

## TC74LCX374F, TC74LCX374FT, TC74LCX374FK

### Low-Voltage Octal D-Type Flip-Flop with 5-V Tolerant Inputs and Outputs

The TC74LCX374 is a high-performance CMOS octal D-type flip-flop. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

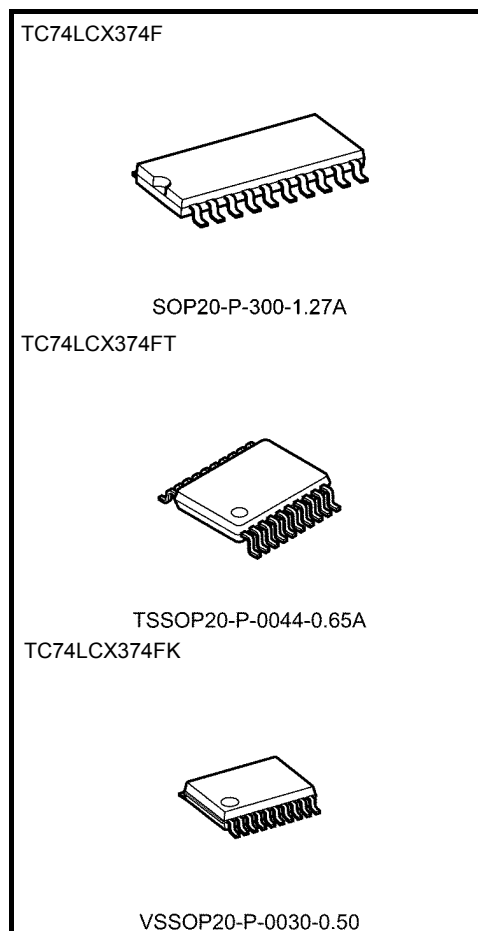
The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5-V supply environment for both inputs and outputs.

This 8 bit D-type flip-flop is controlled by a clock input (CK) and an output enable input ( $\overline{OE}$ ). When the  $\overline{OE}$  input is high, the eight outputs are in a high impedance state.

All inputs are equipped with protection circuits against static discharge.

### Features

- Low-voltage operation:  $V_{CC} = 1.65$  to  $3.6$  V
- High-speed operation:  $t_{pd} = 8.5$  ns (max) ( $V_{CC} = 3.0$  to  $3.6$  V)
- Output current:  $|I_{OH}|/I_{OL} = 24$  mA (min) ( $V_{CC} = 3.0$  V)
- Latch-up performance:  $>\pm 500$  mA
- Available in JEITA SOP, TSSOP and VSSOP (US)
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 374 type

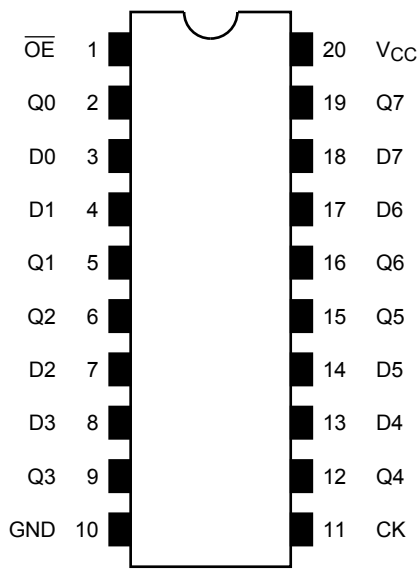


#### Weight

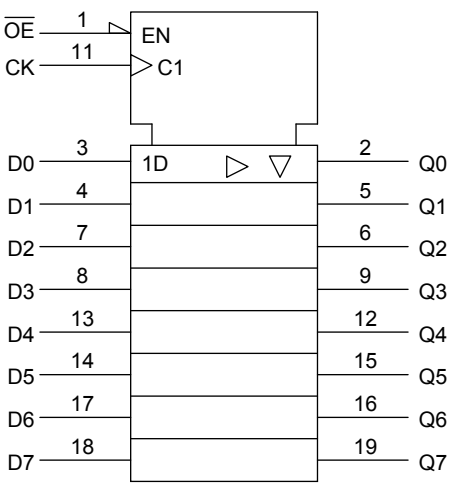
SOP20-P-300-1.27A	: 0.22 g (typ.)
TSSOP20-P-0044-0.65A	: 0.08 g (typ.)
VSSOP20-P-0030-0.50	: 0.03 g (typ.)

Note: The Electrical Characteristics of  $V_{CC}=1.8\pm 0.15$ V is only applicable for products which manufactured from January 2009 onward.

Pin Assignment (top view)



IEC Logic Symbol

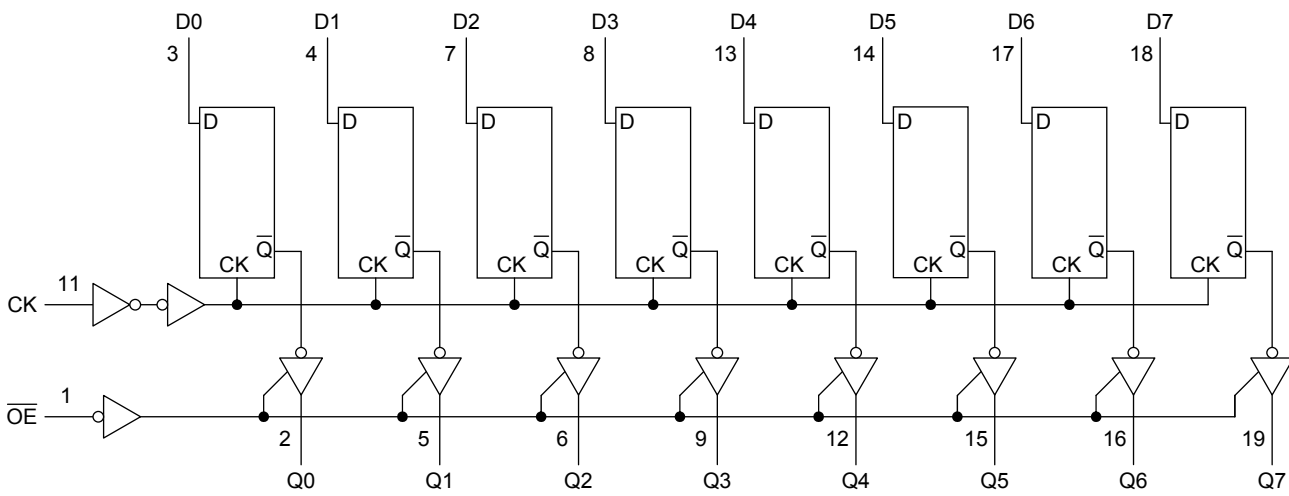


Truth Table

Inputs			Outputs
OE	CK	D	
H	X	X	Z
L		X	Qn
L		L	L
L		H	H

X: Don't care  
Z: High impedance  
Qn: No change

System Diagram



## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to 7.0 (Note 2)	V
		-0.5 to $V_{CC} + 0.5$ (Note 3)	
Input diode current	$I_{IK}$	-50	mA
Output diode current	$I_{OK}$	$\pm 50$ (Note 4)	mA
DC output current	$I_{OUT}$	$\pm 50$	mA
Power dissipation	$P_D$	180	mW
DC $V_{CC}$ /ground current	$I_{CC}/I_{GND}$	$\pm 100$	mA
Storage temperature	$T_{stg}$	-65 to 150	°C

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

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: Output in OFF state

Note 3: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 4:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CC}$	1.65 to 3.6	V
		1.5 to 3.6 (Note 2)	
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 5.5 (Note 3)	V
		0 to $V_{CC}$ (Note 4)	
Output current	$I_{OH}/I_{OL}$	$\pm 24$ (Note 5)	mA
		$\pm 12$ (Note 6)	
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	$dt/dv$	0 to 10 (Note 7)	ns/V

Note 1: The operating ranges must be maintained to ensure the normal operation of the device.  
Unused inputs must be tied to either  $V_{CC}$  or GND.

Note 2: Data retention only

Note 3: Output in OFF state

Note 4: High or low state

Note 5:  $V_{CC} = 3.0$  to  $3.6$  V

Note 6:  $V_{CC} = 2.7$  to  $3.0$  V

Note 7:  $V_{IN} = 0.8$  to  $2.0$  V,  $V_{CC} = 3.0$  V

**Electrical Characteristics**
**DC Characteristics (Ta = -40 to 85°C)**

Characteristics		Symbol	Test Condition			Min	Max	Unit
					V <sub>CC</sub> (V)			
Input voltage	H-level	V <sub>IH</sub>	—		1.65 to 2.3	V <sub>CC</sub> × 0.9	—	V
					2.3 to 2.7	1.7	—	
					2.7 to 3.6	2.0	—	
	L-level	V <sub>IL</sub>	—		1.65 to 2.3	—	V <sub>CC</sub> × 0.1	
					2.3 to 2.7	—	0.7	
					2.7 to 3.6	—	0.8	
Output voltage	H-level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = −100 μA	1.65 to 3.6	V <sub>CC</sub> − 0.2	—	V
				I <sub>OH</sub> = −4 mA	1.65	1.05	—	
				I <sub>OH</sub> = −8 mA	2.3	1.7	—	
				I <sub>OH</sub> = −12 mA	2.7	2.2	—	
				I <sub>OH</sub> = −18 mA	3.0	2.4	—	
				I <sub>OH</sub> = −24 mA	3.0	2.2	—	
	L-level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	1.65 to 3.6	—	0.2	
				I <sub>OL</sub> = 4 mA	1.65	—	0.45	
				I <sub>OL</sub> = 8 mA	2.3	—	0.7	
				I <sub>OL</sub> = 12 mA	2.7	—	0.4	
				I <sub>OL</sub> = 16 mA	3.0	—	0.4	
				I <sub>OL</sub> = 24 mA	3.0	—	0.55	
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 0 to 5.5 V	1.65 to 3.6	—	±5.0	μA	
3-state output OFF state current		I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = 0 to 5.5 V	1.65 to 3.6	—	±5.0	μA	
Power-off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> /V <sub>OUT</sub> = 5.5 V	0	—	10.0	μA	
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	1.65 to 3.6	—	10.0	μA	
			V <sub>IN</sub> /V <sub>OUT</sub> = 3.6 to 5.5 V	1.65 to 3.6	—	±10.0		
Increase in I <sub>CC</sub> per input		ΔI <sub>CC</sub>	V <sub>IH</sub> = V <sub>CC</sub> − 0.6 V	2.7 to 3.6	—	500		

## AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Maximum clock frequency	f <sub>max</sub>	Figure 1, Figure 2	1.8±0.15	50	—	MHz
			2.5±0.2	100	—	
			2.7	100	—	
			3.3 ± 0.3	150	—	
Propagation delay time (CK-Q)	t <sub>pLH</sub> t <sub>pHL</sub>	Figure 1, Figure 2	1.8±0.15	—	30.0	ns
			2.5±0.2	—	10.5	
			2.7	—	9.5	
			3.3 ± 0.3	1.5	8.5	
Output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figure 1, Figure 3	1.8±0.15	—	34.0	ns
			2.5±0.2	—	17.0	
			2.7	—	9.5	
			3.3 ± 0.3	1.5	8.5	
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figure 1, Figure 3	1.8±0.15	—	32.0	ns
			2.5±0.2	—	16.0	
			2.7	—	8.5	
			3.3 ± 0.3	1.5	7.5	
Minimum pulse width (CK)	t <sub>w</sub> (H) t <sub>w</sub> (L)	Figure 1, Figure 2	1.8±0.15	12.0	—	ns
			2.5±0.2	6.0	—	
			2.7	4.0	—	
			3.3 ± 0.3	3.3	—	
Minimum setup time	t <sub>s</sub>	Figure 1, Figure 2	1.8±0.15	10.0	—	ns
			2.5±0.2	5.0	—	
			2.7	2.5	—	
			3.3 ± 0.3	2.5	—	
Minimum hold time	t <sub>h</sub>	Figure 1, Figure 2	1.8±0.15	1.5	—	ns
			2.5±0.2	1.5	—	
			2.7	1.5	—	
			3.3 ± 0.3	1.5	—	
Output to output skew	t <sub>osLH</sub> t <sub>osHL</sub>	(Note)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

Note: Parameter guaranteed by design.

(t<sub>osLH</sub> = |t<sub>pLHm</sub> - t<sub>pLHn</sub>|, t<sub>osHL</sub> = |t<sub>pHLm</sub> - t<sub>pHLn</sub>|)

**Dynamic Switching Characteristics (Ta = 25°C, input:  $t_r = t_f = 2.5$  ns,  $C_L = 50$  pF,  $R_L = 500$   $\Omega$ )**

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V

**Capacitive Characteristics (Ta = 25°C)**

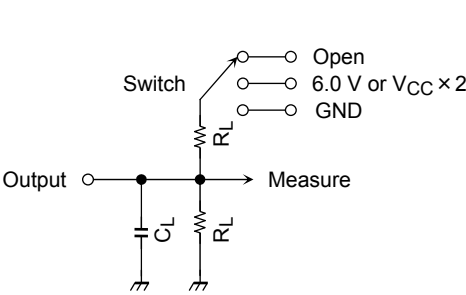
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Input capacitance	C <sub>IN</sub>	—	3.3	7	pF
Output capacitance	C <sub>OUT</sub>	—	3.3	8	pF
Power dissipation capacitance	CPD	f <sub>IN</sub> = 10 MHz (Note)	3.3	25	pF

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

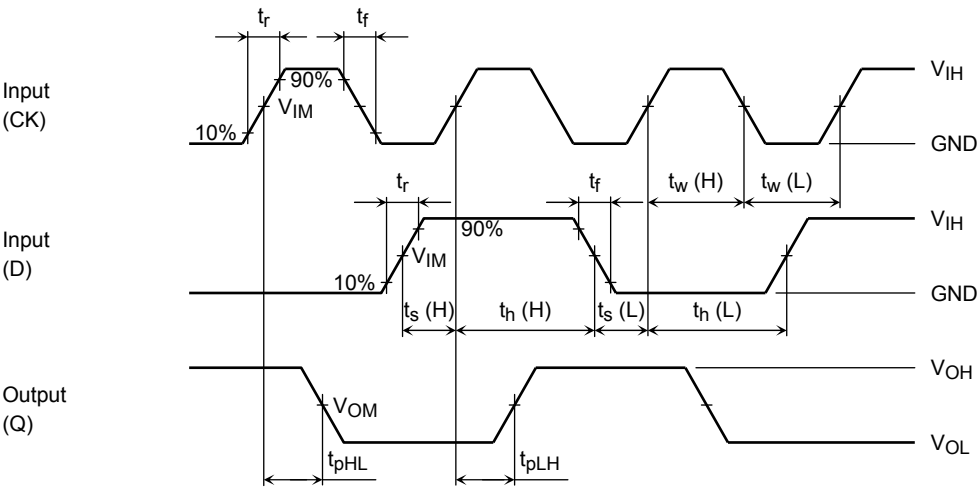
**AC Test Circuit**



Parameter	Switch
t <sub>pLH</sub> , t <sub>pHL</sub>	Open
t <sub>pLZ</sub> , t <sub>pZL</sub>	6.0 V @ V <sub>CC</sub> = 3.3±0.3V
	@ V <sub>CC</sub> = 2.7V
	V <sub>CC</sub> ×2 @ V <sub>CC</sub> = 2.5±0.2V
	@ V <sub>CC</sub> = 1.8±0.15V
t <sub>pHZ</sub> , t <sub>pZH</sub>	GND

**Figure 1**

**AC Waveform**



**Figure 2**  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_w$ ,  $t_s$ ,  $t_h$

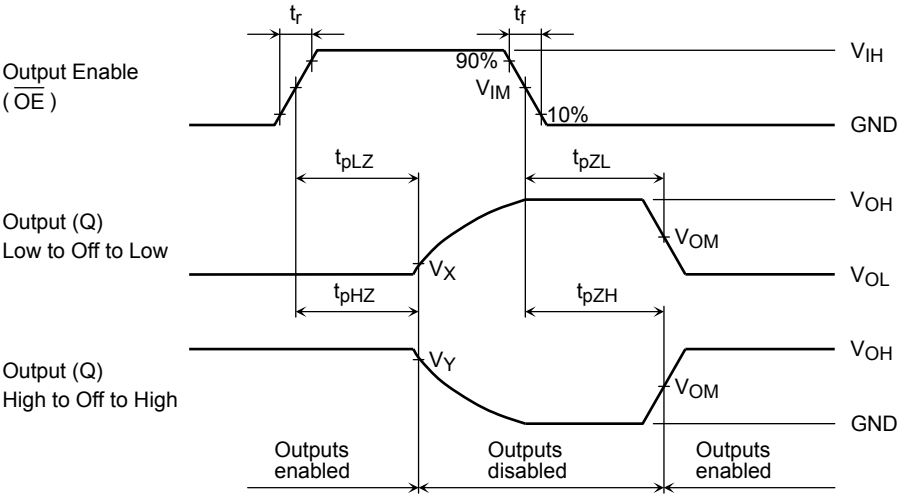


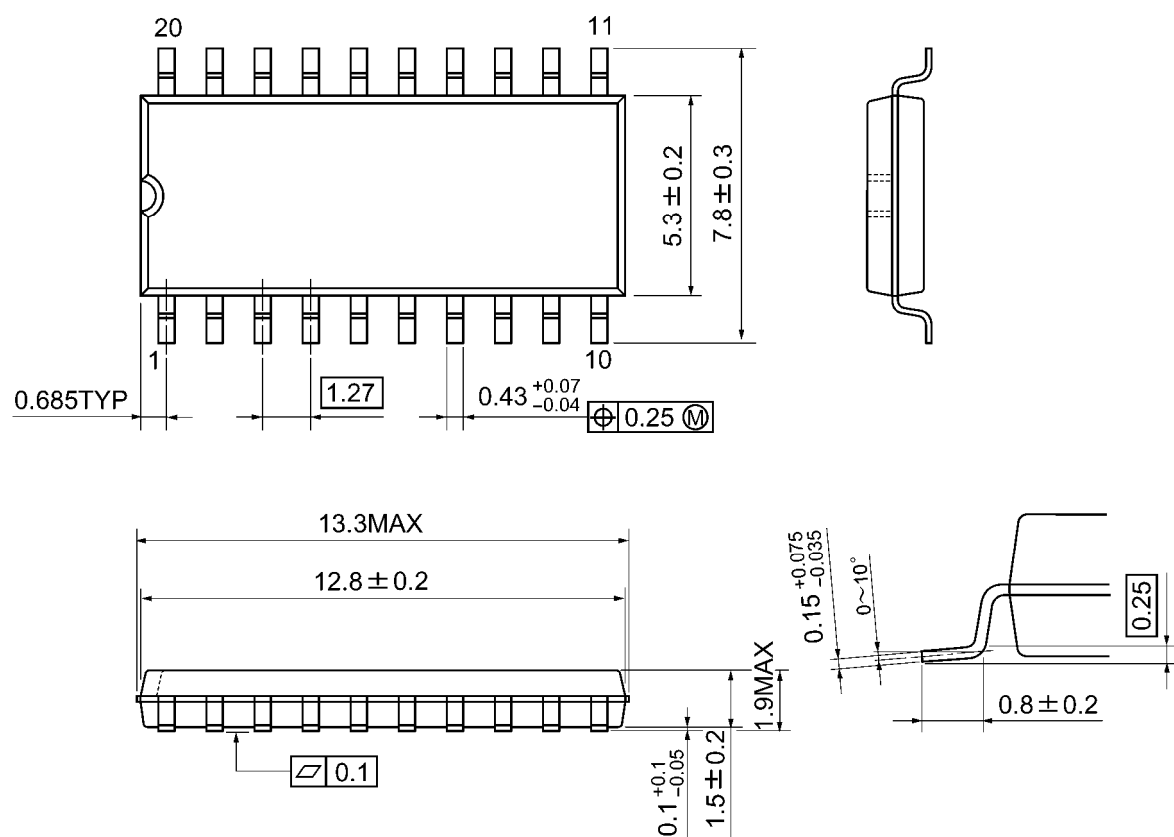
Figure 3  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$

	Symbol	$V_{CC}$		
		$3.3 \pm 0.3 V$ 2.7V	$2.5 \pm 0.2 V$	$1.8 \pm 0.15 V$
Input	$V_{IH}$	2.7V	$V_{CC}$	$V_{CC}$
	$V_{IM}$	1.5V	$V_{CC}/2$	$V_{CC}/2$
	$t_r, t_f$	2.5ns	2.0ns	2.0ns
Output	$V_{OM}$	1.5V	$V_{OH}/2$	$V_{OH}/2$
	$V_X$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$
	$V_Y$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$
Load	$C_L$	50pF	30pF	30pF
	$R_L$	500 $\Omega$	500 $\Omega$	1k $\Omega$

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

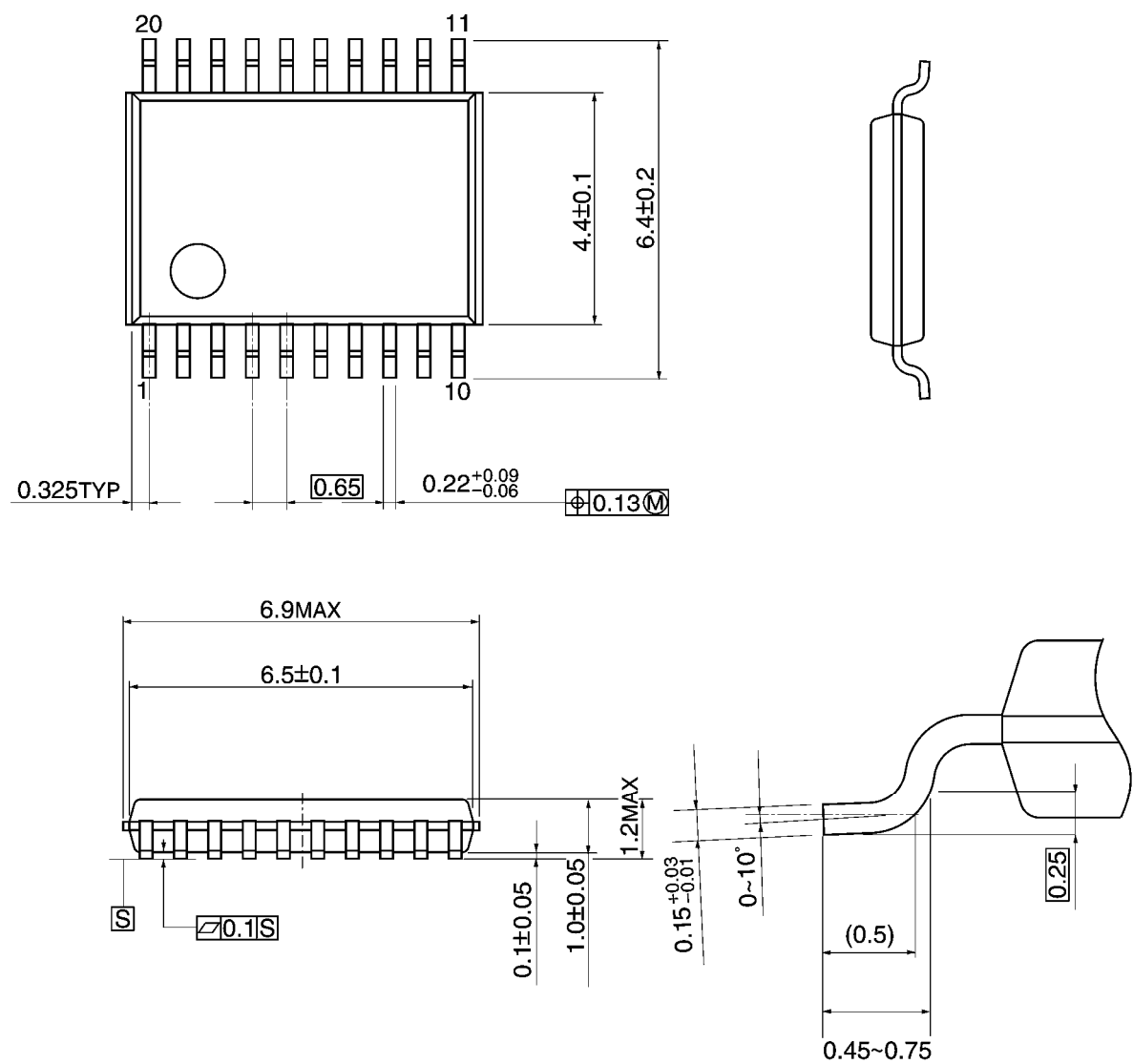


Weight: 0.22 g (typ.)

Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm

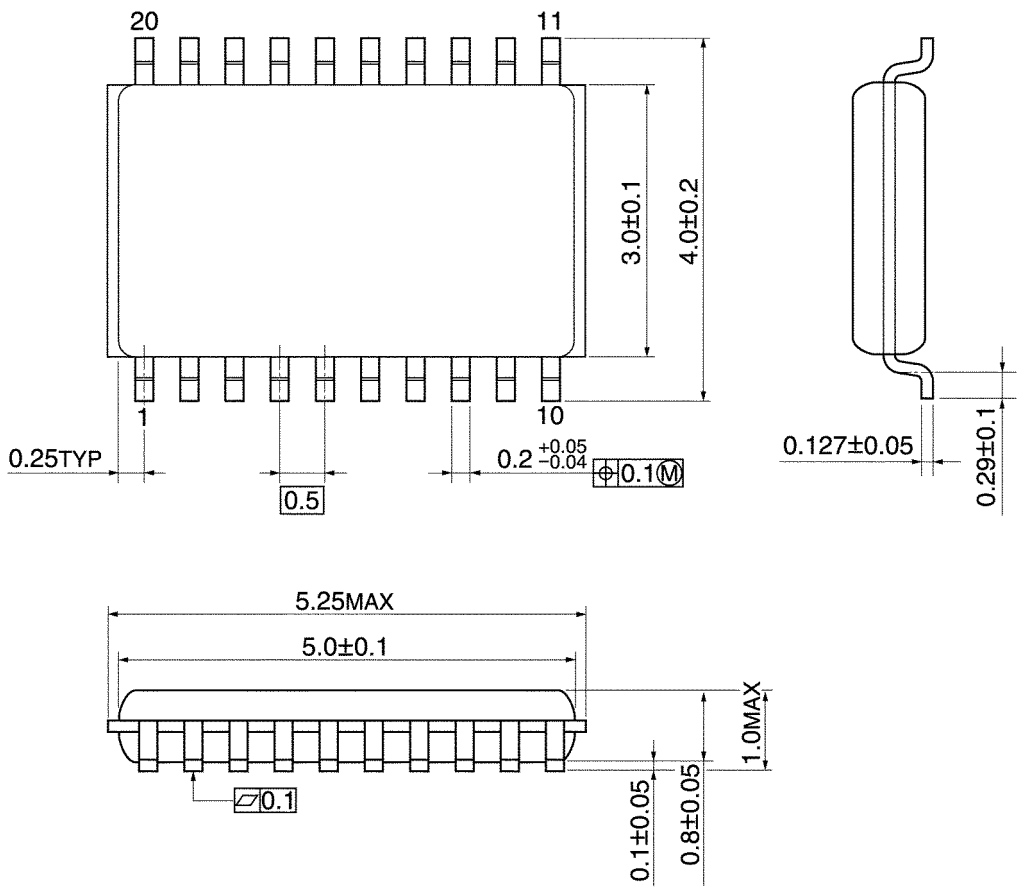


Weight: 0.08 g (typ.)

Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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