TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC7W53F, TC7W53FU, TC7W53FK

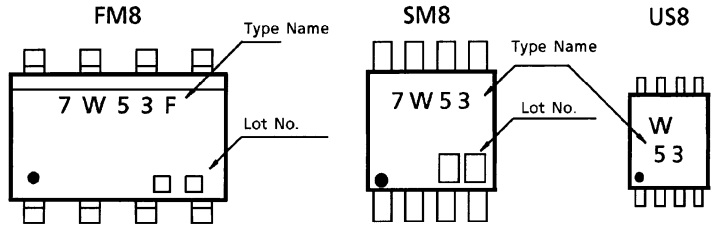
2-CHANNEL MULTIPLEXER / DEMULTIPLEXER

The TC7W53 is a high speed CMOS ANALOG MULTIPLEXER / DEMULTIPLEXER fabricated with silicon gate CMOS technology.
They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.
The TC7W53 has a 2 channel configuration.
The digital signal to the control terminal turns "ON" the corresponding switch of each channel a large amplitude signal (V_{CC}-V_{EE}) can then be switched by the small logical amplitude (V_{CC}-GND) control signal.
For example, in the case of V_{CC} = 5V, GND = 0V, V_{EE} = 5V, signals between −5V and +5V can be switched from the logical circuit with a single power supply of 5V. As the ON-resistance of each switch is low, they can be connected to circuit with low input impedance.
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

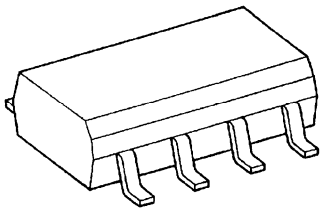
FEATURES

- High Speed ····· t_{pd} = 15ns (Typ.) at V_{CC} = 5V, V_{EE} = 0V
- Low Power Dissipation ····· I_{CC} = 4μA (Max.) at Ta = 25°C
- High Noise Immunity ····· $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Low ON Resistance ····· R_{ON} = 50Ω (Typ.) at V_{CC}-V_{EE} = 9V
- High Degree of Linearity ····· THD = 0.02 (Typ.) at V_{CC}-V_{EE} = 9V
- Pin and Function Compatible with TC4W53

MARKING

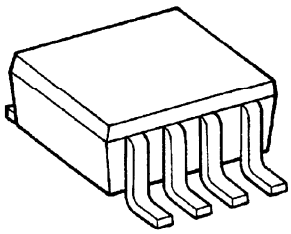


TC7W53F



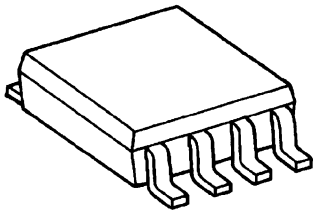
SOP8-P-1.27

TC7W53FU



SSOP8-P-0.65

TC7W53FK



SSOP8-P-0.50A

Weight
SOP8-P-1.27 : 0.05g (Typ.)
SSOP8-P-0.65 : 0.02g (Typ.)
SSOP8-P-0.50A : 0.01g (Typ.)

MAXIMUM RATINGS (Ta = 25°C)

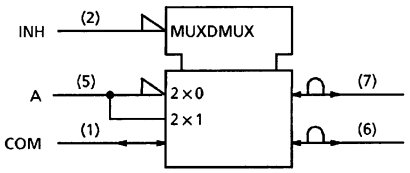
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage Range	V_{CC}	−0.5~7	V
	V_{CC}~V_{EE}	−0.5~13	
Control Input Voltage	V_{IN}	−0.5~V_{CC}+0.5	V
Switch I/O Voltage	$V_{I/O}$	V_{EE}−0.5~V_{CC}+0.5	V
Control Input Diode Current	I_{CK}	±20	mA
I/O Diode Current	I_{IOK}	±20	mA
Switch Through Current	I_T	±25	mA
DC V_{CC}/GND Current	I_{CC}	±25	mA
Power Dissipation	P_D	300 (FM8, SM8)	mW
		200 (US8)	
Storage Temperature	T_{stg}	−65~150	°C
Lead Temperature (10 s)	T_L	260	°C

TRUTH TABLE

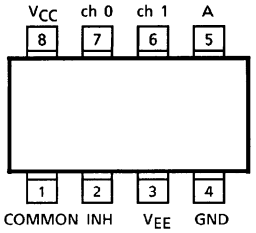
CONTROL INPUT		ON CHANNEL
INH	A	
L	L	ch 0
L	H	ch 1
H	×	NONE

× : Don't care

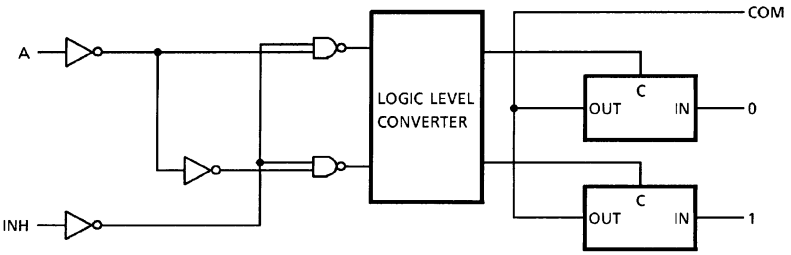
LOGIC SYMBOL



PIN ASSIGNMENT (TOP VIEW)



LOGIC DIAGRAM



RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	2~6	V
	V_{EE}	−6~0	V
	V_{CC}~V_{EE}	2~12	V
Control Input Voltage	V_{IN}	0~V_{CC}	V
Switch I/O Voltage	$V_{I/O}$	0~V_{CC}	V
Operating Temperature	T_{opr}	−40~85	°C
Input Rise and Fall Time	t_r, t_f	0~1000 (V_{CC} = 2.0V)	ns
		0~500 (V_{CC} = 4.5V)	
		0~400 (V_{CC} = 6.0V)	

DC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL		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
High-Level Control Input Voltage	V_{IHC}			2.0	1.5	—	—	1.5	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.2	—	—	4.2	—	
Low-Level Control Input Voltage	V_{ILC}			2.0	—	—	0.5	—	0.5	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.8	—	1.8	
ON Resistance	R_{ON}	V_{IN} = V_{IHC}, $V_{I/O}$ = V_{CC} to GND, $V_{I/O} \leqq$ 2mA	GND	4.5	—	85	180	—	225	Ω
			−4.5	4.5	—	55	120	—	150	
			−6.0	6.0	—	50	100	—	125	
		V_{IN} = V_{IHC}, $V_{I/O}$ = V_{CC} or GND, $V_{I/O} \leqq$ 2mA	GND	2.0	—	150	—	—	—	
			GND	4.5	—	70	150	—	190	
			−4.5	4.5	—	50	100	—	125	
			−6.0	6.0		45	80	—	100	
Difference of ON Resistance Between Switches	ΔR_{ON}	V_{IN} = V_{IHC}, $V_{I/O}$ = V_{CC} to GND, $V_{I/O} \leqq$ 2mA	GND	4.5	—	10	30	—	35	Ω
			−4.5	4.5	—	5	12	—	15	
			−6.0	6.0	—	5	10	—	12	
Input/Output Leakage Current (SWITCH OFF)	I_{OFF}	V_{OS} = GND, V_{IS} = GND to V_{CC}, V_{IN} = V_{ILC} or V_{IHC}	GND	6.0	—	—	±60	—	±600	nA
			−6.0	6.0			±100	—	±1000	
Switch Input Leakage Current (SWITCH ON OUTPUT OPEN)	I_{IZ}	V_{OS} = V_{CC} or GND, V_{IN} = V_{ILC} or V_{IHC}	GND	6.0	—	—	±60	—	±600	nA
			−6.0	6.0			±100	—	±1000	
Control Input Current	I_{IN}	V_{IN} = V_{CC} or GND	GND	6.0	—	—	±0.1	—	±1.0	μA
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND	GND	6.0	—	—	4	—	40	μA
			−6.0	6.0	—	—	8	—	80	

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input $t_r = t_f$ = 6ns, GND = 0V)

CHARACTERISTIC		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		GND	2.0	—	25	60	—	75	ns
			GND	4.5	—	6	12	—	15	
			GND	6.0	—	5	10	—	13	
			−4.5	4.5	—	4	—	—	—	
Output Enable Time	t_{pZL} t_{pZH}	R_L = 1kΩ	GND	2.0	—	50	225	—	280	ns
			GND	4.5	—	14	45	—	56	
			GND	6.0	—	12	38	—	48	
			−4.5	4.5	—	14	—	—	—	
Output Disable Time	t_{pLZ} t_{pHZ}	R_L = 1kΩ	GND	2.0	—	95	225	—	280	ns
			GND	4.5	—	30	45	—	56	
			GND	6.0	—	26	38	—	48	
			−4.5	4.5	—	26	—	—	—	
Control Input Capacitance	C_{IN}		—	—	—	5	10	—	10	pF
Common Terminal Capacitance	C_{IS}		−5.0	5.0	—	11	20	—	20	pF
Switch Terminal Capacitance	C_{OS}		−5.0	5.0	—	7	15	—	15	pF
Feed Through Capacitance	C_{IOS}		−5.0	5.0	—	0.75	2	—	2	pF
Power Dissipation Capacitance	C_{PD}	(Note 1)	GND	5.0	—	67	—	—	—	pF

(Note 1) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation :

$$I_{CC\,(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2$$

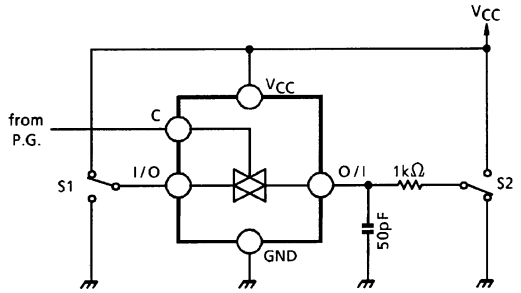
ANALOG SWITCH CHARACTERISTICS (GND = 0V, Ta = 25°C)

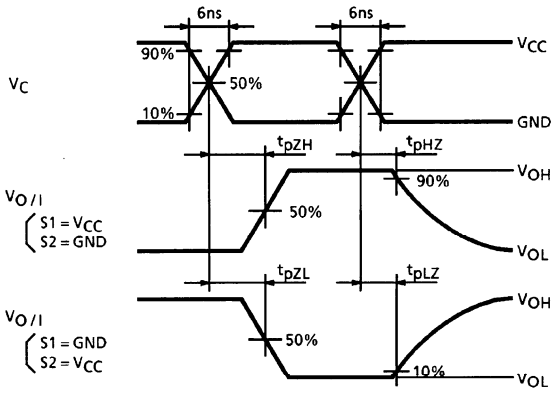
CHARACTERISTIC		TEST CONDITION		V_{EE} (V)	V_{CC} (V)	TYP.	UNIT
Sine Wave Distortion (T.H.D)		$R_L = 10k\Omega$, $C_L = 50pF$, $f_{IN} = 1kHz$	$V_{IN} = 4.0V_{p-p}$	−2.25	2.25	0.025	%
			$V_{IN} = 8.0V_{p-p}$	−4.5	4.5	0.02	
			$V_{IN} = 11\ V_{p-p}$	−6.0	6.0	0.018	
Frequency Response (Switch ON)	f_{MAX}	Adjust f_{IN} voltage to obtain 0dBm at V_{OS} Increase f_{IN} until dB Meter reads −3dB, $R_L = 50\Omega$, $C_L = 10pF$, $f_{IN} = 1MHz$, Sine Wave	*1	−2.25	2.25	120	MHz
			*2			95	
			*1	−4.5	4.5	190	
			*2			150	
			*1	−6.0	6.0	200	
			*2			190	
Feedthrough Attenuation (Switch OFF)		Vin is centered at $(V_{CC}-V_{EE})/2$, Adjust input for 0dBm, $R_L = 600\Omega$, $C_L = 50pF$, $f_{IN} = 1MHz$, Sine Wave		−2.25	2.25	−50	dB
				−4.5	4.5	−50	
				−6.0	6.0	−50	
Crosstalk (Control Input to Signal Output)		$R_L = 600\Omega$, $C_L = 50pF$, $f_{IN} = 1MHz$, Square Wave ($t_r = t_f = 6ns$)		−2.25	2.25	60	mV
				−4.5	4.5	140	
				−6.0	6.0	200	
Crosstalk (Between any switches)		Adjust V_{IN} to obtain 0dBm at Input, $R_L = 600\Omega$, $C_L = 50pF$, $f_{IN} = 1MHz$, Sine Wave		−2.25	2.25	−50	dB
				−4.5	4.5	−50	
				−6.0	6.0	−50	

*1 : Input COMMON Terminal, and measured at SWITCH Terminal.
*2 : Input SWITCH Terminal, and measured at COMMON Terminal.
(Note): These characteristics are determined by design of device.

SWITCHING CHARACTERISTICS TEST CIRCUITS

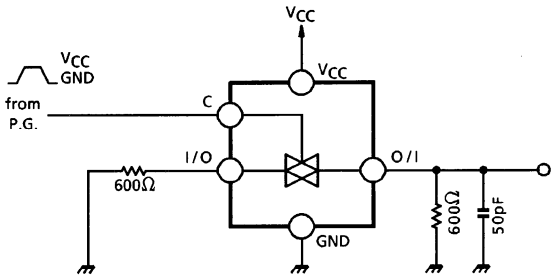
1. t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}



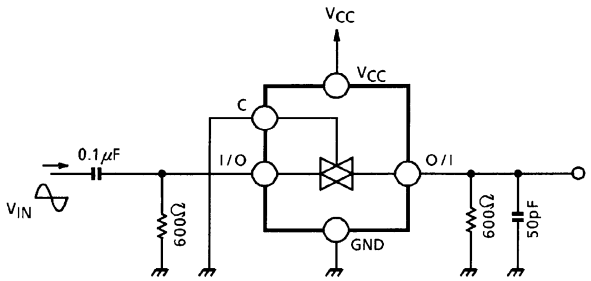


2. CROSS TALK (CONTROL INPUT-SWITCH OUTPUT)

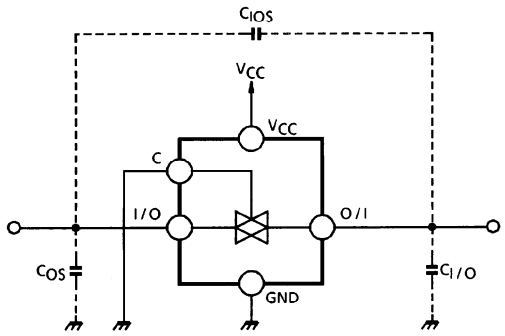
fin = 1MHz, duty = 50%, $t_r = t_f$ = 6ns



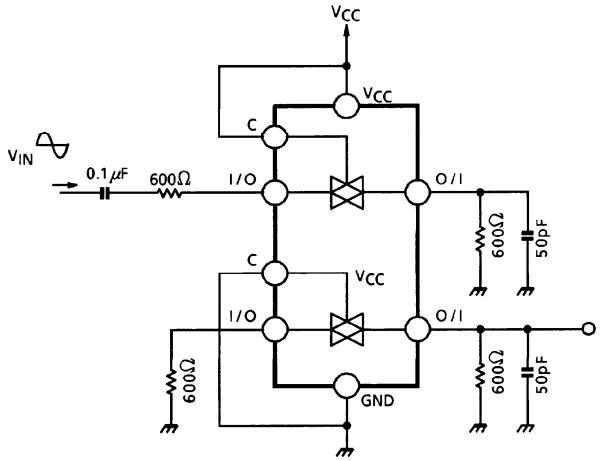
3. FEEDTHROUGH ATTENUATION



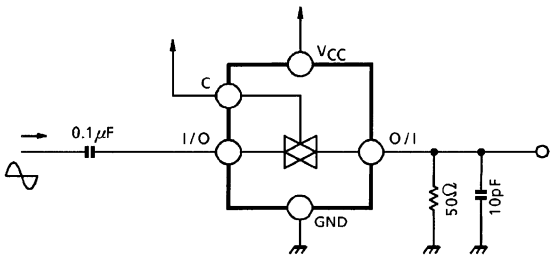
4. Clos, $C_{I/O}$



5. CROSS TALK (BETWEEN ANY TWO SWITCHES)



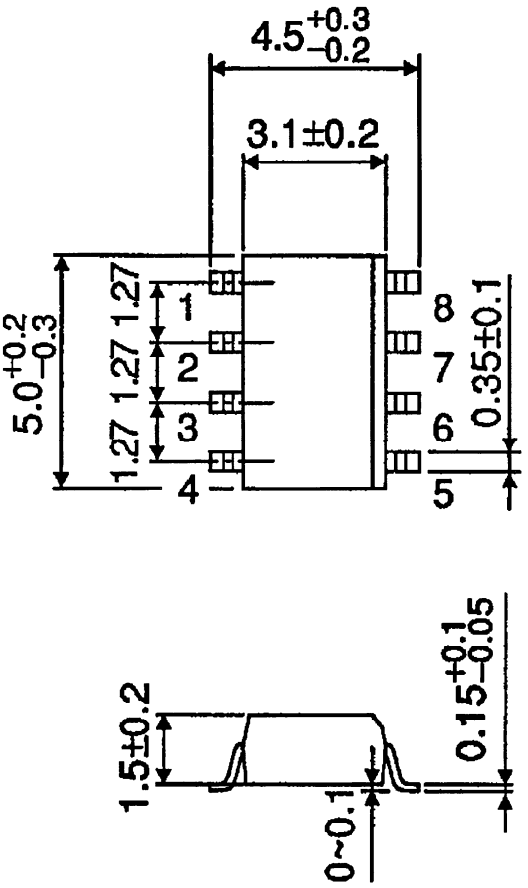
6. FREQUENCY RESPONSE (SWITCH ON)



PACKAGE DIMENSIONS

SOP8-P-1.27

Unit : mm

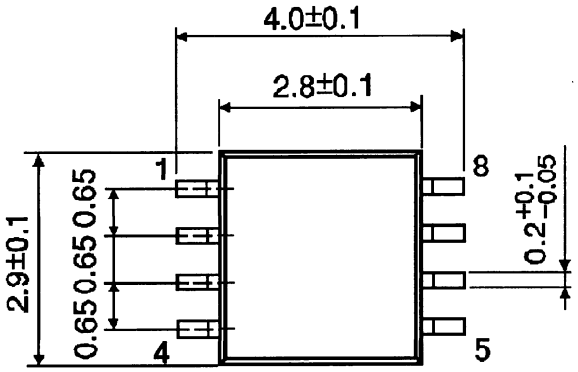


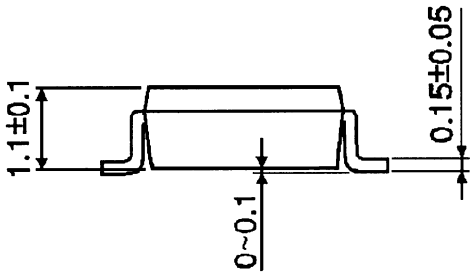
Weight : 0.05g (Typ.)

PACKAGE DIMENSIONS

SSOP8-P-0.65

Unit : mm



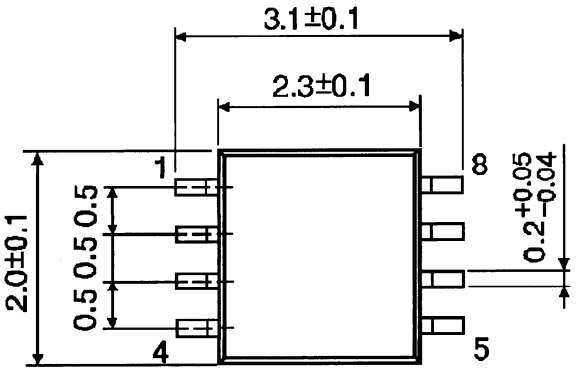


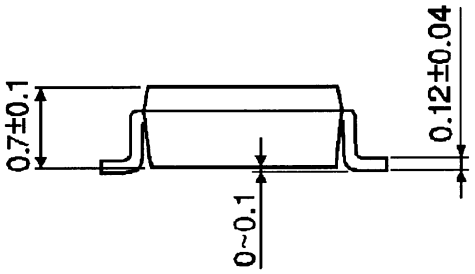
Weight : 0.02g (Typ.)

PACKAGE DIMENSIONS

SSOP8-P-0.50A

Unit : mm





Weight : 0.01g (Typ.)

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000707EBA

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