

## FEATURES

**Broadband frequency range: 0.1 GHz to 8 GHz**

**Nonreflective 50  $\Omega$  design**

**Low insertion loss: 1.7 dB at 6 GHz**

**High isolation: 36 dB at 6 GHz**

**High input linearity at 250 MHz to 8 GHz**

**P1dB: 28 dBm typical**

**IP3: 44 dBm typical**

**Integrated 2 to 4 line decoder**

**16-lead, 3 mm  $\times$  3 mm LFCSP package**

**ESD HBM rating: 250 V (Class 1A)**

## ENHANCED PRODUCT FEATURES

**Supports defense and aerospace applications (AQEC standard)**

**Military temperature range ( $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ )**

**Controlled manufacturing baseline**

**One assembly/test site**

**Product change notification**

**Qualification data available on request**

## APPLICATIONS

**Broadband telecommunications systems**

**Fiber optics**

**Switched filter banks**

**Wireless Infrastructure below 8 GHz**

## GENERAL DESCRIPTION

The HMC344ATCPZ-EP is a broadband, nonreflective, single-pole, four-throw (SP4T) switch manufactured using a gallium arsenide (GaAs) metal semiconductor field effect transistor (MESFET) process. This switch offers high isolation, low insertion loss, and on-chip termination of the isolated ports.

The switch operates with a negative supply voltage ( $V_{EE}$ ) range of  $-5\text{ V}$  to  $-3\text{ V}$  and requires two negative logic control voltages.

## FUNCTIONAL BLOCK DIAGRAM

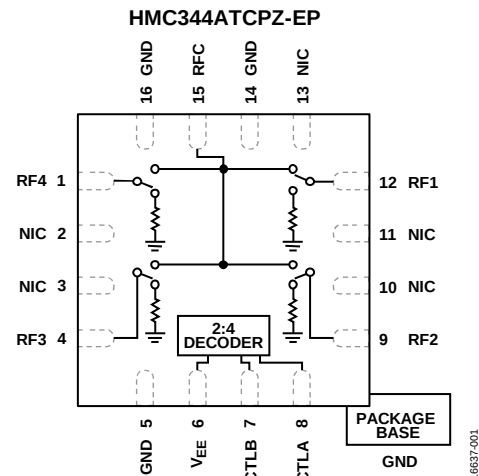


Figure 1.

The HMC344ATCPZ-EP includes an on-chip, binary two-line to four-line decoder that provides logic control from two logic input lines.

The HMC344ATCPZ-EP comes in a 3 mm  $\times$  3 mm, 16-lead LFCSP package and operates from a 0.1 GHz to 8 GHz frequency range.

Additional application and technical information can be found in the [HMC344ALP3E](#) data sheet.

TABLE OF CONTENTS

|                                 |   |                                                  |   |
|---------------------------------|---|--------------------------------------------------|---|
| Features .....                  | 1 | ESD Caution.....                                 | 4 |
| Enhanced Product Features ..... | 1 | Pin Configuration and Function Descriptions..... | 5 |
| Applications.....               | 1 | Interface Schematics .....                       | 6 |
| Functional Block Diagram .....  | 1 | Typical Performance Characteristics .....        | 7 |
| General Description .....       | 1 | Outline Dimensions .....                         | 8 |
| Revision History .....          | 2 | Ordering Guide .....                             | 8 |
| Specifications.....             | 3 |                                                  |   |
| Absolute Maximum Ratings.....   | 4 |                                                  |   |

REVISION HISTORY

3/2018—Revision 0: Initial Version

## SPECIFICATIONS

$V_{EE} = -3\text{ V}$  or  $-5\text{ V}$ , control voltage ( $V_{CTL}$ ) =  $0\text{ V}$  or  $V_{EE}$ , case temperature ( $T_{CASE}$ ) =  $25^{\circ}\text{C}$ ,  $50\ \Omega$  system, unless otherwise noted.

Table 1.

| Parameter                        | Symbol               | Test Conditions/Comments                                                           | Min      | Typ      | Max          | Unit               |
|----------------------------------|----------------------|------------------------------------------------------------------------------------|----------|----------|--------------|--------------------|
| FREQUENCY RANGE                  | f                    |                                                                                    | 0.1      |          | 8            | GHz                |
| INSERTION LOSS                   |                      |                                                                                    |          |          |              |                    |
| Between RFC and RF1 to RF4 (On)  |                      | 0.1 GHz to 2 GHz                                                                   |          | 1.4      | 2.0          | dB                 |
|                                  |                      | 2 GHz to 4 GHz                                                                     |          | 1.4      | 2.0          | dB                 |
|                                  |                      | 4 GHz to 6 GHz                                                                     |          | 1.7      | 2.2          | dB                 |
|                                  |                      | 6 GHz to 8 GHz                                                                     |          | 2.1      | 2.5          | dB                 |
| ISOLATION                        |                      |                                                                                    |          |          |              |                    |
| Between RFC and RF1 to RF4 (Off) |                      | 0.1 GHz to 2 GHz                                                                   | 39       | 43       |              | dB                 |
|                                  |                      | 2 GHz to 4 GHz                                                                     | 33       | 37       |              | dB                 |
|                                  |                      | 4 GHz to 6 GHz                                                                     | 32       | 36       |              | dB                 |
|                                  |                      | 6 GHz to 8 GHz                                                                     | 28       | 32       |              | dB                 |
| RETURN LOSS                      |                      |                                                                                    |          |          |              |                    |
| RFC and RF1 to RF4 (On)          |                      | 0.1 GHz to 2 GHz                                                                   | 12       | 16       |              | dB                 |
|                                  |                      | 2 GHz to 4 GHz                                                                     | 12       | 16       |              | dB                 |
|                                  |                      | 4 GHz to 6 GHz                                                                     | 11       | 16       |              | dB                 |
|                                  |                      | 6 GHz to 8 GHz                                                                     | 6        | 11       |              | dB                 |
| RF1 to RF4 (Off)                 |                      | 0.1 GHz to 8 GHz                                                                   | 11       | 16       |              | dB                 |
| SWITCHING                        |                      |                                                                                    |          |          |              |                    |
| Rise and Fall Time               | $t_{RISE}, t_{FALL}$ | 10% to 90% of radio frequency (RF) output                                          |          | 35       |              | ns                 |
| On and Off Time                  | $t_{ON}, t_{OFF}$    | 50% $V_{CTL}$ to 90% of RF output                                                  |          | 75       |              | ns                 |
| INPUT LINEARITY <sup>1</sup>     |                      |                                                                                    |          |          |              |                    |
| 1 dB Power Compression           | P1dB                 | f = 250 MHz to 8 GHz<br>$V_{EE} = -5\text{ V}$<br>$V_{EE} = -3\text{ V}$           | 23       | 28<br>25 |              | dBm<br>dBm         |
| Third-Order Intercept            | IP3                  | 10 dBm per tone, 1 MHz spacing<br>$V_{EE} = -5\text{ V}$<br>$V_{EE} = -3\text{ V}$ | 40       | 44<br>44 |              | dBm<br>dBm         |
| SUPPLY                           |                      |                                                                                    |          |          |              |                    |
| Voltage                          | $V_{EE}$             | $V_{EE}$ pin                                                                       | -5       |          | -3           | V                  |
| Current                          | $I_{EE}$             |                                                                                    |          | 2.5      | 6            | mA                 |
| DIGITAL CONTROL INPUTS           |                      |                                                                                    |          |          |              |                    |
| Voltage                          | $V_{CTL}$            | CTLA and CTLB pins                                                                 |          |          |              |                    |
| Low                              | $V_{INL}$            | $V_{EE} = -5\text{ V}$<br>$V_{EE} = -3\text{ V}$                                   | -3<br>-1 |          | 0<br>0       | V<br>V             |
| High                             | $V_{INH}$            | $V_{EE} = -5\text{ V}$<br>$V_{EE} = -3\text{ V}$                                   | -5<br>-3 |          | -4.2<br>-2.2 | V<br>V             |
| Current                          | $I_{CTL}$            |                                                                                    |          |          |              |                    |
| Low                              | $I_{INL}$            |                                                                                    |          | 40       |              | $\mu\text{A}$      |
| High                             | $I_{INH}$            |                                                                                    |          | 0.10     |              | $\mu\text{A}$      |
| OPERATING TEMPERATURE            |                      |                                                                                    | -55      |          | +125         | $^{\circ}\text{C}$ |

<sup>1</sup> Input linearity performance degrades at frequencies less than 250 MHz.

## ABSOLUTE MAXIMUM RATINGS

For recommended operating conditions, see Table 1.

Table 2.

| Parameter                                             | Rating                                      |
|-------------------------------------------------------|---------------------------------------------|
| Negative Supply Voltage ( $V_{EE}$ )                  | -7 V                                        |
| Digital Control Input Voltage Range                   | $V_{EE} - 0.5$ V to +1 V                    |
| RF Input Power (See Figure 2)                         |                                             |
| $f = 250$ MHz to 8 GHz, $T_{CASE} = 85^\circ\text{C}$ |                                             |
| $V_{EE} = -5$ V                                       |                                             |
| Through Path                                          | 31 dBm                                      |
| Terminated Path                                       | 26.5 dBm                                    |
| Hot Switching                                         | 22 dBm                                      |
| $V_{EE} = -3$ V                                       |                                             |
| Through Path                                          | 28 dBm                                      |
| Terminated Path                                       | 23.5 dBm                                    |
| Hot Switching                                         | 19 dBm                                      |
| Temperature                                           |                                             |
| Junction, $T_J$                                       | $150^\circ\text{C}$                         |
| Storage                                               | $-65^\circ\text{C}$ to $+150^\circ\text{C}$ |
| Reflow                                                | $260^\circ\text{C}$                         |
| Junction to Case Thermal Resistance, $\theta_{JC}$    |                                             |
| Through Path                                          | $107^\circ\text{C/W}$                       |
| Terminated Path                                       | $137^\circ\text{C/W}$                       |
| Electrostatic Discharge (ESD) Sensitivity             |                                             |
| Human Body Model (HBM)                                | 250 V (Class 1A)                            |

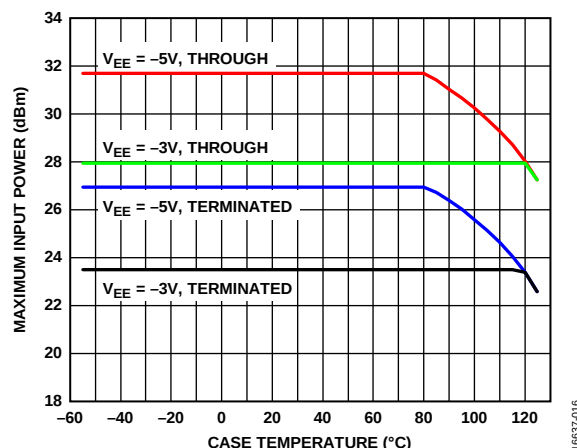


Figure 2. Maximum Input Power vs. Case Temperature Plot

### 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.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

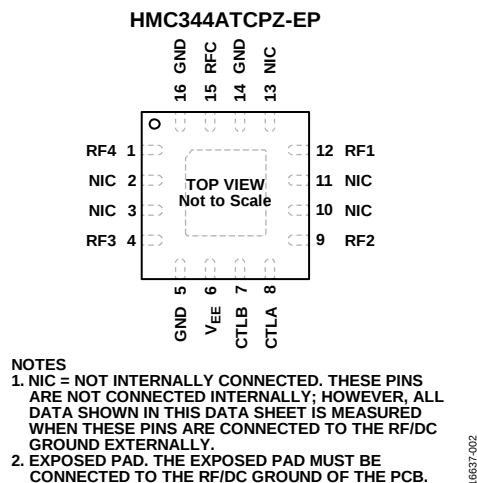


Figure 3. Pin Configuration

Table 3. Pin Function Descriptions

| Pin No.          | Mnemonic        | Description                                                                                                                                                                             |
|------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | RF4             | RF4 Port. This pin is dc-coupled and matched to 50 $\Omega$ . A dc blocking capacitor is required if the RF line potential does not equal 0 V dc.                                       |
| 2, 3, 10, 11, 13 | NIC             | Not Internally Connected. These pins are not connected internally; however, all data shown in this data sheet is measured when these pins are connected to the RF/dc ground externally. |
| 4                | RF3             | RF3 Port. This pin is dc-coupled and matched to 50 $\Omega$ . A dc blocking capacitor is required if the RF line potential does not equal 0 V dc.                                       |
| 5, 14, 16        | GND             | Ground. These pins connect to the RF/dc ground of the PCB.                                                                                                                              |
| 6                | V <sub>EE</sub> | Negative Supply Voltage Pin.                                                                                                                                                            |
| 7                | CTLB            | Control Input 2 Pin. See Table 4 for the control voltage truth table.                                                                                                                   |
| 8                | CTLA            | Control Input 1 Pin. See Table 4 for the control voltage truth table.                                                                                                                   |
| 9                | RF2             | RF2 Port. This pin is dc-coupled and matched to 50 $\Omega$ . A dc blocking capacitor is required if the RF line potential does not equal 0 V dc.                                       |
| 12               | RF1             | RF1 Port. This pin is dc-coupled and matched to 50 $\Omega$ . A dc blocking capacitor is required if the RF line potential does not equal 0 V dc.                                       |
| 15               | RFC             | RF Common Port. This pin is dc-coupled and matched to 50 $\Omega$ . A dc blocking capacitor is required if the RF line potential does not equal 0 V dc.                                 |
|                  | EPAD            | Exposed Pad. The exposed pad must be connected to the RF/dc ground of the PCB.                                                                                                          |

Table 4. Control Voltage Truth Table

| Digital Control Input |      | RF Paths            |                     |                     |                     |
|-----------------------|------|---------------------|---------------------|---------------------|---------------------|
| CTLA                  | CTLB | RFC to RF1          | RFC to RF2          | RFC to RF3          | RFC to RF4          |
| High                  | High | Insertion loss (on) | Isolation (off)     | Isolation (off)     | Isolation (off)     |
| Low                   | High | Isolation (off)     | Insertion loss (on) | Isolation (off)     | Isolation (off)     |
| High                  | Low  | Isolation (off)     | Isolation (off)     | Insertion loss (on) | Isolation (off)     |
| Low                   | Low  | Isolation (off)     | Isolation (off)     | Isolation (off)     | Insertion loss (on) |

INTERFACE SCHEMATICS

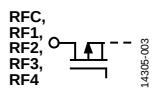


Figure 4. RFC and RF1 to RF4 Interface Schematic

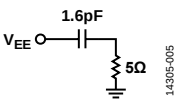


Figure 6. VEE Interface Schematic

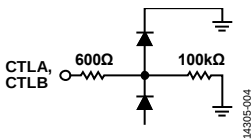


Figure 5. CTLA and CTLB Interface Schematic

## TYPICAL PERFORMANCE CHARACTERISTICS

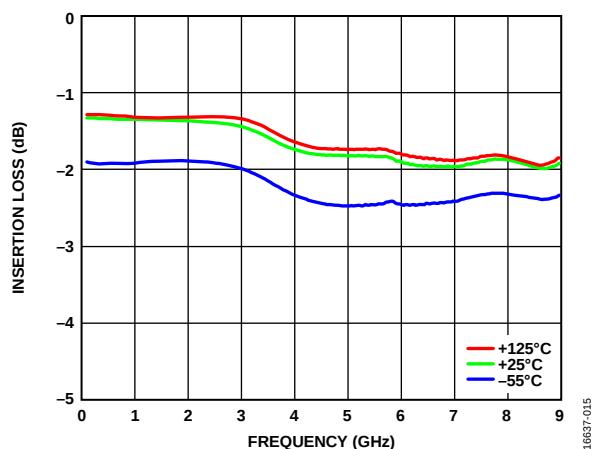


Figure 7. Insertion Loss vs. Frequency at Various Temperatures, Between RFC and RF1

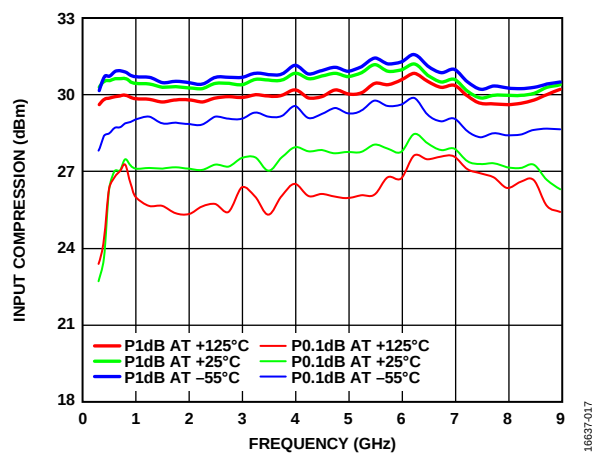


Figure 8. Input Compression vs. Frequency at Various Temperatures,  $V_{EE} = -5\text{ V}$

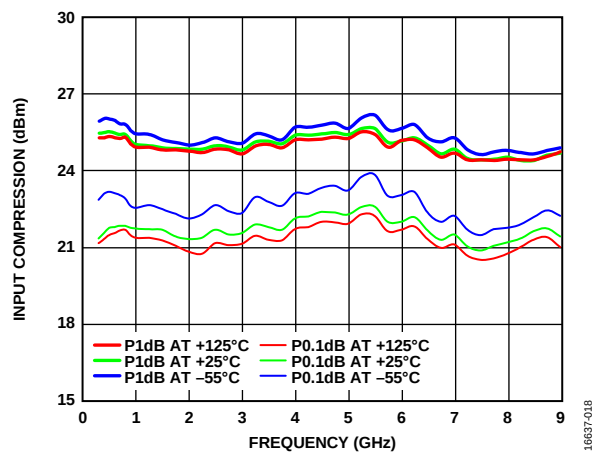
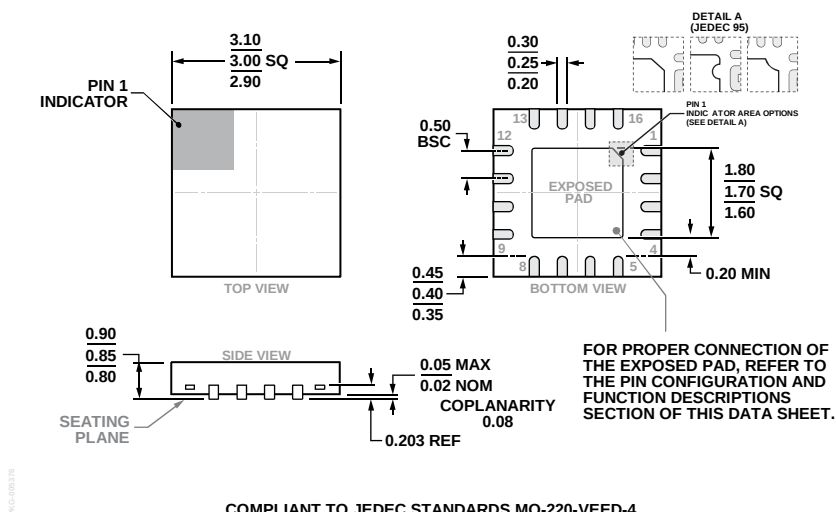


Figure 9. Input Compression vs. Frequency at Various Temperatures,  $V_{EE} = -3\text{ V}$

## OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-220-VEED-4

Figure 10. 16-Lead Lead Frame Chip Scale Package [LFCSP]  
 3 mm × 3 mm Body and 0.85 mm Package Height  
 (CP-16-51)  
 Dimensions shown in millimeters

## ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                           | Package Option |
|--------------------|-------------------|-----------------------------------------------|----------------|
| HMC344ATCPZ-EP-PT  | −55°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP] | CP-16-51       |
| HMC344ATCPZ-EP-R7  | −55°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP] | CP-16-51       |

<sup>1</sup> All models are RoHS compliant parts.