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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.

SCHEM, MBP 15" MLB

08/18/2008

| REV | ZONE | ECN | DESCRIPTION OF CHANGE | CK APPD | ENG APPD |
|-----|------|-----|-----------------------|---------|----------|
| ? | | ? | ? | | |
| | | | | DATE | DATE |
| | | | | ? | ? |

D

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|------|--------|----------------------------------|----------------|------------|
| 1 | 1 | Table of Contents | N/A | N/A |
| 2 | 2 | System Block Diagram | T18_MLB | 12/12/2007 |
| 3 | 3 | Power Block Diagram | T18_MLB | 12/12/2007 |
| 4 | 4 | Power Block Diagram | N/A | N/A |
| 5 | 5 | BOM Configuration | N/A | N/A |
| 6 | 6 | JTAG Scan Chain | DDR | 07/22/2008 |
| 7 | 7 | Functional / ICT Test | N/A | N/A |
| 8 | 8 | Power Aliases | (MASTER) | (MASTER) |
| 9 | 9 | Signal Aliases | (MASTER) | (MASTER) |
| 10 | 10 | CPU FSB | M87_MLB | 10/17/2007 |
| 11 | 11 | CPU Power & Ground | M87_MLB | 10/17/2007 |
| 12 | 12 | CPU Decoupling & VID | M87_MLB | 10/17/2007 |
| 13 | 13 | eXtended Debug Port(MiniXDP) | M99_MLB | 01/08/2008 |
| 14 | 14 | MCP CPU Interface | T18_MLB | 06/18/2008 |
| 15 | 15 | MCP Memory Interface | T18_MLB | 06/18/2008 |
| 16 | 16 | MCP Memory Misc | T18_MLB | 06/18/2008 |
| 17 | 17 | MCP PCIe Interfaces | T18_MLB | 06/18/2008 |
| 18 | 18 | MCP Ethernet & Graphics | T18_MLB | 06/18/2008 |
| 19 | 19 | MCP PCI & LPC | T18_MLB | 06/18/2008 |
| 20 | 20 | MCP SATA & USB | T18_MLB | 06/18/2008 |
| 21 | 21 | MCP HDA & MISC | T18_MLB | 06/18/2008 |
| 22 | 22 | MCP Power & Ground | T18_MLB | 06/18/2008 |
| 23 | 24 | MCP79 A01 Silicon Support | T18_MLB | 03/31/2008 |
| 24 | 25 | MCP Standard Decoupling | T18_MLB | 06/18/2008 |
| 25 | 26 | MCP Graphics Support | AMASON_M98_MLB | 06/18/2008 |
| 26 | 28 | SB Misc | T18_MLB | 12/17/2007 |
| 27 | 29 | FSB/DDR3/FRAMEBUF Vref Margining | DDR | 07/22/2008 |
| 28 | 31 | DDR3 SO-DIMM Connector A | DDR | 07/22/2008 |
| 29 | 32 | DDR3 SO-DIMM Connector B | DDR | 07/22/2008 |
| 30 | 33 | DDR3 Support | T18_MLB | 06/18/2008 |
| 31 | 34 | Right Clutch Connector | YITE_M98_MLB | 07/02/2008 |
| 32 | 35 | ExpressCard Connector | YITE_M98_MLB | 07/02/2008 |
| 33 | 37 | Ethernet PHY (RTL8211CL) | SUMA_M98_MLB | 07/01/2008 |
| 34 | 38 | Ethernet & AirPort Support | SUMA_M98_MLB | 07/01/2008 |
| 35 | 39 | Ethernet Connector | SUMA_M98_MLB | 07/01/2008 |
| 36 | 41 | FireWire LLC/PHY (FW643) | SENSOR | 08/14/2008 |
| 37 | 42 | FireWire Port Power | SENSOR | 08/14/2008 |
| 38 | 43 | FireWire Ports | SENSOR | 08/14/2008 |
| 39 | 45 | SATA Connectors | CHANG_M98_MLB | 07/01/2008 |
| 40 | 46 | External USB Connectors | AMASON_M98_MLB | 07/02/2008 |
| 41 | 48 | Front Flex Support | CHANG_M98_MLB | 07/01/2008 |
| 42 | 49 | SMC | T18_MLB | 06/18/2008 |
| 43 | 50 | SMC Support | AMASON_M98_MLB | 06/18/2008 |
| 44 | 51 | LPC+SPI Debug Connector | CHANG_M98_MLB | 07/01/2008 |
| 45 | 52 | M98 SMBus Connections | DDR | 07/22/2008 |

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| 46 | 53 | Current & Voltage Sensing | SENSOR | 08/14/2008 |
| 47 | 54 | Current Sensing | SENSOR | 08/14/2008 |
| 48 | 55 | Thermal Sensors | SENSOR | 08/14/2008 |
| 49 | 56 | Fan Connectors | M87_MLB | 10/17/2007 |
| 50 | 57 | WELLSRING 1 | AMASON_M98_MLB | 06/18/2008 |
| 51 | 58 | WELLSRING 2 | PWRSQNC | 05/12/2008 |
| 52 | 59 | Sudden Motion Sensor (SMS) | SENSOR | 08/14/2008 |
| 53 | 61 | SPI ROM | CHANG_M98_MLB | 07/01/2008 |
| 54 | 62 | AUDIO:CODEC | AUDIO | 07/09/2008 |
| 55 | 63 | AUDIO: LINE IN | AUDIO | 07/09/2008 |
| 56 | 65 | AUDIO: HEADPHONE AMP | AUDIO | 07/09/2008 |
| 57 | 66 | AUDIO:SPEAKER AMP | AUDIO | 07/09/2008 |
| 58 | 67 | AUDIO: JACKS | AUDIO | 07/09/2008 |
| 59 | 68 | AUDIO: JACK TRANSLATORS | AUDIO | 07/09/2008 |
| 60 | 69 | DC-In & Battery Connectors | T18_MLB | 12/06/2007 |
| 61 | 70 | PBus Supply & Battery Charger | M99_MLB | 12/10/2007 |
| 62 | 71 | IMVP6 CPU VCore Regulator | M87_MLB | 10/17/2007 |
| 63 | 72 | 5V / 3.3V Power Supply | M99_MLB | 01/09/2008 |
| 64 | 73 | 1.5V DDR3 Supply | M99_MLB | 12/13/2007 |
| 65 | 75 | 1.05V / MCP Core Regulator | M99_MLB | 01/08/2008 |
| 66 | 76 | CPU VTT Power Supply | M99_MLB | 12/14/2007 |
| 67 | 77 | Misc Power Supplies | M99_MLB | 12/14/2007 |
| 68 | 78 | Power Control | PWRSQNC | 05/12/2008 |
| 69 | 79 | Power FETs | PWRSQNC | 05/12/2008 |
| 70 | 80 | NV G96 PCI-E | MUXGFX | 07/10/2008 |
| 71 | 81 | NV G96 Core/FB Power | MUXGFX | 07/10/2008 |
| 72 | 82 | NV G96 Frame Buffer I/F | MUXGFX | 07/10/2008 |
| 73 | 84 | GDDR3 Frame Buffer A (Top) | MUXGFX | 07/10/2008 |
| 74 | 85 | GDDR3 Frame Buffer B (Top) | MUXGFX | 07/10/2008 |
| 75 | 86 | NV G96 GPIO/MIO/Misc | MUXGFX | 07/10/2008 |
| 76 | 87 | G96 GPIOs & Straps | MUXGFX | 07/09/2008 |
| 77 | 88 | NV G96 Video Interfaces | MUXGFX | 07/10/2008 |
| 78 | 89 | GPU (G84M) Core Supply | M87_MLB | 10/17/2007 |
| 79 | 90 | LVDS Display Connector | MUXGFX | 02/25/2008 |
| 80 | 93 | Muxed Graphics Support | MUXGFX | 07/10/2008 |
| 81 | 94 | DisplayPort Connector | MUXGFX | 07/10/2008 |
| 82 | 95 | 1.1V / 1V8 FB Power Supply | MUXGFX | 07/10/2008 |
| 83 | 96 | Graphics MUX (GMUX) | MUXGFX | 07/10/2008 |
| 84 | 97 | LCD BACKLIGHT DRIVER | YITE_M98_MLB | 07/02/2008 |
| 85 | 98 | LCD Backlight Support | YITE_M98_MLB | 07/02/2008 |
| 86 | 99 | Misc Power Supplies | MUXGFX | 02/01/2008 |
| 87 | 100 | CPU/FSB Constraints | MUXGFX | 02/18/2008 |
| 88 | 101 | Memory Constraints | MUXGFX | 02/18/2008 |
| 89 | 102 | MCP Constraints 1 | MUXGFX | 02/18/2008 |
| 90 | 103 | MCP Constraints 2 | MUXGFX | 02/18/2008 |

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|------|--------|------------------------------|---------|------------|
| 91 | 104 | Ethernet Constraints | MUXGFX | 02/18/2008 |
| 92 | 105 | FireWire Constraints | MUXGFX | 02/18/2008 |
| 93 | 106 | SMC Constraints | MUXGFX | 02/18/2008 |
| 94 | 107 | GPU (G96) Constraints | MUXGFX | 02/18/2008 |
| 95 | 108 | Project Specific Constraints | MUXGFX | 02/21/2008 |
| 96 | 109 | PCB Rule Definitions | M99_MLB | 01/22/2008 |

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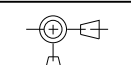
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Schematic / PCB #'s

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|-------------------|---------------|----------|------------|
| 051-7546 | 1 | SCHEM, FIBBO, M98 | SCH | CRITICAL | |
| 820-2330 | 1 | PCBF, FIBBO, M98 | PCB | CRITICAL | |

DRAWING
TITLE=MLB
ABBREV=DRAWING
LAST MODIFIED=Mon Aug 18 01:48:34 2008

| | | | | | |
|---|-------|-------------------------------------|-----------|---|----------------|
| DIMENSIONS ARE IN MILLIMETERS | | METRIC | | APPLE INC. | |
| XX : | _____ | DRAPTER | DESIGN CK | NOTICE OF PROPRIETARY PROPERTY THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE COMPUTER, INC. THE POSSESSOR AGREES TO THE FOLLOWING: I. TO MAINTAIN THE DOCUMENT IN CONFIDENCE II. NOT TO REPRODUCE OR COPY IT III. NOT TO REVEAL OR PUBLISH IN WHOLE OR PART | |
| X.XX : | _____ | ENG APPD | MFG APPD | | |
| X.XXX : | _____ | QA APPD | DESIGNER | | |
| ANGLES : | _____ | RELEASE | SCALE | | |
| DO NOT SCALE DRAWING | | NONE | | TITLE | |
|  THIRD ANGLE PROJECTION | | MATERIAL/FINISH NOTED AS APPLICABLE | | SIZE D | DRAWING NUMBER |
| | | | | 051-7546 | REV. A.0.0 |
| | | | | SHT 1 | OF 96 |

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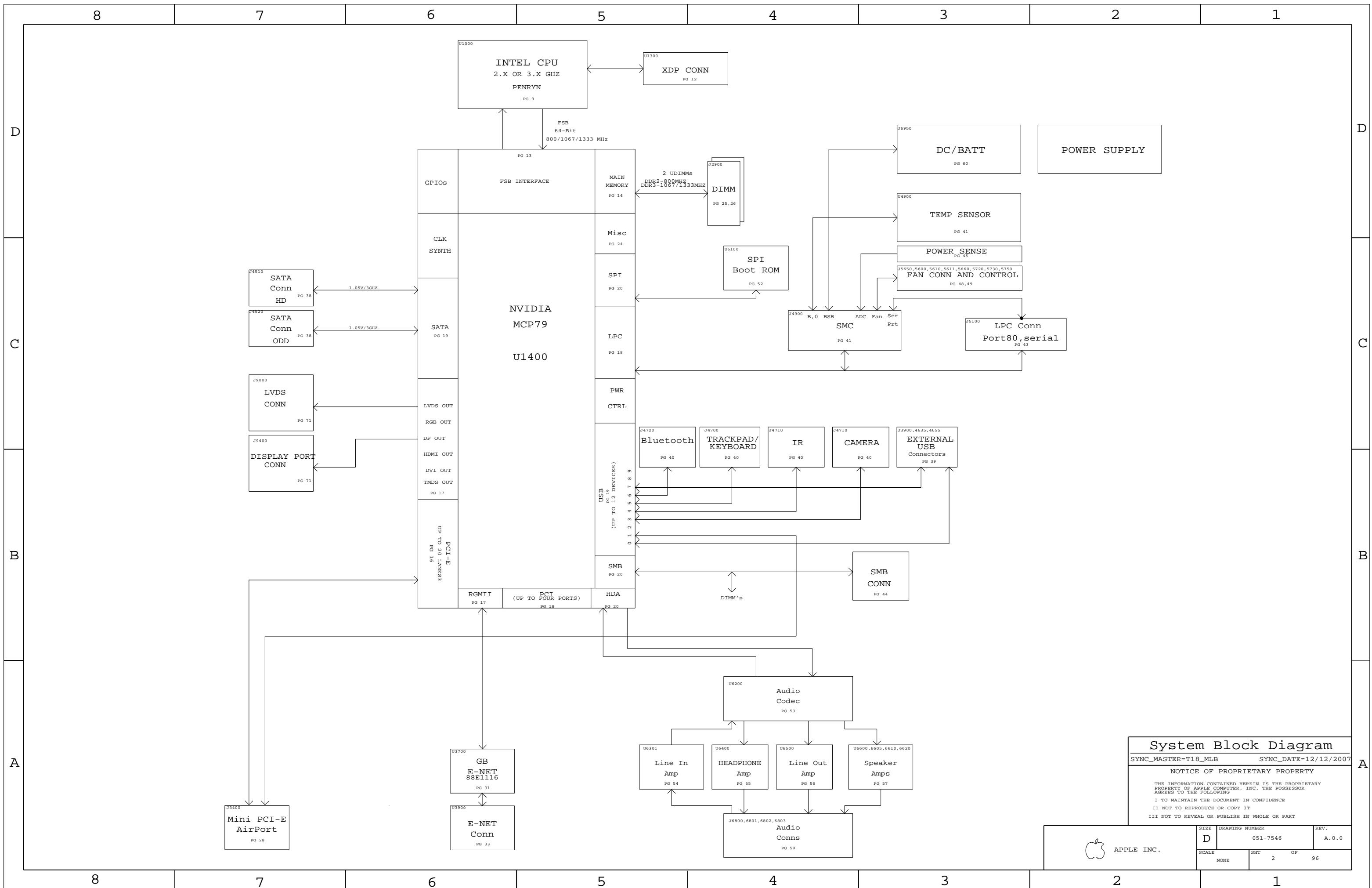
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System Block Diagram

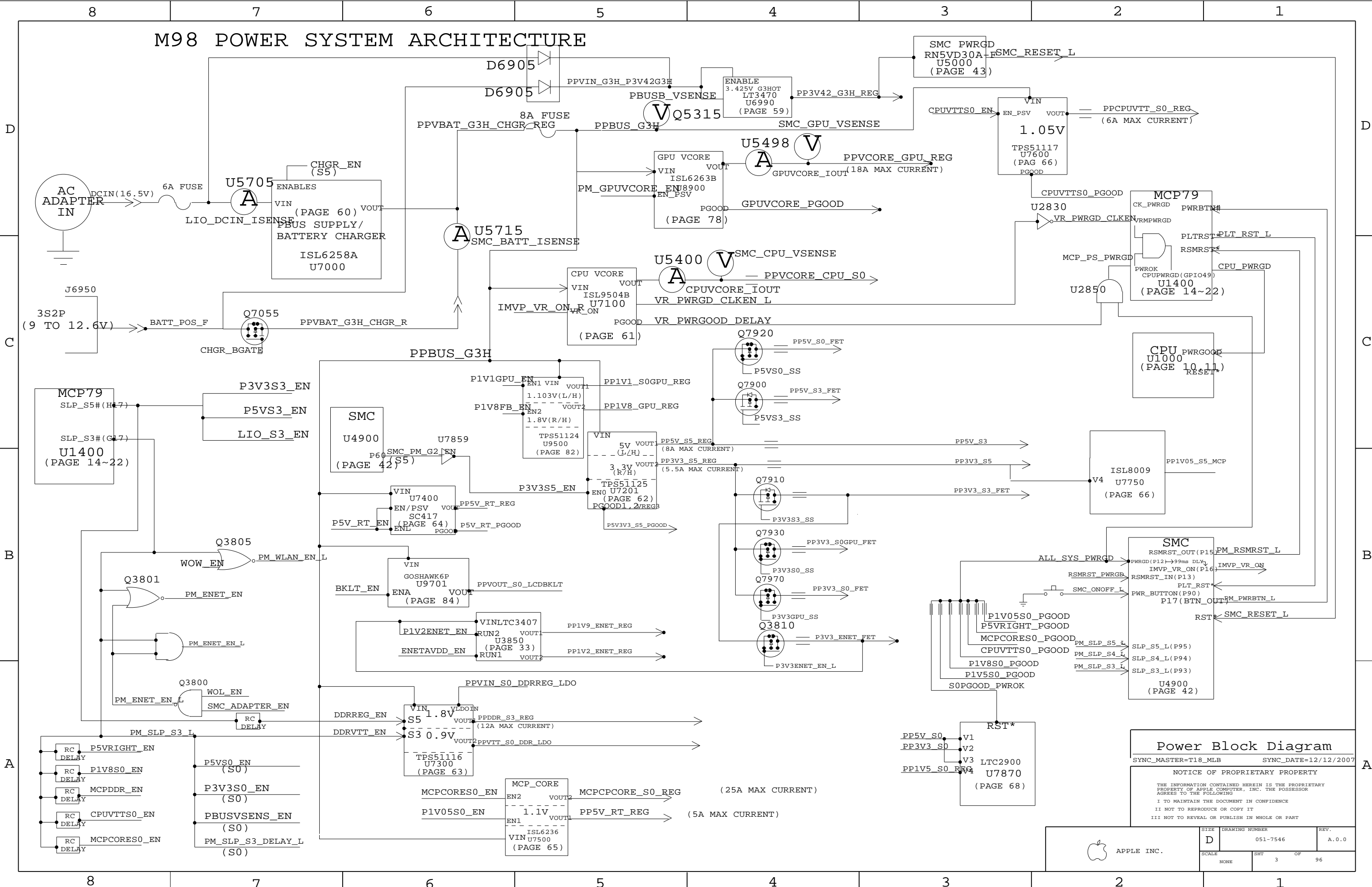
SYNC_MASTER=T18_MLB SYNC_DATE=12/12/2007

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| SCALE | SHT | OF | |
| NONE | 2 | 96 | |

M98 POWER SYSTEM ARCHITECTURE



Power Block Diagram

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Power Block Diagram

SYNC_MASTER=N/A SYNC_DATE=N/A

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| SIZE | DRAWING NUMBER | REV. |
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| SCALE | SHT | OF |
| NONE | 4 | 96 |

BOM Variants

| BOM NUMBER | BOM NAME | BOM OPTIONS |
|------------|--------------------------------|---|
| 630-9334 | PCBA, 2.4GHZ, 256SAM_VRAM, M98 | M98_COMMON, EEE_OZA, CPU_2_4GHZ, FB_256_SAMSUNG |
| 630-9335 | PCBA, 2.4GHZ, 256HYN_VRAM, M98 | M98_COMMON, EEE_OZB, CPU_2_4GHZ, FB_256_HYNIX |
| 630-9336 | PCBA, 2.5GHZ, 512SAM_VRAM, M98 | M98_COMMON, EEE_OZC, CPU_2_5GHZ, FB_512_SAMSUNG |
| 630-9337 | PCBA, 2.5GHZ, 512QIM_VRAM, M98 | M98_COMMON, EEE_OZD, CPU_2_5GHZ, FB_512_QIMONDA |
| 630-9585 | PCBA, 2.8GHZ, 512SAM_VRAM, M98 | M98_COMMON, EEE_2NH, CPU_2_8GHZ, FB_512_SAMSUNG |
| 630-9586 | PCBA, 2.8GHZ, 512QIM_VRAM, M98 | M98_COMMON, EEE_2NJ, CPU_2_8GHZ, FB_512_QIMONDA |

M98 BOM Groups

| BOM GROUP | BOM OPTIONS |
|---------------|--|
| M98_COMMON | ALTERNATE, COMMON, M98_COMMON1, M98_COMMON2, M98_COMMON3, M98_DEBUG, M98_PROGPARTS |
| M98_COMMON1 | ONEWIRE_PU, ISL6258A, MEMRESET_HW, MEMRESET_MCP, MCP_B02, MCP_PROD, MCPSEQ_SMC |
| M98_COMMON2 | BKLT_PLL_NOT, BMON_ENG, MIKEY, BOOT_MODE_USER, GPUVID_1P00V, MUXGFX |
| M98_COMMON3 | DPMUX_EN_S0, DP_ESD, EG_PWRSEQ_HW, DP_CA_DET_EG_PLD, MCP_CS1_NO |
| M98_DEBUG | SMC_DEBUG_YES, XDP, LPCPLUS, VREFMRGN |
| M98_PROGPARTS | GMUX_PROG, BOOTROM_PROG, SMC_PROG, TPAD_PROG |

| BOM GROUP | BOM OPTIONS |
|----------------|-------------------------|
| FB_256_SAMSUNG | VRAM4, VRAM_256_SAMSUNG |
| FB_256_HYNIX | VRAM4, VRAM_256_HYNIX |
| FB_512_SAMSUNG | VRAM4, VRAM_512_SAMSUNG |
| FB_512_QIMONDA | VRAM4, VRAM_512_QIMONDA |

Bar Code Labels / EEE #'s

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|----------------------------------|---------------|----------|------------|
| 826-4393 | 1 | LBL, P/N LABEL, PCB, 28MM X 6 MM | [EEE:OZA] | CRITICAL | EEE_OZA |
| 826-4393 | 1 | LBL, P/N LABEL, PCB, 28MM X 6 MM | [EEE:OZB] | CRITICAL | EEE_OZB |
| 826-4393 | 1 | LBL, P/N LABEL, PCB, 28MM X 6 MM | [EEE:OZC] | CRITICAL | EEE_OZC |
| 826-4393 | 1 | LBL, P/N LABEL, PCB, 28MM X 6 MM | [EEE:OZD] | CRITICAL | EEE_OZD |
| 826-4393 | 1 | LBL, P/N LABEL, PCB, 28MM X 6 MM | [EEE:2NH] | CRITICAL | EEE_2NH |
| 826-4393 | 1 | LBL, P/N LABEL, PCB, 28MM X 6 MM | [EEE:2NJ] | CRITICAL | EEE_2NJ |

Module Parts

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|--|----------------------------|----------|------------------|
| 337S3639 | 1 | IC, PDC, SLB4N, FRQ, 2.4G, 25W, 1066, M0, 3M, BGA | U1000 | CRITICAL | CPU_2_4GHZ |
| 337S3640 | 1 | IC, PDC, SLB4X, FRQ, 2.53G, 35W, 1066, C0, 6M, BGA | U1000 | CRITICAL | CPU_2_5GHZ |
| 338S0554 | 1 | IC, GPU, 55nm, NV G96-GS, BGA969, LF | U8000 | CRITICAL | |
| 338S0570 | 1 | IC, RTL8211CL, GIGE TRANSCEIVER, 48P TQFP | U3700 | CRITICAL | |
| 338S0523 | 1 | IC, FW643-06, 1394B PHY/ONCI LINK/PCI-E, 12 | U4100 | CRITICAL | |
| 338S0600 | 1 | IC, GMCP, MCP79-B01, 35x35MM, BGA1437 | U1400 | CRITICAL | MCP_B01 |
| 338S0563 | 1 | IC, SMC, HS8/2117, 9MMX9MM, TLP | U4900 | CRITICAL | SMC_BLANK |
| 341S2289 | 1 | IC, SMC, DEVELOPMENT, M98 | U4900 | CRITICAL | SMC_PROG |
| 335S0384 | 1 | IC, 32MBIT 8-PIN SPI SERIAL FLASH, SOIC8 | U6100 | CRITICAL | BOOTROM_BLANK |
| 341S2366 | 1 | IC, EFI ROM, DEVELOPMENT, M98 | U6100 | CRITICAL | BOOTROM_PROG |
| 341S2272 | 1 | IC, HDCP ROM, NVG96, 8 PIN SOIC, LP, HF | U8770 | CRITICAL | HDCP_YES |
| 341S2384 | 1 | IR, ENCORE II, CY7C63803-LQXC | U4800 | CRITICAL | |
| 338S0635 | 1 | IC, GMCP, MCP79-B02, 35x35MM, BGA1437 | U1400 | CRITICAL | MCP_B02 |
| 341S2383 | 1 | IC, PSOC +W/USB, 56PIN, MLF, M98 | U5701 | CRITICAL | TPAD_PROG |
| 337S3641 | 1 | IC, PDC, SLB43, FRQ, 2.8G, 35W, 1066, C0, 6M, BGA | U1000 | CRITICAL | CPU_2_8GHZ |
| 333S0482 | 4 | IC, SGRAM, GDDR3, 16Mx32, 800MHZ, 136 FBGA | U8400, U8450, U8500, U8550 | CRITICAL | VRAM_256_SAMSUNG |
| 333S0483 | 4 | IC, SGRAM, GDDR3, 16Mx32, 900MHZ, 136 FBGA | U8400, U8450, U8500, U8550 | CRITICAL | VRAM_256_HYNIX |
| 333S0481 | 4 | IC, SGRAM, GDDR3, 32Mx32, 900MHZ, 136 FBGA | U8400, U8450, U8500, U8550 | CRITICAL | VRAM_512_SAMSUNG |
| 333S0472 | 4 | IC, SGRAM, GDDR3, 32Mx32, 900MHZ, 136 FBGA | U8400, U8450, U8500, U8550 | CRITICAL | VRAM_512_QIMONDA |

| PART NUMBER | ALTERNATE FOR PART NUMBER | BOM OPTION | REF DES | COMMENTS: |
|-------------|---------------------------|------------|---------|-------------------------------|
| 13880603 | 13880602 | | ALL | Muratec alt to Samsung |
| 353S1681 | 353S1294 | | ALL | LMV2011, ORAMP, ORM |
| 152S0276 | 152S0683 | | ALL | Maplayers alt to Delta/Vishay |
| 341S2367 | 341S2366 | | ALL | Macromia alt to SST |
| 152S0876 | 152S0867 | | ALL | Maplayers alt to Delta |
| 157S0058 | 157S0055 | | ALL | Delta alt to TOR Magnetics |
| 353S2312 | 353S1466 | | ALL | INTERSEIL ALT TO INTERSEIL |
| 514-0612 | 514-0607 | | ALL | PUBLINK RCVR ALT TO FORCOMM |
| 514-0613 | 514-0608 | | ALL | PUBLINK RCVR ALT TO FORCOMM |
| 152S0915 | 152S0796 | | ALL | Maplayers alt to Cytosol 180 |

BOM Configuration

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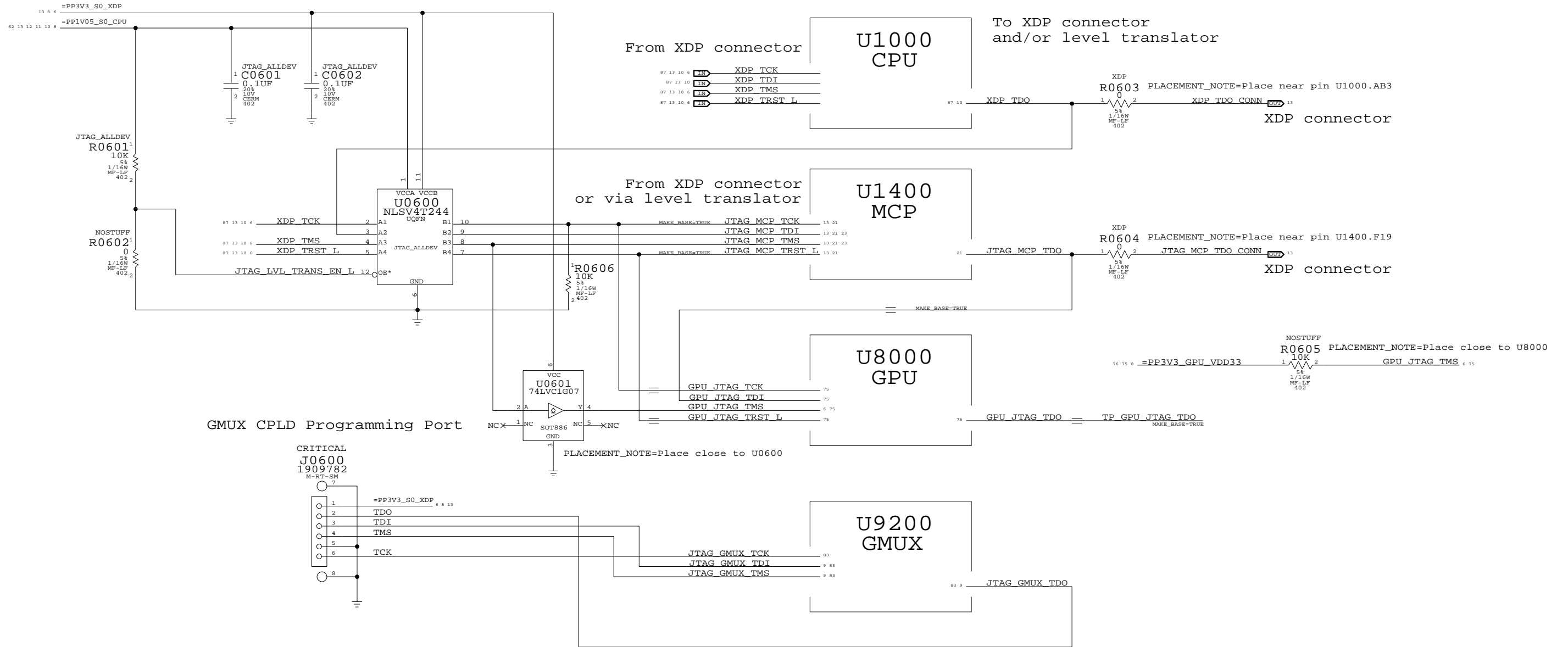
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| NONE | | 5 | 96 |

1.05V TO 3.3V LEVEL TRANSLATOR (M98: ON ICT FIXTURE)



JTAG Scan Chain

SYNC_MASTER=DDR SYNC_DATE=07/22/2008

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| | SCALE NONE | SHEET 6 | OF 96 |

Functional Test Points

ICT Test Points

Fan Connectors

FUNC_TEST

| | | |
|------|-----------------|------|
| TRUE | =PP5V_S0_FAN_LT | 8 49 |
| TRUE | FAN_LT_PWM | 49 |
| TRUE | FAN_LT_TACH | 49 |
| TRUE | FAN_RT_PWM | 49 |
| TRUE | FAN_RT_TACH | 49 |
| TRUE | GND | |

3 TPs per Fan

5 TPs per Fan

LVDS Connectors

FUNC_TEST

| | | |
|------|-----------------------|----------|
| TRUE | =PP3V3_S0_DDC_LCD | 8 76 79 |
| TRUE | PP3V3_SW_LCD | 79 |
| TRUE | BKL_SYNC | 79 84 |
| TRUE | LVDS_DDC_CLK | 79 80 |
| TRUE | LVDS_DDC_DATA | 79 80 |
| TRUE | LVDS_CONN_A_DATA_N<0> | 79 80 94 |
| TRUE | LVDS_CONN_A_DATA_P<0> | 79 80 94 |
| TRUE | LVDS_CONN_A_DATA_N<1> | 79 80 94 |
| TRUE | LVDS_CONN_A_DATA_P<1> | 79 80 94 |
| TRUE | LVDS_CONN_A_DATA_N<2> | 79 80 94 |
| TRUE | LVDS_CONN_A_DATA_P<2> | 79 80 94 |
| TRUE | LVDS_CONN_A_CLK_F_N | 79 94 |
| TRUE | LVDS_CONN_A_CLK_F_P | 79 94 |
| TRUE | LVDS_CONN_B_DATA_N<0> | 79 80 94 |
| TRUE | LVDS_CONN_B_DATA_P<0> | 79 80 94 |
| TRUE | LVDS_CONN_B_DATA_N<1> | 79 80 94 |
| TRUE | LVDS_CONN_B_DATA_P<1> | 79 80 94 |
| TRUE | LVDS_CONN_B_DATA_N<2> | 79 80 94 |
| TRUE | LVDS_CONN_B_DATA_P<2> | 79 80 94 |
| TRUE | LVDS_CONN_B_CLK_F_N | 79 94 |
| TRUE | LVDS_CONN_B_CLK_F_P | 79 94 |
| TRUE | LED_RETURN_1 | 79 84 |
| TRUE | LED_RETURN_2 | 79 84 |
| TRUE | LED_RETURN_3 | 79 84 |
| TRUE | LED_RETURN_4 | 79 84 |
| TRUE | LED_RETURN_5 | 79 84 |
| TRUE | LED_RETURN_6 | 79 84 |

Speaker Connectors

FUNC_TEST

| | | |
|------|------------------|----------|
| TRUE | BI_MIC_LO | 58 59 |
| TRUE | BI_MIC_SHIELD | 58 59 |
| TRUE | BI_MIC_HI | 58 59 |
| TRUE | SPKRCONN_L_P_OUT | 57 58 95 |
| TRUE | SPKRCONN_L_N_OUT | 57 58 95 |
| TRUE | SPKRCONN_R_P_OUT | 57 58 95 |
| TRUE | SPKRCONN_R_N_OUT | 57 58 95 |
| TRUE | SPKRCONN_S_P_OUT | 57 58 95 |
| TRUE | SPKRCONN_S_N_OUT | 57 58 95 |

| | | |
|------|-----|--|
| TRUE | GND | |
|------|-----|--|

6 TPs

SATA ODD Connectors

FUNC_TEST

| | | |
|------|------------------|-------|
| TRUE | PP5V_SW_ODD | 39 |
| TRUE | SMC_ODD_DETECT | 39 42 |
| TRUE | SATA_ODD_R2D_P | 39 89 |
| TRUE | SATA_ODD_R2D_N | 39 89 |
| TRUE | SATA_ODD_D2R_C_N | 39 89 |
| TRUE | SATA_ODD_D2R_C_P | 39 89 |

4 TPs

| | | |
|------|-----|--|
| TRUE | GND | |
|------|-----|--|

5 TPs

EXCARD Connector

FUNC_TEST

| | | |
|------|----------------------------|-------------|
| TRUE | USB2_EXCARD_CONN_N | 32 95 |
| TRUE | USB2_EXCARD_CONN_P | 32 95 |
| TRUE | PCIE_CLK100M_EXCARD_CONN_N | 32 95 |
| TRUE | PCIE_CLK100M_EXCARD_CONN_P | 32 95 |
| TRUE | PCIE_EXCARD_R2D_N | 32 89 95 |
| TRUE | PCIE_EXCARD_R2D_P | 32 89 95 |
| TRUE | PCIE_EXCARD_D2R_P | 17 32 89 |
| TRUE | PCIE_EXCARD_D2R_N | 17 32 89 |
| TRUE | PP3V3_S3_EXCARD_SWITCH | 32 |
| TRUE | PP3V3_S0_EXCARD_SWITCH | 32 |
| TRUE | PP1V5_S0_EXCARD_SWITCH | 32 |
| TRUE | PLT_RESET_SWITCH_L | 32 |
| TRUE | EXCARD_CPPE_L | 32 |
| TRUE | EXCARD_CPUSB_L | 32 |
| TRUE | EXCARD_CLKREO_CONN_L | 32 |
| TRUE | SMBUS_MCP_0_CLK | 13 21 45 90 |
| TRUE | SMBUS_MCP_0_DATA | 13 21 45 90 |

POWER RAILS

| | | |
|------|----------------------|-------------------------|
| TRUE | PM_SLP_S3_L | 21 34 37 42 44 68 81 83 |
| TRUE | PPBUS_G3H | 8 46 |
| TRUE | PPBUS_CPU_IMVP_ISNS | 8 |
| TRUE | PP3V42_G3H | 7 8 43 |
| TRUE | PP5V_S3 | 8 |
| TRUE | PP5V_S0 | 8 |
| TRUE | PPVCORE_S0_CPU | 8 |
| TRUE | PPVCORE_S0_MCP_REG | 8 |
| TRUE | PPVCORE_S0_MCP | 8 |
| TRUE | PP3V3_S5 | 8 95 |
| TRUE | PP3V3_S3 | 8 |
| TRUE | PP3V3_S0 | 8 95 |
| TRUE | PP2V5_S0 | 8 |
| TRUE | PP1V2_S0 | 8 |
| TRUE | PP1V8_S0 | 8 |
| TRUE | PP1V8R1V5_S3 | 8 |
| TRUE | PP1V8R1V5_S0_FET | 8 |
| TRUE | PPMCPDDR_ISNS | 8 |
| TRUE | PP1V05_S0_REG | 8 |
| TRUE | PP1V2R1V05_S5 | 8 |
| TRUE | PPCPUVTT_S0 | 8 |
| TRUE | PPCPUFUSB_ISNS_R | 8 |
| TRUE | PP0V9R0V75_S0_DDRVTT | 8 |
| TRUE | PP1V2R1V05_ENET | 8 |
| TRUE | PP3V3_ENET_PHY | 8 |
| TRUE | PPVP_FW | 8 |
| TRUE | PP1V0_FW | 8 |
| TRUE | PP3V3_S0GPU | 8 |
| TRUE | PP1V1_S0GPU_REG | 8 |
| TRUE | PP1V8_S0GPU_ISNS | 8 |
| TRUE | PPVCORE_GPU | 8 |
| TRUE | PP1V8_S0GPU_ISNS_R | 8 |
| TRUE | PP3V3_S5_AVREF_SMC | 42 43 |
| TRUE | PPVOUT_S0_LCDBKLT | 79 84 |
| TRUE | PPDCIN_G3H | 8 |
| TRUE | PPVTTDDR_S3 | 8 |
| TRUE | PP1V8_GPUIFPX | 8 |

IPD_FLEX_CONN

| | | |
|------|--------------------|-------|
| TRUE | PP3V3_S3_LDO | 51 |
| TRUE | PP18V5_S3 | 51 |
| TRUE | TPAD_GND_F | 7 51 |
| TRUE | Z2_CS_L | 50 51 |
| TRUE | Z2_DEBUG3 | 50 51 |
| TRUE | Z2_MOSI | 50 51 |
| TRUE | Z2_MISO | 50 51 |
| TRUE | Z2_SCLK | 50 51 |
| TRUE | Z2_BOOST_EN | 51 |
| TRUE | Z2_HOST_INTN | 50 51 |
| TRUE | Z2_BOOT_CFG1 | 50 51 |
| TRUE | Z2_CLKIN | 50 51 |
| TRUE | Z2_KEY_ACT_L | 50 51 |
| TRUE | Z2_RESET | 50 51 |
| TRUE | PSOC_MISO | 50 51 |
| TRUE | PSOC_MOSI | 50 51 |
| TRUE | PSOC_SCLK | 50 51 |
| TRUE | SMBUS_SMC_A_S3_SDA | 45 93 |
| TRUE | SMBUS_SMC_A_S3_SCL | 45 93 |
| TRUE | PSOC_F_CS_L | 50 51 |
| TRUE | PICKB_L | 50 51 |

KEYBOARD CONN

| | | |
|------|--------------------|--------|
| TRUE | PP3V42_G3H | 7 8 43 |
| TRUE | WS_KBD1 | 50 |
| TRUE | WS_KBD2 | 50 |
| TRUE | WS_KBD3 | 50 |
| TRUE | WS_KBD4 | 50 |
| TRUE | WS_KBD5 | 50 |
| TRUE | WS_KBD6 | 50 |
| TRUE | WS_KBD7 | 50 |
| TRUE | WS_KBD8 | 50 |
| TRUE | WS_KBD9 | 50 |
| TRUE | WS_KBD10 | 50 |
| TRUE | WS_KBD11 | 50 |
| TRUE | WS_KBD12 | 50 |
| TRUE | WS_KBD13 | 50 |
| TRUE | WS_KBD14 | 50 |
| TRUE | WS_KBD15_CAP | 50 |
| TRUE | WS_KBD16_NUM | 50 |
| TRUE | WS_KBD17 | 50 |
| TRUE | WS_KBD18 | 50 |
| TRUE | WS_KBD19 | 50 |
| TRUE | WS_KBD20 | 50 |
| TRUE | WS_KBD21 | 50 |
| TRUE | WS_KBD22 | 50 |
| TRUE | WS_KBD23 | 50 |
| TRUE | WS_KBD_ONOFF_L | 50 |
| TRUE | WS_LEFT_SHIFT_KBD | 50 |
| TRUE | WS_LEFT_OPTION_KBD | 50 |
| TRUE | WS_CONTROL_KBD | 50 |
| TRUE | KBDLED_ANODE | 51 |
| TRUE | TPAD_GND_F | 7 51 |

Functional / ICT Test

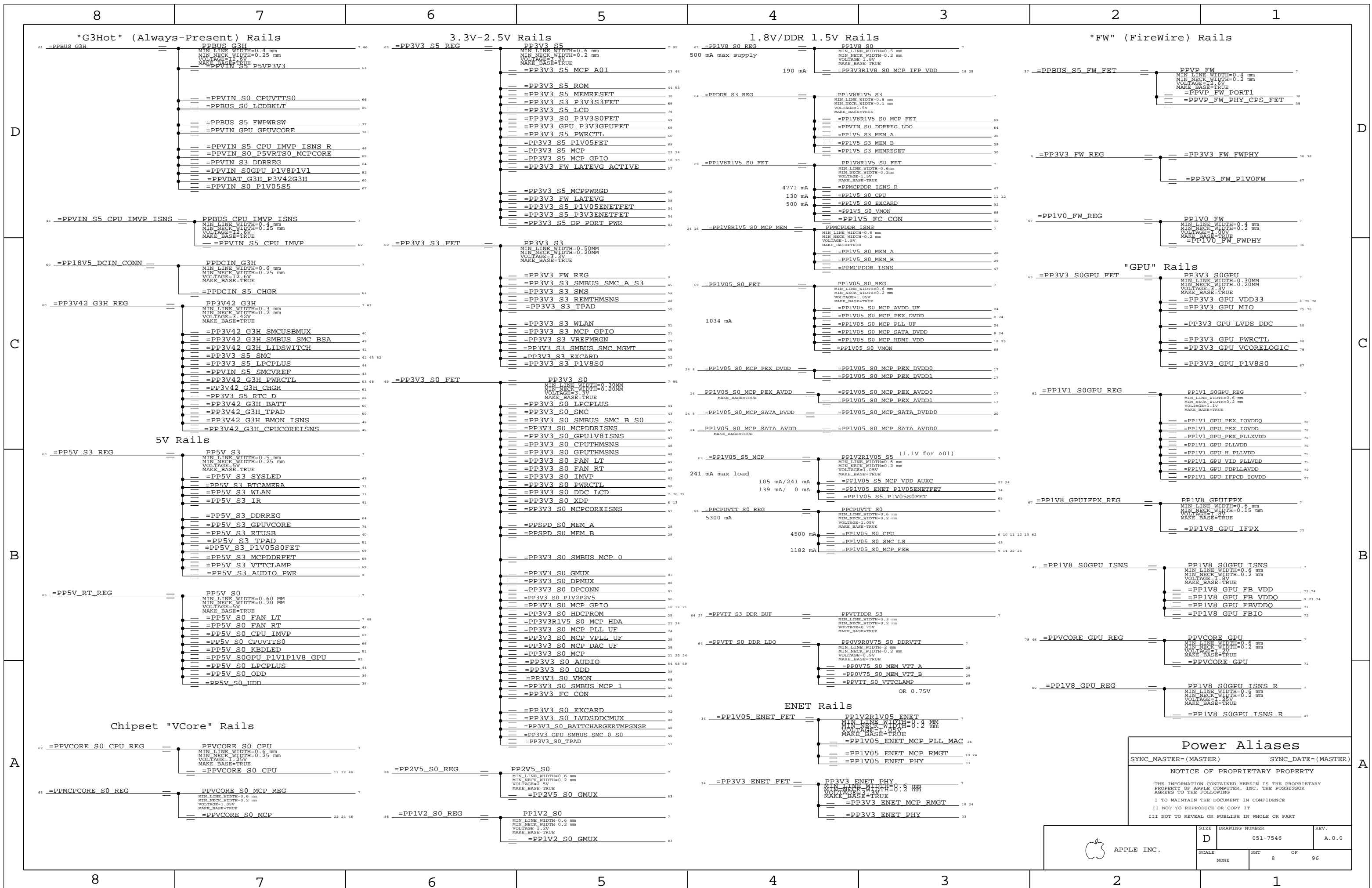
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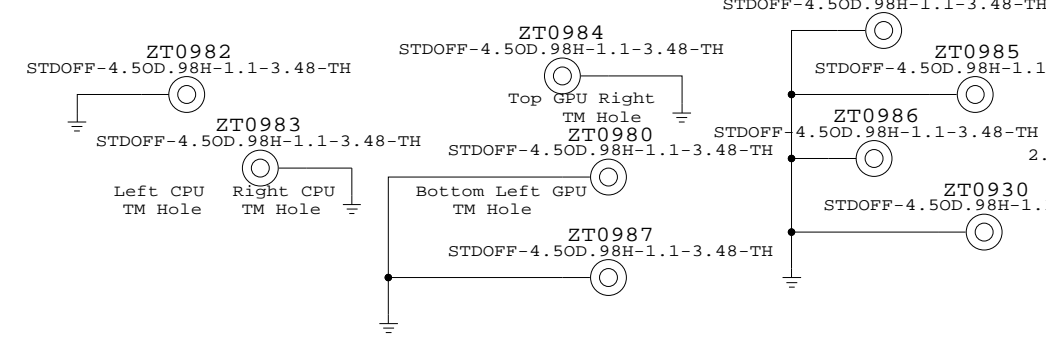
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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 7 | 96 |



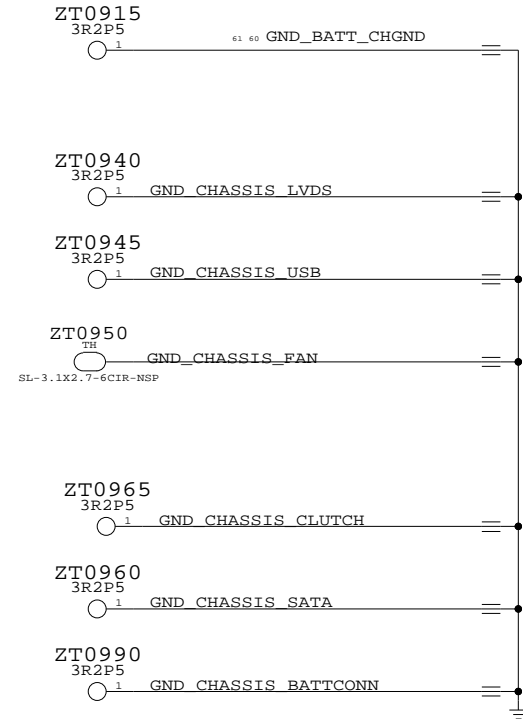
| Power Aliases | | |
|--|--------------------|--|
| SYNC_MASTER=(MASTER) | SYNC_DATE=(MASTER) | |
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Thermal Module Holes

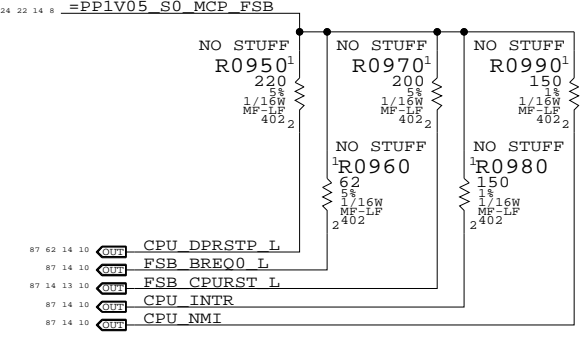


Frame Holes

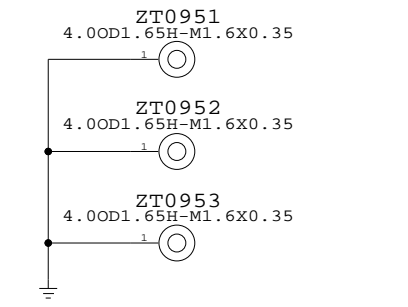


Extra FSB Pull-ups

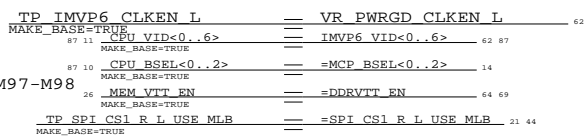
Exist in MRB but not Intel designs. Here for CYA. If found to be necessary, will move to page14.csa



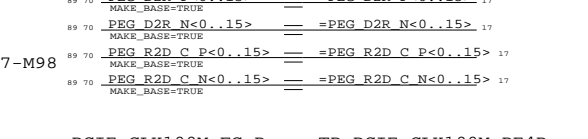
Bosses for VRAM HS



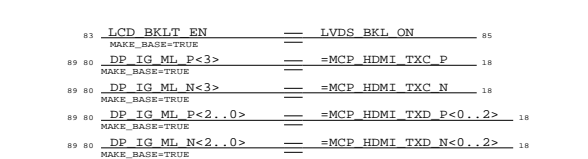
CPU signals



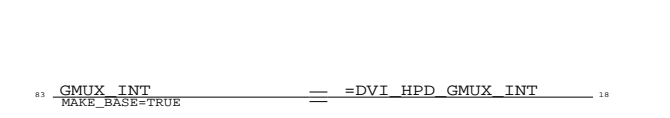
GPU signals



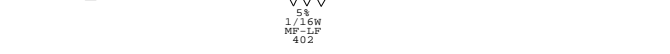
GMUX ALIASES



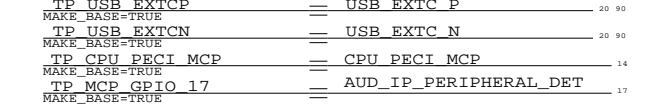
USB ALIASES



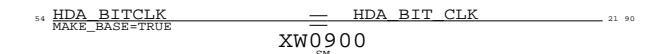
R0903



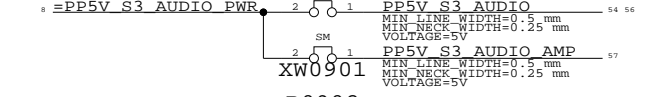
MEM ALIASES



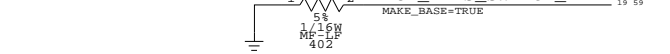
AUDIO ALIASES



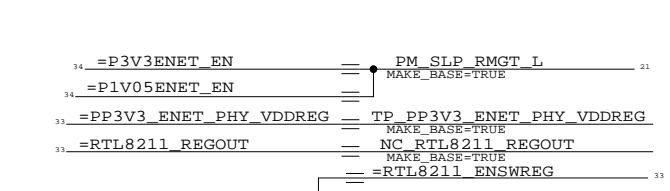
XW900



R0902

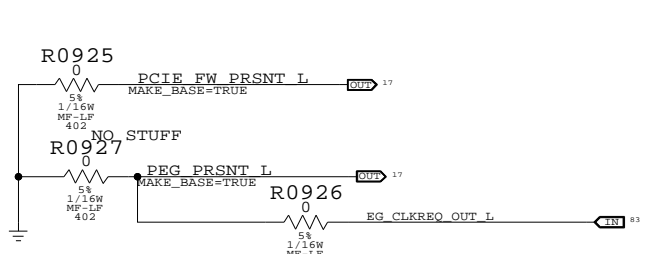


ETHERNET ALIASES

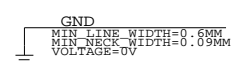


MCP79 PCIe PRSNT# Straps

These need work. Add other PRSNT# straps if needed.



Digital Ground



Signal Aliases

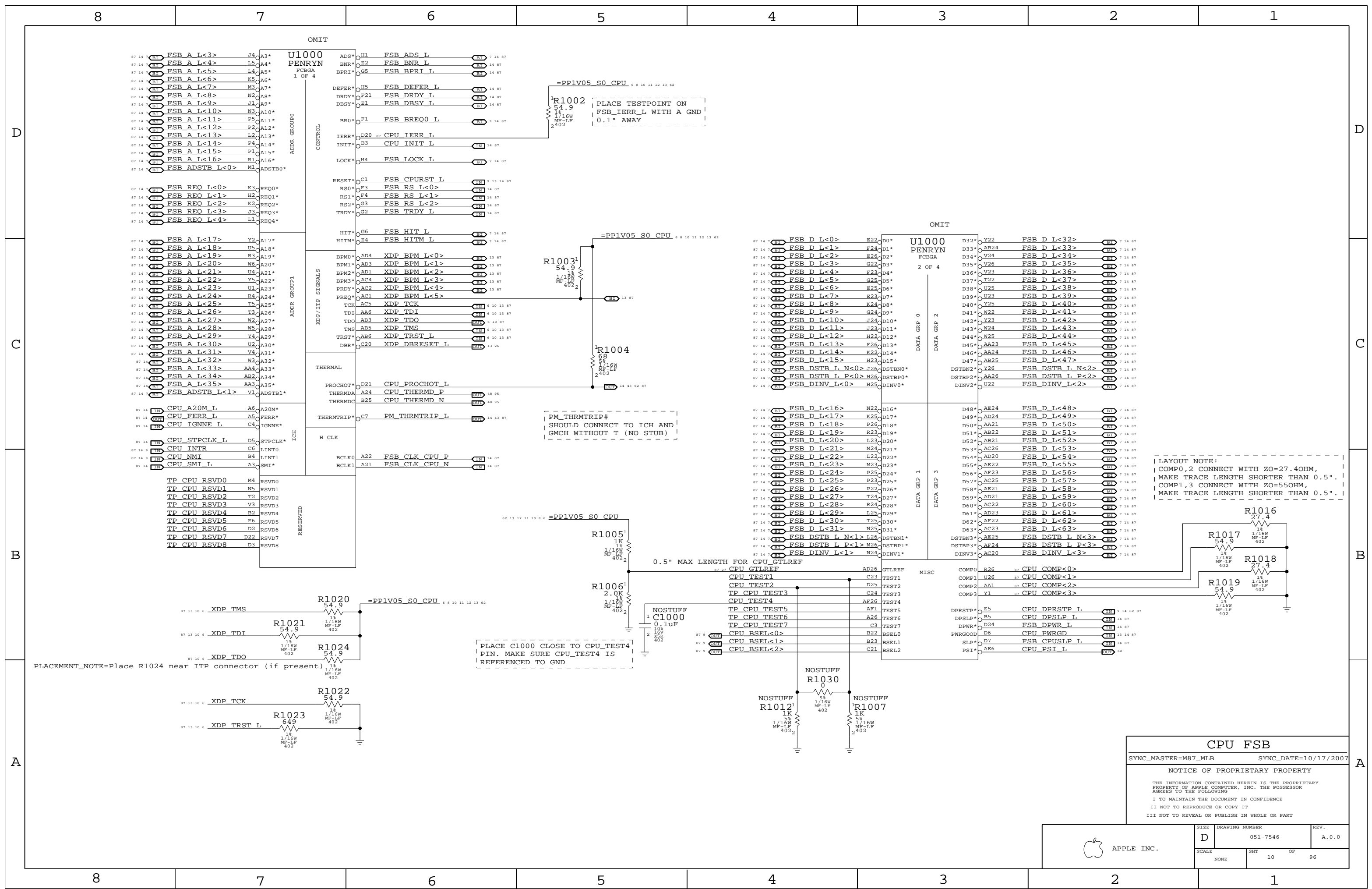
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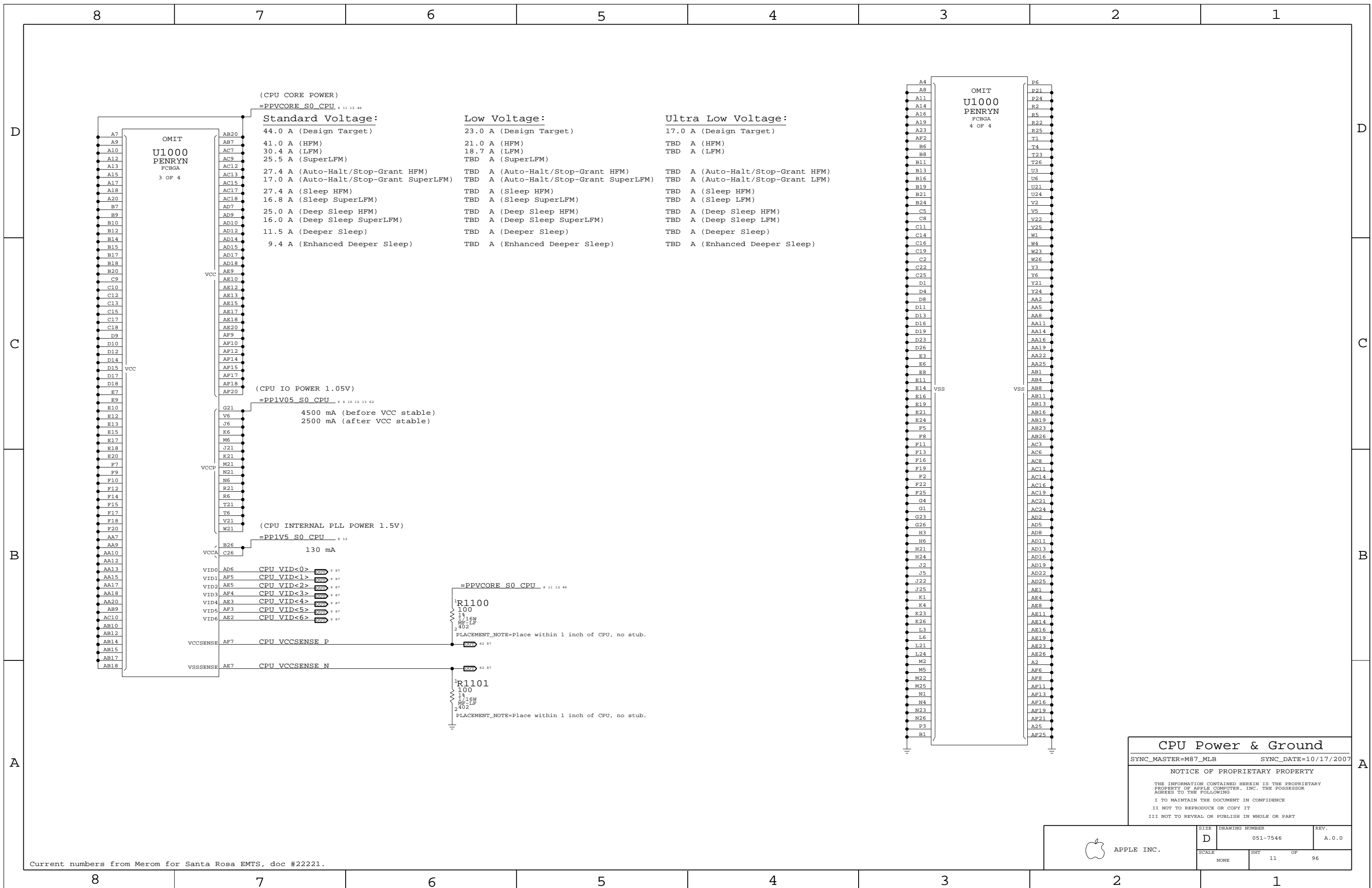
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| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 9 | 96 |



LAYOUT NOTE:
 COMPO,2 CONNECT WITH ZO=27.4OHM,
 MAKE TRACE LENGTH SHORTER THAN 0.5".
 COMPL,3 CONNECT WITH ZO=55OHM,
 MAKE TRACE LENGTH SHORTER THAN 0.5".

CPU FSB
 SYNC_MASTER=M87_MLB SYNC_DATE=10/17/2007
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| SCALE | SHT | OF | 96 |
| NONE | 10 | | |



CPU Power & Ground

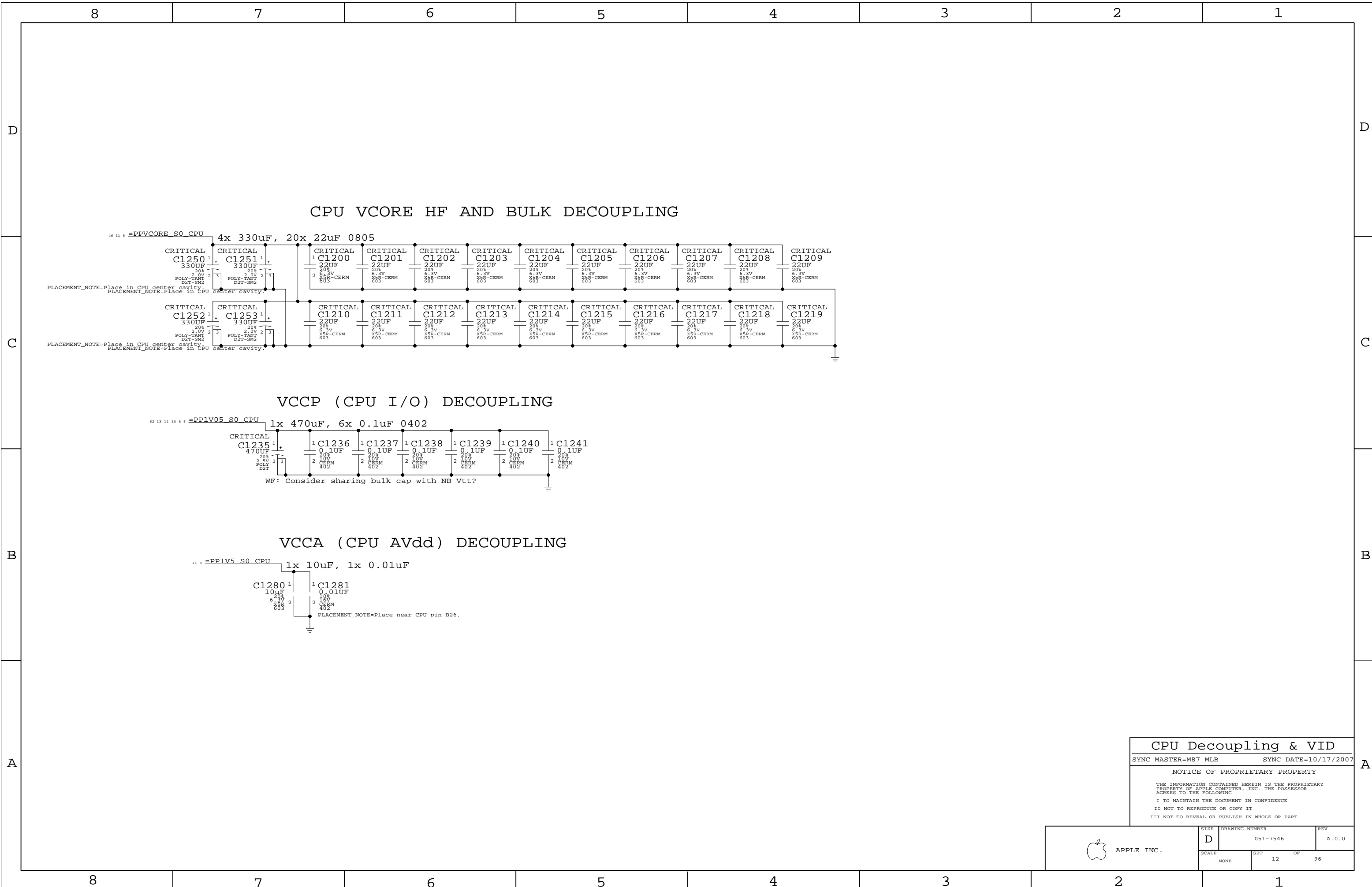
SYNC_MASTER=M87_MLB SYNC_DATE=10/17/2007

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| SCALE | SHT | OF | 96 |
| NONE | 11 | | |



CPU Decoupling & VID
 SYNC_MASTER=M87_MLB SYNC_DATE=10/17/2007

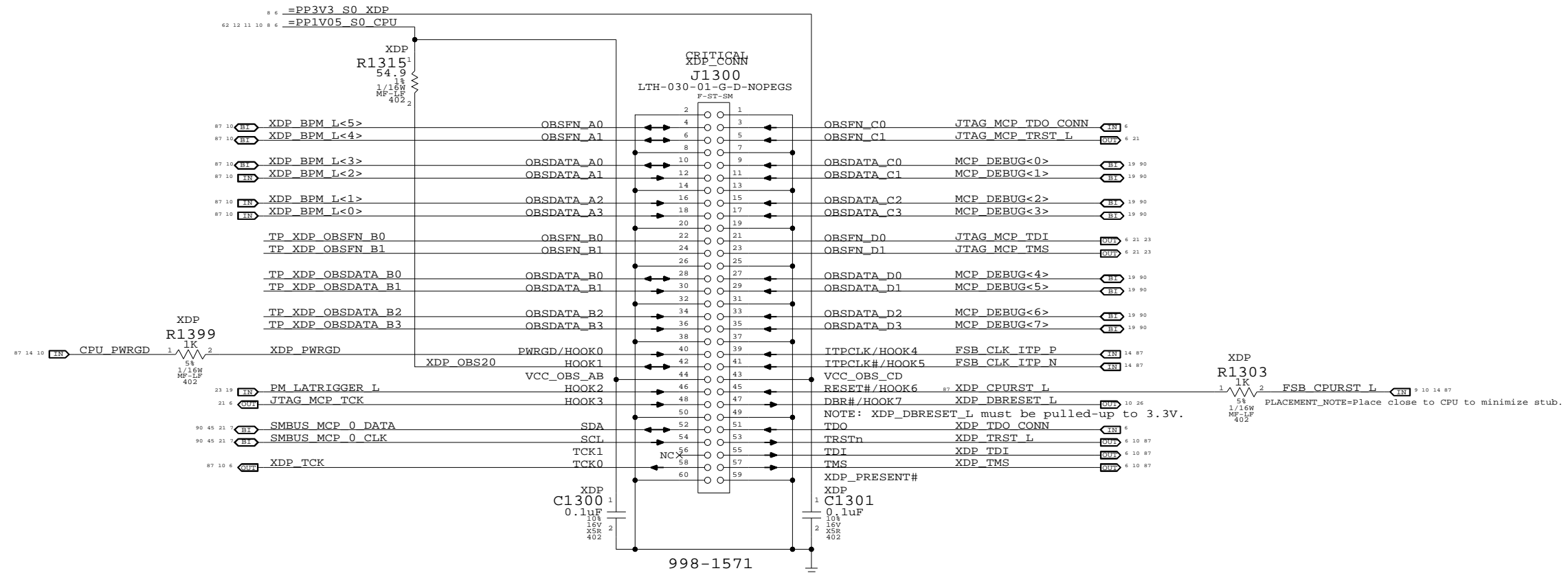
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| | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | |
| NONE | 12 | 96 | |

Mini-XDP Connector

NOTE: This is not the standard XDP pinout.
Use with 920-0620 adapter board to support CPU, MCP debugging.

MCP79-specific pinout



Direction of XDP module

Please avoid any obstructions
on even-numbered side of J1300

eXtended Debug Port (MiniXDP)

SYNC_MASTER=M99_MLB SYNC_DATE=01/08/2008

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| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 13 | 96 |

8

7

6

5

4

3

2

1

D

C

B

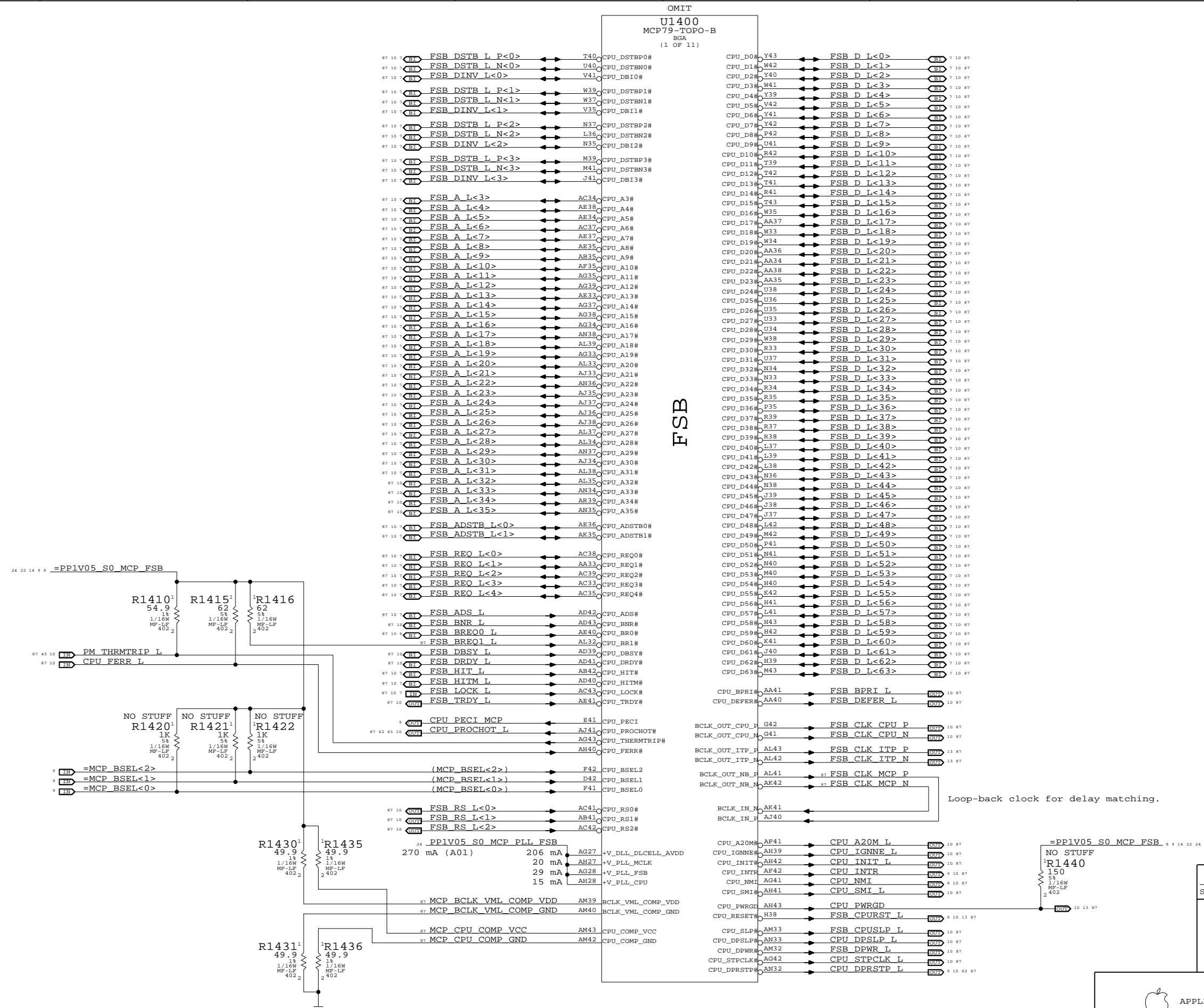
A

D

C

B

A



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8

7

6

5

4

3

2

1



APPLE INC.

MCP CPU Interface

SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008

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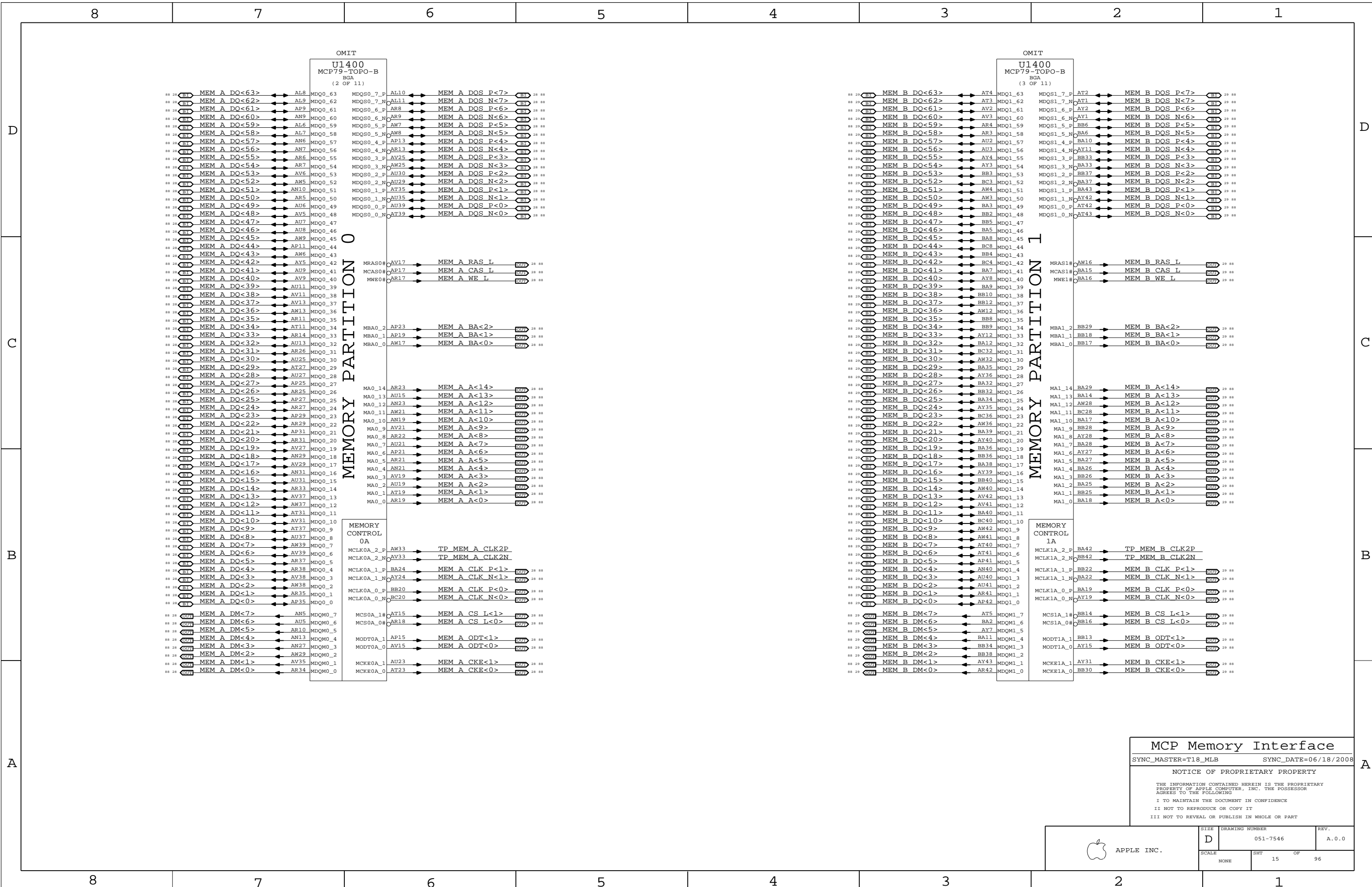
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SIZE DRAWING NUMBER REV.

D 051-7546 A.0.0

SCALE SHEET OF 96



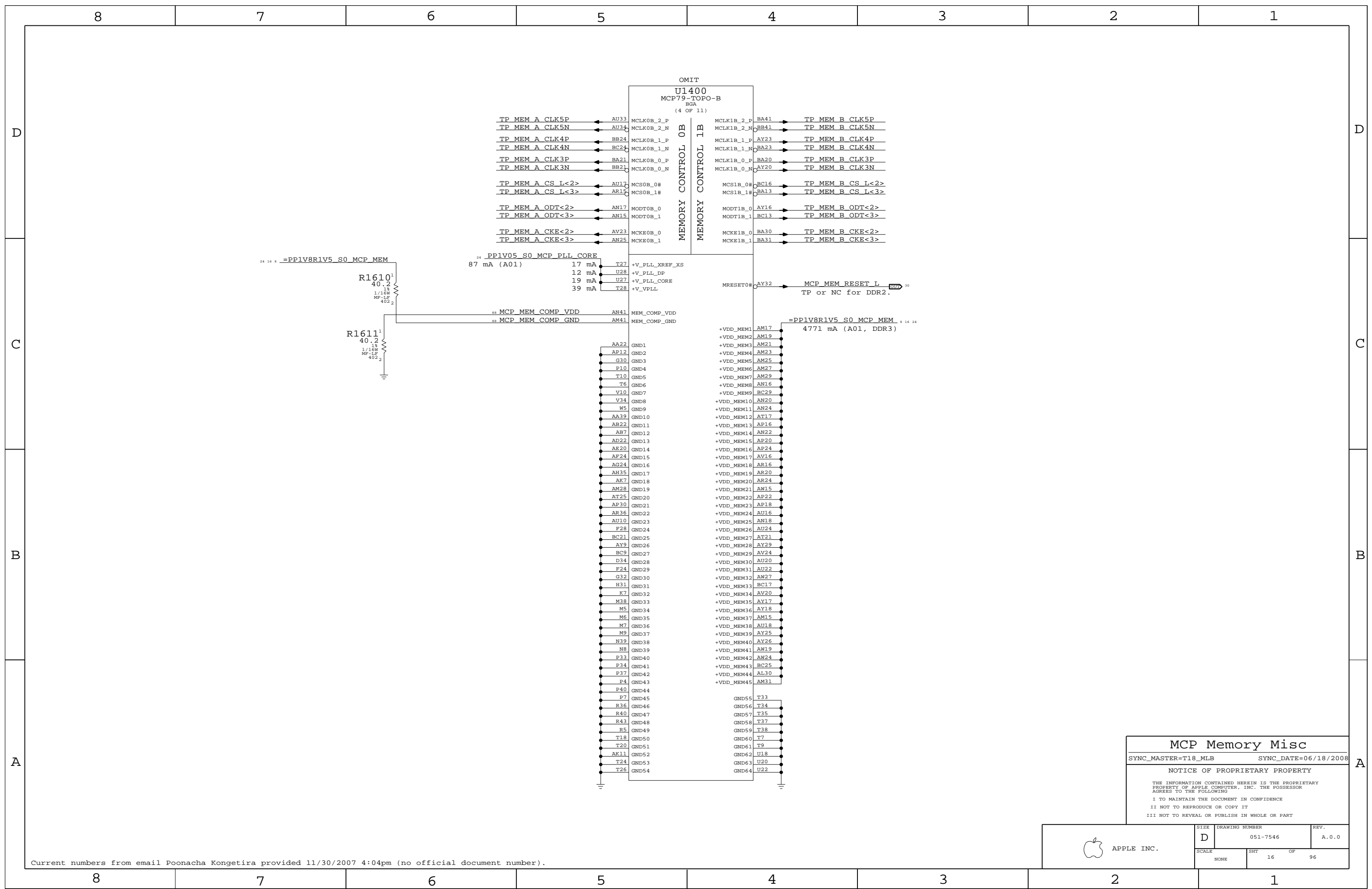
MCP Memory Interface

SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008

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| | SCALE NONE | SHEET 15 | OF 96 |

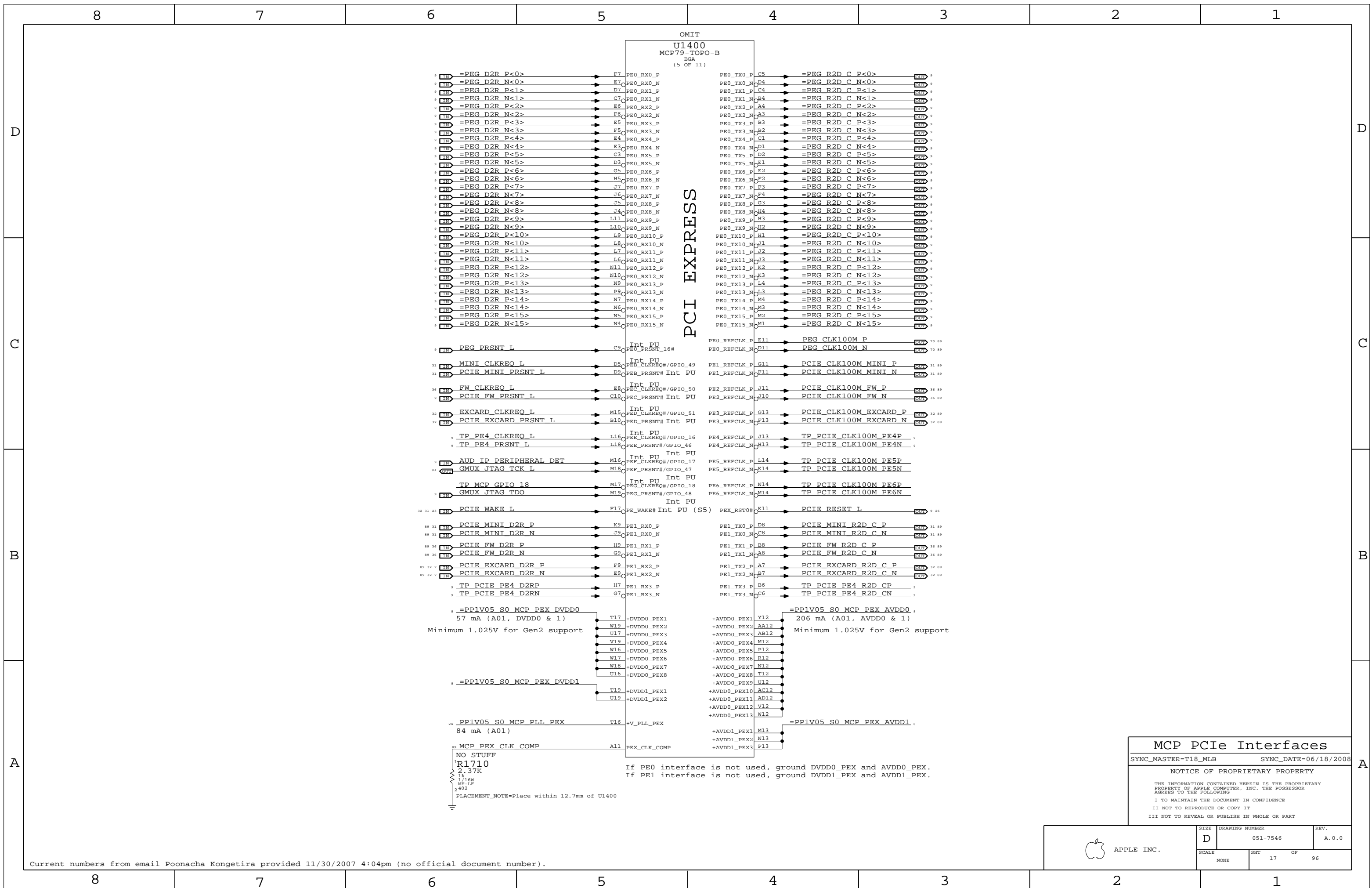


MCP Memory Misc
 SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008

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| | SCALE NONE | SHT 16 | OF 96 |

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MCP PCIe Interfaces

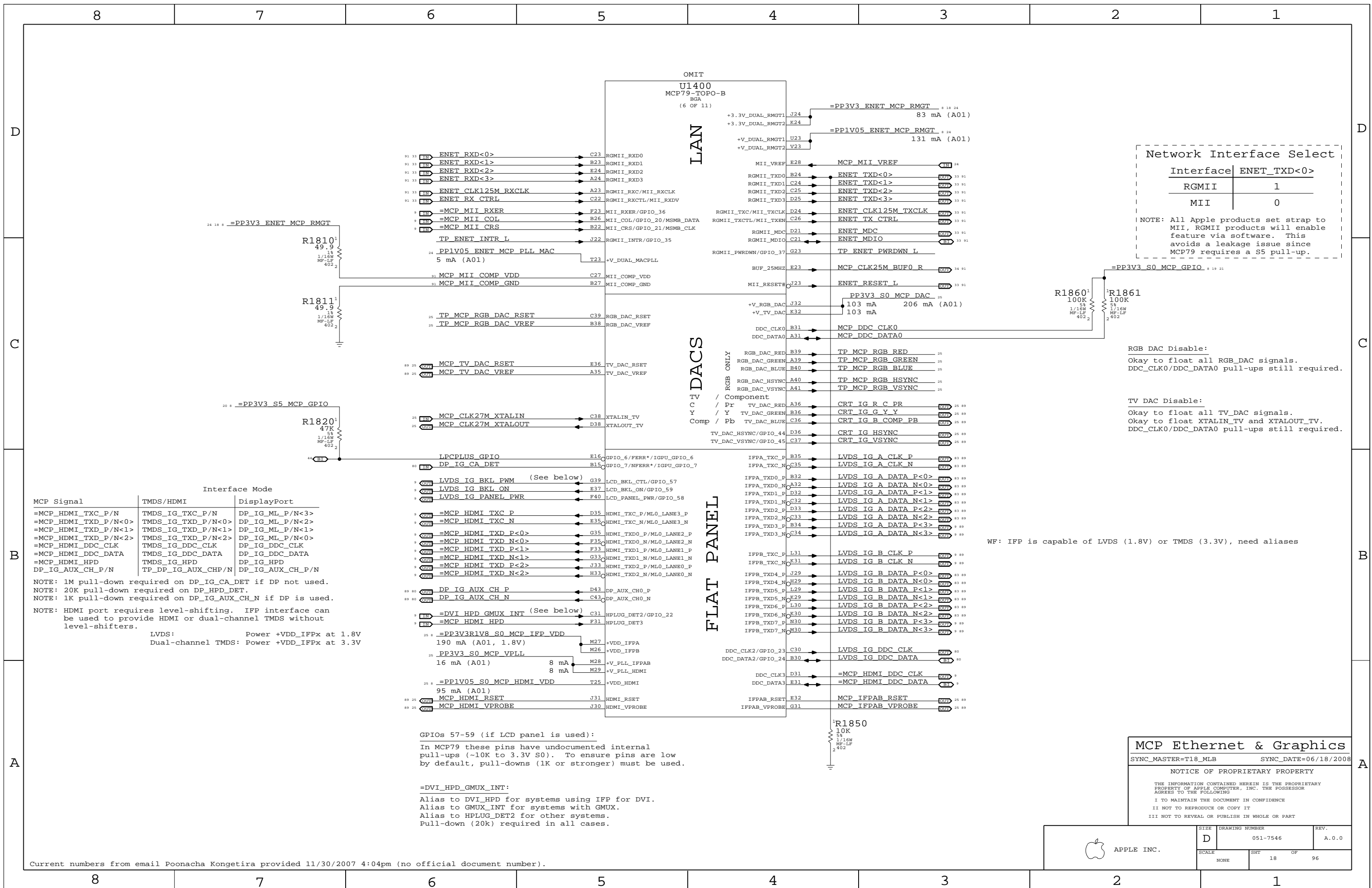
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| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 17 | 96 | |

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Network Interface Select

| Interface | ENET_TXD<0> |
|-----------|-------------|
| RGMII | 1 |
| MII | 0 |

NOTE: All Apple products set strap to MII, RGMII products will enable feature via software. This avoids a leakage issue since MCP79 requires a S5 pull-up.

RGB DAC Disable:
Okay to float all RGB_DAC signals.
DDC_CLK0/DDC_DATA0 pull-ups still required.

TV DAC Disable:
Okay to float all TV_DAC signals.
Okay to float XTALIN_TV and XTALOUT_TV.
DDC_CLK0/DDC_DATA0 pull-ups still required.

Interface Mode

| MCP Signal | TMDS/HDMI | DisplayPort |
|----------------------|---------------------|------------------|
| =MCP_HDMI_TXC_P/N | TMDS_IG_TXC_P/N | DP_IG_ML_P/N<3> |
| =MCP_HDMI_TXD_P/N<0> | TMDS_IG_TXD_P/N<0> | DP_IG_ML_P/N<2> |
| =MCP_HDMI_TXD_P/N<1> | TMDS_IG_TXD_P/N<1> | DP_IG_ML_P/N<1> |
| =MCP_HDMI_TXD_P/N<2> | TMDS_IG_TXD_P/N<2> | DP_IG_ML_P/N<0> |
| =MCP_HDMI_DDC_CLK | TMDS_IG_DDC_CLK | DP_IG_DDC_CLK |
| =MCP_HDMI_DDC_DATA | TMDS_IG_DDC_DATA | DP_IG_DDC_DATA |
| =MCP_HDMI_HPD | TMDS_IG_HPD | DP_IG_HPD |
| DP_IG_AUX_CH_P/N | TP_DP_IG_AUX_CH_P/N | DP_IG_AUX_CH_P/N |

NOTE: 1M pull-down required on DP_IG_CA_DET if DP not used.
NOTE: 20K pull-down required on DP_HPD_DET.
NOTE: 1K pull-down required on DP_IG_AUX_CH_N if DP is used.
NOTE: HDMI port requires level-shifting. IFP interface can be used to provide HDMI or dual-channel TMDS without level-shifters.

LVDS:
Dual-channel TMDS: Power +VDD_IFPx at 1.8V
Power +VDD_IFPx at 3.3V

GPIOs 57-59 (if LCD panel is used):
In MCP79 these pins have undocumented internal pull-ups (~10K to 3.3V S0). To ensure pins are low by default, pull-downs (1K or stronger) must be used.

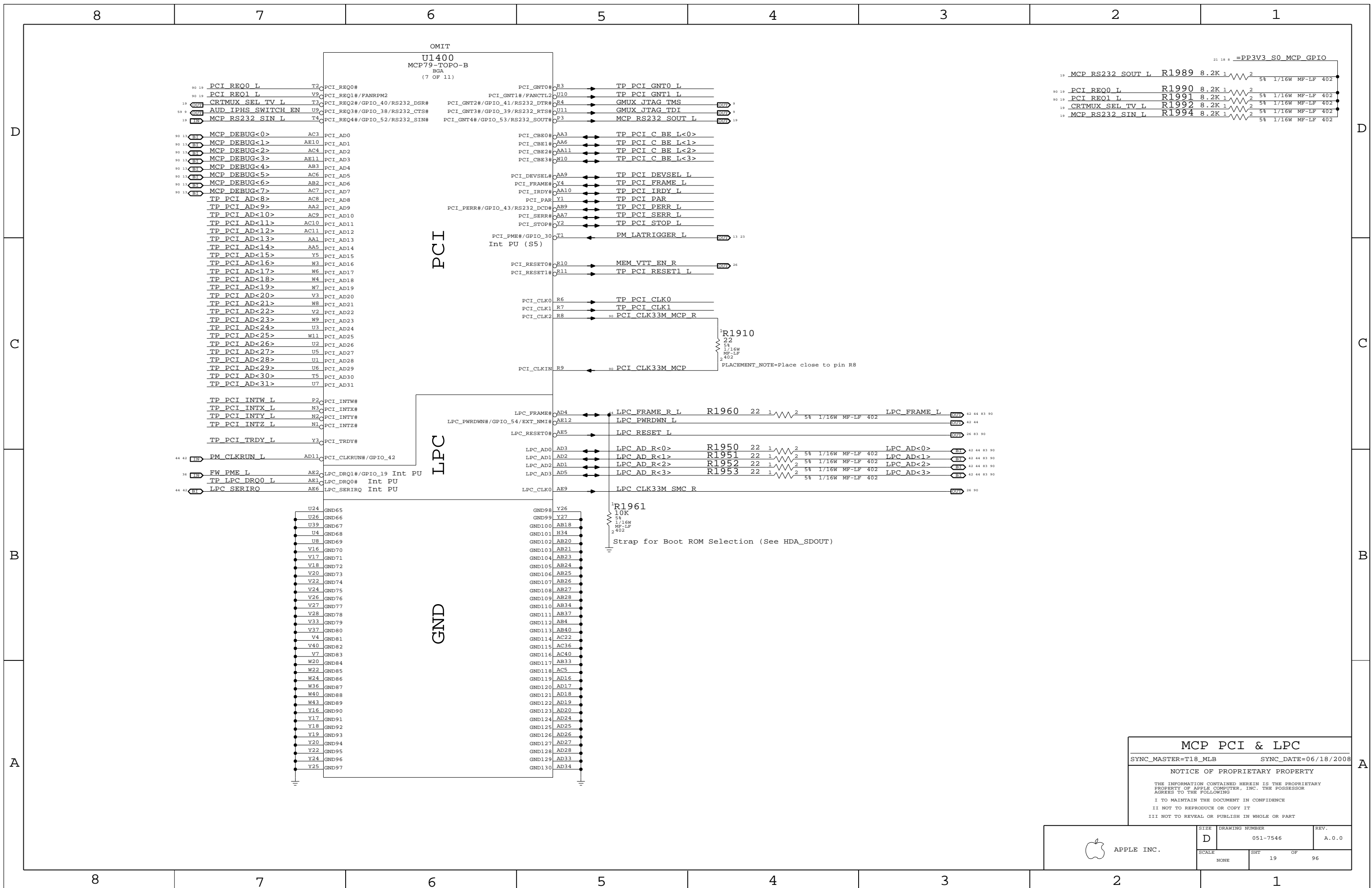
=DVI_HPD_GMUX_INT:
Alias to DVI_HPD for systems using IFP for DVI.
Alias to GMUX_INT for systems with GMUX.
Alias to HPLUG_DET2 for other systems.
Pull-down (20k) required in all cases.

WF: IFP is capable of LVDS (1.8V) or TMDS (3.3V), need aliases

MCP Ethernet & Graphics
SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008

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| NONE | 18 | | |



MCP PCI & LPC

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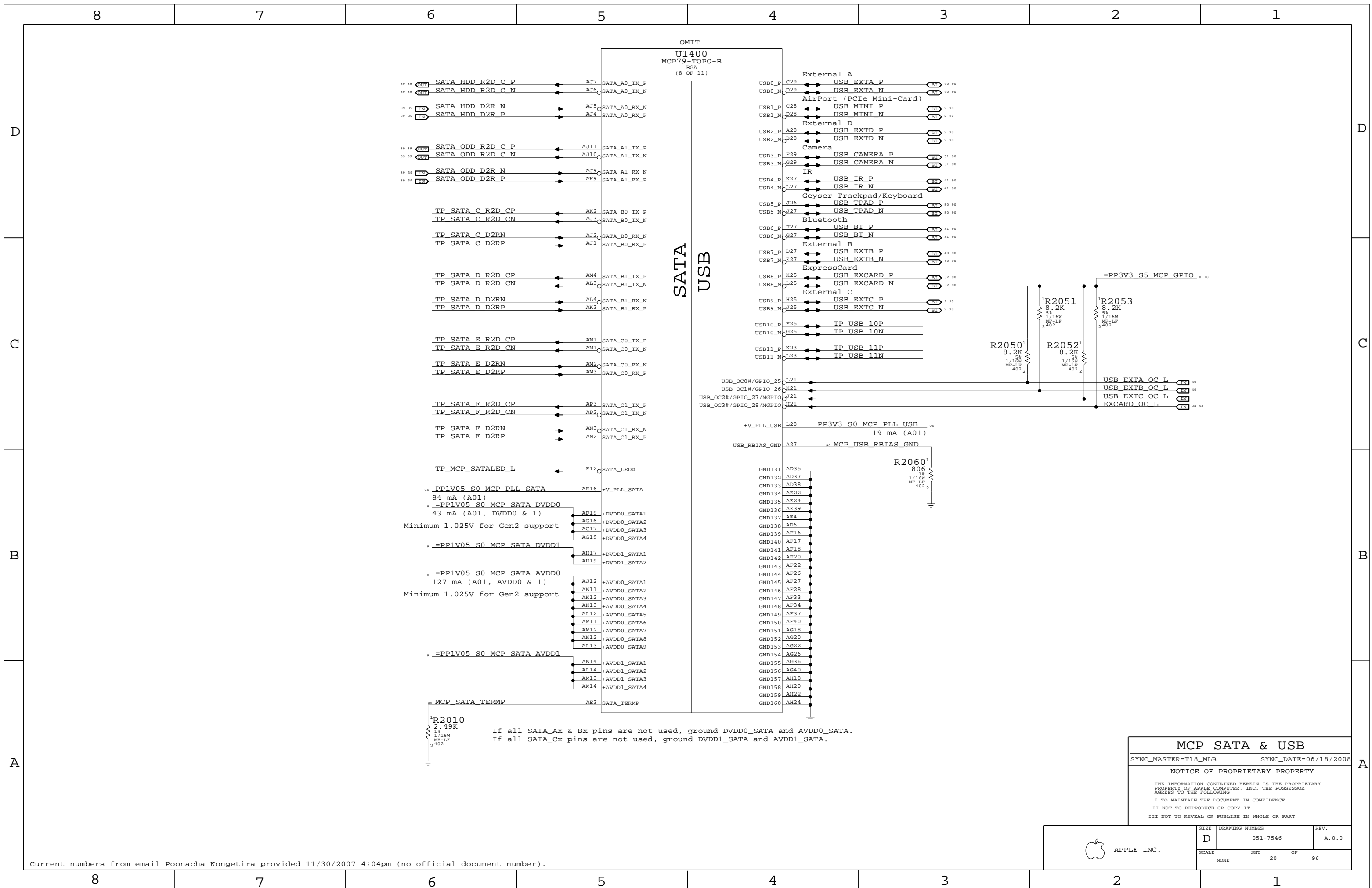
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| | SCALE NONE | SHEET 19 | OF 96 |

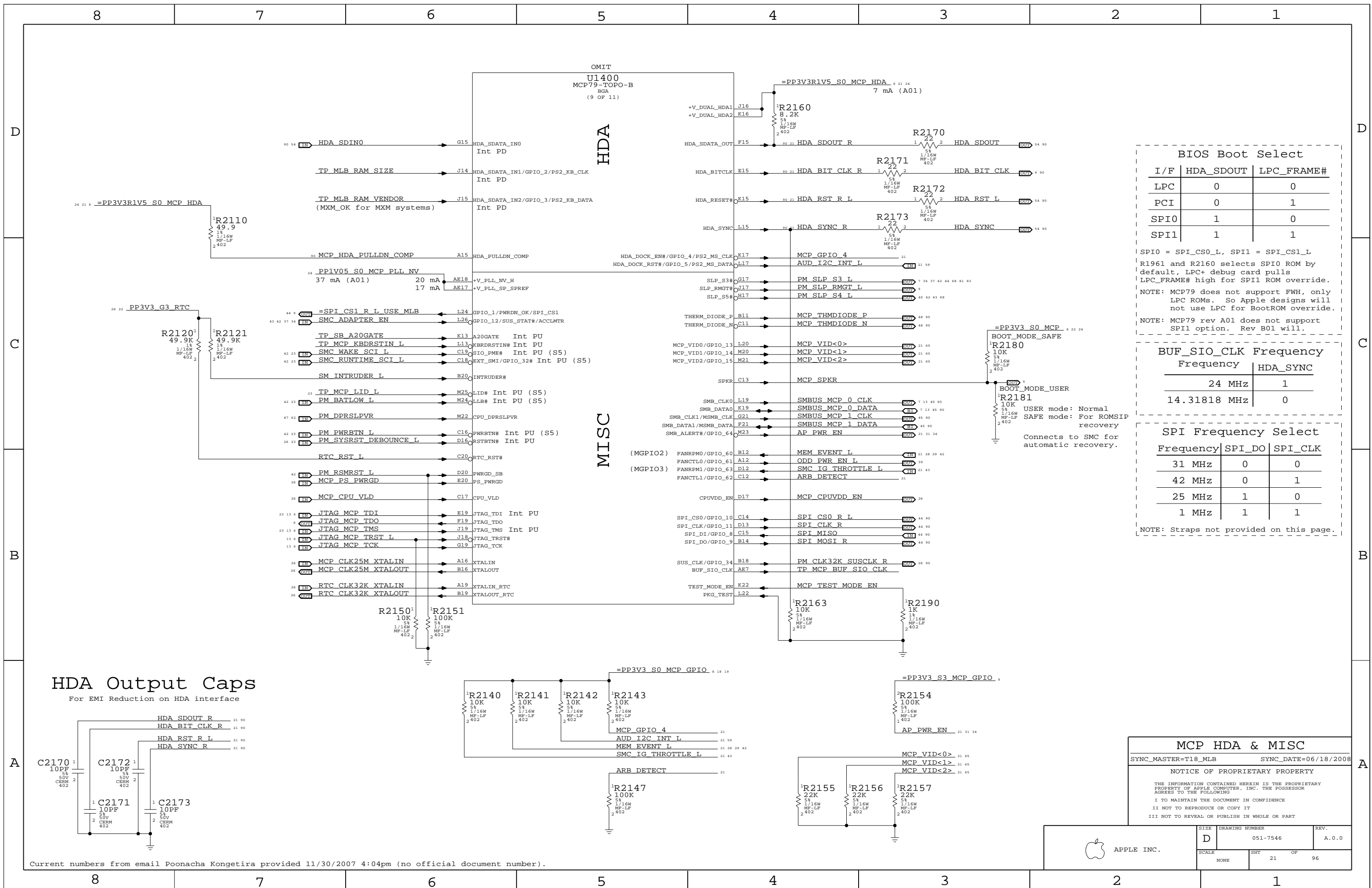


If all SATA_Ax & Bx pins are not used, ground DVDD0_SATA and AVDD0_SATA.
 If all SATA_Cx pins are not used, ground DVDD1_SATA and AVDD1_SATA.

| MCP SATA & USB | | |
|--|----------------------|--|
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| | | | |
|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | 96 |
| NONE | 20 | | |

Current numbers from email Poonacha Kongetira provided 11/30/2007 4:04pm (no official document number).



BIOS Boot Select

| I/F | HDA_SDOUT | LPC_FRAME# |
|------|-----------|------------|
| LPC | 0 | 0 |
| PCI | 0 | 1 |
| SPI0 | 1 | 0 |
| SPI1 | 1 | 1 |

SPI0 = SPI_CS0_L, SPI1 = SPI_CS1_L
 R1961 and R2160 selects SPI0 ROM by default, LPC+ debug card pulls LPC_FRAME# high for SPI1 ROM override.
 NOTE: MCP79 does not support FWB, only LPC ROMs. So Apple designs will not use LPC for BootROM override.
 NOTE: MCP79 rev A01 does not support SPI1 option. Rev B01 will.

BUF_SIO_CLK Frequency

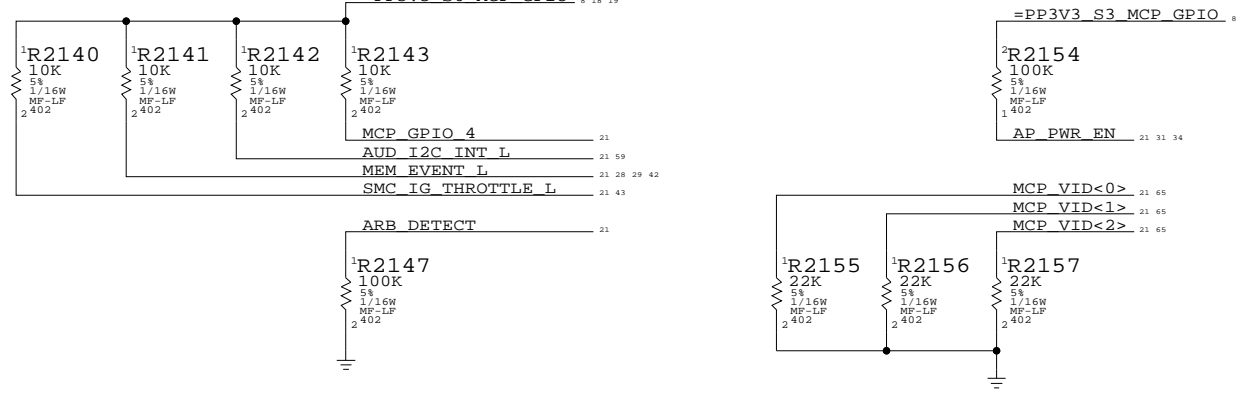
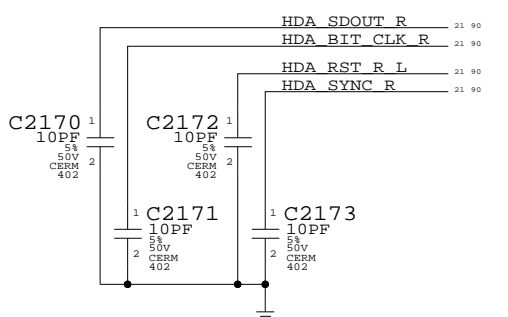
| Frequency | HDA_SYNC |
|--------------|----------|
| 24 MHz | 1 |
| 14.31818 MHz | 0 |

SPI Frequency Select

| Frequency | SPI_DO | SPI_CLK |
|-----------|--------|---------|
| 31 MHz | 0 | 0 |
| 42 MHz | 0 | 1 |
| 25 MHz | 1 | 0 |
| 1 MHz | 1 | 1 |

NOTE: Straps not provided on this page.

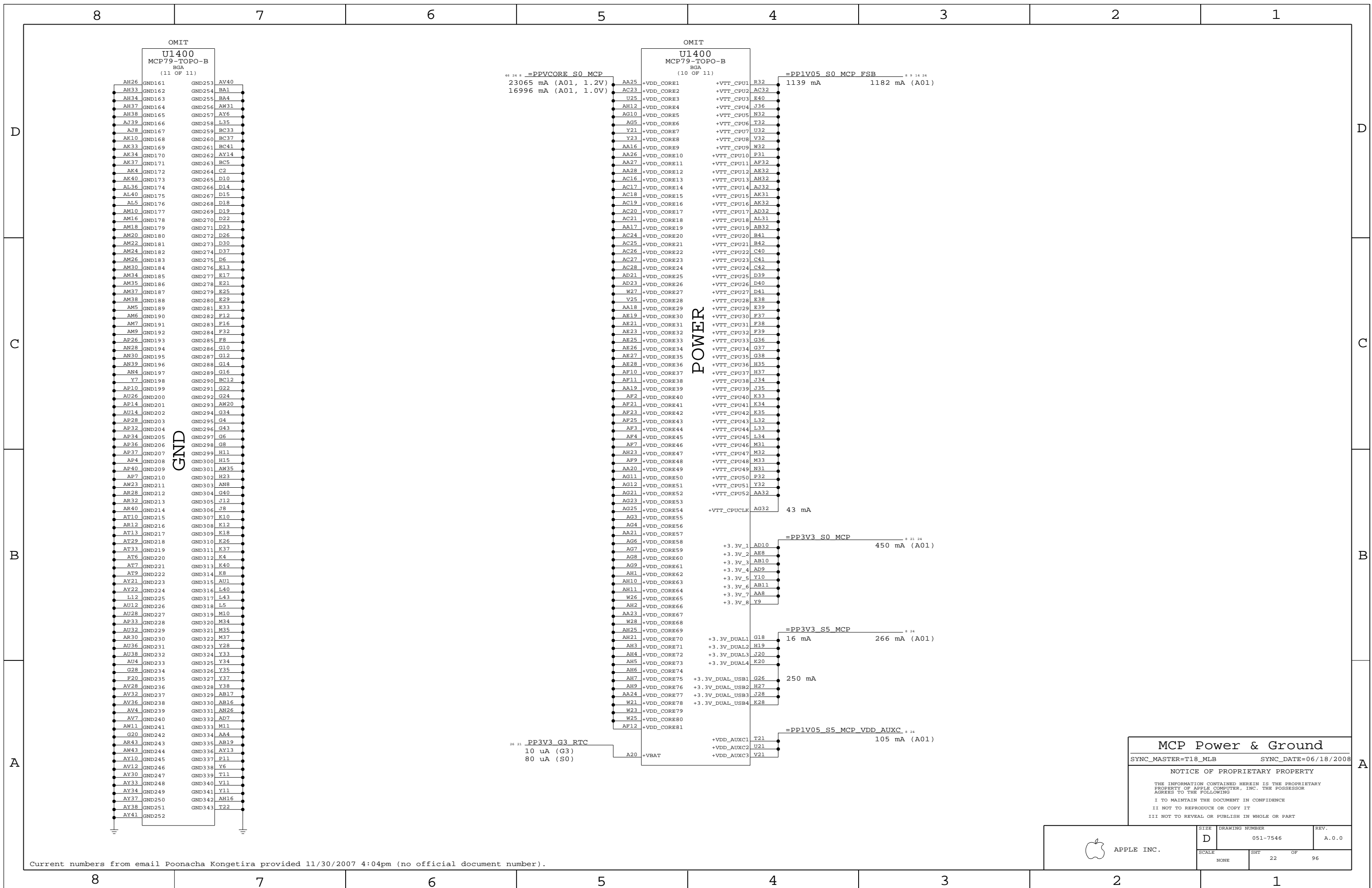
HDA Output Caps
 For EMI Reduction on HDA interface



MCP HDA & MISC
 SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008
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APPLE INC.
 DRAWING NUMBER: 051-7546
 REV: A.0.0
 SCALE: NONE
 SHEET: 21 OF 96

Current numbers from email Poonacha Kongetira provided 11/30/2007 4:04pm (no official document number).



Current numbers from email Poonacha Kongetira provided 11/30/2007 4:04pm (no official document number).

MCP Power & Ground
 SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008
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|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 22 | 96 | |

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D

C

C

B

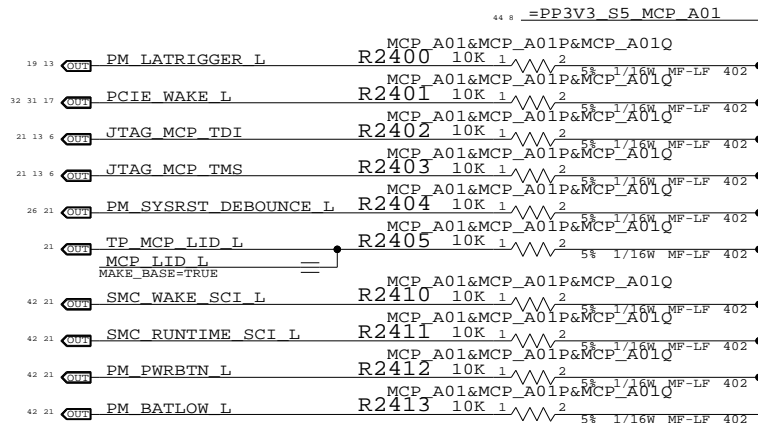
B

A

A

3.3V Interface Pull-ups

These internal pull-ups are missing in Revs A01 & A01P.



MCP79 A01 Silicon Support

SYNC_MASTER=T18_MLB SYNC_DATE=03/31/2008

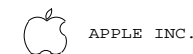
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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 23 | 96 |

8

7

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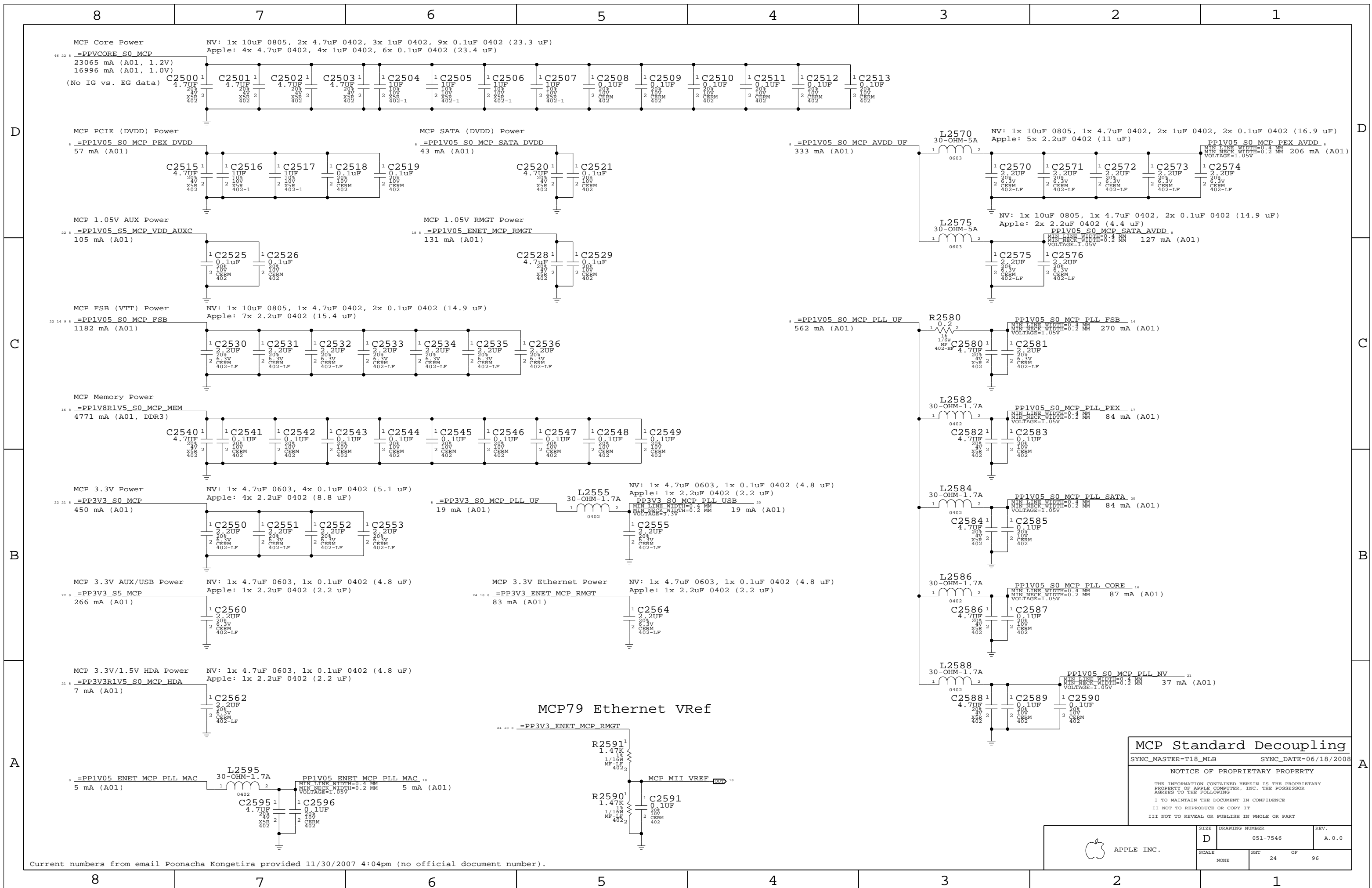
5

4

3

2

1



Current numbers from email Poonacha Kongetira provided 11/30/2007 4:04pm (no official document number).

MCP Standard Decoupling

SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008

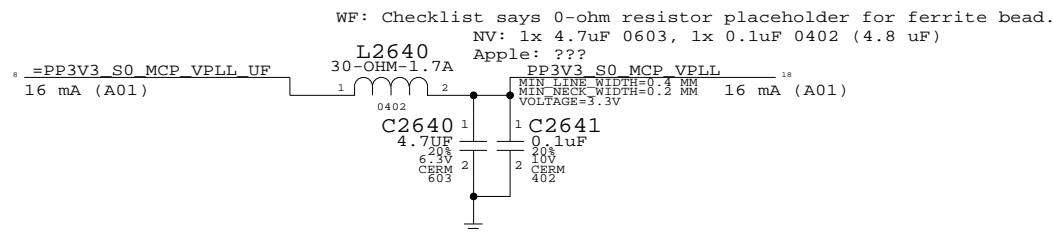
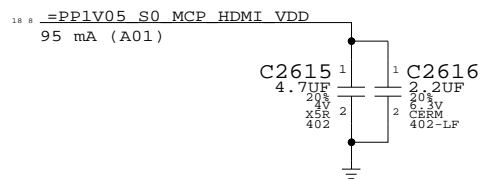
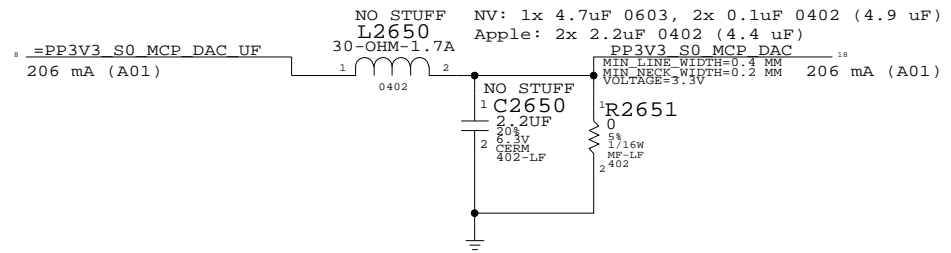
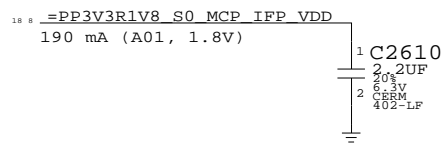
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| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 24 | 96 |

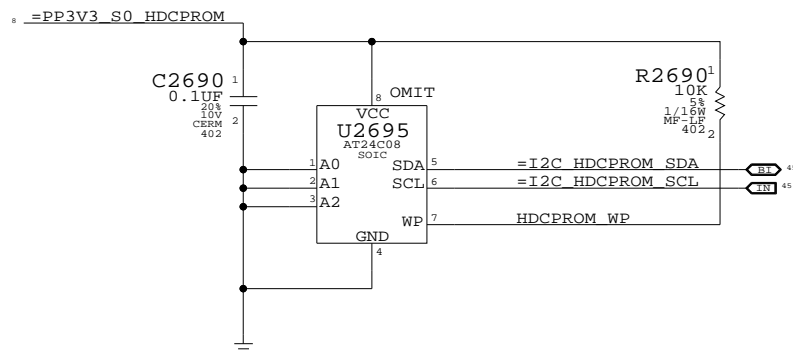
WF: Checklist says 0-ohm resistor placeholder for ferrite bead.
 NV: 1x 4.7uF 0603, 1x 0.1uF 0402 (4.8 uF)
 Apple: 1x 2.2uF 0402 (2.2 uF)



| | | | |
|-------|---------------------|----|-----------------------|
| 18 | TP MCP RGB RED | == | NC MCP RGB RED |
| 18 | TP MCP RGB GREEN | == | NC MCP RGB GREEN |
| 18 | TP MCP RGB BLUE | == | NC MCP RGB BLUE |
| 18 | TP MCP RGB HSYNC | == | NC MCP RGB HSYNC |
| 18 | TP MCP RGB VSYNC | == | NC MCP RGB VSYNC |
| 89 18 | CRT IG R C PR | == | NC CRT IG R C PR |
| 89 18 | CRT IG G Y Y | == | NC CRT IG G Y Y |
| 89 18 | CRT IG B COMP PB | == | NC CRT IG B COMP PB |
| 89 18 | CRT IG HSYNC | == | NC CRT IG HSYNC |
| 89 18 | CRT IG VSYNC | == | NC CRT IG VSYNC |
| 18 | TP MCP RGB DAC RSET | == | NC MCP RGB DAC RSET |
| 18 | TP MCP RGB DAC VREF | == | NC MCP RGB DAC VREF |
| 89 18 | MCP TV DAC RSET | == | NC MCP TV DAC RSET |
| 89 18 | MCP TV DAC VREF | == | NC MCP TV DAC VREF |
| 18 | MCP CLK27M XTALIN | == | NC MCP CLK27M XTALIN |
| 18 | MCP CLK27M XTALOUT | == | NC MCP CLK27M XTALOUT |

HDCP ROM

WF: Open question on which package option(s) nVidia can support.

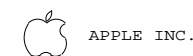


MCP Graphics Support

SYNC_MASTER=AMASON_M98_MLB SYNC_DATE=06/18/2008

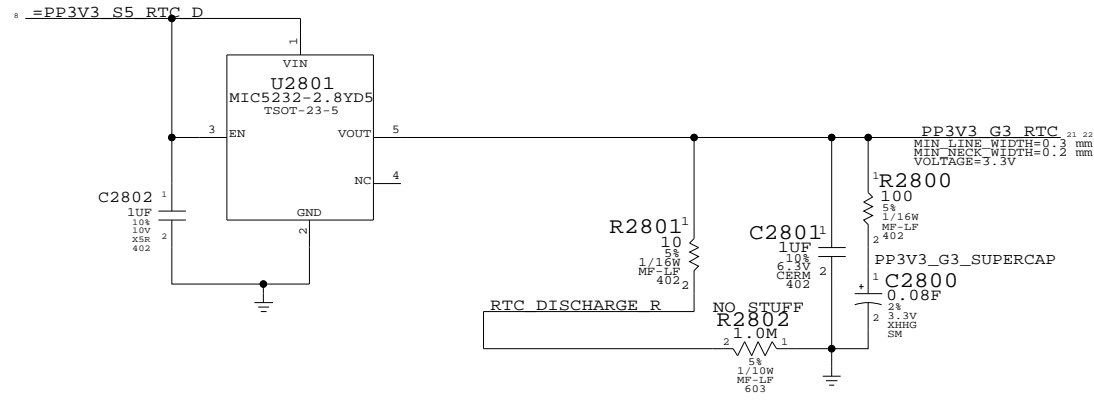
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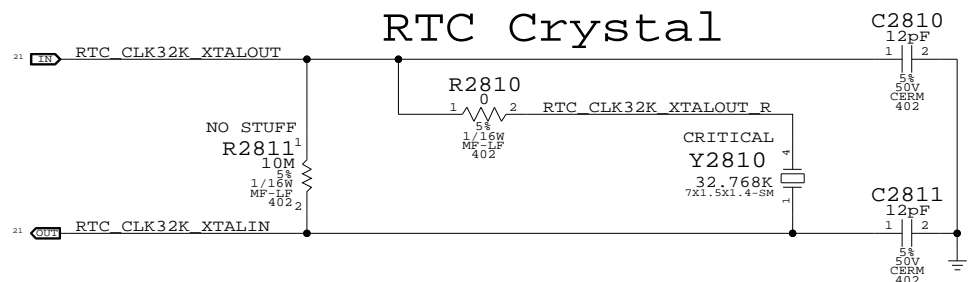


| | | |
|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 25 | 96 |

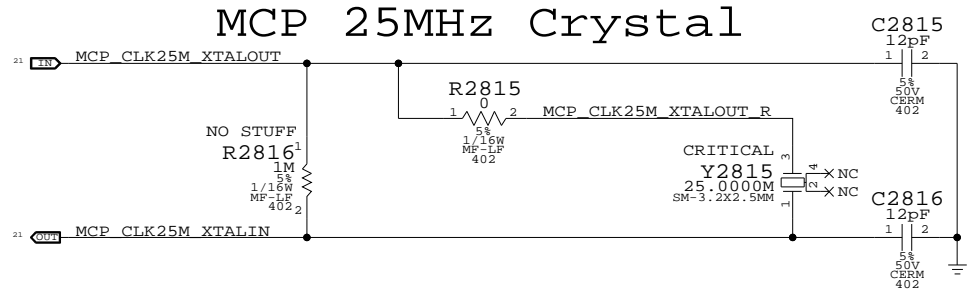
RTC Power Sources



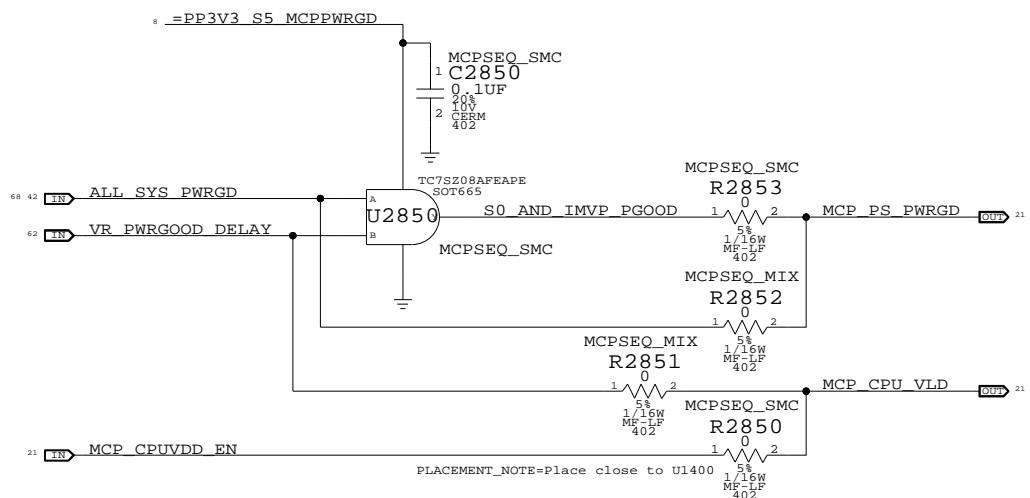
RTC Crystal



MCP 25MHz Crystal

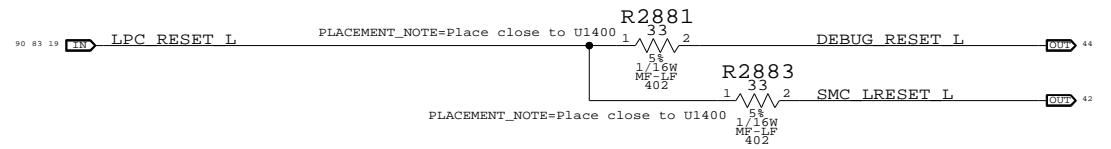


MCP S0 PWRGD & CPU_VLD

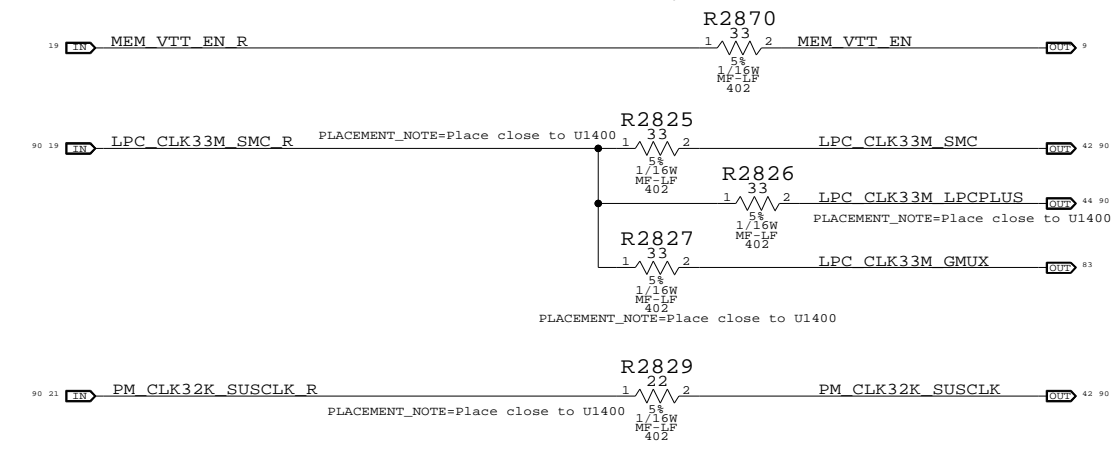
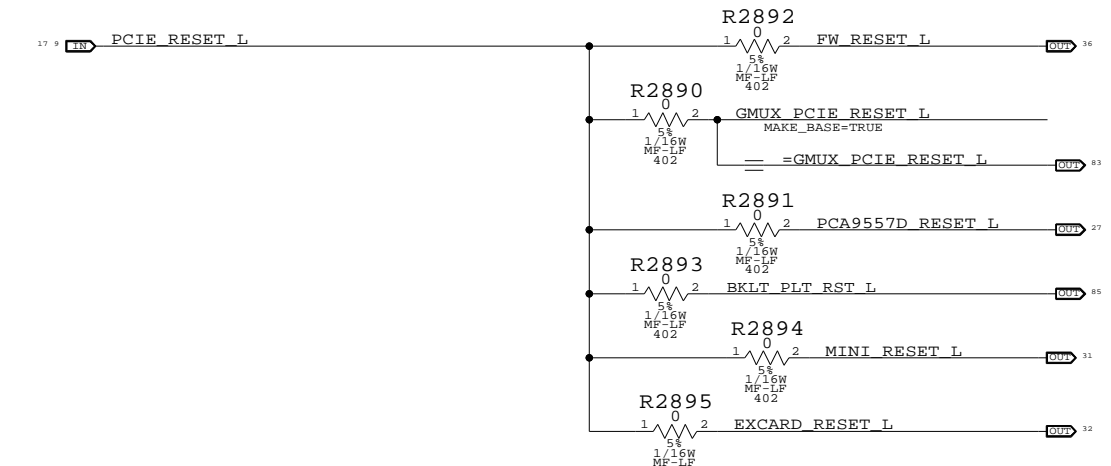


MCPSEQ_SMC represents MCP79 'MLB' power sequencing connections, but results in MCP79 ROMSIP sequence happening after CPU powers up. MCPSEQ_MIX is cross between MLB and internal power sequencing, which results in earlier ROMSIP and MCP FSB I/O interface initialization. SMC 99ms delay from ALL_SYS_PWRGD to IMVP_VR_ON plus IMVP6 delay for VR_PWRGOOD_DELAY should guarantee CPU_VLD does not go high before CPUVDD_EN (which is 40-100ms after PS_PWRGD assertion).
NOTE: If CPU_VLD deasserts during S0 MCP79 will take system to S5 immediately.

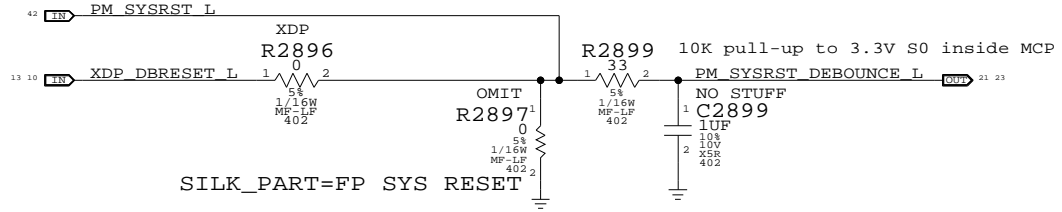
Platform Reset Connections LPC Reset (Unbuffered)



PCIE Reset (Unbuffered)



Reset Button



| SB Misc | | |
|--|----------------------|--|
| SYNC_MASTER=T18_MLB | SYNC_DATE=12/17/2007 | |
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| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 26 | 96 | |

Page Notes

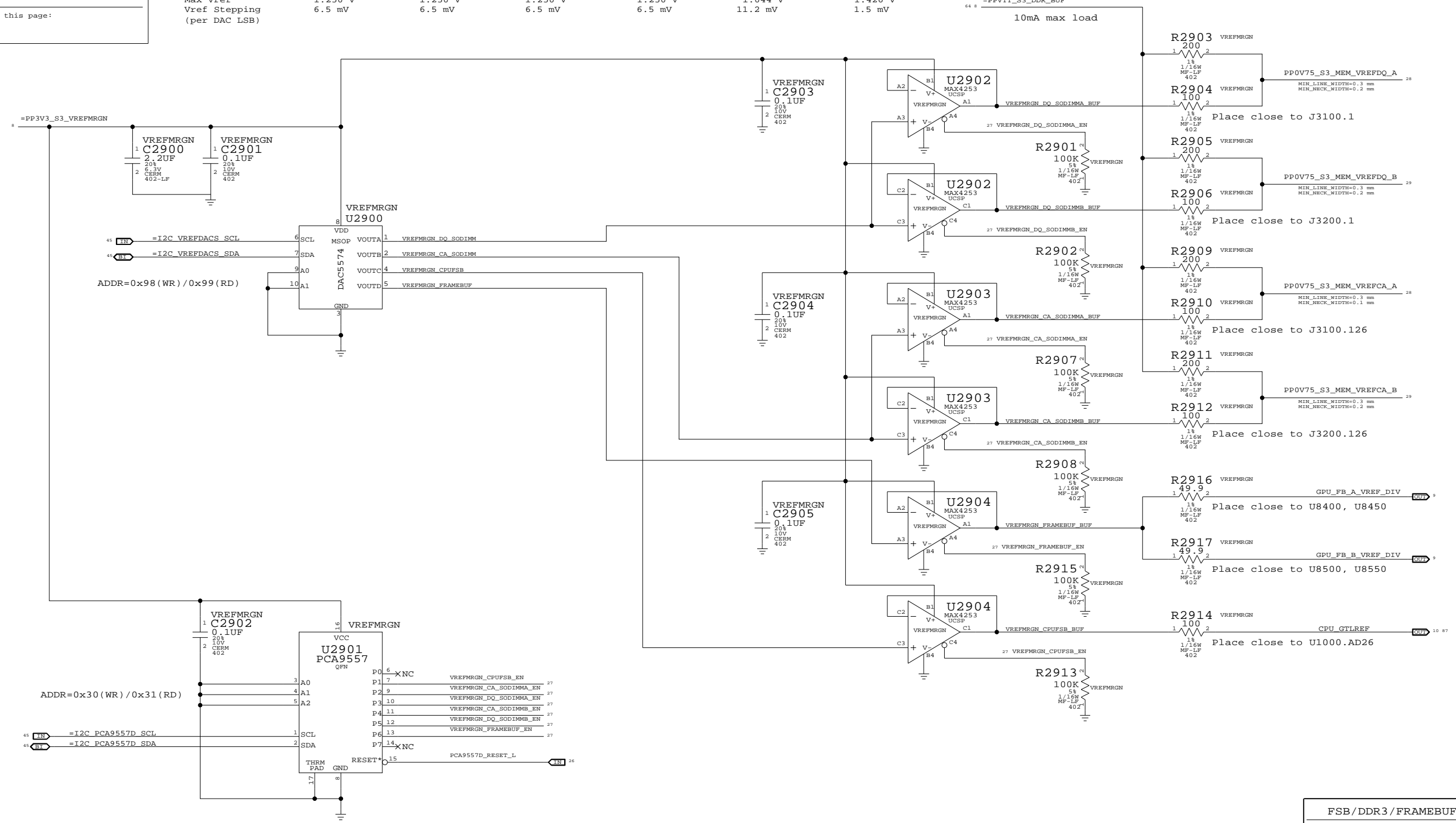
Power aliases required by this page:
 - =PP3V3_S3_VREFMRGN
 - =PP3V3_S5_VREFMRGN
 - =PPVTT_S3_DDR_BUF

Signal aliases required by this page:
 - =I2C_VREFDACS_SCL
 - =I2C_VREFDACS_SDA
 - =I2C_PCA9557D_SCL
 - =I2C_PCA9557D_SDA

BOM options provided by this page:
 VREFMRGN
 NO_VREFMRGN

| | MEM A VREF DQ | MEM A VREF CA | MEM B VREF DQ | MEM B VREF CA | CPU FSB VREF | FRAME BUFFER VREF |
|-----------------------------|---------------|---------------|---------------|---------------|--------------|-------------------|
| DAC channel | A | B | A | B | C | D |
| Min DAC code | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 |
| Max DAC code | 0x87 | 0x87 | 0x87 | 0x87 | 0x55 | 0xFF |
| Max sink I | -3.75 mA | -3.75 mA | -3.75 mA | -3.75 mA | -0.91 mA | -59.04 mA |
| Max source I | 5 mA | 5 mA | 5 mA | 5 mA | 0.52 mA | 51.15 mA |
| Nominal Vref | 0.75 V | 0.75 V | 0.75 V | 0.75 V | 0.70 V | 1.248 V |
| Min Vref | 0.375 V | 0.375 V | 0.375 V | 0.375 V | 0.091 V | 1.042 V |
| Max Vref | 1.250 V | 1.250 V | 1.250 V | 1.250 V | 1.044 V | 1.426 V |
| Vref Stepping (per DAC LSB) | 6.5 mV | 6.5 mV | 6.5 mV | 6.5 mV | 11.2 mV | 1.5 mV |

SO-DIMM A and SO-DIMM B Vref settings should be margined separately (i.e. not simultaneously) due to current limitation of TPS51116 regulator.



Required zero ohm resistors when no VREF margining circuit stuffed

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|----------------------------------|---------------|----------|-------------|
| 116S0004 | 1 | RES.MTL FILM, 0,5%, 0402, SM, LF | R2903 | CRITICAL | NO_VREFMRGN |
| 116S0004 | 1 | RES.MTL FILM, 0,5%, 0402, SM, LF | R2905 | CRITICAL | NO_VREFMRGN |
| 116S0004 | 1 | RES.MTL FILM, 0,5%, 0402, SM, LF | R2909 | CRITICAL | NO_VREFMRGN |
| 116S0004 | 1 | RES.MTL FILM, 0,5%, 0402, SM, LF | R2911 | CRITICAL | NO_VREFMRGN |

FSB/DDR3/FRAMEBUF Vref Margining
 SYNC_MASTER=DDR SYNC_DATE=07/22/2008

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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | 96 |
| NONE | 27 | | |

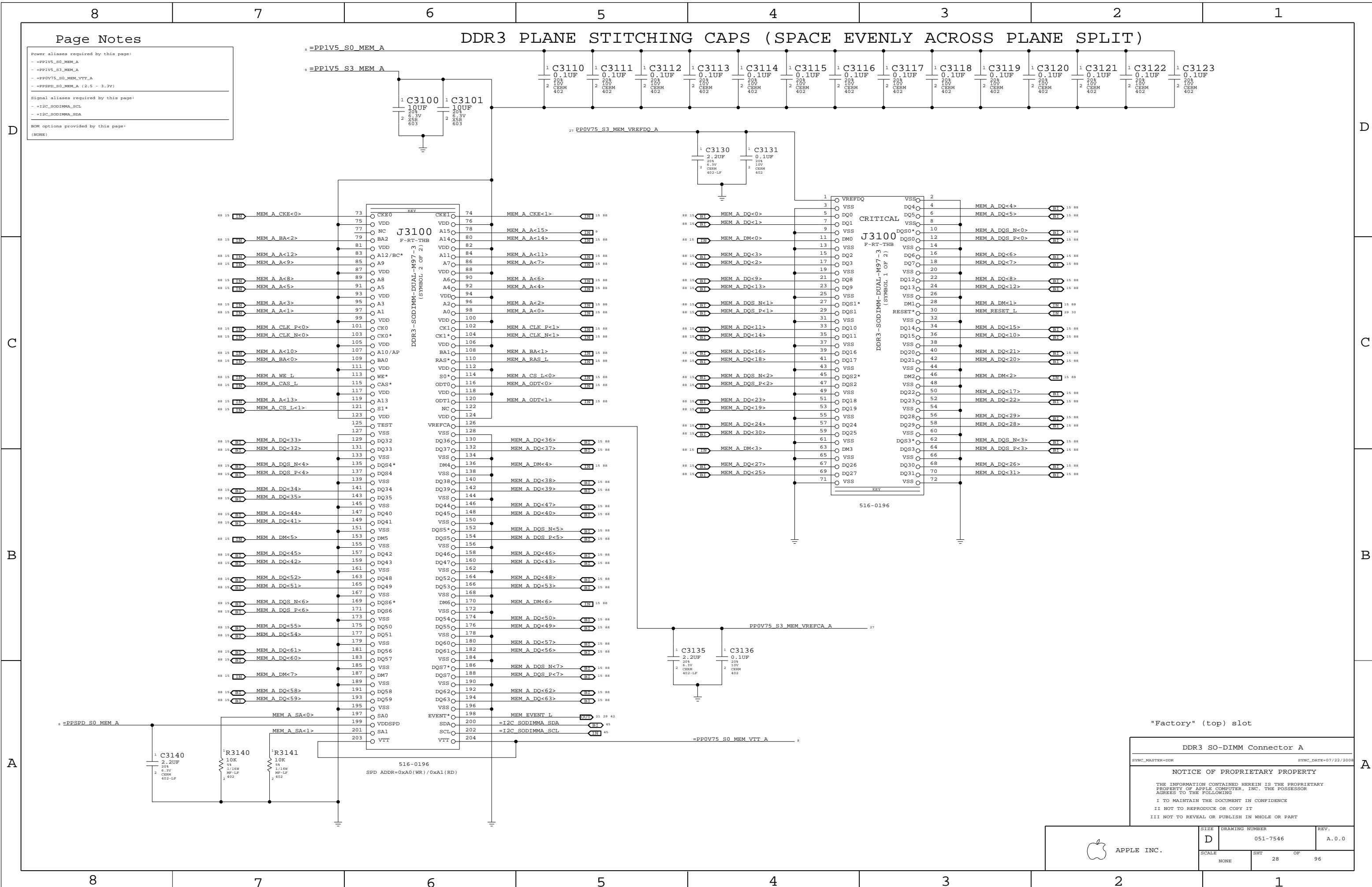
Page Notes

Power aliases required by this page:
 - =PP1V5_S0_MEM_A
 - =PP1V5_S3_MEM_A
 - =PP0V75_S0_MEM_VTT_A
 - =PPSPD_S0_MEM_A (2.5 - 3.3V)

Signal aliases required by this page:
 - =I2C_SODIMMA_SCL
 - =I2C_SODIMMA_SDA

BOM options provided by this page:
 (NONE)

DDR3 PLANE STITCHING CAPS (SPACE EVENLY ACROSS PLANE SPLIT)



"Factory" (top) slot

DDR3 SO-DIMM Connector A

SYNC_MASTER=DDR SYNC_DATE=07/22/2008

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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | NONE | SHT | 28 OF 96 |

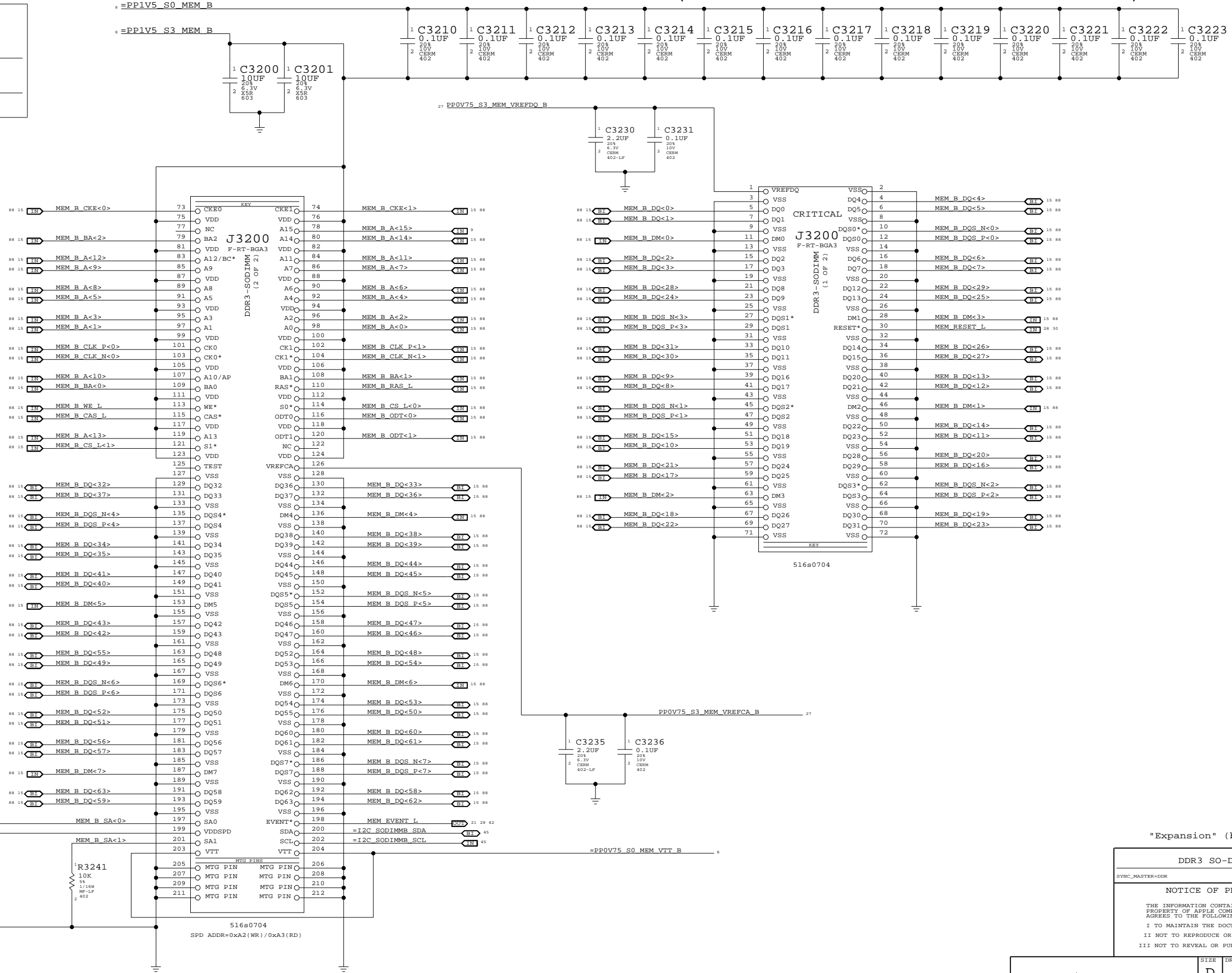
Page Notes

Power aliases required by this page:
 - =PP1V5_S0_MEM_B
 - =PP1V5_S3_MEM_B
 - =PP0V75_S0_MEM_VTT_B
 - =PPSPD_S0_MEM_B (2.5 - 3.3V)

Signal aliases required by this page:
 - =I2C_SODIMMB_SCL
 - =I2C_SODIMMB_SDA

BOM options provided by this page:
 (NONE)

DDR3 PLANE STITCHING CAPS (SPACE EVENLY ACROSS PLANE SPLIT)



"Expansion" (bottom) slot

DDR3 SO-DIMM Connector B
 SYNC_MASTER=DDR SYNC_DATE=07/22/2008

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|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | 96 |
| NONE | 29 | | |

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C

C

B

B

A

A

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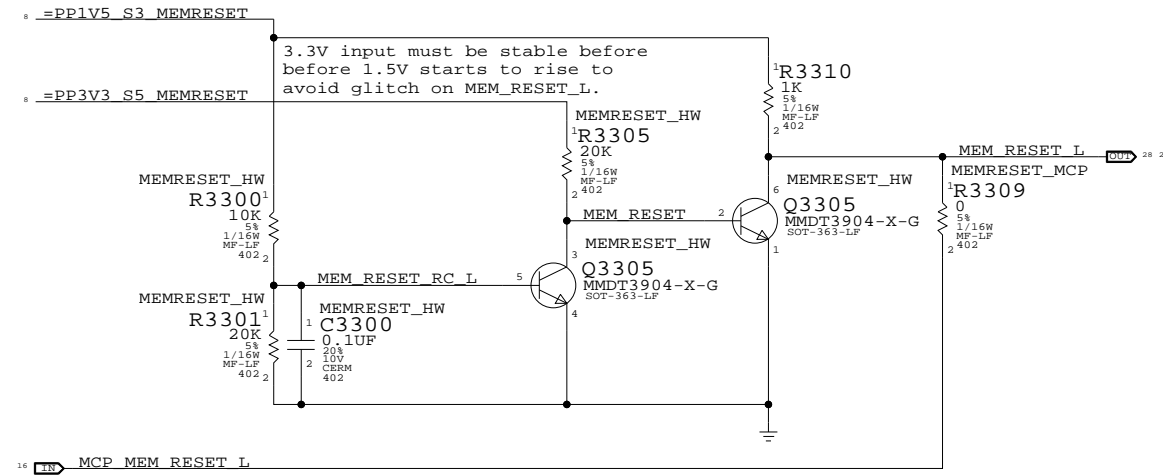
3

2

1

DDR3 RESET Support

MCP79 cannot control this signal directly since it must be high in sleep and MCP MEM rails are not powered in sleep.



DDR3 Support

SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008

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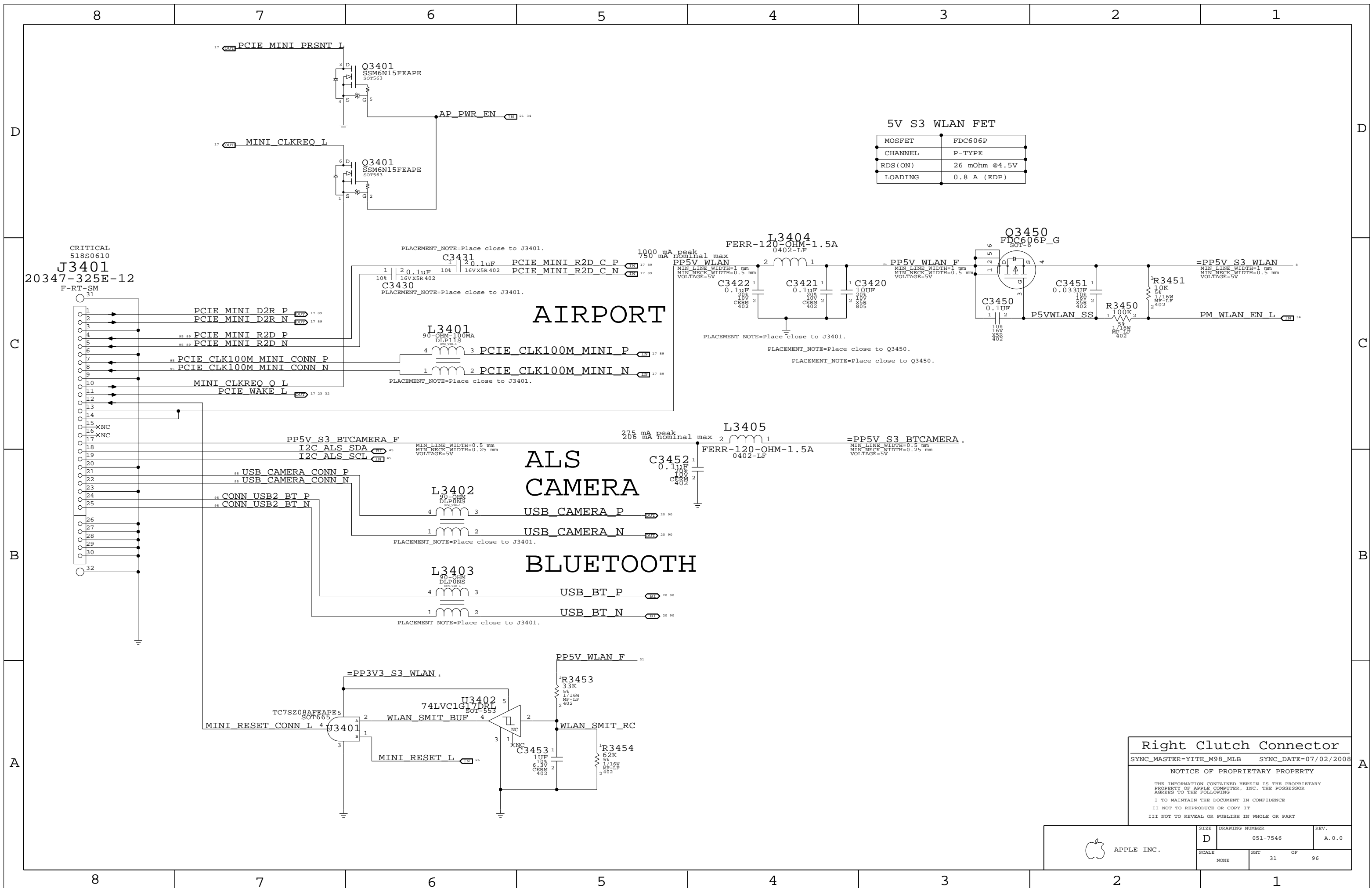
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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 30 | 96 |



5V S3 WLAN FET

| | |
|---------|---------------|
| MOSFET | FDC606P |
| CHANNEL | P-TYPE |
| RDS(ON) | 26 mOhm @4.5V |
| LOADING | 0.8 A (EDP) |

AIRPORT

ALS CAMERA

BLUETOOTH

Right Clutch Connector
 SYNC_MASTER=YITE_M98_MLB SYNC_DATE=07/02/2008

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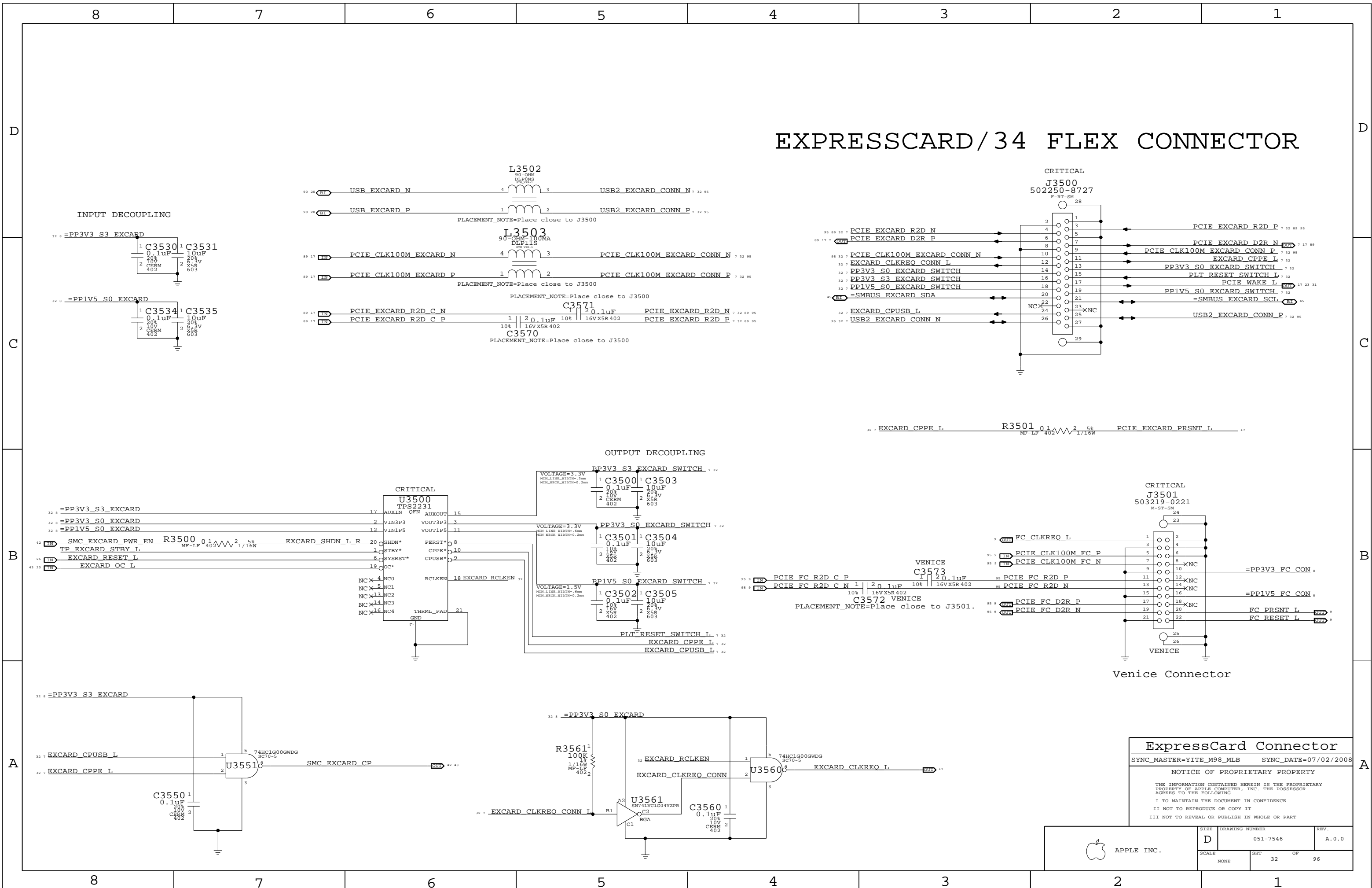
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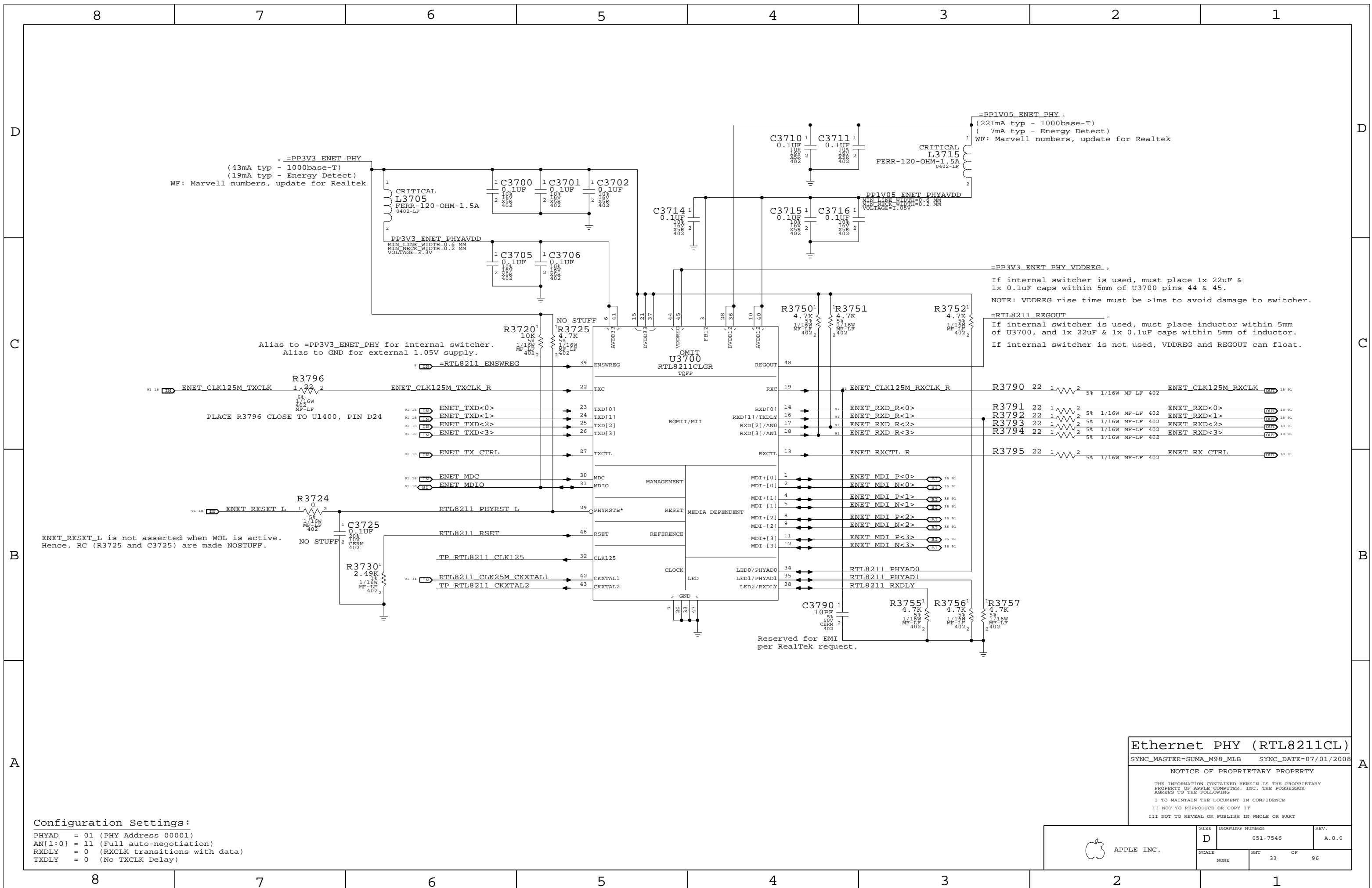
| | | | |
|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 31 | 96 | |

EXPRESSCARD/34 FLEX CONNECTOR



ExpressCard Connector
 SYNC_MASTER=YITE_M98_MLB SYNC_DATE=07/02/2008
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| | D | 051-7546 | A.0.0 |
| SCALE | NONE | SHT | 32 OF 96 |



=PP3V3_ENET_PHY
 (43mA typ - 1000base-T)
 (19mA typ - Energy Detect)
 WF: Marvell numbers, update for Realtek

=PPIV05_ENET_PHY.
 (221mA typ - 1000base-T)
 (7mA typ - Energy Detect)
 WF: Marvell numbers, update for Realtek

Alias to =PP3V3_ENET_PHY for internal switcher.
 Alias to GND for external 1.05V supply.

=PP3V3_ENET_PHY_VDDREG.
 If internal switcher is used, must place 1x 22uF & 1x 0.1uF caps within 5mm of U3700 pins 44 & 45.
 NOTE: VDDREG rise time must be >1ms to avoid damage to switcher.

=RTL8211_REGOUT.
 If internal switcher is used, must place inductor within 5mm of U3700, and 1x 22uF & 1x 0.1uF caps within 5mm of inductor.
 If internal switcher is not used, VDDREG and REGOUT can float.

ENET_RESET_L is not asserted when WOL is active.
 Hence, RC (R3725 and C3725) are made NOSTUFF.

Reserved for EMI per RealTek request.

Configuration Settings:
 PHYAD = 01 (PHY Address 00001)
 AN[1:0] = 11 (Full auto-negotiation)
 RXDLY = 0 (RXCLK transitions with data)
 TXDLY = 0 (No TXCLK Delay)

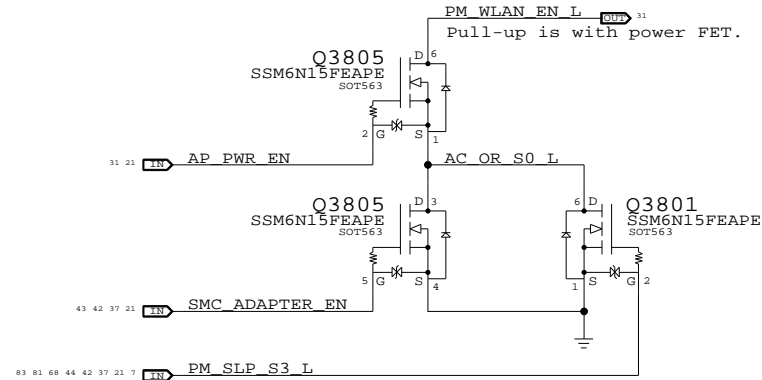
Ethernet PHY (RTL8211CL)
 SYNC_MASTER=SUMA_M98_MLB SYNC_DATE=07/01/2008

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| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 33 | 96 | |

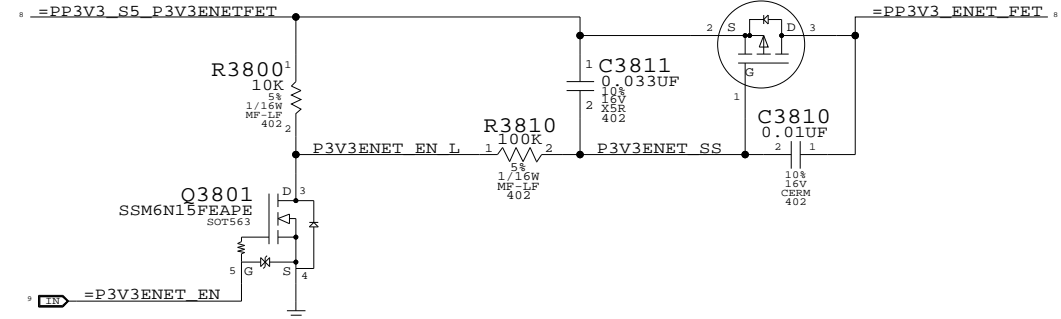
WLAN Enable Generation

"WLAN" = ("S3" && "AP_PWR_EN" && ("AC" || "S0"))
 NOTE: S3 term is guaranteed by S3 pull-up on open-drain AP_PWR_EN signal.



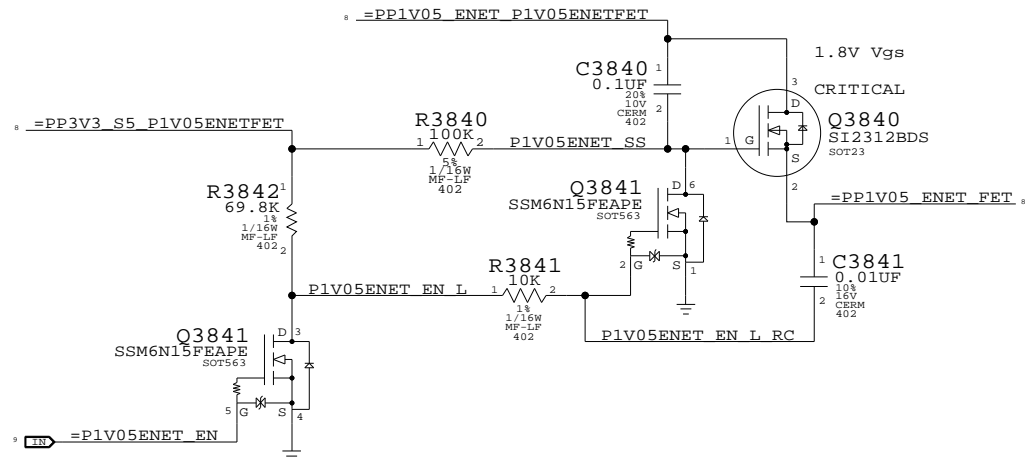
3.3V ENET FET

@ 2.5V Vgs: CRITICAL
 Rds(on) = 90mOhm max Q3810
 I(max) = 1.7A (85C) NTR4101P
 SOT-23-HP



MOBILE:
 Recommend aliasing PM_SLP_RMGT_L and =P3V3ENET_EN. Nets separated on ARB for alternate power options.

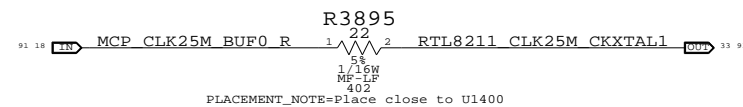
1.05V ENET FET



Non-ARB:
 Recommend aliasing PM_SLP_RMGT_L and =P1V05ENET_EN. Nets separated on ARB for alternate power options.

RTL8211 25MHz Clock

NOTE: MCP79 can provide 25MHz clock, but clock runs whenever RMGT rails are powered. Designs must ensure PHY is powered whenever RMGT rails are, or use separate crystal.



Ethernet & AirPort Support

SYNC_MASTER=SUMA_M98_MLB SYNC_DATE=07/01/2008

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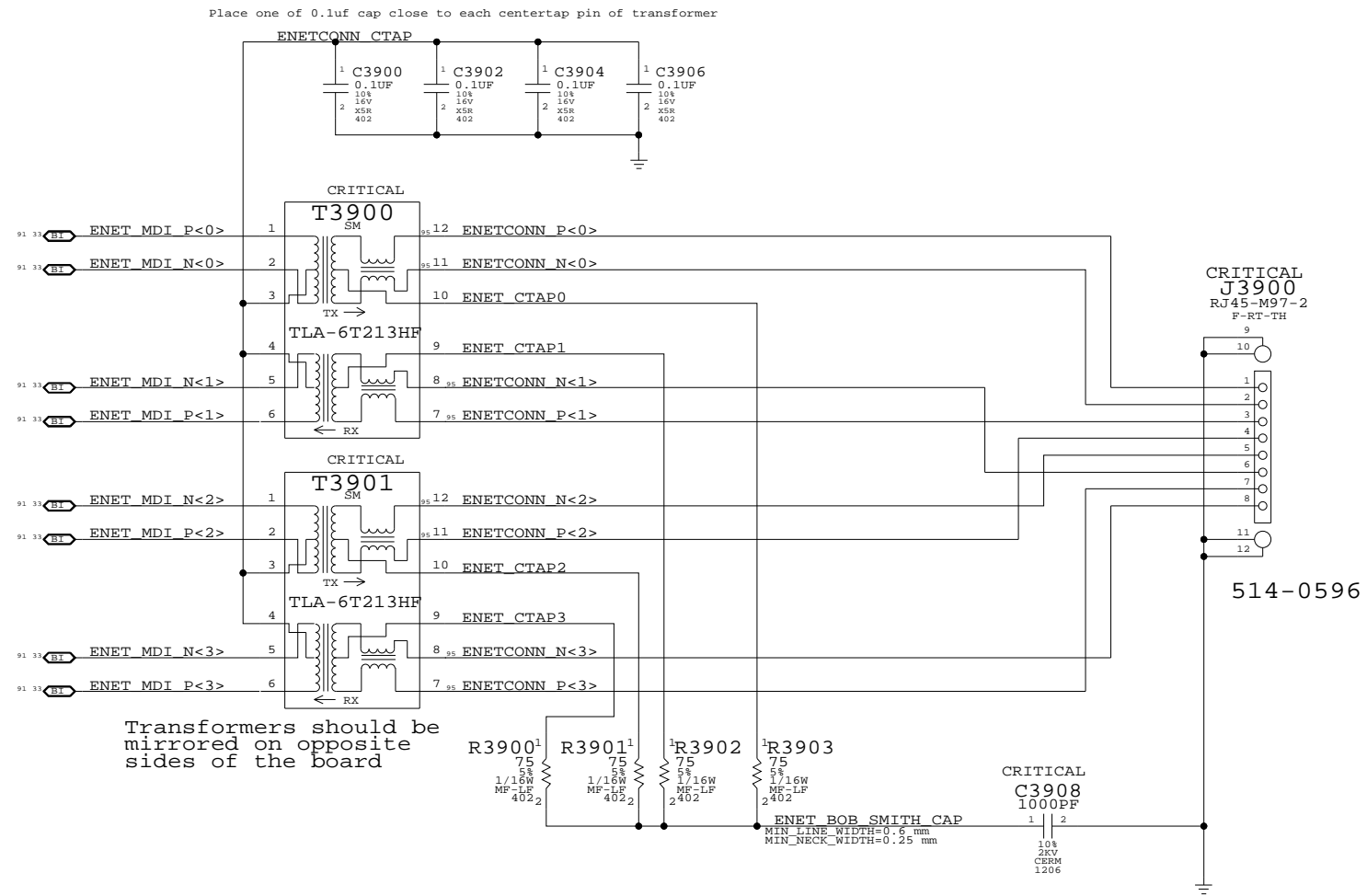
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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 34 | 96 |

Page Notes

Power aliases required by this page:
(NONE)

Signal aliases required by this page:
(NONE)

BOM options provided by this page:
(NONE)



Ethernet Connector

SYNC_MASTER=SUMA_M98_MLB SYNC_DATE=07/01/2008

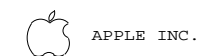
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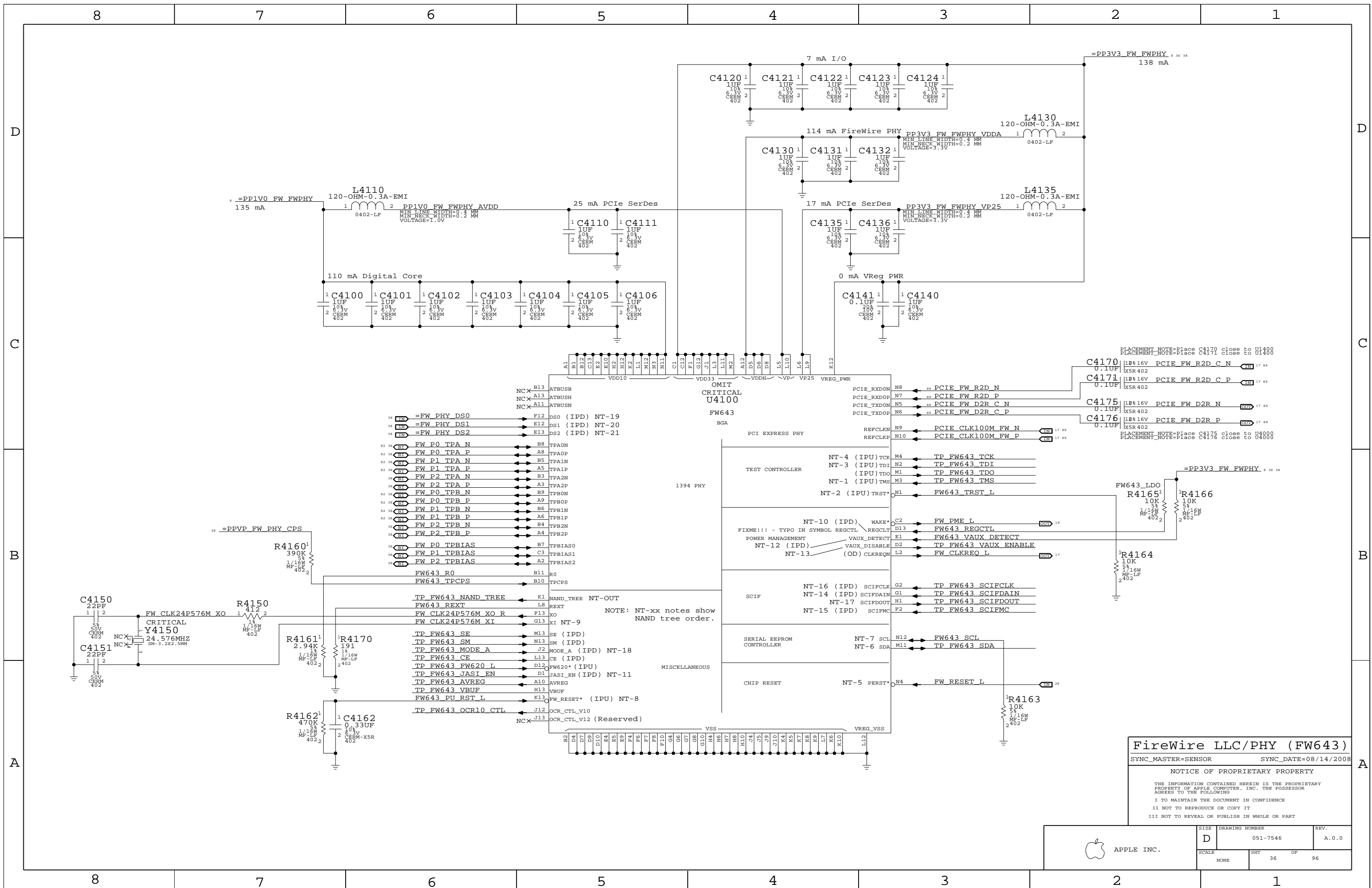
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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
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| SCALE | SHT | OF |
| NONE | 35 | 96 |



FireWire LLC/PHY (FW643)

SYNC_MASTER=SENSOR SYNC_DATE=08/14/2008

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|-------|------|----------------|-------|
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| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | 96 |
| NONE | 36 | | |

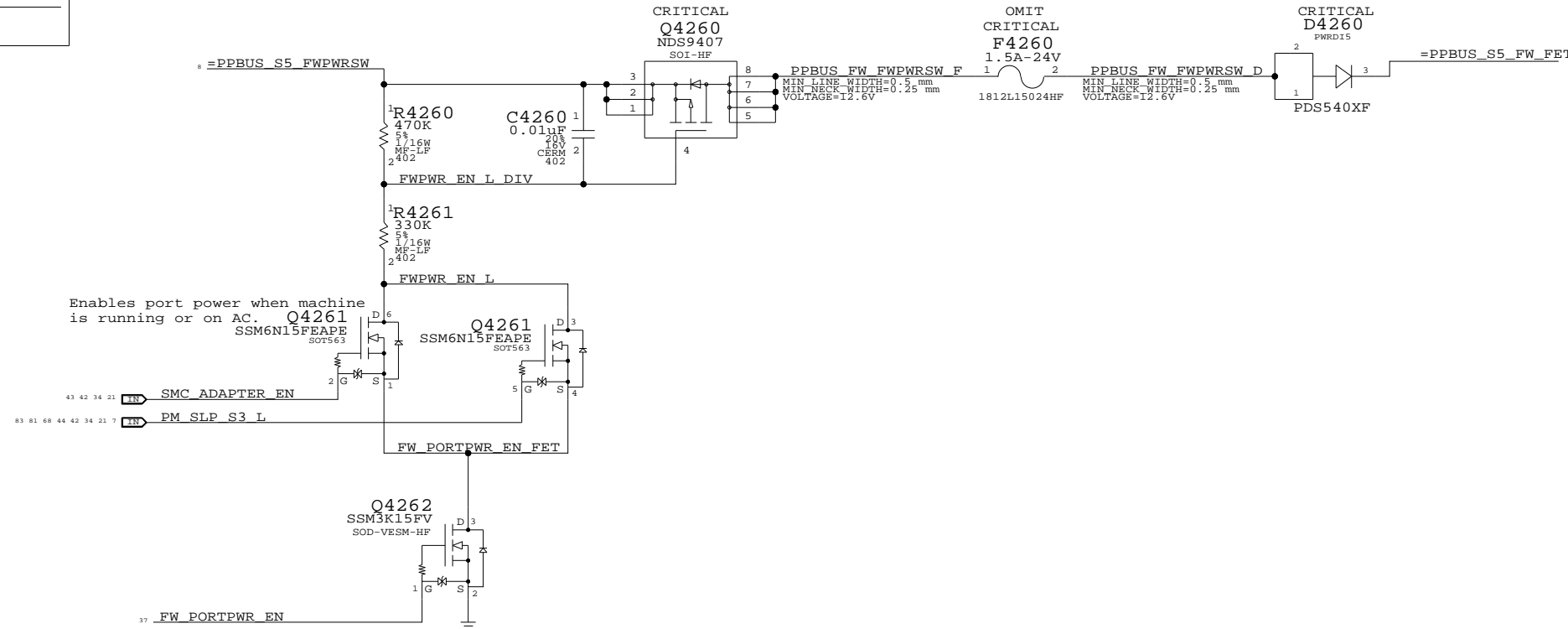
Page Notes

Power aliases required by this page:
 - =PPBUS_S5_FWPWRSW (system supply for bus power)
 - =PP3V3_FW_LATEVG_ACTIVE
 - =PPVP_FW_SUMNODE (power passthru summation node)

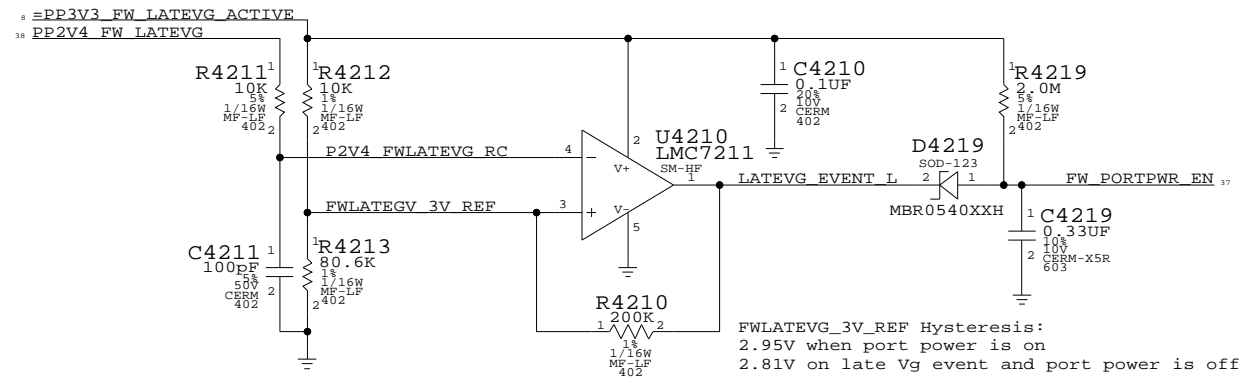
Signal aliases required by this page:
 (NONE)

BOM options provided by this page:
 - FW_PORT_FAULT_PU

FireWire Port Power Switch



Late-VG Event Detection



| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|---------------------------------|---------------|----------|------------|
| 740S0080 | 1 | LITTLEFUSE, 1.5A RESETTABLE 24V | F4260 | CRITICAL | |

FireWire Port Power

SYNC_MASTER=SENSOR SYNC_DATE=08/14/2008

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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 37 | 96 |

Page Notes

Power aliases required by this page:
 - =PPVP_FW_PORT1
 - =PP3V3_FW_LATEVG

Signal aliases required by this page:
 (NONE)

NOTE: This page is expected to contain the necessary aliases to map the FireWire TPA/TPB pairs to their appropriate connectors and/or to properly terminate unused signals.

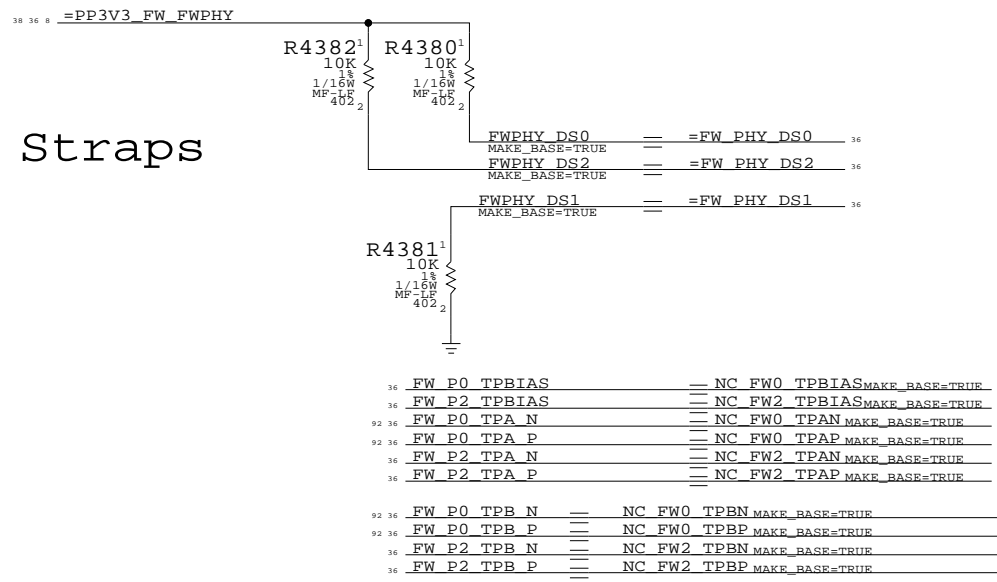
BOM options provided by this page:
 (NONE)

NOTE: FireWire TPA/TPB pairs are NOT constrained on this page. It is assumed that FireWire PHY page will provide the appropriate constraints to apply to entire TPA/TPB XNets.

1394b implementation based on Apple FireWire Design Guide (FWDG 0.6, 5/14/03)

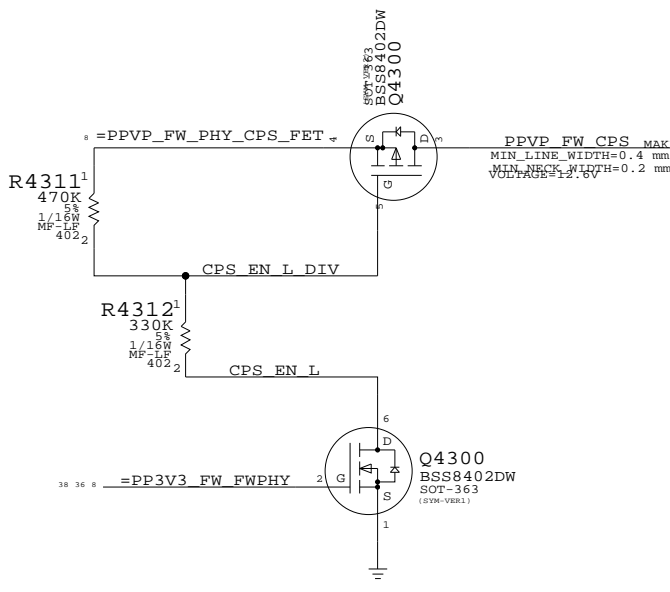
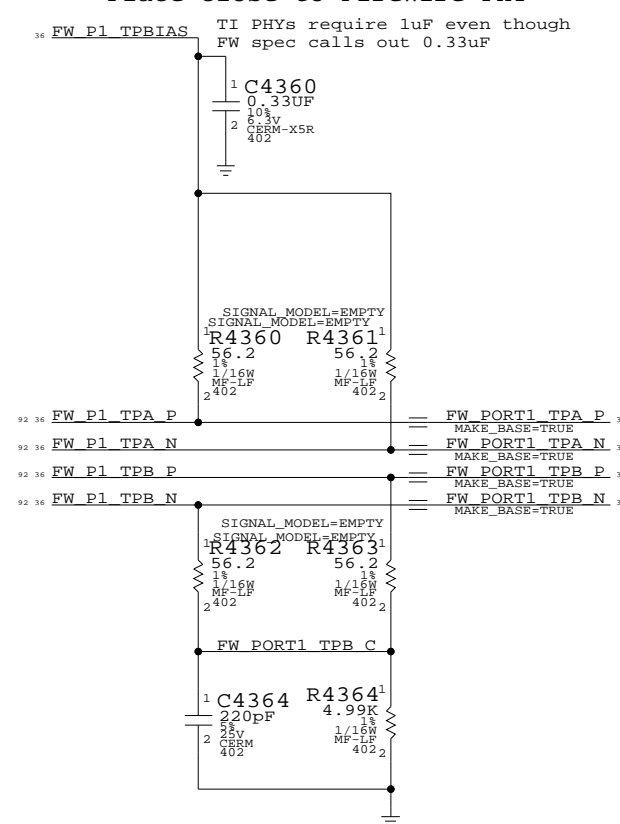
FireWire PHY Config Straps

Configures PHY for:
 - 1-port Portable Power Class (0)
 - Port "1" Bilingual (1394B)

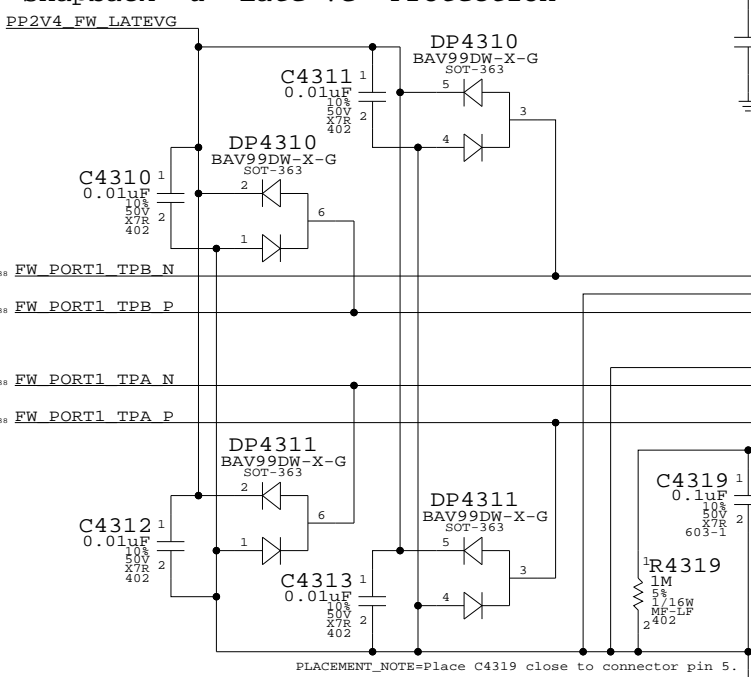


Termination

Place close to FireWire PHY

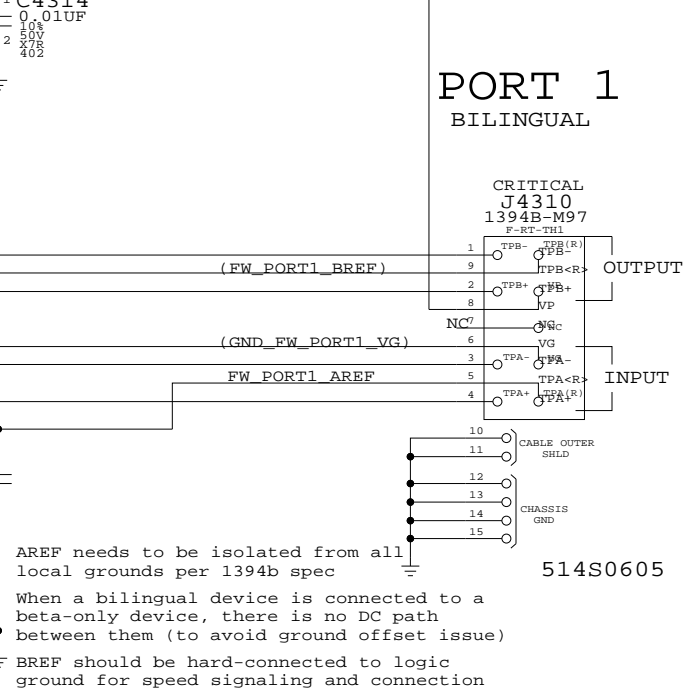


"Snapback" & "Late VG" Protection



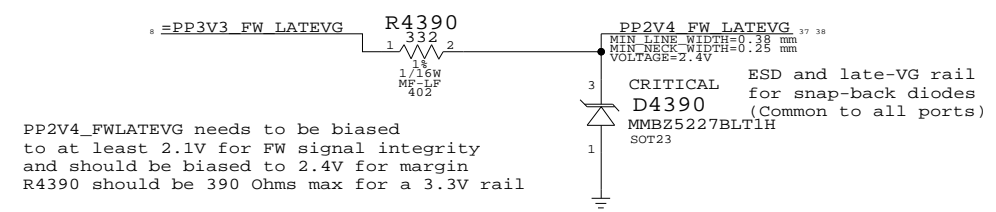
Cable Power

CRITICAL L4310 FERR-250-OHM Note: Trace PPVP_FW_PORT1 must handle up to 5A
 CRITICAL J4310 1394B-M97 F-RT-TH1



AREF needs to be isolated from all local grounds per 1394b spec
 When a bilingual device is connected to a beta-only device, there is no DC path between them (to avoid ground offset issue)
 BREF should be hard-connected to logic ground for speed signaling and connection

Late-VG Protection Power

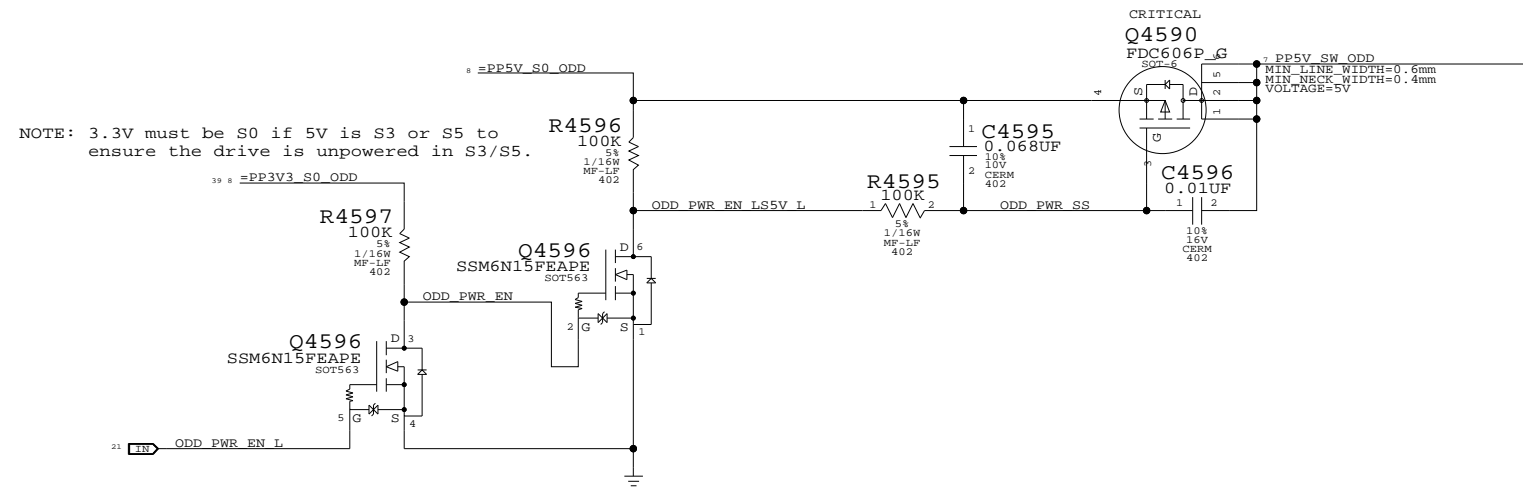


PP2V4_FWLATEVG needs to be biased to at least 2.1V for FW signal integrity and should be biased to 2.4V for margin
 R4390 should be 390 Ohms max for a 3.3V rail

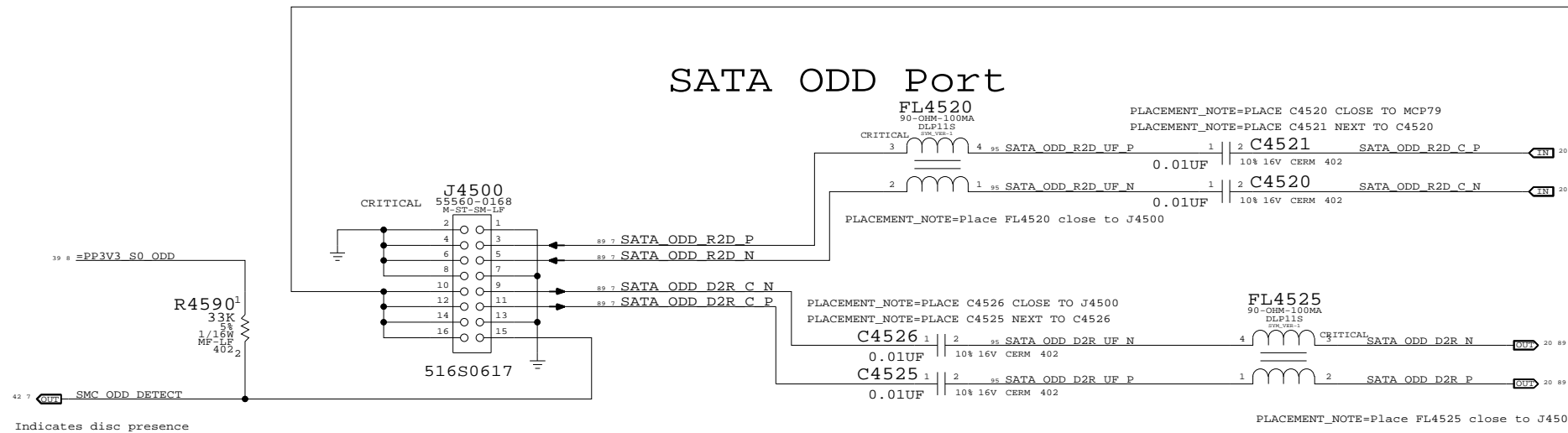
FireWire Ports
 SYNC_MASTER=SENSOR SYNC_DATE=08/14/2008
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| SCALE | SHT | OF | 96 |
| NONE | 38 | | |

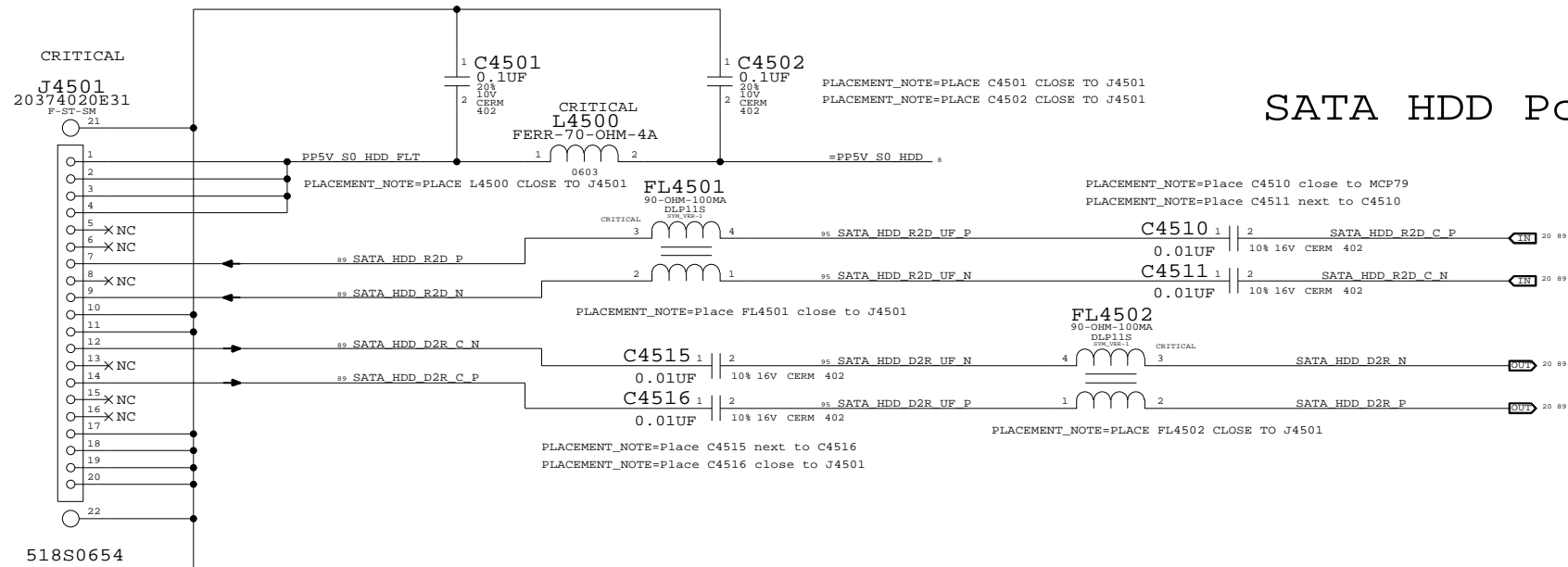
ODD Power Control



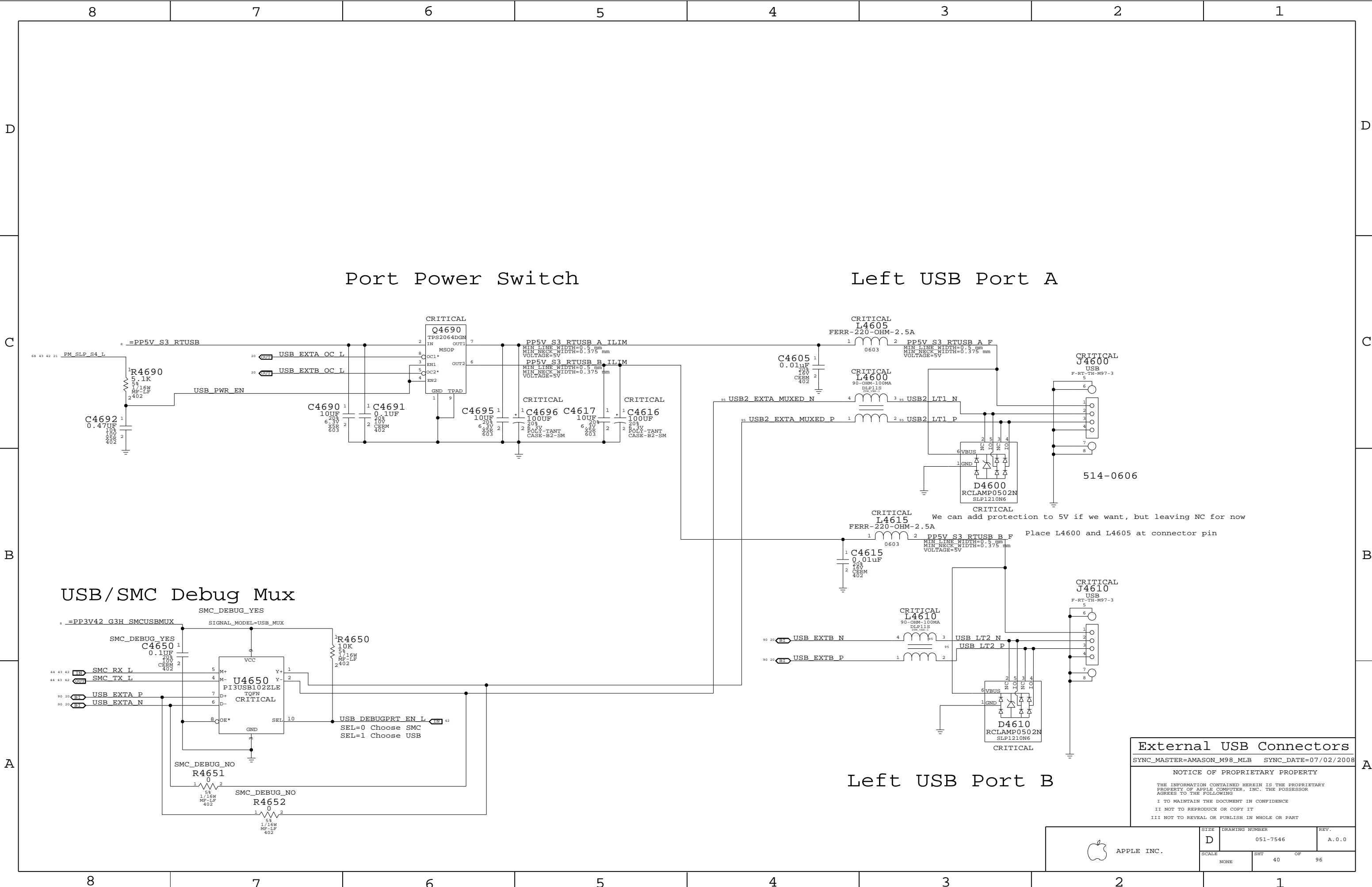
SATA ODD Port



SATA HDD Port



SATA Connectors
 SYNC_MASTER=CHANG_M98_MLB SYNC_DATE=07/01/2008
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Port Power Switch

Left USB Port A

USB/SMC Debug Mux

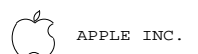
Left USB Port B

External USB Connectors

SYNC_MASTER=AMASON_M98_MLB SYNC_DATE=07/02/2008

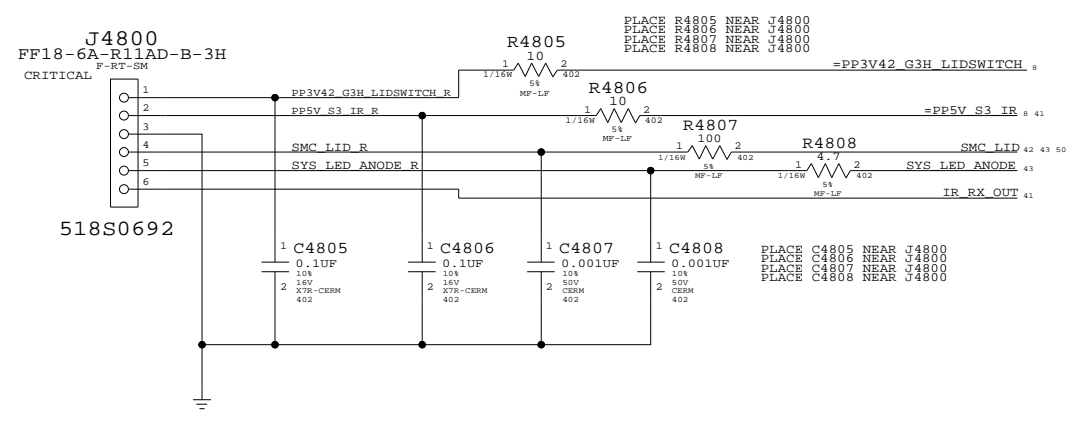
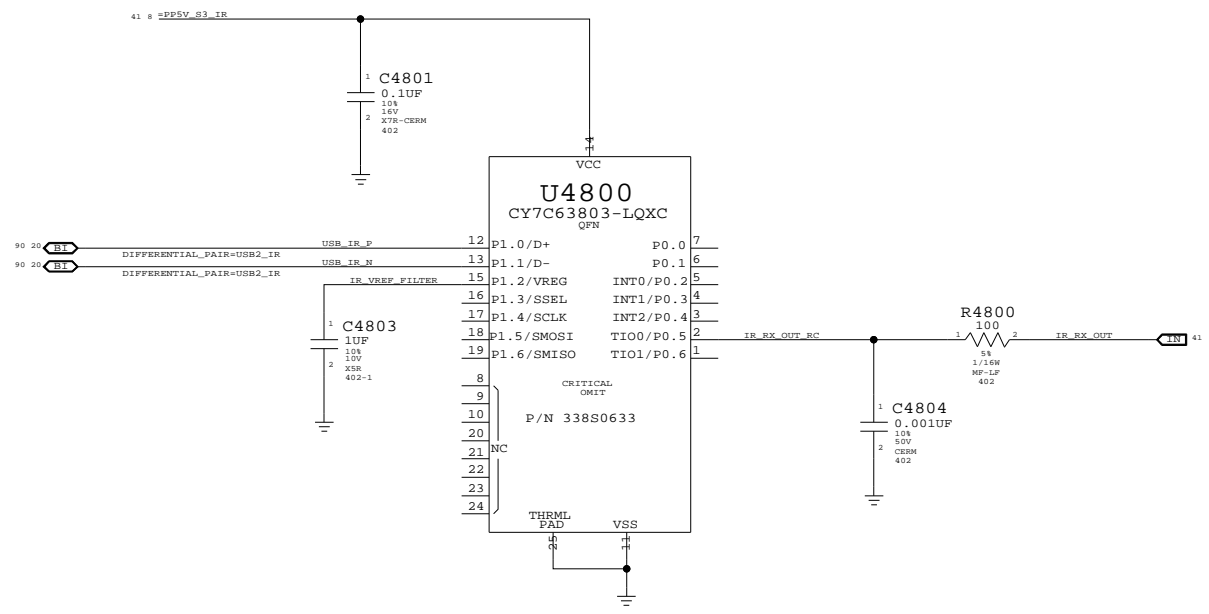
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| SCALE | SHT | OF |
| NONE | 40 | 96 |




Front Flex Support

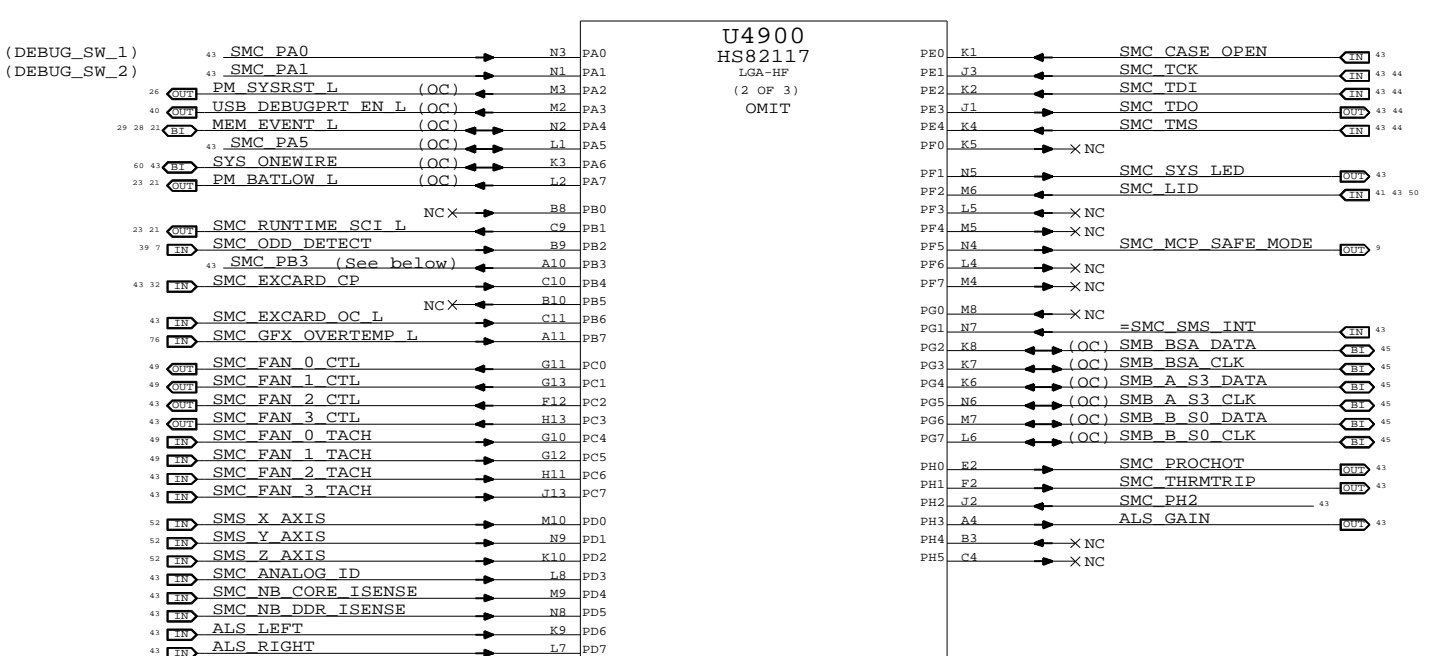
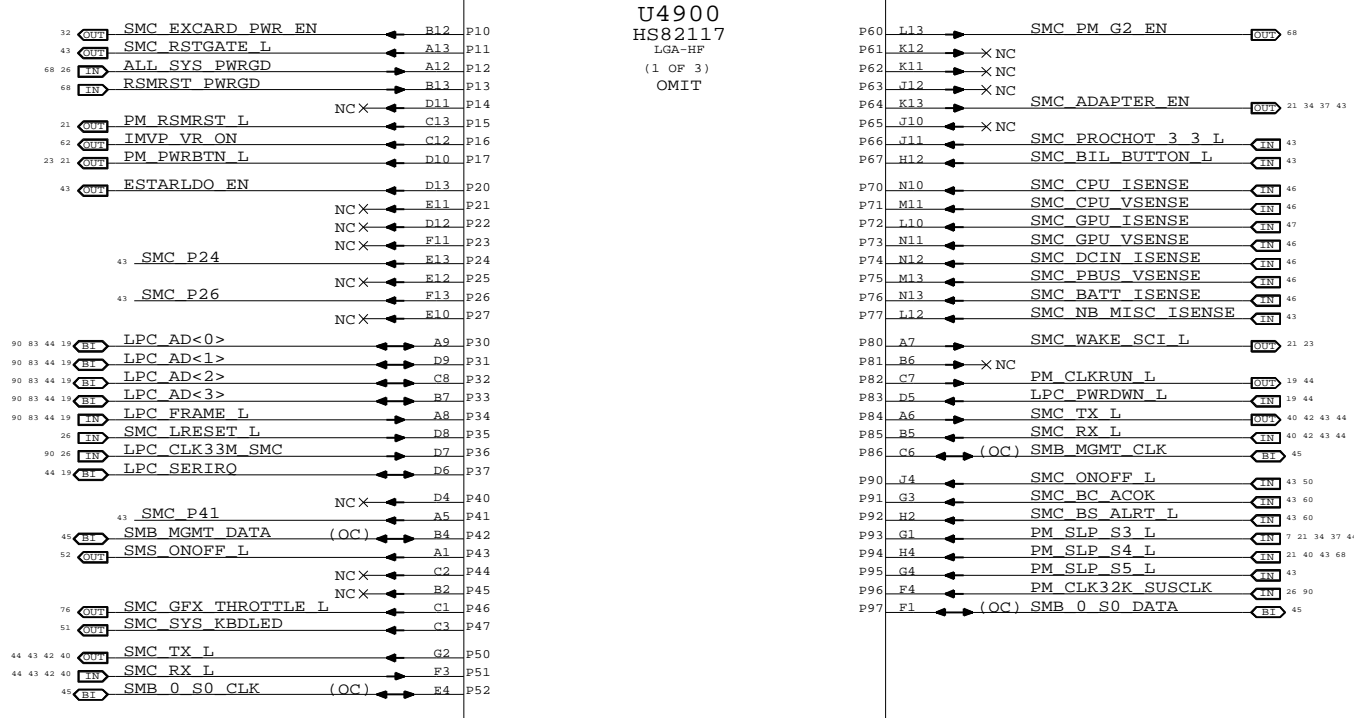
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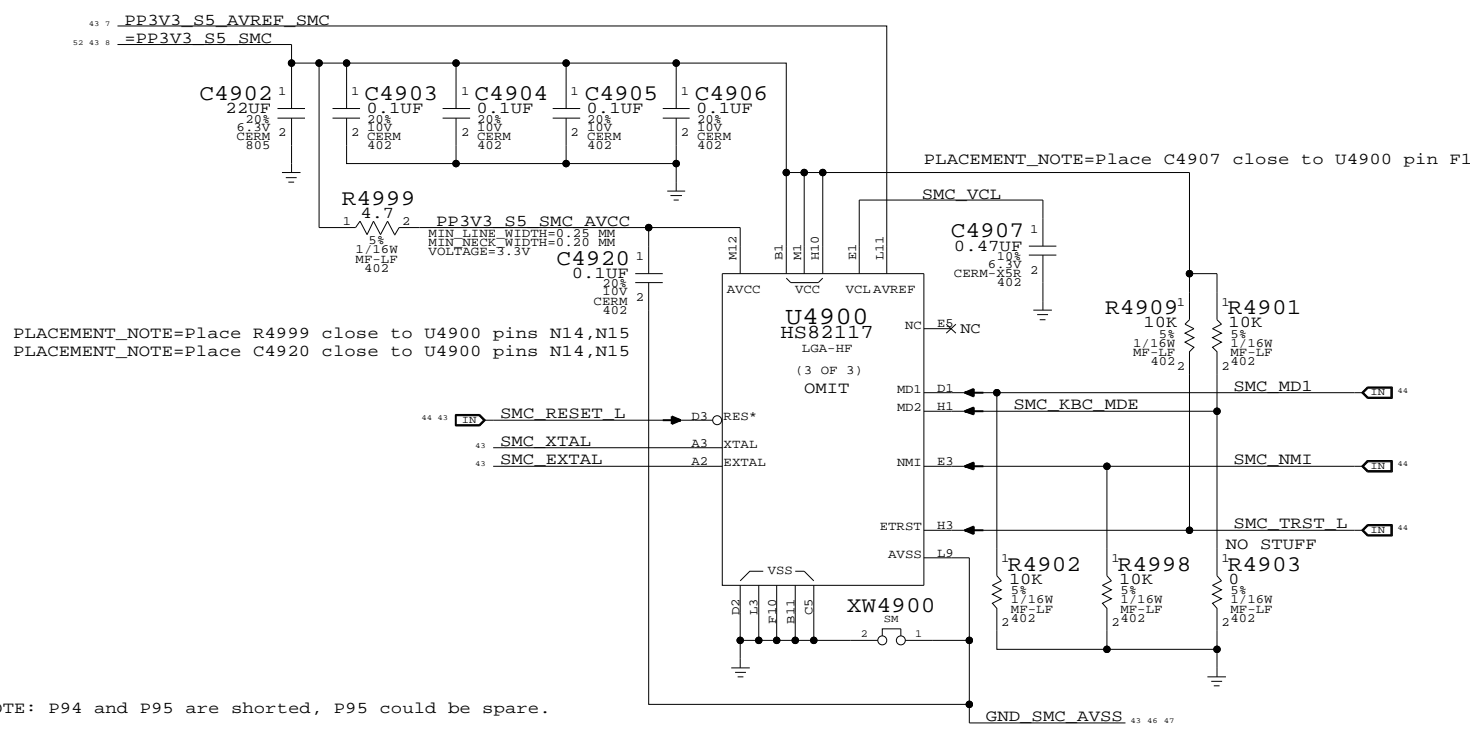
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| SCALE | SHT 41 OF 96 | | |
| NONE | | | |

NOTE: Unused pins have "SMC_Pxx" names. Unused pins designed as outputs can be left floating, those designated as inputs require pull-ups.



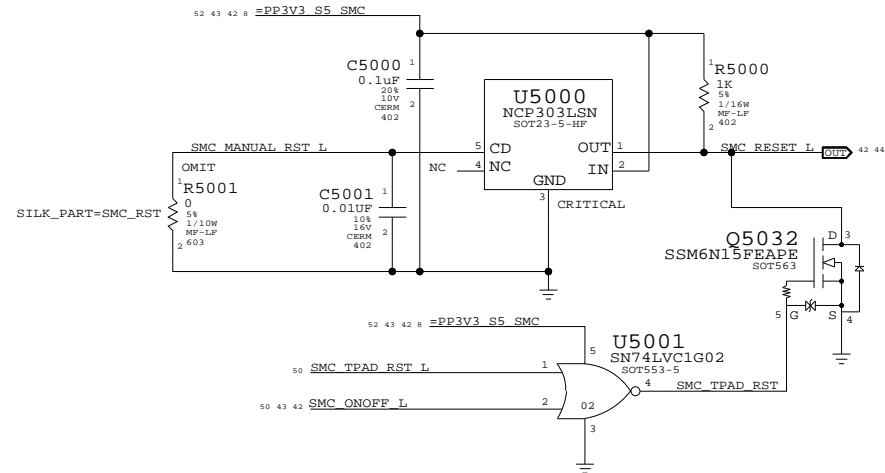
SMC_PB3:
SMC_IG_THROTTLE_L for MG systems.
Otherwise, TP/NC okay (was ISENSE_CAL_EN)



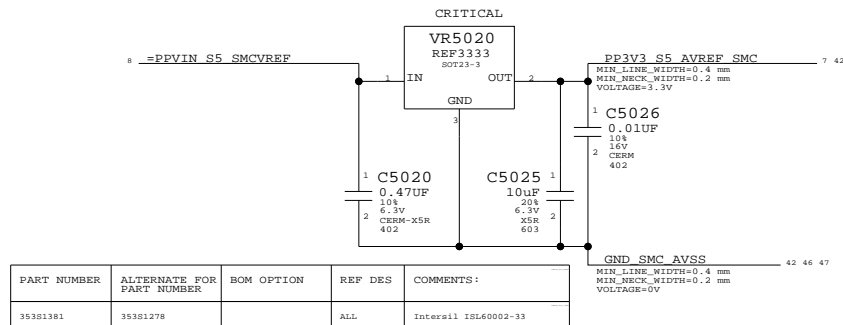
SMC
SYNC_MASTER=T18_MLB SYNC_DATE=06/18/2008
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| SCALE | SHT | OF | 96 |
| NONE | 42 | | |

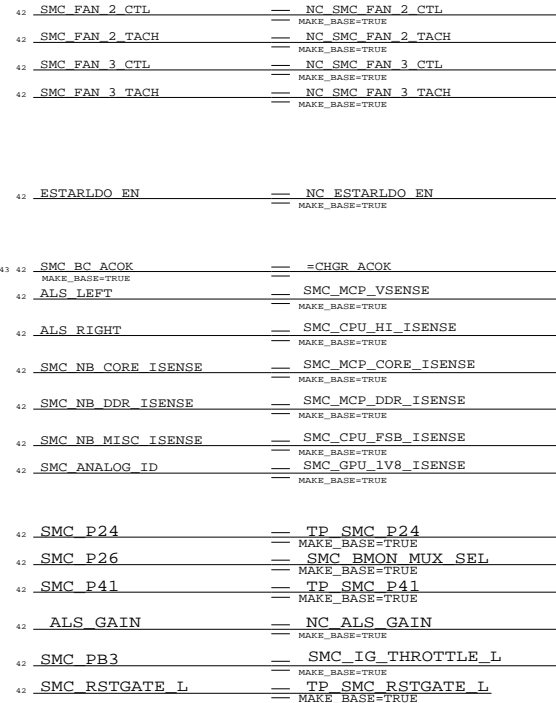
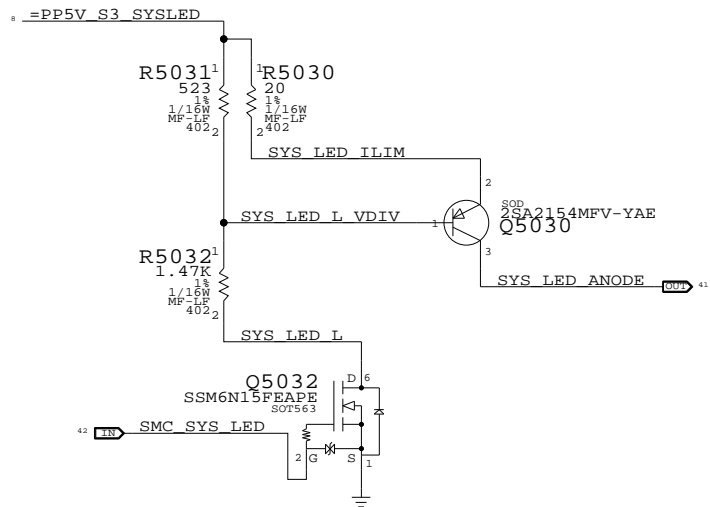
SMC Reset "Button" / Brownout Detect



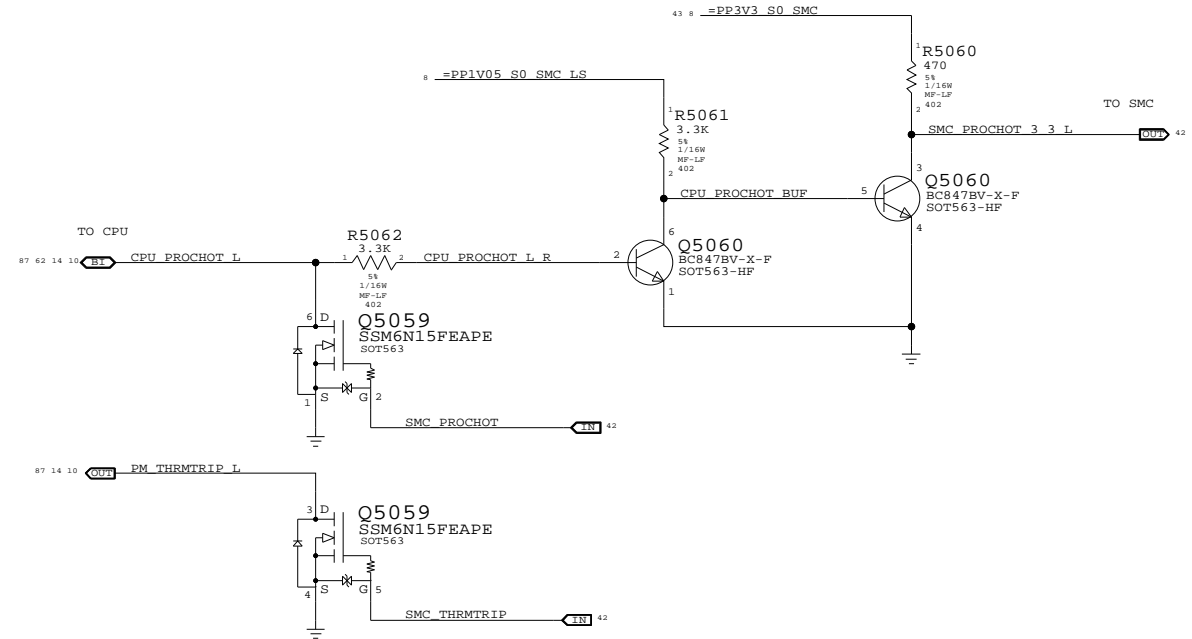
SMC AVREF Supply



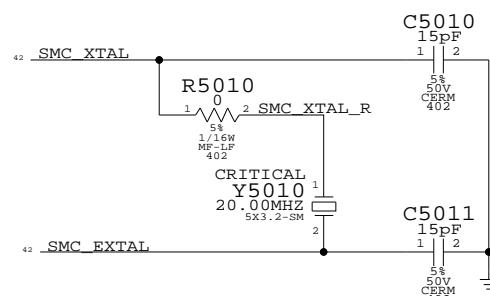
System (Sleep) LED Circuit



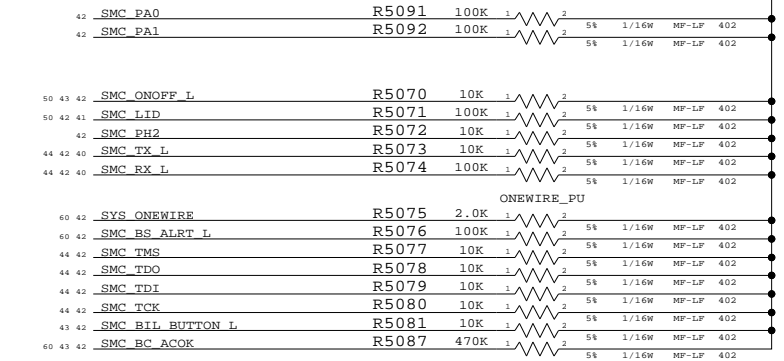
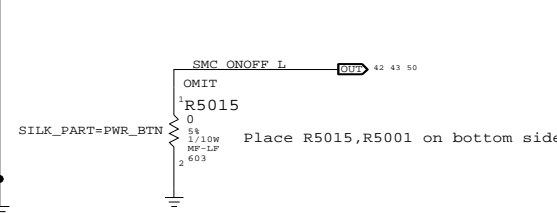
SMC FSB to 3.3V Level Shifting



SMC Crystal Circuit



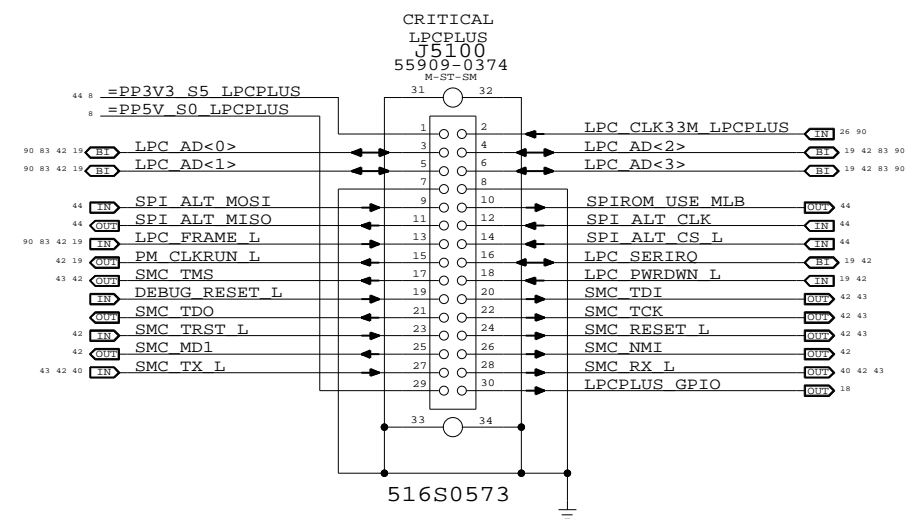
Debug Power "Button"



SMC Support
 SYNC_MASTER=AMASON_M98_MLB SYNC_DATE=06/18/2008
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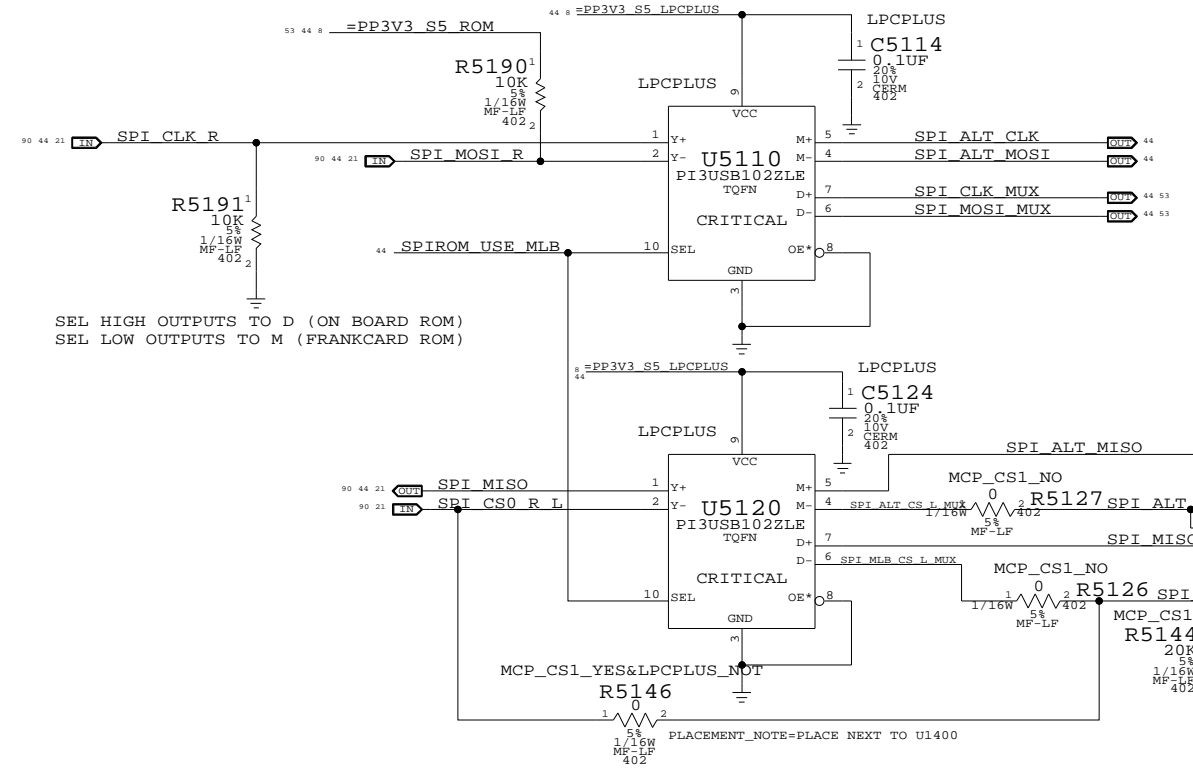
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| SCALE | NONE | SHT | 43 OF 96 |

LPC+SPI Connector



Alternate SPI ROM Support

MUX SEL CONTROLLED BY FRANKCARD SWITCH ONCE CS1 IS SUPPORTED IN MCP

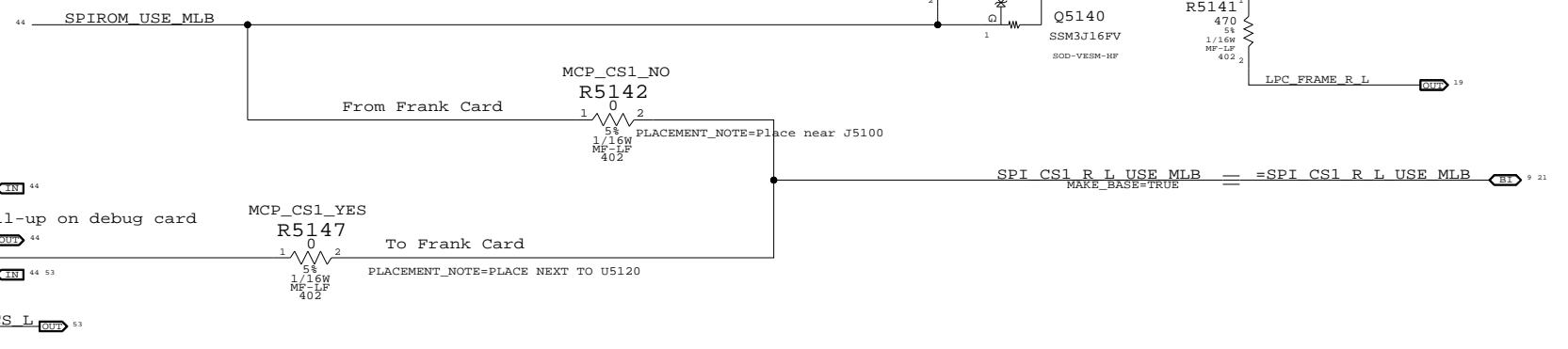


MCP79 Internal SPI MUX Support

NOT SUPPORTED IN REV A01 OR B01 MCP79 SILICON

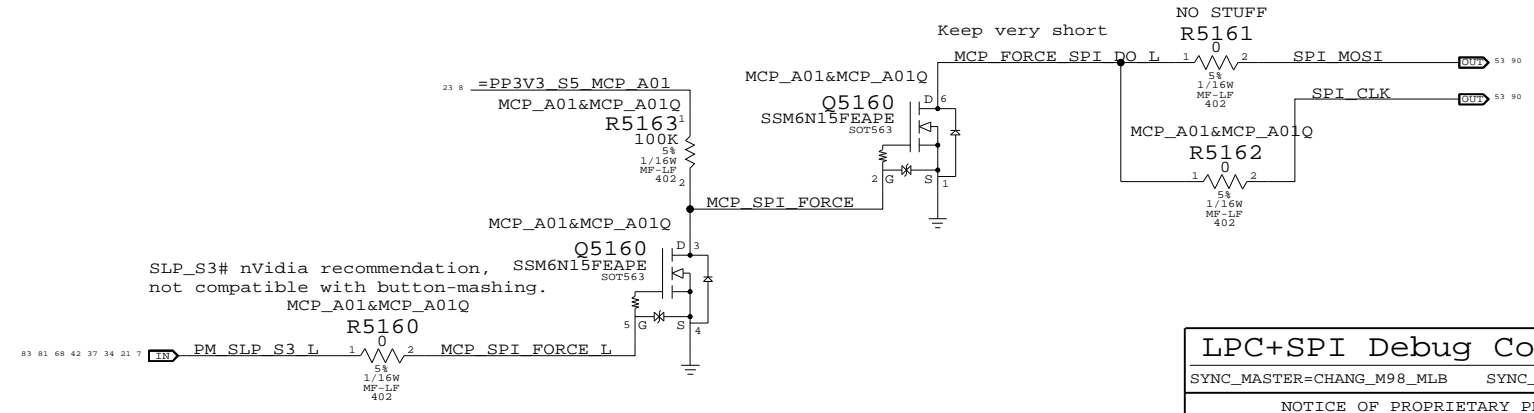
MCP SPI Override Options

MCP79 REV A01 REQUIRES EXTERNAL MUX, REV B01 STILL DOES NOT SUPPORT INTERNAL MUX

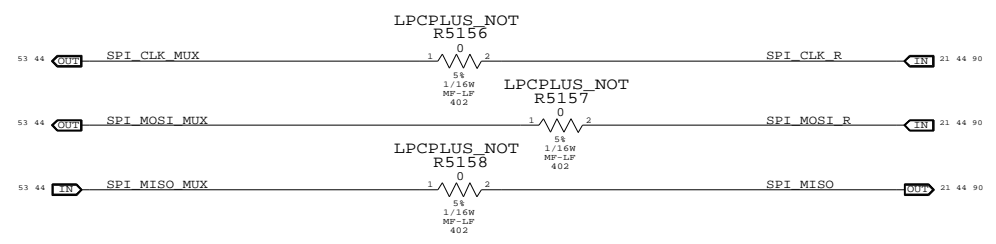


SPI Frequency Clamp

ENSURES MCP79 SPI_DO OR SPI_CLK INPUT IS LOW WHEN STRAP IS LATCHED. NOT NEEDED FOR B01 OR LATER.



SPI MUX BYPASS



LPC+SPI Debug Connector

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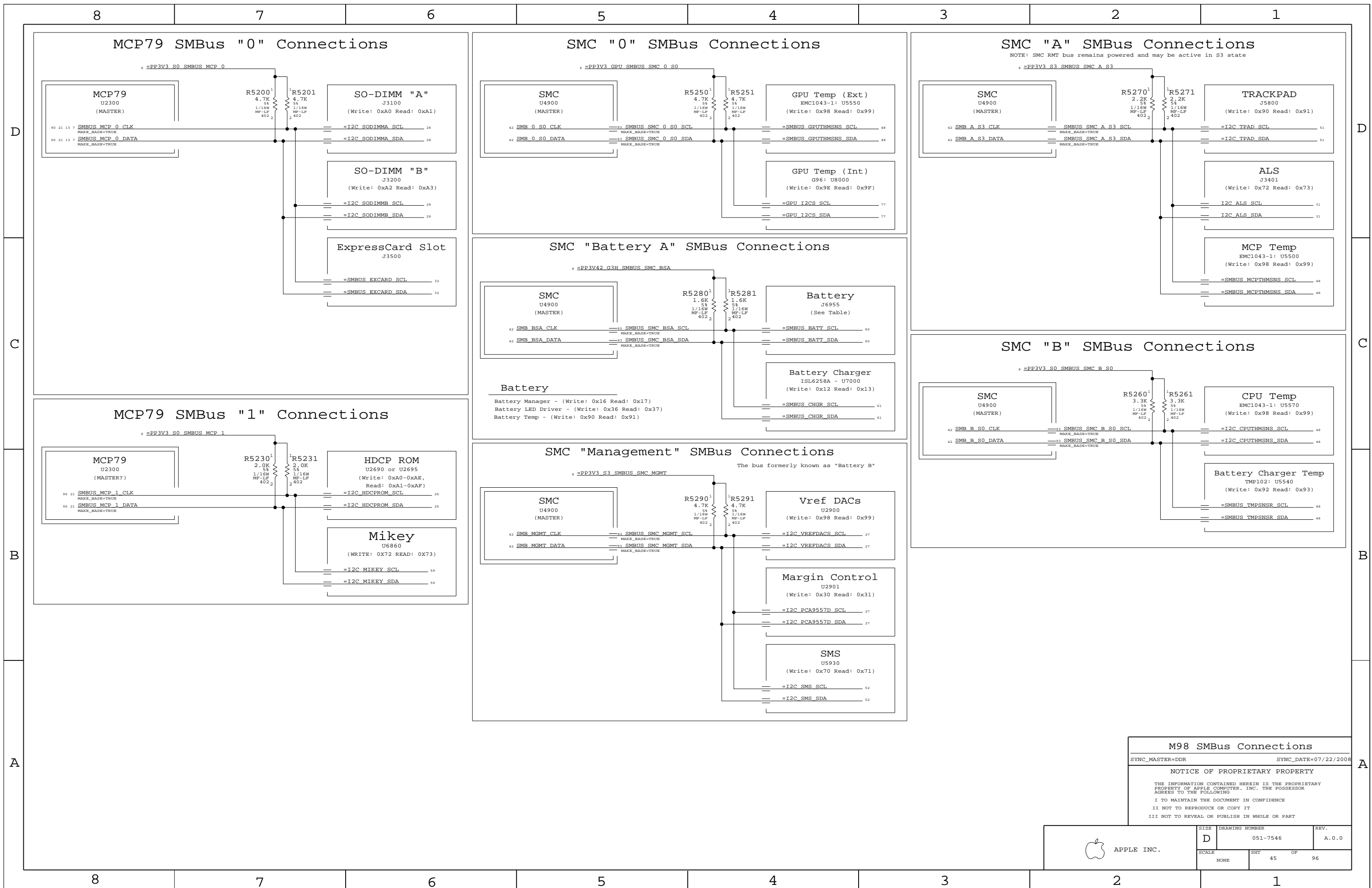
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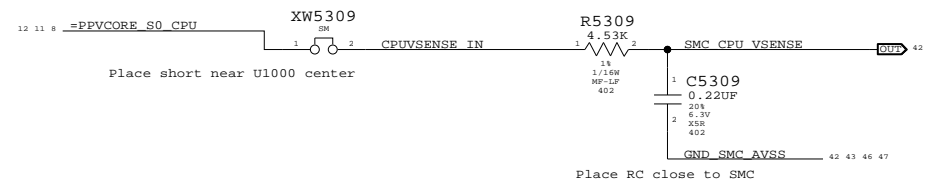
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| NONE | 44 | 96 |



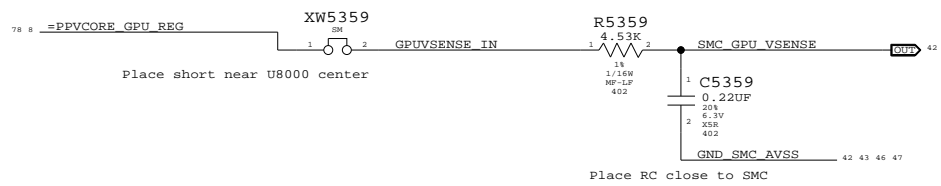
M98 SMBus Connections
 SYNC_MASTER=DDR SYNC_DATE=07/22/2008
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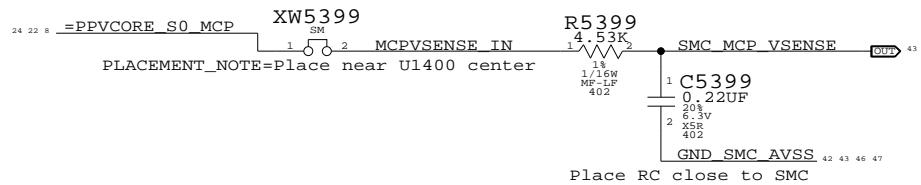
CPU Voltage Sense / Filter



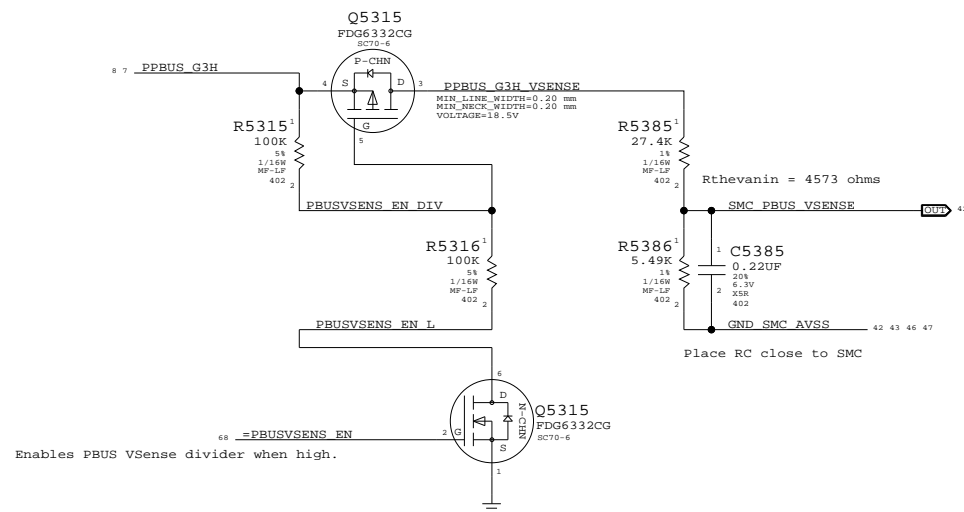
GPU Voltage Sense / Filter



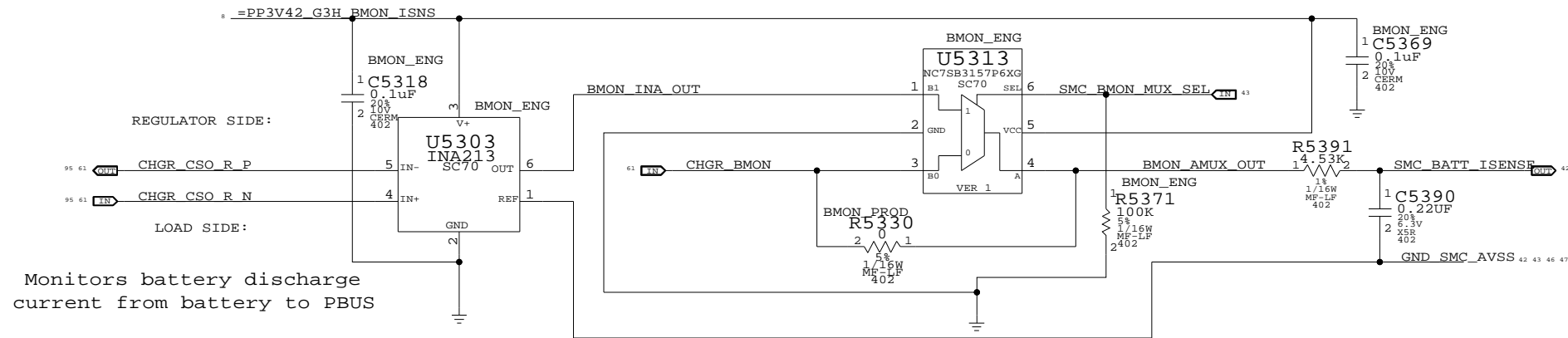
MCP Voltage Sense / Filter



PBUS Voltage Sense & Filter



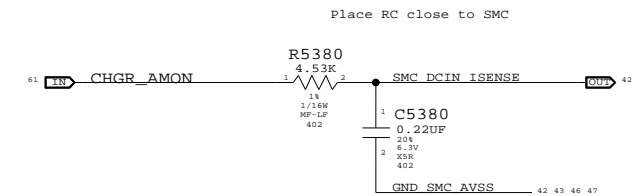
BMON Current Sense - Entire circuit must be near SMC (U4900)



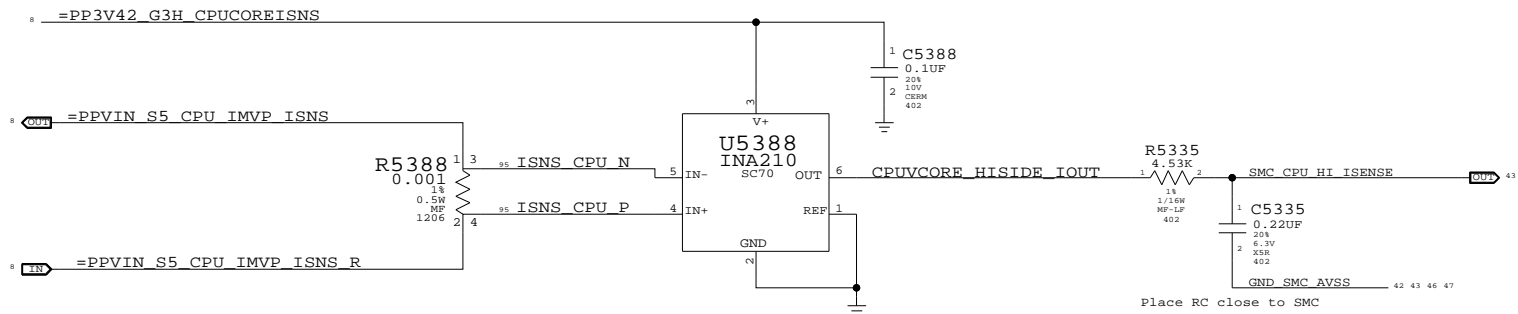
Monitors battery discharge current from battery to PBUS

INA213 has gain of 50V/V

DCIN Current Sense Filter

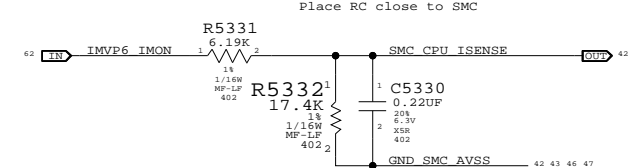


CPU VCore High Side Current Sensor



Consider INA211 (GAIN 500 version) since I=4.93 Amps across R5388

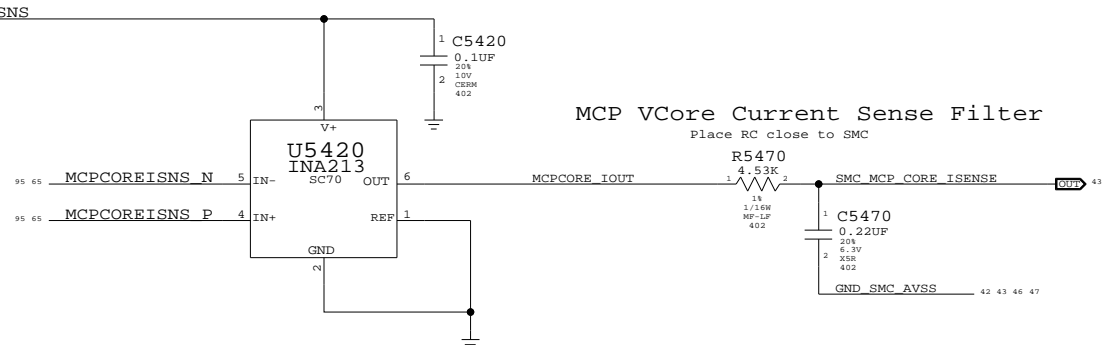
CPU VCore Load Side Current Sense / Filter



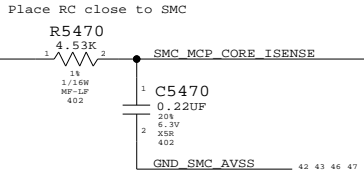
Current & Voltage Sensing
 SYNC_MASTER=SENSOR SYNC_DATE=08/14/2008
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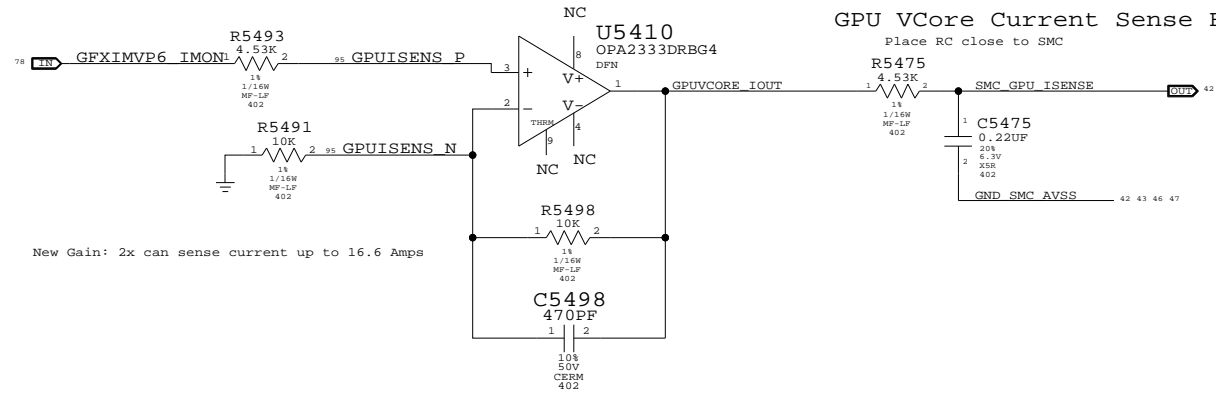
MCP VCore Current Sense



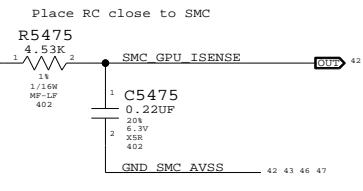
MCP VCore Current Sense Filter



GPU VCore Current Sense



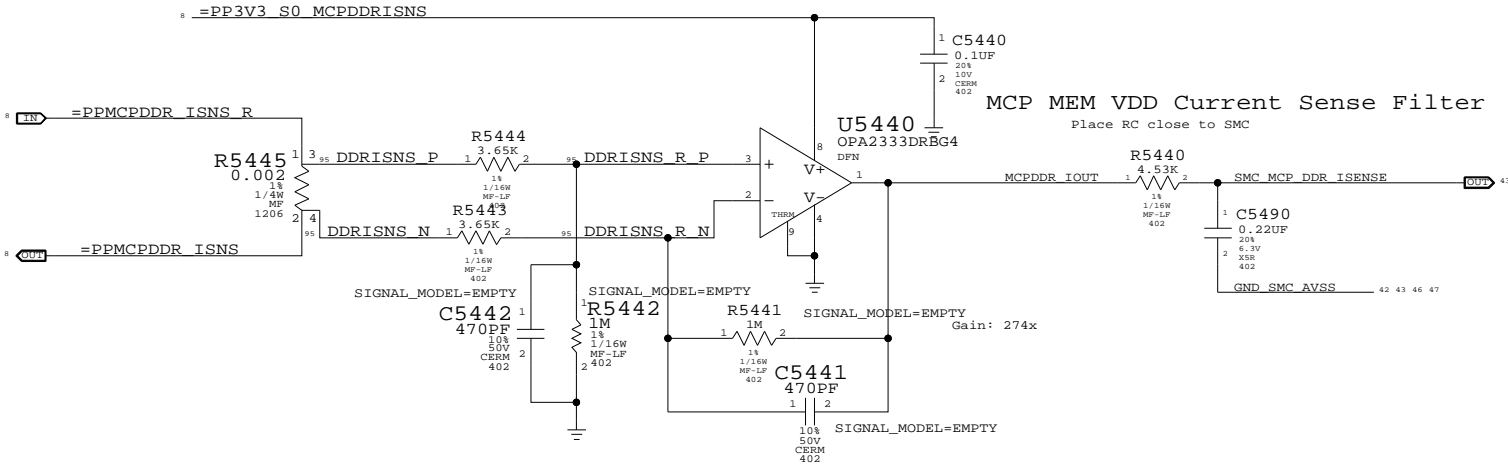
GPU VCore Current Sense Filter



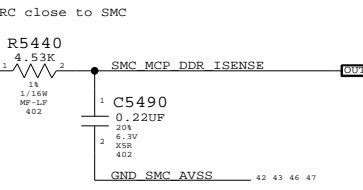
New Gain: 2x can sense current up to 16.6 Amps

GPU VCore Current Sense and GPU 1.8V Current Sense share dual package opamp U5410

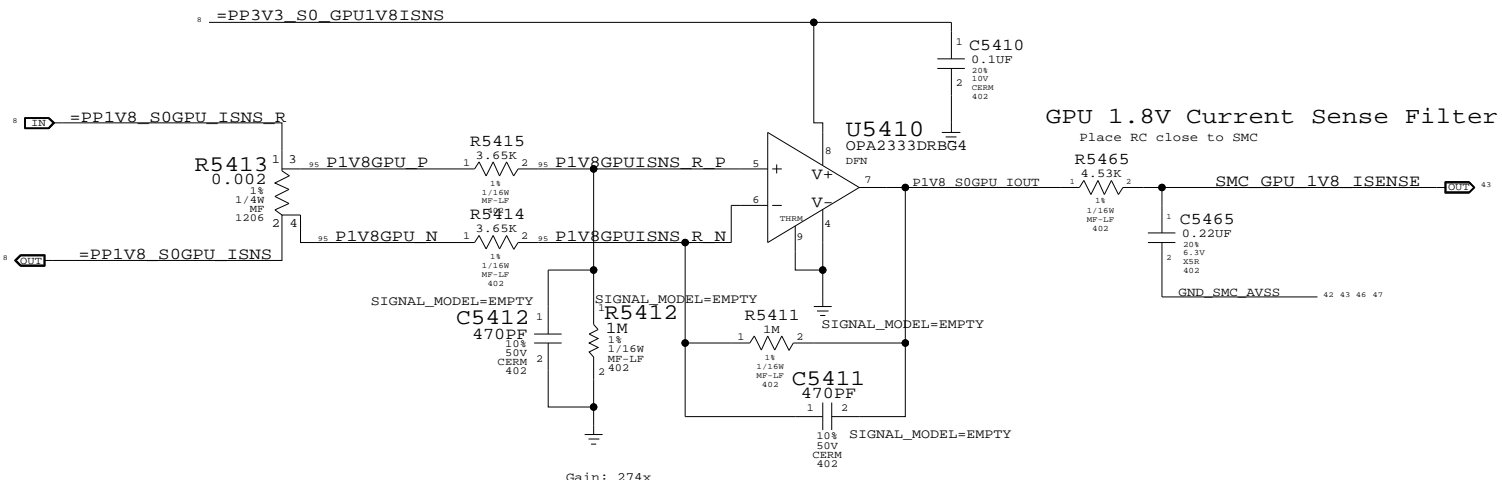
MCP MEM VDD Current Sense



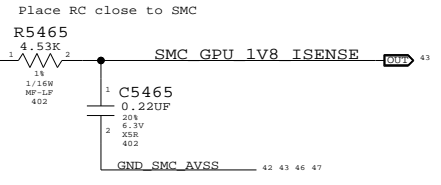
MCP MEM VDD Current Sense Filter



GPU 1.8V Current Sense



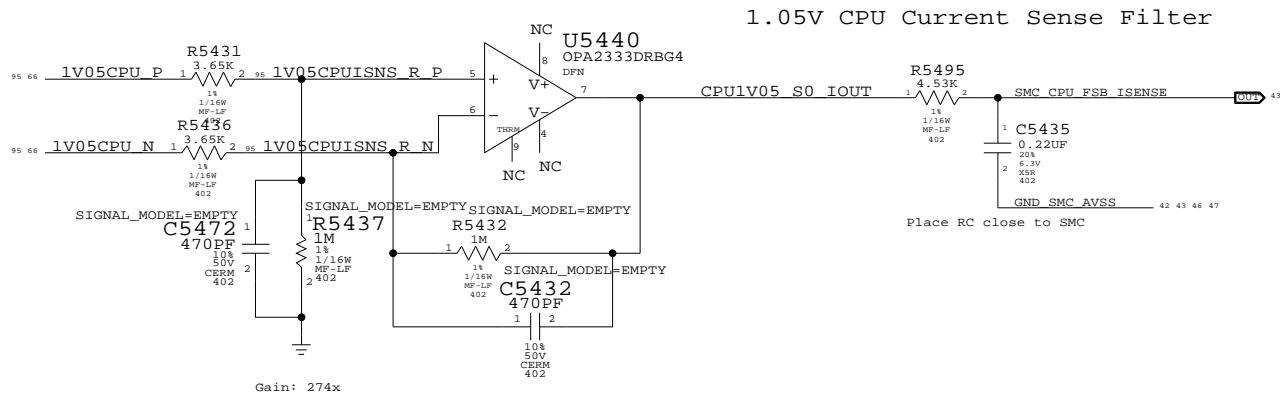
GPU 1.8V Current Sense Filter



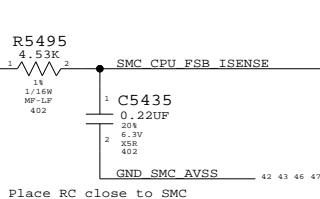
OPA2333s for proto are placeholders for OPA2330

MCP MEM VDD Current Sense and CPU FSB 1.05V Current Sense share dual package opamp U5440

CPU FSB 1.05V Current Sense



1.05V CPU Current Sense Filter



Current Sensing

SYNC_MASTER=SENSOR SYNC_DATE=08/14/2008

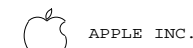
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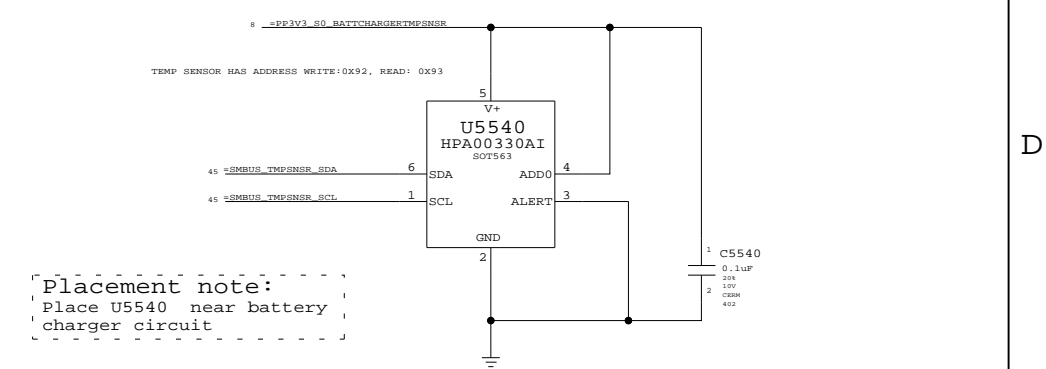
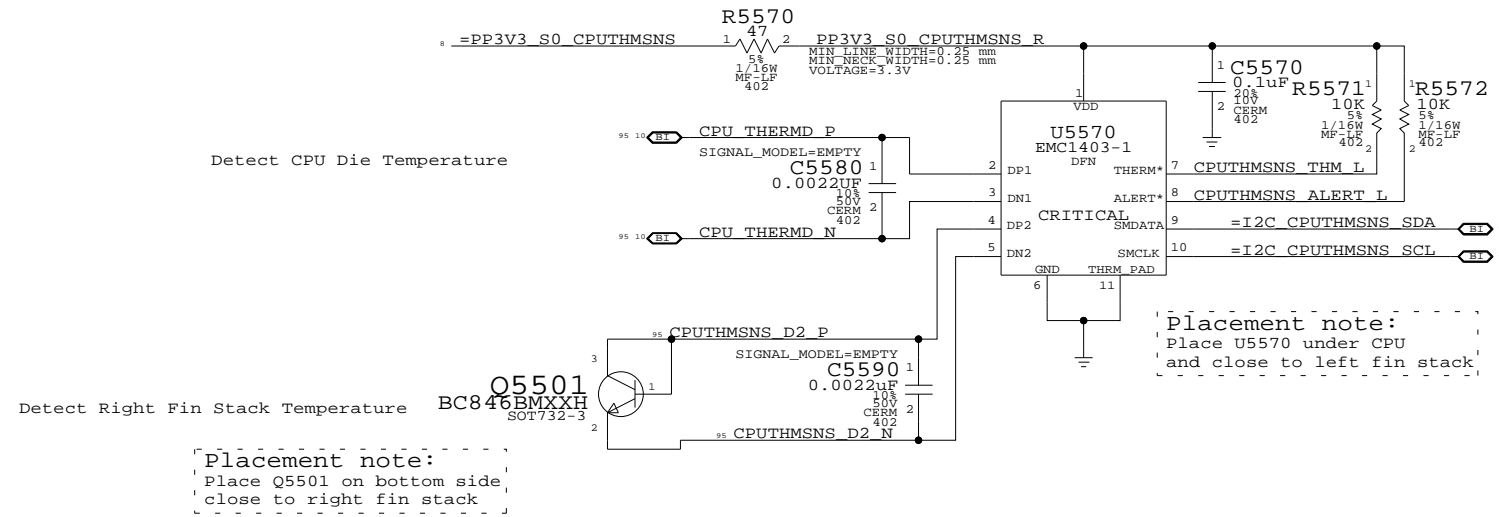


APPLE INC.

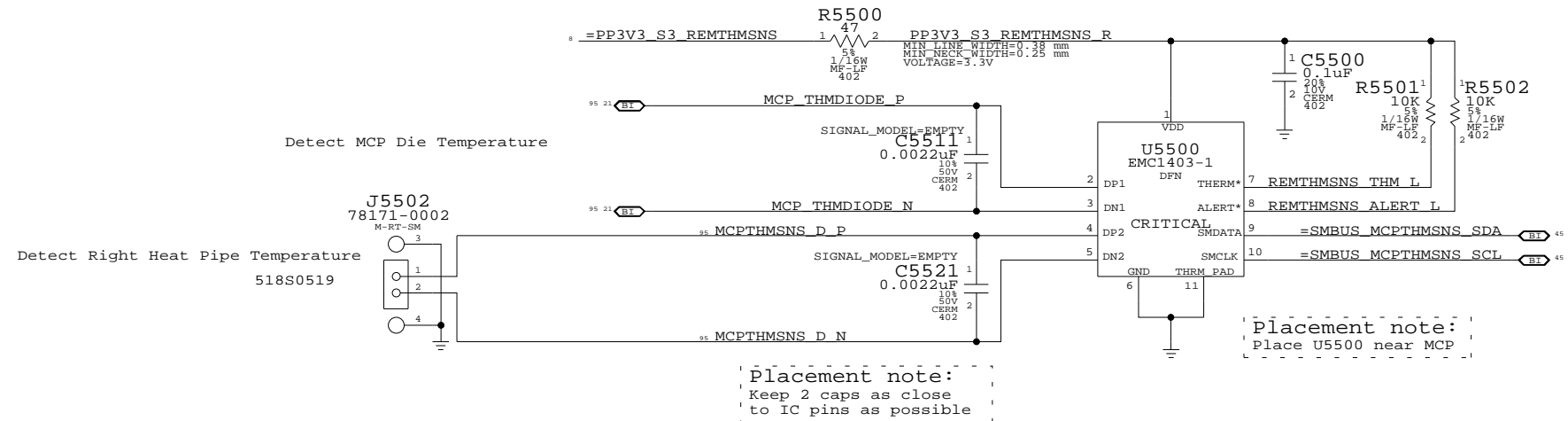
| | | |
|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 47 | 96 |

CPU Proximity/CPU Die/Right Fin Stack

Battery Charger Proximity

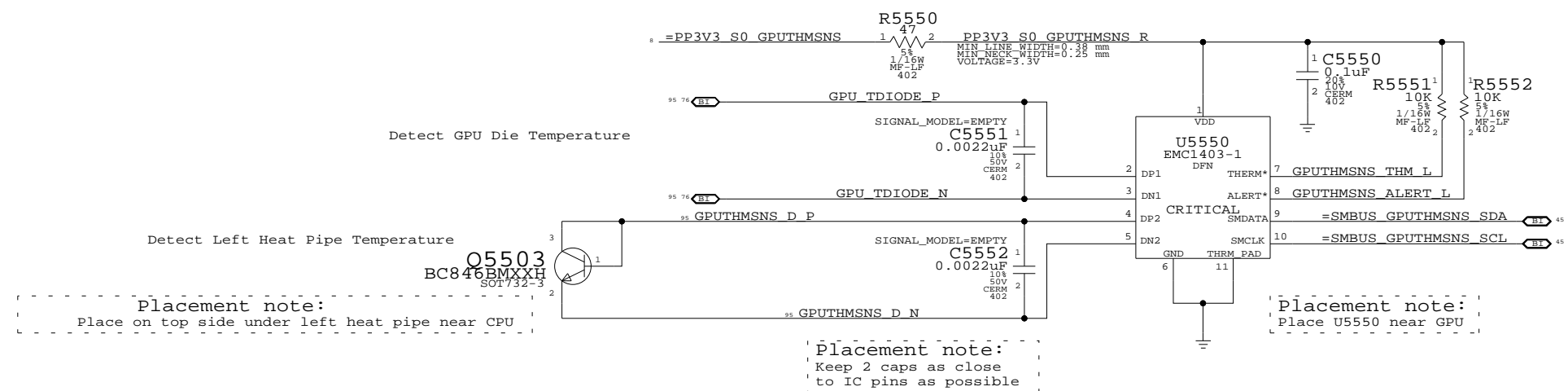


MCP Proximity/MCP Die/Right Heat Pipe



Note: EMC1403 can perform Beta Compensation for External Diode 1 only

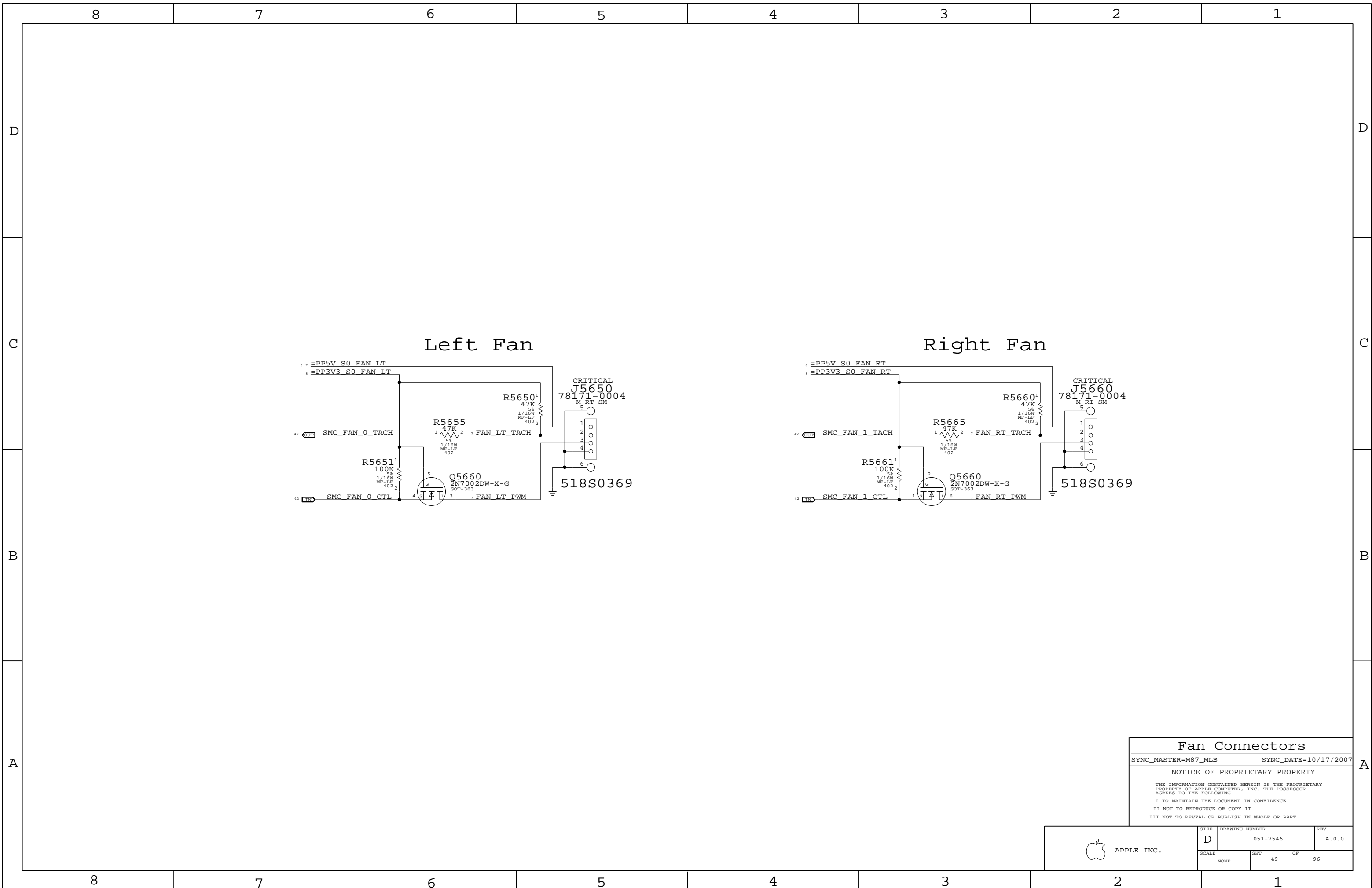
GPU Proximity/GPU Die/Left Heat Pipe



Placement note:
Place on top side under left heat pipe near CPU

| Thermal Sensors | | |
|--|----------------------|--|
| SYNC_MASTER=SENSOR | SYNC_DATE=08/14/2008 | |
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| | | | |
|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | |
| NONE | 48 | 96 | |



Fan Connectors

SYNC_MASTER=M87_MLB SYNC_DATE=10/17/2007

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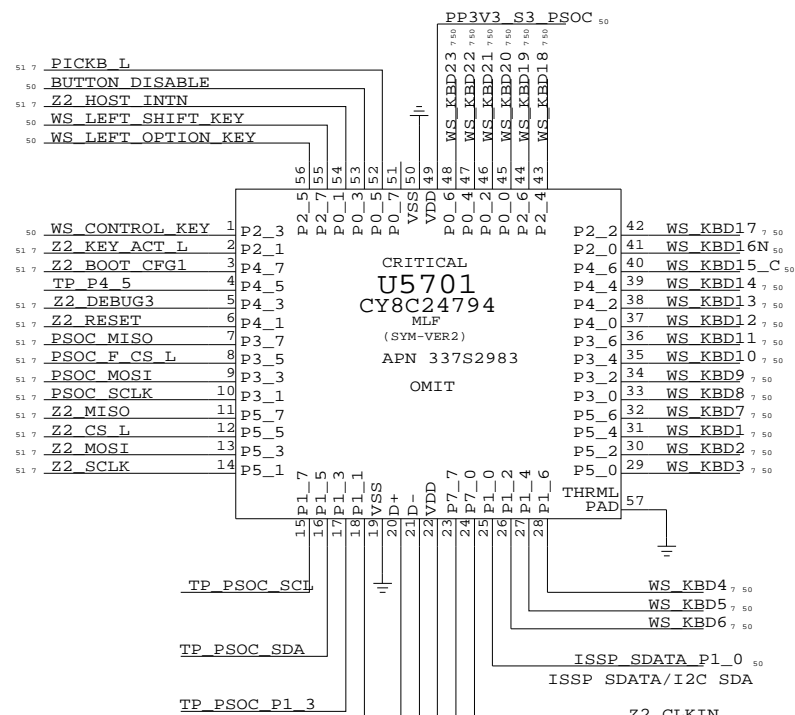
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III NOT TO REVEAL OR PUBLISH IN WHOLE OR PART

| | | | |
|------------|------------------|----------------------------|---------------|
| APPLE INC. | SIZE D | DRAWING NUMBER 051-7546 | REV. A.0.0 |
| | SCALE NONE | SHIT 49 OF 96 | |

PSOC USB CONTROLLER

USB INTERFACES TO MLBACKPAD PICK BUTTONS
SPI HOST TO Z2
KEYBOARD SCANNER



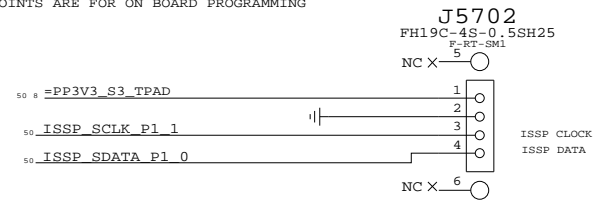
CRITICAL
U5701
CY8C24794
MLF
(SYM-VER2)
APN 337S2983
OMIT

| IC | PIN NAME | CURRENT | R_SNS | V_SNS | POWER |
|-------------|----------|------------|-----------|----------|------------|
| TMP102 | V+ | 10UA | 2.55 KOHM | 0.2555 V | 0.255E-6 W |
| 3V3 LDO | VDD | 80UA | 10 OHM | 0.204 V | 16.32E-6 W |
| PSOC | VOOUT | 60MA MAX | 0.2 OHM | 0.012 V | 0.72E-3 W |
| | VDD | 8MA (TYP) | 1.5 OHM | 0.012 V | 96E-6 W |
| | | 14MA (MAX) | | 0.021 V | 294E-6 W |
| 18V BOOSTER | VIN | 4MA (MAX) | 4.7 OHM | 0.0188 V | 75.2E-6 W |

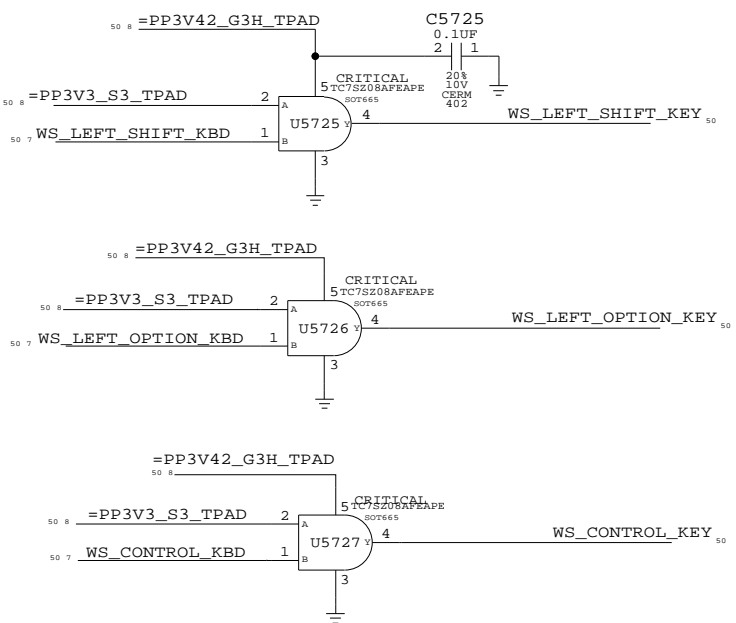
PSOC PROGRAMMING CONNECTOR

TPAD_DEBUG APN 518S0430

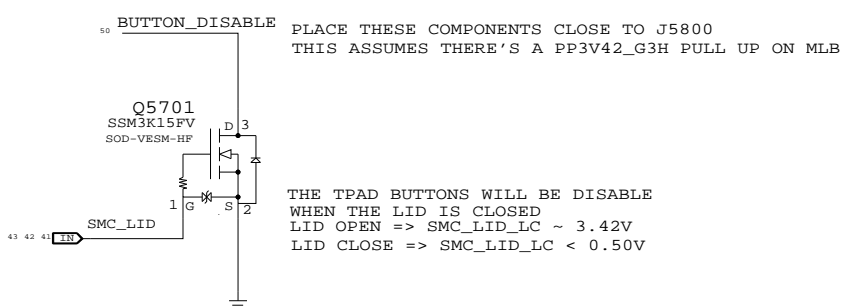
TEST POINTS ARE FOR ON BOARD PROGRAMMING



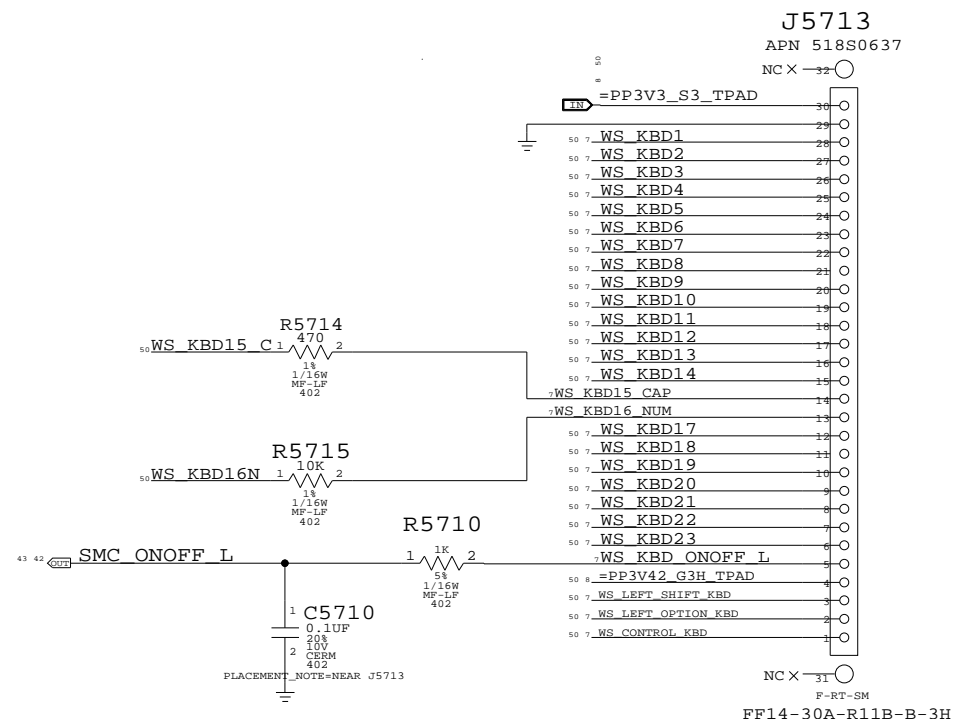
ISOLATION CIRCUIT



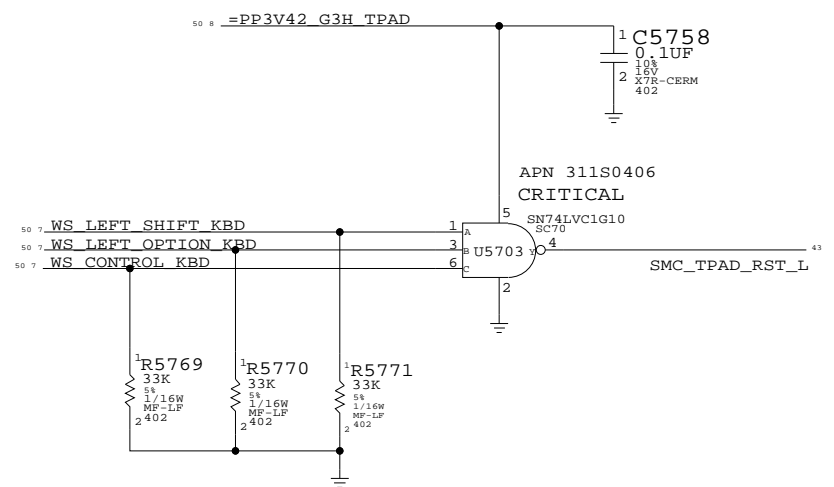
TPAD BUTTONS DISABLE



KEYBOARD CONNECTOR

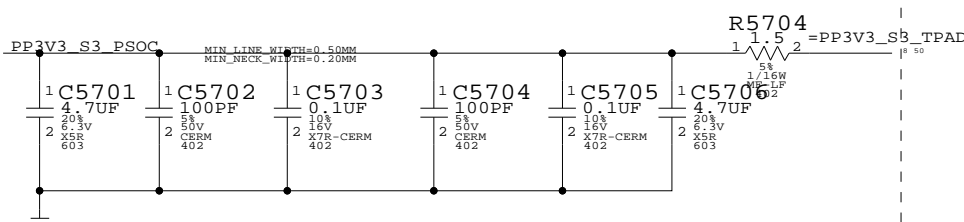


SMC_MANUAL_RESET LOGIC



U5701 CHIP DECOUPLING
PLACE C5701, C5702 & C5703
CLOSE TO U5701VDD PIN 22

PLACE C5704, C5705 & C5706
CLOSE TO U5701VDD PIN 49



WELLSPRING 1
SYNC_MASTER=AMASON_M9SYNCDATE=06/18/2008

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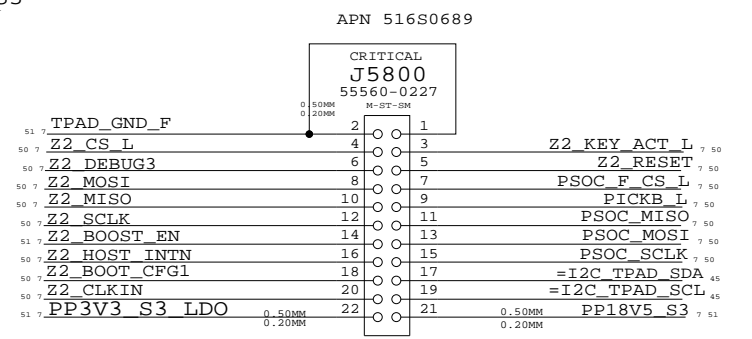
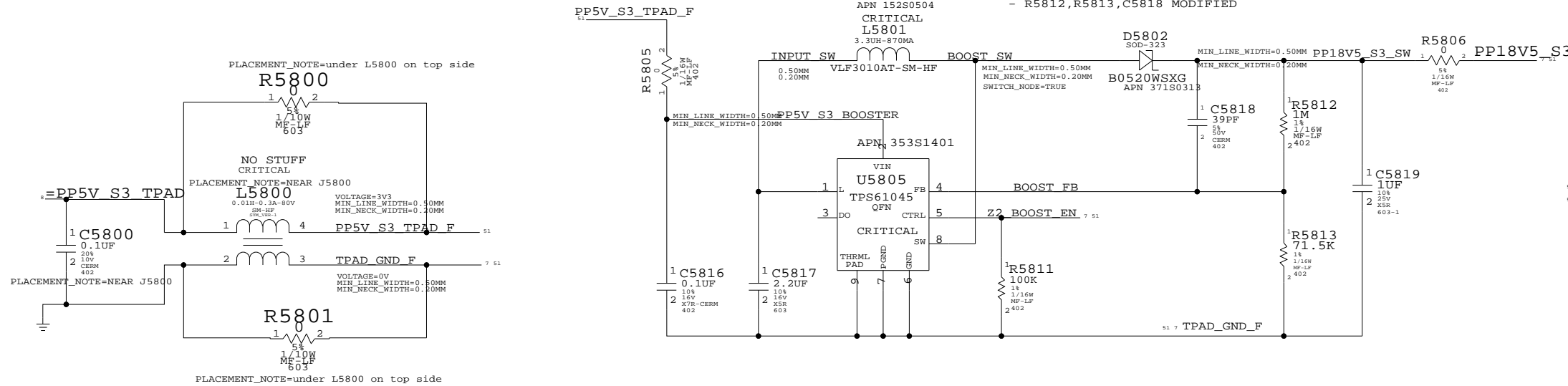
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|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | 96 |
| NONE | 50 | | |

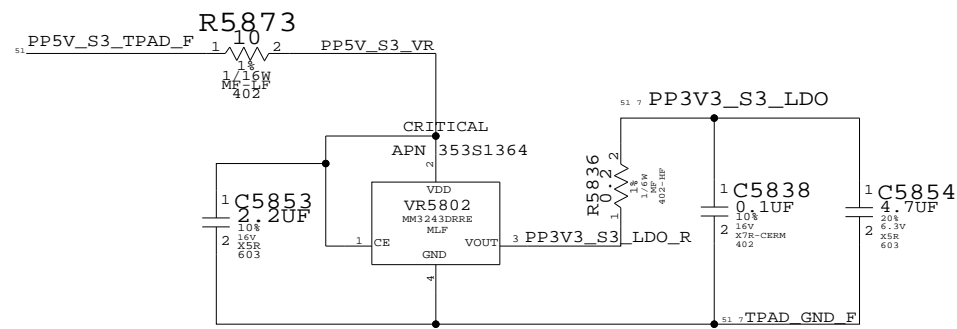
BOOSTER +18.5VDC FOR SENSORS

- BOOSTER DESIGN CONSIDERATION:
- POWER CONSUMPTION
 - DROOP LINE REGULATION
 - RIPPLE TO MEET ERS
 - 100-300 KHZ CLEAN SPECTRUM
 - STARTUP TIME LESS THAN 2MS
 - R5812,R5813,C5818 MODIFIED

IPD FLEX CONNECTOR

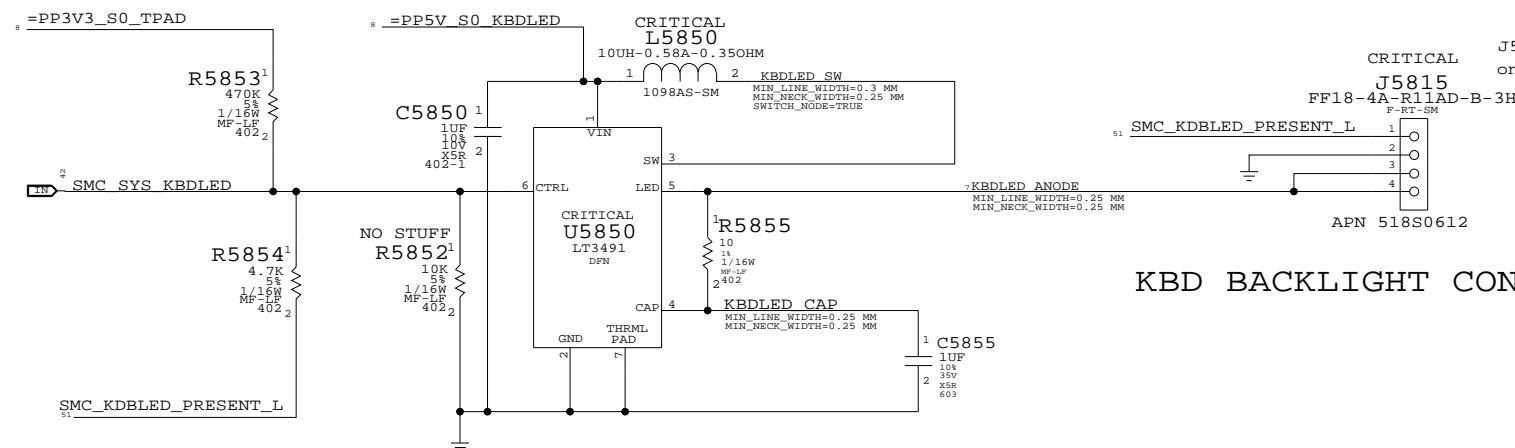


3V3 LDO FOR IPD



Keyboard LED Driver

To detect Keyboard backlight, SMC will tristate SMC_SYS_KBDLED:
 LOW = keyboard backlight present
 HIGH= keyboard backlight not present
 BOM OPTION: KBDLED_YES
 R5853 ALWAYS PRESENT

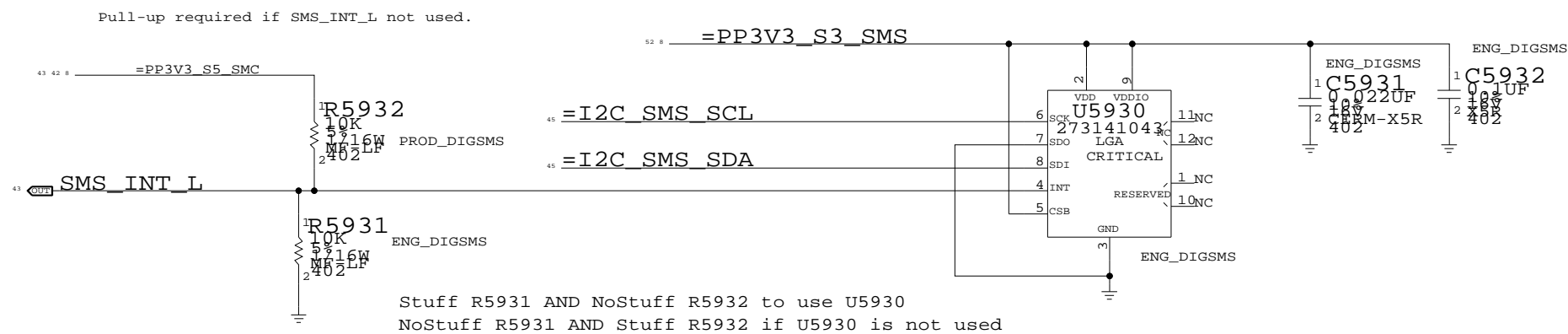


KBD BACKLIGHT CONNECTOR

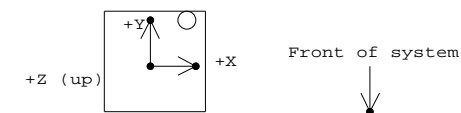
WELLSPRING 2
 SYNC_MASTER=PWRSONC SYNC_DATE=05/12/2008
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|------------|-------|------|----------------|----------|------|-------|
| APPLE INC. | SIZE | D | DRAWING NUMBER | 051-7546 | REV. | A.0.0 |
| | SCALE | NONE | SHT | 51 | OF | 96 |

Digital SMS



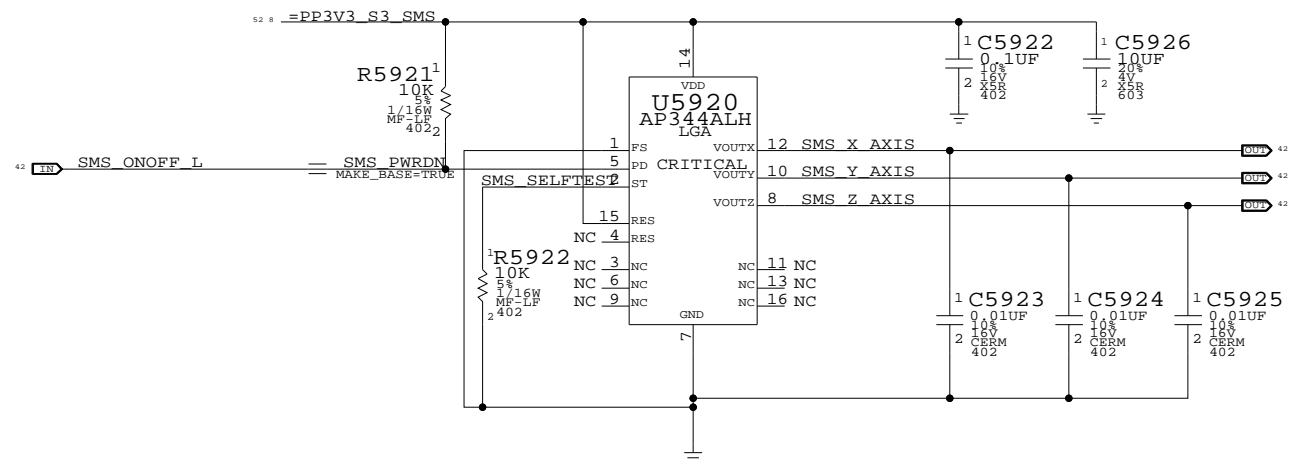
Desired orientation when placed on board top-side:



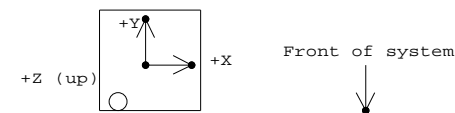
Circle indicates pin 1 location when placed in correct orientation

Analog SMS

R5921 PULLS UP SMS_PWRDN TO TURN OFF SMS WHEN PIN IS NOT BEING DRIVEN BY SMC



Desired orientation when placed on board top-side:



Circle indicates pin 1 location when placed in correct orientation

Sudden Motion Sensor (SMS)

SYNC_MASTER=SENSOR SYNC_DATE=08/14/2008

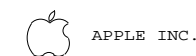
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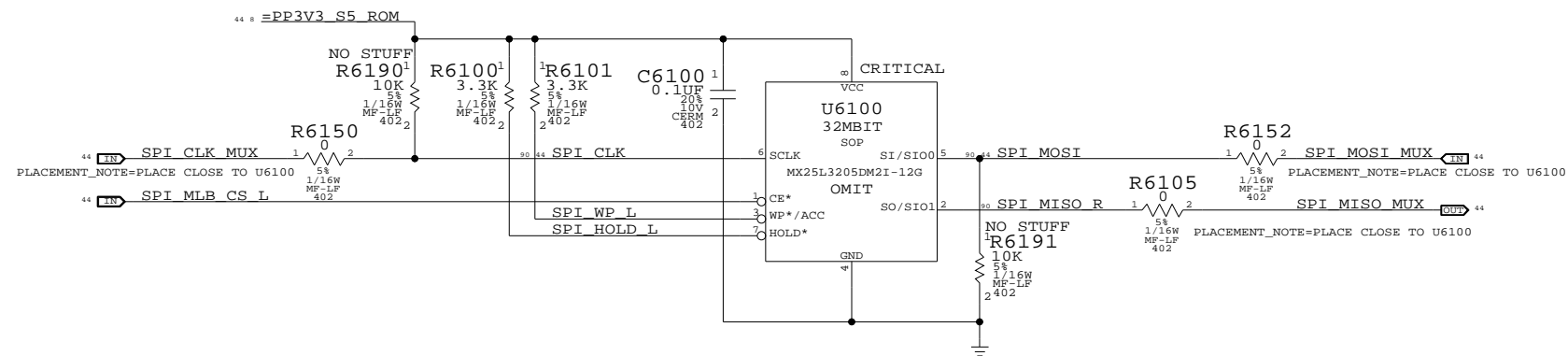
APPLE INC.

SIZE DRAWING NUMBER REV.

D 051-7546 A.0.0

SCALE SHEET OF

NONE 52 OF 96



| MCP79 SPI Frequency Select | | |
|----------------------------|----------|---------|
| Frequency | SPI_MOSI | SPI_CLK |
| 31 MHz | 0 | 0 |
| 42 MHz | 0 | 1 |
| 25 MHz | 1 | 0 |
| 1 MHz | 1 | 1 |

25MHz is selected with R5190 and R5191
 Any of the 4 frequencies can be selected
 with R6190, R6191, R5190 and R5191

SPI ROM

SYNC_MASTER=CHANG_M98_MLB SYNC_DATE=07/01/2008

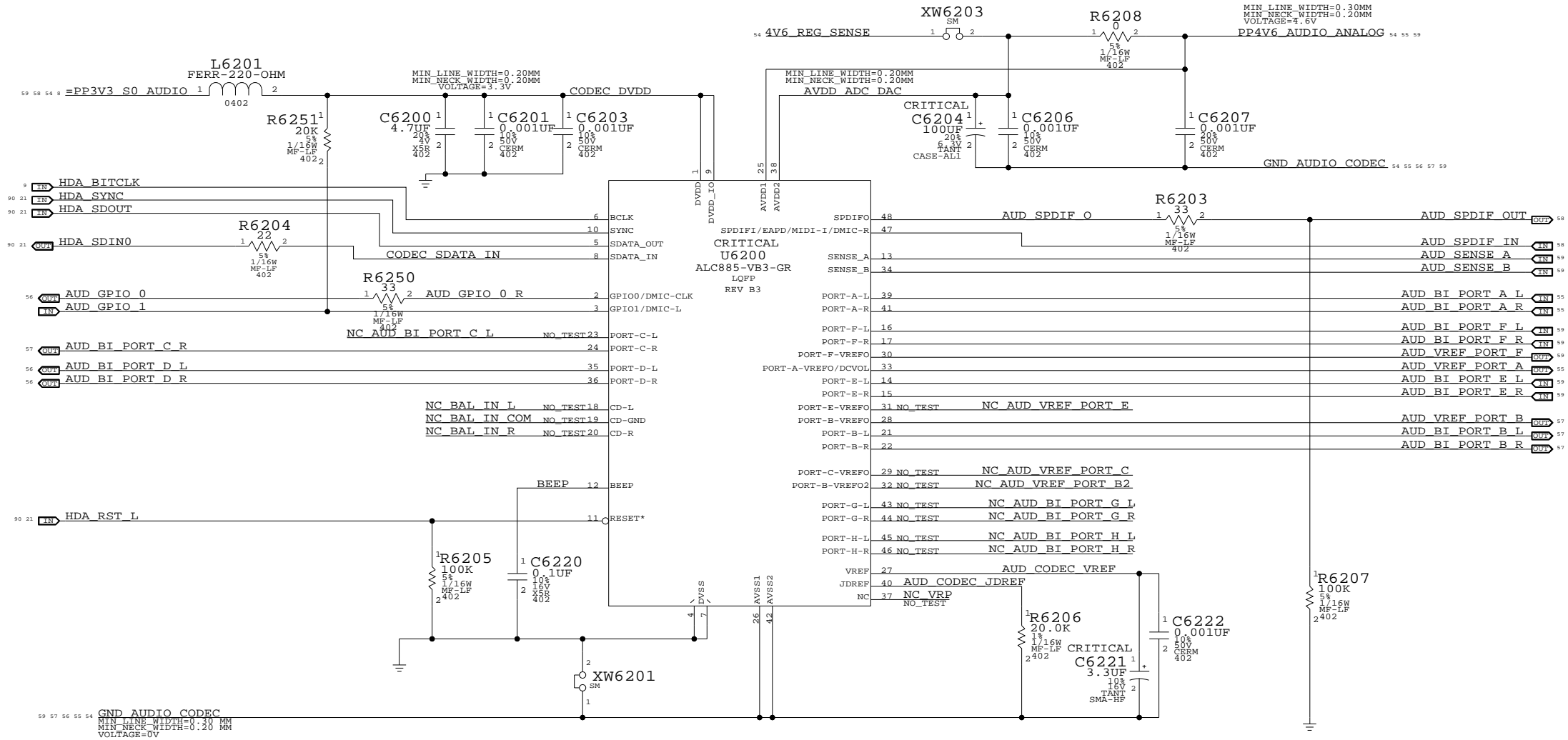
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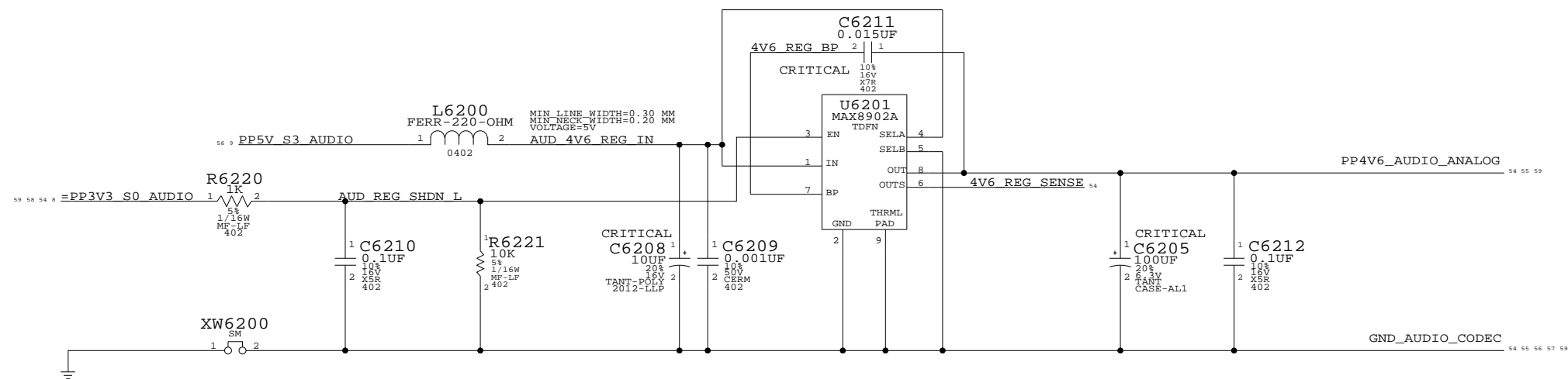
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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 53 | 96 | |

AUDIO CODEC
APPLE P/N 353S1527



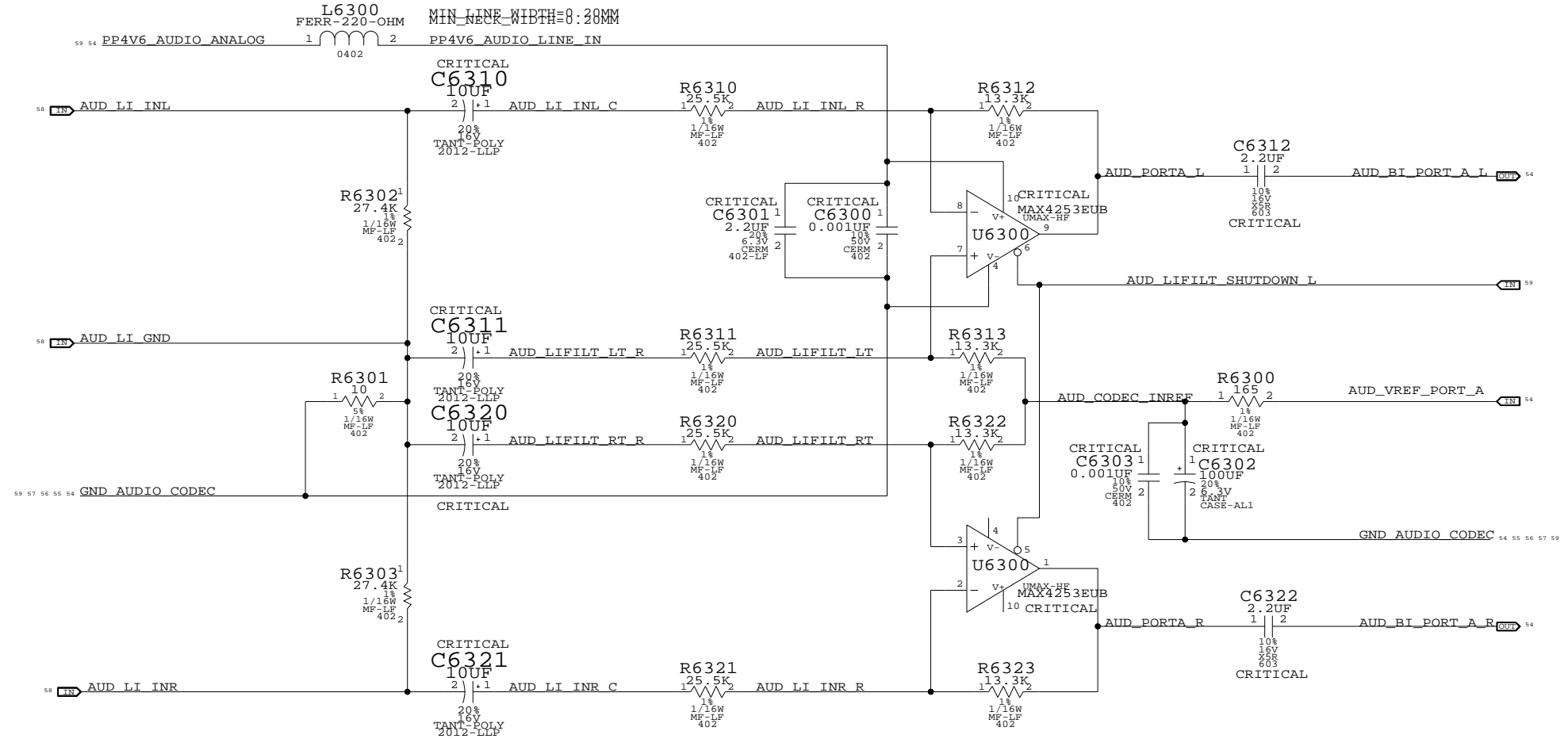
AUDIO 4.6V REGULATOR
APPLE P/N 353S1897




AUDIO:CODEC
 SYNC_MASTER=AUDIO SYNC_DATE=07/09/2008
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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 54 | 96 | |

Pseudo-Diff Line-In Filter
 GAIN = -5.4DB AV = 0.52
 FC = 1.8 HZ

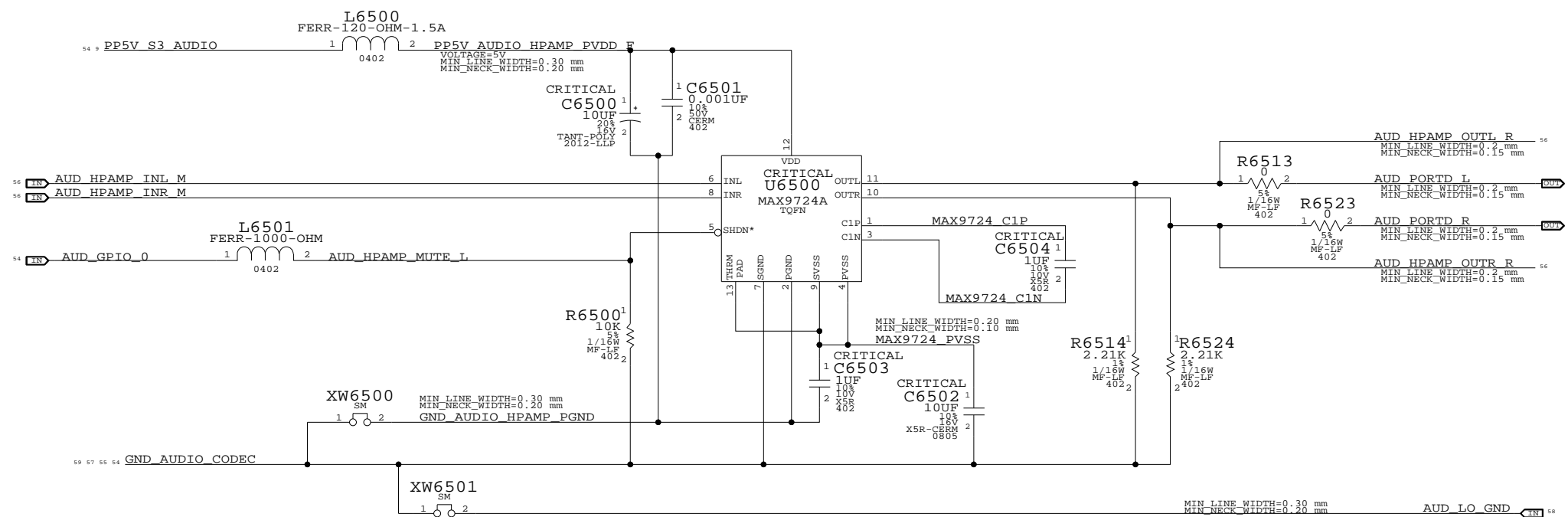


AUDIO: LINE IN
 SYNC_MASTER=AUDIO SYNC_DATE=07/09/2008
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|--|------|----------------|-------|
|  APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | |
| NONE | 55 | 96 | |

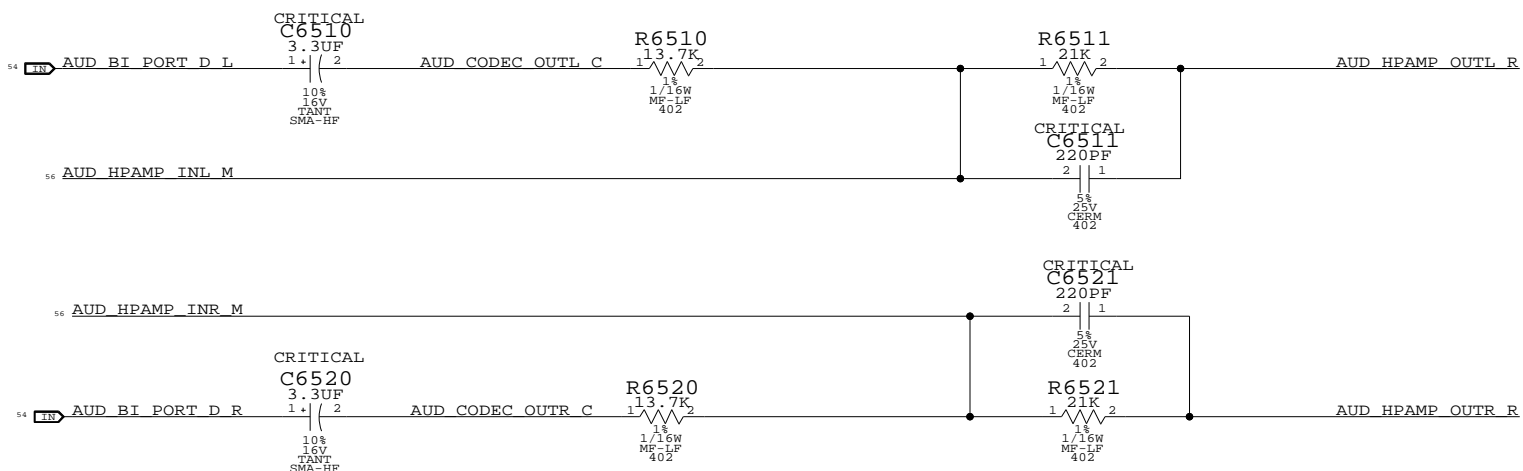
Headphone Amplifier (MAX9724A)

APN: 353S1637



1st Order DAC Filter

HP:3.52 HZ LP:34 KHZ
VOLTAGE GAIN:1.53



AUDIO: HEADPHONE AMP

SYNC_MASTER=AUDIO SYNC_DATE=07/09/2008

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|------------|------------------|----------------------------|---------------|
| APPLE INC. | SIZE D | DRAWING NUMBER 051-7546 | REV. A.0.0 |
| | SCALE NONE | SHT 56 | OF 96 |

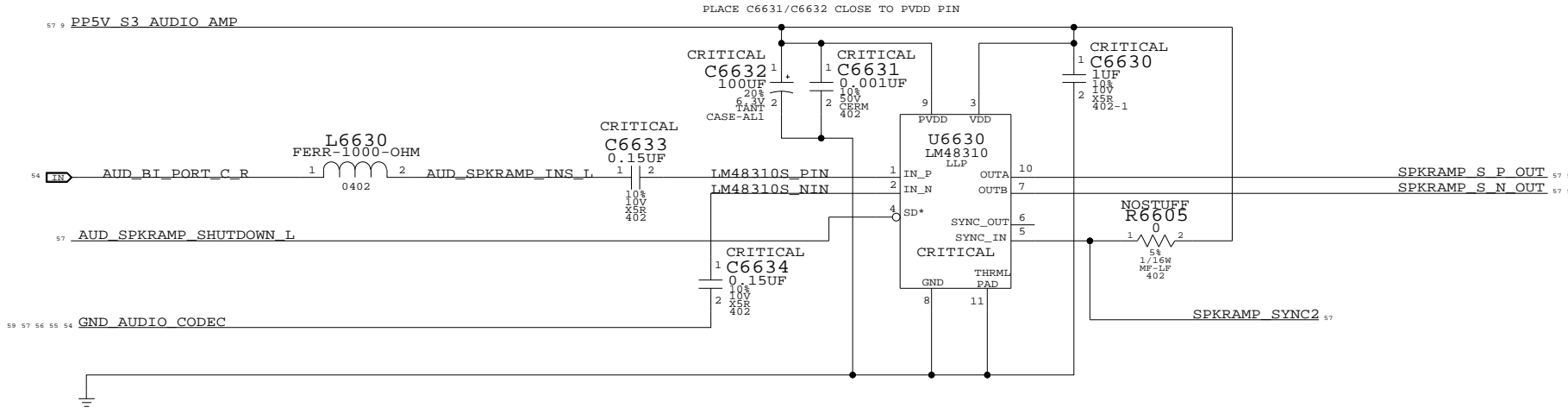
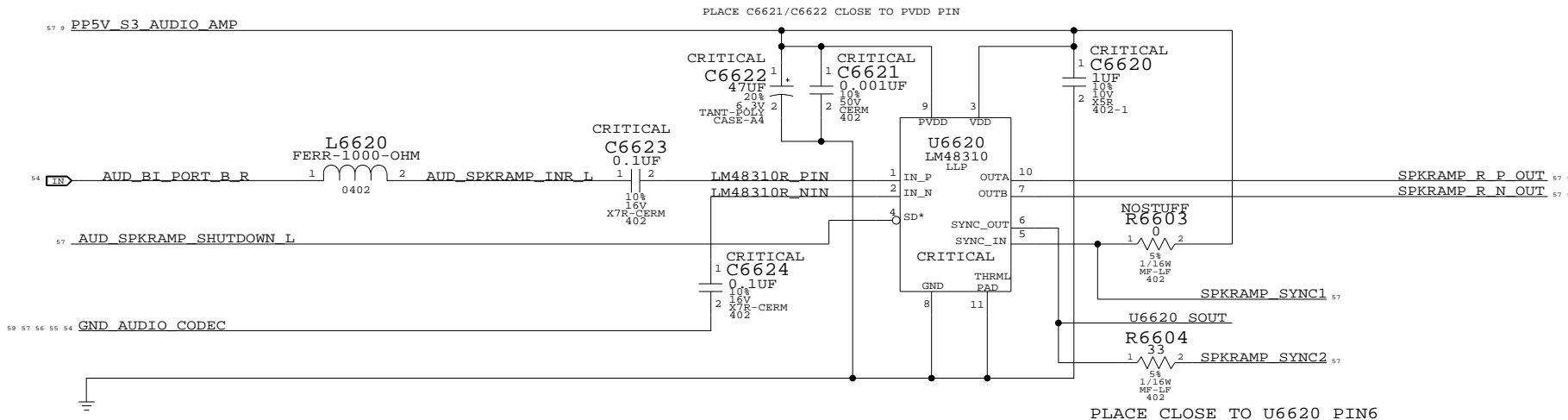
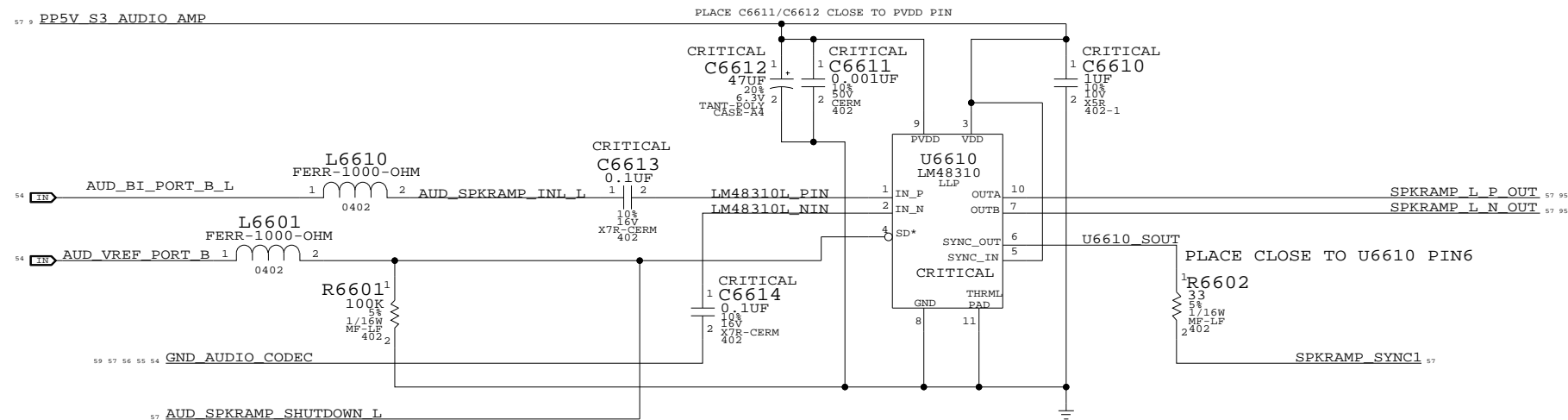
2X MONO SPEAKER AMPLIFIERS (LM48310)

APN: 353S1901

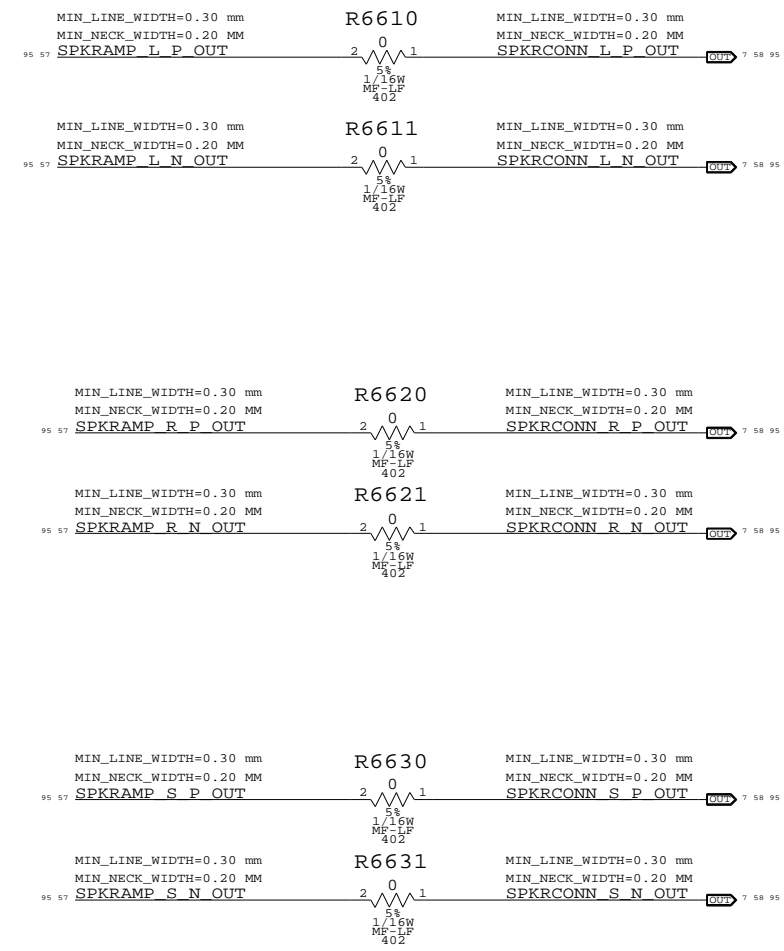
GAIN = 12DB

79Hz < FC (L&R) < 93Hz

53Hz < FC (SUB) < 62Hz



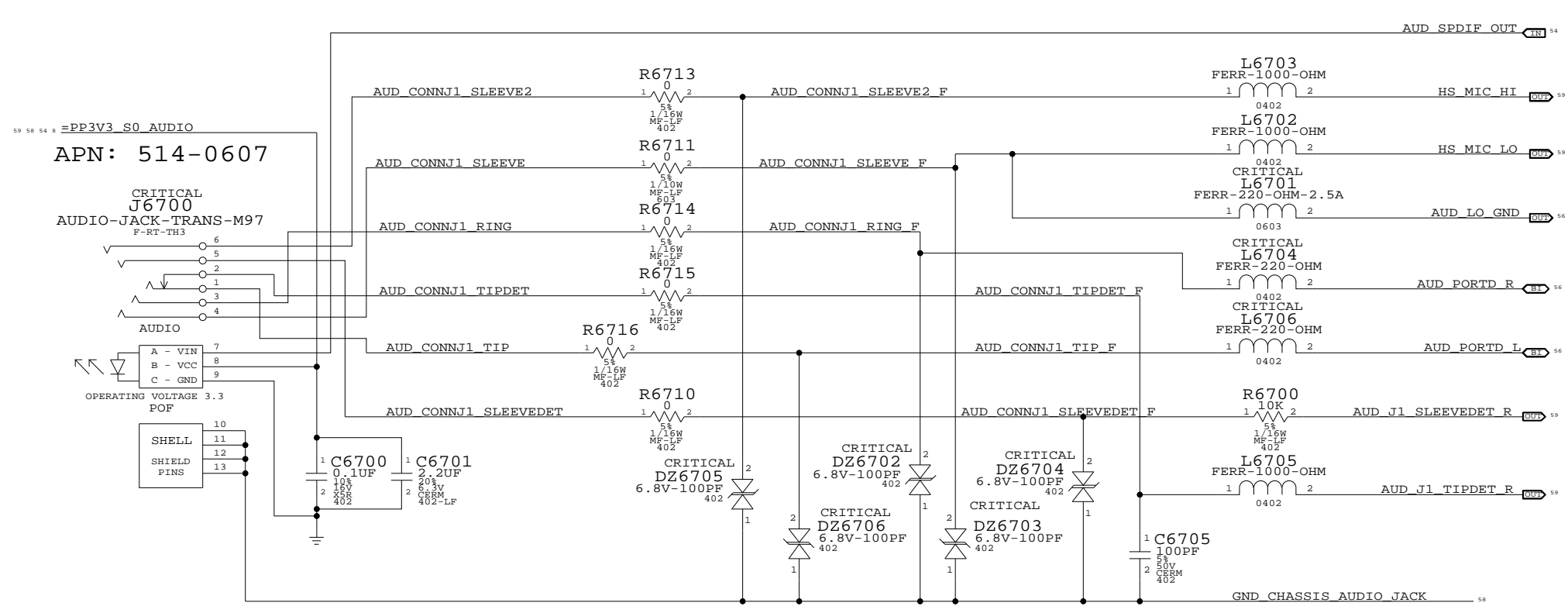
SPEAKER CHECKPOINTS



AUDIO: SPEAKER AMP
 SYNC_MASTER=AUDIO SYNC_DATE=07/09/2008
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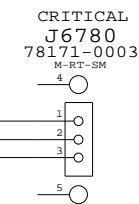
| | | | |
|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 57 | 96 | |

AUDIO JACK 1 LO/HP JACK, SPDIF TX



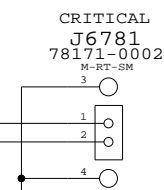
MIC CONNECTOR

APN: 518S0520

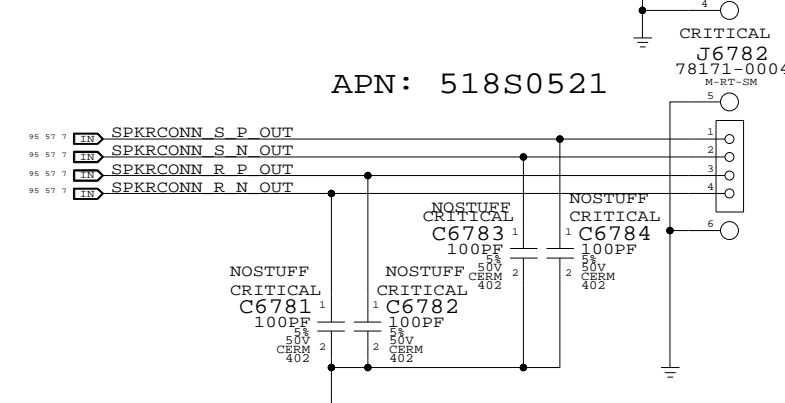


SPEAKER CONNECTOR

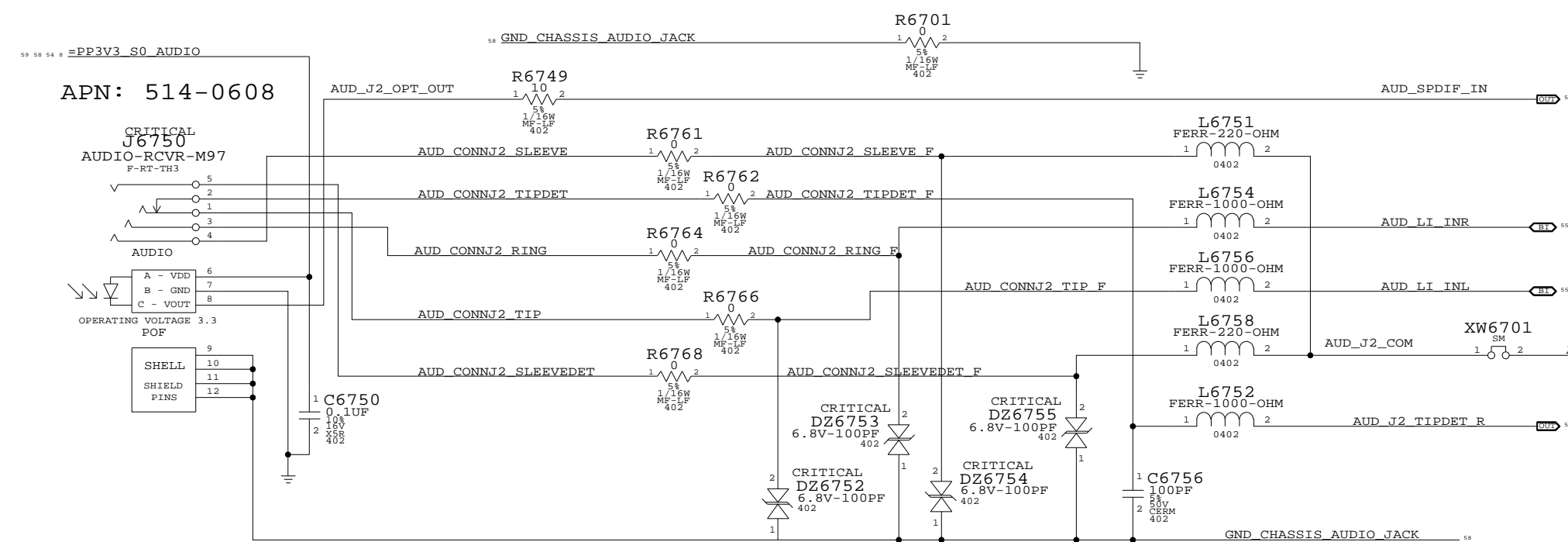
APN: 518S0519



APN: 518S0521



RETURN FOR HF NOISE



AUDIO JACK 2 LINE IN JACK, SPDIF RX

AUDIO: JACKS
 SYNC_MASTER=AUDIO SYNC_DATE=07/09/2008
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|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 58 | 96 | |

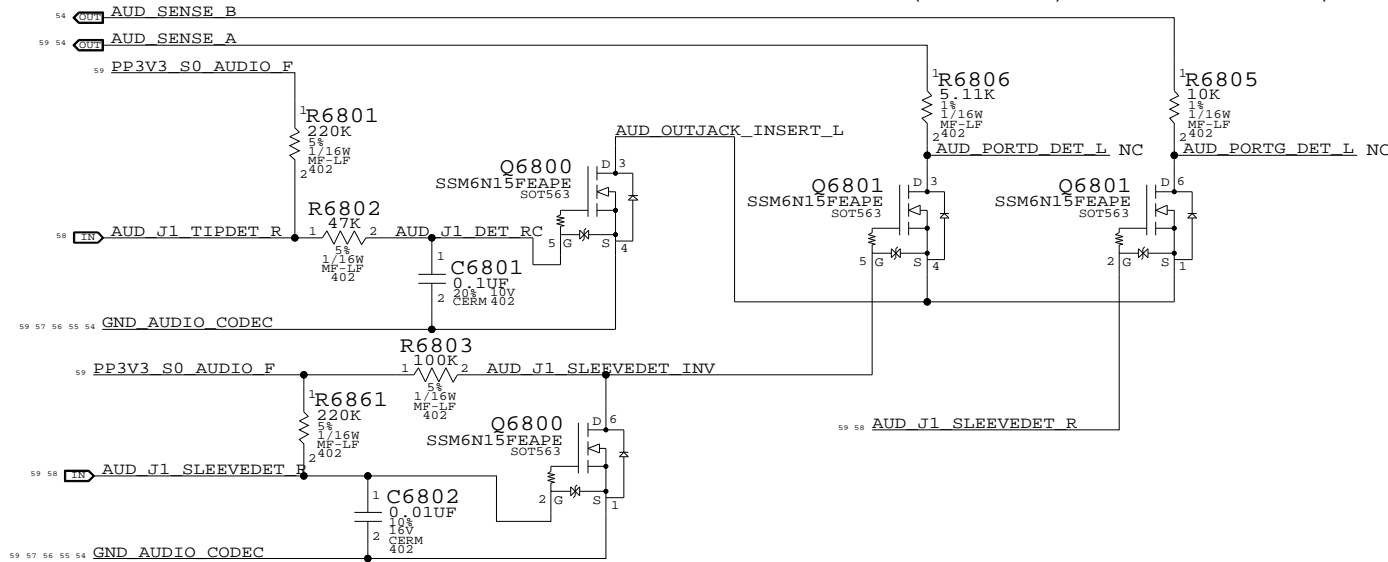
CODEC OUTPUT SIGNAL PATHS

| FUNCTION | VOLUME | CONVERTER | MIXER(OUTPUT) | PIN COMPLEX | MUTE CONTROL | DET ASSIGNMENT |
|-------------|-----------|-----------|---------------|------------------|---------------|----------------|
| HP/LINE OUT | 0X0C (12) | 0X02 (2) | 0X0C (12) | 0X14 (20,D) | GPIO_0 | 0X14 (20,D) |
| SATELLITES | 0X0D (13) | 0X03 (3) | 0X0D (13) | 0X18 (24,B) | VREF_B (100%) | N/A |
| SUB | 0X0F (15) | 0X05 (05) | 0X0F (15) | 0X1A (26,C) | VREF_B (100%) | N/A |
| SPDIF OUT | N/A | 0X06 (6) | | 0x1E (SPDIF OUT) | N/A | 0X16 (22,G) |

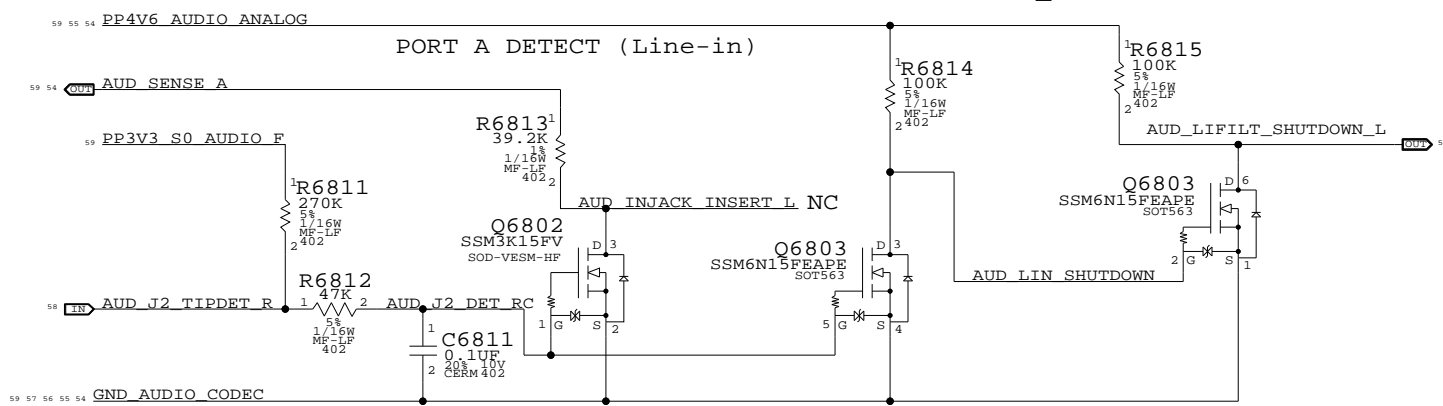
CODEC INPUT SIGNAL PATHS

| FUNCTION | MIXER(INPUT) | CONVERTER | PIN COMPLEX | VREF | DET ASSIGNMENT |
|--------------|--------------|-----------|-----------------|---------------|----------------|
| LINE IN | 0X23 (35) | 0X08 (8) | 0X15 (21,A) | VREF_A (50%) | 0X15 (21,A) |
| SPDIF IN | N/A | 0X0A (10) | 0x1F (SPDIF IN) | N/A | N/A |
| BUILT-IN MIC | 0X24 (36) | 0X07 (7) | 0X19 (25,F) | VREF_F (100%) | N/A |
| HEADSET MIC | 0X24 (36) | 0X07 (7) | 0X1B (27,E) | MIKEY | MIKEY |

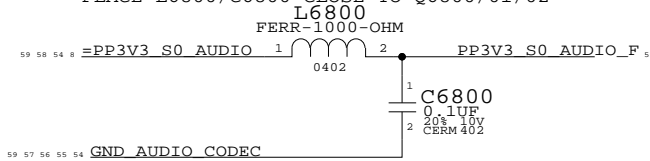
PORT D DETECT (Line-out) PORT G DETECT (SPDIF DELEGATE)



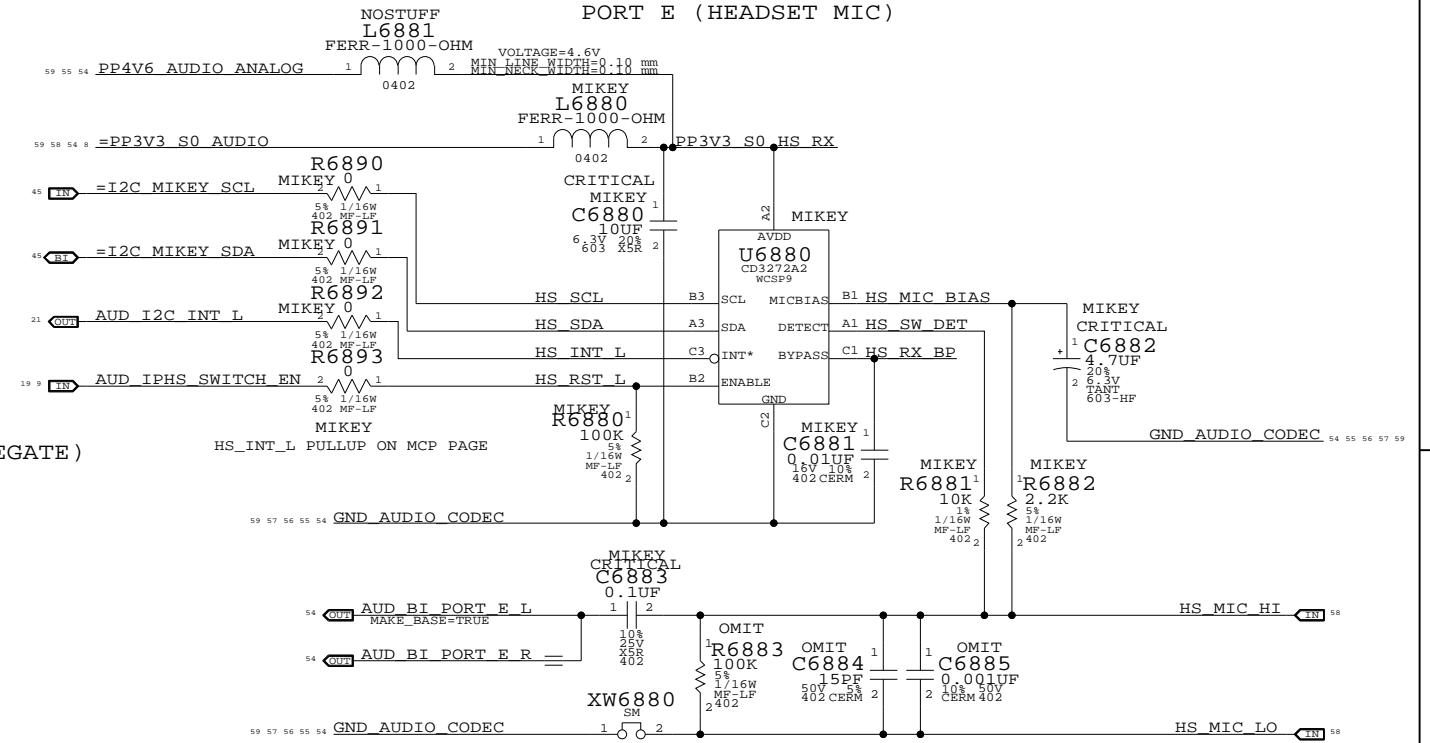
LINE_IN AMP SHUTDOWN CONTROL



PLACE L6800/C6800 CLOSE TO Q6800/01/02

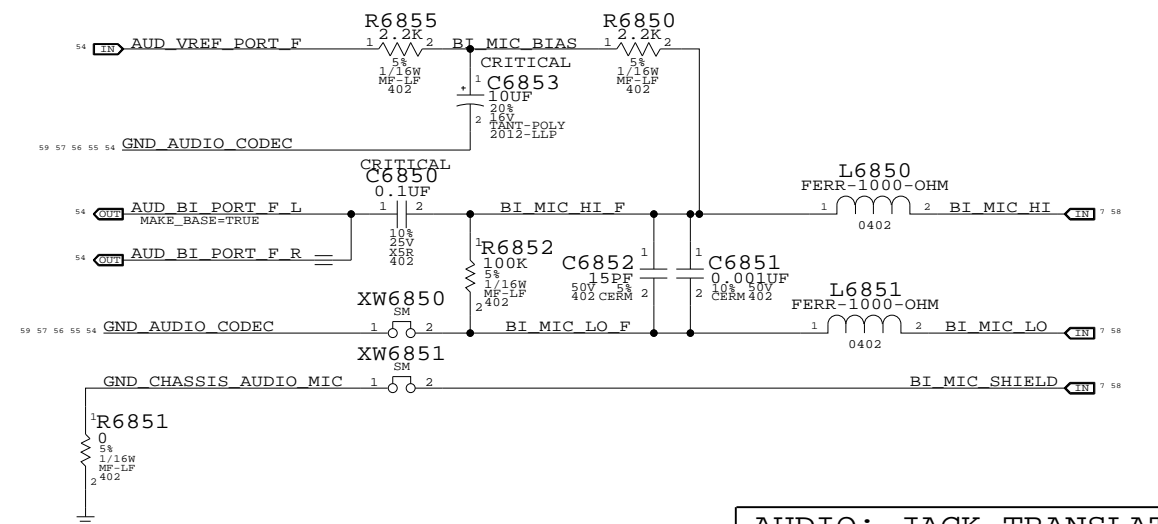


PORT E (HEADSET MIC)



| PART# | QTY | DESCRIPTION | REFERENCE DESIGNATOR(S) | BOM OPTION |
|----------|-----|--------------------------|-------------------------|------------|
| 116S0114 | 1 | 100K 5% 0402 RESISTOR | R6883 | MIKEY |
| 131S1513 | 1 | 15PF 5% 0402 CAPACITOR | C6884 | MIKEY |
| 132S0045 | 1 | 100PF 10% 0402 CAPACITOR | C6885 | MIKEY |
| 116S0004 | 1 | 0 OHMS 5% 0402 RESISTOR | R6883 | NOMIKEY |
| 116S0004 | 1 | 0 OHMS 5% 0402 RESISTOR | C6884 | NOMIKEY |
| 116S0004 | 1 | 0 OHMS 5% 0402 RESISTOR | C6885 | NOMIKEY |

PORT F (BUILT-IN MIC)



AUDIO: JACK TRANSLATORS

SYNC_MASTER=AUDIO SYNC_DATE=07/09/2008

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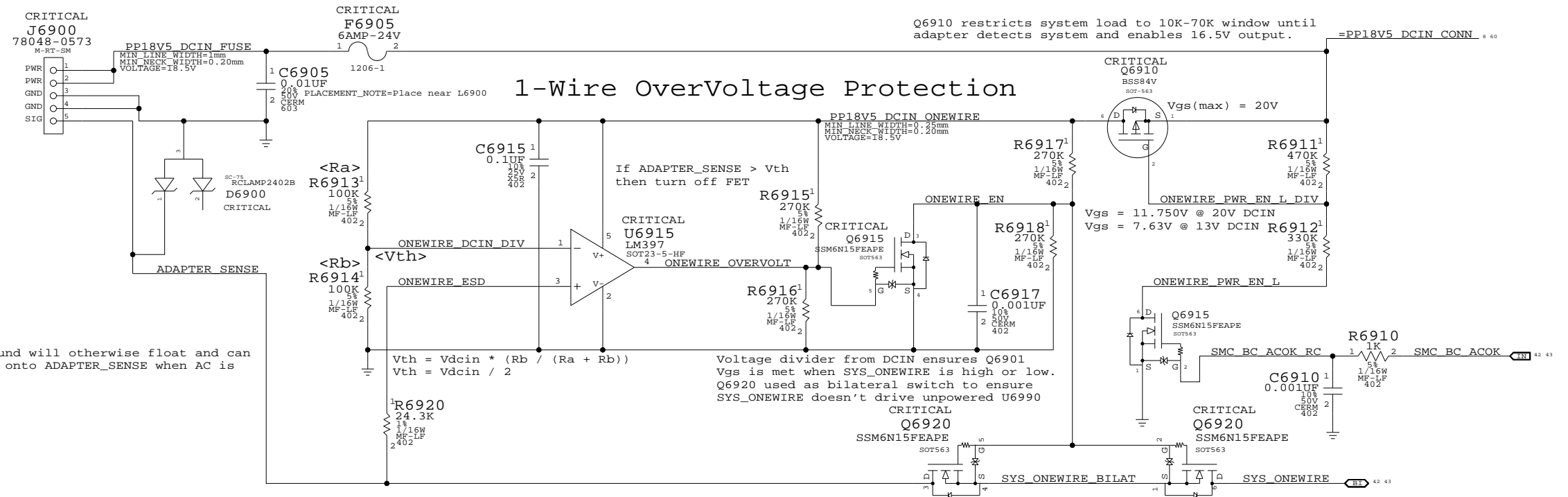
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| SIZE | DRAWING NUMBER | REV. |
|-------|----------------|-------|
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 59 | 96 |

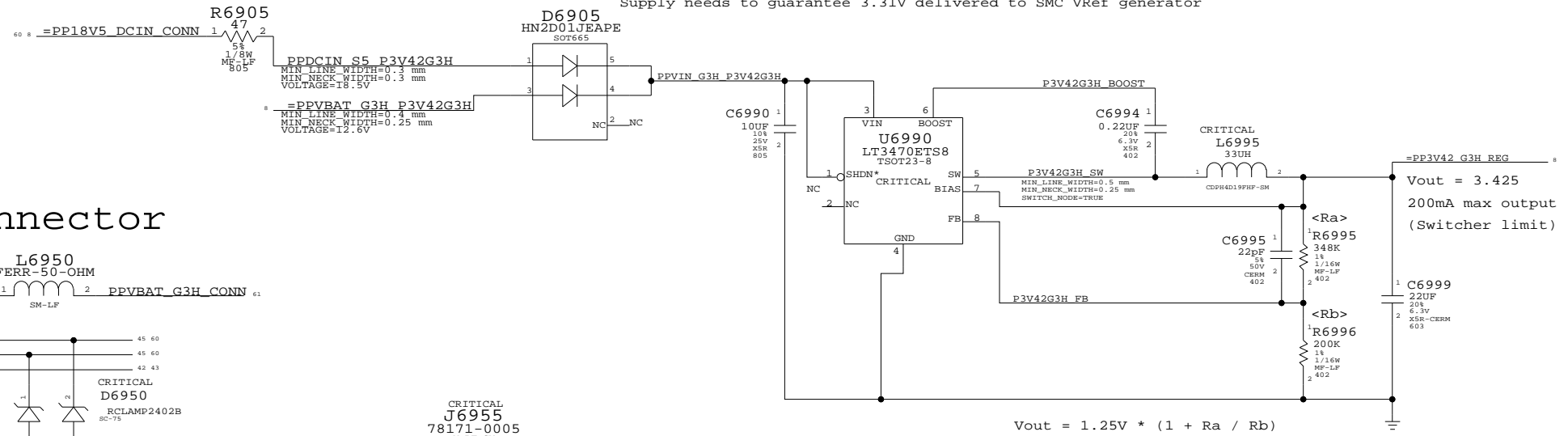
MagSafe DC Power Jack



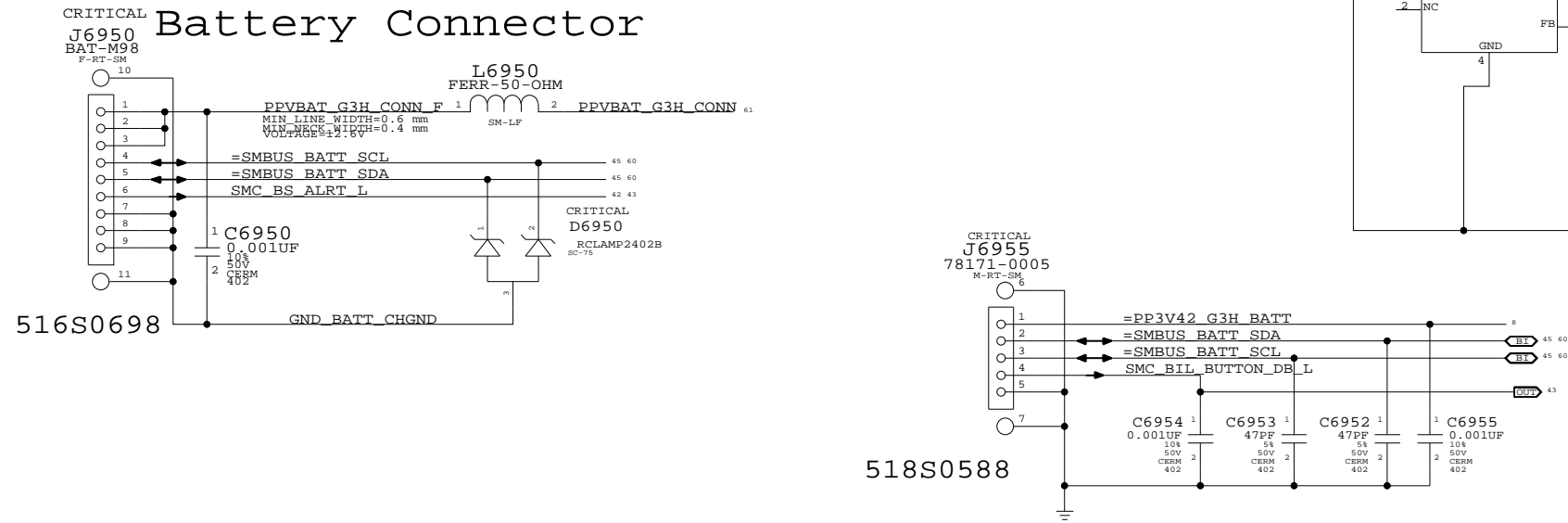
The chassis ground will otherwise float and can send transients onto ADAPTER_SENSE when AC is connected.

3.425V "G3Hot" Supply

Supply needs to guarantee 3.31V delivered to SMC Vref generator



Battery Connector



DC-In & Battery Connectors

SYNC_MASTER=T18_MLB SYNC_DATE=12/06/2007

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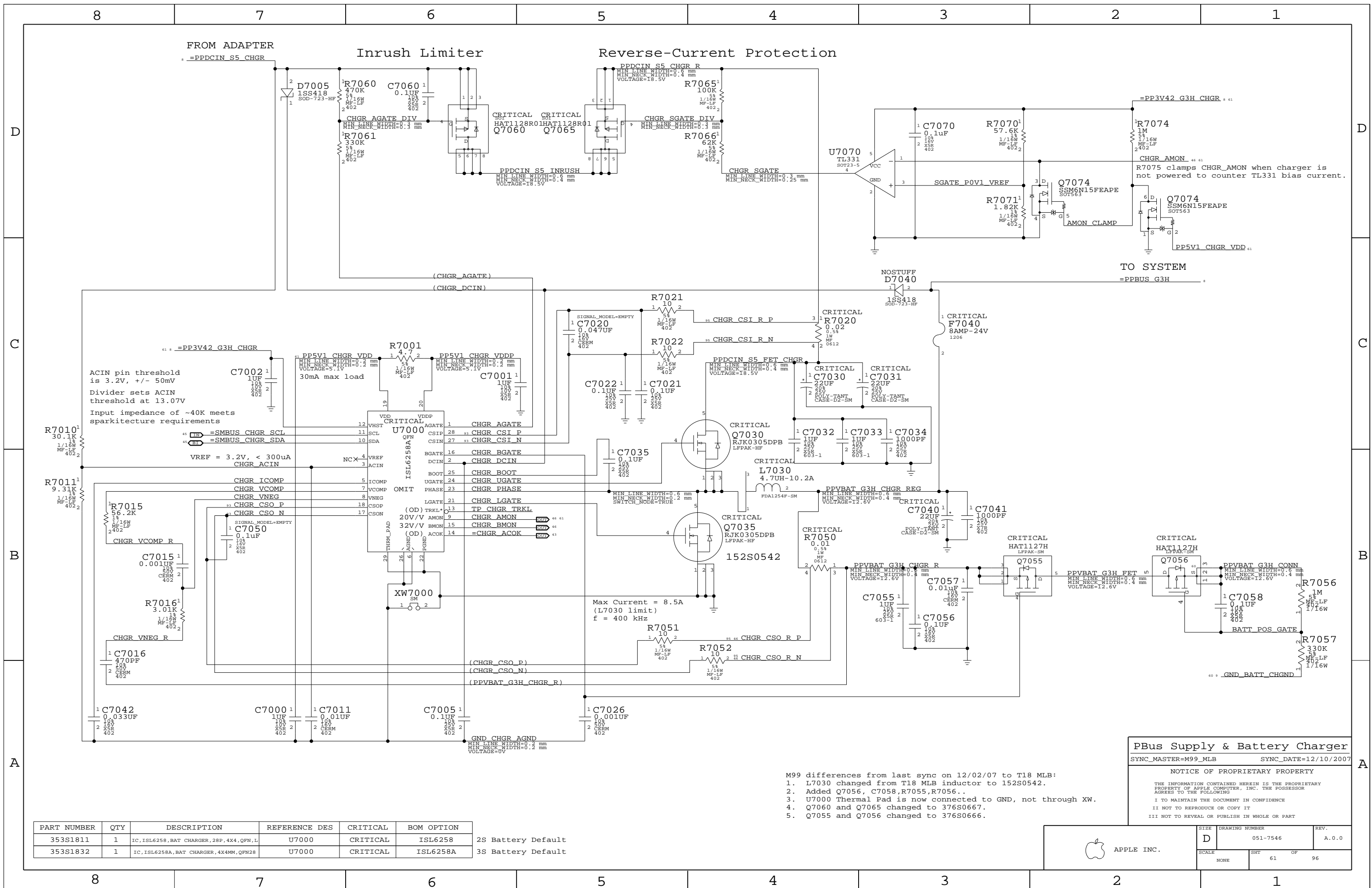
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|------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |

| | | |
|-------|-----|----|
| SCALE | SHT | OF |
| NONE | 60 | 96 |



ACIN pin threshold is 3.2V, +/- 50mV
 Divider sets ACIN threshold at 13.07V
 Input impedance of ~40K meets sparkignition requirements

Max Current = 8.5A (L7030 limit)
 f = 400 kHz

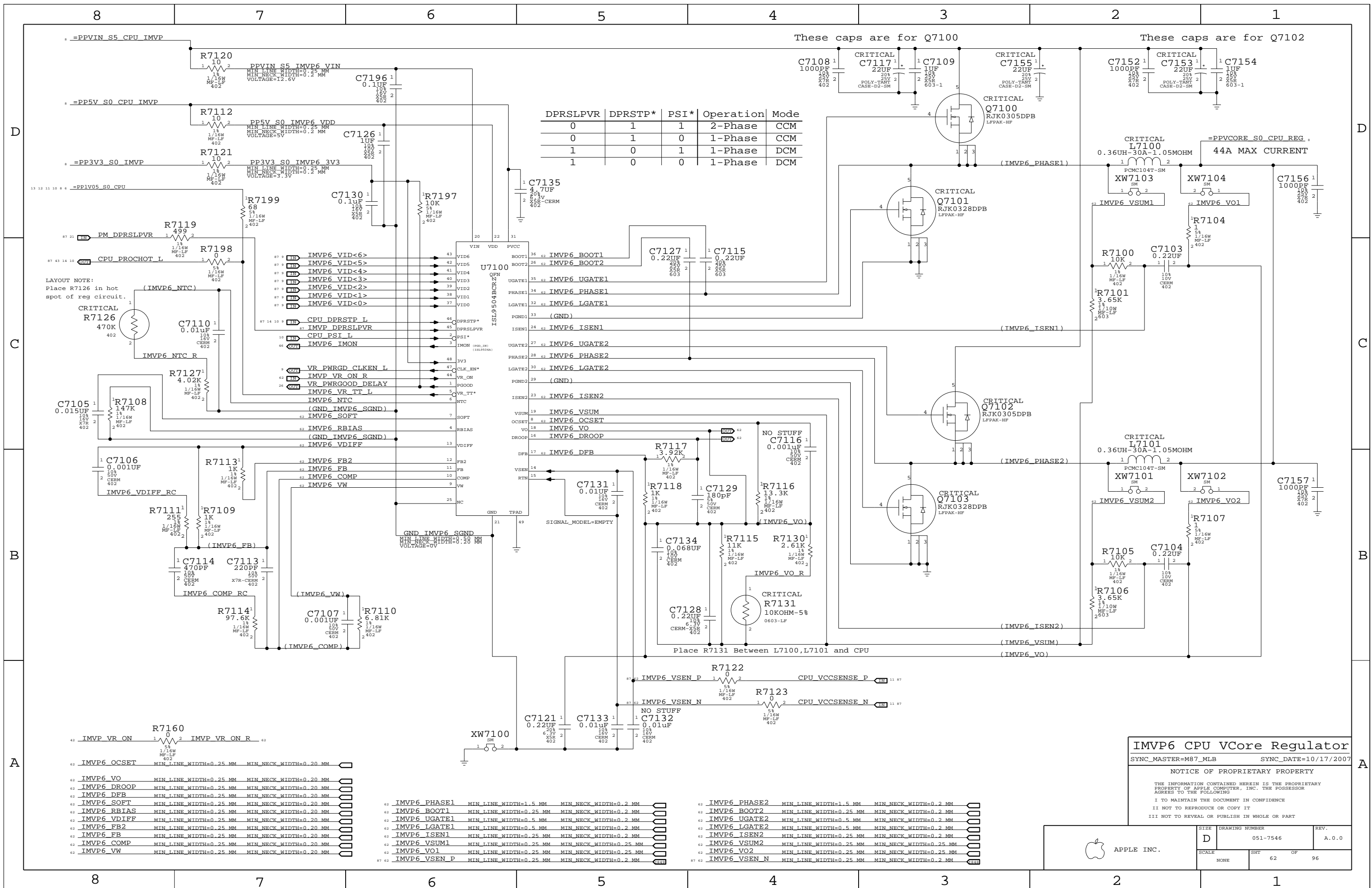
PBus Supply & Battery Charger
 SYNC_MASTER=M99_MLB SYNC_DATE=12/10/2007

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- M99 differences from last sync on 12/02/07 to T18 MLB:
- L7030 changed from T18 MLB inductor to 152S0542.
 - Added Q7056, C7058, R7055, R7056.
 - U7000 Thermal Pad is now connected to GND, not through XW.
 - Q7060 and Q7065 changed to 376S0667.
 - Q7055 and Q7056 changed to 376S0666.

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|--|---------------|----------|--------------------|
| 353S1811 | 1 | IC, ISL6258, BAT CHARGER, 28P, 4X4, QFN, L | U7000 | CRITICAL | 2S Battery Default |
| 353S1832 | 1 | IC, ISL6258A, BAT CHARGER, 4X4MM, QFN28 | U7000 | CRITICAL | 3S Battery Default |

| | |
|------------|--|
| APPLE INC. | SIZE: D DRAWING NUMBER: 051-7546 REV.: A.0.0 |
| | SCALE: NONE SHEET: 61 OF 96 |



| DPRSLPVR | DPRSTP* | PSI* | Operation | Mode |
|----------|---------|------|-----------|------|
| 0 | 1 | 1 | 2-Phase | CCM |
| 0 | 1 | 0 | 1-Phase | CCM |
| 1 | 0 | 1 | 1-Phase | DCM |
| 1 | 0 | 0 | 1-Phase | DCM |

PPVIN_S5_CPU_IMVP
 PP5V_S0_CPU_IMVP
 PP3V3_S0_IMVP
 PP1V05_S0_CPU

LAYOUT NOTE:
 Place R7126 in hot spot of reg circuit.

Place R7131 Between L7100, L7101 and CPU

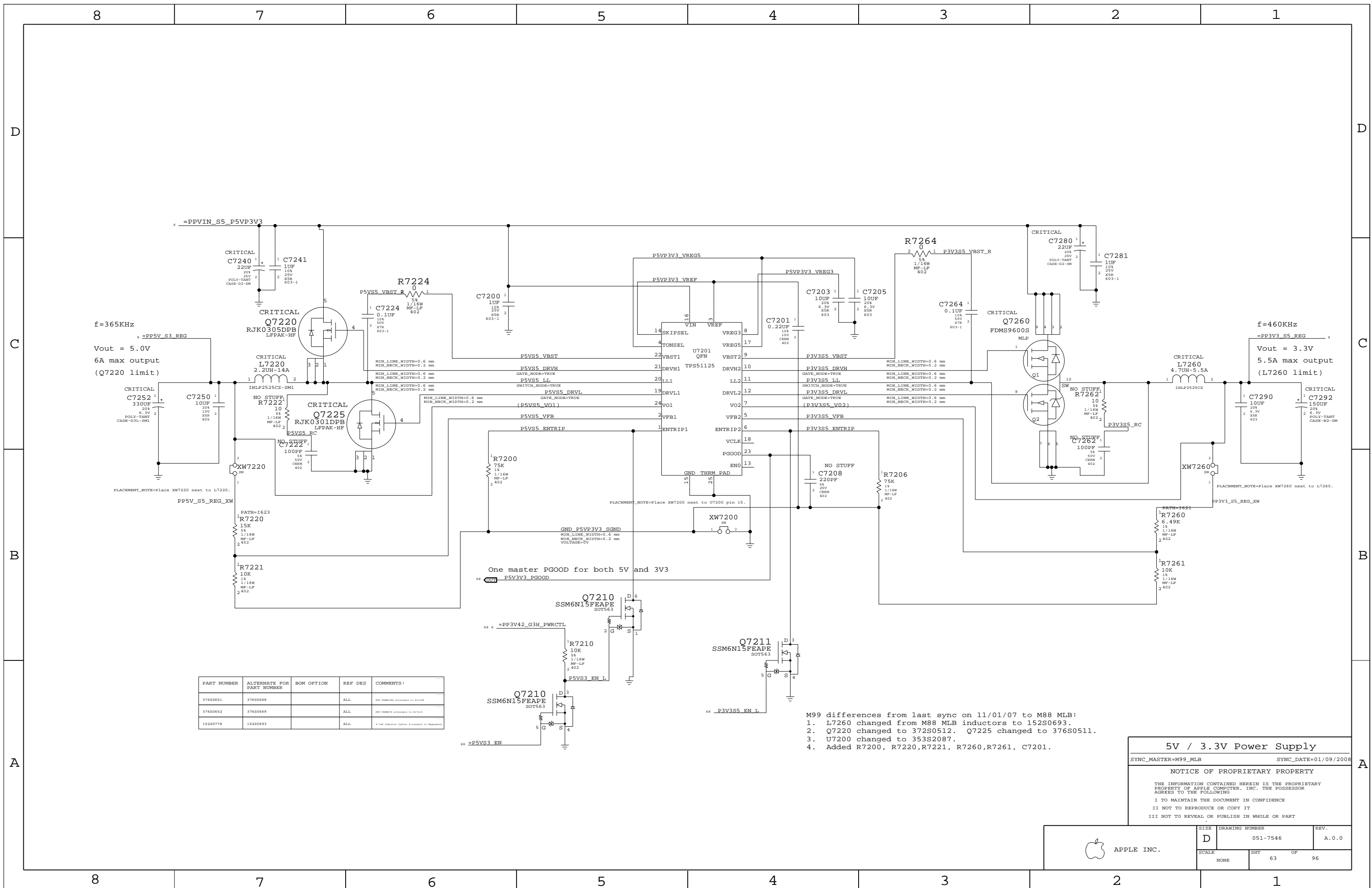
- IMVP VR_ON
- IMVP6_OCSET
- IMVP6_VO
- IMVP6_DROOP
- IMVP6_DFB
- IMVP6_SOFT
- IMVP6_RBIAS
- IMVP6_VDIFF
- IMVP6_FB2
- IMVP6_FB
- IMVP6_COMP
- IMVP6_VW
- IMVP6_PHASE1
- IMVP6_BOOT1
- IMVP6_UGATE1
- IMVP6_LGATE1
- IMVP6_ISEN1
- IMVP6_VSUM1
- IMVP6_VO1
- IMVP6_VSEN_P

- IMVP6_PHASE2
- IMVP6_BOOT2
- IMVP6_UGATE2
- IMVP6_LGATE2
- IMVP6_ISEN2
- IMVP6_VSUM2
- IMVP6_VO2
- IMVP6_VSEN_N

IMVP6 CPU VCore Regulator
 SYNC_MASTER=M87_MLB SYNC_DATE=10/17/2007

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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHEET | OF | |
| NONE | 62 | 96 | |



f=365KHz
 =PP5V_S3_REG
 Vout = 5.0V
 6A max output
 (Q7220 limit)

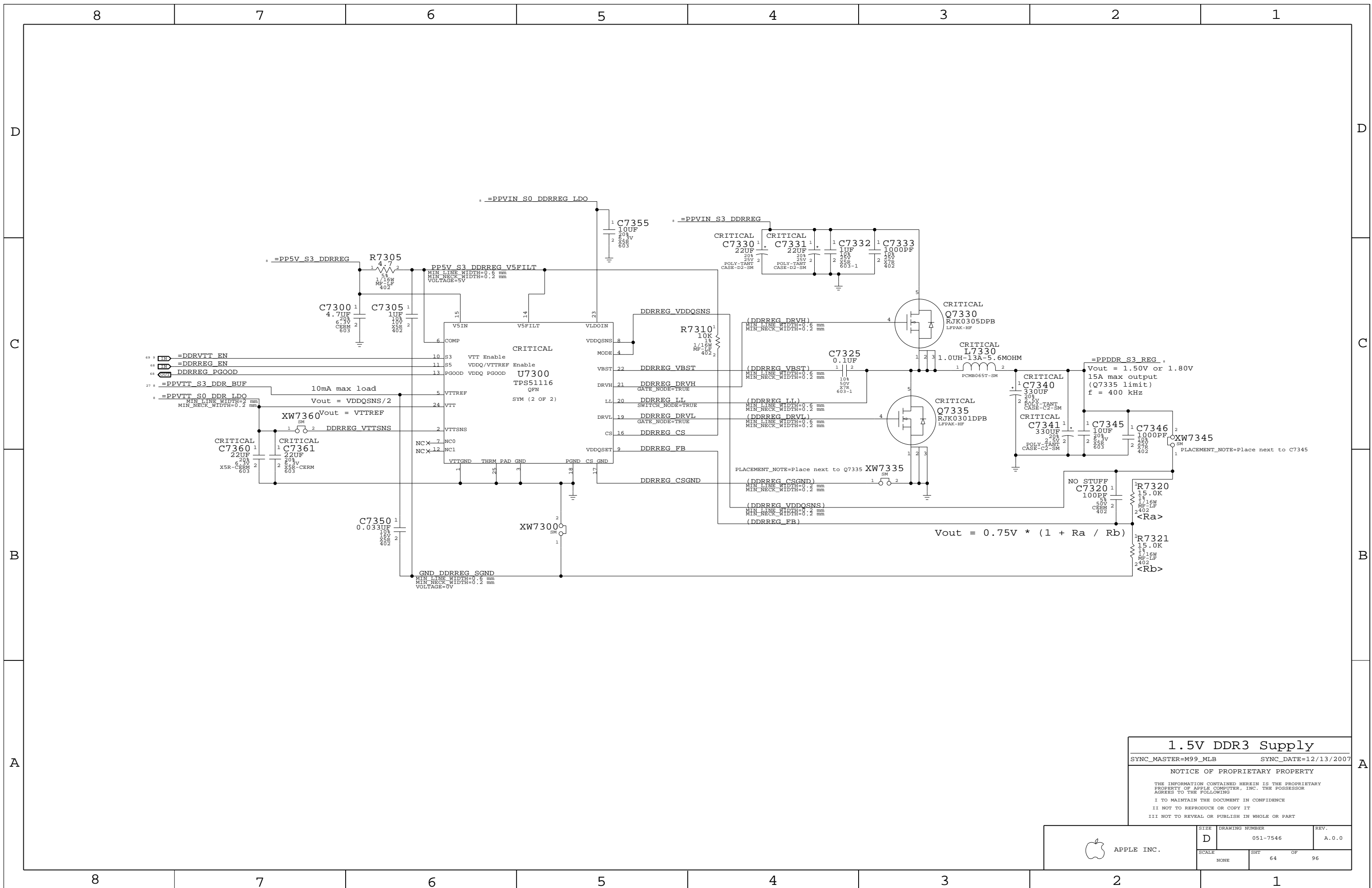
f=460KHz
 =PP3V3_S5_REG
 Vout = 3.3V
 5.5A max output
 (L7260 limit)

| PART NUMBER | ALTERNATE FOR PART NUMBER | BOM OPTION | REF DES | COMMENTS: |
|-------------|---------------------------|------------|---------|---|
| 37680651 | 37680668 | | ALL | NOT PERMITTED ASSOCIATION TO DESIGN |
| 37680652 | 37680669 | | ALL | NOT PERMITTED ASSOCIATION TO DESIGN |
| 15280778 | 15280693 | | ALL | 4-Tap Inductor Option associated to Regulator |

M99 differences from last sync on 11/01/07 to M88 MLB:
 1. L7260 changed from M88 MLB inductors to 152S0693.
 2. Q7220 changed to 372S0512. Q7225 changed to 376S0511.
 3. U7200 changed to 353S2087.
 4. Added R7200, R7220, R7221, R7260, R7261, C7201.

5V / 3.3V Power Supply
 SYNC_MASTER=M99_MLB SYNC_DATE=01/09/2008
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| | | | |
|------------|------------------|----------------------------|---------------|
| APPLE INC. | SIZE D | DRAWING NUMBER 051-7546 | REV. A.0.0 |
| | SCALE NONE | SHEET 63 | OF 96 |



1.5V DDR3 Supply

SYNC_MASTER=M99_MLB SYNC_DATE=12/13/2007

NOTICE OF PROPRIETARY PROPERTY

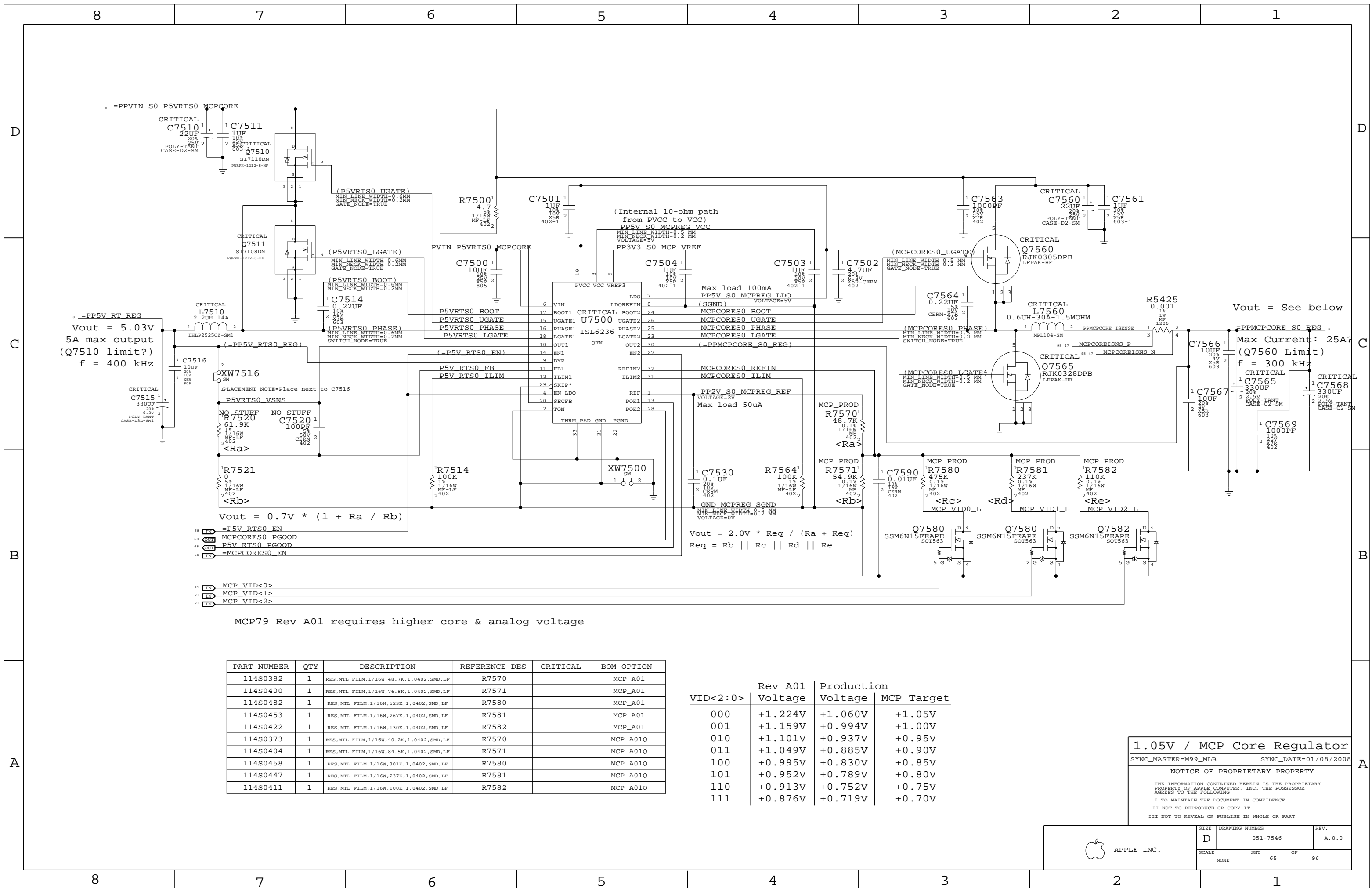
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|---|---|----------------|----------------|------|------|----------|-------|--|
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| | SIZE | DRAWING NUMBER | REV. | | | | | |
| D | 051-7546 | A.0.0 | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">SCALE</td> <td style="text-align: center;">SHT</td> <td style="text-align: center;">OF</td> <td style="text-align: center;">96</td> </tr> <tr> <td style="text-align: center;">NONE</td> <td style="text-align: center;">64</td> <td style="text-align: center;"></td> <td style="text-align: center;"></td> </tr> </table> | SCALE | SHT | OF | 96 | NONE | 64 | | |
| SCALE | SHT | OF | 96 | | | | | |
| NONE | 64 | | | | | | | |



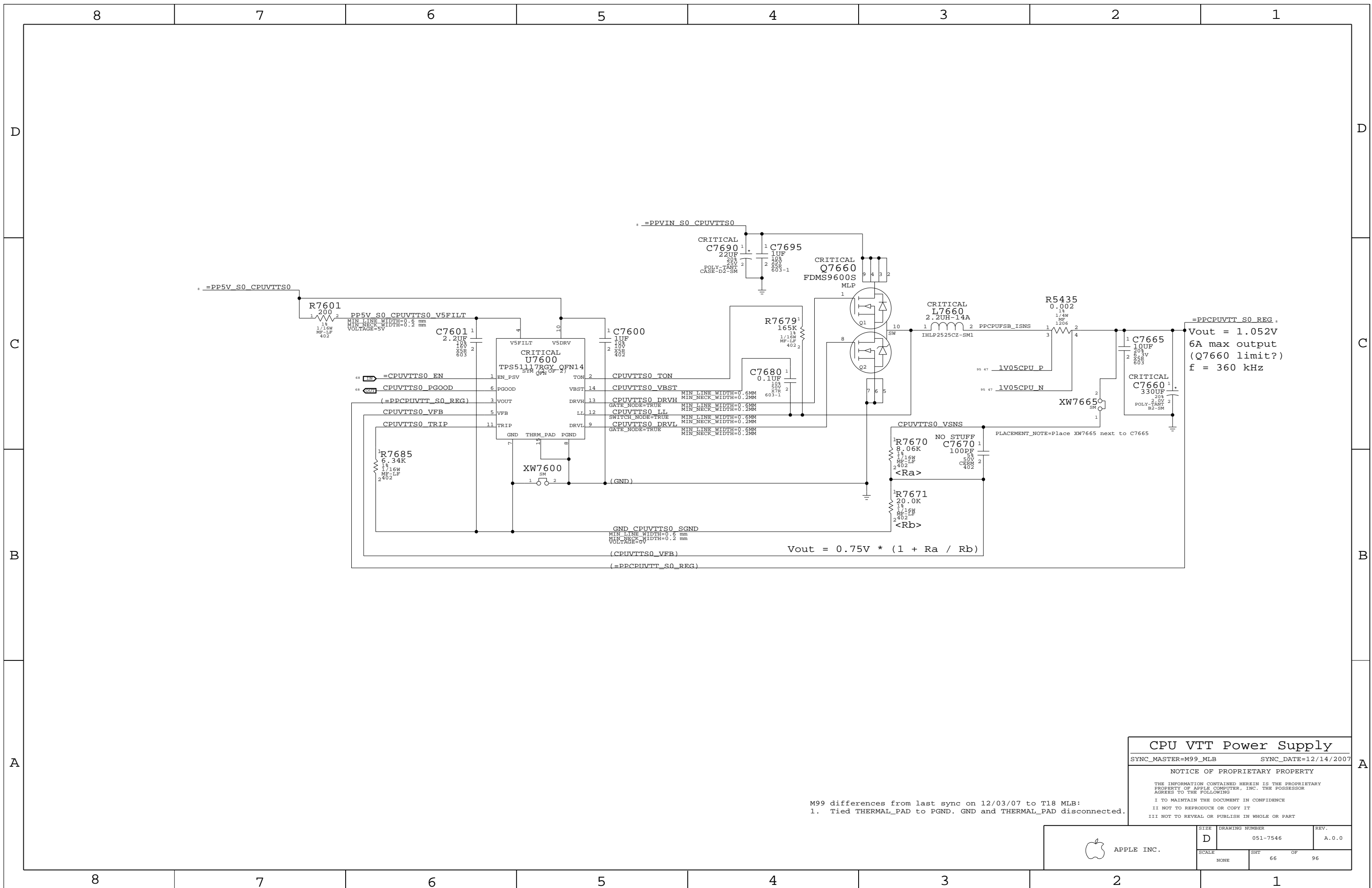
MCP79 Rev A01 requires higher core & analog voltage

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|--|---------------|----------|------------|
| 114S0382 | 1 | RES.MTL FILM,1/16W,48.7K,1,0402,SMD,LF | R7570 | | MCP_A01 |
| 114S0400 | 1 | RES.MTL FILM,1/16W,76.8K,1,0402,SMD,LF | R7571 | | MCP_A01 |
| 114S0482 | 1 | RES.MTL FILM,1/16W,523K,1,0402,SMD,LF | R7580 | | MCP_A01 |
| 114S0453 | 1 | RES.MTL FILM,1/16W,267K,1,0402,SMD,LF | R7581 | | MCP_A01 |
| 114S0422 | 1 | RES.MTL FILM,1/16W,130K,1,0402,SMD,LF | R7582 | | MCP_A01 |
| 114S0373 | 1 | RES.MTL FILM,1/16W,40.2K,1,0402,SMD,LF | R7570 | | MCP_A01Q |
| 114S0404 | 1 | RES.MTL FILM,1/16W,84.5K,1,0402,SMD,LF | R7571 | | MCP_A01Q |
| 114S0458 | 1 | RES.MTL FILM,1/16W,301K,1,0402,SMD,LF | R7580 | | MCP_A01Q |
| 114S0447 | 1 | RES.MTL FILM,1/16W,237K,1,0402,SMD,LF | R7581 | | MCP_A01Q |
| 114S0411 | 1 | RES.MTL FILM,1/16W,100K,1,0402,SMD,LF | R7582 | | MCP_A01Q |

| VID<2:0> | Rev A01 Voltage | Production Voltage | MCP Target |
|----------|-----------------|--------------------|------------|
| 000 | +1.224V | +1.060V | +1.05V |
| 001 | +1.159V | +0.994V | +1.00V |
| 010 | +1.101V | +0.937V | +0.95V |
| 011 | +1.049V | +0.885V | +0.90V |
| 100 | +0.995V | +0.830V | +0.85V |
| 101 | +0.952V | +0.789V | +0.80V |
| 110 | +0.913V | +0.752V | +0.75V |
| 111 | +0.876V | +0.719V | +0.70V |

1.05V / MCP Core Regulator
 SYNC_MASTER=M99_MLB SYNC_DATE=01/08/2008

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CPU VTT Power Supply

SYNC_MASTER=M99_MLB SYNC_DATE=12/14/2007

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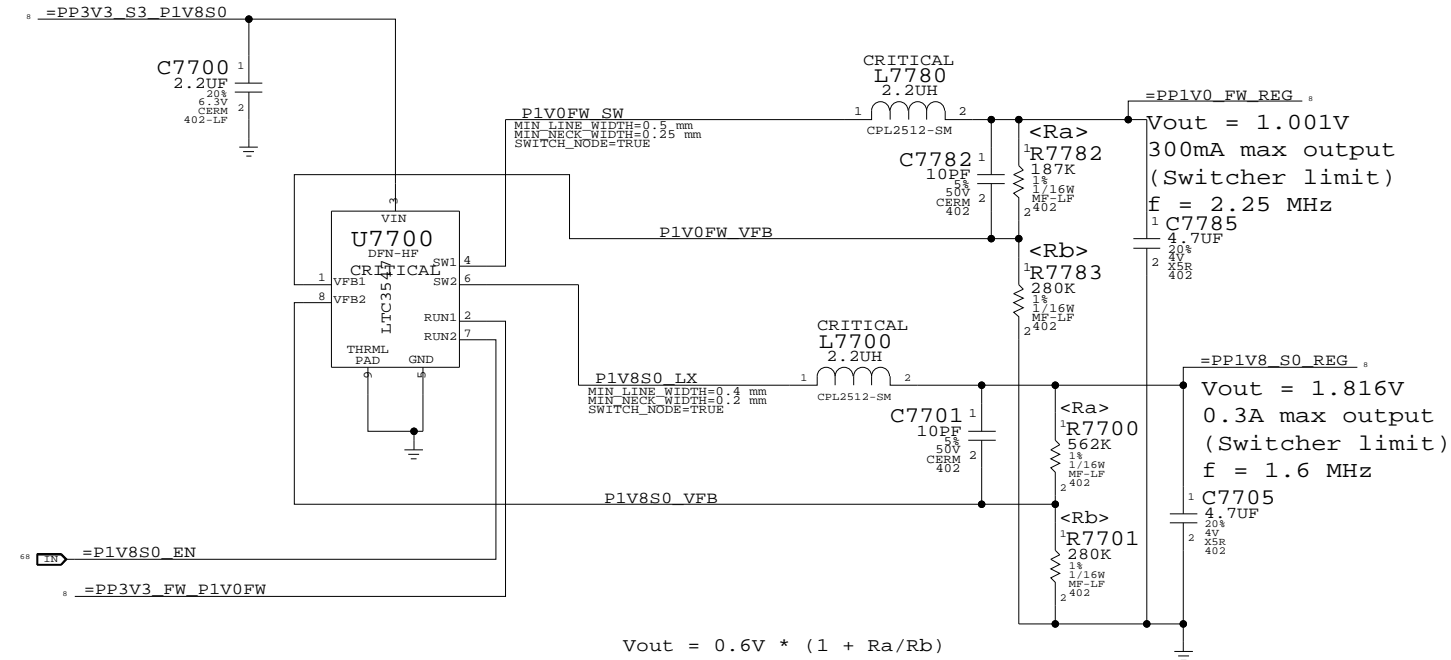
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M99 differences from last sync on 12/03/07 to T18 MLB:
 1. Tied THERMAL_PAD to PGND. GND and THERMAL_PAD disconnected.

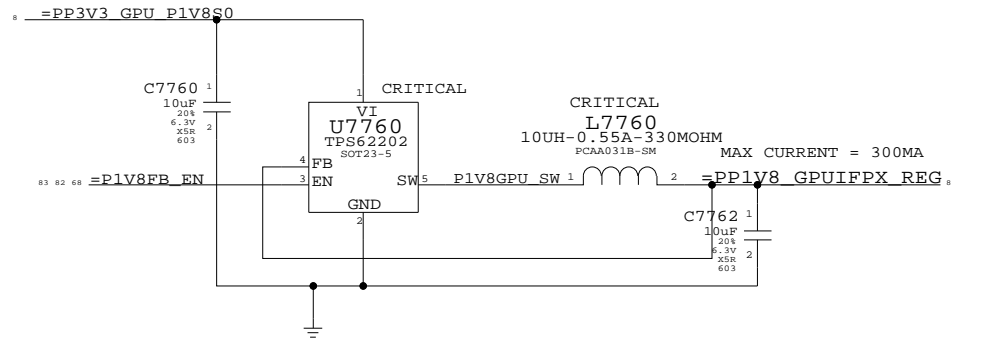
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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | | OF |
| NONE | 66 | | 96 |

1.8V S0 Switcher / 1.0VFW SWITCHER

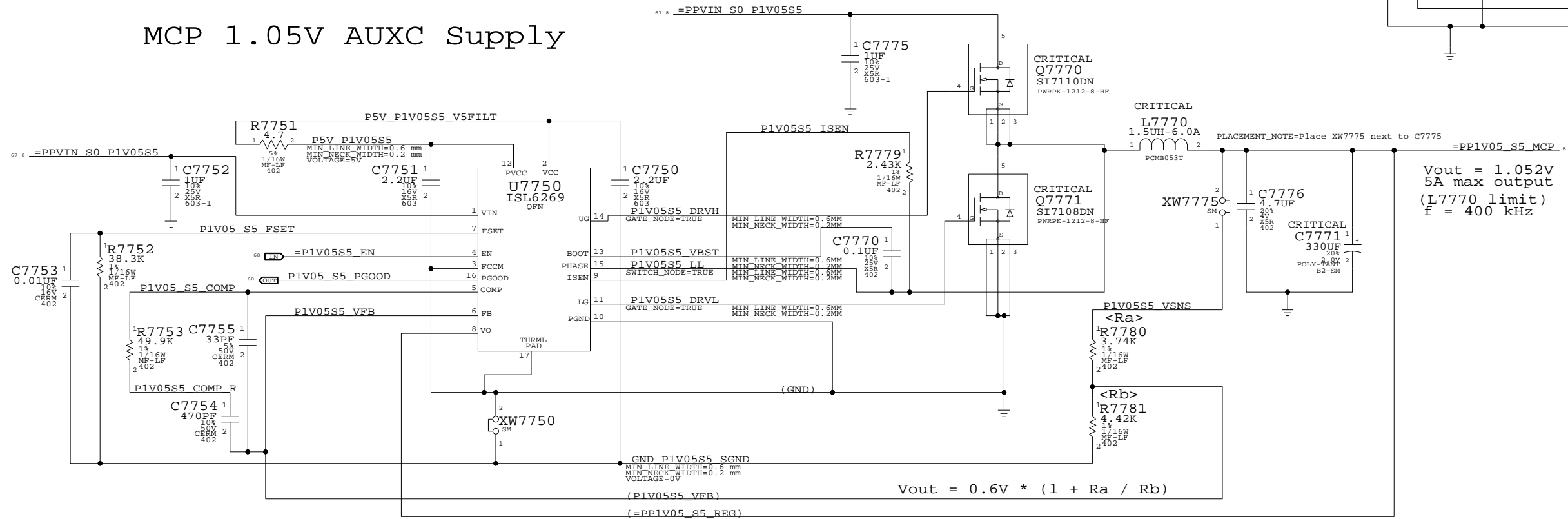
S5 power required for output discharge feature



1.8V S0 Switcher



MCP 1.05V AUXC Supply



Misc Power Supplies

SYNC_MASTER=M99_MLB SYNC_DATE=12/14/2007

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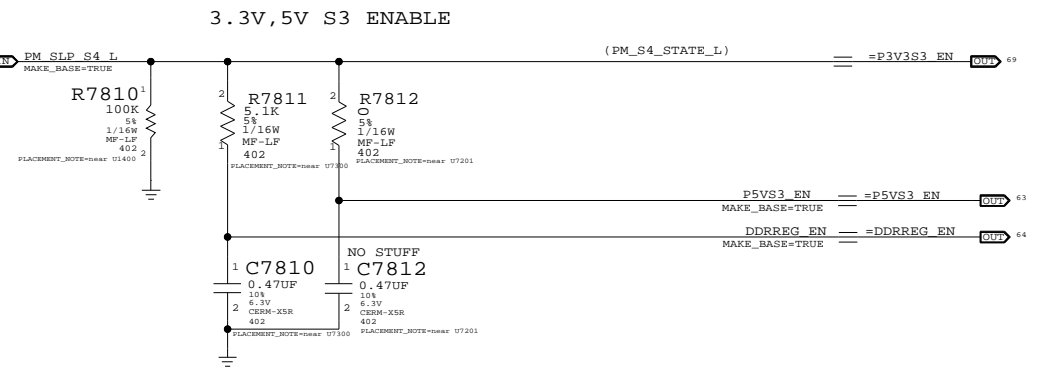
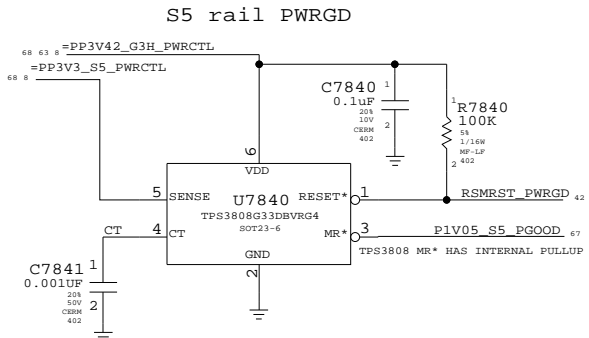
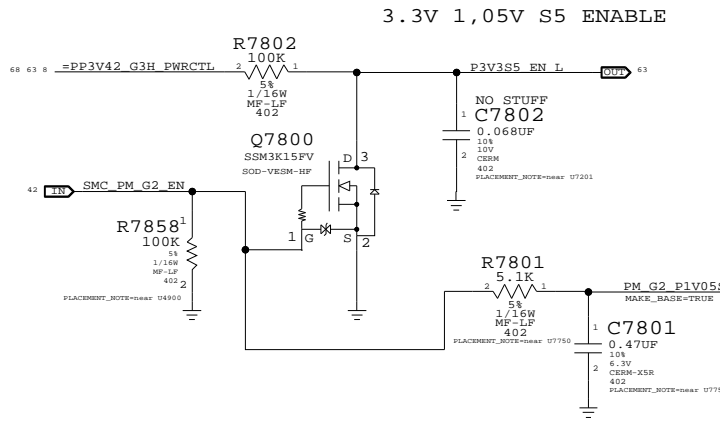
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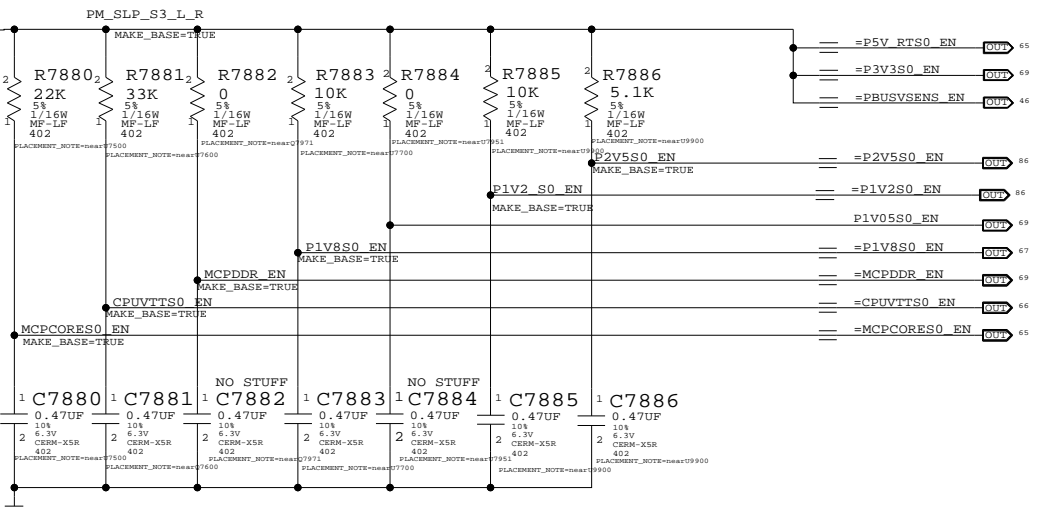
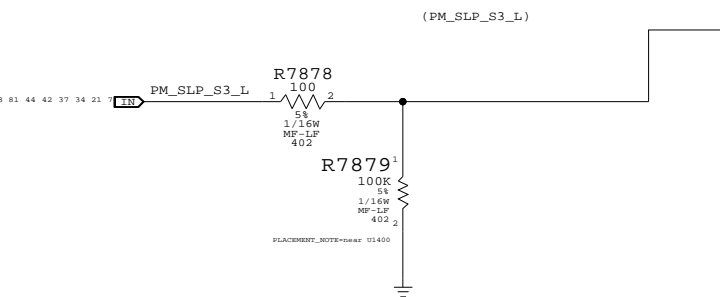
APPLE INC.

| | | |
|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 67 | 96 |

| State | SMC_PM_G2_ENABLE | PM_SLP_S4_L | PM_SLP_S3_L |
|---------------------|------------------|-------------|-------------|
| Run (S0) | 1 | 1 | 1 |
| Sleep (S3) | 1 | 1 | 0 |
| Soft-Off (S5) | 1 | 0 | 0 |
| Battery Off (G3Hot) | 0 | 0 | 0 |

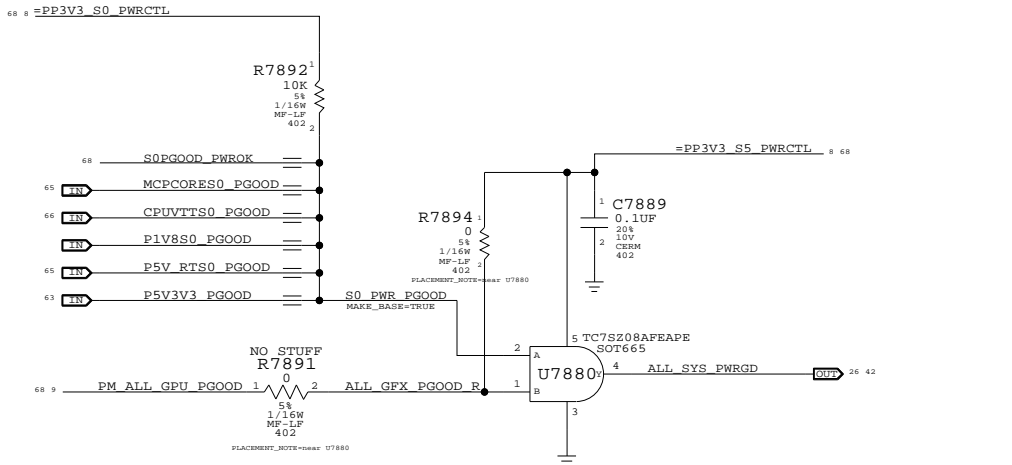


S0 ENABLE

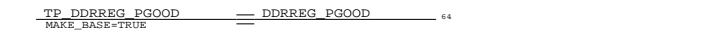


Other S0 RAILS

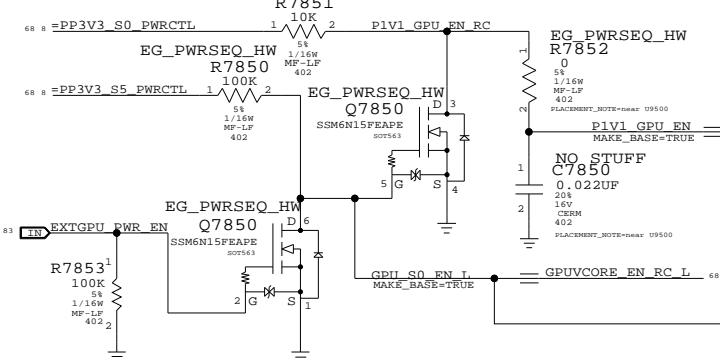
| | |
|------------------|------------------|
| PM_ALL_GFX_PGOOD | high |
| IG | high |
| EG | PM_ALL_GPU_PGOOD |



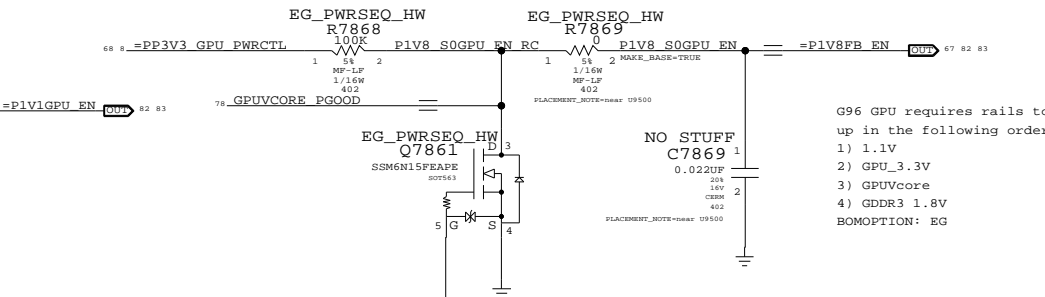
Unused PGOOD signal



1.1V GPU ENABLE



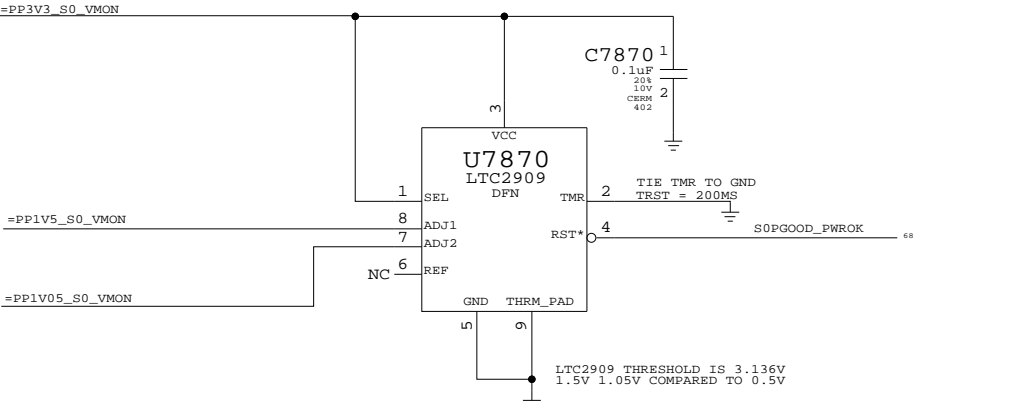
Graphic MEM ENABLE



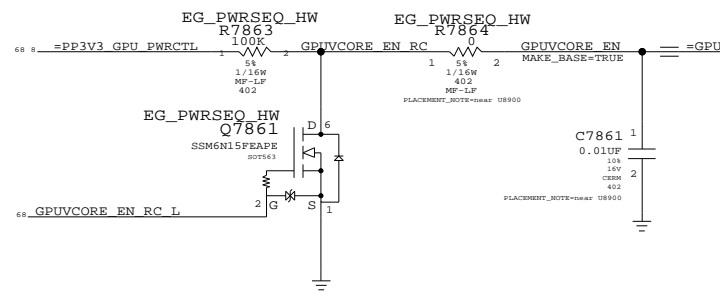
- G96 GPU requires rails to come up in the following order:
- 1) 1.1v
 - 2) GPU_3.3v
 - 3) GPUVcore
 - 4) GDDR3 1.8v
- BOMOPTION: EG

3.3V 1.05V AND 1.5V S0 RAILS MONITOR CIRCUIT

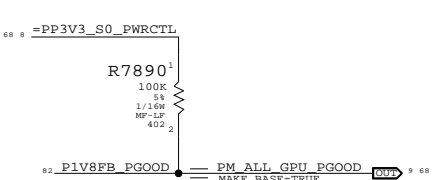
place XW402 if needed to save trace space for pin 7,8



GPUVCORE ENABLE

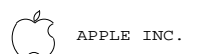


EXT GPU PWRGD Pullup



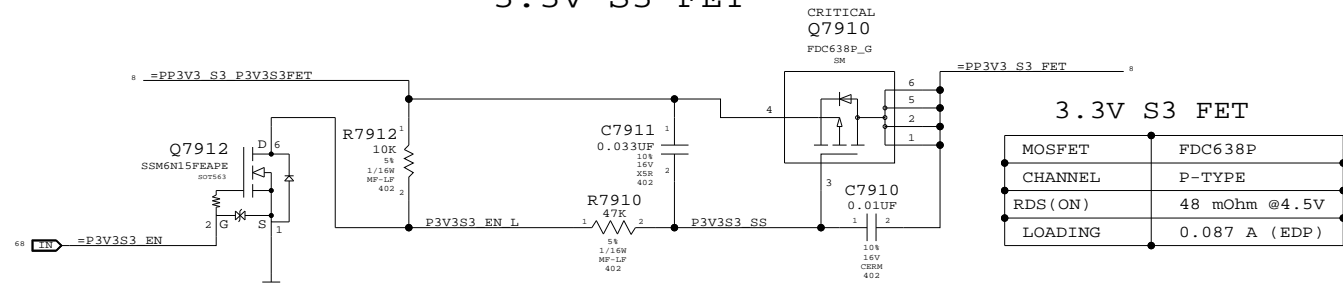
Power Control
SYNC_MASTER=PWRSONC SYNC_DATE=05/12/2008

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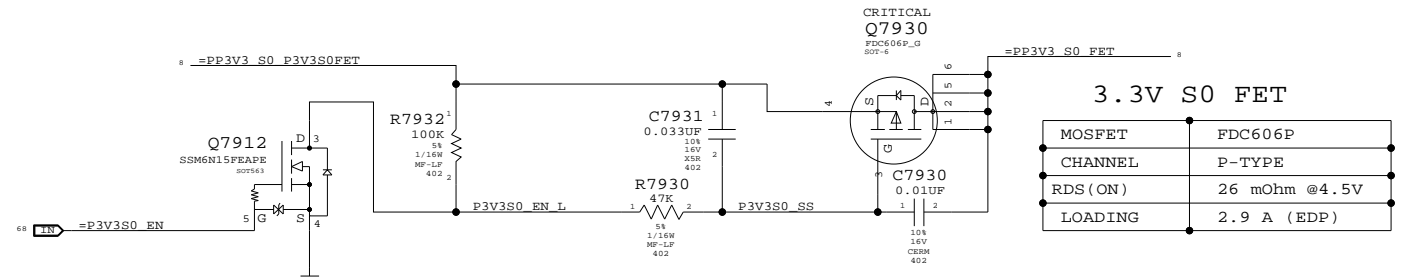
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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 68 | 96 |

3.3V S3 FET



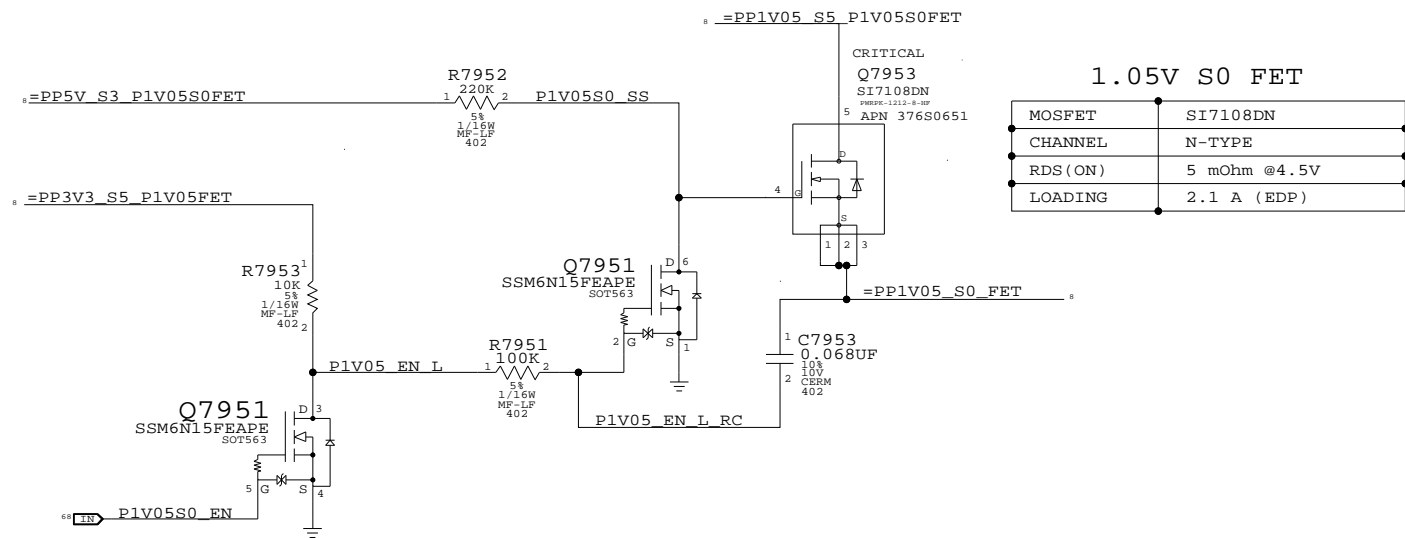
| | |
|---------|---------------|
| MOSFET | FDC638P |
| CHANNEL | P-TYPE |
| RDS(ON) | 48 mOhm @4.5V |
| LOADING | 0.087 A (EDP) |

3.3V S0 FET



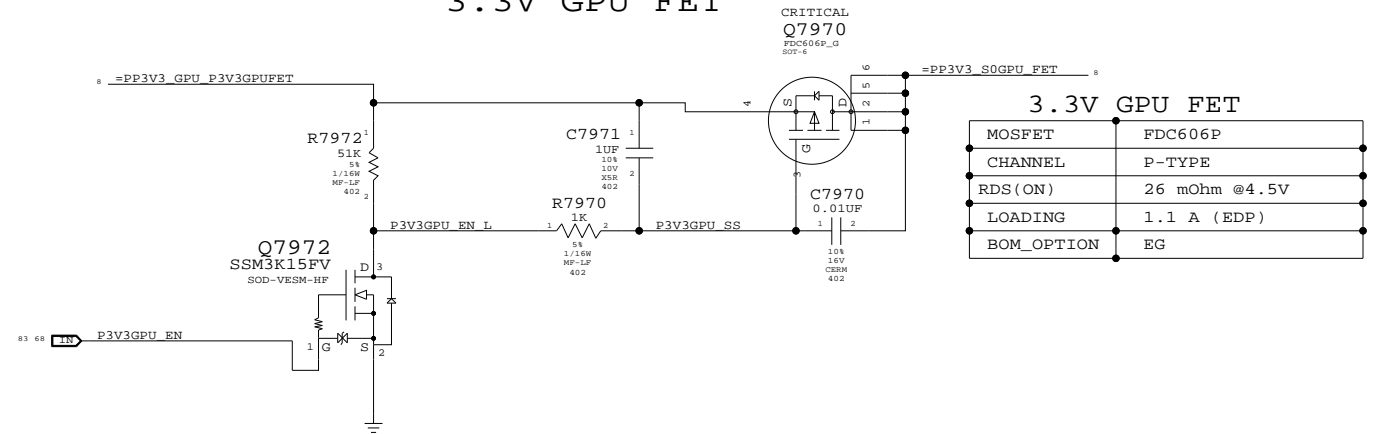
| | |
|---------|---------------|
| MOSFET | FDC606P |
| CHANNEL | P-TYPE |
| RDS(ON) | 26 mOhm @4.5V |
| LOADING | 2.9 A (EDP) |

1.05V S0 FET



| | |
|---------|--------------|
| MOSFET | SI7108DN |
| CHANNEL | N-TYPE |
| RDS(ON) | 5 mOhm @4.5V |
| LOADING | 2.1 A (EDP) |

3.3V GPU FET

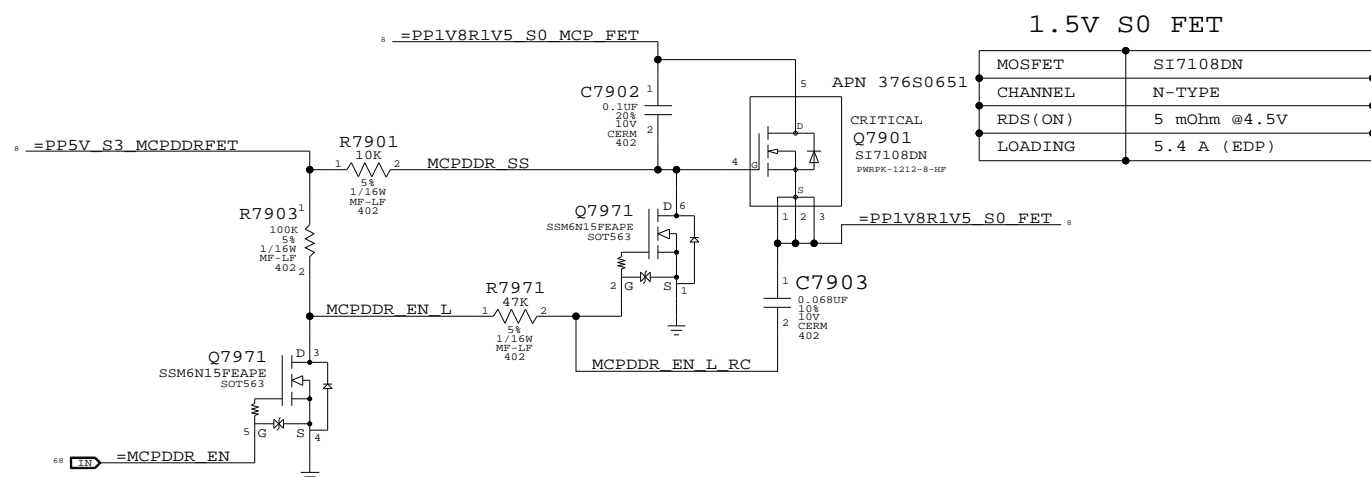


| | |
|------------|---------------|
| MOSFET | FDC606P |
| CHANNEL | P-TYPE |
| RDS(ON) | 26 mOhm @4.5V |
| LOADING | 1.1 A (EDP) |
| BOM_OPTION | EG |

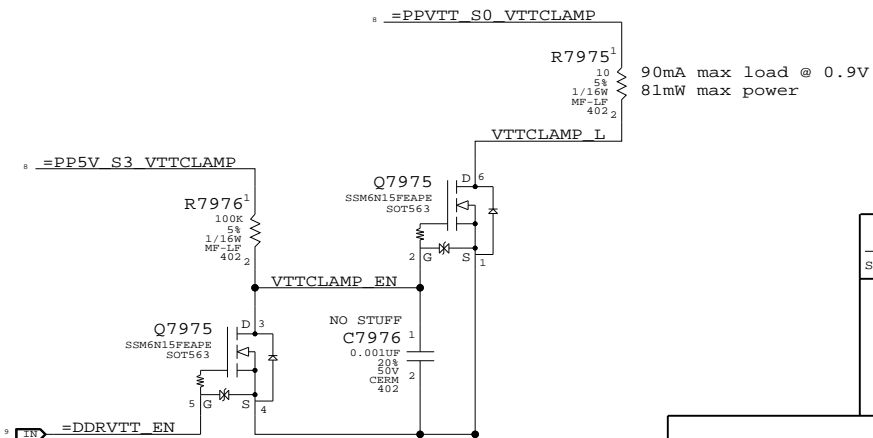
MCP79 DDR FETs

MCP79 DDR pad leakage is high enough that nVidia recommends unpowering during sleep. In order to support unpowering rail, hardware must guarantee MEM_CKE signals are low before rail is turned off, and remains low until after rail turns back on or DIMMs will exit self-refresh prematurely. MEM_VTT_EN output from MCP79 used to enable clamp on VTT rail, which pulls all CKE signals low through VTT termination resistors.

1.5V S0 FET



| | |
|---------|--------------|
| MOSFET | SI7108DN |
| CHANNEL | N-TYPE |
| RDS(ON) | 5 mOhm @4.5V |
| LOADING | 5.4 A (EDP) |



| | |
|--|----------------------|
| Power FETs | |
| SYNC_MASTER=PWRSONC | SYNC_DATE=05/12/2008 |
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| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | REV. |
| NONE | 69 | 96 | |

Page Notes

Power aliases required by this page:
- =PPIV2_GPU_PEX_PLLXVDD
- =PPIV2_GPU_PEX_IOVDDQ
- =PPIV2_GPU_PEX_IOVDD

Signal aliases required by this page:
(NONE)

BOM options provided by this page:
(NONE)

=PPIV1_GPU_PEX_PLLXVDD
=PPIV1_GPU_PEX_IOVDDQ
=PPIV1_GPU_PEX_IOVDD

PEX 1.1V Current = 2A

250mA

1500mA

180mA

L8015 10NH-600MA

PPIV1_GPU_PEX_PLLXVDD F

MIN_LINE_WIDTH=0.25 mm
MIN_DRILL_DIAMETER=0.25 mm
VOLTAGE=1.2V

NC_GPU_DFM

NO_TEST=TRUE

OMIT

U8000

NB9P-GS

BGA

SYMBOL 2 OF 9

H32

M7

P6

P7

R7

U7

V6

AB7

AD6

AF6

AG6

AJ5

D35

AK15

AL7

E7

E35

F7

A2

PEX_IOVDD1

PEX_IOVDD2

PEX_IOVDD3

PEX_IOVDD4

PEX_IOVDD5

PEX_IOVDDQ1

PEX_IOVDDQ2

PEX_IOVDDQ3

PEX_IOVDDQ4

PEX_IOVDDQ5

PEX_IOVDDQ6

PEX_IOVDDQ7

PEX_IOVDDQ8

PEX_IOVDDQ9

PEX_IOVDDQ10

PEX_IOVDDQ11

PEX_IOVDDQ12

PEX_IOVDDQ13

PEX_IOVDDQ14

PEX_IOVDDQ15

PEX_IOVDDQ16

PEX_IOVDDQ17

PEX_IOVDDQ18

PEX_IOVDDQ19

PEX_IOVDDQ20

PEX_IOVDDQ21

PEX_IOVDDQ22

PEX_IOVDDQ23

PEX_IOVDDQ24

PEX_IOVDDQ25

PEX_PLLXVDD

VDD_SENSE

GND_SENSE

AG16

AK17

AK21

AK24

AK27

AG11

AG12

AG13

AG15

AG16

AG17

AG18

AG22

AG23

AG24

AG25

AG26

AJ14

AJ15

AJ19

AJ21

AJ22

AJ24

AJ25

AJ27

AK18

AK20

AK23

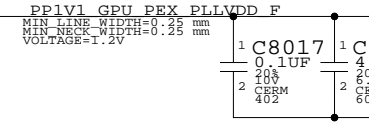
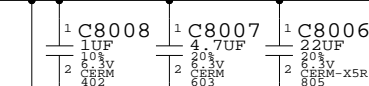
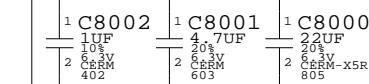
AK26

AL16

AG14

AD20

AD19



NV G96 PCI-E

SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008

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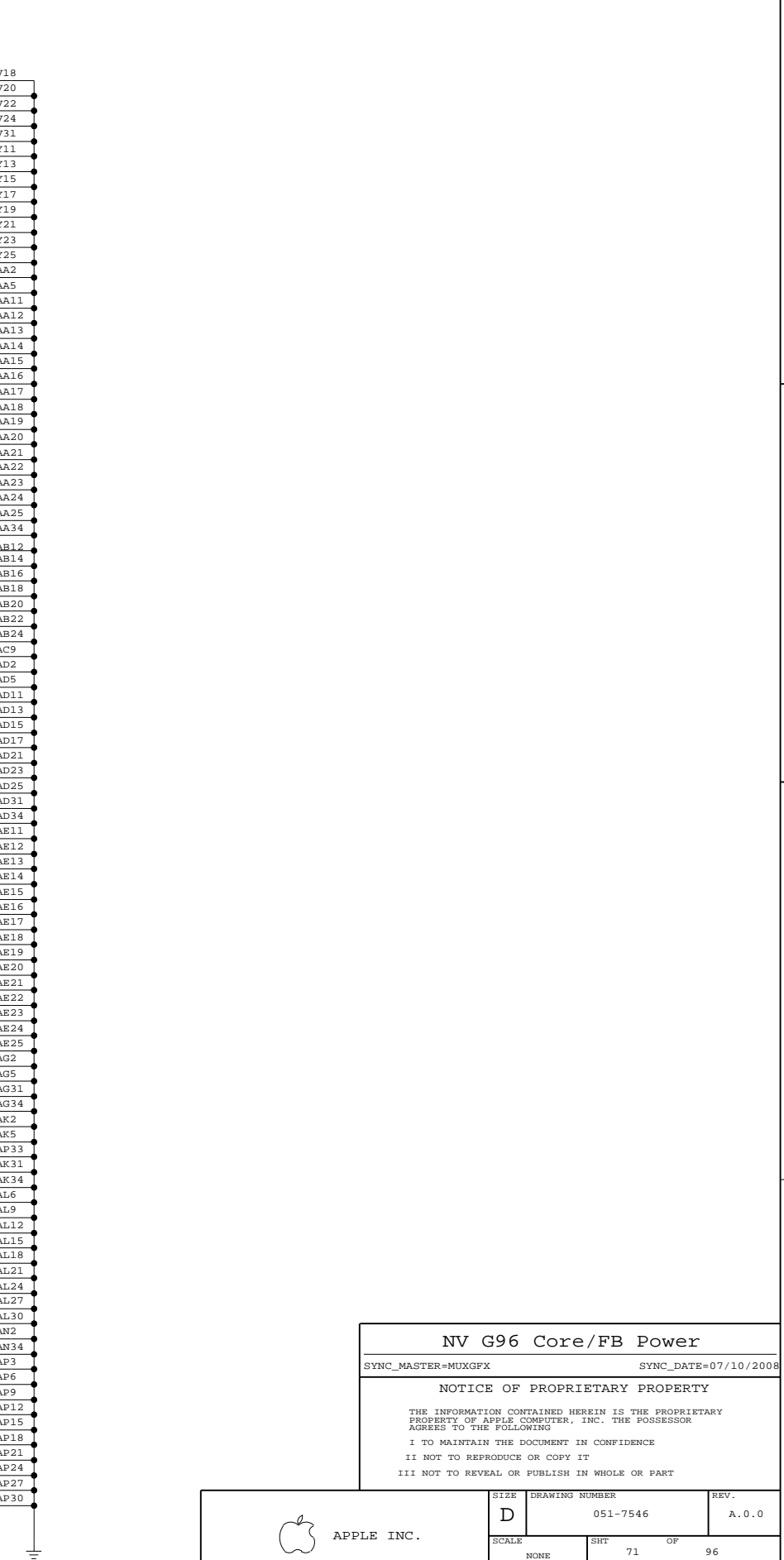
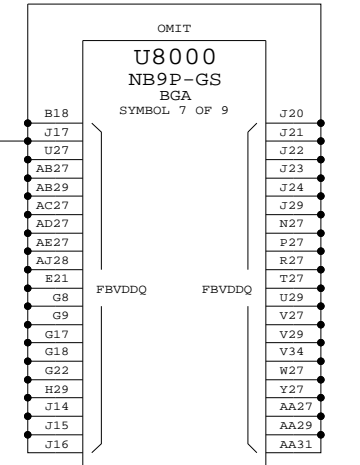
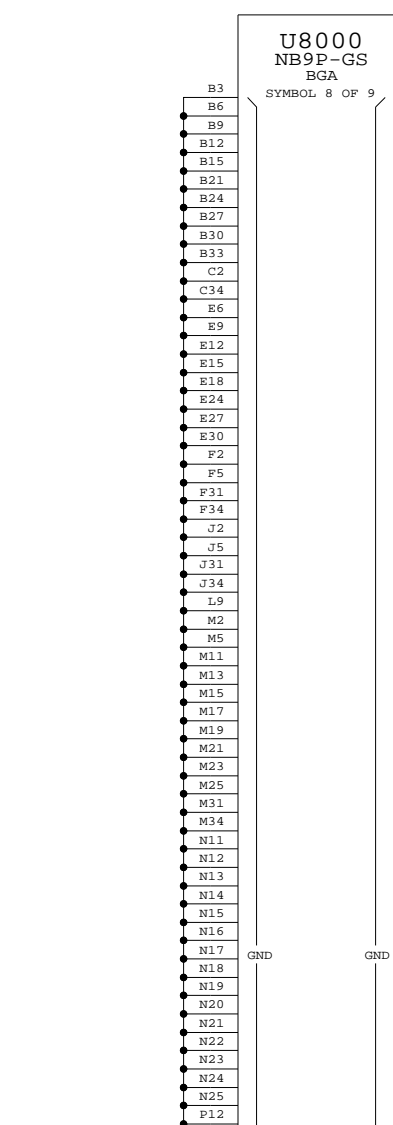
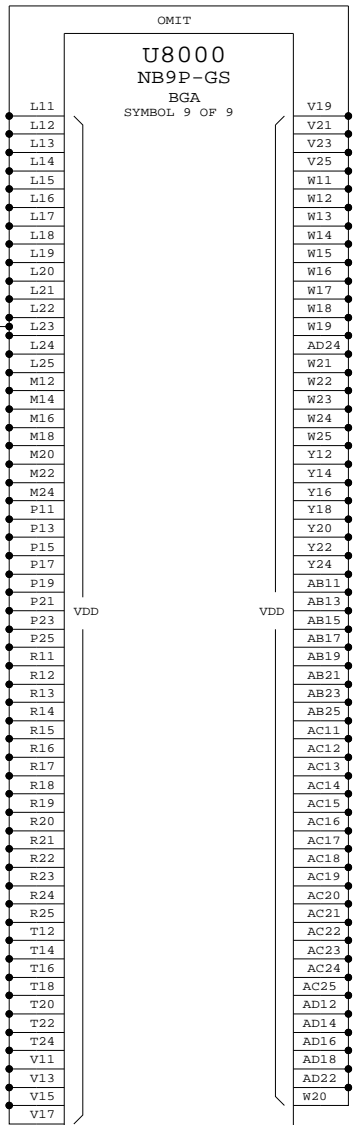
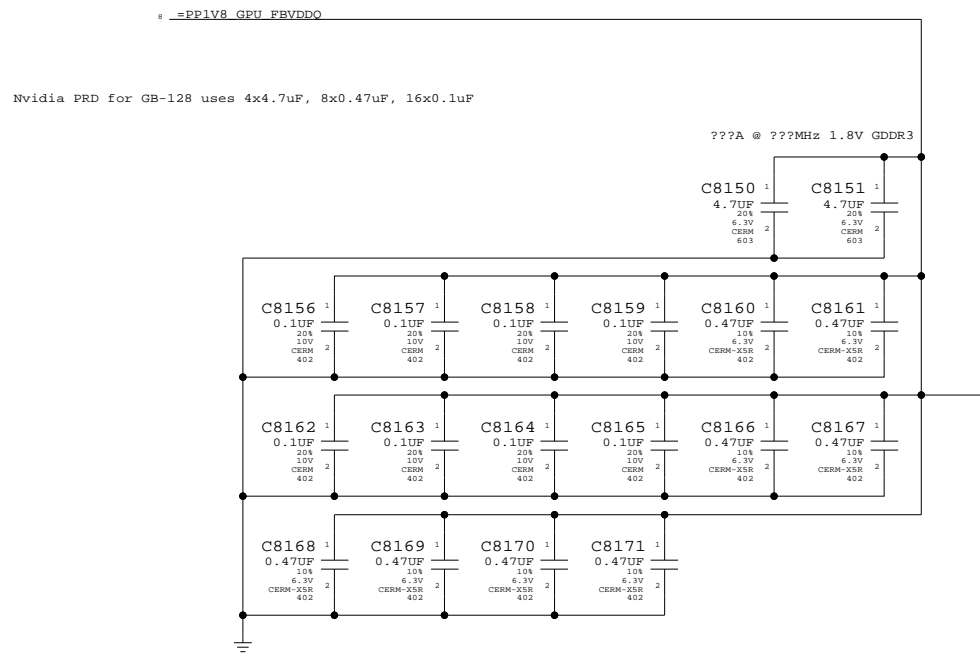
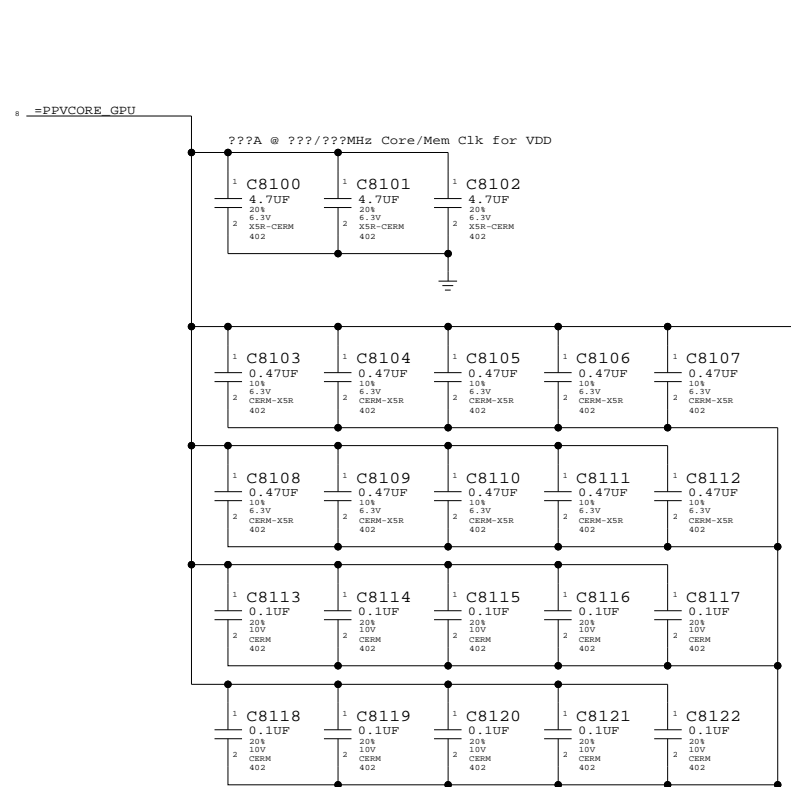
APPLE INC. DRAWING NUMBER 051-7546 REV. A.0.0 SCALE NONE SHEET 70 OF 96

Page Notes

Power aliases required by this page:
 - =PPVCORE_GPU
 - =PP1V8_GPU_FBVDDQ

Signal aliases required by this page:
 (NONE)

BOM options provided by this page:
 (NONE)



NV G96 Core/FB Power

SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008

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| | | | |
|------------|--------------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT 71 OF 96 | | |
| NONE | | | |

Page Notes

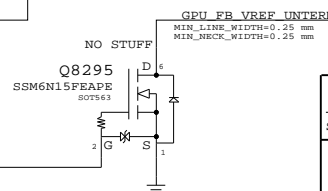
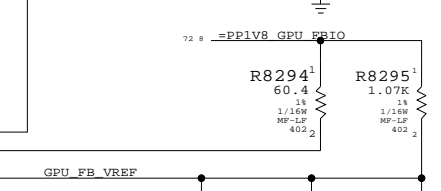
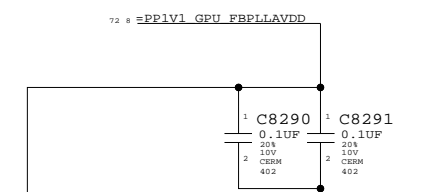
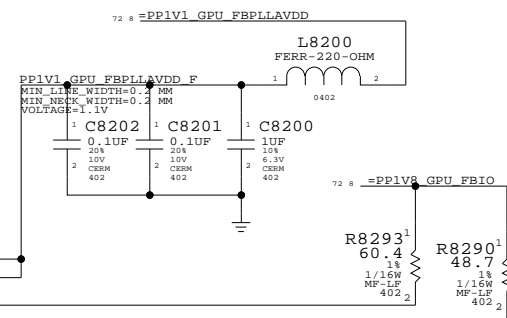
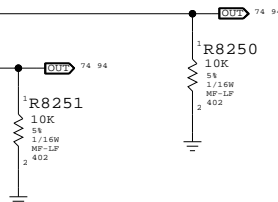
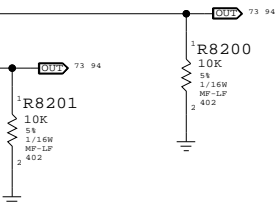
Power aliases required by this page:
- =PP1V2_GPU_FBPLLAVDD
- =PP1V8_GPU_FBIO
Signal aliases required by this page:
(NONE)
BOM options provided by this page:
(NONE)

U8000
NB9P-GS
BGA
SYMBOL 3 OF 9

Table of pin connections for U8000 NB9P-GS, listing signals like FBA_DQ<0> through FBA_DQ<63>, FBA_CMD0 through FBA_CMD30, FBA_CLK0 through FBA_CLK1, FBA_DQM0 through FBA_DQM7, FBA_DQS_RN0 through FBA_DQS_RN7, FBA_DQS_WP0 through FBA_DQS_WP7, FBA_DLLAVDD0, FBA_PLLAVDD0, FBA_DEBUG, FBCAL_PD_VDDQ, FBCAL_PU_GND, FBCAL_TERM_GND, FBA_RFU0 through FBA_RFU7.

U8000
NB9P-GS
BGA
SYMBOL 4 OF 9

Table of pin connections for U8000 NB9P-GS, listing signals like FBC_DQ<0> through FBC_DQ<63>, FBC_CMD0 through FBC_CMD30, FBC_CLK0 through FBC_CLK1, FBC_DQM0 through FBC_DQM7, FBC_DQS_RN0 through FBC_DQS_RN7, FBC_DQS_WP0 through FBC_DQS_WP7, FBC_DLLAVDD1, FBC_PLLAVDD1, FBC_DEBUG, FBC_RFU0 through FBC_RFU7.

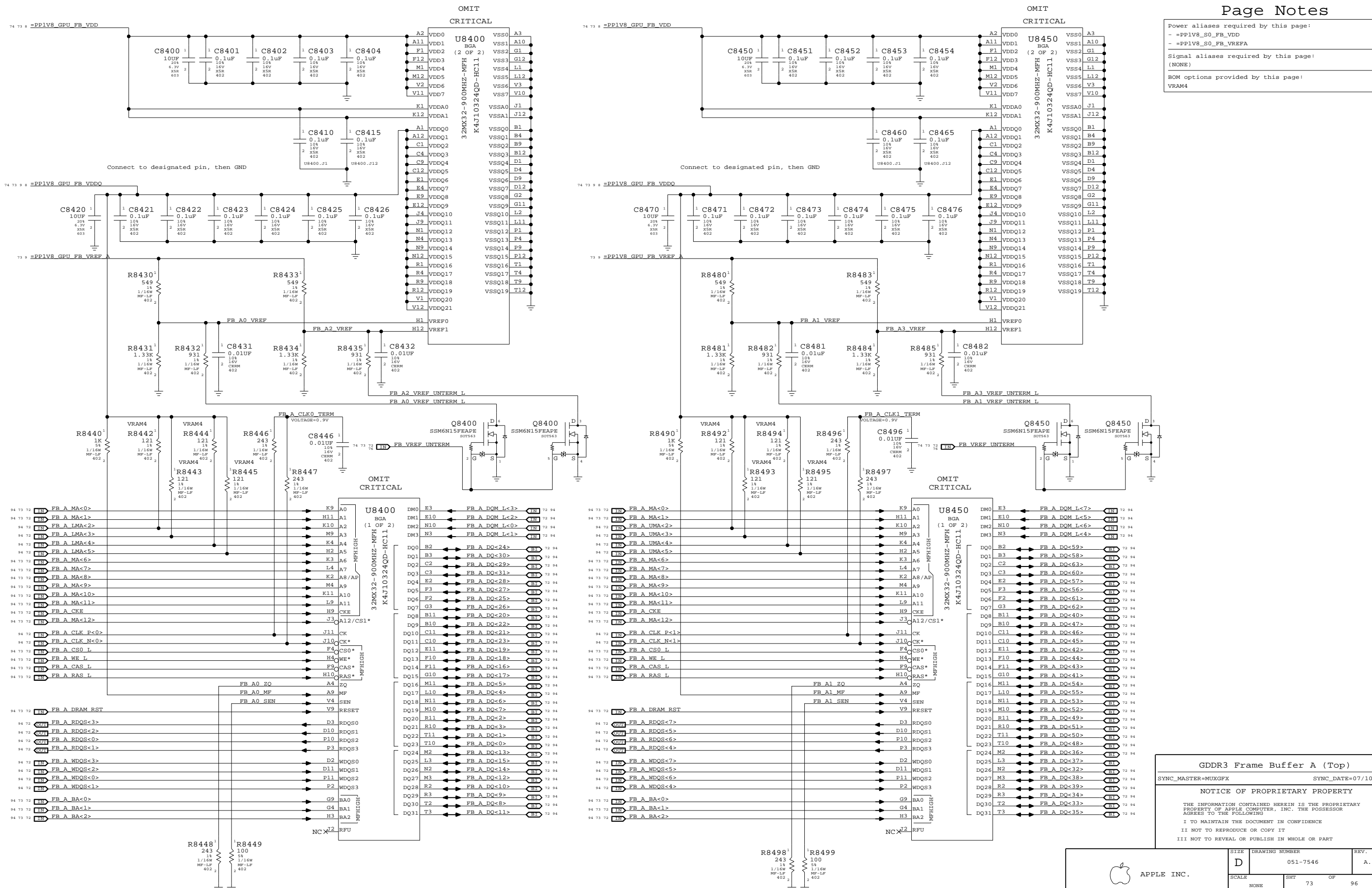


NV G96 Frame Buffer I/F
SYNC_MASTER=MUXGF
SYNC_DATE=07/10/2008
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Power aliases required by this page:
 - =PPIV8_S0_FB_VDD
 - =PPIV8_S0_FB_VREFA

Signal aliases required by this page:
 (NONE)

BOM options provided by this page:
 VRAM4



GDDR3 Frame Buffer A (Top)

SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008 REV. A.0.0

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APPLE INC.

SIZE DRAWING NUMBER REV.

D 051-7546 A.0.0

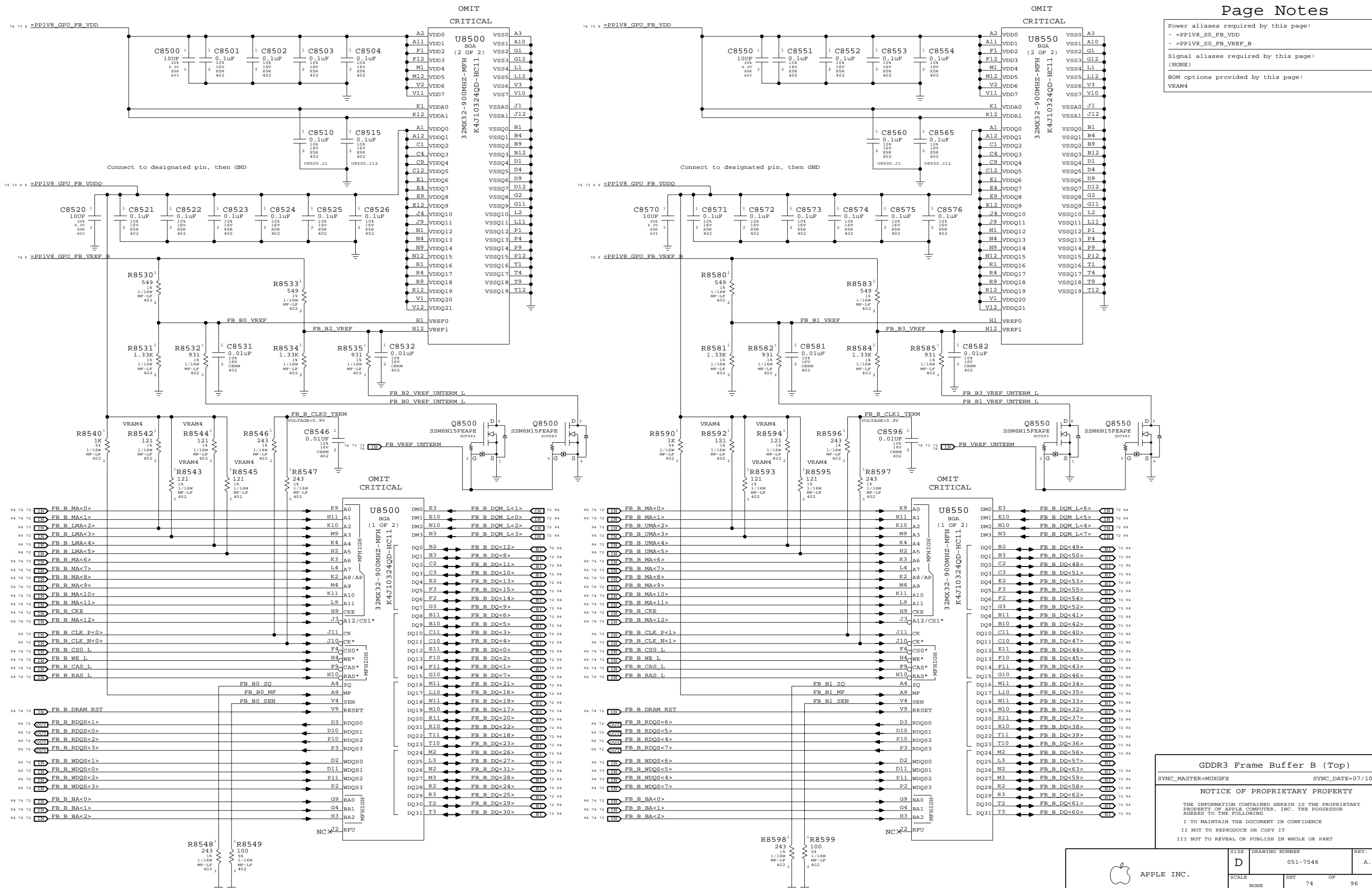
SCALE NONE SHIT 73 OF 96

Page Notes

Power aliases required by this page:
 - =PPIV8_S0_FB_VDD
 - =PPIV8_S0_FB_VREF_B

Signal aliases required by this page:
 (NONE)

BOM options provided by this page:
 VRAM4



GDDR3 Frame Buffer B (Top)

SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008 REV. A.0.0

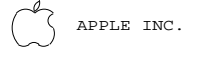
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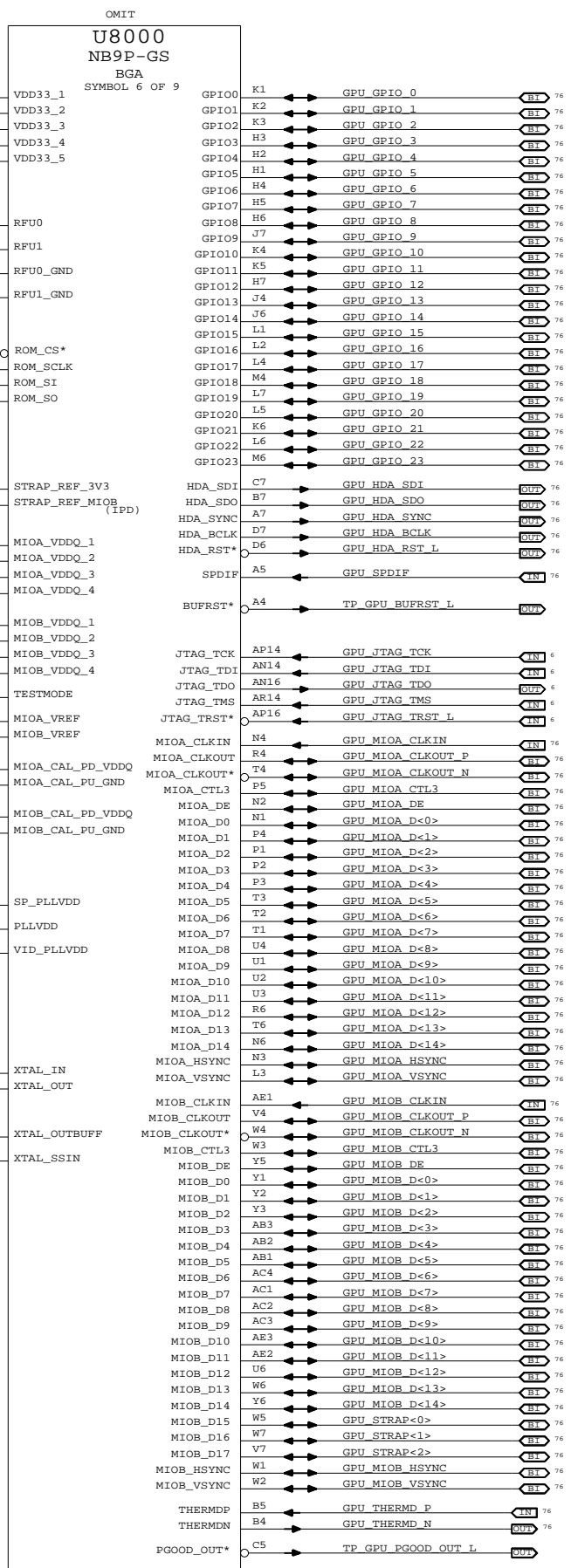
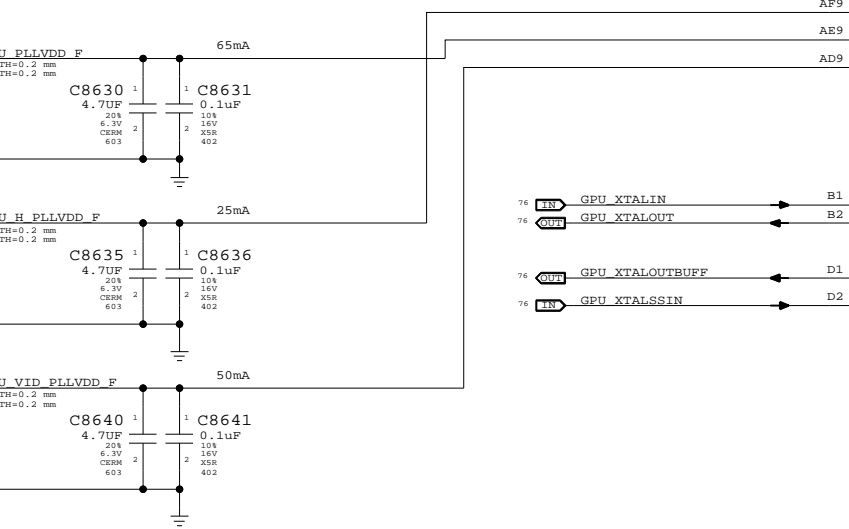
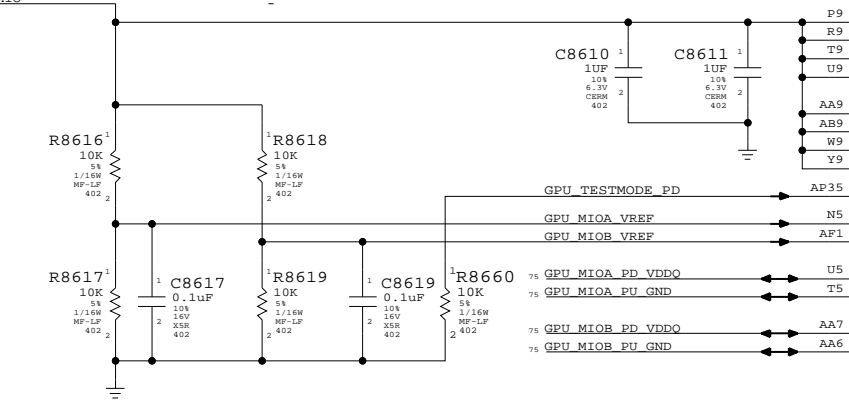
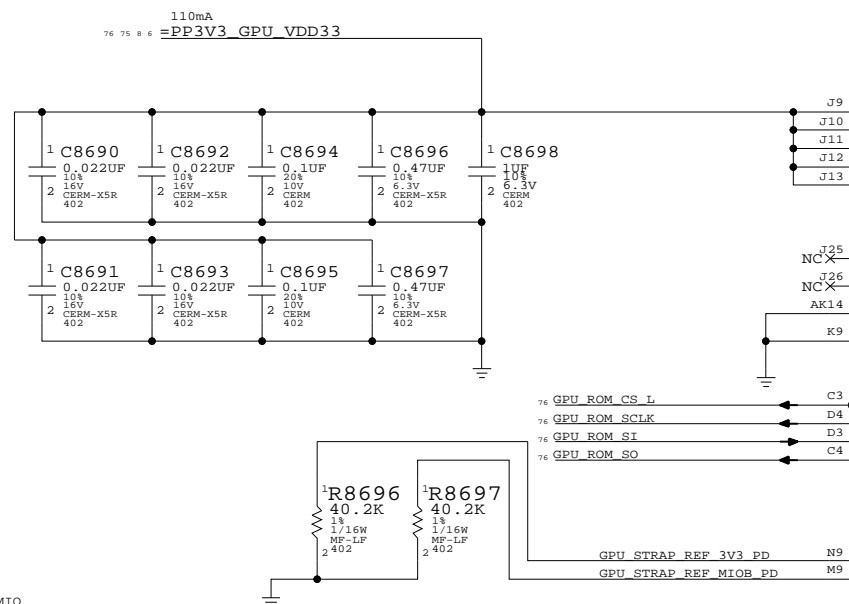
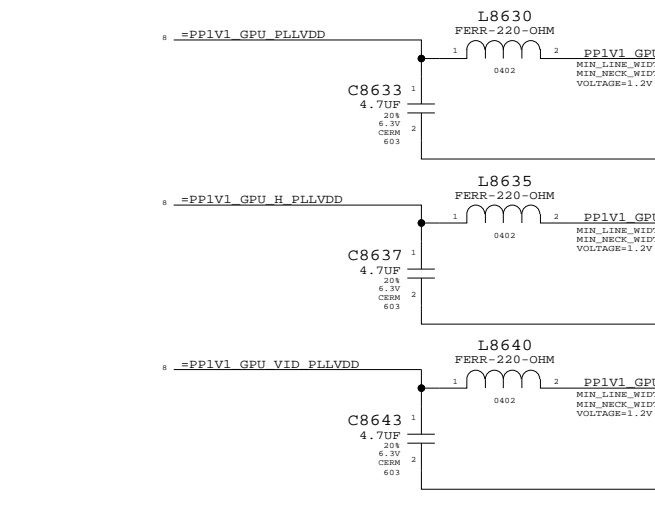
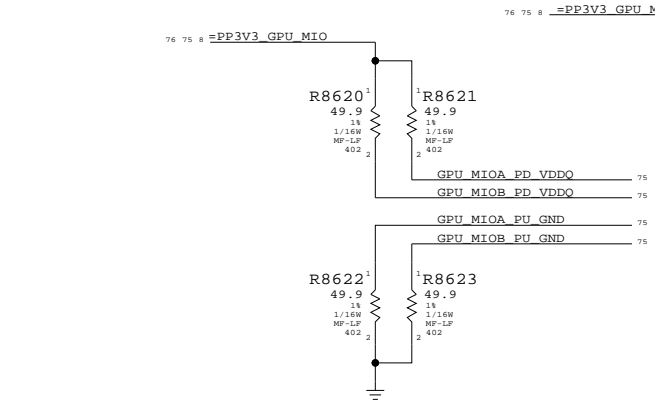
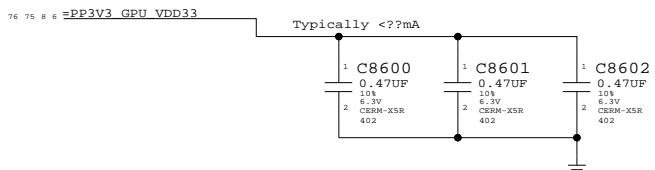
| | | |
|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHEET | OF |
| NONE | 74 | 96 |

Page Notes

Power aliases required by this page:
 - =PP3V3_GPU_VDD33
 - =PP3V3_GPU_MIO
 - =PP1V2_GPU_PLLVDD
 - =PP1V2_GPU_H_PLLVDD
 - =PP1V2_GPU_VID_PLLVDD

Signal aliases required by this page:
 (NONE)

BOM options provided by this page:
 (NONE)



| Pin | Signal | Pin | Signal |
|--------------------|--------|--------------------|--------|
| GPU_GPIO_0 | K1 | GPU_HDA_SDI | C7 |
| GPU_GPIO_1 | K2 | GPU_HDA_SDO | B7 |
| GPU_GPIO_2 | K3 | GPU_HDA_SYNC | A7 |
| GPU_GPIO_3 | H3 | GPU_HDA_BCLK | D7 |
| GPU_GPIO_4 | H2 | GPU_HDA_RST_L | D6 |
| GPU_GPIO_5 | H1 | GPU_SPDIF | A5 |
| GPU_GPIO_6 | H4 | TP_GPU_BUFRST_L | A4 |
| GPU_GPIO_7 | H5 | GPU_JTAG_TCK | AP14 |
| GPU_GPIO_8 | H6 | GPU_JTAG_TDI | AN14 |
| GPU_GPIO_9 | J7 | GPU_JTAG_TDO | AN16 |
| GPU_GPIO_10 | K4 | GPU_JTAG_TMS | AR14 |
| GPU_GPIO_11 | K5 | GPU_JTAG_TRST_L | AP16 |
| GPU_GPIO_12 | H7 | GPU_MIO_CLKIN | N4 |
| GPU_GPIO_13 | J4 | GPU_MIO_CLKOUT_P | R4 |
| GPU_GPIO_14 | J6 | GPU_MIO_CLKOUT_N | T4 |
| GPU_GPIO_15 | L1 | GPU_MIO_CTL3 | P5 |
| GPU_GPIO_16 | L2 | GPU_MIO_DE | N2 |
| GPU_GPIO_17 | L4 | GPU_MIO_D<0> | N1 |
| GPU_GPIO_18 | M4 | GPU_MIO_D<1> | P4 |
| GPU_GPIO_19 | L7 | GPU_MIO_D<2> | P1 |
| GPU_GPIO_20 | L5 | GPU_MIO_D<3> | P2 |
| GPU_GPIO_21 | K6 | GPU_MIO_D<4> | P3 |
| GPU_GPIO_22 | L6 | GPU_MIO_D<5> | T3 |
| GPU_GPIO_23 | M6 | GPU_MIO_D<6> | T2 |
| GPU_HDA_SDI | C7 | GPU_MIO_D<7> | T1 |
| GPU_HDA_SDO | B7 | GPU_MIO_D<8> | U4 |
| GPU_HDA_SYNC | A7 | GPU_MIO_D<9> | U1 |
| GPU_HDA_BCLK | D7 | GPU_MIO_D<10> | U2 |
| GPU_HDA_RST_L | D6 | GPU_MIO_D<11> | U3 |
| GPU_SPDIF | A5 | GPU_MIO_D<12> | R6 |
| TP_GPU_BUFRST_L | A4 | GPU_MIO_D<13> | T6 |
| GPU_JTAG_TCK | AP14 | GPU_MIO_D<14> | N6 |
| GPU_JTAG_TDI | AN14 | GPU_MIO_HSYNC | N3 |
| GPU_JTAG_TDO | AN16 | GPU_MIO_VSYNC | L3 |
| GPU_JTAG_TMS | AR14 | GPU_MIOB_CLKIN | AE1 |
| GPU_JTAG_TRST_L | AP16 | GPU_MIOB_CLKOUT_P | V4 |
| GPU_MIO_CLKIN | N4 | GPU_MIOB_CLKOUT_N | W4 |
| GPU_MIO_CLKOUT_P | R4 | GPU_MIOB_CTL3 | W3 |
| GPU_MIO_CLKOUT_N | T4 | GPU_MIOB_DE | Y5 |
| GPU_MIO_CTL3 | P5 | GPU_MIOB_D<0> | Y1 |
| GPU_MIO_DE | N2 | GPU_MIOB_D<1> | Y2 |
| GPU_MIO_D<0> | N1 | GPU_MIOB_D<2> | Y3 |
| GPU_MIO_D<1> | P4 | GPU_MIOB_D<3> | AB3 |
| GPU_MIO_D<2> | P1 | GPU_MIOB_D<4> | AB2 |
| GPU_MIO_D<3> | P2 | GPU_MIOB_D<5> | AB1 |
| GPU_MIO_D<4> | P3 | GPU_MIOB_D<6> | AC4 |
| GPU_MIO_D<5> | T3 | GPU_MIOB_D<7> | AC1 |
| GPU_MIO_D<6> | T2 | GPU_MIOB_D<8> | AC2 |
| GPU_MIO_D<7> | T1 | GPU_MIOB_D<9> | AC3 |
| GPU_MIO_D<8> | U4 | GPU_MIOB_D<10> | AE3 |
| GPU_MIO_D<9> | U1 | GPU_MIOB_D<11> | AE2 |
| GPU_MIO_D<10> | U2 | GPU_MIOB_D<12> | U6 |
| GPU_MIO_D<11> | U3 | GPU_MIOB_D<13> | W6 |
| GPU_MIO_D<12> | R6 | GPU_MIOB_D<14> | Y6 |
| GPU_MIO_D<13> | T6 | GPU_STRAP<0> | W5 |
| GPU_MIO_D<14> | N6 | GPU_STRAP<1> | W7 |
| GPU_MIO_HSYNC | N3 | GPU_STRAP<2> | V7 |
| GPU_MIO_VSYNC | L3 | GPU_MIOB_HSYNC | W1 |
| GPU_MIOB_CLKIN | AE1 | GPU_MIOB_VSYNC | W2 |
| GPU_MIOB_CLKOUT_P | V4 | GPU_THERMD_P | B5 |
| GPU_MIOB_CLKOUT_N | W4 | GPU_THERMD_N | B4 |
| GPU_MIOB_CTL3 | W3 | TP_GPU_PGOOD_OUT_L | C5 |
| GPU_MIOB_DE | Y5 | | |
| GPU_MIOB_D<0> | Y1 | | |
| GPU_MIOB_D<1> | Y2 | | |
| GPU_MIOB_D<2> | Y3 | | |
| GPU_MIOB_D<3> | AB3 | | |
| GPU_MIOB_D<4> | AB2 | | |
| GPU_MIOB_D<5> | AB1 | | |
| GPU_MIOB_D<6> | AC4 | | |
| GPU_MIOB_D<7> | AC1 | | |
| GPU_MIOB_D<8> | AC2 | | |
| GPU_MIOB_D<9> | AC3 | | |
| GPU_MIOB_D<10> | AE3 | | |
| GPU_MIOB_D<11> | AE2 | | |
| GPU_MIOB_D<12> | U6 | | |
| GPU_MIOB_D<13> | W6 | | |
| GPU_MIOB_D<14> | Y6 | | |
| GPU_STRAP<0> | W5 | | |
| GPU_STRAP<1> | W7 | | |
| GPU_STRAP<2> | V7 | | |
| GPU_MIOB_HSYNC | W1 | | |
| GPU_MIOB_VSYNC | W2 | | |
| GPU_THERMD_P | B5 | | |
| GPU_THERMD_N | B4 | | |
| TP_GPU_PGOOD_OUT_L | C5 | | |

NV G96 GPIO/MIO/Misc
 SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008

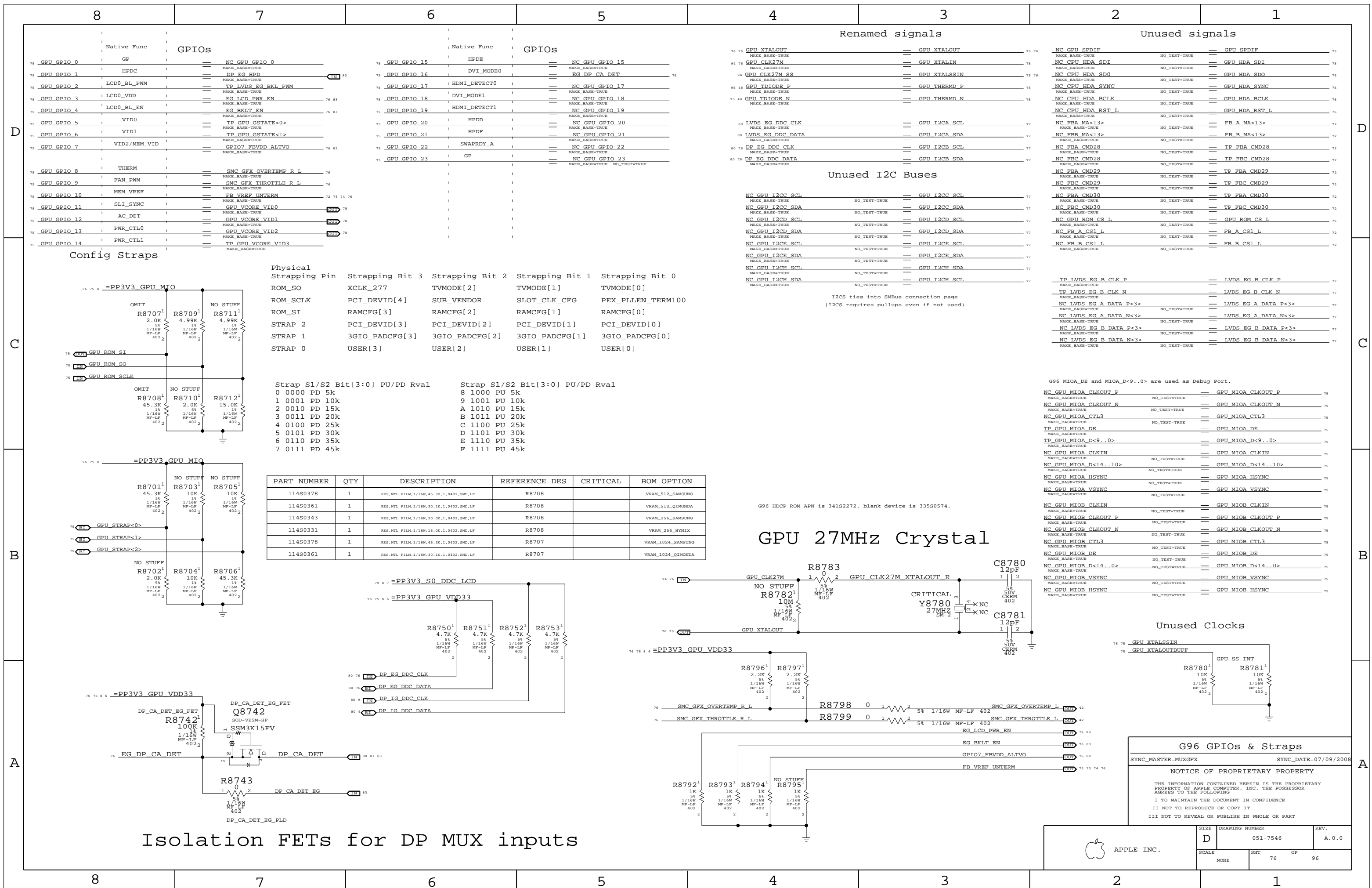
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Renamed signals Unused signals

| | | | | |
|----------------|--------------|----------------------|-----------------|---------------|
| 75 GPU_GPIO_0 | GP | NC_GPU_GPIO_0 | GPU_SPDIF | GPU_SPDIF |
| 75 GPU_GPIO_1 | HPDC | DP_EG_HPD | GPU_HDA_SDI | GPU_HDA_SDI |
| 75 GPU_GPIO_2 | LCD0_BL_PWM | TP_LVDS_EG_BKL_PWM | GPU_HDA_SDO | GPU_HDA_SDO |
| 75 GPU_GPIO_3 | LCD0_VDD | EG_LCD_PWR_EN | GPU_HDA_SYNC | GPU_HDA_SYNC |
| 75 GPU_GPIO_4 | LCD0_BL_EN | EG_BKLT_EN | GPU_HDA_BCLK | GPU_HDA_BCLK |
| 75 GPU_GPIO_5 | VID0 | TP_GPU_GSTATE<0> | GPU_HDA_RST_L | GPU_HDA_RST_L |
| 75 GPU_GPIO_6 | VID1 | TP_GPU_GSTATE<1> | NC_FBA_MA<13> | FB_A_MA<13> |
| 75 GPU_GPIO_7 | VID2/MEM_VID | GPIO7_FBVDD_ALTVO | NC_FBA_MA<13> | FB_B_MA<13> |
| 75 GPU_GPIO_8 | THERM | SMC_GFX_OVERTEMP_R_L | NC_FBA_CMD28 | TP_FBA_CMD28 |
| 75 GPU_GPIO_9 | FAN_PWM | SMC_GFX_THROTTLE_R_L | NC_FBC_CMD28 | TP_FBC_CMD28 |
| 75 GPU_GPIO_10 | MEM_VREF | FB_VREF_UNTERM | NC_FBA_CMD29 | TP_FBA_CMD29 |
| 75 GPU_GPIO_11 | SLI_SYNC | GPU_VCORE_VID0 | NC_FBC_CMD29 | TP_FBC_CMD29 |
| 75 GPU_GPIO_12 | AC_DET | GPU_VCORE_VID1 | NC_FBA_CMD30 | TP_FBA_CMD30 |
| 75 GPU_GPIO_13 | PWR_CTL0 | GPU_VCORE_VID2 | NC_FBC_CMD30 | TP_FBC_CMD30 |
| 75 GPU_GPIO_14 | PWR_CTL1 | TP_GPU_VCORE_VID3 | NC_GPU_ROM_CS_L | GPU_ROM_CS_L |
| | | | NC_FB_A_CS1_L | FB_A_CS1_L |
| | | | NC_FB_B_CS1_L | FB_B_CS1_L |

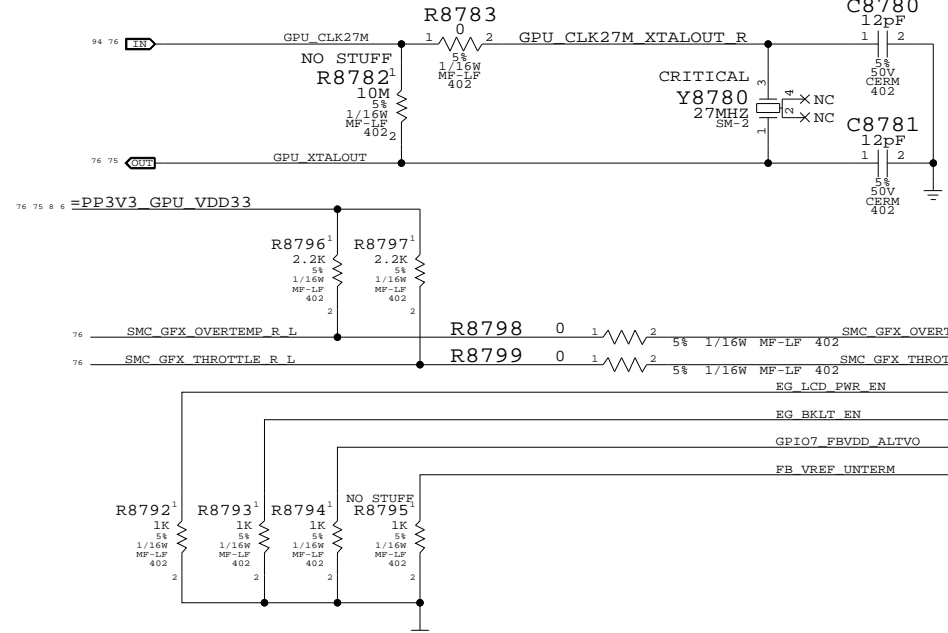
Config Straps

| Strapping Pin | Strapping Bit 3 | Strapping Bit 2 | Strapping Bit 1 | Strapping Bit 0 |
|---------------|-----------------|-----------------|-----------------|-------------------|
| ROM_SO | XCLK_277 | TVMODE[2] | TVMODE[1] | TVMODE[0] |
| ROM_SCLK | PCI_DEVID[4] | SUB_VENDOR | SLOT_CLK_CFG | PEX_PLLEN_TERM100 |
| ROM_SI | RAMCFG[3] | RAMCFG[2] | RAMCFG[1] | RAMCFG[0] |
| STRAP 2 | PCI_DEVID[3] | PCI_DEVID[2] | PCI_DEVID[1] | PCI_DEVID[0] |
| STRAP 1 | 3GIO_PADCFG[3] | 3GIO_PADCFG[2] | 3GIO_PADCFG[1] | 3GIO_PADCFG[0] |
| STRAP 0 | USER[3] | USER[2] | USER[1] | USER[0] |

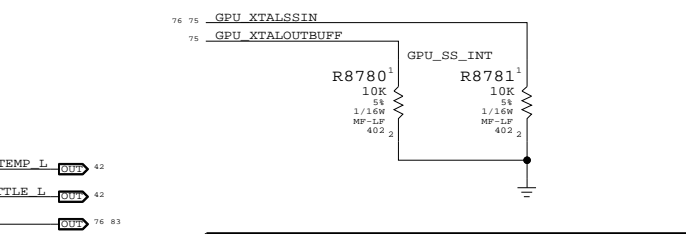
| Strap S1/S2 Bit[3:0] PU/PD Rval | Strap S1/S2 Bit[3:0] PU/PD Rval |
|---------------------------------|---------------------------------|
| 0 0000 PD 5k | 8 1000 PU 5k |
| 1 0001 PD 10k | 9 1001 PU 10k |
| 2 0010 PD 15k | A 1010 PU 15k |
| 3 0011 PD 20k | B 1011 PU 20k |
| 4 0100 PD 25k | C 1100 PU 25k |
| 5 0101 PD 30k | D 1101 PU 30k |
| 6 0110 PD 35k | E 1110 PU 35k |
| 7 0111 PD 45k | F 1111 PU 45k |

| PART NUMBER | QTY | DESCRIPTION | REFERENCE DES | CRITICAL | BOM OPTION |
|-------------|-----|--|---------------|----------|-------------------|
| 114S0378 | 1 | RES.MTL FILM,1/16W,45.3K,1.0402,SMD,LF | R8708 | | VRAM_512_SAMSUNG |
| 114S0361 | 1 | RES.MTL FILM,1/16W,30.1K,1.0402,SMD,LF | R8708 | | VRAM_512_QIMONDA |
| 114S0343 | 1 | RES.MTL FILM,1/16W,20.0K,1.0402,SMD,LF | R8708 | | VRAM_256_SAMSUNG |
| 114S0331 | 1 | RES.MTL FILM,1/16W,15.0K,1.0402,SMD,LF | R8708 | | VRAM_256_HYNIX |
| 114S0378 | 1 | RES.MTL FILM,1/16W,45.3K,1.0402,SMD,LF | R8707 | | VRAM_1024_SAMSUNG |
| 114S0361 | 1 | RES.MTL FILM,1/16W,30.1K,1.0402,SMD,LF | R8707 | | VRAM_1024_QIMONDA |

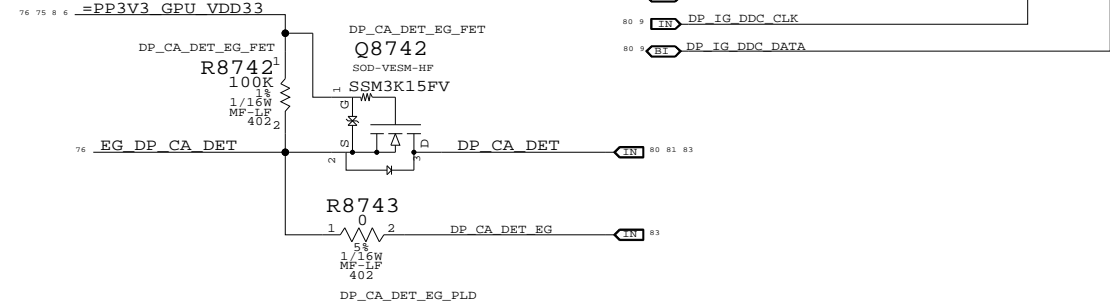
GPU 27MHz Crystal



Unused Clocks



Isolation FETs for DP MUX inputs



G96 GPIOs & Straps
 SYNC_MASTER=MUXGFX SYNC_DATE=07/09/2008

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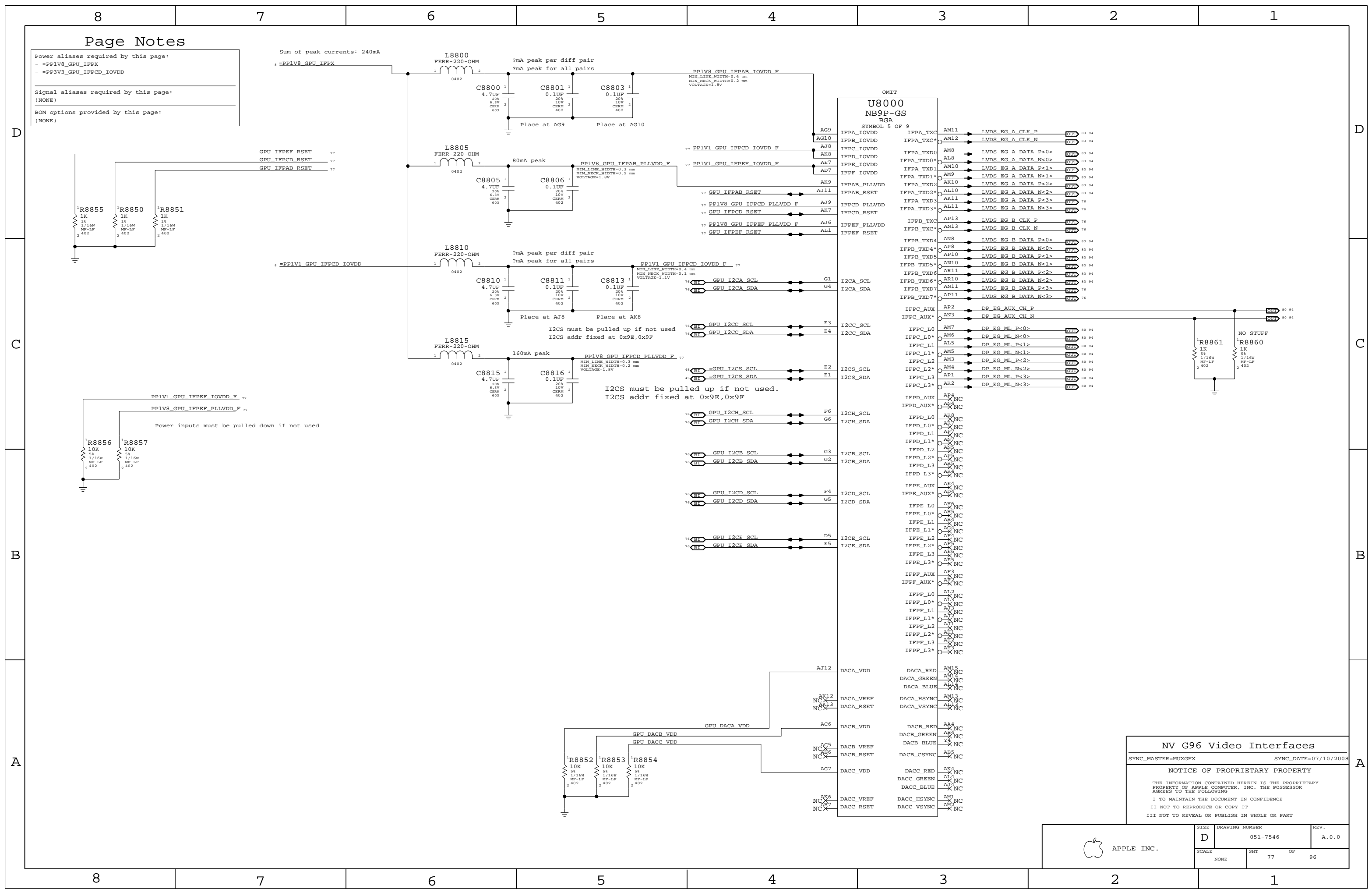
Page Notes

Power aliases required by this page:
 - =PP1V8_GPU_IPFX
 - =PP3V3_GPU_IPFCD_IOVDD

Signal aliases required by this page:
 (NONE)

BOM options provided by this page:
 (NONE)

Sum of peak currents: 240mA
 =PP1V8_GPU_IPFX



NV G96 Video Interfaces

SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008

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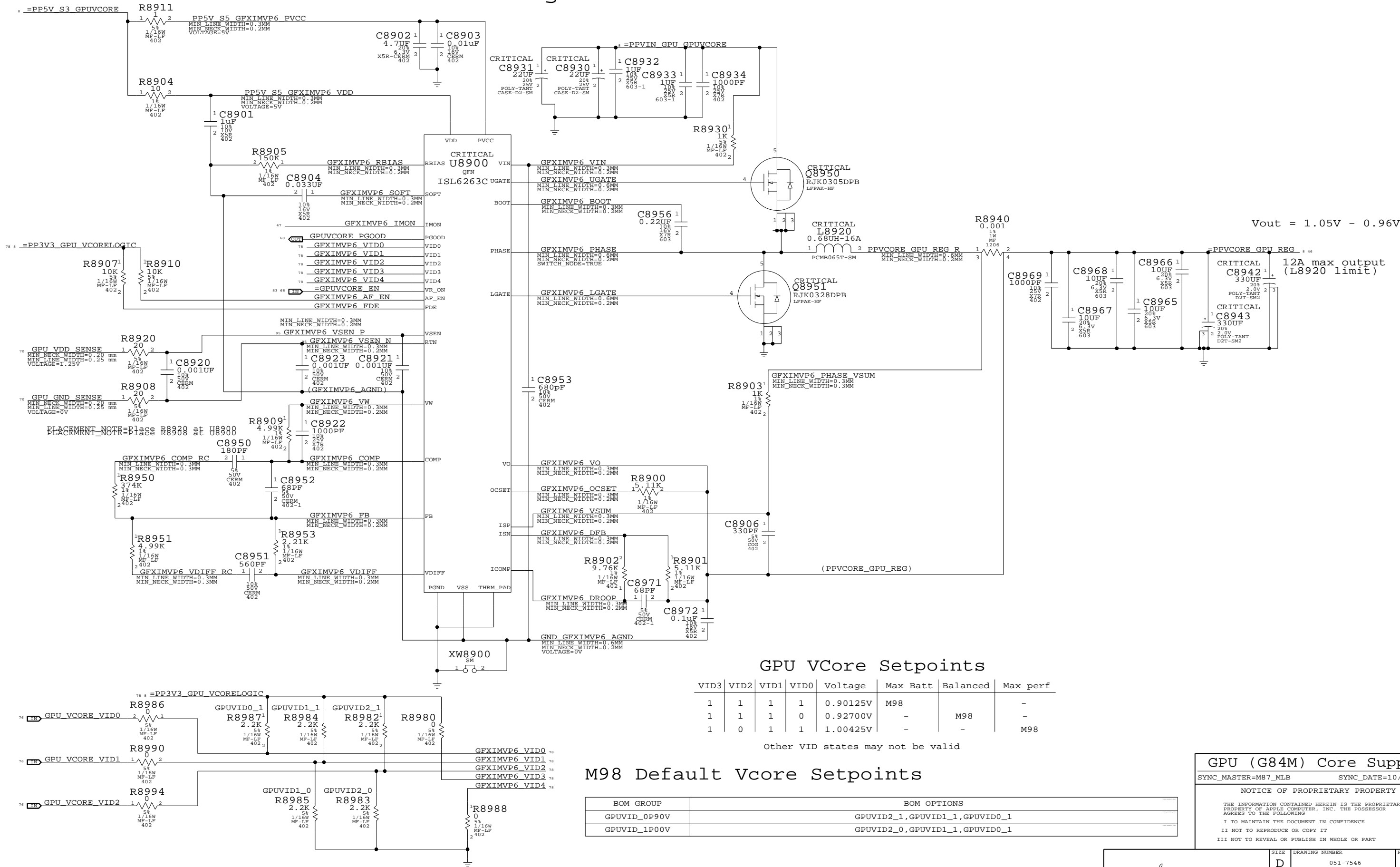
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|------------|------|----------------|----------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | NONE | SHT | 77 OF 96 |

GPU VCore Regulator



GPU VCore Setpoints

| VID3 | VID2 | VID1 | VID0 | Voltage | Max Batt | Balanced | Max perf |
|------|------|------|------|----------|----------|----------|----------|
| 1 | 1 | 1 | 1 | 0.90125V | M98 | | - |
| 1 | 1 | 1 | 0 | 0.92700V | - | M98 | - |
| 1 | 0 | 1 | 1 | 1.00425V | - | - | M98 |

Other VID states may not be valid

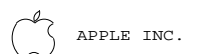
M98 Default Vcore Setpoints

| BOM GROUP | BOM OPTIONS |
|--------------|---------------------------------|
| GPUVID_0P90V | GPUVID2_1, GPUVID1_1, GPUVID0_1 |
| GPUVID_1P00V | GPUVID2_0, GPUVID1_1, GPUVID0_1 |

GPU (G84M) Core Supply

SYNC_MASTER=M87_MLB SYNC_DATE=10/17/2007

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| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 78 | 96 |

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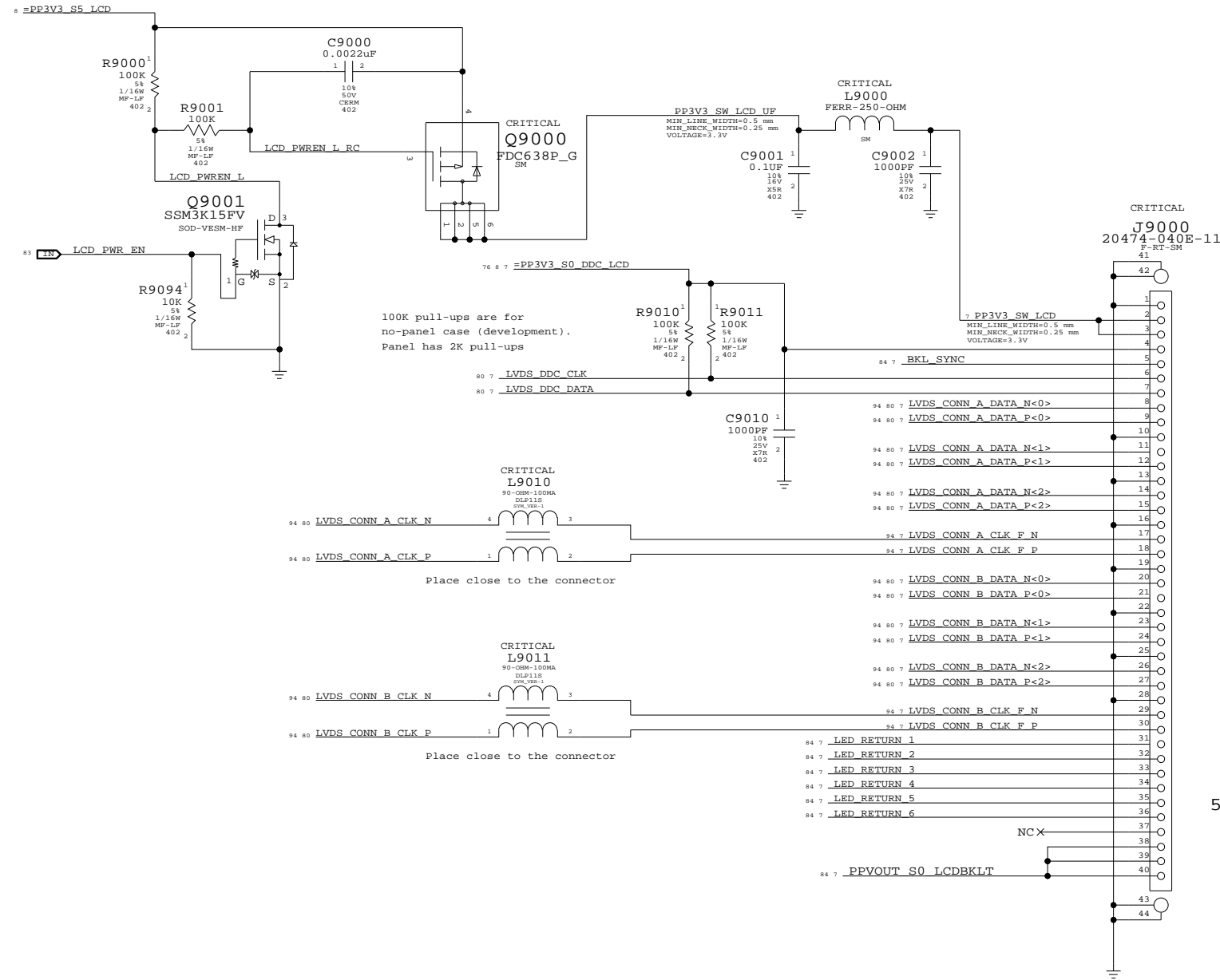
4

3

2

1

LCD (LVDS) INTERFACE



100K pull-ups are for no-panel case (development). Panel has 2K pull-ups

Place close to the connector

Place close to the connector

518S0651

LVDS Display Connector

SYNC_MASTER=MUXGFX SYNC_DATE=02/25/2008

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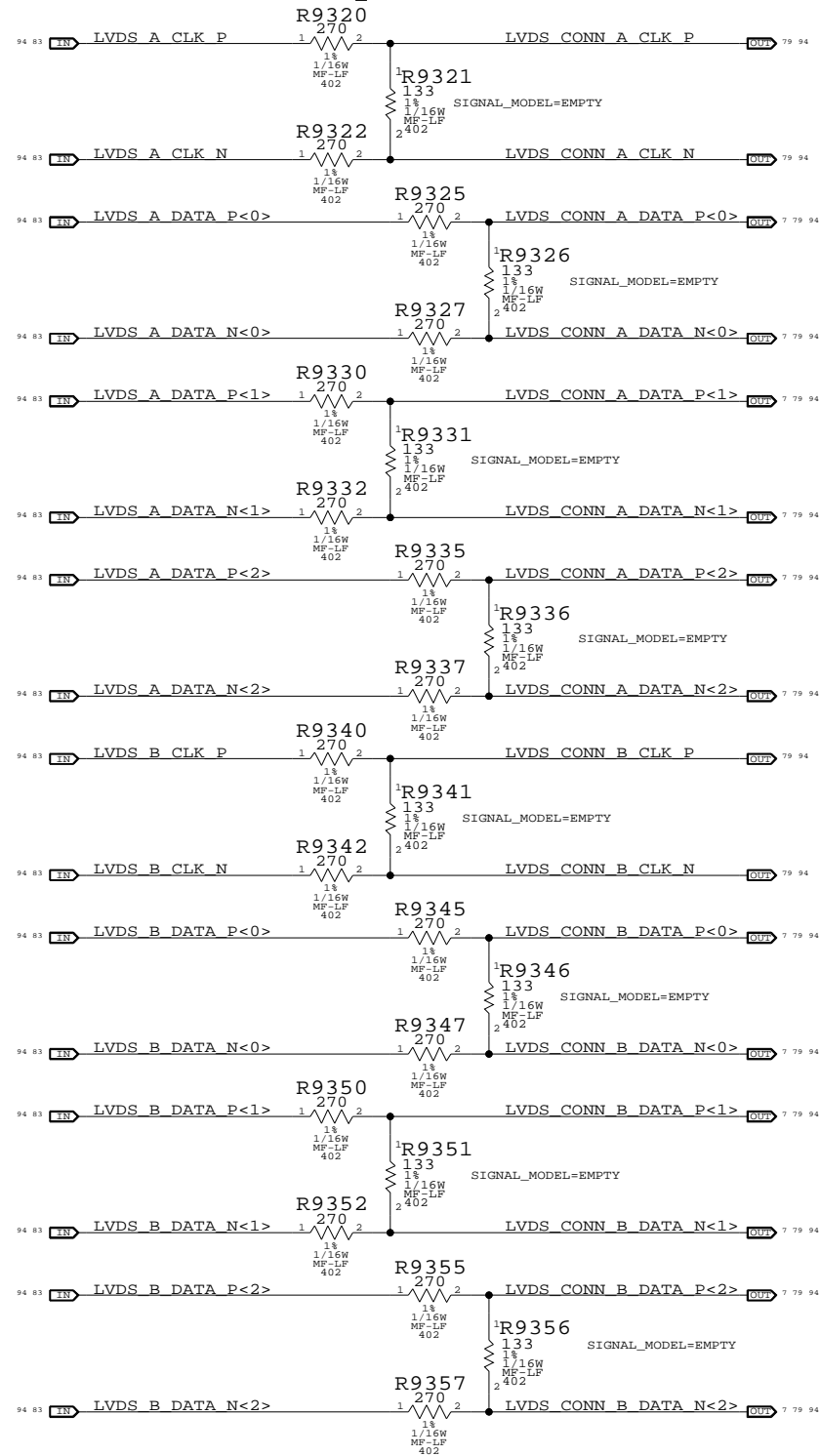
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| | | | |
|----------------|--------------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT 79 OF 96 | | |
| NONE | | | |

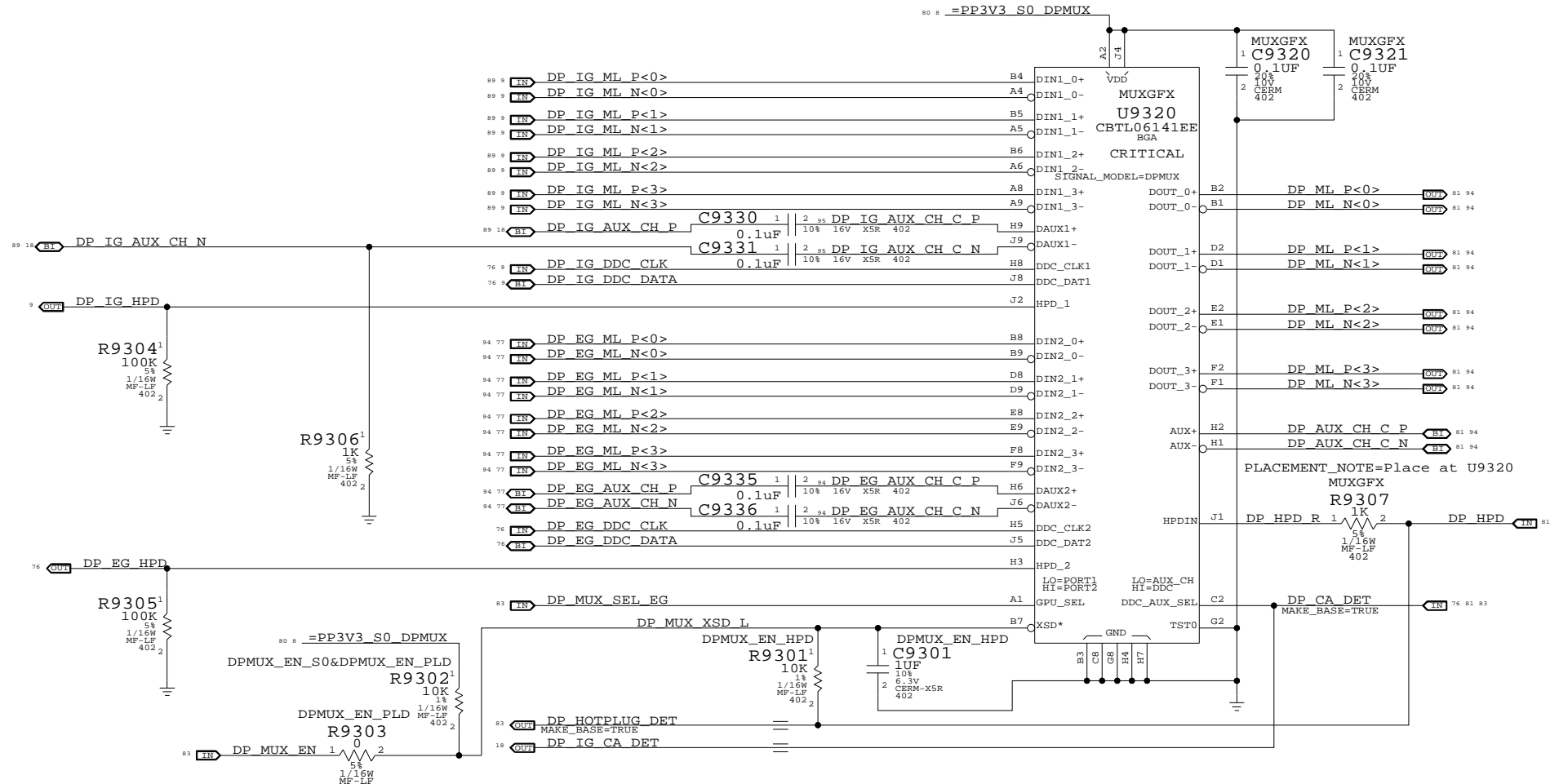
LVDS Transmitter Termination

All emulated LVDS outputs require this termination

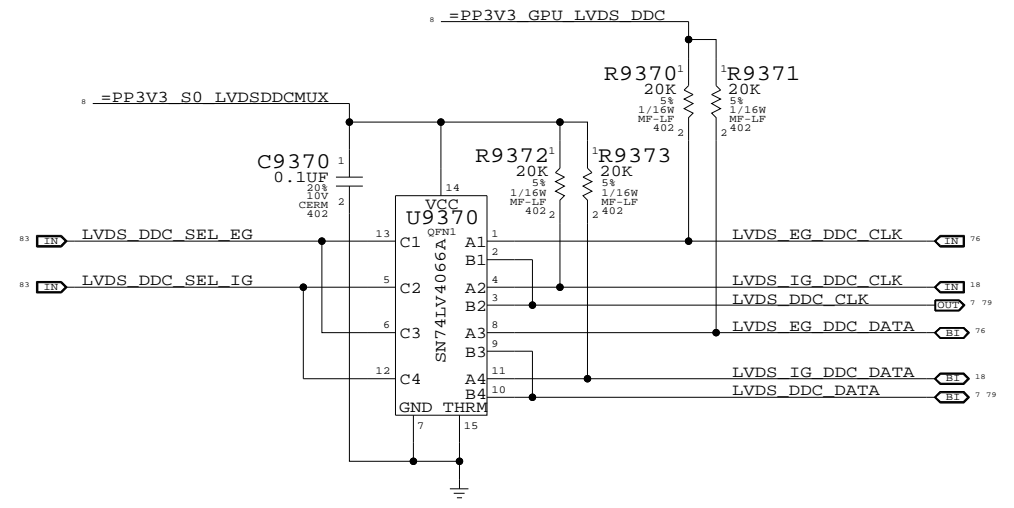
PLACEMENT NOTE=Place at U9200 (All 24 resistors)



DisplayPort Mux



LVDS DDC MUX



Muxed Graphics Support

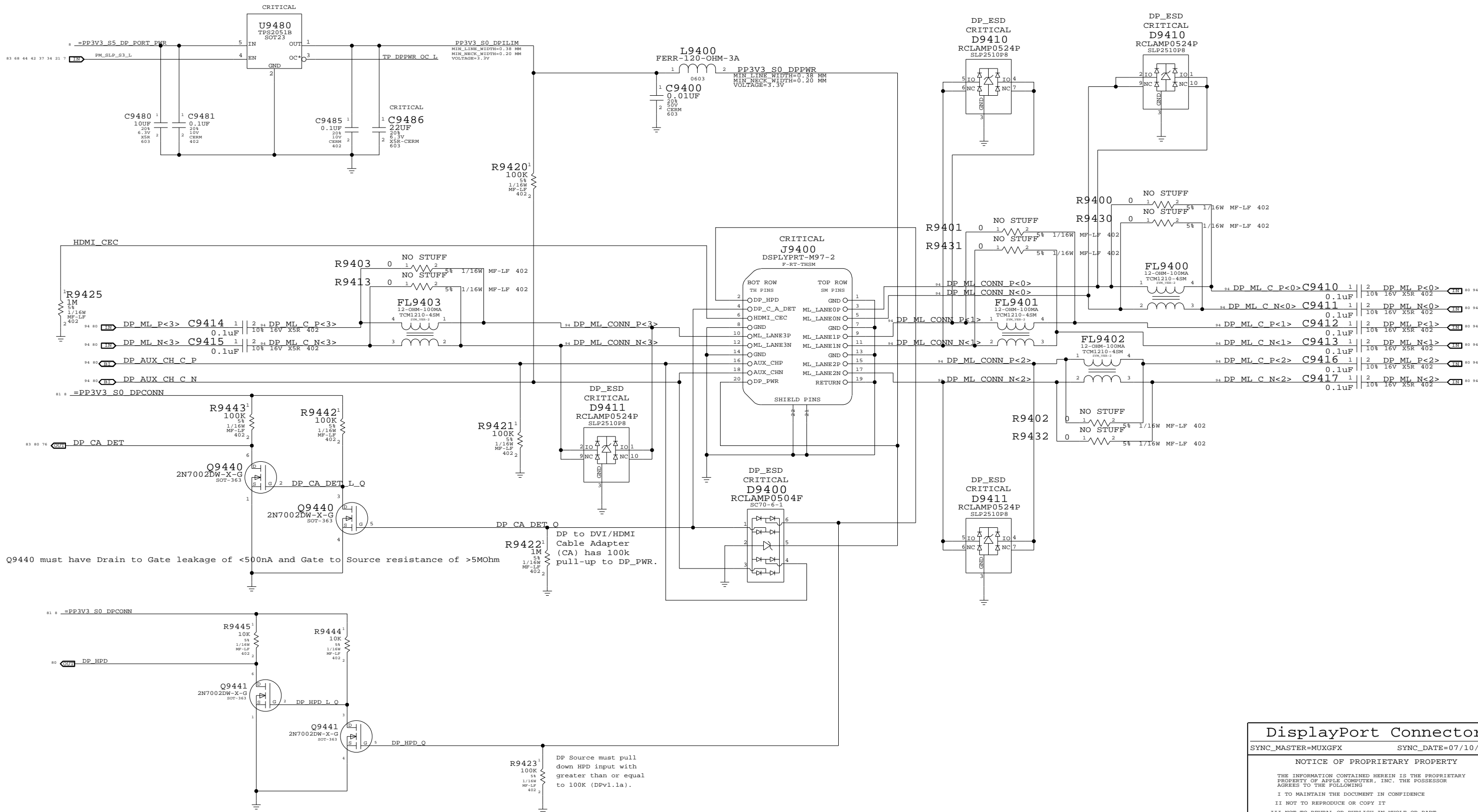
SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008

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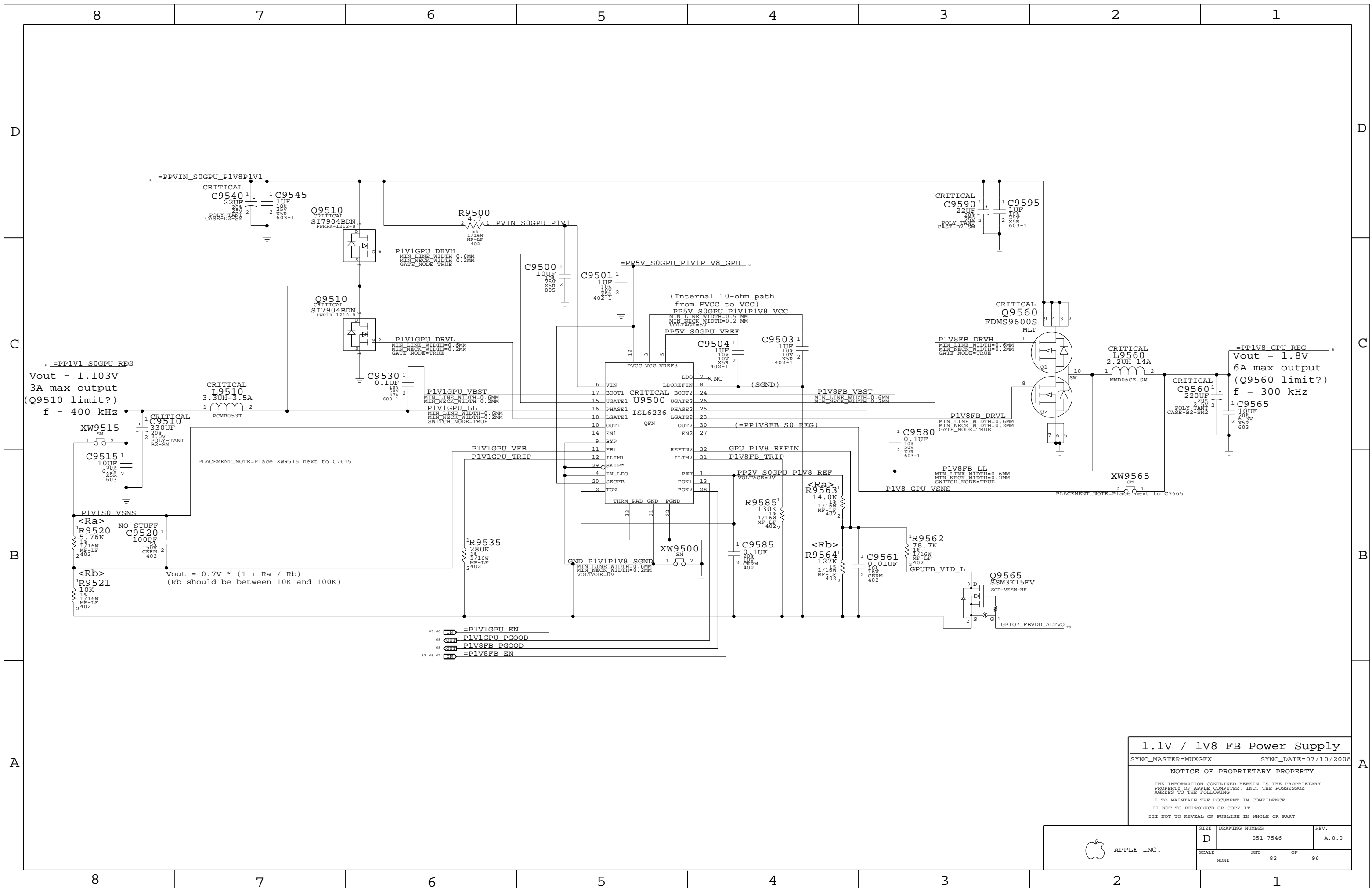
| | | | |
|------------|------|----------------|-------|
| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | 96 |
| NONE | 80 | | |

Port Power Switch



DisplayPort Connector
 SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008
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| APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | NONE | SHT | 81 OF 96 |



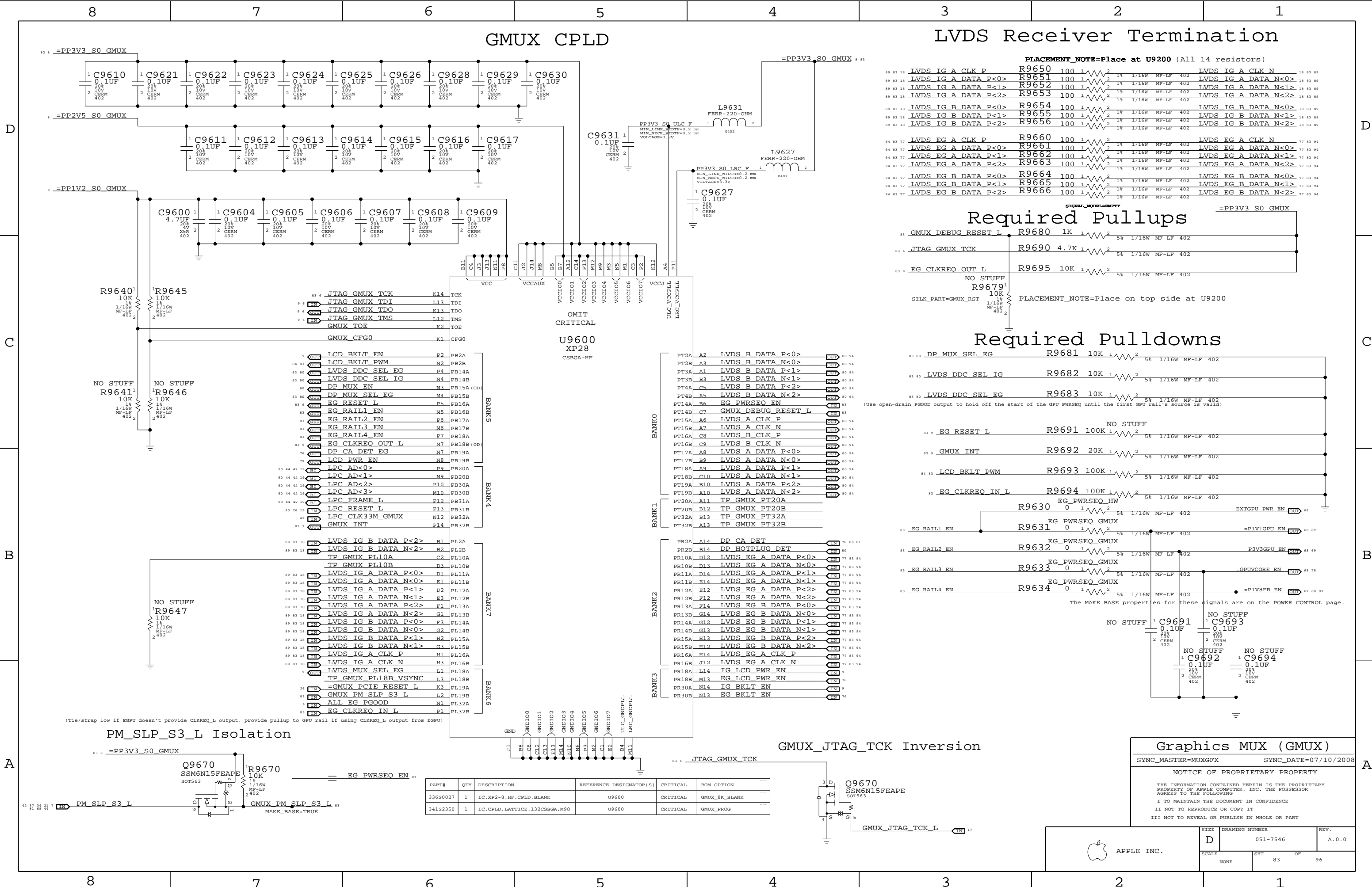
1.1V / 1V8 FB Power Supply

SYNC_MASTER=MUXGFX SYNC_DATE=07/10/2008

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| SCALE | NONE | SHT | 82 OF 96 |



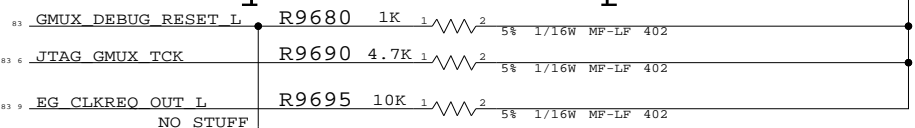
GMUX CPLD

LVDS Receiver Termination

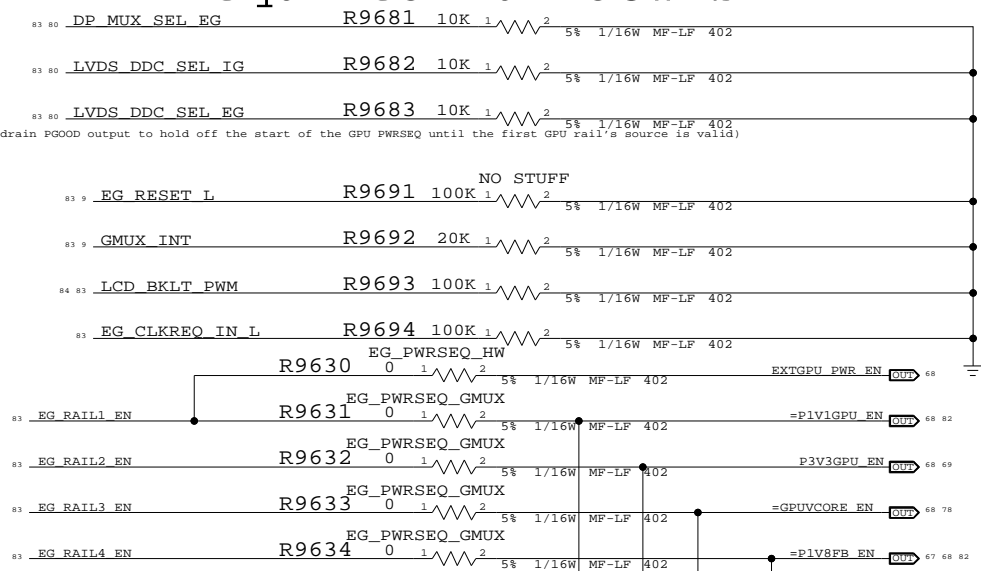
PLACEMENT_NOTE=Place at U9200 (All 14 resistors)

| | | | | | | | |
|----------|---------------------|-------|-----|---|-----------------|---------------------|----------|
| 83 83 18 | LVDS IG A CLK P | R9650 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG A CLK N | 18 83 89 |
| 83 83 18 | LVDS IG A DATA P<0> | R9651 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG A DATA N<0> | 18 83 89 |
| 83 83 18 | LVDS IG A DATA P<1> | R9652 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG A DATA N<1> | 18 83 89 |
| 83 83 18 | LVDS IG A DATA P<2> | R9653 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG A DATA N<2> | 18 83 89 |
| 83 83 18 | LVDS IG B DATA P<0> | R9654 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG B DATA N<0> | 18 83 89 |
| 83 83 18 | LVDS IG B DATA P<1> | R9655 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG B DATA N<1> | 18 83 89 |
| 83 83 18 | LVDS IG B DATA P<2> | R9656 | 100 | 1 | 1/16W MF-LF 402 | LVDS IG B DATA N<2> | 18 83 89 |
| 94 83 77 | LVDS EG A CLK P | R9660 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG A CLK N | 77 83 94 |
| 94 83 77 | LVDS EG A DATA P<0> | R9661 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG A DATA N<0> | 77 83 94 |
| 94 83 77 | LVDS EG A DATA P<1> | R9662 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG A DATA N<1> | 77 83 94 |
| 94 83 77 | LVDS EG A DATA P<2> | R9663 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG A DATA N<2> | 77 83 94 |
| 94 83 77 | LVDS EG B DATA P<0> | R9664 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG B DATA N<0> | 77 83 94 |
| 94 83 77 | LVDS EG B DATA P<1> | R9665 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG B DATA N<1> | 77 83 94 |
| 94 83 77 | LVDS EG B DATA P<2> | R9666 | 100 | 1 | 1/16W MF-LF 402 | LVDS EG B DATA N<2> | 77 83 94 |

Required Pullups



Required Pulldowns



(Use open-drain PGOOD output to hold off the start of the GPU PWRSEQ until the first GPU rail's source is valid)

The MAKE_BASE properties for these signals are on the POWER CONTROL page.

U9600 XP28 CSBGA-HF

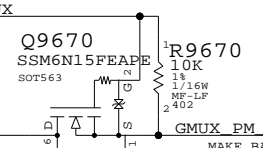
| | | | |
|---------|---------------|-----|------|
| 83 83 8 | JTAG_GMUX_TCK | K14 | TCK |
| 83 83 8 | JTAG_GMUX_TDI | L13 | TDI |
| 83 83 8 | JTAG_GMUX_TDO | K13 | TDO |
| 83 83 8 | JTAG_GMUX_TMS | L12 | TMS |
| 83 83 8 | GMUX_TOE | K2 | TOE |
| 83 83 8 | GMUX_CFG0 | K1 | CFG0 |

| | | | |
|-------------|-----------------|-----|------------|
| 9 | LCD_BKLT_EN | P2 | PB2A |
| 84 | LCD_BKLT_PWM | N2 | PB2B |
| 83 80 | LVDS_DDC_SEL_EG | P4 | PB14A |
| 83 80 | LVDS_DDC_SEL_IG | N4 | PB14B |
| 80 | DP_MUX_SEL_EN | N3 | PB15A (OD) |
| 83 80 | DP_MUX_SEL_EG | M4 | PB15B |
| 83 9 | EG_RESET_L | P5 | PB16A |
| 83 | EG_RAIL1_EN | M5 | PB16B |
| 83 | EG_RAIL2_EN | P6 | PB17A |
| 83 | EG_RAIL3_EN | M6 | PB17B |
| 83 | EG_RAIL4_EN | P7 | PB18A |
| 83 9 | EG_CLKREQ_OUT_L | M7 | PB18B (OD) |
| 76 | DP_CA_DET_EG | N7 | PB19A |
| 79 | LCD_PWR_EN | N8 | PB19B |
| 90 44 12 19 | LPC_AD<0> | P9 | PB20A |
| 90 44 12 19 | LPC_AD<1> | N9 | PB20B |
| 90 44 12 19 | LPC_AD<2> | P10 | PB30A |
| 90 44 12 19 | LPC_AD<3> | M10 | PB30B |
| 90 44 12 19 | LPC_FRAME_L | P12 | PB31A |
| 26 19 | LPC_RESET_L | P13 | PB31B |
| 83 9 | LPC_CLK33M_GMUX | N12 | PB32A |
| 83 9 | GMUX_INT | P14 | PB32B |

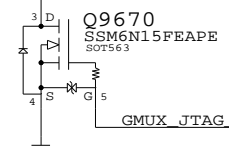
| | | | |
|----------|---------------------|----|-------|
| 83 83 18 | LVDS IG B DATA P<2> | B1 | PL2A |
| 83 83 18 | LVDS IG B DATA N<2> | B2 | PL2B |
| 83 83 18 | TP_GMUX_PL10A | C2 | PL10A |
| 83 83 18 | TP_GMUX_PL10B | D3 | PL10B |
| 83 83 18 | LVDS IG A DATA P<0> | D1 | PL11A |
| 83 83 18 | LVDS IG A DATA N<0> | E1 | PL11B |
| 83 83 18 | LVDS IG A DATA P<1> | D2 | PL12A |
| 83 83 18 | LVDS IG A DATA N<1> | E3 | PL12B |
| 83 83 18 | LVDS IG A DATA P<2> | F1 | PL13A |
| 83 83 18 | LVDS IG A DATA N<2> | G1 | PL13B |
| 83 83 18 | LVDS IG B DATA P<0> | F3 | PL14A |
| 83 83 18 | LVDS IG B DATA N<0> | G2 | PL14B |
| 83 83 18 | LVDS IG B DATA P<1> | H2 | PL15A |
| 83 83 18 | LVDS IG B DATA N<1> | G3 | PL15B |
| 83 83 18 | LVDS IG A CLK P | H1 | PL16A |
| 83 83 18 | LVDS IG A CLK N | H3 | PL16B |
| 9 | LVDS_MUX_SEL_EG | L1 | PL18A |
| 9 | TP_GMUX_PL18B_VSYNC | L3 | PL18B |
| 26 | =GMUX_PCIE_RESET_L | K3 | PL19A |
| 83 | GMUX_PM_SLP_S3_L | L2 | PL19B |
| 83 | ALL_EG_PGOOD | N1 | PL32A |
| 83 | EG_CLKREQ_IN_L | P1 | PL32B |

| PART# | QTY | DESCRIPTION | REFERENCE DESIGNATOR(S) | CRITICAL | BOM OPTION |
|----------|-----|------------------------------|-------------------------|----------|---------------|
| 336S0027 | 1 | IC,XP2-8,HF,CPLD,BLANK | U9600 | CRITICAL | GMUX_8K_BLANK |
| 341S2350 | 1 | IC,CPLD,LATTICE,132CSBGA,M98 | U9600 | CRITICAL | GMUX_PROG |

PM_SLP_S3_L Isolation



GMUX_JTAG_TCK Inversion



Graphics MUX (GMUX)

SYNC_MASTER=MUXGFx SYNC_DATE=07/10/2008

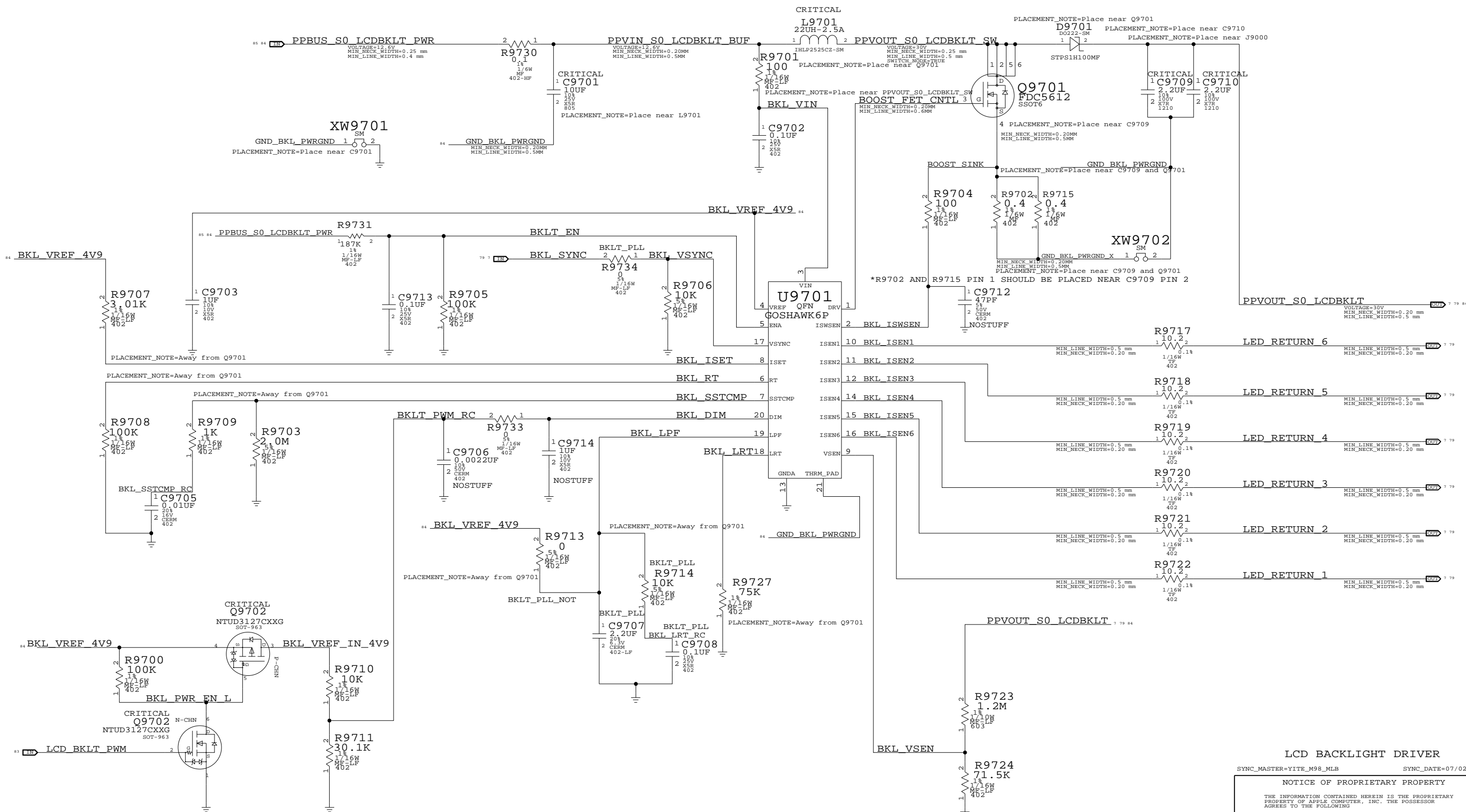
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| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 83 | 96 |

*Q9701, D9701, C9709, C9710, L9701, R9702, AND R9715 SHOULD ALL BE PLACED NEAR EACHOTHER.
 *BOOST_FET_CNTL AND PPVOUT_S0_LCDBKLT_SW SHOULD BE KEPT AS SHORT AS POSSIBLE.



LCD BACKLIGHT DRIVER

SYNC_MASTER=YITE_M98_MLB SYNC_DATE=07/02/2008

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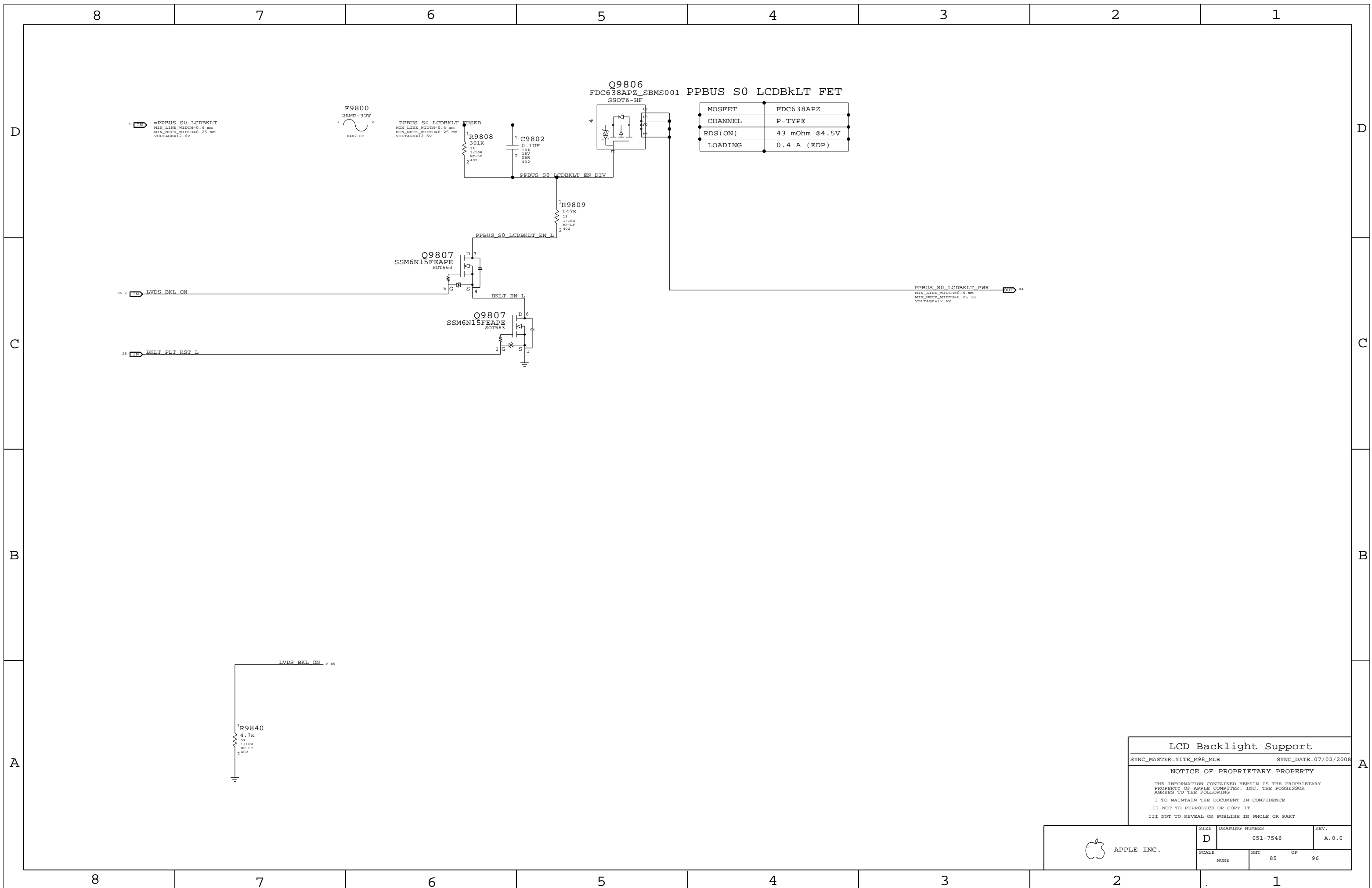
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|-------|----------------|-------|
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| SCALE | SHT | OF |
| NONE | 84 | 96 |

*R9707, R9708, R9709, R9713, R9714, R9727, AND R9729 SHOULD AWAY FROM BOOST CIRCUIT



| | |
|----------|---------------|
| MOSFET | FDC638APZ |
| CHANNEL | P-TYPE |
| RDS (ON) | 43 mOhm @4.5V |
| LOADING | 0.4 A (EDP) |

LCD Backlight Support

SYNC_MASTER=YITE_M98_MLB SYNC_DATE=07/02/2008

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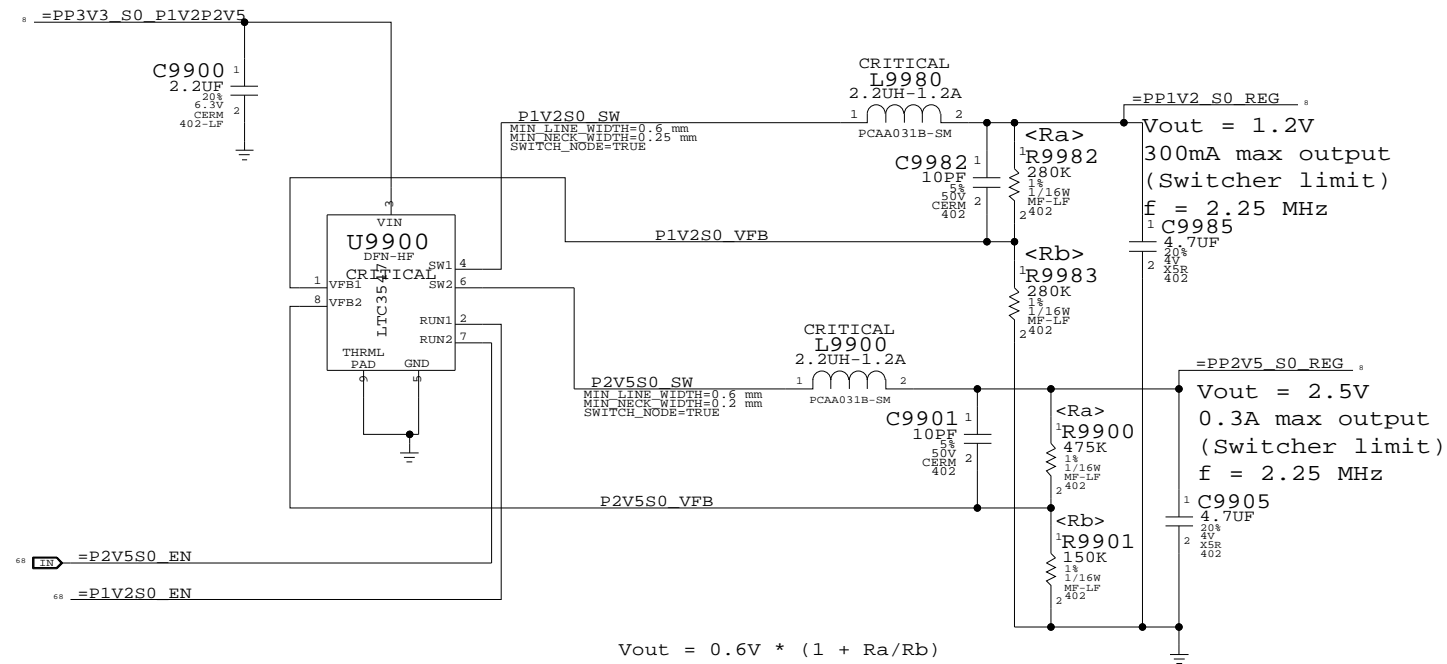
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| NONE | 85 | 96 | |

2.5V/1.2V S3 Switcher



Misc Power Supplies

SYNC_MASTER=MUXGFX SYNC_DATE=02/01/2008

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|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 86 | 96 |

FSB (Front-Side Bus) Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| FSB_50S | * | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =STANDARD | =STANDARD |
| FSB_DSTB_50S | * | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =1:1_DIFFPAIR | =1:1_DIFFPAIR |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT | SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|------------------|------------|----------------------|--------|
| FSB_DATA | * | =2x_DIELECTRIC | ? | FSB_DATA | TOP,BOTTOM | =4x_DIELECTRIC | ? |
| FSB_DSTB | * | =3x_DIELECTRIC | ? | FSB_DSTB | TOP,BOTTOM | =5x_DIELECTRIC | ? |
| FSB_ADDR | * | =STANDARD | ? | FSB_ADDR | TOP,BOTTOM | =3x_DIELECTRIC | ? |
| FSB_ADSTB | * | =2x_DIELECTRIC | ? | FSB_ADSTB | TOP,BOTTOM | =4x_DIELECTRIC | ? |
| FSB_1X | * | =STANDARD | ? | FSB_1X | TOP,BOTTOM | =3x_DIELECTRIC | ? |

All 4x/2x/1x FSB signals with impedance requirements are 50-ohm single-ended.

FSB 4X signals / groups shown in signal table on right.

Signals within each 4x group should be matched within 5 ps of strobe.

DSTB# complementary pairs should be matched within 1 ps of each other, all DSTB#s matched to +/- 300 ps.

Spacing is 2x dielectric between DATA#, DINV# signals, with 3x dielectric spacing to the DSTB#s.

DSTB# complementary pairs are spaced normally and are NOT routed as differential pairs.

FSB 2X signals / groups shown in signal table on right.

Signals within each 2x group should be matched within 20 ps. ADTSB#s should be matched +/- 300 ps.

Spacing is 1x dielectric between ADDR#, REQ# signals, with 2x dielectric spacing to ADSTB#.

FSB 1X signals shown in signal table on right.

Signals within each 1x group should be matched to CPU clock, +0/-1000 mils.

Design Guide recommends each strobe/signal group is routed on the same layer.

Intel Design Guide recommends FSB signals be routed only on internal layers.

NOTE: Intel Design Guide allows closer spacing if signal lengths can be shortened.

SOURCE: MCP79 Interface DG (DG-03328-001_v01), Section 2.2

SOURCE: Santa Rosa Platform DG, Rev 1.5 (#22294), Sections 4.2 & 4.3

CPU Signal Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| CPU_50S | * | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =STANDARD | =STANDARD |
| CPU_27P4S | * | =27P4_OHM_SE | =27P4_OHM_SE | =27P4_OHM_SE | =27P4_OHM_SE | 7 MIL | 7 MIL |

NOTE: 7 mil gap is for VCCsense pair, which Intel says to route with 7 mil spacing without specifying a target impedance.

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT | SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|------------------|------------|----------------------|--------|
| CPU_AGTL | * | =STANDARD | ? | CPU_AGTL | TOP,BOTTOM | =2x_DIELECTRIC | ? |
| CPU_8MIL | * | 8 MIL | ? | | | | |
| CPU_COMP | * | 25 MIL | ? | | | | |
| CPU_GTLREF | * | 25 MIL | ? | | | | |
| CPU_ITP | * | =2:1_SPACING | ? | | | | |
| CPU_VCCSENSE | * | 25 MIL | ? | | | | |

SR DG recommends at least 25 mils, >50 mils preferred

Most CPU signals with impedance requirements are 55-ohm single-ended.

Some signals require 27.4-ohm single-ended impedance.

SOURCE: MCP79 Interface DG (DG-03328-001_v01), Section 2.2

SOURCE: Santa Rosa Platform DG, Rev 0.9 (#20517), Sections 4.4 & 5.8.2.4

MCP FSB COMP Signal Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MCP_50S | * | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| MCP_FSB_COMP | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v01), Section 2.2.4

FSB Clock Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| CLK_FSB_100D | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT | SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|------------------|------------|----------------------|--------|
| CLK_FSB | * | =3x_DIELECTRIC | ? | CLK_FSB | TOP,BOTTOM | =4x_DIELECTRIC | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v01), Section 2.2.5

CPU / FSB Net Properties

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | PROPERTY | VALUE | RANGE |
|---------------------------|--------------|--------------|-----------------------|-------|-------------|
| | PHYSICAL | SPACING | | | |
| FSB_DATA_GROUP0 | FSB_50S | FSB_DATA | FSB D L<15..0> | | 7 10 14 |
| FSB_DATA_GROUP0 | FSB_50S | FSB_DATA | FSB DINV L<0> | | 7 10 14 |
| FSB_DSTB0 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L P<0> | | 7 10 14 |
| FSB_DSTB0 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L N<0> | | 7 10 14 |
| FSB_DATA_GROUP1 | FSB_50S | FSB_DATA | FSB D L<31..16> | | 7 10 14 |
| FSB_DATA_GROUP1 | FSB_50S | FSB_DATA | FSB DINV L<1> | | 7 10 14 |
| FSB_DSTB1 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L P<1> | | 7 10 14 |
| FSB_DSTB1 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L N<1> | | 7 10 14 |
| FSB_DATA_GROUP2 | FSB_50S | FSB_DATA | FSB D L<47..32> | | 7 10 14 |
| FSB_DATA_GROUP2 | FSB_50S | FSB_DATA | FSB DINV L<2> | | 7 10 14 |
| FSB_DSTB2 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L P<2> | | 7 10 14 |
| FSB_DSTB2 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L N<2> | | 7 10 14 |
| FSB_DATA_GROUP3 | FSB_50S | FSB_DATA | FSB D L<63..48> | | 7 10 14 |
| FSB_DATA_GROUP3 | FSB_50S | FSB_DATA | FSB DINV L<3> | | 7 10 14 |
| FSB_DSTB3 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L P<3> | | 7 10 14 |
| FSB_DSTB3 | FSB_DSTB_50S | FSB_DSTB | FSB DSTB L N<3> | | 7 10 14 |
| FSB_ADDR_GROUP0 | FSB_50S | FSB_ADDR | FSB A L<16..3> | | 7 10 14 |
| FSB_ADDR_GROUP0 | FSB_50S | FSB_ADDR | FSB REQ L<4..0> | | 7 10 14 |
| FSB_ADSTB0 | FSB_50S | FSB_ADSTB | FSB ADSTB L<0> | | 7 10 14 |
| FSB_ADDR_GROUP1 | FSB_50S | FSB_ADDR | FSB A L<35..17> | | 7 10 14 |
| FSB_ADSTB1 | FSB_50S | FSB_ADSTB | FSB ADSTB L<1> | | 7 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB ADS L | | 7 10 14 |
| FSB_BREQ0_L | FSB_50S | FSB_1X | FSB_BREQ0 L | | 9 10 14 |
| FSB_BREQ1_L | FSB_50S | FSB_1X | FSB_BREQ1 L | | 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB BNR L | | 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB BPRI L | | 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB DBSY L | | 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB DEFER L | | 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB DRDY L | | 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB HIT L | | 7 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB HITM L | | 7 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB LOCK L | | 7 10 14 |
| FSB_CPURST_L | FSB_50S | FSB_1X | FSB_CPURST L | | 9 10 13 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB RS L<2..0> | | 10 14 |
| FSB_1X | FSB_50S | FSB_1X | FSB TRDY L | | 10 14 |
| CPU_ASYNC | CPU_50S | CPU_AGTL | CPU A20M L | | 10 14 |
| CPU_BSEL | CPU_50S | CPU_AGTL | CPU BSEL<2..0> | | 9 10 |
| CPU_FERR_L | CPU_50S | CPU_8MIL | CPU FERR L | | 10 14 |
| CPU_ASYNC | CPU_50S | CPU_AGTL | CPU IGNE L | | 10 14 |
| CPU_INIT_L | CPU_50S | CPU_AGTL | CPU INIT L | | 10 14 |
| CPU_ASYNC_R | CPU_50S | CPU_AGTL | CPU INTR | | 9 10 14 |
| CPU_ASYNC_R | CPU_50S | CPU_AGTL | CPU NMI | | 9 10 14 |
| CPU_PROCHOT_L | CPU_50S | CPU_AGTL | CPU PROCHOT L | | 10 14 43 62 |
| CPU_PWRGD | CPU_50S | CPU_AGTL | CPU_PWRGD | | 10 13 14 |
| CPU_ASYNC | CPU_50S | CPU_AGTL | CPU SMI L | | 10 14 |
| CPU_ASYNC | CPU_50S | CPU_AGTL | CPU STPCLK L | | 10 14 |
| PM_THERMTRIP_L | CPU_50S | CPU_8MIL | PM_THERMTRIP L | | 10 14 43 |
| FSB_CPUSLP_L | CPU_50S | CPU_AGTL | FSB_CPUSLP L | | 10 14 |
| CPU_PROM_SR | CPU_50S | CPU_AGTL | CPU_PROM_SR | | 10 14 |
| CPU_DPRSTP_L | CPU_50S | CPU_AGTL | CPU DPRSTP L | | 9 10 14 62 |
| CPU_ASYNC | CPU_50S | CPU_AGTL | FSB DPWR L | | 10 14 |
| MCP_CPU_COMP | MCP_50S | MCP_FSB_COMP | MCP BCLK VML COMP VDD | | 14 |
| MCP_CPU_COMP | MCP_50S | MCP_FSB_COMP | MCP BCLK VML COMP GND | | 14 |
| MCP_CPU_COMP | MCP_50S | MCP_FSB_COMP | MCP CPU COMP VCC | | 14 |
| MCP_CPU_COMP | MCP_50S | MCP_FSB_COMP | MCP CPU COMP GND | | 14 |
| FSB_CLK_CPU | CLK_FSB_100D | CLK_FSB | FSB CLK CPU P | | 10 14 |
| FSB_CLK_CPU | CLK_FSB_100D | CLK_FSB | FSB CLK CPU N | | 10 14 |
| FSB_CLK_ITP | CLK_FSB_100D | CLK_FSB | FSB CLK ITP P | | 13 14 |
| FSB_CLK_ITP | CLK_FSB_100D | CLK_FSB | FSB CLK ITP N | | 13 14 |
| FSB_CLK_MCP | CLK_FSB_100D | CLK_FSB | FSB CLK MCP P | | 14 |
| FSB_CLK_MCP | CLK_FSB_100D | CLK_FSB | FSB CLK MCP N | | 14 |
| CPU_IERR_L | CPU_50S | | CPU_IERR L | | 10 |
| PM_DPRSLEVR | CPU_50S | CPU_AGTL | PM_DPRSLEVR | | 21 62 |
| (See above) | CPU_50S | CPU_AGTL | IMVP DPRSLEVR | | 62 |
| CPU_GTLREF | CPU_50S | CPU_GTLREF | CPU GTLREF | | 10 27 |
| CPU_COMP | CPU_50S | CPU_COMP | CPU_COMP<3> | | 10 |
| CPU_COMP | CPU_27P4S | CPU_COMP | CPU_COMP<2> | | 10 |
| CPU_COMP | CPU_50S | CPU_COMP | CPU_COMP<1> | | 10 |
| CPU_COMP | CPU_27P4S | CPU_COMP | CPU_COMP<0> | | 10 |
| XDP_TDI | CPU_50S | CPU_ITP | XDP TDI | | 6 10 13 |
| XDP_TDO | CPU_50S | CPU_ITP | XDP TDO | | 6 10 |
| XDP_TMS | CPU_50S | CPU_ITP | XDP TMS | | 6 10 13 |
| XDP_TCK | CPU_50S | CPU_ITP | XDP TCK | | 6 10 13 |
| XDP_TRST_L | CPU_50S | CPU_ITP | XDP TRST L | | 6 10 13 |
| XDP_BPM_L | CPU_50S | CPU_ITP | XDP BPM L<4..0> | | 10 13 |
| XDP_BPM_L5 | CPU_50S | CPU_ITP | XDP BPM L<5> | | 10 13 |
| (FSB_CPURST_L) | CPU_50S | CPU_ITP | XDP_CPURST L | | 13 |
| | CPU_50S | CPU_8MIL | CPU VID<6..0> | | 9 11 |
| | CPU_50S | CPU_8MIL | IMVP6 VID<6..0> | | 9 62 |
| CPU_VCCSENSE | CPU_27P4S | CPU_VCCSENSE | CPU VCCSENSE P | | 11 62 |
| CPU_VCCSENSE | CPU_27P4S | CPU_VCCSENSE | CPU VCCSENSE N | | 11 62 |
| (CPU_VCCSENSE) | CPU_27P4S | CPU_VCCSENSE | IMVP6 VSEN P | | 62 |
| (CPU_VCCSENSE) | CPU_27P4S | CPU_VCCSENSE | IMVP6 VSEN N | | 62 |

CPU/FSB Constraints

SYNC_MASTER=MUXGFX SYNC_DATE=02/18/2008

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| | | |
|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 87 | 96 |

Memory Bus Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MEM_40S | * | =40_OHM_SE | =40_OHM_SE | =40_OHM_SE | =40_OHM_SE | =STANDARD | =STANDARD |
| MEM_40S_VDD | * | =40_OHM_SE | =40_OHM_SE | =40_OHM_SE | =40_OHM_SE | =STANDARD | =STANDARD |
| MEM_70D | * | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF |
| MEM_70D_VDD | * | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF | =70_OHM_DIFF |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| MEM_CLK2MEM | * | =4:1_SPACING | ? |
| MEM_CTRL2CTRL | * | =2:1_SPACING | ? |
| MEM_CTRL2MEM | * | =2.5:1_SPACING | ? |
| MEM_CMD2CMD | * | =1.5:1_SPACING | ? |
| MEM_CMD2MEM | * | =3:1_SPACING | ? |
| MEM_DATA2DATA | * | =1.5:1_SPACING | ? |
| MEM_DATA2MEM | * | =3:1_SPACING | ? |
| MEM_DQS2MEM | * | =3:1_SPACING | ? |
| MEM_2OTHER | * | 25 MIL | ? |

Memory Bus Spacing Group Assignments

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| MEM_CLK | MEM_CLK | * | MEM_CLK2MEM |
| MEM_CLK | MEM_CTRL | * | MEM_CLK2MEM |
| MEM_CLK | MEM_CMD | * | MEM_CLK2MEM |
| MEM_CLK | MEM_DATA | * | MEM_CLK2MEM |
| MEM_CLK | MEM_DQS | * | MEM_CLK2MEM |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| MEM_CMD | MEM_CMD | * | MEM_CMD2MEM |
| MEM_CMD | MEM_CTRL | * | MEM_CMD2MEM |
| MEM_CMD | MEM_CMD | * | MEM_CMD2CMD |
| MEM_CMD | MEM_DATA | * | MEM_CMD2MEM |
| MEM_CMD | MEM_DQS | * | MEM_CMD2MEM |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| MEM_CTRL | MEM_CTRL | * | MEM_CTRL2CTRL |
| MEM_CTRL | MEM_CTRL | * | MEM_CTRL2MEM |
| MEM_CTRL | MEM_CMD | * | MEM_CTRL2MEM |
| MEM_CTRL | MEM_DATA | * | MEM_CTRL2MEM |
| MEM_CTRL | MEM_DQS | * | MEM_CTRL2MEM |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| MEM_DQS | MEM_DQS | * | MEM_DQS2MEM |
| MEM_DQS | MEM_CTRL | * | MEM_DQS2MEM |
| MEM_DQS | MEM_CMD | * | MEM_DQS2MEM |
| MEM_DQS | MEM_DATA | * | MEM_DQS2MEM |
| MEM_DQS | MEM_DQS | * | MEM_DQS2MEM |

Need to support MEM_*-style wildcards!

DDR2:
 DQ signals should be matched within 20 ps of associated DQS pair.
 DQS intra-pair matching should be within 1 ps, no inter-pair matching requirement.
 All DQS pairs should be matched within 100 ps of clocks.
 CLK intra-pair matching should be within 1 ps, inter-pair matching should be within 140 ps.
 A/BA/cmd signals should be matched within 75 ps, no CLK matching requirement.
 All memory signals maximum length is 1.005 ps. CLK minimum length is 594 ps (lengths include substrate).
 DQ/A/BA/cmd signal spacing is 3x dielectric, DQS/CLK is 4x dielectric.

DDR3:
 DQ signals should be matched within 5 ps of associated DQS pair.
 DQS intra-pair matching should be within 1 ps, inter-pair matching should be within 180 ps
 No DQS to clock matching requirement.
 CLK intra-pair matching should be within 1 ps, inter-pair matching should be within 2 ps.
 A/BA/cmd signals should be matched within 5 ps of CLK pairs.
 All memory signals maximum length is 1.005 ps. CLK minimum length is 594 ps (lengths include substrate).
 DQ/A/BA/cmd signal spacing is 3x dielectric, DQS/CLK is 4x dielectric.

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.3
 SOURCE: Santa Rosa Platform DG, Rev 1.0 (#21112), Section 6.2

MCP MEM COMP Signal Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MCP_MEM_COMP | * | Y | 7 MIL | 7 MIL | =STANDARD | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| MCP_MEM_COMP | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.3.4

Memory Net Properties

| ELECTRICAL_CONSTRAINT_SET | PHYSICAL | SPACING | NET_TYPE |
|---------------------------|--------------|--------------|-------------------|
| MEM_A_CLK | MEM_70D_VDD | MEM_CLK | MEM A CLK P<5..0> |
| MEM_A_CLK | MEM_70D_VDD | MEM_CLK | MEM A CLK N<5..0> |
| MEM_A_CNTRL | MEM_40S_VDD | MEM_CTRL | MEM A CKE<3..0> |
| MEM_A_CNTRL | MEM_40S_VDD | MEM_CTRL | MEM A CS L<3..0> |
| MEM_A_CNTRL | MEM_40S_VDD | MEM_CTRL | MEM A ODT<3..0> |
| MEM_A_CMD | MEM_40S_VDD | MEM_CMD | MEM A A<14..0> |
| MEM_A_CMD | MEM_40S_VDD | MEM_CMD | MEM A BA<2..0> |
| MEM_A_CMD | MEM_40S_VDD | MEM_CMD | MEM A RAS L |
| MEM_A_CMD | MEM_40S_VDD | MEM_CMD | MEM A CAS L |
| MEM_A_CMD | MEM_40S_VDD | MEM_CMD | MEM A WE L |
| MEM_A_DQ_BYTE0 | MEM_40S | MEM_DATA | MEM A DQ<7..0> |
| MEM_A_DQ_BYTE1 | MEM_40S | MEM_DATA | MEM A DQ<15..8> |
| MEM_A_DQ_BYTE2 | MEM_40S | MEM_DATA | MEM A DQ<23..16> |
| MEM_A_DQ_BYTE3 | MEM_40S | MEM_DATA | MEM A DQ<31..24> |
| MEM_A_DQ_BYTE4 | MEM_40S | MEM_DATA | MEM A DQ<39..32> |
| MEM_A_DQ_BYTE5 | MEM_40S | MEM_DATA | MEM A DQ<47..40> |
| MEM_A_DQ_BYTE6 | MEM_40S | MEM_DATA | MEM A DQ<55..48> |
| MEM_A_DQ_BYTE7 | MEM_40S | MEM_DATA | MEM A DQ<63..56> |
| MEM_A_DQ_BYTE0 | MEM_40S | MEM_DATA | MEM A DM<0> |
| MEM_A_DQ_BYTE1 | MEM_40S | MEM_DATA | MEM A DM<1> |
| MEM_A_DQ_BYTE2 | MEM_40S | MEM_DATA | MEM A DM<2> |
| MEM_A_DQ_BYTE3 | MEM_40S | MEM_DATA | MEM A DM<3> |
| MEM_A_DQ_BYTE4 | MEM_40S | MEM_DATA | MEM A DM<4> |
| MEM_A_DQ_BYTE5 | MEM_40S | MEM_DATA | MEM A DM<5> |
| MEM_A_DQ_BYTE6 | MEM_40S | MEM_DATA | MEM A DM<6> |
| MEM_A_DQ_BYTE7 | MEM_40S | MEM_DATA | MEM A DM<7> |
| MEM_A_DQS0 | MEM_70D | MEM_DQS | MEM A DQS P<0> |
| MEM_A_DQS0 | MEM_70D | MEM_DQS | MEM A DQS N<0> |
| MEM_A_DQS1 | MEM_70D | MEM_DQS | MEM A DQS P<1> |
| MEM_A_DQS1 | MEM_70D | MEM_DQS | MEM A DQS N<1> |
| MEM_A_DQS2 | MEM_70D | MEM_DQS | MEM A DQS P<2> |
| MEM_A_DQS2 | MEM_70D | MEM_DQS | MEM A DQS N<2> |
| MEM_A_DQS3 | MEM_70D | MEM_DQS | MEM A DQS P<3> |
| MEM_A_DQS3 | MEM_70D | MEM_DQS | MEM A DQS N<3> |
| MEM_A_DQS4 | MEM_70D | MEM_DQS | MEM A DQS P<4> |
| MEM_A_DQS4 | MEM_70D | MEM_DQS | MEM A DQS N<4> |
| MEM_A_DQS5 | MEM_70D | MEM_DQS | MEM A DQS P<5> |
| MEM_A_DQS5 | MEM_70D | MEM_DQS | MEM A DQS N<5> |
| MEM_A_DQS6 | MEM_70D | MEM_DQS | MEM A DQS P<6> |
| MEM_A_DQS6 | MEM_70D | MEM_DQS | MEM A DQS N<6> |
| MEM_A_DQS7 | MEM_70D | MEM_DQS | MEM A DQS P<7> |
| MEM_A_DQS7 | MEM_70D | MEM_DQS | MEM A DQS N<7> |
| MEM_B_CLK | MEM_70D_VDD | MEM_CLK | MEM B CLK P<5..0> |
| MEM_B_CLK | MEM_70D_VDD | MEM_CLK | MEM B CLK N<5..0> |
| MEM_B_CNTRL | MEM_40S_VDD | MEM_CTRL | MEM B CKE<3..0> |
| MEM_B_CNTRL | MEM_40S_VDD | MEM_CTRL | MEM B CS L<3..0> |
| MEM_B_CNTRL | MEM_40S_VDD | MEM_CTRL | MEM B ODT<3..0> |
| MEM_B_CMD | MEM_40S_VDD | MEM_CMD | MEM B A<14..0> |
| MEM_B_CMD | MEM_40S_VDD | MEM_CMD | MEM B BA<2..0> |
| MEM_B_CMD | MEM_40S_VDD | MEM_CMD | MEM B RAS L |
| MEM_B_CMD | MEM_40S_VDD | MEM_CMD | MEM B CAS L |
| MEM_B_CMD | MEM_40S_VDD | MEM_CMD | MEM B WE L |
| MEM_B_DQ_BYTE0 | MEM_40S | MEM_DATA | MEM B DQ<7..0> |
| MEM_B_DQ_BYTE1 | MEM_40S | MEM_DATA | MEM B DQ<15..8> |
| MEM_B_DQ_BYTE2 | MEM_40S | MEM_DATA | MEM B DQ<23..16> |
| MEM_B_DQ_BYTE3 | MEM_40S | MEM_DATA | MEM B DQ<31..24> |
| MEM_B_DQ_BYTE4 | MEM_40S | MEM_DATA | MEM B DQ<39..32> |
| MEM_B_DQ_BYTE5 | MEM_40S | MEM_DATA | MEM B DQ<47..40> |
| MEM_B_DQ_BYTE6 | MEM_40S | MEM_DATA | MEM B DQ<55..48> |
| MEM_B_DQ_BYTE7 | MEM_40S | MEM_DATA | MEM B DQ<63..56> |
| MEM_B_DQ_BYTE0 | MEM_40S | MEM_DATA | MEM B DM<0> |
| MEM_B_DQ_BYTE1 | MEM_40S | MEM_DATA | MEM B DM<1> |
| MEM_B_DQ_BYTE2 | MEM_40S | MEM_DATA | MEM B DM<2> |
| MEM_B_DQ_BYTE3 | MEM_40S | MEM_DATA | MEM B DM<3> |
| MEM_B_DQ_BYTE4 | MEM_40S | MEM_DATA | MEM B DM<4> |
| MEM_B_DQ_BYTE5 | MEM_40S | MEM_DATA | MEM B DM<5> |
| MEM_B_DQ_BYTE6 | MEM_40S | MEM_DATA | MEM B DM<6> |
| MEM_B_DQ_BYTE7 | MEM_40S | MEM_DATA | MEM B DM<7> |
| MEM_B_DQS0 | MEM_70D | MEM_DQS | MEM B DQS P<0> |
| MEM_B_DQS0 | MEM_70D | MEM_DQS | MEM B DQS N<0> |
| MEM_B_DQS1 | MEM_70D | MEM_DQS | MEM B DQS P<1> |
| MEM_B_DQS1 | MEM_70D | MEM_DQS | MEM B DQS N<1> |
| MEM_B_DQS2 | MEM_70D | MEM_DQS | MEM B DQS P<2> |
| MEM_B_DQS2 | MEM_70D | MEM_DQS | MEM B DQS N<2> |
| MEM_B_DQS3 | MEM_70D | MEM_DQS | MEM B DQS P<3> |
| MEM_B_DQS3 | MEM_70D | MEM_DQS | MEM B DQS N<3> |
| MEM_B_DQS4 | MEM_70D | MEM_DQS | MEM B DQS P<4> |
| MEM_B_DQS4 | MEM_70D | MEM_DQS | MEM B DQS N<4> |
| MEM_B_DQS5 | MEM_70D | MEM_DQS | MEM B DQS P<5> |
| MEM_B_DQS5 | MEM_70D | MEM_DQS | MEM B DQS N<5> |
| MEM_B_DQS6 | MEM_70D | MEM_DQS | MEM B DQS P<6> |
| MEM_B_DQS6 | MEM_70D | MEM_DQS | MEM B DQS N<6> |
| MEM_B_DQS7 | MEM_70D | MEM_DQS | MEM B DQS P<7> |
| MEM_B_DQS7 | MEM_70D | MEM_DQS | MEM B DQS N<7> |
| MCP_MEM_COMP | MCP_MEM_COMP | MCP_MEM_COMP | MCP MEM COMP VDD |
| MCP_MEM_COMP | MCP_MEM_COMP | MCP_MEM_COMP | MCP MEM COMP GND |

Memory Constraints

SYNC_MASTER=MUXGFX SYNC_DATE=02/18/2008

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| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| PCIE_90D | * | =90_OHM_DIFF | =90_OHM_DIFF | =90_OHM_DIFF | 13.1 MM | =90_OHM_DIFF | =90_OHM_DIFF |
| CLK_PCIE_100D | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| PCIE | * | =3X_DIELECTRIC | ? |
| CLK_PCIE | * | 20 MIL | ? |
| MCP_PEX_COMP | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.4

Analog Video Signal Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| CRT_50S | * | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =50_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| CRT | * | =4:1_SPACING | ? |
| CRT_2CRT | * | =STANDARD | ? |
| CRT_2CLK | * | 50 MIL | ? |
| CRT_2SWITCHER | * | 250 MIL | ? |
| CRT_SYNC | * | 16 MIL | ? |
| MCP_DAC_COMP | * | =2:1_SPACING | ? |

CRT signal single-ended impedance varies by location:

- 37.5-ohm from MCP to first termination resistor.
- 50-ohm from first to second termination resistor.
- 75-ohm from output of three-pole filter to connector (if possible).

R/G/B signals should be matched as close as possible and < 10 inches.

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Sections 2.5.1 & 2.5.2.

Digital Video Signal Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| DP_100D | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |
| LVDS_100D | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |
| MCP_DV_COMP | * | Y | 20 MIL | 20 MIL | =STANDARD | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| DISPLAYPORT | * | =3X_DIELECTRIC | ? |
| LVDS | * | =3X_DIELECTRIC | ? |

LVDS intra-pair matching should be 5 mils. Pairs should be within 100 mils of clock length. DisplayPort/TMDS intra-pair matching should be 5 ps. Inter-pair matching should be within 150 ps. DisplayPort AUX CH intra-pair matching should be 5 ps. No relationship to other signals. Max length of LVDS/DisplayPort/TMDS traces: 12 inches.

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Sections 2.5.3 & 2.5.4.

SATA 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 |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| SATA_100D | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| SATA | * | =4X_DIELECTRIC | ? |
| SATA_TERM | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.7.1.

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | | |
|---------------------------|------------------|--------------|-----------------------|------------------------|
| | PHYSICAL | SPACING | | |
| | PCIE_90D | PCIE | PEG R2D P<15..0> | 70 |
| | PCIE_90D | PCIE | PEG R2D N<15..0> | 70 |
| | PCIE_90D | PCIE | PEG R2D C P<15..0> | 9 70 |
| | PCIE_90D | PCIE | PEG R2D C N<15..0> | 9 70 |
| | PCIE_90D | PCIE | PEG D2R P<15..0> | 9 70 |
| | PCIE_90D | PCIE | PEG D2R N<15..0> | 9 70 |
| | PCIE_90D | PCIE | PEG D2R C P<15..0> | 70 |
| | PCIE_90D | PCIE | PEG D2R C N<15..0> | 70 |
| | PCIE_90D | PCIE | PCIE MINI R2D P | 31 95 |
| | PCIE_90D | PCIE | PCIE MINI R2D N | 31 95 |
| | PCIE_90D | PCIE | PCIE MINI R2D C P | 17 31 |
| | PCIE_90D | PCIE | PCIE MINI R2D C N | 17 31 |
| | PCIE_90D | PCIE | PCIE MINI D2R P | 17 31 |
| | PCIE_90D | PCIE | PCIE MINI D2R N | 17 31 |
| | PCIE_90D | PCIE | PCIE FW R2D P | 36 |
| | PCIE_90D | PCIE | PCIE FW R2D N | 36 |
| | PCIE_90D | PCIE | PCIE FW R2D C P | 17 36 |
| | PCIE_90D | PCIE | PCIE FW R2D C N | 17 36 |
| | PCIE_90D | PCIE | PCIE FW D2R P | 17 36 |
| | PCIE_90D | PCIE | PCIE FW D2R N | 17 36 |
| | PCIE_90D | PCIE | PCIE FW D2R C P | 36 |
| | PCIE_90D | PCIE | PCIE FW D2R C N | 36 |
| | PCIE_90D | PCIE | PCIE EXCARD R2D P | 7 32 95 |
| | PCIE_90D | PCIE | PCIE EXCARD R2D N | 7 32 95 |
| | PCIE_90D | PCIE | PCIE EXCARD R2D C P | 17 32 |
| | PCIE_90D | PCIE | PCIE EXCARD R2D C N | 17 32 |
| | PCIE_90D | PCIE | PCIE EXCARD D2R P | 7 17 32 |
| | PCIE_90D | PCIE | PCIE EXCARD D2R N | 7 17 32 |
| | CLK_PCIE_100D | CLK_PCIE | PEG CLK100M P | 17 70 |
| | CLK_PCIE_100D | CLK_PCIE | PEG CLK100M N | 17 70 |
| | CLK_PCIE_100D | CLK_PCIE | PCIE CLK100M MINI P | 17 31 |
| | CLK_PCIE_100D | CLK_PCIE | PCIE CLK100M MINI N | 17 31 |
| | CLK_PCIE_100D | CLK_PCIE | PCIE CLK100M FW P | 17 36 |
| | CLK_PCIE_100D | CLK_PCIE | PCIE CLK100M FW N | 17 36 |
| | CLK_PCIE_100D | CLK_PCIE | PCIE CLK100M EXCARD P | 17 32 |
| | CLK_PCIE_100D | CLK_PCIE | PCIE CLK100M EXCARD N | 17 32 |
| | MCP_PEX_CLK_COMP | MCP_PEX_COMP | MCP PEX CLK COMP | 17 |
| | CRT_RED | CRT_50S | CRT IG R C PR | 18 25 |
| | CRT_GREEN | CRT_50S | CRT IG G Y Y | 18 25 |
| | CRT_BLUE | CRT_50S | CRT IG B COMP PB | 18 25 |
| | CRT_SYNC | CRT_50S | CRT IG HSYNC | 18 25 |
| | CRT_SYNC | CRT_50S | CRT IG VSYNC | 18 25 |
| | MCP_DAC_RSET | MCP_DAC_COMP | MCP TV DAC RSET | 18 25 |
| | MCP_DAC_VREF | MCP_DAC_COMP | MCP TV DAC VREF | 18 25 |
| | TMDS_IG_TXC | DP_100D | DISPLAYPORT | TMDS IG TXC P |
| | TMDS_IG_TXC | DP_100D | DISPLAYPORT | TMDS IG TXC N |
| | TMDS_IG_TXD | DP_100D | DISPLAYPORT | TMDS IG TXD P<2..0> |
| | TMDS_IG_TXD | DP_100D | DISPLAYPORT | TMDS IG TXD N<2..0> |
| | DP_ML | DP_100D | DISPLAYPORT | DP IG ML P<3..0> |
| | DP_ML | DP_100D | DISPLAYPORT | DP IG ML N<3..0> |
| | DP_AUX_CH | DP_100D | DISPLAYPORT | DP IG AUX CH P |
| | DP_AUX_CH | DP_100D | DISPLAYPORT | DP IG AUX CH N |
| | MCP_HDMI_RSET | MCP_DV_COMP | MCP HDMI RSET | 18 25 |
| | MCP_HDMI_VPROBE | MCP_DV_COMP | MCP HDMI VPROBE | 18 25 |
| | LVDS_IG_A_CLK | LVDS_100D | LVDS | LVDS IG A CLK P |
| | LVDS_IG_A_CLK | LVDS_100D | LVDS | LVDS IG A CLK N |
| | LVDS_IG_A_DATA | LVDS_100D | LVDS | LVDS IG A DATA P<2..0> |
| | LVDS_IG_A_DATA | LVDS_100D | LVDS | LVDS IG A DATA N<2..0> |
| | LVDS_IG_A_DATA3 | LVDS_100D | LVDS | LVDS IG A DATA P<3> |
| | LVDS_IG_A_DATA3 | LVDS_100D | LVDS | LVDS IG A DATA N<3> |
| | LVDS_IG_B_CLK | LVDS_100D | LVDS | LVDS IG B CLK P |
| | LVDS_IG_B_CLK | LVDS_100D | LVDS | LVDS IG B CLK N |
| | LVDS_IG_B_DATA | LVDS_100D | LVDS | LVDS IG B DATA P<2..0> |
| | LVDS_IG_B_DATA | LVDS_100D | LVDS | LVDS IG B DATA N<2..0> |
| | LVDS_IG_B_DATA3 | LVDS_100D | LVDS | LVDS IG B DATA P<3> |
| | LVDS_IG_B_DATA3 | LVDS_100D | LVDS | LVDS IG B DATA N<3> |
| | MCP_IFPAB_RSET | MCP_DV_COMP | MCP IFPAB RSET | 18 25 |
| | MCP_IFPAB_VPROBE | MCP_DV_COMP | MCP IFPAB VPROBE | 18 25 |
| | SATA_HDD_R2D | SATA_100D | SATA | SATA HDD R2D C P |
| | SATA_HDD_R2D | SATA_100D | SATA | SATA HDD R2D C N |
| | SATA_HDD_R2D | SATA_100D | SATA | SATA HDD R2D P |
| | SATA_HDD_R2D | SATA_100D | SATA | SATA HDD R2D N |
| | SATA_HDD_D2R | SATA_100D | SATA | SATA HDD D2R P |
| | SATA_HDD_D2R | SATA_100D | SATA | SATA HDD D2R N |
| | SATA_HDD_D2R | SATA_100D | SATA | SATA HDD D2R C P |
| | SATA_HDD_D2R | SATA_100D | SATA | SATA HDD D2R C N |
| | SATA_ODD_R2D | SATA_100D | SATA | SATA ODD R2D C P |
| | SATA_ODD_R2D | SATA_100D | SATA | SATA ODD R2D C N |
| | SATA_ODD_R2D | SATA_100D | SATA | SATA ODD R2D P |
| | SATA_ODD_R2D | SATA_100D | SATA | SATA ODD R2D N |
| | SATA_ODD_D2R | SATA_100D | SATA | SATA ODD D2R P |
| | SATA_ODD_D2R | SATA_100D | SATA | SATA ODD D2R N |
| | SATA_ODD_D2R | SATA_100D | SATA | SATA ODD D2R C P |
| | SATA_ODD_D2R | SATA_100D | SATA | SATA ODD D2R C N |
| | MCP_SATA_TERM | SATA_TERM | MCP SATA TERM | 20 |

MCP Constraints 1
 SYNC_MASTER=MUXGFX SYNC_DATE=02/18/2008

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PCI Bus Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| PCI_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |
| CLK_PCI_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| PCI | * | =STANDARD | ? |
| CLK_PCI | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.8.

LPC Bus Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| LPC_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |
| CLK_LPC_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| LPC | * | 6 MIL | ? |
| CLK_LPC | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.9.1.

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 |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MCP_USB_RBIAIS | * | =STANDARD | 8 MIL | 8 MIL | =STANDARD | =STANDARD | =STANDARD |
| 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 | SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|------------------|------------|----------------------|--------|
| USB | * | =2x_DIELECTRIC | ? | USB | TOP,BOTTOM | =4x_DIELECTRIC | ? |

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 | * | =2x_DIELECTRIC | ? |

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 | * | =2x_DIELECTRIC | ? |
| MCP_HDA_COMP | * | 8 MIL | ? |

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

SIO Signal Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| CLK_SLOW_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| CLK_SLOW | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.13.

SPI 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 |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| SPI_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| SPI | * | 8 MIL | ? |

SOURCE: MCP79 Interface DG (DG-03328-001_v0D), Section 2.14.

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | MCP CONSTRAINT | PAGE |
|---------------------------|----------------|----------|---------------------|-------------|
| | PHYSICAL | SPACING | | |
| MCP_DEBUG | PCI_55S | PCI | MCP_DEBUG<7..0> | 13 19 |
| PCI_AD | PCI_55S | PCI | PCI_AD<23..8> | 13 19 |
| PCI_AD24 | PCI_55S | PCI | PCI_AD<24> | 13 19 |
| PCI_AD | PCI_55S | PCI | PCI_AD<31..25> | 13 19 |
| PCI_AD | PCI_55S | PCI | PCI_PAR | 13 19 |
| PCI_C_BE_L | PCI_55S | PCI | PCI_C_BE_L<3..0> | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_IRDY_L | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_DEVSEL_L | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_PERR_L | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_SERR_L | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_STOP_L | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_TRDY_L | 13 19 |
| PCI_CNTRL | PCI_55S | PCI | PCI_FRAME_L | 13 19 |
| PCI_REQ0_L | PCI_55S | PCI | PCI_REQ0_L | 13 19 |
| PCI_GNT0_L | PCI_55S | PCI | PCI_GNT0_L | 13 19 |
| PCI_REQ1_L | PCI_55S | PCI | PCI_REQ1_L | 13 19 |
| PCI_GNT1_L | PCI_55S | PCI | PCI_GNT1_L | 13 19 |
| PCI_INTW_L | PCI_55S | PCI | PCI_INTW_L | 13 19 |
| PCI_INTX_L | PCI_55S | PCI | PCI_INTX_L | 13 19 |
| PCI_INTY_L | PCI_55S | PCI | PCI_INTY_L | 13 19 |
| PCI_INTZ_L | PCI_55S | PCI | PCI_INTZ_L | 13 19 |
| MCP_PCI_CLK2 | CLK_PCI_55S | CLK_PCI | PCI_CLK33M MCP_R | 19 |
| CLK_PCI_55S | CLK_PCI_55S | CLK_PCI | PCI_CLK33M MCP | 19 |
| LPC_AD | LPC_55S | LPC | LPC_AD<3..0> | 19 42 44 83 |
| LPC_FRAME_L | LPC_55S | LPC | LPC_FRAME_L | 19 42 44 83 |
| LPC_RESET_L | LPC_55S | LPC | LPC_RESET_L | 19 26 83 |
| MCP_LPC_CLK0 | CLK_LPC_55S | CLK_LPC | LPC_CLK33M SMC_R | 19 26 |
| CLK_LPC_55S | CLK_LPC_55S | CLK_LPC | LPC_CLK33M SMC | 26 42 |
| CLK_LPC_55S | CLK_LPC_55S | CLK_LPC | LPC_CLK33M LPCPLUS | 26 44 |
| USB_EXTN | USB_90D | USB | USB_EXTN_P | 20 40 |
| USB_EXTN | USB_90D | USB | USB_EXTN_N | 20 40 |
| USB_EXTN | USB_90D | USB | USB_EXTN_MUXED_P | 20 40 |
| USB_EXTN | USB_90D | USB | USB_EXTN_MUXED_N | 20 40 |
| USB_MINI | USB_90D | USB | USB_MINI_P | 9 20 |
| USB_MINI | USB_90D | USB | USB_MINI_N | 9 20 |
| USB_EXTD | USB_90D | USB | USB_EXTD_P | 9 20 |
| USB_EXTD | USB_90D | USB | USB_EXTD_N | 9 20 |
| USB_CAMERA | USB_90D | USB | USB_CAMERA_P | 9 20 31 |
| USB_CAMERA | USB_90D | USB | USB_CAMERA_N | 9 20 31 |
| USB_BT | USB_90D | USB | USB_BT_P | 20 31 |
| USB_BT | USB_90D | USB | USB_BT_N | 20 31 |
| USB_TPAD | USB_90D | USB | USB_TPAD_P | 20 50 |
| USB_TPAD | USB_90D | USB | USB_TPAD_N | 20 50 |
| USB_IR | USB_90D | USB | USB_IR_P | 20 41 |
| USB_IR | USB_90D | USB | USB_IR_N | 20 41 |
| USB_EXTB | USB_90D | USB | USB_EXTB_P | 20 40 |
| USB_EXTB | USB_90D | USB | USB_EXTB_N | 20 40 |
| USB_EXCARD | USB_90D | USB | USB_EXCARD_P | 20 32 |
| USB_EXCARD | USB_90D | USB | USB_EXCARD_N | 20 32 |
| USB_EXTC | USB_90D | USB | USB_EXTC_P | 9 20 |
| USB_EXTC | USB_90D | USB | USB_EXTC_N | 9 20 |
| MCP_USB_RBIAIS | MCP_USB_RBIAIS | | MCP_USB_RBIAIS_GND | 20 |
| SMBUS_MCP_0_CLK | SMB_55S | SMB | SMBUS_MCP_0_CLK | 7 13 21 45 |
| SMBUS_MCP_0_DATA | SMB_55S | SMB | SMBUS_MCP_0_DATA | 7 13 21 45 |
| SMBUS_MCP_1_CLK | SMB_55S | SMB | SMBUS_MCP_1_CLK | 21 45 |
| SMBUS_MCP_1_DATA | SMB_55S | SMB | SMBUS_MCP_1_DATA | 21 45 |
| HDA_BIT_CLK | HDA_55S | HDA | HDA_BIT_CLK | 9 21 |
| HDA_BIT_CLK | HDA_55S | HDA | HDA_BIT_CLK_R | 21 |
| HDA_SYNC | HDA_55S | HDA | HDA_SYNC | 21 54 |
| HDA_SYNC | HDA_55S | HDA | HDA_SYNC_R | 21 |
| HDA_RST_L | HDA_55S | HDA | HDA_RST_R_L | 21 |
| HDA_RST_L | HDA_55S | HDA | HDA_RST_L | 21 54 |
| HDA_SDIN0 | HDA_55S | HDA | HDA_SDIN0 | 21 54 |
| HDA_SDIN0 | HDA_55S | HDA | HDA_SDIN_CODECS | 21 54 |
| HDA_SDOUT | HDA_55S | HDA | HDA_SDOUT | 21 54 |
| HDA_SDOUT | HDA_55S | HDA | HDA_SDOUT_R | 21 |
| MCP_HDA_PULLDN_COMP | MCP_HDA_COMP | | MCP_HDA_PULLDN_COMP | 21 |
| MCP_SUS_CLK | CLK_SLOW_55S | CLK_SLOW | PM_CLK32K_SUSCLK_R | 21 26 |
| CLK_SLOW_55S | CLK_SLOW_55S | CLK_SLOW | PM_CLK32K_SUSCLK | 26 42 |
| SPI_CLK | SPI_55S | SPI | SPI_CLK_R | 21 44 |
| SPI_CLK | SPI_55S | SPI | SPI_CLK | 44 53 |
| SPI_MOSI | SPI_55S | SPI | SPI_MOSI_R | 21 44 |
| SPI_MOSI | SPI_55S | SPI | SPI_MOSI | 44 53 |
| SPI_MISO | SPI_55S | SPI | SPI_MISO | 21 44 |
| SPI_MISO | SPI_55S | SPI | SPI_MISO_R | 53 |
| SPI_CS0 | SPI_55S | SPI | SPI_CS0_R_L | 21 44 |
| SPI_CS0 | SPI_55S | SPI | SPI_CS0_L | 21 44 |

MCP Constraints 2

SYNC_MASTER=MUXGFX SYNC_DATE=02/18/2008

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| NONE | 90 | 96 |

MCP RGMII (Ethernet) Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MCP_MII_COMP | * | =STANDARD | 7.5 MIL | 7.5 MIL | =STANDARD | =STANDARD | =STANDARD |
| ENET_MII_55S | * | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =STANDARD | =STANDARD |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| MCP_BUF0_CLK | * | =3:1_SPACING | ? |
| ENET_MII | * | 12 MIL | ? |

SOURCE: MCP73 Interface DG (DG-02974-001_v01), Sections 2.7.2 & 2.7.4

88E1116R (Ethernet PHY) Constraints

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| ENET_MDI_100D | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| ENET_MDI | * | 25 MIL | ? |

SOURCE: MCP73 Interface DG (DG-02974-001_v01), Section 2.7.4

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | |
|---------------------------|---------------|--------------|------------------------------|
| | PHYSICAL | SPACING | |
| MCP_MII_COMP | MCP_MII_COMP | | MCP MII COMP VDD 18 |
| MCP_MII_COMP | MCP_MII_COMP | | MCP MII COMP GND 18 |
| MCP_CLK25M_BUF0 | ENET_MII_55S | MCP_BUF0_CLK | MCP CLK25M BUF0 R 18 34 |
| | ENET_MII_55S | MCP_BUF0_CLK | RTL8211 CLK25M CKXTAL1 33 34 |
| ENET_INTR_L | ENET_MII_55S | ENET_MII | ENET INTR L 18 33 |
| ENET_MDIO | ENET_MII_55S | ENET_MII | ENET MDIO 18 33 |
| ENET_MDC | ENET_MII_55S | ENET_MII | ENET MDC 18 33 |
| ENET_PWRDWN_L | ENET_MII_55S | ENET_MII | ENET PWRDWN L 18 33 |
| | ENET_MII_55S | ENET_MII | ENET CLK125M RXCLK R 33 |
| ENET_RXCLK | ENET_MII_55S | ENET_MII | ENET CLK125M RXCLK 18 33 |
| | ENET_MII_55S | ENET_MII | ENET RXD R<3..0> 33 |
| ENET_RXD | ENET_MII_55S | ENET_MII | ENET RXD<0> 18 33 |
| ENET_RXD_STRAP | ENET_MII_55S | ENET_MII | ENET RXD<3..1> 18 33 |
| ENET_RXD | ENET_MII_55S | ENET_MII | ENET RX CTRL 18 33 |
| ENET_TXCLK | ENET_MII_55S | ENET_MII | ENET CLK125M TXCLK 18 33 |
| ENET_TXD0 | ENET_MII_55S | ENET_MII | ENET TXD<0> 18 33 |
| ENET_TXD | ENET_MII_55S | ENET_MII | ENET TXD<3..1> 18 33 |
| ENET_TXD | ENET_MII_55S | ENET_MII | ENET TX CTRL 18 33 |
| | ENET_MII_55S | ENET_MII | ENET RESET L 18 33 |
| ENET_MDI | ENET_MDI_100D | ENET_MDI | ENET MDI P<3..0> 33 35 |
| | ENET_MDI_100D | ENET_MDI | ENET MDI N<3..0> 33 35 |

Ethernet Constraints

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| NONE | 91 | 96 |

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FireWire 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 |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| FW_110D | * | =110_OHM_DIFF | =110_OHM_DIFF | =110_OHM_DIFF | =110_OHM_DIFF | =110_OHM_DIFF | =110_OHM_DIFF |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| FW_TP | * | =3:1_SPACING | ? |

FireWire Net Properties

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | SPACING | | |
|---------------------------|----------|-------|-------------|--|-------|
| | PHYSICAL | | | | |
| FW_P0_TPA | FW_110D | FW_TP | FW_P0_TPA_P | | 36 38 |
| FW_P0_TPA | FW_110D | FW_TP | FW_P0_TPA_N | | 36 38 |
| FW_P0_TPB | FW_110D | FW_TP | FW_P0_TPB_P | | 36 38 |
| FW_P0_TPB | FW_110D | FW_TP | FW_P0_TPB_N | | 36 38 |
| FW_P1_TPA | FW_110D | FW_TP | FW_P1_TPA_P | | 36 38 |
| FW_P1_TPA | FW_110D | FW_TP | FW_P1_TPA_N | | 36 38 |
| FW_P1_TPB | FW_110D | FW_TP | FW_P1_TPB_P | | 36 38 |
| FW_P1_TPB | FW_110D | FW_TP | FW_P1_TPB_N | | 36 38 |
| Port 2 Not Used | | | | | |

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FireWire Constraints

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| NONE | 92 | 96 |

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| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| IT01_DIFFPAIR | * | =STANDARD | =STANDARD | =STANDARD | =STANDARD | 0.1 MM | 0.1 MM |

SMC SMBus Net Properties

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | | |
|---------------------------|----------|---------|--------------------|------|
| | PHYSICAL | SPACING | | |
| SMBUS_SMC_A_S3_SCL | SMB_55S | SMB | SMBUS_SMC_A_S3_SCL | 7 45 |
| SMBUS_SMC_A_S3_SDA | SMB_55S | SMB | SMBUS_SMC_A_S3_SDA | 7 45 |
| SMBUS_SMC_B_S0_SCL | SMB_55S | SMB | SMBUS_SMC_B_S0_SCL | 45 |
| SMBUS_SMC_B_S0_SDA | SMB_55S | SMB | SMBUS_SMC_B_S0_SDA | 45 |
| SMBUS_SMC_0_S0_SCL | SMB_55S | SMB | SMBUS_SMC_0_S0_SCL | 45 |
| SMBUS_SMC_0_S0_SDA | SMB_55S | SMB | SMBUS_SMC_0_S0_SDA | 45 |
| SMBUS_SMC_BSA_SCL | SMB_55S | SMB | SMBUS_SMC_BSA_SCL | 45 |
| SMBUS_SMC_BSA_SDA | SMB_55S | SMB | SMBUS_SMC_BSA_SDA | 45 |
| SMBUS_SMC_MGMT_SCL | SMB_55S | SMB | SMBUS_SMC_MGMT_SCL | 45 |
| SMBUS_SMC_MGMT_SDA | SMB_55S | SMB | SMBUS_SMC_MGMT_SDA | 45 |

SMBus Charger Net Properties

| ELECTRICAL_CONSTRAINT_SET | NET_TYPE | | | |
|---------------------------|---------------|---------|------------|----|
| | PHYSICAL | SPACING | | |
| CHGR_CSI | 1T01_DIFFPAIR | | CHGR_CSI_P | 61 |
| | 1T01_DIFFPAIR | | CHGR_CSI_N | 61 |
| CHGR_CSO | 1T01_DIFFPAIR | | CHGR_CSO_P | 61 |
| | 1T01_DIFFPAIR | | CHGR_CSO_N | 61 |

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SMC Constraints

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| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| SENSE_1T01_55S | * | =1:1_DIFFPAIR | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =1:1_DIFFPAIR | =1:1_DIFFPAIR |
| THERM_1T01_55S | * | =1:1_DIFFPAIR | =55_OHM_SE | =55_OHM_SE | =55_OHM_SE | =1:1_DIFFPAIR | =1:1_DIFFPAIR |
| DIFFPAIR | * | =1:1_DIFFPAIR | | | =1:1_DIFFPAIR | | =1:1_DIFFPAIR |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| SENSE | * | =2:1_SPACING | ? |
| THERM | * | =2:1_SPACING | ? |
| AUDIO | * | =2:1_SPACING | ? |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| ENETCONN | * | 25 MILS | ? |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| GND | * | =STANDARD | ? |
| PP1V8_MEM | * | =STANDARD | ? |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| GND_P2MM | * | 0.20 MM | 1000 |
| PWR_P2MM | * | 0.20 MM | 1000 |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| MEM_CLK | GND | * | GND_P2MM |
| MEM_CMD | GND | * | GND_P2MM |
| MEM_CTRL | GND | * | GND_P2MM |
| MEM_DATA | GND | * | GND_P2MM |
| MEM_DQS | GND | * | GND_P2MM |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| CLK_FSB | GND | * | GND_P2MM |
| CPU_COMP | GND | * | GND_P2MM |
| CPU_GTLREF | GND | * | GND_P2MM |
| CPU_VCCSENSE | GND | * | GND_P2MM |
| FSB_DSTB | FSB_DSTB | * | GND_P2MM |
| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
| ENET_MDI | GND | * | GND_P2MM |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| LVDS | GND | * | GND_P2MM |

Memory Constraint Relaxations

Allow 0.127 mm necks for >0.127 mm lines for GMCH fanout.

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|--------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MEM_70D | BOTTOM | | | 0.127 MM | 6.35 MM | | |

Graphics ,SATA Constraint Relaxations

Alternate diffpair width/gap through BGA fanout areas (95-ohm diff)

| NET_PHYSICAL_TYPE | AREA_TYPE | PHYSICAL_RULE_SET |
|-------------------|-----------|-------------------|
| LVDS_100D | BGA | 100_DIFF_BGA |
| DP_100D | BGA | 100_DIFF_BGA |
| SATA_100D | BGA | 100_DIFF_BGA |

M99 Specific Net Properties

| ELECTRICAL_CONSTRAINT_SET | PHYSICAL | NET_TYPE | SPACING |
|---------------------------|----------------|-------------------|---------|
| ENET_MDI_100D | ENETCONN | ENETCONN | |
| SATA_100D | SATA | SATA_ODD_R2D_UF_P | |
| SATA_100D | SATA | SATA_ODD_R2D_UF_N | |
| SATA_100D | SATA | SATA_ODD_D2R_UF_P | |
| SATA_100D | SATA | SATA_ODD_D2R_UF_N | |
| SATA_100D | SATA | SATA_HDD_D2R_UF_P | |
| SATA_100D | SATA | SATA_HDD_D2R_UF_N | |
| SATA_100D | SATA | SATA_HDD_R2D_UF_P | |
| SATA_100D | SATA | SATA_HDD_R2D_UF_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | GF3IMVP6_VSEN_P | |
| SENSE_1T01_55S | SENSE | GF3IMVP6_VSEN_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | MCPCOREISNS_P | |
| SENSE_1T01_55S | SENSE | MCPCOREISNS_N | |
| CPU_THERMD_DP | THERM_1T01_55S | CPUTHMSNS_D2_P | |
| CPU_THERMD_DP | THERM_1T01_55S | CPUTHMSNS_D2_N | |
| CPU_THERMD_DP | THERM_1T01_55S | CPU_THERMD_P | |
| CPU_THERMD_DP | THERM_1T01_55S | CPU_THERMD_N | |
| GPU_THERMD_DP | THERM_1T01_55S | GPU_THERMD_P | |
| GPU_THERMD_DP | THERM_1T01_55S | GPU_THERMD_N | |
| GPU_THERMD_DP | THERM_1T01_55S | GPU_TDIODE_P | |
| GPU_THERMD_DP | THERM_1T01_55S | GPU_TDIODE_N | |
| MCP_THERMD_DP | THERM_1T01_55S | MCP_THERMD_P | |
| MCP_THERMD_DP | THERM_1T01_55S | MCP_THERMD_N | |
| MCP_THERMD_DP | THERM_1T01_55S | MCP_THMDIODE_P | |
| MCP_THERMD_DP | THERM_1T01_55S | MCP_THMDIODE_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | 1V05CPUISNS_R_P | |
| SENSE_1T01_55S | SENSE | 1V05CPUISNS_R_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | DDRISNS_R_P | |
| SENSE_1T01_55S | SENSE | DDRISNS_R_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | GPUISNS_P | |
| SENSE_1T01_55S | SENSE | GPUISNS_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | 1V05CPU_P | |
| SENSE_1T01_55S | SENSE | 1V05CPU_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | DDRISNS_P | |
| SENSE_1T01_55S | SENSE | DDRISNS_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | P1V8GPU_P | |
| SENSE_1T01_55S | SENSE | P1V8GPU_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | ISNS_CPU_P | |
| SENSE_1T01_55S | SENSE | ISNS_CPU_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | GND | |
| SENSE_1T01_55S | SENSE | GND | |
| SB_POWER | PP3V3_S5 | | |
| SB_POWER | PP3V3_S0 | | |
| SB_POWER | PP1V5_S0 | | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | P1V8GPUISNS_P | |
| SENSE_1T01_55S | SENSE | P1V8GPUISNS_N | |
| SENSE_DIFFPAIR | SENSE_1T01_55S | P1V8GPUISNS_R_P | |
| SENSE_1T01_55S | SENSE | P1V8GPUISNS_R_N | |

M99 Specific Net Properties

| ELECTRICAL_CONSTRAINT_SET | PHYSICAL | NET_TYPE | SPACING |
|---------------------------|---------------|----------|----------------------------|
| (PCIE_EXCARD) | PCIE_90D | PCIE | PCIE_EXCARD_R2D_P |
| (PCIE_EXCARD) | PCIE_90D | PCIE | PCIE_EXCARD_R2D_N |
| (PCIE_MINI) | PCIE_90D | PCIE | PCIE_MINI_R2D_P |
| (PCIE_MINI) | PCIE_90D | PCIE | PCIE_MINI_R2D_N |
| CLK_PCIE_100D | CLK_PCIE | CLK_PCIE | PCIE_CLK100M_MINI_CONN_P |
| CLK_PCIE_100D | CLK_PCIE | CLK_PCIE | PCIE_CLK100M_MINI_CONN_N |
| 1T01_DIFFPAIR | | | CHGR_CSI_R_P |
| 1T01_DIFFPAIR | | | CHGR_CSI_R_N |
| 1T01_DIFFPAIR | | | CHGR_CSO_R_P |
| 1T01_DIFFPAIR | | | CHGR_CSO_R_N |
| (USB_EXTN) | USB_90D | USB | USB2_EXTN_MUXED_P |
| (USB_EXTN) | USB_90D | USB | USB2_EXTN_MUXED_N |
| (USB_EXTN) | USB_90D | USB | USB2_LTI_P |
| (USB_EXTN) | USB_90D | USB | USB2_LTI_N |
| (USB_EXTD) | USB_90D | USB | CONN_TPAD_USB_P |
| (USB_EXTD) | USB_90D | USB | CONN_TPAD_USB_N |
| (USB_CAMERA) | USB_90D | USB | USB_CAMERA_CONN_P |
| (USB_CAMERA) | USB_90D | USB | USB_CAMERA_CONN_N |
| | USB_90D | USB | CONN_USB2_BT_P |
| | USB_90D | USB | CONN_USB2_BT_N |
| | USB_90D | USB | USB_LT2_P |
| | USB_90D | USB | USB_LT2_N |
| | USB_90D | USB | USB2_EXCARD_CONN_P |
| | USB_90D | USB | USB2_EXCARD_CONN_N |
| DP_100D | DISPLAYPORT | DP | DP_IG_AUX_CH_C_P |
| DP_100D | DISPLAYPORT | DP | DP_IG_AUX_CH_C_N |
| MCP_PE4_REFCLK | CLK_PCIE_100D | CLK_PCIE | PCIE_CLK100M_FC_P |
| MCP_PE4_REFCLK | CLK_PCIE_100D | CLK_PCIE | PCIE_CLK100M_FC_N |
| PCIE_FC_R2D | PCIE_90D | PCIE | PCIE_FC_R2D_C_P |
| PCIE_FC_R2D | PCIE_90D | PCIE | PCIE_FC_R2D_C_N |
| PCIE_FC_D2R | PCIE_90D | PCIE | PCIE_FC_D2R_P |
| PCIE_FC_D2R | PCIE_90D | PCIE | PCIE_FC_D2R_N |
| | PCIE_90D | PCIE | PCIE_FC_R2D_P |
| | PCIE_90D | PCIE | PCIE_FC_R2D_N |
| CLK_PCIE_100D | CLK_PCIE | CLK_PCIE | PCIE_CLK100M_EXCARD_CONN_N |
| CLK_PCIE_100D | CLK_PCIE | CLK_PCIE | PCIE_CLK100M_EXCARD_CONN_P |
| SPK_OUT | DIFFPAIR | AUDIO | SPKRCONN_L_P_OUT |
| SPK_OUT | DIFFPAIR | AUDIO | SPKRCONN_L_N_OUT |
| SPK_OUT | DIFFPAIR | AUDIO | SPKRCONN_S_P_OUT |
| SPK_OUT | DIFFPAIR | AUDIO | SPKRCONN_S_N_OUT |
| SPK_OUT | DIFFPAIR | AUDIO | SPKRCONN_R_P_OUT |
| SPK_OUT | DIFFPAIR | AUDIO | SPKRCONN_R_N_OUT |
| | DIFFPAIR | AUDIO | SPKRAMP_L_P_OUT |
| | DIFFPAIR | AUDIO | SPKRAMP_L_N_OUT |
| | DIFFPAIR | AUDIO | SPKRAMP_R_P_OUT |
| | DIFFPAIR | AUDIO | SPKRAMP_R_N_OUT |
| | DIFFPAIR | AUDIO | SPKRAMP_S_P_OUT |
| | DIFFPAIR | AUDIO | SPKRAMP_S_N_OUT |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|--------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MEM_40S | TOP | OVERWRITE | OVERWRITE | 0.09 MM | 5.8 MM | OVERWRITE | OVERWRITE |
| MEM_40S_VDD | TOP | OVERWRITE | OVERWRITE | 0.09 MM | 5.8 MM | OVERWRITE | OVERWRITE |
| MEM_70D | TOP | OVERWRITE | OVERWRITE | 0.09 MM | 5.8 MM | OVERWRITE | OVERWRITE |
| MEM_70D_VDD | TOP | OVERWRITE | OVERWRITE | 0.09 MM | 100 MIL | OVERWRITE | OVERWRITE |
| PCIE_90D | TOP | OVERWRITE | OVERWRITE | 0.09 MM | 100 MIL | OVERWRITE | OVERWRITE |
| USB_90D | TOP | OVERWRITE | OVERWRITE | 0.09 MM | 500 MIL | OVERWRITE | OVERWRITE |
| MCP_DV_COMP | TOP | OVERWRITE | OVERWRITE | 0.1 MM | 500 MIL | OVERWRITE | OVERWRITE |
| MCP_MEM_COMP | TOP | OVERWRITE | OVERWRITE | 0.1 MM | 500 MIL | OVERWRITE | OVERWRITE |
| MCP_MII_COMP | TOP | OVERWRITE | OVERWRITE | 0.1 MM | 500 MIL | OVERWRITE | OVERWRITE |
| MCP_USB_RBIAIS | TOP | OVERWRITE | OVERWRITE | 0.1 MM | 500 MIL | OVERWRITE | OVERWRITE |
| MCP_DV_COMP | TOP | OVERWRITE | OVERWRITE | 0.25 MM | 250 MIL | OVERWRITE | OVERWRITE |
| CPU_27P4S | BOTTOM | OVERWRITE | OVERWRITE | 0.23 MM | 100 MIL | OVERWRITE | OVERWRITE |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| MEM_40S | ISL4, ISL9 | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE |
| MEM_40S_VDD | ISL3, ISL10 | N | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE |
| MEM_70D | ISL4, ISL9 | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE |
| MEM_70D_VDD | ISL3, ISL10 | N | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE | OVERWRITE |

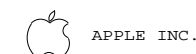
Ground-referenced memory signals (DQ,DQM,DQS) MAY route on ISL9 (VDD-referenced plane)but not next to VDD island. Forces power-referenced memory signals (CLK,ADDR,CTRL) to not route on ISL3, ISL4 & ISL10(GND-referenced planes).

Project Specific Constraints

SYNC_MASTER=MUXGFY SYNC_DATE=02/21/2008

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| | | |
|-------|----------------|-------|
| SIZE | DRAWING NUMBER | REV. |
| D | 051-7546 | A.0.0 |
| SCALE | SHT | OF |
| NONE | 95 | 96 |

M99 Board-Specific Spacing & Physical Constraints

| BOARD LAYERS | | | | BOARD AREAS | | | | BOARD UNITS (MIL OR MM) | ALLEGRO VERSION |
|---|--|--|--|--------------|--|--|--|----------------------------|--------------------|
| TOP, ISL2, ISL3, ISL4, ISL5, ISL6, ISL7, ISL8, ISL9, ISL10, ISL11, BOTTOM | | | | NO_TYPE, BGA | | | | 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 | =50_OHM_SE | 14 MM | 0 MM | 0 MM |
| STANDARD | * | Y | =DEFAULT | =DEFAULT | 10 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 | 0.090 MM | 0.090 MM | | | |
| 55_OHM_SE | * | Y | 0.076 MM | 0.076 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 |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 50_OHM_SE | TOP, BOTTOM | Y | 0.110 MM | 0.095 MM | | | |
| 50_OHM_SE | * | Y | 0.090 MM | 0.090 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 |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 40_OHM_SE | TOP, BOTTOM | Y | 0.165 MM | 0.095 MM | | | |
| 40_OHM_SE | * | Y | 0.135 MM | 0.135 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 |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 27P4_OHM_SE | TOP, BOTTOM | Y | 0.310 MM | 0.095 MM | | | |
| 27P4_OHM_SE | * | Y | 0.250 MM | 0.250 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 |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 70_OHM_DIFF | * | N | =STANDARD | =STANDARD | =STANDARD | =STANDARD | =STANDARD |
| 70_OHM_DIFF | ISL3, ISL4 | Y | 0.160 MM | 0.160 MM | | 0.175 MM | 0.175 MM |
| 70_OHM_DIFF | ISL9, ISL10 | Y | 0.160 MM | 0.160 MM | | 0.175 MM | 0.175 MM |
| 70_OHM_DIFF | ISL2, ISL11 | Y | 0.170 MM | 0.170 MM | | 0.150 MM | 0.150 MM |
| 70_OHM_DIFF | TOP, BOTTOM | Y | 0.170 MM | 0.095 MM | | 0.150 MM | 0.150 MM |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 80_OHM_DIFF | * | N | =STANDARD | =STANDARD | =STANDARD | =STANDARD | =STANDARD |
| 80_OHM_DIFF | ISL3, ISL4 | Y | 0.125 MM | 0.125 MM | | 0.180 MM | 0.180 MM |
| 80_OHM_DIFF | ISL9, ISL10 | Y | 0.125 MM | 0.125 MM | | 0.180 MM | 0.180 MM |
| 80_OHM_DIFF | ISL2, ISL11 | Y | 0.140 MM | 0.140 MM | | 0.190 MM | 0.190 MM |
| 80_OHM_DIFF | TOP, BOTTOM | Y | 0.140 MM | 0.095 MM | | 0.190 MM | 0.190 MM |

| 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 | ISL3, ISL4 | Y | 0.102 MM | 0.102 MM | | 0.220 MM | 0.220 MM |
| 90_OHM_DIFF | ISL9, ISL10 | Y | 0.102 MM | 0.102 MM | | 0.220 MM | 0.220 MM |
| 90_OHM_DIFF | ISL2, ISL11 | Y | 0.115 MM | 0.115 MM | | 0.230 MM | 0.230 MM |
| 90_OHM_DIFF | TOP, BOTTOM | Y | 0.115 MM | 0.095 MM | | 0.230 MM | 0.230 MM |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 100_OHM_DIFF | * | N | =STANDARD | =STANDARD | =STANDARD | =STANDARD | =STANDARD |
| 100_OHM_DIFF | ISL3, ISL4 | Y | 0.080 MM | 0.080 MM | | 0.200 MM | 0.200 MM |
| 100_OHM_DIFF | ISL9, ISL10 | Y | 0.080 MM | 0.080 MM | | 0.200 MM | 0.200 MM |
| 100_OHM_DIFF | ISL2, ISL11 | Y | 0.089 MM | 0.089 MM | | 0.220 MM | 0.220 MM |
| 100_OHM_DIFF | TOP, BOTTOM | Y | 0.089 MM | 0.089 MM | | 0.220 MM | 0.220 MM |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 110_OHM_DIFF | * | N | =STANDARD | =STANDARD | =STANDARD | =STANDARD | =STANDARD |
| 110_OHM_DIFF | ISL3, ISL4 | Y | 0.077 MM | 0.077 MM | | 0.330 MM | 0.330 MM |
| 110_OHM_DIFF | ISL9, ISL10 | Y | 0.077 MM | 0.077 MM | | 0.330 MM | 0.330 MM |
| 110_OHM_DIFF | ISL2, ISL11 | Y | 0.077 MM | 0.077 MM | | 0.330 MM | 0.330 MM |
| 110_OHM_DIFF | TOP, BOTTOM | Y | 0.077 MM | 0.077 MM | | 0.330 MM | 0.330 MM |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| DEFAULT | * | 0.1 MM | ? |
| STANDARD | * | =DEFAULT | ? |
| BGA_P1MM | * | =DEFAULT | ? |
| BGA_P2MM | * | =DEFAULT | ? |
| BGA_P3MM | * | =DEFAULT | ? |

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| 1.5:1_SPACING | * | 0.15 MM | ? |
| 1.8:1_SPACING | * | 0.18 MM | ? |
| 2:1_SPACING | * | 0.2 MM | ? |
| 2.5:1_SPACING | * | 0.25 MM | ? |
| 3:1_SPACING | * | 0.3 MM | ? |
| 4:1_SPACING | * | 0.4 MM | ? |

| NET_SPACING_TYPE1 | NET_SPACING_TYPE2 | AREA_TYPE | SPACING_RULE_SET |
|-------------------|-------------------|-----------|------------------|
| * | * | BGA | BGA_P1MM |
| MEM_CLK | * | BGA | BGA_P2MM |
| CLK_FSB | * | BGA | BGA_P2MM |
| CLK_PCIE | * | BGA | BGA_P2MM |
| CLK_SLOW | * | BGA | BGA_P2MM |
| FSB_DSTB | FSB_DSTB | BGA | BGA_P3MM |

NOTE: From T18 MLB, changed to reflect M99 stackup.

| SPACING_RULE_SET | LAYER | LINE-TO-LINE SPACING | WEIGHT |
|------------------|-------|----------------------|--------|
| 2X_DIELECTRIC | * | 0.140 MM | ? |
| 3X_DIELECTRIC | * | 0.210 MM | ? |
| 4X_DIELECTRIC | * | 0.280 MM | ? |
| 5X_DIELECTRIC | * | 0.350 MM | ? |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 1:1_DIFFPAIR | * | Y | =STANDARD | =STANDARD | =STANDARD | 0.1 MM | 0.1 MM |

| PHYSICAL_RULE_SET | LAYER | ALLOW ROUTE ON LAYER? | MINIMUM LINE WIDTH | MINIMUM NECK WIDTH | MAXIMUM NECK LENGTH | DIFFPAIR PRIMARY GAP | DIFFPAIR NECK GAP |
|-------------------|-------------|-----------------------|--------------------|--------------------|---------------------|----------------------|-------------------|
| 100_DIFF_BGA | * | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF | =100_OHM_DIFF |
| 100_DIFF_BGA | ISL3, ISL4 | Y | 0.075 MM | 0.075 MM | | 0.125 MM | 0.125 MM |
| 100_DIFF_BGA | ISL9, ISL10 | Y | 0.075 MM | 0.075 MM | | 0.125 MM | 0.125 MM |

NOTE: 100_DIFF_BGA is 100-ohms differential impedance on outer layers and 95-ohms on inner layers.

PCB Rule Definitions

SYNC_MASTER=M99_MLB SYNC_DATE=01/22/2008


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| | | | |
|--|------|----------------|-------|
|  APPLE INC. | SIZE | DRAWING NUMBER | REV. |
| | D | 051-7546 | A.0.0 |
| SCALE | SHT | OF | |
| NONE | 96 | 96 | |