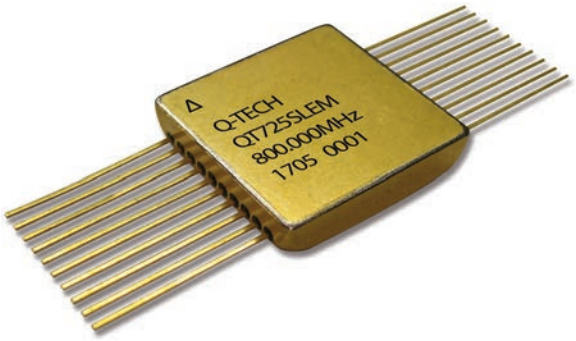
Description

Q-Tech QT725S low noise Voltage Controlled SAW Oscillators provide superior performance at operating frequencies from 400 MHz to 1.3GHz. QT725S delivers low phase noise; -135 dBc/Hz at 10 kHz offset and –168 dBc/Hz noise floor. Typical vibration sensitivity is 1ppb/g.

The QT725S VCSO is a Class 2 hybrid per MIL-PRF-55310, hermetically sealed, in a 20-pin Flat-Pack 0.625" square, and operated at maximum temperature range for –40°C to +85°C. Absolute Pull range (APR) is ±20ppm.



Features

- Made in USA
- Hermetically sealed packages
- Supply voltages 3.3Vdc, 5.0Vdc and 12.0Vdc
- Wide temperature range –40°C to +85°C with guaranteed APR
- Screened to MIL-PRF-55310, Level S or Modified MIL-PRF-38534, Class K
- Sine Wave Output
- 300k(Si) Radiation Tolerant
- Low Phase Noise
- Low Vibration sensitivity < 2 ppb/g

Ordering Information

(Sample part number)
QT725SCEM-1.000GHz

QT725S	C	E	M	-	1.000GHz

Model:
QT725S = Straight leads
QT727S = Lead Formed

Supply Voltage:
L = +3.3Vdc ±5%
C = +5Vdc ±5%
D = +12Vdc ±5%

Operating Temperature:
E = -40ºC to +85ºC
F = -20ºC to +70ºC

Frequency
400 MHz - 1.3 GHz 1/

Screening and QCI:

B	=	BreadBoard Model
E	=	Engineering Model
M	=	Flight Model (Screening and QCI per MIL-PRF-38534 [modified] See Tables III-IX)
S	=	Flight Model (Screening and QCI per MIL-PRF-55310, Level S; See Tables X-Xd)

1/ Please contact Q-Tech for higher frequencies

Applications

- Phase Lock Loops (PLL)
- Satellites
- Aerospace
- Space Clock Recovery
- Low Phase Noise, High Frequency

Packaging Options

- Standard ESD packaging

1.0 REQUIREMENTS

1.1 General Requirements
The parts shall comply with the requirements of MIL-PRF-38534, Class K and MIL-PRF-55310, Level S except as modified or supplemented herein.

1.2 Approved Source of Supply
Hybrid SAW oscillators shall be supplied from the manufacturer specified in "Source of Supply" below.

1.3 Case Outline and Terminial Connections
The case outline and terminal connections shall be as specified in Figure 1 (A or B) herein.

1.4 Maximum Ratings
The maximum ratings shall be as specified in Table I herein.

1.5 Electrical Performance Requirements
The electrical performance requirements shall be as specified herein.

1.6 Design and Construction
The design and construction of the device shall be as specified herein. As a minimum, the device shall meet the design and construction requirements of MIL-PRF-55310.

1.6.1 Engineering Model and Breadboard Model Oscillators
Unless otherwise specified in the data sheet, the general requirements for non-flight hardware (Breadboard and Engineering models) shall be defined in Q-Tech form **F1221, Definitions for Hybrid Product Development Levels**.

1.7 Radiation Hardness
No elements shall be used in the unit that latch-up in a single event upset (SEU) environment. All devices used in the unit shall be capable of meeting all electrical performance requirements after being subjected to the total dose level 300kRad.

1.8 Element Derating
All active and passive elements shall be derated in accordance with the applicable hybrid microcircuit element requirements of MIL-STD-975. Elements shall not operate in excess of derated values.

1.9 Element Evaluation
All piece parts shall be derived from lots that meet the element evaluation requirements of MIL-PRF-38534, Class K, except for the following exceptions:

1.9.1 Active Elements
a) Visual Inspection of Silicon on Sapphire Microcircuits
Semicircular crack(s) or multiple adjacent cracks, not in the active area, starting and terminating at the edge of the die are acceptable.
Note: Attached (chip in place) sapphire is nonconductive material and shall not be considered as foreign material and will be considered as nonconductive material for all inspection criteria.

b) Subgroup 4 – Scanning Electron Microscope (SEM) Inspection
The manufacturer may allow the die distributor, at his option, select two dice from a waffle pack (containing a maximum quantity of 100 die), visually inspect for the worst case metallization of the 2 dice, and take SEM photographs of the worst case.

c) Subgroup 5 – Radiation Tests
Subgroup 5 radiation tests are not required unless otherwise specified in the detail SCD.

1.9.2 Package Elements
a) Salt Spray
Salt spray testing is not required.

1.10 **SAW Resonator Material**
Unless otherwise specified by the detail SCD, the resonator shall be described per ANSI/IEEE 176-1987.

1.11 **SAW Resonator Mounting**
The package SAW resonator shall be epoxy attached in such a manner as to assure adequate crystal performance when the oscillator is subjected to the environmental conditions specified herein.

1.12 **Thick Film Hybrid Technology**
When possible, all piece part electronic elements (except the SAW resonator) shall be mounted on the surface of thick film substrates. All lead attachment shall have appropriate strain relief. There shall be no solder allowed internally.

1.13 **Package Material and Finish**
The package material and finish shall be in accordance with MIL-PRF-38534 and as specified.

1.14 **Lead Material and Finish**
The lead material and finish shall be in accordance with MIL-PRF-38534 and as specified herein.

1.15 **Maximum Allowable Leak Rate**
The maximum allowable leakage rate shall be as specified by MIL-STD-883, Method 1014 based on the internal cavity volume. The hermetic seal (fine and gross leak) tests shall be in accordance with MIL-STD-883, Method 1014.

1.16 **Weight**
The weight of the crystal oscillator shall be 6 ounces maximum.

1.17 **Electrical Performance Limits and Conditions**
Unless otherwise specified, the electrical performance limits and conditions shall be as specified in Table II herein.

1.18 **Spurious Output Frequencies**
The oscillator shall not break into other (unwanted) modes of oscillations.

1.19 **Delta Criteria**
The crystal oscillator shall meet the parameter delta criteria of Table II herein. The change in the parameter (delta) shall be calculated between the initial measurement and the present (interim or final) measurement.

1.20 **Marking**
Each unit shall be permanently marked with the manufacturer's name or symbol, part number, lot date code number, and serial number. The unit shall be marked with the outline of an equilateral triangle near pin 1 to show that it contains devices which are sensitive to electrostatic discharge.

1.21 **Traceability**
Material, element, and process traceability requirements shall be as specified by MIL-PRF-38534 for Class K hybrid microcircuits.

1.22 **Rework Provisions**
Rework shall be in accordance with the provisions of MIL-PRF-38534 except rebonding to microcircuit elements shall be as specified by MIL-PRF-38535 and transistor elements shall be as specified by MIL-PRF-19500.

2.0 QUALITY ASSURANCE PROVISIONS

2.1 Responsibility for Tests and Inspections

Unless otherwise specified in the contract or purchase order, the supplier shall be responsible for the performance of all inspection requirements as specified. Except as otherwise specified in the contract or purchase order, the supplier may use their own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Customer. The Customer reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements, and to return any product failing to meet the specified requirements.

2.2 Screening

Hybrid SAW oscillators shall have been subjected to and successfully passed all screening tests as specified in Table IV or Table X herein in order to be acceptable for delivery. All variable data shall be read and recorded. Devices which fail any test criteria in the screening sequence shall be removed from the lot at the time of observation or immediately at the conclusion of the test in which the failure was observed. Once rejected and verified as a device failure, rework and subsequent rescreening in accordance with the rework provisions may be performed.

2.2.1 Nondestructive Wire Bond Pull

Except for the wires connecting the crystal to the circuit (if applicable), 100% nondestructive wire bond pull shall be performed on each hybrid SAW oscillator in accordance with MIL-STD-883, Method 2023. The total number of failed wires and the total number of devices failed shall be recorded. The lot shall have a percent defective allowable (PDA) of 2% or less based on the total number of wires pulled in the production lot.

2.2.2 Internal Visual Inspection

Internal visual inspection shall be in accordance with the Condition K (Class S) requirements of MIL-STD-883, Methods 2017 and 2032. During the time interval between final internal visual inspection and preparation for sealing, hybrid SAW oscillators shall be stored in a dry, controlled environment as defined in MIL-STD-883, Method 2017, or in a vacuum bake oven. The following details shall apply:

a) The final internal visual inspection shall occur after SAW resonator installation and prior to cover seal.
b) Hybrid SAW oscillator inspection and preparation for sealing shall be in a class 100 environment as defined in Federal Standard 209 (ISO Standard 14644).
c) Hybrid SAW oscillators shall be in a covered container when transferred from one controlled environment to another.

2.2.3 Stabilization Bake

Stabilization bake shall be performed prior to package seal. Stabilization bake shall be performed in a vacuum environment.

2.2.4 Temperature Cycling

Unless otherwise specified, temperature cycling shall be in accordance with Table IV or Table X herein.

2.2.5 Constant Acceleration

Constant acceleration shall be performed in the Y1 orientation.

2.2.6 Particle Impact Noise Detection (PIND) Test

PIND testing shall be performed in accordance with MIL-STD-883, Method 2020, Condition A or B. The PIND test shall be performed using five independent passes and all failures found at the end of each pass are rejected. The survivors of the last pass are acceptable. The cumulative number of defective devices shall not exceed 25%.

2.2.7 Pre Burn-In Electrical Characteristics Test

Unless otherwise specified, pre burn-in electrical testing shall consist of the tests listed in Table IX or Table Xd. Electrical performance limits shall be in accordance with Table III herein.

2.2.8 **Burn-In**

The burn-in periods shall be two burn-in periods of 160 hours minimum each or 240 hours minimum in accordance with Table IV or Table X herein. Electrical testing shall be performed after the first burn-in period to select acceptable devices for the second burn-in period.

2.2.9 **Interim Electrical Testing**

Unless otherwise specified, interim electrical testing shall consist of the tests listed in Table IX or Table Xd. Electrical performance limits shall be in accordance with Table III herein.

2.2.10 **Final Electrical Testing**

Unless otherwise specified, final electrical testing shall consist of the tests listed in Table IX or Table Xd. Electrical performance limits shall be in accordance with Table III herein.

2.2.10.1 **Delta Limits Review**

Unless otherwise specified, delta limits shall be in accordance with Table II herein.

2.2.10.2 **Percent Defective Allowable (PDA)**

The percent defective allowable shall be 2% or one device, whichever is greater. PDA accountability shall be based on failures occurring during the second period of burn-in only. PDA shall be applicable to the +25°C supply current only.

2.2.11 **Seal Test**

Seal test may be performed in any sequence between the final electrical test and the external visual but it shall be performed after all shearing and forming operations on the terminals. All hybrid crystal oscillators having any physical processing steps (e.g. solder dipping to the glass seal) performed following seal or external visual shall be retested for hermeticity and visual defects.

2.2.12 **Radiographic Inspection**

Radiographic inspection shall be performed in accordance with MIL-STD-883, Method 2012, views X-, Y-, and Z-axis.

2.2.14 **External Visual**

The final external visual screen shall be conducted in accordance with MIL-STD-883, Method 2009 after all other 100% screens have been performed to determine that no damage to, or contamination of the package exterior has occurred.

2.3 **Quality Conformance Inspection (QCI)**

Quality conformance inspection shall be as specified herein. All records shall be traceable to the lot number and unit serial number. Samples used for Group A that pass all tests may be delivered on contract.

2.3.1 **Oscillator Group A Inspection**

Group A inspection shall be conducted in accordance with Table V or Table Xa herein. Group A inspection shall be performed on units that have passed the screening tests. All electrical performance tests shall be performed during Group A with the exception of any tests performed as part of final electrical testing during 100% screening.

2.3.2 **Oscillator Group B Inspection**

Group B inspection shall be conducted in accordance with Table VI or Table Xb herein. The screening test rejects that have been subjected in screening through completion of Burn-in tests may be used for Group B Inspection in accordance with Table VI.

2.3.2.1 **Frequency Aging**

The energized hybrid SAW oscillator(s) shall be maintained at a temperature of 70 ± 3 °C for a continuous period of 30 days. Unless otherwise specified, the frequency of the oscillator shall be measured in accordance with MIL-PRF-55310. The measuring instrument's accuracy shall be commensurate with the required accuracy of the oscillator. The same measuring instruments shall be used throughout the aging test. If any condition develops that will change the temperature of the oscillator from the aging temperature for a time interval of more than one hour, no measurement shall be made until 24 hours after the temperature restoration and the specified test period shall be lengthened by the length of time that the temperature failed.

2.3.2.2 When performing screening in accordance with Table IV, Aging tests may be terminated after 15 days if the drift does not exceed one-half of the specified Aging rate.

2.3.3 **Oscillator Group C Inspection**

Group C inspection shall be conducted in accordance with Table VII or Table Xc herein.

2.3.4 **Oscillator Group D Inspection**

Group D inspection shall be conducted in accordance with Table VIII herein. The generic package evaluation data may be submitted to the Customer for review in lieu of performing this test.

2.3.4.1 **Group D Samples**

Sealed empty packages that have been subjected to the handling and stress conditions may be used for Group D testing.

2.4 **Destructive Physical Analysis (DPA)**

A DPA may be performed on each lot of devices in accordance with MIL-STD-883, Method 5009. The DPA shall be performed by the Customer.

2.5 **Workmanship**

Devices shall be manufactured, processed, and tested in a careful and professional manner in accordance with good engineering practice, with the requirements of this specification, and with the production practices, workmanship instructions, and inspections and test procedures prepared by the manufacturer in fulfillment of the product assurance program.

2.6 **Data**

2.6.1 **Design and Part Configuration Documentation**

The manufacturer shall establish baseline documentation sufficient to completely define and control the configuration of devices supplied to this specification. The documentation shall form the basis for defining the device qualified to this specification and all devices supplied on subsequent procurement shall be the same as that qualified. No changes in construction, technology, or manufacturing processing shall occur without Customer approval.

2.6.2 **Design Documentation**

When required by the purchase order, design, topography, circuit schematic, and process and flow charts for all assembly, inspection, and test operations for devices to be supplied under this specification on the initial procurement shall be established and shall be available in-plant for review by the procuring activity upon request. This design documentation shall be sufficient to depict the physical and electrical construction of the devices supplied under this specification and shall be traceable to the specific parts, drawings, or part type numbers to which it applies, and to the production lot(s) and inspection lot codes under which devices are manufactured and tested so that revisions can be identified.

2.6.2.1 **Technical Data Package**

When required by purchase order, the following design documentation and information is deliverable 30 days prior to the start of production. The Technical Data Package shall consist of the following:

a) Assembly Drawing(s)
b) All Electrical Schematics and Drawings Not Considered Proprietary or Controlled by Export Regulations
c) Assembly and Screening Travelers to be Used During the Manufacture of Devices Supplied to this SCD.
d) Parts and Materials List

2.6.3 **Design Documentation Approval**

After the design documentation is approved by the Customer, any changes or revisions to these documents must be submitted for review and approval to the Customer prior to processing subsequent lots, or at the time of placement of subsequent purchase order.

2.7 **Test Report**

A test report shall be supplied with each shipment of hybrid crystal oscillators and shall include the following information, as a minimum:

a) Certificate of Compliance to all specifications and purchase order requirements. As a minimum, the Certificate of Compliance shall include the following:
   1) Purchase Order Number
   2) Applicable Part Number
   3) Manufacturer Lot Number
   4) Lot Date Code
b) Parts and Materials Traceability Information
c) Certificate of Crystal Sweeping
d) Manufacturing Lot Traveler.
e) Screening Attributes and Variables Data as Applicable
f) Quality Conformance Inspection Attributes and Variables Data as Applicable
g) Radiographic Inspection Negatives

2.8 **Problem Reporting**

The manufacturer shall notify the Customer technical representative within 24 hours of the occurrence of the following:

a) Any Failures Detected During Quality Conformance Inspection
b) Delays Resulting from:
   1) Test Equipment Breakdown
   2) Test Error
   3) Other Testing-Related Problems that Adversely Affect Schedule

2.9 **Customer Source Inspection**

Provisions for periodic in-process source inspection by the Customer shall be included in the supplier's manufacturing plan. The supplier shall provide Customer 72 hours minimum notice when the deliverable devices are ready for an in-process source inspection. The inspection points shall, as a minimum, be:

a) Pre-Cap Visual Inspection
b) Pre-Shipment Inspection

2.10 **Retention of Records**

All records pertaining to the design, processes, incoming receiving, in-process inspections, screening and quality conformance inspection, product lot identification, product traceability, failure reports and analyses, etc. shall be retained by the supplier for a period of 10 years from the date of product shipment.

3 PREPARATION FOR DELIVERY

3.1 **Packaging**

The requirements for packaging shall be in accordance with MIL-PRF-55310.

3.2 **Electrostatic Discharge Sensitivity**

The devices supplied to this drawing shall be considered to be electrostatic discharge sensitive and require further protection and shall use one of the packaging requirements in accordance with MIL-PRF-38534, Category A, Section 5.

4 **NOTES**

4.1 **Ordering Data**

The contract or purchase order should specify the following:

a) Customer part number.
b) Quality Conformance Inspection requirements.
c) Requirements for special technical documentation Data Package.
d) Test data requirements.
e) Special packaging.
f) Requirement for source inspection and notification.

4.2 **Handling**

The devices used must be handled with certain precautions to avoid damage due to electrostatic discharge.

4.3 **Certificate of Conformance**

Certificate of conformance to this specification, signed by an authorized representative of the manufacturer, shall accompany each shipment.

4.4 **Approved Sources of Supply**

4.4.1 **Approved Manufacturer**

Q-Tech Corporation
10150 West Jefferson Boulevard
Culver City, CA 90232-3510 USA

TABLE I - ABSOLUTE MAXIMUM RATINGS*

PARAMETERS	SYMBOL	CONDITIONS	RATING	UNIT
Supply voltage (Voltage Codes L and C) 1/	Vcc	Between Vcc and Vss	-0.5 to +7.0	V
Supply voltage (Voltage Code D) 1/	Vcc	Between Vcc and Vss	-0.5 to +15.0	V
Operating Case Temperature	Tc		-40 to +85	°C
Junction Temperature	Tj		+150	°C
Storage Temperature	Tstg		-65 to +150	°C
Lead solder Temperature/Time			+250/10	°C/s
Package Thermal Resistance	θJC		50	°C/W

1/ Vcc parameter ratings are values that must not be exceeded. This product may suffer permanent damage if maximum ratings are exceeded. Operation and characteristics are guaranteed within recommended operating conditions.

TABLE II - DELTA LIMITS

TEST	PARAMETER	SYMBOL	DELTA LIMITS
Burn-In (Second or after 240 hour burn-in period)	Supply current	Icc	±10% of initial reading
Frequency aging at 70°C	Output frequency	F0	Refer to Table III
Life Test after 1000 hours at 125°C	Supply current	Icc	±10% of initial reading

TABLE III - ELECTRICAL CHARACTERISTICS

PARAMETERS	SYMBOL	TEST CONDITIONS [1]	MIN	TYP	MAX	UNIT
Center Frequency [2]	FO		400		1300	MHz
Supply Voltage	Vcc		3.135	3.3	3.465	V
			4.75	5.0	5.25	
			11.4	12.0	12.6	
Operating temperature	Top	See Temperature code				ºC
Supply current	Icc	at Vcc=3.465V at Vcc=5.25V at Vcc=12.6V	- - -	50 65 100	60 80 110	mA
Frequency Stability	DF/DT	Over operating Temperature range	-200		+50	ppm
Control Voltage	Vc		0		3.3	V
			0		5.0	
			0		12.0	
Absolute Pull Range	APR		±10	±20		ppm
Tuning K Vcc=5.0V	Kvco	For 1GHz Output		70		kHz/V
Tuning Kr=Kmax/Kmin.				3:1	4:1	
Output Power	Po	50 ohms	7.0	8.0	12.0	dBm
Harmonics					-30	dBc
Sub-Harmonics					-20	dBc
Non-harmonics Spurious				<-80	<-80	dBc
SSB Phase Noise 1 GHz (500 MHz X2)		At 1kHz		-105	-95	dBc/Hz
		At 10kHz		-135	-125	
		At 100kHz		-155	-150	
		At 1MHz (Noise floor)		-168	-155	
Vibration Sensitivity				1	2	ppb/g
Aging (at 70ºC±3ºC)		First (1) Year	-20	±10	20	ppm
		Life	-30		30	
Integrated Jitter (RMS) @ 1GHz		100Hz to 20MHz 1kHz to 20MHz 10kHz to 20MHz		900 84 16		fs

[1] Test Conditions Unless Stated Otherwise: Nominal Vcc, Nominal Load, +25ºC ± 3ºC
[2] Direct Frequency Output or Internal Multiplication is used based on noise requirements.

TABLE IV - SCREENING TESTS MIL-PRF-38534, CLASS K (MODIFIED)

TEST DESCRIPTION	STANDARD	METHOD	CONDITION	COMMENTS
Non Destructive Bond Pull	883	2023		2.4 grams
Internal Visual	883	2017	K	Class S
Stabilization Bake	883	1008	C	48 hours at +150°C
Temperature Cycling	883	1010	C, 10 Cycles	
Constant Acceleration	883	2001	A	Y1 direction only
Particle Impact Noise Detection (PIND)	883	2020	B	5 passes Note 1
Pre Burn-In Electrical	Refer to Table III and Table IX			
Burn-In	883	2015	125°C for 160 hours	Note 2
Interim Electrical	Refer to Table III and Table IX			
Burn-In	883	1015	125°C for 160 hours	
Final Electrical	Refer to Table III and Table IX			
Percentage Defective Allowance (PDA)	2% or one unit whichever greater			Note 4
Seal; Fine Leak	883	1014	B1	
Seal; Gross Leak	883	1014	B2	
Radiographic Inspection	883	2012	Class S	
Frequency Aging	MIL-PRF-55310	-	70°C±3°C	Note 3
External Visual	883	2009		

NOTES

1) PIND testing shall be performed using five (5) independent passes and all failures found at the end of each pass are rejected. The survivors of the last pass are acceptable.

2) Burn-in shall be under the specified load and nominal voltage conditions.

3) Normally, frequency aging tests are for 30 days. However, the frequency aging test may be ceased if after 15 days the measured aging rate is less than half of the specified aging rate.

4) Percent defective allowable (PDA) of selected critical parameters is accountable from interim to final electrical testing of current (Icc) at room temperature only.

TABLE V - GROUP A INSPECTION

TEST DESCRIPTION	CONDITION
Supply Current	25°C and temperature extremes
Frequency - Temperature Stability	Over specified operating temperature range, measure output frequency at minimum eleven equispaced points of the temperature extremes. Test points shall include room temperature
Frequency - Voltage Tolerance	25°C and temperature extremes
Output Power	
Harmonics	
Sub-Harmonics	
Absolute Pull Range	
Spurious	
Phase Noise	25°C

NOTES
1. All electrical performance shall be performed during Group A with the exception of any tests performed as part of the final electrical testing during 100 percent screening.
2. Electrical performance characteristics and requirements shall be in accordance with Table III and Table IX herein.

TABLE VI - GROUP B INSPECTION

SUB-GROUP	TEST DESCRIPTION	MIL-STD-883		QUANTITY (Accept No.)
		METHOD	CONDITION	
1	Physical dimensions	2016	-	2(0)
2	Particle impace noise detection (note 2)	2020	B	15 (0)
3	Resistance to solvents	2015	-	3(0)
4	Internal visual and mechanical	2014	-	1(0)
5	Bond strength (note 3)	2011	C or D	2(0)
6	Die shear strength (note 4)	2019	-	2(0)
7	Solderability (note 5)	2003	Solder temp.: 245°C±5°C	1(0)
8	Seal; Fine and Gross Leak (note 6)	1014	B1 and B2	4(0)
9	ESD classification (note 7)	3015	-	3 (0) +3

NOTES
1. Non catastrophic screening test rejects may be used for Group B.
2. To be omitted. Being performed during screening, see Table IV.
3. Subgroup 5 shall be performed in accordance with the Group B bond strength requirements of MIL-PRF- 38534. This test is may be performed in-process any time prior to cover seal.
4. Die shear test samples shall not be the same units as subjected to bond pull. Die shear specimens shall not b exposed to the 300 °C preconditioning used for the bond strength test.
5. Solder temperature shall be 245 +5 ºC.
6. Subgroup 8, the fine and gross leak tests are being done during screening, see Table IV.
7. Subgroup 9, the ESD classification test, is not required. The hybrid has been classified as ESDS Class 1 (i.e., Electrostatic voltage = 0 to 1999 V) and shall be marked accordingly. Total of six units required (three units for testing and three units for setup).

TABLE VII - GROUP C INSPECTION

SUBGROUP	TEST DESCRIPTION	MIL-STD-883		QUANTITY (Accept No.)
		METHOD	CONDITION	
1	External visual	2009	-	5(0)
	Temperature cycling	1010	C, 20 cycles	
	Constant acceleration	2001	A, Y1 direction only	
	Seal (fine and gross leak)	1014	B1 and B2	
	Radiographic inspection	2012	-	
	Visual examination	2009		
	End point electricals			
2	End point electricals			5(0)
	Steady state life	1005	1000 hours at 125°C	
	End point electricals			
3	Internal water vapor content	1018		3(0) or 5(1)

NOTES

1. It is recommended to use 10 specimens for Group C Inspection - 5 units for Subgroups 1 and 3, and 5 units for Subgroup 2. 5 units may be used for Group C Inspection, but the Customer procures this quantity at their own risk. Usage of specimens that have completed Subgroups 1 and 2 Testing for Subgroup 3 Testing is not recommended. This limited acquisition shall only be used if this risk is acceptable to the Customer, and the Customer assumes responsibility for Subgroup 3 failures if only five units are procured for Group C Inspection.
2. Subgroup 3 Testing shall only use specimens that have completed Subgroup 1 Testing.
3. End point electricals shall be as specified in accordance with Table III and Table IX herein.
4. Frequency accuracy (and/or frequency/temperature stability) limits for post steady state life electrical testing shall be relaxed by six times the projected first year aging limit (±120ppm) as specified in the this specification. If no such limit is specified, the limit shall be relaxed ± 60ppm. Notwithstanding, device performance that appears out-of-family shall be subjected to further evaluation.

TABLE VIII - GROUP D INSPECTION

SUBGROUP	TEST DESCRIPTION	MIL-STD-883		QUANTITY (Accept No.)
		METHOD	CONDITION	
1	Thermal shock	1011	C	5(0)
	Stabilization bake	1008	1 hour at 150°C	5(0)
	Lead integrity	2004	B2 (lead fatigue)	1(0)
	Seal (fine and gross leak)	1014	B1 and B2	5(0)

TABLE IX - E.T. MEASUREMENT REQUIREMENTS/MATRIX

ELECTRICAL PARAMETERS	PRE BURN-IN @25 °C	PRE BURN-IN @LOW TEMP.	PRE BURN-IN @ HIGH TEMP.	INTERIM BURN-IN @25 °C	POST BURN-IN @25 °C	POST BURN-IN @LOW TEMP.	POST BURN-IN @ HIGH TEMP.	GROUP A @25 °C	GROUP A @LOW TEMP.	GROUP A @ HIGH TEMP.	GROUP C
Output Frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ (Note 3)
Frequency/Temperature stability								See Note 2			
Frequency/voltage stability	✓				✓			✓	✓	✓	✓
Input Current	✓			✓	✓	✓	✓	✓	✓	✓	✓
Output Power	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Harmonics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sub-Harmonics	✓	✓	✓	✓	✓			✓	✓	✓	✓
Absolute Pull Range	✓	✓	✓	✓	✓			✓	✓	✓	✓
Phase Noise	✓				✓			✓			✓
Spurious	✓				✓			✓	✓	✓	✓

✓ = Required measurement

NOTES
1. Electrical performance characteristic shall be in accordance with Table III herein.
2. Measure the output frequency at minimum eleven equispaced points of the specified operating temperature range. Test points shall include reading at room temperature.
3. Frequency accuracy (and/or frequency/temperature stability) limits for post steady state life electrical testing shall be relaxed by six times the projected first year aging limit (±120ppm) as specified in the this specification. If no such limit is specified, the limit shall be relaxed ± 60ppm. Notwithstanding, device performance that appears out-of-family shall be subjected to further evaluation.
4. Read and recorded all measurements.

TABLE X - SCREENING OPTION S (MIL-PRF-55310, Level S)

TEST DESCRIPTION	MIL STD	METHOD	CONDITION	QTY	COMMENTS
Non Destructive Bond Pull	883	2023	Level S	100%	2.4 grams
Internal Visual	883	2017 2032	Class K	100%	Class S
Stabilization Bake	883	1008	C	100%	48 hours at +150°C
Random Vibration	883	2026	I-B	100%	Three mutually perpendicular directions
Thermal Shock	883	1011	A	100%	
Temperature Cycling	883	1010	C	100%	10 cycles
Constant Acceleration	883	2001	A	100%	Y1 direction only (5,000g's)
Particle Impact Noise Detection (PIND)	883	2020	A	100%	
Pre Burn-In Electrical	Refer to Table III and Table Xd			100%	
Burn-In	883	1015	+125°C for 240 hours minimum	100%	With load and nominal supply voltage
Final Electrical	Refer to Table III and Table Xd			100%	
Percent Defective Allowance (PDA)	55310		Level S		2% or 1 unit, whichever is greater (Supply Current ±10%, Output Level ±10%)
Seal Fine and Gross Leak	883	1014	B1 and B2	100%	
Radiographic Inspection	883	2012	Class S	100%	
External Visual	883	2009		100%	

NOTES
1. 100% QCI Group A and Group B (Aging) Inspections are performed. See Table Xa, and Table Xb.

TABLE Xa - GROUP A INSPECTION

SUBGROUP	TEST DESCRIPTION	CONDITION	QUANTITY
1 (Note 1)	Supply Current	25°C and temperature extremes	100%
	Frequency - Temperature Stability	Over specified operating temperature range, measure output frequency at minimum eleven equispaced points of the temperature extremes. Test points shall include room temperature.	
	Frequency - Voltage Tolerance	25°C and temperature extremes	
	Output Power		
	Harmonics		
	Sub-Harmonics		
	Absolute Pull Range		
	Spurious		
	Phase Noise	25°C	
	Visual and Mechanical	MIL-STD-883, Method 2009 & 2016	100%
2 (Note 2)	Solderability	MIL-STD-202, Method 208	5 samples

1. Per MIL-PRF-55310, electrical rejects from the subgroup 1 test and/or screening rejects that have been subjected to burn-in, as a minimum can be used for the test. All electrical performance tests shall be performed during Group A with the exception of any tests performed as part of final electrical testing during 100% screening.
2. As an alternative, the manufacturer may use empty test packages for the solderability test provided the empty packages have been subjected to the same environmental conditions and processes as the completed oscillators. If there is one or more defects, the lot shall be considered to have failed.

TABLE Xb - GROUP B INSPECTION

SUBGROUP	TEST CONDITIONS (I.A.W. MIL-PRF-55310 & As Specified Herein)	CONDITION
Frequency Aging	+70° ±3°C for 30 days	100%

NOTES
1. Frequency Aging is up to 30 days. Aging may be ceased if value at 15 days is half than the limit of the 30-day aging value.

TABLE Xc - GROUP C INSPECTION

	TEST/INSPECTION OPERATION	TEST CONDITIONS & REQUIREMENTS (I.A.W. MIL-PRF-55310 & As Specified Herein)	QUANTITY (Accept Nº)
1	Vibration, Sinusoidal (Non-operating)	MIL-STD-202, Method 204, Cond. G	All sample units 4(0)
	Shock, Specified Pulse (Non-operating)	MIL-STD-202, Method 213, Cond. I Two Blows in each of the three mutually perpendicular axis MIL-PRF-55310, Para.4.8.41	
	Random Vibration (Non-operating)	MIL-STD-202, Method 2026, Condition I-J	
2	Thermal Shock	MIL-STD-202, Method 107, Cond. B MIL-PRF-55310, Para.4.8.45	1/4 of all sample units 1(0)
	Ambient Pressure (Non-operating)	MIL-PRF-55310, Para.4.8.46.1	
	Ambient Pressure (Operating)	MIL-STD-202, Method 105, Cond. C MIL-PRF-55310, Para.4.8.46.2	
	Storage Temperature	MIL-PRF55310, Para.4.8.47	
3	Resistance to Soldering Heat	MIL-STD-202, Method 210, Cond. C MIL-PRF-55310, Para.4.8.49.1	1/4 of all sample units 1(0)
	Moisture Resistance	MIL-STD-202, Method 106 (Step 7b, Vibration subcycle shall be omitted) MIL-PRF-55310, Para.4.8.50	
	Salt Atmosphere	MIL-STD-883, Method 1009, Cond. A	
4	Terminal Strength	MIL-STD-202, Method 211, Cond. C (Bend: 5 times each terminal at 45º angle, using a 2 lb weight) MIL-PRF-55310, Para.4.8.52.2	1/4 of all sample units 1(0)
	Resistance to Solvents	MIL-STD-202, Method 215 MIL-PRF-55310, Para.4.8.54	
5	Life Test	End Point Electricals (Note 2) Life Test End Point Electricals (Note 2)	1/4 of all sample units 1(0)

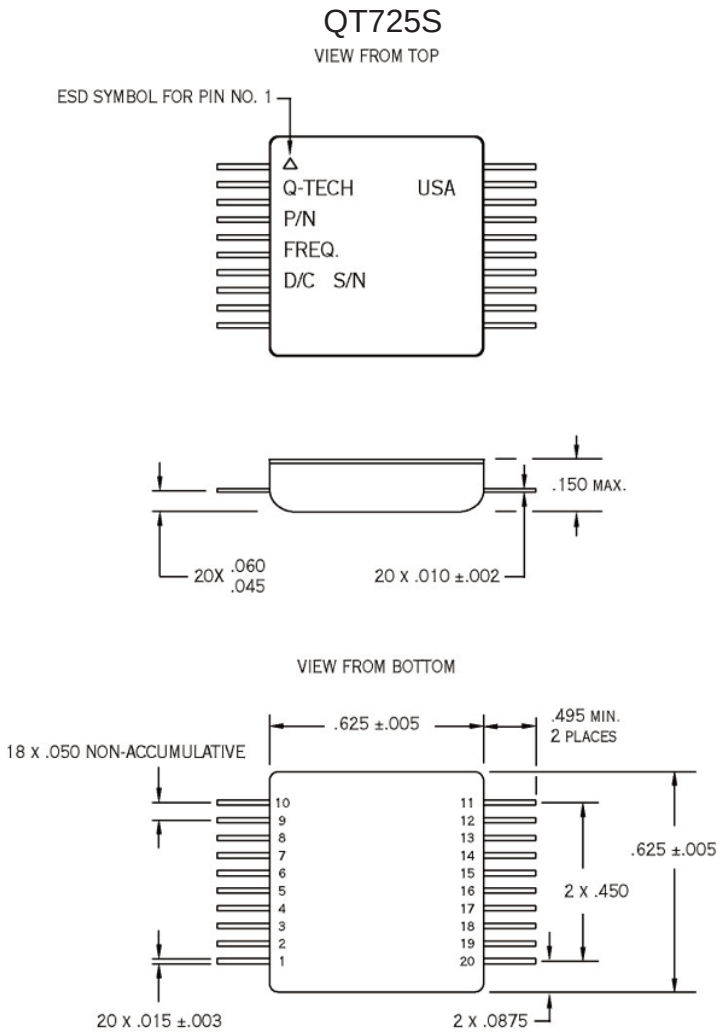
NOTES
1. Group C sample units shall be randomly selected from units that have passed Group A and Group B Inspections.
2. Measure current, frequency, and output waveform at 25ºC and temperature extremes. Frequency after life test shall be within ±10ppm of pre-life frequency.

TABLE Xd - ELECTRICAL TEST – Measurement Requirements (Note 1)

ELECTRICAL PARAMETERS (Note 5)	PRE BURN-IN @25 °C	PRE BURN-IN @LOW TEMP.	PRE BURN-IN @ HIGH TEMP.	POST BURN-IN @25 °C	POST BURN-IN @LOW TEMP.	POST BURN-IN @ HIGH TEMP.	GROUP A @25 °C	GROUP A @LOW TEMP.	GROUP A @ HIGH TEMP.	GROUP C (Note 3)
Output Frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Frequency/Temperature stability							See Note 2			
Frequency/voltage stability	✓			✓			✓	✓	✓	✓
Input Current	✓			✓	✓	✓	✓	✓	✓	✓
Output Power	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Harmonics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sub-Harmonics	✓	✓	✓	✓			✓	✓	✓	✓
Absolute Pull Range	✓	✓	✓	✓			✓	✓	✓	✓
Phase Noise	✓			✓			✓			✓
Spurious	✓			✓			✓	✓	✓	✓

NOTES

1. Electrical performance characteristics shall be in accordance with Table III herein.
2. Measure the output frequency at eleven equispaced points minimum of the specified operating temperature range. Test points shall include readings at room temperature.
3. As required in accordance with MIL-PRF-55310.
4. Read and recorded all measurements.
5. All electrical performance tests shall be performed during Group A with the exception of any tests performed as part of final electrical testing during 100% screening.



TERMINAL CONNECTIONS

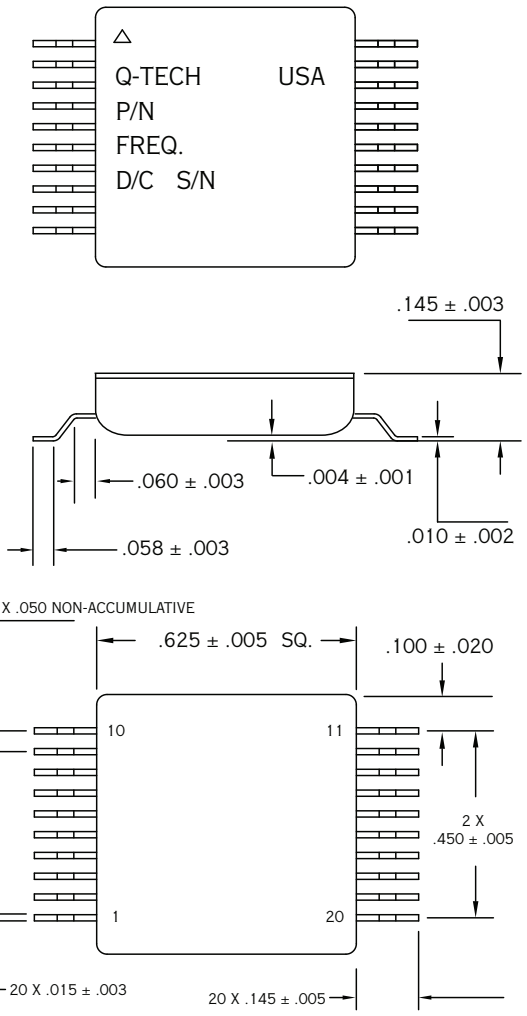
Terminal No.	Connections	Terminal No.	Connections
1	Vc	11	Gnd / Case
2	Gnd / Case	12	Gnd / Case
3	Gnd / Case	13	Gnd / Case
4	Gnd / Case	14	Gnd / Case
5	Gnd / Case	15	Gnd / Case
6	Gnd / Case	16	Gnd / Case
7	Gnd / Case	17	Gnd / Case
8	Gnd / Case	18	Gnd / Case
9	Output	19	Gnd / Case
10	Gnd / Case	20	Vcc

*Lead numbers are for reference only and not marked on units

FIGURE 1A*

Dimensions are in Inches

QT727S



TERMINAL CONNECTIONS

Pin No.	Function	Pin No.	Function
1	Vc	11	Gnd / Case
2	Gnd / Case	12	Gnd / Case
3	Gnd / Case	13	Gnd / Case
4	Gnd / Case	14	Gnd / Case
5	Gnd / Case	15	Gnd / Case
6	Gnd / Case	16	Gnd / Case
7	Gnd / Case	17	Gnd / Case
8	Gnd / Case	18	Gnd / Case
9	Output	19	Gnd / Case
10	Gnd / Case	20	Vcc

*Lead numbers are for reference only and not marked on units

FIGURE 1B*

Dimensions are in Inches

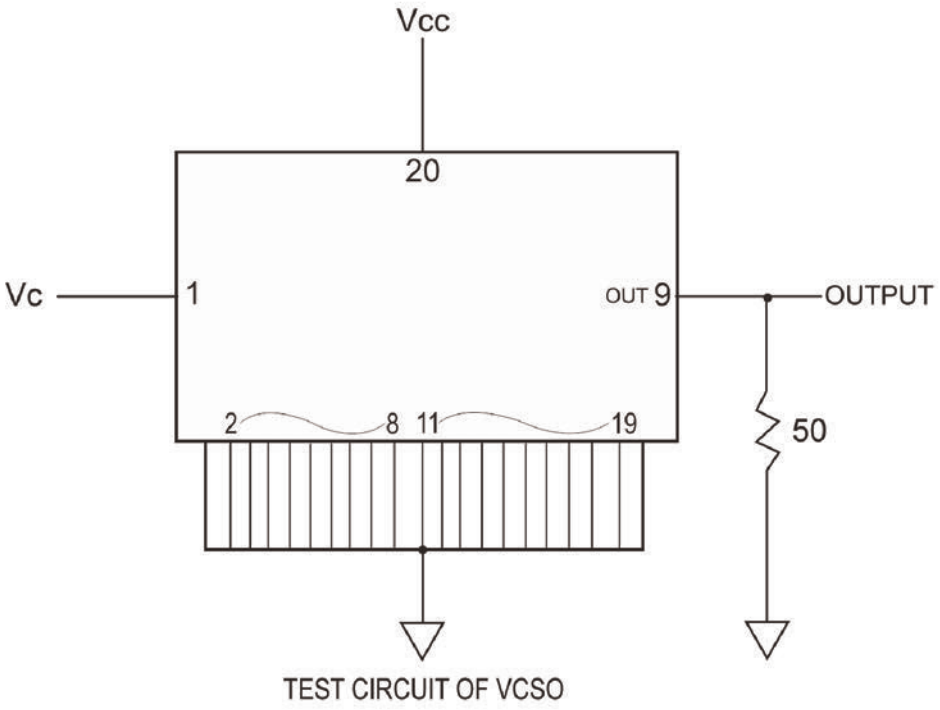
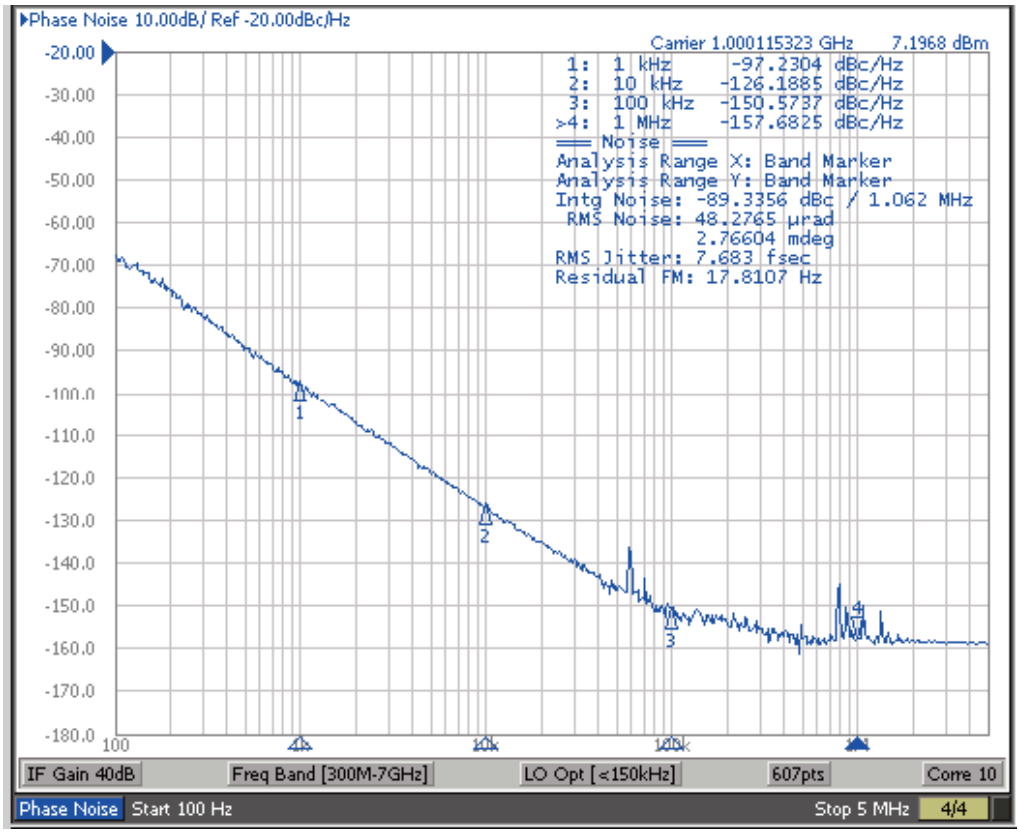
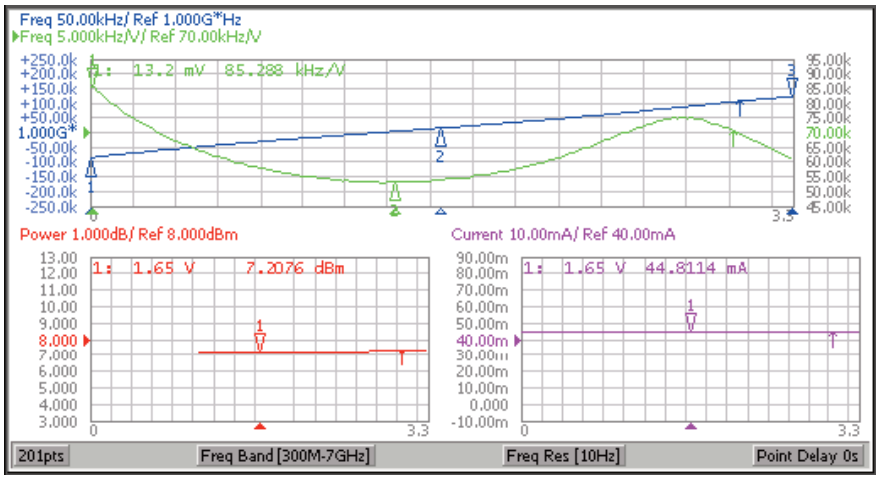


FIGURE 2

PHASE NOISE OF A VCSO 1GHz AT 3.3VDC +85ºC

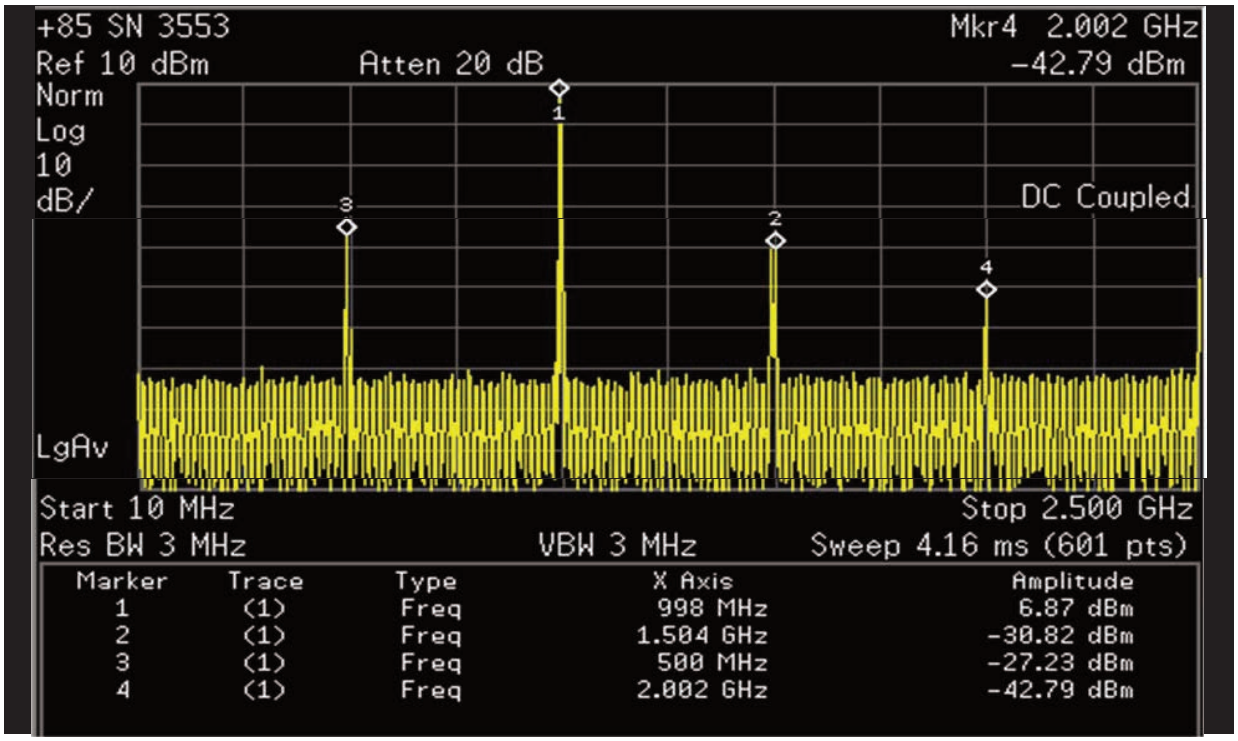


OUTPUT POWER AND PULLING OF A VCSO 1GHz AT 3.3VDC +25ºC

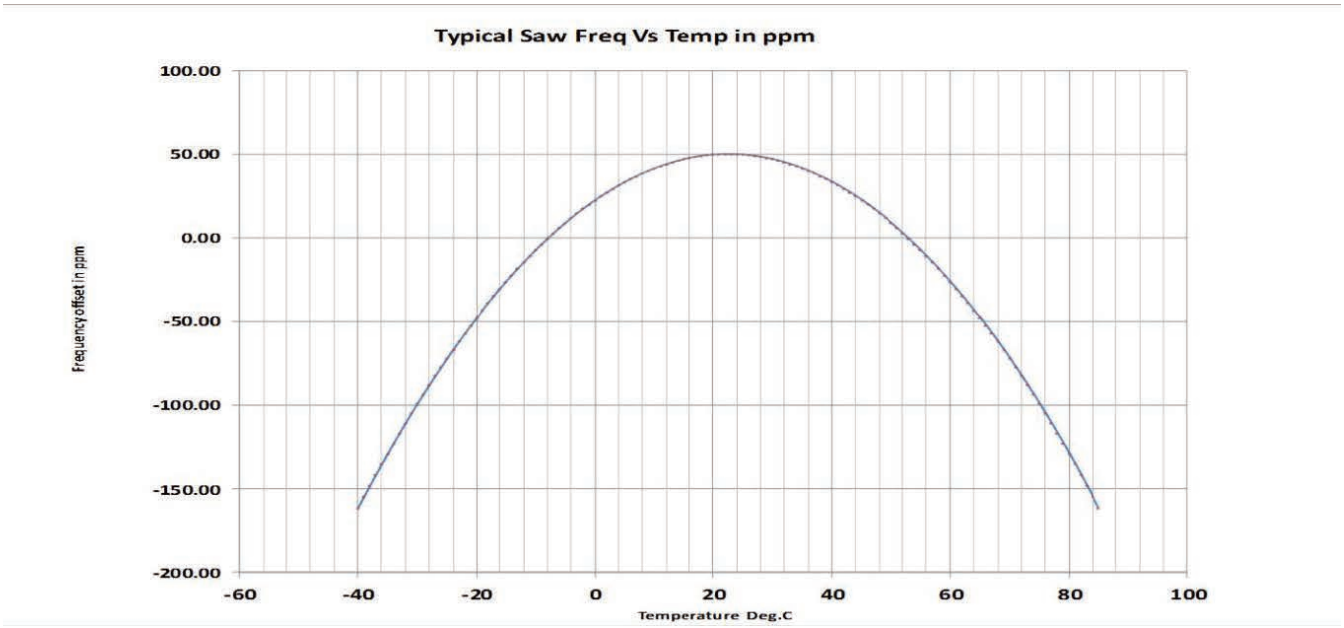


OUTPUT POWER SPECTRUM OF A 1GHz VCSO AT +25°C

OUTPUT POWER SPECTRUM OF A 1GHz VCSO AT +85°C



FREQUENCY VERSUS TEMPERATURE CURVE



ESD RATINGS

Proper ESD precautions should be taken when handling and mounting semiconductor products. Built in ESD protection circuitry ratings are as follows:		
Model	Minimum	Conditions
Human Body Model	Class 1C, 2000V	MIL-STD-883, Method 3015.7

DCO	REV	REVISION SUMMARY	PAGE	DATE
6864	B	Changed Phase Noise plot on page 20 to fix RMS Jitter (previously used unknown/incorrect integration bandwidth)	20	6/12/2017
		Change breadboard option 'BB' to 'B'	1	
		Fixed references of crystal oscillators/resonators to SAW	2 - 5	
		Changed burn in period par. 2.2.8	5	
		Fix Typos	All	
		Remove Phase Noise testing over temperature (should only be 25°C)	11, 13, 14, 16	
7060	C	Revise Par 1.24: Update information regarding Engineering Model definitions in form F1221. Add Breadboard Model to the same paragraph Move Par 1.24 to be Par 1.6.1 Remove Par 1.23 (prototype oscillators). Refer to definitions for breadboard models (par 1.6.1)	2, 3	01/29/2018
		Revise Par 2.2.8: Change 160 hours to two Burn-Ins of 160 hours minimum each and add reference tables for burn-in	5	
		Add RMS Jitter to Table III	9	
		Change min. and typ. values of Absolute Pull Range Minimum: WAS ±20, IS NOW ±10 Typical: WAS ±30, IS NOW ±20	9	
		Move Aging paragraph under screening to Group B paragraph	4, 5	
		Remove 30 days verbiage from Delta Limits Table	8	
		Table Xa revised note 1 & Table Xd add Note 5 for Group A electrical testing exceptions	14, 16	
		Update QT727S Outline image	18	
10115	D	Add voltage option 'D' for +12.0Vdc	1, 8, 9	08/01/2019
		Changed frequency unit to MHz in Table III. Range is now listed as 400 to 1300 MHz. Previously specified inaccurately (was 400 - 1.3 GHz)	9	
		Add 'Harmonics' Specification in Table III	9	
		Update MIL-PRF-55310 Screening/QCI to the latest revision of MIL-PRF-55310 (Revision F)	14 - 16	
11724	E	Update Radiation tolerance to 300kRad (Si) Update Table X to include random vibration test Update phase noise specification Update Group C Table for Random vibration and terminal strength test conditions	1, 9	07/23/2020