

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.

It achieves 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.

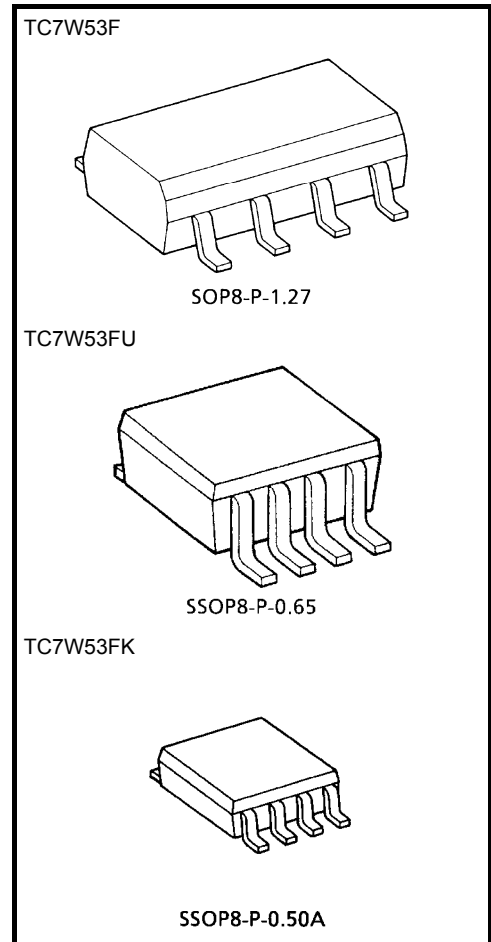
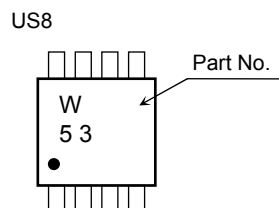
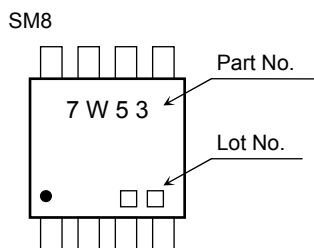
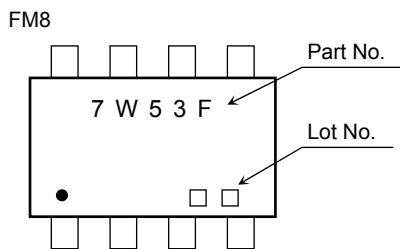
For example, in the case of $V_{CC} = 5\text{ V}$, $GND = 0\text{ V}$, $V_{EE} = 5\text{ V}$, signals between -5 V and $+5\text{ V}$ can be switched from the logical circuit with a signal power supply of 5 V . As the ON-resistance of each switch is low, they can be connected to circuit with low input impedance.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

Features

- High speed: $t_{pd} = 15\text{ ns}$ (typ.) at $V_{CC} = 5\text{ V}$, $V_{EE} = 0\text{ V}$
- Low power dissipation: $I_{CC} = 1\text{ }\mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- Low ON resistance: $R_{ON} = 50\text{ }\Omega$ (typ.) at $V_{CC} - V_{EE} = 9\text{ V}$
- High degree of linearity: $THD = 0.02$ (typ.) at $V_{CC} - V_{EE} = 9\text{ V}$
- Pin and function compatible with TC4W53

Marking



Weight

SOP8-P-1.27: 0.05 g (typ.)

SSOP8-P-0.65: 0.02 g (typ.)

SSOP8-P-0.50A: 0.01 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

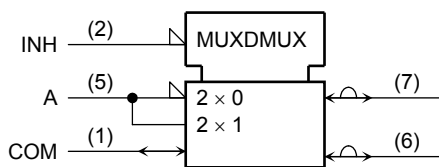
Characteristics	Symbol	Rating	Unit
Supply voltage range	V _{CC}	-0.5 to 7	V
	V _{CC} - V _{EE}	-0.5 to 13	
Control input voltage	V _{IN}	-0.5 to V _{CC} + 0.5	V
Switch I/O voltage	V _{I/O}	V _{EE} - 0.5 to V _{CC} + 0.5	V
Control input diode current	I _{CK}	±20	mA
I/O diode current	I _{I/O}	±20	mA
Switch 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 range	T _{stg}	-65 to 150	°C
Lead temperature (10 s)	T _L	260	°C

Truth Table

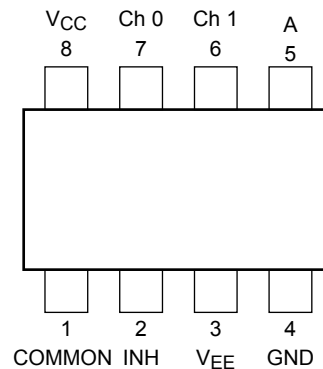
Control Input		On Channel
INH	A	
L	L	Ch 0
L	H	Ch 1
H	X	None

X: Don't care

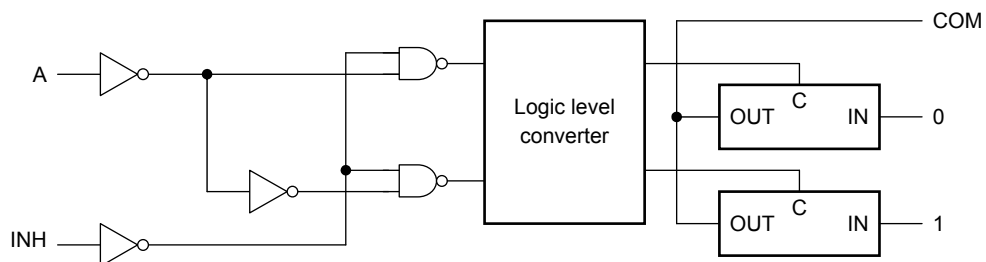
Logic Symbol



Pin Assignment (top view)



Logic Diagram



Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 12	V
	V_{EE}	-6 to 0	
	$V_{CC} - V_{EE}$	2 to 12	
Control input voltage	V_{IN}	0 to V_{CC}	V
Switch I/O voltage	$V_{I/O}$	V_{EE} to V_{CC}	V
Operating temperature range	T_{opr}	-40 to 85	°C
Input rise and fall time	t_r, t_f	0 to 1000 ($V_{CC} = 2.0$ V)	ns
		0 to 500 ($V_{CC} = 4.5$ V)	
		0 to 400 ($V_{CC} = 6.0$ V)	

Electrical Characteristics

DC Electrical Characteristics

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40$ to 85°C		Unit			
			V_{EE} (V)	V_{CC} (V)	Min	Typ.	Max		Min	Max	
Control input voltage	High level	V_{IHC}	—	—	2.0	1.5	—	—	1.5	—	V
				—	4.5	3.15	—	—	3.15	—	
				—	6.0	4.2	—	—	4.2	—	
	Low level	V_{ILC}	—	—	2.0	—	—	0.5	—	0.5	
				—	4.5	—	—	1.35	—	1.35	
				—	6.0	—	—	1.8	—	1.8	
ON resistance	R_{ON}	$V_{IN} = V_{ILC}$ or V_{IHC} $V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O} \leq 2$ mA	GND	4.5	—	85	180	—	225	Ω	
			-4.5	4.5	—	55	120	—	150		
			-6.0	6.0	—	50	100	—	125		
		$V_{IN} = V_{ILC}$ or V_{IHC} $V_{I/O} = V_{CC}$ or V_{EE} $I_{I/O} \leq 2$ mA	GND	2.0	—	150	—	—	—		
			GND	4.5	—	70	150	—	190		
			-4.5	4.5	—	50	100	—	125		
Difference of ON resistance between switches	ΔR_{ON}	$V_{IN} = V_{ILC}$ or V_{IHC} $V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O} \leq 2$ mA	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}	$V_{OS} = V_{CC}$ or GND $V_{IS} = \text{GND}$ 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 ($C_L = 50 \text{ pF}$, input $t_r = t_f = 6 \text{ ns}$, $GND = 0 \text{ V}$)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V _{EE} (V)	V _{CC} (V)	Min	Typ.	Max		Min	Max
Phase difference between input and output	$\phi/I/O$	—	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}	$R_L = 1 \text{ k}\Omega$	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}	$R_L = 1 \text{ k}\Omega$	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)	GND	5.0	—	67	—	—	—	pF

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

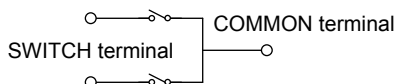
Analog Switch Characteristics (GND = 0 V, Ta = 25°C)

Characteristics	Symbol	Test Condition	V _{EE} (V)		V _{CC} (V)		Typ.	Unit
Sine wave distortion (T.H.D)	—	R _L = 10 kΩ, C _L = 50 pF f _{IN} = 1 kHz	V _{IN} = 4.0 Vp-p	-2.25	-2.25	0.025	%	
			V _{IN} = 8.0 Vp-p	-4.5	4.5	0.02		
			V _{IN} = 11 Vp-p	-6.0	6.0	0.018		
Frequency response (switch ON)	t _{MAX}	Adjust F _{IN} voltage to obtain 0dBm at V _{OS} Increase F _{IN} until dB Meter reads -3dB R _L = 50 Ω, C _L = 10 pF f _{IN} = 1 MHz, sine wave	(Note1)	-2.25	-2.5	120	MHz	
			(Note2)	-2.25	-2.5	95		
			(Note1)	-4.5	4.5	190		
			(Note2)	-4.5	4.5	150		
			(Note1)	-6.0	6.0	200		
			(Note2)	-6.0	6.0	190		
Feedthrough attenuation (switch OFF)	—	V _{IN} is centered at (V _{CC} -V _{EE})/2. Adjust input for 0dBm R _L = 600 Ω, C _L = 50 pF f _{IN} = 1 MHz, 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 Ω, C _L = 50 pF f _{IN} = 1 MHz, square wave (t _r = t _f = 6 ns)	-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 Ω, C _L = 50 pF f _{IN} = 1 MHz, sine wave	2.25	2.25	-50	dB		
			-4.5	-4.5	-50			
			6.0	6.0	-50			

Note: These characteristics are determined by design of device.

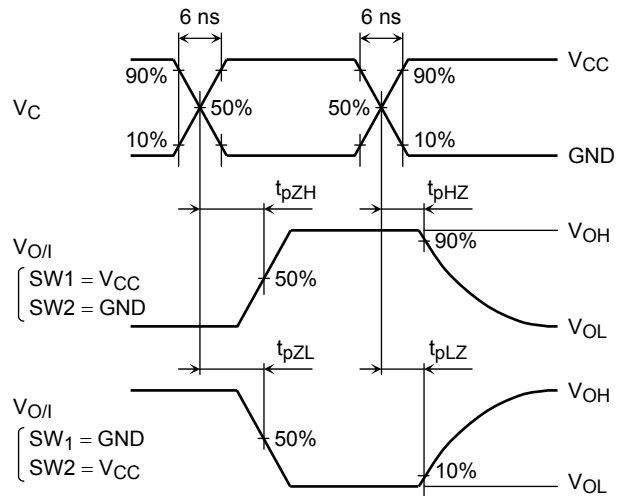
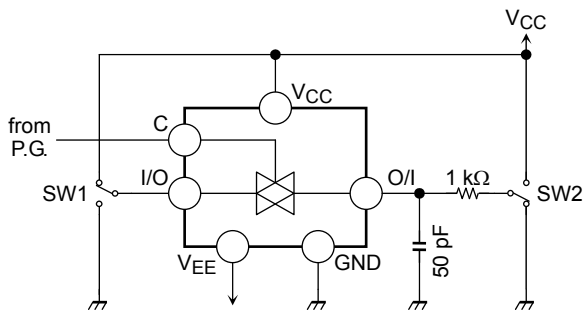
Note 1: Input COMMON terminal, and measure at SWITCH terminal.

Note 2: Input SWITCH terminal, and measure at COMMON terminal.



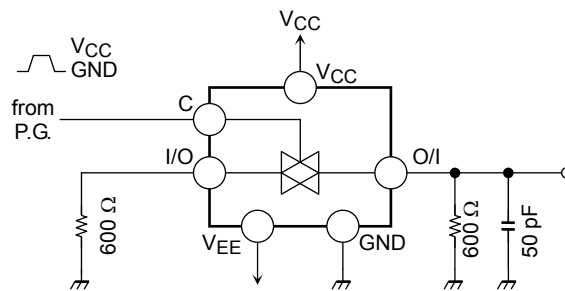
Switching Characteristics Test Circuits

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

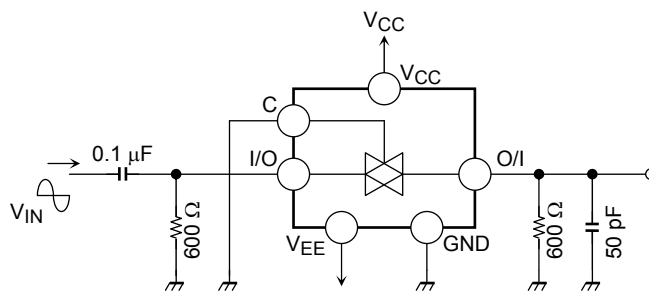


2. Cross Talk (control input-switch output)

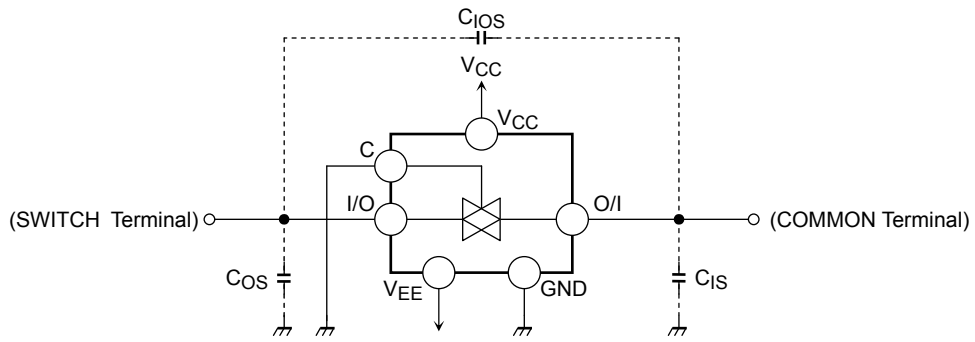
$f_{in} = 1$ MHz, duty = 50% and $t_r = t_f = 6$ ns



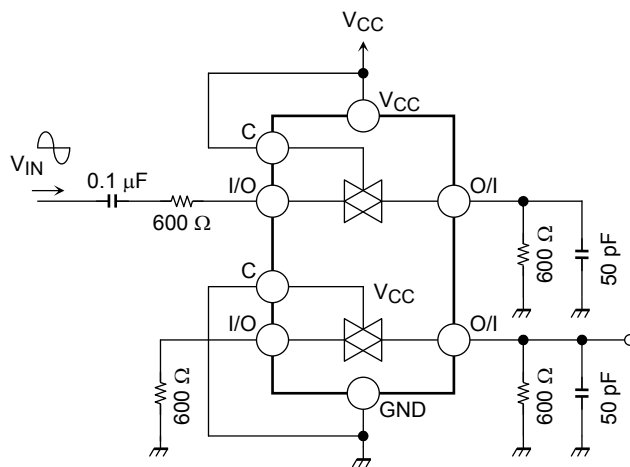
3. Feed Through Attenuation



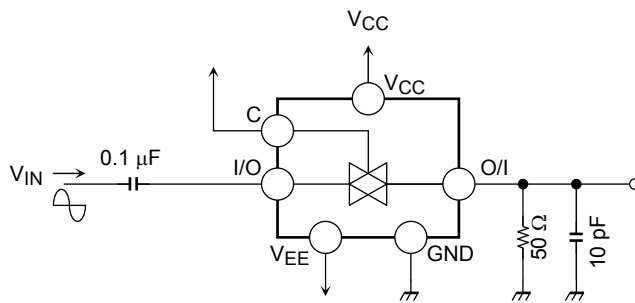
4. Clos, C_{I/O}



5. Cross Talk (between any two switches)



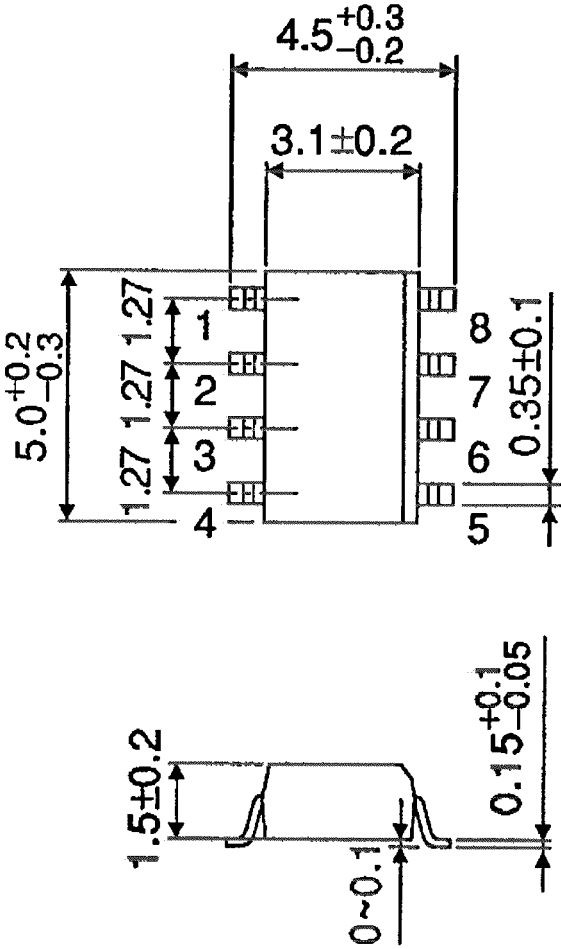
6. Frequency Response (switch ON)



Package Dimensions

SOP8-P-1.27

Unit : mm

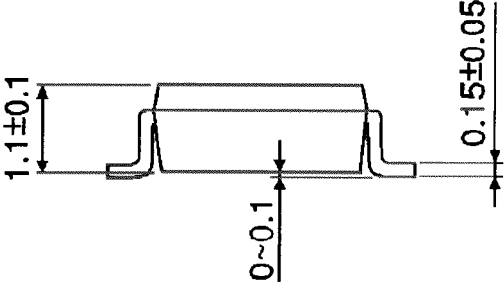
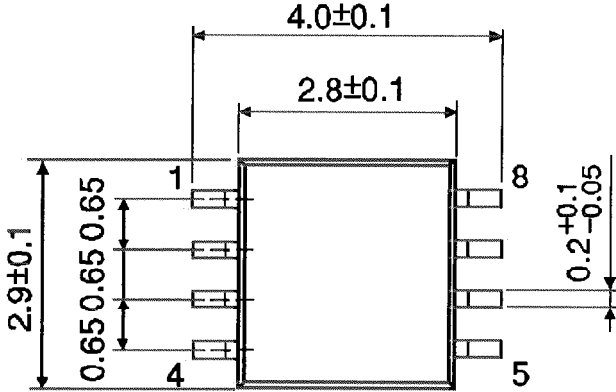


Weight: 0.05 g (typ.)

Package Dimensions

SSOP8-P-0.65

Unit : mm

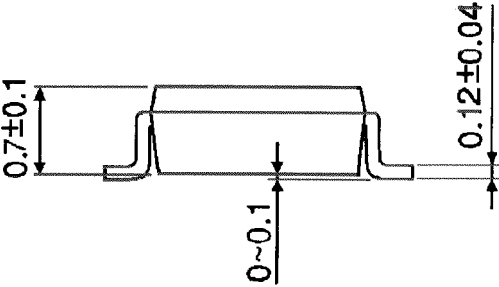
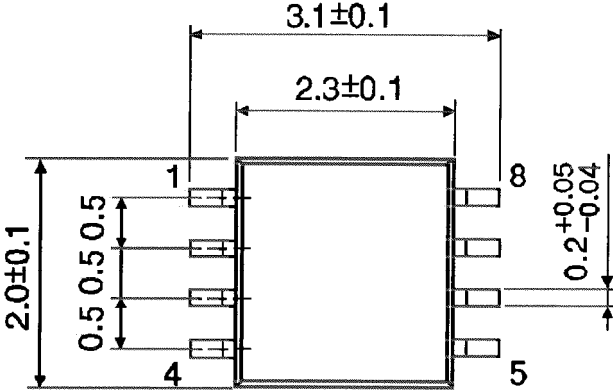


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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JONHON

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