

DATA SHEET

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- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

HEF4013B **flip-flops** Dual D-type flip-flop

Product specification
File under Integrated Circuits, IC04

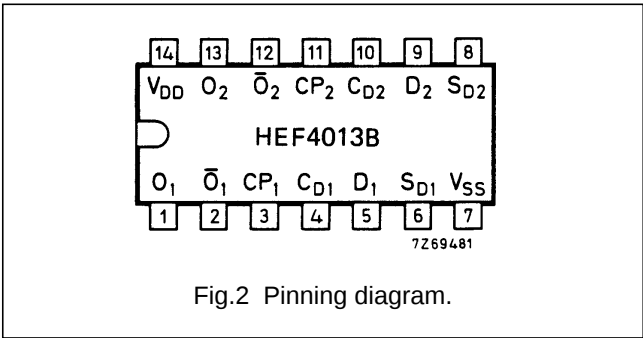
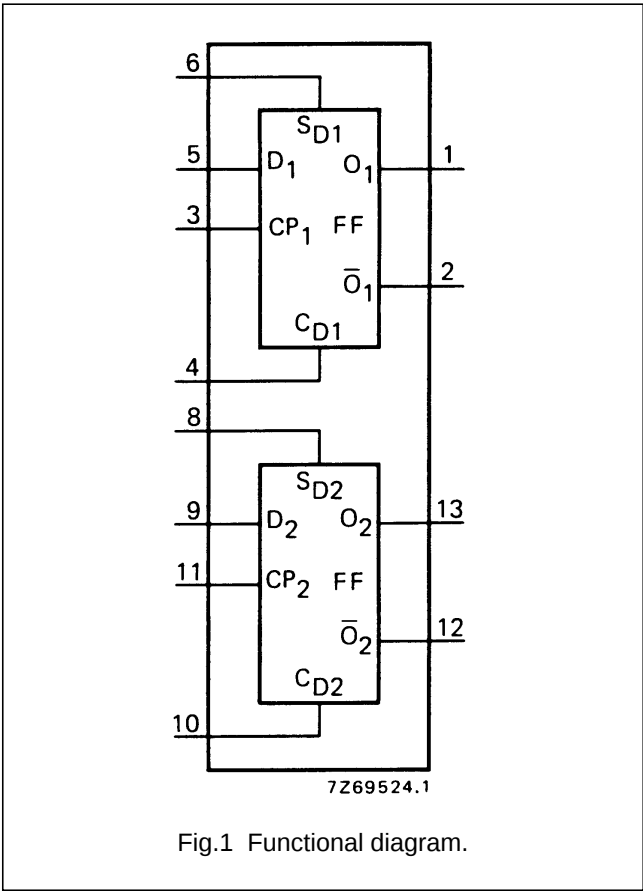
January 1995

Dual D-type flip-flop

HEF4013B
flip-flops

DESCRIPTION

The HEF4013B is a dual D-type flip-flop which features independent set direct (S_D), clear direct (C_D), clock inputs (CP) and outputs (O, $\overline{O}$). Data is accepted when CP is LOW and transferred to the output on the positive-going edge of the clock. The active HIGH asynchronous clear-direct (C_D) and set-direct (S_D) are independent and override the D or CP inputs. The outputs are buffered for best system performance. Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.



FUNCTION TABLES

INPUTS				OUTPUTS	
S_D	C_D	CP	D	O	$\overline{O}$
H	L	X	X	H	L
L	H	X	X	L	H
H	H	X	X	H	H

INPUTS				OUTPUTS	
S_D	C_D	CP	D	$O_n + 1$	$\overline{O_n} + 1$
L	L		L	L	H
L	L		H	H	L

Notes

- 1. H = HIGH state (the more positive voltage)
L = LOW state (the less positive voltage)
X = state is immaterial
 = positive-going transition
 $O_n + 1$ = state after clock positive transition

PINNING

- D data inputs
- CP clock input (L to H edge-triggered)
- S_D asynchronous set-direct input (active HIGH)
- C_D asynchronous clear-direct input (active HIGH)
- O true output
- $\overline{O}$ complement output

- HEF4013BP(N): 14-lead DIL; plastic (SOT27-1)
- HEF4013BD(F): 14-lead DIL; ceramic (cerdip) (SOT73)
- HEF4013BT(D): 14-lead SO; plastic (SOT108-1)
- (): Package Designator North America

FAMILY DATA, I_{DD} LIMITS category FLIP-FLOPS

See Family Specifications

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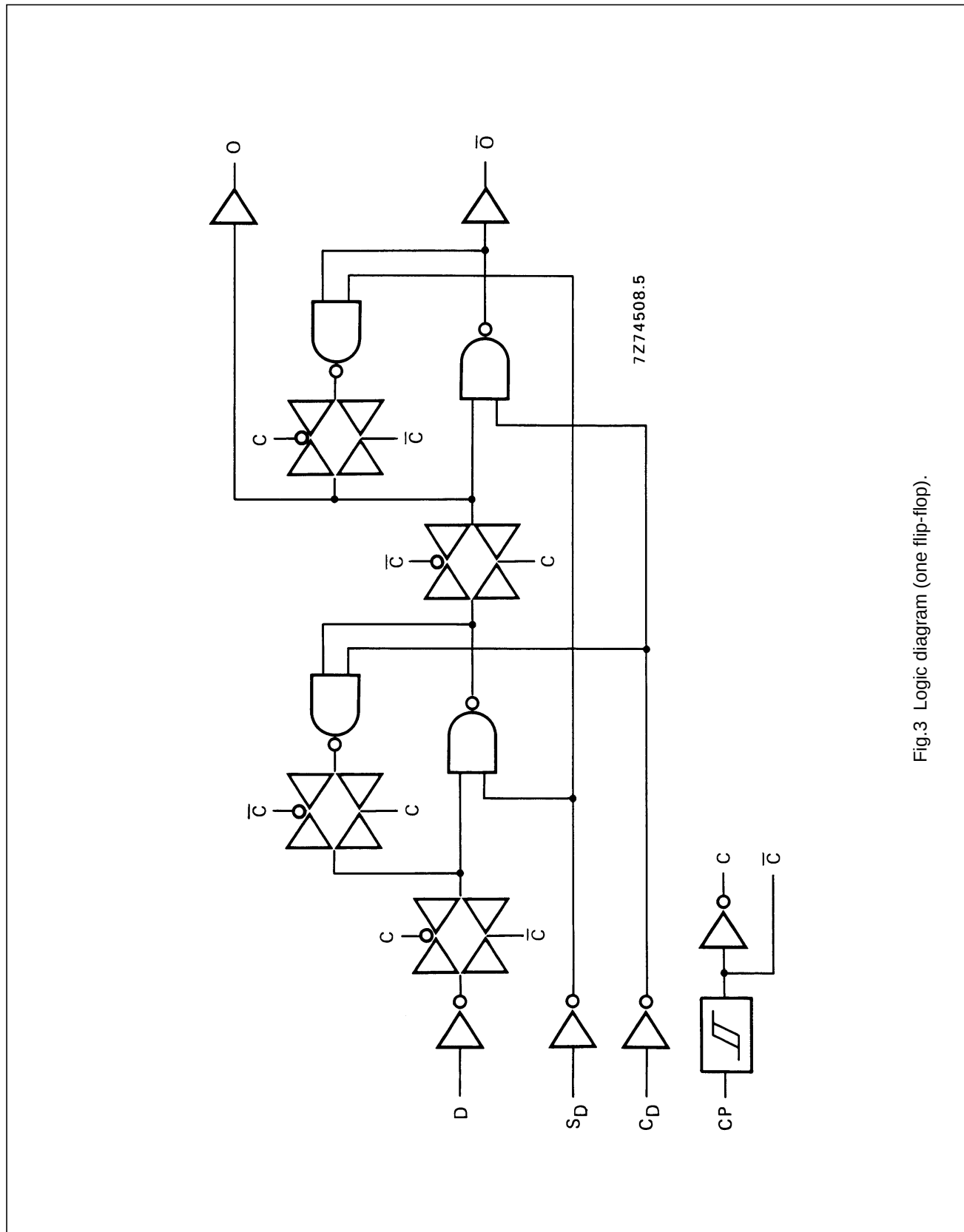


Fig.3 Logic diagram (one flip-flop).

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AC CHARACTERISTICS

 $V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $C_L = 50\text{ pF}$; input transition times $\leq 20\text{ ns}$

	V _{DD} V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA	
Propagation delays CP → O, $\overline{O}$ HIGH to LOW	5 10 15	t _{PHL}		110 45 30	220 90 60 ns	83 ns + (0,55 ns/pF) C _L 34 ns + (0,23 ns/pF) C _L 22 ns + (0,16 ns/pF) C _L	
LOW to HIGH	5 10 15		t _{PLH}		95 40 30	190 80 60 ns	68 ns + (0,55 ns/pF) C _L 29 ns + (0,23 ns/pF) C _L 22 ns + (0,16 ns/pF) C _L
S _D → $\overline{O}$ HIGH to LOW	5 10 15			t _{PHL}		100 40 30	200 80 60 ns
S _D → O LOW to HIGH	5 10 15	t _{PLH}				75 35 25	150 70 50 ns
C _D → O HIGH to LOW	5 10 15		t _{PHL}			100 40 30	200 80 60 ns
C _D → $\overline{O}$ LOW to HIGH	5 10 15			t _{PLH}		60 30 20	120 60 40 ns
Output transition times HIGH to LOW	5 10 15	t _{THL}			60 30 20	120 60 40 ns	10 ns + (1,0 ns/pF) C _L 9 ns + (0,42 ns/pF) C _L 6 ns + (0,28 ns/pF) C _L
LOW to HIGH	5 10 15		t _{TLH}		60 30 20	120 60 40 ns	10 ns + (1,0 ns/pF) C _L 9 ns + (0,42 ns/pF) C _L 6 ns + (0,28 ns/pF) C _L

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	V_{DD} V	SYMBOL	MIN.	TYP.	MAX.	
Set-up time D $\rightarrow$ CP	5 10 15	t_{su}	40 25 15	20 10 5	ns ns ns	see also waveforms Figs 4 and 5
Hold time D $\rightarrow$ CP	5 10 15	t_{hold}	20 20 15	0 0 0	ns ns ns	
Minimum clock pulse width; LOW	5 10 15	t_{WCPL}	60 30 20	30 15 10	ns ns ns	
Minimum S_D pulse width; HIGH	5 10 15	t_{WSDH}	50 24 20	25 12 10	ns ns ns	
Minimum C_D pulse width; HIGH	5 10 15	t_{WCDH}	50 24 20	25 12 10	ns ns ns	
Recovery time for S_D	5 10 15	t_{RSD}	15 15 15	-5 0 0	ns ns ns	
Recovery time for C_D	5 10 15	t_{RCD}	40 25 25	25 10 10	ns ns ns	
Maximum clock pulse frequency	5 10 15	f_{max}	7 14 20	14 28 40	MHz MHz MHz	

	V_{DD} V	TYPICAL FORMULA FOR P (μW)	
Dynamic power dissipation per package (P)	5 10 15	$850 f_i + \sum (f_o C_L) \times V_{DD}^2$ $3\,600 f_i + \sum (f_o C_L) \times V_{DD}^2$ $9\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	where f_i = input freq. (MHz) f_o = output freq. (MHz) C_L = total load cap. (pF) $\sum (f_o C_L)$ = sum of outputs V_{DD} = supply voltage (V)

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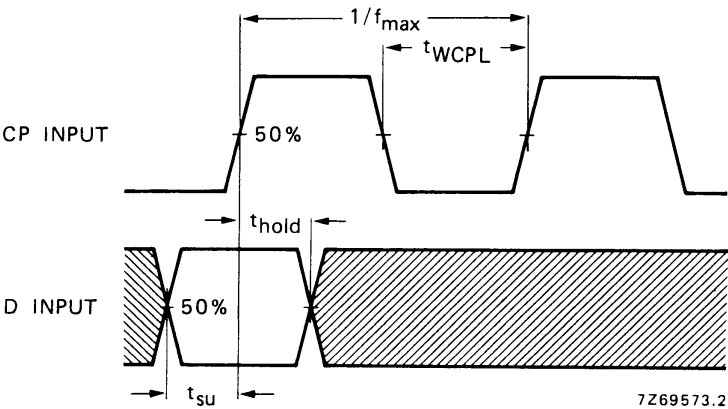


Fig.4 Waveforms showing set-up times, hold times and minimum clock pulse width. Set-up and hold times are shown as positive values but may be specified as negative values.

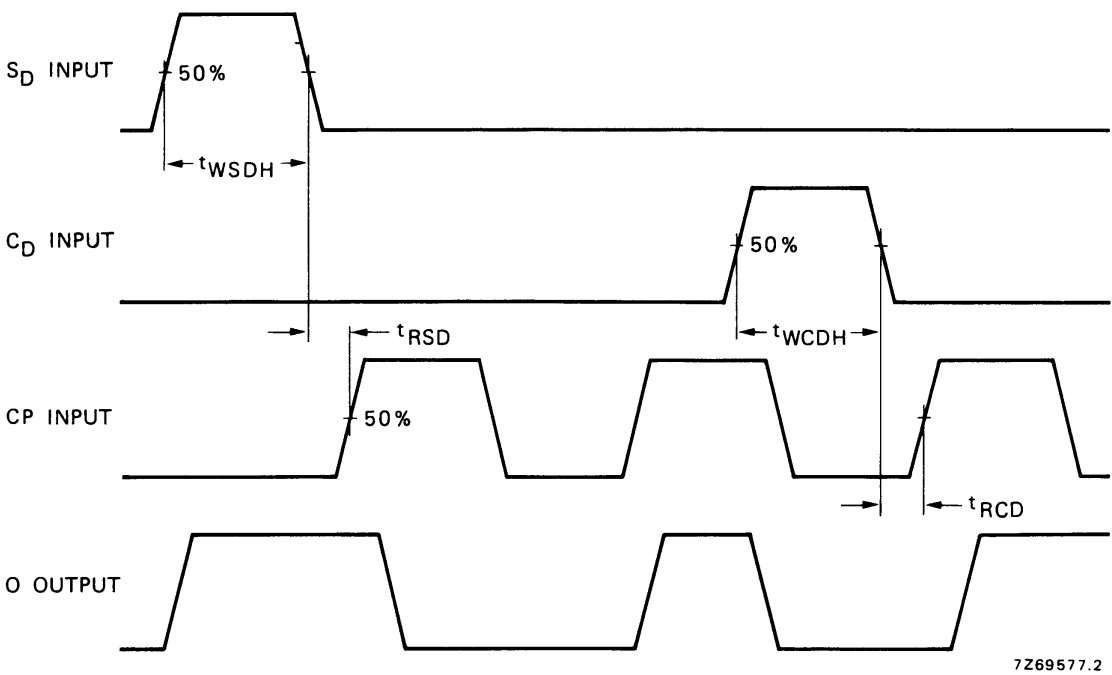


Fig.5 Waveforms showing recovery times for S_D and C_D ; minimum S_D and C_D pulse widths.

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APPLICATION INFORMATION

Some examples of applications for the HEF4013B are:

- Counters/dividers
- Registers
- Toggle flip-flops

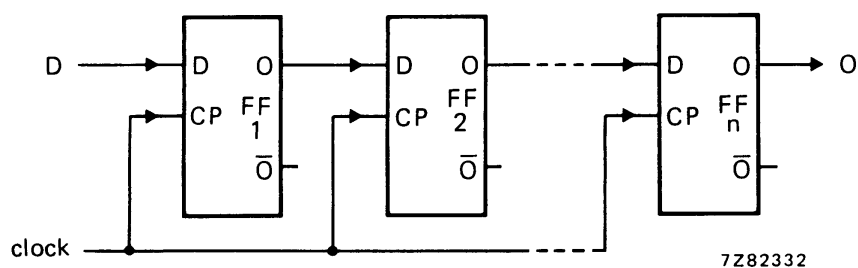


Fig.6 Typical application of the HEF4013B in an n-stage shift register.

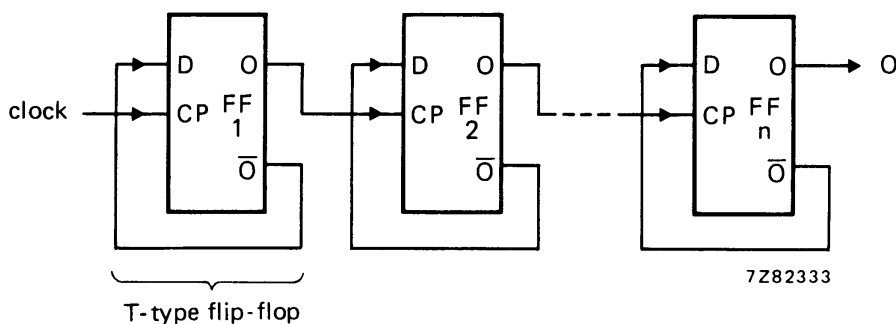


Fig.7 Typical application of the HEF4013B in a binary ripple up-counter; divide-by- 2^n .

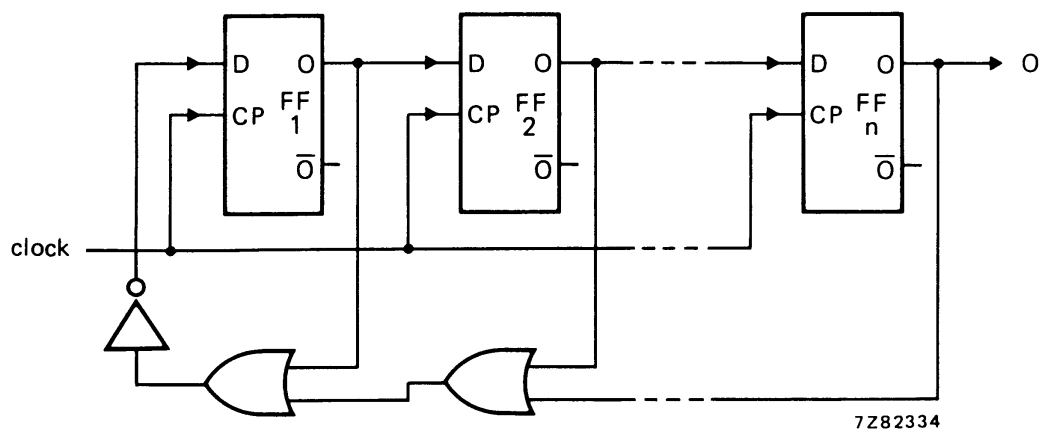


Fig.8 Typical application of the HEF4013B in a modified ring counter; divide-by- $(n + 1)$.

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HEF4013B; Dual D-type flip-flop

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Description

The HEF4013B is a dual D-type flip-flop which features independent set direct (S_D), clear direct (C_D), clock inputs (CP) and outputs (O, O). Data is accepted when CP is LOW and transferred to the output on the positive-going edge of the clock. The active HIGH asynchronous clear-direct (C_D) and set-direct (S_D) are independent and override the D or CP inputs. The outputs are buffered for best system performance. Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

Datasheet

Type nr.	Title	Publication release date	Datasheet status	Page count	File size (kB)	Datasheet
HEF4013B	Dual D-type flip-flop	01-Jan-95	Product Specification	7	79	☐ Download

Additional datasheet info

To complete the device datasheet with package and family information, also download the following PDF files .

Document	Description	Refer to catalog
1 ☐ HEF_FAMILY_SPECIFICATIONS	HEF Family Specifications, The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEF	ICL02

Products, packages, availability and ordering

<u>Partnumber</u>	<u>North American Partnumber</u>	<u>Order code (12nc)</u>	<u>marking/packing</u>	<u>package</u>	<u>device status</u>	<u>buy online</u>
HEC4013BT		9352 298 80112	Standard Marking * Bulk Pack	SOT108	Full production	-
		9352 298 80118	Standard Marking * Reel Pack, SMD, 13"	SOT108	Full production	-
HEF4013BP	HEF4013BPN	9332 776 10652	Standard Marking * Bulk Pack, CECC	SOT27	Full production	
HEF4013BT	HEF4013BTD	9333 726 60652	Standard Marking * Bulk Pack, CECC	SOT108	Full production	
	HEF4013BTD-T	9333 726 60653	Standard Marking * Reel Pack, SMD, 13", CECC	SOT108	Full production	
HEF4013BTS	HEF4013BTSDB	9352 452 90112	Standard Marking * Bulk Pack	SOT337	Full production	
	HEF4013BTSDB-T	9352 452 90118	Standard Marking * Reel Pack, SMD, 13"	SOT337	Full production	
HEF4013BU		9333 736 00005	No Marking * Chips on Wafer, Pre-Sawn, On FFC	NONE	Full production	-

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