

Radiation Hardened and Radiation Tolerant Solutions

Microprocessors | Microcontrollers | Memories
Interfaces and Connectivity





Commitment to Space and High Reliability

Microchip's portfolio is the broadest portfolio for Space solutions and represents more than 60 years of Flight Heritage. Throughout all our different product lines, Microchip is proud to have been embedded in over 90 Space missions.

With over 35 years of experience in the space industry from Atmel heritage, Microchip Aerospace and Defense France Product line is committed to support the space industry, delivering high-end solutions and services and continue investing and developing new solutions for the global space market from traditional to New Space challenges.

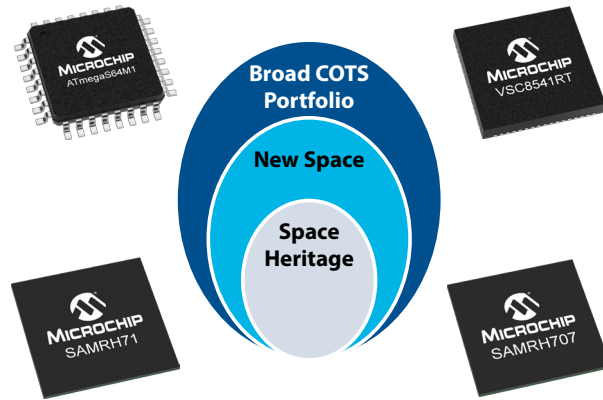
Microchip's Space Integrated Circuits portfolio is the most attractive and competitive on the market, including:

- AVR®, SPARC® and Arm® Microcontroller and Microprocessors
- Rad Hard and Rad Tolerant Memories, SRAM and EEPROM
- Interfaces and Connectivity solutions like Ethernet

Microchip ADG Product line is using a qualified supply chain in Europe. With unrivalled Sparc Processors flight heritage, Microchip is a key contributor to the European space ecosystem, delivering European and ESCC-qualified solutions. We are increasing this European footprint in space with a wide range of new solutions under European export control, funded by local space agencies in Europe, such as ESA, CNES and DLR.

Unique Scalable Solutions

The accelerating deployment of large constellations of low earth orbit (LEO) satellites, CubeSats and NanoSats is transforming how the space industry looks at its supply chain and component reliability requirements.

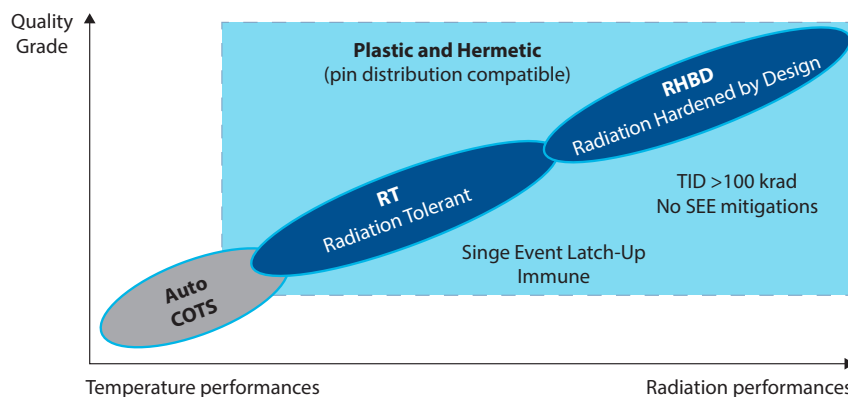


Microchip's commercial leadership: our new space offering is based on very high-volume COTS, Microchip is also recognized as a MCU and FPGA Market leader, as well as a leader in Connectivity, Ethernet domains. Second, is Microchip's longevity and leadership in Space:

- Market Leader
- More than 60 years of Flight heritage
- A recognized and qualified portfolio
- A strong expertise in radiation and a recognized qualified portfolio

Microchip is proposing a unique scalable approach. For example, a "COTS to Rad Tolerant" device is a version of the original COTS design that includes radiation improvements to provide full Latchup immunity in space. The devices were not initially designed for this environment but are selected to achieve between 20Krad to 50Krad radiation tolerance and then packaged either in ceramic (under a QML equivalent flow) or plastic (under a high reliability quality flow) that provides the optimal qualification level at limited cost with full traceability. This second option could even be extended to target COTS to Rad Hard devices. Component suppliers can reuse advanced COTS architectures and proven designs to create Rad Hard solutions that reach >100 Krad radiation immunity with a low SEU error rate. With this COTS upgrade approach, both RT and RHBD devices become part of the same device ecosystem as the initial COTS device.

- Latch-up immune with a SEL LET > 60 Mev
- Minimum TID 30 Krad
- Full characterization TID and SEU for all functional blocks available in a Radiation report
- Safety dedicated application note for system mitigation (hard and soft)





Broad Range of Processing Solutions

For more than three decades, we have been providing leading-edge, highly integrated microcontrollers solutions for a wide variety of space applications.

Microchip proposes scalable solutions from our latest innovative automotive COTS devices to radiation-hardened (rad-hard), radiation-tolerant (rad-tolerant) and high-reliability (high-REL) versions with proven, long-term reliability.

We adapt, such as 8-bit AVR microcontrollers (MCUs) and SAM Arm core-based MCUs and MPUs. This portfolio of solutions will reduce your costs, speed up your time to market and improve the performance of your critical systems.

Rad-Tolerant MCUs and MPUs

Our rad-tolerant portfolio is based on our widely deployed commercial AVR, Arm® and DSPIC devices. Featuring proven and industry-leading cores and peripherals, these rad-tolerant devices are robust against radiation effects and insure latch up immunity and non-destruction in critical environments.

- ATmegaS128 8-bit AVR-based MCU
- ATmegaS64M1 8-bit AVR-based MCU
- SAMV71Q21RT Arm Cortex-M7 based MCU
- SAM3X8ERT Arm Cortex-M3 based MCU

Rad-Hard MCUs and MPUs

Our SPARC® processor-based MPUs have an unrivaled flight heritage and we continue to meet the advanced requirements of a new generation of space applications with our Arm Cortex® core-based rad-hard solutions:

- SAMRH707F18 Arm Cortex-M7-based Microcontrollers (MCUs)
- SAMRH71F20 Arm Cortex-M7-based processors
- AT697F SPARC v8-based processors



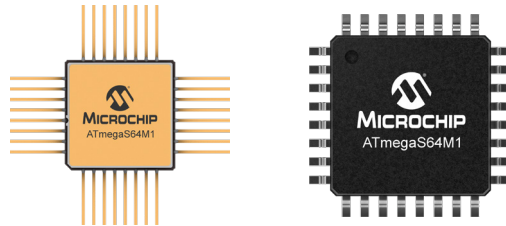
Rad-Tolerant MCUs and MPUs

Rad-Tolerant 8-bit AVR Microcontroller: ATmegaS128/ATmegaS64M1

Microchip brings the automotive-leading high performance and low power 8-bit AVR core to the aerospace industry. ATmegaS128 and ATmegaS64M1 are processed for enhanced radiation, extended temperature, and increased reliability in critical aerospace applications.

It takes advantage of mature Atmel AVR tools designed and used in the mass market worldwide for many years and is ideal for small footprint and low power applications like motor control and remote terminal units.

- **ATmegaS128** features 10-bit ADC, 6 PWM channels and UART/TWI/SPI interfaces.
- **ATmegaS64M1** integrates CAN controller, power stage controller, ADC, DAC and analog comparators

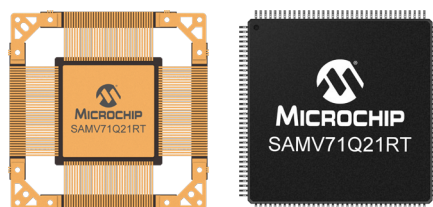


Rad-Tolerant 32-bit ARM Microcontroller: SAM3X8ERT/SAMV71Q21RT

This Rad-Tolerant ARM-based Microcontrollers family provides the best combination of connectivity interfaces along with the highest processing levels. With SAMV71Q21RT, customers will take advantage of the powerful M7 core coupled with high bandwidth communication interfaces such as CAN FD and Ethernet TSN.

- **SAM3X8ERT, 32-bit ARM Cortex-M3** core-based features dual-bank Flash, dual-bank SRAM, dual CAN2.0B and error code correction (ECC) on dual-bank Flash and external memory interface for system risk mitigation. SAM3X8ERT also features Ethernet 10/100 with dedicated DMA, a 12-bit ADC/DAC, temperature sensor, 32-bit timers, PWM timer and RT
- **SAMV71Q21RT, 32-bit ARM Cortex-M7** core-based MCU, allows deterministic code execution using TCM, complex calculation and coprocessing (FPU), communication threads parallelism (Hmatrix architecture), low latency memories access, scalable power saving modes and operating system free RTOS supported.

Product	CPU	Max Operating Freq (MHz)	Flash (Kbytes)	Operating Voltage	Total Ionizing Dose (TID)	Single Event Latchup (SEL)	Temp Min (°C)	Temp Max (°C)	Packages
ATmegaS128	AVR® 8-bit	8	128	3.3V	30 kRad	>62.5 MeV.cm ² /mg	-55	+125	64\CQFP 64\TQFP
ATmegaS64M1	AVR 8-bit	8	64	3.3V	30 kRad	>62.5 MeV.cm ² /mg	-55	+125	32\CQFP 32\TQFP
SAM3X8ERT	Arm® Cortex®-M3	84	512	3.3V	30 kRad	>62.5 MeV.cm ² /mg	-40	+105	144\CQFP 144\LQFP
SAMV71Q21RT	Arm Cortex-M7	300	2048	3.3V	30 kRad	>62.5 MeV.cm ² /mg	-55	+125	144\CQFP 144\LQFP



Rad-Hard MCUs and MPUs

Microchip's space microprocessors, based on the SPARC architecture with worldwide sales of over 4,000 flight models with the TSC695 and over 5,000 combined flight models with the AT697F, are proud of this unrivalled flight heritage.

Microchip has also introduced the Arm core-based solution with Arm Cortex M7 Core running up to 100 MHz delivering up to 200 DMips.

The **SAMRH71** and **SAMRH707** are **radiation hardened processing units ICs** providing the best combination of space connectivity interfaces along with high processing power.

The SAMRH71 and SAMRH707 are designed for high level radiation performances, extreme temperature, and high reliability in aerospace application. It takes advantage of the powerful ARM Cortex M7 coupled with high bandwidth communication interfaces such as SpaceWire, MIL-STD-1553, CAN FD and Ethernet with TSN capabilities.

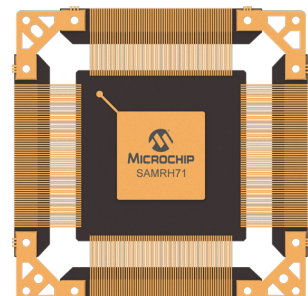
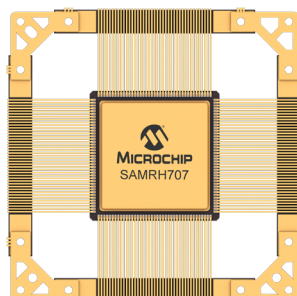
The SAMRH707 is embedding also advanced analog functions with 12-bit ADC and DAC.

- Arm Cortex-M7 > 200 DMIPS
- SEL >78 MeV.cm²/mg & TID>150 kRad
- Mil-Std-1553
- Spacewire
- Ethernet - gptp
- CAN FD
- 12-bit ADC (1 Msps)
- 12-bit DAC
- NVM

Easy evaluation with the [SAMRH71F20-EK](#) or [SAMRH707-EK](#) hardware development platform

Supported by [MPLAB® X IDE](#) and [MPLAB Harmony](#).

Product	CPU	Max Operating Freq (MHz)	Flash (kBytes)	SRAM (kBytes)	Operating Voltage	TID - Total Ionizing Dose	SEL - Single Event Latchup	Temp Min (°C)	Temp Max (°C)	Packages
AT697F	Leon2-FT - Sparc V8	100	0	0	1.8V Core/ 3.3V IO	300 kRad	>95 MeV.cm ² /mg	-55	+125	256\CQFP
AT7913E	Leon2-FT - Sparc V8	50	0	64	1.8V Core/ 3.3V IO	300 kRad	>95 MeV.cm ² /mg	-55	+125	352\CQFP
AT7991	Leon2-FT - Sparc V8	87	0	0	1.8V Core/ 3.3V IO	300 kRad	>62.5 MeV.cm ² /mg	-55	+125	352\CQFP
SAMRH71	Arm® Cortex®-M7	100	128	1024	1.8V Core/ 3.3V IO	100 kRad	>78 MeV.cm ² /mg	-55	+125	256\CQFP\ BGA
SAMRH707	Arm Cortex-M7	50	128	384	1.8V Core/ 3.3V IO	100 kRad	>78 MeV.cm ² /mg	-55	+125	164\CQFP 484\BGA



Leading-Edge Memory Solutions

As a leading supplier of memory products, we offer a portfolio of devices that have been developed through years of research and testing so that they are ready to withstand the harsh environments found in space applications. Some of these devices have been in production for more than 25 years, and they are backed by our client-driven obsolescence practice of continuing to supply a product for as long as possible.

Rad-Tolerant Memories

Our rad-tolerant portfolio is based on our widely deployed commercial and automotive memories. Featuring industry-proven technologies, these rad-tolerant devices stand up against radiation effects and insure latch up immunity and survivability in critical environments.

- SST26LF064RT 64 Mb Serial Flash
- SST38LF6401RT 64 Mb Parallel Flash
- AT17LV010 1 Mb Serial EEPROM
- AT28C010 1 Mb Parallel EEPROM

Rad-Hard Memories

With our flight heritage of space applications based on SRAM memories, we support the space industry's requirements for robust devices that can withstand radiation effects. These products also feature optimized power consumption and are available in small-footprint packages.

- AT65609 1 Mb SRAM
- AT60142 4 Mb SRAM
- AT68166 16 Mb SRAM
- AT7910 4 Mb Serial EEPROM



Product	Memory Type	Memory Size	Memory Organization	Access Time/ Frequency	Operating Voltage	TID - Total Ionizing Dose	SEL - Single Event Latchup	Temp. Min (°C)	Temp. Max (°C)	Packages
AT60142H	SRAM	4 Mbits	512k x8	15 ns	3.3V	300 kRad	>80 MeV.cm ² /mg	-55	+125	36\CDFP
AT60142HT	SRAM	4 Mbits	512k x8	17 ns	3.3V	300 kRad	>80 MeV.cm ² /mg	-55	+125	36\CDFP
AT68166H	SRAM	16 Mbits	512k x32	18 ns	3.3V	300 kRad	>80 MeV.cm ² /mg	-55	+125	68\CQFP
AT68166HT	SRAM	16 Mbits	512k x32	20 ns	3.3V	300 kRad	>80 MeV.cm ² /mg	-55	+125	68\CQFP
AT69170F	EEPROM (Serial)	4 Mbits	4M x1	400 kHz (TWI)	3.3V	20 kRad/ 60 kRad (unbiased)	>95 MeV.cm ² /mg	-55	+125	18\CERDIP
AT17LV010-10DP	EEPROM (Serial)	1 Mbits	1M x1	400 kHz (TWI)	3.3V	20 kRad/ 60 kRad (unbiased)	>80 MeV.cm ² /mg	-55	+125	28\CDFP
AT28C010-12DK	EEPROM (Parallel)	1 Mbits	128k x8	120 ns	5V	10 kRad/ 30 kRad (unbiased)	>80 MeV.cm ² /mg	-55	+125	32\CDFP
SST26LF064RT	Flash (Serial)	64 Mbits	16M x4/ 64M x1	80MHz (QSPI)	3.3V	50kRad	>78 MeV.cm ² /mg	-55	+125	8\CDFP 8\SQIJ
SST38LF6401RT	Flash (Parallel)	64 Mbits	4M x16	90 ns	3.3V	50 kRad	>78 Mev	-55	+125	48\MFPF 48\TSOP





Connectivity and Interfaces

From supporting sophisticated connectivity protocols to offering simpler interface options, our comprehensive solutions enable you to develop robust and highly reliable embedded systems with SpaceWire solutions, MIL-STD1553 solutions and Ethernet solutions.

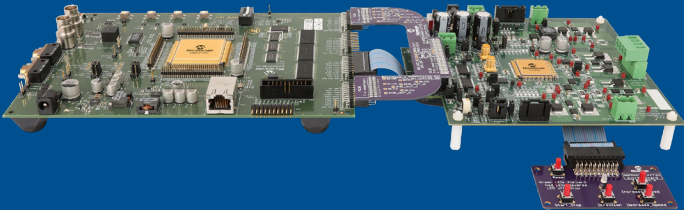
- AT7910 SpaceWire routing switch
- VSC8541RT 1 Port GbE Cu PHY with SyncE, (R/G/RG)MII
- VSC8540RT 1 Port FE Cu PHY with SyncE, (R/RG)MII
- VSC8574RT 4 ports GbE Cu/Fiber PHY with (Q)SGMII & IEEE1588

Space System Design with Microchip

We offer a wide range of mission and application-specific solutions. On-board Computing, Motor Control, Telemetry Tracking and Control, and Guidance and Navigation are all examples of Microchip's solutions that deliver complete end-to-end performance. If your system requires processing, interface, control, communications, RF, time and frequency, or power delivery, we offer complete confidence in the reliability and performance required to accomplish your mission.

Microchip also has support from FAEs around the globe, and an in-house team of radiation effects experts for modeling, simulation, and testing

We also offer a suite of system use case examples, evaluation cards, software IP and IDE that provide our clients with the capability to begin their designs with unprecedented speed like Motor Control, In-Flight Reprogramming, as well as Telemetry Control and more.



Motor Control with SAMRH71 and LX7720



Ordering Information

Most of our space solutions has been developed in France and delivered from France under classification number FR3A001.a.2.c. All the information related to export control can be found here: <https://www.microchip.com/exportcontroldata/>

Rad-Hard and Rad-Tol MCUs and MPUs

Family	Description	CPN	Quality Grade	MOQ
ATmegaS128	8-bit AVR®	ATmegaS128-ZC-E	Engineering samples	1
		ATmegaS128-ZC-MQ	MQ	5
		ATmegaS128-ZC-SV	SV	5
		ATMEGAS128-MD-HP	Hirel Plastic	270
ATmegaS64M1	8-bit AVR	ATmegaS64M1-KH-E	Engineering samples	1
		ATmegaS64M1-KH-MQ	MQ	5
		ATmegaS64M1-KH-SV	SV	5
		ATMEGAS64M1-MA-HP	Hirel Plastic	250
AT697F	32-bit SPARC® V8	5962-0722402QYC	QML-Q	5
		5962-0722402VYC	QML-V	5
		5962R0722402VYC	QML-V RHA	5
AT7913E	32-bit SPARC V8 SpaceWire	5962-10A0301QZC	QML-Q	5
		5962-10A0301VZC	QML-V	5
AT7991E	32-bit SPARC V8 GNSS Baseband	AT7991E-YF-MQ	MQ	1
		AT7991E-YF-SV	SV	1
SAM3X8ERT	32-bit Arm® Cortex®-M3	SAM3X8ERT-DHB-E	Engineering samples	1
		SAM3X8ERT-DHB-MQ	-MQ	5
		SAM3X8ERT-DHB-SV	-SV	5
		SAM3X8ERT-H8X-HP	Hirel Plastic	240
SAMV71Q21RT	32-bit Arm Cortex-M7	SAMV71Q21RT-DHB-E	Engineering samples	1
		SAMV71Q21RT-DHB-MQ	MQ	5
		SAMV71Q21RT-DHB-SV	SV	5
		SAMV71Q21RT-H8X-HP	Hirel Plastic	240
SAMRH71	32-bit Arm Cortex-M7	SAMRH71F20E-7GB-E	Engineering samples	1
		SAMRH71F20E-EK	Evaluation kit	1
		SAMRH71F20E-7GB-MQ	MQ	5
		SAMRH71F20E-7GB-SV	SV	5
		SAMRH71F20E-7GB-SR	RHA equivalent	5
		951200602	ESCC QML	5
		951200602R	ESCC QML RHA	5
		SAMRH71F20E-HFB-HP	Hirel Plastic	40
SAMRH707	32-bit Arm Cortex-M7	SAMRH707F18B-DRB-E	Engineering samples	1
		SAMRH707F18B-EK	Evaluation kit	1
		SAMRH707F18B-DRB-MQ	MQ	5
		SAMRH707F18B-DRB-SV	SV	5
		SAMRH707F18B-DRB-SR	RHA equivalent	5
		SAMRH707F18B-4QB-HP	Hirel Plastic	40

Memories

Family	Description	CPN	Quality Grade	MOQ
65609E	SRAM 128K x 8	5962-0250101QXC	QML-Q	5
		5962-0250101VXC	QML-V	5
		5962R0250101VXC	QML-V RHA	5
		MMDJ-65609EV-40-E	Engineering samples	1
65609EHV	SRAM 128K x 8	5962-8959849QTC	QML-Q	5
		5962-8959849VTC	QML-V	5
		5962R8959849VTC	QML-V RHA	5
		AT65609EHV-DJ40-E	Engineering samples	1
AT60142H	SRAM 512K x 8	5962-0520804QYC	QML-Q	5
		5962-0520804VYC	QML-V	5
		5962R0520804VYC	QML-V RHA	5
		AT60142H-DS15M-E	Engineering samples	1
AT60142HT	SRAM 512K x 8	5962-0520803QYC	QML-Q	5
		5962-0520803VYC	QML-V	5
		5962R0520803VYC	QML-V RHA	5
		AT60142HT-DS17M-E	Engineering samples	1
AT68166H	SRAM 4* 512K x 8	5962-0622906QYC	QML-Q	5
		5962-0622906VYC	QML-V	5
		5962R0622906VYC	QML-V RHA	5
		AT68166H-YS18-E	Engineering samples	1
AT68166H	SRAM 4* 512K x 8 (20 ns)	5962-0622908QXC	QML-Q	5
		5962-0622908VXC	QML-V	5
		5962R0622908VXC	QML-V RHA	5
		AT68166H-YM20-E	Engineering samples	1
AT68166HT	SRAM 4* 512K x 8	5962-0622905QYC	QML-Q	5
		5962-0622905VYC	QML-V	5
		5962R0622905VYC	QML-V RHA	5
		AT68166HT-YS20-E	Engineering samples	1
AT68166HT	SRAM 4* 512K x 8 (25 ns)	5962-0622907QXC	QML-Q	5
		5962-0622907VXC	QML-V	5
		5962R0622907VXC	QML-V RHA	5
		AT68166HT-YM25-E	Engineering samples	1
AT17LV010	EEPROM Serial 1M x 1	AT17LV010-10DP-E	Engineering samples	5
		AT17LV010-10DP-MQ	MQ	5
		AT17LV010-10DP-SV	SV	5
		AT17LV010-10JU-HP	Hirel Plastic	1
AT28C010	Paralell EEPROM 128K x 8	AT28C010-12DK-E	Engineering samples	1
		AT28C010-12DK-MQ	MQ	5
		AT28C010-12DK-SV	SV	5
AT69170F	Serial EEPROM 4M x 1	AT69170F-DT-E	Engineering samples	1
		AT69170F-DT-MQ	MQ	5
		AT69170F-DT-SV	SV	5
SST38LF6401RT	Flash Serial 64 Mb	SST38LF6401-90-RT/3YB-E	Engineering samples	1
		SST38LF6401-90-RT/3YB-MQ	MQ	5
		SST38LF6401-90-RT/3YB-SV	SV	5
		SST38LF6401-90-RT/TV-HP	Hirel Plastic	288
SST26LF064RT	Flash Serial 64 Mb	SST26LF064-80-RT/HHB-E	Engineering samples	1
		SST26LF064-80-RT/HHB-MQ	MQ	5
		SST26LF064-80-RT/HHB-SV	SV	5
		SST26LF064-80-RT/SM-HP	Hirel Plastic	270



Interfaces and Connectivity ICs

Family	Description	CPN	Quality Grade	MOQ
AT7910	Spacewire Router Compliant with ECSS-E-ST-50-12C	AT7910E-KB-ER	Engineering samples	1
		AT7910E-KB-MQR	MQ	5
		AT7910E-KB-SVR	SV	5
VSC8540RT	1 Port FE Cu PHY with SyncE, (R/RG)MII	VSC8540WZBRT-E	Engineering samples	1
		VSC8540WZBRT-MQ	MQ	5
		VSC8540WZBRT-SV	SV	5
		VSC8540XMVRT-HP	Hirel Plastic	260
VSC8541RT	1 Port GbE Cu PHY with SyncE, (R/G/RG)MII	VSC8541WZBRT-E	Engineering samples	1
		VSC8541WZBRT-MQ	MQ	5
		VSC8541WZBRT-SV	SV	5
		VSC8541XMVRT-HP	Hirel Plastic	260
VSC8574RT	4 ports GbE Cu/Fiber PHY with (Q)SGMII & IEEE1588	VSC8574RT-7GB-E	Engineering samples	1
		VSC8574RT-7GB-MQ	MQ	5
		VSC8574RT-7GB-SV	SV	5
		VSC8574RT-XKS-HP	Hirel Plastic	90

Aerospace and Defense hotline: <https://microchipsupport.force.com/s/>

Other qualification options are possible, please check quality flow on the web and contact your sales channel for any specific request.



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