

November 8, 2019

## GENERAL

### **Q1) What is the maximum temperature for Tekmos High Temperature ICs?**

Tekmos has two types of high temperature offerings: Bulk Silicon and SOI. The first is pushing bulk silicon substrate devices to the temperatures where leakage becomes excessive, slightly over 200°C. The second, newer SOI processing yields devices that will work to over 300°C.

### **Q2) What is the history of Tekmos in the high temperature market?**

Tekmos has been developing libraries and related technologies for high temperature applications since 2010. Our 175°C TK68HC811E2 began production in 2014. Our first 250°C custom ASIC was shipped in 2012. There are currently multiple high temperature products in design and manufacture at Tekmos: EEPROMs, FPGAs, ASICs, and microcontrollers. We presented papers at the International Conference on High Temperature Electronics in 2013, 2014, and 2015.

### **Q3) How does SOI differ from older silicon technologies?**

SOI is an acronym for Silicon On Insulator. The more commonly used CMOS (Complementary Metal Oxide Semiconductor) technology inherently has a path for current leakage through the bulk semiconductor. Since SOI does not have this path, the leakage will be significantly less. This leakage results in excessive current. With the typical semiconductor, the leakage becomes so large around 200-225°C that the devices no longer work. While there are other leakage paths in SOI technology, they are usually not a problem until temperatures reach about 300°C or greater.

### **Q4) What are the temperature limits of SOI technology?**

We will not know the practical temperature limits of SOI until more data is taken. Tekmos has tested product up to 320°C. Leakage tends to dominate at this temperature. Bulk silicon devices reach this same performance point at about 220°C.

### **Q5) Can I do small runs for ROM or other ASIC?**

Tekmos has a long history of small runs for ROMs and ASICs. While higher volume production is inherently more efficient because of economy of scale, low volumes can be supported in our program.

### **Q6) Does Tekmos perform the wafer fab, assembly, and testing of its products?**

Tekmos is a fabless semiconductor company. We design our own products as well as implement and manufacture for other companies. We ship parts ready for use. The actual processing of silicon and the packaging of the devices is subcontracted to other companies. We do all design, final testing, special testing upon request, life testing, burn-in, baking, and reliability studies at our facility located in Austin, Texas. This allows us to have access to a wider variety of processes and packages and to concentrate on our core competencies.

### **Q7) Which foundries does Tekmos use for SOI processing?**

Tekmos uses the XI10 process at X-Fab for SOI processing. Most of the industry uses the XI10 process for SOI. It is 1.0 micron, which does restrict the maximum speed for designs. This process is presently sole-sourced.

## TECHNOLOGY

### **Q8) How does temperature affect performance?**

Everything works slower at elevated temperature. With the 1.0 micron SOI process, the maximum speed at 250°C at 5 volts is around 15MHz. The same part at 3.3 volts will work to about 7MHz. These rule of thumb numbers are approximate.

### **Q9) What is the lifetime of the devices at temperature?**

Lifetime is a function of operating temperature, processing, process, and packaging. Tekmos has run bulk silicon devices for 4000 hours at 208°C without failure. Our SOI devices have been run for 2000 hours at 270°C without any failures.

### **Q10) What does voltage do to performance at temperature?**

Performance generally varies with the square of the voltage; Temperature does not change this effect. This means, in approximate numbers, that a 5 volt design will work about twice as fast at 3.3 volts. This relationship is maintained over the temperature range.

## RELIABILITY / CERTIFICATIONS / WORKING TOGETHER

### **Q11) Is Tekmos ISO certified?**

Yes. Tekmos is a BSI ISO 9001:2008 registered company and is committed to quality excellence. That commitment is employed through a Quality Management System of the design, test, packaging and shipping of semiconductors. Outsourced activities for high temperature devices include wafer fabrication, and device assembly.

### **Q12) What type of reliability data is available for bulk silicon devices?**

Tekmos continuously collects reliability data on its parts. It is available upon request.

### **Q13) What other certifications does Tekmos have now or is planning for in the future?**

Tekmos also has ISO14001 environmental certification. We are working on the AS9100 aerospace certification.

### **Q14) Can I schedule a conference call to discuss Tekmos product roadmaps and my specific requirements?**

Yes. Tekmos welcomes discussion of roadmaps and your specific requirements.

### **Q15) Can I schedule a visit to meet with Tekmos at its headquarters?**

Yes. Many customers find it quite useful to discuss their projects and review any unusual features of their products in person before the project is started at Tekmos.

### **Q16) Can customers be actively involved in the design/conversion process?**

Yes, we prefer it. Designs are so complicated that the interpretation of specifications is best done as a collaborative task. Additionally, in the process of preparing a design for fabrication, additional features and functions can be included if customer engineering is working closely with Tekmos engineering.

### **Q17) What does it take to have a plant inspection?**

Tekmos welcomes customer visits. Contact Tekmos Sales ([sales@tekmos.com](mailto:sales@tekmos.com)). Many customers have visited to simply meet the team, to have design discussions, or to conduct quality audits.

**Q18) What are the performance monitors that Tekmos puts on its devices?**

Tekmos routinely adds performance monitors in the form of ring oscillators to designs. These oscillators are sensitive to a variety of processing parameters and can give reliability information much better than a mere pass/fail criteria. Threshold shift and hot electron injection can be detected as parts are subjected to accelerated aging even when the device being tested has not had a hard failure. These structures give more information than regular life tests.

**PACKAGING****Q19) What high temperature packaging options are available?**

High temperature parts are available in ceramic packages or as bare die. Bulk silicon devices are bonded with aluminum wires to aluminum pads. For SOI device, we can optionally use gold, nickel palladium pads and gold wire bonding.

**80H51****Q20) What is the maximum speed of the Tekmos 80H51?**

We expect the maximum clock frequency of 20MHz at 5 volts for 250°C operation. The Tekmos SOI 80H51 is still in development, using the design proven at lower temperatures in bulk silicon. It will likely function slower at 300°C with significant leakage.

**Q21) What variations of the 80H51 are available?**

The Tekmos standard 80H51 contains an ADC, an SPI port, and a bootstrap mode; features that are not available on standard 8051 parts. Other special circuitry could be included in a development for special applications.

**Q22) What memory can I use with the 80H51?**

The internal ROM is usually sufficient. External RAM may be used if rated for the system operating temperature.

**Q23) What is your Bootstrap Mode and why might I need it?**

The bootstrap mode in the Tekmos high temperature 80H51 allows download to RAM, if the application allows.

**Q24) Is your TK68HC811E2 the same as the Freescale part?**

It is functionally the same.

**Q25) Do you have (or will you have) ARM processors?**

ARM processors are available under licensing.

**Q26) Is it possible to get custom versions of the Tekmos 80H51?**

Many of Tekmos designs have evolved into new versions. The considerations include the technical aspects of the change as well as the cost of the change, potential volume, and whether there is a general interest in the proposed variation.

**Q27) Can the Tekmos 80H51 be purchased as known good die?**

Yes. Many of the Tekmos parts are available as good die.

**Q28) Can I obtain a data sheet for the 80H51?**

Yes. It is on our website ([www.Tekmos.com](http://www.Tekmos.com)).

**HIGH TEMPERATURE ASICS****Q29) When will Tekmos be ready to start high temperature ASIC designs?**

Tekmos is currently producing 250°C ASICs.

**Q30) What does the customer need to provide for Tekmos to generate a 250°C ASIC?**

The information needed to develop an ASIC for high temperature is the same as for lower temperature. In fact, designs that are currently in standard processing with basic silicon substrate can be converted to high temperature SOI ASICs. Design files, netlist, vectors, other specifications, etc. are necessary. It is best to have a conversation between the customer engineer and a Tekmos engineer before starting this process. Contact [sales@tekmos.com](mailto:sales@tekmos.com) for more information.

**HIGH TEMPERATURE EEPROM****Q31) What is the maximum operation temperature of the Tekmos EEPROM?**

The Tekmos High Temperature EEPROM is processed using the Bulk Silicon approach to high temperature devices. It is rated for 200°C operation.

**Q32) How large will the Tekmos High Temperature EEPROM memory be?**

The memory size will be 256k bits.

**Q33) What data retention is expected with the Tekmos EEPROM at maximum rated temperature?**

The device uses refresh and bit swapping which will result in a long, indefinite data retention.

**BUSINESS****Q34) What is Tekmos's history?**

Tekmos has been in the business of microcontrollers, conversion from FPGAs to gate arrays, and development of legacy replacement parts since 1997. The emphasis on high temperature devices is an extension of our technical expertise in design.

**Q35) When can I obtain samples of devices?**

The TK68HC811E2, TK15530, and TK74H373 are available now. High temperature SOI ASICs can be started now.

**Q36) What is the lead time for production deliveries?**

Seventeen weeks.

**Q37) Who do I contact to order samples, get a price quotation, or ask technical support questions?**

Please contact us at: [sales@tekmos.com](mailto:sales@tekmos.com).