TDA3x SoC processor delivers cost-effective ADAS solutions for front, rear and surround view applications

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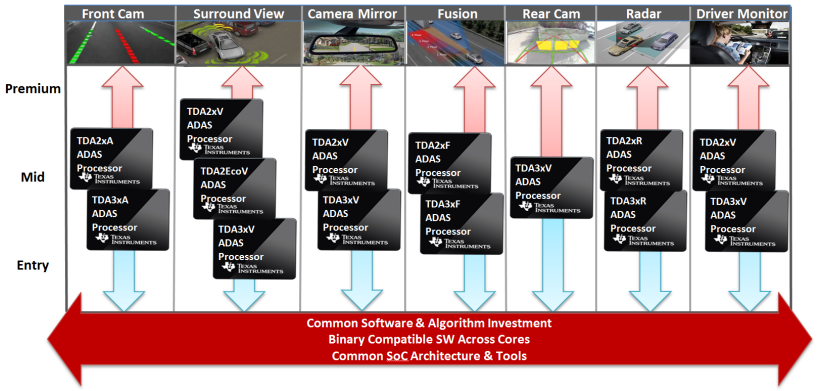
Introduction

The number of TDAx SoCs in serial production vehicles recently surpassed 15 million. The devices are used in the broadest portfolio of ADAS applications, encompassing camera-based front, rear, radar and surround view systems. While it took seven years to reach this milestone, the next major volume milestone will be reached in much less time. These SoCs are pushed to maximum performance by 15 lead customers with impressive ADAS engineering, enabling over 25 OEMs to produce systems in more than 100 car models to date.

TDA3x SoC processors augment TI's extensive portfolio of System-on-Chip (SoC) offerings in the Advanced Driver Assistance Systems (ADAS) space. Last year TI announced the TDA2x SoC processors to target front, surround and fusion ADAS solutions. The TDA3x SoC processor builds on the TDA SoC family scaling sophisticated innovation into ADAS solutions for entry- to mid-segment automobiles.



Extending TI's highly integrated and scalable family of automotive processors, with the TDA3x SoC, car manufacturers can develop sophisticated advanced driver assistance systems (ADAS) applications that meet or exceed the NCAP requirements, reduce collisions on the road and enable a more autonomous driving experience in entry- to mid-level automobiles. Developed on the same architecture as predecessor TDA SoCs, the TDA3x SoC processor offers scalability from the TDA2x SoC processor on front camera and surround view and fusion applications with the addition of smart rear camera and radar.

The TDA3x SoC processor enables ADAS algorithms such as autonomous emergency braking, lane keep assist, advanced cruise control, traffic sign recognition, pedestrian and object detection, forward collision warning and back over prevention in a broad range of ADAS applications, including front camera, parking assist, surround view, fusion, radar and smart rear camera. The TDA3x SoC will allow customers to develop ADAS applications that address cost-sensitive NCAP regulations such as Europe's lane departure warning, traffic sign recognition and object detection enabling autonomous emergency braking (AEB). The next section details various application use cases with TDA3x SoC.

TDA3x scales TDAx SoC family to entry-to mid-level automobiles

Front camera

TDA3x support for CSI2 peripheral enables interface to the latest generation of automotive imaging sensors. The parallel video input is still there in order to support interface of the TDA3x SoC to legacy imaging sensors. For data integrity the external memory interface (EMIF) on TDA3x SoC supports optional single error correct double error detect (SECDED). If this feature is enabled the ECC bits are calculated for all accesses that are within the address ranges protected with ECC and stored in a separate memory device (as shown in **Figure 1**).

Two TMS320C66x DSP cores and TI's Vision AccelerationPac based on the embedded vision engine (EVE) provide compute horsepower for front camera applications and allow concurrent execution of multiple front camera functions such as intelligent head beam, traffic sign recognition, lane keep assist, object detection and more.

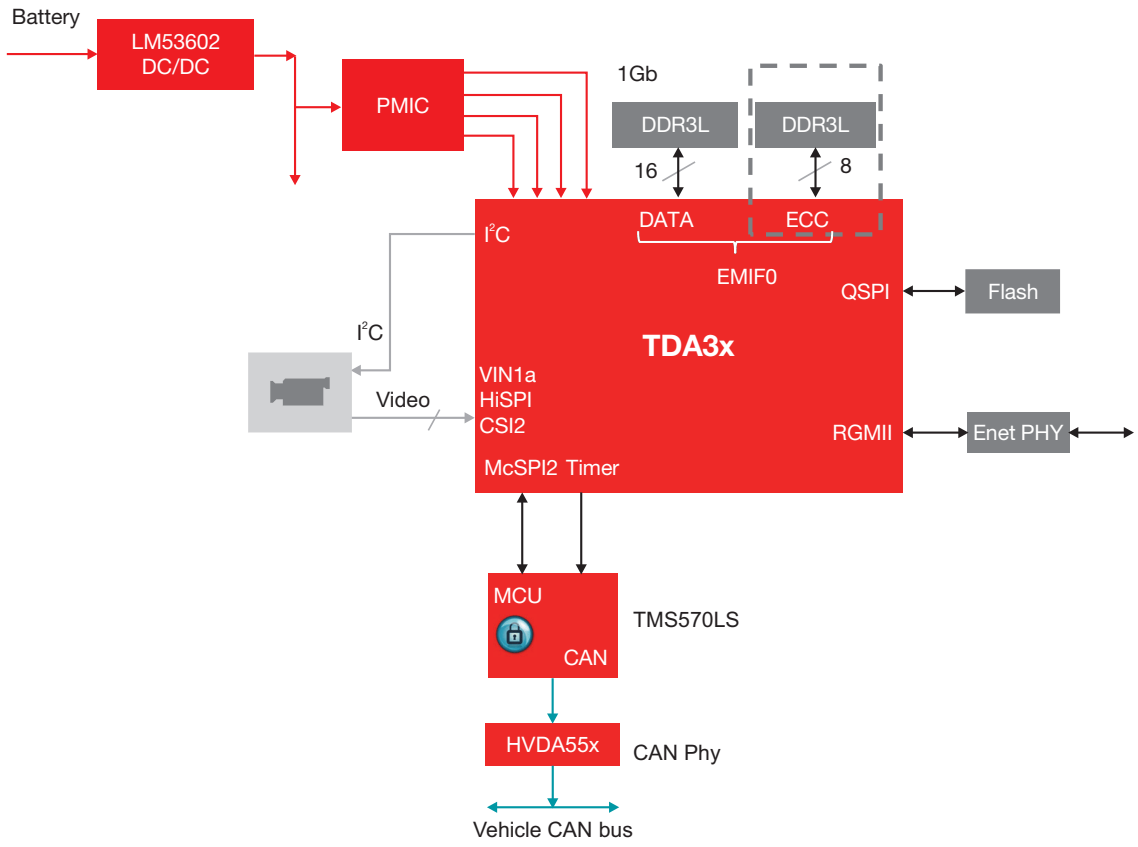


***Figure 1**. Front camera block diagram with TDA3x SoC processor.*

Surround view

The TDA3x SoC processor supports one instance of legacy parallel video input from the TDA2x SoC processor. The Video Input Port (VIP) enables interface to four 8-bit imaging sensors via TI FPD Link serializer/deserializers. This opens the TDA3x SoC to highly power and size-optimized entry-level surround view applications. The Image Signal Processor (ISP) hardware accelerator supporting wide dynamic range imaging and lens distortion correction significantly reduces the power dissipation footprint of the TDA3x processor by offloading these imaging tasks from the DSP core and Vision AccelrationPac(EVE). The display

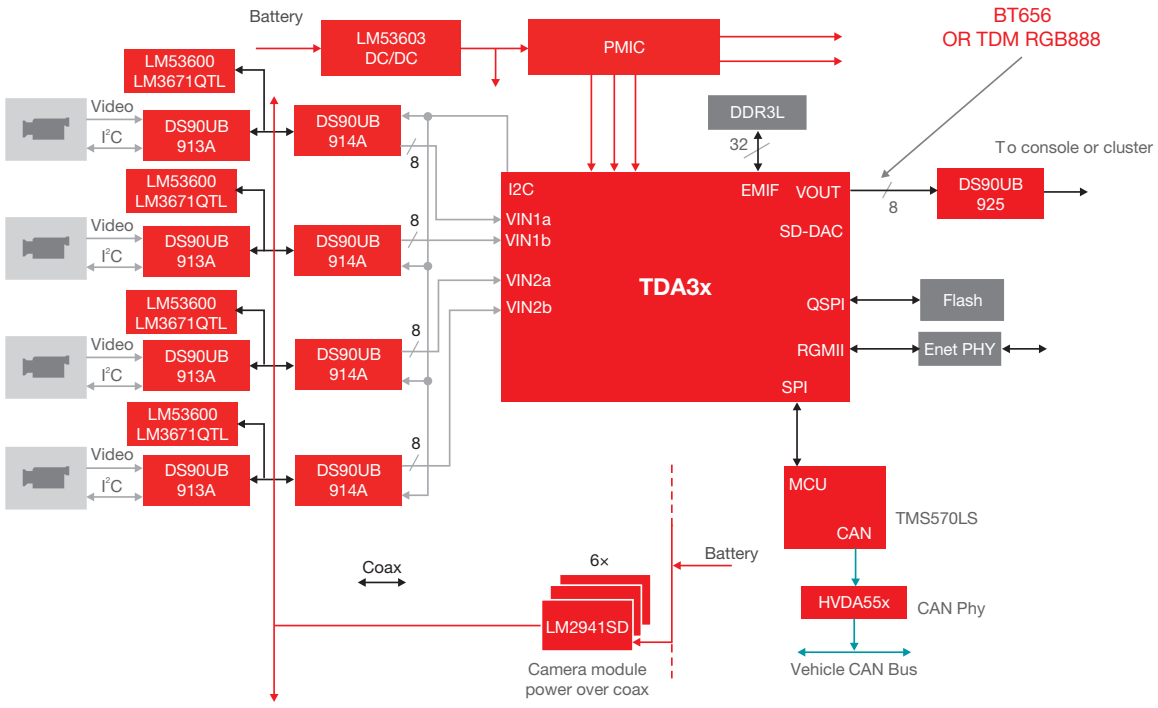


***Figure 2**. Surround view solution on TDA3x SoC processor.*

subsystem (DSS) on the TDA3x SoC is capable of offloading from the DSP and EVE various surround view application-specific pixel processing such as scaling, color space conversion, filtering, blending, color keying, graphics overlay, etc.

Smart rear camera

Today's typical rear camera system is no longer a simple raw video feed from the camera to the cockpit display. With the modern incorporation of sensing technologies such as radar and ultrasonic for back-up safety, along with increased analytics needs, processing requirements are more demanding than ever. These systems have evolved away from simple standalone cameras and into the sensor fusion domain. The TDA3x SoC processor comfortably handles these increased computing needs with maximum efficiency. With powerful engines such as the C66x DSP and EVE, the TDA3x offers substantial performance to enable analytics functions such as pedestrian detection and dynamic path lines. Furthermore, due to small system size and lack of any type of active cooling, it is critical to minimize energy dissipated by a rear-view SoC. The TDA3x processor's hardware accelerators such as ISP and DSS make reduction of power dissipation possible by offloading rear-view imaging tasks from the DSP core and EVE. This optimal balance of efficiency and performance make the TDA3x SoC processor the perfect fit to put the "smart" in today's smart rear camera.

Radar

The C66x DSP and EVE excel at the type of processing found in radar systems which makes the TDA3x SoC very applicable in mid-range or long-range radars. The high-level block diagram shown in **Figure 4**, illustrates a long-range radar system with four transmitters and eight receivers built around the TDA3x SoC. Output from dual, high-end

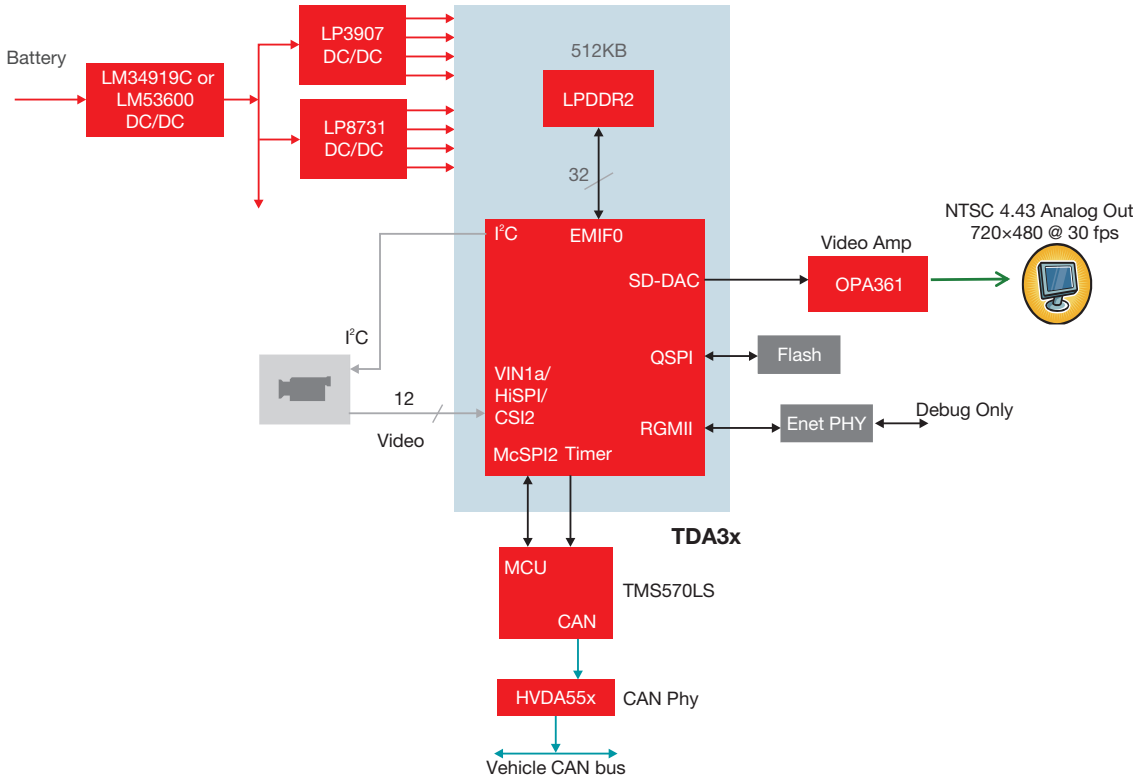


***Figure 3**. Size-constrained ADAS camera on a TDA3x processor.*

analog-to-digital converters (ADC) is connected to the TDA3x SoC via two parallel video inputs. The legacy VIP enables interface to two 13-bit outputs from dual ADCs.

Fusion

The TDAx family and TDA3x specifically offer Fusion solutions for different sensor inputs such as camera and radar. The C66x DSP and EVE provide processing capability for both image and radar data making the TDAx architecture a very good fit for fusion applications.

TDA3x SoC block diagram

The TDA3x SoC processor shares the same architecture with earlier SoCs from the TDA platform, which enables manufacturers to scale their product investments and deliver a diverse portfolio of products with hardware and software compatibility. The TDA3x SoC enables manufacturers to quickly bring the next-generation of ADAS features to the road in more affordable cars. The TDA3x SoC (see **Figure 5**) is based on a heterogeneous, scalable architecture that includes TI's fixed- and floating-point dual-TMS320C66x DSP cores, a fully programmable Vision AccelerationPac with (EVE), dual ARM® Cortex®-M4 cores along with an image signal processor (ISP) and a host of peripherals. Incremental peripheral additions on the TDA3x SoC processor from the TDA2x SoC processor are a 10-bit analog-to-digital converter, a standard-definition video digital-to-analog converter and four lanes of CSI2 or HiSPI video input. In addition to CSI2/HiSPI video input, the TDA3x SoC supports one instance of legacy parallel video input port from the TDA2x SoC.

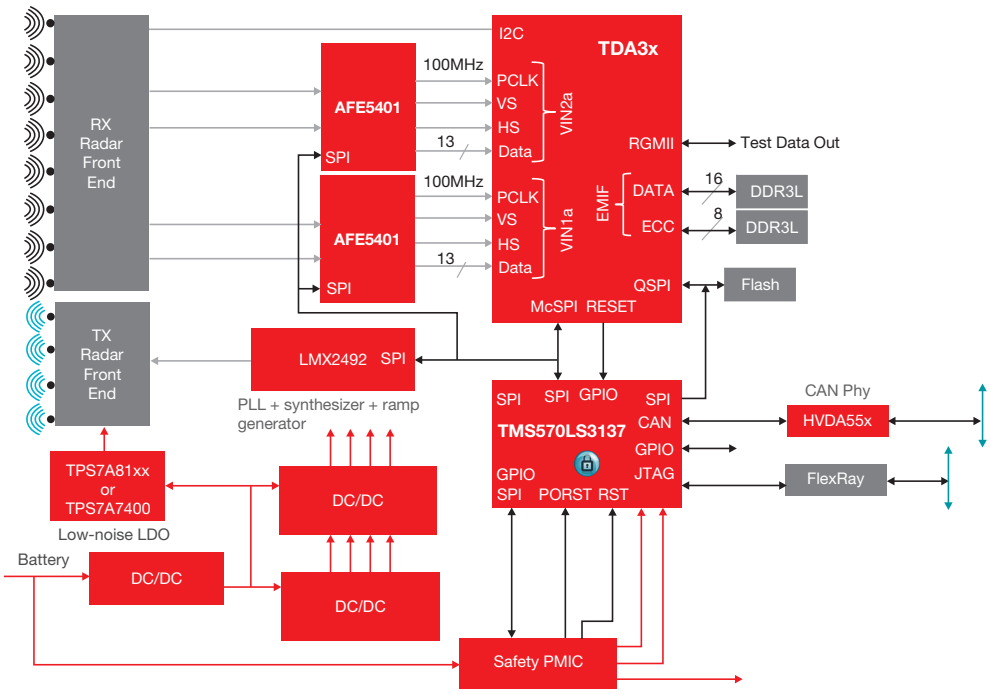


***Figure 4**. Radar on a TDA3x processor.*

The TDA3x processor also introduces the latest ISP hardware accelerator with support for wide dynamic range and lens distortion correction. The display subsystem (DSS) on the TDA3x SoC supports various pixel-processing capabilities on two video, one graphic and one write-back pipeline. The DSS supports one MIPI DPI2.0 and one composite video-out display interface.

The TDA3x comes in a 15 mm^2 BGA package with a 0.65 mm pitch.

The TDA3x EMIF supports interface to LPDDR2/DDR2/DDR3/DDR3L in a 16-bit or 32-bit wide configuration.

Table 1 shows various cores and video input/output peripherals that can be used in specific use cases (Front Camera, Surround View, Rear Camera, Camera Monitoring System).

	Front camera	Surround view CSI	Surround view parallel	Rear view
DSP1	●	●	●	●
DSP2	●			
EVE	●	●	●	●
CSI input	●	●		●
ISP		●	●	●
VOUT		● (24b)	● (8b)	●
VIN1a	●		●	●
VIN1b			●	
VIN2a			●	
VIN2b			●	

***Table 1.** Configuration of different ADAS applications on the TDA3x SoC.*

New features in the TDA3x SoC processor

The TDA3x SoC introduces several new features that offer significant advantages to customers.

ISP integration reducing system cost, complexity and size

By integrating an ISP that enables raw/Bayer sensors, the TDA3x processor delivers improved image quality without increasing the size, cost or complexity of the solution. Variants of the TDA3x SoC have a full-featured ISP including noise filters, Color Filter Array, Video Noise Temporal Filtering (VNTF), exposure and white balance controls, as well as optional support for wide dynamic range (WDR) and lens distortion correction (LDC). The ISP can support a range of combinations for mono, stereo and up to four camera inputs providing an industry-leading integrated solution.

Enhanced design for functional safety to help customers develop safer vehicles

TI's TDA3x processor is being developed to meet the relevant requirements of the ISO 26262 functional safety standard. The TDA3x SoC leverages a wide range of diagnostics from TI's award winning Hercules™ TMS570 safety MCU family to enhance the existing TDA2x platform safety concept. The combination of hardware, software, tools and support helps TDA3x processor customers develop systems to meet challenging functional safety requirements and achieve system-level functional safety certification more efficiently.

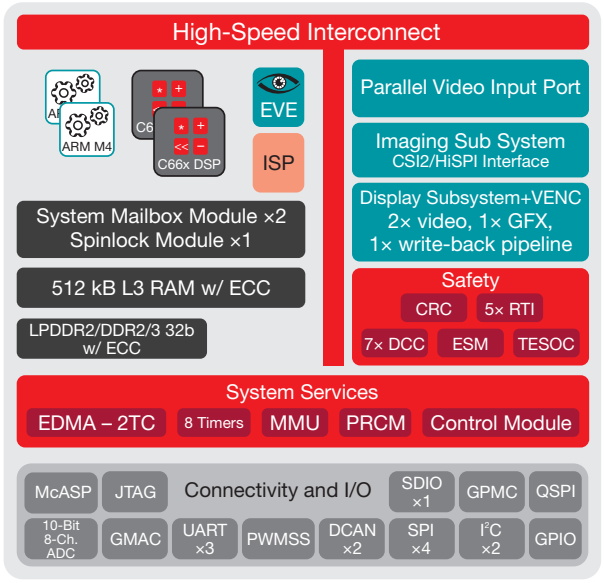


***Figure 5**. TDA3x processor block diagram.*

TI's software and tools development ecosystem get you started TODAY

- **TI Vision Software Development Kit (SDK) TI Vision SDK: Optimized vision libraries for ADAS systems:** The TDA family provides the TI VisionSDK and royalty-free software libraries to customers designing ADAS solutions to develop products for a broad range of vehicles, from entry to luxury, on the same platform with the reduced level of investment, lowering cost and time to market. The TI Vision SDK is based in TI's RTOS SYS/BIOS™ and available today. More details on the TI Vision SDK.
- **TDA3x SoC Processor Evaluation Module (EVM):** The TDA3x evaluation module (EVM) (see **Figure 6**), available for evaluation today, is designed to speed development efforts and reduce time to market for ADAS customers. The main board integrates key peripherals such as Ethernet, FPD Link and HDMI.

Availability

TI's TDA3x is now available in a 15 mm^2 package and comes complete with TI's Vision SDK as well as EVE and DSP libraries.

Conclusion

With the TDA3x SoC processor from TI, car manufacturers can develop sophisticated advanced driver assistance systems (ADAS) applications that meet or exceed the NCAP requirements, reduce collisions on the road, and enable a safer driving experience in entry-to-mid segment automobiles. "The introduction of the automotive industry's first integrated Image Signal Processor (ISP) offers advantages of miniaturization and power reduction. Increased functional safety features enable a higher ASIL level for the system. The TDA3x SoC is the perfect platform to develop powerful and efficient ADAS solutions that will make our roads safer for years to come. For additional information about the TDA family and specifically the TDA3x SoC processor, please visit www.ti.com/adastda.

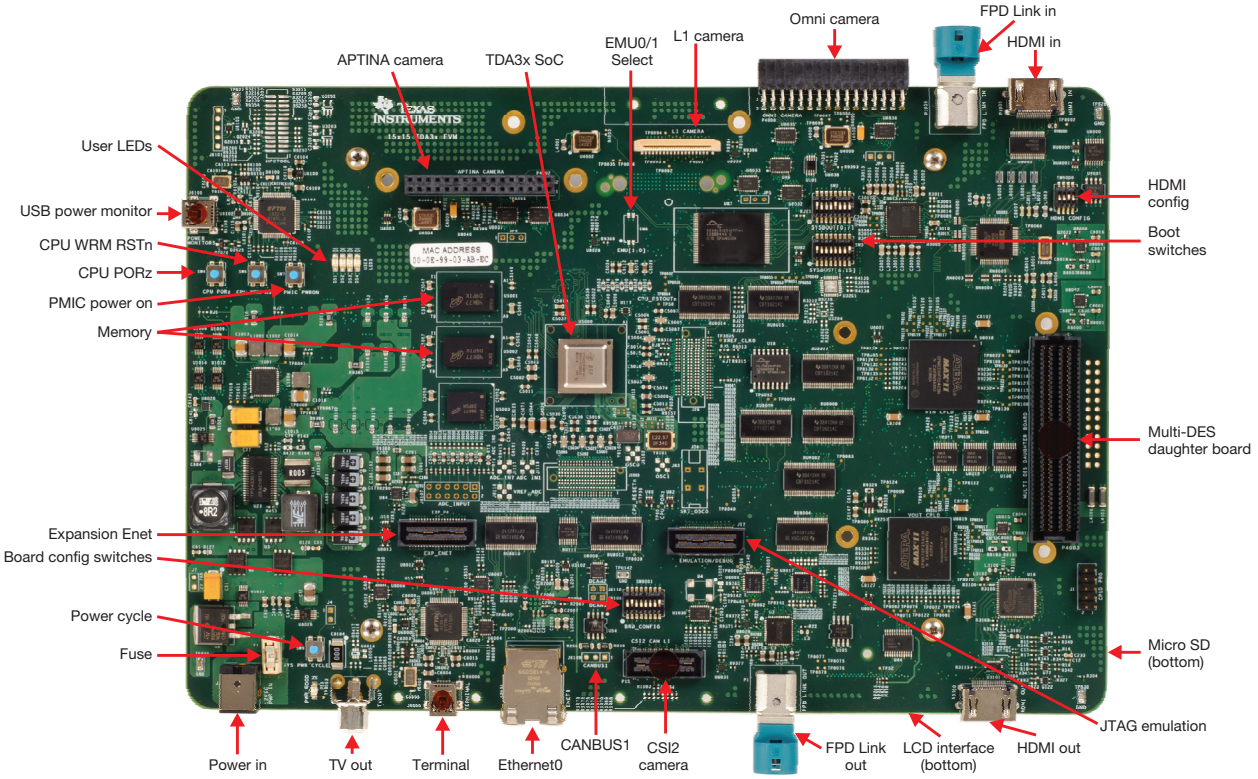


Figure 6. *TDA3x Evaluation Module (EVM).*

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