COS/MOS INTEGRATED CIRCUIT

HCC/HCF 4511B

PRELIMINARY DATA

BCD-TO-SEVEN SEGMENT LATCH/DECODER/DRIVER

- HIGH-OUTPUT-SOURCING CAPABILITY (up to 25 mA)
- INPUT LATCHES FOR BCD CODE STORAGE
- LAMP TEST AND BLANKING CAPABILITY
- 7-SEGMENT OUTPUTS BLANKED FOR BCD INPUT CODES > 1001
- QUIESCENT CURRENT SPECIFIED TO 20V
- MAXIMUM INPUT LEAKAGE OF 1 μA AT 18V (FULL PACKAGE-TEMPERATURE RANGE)
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS

The **HCC 4511B** (extended temperature range) and the **HCF 4511B** (intermediate temperature range) are monolithic integrated circuits available in 16-lead dual in-line plastic or ceramic package and ceramic flat package.
The **HCC/HCF 4511B** types are BCD-to-7-segment latch decoder drivers constructed with COS/MOS logic and n-p-n bipolar transistor output devices on a single monolithic structure. These devices combine the low quiescent power dissipation and high noise immunity features of COS/MOS with n-p-n bipolar output transistors capable of sourcing up to 25 mA. This capability allows the **HCC/HCF 4511B** types to drive LED's and other displays directly.
Lamp Test ($\overline{LT}$), Blanking ($\overline{BL}$), and Latch Enable or Strobe inputs are provided to test the display, shut off or intensity-modulate it, and store or strobe a BCD code, respectively. Several different signal may be multiplexed and displayed when external multiplexing circuitry is used.

ABSOLUTE MAXIMUM RATINGS

V_{DD}*	Supply voltage	-0.5 to 20	V
V_I	Input voltage	-0.5 to V_{DD} +0.5	V
I_I	DC input current (any one input)	± 10	mA
P_{tot}	Total power dissipation (per package)	200	mW
	Dissipation per output transistor for T_{op}= full package-temperature range	100	mW
T_{op}	Operating temperature: for **HCC** types	-55 to 125	°C
	for **HCF** types	-40 to 85	°C
T_{stg}	Storage temperature	-65 to 150	°C

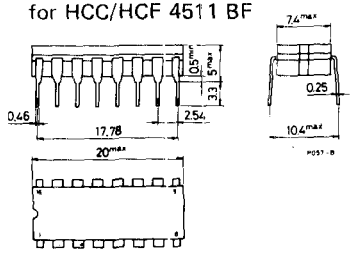
* All voltage values are referred to V_{SS} pin voltage

ORDERING NUMBERS:

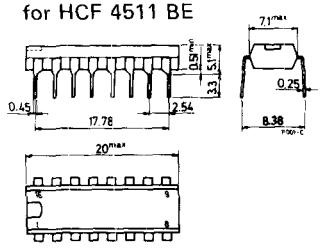
HCC 4511 BD for dual in-line ceramic package
HCC 4511 BF for dual in-line ceramic package, frit seal
HCC 4511 BK for ceramic flat package
HCF 4511 BE for dual in-line plastic package
HCF 4511 BF for dual in-line ceramic package, frit seal

MECHANICAL DATA (dimensions in mm)

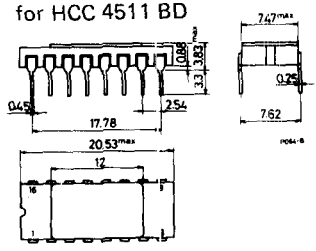
Dual in-line ceramic package for HCC/HCF 4511 BF



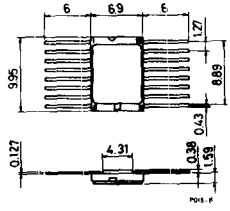
Dual in-line plastic package for HCF 4511 BE



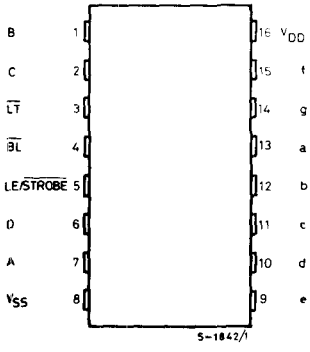
Dual in-line ceramic package for HCC 4511 BD



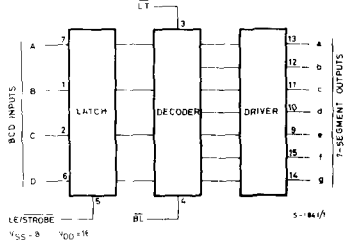
Ceramic flat package for HCC 4511 BK



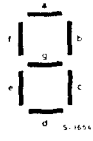
CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM



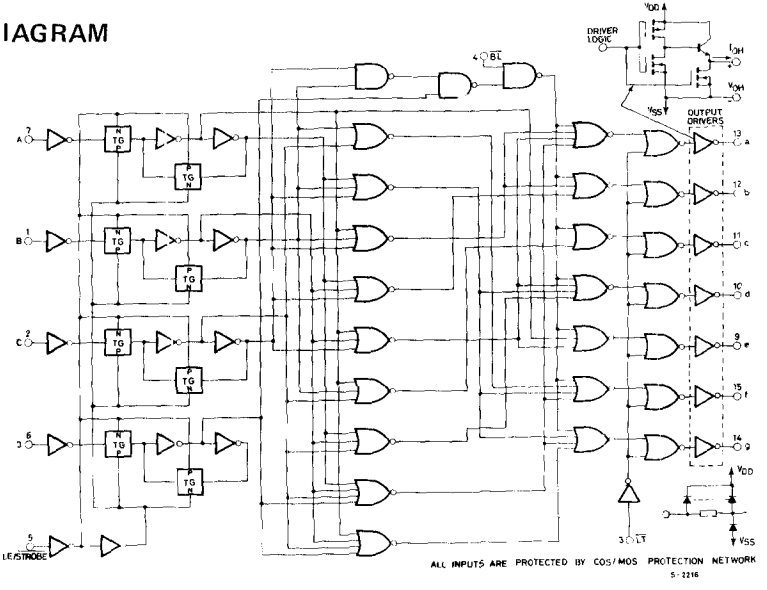
DISPLAY



RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage	3 to 18	V
V_I	Input voltage	0 to V_{DD}	V
T_{op}	Operating temperature: for **HCC** types	-55 to 125	°C
	for **HCF** types	-40 to 85	°C

LOGIC DIAGRAM

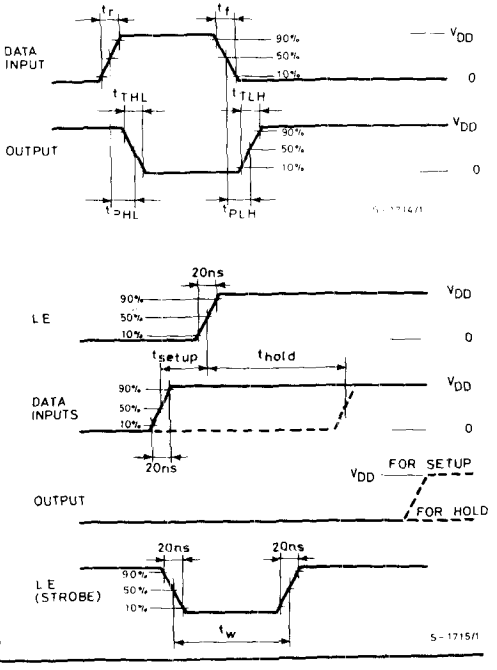


TRUTH TABLE

LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	Display
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	1	1	0	1	1	0	1	2
0	1	1	0	0	1	1	1	1	1	1	0	0	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	1	0	0	0	0	7
0	1	1	1	0	0	0	1	1	1	1	1	1	1	8
0	1	1	1	0	0	1	1	1	1	0	0	1	1	9
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	1	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X				*				*

X = Don't care
* = Depends on BCD code previously applied when LE= 0
Note: Display is blank for all illegal input codes (BCD > 1001)

WAVEFORMS



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

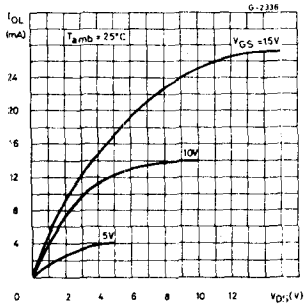
Parameter			Test conditions				Values							Unit
			V_I (V)	V_O (V)	$\|I_{OH}\|$ (mA)	V_{DD} (V)	T_{Low}* Min.	T_{Low}* Max.	25°C Min.	25°C Typ.	25°C Max.	T_{High}* Min.	T_{High}* Max.	
I_L	Quiescent supply current					5		5		0.04	5		150	µA
						10		10		0.04	10		300	
						15		20		0.04	20		600	
						20		100		0.08	100		3000	
V_{OH}	Output high voltage		0/5			5	4		4.1	4.55		4.2		V
			0/10			10	9		9.1	9.55		9.2		
			0/15			15	14		14.1	14.55		14.2		
V_{OL}	Output low voltage		5/0			5		0.05			0.05		0.05	V
			10/0			10		0.05			0.05		0.05	
			15/0			15		0.05			0.05		0.05	
V_{IH}	Input high voltage			0.5/3.8		5	3.5		3.5			3.5		V
				1/8.8		10	7		7			7		
				1.5/13.8		15	11		11			11		
V_{IL}	Input low voltage			3.8/0.5		5		1.5			1.5		1.5	V
				8.8/1		10		3			3		3	
				13.8/1.5		15		4			4		4	
V_{OH}	Output drive voltage				0	5	4		4.10	4.55		4.20		V
					5					4.25				
					10		3.80		3.90	4.10		3.90		
					15					3.95		3.50		
					20		3.55		3.40	3.75				
					25		3.40		3.10	3.55				
					0	10	9		9.10	9.55		9.20		
					5					9.25				
					10		8.85		9	9.15				
					15					9.05				
					20		8.70		8.60	8.90		8.40		
					25		8.60		8.30	8.75				
					0	15	14		14.10	14.55		14.20		
					5					14.30				
					10		13.90		14	14.20		14		
					15					14.10				
					20		13.75		13.70	13.95		13.50		
					25		13.65		13.50	13.80		13.10		
I_{OL}	Output sink current	HCC types	0/5	0.4		5	0.64		0.51	1		0.36		mA
			0/10	0.5		10	1.6		1.3	2.6		0.9		
			0/15	1.5		15	4.2		3.4	6.8		2.4		
		HCF types	0/5	0.4		5	0.61		0.51	1		0.42		
			0/10	0.5		10	1.5		1.3	2.6		1.1		
			0/15	1.5		15	4		3.4	6.8		2.8		
I_{IH}, I_{IL}**	Input leakage current		0/18	0/18		18		± 0.1		$± 10^{-5}$	± 0.1		± 1	µA
C_I**	Input capacitance									5	7.5			pF

* T_{Low} = − 55°C for **HCC** device; −40°C for **HCF** device.
* T_{High} = +125°C for **HCC** device; +85°C for **HCF** device.
The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD} = 5V
2V min. with V_{DD} = 10V
2.5V min. with V_{DD} = 15V
** Any input

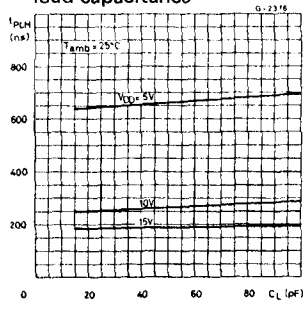
DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 50 pF, R_L = 200 kΩ, typical temperature coefficient for all V_{DD} values is 0.3%/°C, all input rise and fall times = 20 ns)

Parameter		Test conditions	Values			Unit
		V_{DD} (V)	Min.	Typ.	Max.	
t_{PHL}	Propagation delay time (Data)	5		520	1040	ns
		10		210	420	
		15		150	300	
t_{PLH}	Propagation delay time (Data)	5		660	1320	ns
		10		260	520	
		15		180	360	
t_{PHL}	Propagation delay time ($\overline{BL}$)	5		350	700	ns
		10		175	350	
		15		125	250	
t_{PLH}	Propagation delay time ($\overline{BL}$)	5		400	800	ns
		10		175	350	
		15		150	300	
t_{PHL}	Propagation delay time ($\overline{LT}$)	5		250	500	ns
		10		125	250	
		15		85	170	
t_{PLH}	Propagation delay time ($\overline{LT}$)	5		150	300	ns
		10		75	150	
		15		50	100	
t_{TLH}	Transition time	5		40	100	ns
		10		30	75	
		15		20	65	
t_{THL}	Transition time	5		125	310	ns
		10		75	185	
		15		65	160	
t_{setup}	Setup time	5	150	75		ns
		10	70	35		
		15	40	20		
t_{hold}	Hold time	5	0	-75		ns
		10	0	-35		
		15	0	-20		
t_W	Strobe pulse width	5	400	200		ns
		10	160	80		
		15	100	50		

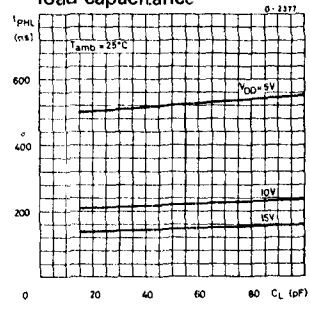
Typical output low (sink) current characteristics



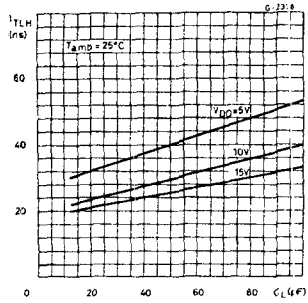
Typical data-to-output,low-to-high-level propagation delay time as a function of load capacitance



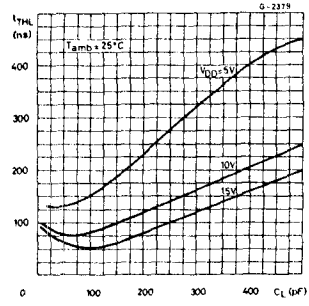
Typical data-to-output,high-to-low-level propagation delay time as a function of load capacitance



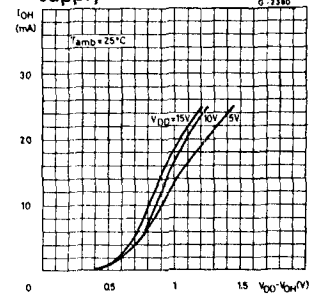
Typical low-to-high level transition time as a function of load capacitance



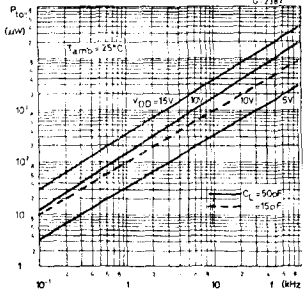
Typical high-to-low transition time as a function of load capacitance



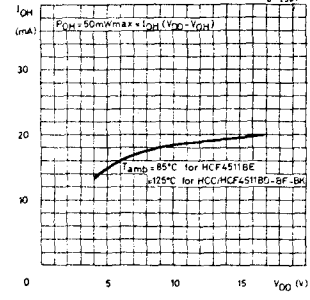
Typical voltage drop (V_{DD} to output) vs. output source current as a function of supply



Typical dynamic power dissipation characteristics



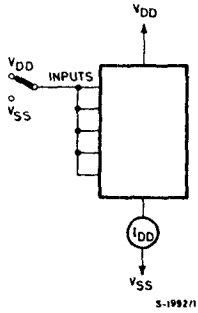
Derated static output current per output



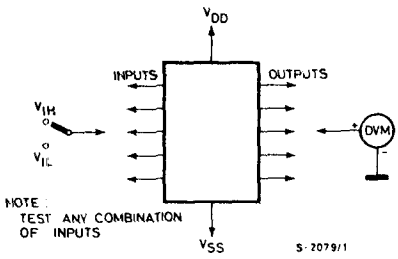
Maximum continuous derated output current I_{OH} applies to a single output with all other outputs sourcing an equal amount of current at the supply voltages shown. Operation above the derating curve is not recommended.

TEST CIRCUITS

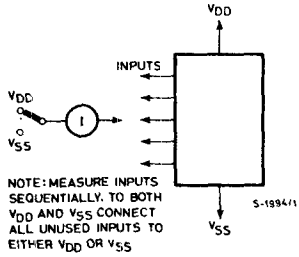
Quiescent device current



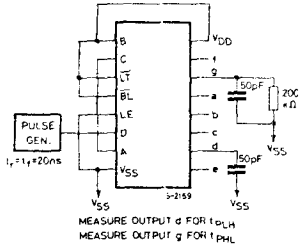
Noise immunity



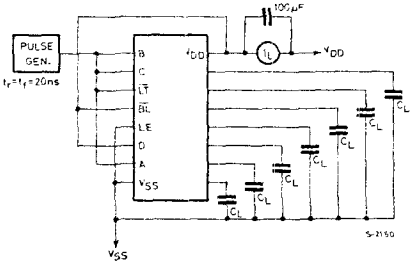
Input leakage current



Data propagation delay

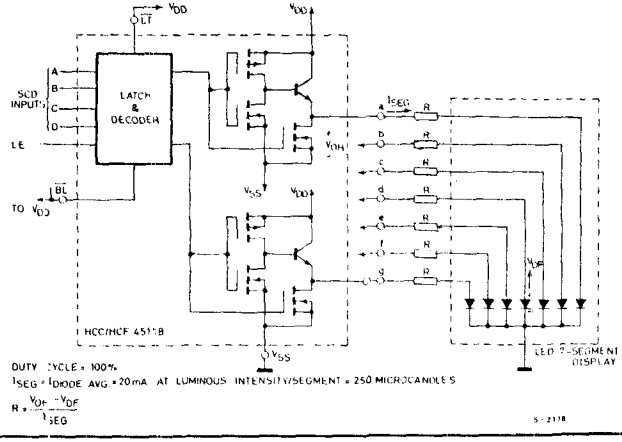


Dynamic power dissipation



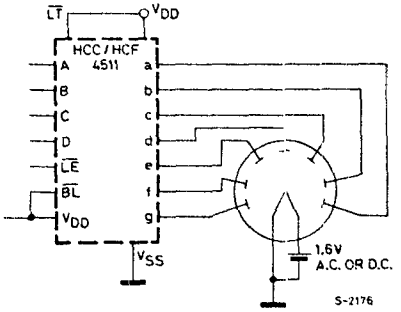
APPLICATIONS (Interfacing with various displays)

Driving common-cathode 7-segment LED displays



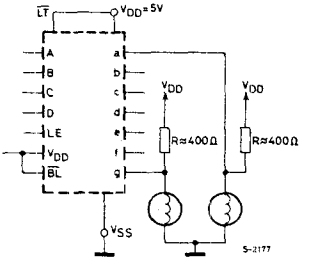
APPLICATIONS (continued)

Driving low-voltage fluorescent displays



A medium-brightness intensity display can be obtained with low-voltage fluorescent displays such as the Tung-Sot Digivac S/G Series.

Driving incandescent displays



2 of 7 Segments Shown Connected

Resistors R from V_{DD} to each 7-segment driver output are chosen to keep all Numitron segments slightly on and warm.