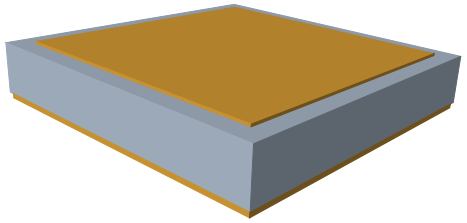
1. Description

- Raytron's Si trench capacitor series uses 3D structures to increase the electrode surfaces, and therefore increase the capacitance for a given footprint. Raytron's Si trench capacitor adopts semiconductor processes such as deep silicon etching, thin film deposition, patterning, and exhibits superior performance including high capacitance per unit area, high dielectric breakdown and high reliability. Furthermore, all electrical tests are completed at the end of the production steps.



M01XX-PDS-F01

Figure 1. Si Trench Capacitor Outline

2. Applications

- DC Decoupling
- DC Blocking
- RF Bypassing Function
- Fixed Capacitance Tuning Unit in Filters, Oscillators, Matching networks

3. Features

- Excellent Long-term Reliability
- Low Insertion Loss
- Wide Temperature Operation
- Large Capacitance Per Unit Area
- Low ESL and ESR

4. Absolute Maximum Ratings

Table 1. Si Trench Capacitors Absolute Maximum Ratings[1]

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature Range	T_{OP}	-55	-	+150	°C
Storage Temperature Range	T_{STG}	-70	-	+165	°C

[1]. Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value.

Table of Contents

No.	Contents	Page
1	Description	1
2	Applications	1
3	Features	1
4	Absolute Maximum Ratings	1
5	Electrical Specifications	3
6	Part Numbers	3
7	Chip Dimensions	4
8	I-V Curve	5
9	Assembly Information	6
10	Reliability	7
11	Handling Precautions	8
12	Contact Information	8
13	Disclaimer	9

5. Electrical Specifications

Table 2. Si Trench Capacitors Electrical Specifications[1]

Parameter	Min.	Typ.	Max.	Units
Capacitance	0.08	-	4.7	nF
Capacitance Tolerance	-15	-	+15	%
Temperature Coefficient	-	70	-	ppm/°C
Insulation Resistance	1	-	-	GΩ@100V
Equivalent Series Inductance (ESL)	-	10	-	pH
Equivalent Series Resistance (ESR)	-	13	-	mΩ
Leakage Current @100V	-	-	1	nA

[1]. These electrical specifications are exemplified by M0156. However, there are differences in performance between the devices. For more details, please use the contact form at chapter 11.

6. Part Numbers

Table 3. M012X Si Trench Capacitor

Part Number	Capacitance (nF±15%)	Pad/Chip Dimensions (mm±0.015mm)	Breakdown Voltage (V)
M0120	0.08	0.164/0.25	150
M0121	0.1	0.164/0.25	150
M0122	0.15	0.164/0.25	150
M0123	0.22	0.164/0.25	150
M0125	0.1	0.164/0.25	250
M0126	1	0.164/0.25	40

Table 4. M013X Si Trench Capacitor

Part Number	Capacitance (nF±15%)	Pad/Chip Dimensions (mm±0.015mm)	Breakdown Voltage (V)
M0130	0.1	0.295/0.381	150
M0131	0.15	0.295/0.381	150
M0132	0.22	0.295/0.381	150
M0133	0.33	0.295/0.381	150
M0135	0.47	0.295/0.381	150
M0136	0.85	0.295/0.381	150
M0137	0.1	0.280/0.380	250
M0138	0.22	0.295/0.381	250
M0139	1	0.295/0.381	150

Table 5. M015X/M016X Si Trench Capacitor

Part Number	Capacitance (nF±15%)	Pad/Chip Dimensions (mm±0.015mm)	Breakdown Voltage (V)
M0150	0.1	0.4/0.5	150
M0151	0.15	0.4/0.5	150
M0152	0.22	0.4/0.5	150
M0153	0.33	0.4/0.5	150
M0155	0.47	0.4/0.5	150
M0156	1	0.4/0.5	150
M0157	1.5	0.4/0.5	150
M0158	0.1	0.4/0.5	250
M0159	0.22	0.4/0.5	250
M0160	0.33	0.4/0.5	250
M0161	0.47	0.4/0.5	250
M0162	1	0.43/0.5	250
M0163	1.5	0.43/0.5	250
M0165	4.7	0.4/0.5	40

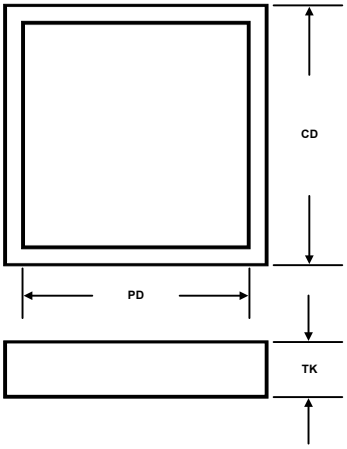
Table 6. M017X Si Trench Capacitor

Part Number	Capacitance (nF±15%)	Pad/Chip Dimensions (mm±0.015mm)	Breakdown Voltage (V)
M0170	0.47	0.58/0.8	250
M0171	1	0.58/0.8	250
M0172	1.5	0.58/0.8	250
M0173	2	0.68/0.76	250

Table 7. M018X Si Trench Capacitor

Part Number	Capacitance (nF±15%)	Pad/Chip Dimensions (mm±0.015mm)	Breakdown Voltage (V)
M0180	200	8.5/8.9	250

7. Chip Dimensions



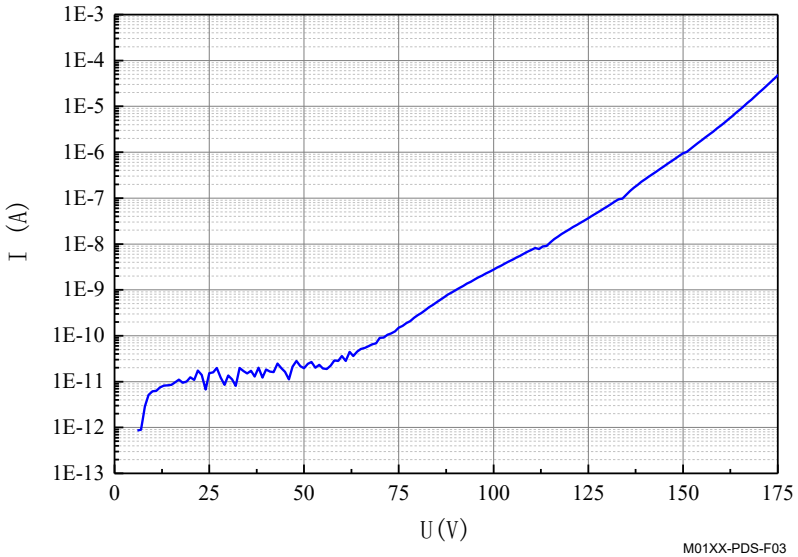
M01XX-PDS-F02

- CD: Chip Dimension, PD: Pad Dimension, TK: Thickness
- CD & PD refer to Table 3, Table4, Table5 and Table6. Si Trench Capacitor Part Numbers, meanwhile TK fixed as 0.25±0.015mm

Figure 2. Si Trench Capacitor Chip Dimensions

8. I-V Curve

■ Typical I-V Curve



M01XX-PDS-F03

Figure 3. I-V Curve of Si Trench Capacitor M0156

9. Assembly Information

■ Assembly Diagram

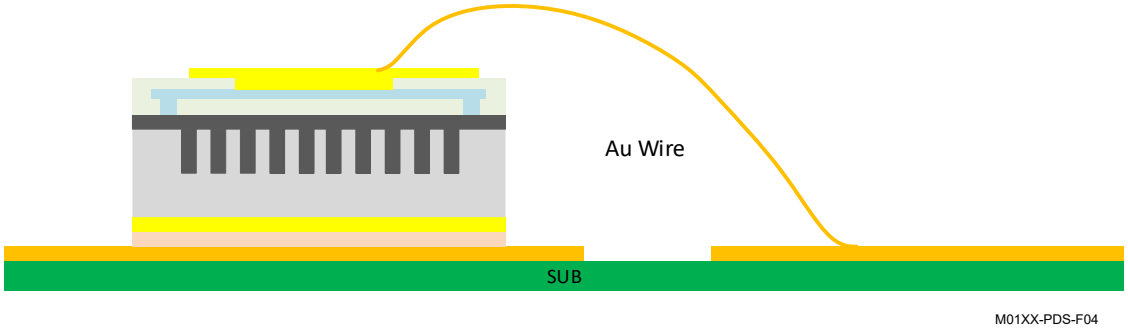


Figure 4. M01XX Assembly Diagram

- M01XX could be directly mounted on the PCB using die bonding and wire bonding. Bottom and top electrode in Gold (Au). Other to finishings available on request.
- Compatible with standard wire bonding assembly (ball and wedege).

10. Reliability

■ Bonding Strength

Table 7. M0173 Boding Strength

Item	Specifications	Test Methods
Bonding Strength (M0173)	Ball Shear: 15g Min. Wire Pull: 3g Min. Die Shear: 1kg Min.	Mount the capacitors on a sintered silver substrate and bond a 25μm gold wire to the capacitor electrode using wedge bonding, the bonding force is 20g.

■ TDDB Test

Table 8. M0173 TDDB Test

Item	Test Condition	Characteristics
Time Dependent Dielectric Breakdown Test (M0173)	Temperature Condition: 100V@125℃ Test Duration: 96h; Leakage current shall be measured precisely every 8 hours for a total of 12 times	1. Measurement Frequency: 1kHz 2. Measurement Item: Leakage Current, Failure Time.

- Capacitors could be considered to have failed if any of the following conditions is met: 1. An irreversible breakdown effect occurs; 2. For hard breakdown, the ratio of two consecutive precise current measurements exceeds 200%; 3. For soft breakdown: The ratio of two consecutive precise current measurements exceeds 50%

After the TDDB-96H test, no significant degradation in the capacitance value was observed for the M0173 samples.

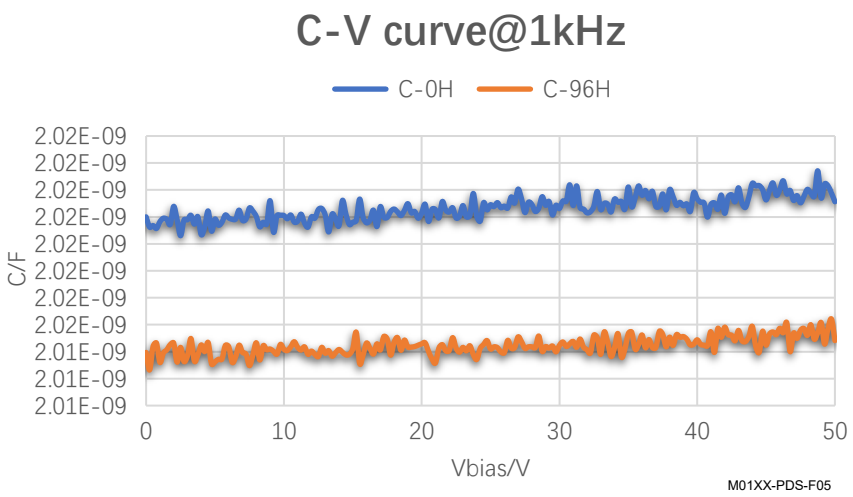


Figure 5: M0173 C-V Curve (0h and 96h)

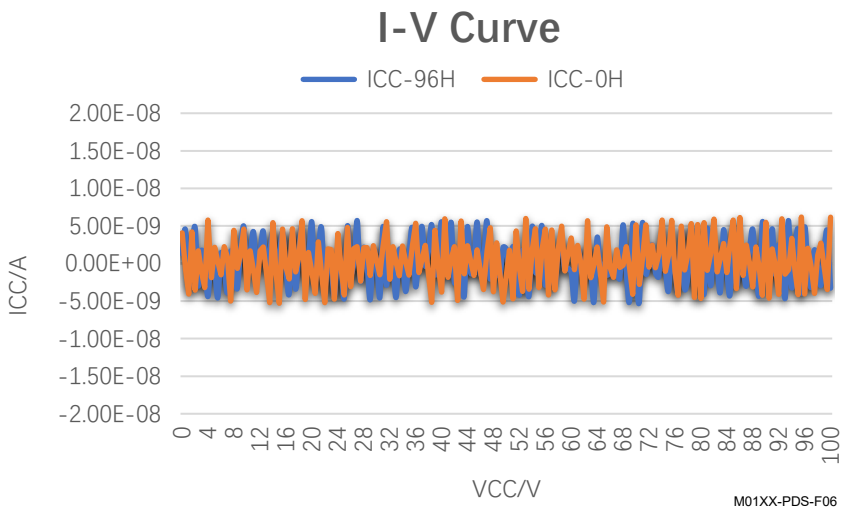


Figure 6: M0173 I-V Curve (0h and 96h)

11. Handling Precautions

- **Storage**
  All bare dies ship in either Waffle or Gel Pak, which is an ESD protective container, and then sealed in an ESD protective bag. After opening the sealed ESD protective bag, all dies must be stored in a dry nitrogen environment.
- **Cleanliness**
  Handle the dies in a clean environment. Never use liquid cleaning systems to clean the dies.
- **ESD Caution**
  ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore proper ESD precautions should be taken to avoid performance degradation or loss of functionality.



12. Contact Information

For the latest specifications, additional product information, technical support and sales support, please contact:

- **Email:** RF.support@raytrontek.com
- **Web:** www.raytrontek.com

13. Disclaimer

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