*Millimeter Wave Precision*

# Fixed Attenuator Die    KAT-D-Series

50Ω    Up to 2W    DC to 50 GHz

## The Big Deal
- Ultra-wide band, DC to 50 GHz
- Excellent power handling, up to 2W
- Contiguous ground plane for easy installation

## Product Overview

Mini-Circuits' KAT-D-series MMIC attenuator dice (RoHS compliant) are fixed value, absorptive attenuators fabricated using highly repetitive MMIC processing with thin film resistors on GaAs substrates.  Providing precise attenuation from DC up to 50 GHz, these attenuators are ideal for a very wide range of applications up to millimeter wave bands including 5G systems and more.  KAT-D-series attenuator dice are available from stock with nominal attenuation values of 0 to 10 dB (in 1 dB steps), and 12, 15, 20, and 30 dB.

## Key Features

| Feature | Advantages |
|---|---|
| Ultra-wide band operation, DC to 50 GHz | KAT-D-series attenuator dice support a wide array of applications including 5G systems, microwave communications, satellite, defense and aerospace, medical broadband and optical applications |
| Single, contiguous ground plane | The attenuators achieve ultra-wide band performance up to 50 GHz with single, contiguous ground plane, simplifying installation into customer hybrids. |
| High power handling, up to 2W | Power handling up to 2W makes KAT attenuator dice suitable for a wide range of system power requirements. |
| Wide range of nominal attenuation values: 0 to 10 dB (in 1 dB steps) and 12, 15, 20 and 30 dB | Small increment offerings enable circuit designers to change attenuation values without motherboard redesign, making the KAT-D-series ideal for adjusting attenuation values based on test results. |
| Excellent attenuation flatness | Provides precise, consistent attenuation across the entire frequency band, ideal for broadband and multi-band usage. |

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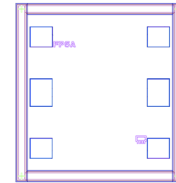
# Fixed Attenuator Die    KAT-5-D+

## 50Ω    1.4W    5dB    DC to 50 GHz

### Product Features
• Wide bandwidth, DC to 50 GHz
• Excellent attenuation accuracy & flatness
• Exceptional power handling, up to 1.4W

### Typical Applications
• Cellular
• PCS
• Communications
• Radar
• Defense
• 5G

*Ordering Information: Refer to Last Page*

### General Description
KAT-5-D+ is an absorptive attenuator Die fabricated using highly repetitive MMIC process including thin film resistors on GaAs substrate. KAT-5-D+ attenuator Die contains through-wafer vias to realize low thermal resistance and wideband operation.
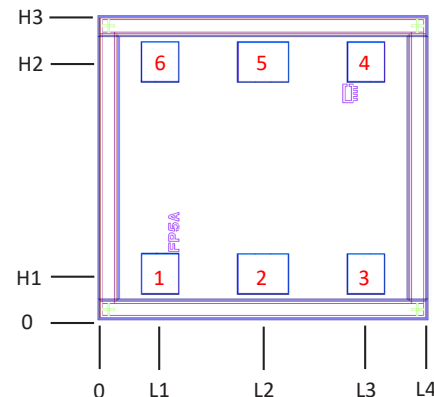
### Simplified Schematic



RF-IN    RF-OUT

GND
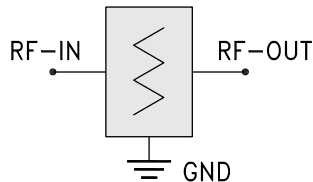
| Pad # | Description |
|-------|-------------|
| 2 | RF-IN |
| 5 | RF-OUT |
| 1,3,4,6 | Ground |
| Die bottom | Ground |

Note:  1. Bond Pad material - Gold
       2. Bottom of Die - Gold plated

### Bonding Pad Position / Description



### Die dimensions in µm

| L1 | L2 | L3 | L4 | H1 | H2 | H3 | Thickness | Bond pad size |
|-----|-----|-----|-----|-----|-----|-----|-----------|---------------|
| 125 | 375 | 625 | 750 | 85 | 615 | 700 | 100 | 125 x 100 |

*(Numbers on bond pads are for identification only, not marked on Die)*

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# KAT-5-D+

## Electrical Specifications at 25°C, 50Ω

| Parameter | | Condition (GHz) | Die Typ.[1] | Die Eval Board Typ.[2] | Unit |
|---|---|---|---|---|---|
| Frequency Range | | | DC-50 | DC-50 | GHz |
| Attenuation | | DC-5 | 5.0 ± 0.1 | 4.9 ± 0.1 | dB |
| | | 5-15 | 5.0 ± 0.1 | 5.1 ± 0.2 | |
| | | 15-18 | 5.0 ± 0.1 | 5.2 ± 0.2 | |
| | | 18-26.5 | 5.0 ± 0.1 | 5.2 ± 0.2 | |
| | | 26.5-43.5 | 4.7 ± 0.5 | 4.9 ± 0.3 | |
| | | 43.5-50 | -- | 5.1 ± 0.3 | |
| VSWR | | DC-5 | 1.1 | 1.1 | :1 |
| | | 5-15 | 1.1 | 1.2 | |
| | | 15-18 | 1.1 | 1.5 | |
| | | 18-26.5 | 1.1 | 1.4 | |
| | | 26.5-43.5 | 1.2 | 1.3 | |
| | | 43.5-50 | -- | 1.5 | |
| Operating Input Power at[3] : | 25°C | DC-50 | 1.4 | 1.4 | W |
| | 85°C | DC-50 | 1 | 1 | W |

1. Electrical specifications are typical measured characteristics on die using MPI Titan Series 250 µm pitch GSG probe.
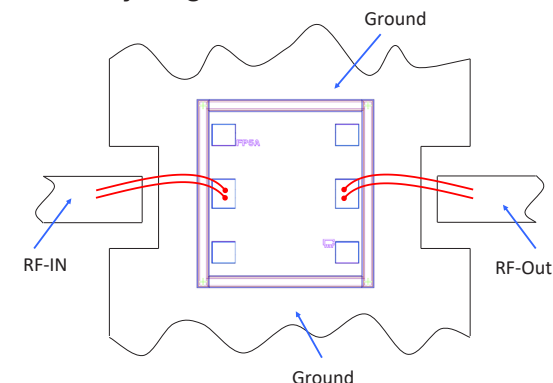2. Measured on X-Microwave Drop-In / Evaluation Block, XM-B1A2-0204D
3. Tested in industry standard 2x2 mm, 6-lead MCLP package.
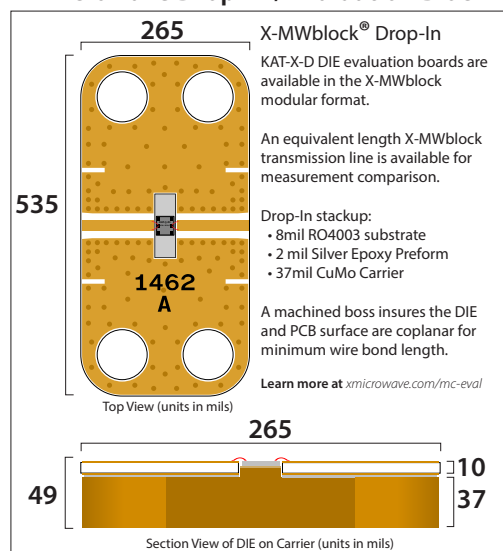
## Absolute Maximum Ratings

| | |
|---|---|
| Operating Temperature (ground) | -40°C to 85°C |
| RF Input Power | 1.4W |

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

## Assembly Diagram



(Ground Bond Wires are optional)

## X-Microwave Drop-In / Evaluation Block



X-MWblock® Drop-In

KAT-X-D DIE evaluation boards are available in the X-MWblock modular format.

An equivalent length X-MWblock transmission line is available for measurement comparison.

Drop-In stackup:
- 8mil RO4003 substrate
- 2 mil Silver Epoxy Preform
- 37mil CuMo Carrier

A machined boss insures the DIE and PCB surface are coplanar for minimum wire bond length.

**Learn more at** *xmicrowave.com/mc-eval*

Top View (units in mils)

Section View of DIE on Carrier (units in mils)

*X-MWblock is a Registered Trademark of X-Microwave, LLC*

## Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.

2. ESD
   MMIC GaAs Attenuator dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.

3. Die Attach
   The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.

4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

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## Additional Detailed Technical Information
*additional information is available on our dash board.*

| | |
|---|---|
| **Performance Data** | Data Table |
| | Swept Graphs |
| | S-Parameter (S2P Files) |
| **Case Style** | Die |
| **Die Ordering and packaging information** | Quantity, Package |
| | Small, Gel - Pak: 5,10,50,100  KGD*          KAT-5-DG+ |
| | Medium†, Partial wafer: KGD*<2.115K          KAT-5-DP+ |
| | Large†, Full Wafer                                            KAT-5-DF+ |
| | †*Available upon request contact sales representative* |
| | Refer to AN-60-067 |
| **Die TB Reference** | XM-B1A2-0204D (Please check X-Microwave's Website) |
| **Environmental Ratings** | ENV-80 |

*Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and then visually inspected per Mini-Circuits' criteria. Though this is not definitive, it does provide a higher degree of confidence that the dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

## ESD Rating**
Human Body Model (HBM): Class 2 (Pass 2000V) in accordance with ANSI/ESD STM5.1-2001

** Tested in industry standard 2x2 mm, 6-lead  MCLP package.

**Additional Notes**

A. 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.

B. 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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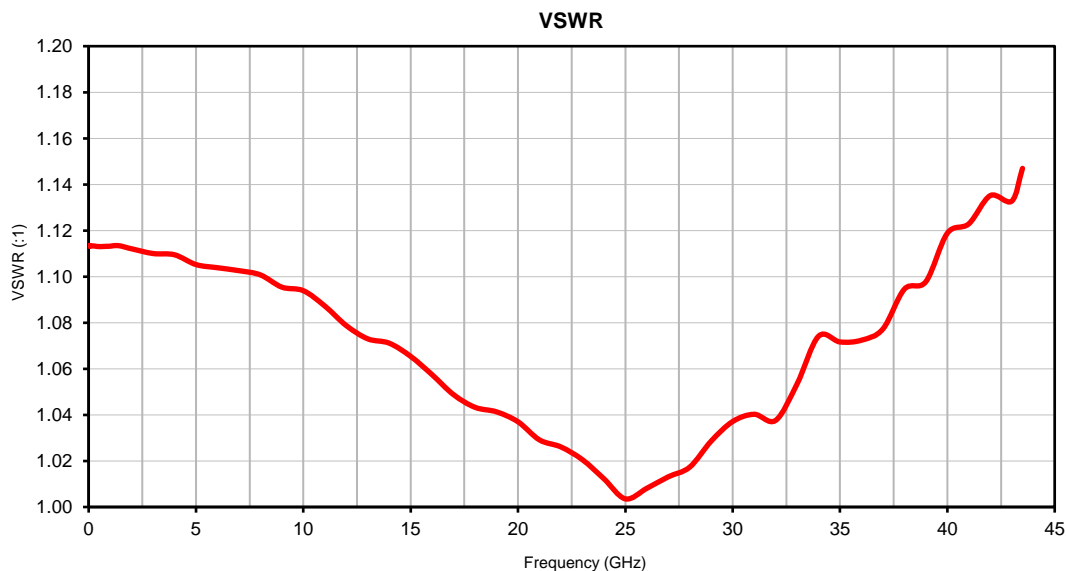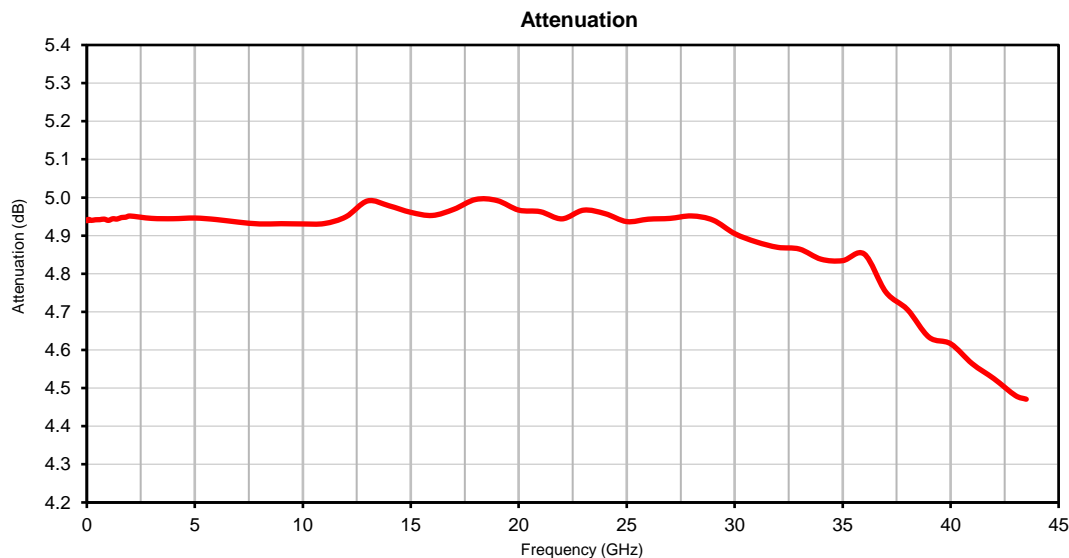
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# Fixed Attenuator Die          KAT-5-DG+

*Typical Performance Data*

| FREQUENCY (GHz) | ATTENUATION (dB) | VSWR (:1) |
|---|---|---|
| 0.01 | 4.94 | 1.11 |
| 0.02 | 4.94 | 1.11 |
| 0.04 | 4.94 | 1.11 |
| 0.06 | 4.94 | 1.11 |
| 0.08 | 4.94 | 1.11 |
| 0.10 | 4.94 | 1.11 |
| 0.20 | 4.94 | 1.11 |
| 0.40 | 4.94 | 1.11 |
| 0.60 | 4.94 | 1.11 |
| 0.80 | 4.94 | 1.11 |
| 1.00 | 4.94 | 1.11 |
| 1.20 | 4.94 | 1.11 |
| 1.40 | 4.94 | 1.11 |
| 1.60 | 4.95 | 1.11 |
| 1.80 | 4.95 | 1.11 |
| 2.00 | 4.95 | 1.11 |
| 3.00 | 4.95 | 1.11 |
| 4.00 | 4.94 | 1.11 |
| 5.00 | 4.95 | 1.11 |
| 6.00 | 4.94 | 1.10 |
| 7.00 | 4.94 | 1.10 |
| 8.00 | 4.93 | 1.10 |
| 9.00 | 4.93 | 1.10 |
| 10.0 | 4.93 | 1.09 |
| 11.0 | 4.93 | 1.09 |
| 12.0 | 4.95 | 1.08 |
| 13.0 | 4.99 | 1.07 |
| 14.0 | 4.98 | 1.07 |
| 15.0 | 4.96 | 1.07 |
| 16.0 | 4.95 | 1.06 |
| 17.0 | 4.97 | 1.05 |
| 18.0 | 4.99 | 1.04 |
| 19.0 | 4.99 | 1.04 |
| 20.0 | 4.97 | 1.04 |
| 21.0 | 4.96 | 1.03 |
| 22.0 | 4.94 | 1.03 |
| 23.0 | 4.97 | 1.02 |
| 24.0 | 4.96 | 1.01 |
| 25.0 | 4.94 | 1.00 |
| 26.0 | 4.94 | 1.01 |
| 27.0 | 4.95 | 1.01 |
| 28.0 | 4.95 | 1.02 |
| 29.0 | 4.94 | 1.03 |
| 30.0 | 4.91 | 1.04 |
| 31.0 | 4.88 | 1.04 |
| 32.0 | 4.87 | 1.04 |
| 33.0 | 4.86 | 1.05 |
| 34.0 | 4.84 | 1.07 |
| 35.0 | 4.83 | 1.07 |
| 36.0 | 4.85 | 1.07 |
| 37.0 | 4.75 | 1.08 |
| 38.0 | 4.71 | 1.09 |
| 39.0 | 4.63 | 1.10 |
| 40.0 | 4.62 | 1.12 |
| 41.0 | 4.56 | 1.12 |
| 42.0 | 4.52 | 1.14 |
| 43.0 | 4.48 | 1.13 |
| 43.5 | 4.47 | 1.15 |

# Fixed Attenuator Die

## *Typical Performance Curves*

**Attenuation**



**VSWR**

# Mini-Circuits

**Environmental Specifications**     **ENV80**

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 | -40° to 85° C or -40° to 105° C  or -55° to 105° C or -45° to 105° C<br>Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment (Die) | -65° to 150°C | Individual Model Data Sheet |
| Storage Environment(Packaging) | -40° to 70°C and 40 to 60% humidity (In Factory Shipped Package) | |

ENV80    Rev: C       06/10/24    DCO-1455  File: ENV80.pdf

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