(Note 3)
Write cycle time	T <sub>WR</sub>	—	5	—	5	ms/page	(Note 4)
Endurance							
High Endurance Block	—	10M	—	10M	—	cycles	25°C, V <sub>CC</sub> = 5.0V, Block Mode
Rest of Array	—	1M	—	1M	—		(Note 5)

## 11.4 Pinning

### PDIP



### SOIC



Name	Function
A0,A1,A2	User Configurable Chip Selects
Vss	Ground
SDA	Serial Address/Data I/O
SCL	Serial Clock
Vcc	+4.5V to 5.5V Power Supply
NC	<b>No Internal Connection</b>

## 13. 512K CMOS Serial Flash – MX25L512

### 13.1. General Description

The MX25L512 is a CMOS 524,288 bit serial Flash memory, which is configured as 65,536 x 8 internally. The MX25L512 feature a serial peripheral interface and software protocol allowing operation on a simple 3-wire bus. The three bus signals are a clock input (SCLK), a serial data input (SI), and a serial data output (SO). SPI access to the device is enabled by CS# input. The MX25L512 provide sequential read operation on whole chip. After program/erase command is issued, auto program/ erase algorithms which program/ erase and verify the specified page or sector/block locations will be executed. Program command is executed on page (256 bytes) basis, and erase command is executes on chip or sector (4K-bytes). To provide user with ease of interface, a status register is included to indicate the status of the chip. The status read command can be issued to detect completion status of a program or erase operation via WIP bit. When the device is not in operation and CS# is high, it is put in standby mode and draws less than 10uA DC current. The MX25L512 utilize MXIC's proprietary memory cell, which reliably stores memory contents even after 100,000 program and erase cycles.

### 13.2. Features

#### GENERAL

- Serial Peripheral Interface (SPI) compatible -- Mode 0 and Mode 3
- 524,288 x 1 bit structure
- 16 Equal Sectors with 4K byte each
- Any Sector can be erased individually
- Single Power Supply Operation
- 2.7 to 3.6 volt for read, erase, and program operations
- Latch-up protected to 100mA from -1V to Vcc +1V
- Low Vcc write inhibit is from 1.5V to 2.5V

#### PERFORMANCE

- High Performance
- Fast access time: 85MHz serial clock (15pF + 1TTL Load) and 66MHz serial clock (30pF + 1TTL Load)
- Fast program time: 1.4ms(typ.) and 5ms(max.)/page (256-byte per page)
- Fast erase time: 60ms(typ.) and 120ms(max.)/sector (4K-byte per sector) ; 1s(typ.) and 2s(max.)/chip(512Kb)
- Low Power Consumption
- Low active read current: 12mA(max.) at 85MHz, 8mA(max.) at 66MHz and 4mA(max.) at 33MHz
- Low active programming current: 15mA (max.)
- Low active erase current: 15mA (max.)
- Low standby current: 10uA (max.)
- Deep power-down mode 1uA (typical)
- Minimum 100,000 erase/program cycles

## SOFTWARE FEATURES

- Input Data Format
- 1-byte Command code
- Block Lock protection
- The BP0~BP1 status bit defines the size of the area to be software protected against Program and Erase instructions.
- Auto Erase and Auto Program Algorithm
- Automatically erases and verifies data at selected sector
- Automatically programs and verifies data at selected page by an internal algorithm that automatically times the program pulse widths (Any page to be programmed should have page in the erased state first)
- Status Register Feature
- Electronic Identification
- JEDEC 2-byte Device ID
- RES command, 1-byte Device ID

## HARDWARE FEATURES

- SCLK Input
- Serial clock input
- SI Input
- Serial Data Input
- SO Output
- Serial Data Output
- WP# pin
- Hardware write protection
- HOLD# pin pause the chip without deselection of the chip
- PACKAGE
- 8-pin SOP (150mil)
- All Pb-free devices are RoHS Compliant

## 11.3 Absolute Maximum Ratings

Supply voltage range	$V_P$		1,6 to 6,0 V
Total quiescent current (at $V_P = 3$ V)	$I_{tot}$	typ.	3,2 mA
<b>Bridge tied load application (BTL)</b>			
Output power at $R_L = 32 \Omega$ $V_P = 3$ V; $d_{tot} = 10\%$	$P_o$	typ.	140 mW
D.C. output offset voltage between the outputs	$ \Delta V $	max.	70 mV
Noise output voltage (r.m.s. value) at $f = 1$ kHz; $R_S = 5$ k $\Omega$	$V_{no(rms)}$	typ.	140 $\mu$ V
<b>Stereo application</b>			
Output power at $R_L = 32 \Omega$ $d_{tot} = 10\%$ ; $V_P = 3$ V	$P_o$	typ.	35 mW
$d_{tot} = 10\%$ ; $V_P = 4,5$ V	$P_o$	typ.	75 mW
Channel separation at $R_S = 0 \Omega$ ; $f = 1$ kHz	$\alpha$	typ.	40 dB
Noise output voltage (r.m.s. value) at $f = 1$ kHz; $R_S = 5$ k $\Omega$	$V_{no(rms)}$	typ.	100 $\mu$ V

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage	$V_P$	max.	6 V
Peak output current	$I_{OM}$	max.	150 mA
Total power dissipation	see derating curve Fig.1		
Storage temperature range	$T_{stg}$		-55 to + 150 °C
Crystal temperature	$T_c$	max.	100 °C
A.C. and d.c. short-circuit duration at $V_P = 3,0$ V (during mishandling)	$t_{sc}$	max.	5 s

$V_P = 3$  V;  $f = 1$  kHz;  $R_L = 32 \Omega$ ;  $T_{amb} = 25$  °C; unless otherwise specified

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>Supply</b>					
Supply voltage	$V_P$	1,6	–	6,0	V
Total quiescent current	$I_{tot}$	–	3,2	4	mA
<b>Bridge-tied load application (BTL); see Fig.4</b>					
Output power*					
$V_P = 3,0$ V; $d_{tot} = 10\%$	$P_o$	–	140	–	mW
$V_P = 4,5$ V; $d_{tot} = 10\%$ ( $R_L = 64 \Omega$ )	$P_o$	–	150	–	mW
Voltage gain	$G_v$	–	32	–	dB
Noise output voltage (r.m.s. value)					
$R_S = 5$ k $\Omega$ ; $f = 1$ kHz	$V_{no(rms)}$	–	140	–	$\mu$ V
$R_S = 0 \Omega$ ; $f = 500$ kHz; $B = 5$ kHz	$V_{no(rms)}$	–	tbf	–	$\mu$ V
D.C. output offset voltage (at $R_S = 5$ k $\Omega$ )	$ \Delta V $	–	–	70	mV
Input impedance (at $R_S = \infty$ )	$ Z_i $	1	–	–	M $\Omega$
Input bias current	$I_i$	–	40	–	nA
<b>Stereo application; see Fig.5</b>					
Output power*					
$V_P = 3,0$ V; $d_{tot} = 10\%$	$P_o$	–	35	–	mW
$V_P = 4,5$ V; $d_{tot} = 10\%$	$P_o$	–	75	–	mW
Voltage gain	$G_v$	24.5	26	27.5	dB
Noise output voltage (r.m.s. value)					
$R_S = 5$ k $\Omega$ ; $f = 1$ kHz	$V_{no(rms)}$	–	100	–	$\mu$ V
$R_S = 0 \Omega$ ; $f = 500$ kHz; $B = 5$ kHz	$V_{no(rms)}$	–	tbf	–	$\mu$ V
Channel separation					
$R_S = 0 \Omega$ ; $f = 1$ kHz	$\alpha$	30	40	–	dB
Input impedance (at $R_S = \infty$ )	$ Z_i $	2	–	–	M $\Omega$
Input bias current	$I_i$	–	20	–	nA

## 14. Integrated DVB-T Receiver

### 13.1 General Description

CT216T is a highly integrated single chip for DVB-T compliant STB solution. Compared with Cheertek's previous generations of STB receiver devices. CT216T further integrates COFDM demodulator USB 2.0 HS host controller, memory card reader, 1/2-bit SPIFlash interface, audio DAC, PWM in/out and SAR-ADC functions. In addition special enhancements are provided such as MPEG-4 video decoding, 16-bit OSD with anti-

flickering, HW JPEG decoding, flesh tone and black-white extensions, and improvement of small video quality.

CT216T includes COFDM demodulator transport stream de-multiplexer, DVB-CSA compliant de-scrambler, RISC MPUs, MPEG-1/2/4 AV decoder, digital TV encoder, audio DACs, USB 2.0 HS host controller, memory card reader, smart card reader, CI controller and other peripherals.

CT216T is designed in focus on the market of single tuner input product which makes, it a cost effective solution. Supports include free to air, conditional access for SC (Smart card) and CI portable devices, PVR, LCD TV, and other DVB-T applications.

## 13.2 Features

### COFDM Demodulator

- ETSI EN 300 744 DVB-T NorDig Unified 1.0.3, and D-book compliant
- Automatic spectral inversion, detection
- Integrated ADC
- Direct IF (36.167 MHz or 43.75 MHz) or low IF (4.57 MHz) supported
- Single IF AGC or dual RF/IF AGC controls with  $\Delta\Sigma$  modulation
- Impulsive noise cancellation
- Carrier acquisition range:  $\pm 400$  kHz (extensible to  $\pm 600$  kHz in 8MHz BW)
- Adjacent channel interference (ACI) filter, for supporting 6, 7, and 8MHz channels with one 8MHz analog filter
- Co-channel interference (CCI) suppression
- RF signal strength monitor

### MPU

- Three 32-bit RISC MPU run up to 166MHz with total 448DMIPS
- 8KB I-Cache and 8KB D-Cache
- Two general purpose timers
- Watchdog timer
- DSU for source level debug

### Memory

- 6-bit SDRAM controller supports up to 32MB (16MB for 128-pin)
- Unified memory architecture
- Parallel flash (216-pin only)
- 1/2-bit SPI flash

### Transport De-multiplexing

- TS, PES, and ES demultiplexing
- OneTS path
- CI CAM interface (216-pin only)
- 32 general purpose PID filters
- 32 Section filters
- CRC-32 accelerator

- DVB-CSA de-scramblers

### **Video Decoding and Processing**

- MPEG-2 MP@ML
- MPEG-4 SP&ASP
- PAL/NTSC format conversion
- 3:2 pull down
- Zoom in/out from 1/16X to 16X
- HW JPEG decode
- 4/8/16-bit OSD with anti-flickering
- On chip NTSC/PAL TV encoder
- CVBS, S-VHS, and component video
- VBI insertion for Teletext, CC and WSS
- ITU-R BT.601 and ITU-R BT.656 outputs
- Flesh tone extension
- Black/white extension,

### **Audio Decoding and Processing**

- MPEG-1: layer 1/2/3
- MPEG-2: layer 1/2
- Decode MPEG-2 and MPEG-1 audio at sampling frequency of 16K, 22.05K, 24K, 32K, 44.1K, and 48KHz
- Decode CU-DA at sampling frequency of 44.1 KHz
- SPDIF out for AC-3 by-pass
- Embedded 2 channels audio DAC for L/R outputs
- Digital mute control and volume adjustment

### **OSD(On Screen Display)**

- There are total 9 display planes: border; background. video. RS1 (Rectangle Strip 1), RS2, OSD, RS3, RS4, and cursor.
- 4/8/16-bit OSD with anti-flickering and anti-flutter
- Support alpha-blending per color
- Adjustable brightness control in window
- Bitmap OSD
- Support horizontal pixel duplication to enlarge bitmap automatically
- Support sub-region redraw to facilitate bitmap display.

### **Digital TV Encoder**

- NTSC-M, PAL-B, D, G, H, I, Nc, M encoding
- Four video DACs to provide 6 configuration output: modes
- Support CVBS, S-VHS. and component video outs
- VBI insertion for Teletext, CC and WSS
- Color burst amplitude control
- Programmable sync. level
- On chip, color-bar generator



### High Speed I/O

- USB 2.0 HS host controller
- Memory card reader with SD, MMC, and MS interfaces
- Compliant with SD spec. 1.1 and MMC spec. 4.0 with 1-bit & 4-bit modes.
- Compliant with Memory Stick Pro format spec. 1.02 and Memory stick format spec 1.43 with 1-bit and 4-bit modes.

### Peripherals

- Up to 3 full duplex UART with 16-byte FIFO
- 2-wire serial (2WS) in master mode . . .
- Up to 2 ISO-7816 compliant SC (1 in 128-pin, can also be used as UART)
- 5 digits 7-Segment LED control
- 5x3 two-dimension key scan
- 2 SAR-ADC input
- 4 PWM input/output
- 1 HW IR command decode
- GPIO

### Electrical and Physical Characteristics

- Capable of using single 27MHz clock input crystal
- 1.8V and 3.3V dual power supply
- Power standby mode
- PQFP-128 (CT216T-Z) or LQFP-216 (CT216T-R) package

## 13.3 Absolute Maximum Rating and Electrical Characteristics

### Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
VDD18, USB_AVD18	DC power supply	1.62	1.98	V
VDD33, AVD33 VCCA, USB_AVD33 PLL_AVD33	DC power supply	3.0	3.6	V
V <sub>IN</sub>	Input Voltage	VSS-0.3	5.5	V
I <sub>IN</sub>	Input Current	-10	+10	mA
T <sub>A</sub>	Ambient Operating Temperature	0	70	°C
T <sub>STG</sub>	Storage Temperature	-55	+150	°C
T <sub>ESD</sub>	ESD Protection (HBM)	-	2000	V

## 7.2 DC Characteristics

VDD33-VSS=3.3V±10%, VDD18-VSS=1.8V±10%, T<sub>A</sub>=25° C, MCLK=64MHz

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
PLL_AVD33	Analogue power supply for clock generator		3.0	3.3	3.6	V
VCCA, AVD33 USB_AVD33	Analogue power supply for ADC & DAC		3.0	3.3	3.6	V
VDD33-VSS	Digital power supply for IO buffers		3.0	3.3	3.6	V
VDD18-VSS	Digital power supply for core		1.62	1.8	1.98	V
I <sub>DD18</sub>	Operating Current @1.8V			TBD		mA
I <sub>DD33</sub>	Operating Current @3.3V			TBD		mA
I <sub>DDPLL</sub>	Operating Current of PLL			1		mA
I <sub>DDDAC</sub>	Operating Current of DAC per channel			40		mA
I <sub>STBY</sub>	Standby Current	Standby. All DAC are off.		TBD		mA
I <sub>LK</sub>	Input Leakage		-10		+10	uA
V <sub>OL</sub>	Output Voltage Low				0.4	V
V <sub>OH</sub>	Output Voltage High		2.4			V
V <sub>IH</sub>	Input Voltage High		2.0		5.5	V
V <sub>IL</sub>	Input Voltage Low		-0.3		0.8	V

## 15. IC DESCRIPTIONS

### 15.1. LM1117

#### 15.1.1. General Description

The LM1117 is a series of low dropout voltage regulators with a dropout of 1.2V at 800mA of load current. It has the same pin-out as National Semiconductor's industry standard LM317. The LM1117 is available in an adjustable version, which can set the output voltage from 1.25V to 13.8V with only two external resistors. In addition, it is also available in five fixed voltages, 1.8V, 2.5V, 2.85V, 3.3V, and 5V. The LM1117 offers current limiting and thermal shutdown. Its circuit includes a zener trimmed bandgap reference to assure output voltage accuracy to within  $\pm 1\%$ . The LM1117 series is available in SOT-223, TO-220, and TO-252 D-PAK packages. A minimum of 10 $\mu$ F tantalum capacitor is required at the output to improve the transient response and stability.

#### 15.1.2. Features

- Available in 1.8V, 2.5V, 2.85V, 3.3V, 5V, and Adjustable Versions
- Space Saving SOT-223 Package
- Current Limiting and Thermal Protection
- Output Current 800mA
- Line Regulation 0.2% (Max)
- Load Regulation 0.4% (Max)
- Temperature Range
- LM1117 0°C to 125°C
- LM1117I -40°C to 125°C

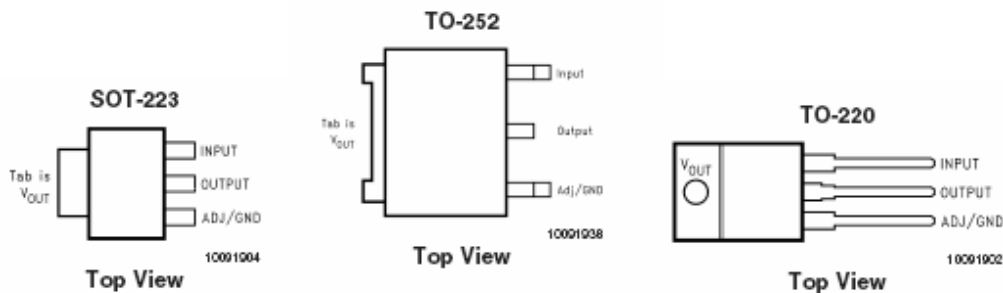
#### 15.1.3. Applications

- 2.85V Model for SCSI-2 Active Termination
- Post Regulator for Switching DC/DC Converter
- High Efficiency Linear Regulators 15
- 32" TFT TV Service Manual 10/01/2005
- Battery Charger
- Battery Powered Instrumentation

#### 15.1.4. Absolute Maximum Ratings

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
DC Input Voltage	$V_{IN}$		7	V
Lead Temperature (Soldering, 5 Seconds)	$T_{SOL}$		260	°C
Storage Temperature Range	$T_{STG}$	-65	150	°C
Operating Junction Temperature Range	$T_{OPR}$	0	125	°C

### 15.1.5. Pinning



## 15.2. 74HCT4053

### 15.2.1. General Description

The 74HC4053; 74HCT4053 is a high-speed Si-gate CMOS device and is pin compatible with the HEF4053B. It is specified in compliance with JEDEC standard no. 7A. The 74HC4053; 74HCT4053 is triple 2-channel analog multiplexer/demultiplexer with a common enable input (E). Each multiplexer/demultiplexer has two independent inputs/outputs ( $nY0$  and  $nY1$ ), a common input/output ( $nZ$ ) and three digital select inputs ( $S_n$ ). With E LOW, one of the two switches is selected (low-impedance ON-state) by S1 to S3. With E HIGH, all switches are in the high-impedance OFF-state, independent of S1 to S3. VCC and GND are the supply voltage pins for the digital control inputs (S1 to S3 and E). The VCC to GND ranges are 2.0 V to 10.0 V for 74HC4053 and 4.5 V to 5.5 V for 74HCT4053. The analog inputs/outputs ( $nY0$  and  $nY1$ , and  $nZ$ ) can swing between VCC as a positive limit and VEE as a negative limit. VCC - VEE may not exceed 10.0 V. For operation as a digital multiplexer/demultiplexer, VEE is connected to GND (typically ground).

### 15.2.2. Features

- Low ON resistance:
- 80 W (typical) at VCC - VEE = 4.5 V
- 70 W (typical) at VCC - VEE = 6.0 V
- 60 W (typical) at VCC - VEE = 9.0 V
- Logic level translation:
- To enable 5 V logic to communicate with  $\pm 5$  V analog signals
- Typical 'break before make' built in
- Complies with JEDEC standard no. 7A
- ESD protection: HBM EIA/JESD22-A114-C exceeds 2000 V, MM EIA/JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

### 15.2.3. Applications

- Analog multiplexing and demultiplexing
- Digital multiplexing and demultiplexing
- Signal gating

### 15.2.4. Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{CC}$	supply voltage		-0.5	+11.0	V	
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA	
$I_{SK}$	switch clamping current	$V_S < -0.5\text{ V}$ or $V_S > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA	
Symbol	Parameter	Conditions	Min	Max	Unit	
$I_S$	switch current	$-0.5\text{ V} < V_S < V_{CC} + 0.5\text{ V}$	-	$\pm 25$	mA	
$I_{EE}$	negative supply current		-	-20	mA	
$I_{CC}$	quiescent supply current		-	50	mA	
$I_{GND}$	ground current		-	-50	mA	
$T_{stg}$	storage temperature		-65	+150	°C	
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$				
	DIP16 package		<a href="#">[2]</a>	-	750	mW
	SO16 package		<a href="#">[3]</a>	-	500	mW
	SSOP16 package		<a href="#">[4]</a>	-	500	mW
	TSSOP16 package		<a href="#">[4]</a>	-	500	mW
	DHVQFN16 package		<a href="#">[5]</a>	-	500	mW
$P_S$	power dissipation per switch		-	100	mW	

### 15.2.5. Pinning

Symbol	Pin	Description
2Y1	1	2 independent input/output 1
2Y0	2	2 independent input/output 0
3Y1	3	3 independent input/output 1
3Z	4	3 common input/output
3Y0	5	3 independent input/output 0
E	6	enable input (active LOW)
$V_{EE}$	7	negative supply voltage
GND	8	ground (0 V)
S3	9	select input 3
S2	10	select input 2
S1	11	select input 1
1Y0	12	1 independent input/output 0
1Y1	13	1 independent input/output 1
1Z	14	1 common input/output
2Z	15	2 common input/output
$V_{CC}$	16	supply voltage

## 15.3. NUP4004M5

### 15.3.1. General Description

This 5-Pin bi-directional transient suppressor array is designed for applications requiring transient overvoltage protection capability. It is intended for use in transient voltage and

ESD sensitive equipment such as computers, printers, cell phones, medical equipment, and other applications. Its integrated design provides bi-directional protection for four separate lines using a single TSOP-5 package. This device is ideal for situations where board space is a premium.

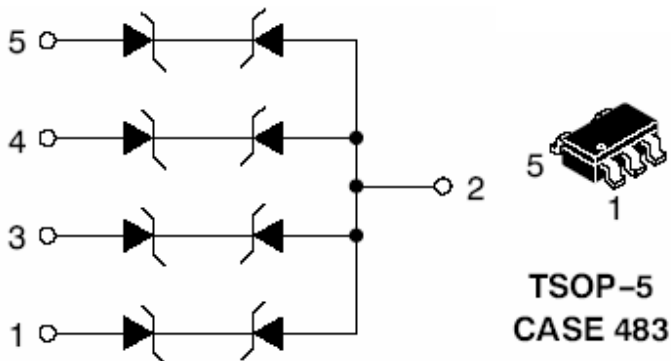
### 15.3.2. Features

- Bi-directional Protection for Four Lines in a Single TSOP-5 Package
- Low Leakage Current
- Low Capacitance
- Provides ESD Protection for JEDEC Standards JESD22
- Machine Model = Class C
- Human Body Model = Class 3B
- Provides ESD Protection for IEC 61000-4-2, 15 kV (Air), 8 kV (Contact)
- This is a Pb-Free Device

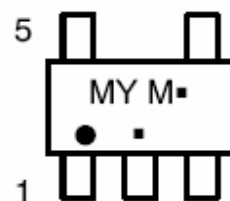
### 15.3.3. Absolute Maximum Ratings

Rating	Symbol	Value	Unit
Operating Junction Temperature Range	$T_J$	-40 to 125	$^{\circ}\text{C}$
Storage Temperature Range	$T_{\text{STG}}$	-55 to 150	$^{\circ}\text{C}$
Lead Solder Temperature – Maximum (10 sec)	$T_L$	260	$^{\circ}\text{C}$
Human Body Model ( HBM) Machine Model (MM) IEC 61000-4-2 Air (ESD) IEC 61000-4-2 Contact (ESD)	ESD	16 0.4 30 30	kV

### 15.3.4. Pinning



### MARKING DIAGRAM



## 15.4. FDN336P

### 15.4.1. General Description

The ST24LC21 is a 1K bit electrically erasable programmable memory (EEPROM), organized by 8 bits. This device can operate in two modes: Transmit Only mode and I2C bidirectional mode. When powered, the device is in Transmit Only mode with EEPROM data clocked out from the rising edge of the signal applied on VCLK. The device will switch to the I2C bidirectional mode upon the falling edge of the signal applied on SCL pin. The ST24LC21 cannot switch from the I2C bidirectional mode to the Transmit Only mode (except when the power supply is removed). The device operates with a power supply value as low as 2.5V. Both Plastic Dual-in-Line and Plastic Small Outline packages are available.

### 15.4.2. Features

- 1 MILLION ERASE/WRITE CYCLES
- 40 YEARS DATA RETENTION
- 2.5V to 5.5V SINGLE SUPPLY VOLTAGE
- 400k Hz COMPATIBILITY OVER the FULL RANGE of SUPPLY VOLTAGE
- TWO WIRE SERIAL INTERFACE I2C BUS COMPATIBLE
- PAGE WRITE (up to 8 BYTES)
- BYTE, RANDOM and SEQUENTIAL READ MODES
- SELF TIMED PROGRAMMING CYCLE
- AUTOMATIC ADDRESS INCREMENTING
- ENHANCED ESD/LATCH UP PERFORMANCES

### 15.4.3. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit	
T <sub>A</sub>	Ambient Operating Temperature	grade 1	0 to 70	°C
T <sub>STG</sub>	Storage Temperature		-65 to 150	°C
T <sub>LEAD</sub>	Lead Temperature, Soldering	(SO8 package) 40 sec (PSDIP8 package) 10 sec	215 260	°C
V <sub>IO</sub>	Input or Output Voltages		-0.3 to 6.5	V
V <sub>CC</sub>	Supply Voltage		-0.3 to 6.5	V
V <sub>ESD</sub>	Electrostatic Discharge Voltage (Human Body model) <sup>(2)</sup>		4000	V
	Electrostatic Discharge Voltage (Machine model) <sup>(3)</sup>		500	V

### 15.4.4. Pinning



## 15.5. TL062 -

### 15.5.1. General Description

Low-power JFET-input operational amplifier

### 15.5.2. Features

- Very Low Power Consumption
- Typical Supply Current . . . 200  $\mu$ A (Per Amplifier)
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Common-Mode Input Voltage Range Includes VCC+
- Output Short-Circuit Protection
- High Input Impedance . . . JFET-Input Stage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- High Slew Rate . . . 3.5 V/ $\mu$ s Typ

### 15.5.3. Absolute Maximum Ratings

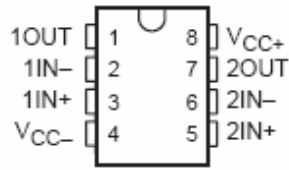
		TL06_C TL06_AC TL06_BC	TL06_I	TL06_M	UNIT
Supply voltage, V <sub>CC+</sub> (see Note 1)		18	18	18	V
Supply voltage, V <sub>CC-</sub> (see Note 1)		-18	-18	-18	V
Differential input voltage, V <sub>ID</sub> (see Note 2)		$\pm$ 30	$\pm$ 30	$\pm$ 30	V
Input voltage, V <sub>I</sub> (see Notes 1 and 3)		$\pm$ 15	$\pm$ 15	$\pm$ 15	V
Duration of output short circuit (see Note 4)		Unlimited	Unlimited	Unlimited	
Package thermal impedance, $\theta_{JA}$ (see Notes 5 and 6)	D (8-pin) package	97	97		$^{\circ}$ C/W
	D (14-pin) package	86	86		
	N package	80	80		
	NS package	76	76		
	P package	85	85		
	PS package	95	95		
	PW (14-pin) package	113	113		
Package thermal impedance, $\theta_{JC}$ (see Notes 7 and 8)	FK package			5.61	$^{\circ}$ C/W
	J package			15.05	
	JG package			14.5	
	W package			14.65	
Operating virtual junction temperature, T <sub>J</sub>		150	150	150	$^{\circ}$ C
Case temperature for 60 seconds	FK package			260	$^{\circ}$ C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J, JG, U, or W package			300	$^{\circ}$ C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, N, NS, P, PS, or PW package	260	260		$^{\circ}$ C
Storage temperature range, T <sub>stg</sub>		-65 to 150	-65 to 150	-65 to 150	$^{\circ}$ C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values except differential voltages are with respect to the midpoint between V<sub>CC+</sub> and V<sub>CC-</sub>.
  2. Differential voltages are at IN+ with respect to IN-.
  3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
  4. The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.
  5. Maximum power dissipation is a function of T<sub>J(max)</sub>,  $\theta_{JA}$ , and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J(max)</sub> - T<sub>A</sub>)/ $\theta_{JA}$ . Operating at the absolute maximum T<sub>J</sub> of 150 $^{\circ}$ C can affect reliability.
  6. The package thermal impedance is calculated in accordance with JESD 51-7.
  7. Maximum power dissipation is a function of T<sub>J(max)</sub>,  $\theta_{JC}$ , and T<sub>C</sub>. The maximum allowable power dissipation at any allowable case temperature is P<sub>D</sub> = (T<sub>J(max)</sub> - T<sub>C</sub>)/ $\theta_{JC}$ . Operating at the absolute maximum T<sub>J</sub> of 150 $^{\circ}$ C can affect reliability.
  8. The package thermal impedance is calculated in accordance with MIL-STD-883.



### 15.5.4. Pinning



## 15.6. PI5V330

### 15.6.1. General Description

Pericom Semiconductor's PI5V series of mixed signal video circuits are produced in the Company's advanced CMOS low-power technology, achieving industry leading performance. The PI5V330 is a true bidirectional Quad 2-channel multiplexer/demultiplexer that is recommended for both RGB and composite video switching applications. The VideoSwitch can be driven from a current output RAMDAC or voltage output composite video source. Low ON-resistance and wide bandwidth make it ideal for video and other applications. Also this device has exceptionally high current capability which is far greater than most analog switches offered today. A single 5V supply is all that is required for operation. The PI5V330 offers a high-performance, low-cost solution to switch between video sources. The application section describes the PI5V330 replacing the HC4053 multiplier and buffer/amplifier.

### 15.6.2. Features

- High-performance, low-cost solution to switch between video sources
- Wide bandwidth: 200 MHz
- Low ON-resistance: 3Ω
- Low crosstalk at 10 MHz: .58 dB
- Ultra-low quiescent power (0.1 μA typical)
- Single supply operation: +5.0V
- Fast switching: 10 ns
- High-current output: 100 mA
- Packages available:
  - 16-pin 300-mil wide plastic SOIC (S)
  - 16-pin 150-mil wide plastic SOIC (W)
  - 16-pin 150-mil wide plastic QSOP (Q)

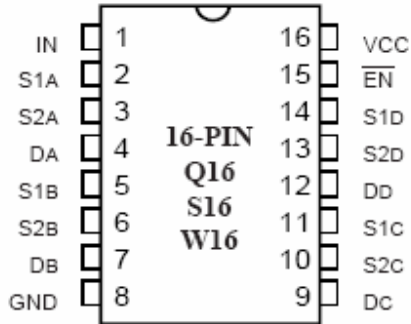
### 15.6.3. Absolute Maximum Ratings

Storage Temperature .....	-65°C to +150°C
Ambient Temperature with Power Applied .....	-40°C to +85°C
Supply Voltage to Ground Potential (Inputs & Vcc Only) ..	-0.5V to +7.0V
Supply Voltage to Ground Potential (Outputs & D/O Only) ..	-0.5V to +7.0V
DC Input Voltage .....	-0.5V to +7.0V
DC Output Current .....	120 mA
Power Dissipation .....	0.5W

**Note:**

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

### 15.6.4. Pinning



Pin Name	Description
S1A, S2A S1B, S2B S1C, S2C S1D, S2D	Analog Video I/O
IN	Select Input
$\overline{\text{EN}}$	Enable
DA, DB, DC, DD	Analog Video I/O
GND	Ground
VCC	Power

## 15.7. AZC099-04S

### 15.7.1. General Description

AZC099-04S is a high performance and low cost design which includes surge rated diode arrays to protect high speed data interfaces. The AZC099-04S family has been specifically designed to protect sensitive components, which are connected to data and transmission lines, from over-voltage caused by Electrostatic Discharging (ESD), Electrical Fast Transients (EFT), and Lightning.

AZC099-04S is a unique design which includes surge rated, low capacitance steering diodes and a unique design of clamping cell which is an equivalent TVS diode in a single package. During transient conditions, the steering diodes direct the transient to either the power supply line or to the ground line. The internal unique design of clamping cell prevents over-voltage on the power line, protecting any downstream components. AZC099-04S may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 ( $\pm 15\text{kV}$  air,  $\pm 8\text{kV}$  contact discharge).

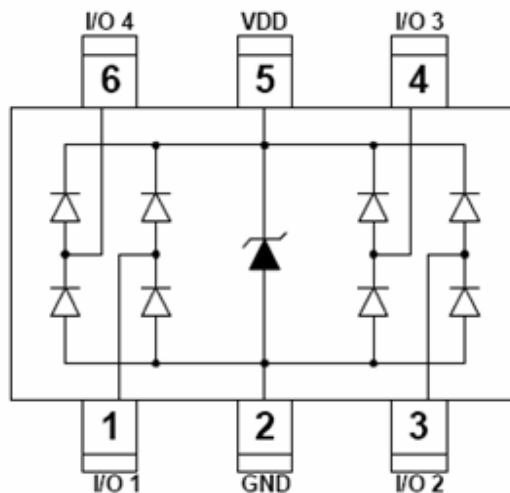
### 15.7.2. Features

- ESD Protect for 4 high-speed I/O channels
- Provide ESD protection for each channel to IEC 61000-4-2 (ESD)  $\pm 15\text{kV}$  (air),  $\pm 8\text{kV}$  (contact) IEC 61000-4-4 (EFT) (5/50ns) Level-3, 20A for I/O, 40A for Power IEC 61000-4-5 (Lightning) 4A (8/20 $\mu\text{s}$ )
- 5V operating voltage □□ Low capacitance : 1.0pF typical
- Fast turn-on and Low clamping voltage
- Array of surge rated diodes with internal equivalent TVS diode
- Small package saves board space
- Solid-state silicon-avalanche and active circuit triggering technology

### 15.7.3. Absolute Maximum Ratings

PARAMETER	PARAMETER	RATING	UNITS
Peak Pulse Current ( $t_p = 8/20\mu s$ )	$I_{PP}$	5.5	A
Operating Supply Voltage (VDD-GND)	$V_{DC}$	6	V
ESD per IEC 61000-4-2 (Air)	$V_{ESD}$	15	kV
ESD per IEC 61000-4-2 (Contact)		8	
Lead Soldering Temperature	$T_{SOL}$	260 (10 sec.)	°C
Operating Temperature	$T_{OP}$	-55 to +85	°C
Storage Temperature	$T_{STO}$	-55 to +150	°C
DC Voltage at any I/O pin	$V_{IO}$	(GND – 0.5) to (VDD + 0.5)	V

### 15.7.4. Pinning



## 15.8. TDA1308

### 15.8.1. General Description

The TDA1308; TDA1308A is an integrated class-AB stereo headphone driver contained in an SO8, DIP8 or a TSSOP8 plastic package. The TDA1308AUK is available in an 8 bump wafer level chip-size package (WLCSF8). The device is fabricated in a 1 mm Complementary Metal Oxide Semiconductor (CMOS) process and has been primarily developed for portable digital audio applications. The difference between the TDA1308 and the TDA1308A is that the TDA1308A can be used at low supply voltages.

### 15.8.2. Features

- Wide temperature range
- No switch ON/OFF clicks
- Excellent power supply ripple rejection
- Low power consumption
- Short-circuit resistant
- High performance
- High signal-to-noise ratio

- High slew rate
- Low distortion
- Large output voltage swing

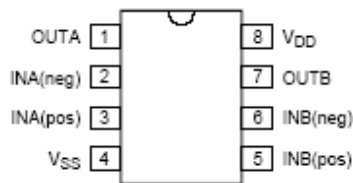
### 15.8.3. Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DD}$	supply voltage		0	8.0	V
$t_{SC(O)}$	output short-circuit duration	$T_{amb} = 25\text{ }^{\circ}\text{C};$ $P_{tot} = 1\text{ W}$	20	-	s
$T_{stg}$	storage temperature		-65	+150	$^{\circ}\text{C}$
$T_{amb}$	ambient temperature		-40	+85	$^{\circ}\text{C}$
$V_{esd}$	electrostatic discharge voltage	HBM	[1] -2	+2	kV
		MM	[2] -200	+200	V

[1] Human body model (HBM): C = 100 pF; R = 1500  $\Omega$ ; 3 pulses positive plus 3 pulses negative.

[2] Machine model (MM): C = 200 pF; L = 0.5 mH; R = 0  $\Omega$ ; 3 pulses positive plus 3 pulses negative.

### 15.8.4. Pinning



Symbol	Pin	Description
OUTA	1	output A
INA(neg)	2	inverting input A
INA(pos)	3	non-inverting input A
$V_{SS}$	4	negative supply
INB(pos)	5	non-inverting input B

## 15.9. ST3222

### 15.9.1. General Description

The ST3222 is a 3V powered EIA/TIA-232 and V.28/V.24 communications interface with low power requirements and high data-rate capabilities. ST3222 has a proprietary low dropout transmitter output stage providing true RS-232 performance from 3 to 3.6V power supplies. The device requires only four small 0.1mF standard external capacitors for operating from 3V supply. The ST3222 has two receivers and two drivers. The ST3222 features a 1mA shutdown mode that reduces power consumption and extends battery life in portable systems. Its receivers can remain active in shutdown mode, allowing external devices such as modems to be monitored using only 1mA supply current. The device is guaranteed to run at data rates of 250Kbps while maintaining RS-232 output levels.

### 15.9.2. Features

- 300mA SUPPLY CURRENT
- 250Kbps MINIMUM GUARENTEED DATA RATE
- 6V/ms MINIMUM GUARANTEED SLEW RATE
- MEET EIA/TIA-232 SPECIFICATIONS DOWN TO 3V
- AVAILABLE IN SO-18 AND TSSOP20

### 15.9.3. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.3 to 6	V
V+	Doubled Voltage Terminal	(V <sub>CC</sub> - 0.3) to 7	V
V-	Inverted Voltage Terminal	0.3 to -7	V
V+ + V-		13	V
T <sub>IN</sub>	Transmitter Input Voltage Range	-0.3 to 6	V
SHDN	Transmitter Input Voltage Range	-0.3 to 6	V
R <sub>IN</sub>	Receiver Input Voltage Range	± 25	V
T <sub>OUT</sub>	Transmitter Output Voltage Range	± 13.2	V
R <sub>OUT</sub>	Receiver Output Voltage Range	-0.3 to (V <sub>CC</sub> + 0.3)	V
t <sub>SHORT</sub>	Transmitter Output Short to GND Time	Continuous	

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. V+ and V- can have a maximum magnitude of +7V, but their absolute addition can not exceed 13 V.

### 15.9.4. Pinning

PIN N° (SO-18)	PIN N° (TSSP20)	SYMBOL	NAME AND FUNCTION
1	1	EN	Receiver Enable Control. Drive low for normal operation. Drive high to force the receivers outputs (R_OUT) into a high-impedance state.
2	2	C <sub>1+</sub>	Positive Terminal for the first Charge Pump Capacitor
3	3	V+	5.5V Generated By The Charge Pump.
4	4	C <sub>1-</sub>	Negative Terminal for the first Charge Pump Capacitor
5	5	C <sub>2+</sub>	Positive Terminal for the second Charge Pump Capacitor
6	6	C <sub>2-</sub>	Negative Terminal for the second Charge Pump Capacitor
7	7	V-	-5.5V Generated By The Charge Pump.
8	8	T <sub>2OUT</sub>	Second Transmitter Output Voltage
9	9	R <sub>2IN</sub>	Second Receiver Input Voltage
10	10	R <sub>2OUT</sub>	Second Receiver Output Voltage
	11	NC	Not Connected
11	12	T <sub>2IN</sub>	Second Transmitter Input Voltage
12	13	T <sub>1IN</sub>	First Transmitter Input Voltage
	14	NC	Not Connected
13	15	R <sub>1OUT</sub>	First Receiver Output Voltage
14	16	R <sub>1IN</sub>	First Receiver Input Voltage
15	17	T <sub>1OUT</sub>	First Transmitter Output Voltage
16	18	GND	Ground
17	19	V <sub>CC</sub>	Supply Voltage
18	20	SHDN	Active Low Shutdown Control Input. Drive Low To Shut-down Trnasmittes And Charge Pump

## 15.10. LM358D

### 15.10.1. General Description

The LM158 series consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a

single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Application areas include transducer amplifiers, dc gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM158 series can be directly operated off of the standard +5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional  $\pm 15V$  power supplies. The LM358 and LM2904 are available in a chip sized package (8-Bump micro SMD) using National's micro SMD package technology.

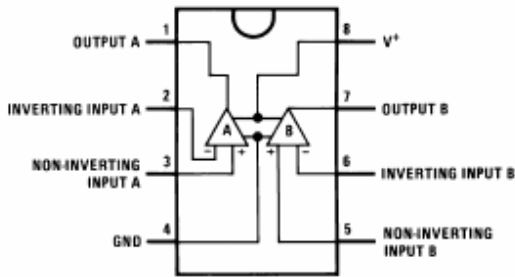
### 15.10.2. Features

- Available in 8-Bump micro SMD chip sized package,
- Internally frequency compensated for unity gain
- Large dc voltage gain: 100 dB
- Wide bandwidth (unity gain): 1 MHz (temperature compensated)
- Wide power supply: Single supply: 3V to 32V or dual supplies:  $\pm 1.5V$  to  $\pm 16V$
- Low supply current drain (500  $\mu A$ )—essentially independent of supply voltage
- Low input offset voltage: 2 mV
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing

### 15.10.3. Absolute Maximum Ratings

	LM158/LM258/LM358 LM158A/LM258A/LM358A
Supply Voltage, $V^+$	32V
Differential Input Voltage	32V
Input Voltage	-0.3V to +32V
Power Dissipation (Note 1)	
Molded DIP	830 mW
Metal Can	550 mW
Small Outline Package (M)	530 mW
micro SMD	435mW
Output Short-Circuit to GND (One Amplifier) (Note 2)	
$V^+ \leq 15V$ and $T_A = 25^\circ C$	Continuous
Input Current ( $V_{IN} < -0.3V$ ) (Note 3)	50 mA
Operating Temperature Range	
LM358	0°C to +70°C
LM258	-25°C to +85°C
LM158	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature, DIP (Soldering, 10 seconds)	260°C
Lead Temperature, Metal Can (Soldering, 10 seconds)	300°C
Soldering Information	
Dual-In-Line Package	
Soldering (10 seconds)	260°C
Small Outline Package	
Vapor Phase (60 seconds)	215°C
Infrared (15 seconds)	220°C
See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods surface mount devices.	
ESD Tolerance (Note 10)	250V

### 15.10.4. Pinning



## 15.11. 74LCX244

### 15.11.1. General Description

The LCX244 contains eight non-inverting buffers with 3-STATE outputs. The device may be employed as a memory address driver, clock driver and bus-oriented transmitter/receiver. The LCX244 is designed for low voltage (2.5V or 3.3V) VCC applications with capability of interfacing to a 5V signal environment. The LCX244 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### 15.11.2. Features

- 5V tolerant inputs and outputs
- 2.3V to 3.6V VCC specifications provided
- 6.5ns Tpd max. (VCC=3.3V), 10 $\mu$ A ICCmax.
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal
- $\pm 24$ mA output drive (VCC=3.0V)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500mA
- ESD performance: Human body model >2000V, Machine model >200V
- Leadless DQFN package

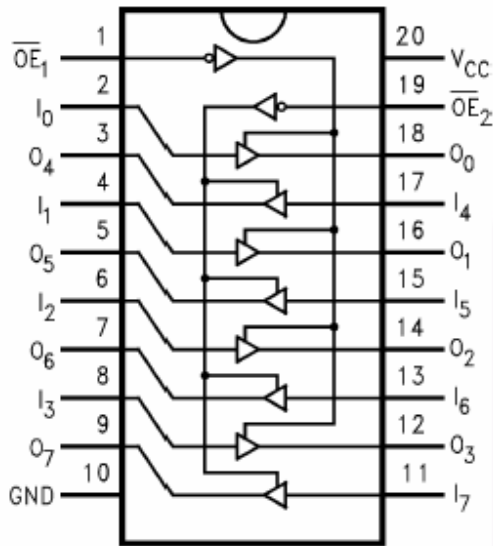
### 15.11.3. Absolute Maximum Ratings

Symbol	Parameter	Rating
V <sub>CC</sub>	Supply Voltage	-0.5V to +7.0V
V <sub>I</sub>	DC Input Voltage	-0.5V to +7.0V
V <sub>O</sub>	DC Output Voltage Output in 3-STATE	-0.5V to +7.0V
	Output in HIGH or LOW State <sup>(3)</sup>	-0.5V to V <sub>CC</sub> + 0.5V
I <sub>IK</sub>	DC Input Diode Current, V <sub>I</sub> < GND	-50mA
I <sub>OK</sub>	DC Output Diode Current V <sub>O</sub> < GND	-50mA
	V <sub>O</sub> > V <sub>CC</sub>	+50mA
I <sub>O</sub>	DC Output Source/Sink Current	$\pm 50$ mA
I <sub>CC</sub>	DC Supply Current per Supply Pin	$\pm 100$ mA
I <sub>GND</sub>	DC Ground Current per Ground Pin	$\pm 100$ mA
T <sub>STG</sub>	Storage Temperature	-65°C to +150°C

**Note:**

3. I<sub>O</sub> Absolute Maximum Rating must be observed.

### 15.11.4. Pinning



Inputs		Outputs
$\overline{OE}_1$	$I_n$	(Pins 12, 14, 16, 18)
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	$I_n$	(Pins 3, 5, 7, 9)
L	L	H
L	H	L
H	X	Z

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance

## 15.12. 74LCX245

### 15.12.1. General Description

The LCX245 contains eight non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is designed for low voltage (2.5V and 3.3V) VCC applications with capability of interfacing to a 5V signal environment. The T/R input determines the direction of data flow through the device. The OE input disables both the A and B ports by placing them in a high impedance state.

The LCX245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### 15.12.2. Features

- 5V tolerant inputs and outputs
- 2.3V to 3.6V VCC specifications provided
- 7.0ns tPDmax. (VCC=3.3V), 10µA ICCmax.
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal
- ±24mA output drive (VCC=3.0V)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500mA
- ESD performance: Human body model>2000V, Machine model>200V
- Leadless DQFN package



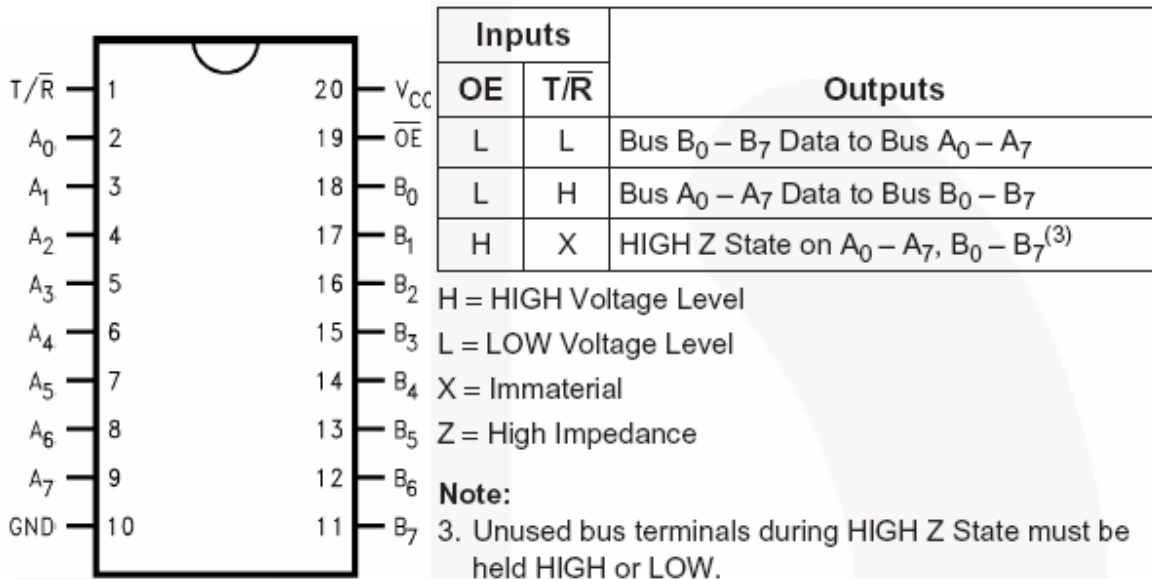
### 15.12.3. Absolute Maximum Ratings

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	-0.5V to +7.0V
$V_I$	DC Input Voltage	-0.5V to +7.0V
$V_O$	DC Output Voltage Output in 3-STATE	-0.5V to +7.0V
	Output in HIGH or LOW State <sup>(4)</sup>	-0.5V to $V_{CC} + 0.5V$
$I_{IK}$	DC Input Diode Current, $V_I < GND$	-50mA
$I_{OK}$	DC Output Diode Current $V_O < GND$	-50mA
	$V_O > V_{CC}$	+50mA
$I_O$	DC Output Source/Sink Current	$\pm 50mA$
$I_{CC}$	DC Supply Current per Supply Pin	$\pm 100mA$
$I_{GND}$	DC Ground Current per Ground Pin	$\pm 100mA$
$T_{STG}$	Storage Temperature	-65°C to +150°C

**Note:**

4.  $I_O$  Absolute Maximum Rating must be observed.

### 15.12.4. Pinning



## 15.13. FSA3157

### 15.13.1. General Description

The NC7SB3157 / FSA3157 is a high-performance, single-pole / double-throw (SPDT) analog switch or 2:1 multiplexer/ de-multiplexer bus switch. The device is fabricated with advanced sub-micron CMOS technology to achieve high-speed enable and disable times and low on resistance. The break-beforemake select circuitry prevents disruption of signals on the B Port due to both switches temporarily being enabled during select pin switching. The device is specified to operate over the 1.65 to 5.5V VCC operating range.

The control input tolerates voltages up to 5.5V, independent of the VCC operating range.

### 15.13.2. Features

- Useful in both analog and digital applications
- Space-saving, SC70 6-lead surface mount package
- Ultra-small, MicroPak™ Pb-free leadless package
- Low On Resistance: <math><10\Omega</math> on typical at 3.3V VCC
- Broad VCC operating range: 1.65V to 5.5V
- Rail-to-rail signal handling
- Power-down, high-impedance control input
- Over-voltage tolerance of control input to 7.0V
- Break-before-make enable circuitry
- 250 MHz, 3dB bandwidth

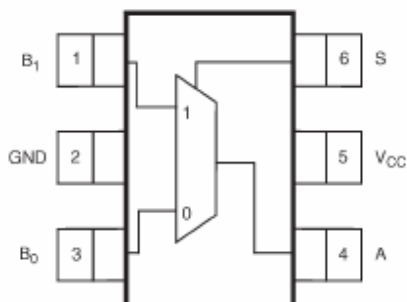
### 15.13.3. Absolute Maximum Ratings

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	-0.5V to +7.0V
$V_S$	DC Switch Voltage <sup>(1)</sup>	-0.5V to $V_{CC} + 0.5V$
$V_{IN}$	DC Input Voltage <sup>(1)</sup>	-0.5V to +7.0V
$I_{IK}$	DC Input Diode Current at $V_{IN} < 0V$	-50mA
$I_{OUT}$	DC Output Current	128mA
$I_{CC}/I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 100mA$
$T_{STG}$	Storage Temperature Range	-65°C to +150°C
$T_J$	Junction Temperature Under Bias	150°C
$T_L$	Junction Lead Temperature (Soldering, 10 seconds)	260°C
$P_D$	Power Dissipation at +85°C	180mW
ESD	Electrostatic Discharge, Human Body Model	4000V

**Note:**

1. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

### 15.13.4. Pinning



Pin Names	Description
A, B <sub>0</sub> , B <sub>1</sub>	Data Ports
S	Control Input

## 15.14. FMS6145

### 15.14.1. General Description

The FMS6145 Low-Cost Video Filter (LCVF) is intended to replace passive LC filters and drivers with a low-cost integrated device. Five 4th-order filters provide improved image quality compared to typical 2nd or 3rd-order passive solutions. The FMS6145 may be directly driven by a DC-coupled DAC output or an AC-coupled signal. Internal diode clamps and bias circuitry may be used if AC-coupled inputs are required. The outputs can drive AC- or DC-coupled single (150Ω) or dual (75Ω) loads. DC coupling the outputs removes the need for output coupling capacitors. The input DC levels are offset approximately +280mV at the output.

### 15.14.2. Features

- Five 4th-order 8MHz (SD) filters
- Drives single, AC- or DC-coupled, video loads (2Vpp, 150Ω)
- Drives dual, AC- or DC-coupled, video loads (2Vpp, 75Ω)
- Transparent input clamping
- AC- or DC-coupled inputs
- AC- or DC-coupled outputs
- DC-coupled outputs eliminate AC-coupling capacitors
- 5V only
- Robust 8kV ESD protection
- Lead-free TSSOP-14 package

### 15.14.3. Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
DC Supply Voltage	-0.3	6	V
Analog and Digital I/O	-0.3	$V_{CC} + 0.3$	V
Output Channel - Any One Channel (Do Not Exceed)		50	mA

### 15.14.4. Pinning

Pin #	Name	Type	Description
1	IN1	Input	Video input, channel 1
2	IN2	Input	Video input, channel 2
3	IN3	Input	Video input, channel 3
4	V <sub>CC</sub>	Input	+5V supply, do not float
5	IN4	Input	Video input, channel 4
6	IN5	Input	Video input, channel 5
7, 8	NC		No Connect
9	OUT5	Output	Filtered video output, channel 5
10	OUT4	Output	Filtered video output, channel 4
11	GND	Output	Must be tied to ground, do not float
12	OUT3	Output	Filtered video output, channel 3
13	OUT2	Output	Filtered video output, channel 2
14	OUT1	Output	Filtered video output, channel 1

## 15.15. MT48LC4M16A2TG8E

### 15.15.1. General Description

The 64Mb SDRAM is a high-speed CMOS, dynamic random-access memory containing 67,108,864 bits. It is internally configured as a quad-bank DRAM with a synchronous interface (all signals are registered on the positive edge of the clock signal, CLK). Each of the x4's 16,777,216-bit banks is organized as 4,096 rows by 1,024 columns by 4 bits. Each of the x8's 16,777,216-bit banks is organized as 4,096 rows by 512 columns by 8 bits. Each of the x16's 16,777,216-bit banks is organized as 4,096 rows by 256 columns by 16 bits. Read and write accesses to the SDRAM are burst oriented; accesses start at a selected location and continue for a programmed number of locations in a programmed sequence. Accesses begin with the registration of an ACTIVE command, which is then followed by a READ or WRITE command. The address bits registered coincident with the ACTIVE command are used to select the bank and row to be accessed (BA0, BA1 select the bank; A0-A11 select the row).

### 15.15.2. Features

- PC66-, PC100- and PC133-compliant
- 143 MHz, graphical 4 Meg x 16 option
- Fully synchronous; all signals registered on positive edge of system clock
- Internal pipelined operation; column address can be changed every clock cycle
- Internal banks for hiding row access/precharge
- Programmable burst lengths: 1, 2, 4, 8 or full page
- Auto Precharge, includes CONCURRENT AUTO PRECHARGE, and Auto Refresh Modes
- Self Refresh Modes: standard and low power
- 64ms, 4,096-cycle refresh
- LVTTTL-compatible inputs and outputs
- Single +3.3V  $\pm 0.3V$  power supply

### 15.15.3. Absolute Maximum Ratings

Voltage on V <sub>DD</sub> , V <sub>DDQ</sub> Supply	
Relative to V <sub>SS</sub> .....	-1V to +4.6V
Voltage on Inputs, NC or I/O Pins	
Relative to V <sub>SS</sub> .....	-1V to +4.6V
Operating Temperature,	
T <sub>A</sub> (commercial) .....	0°C to +70°C
Operating Temperature,	
T <sub>A</sub> (industrial) .....	-40°C to +85°C
Storage Temperature (plastic) .....	-55°C to +150°C
Power Dissipation .....	1W

## 15.15.4. Pinning

PIN NUMBERS	SYMBOL	TYPE	DESCRIPTION
38	CLK	Input	Clock: CLK is driven by the system clock. All SDRAM input signals are sampled on the positive edge of CLK. CLK also increments the internal burst counter and controls the output registers.
37	CKE	Input	Clock Enable: CKE activates (HIGH) and deactivates (LOW) the CLK signal. Deactivating the clock provides PRECHARGE POWER-DOWN and SELF REFRESH operation (all banks idle), ACTIVE POWER-DOWN (row active in any bank) or CLOCK SUSPEND operation (burst/access in progress). CKE is synchronous except after the device enters power-down and self refresh modes, where CKE becomes asynchronous until after exiting the same mode. The input buffers, including CLK, are disabled during power-down and self refresh modes, providing low standby power. CKE may be tied HIGH.
19	CS#	Input	Chip Select: CS# enables (registered LOW) and disables (registered HIGH) the command decoder. All commands are masked when CS# is registered HIGH. CS# provides for external bank selection on systems with multiple banks. CS# is considered part of the command code.
16, 17, 18	WE#, CAS#, RAS#	Input	Command Inputs: WE#, CAS# and RAS# (along with CS#) define the command being entered.
39	x4, x8: DQM	Input	Input/Output Mask: DQM is an input mask signal for write accesses and an output enable signal for read accesses. Input data is masked when DQM is sampled HIGH during a WRITE cycle. The output buffers are placed in a High-Z state (two-clock latency) when DQM is sampled HIGH during a READ cycle. On the x4 and x8, DQML (Pin 15) is a NC and DQMH is DQM. On the x16, DQML corresponds to DQ0-DQ7 and DQMH corresponds to DQ8-DQ15. DQML and DQMH are considered same state when referenced as DQM.
15, 39	x16: DQML, DQMH		
20, 21	BA0, BA1	Input	Bank Address Inputs: BA0 and BA1 define to which bank the ACTIVE, READ, WRITE or PRECHARGE command is being applied.
23-26, 29-34, 22, 35	A0-A11	Input	Address Inputs: A0-A11 are sampled during the ACTIVE command (row-address A0-A11) and READ/WRITE command (column-address A0-A9 [x4]; A0-A8 [x8]; A0-A7 [x16]; with A10 defining auto precharge) to select one location out of the memory array in the respective bank. A10 is sampled during a PRECHARGE command to determine if all banks are to be precharged (A10 HIGH) or bank selected by BA0, BA1 (LOW). The address inputs also provide the op-code during a LOAD MODE REGISTER command.
2, 4, 5, 7, 8, 10, 11, 13, 42, 44, 45, 47, 48, 50, 51, 53	DQ0-DQ15	x16: I/O	Data Input/Output: Data bus for x16 (4, 7, 10, 13, 42, 45, 48, 51 are NCs for x8; and 2, 4, 7, 8, 10, 13, 42, 45, 47, 48, 51, 53 are NCs for x4).
2, 5, 8, 11, 44, 47, 50, 53	DQ0-DQ7	x8: I/O	Data Input/Output: Data bus for x8 (2, 8, 47, 53 are NCs for x4).
5, 11, 44, 50	DQ0-DQ3	x4: I/O	Data Input/Output: Data bus for x4.
36, 40	NC	-	No Connect: These pins should be left unconnected.
3, 9, 43, 49	V <sub>DDQ</sub>	Supply	DQ Power: Isolated DQ power on the die for improved noise immunity.
6, 12, 46, 52	V <sub>SSQ</sub>	Supply	DQ Ground: Isolated DQ ground on the die for improved noise immunity.
1, 14, 27	V <sub>DD</sub>	Supply	Power Supply: +3.3V ±0.3V.
28, 41, 54	V <sub>SS</sub>	Supply	Ground.

## 15.16. MP1583

### 15.16.1. General Description

The MP1583 is a step-down regulator with a built in internal Power MOSFET. It achieves 3A continuous output current over a wide input supply range with excellent load and line regulation.

Current mode operation provides fast transient response and eases loop stabilization. Fault condition protection includes cycle-by-cycle current limiting and thermal shutdown. Adjustable soft-start reduces the stress on the input source at turn-on. In shutdown mode the regulator draws 20µA of supply current.

The MP1583 requires a minimum number of readily available external components to complete a 3A step down DC to DC converter solution.

### 15.16.2. Features

- 3A Output Current
- Programmable Soft-Start
- 100mΩ Internal Power MOSFET Switch
- Stable with Low ESR Output Ceramic Capacitors
- Up to 95% Efficiency
- 20μA Shutdown Mode
- Fixed 385KHz frequency
- Thermal Shutdown
- Cycle-by-Cycle Over Current Protection
- Wide 4.75 to 23V operating Input Range
- Output Adjustable From 1.22 to 21V
- Under Voltage Lockout
- Available in 8 pin SOIC Package
- 3A Evaluation Board Available

### 15.16.3. Absolute Maximum Ratings

Supply Voltage $V_{IN}$	-0.3V to 28V
Switch Voltage $V_{SW}$	-1V to $V_{IN}+0.3V$
Boost Voltage $V_{BS}$	$V_{SW}-0.3V$ to $V_{SW}+6V$
All Other Pins	-0.3V to 6V
Junction Temperature	150°C
Lead Temperature	260°C
Storage Temperature	-65°C to 150°C

### 15.16.4. Pinning

#	Name	Description
1	BS	High-Side Gate Drive Boost Input. BS supplies the drive for the high-side n-channel MOSFET switch. Connect a 4.7nF or greater capacitor from SW to BS to power the high side switch.
2	IN	Power Input. IN supplies the power to the IC, as well as the step-down converter switches. Drive IN with a 4.75V to 23V power source. Bypass IN to GND with a suitably large capacitor to eliminate noise on the input to the IC. See <i>Input Capacitor</i>
3	SW	Power Switching Output. SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load. Note that a capacitor is required from SW to BS to power the high-side switch.
4	GND	Ground. (Note: Connect the exposed pad on backside to Pin 4).
5	FB	Feedback Input. FB senses the output voltage to regulate that voltage. Drive FB with a resistive voltage divider from the output voltage. The feedback threshold is 1.222V. See <i>Setting the Output Voltage</i>
6	COMP	Compensation Node. COMP is used to compensate the regulation control loop. Connect a series RC network from COMP to GND to compensate the regulation control loop. In some cases, an additional capacitor from COMP to GND is required. See <i>Compensation</i>
7	EN	Enable Input. EN is a digital input that turns the regulator on or off. Drive EN high to turn on the regulator, drive it low to turn it off. For automatic startup, leave EN unconnected.
8	SS	Soft Start Control Input. SS controls the soft start period. Connect a capacitor from SS to GND to set the soft-start period. A 0.1μF capacitor sets the soft-start period to 10ms. To disable the soft-start feature, leave SS unconnected.

## 15.17. MP2112

### 15.17.1. General Description

The MP2112 is a 1MHz constant frequency, current mode, PWM step-down converter. The device integrates a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. It is ideal for powering portable equipment that powered by a single cell Lithium-Ion (Li+) battery. The MP2112 can supply 1A of load current from a 2.5V to 6V input voltage. The output voltage can be regulated as low as 0.6V. The MP2112 can also run at 100% duty cycle for low dropout applications. The MP2112 is available in a space-saving 6-pin QFN package.

### 15.17.2. Features

- High Efficiency: Up to 95%
- 1MHz Constant Switching Frequency
- 1A Available Load Current
- 2.5V to 6V Input Voltage Range
- Output Voltage as Low as 0.6V
- 100% Duty Cycle in Dropout
- Current Mode Control
- Short Circuit Protection
- Thermal Fault Protection
- <0.1µA Shutdown Current
- Space Saving 3mm x 3mm QFN6 Package

### 15.17.3. Absolute Maximum Ratings

$V_{IN}$ to GND .....	-0.3V to +6.5V
$V_{SW}$ to GND.....	-0.3V to $V_{IN}$ +0.3V
$V_{FB}$ , $V_{EN}$ to GND .....	-0.3V to +6.5V
Junction Temperature .....	+150°C
Lead Temperature .....	+260°C
Storage Temperature .....	-65°C to +150°C

### 15.17.4. Pinning

Pin #	Name	Description
1	FB	Feedback Input. Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.
2	GND	Ground.
3	SW	Power Switch Output. Inductor connection to drains of the internal PFET and NFET switches.
4	VINB	Supply Input-Power.
5	VINA	Supply Input-Analog.
6	EN	Enable Input.

## 15.18. STLITE49M

### 15.18.1. General Description

The ST7LITE49M is a member of the ST7 microcontroller family. All ST7 devices are based on a common industry-standard 8-bit core, featuring an enhanced instruction set. The ST7LITE49M features FLASH memory with byte-by-byte In-Circuit Programming (ICP) and In-Application Programming (IAP) capability. Under software control, the ST7LITE49M device can be placed in Wait, Slow, or Halt mode, reducing power consumption when the application is in idle or standby state. The enhanced instruction set and addressing modes of the ST7 offer both power and flexibility to software developers, enabling the design of highly efficient and compact application code. In addition to standard 8-bit data management, all ST7 microcontrollers feature true bit manipulation, 8x8 unsigned multiplication and indirect addressing modes. The ST7LITE49M features an on-chip Debug Module (DM) to support In-Circuit Debugging (ICD). For a description of the DM registers, refer to the ST7 ICC Protocol Reference Manual.

### 15.18.2. Features

- Memories: 4 Kbytes single voltage extended Flash (XFlash) Program memory with Read-out protection In-Circuit Programming and In-Application programming (ICP and IAP) Endurance: 10K write/erase cycles guaranteed Data retention: 20 years at 55 °C, 384 bytes RAM, 128 bytes data EEPROM with read-out protection, 300K write/erase cycles guaranteed, data retention: 20 years at 55 °C.
- Clock, Reset and Supply Management: 3-level low voltage supervisor (LVD) for main supply and an auxiliary voltage detector (AVD) for safe power-on/off, Clock sources: Internal trimmable 8 MHz RC oscillator, auto wake-up internal low power, low frequency oscillator, crystal/ceramic resonator or external clock, Five power saving modes: Halt, Active-Halt, Auto Wake-up from Halt, Wait and Slow
- I/O Ports: Up to 24 multifunctional bidirectional I/Os, 8 high sink outputs
- 5 timers: Configurable watchdog timer, Dual 8-bit Lite Timers with prescaler, 1 real time base and 1 input capture, Dual 12-bit Auto-reload Timers with 4 PWM outputs, input capture, output compare, dead-time generation and enhanced one pulse mode functions
- Communication interface: I<sup>2</sup>C multimaster interface
- A/D converter: 10 input channels
- Interrupt management: 13 interrupt vectors plus TRAP and RESET
- Instruction set: 8-bit data manipulation, 63 basic instructions with illegal opcode detection, 17 main addressing modes, 8 x 8 unsigned multiply instructions
- Development tools: Full HW/SW development package, DM (Debug Module)

### 15.18.3. Absolute Maximum Ratings

Symbol	Ratings	Maximum value	Unit
$V_{DD} - V_{SS}$	Supply voltage	7.0	V
$V_{IN}$	Input voltage on any pin <sup>(1)(2)</sup>	$V_{SS}-0.3$ to $V_{DD}+0.3$	
$V_{ESD(HBM)}$	Electrostatic discharge voltage (Human Body Model)	see <a href="#">Section 13.8.3 on page 156</a>	
$V_{ESD(CDM)}$	Electrostatic discharge voltage (Charge Device Model)		



### 15.18.4. Pinning

Pin Number		Pin Name	Type	Level		Port / Control						Main function (after reset)	Alternate function	
LQFP32	SDIP32			Input	Output	Input				Output				
						float	wpu	int	ana	OD <sup>(1)</sup>	PP			
1	5	PA3 (HS)/ATPWM1	I/O	C <sub>T</sub>	HS	x					x	x	Port A3 (HS)	ATPWM1
2	6	PA4 (HS)/ATPWM2/MCO	I/O	C <sub>T</sub>	HS	x	ei0				x	x	Port A4 (HS)	ATPWM2/MCO
3	7	PA5 (HS)/ATPWM3	I/O	C <sub>T</sub>	HS	x					x	x	Port A5 (HS)	ATPWM3
4	8	PA6 (HS)/I2CDATA	I/O	C <sub>T</sub>	HS	x			ei0		T		Port A6 (HS)	I2CDATA
5	9	PA7 (HS)/I2CCLK	I/O	C <sub>T</sub>	HS	x					T		Port A7 (HS)	I2CCLK
6	10	RESET					x				x		Reset	
8	12	V <sub>DD</sub> <sup>(2)</sup>	S										Digital Supply Voltage	
9	13	V <sub>SS</sub> <sup>(2)</sup>	S										Digital Ground Voltage	
10	14	OSC1	I										Resonator oscillator inverter input or External clock input	
11	15	OSC2	O										Resonator oscillator output	
12	16	V <sub>SSA</sub> <sup>(2)</sup>	S										Analog Ground Voltage	
13	17	V <sub>DDA</sub> <sup>(2)</sup>	S										Analog Supply Voltage	

Pin Number		Pin Name	Type	Level		Port / Control						Main function (after reset)	Alternate function	
LQFP32	SDIP32			Input	Output	Input				Output				
						float	wpu	int	ana	OD <sup>(1)</sup>	PP			
14	18	PB0/AIN0	I/O	C <sub>T</sub>		x				x	x	x	Port B0	AIN0
15	19	PB1/AIN1/CLKIN	I/O	C <sub>T</sub>		x				x	x	x	Port B1	AIN1/External clock source
16	20	PB2/AIN2	I/O	C <sub>T</sub>		x				x	x	x	Port B2	AIN2
17	21	PB3/AIN3	I/O	C <sub>T</sub>		x				x	x	x	Port B3	AIN3
18	22	PB4/AIN4	I/O	C <sub>T</sub>		x				x	x	x	Port B4	AIN4
19	23	PB5/AIN5	I/O	C <sub>T</sub>		x				x	x	x	Port B5	AIN5
20	24	PB6/AIN6	I/O	C <sub>T</sub>		x				x	x	x	Port B6	AIN6
21	25	PB7/AIN7	I/O	C <sub>T</sub>		x				x	x	x	Port B7	AIN7
22	26	PC0/AIN8	I/O	C <sub>T</sub>		x				x	x	x	Port C0	AIN8
23	27	PC1/AIN9	I/O	C <sub>T</sub>		x				x	x	x	Port C1	AIN9
24	28	PC2/ICCDATA	I/O	C <sub>T</sub>		x					x	x	Port C2	ICCDATA
25	29	PC3/ICCLK	I/O	C <sub>T</sub>		x	x				x	x	Port C3	ICCLK
26	30	PC4/LTIC	I/O	C <sub>T</sub>		x					x	x	Port C4	LTIC
27	31	PC5	I/O	C <sub>T</sub>		x					x	x	Port C5	
28	32	PC6	I/O	C <sub>T</sub>		x					x	x	Port C6	
29	1	PC7/BREAK	I/O	C <sub>T</sub>		x					x	x	Port C7	BREAK
30	2	PA0 (HS)	I/O	C <sub>T</sub>	HS	x					x	x	Port A0 (HS)	
31	3	PA1 (HS)/ATIC	I/O	C <sub>T</sub>	HS	x					x	x	Port A1 (HS)	ATIC
32	4	PA2 (HS)/ATPWM0	I/O	C <sub>T</sub>	HS	x					x	x	Port A2 (HS)	ATPWM0

1. In the open-drain output column, T defines a true open-drain I/O (P-Buffer and protection diode to V<sub>DD</sub> are not implemented).

2. It is mandatory to connect all available V<sub>DD</sub> and V<sub>DDA</sub> pins to the supply voltage and all V<sub>SS</sub> and V<sub>SSA</sub> pins to ground.

## 15.19. MAX809LTR

### 15.19.1. General Description

The MAX809 and MAX810 are cost-effective system supervisor circuits designed to monitor VCC in digital systems and provide a reset signal to the host processor when necessary. No external components are required. The reset output is driven active within 10  $\mu$ sec of VCC falling through the reset voltage threshold. Reset is maintained active for a timeout period which is trimmed by the factory after VCC rises above the reset threshold. The MAX810 has an active-high RESET output while the MAX809 has an active-low RESET output. Both devices are available in SOT-23 and SC-70 packages. The MAX809/810 are optimized to reject fast transient glitches on the VCC line. Low supply current of 0.5  $\mu$ A (VCC = 3.2 V) makes these devices suitable for battery powered applications.

### 15.19.2. Features

- Precision VCC Monitor for 1.5 V, 2.5 V, 3.0 V, 3.3 V, and 5.0 V Supplies
- Precision Monitoring Voltages from 1.2 V to 4.9 V Available in 100 mV Steps
- Four Guaranteed Minimum Power-On Reset Pulse Width Available (1 ms, 20 ms, 100 ms, and 140 ms)
- RESET Output Guaranteed to VCC = 1.0 V.
- Low Supply Current
- Compatible with Hot Plug Applications
- VCC Transient Immunity
- No External Components
- Wide Operating Temperature: -40°C to 105°C
- Pb-Free Packages are Available

### 15.19.3. Absolute Maximum Ratings

Rating	Symbol	Value	Unit
Power Supply Voltage (V <sub>CC</sub> to GND)	V <sub>CC</sub>	-0.3 to 6.0	V
RESET Output Voltage (CMOS)		-0.3 to (V <sub>CC</sub> + 0.3)	V
Input Current, V <sub>CC</sub>		20	mA
Output Current, RESET		20	mA
dV/dt (V <sub>CC</sub> )		100	V/ $\mu$ sec
Thermal Resistance, Junction-to-Air (Note 1)	SOT-23 SC-70 R <sub>θJA</sub>	301 314	°C/W
Operating Junction Temperature Range	T <sub>J</sub>	-40 to +105	°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +150	°C
Lead Temperature (Soldering, 10 Seconds)	T <sub>sol</sub>	+260	°C
ESD Protection Human Body Model (HBM): Following Specification JESD22-A114 Machine Model (MM): Following Specification JESD22-A115		2000 200	V
Latchup Current Maximum Rating: Following Specification JESD78 Class II Positive Negative	I <sub>Latchup</sub>	200 200	mA

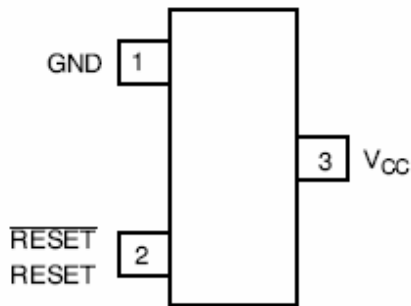
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. This based on a 35x35x1.6mm FR4 PCB with 10mm<sup>2</sup> of 1 oz copper traces under natural convection conditions and a single component characterization.

2. The maximum package power dissipation limit must not be exceeded.

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}} \quad \text{with } T_{J(max)} = 150^\circ\text{C}$$

### 15.19.4. Pinning



Pin No.	Symbol	Description
1	GND	Ground
2	RESET (MAX809)	RESET output remains low while V <sub>CC</sub> is below the reset voltage threshold, and for a reset timeout period after V <sub>CC</sub> rises above reset threshold
2	RESET (MAX810)	RESET output remains high while V <sub>CC</sub> is below the reset voltage threshold, and for a reset timeout period after V <sub>CC</sub> rises above reset threshold
3	V <sub>CC</sub>	Supply Voltage (Typ)

## 16. SERVICE MENU SETTINGS

In order to reach service menu, First Press “MENU” Then press the remote control code, which is “4725”. In DTV mode, first press “MENU” and select “TV SETUP”. Then, press “4725”.

### 16.1. Video Setup

Panel Info <.....>

32\_LC\_SAC1

Blue Background <.....>

If “Menu” selected, “Blue Background” item is seen in “Feature” menu.

If “Yes” selected, “Blue Background” is on and not seen in “Feature” menu

Film Mode <.....>

If “Yes” selected, “Film Mode” feature is active.

Dynamic Contrast <.....>

If “Yes” selected, “Dynamic Contrast” feature is active.

Game Mode <.....>

If “Yes” selected, “Game Mode” feature is active

SRGB For PC <.....>

If “Yes” selected, PCs can use SRGB option.

Dynamic Noise Reduction<.....>

If “Yes” selected, “Dynamic Noise Reduction” feature is active

WSS Option<.....>

If “Yes” selected, WSS Option can be used

### 16.2. AudioSetup

BG<.....>

Europe

**New Zeland**  
**Australia**  
**No**

**DK<.....>**

**I<.....>**

**L<.....>**

**Equalizer <.....>**

If "Yes" selected, "**Equalizer**" item is seen in "**Sound**" menu.

**Headphone <.....>**

If "Yes" selected, "**Headphone**" item is seen in "**Sound**" menu.

**Power On/Off Melody <.....>**

If "Yes" selected, when power on/off conditions, the power on/off melody can be heard.

**Dynamic Bass <.....>** Value between 0 to 12

**Effect<.....>** Value between 0 to 7

**Audio Delay ,offset <.....>** Value between 0 to 190

**Audio Setup Cont...2**

**Carrier mute<.....>** Value between 0 to 28

**Headphone Sound Select <.....>**

**Always Active Select**

**Always Inactive Select**

**Menu**

**Always Main Menu**

**Always PIP/PAP Window**

**Sound Mode Detect Time <.....>** Value between 0 to 255

**Noise Reduction Threshold <.....>** Value between 0 to 255

**Noise Reduction Time <.....>** Value between 0 to 15

**AVL Attack Time <.....>** Value between 0 to 255

**AVL Release Time <.....>** Value between 0 to 255

**Prescales ( AVL On)**

**FM Prescale<.....>** Value between 0 to 255

**AM Prescale <.....>** Value between 0 to 255

**NICAM Prescale <.....>** Value between 0 to 255

**SCART Prescale <.....>** Value between 0 to 255

**FAV Prescale <.....>** Value between 0 to 255

**DTV Prescale <.....>** Value between 0 to 255

**HDMI Prescale <.....>** Value between 0 to 255

**YPbPr/PC Prescale <.....>** Value between 0 to 255

**An. USB Prescale <.....>** Value between 0 to 255

**Dig. USB Prescale <.....>** Value between 0 to 255

**Prescales ( AVL Off)**

**FM Prescale<.....>** Value between 0 to 255

**AM Prescale <.....>** Value between 0 to 255

**NICAM Prescale <.....>** Value between 0 to 255

**SCART Prescale <.....>** Value between 0 to 255

**FAV Prescale <.....>** Value between 0 to 255

**DTV Prescale <.....>** Value between 0 to 255

**HDMI Prescale <.....>** Value between 0 to 255

**YPbPr/PC Prescale <.....>** Value between 0 to 255

**An. USB Prescale** <.....> Value between 0 to 255  
**Dig. USB Prescale** <.....> Value between 0 to 255  
**Clipping Levels ( AVL On)**  
**FM Clipping** <.....> Value between 0 to 255  
**AM Clipping** <.....> Value between 0 to 255  
**NICAM Clipping** <.....> Value between 0 to 255  
**SCART Clipping** <.....> Value between 0 to 255  
**FAV Clipping** <.....> Value between 0 to 255  
**DTV Clipping** <.....> Value between 0 to 255  
**HDMI Clipping** <.....> Value between 0 to 255  
**YPbPr/PC Clipping** <.....> Value between 0 to 255  
**An. USB Clipping** <.....> Value between 0 to 255  
**Dig. USB Clipping** <.....> Value between 0 to 255  
**Clipping Levels ( AVL Off)**  
**FM Clipping** <.....> Value between 0 to 255  
**AM Clipping** <.....> Value between 0 to 255  
**NICAM Clipping** <.....> Value between 0 to 255  
**SCART Clipping** <.....> Value between 0 to 255  
**FAV Clipping** <.....> Value between 0 to 255  
**DTV Clipping** <.....> Value between 0 to 255  
**HDMI Clipping** <.....> Value between 0 to 255  
**YPbPr/PC Clipping** <.....> Value between 0 to 255  
**An. USB Clipping** <.....> Value between 0 to 255  
**Dig. USB Clipping** <.....> Value between 0 to 255

### 16.3. Service Scan/Tuning Setup

**First Search for L/L'** <.....>  
**ATS Delay Time (ms)** <.....> Value between 0 to +200  
**Main Tuner Setup**  
**Tuner Type**  
**LC\_TDTC\_GXX1D**  
**Thomson DTT7543X**  
**Philips TD1318AF-3**  
**Samsung DTOs403LH172A**  
**Generic ( Analog Only)**  
**Control Byte** <.....> Value between 0 to +255  
**BSW1** <.....> Value between 0 to +255  
**BSW2** <.....> Value between 0 to +255  
**BSW3** <.....> Value between 0 to +255  
**Low-Mid – Low Byte** <.....>  
**Low-Mid – High Byte** <.....>  
**Mid-High – Low Byte** <.....>  
**Mid-High – High Byte** <.....>  
**S Band TOP** <.....>  
**VIF TOP** <.....> Value between 0 to +15  
**VIF TOP SECAM** <.....> Value between 0 to +15  
**VIF TOP DK** <.....> Value between 0 to +15  
**Synch Threshold** <.....> Value between 0 to +40

## 16.4. Options

### Options-1

**Power Up**

**Standby**

**Last state**

**TV Open Mode**

**Source**

**1st TV**

**Last Tv**

**First APS <.....>**

*If "Yes" selected, first time TV opens by asking APS.*

**APS Volume <.....>** *Value between 0 to +63*

**Burn In Mode <.....>**

*If "Yes" selected, TV opens with Burn-In mode. This mode is used in manufacturing.*

**APS Test**

**Autostore <.....>**

*If "Yes" selected, Channel is automatically stored.*

**Unicode Enabled <.....>**

*If "Yes" selected,Unicode characters can be read in the USB Files.*

### Options-2

**Source List menu <.....>**

*If "Yes" selected, Sorce List Menu appears on the screen when press "source" button.*

**RS232 for B2B <.....>**

*If "Yes" selected, Remote Control commandsthe TV via RS232 and vice versa.*

**RC Select <.....>**

**RC Group 1**

**RC Group 2**

**RC Group 3**

**RC Group 4**

**RC Group 5**

**RC Group 6**

**Double Digit Key <.....>**

*If "Yes" selected, Double Digit Button on RC activates.*

**Protection <.....>**

*If "Yes" selected,short circuit protection activates.*

**Led Type <.....>**

**1 Led 1 Color**

**1 Led 2 Color**

**2 Led 2 Color**

**1 Led 3 Color**

**2 Led 3 Color**

**200 Programme <.....>**

*If "Yes" selected, totaly 200 programmes can be used.*

**TouchPad <.....>**

*If "Yes" selected, TouchPad can be used.*

## Teletext Options

**TXT Darkness** <.....> Value between 0 to +63

**TXT Type** <.....>

**Fasttext&Toptext**

**No**

**Default**

**Fasttext**

**Toptext**

**TXT Language** <.....>

**Menu**

**West**

**East**

**Cyrillic**

**Turk/Gre**

**Arabic**

**Persian**

**Auto**

**No Txt Warning** <.....>

If "Yes" selected, "No Txt Transmission" warning appears on the screen when pressing txt button from RC.

**Txt Subtitle** <.....>

If "Yes" selected, Teletext subtitles can be seen.

## Optional Features

**Default Zoom** <.....>

**Menu**

**16:9**

**4:3**

**Panaromic**

**14:9 Zoom**

**Menu Timeout** <.....>

**Menu**

**15 Sec**

**30 Sec**

**60 Sec**

**No Time**

**Backlight** <.....>

If "Yes" selected, "**Backlight**" feature is active.

**100 Step Slider** <.....>

If "Yes" selected, 64 step sliders will become 100 step sliders.

**Analog USB Enabled** <.....>

If "Yes" selected, "**Analog USB**" option is active.

**Menu Double Size** <.....>

If "Yes" selected, menu sizes increases.

**CEC Enable** <.....>

If "Yes" selected, "**CEC**" feature is active.

**Digital USB Hotplug** <.....>

If "Yes" selected, "**Digital USB Hotplug**" feature is active.

### **PIP Options**

**Pip <.....>**

**AV PIP**

**No PIP**

**PC PIP**

**Hotel Options <.....>**

**Hotel TV <.....>**

*If "Yes" selected, "Hotel TV" feature is active.*

**IR Smartloader <.....>**

*If "Yes" selected, "IR Smartloader" feature is active.*

### **16.5. External Source Settings**

**TV <.....>**

**DTV <.....>**

**Ext 2 <.....>**

**Ext 2 S <.....>**

**FAV <.....>**

**BAV <.....>**

**S-Video <.....>**

**HDMI 1 <.....>**

**HDMI 2 <.....>**

**HDMI 3 <.....>**

**HDMI 4 <.....>**

**YPbPr <.....>**

**PC <.....>**

### **16.6. Preset**

**User Adj.**

**ADC Adj.**

**Service Adj.**

**All Adj.**

**Init Factory Channels.**

### **16.7. NVM Edit**

**NVM-edit addr. (hex)**

**NVM-edit data (hex)**

**NVM-data dec**

### **16.8. Programming**

**HDMI DDC Update Mode <.....>**

**HDCP Key Update Mode <.....>**

**Software Bypass <.....>**

*If "On" selected, speaker effects are bypassed.*

**LVDS Clock Step <.....>** Value between 0 to +255

**Memory Clock Step <.....>** Value between 0 to +255

**DTV Download <.....>**

*If "On" selected, DTV software can be updated from SCART.*



### **DSUB9 Download <.....>**

*If "On" selected, DTV software can be updated from DSUB9.*

### **16.9. Diagnostic**

**Eeprom I2C**

**Tuner I2C**

**IF I2C**

**HDMI I2C**

**DTV RS232**

### **16.10. Product Info**

## **17. SOFTWARE UPDATE DESCRIPTION**

### **16.1 17MB35 Analog Part Software Update With Bootloader Procedure**

#### **1.1 The File Types Used By The Bootloader**

All file types that used by the bootloader software are listed below:

**1. The Binary File :** It has ".bin" extension and it is the tv application. Its size is 1920 Kb.

**2. The Config Binary File :** It has ".cin" extension and it is the config of the tv application. Its size may be 64 Kb or a few times 64 Kb.

**3. The Test Script File :** It has ".txt" extension and it is the test script that is parsed and executed by the bootloader. It don't have to be any times of 64 Kb.

**4. The Test Binary File :** It has ".tin" extension and it is used and written by the test groups. It is run to understand the problem part of the hardware.

Allthough a file that is used by the bootloader can be had any one of these extensions, its name has to be "VESTEL\_S" and it has to be located in the root directory of the usb device.

#### **1.2 Usage of The Bootloader**

1. The starting to pass through : The chassis is only powered up.

2. The starting to download something : When chassis is powered up the menu key has to be pushed. Before the chassis is powered up and if any usb device is plugged to the usb port, the programme is downloaded from usb firstly.

Any usb device is plugged to usb port , user must open hyperterminal in the pc and connect pc to chassis via Mstar debug tool and any one of scart, dsub9 or I2c connectors. Serial connection settings are listed below:

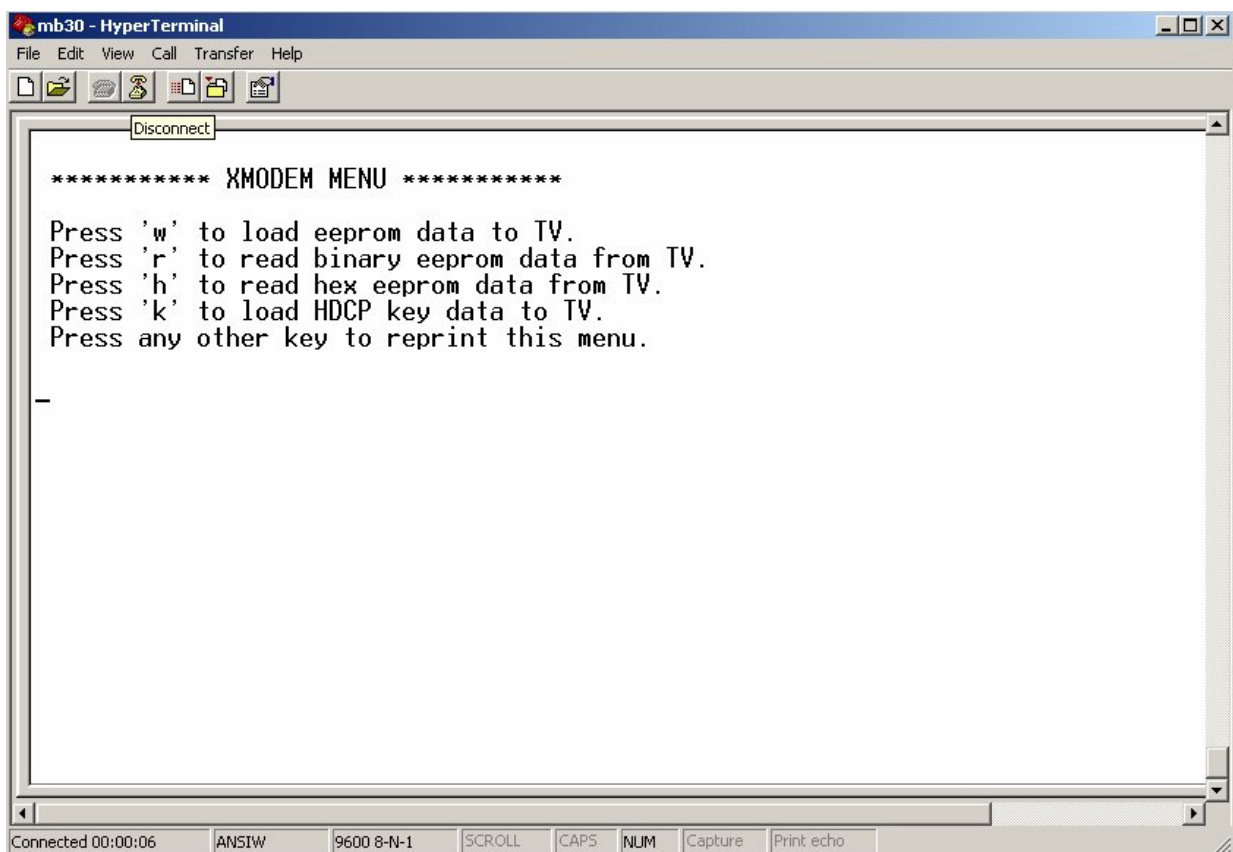
- Bit per second: 115200
- Data bits: 8



Programming		
1. HDMI DDC Update Mode		Off
2. HDCP Key Update Mode		Off
3. Software Bypass		On
4. LVDS Clock Step		255
5. Memory Clock Step		255
6. DTV Download		Off

**Figure 2. The Programming Service Menu**

After then you must see Xmodem menu in the hyperterminal. To download hdcp key press k or to download eeprom content press w.



**Figure 3. Xmodem Menu**

If the repeated "C" characters are seen you can transfer file content via select Transfer->Send File and choose "Xmodem" protocol and click the "Send" button.

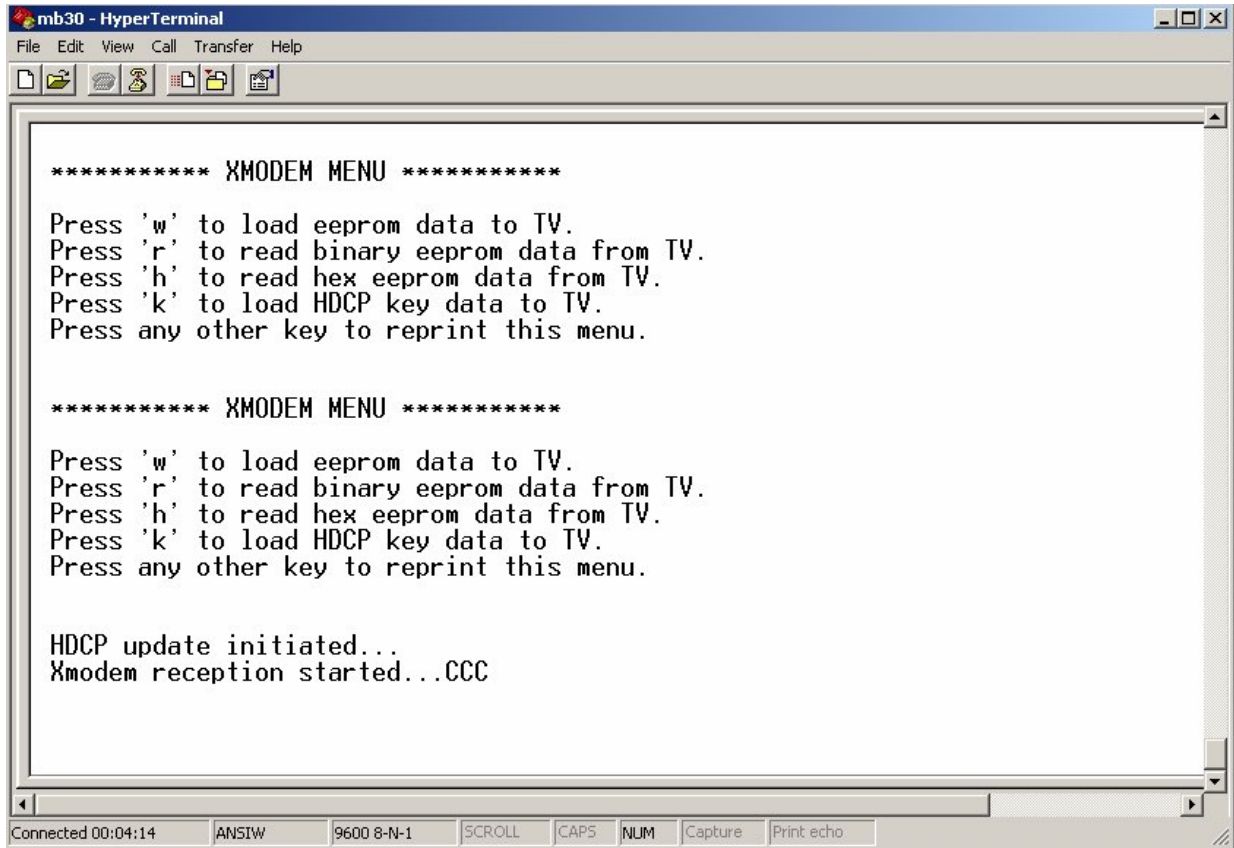


Figure 4. The Starting To Send

## 16.2 17MB30 HDCP key upload procedure.

- 1) Turn on TV set.
- 2) Open a COM connection using following parameters and select ISP COM Port No  
Baud Rate: 9600 bps  
Data Bits: 8  
Stop Bits: 1  
Parity: None  
Flow Control: None
- 3) Enter service menu by pressing “4” “7” “2” “5” consecutively while main menu is open
- 4) Select “9. Programming”
- 5) Select “HDMI HDCP Update Mode” yes.
- 6) On Hyper Terminal Window press “k”
- 7) Click on send file under Transfer Tab.
- 8) Select Xmodem and choose the HDCP key to be uploaded.
- 9) Press send button
- 10) Restart TV set

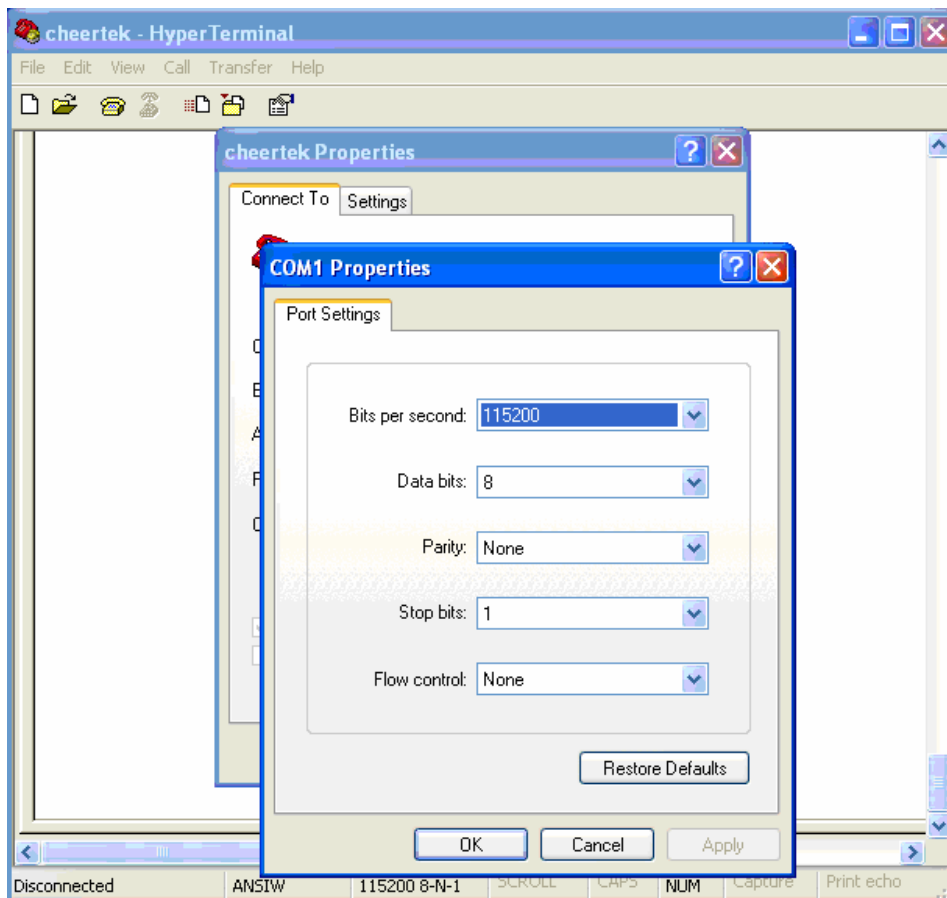
## 16.3 17MB35 Digital Software Update From SCART

### Adjusting DTV Download Mode:

1. Power on the TV.
2. Exit the Stby Mode.
3. Enter the "Tv Menu".
4. Enter "4725" for jumping to "Service Settings".
5. Select "8. Programming" step.
6. Change "6. DTV Download" to "On".
7. Switch to the Stby mode.

### Adjusting HyperTerminal:

1. Connect the "MB35 SCART Interface" to SCART1 (bottom SCART plug).
2. Also connect the "MB35 SCART Interface" to PC.
3. Open "HyperTerminal".
4. Determine the "COM" settings listed and showed below.
  - Bit per second: 115200
  - Data bits: 8
  - Parity: None
  - Stop bits: 1
  - Flow control: None

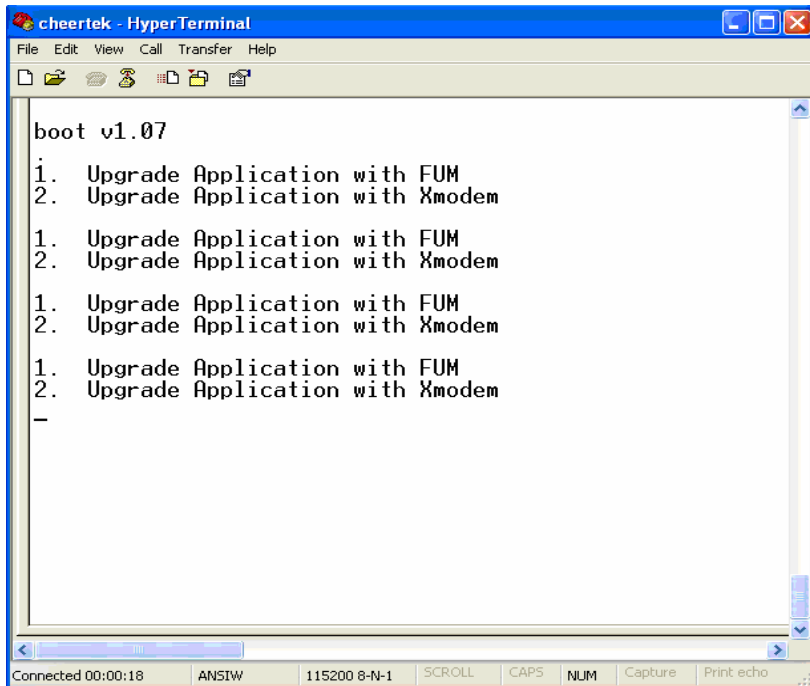


COM Properties Window

6. Click "OK".

## Software Updating Procedure

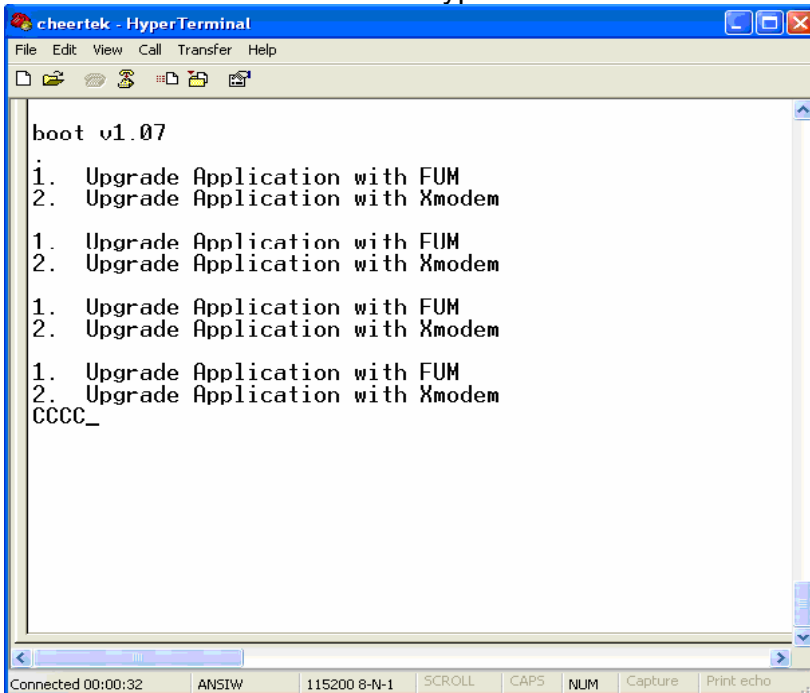
1. In the HyperTerminal Menu, click the “Connect” button.
2. Exit the Stby Mode.
3. The “Space” button on the keyboard must be pressed, when the following window can be seen.



```
cheertek - HyperTerminal
File Edit View Call Transfer Help
boot v1.07
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
-
```

Selection Window

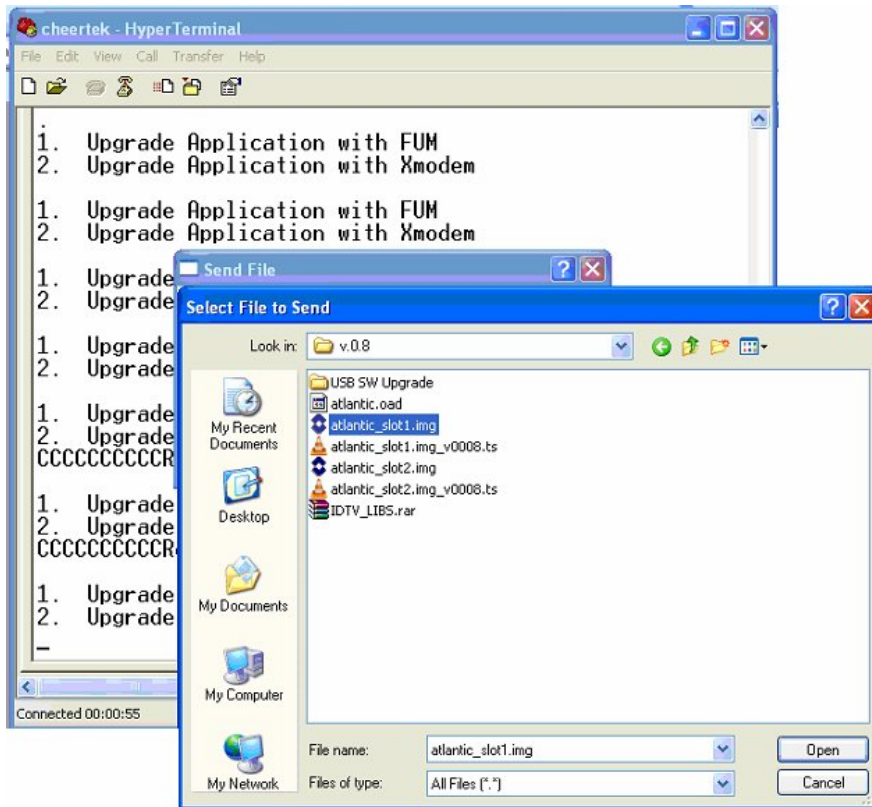
4. Press the “2” button on the keyboard for choosing “2. Upgrade Application with Xmodem”.
5. Repeating “C” characters are seen in the “HyperTerminal” menu.



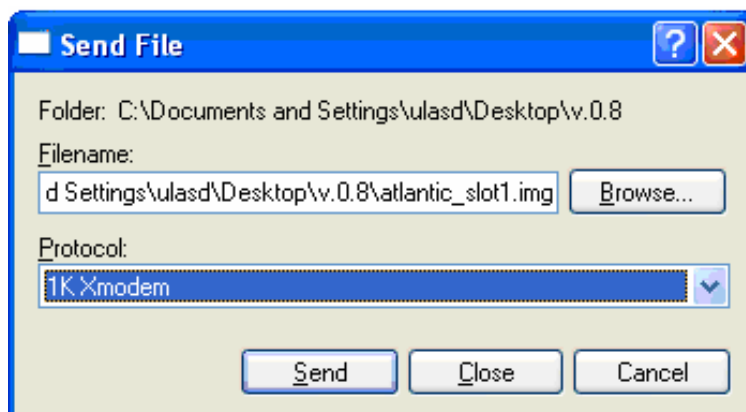
```
cheertek - HyperTerminal
File Edit View Call Transfer Help
boot v1.07
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
1. Upgrade Application with FUM
2. Upgrade Application with Xmodem
CCCC_
```

The Sample Output Before Sending The File

6. Click the “Send” button on the HyperTerminal
7. Select the “Filename **xxxx\_slot1.img**” using “Browse”.
8. Choose the “1K Xmodem” from “Protocol” option.

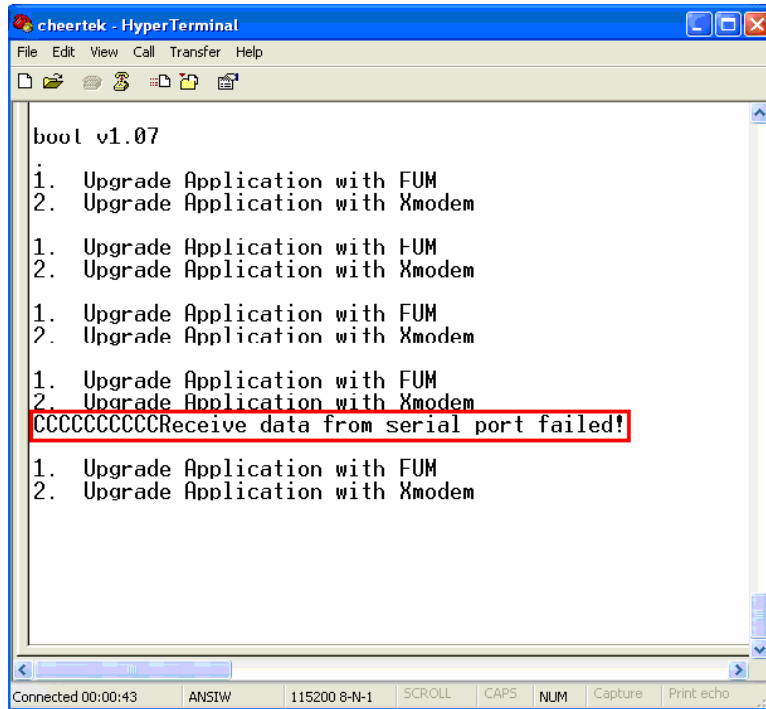


Selection of File



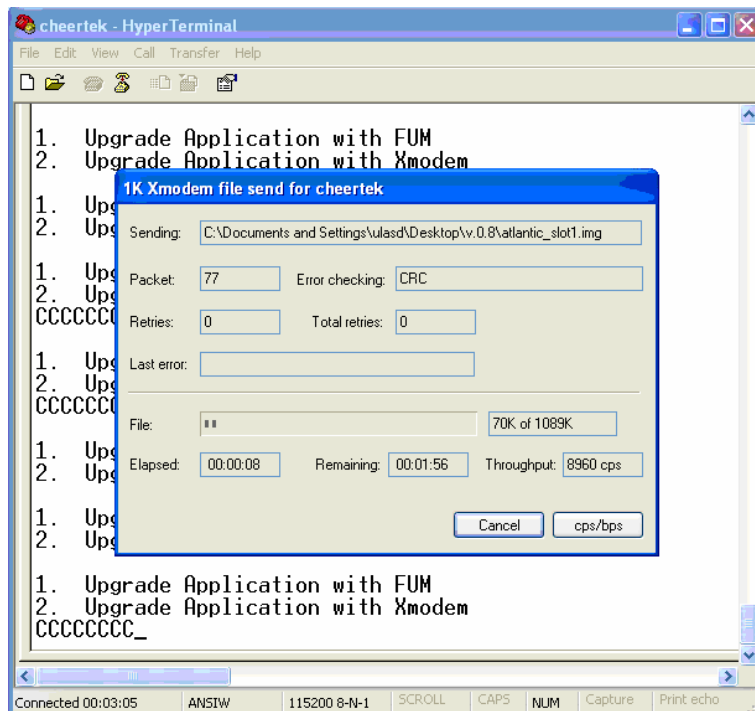
File and Protocol Selection Window

**Note:** In the Software updating Procedure section, when the first “C” character is seen, the filename selection process must be finished before 10 seconds. If the process can not be finished, the file sending operation will be cancelled. The following figure shows this situation.



Capture of Receiving Data Failing

9. When sending the file the following window must be seen.



Capture of Sending Process

10. After the sending process the following HyperTerminal window must be seen.



```
cheertek - HyperTerminal
File Edit View Call Transfer Help

erase sector 0x00050000...success
erase sector 0x00060000...success
erase sector 0x00070000...success
erase sector 0x00080000...success
erase sector 0x00090000...success
erase sector 0x000a0000...success
erase sector 0x000b0000...success
erase sector 0x000c0000...success
erase sector 0x000d0000...success
erase sector 0x000e0000...success
erase sector 0x000f0000...success
erase sector 0x00100000...success
erase sector 0x00110000...success
erase sector 0x00120000...success

Start to write to flash...

Write to flash finished

Please reboot the system!!

1. Upgrade Application with FUM
2. Upgrade Application with Xmodem

Connected 00:05:44  ANSIV  115200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

Capture of End of The Sending Process

11. For sending second program file, the Software Updating Procedure must be repeated from the step X. Select the “Filename xxxx\_slot2.img” using “Browse”.
12. After sending the second program file, the Software Updating Procedure will be succesful.

**Note:** After the File Sending Process,

1. Upgrade Application with FUM
2. Upgrade Application with Xmodem, options must be seen.

```
cheertek - HyperTerminal
File Edit View Call Transfer Help

erase sector 0x00250000...success
erase sector 0x00260000...success
erase sector 0x00270000...success
erase sector 0x00280000...success
erase sector 0x00290000...success
erase sector 0x002a0000...success
erase sector 0x002b0000...success
erase sector 0x002c0000...success
erase sector 0x002d0000...success
erase sector 0x002e0000...success
erase sector 0x002f0000...success
erase sector 0x00300000...success
erase sector 0x00310000...success
erase sector 0x00320000...success

Start to write to flash...

Write to flash finished

Please reboot the system!!

1. Upgrade Application with FUM
2. Upgrade Application with Xmodem

Connected 00:09:28  ANSIV  115200 8-N-1  SCROLL  CAPS  NUM  Capture  Print echo
```

End of The Sending Process

### Checking Of The New Software

1. Turn off and on the TV.
2. Enter the "Setup" submenu in the "DTV Menu".
3. Choose the "Configuration" option.
4. For controlling new software, check the "Receiver Upgrade" option.

### 16.4 17MB35 Digital Software Update From USB

Software upgrade is possible via USB disk by following the steps below.

1. Copy the bin file, including higher version than the software loaded in flash, into the USB flash memory root directory. This file should be named up.bin.
2. Insert the USB disk.
3. Digital module performs version and CRC check. If version and CRC check is successful, then a message prompt appears to notify user about new version. If the user confirms loading of new version, upgrade.bin file is written into flash unused slot.
4. Digital module disables the previous software in the flash and then a system reset is performed.
5. After the reset, digital module starts with new software.

#### *Revert operation:*

With revert operation, it is possible to *downgrade* the software.

Revert operation is very similar to upgrade process. In the revert operation, file name should be f\_up.bin. Also user confirmation is not asked.

1. Copy the bin file into the USB flash memory root directory. This file should be named force\_upgrade.bin.
2. Insert the USB disk.
3. A lower version than the software in flash can be loaded with revert operation. Digital module performs only CRC check. If CRC check is successful, then force\_upgrade.bin file is written into flash unused slot.
4. Digital module disables the previous software in the flash.
5. A message prompt is displayed to notify user about end of revert process.
6. Power off/on is required to start digital module with the new software.

For controlling new software, check the "Receiver Upgrade" option.

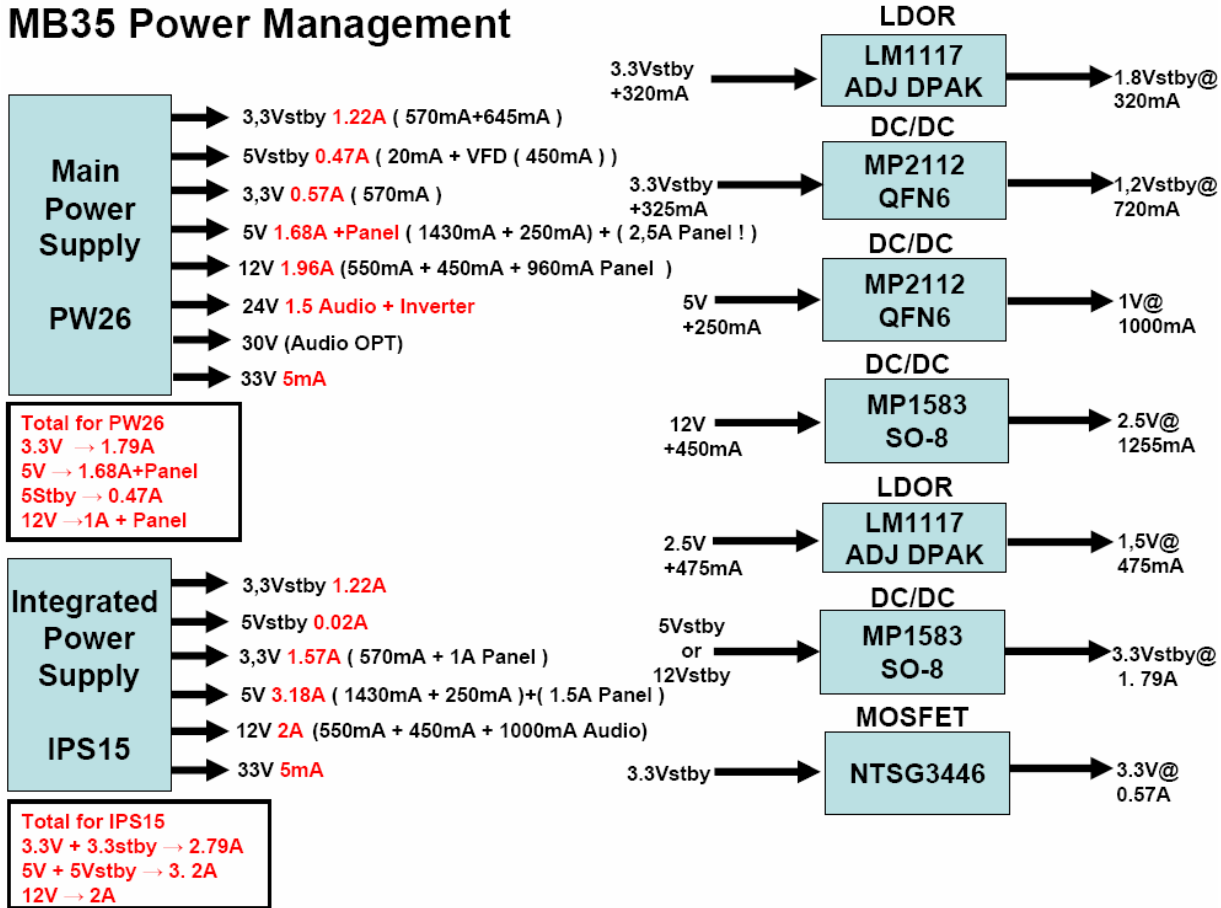
## 18. BLOCK DIAGRAMS

### 18.1. General Block Diagram



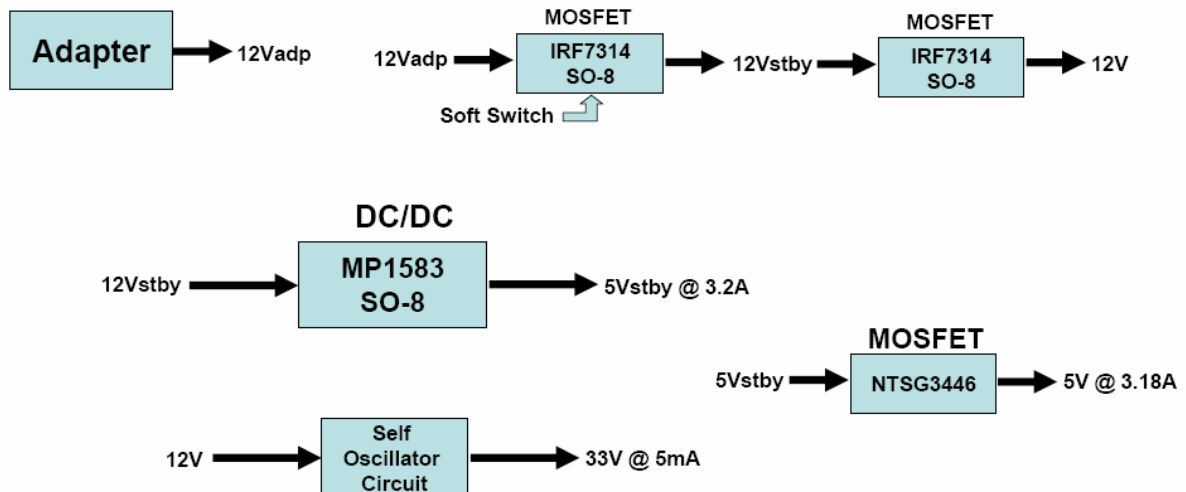
## 18.2. Power Management

### MB35 Power Management

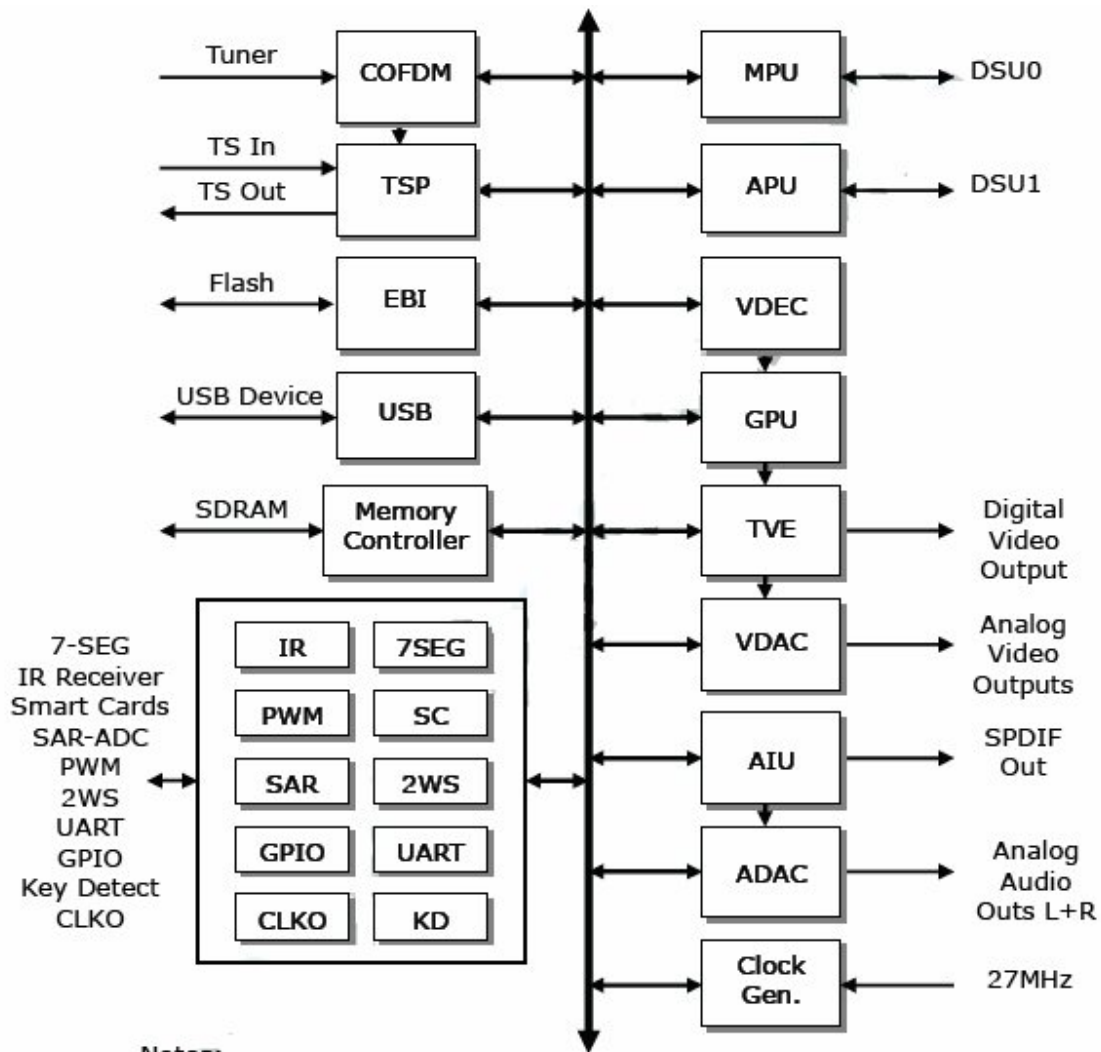


#### OPTIONS:

•MOBIL & DVD Options ( Adapter or Car Battery )



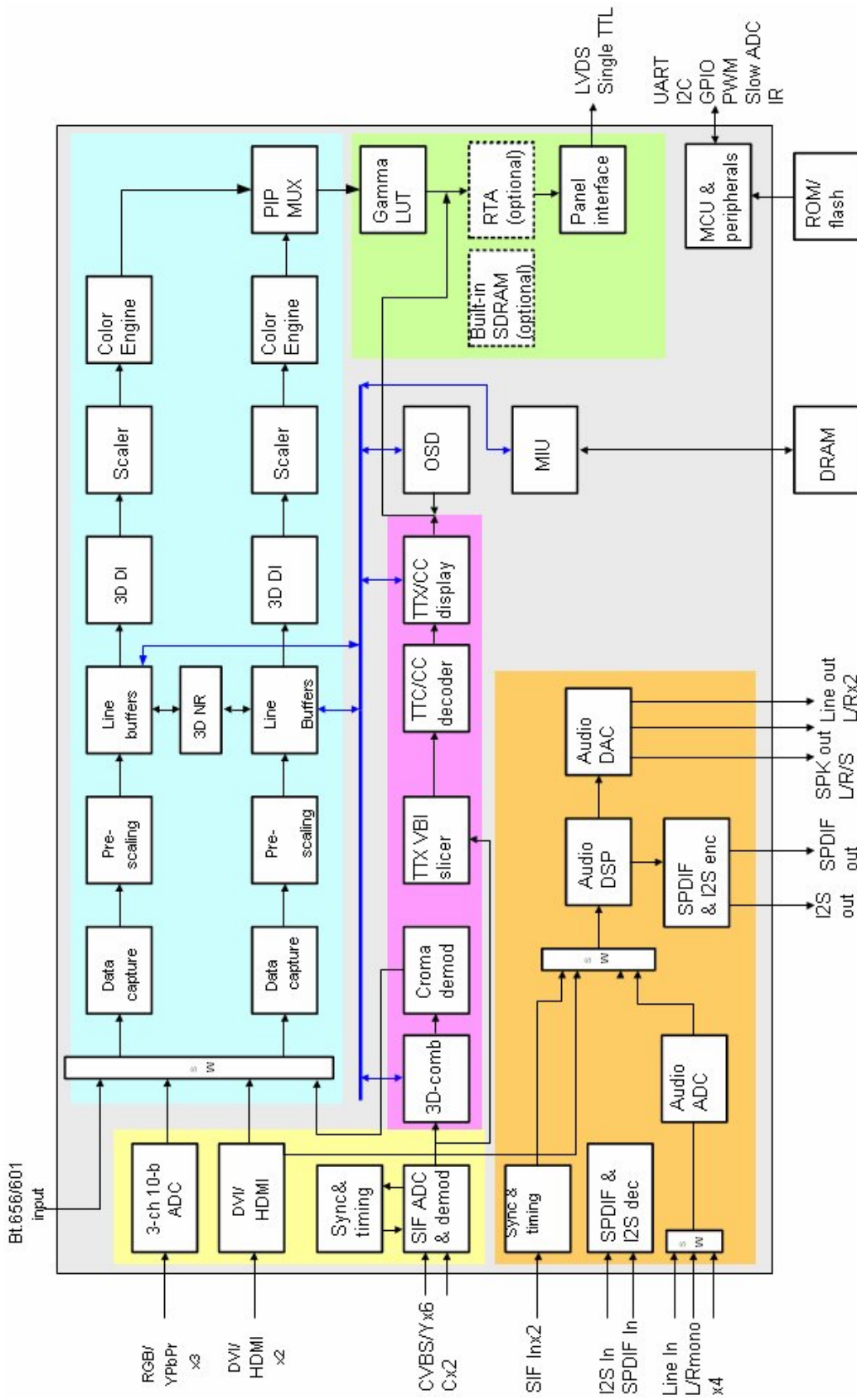
### 18.3. Integrated DVB-T Receiver Block Diagram

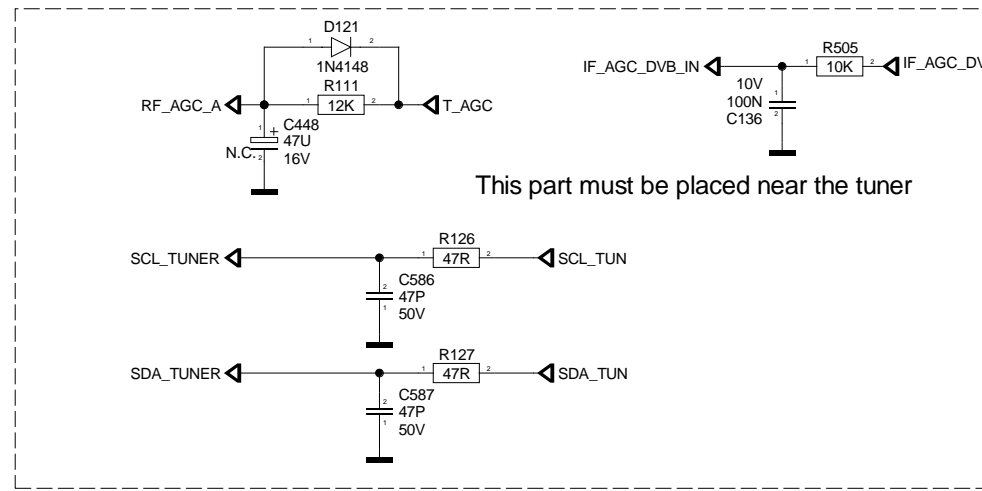
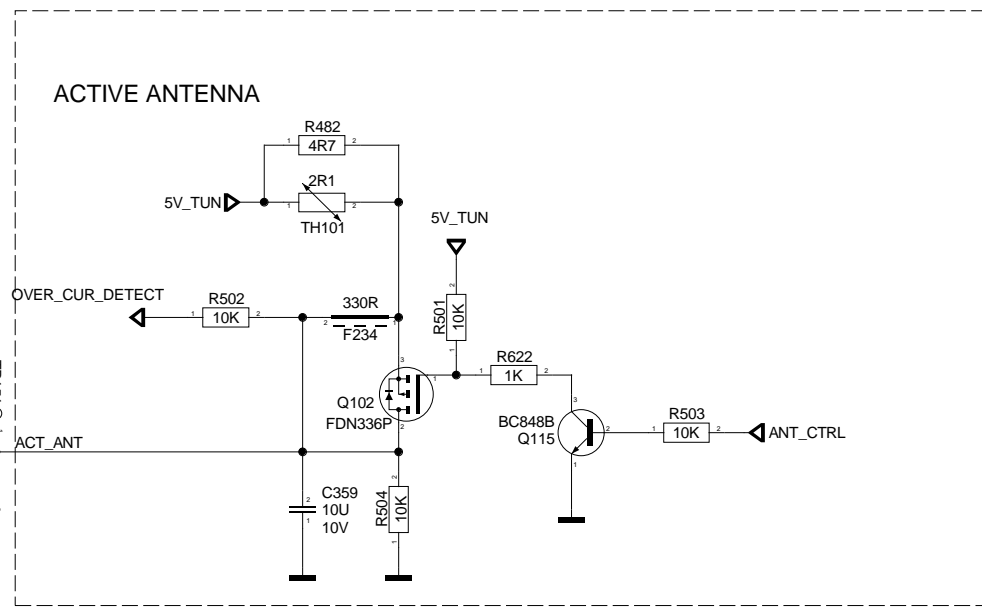
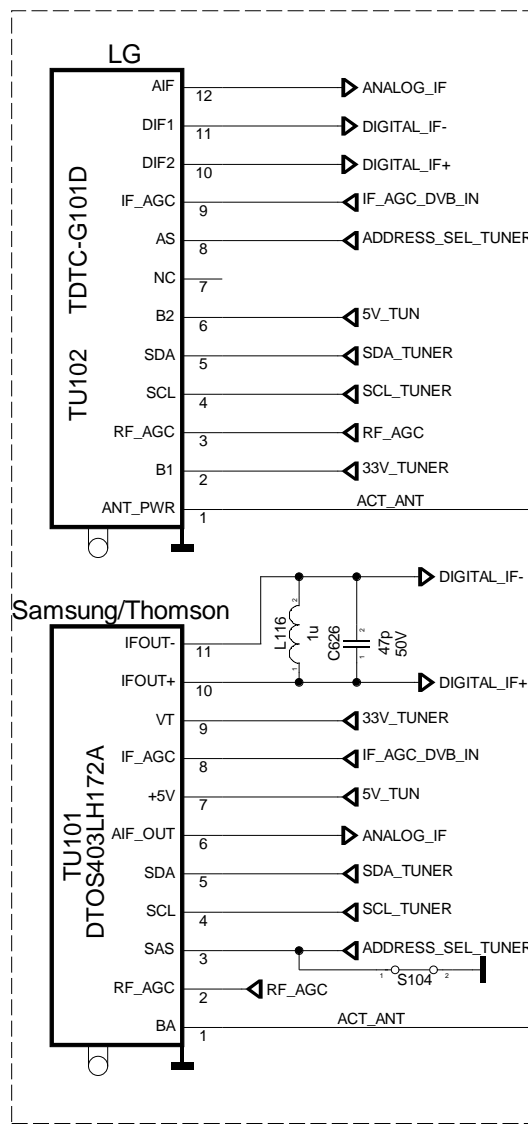


**Notes:**

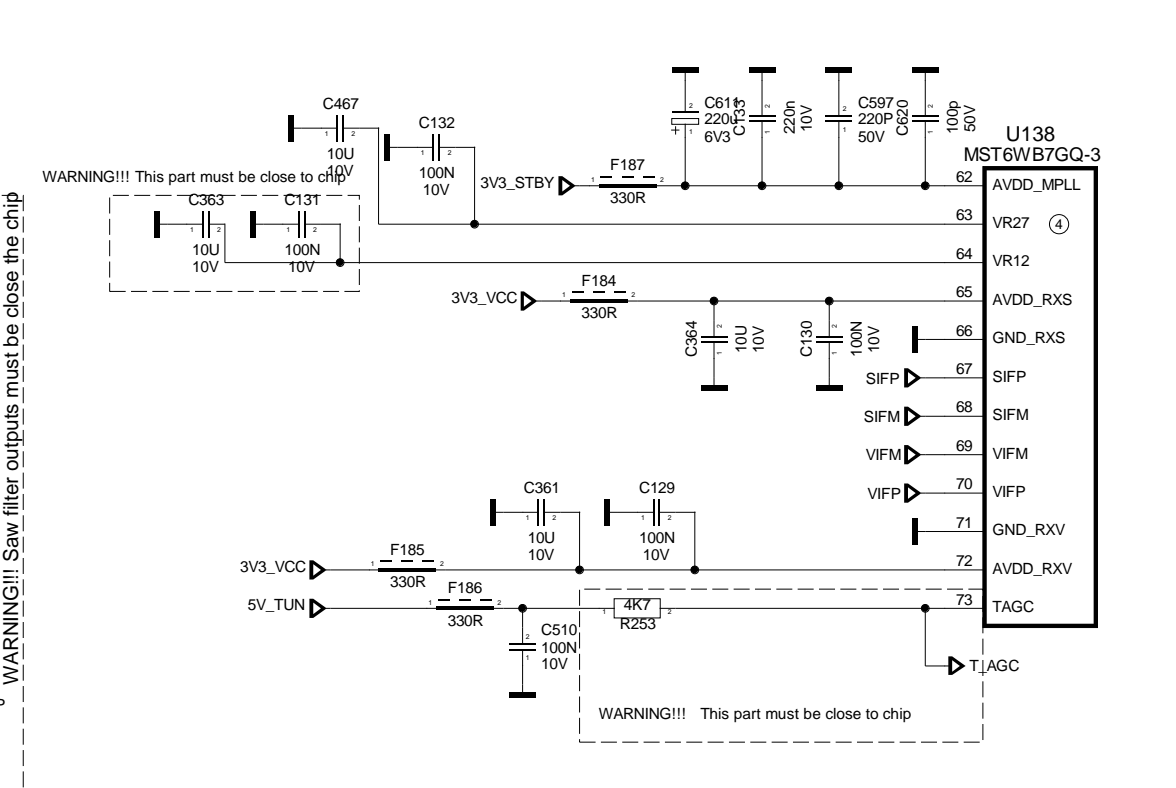
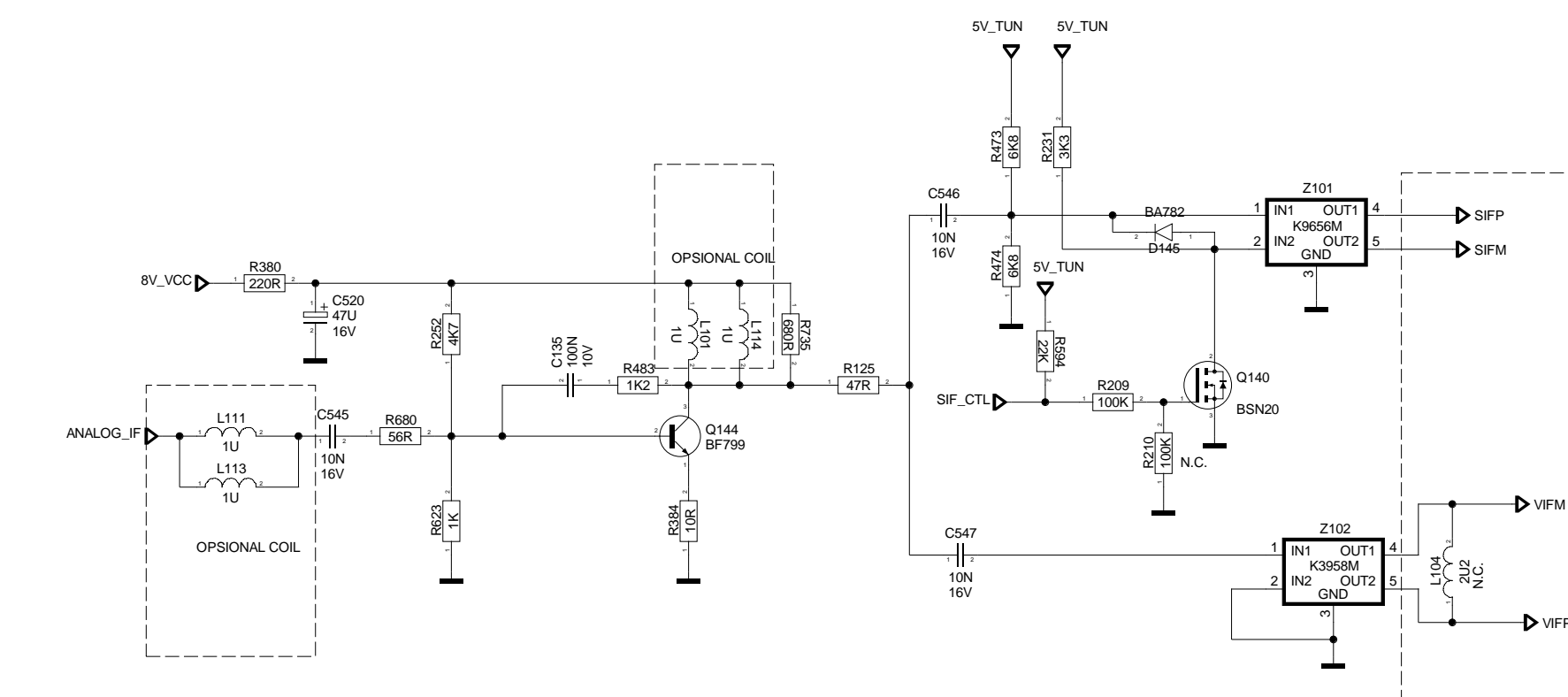
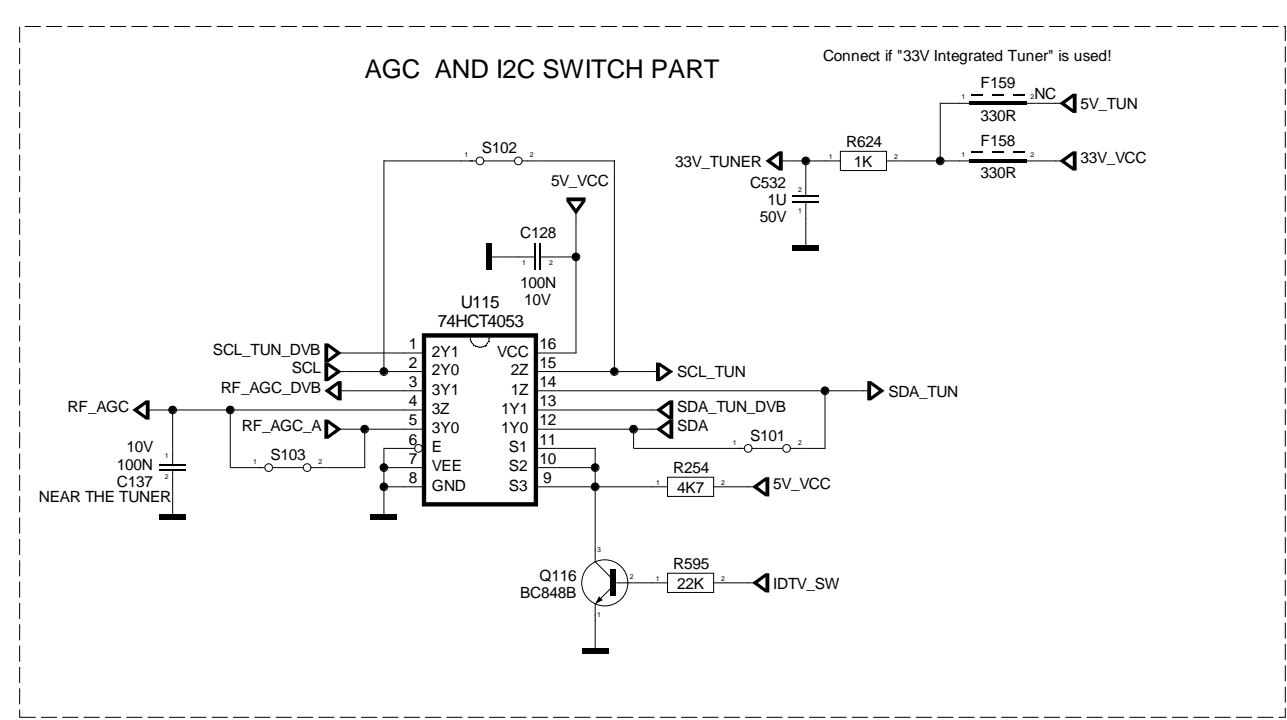
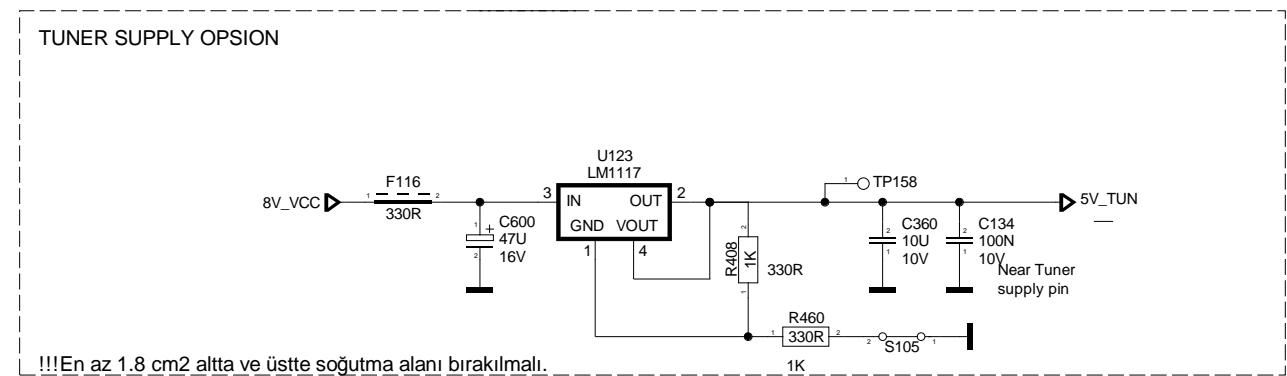
1. **APU:** Audio Processor Unit
2. **TSP:** Transport Stream Processor
3. **AIU:** Audio Interface Unit
4. **VDEC:** Video Decoder
5. **GPU:** Graphics Processing Unit
6. **EBI:** Extended Bus Interface

## 18.4. MSTAR Block Diagram





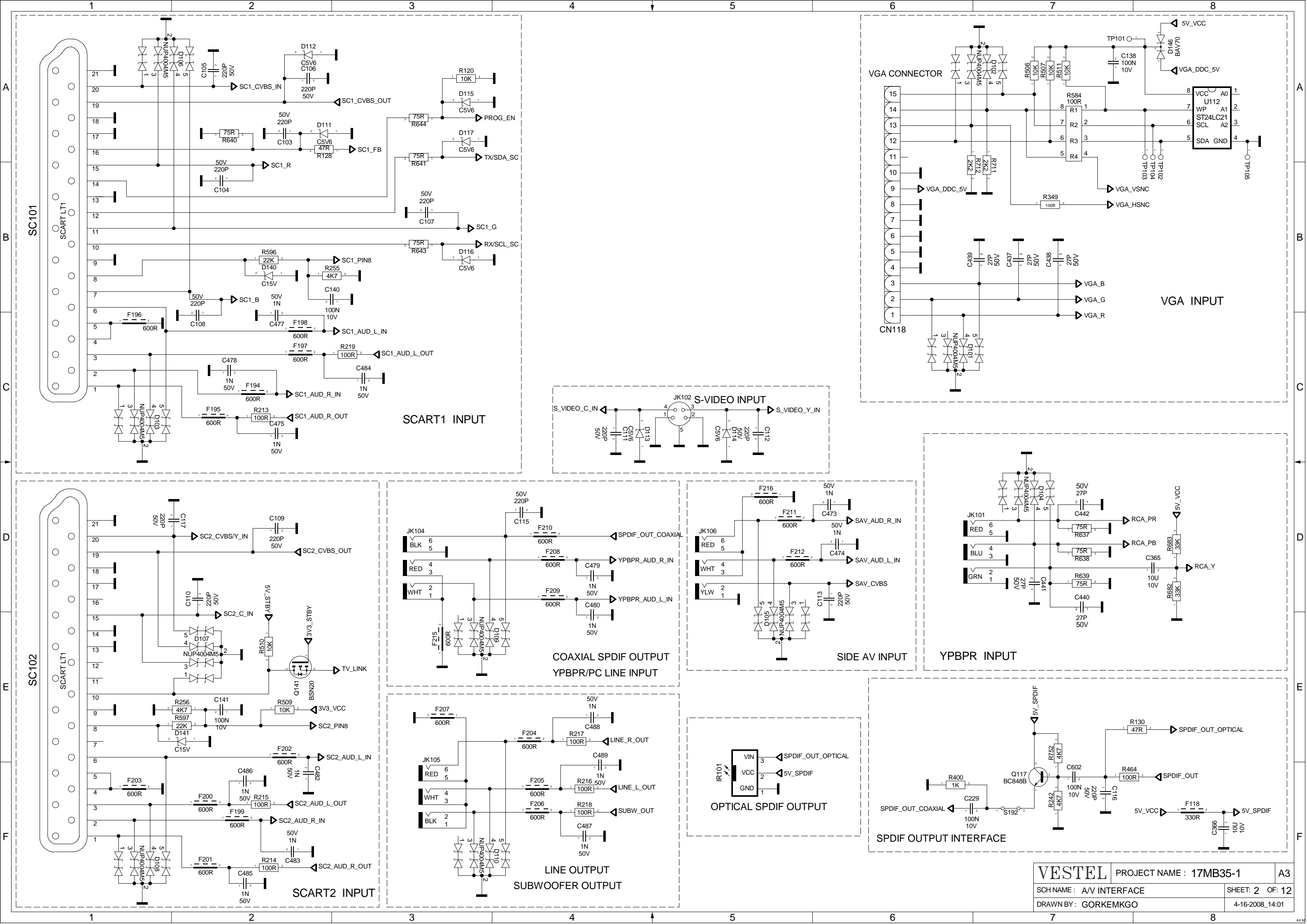
This part must be placed near the tuner



WARNING!!! Saw filter outputs must be close the chip

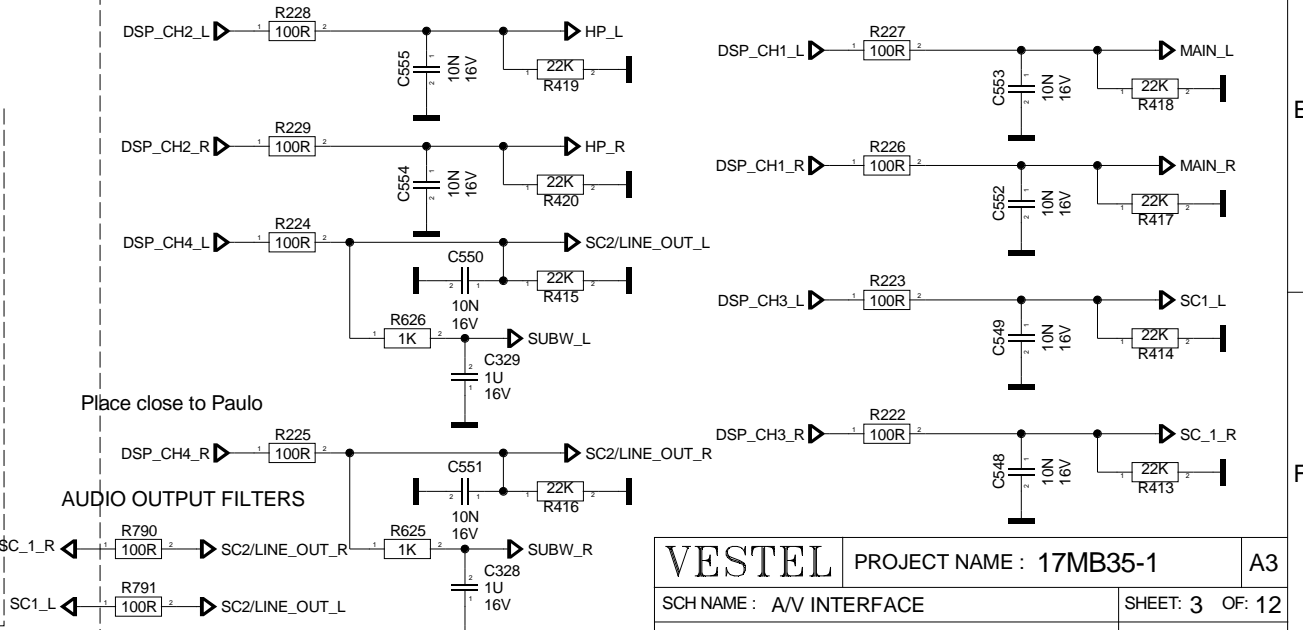
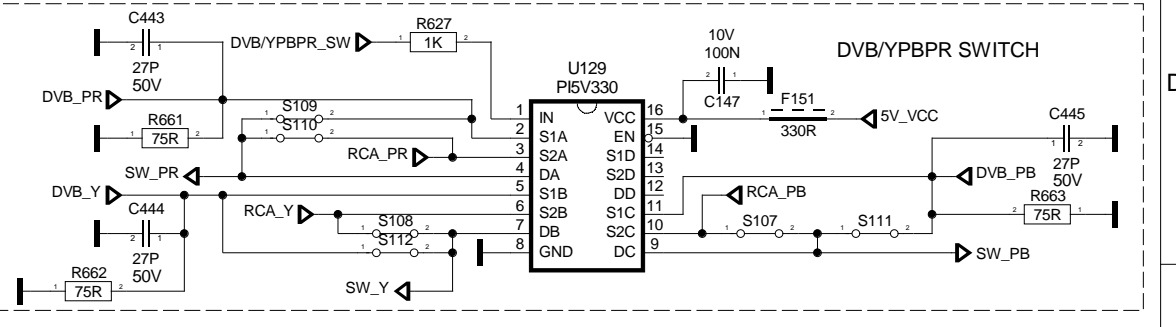
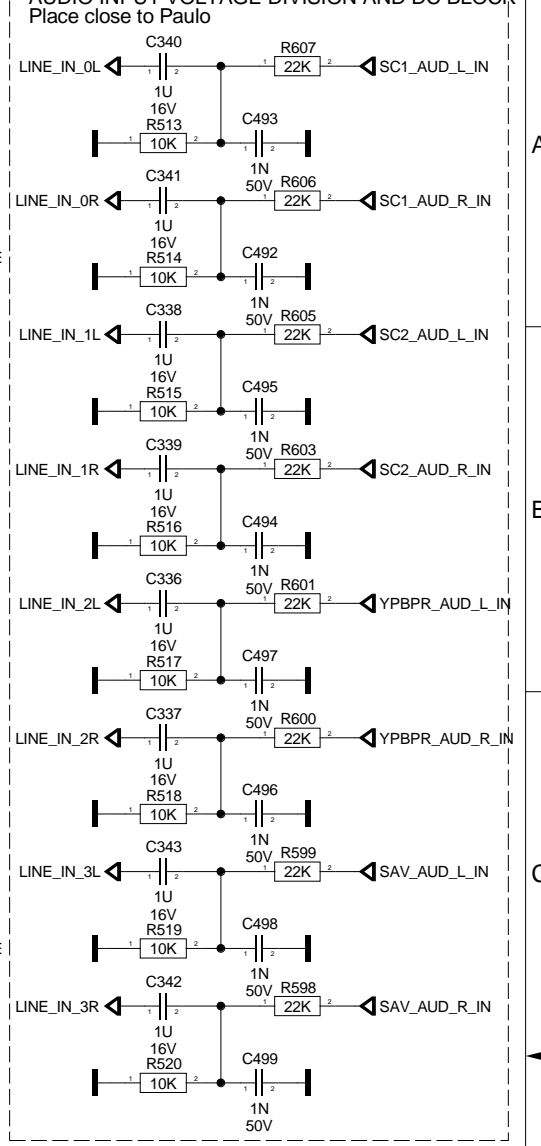
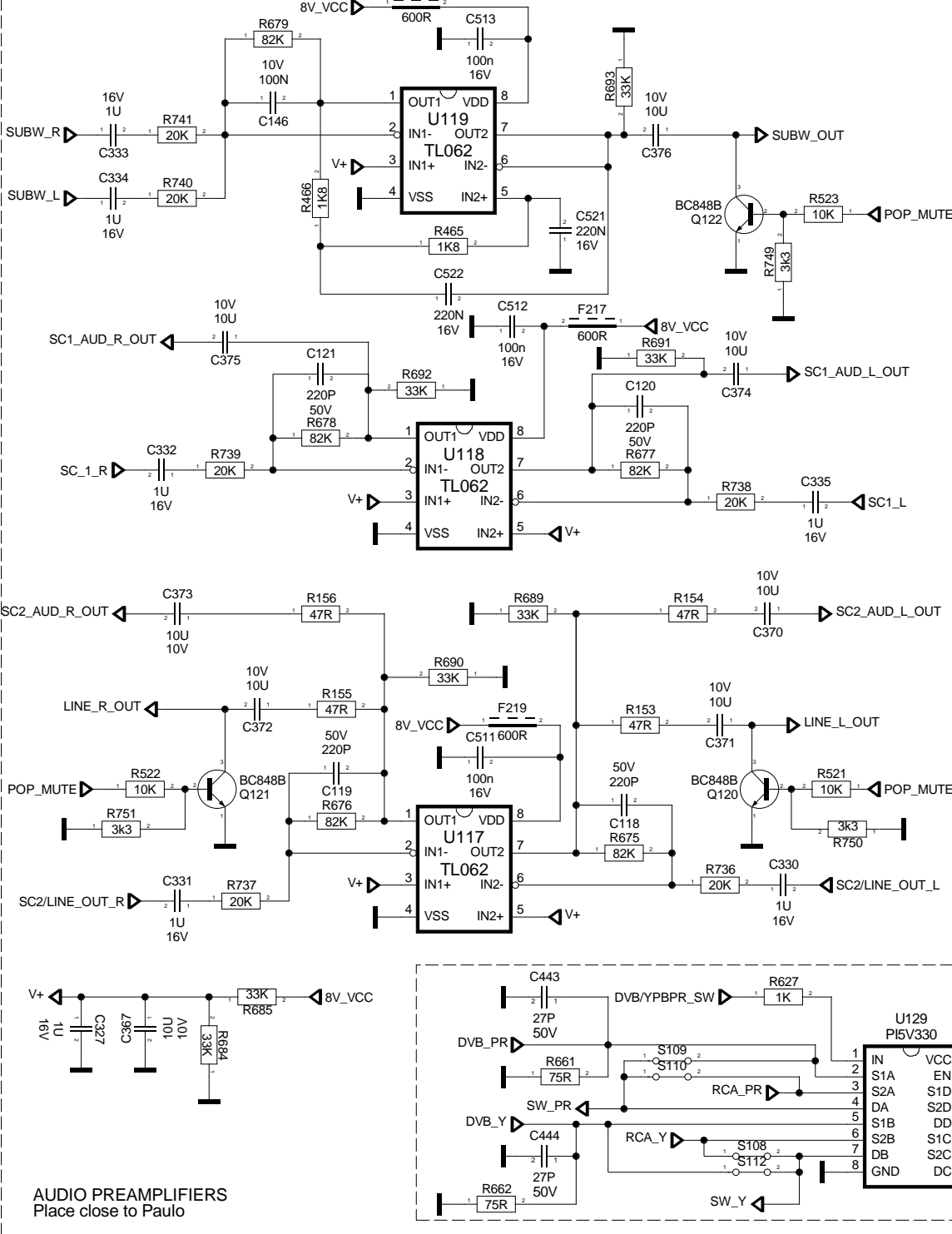
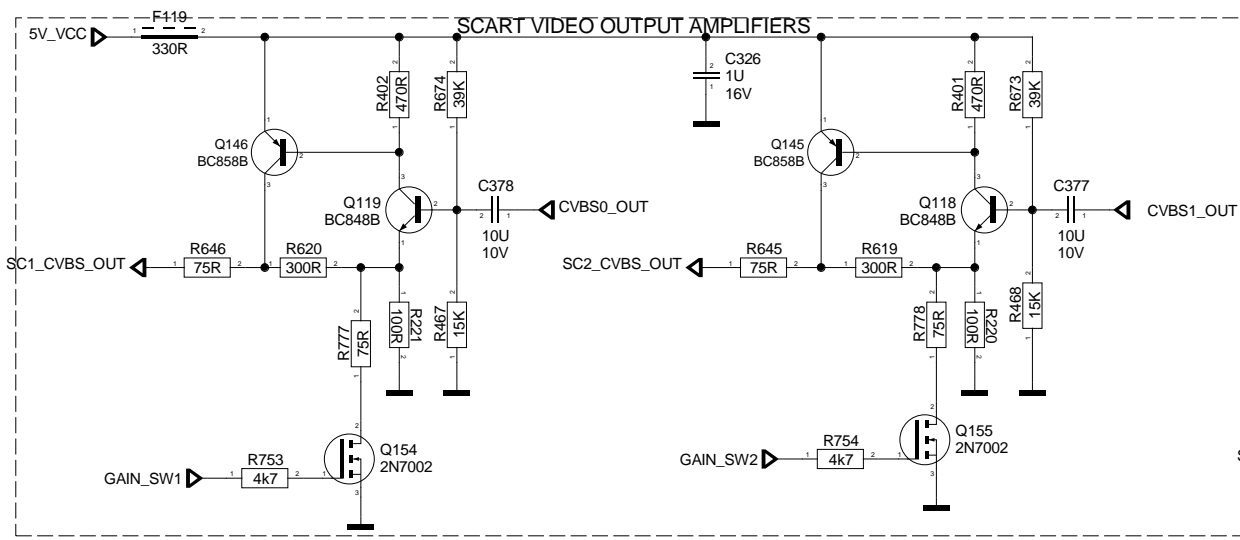
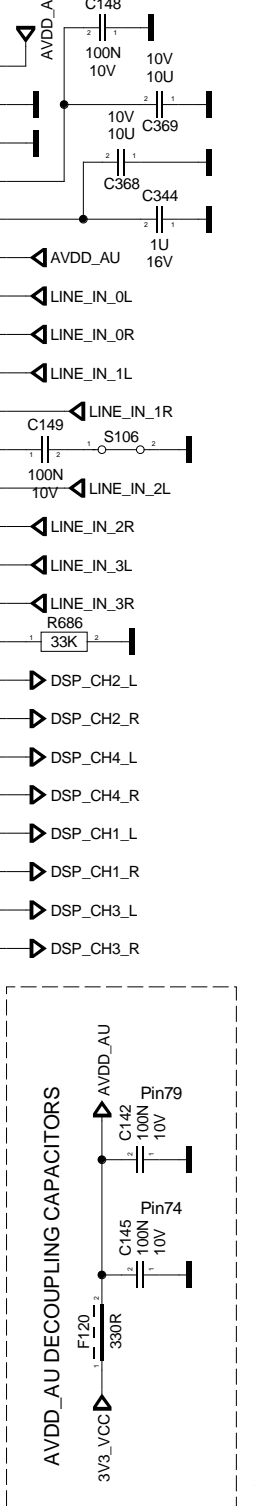
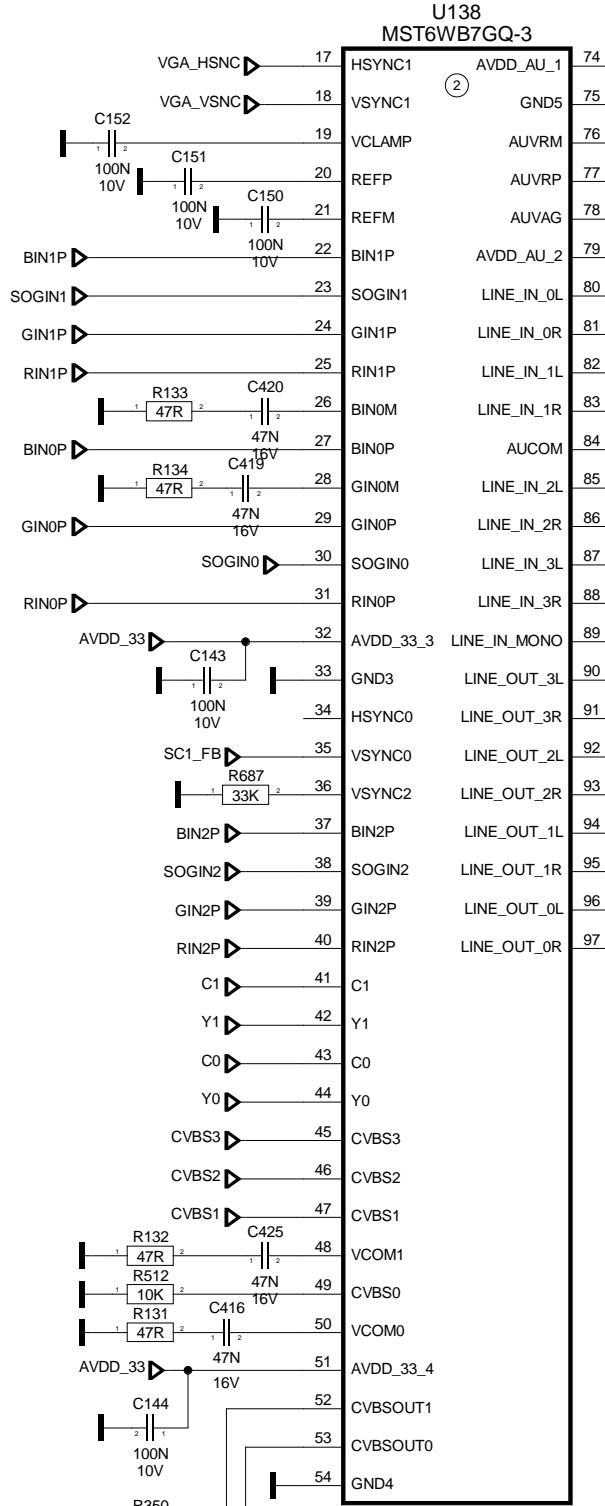
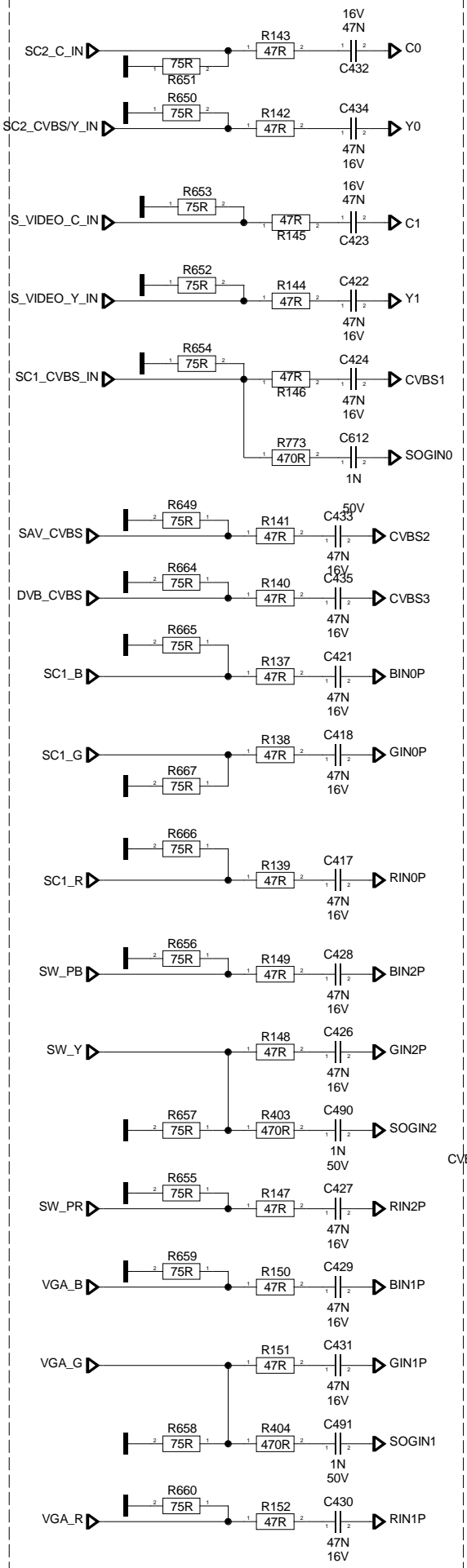
WARNING!!! This part must be close to chip

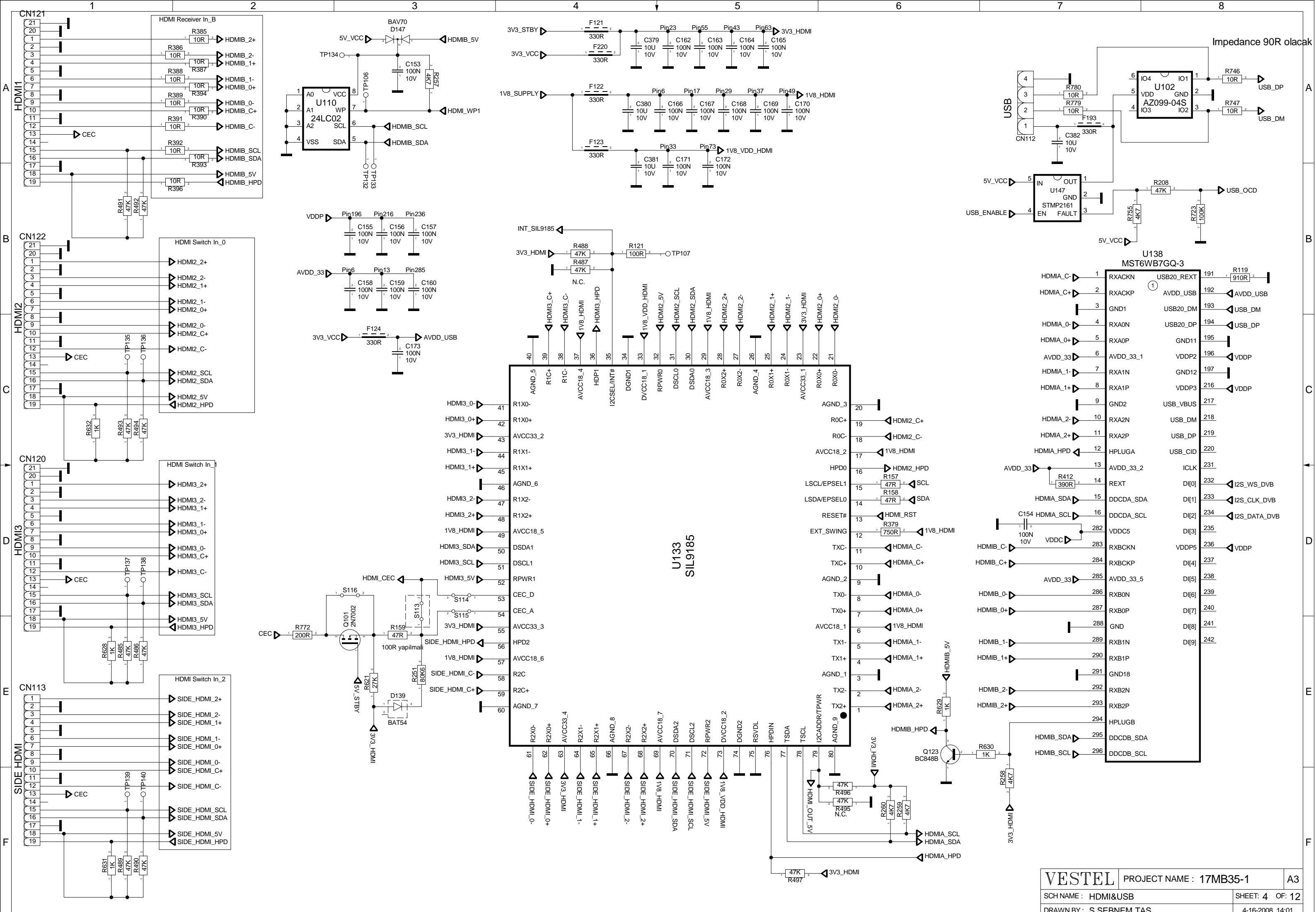
V-1 e gecerken yapılan updateleler  
Video SAW filtre cikislari caprazlandi

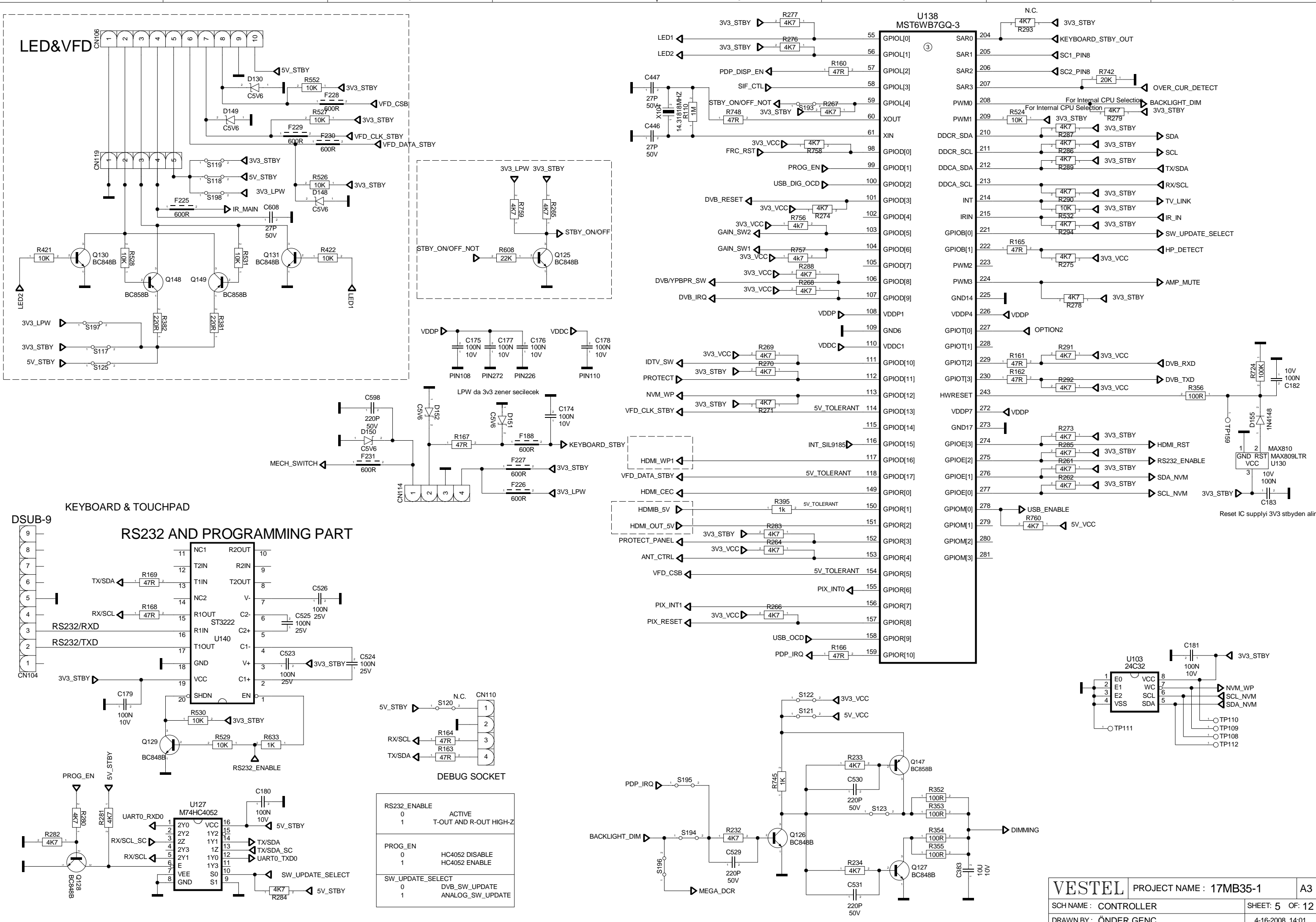




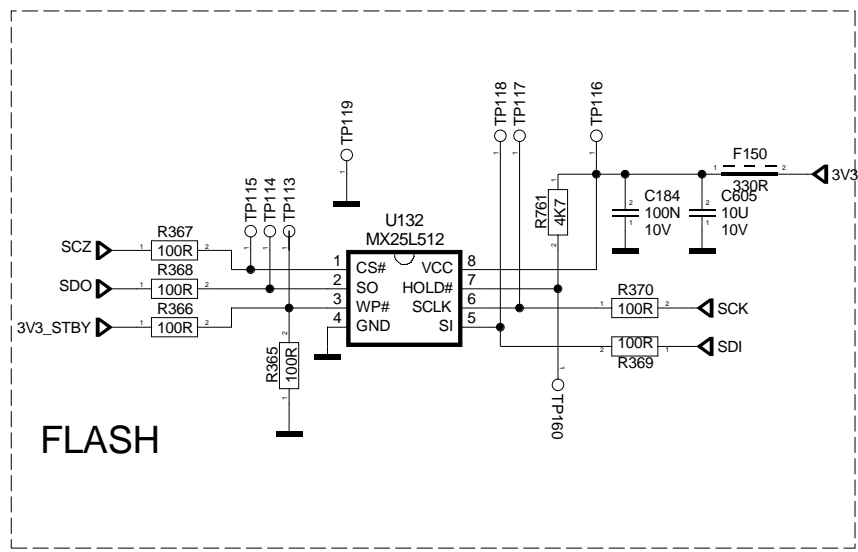
**VIDEO TERMINATIONS AND DIFFERENTIAL TRACING**  
Place 75R termination resistors close to Paulo reference GNDs



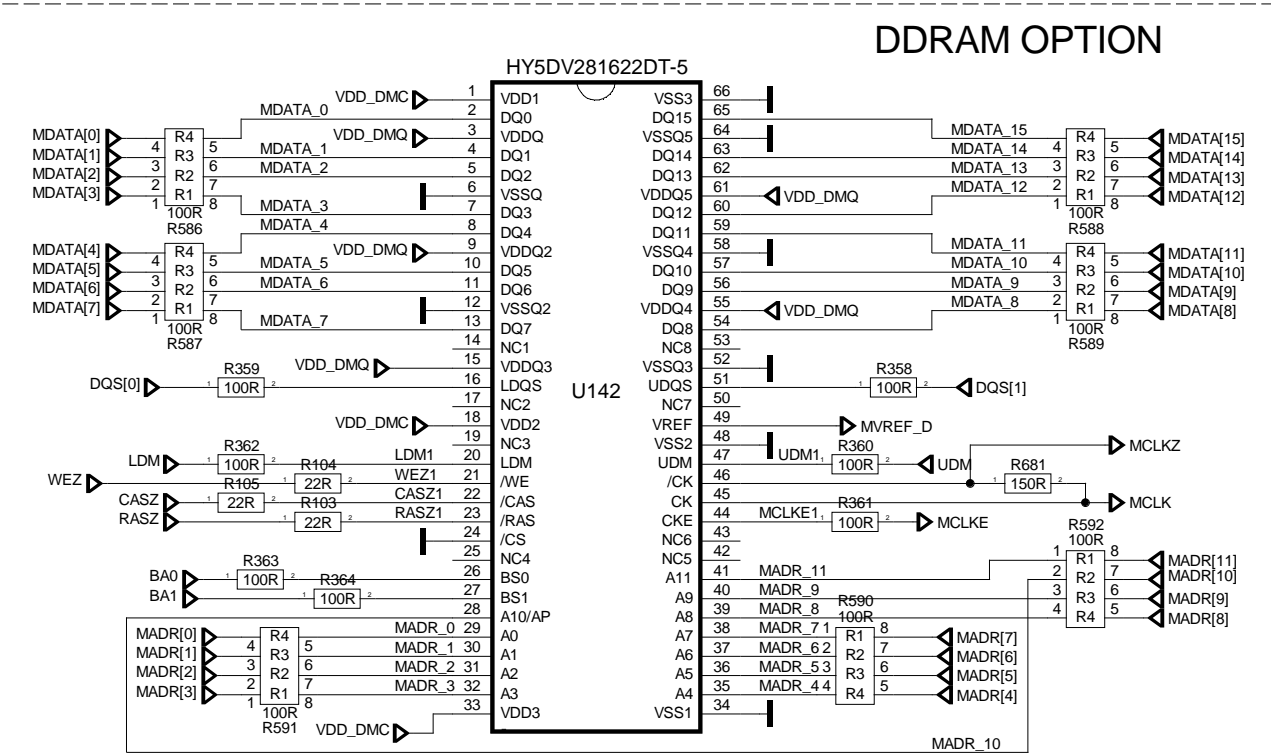
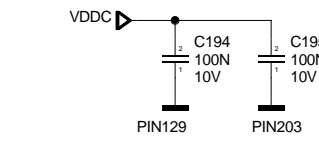
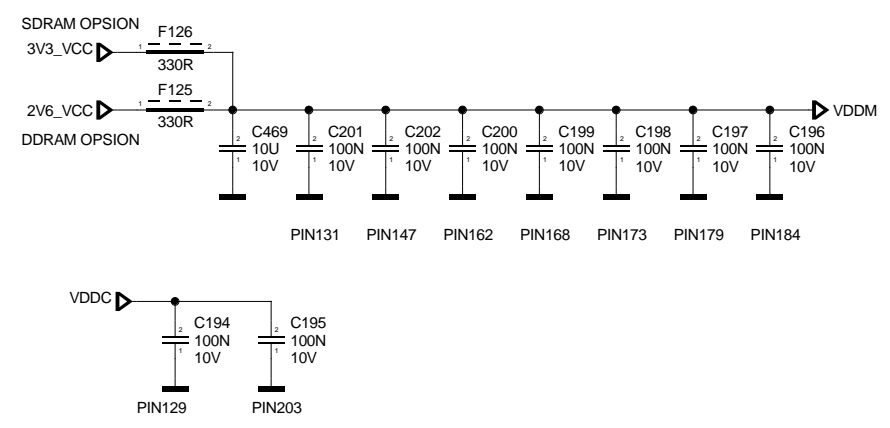




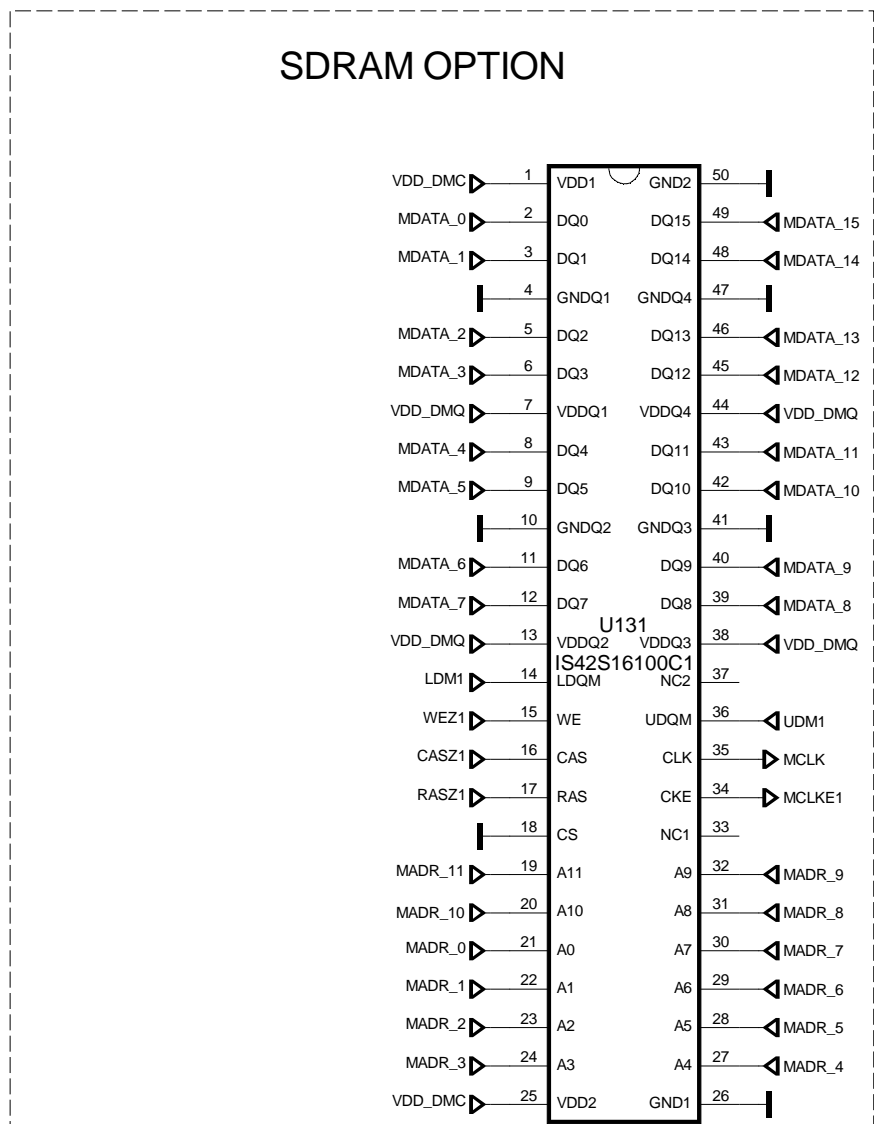
RS232_ENABLE	0	ACTIVE
RS232_ENABLE	1	T-OUT AND R-OUT HIGH-Z
PROG_EN	0	HC4052 DISABLE
PROG_EN	1	HC4052 ENABLE
SW_UPDATE_SELECT	0	DVB_SW_UPDATE
SW_UPDATE_SELECT	1	ANALOG_SW_UPDATE



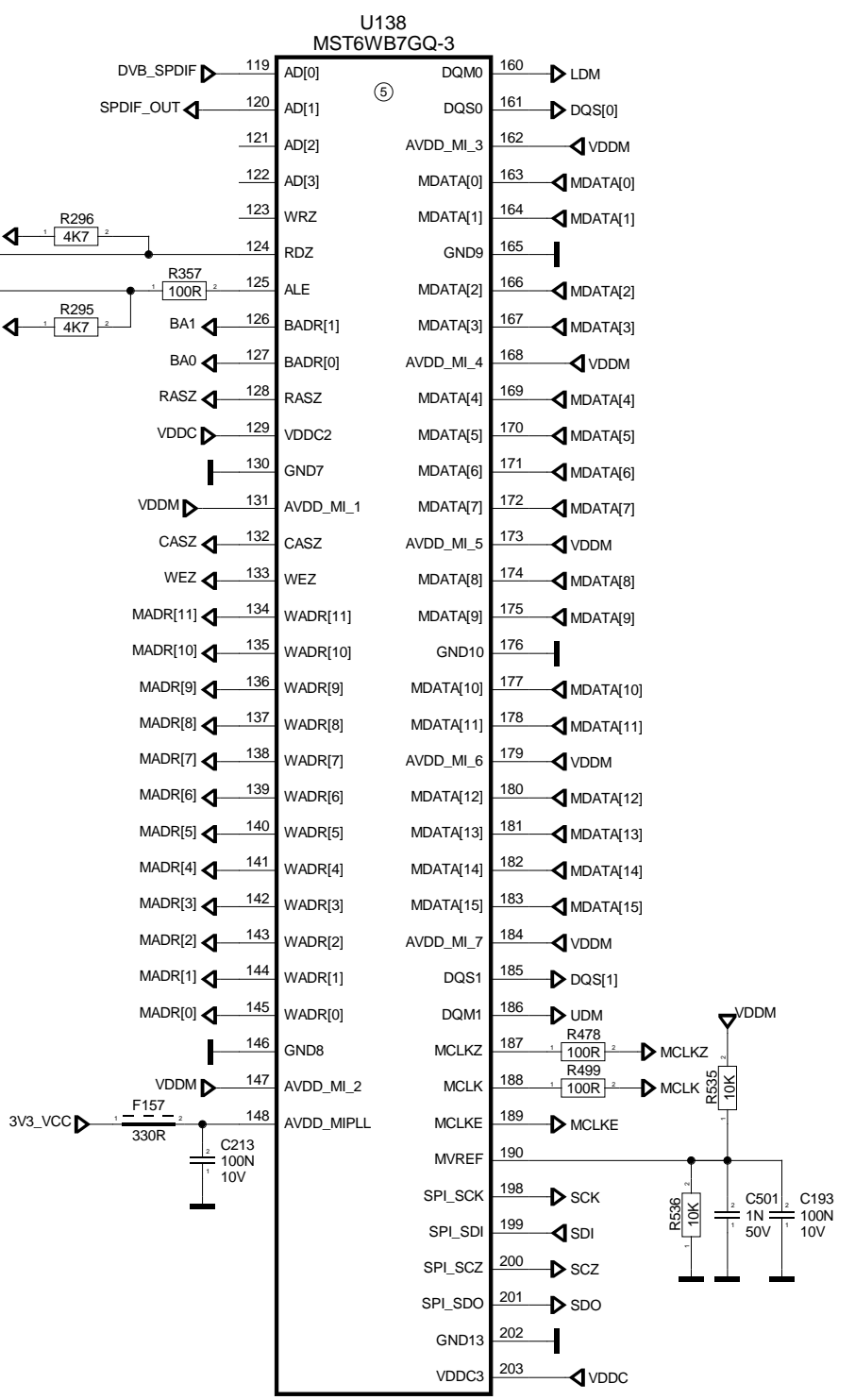
FLASH



DDRAM OPTION

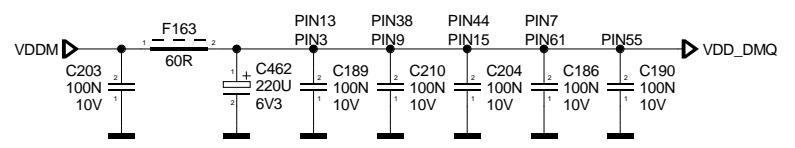
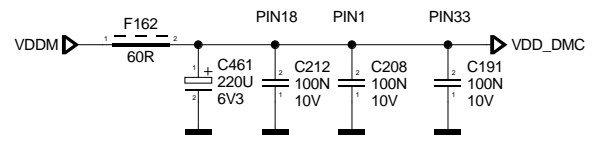
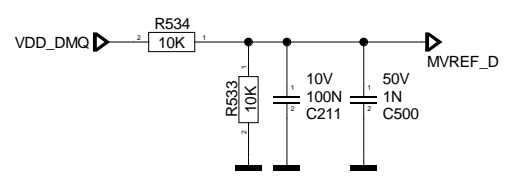


SDRAM OPTION

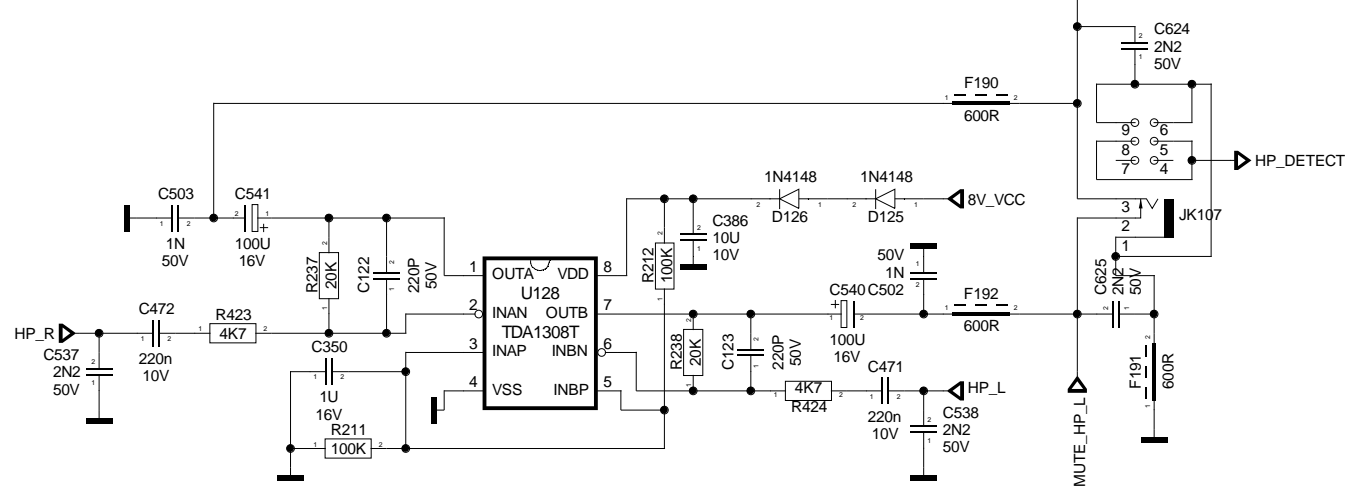


U138  
MST6WB7GQ-3

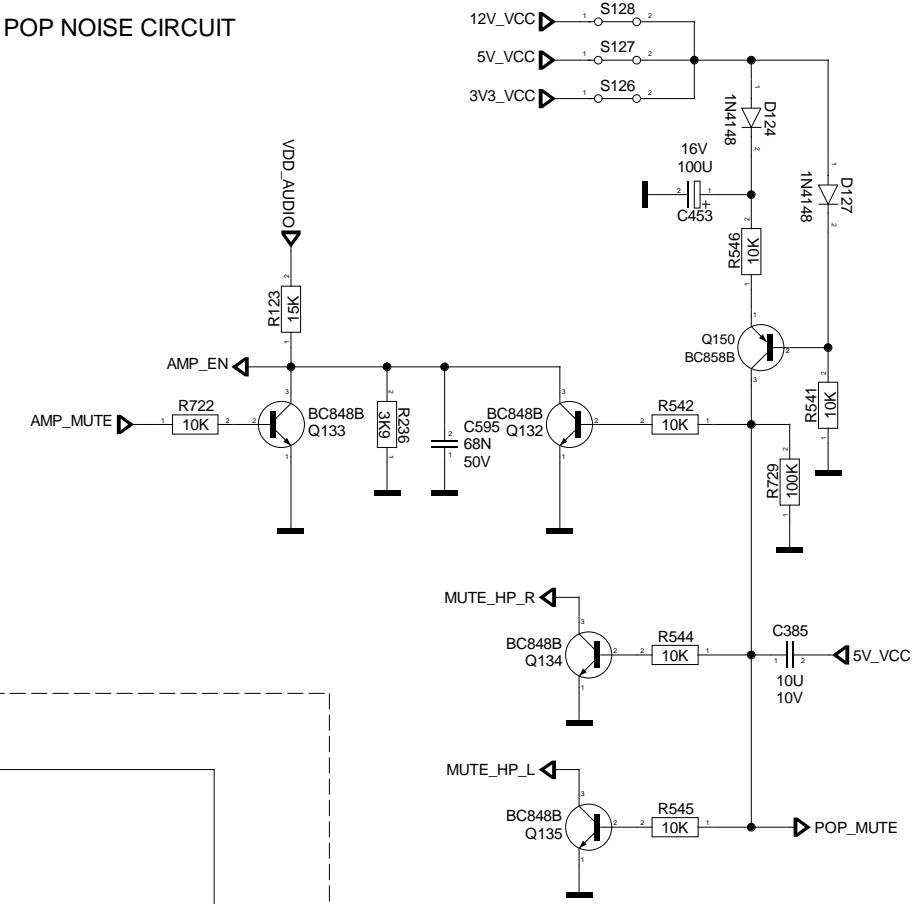
WARNING!!!DON'T USE VIA FOR DQS,MCLK,MCLKZ AND DATA SIGNALS



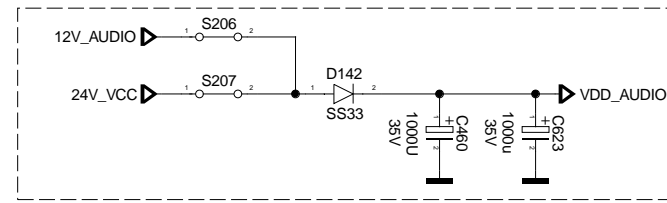
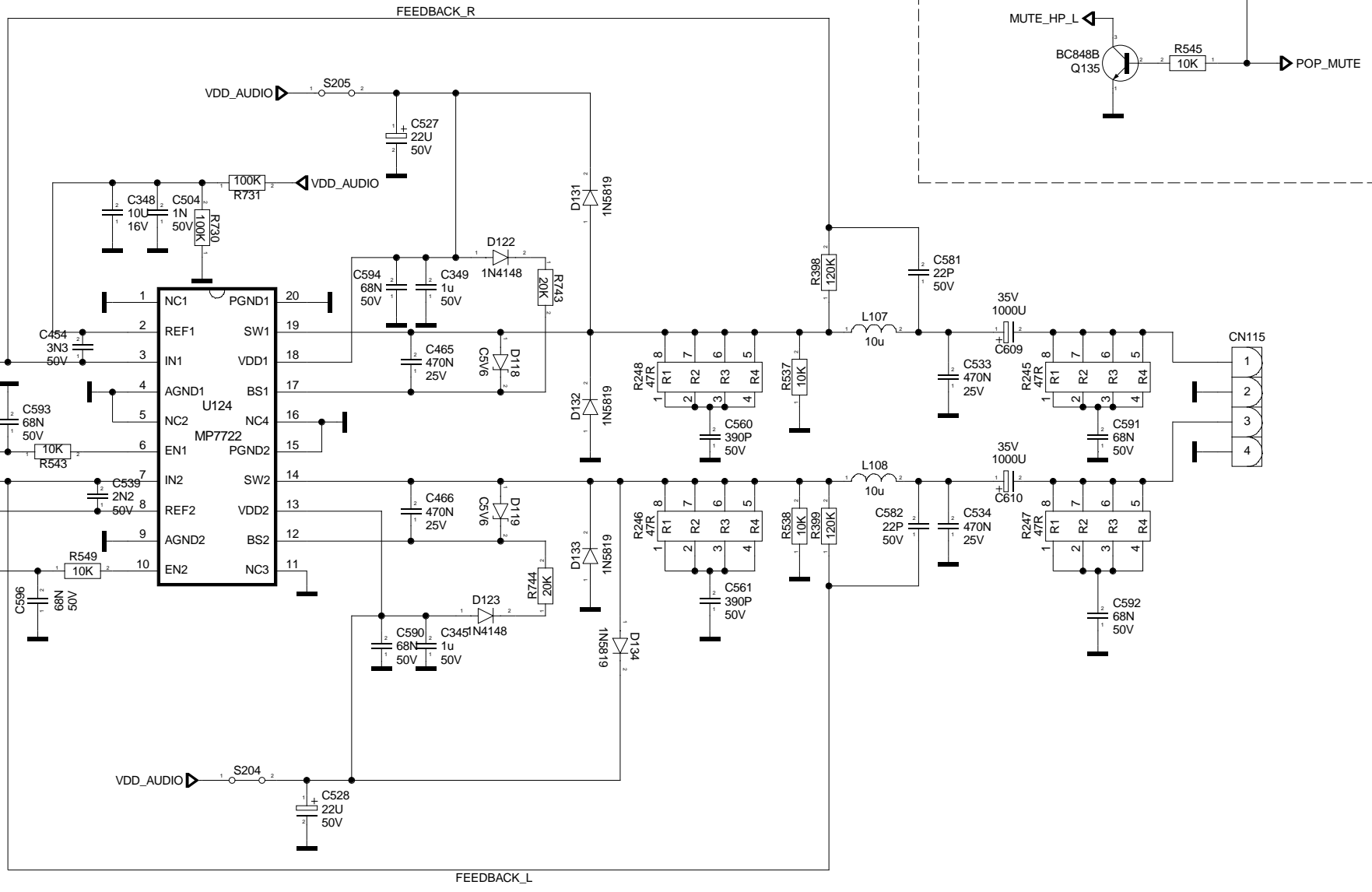
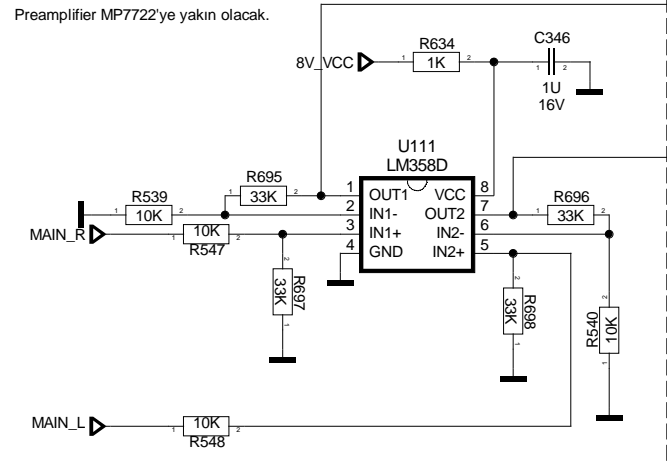
HEADPHONE AMPLIFIER



POP NOISE CIRCUIT

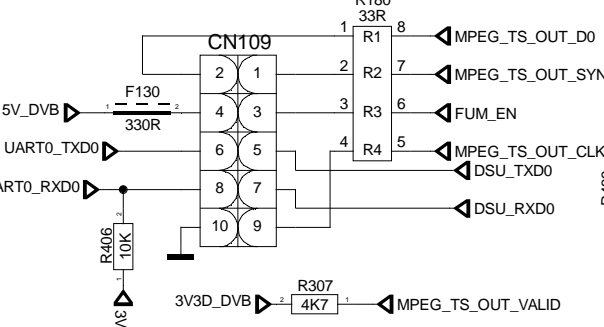


PREAMPLIFIER

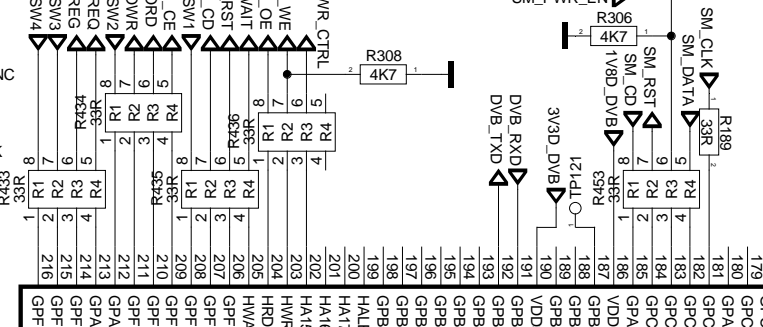




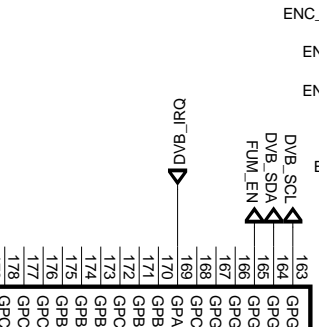
### FUM Interface



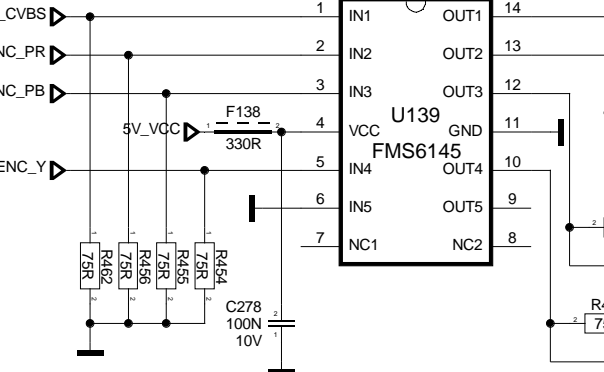
### CI CONTROL SIGNALS



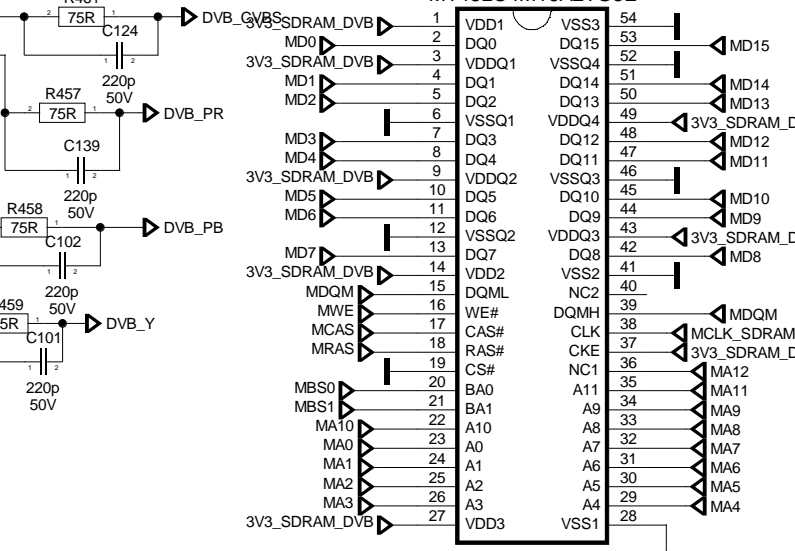
### SMART CARD INTERFACE



### DVB VIDEO FILTER&AMP



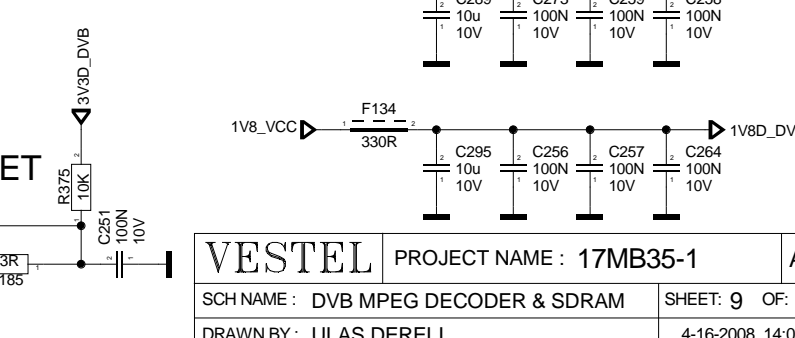
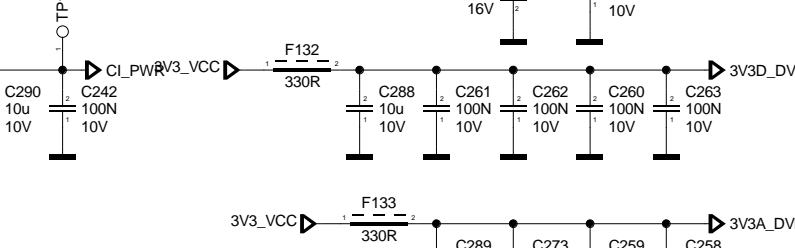
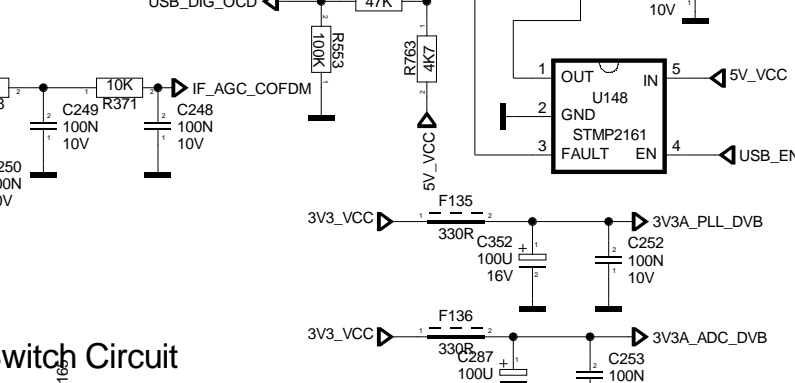
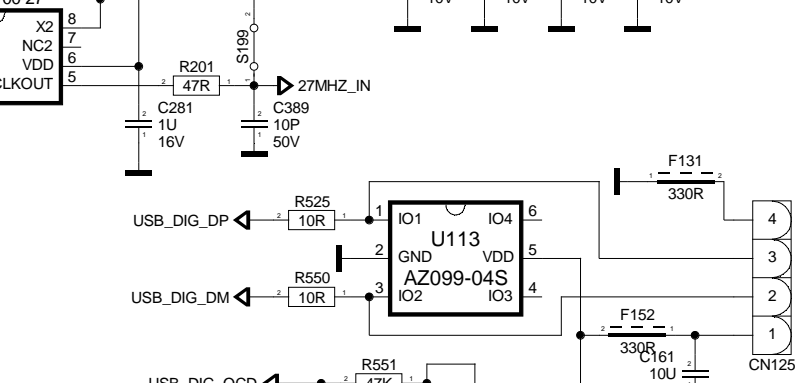
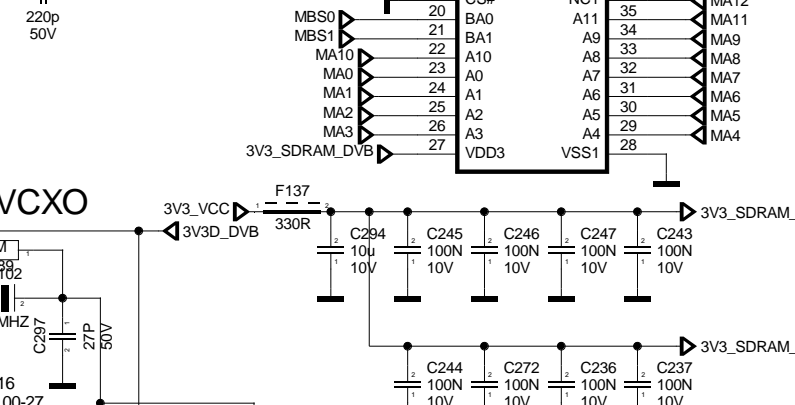
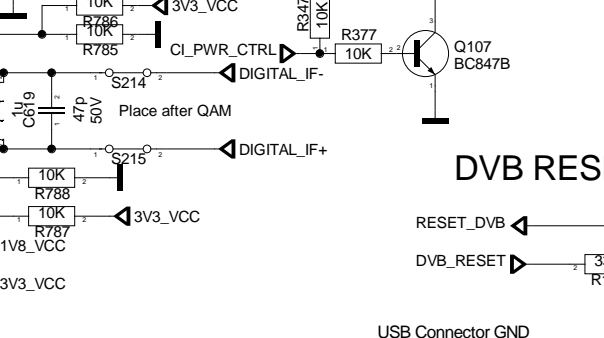
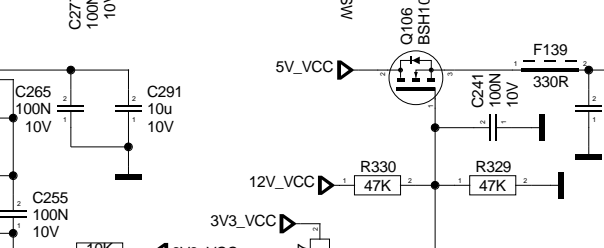
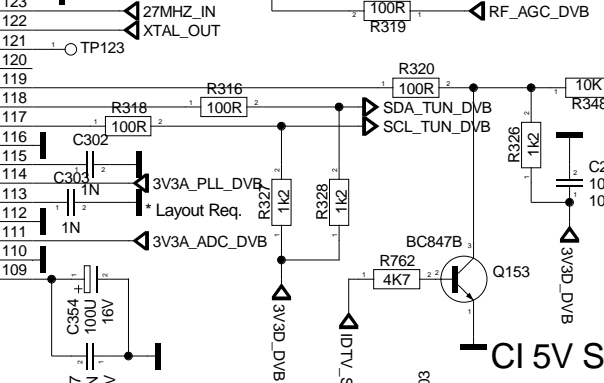
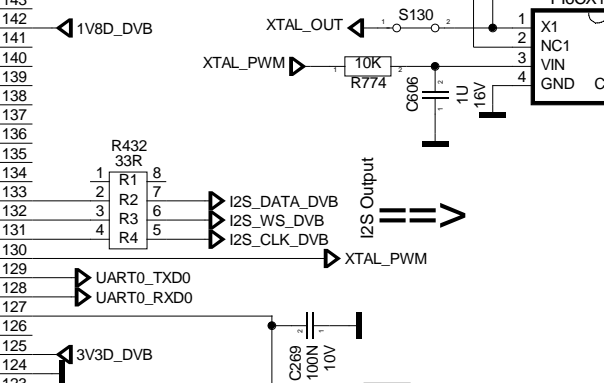
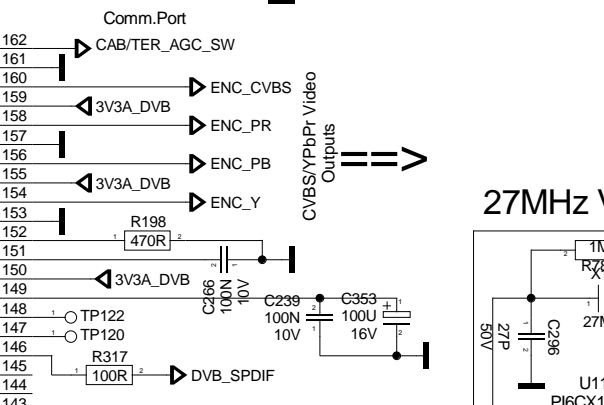
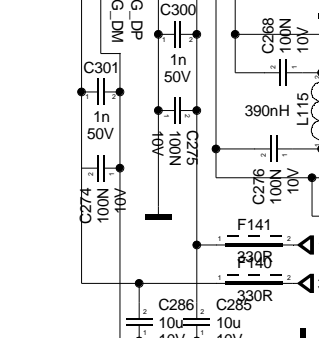
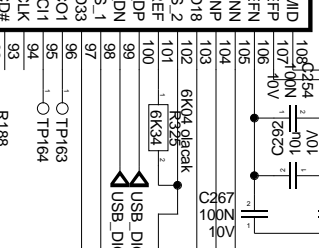
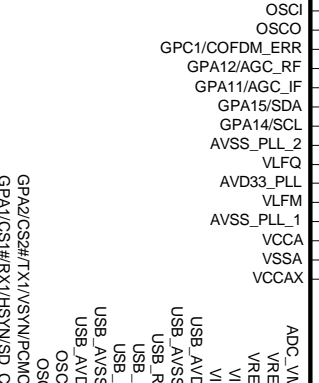
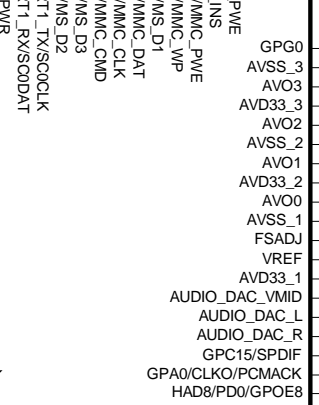
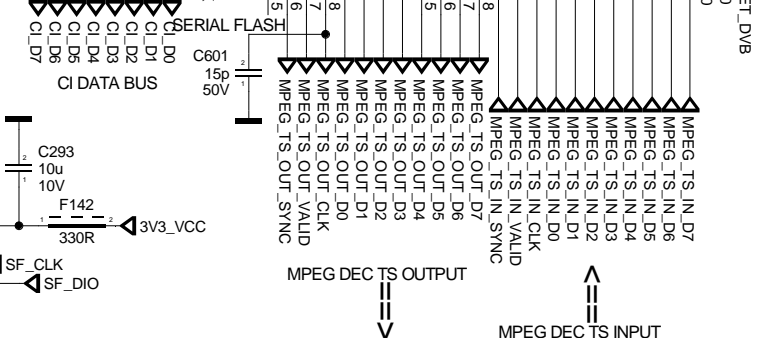
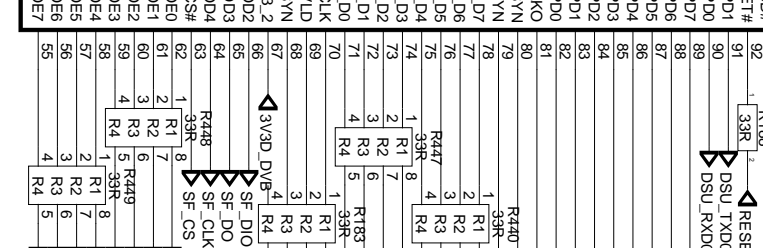
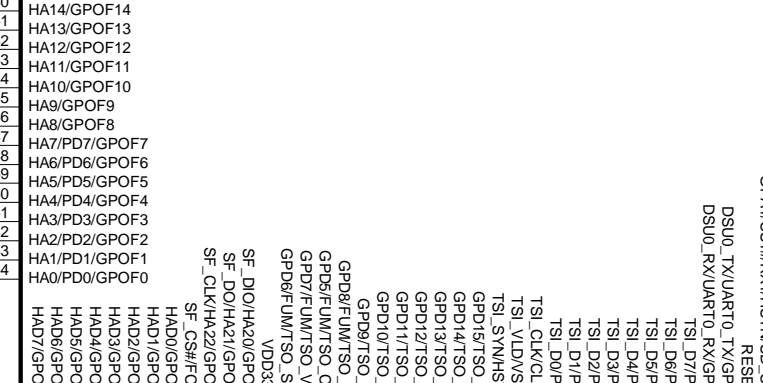
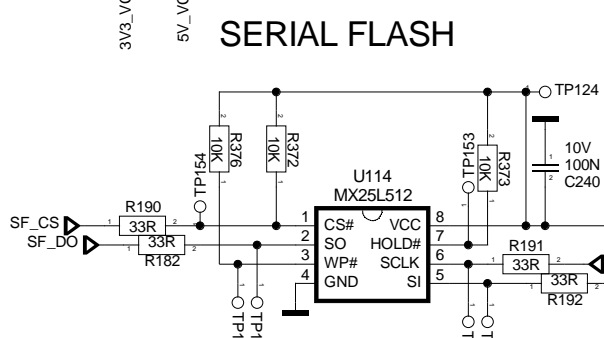
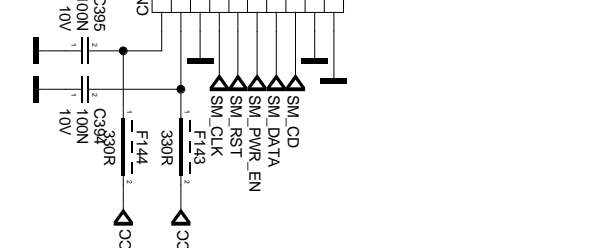
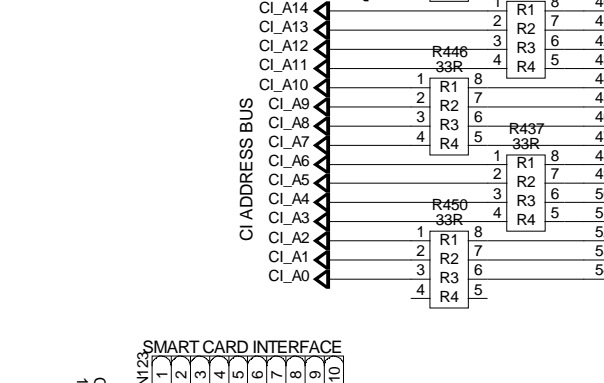
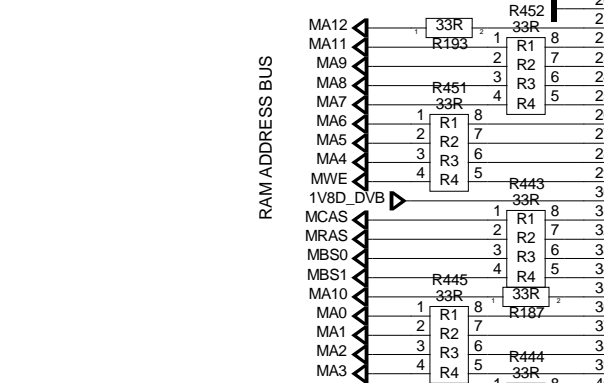
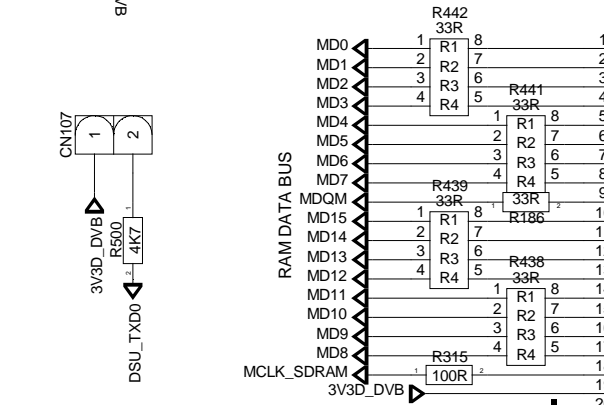
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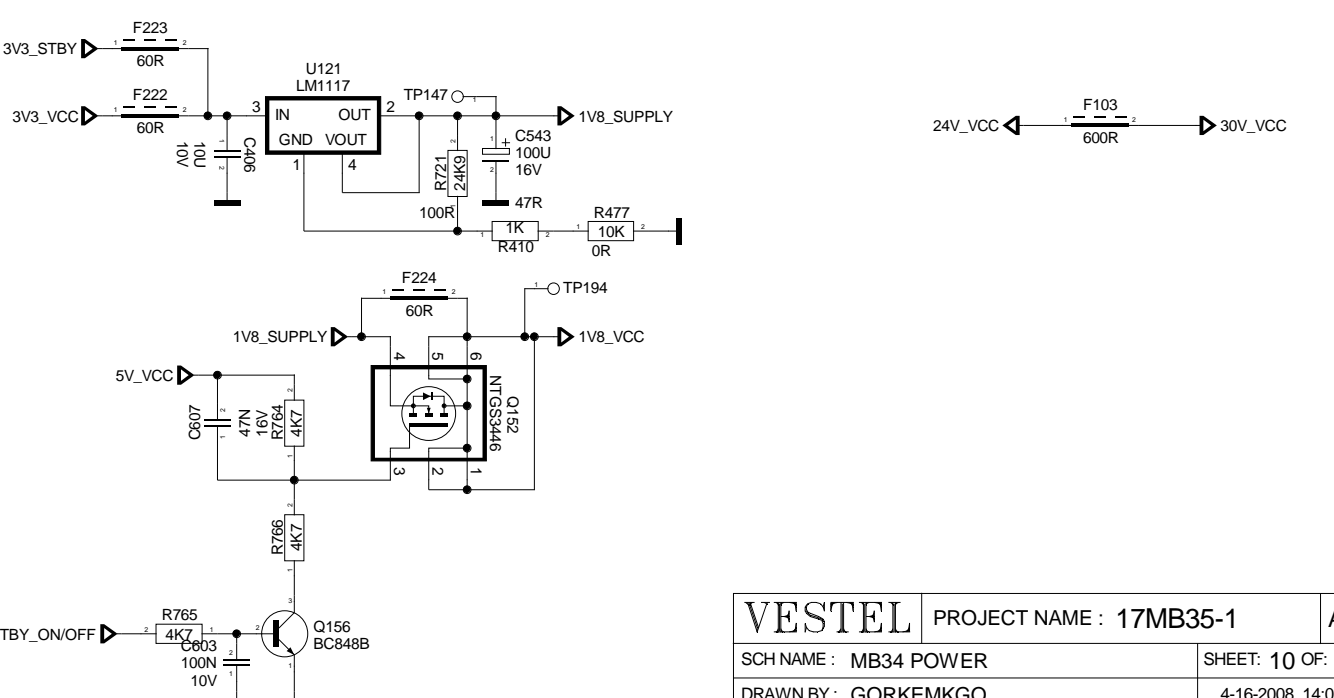
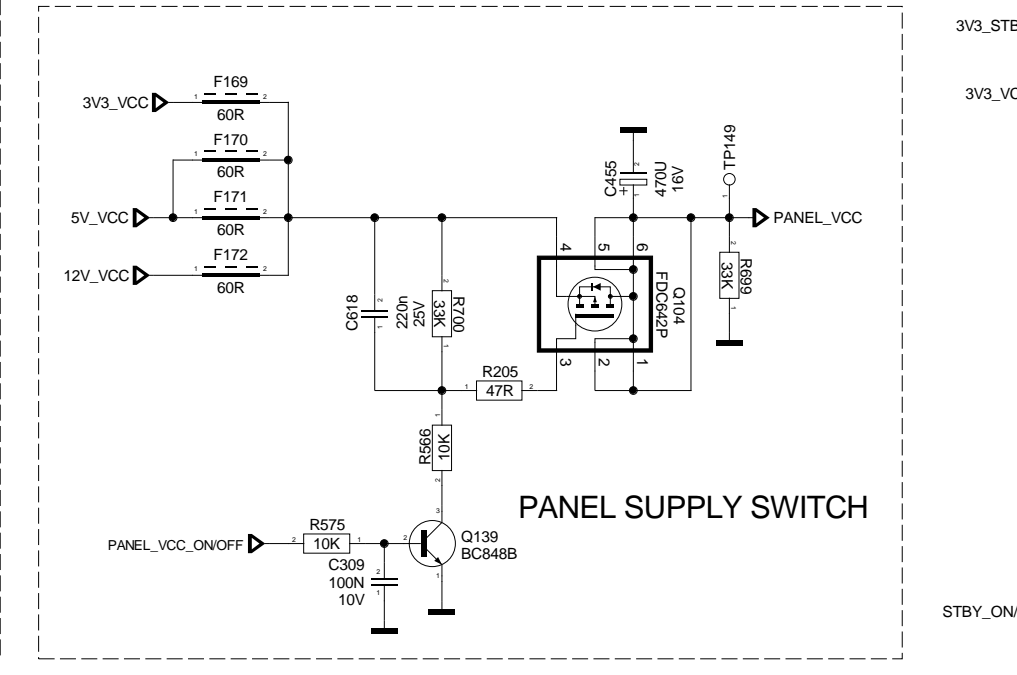
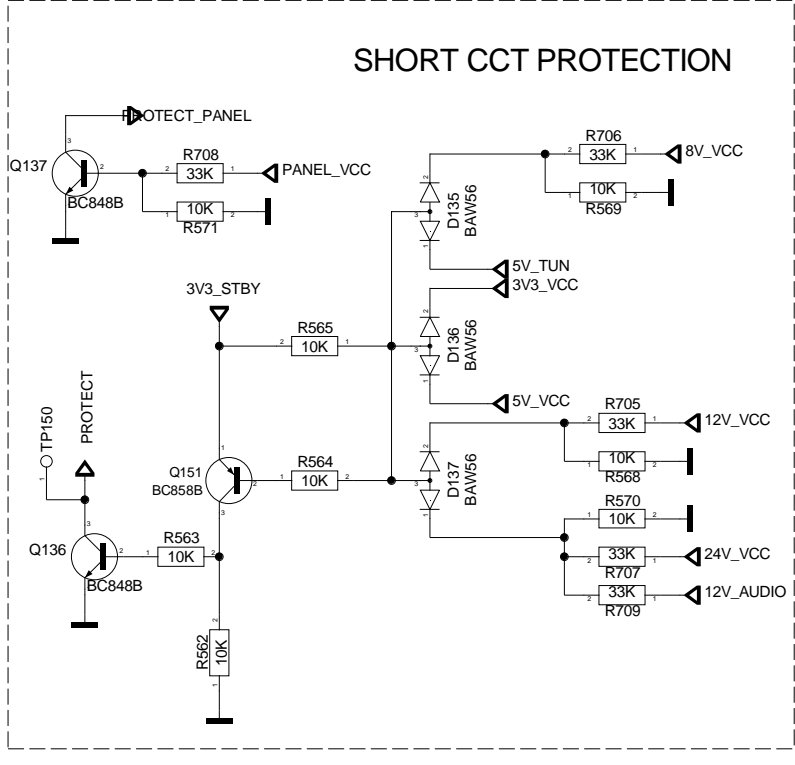
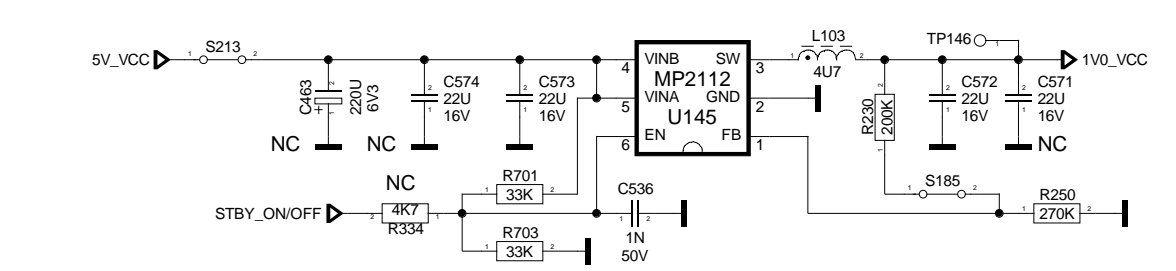
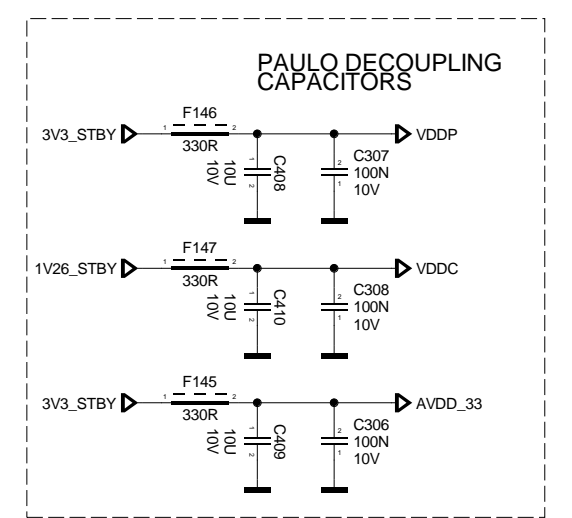
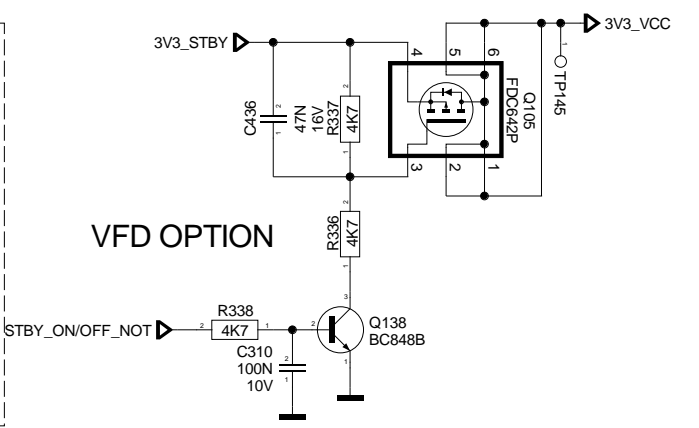
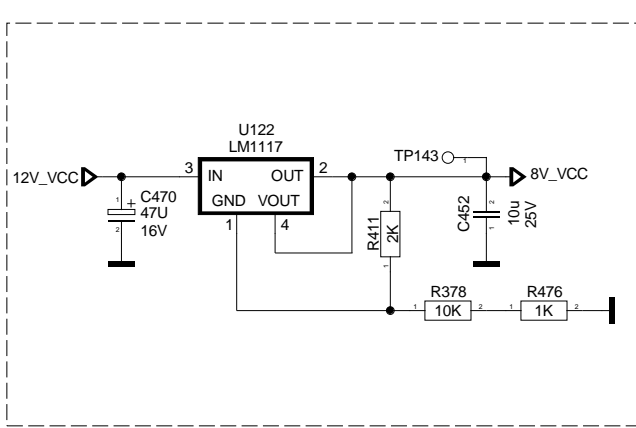
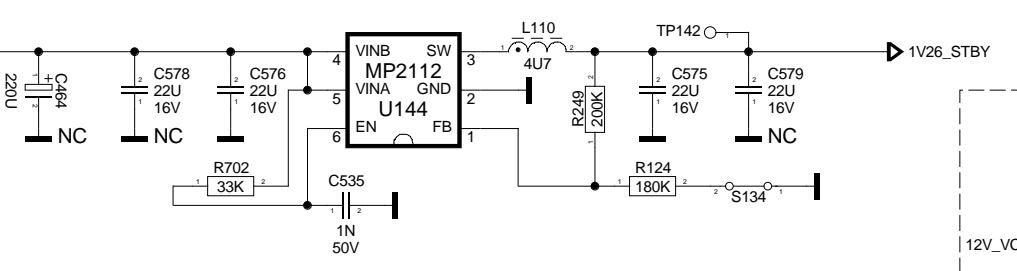
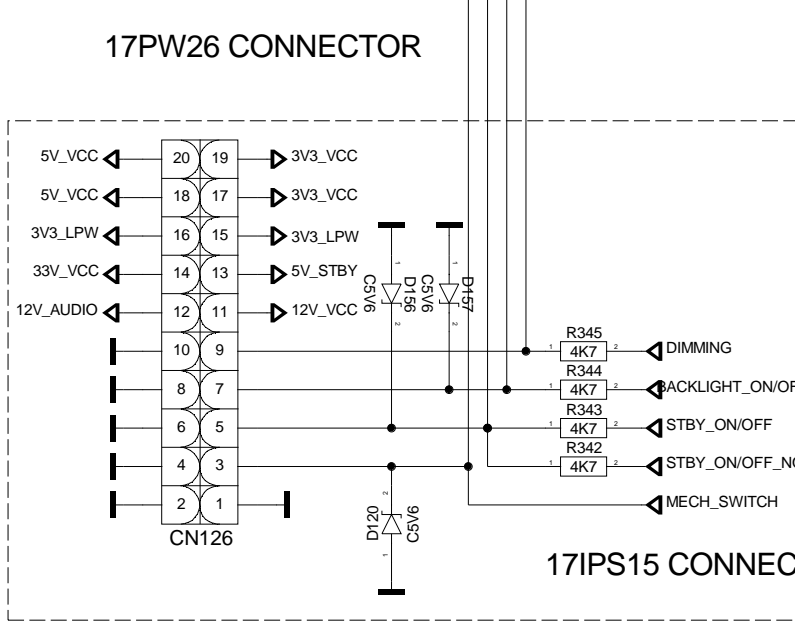
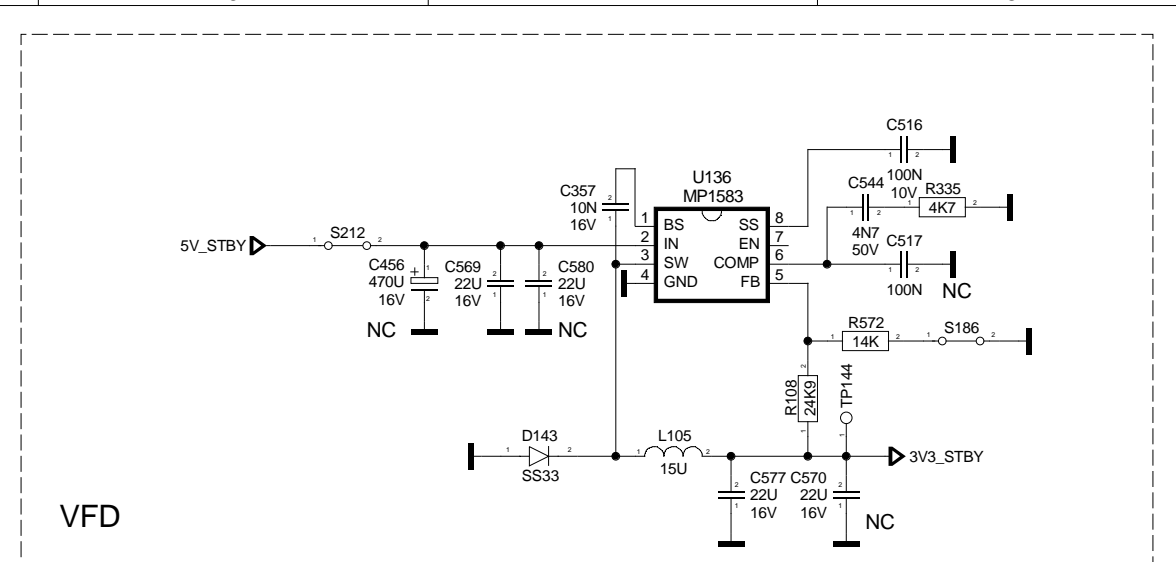
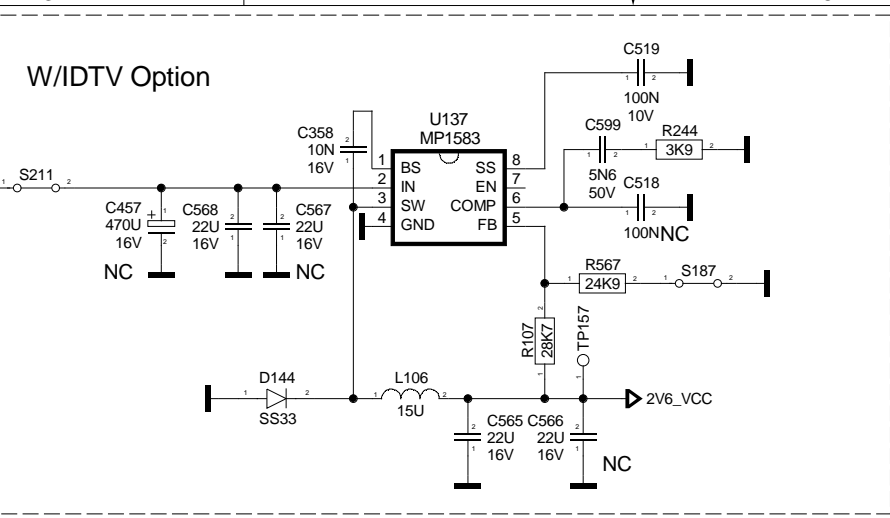
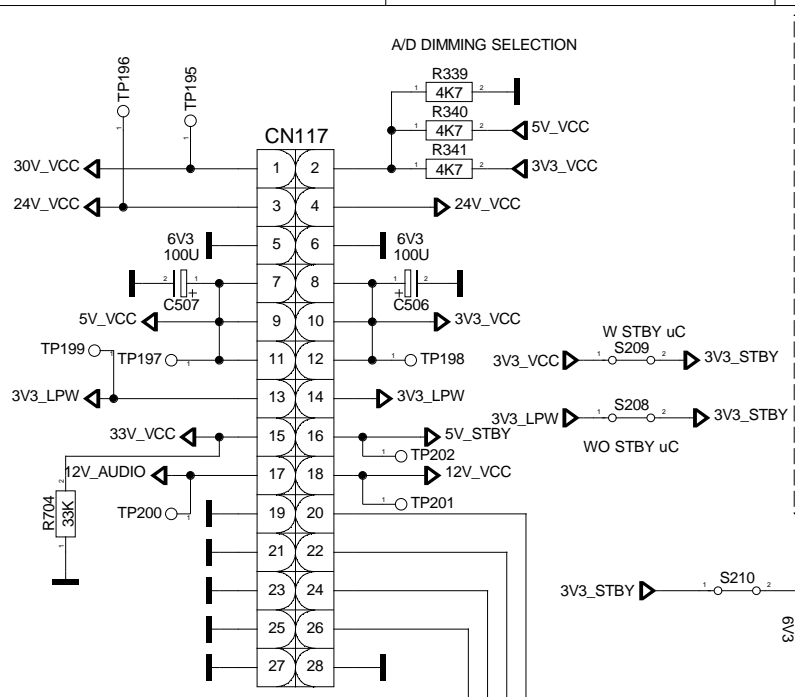


# CHEERTEK

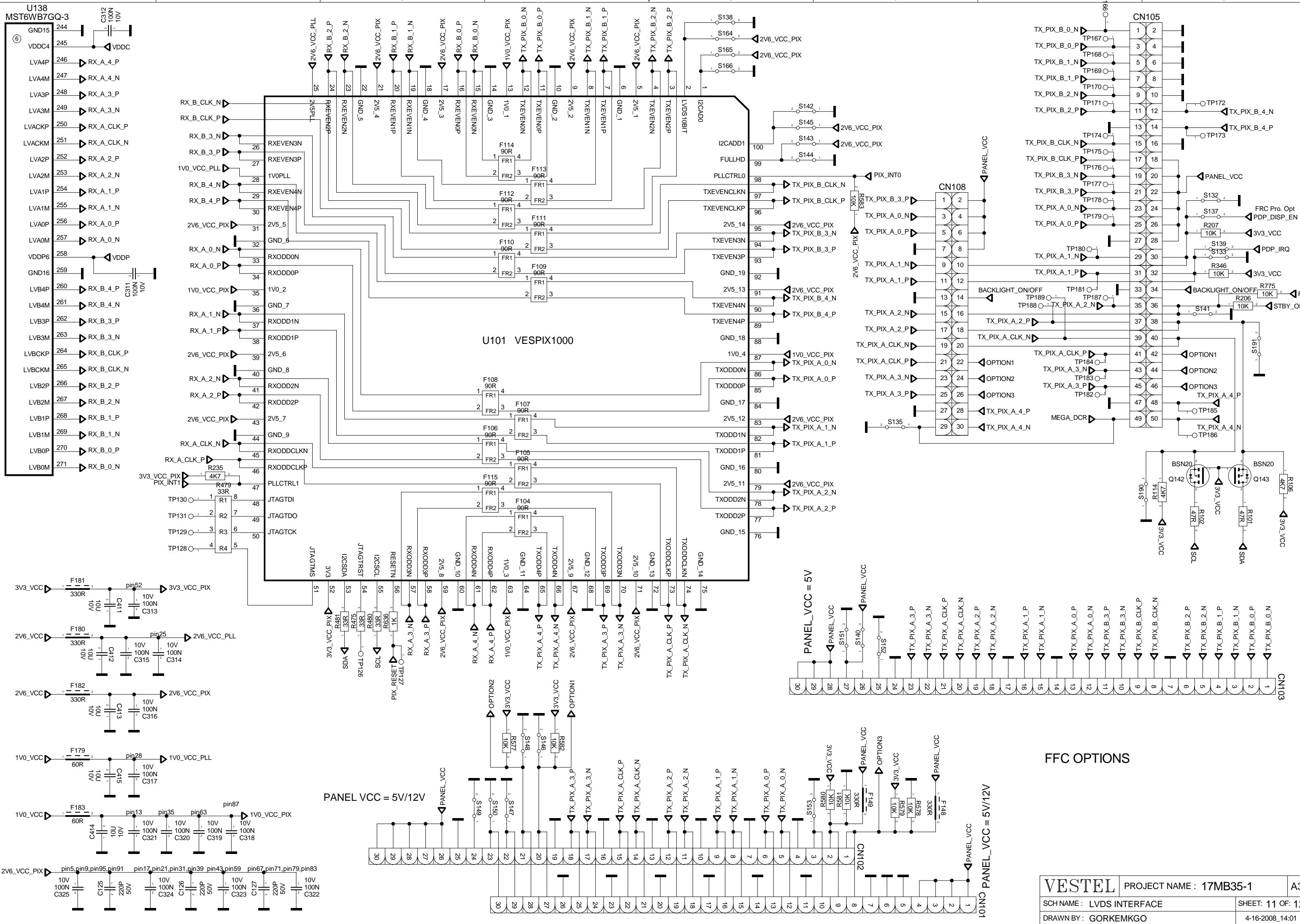
# MPEG DECODER

U104  
CT216T-R









FFC OPTIONS

<b>VESTEL</b>		PROJECT NAME : 17MB35-1	A3
SCH NAME : LVDS INTERFACE		SHEET: 11 OF: 12	
DRAWN BY : GORKEMKGO		4-16-2008_14:01	

