

T-51-11

CD4016A Types

CMOS Quad Bilateral Switch

For Transmission or Multiplexing of Analog or Digital Signals

The RCA-CD4016A Series types are quad bilateral switches intended for the transmission or multiplexing of analog or digital signals. Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch ON or OFF. These types are supplied in 14-lead hermetic dual-in-line ceramic packages (D and F suffixes), 14-lead dual-in-line plastic packages (E suffix), 14-lead ceramic flat packages (K suffix), and in chip form (H suffix).

Features:

- 15-V digital or ± 7.5-V peak-to-peak switching
- 280-Ω typical ON resistance for 15-V operation
- Switch ON resistance matched to within 10 Ω typ. over 15-V signal-input range
- High ON/OFF output-voltage ratio: 65 dB typ. @ $f_{is} = 10$ kHz, $R_L = 10$ kΩ

- High degree of linearity: <0.5% distortion typ. @ $f_{is} = 1$ kHz, $V_{is} = 5$ V_{p-p}, $V_{DD} - V_{SS} \geq 10$ V, $R_L = 10$ kΩ
- Extremely low OFF switch leakage resulting in very low offset current and high effective OFF resistance: 100 pA typ. @ $V_{DD} - V_{SS} = 10$ V, $T_A = 25^\circ\text{C}$
- Extremely high control input impedance (control circuit isolated from signal circuit: 10¹² Ω typ.)
- Low crosstalk between switches: -50 dB typ. @ $f_{is} = 0.9$ MHz, $R_L = 1$ kΩ
- Matched control-input to signal-output capacitance: Reduces output signal transients
- Frequency response, switch ON = 40 MHz (typ.)
- Quiescent current specified to 15 V
- Maximum input leakage current of 1 μA at 15 V (full package-temperature range)

Applications:

- Analog signal switching/multiplexing
- Signal gating
- Squelch control
- Chopper
- Modulator
- Demodulator
- Commutating switch

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following range:

CHARACTERISTIC	LIMITS		UNITS
	Min.	Max.	
Supply Voltage Range (For $T_A =$ Full Package Temperature Range)	3	12	V

TYPICAL "ON" RESISTANCE CHARACTERISTICS

CHARACTERISTIC	SUPPLY CONDITIONS		LOAD CONDITIONS					
	V_{DD} (V)	V_{SS} (V)	$R_L = 1k\Omega$		$R_L = 10k\Omega$		$R_L = 100k\Omega$	
			VALUE (Ω)	V_{is} (V)	VALUE (Ω)	V_{is} (V)	VALUE (Ω)	V_{is} (V)
R_{ON}	15	0	200	0.15	200	0.15	180	0.15
$R_{ON(max)}$	15	0	300	0.11	300	0.93	320	0.92
R_{ON}	10	0	290	0.10	250	0.10	240	0.10
$R_{ON(max)}$	10	0	500	0.74	560	0.56	610	0.55
R_{ON}	5	0	860	0.5	470	0.5	450	0.5
$R_{ON(max)}$	5	0	1.7k	0.42	7k	0.29	33k	0.27
R_{ON}	7.5	-7.5	200	0.75	200	0.75	180	0.75
$R_{ON(max)}$	7.5	-7.5	290	0.25	280	0.25	400	0.25
R_{ON}	5	-5	260	0.5	250	0.5	240	0.5
$R_{ON(max)}$	5	-5	310	0.5	250	0.5	240	0.5
R_{ON}	5	-5	600	0.25	580	0.25	760	0.25
R_{ON}	2.5	-2.5	590	0.25	450	0.25	490	0.25
$R_{ON(max)}$	2.5	-2.5	720	0.25	520	0.25	520	0.25
R_{ON}	2.5	-2.5	232k	0.25	300k	0.25	870k	0.25

* Variation from a perfect switch, $R_{ON} = 0\Omega$.

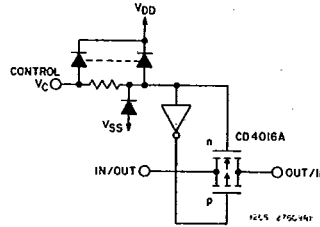
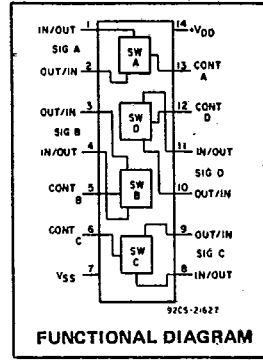


Fig. 1—Schematic diagram — 1 of 4 identical sections.

- Digital signal switching/multiplexing
- CMOS logic implementation
- Analog-to-digital & digital-to-analog conversion
- Digital control of frequency, impedance, phase, and analog-signal gain

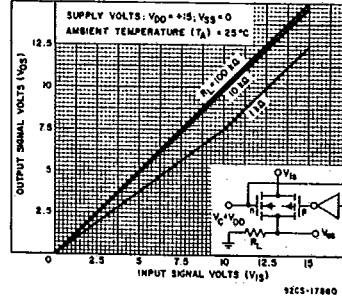


Fig. 2 — Typ. "ON" characteristics for 1 of 4 switches with $V_{DD} = +15$ V, $V_{SS} = 0$ V.

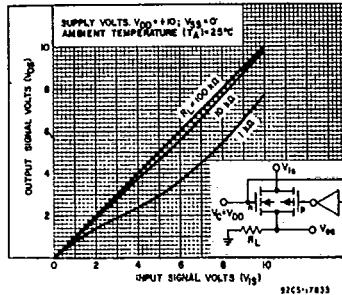


Fig. 3 — Typ. "ON" characteristics for 1 of 4 switches with $V_{DD} = +10$ V, $V_{SS} = 0$ V.

CD4016A Types

ELECTRICAL CHARACTERISTICS (All inputs. $V_{SS} \leq V_I \leq V_{DD}$)
Recommended DC Supply Voltage ($V_{DD}-V_{SS}$) . . . 3 to 15 V

Characteristic	Test Conditions All Voltage Values are in Volts	Limits						Unit	
		Values at -55°C, +25°C, +125°C Apply to D, F, K, H Packages Values at -40°C, +25°C, +85°C Apply to E Package							
		V _{DD} (V)	-55°	-40°	+85°	+125°	+25°C		
					Typ.	Max.			
Quiescent Device Current, I _L max (All switches ON or all Switches OFF) D, F, H Pkgs		5	0.25	-	-	10	0.01	0.25	μA
		10	0.5	-	-	20	0.01	0.5	
		15	2	-	-	40	0.01	2	
E, Y Pkgs		5	-	0.25	5	-	-	0.25	μA
		10	-	0.5	10	-	-	0.5	
		15	-	2	20	-	-	2	

Signal Inputs (V _{IS}) and Outputs (V _{OS})													
Characteristic	V _C V _{DD}	V _{SS}	V _{IS}	Typ/Max				Typ/Max					
				Typ/Max	Typ/Max	Typ/Max	Typ/Max	Typ/Max	Typ/Max				
ON Resistance, R _{ON}	+	-	0	R _L = 10 kΩ*						Ω			
				+7.5	+7.5	120/360	130/370	260/520	300/600			200	400
					-7.5	120/360	130/370	260/520	300/600			200	400
					±0.25	130/775	160/790	400/1080	470/1230			280	850
				+5	+5	130/600	150/610	340/840	400/960			250	660
					-5	130/600	150/610	340/840	400/960			250	660
					±0.25	325/1870	370/1900	770/2380	900/2600			580	2000
				+15	+15	120/360	130/370	260/520	300/600			200	400
					0	120/360	130/370	260/520	300/600			200	400
					±0.25	130/360	130/370	260/520	300/600			200	400
				+10	+10	130/600	150/610	340/840	400/960			250	660
					0	130/600	150/610	340/840	400/960			250	660
±0.25	300/1870	350/1900	750/2380		880/2600	560	2000						
ΔON Resistance Between Any 2 of 4 Switches ΔR _{ON}	+	-	±7.5	R _L = 10 kΩ*						Ω			
				+7.5	-7.5	±7.5	-	-	-			10	-
				+5	-5	±5	-	-	-			15	-
Sine Wave Response (Distortion)	+	-	5	R _L = 10 kΩ						%			
				f _{IS} = 1 kHz	-	-	-	-	0.4			-	
Frequency Response Switch ON (Sine-Wave Input)	+	-	-5	V _{DD} = +5, V _C = V _{SS} = -5, p-p						MHz			
				R _L = 1 kΩ	-	-	-	-	40			-	
Feedthrough Switch OFF	+	-	-5	R _L = 1 kΩ						MHz			
				20 log ₁₀ $\frac{V_{OS}}{V_{IS}}$	-	-	-	-	1.25			-	
Input or Output Leakage Current Switch OFF (Effective OFF Resistance)	V _{DD}	V _C V _{SS}	±7.5							μA			
				+7.5	-7.5	-	-	-	-			±100	-
	+5	-5	±5							nA			

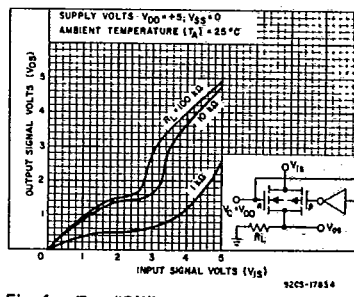


Fig. 4 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +5 V, V_{SS} = 0 V.

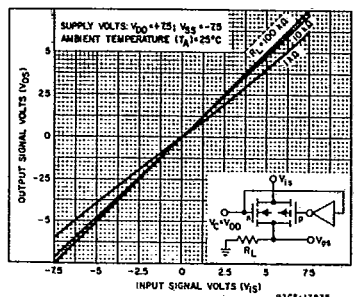


Fig. 5 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +7.5 V, V_{SS} = -7.5 V.

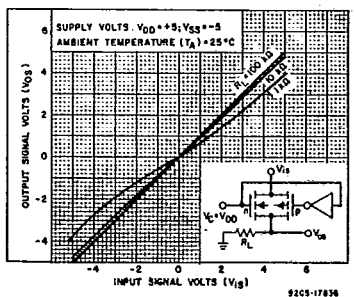


Fig. 6 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +5 V, V_{SS} = -5 V.

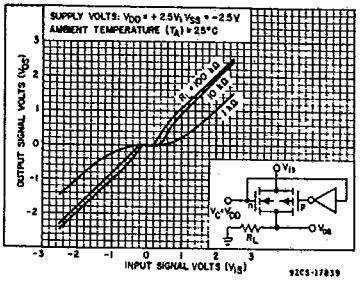


Fig. 7 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +2.5 V, V_{SS} = -2.5 V.

CD4016A Types

ELECTRICAL CHARACTERISTICS (Cont'd) $V_{SS} < V_i < V_{DD}$
Recommended DC Supply Voltage ($V_{DD}-V_{SS}$) . . 3 to 15 V

Characteristic	Test Conditions All Voltage Values are in Volts	Limits						Unit
		Values at -55°C, +25°C, +125°C Apply to D, F, K, H Packages Values at -40°C, +25°C, +85°C Apply to E Package						
		-55°	-40°	+85°	+125°	+25°C		
Typ.	Max.							
Crosstalk Between Any 2 of 4 Switches (f = -50 dB)	$V_C(A) = V_{DD} = +5$ $V_C(B) = V_{SS} = -5$ $V_{is}(A) = 5$ p-p $R_L = 1$ k Ω $20 \log_{10} \frac{V_{os}(B)}{V_{is}(A)} = -50$ dB	-	-	-	-	0.9	-	MHz
Propagation Delay (Signal Input to Signal Output) t_{pd}	$V_C = V_{DD} = 10$ $V_{SS} = GND$ $C_L = 50$ pF $V_{is} = 10$ Sq. Wave $t_r, t_f = 20$ ns	-	-	-	-	20	50	ns
Capacitance: Input, C_{i5} Output, C_{o5} Feedthrough, C_{i05}	$V_{DD} = +5$ $V_{CC} = V_{SS} = -5$	-	-	-	-	4	-	pF
Control (V_C)[†]								
Switch Threshold Voltage, V_{TH}	$V_{is} \leq V_{DD}, I_{is} = 10 \mu A$ $V_{DD} - V_{SS} = 15, 10, 5$	0.7min 2.9max	-	-	0.2min 2.4max	0.5min 1.5	2.7	V
Input Leakage Current, $I_{iL, max}$	$V_{is} \leq V_{DD}$ $V_{DD} = 15$	$\pm 10^{-5}$ typ; ± 1 max.						μA
Crosstalk (Control Input to Signal Output)	$V_C = 10$ (Sq. Wave) $t_r, t_f = 20$ ns $R_L = 10$ k Ω $V_{DD} = 10$	-	-	-	-	50	-	mV
Turn-On Propagation Delay, t_{pdc}	$V_{DD} - V_{SS} = 10$ $V_C = 10$ (See Fig. 25) $t_r, t_f = 20$ ns $C_L = 15$ pF $R_L = 1$ k Ω	-	-	-	-	20	40	ns
Maximum Allowable Control Input Repetition Rate	$V_{DD} = 10$ $V_{SS} = GND$ $R_L = 1$ k Ω $C_L = 15$ pF $V_{CC} = 10$ (Sq. Wave) $t_r, t_f = 20$ ns	-	-	-	-	10	-	MHz
Av. Input Capacitance, C_1		-	-	-	-	5	-	μF

- * Limit determined by minimum feasible leakage current measurement for automatic testing.
- ▲ Symmetrical about 0 volts.
- For all test conditions.
- † All control inputs protected by COS/MOS protection network.

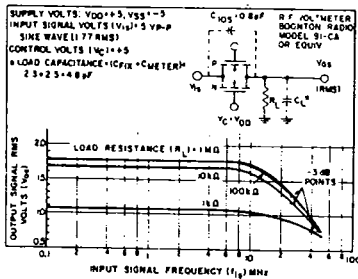


Fig. 11 - Typical switch frequency response - switch "ON".

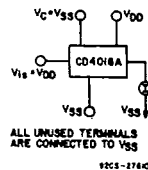


Fig. 12 - "OFF" switch input or output leakage current test circuit.

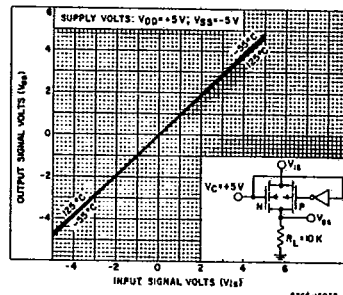


Fig. 8 - Typ. "ON" characteristics as a function of temp. for 1 of 4 switches with $V_{DD} = +5$ V, $V_{SS} = -5$ V.

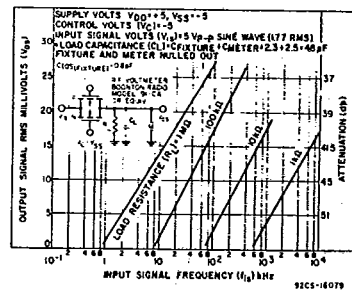


Fig. 9 - Typ. feedthru vs. frequency - switch "OFF".

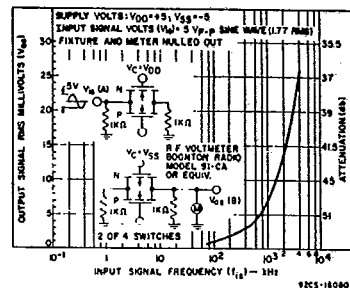


Fig. 10 - Typical crosstalk between switch circuits in the same package.

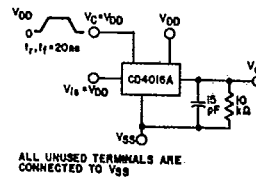
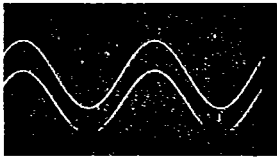


Fig. 13 - Test circuit for square-wave response.

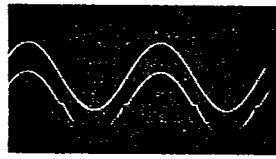
CD4016A Types



SCALE X = 0.2 ms/DIV Y = 2.0 V/DIV
V_{DD} = V_C = +7.5V, V_{SS} = -7.5V, R_L = 10KΩ
C_L = 15 pF
f_{IS} = 1 KHz V_{IS} = 5V p-p
DISTORTION = 0.2 %

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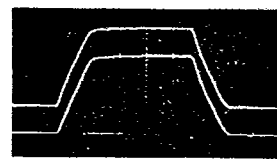
Fig.14 - Typical sine wave response of V_{DD} = +7.5 V, V_{SS} = -7.5 V.



SCALE X = 0.2 ms/DIV Y = 2.0 V/DIV
V_{DD} = V_C = +2.5V, V_{SS} = -2.5V, R_L = 10KΩ
C_L = 15 pF
f_{IS} = 1 KHz V_{IS} = 5V p-p
DISTORTION = 3 %

92CS-27614

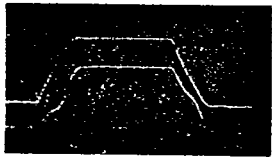
Fig.15 - Typical sine wave response of V_{DD} = +2.5 V, V_{SS} = -2.5 V.



SCALE X = 100 ns/DIV
Y = 5.0 V/DIV

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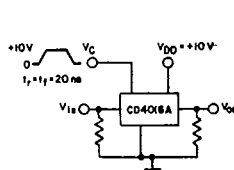
Fig.16 - Typical square wave response at V_{DD} = V_C = +15 V, V_{SS} = Gnd.



SCALE X = 100 ns/DIV
Y = 2 V/DIV

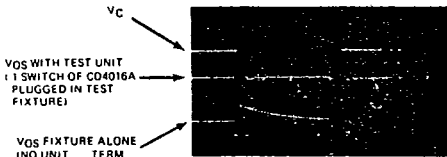
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Fig.17 - Typical square wave response at V_{DD} = V_C = +5 V, V_{SS} = Gnd.



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

(a)



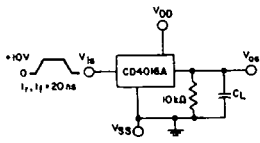
V_{OS} WITH TEST UNIT (1 SWITCH OF CD4016A PLUGGED IN TEST FIXTURE)

V_{OS} FIXTURE ALONE (NO UNIT TERM 5 TO 3 OF SOCKET)

V_C = 10V PER DIV
V_{OS} = 0.2V PER DIV
t = 100ns PER DIV

92CS-27618

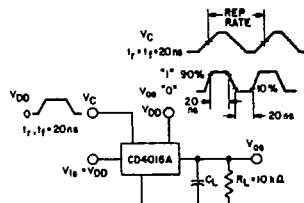
Fig.18 - Crosstalk-control input to signal output.



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

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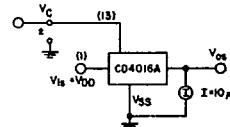
Fig.19 - Propagation delay time signal input (V_{IS}) to signal output (V_{OS}).



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

92CS-27620

Fig.20 - Max. allowable control-input repetition rate.



92CS-27621

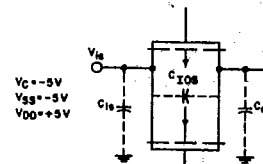
SWITCH THRESHOLD VOLTAGE IS DEFINED AS THE VOLTAGE APPLIED TO A TRANSMISSION GATE CONTROL WHICH CAUSES 10 μA OF TRANSMISSION GATE CURRENT.

Fig.21 - Switch threshold voltage.

MAXIMUM RATINGS, Absolute-Maximum Values:

STORAGE-TEMPERATURE RANGE (T _{stg})	-65 to +150°C
OPERATING-TEMPERATURE RANGE (T _A)	
PACKAGE TYPES D, F, K, H	-55 to +125°C
PACKAGE TYPE E	-40 to +85°C
DC SUPPLY-VOLTAGE RANGE (V _{DD})	
(Voltages referenced to V _{SS} Terminal)	-0.5 to +15 V
POWER DISSIPATION PER PACKAGE (P _D)	
FOR T _A = -40 to +60°C (PACKAGE TYPE E)	500 mW
FOR T _A = +60 to +85°C (PACKAGE TYPE E)	Derate Linearly at 12 mW/°C to 200 mW
FOR T _A = -55 to +100°C (PACKAGE TYPES D, F, K)	500 mW
FOR T _A = +100 to +125°C (PACKAGE TYPES D, F, K)	Derate Linearly at 12 mW/°C to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR T _A = FULL PACKAGE TEMPERATURE RANGE (ALL PACKAGE TYPES)	100 mW
INPUT VOLTAGE RANGE, ALL INPUTS	-0.5 to V _{DD} + 0.5 V
LEAD TEMPERATURE (DURING SOLDERING)	
At distance 1/16 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max.	+265°C

MEASURED ON BOONTON CAPACITANCE BRIDGE MODEL 75A (1 MHz)



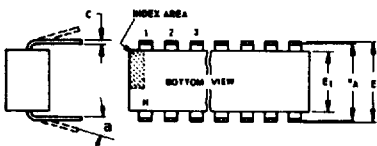
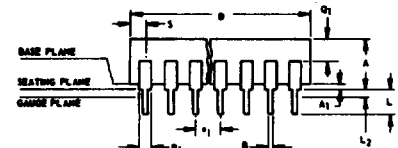
ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

92CS-27622

Fig.22 - Capacitance C_{IOS} and C_{OIS}.

Dimensional Outlines

Dual-In-Line Welded-Seal Ceramic Packages



- NOTES:**
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L_2 when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N_1 is the quantity of allowable missing leads.

(D) SUFFIX (JEDEC MO-001-AD)
14-Lead Dual-In-Line Welded-Seal Ceramic Package

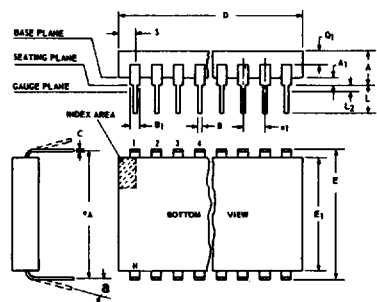
SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.160		3.05	4.06
A ₁	0.020	0.065		0.51	1.65
B	0.014	0.020		0.356	0.508
B ₁	0.060	0.065		1.27	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.770		18.93	19.55
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e_1	0.100 TP		2	2.54 TP	
e_A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	14		5	14	
N ₁	0		6	0	
Q ₁	0.050	0.085		1.27	2.15
S	0.065	0.090		1.66	2.28

92SS-4411R2

(D) SUFFIX (JEDEC MO-001-AE)
16-Lead Dual-In-Line Welded-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.160		3.05	4.06
A ₁	0.020	0.065		0.51	1.65
B	0.014	0.020		0.356	0.508
B ₁	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.785		18.93	19.93
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e_1	0.100 TP		2	2.54 TP	
e_A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	16		5	16	
N ₁	0		6	0	
Q ₁	0.050	0.085		1.27	2.15
S	0.015	0.060		0.39	1.52

92SS-4266R5



- NOTES:**
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L_2 when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N_1 is the quantity of allowable missing leads.

(D) SUFFIX (JEDEC MO-015-AG)
24-Lead Dual-In-Line Welded-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.090	0.200		2.29	5.08
A ₁	0.020	0.070		0.51	1.78
B	0.015	0.020		0.381	0.508
B ₁	0.045	0.055		1.143	1.397
C	0.008	0.012	1	0.204	0.304
D	1.15	1.22		29.21	30.98
E	0.600	0.625		15.24	15.87
E ₁	0.480	0.520		12.20	13.20
e_1	0.100 TP		2	2.54 TP	
e_A	0.600 TP		2, 3	15.24 TP	
L	0.100	0.180		2.54	4.57
L ₂	0.000	0.030		0.00	0.76
a	0°	15°	4	0°	15°
N	24		5	24	
N ₁	0		6	0	
Q ₁	0.020	0.080		0.51	2.03
S	0.020	0.060		0.51	1.52

92CS-19948R4

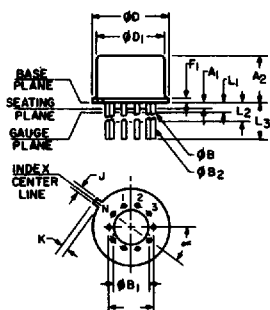
(D) SUFFIX (JEDEC MO-015-AH)
28-Lead Dual-In-Line Welded-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.090	0.200		2.29	5
A ₁	0	0.070	2	0	1.77
B	0.015	0.020		0.381	0.508
B ₁	0.015	0.065		0.39	1.39
C	0.008	0.012	1	0.204	0.304
D	1.380	1.420		35.06	36.06
E	0.600	0.625		15.24	15.87
E ₁	0.485	0.515		12.32	13.08
e_1	0.100 TP		2	2.54 TP	
e_A	0.600 TP		2, 3	15.24 TP	
L	0.100	0.200		2.6	5
L ₂	0	0.030		0	0.76
a	0°	15°	4	0°	15°
N	28		5	28	
N ₁	0		6	0	
Q ₁	0.020	0.070		0.51	1.77
S	0.040	0.070		1.02	1.77

92CM-20250R2

TO-5 Style Package

(T) SUFFIX (JEDEC MO-006-AG)
12-Lead Metal Package



92CS-19774

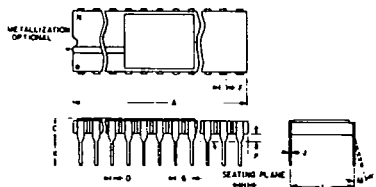
SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
a	0.230		2	5.84 TP	
A ₁	0	0		0	0
A ₂	0.165	0.185		4.19	4.70
ϕB	0.016	0.019	3	0.407	0.482
ϕB_1	0	0		0	0
ϕB_2	0.016	0.021	3	0.407	0.533
ϕD	0.335	0.370		8.51	9.39
ϕD_1	0.305	0.335		7.75	8.50
F ₁	0.020	0.040		0.51	1.01
j	0.028	0.034		0.712	0.863
k	0.029	0.045	4	0.74	1.14
L ₁	0.000	0.050	3	0.00	1.27
L ₂	0.250	0.500	3	6.4	12.7
L ₃	0.500	0.562	3	12.7	14.27
a	30° TP			30° TP	
N	12		6	12	
N ₁	1		5	1	

NOTES:

- Refer to Rules for Dimensioning Axial Lead Product Outlines.
- Leads at gauge plane within 0.007" (0.178 mm) radius of True Position (TP) at maximum material condition.
- ϕB applies between L₁ and L₂. ϕB_2 applies between L₂ and 0.500" (12.70 mm) from seating plane. Diameter is uncontrolled in L₁ and beyond 0.500" (12.70 mm).
- Measure from Max. ϕD .
- N_1 is the quantity of allowable missing leads.
- N is the maximum quantity of lead positions.

Dimensional Outlines (Cont'd)

DUAL-IN-LINE SIDE-BRAZED CERAMIC PACKAGES



(D) SUFFIX
18-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.890	0.915		22.606	23.241
C	—	0.200		—	5.080
D	0.015	0.021		0.381	0.533
F	0.054	REF.	1	1.371	REF.
G	0.100	BSC	1	2.54	BSC
H	0.035	0.065		0.889	1.651
J	0.008	0.012	3	0.203	0.304
K	0.125	0.150		3.175	3.810
L	0.290	0.310	2	7.366	7.874
M	0°	15°		0°	15°
P	0.025	0.045		0.635	1.143
N	18			18	

92CS-27231R1

(D) SUFFIX
22-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	1.065	1.100		27.05	27.94
C	0.085	0.145		2.16	3.68
D	0.017	0.023		0.43	0.58
F	0.040	REF.	1	1.02	REF.
G	0.100	BSC	1	2.54	BSC
H	0.030	0.070		0.76	1.78
J	0.008	0.012	3	0.20	0.30
K	0.125	0.175		3.18	4.45
L	0.380	0.420	2	9.65	10.67
M	—	7°		—	7°
P	0.025	0.050		0.64	1.27
N	22			22	

92CS-25186R2

NOTES:

- Leads within 0.005" (0.13 mm)-radius of True Position at maximum material condition.
- Dimension "L" to center of leads when formed parallel.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).

(D) SUFFIX
24-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	1.180	1.220		29.98	30.98
C	0.085	0.145		2.16	3.68
D	0.015	0.023		0.39	0.58
F	0.040	REF.		1.02	REF.
G	0.100	BSC	1	2.54	BSC
H	0.030	0.070		0.77	1.77
J	0.008	0.012	3	0.21	0.30
K	0.125	0.175		3.18	4.44
L	0.580	0.620	2	14.74	15.74
M	—	7°		—	7°
P	0.025	0.050		0.64	1.27
N	24			24	

92CS-30968R1

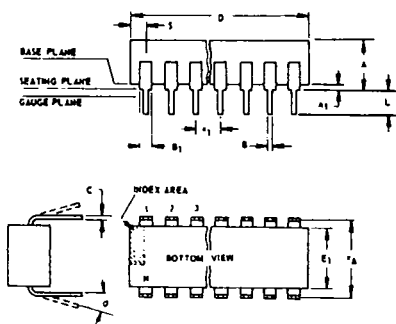
(D) SUFFIX
40-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	1.980	2.020		50.30	51.30
C	0.095	0.155		2.43	3.93
D	0.017	0.023		0.43	0.58
F	0.050	REF.		1.27	REF.
G	0.100	BSC	1	2.54	BSC
H	0.030	0.070		0.76	1.78
J	0.008	0.012	3	0.20	0.30
K	0.125	0.175		3.18	4.45
L	0.580	0.620	2	14.74	15.74
M	—	7°		—	7°
P	0.025	0.050		0.64	1.27
N	40			40	

92CM-27029R2

Dual-In-Line Plastic and Frit-Seal Ceramic Packages

(E) SUFFIX (JEDEC MO-001-AN)
8-Lead Dual-In-Line Plastic
(Mini-DIP) Package



SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A ₁	0.020	0.050		0.508	1.27
B	0.014	0.020		0.356	0.508
B ₁	0.035	0.065		0.889	1.65
C	0.008	0.012	1	0.203	0.304
D	0.370	0.400		9.40	10.16
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100	TP	2	2.54	TP
e _A	0.300	TP	2, 3	7.62	TP
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.762
a	0	15	4	0	15
N	8		5	8	
N ₁	0		6	0	
O ₁	0.040	0.075		1.02	1.90
S	0.015	0.060		0.381	1.52

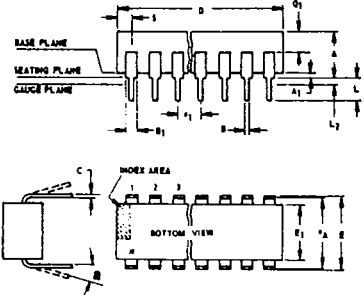
92CS-24026 R1

NOTES:

- Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

Dimensional Outlines (Cont'd)

Dual-In-Line Plastic and Frit-Seal Ceramic Packages (Cont'd)



NOTES:
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
1. When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
3. eA applies in zone L2 when unit installed.
4. a applies to spread leads prior to installation.
5. N is the maximum quantity of lead positions.
6. N1 is the quantity of allowable missing leads.

(E) and (F) SUFFIXES (JEDEC MO-001-AB)
14-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A1	0.020	0.050		0.51	1.27
B	0.014	0.020		0.356	0.508
B1	0.050	0.065		1.27	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.770		18.93	19.55
E	0.300	0.325		7.62	8.25
E1	0.240	0.260		6.10	6.60
e1	0.100 TP		2	2.54 TP	
eA	0.300 TP		2,3	7.62 TP	
L	0.125	0.150		3.18	3.81
L2	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	14		5	14	
N1	0		6	0	
Q1	0.040	0.075		1.02	1.90
S	0.065	0.090		1.66	2.28

92SS-4296R3

(E) and (F) SUFFIXES (JEDEC MO-001-AC)
16-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A1	0.020	0.050		0.51	1.27
B	0.014	0.020		0.356	0.508
B1	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.785		18.93	19.93
E	0.300	0.325		7.62	8.25
E1	0.240	0.260		6.10	6.60
e1	0.100 TP		2	2.54 TP	
eA	0.300 TP		2,3	7.62 TP	
L	0.125	0.150		3.18	3.81
L2	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	16		5	16	
N1	0		6	0	
Q1	0.040	0.075		1.02	1.90
S	0.015	0.060		0.39	1.52

92CM-15967R4

(E) SUFFIX
18-Lead Dual-In-Line Plastic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A1	0.020	0.050		0.508	1.27
B	0.014	0.020		0.356	0.508
B1	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D	0.845	0.885		21.47	22.47
E1	0.240	0.260		6.10	6.60
e1	0.100 TP		2	2.54 TP	
eA	0.300 TP		2,3	7.62 TP	
L	0.125	0.150		3.18	3.81
L2	0	0.030		0	0.762
a	0°	15°	4	0°	15°
N	18		5	18	
N1	0		6	0	
S	0.015	0.060		0.39	1.52

92CS-30630

(E) SUFFIX
22-Lead Dual-In-Line Plastic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A1	0.020	0.050		0.508	1.27
B	0.015	0.020		0.381	0.508
B1	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D		1.120			28.44
E	0.390	0.420		9.91	10.66
E1	0.345	0.355		8.77	9.01
e1	0.100 TP		2	2.54 TP	
eA	0.400 TP		2,3	10.16 TP	
L	0.125	0.150		3.18	3.81
L2	0	0.030		0	0.762
a	2°	15°	4	2°	15°
N	22		5	22	
N1	0		6	0	
Q1	0.055	0.085		1.40	2.15
S	0.015	0.060		0.381	1.27

92CS-30830

(F) SUFFIX (JEDEC MO-001-AG)
16-Lead Dual-In-Line Frit-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.165	0.210		4.20	5.33
A1	0.015	0.045		0.381	1.14
B	0.015	0.020		0.381	0.508
B1	0.045	0.070		1.15	1.77
C	0.009	0.011	1	0.229	0.279
D	0.750	0.795		19.05	20.19
E	0.295	0.325		7.50	8.25
E1	0.245	0.300		6.23	7.62
e1	0.100 TP		2	2.54 TP	
eA	0.300 TP		2,3	7.62 TP	
L	0.120	0.160		3.05	4.06
L2	0.000	0.030		0.000	0.76
a	2°	15°	4	2°	15°
N	16		5	16	
N1	0		6	0	
Q1	0.050	0.080		1.27	2.03
S	0.010	0.060		0.254	1.52

92CM-22284R1

(E) and (F) SUFFIXES (JEDEC MO-015-AA)
24-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

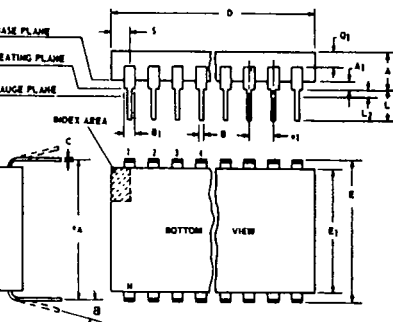
SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.250		3.10	6.30
A1	0.020	0.070		0.51	1.77
B	0.016	0.020		0.407	0.508
B1	0.028	0.070		0.72	1.77
C	0.008	0.012	1	0.204	0.304
D	1.20	1.29		30.48	32.76
E	0.600	0.625		15.24	15.87
E1	0.515	0.580		13.09	14.73
e1	0.100 TP		2	2.54 TP	
eA	0.600 TP		2,3	15.24 TP	
L	0.100	0.200		2.54	5.00
L2	0.000	0.030		0.00	0.76
a	0°	15°	4	0°	15°
N	24		5	24	
N1	0		6	0	
Q1	0.040	0.075		1.02	1.90
S	0.040	0.100		1.02	2.54

92CS26938R2

(E) SUFFIX
40-Lead Dual-In-Line Plastic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.250		3.10	6.30
A1	0.020	0.070		0.51	1.77
B	0.016	0.020		0.407	0.508
B1	0.028	0.070		0.72	1.77
C	0.008	0.012	1	0.204	0.304
D	2.000	2.090		50.80	53.09
E1	0.515	0.580		13.09	14.73
e1	0.100 TP		2	2.54 TP	
eA	0.600 TP		2,3	15.24 TP	
L	0.100	0.200		2.54	5.00
L2	0.000	0.030		0.00	0.76
a	0°	15°	4	0°	15°
N	40		5	40	
N1	0		6	0	
Q1	0.065	0.095		1.66	2.41
S	0.040	0.100		1.02	2.54

92CS-30959



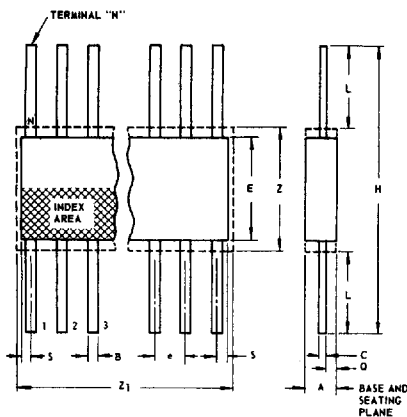
NOTES:
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
1. When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
3. eA applies in zone L2 when unit installed.
4. a applies to spread leads prior to installation.
5. N is the maximum quantity of lead positions.
6. N1 is the quantity of allowable missing leads.

T-90-20

Dimensional Outlines (Cont'd)

Ceramic Flat Packs

**(K) SUFFIX (JEDEC MO-004-AF)
14-Lead**



SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.008	0.100		0.21	2.54
B	0.015	0.019	1	0.381	0.482
C	0.003	0.006	1	0.077	0.152
e	0.050 TP		2	1.27 TP	
E	0.200	0.300		5.1	7.6
H	0.600	1.000		15.3	25.4
L	0.150	0.350		3.9	8.8
N	14		3	14	
Q	0.005	0.050		0.13	1.27
S	0.000	0.050		0.00	1.27
Z	0.300		4	7.62	
Z ₁	0.400		4	10.16	

92SS-4300R3

NOTES:

1. Refer to JEDEC Publication No. 95 for Rules for Dimensioning Peripheral Lead Outlines.
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at maximum material condition.
3. N is the maximum quantity of lead positions.
4. Z and Z₁ determine a zone within which all body and lead irregularities lie.

**(K) SUFFIX (JEDEC MO-004-AG)
16-Lead**

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.008	0.100		0.21	2.54
B	0.015	0.019	1	0.381	0.482
C	0.003	0.006	1	0.077	0.152
e	0.050 TP		2	1.27 TP	
E	0.200	0.300		5.1	7.6
H	0.600	1.000		15.3	25.4
L	0.150	0.350		3.9	8.8
N	16		3	16	
Q	0.005	0.050		0.13	1.27
S	0.000	0.025		0.00	0.63
Z	0.300		4	7.62	
Z ₁	0.400		4	10.16	

92CS-17271R3

**(K) SUFFIX
24-Lead**

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.075	0.120		1.91	3.04
B	0.018	0.022	1	0.458	0.558
C	0.004	0.007	1	0.102	0.177
e	0.050 TP		2	1.27 TP	
E	0.600	0.700		15.24	17.78
H	1.150	1.350		29.21	34.29
L	0.225	0.325		5.72	8.25
N	24		3	24	
Q	0.035	0.070		0.89	1.77
S	0.060	0.110	1	1.53	2.79
Z	0.700		4	17.78	
Z ₁	0.750		4	19.05	

92CS-19949R2

**(K) SUFFIX
28-Lead**

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.075	0.120		1.91	3.04
B	0.018	0.022	1	0.458	0.558
C	0.004	0.007	1	0.102	0.177
e	0.050 TP		2	1.27 TP	
E	0.600	0.700		15.24	17.78
H	1.150	1.350		29.21	34.29
L	0.225	0.325		5.72	8.25
N	28		3	28	
Q	0.035	0.070		0.89	1.77
S	0	0.060	1	0	1.53
Z	0.700		4	17.78	
Z ₁	0.750		4	19.05	

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