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M81016P/FP/KP

OCTAL D-TYPE FLIP-FLOP DRIVER WITH CLEAR

DESCRIPTION

M81016 is octal D-type flip-flop driver by 20-pin package. It has 8 same circuit units which is composed of D-type flip-flop logic circuit and high voltage NchMOS output transistor. M81016 has a common direct clear input and a common clock input.

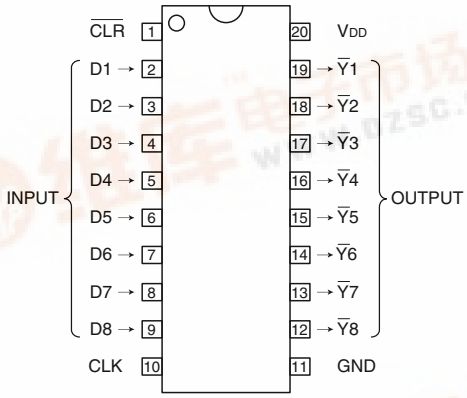
FEATURES

- Lineup with three packages
- High breakdown voltage (BV_{DSX} ≥ 40V)
- Drain output current ($I_{DS(max)}$ = 200mA)
- With input protection diodes
- Pin assignment of input-output flow through
- Wide operating temperature range (Ta = –40 to +85°C)

APPLICATION

LED drive

PIN CONFIGURATION (TOP VIEW)



Package type 20P4B(P)
20P2N-A(FP)
20P2E-A(KP)

FUNCTION

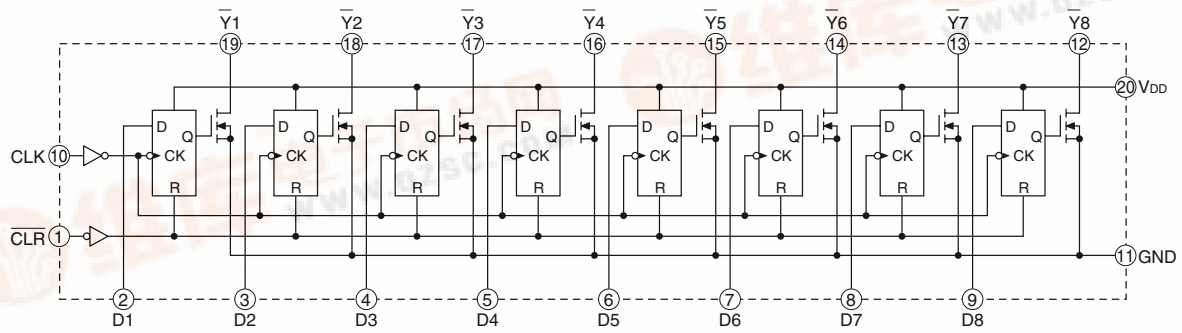
The common direct clear input and common clock input are connected to every circuit unit by the same way. Signal at the D inputs is transferred to $\overline{Y}$ outputs by D-type flip-flops on the positive-going edge of the clock pulse.

If $\overline{CLR}$ is set to “L”, outputs $\overline{Y}$1-$\overline{Y}$8 will be altogether set to “H” regardless of D1-D8 and CLK.

The maximum drain current of an output is 200mA. The maximum between drain-source is 40V.

Moreover, M81016FP/KP can save space with mini-flat package.

LOGIC DIAGRAM (POSITIVE LOGIC)



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M81016P/FP/KP

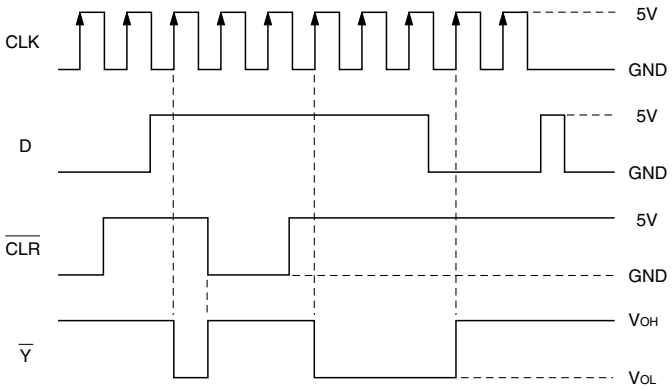
OCTAL D-TYPE FLIP-FLOP DRIVER WITH CLEAR

FUNCTION TABLE (EACH CHANNEL)

INPUT			OUTPUT : $\overline{Y}$
$\overline{CLR}$	CLK	D	
L	X	X	H
H	↑	L	H
H	↑	H	L
H	L	X	Latched
H	↓	X	Latched

H : High level
L : Low level
X : Irrelevant

TIMING DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Unless otherwise noted, Ta = –40 ~ +85°C)

Symbol	Parameter	Conditions		Ratings	Unit
V_{DD}	Supply voltage			7	V
V_{DS}	Drain-to-source voltage	Output, H		–0.5 ~ +40	V
V_I	Input voltage			–0.5 ~ V_{DD}	V
I_{DS}	Drain output current	Current per circuit output, L		200	mA
P_d	Power dissipation	Ta = 25°C, when mounted on board	M81016P	1.47	W
			M81016FP	1.10	
			M81016KP	0.68	
T_{opr}	Operating temperature			–40 ~ +85	°C
T_{stg}	Storage temperature			–55 ~ +125	°C

RECOMMENDED OPERATING CONDITIONS (Unless otherwise noted, Ta = –40 ~ +85°C)

Symbol	Parameter		Conditions	Limits			Unit
				min	typ	max	
V_{DD}	Supply voltage			4.5	5.0	5.5	V
V_{DS}	Drain-to-source voltage			0	—	40	V
V_{IH}	"H" input voltage			0.7V_{DD}	—	V_{DD}	V
V_{IL}	"L" input voltage			0	—	0.3V_{DD}	V
I_{DS}	Drain output current (Current per 1 circuit when 8 circuits are coming on simultaneously)	P	Duty Cycle no more than 45%	0	—	200	mA
			Duty Cycle no more than 100%	0	—	135	
		FP	Duty Cycle no more than 34%	0	—	200	
			Duty Cycle no more than 100%	0	—	120	
		KP	Duty Cycle no more than 18%	0	—	200	
			Duty Cycle no more than 100%	0	—	95	
V_{IN}	Input voltage			0	—	V_{DD}	V
t_r,t_f	Rise time, Fall time, drain output		V_{DD} = 4.5V	0	—	500	ns
t_{su}	Setup time before CLK ↑		V_{DD} = 4.5V	20	—	—	ns
t_h	Hold time, data after CLK ↑		V_{DD} = 4.5V	5	—	—	ns
t_w	Pulse duration		V_{DD} = 4.5V	40	—	—	ns
f	Clock frequency		V_{DD} = 4.5V	—	—	20	MHz

MITSUBISHI ELECTRIC

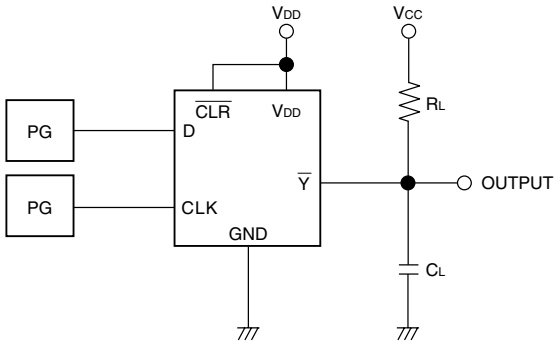
ELECTRICAL CHARACTERISTICS (Unless otherwise noted, V_{DD} = 5V, Ta = 25°C)

Symbol	Parameter	Test conditions		Limits			Unit
				min	typ	max	
$V_{(BR)DSX}$	Drain-source breakdown voltage	I_{DS} = 1mA		40	—	—	V
I_{DSX}	Drain-source leakage current	V_{DS} = 40V		—	0.002	5	μA
I_{IH}	"H" input current	V_{DD} = 5.5V, V_I = 5.5V		—	0.005	1	μA
I_{IL}	"L" input current	V_{DD} = 5.5V, V_I = 0V		—	0.005	–1	μA
I_{CC}	Supply current	V_{DD} = 5.5V	All outputs off	—	0.005	5	μA
		V_I = 5.5V or 0V	All outputs on	—	0.005	5	
V_{DS}	"L" output voltage	I_{DS} = 100mA, V_{DD} = 4.5V		—	0.25	0.38	V
		I_{DS} = 200mA, V_{DD} = 4.5V		—	0.51	0.77	
$R_{DS(on)}$	Drain-source on-state resistance	I_{DS} = 100mA, V_{DD} = 4.5V		—	2.5	3.8	Ω

SWITCHING CHARACTERISTICS (V_{DD} = 5V, Ta = 25°C)

Symbol	Parameter	Test conditions	Limits			Unit
			min	typ	max	
t_{TLH}	Low-level to high-level and high-level to low-level output transition time	C_L = 30pF (Note 1)	—	10	—	ns
t_{THL}			—	3	—	ns
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (CLK)		—	35	—	ns
t_{PHL}			—	30	—	ns
$t_{PLH(R)}$	Low-level to high-level output propagation time ($\overline{CLR}$)		—	35	—	ns

NOTE 1 TEST CIRCUIT

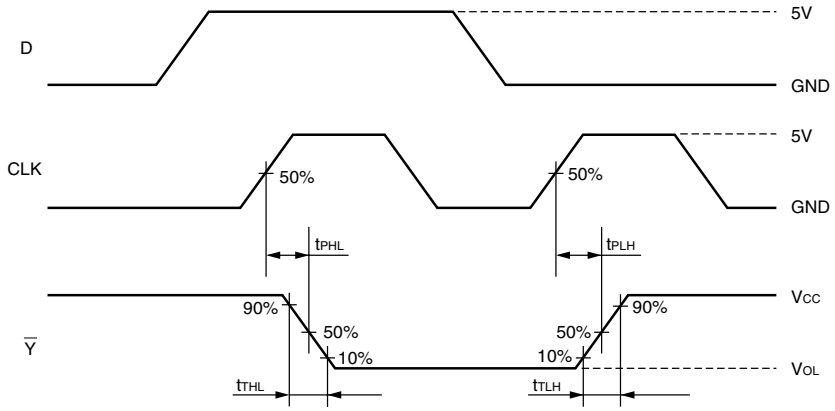


(1) Pulse generator (PG) characteristics : PRR = 1MHz, Duty Cycle = 50%, t_r = 6ns, t_f = 6ns, Zo = 50Ω, V_I = 5V

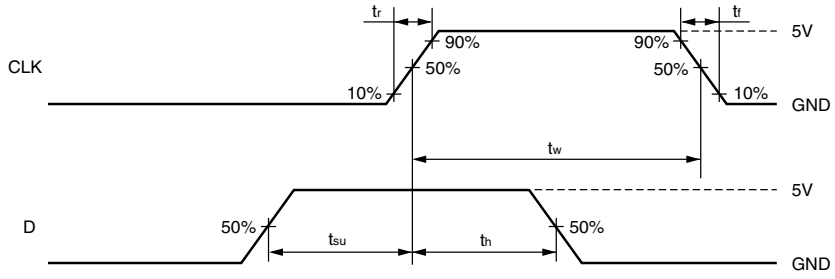
(2) Output conditions : R_L = 240Ω, V_{CC} = 24V, V_{DD} = 5V

(3) Electrostatic capacity C_L includes floating capacitance at connections and input capacitance at probes.

TIMING DIAGRAM



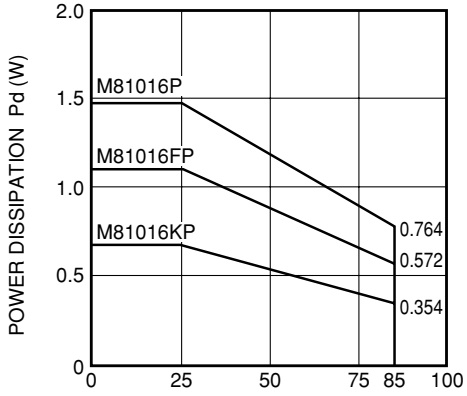
SWITCHING TIMES



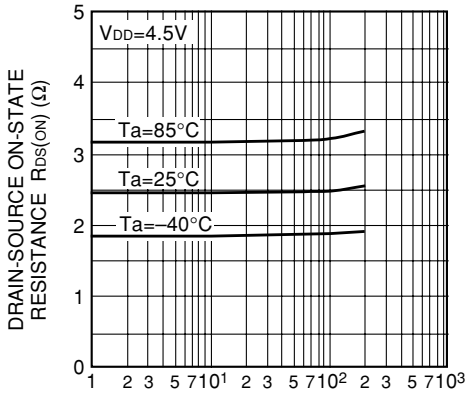
INPUT SETUP AND HOLD WAVEFORMS

TYPICAL CHARACTERISTICS

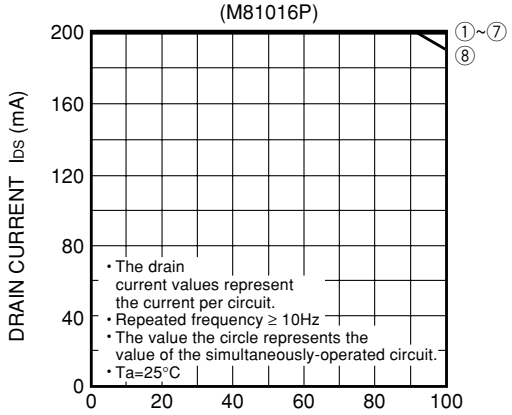
THERMAL DERATING FACTOR CHARACTERISTICS



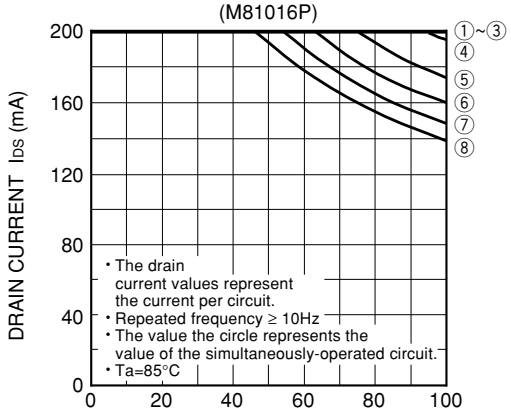
DRAIN-SOURCE ON-STATE RESISTANCE VS DRAIN CURRENT CHARACTERISTICS



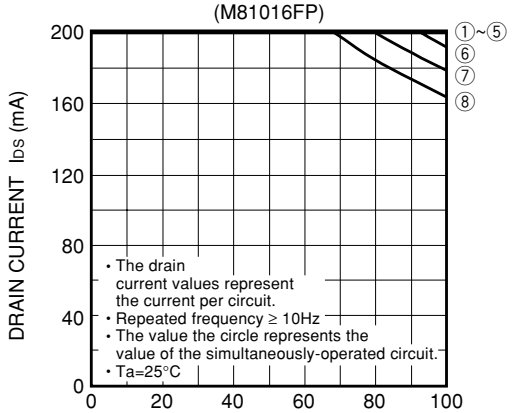
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016P)



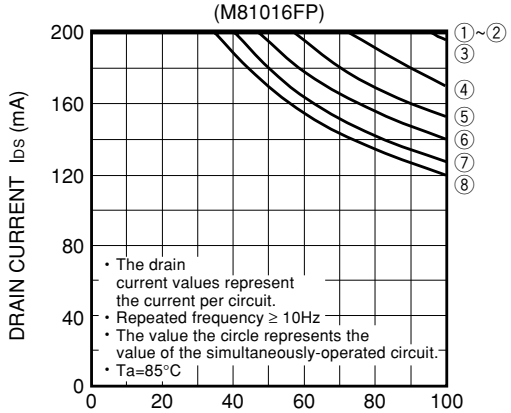
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016P)



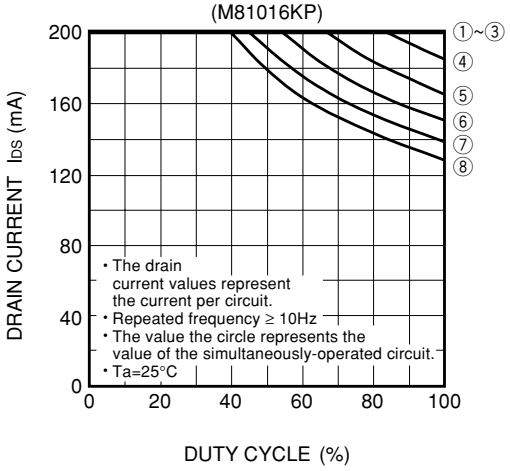
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016FP)



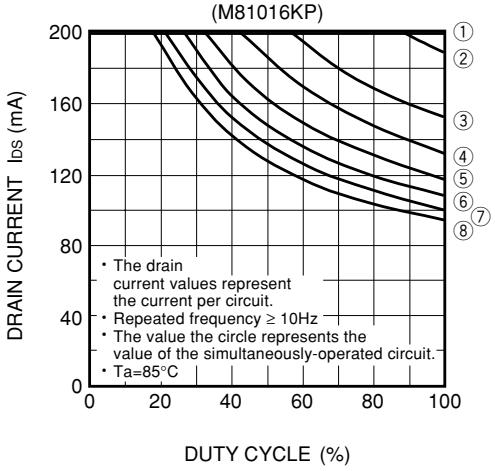
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016FP)



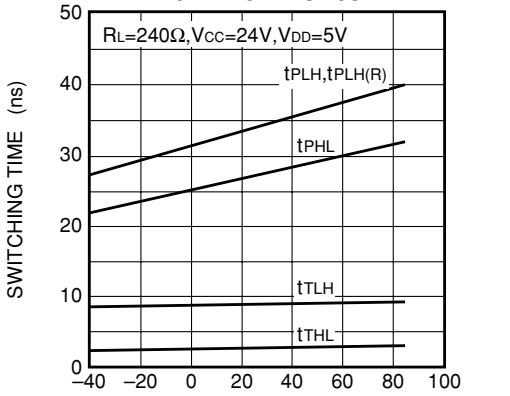
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016KP)



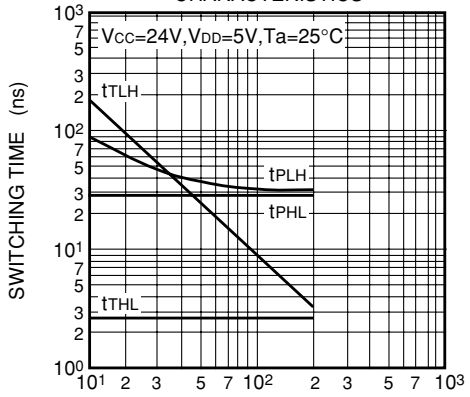
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016KP)



SWITCHING TIME-AMBIENT TEMPERATURE CHARACTERISTICS



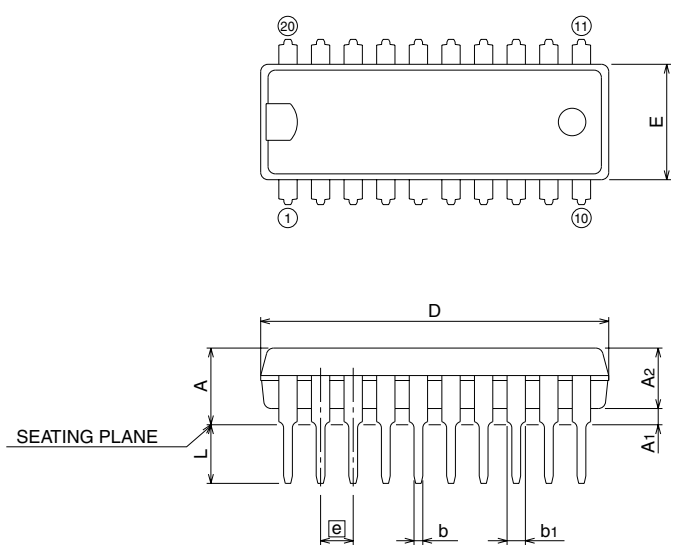
SWITCHING TIME-DRAIN CURRENT CHARACTERISTICS



20P4B

Plastic 20pin 300mil SDIP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SDIP20-P-300-1.78	–	1.0	Alloy 42/Cu Alloy

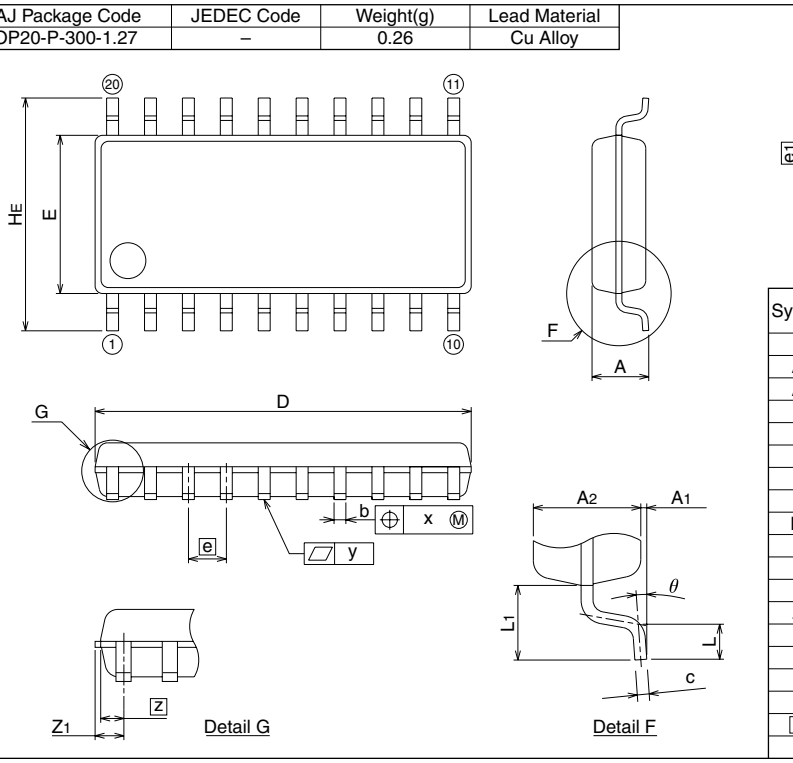


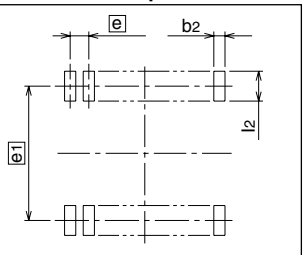
Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	–	–	4.5
A1	0.51	–	–
A2	–	3.3	–
b	0.38	0.48	0.58
b1	0.9	1.0	1.3
c	0.22	0.27	0.34
D	18.8	19.0	19.2
E	6.15	6.3	6.45
e	–	1.778	–
e1	–	7.62	–
L	3.0	–	–
θ	0°	–	15°

20P2N-A

Plastic 20pin 300mil SOP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SOP20-P-300-1.27	–	0.26	Cu Alloy





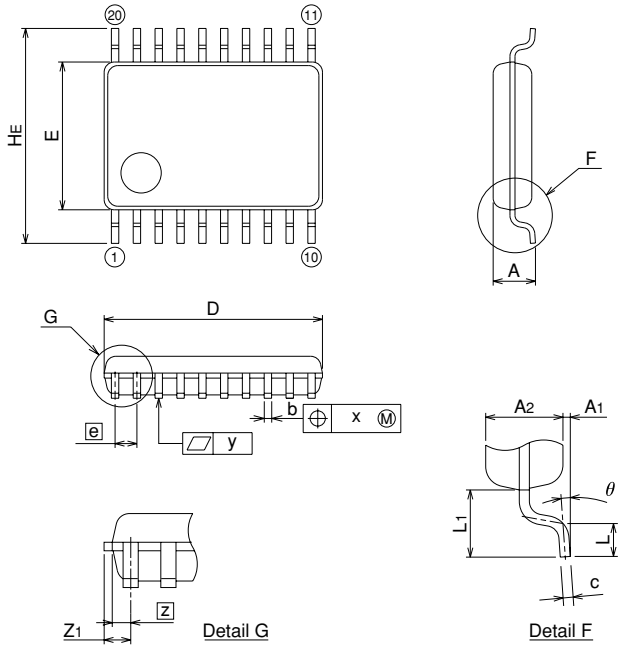
Recommended Mount Pad

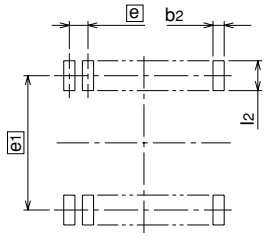
Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	–	–	2.1
A1	0	0.1	0.2
A2	–	1.8	–
b	0.35	0.4	0.5
c	0.18	0.2	0.25
D	12.5	12.6	12.7
E	5.2	5.3	5.4
e	–	1.27	–
HE	7.5	7.8	8.1
L	0.4	0.6	0.8
L1	–	1.25	–
Z	–	0.585	–
Z1	–	–	0.735
x	–	–	0.25
y	–	–	0.1
θ	0°	–	8°
b2	–	0.76	–
e1	–	7.62	–
l2	1.27	–	–

20P2E-A

Plastic 20pin 225mil SSOP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SSOP20-P-225-0.65	–	0.08	Alloy 42





Recommended Mount Pad

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	–	–	1.45
A_1	0	0.1	0.2
A_2	–	1.15	–
b	0.17	0.22	0.32
c	0.13	0.15	0.2
D	6.4	6.5	6.6
E	4.3	4.4	4.5
e	–	0.65	–
H_E	6.2	6.4	6.6
L	0.3	0.5	0.7
L_1	–	1.0	–
z	–	0.325	–
Z_1	–	–	0.475
x	–	–	0.13
y	–	–	0.1
θ	0°	–	10°
b_2	–	0.35	–
e_1	–	5.8	–
l_2	1.0	–	–