电子元器件系列(中国.厦门)

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High Reliability and Vectron International

Our Heritage

We're proud to say that the United States' first successful space exploration mission, the launch in 1958 of a Jupiter-C rocket carrying the Explorer Satellite, carried our frequency control products.

Today, we draw on the experience and expertise gained in those early years to remain the leading supplier of frequency control devices for military and commercial space programs, utilizing state-of-the-art design, manufacturing and control systems to meet and exceed customer requirements for reliability, performance and value.

A Success Story

The following is a partial listing of programs that have used our crystals, filters and oscillators:

North American Satellite Programs

2K15, Advanced EHF, Apollo, Astrolink, ATV Space Station, Beacon, Canadaarm, Cassini-Huygens, Cassiope, Centaur, Dawn Mission, Delta IV, DS1-SDST, DSCS, Echostar, EKV, Explorer, Firestone, FLTSATCOM, Freedom 7, Gemini, Globalstar, GOES, GPS, Helioseismic Magnetic Imager, HIFI LSU, Hubble Space Telescope, Icesat, Intelsat, ISAT, James Webb Space Telescope, KAP (IKONOS II), Leasat, Lynx, Magellan, Mariner, Marisat, Mars 01, Mars Climate Orbiter, Mars Global, Mars Lander, Mars Observer, Mars Odyssey, Mars Pathfinder, Mars Polar Lander, Mars Spirit, Mars Surveyor, Mars-2001, Mercury, Milstar, MIMU, MTSAT, MUOS, Navstar, Near Earth Asteroid, New Horizions, Nimbus, NPOESS (CMIS), BSCAT, OGO, Orbcomm, Orbview, Panamsat, Pioneer, PMM, Radarsat 2, Ranger, Saturn, SBIRS, SBSS, SCISAT, SDI, Solar Dynamics Observatory, Space Shuttle, Space Station, Spaceway, Surveyor, TDRS 1-7, Telestar, Tiros, Transit, UHF Follow-on, Vanguard, Voyager, Worldview,

European Space Programs

AmerHis, Cassini-Huygens, Chandrayaan, COSMO SKYMED, Envisat, ERS, Galileo, Globalstar, GOCE, Herschel, Hot Bird, Inmarsat, MCP, Meghatropiques, METOP/IASI, Nanosat 1B, New Skies, Oceansat-2, Planck, PMM, Radarsat, Rosetta, Satelcom, SICRAL, Skynet 1-5, SMOS, Swarm, Terra Sar, Van Gogh, Viking, W3A, XMM

Asian and Other Areas Space Programs

AMOS, C+A217, Chinastar, Gimpel Top-Up, GSAT-4, GSIB-V2, IGS, INSAT, Intelsat, KG207, Kompsat 2-3, Koreasat, Koreasat 5, MDS, OPTUS, PGO, Zenith

The Vectron Family Tree

Vectron Frequency Control University

Vectron International offers it's FCU to provide both commercial and military personnel with a comprehensive overview of the manufacturing process and basic design information for crystals, crystal oscillators (XO, VCXO's, TCXO's, OCXO's, EMXO's, VCSO's), crystal filters, SAW filters, and oscillator based modules. As the focus is product training, we will use our frequency control components for training examples where necessary, though there will be no sales pitch for Vectron products. These classes have been attended by both technical and non-technical personnel with excellent results. The training session is free and you will be provided with all reference material required. Vectron covers your hotel accomodations and meals. You provide the transportation to and from the hotel. Sessions are held several times per year and they alternate between our Mt. Holly Springs, PA and our Hudson, NH facilities. To get more information on our FCU, log onto our web site at www.vectron.com and click on Vectron FCU.

High-Reliability Clock Oscillators (XO)

XO (Crystal Oscillator or Clock Oscillator) = An uncompensated, fixed frequency, oscillator that does not contain the means for reducing the Frequency vs Temperature characteristic.

A Space Level Clock Oscillator without generating an SCD?

Vectron's OS-68338 Spec. is the answer!

Why OS-68338?

- No SCD to write
- No Additional Qualification Required
- Quicker Delivery
- Lower Overall Cost
- Multiple Screening Choices
- Multiple Package Choices

Vectron International has created a general specification for High Reliability Space Clock Oscillators that can be used in the absence of a customer generated SCD. Vectron's' OS-68338 specification has become the industry standard by many of the leading satellite OEM's. This specification defines the design, assembly and functional evaluation for a wide variety of TTL and ACMOS clock oscillators for various mechanical configurations. We invite you to download this specification from our website. All of the models listed below are fully qualified and have a proven track record in space applications. Save Time. Save Money. Go the proven route. Use the OS-68338 Specification. The following are excerpts from our spec.

Model Selection Chart

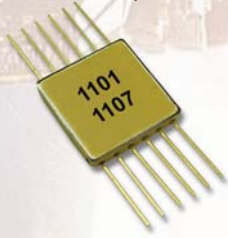
Space Model #	Package Style	Output Frequency Range Available	Input Voltage	Output Waveform	Frequency Accuracy @ Room Temp.	Frequency Stability Over Temp Range[1]
1101	12 Lead Flatpack	0.35 to 100.00 MHz	3.3 or 5.0	ACMOS	±15 ppm max.	±50 ppm max.
1102	14 Lead Flatpack			ACMOS		
1103	16 Lead Flatpack			ACMOS		
1104[2]	20 Lead Flatpack			ACMOS		
1105	14 Pin DIP			ACMOS		
1106	20 Lead Ceramic			ACMOS		
1113	40 Pad LCC			ACMOS		
1115	4 Pin 1/2 DIP			ACMOS		
1116	J-Lead SMT			ACMOS		
1118	4 Pad 5 x 7 mm	0.70 to 50.00 MHz		ACMOS		
1107	12 Lead Flatpack	0.35 to 85.00 MHz		TTL		
1108	14 Lead Flatpack			TTL		
1109	16 Lead Flatpack			TTL		
1110	20 Lead Flatpack			TTL		
1111	14 Pin DIP			TTL		
1112	20 Lead Ceramic			TTL		
1114	40 Pad LCC			TTL		
1117	J-Lead SMT			TTL		

(1) Operating Temperature Range -55° to +125°C

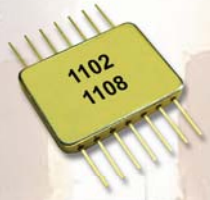
(2) Contact the factory for ACMOS requirements extending to 160MHz (Vectron model PX-369)

40 Pad LCC

12 lead Flatpack



14 lead Flatpack



14 Pin DIP

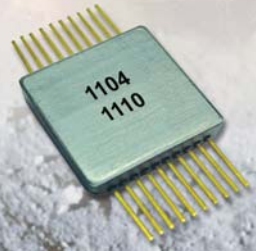
4 Pin ½ DIP

J-lead SMT

4 Pad (5X7mm)

16 lead Flatpack

20 lead Flatpack



An example of building a part number using our OS-68338 specification:

1104 R 10M00000 A F

- **1104** — Model # (Table 1)
- **R** — Design Pedigree
  - **R** = 100 krad Class S die, Swept Quartz
  - **V** = 100krad Class S die, Cultured Quartz
  - **X** = Class S die, Cultured Quartz
  - **B** = Class B die, Swept Quartz
  - **C** = Class B die, Cultured Quartz
  - **D** = Ruggedized COTS, Cultured Quartz
- **10M00000** — Frequency
- **A** — Input Voltage
  - **A** = 5.0V
  - **B** = 3.3V
- **F** — Screening Option per Table below

Screening Options

Operation Listing	Requirements & Conditions	Option A	Option B	Option C	Option D	Option E	Option F	Option G	Option X
Screening	**MIL Class Similarity**	**K 100%**	**B- 100%**	**S- 100%**	**K+ 100%**	**B 100%**	**S 100%**	**100%**	**EM 100%**
Non-Destruct Bond Pull	MIL-STD-883, Meth 2023	Completed During Assembly							
Internal Visual	MIL-STD-883, Meth 2017, Class K, Meth 2032, Class K	Completed During Assembly							
Stabilization (Vacuum) Bake	MIL-STD-883, Meth 1008, Cond C, 150° C, 48 hours min.	Completed During Assembly							
Thermal Shock	MIL-STD-883, Meth 1011, Cond A	NR	NR	X	NR	NR	X	NR	NR
Temperature Cycle	MIL-STD-883, Meth 1010, Cond B, 10 cycles	X Cond C	X Cond B	X Cond B	X Cond C	X Cond B	X Cond B	X Cond B	NR
Constant Acceleration	MIL-STD-883, Meth 2001, Cond A, Y1 Plane only, 5000 g's	X	X	X	X	X	X	X	NR
Particle Impact Noise Detection	MIL-STD-883, Meth 2020, Cond B	X	X	X	X	X	X	NR	X
Electrical Testing, Pre Burn-In	Tests per Table 3, Nominal Vcc & Temp	X	X	X	X 3/	X	X	X	X
Freq. Temp Slew Text	Operating Temp. range, frequency plotted at 1.0°C steps	AR	AR	AR	AR	AR	AR	NR	NR
1st Burn-In	MIL-STD-883, Meth 1015, Condition B	X 160 Hrs	X 160 Hrs	X 240 Hrs	X 160 Hrs	X 160 Hrs	X 240 Hrs	X 160 Hrs	NR
Electrical Testing, Intermediate	Tests per Table 3, Nominal Vcc & Temp	X	X	X	X 4/	X	X	X	X
2nd Burn-In	MIL-STD-883, Meth 1015, Condition B	X 160 Hrs	NR	NR	X 160 Hrs	NR	NR	NR	NR
Electrical Testing, Post Burn-In (Group A)	Tests per Table 3, Nominal Vcc & Extremes and Nominal Temp & Extremes	X	X	X	X 5/	X	X	X Nom Vcc	NR
Seal: Fine Leak	MIL-STD-883, Meth 1014, Cond A2, 5 x 10^{-8} atm cc/sec max	X	X	X	X	X	X	X	X
Seal: Gross Leak	MIL-STD-202, Meth 112, Cond D	X	X	X	X	X	X	X	X
Radiographic Inspection	MIL-STD-883, Meth 2012	X	AR	AR	X	AR	X	X	NR
Solderability	MIL-STD-883, Meth 2003	6/	6/	6/	6/	6/	6/	6/	6/
External Visual & Mechanical	MIL-STD-883, Meth 2009	X 7/	X 7/	X 7/	X 7/	X 7/	X 7/	X 7/	X 7/

MIL-PRF-55310, Class S Oscillators

Vectron International is the only company qualified to supply Class S Oscillators in accordance with MIL-PRF-55310. Vectron is QPL listed for MIL-PRF-55310/16.

Package Style	Output Frequency Range Available	Input Voltage	Output Waveform	Initial Accuracy @ +23°C	Operating Temp Range	Frequency Stability over OTR
14 Pin DIP	375KHz to 80MHz	5	TTL	±15ppm	-55° to +125°C	±50ppm

14 Pin DIP

High-Reliability Temperature Compensated Crystal Oscillators (TCXO)

TCXO: A TCXO is an XO or VCXO combined with temperature compensation providing output stabilities as tight as ±1ppm over the operating temperature range.

A Space Level TCXO without generating an SCD?

Vectron's DOC200103 specification is the answer!

Why DOC200103?

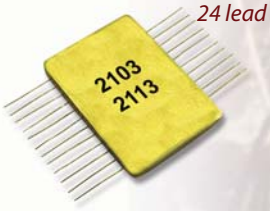
- No SCD to write
- No Additional Qualification Required
- Quicker Delivery
- Lower Overall Cost
- Multiple Screening Choices
- Multiple Package Choices

Vectron International has created a general specification for High Reliability Space TCXO's that can be used in the absence of a customer generated SCD. Vectron's' DOC200103 specification has become the industry standard by many of the leading satellite OEM's. This specification defines the design, assembly and functional evaluation for a wide variety of CMOS and Sine wave temperature compensated crystal oscillators for various mechanical configurations. We invite you to download this specification from our website. All of the models listed below are fully qualified and have a proven track record in space applications. Save Time. Save Money. Go the proven route. Use the DOC200103 Specification. The following are excerpts from our spec.

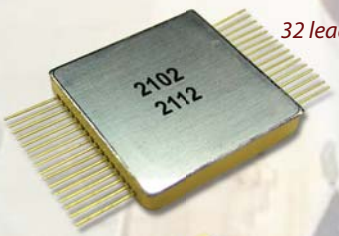
Model Selection Chart

Space Model #	Package Style	Output Frequency Range Available	Input Voltage	Output Waveform	Frequency vs Temperature
2101	24 Pin DDIP	0.300 to 100 MHz	+3.3V or +5V	CMOS	See Chart Below
2102	32 Lead Flatpack	0.300 to 100 MHz	+3.3V or +5V	CMOS	See Chart Below
2103	24 Lead Flatpack	0.300 to 100 MHz	+3.3V or +5V	CMOS	See Chart Below
2104	14 Lead Flatpack	0.300 to 100 MHz	+3.3V or +5V	CMOS	See Chart Below
2111	24 Pin DDIP	10 to 225 MHz	+5V, +12V or +15V	Sine	See Chart Below
2112	32 Lead Flatpack	10 to 150 MHz	+5V, +12V or +15V	Sine	See Chart Below
2113	24 Lead Flatpack	10 to 425 MHz	+12V or +15V	Sine	See Chart Below
2114	14 Lead Flatpack	10 to 150 MHz	+5V, +12V or +15V	Sine	See Chart Below

24 lead Flatpack



32 lead Flatpack



24 Pin DDIP

14 lead Flatpack

Frequency vs Temperature Selection Chart

Frequency Stability	Operating Temperature Range
±1 ppm	0° to +50°C
±1 ppm	0° to +70°C
±2 ppm	0° to +70°C
±5 ppm	0° to +70°C
±1 ppm	-20° to +70°C
±2 ppm	-20° to +70°C
±5 ppm	-20° to +70°C
±4 ppm	-40° to +85°C
±5 ppm	-40° to +85°C
±10 ppm	-55° to +105°C

An example of building a part number using our DOC200103 specification:

2101 R 100M00000 E B S

- **2101** — Model # (Table 1)
- **R** — Design Pedigree
  - E = Class S Components, Enhanced Element Evaluation Swept Quartz
  - R = Class S Components, Swept Quartz
  - B = Class B Components, Swept Quartz
  - C = Class B Components, Cultured Quartz
  - D = Ruggedized COTS, Cultured Quartz, Commercial Grade Components
- **100M00000** — Frequency
- **E** — Temperature Stability
  - B = ±1ppm, 0°C to +50°C
  - D = ±1ppm, 0°C to +70°C
  - F = ±2ppm, 0°C to +70°C
  - I = ±5ppm, 0°C to +70°C
  - K = ±1ppm, -20°C to +70°C
  - M = ±2ppm, -20°C to +70°C
  - R = ±5ppm, -20°C to +70°C
  - V = ±4ppm, -40°C to +85°C
  - W = ±5ppm, -40°C to +85°C
  - Y = ±10ppm, -55°C to +105°C
- **B** — Input Voltage
  - A = 3.3V
  - B = 5V
  - C = 12V
  - D = 15V
- **S** — Screening Option per Table below

Screening Options

Screening & Testing Options				
Option Code	**S**	**C**	**B**	**X**
Screening (By Class Similarity)	**Mil-PRF-55310 Class 'S'**	**Mil-PRF-55310 Class 'B' modified**	**Mil-PRF-55310 Class 'B'**	**Engineering Model (EM)**
Non-Destruct Wire Bond Pull	100%	N/A	N/A	N/A
Internal Visual	M883, Method 2017 for Class 'S'	M883, Method 2017 for Class 'B'	M883, Method 2017 for Class 'B'	M883, Method 2017 for Class 'B'
Stabilization Bake	48hrs minimum @ 150°C	48hrs minimum @ 150°C	48hrs minimum @ 150°C	48hrs minimum @ 150°C
Thermal Shock	M883, Method 1011, TC 'A'	N/A	N/A	N/A
Temperature Cycling	M883, Method 1010, TC 'B'	M883, Method 1010, TC 'B'	M883, Method 1010, TC 'B'	N/A
Constant Acceleration	M883, Method 2001, TC 'A' (5000g, Y1 Axis only)	M883, Method 2001, TC 'A' (5000g, Y1 Axis only)	M883, Method 2001, TC 'A' (5000g, Y1 Axis only)	N/A
Seal Test (Fine & Gross)	100%	100%	100%	100%
PIND	M883, Method 2020, TC 'B'	M883, Method 2020, TC 'B'	N/A	N/A
Electrical Test Frequency, Output Levels, Input Current	@ +25°C only	@ +25°C only	@ +25°C only	@ +25°C only
Burn-In (Powered with load)	+125°C for 240 hours	+125°C for 160 hours	+125°C for 160 hours	N/A
Electrical Test Frequency, Output Levels, Input Current	@ +25°C & Temp Extremes	@ +25°C & Temp Extremes	@ +25°C & Temp Extremes	N/A
PDA	2% applies to input Current @ +25°C	10% applies to input Current @ +25°C	10% applies to input Current @ +25°C	N/A
Radiographic	M883, Method 2012	N/A	N/A	N/A
Group 'A' Testing	100%	Sample per Mil-PRF-55310	Sample per Mil-PRF-55310	N/A
Group 'B' Testing (30 day Aging @ +70°C)	100%	Sample per Mil-PRF-55310	Sample per Mil-PRF-55310	N/A

High-Reliability Voltage Controlled Crystal Oscillators (VCXO)

VCXO (Voltage Controlled Crystal Oscillator) = A VCXO is an uncompensated XO with a control voltage input, which allows the user to shift the frequency by ±50 ppm up to ±200 ppm.

Vectron International has a nice selection of space qualified VCXO platforms in both surface mount and through hole configurations. See the selection chart below

VCXO Space Platforms

Space Model #	Legacy Space Model #	Package Style	Output Frequency Range Available	Input Volt.	Output Waveform	Absolute Pull Range*	Temperature Range
VX-409	C1794	4 Pin DIP	0.375 MHz to 40 MHz	5	CMOS	±50 ppm	-40°C to +85°C
VX-209	487Y(HHHH)	16 Lead Flatpack	10 MHz to 200 MHz	15	Sine	±50 ppm	-40°C to +85°C
VX-209	487Y(HHHH)	24 Lead Flatpack	201 MHz to 500 MHz	15	Sine	±50 ppm	-40°C to +85°C
VX-509	5116	9 x 14 mm J Lead	1 MHz to 85 MHz	5 or 3.3	ACMOS	±50 ppm	-40°C to +85°C

*Absolute Pull Range (APR) is the minimum guaranteed amount the VCXO can be varied from the center frequency. It accounts for degradations due to temperature, aging, power supply and load variations.

16 Lead Flatpack

J-Lead

4 Pin DIP

24 Lead Flatpack

High Reliability Voltage Controlled Saw Oscillators (VCSO)

VCSO (Voltage Controlled SAW Oscillator) = A VCSO is the same as a VCXO, except the resonator is a Surface Accoustic Wave Device as opposed to a Bulk Accoustic Wave Device (standard quartz crystal).

VCSO Space Platforms

Space Model #	Package Style	Output Frequency Range Available	Input Voltage	Output Waveform	Absolute Pull Range*	Temperature Range
VS-209	16 lead, 1" Sq. Flat-Pack	500 MHz to 1200 MHz	5V or 12V	Sine Wave	±50ppm	-40°C to +85°C
VS-509	9 x 14mm J-Lead	500 MHz to 1200 MHz	5V or 12V	Sine Wave	±50ppm	-40°C to +85°C

*Absolute Pull Range (APR) is the minimum guaranteed amount the VCSO can be varied from the center frequency. It accounts for degradations due to temperature, aging, power supply and load variations.

16 Lead Flatpack

J-Lead

Oven Controlled Crystal Oscillator (OCXO)

An OCXO is either an XO or VCXO combined with an oven maintaining the crystal unit at a precise temperature over the operating temperature range. The OCXO is the most accurate of all crystal oscillators.

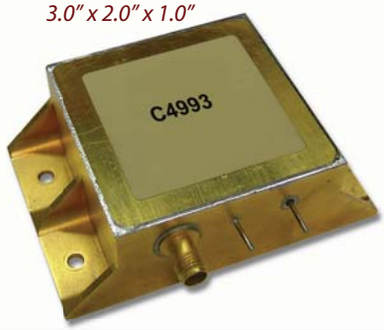
OCXO Space Platforms

Space Model #	Package Style	Output Frequency Range Available	Input Voltage	Output Waveform	Freq Stability as tight as
C4991	1.5" x 1.5" x 0.85"	1 MHz to 125 MHz	5V, 12V or 15V	Sine	5 ppb
C4992	1.39" x 0.8" x 0.6"	1 MHz to 125 MHz	5V, 12V	Sine/CMOS	20 ppb
C4993	3.0" x 2.0" x 1.0"	1 MHz to 125 MHz	5V, 12V or 15V	Sine	5 ppb
Due to the complexity of OCXO's, we recommend that you contact our MIL/Space Product Manager to discuss your needs and arrive at the best solution for your application.					

1.5" x 1.5" x 0.85"

1.39" x 0.8" x 0.6"

3.0" x 2.0" x 1.0"



Evacuated Miniature Crystal Oscillator (EMXO)

An EMXO is a unique miniaturized oven controlled oscillator in an evacuated enclosure. This design provides a very small physical size, low profile, low power consumption, fast warm-up and tight temperature stabilities.

EMXO Space Platforms

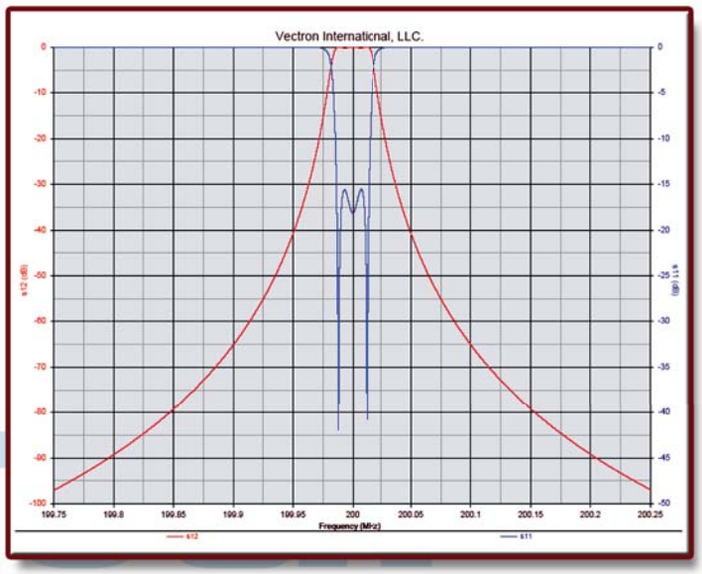
Space Model #	Legacy Space Model#	Package Style	Output Frequency Range Available	Input Voltage	Output Waveform	Freq Stability as tight as
EX-209	EX-245	1.03" x 0.93" x 0.35"	10 MHz to 40 MHz	5V	CMOS or Sine	30 ppb

1.03" x 0.93" x 0.35"

High Reliability Crystal Filters

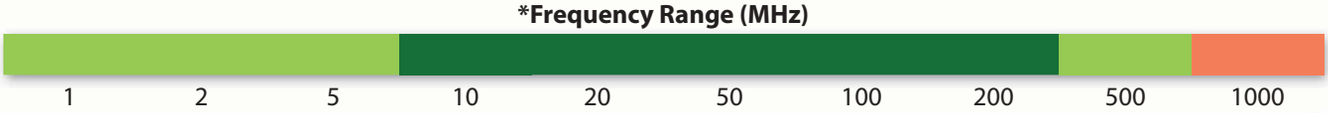
Vectron International, LLC is the worldwide leading supplier of high reliability filter products. Whether your application is ground based or space flight, military or commercial, Vectron has the engineering capability and manufacturing expertise necessary to assure the success of your project. Our high reliability heritage extends to the origin of the space age, and our participation in high reliability projects is unequalled in the industry.

Filters are available using either discrete or monolithic (BAW) filter crystal technology. Phase or amplitude matching, amplitude equalization, delay equalization, phase linearity, and pulse response analysis and testing may be considered. Vectron engineers use advanced software to accurately model and analyze designs in terms of both linear and electromagnetic characteristics.



Product capability: Crystal (BAW) filters (discrete and monolithic resonator)

***Frequency Range (MHz)**

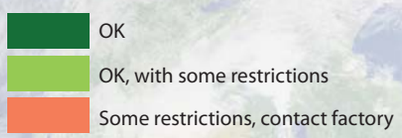


*some exceptions and limitations apply

***Bandwidth Range (%)**

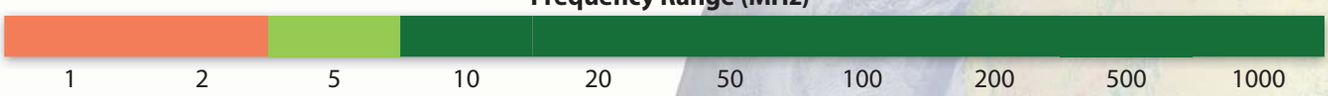
*some exceptions and limitations apply

Filter type: Bandpass, Band-reject
Response Characteristics: All-pole (Chebyshev), elliptic, linear phase types, etc...
Shape Factor Range: 1.07:1 to 30:1
Packaging: Custom; let us select a Vectron package or tell us what you need.



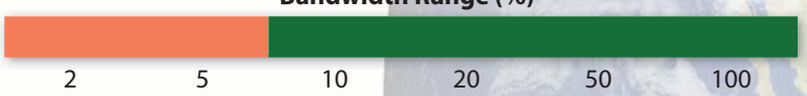
Product capability: LC filters

***Frequency Range (MHz)**



*some exceptions and limitations apply

***Bandwidth Range (%)**



*some exceptions and limitations apply

Filter type: Lowpass, Highpass, Bandpass
Response Characteristics: All-pole (Chebyshev), elliptic, linear phase types, etc...
Shape Factor Range: 1.5:1 to 30:1 (some limitations and exceptions apply)
Packaging: Custom; let us select a Vectron package or tell us what you need.

Our engineering team is available to discuss higher level integrated assemblies. Call our switchboard at 717-486-3411 and ask to speak to a crystal filter engineer.

SAW Filters for Space Applications

Vectron International offers SAW Filters for Space Applications from its Teltow plant in Germany. This facility offers a full set of SAW design principles for customized products and supports the low volumes typical of space applications. The SAW filter designs have internal matching ability.

Our VI Teltow plant is TS16949 and ISO14000 certified. Additional production and testing steps are used on a case by case basis to ensure high reliability. Our focus is to define the requirements with the customer and to report to the customer with quality tools like PPAP and APQP. With numerous tools such as FEMA, we ensure the ordered parts reach our customer in spec and on time.

Typical SAW Filters for space applications

Space Model #	Frequency (MHz)	Bandwidth (MHz)	Insertion Loss (dB)	Package Size (mm)
TFS35A	35.42	1.7	17	13 x 6
TFS1575D	1575.42	20	5	3 x 3
TFS1227	1227	20	4.5	3 x 3
TFS140E	140.455	0.05	5	11 x 5
TFS188A	188	0.6	4.8	11 x 5
TFS457	457.5	24	2.7	5 x 5
TFS590	590	0.4	6	7 x 5
TFS1220	1220	0.2	4	3.8 x 3.8
Center Frequency Range Available: 35 MHz to 2700 MHz				

This filter family offers high reliability under specific environmental conditions. However, each solution is unique.

VI Teltow has developed a technology for matching the SAW chip internally. Thus, we can support customer requests for SAW solutions without external matching. Some SAW Filters do not require external matching elements because they are naturally impedance matched. An example of this is the TFS1575D.

SDRL's & Special Contract Requirements

Program Management:
Where customers require constant frequent delivery updates and that special attention necessary to every detail, we offer Program Management. One of our program managers will be assigned the order and follow the program from the very beginning to the final shipment reporting back to the customer with status on all major milestones on a bi-weekly basis.

Swept Quartz Material:
For those applications where the products need to operate successfully in an extreme radiation environment, we offer swept quartz raw material for the crystal units. This provides the ultimate in radiation protection within our frequency control products. Swept Quartz is normally always used in equipment launched into space.

Radiation Tolerant Active Devices:
In addition to swept quartz material for the crystal units, we utilize radiation tolerant active devices with a proven track record for all space applications.

Element Evaluation:
Some contracts require us to perform element evaluation on the active devices used in our products. Reliability Level S and higher almost always require this to be done. Enhanced element evaluation is also available.

Acceptance Test Procedure:
An ATP can be written for your program outlining the complete test sequence. The ATP will be submitted to you for approval prior to the start of Acceptance Testing.

Qualification Test Procedure:
Where Qualification Testing is a part of the order, a Qualification Test Procedure is typically required. The QTP will be written and submitted to you for approval prior to the start of the testing.

PID (Process Identification Document)
On some occasions, the contract requires a PID to be written and submitted for approval. A PID is a detailed list of each document used in the manufacturing process. A PID can be an enormous document that takes quite an effort to produce, but once it is accomplished, the customer has a complete record of how each manufacturing step was performed. A PID can be fairly expensive. It is normally done prior to the start of flight unit manufacturing.

Parts List/Materials List:
Many space programs require us to submit a parts list and materials list for approval prior to the start of the flight unit manufacturing sequence. We can do this task when required.

MTBF (Mean Time Between Failure) Calculation:
Sometimes our customers want an MTBF calculation submitted to them as proof that we meet and exceed their reliability specification. We have done this many times and have the engineers and systems in place to quickly do this task. The resultant calculation can be submitted to the customer in either Mean Time Between Failure (MTBF) or Failure In Time (FITS).

FMEA (Failure Mode and Effects Analysis)
Requirements for a FEMA are rare but they do occur. Where required, we can perform the analysis and submit the report.

Traceability:
All orders for space products will typically require traceability as a requirement. Based on this assumption, Vectron automatically uses shop travelers which record all material used and the details of each operation back to the beginning of the manufacturing sequence. Where required, we can also provide traceability on the swept quartz material back to the autoclave lot.

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DPA (Destructive Physical Analysis):
DPA is almost always done by our customers but can be performed at an outside test facility chosen by Vectron. This test entails the destruction of sample units from the flight lot and a complete analysis of their construction.

Worst Case Analysis:
This calculation takes the tolerances of each component used in the product over the required life of the spacecraft and provides a picture of what possibly can happen under the very worst operating conditions.

Long Term Aging Predictions:
When our products are going into equipment that will operate for long periods of time, our customers specify aging rate limits. When limits like 20 years are specified, we must do testing and predict what the aging of our units will be during the 20 year period. We have developed in-house aging systems and various test methods and formulas specifically designed for this purpose, which have been approved by NASA and/or our space customer base. A report on each shipped flight unit is submitted as part of the test report package.

Radiographic Inspection:
X-ray inspection is a normal requirement on space programs. We have the necessary equipment in-house to do real time views. This equipment provides the ultimate in testing analysis.

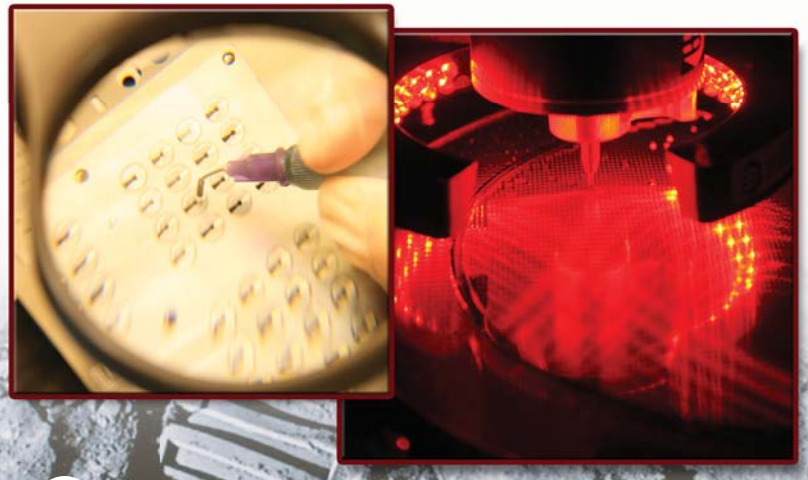
Pre-Cap Customer Inspection and Final Customer Inspection:
Most high reliability space programs require a source inspector to visit our plant and view the units just prior to their sealing process and also to review the test package and mechanical dimensions and marking just prior to final shipment. We have source inspectors visiting our plant on a daily basis and our quality personnel are able to efficiently handle this task.

Government Source Inspection:
We are able to provide GSI where required and are serviced by government inspectors working out of the New Cumberland, PA office of DCMA.

Customized Environmental Testing:
Over our 50 years of providing space products to the industry, we came to the conclusion early on that we needed to have most test equipment in-house. There were two reasons for this; We could control our delivery commitments and the shear volume of the testing necessitated in-house capability. In addition, our customer base was asking us to do unique environmental testing specific to their programs. We have environmental test engineers on staff that can design tests and their required test fixtures meeting most environmental test specifications sent to us.

PDR/CDR/MRR:
A Preliminary Design Review, Critical Design Review and or Manufacturing Readiness Review are typically required on many space programs. We cooperate fully with our customers where these are required with the meetings held at our facility.

Radiation Testing:
Radiation testing is becoming more commonplace and is performed by an outside test laboratory chosen by our high reliability test engineers. Outsourced testing can include: TID (Total Ionizing Dose) at both high dose rates and low dose rates (ELDRS); Neutron Fluence; Destructive (SEL, SEB, SEGR) and non-destructive (SEU, SEFI) single event effects (SEE).



In-House Test Capabilities

	MIL-STD-202		MIL-STD-883	
Test	Method	Test Cond.	Method	Test Cond.
Salt Atmosphere	101	A,B	1019	A,B,C,D
Temperature Cycling	102	C	1010	A,B,C
Humidity	103	A,B		
Immersion (Seal)	104	A,B,C	1002	A,B,C
Moisture Resistance	106		1004	
Thermal Shock	107	All	1011	All
Life	108	A,B,C,D	1005	
Seal	112	All	1014	A,C
Vibration, Sine	204	All		A,B,C
Vibration, Random	214	All	2007	
Radiographic (Real Time)	209		2012	A,B,C,D,E,F
Acceleration	212	A,B,C	2001	
Shock	213	All	2002	A,B
PIND			2020	
Solderability w/Steam Age	208		2003	
Barometric Pressure	105	A,B,C		
Resistance to Soldering Heat	210	B,C		
Aging at Room Temperature				
Aging at Elevated Temperature				
Die Shear Testing			2019	
Terminal Strength	211	A,B,C		
Phase Noise Under Vibration				
g Sensitivity				
Wirebond Pull Testing			2023,2011	
Other Tests				
RGA	Outside Test			
Radiation	Outside Test			
Pyrotechnic Shock	Outside Test			

In addition to our extensive, in-house test capabilities, we utilize outside test laboratories for the following tests:

World Class Production & Test

Our space and military hybrid manufacturing and test facilities are segregated from our commercial product areas with their own engineering, management and quality personnel providing a focused approach to giving our customers the best in quality and on-time deliveries.

Our people are our most valuable asset and the very low turnover rate of production, engineering and management personnel provides us with experience unparalleled in our industry. Our most experienced production people are assigned to the space product lines providing a top quality product.

We have two Class 100,000 clean rooms totaling 9,350 sq ft for our hybrid production which are maintained to Class 10,000 and the many additional Class 100 Laminar Flow work centers provide us with the right environment to build products second to none in our industry. Couple the clean room area with state-of-the-art manufacturing equipment and the industry's best people, and we have a facility that we love to show off to our many visitors.