

GreenPAK FAQ

Why should I consider GreenPAK™ for my next design?

The primary benefits for GreenPAK are:

1. **Flexibility:** because GreenPAK is programmed in minutes, your design can be quickly and easily changed to adapt to new requirements and correct system bugs. Changes that in the past would require a board spin can be made in minutes on your desktop.
2. **Low Power:** GreenPAK designs typically run at a few microamps in standby, and typically use less than 100 milliamps average in active mode. The architecture of each GreenPAK device is optimized to give you maximum control over power consumption.
3. **Small Size:** It is common that the circuitry replaced by GreenPAK is 5 – 10 times larger board area than the GreenPAK.

How should I pick the part that works best for my design?

The choice of the GreenPAK part depends on how many I/Os are required, functional blocks (ACMP, ADC, DCMP/PWM), accuracy and the price.

Do I have to program GreenPAK in production?

Renesas supports production programming of GreenPAK devices in quantities down to the order minimum quantity.

What does Renesas need from me to move into production on GreenPAK?

You need to provide a code file that you have approved for production.

If Renesas assists me with doing the design for GreenPAK, how long does it take to get the first version?

It is usually very quick. It can be as short as 24 hours, to as long as 2 weeks.

What is the maximum data rate of GreenPAK?

The maximum data rate is dependent on which internal blocks the signal will travel through. The fastest rate is through connection with no internal blocks (Input PIN -> Output PIN). The next fastest is Input PIN -> LUT -> Output PIN.

Can I apply a voltage higher than VDD on an input pin?

Yes, but not more than $VDD + 0.3\text{ V}$. Every IO pin is clamped by an ESD diode to VDD, so applying a higher voltage will result in excess current running through the protection diode.

What is the input impedance seen at the analog pin?

It depends on the analog block used and its configuration (buffer, low bandwidth, gain and so on). Allow for at least 0.1 μ A. due to leakage from ESD protection structure.

How is quiescent current defined, and how is it so low?

The quiescent current is defined as the current for the design when all inputs and outputs are static, and oscillator and analog blocks are in non-operational mode if they are used in the design. Very low current consumption is made possible by GreenPAK's capability to dynamically turn on oscillator and analog blocks for the time during which they are required, and then turn them off during periods they are not used in the design.

What is propagation delay time of GreenPAK?

This greatly depends on the design factors: blocks used, how many connections were made, VDD, operating temperature and so on. Please refer to the "Timing Estimator" section in the datasheet for more detailed information.

What is the state of the pins at power on and during the power on sequence?

All PINs are in High Impedance state at power on and during the power on sequence.

How does the part configure itself at start-up?

GreenPAK loads data bits from the Non-Volatile Memory (NVM) to an SRAM register array during the start-up process, which configures all blocks and connections.

What type of Non-Volatile Memory (NVM) is onboard?

The NVM is one-time programmable (OTP) memory using the OTP Fuse from TSMC's 0.18 μ m 1.8 V / 5 V Logic process. Programming is done via hot electron injection generated by avalanche impact ionization in the bit cell.

How can the Dev board emulate the design if the part is OTP?

The chip has NVM memory that is used for storing data when it is turned off and is one-time programmable. After powering up the data is being copied to the register (buffer), from where it is used to configure the chip. In the emulation mode the NVM is not used, chip configuration is being directly written to the buffer. So, even the chip is one-time programmable, using of emulation mode practically does not have restrictions.

Can I purchase GreenPAK devices and program them myself?

Some GreenPAK devices use One Time Programmable (OTP) memory, and some of the parts use Multi-Time Programmable (MTP) memory for non-volatile storage of configuration data.

All devices that have MTP memory also support In-System Programming (ISP), so these devices can be mounted to the board and programmed in a subsequent manufacturing step. Therefore, Renesas does support purchasing blank GreenPAK that include In-System Programming (ISP).

While it is physically possible to also program the OTP based devices, this programming will require applying high voltages (7.5 V), as well as specific signal sequences and clocking on the pins, which will require extensive modification to the target board. There are also no commercially available production programming solutions that will support GreenPAK devices. For these reasons, Renesas does not recommend for customers to buy blank OTP devices.

Can I solder blank parts on my board and then program the One Time Programmable (OTP) memory NVM?

While it is physically possible to also program the OTP based devices, this programming will require applying high voltages (7.5 V), as well as specific signal sequences and clocking on the pins, which will require extensive modification to the target board. There are also no commercially available production programming solutions that will support GreenPAK devices. For these reasons, Renesas does not recommend for customers to buy blank OTP devices.

The NVM is read each time the part powers up, so how many read cycles can the NVM reliably perform in its lifetime?

NVM testing is performed as part of the device qualification and quarterly thereafter as part of the ongoing reliability monitor. The testing is performed in accordance with JESD22-A103 condition B, 1000 hours @ +150 °C. To date 1,815,000 device hours have been accumulated with no failures. Assuming an in-use temperature of +25 °C and a 90 % confidence interval there would be less than 1 failure for every 1,000,000,000 device hours.

What sort of data is there concerning environmental effects (Temperature, radiation, etc.) on NVM reliability and lifetime?

Temperature effects have been studied as outlined above. No MIL-STD_883 M1032 radiation testing has been conducted.

What is the Export Control Classification Number (ECCN) for GreenPAK parts?

GreenPAK products are used on commercial/consumer application only and are not on the commerce control list, therefore are designated as EAR99.

What are the HTS codes for GreenPAK parts?

- ICs - 8542.39.0000
- Boards - 8452.31.0000

How to read the marking on IC package?

Please check the product datasheet on individual part numbers for the Package Top Marking System Definition.

Revision History

Revision	Date	Description
1.00	Mar 3, 2022	Initial release.