

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74HC173AP, TC74HC173AF

## Quad D-Type Register (3-state)

The TC74HC173A is a high speed CMOS D-TYPE REGISTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

It consists a 4-bit register consisting of D-type flip-flops and 3-state buffers. The four flip-flops are controlled by a common clock input (CK) and a common clear input (CLR).

Signals applied to the data inputs (D1~D4) are stored in the respective flip-flops on the positive going transition of CK when clock control inputs (G1, G2) are held low.

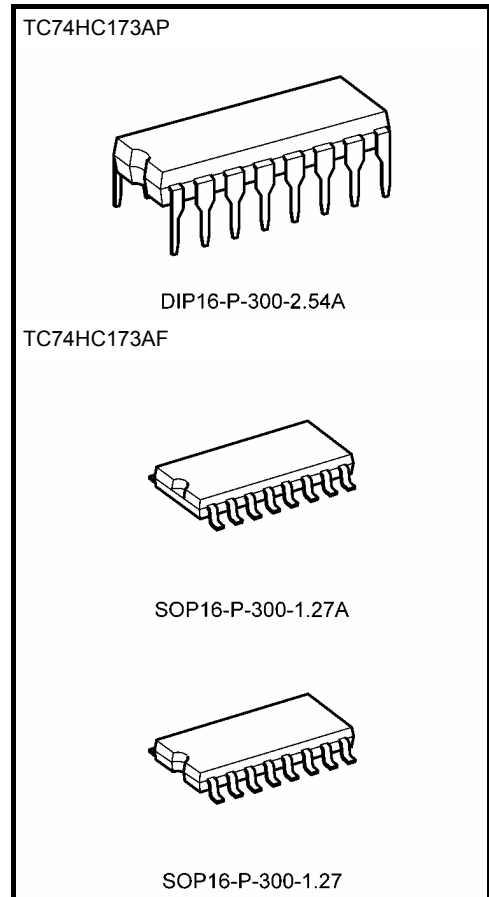
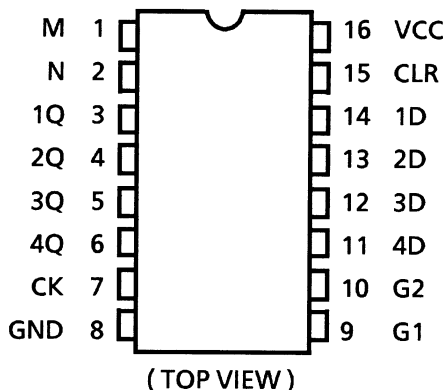
The clear function is asynchronous to CK and active on a high level. The stored data are enabled to each outputs when output control inputs (M, N) are held low, else the outputs are high impedance state.

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

### Features

- High speed:  $f_{max} = 47$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) at  $T_a = 25^\circ$ C
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- Output drive capability: 15 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 6$  mA (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} (opr) = 2\sim 6$  V
- Pin and function compatible with 74LS173

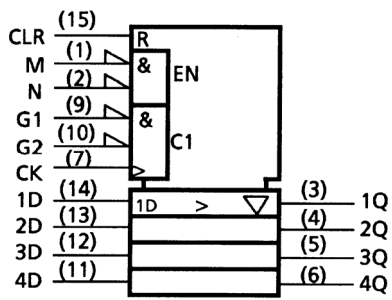
### Pin Assignment



### Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOP16-P-300-1.27	: 0.18 g (typ.)

## IEC Logic Symbol



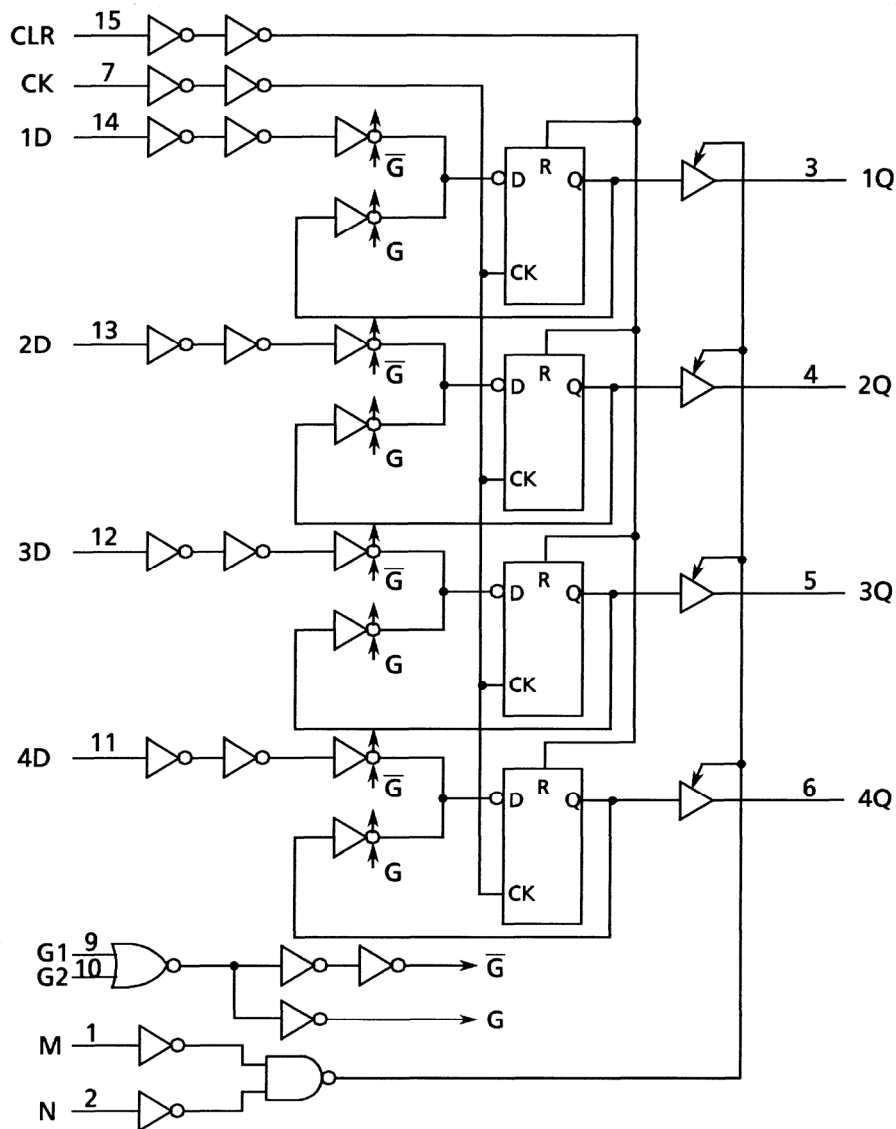
## Truth Table

CLR	CK	Data Inable		Dn	Outputs Control		Qn
		G1	G2		M	N	
X	X	X	X	X	H	X	Z
X	X	X	X	X	X	H	Z
H	X	X	X	X	L	L	L
L	↓	X	X	X	L	L	Q0
L	↑	H	X	X	L	L	Q0
L	↑	X	H	X	L	L	Q0
L	↑	L	L	H	L	L	H
L	↑	L	L	L	L	L	L

X: Don't care

Z: High impedance

**System Diagram**



**Absolute Maximum Ratings (Note 1)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5~7	V
DC input voltage	$V_{IN}$	-0.5~ $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5~ $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 35$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65~150	$^{\circ}C$

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}C$ . From  $T_a = 65$  to  $85^{\circ}C$  a derating factor of  $-10$  mW/ $^{\circ}C$  shall be applied until 300 mW.

## Recommended Operating Conditions (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2~6	V
Input voltage	$V_{IN}$	0~ $V_{CC}$	V
Output voltage	$V_{OUT}$	0~ $V_{CC}$	V
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	$t_r, t_f$	0~1000 ( $V_{CC} = 2.0$ V)	ns
		0~500 ( $V_{CC} = 4.5$ V)	
		0~400 ( $V_{CC} = 6.0$ V)	

Note: The recommended operating conditions are required to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40\sim 85^\circ\text{C}$		Unit	
				Min	Typ.	Max	Min	Max		
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	—	1.50	—	V	
			4.5	3.15	—	—	3.15	—		
			6.0	4.20	—	—	4.20	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	—	0.50	V	
			4.5	—	—	1.35	—	1.35		
			6.0	—	—	1.80	—	1.80		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20 \mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			$I_{OH} = -6 \text{ mA}$	4.5	4.18	4.31	—	4.13	—	
		$I_{OH} = -7.8 \text{ mA}$	6.0	5.68	5.80	—	5.63	—		
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20 \mu\text{A}$	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			$I_{OL} = 6 \text{ mA}$	4.5	—	0.17	0.26	—	0.33	
		$I_{OL} = 7.8 \text{ mA}$	6.0	—	0.18	0.26	—	0.33		
3-state output off-state current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	—	$\pm 0.5$	—	$\pm 5.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	4.0	—	40.0	$\mu\text{A}$	

## Timing Requirements (input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 ~85°C	Unit	
			V <sub>CC</sub> (V)	Typ.	Limit		Limit
Minimum pulse width (CK)	$t_W (L)$ $t_W (H)$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum pulse width (CLR)	$t_W (H)$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time (G1, G2)	$t_s$	—	2.0	—	100	125	ns
			4.5	—	20	25	
			6.0	—	17	21	
Minimum set-up time (D)	$t_s$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum hold time (G1, G2, D)	$t_h$	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Minimum removal time (CLR)	$t_{rem}$	—	2.0	—	5	5	ns
			4.5	—	5	5	
			6.0	—	5	5	
Clock frequency	f	—	2.0	—	9	7	ns
			4.5	—	43	34	
			6.0	—	51	40	

## AC Characteristics (input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40~85°C		Unit	
		CL (pF)	V <sub>CC</sub> (V)	Min	Typ.	Max	Min	Max		
Output transition time	$t_{TLH}$ $t_{THL}$	—	50	2.0	—	20	60	—	75	ns
				4.5	—	6	12	—	15	
				6.0	—	5	10	—	13	
Propagation delay time (CK-Q)	$t_{pLH}$ $t_{pHL}$	—	50	2.0	—	50	115	—	145	ns
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	65	155	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Propagation delay time (CLR-Q)	$t_{pHL}$	—	50	2.0	—	50	115	—	145	ns
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	63	155	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Output enable time	$t_{pZL}$ $t_{pZH}$	$R_L = 1$ k $\Omega$	50	2.0	—	50	115	—	145	ns
				4.5	—	15	23	—	29	
				6.0	—	12	20	—	25	
			150	2.0	—	63	115	—	195	
				4.5	—	20	31	—	39	
				6.0	—	16	26	—	33	
Output disable time	$t_{pLZ}$ $t_{pHZ}$	$R_L = 1$ k $\Omega$	50	2.0	—	36	135	—	170	ns
				4.5	—	17	27	—	34	
				6.0	—	15	23	—	29	
Maximum clock frequency	$f_{max}$	—	50	2.0	9	20	—	7	—	MHz
				4.5	43	67	—	34	—	
				6.0	51	84	—	40	—	
Input capacitance	$C_{IN}$	—	—	—	5	10	—	10	pF	
Output capacitance	$C_{OUT}$	—	—	—	10	—	—	—	pF	
Power dissipation capacitance	$C_{PD}$ (Note)	—	—	—	45	—	—	—	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:

$$I_{CC} (opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per flip flop)}$$

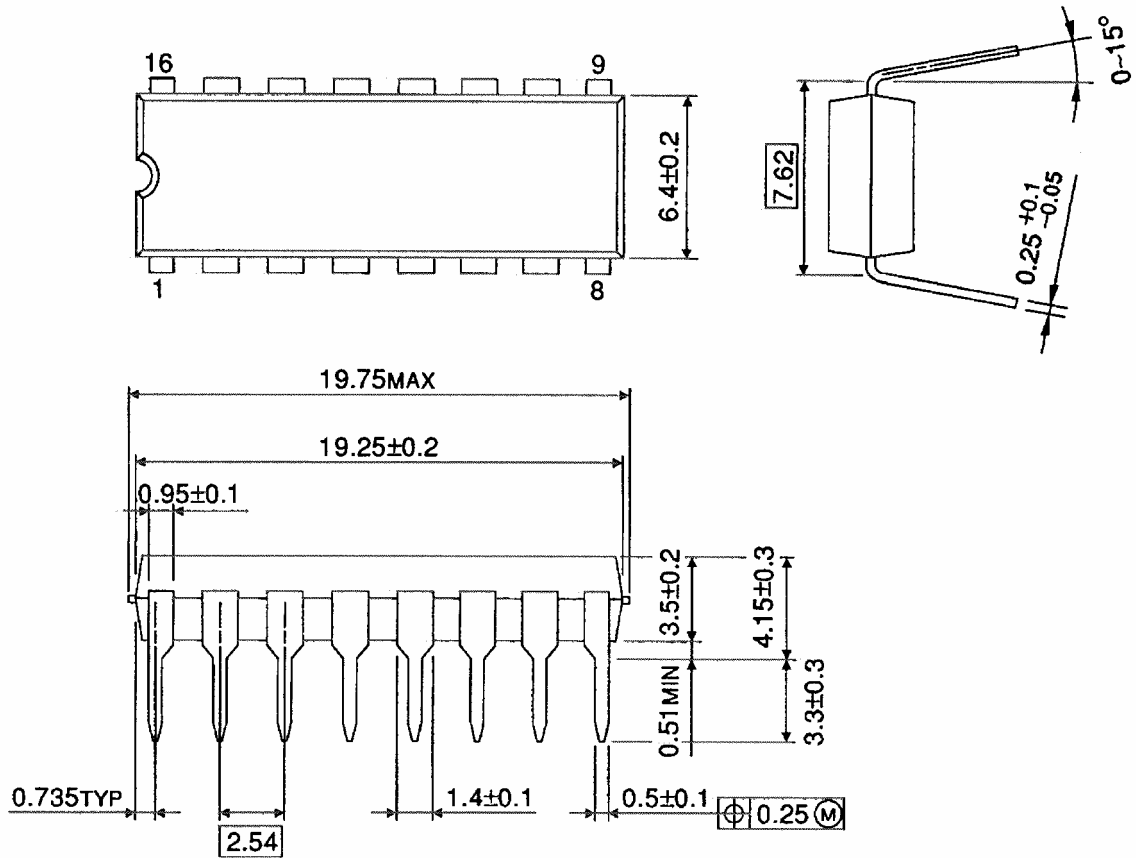
And the total  $C_{PD}$  when n pcs of flip flop operate be gained by the following equation:

$$C_{PD} (total) = 28 + 17 \cdot n$$

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

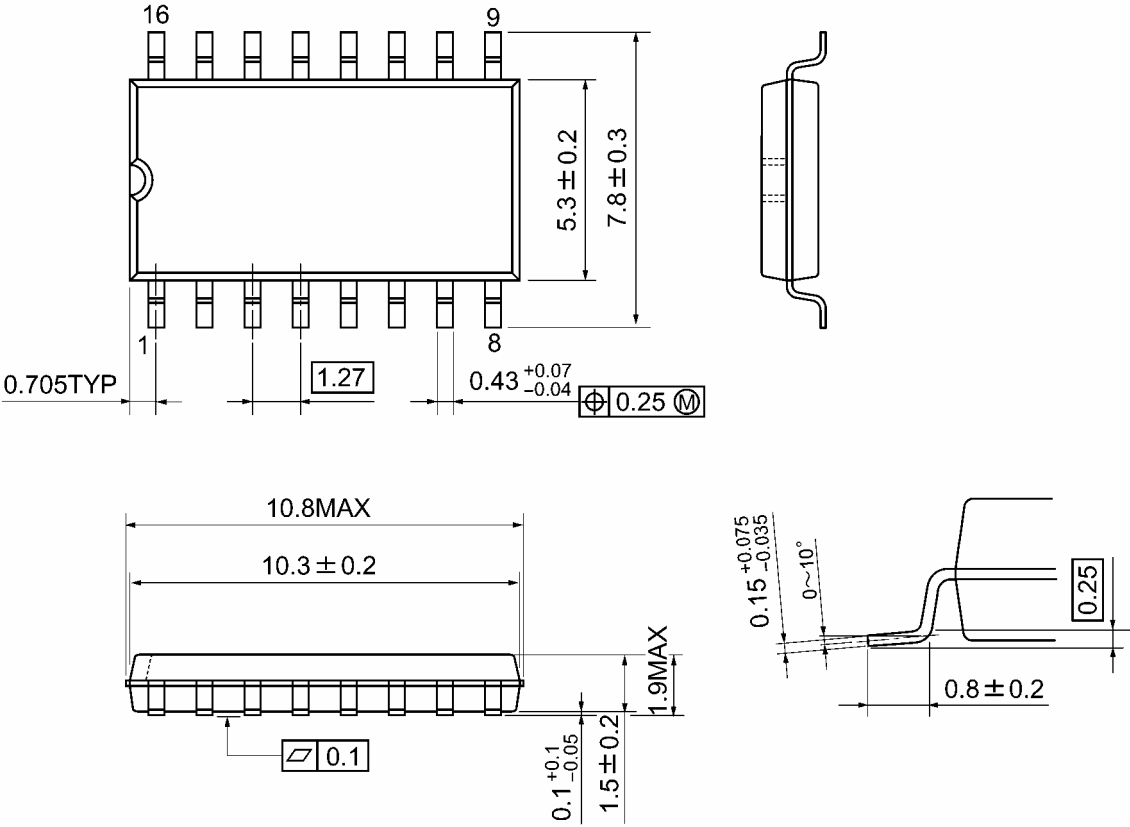


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



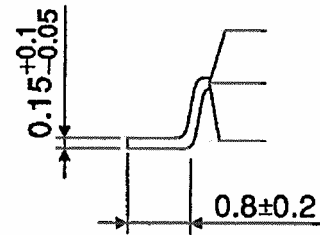
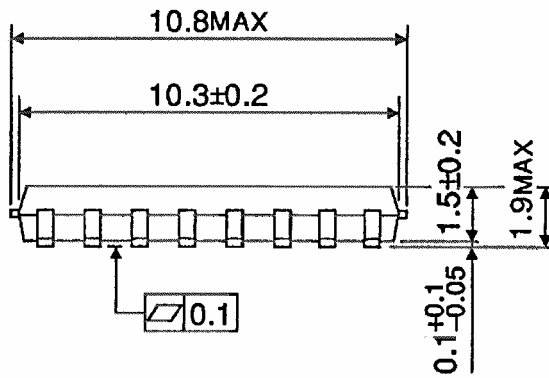
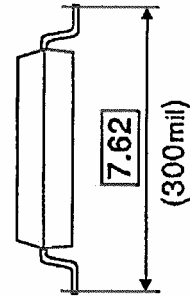
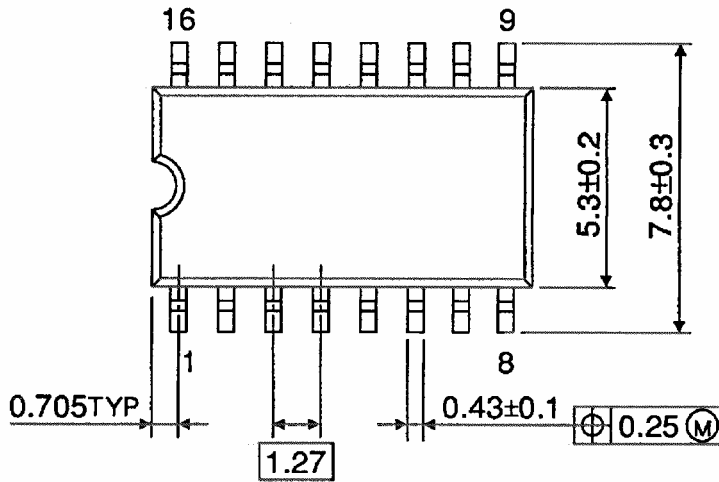
Weight: 0.18 g (typ.)



**Package Dimensions**

SOP16-P-300-1.27

Unit : mm



Weight: 0.18 g (typ.)

**Note: Lead (Pb)-Free Packages****DIP16-P-300-2.54A SOP16-P-300-1.27A****RESTRICTIONS ON PRODUCT USE**

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