

Precision

Digital Step Attenuator

TOAT-124+

50Ω TTL Control, Pin Diode 10 to 1000 MHz

Maximum Ratings

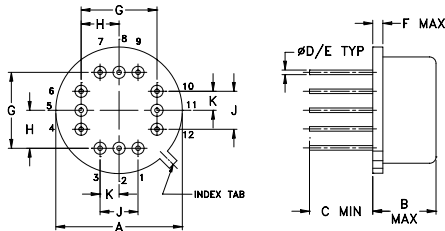
| | |
|-----------------------|----------------|
| Operating Temperature | -55°C to 100°C |
| Storage Temperature | -55°C to 125°C |
| Input Power | 15 dBm |
| DC Voltage | 5.5 V |
| TTL | 5.5V |

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

| | |
|----------------|--------------|
| RF IN | 4 |
| RF OUT | 11 |
| TTL CONTROL #1 | 2 |
| TTL CONTROL #2 | 3 |
| TTL CONTROL #3 | 1 |
| +5V DC | 12 |
| CASE GROUND | 5,6,7,8,9,10 |

Outline Drawing



Outline Dimensions (inch/mm)

| | | | | | |
|-------|------|------|------|------|-------|
| A | B | C | D | E | F |
| .600 | .250 | .25 | .016 | .020 | .04 |
| 15.24 | 6.35 | 6.35 | 0.41 | 0.51 | 1.02 |
| G | H | J | K | | wt |
| .400 | .200 | .200 | .100 | | grams |
| 10.16 | 5.08 | 5.08 | 2.54 | | 4.0 |

Features

- wideband, 10 to 1000 MHz
- excellent step accuracy, 0.2 dB typ.
- excellent VSWR 1.3 typ.
- low DC current, 6 mA typ.
- hermetic, metal, TO-8 case

Applications

- base stations
- cellular
- test-sets
- military, hi-rel application

Digital Step Attenuator Electrical Specifications

| MODEL NO. | FREQUENCY (MHz) | | PRIMARY ATTENUATION STEPS (dB) | | | ATTENUATION (dB) | | VSWR (:1) | | |
|-----------|-----------------|-------|--------------------------------|--------|-------|-------------------|-----------------|-----------|-----|-----|
| | f_L | f_U | #1 | #2 | #3 | (1,1,1)** Nom. | (0,0,0) Max. | L | M | U |
| TOAT-124+ | 10 | 1000 | 1±0.25 | 2±0.25 | 4±0.3 | 7.0 | 4.0 | 1.6 | 1.4 | 1.5 |

L=10 to 100 MHz M=100 to 500 MHz U=500 to 1000 MHz

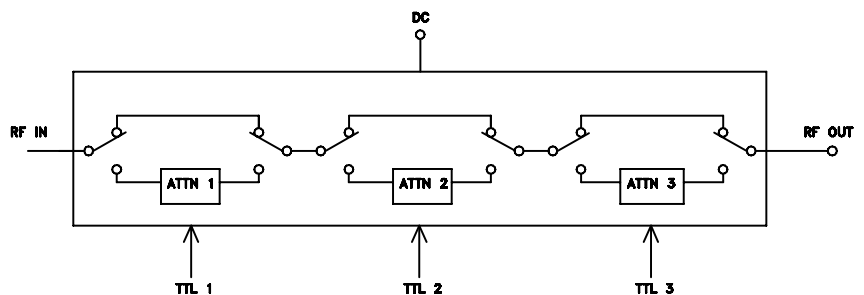
** Total attenuation above thru-loss.

1. Step accuracy is specified for basic steps. For combination of steps accuracy is additive.
2. Thru-loss is minimum insertion loss with all attenuation elements bypassed (All TTL controls state are Low)
3. For optimum operation of TOAT models, ensure the device case is properly connected to the ground plane (of PC board)

Additional Specifications

| | |
|---|---|
| DC Voltage | +5V |
| DC Current | 12mA max. |
| Switching Time (50% TTL to within specified accuracy of the next-selected attenuation step, and to within 0.1 dB of steady-state Thru-Loss) | 10µs typ., 15µs max., |
| TTL Input High Threshold | 2V min |
| TTL Input Low Threshold | 0.8V max. |
| TTL Toggle Rate | 50 kHz typ. |
| 1dB Compression | 0 dBm (10-100 MHz) +10 dBm (100-1000MHz) |

Electrical Schematic



Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
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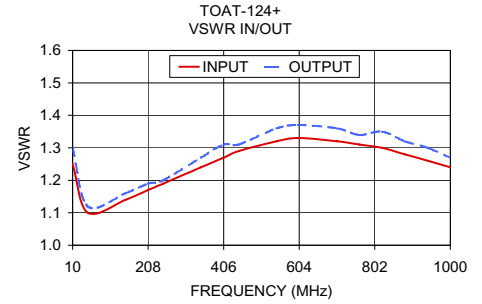
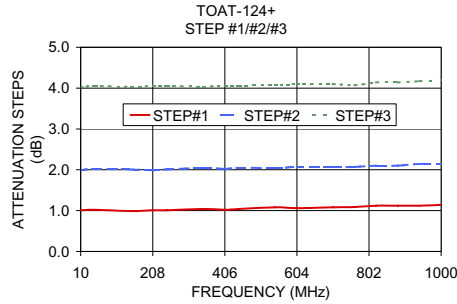
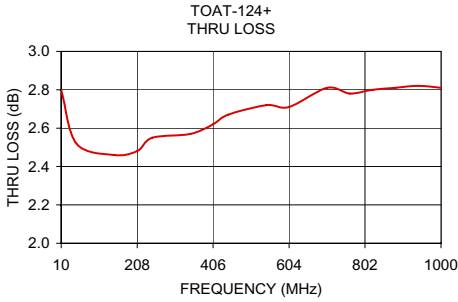
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CASE STYLE: QQ96

+RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

REV. C
M151107
TOAT-124+
DJ/VV/CP
151008



Step Attenuation* at TTL Control State

| FREQ. | 000 | 001 | 010 | 011 | 100 | 101 | 110 | 111 |
|---------|----------------|------|------|------|------|------|------|------|
| (MHz) | THRU LOSS (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) |
| 10.00 | 2.80 | 1.01 | 1.99 | 3.01 | 4.02 | 5.03 | 6.03 | 7.03 |
| 49.60 | 2.52 | 1.02 | 2.02 | 3.05 | 4.05 | 5.06 | 6.05 | 7.09 |
| 148.60 | 2.46 | 0.99 | 2.01 | 3.02 | 4.03 | 5.03 | 6.02 | 7.07 |
| 208.00 | 2.48 | 1.01 | 1.99 | 3.00 | 4.05 | 5.07 | 6.02 | 7.05 |
| 247.60 | 2.55 | 1.01 | 2.01 | 3.03 | 4.05 | 5.06 | 6.02 | 7.02 |
| 346.60 | 2.57 | 1.04 | 2.04 | 3.03 | 4.04 | 5.07 | 6.08 | 7.06 |
| 406.00 | 2.62 | 1.02 | 2.02 | 3.03 | 4.05 | 5.06 | 6.04 | 7.05 |
| 445.60 | 2.67 | 1.04 | 2.05 | 3.09 | 4.06 | 5.11 | 6.06 | 7.09 |
| 544.60 | 2.72 | 1.08 | 2.04 | 3.11 | 4.08 | 5.14 | 6.06 | 7.13 |
| 604.00 | 2.71 | 1.06 | 2.07 | 3.11 | 4.09 | 5.14 | 6.11 | 7.15 |
| 703.00 | 2.81 | 1.08 | 2.07 | 3.11 | 4.10 | 5.17 | 6.09 | 7.16 |
| 762.40 | 2.78 | 1.09 | 2.07 | 3.17 | 4.07 | 5.20 | 6.10 | 7.21 |
| 821.80 | 2.80 | 1.12 | 2.10 | 3.20 | 4.14 | 5.25 | 6.17 | 7.27 |
| 881.20 | 2.81 | 1.12 | 2.10 | 3.19 | 4.14 | 5.23 | 6.22 | 7.30 |
| 940.60 | 2.82 | 1.12 | 2.14 | 3.20 | 4.17 | 5.31 | 6.22 | 7.35 |
| 1000.00 | 2.81 | 1.14 | 2.14 | 3.28 | 4.19 | 5.37 | 6.28 | 7.42 |

INPUT VSWR

| FREQ. | 001 | 010 | 011 | 100 | 101 | 110 | 111 |
|---------|------|------|------|------|------|------|------|
| (MHz) | | | | | | | |
| 10.00 | 1.25 | 1.26 | 1.22 | 1.27 | 1.23 | 1.24 | 1.20 |
| 49.60 | 1.10 | 1.10 | 1.09 | 1.10 | 1.09 | 1.09 | 1.08 |
| 148.60 | 1.14 | 1.12 | 1.12 | 1.13 | 1.12 | 1.11 | 1.11 |
| 208.00 | 1.17 | 1.15 | 1.15 | 1.16 | 1.16 | 1.14 | 1.14 |
| 247.60 | 1.19 | 1.17 | 1.17 | 1.17 | 1.18 | 1.16 | 1.16 |
| 346.60 | 1.24 | 1.21 | 1.22 | 1.22 | 1.23 | 1.20 | 1.22 |
| 406.00 | 1.27 | 1.24 | 1.25 | 1.24 | 1.26 | 1.22 | 1.24 |
| 445.60 | 1.29 | 1.25 | 1.27 | 1.26 | 1.27 | 1.24 | 1.26 |
| 544.60 | 1.32 | 1.28 | 1.30 | 1.29 | 1.31 | 1.27 | 1.30 |
| 604.00 | 1.33 | 1.29 | 1.31 | 1.31 | 1.33 | 1.29 | 1.32 |
| 703.00 | 1.32 | 1.28 | 1.32 | 1.31 | 1.33 | 1.29 | 1.34 |
| 762.40 | 1.31 | 1.28 | 1.32 | 1.31 | 1.34 | 1.29 | 1.34 |
| 821.80 | 1.30 | 1.26 | 1.31 | 1.30 | 1.33 | 1.29 | 1.35 |
| 881.20 | 1.28 | 1.25 | 1.31 | 1.29 | 1.33 | 1.29 | 1.35 |
| 940.60 | 1.26 | 1.23 | 1.30 | 1.27 | 1.32 | 1.27 | 1.34 |
| 1000.00 | 1.24 | 1.21 | 1.29 | 1.25 | 1.31 | 1.26 | 1.34 |

OUTPUT VSWR

| FREQ. | 001 | 010 | 011 | 100 | 101 | 110 | 111 |
|---------|------|------|------|------|------|------|------|
| (MHz) | | | | | | | |
| 10.00 | 1.30 | 1.27 | 1.25 | 1.16 | 1.16 | 1.15 | 1.15 |
| 49.60 | 1.12 | 1.10 | 1.10 | 1.07 | 1.07 | 1.07 | 1.06 |
| 148.60 | 1.16 | 1.13 | 1.14 | 1.09 | 1.10 | 1.09 | 1.09 |
| 208.00 | 1.19 | 1.16 | 1.16 | 1.11 | 1.11 | 1.09 | 1.10 |
| 247.60 | 1.20 | 1.18 | 1.18 | 1.13 | 1.13 | 1.11 | 1.12 |
| 346.60 | 1.27 | 1.23 | 1.23 | 1.16 | 1.17 | 1.16 | 1.15 |
| 406.00 | 1.31 | 1.25 | 1.26 | 1.18 | 1.19 | 1.17 | 1.19 |
| 445.60 | 1.31 | 1.27 | 1.28 | 1.19 | 1.20 | 1.18 | 1.18 |
| 544.60 | 1.36 | 1.30 | 1.30 | 1.21 | 1.22 | 1.21 | 1.21 |
| 604.00 | 1.37 | 1.31 | 1.31 | 1.21 | 1.22 | 1.21 | 1.23 |
| 703.00 | 1.36 | 1.32 | 1.33 | 1.22 | 1.23 | 1.24 | 1.23 |
| 762.40 | 1.34 | 1.30 | 1.32 | 1.23 | 1.24 | 1.25 | 1.25 |
| 821.80 | 1.35 | 1.30 | 1.31 | 1.22 | 1.24 | 1.25 | 1.24 |
| 881.20 | 1.32 | 1.29 | 1.28 | 1.22 | 1.22 | 1.23 | 1.25 |
| 940.60 | 1.30 | 1.27 | 1.29 | 1.23 | 1.23 | 1.25 | 1.25 |
| 1000.00 | 1.27 | 1.26 | 1.27 | 1.23 | 1.23 | 1.27 | 1.24 |

* Step attenuation above thru-loss (TTL logic 000)

Notes

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Digital Step Attenuator

TOAT-124+

Typical Performance Data

| FREQUENCY (MHz) | STEP ATTENUATION* AT TTL CONTROL STATE (dB) | | | | | | | |
|--------------------|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 000 THRU LOSS | 001 1 dB | 010 2 dB | 011 3 dB | 100 4 dB | 101 5 dB | 110 6 dB | 111 7 dB |
| 10.0 | 2.80 | 1.01 | 1.99 | 3.01 | 4.02 | 5.03 | 6.03 | 7.03 |
| 49.6 | 2.52 | 1.02 | 2.02 | 3.05 | 4.05 | 5.06 | 6.05 | 7.09 |
| 148.6 | 2.46 | 0.99 | 2.01 | 3.02 | 4.03 | 5.03 | 6.02 | 7.07 |
| 208.0 | 2.48 | 1.01 | 1.99 | 3.00 | 4.05 | 5.07 | 6.02 | 7.05 |
| 247.6 | 2.55 | 1.01 | 2.01 | 3.03 | 4.05 | 5.06 | 6.02 | 7.02 |
| 346.6 | 2.57 | 1.04 | 2.04 | 3.03 | 4.04 | 5.07 | 6.08 | 7.06 |
| 406.0 | 2.62 | 1.02 | 2.02 | 3.03 | 4.05 | 5.06 | 6.04 | 7.05 |
| 445.6 | 2.67 | 1.04 | 2.05 | 3.09 | 4.06 | 5.11 | 6.06 | 7.09 |
| 544.6 | 2.72 | 1.08 | 2.04 | 3.11 | 4.08 | 5.14 | 6.06 | 7.13 |
| 604.0 | 2.71 | 1.06 | 2.07 | 3.11 | 4.09 | 5.14 | 6.11 | 7.15 |
| 703.0 | 2.81 | 1.08 | 2.07 | 3.11 | 4.10 | 5.17 | 6.09 | 7.16 |
| 762.4 | 2.78 | 1.09 | 2.07 | 3.17 | 4.07 | 5.20 | 6.10 | 7.21 |
| 821.8 | 2.80 | 1.12 | 2.10 | 3.20 | 4.14 | 5.25 | 6.17 | 7.27 |
| 881.2 | 2.81 | 1.12 | 2.10 | 3.19 | 4.14 | 5.23 | 6.22 | 7.30 |
| 940.6 | 2.82 | 1.12 | 2.14 | 3.20 | 4.17 | 5.31 | 6.22 | 7.35 |
| 1000.0 | 2.81 | 1.14 | 2.14 | 3.28 | 4.19 | 5.37 | 6.28 | 7.42 |

* Step Attenuation above Thru Loss (TTL Logic 000).

| FREQUENCY (MHz) | INPUT VSWR AT TTL CONTROL STATE (:1) | | | | | | |
|--------------------|---|-------------|-------------|-------------|-------------|-------------|-------------|
| | 001 1 dB | 010 2 dB | 011 3 dB | 100 4 dB | 101 5 dB | 110 6 dB | 111 7 dB |
| 10.0 | 1.25 | 1.26 | 1.22 | 1.27 | 1.23 | 1.24 | 1.20 |
| 49.6 | 1.10 | 1.10 | 1.09 | 1.10 | 1.09 | 1.09 | 1.08 |
| 148.6 | 1.14 | 1.12 | 1.12 | 1.13 | 1.12 | 1.11 | 1.11 |
| 208.0 | 1.17 | 1.15 | 1.15 | 1.16 | 1.16 | 1.14 | 1.14 |
| 247.6 | 1.19 | 1.17 | 1.17 | 1.17 | 1.18 | 1.16 | 1.16 |
| 346.6 | 1.24 | 1.21 | 1.22 | 1.22 | 1.23 | 1.20 | 1.22 |
| 406.0 | 1.27 | 1.24 | 1.25 | 1.24 | 1.26 | 1.22 | 1.24 |
| 445.6 | 1.29 | 1.25 | 1.27 | 1.26 | 1.27 | 1.24 | 1.26 |
| 544.6 | 1.32 | 1.28 | 1.30 | 1.29 | 1.31 | 1.27 | 1.30 |
| 604.0 | 1.33 | 1.29 | 1.31 | 1.31 | 1.33 | 1.29 | 1.32 |
| 703.0 | 1.32 | 1.28 | 1.32 | 1.31 | 1.33 | 1.29 | 1.34 |
| 762.4 | 1.31 | 1.28 | 1.32 | 1.31 | 1.34 | 1.29 | 1.34 |
| 821.8 | 1.30 | 1.26 | 1.31 | 1.30 | 1.33 | 1.29 | 1.35 |
| 881.2 | 1.28 | 1.25 | 1.31 | 1.29 | 1.33 | 1.29 | 1.35 |
| 940.6 | 1.26 | 1.23 | 1.30 | 1.27 | 1.32 | 1.27 | 1.34 |
| 1000.0 | 1.24 | 1.21 | 1.29 | 1.25 | 1.31 | 1.26 | 1.34 |

| FREQUENCY (MHz) | OUTPUT VSWR AT TTL CONTROL STATE (:1) | | | | | | |
|--------------------|--|-------------|-------------|-------------|-------------|-------------|-------------|
| | 001 1 dB | 010 2 dB | 011 3 dB | 100 4 dB | 101 5 dB | 110 6 dB | 111 7 dB |
| 10.0 | 1.30 | 1.27 | 1.25 | 1.16 | 1.16 | 1.15 | 1.15 |
| 49.6 | 1.12 | 1.10 | 1.10 | 1.07 | 1.07 | 1.07 | 1.06 |
| 148.6 | 1.16 | 1.13 | 1.14 | 1.09 | 1.10 | 1.09 | 1.09 |
| 208.0 | 1.19 | 1.16 | 1.16 | 1.11 | 1.11 | 1.09 | 1.10 |
| 247.6 | 1.20 | 1.18 | 1.18 | 1.13 | 1.13 | 1.11 | 1.12 |
| 346.6 | 1.27 | 1.23 | 1.23 | 1.16 | 1.17 | 1.16 | 1.15 |
| 406.0 | 1.31 | 1.25 | 1.26 | 1.18 | 1.19 | 1.17 | 1.19 |
| 445.6 | 1.31 | 1.27 | 1.28 | 1.19 | 1.20 | 1.18 | 1.18 |
| 544.6 | 1.36 | 1.30 | 1.30 | 1.21 | 1.22 | 1.21 | 1.21 |
| 604.0 | 1.37 | 1.31 | 1.31 | 1.21 | 1.22 | 1.21 | 1.23 |
| 703.0 | 1.36 | 1.32 | 1.33 | 1.22 | 1.23 | 1.24 | 1.23 |
| 762.4 | 1.34 | 1.30 | 1.32 | 1.23 | 1.24 | 1.25 | 1.25 |
| 821.8 | 1.35 | 1.30 | 1.31 | 1.22 | 1.24 | 1.25 | 1.24 |
| 881.2 | 1.32 | 1.29 | 1.28 | 1.22 | 1.22 | 1.23 | 1.25 |
| 940.6 | 1.30 | 1.27 | 1.29 | 1.23 | 1.23 | 1.25 | 1.25 |
| 1000.0 | 1.27 | 1.26 | 1.27 | 1.23 | 1.23 | 1.27 | 1.24 |

REV. X1
TOAT-124+
070701
Page 1 of 1



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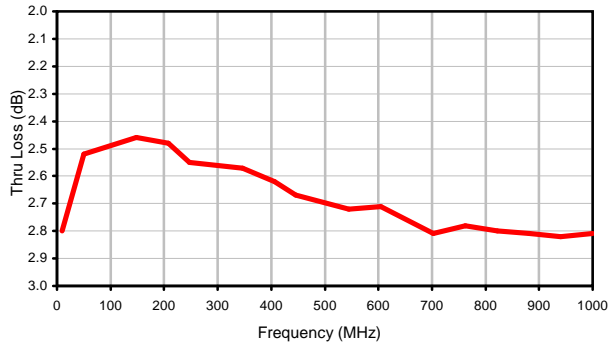


Digital Step Attenuator

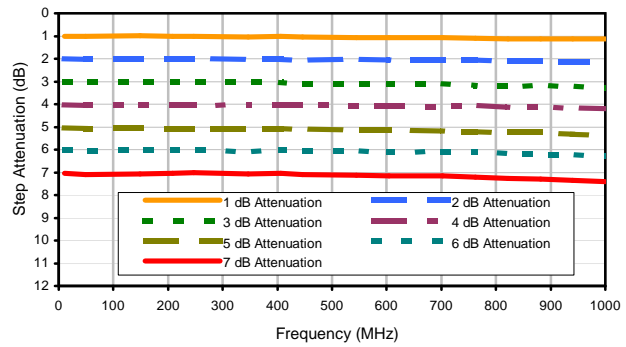
Typical Performance Curves

TOAT-124+

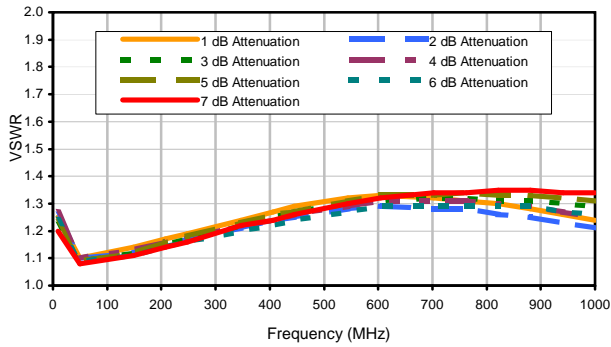
Thru Loss



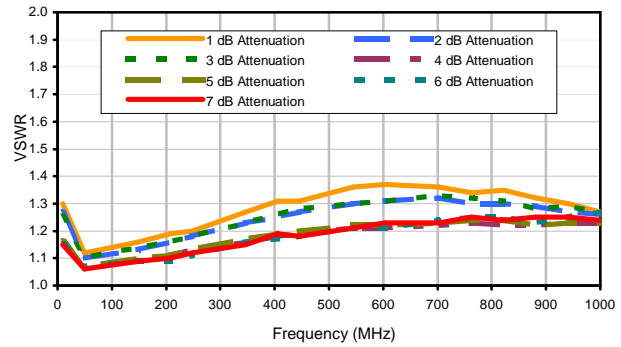
Step Attenuation



Input VSWR



Output VSWR



REV. X1
TOAT-124+
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Page 1 of 1



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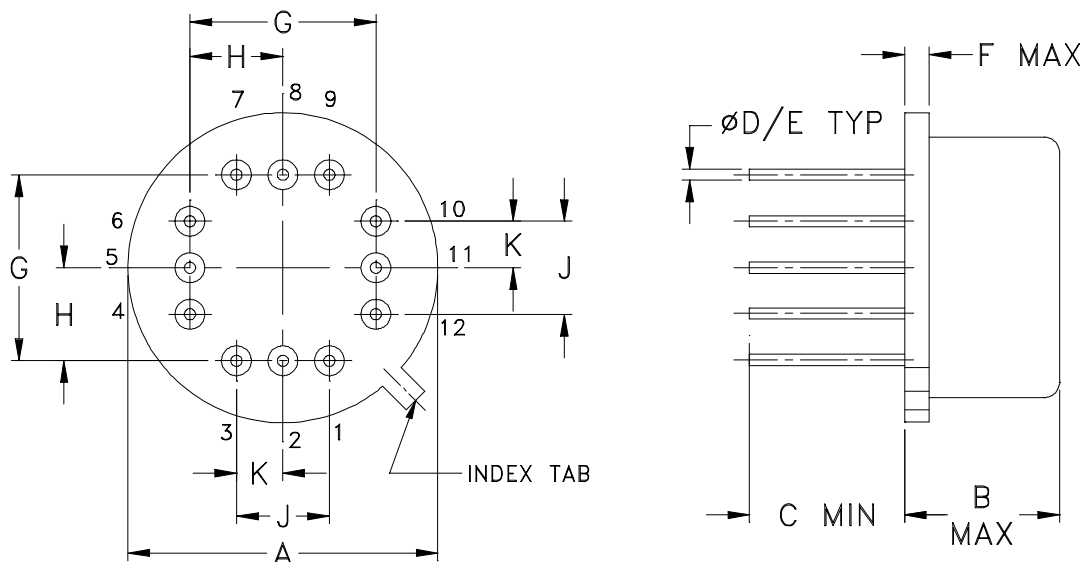
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see minicircuits.com

Case Style

QQ

QQ95
QQ96

Outline Dimensions



| CASE# | A | B | C | D | E | F | G | H | J | K | WT. GRAM |
|-------|-----------------|----------------|---------------|---------------|---------------|---------------|-----------------|----------------|----------------|----------------|----------|
| QQ95 | .500 (12.70) | .250 (6.35) | .25 (6.35) | .016 (.41) | .020 (.51) | .04 (1.02) | .300 (7.62) | .150 (3.81) | .150 (3.81) | .075 (1.91) | 3.5 |
| QQ96 | .600 (15.24) | .250 (6.35) | .25 (6.35) | .016 (.41) | .020 (.51) | .04 (1.02) | .400 (10.16) | .200 (5.08) | .200 (5.08) | .100 (2.54) | 4.0 |

Dimensions are in inches (mm). Tolerances: 2 Pl. $\pm .03$; 3 Pl. $\pm .015$

Notes:

- Header material: Kovar.
Pin material: Kovar.
Cover material: Nickel.
- Pin finish: Gold plate 25 μ inches (.64 microns) min.
- For pin designations see specification data sheet.
- Pin numbers do not appear on unit, for reference only.

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All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification | Test/Inspection Condition | Reference/Spec |
|--------------------------------|---|---|
| Operating Temperature | -55° to 100° C Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C Ambient Environment | Individual Model Data Sheet |
| Thermal Shock | -55° to 100°C, 10 cycles | MIL-STD-202, Method 107, Condition A, except +100°C & 10 cycles |
| Constant Acceleration | 5000g, Y1 axis | MIL-STD-883, Method 2001, Condition A, except Y1 axis only |
| Solderability | 10X Magnification | J-STD-002, 95% Coverage |
| Resistance to Solder Heat | 260°C for 10 seconds | MIL-STD-202, Method 210, Condition B |
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215 |
| Gross Leak | 125°C Bubble Test | MIL-STD-202, Method 112, Condition D |