# 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.

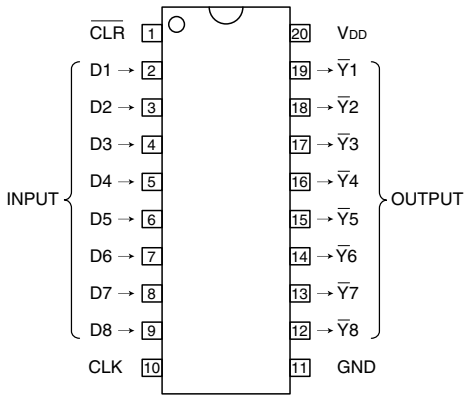
## FEATURES

- Lineup with three packages
- High breakdown voltage ($BV_{DSX} \geq 40V$)
- 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

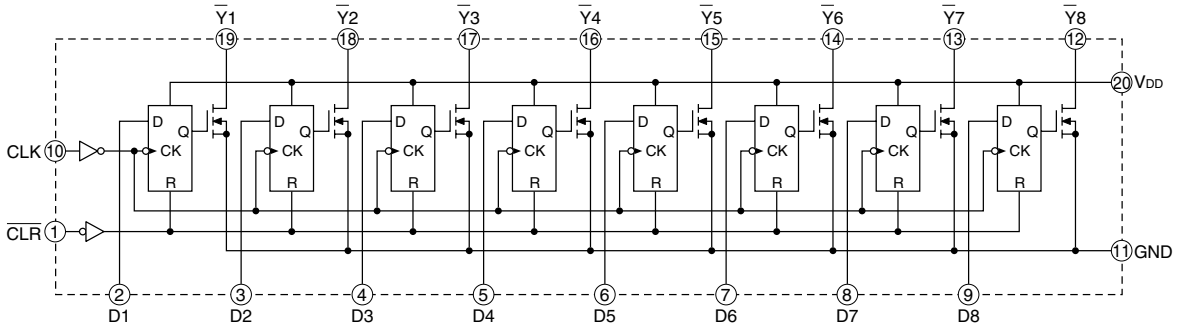
The common direct clear input and common clock input are connected to every circuit unit by the same way. Signal at the D inputs is transferred to $\overline{Y}$ outputs by D-type flip-flops on the positive-going edge of the clock pulse.

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)






MITSUBISHI ELECTRIC

# M81016P/FP/KP

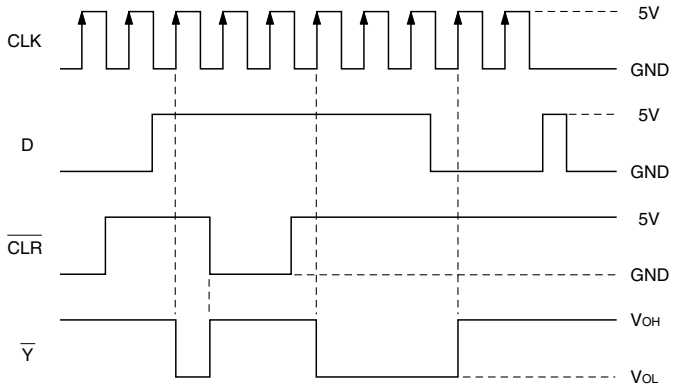
OCTAL D-TYPE FLIP-FLOP DRIVER WITH CLEAR

## 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 | | | 0.7$V_{DD}$ | — | $V_{DD}$ | V |
| $V_{IL}$ | “L” input voltage | | | 0 | — | 0.3$V_{DD}$ | 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

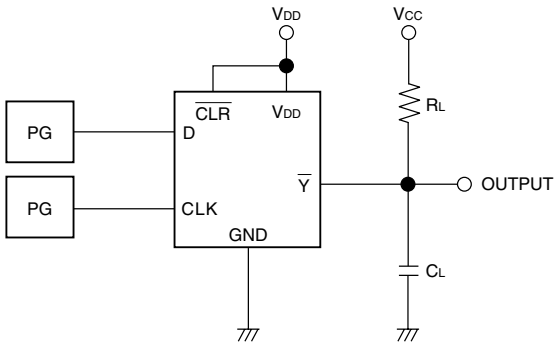
**ELECTRICAL CHARACTERISTICS (Unless otherwise noted, $V_{DD}$ = 5V, Ta = 25°C)**

| 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**

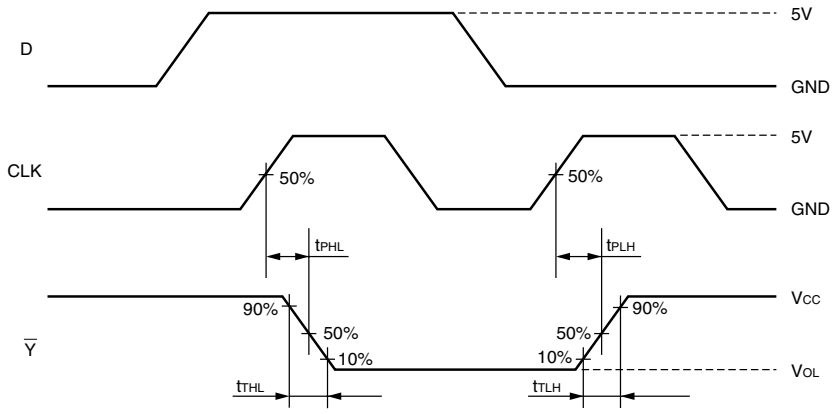



(1) Pulse generator (PG) characteristics : PRR = 1MHz, Duty Cycle = 50%, $t_r$ = 6ns, $t_f$ = 6ns, $Z_O$ = 50Ω, $V_I$ = 5V

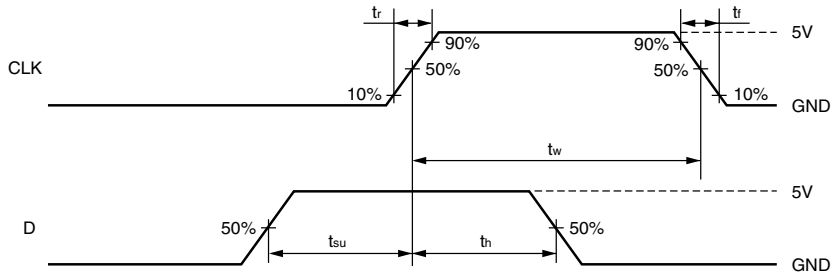
(2) Output conditions : $R_L$ = 240Ω, $V_{CC}$ = 24V, $V_{DD}$ = 5V

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

**TIMING DIAGRAM**



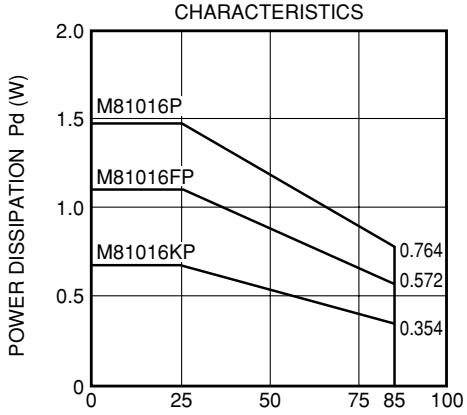

SWITCHING TIMES



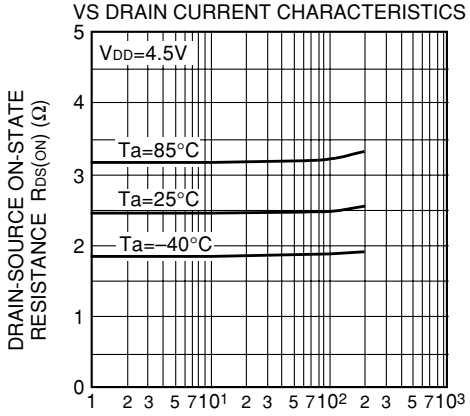

INPUT SETUP AND HOLD WAVEFORMS

## TYPICAL CHARACTERISTICS

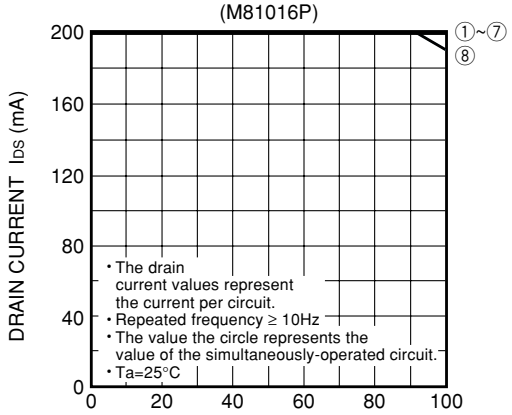
THERMAL DERATING FACTOR CHARACTERISTICS



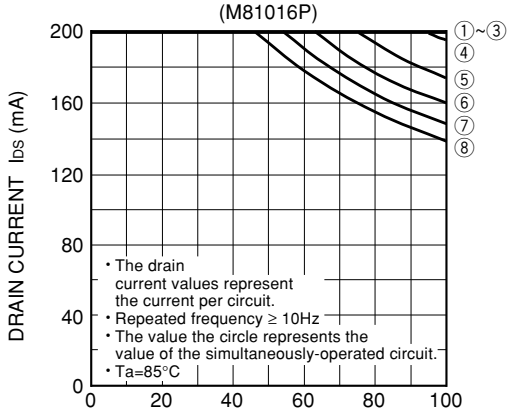

DRAIN-SOURCE ON-STATE RESISTANCE VS DRAIN CURRENT CHARACTERISTICS



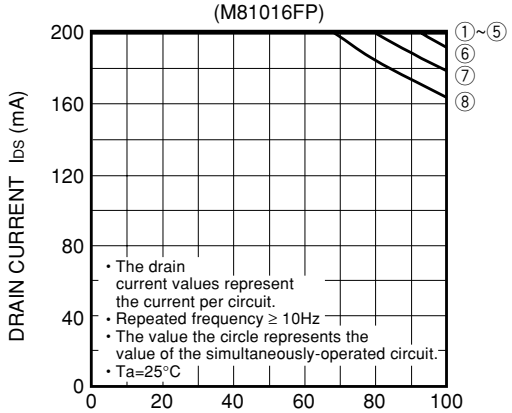

DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016P)



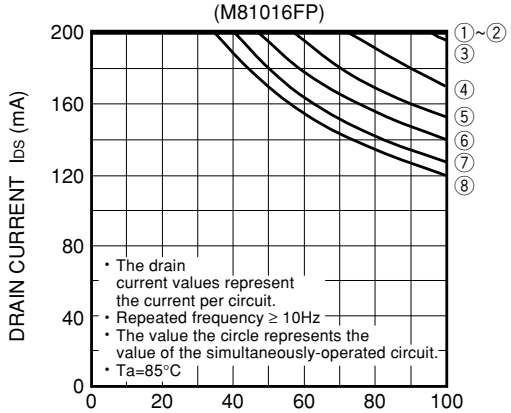

DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016P)



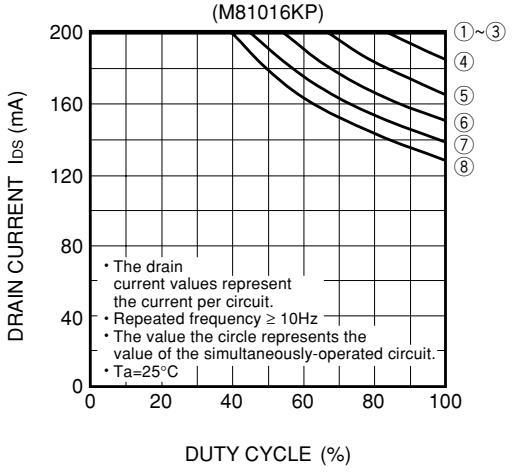

DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016FP)



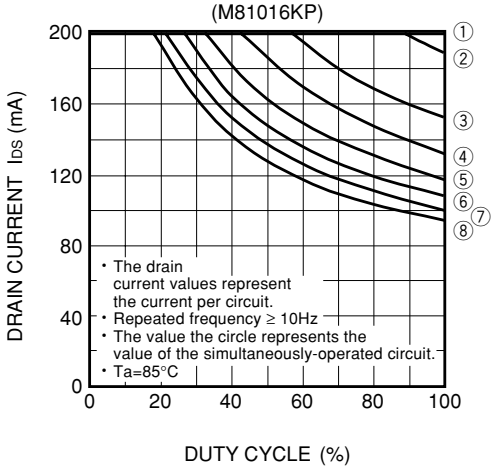

DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016FP)



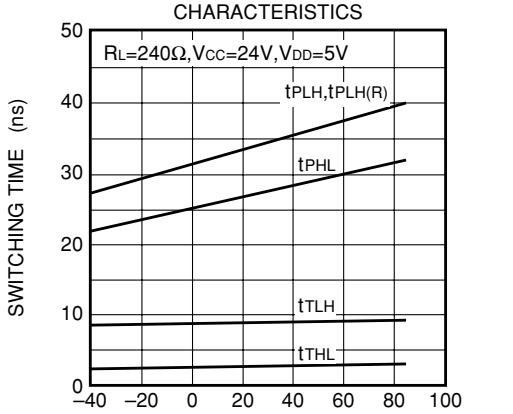
DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016KP)



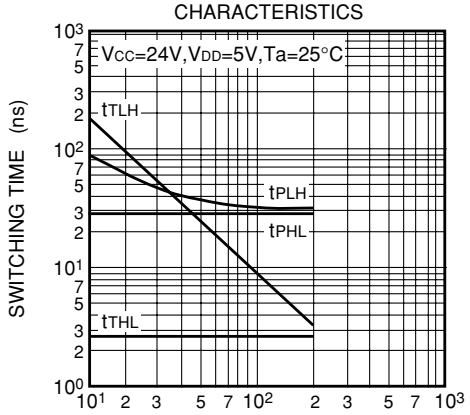

DUTY CYCLE-DRAIN CURRENT CHARACTERISTICS (M81016KP)




SWITCHING TIME-AMBIENT TEMPERATURE CHARACTERISTICS



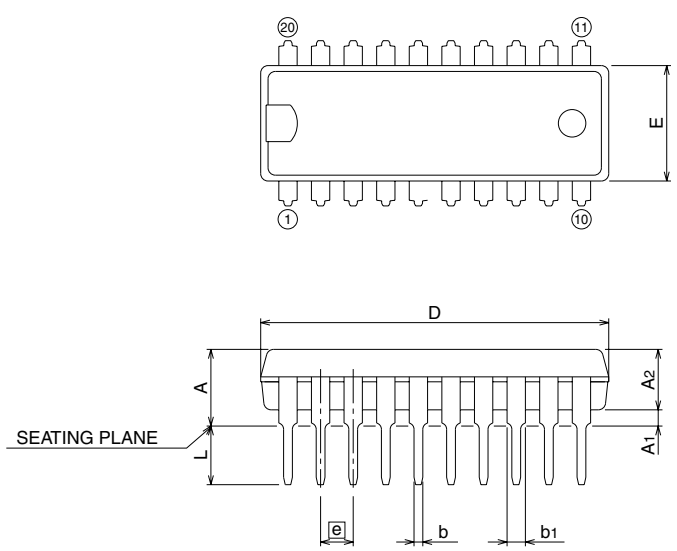

SWITCHING TIME-DRAIN CURRENT CHARACTERISTICS



## 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 |

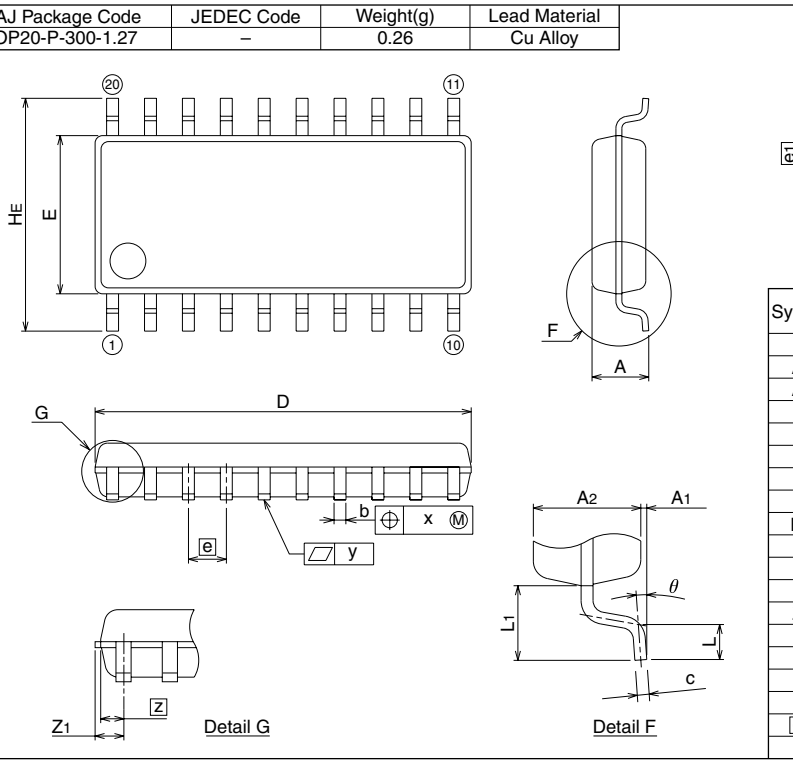


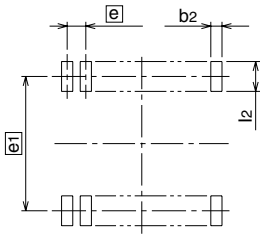

| Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| A | – | – | 4.5 |
| A1 | 0.51 | – | – |
| A2 | – | 3.3 | – |
| b | 0.38 | 0.48 | 0.58 |
| b1 | 0.9 | 1.0 | 1.3 |
| c | 0.22 | 0.27 | 0.34 |
| D | 18.8 | 19.0 | 19.2 |
| E | 6.15 | 6.3 | 6.45 |
| e | – | 1.778 | – |
| 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 |



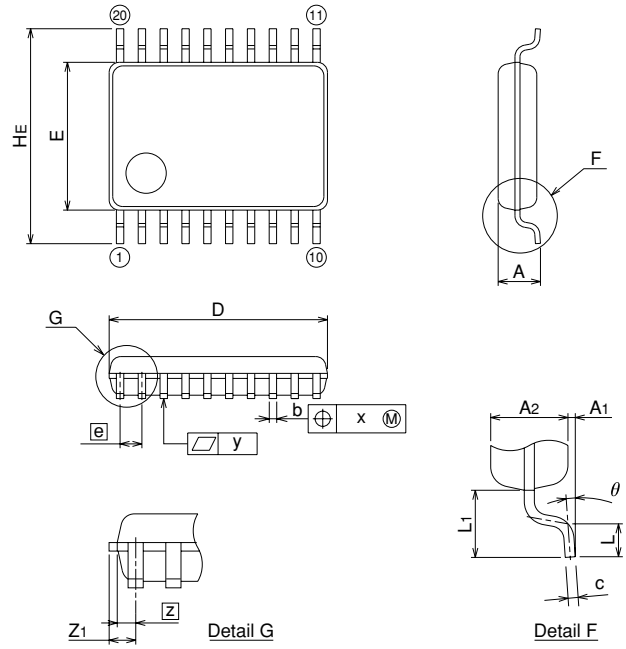

Recommended Mount Pad

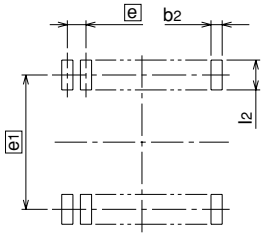
| Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| A | – | – | 2.1 |
| A1 | 0 | 0.1 | 0.2 |
| A2 | – | 1.8 | – |
| b | 0.35 | 0.4 | 0.5 |
| c | 0.18 | 0.2 | 0.25 |
| D | 12.5 | 12.6 | 12.7 |
| E | 5.2 | 5.3 | 5.4 |
| e | – | 1.27 | – |
| HE | 7.5 | 7.8 | 8.1 |
| L | 0.4 | 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 | – | – |