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1. ALL RESISTANCE VALUES ARE IN OHMS, 0.1 WATT +/- 5%.
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL CRYSTALS & OSCILLATOR VALUES ARE IN HERTZ.

| REV | ECN        | DESCRIPTION OF REVISION | CK APPD | DATE       |
|-----|------------|-------------------------|---------|------------|
| 6   | 0000955408 | ENGINEERING RELEASED    |         | 2010-08-09 |

# SCHEM, PCB, LIO, K16

DVT, 2010-08-09

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|------|----------------------------|-----------|--------------|
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| 13   | 103 MCP Constraints 2      | (K24_MLB) | (04/06/2009) |

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Schematic / PCB #'s

| PART NUMBER | QTY | DESCRIPTION                     | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|---------------------------------|---------------|----------|------------|
| 051-8540    | 1   | SCHEM, PCB, LIO, K16            | SCH           | CRITICAL |            |
| 820-2869    | 1   | PCBF, LIO, K16                  | PCB           | CRITICAL |            |
| 825-7557    | 1   | LBL, P/N LABEL, PCB, 28MM X 6MM | [EEEE_DD1Q]   | CRITICAL |            |

BOM: 639-1057 PCBA, LIO, K16

MCO: 056-3614 MCO, LIO, K16

| DRAWING TITLE   |  | DRAWING NUMBER | SIZE     |
|---|--|----------------|----------|
| SCHEM, PCB, LIO, K16  |  | 051-8540       | D        |
| Apple Inc.  |  | REVISION       | 6.0.0    |
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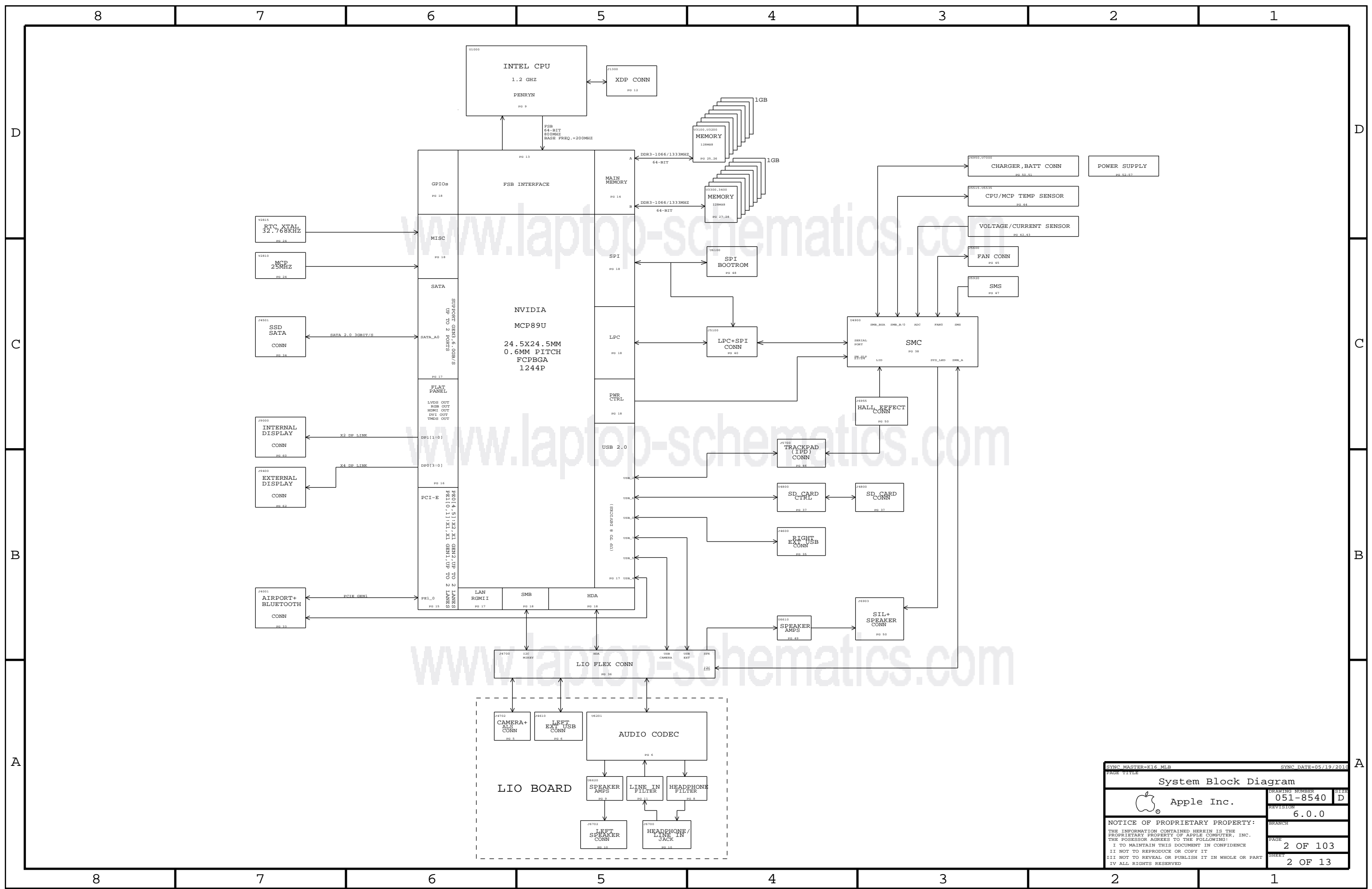
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|   |                |                      |           |
|---|----------------|----------------------|-----------|
| SYNC MASTER=K16_MLB   |                | SYNC DATE=05/19/2011 |           |
| System Block Diagram  |                |                      |           |
| Apple Inc.  | DRAWING NUMBER | 051-8540             | SIZE<br>D |
|   | REVISION       | 6.0.0                |           |
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# Functional Test Points

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| AUDIO |                            |
|-------|----------------------------|
| TRUE  | I2C MIKEY_SCL 6 11 13      |
| TRUE  | I2C MIKEY_SDA 6 11 13      |
| TRUE  | AUD_GPIO_3 6 7 9           |
| TRUE  | AUD_TPHS_SWITCH_EN 6 11    |
| TRUE  | AUD_I2C_INT_L 6 11         |
| TRUE  | AUD_IP_PERIPHERAL_DET 6 11 |
| TRUE  | HDA_BIT_CLK 6 7 13         |
| TRUE  | HDA_RST_L 6 7 13           |
| TRUE  | HDA_SDINO 6 7 13           |
| TRUE  | HDA_SDOUT 6 7 13           |
| TRUE  | HDA_SYNC 6 7 13            |
| TRUE  | SPKRAMP_INL_N 9            |
| TRUE  | SPKRAMP_INL_P 9            |
| TRUE  | BI_MIC_HI_F 11             |
| TRUE  | BI_MIC_LO_F 11             |
| TRUE  | BI_MIC_SHIELD 10 11        |
| TRUE  | SPKRAMP_L_P_OUT 9 10       |
| TRUE  | SPKRAMP_L_N_OUT 9 10       |

(PLACE BOTH NEAR J4720)

| SMC  |                       |
|------|-----------------------|
| TRUE | SMC_BC_ACOK 6 12      |
| TRUE | SYS_ONEWIRE 4 12      |
| TRUE | ADAPTER_SENSE_UF_L 12 |
| TRUE | SMC_LID 4             |

| I2C  |                  |
|------|------------------|
| TRUE | I2C_LIO_SCL 6 13 |
| TRUE | I2C_LIO_SDA 6 13 |

| POWER |                   |
|-------|-------------------|
| TRUE  | PP18V5_DCIN_UF 12 |
| TRUE  | PP18V5_G3H 4      |
| TRUE  | PP5V_S3 4         |
| TRUE  | PP3V3_S0 4        |
| TRUE  | PP1V5_S0 4        |
| TRUE  | PP3V42_G3H 4      |

(NEED 4 TP NEAR J6910)  
(NEED 1 EACH TP NEAR J4701 AND J4702)

| USB  |                        |
|------|------------------------|
| TRUE | USB_EXTB_N 5 6 13      |
| TRUE | USB_EXTB_P 5 6 13      |
| TRUE | USB_CAMERA_N 6 13      |
| TRUE | USB_CAMERA_P 6 13      |
| TRUE | USB_CAMERA_CONN_N 6 13 |
| TRUE | USB_CAMERA_CONN_P 6 13 |
| TRUE | USB_EXTB_OC_L 5 6      |
| TRUE | USB_PWR_EN 5 6         |


(PLACE BOTH NEAR J4720)  
(PLACE BOTH NEAR J4700)  
(PLACE BOTH NEAR J4720)

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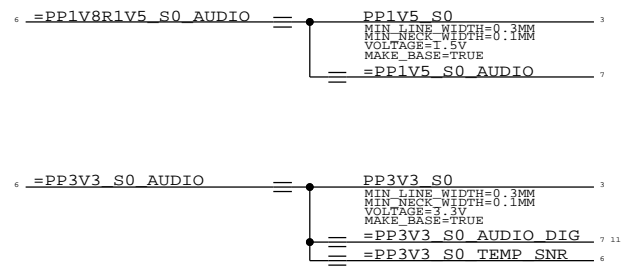
| GROUNDS |                     |
|---------|---------------------|
| TRUE    | GND_ADAPTER_UF 12   |
| TRUE    | GND_DCIN_CHGND 4 12 |
| TRUE    | GND                 |

(NEED 2 TP NEAR J4720)  
(NEED 8 TP NEAR J4700)  
(NEED 4 TP NEAR J4701-J4706)  
(NEED 2 TP NEAR J6701)  
(NEED 2 TP NEAR J6702)

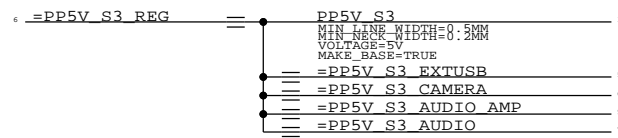
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|   |  |                        |          |
|---|--|------------------------|----------|
| SYNC_MASTER=(K6 MLB)  |  | SYNC_DATE=(12/11/2009) |          |
| PAGE TITLE  |  |                        |          |
| <b>FUNC TEST</b>  |  |                        |          |
|  Apple Inc.  |  | DRAWING NUMBER         | 051-8540 |
|   |  | REVISION               | 6.0.0    |
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|   |  | SHEET                  | 3 OF 13  |
|   |  | SIZE                   | D        |

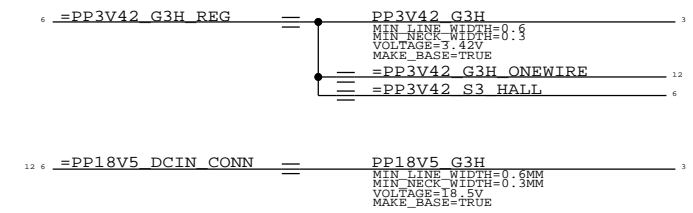
"S0,S0M" RAILS



"S3" RAILS

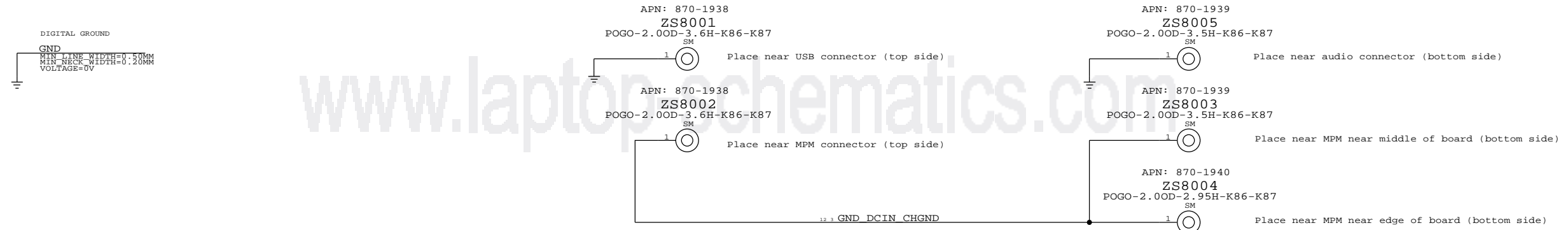


"G3H" RAILS

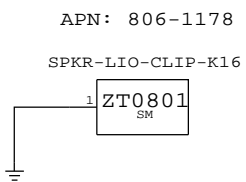


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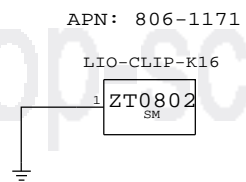
Pogo pins



Speaker clip



Power cable clip

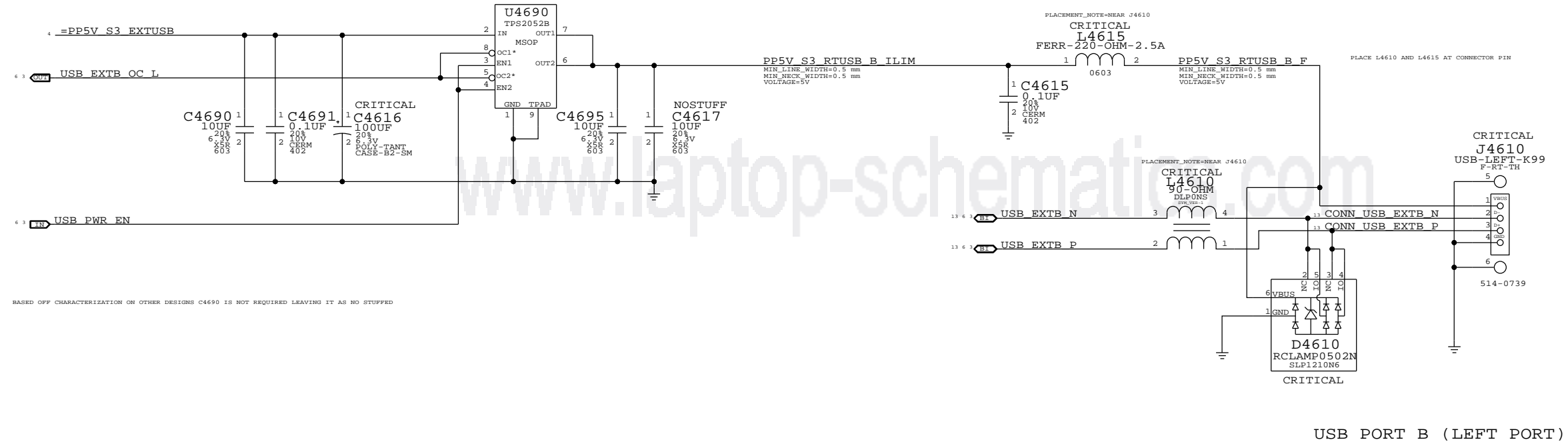


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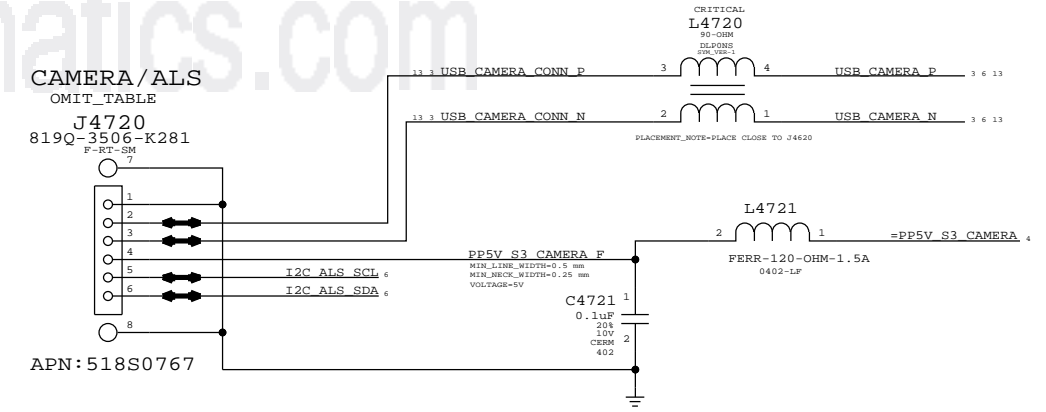
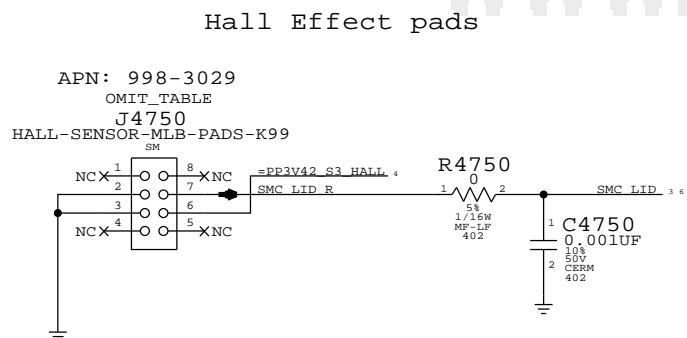
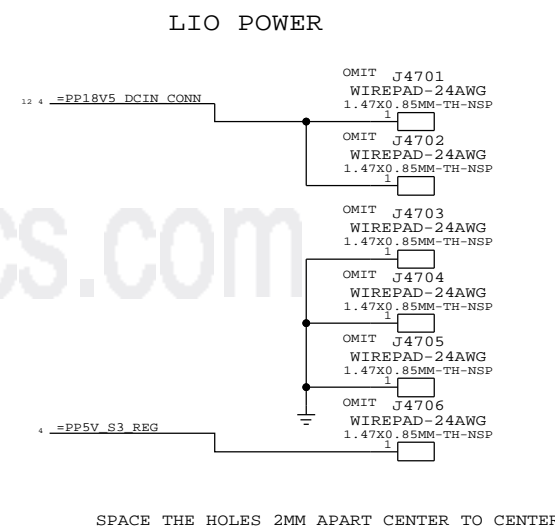
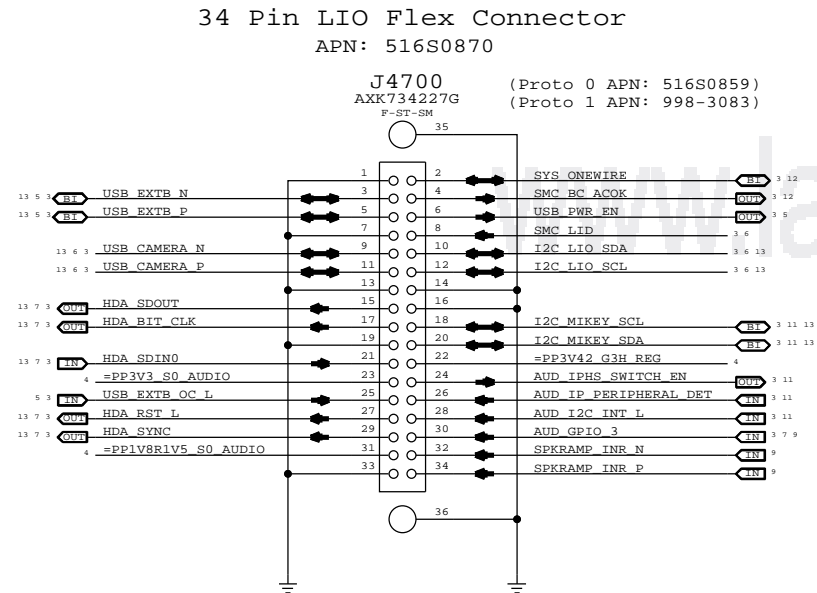
|   |  |                        |          |
|---|--|------------------------|----------|
| SYNC MASTER=(K24_MLB)   |  | SYNC DATE=(02/04/2009) |          |
| <b>Power Aliases</b>  |  |                        |          |
| Apple Inc.  |  | DRAWING NUMBER         | SIZE     |
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|   |  | SHEET                  | 4 OF 13  |

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Port Power Switch



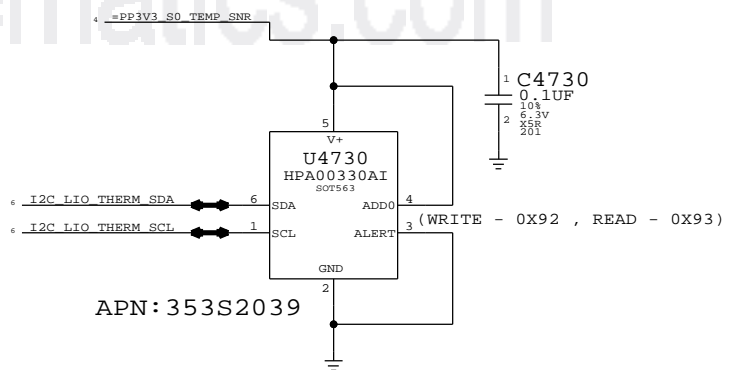
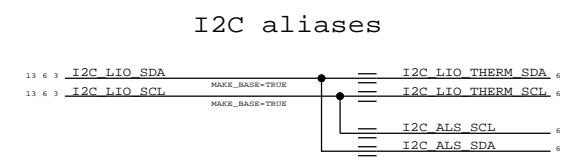
|   |  |                        |           |
|---|--|------------------------|-----------|
| SYNC MASTER=(K84_MLB)   |  | SYNC DATE=(11/09/2009) |           |
| External USB Connectors   |  |                        |           |
| Apple Inc.  |  | DRAWING NUMBER         | 051-8540  |
|   |  | REVISION               | 6.0.0     |
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|   |  | PAGE                   | 46 OF 103 |
|   |  | SHEET                  | 5 OF 13   |



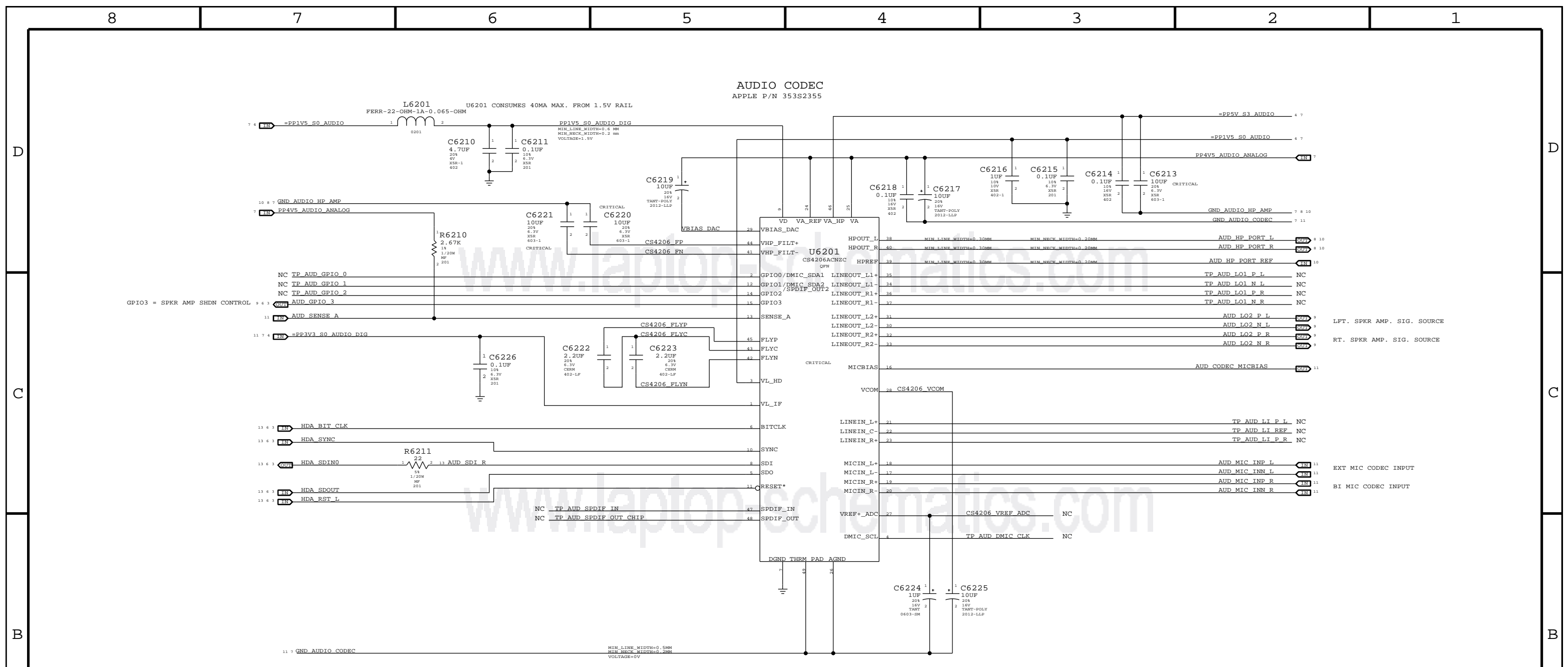
| PART NUMBER | QTY | DESCRIPTION                  | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|------------------------------|---------------|----------|------------|
| 607-6812    | 1   | SUBASSY,PCBA HALL EFFECT,K16 | J4750         | CRITICAL |            |

639-1017 (K16 Hall effect board) reports to 607-6812

| PART NUMBER | QTY | DESCRIPTION                  | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|------------------------------|---------------|----------|------------|
| 518S0815    | 1   | CONN,HDR,TWIN-AX,P=0.4,6P,HF | J4720         | CRITICAL |            |



|   |  |                  |           |
|---|--|------------------|-----------|
| PAGE TITLE  |  | SYNC DATE=MASTER |           |
| <b>LIO CONNECTORS</b>   |  |                  |           |
| Apple Inc.  |  | DRAWING NUMBER   | 051-8540  |
|   |  | REVISION         | 6.0.0     |
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|   |  | SHEET            | 6 OF 13   |

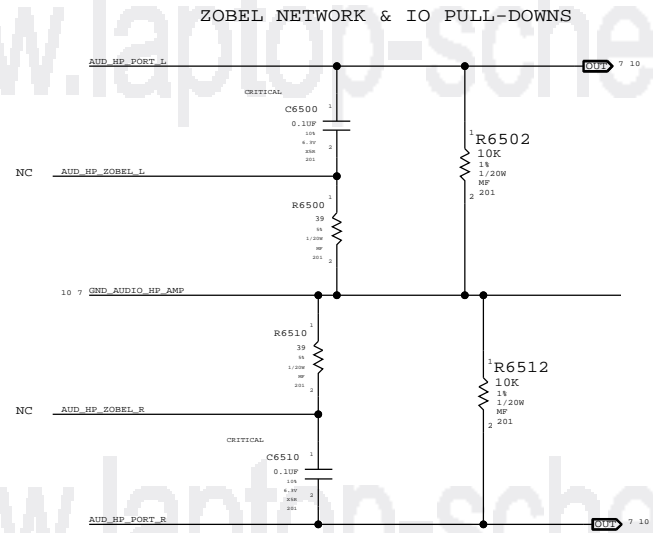


**NOTES ON CODEC I/O**

DIFF FSINPUT= 2.45VRMS  
 SE FSINPUT= 1.22VRMS  
 DAC1 FSOUTPUT= 1.34VRMS  
 DAC2/3 FSOUTPUTDIFF= 2.67VRMS  
 DAC2/3 FSOUTPUTSE= 1.34VRMS

|   |  |                      |           |
|---|--|----------------------|-----------|
| PAGE TITLE  |  | SYNC DATE=05/19/2010 |           |
| <b>AUDIO: CODEC/REGULATOR</b>   |  |                      |           |
| Apple Inc.  |  | DRAWING NUMBER       | 051-8540  |
|   |  | REVISION             | 6.0.0     |
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|   |  |                      |           |
|---|--|----------------------|-----------|
| SYNC MASTER=AUDIO   |  | SYNC DATE=05/19/2010 |           |
| PAGE TITLE  |  |                      |           |
| <b>AUDIO: HEADPHONE FILTER</b>  |  |                      |           |
| Apple Inc.  |  | DRAWING NUMBER       | 051-8540  |
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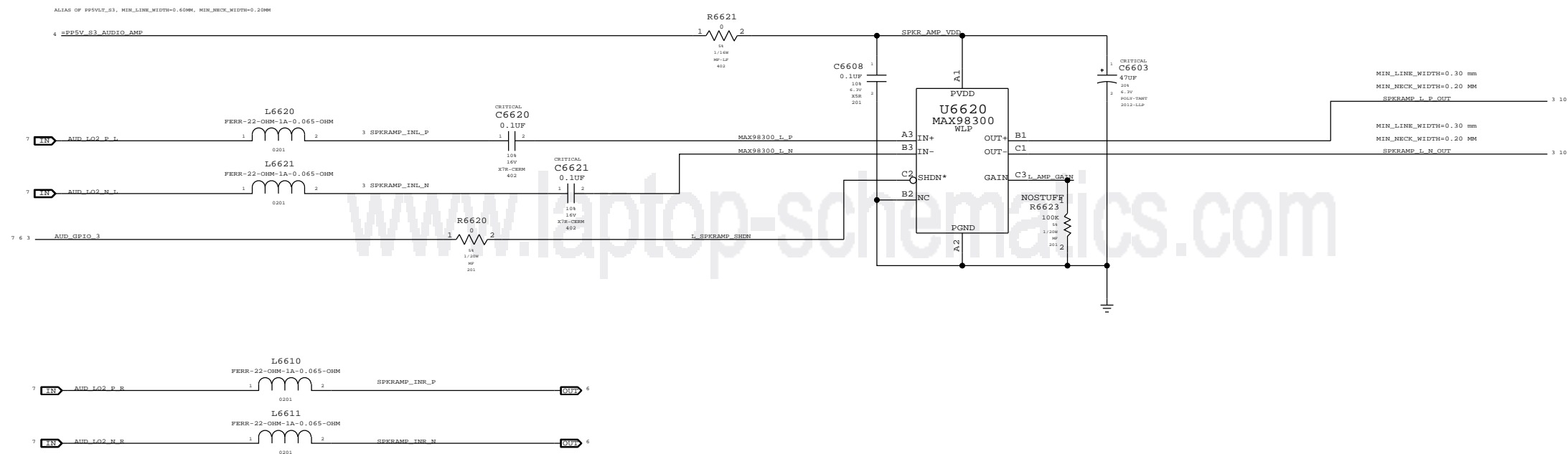
SPEAKER AMPLIFIERS

APN:353S2888

SPEAKER LOWPASS 80 HZ < FC < 132 HZ


GAIN 6DB

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|   |                |                      |                   |
|---|----------------|----------------------|-------------------|
| SYMC_WAFER-AUDIO  |                | SYMC_DATE-05/19/2011 |                   |
| PAGE TITLE  |                |                      |                   |
| AUDIO: SPEAKER AMP  |                |                      |                   |
|  Apple Inc.  | DRAWING NUMBER | 051-8540             | SIZE<br>D         |
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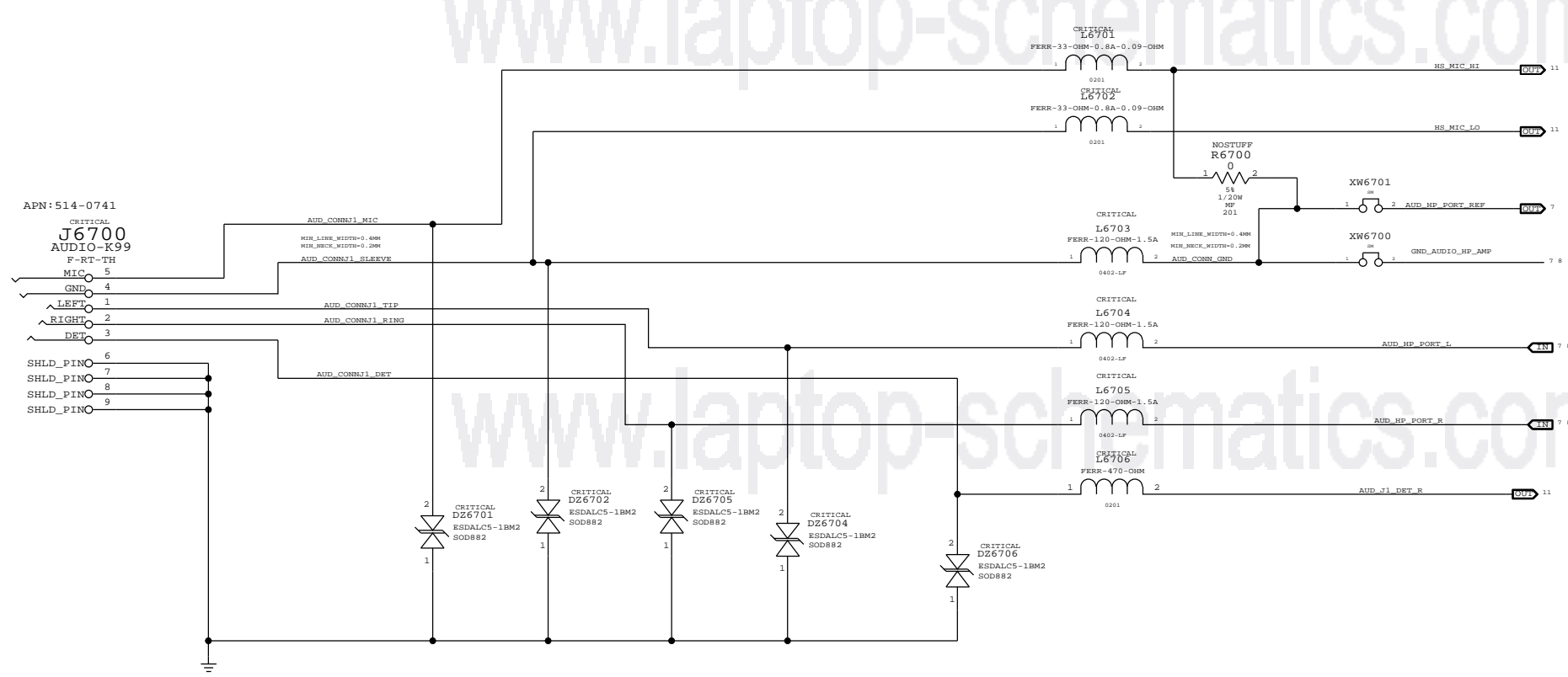
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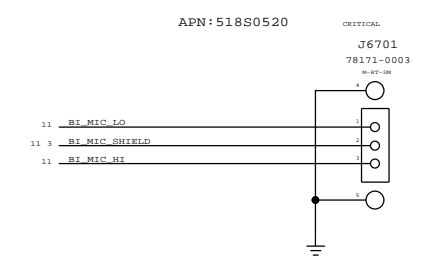
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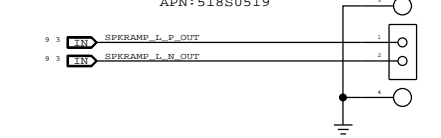
AUDIO JACK: HP CONNECTOR WITH MIKEY



MIC CONNECTOR



LEFT SPEAKER CONNECTOR



RIGHT SPEAKER ON MLB

|   |  |                        |           |
|---|--|------------------------|-----------|
| SYMC: MASTER-AUDIO  |  | SYMC: DATE: 05/19/2011 |           |
| AUDIO: JACK   |  |                        |           |
| Apple Inc.  |  | DRAWING NUMBER         | SIZE      |
|   |  | 051-8540               | D         |
|   |  | REVISION               |           |
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|   |  | PAGE                   | 67 OF 103 |
|   |  | SHEET                  | 10 OF 13  |
|   |  |                        |           |

D  
C  
B  
A

D  
C  
B  
A

CODEC OUTPUT SIGNAL PATHS

| FUNCTION    | VOLUME   | CONVERTER | PIN COMPLEX | MUTE CONTROL      | DET ASSIGNMENT |
|-------------|----------|-----------|-------------|-------------------|----------------|
| HP/LINE OUT | 0X02 (2) | 0X02 (2)  | 0X09 (9,A)  | GPIO_0 AND GPIO_1 | 0X09 (A)       |
| SPEAKERS    | 0X04 (4) | 0X04 (4)  | 0X0B (11)   | GPIO_3            | N/A            |

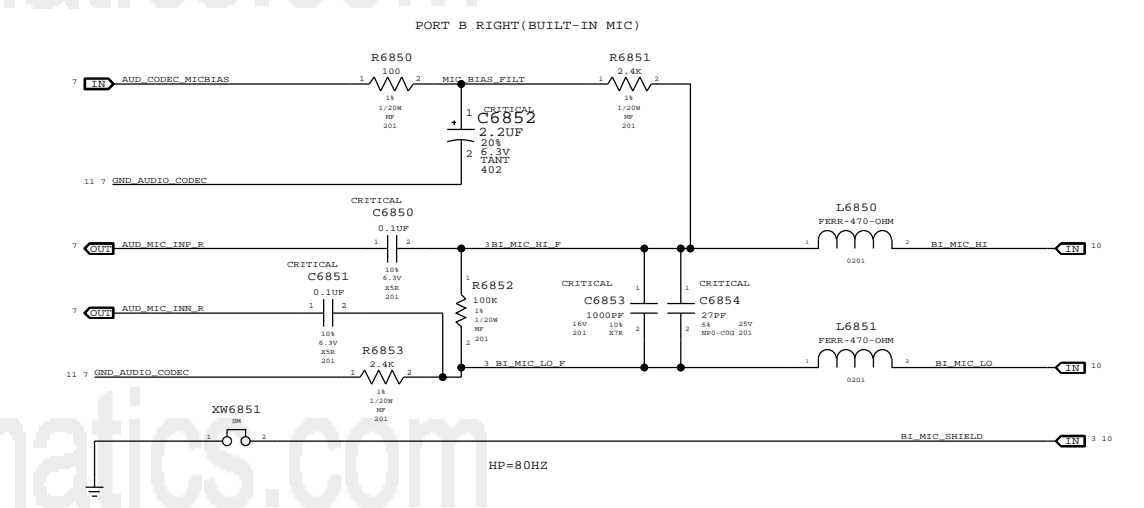
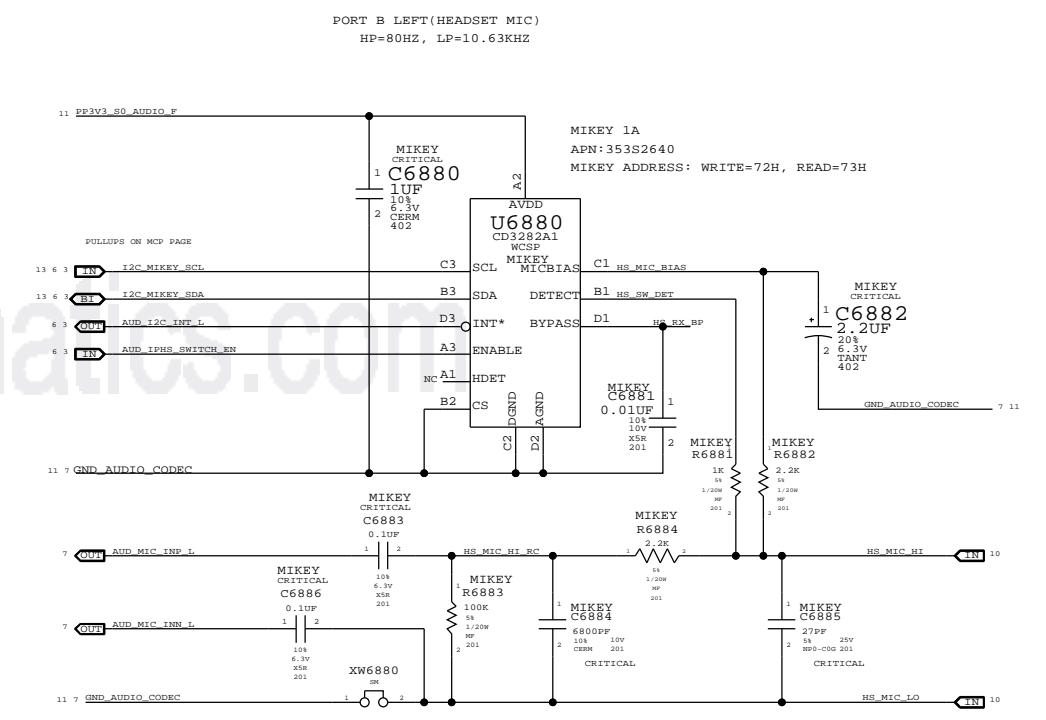
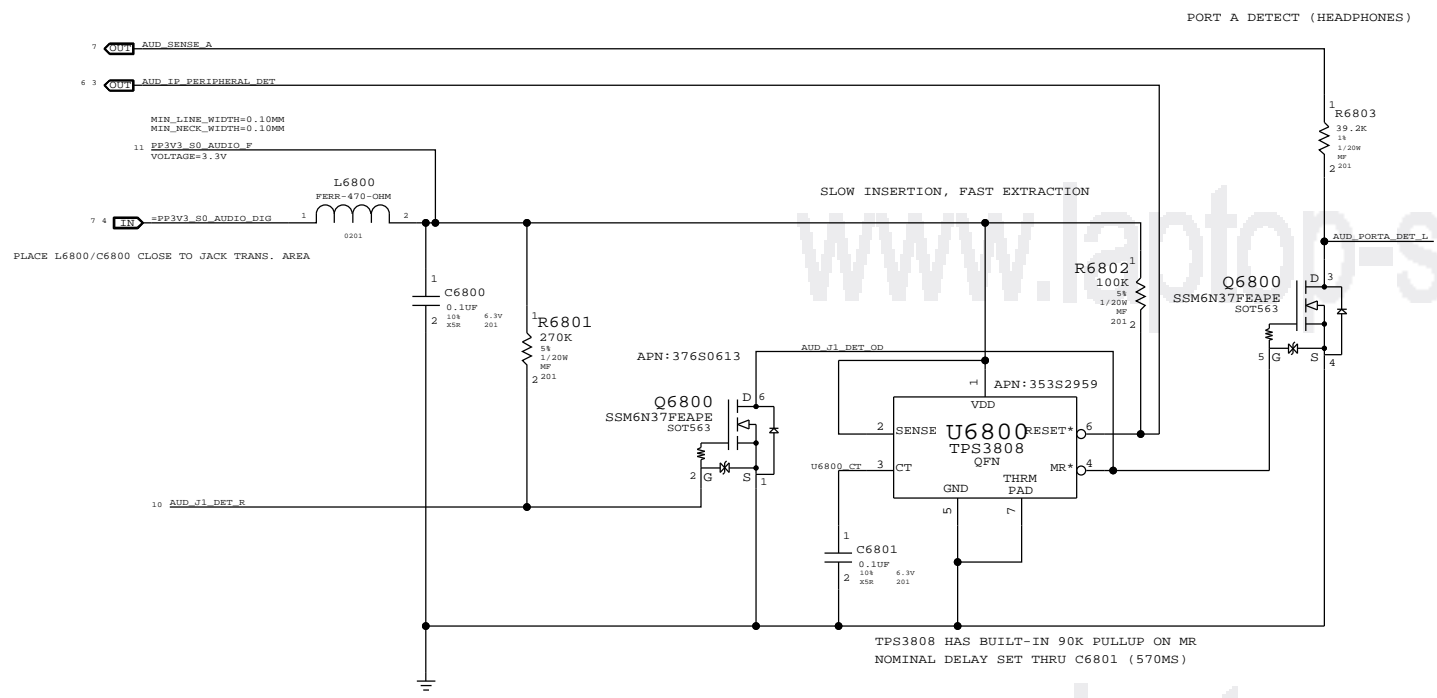
CODEC INPUT SIGNAL PATHS

| FUNCTION     | CONVERTER | PIN COMPLEX         | VREF           | DET ASSIGNMENT |
|--------------|-----------|---------------------|----------------|----------------|
| BUILT-IN MIC | 0X06 (6)  | 0XD (13,B,RIGHT)    | MIC_BIAS (80%) | N/A            |
| HEADSET MIC  | 0X06 (6)  | 0XD (13,V22,B,LEFT) | MIKEY          | MIKEY          |

SOUTHBIDGE RESOURCE/PIN ALLOCATIONS

| FUNCTION                     | NET NAME              | SB GPIO/INT |
|------------------------------|-----------------------|-------------|
| PERIPHERAL/EXTRACTION DETECT | AUD_IP_PERIPHERAL_DET | GPIO 38     |
| MIKEY INTERRUPT              | AUD_I2C_INT_L         | GPIO 55     |
| MIKEY ENABLE                 | AUD_IPHS_SWITCH_EN    | GPIO 2      |



SYNC MASTER=AUDIO SYNC DATE=08/05/2010

**AUDIO: JACK TRANSLATORS**

Apple Inc.

051-8540  
6.0.0

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11 OF 13

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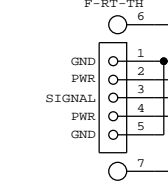
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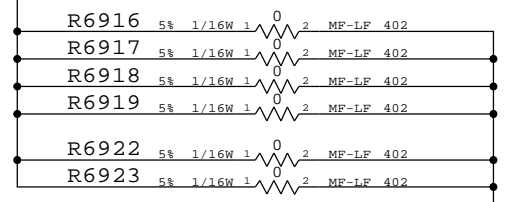
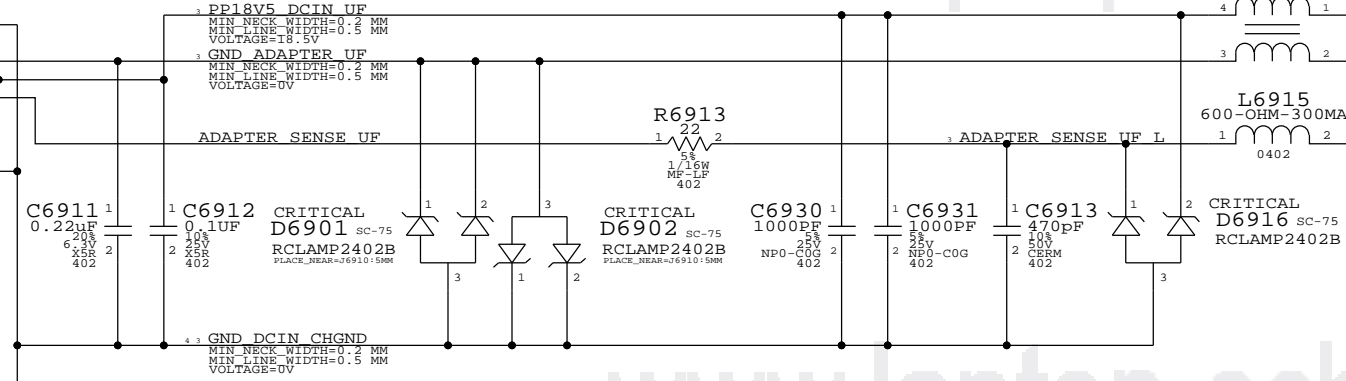
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MPM Connector

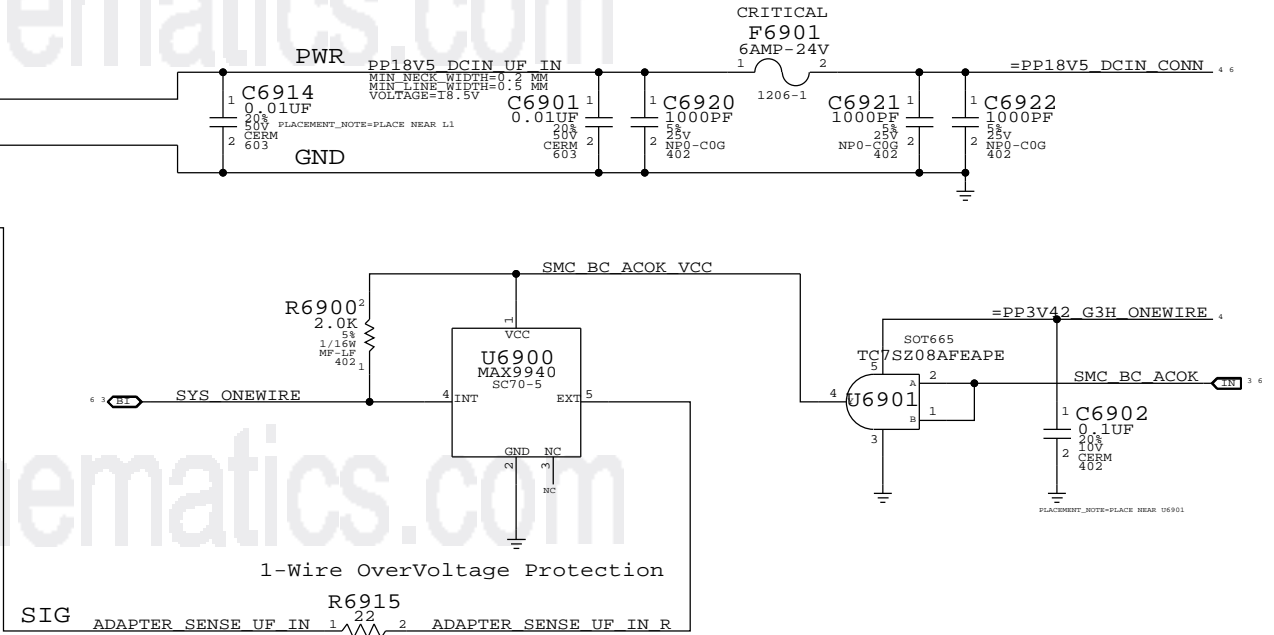
CRITICAL  
J6910  
MPM-DC-K99  
F-RT-TH



514-0736



Shorts added to provide path for ESD from chassis GND to the case.



|   |                |                  |           |
|---|----------------|------------------|-----------|
| SYNC MASTER=MASTER  |                | SYNC DATE=MASTER |           |
| PAGE TITLE<br><b>MPM CONNECTOR</b>  |                |                  |           |
| Apple Inc.  | DRAWING NUMBER | 051-8540         | SIZE<br>D |
|   | REVISION       | 6.0.0            |           |
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K16 LIO BOARD-SPECIFIC SPACING & PHYSICAL CONSTRAINTS

| BOARD LAYERS                        | BOARD AREAS       | BOARD UNITS (MIL OR MM) | ALLEGRO VERSION |
|-------------------------------------|-------------------|-------------------------|-----------------|
| TOP, I2L2, I2L3, I2L4, I2L5, BOTTOM | NO_TYPE, SDA_P10M | MM                      | 15.5.1          |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| DEFAULT           | *     | Y                     | =50_OHM_SE         | 0.100MM            | 30 MM               | 0 MM                 | 0 MM              |
| STANDARD          | *     | Y                     | =DEFAULT           | =DEFAULT           | 12.7 MM             | =DEFAULT             | =DEFAULT          |

| PHYSICAL_RULE_SET | LAYER       | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 55_OHM_SE         | TOP, BOTTOM | Y                     | 0.115 MM           | 0.115 MM           |                     |                      |                   |
| 55_OHM_SE         | *           | Y                     | 0.110 MM           | 0.110 MM           | =STANDARD           | =STANDARD            | =STANDARD         |

| PHYSICAL_RULE_SET | LAYER       | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 90_OHM_DIFF       | *           | N                     | =STANDARD          | =STANDARD          | =STANDARD           | =STANDARD            | =STANDARD         |
| 90_OHM_DIFF       | I2L3, I2L4  | Y                     | 0.115 MM           | 0.115 MM           |                     | 0.130 MM             | 0.130 MM          |
| 90_OHM_DIFF       | TOP, BOTTOM | Y                     | 0.110 MM           | 0.110 MM           |                     | 0.125 MM             | 0.125 MM          |

| PHYSICAL_RULE_SET | LAYER       | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 50_OHM_SE         | TOP, BOTTOM | Y                     | 0.090 MM           | 0.090 MM           |                     |                      |                   |
| 50_OHM_SE         | *           | Y                     | 0.076 MM           | 0.076 MM           | =STANDARD           | =STANDARD            | =STANDARD         |

| SPACING_RULE_SET | LAYER       | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------------|----------------------|--------|
| 24_DISELECTRIC   | TOP, BOTTOM | 0.193 MM             | ?      |
| 24_DISELECTRIC   | TOP, BOTTOM | 0.193 MM             | ?      |
| 24_DISELECTRIC   | -           | 0.254 MM             | ?      |
| 48_DISELECTRIC   | -           | 0.305 MM             | ?      |

USB 2.0 Interface Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| USB_90D           | *     | =90_OHM_DIFF          | =90_OHM_DIFF       | =90_OHM_DIFF       | =90_OHM_DIFF        | =90_OHM_DIFF         | =90_OHM_DIFF      |

| SPACING_RULE_SET | LAYER       | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------------|----------------------|--------|
| USB              | *           | =24_DISELECTRIC      | ?      |
| USB              | TOP, BOTTOM | =24_DISELECTRIC      | ?      |

SOURCE: MCP79 Interface DG (DG-03328-001\_v0D), Section 2.10.1.

SMBus Interface Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| SMB_55S           | *     | =55_OHM_SE            | =55_OHM_SE         | =55_OHM_SE         | =55_OHM_SE          | =STANDARD            | =STANDARD         |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| SMB              | *     | =24_DISELECTRIC      | ?      |

SOURCE: MCP79 Interface DG (DG-03328-001\_v0D), Section 2.11.1.

HD Audio Interface Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| HDA_55S           | *     | =55_OHM_SE            | =55_OHM_SE         | =55_OHM_SE         | =55_OHM_SE          | =STANDARD            | =STANDARD         |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| HDA              | *     | =24_DISELECTRIC      | ?      |

SOURCE: MCP79 Interface DG (DG-03328-001\_v0D), Section 2.12.1.

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE |         |                   |        |
|---------------------------|----------|---------|-------------------|--------|
|                           | PHYSICAL | SPACING |                   |        |
| USB_EXTB_N                | USB_90D  | USB     | CONN USB_EXTB N   | 5      |
| USB_EXTB_P                | USB_90D  | USB     | CONN USB_EXTB P   | 5      |
| USB_EXTB_N                | USB_90D  | USB     | USB_EXTB N        | 3 6    |
| USB_EXTB_P                | USB_90D  | USB     | USB_EXTB P        | 3 6    |
| USB_CAMERA_P              | USB_90D  | USB     | USB CAMERA P      | 3 6    |
| USB_CAMERA_N              | USB_90D  | USB     | USB CAMERA N      | 3 6    |
| USB_CAMERA_CONN_P         | USB_90D  | USB     | USB CAMERA CONN P | 3 6    |
| USB_CAMERA_CONN_N         | USB_90D  | USB     | USB CAMERA CONN N | 3 6    |
| I2C_LIO_SDA               | SMB_55S  | SMB     | I2C LIO_SDA       | 3 6    |
| I2C_LIO_SCL               | SMB_55S  | SMB     | I2C LIO_SCL       | 3 6    |
| I2C_MIKEY_SCL             | SMB_55S  | SMB     | I2C MIKEY_SCL     | 3 6 11 |
| I2C_MIKEY_SDA             | SMB_55S  | SMB     | I2C MIKEY_SDA     | 3 6 11 |
| HDA_BIT_CLK               | HDA_55S  | HDA     | HDA BIT_CLK       | 3 6 7  |
| HDA_SYNC                  | HDA_55S  | HDA     | HDA_SYNC          | 3 6 7  |
| HDA_RST_L                 | HDA_55S  | HDA     | HDA_RST_L         | 3 6 7  |
| HDA_SDIN0                 | HDA_55S  | HDA     | HDA_SDIN0         | 3 6 7  |
| AUD_SDI_R                 | HDA_55S  | HDA     | AUD_SDI_R         | 7      |
| HDA_SDOUT                 | HDA_55S  | HDA     | HDA_SDOUT         | 3 6 7  |

|   |  |                        |  |
|---|--|------------------------|--|
| SYNC MASTER=(K24_MLB)   |  | SYNC DATE=(04/06/2009) |  |
| PAGE TITLE<br><b>MCP Constraints 2</b>  |  |                        |  |
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