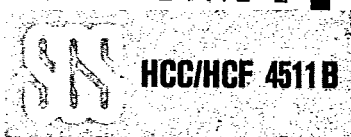


COS/MOS INTEGRATED CIRCUIT

S G S-THOMSON 07C D 7929237 0014972 6



41C 08986 0T-57-17

7929225 S G S SEMICONDUCTOR CORP

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 FOR HCC DEVICE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100 mA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD No. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

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: HCC types HCF types	-0.5 to 20 -0.5 to 18	V 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) Dissipation per output transistor for T_{op} = full package-temperature range	200 100	mW mW
T_{op}	Operating temperature: HCC types HCF types	-55 to 125 -40 to 85	°C °C
T_{stg}	Storage temperature	-65 to 150	°C

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

ORDERING NUMBERS:

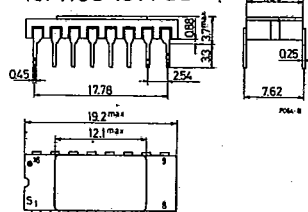
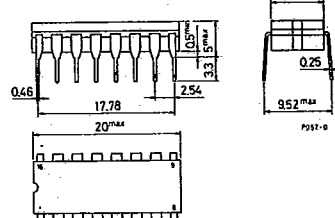
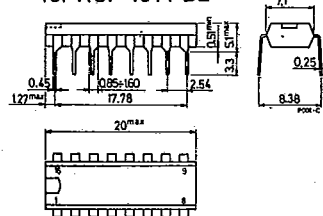
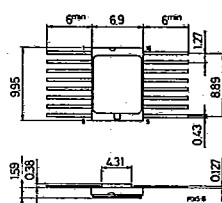
HCC 4511 BD for dual in-line ceramic package
HCC 4511 BF for dual in-line ceramic package, frit seal
HCC 4511 BK for ceramic flat package
HCF 4511 BE for dual in-line plastic package
HCF 4511 BF for dual in-line ceramic package, frit seal



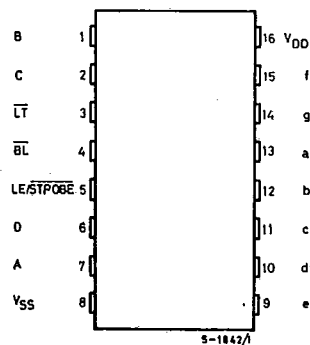
41C 08987 DT-51-17

7929225 S G S SEMICONDUCTOR CORP

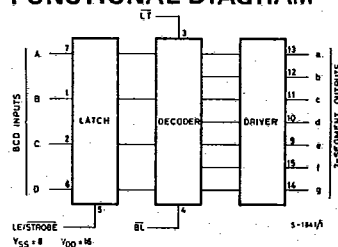
MECHANICAL DATA (dimensions in mm)

Dual in-line ceramic package
for HCC 4511 BDDual in-line ceramic package
for HCC/HCF 4511 BFDual in-line plastic package
for HCF 4511 BECeramic flat package
for HCC 4511 BK

CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM



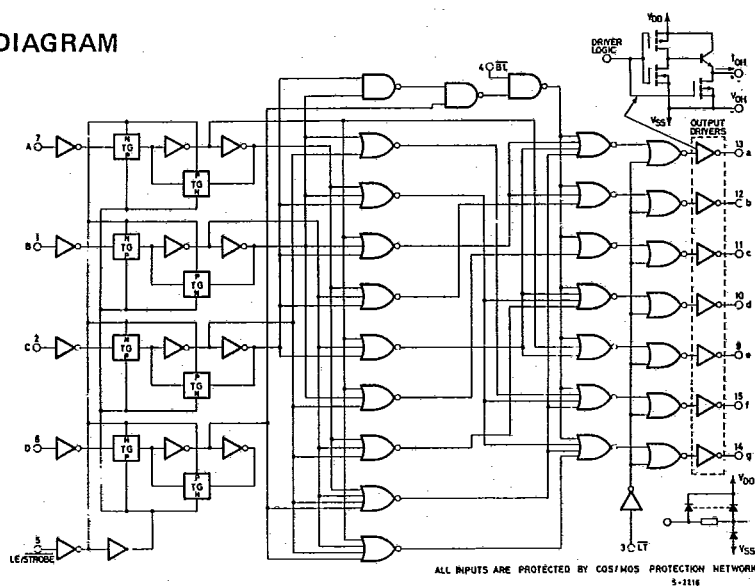
DISPLAY



RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage: HCC types	3 to 18	V
	HCF types	3 to 15	V
V_I	Input voltage	0 to V_{DD}	V
T_{op}	Operating temperature: HCC types	-55 to 125	°C
	HCF types	-40 to 85	°C

LOGIC DIAGRAM



TRUTH TABLE

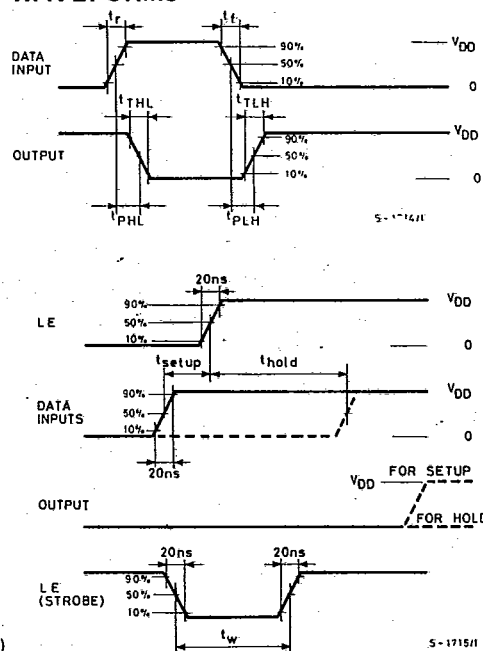
LE	BT	LT	D	C	B	A	a	b	c	d	e	f	g	Display
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	1	1	0	1	1	0	1	2
0	1	1	0	0	1	1	1	1	1	0	0	1	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	0	0	0	0	0	7
0	1	1	1	0	0	0	0	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} *		25°C			T _{High} *		
							Min.	Max.	Min.	Typ.	Max.	Min.		Max.
I _L	Quiescent current	HCC types	0/ 5			5		5		0.04	5		150	μA
			0/10			10		10		0.04	10		300	
			0/15			15		20		0.04	20		600	
			0/20			20		100		0.08	100		3000	
		HCF types	0/ 5			5		20		0.04	20		150	
			0/10			10		40		0.04	40		300	
			0/15			15		80		0.04	80		600	
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	HCC types		0	5	4.1		4.10	4.55		4.20		V	
				5					4.25					
				10		3.80		3.90	4.10		3.90			
				15					3.95					
				20		3.55		3.40	3.75					
				25		3.40		3.10	3.55					
				0	10	9		9.10	9.55		9.20		V	
				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		V	
				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			



HCC/HCF 4511B

STATIC ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions				Values						Unit	
		V _I (V)	V _O (V)	I _{OH} (mA)	V _{DD} (V)	T _{Low} *		25°C			T _{High} *		
						Min.	Max.	Min.	Typ.	Max.	Min.		Max.
V _{OH} Output drive voltage	HCF types			0	5	4.1		4.1	4.57		4.1		V
				5					4.24				
				10		3.6		3.6	4.12		3.3		
				15					3.94				
				20		2.8		2.8	3.75		2.5		
				25					3.54				
				0	10	9.1		9.1	9.58		9.1		V
				5					9.26				
				10		8.75		8.75	9.17		8.45		
				15					9.04				
				20		8.1		8.1	8.90		7.8		
				25					8.75				
				0	15	14.1		14.1	14.59		14.1		V
				5					14.27				
				10		13.75		13.75	14.18		13.45		
				15					14.07				
				20		13.1		13.1	13.95		12.8		
				25					13.80				
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	0.52		0.44	1		0.36		
		0/10	0.5		10	1.3		1.1	2.6		0.9		
		0/15	1.5		15	3.6		3	6.8		2.4		
I _{IH} , I _{IL} Input leakage current	HCC types	0/18	Any input	18		±0.1		±10 ⁻⁵	±0.1		± 1	μA	
	HCF types	0/15		15		±0.3		±10 ⁻⁵	±0.3		± 1		
C _I Input capacitance			Any input					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

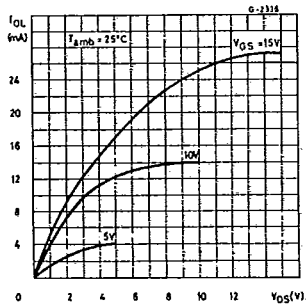
HCC/HCF 4511B

7929225 S G S SEMICONDUCTOR CORP

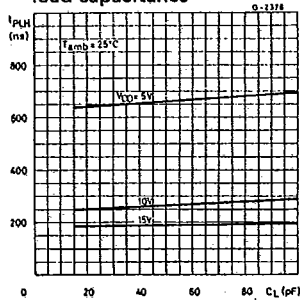
DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$, $C_L = 50 \text{ pF}$, $R_L = 200 \text{ k}\Omega$,
typical temperature coefficient for all $V_{DD} = 0.3\%/^{\circ}\text{C}$ values, all input rise and fall time = 20 ns)

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 (BL)		5		350	700	ns
			10		175	350	
			15		125	250	
t _{PLH}	Propagation delay time (BL)		5		400	800	ns
			10		175	350	
			15		150	300	
t _{PHL}	Propagation delay time (LT)		5		250	500	ns
			10		125	250	
			15		85	170	
t _{PLH}	Propagation delay time (LT)		5		150	300	ns
			10		75	150	
			15		50	100	
t _{TLH}	Transition time		5		40	80	ns
			10		30	60	
			15		20	50	
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		

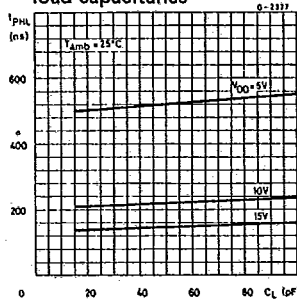
Typical output low (sink) current characteristics



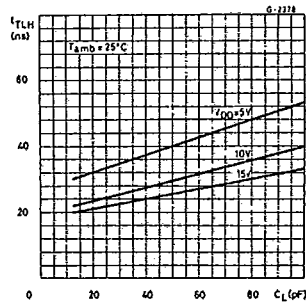
Typical data-to-output, low-to-high-level propagation delay time as a function of load capacitance



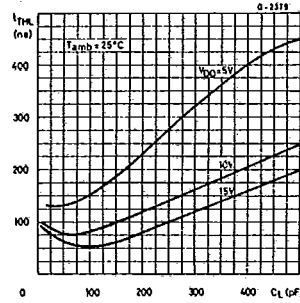
Typical data-to-output, high-to-low-level propagation delay time as a function of load capacitance



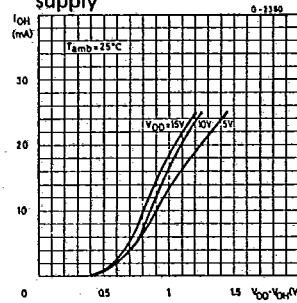
Typical low-to-high level transition time as a function of load capacitance



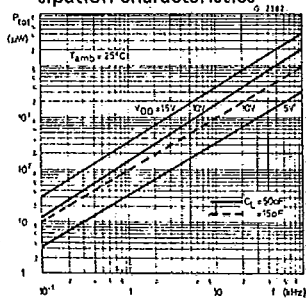
Typical high-to-low transition time as a function of load capacitance



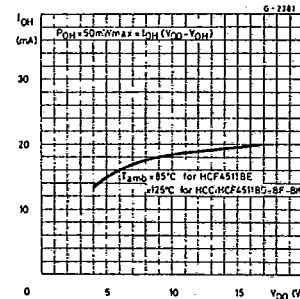
Typical voltage drop (V_DD to output) vs. output source current as a function of supply



Typical dynamic power dissipation characteristics



Derated static output current per output



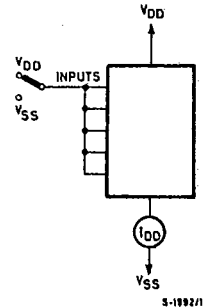
Maximum continuous derated output current I_{OH} applies to a single output with all other outputs sourcing an equal amount of current at the supply voltages shown. Operation above the derating curve is not recommended.

HCC/HCF 4511B

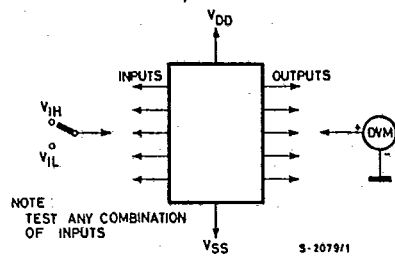
7929225 S G S SEMICONDUCTOR CORP

TEST CIRCUITS

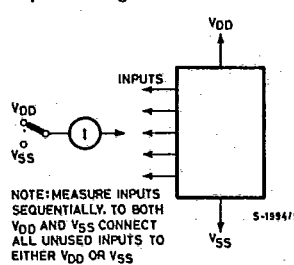
Quiescent device current



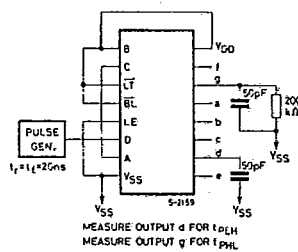
Noise immunity



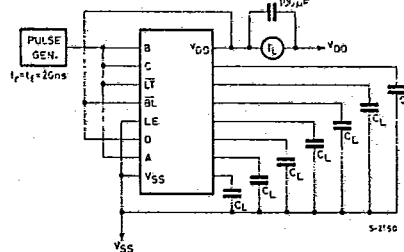
Input leakage current



Data propagation delay

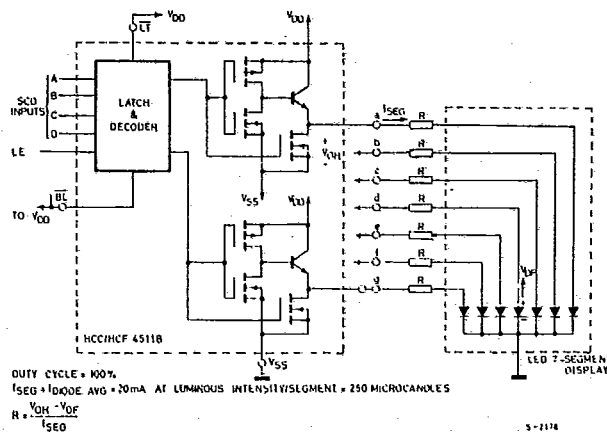


Dynamic power dissipation



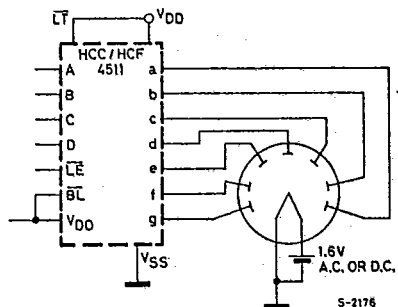
APPLICATIONS (Interfacing with various displays)

Driving common-cathode 7-segment LED displays



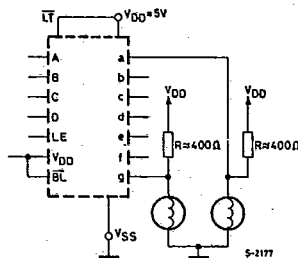
APPLICATIONS (continued)

Driving low-voltage fluorescent displays



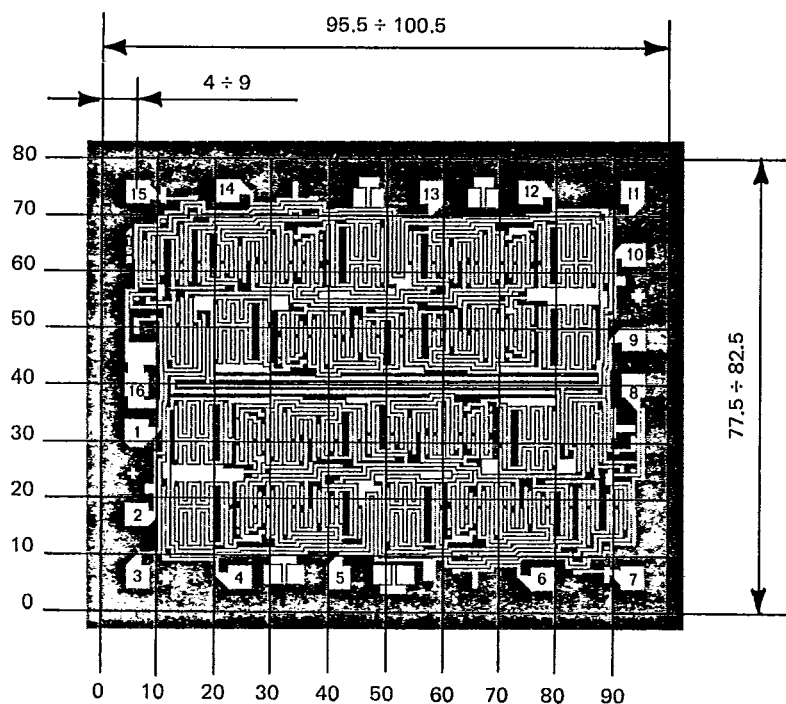
A medium-brightness intensity display can be obtained with low-voltage fluorescent displays such as the Tung-Sot Digivac S/G Series.

Driving incandescent displays

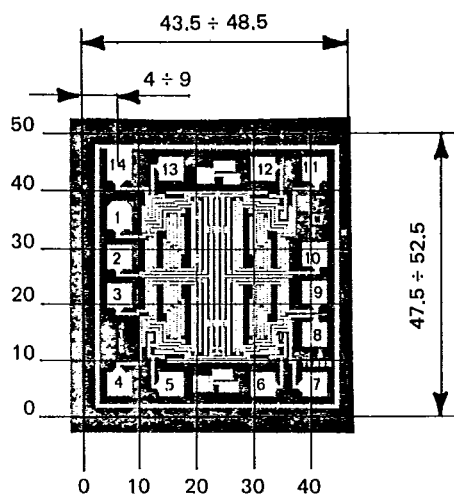


2 of 7 Segments Shown Connected

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



4015B



4016B