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AI evaluation boards with CAN connectivity

For four years, Nvidia offers several system-on-modules (SOM) with one or two CAN FD interfaces. The CAN FD protocol controllers support the time-triggered CAN (TTCAN) protocol extension. These SOMs are Jetson AGX Orin, Jetson Orin NX, Jetson Orin Nano, Jetson Xavier NX series, and Jetson AGX Xavier series.

The CAN protocol controller is part of Nvidia's system-on-chips. It supports CAN CC (classic) and CAN FD data frame formats with 11-bit and 29-bit CAN-Identifiers. In CAN FD mode the maximum data-phase bit rate is specified as 15 Mbit/s. Using the SN65HVD230 CAN transceiver piggy-back module by Waveshare enables transmission rates up to 5 Mbit/s depending on the used topology. These modules recommended by Nvidia are based on 3,3-V CAN FD transceiver chips by Texas Instruments. The nominal and the data-phase bit rates are configurable. The Jetson AGX Orin and the Jetson AGX Xavier board families come with two CAN ports accessible at the 40-pin header connector.

To start CAN communication, the user needs to load CAN kernel drivers in the right order. To use the network, the developer first brings up CAN nodes on the network and installs a group of CAN utilities for testing. Then he/she can transfer frames (loopback test) and debug the network interface, if necessary. Several other debugging techniques can be useful in appropriate cases:

- ◆ If a loopback test shows that the CAN controller is working correctly and it is still not possible to send or receive frames, try reconnecting the transceiver and confirm that the connections are correctly made.
- ◆ Check whether all of the steps necessary to enable CAN communication were done properly.
- ◆ Connect an oscilloscope and see whether the bus is behaving properly.

- ◆ If the device logs a "No buffer space available" message during transmission, enter the command `$ cangen -L 8 can0 -p 1000` to use the polling mechanism.

The user can obtain higher data bit rates by configuring the TDCR (transmission delay compensation register), but should make sure that the transceiver being used is able to support higher bit rates. Additionally, it is possible to change the CAN parent clock on T194 platforms (only on Jetson Xavier NX series and Jetson AGX Xavier series boards). On development cards with the T194 SOC, the CAN parent clock is PLL_C. The PLL_C clock's core clock frequency is set to 34 MHz. To set a higher clock frequency or to obtain a bit rate of exactly 1 Mbit/s, the user can enable the PLLAON clock and make it the parent clock of the MTTCAN protocol controller. ▶

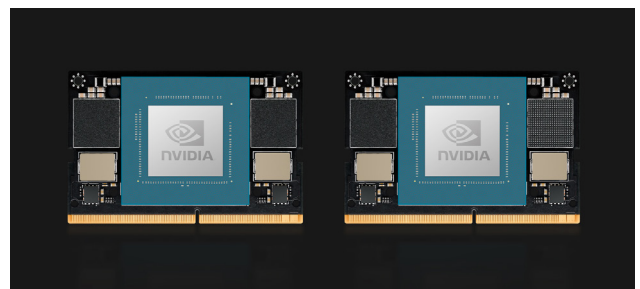


Figure 1: Jetson Orin Nano evaluation board (Source: Nvidia)

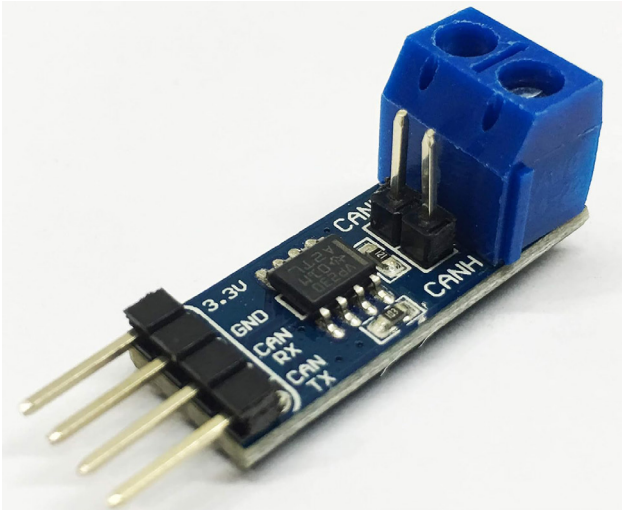


Figure 2: CAN transceiver piggy-back (Source: Waveshare)

Linux and QNX operating systems support Nvidia SOCs. Jetpack is a Linux-compliant software development kit (SDK) from Nvidia. Redhawk Linux is also available for the Jetson platform, accompanied by Nightstar real-time development tools, CUDA/GPU enhancements, and a framework for hardware-in-the-loop and man-in-the-loop simulations. The QNX operating system is also suitable for the Jetson platform. There are success reports of installing and running specific QNX packages on certain Jetson boards.

Developer kit for autonomous machines

Four years ago, the Jetson Xavier NX module, a platform to develop AI applications, has been launched. Using cloud-native technologies, developers can take advantage of the module's AI and compute performance in its credit-card-sized form factor. Manufacturers of smart machines and developers of AI applications can build and deploy software-defined features on embedded and edge devices targeting robotics, smart cities, healthcare, industrial IoT (Internet of Things), and more.

Sertac Karaman, associate professor of aeronautics and astronautics at the Massachusetts Institute of Technology, said: "The Jetson Xavier NX allows us to get higher performance within a tighter size and power budget, enabling innovative development of compact drones for a variety of practical applications. We believe the Jetson platform with cloud-native support is an important new development to help build and deploy future generations of autonomous machines."

The developer kit is smaller than a credit card (70 mm x 45 mm). It is powered by the Cuda-X computing stack and comprises the Jetpack SDK. It combines a reference module and carrier board with a Linux software development environment.

Two years ago, the Jetson AGX Orin developer kit followed. It is intended for advanced robotics, autonomous machines, and next-generation embedded as well as edge computing. The product delivers 275 trillion operations per second (TOPS), giving customers over eight times the processing power of its predecessor, Jetson AGX Xavier, while maintaining the same palm-sized form factor and pin

compatibility. It features an Ampere architecture GPU, Arm Cortex-A78AE CPUs, deep learning and vision accelerators, high-speed interfaces, faster memory bandwidth, and multi-modal sensor support to feed multiple, concurrent AI application pipelines.

"As AI transforms manufacturing, healthcare, retail, transportation, smart cities, and other essential sectors of the economy, demand for processing continues to surge," said Deepu Talla, vice president of Embedded and Edge Computing at Nvidia. "A million developers and more than 6000 companies have already turned to Jetson. The availability of Jetson AGX Orin will supercharge the efforts of the entire industry as it builds the next generation of robotics and edge AI products."

"With the global population expected to reach nearly 10 billion people by 2050, farmers have a steep challenge of feeding the world and they can't do it alone. With less available land and labor, and many variables to work through, deploying and scaling advanced technology like autonomy is key to building a continually smart, evolving and more efficient farm. Our fully autonomous tractor, featuring two Nvidia Jetson GPUs for quick and accurate image classification at the edge, will be on farms this year, supporting farmers in overcoming challenges and providing for our growing world," explained Jahmy Hindman, chief technology officer at John Deere.

"As a recognized medical technology leader, Medtronic continues to innovate and advance solutions to improve surgical patient care. We recognize the key role for AI in digitization of surgery through quantitative analytics and real-time clinical decision support systems. The latest Nvidia Jetson platform brings us a new level of computational performance in the operating room and enables us to advance intraoperative systems to better support surgeons, through data-enabled solutions," said Dan Stoyanov, chief scientific officer at Medtronic Digital Surgery.

One and a half year ago, the Jetson Orin Nano system-on-module that delivers up to eighty times the performance over the prior generation, has been introduced. It is also intended for entry-level edge AI and robotics. Now, the Jetson family spans six Orin-based production modules. This includes the Orin Nano — which delivers up to 40 TOPS of AI performance in the smallest Jetson form factor — up to the AGX Orin, delivering 275 TOPS for advanced autonomous machines. The product supports multimodal sensors and addresses Robotics Operating System (ROS) developers. ROS is a development environment, which supports CAN-based communication including CANopen CC (classic).

The Orin Nano modules are available in two versions. The Orin Nano 8GB delivers up to 40 TOPS with power configurable from 7 W to 15 W, while the 4GB version delivers up to 20 TOPS with power options as low as 5 W to 10 W. The Jetson Orin platform is designed to solve the robotics challenges and brings accelerated computing to over 700000 ROS developers. Combined with the powerful hardware capabilities of Orin Nano, enhancements in the latest Isaac software for ROS by Nvidia put more performance and productivity in the hands of roboticists. ◀

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