FAIRCHILD
SEMICONDUCTOR™

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NC7S04
TinyLogic® HS Inverter

General Description

The NC7S04 is a single high performance CMOS Inverter. Advanced Silicon Gate CMOS fabrication assures high speed and low power circuit operation over a broad V_{CC} range. ESD protection diodes inherently guard both input and output with respect to the V_{CC} and GND rails. Three stages of gain between input and output assures high noise immunity and reduced sensitivity to input edge rate.
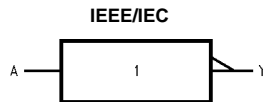
Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- High Speed: t_{PD} = 3 ns typ
- Low Quiescent Power: I_{CC} < 1 μA
- Balanced Output Drive: 2 mA I_{OL}, −2 mA I_{OH}
- Broad V_{CC} Operating Range: 2V – 6V
- Balanced Propagation Delays
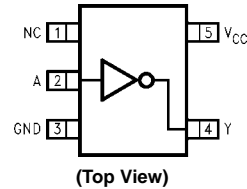- Specified for 3V operation

Ordering Code:

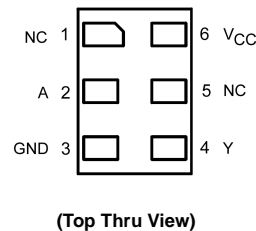| Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
NC7S04M5X	MA05B	7S04	5-Lead SOT23, JEDEC MO-178, 1.6mm	3k Units on Tape and Reel
NC7S04P5X	MAA05A	S04	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3k Units on Tape and Reel
NC7S04L6X	MAC06A	AA	6-Lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel

Logic Symbol

IEEE/IEC

Pin Descriptions

Pin Names	Description
A	Input
Y	Output
NC	No Connect

Function Table

$$Y = \overline{A}$$

Input	Output
A	**Y**
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

Connection Diagrams

Pin Assignments for SC70 and SOT23

(Top View)

Pad Assignments for MicroPak

(Top Thru View)

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MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

NC7S04

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
@$V_{IN} \leq -0.5V$	−20 mA
@$V_{IN} \geq V_{CC} + 0.5V$	+20 mA
DC Input Voltage (V_{IN})	−0.5V to V_{CC} +0.5V
DC Output Diode Current (I_{OK})	
@$V_{OUT} \leq -0.5V$	−20 mA
@$V_{OUT} \geq V_{CC} + 0.5V$	+20 mA
DC Output Voltage (V_{OUT})	−0.5V to V_{CC} +0.5V
DC Output Source or Sink	
Current (I_{OUT})	±12.5 mA
DC V_{CC} or Ground Current per	
Output Pin (I_{CC} or I_{GND})	±25 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature (T_J)	150°C
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C
Power Dissipation (P_D) @ +85°C	
SOT23-5	200 mW
SC70-5	150 mW

Recommended Operating Conditions (Note 2)

Supply Voltage (V_{CC})	2.0V to 6.0V
Input Voltage (V_{IN})	0V to V_{CC}
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_A)	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
V_{CC} @ 2.0V	0 to 1000 ns
V_{CC} @ 3.0V	0 to 750 ns
V_{CC} @ 4.5V	0 to 500 ns
V_{CC} @ 6.0V	0 to 400 ns
Thermal Resistance (θ_{JA})	
SOT23-5	300°C/W
SC70-5	425°C/W

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of circuits outside the databook specifications.

Note 2: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions
			Min	Typ	Max	Min	Max		
V_{IH}	HIGH Level Input Voltage	2.0	1.50			1.50		V	
		3.0 - 6.0	0.7 V_{CC}			0.7 V_{CC}			
V_{IL}	LOW Level Input Voltage	2.0			0.50		0.50	V	
		3.0 - 6.0			0.3 V_{CC}		0.3 V_{CC}		
V_{OH}	HIGH Level Output Voltage	2.0	1.90	2.0		1.90		V	$I_{OH} = -20$ μA $V_{IN} = V_{IL}$
		3.0	2.90	3.0		2.90			
		4.5	4.40	4.5		4.40			
		6.0	5.90	6.0		5.90			
		3.0	2.68	2.85		2.63		V	$V_{IN} = V_{IL}$ $I_{OH} = -1.3$ mA
		4.5	4.18	4.35		4.13			$I_{OH} = -2.0$ mA
		6.0	5.68	5.85		5.63			$I_{OH} = -2.6$ mA
V_{OL}	LOW Level Output Voltage	2.0		0.0	0.10		0.10	V	$I_{OL} = 20$ μA $V_{IN} = V_{IH}$
		3.0		0.0	0.10		0.10		
		4.5		0.0	0.10		0.10		
		6.0		0.0	0.10		0.10		
		3.0		0.1	0.26		0.33	V	$V_{IN} = V_{IH}$ $I_{OL} = 1.3$ mA
		4.5		0.1	0.26		0.33		$I_{OL} = 2.0$ mA
		6.0		0.1	0.26		0.33		$I_{OL} = 2.6$ mA
I_{IN}	Input Leakage Current	6.0			±0.1		±1.0	μA	$V_{IN} = V_{CC}$, GND
I_{CC}	Quiescent Supply Current	6.0			1.0		10.0	μA	$V_{IN} = V_{CC}$, GND

AC Electrical Characteristics

| Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$ Min	Typ	Max	$T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions	Figure Number
t_{PLH}, t_{PHL}	Propagation Delay	5.0		3.0	15.0			ns	$C_L = 15$ pF	Figures 1, 3
		2.0		18.0	100.0		125.0	ns	$C_L = 50$ pF	
		3.0		10.0	27.0		35.0			
		4.5		7.0	20.0		25.0			
		6.0		6.0	17.0		21.0			
t_{TLH}, t_{THL}	Output Transition Time	5.0		3.0	10.0			ns	$C_L = 15$ pF	Figures 1, 3
		2.0		25.0	125.0		155.0	ns	$C_L = 50$ pF	
		3.0		16.0	35.0		45.0			
		4.5		11.0	25.0		31.0			
		6.0		9.0	21.0		26.0			
C_{IN}	Input Capacitance	Open		2.0	10.0		10.0	pF		
C_{PD}	Power Dissipation Capacitance	5.0		6.0				pF	(Note 3)	Figure 2

Note 3: C_{PD} is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I_{CCD}) at no output loading and operating at 50% duty cycle. (See Figure 2.) C_{PD} is related to I_{CCD} dynamic operating current by the expression:
$I_{CCD} = (C_{PD}) (V_{CC}) (f_{IN}) + (I_{CC}static)$.

AC Loading and Waveforms
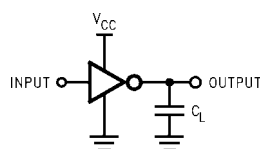
C_L includes load and stray capacitance
Input PRR = 1.0 MHz, t_w = 500 ns

FIGURE 1. AC Test Circuit
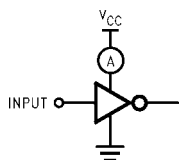
Input = AC Waveforms;
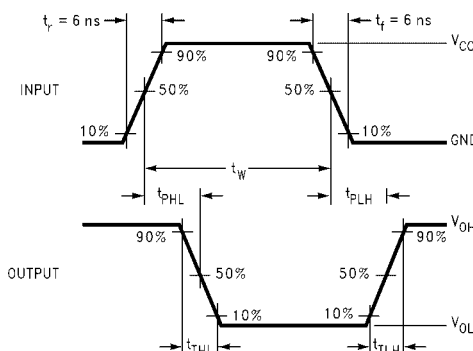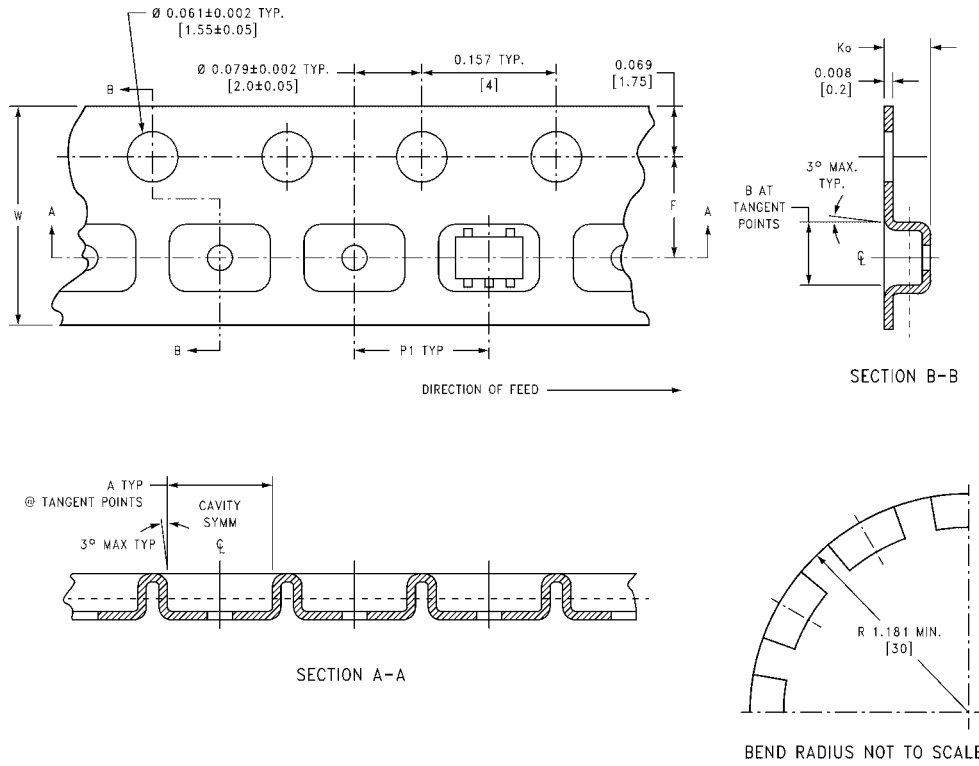PRR = Variable; Duty Cycle = 50%

FIGURE 2. I_{CCD} Test Circuit

FIGURE 3. AC Waveforms

Tape and Reel Specification

TAPE FORMAT FOR SOT23, SC70

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
M5X, P5X	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

TAPE DIMENSIONS inches (millimeters)

Ø 0.061±0.002 TYP.
[1.55±0.05]

Ø 0.079±0.002 TYP.
[2.0±0.05]

0.157 TYP.
[4]

0.069
[1.75]

Ko

0.008
[0.2]

3° MAX.
TYP.

B AT
TANGENT
POINTS

SECTION B-B

W

A

B

F

A

P1 TYP

DIRECTION OF FEED

A TYP
@ TANGENT POINTS

CAVITY
SYMM

3° MAX TYP

SECTION A-A

R 1.181 MIN.
[30]

BEND RADIUS NOT TO SCALE

| Package	Tape Size	DIM A	DIM B	DIM F	DIM K_o	DIM P1	DIM W
SC70-5	8 mm	0.093 (2.35)	0.096 (2.45)	0.138 ± 0.004 (3.5 ± 0.10)	0.053 ± 0.004 (1.35 ± 0.10)	0.157 (4)	0.315 ± 0.004 (8 ± 0.1)
SOT23-5	8 mm	0.130 (3.3)	0.130 (3.3)	0.138 ± 0.002 (3.5 ± 0.05)	0.055 ± 0.004 (1.4 ± 0.11)	0.157 (4)	0.315 ± 0.012 (8 ± 0.3)

Tape and Reel Specification (Continued)

TAPE FORMAT FOR MicroPak

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
	Leader (Start End)	125 (typ)	Empty	Sealed
L6X	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

TAPE DIMENSIONS inches (millimeters)

SECTION B-B
SCALE:10X
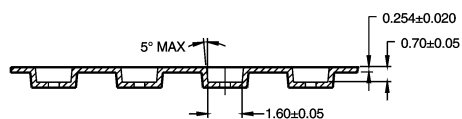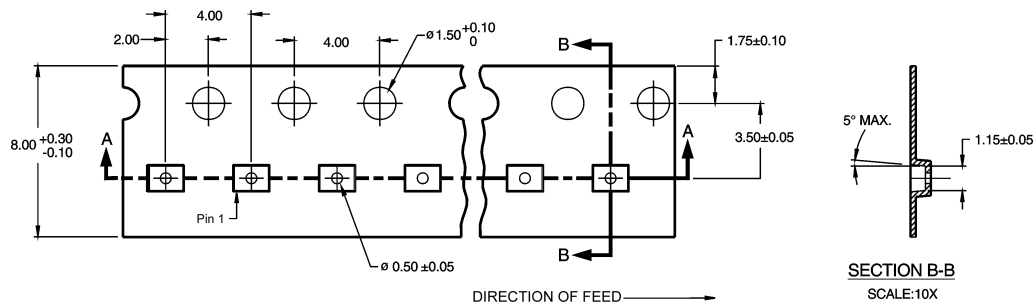
SECTION A-A
SCALE:10X

DIRECTION OF FEED
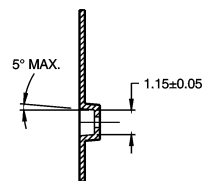
REEL DIMENSIONS inches (millimeters)

TAPE SLOT

DETAIL X

DETAIL X
SCALE: 3X
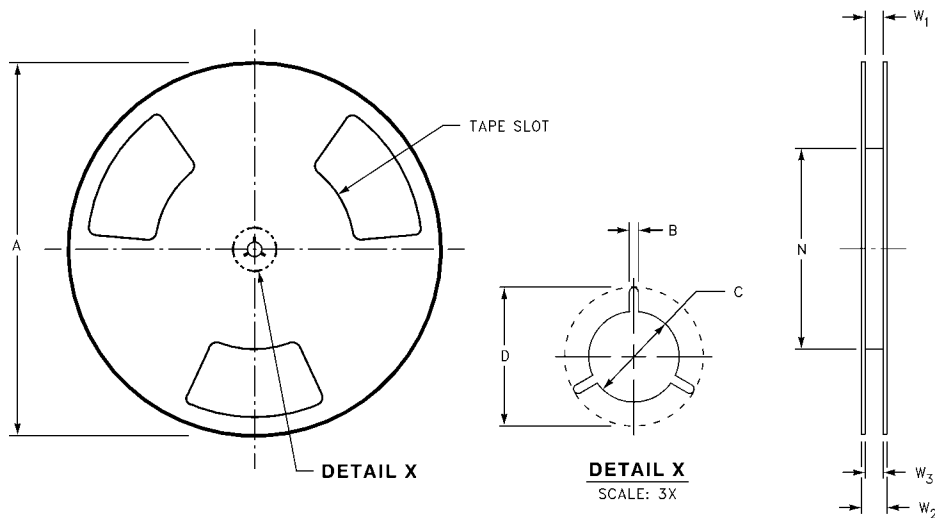
Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/–0.000 (8.40 + 1.50/–0.00)	0.567 (14.40)	W1 + 0.078/–0.039 (W1 + 2.00/–1.00)

Physical Dimensions inches (millimeters) unless otherwise noted

SYMM

3.00
2.80

A

5   4

B

3.00
2.60

1.70
1.50

1   2   3

0.95

0.50
0.30

1.90

⊕ 0.20 Ⓜ C A B

0.95   0.95

2.60

1.00

0.70

LAND PATTERN RECOMMENDATION

1.25
0.90

1.40
0.95
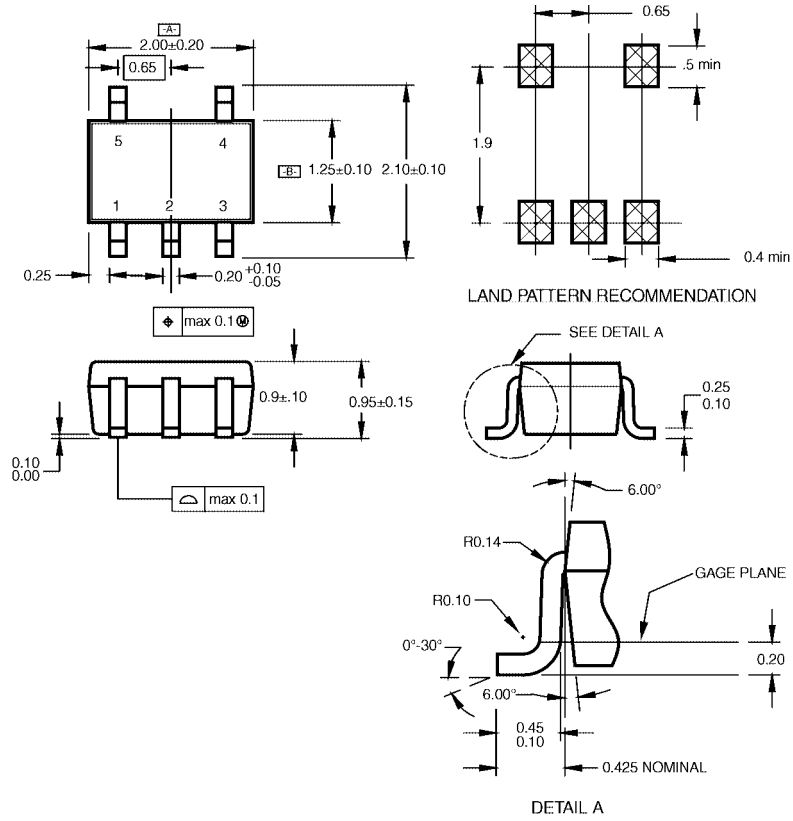
0.15
0.05

C

◯ 0.10 C

SEE DETAIL A

0.20
0.08
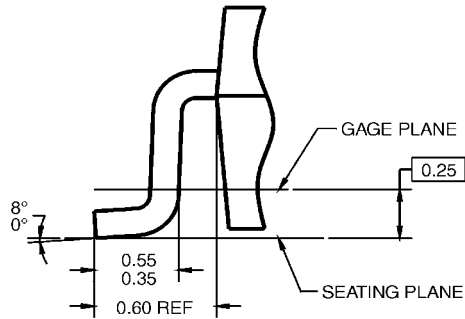
NOTES: UNLESS OTHERWISE SPECIFIED
   A) THIS PACKAGE CONFORMS TO JEDEC
        MO-178, ISSUE B, VARIATION AA,
        DATED JANUARY 1999.
   B) ALL DIMENSIONS ARE IN MILLIMETERS.

GAGE PLANE

0.25

8°
0°

0.55
0.35

0.60 REF

SEATING PLANE

MA05BRevC

DETAIL A

5-Lead SOT23, JEDEC MO-178, 1.6mm
Package Number MA05B

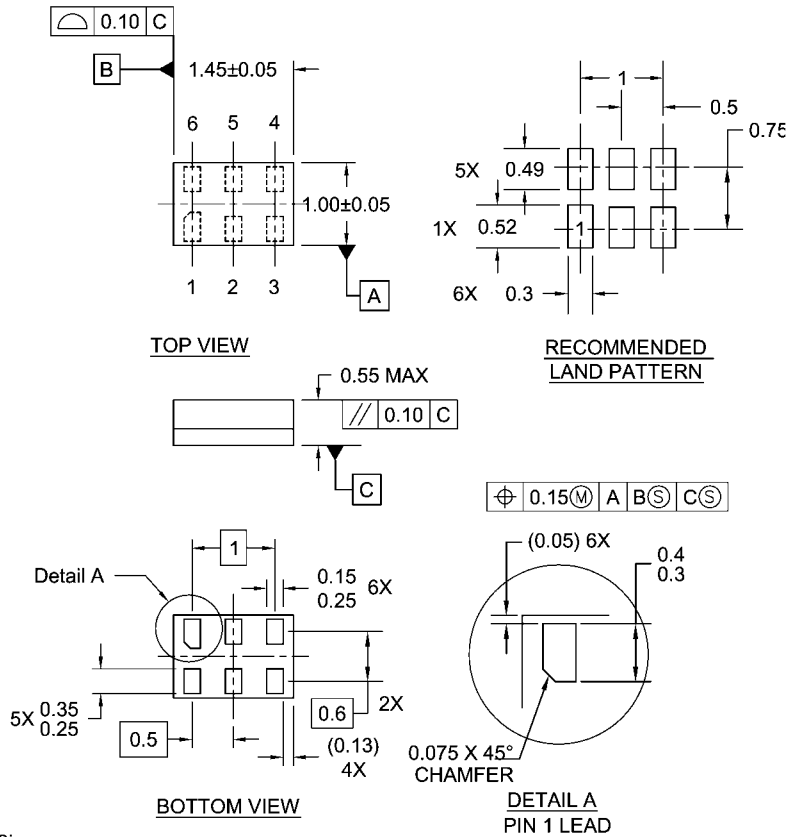# Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

-A-
2.00±0.20
0.65

5   4

-B- 1.25±0.10 2.10±0.10

1   2   3

0.25   0.20 +0.10 -0.05

⊕ max 0.1 ⊕

0.9±.10   0.95±0.15

0.10
0.00

⌒ max 0.1

0.65

.5 min

1.9

0.4 min

LAND PATTERN RECOMMENDATION

SEE DETAIL A

0.25
0.10

6.00°

R0.14

GAGE PLANE

R0.10

0°-30°

0.20

6.00°

0.45
0.10

0.425 NOMINAL

DETAIL A

NOTES:

A. CONFORMS TO EIAJ REGISTERED OUTLINE DRAWING SC88A.
B. DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.
C. DIMENSIONS ARE IN MILLIMETERS.

MAA05ARevC

5-Lead SC70, EIAJ SC-88a, 1.25mm Wide
Package Number MAA05A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

⌓ | 0.10 | C

B ◄ 1.45±0.05 →

6 5 4

1.00±0.05

1 2 3 ──┤ A

TOP VIEW

1
0.5
0.75

5X 0.49

1X 0.52

6X 0.3

RECOMMENDED
LAND PATTERN

0.55 MAX

// | 0.10 | C

C

⊕ | 0.15Ⓜ | A | BⓈ | CⓈ

1

Detail A

0.15
0.25 6X

5X 0.35
     0.25

0.5

(0.13)
4X

0.6 2X

BOTTOM VIEW

(0.05) 6X

0.4
0.3

0.075 X 45°
CHAMFER

DETAIL A
PIN 1 LEAD

Notes:

1. JEDEC PACKAGE REGISTRATION IS ANTICIPATED
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06ARevB

6-Lead MicroPak, 1.0mm Wide
Package Number MAC06A

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