

# HD74HC109

## Dual J- $\bar{K}$ Flip-Flops (with Preset and Clear)

REJ03D0561-0200  
 (Previous ADE-205-434)  
 Rev.2.00  
 Oct 11, 2005

### Description

Each flip-flop has independent J,  $\bar{K}$ , preset, clear and clock inputs and Q and  $\bar{Q}$  outputs. This device is edge sensitive to the clock input and changes state on the positive going transition of the clock pulse. Clear and preset are independent of the clock and accomplished by a low logic level on the corresponding input.





### Features

- High Speed Operation:  $t_{pd}$  (Clock to Q) = 15 ns typ ( $C_L = 50$  pF)
- High Output Current: Fanout of 10 LSTTL Loads
- Wide Operating Voltage:  $V_{CC} = 2$  to 6 V
- Low Input Current: 1  $\mu$ A max
- Low Quiescent Supply Current:  $I_{CC}$  (static) = 2  $\mu$ A max ( $T_a = 25^\circ\text{C}$ )
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74HC109P	DILP-16 pin	PRDP0016AE-B (DP-16FV)	P	—
HD74HC109FPEL	SOP-16 pin (JEITA)	PRSP0016DH-B (FP-16DAV)	FP	EL (2,000 pcs/reel)
HD74HC109RPEL	SOP-16 pin (JEDEC)	PRSP0016DG-A (FP-16DNV)	RP	EL (2,500 pcs/reel)

Note: Please consult the sales office for the above package availability.

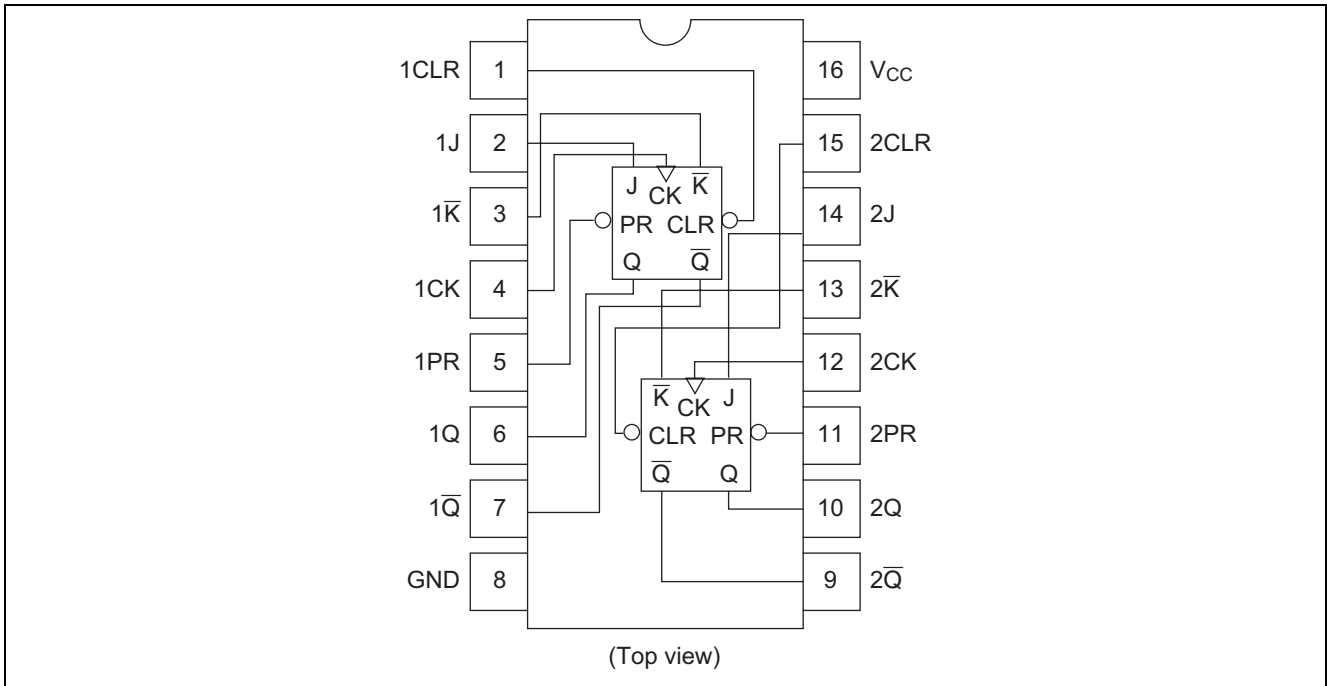
### Function Table

Inputs					Outputs	
Preset	Clear	Clock	J	$\bar{K}$	Q	$\bar{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	$H^{*1}$	$H^{*1}$
H	H		L	L	L	H
H	H		H	L	Toggle	
H	H		L	H	$Q_0$	$\bar{Q}_0$
H	H		H	H	H	L
H	H	L	X	X	$Q_0$	$\bar{Q}_0$

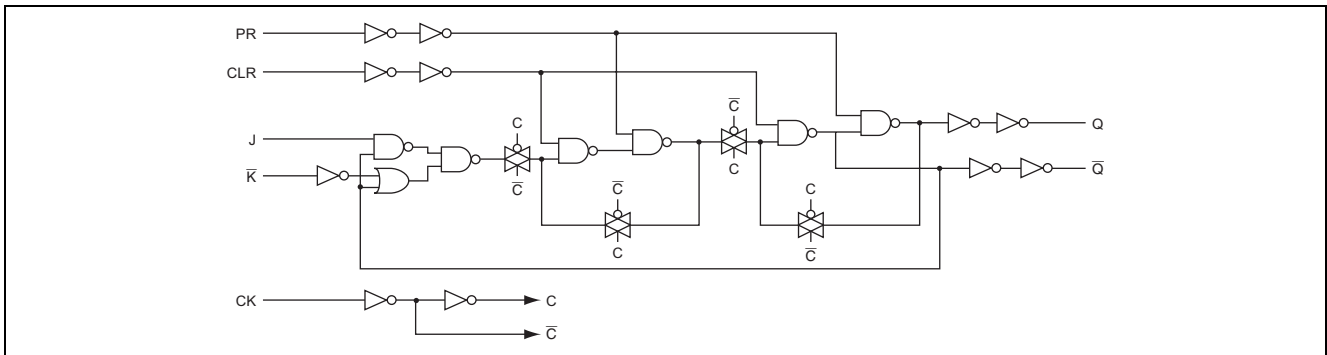
Note: 1. Q and  $\bar{Q}$  will remain high as long as preset and clear input are low, but Q and  $\bar{Q}$  are unpredictable if preset and clear input go high simultaneously.

H: High level  
 L: Low level  
 X: Irrelevant

### Pin Arrangement



### Logic Diagram (1/2)



### Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V
Input / Output voltage	$V_{in}, V_{out}$	-0.5 to $V_{CC} + 0.5$	V
Input / Output diode current	$I_{IK}, I_{OK}$	$\pm 20$	mA
Output current	$I_O$	$\pm 25$	mA
$V_{CC}, GND$ current	$I_{CC}$ or $I_{GND}$	$\pm 50$	mA
Power dissipation	$P_T$	500	mW
Storage temperature	$T_{stg}$	-65 to +150	$^{\circ}C$

Note: The absolute maximum ratings are values, which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

### Recommended Operating Conditions

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	$V_{CC}$	2 to 6	V	
Input / Output voltage	$V_{IN}, V_{OUT}$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to 85	°C	
Input rise / fall time <sup>*1</sup>	$t_r, t_f$	0 to 1000	ns	$V_{CC} = 2.0\text{ V}$
		0 to 500		$V_{CC} = 4.5\text{ V}$
		0 to 400		$V_{CC} = 6.0\text{ V}$

Note: 1. This item guarantees maximum limit when one input switches.  
 Waveform: Refer to test circuit of switching characteristics.

### Electrical Characteristics

Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40\text{ to }+85^\circ\text{C}$		Unit	Test Conditions	
			Min	Typ	Max	Min	Max			
Input voltage	$V_{IH}$	2.0	1.5	—	—	1.5	—	V		
		4.5	3.15	—	—	3.15	—			
		6.0	4.2	—	—	4.2	—			
	$V_{IL}$	2.0	—	—	0.5	—	0.5	V		
		4.5	—	—	1.35	—	1.35			
		6.0	—	—	1.8	—	1.8			
Output voltage	$V_{OH}$	2.0	1.9	2.0	—	1.9	—	V	$V_{in} = V_{IH}\text{ or }V_{IL}$	$I_{OH} = -20\ \mu\text{A}$
		4.5	4.4	4.5	—	4.4	—			$I_{OH} = -4\ \text{mA}$
		6.0	5.9	6.0	—	5.9	—			$I_{OH} = -5.2\ \text{mA}$
		4.5	4.18	—	—	4.13	—			
		6.0	5.68	—	—	5.63	—			
	$V_{OL}$	2.0	—	0.0	0.1	—	0.1	V	$V_{in} = V_{IH}\text{ or }V_{IL}$	$I_{OL} = 20\ \mu\text{A}$
		4.5	—	0.0	0.1	—	0.1			
		6.0	—	0.0	0.1	—	0.1			
		4.5	—	—	0.26	—	0.33			$I_{OL} = 4\ \text{mA}$
		6.0	—	—	0.26	—	0.33			$I_{OL} = 5.2\ \text{mA}$
Input current	$I_{in}$	6.0	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$	$V_{in} = V_{CC}\text{ or GND}$	
Quiescent supply current	$I_{CC}$	6.0	—	—	2.0	—	20	$\mu\text{A}$	$V_{in} = V_{CC}\text{ or GND}, I_{out} = 0\ \mu\text{A}$	

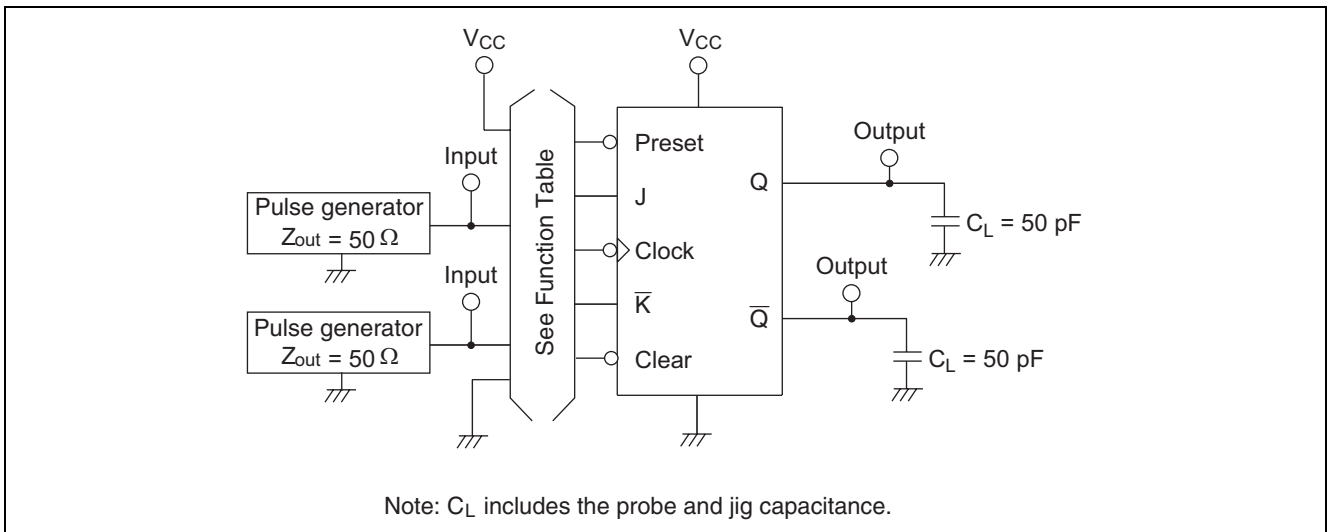
### Switching Characteristics ( $C_L = 50\ \text{pF}$ , Input $t_r = t_f = 6\ \text{ns}$ )

Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40\text{ to }+85^\circ\text{C}$		Unit	Test Conditions	
			Min	Typ	Max	Min	Max			
Maximum clock frequency	$f_{max}$	2.0	—	—	5	—	4	ns		
		4.5	—	—	27	—	21			
		6.0	—	—	32	—	25			
Propagation delay time	$t_{PLH}, t_{PHL}$	2.0	—	—	175	—	220	ns	Clock to Q or $\bar{Q}$	
		4.5	—	15	35	—	44			
		6.0	—	—	30	—	37			
	$t_{rem}$	2.0	—	—	190	—	240	ns	Preset or Clear to Clock	
		4.5	—	14	38	—	48			
		6.0	—	—	32	—	41			
Removal time	$t_{rem}$	2.0	25	—	—	32	—	ns		
		4.5	5	1	—	6	—			
		6.0	4	—	—	5	—			

**Switching Characteristics** ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

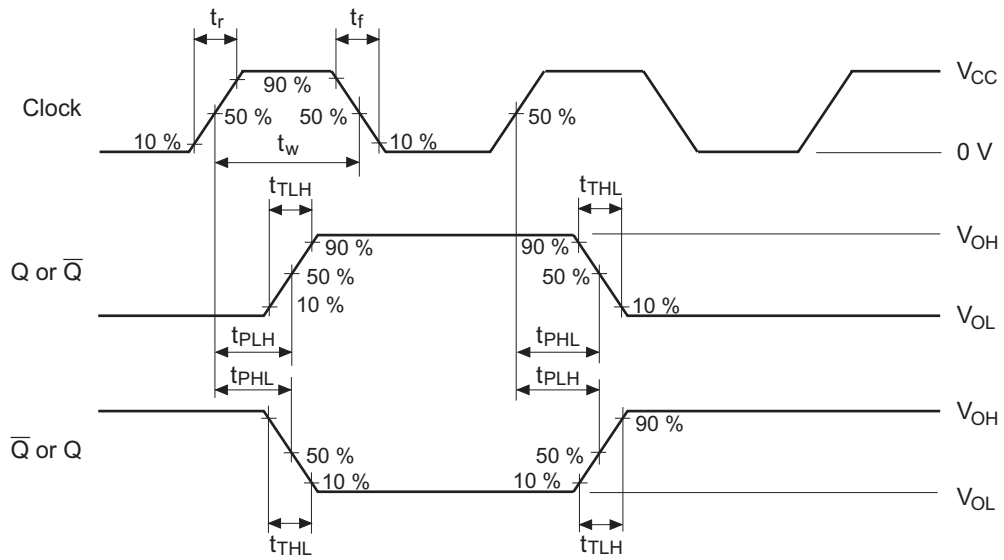
Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } +85^\circ\text{C}$		Unit	Test Conditions
			Min	Typ	Max	Min	Max		
Setup time	$t_{su}$	2.0	100	—	—	125	—	ns	Data to Latch Enable
		4.5	20	4	—	25	—		
		6.0	17	—	—	21	—		
Hold time	$t_h$	2.0	0	—	—	0	—	ns	Latch Enable to Data
		4.5	0	-4	—	0	—		
		6.0	0	—	—	0	—		
Pulse width	$t_w$	2.0	80	—	—	100	—	ns	Latch Enable
		4.5	16	5	—	20	—		
		6.0	14	—	—	17	—		
Output rise/fall time	$t_{TLH}, t_{THL}$	2.0	—	—	75	—	95	ns	
		4.5	—	5	15	—	19		
		6.0	—	—	13	—	16		
Input capacitance	$C_{in}$	—	—	5	10	—	10	pF	

**Test Circuit**

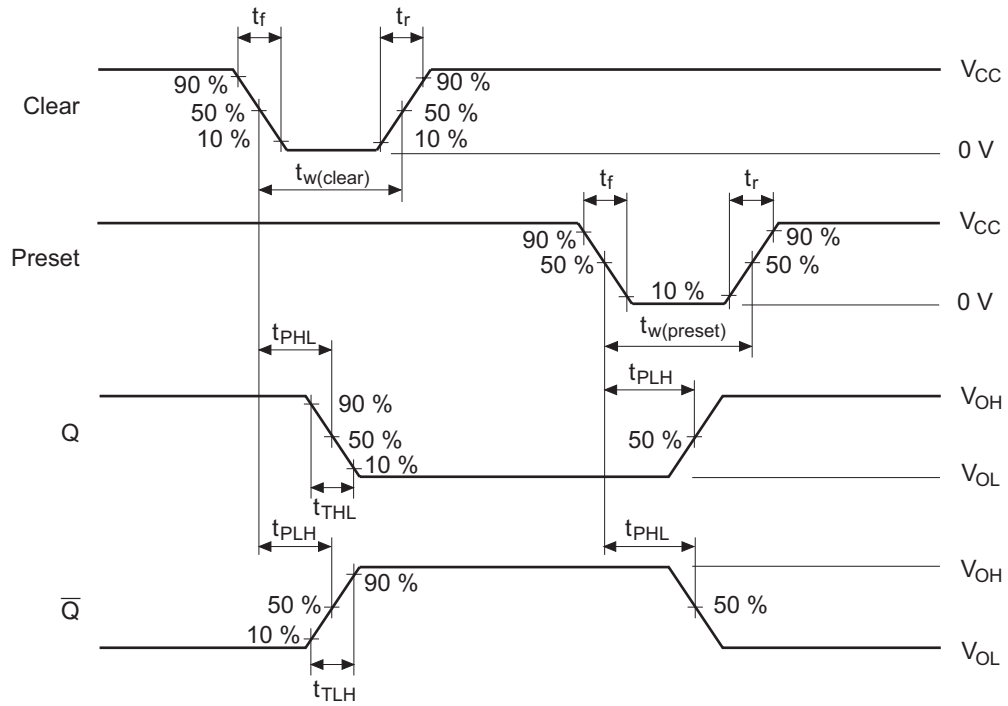


Waveforms

• Waveform – 1

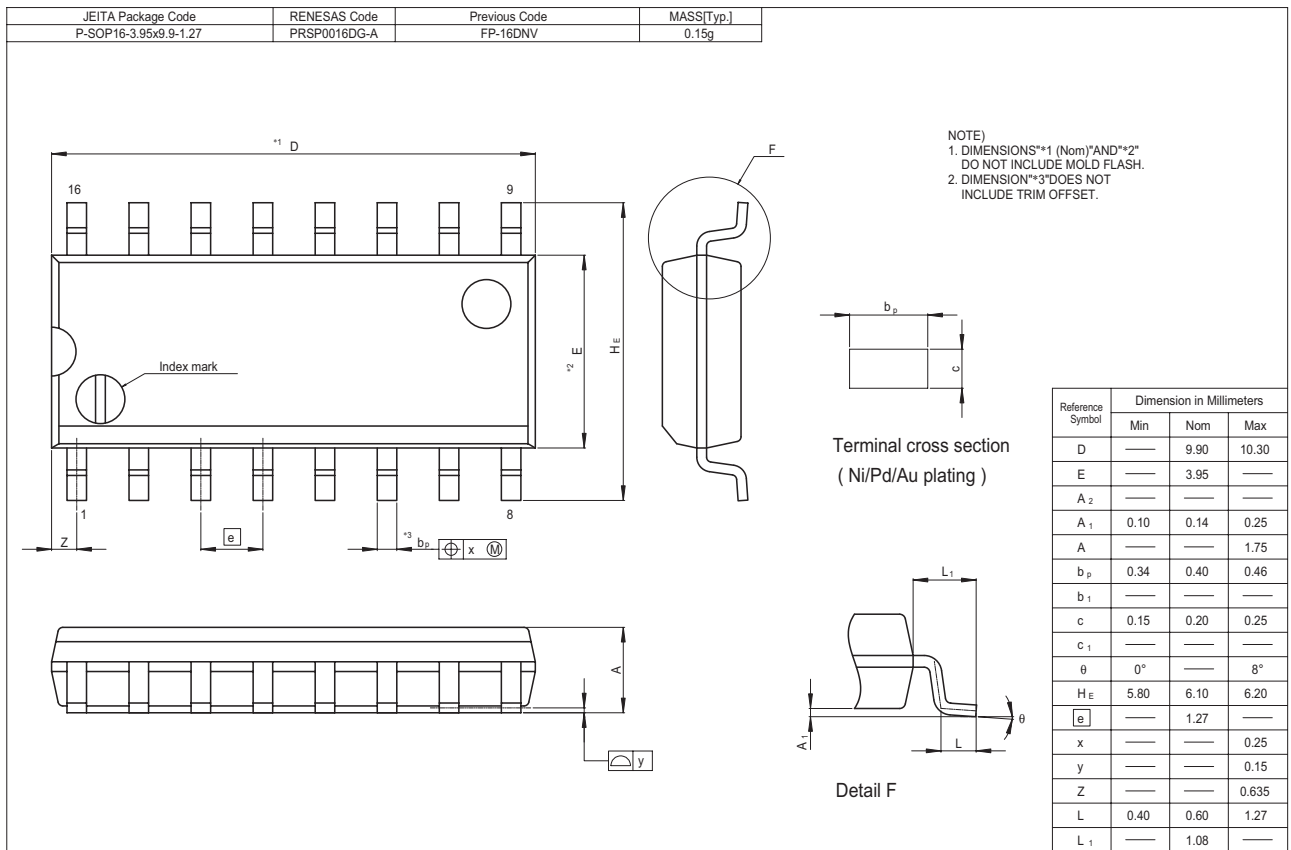
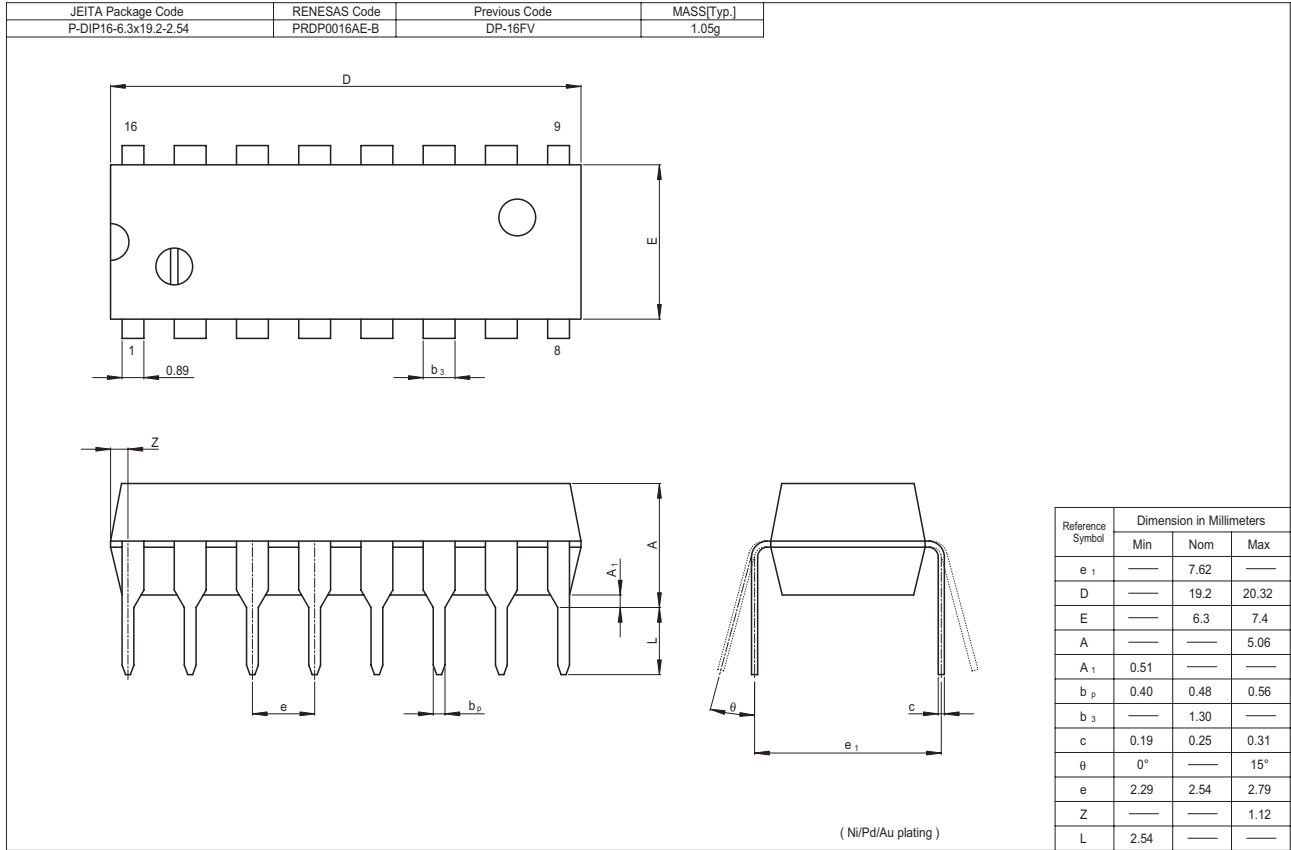


• Waveform – 2

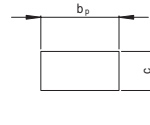
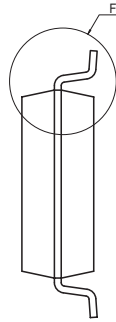
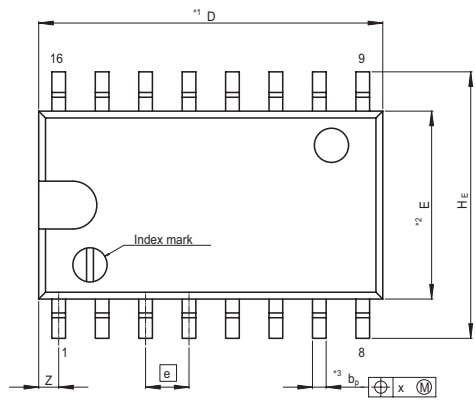


- Notes: 1. Input waveform:  $PRR \leq 1 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_r \leq 6 \text{ ns}$ ,  $t_f \leq 6 \text{ ns}$   
 2. The output are measured one at a time with one transition per measurement.

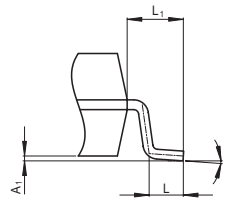
Package Dimensions



JEITA Package Code P-SOP16-5.5x10.06-1.27	RENESAS Code PRSP0016DH-B	Previous Code FP-16DAV	MASS[Typ.] 0.24g
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Terminal cross section  
( Ni/Pd/Au plating )



Detail F

NOTE)  
1. DIMENSIONS\*1 (Nom)\*AND\*2\*  
DO NOT INCLUDE MOLD FLASH.  
2. DIMENSION\*3\*DOES NOT  
INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	10.06	10.5
E	—	5.50	—
A <sub>2</sub>	—	—	—
A <sub>1</sub>	0.00	0.10	0.20
A	—	—	2.20
b <sub>p</sub>	0.34	0.40	0.46
b <sub>1</sub>	—	—	—
c	0.15	0.20	0.25
c <sub>1</sub>	—	—	—
$\theta$	0°	—	8°
H <sub>E</sub>	7.50	7.80	8.00
e	—	1.27	—
x	—	—	0.12
y	—	—	0.15
Z	—	—	0.80
L	0.50	0.70	0.90
L <sub>1</sub>	—	1.15	—

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