

# **FEATURES**

#### MULTI-CHANNEL DIGITAL AUDIO SOLUTION

- FOR DVD AND CD PLAYERS
- PC AUDIO SYSTEMS
- HOME THEATRE WITH SURROUND
- 6x35W, 1x70W

#### TYPICAL PERFORMANCE

- THD+N < 0.08% (1W, 1kHz)
- SNR: 89dB (A-weighted)
- 88% EFFICIENT AT 30W

#### INPUT/OUTPUT

- S/PDIF COAX/OPTICAL (STEREO)
- I<sup>2</sup>S INPUT/OUTPUT (6.1 CHANNELS)
- Intel AC`97 LINK INPUT INTERFACE
- SAMPLE RATES FROM 32 TO 96kHz
- STEREO ADC ANALOG INPUT

#### DIGITAL PREAMP FEATURES

- VOLUME, BALANCE
- BASS, TREBLE

TECHNOLOGY, INC.

- PARAMETRIC EQ
- ANTICLIPPING, AUTO MUTE
- BASS MANAGEMENT

# EB-5160 DDX 6.1 Channel Evaluation Amplifier

### **GENERAL DESCRIPTION**

The EB-5160 is an evaluation amplifier that showcases Apogee's patented all-digital, high efficiency Direct Digital Amplification (DDX®) technology. The board features two DDX-4100 Controllers and four DDX-2060 Power Devices which provide full digital audio preamplifier functions and power amplification for seven channels. The board includes coaxial and optical S/PDIF interfaces, analog input, digital volume, balance, bass, treble and EQ controls and local power regulation. Automatic fault protection guards the system from excess voltage, current and temperature.

### **ORDERING INFO**

EB-5160 – DDX 6.1 channel evaluation amplifier



This is preliminary information on a new product. Details are subject to change without notice. Document # 09010001-03 February 2002

EB-5160 BLOCK DIAGRAM

# **Recommended Operating Conditions [1]**

#### EB-5160

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
VL	Logic Power supply voltage - J4 Terminal block	6.5	7.0	15	V
VB+	H-Bridge Power supply voltage - J2 Terminal block	9	28	30	V
VIH	Logic inputs, High - J5, J6, J9 Headers	2.7		3.6	V
VIL	Logic inputs, Low - J5, J6, J9 Headers			0.65	V
Fs	PCM Input Sample Rate - SRC enabled	32		96	KHz
VinA	Analog Inputs - J20,J22			1.3	Vpk
T <sub>A</sub>	Ambient Temperature	0		70	°C

1. Performance not guaranteed beyond recommended operating conditions.

## **Electrical Characteristics [2]**

Refer to circuit Sheets 1-10. VB+=28V, f=1kHz, TA=25C, RL=8 $\Omega$ , and measurement bandwidth 20kHz.									
SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNIT			
De	Output power - L, C, R, LS, RS, E	THD+N <1%		33		Wrms			
PO	Output power - SUB	THD+N <1%, RL=4 $\Omega$		65		Wrms			
VB+ <sub>TH</sub>	Over voltage Protection Threshold		30	35		V			
VB+ <sub>TL</sub>	Under voltage Protection Threshold			7	9	V			
١L	VL supply current - J4 Power	VL= +7.0V	250	440	550	mA			
	VB+ supply current in Powerdown	SW2 POS3, 4,5,6 closed.		3	5	mA			
	VB+ quiescent current	Damped State (Muted) SW2 POS3, 4,5,6 open.		105		mA			
I <sub>B+</sub>	VB+ supply current - J2 Power	7-Chan. switching at 384KHz. Dither signal applied at J6		281		mA			
		All channels driven to full scale output			12	А			
Isco	Short circuit output current limit	L, C, R, LS, RS, E Outputs	3.0	5.0	6.5	А			
		SUB Output	6.0	10	13	A			
THD+N	Total Harmonic Distortion + Noise	Po=1.0 Wrms Po= 33 Wrms		.08 .31	.20 .55	%			
SNR	Signal-to-Noise Ratio, all channels	A-weighted		89		dB			
η	Efficiency (Single DDX-2060 driven), VB+ Supply only	Po=2 x 33W		88		%			
СХ	Output Channel Cross Talk, (all VB+ supplies linked)	Left output at -6 db FS: To Right channel To other channels		-74 -80		dB dB			

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2. Characteristics are for the DDX-2060 power device driven by DDX-4100 processor.



### **EB-5160 OVERVIEW**

The EB-5160 is an all-digital audio amplifier evaluation board that demonstrates the application of Apogee's DDX-4100/2060 chip set to multi-channel audio.

### HARDWARE DESCRIPTION

The EB-5160 amplifier consists of up to 7 channels of audio amplification rated at 6x35W + 1x70W. There are two DDX-4100 processing ICs and four DDX-2060 power devices on this board. The system may be configured for 2.1, 4.1, 5.1, and 6.1 channels. The default board setup is 5.1 channels. The EB-5160 is shipped with jumpers placed to configure the board for two Analog inputs, sent to all channels. Figure 12 shows the physical location of connectors and configuration switches and jumpers.

A Graphical User's Interface (GUI) is included with the board. The GUI communicates I<sup>2</sup>C serial information through the PC's parallel port in accordance with the protocol detailed in section 11 of the DDX-4100 datasheet. Additional control and status bits are sent and monitored via the parallel port as well. Once configured(SW2: POS2 closed, see Fig. 12), the parallel port connector can be removed without causing settings to change. The hardware circuit is described on Sheet 8 of the schematic and consists of a DB25 connector and with a one to one pin mapping from the PC's parallel port and several inverting buffers to send and receive information.

### **DDX-4100 OVERVIEW**

The DDX-4100 Controller is a 3.3V digital integrated circuit that converts serial PCM digital audio signals into PWM drive signals. These PWM signals are then amplified by the DDX-2060 for audio output. The device supports volume, bass, treble, 4 biquad EQ stages, muting and anti-clipping functions under  $I^2C$  control. A block diagram of the device is shown in Figure 1.



Figure 1 - DDX-4100 Block Diagram

### DDX-2060 OVERVIEW

The DDX-2060 Power Device is a dual channel H-Bridge that can deliver over 35 watts per channel of audio output power. The DDX-2060 includes a logic interface, integrated bridge drivers, high efficiency MOSFET outputs and protection circuitry. Two logic level signals per channel are used to control high-speed MOSFET switches to connect the speaker load to the input supply or to ground in a bridge configuration, according to Apogee's patented damped ternary PWM. The DDX-2060 includes thermal. and over-current. over-voltage protection and under-voltage lockout with automatic recovery. A thermal warning status is also provided.



Figure 2 - DDX-2060 Block Diagram



### SCHEMATIC DESCRIPTION

#### S/PDIF INPUT INTERFACE (Sheets 2 and 3)

Each of the two DDX-4100 controllers has a direct S/PDIF connection available. The EB-5160x accommodates either coaxial or optical S/PDIF digital audio interfaces. Either input may be selected by moving jumper J8 or J11. Connect pins 1-2 for optical or pins 2-3 for coaxial S/PDIF. The DDX-4100 will support sample rates from 32kHz to 96kHz, with an internal sample rate converter (SRC).

#### ANALOG INPUTS (Sheet 9)

Stereo analog inputs can be brought through RCA connectors J20(Left) and J22(Right). These signals are converted to digital by analog to digital converter U15, and may be jumper connected to any I<sup>2</sup>S data signal.

# DIGITAL SIGNAL PROCESSING (Sheets 2 and 3)

The DDX-4100 converts pulse code modulated, PCM, digital audio input signals into pulse-widthmodulated, PWM, digital output signals. As supplied, the EB-5160 is configured to use the internal sample rate converter, SRC, in the DDX-4100. When the SRC is enabled all PCM input sample rates are converted to a fixed PWM output rate determined by the clock frequency applied to the XTI input. The EB-5160 is configured with a 24.576MHz crystal, which corresponds with a PWM output rate of 384KHz, or an effective sample rate of 48KHz. SRC bypass is provided for applications that supply a synchronous master clock derived from the PCM data source. As with all digital audio systems synchronous clocking should be used for the highest guality output. Refer to the DDX-4100 datasheet for more information on the SRC. Signals from I<sup>2</sup>S or the S/PDIF receiver are applied as inputs to the DDX processor. Output PWM signals from the DDX processor are applied to the inputs of the DDX power stage.

The DDX-4100 has independent volume control registers that have an adjustment range from 0dB to -111dB in 1.5 dB increments. Tone control registers boost or cut the treble and bass by 12dB, in 2dB steps. EQ filters are IIR biquads configurable by programmable coefficients. The

DDX-4100 Filter Editor program is provided to simplify generation of the filter coefficients.

#### MCU

An expansion provision is available for an MCU control interface. A PIC16 microcontroller with a multi-input ADC is installed at position U1(Sheet 10) to implement a master volume control as well as three volume controls; one for left, center and right, one for surround channels, and one for the subwoofer. These levels are adjusted using four on-board potentiometers. The DC voltages set by the potentiometers are read by the microcontroller interfaced to the I<sup>2</sup>C input of the DDX-4100. For MCU control, make sure J19, pins 3 and 5 are shorted, and pins 4 and 6 are shorted, and J24 pins 2 and 3 are shorted. Refer to Sheet 8 of the Schematic. Expansion Header J1 controls I<sup>2</sup>S or S/PDIF input selection. Shorting J1, pins 1 and 2 selects S/PDIF input. Removing the short selects  $I^2S$ . Additional pins on J1 are provided for custom interface development.

#### POWER OUTPUT (Sheets 4 to 7)

The DDX-2060 provides power amplification by translating logic level PWM signals into power level signals. These power level signals are applied to a passive two-pole lowpass filter to reconstruct the audio signal providing power to the load. The output filter functions to prevent unwanted switching frequency signals from reaching the load. A filter design for 80hm loads is shown on Sheets 4 to 6 of the schematic for reference.

The DDX-2060 is designed for stereo operation as either two independent full-bridges or for mono operation as one full-bridge with twice the current capability, enabling higher output power. The EB-5160 demonstrates both configurations. Sheet 7 shows the mono 70W at 40hm. configuration, for the subwoofer output.

Peak voltage on the DDX-2060 output and power pins must not exceed 40V. Snubbers are employed to protect the output MOSFETs from inductive transients, which can reach levels higher than the supply voltage. Output snubbers for the stereo implementation are R29 & C73 and R37 & C86 on Sheet 4 and the snubber for the mono implementation is R14/74 & C153 on Sheet 7.



A thermal warning indicator is activated by the DDX-2060 if the junction temperature exceeds 130°C. The thermal warning output is used to force the overtemperature LEDs (D5-D8 on Sheets 4 to 7) to change color from green to red. If Autoprotect is enabled, the overheating chip's channels will mute. The DDX-2060 shuts down when it reaches 150°C.



### SUPPLY VOLTAGE, REGULATORS (Sheet 1)

The EB-5160 features local power regulation for logic supplies. Separate inputs are available for logic supply as well as each of the four output power sections. This offers flexibility to run different speaker sets on different supply levels. All four power output supplies come strapped together with jumpers JP1-JP6 from the factory. These must be removed if more than one output power stage supply is to be used.

Input protection is provided for the amplifier by diodes D1-D4. These diodes will protect from overvoltage and reverse power connection.

Supervisor U2 is used for power-on-reset and power-off sequencing.

#### HEADERS (Sheets 2 and 3)

Headers J5 and J9 are PWM and  $I^2S$  outputs. They facilitate monitoring and debug. J6 has the  $I^2S/AC'97$  inputs for multi-channel operation. AC'97 and  $I^2S$  are the only input interfaces that support 4.1, 5.1 and 6.1 channel operation.

#### SWITCHES

Momentary pushbutton SW1 provides a global RESET signal. DIP switch SW2 has six switches. SW2: POS2 open selects AC'97, closed selects I<sup>2</sup>S input mode. Switches 3 thru 6 enable the four power outputs (Surround R/L, Front R/L, SUBW, and EFFECTS/CENTER) when in Open position. Default settings are positions 1 and 2 Closed and 3 through 6 Open. Refer to Demo Board Setup for operation.

#### POWER-UP, POWER-DOWN

Applying Logic Power, VL, then Output Power, VB+, is the preferred power on sequence. Removing VB+ then VL is the preferred power off sequence.

#### ADDITIONAL INFORMATION

#### BILL of MATERIALS

A bill of materials for the evaluation board is provided in Table 1 for reference. Note equivalent components from alternate manufacturers may be substituted. No warranty of system performance or fitness for use is implied by Apogee through use of the reference bill of materials.

#### PERFORMANCE MEASUREMENTS

Class D amplifiers produce measurable switching noise outside the audio bandwidth. Apogee's DDX amplifier uses a patented PWM modulation scheme that significantly reduces the size of these products compared to typical Class D designs. However, in order to obtain accurate performance measurements in the audio band (i.e., 20Hz to 20kHz), additional filtering is required.

The Typical Performance data in was taken using a AES17 brick wall filter with a break frequency of 20kHz. This type of filter is often provided as part of audio measurement systems.

Typical performance measurements for the evaluation board are shown in Figures 4 through 7.

### ALTERNATE CONFIGURATIONS

#### 6.1 Channel Configuration & Operation

To reconfigure the board for 7 discrete channels (6.1) operation, remove R23, near U7, pin 1. (See Sheet 3). Digital audio comes in through  $l^2S$ .

#### 4.1, 2.1 Channel Configuration & Operation

For bass redirection via 'Main' processor to SUBW channel, R79 and R81 must be removed. Zero-ohm jumpers must be installed in R78 and R80. These are found between J6 and LED D8 (see Sheet 7). Digital audio can be delivered on I<sup>2</sup>S for 4.1 channels, or S/PDIF for 2.1 channels. For 4.1 channels on S/PDIF, two stereo S/PDIF inputs must be used. Main and Aux controllers each provide two channels, and the Main controller can redirect the bass signal to a Subwoofer. This can be set up with the GUI.



## DEMO BOARD SETUP

This procedure contains three methods for configuring the production release EB-5160 RevC Demo Board. Please refer to the EB-5160 Datasheet or schematic and assembly drawing when using this procedure.

Described below are three methods for configuring the demonstration board.

- The first method is 5.1 discrete channels of operation using the I<sup>2</sup>S serial input interface. The demonstration board must be connected to the I<sup>2</sup>S outputs of an AC3 decoder IC, e.g. the STA310. This method is most appropriate for testing in a laboratory setting.
- 2. The second method is stereo operation using the analog interface. The serial digital output of the ADC can be tied to any stereo pair or operate all of the channels. This method is the simplest setup for demonstration purposes.
- 3. The third method is 2.1 channels of operation using the S/PDIF digital inputs. The S/PDIF input labeled "Main" either coaxial or optical input applies for the primary L,R channels. The S/PDIF input labeled "Aux" is for the subwoofer channel. This method is most appropriate for demonstrating true digital operation from a convenient digital source.





#### FIGURE 12 - DDX EVALUATION AMPLIFIER ASSEMBLY DRAWING



### Configure EB-5160 for 5.1 Channel operation using I<sup>2</sup>S serial digital input:

- 1. Jumper Selection
  - J19 pins 1-3 and 2-4 shorted and J24 pins 1-2 shorted. (PC operation)
  - J21 pins open. Must remove all shorting jumpers.
  - J23 pins 2-3 shorted (ADC slave mode)
- 2. <u>Dip Switch Selection</u>
  - Switch SW1 & SW2 in *Closed* position
  - Switches 3 6 control which output stage is on (*Open* = on)
    - SW3 controls U10 (SL, SR)
    - o SW4 controls U9 (L, R)
    - SW5 controls U12 (Sub) {4 Ohm}
    - SW6 controls U11 (C, E) {Effects channel for an 8 Ohm Sub.}
- 3. <u>Connecting to a computer</u>
  - Using the supplied parallel cable, connect JDP1 to the parallel port on your computer.
- 4. <u>Power connections</u>
  - Connect a 7 Volt DC power supply to J4 (logic power)
    - Negative connection is next to the bump on the terminal block. Positive connection has square pad on solder side of PCB.
  - Connect a 28 Volt DC power supply to J2 (output power) {9V to 30V DC power supply is OK. Board requires 28V for rated output power.}
    - Facing J2, the negative power connection is next to the bump on the terminal block with a positive connection next and then repeating in pairs of two (- +, +, +, +). Power can be applied to any of the terminal pairs. The square pad on the solder side of the PCB is the positive connection on the first power pair.
- 5. <u>I<sup>2</sup>S Digital Input connections</u>
  - Connect I<sup>2</sup>S signals from an AC3 decoder IC or test equipment at J6. The board defaults to the I<sup>2</sup>S serial protocol. See the DDX4100 datasheet for details.
    - Refer to schematic page 3 for connections. {L,R data to pin 1, LS,RS data to pin 3, C,Sub to pin 5,7, LRCK to pin 9, BCK to pin 11. GND to pins 2,4,6,8,10,12.} Do not exceed +3.3V levels on any of these signals. Also, signals should remain static {logic low level} until the board is configured to operate.
- 6. Speaker connections
  - Connect 8 Ohm speakers and a 4 Ohm subwoofer {recommended}.
    - o L,R,LS,RS,C outputs at J12, J13, J14, J15, J16 terminal blocks.
    - Connect an 8 Ohm subwoofer to the Effects output at J17 or a 4 Ohm subwoofer to the Sub output at J18. Both may be connected as well.
    - Negative speaker connections are next to the bumps on the terminal blocks. Positive speaker connections are at the square pads on the solder side of the PCB.
- 7. Configuring GUI
  - Run the EB5160 Control Panel (EB-5160.exe)
  - Apply power to logic J4 (+7V) and to output J2 (+28V)
  - Go to "Registers" page.
  - On "Registers" page under 'HW Reset/PWDN' press the *Reset* button.
  - On "Registers" page under 'I/O Test' **press** the *Test* button. The control panel should report "*Main Passed, Aux Passed*" indicating proper I2C communication with both IC's.
  - On "Settings" page, uncheck **DDX Reset** under the 'Commands' section.
  - On "Settings" page press *Turn ON* under the 'Commands' section.
  - On "Settings" page uncheck *Mute All* under the 'Controls' section.
  - Volume sliders L,R,LS,RS channels control outputs from the *Main IC* {U5}. Volume sliders CNT,EFX,LFE control outputs from the *Aux IC* {U7} or the *Main IC* {U5}.
  - Tone sliders control L,R channel outputs and the Selected {U7-L or U7-R} output.

#### Apogee EB-5160 Demo Board is now ready to operate!



#### Configure EB-5160 for Two Channel operation using Analog :

- 1. Jumper Selection
  - J19 pins 1-3 and 2-4 shorted and J24 pins 1-2 shorted. (PC operation)
  - J21 pins as follows:
    - Pins 1-2 shorted applies stereo data to L,R channels.
    - Pins 3-4 shorted applies stereo data to LS,RS channels.
    - Pins 5-6 shorted applies stereo data to C,E,Sub channels.
    - Pins 1-2, 3-4, 5-6 shorted applies stereo data to all channels.
  - J23 pins 1-2 shorted (ADC master mode)
- 2. Dip Switch Selection
  - Switch SW1 & SW2 in *Closed* position
  - Switches 3 6 control which output stage is on (*Open* = on)
    - o SW3 controls U10 (SL, SR)
    - SW4 controls U9 (L, R)
    - SW5 controls U12 (Sub) {4 Ohm}
    - SW6 controls U11 (C, E) {Effects channel for an 8 Ohm Sub.}
- 3. <u>Connecting to a computer</u>
  - Using the supplied parallel cable, connect JDP1 to the parallel port on your computer.
- 4. <u>Power connections</u>
  - Connect a 7 Volt DC power supply to J4 (logic power)
    - Negative connection is next to the bump on the terminal block. Positive connection has square pad on solder side of PCB.
    - Connect a 28 Volt DC power supply to J2 (output power) {9V to 30V on the terminal block with a positive connection next and then repeating in pairs of two (-+, -+, -+, -+). Power can be applied to any of the terminal pairs. The square pad on the solder side of the PCB is the positive connection on the first power pair.
- 5. Analog Input connections
  - Connect an analog source to RCA connectors J20 {Left} and J22 {Right}. Note, analog signals above 1.3V peak will saturate the ADC inputs. Disconnect signals from the J6 header {I2S/AC97 inputs} to prevent signal contention.
- 6. Speaker connections
  - Connect 8 Ohm speakers and a 4 Ohm subwoofer {recommended}.
    - o L,R,LS,RS,C outputs at J12,J13,J14,J15,J16 terminal blocks.
    - Connect an 8 Ohm subwoofer to the Effects output at J17 or a 4 Ohm subwoofer to the Sub output at J18. Both are OK.
    - Negative speaker connections are next to the bumps on the terminal blocks. Positive speaker connections are at the square pads on the solder side of the PCB.
- 7. <u>Configuring GUI</u>
  - Run the EB5160 Control Panel (EB-5160.exe)
  - Apply power to logic J4 (+7V) and to output J2 (+28V)
  - Go to "Registers" page.
  - On "Registers" page under 'HW Reset/PWDN' press the *Reset* button.
  - On "Registers" page under 'I/O Test' **press** the *Test* button. The control panel should report "*Main Passed, Aux Passed*" indicating proper I2C communication with both IC's.
  - On "Settings" page, uncheck DDX Reset under the 'Commands' section.
  - On "Settings" page press *Turn ON* under the 'Commands' section.
  - On "Settings" page uncheck *Mute All* under the 'Controls' section.
  - Volume sliders L,R,LS,RS channels control outputs from the *Main IC* {U5}. Volume sliders CNT,EFX,LFE control outputs from the *Aux IC* {U7} or the *Main IC* {U5}.
  - Tone sliders control L,R channel outputs and the Selected {U7-L or U7-R} output.

### Apogee EB-5160 Demo Board is now ready to operate!



### Configure EB-5160 for 2.1 Channels operation using S/PDIF inputs

- 1. Jumper Selection
  - J8 selects either optical (U6) or coaxial (J7) inputs for the main processor (U5).
    - Pins 1-2 shorted for coaxial
    - Pins 2-3 shorted for optical
  - J11 selects either optical (U8) or coaxial (J10) inputs for the auxiliary processor (U7).
    - Pins 1-2 shorted for coaxial
    - Pins 2-3 shorted for optical
  - J19 pins 1-3 and 2-4 shorted and J24 pins 1-2 shorted. (PC operation)
- 2. Dip Switch Selection
  - Switch SW1 & SW2 in *Closed* position
    - Switches 3 6 control which output stage is on (*Open* = on)
      - SW3 controls U10 (SL, SR)
        - o SW4 controls U9 (L, R)
        - SW5 controls U12 (Sub) {4 Ohm}
        - SW6 controls U11 (C, E) {Effects channel for an 8 Ohm Sub.}
- 3. <u>Connecting to a computer</u>
  - Using the supplied parallel cable, connect JDP1 to the parallel port on your computer.
- 4. <u>Power connections</u>
  - Connect a 7 Volt DC power supply to J4 (logic power)
    - Negative connection is next to the bump on the terminal block. Positive connection has square pad on solder side of PCB.
  - Connect a 28 Volt DC power supply to J2 (output power) {9V to 30V DC power supply is OK. Board requires 28V for rated output power.}
    - Facing J2, the negative power connection is next to the bump on the terminal block with a positive connection next and then repeating in pairs of two (-+, -+, -+, -+). Power can be applied to any of the terminal pairs. The square pad on the solder side of the PCB is the positive connection on the first power pair.
- 5. <u>S/PDIF Input connections</u>
  - Connect an S/PDIF PCM (<u>not AC3</u>) digital source {L,R}either coaxial or optical at J7 or U6 for the *Main IC* {U5} and/or another {C,Sub} at J10 or U8 for the *Aux IC* {U7}. Select the appropriate jumper connections from above.
- 6. <u>Speaker connections</u>
  - Connect 8 Ohm speakers and a 4 Ohm subwoofer.
    - L,R outputs at J12,J13 terminal blocks.
    - Connect a 4 Ohm subwoofer to the Sub output at J18
    - Negative speaker connections are next to the bumps on the terminal blocks. Positive speaker connections are at the square pads on the solder side of the PCB.
- 7. Configuring GUI
  - Run the EB5160 Control Panel (EB-5160.exe)
  - Apply power to logic J4 (+7V) and to output J2 (+28V)
  - Go to "Registers" page.
  - On "Registers" page under 'HW Reset/PWDN' press the Reset button.
  - On "Registers" page under 'I/O Test' **press** the *Test* button. The control panel should report "*Main Passed, Aux Passed*" indicating proper I2C communication with both IC's.
  - Go to "Settings" page.
  - On "Settings" page, under 'Input Interface' section, select the S/PDIF option.
  - On "Settings" page, uncheck **DDX Reset** under the 'Commands' section.
  - On "Settings" page press *Turn ON* under the 'Commands' section.
  - On "Settings" page uncheck *Mute All* under the 'Controls' section.
  - Volume sliders L,R control outputs from the *Main IC* {U5}. Volume slider LFE controls output from the *Aux IC* {U7} or the *Main IC*{U5}. <u>S/PDIF input applies only to the L,R</u> channels on the *Main IC* and R {Sub} channel on the *Aux IC*.
  - Tone sliders control L,R channel outputs and the Selected {U7-L or U7-R} output. Apogee EB-5160 Demo Board is now ready to operate!

# **GUI: Settings Page**

∯EB-5160 Control Panel	×
Settings Registers	
Settings   Registers     Mute   Controls     Volume L   0.0 dB     Volume R   0.0 dB     Volume LS   0.0 dB     Volume RS   0.0 dB     Volume CNT   0.0 dB     Volume EFX   0.0 dB     Volume SUB   0.0 dB     Volume SUB   0.0 dB     Mute All   Lock L/R Volume     Left/Right Bass   Bypass     Center/Sub Bass   Bypass     Center/Sub Bass   Bypass	Power Status Thermal Warn. L/R Thermal Warn. LS/RS Thermal Warn. LS/RS Thermal Warn. C/E Thermal Warn. C/E Thermal Warn. SUB AC97 Control Full Compliant PS Serial Control Bit Clock Polarity HIGH DDX-4100 Status - Main SRC Lock SPDIF Lock DDX-4100 Status - Aux DDX-4100 Status - Aux
Center/Sub Treble Bypass Side Firing Phantom Center Bass Redirection Center Chan. Source O U7-LS O U7-L O U5-CNT O U7-RS O U7-	n SRC Lock SPDIF Lock Output Interface Ce Subwoofer Chan. Source 'R © U7-R © U5-LFE LB Clock Polarity LOW ▼
Main   Aux     Static EQ   Static EQ     DSP Bypass   DSP Bypass     SRC Bypass   SRC Bypass     DDX® Zero Detect   DDX® Zero Detect     DDX® Compression   DDX® Compression     DDX® Extended Gain   1x No Compression     SRC Threshold   SRC Threshold     61.125 kHz   Image: Compression	Commands   Alignment     Image: Tool Tips   Master     DDX® Reset   Image: Turn OFF     Standby   Load Settings     Save Settings   Image: Tool Settings
EB-5160 Control Panel © Apogee T	echnology, Inc.

"Tool Tips" automatically display the function of each control. For instance, if you position the cursor over "SRC Bypass" in the Main area (lower left), the tip will display: **SRC Block Bypassed, Input Directly Connected to DSP.** 



# **GUI: Registers Page**

BEB-5160 Control Panel	×
Settings Registers	
Load/Save Coefficients	Manual I/O Control
Filename <pre></pre>	Device Control
Load Coef. File Save Coef. File Write Coef. Mem. Read Coefficients	MAIN (U5) ADD 0 ADX (U7)
Coefficient File Comments	
	Register I/O
Main Coefficients   Aux. Coefficients     Coefficient   Value     LR00   00000     LR01   00000     LR02   00000     LR03   00000     LR04   00000     LR11   00000     LR12   00000     LR13   00000     LR14   00000     LR20   00000     LR21   00000     LR22   00000     LR23   00000     LR24   00000     LR31   00000     LR44   00000     LR53   00000     LF23   00000     LF23   00000     LF23   00000     LF23   00000     LF	Address Data 00 <-Hex-> 0x00 0 <-Dec-> 0 Read Register Write Register 1/0 Test Autofind LPT 0x378 HW Reset/PWDN Reset Before Testing Test Board 1/0 Reset Reset Unknown Aux Unknown

DDX-4100 registers can be written or read from the **Registers** window. **Load/Save Coefficients** handles the EQ Coefficients File (see next page). Main and Aux Coefficients display the EQ Filter coefficients. **Manual I/O Control** lets users read and write to individual, named registers.



# **FILTER EDITOR**

DDX4100 Filter Editor						
Left/Right Surround Left/Sur	round Right   Center   Subwool	fer 🛛 * All Channels * 🗍				
95 db						
	125 250 500	1.k2.k	4 k 8 k 16			
Gain Freq Q 60 1.007	Gain Freq Q -15 1008 1.414	Gain Freq Q -13 3059 2.404	Gain Freq Q +14 11213 2.134			
Hipass C Parametric Lopass C 0#	O Hipass ⊙ Parametric	C Hipass ⊙ Parametric	C Hipass ⊙ Parametric			
Stable: Yes	Stable: Yes	Stable: Yes	Stable: Yes			
Note: to set a parameter to a precise value, right click on the related knob. Scaling: -12.94 dB						
Help Write File						

Create filters by right-clicking mouse to add points, then drag points with mouse, or by selecting type of filter, clicking on knob and moving mouse up or down. When filter is complete, click "Write File...". This file is used by the GUI to write EQ filter coefficients into DDX-4100 chips on the EB-5160.



# SHEET 1: REGULATORS AND FILTERS





# SHEET 2: DDX-4100 MAIN PROCESSOR



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# SHEET 3: DDX-4100 AUX PROCESSOR



This is preliminary information on a new product. Details are subject to change without notice. Document # 09010001-03 February 2002 February 2002

R21.

NOT USED:

# SHEET 4: L & R OUTPUTS



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# SHEET 5: LS & RS OUTPUTS



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# SHEET 6: C & E OUTPUTS



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# SHEET 7: SUBWOOFER OUTPUT



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## **SHEET 8: PC INTERFACE**



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# SHEET 9: ANALOG INTERFACE



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SHEET 10: MCU



# Typical Performance Characteristics at Vcc = 28V, $8\Omega$ load.

Fig 4: Frequency Response: Left Channel SRC bypassed(top), SRC active(bottom)



Fig 6: Left Chnl. THD+N vs. Output Power



%

Fig 8: Left ChnI.THD+N vs Frequency 10W (top), 1W(btm)



APOGEE-TECHNOLOGY, INC.



Fig 5: Frequency response: Subwoofer

Fig 7: SUBW THD+N vs. Output Power



Fig. 9: SUBW THD+N vs Frequency 20W



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# Fig 10: FFT: 1W, 44.1kHz Fs

Fig.11: IMD: -3dB, 19 & 20kHz, 44.1kHz Fs



Note: The FFT plots are scaled in dBV (relative to 1Vrms) not dB relative to full scale output. Relative to full scale output, subtract 24dB from the FFT plot's Y-axis.



## **BILL OF MATERIALS**

APOGEE TECHNOLOGY 129 MORGAN DRIVE NORWOOD, MA 02062 Voice 781-551-9450 Fax 781-440-9528 EB-5160 DDX Evaluation Board / Reference Design 5.1 Channels PCB P/N 721-00321 PL10702-301 REV B

Bill Of Materials for Assembly August 15, 2001 Proprietary Information

Item	Quantity	Reference	Part	Description	Package	Mfr. Part No.
1	40	C1,C2,C3,C4,C5,C6,C7,C31,	100nF	Capacitor, Ceramic, Y5V, 100nF, 25V, +80/ -20%	Chip 0805	ECJ-2VF1E104Z
		C32,C33,C37,C38,C39,C40,				
		C41,C42,C43,C44,C45,C46,				
		C51,C52,C53,C54,C55,C56,				
		C57,C58,C59,C60,C68,C77,				
		C94,C103,C120,C129,C143,				
		C152,C159,C160				
2	26	C65.C70.C74.C80.C81.C87.		Capacitor, Ceramic, X7R, 100nF, 50V, 10%	Chip 0805	ECJ-2YB1H104K
		C88.C91.C96.C100.C106.C107.				
		C113 C114 C117 C122 C126				
		C132 C133 C139 C140 C144				
		C157.C158.C164.C168				
3	12	C64 C76 C79 C89 C90 C102		Capacitor, Polyester Film, 100nF, 100V, 5%	Radial W3.5/I 7.2mm	2222 370 22104
		C105 C115 C116 C128 C131 C141				
		AI TERNATE		Capacitor Ceramic X7R 100nE 50V 10%	Chip 1206	FC4L3VB1H104K
4	3	C8 C171 C172	47nF	Capacitor Ceramic NPO 47nE 50V 5%	Chip 0805	EC.I-2VC1H470.I
	, in the second	AI TERNATE	ii pi		0110 0000	ECLI-V1H470.ICG
5	10	C9 C10 C11 C12 C13 C15	4 7nE	Capacitor Ceramic X7P 4 7nE 50V 10%	Chip 0805	EC L2/B1H472K
	15	C17 C18 C19 C20 C21 C22	4.710		0110 0000	EGG-2VBIIHIZI
		C23 C24 C25 C26 C30 C34			1	
		C35				
6	24	C14 C66 C71 C72 C82 C84	10nE	Capacitor Ceramic X7R 10nE 50V 10%	Chin 0805	EC.1-21/B1H103K
	27	C85 C92 C97 C98 C108	1011		0110 0000	E00-24Birrioor
		C110 C111 C118 C123 C124				
		C134 C136 C137 C147 C149				
		C150, C162, C167				
7		0100,0102,0107				
0	2	C17 C174	100 JE	Consister Aluminum Electrolitic EC Series 100uE 251/ 200/	Dadial DC 2/U11 2/LC2 0/ Emm	EEU EC1E1018
0	2	C27,C174	1000F	Capacitor, Aluminum Electrolytic, PC-Series, 1000P, 25V, 20%	EIA Sizo R	ECS TO 12226D
9	1	C28,C29,C30,C47,C30,C81,C173	220F	Capacitor, Tantalum Electrolytic, 220F, 0.3V, 20%	Chip 0905	EC3-100A220R
10	4	087 003 0110 0143	1000 JE	Capacitor, Ceramic, NFO, TopF, 50V, 5%	Crip 0805	
10	4	007,093,0119,0142	1000uF	Capacitor, Aluminum Electrolytic, FC-Series, 1000uF, 35V, 20%	Radial D10/H20/E37.57.01111	2222 270 12474
12	0	C135 C161 C165	4701	Capacitor, Polyester Film, 47011, 037, 378	Naulai W4.3/E7.2/11/1	2222 370 12474
10	6	C135,C101,C105	220mF	Conscient Commin X7D 220nE 100V/ 109/	Chip 0905	EC 1 0/ P043211/
14	0	C75 C78 C101 C104 C127	1uE	Capacitor, Ceramic, X7P, 1uE, 50V, 10%	Chip 1912	C1912C105K5DAC
14	0	C130 C146 C155	iui	Capacitor, Ceramic, X/R, Tur, 30V, 1078		C1812C103N3IVAC
				Capacitor Tantalum Electrolutic 1uE 351/ 20%	EIA Sizo P	ECS T1\/Y105P
15	4	C163 C160 C166 C170		Capacitor, Tantalum Electrolytic, 101, 337, 2076		
10	4	C105,C109,C100,C170	220mF	Capacitor, Talitalum Electrolytic, TuF, 16V, 20%	EIA JZE A	2000 270 40004
10	4	C145,C146,C154,C156	2201F	Capacitor, Polyester Film, 2201F, 63V, 5%	Radial W3.3/L7.2000	2222 370 12224
10	1	C153	1.001 690nE	Capacitor, Coramic X7D, 690nE, 100V, 10%	Chip 0905	EC 1 21/02/091K
10	4	0100	25V	Diada TVS 1.5KW Uni Diractional 20V Standoff 25.9VPD 7%	CUDU CUDU CUDU CUDU CUDU CUDU CUDU CUDU	
19	4			LED T4 2/4 Creen/Ded Milite Diffused	51VIC5	L NI41MD02
20	4	LO, LO, U/, LO		LED, 11 5/4, Green/Red, White Diffused	TT 374/ 0.1" spacing	LINT IVVP23
21	1		LUNDED	Droub Connector, 20-pin, Male, PCD-MOUNT, Right Angle	0.100 Centers	1412304
~ ~ ~	8	JF 1,JF2,JF3,JF4,JF5,JF6,JF7,JP8	JUMPER	Duss wire Jumper, 22 AWG	0.100 Centers	TOW 106 07 6 D 11
23	2	01,10	EAPANSIUN, IZS/AC97	rieduer, 12-pill, 2A0, U. IU Spacing.	0. TOU CENTERS	13W-100-07-3-D-LL
24	1	JZ	PVVK	Connector, Terminal Block Mug, 5.08mm, 14-30 AWG, Eight-position	0 X 5 00mm	1729100
20	ð 2	0 IE		Connector, Terminal Block Plug, 5.06mm, 14-30 AVVG, TWO-position	2 x 3.00/fm	1/29120 TOW 100.07 C D LL
20	2	13,13		neauer, ro-pin, 2A9, U.TU spacing.	U. TUU Centers	1 3W-109-07-3-D-LL
27	4	J7,J10,J20,J22	S/PDIF,LEFT,RIGHT	KCA Priorio connector, Right Angle PCB, Tin Plate	0.400.0	901 TOM 400.07.0.0.11
28	4	J8,J11,J23,J24	INPUT, M/S	Header, 3-pin, 1x3, 0.10 spacing.	0.100 Centers	15W-103-07-5-5-LL
29	2	J 13,JZ I	IZU SELECT, ADC	neauer, o-pin, 2X3, U. IU spacing.	0.100 Centers	1 3W-103-07-3-D-LL
30	8	Usea on J8,J11,J19,J21,J23, J24.	JUMPERS	Shorung Jumper	0.40	SPUUZSYAN
31	12	L1,L2,L3,L4,L5,L11,L14,	FERRITE	Choke, Common- Mode Ferrite, SMD, 10A, 63 Ohms at 100MHz	SMD	CIVI3322X630R-00
		L17,L20,L23,L26,L29				
	<u> </u>	ALIERNAIE	5 1 450	Choke, Common-Mode Ferrite, 10A, 170 Ohms at 100MHz	Radial	CIVI2545X111B-00
32	4	Lb,L8,L35,L36	⊢errite 150	Ferrite Cnip, EMI Supression, SMD, 150 Ohm @100MHz, 0.2A	Chip 0805	HZ0805E601R-00
33	3	L7,L9,L31	100nH	Inductor, SMD, 100nH, 10%, 300mA	Chip 0805	LL2012-FR10K



# **BILL OF MATERIALS (continued)**

H     U     No.11 (3) (3) (3) (3) (3) (3) (3) (3) (3) (3)	33	3	L7,L9,L31	100nH	Inductor, SMD, 100nH, 10%, 300mA	Chip 0805	LL2012-FR10K
Image: Solution of the state state of the state s	34	12	L10.L12.L13.L15.L16.L18.	22uH	Inductor, 22uH, 5%, 2.0A, .062 DCR	Radial D8.5/H11/LS5mm	
Image: https://www.section.org/limits/section.o					Inductor, 22uH, 10%, 2.0A, .062 DCR		
Image     AlterNation     Image Description     Image Desco			L19.L21.L22.L24.L25.L27				
9     2     28.13     99.44     Polart 100, 145, 031021     Bodat 5.40017     Bodat 5.40017.00, 280170     Poly-100170       98     1     Poly-100170     Poly-100170     Poly-100170     Poly-100170     Poly-100170       98     2     Restar 5.400170     Status 5.500170     Poly-100170			ALTERNATE		Inductor, 22uH, 5%, 6.1A, .046 DCR	Radial D.450/H.710/LS.290	RL-5480-4-22
Image: Base International Automatic Data Tools, Tao, 190, 190, 190, 190, 190, 190, 190, 190	35	2	L28.L30	10uH	Inductor, 10uH, 10%, 8.8A, .031 DCR	Radial D.450/H.710/LS.290/.032	RL-5480-4-10
38     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     2     1     1     2     1		_	AI TERNATE		Inductor 10uH 10% 10A 01 DCB	Badial D 61/H 83/I S 50/ 054	PCV-2-103-10
37     1	36						
58     8     6 A G5 00 72 80.0 210 011     20004     Trewsiter, MN, 3007, 400 CED     507.3     PMAT1304       91     2     R15,8     FULL     State     FULL     State     FULL     State       40     2     R15,8     FULL     FULL <td>37</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	37						
30     2	38	8	04 05 06 07 08 09 010 011	2013004	Transistor NPN 330mW 40V CEO	SOT-23	EMMT3004
40     2     01.54     01.0     Patterine international states that fight angle conservations     0.0000     Diversions     Diversions <thdiversions< th=""></thdiversions<>	30	2	P2 P5	10k	Potentiometer 10k 9mm Audio Linear taner Right angle	0.100 Centers	EVILE24E25B14
41     2     8, 12, 21, 84, 22, 83, 24, 84, 36, 96, 14     Based Column C	40	2	P1 P4	IOK	Potentiometer, 10k, 9mm Audio, Linear taper, Right angle Potentiometer, 10k, 9mm Audio, Linear taper, Right angle, Center Detent	0.100 Centers	EVILE34E25B14
1     2     6 Mark Mark Barg Mark Mark Mark     Concerning Mark Mark Mark Mark Mark Mark Mark Mark	40	21	P6 P12 P18 P25 P32 P43		Resistor, Chin, Thk Film, 10K, 5%, 1/10W, 200nnm	Chip 0805	EP L6GEV 1103V
Nort Star Star Star Star Star Star Star St	71	21	DE4 D70 D92 D92 D96 D90		Resistor, Onip, The Film, Tole, 5%, 1710W, 200ppm	Chip 0000	210-002131030
International Status     Add Status     <			R04,R70,R02,R03,R00,R03, R04 R04 R06 R07 R08 R00				
4     1     NOME OF NAME     49     Residue CND, The Fan, 438, 1%, 110W, 100ppm     Che 0805     ER.JEEN3       45     4     1     R112L13     48.9     1     R112L13     R11			P100 P101 P102				
44     3     NSLE2X3     49.9     Pender Chip, Int Film, 142, 1%, 17.04     Chip Cole     Pender Chip     Pender Chip       44     -	40	0	R100,R101,R102	40.0	Desister Ohio This Film 40.0 4% 4/40M/ 400-per	Chi= 0005	
3     6     7.5     7.6	42	3	R3,L32,L33	49.9	Resistor, Chip, Thk Film, 49.9, 1%, 1/10W, 100ppm	Chip 0805	ERJ-0ENF49R9V
H     I     R10     P11     Resider Chip, The Fink, 121, 1%, 1100, 100ppm     Dbp 0805     FILA ENFT200Y       46     I     R11     R10     200     Resider Chip, The Fink, 201, 1100, 100ppm     Dbp 0805     FILA ENFT200Y       47     I     R13, R15710,R22,R84,R87     3:58     Resider Chip, The Fink, 25, 55, 1100, 200ppm     Dbp 0805     FILA ENFT200Y       48     I     R13, R23,R28,R27,R82,R83,     0     Zen Orm Aumper, SM0 0005     Dbp 0805     FILA ENFT200Y       49     I     R19,R23,R28,R27,R82,R83,R83,R57,R03     -     Cen Orm Aumper, SM0 0005     FILA ENFT200Y     Explored Chip, The Film, 75, 55, 1100, 200ppm     Dbp 0805     ERJ ENFT200Y       50     2.5     R2, R27,R80,R81,R83,R55,R103     -     Cen Orm Aumper, SM0 0005     Dbp 0805     ERJ ENFT200Y       51     8     R14,R28,R73,R44,R42,R42     Cen     Centor, The Film, 3.05, 55, 110W, 200ppm     Dhp 1210     ERJ ENTT200Y       52     12     R03,R14,R42,R43,R58,R64,R5     300     Resider, Chip, The Film, 3.05, 5, 110W, 200ppm     Dhp 1210     ERJ ENTT200Y       54     8     R32,R32,R444,R44,R43,R58,R64,R5     <	43						
48     1     H10     H11     H100     H110     H100     H100 </td <td>44</td> <td></td> <td>210</td> <td>101</td> <td></td> <td>01.00005</td> <td></td>	44		210	101		01.00005	
44     6     1     R13.R15.R16.R22.R64.R87     3.0k     Relation (, mp., mk. min., abs, m. min., abs, m. mol., abs, m. mo	45	1	R10	121	Resistor, Chip, Thk Film, 121, 1%, 1/10W, 100ppm	Chip 0805	ERJ-6ENF1210V
47     6     H13.M18.202/M4.87     3.9k     Messador, Chej, In Kim, Jan, Sey, Turly, Zobgen     Cho Both     EH4.46Er, VJ20V       48     21     Relation, Chej, In Kim, Jan, Sey, Turly, Zobgen     Cho Both     EH4.46Er, VJ20V       40     19     H13.R23.R38.R27,R82.R83.     0     22 ro Chm Aunger, SM0 005     Chu Both     EH4.46Er, VJ20V       40     H13.R23.R38.R27,R82.R83.     0     22 ro Chm Aunger, SM0 005     Chu Both     EH4.46Er, VJ20V       41     RRM.R74.R87.R88.R80.     1     MEG     Relation, Chu, Thi Kim, 20, 5%, 140V, 200gpm     Chip 0805     EH4.46Er, VJ20V       51     8     R14.R42.R37.R48.R86.R13     20     Relation, Chu, Thi Kim, 20, 5%, 140W, 200gpm     Chip 0805     EH4.46Er, VJ30V       52     12     R03.R13.R38.R98.R61     20     Relation, Chu, Thi Kim, 20, 5%, 140W, 200gpm     Chip 0805     EH4.46Er, VJ30V       53     8     R33.R444.R48,R95.R68.R0.     300     Relation, Chu, Thi Rin, 30, 5%, 140W, 200gpm     Chip 0805     ER4.46Er/1472V       54     8     R83.R64.R47,R67.R60.     18K     Relation, Chu, Thir Rin, 30, 5%, 110W, 200gpm     Chip 0805     ER4.46Er/1472V	46	1	R11	200	Resistor, Chip, Thk Film, 200, 1%, 1/10W, 100ppm	Chip 0805	ERJ-6ENF2000V
44     10     12     R14,823,R27,R22,R27,R22,R62,R27,R62,R62     0     Zero     Chip 0805     Ch	47	6	R13,R15,R16,R22,R84,R87	3.9k	Resistor, Chip, Thk Film, 3.9K, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ392V
44     19     R19.823.R28,R27.M22.R33, R24.M25.R28,R27.M22.R33, R24.M25.R27.M23.R38,R93, R24.M25.R27.M23.R38,R93,R1103     0     Zero Chm, Junge, SMD 0065     Chip 0805     CRJ.45621/000V       51     6     R24.R25.R27.M21.R38,R93,R1103     Feastor, Chip, This Fam, 20, 5%, 110W, 200ppm     Chip 0805     CRJ.452       51     6     R24.R25.R27.M21.R38,R93,R114     Co     Resistor, Chip, This Fam, 20, 5%, 114W, 200ppm     Chip 1210     CRJ.474.200U       52     12     R20.R23     R34.R44     R44     Chip 1210     CRJ.474.200U       53     6     R23.R37.R38,R38,R1     Co     Resistor, Chip, This Fam, 52.5%, 114W, 200ppm     Chip 10805     CRJ.456.271.000U       54     6     R23.R58,R38,R1     Resistor, Chip, This Fam, 50.5%, 110W, 200ppm     Chip 0805     CRJ.456.271.00U       56     7     R7.771     3     Resistor, Chip, This Fam, 30.5%, 110W, 200ppm     Chip 10805     CRJ.456.271.01V       56     7     R7.876     Resistor, Chip, This Fam, 30.5%, 110W, 200ppm     Chip 0805     CRJ.466.271.02V       57     75     R8.860.R14.861.874.861.87.861     R8.860.700, This Fam, 150.5%, 110W, 200ppm     Chip 10805     CRJ.466.271.	48	2	R24,R17	75	Resistor, Chip, Thk Film, 75, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ750V
Red, Red, Red, Red, Red, Red, Red, Red,	49	19	R19,R23,R26,R27,R62,R63,	0	Zero Ohm Jumper, SMD 0805	Chip 0805	ERJ-6GEYJ000V
RT8.R79.R80.R81 (R83.R81,R03     V     Resister, Chip, Thk Film, 1MEG, 5%, 1/10W, 200ppm     Chip 0605     ERJ-6GEV 1069/       61     8     R14.R29.R37.R40.R48,R51     20     Resister, Chip, Thk Film, 20, 5%, 1/4W, 200ppm     Chip 0605     ERJ-404       62     12     R30.R37.R3.R3.R41,R42,     6.2     Resister, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0605     ERJ-60EV 1049/       63     8     R3.R3.R4.R44,R45,R58.R58,R61     -			R64,R65,R66,R67,R68,R69,				
60     2     R14,R28,R37,R40,R48,R51     1 MEC     Resistor, Chip, Thr. Film, 10W, 200ppm     Chip 1210     ER.14/1203U       2     12     R58,R74     A     A     A     A       2     12     R58,R74     A     A     A     A       3     8     R53,R38,R48,R42     6.2     Resistor, Chip, Thr. Film, 52, 5%, 140W, 200ppm     Chip 1210     ER.1-47/1204       4     R49,R58,R58,R68,R61     A     A     A     A       54     8     833,R38,R44,R42,R58,568     300     Resistor, Chip, Thr. Film, 300, 5%, 1/10W, 200ppm     Chip 0805     ER.466EY.J183V       54     8     R33,R38,R44,R42,R58,568     300     Resistor, Chip, Thr. Film, 300, 5%, 1/10W, 200ppm     Chip 0805     ER.466EY.J183V       56     1     R75,R76     A     Resistor, Chip, Thr. Film, 18, 5%, 1/10W, 200ppm     Chip 0805     ER.466EY.J183V       57     R88,R08,104.R105.L34     1160     Resistor, Chip, Thr. Film, 18, 5%, 1/10W, 200ppm     Chip 0805     ER.466EY.J162V       58     1     R92     R77,R71     3     Resistor, Chip, Thr. Film, 18, 5%, 1/10W			R78,R79,R80,R81,R93,R95,R103				
61     8     R14.R29.R37.R40.R48.R51     20     Resistor, Chip, Thk Film, 20, 5%, 14/44, 2000pm     Chip 1210     ER.1-14/4200U       52     12     R30.R37.R38.R39.R41.R42,     6.2     Resistor, Chip, Thk Film, 6.2, 5%, 14/44, 200pm     Chip 1210     ER.1-46.42.00U       53     8     R33.R38.R41.R44.R45.R55.R68,     300     Resistor, Chip, Thk Film, 50, 5%, 11/0W, 200ppm     Chip 0806     ER.4-65EY.V153V       54     8     R35.R38.R46.R47.R57.R80,     18K     Resistor, Chip, Thk Film, 18.5%, 11/0W, 200ppm     Chip 0805     ER.4-65EY.V153V       55     2     R77.R71     3     Resistor, Chip, Thk Film, 18.5%, 11/0W, 200ppm     Chip 0805     ER.4-65EY.V163V       56     1     R45     116     Resistor, Chip, Thk Film, 18.5%, 11/0W, 200ppm     Chip 0805     ER.4-65EY.V153V       57     5     R88.R00.R104.R105.L34     150     Resistor, Chip, Thk Film, 15.5%, 11/0W, 200ppm     Chip 0805     ER.4-65EY.V153V       58     1     891     RESET     Swator, Chip, Thk Film, 15.5%, 11/0W, 200ppm     Chip 0805     ER.4-65EY.V153V       58     10     11     R01     RESET     Swator, Chip, Thk Fi	50	2	R20,R28	1 MEG	Resistor, Chip, Thk Film, 1MEG, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ105V
Image: Problem     Persistor, Chip, Thk Film, 62, 5%, 1/4W, 200ppm     Chip 1210     ENJ-44YABR2U       Image: Problem     Resistor, Chip, Thk Film, 62, 5%, 1/4W, 200ppm     Chip 1210     ENJ-44YABR2U       Image: Problem     Resistor, Chip, Thk Film, 300, 5%, 1/10W, 200ppm     Chip 200     ERJ-66CY1301       Image: Problem     Resistor, Chip, Thk Film, 300, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1301       Image: Problem     Resistor, Chip, Thk Film, 300, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1301       Image: Problem     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1302       Image: Problem     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1302       Image: Problem     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1302       Image: Problem     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1302       Image: Problem     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1302       Image: Problem     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ERJ-66CY1302       Image: Problem     Resistor, Chip, Thk Film, 47K, 5%, 1/10W, 200ppm     Chip 0805	51	8	R14,R29,R37,R40,R48,R51	20	Resistor, Chip, Thk Film, 20, 5%, 1/4W, 200ppm	Chip 1210	ERJ-14YJ200U
52     12     Rols X1 / R3R 289, 441, R42,     6.2     Resistor, Chip, Thk Film, 6.2, 5%, 14W, 200ppm     Chip 1210     ER-144/R82U       53     8     R3R 283, R48, R44, R45, R58, R56,     300     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ER-1467, V130V       54     8     R3R 283, R44, R45, R57, R60,     18K     Resistor, Chip, Thk Film, 30, 5%, 1/10W, 200ppm     Chip 0805     ER-1447, V13R0U       55     2     R77, R71     3     Resistor, Chip, Thk Film, 18, 5%, 1/10W, 200ppm     Chip 0805     ER-1447, V13R0U       56     1     R85     NR3, R71, R41     3     Resistor, Chip, Thk Film, 150, 5%, 1/10W, 200ppm     Chip 0805     ER-147, V13R0U       57     5     R88, R00, R104, R105, L34     155     Resistor, Chip, Thk Film, 150, 5%, 1/10W, 200pm     Chip 0805     ER-147, V13R0U       58     1     R92     47K     Resistor, Chip, Thk Film, 150, 5%, 1/10W, 200pm     Chip 0805     ER-147, V13R0U       58     R102     M2     W1P-4     Presistor, Chip, Thk Film, 150, 5%, 1/10W, 200pm     Chip 0805     ER-1462, V1473V       58     1     SW1     R24     R14, R45,			R58,R74				
Image     Image     Image     Image     Image     Image       53     8     R33,R34,R44,R58,R58,R58,     300     Resistor, Chip, Thk Film, 300, 5%, 1/10W, 200ppm     Chip 0805     ERJ+6GEYJ183V       54     8     R35,R34,R44,R58,R58,R54,     1     R2     R75,R73     Image     Imag	52	12	R30,R31,R38,R39,R41,R42,	6.2	Resistor, Chip, Thk Film, 6.2, 5%, 1/4W, 200ppm	Chip 1210	ERJ-14YJ6R2U
53     8     R33,R34,R44,R45,R56,R56,R5     300     Resistor, Chip, Thk Film, 300, 5%, 1/10W, 200ppm     Chip 0805     ERL-EGY1301V       54     8     R53,R38,R46,P47,R57,R60,     18K     Resistor, Chip, Thk Film, 38, 5%, 1/10W, 200ppm     Chip 0805     ERL-6GY1301V       55     2     R77,R71     3     Resistor, Chip, Thk Film, 30, 5%, 1/4W, 200ppm     Chip 0805     ERL-6GY1302V       56     1     R85     11     R02     ERL-14YL380U     ERL-14YL380U       57     5     R88,R08,R014,R105,L34     1150     Resistor, Chip, 5%, 1/10W, 200ppm     Chip 0805     ERL-6GY1302V       58     1.     R02     47.K     Resistor, Chip, Thk Film, 150, 5%, 1/10W, 200ppm     Chip 0805     ERL-6GY1474V       59     1.     SW1     RESET     SWtch, Momenary Tact. SMD, 200pf     SMD     B38-1002       60     1.     V12     DS123A1-15     Stypervisor, 3.3 V Econcerest     S07-223     D5123A1-15SM       61     1.     U2     DS123A1-15     Supervisor, 3.3 V Econcerest     S07-232     LD108055       62     1.     U2     DS123			R49,R50,R52,R53,R59,R61				
Image: Name of the second se	53	8	R33,R34,R44,R45,R55,R56,	300	Resistor, Chip, Thk Film, 300, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ301V
54     8     R3R,R36,R46,R47,R57,R60,     19K     Resistor, Chp, Thr, Film, 19k, 5%, 1/10W, 200ppm     Chip 0805     ERJ.46EY1183V       55     2     R77,R71     3     Resistor, Chip, Thr, Film, 30, 5%, 1/4W, 200ppm     Chip 1210     ERJ.46EY1182V       56     1     R85     1k     Resistor, Chip, Thr, Film, 150, 5%, 1/10W, 200ppm     Chip 0805     ERJ.46EY117V       57     5     R88,R00,R104,R105,L34     150     Resistor, Chip, Thr, Film, 150, 5%, 1/10W, 200ppm     Chip 0805     ERJ.46EY147V       58     1     R92     47K     Resistor, Chip, Thr, Film, 150, 5%, 1/10W, 200ppm     Chip 0805     ERJ.46EY147V       59     1     SW1     RESET     Switch, Momentary Tacl.SM0, 200pf     SMD     B35:1002       60     1     SW2     SW DIP.6     DIP Switch, 6 position, Raised-rocker, sealed     DIP     7658065       61     1     U1     PC1(16LC72A-04/SP     Microcontroller, 8-84, 2-8Pn, w/s C-hannel ADC     DIP 28/L14W.301LS.10     PIC14LC72A-04/SP       62     1     U2     DS123A-15     Supervisor     SOT     SOT     SOT       63 <td></td> <td></td> <td>R72,R73</td> <td></td> <td></td> <td></td> <td></td>			R72,R73				
Image: Mark Stress     Image: Mark Stres      1     101	54	8	R35,R36,R46,R47,R57,R60,	18K	Resistor, Chip, Thk Film, 18k, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ183V
55 2 R77.R71 3 Resistor, Chip, Thk Film, 3.0, 5%, 14W, 200ppm Chip 1210 ERJ-43/L3R0U   56 1 R85 1k Resistor, Chip, Thk Film, 18, 5%, 110W, 200ppm Chip 0805 ERJ-65EY,1473V   57 5 R88,R90,R104,R105,L34 150 Resistor, Chip, Thk Film, 18, 5%, 110W, 200ppm Chip 0805 ERJ-65EY,1473V   58 1 R92 47k Resistor, Chip, Thk Film, 150, 5%, 110W, 200ppm Chip 0805 ERJ-65EY,1473V   59 1 SW1 RESET Strick, Momentary Tact, SM0, 203gf SMD B3S-1002   60 1 U1 RESET Strick, Momentary Tact, SM0, 203gf DIP 240,14W 30LS:10 PIC16LC72A-045P   61 1 U1 PIC16LC72A-045P Microcontroller, 648,28-Pin, wf 5-channel ADC DIP 240,14W 30LS:10 PIC16LC72A-045P   62 1 U2 DS123A-15S Supervisor, 3.3V Econoreset S01-223 D51233A-15SM   63 1 U3 LD1080F0 Linear LDO Regulator, Adjustable, 1.5A TO-220 LD1080F0   64 1 U4 DD10X0100 DDX Digital Processor, 4.1 Channels TO5P-44 DDX-1000   65 2 U8,UB GP1F31R Toslink Light Receining Unit Read GP1F31R			R75,R76				
56     1     R85     1k     Resistor, Chip, Thik Film, 1K, 5%, 11/0W, 200ppm     Chip 0805     ERJ-6GEY.112V       57     5     R88,R80,R104,R105,L34     150     Resistor, Chip, Thik Film, 150, 5%, 11/0W, 200ppm     Chip 0805     ERJ-6GEY.1151V       58     1     R92     47k     Resistor, Chip, Thik Film, 156, 5%, 11/0W, 200ppm     Chip 0805     ERJ-6GEY.1473V       59     1     SW1     RESET     Switch, Momentary Tact, SMD, 230g1     SMD     B33-1002       60     1     SW1     RESET     Switch, Momentary Tact, SMD, 230g1     SMD     B33-1002       61     1     U1     PIC16LC72A-04/SP     Microcontroller, 8-Bit, 28-Pin, w/ 5-Channel ADC     DIP<28/L1.4/W.30LS.10	55	2	R77,R71	3	Resistor, Chip, Thk Film, 3.0, 5%, 1/4W, 200ppm	Chip 1210	ERJ-14YJ3R0U
57     5     R88,R90,R104,R105,L34     150     Resistor, Chip, Thk Film, 150, 5%, 1/10W, 200ppm     Chip 0805     ERL+6GEY.J151V       58     1     R92     47k     Resistor, Chip, Thk Film, 47k, 5%, 1/10W, 200ppm     Chip 0805     ERL+6GEY.J151V       59     1     SW1     RESET     Switch, Momentary Tact.SMD, 230g1     SMD     BSJ-002       60     1     SW2     SW DIP-6     DIP Switch, Popesition, Raised-rocker, sealed     DIP     765B06S       61     1     U1     PIC16LC72A-04/SP     Microcontroller, 8-Bit, 28-Pin, w/ 5-Channel ADC     DIP-28/L1, 4W 30LS.10     PIC18LC72A-04/SP       62     1     U2     DS123A-15     Supervisor, 3.3V Econreset     SDT-223     DS123A-15/SM       63     1     U3     LD1080V50     Linear LDO Regulator, Al, Istaak     TO-220     LD1080V50       64     1     U4     LD1080V50     Linear LDO Regulator, Al, Istaak     TO-223     DDX4100       65     2     U7,U5     DDX4100     DDX Power IC, S0W x2-Channels     POWERSO-36     DDX-2060       66     1     U13     T4LVX14 <td>56</td> <td>1</td> <td>R85</td> <td>1k</td> <td>Resistor, Chip, Thk Film, 1k, 5%, 1/10W, 200ppm</td> <td>Chip 0805</td> <td>ERJ-6GEYJ102V</td>	56	1	R85	1k	Resistor, Chip, Thk Film, 1k, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ102V
58     1     R82     47k     Resistor, Chip, Thk Film, 47k, 55k, 1/10W, 200ppm     Chip 0805     ERL+6GEY1473V       59     1     SW11     RESET     Switch, Momentary Tack, SMD, 230gf     SMD     B3S-1002       60     1     SW2     SW DIP-6     DIP Switch, 6-position, Faised-trocker, sealed     DIP     TotsB065       61     1     U1     PIC16LC72A-04/SP     Microcontroller, 8-88t, 28-Pin, wf S-Channel ADC     DIP-28U.1.4/W.30/LS.10     PIC16LC72A-04/SP       62     1     U2     DS1233A-15     Supenvisor, 3.3.V Econcrest     S0T-223     DS1233A-15/SM       63     1     U3     LD1068V50     Linear LDO Regulator, 5V, 1.5A     To-220     LD1088DT       64     1     U4     LD1088DT     Linear LDO Regulator, 4/Justable, 1.5A     To-252     LD1088DT       65     2     U8,U6     GP1F31R     Toslink Light Receiving Unit     Radial     GP1F31R       67     4     U9,U10,U11,U12     DDX2060     DDX 2voer (1.5) SW x 2-Channels     SOIC-14     TC74/XV14FN       68     1     U13     T4LVX14     Hex	57	5	R88,R90,R104,R105,L34	150	Resistor, Chip, Thk Film, 150, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ151V
59     1     SW1     RESET     Switch, Montany Tact, SMD, 20gf.     SMD     935-1002       60     1     SW2     SW DIP-6     DIP Switch, 6-pagnion, Raised-rocker, sealed     DIP     785B08       61     1     U1     PIC16LC72A-04/SP     Microcontroller, 8-Bit, 28-Pin, wir 5-Channel ADC     DIP-28/L1.4W.30/LS.10     PIC16LC72A-04/SP       62     1     U2     DS1233A-15     Supervison.33 VE concrest     SOT-223     DS1233A-15/SM       63     1     U3     LD1086V50     Linear LDO Regulator, VS, 15A     TO-220     LD1086DT       64     1     U4     LD1086DT     Linear LDO Regulator, Adjustable, 1.5A     TO-252     LD1086DT       65     2     U7.05     DDX4100     DOX Digit Processor, 4.1 Channels     TOP-44     DDX-4100       66     2     U8.06     GP1F31R     Toslik Lipit Receiving Low Voltage, 5V Tolerant     SOIC-14     TC744/V14FN       67     4     U9.U10.U11.U12     DDX2060     DDX Power Low Voltage, 5V Tolerant     SOIC-14     TC744/V14FN       69     1     U14     TAACT14     Hex I	58	1	R92	47k	Resistor, Chip, Thk Film, 47k, 5%, 1/10W, 200ppm	Chip 0805	ERJ-6GEYJ473V
60     1     SW2     SW DIP-6     DIP Switch, 6-position, Raised-rocker, sealed     DIP     76SB06S       61     1     U1     PIC16LC72A-04/SP     Microcontroller, 8-Bit, 28-Pin, wi S-Channel ADC     DIP-28/L1.4W.30LS.10     PIC16LC72A-04/SP       62     1     U2     DS1233A-15     Supervisor, 3.3V Econcrest     S0T-223     DS1233A-15/SM       63     1     U3     LD1086V50     Linear LDO Regulator, 5V, 1.5A     TO-220     LD1086V50       64     1     U4     LD1086DT     Linear LDO Regulator, 5V, 1.5A     TO-2262     LD1086DT       65     2     U7,U5     DDX4100     DDX bigital Processor, 4.1 Channels     TOF-44     DDX-4100       66     2     U8,U6     GP1F31R     Tosink Light Receiving Unit     Radial     GP1F31R       67     4     U9,U10,U11,U12     DDX2060     DDX Power IC, S9W x 2-Channels     POWERSO-36     DDX-2060       68     1     U13     74LVX14     Hex Inverter, Schmitt-Trigger, LDW-Voltage, SV Tolerant     SOIC-14     TC74LVX14FN       70     1     U15     CS5333     Stere	59	1	SW1	RESET	Switch, Momentary Tact, SMD, 230gf	SMD	B3S-1002
61     1     U1     PIC16LC72A04/SP     Microcontroller, 8-Bit, 28-Pin, w/ 5-Channel ADC     DIP-28L1.4W.30LS.10     PIC16LC72A04/SP       62     1     U2     DS1233A-15     Supervisor, 32V Econorset     SOT-223     DS1233A-15/SGM       63     1     U3     LD1080F90     Linear LDO Regulator, 5V.15A     TO-220     LD1080F70       64     1     U4     LD1080F70     Linear LDO Regulator, 5V.15A     TO-220     LD1080F70       65     2     U7,U5     DDX4100     DDX Digital Processor, 4.1 Channels     TOFP-44     DDX4100       66     2     U8,U6     GP1F31R     Toslink Light Receiving Unit     Radial     GP1F31R       67     4     U9,U10,U11,U12     DDX2060     DDX Power (10, SW x2-Channels     SOIC-14     TC74/KV14FN       68     1     U13     74/LVX14     Hex Inverter, Schmitt-Tingger, TTL Compatible     SOIC-14     TC74/KV14FN       69     1     U14     74A/CT14     Hex Inverter, Schmit-Tingger, TTL Compatible     SOIC-14     TC74/KC14FN       70     1     U15     CSS333     Stereo AOC_2	60	1	SW2	SW DIP-6	DIP Switch, 6-position, Raised-rocker, sealed	DIP	76SB06S
62     1     U2     DS1233A-15     Supervisor, 3.3V Econoreset     SOT-223     DS1233A-15/SM       63     1     U3     LD1086V50     Linear LDO Regulator, 5V, 1.5A     TO-220     LD1086V50       64     1     U4     LD1086V50     Linear LDO Regulator, 5V, 1.5A     TO-220     LD1086DT       65     2     U7,U5     DDX4100     DDX Digital Processor, 4.1 Channels     TQFP-44     DDX4100       66     2     U8,U6     GP1F31R     Tosink Light Receiving Unit     Radial     GP1F31R       67     4     U9,U10,U11,U12     DDX2000     DDX Power (C, 39W x2-Channels     POWERSO-36     DDX-2060       68     1     U13     74LVX14     Hex Inveter, Schmitt-Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74ACT14FN       69     1     U14     7AACT14     Hex Inveter, Schmitt-Trigger, TL Compatible     SOIC-14     TC74ACT14FN       71     2     Y2,Y1     24.576MHz     Crystal, 24.576MHz     SMD     HOM-924.576MABJT       72     1     Used with U8,U10,U11,U12     Heatsink, SMD, D3PAK     SMD	61	1	U1	PIC16LC72A-04/SP	Microcontroller, 8-Bit, 28-Pin, w/ 5-Channel ADC	DIP-28/L1.4/W.30/LS.10	PIC16LC72A-04/SP
63     1     U3     LD1086V50     Lnear LDO Regulator, 5V, 1.5A     TO-220     LD1086V50       64     1     U4     LD1086DT     Linear LDO Regulator, Adjustable, 1.5A     TO-220     LD1086DT       65     2     U7.U5     DDX4100     DDX Digital Processor, 4.1 Channels     TO-F24     DDX-4100       66     2     U8.06     GP1F31R     Toslink Light Receiving Unit     Radial     GP1F31R       67     4     U9.U10,U11.U12     DDX2060     DDX Power IC. 35W x 2-Channels     POWERSO-36     DDX-2060       68     1     U13     74LVX14     Hex Inverter, Schmitt-Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt-Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74LVX14FN       70     1     U15     CS5333     Stereo ADC, 24-Bit, 96 Hz     SMD     HeXH=24-576MHz       71     2     V2,Y1     24-576MHz     DIP Socket, 28-Fin, 0.300"     DIP-28L1.4W.30/LS.10     110-93-324-41-001       73     4     Used with U9,U10,U11,U12     Heatsink, MO-292	62	1	U2	DS1233A-15	Supervisor, 3.3V Econoreset	SOT-223	DS1233A-15/SM
64     1     U4     LD1086DT     Linear LDO Regulator, Adjustable, 1.5A     TO-252     LD1086DT       65     2     U7,U5     DDX4100     DOX Digital Processor, 4.1 Channels     TO-P-44     DDX-4100       66     2     U8,U6     GP1731R     Toslink Light Receiving Unit     Radial     GP1751R       67     4     U9,U10,U11,U12     DDX2060     DDX Power (1, 5) W x 2-Channels     POWERSO-36     DDX-2060       68     1     U13     74LVX14     Hex Inverter, Schmitt Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt Trigger, TL Compatible     SOIC-14     TC74ACT14FN       70     1     U15     CSS333     Stereo ADC, 24B, 96 MHz     TSSOP-16     CSS333-XZ       71     2     Y2Y1     24.576MHz MHz     CSMAD.     57340000010       73     4     Used with U9,U10,U11,U12     Heatsink, MOD. OPAX     SMD     57340000010       75     4      Printed Circuit Board, 5'x 10''.2-Layer     S7400000010     724-0321 REVA	63	1	U3	LD1086V50	Linear LDO Regulator, 5V, 1.5A	TO-220	LD1086V50
65     2     U7,U5     DDX4100     DDX Digital Processor, 4.1 Chamels     TQFP-44     DDX4100       66     2     U8,U6     GP1F31R     Toslink Light Receiving Unit     Radial     GP1F31R       67     4     U9,U10,U11,U12     DDX2000     DDX Power IC, 39W x2-Channels     POWERSO-36     DDX-3080       68     1     U13     74LVX14     Hex Inverter, Schmitt-Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt-Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74ACT14FN       70     1     U15     CS5333     Stereo ADC, 24-Bt, 96 M4z     TSSOP-16     CS5333-VZ       71     2     Y2,Y1     24.576MHz MHz     Crystal, 24.576MHz     SMD     HCM49-24.576MABJT       72     1     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     T01-93-324-41.001       73     4     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     T721-00321 REVA       74     1     Expression, 0.5* x 0.5* x 0.5* x 0.5*     S66022B00000     T66022B00000	64	1	U4	LD1086DT	Linear LDO Regulator, Adjustable, 1.5A	TO-252	LD1086DT
66     2     U8,U6     GP1F31R     Toslink Light Receiving Unit     Radial     GP1F31R       67     4     U9,U10,U11,U12     DDX2060     DDX Power (C, SW x 2-Channels     POWERSO-36     DDX-2060       68     1     U13     74LVX14     Hex Inverter, Schmit-Trigger, Low-Voltage, 5V Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74LVX14     Hex Inverter, Schmit-Trigger, TTL Compatible     SOIC-14     TC74LVX14FN       70     1     U15     CS8333     Stereo ADC, 24-81, 96 M4z     TSSOP-16     CS8333-KZ       71     2     Y2,Y1     24.576MHz MHz     CYstal, 24.576MHz     SMD     HCMay-24.576MABJT       72     1     Used with U9,U10,U11,U12     DIP Socket, 28-Pin, 0.300"     DIP-28L1.4W.30/LS.10     110-93-324.41-001       73     4     Used with U9,U10,U11,U12     Printed Circuit Board, 5'x 10", 2-Layer     SMD     573400000010       74     1     Printed Circuit Board, 5'x 10", 2-Layer     Z740.0321 ReVA     Machine Screw, Panhead, 4.40 x 5/16     Z       76     1     Bumpon, Round, 6, 4.4' W x 0.20" H     Edit Adit Adit Adit	65	2	U7,U5	DDX4100	DDX Digital Processor, 4.1 Channels	TQFP-44	DDX-4100
67     4     Up,U10,U11,U12     DDX 2060     DDX Power IC, 35W x 2.Channels     POWERSO-36     DDX-2060       68     1     U13     74LVX14     Hex Inverter, Schmitt-Tigger, Un-Voltage, 5V Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt-Tigger, TLC compatible     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt-Tigger, TLC compatible     SOIC-14     TC74LVX14FN       70     1     U15     C.S5333     Stereo ADC, 24-Bt, 96 Hrz     TSSOP-16     CS5333-K2       71     2     Y2,Y1     24.576MHz     Crystal, 24.576MHz     SMD     HCM49-24.576MABJT       72     1     Used with U1     DIP Socket, 28-Pin, 0.300*     DIP-28L1.4W.30LS.10     110-93-324-41-001       73     4     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     SMD     57840000010       74     1     Edwith U9,U10,U11,U12     Heatsink, TO-220, Side-on, 0.5'x 0.5'x 0.75'     SMD     576802B00000       75     4     Lock Wath DP1     Machine Screw, Panhead, 440 x 5/16	66	2	U8.U6	GP1F31R	Toslink Light Receiving Unit	Radial	GP1F31R
68     1     U13     74LVX14     Hex Inverter, Schmitt-Trigger, Low-Voltage, SV Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt-Trigger, Low-Voltage, SV Tolerant     SOIC-14     TC74LVX14FN       69     1     U14     74ACT14     Hex Inverter, Schmitt-Trigger, Low-Voltage, SV Tolerant     SOIC-14     TC74ACT14FN       70     1     U15     CS5333     Stereo ADC, 24-Bt, 96 Hz     TSSOP-16     CS53334Z       71     2     Y2,Y1     24.576MHz MHz     Crystal, 24.576MHz     SMD     HCM49-24.576MABJT       72     1     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     SMD     57840000010       73     4     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     721-00321 REVA       75     4      Bumpon, Round, Black, 0.4* W to 20* H         76     1      Heatsink, TO-202,Slide-on, 0.5* X0.5* SO     576022800000        77     2     Used with JDP1     Machine Screw, Panhead, 440 x 5/16         78	67	4	U9,U10,U11,U12	DDX2060	DDX Power IC, 35W x 2-Channels	POWERSO-36	DDX-2060
69     1     U14     74ACT14     Hex Inverter, Schmitt-Trigger, TTL Compatible     SOIC-14     TC74ACT14FN       70     1     U15     CS533     Stereo ADC, 248, 96 HHz     TSSOP-16     CS5333-KZ       71     2     Y2,Y1     24.576MHz MHz     CS48,33 KZ     SMD     HCM49-24.576MAB.JT       72     1     Used with U1     DIP Socket, 25.970,000*     DIP-28/L1.4/W.30/LS.10     110.93-324.41.001       73     4     Used with U9,U10.U11,U12     Heatsink, SMD. DSPAK     SMD     573400D000010       74     1     Printed Circuit Board, 5 x 10*, 2-Layer     SMD     573400000010       75     4     Bumpon, Round, Black, 0.44* W X 0.20*H     E     E       76     1     Heatsink, TO-220, Stide-0.0, 5* x 0.5* x 0.5*     576802B00000     E       77     2     Used with JDP1     Machine Screw, Panhead, 4.40 x 5/18     E     E       78     2     Used with JDP1     Lock Washre, #4     E     E       79     2     Used with JDP1     Hex xut, #4     E     E       80     1	68	1	U13	74LVX14	Hex Inverter, Schmitt-Trigger, Low-Voltage, 5V Tolerant	SOIC-14	TC74LVX14FN
70     1     U15     CS5333     Stereo ADC, 24-Bi, 96 kHz     TSSOP-16     CS5333-KZ       71     2     Y2,Y1     24.576MHz     Crystal, 24.576MHz     SMD     HCM49-24.576MABJT       72     1     Used with U1     DIP Socket, 28-Pin, 0.30°     DIP-28/L1.4W.30/LS.10     110-93-324-41-001       73     4     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     57840000010       74     1     Printed Circuit Daord, 5'x 10', 2-Layer     SMD     721-00321 REVA       75     4     Lee with U9,U10,U11,U12     Heatsink, TO-220, Sild-on, 0.5'x 0.5''     S76802B00000       76     1     Heatsink, TO-220, Sild-on, 0.5'x 0.5''     S76802B00000     S76802B00000       77     2     Used with JDP1     Machine Screw, Panhead, 4-40 x 5/16     Edited Screw, Panhead, 4-40 x 5/16     Edited Screw, Panhead, 4-40 x 5/16     S602B00000       78     2     Used with JDP1     Lock Washer, #4     Edited Screw, Panhead, 4-40 x 5/16     Edited Screw,	69	1	U14	74ACT14	Hex Inverter. Schmitt-Trigger. TTL Compatible	SOIC-14	TC74ACT14FN
2     Y2,Y1     24.576MHz MHz     Crystal 24.576MHz     SMD     HCM49-24.576MABJT       72     1     Used with U1     DIP Socket, 25.Ph, 0.300"     DIP-28L1.4W.30/LS.10     110-93-324.41-001       73     4     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     57840D000010       74     1     Printed Circuit Board, 5" x 10", 2-Layer     771-00321 REVA     7721-00321 REVA       75     4     Bumpon, Round, Black, 0.44" W X 0.20" H     721-00321 REVA     76       76     1     Heatsink, TO-220, Silde-on, 0.5" x 0.5" x 0.5"     576802B00000     76       77     2     Used with JDP1     Machine Screw, Panhead, 440 x 5/16     20     20       78     2     Used with JDP1     Lock Washer, #4     20.Vec with JDP1     Exp.4624/202V       80     1     R87     2.0k     Resistor, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805     ERJ-6GEYJ202V	70	1	U15	CS5333	Stereo ADC. 24-Bit. 96 kHz	TSSOP-16	CS5333-KZ
72     1     Used with U1     Display, Exclosure and Display, Exclosure and	71	2	Y2 Y1	24 576MHz MHz	Crystal 24 576MHz	SMD	HCM49-24 576MAB IT
13     4     Used with U9,U10,U11,U12     Heatsink, SMD, D3PAK     SMD     T03400CM001       74     1     Printed Circuit Board, 5'x 10', 2-Layer     SMD     721-00321 REVA       75     4     Endown Market Board, 5'x 10', 2-Layer     721-00321 REVA       76     1     Bumpon, Round, Black, 0.44' W x 0.0'' H     76       76     1     Heatsink, TO-220, Sild-on, 0.5' x 0.5''     576802B00000       77     2     Used with JDP1     Machine Screw, Panhead, 4-40 x 5/16     F       78     2     Used with JDP1     Lock Washer, #4     F       79     2     Used with JDP1     Hesistr, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805       800     1     R87     2.0k     Resistor, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805	72	1	Used with U1	21.010111211112	DIP Socket 28-Pin 0.300"	DIP-28/I 1 4/W 30/I S 10	110-93-324-41-001
1     1     01400000000000000000000000000000000000	73	4	Used with U9 U10 U11 U12		Heatsink SMD D3PAK	SMD	573400D00010
1     1	74	1			Printed Circuit Board 5" x 10" 2-I aver		721-00321 REVA
76     1     Dumport, NAUGU TI     Constraints     S76     576     S76802B0000       77     2     Used with JDP1     Heatsink, TO-220, Side-0, 0.5 * 0.5 * 30.5 * 0.5 *     S76802B0000     S76802B0000       78     2     Used with JDP1     Machine Screew, Panhead, 4.40 x 5/16     S76802B0000       78     2     Used with JDP1     Lock Washer, #4     S769     S76802B0000       79     2     Used with JDP1     Hex Nut, #4     S76802B0000     ERJ-6GEYJ202V       80     1     R87     2.0 k     Resistor, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805     ERJ-6GEYJ202V	75	4			Rumpon Round Black 0.44" W x 0.20" H	1	
17     2     Used with JDP1     Machine Screw, Panhead, 440 x 5/16     S780/2800000       78     2     Used with JDP1     Lock Washer, #4         79     2     Used with JDP1     Lock Washer, #4         80     1     R87     2.0k     Resistor, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805     ERJ-6GEYJ202V	76	1	1		Heatsink TO-220 Slide on 0.5" x 0.5" x 0.75"	1	576802B00000
78     2     Used with JDP1     Lock Washer, #4       79     2     Used with JDP1     Hex Nut, #4       80     1     R87     2.0k     Resistor, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805     ERJ-6GEYJ202V	70	2	Lised with IDP1		Machine Screw Danhead 4-40 x 5/16	<u> </u>	370002800000
19     2     Used with JDP1     LCK PTable (#1)       79     2     Lsed with JDP1     Hex Nut, #4       80     1     R87     2.0k       Notest     ERJ-6GEYJ202V	78	2	Lead with IDP1		I ock Washer #4	<u> </u>	
rs     2     Useu wuru JUF 1     Imex NUL, #4       80     1     R87     2.0k     Resistor, Chip, Thick Film, 2.0K, 5%, 1/10W, 200ppm     Chip 0805     ERJ-6GEYJ202V       Notest	70		Llood with JDP1		Look Webner, #*	ł	1
ov i i proz 2.uk jesistor, crip, inick Him, 2.uk, 5%, 1/10W, 200pm jong usub jekJ-6GEY/202V Notce:	/9	2	Dog Willi JDP1	0.01-	Desister Chie Thisk Film 2.0K FM 4/40M 200ses	Chie 0005	ED 1 COEX 1999V
	80	1 Notes:	1507	2.UK	Resistor, Grip, Trick Film, 2.0K, 5%, 1/10W, 200ppm	Chip 0605	EKJ-0GEYJ2U2V

Reference Designations not used: C16, J3, Q1, Q2, Q3, R7, R8, R9, R21.
Install shorting jumpers find #30 on J8 pins 1-2, J11 pins 1-2, J19 pins 1-3 and 2-4, J21 pins 1-2 and 3-4 and 5-6, J23 pins 1-2, and J24 pins1-2.

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