singmai SM05 NTSC PAL Video Encoder Module User Manual

SM05 NTSC PAL Video Encoder Module
User Manual

Contents

Introduction

SM05 is a broadcast-quality NTSC/PAL video encoder module.
The SM05 accepts SDI video (SMPTE-259M) which is then encoded to broadcast quality NTSC or PAL video output. For driving long lengths of cable pre-emphasis may be applied to the output to boost high frequencies and compensate for cable attenuation.
In the absence of the SDI input, the output will switch to a color bar pattern.
The SM05 requires 5VDC power which is provided via the supplied AC-DC converter.

Connecting up the module

A plan view of the SM05 module is shown in Figure 1.

Figure 1 SM05 Connections.

SM05 requires a 5VDC supply which is provided via the supplied AC-DC adaptor. The adaptor accepts AC between 100 and 240VAC – the full specification is provided in Appendix A.
Connect the 5VDC jack from the adaptor to the +5VDC socket on the SM05. The yellow 'FPGA Configured' LED (in the RJ-45 differential out connector) should light showing the FPGA has been configured successfully and the board is ready for use.
Connect the CVBS output to a monitor. By default, the output will be 75% NTSC color bars.
Connect up a valid SDI input (525i or 625i, SMPTE-259M). If the SDI input can lock to the signal the SDI Lock LED will light and the CVBS output will switch to the SDI input. The SM05 auto detects the input standard. If the SDI input is lost, the SM05 will revert to a color bar output at the last SDI standard.
SM05 provides simultaneous single-ended coaxial and differential twisted-pair (UTP) outputs. The UTP outputs are connected via an RJ45-style connector. Figure 2 shows the pin assignments for the connector: (pin 1 for the 'VIDEO+' (non-inverted) signal, and pin 2 'VIDEO-' (inverted) signal).
When driving long lengths of cable, especially UTP and low-cost coaxial cable (e.g. RG-59) there is a high-frequency loss. Usually, this is compensated for by adding high-frequency peaking at the receiver. However, this impacts negatively on the signal-to-noise ratio of the video. Therefore, the SM05 allows you to add high-frequency pre-emphasis to the CVBS output. You can adjust the pre-emphasis in eight steps using the rotary 'pre-emphasis switch. Up to 6dB of high-frequency gain may be applied, which compensates for up to 300m of UTP or coaxial cable. The frequency response of the pre-emphasis filter is shown in Figure 3.

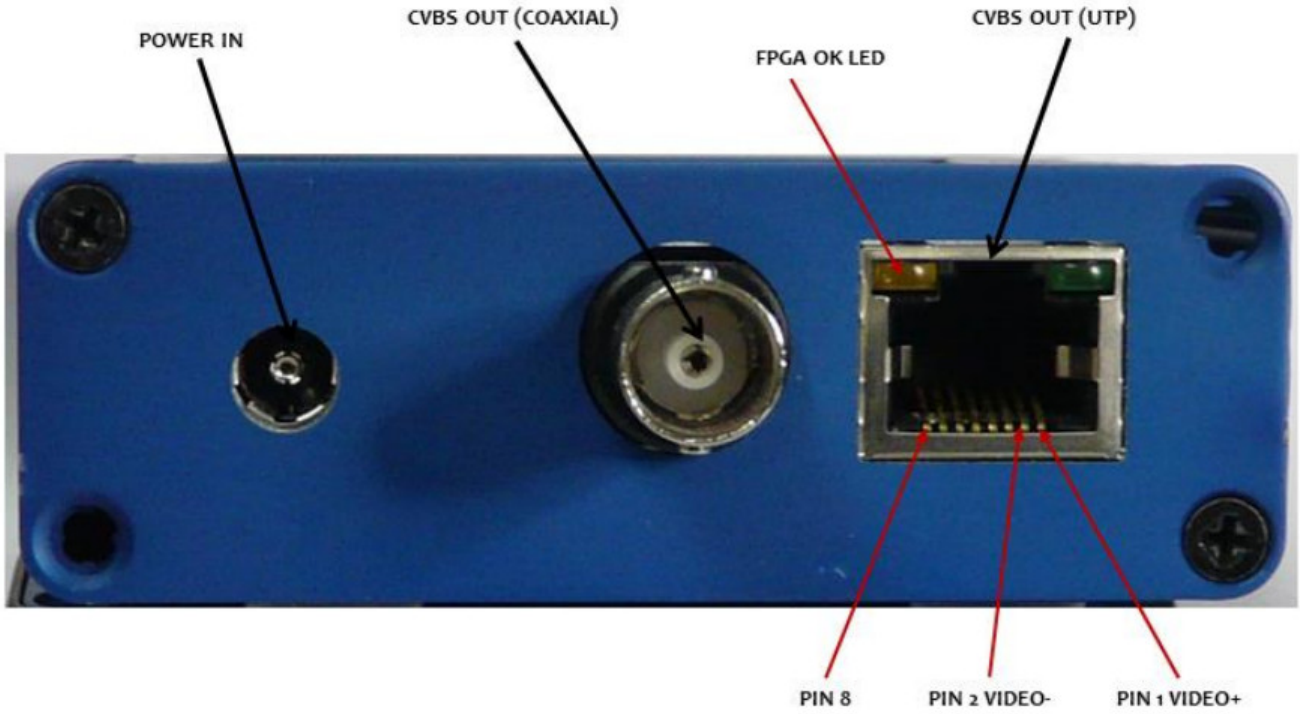
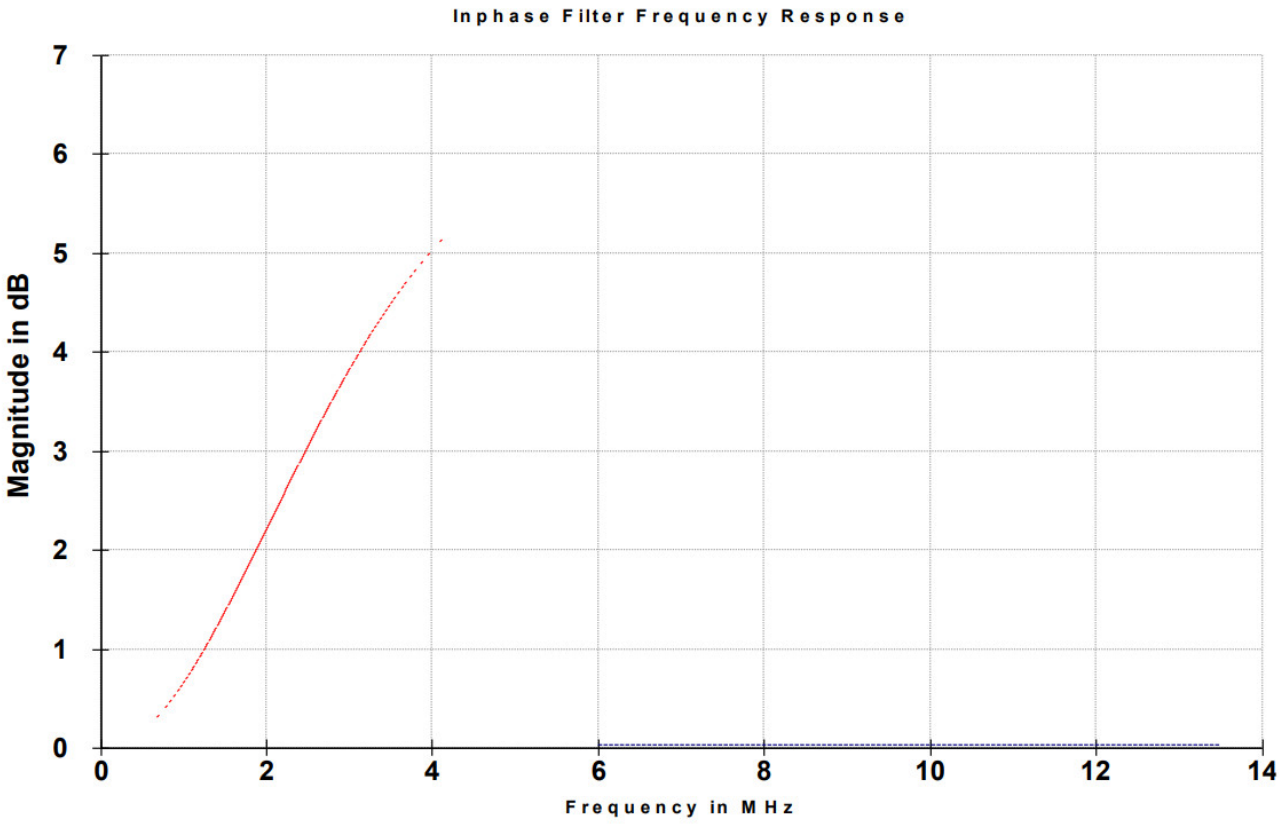


Figure 2 SM05 UTP connections.



Reprogramming the FPGA

The FPGA may be reprogrammed to install new features or improvements. As the SM05 uses an Altera FPGA it is necessary to download the Quartus programmer software. This may be downloaded from the SingMai website using the following links: **https://www.singmai.com/Quartus/QuartusProgrammerSetup-17.1.0.590-windows.exe**
(64-bit version) **https://www.singmai.com/Quartus/QuartusProgrammerSetup-17.1.0.590-windows32.exe**
(32-bit version)
The files are 365MB in size, so downloading may take a little time.

Also, it is necessary to use the USB-Blaster module: we use the Terasic version:
https://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&No=46
Once the programmer file is downloaded, double-click it and you should see this screen.

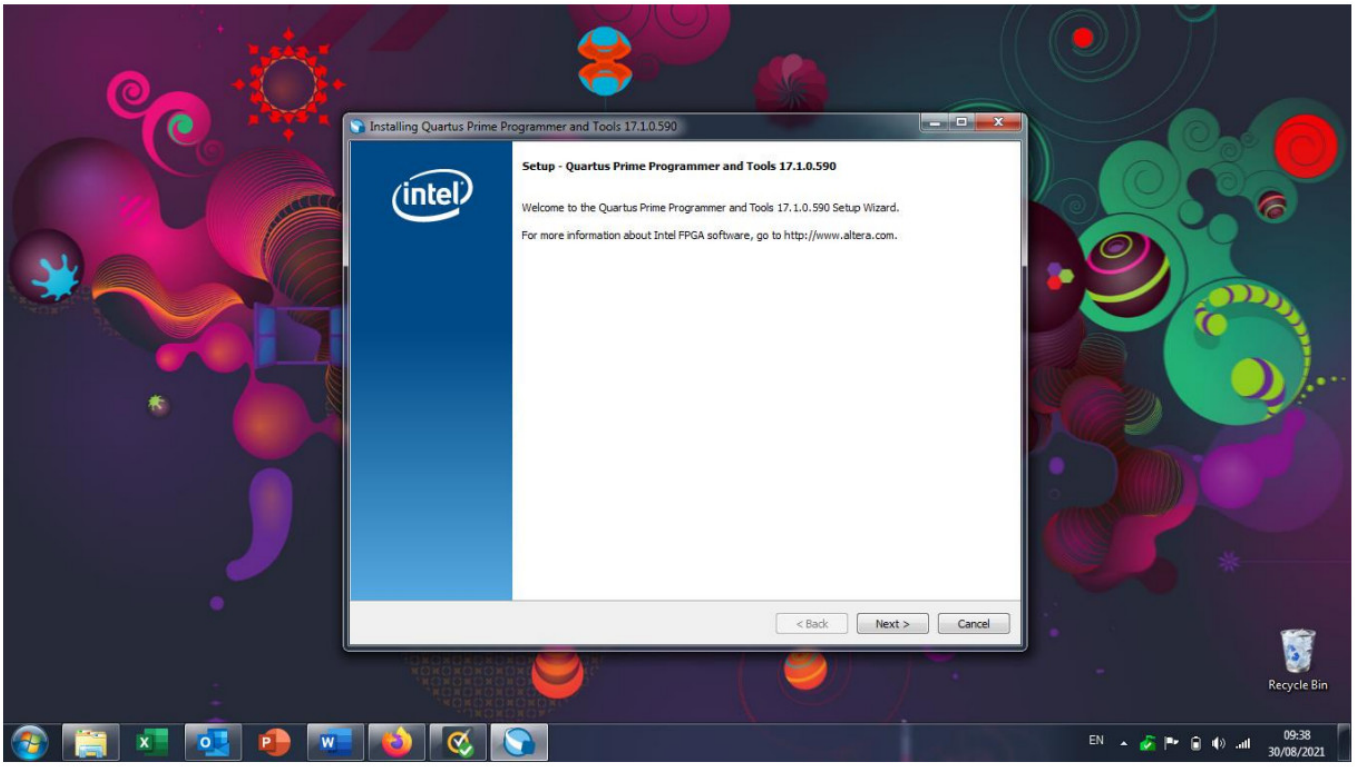


Figure 4 Quartus Programmer installation – Screen 1.

Click Next and you should see this screen.

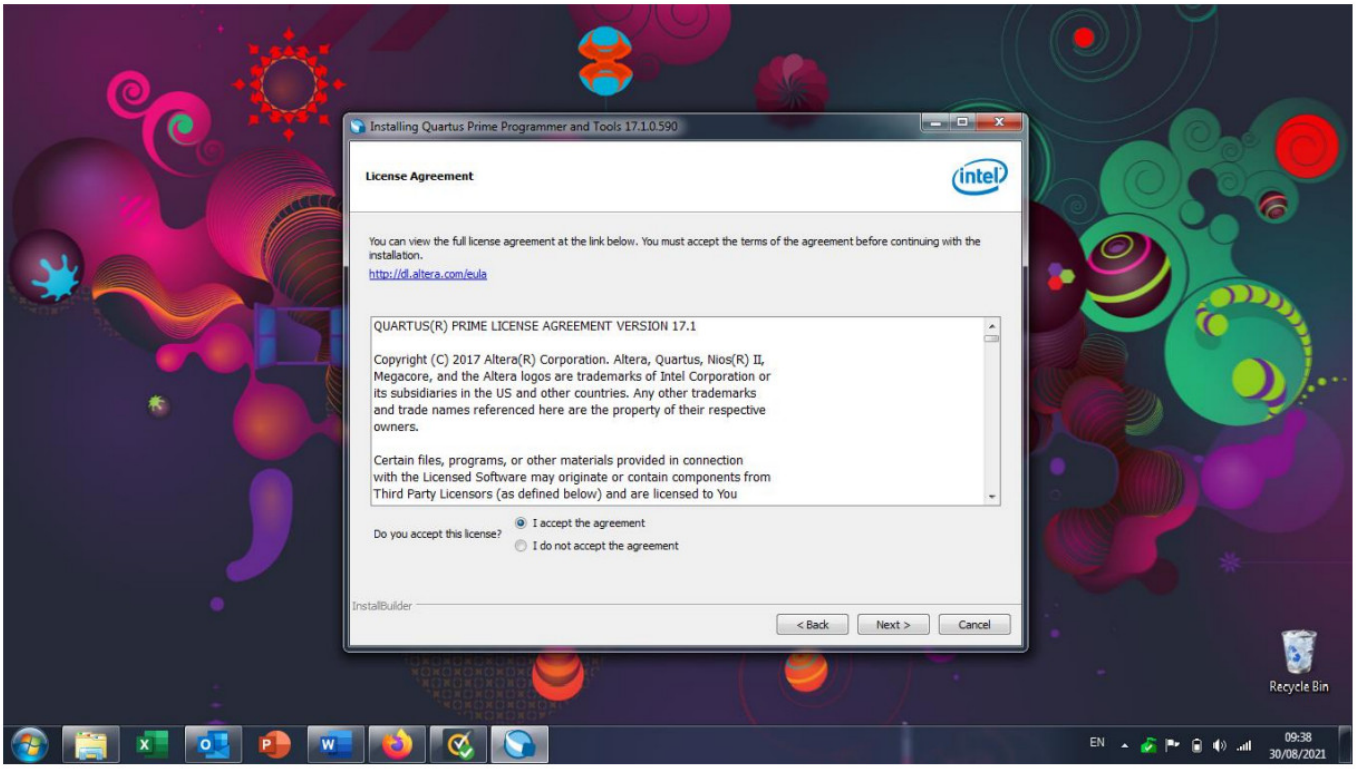


Figure 5 Quartus Programmer installation – Screen 2.

Click the ‘I accept the agreement box and then Next.

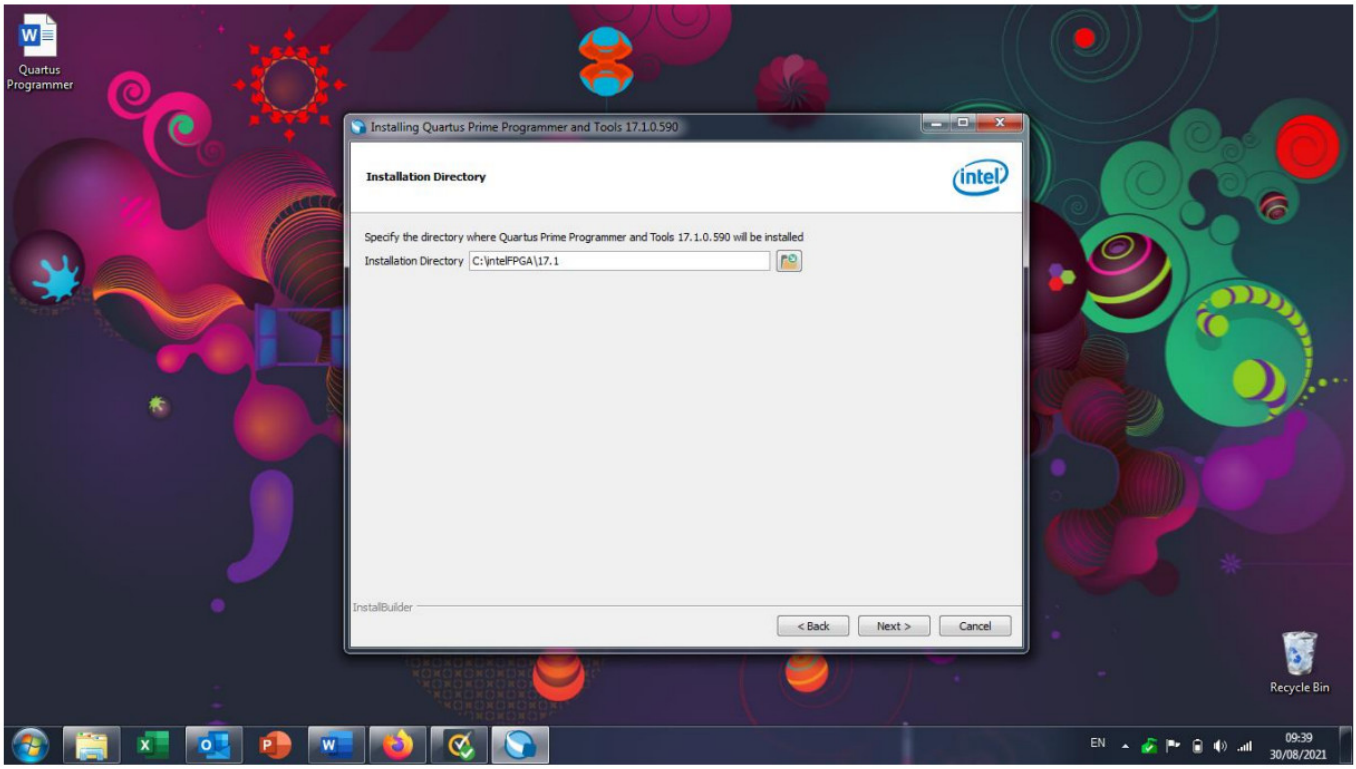


Figure 6 Quartus Programmer installation – Screen 3.

Make a note of the installation directory and then click Next.

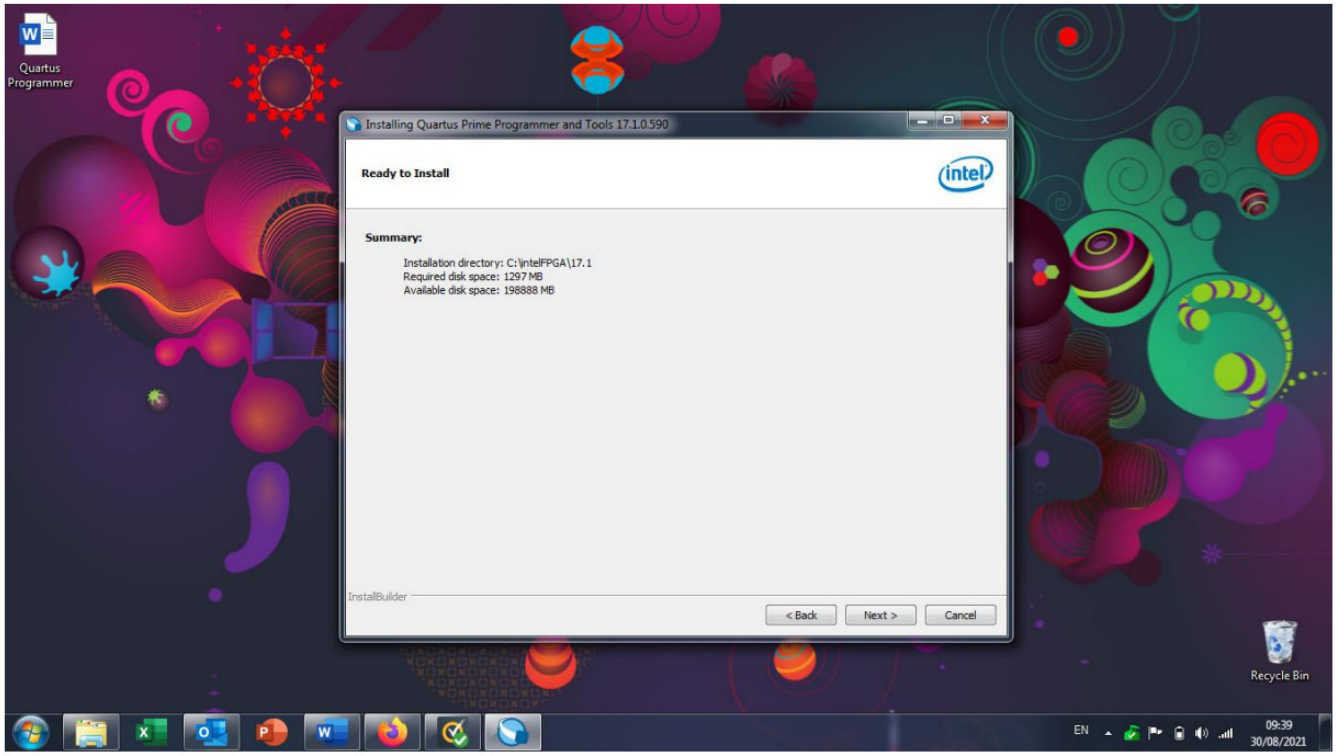


Figure 7 Quartus Programmer installation – Screen 4.

Click Next and the installation should begin.

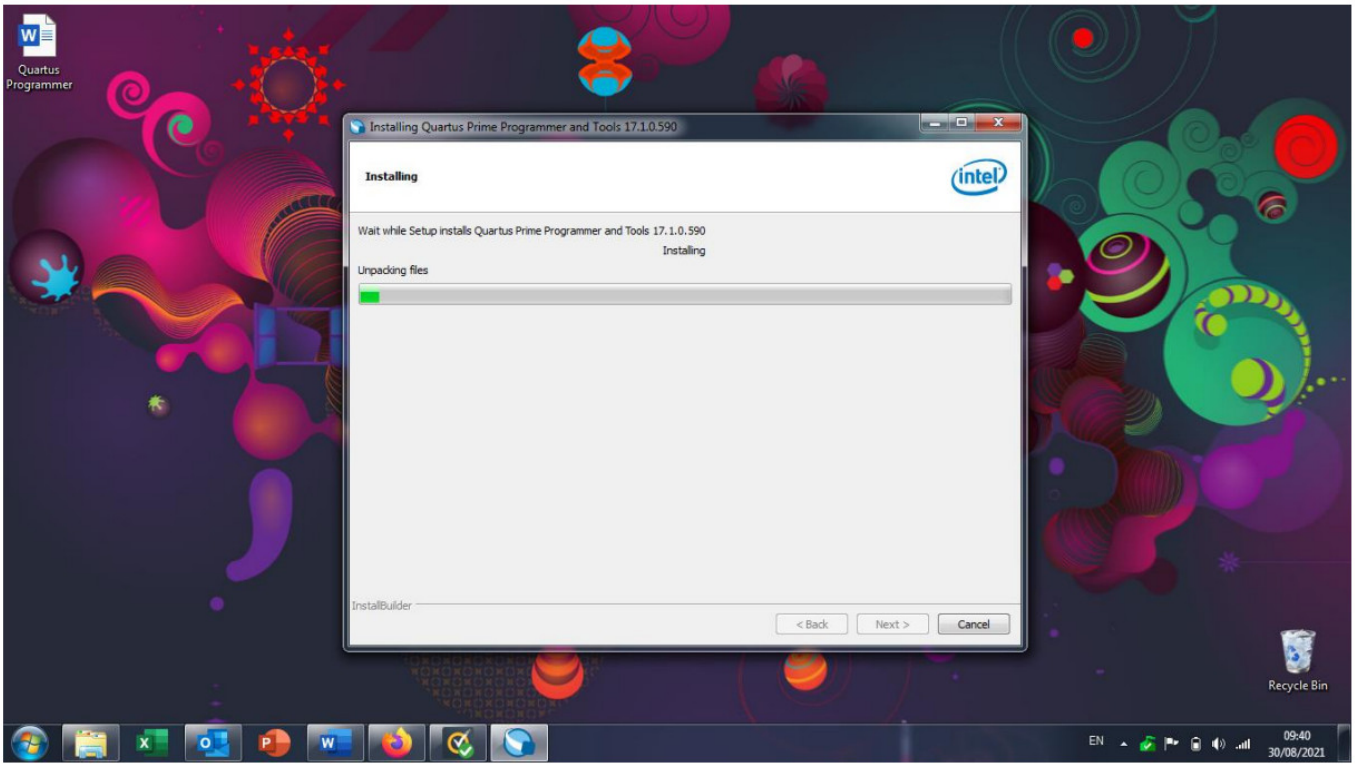


Figure 8 Quartus Programmer installation – Screen 5.

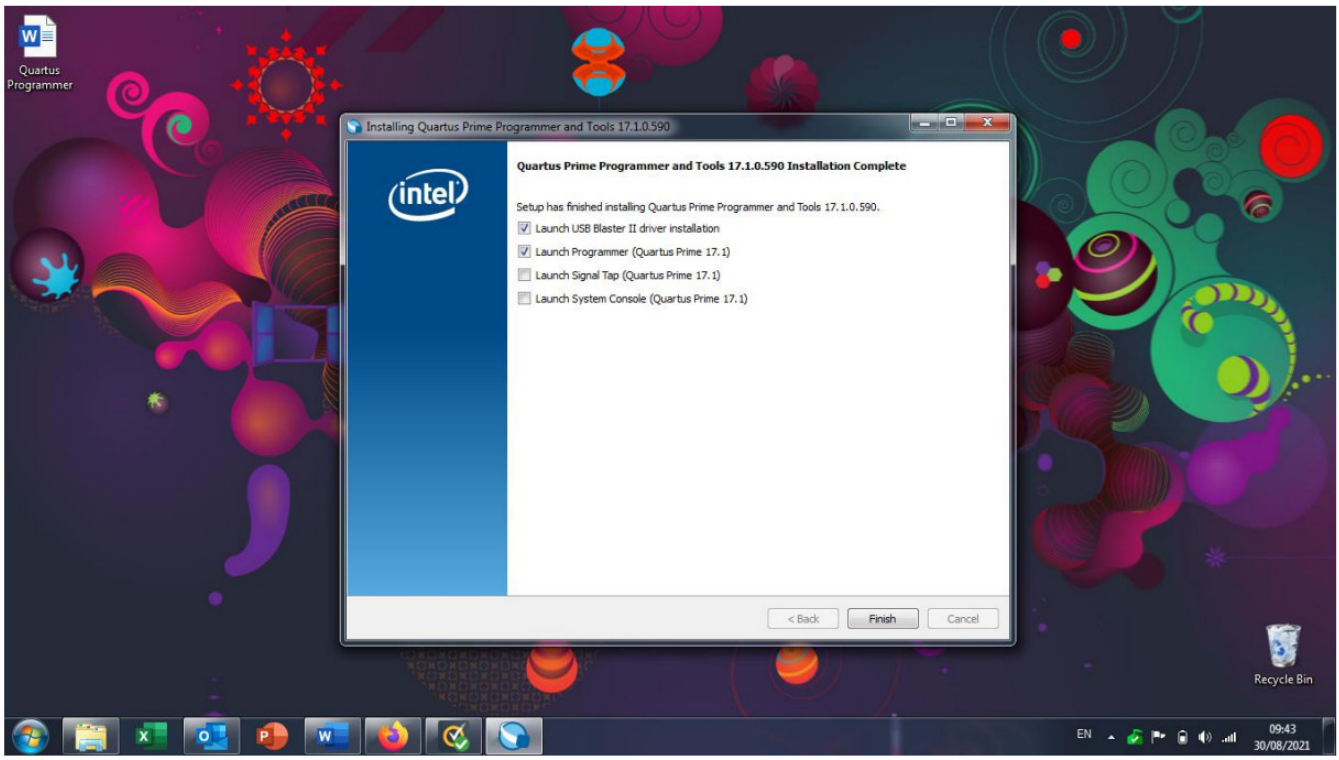


Figure 9 Quartus Programmer installation – Screen 6.

Unclick the Signal Tap and System Console boxes and then click Finish. You should then see the Device Driver installation Wizard.

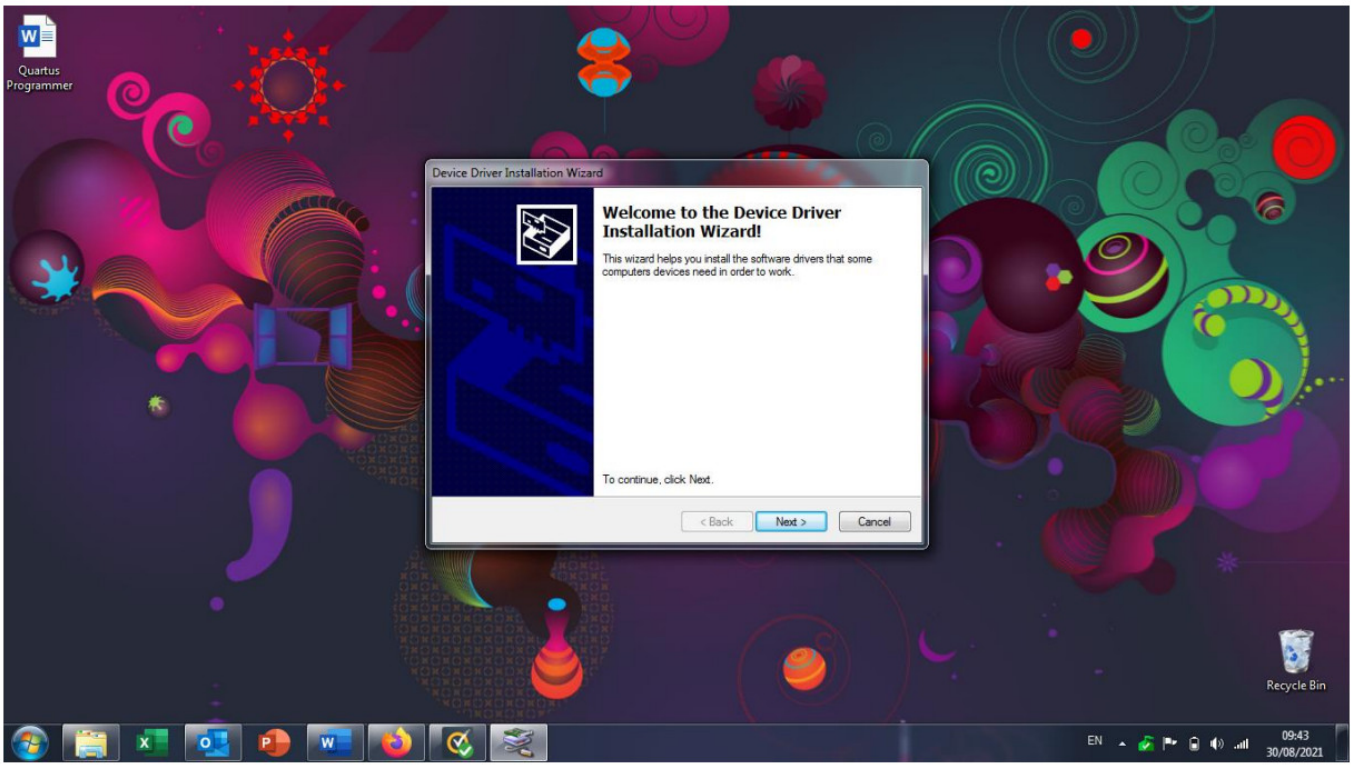


Figure 10 Quartus Programmer – Device Installation.

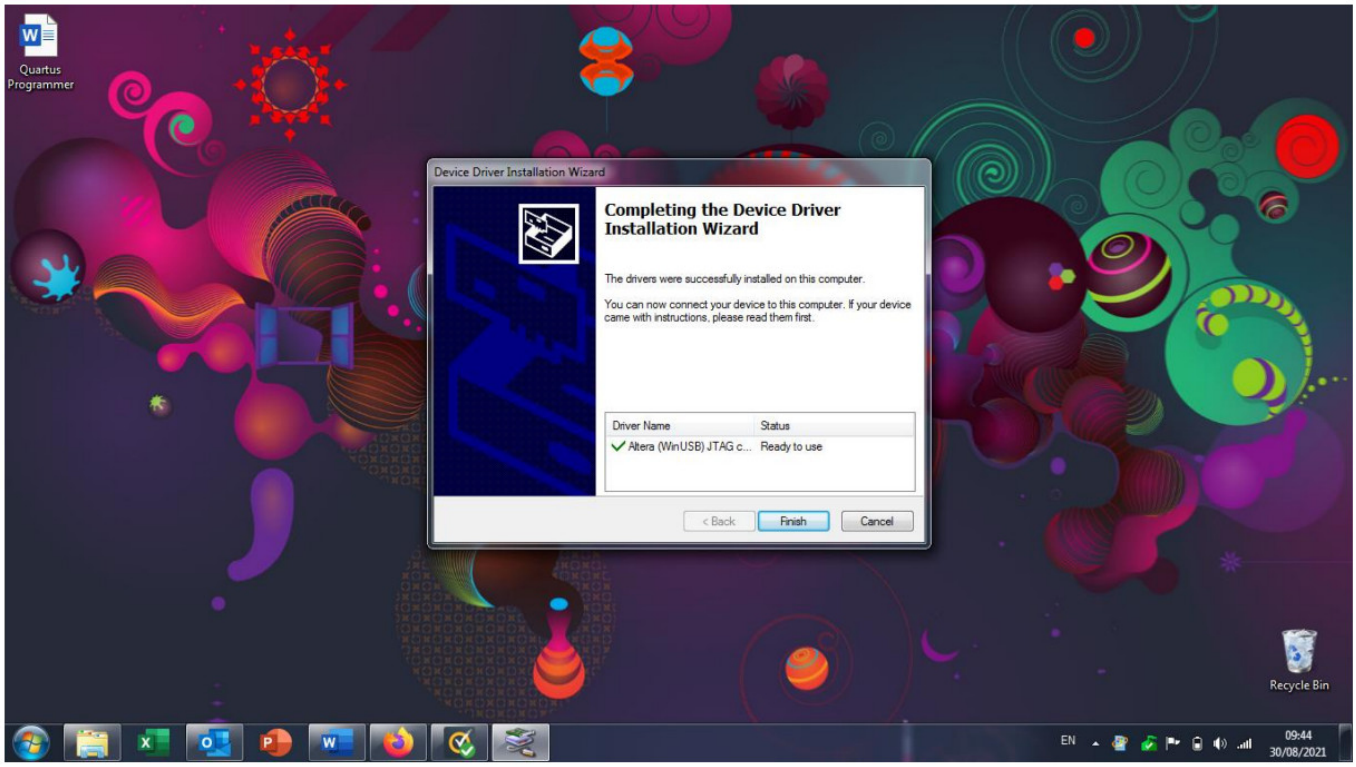
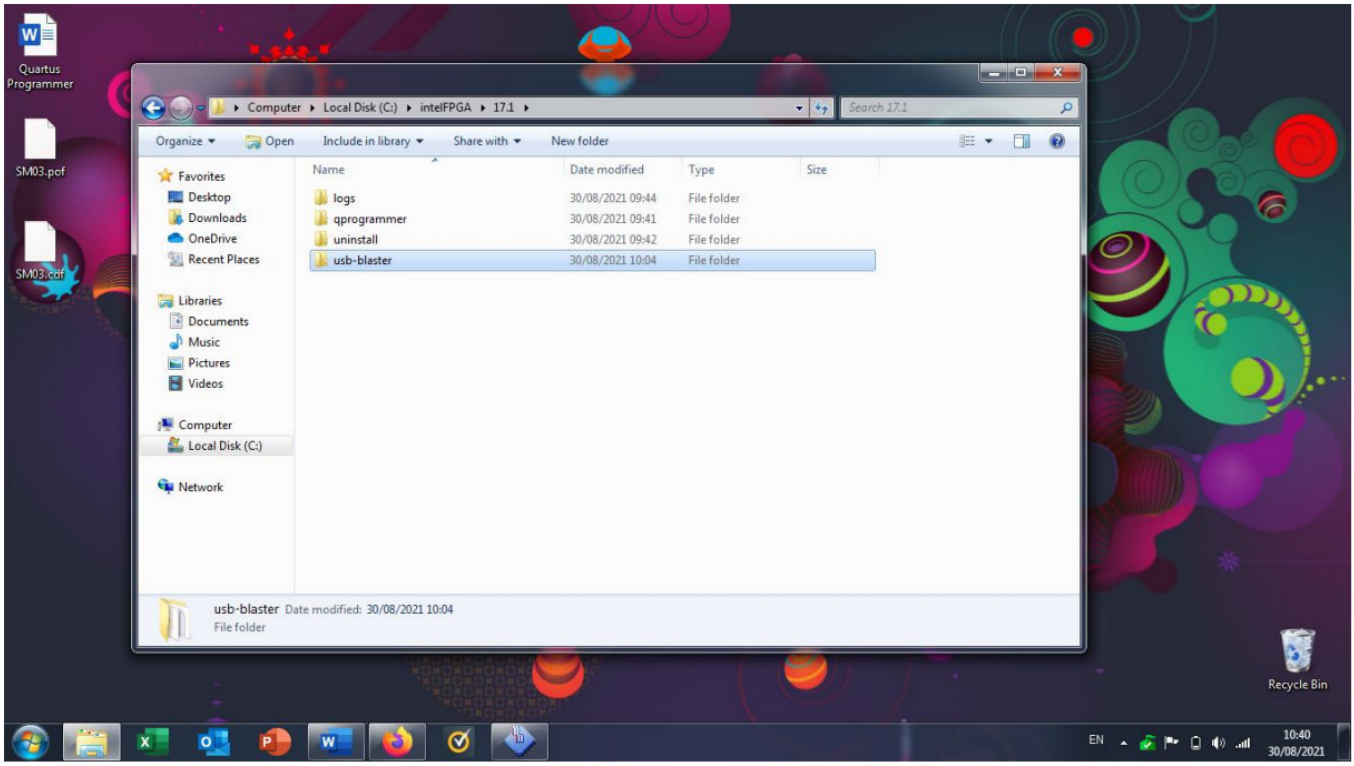


Figure 11 Quartus Programmer – Device Installation.

The device driver does not always install correctly and, if not, has to be manually installed.
Download the drivers from the SingMai website: https://www.singmai.com/Quartus/usb-blaster.zip
Place this file in the same directory as the programmer installation directory as shown in Figure 12 and unzip the file to there.



Plug in the USB Blaster to a USB port and you should be prompted for a driver – choose to browse to point to the usb-driver directory (only point to the top level, not any sub-directories). If the driver installation is not automatic, it is necessary to go to the Device Manager and manually install the driver from there.
Open the Quartus programmer if it is not already open. You should see a screen similar to the one below.

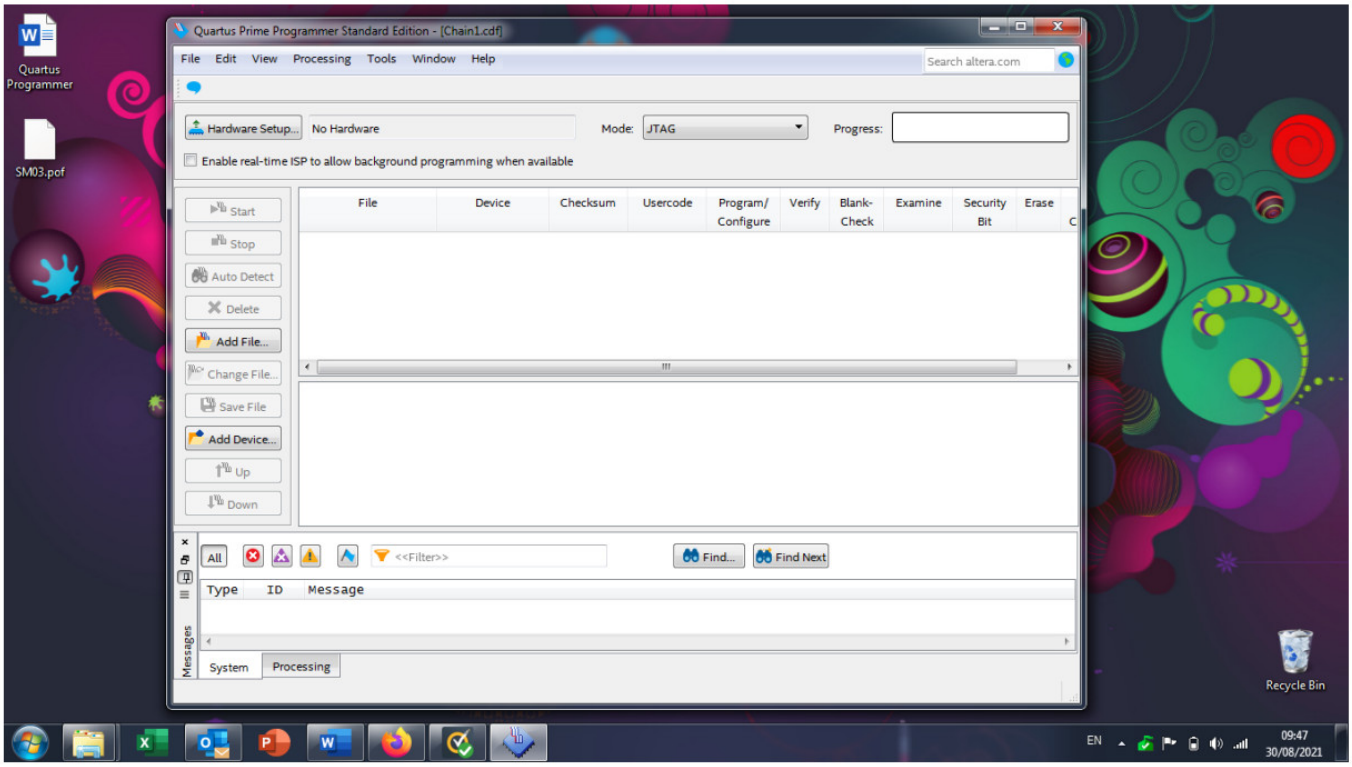
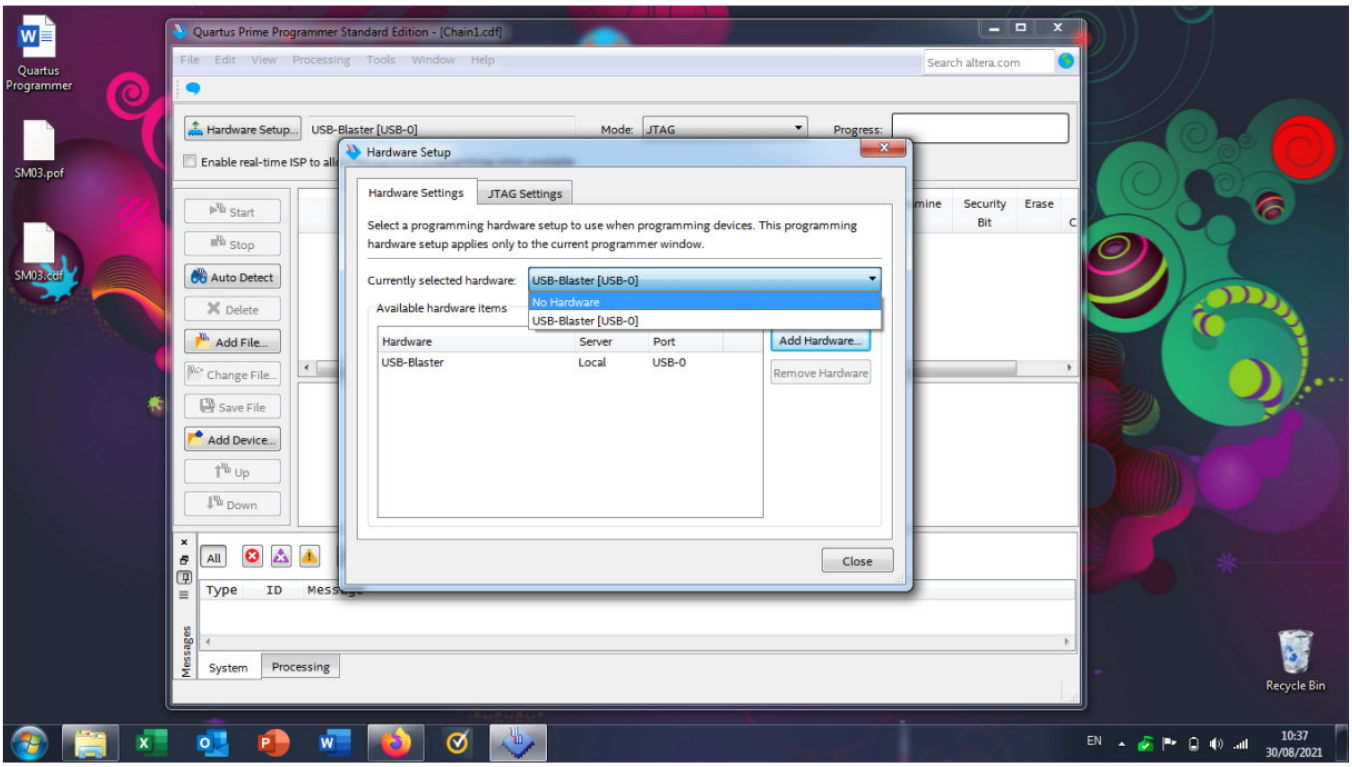


Figure 13 Quartus Programmer screen.

Click on Hardware setup and choose the USB Blaster.



The USB-Blaster 10-way header plugs into J3, and the 10W header on the SM05. The header is polarized to ensure the cable cannot be inserted the wrong way (see Figure 15).

Figure 15 Re-programming the SM05.

Technical Overview

The SM05 schematics are shown in Figures 16 – 21.
The 5VDC input is filtered and linear regulators U1 and U20 generate the required local supplies. U14 generates power on reset for the FPGA.

U2 and U3 generate the FPGA power supplies.
U4 equalizes the SDI input and U18 de-serializes the SDI from the 270Mb input to 5 channels of LVDS plus a recovered clock. The LVDS inputs are decoded in the FPGA to YCbCr component video plus the synchronizing signals.
U7 is an Altera (Intel) EP4CE15 FPGA. This FPGA contains the PT8 video encoder IP core, The SDI decoder, a color bar pattern generator, and the SingMai PT13 IP core microprocessor which provides the control function. The FPGA is configured using a pre-programmed EEPROM.
X1 is a 27MHz MEMS oscillator that provides a stable clock for PT13, as well as the pattern generator and PT8 when the SDI input is absent.
SW1 is the user input for the pre-emphasis control.
U8, a 10-bit DAC, converts the PT8 digital composite video to complementary analog outputs.
These are amplified by U21 to provide the correct output levels, before being filtered by U9 to remove the clock and reconstitute the analog waveform.
The input to the PT8 may be either an internal (to the FPGA) video color bar generator or the BT656 output from the Gennum GS9090B SDI de-serialiser IC.

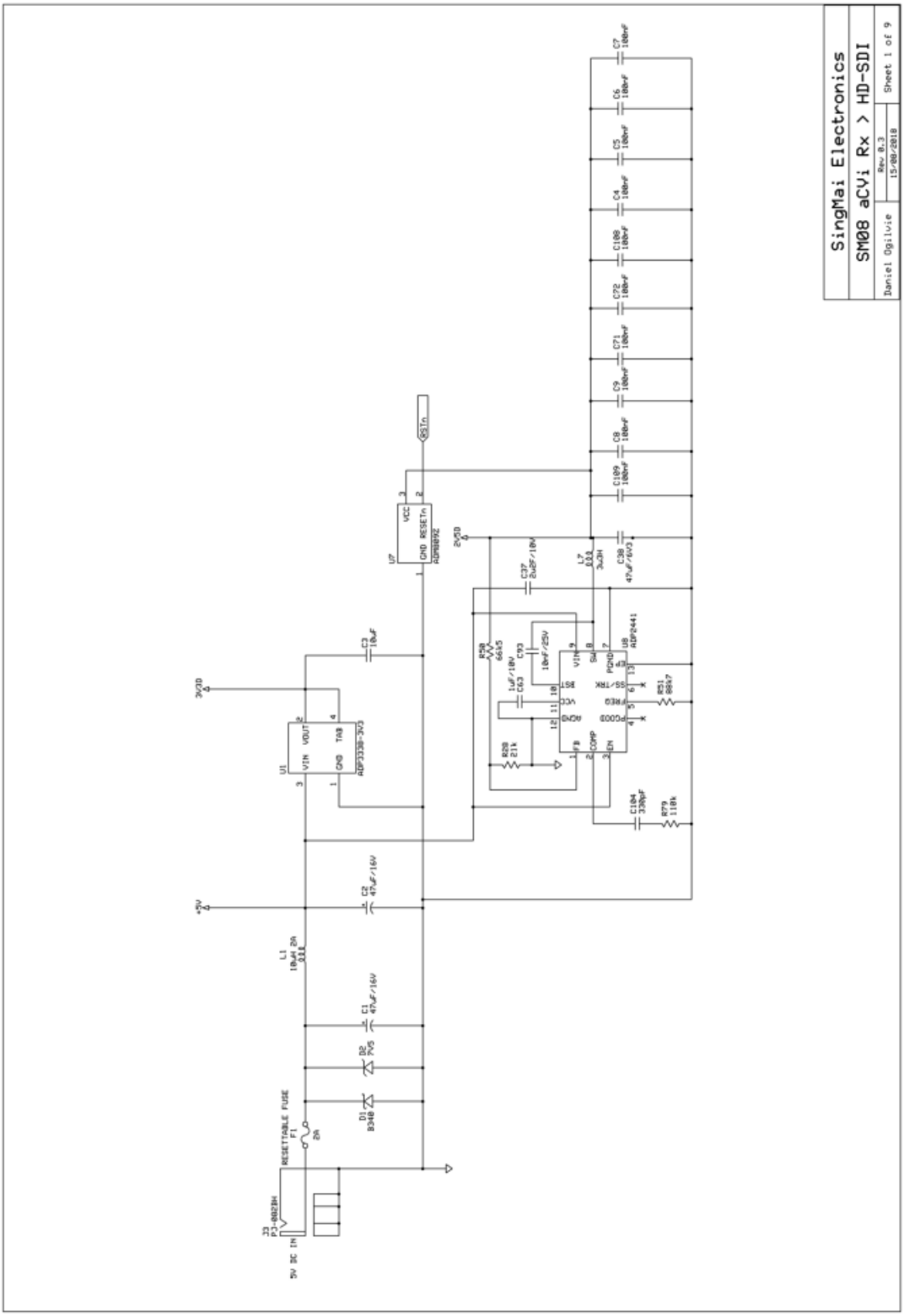


Figure 7 SM08 Schematics - Sheet 1.

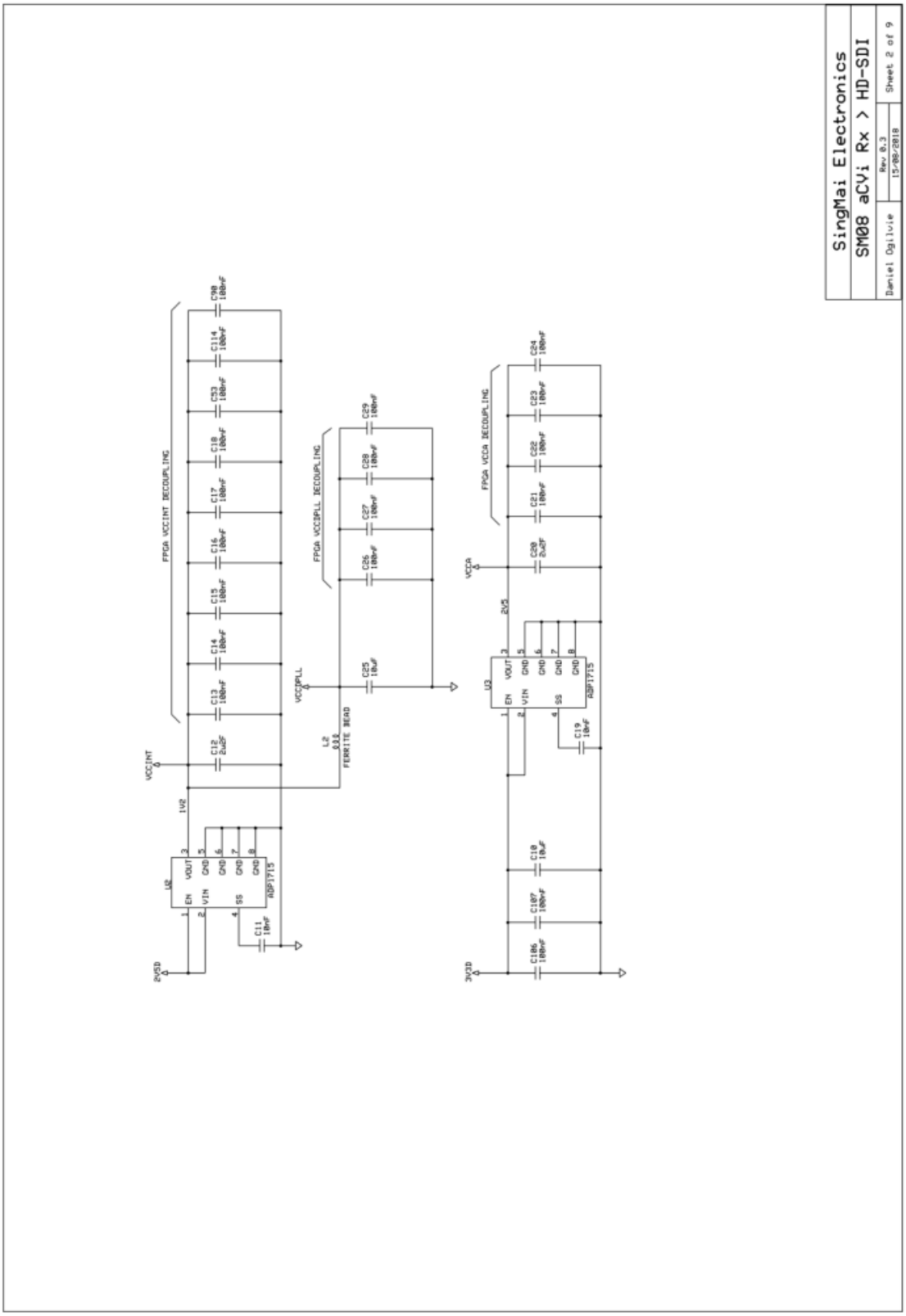


Figure 8 SM08 Schematics - Sheet 2.

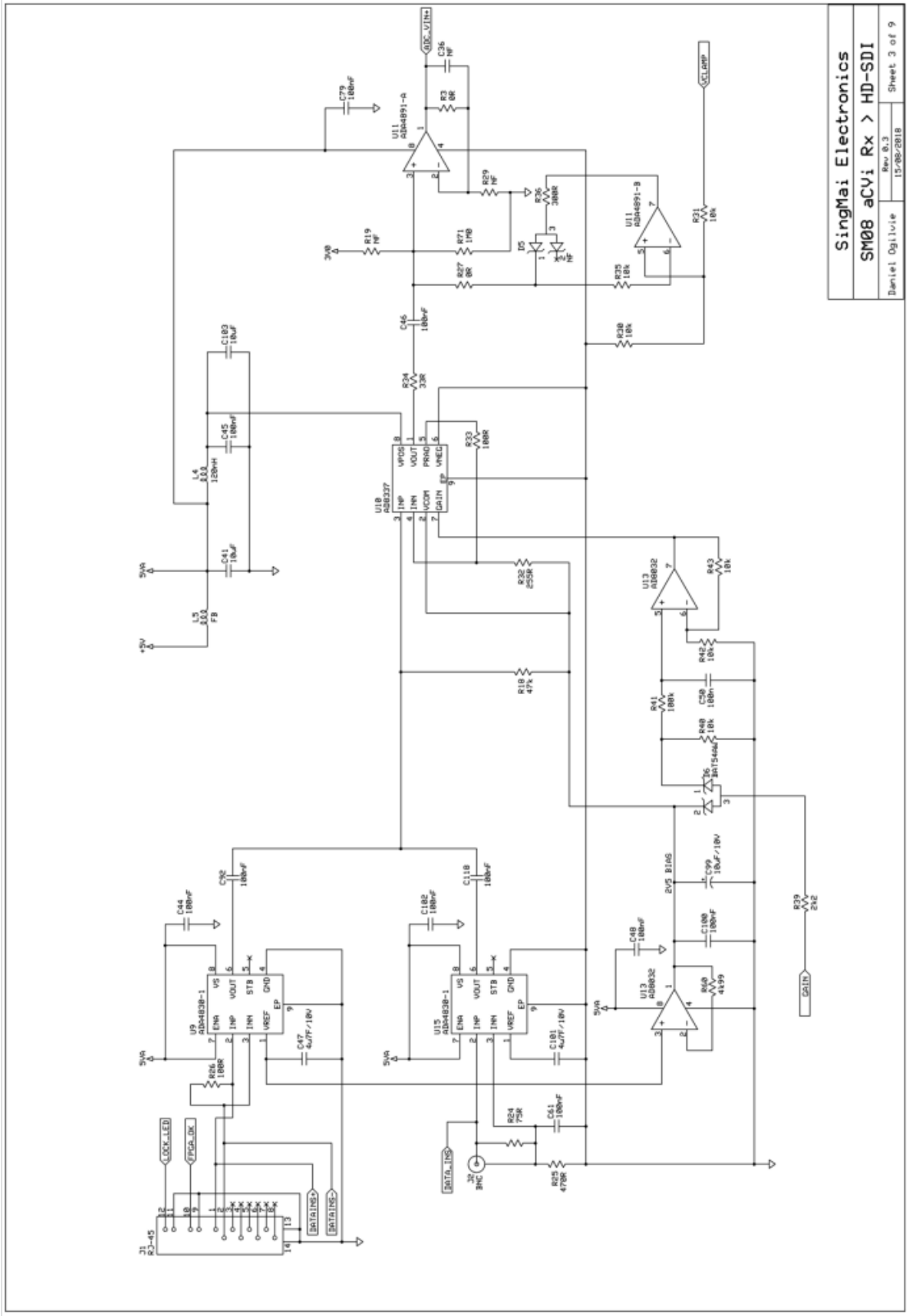


Figure 9 SM08 Schematics - Sheet 3.

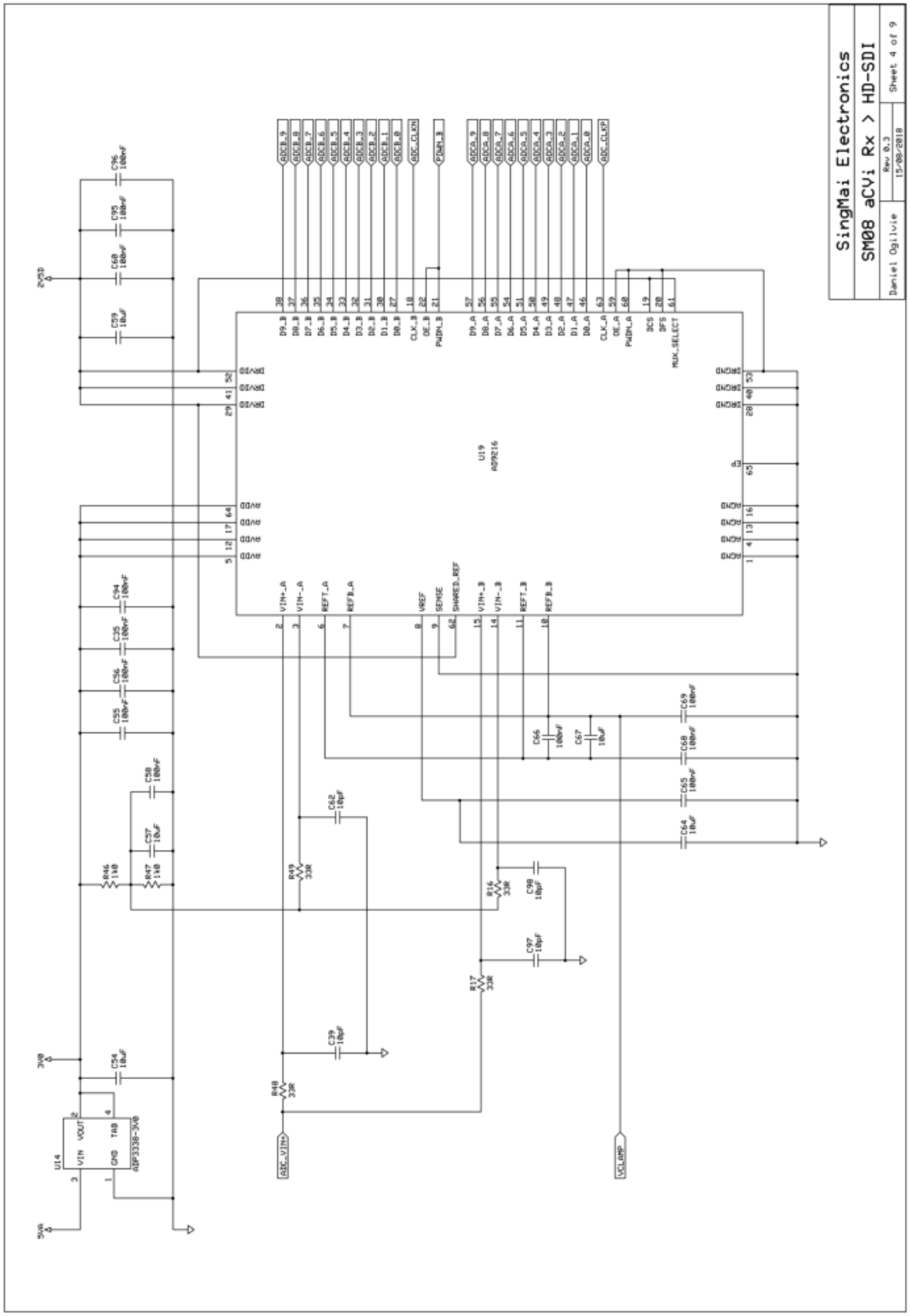


Figure 10 SM08 Schematics - Sheet 4.

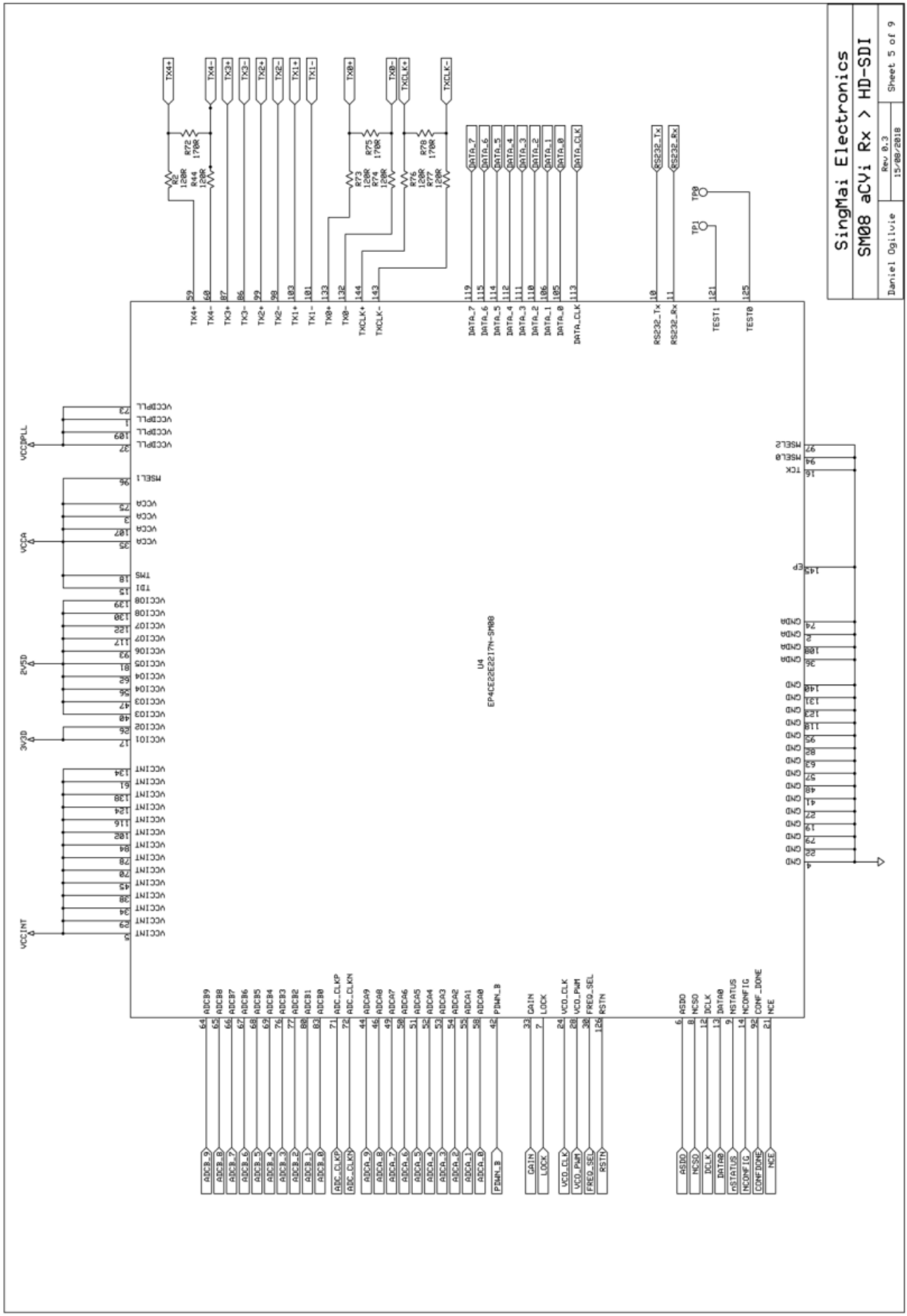


Figure 11 SM08 Schematics - Sheet 5.

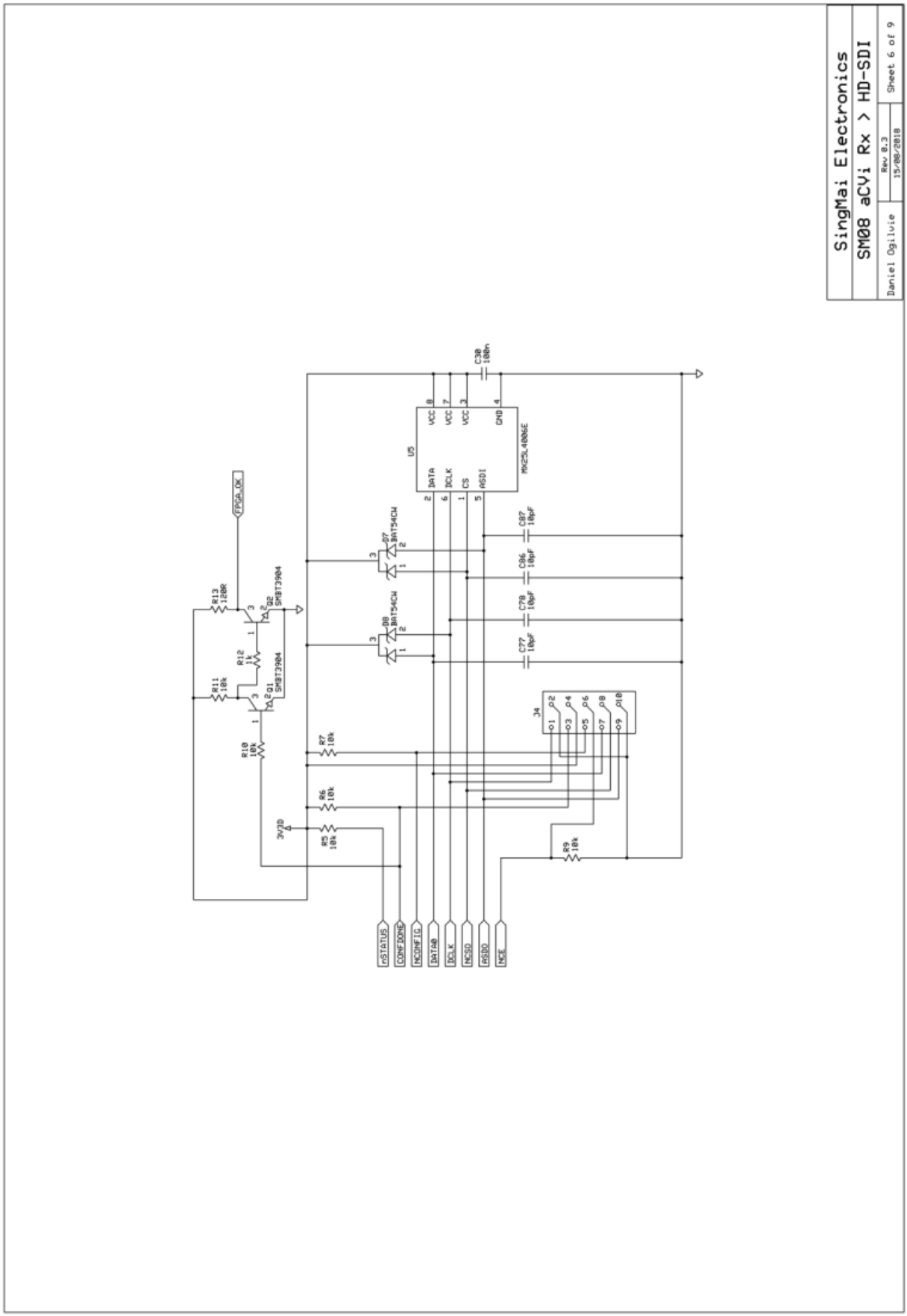


Figure 12 SM08 Schematics - Sheet 6.

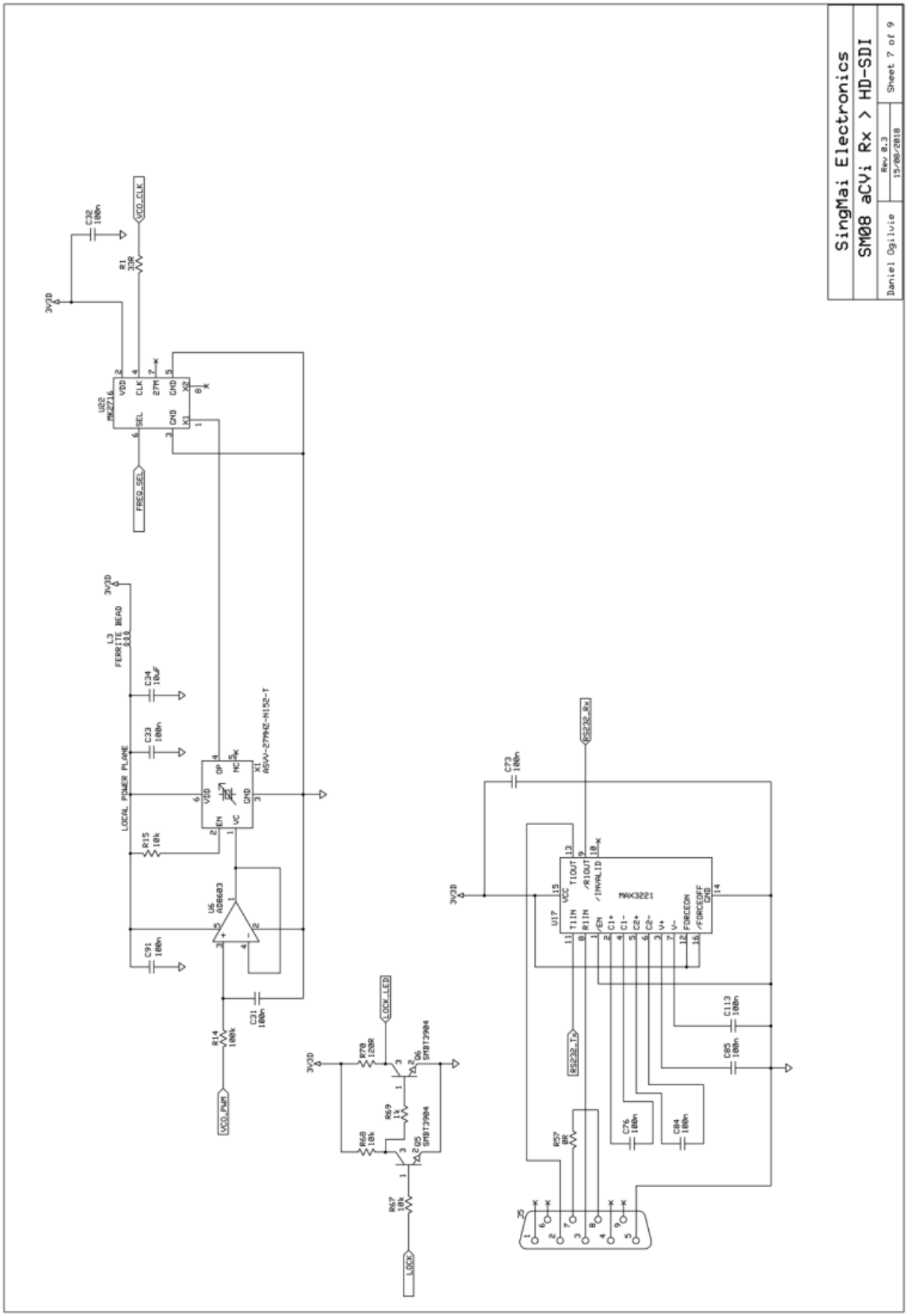


Figure 13 SM08 Schematics - Sheet 7.

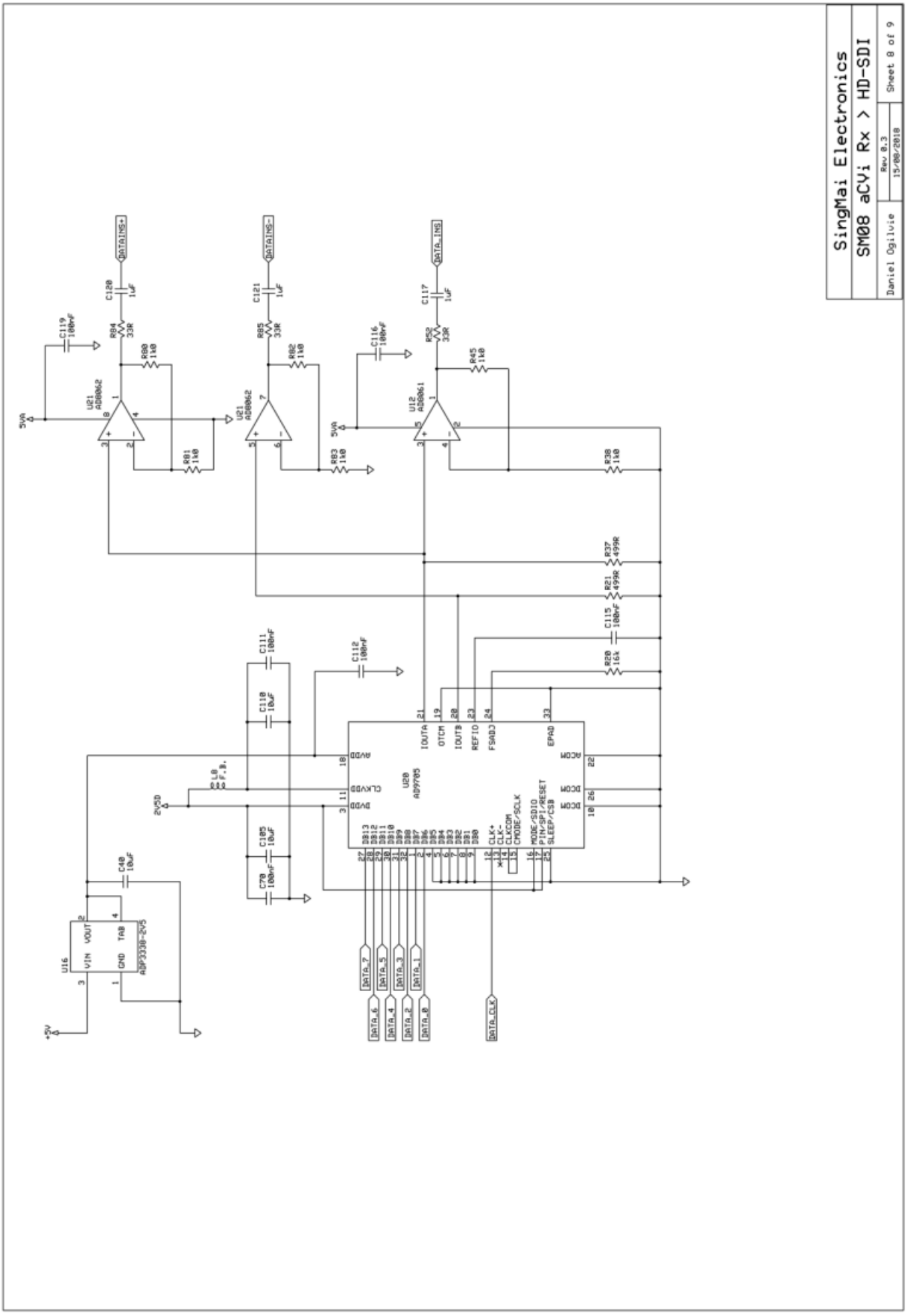


Figure 14 SM08 Schematics - Sheet 8.

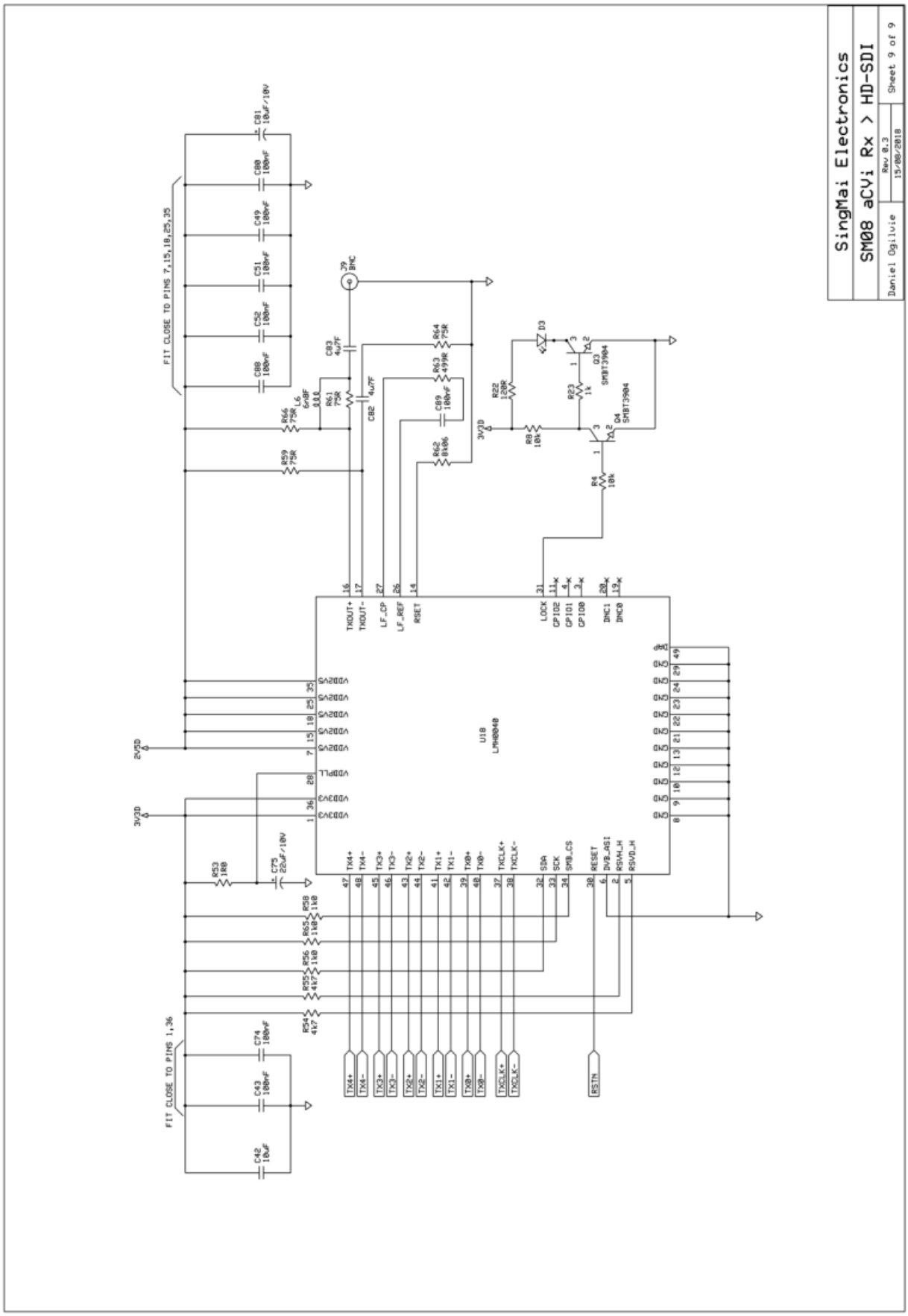


Figure 15 SM08 Schematics - Sheet 9.

Specification

Power:	+5VDC ± 5% @ —450mA.
Dimensions:	120mm x 78mm x 27mm.
Video output:	NTSC-M, PAL (switch selectable). 1.0V pk-pk (75% bars) into 750.
SDI input:	SMPTE-259M compatible.
Luma frequency response:	5.5MHz ± 0.2dB (sinx/x corrected).
Chroma frequency response:	1.3MHz (-3dB).
Pre-emphasis gain:	+6dB @ 6MHz.
K-factor:	<1.0%.
Differential gain:	<1% (sinx/x corrected).
Differential phase:	<1° (sinx/x corrected).
Signal/noise ratio:	-65dB (black input), -58dB (luma ramp).
Chroma/luma delay:	< +/- lOns.
Operating temperature:	0 — 40 degC.

Appendix A: Power supply specification

The AC-DC converter supplied with the SM06 is a model TE10A0503F01 from SL Power Electronics. It accepts all AC inputs from 90-264VAC and provides a 5V, 2A DC output for the SM06. The detailed specification is shown below.

https://slpower.com/

FEATURES AND BENEFITS

Universal Input 90VAC-264VAC Input Range Oesisop and Wal-Plug Versions	Neets ‘Hem I ndustrials lev els of 046100 0 EMC Requi rements
Up to 12W of AC-DC Power	> 10-Year EC ap Life
IP22 Rated Enclosure	>1900900 H ours MTBF
Approved to EN/IEGU160950-1 to Edition, An2	3 Year Warra nty
Meets EN55022/CISPR22, FCC Part 15109 Class B Conducted 8 Radiated Emissions, with 6d b Margin	Meets DoE E ffiLlen4 Level VI Requirem ents No Load Input Power Average Effic iency

MODEL SELECTION

Model Num ber	Volts	Output tput Current	Output Power	Ripple & Noise	Line Regulat ion	Load Regulati on	Output Conn ector	

TE10A0503F01	**5.OV**	**2.0A**	**1019**	**75mV p k-pk**	**4.1S**	**±5%**	**25mm x 5.5 mm x 9.5mm Straight Barrel Type, Center Positive**	**Input Configuration Class I Desktop, 1E060320 C14 Receptacle**
TE10A0603F01	**5.9V**	**1.6A**	**10W**	**75mV p k-pk**	**±1%**	**±5%**		
TE10-40703F01	**7.5V**	**1.3A**	**10B**	***75mV p k-pk***	**ft%**	**±5%**		
TE10AI203F01	**12.OV**	**1.0A**	**12W**	**120mV pk-pk**	**±1%**	**±5%**		
TE10A2403F01	**24.0V**	**0.5A**	**12W**	**240mV pk-pk**	**±1%**	**±5%**		
TE10A0503N01	**5.OV**	**2.0A**	**109/**	**75mV p k-pk**	**±1%**	**±5%**	**25mm x 5.5 mm x 9.5mm Straight Barrel Type, Center Positive**	**Class II Desktop, IEC60320 CS Receptacle**
TE10A0603N01	**5.9V**	**1.6A**	**10W**	**75mV p k-pk**	**1.1%**	**±5%**		
TE10A0703N01	**7.5V**	**1.3A**	**10W**	**75mV p k–pk**	±1%	**±.5%**		
TE10AI203N01	**12.OV**	**1.0A**	**12W**	**120mV pk-pk**	**±1%**	**±5%**		
TE10A2403N01	**24.0V**	**0.5A**	**12W**	**240mV pk-pk**	**±1%**	**±5%**		
TE10A0503Q01	**5.OV**	**2.0A**	**1019**	**75mV p ki***	**±1%**	**±5%**	**2.5mm x 5.5 mm x 9.5mm Straight Barrel Type, Center Positive**	**Class II Desktop. IEC60320 C18 Receptacle**
TE10A0603Q01	**5.9V**	**1.6A**	**10W**	**75mV p k-pk**	**±1%**	**±5%**		
TE10A0703Q01	**7.5V**	**1.3A**	**10W**	**75mV p k-pk**	**±-1%**	**±5%**		
TE10AI203Q01	**12.OV**	**1.0A**	**12W**	**120mV pk-pk**	**±1%**	**±5%**		
TE10A2403Q01	**24.0V**	**0.5A**	**12W**	**240mV pk-pk**	**±1%**	**±5%**		
TE10A05031301	**5.OV**	**2.0A**	**10he**	**75mV p k-pk**	**±1%**	**±5%**		

TE10A06031 301	**5.9V**	**1.6A**	**10W**	**75mV p k-pk**	**±1%**	**±5%**	**25mm x 5.5 mm s 9.5mm Straight Bar rel Type. Center Positi ve**	**Class It Wall-Plu g- Interchan geable Blade s (North Blade American incl uded)**
TE10A07031 301	**7.5V**	**1.3A**	**10W**	**75mV p ki***	**±1%**	**±5%**		
TE10AI2038 01	**12.OV**	**1.0A**	**12W**	**120mV plc–pk**	**4.19,**	**±5%**		
TE10A2403 B01	**24.0V**	**0.5A**	**12W**	**240mV pk-pk**	**±1%**	**±5%**		

Output Model Number Current		Volts	**OutputP urer**	**RippleW ise**	**LineReg ulation**	**Load Regulati on**	**Output Connector**	**Input Configurati on**
TE1OAD5 D3001	**5.Thir**	**2.0.**	10W	**75rOf pk -pk**	±1%	**±5%**	**2_5rnm xrn x 9.5mrn Str aight Barrel Type, Center Positive**	**Clue II Wall - PI ug,Fixed North Amer ican Blades ’**
TE1DA’D6 03001	**5..9V**	**1.6A**	101A1	**75rnYpk-pk**	±1%	**-15%**		
TEI		**1.3A**	10W	**pk-pk**	±1%	**-15%**		
TE10AI203 001	**12.0V**	**1.0A**	**12W**	**1:20rrei pk-pk**	±1%	**±5%**		
TE10A240 3001	**24.V1**	**0.5A**	**12W**	**24OrriV pk-pk**	±1%	**±5%**		

INPUT

Input Voltage and Frequency	100VAC-240VAC, .110%, 47H.-63Hz„ le
Input Current	115VAC: 0.450. 230VAC: 0.28A
Inrush Current	264VAC, the cold start will not exceed 40A
Input Fuses	FI, FT 3.150. 250VAC fuses (line & neutral lines) provided on all models
Earth Leakage Current	$Input_{utpu}$-CND:$_{E}$;500pAgt$_{v}$V$_{A}$A$_{c}$C. : Hz, NC
Efficiency	Meer US DoE Efficiency Level VI Average efficiency levels
No Load Input Power	c0.1W per DoE Efficiency Level VI Requirements

PROTECTION

OverlemPerMore Protection	Will shutdown upon an over-temperature condition. Auto-recovery
Overload Protection	130% to 180% of rating, Hiccup Mode
Overcharge Protection	130% to 150% of output voltage, Hiccup mode
Short Circuit Protection	Hiccup Mode, Auto-recovery

OUTPUT

Output Voltage	**See models on page 1**
Output Power	**10W to 12W continuous – See models for specific voltage model ratings**
Turn On Time	**Less than 700mS (5115VAC, full Load**
Hold-up Time	**20mS min.. at Full Load. 100VAC input**
Ripple and Noise	**See models on pg 1**
Transient Response	**500ps response time for a return to within 03% of the final value for any 50% load step over the range of 5% to 100% of rated load..[1]1i/titc 0.2A/ps.** **Max. voltage deviation is +/-3.5%**
Total Load Regulation	**See models on page 1**

SAFETY

Safety Standards	**aVCSAAILPEC 60950-1 &Edition. Am 2**
Drop Test	**1.4m from tabletop to a wooden platform. 6 faces**

ISOLATION

Isolation	**Input-Output: 4000VAC input-Ground: 1500VAC Output-Ground: 1500VAC**

ENVIRONMENT

Operating temperature	wart up at -au, tun Loso, mamma perms more all parameters are within pu blished specifications)
Storage Temperature	-40°C to +35°C
Relative Humidity	5%to 95%, non-condensing
Weight	110 grams
Dimensions	See outline drawings
Temperature Derating	See derating chart
Operating Altitude	Operating: to 5000m. Non-operating: -500ft to 40,000ft.
Vibration	Operating: 0.003g/H4 1.5 grams overall 3 axes, 10 min/axis. 1 Hz-500Hz. Non-Opar.: random waveform, 3 minutes/axis. 3 axes and Sine waveform, Vib. frequency/acceleration: 10-500Hz/1g, sweep rate of 1 octave/minutes. Vibration time of 10 sweeps/axes, 3 axes
Shock	Operating: Half-sine, 20gpk, 1OrnS, 3 axes, 6 shocks total Non-Operating: Half-sine wav eform, impact acceleration of 100G, Pulse &ration of 6rnS, Number of shocks: 3 for each of the three-axis

RELIABILITY

MTBF	> 1O00,000 hours. full load, 110VAC & 220VAC input, 25°C amb.. per Telc ordia 332 Issue 6, Stress Method
E.Ccp **Life**	> 70-year life based on calculations et115VAC/60Hz & 230VAC/50Hz, amb ient 25°C at 24 hours/day, 365 days year, 6 power-up cycle/daY

All specifications are typical at nominal input, full load, at 25°C ambient unless noted.

EMI/EMC COMPLIANCE

Conducted Emissions	EN55022/CISPR22 Class B. FCC Part 15.107, Class 13: 6db margi n type, et 115VAC, and 230VAC
Radiated Emissions	EN55022/CISPR22 Class 8, FCC Part 15.109, Class 13: 3db margi n type, et 115VAC and 230VAC
Electro-Static Discharge (ESD) Immunity on Power Ports	EN55024/IEC61000-4-2, Level 4:111kV contact, $_{.0}$ *SCV air,* Criteria A
Radiated RF EM Fields Susceptibility	EN55022/EN61000-4-3, 10V/m, 80MHz-2.7G/k 80%AM at 1kHz
EFT/Burst Immunity	EN55024/IEC61000-4-4, Level *A,* 1.4.4kV, 100kHz rep rate. 408. Cr iteria A
Surges, Line to Line (DM), and Line to Gr ound (CM)	EN55024/IEC61000-4-5, Level *8.* 62l& DM, 64kV CM, Criteria A
Conducted RF Immunity	EN55022/IEC61000-4-6, 3.6V/m – Level 4, 0.15MHz to BOMHr and 12V/m in ISM and amateur radio bends between 0.15MHz and 80MHz, 80%AM at 1kHz
Power Frequency Magnetic Field Immunit y	EN55024/IEC1000-4-8, Level 4:30 Wm, 50Hz/60Hz
Voltage Dip Immunity	EN55024/IECEN61000-4-11: -100% dip for 20mS, Criteria A -100% dip for 5000mS (250/300 cries), Criteria B -60% dip for 100mS, Crit eria B -30% dip for 500rnS, Criteria A
Harmonic Current Emissions	EN55011/EN61000-3-2, Class A
Flicker Teat	EN61000-3-3
Common Mode Noise	High Frequency (100kHz-20MHz): <40mA pk-pk

SM08 User Manual Revision 0.1
TE10 Oetasheet v0819

Documents / Resources

	singmai SM05 NTSC PAL Video Encoder Module [pdf] User Manual SM05, NTSC PAL Video Encoder Module, SM05 NTSC PAL Video Encoder Module, Video En coder Module, Encoder Module

References

- PT13 IP Core - Free Download - Compact Microprocessor for Altera FPGAS - SingMai Electronics
- PT8 IP Core - Broadcast Quality Analogue Video Encoder (NTSC & PAL) - SingMai Electronics
- Terasic - USB Blaster Cable - USB Blaster Download Cable