

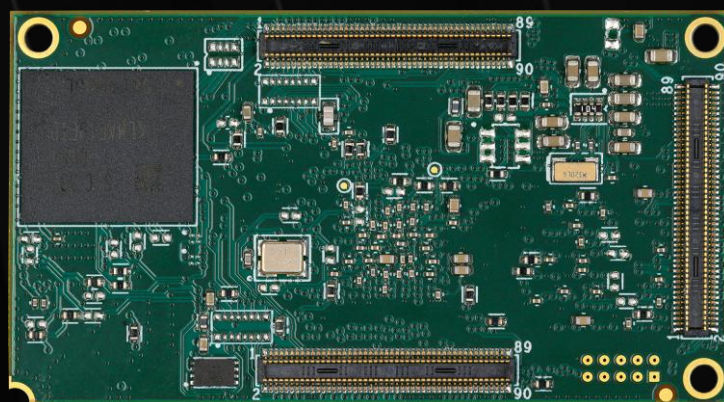


Rev. 1.07, 1/2026

VARISCITE LTD.

DART-MX93 Datasheet

NXP i.MX 93™ - based System-on-Module



VARISCITE LTD.

DART-MX93 Datasheet

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1. Document Revision History

| Revision | Date | Notes |
|----------|-----------------|---|
| 1.0 | June 2, 2022 | Initial Release |
| 1.01 | Aug 11, 2024 | Updated Bluetooth version to 5.4 |
| 1.02 | August 18, 2024 | <p>1. Corrected signal name typo: ENET - pins J1.4, J1.10, J1.74, J1.82, J1.88, J1.86, J2.65, J2.70 sections 7.4, 8.4 USDHC - pins J1.86, J2.35, J3.64 sections 7.4, 8.6 LPSP1 - pins J2.10, J2.89, J2.40, J3.30, J2.86, J2.79 sections 7.4, 8.11 FLEXSPI - pins J2.43 7.4, 8.12 TPM - pins J2.88, J2.32, J2.86, J2.85, J1.19, J2.89 sections 7.4, 8.13</p> <p>2. Corrected pinmux tables: GPIO - pins J3.62, J2.48, J2.36, J2.74, J2.45, J1.10 sections 7.4, 8.16 LCDIF - pins J2.83, J3.64 in sections 7.4, 8.2.3 FLEXIO - pins J2.48, J2.36, J2.45, J2.26, J1.10, J2.24 sections 7.4, 8.17 LPTMR - pin J2.50, J2.56, J3.62, J1.12, J1.84, J1.14, J2.25, J1.16 sections 7.4, 8.18</p> <p>3. Updated note J2.25</p> |
| 1.03 | October 1, 2024 | <p>1. Block Diagram BT version updated to 5.4 2. SDEX assembly option added to Table 1 3. Power consumption table updated</p> |
| 1.04 | Nov 17, 2024 | Corrected typo section 7.1 |
| 1.05 | Jan 07, 2025 | 1. Section 8.23.2 – Corrected J2.90 state for SD/eMMC boot selection; Updated USB1/2 Serial Downloader note |
| 1.06 | Mar 26, 2025 | Fixed J1.9 in EC assembly connection. |
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4. Overview

4.1 General Information

The DART-MX93 offers a high-performance processing for a low-power System-on-Module. The product is based on the i.MX 93 family which represents NXP's latest power-optimized processors for smart home, building control, contactless HMI, IoT edge, and Industrial applications.

The i.MX 93 includes powerful dual Arm® Cortex® -A55 processors with speeds up to 1.7 GHz integrated with a NPU that accelerates machine learning inference. A general-purpose Arm® Cortex® -M33 running up to 250 MHz is for real-time and low-power processing. Robust control networks are possible via CAN-FD interface. Also, dual 1 Gbps Ethernet controllers, one supporting Time Sensitive Networking (TSN), drive gateway applications with low latency.

The DART-MX93 provides an ideal building block for simple integration with a wide range of products in target markets requiring high-performance processing with low power consumption, compact size, and a very cost-effective solution.

Supporting products:

- DT8M Custom Board – evaluation board
 - ✓ Carrier Board, compatible with DART-MX93
 - ✓ Schematics
- VAR-DVK-DT93 full development kit, including:
 - ✓ DT8M Custom Board
 - ✓ DART-MX93
 - ✓ Display and touch
 - ✓ Accessories and cables
- O.S support
 - ✓ Linux BSP

Contact Variscite support services for further information: support@variscite.com.

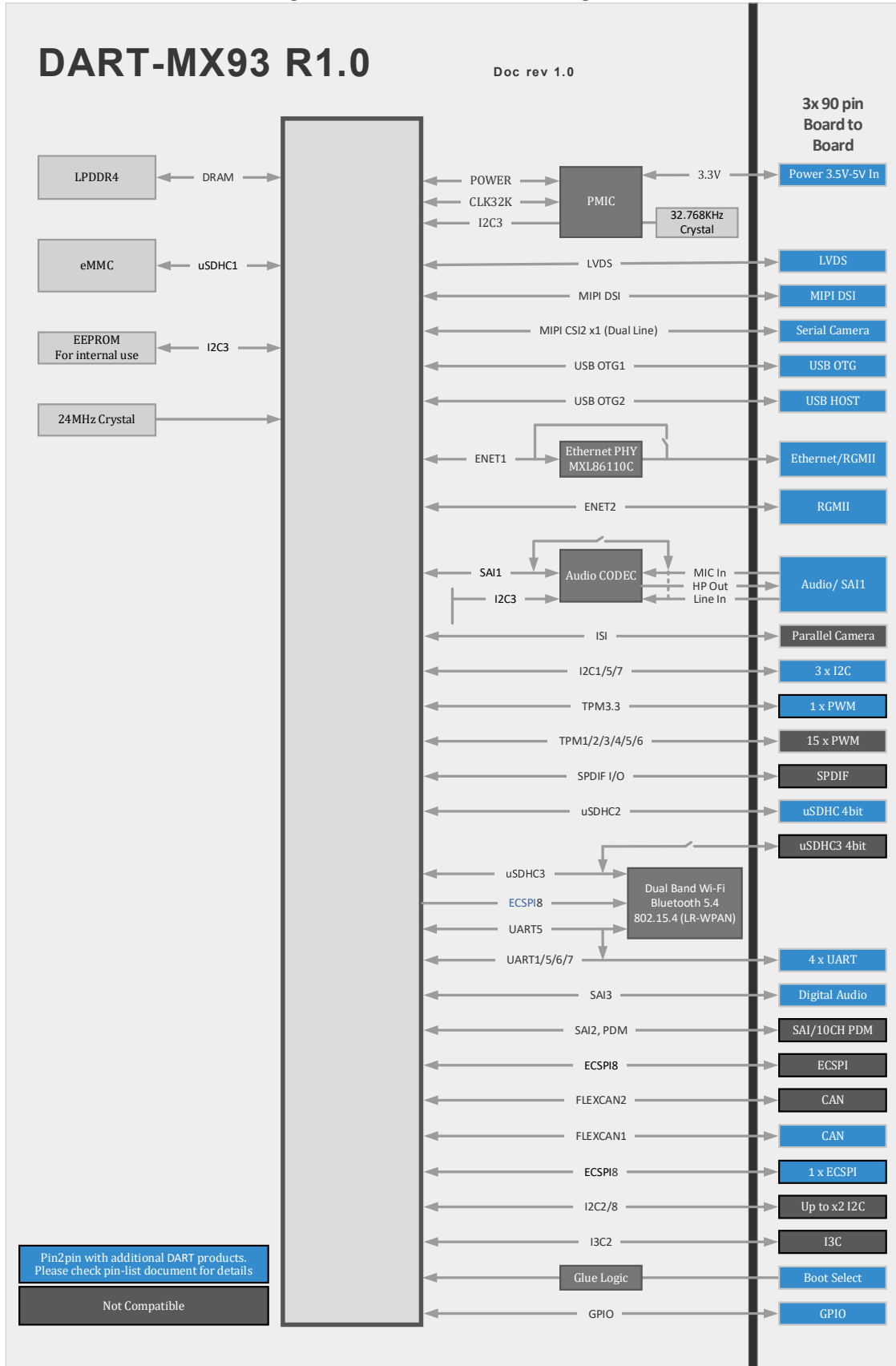
4.2 Feature Summary

- Cortex®-A55 MPCore platform
 - Two Cortex®-A55 processors operating up to 1.7 GHz
 - Media Processing Engine (MPE) with Arm® NEON™ technology supporting the Advanced Single Instruction Multiple Data architecture
 - Floating Point Unit (FPU) with support of the Arm® VFPv4-D16 architecture
 - Support of 64-bit Arm® v8.2-A architecture
 - 256 KB cluster L3 cache
 - Parity/ECC protection on L1 cache, L2 cache, and TLB RAMs
- Cortex®-M33 core platform
 - Cortex®-M33 CPU operating up to 250 MHz
 - Support FPU
 - Support MPU
 - Support NVIC
 - Support FPB
 - Support DWT and ITM
 - Two-way set-associative 16 KB System Cache with parity support
 - Two-way set-associative 16 KB Code Cache with parity support
 - 256 KB tightly coupled memory (TCM)
- Neural Processing Unit (NPU)
 - Neural Network performance (256 MACs operating up to 1.0 GHz and 2 OPS/MAC)
 - NPU targets 8-bit and 16-bit integer RNN
 - Handles 8-bit weights
- Image Sensor Interface (ISI)
 - Standard pixel formats commonly used in many camera input protocols
 - Programmable resolutions up to 2K
 - Image processing for:
 - Supports one source of up to 2K horizontal resolution
 - Supports pixel rate up to 200 Mpixel/s
 - Image down scaling via decimation and bi-phase filtering
 - Color space conversion
 - Interlaced to progressive conversions
- On-chip memory
 - Boot ROM (256 KB) for Cortex®-A55
 - Boot ROM (256 KB) for Cortex®-M33
 - On-chip RAM (640 KB)
- RAM memory
 - Up to 2GBytes of LPDDR4/LPDDR4X RAM
- Storage
 - Up to 128GBytes of eMMC5.1 (8bit) interface supporting up to 400MB/sec
- Pixel Pipeline (PXP)
 - BitBlit
 - Flexible image composition options—alpha, chroma key
 - Porter-Duff operation
 - Image rotation (90°, 180°, 270°)
 - Image resize
 - Color space conversion
 - Multiple pixel format support (RGB, YUV444, YUV422, YUV420, YUV400)
 - Standard 2D-DMA operation
- LCDIF Display Controller
 - The LCDIF can drive any of:

- MIPI DSI: up to 1920x1200p60
 - LVDS Tx: up to 1366x768p60 or 1280x800p60
- MIPI CSI-2 Interface
 - One 2-lane MIPI CSI-2 camera input:
 - Complaint with MIPI CSI-2 specification v1.2 and MIPI D-PHY specification v1.2
 - Support up to 2 Rx data lanes (plus 1 Rx clock lane)
 - Support 80 Mbps – 1.5 Gbps per lane data rate in high-speed operation
 - Support 10 Mbps data rate in low power operation
- MIPI DSI Interface
 - One 4-lane MIPI DSI display with data supplied by the LCDIF
 - Compliant with MIPI DSI specification v1.2 and MIPI D-PHY specification v1.2
 - Capable of resolutions achievable with a 200 MHz pixel clock and active pixel rate of 140 Mpixel/s with 24-bit RGB.
 - Support 80 Mbps—1.5 Gbps data rate per lane in high-speed operation
 - Support 10 Mbps data rate in low power operation
- Other Interfaces
 - SDIO/MMC
 - Resistive touch controller
 - Serial interfaces (ECSPI, FlexSPI, I2C, UART, CAN, JTAG, SAI)
 - GPIOs
- Single power supply: 3.5V - 5V
- Dimensions (W x L x H): 30 mm x 55 mm x 5.13 mm
- Industrial temperature range: -40°C to 85°C

4.3 Block Diagram

Figure 1 : DART-MX93 Block Diagram



5. Main Hardware Components

This section summarizes the main hardware building blocks of the DART-MX93.

5.1 NXP i.MX 93

5.1.1 Overview

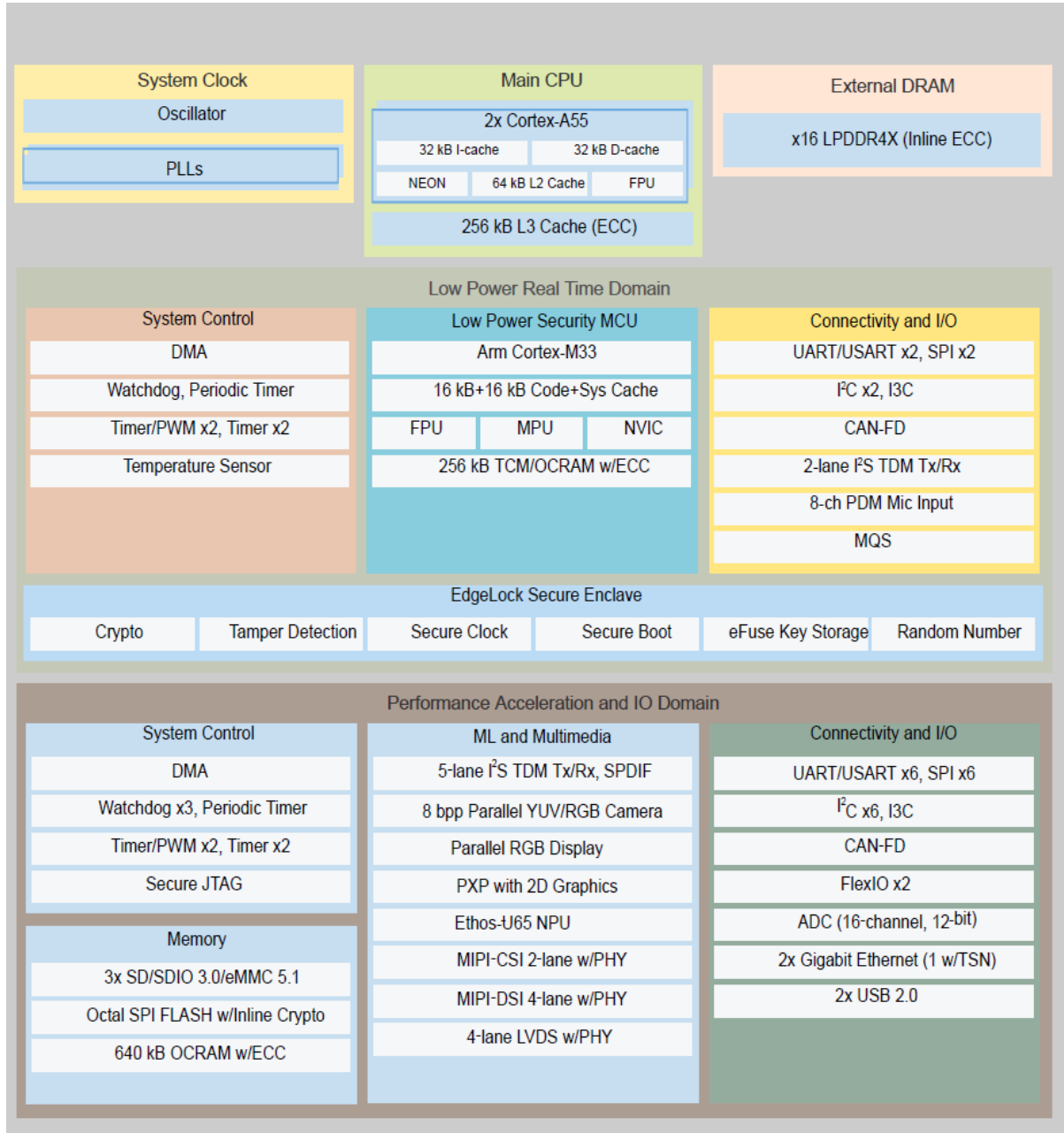
i.MX 93 applications processors deliver efficient machine learning (ML) acceleration and advanced security with integrated EdgeLock® secure enclave to support energy-efficient edge computing. The i.MX 93 applications processors are the first in the i.MX portfolio to integrate the scalable Arm Cortex®-A55 core, bringing performance and energy efficiency to Linux®-based edge applications and the Arm Ethos®-U65 microNPU, enabling developers to create more capable, cost-effective, and energy-efficient ML applications.

Optimizing performance and power efficiency for Industrial, IoT and automotive devices, i.MX 93 processors are built with NXP's innovative Energy Flex architecture. The SoCs offer a rich set of peripherals targeting automotive, industrial and consumer IoT market segments.

Part of the EdgeVerse™ portfolio of intelligent edge solutions, the i.MX 93 family will be offered in commercial, industrial, extended industrial and automotive level qualification and backed by NXP's product longevity program.

5.1.2i.MX93 Block Diagram

Figure 2 : i.MX93 Block Diagram



5.1.3 Arm Cortex®-A55 MPCore cluster

- One cluster of 2x Cortex-A55 cores
- Each core includes 32kB L1-I, 32kB L1-D and 64kB L2 cache per core
- 256kB shared cluster L3 cache
- Core cache protection (parity/ECC) supported

5.1.4 Arm Cortex®-M33 Platform

- Microcontroller available both for boot and for customer application
- Arm Cortex®-M33 Processor:
 - 16KB L1 Instruction Cache
 - 16KB L1 Data Cache
 - 256 KByte TCM, also accessible as SRAM by the rest of the system
- ECC support for both cache and TCM

5.1.5 On Chip Memory

- Boot ROM (256KB)
- 256KB Tightly Coupled RAM (TCM) for CM33, with ECC
- 640KB of SoC-specific OCRAM

5.1.6 External Memory

- One 16-bit DRAM controller:
 - Maximum supported capacity is 2GByte
 - LPDDR4X supported

5.1.7 Graphics

- PXP 2D accelerator
- LCDIF display
 - LDB and 4-lane LVDS display (up to 1366x768 or 1280x800)
 - Parallel display (up to 1366x768 or 1280x800)
 - One 4-lane MIPI-DPHY DSI Tx PHY and MIPI-DSI Controller
- ISI camera interface
 - MIPI-DPHY CSI Rx PHY and MIPI-CSI Controller compliant to MIPI-DSI specification v1.2 and MIPI-DPHY specification v1.2
 - Image processing for
 - One processed camera stream at 1080p30, or
 - One not processed camera stream (no scaling) at 4kp30 depending on system loading and use case
 - Image down scaling via decimation and bi-phase filtering
 - Color space conversion
 - Interlaced to progressive conversions

5.1.8 Machine Learning

- High-efficiency Neural-network Processing Unit (NPU)

5.1.9 Audio

- SPDIF supports raw capture mode that can save all the incoming bits into audio buffer.
- Up to 3x Synchronous Audio Interface (SAI) modules supporting I2S, AC97, TDM, and Codec/DSP interfaces
- Digital microphone input, up to 8-channel PDM

Note: *The above list refers to the chip capabilities, part of the pins is used on the SOM therefore the exact number of interfaces can be lower.*

5.1.10 Connectivity

- 2x USB 2.0 OTG controller with integrated PHY interfaces
- 3x Ultra Secure Digital Host Controller (uSDHC) interfaces
 - uSDHC1 with boot support for eMMC 5.1 compliance with HS400 DDR signaling to support up to 400 MB/sec
 - uSDHC2 with boot support for SD/SDIO 3.0 compliance with 200 MHz SDR signaling to support up to 100 MB/sec
 - Support for SDXC (extended capacity)
 - USDHC3 to support use cases that need simultaneous support for all three of 1x eMMC, 1x SD Card and 1x SDIO (for WIFI connectivity)
- Up to 8x Universal asynchronous receiver/transmitter (LPUARTs) modules
- Up to 8x LPSPi modules
- Up to 8x I2C modules
- Up to 2x I3C modules
- Up to 2x CAN-FD modules
- Up to 2x 32-pin FlexIO modules
- Up to 1x 1G-bit Ethernet with AVB support (ENET)

Note: *The above list refers to the chip capabilities, part of the pins is used on the SOM therefore the exact number of interfaces can be lower.*

5.1.11 Timers and PWMs

- 2x Low Power Periodical Interrupt Timer (LPIT)
 - 4 channels
 - 4 external trigger sources
 - Generic 32-bit resolution timer
 - Periodical interrupt generation
- 6x Timer/PWM module (TPM)
 - Prescaler divide-by 1, 2, 4, 8, 16, 32, 64, or 128
 - 16-bit counter, support free-running counter or modulo counter mode, counting-up or down
 - Includes 6 channels that can be configured for input capture, output compare, edge-aligned PWM mode, or center aligned PWM mode
- 2x Low-Power Timer (LPTMR)
- 5x WatchDog modules (WDOG)

Note: The above list refers to the chip capabilities, part of the pins is used on the SOM therefore the exact number of interfaces can be lower.

5.1.12 GPIO and Pin Multiplexing:

- General-purpose input/output (GPIO) modules with interrupt capability
- Input/output multiplexing controller (IOMUXC) to provide centralized pad control

5.1.13 Analog:

- 1x 12-bit Analog Digital Converter (ADC)

5.1.14 Security:

- TRDC – Resource Domain Controller
 - Supports up to 16 resource domains
- Arm TrustZone® (TZ) architecture
- Secure and trusted access control
- Battery Backed Security Module (BBSM)
 - Monotonic counter - Secure real-time clock (RTC) - Zeroizable Master Key

5.1.15 System Debug

- Arm CoreSight® debug and trace architecture
- Trace Port Interface Unit (TPIU) to support off-chip real-time trace
- Support for 5-pin (JTAG) and SWD debug interfaces

5.1.16 Power Management

- One PMIC to supply all power rails.
- Temperature sensor with programmable trim points
- GPC hardware power management controller

5.2 Memory

5.2.1 RAM

The DART-MX93 is available with up to 2GB of LPDDR4 or LPDDR4X memory.

5.2.2 Non-volatile Storage Memory

The DART-MX93 is available with a non-volatile MLC eMMC storage memory with optional densities of up to 128GB. It is used for Flash Disk purposes, O.S. run-time-image, Boot-loader, and application/user data storage.

5.3 Audio (WM8904)

The WM8904 is a high performance ultra-low power stereo CODEC optimized for portable audio applications.

The device features stereo ground-referenced headphone amplifiers using the Wolfson 'Class-W' amplifier techniques. It incorporates an innovative dual-mode charge pump architecture - to optimize efficiency and power consumption during playback.

The ground-referenced headphone output eliminates AC coupling capacitors, and both outputs include common mode feedback paths to reject ground noise. Control sequences for audio path setup can be pre-loaded and executed by an integrated control write sequencer to reduce software driver development and minimize pops and clicks via SilentSwitch™ technology. The input impedance is constant with PGA gain setting. A stereo digital microphone interface is provided, with a choice of two inputs. A dynamic range controller provides compression and level control to support a wide range of portable recording applications. Anti-clip and quick release features offer good performance in the presence of loud impulsive noises. ReTune™ Mobile 5-band parametric equalizer with fully programmable coefficients is integrated for optimization of speaker characteristics. Programmable dynamic range control is also available for maximizing loudness, protecting speakers from clipping, and preventing premature shutdown due to battery droop. Common audio sampling frequencies are supported from a wide range of external clocks, either directly or generated via the FLL.

Features:

- 3.0mW quiescent power consumption for DAC to headphone playback
- DAC SNR 96dB typical, THD -86dB typical
- ADC SNR 91dB typical, THD -80dB typical
- 2.4mW quiescent power consumption for analogue bypass playback
- Control write sequencer for pop minimized start-up and shutdown
- Single register writes for default start-up sequence
- Integrated FLL provides all necessary clocks - Self-clocking modes allow processor to sleep - All standard sample rates from 8kHz to 96kHz
- Stereo digital microphone input
- 2 single ended inputs per stereo channel
- Digital Dynamic Range Controller (compressor / limiter)
- Digital sidetone mixing
- Ground-referenced headphone driver

5.4 Wi-Fi + BT + LR-WPAN

DART-MX93 module can be configured either for using one of two Wi-Fi modules based on NXP chipset:

- 2.4GHz & 5GHz Wi-Fi® + Bluetooth® + 802.15.4 Module based on NXP IW612 chipset
- 2.4GHz & 5GHz Wi-Fi® + Bluetooth® Module based on NXP IW611 chipset

Both realize the necessary PHY/MAC layers to support WLAN applications in conjunction with a host processor over a SDIO interface.

The modules also provide a Bluetooth/BLE platform through the HCI transport layer. Both WLAN and Bluetooth share the same antenna port or may be ordered with dual antenna ports.

The SOM can be ordered with 802.15.4 low-rate wireless personal area network (LR-WPAN)

DART-MX93 Wi-Fi Key Features:

- 1x1 2.4/5 GHz, up to 80 MHz channel
- UL/DL MU-MIMO and OFDMA
- Target Wake Time, Dual Carrier Modulation, Extended Range
- 802.11az accurate ranging
- WPA3 security

DART-MX93 Bluetooth Key Features:

- Supports Bluetooth 5.4
- Integrated high power PA up to +20 dBm transmit power
- Full featured Bluetooth baseband
- SCO/eSCO links with hardware accelerated audio signal processing
- Bluetooth LE 2 Mbit/s, Long Range, Advertising Extensions
- LE Audio with Isochronous channels (I2S/PCM)

DART-MX93 802.15.4 Key Features:

- IEEE 802.15.4-2015 compliant supporting Thread in 2.4 GHz band
- Integrated high power PA up to +20 dBm transmit power
- Shared transmitter and antenna pin with Bluetooth
- Simultaneous receive with Bluetooth

5.4.1 DART-MX93 2.4GHz & 5GHz Wi-Fi® + Bluetooth® + 802.15.4 Option

The DART-MX93 contains Murata's certified high-performance Type 2EL Module based upon the NXP IW612 chipset supporting Wi-Fi® 11a/b/g/n/ac/ax + Bluetooth® 5.4 + 802.15.4 wireless connectivity.

5.4.2 DART-MX93 2.4GHz & 5GHz Wi-Fi® + Bluetooth® Option

The DART-MX93 contains Murata's certified high-performance Type 2DL Module based upon the NXP IW611 chipset supporting Wi-Fi® 11a/b/g/n/ac/ax + Bluetooth® 5.4 wireless connectivity.

5.5 PMIC

The DART-MX93 features Dual Freescale/NXP's PCA9541 chip as a Power Management Integrated circuit (PMIC) designed specifically for use with NXP's i.MX 93 series of application processors. The PCA9541 regulates power rails required on SOM from a single 3.3V power supply.

The PMIC is fully programmable via the I2C interface and associated register map. Additional communication is provided by direct logic interfacing including interrupt, watchdog and reset.

5.6 10/100/1000 Mbps Ethernet Transceiver

The DART-MX93 features on board an MXL86110C or MXL86110I Integrated Ethernet Transceiver. Key features include:

- 1000BASE-T (IEEE 802.3), 100BASE-TX (IEEE 802.3) and 10BASE-T_e (IEEE 802.3)
- Ethernet twisted pair copper cable of category CAT5 or higher
- Low EMI voltage mode line driver with integrated termination resistors
- Transformer less Ethernet for backplane applications
- Auto-Negotiation (ANEG) with extended next page support
- Auto-MDIX and polarity correction
- Auto-Down speed (ADS)
- Energy-Efficient Ethernet (EEE) and power down mode
- Wake-on-LAN (WoL)
- 10k byte jumbo frame support
- RGMII Interface
- An MDIO slave interface supports IEEE 802.3 Clause 22 and Clause 45
- An MDIO interface clock of up to 12.5 MHz
- Three MDIO message frame types: Clause 22, Clause 22 Extended, and Clause 45
- Two fully programmable LEDs

5.7 EEPROM

The DART-MX93 uses 4Kbit serial EEPROM to store memory calibration and manufacturing parameters. This EEPROM is connected to I2C3 bus and intended only for holding the above information. The SOM may not boot if the contents of EEPROM device are corrupted.

6. DART-MX93 Hardware Configuration

The table below lists the Hardware configurations options orderable for the DART-MX93.

Table 1 Hardware Configuration Options

| Option | Description |
|--------|--|
| EC | Ethernet PHY assembled on SOM |
| AC | Audio Codec assembled on SOM |
| WBE | 2.4GHz & 5GHz Wi-Fi® + Bluetooth® + 802.15.4 Module assembled on SOM |
| WBD | 2.4GHz & 5GHz Wi-Fi® + Bluetooth® Module assembled on SOM |
| COEX | Expose WCI-2 coexistence management lines |
| BTRST | Expose Bluetooth® and 802.15.4 reset lines |
| ANT2 | Dual antenna mode. ANT1 for Wi-Fi, ANT2 for BT and 802.15.4 |
| WRST | Expose 2.4GHz & 5GHz Wi-Fi® reset line |
| SDEX | Expose uSDHC3 interface, available only when no WBD/WBE is selected |

Note 1: *Additional orderable options may be available that are not included in this datasheet. For a complete list of configuration options, please visit the Variscite official website or contact their sales personnel.*

7. External Connectors

7.1 Board to Board Connector

- The DART-MX93 exposes three 90-pin board-to-board connectors.
- The recommended mating connector is: **Hirose Electric Co Ltd PN: DF40C-90DS-0.4V(51)**

7.2 Wi-Fi & BT, 802.15.4 Connector

In Modules with Wi-Fi "WBE" or "WBD" Configuration - a combined Wi-Fi + BT antenna connector is assembled. In case of "ANT2" Configuration dual Antenna connectors are assembled.

- Connector type: U.FL JACK connector
- Cable and antenna shall have a 50 Ohm characteristic impedance

7.3 DART-MX93 Connector Pin-out

Table 2: DART-MX93 Pinout

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|----------------|--|------------|--------------|
| J1.1 | | PMIC_NINT | Runs @ 1.8V. Has an internal 100K pull up. | | PCA9451.13 |
| J1.2 | EC | ETH0_MDI_B_P | | | MxL86110x.4 |
| J1.2 | Non-EC | ENET1_TD1 | Runs @ 1.8V. | GPIO4_IO4 | SOC.T12 |
| J1.3 | EC | NC | | | |
| J1.3 | Non-EC | ENET1_TX_CTL | Runs @ 1.8V. | GPIO4_IO6 | SOC.V10 |
| J1.4 | EC | ETH0_MDI_B_M | | | MxL86110x.5 |
| J1.4 | Non-EC | ENET1_TD0 | Runs @ 1.8V. | GPIO4_IO5 | SOC.W11 |
| J1.5 | EC | LED_LINK10_100 | Connected to GND | | |
| J1.5 | Non-EC | ENET1_TXC | Runs @ 1.8V. | GPIO4_IO7 | SOC.U10 |
| J1.6 | EC | ETH0_MDI_A_M | | | MxL86110x.2 |
| J1.6 | Non-EC | ENET1_TD2 | Runs @ 1.8V. | GPIO4_IO3 | SOC.U12 |
| J1.7 | EC | ETH0_LED_LINK | | | MxL86110x.33 |
| J1.7 | Non-EC | ENET1_RXC | Runs @ 1.8V. Has EMI filter. | GPIO4_IO9 | SOC.AA7 |
| J1.8 | EC | ETH0_MDI_A_P | | | MxL86110x.1 |
| J1.8 | Non-EC | ENET1_TD3 | Runs @ 1.8V. | GPIO4_IO2 | SOC.V12 |
| J1.9 | EC | ETH0_LED_ACT | | | MxL86110x.34 |
| J1.9 | Non-EC | ENET1_RX_CTL | Runs @ 1.8V. | GPIO4_IO8 | SOC.Y8 |
| J1.10 | EC | ETH0_MDI_C_P | | | MxL86110x.6 |
| J1.10 | Non-EC | ENET1_RD0 | Runs @ 1.8V. | GPIO4_IO10 | SOC.AA8 |
| J1.11 | | ENET1_MDIO | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | GPIO4_IO1 | SOC.AA10 |
| J1.12 | EC | ETH0_MDI_C_M | | | MxL86110x.7 |
| J1.12 | Non-EC | ENET1_RD1 | Runs @ 1.8V. | GPIO4_IO11 | SOC.Y9 |
| J1.13 | | ENET1_MDC | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | GPIO4_IO0 | SOC.AA11 |
| J1.14 | EC | ETH0_MDI_D_P | | | MxL86110x.9 |
| J1.14 | Non-EC | ENET1_RD2 | Runs @ 1.8V. | GPIO4_IO12 | SOC.AA9 |
| J1.15 | | NVCC_BBSM | | | PCA9451.3 |
| J1.16 | EC | ETH0_MDI_D_M | | | MxL86110x.10 |
| J1.16 | Non-EC | ENET1_RD3 | Runs @ 1.8V. | GPIO4_IO13 | SOC.Y10 |
| J1.17 | | GPIO_IO07 | | GPIO2_IO7 | SOC.L21 |
| J1.18 | | GND | | | |
| J1.19 | | GPIO_IO06 | | GPIO2_IO6 | SOC.L20 |
| J1.20 | | ONOFF | Runs @ 1.8V. | | SOC.A19 |
| J1.21 | | GND | | | |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|----------------|---|------------|---------------|
| J1.22 | | PMIC_RST_B | Runs @ 1.8V. Pull low to hold DART internal regulators OFF. Pulse low for cold reboot. Has an internal 100K pull up. | | PCA9451.8 |
| J1.23 | WBD/WBE | BT_HOST_WAKE | Runs @ 1.8V. | | LBES5PL2xL.76 |
| J1.23 | Non-WBD/WBE | NC | | | |
| J1.24 | | POR_B | Runs @ 1.8V. Pull low to hold SOC in reset state. Pulse low for Warm reboot. Has an internal 100K pull up. | | PCA9451.9 |
| J1.25 | WBD/WBE | WIFI_HOST_WAKE | Runs @ 1.8V. | | LBES5PL2xL.73 |
| J1.25 | Non-WBD/WBE | NC | | | |
| J1.26 | | PMIC_STBY_REQ | Runs @ 1.8V. | | SOC.B18 |
| J1.27 | | VDD_3V3 | Power output from PMIC. Recommend to use as base board 3.3V regulator enable. | | PCA9451.19 |
| J1.28 | | CCM_CLKO3 | Runs @ 1.8V. | GPIO4_IO28 | SOC.U4 |
| J1.29 | | NC | | | |
| J1.30 | | GND | | | |
| J1.31 | | NC | | | |
| J1.32 | WBD/WBE | BT_DEV_WAKE | Runs @ 1.8V. | | LBES5PL2xL.75 |
| J1.32 | Non-WBD/WBE | NC | | | |
| J1.33 | | GND | | | |
| J1.34 | | NC | | | |
| J1.35 | | NC | | | |
| J1.36 | WBD/WBE | BT_PCM_IN | Runs @ 1.8V. | | LBES5PL2xL.93 |
| J1.36 | Non-WBD/WBE | NC | | | |
| J1.37 | | NC | | | |
| J1.38 | | NC | | | |
| J1.39 | WBD/WBE | RF_CNTL1 | Runs @ 1.8V. | | LBES5PL2xL.26 |
| J1.39 | Non-WBD/WBE | NC | | | |
| J1.40 | | NC | | | |
| J1.41 | | NC | | | |
| J1.42 | | NC | | | |
| J1.43 | | NC | | | |
| J1.44 | | NC | | | |
| J1.45 | | NC | | | |
| J1.46 | | NC | | | |
| J1.47 | | NC | | | |
| J1.48 | | NC | | | |
| J1.49 | | GND | | | |
| J1.50 | | NC | | | |
| J1.51 | | NC | | | |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|----------------|---|-----------|---------------|
| J1.52 | BTRST | BT_KILL | Runs @ 1.8V. | | LBES5PL2xL.64 |
| J1.52 | Non-BTRST | GND | | | |
| J1.53 | | NC | | | |
| J1.54 | WBD/WBE | BT_PCM_CLK | Runs @ 1.8V. | | LBES5PL2xL.57 |
| J1.54 | Non-WBD/WBE | NC | | | |
| J1.55 | WBD/WBE | WLAN_SPI_CS0 | Runs @ 1.8V. | | LBES5PL2xL.4 |
| J1.55 | Non-WBE | GND | | | |
| J1.56 | WBD/WBE | BT_PCM_OUT | Runs @ 1.8V. | | LBES5PL2xL.59 |
| J1.56 | Non-WBD/WBE | NC | | | |
| J1.57 | | NC | | | |
| J1.58 | WRST | WB_KILL | Runs @ 1.8V. | | LBES5PL2xL.63 |
| J1.58 | Non-WRST | GND | | | |
| J1.59 | | NC | | | |
| J1.60 | | NC | | | |
| J1.61 | WBE | WLAN_SPI_RXD | Runs @ 1.8V. | | LBES5PL2xL.6 |
| J1.61 | Non-WBE | GND | | | |
| J1.62 | | NC | | | |
| J1.63 | WBE | WLAN_SPI_TXD | Runs @ 1.8V. | | LBES5PL2xL.7 |
| J1.63 | Non-WBE | NC | | | |
| J1.64 | WBD/WBE | RF_CNTLO | Runs @ 1.8V. | | LBES5PL2xL.27 |
| J1.64 | Non-WBD/WBE | GND | | | |
| J1.65 | WBD/WBE | BT_PCM_SYNC | Runs @ 1.8V. | | LBES5PL2xL.61 |
| J1.65 | Non-WBD/WBE | NC | | | |
| J1.66 | WBD/WBE | RF_CNTL3 | Runs @ 1.8V. | | LBES5PL2xL.25 |
| J1.66 | Non-WBD/WBE | NC | | | |
| J1.67 | WBE | WLAN_SPI_CLK | Runs @ 1.8V. | | LBES5PL2xL.8 |
| J1.67 | Non-WBE | GND | | | |
| J1.68 | WBD/WBE | RF_CNTL4 | Runs @ 1.8V. | | LBES5PL2xL.24 |
| J1.68 | Non-WBD/WBE | NC | | | |
| J1.69 | | NC | | | |
| J1.70 | BTRST | LR_KILL | Runs @ 1.8V. | | LBES5PL2xL.38 |
| J1.70 | Non-BTRST | GND | | | |
| J1.71 | | NC | | | |
| J1.72 | | NC | | | |
| J1.73 | | MIPI_CSI1_D1_P | | | SOC.B10 |
| J1.74 | | SD2_CD_B | External SD card detect input. Will change level according to J1.90 NVCC_SD. | GPIO3_IO0 | SOC.Y17 |
| J1.75 | | MIPI_CSI1_D1_N | | | SOC.A10 |
| J1.76 | | GND | | | |
| J1.77 | | NC | | | |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|-----------------|---|------------|------------|
| J1.78 | | SD2_DATA2 | Will change level according to J1.90 NVCC_SD. | GPIO3_IO5 | SOC.Y20 |
| J1.79 | | NC | | | |
| J1.80 | | SD2_DATA1 | Will change level according to J1.90 NVCC_SD. | GPIO3_IO4 | SOC.AA18 |
| J1.81 | | MIPI_CSI1_D0_P | | | SOC.B11 |
| J1.82 | | SD2_CLK | Will change level according to J1.90 NVCC_SD. | GPIO3_IO1 | SOC.AA19 |
| J1.83 | | MIPI_CSI1_D0_N | | | SOC.A11 |
| J1.84 | | SD2_DATA3 | Will change level according to J1.90 NVCC_SD. | GPIO3_IO6 | SOC.AA20 |
| J1.85 | | GND | | | |
| J1.86 | | SD2_DATA0 | Will change level according to J1.90 NVCC_SD. | GPIO3_IO3 | SOC.Y18 |
| J1.87 | | MIPI_CSI1_CLK_P | | | SOC.E10 |
| J1.88 | | SD2_CMD | Will change level according to J1.90 NVCC_SD. | GPIO3_IO2 | SOC.Y19 |
| J1.89 | | MIPI_CSI1_CLK_N | | | SOC.D10 |
| J1.90 | | NVCC_SD | Power output for SD2 pins reference 1.8V/3.3V. | | PCA9451.55 |
| J2.1 | | NC | | | |
| J2.2 | AC | HPLOUT | 100nF and 20Ω Zobel network required | | WM8904.13 |
| J2.2 | Non-AC | SAI1_RXD0 | | GPIO1_IO14 | SOC.H20 |
| J2.3 | | NC | | | |
| J2.4 | AC | HPROUT | 100nF and 20Ω Zobel network required | | WM8904.15 |
| J2.4 | Non-AC | SAI1_TXC | | GPIO1_IO12 | SOC.G20 |
| J2.5 | | NC | | | |
| J2.6 | AC | HPOUTFB | | | WM8904.14 |
| J2.6 | Non-AC | I2C2_SCL | | GPIO1_IO2 | SOC.D20 |
| J2.7 | | NC | | | |
| J2.8 | AC | LINEIN1_LP | | | WM8904.26 |
| J2.8 | Non-AC | I2C2_SDA | | GPIO1_IO3 | SOC.D21 |
| J2.9 | | NC | | | |
| J2.10 | AC | LINEIN1_RP | | | WM8904.24 |
| J2.10 | Non-AC | SAI1_TXFS | BOOT_MODE2 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | GPIO1_IO11 | SOC.G21 |
| J2.11 | | NC | | | |
| J2.12 | | AGND | | | |
| J2.13 | | NC | | | |
| J2.14 | AC | DMIC_CLK | DMIC output. | | WM8904.1 |
| J2.14 | Non-AC | SAI1_TXD0 | BOOT_MODE3 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | GPIO1_IO13 | SOC.H21 |
| J2.15 | | NC | | | |
| J2.16 | AC | DMIC_DATA | Runs @ 1.8V. DMIC input. | | WM8904.27 |
| J2.16 | Non-AC | UART2_RXD | | GPIO1_IO6 | SOC.F20 |
| J2.17 | | NC | | | |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|------------------|---|------------|---------------|
| J2.18 | | GND | | | |
| J2.19 | | NC | | | |
| J2.20 | | DAP_TDO_TRACESWO | Runs @ 1.8V. Used on DART for BT communication. Pin can be used when BT disabled. | GPIO3_IO31 | SOC.Y2 |
| J2.21 | | NC | | | |
| J2.22 | | DAP_TMS_SWDIO | Runs @ 1.8V. Used on DART for BT communication. Pin can be used when BT disabled. | GPIO3_IO29 | SOC.W2 |
| J2.23 | | GND | | | |
| J2.24 | | DAP_TDI | Runs @ 1.8V. Used on DART for BT communication. Pin can be used when BT disabled. | GPIO3_IO28 | SOC.W1 |
| J2.25 | SDEX | SD2_RESET_B | Runs @ J1.90 VDD_SDIO2 level. | GPIO3_IO7 | SOC.AA17 |
| J2.25 | Non-SDEX | NC | | | |
| J2.26 | | DAP_TCLK_SWCLK | Runs @ 1.8V. Used on DART for BT communication. Pin can be used when BT disabled. | GPIO3_IO30 | SOC.Y1 |
| J2.27 | SDEX | ENET2_MDIO | Runs @ 1.8V. | GPIO4_IO15 | SOC.AA6 |
| J2.27 | Non-SDEX | NC | | | |
| J2.28 | | WDOG_ANY | | GPIO1_IO15 | SOC.J18 |
| J2.29 | SDEX | SD3_DATA3 | Runs @ 1.8V. | GPIO3_IO25 | SOC.T14 |
| J2.29 | Non-SDEX | NC | | | |
| J2.30 | | I2C1_SDA | | GPIO1_IO1 | SOC.C21 |
| J2.31 | SDEX | SD3_DATA2 | Runs @ 1.8V. | GPIO3_IO24 | SOC.U14 |
| J2.31 | Non-SDEX | NC | | | |
| J2.32 | | I2C1_SCL | | GPIO1_IO0 | SOC.C20 |
| J2.33 | SDEX | SD3_DATA1 | Runs @ 1.8V. | GPIO3_IO23 | SOC.V14 |
| J2.33 | Non-SDEX | NC | | | |
| J2.34 | | GPIO_IO19 | | GPIO2_IO19 | SOC.R17 |
| J2.35 | SDEX | SD3_DATA0 | Runs @ 1.8V. | GPIO3_IO22 | SOC.T16 |
| J2.35 | Non-SDEX | NC | | | |
| J2.36 | | GPIO_IO20 | | GPIO2_IO20 | SOC.T20 |
| J2.37 | COEX | COEX_SIN | Runs @ 1.8V. | | LBES5PL2xL.69 |
| J2.37 | Non-COEX | NC | | | |
| J2.38 | | GPIO_IO16 | | GPIO2_IO16 | SOC.R21 |
| J2.39 | COEX | COEX_SOUT | Runs @ 1.8V. | | LBES5PL2xL.70 |
| J2.39 | Non-COEX | NC | | | |
| J2.40 | | GPIO_IO18 | | GPIO2_IO18 | SOC.R18 |
| J2.41 | | VDD | | | PCA9451.15 |
| J2.42 | | GPIO_IO26 | | GPIO2_IO26 | SOC.V20 |
| J2.43 | SDEX | SD3_CMD | Runs @ 1.8V. | GPIO3_IO21 | SOC.U16 |
| J2.43 | Non-SDEX | NC | | | |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|-----------------|--|------------|---------|
| J2.44 | | GPIO_IO21 | | GPIO2_IO21 | SOC.T21 |
| J2.45 | SDEX | SD3_CLK | Runs @ 1.8V. | GPIO3_IO20 | SOC.V16 |
| J2.45 | Non-SDEX | NC | | | |
| J2.46 | | GPIO_IO17 | | GPIO2_IO17 | SOC.R20 |
| J2.47 | | GND | | | |
| J2.48 | | GPIO_IO10 | | GPIO2_IO10 | SOC.N17 |
| J2.49 | | NC | | | |
| J2.50 | | PDM_CLK | | GPIO1_IO8 | SOC.G17 |
| J2.51 | | NC | | | |
| J2.52 | | NC | | | |
| J2.53 | | GND | | | |
| J2.54 | | GPIO_IO27 | | GPIO2_IO27 | SOC.W21 |
| J2.55 | | NC | | | |
| J2.56 | | PDM_BIT_STREAM0 | | GPIO1_IO9 | SOC.J17 |
| J2.57 | | NC | | | |
| J2.58 | | NC | | | |
| J2.59 | | NC | | | |
| J2.60 | | GPIO_IO25 | | GPIO2_IO25 | SOC.V21 |
| J2.61 | | NC | | | |
| J2.62 | | NC | | | |
| J2.63 | | NC | | | |
| J2.64 | | ENET2_RX_CTL | Runs @ 1.8V. | GPIO4_IO22 | SOC.Y4 |
| J2.65 | | ENET2_RD0 | Runs @ 1.8V. | GPIO4_IO24 | SOC.AA4 |
| J2.66 | | ENET2_RD2 | Runs @ 1.8V. | GPIO4_IO26 | SOC.AA5 |
| J2.67 | | ENET2_TD1 | Runs @ 1.8V. | GPIO4_IO18 | SOC.U8 |
| J2.68 | | ENET2_RD3 | Runs @ 1.8V. | GPIO4_IO27 | SOC.Y6 |
| J2.69 | | ENET2_RD1 | Runs @ 1.8V. | GPIO4_IO25 | SOC.Y5 |
| J2.70 | | ENET2_TD0 | Runs @ 1.8V. | GPIO4_IO19 | SOC.T8 |
| J2.71 | | ENET2_TXC | Runs @ 1.8V. | GPIO4_IO21 | SOC.U6 |
| J2.72 | | ENET2_RXC | Runs @ 1.8V. | GPIO4_IO23 | SOC.AA3 |
| J2.73 | | ENET2_TD3 | Runs @ 1.8V. | GPIO4_IO16 | SOC.T10 |
| J2.74 | | ENET2_TX_CTL | Runs @ 1.8V. | GPIO4_IO20 | SOC.V6 |
| J2.75 | | GND | | | |
| J2.76 | | CCM_CLKO1 | Runs @ 1.8V. Has an internal 12K pull down. | GPIO3_IO26 | SOC.AA2 |
| J2.77 | | GPIO_IO15 | | GPIO2_IO15 | SOC.P21 |
| J2.78 | | ENET2_TD2 | Runs @ 1.8V. Internal buffer connected to this pin. It drives BOOT_MODE0, latched with POR_B rise. | GPIO4_IO17 | SOC.V8 |
| J2.79 | | GPIO_IO12 | | GPIO2_IO12 | SOC.N20 |
| J2.80 | | GPIO_IO11 | | GPIO2_IO11 | SOC.N18 |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|----------------|---|------------|--------------|
| J2.81 | | GPIO_IO13 | | GPIO2_IO13 | SOC.N21 |
| J2.82 | EC | ETH_INT | Runs @ 1.8V. Has an internal 1.47K pull up. | | MxL86110x.31 |
| J2.82 | Non-EC | NC | | | |
| J2.83 | | GPIO_IO14 | | GPIO2_IO14 | SOC.P20 |
| J2.84 | | GND | | | |
| J2.85 | | GPIO_IO05 | | GPIO2_IO5 | SOC.L18 |
| J2.86 | | GPIO_IO04 | | GPIO2_IO4 | SOC.L17 |
| J2.87 | | GPIO_IO09 | | GPIO2_IO9 | SOC.M21 |
| J2.88 | | UART1_RXD | Used as console debug on Variscite release. | GPIO1_IO4 | SOC.E20 |
| J2.89 | | GPIO_IO8 | | GPIO2_IO8 | SOC.M20 |
| J2.90 | | UART1_TXD | Used as console debug on Variscite release. BOOT_MODE0 pin. Do not drive until after POR_B rise + 30ms. Internal buffer connected to J2.78 drives this pin. The sate latched with POR_B rise. | GPIO1_IO5 | SOC.E21 |
| J3.1 | | NC | | | |
| J3.2 | | LVDS_D0_P | | | SOC.B5 |
| J3.3 | | NC | | | |
| J3.4 | | LVDS_D0_N | | | SOC.A5 |
| J3.5 | | LVDS_D2_P | | | SOC.B2 |
| J3.6 | | LVDS_D1_P | | | SOC.B4 |
| J3.7 | | LVDS_D2_N | | | SOC.A2 |
| J3.8 | | LVDS_D1_N | | | SOC.A4 |
| J3.9 | | GND | | | |
| J3.10 | | GND | | | |
| J3.11 | | LVDS_CLK_P | | | SOC.B3 |
| J3.12 | | MIPI_DSI1_D0_P | | | SOC.B6 |
| J3.13 | | LVDS_CLK_N | | | SOC.A3 |
| J3.14 | | MIPI_DSI1_D0_N | | | SOC.A6 |
| J3.15 | | GND | | | |
| J3.16 | | MIPI_DSI1_D1_P | | | SOC.B7 |
| J3.17 | | LVDS_D3_P | | | SOC.C1 |
| J3.18 | | MIPI_DSI1_D1_N | | | SOC.A7 |
| J3.19 | | LVDS_D3_N | | | SOC.B1 |
| J3.20 | | MIPI_DSI1_D3_P | | | SOC.B9 |
| J3.21 | | GND | | | |
| J3.22 | | MIPI_DSI1_D3_N | | | SOC.A9 |
| J3.23 | | MIPI_DSI1_D2_P | | | SOC.B8 |
| J3.24 | | GND | | | |
| J3.25 | | MIPI_DSI1_D2_N | | | SOC.A8 |
| J3.26 | | USB2_VBUS | Runs @ 5.0V. | | SOC.E14 |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|-----------------|---|------------|--------------|
| | | | VBUS detect input | | |
| J3.27 | | GND | | | |
| J3.28 | | NC | | | |
| J3.29 | | MIPI_DSI1_CLK_N | | | SOC.D6 |
| J3.30 | | GPIO_IO00 | | GPIO2_IO0 | SOC.J21 |
| J3.31 | | MIPI_DSI1_CLK_P | | | SOC.E6 |
| J3.32 | WBE | WLAN_SPI_IRQ | Runs @ 1.8V. Has an internal 10K pullup. | | LBES5PL2xL.5 |
| J3.32 | Non-WBE | NC | | | |
| J3.33 | | GND | | | |
| J3.34 | | GND | | | |
| J3.35 | | NC | | | |
| J3.36 | | NC | | | |
| J3.37 | | NC | | | |
| J3.38 | | GPIO_IO02 | | GPIO2_IO2 | SOC.K20 |
| J3.39 | | GND | | | |
| J3.40 | | NC | | | |
| J3.41 | | NC | | | |
| J3.42 | | GPIO_IO22 | | GPIO2_IO22 | SOC.U18 |
| J3.43 | | NC | | | |
| J3.44 | | USB2_ID | USB2 PHY native ID analogue input. Not recommended to use. | | SOC.E12 |
| J3.45 | | GND | | | |
| J3.46 | | GPIO_IO23 | | GPIO2_IO23 | SOC.U20 |
| J3.47 | | USB2_D_P | | | SOC.B15 |
| J3.48 | | CCM_CLKO2 | Runs @ 1.8V. | GPIO3_IO27 | SOC.Y3 |
| J3.49 | | USB2_D_N | | | SOC.A15 |
| J3.50 | | GPIO_IO01 | | GPIO2_IO1 | SOC.J20 |
| J3.51 | | GND | | | |
| J3.52 | | CCM_CLKO4 | Runs @ 1.8V. | GPIO4_IO29 | SOC.V4 |
| J3.53 | | NC | | | |
| J3.54 | | NC | | | |
| J3.55 | | NC | | | |
| J3.56 | | USB1_ID | USB2 PHY native ID analogue input. Not recommended to use. | | SOC.C11 |
| J3.57 | | GND | | | |
| J3.58 | | GPIO_IO03 | | GPIO2_IO3 | SOC.K21 |
| J3.59 | | NC | | | |
| J3.60 | | NC | | | |
| J3.61 | | NC | | | |
| J3.62 | | PDM_BIT_STREAM1 | | GPIO1_IO10 | SOC.G18 |

| Pin | Assembly Option | Pad Name | Notes | GPIO | Ball |
|-------|-----------------|-------------|---|------------|---------|
| J3.63 | | GND | | | |
| J3.64 | | GPIO_IO24 | | GPIO2_IO24 | SOC.U21 |
| J3.65 | | USB1_D_P | | | SOC.B14 |
| J3.66 | | USB1_VBUS | Runs @ 5.0V. VBUS detect input. | | SOC.F12 |
| J3.67 | | USB1_D_N | | | SOC.A14 |
| J3.68 | | GND | | | |
| J3.69 | | NC | | | |
| J3.70 | | TAMPER0 | Runs @ 1.8V. | | SOC.B16 |
| J3.71 | | VBAT | | | |
| J3.72 | | TAMPER1 | Runs @ 1.8V. | | SOC.F14 |
| J3.73 | | VBAT | | | |
| J3.74 | | GND | | | |
| J3.75 | | VBAT | | | |
| J3.76 | | ADC_IN0 | Runs @ 1.8V. | | SOC.B19 |
| J3.77 | | VBAT | | | |
| J3.78 | | ADC_IN1 | Runs @ 1.8V. | | SOC.A20 |
| J3.79 | | VBAT | | | |
| J3.80 | | ADC_IN2 | Runs @ 1.8V. | | SOC.B20 |
| J3.81 | | VBAT | | | |
| J3.82 | | ADC_IN3 | Runs @ 1.8V. | | SOC.B21 |
| J3.83 | | VBAT | | | |
| J3.84 | | CLKIN1 | Runs @ 1.8V. Has an internal 100K pull down. | | SOC.B17 |
| J3.85 | | VBAT | | | |
| J3.86 | | CLKIN2 | Runs @ 1.8V. Has an internal 100K pull down. | | SOC.A18 |
| J3.87 | | VBAT | | | |
| J3.88 | | PMIC_ON_REQ | Runs @ 1.8V. | | SOC.A17 |
| J3.89 | | VBAT | | | |
| J3.90 | | NC | | | |

7.4 DART-MX93 Connector Pin Mux

Table 3: DART-MX93 PINMUX

| Pin | Assy | Alt0 | Alt1 | Alt2 | Alt3 | Alt4 | Alt5 | Alt6 | Alt7 |
|-------|--------|------------------------------|---|-------------------|--------------|--------------------|--------------|------------|-------------------|
| J1.2 | Non-EC | enet_qos.RGMII_TD1 | uart3.RTS_B | i3c2.PUR | usb1.OTG_OC | flexio2.FLEXIO[4] | gpio4.IO[4] | i3c2.PUR_B | |
| J1.3 | Non-EC | enet_qos.RGMII_TX_CTL | uart3.DTR_B | | | flexio2.FLEXIO[6] | gpio4.IO[6] | | |
| J1.4 | Non-EC | enet_qos.RGMII_TD0 | uart3.TX | | | flexio2.FLEXIO[5] | gpio4.IO[5] | | |
| J1.5 | Non-EC | enet_qos.RGMII_TXC | enet_qos.TX_ER | | | flexio2.FLEXIO[7] | gpio4.IO[7] | | |
| J1.6 | Non-EC | enet_qos.RGMII_TD2 | IN=enet_qos.TX_CLK OUT=ENET_CLK_ROOT | can2.RX | usb2.OTG_OC | flexio2.FLEXIO[3] | gpio4.IO[3] | | |
| J1.7 | Non-EC | enet_qos.RGMII_RXC | enet_qos.RX_ER | | | flexio2.FLEXIO[9] | gpio4.IO[9] | | |
| J1.8 | Non-EC | enet_qos.RGMII_TD3 | | can2.TX | usb2.OTG_ID | flexio2.FLEXIO[2] | gpio4.IO[2] | | |
| J1.9 | Non-EC | enet_qos.RGMII_RX_CTL | uart3.DSR_B | | usb2.OTG_PWR | flexio2.FLEXIO[8] | gpio4.IO[8] | | |
| J1.10 | Non-EC | enet_qos.RGMII_RD0 | uart3.RX | | | flexio2.FLEXIO[10] | gpio4.IO[10] | | |
| J1.11 | | enet_qos.MDIO ^[4] | uart3.RIN_B | i3c2.SDA | usb1.OTG_PWR | flexio2.FLEXIO[1] | gpio4.IO[1] | | |
| J1.12 | Non-EC | enet_qos.RGMII_RD1 | uart3.CTS_B | | lptmr2.ALT1 | flexio2.FLEXIO[11] | gpio4.IO[11] | | |
| J1.13 | | enet_qos.MDC ^[4] | uart3.DCD_B | i3c2.SCL | usb1.OTG_ID | flexio2.FLEXIO[0] | gpio4.IO[0] | | |
| J1.14 | Non-EC | enet_qos.RGMII_RD2 | | | lptmr2.ALT2 | flexio2.FLEXIO[12] | gpio4.IO[12] | | |
| J1.16 | Non-EC | enet_qos.RGMII_RD3 | | | lptmr2.ALT3 | flexio2.FLEXIO[13] | gpio4.IO[13] | | |
| J1.17 | | gpio2.IO[7] | spi3.PCS1 | isi.D[1] | lcdif.D[3] | spi7.SCK | uart6.RTS_B | i2c7.SCL | flexio1.FLEXIO[7] |
| J1.19 | | gpio2.IO[6] | tpm5.CH0 | pdm.BIT_STREAM[1] | lcdif.D[2] | spi7.SOUT | uart6.CTS_B | i2c7.SDA | flexio1.FLEXIO[6] |
| J1.28 | | ccmsrcgpcmix.CLK03 | | | | flexio2.FLEXIO[28] | gpio4.IO[28] | | |
| J1.74 | | usdhc2.CD_B | enet_qos.1588_EVENT0_IN | i3c2.SCL | | flexio1.FLEXIO[0] | gpio3.IO[0] | | |
| J1.78 | | usdhc2.DATA2 | enet2.1588_EVENT1_OUT | mqs2.RIGHT | | flexio1.FLEXIO[5] | gpio3.IO[5] | | |
| J1.80 | | usdhc2.DATA1 | enet2.1588_EVENT1_IN | can2.RX | | flexio1.FLEXIO[4] | gpio3.IO[4] | | |
| J1.82 | | usdhc2.CLK | enet_qos.1588_EVENT0_OUT | i3c2.SDA | | flexio1.FLEXIO[1] | gpio3.IO[1] | | |

| Pin | Assy | Alt0 | Alt1 | Alt2 | Alt3 | Alt4 | Alt5 | Alt6 | Alt7 |
|-------|--------|-----------------------------|--------------------------------|-------------------|-------------|--------------------|------------------------------|----------------------------|-----------------|
| J1.84 | | usdhc2.DATA3 | lptmr2.ALT1 | mqs2.LEFT | | flexio1.FLEXIO[6] | gpio3.IO[6] | | |
| J1.86 | | usdhc2.DATA0 | enet2.1588_EVENT0_OUT | can2.TX | | flexio1.FLEXIO[3] | gpio3.IO[3] | | |
| J1.88 | | usdhc2.CMD | enet2.1588_EVENT0_IN | i3c2.PUR | i3c2.PUR_B | flexio1.FLEXIO[2] | gpio3.IO[2] | | |
| J2.2 | Non-AC | sai1.RX_DATA[0] | sai1.MCLK | spi1.SOUT | uart2.DSR_B | mqs1.RIGHT | gpio1.IO[14] | | |
| J2.4 | Non-AC | sai1.TX_BCLK | uart2.CTS_B | spi1.SIN | uart1.DSR_B | can1.RX | gpio1.IO[12] | | |
| J2.6 | Non-AC | i2c2.SCL | i3c1.PUR | uart2.DCD_B | tpm2.CH2 | sai1.RX_SYNC | gpio1.IO[2] | i3c1.PUR_B | |
| J2.8 | Non-AC | i2c2.SDA | | uart2.RIN_B | tpm2.CH3 | sai1.RX_BCLK | gpio1.IO[3] | | |
| J2.10 | | sai1.TX_SYNC ^[3] | sai1.TX_DATA[1] ^[3] | spi1.PCS0 | uart2.DTR_B | mqs1.LEFT | gpio1.IO[11] BOOT_MODE[2] | | |
| J2.14 | Non-AC | sai1.TX_DATA[0] | uart2.RTS_B | spi1.SCK | uart1.DTR_B | can1.TX | gpio1.IO[13] BOOT_MODE[3] | | |
| J2.13 | Non-AC | uart2.RX | uart1.CTS_B | spi2.SOUT | tpm1.CH2 | sai1.MCLK | gpio1.IO[6] | | |
| J2.20 | | dap.TDO_TRACESWO | mqs2.RIGHT | | can2.RX | flexio1.FLEXIO[31] | gpio3.IO[31] | uart5.TX ^[1] | |
| J2.22 | | dap.TMS_SWDIO | | | | flexio2.FLEXIO[31] | gpio3.IO[29] | uart5.RTS_B ^[1] | |
| J2.24 | | dap.TDI | mqs2.LEFT | | can2.TX | flexio2.FLEXIO[30] | gpio3.IO[28] | uart5.RX ^[1] | |
| J2.25 | SDEX | usdhc2.RESET_B | lptmr2.ALT2 | | | flexio1.FLEXIO[7] | gpio3.IO[7] | | |
| J2.26 | | dap.TCLK_SWCLK | | | | flexio1.FLEXIO[30] | gpio3.IO[3] | uart5.CTS_B ^[1] | |
| J2.27 | SDEX | enet2.MDIO | uart4.RIN_B | sai2.RX_BCLK | | flexio2.FLEXIO[15] | gpio4.IO[15] | | |
| J2.28 | | wdog1.WDOG_ANY | | | | | gpio1.IO[15] | | |
| J2.29 | SDEX | usdhc3.DATA3 | flexspi.A_DATA[3] | | | flexio1.FLEXIO[25] | gpio3.IO[25] | | |
| J2.30 | | i2c1.SDA | i3c1.SDA | uart1.RIN_B | tpm2.CH1 | | gpio1.IO[1] | | |
| J2.31 | SDEX | usdhc3.DATA2 | flexspi.A_DATA[2] | | | flexio1.FLEXIO[24] | gpio3.IO[24] | | |
| J2.32 | | i2c1.SCL | i3c1.SCL | uart1.DCD_B | tpm2.CH0 | | gpio1.IO[0] | | |
| J2.33 | SDEX | usdhc3.DATA1 | flexspi.A_DATA[1] | | | flexio1.FLEXIO[23] | gpio3.IO[23] | | |
| J2.34 | | gpio2.IO[19] | sai3.RX_SYNC | pdm.BIT_STREAM[3] | lcdif.D[15] | spi5.SIN | spi4.SIN | tpm6.CH2 | sai3.TX_DATA[0] |
| J2.35 | SDEX | usdhc3.DATA0 | flexspi.A_DATA[0] | | | flexio1.FLEXIO[22] | gpio3.IO[22] | | |

| Pin | Assy | Alt0 | Alt1 | Alt2 | Alt3 | Alt4 | Alt5 | Alt6 | Alt7 |
|-------|------|--------------------|-----------------------------|-------------------|-------------|--------------------|----------------|-------------|--------------------|
| J2.36 | | gpio2.IO[20] | sai3.RX_DATA[0] | pdm.BIT_STREAM[0] | lcdif.D[16] | spi5.SOUT | spi4.SOUT | tpm3.CH1 | flexio1.FLEXIO[20] |
| J2.38 | | gpio2.IO[16] | sai3.TX_BCLK | pdm.BIT_STREAM[2] | lcdif.D[12] | uart3.CTS_B | spi4.PCS2 | uart4.CTS_B | flexio1.FLEXIO[16] |
| J2.40 | | gpio2.IO[18] | sai3.RX_BCLK | isi.D[9] | lcdif.D[14] | spi5.PCS0 | spi4.PCS0 | tpm5.CH2 | flexio1.FLEXIO[18] |
| J2.42 | | gpio2.IO[26] | usdhc3.DATA2 ^[2] | pdm.BIT_STREAM[1] | lcdif.D[22] | tpm5.CH3 | dap.TDI | spi8.PCS1 | sai3.TX_SYNC |
| J2.43 | SDEX | usdhc3.CMD | flexspi.A_SS0_B | | | flexio1.FLEXIO[21] | gpio3.IO[21] | | |
| J2.44 | | gpio2.IO[21] | sai3.TX_DATA[0] | pdm.CLK | lcdif.D[17] | spi5.SCK | spi4.SCK | tpm4.CH1 | sai3.RX_BCLK |
| J2.45 | SDEX | usdhc3.CLK | flexspi.A_SCLK | | | flexio1.FLEXIO[20] | gpio3.IO[20] | | |
| J2.46 | | gpio2.IO[17] | sai3.MCLK | isi.D[8] | lcdif.D[13] | uart3.RTS_B | spi4.PCS1 | uart4.RTS_B | flexio1.FLEXIO[17] |
| J2.48 | | gpio2.IO[10] | spi3.SOUT | isi.D[4] | lcdif.D[6] | tpm4.EXTCLK | uart7.CTS_B | i2c8.SDA | flexio1.FLEXIO[10] |
| J2.50 | | pdm.CLK | mqs1.LEFT | | | lptmr1.ALT1 | gpio1.IO[8] | can1.TX | |
| J2.54 | | gpio2.IO[27] | usdhc3.DATA3 ^[2] | can2.RX | lcdif.D[23] | tpm6.CH3 | dap.TMS_SWDIO | spi5.PCS1 | flexio1.FLEXIO[27] |
| J2.56 | | pdm.BIT_STREAM[0] | mqs1.RIGHT | spi1.PCS1 | tpm1.EXTCLK | lptmr1.ALT2 | gpio1.IO[9] | can1.RX | |
| J2.60 | | gpio2.IO[25] | usdhc3.DATA1 ^[2] | can2.TX | lcdif.D[21] | tpm4.CH3 | dap.TCLK_SWCLK | spi7.PCS1 | flexio1.FLEXIO[25] |
| J2.64 | | enet2.RGMII_RX_CTL | uart4.DSR_B | sai2.TX_DATA[0] | | flexio2.FLEXIO[22] | gpio4.IO[22] | | |
| J2.65 | | enet2.RGMII_RD0 | uart4.RX | sai2.TX_DATA[2] | | flexio2.FLEXIO[24] | gpio4.IO[24] | | |
| J2.66 | | enet2.RGMII_RD2 | uart4.CTS_B | sai2.MCLK | mqs2.RIGHT | flexio2.FLEXIO[26] | gpio4.IO[26] | | |
| J2.67 | | enet2.RGMII_TD1 | uart4.RTS_B | sai2.RX_DATA[2] | | flexio2.FLEXIO[18] | gpio4.IO[18] | | |
| J2.68 | | enet2.RGMII_RD3 | spdif1.OUT | spdif1.IN | mqs2.LEFT | flexio2.FLEXIO[27] | gpio4.IO[27] | | |
| J2.69 | | enet2.RGMII_RD1 | spdif1.IN | sai2.TX_DATA[3] | | flexio2.FLEXIO[25] | gpio4.IO[25] | | |
| J2.70 | | enet2.RGMII_TD0 | uart4.TX | sai2.RX_DATA[3] | | flexio2.FLEXIO[19] | gpio4.IO[19] | | |
| J2.71 | | enet2.RGMII_TXC | enet2.TX_ER | sai2.TX_BCLK | | flexio2.FLEXIO[21] | gpio4.IO[21] | | |
| J2.72 | | enet2.RGMII_RXC | enet2.RX_ER | sai2.TX_DATA[1] | | flexio2.FLEXIO[23] | gpio4.IO[23] | | |
| J2.73 | | enet2.RGMII_TD3 | | sai2.RX_DATA[0] | | flexio2.FLEXIO[16] | gpio4.IO[16] | | |
| J2.74 | | enet2.RGMII_TX_CTL | uart4.DTR_B | sai2.TX_SYNC | | flexio2.FLEXIO[20] | gpio4.IO[20] | | |
| J2.76 | | ccmsrcgpcmix.CLK01 | | | | flexio1.FLEXIO[26] | gpio3.IO[26] | | |

| Pin | Assy | Alt0 | Alt1 | Alt2 | Alt3 | Alt4 | Alt5 | Alt6 | Alt7 |
|-------|------|--------------------|---|-------------------|-------------|--------------------|-----------------------------|-----------|--------------------|
| J2.77 | | gpio2.IO[15] | uart3.RX | isi.D[7] | lcdif.D[11] | spi8.SCK | uart8.RTS_B | uart4.RX | flexio1.FLEXIO[15] |
| J2.78 | | enet2.RGMII_TD2 | IN=enet2.TX_CLK OUT= ENET_REF_CLK_ROOT | sai2.RX_DATA[1] | | flexio2.FLEXIO[17] | gpio4.IO[17] | | |
| J2.79 | | gpio2.IO[12] | tpm3.CH2 | pdm.BIT_STREAM[2] | lcdif.D[8] | spi8.PCS0 | uart8.TX | i2c8.SDA | sai3.RX_SYNC |
| J2.80 | | gpio2.IO[11] | spi3.SCK | isi.D[5] | lcdif.D[7] | tpm5.EXTCLK | uart7.RTS_B | i2c8.SCL | flexio1.FLEXIO[11] |
| J2.81 | | gpio2.IO[13] | tpm4.CH2 | pdm.BIT_STREAM[3] | lcdif.D[9] | spi8.SIN | uart8.RX | i2c8.SCL | flexio1.FLEXIO[13] |
| J2.83 | | gpio2.IO[14] | uart3.TX | isi.D[6] | lcdif.D[10] | spi8.SOUT | uart8.CTS_B | uart4.TX | flexio1.FLEXIO[14] |
| J2.85 | | gpio2.IO[5] | tpm4.CH0 | pdm.BIT_STREAM[0] | lcdif.D[1] | spi7.SIN | uart6.RX | i2c6.SCL | flexio1.FLEXIO[5] |
| J2.86 | | gpio2.IO[4] | tpm3.CH0 | pdm.CLK | lcdif.D[0] | spi7.PCS0 | uart6.TX | i2c6.SDA | flexio1.FLEXIO[4] |
| J2.87 | | gpio2.IO[9] | spi3.SIN | isi.D[3] | lcdif.D[5] | tpm3.EXTCLK | uart7.RX | i2c7.SCL | flexio1.FLEXIO[9] |
| J2.88 | | uart1.RX | seco.RX | spi2.SIN | tpm1.CH0 | | gpio1.IO[4] | | |
| J2.89 | | gpio2.IO[8] | spi3.PCS0 | isi.D[2] | lcdif.D[4] | tpm6.CH0 | uart7.TX | i2c7.SDA | flexio1.FLEXIO[8] |
| J2.90 | | uart1.TX | seco.TX | spi2.PCS0 | tpm1.CH1 | | gpio1.IO[5] BOOT_MODE[0] | | |
| J3.30 | | gpio2.IO[0] | | isi.PCLK | lcdif.PCLK | spi6.PCS0 | uart5.TX ^[1] | i2c5.SDA | flexio1.FLEXIO[0] |
| J3.38 | | gpio2.IO[2] | i2c4.SDA | isi.FRAME_VALID | lcdif.VSYNC | spi6.SOUT | uart5.CTS_B ^[1] | i2c6.SDA | flexio1.FLEXIO[2] |
| J3.42 | | gpio2.IO[22] | usdhc3.CLK ^[2] | spdif1.IN | lcdif.D[18] | tpm5.CH1 | tpm6.EXTCLK | i2c5.SDA | flexio1.FLEXIO[22] |
| J3.46 | | gpio2.IO[23] | usdhc3.CMD ^[2] | spdif1.OUT | lcdif.D[19] | tpm6.CH1 | | i2c5.SCL | flexio1.FLEXIO[23] |
| J3.48 | | ccmsrcgpcmix.CLKO2 | | | | flexio1.FLEXIO[27] | gpio3.IO[27] | | |
| J3.50 | | gpio2.IO[1] | | isi.D[0] | lcdif.DE | spi6.SIN | uart5.RX ^[1] | i2c5.SCL | flexio1.FLEXIO[1] |
| J3.52 | | ccmsrcgpcmix.CLKO4 | | | | flexio2.FLEXIO[29] | gpio4.IO[29] | | |
| J3.58 | | gpio2.IO[3] | i2c4.SCL | isi.LINE_VALID | lcdif.HSYNC | spi6.SCK | uart5.RTS_B ^[1] | i2c6.SCL | flexio1.FLEXIO[3] |
| J3.62 | | pdm.BIT_STREAM[1] | m33.NMI | spi2.PCS1 | tpm2.EXTCLK | lptmr1.ALT3 | gpio1.IO[10] | | |
| J3.64 | | gpio2.IO[24] | usdhc3.DATA0 ^[2] | | lcdif.D[20] | tpm3.CH3 | dap.TDO_TRACESWO | spi6.PCS1 | flexio1.FLEXIO[24] |

Note [1]: The UART5 interface is utilized internally for Bluetooth communication.
To use UART5 externally, Bluetooth must be turned off, or a Non-WBD/WBE SOM should be employed.

Note [2]: *The USDHC3 interface is utilized internally for Wi-Fi communication.
To use USDHC3 externally, Wi-Fi must be turned off, or a Non-WBD/WBE SOM should be employed.*

Note [3]: *The SAI1 interface is utilized internally for Codec communication.
To use SAI1 externally, Codec should be disabled in device tree, or a Non-AC SOM should be employed*

Note [4]: *The ENET_QOS.MDIO bus is used internally for Ethernet PHY communication.
When the EC SOM is employed, the functionality of these pins cannot be changed.
The signals are routed through a bidirectional voltage translator and have 1.47K Ω pull-ups, which may limit the bandwidth.*

8. SOM's Interfaces

8.1 Trace Impedance

SOM traces are designed with the below table impedance list per signal group.

Table is a reference when you are updating or creating constraints in the PCB design tool to set up the impedances/trace widths.

Table 4: SOM Signal Group Traces Impedance

| Signal Group | Impedance |
|--|---------------------------|
| All single ended signals | 50 Ω Single ended |
| USB Differential signals | 90 Ω Differential |
| Differential signals including: Ethernet, MIPI (CSI and DSI), LVDS | 100 Ω Differential |

8.2 Display Interfaces

The i.MX 93 SoC includes one instance of LCDIF

One LCDIF can drive any of three displays or drive the same output to multiple displays:

- MIPI DSI (up to 1920x1200p60)
- LVDS Tx (up to 1366x768p60 or 1280x800p60)
- Parallel Display

8.2.1 LVDS

The LVDS Display Bridge (LDB) connects to an External LVDS Display Interface. The purpose of the LDB is to support flow of synchronous RGB data to external display devices through the LVDS interface.

- Supports FPD link
- Supports single channel (4 lanes) output at up to 80MHz pixel clock and LVDS clock, with 7:1 ratio from LVDS data to pixel clock, implying up to 560Mbps LVDS data rate. This supports resolutions up to approximately 1366x768p60 or 1280x800p60.
- Supports VESA and JEIDA pixel mapping
- Supports LVDS Transmitter with four 7-bit channels. Each channel sends the 6-pixel bits and one control signal at 7 times the pixel clock rate. The data and control signals are transmitted over an LVDS link.

8.2.1.1 LVDS0 Signals

Table 5: LVDS Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|---------------------------------|--------|
| J3.13 | | LVDS_CLK_N | 0 | Differential Pair Negative side | SOC.A3 |
| J3.11 | | LVDS_CLK_P | 0 | Differential Pair Positive side | SOC.B3 |
| J3.4 | | LVDS_D0_N | 0 | Differential Pair Negative side | SOC.A5 |
| J3.2 | | LVDS_D0_P | 0 | Differential Pair Positive side | SOC.B5 |
| J3.8 | | LVDS_D1_N | 0 | Differential Pair Negative side | SOC.A4 |
| J3.6 | | LVDS_D1_P | 0 | Differential Pair Positive side | SOC.B4 |
| J3.7 | | LVDS_D2_N | 0 | Differential Pair Negative side | SOC.A2 |
| J3.5 | | LVDS_D2_P | 0 | Differential Pair Positive side | SOC.B2 |
| J3.19 | | LVDS_D3_N | 0 | Differential Pair Negative side | SOC.B1 |
| J3.17 | | LVDS_D3_P | 0 | Differential Pair Positive side | SOC.C1 |

8.2.2 DSI

The i.MX 93 SOC support one 4-lane MIPI DSI display with pixels from the LCDIF. The key features of the MIPI DSI (controller and PHY) include:

- Compliant to MIPI-DSI specification v1.2 and MIPI-DPHY specification v1.2
- Maximum resolution limited to resolutions achievable with a 200MHz pixel clock and active pixel rate of 140Mpixel/s with 24-bit RGB. Resolutions up to 1920x1200p60
- Support up to 1.5Gbps data rate per lane in high-speed and 10Mbps in low-speed operation

8.2.2.1 DSI Signals

Table 6: MIPI DSI Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-----------------|------|---------------------------------|--------|
| J3.29 | | MIPI_DSI1_CLK_N | 0 | Differential Pair Negative side | SOC.D6 |
| J3.31 | | MIPI_DSI1_CLK_P | 0 | Differential Pair Positive side | SOC.E6 |
| J3.14 | | MIPI_DSI1_D0_N | 0 | Differential Pair Negative side | SOC.A6 |
| J3.12 | | MIPI_DSI1_D0_P | 0 | Differential Pair Positive side | SOC.B6 |
| J3.18 | | MIPI_DSI1_D1_N | 0 | Differential Pair Negative side | SOC.A7 |
| J3.16 | | MIPI_DSI1_D1_P | 0 | Differential Pair Positive side | SOC.B7 |
| J3.25 | | MIPI_DSI1_D2_N | 0 | Differential Pair Negative side | SOC.A8 |
| J3.23 | | MIPI_DSI1_D2_P | 0 | Differential Pair Positive side | SOC.B8 |
| J3.22 | | MIPI_DSI1_D3_N | 0 | Differential Pair Negative side | SOC.A9 |
| J3.20 | | MIPI_DSI1_D3_P | 0 | Differential Pair Positive side | SOC.B9 |

8.2.3 LCDIF

The LCD Interface (LCDIF) is a system master that fetches graphics stored in memory and display them on a TFT LCD panel. A wide range of panel sizes is supported and the timing of the interface signals is highly configurable. Graphics are read directly from memory. Graphics may be encoded in a variety of formats to optimize memory usage.

8.2.3.1 LCDIF Signals

Table 7: LCDIF Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.86 | | lcdif.D[0] | 3 | | SOC.L17 |
| J2.83 | | lcdif.D[10] | 3 | | SOC.P20 |
| J2.85 | | lcdif.D[1] | 3 | | SOC.L18 |
| J2.77 | | lcdif.D[11] | 3 | | SOC.P21 |
| J2.38 | | lcdif.D[12] | 3 | | SOC.R21 |
| J2.46 | | lcdif.D[13] | 3 | | SOC.R20 |
| J2.40 | | lcdif.D[14] | 3 | | SOC.R18 |
| J2.34 | | lcdif.D[15] | 3 | | SOC.R17 |
| J2.36 | | lcdif.D[16] | 3 | | SOC.T20 |
| J2.44 | | lcdif.D[17] | 3 | | SOC.T21 |
| J3.42 | | lcdif.D[18] | 3 | | SOC.U18 |
| J3.46 | | lcdif.D[19] | 3 | | SOC.U20 |
| J1.19 | | lcdif.D[2] | 3 | | SOC.L20 |
| J3.64 | | lcdif.D[20] | 3 | | SOC.U21 |
| J2.60 | | lcdif.D[21] | 3 | | SOC.V21 |
| J2.42 | | lcdif.D[22] | 3 | | SOC.V20 |
| J2.54 | | lcdif.D[23] | 3 | | SOC.W21 |
| J1.17 | | lcdif.D[3] | 3 | | SOC.L21 |
| J2.89 | | lcdif.D[4] | 3 | | SOC.M20 |
| J2.87 | | lcdif.D[5] | 3 | | SOC.M21 |
| J2.48 | | lcdif.D[6] | 3 | | SOC.N17 |
| J2.80 | | lcdif.D[7] | 3 | | SOC.N18 |
| J2.79 | | lcdif.D[8] | 3 | | SOC.N20 |
| J2.81 | | lcdif.D[9] | 3 | | SOC.N21 |
| J3.50 | | lcdif.DE | 3 | | SOC.J20 |
| J3.58 | | lcdif.HSYNC | 3 | | SOC.K21 |
| J3.30 | | lcdif.PCLK | 3 | | SOC.J21 |
| J3.38 | | lcdif.VSYNC | 3 | | SOC.K20 |

8.3 Camera Interface

8.3.1 MIPI CSI-2

The i.MX93 SOC supports one 2-lane MIPI CSI2 camera inputs. The key features of the MIPI CSI2 (controller and PHY) include:

- Compliant to MIPI-DSI specification v1.2 and MIPI-DPHY specification v1.2
- Supports up to 2 Rx data lanes (plus 1 Rx clock lane)

8.3.1.1 MIPI-CSI2 Signals

Table 8: MIPI-CSI2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-----------------|------|---------------------------------|---------|
| J1.89 | | MIPI_CSI1_CLK_N | 0 | Differential Pair Negative side | SOC.D10 |
| J1.87 | | MIPI_CSI1_CLK_P | 0 | Differential Pair Positive side | SOC.E10 |
| J1.83 | | MIPI_CSI1_DO_N | 0 | Differential Pair Negative side | SOC.A11 |
| J1.81 | | MIPI_CSI1_DO_P | 0 | Differential Pair Positive side | SOC.B11 |
| J1.75 | | MIPI_CSI1_D1_N | 0 | Differential Pair Negative side | SOC.A10 |
| J1.73 | | MIPI_CSI1_D1_P | 0 | Differential Pair Positive side | SOC.B10 |

8.3.2 ISI - Image Sensing Interface

The ISI module interfaces to a pixel link source to obtain the image data for processing in its pipeline channel. The pipeline processes the image line from a configured source and performs one or more functions that are configured by software, such as down scaling, color space conversion, de-interlacing, alpha insertion, and cropping and rotation (horizontal and vertical). The processed image is stored into programmable memory locations.

The ISI module implements limited flow control mechanism to control output from its internal buffer flushing or sourcing an image ROM memory. Depending on the format type, the ISI is capable of processing and storing one line of pixels from the incoming

The key features of the ISI include:

- Up to 2K resolution at 30 or 60 fps (24bpp) on each channel.
- Input sources:
 - 1 pixel link interface that can interface to 1 camera sensor.
 - System memory (AXI master, internally converted to pixel link interface).
- Each processing pipeline or channel can be assigned to the same or different pixel input source.
- Stream multiplexing
 - Simple de-interlacing methods supported for interlaced input sources:
 - Weaving
- Stream manipulation
 - Supported pixel formats of images to be stored into memory
 - RAW8, RAW10, RAW12, RAW14, RAW16, RAW32
 - RGB888, BGR888, RGB565, RGB 10-bit, BGR 10-bit
 - YUV444, YUV422, YUV420 (8-bit, 10-bit, 12-bit) in planar or semi-planar formats
 - More formats listed in the description of FORMAT field in the channel's IMG_CTRL register

- Downscaling of input image via decimation and bilinear filtering
 - Decimation by 2, 4, or 8 supported
 - Bilinear filter further downscales by 1.0 to 2.0 (fractional downscaling)
- Color Space Conversion (CSC)
 - RGB, YUV, YCbCr
 - User defined color space matrix-based conversion
- Alpha channel insertion for RGB formats
 - Global alpha value
- Separate rectangular region of interest (ROI) alpha value. ROI alpha value has higher priority than global alpha value.
 - Up to 4 ROI non-overlapping rectangles supported
- Mirroring (Image flip): Horizontal and vertical flipping supported.
- Frame awareness and frame skipping
 - Clean frame start and shutdown based on HSYNC and VSYNC
 - Buffer overrun protection
 - Buffer underrun deterministic behavior
- Stream output options
 - Output to memory
 - Input source is converted to and processed by the processing pipeline as YUV444 or RGB.
 - Processed images are outputted from pipeline and stored into memory location specified by software.
 - Full line storage is available at processing channel output before outputting data to AXI. This storage can automatically split or combine depending on the output format being used.
 - Dual buffered addresses are used in ping pong fashion with active buffer status indication.
 - Line and frame stored interrupt status are used for software to track progress of frame.
- Flow control
 - Panic indication is used for software and device to increase priority of its write transactions to avoid potential overflow in output buffers. Software can configure thresholds for panic indication.
 - When pixels are sourced from memory or input line buffers are flushed, software can select to program the rate at which pixels are sent out. By default, one pixel is sent out per clock.
 - Back pressure mechanism is used to stall the channel pipeline during line buffer flushing and sourcing image from memory when AXI bus is unable accept data and the output buffers are low on storage.
- Metadata processing
 - The embedded data from the sensor can be processed and written out.

8.3.2.1 ISI Signals

Table 9: ISI Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-----------------|------|-------|---------|
| J3.50 | | isi.D[0] | 2 | | SOC.J20 |
| J1.17 | | isi.D[1] | 2 | | SOC.L21 |
| J2.89 | | isi.D[2] | 2 | | SOC.M20 |
| J2.87 | | isi.D[3] | 2 | | SOC.M21 |
| J2.48 | | isi.D[4] | 2 | | SOC.N17 |
| J2.80 | | isi.D[5] | 2 | | SOC.N18 |
| J2.83 | | isi.D[6] | 2 | | SOC.P20 |
| J2.77 | | isi.D[7] | 2 | | SOC.P21 |
| J2.46 | | isi.D[8] | 2 | | SOC.R20 |
| J2.40 | | isi.D[9] | 2 | | SOC.R18 |
| J3.38 | | isi.FRAME_VALID | 2 | | SOC.K20 |
| J3.58 | | isi.LINE_VALID | 2 | | SOC.K21 |
| J3.30 | | isi.PCLK | 2 | | SOC.J21 |

8.4 Ethernet Interface

The i.MX 93 SOC implements Two Ethernet controllers both capable of simultaneous operation. One 1G-bit Ethernet with AVB support (ENET) plus a separate 1Gbit Ethernet QoS with TSN support.

ENET_QOS (Ethernet Quality of Service) - Gigabit Ethernet controller based on Synopsys Proprietary with support for TSN (time-sensitive networking) in addition to EEE, Ethernet AVB, and IEEE 1588

ENET1 - Gigabit Ethernet controller with support for Energy Efficient Ethernet (EEE), Ethernet AVB (Audio Video Bridging, IEEE 802.1Qav), and IEEE 1588 time-stamping module which provides accurate clock synchronization for distributed control nodes for industrial automation applications.

8.4.1 ENET_QOS (Ethernet Quality of Service)

The SOM can be ordered in one of the following configurations:

- **“EC” configuration** – The DART-MX93 includes an on SOM a Gigabit PHY (MaxLinear MxL86110) connected to ENET_QOS RGMII interface signals. External connector and magnetics should be implemented on carrier board to complete the interface to the media.
- **“no EC” configuration** – The DART-MX93 exposes the ENET_QOS RGMII/RMII interface signals to the SO-DIMM connector and ENET_QOS pins are referenced to 1.8V.

8.4.1.1 Ethernet PHY

The on SOM MaxLinear MxL86110x Gigabit PHY in conjunction with external magnetics on carrier board complete the interface to the media.

PHY LINK LEDs are fully configurable, default operation shown in below table.

The Following External Gigabit magnetics are required to complete the Ethernet PHY interface to the media.

Table 10: Gigabit Ethernet Magnetics

| Vendor | P/N | Package | Cores | Configuration |
|--------|-------------|-----------------|-------|---------------|
| Pulse | H5007NL | Transformer | 8 | Auto-MDX |
| TDK | TLA-7T101LF | Transformer | 8 | Auto-MDX |
| Pulse | J0G-0009NL | Integrated RJ45 | 8 | Auto-MDX |

Table 11: Ethernet PHY Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|---------------|------|---------------------------------|--------------|
| J1.2 | EC | ETH0_MDI_B_P | 0 | Differential Pair Positive side | MxL86110x.4 |
| J1.4 | EC | ETH0_MDI_B_M | 0 | Differential Pair Negative side | MxL86110x.5 |
| J1.6 | EC | ETH0_MDI_A_M | 0 | Differential Pair Negative side | MxL86110x.2 |
| J1.7 | EC | ETH0_LED_LINK | 0 | Runs @ 3.3V. Active High. | MxL86110x.33 |
| J1.8 | EC | ETH0_MDI_A_P | 0 | Differential Pair Positive side | MxL86110x.1 |
| J1.9 | EC | ETH0_LED_ACT | 0 | Runs @ 3.3V. Active High. | MxL86110x.34 |
| J1.10 | EC | ETH0_MDI_C_P | 0 | Differential Pair Positive side | MxL86110x.6 |
| J1.12 | EC | ETH0_MDI_C_M | 0 | Differential Pair Negative side | MxL86110x.7 |
| J1.14 | EC | ETH0_MDI_D_P | 0 | Differential Pair Positive side | MxL86110x.9 |
| J1.16 | EC | ETH0_MDI_D_M | 0 | Differential Pair Negative side | MxL86110x.10 |
| J2.82 | EC | ETH_INT | 0 | Runs @ 1.8V. | MxL86110x.31 |

Table 12: MxL86110x Ethernet PHY LED Behavior

| Symbol | 10M link | 10M active | 100M link | 100M active | 1000M link | 1000M active |
|-----------------|----------|------------|-----------|-------------|------------|--------------|
| LED_10_100_1000 | ON | ON | ON | ON | ON | ON |
| LED_ACT | OFF | BLINK | OFF | BLINK | OFF | BLINK |

ON = active; OFF = inactive

8.4.1.2 ENET_QOS Signals

Table 13: ENET_QOS RMII/RGMII Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|---|------|--|----------|
| J1.74 | | enet_qos.1588_EVENT0_IN | 1 | Will change level according to J1.90 NVCC_SD. | SOC.Y17 |
| J1.82 | | enet_qos.1588_EVENT0_OUT | 1 | Will change level according to J1.90 NVCC_SD. | SOC.AA19 |
| J1.13 | | enet_qos.MDC | 0 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA11 |
| J1.11 | | enet_qos.MDIO | 0 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA10 |
| J1.10 | Non-EC | enet_qos.RGMII_RD0 | 0 | Runs @ 1.8V. | SOC.AA8 |
| J1.12 | Non-EC | enet_qos.RGMII_RD1 | 0 | Runs @ 1.8V. | SOC.Y9 |
| J1.14 | Non-EC | enet_qos.RGMII_RD2 | 0 | Runs @ 1.8V. | SOC.AA9 |
| J1.16 | Non-EC | enet_qos.RGMII_RD3 | 0 | Runs @ 1.8V. | SOC.Y10 |
| J1.9 | Non-EC | enet_qos.RGMII_RX_CTL | 0 | Runs @ 1.8V. | SOC.Y8 |
| J1.7 | Non-EC | enet_qos.RGMII_RXC | 0 | Runs @ 1.8V. Has EMI filter. | SOC.AA7 |
| J1.4 | Non-EC | enet_qos.RGMII_TD0 | 0 | Runs @ 1.8V. | SOC.W11 |
| J1.2 | Non-EC | enet_qos.RGMII_TD1 | 0 | Runs @ 1.8V. | SOC.T12 |
| J1.6 | Non-EC | enet_qos.RGMII_TD2 | 0 | Runs @ 1.8V. | SOC.U12 |
| J1.8 | Non-EC | enet_qos.RGMII_TD3 | 0 | Runs @ 1.8V. | SOC.V12 |
| J1.3 | Non-EC | enet_qos.RGMII_TX_CTL | 0 | Runs @ 1.8V. | SOC.V10 |
| J1.5 | Non-EC | enet_qos.RGMII_TXC | 0 | Runs @ 1.8V. | SOC.U10 |
| J1.7 | Non-EC | enet_qos.RX_ER | 1 | Runs @ 1.8V. Has EMI filter. | SOC.AA7 |
| J1.5 | Non-EC | enet_qos.TX_ER | 1 | Runs @ 1.8V. | SOC.U10 |
| J1.6 | Non-EC | INPUT=enet_qos.TX_CLK OUTPUT=ENET_CLK_ROOT | 1 | Runs @ 1.8V. | SOC.U12 |

8.4.2 ENET2

ENET2 RGMII/RMII interface signals are always exported through SO-DIMM connector. Signals, in conjunction to MDIO signals exported from SO-DIMM connector, they can be used to interface an external Ethernet PHY.

ENET2 pins are referenced to 1.8V.

8.4.2.1 ENET2 Signals

Table 14: ENET2 RMII/RGMII Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--|------|---|----------|
| J1.88 | | enet2.1588_EVENT0_IN | 1 | Will change level according to J1.90 NVCC_SD. | SOC.Y19 |
| J1.86 | | enet2.1588_EVENT0_OUT | 1 | Will change level according to J1.90 NVCC_SD. | SOC.Y18 |
| J1.80 | | enet2.1588_EVENT1_IN | 1 | Will change level according to J1.90 NVCC_SD. | SOC.AA18 |
| J1.78 | | enet2.1588_EVENT1_OUT | 1 | Will change level according to J1.90 NVCC_SD. | SOC.Y20 |
| J2.27 | SDEX | enet2.MDIO | 0 | Runs @ 1.8V. | SOC.AA6 |
| J2.65 | | enet2.RGMII_RD0 | 0 | Runs @ 1.8V. | SOC.AA4 |
| J2.69 | | enet2.RGMII_RD1 | 0 | Runs @ 1.8V. | SOC.Y5 |
| J2.66 | | enet2.RGMII_RD2 | 0 | Runs @ 1.8V. | SOC.AA5 |
| J2.68 | | enet2.RGMII_RD3 | 0 | Runs @ 1.8V. | SOC.Y6 |
| J2.64 | | enet2.RGMII_RX_CTL | 0 | Runs @ 1.8V. | SOC.Y4 |
| J2.72 | | enet2.RGMII_RXC | 0 | Runs @ 1.8V. | SOC.AA3 |
| J2.70 | | enet2.RGMII_TD0 | 0 | Runs @ 1.8V. | SOC.T8 |
| J2.67 | | enet2.RGMII_TD1 | 0 | Runs @ 1.8V. | SOC.U8 |
| J2.78 | | enet2.RGMII_TD2 | 0 | Runs @ 1.8V. Internal buffer connected to this pin drives BOOT_MODE0 (J2.90), latched with POR_B rise. | SOC.V8 |
| J2.73 | | enet2.RGMII_TD3 | 0 | Runs @ 1.8V. | SOC.T10 |
| J2.74 | | enet2.RGMII_TX_CTL | 0 | Runs @ 1.8V. | SOC.V6 |
| J2.71 | | enet2.RGMII_TXC | 0 | Runs @ 1.8V. | SOC.U6 |
| J2.72 | | enet2.RX_ER | 1 | Runs @ 1.8V. | SOC.AA3 |
| J2.71 | | enet2.TX_ER | 1 | Runs @ 1.8V. | SOC.U6 |
| J2.78 | | IN=enet2.TX_CLK OUT=ENET_REF_CLK_ROOT | 1 | Runs @ 1.8V. Internal buffer connected to this pin drives BOOT_MODE0 (J2.90), latched with POR_B rise. | SOC.V8 |

8.5 Wi-Fi, BT, 802.15.4

The DART-MX93 contains a certified high-performance Wi-Fi, Bluetooth, 802.15.4 module:

- Wi-Fi® 802.11a/b/g/n/ac/ax
- Bluetooth® 5.4 BR/EDR/LE
- 802.15.4
- Modules have an antenna connection through a 50Ω U. FL JACK connector

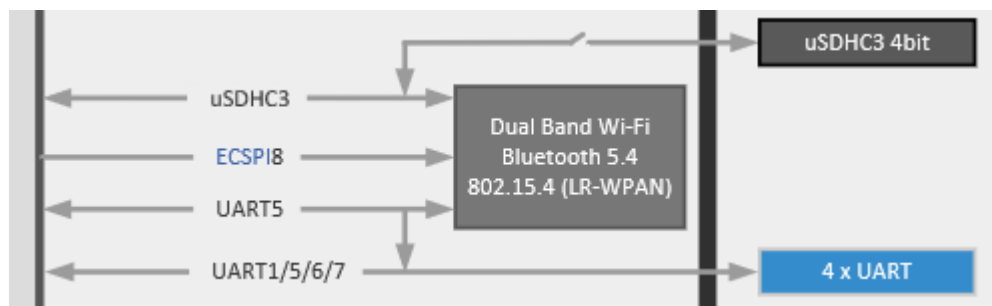


Figure 3: DART-MX93 Wi-Fi Module Internal Connection

8.5.1 Interface Implementation Options

8.5.1.1 Module Configuration with “WBD” Option

- System use: **Wi-Fi and Bluetooth.**
 - BT UART external interface pins should be left floating.
- System use: **Wi-Fi and no BT.**
 - In this case, disable the BT module (using GPIO4.IO[15]).
 - BT UART interface pins can be used externally with any of the alternate functions.
- System use: **BT and no Wi-Fi.**
 - Disable Wi-Fi function.
 - Enable the BT module (using GPIO4.IO[15]).

8.5.1.2 Module Configuration with “WBE” Option

- System use: **Wi-Fi and Bluetooth and 802.15.4.**
 - BT UART external interface pins should be left floating.
 - TP SPI pins can be used in SPI mode only
- System use: **Wi-Fi and no BT no 802.15.4.**
 - In this case, disable the BT and 802.15.4 module (using GPIO4.IO[15]).
 - BT UART and TP SPI interface pins can be used externally with any of the alternate functions.
- System use: **BT and 802.15.4 and no Wi-Fi.**
 - Disable Wi-Fi function.
 - Enable the BT and 802.15.4 module (using GPIO4.IO[15]).

8.5.1.3 Module Configuration without “WBD” or “WBE” Option

- System use: **no Wi-Fi and no BT.**
 - BT UART interface accessible externally with any of its alternative functions.
 - SD3 interface accessible externally with any of its alternative functions.

SD3 is working at 1.8V levels

8.5.2 Bluetooth Interface Signals

Table 15: BT UART Interface Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|---|--------|
| J2.26 | | uart5.CTS_B | 6 | Runs @ 1.8V. Used internally with "WBD" or "WBE" Function can be released if BT Function disabled Always exposed | SOC.Y1 |
| J2.22 | | uart5.RTS_B | 6 | Runs @ 1.8V. Used internally with "WBD" or "WBE" Function can be released if BT Function disabled Always exposed | SOC.W2 |
| J2.24 | | uart5.RX | 6 | Runs @ 1.8V. Used internally with "WBD" or "WBE" Function can be released if BT Function disabled Always exposed | SOC.W1 |
| J2.20 | | uart5.TX | 6 | Runs @ 1.8V. Used internally with "WBD" or "WBE" Function can be released if BT Function disabled Always exposed | SOC.Y2 |

8.5.3 Wakeup signals

The DART-MX93 exposes Wi-Fi and BT wakeup signals of the modules on the SOM. The voltage levels of the signals are 1.8V.

The purpose of these signals is to be connected externally to some GPIO lines and use as a wakeup source for the main CPU.

For implementation, please check out the Wi-Fi module datasheet.

Table 16: Wakeup Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|---------|----------------|------|--------------|---------------|
| J1.25 | WBD/WBE | WIFI_HOST_WAKE | | Runs @ 1.8V. | LBES5PL2xL.73 |
| J1.32 | WBD/WBE | BT_DEV_WAKE | | Runs @ 1.8V. | LBES5PL2xL.75 |
| J1.23 | WBD/WBE | BT_HOST_WAKE | | Runs @ 1.8V. | LBES5PL2xL.76 |

8.6 Ultra-Secured Digital Host Controller

The DART-MX93 exposes the uSDHC2 controller 4-bit interface for supporting interface between the host system and the SD/SDIO/MMC cards.

Key features of uSDHC2:

- SD/SDIO standard, up to version 3.0.
- compliance with 200 MHz SDR signaling to support up to 100 MB/sec
- 1.8 V and 3.3 V operation
- Support for SDXC (extended capacity)

8.6.1 uSDHC1 Signals

uSDHC controller, uSDHC1, is used internally for the eMMC storage chip on the SOM.

8.6.2 uSDHC2 Signals

uSDHC2 pins are referenced to LDO5 power supply of the PMIC.

By default, this LDO supplies 3.3V to allow proper boot from SD Card.

The system uses SD2_VSELECT pin to switch between 3.3V and 1.8V.

This pin functionality can be changed to GPIO3.IO[19] and controlled programmatically.

It is also possible to control the voltage of the LDO by I2C commands.

- Low state will select 3.3V interface
- High state will select 1.8V interface

Table 17: uSDHC2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|----------------|------|---|----------|
| J1.74 | | usdhc2.CD_B | 0 | External SD card detect input. Add 10K external pull up to J1.90. Will change level according to J1.90 NVCC_SD. | SOC.Y17 |
| J1.82 | | usdhc2.CLK | 0 | Will change level according to J1.90 NVCC_SD. | SOC.AA19 |
| J1.88 | | usdhc2.CMD | 0 | Will change level according to J1.90 NVCC_SD. | SOC.Y19 |
| J1.86 | | usdhc2.DATA0 | 0 | Will change level according to J1.90 NVCC_SD. | SOC.Y18 |
| J1.80 | | usdhc2.DATA1 | 0 | Will change level according to J1.90 NVCC_SD. | SOC.AA18 |
| J1.78 | | usdhc2.DATA2 | 0 | Will change level according to J1.90 NVCC_SD. | SOC.Y20 |
| J1.84 | | usdhc2.DATA3 | 0 | Will change level according to J1.90 NVCC_SD. | SOC.AA20 |
| J2.25 | SDEX | usdhc2.RESET_B | 0 | Runs @ J1.90 VDD_SDIO2 level. | SOC.AA17 |

8.6.3 uSDHC3 Signals

uSDHC3 controller is used internally for the Wi-Fi interface on the SOM.
 It can be used when the Wi-Fi is not assembled via two different pin locations.
 One location operates in 3.3V voltage levels and other operates in 1.8V voltage levels.
 3.3V level group is always exposed, but uSDHC3 function cannot be used in parallel with Wi-Fi.
 1.8V level group exposed only on SOMs without Wi-Fi module assembled.

Table 18: uSDHC3 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|---|---------|
| J2.45 | SDEX | usdhc3.CLK | 0 | Runs @ 1.8V. | SOC.V16 |
| J3.42 | | usdhc3.CLK | 1 | Runs @ 3.3V. Cannot be used if the Wi-Fi module is active. | SOC.U18 |
| J2.43 | SDEX | usdhc3.CMD | 0 | Runs @ 1.8V. | SOC.U16 |
| J3.46 | | usdhc3.CMD | 1 | Runs @ 3.3V. Cannot be used if the Wi-Fi module is active. | SOC.U20 |
| J2.35 | SDEX | usdhc3.DATA0 | 0 | Runs @ 1.8V. | SOC.T16 |
| J3.64 | | usdhc3.DATA0 | 1 | Runs @ 3.3V. Cannot be used if the Wi-Fi module is active. | SOC.U21 |
| J2.33 | SDEX | usdhc3.DATA1 | 0 | Runs @ 1.8V. | SOC.V14 |
| J2.60 | | usdhc3.DATA1 | 1 | Runs @ 3.3V. Cannot be used if the Wi-Fi module is active. | SOC.V21 |
| J2.31 | SDEX | usdhc3.DATA2 | 0 | Runs @ 1.8V. | SOC.U14 |
| J2.42 | | usdhc3.DATA2 | 1 | Runs @ 3.3V. Cannot be used if the Wi-Fi module is active. | SOC.V20 |
| J2.29 | SDEX | usdhc3.DATA3 | 0 | Runs @ 1.8V. | SOC.T14 |
| J2.54 | | usdhc3.DATA3 | 1 | Runs @ 3.3V. Cannot be used if the Wi-Fi module is active. | SOC.W21 |

8.7 USB 2.0

The DART-MX93 consists Two USB controllers and PHYs that support USB 2.0.

8.7.1 USB Port1 Interface Signals

Table 19: USB 3.0/2.0 Port 1 Interface signals

| Pin# | Assy | Pin Function | Alt # | Notes | Ball |
|-------|--------|--------------|-------|---|----------|
| J1.13 | | usb1.OTG_ID | 3 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. Not recommended to use a native USB_ID. General GPIO usage is recommended. | SOC.AA11 |
| J1.2 | Non-EC | usb1.OTG_OC | 3 | Runs @ 1.8V. | SOC.T12 |
| J1.11 | | usb1.OTG_PWR | 3 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA10 |
| J3.67 | | USB1_D_N | 0 | Differential Pair Negative side | SOC.A14 |
| J3.65 | | USB1_D_P | 0 | Differential Pair Positive side | SOC.B14 |
| J3.56 | | USB1_ID | 0 | Runs @ 1.8V. USB1 native ID analogue input. No GPIO function. Not recommended to use a native USB_ID. General GPIO usage is recommended. | SOC.C11 |
| J3.66 | | USB1_VBUS | 0 | Runs @ 5.0V. VBUS detect input. | SOC.F12 |

Note: Usage of native USB_ID in i.MX93 requires patches not included in NXP formal release.
For simple OTG implementation, use a CC Logic chip and connect to GPIO.
See the EVK schematics for reference. USB1_ID can be left floating if not used.

8.7.2 USB Port2 Interface Signals

Table 20: USB 2.0 Port 2 Interface signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|---------|
| J1.8 | Non-EC | usb2.OTG_ID | 3 | Runs @ 1.8V. Not recommended to use a native USB_ID. General GPIO usage is recommended. | SOC.V12 |
| J1.6 | Non-EC | usb2.OTG_OC | 3 | Runs @ 1.8V. | SOC.U12 |
| J1.9 | Non-EC | usb2.OTG_PWR | 3 | Runs @ 1.8V. | SOC.Y8 |
| J3.49 | | USB2_D_N | 0 | | SOC.A15 |
| J3.47 | | USB2_D_P | 0 | | SOC.B15 |
| J3.44 | | USB2_ID | 0 | Runs @ 1.8V. USB2 native ID analogue input. No GPIO function. Not recommended to use a native USB_ID. General GPIO usage is recommended. | SOC.E12 |
| J3.26 | | USB2_VBUS | 0 | Runs @ 5.0V. VBUS detect input. | SOC.E14 |

Note: Usage of native USB_ID in i.MX93 requires patches not included in NXP formal release.
For simple OTG implementation, use a CC Logic chip and connect to GPIO.
See the EVK schematics for reference. USB1_ID can be left floating if not used.

8.8 Audio

The DART-MX93 features the following audio interfaces:

- WM8904CGEFL Audio codec interfaces:
 - Analog outputs & inputs: stereo line-in & Stereo HP out.
 - Digital microphone input
- Five external SAI (synchronous audio interface) modules supporting I2S, AC97, TDM, codec/DSP and DSD interfaces:
 - SAI-1 supports to up to 16-channels TX (8 lanes) and 16-channels RX (8 lanes) at 768KHz/32-bit
 - SAI-2/5 supports to up to 8-channels TX (4 lanes) and 8-channels RX (4 lanes) at 768KHz/32-bit
 - SAI-3 supports up to 4-channels TX (2 lanes) and 4-channels RX (2 lanes) at 768KHz/32-bit
 - SAI-6 supports to up to 2-channels TX (1 lanes) and 2-channels RX (1 lanes) at 768KHz/32-bit when multiplexed on SAI1, or up to 384kHz/32-bit when multiplexed on Ethernet primary pins
 - SAI-7 supports to up to 2-channels TX (1 lanes) and 2-channels RX (1 lanes) at 384KHz/32-bit
- PDM supporting up to 8-channels (4 lanes)
- S/PDIF Input and Output, including a new Raw Capture input mode
- Hifi4 Audio DSP, operating up to 800 MHz

Analog audio signals are part of the SOM WM8904 audio codec, available with **“AC” Configuration** only. The codec interfaces the SoC via SAI3 lines, when not assembled, SoC balls are exported to SOM connector instead of Analog codec interface pins.

The Codec features stereo ground-referenced headphone amplifiers using the Wolfson ‘Class-W’ amplifier techniques -incorporating an innovative dual-mode charge pump architecture - to optimize efficiency and power consumption during playback. The ground-referenced headphone and line outputs eliminate AC coupling capacitors, and both outputs include common mode feedback paths to reject ground noise.

The following figure illustrates the connectivity for no large AC coupling capacitors implemented on SOM.

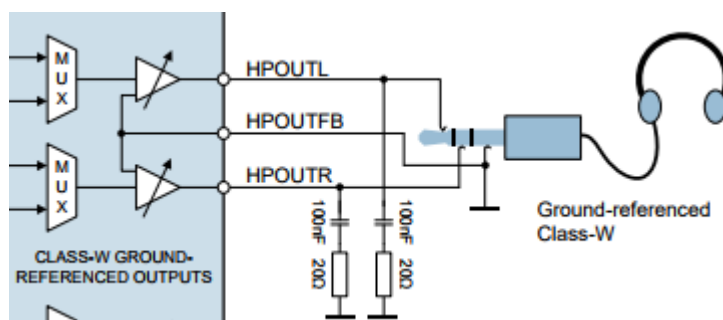


Figure 4: WM8904 Headphone connectivity

8.8.1 WM8904CGEFL Audio Codec

8.8.1.1 Audio Codec Signals

Table 21: Analog audio Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|---|-----------|
| J2.12 | | AGND | 0 | | |
| J2.2 | AC | HPLOUT | 0 | 100nF and 20Ω Zobel network required. | WM8904.13 |
| J2.6 | AC | HPOUTFB | 0 | Headphone output ground loop noise rejection feedback. Should be connected to GND near the HP Connector. | WM8904.14 |
| J2.4 | AC | HPROUT | 0 | 100nF and 20Ω Zobel network required. | WM8904.15 |
| J2.14 | AC | DMIC_CLK | 0 | DMIC output. | WM8904.1 |
| J2.16 | AC | DMIC_DATA | 0 | Runs @ 1.8V. DMIC input. | WM8904.27 |
| J2.8 | AC | LINEIN1_LP | 0 | | WM8904.26 |
| J2.10 | AC | LINEIN1_RP | 0 | | WM8904.24 |

8.8.2 Serial Audio Interface

The SAI module provides a synchronous audio interface that supports full duplex serial interfaces with frame synchronization, such as I2S, AC97, TDM, and codec/DSP interfaces.

8.8.2.1 SAI Signals

Table 22: Serial Audio Interface Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|-----------------|------|---|---------|
| J2.2 | Non-AC | sai1.MCLK | 1 | | SOC.H20 |
| J2.16 | Non-AC | sai1.MCLK | 4 | | SOC.F20 |
| J2.8 | Non-AC | sai1.RX_BCLK | 4 | | SOC.D21 |
| J2.2 | Non-AC | sai1.RX_DATA[0] | 0 | | SOC.H20 |
| J2.6 | Non-AC | sai1.RX_SYNC | 4 | | SOC.D20 |
| J2.4 | Non-AC | sai1.TX_BCLK | 0 | | SOC.G20 |
| J2.14 | Non-AC | sai1.TX_DATA[0] | 0 | BOOT_MODE3 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | SOC.H21 |
| J2.10 | | sai1.TX_DATA[1] | 1 | BOOT_MODE2 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | SOC.G21 |
| J2.10 | | sai1.TX_SYNC | 0 | BOOT_MODE2 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | SOC.G21 |
| J2.66 | | sai2.MCLK | 2 | Runs @ 1.8V. | SOC.AA5 |
| J2.27 | SDEX | sai2.RX_BCLK | 2 | Runs @ 1.8V. | SOC.AA6 |
| J2.73 | | sai2.RX_DATA[0] | 2 | Runs @ 1.8V. | SOC.T10 |
| J2.78 | | sai2.RX_DATA[1] | 2 | Runs @ 1.8V. Internal buffer connected to this pin drives BOOT_MODE0 (J2.90), latched with POR_B rise. | SOC.V8 |
| J2.67 | | sai2.RX_DATA[2] | 2 | Runs @ 1.8V. | SOC.U8 |
| J2.70 | | sai2.RX_DATA[3] | 2 | Runs @ 1.8V. | SOC.T8 |
| J2.71 | | sai2.TX_BCLK | 2 | Runs @ 1.8V. | SOC.U6 |
| J2.64 | | sai2.TX_DATA[0] | 2 | Runs @ 1.8V. | SOC.Y4 |
| J2.72 | | sai2.TX_DATA[1] | 2 | Runs @ 1.8V. | SOC.AA3 |
| J2.65 | | sai2.TX_DATA[2] | 2 | Runs @ 1.8V. | SOC.AA4 |
| J2.69 | | sai2.TX_DATA[3] | 2 | Runs @ 1.8V. | SOC.Y5 |
| J2.74 | | sai2.TX_SYNC | 2 | Runs @ 1.8V. | SOC.V6 |
| J2.46 | | sai3.MCLK | 1 | | SOC.R20 |
| J2.40 | | sai3.RX_BCLK | 1 | | SOC.R18 |
| J2.44 | | sai3.RX_BCLK | 7 | | SOC.T21 |
| J2.36 | | sai3.RX_DATA[0] | 1 | | SOC.T20 |
| J2.34 | | sai3.RX_SYNC | 1 | | SOC.R17 |
| J2.79 | | sai3.RX_SYNC | 7 | | SOC.N20 |
| J2.38 | | sai3.TX_BCLK | 1 | | SOC.R21 |
| J2.34 | | sai3.TX_DATA[0] | 7 | | SOC.R17 |

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-----------------|------|-------|---------|
| J2.44 | | sai3.TX_DATA[0] | 1 | | SOC.T21 |
| J2.42 | | sai3.TX_SYNC | 7 | | SOC.V20 |

8.8.3PDM - Microphone Interface (MICFIL)

The PDM module of the i.MX93 SOC, provides a popular way to deliver audio from microphones to the processor in several applications, such as mobile telephones. Up to 8 channels can be implemented with 4 lanes.

The PDM Microphone Interface module is composed of:

- A decimation filter by channel that:
 - Consists, internally, of a cascade integrator comb (CIC) filter, a DC remover, and half-band filters. The filtering results are stored in individual FIFOs (a FIFO per channel). These FIFOs have overflow and underflow detectors to deliver an error interrupt request.
 - Implements a low-pass filter in the audio band (20 Hz–20.0 kHz @48 kHz output sampling rate by default) with a configurable decimation rate. You can implement it using a series of CIC, half-band, and DC remover filters.
 - Stores its output into a FIFO buffer, and each FIFO is mapped to MICFIL Output Result (DATA0 - DATA7). It is possible to generate either an interrupt or a DMA request when, in each FIFO of all enabled channels, the number of data stored surpasses a configured watermark.
 - Independently on decimation filters, there is a Hardware Voice Activity Detector (HWVAD) which implements voice-detection algorithms to generate wake-up interrupts.
- A shared time generator unit that:
 - Delivers the PDM_CLK to all microphones that must operate at the same clock frequency. Each input interface receives a time multiplexed PDM bitstream from two PDM microphones and it separates audio information in two channels: left (0) and right (1). Every decimation filter, corresponding to its channel, does this processing.
 - Generates the PDM_CLK to the microphones. This clock is the same and is active for all the PDM microphones, which means, it is not possible to turn off the PDM_CLK only for one single microphone.
- An input interface for each pair of PDM microphones
- A FIFO by channel
- A shared DMA interface, interrupt interface, and bus interface
- A shared interface to the chip
- A Hardware Voice Activity Detector (HWVAD)

PDM block main features are:

- Decimation filters:
 - Fixed-point filtering
 - 24-bit PCM audio output
 - Internal clock divider for a programmable PDM clock generation
- Full or partial set of channel operations with individual enable controls

- Programmable decimation rate
- Programmable DC remover
- Programmable DC remover at output
- Range adjustment capability
- FIFOs with interrupt and DMA capability: each FIFO having a length of 32 entries
- HWVAD, equipped with:
 - Interrupt capability
 - Zero-Crossing Detection (ZCD) option

Table 23: PDM Interface Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-------------------|------|-------|---------|
| J2.36 | | pdm.BIT_STREAM[0] | 2 | | SOC.T20 |
| J2.56 | | pdm.BIT_STREAM[0] | 0 | | SOC.J17 |
| J2.85 | | pdm.BIT_STREAM[0] | 2 | | SOC.L18 |
| J1.19 | | pdm.BIT_STREAM[1] | 2 | | SOC.L20 |
| J2.42 | | pdm.BIT_STREAM[1] | 2 | | SOC.V20 |
| J3.62 | | pdm.BIT_STREAM[1] | 0 | | SOC.G18 |
| J2.38 | | pdm.BIT_STREAM[2] | 2 | | SOC.R21 |
| J2.79 | | pdm.BIT_STREAM[2] | 2 | | SOC.N20 |
| J2.34 | | pdm.BIT_STREAM[3] | 2 | | SOC.R17 |
| J2.81 | | pdm.BIT_STREAM[3] | 2 | | SOC.N21 |
| J2.44 | | pdm.CLK | 2 | | SOC.T21 |
| J2.50 | | pdm.CLK | 0 | | SOC.G17 |
| J2.86 | | pdm.CLK | 2 | | SOC.L17 |

8.8.4MQS - Medium Quality Sound

Medium quality sound (MQS) is used to generate medium quality audio via a standard GPIO in the pin mux, allowing the user to connect stereo speakers or headphones to a power amplifier without an additional DAC chip.

Table 24: MQS Interface Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|---|----------|
| J2.10 | | mqs1.LEFT | 4 | BOOT_MODE2 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | SOC.G21 |
| J2.50 | | mqs1.LEFT | 1 | | SOC.G17 |
| J2.2 | Non-AC | mqs1.RIGHT | 4 | | SOC.H20 |
| J2.56 | | mqs1.RIGHT | 1 | | SOC.J17 |
| J1.84 | | mqs2.LEFT | 2 | Will change level according to J1.90 NVCC_SD. | SOC.AA20 |
| J2.24 | | mqs2.LEFT | 1 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.W1 |
| J2.68 | | mqs2.LEFT | 3 | Runs @ 1.8V. | SOC.Y6 |
| J1.78 | | mqs2.RIGHT | 2 | Will change level according to J1.90 NVCC_SD. | SOC.Y20 |
| J2.20 | | mqs2.RIGHT | 1 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y2 |
| J2.66 | | mqs2.RIGHT | 3 | Runs @ 1.8V. | SOC.AA5 |

8.8.5SPDIF – Sony Philips Digital Interface Format

A standard audio file transfer format, developed jointly by the Sony and Phillips corporations. It supports Transmitter and Receiver functionality including frequency measurement block that allows the precise measurement of an incoming sampling frequency.

The SPDIF receiver extracts the audio data from each SPDIF frame and places the data in the SPDIF Rx left and right FIFOs with Channel Status and User bits.

For the SPDIF transmitter, the audio data is provided by the processor dedicated registers along with Channel Status and User bits.

Table 25: SPDIF Interface Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|--------------|---------|
| J2.68 | | spdif1.IN | 2 | Runs @ 1.8V. | SOC.Y6 |
| J2.69 | | spdif1.IN | 1 | Runs @ 1.8V. | SOC.Y5 |
| J3.42 | | spdif1.IN | 2 | | SOC.U18 |
| J2.68 | | spdif1.OUT | 1 | Runs @ 1.8V. | SOC.Y6 |
| J3.46 | | spdif1.OUT | 2 | | SOC.U20 |

8.9 LPUART

The DART-MX93 exposes up to seven LPUART interfaces some of which are multiplexed with other peripherals. UART5 is used on SOM for Bluetooth interface and can be accessible only if the BT is disabled or on SOM without **“WBD” and “WBE” Configuration**.

The LPUART includes the following features:

- Full-duplex, standard NRZ format
- Programmable baud rates (13-bit modulo divider) with a configurable oversampling ratio (OSR)
- Asynchronous operations of transmit and receive baud rates with respect to the bus clock:
 - Baud rate can be configured independently of the bus clock frequency.
 - Operation in Low-Power modes is supported.
- Interrupt, DMA, or polled operations:
 - Transmit data empty and transmission complete
 - Receive data full
 - Receive overrun, parity error, framing error, and noise error
 - Idle receiver detect
 - Active edge on receive pin
 - Break detect supporting LIN
 - Receive data match
- Hardware parity generation and checking
- Programmable 7-bit, 8-bit, 9-bit, or 10-bit character length
- Programmable 1-bit or 2-bit stop bits
- Support for three receiver wakeup methods:
 - Idle line wakeup
 - Address mark wakeup
 - Receive data match
- Automatic address matching to reduce ISR overhead:
 - Address mark matching
 - Idle line address matching
 - Address match start, address match end
- Optional 13-bit and 11-bit break character generation
- Configurable idle length detection supporting 1, 2, 4, 8, 16, 32, 64, or 128 idle characters
- Selectable transmitter output and receiver input polarity
- Hardware flow control support for request to send (RTS) and clear to send (CTS) signals
- Selectable IrDA 1.4 return-to-zero-inverted (RZI) format with a programmable pulse width
- Independent FIFO structure for transmit and receive functions:
 - Separate configurable watermarks for receive and transmit requests
 - Option for receiver to assert request after a configurable number of idle characters, if receive FIFO is not empty

Unlike other i.MX8M based SOMs the direction of the UART lines cannot be programmed. The following table shows the direction of signals of i.MX93 LPUARTs

Table 26: LPUART I/O Direction

| Signal | Direction |
|-------------|-----------|
| uartX.TX | Output |
| uartX.RX | Input |
| uartX.RTS_B | Output |
| uartX.CTS_B | Input |

8.9.1 LPUART1 Signals

Table 27: LPUART1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|---------|
| J2.16 | Non-AC | uart1.CTS_B | 1 | | SOC.F20 |
| J2.32 | | uart1.DCD_B | 2 | | SOC.C20 |
| J2.4 | Non-AC | uart1.DSR_B | 3 | | SOC.G20 |
| J2.14 | Non-AC | uart1.DTR_B | 3 | BOOT_MODE3 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | SOC.H21 |
| J2.30 | | uart1.RIN_B | 2 | | SOC.C21 |
| J2.88 | | uart1.RX | 0 | Used as console debug on Variscite release. | SOC.E20 |
| J2.90 | | uart1.TX | 0 | Used as console debug on Variscite release. BOOT_MODE0 pin. Do not drive until after POR_B rise + 30ms. Internal buffer connected to J2.78 drives this pin, latched with POR_B rise. | SOC.E21 |

8.9.2 LPUART3 Signals

Table 28: LPUART3 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|----------|
| J1.12 | Non-EC | uart3.CTS_B | 1 | Runs @ 1.8V. | SOC.Y9 |
| J2.38 | | uart3.CTS_B | 4 | | SOC.R21 |
| J1.13 | | uart3.DCD_B | 1 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA11 |
| J1.9 | Non-EC | uart3.DSR_B | 1 | Runs @ 1.8V. | SOC.Y8 |
| J1.3 | Non-EC | uart3.DTR_B | 1 | Runs @ 1.8V. | SOC.V10 |
| J1.11 | | uart3.RIN_B | 1 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA10 |
| J1.2 | Non-EC | uart3.RTS_B | 1 | Runs @ 1.8V. | SOC.T12 |
| J2.46 | | uart3.RTS_B | 4 | | SOC.R20 |
| J1.10 | Non-EC | uart3.RX | 1 | Runs @ 1.8V. | SOC.AA8 |
| J2.77 | | uart3.RX | 1 | | SOC.P21 |
| J1.4 | Non-EC | uart3.TX | 1 | Runs @ 1.8V. | SOC.W11 |

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.83 | | uart3.TX | 1 | | SOC.P20 |

8.9.3LPUART4 Signals

Table 29: LPUART4 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|--------------|---------|
| J2.38 | | uart4.CTS_B | 6 | | SOC.R21 |
| J2.66 | | uart4.CTS_B | 1 | Runs @ 1.8V. | SOC.AA5 |
| J2.64 | | uart4.DSR_B | 1 | Runs @ 1.8V. | SOC.Y4 |
| J2.74 | | uart4.DTR_B | 1 | Runs @ 1.8V. | SOC.V6 |
| J2.27 | SDEX | uart4.RIN_B | 1 | Runs @ 1.8V. | SOC.AA6 |
| J2.46 | | uart4.RTS_B | 6 | | SOC.R20 |
| J2.67 | | uart4.RTS_B | 1 | Runs @ 1.8V. | SOC.U8 |
| J2.65 | | uart4.RX | 1 | Runs @ 1.8V. | SOC.AA4 |
| J2.77 | | uart4.RX | 6 | | SOC.P21 |
| J2.70 | | uart4.TX | 1 | Runs @ 1.8V. | SOC.T8 |
| J2.83 | | uart4.TX | 6 | | SOC.P20 |

8.9.4LPUART5 Signals

Table 30: LPUART5 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|---|---------|
| J2.26 | | uart5.CTS_B | 6 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y1 |
| J3.38 | | uart5.CTS_B | 5 | | SOC.K20 |
| J2.22 | | uart5.RTS_B | 6 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. Has an internal 10K pull down. | SOC.W2 |
| J3.58 | | uart5.RTS_B | 5 | | SOC.K21 |
| J2.24 | | uart5.RX | 6 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.W1 |
| J3.50 | | uart5.RX | 5 | | SOC.J20 |
| J2.20 | | uart5.TX | 6 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y2 |
| J3.30 | | uart5.TX | 5 | | SOC.J21 |

8.9.5LPUART6 Signals

Table 31: LPUART6 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J1.19 | | uart6.CTS_B | 5 | | SOC.L20 |
| J1.17 | | uart6.RTS_B | 5 | | SOC.L21 |
| J2.85 | | uart6.RX | 5 | | SOC.L18 |
| J2.86 | | uart6.TX | 5 | | SOC.L17 |

8.9.6 LPUART7 Signals

Table 32: LPUART7 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.48 | | uart7.CTS_B | 5 | | SOC.N17 |
| J2.80 | | uart7.RTS_B | 5 | | SOC.N18 |
| J2.87 | | uart7.RX | 5 | | SOC.M21 |
| J2.89 | | uart7.TX | 5 | | SOC.M20 |

8.9.7 LPUART8 Signals

Table 33: LPUART8 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.83 | | uart8.CTS_B | 5 | | SOC.P20 |
| J2.77 | | uart8.RTS_B | 5 | | SOC.P21 |
| J2.81 | | uart8.RX | 5 | | SOC.N21 |
| J2.79 | | uart8.TX | 5 | | SOC.N20 |

8.10 Flexible Controller Area Network

The FlexCAN module is a communication controller implementing the CAN protocol according to the ISO 11898-1:2015 standard and CAN 2.0 B protocol specifications

Signal Description:

- CAN Rx: The receive pin from the CAN bus transceiver. Dominant state is represented by logic level '0'. Recessive state is represented by logic level '1'.
- CAN Tx: The transmit pin to the CAN bus transceiver. Dominant state is represented by logic level '0'. Recessive state is represented by logic level '1'.

8.10.1 FLEXCAN1 Signals

Table 34: FLEXCAN1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|---|---------|
| J2.4 | Non-AC | can1.RX | 4 | | SOC.G20 |
| J2.56 | | can1.RX | 6 | | SOC.J17 |
| J2.14 | Non-AC | can1.TX | 4 | BOOT_MODE3 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | SOC.H21 |
| J2.50 | | can1.TX | 6 | | SOC.G17 |

8.10.2 FLEXCAN2 Signals

Table 35: FLEXCAN2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|---|----------|
| J1.6 | Non-EC | can2.RX | 2 | Runs @ 1.8V. | SOC.U12 |
| J1.80 | | can2.RX | 2 | Will change level according to J1.90 NVCC_SD. | SOC.AA18 |
| J2.20 | | can2.RX | 3 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y2 |
| J2.54 | | can2.RX | 2 | | SOC.W21 |
| J1.8 | Non-EC | can2.TX | 2 | Runs @ 1.8V. | SOC.V12 |
| J1.86 | | can2.TX | 2 | Will change level according to J1.90 NVCC_SD. | SOC.Y18 |
| J2.24 | | can2.TX | 3 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.W1 |
| J2.60 | | can2.TX | 2 | | SOC.V21 |

8.11 LPSPI - Low Power Serial Peripheral Interface

The DART-MX93 exposes up to 7 LPSPI interfaces.

LPSPI provides an efficient interface to a SPI bus, either as a master or slave. A SPI bus is a synchronous serial communication interface used in embedded systems. It is typically used to perform short distance communications between microcontrollers and peripheral devices, on printed circuit boards. Typical applications include interfacing to Secure Digital cards and LCD displays.

Key features of the ECSPi include:

- Requires minimal CPU overhead, with DMA offloading of FIFO register accesses
- Continues operating in Stop mode, if configured to do so and an appropriate clock is available
- Supports DMA accesses and generates DMA requests
- 32-bit word size
- Configurable clock polarity and phase
- Master mode—supports up to 2 peripheral chip selects
- Slave mode
- 8-word transmit and command FIFO
- 8-word receive FIFO
- Flexible timing parameters in Master mode, including SCK frequency and duty cycle, and delays between PCS and SCK edges
- Continuous transfer option to keep PCS asserted across multiple frames
- Full-duplex transfers support 1-bit transmit and receive on each clock edge
- Half-duplex transfers support:
 - 1-bit transmit or receive on each clock edge
- Receive data match logic supports discard of non-matching data and interrupt on data match

Note: For interacting multiple peripherals on same SPI bus, one can define any GPIO to be used as chip select. Examples can be found in our DTS files.

8.11.1 LPSPI1 Signals

Table 36: LPSPI1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|---|---------|
| J2.10 | | spi1.PCS0 | 2 | BOOT_MODE2 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | SOC.G21 |
| J2.56 | | spi1.PCS1 | 2 | | SOC.J17 |
| J2.14 | Non-AC | spi1.SCK | 2 | BOOT_MODE3 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | SOC.H21 |
| J2.4 | Non-AC | spi1.SIN | 2 | | SOC.G20 |
| J2.2 | Non-AC | spi1.SOUT | 2 | | SOC.H20 |

8.11.2 LPSPI3 Signals

Table 37: LPSPI3 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.89 | | spi3.PCS0 | 1 | | SOC.M20 |
| J1.17 | | spi3.PCS1 | 1 | | SOC.L21 |
| J2.80 | | spi3.SCK | 1 | | SOC.N18 |
| J2.87 | | spi3.SIN | 1 | | SOC.M21 |
| J2.48 | | spi3.SOUT | 1 | | SOC.N17 |

8.11.3 LPSPI4 Signals

Table 38: LPSPI4 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.40 | | spi4.PCS0 | 5 | | SOC.R18 |
| J2.46 | | spi4.PCS1 | 5 | | SOC.R20 |
| J2.38 | | spi4.PCS2 | 5 | | SOC.R21 |
| J2.44 | | spi4.SCK | 5 | | SOC.T21 |
| J2.34 | | spi4.SIN | 5 | | SOC.R17 |
| J2.36 | | spi4.SOUT | 5 | | SOC.T20 |

8.11.4 LPSPI5 Signals

Table 39: LPSPI5 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.40 | | spi5.PCS0 | 4 | | SOC.R18 |
| J2.54 | | spi5.PCS1 | 6 | | SOC.W21 |
| J2.44 | | spi5.SCK | 4 | | SOC.T21 |
| J2.34 | | spi5.SIN | 4 | | SOC.R17 |
| J2.36 | | spi5.SOUT | 4 | | SOC.T20 |

8.11.5 LPSPi6 Signals

Table 40: LPSPi6 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J3.30 | | spi6.PCS0 | 4 | | SOC.J21 |
| J3.64 | | spi6.PCS1 | 6 | | SOC.U21 |
| J3.58 | | spi6.SCK | 4 | | SOC.K21 |
| J3.50 | | spi6.SIN | 4 | | SOC.J20 |
| J3.38 | | spi6.SOUT | 4 | | SOC.K20 |

8.11.6 LPSPi7 Signals

Table 41: LPSPi7 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.86 | | spi7.PCS0 | 4 | | SOC.L17 |
| J2.60 | | spi7.PCS1 | 6 | | SOC.V21 |
| J1.17 | | spi7.SCK | 4 | | SOC.L21 |
| J2.85 | | spi7.SIN | 4 | | SOC.L18 |
| J1.19 | | spi7.SOUT | 4 | | SOC.L20 |

8.11.7 LPSPi8 Signals

Table 42: LPSPi8 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.79 | | spi8.PCS0 | 4 | | SOC.N20 |
| J2.42 | | spi8.PCS1 | 6 | | SOC.V20 |
| J2.77 | | spi8.SCK | 4 | | SOC.P21 |
| J2.81 | | spi8.SIN | 4 | | SOC.N21 |
| J2.83 | | spi8.SOUT | 4 | | SOC.P20 |

8.12 FlexSPI - Flexible Serial Peripheral Interface

The DART-MX93 exposes one FlexSPI module which can be used to interface external serial flash devices.

The module contains the following features:

- Flexible sequence engine to support various flash vendor devices
- Single pad/Dual pad/Quad pad mode of operation
- Single Data Rate/Double Data Rate mode of operation
- DMA support
- Memory mapped read access to connected flash devices

Note: To use FLeXSPI a special assembly module should be ordered. The module should not have a Wi-Fi option assembled, and SDEX assembly option should be selected. FlexSPI signals are referenced to 1.8v.

8.12.1 FlexSPI Signals

Table 43: FlexSPI Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-------------------|------|--------------|---------|
| J2.35 | SDEX | flexspi.A_DATA[0] | 1 | Runs @ 1.8V. | SOC.T16 |
| J2.33 | SDEX | flexspi.A_DATA[1] | 1 | Runs @ 1.8V. | SOC.V14 |
| J2.31 | SDEX | flexspi.A_DATA[2] | 1 | Runs @ 1.8V. | SOC.U14 |
| J2.29 | SDEX | flexspi.A_DATA[3] | 1 | Runs @ 1.8V. | SOC.T14 |
| J2.45 | SDEX | flexspi.A_SCLK | 1 | Runs @ 1.8V. | SOC.V16 |
| J2.43 | SDEX | flexspi.A_SS0_B | 1 | Runs @ 1.8V. | SOC.U16 |

8.13 TPM - Timer/PWM Module

The DART-MX93 exports up to 6 TPM channels.

The TPM (Timer/PWM Module) is a 4-channel timer that supports input capture, output compare, and the generation of PWM signals to control electric motor and power management applications. The counter, compare and capture registers are clocked by an asynchronous clock that can remain enabled in low power modes.

PWM Features:

- TPM clock mode is selectable
 - Can increment on every edge of the asynchronous counter clock
 - Can increment on rising edge of an external clock input synchronized to the asynchronous counter clock
- Pre-scaler divide-by 1, 2, 4, 8, 16, 32, 64, or 128
- TPM includes a 32-bit TPM counter
 - It can be a free-running counter or modulo counter
 - The counting can be up or up-down
- Includes 4 channels that can be configured as follows:
 - Input capture mode: the capture can occur on rising edges, falling edges or both edges
 - Output compare mode: the output signal can be set, cleared, pulsed, or toggled on match
- Edge-aligned or center-aligned PWM mode for all channels
- Support the generation of an interrupt and/or DMA request per channel
- Support the generation of an interrupt and/or DMA request when the counter overflows
- Support selectable trigger input to optionally reset or cause the counter to start incrementing.
 - The counter can also optionally stop incrementing on counter overflow
- Support the generation of hardware triggers when the counter overflows and per channel

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-------------------|------|--------------|---------|
| J2.35 | SDEX | flexspi.A_DATA[0] | 1 | Runs @ 1.8V. | SOC.T16 |
| J2.33 | SDEX | flexspi.A_DATA[1] | 1 | Runs @ 1.8V. | SOC.V14 |
| J2.31 | SDEX | flexspi.A_DATA[2] | 1 | Runs @ 1.8V. | SOC.U14 |
| J2.29 | SDEX | flexspi.A_DATA[3] | 1 | Runs @ 1.8V. | SOC.T14 |
| J2.45 | SDEX | flexspi.A_SCLK | 1 | Runs @ 1.8V. | SOC.V16 |
| J2.43 | SDEX | flexspi.A_SS_B | 1 | Runs @ 1.8V. | SOC.U16 |

8.13.1 TPM1 Signals

Table 44: TPM1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|---------|
| J2.88 | | tpm1.CH0 | 3 | Used as console debug on Variscite release. | SOC.E20 |
| J2.90 | | tpm1.CH1 | 3 | Used as console debug on Variscite release. BOOT_MODE0 pin. Do not drive until after POR_B rise + 30ms. Internal buffer connected to J2.78 drives this pin, latched with POR_B rise. | SOC.E21 |
| J2.16 | Non-AC | tpm1.CH2 | 3 | | SOC.F20 |
| J2.56 | | tpm1.EXTCLK | 3 | | SOC.J17 |

8.13.2 TPM2 Signals

Table 45: TPM2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|-------|---------|
| J2.32 | | tpm2.CH0 | 3 | | SOC.C20 |
| J2.30 | | tpm2.CH1 | 3 | | SOC.C21 |
| J2.6 | Non-AC | tpm2.CH2 | 3 | | SOC.D20 |
| J2.8 | Non-AC | tpm2.CH3 | 3 | | SOC.D21 |
| J3.62 | | tpm2.EXTCLK | 3 | | SOC.G18 |

8.13.3 TPM3 Signals

Table 46: TPM3 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.86 | | tpm3.CH0 | 1 | | SOC.L17 |
| J2.36 | | tpm3.CH1 | 6 | | SOC.T20 |
| J2.79 | | tpm3.CH2 | 1 | | SOC.N20 |
| J3.64 | | tpm3.CH3 | 4 | | SOC.U21 |
| J2.87 | | tpm3.EXTCLK | 4 | | SOC.M21 |

8.13.4 TPM4 Signals

Table 47: TPM4 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.85 | | tpm4.CH0 | 1 | | SOC.L18 |
| J2.44 | | tpm4.CH1 | 6 | | SOC.T21 |
| J2.81 | | tpm4.CH2 | 1 | | SOC.N21 |
| J2.60 | | tpm4.CH3 | 4 | | SOC.V21 |
| J2.48 | | tpm4.EXTCLK | 4 | | SOC.N17 |

8.13.5 TPM5 Signals

Table 48: TPM5 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J1.19 | | tpm5.CH0 | 1 | | SOC.L20 |
| J3.42 | | tpm5.CH1 | 4 | | SOC.U18 |
| J2.40 | | tpm5.CH2 | 6 | | SOC.R18 |
| J2.42 | | tpm5.CH3 | 4 | | SOC.V20 |
| J2.80 | | tpm5.EXTCLK | 4 | | SOC.N18 |

8.13.6 TPM6 Signals

Table 49: TPM6 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.89 | | tpm6.CH0 | 4 | | SOC.M20 |
| J3.46 | | tpm6.CH1 | 4 | | SOC.U20 |
| J2.34 | | tpm6.CH2 | 6 | | SOC.R17 |
| J2.54 | | tpm6.CH3 | 4 | | SOC.W21 |
| J3.42 | | tpm6.EXTCLK | 5 | | SOC.U18 |

8.14 LPI2C - Low Power Inter-Integrated Circuit

The DART-MX93 exposes up to seven I2C Interfaces provides access to external serial devices.

The I2C (Inter-Integrated Circuit) serial bus is multi-controller, multi-target, packet-switched, and single-ended, and is often used to attach microcontroller ICs to lower-speed peripheral ICs.

LPI2C is a low-power Inter-Integrated Circuit (I2C) module that supports an efficient interface to an I2C bus as a controller and/or as a target. The LPI2C module also complies with the System Management Bus (SMBus) Specification, version 3. The SMBus is a single-ended simple two-wire bus, which is typically used for low-bandwidth communications.

The LPI2C has the following key features:

- Standard, Fast, Fast+ and Ultra-Fast modes
- High-speed mode (HS) in target mode
- Multi-controller, including synchronization and arbitration. Multi-controller means that any number of controller nodes can be present. Additionally, controller and target roles may be changed between messages (after a STOP is sent).
- Clock stretching. Sometimes multiple I2C nodes may drive the lines at the same time. If any I2C node is driving a line low, then that line is low. I2C nodes that are starting to transmit a logical one (by letting the line float high) can detect that the line is low. In this way, the nodes can identify that another I2C node is active at the same time.
 - When node detection is used on the SCL line, it is called clock stretching. Clock stretching is used as an I2C flow control mechanism.
 - When node detection is used on the SDA line, it is called arbitration. Arbitration ensures that there is only one I2C node transmitter at a time.
- General call, seven-bit addressing, and ten-bit addressing
- Software reset, START byte, and Device ID (also require software support)

8.14.1 LPI2C1 Signals

Table 50: LPI2C1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.32 | | i2c1.SCL | 0 | | SOC.C20 |
| J2.30 | | i2c1.SDA | 0 | | SOC.C21 |

8.14.2 LPI2C2 Signals

Table 51: LPI2C2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|------|--------|--------------|------|-------|---------|
| J2.6 | Non-AC | i2c2.SCL | 0 | | SOC.D20 |
| J2.8 | Non-AC | i2c2.SDA | 0 | | SOC.D21 |

8.14.3 LPI2C4 Signals

Table 52: LPI2C4 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J3.58 | | i2c4.SCL | 1 | | SOC.K21 |
| J3.38 | | i2c4.SDA | 1 | | SOC.K20 |

8.14.4 LPI2C5 Signals

Table 53: LPI2C5 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J3.46 | | i2c5.SCL | 6 | | SOC.U20 |
| J3.50 | | i2c5.SCL | 6 | | SOC.J20 |
| J3.30 | | i2c5.SDA | 6 | | SOC.J21 |
| J3.42 | | i2c5.SDA | 6 | | SOC.U18 |

8.14.5 LPI2C6 Signals

Table 54: LPI2C6 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.85 | | i2c6.SCL | 6 | | SOC.L18 |
| J3.58 | | i2c6.SCL | 6 | | SOC.K21 |
| J2.86 | | i2c6.SDA | 6 | | SOC.L17 |
| J3.38 | | i2c6.SDA | 6 | | SOC.K20 |

8.14.6 LPI2C7 Signals

Table 55: LPI2C7 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J1.17 | | i2c7.SCL | 6 | | SOC.L21 |
| J2.87 | | i2c7.SCL | 6 | | SOC.M21 |
| J1.19 | | i2c7.SDA | 6 | | SOC.L20 |
| J2.89 | | i2c7.SDA | 6 | | SOC.M20 |

8.14.7 LPI2C8 Signals

Table 56: LPI2C8 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.80 | | i2c8.SCL | 6 | | SOC.N18 |
| J2.81 | | i2c8.SCL | 6 | | SOC.N21 |
| J2.48 | | i2c8.SDA | 6 | | SOC.N17 |
| J2.79 | | i2c8.SDA | 6 | | SOC.N20 |

8.15 I3C - Improved Inter-Integrated Circuit

The MIPI Alliance Improved Inter-Integrated Circuit (MIPI I3C) improves upon the use and power of I2C, and provides an alternative to SPI for mid-speed applications.

The I3C bus protocol supports:

- In-band interrupts (IBI). These interrupts go from target to controller without extra wires, and the controller knows which target sent the interrupt.
- Common Command Codes (CCC)
- Dynamic addressing
- Multi-controller/multi-drop
- Hot-Join (HJ)
- I2C compatibility

The I3C peripheral supports all required and most optional features of the MIPI Alliance Specification for I3C, v1.0 and v1.1, except for ternary data rates (HDR-TSP and HDR-TSL).

The I3C module has the following key features:

- Two-wire multi-drop bus capable of 12.5 MHz clock speeds, with up to 11 devices.
 - Uses standard pads with 4 mA drive.
 - Dynamically assigns target addresses, and targets do not require static addresses. However, targets may have an I2C static address assigned at start-up, so the target can operate on an I2C bus. By default, I3C supports seven-bit I2C-style addresses.
 - Supports extended I2C 10-bit addressing through Map Feature Control 1 (SMAPCTRL1) register.
 - Allows targets to use the inbound SCL clock as the peripheral clock (instead of the clock from the controller) so devices can have slow or inaccurate clocks internally.
 - Allows simple targets, such as temperature sensors, to have no internal clock.
 - I3C controller supports handoff from Open Drain to Push-Pull mode for ACK to data transfer.
 - Normally the controller terminates the read, but for I3C, the target can also end the read.
- In-Band Interrupts (IBI) allow targets to send notifications to a controller.
 - Can be equivalent to a separate GPIO, but can also be directly data-bearing.
 - Can be prioritized. When multiple targets send interrupts to a controller at the same time, the order is resolved. Dynamic addresses establish the priority of the targets, so the controller controls the priority of the targets. Targets with lower-value dynamic addresses are higher priority level IBIs.
 - Can start interrupts even when the controller is not active on the bus. No free-running clock is needed, but starting an interrupt requires a Bus Available condition.
 - Can resolve an initial event via a time-stamping option, not requiring an interrupt.
- Built-in commands are in a separate space. These commands do not collide with normal controller-to-target messages.
 - Controls bus behavior, modes and states, low-power state, inquiries, and more.
 - Has additional room for new built-in commands to be used by other groups.
- Organized forms of multi-controller modes:
 - Secondary controllers, which use clean handoffs between different controllers.
- Hot-join onto I3C bus allows devices to connect to the bus later than when the bus starts.

- Enables a device or module to get onto the I3C bus when it woke up after power-up or was physically inserted onto the I3C bus.
- Provides a clean method for notification when new devices or modules get onto the I3C bus.
- Can use both I2C and I3C buses.
 - I3C supports specific legacy I2C devices on the bus.
 - I3C target devices can operate on I2C buses.
 - Supports bridging to I2C, SPI, UART, and other buses.
- Higher data rate modes are available.
 - Has a High Data Rate - Double Data Rate (HDR-DDR) mode, which is double the data rate of SDR (about 20 Mbit/s)
 - Only the controller and the specific target must support the higher data rate. The other targets can ignore it.

The I3C peripheral supports the full I3C feature set, except for the ternary data rates (HDR-TSP and HDR-TSL).

8.15.1 I3C1 Signals

Table 57: I3C1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|-------|---------|
| J2.6 | Non-AC | i3c1.PUR | 1 | | SOC.D20 |
| J2.6 | Non-AC | i3c1.PUR_B | 6 | | SOC.D20 |
| J2.32 | | i3c1.SCL | 1 | | SOC.C20 |
| J2.30 | | i3c1.SDA | 1 | | SOC.C21 |

8.15.2 I3C2 Signals

Table 58: I3C2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|----------|
| J1.2 | Non-EC | i3c2.PUR | 2 | Runs @ 1.8V. | SOC.T12 |
| J1.88 | | i3c2.PUR | 2 | Will change level according to J1.90 NVCC_SD. | SOC.Y19 |
| J1.2 | Non-EC | i3c2.PUR_B | 6 | Runs @ 1.8V. | SOC.T12 |
| J1.88 | | i3c2.PUR_B | 3 | Will change level according to J1.90 NVCC_SD. | SOC.Y19 |
| J1.13 | | i3c2.SCL | 2 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA11 |
| J1.74 | | i3c2.SCL | 2 | External SD card detect input. Will change level according to J1.90 NVCC_SD. Runs @ 3.3V. | SOC.Y17 |
| J1.11 | | i3c2.SDA | 2 | Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA10 |
| J1.82 | | i3c2.SDA | 2 | Will change level according to J1.90 NVCC_SD. | SOC.AA19 |

8.16 GPIO - General-Purpose Input/Output

The DART-MX93 exposes up to 85 General-Purpose Input/Output pins.

The GPIO module has the following key features:

- Port Data Input (PDIR) register displays the logic value on each pin when the pin is configured for any digital function provided the corresponding Port Control and Interrupt module for that pin are enabled.
- Port Data Output (PDOR) register with corresponding set/clear/toggle registers controls output data of each pin when the pin is configured for the GPIO function.
- Port Data Direction (PDDR) register controls the direction of each pin when the pin is configured for the GPIO function.
- Port Input Disable (PIDR) register controls the disable of the input for each general-purpose pin.
- Pin interrupts
 - Interrupt flag and enable registers for each pin are functional in all digital pin muxing modes.
 - Support for interrupt or DMA request configured per pin.
 - Support for edge sensitive (rising or falling, or both) or level sensitive (low, high) configured per pin.
 - Asynchronous wake-up in Low-Power modes.
 - GPIO module generates a total of 2 interrupts and 2 DMA requests.
 - Each pin can be used to generate a single interrupt or DMA request.
- Protection registers
 - Each pin is configured for Secure or Non-Secure and Privilege/Non-Privilege access.
 - Each interrupt and DMA request domain is configured for Secure or Non-Secure and Privilege/Non-Privilege access.

8.16.1.1 GPIO Signals

Table 59: GPIO Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|---------|
| J2.32 | | gpio1.I0[0] | 5 | | SOC.C20 |
| J2.30 | | gpio1.I0[1] | 5 | | SOC.C21 |
| J3.62 | | gpio1.I0[10] | 5 | | SOC.G18 |
| J2.10 | | gpio1.I0[11] | 5 | BOOT_MODE2 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | SOC.G21 |
| J2.4 | Non-AC | gpio1.I0[12] | 5 | | SOC.G20 |
| J2.14 | Non-AC | gpio1.I0[13] | 5 | BOOT_MODE3 pin. Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | SOC.H21 |
| J2.2 | Non-AC | gpio1.I0[14] | 5 | | SOC.H20 |
| J2.28 | | gpio1.I0[15] | 5 | | SOC.J18 |
| J2.6 | Non-AC | gpio1.I0[2] | 5 | | SOC.D20 |
| J2.8 | Non-AC | gpio1.I0[3] | 5 | | SOC.D21 |
| J2.88 | | gpio1.I0[4] | 5 | Used as console debug on Variscite release. | SOC.E20 |
| J2.90 | | gpio1.I0[5] | 5 | Used as console debug on Variscite release. BOOT_MODE0 pin. Do not drive until after POR_B rise + 30ms. Internal buffer connected to J2.78 drives this pin, latched with POR_B rise. | SOC.E21 |
| J2.16 | Non-AC | gpio1.I0[6] | 5 | | SOC.F20 |
| J2.50 | | gpio1.I0[8] | 5 | | SOC.G17 |
| J2.56 | | gpio1.I0[9] | 5 | | SOC.J17 |
| J3.30 | | gpio2.I0[0] | 0 | | SOC.J21 |
| J2.48 | | gpio2.I0[10] | 0 | | SOC.N17 |
| J3.50 | | gpio2.I0[1] | 0 | | SOC.J20 |
| J2.80 | | gpio2.I0[11] | 0 | | SOC.N18 |
| J2.79 | | gpio2.I0[12] | 0 | | SOC.N20 |
| J2.81 | | gpio2.I0[13] | 0 | | SOC.N21 |
| J2.83 | | gpio2.I0[14] | 0 | | SOC.P20 |
| J2.77 | | gpio2.I0[15] | 0 | | SOC.P21 |
| J2.38 | | gpio2.I0[16] | 0 | | SOC.R21 |
| J2.46 | | gpio2.I0[17] | 0 | | SOC.R20 |
| J2.40 | | gpio2.I0[18] | 0 | | SOC.R18 |
| J2.34 | | gpio2.I0[19] | 0 | | SOC.R17 |
| J2.36 | | gpio2.I0[20] | 0 | | SOC.T20 |
| J3.38 | | gpio2.I0[2] | 0 | | SOC.K20 |
| J2.44 | | gpio2.I0[21] | 0 | | SOC.T21 |
| J3.42 | | gpio2.I0[22] | 0 | | SOC.U18 |
| J3.46 | | gpio2.I0[23] | 0 | | SOC.U20 |

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|---|----------|
| J3.64 | | gpio2.I0[24] | 0 | | SOC.U21 |
| J2.60 | | gpio2.I0[25] | 0 | | SOC.V21 |
| J2.42 | | gpio2.I0[26] | 0 | | SOC.V20 |
| J2.54 | | gpio2.I0[27] | 0 | | SOC.W21 |
| J3.58 | | gpio2.I0[3] | 0 | | SOC.K21 |
| J2.86 | | gpio2.I0[4] | 0 | | SOC.L17 |
| J2.85 | | gpio2.I0[5] | 0 | | SOC.L18 |
| J1.19 | | gpio2.I0[6] | 0 | | SOC.L20 |
| J1.17 | | gpio2.I0[7] | 0 | | SOC.L21 |
| J2.89 | | gpio2.I0[8] | 0 | | SOC.M20 |
| J2.87 | | gpio2.I0[9] | 0 | | SOC.M21 |
| J1.74 | | gpio3.I0[0] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.Y17 |
| J1.82 | | gpio3.I0[1] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.AA19 |
| J1.88 | | gpio3.I0[2] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.Y19 |
| J2.45 | SDEX | gpio3.I0[20] | 5 | Runs @ 1.8V. | SOC.V16 |
| J2.43 | SDEX | gpio3.I0[21] | 5 | Runs @ 1.8V. | SOC.U16 |
| J2.35 | SDEX | gpio3.I0[22] | 5 | Runs @ 1.8V. | SOC.T16 |
| J2.33 | SDEX | gpio3.I0[23] | 5 | Runs @ 1.8V. | SOC.V14 |
| J2.31 | SDEX | gpio3.I0[24] | 5 | Runs @ 1.8V. | SOC.U14 |
| J2.29 | SDEX | gpio3.I0[25] | 5 | Runs @ 1.8V. | SOC.T14 |
| J2.76 | | gpio3.I0[26] | 5 | Runs @ 1.8V. Has an internal 12K pull down. | SOC.AA2 |
| J3.48 | | gpio3.I0[27] | 5 | Runs @ 1.8V. | SOC.Y3 |
| J2.24 | | gpio3.I0[28] | 5 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.W1 |
| J2.22 | | gpio3.I0[29] | 5 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.W2 |
| J1.86 | | gpio3.I0[3] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.Y18 |
| J2.26 | | gpio3.I0[3] | 5 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y1 |
| J2.20 | | gpio3.I0[31] | 5 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y2 |
| J1.80 | | gpio3.I0[4] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.AA18 |
| J1.78 | | gpio3.I0[5] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.Y20 |
| J1.84 | | gpio3.I0[6] | 5 | Will change level according to J1.90 NVCC_SD. | SOC.AA20 |
| J2.25 | SDEX | gpio3.I0[7] | 5 | Runs @ J1.90 VDD_SDIO2 level. | SOC.AA17 |
| J1.13 | | gpio4.I0[0] | 5 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA11 |

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|--|----------|
| J1.10 | Non-EC | gpio4.IO[10] | 5 | Runs @ 1.8V. | SOC.AA8 |
| J1.11 | | gpio4.IO[1] | 5 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA10 |
| J1.12 | Non-EC | gpio4.IO[11] | 5 | Runs @ 1.8V. | SOC.Y9 |
| J1.14 | Non-EC | gpio4.IO[12] | 5 | Runs @ 1.8V. | SOC.AA9 |
| J1.16 | Non-EC | gpio4.IO[13] | 5 | Runs @ 1.8V. | SOC.Y10 |
| J2.27 | SDEX | gpio4.IO[15] | 5 | Runs @ 1.8V. | SOC.AA6 |
| J2.73 | | gpio4.IO[16] | 5 | Runs @ 1.8V. | SOC.T10 |
| J2.78 | | gpio4.IO[17] | 5 | Runs @ 1.8V. Internal buffer connected to this pin drives BOOT_MODE0 (J2.90), latched with POR_B rise. | SOC.V8 |
| J2.67 | | gpio4.IO[18] | 5 | Runs @ 1.8V. | SOC.U8 |
| J2.70 | | gpio4.IO[19] | 5 | Runs @ 1.8V. | SOC.T8 |
| J1.8 | Non-EC | gpio4.IO[2] | 5 | Runs @ 1.8V. | SOC.V12 |
| J2.74 | | gpio4.IO[20] | 5 | Runs @ 1.8V. | SOC.V6 |
| J2.71 | | gpio4.IO[21] | 5 | Runs @ 1.8V. | SOC.U6 |
| J2.64 | | gpio4.IO[22] | 5 | Runs @ 1.8V. | SOC.Y4 |
| J2.72 | | gpio4.IO[23] | 5 | Runs @ 1.8V. | SOC.AA3 |
| J2.65 | | gpio4.IO[24] | 5 | Runs @ 1.8V. | SOC.AA4 |
| J2.69 | | gpio4.IO[25] | 5 | Runs @ 1.8V. | SOC.Y5 |
| J2.66 | | gpio4.IO[26] | 5 | Runs @ 1.8V. | SOC.AA5 |
| J2.68 | | gpio4.IO[27] | 5 | Runs @ 1.8V. | SOC.Y6 |
| J1.28 | | gpio4.IO[28] | 5 | Runs @ 1.8V. | SOC.U4 |
| J3.52 | | gpio4.IO[29] | 5 | Runs @ 1.8V. | SOC.V4 |
| J1.6 | Non-EC | gpio4.IO[3] | 5 | Runs @ 1.8V. | SOC.U12 |
| J1.2 | Non-EC | gpio4.IO[4] | 5 | Runs @ 1.8V. | SOC.T12 |
| J1.4 | Non-EC | gpio4.IO[5] | 5 | Runs @ 1.8V. | SOC.W11 |
| J1.3 | Non-EC | gpio4.IO[6] | 5 | Runs @ 1.8V. | SOC.V10 |
| J1.5 | Non-EC | gpio4.IO[7] | 5 | Runs @ 1.8V. | SOC.U10 |
| J1.9 | Non-EC | gpio4.IO[8] | 5 | Runs @ 1.8V. | SOC.Y8 |
| J1.7 | Non-EC | gpio4.IO[9] | 5 | Runs @ 1.8V. Has EMI filter. | SOC.AA7 |

8.17 FlexIO - Flexible I/O

Flexible I/O (FlexIO) is a highly configurable module providing a wide range of functionality, including:

- Emulation of various serial or parallel communication protocols
- Flexible 16-bit timers with support for various trigger, reset, enable, and disable conditions
- Programmable logic blocks which allow the implementation of digital logic functions on-chip and configurable interaction of internal and external modules
- Programmable state machine for offloading basic system control functions from the CPU

The FlexIO module has the following key features:

- Array of 32-bit shift registers with transmit, receive, data match, logic, and state modes
- Double-buffered shifter operation for continuous data transfer
- Shifter concatenation to support large transfer sizes
- Automatic start and stop bit generation
- 1, 2, 4, 8, 16, or 32 multi-bit shift widths for parallel interface support
- Interrupt, DMA, or polled transmit and receive operation
- Programmable baud rates independent of bus clock frequency, with support for asynchronous operation during Stop mode
- Highly flexible 16-bit timers with support for various internal or external trigger, reset, enable, and disable conditions
- Programmable logic mode for integrating external digital logic functions on-chip, or combining pin, shifter, or timer functions to generate complex outputs
- Programmable state machine for offloading basic system control functions from CPU, with support for up to eight states, eight outputs, and three selectable inputs per state
- Integrated general purpose input/output registers and pin rising or falling edge interrupts to simplify software support
- Support for a wide range of protocols, including but not limited to:
 - UART
 - I2C
 - SPI
 - I2S
 - Camera IF
 - Motorola 68K or Intel 8080 bus
 - PWM or waveform generation
 - Input-capture (pulse edge interval measurement), such as SENT

8.17.1 FlexIO1 Signals

Table 60: FlexIO1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------------|------|---|----------|
| J1.74 | | flexio1.FLEXIO[0] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.Y17 |
| J3.30 | | flexio1.FLEXIO[0] | 7 | | SOC.J21 |
| J1.82 | | flexio1.FLEXIO[1] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.AA19 |
| J2.48 | | flexio1.FLEXIO[10] | 7 | | SOC.N17 |
| J3.50 | | flexio1.FLEXIO[1] | 7 | | SOC.J20 |
| J2.80 | | flexio1.FLEXIO[11] | 7 | | SOC.N18 |
| J2.81 | | flexio1.FLEXIO[13] | 7 | | SOC.N21 |
| J2.83 | | flexio1.FLEXIO[14] | 7 | | SOC.P20 |
| J2.77 | | flexio1.FLEXIO[15] | 7 | | SOC.P21 |
| J2.38 | | flexio1.FLEXIO[16] | 7 | | SOC.R21 |
| J2.46 | | flexio1.FLEXIO[17] | 7 | | SOC.R20 |
| J2.40 | | flexio1.FLEXIO[18] | 7 | | SOC.R18 |
| J1.88 | | flexio1.FLEXIO[2] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.Y19 |
| J2.36 | | flexio1.FLEXIO[20] | 7 | | SOC.T20 |
| J2.45 | SDEX | flexio1.FLEXIO[20] | 4 | Runs @ 1.8V. | SOC.V16 |
| J3.38 | | flexio1.FLEXIO[2] | 7 | | SOC.K20 |
| J2.43 | SDEX | flexio1.FLEXIO[21] | 4 | Runs @ 1.8V. | SOC.U16 |
| J2.35 | SDEX | flexio1.FLEXIO[22] | 4 | Runs @ 1.8V. | SOC.T16 |
| J3.42 | | flexio1.FLEXIO[22] | 7 | | SOC.U18 |
| J2.33 | SDEX | flexio1.FLEXIO[23] | 4 | Runs @ 1.8V. | SOC.V14 |
| J3.46 | | flexio1.FLEXIO[23] | 7 | | SOC.U20 |
| J2.31 | SDEX | flexio1.FLEXIO[24] | 4 | Runs @ 1.8V. | SOC.U14 |
| J3.64 | | flexio1.FLEXIO[24] | 7 | | SOC.U21 |
| J2.29 | SDEX | flexio1.FLEXIO[25] | 4 | Runs @ 1.8V. | SOC.T14 |
| J2.60 | | flexio1.FLEXIO[25] | 7 | | SOC.V21 |
| J2.76 | | flexio1.FLEXIO[26] | 4 | Runs @ 1.8V. Has an internal 12K pull down. | SOC.AA2 |
| J2.54 | | flexio1.FLEXIO[27] | 7 | | SOC.W21 |
| J3.48 | | flexio1.FLEXIO[27] | 4 | Runs @ 1.8V. | SOC.Y3 |
| J1.86 | | flexio1.FLEXIO[3] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.Y18 |
| J2.26 | | flexio1.FLEXIO[30] | 4 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y1 |
| J3.58 | | flexio1.FLEXIO[3] | 7 | | SOC.K21 |
| J2.20 | | flexio1.FLEXIO[31] | 4 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.Y2 |
| J1.80 | | flexio1.FLEXIO[4] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.AA18 |

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|-------------------|------|---|----------|
| J2.86 | | flexio1.FLEXIO[4] | 7 | | SOC.L17 |
| J1.78 | | flexio1.FLEXIO[5] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.Y20 |
| J2.85 | | flexio1.FLEXIO[5] | 7 | | SOC.L18 |
| J1.19 | | flexio1.FLEXIO[6] | 7 | | SOC.L20 |
| J1.84 | | flexio1.FLEXIO[6] | 4 | Will change level according to J1.90 NVCC_SD. | SOC.AA20 |
| J1.17 | | flexio1.FLEXIO[7] | 7 | | SOC.L21 |
| J2.25 | SDEX | flexio1.FLEXIO[7] | 4 | Runs @ J1.90 VDD_SDIO2 level. | SOC.AA17 |
| J2.89 | | flexio1.FLEXIO[8] | 7 | | SOC.M20 |
| J2.87 | | flexio1.FLEXIO[9] | 7 | | SOC.M21 |

8.17.2 FlexIO2 Signals

Table 61: FlexIO2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------------|------|--|----------|
| J1.13 | | flexio2.FLEXIO[0] | 4 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA11 |
| J1.10 | Non-EC | flexio2.FLEXIO[10] | 4 | Runs @ 1.8V. | SOC.AA8 |
| J1.11 | | flexio2.FLEXIO[1] | 4 | Runs @ 3.3V. Routed through PMIC internal voltage translator. Has an internal 1.47K pull up. | SOC.AA10 |
| J1.12 | Non-EC | flexio2.FLEXIO[11] | 4 | Runs @ 1.8V. | SOC.Y9 |
| J1.14 | Non-EC | flexio2.FLEXIO[12] | 4 | Runs @ 1.8V. | SOC.AA9 |
| J1.16 | Non-EC | flexio2.FLEXIO[13] | 4 | Runs @ 1.8V. | SOC.Y10 |
| J2.27 | SDEX | flexio2.FLEXIO[15] | 4 | Runs @ 1.8V. | SOC.AA6 |
| J2.73 | | flexio2.FLEXIO[16] | 4 | Runs @ 1.8V. | SOC.T10 |
| J2.78 | | flexio2.FLEXIO[17] | 4 | Runs @ 1.8V. Internal buffer connected to this pin drives BOOT_MODE0 (J2.90), latched with POR_B rise. | SOC.V8 |
| J2.67 | | flexio2.FLEXIO[18] | 4 | Runs @ 1.8V. | SOC.U8 |
| J2.70 | | flexio2.FLEXIO[19] | 4 | Runs @ 1.8V. | SOC.T8 |
| J1.8 | Non-EC | flexio2.FLEXIO[2] | 4 | Runs @ 1.8V. | SOC.V12 |
| J2.74 | | flexio2.FLEXIO[2] | 4 | Runs @ 1.8V. | SOC.V6 |
| J2.71 | | flexio2.FLEXIO[21] | 4 | Runs @ 1.8V. | SOC.U6 |
| J2.64 | | flexio2.FLEXIO[22] | 4 | Runs @ 1.8V. | SOC.Y4 |
| J2.72 | | flexio2.FLEXIO[23] | 4 | Runs @ 1.8V. | SOC.AA3 |
| J2.65 | | flexio2.FLEXIO[24] | 4 | Runs @ 1.8V. | SOC.AA4 |
| J2.69 | | flexio2.FLEXIO[25] | 4 | Runs @ 1.8V. | SOC.Y5 |
| J2.66 | | flexio2.FLEXIO[26] | 4 | Runs @ 1.8V. | SOC.AA5 |
| J2.68 | | flexio2.FLEXIO[27] | 4 | Runs @ 1.8V. | SOC.Y6 |
| J1.28 | | flexio2.FLEXIO[28] | 4 | Runs @ 1.8V. | SOC.U4 |
| J3.52 | | flexio2.FLEXIO[29] | 4 | Runs @ 1.8V. | SOC.V4 |
| J1.6 | Non-EC | flexio2.FLEXIO[3] | 4 | Runs @ 1.8V. | SOC.U12 |

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------------|------|---|---------|
| J2.24 | | flexio2.FLEXIO[30] | 4 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. | SOC.W1 |
| J2.22 | | flexio2.FLEXIO[31] | 4 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. Has an internal 10K pull down. | SOC.W2 |
| J1.2 | Non-EC | flexio2.FLEXIO[4] | 4 | Runs @ 1.8V. | SOC.T12 |
| J1.4 | Non-EC | flexio2.FLEXIO[5] | 4 | Runs @ 1.8V. | SOC.W11 |
| J1.3 | Non-EC | flexio2.FLEXIO[6] | 4 | Runs @ 1.8V. | SOC.V10 |
| J1.5 | Non-EC | flexio2.FLEXIO[7] | 4 | Runs @ 1.8V. | SOC.U10 |
| J1.9 | Non-EC | flexio2.FLEXIO[8] | 4 | Runs @ 1.8V. | SOC.Y8 |
| J1.7 | Non-EC | flexio2.FLEXIO[9] | 4 | Runs @ 1.8V. Has EMI filter. | SOC.AA7 |

8.18 LPTMR - Low-Power Timer

The low-power timer (LPTMR) can be configured to operate as a time counter with optional prescaler, or as a pulse counter with optional glitch filter, across all power modes, including the low-power modes. It is reset only on Power on Reset (POR) or Low Voltage Detect (LVD), allowing it to be used as a time-of-day counter.

The LPTMR module has the following key features:

- 32-bit time counter or pulse counter with compare
 - Optional interrupt can generate asynchronous wake-up from any low-power mode.
 - Hardware trigger output.
 - Counter supports free-running mode or reset on compare.
- Configurable clock source for prescaler/glitch filter
- Configurable input source for pulse counter
 - Rising-edge or falling-edge

8.18.1 LPTMR1 Signals

Table 62: LPTMR1 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|-------|---------|
| J2.50 | | lptmr1.ALT1 | 4 | | SOC.G17 |
| J2.56 | | lptmr1.ALT2 | 4 | | SOC.J17 |
| J3.62 | | lptmr1.ALT3 | 4 | | SOC.G18 |

8.18.2

8.18.3 LPTMR2 Signals

Table 63: LPTMR2 Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|--------------|------|---|----------|
| J1.12 | Non-EC | lptmr2.ALT1 | 3 | Runs @ 1.8V. | SOC.Y9 |
| J1.84 | | lptmr2.ALT1 | 1 | Will change level according to J1.90 NVCC_SD. | SOC.AA20 |
| J1.14 | Non-EC | lptmr2.ALT2 | 3 | Runs @ 1.8V. | SOC.AA9 |
| J2.25 | SDEX | lptmr2.ALT2 | 1 | Runs @ J1.90 VDD_SDIO2 level. | SOC.AA17 |
| J1.16 | Non-EC | lptmr2.ALT3 | 3 | Runs @ 1.8V. | SOC.Y10 |

8.19 Reference Clocks

The DART-MX93 exposes the clock outputs from the internal CCM module which can be used to clock external devices.

8.19.1 Clock Signals

Table 64: Clock Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------------|------|--|---------|
| J2.76 | | ccmsrcgpcmix.CLKO1 | 0 | Runs @ 1.8V. Has an internal 12K pull down. | SOC.AA2 |
| J3.48 | | ccmsrcgpcmix.CLKO2 | 0 | Runs @ 1.8V. | SOC.Y3 |
| J1.28 | | ccmsrcgpcmix.CLKO3 | 0 | Runs @ 1.8V. | SOC.U4 |
| J3.52 | | ccmsrcgpcmix.CLKO4 | 0 | Runs @ 1.8V. | SOC.V4 |

8.20 ADC

The DART-MX93 integrates 1 ADC. The main features are:

- It includes eight channels, four of them connected to pins in the package.
- Support the 1MS/s frequency of operation
- Multiple modes of starting conversion (Normal, Injected)
- Normal mode supports One-Shot and Scan (continuous) conversions
- Injected mode supports One-Shot conversions only
- Support TRGMUX to allow 16 trigger channels to be used by any ADC channel

8.20.1 ADC Signals

Table 65: ADC Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|----------------|------|--------------|---------|
| J3.76 | | anamix.adc_in0 | 0 | Runs @ 1.8V. | SOC.B19 |
| J3.78 | | anamix.adc_in1 | 0 | Runs @ 1.8V. | SOC.A20 |
| J3.80 | | anamix.adc_in2 | 0 | Runs @ 1.8V. | SOC.B20 |
| J3.82 | | anamix.adc_in3 | 0 | Runs @ 1.8V. | SOC.B21 |

8.21 DAP - Debug Access Port

DAP is a standard Arm component, comprising of several components. These components are used to access the DAP from an external debugger and Access Ports to access on-chip debug system resources. The DAP supports 1149.1/Arm SW-DP interface, which means that the JTAG interface can be operate in standard 5-pin JTAG-DP interface or in 2-pin SW-DP interface. The following figure shows the connectivity between the DAP and the pads.

8.21.1 DAP Signals

Table 66: DAP Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|------------------|------|---|---------|
| J2.26 | | dap.TCLK_SWCLK | 0 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage | SOC.Y1 |
| J2.60 | | dap.TCLK_SWCLK | 5 | | SOC.V21 |
| J2.24 | | dap.TDI | 0 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage | SOC.W1 |
| J2.42 | | dap.TDI | 5 | | SOC.V20 |
| J2.20 | | dap.TDO_TRACESWO | 0 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage | SOC.Y2 |
| J3.64 | | dap.TDO_TRACESWO | 5 | | SOC.U21 |
| J2.22 | | dap.TMS_SWDIO | 0 | Runs @ 1.8V. Used on DART for BT communication. If BT not required internal buffer can be disabled, and pin function released to customer usage. Has an internal 10K pull down. | SOC.W2 |
| J2.54 | | dap.TMS_SWDIO | 5 | | SOC.W21 |

8.22 Power

8.22.1 Power

Table 67: Power

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|--------------|------|--|------------|
| J3.71 | | VBAT | | | |
| J3.73 | | VBAT | | | |
| J3.75 | | VBAT | | | |
| J3.77 | | VBAT | | | |
| J3.79 | | VBAT | | | |
| J3.81 | | VBAT | | | |
| J3.83 | | VBAT | | | |
| J3.85 | | VBAT | | | |
| J3.87 | | VBAT | | | |
| J3.89 | | VBAT | | | |
| J1.15 | | NVCC_BBSM | | | PCA9451.3 |
| J1.90 | | NVCC_SD | | Power output for SD2 pins reference. 1.8V/3.3V- set by DART PMIC. | PCA9451.55 |
| J3.66 | | USB1_VBUS | | Runs @ 5.0V. VBUS Reference Voltage input. | SOC.F12 |
| J3.26 | | USB2_VBUS | | Runs @ 5.0V. VBUS Reference Voltage input. | SOC.E14 |

8.22.2 Ground

Table 68: Digital Ground Pins

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|-------------|--------------|------|-------|------|
| J2.12 | | AGND | 0 | | |
| J1.18 | | GND | 0 | | |
| J1.21 | | GND | 0 | | |
| J1.30 | | GND | 0 | | |
| J1.33 | | GND | 0 | | |
| J1.49 | | GND | 0 | | |
| J1.52 | Non-BTRST | GND | 0 | | |
| J1.55 | Non-WBE | GND | 0 | | |
| J1.58 | Non-WRST | GND | 0 | | |
| J1.61 | Non-WBE | GND | 0 | | |
| J1.64 | Non WBD/WBE | GND | 0 | | |
| J1.67 | Non WBE | GND | 0 | | |
| J1.70 | Non-BTRST | GND | 0 | | |
| J1.76 | | GND | 0 | | |
| J1.85 | | GND | 0 | | |
| J2.18 | | GND | 0 | | |
| J2.23 | | GND | 0 | | |
| J2.47 | | GND | 0 | | |
| J2.53 | | GND | 0 | | |
| J2.75 | | GND | 0 | | |
| J2.84 | | GND | 0 | | |
| J3.9 | | GND | 0 | | |
| J3.10 | | GND | 0 | | |
| J3.15 | | GND | 0 | | |
| J3.21 | | GND | 0 | | |
| J3.24 | | GND | 0 | | |
| J3.27 | | GND | 0 | | |
| J3.33 | | GND | 0 | | |
| J3.34 | | GND | 0 | | |
| J3.39 | | GND | 0 | | |
| J3.45 | | GND | 0 | | |
| J3.51 | | GND | 0 | | |
| J3.57 | | GND | 0 | | |
| J3.63 | | GND | 0 | | |
| J3.68 | | GND | 0 | | |
| J3.74 | | GND | 0 | | |

8.23 General System Control

8.23.1 General System Control Signals

Table 69: General System Control Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|------|----------------|------|---|------------|
| J1.1 | | PMIC_NINT | 0 | Runs @ 1.8V. Has an internal 100K pull up. | PCA9451.13 |
| J3.88 | | PMIC_ON_REQ | 0 | Runs @ 1.8V. | SOC.A17 |
| J1.22 | | PMIC_RST_B | 0 | Runs @ 1.8V. PMIC reset input. Pull low to hold DART internal regulators OFF. Pulse low for cold reboot. Has an internal 100K pull up. | PCA9451.8 |
| J1.26 | | PMIC_STBY_REQ | 0 | Runs @ 1.8V. | SOC.B18 |
| J1.20 | | ONOFF | 0 | Runs @ 1.8V. | SOC.A19 |
| J1.24 | | POR_B | 0 | Runs @ 1.8V. Pull low to hold SOC in reset state. Pulse low for warm reboot. Has an internal 100K pull up. | PCA9451.9 |
| J3.70 | | TAMPER0 | 0 | Runs @ 1.8V. | SOC.B16 |
| J3.72 | | TAMPER1 | 0 | Runs @ 1.8V. | SOC.F14 |
| J2.28 | | wdog1.WDOG_ANY | 0 | | SOC.J18 |
| J3.84 | | CLKIN1 | 0 | Runs @ 1.8V. Has an internal 100K pull down. | SOC.B17 |
| J3.86 | | CLKIN2 | 0 | Runs @ 1.8V. Has an internal 100K pull down. | SOC.A18 |

8.23.2 Boot configuration

The DART-MX93 can be boot from the following sources:

- Internal source - eMMC Flash memory (J2.90 set to Low)
- External source
 - SD Card (J2.90 set to High and SD Card plugged in)
 - USB UUU Serial Downloader (J2.90 set to High and SD Card is not plugged in)

To select other boot modes the following pins can be used.

The BOOT_MODE[1] is not exposed and always pulled up on the SOM.

Table 70: BOOT_MODE Signals

| Pin# | Assy | Pin Function | Alt# | Notes | Ball |
|-------|--------|-----------------|------|---|---------|
| J2.10 | | BOOT_MODE[2] | | Has an internal SOC PD. Do not drive until after POR_B rise + 30ms | SOC.G21 |
| J2.14 | Non-AC | BOOT_MODE[3] | | Has an internal SOC PD. Do not drive until after POR_B rise + 30ms. | SOC.H21 |
| J2.90 | | BOOT_MODE[0] | | Used as console debug on Variscite release. Do not drive until after POR_B rise + 30ms Internal buffer connected to J2.78 drives this pin, latched with POR_B rise. | SOC.E21 |
| J2.78 | | enet2.RGMII_TD2 | | Runs @ 1.8V. Internal buffer connected to this pin drives BOOT_MODE0 (J2.90). Latched with POR_B rise. | SOC.V8 |

Table 71: Available boot modes

| BOOT_MODE [3:0] | BOOT CORE | BOOT DEVICE | Notes |
|-----------------|------------|--|---|
| 0000 | Cortex-A55 | From internal fuses | |
| 0001 | Cortex-A55 | USB1/2 Serial Downloader | Can be achieved by J2.90 set to High and SD Card is not plugged in |
| 0010 | Cortex-A55 | USDHC1 8-bit eMMC 5.1 | Variscite EVK and SW support this mode |
| 0011 | Cortex-A55 | USDHC2 4-bit SD3.0 | Variscite EVK and SW support this mode |
| 0100 | Cortex-A55 | FlexSPI Serial NOR. Supports SFDP (JESD-216) parameters | |
| 0101 | Cortex-A55 | FlexSPI Serial NAND 2K page | |
| 0110 | Cortex-A55 | Infinite Loop | |
| 0111 | Cortex-A55 | Test Mode | |
| 1000 | Cortex-M33 | From internal fuses | |
| 1001 | Cortex-M33 | USB1 Serial Downloader | |
| 1010 | Cortex-M33 | USDHC1 8-bit eMMC 5.1 | |
| 1011 | Cortex-M33 | USDHC2 4-bit SD3.0 | |
| 1100 | Cortex-M33 | FlexSPI Serial NOR. Supports SFDP (JESD-216) parameters | |
| 1101 | Cortex-M33 | FlexSPI Serial NAND 2K page | |
| 1110 | Cortex-M33 | Infinite Loop | |
| 1111 | Cortex-M33 | Test Mode | |

9. Assembly Options

To make the solution as Flexible as possible the following assembly options were added. The assembly options help customers to order the SOM variant that includes only the needed interfaces with a lower cost.

9.1 Ethernet PHY

The SOM can be ordered without Ethernet PHY chip assembled; it allows reducing the overall cost of the product in case the Ethernet Interfaces are not used.
when not assembled, SoC balls are exported to SOM connector instead of Ethernet interface pins.

9.2 Analog Audio Codec

The SOM can be ordered without Audio Codec chip assembled. This allows reducing the overall cost of the product in case the Analog Audio Codec is not used.
when not assembled, SoC balls are exported to SOM connector instead of Analog codec interface pins.

9.3 Single/Dual band Wi-Fi and BT/BLE combo

The SOM can be ordered without the Single or Dual band Wi-Fi and BT/BLE combo chip assembled, it allows reducing the overall cost of the product in case the Wi-Fi and BT/BLE is not used.

9.4 LPDDR4

The SOM can be ordered with different RAM size capacities, it allows reducing the overall cost of the product in case lower RAM size is sufficient.

9.5 eMMC

The SOM can be ordered with different eMMC size capacities, it allows reducing the overall cost of the product in case lower eMMC size is sufficient.

10. Electrical Specifications

10.1 Absolute Maximum Ratings

Table 72: Absolute Maximum Ratings

| Pin # | Min | Max | Units | Comments |
|--|------|----------|-------|--------------------------------|
| VBAT | -0.3 | 6.0 | V | |
| USB_OTG1_VBUS, USB_OTG2_VBUS | -0.3 | 5.25 | V | |
| Vin/Vout input/output voltage range (GPIO Type Pins) | -0.3 | OVDD+0.3 | | OVDD is the I/O supply voltage |
| ESD damage immunity Human Body Model (HBM) | -- | TBD | | |
| ESD damage immunity Charge Device Model (CDM) | -- | TBD | | |

10.2 Operating Conditions

Table 73: Operating Ranges

| Pin # | Min | Typ | Max | Unit |
|------------------------------|------|-----|------|------|
| VCC_SOM | 3.5 | 3.7 | 5.5 | V |
| USB_OTG1_VBUS/ USB_OTG2_VBUS | 4.75 | 5 | 5.25 | V |

10.3 Peripheral Voltage Levels

Most of the peripheral interface lines used as inputs or output to the DART-MX93 uses 3.3V LVCMOS levels, except the following interfaces: SD2, ENET_QOS, ENET1, HDMI, PCIe, USB, MIPI-DSI, MIPI-CSI, LVDS.

USB/MIPI-DSI/MIPI-CSI/LVDS: Interfaces follow a different standard since they are high-speed signals.

uSDHC2: (SDIO lines) interface IOs will change voltage between 3.3V and 1.8V depending on the SD card capabilities.

With other alternative function user can determine the voltage uSDHC2 IOs bank will be 1.8V or 3.3V using gpio3.IO[19].

ENET_QOS: interface available in case SOM is ordered **without "EC"** configuration. IOs voltage is 1/8V.

ENET1: IOs voltage is 1/8V.

10.4 Power Consumption

Table 74: DART-MX93 Power Consumption

| Mode | Voltage | Current | Power | Conditions |
|----------------------------------|---------|---------|--------|---|
| Run | 3.7V | 0.690A | 2.553W | Linux up, Wi-Fi connected and Iperf is running 802.11ax 5GHz |
| Run | 3.7V | 0.590A | 2.183W | Linux up, Wi-Fi connected and Iperf is running 802.11n 2.4GHz |
| Run | 3.7V | 0.505A | 1.868W | Linux up. Ethernet0 running Iperf |
| Run | 3.7V | 0.380A | 1.406W | Linux up. Ethernet0, Ethernet1, Wi-Fi module up |
| Standby | 3.7V | 60mA | 0.222W | Memory retention mode |
| Off (RTC) | 3.7V | 1.9mA | 7.03mW | All power rails are Off, only Internal SoC RTC is powered |
| Minimum Recommended Power Supply | 3.7V | 2A | 7.4W | See note below |

Note: The Wi-Fi module needs a power source that can provide a peak current of ~1000mA@1.8V during DPD calibration when the firmware is downloaded, even though its max continuous supply current during transmission/reception is less.

Module calibration occurs:

- When the Module is initially powered up.
- The module is reset.
- When the radio is initialized.
- Every two minutes after the radio is initialized.

NOTE

Setup:

HW: DART-MX93D_V2_1700C_2048R_16G_AC_EC_WBD_ET_REV2.0A

SW: mx93-yocto-mickledore-6.1.36_2.1.0-v2.3

DISCLAIMER:

The power consumption measurements apply only to limited operation scenarios. Actual power consumption may vary depending on the interfacing peripherals and user application modes; Users must conduct testing per their specific operation scenarios.

Depending on the specific use cases and end product system design, an appropriate thermal solution should be applied.

11. Environmental Specifications

Table 75: Environmental Specifications

| Parameter | Min | Max |
|--|---------------|------|
| Commercial Operating Temperature Range | 0°C | 70°C |
| Extended Operating Temperature Range | -25°C | 85°C |
| Industrial Operating Temperature Range | -40°C | 85°C |
| Storage Temperature Range | -40°C | 85°C |
| Relative humidity (operation) | 10% | 90% |
| Relative humidity (storage) | 05% | 95% |
| MTBF Prediction Method Model: Telcordia Technologies Special Report SR-332, Issue 4 50°C, GB | > 5000 Khrs * | |

Note: Industrial Temperature is only based on the operating temperature grade of the SoM components. Customer should consider specific thermal design for the final product based upon the specific environmental and operational conditions.

*Preliminary information

12. Mechanical

12.1 Carrier Board Mounting

The SOM has four mounting holes for mounting it to the carrier board which are plated holes and connected to GND.

Note: The size and footprint of SOM 90-pin connectors Hirose P/N: DF40C-90DP-0.4V(51) are different from mating carrier board 90-pin connectors (see section 7.1).

To ensure correct positioning of the carrier board connectors and holes please refer to VAR-DT8MCustomBoard DXF available here (under documentation tab):

<http://www.variscite.com/products/single-board-computers/var-dt8mcustomboard>

It is recommended NOT to place any components under the SOM.

12.2 Standoffs

Customers requiring a mechanical solution for mounting in harsh vibration environments can use the following standoff:

Manufacturer: **MAC8**

PN: **TH-1.6-1.5-M2**

Link: <http://www.mac8japan.com/English%20Catalog/TH1.6%20Series-2.pdf>

12.3 SOM Dimensions

The size, mounting holes, and connectors relative locations can be found on the figures below.
All dimensions given in millimeter and [mils] units.

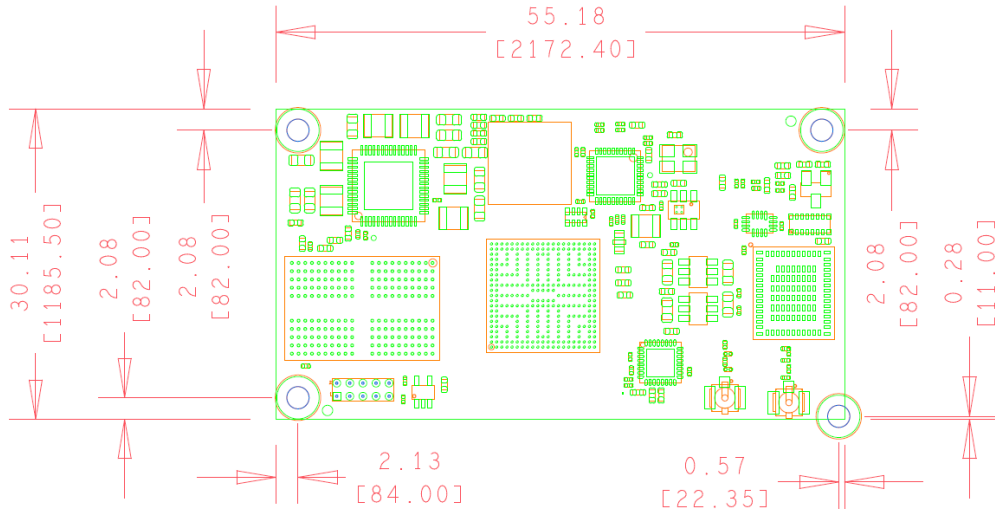


Figure 5: DART-MX93 Component Side Mechanics (Top view)

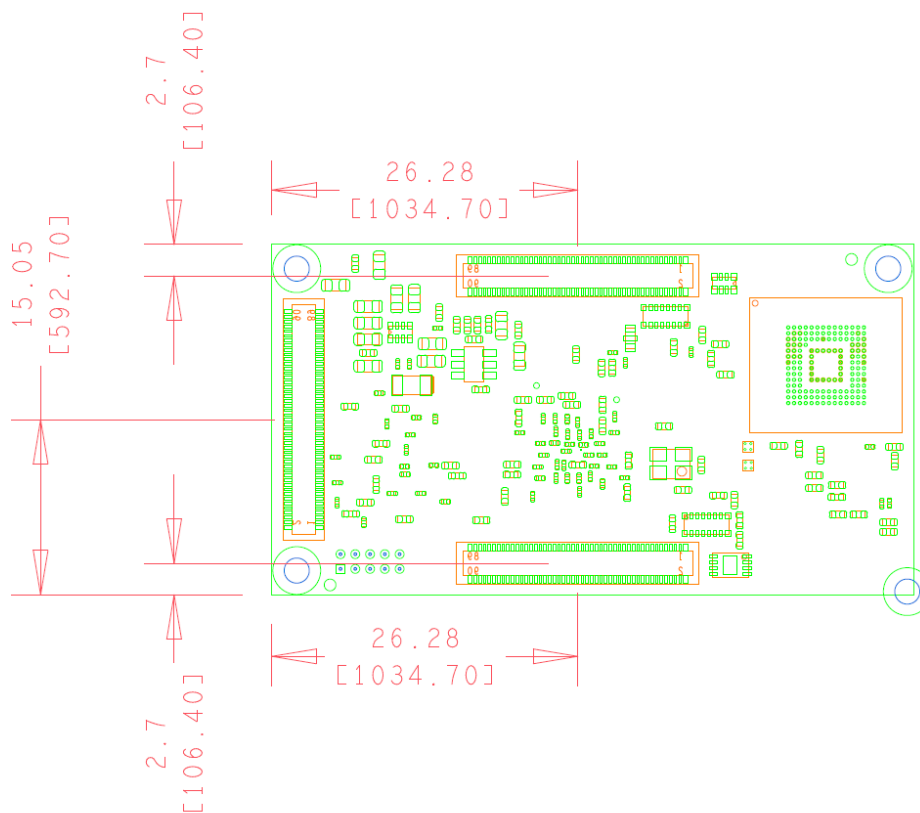


Figure 6: DART-MX93 Print Side Mechanics (Top view)

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