COS/MOS
INTEGRATED
CIRCUIT

HCC/HCF 4511B

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

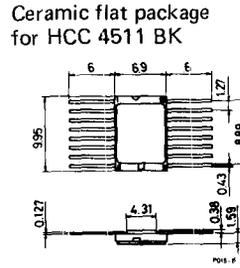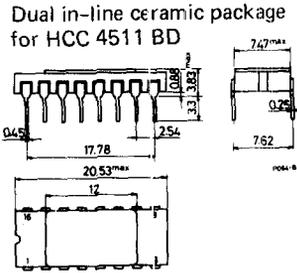|			
V_{DD} *	Supply voltage	–0.5 to 20	V
V_I	Input voltage	–0.5 to V_{DD} +0.5	V
I_I	DC input current (any one input)	± 10	mA
P_{tot}	Total power dissipation (per package)	200	mW
	Dissipation per output transistor		
	for T_{op} = full package-temperature range	100	mW
T_{op}	Operating temperature: for **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:
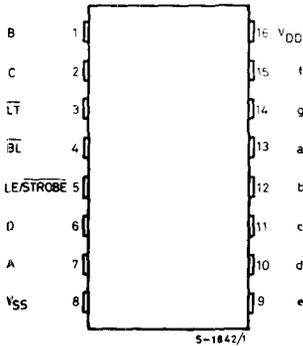
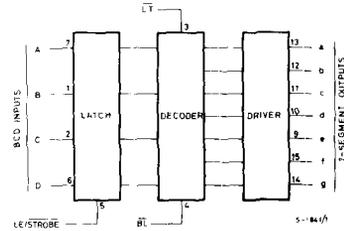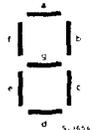|		
HCC 4511	BD	for dual in-line ceramic package
HCC 4511	BF	for dual in-line ceramic package, frit seal
HCC 4511	BK	for ceramic flat package
HCF 4511	BE	for dual in-line plastic package
HCF 4511	BF	for dual in-line ceramic package, frit seal

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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

B	1		16	V_{DD}
C	2		15	f
$\overline{LT}$	3		14	g
$\overline{BL}$	4		13	a
LE/STROBE	5		12	b
D	6		11	c
A	7		10	d
V_{SS}	8		9	e

S-1842/1

FUNCTIONAL DIAGRAM

BCD INPUTS — LATCH — DECODER — DRIVER — 7-SEGMENT OUTPUTS

V_{SS} = 8 V_{DD} = 16
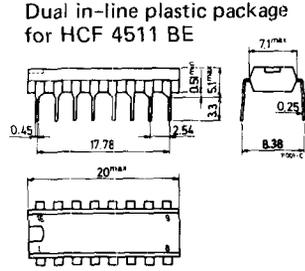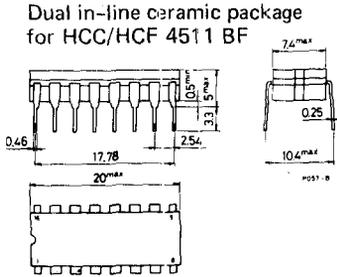
DISPLAY

RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage	3 to 18	V
V_1	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

ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK
5-2216
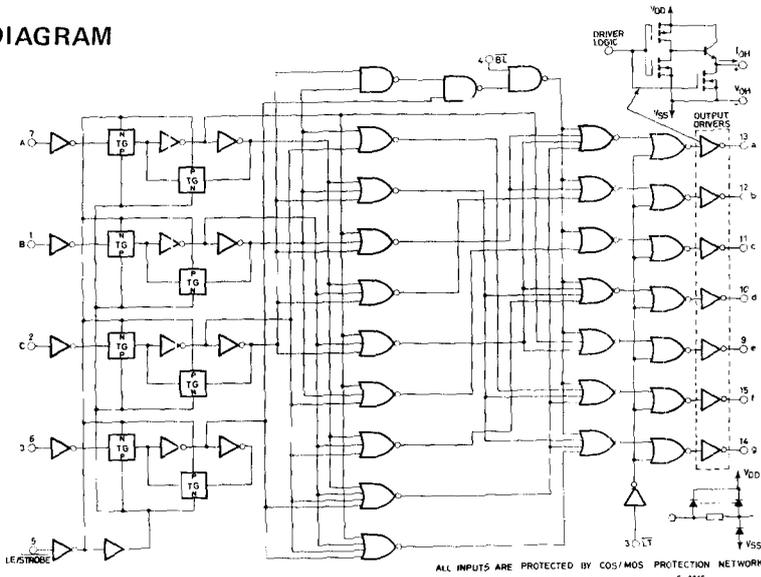
TRUTH TABLE

LE	BI	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
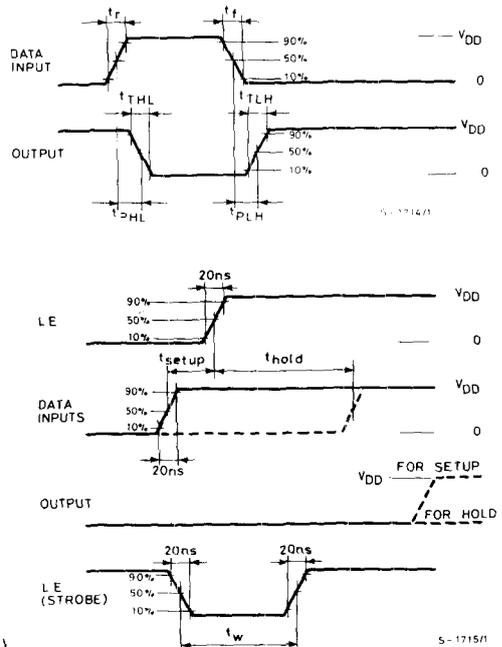
STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

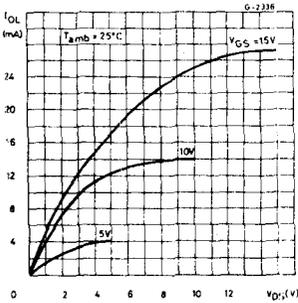| Parameter		V_I (V)	V_O (V)	$|I_{OH}|$ (mA)	V_{DD} (V)	T_{Low}* Min.	T_{Low}* Max.	25°C Min.	25°C Typ.	25°C Max.	T_{High}* Min.	T_{High}* Max.	Unit
I_L	Quiescent supply current				5		5		0.04	5		150	
					10		10		0.04	10		300	μA
					15		20		0.04	20		600	
					20		100		0.08	100		3000	
V_{OH}	Output high voltage	0/5			5	4		4.1	4.55		4.2		
		0/10			10	9		9.1	9.55		9.2		V
		0/15			15	14		14.1	14.55		14.2		
V_{OL}	Output low voltage	5/0			5		0.05			0.05		0.05	
		10/0			10		0.05			0.05		0.05	V
		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		
			1/8.8		10	7		7			7		V
			1.5/13.8		15	11		11			11		
V_{IL}	Input low voltage		3.8/0.5		5		1.5			1.5		1.5	
			8.8/1		10		3			3		3	V
			13.8/1.5		15		4			4		4	
V_{OH}	Output drive voltage			0		4		4.10	4.55		4.20		
				5					4.25				
				10	5	3.80		3.90	4.10		3.90		
				15					3.95		3.50		V
				20		3.55		3.40	3.75				
				25		3.40		3.10	3.55				
				0		9		9.10	9.55		9.20		
				5					9.25				
				10	10	8.85		9	9.15				
				15					9.05				V
				20		8.70		8.60	8.90		8.40		
				25		8.60		8.30	8.75				
				0		14		14.10	14.55		14.20		
				5					14.30				
				10	15	13.90		14	14.20		14		
				15					14.10				V
				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		
		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		mA
		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	
		10		210	420	ns
		15		150	300	
t_{PLH}	Propagation delay time (Data)	5		660	1320	
		10		260	520	ns
		15		180	360	
t_{PHL}	Propagation delay time ($\overline{BL}$)	5		350	700	
		10		175	350	ns
		15		125	250	
t_{PLH}	Propagation delay time ($\overline{BL}$)	5		400	800	
		10		175	350	ns
		15		150	300	
t_{PHL}	Propagation delay time ($\overline{LT}$)	5		250	500	
		10		125	250	ns
		15		85	170	
t_{PLH}	Propagation delay time ($\overline{LT}$)	5		150	300	
		10		75	150	ns
		15		50	100	
t_{TLH}	Transition time	5		40	100	
		10		30	75	ns
		15		20	65	
t_{THL}	Transition time	5		125	310	
		10		75	185	ns
		15		65	160	
t_{setup}	Setup time	5	150	75		
		10	70	35		ns
		15	40	20		
t_{hold}	Hold time	5	0	−75		
		10	0	−35		ns
		15	0	−20		
t_W	Strobe pulse width	5	400	200		
		10	160	80		ns
		15	100	50		

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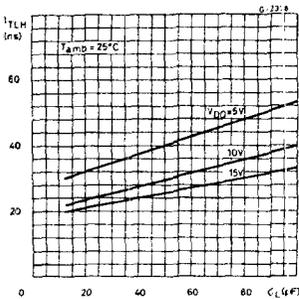Typical output low (sink) current characteristics

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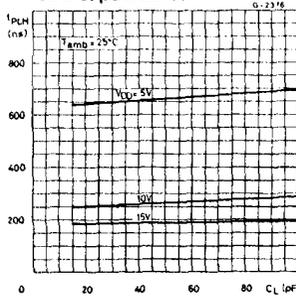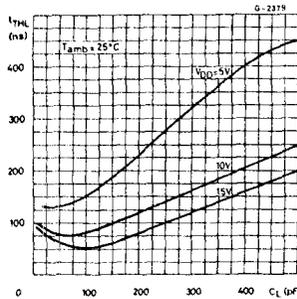

Typical data-to-output, high-to-low-level propagation delay time as a function of load capacitance
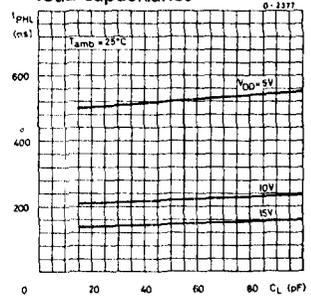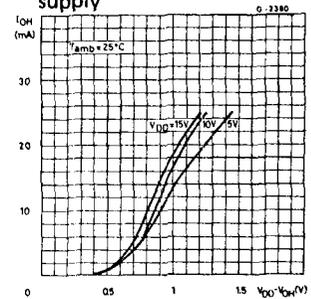

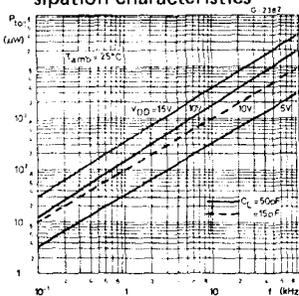Typical low-to-high level transition time as a function of load capacitance

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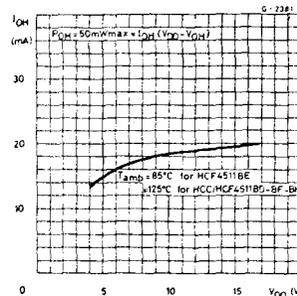

Typical voltage drop (V_{DD} to output) vs. output source current as a function of supply

Typical dynamic power dissipation characteristics

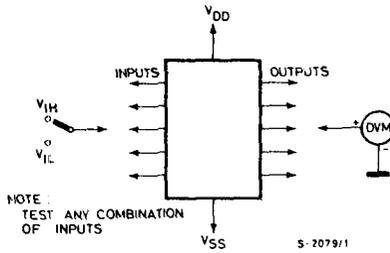Derated static output current per output

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.
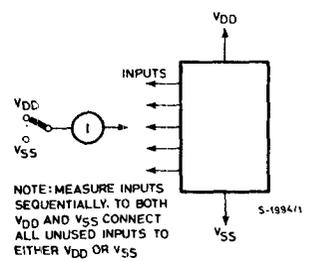
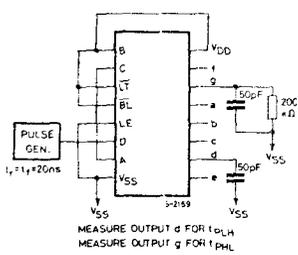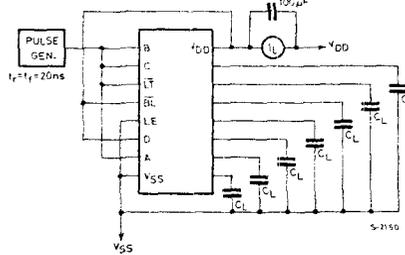# TEST CIRCUITS

Quiescent device current
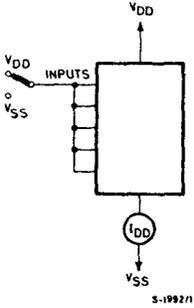
S-1992/1

Noise immunity

NOTE:
TEST ANY COMBINATION
OF INPUTS

S-2079/1

Input leakage current

NOTE: MEASURE INPUTS
SEQUENTIALLY. TO BOTH
V_{DD} AND V_{SS} CONNECT
ALL UNUSED INPUTS TO
EITHER V_{DD} OR V_{SS}

S-1994/1

Data propagation delay

$t_r = t_f = 20ns$

MEASURE OUTPUT d FOR t_{PLH}
MEASURE OUTPUT g FOR t_{PHL}

S-2159

Dynamic power dissipation

$t_r = t_f = 20ns$

S-2160

APPLICATIONS (Interfacing with various displays)

Driving common-cathode 7-segment LED displays

DUTY CYCLE = 100%.
$I_{SEG} = I_{DIODE}$ AVG = 20 mA AT LUMINOUS INTENSITY/SEGMENT = 250 MICROCANDLES

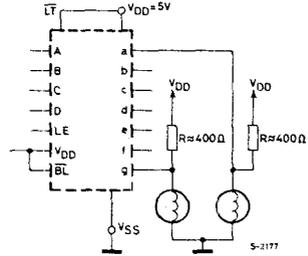$R = \dfrac{V_{OH} - V_{DF}}{I_{SEG}}$

S-2178
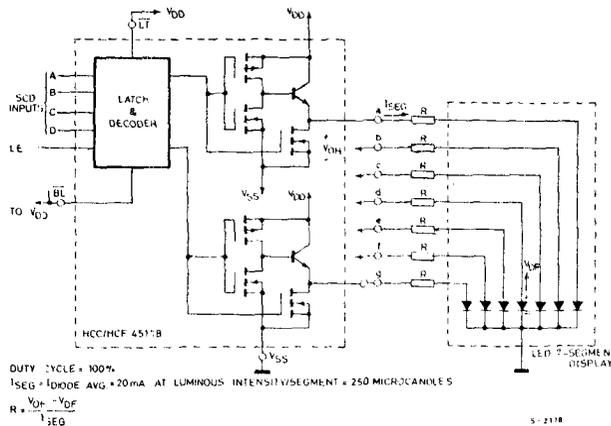
APPLICATIONS (continued)

Driving low-voltage fluorescent displays

S-2176
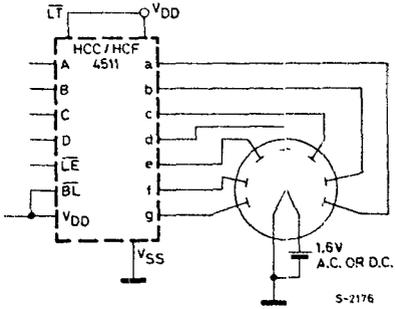
A medium-brightness intensity display can be obtained with low-voltage fluorescent displays such as the Tung-Sot Digivac S/G Series.

Driving incandescent displays

S-2177

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.