**Freescale Semiconductor**
Hardware Getting Started Guide

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# MSC8156ADS

This document describes the MSC8156ADS and its related hardware kit. The MSC8156ADS getting started procedure explains and verifies the board's basic operation in a step-by-step format.

Settings for switches, jumpers, LEDs, and push buttons are shown, and there are instructions for connecting peripheral devices.

The MSC8156ADS functions with an integrated development environment (IDE), such as Freescale's *CodeWarrior* IDE. Instructions for working with the IDE are beyond the scope of this document.

**Note**

**The MSC8156ADS is provided with an MSC8156 DSP. The basic MSC8156ADS is the environment board for developing applications for the MSC8154, MSC8156, MSC8251, MSC8252, MSC8254, and MSC8256.**

**Contents**

# 1 Definitions, Acronyms, and Abbreviations

**Table 1. Definitions, Acronyms, and Abbreviations**

| Usage | Description |
|---|---|
| ADS | Application Development System |
| AMC | Advanced Mezzanine Card (Form Factor) |
| BCSR | Board Control and Status Register (implemented in FPGA) |
| BP | Boot Patch Bit (in RCW) |
| BPRT | Boot Port Bit (in RCW) |
| CLK SEL | Clock Select |
| CLKIN | Clock Input |
| CLKOUT/CLKO | Clock Output |
| CS | PCB Component Side |
| CTLS | Serial RapidIO interface System Mode Bit (in RCW) |
| DDR | Double Data Rate Memory |
| DEVID | Device ID Bit (in RCW) |
| DIP | Dual-in-Line Package (switches) |
| EEPROM | Electrical Erasable Programmable Memory |
| EN | Enable |
| EP | PCI Express End Point |
| ETH | Ethernet |
| eUTAP | Embedded UTAP |
| EWDT | Watchdog Timer Bit (in RCW) |
| EXP | AMC Expand Card |
| FPGA | Field-Programmable Gate Array |
| FSL | Freescale Semiconductor |
| GE | Gigabit Ethernet Port Bit (in RCW) |
| GE/TDM | GETH/TDM Port |
| GETH | Gigabit Ethernet |
| GPIO | General Purpose IO |
| HDC | Hardcoded Option (RCW Source) |
| HRESET/HRST | Hard Reset |
| I/F | Interface |
| $I^2C$ | Inter-Integrated Circuit Multi-master Serial Computer Bus |
| IDE | Integrated Development Environment |
| IO | Input/Output |
| J/JP | Jumper |
| LD/LED | Light-emitting Diode |
| MAPLE-B | Multi-Accelerator Platform Engine, Baseband |
| MODCK | Clock Mode |
| MSC8154 | Four Core Broadband Wireless Access DSP with MAPLE-B |
| MSC8156 | Six Core Broadband Wireless Access DSP with MAPLE-B |
| MSC8251 | Single Core DSP without MAPLE-B |
| MSC8252 | Two Core DSP without MAPLE-B |

**Table 1. Definitions, Acronyms, and Abbreviations (continued)**

| Usage | Description |
|---|---|
| MSC8254 | Four Core DSP without MAPLE-B |
| MSC8256 | Six Core DSP without MAPLE-B |
| MUX | Multiplexer |
| NMI | Non-Maskable Interrupt |
| OnCE/OCE | On-Chip Emulator, MSC815x Debug Port |
| PCB | Printed Circuit Board |
| PCI | Peripheral Components Interconnect Bus |
| PG | “Power Good” |
| PLL | Phased Lock Loop |
| PRDY | PCI Express Ready Bit (in RCW) |
| PRESET | Power-on-Reset |
| PRG | FPGA Programming |
| PS | PCB Print Side |
| RC | MSC815x Internal Module PCI Express Root Complex |
| RC[x] | Reset Configuration Bit x |
| RCW | Reset Configuration Word |
| RGMII | Reduced General Media Independent Interface |
| RHE | RIO Host Bit (in RCW) |
| RJ45 and RJ48 | Ethernet or E1/T1 Connectors |
| RMII | Reduced Media Independent Interface |
| RMU | Serial RapidIO interface Access Port Bit (in RCW) |
| S1/2P | SerDes 1/2 Port |
| SBETH | Simple Boot from Ethernet Bit (in RCW) |
| SCLK | SerDes Reference Clock Bit (in RCW) |
| SerDes | • Serializer/Deserializer<br>• High Speed Serial Communication Lines: PCI Express, serial RapidIO interface, SGMII, and so forth. |
| SGMII | Serial Gigabit Media Independent Interface |
| SIG | Signalling |
| SMF | MSC815x Special Mode Bit (in RCW) |
| SMII | Serial Media Independent Interface |
| SOCDIMM | SODIMM with ECC Functionality |
| SODIMM | Mini DIMM Form Factor |
| SPI | Synchronous Peripheral Interface |
| SRC | Configuration Source |
| SRESET/SRST | Soft Reset |
| SW | Switch |
| TDM | Time Division Multiplexing |
| UART | Universal Asynchronous Receiver/Transmitter |
| USB | Universal Serial Bus |
| UTAP | USB TAP “Wiggler” |

# 2 Bit and Byte Conventions

**Table 2. Bit and Byte Terminology**

| Bit | | Byte | |
|---|---|---|---|
| Binary digit with a single binary value, 1 or 0. Commonly used for measuring the amount of data transferred in one second between two telecommunication points. | | A unit of data, eight binary units long, that is used as a measure of computer processor storage and real and virtual memory. | |
| Kbps = Kbit | Kilobit per second<br>(1 Kbps = 1000 bits) | Kbyte = KB = KByte | 1 Kilobyte = 1024 bytes |
| Mbps = Mbit | Megabit per second<br>(1 Mbps = 1,000,000 bits) | Mbyte = MB = MByte | 1 Megabyte = ~ 1,000,000 bytes |
| Gbps = Gbit | Gigabit per second<br>(1 Gbps = “billions of bits”) | Gbyte = GB = GByte | 1 Gigabyte = ~ 1 billion bytes |

# 3 Related Reading

The below noted documents are available on the Freescale website (www.freescale.com) and from your local sales office or distributor.

**Table 3. Related Reading**

| Document | Description |
|---|---|
| CodeWarrior Kit Configuration Guide | • Complete hardware setup explanation.<br>• Kit Configuration Guide explains setting up and using each SW component in the development kit. |
| Data Sheet | Electrical specifications for the MSC8154, MSC8156, MSC8251, MSC8252, MSC8254, and MSC8256 device. |
| Reference Manual | Detailed functional description for the following DSPs:<br>• MSC8154<br>• MSC8156<br>• MSC8251<br>• MSC8252<br>• MSC8254<br>• MSC8256. |
| **Note:** The ADS supports the MSC8154, MSC8156, MSC8251, MSC8252, MSC8254, and MSC8256 DSPs. For details on these products, refer to the device specific data sheet and reference manual available on the *www.freescale.com* website or through your local sales office or distributor. | |

# 4 Hardware Kit Contents

1. MSC8156ADS with attached plastic spacers and screws
2. AC/DC 12 V/5.5 A universal power supply kit (1)
3. RS-232 standard serial cable with two 9-pin connectors (1)
4. Ethernet cables (2)
5. USB cable Type A to Type B (1)
6. Allen key (1)

**PRINTED MATTER (not shown in Fig. 1)**

- MSC8156ADS Hardware Getting Started
- Freescale Warranty Card: 920-75133
- Safety Notice: 926-75254
- Contact Information Sheet: 920-90570-00

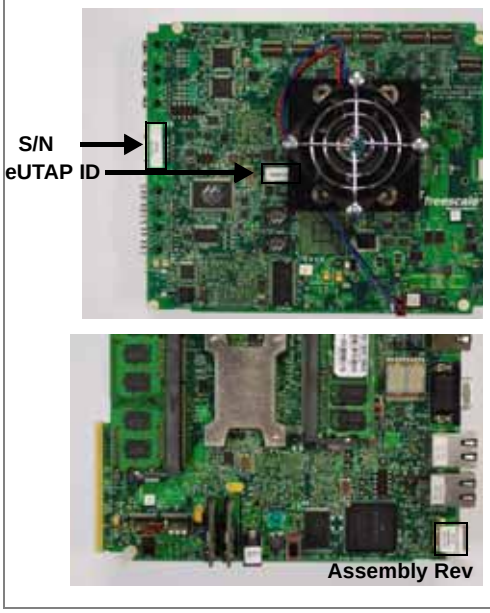







**Figure 1. Hardware Kit Inventory**

# 5 Switch Default Settings

The MSC8156ADS has dual-in-line package (DIP) switches; see Figure 2 and Table 4.

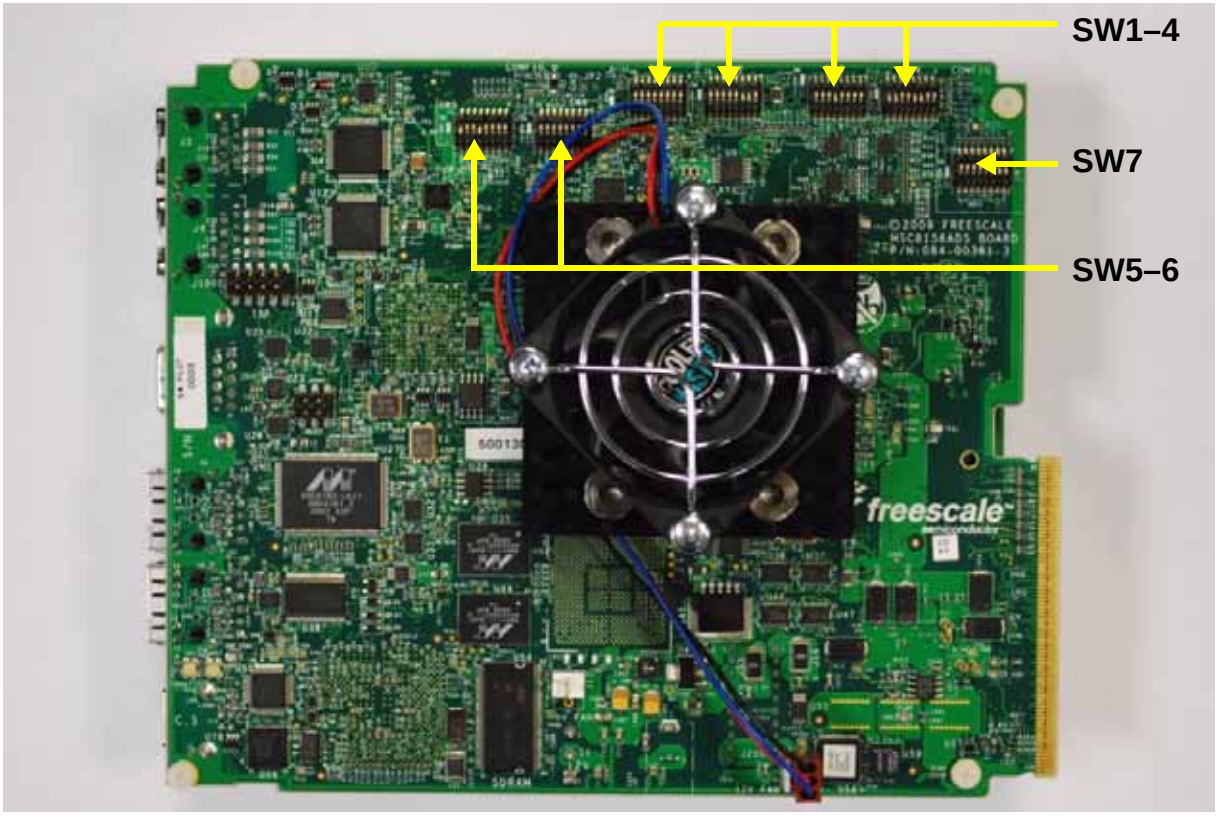
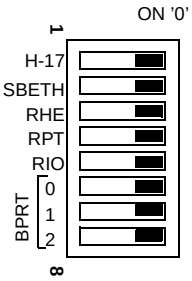



**Figure 2. MSC8156ADS DIP-Switch Locations**

**Table 4. MSC8156ADS DIP-Switch Configurations**

| SW1 Configuration | |
|---|---|
|  | **SW1.1: Boot Patch (BP)**<br>• Default: ON<br>**SW1.2: Simple Boot from ETH (SBETH)**<br>• Default: ON (disable)<br>**SW1.3: RIO Host (RHE)**<br>• Default: ON (disable)<br>**SW1.4: RapidIO Pass-Through Mode 1 (RPT)**<br>• Default: ON (disable)<br>**SW1.5: RapidIO Pass-Through Mode 2 (RIO)**<br>• Default: ON (disable)<br>**SW1.6-8: Boot Port (BPRT) Bits 0 - 2**<br>• Default: ON (boot from $I^2C$ EEPROM) |

## Table 4. MSC8156ADS DIP-Switch Configurations (continued)

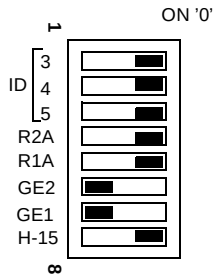
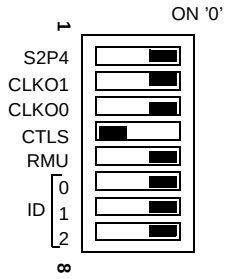
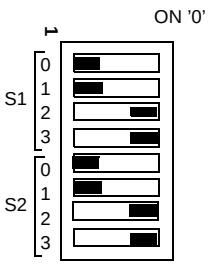
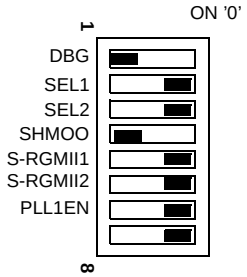
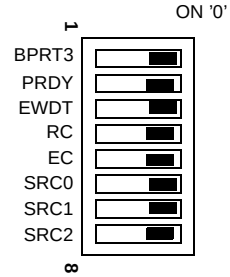
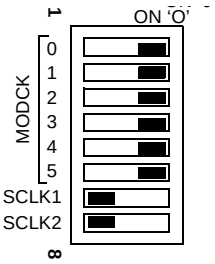
| SW2 Configuration | |
|---|---|
|  | **SW2.1-3: Device ID (DEVID) Bits 3:5**<br>• Default: ON (DEVID[5:3] = 0)<br>**SW2.4: Serial RapidIO interface Port 2 (R2A)**<br>• Default: ON (no ID accepted)<br>**SW2.5: Serial RapidIO interface Port 1 (R1A)**<br>• Default: ON (no ID accepted)<br>**SW2.6: RGMII Port 2 IO (GE2)**<br>• Default: OFF (RGMII2 is active)<br>**SW2.7: RGMII Port 1 IO (GE1)**<br>• Default: OFF (RGMII1 is active)<br>**SW2.8: SMF**<br>• Default: ON ~~(mode disable); hidden bit~~ |
| **SW3 Configuration** | |
|  | **SW3.1: SerDes Port 2 (S2P4)**<br>• Default: ON (S1P[4:0] = 3)<br>• S2P: Bit 4<br>**SW3.2-3: CLOCK-OUT Control (CLKO0, CLKO1)**<br>• Default: ON (CLKOUT = 75 MHz)<br>**SW3.4: Serial RapidIO interface System Mode (CTLS)**<br>• Default: OFF<br>• Works in Common Transport Large System mode.<br>**SW3.5: Serial RapidIO interface Access Port (RMU)**<br>• Default: ON<br>• Selects SerDes Port1 RMU local memory access.<br>**SW3.6-8: DEVID Bits 0–2**<br>• Default: ON (DEFID[2:0] = 0) |
| **SW4 Configuration** | |
|  | **SW4.1-4: SerDes Port 1 (S1P) Configuration Bits 0–3**<br>• Default: OFF OFF ON ON (S0P = 3)<br>• SerDes Port1 configures as Serial RapidIO interface x4 3.125GHz.<br>**SW4.5-8: SerDes Port 2 (S2P) Configuration Bits 0–3**<br>• Default: OFF OFF ON ON (S1P = 3)<br>• SerDes Port2 configures as Serial RapidIO interface x4 3.125GHz. |

**Table 4. MSC8156ADS DIP-Switch Configurations (continued)**

| SW5 Configuration | |
|---|---|
|  | **SW5.1: Debug Request**<br>• Default: OFF (MSC815x enters Debug mode after reset.)<br>**SW5.2: SGMII/Serial RapidIO interface Differential Switch Select 1**<br>• Default: ON (MSC815x works in SerDes Port1 Serial RapidIO interface x4 mode.)<br>**SW5.3: SGMII/Serial RapidIO interface Differential Switch Select 2**<br>• Default: ON (MSC815x works in SerDes Port2 Serial RapidIO interface x4 mode.)<br>**SW5.4: SHMOO**<br>• Default: OFF<br>**SW5.5: SGMII or RGMII Select 1**<br>• Default: ON (RGMII mode for GE port 1.)<br>**SW5.6: SGMII or RGMII Select 2**<br>• Default: ON (RGMII mode for GE port 2.)<br>**SW5.7: PLL1EN**<br>• Default: ON (Enable to PLL.)<br>**SW5.8: Spare**<br>• Default: ON |
| **SW6 Configuration** | |
|  | **SW6.1: Boot Port (BPRT) Bit 3**<br>• Default: ON (BPRT[3:0] = 0 for boot from $I^2C$ EEPROM)<br>**SW6.2: PCI Express Ready (PRDY)**<br>• Default: ON (Not ready for PCI Express RC mode.)<br>**SW6.3: Watchdog (EWDT)**<br>• Default: ON (Watchdog disabled.)<br>**SW6.4: PCI Express Root Complex (RC)**<br>• Default: ON (PCI Express functions if EP mode-enabled.); ~~hidden bit~~<br>**SW6.5: RCWH30 (EC)**<br>**SW6.6-8: Configuration Source (SRC) Bits 0 - 2**<br>• Default: ON ON ON (RCW loaded from DIP-switches.) |
| **SW7 Configuration** | |
|  | **SW7.1-6: MODCK bit 0 to 5.**<br>• Default: ON (MODCK[5:0] = 0)<br>**SW7.7: SerDes Port 1 Reference Clock (SCLK1)**<br>• Default: OFF (SerDes Port 1 reference clock is 125MHz.)<br>**SW7.8: SerDes Port 2 Reference Clock (SCLK2)**<br>• Default: OFF (SerDes Port 2 reference clock is 125MHz.) |

The default DIP-switch positions establish MSC8156ADS configuration modes; listed in Table 5.

**Note**

**Ensure DIP-switches are set according to default values.**

**Table 5. MSC8156ADS Default Configuration Modes**

| Mode | Value |
|---|---|
| CLKIN | 100 MHz |
| CLKOUT | 75 MHz |
| Cores | 1000 MHz |
| DDR1 and DDR2 | 800 Mbps |
| MAPLE | 450 MHz |
| QUICC Engine Subsystem | 500 MHz |
| Serial RapidIO interface | 3.125 Gbps |

# 6 Jumper Default Settings

Table 6 lists MSC8156ADS factory default jumper settings. See Figure 3 for jumper locations.

**Table 6. MSC8156ADS Jumper Default Settings**

| # | Name | OPEN Position | CLOSED Position |
|---|---|---|---|
| J2002-3 and J2004-5 | 2xC | • MSC8154 mode. This includes MSC8154, MSC8251, MSC8252, and MSC8254. | • MSC8156 mode. This includes MSC8156 and MSC8256. |
| JP1 | AMC EXP | • Default<br>• Single board mode | • Two MSC8156-ADS boards are linked via an AMC-X-Over expansion card.<br>• JTAG bus is chained. |
| JP2 | PRESET | • Default<br>• MSC8156ADS functions normally. | • MSC8156-ADS is in continuous PRESET (debug mode). |
| JP3 | CLK SEL | - | **1-2 (Default)**<br>• MSC815x clock source is clock oscillator “CLKIN”:<br>**2-3**<br>• MSC815x clock source is an external pulse generator connected to P2 “EXT CLK”. |
| JP1000 | PRG | • Default | **1-2**<br>• Forces FPGA programming over eUTAP.<br>**2-3**<br>• Forces FPGA programming over J1000 ISP connector. |

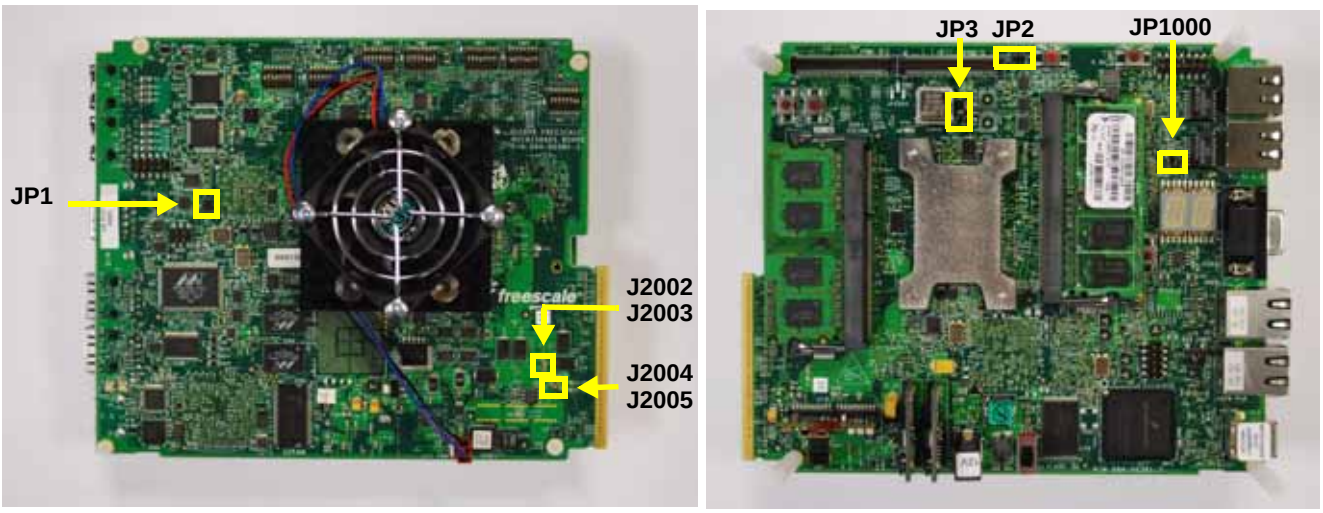



**Figure 3. MSC8156ADS Jumper (JP) Locations**

# 7 Connector Default Settings

Table 7 lists MSC8156ADS factory default connector, header, and socket settings. See Figure 4 for connector locations.

**Table 7. MSC8156ADS Connector Default Settings**

| # | Type | Description | Function |
|---|---|---|---|
| J1 | Connector (64-pin) | PTMC-3 | • Transmits MSC815x TDM port signals.<br>• Used for interconnection and debug purposes. |
| J2 | Connector (64-pin) | PTMC-1 | • Transmits MSC815x GPIO signals.<br>• Used for interconnection and debug purposes. |
| J3 | Connector (RJ48) | E1/T1-0,1 | • Transmits MSC815x TDM Analog Port 0 and 1 signals. |
| J4 | Connector (RJ48) | E1/T1-2,3 | • Transmits MSC815x TDM Analog Port 2 and 3 signals. |
| J5 | SODIMM Socket (200-pin) | DDR2-SODIMM | • DDR2 SODIMM socket |
| J6 | SODIMM Socket (204-pin) | DDR3-SODIMM | • DDR3 SODIMM socket |
| J7 | Connector (9-pin) | DB9F | • MSC815x UART interface |
| J8 | Connector (RJ45) | GE1 | • MSC815x GETH port1 1000-BaseT |
| J9 | Header (10-pin) | DPI | • MPC866 debug port connector |
| J10 | Header (3-pin) | 866 UART | • MPC866 UART interface |
| J11 | Connector (RJ45) | GE2 | • MSC815x GETH port2 1000-BaseT |
| J12 | Header (2-pin) | 5V FAN | • Provides power for on-socket fan. |
| J13 | Socket (Type B) | USB2.0 | • USB2.0 interface |
| J1000 | Header (10-pin) | ISP | • Lattice FPGA programming |
| J2000 | Header (3-pin) | 12V FAN | • Provides power for on-socket fan. |
| P1 | Header (14-pin) | OnCE | • OnCE connector for external UTAP |
| P2 | RF Connector | EXT CLK | • [Optional] External pulse generator for MSC815x CLKIN input. |

**Table 7. MSC8156ADS Connector Default Settings (continued)**

| # | Type | Description | Function |
|---|---|---|---|
| P3 | RF Connector | CLKOUT | • [Optional] Measures MSC815x CLKOUT signal. |
| P4 | Edge Connector | AMC Backplane | • SerDes high-speed connector |
| P5 | Power Connector | 12V | • External power supply |

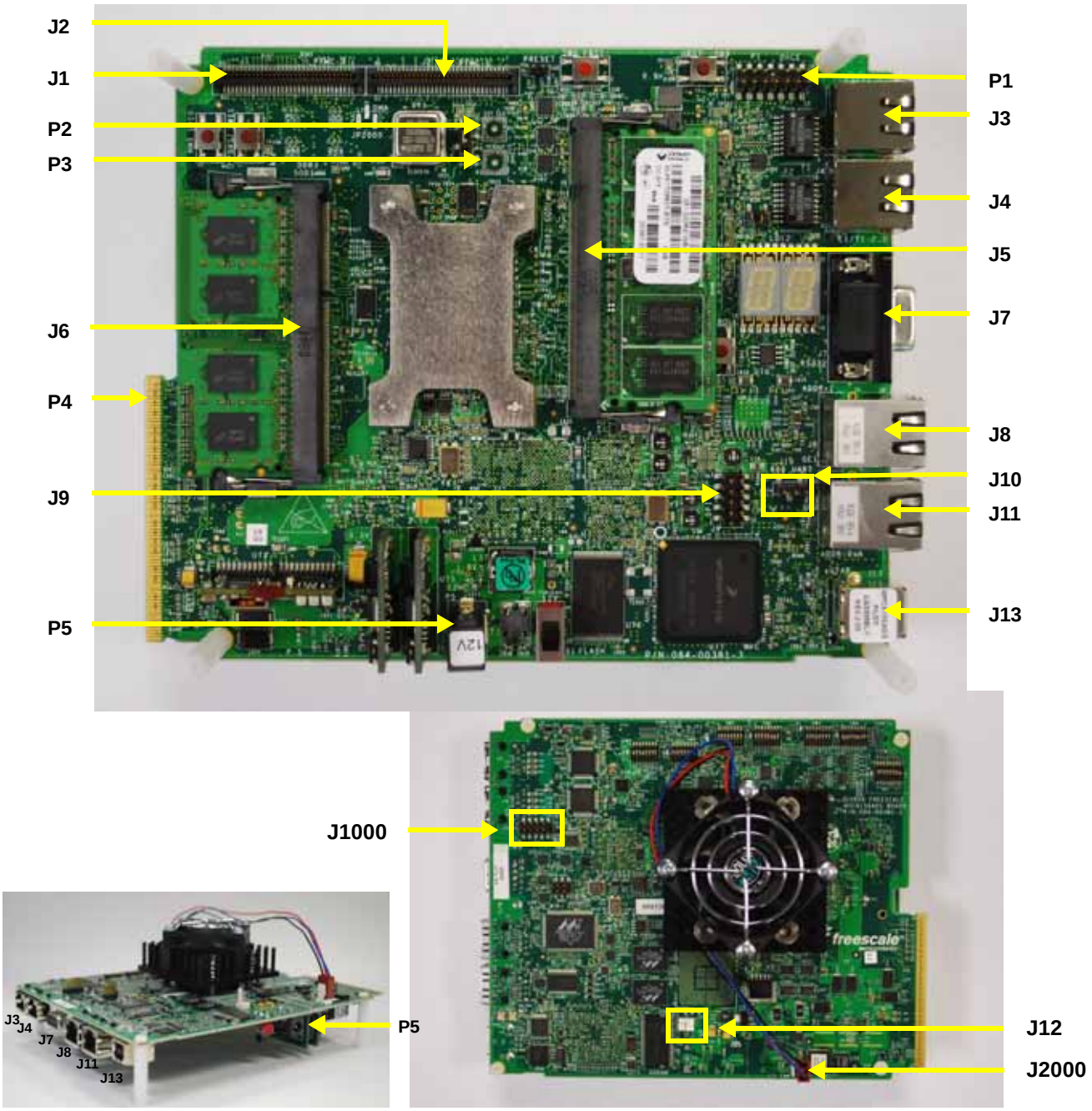



**Figure 4. MSC8156ADS Connector Locations**

# 8 LED Indicators

Table 8 lists MSC8156ADS LED indicator functions. See Figure 5 for LED locations.

**Table 8. MSC8156ADS LEDs**

| # | NAME | Color | LED On | Flashing LED | LED Off |
|---|---|---|---|---|---|
| LD1 | LINK-2 | Green | SGMII switch Port 2 link | - | No link. |
| LD2 | LINK-1 | Green | SGMII switch Port 1 link | - | No link. |
| LD3 | TARGET | Multicolor | - | Indicates one of the below:<br>• Red for powered but not configured eUTAP.<br>• Green for properly configured eUTAP.<br>• Orange when transferring data. | eUTAP is inactive. |
| LD4 | HOST | Multicolor | Indicates one of the below:<br>• Unlit until debugger connects to eUTAP.<br>• Green when target is running.<br>• Red if target pauses.<br>• Orange when target is in mixed mode. | - | eUTAP is inactive. |
| LD5 | BOOT | Green | - | MSC815x boot from:<br>• $I^2C$ EEPROM, or<br>• SPI Flash. | Normal operation. |
| LD6 | SIG2 | Green | Indicates BCSR0.6 is low. | - | Indicates BCSR0.6 is high. |
| LD7 | SIG0 | Orange | Indicates one of the below:<br>• BCSR11.0 is low.<br>• MSC815x HRESET is asserted. | - | Indicates that:<br>• BCSR11.0 is high.<br>• MSC815x HRESET is negated. |
| LD8 | DEBUG | Green | MSC815x in debug mode. | - | MSC815x in run mode. |
| LD9 | SIG3 | Green | Indicates BCSR11.6 is low. | - | Indicates BCSR11.6 is high. |
| LD10 | SIG1 | Orange | Indicates one of the below:<br>• BCSR11.1 is low.<br>• MSC815x SRESET is asserted. | - | Indicates that:<br>• BCSR11.1 is high.<br>• MSC815x SRESET is negated. |
| LD11 | PRG | Green | FPGA programming is in progress. | - | Normal operation |
| LD12 | - | LED Display | - | - | - |
| LD13 | 12V | Green | Indicates external 12V power source. [1] | - | Power off |
| LD14 | PG | Green | “Power Good” | - | No power |

[1] Critical indicator.

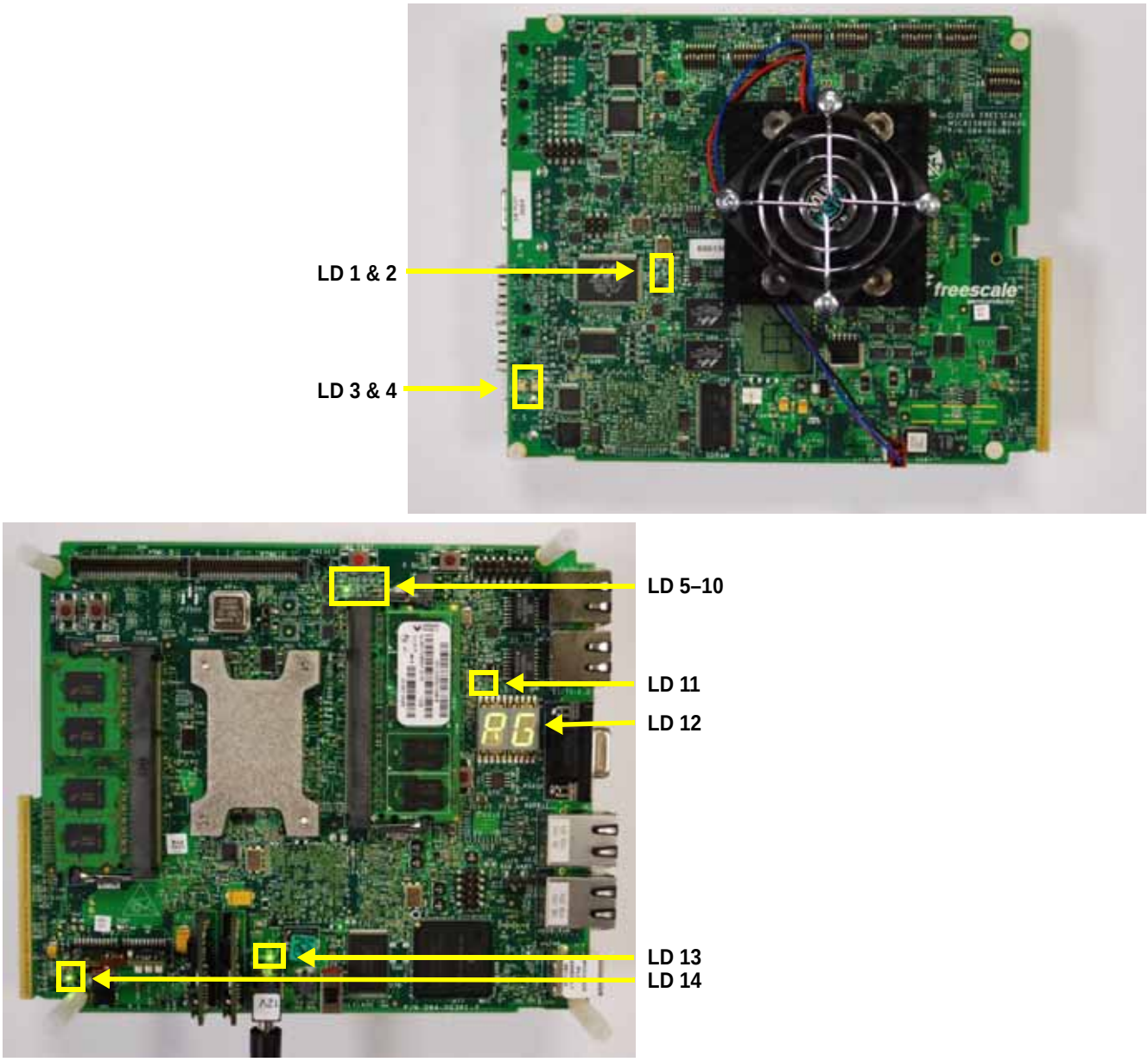



**Figure 5. MSC8156ADS LED Locations**

# 9 LED Scroll Display

The MSC8156ADS features a two-digit LED (LD12) display that provides status information. The scroll bar option, available via the SW12 push button, allows users to move through available settings.

1. Apply power to the MSC8156ADS.
2. Initial state of LD12 provides category readings; see Table 9.
3. Push SW12 once for core temperature reading.
4. Push SW12 again to return to category readings.

**Note**

**For easier reading, an asterisk symbol separates display categories and mode values.**

**Table 9. LED Indicators**

| Category | Mode Values | Description |
|---|---|---|
| RCW | 4CYC | • Multiplexed external RCW loading.<br>• RCW is driven by external logic on RC[15–0] in four cycles. |
| | RDUC | • RCW from RC[21–0]. |
| | I2CS | • RCW is loaded from $I^2C$ EEPROM with memory size < 4 KB (referred to as small EEPROM). |
| | I2CB | • RCW is loaded from $I^2C$ EEPROM with memory size > 16 KB (referred to as large EEPROM). |
| | HDC1 or HDC2 | • RCW source is an internal hardcoded option (1 or 2) |
| GE/TDM | GE | • RGMII Ethernet I/F is active on the MUX port. |
| | TDM | • TDM ports 0 to 3 are selected on the MUX port. |
| ETH | RGMII1.RGMII2 | • DIP-switches SW5.5 and 5.6 enable RGMII and SGMII mode combinations for GETH ports. |
| | RGMII1.SGMII2 | |
| | SGMII1.RGMII2 | |
| | SGMII1.SGMII2 | |
| BOOT | I2C | • Boot from $I^2C$ EEPROM |
| | SPI | • Boot from SPI Serial Flash |
| | Serial RapidIO interface | • Boot from Serial RapidIO interface port over AMC edge connector |
| | RGMII1 or RGMII2 | • Boot from appropriate RGMII port. |
| | SGMII1 or SGMII2 | • Boot from appropriate SGMII port. |

# 10 Power Switch and Push Buttons

Table 10 lists the functioning of the MSC8156ADS power switch and push buttons. Figure 6 shows their location.

**Table 10. Power Switch and Push Button Functionality**

| Push Button | Position | Description & Default |
|---|---|---|
| S1: ON/OFF |  | Power switch |
| SW8: PRESET |  | Press to PRESET all board components. |
| SW9: HRST |  | Press for HRESET. |
| SW10: NMI (IRQ0) |  | Press to issue a level 0 interrupt to the board.<br>**Note**<br>**This aborts program execution.** |
| SW11: SRST |  | Press for SRESET. |
| SW12: SCROLL |  | Press to scroll through LED displays. |

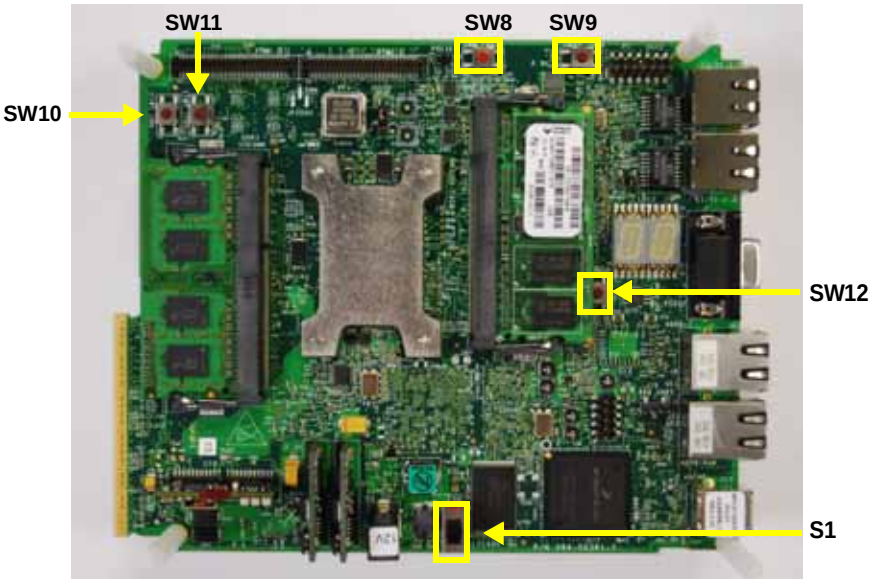



**Figure 6. MSC8156ADS Power Switch and Push Button Locations**

# 11 Getting Started Procedure

Use the following steps to set up and initial the ADS:

1. Review the kit contents as listed in Section 4 *Hardware Kit Contents* and make sure you have all the components.
2. Review the default switch settings as listed in Section 5 *Switch Default Settings* and verify that all switches on the board are set correctly.
3. Review the jumper settings as listed in Section 6 *Jumper Default Settings* and verify that all jumpers are set correctly for your desired configuration.
4. Assemble and connect the 12 V power supply (see Figure 7) using the following steps:
   a) Make sure that all power is turned off.
   b) Assemble the AC/DC power supply kit, as follows:
      — Attach the power cable with the country-specific wall output plug for your area.
      — Attach the cable with the plug for the board connection.
   c) Connect the AC/DC power supply cable to the 12 V (P5) board jack.
   d) Plug the power cable into the wall outlet.
   e) Insert one end of the USB cable into J13, the board USB socket. Insert the other cable end into the USB port on a PC.

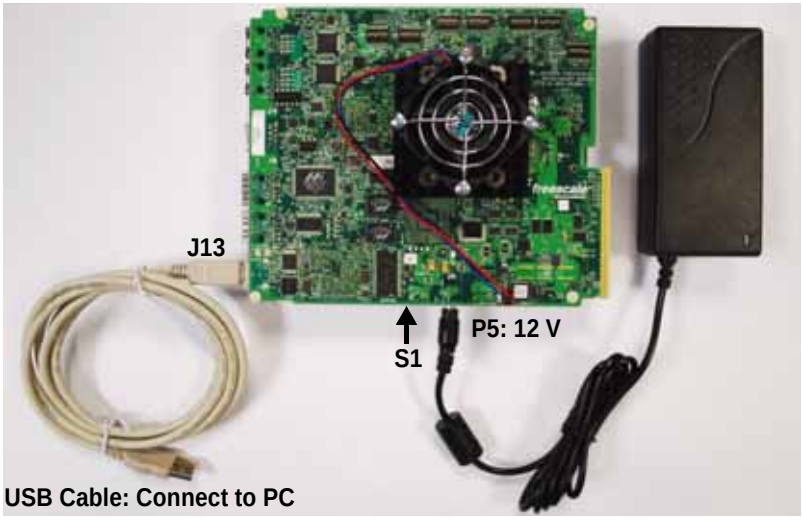



**Figure 7. Power Supply Assembly**

5. Referring to the information listed in Section 8 *LED Indicators*, perform the initial power up and check using the following steps:
   a) Move the power switch (S1) to the ON position, and check for completion of the PRESET sequence; LEDs 13 and 14 display a constant green light.
   b) Power the system off by moving the power switch (S1) to the OFF position.

**Note**

**Standalone Mode: The board receives power from an external 12 V power supply via the 12 V power jack (P5).**

**AMC Mode: The board receives power from the AMC-X-Over card.**

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