DOC200103
CMOS/SINE Hybrid TCXO
Hi-Rel Standard

General

	Rev	Cage Code
Vectron® Oscillators	**M**	**00136**

This specification defines the design, assembly, and functional evaluation of high reliability, Space qualified, hybrid TCXOs produced by Microchip. Devices delivered to this specification represent the standardized Parts, Materials and Processes (PMP) Program developed, implemented, and certified for advanced applications and extended environments.

For more information see Space Oscillators.

For technical support regarding this Hi-Rel Standard, please contact VOP-Support@microchip.com.

Applications Overview

The designs represented by these products were primarily developed for the MIL-Aerospace community. The lesser Design Pedigrees and Screening Options imbedded within DOC200103 bridge the gap between Space and COTS hardware by providing custom hardware with measures of mechanical, assembly and reliability assurance needed for Military, Ruggedized COTS, or Commercial environments.

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1. Applicable Documents

1.1. Specifications and Standards

The following specifications and standards form a part of this document to the extent specified herein. The issue currently in effect on the date of quotation will be the product baseline, unless otherwise specified. In the event of conflict between the texts of any references cited herein, the text of this document shall take precedence.

Table 1-1. Military

Document	Title
MIL-PRF-55310	Oscillators, Crystal Controlled, General Specification For
MIL-PRF-38534	Hybrid Microcircuits, General Specification For

Table 1-2. Standards

Document	Title
MIL-STD-202	Test Method Standard, Electronic and Electrical Component Parts
MIL-STD-883	Test Methods and Procedures for Microelectronics

Table 1-3. Other

Document	Title
QSP-90100	Quality Systems Manual, Microchip
DOC011627	Identification Common Documents, Materials and Processes, Hi-Rel XO
DOC203982	DPA Specification
QSP-91502	Procedure for Electrostatic Discharge Precautions
DOC208191	Enhanced Element Evaluation for Space Level Hybrid Oscillators
DOC220429	Packaging Standards, Hi-Rel Series

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2. General Requirements

2.1. Classification

All devices delivered to this specification are of hybrid technology conforming to Type 3, Class 2 of MIL-PRF-55310. Devices carry a Class 1C ESDS classification per MIL-PRF-38534 and are marked with a single equilateral triangle at pin 1 per MIL-PRF-55310.

2.2. Item Identification

External packaging choices are either metal flatpacks or DDIP with either Sinewave or CMOS logic output. Unique Model Number Series are utilized to identify device package configurations and output waveform as listed in Table 6-1.

2.3. Absolute Maximum Ratings

Table 2-1. Absolute Maximum Ratings

Parameter	Value
Supply Voltage Range (V_{CC})	–0.5Vdc to +5.0Vdc (Vcc = +3.3V) –0.5Vdc to +7.0Vdc (Vcc = +5V) –0.5Vdc to +16.5Vdc (Vcc = +12V) –0.5Vdc to +18Vdc (Vcc = +15V)
Storage Temperature Range (T_{STG})	-65 °C to +125 °C
Junction Temperature (T_J)	+150 °C
Lead Temperature (soldering, 10 seconds)	+300 °C

2.4. Design, Parts, Materials and Processes, Assembly, Inspection, and Test

2.4.1. Design

The ruggedized designs implemented for these devices are proven in military and space applications under extreme environments. All designs utilize a 4-point crystal mount. For radiation characteristics, see 3.1.5. Radiation for details on the component requirements for the various oscillator design pedigrees.

2.4.1.1. Design and Configuration Stability

Barring changes to improve performance by reselecting passive chip component values to offset component tolerances, there will not be fundamental changes to the design or assembly or parts, materials and processes after first product delivery of that item without notification.

2.4.1.2. Environmental Integrity

Designs have passed the environmental qualification levels of MIL-PRF-55310. These designs have also passed extended dynamic levels of at least:

a. Sine Vibration: MIL-STD-202, Method 204, Condition G (30g pk.)

b. Random Vibration: MIL-STD-202, Method 214, Condition II-J (43.92g rms, three-minute duration in each of three mutually perpendicular directions) except model numbers 2105, 2115, 2205 and 2215 which are rated at Condition II-F (24.06g rms)

c. Mechanical Shock: MIL-STD-202, Method 213, Condition F (1500g, 0.5ms)

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2.4.2. Prohibited Parts, Materials and Processes

The items listed are prohibited for use in high reliability devices produced to this specification.

a. Gold metallization of package elements without a barrier metal.

b. Zinc chromate as a finish.

c. Cadmium, zinc, or pure tin external or internal to the device.

d. Plastic encapsulated semiconductor devices.

e. Ultrasonically cleaned electronic parts.

f. Heterojunction Bipolar Transistor (HBT) technology.

2.4.3. Assembly

Manufacturing utilizes standardized procedures, processes, and verification methods to produce MIL-PRF-55310 Class S/MIL-PRF-38534 Class K equivalent devices. MIL-PRF-38534 Group B Option 1 in-line inspection is included on design pedigrees E and R per paragraph 7.1 to further verify lot pedigree. Devices are handled in accordance with the Microchip document QSP-91502 (Procedure for Electrostatic Discharge Precautions). Element replacement will be as specified in MIL-PRF-38534, Rev L.

2.4.4. Inspection

The inspection requirements of MIL-PRF-55310 apply to all devices delivered to this document. Inspection conditions and standards are documented in accordance with the Quality Assurance, ISO-9001 and AS9100 derived, System of QSP-90100.

2.4.5. Test

The Screening test matrix of Table 6-8 is tailored for selectable-combination testing to eliminate costs associated with the development/maintenance of device-specific documentation packages while maintaining performance integrity.

2.4.6. Marking

Device marking shall be in accordance with the requirements of MIL-PRF-55310. In addition, when devices are identified with laser marking, the Resistance to Solvents test specified in MIL-PRF-55310 Group C, MIL-PRF-55310 Qualification or MIL-PRF-38534 Group B Inspection will not be performed.

2.4.7. Ruggedized COTS Design Implementation

Design Pedigree “D” devices (see 4.2. Optional Design, Test, and Data Parameters) use the same robust designs as the other device pedigrees. They do not include the provisions of traceability or the Class-qualified componentry noted in 2.4.3. Assembly and 3.1. Components.

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3. Detail Requirements

3.1. Components

3.1.1. Crystals

Cultured quartz crystal resonators are used to provide the selected frequency for the devices. Premium Q swept quartz is standard for all Design Pedigrees E, R and B because of its superior radiation tolerance. The manufacturer has a documented crystal evaluation program in accordance with MIL-PRF-55310.

3.1.2. Passive Components

3.1.2.1. Design Pedigree E

Where available, resistors shall be Established Reliability, Failure Rate R (as a minimum) and capacitors shall be Failure Rate S. Where resistors and capacitors are not available as ER parts, and for all other passive components, the parts shall be from homogeneous manufacturing lots that have successfully completed the Enhanced Element Evaluation of DOC208191 which meets the requirements of MIL-PRF-38534 Revision L for Class K.

3.1.2.2. Design Pedigree R

Where available, resistors shall be Established Reliability, Failure Rate R (as a minimum) and capacitors shall be Failure Rate S. Where resistors and capacitors are not available as ER parts, and for all other passive components, the parts shall be from homogeneous manufacturing lots that have successfully completed the Class K Element Evaluation of MIL-PRF-38534 Revision K for Class K.

3.1.2.3. Design Pedigrees B and C

All passive elements shall comply with the Element Evaluation requirements of MIL-PRF-55310 Class B as a minimum.

3.1.2.4. Design Pedigree D

Passive elements will be COTS level or higher.

3.1.3. Microcircuits (Voltage Regulators, CMOS Devices, etc.)

3.1.3.1. Design Pedigree E

Microcircuits shall be from homogeneous wafer lots that meet the Enhanced Element Evaluation requirements in DOC208191 and meet the requirements of MIL- PRF-38534 Revision L for Class K.

3.1.3.2. Design Pedigree R

Microcircuits shall be from homogeneous wafer lots that have successfully completed the MIL-PRF-38534, Revision K Lot Acceptance Tests for Class K.

3.1.3.3. Design Pedigrees B and C

Microcircuits are procured from wafer lots that have successfully completed the MIL-PRF-55310 Lot Acceptance Tests for Class B as a minimum.

3.1.3.4. Design Pedigree D

Microcircuits can be COTS level or higher.

3.1.4. Semiconductors (Transistors, Diodes, etc.)

3.1.4.1. Design Pedigree E

Semiconductors shall be from homogeneous wafer lots that meet the Enhanced Element Evaluation requirements in DOC208191 and meet the requirements of MIL-PRF-38534 Revision L for Class K.

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3.1.4.2. Design Pedigree R

Semiconductors shall be from homogeneous wafer lots that have successfully completed the MIL-PRF-38534, Revision K Lot Acceptance Tests for Class K devices as a minimum.

3.1.4.3. Design Pedigrees B and C

Semiconductors are procured from wafer lots that have successfully completed the MIL-PRF-55310 Lot Acceptance Tests for Class B devices as a minimum.

3.1.4.4. Design Pedigree D

Semiconductors can be COTS level or higher.

3.1.5. Radiation

Microcircuits and semiconductors for Design Pedigrees E and R are from wafer lots that are certified to 100 krad (Si) total dose minimum. Sinewave devices are assembled with all bipolar semiconductors and bipolar constructed microcircuits. ACMOS devices are assembled with all bipolar semiconductors and bipolar constructed microcircuits, except for the ACMOS chip used to provide the CMOS output. In addition, the bipolar transistors are considered insensitive to Single Event Effects. The ACMOS die is from a certified wafer lot that is radiation tested to a minimum of 100 krad. NSC, the 54ACT designer, has characterized the SET LET up to 40 MeV-cm^2/mg and SEL LET up to 120 MeV-cm^2/mg for the FACT™ family (AN-932). Microchip conducted additional SEE testing in 2008 to verify this performance since our lot wafer testing does not include these parameters and determinations.

3.1.6. Packages

Packages are procured that meet the construction, lead materials and finishes as specified in MIL-PRF-55310. All leads are Kovar with gold plating over a nickel underplate. Package lots are evaluated in accordance with the requirements of MIL-PRF-38534. Microchip will not perform Salt Spray testing as part of MIL-PRF-55310 Group C/Qualification. In accordance with MIL-PRF-55310, package evaluation results for salt atmosphere will be substituted for Salt Spray testing during MIL-PRF-55310 Group C/Qualification. In addition, we perform Terminal Strength testing per MIL-STD-202, Method 211, Test Condition C with the following exceptions: Flatpacks (8 oz load for flat leads); DIP (five bends at 45° for 0.018” pins).

3.1.7. Traceability and Homogeneity

Design pedigrees E and R utilize homogeneous material. All design pedigrees except option D have active device lots that are traceable to the manufacturer’s individual wafer. For design pedigrees E and R only, passive elements except select values, crystals, and other materials are traceable to their manufacturing lots. Swept quartz crystals are traceable to the quartz bar and the processing details of the autoclave lot; however, multiple lots of un-plated crystals, bases, and covers may be combined into a single sealed crystal manufacturing lot. Manufacturing lot and date code information shall be recorded, by TCXO serial number, of every component and all materials used in the manufacture of those TCXOs. A production lot, as defined by Microchip, is all oscillators that have been kitted and built as a single group. The maximum deliverable quantity with a single lot date code is 100 units. Order quantities that exceed 100 units will be delivered in multiple lot date codes with deliveries separated by four weeks. If applicable, each production lot will be kitted with homogeneous material which is then allocated across multiple lot date code builds to satisfy the deliverable order quantity. When ordered, Group C Inspection, lot qualifications, and/or DPA will be performed on the first build lot within the production lot unless otherwise stated on the purchase order.

3.2. Mechanical

3.2.1. Package Outline

Table 6-1 links each Hi-Rel Standard Model Number of this specification to a corresponding package style. Mechanical Outline information of each package style is found in the referenced figure.

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3.2.2. Thermal Characteristics

Because these TCXOs are multichip hybrid designs, the actual θ_{jc} to any one given semiconductor die will vary, but the combined average for all active devices results in a θ_{jc} of approximately 40 °C/W. The typical die temperature rise at any one given semiconductor is 2 °C to 4 °C. With the oscillator operating at +125 °C, the average junction temperature is approximately +129 °C and under no circumstance will it ever exceed the maximum manufacturer's rated junction temperature.

3.2.3. Lead Forming

When the lead forming option is specified, the applicable leak test specified in screening will be performed after forming.

3.3. Electrical

3.3.1. Supply Voltages

CMOS devices are designed for 3.3 or 5 Vdc ±5% operation. Sinewave devices are designed for 3.3, 5, 12 or 15 Vdc ±5% operation.

3.3.2. Temperature Range

Operating range is in accordance with (IAW) the chosen temperature stability code.

3.3.3. Frequency Tolerance

Temperature stability includes initial accuracy at +25 °C (with EFC), load ±10% and supply ±5%.

3.3.4. Frequency Set

All devices include an External Frequency Control (EFC) pin for the purpose of externally setting each TCXO to its nominal frequency. The EFC shall be accomplished by connecting a resistor or trimmer potentiometer from that pin to GND. The EFC resistance adjustment range is 0Ω or GND to 20 kΩ max with nominal frequency typically occurring in the 3 kΩ to 13 kΩ range. Customers will be furnished with the applicable EFC resistor value that can be used to set each individual device within ±0.2 ppm of nominal frequency at time of shipment. Purchase orders with Program Management have the ability to obtain the serialized EFC set resistor values immediately following the Group A Electrical Test (Screening Option X only) or Group B Aging.

3.3.5. Frequency Aging

Aging limits, when tested in accordance with MIL-PRF-55310 Group B inspection, shall not exceed ±1 ppm for the first year and ±5 ppm for 15 years for oscillators that use crystals in the 10 MHz to 75 MHz range. For oscillators that use crystals greater than 75 MHz, the aging shall not exceed ±2 ppm for the first year and ±10 ppm for 15 years.

3.3.5.1. Frequency Aging Duration Option

For Screening Option F, the Aging test will be terminated after 15 days if the aging projection is less than the specified aging limit. This is a common method of expediting 30-day Aging without incurring risk to the hardware and used quite successfully for numerous customers. It is based on the 'least squares fit' determinations of MIL-PRF-55310 paragraph 4.8.35. Microchip's automated aging systems acquire data every four hours, compared to the minimum MIL-PRF-55310 requirement of once every 72 hours. This makes an extensive amount of data available to perform very accurate aging projections. The delivered data would include the Aging plots projected to 30 days. If the units would not perform within that limit then they would continue to the full 30-day term. For all other screening options, please advise by purchase order text if this is an acceptable option to exercise as it assists in Production Test planning.

3.3.6. Operating Characteristics

See Table 6-3–Table 6-7. Waveform measurement points and logic limits are in accordance with MIL-PRF-55310. Start-up time is 10 ms typical and 30 ms maximum.

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3.3.7. Outputs and Loads

Standard Sinewave (50 Ω) and CMOS (10 kΩ, 15 pF) test loads are in accordance with MIL-PRF-55310. Note that the sinewave outputs are AC coupled.

3.3.8. Phase Noise

Contact the factory for typical performance. If custom and/or guaranteed performance is required, Microchip can assign a custom part number.

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4. Quality Assurance Provisions and Verification

4.1. Verification and Test

Device lots shall be tested prior to delivery in accordance with the applicable Screening Option letter as stated by the 16th character of the part number. Table 6-8 tests are conducted in the order shown and annotated on the appropriate process travelers and data sheets of the governing test procedure. For devices that require Screening Options that include MIL-PRF-55310 Group A Testing, the Post-Burn-In Electrical Test and the Group A Electrical Test are combined into one operation.

4.1.1. Screening Options

The Screening Options, by letter, are summarized as:

Table 4-1. Screening Options

Screening Option	Description
K	Modified MIL-PRF-38534 Class K Screening, Group A QCI and 30-day aging
F	MIL-PRF-55310, Rev F, Class S Screening, Groups A & B QCI
S	MIL-PRF-55310, Rev E, Class S Screening, Groups A & B QCI
C	Modified MIL-PRF-55310 Class B Screening, Groups A & B QCI
B	MIL-PRF-55310, Class B Screening, Groups A & B QCI
X	Engineering Model (EM)

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4.2. Optional Design, Test, and Data Parameters

The following is a list of design, assembly, inspection and test options that can be selected or added by purchase order request.

a. Design Pedigree (choose one as the 5th character in the part number):

Table 4-2. Design Pedigree

Design Pedigree	Description
E	Enhanced Element Evaluation (MIL-PRF-38534 Rev L for Class K components as specified in DOC208191), 100 krad die, Premium Q Swept Quartz
R	MIL-PRF-38534 Rev K element evaluation for Class K components,100 krad die, Premium Q Swept Quartz
B	Class B components, Premium Q Swept Quartz
C	Class B components, Non-Swept Quartz
D	COTS components, Non-Swept Quartz

b. Input Voltage as the 15th character. See Ordering Part Number.

c. Not Used

d. Radiographic Inspection

e. Group C Inspection: IAW MIL-PRF-55310, Rev E (requires 8 destruct specimens)

f. Group C Inspection: IAW MIL-PRF-55310, Rev F (requires 8 destruct specimens, includes Random Vibration, MIL-STD-883, Method 1014 Leak Test and Life Test)

g. Group C Inspection: IAW MIL-PRF-38534, Table C-Xc, Condition PI (requires 8 destruct specimens – 5 pc. Life, 3 pc. RGA). Subgroup 1 fine leak test to be performed per MIL-STD-202, Method 112, Condition C.

h. Internal Water-Vapor Content (RGA) samples and test performance

i. MTBF Reliability Calculations: IAW MIL-HDBK-217 unless otherwise specified

j. Worst Case Circuit Analysis: IAW MIL-HDBK-1547 unless otherwise specified

k. Derating and Thermal Analysis: IAW MIL-HDBK-1547 with T_j Max = +105 °C; Case Temperature = +85 °C unless otherwise specified

l. Process Identification Documentation (PID)

m. Customer Source Inspection (pre-cap/final) [Note: Model numbers 2105, 2205, 2115 and 2215 require two pre-cap inspections.]

n. Destruct Physical Analysis (DPA): IAW MIL-STD-1580 with exceptions as specified in Microchip DOC203982. The DPA leak test specified will agree with the screening option selected.

o. Qualification: IAW MIL-PRF-55310, Rev F, Table IV (requires 16 destruct specimens). Includes Group III, SG1 through SG6 only. ESD (SG7) not performed.

p. Qualification: IAW EEE-INST-002, Section C4, Table 3, Level 1 or 2 (requires 11 destruct specimens)

q. High Resolution Digital Pre-Cap Photographs (20 Megapixels minimum)

r. Hot solder dip of leads with Sn63/Pb37 solder prior to shipping.

s. As Designed Parts, Materials and Processes List

4.2.1. NASA EEE-INST-002

A combination of Design Pedigree R, Option F Screening, and performance of Qualification per EEE-INST-002, Section C4, Table 3 on 11 destruct specimens, meet the requirements of Level 1 and Level 2 device reliability

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4.3. Test Conditions

Unless otherwise stated herein, inspections are performed in accordance with those specified in MIL-PRF-55310. Process travelers identify the applicable methods, conditions and procedures to be used. Examples of electrical test procedures that correspond to MIL-PRF-55310 requirements are shown in Table 6-7.

4.4. Delta Limit Exception

When MIL-PRF-55310, Revision F was being reviewed for release by manufacturers and users, Microchip and other organizations recommended that burn-in delta limits not be applied to logic level measurements due to the inconsistency in attempting to measure small changes in logic levels which inherently have ringing in the signal. This is especially true in higher frequency oscillators measured in automated test systems that are affected by cable length that is not representative of the user's application and contact resistance in test fixtures that do not provide a consistent Vcc or Ground connection. The exact test setup conditions may vary slightly from pre-burn-in to post-burn-in and cause small artificial deltas in logic level measurements that are not indicative of an issue. Any significant changes in logic levels will be reflected in supply current deltas and/or logic levels that exceed the min/max limits. As a result, we take exception to MIL-PRF-55310, Revision F, Para. 4.4.5 and the delta limit for Output Low Level as specified in 4.4.5(c) shall not be applied to Burn-in PDA.

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4.5. Deliverable Data

The manufacturer supplies the following data, as a minimum, with each lot of devices:

a. As applicable to the Screening Option chosen, completed assembly and screening lot travelers, screening data, including radiographic images, and rework history.

b. Electrical test variables data and EFC set resistor values, identified by unique serial number.

c. Special items when required by purchase order such as Group C, DPA, RGA, and Pre-Cap Photos. Unless otherwise specified on purchase order, all destruct specimens will be shipped. As delivered, all destruct specimens will be identified by subgroup (if applicable) and packaged separately from flight units.

d. For Design Pedigrees E and R, traceability, component LAT, enclosure LAT, and wafer lot specific RLAT data for non-SMD active devices (if applicable).

e. Certificate of Conformance.

4.6. Discrepant Material

All MRB authority resides with the procuring activity.

4.7. Failure Analysis

Any failure during Qualification or Group C Inspection will be evaluated for root cause. The customer will be notified after occurrence and upon completion of the evaluation.

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5. Preparation for Delivery

5.1. Packaging

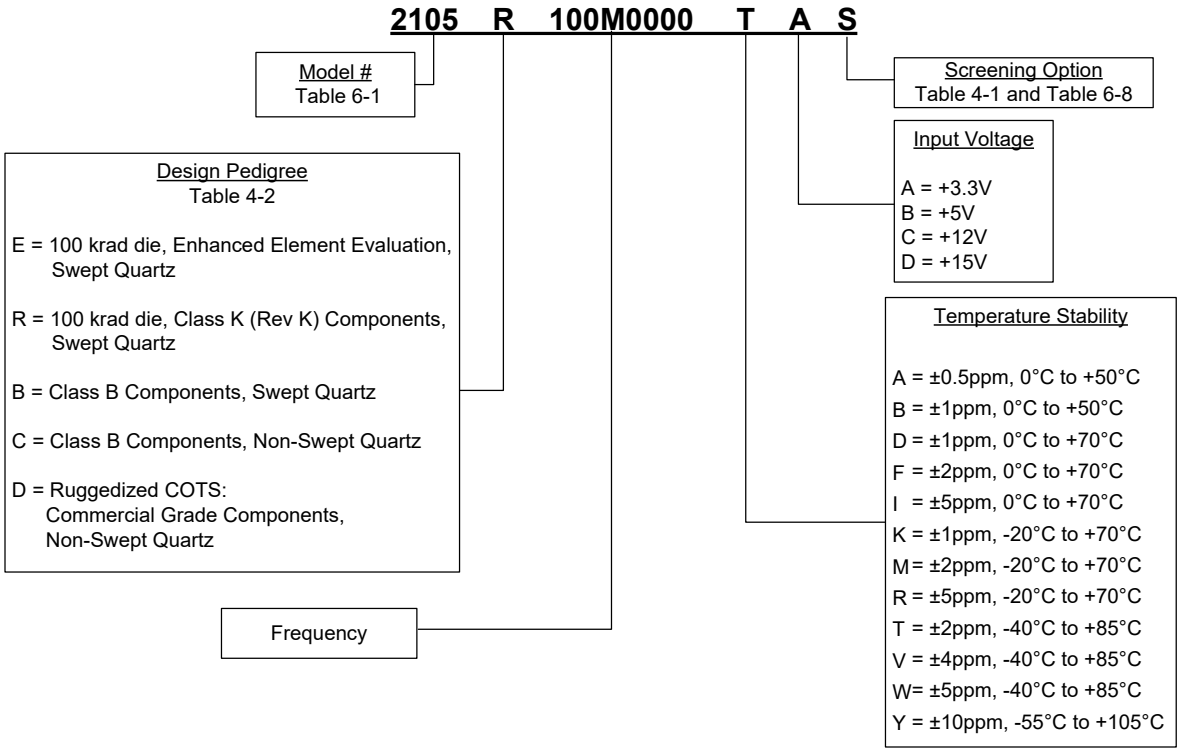
Devices will be packaged in a manner that prevents handling and transit damage during shipping. Devices will be handled in accordance with ANSI/ESD S20.20. Devices will be packaged for transport in accordance with DOC220429. Please note that “one unit per package” is available for a fee; however, this service must be requested as part of the official RFQ

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6. Ordering Information

6.1. Ordering Part Number

The ordering part number consists of an alphanumeric string of 16 continuous characters, without spaces.



6.1.1. Model Number

The device model number is the four (4) digit number assigned to a corresponding package and output combination per Table 6-1.

6.1.2. Design Pedigree

Class S designs are identified by the letters “E” and “R,” while Class B designs are indicated by either the letter “B” or “C”. Ruggedized COTS, which utilized commercial grade components, are designated by the letter “D”.

6.1.3. Output Frequency

The nominal output frequency is expressed in the format as specified in MIL-PRF-55310 utilizing eight (8) total characters. (Example: 300 kHz = 300K0000, 8 MHz = 8M000000, 10 MHz = 10M00000, 500 MHz = 500M0000).

6.1.4. Input Voltage

Voltage is the 15th character. Voltage availability is dependent on platform.

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6.1.5. Screening Options

The 16th character is the Screening Option selected from Table 6-8.

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6.2. Electrical Characteristics and Test Parameters

Optional test and documentation requirements shall be specified by separate purchase order line items (as listed in 4.2. Optional Design, Test, and Data Parameters).

Table 6-1. Item Identification and Package Outline

Model #	Package	Output	Mechanical Outline and I/O Connections
2101	24 Pin DDIP	CMOS	Figure 6-1
2102	32 Lead Flatpack	CMOS	Figure 6-2
2103	24 Lead Flatpack	CMOS	Figure 6-3
2104	14 Lead Flatpack	CMOS	Figure 6-4
2105	14 Lead Flatpack	CMOS	Figure 6-5
2202[1]	32 Lead Flatpack	CMOS	Figure 6-6
2203[1]	24 Lead Flatpack	CMOS	Figure 6-7
2204[1]	14 Lead Flatpack	CMOS	Figure 6-8
2205[1]	14 Lead Flatpack	CMOS	Figure 6-9
2111	24 Pin DDIP	Sine	Figure 6-1
2112	32 Lead Flatpack	Sine	Figure 6-2
2113	24 Lead Flatpack	Sine	Figure 6-3
2114	14 Lead Flatpack	Sine	Figure 6-4
2115	14 Lead Flatpack	Sine	Figure 6-5
2212[1]	32 Lead Flatpack	Sine	Figure 6-6
2213[1]	24 Lead Flatpack	Sine	Figure 6-7
2214[1]	14 Lead Flatpack	Sine	Figure 6-8
2215[1]	14 Lead Flatpack	Sine	Figure 6-9

Note: [1] Models 2202 through 2205 and 2212 through 2215 represent lead formed versions.

Table 6-2. Typical Weight

Model #	Package	Typical Weight (grams)
2101, 2111	24 Pin DDIP	21
2102, 2202, 2112, 2212	32 Lead Flatpack	10
2103, 2203, 2113, 2213	24 Lead Flatpack	16
2104, 2204, 2114, 2214	14 Lead Flatpack	19
2105, 2205, 2115, 2215	14 Lead Flatpack	8

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Table 6-3. Electrical Performance Characteristics–Models 2101, 2102, 2103, 2104, 2105, 2202, 2203, 2204, 2205

Supply Voltage Options[1]: +3.3V or +5V						
Frequency Range (MHz)	Max Current (mA)		Max Rise/Fall Times[2] (ns)	Duty Cycle[2] (%)	Max CMOS Load (pF)	
0.300–100	5.25V	3.465V	5	40 to 60	5.25V	3.465V
	50	35			50	35

Note:
[1] Waveform measurement points and logic limits are in accordance with MIL-PRF-55310, Para 3.6.20.3.
[2] Tested with 15 pF.

Table 6-4. Electrical Performance Characteristics–Model 2111

Supply Voltage Options: +3.3V, +5V, +12V or +15V						
Frequency Range (MHz)	Max Current (mA)		Min Power Out (dBm)		Harmonics/ Subharmonics (>75 MHz) (dBc)	Spurious (dBc)
10–225	3.3V/5V	12V/15V	3.3V/5V	12V/15V	< -20	< -70
	20	35	+3	+7		

Table 6-5. Electrical Performance Characteristics–Models 2112, 2114, 2115, 2212, 2214, 2215

Supply Voltage Options: +3.3V, +5V, +12V or +15V							
Frequency Range (MHz)	Max Current (mA)		Min Power Out (dBm)			Harmonics/ Subharmonics (>75 MHz) (dBc)	Spurious (dBc)
10–150	3.3V/5V	12V/15V	3.3V	5V	12V/15V	< -20	< -70
	20	35	0	+3	+7		

Table 6-6. Electrical Performance Characteristics–Models 2113, 2213

Supply Voltage Options: +12V or +15V						
Frequency Range (MHz)	Max Current (mA)		Min Power Out (dBm)		Harmonics/ Subharmonics (>75 MHz) (dBc)	Spurious (dBc)
10–500	12V	15V	12V	15V	< -20	< -70
	25	35	+5	+7		

Table 6-7. Electrical Test Parameters

Operation Listing	Requirements and Conditions
PERFORMED DURING ALL ELECTRICAL TESTS	
Input Current	MIL-PRF-55310, Para 4.8.5.1
Initial Accuracy at Reference Temperature	MIL-PRF-55310, Para 4.8.6
Output Logic Voltage Levels	MIL-PRF-55310, Para 4.8.21.3
Rise and Fall Times	MIL-PRF-55310, Para 4.8.22
Duty Cycle	MIL-PRF-55310, Para 4.8.23
PERFORMED DURING POST BURN-IN ELECTRICAL ONLY	
Overvoltage Survivability	MIL-PRF-55310, Para 4.8.4
Initial Frequency – Temperature Accuracy	MIL-PRF-55310, Para 4.8.10.1
Frequency – Voltage Tolerance	MIL-PRF-55310, Para 4.8.14
Start-up Time	MIL-PRF-55310, Para 4.8.29

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Table 6-8. Screening and Test Matrix

OPN. NO.	Operation Listing	Requirements and Conditions	Option K	Option F	Option S	Option C	Option B	Option X
	SCREENING	MIL Class Similarity (MIL-PRF-55310, Class S/B or MIL-PRF-38534, Class K)	M38534K K	M55310F S	M55310E S	M55310F B+	M55310F B	EM
1	Non-Destruct Bond Pull	MIL-STD-883, Method 2023	X	X	X	NR	NR	NR
2	Internal Visual	MIL-STD-883, Method 2017 Class K or H, Method 2032 Class K or H	X K	X K	X K	X H	X H	X H
3	Stabilization (Vacuum) Bake	MIL-STD-883, Method 1008, Cond. C, 150 °C	X 48 hrs.	X 48 hrs.	X 48 hrs.	X 48 hrs.	X 48 hrs.	X 24 hrs.
4	Random Vibration	MIL-STD-883, Method 2026, Cond. I-B, 15 mins in each axis	NR	X	NR	NR	NR	NR
5	Thermal Shock	MIL-STD-883, Method 1011, Cond. A	X	X	X	NR	NR	NR
6	Temperature Cycle	MIL-STD-883, Method 1010, Cond. B 10 cycles min. MIL-STD-883, Method 1010, Cond. C 10 cycles min.	X NR	NR X	X NR	X NR	X NR	NR NR
7	Constant Acceleration	MIL-STD-883, Method 2001, Cond. A,Y1 plane only, 5000g	X	X	X	X	X	NR
8	Particle Impact Noise Detection	MIL-STD-883, Method 2020, Cond. B MIL-STD-883, Method 2020, Cond. A	X NR	NR X	X NR	X NR	NR NR	NR NR
9	Electrical Testing, Pre Burn-In	Nominal Vcc, +25 °C	X	X	X	X	X	X
10	1st Burn-In	MIL-STD-883, Method 1015, Cond. B	X 160 hrs.	X 240 hrs.	X 240 hrs.	X 160 hrs.	X 160 hrs.	NR
11	Electrical Testing, Intermediate	Nominal Vcc, +25°C and Op Temp Extremes	X	NR	NR	NR	NR	NR
12	2nd Burn-In	MIL-STD-883, Method 1015, Cond. B	X 160 hrs.	NR	NR	NR	NR	NR
13	Electrical Testing, Post Burn-In	Nominal Vcc and extremes, nominal temperature and extremes	X	X	X	X	X	NR
14	Seal: Fine Leak	MIL-STD-202, Method 112, Cond. C (5×10^{-8} atm cc/sec max) MIL-STD-883, Method 1014, Cond. A2 or B1	X NR	NR X	X NR	X NR	X NR	X NR
15	Seal: Gross Leak	MIL-STD-202, Method 112, Cond. D MIL-STD-883, Method 1014, Cond. B2 or B3	X NR	NR X	X NR	X NR	X NR	X NR
16	Radiographic Inspection	MIL-STD-883, Method 2012	X	X	X	X	NR	NR
17	Solderability	MIL-STD-883, Method 2003	1	1	1	1	1	1
18	External Visual	MIL-STD-883, Method 2009	X	X	X	X	X	NR
19	Group A Electrical Test[3]	MIL-PRF-55310	X	X	X	Sample	Sample	NR
20	Aging, 30 Day[2] (M55310 Group B)	MIL-PRF-55310, para. 4.8.35.1	X	X	X	Sample	Sample	NR
21	Group C Inspection (optional)	See 4.2. Optional Design, Test, and Data Parameters for details of supplier recommended Group C Inspection options	4.2(g)	4.2(f)	4.2(e)	4.2(e)	4.2(e)	NR

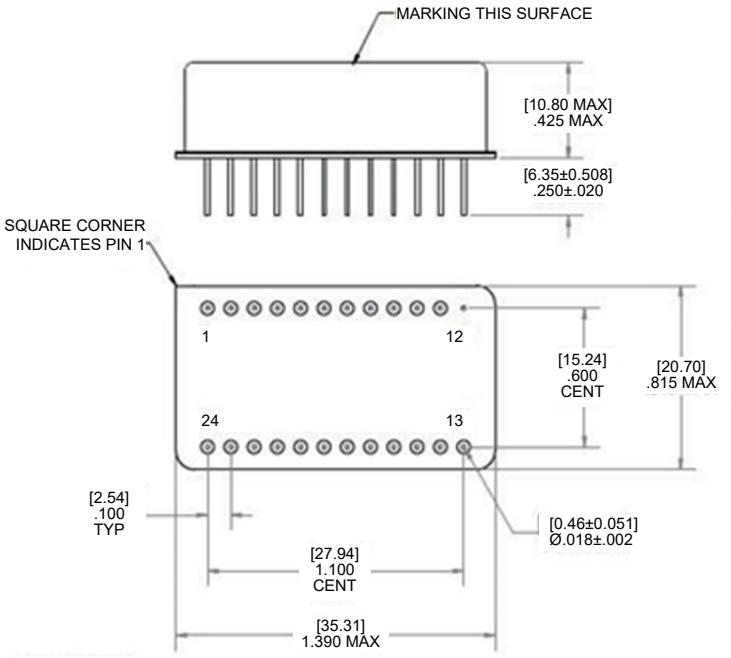
LEGEND: X = Required, NR = Not Required

Notes:

1. Performed at package LAT. Include LAT data sheet.
2. See 3.3.5.1. Frequency Aging Duration Option.
3. See 4.4. Delta Limit Exception.

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Figure 6-1. Models 2101/2111 Package Outline



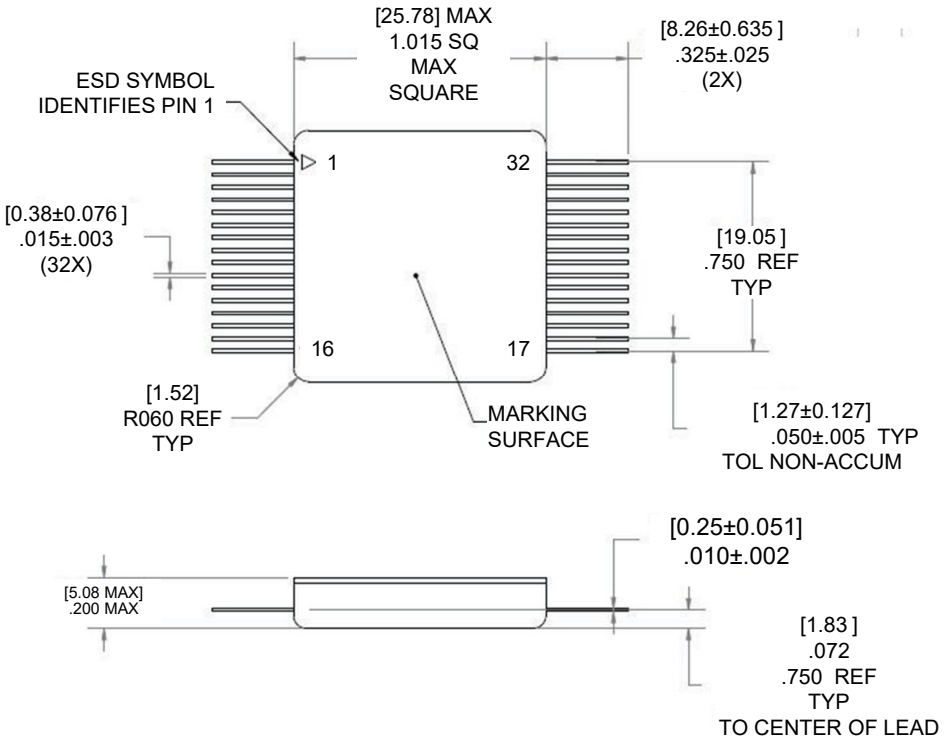
Pin	Function
1	EFC
12	GND/Case
13	RF Output
24	Vcc
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure and cover material: Kovar
4. Enclosure plating: Gold over nickel
5. Cover plating: Electroless nickel
6. Tolerance (unless otherwise specified): XXX± .005 [.130], XX±.01 [.25]

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Figure 6-2. Models 2102/2112 Package Outline



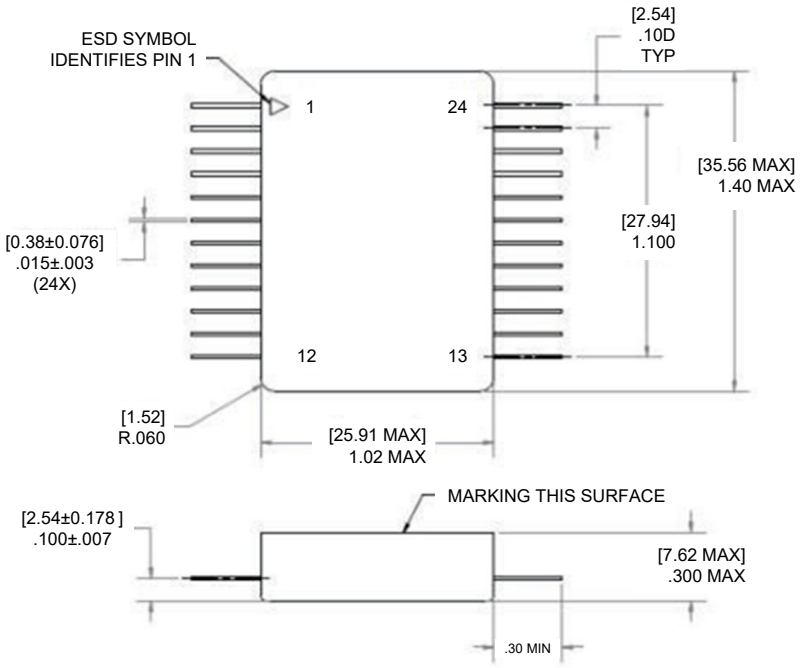
Pin	Function
4	EFC
5	GND/Case
11,13	Vcc
12	RF Output
All Others	No Internal Connection

Notes:

1. Leads 11 and 13 are connected internally. Either or both can be used
2. Pin numbers are for reference only and do not appear on the unit
3. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
4. Enclosure and cover material: Kovar
5. Enclosure plating: Gold over nickel
6. Cover plating: Electroless nickel
7. Tolerance (unless otherwise specified): XXX± .005 [.130], XX± .01 [.25]

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Figure 6-3. Models 2103/2113 Package Outline



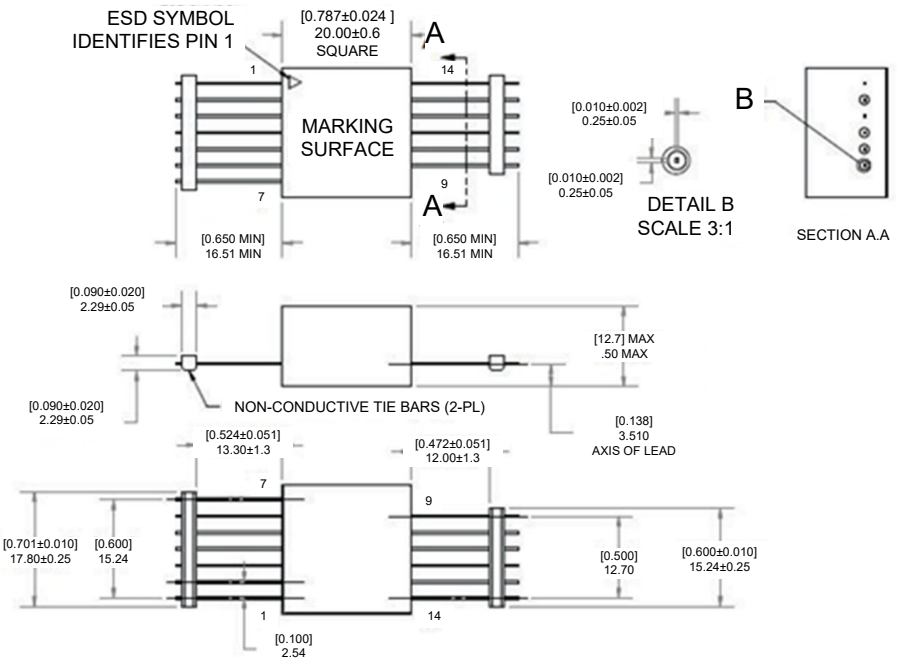
Pin	Function
1	EFC
12	GND/Case
13	RF Output
24	Vcc
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure material: Kovar
4. Enclosure plating: Gold over nickel
5. Tolerance (unless otherwise specified): XXX± .005 [.130], XX± .02 [.50]

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Figure 6-4. Models 2104/2114 Package Outline



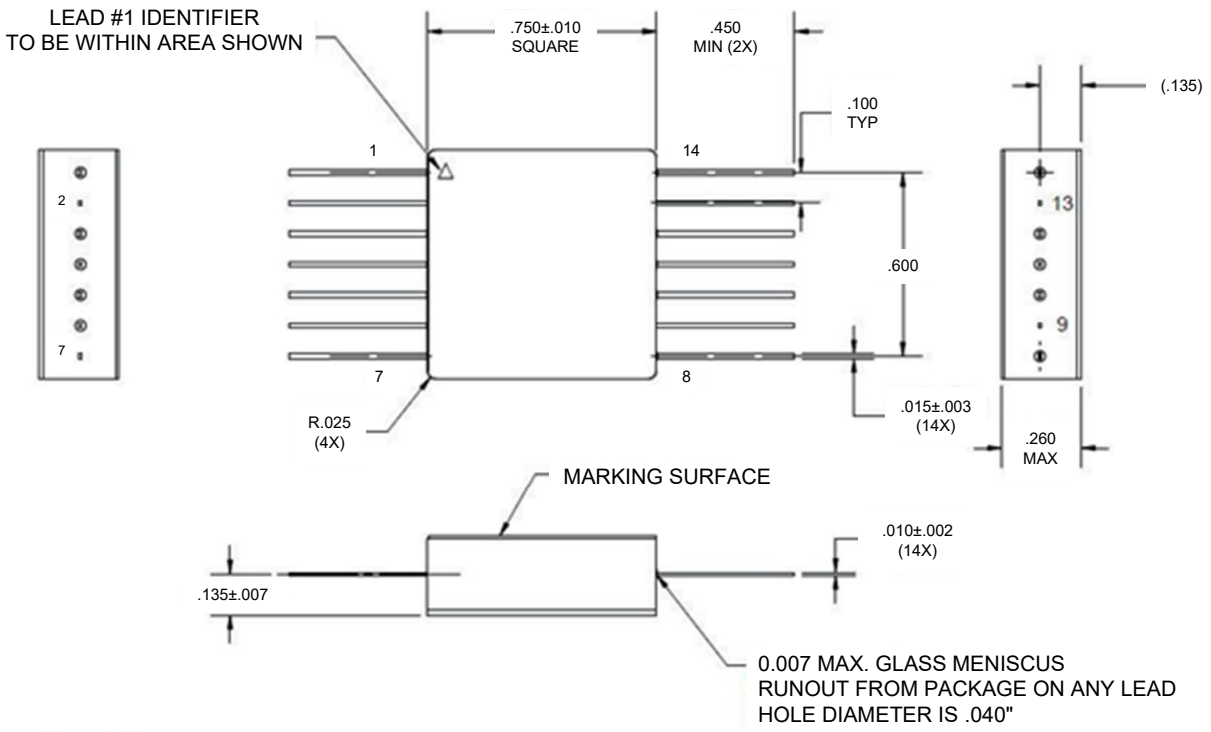
Pin	Function
1, 3, 7, 12, 14	GND/Case
2	Vcc
6	EFC
13	RF Output
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure material: Kovar
4. Enclosure plating: Gold over nickel
5. Tolerance (unless otherwise specified): XXX± .130 [.005], XX± .25 [.01]

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Figure 6-5. Model 2105/2115 Package Outline



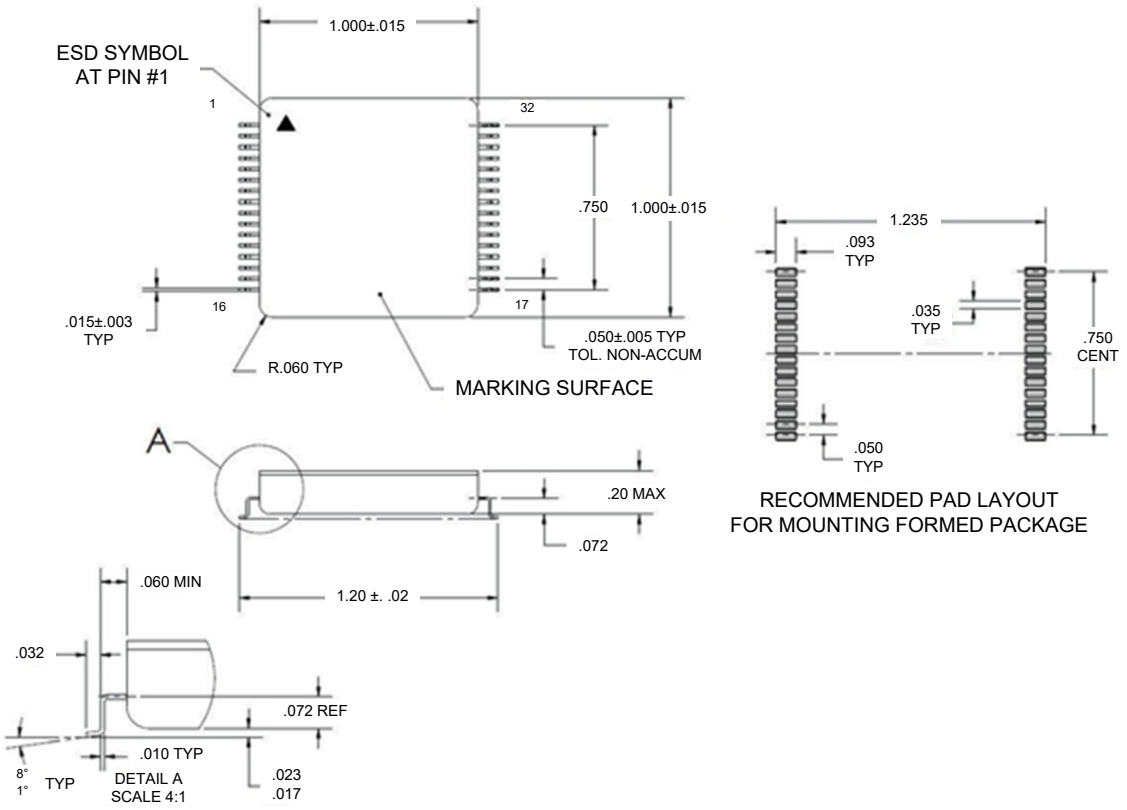
Pin	Function
1	EFC
2, 7, 9, 13	GND/Case
8	RF Output
14	Vcc
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure material: Kovar
4. Enclosure plating: Gold over nickel
5. Tolerance (unless otherwise specified): XXX± .005, XX± .02

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Figure 6-6. Models 2202/2212 Package Outline and Land Pattern



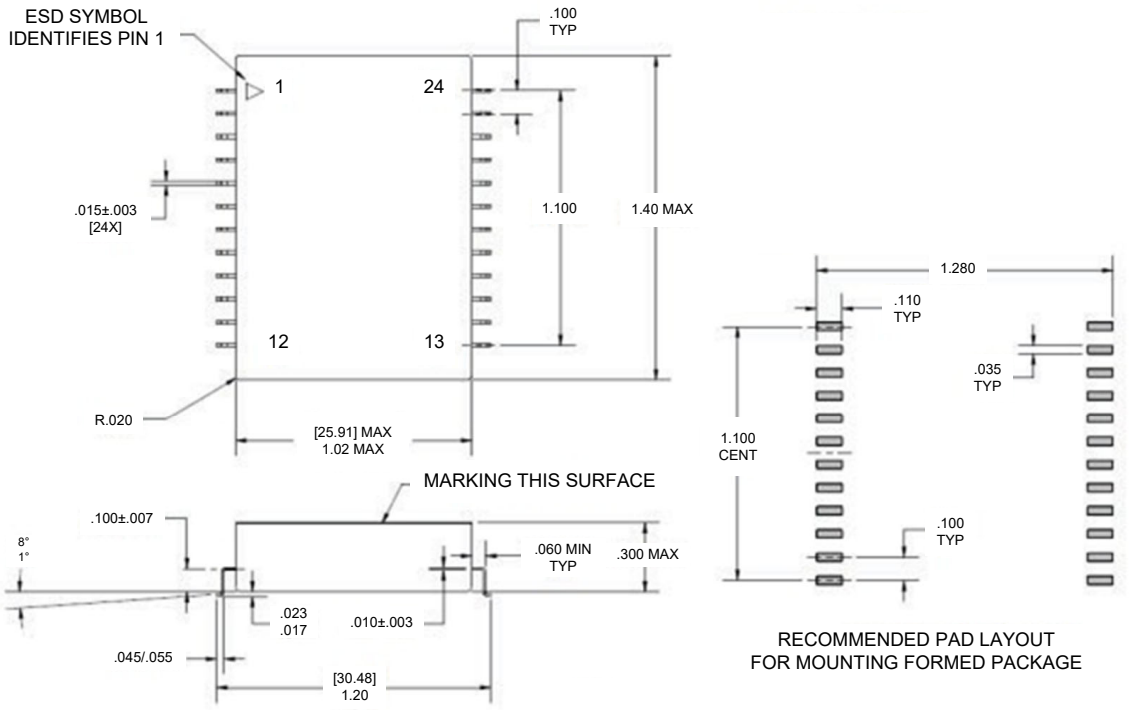
Pin	Function
4	EFC
5	GND/Case
11, 13	Vcc
12	RF Output
All Others	No Internal Connection

Notes:

1. Leads 11 and 13 are connected internally. Either or both can be used.
2. Pin numbers are for reference only and do not appear on the unit
3. We recommend all “no internal connection” pins be externally tied to ground. Lid it internally tied to case ground.
4. Enclosure material: Kovar
5. Enclosure plating: Electroless nickel
6. Tolerance (unless otherwise specified): XXX± .005, XX± .02

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Figure 6-7. Models 2203/2213 Package Outline and Land Pattern



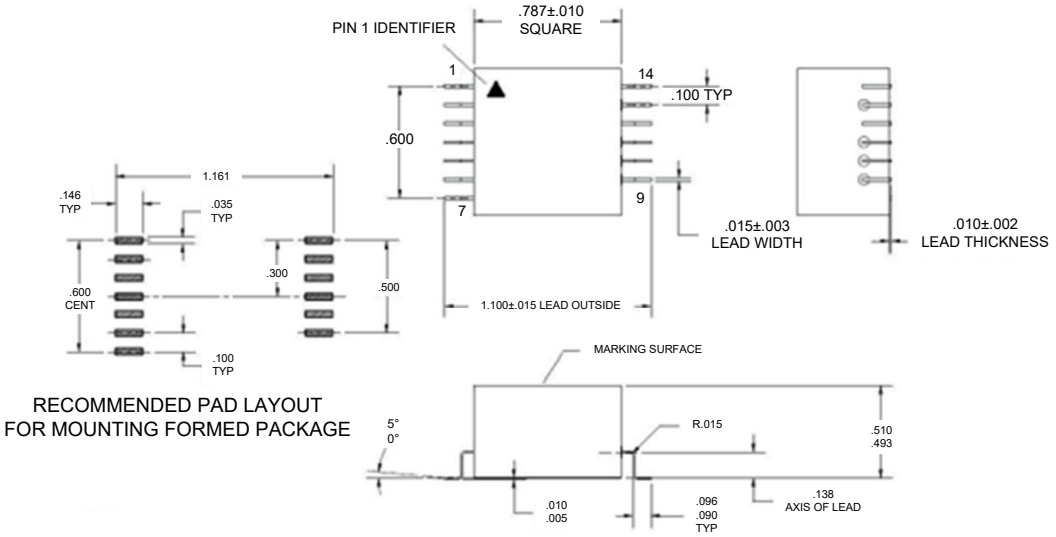
Pin	Function
1	EFC
12	GND/Case
13	RF Output
24	Vcc
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure material: Kovar
4. Enclosure plating: Gold over nickel
5. Tolerance (unless otherwise specified): XXX± .005, XX± .02

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Figure 6-8. Models 2204/2214 Package Outline and Land Pattern



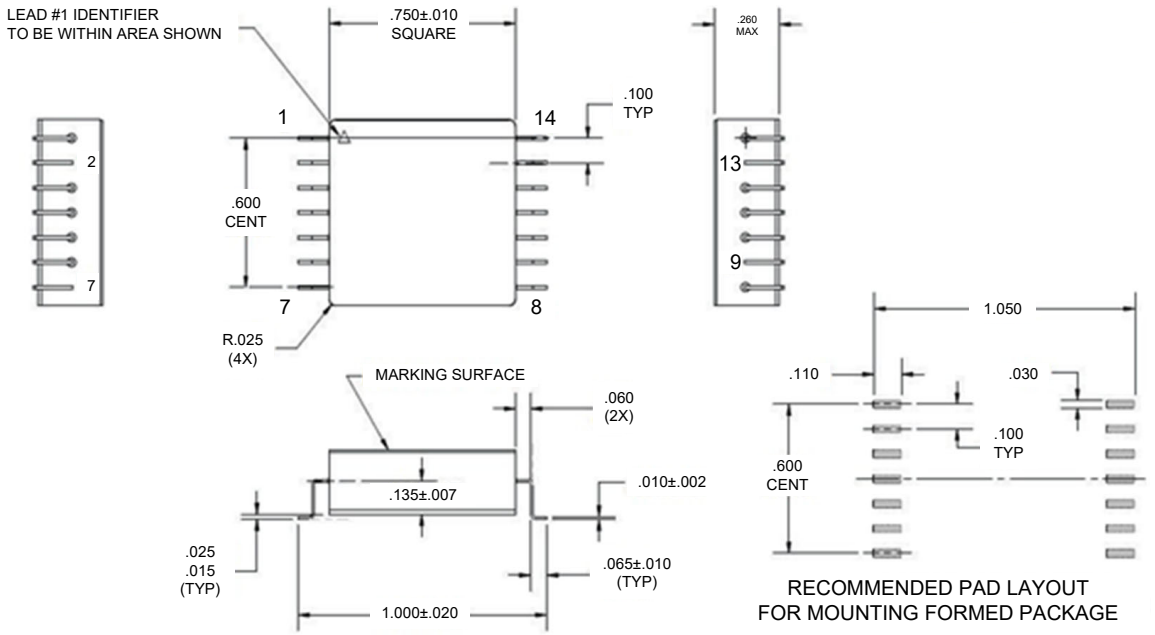
Pin	Function
1, 3, 7, 12, 14	GND/Case
2	Vcc
6	EFC
13	RF Output
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure material: Kovar
4. Enclosure plating: Gold over nickel
5. Tolerance (unless otherwise specified): XXX± .005, XX± .02

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Figure 6-9. Model 2205/2215 Package Outline and Land Pattern



Pin	Function
1	EFC
2, 7, 9, 13	GND/Case
8	RF Output
14	Vcc
All Others	No Internal Connection

Notes:

1. Pin numbers are for reference only and do not appear on the unit
2. We recommend all “no internal connection” pins be externally tied to ground. Lid is internally tied to case ground.
3. Enclosure material: Kovar
4. Enclosure plating: Gold over nickel
5. Tolerance (unless otherwise specified): XXX± .005, XX± .02

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7. Revision History

Revision	Date	Description
B	02/2026	• Updated Hi-Rel Standard revision to M • Made minor grammatical changes throughout • Added contact information to General • Updated Table 1-3 Other to say Microchip instead of Vectron • Updated Table 2-1 Absolute Maximum Ratings Storage Temperature Range and Junction Temperature rows to fix values in parenthesis • Updated SET LET and SEL LET information in Section 3.1.5 Radiation • Added sentence to the end of section 3.1.6 Packages • Moved Section 3.1.6.1 Traceability and Homogeneity to be Section 3.1.7 • Added reference to homogeneous material in Section 3.1.7 Traceability and Homogeneity and reordered information • Added Program Management information to Section 3.3.4 Frequency Set • Updated the table range in Section 3.3.6 Operating Characteristics • Updated Table 4-2 Design Pedigree rows R and B with Premium Q Swept Quartz • Updated Section 4.2 Optional Design, Test, and Data Parameters – Added cross reference to line b – Added MIL-HDBK-217 information to line i – Added DPA leak information to line n • Updated Section 4.2.1 NASA EEE-INST-002 to include destruct specimens • Added information to Section 4.5 Deliverable Data on lines b with reference resistor values and c with reference destruct specimens • Removed ESD from Section 5.1 Packaging • Added reference to ANSI/ESD S20.20 to Section 5.1 Packaging • Added alphanumeric information to Section 6.1 Ordering Part Number • Added Frequency to the figure in Section 6.1 Ordering Part Number • Removed cross references in Section 6.1.2 Design Pedigree • Updated Section 6.1.3 Output Frequency to add examples • Renamed Section 6.2 Option Design, Test and Data Parameters to Electrical Characteristics and Test Parameters and reworded opening sentence • Updated Table 6-7 Electrical Test Parameters adding section headers and removing (Fast/Slow Start) from Start up Time • Changed TC to Cond in Table 6-8 Screening and Test Matrix rows 14 and 15 • Removed figure notes and added them to tables in Section 6.2 Optional Design, Test and Data Parameters • Updated value in Figure 6-3 Models 2103/2113 Package Outline from 300 to .300 • Updated value in Figure 6-4 Models 2104/2114 Package Outline from 1 to .1 • Updated values in Figure 6-6 Models 2202/2212 Package Outline from .0750 to .750 and 1.00 to 1.000
A	04/2025	Converted Vectron Hi-Rel Standard revision L to Microchip branding with document number DS00005937 revision A. Minor text changes throughout.

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