Quad-core Inverter
Smart and Powerful Inverter

The developments of inverter, UPS, EV charger and VFD are based on the developments of power device and control chip. From 2008 to 2018 the inverter's price has been reduced by more than 80%, yet the efficiency has been increased by more than 10%. These all depend on the improvements of power device and control chip.

For inverter control chip, Texas Instruments is No.1 in this area. To ensure the leading performance of chips in power electronic industry, TI has made a lot effort on design. DSP controller TMS320C200 is with built-in flash rom, high speed A/D converter, high speed I/O port, reliable CAN module, PWM controller, etc. Nearly all the necessary functions have been integrated. For the software part, TI used SVPWM, PID control, phase-sync loops, MPPT tracking and islanding detection. Further, TI designed a large amount of sample programs. And even for the inverter's topology and chip peripheral circuit design, TI provides designing principle and samples. With these software and hardware support, inverter manufacturer can quickly launch new products. For quite a while inverter only has one core chip, which is DSP.

The development of string inverters did not 100% follow TI's roadmap and it provides opportunities to other control chip suppliers. Firstly, power capacity of inverters grows larger and for low voltage 400V on-grid inverters, the maximum capacity could reach up to 80kW. Also, inverter has to manage more and more devices like panels, DC cables and even AC distribution cabinet and grid. Further, the communication functions become more powerful. Inverter needs multiple USB, RS485, RS232 ports to connect with computer, flash disk, data logger, meter and CT. In this case, one DSP is no longer enough. CPLD chips which is designed to handle complicated processing and ARM communication specified chips are now necessary.

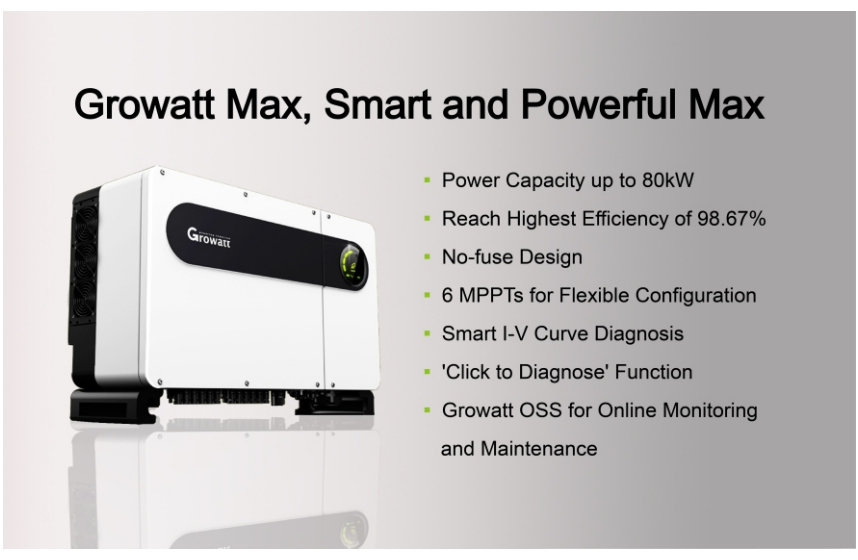
Power capacity has increased from 10kw to 80kw by eight times, but the volume increased from 43dm3 to 146 dm3 by only 3.4 times, which means the power density has increased by 1.86 times. The increasing power not only brings larger current but also the complexity of control algorithm. Take Growatt 80k inverter for example. With 6 MPPTs, it needs to control six different circuits and the controlling difficulty increased by six times.

More functions: string monitoring, I/V curve diagnosis, AFCI detection, panels PID healing, grid error recording, power factor adjustment and grid harmonics adjustment. With the development of solar industry these years, there are fewer and fewer suitable roofs with good grid environment. The installation environment become harsh with low PF or high harmonics. Inverter, as the only smart device in the solar system, needs to provide more added values to make PV industry more competitive, so that revenue from electricity bill is no longer the only income source.

DPS, CPLD and ARM are all embedded processors with calculation, storage and processing functions. With different expertise, they are for different applications.

DSP, digital signal processing expert, has got the most sufficient software instructions and focuses mostly on calculation. Growatt 80kw inverter has dual DSPs, one is for PV side MPPT and voltage boosting, the other is for AC side inverting, and they are independent but cooperative to enhance the system reliability.

CPLD is high speed programmable logic components with the fastest speed and hard ware algorithm. It can deal with multiple tasks simultaneously. For example, you have a solar system on roof of a factory that's with large overhead crane. Start and stop of the crane will lead to short-time high harmonics, and regular inverter cannot protect the IGBT within such short time and it will cause IGBT to blow. For Growatt Max series inverter, through DSP + CPLD combination along with inverter waveform tracing current limitation function, it can improve the acting speed for 10+ times. Therefore, Growatt Max can shut down the IGBT before electric surge.



ARM is the communication expert and is mainly used for task management. Nowadays more than 90% phones uses ARM architecture, just like TI. ARM provides a serial of communication solutions like SPI bus, 232 bus, 485 bus, USB bus and Ethernet bus. The data bus is separated from address bus in order to achieve quick information exchange between control chips, operation monitoring, data storage and external communication with higher data renew frequency and shorter software updating time.

Growatt Max series string inverter adopts a quad-core architecture with dual DSP, CPLD and ARM, which makes it more functional and reliable. To date, it has been widely used in many scenarios like Chengdu Shuangliu airport (high EMC requirement), Jiangsu Changzhou machine factory (high harmonics), Changchun Auto factory(ultra-low temperature), and Zhuhai water processing factory(high humidity). In these cases, the inverter works stably, generates high power, and perfectly handles various harsh climate environments and electrical environments.