

*This device changed
to PL-1115. Because
of High Quality Circuit*
JH

CD4013BM/CD4013BC Dual D Flip-Flop

general description

The CD4013B dual D flip-flop is a monolithic complementary MOS (CMOS) integrated circuit constructed with N and P channel enhancement transistors. Each flip-flop has independent data, set, reset, and clock inputs and "Q" and "Q̄" outputs. These devices can be used for shift register applications, and by connecting "Q̄" output to the data input, for counter and toggle applications. The logic level present at the "D" input is transferred to the Q output during the positive-going transition of the clock pulse. Setting or resetting is independent of the clock and is accomplished by a high level on the set or reset line respectively.

features

- Wide supply voltage range 3.0V to 15V
- High noise immunity 0.45 V_{DD} typ

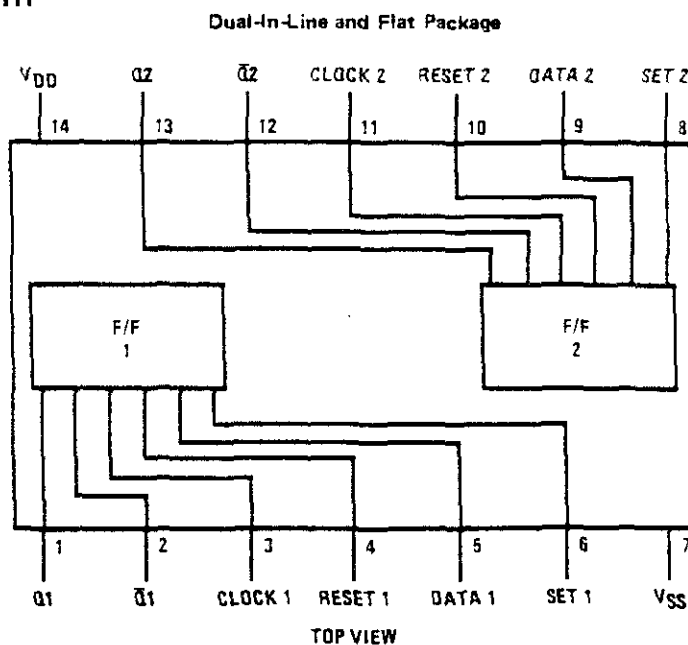
- Low power TTL compatibility

fan out of 2
driving 74L
or 1 driving 74LS

applications

- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm system
- Industrial electronics
- Remote metering
- Computers

connection diagram



truth table

CL†	D	R	S	Q	Q̄
	0	0	0	0	1
	1	0	0	1	0
	x	0	0	Q	Q̄
x	x	1	0	0	1
x	x	0	1	1	0
x	x	1	1	1	1

No change

† = Level change

x = Don't care case

absolute maximum ratings

(Notes 1 and 2)

V _{DD} dc Supply Voltage	-0.5 to +18 V _{DC}
V _{IN} Input Voltage	-0.5 to V _{DD} +0.5 V _{DC}
T _S Storage Temperature Range	-65°C to +150°C
P _D Package Dissipation	500 mW
T _L Lead Temperature (Soldering, 10 seconds)	300°C

recommended operating conditions

(Note 2)

V _{DD} dc Supply Voltage	+3 to +15 V _{DC}
V _{IN} Input Voltage	0 to V _{DD} V _{DC}
T _A Operating Temperature Range	-55°C to +125°C
	CD4013BM
	CD4013BC
	-40°C to +85°C

dc electrical characteristics CD4013BM (Note 2)

PARAMETER	CONDITIONS	-55°C		25°C			125°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
I _{DD} Quiescent Device Current	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		1.0 2.0 4.0			1.0 2.0 4.0		30 60 120	μA μA μA
V _{OL} Low Level Output Voltage	I _{OI} < 1.0μA V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
V _{OH} High Level Output Voltage	I _{OI} < 1.0μA V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V V V
V _{IL} Low Level Input Voltage	I _{OI} < 1.0μA V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1.0V or 9.0V V _{DD} = 15V, V _O = 1.5V or 13.5V		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V
V _{IH} High Level Input Voltage	I _{OI} < 1.0μA V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1.0V or 9.0V V _{DD} = 15V, V _O = 1.5V or 13.5V	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
I _{OL} Low Level Output Current	V _{DD} = 5V, V _O = 0.4V V _{DD} = 10V, V _O = 0.5V V _{DD} = 15V, V _O = 1.5V	0.64 1.6 4.2		0.51 1.3 3.4	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I _{OH} High Level Output Current	V _{DD} = 5V, V _O = 4.6V V _{DD} = 10V, V _O = 9.5V V _{DD} = 15V, V _O = 13.5V	-0.64 -1.6 -4.2		-0.51 -1.3 -3.4	-0.88 -2.25 -8.8		-0.36 -0.9 -2.4		mA mA mA
I _{IN} Input Current	V _{DD} = 15V, V _{IN} = 0V V _{DD} = 15V, V _{IN} = 15V		-0.1 0.1		-10 ⁻⁵ 10 ⁻⁵	-0.1 0.1		-1.0 1.0	μA μA

dc electrical characteristics CD4013BC (Note 2)

PARAMETER	CONDITIONS	-40°C		25°C			85°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
I _{DD} Quiescent Device Current	V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		4.0 8.0 16.0			4.0 8.0 16.0		30 60 120	μA μA μA
V _{OL} Low Level Output Voltage	I _{OI} < 1.0μA V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
V _{OH} High Level Output Voltage	I _{OI} < 1.0μA V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V V V
V _{IL} Low Level Input Voltage	I _{OI} < 1.0μA V _{DD} = 5V, V _O = 0.5V or 4.5V V _{DD} = 10V, V _O = 1.0V or 9.0V V _{DD} = 15V, V _O = 1.5V or 13.5V		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V

dc electrical characteristics (con't) CD4013BC (Note 2)

PARAMETER	CONDITIONS	-40°C		25°C			85°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
V_{IH} High Level Input Voltage	$I_{IOL} < 1.0\mu A$								
	$V_{DD} = 5V, V_O = 0.5V \text{ or } 4.5V$	3.5		3.5			3.5		V
	$V_{DD} = 10V, V_O = 1.0V \text{ or } 9.0V$	7.0		7.0			7.0		V
	$V_{DD} = 15V, V_O = 1.5V \text{ or } 13.5V$	11.0		11.0			11.0		V
I_{OL} Low Level Output Current	$V_{DD} = 5V, V_O = 0.4V$	0.52		0.44	0.88		0.36		mA
	$V_{DD} = 10V, V_O = 0.5V$	1.3		1.1	2.25		0.9		mA
	$V_{DD} = 15V, V_O = 1.5V$	3.6		3.0	8.8		2.4		mA
I_{OH} High Level Output Current	$V_{DD} = 5V, V_O = 4.6V$	-0.52		-0.44	-0.88		-0.36		mA
	$V_{DD} = 10V, V_O = 9.5V$	-1.3		-1.1	-2.25		-0.9		mA
	$V_{DD} = 15V, V_O = 13.5V$	-3.6		-3.0	-8.8		-2.4		mA
I_{IN} Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.3		-10^{-5}	-0.3		-1.0	μA
	$V_{DD} = 15V, V_{IN} = 15V$		0.3		10^{-5}	0.3		1.0	μA

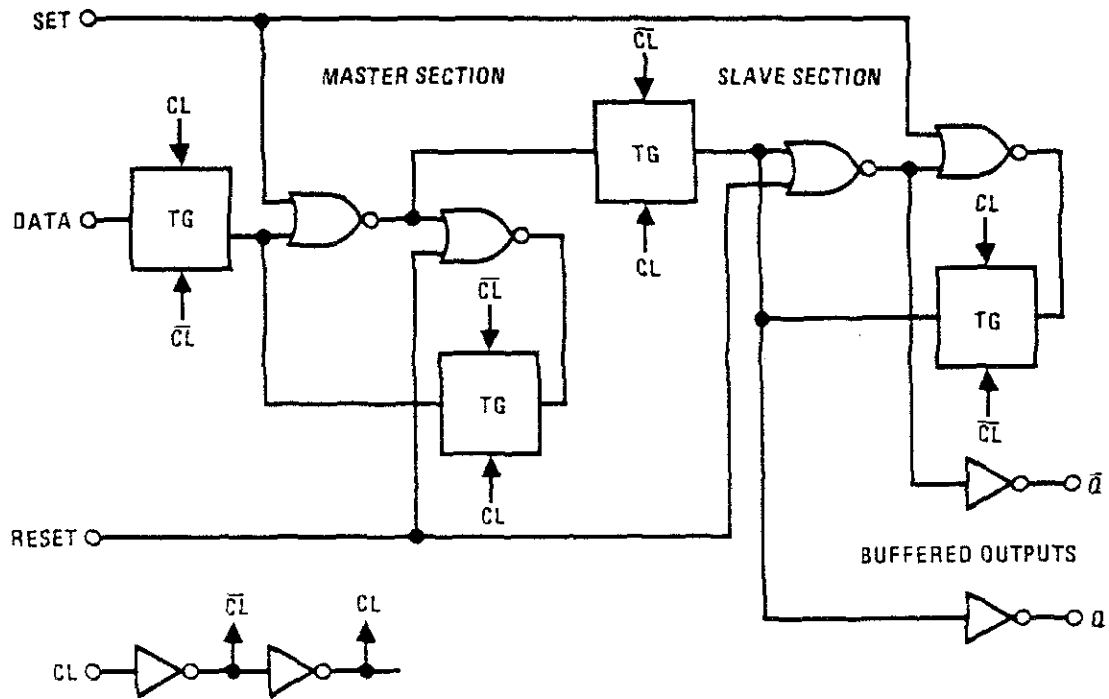
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed; they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

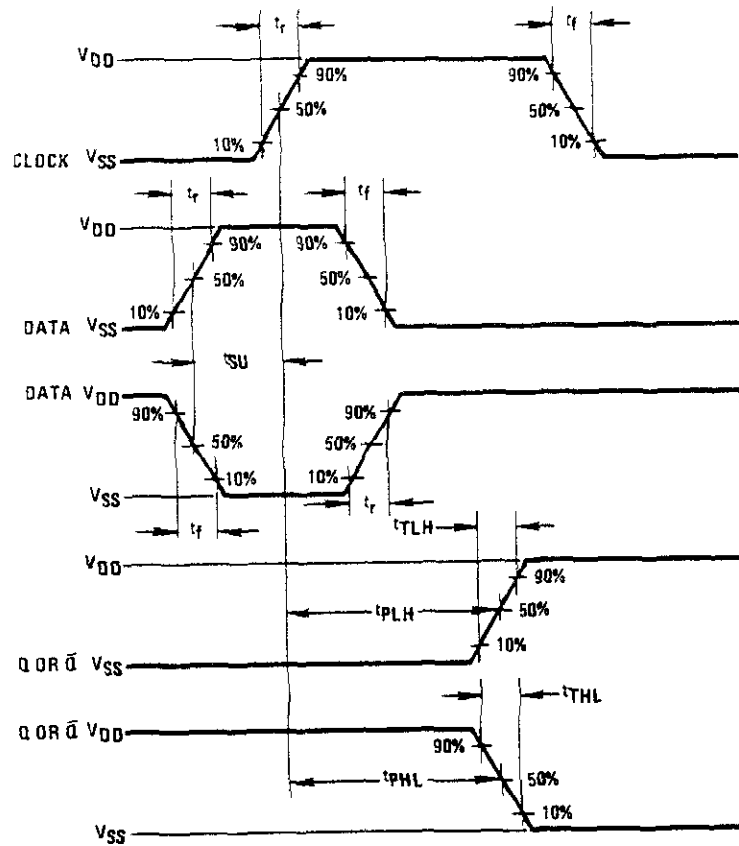
ac electrical characteristics $T_A = 25^\circ C$, $C_L = 50 \text{ pF}$, $R_L = 200k$, unless otherwise specified.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
CLOCK OPERATION					
t_{PHL} or t_{PLH} Propagation Delay Time	$V_{DD} = 5V$		200	350	ns
	$V_{DD} = 10V$		80	160	ns
	$V_{DD} = 15V$		65	120	ns
t_{THL} or t_{TLH} Transition Time	$V_{DD} = 5V$		100	200	ns
	$V_{DD} = 10V$		50	100	ns
	$V_{DD} = 15V$		40	80	ns
t_{WL} or t_{WH} Minimum Clock Pulse Width	$V_{DD} = 5V$		100	200	ns
	$V_{DD} = 10V$		40	80	ns
	$V_{DD} = 15V$		32	65	ns
t_{RCL} , t_{FCL} Maximum Clock Rise and Fall Time	$V_{DD} = 5V$			15	μs
	$V_{DD} = 10V$			10	μs
	$V_{DD} = 15V$			5	μs
t_{SU} Minimum Set-Up Time	$V_{DD} = 5V$		20	40	ns
	$V_{DD} = 10V$		15	30	ns
	$V_{DD} = 15V$		12	25	ns
f_{CL} Maximum Clock Frequency	$V_{DD} = 5V$	2.5	5		MHz
	$V_{DD} = 10V$	8.2	12.5		MHz
	$V_{DD} = 15V$	7.6	15.5		MHz
SET AND RESET OPERATION					
$t_{PHL}(R)$, $t_{PLH}(S)$ Propagation Delay Time	$V_{DD} = 5V$		150	300	ns
	$V_{DD} = 10V$		65	130	ns
	$V_{DD} = 15V$		45	90	ns
$t_{WH}(R)$, $t_{WH}(S)$ Minimum Set and Reset Pulse Width	$V_{DD} = 5V$		90	180	ns
	$V_{DD} = 10V$		40	90	ns
	$V_{DD} = 15V$		25	50	ns
C_{IN} Average Input Capacitance	Any Input		5	7.5	pF

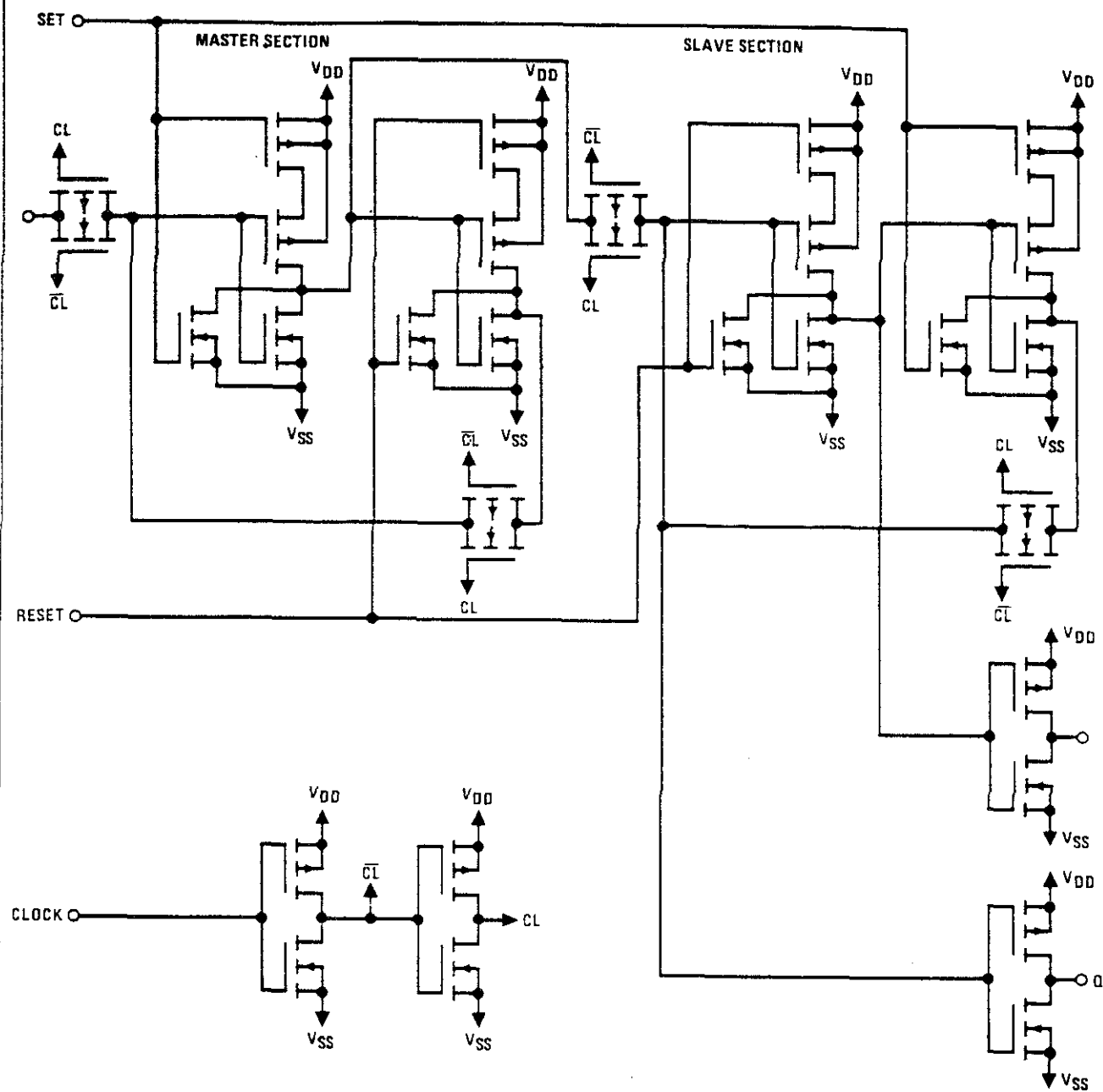
logic diagram



switching time waveforms



schematic diagram



ALL P-SUBSTRATES () CONNECTED TO VDD

ALL N-SUBSTRATES () CONNECTED TO VSS

4000 CMOS



Philips Semiconductors

SGS-THOMSON MICROELECTRONICS

4000 CMOS offers low power consumption, high noise immunity and operates over 3V to 15V (18V max.).

Series Prefix/Suffix:

'CD/CN' = Fairchild, 'CD/BE' = Harris, 'HEF' = Philips, 'HCF' = STM, 'MC' = Motorola

Note: Due to type number consolidation by Philips Semiconductors the HEF4000 family will be supplied with a BP suffix and not P. There is no difference in specification whatsoever.

Suffix: -BCN/BCP/BE/P/BEY= Buffered, CN/UBE/UBCP/UBP/UBEY= Unbuffered.

Price Each

Mfrs. List No.	Order Code	1+	25+	100+	300+	1K+
MIXED QUANTITY PRICING						
HEF4000BP	384-409	0.44	0.33	0.25	0.20	0.16
CD4001BCN	384-410	0.20	0.17	0.12	0.10	0.09
CD4001BE	573-619	0.25	0.17	0.13	0.10	0.08
HCF4001BEY	384-422†	0.22	0.17	0.14	0.12	—
HEF4001BP	384-434	0.50	0.25	0.19	0.17	0.16
HEF4001UBP	384-446	0.29	0.21	0.16	0.14	0.12
MC14001BCP	700-150	0.35	0.22	0.16	—	—
HEF4002BP	384-471	0.50	0.25	0.19	0.18	0.16
MC14002BCP	704-581	0.35	0.22	0.16	—	—
HEF4006BP	384-495	0.55	0.40	0.31	0.26	0.22
CD4007CN	384-501	0.20	0.17	0.12	—	—
HEF4007UBP	384-513	0.29	0.21	0.16	0.14	0.12
MC14008BCP	700-472	0.60	0.35	0.25	—	—
CD4010CN	384-549	0.25	0.21	0.15	0.13	0.12
CD4011BCN	384-550	0.20	0.17	0.12	—	—
CD4011BE	573-632	0.26	0.17	0.13	0.10	0.08
HCF4011BEY	384-562†	0.22	0.17	0.14	0.12	—
HEF4011BP	384-574	0.50	0.25	0.19	0.18	0.16
HEF4011UBP	384-586	0.29	0.21	0.16	0.14	0.12
MC14011BCP	700-162	0.35	0.22	0.16	—	—
HEF4012BP	384-604	0.50	0.25	0.19	0.18	0.16
CD4013BCN	384-616	0.22	0.19	0.14	—	—
CD4013BE	573-644	0.26	0.17	0.13	0.10	0.08
HCF4013BEY	384-628†	0.30	0.20	0.15	0.13	—
HEF4013BP	384-630	0.31	0.23	0.19	0.16	0.13
MC14013BCP	700-174	0.35	0.22	0.16	—	—
CD4014BCN	384-641	0.37	0.32	0.24	0.19	0.18
CD4015BCN	384-653	0.37	0.32	0.24	0.19	0.18
HEF4015BP	384-677	0.93	0.46	0.35	0.34	0.30
CD4016BCN	527-592	0.20	0.17	0.12	—	—
HEF4016BP	384-690	0.62	0.31	0.23	0.22	0.20
MC14016BCP	700-411	0.35	0.22	0.16	—	—
CD4017BCN	384-707	0.33	0.27	0.20	0.17	0.15
CD4017BE	573-656	0.38	0.25	0.19	0.15	0.12
HEF4017BP	384-720	0.87	0.43	0.33	0.32	0.28
MC14017BCP	704-593	0.50	0.32	0.22	—	—
HEF4018BP	384-744	0.96	0.48	0.36	0.34	0.31
CD4019BCN	384-756	0.27	0.22	0.17	0.14	0.13
HEF4019BP	384-768	0.58	0.43	0.33	0.27	0.23
CD4020BCN	384-770	0.34	0.28	0.21	—	—
CD4020BE	573-668	0.51	0.34	0.25	0.20	0.17
HEF4020BP	384-781	1.14	0.57	0.43	0.40	0.37
MC14020BCP	700-186	0.50	0.32	0.22	—	—
CD4021BCN	384-793	0.34	0.28	0.21	0.17	0.16
HEF4021BP	384-800	0.93	0.46	0.35	0.33	0.30
MC14021BCP	700-198	0.50	0.32	0.22	—	—
CD4022BCN	384-811	0.40	0.33	0.24	0.20	0.18
HEF4022BP	384-823†	0.93	0.46	0.35	0.33	0.30
CD4023BCN	384-835	0.20	0.17	0.12	0.10	0.09
HEF4023BP	384-847	0.50	0.25	0.19	0.17	0.16
MC14023BCP	700-204	0.35	0.22	0.16	—	—
CD4024BCN	384-859	0.29	0.24	0.18	0.15	0.14
HEF4024BP	384-860	0.93	0.46	0.35	0.33	0.30
MC14025BCP	640-402	0.35	0.22	0.16	—	—
HEF4025BP	384-896	0.50	0.25	0.19	0.17	0.16
CD4027BCN	384-914	0.27	0.22	0.17	0.14	0.13
CD4027BE	573-670	0.37	0.25	0.19	0.15	0.12
HEF4027BP	384-938	0.70	0.35	0.26	0.25	0.23
MC14027BCP	700-216	0.45	0.30	0.20	—	—
CD4028BCN	384-940	0.30	0.25	0.19	0.15	0.14
HEF4028BP	384-963	0.79	0.39	0.30	0.28	0.26
MC14028BCP	700-228	0.50	0.32	0.22	—	—
CD4029BCN	384-975	0.37	0.32	0.24	0.19	0.18
HEF4029BP	384-999	1.01	0.50	0.38	0.36	0.33

† Available until stocks are exhausted

Continued

IC3

Mfrs. List No.	Order Code	0.24	0.20	0.14	0.12	0.11	1K+
CD4030CN	385-001	0.24	0.20	0.14	0.12	0.11	
HEF4030BP	385-013	0.35	0.26	0.20	0.17	0.14	
HEF4035BP	385-050	1.01	0.50	0.38	0.36	0.33	
CD4040BCN	385-062	0.34	0.29	0.22	0.18	0.16	
CD4040BE	573-681	0.56	0.38	0.28	0.22	0.19	
HCF4040BEY	385-074†	0.48	0.39	0.32	0.27	—	
HEF4040BP	385-086	0.92	0.46	0.34	0.32	0.30	
MC14040BCP	700-230	0.50	0.32	0.22	—	—	
HEF4041BP	385-104	0.56	0.41	0.31	0.26	0.21	
HEF4042BP	385-130	1.01	0.50	0.38	0.36	0.33	
CD4043BCN	385-141	0.32	0.26	0.20	0.16	0.15	
HEF4043BP	385-165	0.93	0.46	0.35	0.33	0.30	
CD4044BCN	385-177	0.32	0.26	0.20	0.16	0.15	
HEF4044BP	385-190	0.93	0.46	0.35	0.33	0.30	
CD4046BCN	385-207	0.33	0.28	0.21	0.17	0.16	
CD4046BE	573-693	0.53	0.36	0.27	0.21	0.18	
HEF4046BP	385-219	1.01	0.50	0.38	0.36	0.33	
CD4047BCN	385-220	0.37	0.32	0.23	0.19	0.17	
CD4047BE	573-700	0.48	0.32	0.24	0.19	0.16	
HEF4047BP	385-244	1.07	0.53	0.40	0.38	0.35	
CD4049UBCN	385-268	0.25	0.21	0.16	0.13	0.12	
CD4049UBE	573-711	0.35	0.23	0.17	0.14	0.12	
HCF4049UBEY	385-270†	0.24	0.19	0.15	0.13	—	
HEF4049BP	385-281	0.72	0.36	0.27	0.25	0.24	
CD4050BCN	385-293	0.27	0.22	0.16	0.13	0.12	
CD4050BE	573-723	0.35	0.23	0.17	0.14	0.12	
HEF4050BP	385-311	0.72	0.36	0.27	0.25	0.24	
MC14050BCP	700-241	0.44	0.28	0.20	—	—	
CD4051BCN	385-323	0.28	0.23	0.17	0.14	0.13	
CD4051BE	573-735	0.43	0.28	0.21	0.17	0.14	
HEF4051BP	385-347	0.83	0.41	0.31	0.29	0.27	
MC14051BCP	700-393	0.50	0.32	0.22	—	—	
CD4052BCN	385-359	0.28	0.23	0.17	0.14	0.13	
CD4052BE	573-747†	0.43	0.28	0.21	0.17	0.14	
HEF4052BP	385-360	0.87	0.43	0.33	0.30	0.28	
MC14052BCP	700-400	0.50	0.32	0.22	—	—	
CD4053BCN	385-372	0.28	0.23	0.17	0.14	0.13	
CD4053BE	573-759	0.43	0.28	0.21	0.17	0.14	
HEF4053BP	385-384	0.83	0.41	0.31	0.29	0.27	
HCF4056BEY	385-396†	0.45	0.36	0.29	0.24	—	
HEF4059BP	385-402	3.50	2.57	1.98	1.63	1.40	
CD4060BCN	385-414	0.31	0.26	0.20	0.16	0.15	
CD4060BE	573-760	0.45	0.30	0.23	0.18	0.15	
HEF4060BP	385-438	0.52	0.39	0.31	0.26	0.22	
MC14060BCP	700-253	0.50	0.32	0.22	—	—	
CD4066BCN	385-451	0.24	0.20	0.15	0.12	0.11	
CD4066BE	573-772	0.35	0.23	0.17	0.14	0.12	
HCF4066BEY	385-463†	0.28	0.22	0.18	0.15	—	
HEF4066BP	385-475	0.68	0.34	0.25	0.23	0.22	
HEF4067BP	385-499	2.31	1.70	1.31	1.08	0.93	
HEF4068BP	385-505	0.50	0.25	0.19	0.17	0.16	
CD4069CN*	385-517	0.20	0.17	0.12	0.10	0.09	
CD4069UBE	573-784	0.26	0.17	0.13	0.10	0.08	
HEF4069UBP	385-530	0.54	0.27	0.20	0.19	0.18	
MC14069UBCP	700-265	0.35	0.22	0.16	—	—	
CD4070BCN*	385-542	0.21	0.18	0.13	0.11	0.10	
CD4070BE	573-796	0.26	0.17	0.13	0.10	0.08	
HCF4070BEY	385-554†	0.22	0.18	0.15	0.13	—	
HEF4070BP	385-566	0.62	0.31	0.23	0.22	0.20	
MC14070BCP	700-423	0.35	0.22	0.16	—	—	
CD4071BCN	385-578	0.20	0.17	0.12	0.10	0.09	
CD4071BE	573-802	0.26	0.17	0.13	0.10	0.08	
HCF4071BEY	385-580†	0.22	0.18	0.15	0.13	—	
HEF4071BP	385-591	0.50	0.25	0.19	0.17	0.16	
MC14071BCP	700-277	0.35	0.22	0.16	—	—	
HEF4072BP	385-610	0.50	0.25	0.19	0.17	0.16	
MC14072BCP	700-289	0.35	0.22	0.16	—	—	
HEF4073BP	385-633	0.50	0.25	0.19	0.17	0.16	
HEF4075BP	385-657	0.50	0.25	0.19	0.17	0.16	
HEF4076BP	385-670	0.93	0.46	0.35	0.33	0.30	
MC14076BCP	704-805	0.42	0.25	0.22	—	—	
HEF4077BP	385-694	0.50	0.25	0.19	0.17	0.16	
HEF4078BP	385-700	0.45	0.22	0.17	0.16	0.15	
CD4081BCN	385-712	0.20	0.17	0.12	0.10	0.09	
CD4081BE	573-814	0.26	0.17	0.13	0.10	0.08	
HCF4081BEY	385-724†	0.22	0.18	0.15	0.13	—	
HEF4081BP	385-736	0.50	0.25	0.19	0.17	0.16	

† Available until stocks are exhausted

Continued