

## Voltage Supervisor

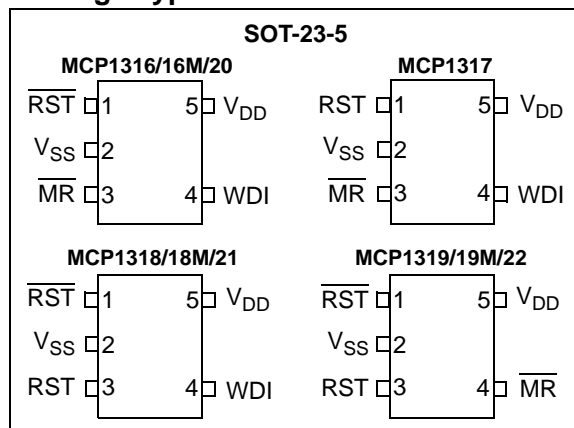
### Features

- Low supply current: 1  $\mu$ A (typical), 10  $\mu$ A (max.)
- Precision monitoring trip point options:
  - 2.9V and 4.6V (Standard Offerings)
  - 2.0V to 4.7V in 100 mV increments, (Contact the local Microchip Sales Office)
- Resets microcontroller in a power-loss event
- Reset Delay Time Out Option:
  - 1.4 ms, 30 ms, 200 ms, or 1.6s (typical)
- Watchdog Timer Input Time Out Options:
  - 6.3 ms, 102 ms, 1.6s, or 25.6s (typical)
- Manual Reset ( $\overline{\text{MR}}$ ) input (active-low)
- Single and Complementary Reset output(s)
- Reset Output Options:
  - Push-Pull (active-high or active-low)
  - Open-Drain (internal or external Pull-up)
- Temperature Range:
  - $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  for trip points 2.0 to 2.4V and,
  - $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  for trip points  $> 2.5\text{V}$
- Voltage Range: 1.0V to 5.5V
- Lead Free Packaging

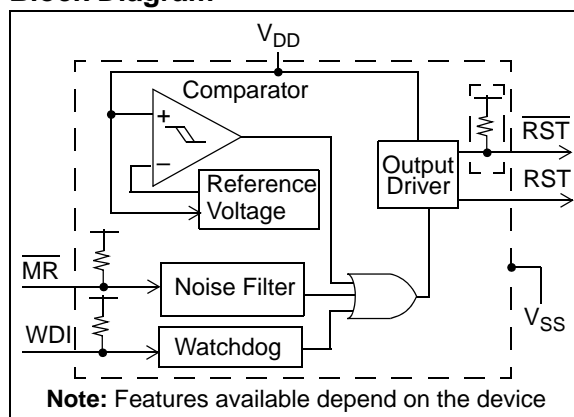
### Description

The MCP131X/2X are voltage supervisor devices designed to keep a microcontroller in Reset until the system voltage has reached and stabilized at the proper level for reliable system operation. The table below shows the available features for these devices.

### Package Types



### Block Diagram



### Device Features

Device	Reset Output A			Reset Output B			WDI Input	$\overline{\text{MR}}$ Input
	Type	Pull-up Resistor	Active Level	Type	Pull-up Resistor	Active Level		
MCP1316	Push-Pull	—	Low	—	—	—	Yes	Yes
MCP1316M	Open-Drain	Internal	Low	—	—	—	Yes	Yes
MCP1317	Push-Pull	—	High	—	—	—	Yes	Yes
MCP1318	Push-Pull	—	Low	Push-Pull	—	High	Yes	No
MCP1318M	Open-Drain	Internal	Low	Push-Pull	—	High	Yes	No
MCP1319	Push-Pull	—	Low	Push-Pull	—	High	No	Yes
MCP1319M	Open-Drain	Internal	Low	Push-Pull	—	High	No	Yes
MCP1320	Open-Drain	External	Low	—	—	—	Yes	Yes
MCP1321	Open-Drain	External	Low	Push-Pull	—	High	Yes	No
MCP1322	Open-Drain	External	Low	Push-Pull	—	High	No	Yes

# MCP131X/2X

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Supply Voltage ( $V_{DD}$ to $V_{SS}$ )	7.0V
Input current ( $V_{DD}$ )	10 mA
Output current ( $\overline{RST}$ )	10 mA
Voltage on all inputs and outputs, except Open-Drain $\overline{RST}$ (with no internal pull-up resistor), w.r.t. $V_{SS}$	-0.6V to ( $V_{DD} + 1.0V$ )
Voltage on Open-Drain $\overline{RST}$ (with no internal pull-up resistor) w.r.t. $V_{SS}$	-0.6V to 13.5V
Storage temperature	-65°C to +150°C
Ambient temp. with power applied	-40°C to +125°C
Maximum Junction temp. with power applied	150°C
Power Dissipation ( $T_A \leq 70^\circ\text{C}$ ):	
5-Pin SOT-23A	240 mW
ESD protection on all pins	$\geq 4$ kV

† **Notice:** Stresses above those listed under “Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

## DC CHARACTERISTICS

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions
Operating Voltage Range	$V_{DD}$	1.0	—	5.5	V	
Specified $V_{DD}$ Value to $V_{OUT}$ Low	$V_{DD}$	1.0	—	—	V	$I_{\overline{RST}} = 10\ \mu\text{A}$ , $V_{\overline{RST}} < 0.3V$
Operating Current:	$I_{DD}$	—	5	10	$\mu\text{A}$	Watchdog Timer Active
		—	1	2	$\mu\text{A}$	Watchdog Timer Inactive
		—	1	2	$\mu\text{A}$	$V_{DD} < V_{TRIP}$
		—	5	10	$\mu\text{A}$	Reset Delay Timer Active

- Note**
- 1: Trip point is  $\pm 1.5\%$  from typical value.
  - 2: Trip point is  $\pm 2.5\%$  from typical value.
  - 3: Hysteresis is minimum = 1%, maximum = 6% at  $+25^\circ\text{C}$ .
  - 4: This specification allows this device to be used in PIC<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). The total time that the  $\overline{RST}$  pin can be above the maximum device operational voltage (5.5V) is 100s. Current into the  $\overline{RST}$  pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  ( $+25^\circ\text{C}$  preferred). For additional information, refer to [Figure 2-35](#).
  - 5: This parameter is established by characterization and is not 100% tested.
  - 6: Custom ordered voltage trip point; minimum order volume requirement. Information available upon request.

## DC CHARACTERISTICS (CONTINUED)

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters		Sym	Min	Typ	Max	Units	Conditions
V <sub>DD</sub> Trip Point	MCP13XX-20 (Note 6)	V <sub>TRIP</sub>	1.970	2.00	2.030	V	T <sub>A</sub> = +25°C (Note 1)
			1.950	2.00	2.050	V	T <sub>A</sub> = -40°C to +85°C (Note 2)
	MCP13XX-21 (Note 6)		2.069	2.10	2.132	V	T <sub>A</sub> = +25°C (Note 1)
			2.048	2.10	2.153	V	T <sub>A</sub> = -40°C to +85°C (Note 2)
	MCP13XX-22 (Note 6)		2.167	2.20	2.233	V	T <sub>A</sub> = +25°C (Note 1)
			2.145	2.20	2.255	V	T <sub>A</sub> = -40°C to +85°C (Note 2)
	MCP13XX-23 (Note 6)		2.266	2.30	2.335	V	T <sub>A</sub> = +25°C (Note 1)
			2.243	2.30	2.358	V	T <sub>A</sub> = -40°C to +85°C (Note 2)
	MCP13XX-24 (Note 6)		2.364	2.40	2.436	V	T <sub>A</sub> = +25°C (Note 1)
			2.340	2.40	2.460	V	T <sub>A</sub> = -40°C to +85°C (Note 2)
	MCP13XX-25 (Note 6)		2.463	2.50	2.538	V	T <sub>A</sub> = +25°C (Note 1)
			2.438	2.50	2.563	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-26 (Note 6)		2.561	2.60	2.639	V	T <sub>A</sub> = +25°C (Note 1)
			2.535	2.60	2.665	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-27 (Note 6)		2.660	2.70	2.741	V	T <sub>A</sub> = +25°C (Note 1)
			2.633	2.70	2.768	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-28 (Note 6)		2.758	2.80	2.842	V	T <sub>A</sub> = +25°C (Note 1)
			2.730	2.80	2.870	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-29		2.857	2.90	2.944	V	T <sub>A</sub> = +25°C (Note 1)
			2.828	2.90	2.973	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-30 (Note 6)		2.955	3.00	3.045	V	T <sub>A</sub> = +25°C (Note 1)
			2.925	3.00	3.075	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-31 (Note 6)		3.054	3.10	3.147	V	T <sub>A</sub> = +25°C (Note 1)
			3.023	3.10	3.178	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-32 (Note 6)		3.152	3.20	3.248	V	T <sub>A</sub> = +25°C (Note 1)
			3.120	3.20	3.280	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-33 (Note 6)		3.251	3.30	3.350	V	T <sub>A</sub> = +25°C (Note 1)
			3.218	3.30	3.383	V	T <sub>A</sub> = -40°C to +125°C (Note 2)

**Note 1:** Trip point is  $\pm 1.5\%$  from typical value.

**Note 2:** Trip point is  $\pm 2.5\%$  from typical value.

**Note 3:** Hysteresis is minimum = 1%, maximum = 6% at +25°C.

**Note 4:** This specification allows this device to be used in PIC<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). The total time that the RST pin can be above the maximum device operational voltage (5.5V) is 100s. Current into the RST pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between 0°C to +70°C (+25°C preferred). For additional information, refer to [Figure 2-35](#).

**Note 5:** This parameter is established by characterization and is not 100% tested.

**Note 6:** Custom ordered voltage trip point; minimum order volume requirement. Information available upon request.

# MCP131X/2X

## DC CHARACTERISTICS (CONTINUED)

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters		Sym	Min	Typ	Max	Units	Conditions
V <sub>DD</sub> Trip Point (Con't)	MCP13XX-34 (Note 6)	V <sub>TRIP</sub>	3.349	3.40	3.451	V	T <sub>A</sub> = +25°C (Note 1)
			3.315	3.40	3.385	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-35 (Note 6)		3.448	3.50	3.553	V	T <sub>A</sub> = +25°C (Note 1)
			3.413	3.50	3.588	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-36 (Note 6)		3.546	3.60	3.654	V	T <sub>A</sub> = +25°C (Note 1)
			3.510	3.60	3.690	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-37 (Note 6)		3.645	3.70	3.756	V	T <sub>A</sub> = +25°C (Note 1)
			3.608	3.70	3.793	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-38 (Note 6)		3.743	3.80	3.857	V	T <sub>A</sub> = +25°C (Note 1)
			3.705	3.80	3.895	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-39 (Note 6)		3.842	3.90	3.959	V	T <sub>A</sub> = +25°C (Note 1)
			3.803	3.90	3.998	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-40 (Note 6)		3.940	4.00	4.060	V	T <sub>A</sub> = +25°C (Note 1)
			3.900	4.00	4.100	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-41 (Note 6)		4.039	4.10	4.162	V	T <sub>A</sub> = +25°C (Note 1)
			3.998	4.10	4.203	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-42 (Note 6)		4.137	4.20	4.263	V	T <sub>A</sub> = +25°C (Note 1)
			4.095	4.20	4.305	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-43 (Note 6)		4.236	4.30	4.365	V	T <sub>A</sub> = +25°C (Note 1)
			4.193	4.30	4.408	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-44 (Note 6)		4.334	4.40	4.466	V	T <sub>A</sub> = +25°C (Note 1)
			4.290	4.40	4.510	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-45 (Note 6)		4.433	4.50	4.568	V	T <sub>A</sub> = +25°C (Note 1)
			4.388	4.50	4.613	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-46		4.531	4.60	4.669	V	T <sub>A</sub> = +25°C (Note 1)
			4.485	4.60	4.715	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
	MCP13XX-47 (Note 6)		4.630	4.70	4.771	V	T <sub>A</sub> = +25°C (Note 1)
			4.583	4.70	4.818	V	T <sub>A</sub> = -40°C to +125°C (Note 2)
V <sub>DD</sub> Trip Point Tempco	T <sub>TPCO</sub>	—	±40	—	ppm/°C		

- Note 1:** Trip point is ±1.5% from typical value.  
**Note 2:** Trip point is ±2.5% from typical value.  
**Note 3:** Hysteresis is minimum = 1%, maximum = 6% at +25°C.  
**Note 4:** This specification allows this device to be used in PIC<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) feature (see device-specific programming specifications for voltage requirements). The total time that the RST pin can be above the maximum device operational voltage (5.5V) is 100s. Current into the RST pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between 0°C to +70°C (+25°C preferred). For additional information, refer to [Figure 2-35](#).  
**Note 5:** This parameter is established by characterization and is not 100% tested.  
**Note 6:** Custom ordered voltage trip point; minimum order volume requirement. Information available upon request.

## DC CHARACTERISTICS (CONTINUED)

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions	
Threshold Hysteresis (Note 3)	MCP13XX-20 (Note 6)	$V_{HYS}$	0.020	—	0.120	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	
	MCP13XX-21 (Note 6)	$V_{HYS}$	0.021	—	0.126	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	
	MCP13XX-22 (Note 6)	$V_{HYS}$	0.022	—	0.132	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	
	MCP13XX-23 (Note 6)	$V_{HYS}$	0.023	—	0.138	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	
	MCP13XX-24 (Note 6)	$V_{HYS}$	0.024	—	0.144	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	
	MCP13XX-25 (Note 6)	$V_{HYS}$	0.025	—	0.150	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	
	MCP13XX-26 (Note 6)	$V_{HYS}$	0.026	—	0.156	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	
	MCP13XX-27 (Note 6)	$V_{HYS}$	0.027	—	0.162	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	
	MCP13XX-28 (Note 6)	$V_{HYS}$	0.028	—	0.168	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	
	MCP13XX-29 (Note 6)	$V_{HYS}$	0.029	—	0.174	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	
MCP13XX-30 (Note 6)	$V_{HYS}$	0.030	—	0.180	V	$T_A = +25^\circ\text{C}$ (Note 3)	
		(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		
MCP13XX-31 (Note 6)	$V_{HYS}$	0.031	—	0.186	V	$T_A = +25^\circ\text{C}$ (Note 3)	
		(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		
MCP13XX-32 (Note 6)	$V_{HYS}$	0.032	—	0.192	V	$T_A = +25^\circ\text{C}$ (Note 3)	
		(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		
MCP13XX-33 (Note 6)	$V_{HYS}$	0.033	—	0.198	V	$T_A = +25^\circ\text{C}$ (Note 3)	
		(Note 6)		V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		

- Note 1:** Trip point is  $\pm 1.5\%$  from typical value.  
**Note 2:** Trip point is  $\pm 2.5\%$  from typical value.  
**Note 3:** Hysteresis is minimum = 1%, maximum = 6% at  $+25^\circ\text{C}$ .  
**Note 4:** This specification allows this device to be used in PIC<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). The total time that the  $\overline{\text{RST}}$  pin can be above the maximum device operational voltage (5.5V) is 100s. Current into the  $\overline{\text{RST}}$  pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  ( $+25^\circ\text{C}$  preferred). For additional information, refer to [Figure 2-35](#).  
**Note 5:** This parameter is established by characterization and is not 100% tested.  
**Note 6:** Custom ordered voltage trip point; minimum order volume requirement. Information available upon request.

# MCP131X/2X

## DC CHARACTERISTICS (CONTINUED)

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters		Sym	Min	Typ	Max	Units	Conditions
Threshold Hysteresis (Continued) (Note 3)	MCP13XX-34 (Note 6)	$V_{HYS}$	0.034	—	0.204	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-35 (Note 6)		0.035	—	0.210	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-36 (Note 6)		0.036	—	0.216	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-37 (Note 6)		0.037	—	0.222	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-38 (Note 6)		0.038	—	0.228	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-39 (Note 6)		0.039	—	0.234	V	$T_A = +25^\circ\text{C}$ (Note 1)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-40 (Note 6)		0.040	—	0.240	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-41 (Note 6)		0.041	—	0.246	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-42 (Note 6)		0.042	—	0.252	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
	MCP13XX-43 (Note 6)		0.043	—	0.258	V	$T_A = +25^\circ\text{C}$ (Note 3)
			(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$
MCP13XX-44 (Note 6)	0.044	—	0.264	V	$T_A = +25^\circ\text{C}$ (Note 3)		
	(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		
MCP13XX-45 (Note 6)	0.045	—	0.270	V	$T_A = +25^\circ\text{C}$ (Note 3)		
	(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		
MCP13XX-46 (Note 6)	0.046	—	0.276	V	$T_A = +25^\circ\text{C}$ (Note 3)		
	(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		
MCP13XX-47 (Note 6)	0.047	—	0.282	V	$T_A = +25^\circ\text{C}$ (Note 3)		
	(Note 6)			V	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		

**Note 1:** Trip point is  $\pm 1.5\%$  from typical value.

**Note 2:** Trip point is  $\pm 2.5\%$  from typical value.

**Note 3:** Hysteresis is minimum = 1%, maximum = 6% at  $+25^\circ\text{C}$ .

**Note 4:** This specification allows this device to be used in PIC<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). The total time that the  $\overline{\text{RST}}$  pin can be above the maximum device operational voltage (5.5V) is 100s. Current into the  $\overline{\text{RST}}$  pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  ( $+25^\circ\text{C}$  preferred). For additional information, refer to [Figure 2-35](#).

**Note 5:** This parameter is established by characterization and is not 100% tested.

**Note 6:** Custom ordered voltage trip point; minimum order volume requirement. Information available upon request.

## DC CHARACTERISTICS (CONTINUED)

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions	
RST/ $\overline{\text{RST}}$ Low-Level Output Voltage	$V_{OL}$	—	—	0.3	V	$I_{OL} = 50\ \mu\text{A}$ , $1.0V \leq V_{DD} \leq 1.5V$	
		—	—	0.3	V	$I_{OL} = 100\ \mu\text{A}$ , $1.5V < V_{DD} \leq 2.5V$	
		—	—	0.3	V	$I_{OL} = 2\ \text{mA}$ , $2.5V < V_{DD} \leq 4.5V$	
		—	—	0.3	V	$I_{OL} = 4\ \text{mA}$ , $V_{DD} > 4.5V$	
RST/ $\overline{\text{RST}}$ High-Level Output Voltage (Push-Pull Outputs only)	$V_{OH}$	$V_{DD} - 0.7$	—	—	V	$I_{OH} = 2.5\ \text{mA}$ , $V_{DD} \geq 2.5V$	
		$V_{DD} - 0.7$	—	—	V	$I_{OH} = 500\ \mu\text{A}$ , $V_{DD} \geq 1.5V$	
Input Low Voltage ( $\overline{\text{MR}}$ and WDI pins)	$V_{IL}$	$V_{SS}$	—	$0.3V_{DD}$	V		
Input High Voltage ( $\overline{\text{MR}}$ and WDI pins)	$V_{IH}$	$0.7V_{DD}$	—	$V_{DD}$	V		
Open-Drain High Voltage on Output ( <b>Note 4</b> )	$V_{ODH}$	—	—	13.5 <sup>(4)</sup>	V	Open-Drain Output pin only, $V_{DD} = 3.0V$ , Time voltage $> 5.5V$ applied $\leq 100\ \text{s}$ , current into pin limited to $2\ \text{mA}$ , $+25^\circ\text{C}$ operation recommended ( <b>Note 4</b> , <b>Note 5</b> )	
Input Leakage Current ( $\overline{\text{MR}}$ and WDI)	$I_{IL}$	—	—	$\pm 1$	$\mu\text{A}$	$V_{SS} \leq V_{PIN} \leq V_{DD}$	
Open-Drain Output Leakage Current ( <b>MCP1316M</b> , <b>MCP1318M</b> , <b>MCP1319M</b> , <b>MCP1320</b> , <b>MCP1321</b> , and <b>MCP1322</b> only)	$I_{OD}$	—	0.003	1.0	$\mu\text{A}$		
Pull-up Resistance	$\overline{\text{MR}}$ pin	$R_{PU}$	—	52	—	$\text{k}\Omega$	$V_{DD} = 5.5V$
	WDI pin		—	52	—	$\text{k}\Omega$	$V_{DD} = 5.5V$
	$\overline{\text{RST}}$ pin		—	4.7	—	$\text{k}\Omega$	$V_{DD} = 5.5V$ , <b>MCP131XM</b> devices only
Input Pin Capacitance ( $\overline{\text{MR}}$ and WDI)	$C_I$	—	100	—	$\text{pF}$		
Output Pin Capacitive Loading (RST and $\overline{\text{RST}}$ )	$C_O$	—	—	50	$\text{pF}$	This is the tester loading to meet the AC timing specifications.	

**Note 1:** Trip point is  $\pm 1.5\%$  from typical value.

**2:** Trip point is  $\pm 2.5\%$  from typical value.

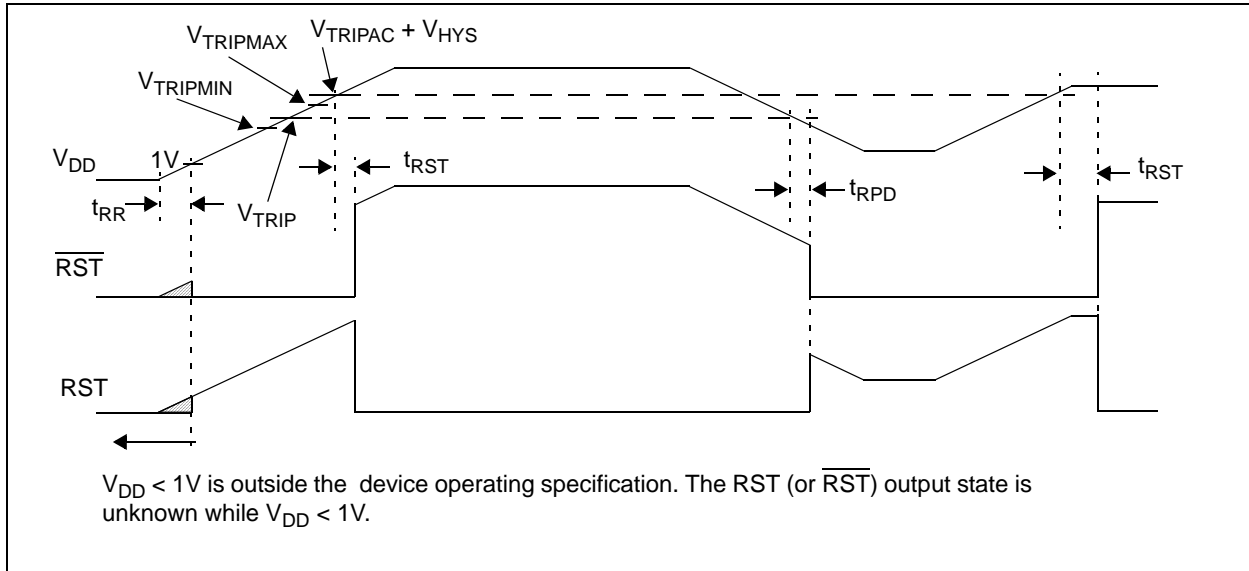
**3:** Hysteresis is minimum =  $1\%$ , maximum =  $6\%$  at  $+25^\circ\text{C}$ .

**4:** This specification allows this device to be used in PIC<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). The total time that the  $\overline{\text{RST}}$  pin can be above the maximum device operational voltage ( $5.5V$ ) is  $100\text{s}$ . Current into the  $\overline{\text{RST}}$  pin should be limited to  $2\ \text{mA}$ . It is recommended that the device operational temperature be maintained between  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  ( $+25^\circ\text{C}$  preferred). For additional information, refer to [Figure 2-35](#).

**5:** This parameter is established by characterization and is not  $100\%$  tested.

**6:** Custom ordered voltage trip point; minimum order volume requirement. Information available upon request.

# MCP131X/2X



**FIGURE 1-1:** Device Voltage and Reset Pin Waveforms.

**TABLE 1-1: DEVICE VOLTAGE AND RESET PIN TIMINGS**

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1320**, **MCP1321**, and **MCP1322**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions
Falling $V_{DD}$ Trip Point Detected to RST or $\overline{RST}$ Active	$t_{RPD}$	—	650	—	$\mu\text{s}$	$V_{DD}$ ramped from $V_{TRIPMAX} + 250\text{ mV}$ down to $V_{TRIPMIN} - 200\text{ mV}$ , $V_{DD}$ falling @ $5\text{ mV}/\mu\text{s}$ , $C_L = 50\text{ pF}$ ( <b>Note 1</b> )
$V_{DD}$ Rise Rate	$t_{RR}$	<b>Note 3</b>				
Reset active time (MR Rising Edge, POR/BOR Inactive, or WDT time out) to RST/ $\overline{RST}$ Inactive	$t_{RST}$	1.0	1.4	2.0	ms	<b>Note 2</b>
		20	30	40	ms	<b>Note 2</b>
		140	200	280	ms	Standard Time Out
		1120	1600	2240	ms	<b>Note 2</b>
RST Rise Time after RST Active ( <b>Push-Pull Outputs only</b> )	$t_{RT}$	—	5	—	$\mu\text{s}$	For RST 10% to 90% of $V_{DD}$ , $C_L = 50\text{ pF}$ ( <b>Note 1</b> )
RST Rise Time after RST Inactive ( <b>Push-Pull Outputs only</b> )		—	5	—	$\mu\text{s}$	For RST 10% to 90% of $V_{DD}$ , $C_L = 50\text{ pF}$ ( <b>Note 1</b> )
RST Fall Time after RST Inactive	$t_{FT}$	—	5	—	$\mu\text{s}$	For RST 90% to 10% of $V_{DD}$ , $C_L = 50\text{ pF}$ ( <b>Note 1</b> )
$\overline{RST}$ Fall Time after $\overline{RST}$ Active		—	5	—	$\mu\text{s}$	For $\overline{RST}$ 90% to 10% of $V_{DD}$ , $C_L = 50\text{ pF}$ ( <b>Note 1</b> )

**Note 1:** These parameters are for design guidance only and are not 100% tested.

**Note 2:** Custom ordered Reset active time; minimum order volume requirement.

**Note 3:** Designed to be independent of  $V_{DD}$  rise rate. Device characterization was done with a rise rate as slow as  $0.1\text{ V/s}$  (@  $+25^\circ\text{C}$ ).



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## TEMPERATURE CHARACTERISTICS

**Electrical Specifications:** Unless otherwise noted, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP1316**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Temperature Ranges</b>						
Specified Temperature Range	$T_A$	-40	—	+85	$^\circ\text{C}$	<b>MCP13XX-25</b> (or below)
Specified Temperature Range	$T_A$	-40	—	+125	$^\circ\text{C}$	Except <b>MCP13XX-25</b> (or below)
Maximum Junction Temperature	$T_J$	—	—	+150	$^\circ\text{C}$	
Storage Temperature Range	$T_A$	-65	—	+150	$^\circ\text{C}$	
<b>Package Thermal Resistances</b>						
Thermal Resistance, 5L-SOT23	$\theta_{JA}$	—	255.9	—	$^\circ\text{C/W}$	

# MCP131X/2X

## 6.0 STANDARD DEVICE OFFERINGS

Table 7-1 shows the standard devices that are available and their respective configuration. The configuration includes the:

- Voltage Trip Point ( $V_{TRIP}$ )
- Reset Time Out ( $t_{RST}$ )
- Watchdog Time Out ( $t_{WDT}$ )

Table 7-1 also shows the order number for that given device configuration.

**TABLE 7-1: STANDARD VERSIONS**

Device	Reset Threshold (V)	Reset Time Out (ms)		Watchdog Time Out (s)		Order Number
		Minimum	Typical	Minimum	Typical	
MCP1316	2.90	140	200	1.12	1.6	MCP1316T-29LE/OT
MCP1316	4.60	140	200	1.12	1.6	MCP1316T-46LE/OT
MCP1316M	2.90	140	200	1.12	1.6	MCP1316MT-29LE/OT
MCP1316M	4.60	140	200	1.12	1.6	MCP1316MT-46LE/OT
MCP1317	2.90	140	200	1.12	1.6	MCP1317T-29LE/OT
MCP1317	4.60	140	200	1.12	1.6	MCP1317T-46LE/OT
MCP1318	2.90	140	200	1.12	1.6	MCP1318T-29LE/OT
MCP1318	4.60	140	200	1.12	1.6	MCP1318T-46LE/OT
MCP1318M	2.90	140	200	1.12	1.6	MCP1318MT-29LE/OT
MCP1318M	4.60	140	200	1.12	1.6	MCP1318MT-46LE/OT
MCP1319	2.90	140	200	—	—	MCP1319T-29LE/OT
MCP1319	4.60	140	200	—	—	MCP1319T-46LE/OT
MCP1319M	2.90	140	200	—	—	MCP1319MT-29LE/OT
MCP1319M	4.60	140	200	—	—	MCP1319MT-46LE/OT
MCP1320	2.90	140	200	1.12	1.6	MCP1320T-29LE/OT
MCP1320	4.60	140	200	1.12	1.6	MCP1320T-46LE/OT
MCP1321	2.90	140	200	1.12	1.6	MCP1321T-29LE/OT
MCP1321	4.60	140	200	1.12	1.6	MCP1321T-46LE/OT
MCP1322	2.90	140	200	—	—	MCP1322T-29LE/OT
MCP1322	4.60	140	200	—	—	MCP1322T-46LE/OT

## 7.0 CUSTOM CONFIGURATIONS

Table 7-2 shows the codes that specify the desired Reset time out ( $t_{RST}$ ) and Watchdog Timer time out ( $t_{WDT}$ ) for custom devices.

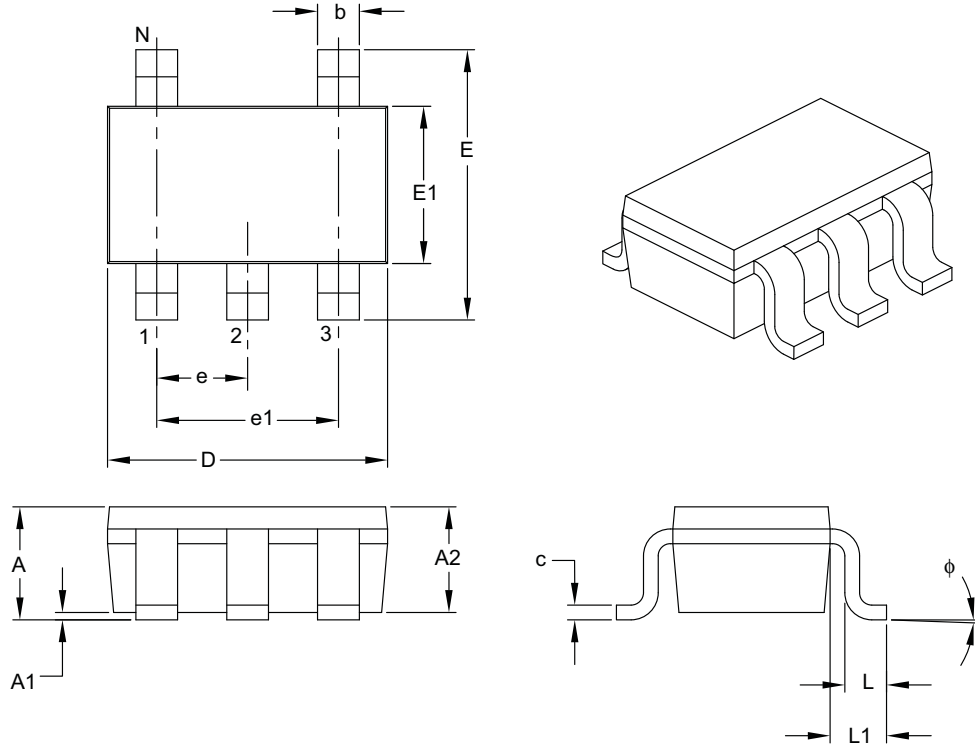
The voltage trip point ( $V_{TRIP}$ ) is specified by the two digits of the desired typical trip point voltage. As an example, if the desired  $V_{TRIP}$  selection has a typical  $V_{TRIP}$  of 2.7V, the code is 27.

**TABLE 7-2: DELAY TIME OUT ORDERING CODES**

Code	Typical Delay Time (ms)		Comment	Code	Typical Delay Time (ms)		Comment
	Reset	WDT			Reset	WDT	
A	1.6	6.3	Note 1	J	200.0	6.3	Note 1
B	1.6	102.0	Note 1	K	200.0	102.0	Note 1
C	1.6	1600.0	Note 1	L	200.0	1600.0	Delay timings for standard device offerings
D	1.6	25600.0	Note 1	M	200.0	25600.0	Note 1
E	30.0	6.3	Note 1	N	1600.0	6.3	Note 1
F	30.0	102.0	Note 1	P	1600.0	102.0	Note 1
G	30.0	1600.0	Note 1	Q	1600.0	1600.0	Note 1
H	30.0	25600.0	Note 1	R	1600.0	25600.0	Note 1

**Note 1:** This delay timing combination is not the standard offering. For information on ordering devices with these delay times, contact your local Microchip sales office. Minimum purchase volumes are required.

## 5-Lead Plastic Small Outline Transistor (OT) [SOT-23]



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	5		
Lead Pitch	e	0.95 BSC		
Outside Lead Pitch	e1	1.90 BSC		
Overall Height	A	0.90	–	1.45
Molded Package Thickness	A2	0.89	–	1.30
Standoff	A1	0.00	–	0.15
Overall Width	E	2.20	–	3.20
Molded Package Width	E1	1.30	–	1.80
Overall Length	D	2.70	–	3.10
Foot Length	L	0.10	–	0.60
Footprint	L1	0.35	–	0.80
Foot Angle	$\phi$	0°	–	30°
Lead Thickness	c	0.08	–	0.26
Lead Width	b	0.20	–	0.51

### Notes:

- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M.

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-091B

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	X	XX	X	X	/	XX
Device	Tape/Reel Option	V <sub>TRIP</sub> Options	Time Out Options	Temperature Range		Package
Device:						
MCP1316T:						MicroPower Voltage Detector (Tape and Reel)
MCP1316MT:						MicroPower Voltage Detector (Tape and Reel)
MCP1317T:						MicroPower Voltage Detector (Tape and Reel)
MCP1318T:						MicroPower Voltage Detector (Tape and Reel)
MCP1318MT:						MicroPower Voltage Detector (Tape and Reel)
MCP1319T:						MicroPower Voltage Detector (Tape and Reel)
MCP1319MT:						MicroPower Voltage Detector (Tape and Reel)
MCP1320T:						MicroPower Voltage Detector (Tape and Reel)
MCP1321T:						MicroPower Voltage Detector (Tape and Reel)
MCP1322T:						MicroPower Voltage Detector (Tape and Reel)
V <sub>TRIP</sub> Options: (Note 1)		29 = 2.90V 46 = 4.60V				
Time Out Options: (Note 1)			L = t <sub>RST</sub> = 200 ms (typ), t <sub>WDT</sub> = 1.6 s (typ)			
Temperature Range:				I = -40°C to +85°C (Only for trip points 2.0V to 2.4V) E = -40°C to +125°C (For trip point ≥ 2.5V)		
Package:						OT = SOT-23, 5-lead
<b>Note 1:</b>	Custom ordered voltage trip points and time outs available. Please contact your local Microchip sales office for additional information. Minimum purchase volumes are required.					
<b>Examples:</b>						
a)	MCP1316T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1316T-46LE/OT:					5-Lead SOT-23-5
c)	MCP1316MT-29LE/OT:					5-Lead SOT-23-5
d)	MCP1316MT-46LE/OT:					5-Lead SOT-23-5
a)	MCP1317T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1317T-46LE/OT:					5-Lead SOT-23-5
a)	MCP1318T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1318MT-29LE/OT:					5-Lead SOT-23-5
c)	MCP1318T-46LE/OT:					5-Lead SOT-23-5
d)	MCP1318MT-46LE/OT:					5-Lead SOT-23-5
a)	MCP1319T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1318MT-29LE/OT:					5-Lead SOT-23-5
c)	MCP1319T-46LE/OT:					5-Lead SOT-23-5
d)	MCP1318MT-46LE/OT:					5-Lead SOT-23-5
a)	MCP1320T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1320T-46LE/OT:					5-Lead SOT-23-5
a)	MCP1321T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1321T-46LE/OT:					5-Lead SOT-23-5
a)	MCP1322T-29LE/OT:					5-Lead SOT-23-5
b)	MCP1322T-46LE/OT:					5-Lead SOT-23-5