

# 23–34 GHz Surface Mount SPDT Switch


**AP640R5-A3**

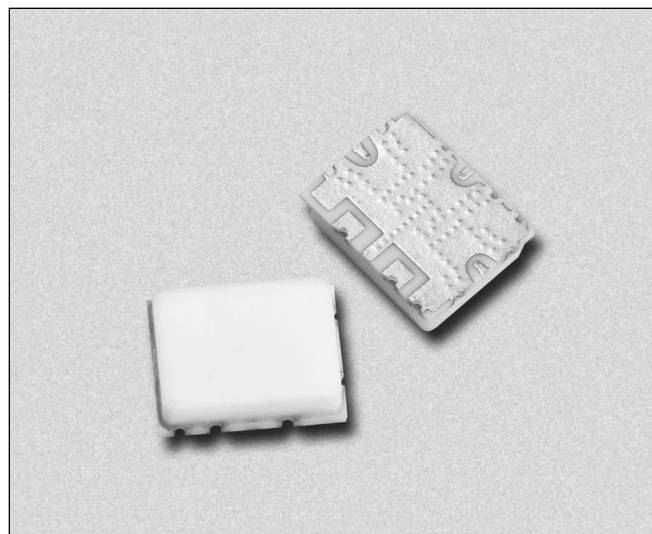
Patent Pending

## Features

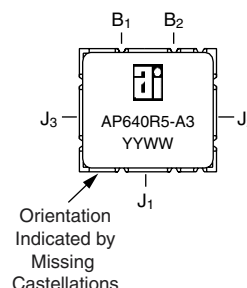
- Surface Mount Package
- Low Loss, 1.3 dB
- High Isolation, 33 dB
- High Power Handling, +33 dBm CW
- Fast Switching Speed, 2 nS
- 100% RF and DC Testing

## Description

The AP640R5-A3 is a broadband millimeterwave single-pole double-throw (SPDT) switch in a rugged surface mount package which is compatible with high-volume solder installation. Based on PIN diode MMIC technology, the switch is designed for use in millimeterwave communication and sensor systems when low loss and high linearity are required. Typical applications are transmit/receive function for TDD systems or switching between signal paths. The robust ceramic surface mount package provides excellent electrical performance and a high degree of environmental protection for long-term reliability. All switches are screened at the operating frequencies prior to shipment for guaranteed performance. Switch is targeted for high-volume broadband applications such as satellite and fixed wireless systems.



## Pin Out

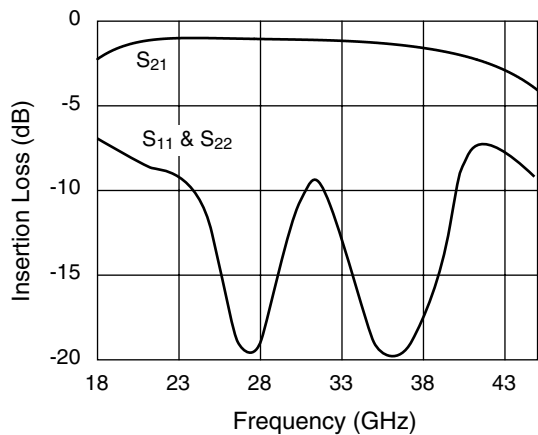


## Electrical Specifications at 25°C

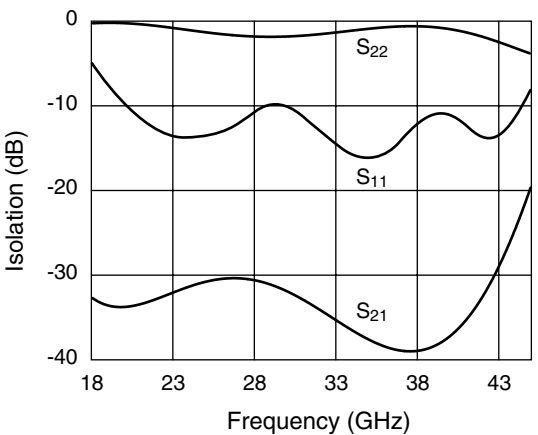
| Parameter                                     | Symbol       | Min. | Typ. | Max. | Unit    |
|-----------------------------------------------|--------------|------|------|------|---------|
| Operating Bandwidth                           | BW           | 23   |      | 34   | GHz     |
| Insertion Loss                                | IL           |      | 1.3  | 2    | dB      |
| Isolation                                     | ISO          | 28   | 33   |      | dBm     |
| Return Loss                                   | RL           |      | 9    |      | dB      |
| Leakage Current @ $V_R = -50$ V               | $I_{DD}$     |      | 1    | 10   | $\mu$ A |
| Switching Speed <sup>1</sup>                  | $t_{switch}$ |      | 2    |      | ns      |
| Output Power at 1 dB Compression <sup>1</sup> | $P_1$ dB     |      | 33   |      | dBm     |

1. Not measured on a 100% basis.

Typical Performance Data

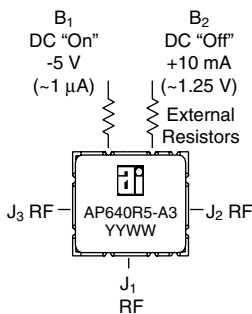


Insertion Loss vs. Frequency



Isolation vs. Frequency

Bias Arrangement



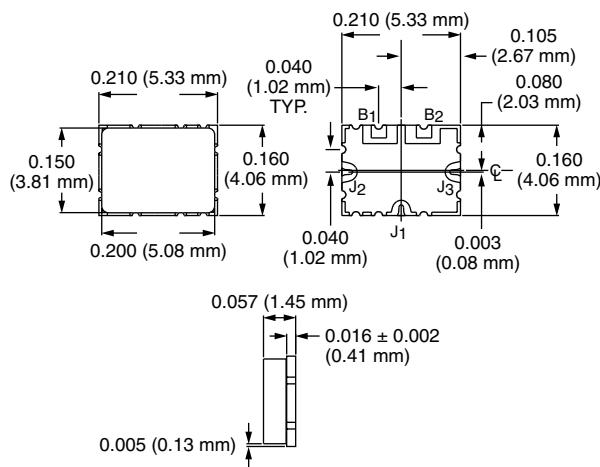
Absolute Maximum Ratings

| Characteristic                          | Value           |
|-----------------------------------------|-----------------|
| Operating Temperature (T <sub>C</sub> ) | -55°C to +85°C  |
| Storage Temperature (T <sub>ST</sub> )  | -65°C to +125°C |
| DC Reverse Bias (V <sub>BR</sub> )      | -70 V (-10 mA)  |
| DC Forward Bias (V <sub>BF</sub> )      | +1.3 V (50 mA)  |
| Input Power (P <sub>IN</sub> )          | +40 dBm         |

Truth Table

| B <sub>1</sub> | B <sub>2</sub> | J <sub>1</sub> -J <sub>2</sub> | J <sub>1</sub> -J <sub>3</sub> |
|----------------|----------------|--------------------------------|--------------------------------|
| +10 mA         | -5 V           | Insertion Loss                 | Isolation                      |
| -5 V           | +10 mA         | Isolation                      | Insertion Loss                 |

Outline



## Typical S-Parameters — Insertion Loss

| Frequency<br>(GHz) | S <sub>11</sub> |             | S <sub>21</sub> |             | S <sub>12</sub> |             | S <sub>22</sub> |             |
|--------------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|
|                    | Mag. (dB)       | Ang. (Deg.) | Mag. (dB)       | Ang. (Deg.) | Mag. (dB)       | Ang. (Deg.) | Mag. (dB)       | Ang. (Deg.) |
| 18                 | -6.5            | 144         | -2.28           | 45          | -2.28           | 45          | -7.4            | 151         |
| 20                 | -10.2           | -155        | -1.11           | -18         | -1.11           | -18         | -11.5           | -79         |
| 21                 | -8.3            | -167        | -1.23           | -43         | -1.23           | -43         | -8.5            | -96         |
| 22                 | -11.7           | 160         | -1.20           | -66         | -1.20           | -66         | -9.7            | -95         |
| 23                 | -13.2           | 76          | -1.15           | -90         | -1.15           | -90         | -10.1           | -77         |
| 24                 | -10.7           | 24          | -1.16           | -114        | -1.16           | -114        | -9.7            | -77         |
| 25                 | -12.0           | -3          | -0.94           | -139        | -0.94           | -139        | -12.4           | -93         |
| 26                 | -17.8           | -26         | -0.72           | -165        | -0.72           | -165        | -20.7           | -104        |
| 27                 | -32.1           | 52          | -0.83           | 168         | -0.83           | 168         | -30.5           | -50         |
| 28                 | -25.4           | 167         | -0.82           | 145         | -0.82           | 144         | -24.6           | -78         |
| 29                 | -15.0           | 162         | -1.01           | 120         | -1.01           | 119         | -15.5           | -111        |
| 30                 | -10.2           | 145         | -1.37           | 95          | -1.37           | 95          | -10.8           | -133        |
| 31                 | -9.0            | 123         | -1.48           | 74          | -1.48           | 73          | -10.0           | -154        |
| 32                 | -10.8           | 95          | -1.45           | 52          | -1.45           | 52          | -10.9           | -176        |
| 33                 | -13.5           | 59          | -1.42           | 30          | -1.42           | 29          | -11.5           | 154         |
| 34                 | -14.9           | 20          | -0.94           | 4           | -0.94           | 4           | -13.7           | 126         |
| 35                 | -22.4           | -13         | -0.93           | -23         | -0.93           | -23         | -22.9           | 126         |
| 36                 | -29.3           | 141         | -0.91           | -51         | -0.91           | -51         | -19.9           | -113        |
| 38                 | -21.4           | 88          | -1.41           | -108        | -1.41           | -108        | -19.3           | -90         |
| 40                 | -12.4           | 179         | -2.87           | -161        | -2.87           | -161        | -7.8            | -44         |
| 42                 | -9.5            | 123         | -2.25           | 154         | -2.25           | 154         | -8.3            | -18         |
| 44                 | -14.9           | -84         | -2.99           | 87          | -2.99           | 86          | -9.4            | 12          |
| 45                 | -9.6            | -156        | -4.34           | 51          | -4.34           | 51          | -16.3           | 83          |

## Typical S-Parameters — Isolation

| Frequency<br>(GHz) | S <sub>11</sub> |             | S <sub>21</sub> |             | S <sub>12</sub> |             | S <sub>22</sub> |             |
|--------------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|
|                    | Mag. (dB)       | Ang. (Deg.) | Mag. (dB)       | Ang. (Deg.) | Mag. (dB)       | Ang. (Deg.) | Mag. (dB)       | Ang. (Deg.) |
| 18                 | -7.1            | 154         | -31.7           | -4          | -31.7           | -4          | -0.3            | -119        |
| 20                 | -8.9            | -177        | -35.6           | -52         | -35.6           | -52         | -0.2            | -137        |
| 21                 | -10.6           | 176         | -37.5           | -45         | -37.6           | -45         | -0.3            | -144        |
| 22                 | -19.2           | 161         | -28.8           | -64         | -28.9           | -64         | -0.5            | -152        |
| 23                 | -27.5           | 43          | -28.9           | -107        | -28.9           | -107        | -0.6            | -170        |
| 24                 | -17.3           | 50          | -29.5           | -139        | -29.4           | -139        | -0.7            | 163         |
| 25                 | -12.6           | 28          | -30.4           | -164        | -30.4           | -164        | -1.2            | 136         |
| 26                 | -13.6           | -3          | -31.1           | 173         | -31.1           | 173         | -3.0            | 126         |
| 27                 | -20.7           | -78         | -37.2           | 123         | -37.2           | 124         | -2.2            | 127         |
| 28                 | -13.0           | 167         | -32.9           | 171         | -33.0           | 171         | -1.4            | 120         |
| 29                 | -10.2           | 119         | -30.3           | 154         | -30.2           | 154         | -1.0            | 107         |
| 30                 | -11.3           | 106         | -29.8           | 120         | -29.8           | 120         | -1.0            | 88          |
| 31                 | -12.1           | 99          | -30.1           | 91          | -30.0           | 91          | -1.3            | 57          |
| 32                 | -15.6           | 69          | -33.8           | 41          | -33.9           | 40          | -1.7            | 21          |
| 33                 | -21.5           | 36          | -34.6           | 74          | -34.7           | 74          | -1.8            | -7          |
| 34                 | -19.7           | 8           | -33.0           | 30          | -32.9           | 30          | -1.6            | -34         |
| 35                 | -30.3           | -57         | -37.7           | -18         | -37.8           | -20         | -1.3            | -59         |
| 36                 | -21.2           | 112         | -44.4           | 5           | -44.3           | 7           | -1.0            | -82         |
| 38                 | -15.6           | -180        | -42.3           | -60         | -42.2           | -61         | -0.2            | -105        |
| 40                 | -13.1           | 132         | -31.9           | -164        | -32.0           | -164        | -0.2            | -115        |
| 42                 | -29.3           | 128         | -31.3           | 121         | -31.1           | 121         | -2.1            | -148        |
| 44                 | -17.4           | -105        | -29.0           | 136         | -29.2           | 135         | -3.8            | 124         |
| 45                 | -8.8            | -172        | -17.2           | 49          | -17.2           | 49          | -3.4            | 117         |

## Alpha-2™ Surface Mount Package Handling and Mounting

Millimeterwave components require careful mounting design to maintain optimal performance. Alpha-2™ surface mount packages (patent pending) provide a rugged and repeatable electrical connection using standard solder techniques.

The -A3 package is one of several parts in the Alpha-2™ surface mount package family.

### Handling

The -A3 surface mount package is very rugged. However, due to ceramic's brittle nature one should exercise care when handling with metal tools. Do not apply heavy pressure to the lid. Vacuum tools may be used to pick and place this part.

Only personnel trained in both ESD precautions and handling precautions should be allowed to handle these packages.

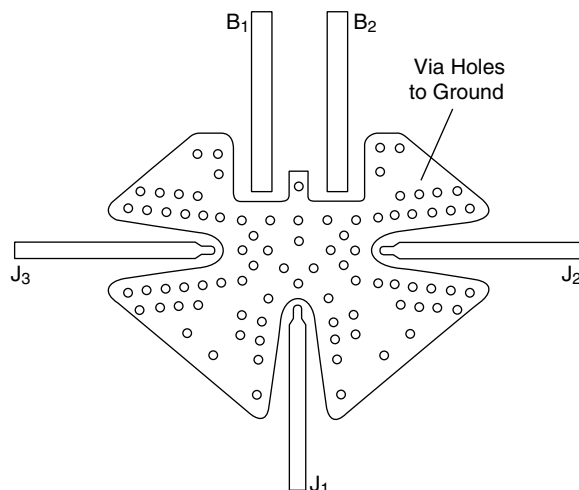
### Package Construction

The -A3 surface mount package consists of a base and a lid. The package base is ceramic with filled vias and plated castellations. The package lid is un-plated alumina. The lid seal is epoxy.

### Mounting Design

The -A3 surface mount package is installed on top of a printed circuit board on a specially designed footprint.

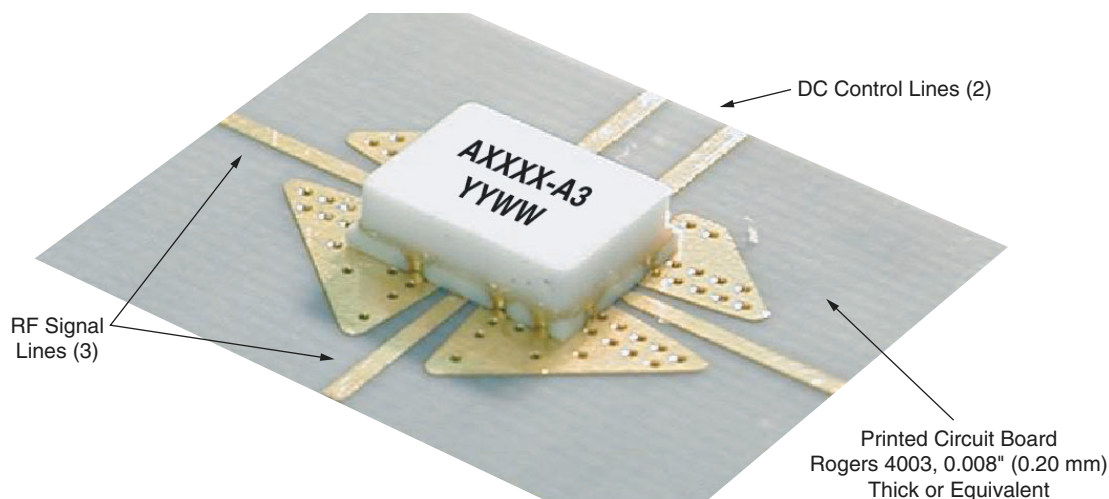
Mounting footprint geometry for the -A3 package will be supplied by Alpha Industries in electronic formats or paper drawing.



Footprint Geometry for -A3 Surface Mount Package.

### Mounting the Package

The -A3 surface mount package is compatible with high-volume surface mount installation using solder. RF and DC connections are accomplished with metallized edge castellations that hold solder fillets. Ground connections are accomplished by both metallized edge castellations and filled vias to the bottom of the package. Care should be taken to ensure that there are no voids or gaps in the solder so that a good RF, DC, and ground contact is maintained.



-A3 Surface Mount Package Installation.