Technical Brief

Health, Education and Consumer Industries
Digital Signage

Intelligent Display 8K Experiences with Intel® Smart Display Module

Intel® Smart Display Module (Intel® SDM) is the display catalyst in driving the future of intelligent display experience

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Overview

Intel® SDM has become Intel's display catalyst in driving future display technology, maintaining a longer term and a robust roadmap ahead. It has entered the growth phase of the product life cycle, which emphasizes on broader integration and expansion of market and product usage. For example, the SDM-S is the size of a credit card** in flat panel displays and Smart Projector usages.

Intel® SDM is making its way and growing stronger in the audio-visual (AV) and broadcast market, with opportunities to explore in the rapidly growing LED Video Wall market.

Display OEM have proven that Intel® SDM provides standardization and interoperability across the product lines and suppliers with Intel products and platforms. Intel® SDM integrates its sleekest designs into spaces where workloads are optimized. This enables rich visual experiences to enhance users' engagement.

Intel® SDM is a future-oriented design with optimal processing capabilities and scalable to desired workloads. It is easy to upgrade with sustainable platforms, features and supports display resolutions up to 8K and beyond.

Intel® SDM provides an in-route to broad display applications, such as large panels, all-in-one displays, video walls, and projectors. It can be easily integrated into the display and reduces the system complexity by providing greater flexibility in the choice of processors.

Figure 1: Intel® SDM with 11th Gen Intel® Core™ Processor

Accelerating Adoption of Compute Module Market

How did Intel® SDM help the market thrive?

The evolution started more than a decade ago, when the market began to move towards modularization and standardization. Open Pluggable Specifications (OPS) was used to scale and reduce the development cost. Intel provided OPS that supported all Intel processors.

To provide further technology leadership and meet stricter standardizations, Intel® SDM was launched in 2018 with the SDM-L (SDM Large) and SDM-S (SDM Small) specifications, on Intel products and platforms. Intel® SDM provides interoperability and scalability to the market, especially to the ecosystem partners.

Intel® SDM usages have now expanded through the leading partners to support more interfaces such as:

- NDI
- 12G SDI
- SMPTE ST 2110

Intel® SDM continues to lead in future-oriented technology, such as 8K Display, 5G, Intel® Wi-Fi 6E, and Intel® FPGA with the following business values.

Minimum Space and Maximum Flexibility

Intel® SDM advocates a more connected future. It enables the integration of robust computing capabilities into the sleeker displays, for future-oriented designs that deliver lasting value.

Intel® SDM can accommodate new designs and applications that require minimal space and deliver maximum performance. These are also protected with the highest degree of security possible. Intel® SDM can keep digital displays from being a point of vulnerability for businesses as it incorporates the latest in Intel hardware-based security.

Future Oriented Capabilities

Intel® SDM provides future functionality. It supports resolutions up to 8K, and video capture when available. The flexibility of the module, whether built-in or attached externally, provides maximum peripheral integration and high-speed PCI Express (PCIe) connectivity, which supports multiple generations of Intel processors.

Ease of Integration

Intel® SDM offers a seamless device management experience. A PCIe connector supports the development on multiple Intel processors, be it the compact and energy-efficient Intel Atom® processor, or the performance driven Intel® Core™ processor, and multiple display resolutions.

The PCIe connector also supports higher bandwidth and higher resolution displays. It provides a built-in I/O, which eliminates the need for an external I/O, and further reduces the space required. The use of the physical PCIe connection makes Intel® SDM a ubiquitously scalable module. For example, moving from PCIe Gen 3 to Gen 4 as you add 8K interface support.

Introducing Intel® SDM with 11th Gen Intel® Core™ Codenamed Armor Mine

Armor Mine is a reference design for Intel® SDM to enable 8K Display using 11th Gen Intel® Core™ U - Series processor platforms. The reference design is compliant to Intel® SDM Specification Version 3.0 and comes in Intel® SDM Large Form factor.

Armor Mine Reference Design includes two main boards (refer to Figure 2):

- Intel® Smart Display Module (Intel® SDM)
- Peripheral Interface Board (PIB)

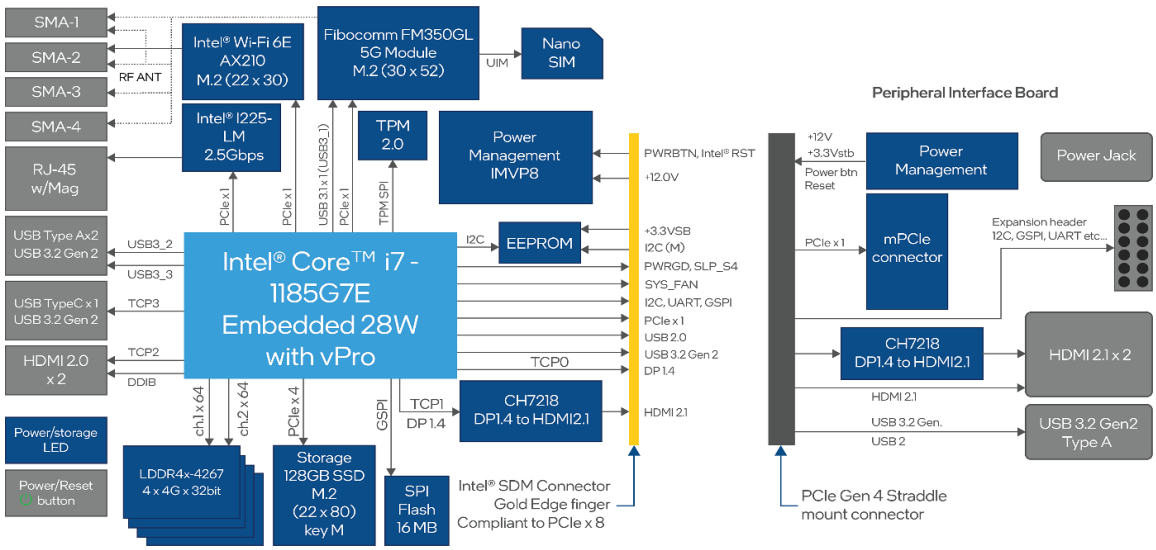

Figure 2: Intel® SDM Codenamed Armor Mine Block Diagram

Armor Mine is based on the 11th Gen Intel® Core™ i7 -1185G7E processor with memory, storage, display, and major connectivity interfaces. (Refer to Table 1)

The PIB serves as a module to test the Intel® SDM. Intel® SDM connector (Gold fingers compliant to PCIe x 8) are connected to PCIe Gen 4 connector on PIB Boards. PIB allows testing of Intel® SDM without inserting it in the display.

Table 1: Armor Mine - Specifications

Features	Specifications
Form Factor	Intel® SDM Large 175 mm x 100 mm
Processor	Intel® Core™ i7 1185G7E, 28 W (TGL UP3) with vPro 4 Cores, 8 Threads 12 MB Intel® Smart Cache 1.8 GHz Base Frequency with up to 4.4 GHz Turbo Frequency
Memory	16 GB LPDDR4x-4267, Dual Channel x 64-bit (total 128-bit Memory Interface)
Storage	128 GB M.2 PCIe NVMe 16 MB Flash EEPROM complaint to Intel® SDM 3.0 specification
Display[1]	1 x DP1.4 to Intel® SDM connector (up to 8K) 1x HDMI 2.1 to Intel® SDM connector (up to 8K) 2x HDMI 2.0 through I/O Panel (up to 4K) 1 x DP 1.4 through USB Type C on I/O Panel (up to 8K)
Connectivity	1x 2.5 Gbps Ethernet 1x BT/Wi-Fi (AX 210 Intel® Wi-Fi 6E Module) 1x 5G Module supported through M.2 3052 Key B (not supplied with Intel® SDM, for validation only)
USB	1x USB3 Type C on I/O panel (USB 3.2 Gen 2) 2x USB3 Type A on I/O panel (USB 3.2 Gen 2) 1x USB 3.2 Gen 2 + USB 2.0 to Intel® SDM connector
Expansion	1x PCIe Lane to Intel® SDM connector 1x I2C, 1xGSPI, 1xUART to Intel® SDM connector
System Control	Power ON, Intel® RST from Intel® SDM connector Power GD, SLP, SDM_DET, SYS_FAN to Intel® SDM connector
OS	Windows* 10 LTSC (only EVAL Version)
Other	TPM 2.0 for Security Audio Supported through HDMI ports – no additional Audio Codec
Power Supply[2]	Up to 100 Watts
Operating Condition[3]	Operating temperature: 0°C to 55°C Operating humidity: 0% to 90% (non-condensing) Non-operating temperature: -40°C to 85°C Non-operating humidity: 0% to 95% (non-condensing)

Notes:

1 Table 2 shows the maximum resolution and concurrent display support available.

2 Power consumption depends on workload usage scenario. It is recommended that display provides minimum 10A current at 12V to this module.

3 Operating conditions are provided at board level (without chassis). Panel makers, Display OEMs are expected to perform due diligence for their thermal requirement for system level operation, that is, module inserted in chassis or display.

Table 2: Armor Mine - Maximum Concurrent Display

Number of concurrent displays	Maximum Concurrent Display Support Display Interface Table				
	HDMI 2.1_1 (PIB)	HDMI 2.1_2 (PIB)	HDMI 2.0_1 (I/O Bracket)	HDMI 2.0_2 (I/O Bracket)	DP 1.4 over Type C (I/O Bracket)
1	8K60	-	-	-	-
1	-	8K60	-	-	-
1	-	-	-	-	8K60
4	4K60	4K60	4K60	4K60	-
4	-	4K60	4K60	4K60	4K60

Notes:

- Armor Mine includes five display interfaces but at any time, a maximum of four concurrent displays can be supported. The resolution limitation mentioned in Table 2.
- When 8K60 is enabled, it is recommended to connect only one 8K Display from any of the three potential interfaces available in Armor Mine (Example: connect to only 1 from 2x HDMI 2.1 on PIB and DP 1.4 over Type C).
- Armor Mine can support end to end playback of 8K60 FPS content in Windows* OS, and only up to 8K30 FPS end to end playback of HDR content is validated. Custom implementation of media player may be required to achieve end to end playback of 8K60 FPS content with HDR enabled.
- Armor Mine follows the media and display capability support inline to the capability of 11th Gen Intel® Core™ processor. For more information, please refer to documentation for 11th Gen Intel® Core™ processor here.

Refer to Figure 3 for the various I/O connectors of Armor Mine.

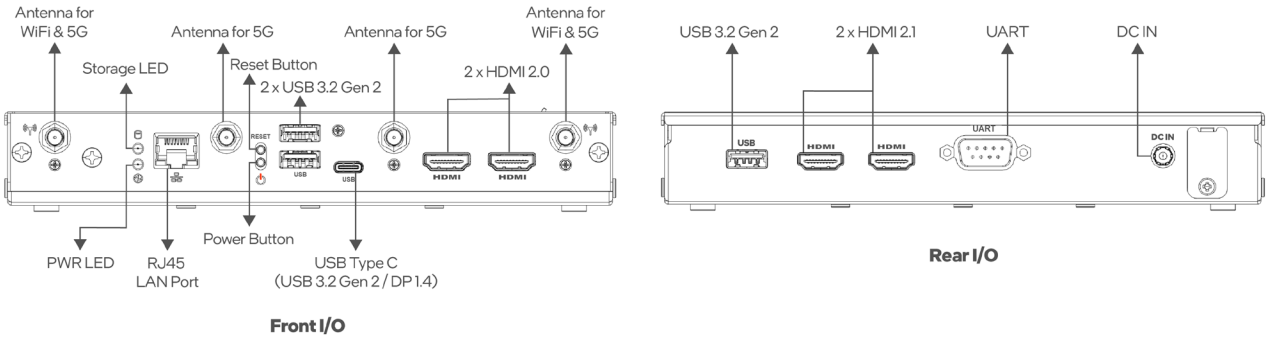

Figure 3: Armor Mine Reference Design External Connectors

Refer to Figure 4 for I/O connectors of Armor Mine Reference Design with chassis.

Note:

An additional chassis is built for the convenience of the customer and is provided along with the samples on request basis. However, chassis is not part of the reference design. All the specifications mentioned in Table 1 are applicable to Armor Mine reference design, which is SDM-L module and PIB without chassis.

Figure 4: Armor Mine with Chassis and Key Connector Accessible from Outside

Armor Mine Collaterals

The following reference design collaterals are available for downloads for Intel® SDM approved customers and CNDA is required.

- Schematic in Allegro DSN and PDF format for Intel® SDM and PIB
- Layout in Allegro (.brd) format for Intel® SDM and PIB
- Thermal mechanical design guidelines document
- 3D Mechanical files of Intel® SDM and PIB[1] in STEP and PDF format
- User guide

Learn more at intel.com/SDModule
Questions? Click here for any inquiries.

[1] Since chassis is not part of the reference design, Intel does not provide the chassis design files. Intel provides only the 3D board files (Intel® SDM and PIB).

Resources for Customers

- Open Pluggable Specifications (OPS)
- Intel® NUC
- 8K Technology
- Intel® Distribution of OpenVINO™ Toolkit
- Intel® Active Management Technology (Intel® AMT)
- Intel® FPGA

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**Comparative dimension with SDM-S dimension of 60 mm x 100 mm

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