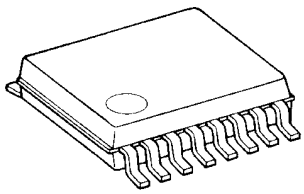
Preliminary TOSHIBA CMOS Digital Integrated Circuit Sillicon Monolithic

TC7MZ4051FK, TC7MZ4052FK, TC7MZ4053FK

TC7MZ4051FK 8-Channel Analog Multiplexer/Demultiplexer

TC7MZ4052FK Dual 4-Channel Analog Multiplexer/Demultiplexer

TC7MZ4053FK Triple 2-Channel Analog Multiplexer/Demultiplexer



VSSOP16-P-0030-0.50

Weight: 0.02 g (typ.)

The TC7MZ4051/4052/4053FK are high-speed, low-voltage drive analog multiplexer/demultiplexers using silicon gate CMOS technology. In 3 V and 5 V systems these can achieve high-speed operation with the low power dissipation that is a feature of CMOS.

The TC7MZ4051/4052/4053FK offer analog/digital signal selection as well as mixed signals. The 4051 has an 8-channel configuration, the 4052 has an 4-channel × 2 configuration, and the 4053 has a 2-channel × 3 configuration.

The switches for each channel are turned ON by the control pin digital signals.

Although the control signal logical amplitude (V_{CC} – GND) is small, the device can perform large-amplitude (V_{CC} – V_{EE}) signal switching.

For example, if V_{CC} = 3 V, GND = 0 V, and V_{EE} = –3 V, signals between –3 V and +3 V can be switched from the logical circuit using a single 3 V power supply.

All input pins are equipped with a newly developed input protection circuit that avoids the need for a diode on the plus side (forward side from the input to the V_{CC}). As a result, for example, 5 V signals can be permitted on the inputs even when the power supply voltage to the circuits is off. As a result of this input power protection, the TC7MZ4051/4052/4053FK can be used in a variety of applications, including in the system which has two power supplies, and in battery backup circuits.

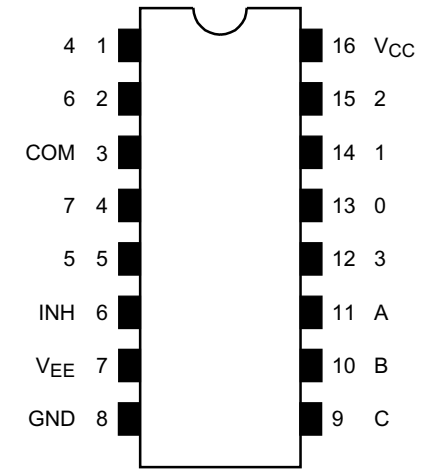
Features

- Low ON resistance: R_{on} = 65 Ω (typ.) (V_{CC} – V_{EE} = 3 V)
  R_{on} = 45 Ω (typ.) (V_{CC} – V_{EE} = 6 V)
- High speed: t_{pd} = 5 ns (typ.) (V_{CC} = 3.0 V)
- Low power dissipation: I_{CC} = 4 μA (max) (Ta = 25°C)
- Input level: V_{IL} = 0.8 V (max) (V_{CC} = 3 V)
  V_{IH} = 2.0 V (min) (V_{CC} = 3 V)
- Power down protection is provided on all control inputs
- Pin and function compatible with 74HC4051/4052/4053

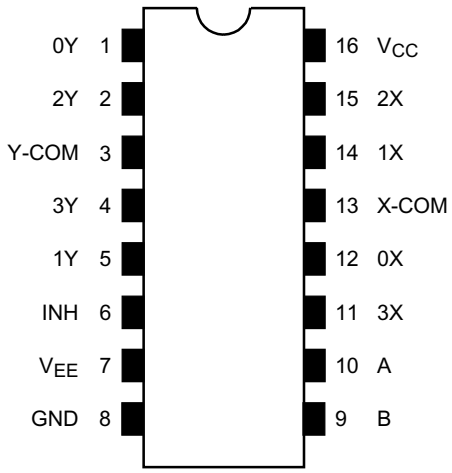
980910EBA1

Pin Assignment (top view)

TC7MZ4051FK



TC7MZ4052FK



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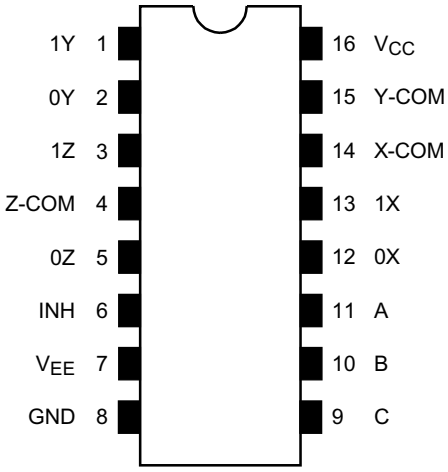


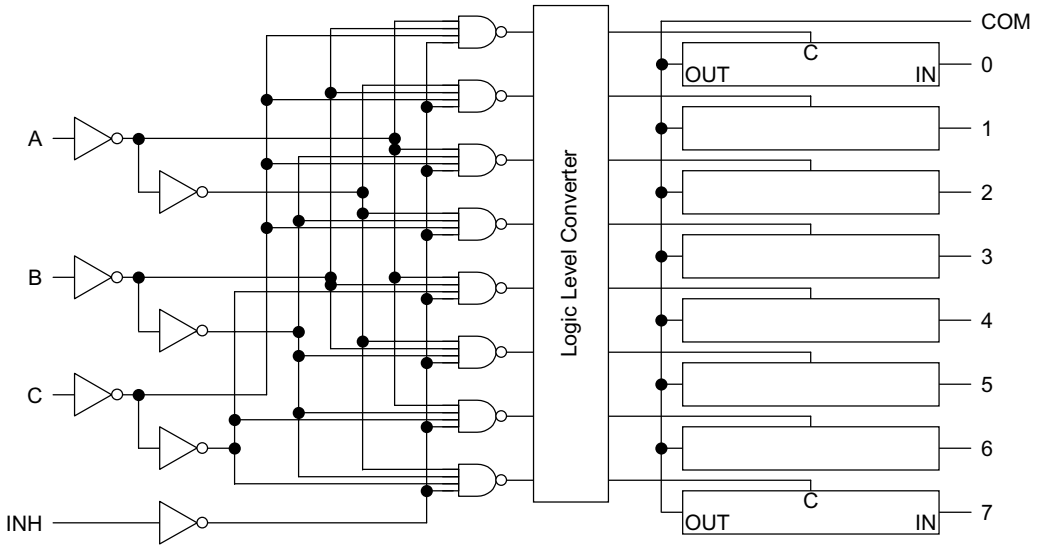
Truth Table

Control Inputs				"ON" Channel		
Inhibit	C*	B	A	MZ4051	MZ4052	MZ4053
L	L	L	L	0	0X, 0Y	0X, 0Y, 0Z
L	L	L	H	1	1X, 1Y	1X, 0Y, 0Z
L	L	H	L	2	2X, 2Y	0X, 1Y, 0Z
L	L	H	H	3	3X, 3Y	1X, 1Y, 0Z
L	H	L	L	4	—	0X, 0Y, 1Z
L	H	L	H	5	—	1X, 0Y, 1Z
L	H	H	L	6	—	0X, 1Y, 1Z
L	H	H	H	7	—	1X, 1Y, 1Z
H	X	X	X	None	None	None

X: Don't care, *: Except MZ4052

System Diagram

TC7MZ4051FK



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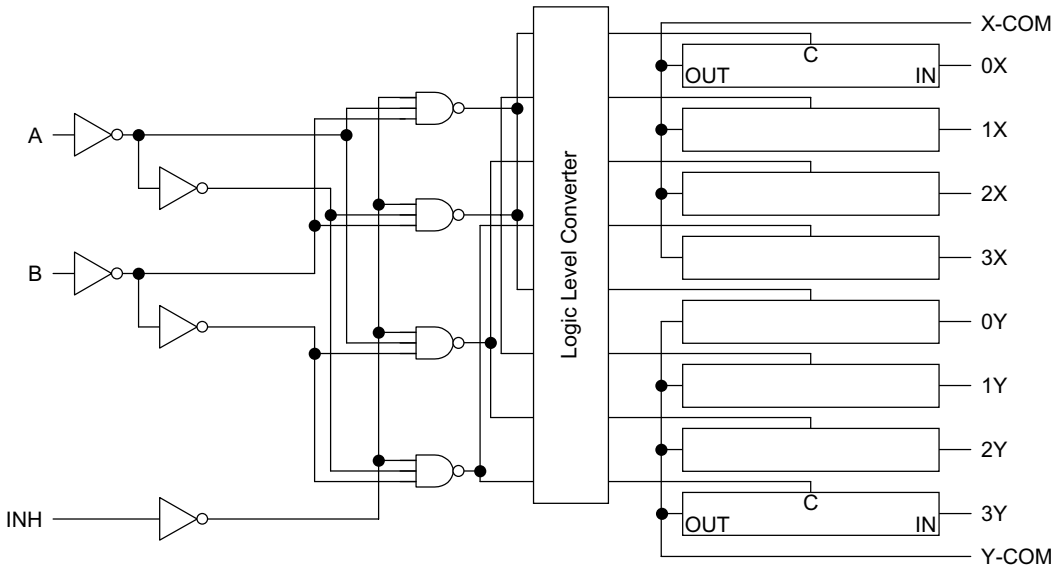

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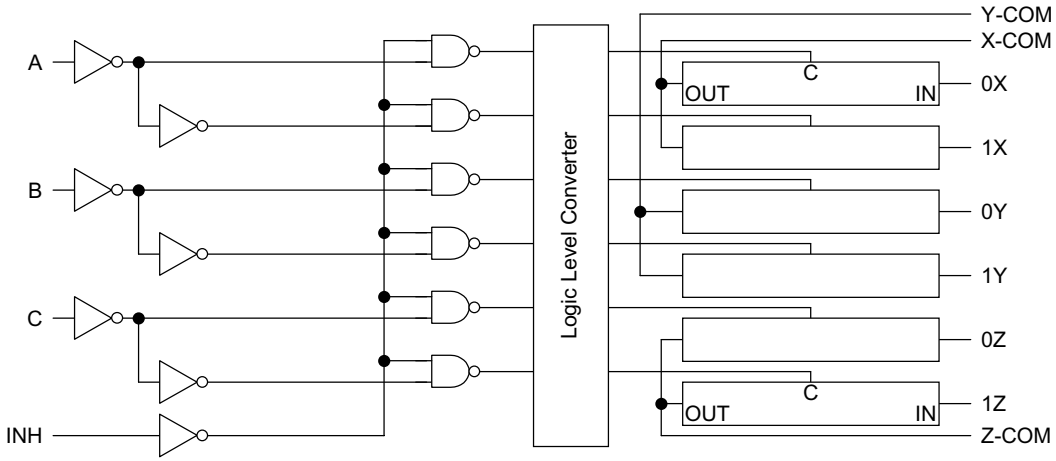


Absolute Maximum Ratings

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	−0.5~7.0	V
	V_{CC}~V_{EE}	−0.5~7.0	
Control input voltage	V_{IN}	−0.5~7.0	V
Switch I/O voltage	$V_{I/O}$	V_{EE} − 0.5~V_{CC} + 0.5	V
Input diode current	I_{IK}	−20	mA
I/O diode current	I_{IOK}	±20	mA
Switch through current	I_T	±25	mA
DC V_{CC} or ground current	I_{CC}	±50	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	−65~150	°C

Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2~6	V
	V_{EE}	−4~0	
	V_{CC}~V_{EE}	2~6	
Input voltage	V_{IN}	0~6.0	V
Switch I/O voltage	$V_{I/O}$	V_{EE}~V_{CC}	V
Operating temperature	T_{opr}	−40~85	°C
Input rise and fall time	dt/dv	0~100	ns/V

Electrical Characteristics

DC Electrical Characteristics

Characteristics		Symbol	Test Condition			Ta = 25°C			Ta = −40~85°C		Unit
				V_{EE} (V)	V_{CC} (V)	Min	Typ.	Max	Min	Max	
Input voltage	High-level	V_{IH}	—		2.0	1.5	—	—	1.5	—	V
					3.0	2.0	—	—	2.0	—	
					6.0	4.2	—	—	4.2	—	
	Low-level	V_{IL}	—		2.0	—	—	0.5	—	0.5	
					3.0	—	—	0.8	—	0.8	
					6.0	—	—	1.8	—	1.8	
ON resistance		R_{ON}	V_{IN} = V_{IL} or V_{IH} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O}$ = 2 mA	GND	3.0	—	—	150	—	180	Ω
				−3.0	3.0	—	—	100	—	125	
			V_{IN} = V_{IL} or V_{IH} $V_{I/O}$ = V_{CC} or V_{EE} $I_{I/O}$ = 2 mA	GND	2.0	—	—	—	—	—	
				GND	3.0	—	50	120	—	150	
				−3.0	3.0	—	30	80	—	100	
Difference of ON resistance between switches		ΔR_{ON}	V_{IN} = V_{IL} or V_{IH} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O}$ = 2 mA	GND	2.0	—	10	—	—	—	Ω
				GND	3.0	—	5	15	—	20	
				−3.0	3.0	—	5	10	—	15	
Input/Output leakage current (switch OFF)		I_{OFF}	V_{OS} = V_{CC} or GND V_{IS} = GND to V_{CC} V_{IN} = V_{IL} or V_{IH}	GND	3.0	—	—	±0.25	—	±2.5	μA
				−3.0	3.0	—	—	±0.5	—	5.0	
Input/Output leakage current (switch ON, output open)		I_{IN}	V_{OS} = V_{CC} or GND V_{IN} = V_{IL} or V_{IH}	GND	3.0	—	—	±0.25	—	±2.5	μA
				−3.0	3.0	—	—	±0.5	—	±5.0	
Control input current		I_{IN}	V_{IN} = V_{CC} or GND	GND	6.0	—	—	±0.1	—	±0.1	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND	GND	3.0	—	—	4.0	—	40.0	μA
				−3.0	3.0	—	—	8.0	—	80.0	

AC Electrical Characteristics (CL = 50 pF, Input: $t_r = t_f = 3$ ns, GND = 0 V)

Characteristics	Symbol	Test Condition		V_{EE} (V)	V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40~85°C Min	Ta = −40~85°C Max	Unit
Phase difference between input and output	ϕI/O	All types		GND	2.0	—	10		—		ns
				GND	3.0	—	5		—		
				GND	4.5	—	4		—		
				−3.0	3.0	—	3		—		
Output enable time	t_{pZL} t_{pZH}	4051	Figure 1, Figure 5 (Note1)	GND	2.0	—			—		ns
				GND	3.0	—	8		—		
				GND	4.5	—			—		
				−3.0	3.0	—			—		
		4052	Figure 1, Figure 5 (Note1)	GND	2.0	—			—		
				GND	3.0	—	8		—		
				GND	4.5	—			—		
				−3.0	3.0	—			—		
		4053	Figure 1, Figure 5 (Note1)	GND	2.0	—			—		
				GND	3.0	—	6		—		
				GND	4.5	—			—		
				−3.0	3.0	—			—		
Output disable time	t_{pLZ} t_{pHZ}	4051	Figure 1, Figure 5 (Note1)	GND	2.0	—			—		ns
				GND	3.0	—	10		—		
				GND	4.5	—			—		
				−3.0	3.0	—			—		
		4052	Figure 1, Figure 5 (Note1)	GND	2.0	—			—		
				GND	3.0	—	10		—		
				GND	4.5	—			—		
				−3.0	3.0	—			—		
		4053	Figure 1, Figure 5 (Note1)	GND	2.0	—			—		
				GND	3.0	—	9		—		
				GND	4.5	—			—		
				−3.0	3.0	—			—		
Control input capacitance	C_{in}	All types	(Note2)	—	—	—					pF
COMMON terminal capacitance	C_{IS}	4051 4052 4053	Figure 2 (Note2)	−3.0	3.0	—	TBD	—	—	—	pF
SWITCH terminal capacitance	C_{OS}	4051 4052 4053	Figure 2 (Note2)	−3.0	3.0	—	TBD	—	—	—	pF
Feedthrough capacitance	C_{IOS}	4051 4052) 4053	Figure 2 (Note2)	−3.0	3.0	—	TBD	—	—	—	pF
Power dissipation capacitance	C_{PD}	4051 4052 4053	Figure 2 (Note2)	GND	6.0	—	TBD	—	—	—	pF

Note1: $R_L = 500\ \Omega$

Note2: C_{in}, C_I, C_{OS} and C_{IOS} are guaranteed by the design.

Note3: C_{PD} is defined as the value of the internal equivalent capacitance of IC which is calculated from the operating current can be obtained by the equiation:

$$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

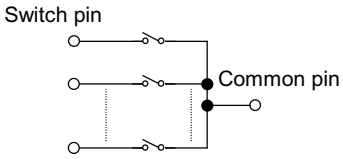
Analog Switch Characteristics (GND = 0 V, Ta = 25°C)

Characteristics	Symbol	Test Condition		V_{EE} (V)	V_{CC} (V)	Typ.	Unit
Frequency response (switch ON)	f_{max}	Adjust V_{IN} so that the output is 0 dBm. Now measure the frequency when the output drops −3 dB. R_L = 50 Ω, C_L = 10 pF, f_{IN} = 1 MHz, sine wave Figure 3	All (Note4)	−3.0	3.0		MHz
			4051 4052 (Note5) 4053				
Crosstalk (between any switches)		Measure the leak voltage when V_{IN} is adjusted so that the input is 0 dBm. R_L = 600 Ω, C_L = 50 pF, f_{IN} = 1 MHz, sine wave Figure 4		−3.0	3.0	−50	dB

Note4: Input COMMON terminal, and measured at SWITCH terminal.

Note5: Input SWITCH terminal, and measured at COMMON terminal.

∗: These characterictics are determined by design of devices.



AC Test Circuit

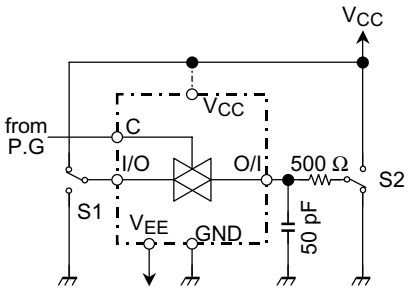


Figure 1 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

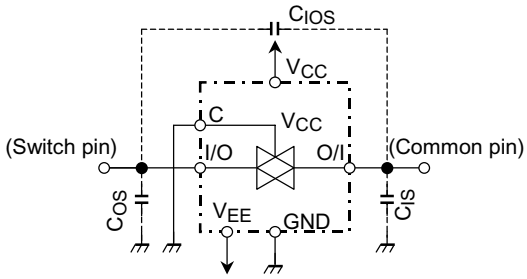


Figure 2 C_{IOS}, C_{IS}, C_{OS}

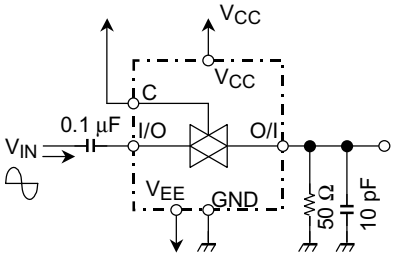


Figure 3 Frequency Response (switch on)

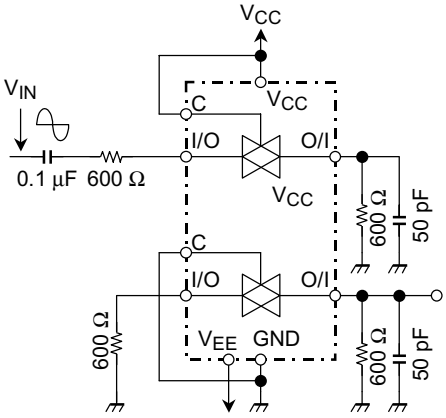


Figure 4 Cross Talk (between any two switches)

AC Waveform

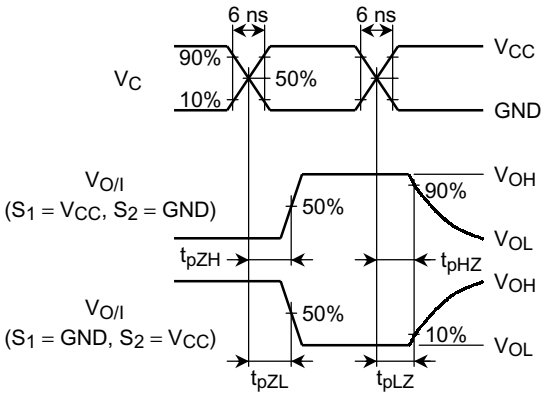
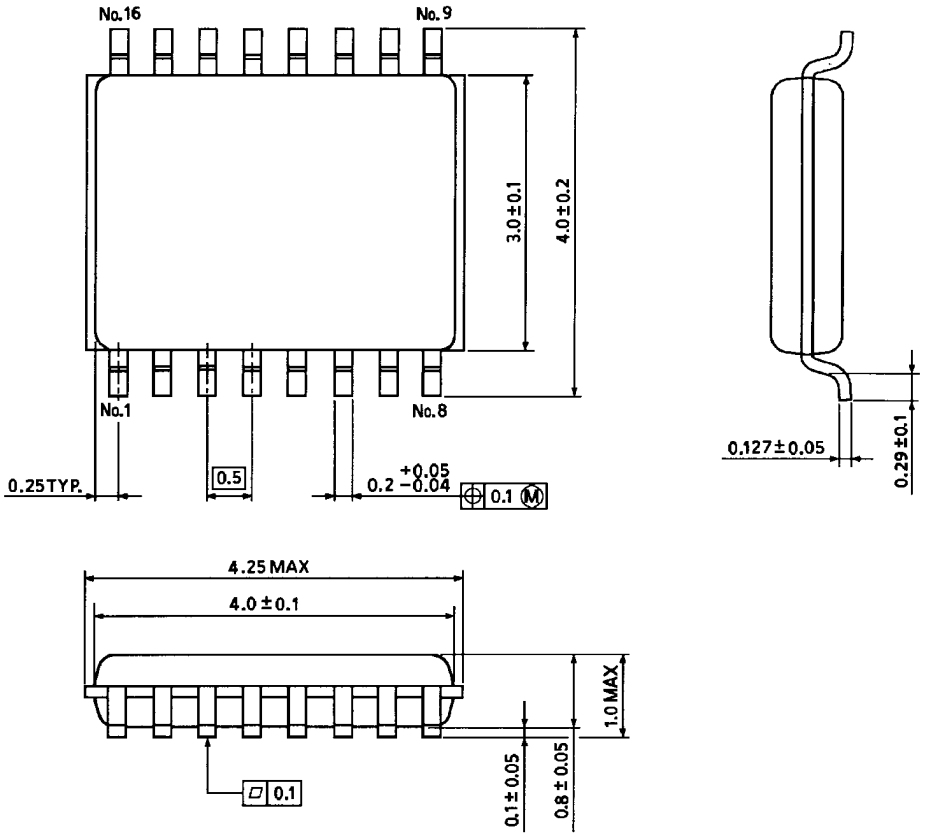


Figure 5 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

Package Dimensions

VSSOP16-P-0030-0.50 Unit : mm



Weight: 0.02 g (typ.)