

CD405xB-Q1 具有逻辑电平转换功能的汽车类 CMOS 单路 8 通道模拟多路复用器或多路信号分离器

1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
 - 温度等级 1：-45°C 至 +125°C， T_A
- 各种数字和模拟信号电平：
 - 数字：3 V 至 20 V
 - 模拟： $\leq 20V_{P-P}$
- 在 $V_{DD} - V_{EE} = 18V$ 时的 $15V_{P-P}$ 信号输入范围内，具有 125Ω (典型值) 的低导通电阻
- 在 $V_{DD} - V_{EE} = 18V$ 时，通道漏电流为 $\pm 100pA$ (典型值)，具有高关断电阻
- 适用于 3V 至 20V 数字寻址信号 ($V_{DD} - V_{SS} = 3V$ 至 20V) 的逻辑电平转换功能，可将模拟信号切换至与 $20V_{P-P}$ ($V_{DD} - V_{EE} = 20V$) 相匹配的开关特性， $V_{DD} - V_{EE} = 15V$ 时， $r_{ON} = 5\Omega$ (典型值)，在所有数字控制输入和电源条件下，具有极低的静态功率损耗，在 $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10V$ 时，功率损耗为 $0.2\mu W$ (典型值)
- 二进制地址片上解码
- 5V、10V 和 15V 参数额定值
- 针对 20V 下的静态电流进行了 100% 测试
- 在全封装温度范围内，18V 时的最大输入电流为 $1\mu A$ ，18V 和 25°C 时为 $100nA$
- 先断后合开关消除了通道重叠

2 应用

- 模拟和数字多路复用和多路信号分离
- 模数和数模转换
- 信号门控
- 工厂自动化
- 电视
- 电器
- 消费类音频
- 可编程逻辑电路
- 传感器

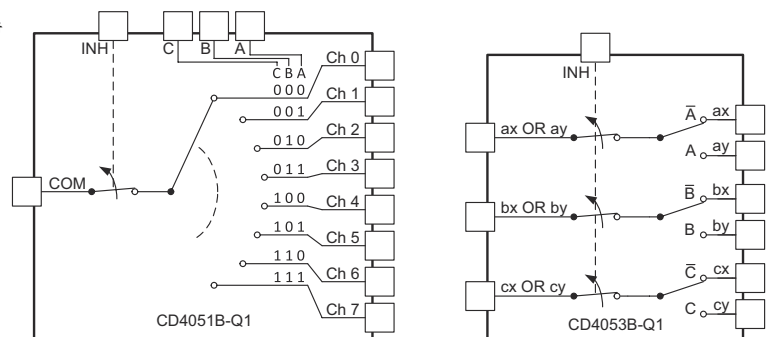
3 说明

CD405xB-Q1 模拟多路复用器和多路信号分离器是数字控制的模拟开关，具有低接通阻抗和极低的关断漏电流。这些多路复用器电路在整个 $V_{DD} - V_{SS}$ 和 $V_{DD} - V_{EE}$ 电源电压范围内，消耗的静态功率极低，而不受控制信号的逻辑状态影响。

封装信息⁽¹⁾

器件型号	封装	封装尺寸 (标称值)
CD405xB-Q1	D (SOIC, 16)	9.90mm × 3.91mm
	PW (TSSOP, 16)	5.00mm × 4.40mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。



CD405xB-Q1 的功能图

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4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision B (April 2019) to Revision C (March 2023)	Page
• 更新了整个文档中的表格、图和交叉参考的编号格式.....	1
• 更新了整个数据表中的 CD4051-Q1 规格.....	1

Changes from Revision A (January 2008) to Revision B (April 2019)	Page
• 新增了引脚配置和功能部分、ESD 等级表、特性说明部分、器件功能模式、应用和实现部分、电源相关建议部分、布局部分、器件和文档支持部分以及机械、封装和可订购信息部分.....	1
• 从数据表中删除了器件型号 CD4052B-Q1.....	1

5 Pin Configuration and Functions

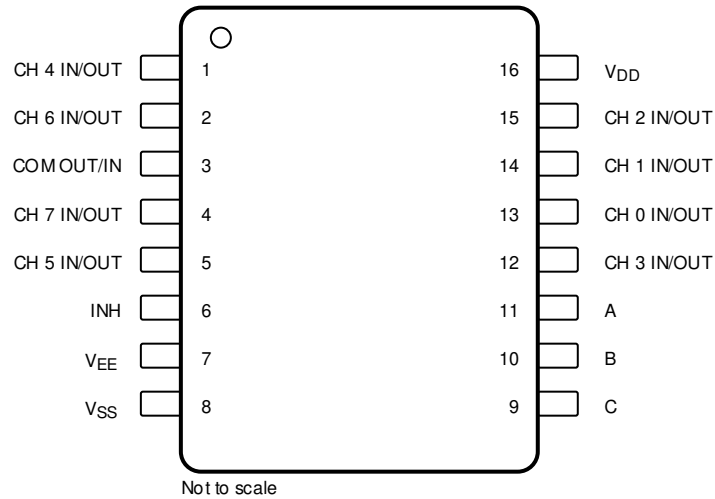


图 5-1. CD4051B-Q1 D or PW Package, (Top View)

表 5-1. Pin Functions CD4051B-Q1

PIN		TYPE ⁽¹⁾	DESCRIPTION
NO.	NAME		
1	CH 4 IN/OUT	I/O	Channel 4 in/out
2	CH 6 IN/OUT	I/O	Channel 6 in/out
3	COM OUT/IN	I/O	Common out/in
4	CH 7 IN/OUT	I/O	Channel 7 in/out
5	CH 5 IN/OUT	I/O	Channel 5 in/out
6	INH	I	Disables all channels. See 表 8-1.
7	VEE	—	Negative power input
8	VSS	—	Ground
9	C	I	Channel select C. See 表 8-1.
10	B	I	Channel select B. See 表 8-1.
11	A	I	Channel select A. See 表 8-1.
12	CH 3 IN/OUT	I/O	Channel 3 in/out
13	CH 0 IN/OUT	I/O	Channel 0 in/out
14	CH 1 IN/OUT	I/O	Channel 1 in/out
15	CH 2 IN/OUT	I/O	Channel 2 in/out
16	VDD	—	Positive power input

(1) I = input, O = output

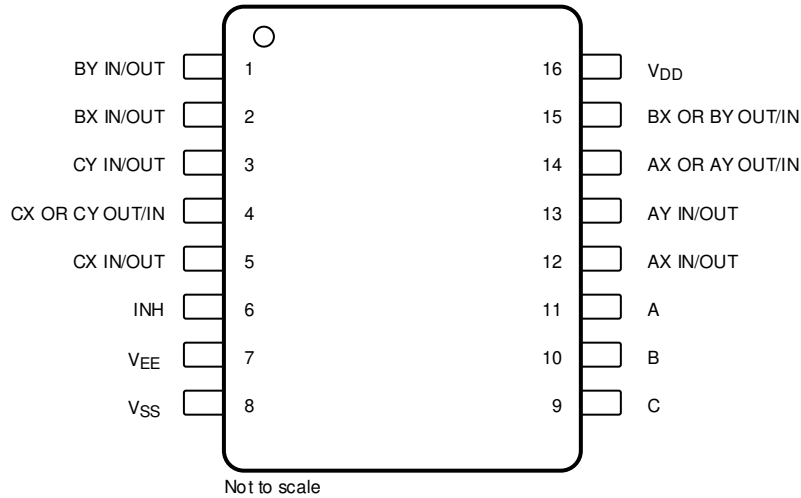


图 5-2. CD4053B-Q1 D or PW Package, (Top View)

表 5-2. Pin Functions CD4053B-Q1

PIN		TYPE ⁽¹⁾	DESCRIPTION
NO.	NAME		
1	BY IN/OUT	I/O	B channel Y in/out
2	BX IN/OUT	I/O	B channel X in/out
3	CY IN/OUT	I/O	C channel Y in/out
4	CX OR CY OUT/IN	I/O	C common out/in
5	CX IN/OUT	I/O	C channel X in/out
6	INH	I	Disables all channels. See 表 8-1.
7	V _{EE}	—	Negative power input
8	V _{SS}	—	Ground
9	C	I	Channel select C. See 表 8-1.
10	B	I	Channel select B. See 表 8-1.
11	A	I	Channel select A. See 表 8-1.
12	AX IN/OUT	I/O	A channel X in/out
13	AY IN/OUT	I/O	A channel Y in/out
14	AX OR AY OUT/IN	I/O	A common out/in
15	BX OR BY OUT/IN	I/O	B common out/in
16	V _{DD}	—	Positive power input

(1) I = input, O = output

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)^{(1) (2)}

		MIN	MAX	UNIT	
	Supply Voltage	V+ to V-, Voltages Referenced to V _{SS} Terminal	- 0.5	20	V
	DC Input Voltage		- 0.5	V _{DD} +0.5	V
	DC Input Current	Any One Input	- 10	10	mA
T _{JMAX1}	Maximum junction temperature, ceramic package			175	°C
T _{JMAX2}	Maximum junction temperature, plastic package			150	°C
T _{stg}	Storage temperature		- 65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Rating* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to ground, unless otherwise specified.

6.2 ESD Ratings

			VALUE	UNIT
CD4051B-Q1				
V _(ESD)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins ⁽¹⁾	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾	±750	
CD4053B-Q1				
V _(ESD)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins ⁽¹⁾	±2500	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾	±1500	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

	MIN	NOM	MAX	UNIT
Temperature Range	- 55		125	°C

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		CD405xB-Q1		UNIT
		D (SOIC)	PW (TSSOP)	
		16 PINS	16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	86.7	116.5	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	47.3	47.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	45.3	63.0	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	12.1	6.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	44.9	62.1	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics - CD4051B-Q1

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER	TEST CONDITIONS					MIN	TYP	MAX	UNIT	
	V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP					
SIGNAL INPUTS (V_{IS}) AND OUTPUTS (V_{OS}) - CD4051B-Q1										
Quiescent Device Current, I_{DD} (Max)	0 V	0 V	0 V	5 V	- 55°C			60	μA	
					- 40°C			60		
					25°C		17	60		
					85°C			150		
					125°C			150		
	0 V	0 V	0 V	10 V	- 55°C			60		
					- 40°C			60		
					25°C		18	60		
					85°C			300		
					125°C			300		
	0 V	0 V	0 V	15 V	- 55°C			60		
					- 40°C			60		
					25°C		18	60		
					85°C			600		
					125°C			600		
	0 V	0 V	0 V	20 V	- 55°C			100		
					- 40°C			100		
					25°C		18	100		
					85°C			3000		
					125°C			3000		
Drain to Source ON Resistance r_{ON} (Max) $0 \leq V_{IS} \leq V_{DD}$	0 V	0 V	0 V	5 V	- 55°C			800	Ω	
					- 40°C			850		
					25°C		470	1050		
					85°C			1200		
					125°C			1300		
	0 V	0 V	0 V	10 V	- 55°C			310		
					- 40°C			300		
					25°C		180	400		
					85°C			520		
					125°C			550		
	0 V	0	0	15 V	- 55°C			200		
					- 40°C			210		
25°C						125	240			
85°C							300			
125°C							300			
Change in ON Resistance (Between Any Two Channels), ΔR_{ON}	0 V	0 V	0 V	5 V	25°C		15	Ω		
						0 V	0 V		10 V	10
										0 V

6.5 Electrical Characteristics - CD4051B-Q1 (continued)

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER		TEST CONDITIONS				MIN	TYP	MAX	UNIT
		V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP			
OFF Channel Leakage Current: Any Channel OFF (Max) or ALL Channels OFF (COMMON OUT/IN) (Max)						- 55°C	± 100		
						- 40°C			
			0 V	0 V	18 V	25°C	± 0.3	± 100 ⁽²⁾	nA
						85°C	± 1000 ⁽²⁾		
						125°C			
ON Channel Leakage Current: Any Channel ON (Max) or ALL Channels ON (COMMON OUT/IN) (Max)		5 or 0	- 5 V	0 V	10.5 V	85°C	± 800		nA
		5	0 V	0 V	18 V	85°C	± 800		
Capacitance	Input, C_{IS}						5		pF
	Output, C_{OS}	CD4051-Q1	0 V	0 V	10 V	25°C	30		
	Feed-through, C_{IOS}						0.2		
Prop Delay		V_{DD}	$R_L = 200\text{ k}\ \Omega$		5 V	25°C	30	60	ns
			$C_L = 50\text{ pF}$		10 V		15	30	
			$t_r, t_f = 20\text{ ns}$		15 V		10	20	

6.5 Electrical Characteristics - CD4051B-Q1 (continued)

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER		TEST CONDITIONS					MIN	TYP	MAX	UNIT
		V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP				
CONTROL (ADDRESS OR INHIBIT), V_C - CD4051B-Q1										
Input Low Voltage, V_{IL} , (Max)					5 V	- 55°C	0.8		V	
						- 40°C	0.8			
						25°C	0.8			
						85°C	0.8			
						125°C	0.8			
					10 V	- 55°C	0.8			
						- 40°C	0.8			
						25°C	0.8			
						85°C	0.8			
						125°C	0.8			
					15 V	- 55°C	0.8			
						- 40°C	0.8			
						25°C	0.8			
						85°C	0.8			
						125°C	0.8			
Input High Voltage, V_{IH} , (Min)					5 V	- 55°C	3.5		V	
						- 40°C	3.5			
						25°C	3.5			
						85°C	3.5			
						125°C	3.5			
					10 V	- 55°C	7			
						- 40°C	7			
						25°C	7			
						85°C	7			
						125°C	7			
					15 V	- 55°C	11			
						- 40°C	11			
						25°C	11			
						85°C	11			
						125°C	11			
Input current, I_{IN} (Max)					18 V	- 55°C	± 1		μA	
						- 40°C	± 1			
						25°C	± 0.6			
						85°C	± 1			
						125°C	± 1			
Propagation Delay Time	Address-to-Signal OUT (Channels ON or OFF) (See Figure 7-2 Figure 7-3, and Figure 7-8)	$t_r, t_f = 20\text{ns}$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$	0 V	0 V	5 V	450 720		ns		
			0 V	0 V	10 V	160 320				
			0 V	0 V	15 V	120 240				
			- 5 V	0 V	5 V	225 450				

6.5 Electrical Characteristics - CD4051B-Q1 (continued)

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER		TEST CONDITIONS					MIN	TYP	MAX	UNIT
		V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP				
Propagation Delay Time	Inhibit-to-Signal OUT (Channel Turning ON) (See Figure 7-3)	$t_r, t_f = 20\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 1\text{ k}\Omega$	0 V	0 V	5 V		400	720	ns	
			0 V	0 V	10 V		160	320		
			0 V	0 V	15 V		120	240		
			- 10 V	0 V	5 V		200	400		
Propagation Delay Time	Inhibit-to-Signal OUT (Channel Turning OFF) (See Figure 7-10)	$t_r, t_f = 20\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$	0 V	0 V	5 V		200	450	ns	
			0 V	0 V	10 V		90	210		
			0 V	0 V	15 V		70	160		
			- 10 V	0 V	5 V		130	300		
Input Capacitance, C_{IN} (Any Address or Inhibit Input)			- 5 V	0 V	5 V	25°C	5	7.5	pF	

(1) Peak-to-Peak voltage symmetrical about $(V_{DD} - V_{EE}) / 2$.

(2) Determined by minimum feasible leakage measurement for automatic testing.

6.6 AC Performance Characteristics - CD4051B-Q1

 $V_{DD} = +15\text{ V}$, $V_{SS} = V_{EE} = 0\text{ V}$,

 $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS				TYP	UNIT	
	V_{IS} (V)	V_{DD} (V)	R_L (k Ω)				
Cutoff (- 3 dB) Frequency Channel ON (Sine Wave Input)	5 ⁽¹⁾	10	1	V_{OS} at Common OUT/IN	CD4051-Q1	20	MHz
	$V_{EE} = V_{SS}$, $20\text{Log}(V_{OS}/V_{IS}) = -3\text{ dB}$			V_{OS} at Any Channel		60	
Total Harmonic Distortion, THD	2 ⁽¹⁾	5	10			0.3%	%
	3 ⁽¹⁾	10	10			0.2%	
	5 ⁽¹⁾	15	10			0.12%	
	$V_{EE} = V_{SS}$, $f_{IS} = 1\text{ kHz}$ Sine Wave						
- 40 dB Feed-through Frequency (All Channels OFF)	5 ⁽¹⁾	10	1	V_{OS} at Common OUT/IN	CD4051-Q1	12	MHz
	$V_{EE} = V_{SS}$, $20\text{Log}(V_{OS}/V_{IS}) = -40\text{ dB}$			V_{OS} at Any Channel		8	MHz
- 40 dB Signal Crosstalk Frequency	5 ⁽¹⁾	10	1			3	MHz
Address-or-Inhibit-to- Signal Crosstalk						65	mV _{PEAK}
	$V_{EE} = 0$, $V_{SS} = 0$, t_r , $t_f = 20\text{ ns}$, mV _{PEAK} $V_{CC} = V_{DD} - V_{SS}$ (Square Wave)					65	mV _{PEAK}

(1) Peak-to-Peak voltage symmetrical about $(V_{DD} - V_{EE}) / 2$.

(2) Both ends of channel.

6.7 Electrical Characteristics - CD4053B-Q1

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER	TEST CONDITIONS					MIN	TYP	MAX	UNIT
	V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP				
SIGNAL INPUTS (V_{IS}) AND OUTPUTS (V_{OS}) - CDIP, PDIP, SOIC and SOP Packages									
Quiescent Device Current, I_{DD} (Max)	0 V	0 V	0 V	5 V	- 55°C			5	μA
					- 40°C			5	
					25°C	0.04		5	
					85°C			150	
					125°C			150	
	0 V	0 V	0 V	10 V	- 55°C			10	
					- 40°C			10	
					25°C	0.04		10	
					85°C			300	
					125°C			300	
	0 V	0 V	0 V	15 V	- 55°C			20	
					- 40°C			20	
					25°C	0.04		20	
					85°C			600	
					125°C			600	
	0 V	0 V	0 V	20 V	- 55°C			100	
					- 40°C			100	
					25°C	18		100	
					85°C			3000	
					125°C			3000	
Drain to Source ON Resistance r_{ON} (Max) $0 \leq V_{IS} \leq V_{DD}$	0 V	0 V	5 V	- 55°C			800	Ω	
				- 40°C			850		
				25°C	470		1050		
				85°C			1200		
				125°C			1300		
	0 V	0 V	10 V	- 55°C			310		
				- 40°C			300		
				25°C	180		400		
				85°C			520		
				125°C			550		
	0 V	0	15 V	- 55°C			200		
				- 40°C			210		
25°C				125		240			
85°C						300			
125°C						300			
Change in ON Resistance (Between Any Two Channels), ΔR_{ON}	0 V	0 V	5 V	25°C			15	Ω	
	0 V	0 V	10 V				10		
	0 V	0 V	15 V				5		

6.7 Electrical Characteristics - CD4053B-Q1 (continued)

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER		TEST CONDITIONS					MIN	TYP	MAX	UNIT
		V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP				
OFF Channel Leakage Current: Any Channel OFF (Max) or ALL Channels OFF (COMMON OUT/IN) (Max)			0 V	0 V	18 V	- 55°C		± 100	nA	
						- 40°C				
						25°C		± 0.01 100 ⁽²⁾		
						85°C		± 1000 ⁽²⁾		
						125°C				
ON Channel Leakage Current: Any Channel ON (Max) or ALL Channels ON (COMMON OUT/IN) (Max)		5 or 0	- 5 V	0 V	10.5 V	85°C		± 300	nA	
							5	0 V		0 V
Capacitance	Input, C_{IS}		0 V	0 V	10 V	25°C		5	pF	
	Output, C_{OS}						CD4053-Q1			9
	Feed-through, C_{IOS}									0.2
Prop Delay		V_{DD}	$R_L = 200\text{ k}\ \Omega$		5 V	25°C		30 60	ns	
			$C_L = 50\text{ pF}$		10 V			15 30		
			$t_r, t_f = 20\text{ ns}$		15 V			10 20		

6.7 Electrical Characteristics - CD4053B-Q1 (continued)

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER		TEST CONDITIONS					MIN	TYP	MAX	UNIT
		V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP				
CONTROL (ADDRESS OR INHIBIT), V_C - CDIP, PDIP, SOIC and SOP Packages										
Input Low Voltage, V_{IL} , (Max)					5 V	- 55°C	1.5		V	
						- 40°C	1.5			
						25°C		1.5		
						85°C	1.5			
						125°C	1.5			
					10 V	- 55°C	3			
						- 40°C	3			
						25°C		3		
						85°C	3			
						125°C	3			
					15 V	- 55°C	4			
						- 40°C	4			
						25°C		4		
						85°C	4			
						125°C	4			
Input High Voltage, V_{IH} , (Min)					5 V	- 55°C	3.5		V	
						- 40°C	3.5			
						25°C	3.5			
						85°C	3.5			
						125°C	3.5			
					10 V	- 55°C	7			
						- 40°C	7			
						25°C	7			
						85°C	7			
						125°C	7			
					15 V	- 55°C	11			
						- 40°C	11			
						25°C	11			
						85°C	11			
						125°C	11			
Input current, I_{IN} (Max)					18 V	- 55°C	± 0.1		μA	
						- 40°C	± 0.1			
						25°C	$\pm 10^{-5} \pm 0.1$			
						85°C	± 1			
						125°C	± 1			
Propagation Delay Time	Address-to-Signal OUT (Channels ON or OFF) (See Figure 7-2 Figure 7-3, and Figure 7-8)	$t_r, t_f = 20\text{ns}$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$	0 V	0 V	5 V		450	720	ns	
			0 V	0 V	10 V		160	320		
			0 V	0 V	15 V		120	240		
			- 5 V	0 V	5 V		225	450		

6.7 Electrical Characteristics - CD4053B-Q1 (continued)

Over operating free-air temperature range, $V_{SUPPLY} = \pm 5\text{ V}$, and $R_L = 100\ \Omega$, (unless otherwise noted)⁽¹⁾

PARAMETER		TEST CONDITIONS					MIN	TYP	MAX	UNIT
		V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	TEMP				
Propagation Delay Time	Inhibit-to-Signal OUT (Channel Turning ON) (See Figure 7-3)	$t_r, t_f = 20\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 1\text{ k}\Omega$	0 V	0 V	5 V		400	720	ns	
			0 V	0 V	10 V		160	320		
			0 V	0 V	15 V		120	240		
			- 10 V	0 V	5 V		200	400		
Propagation Delay Time	Inhibit-to-Signal OUT (Channel Turning OFF) (See Figure 7-10)	$t_r, t_f = 20\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$	0 V	0 V	5 V		200	450	ns	
			0 V	0 V	10 V		90	210		
			0 V	0 V	15 V		90	160		
			- 10 V	0 V	5 V		130	300		
Input Capacitance, C_{IN} (Any Address or Inhibit Input)			- 5 V	0 V	5 V	25°C	5	7.5	pF	

- (1) Peak-to-Peak voltage symmetrical about $(V_{DD} - V_{EE}) / 2$.
(2) Determined by minimum feasible leakage measurement for automatic testing.

6.8 AC Performance Characteristics - CD4053B-Q1

$V_{DD} = +15\text{ V}$, $V_{SS} = V_{EE} = 0\text{ V}$,

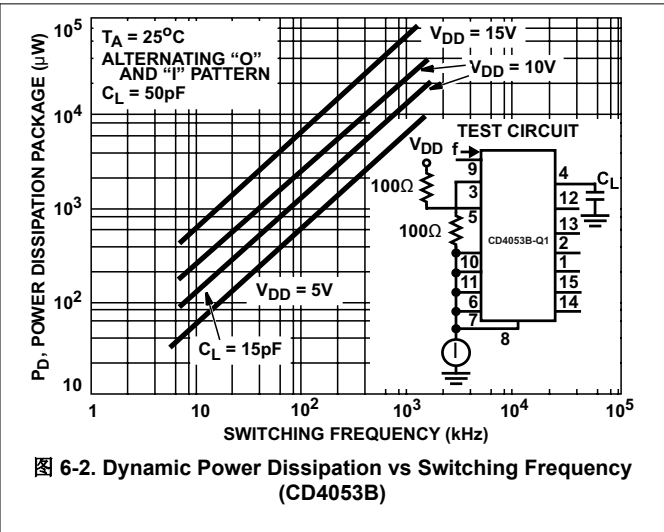
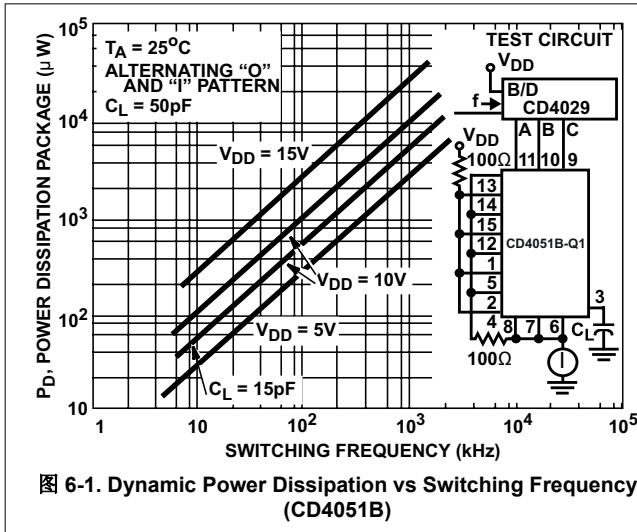
$T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS			TYP	UNIT		
	V_{IS} (V)	V_{DD} (V)	R_L (k Ω)				
Cutoff (- 3 dB) Frequency Channel ON (Sine Wave Input)	5 ⁽¹⁾	10	1	V_{OS} at Common OUT/IN	CD4053-Q1	30	MHz
	$V_{EE} = V_{SS}$, $20\text{Log}(V_{OS}/V_{IS}) = -3\text{ dB}$			V_{OS} at Any Channel		60	
Total Harmonic Distortion, THD	2 ⁽¹⁾	5	10			0.3%	%
	3 ⁽¹⁾	10	10			0.2%	
	5 ⁽¹⁾	15	10			0.12%	
	$V_{EE} = V_{SS}$, $f_{IS} = 1\text{ kHz}$ Sine Wave						
- 40 dB Feed-through Frequency (All Channels OFF)	5 ⁽¹⁾	10	1	V_{OS} at Common OUT/IN	CD4053-Q1	8	MHz
	$V_{EE} = V_{SS}$, $20\text{Log}(V_{OS}/V_{IS}) = -40\text{ dB}$			V_{OS} at Any Channel		8	MHz
- 40 dB Signal Crosstalk Frequency	5 ⁽¹⁾	10	1			3	MHz
	$V_{EE} = V_{SS}$, $20\text{Log}(V_{OS}/V_{IS}) = -3\text{ dB}$			Between Any Two Sections, CD4053-Q1 Only	In Pin 2, Out Pin 14	2.5	MHz
					In Pin 15, Out Pin 14	6	MHz
Address-or-Inhibit-to- Signal Crosstalk		10	10 ⁽²⁾			65	mV _{PEAK}
	$V_{EE} = 0$, $V_{SS} = 0$, t_r , $t_f = 20\text{ ns}$, mV _{PEAK} $V_{CC} = V_{DD} - V_{SS}$ (Square Wave)					65	mV _{PEAK}

(1) Peak-to-Peak voltage symmetrical about $(V_{DD} - V_{EE}) / 2$.

(2) Both ends of channel.

6.9 Typical Characteristics



7 Parameter Measurement Information

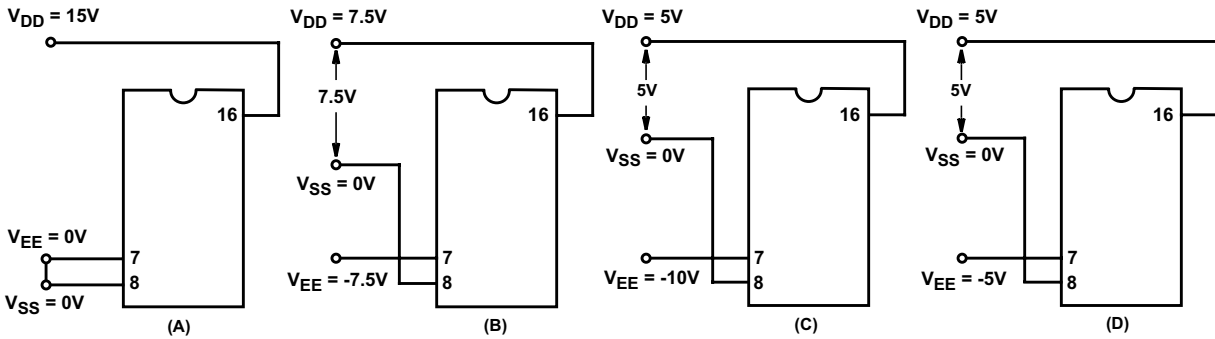


图 7-1. Typical Bias Voltages

备注

The ADDRESS (digital-control inputs) and INHIBIT logic levels are: 0 = V_{SS} and 1 = V_{DD} . The analog signal (through the TG) may swing from V_{EE} to V_{DD} .

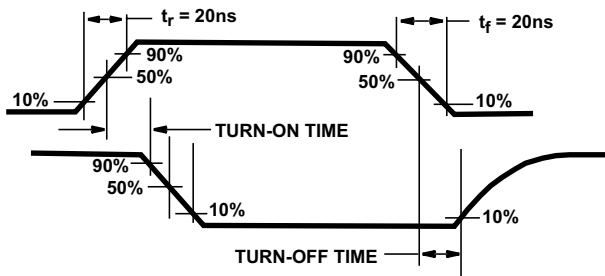


图 7-2. Waveforms, Channel Being Turned ON ($R_L = 1\text{ k}\Omega$)

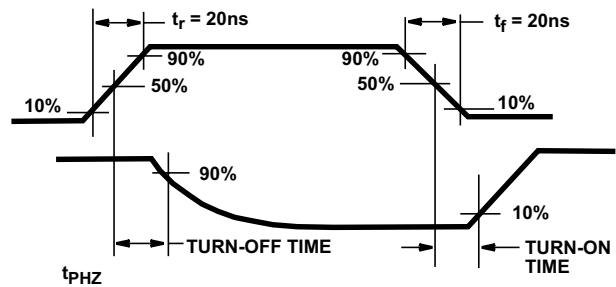


图 7-3. Waveforms, Channel Being Turned OFF ($R_L = 1\text{ k}\Omega$)

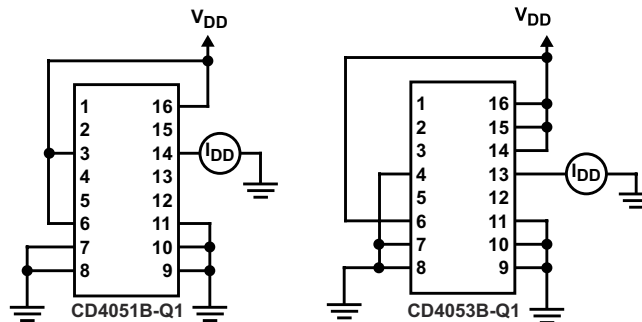


图 7-4. OFF Channel Leakage Current - Any Channel OFF

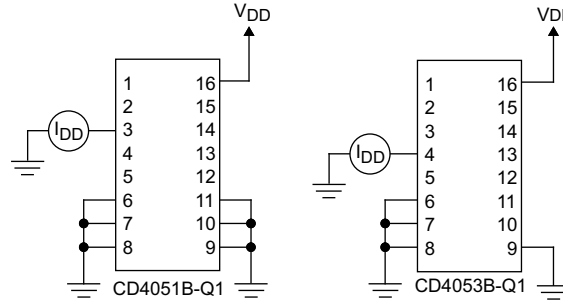


图 7-5. On Channel Leakage Current - Any Channel On

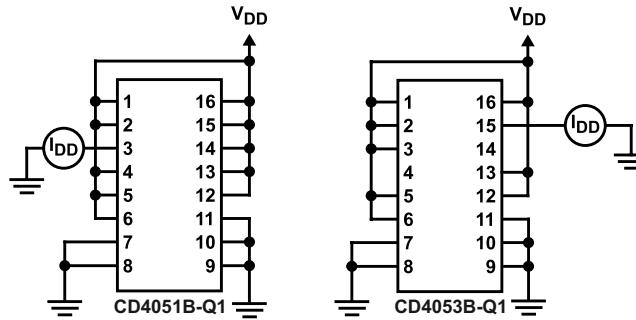


图 7-6. OFF Channel Leakage Current - All Channels OFF

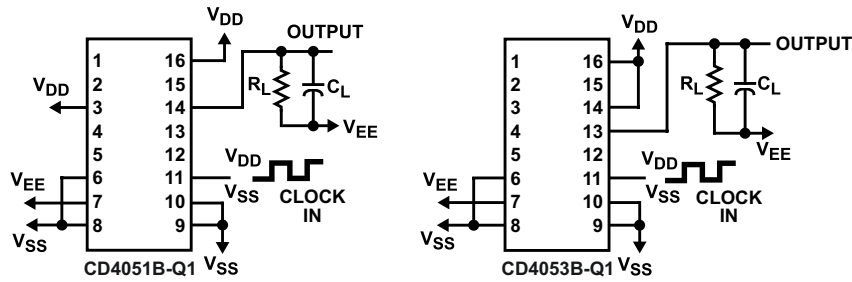


图 7-7. Propagation Delay - Address Input to Signal Output

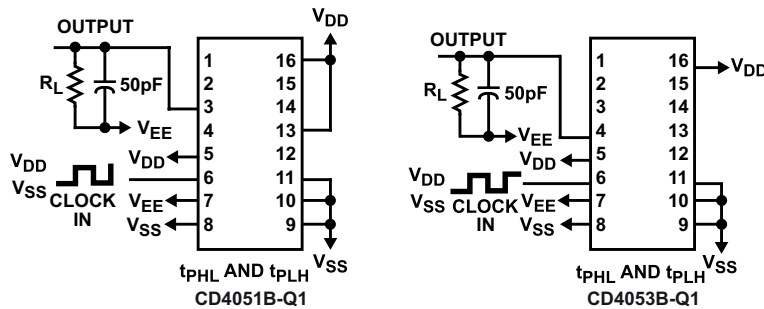
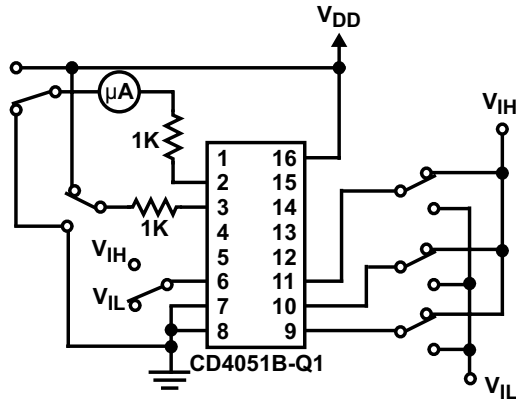
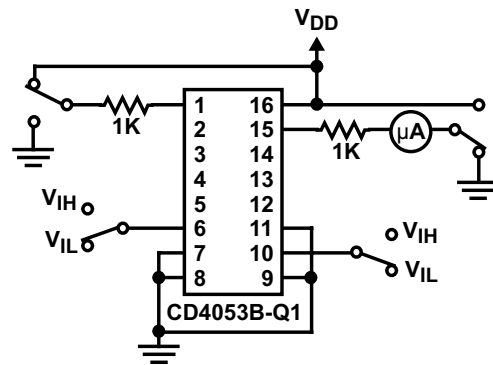


图 7-8. Propagation Delay - Inhibit Input to Signal Output



MEASURE $< 2\mu\text{A}$ ON ALL
"OFF" CHANNELS (e.g., CHANNEL 6)



MEASURE $< 2\mu\text{A}$ ON ALL
"OFF" CHANNELS (e.g., CHANNEL 6)

图 7-9. Input Voltage Test Circuits (Noise Immunity)

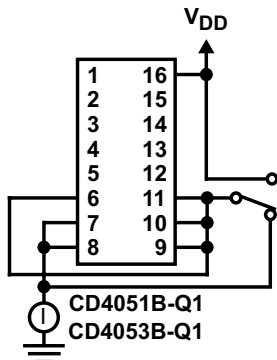


图 7-10. Quiescent Device Current

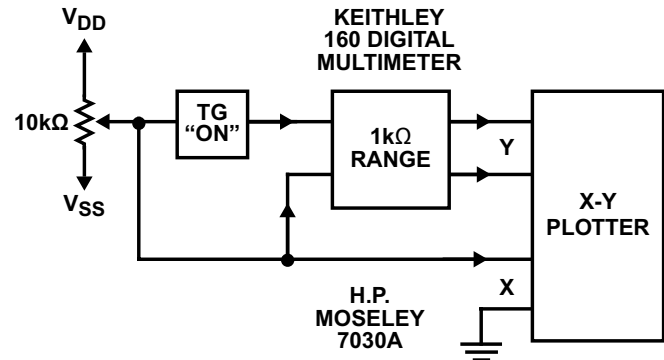
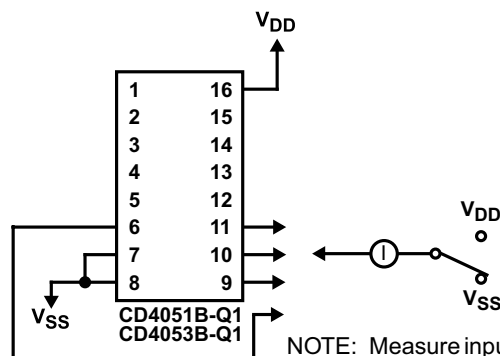


图 7-11. Channel ON Resistance Measurement Circuit



NOTE: Measure inputs sequentially,
to both V_{DD} and V_{SS} connect all
unused inputs to either V_{DD} or V_{SS} .

图 7-12. Input Current

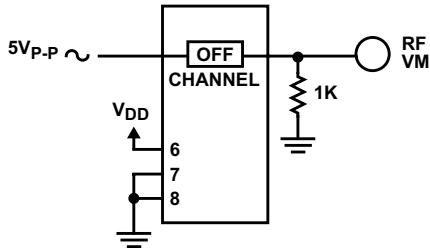


图 7-13. Feed-Through (All Types)

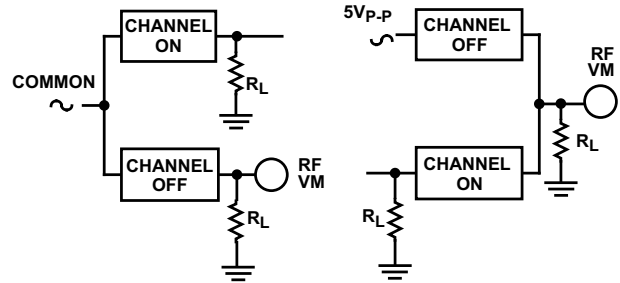


图 7-14. Crosstalk Between Any Two Channels (All Types)



图 7-15. Crosstalk Between Duals or Triplets (CD4053B-Q1)

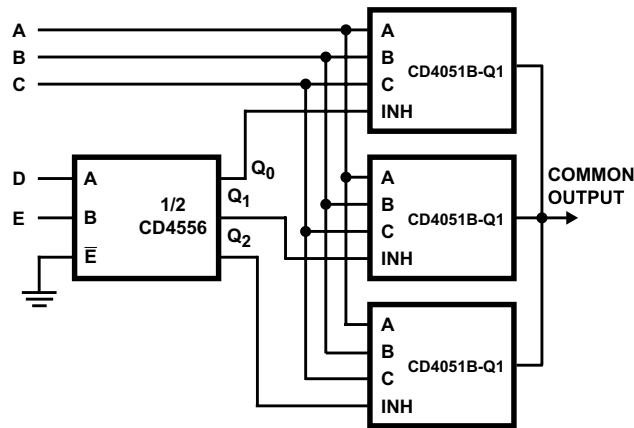


图 7-16. 24-to-1 MUX Addressing

8 Detailed Description

8.1 Overview

The CD4051B-Q1 and CD4053B-Q1 analog multiplexers are digitally-controlled analog switches having low ON impedance and very low OFF leakage current. Control of analog signals up to 20 V_{P-P} can be achieved by digital signal amplitudes of 4.5 V to 20 V (if $V_{DD} - V_{SS} = 3$ V, a $V_{DD} - V_{EE}$ of up to 13 V can be controlled; for $V_{DD} - V_{EE}$ level differences above 13 V, a $V_{DD} - V_{SS}$ of at least 4.5 V is required). For example, if $V_{DD} = +4.5$ V, $V_{SS} = 0$ V, and $V_{EE} = -13.5$ V, analog signals from -13.5 V to $+4.5$ V can be controlled by digital inputs of 0 V to 5 V. These multiplexer circuits dissipate extremely low quiescent power over the full $V_{DD} - V_{SS}$ and $V_{DD} - V_{EE}$ supply-voltage ranges, independent of the logic state of the control signals. When a logic 1 is present at the inhibit input terminal, all channels are off.

The CD4051B-Q1 device is a single 8-channel multiplexer having three binary control inputs, A, B, and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output.

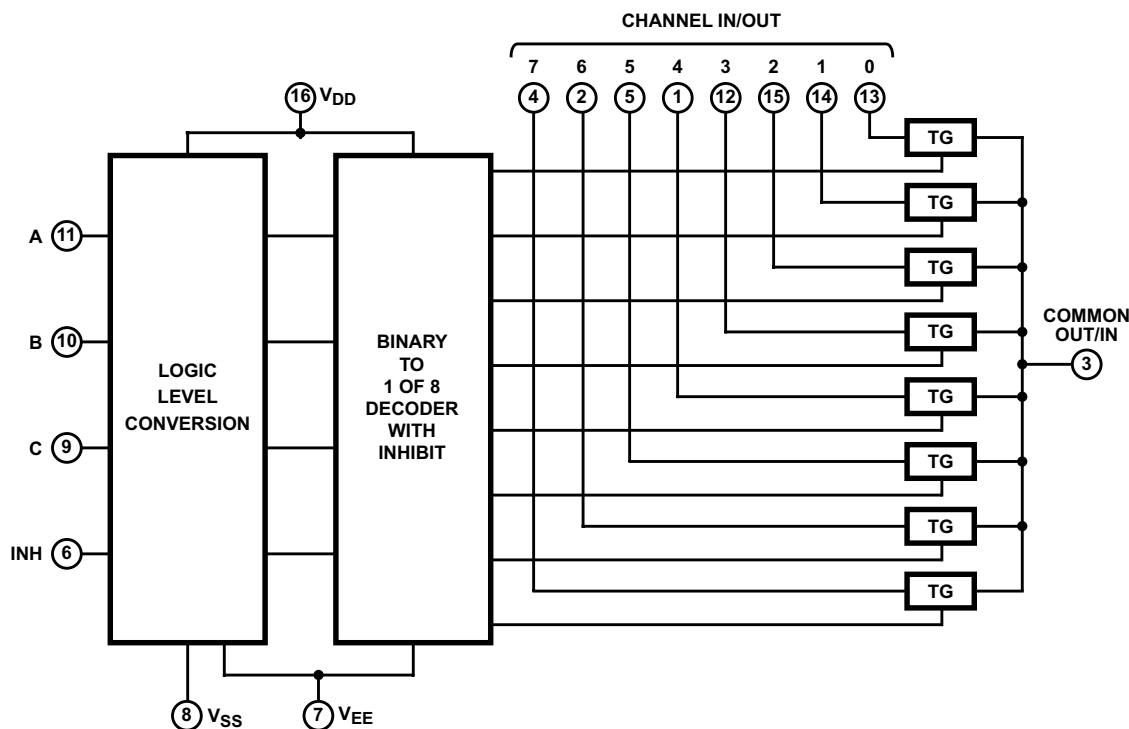
CD4051B-Q1, CD4053B-Q1

ZHCSJL6C - AUGUST 1998 - REVISED MARCH 2023

The CD4053B-Q1 device is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a single-pole, double-throw configuration.

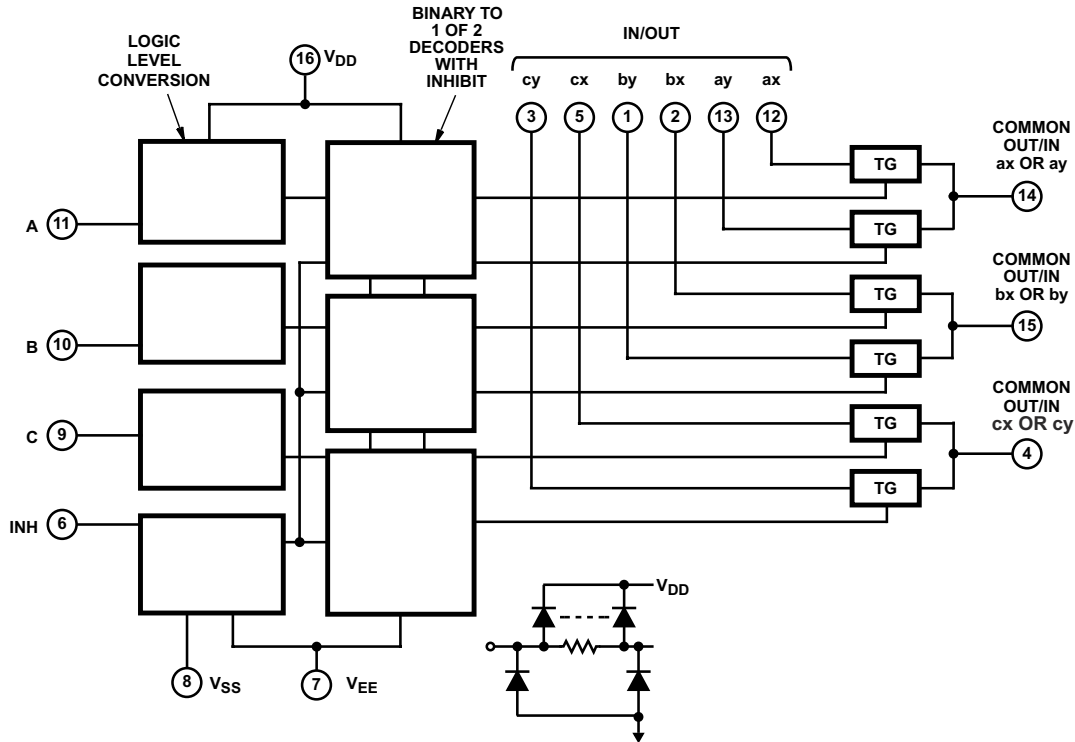
When these devices are used as demultiplexers, the CHANNEL IN/OUT terminals are the outputs and the COMMON OUT/IN terminals are the inputs.

8.2 Functional Block Diagrams



All inputs are protected by standard CMOS protection network.

图 8-1. Functional Block Diagram, CD4051B-Q1



All inputs are protected by standard CMOS protection network.

图 8-2. Functional Block Diagram, CD4053B-Q1

8.3 Feature Description

The CD405xB-Q1 line of multiplexers and demultiplexers can accept a wide range of digital and analog signal levels. Digital signals range from 3 V to 20 V, and analog signals are accepted at levels ≤ 20 V. The devices have low ON resistance, typically 125Ω over 15 V_{P-P} signal input range for $V_{DD} - V_{EE} = 18$ V. This feature allows for very little signal loss through the switch. Matched switch characteristics are typically $r_{ON} = 5 \Omega$ for $V_{DD} - V_{EE} = 15$ V.

The CD405xB-Q1 devices also have high OFF resistance, which keeps from wasting power when the switch is in the OFF position, with typical channel leakage of ± 100 pA at $V_{DD} - V_{EE} = 18$ V. Very low quiescent power dissipation under all digital-control input and supply conditions, typically $0.2 \mu\text{W}$ at $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10$ V keeps power consumption total very low. All devices have been 100% tested for quiescent current at 20 V with maximum input current of $1 \mu\text{A}$ at 18 V over the full package temperature range, and only 100 nA at 18 V and 25°C .

Logic-level conversion for digital addressing signals of 3 V to 20 V ($V_{DD} - V_{SS} = 3$ V to 20 V) to switch analog signals to 20 V_{P-P} ($V_{DD} - V_{EE} = 20$ V). Binary address decoding on chip makes channel selection easy. When channels are changed, a break-before-make system eliminates channel overlap.

8.4 Device Functional Modes

表 8-1. Truth Table⁽¹⁾

INPUT STATES				ON CHANNEL(S)
INHIBIT	C	B	A	
CD4051B-Q1				
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	X	X	X	None
CD4053B-Q1				
L	L	L	L	ay or by or cy
L	H	H	H	ay or by or cy
H	X	X	X	None

(1) X = Do not care

9 Application and Implementation

备注

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

9.1 Application Information

The CD405xB-Q1 multiplexers and demultiplexers can be used for a wide variety of applications.

9.2 Typical Application

One application of the CD4051B-Q1 is to use it in conjunction with a microcontroller to poll a keypad. 图 9-1 shows the basic schematic for such a polling system. The microcontroller uses the channel select pins to cycle through the different channels while reading the input to see if a user is pressing any of the keys. This application is a very robust setup, allowing for multiple simultaneous key-presses with very little power consumption. This setup also uses very few pins on the microcontroller. The down side of polling is that the microcontroller must continually scan the keys for a press and can do little else during this process.

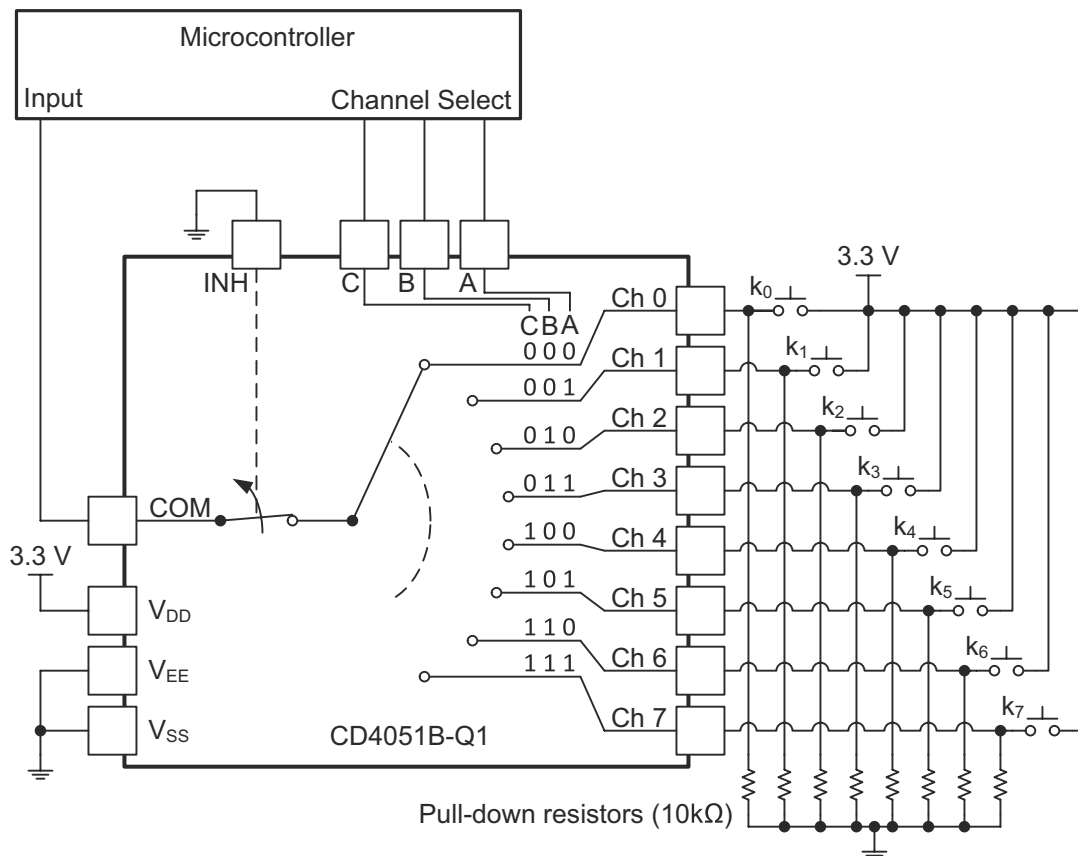


图 9-1. The CD4051B-Q1 Being Used to Help Read Button Presses on a Keypad

9.2.1 Design Requirements

These devices use CMOS technology and have balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads, so routing and load conditions should be considered to prevent ringing.

9.2.2 Detailed Design Procedure

- Recommended Input Conditions:
 - For switch time specifications, see propagation delay times in [Electrical Characteristics](#).
 - Inputs should not be pushed more than 0.5 V above V_{DD} or below V_{EE} .
 - For input voltage level specifications for control inputs, see V_{IH} and V_{IL} in [Electrical Characteristics](#).
- Recommended Output Conditions:
 - Outputs should not be pulled above V_{DD} or below V_{EE} .
- Input or output current consideration:
 - The CD405xB-Q1 series of parts do not have internal current drive circuitry and thus cannot sink or source current. Any current will be passed through the device.

9.2.3 Application Curve

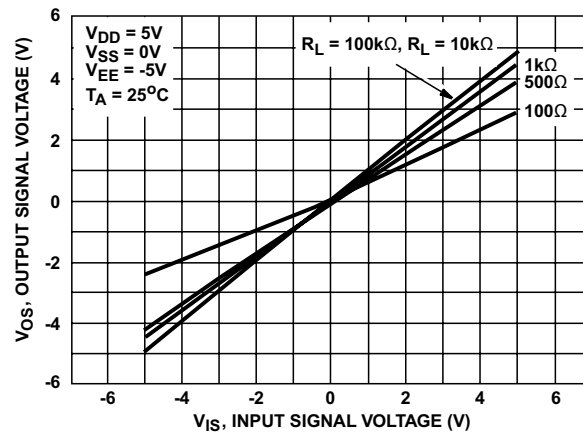


图 9-2. ON Characteristics for 1 of 8 Channels (CD4051B-Q1)

9.3 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Electrical Characteristics](#).

Each V_{CC} terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1- μF bypass capacitor is recommended. If there are multiple pins labeled V_{CC} , then a 0.01- μF or 0.022- μF capacitor is recommended for each V_{CC} because the V_{CC} pins will be tied together internally. For devices with dual supply pins operating at different voltages, for example V_{CC} and V_{DD} , a 0.1- μF bypass capacitor is recommended for each supply pin. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1- μF and 1- μF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

9.4 Layout

9.4.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This reflection is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. 图 9-3 shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

9.4.2 Layout Example

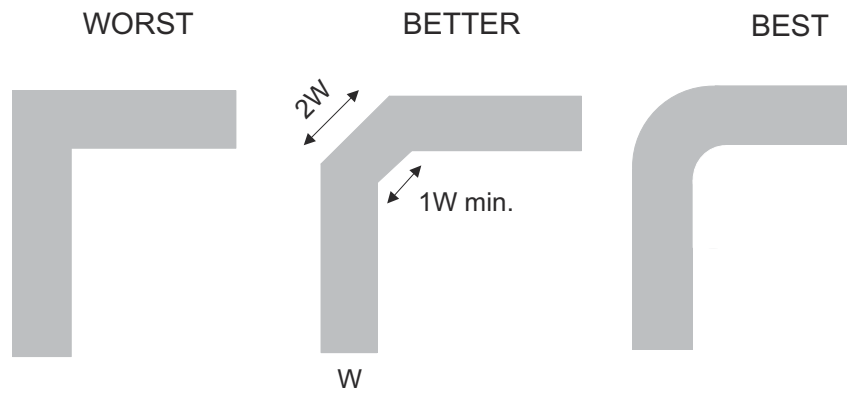


图 9-3. Trace Example

10 Device and Documentation Support

10.1 Documentation Support

10.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [Implications of Slow or Floating CMOS Inputs](#)

10.2 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](https://www.ti.com) 上的器件产品文件夹。点击 [订阅更新](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

10.3 支持资源

[TI E2E™ 支持论坛](#) 是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [《使用条款》](#)。

10.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

10.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

10.6 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD4051BQPWRQ1	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CM051BQ	Samples
CD4053BQM96G4Q1	NRND	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CD4053Q	
CD4053BQM96Q1	NRND	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	CD4053Q	

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF CD4051B-Q1, CD4053B-Q1 :

- Catalog : [CD4051B](#), [CD4053B](#)
- Military : [CD4051B-MIL](#), [CD4053B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4051BQPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4051BQPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4051BQPWRQ1	TSSOP	PW	16	2000	367.0	367.0	35.0
CD4051BQPWRQ1	TSSOP	PW	16	2000	367.0	367.0	35.0

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.



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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

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NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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