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MCP131X/2X

Voltage Supervisor

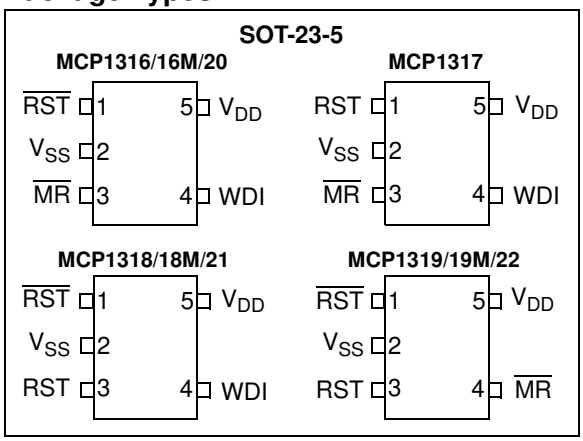
Features:

- Low Supply Current: 1 µA (Typical),10 µA (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 ($\overline{MR}$) 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°C to +85°C for Trip Points 2.0 to 2.4V and,
  - -40°C to + 125°C for Trip Points > 2.5V
- Voltage Range: 1.0V to 5.5V
- Lead Free Packaging

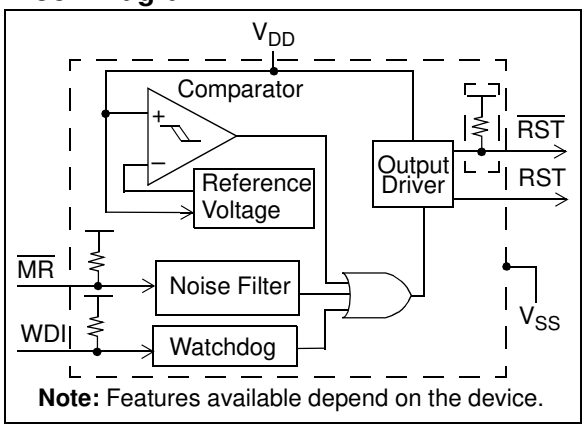
Description:

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



Note: Features available depend on the device.

Device Features

Device	Reset Output A			Reset Output B			WDI Input	$\overline{MR}$ 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

NOTES:

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 ($T_A \leq +70°C$):
5-Pin SOT-23A .....240 mW

ESD protection on all pins .....≥ 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 kΩ (only **MCP1320**, **MCP1321** and **MCP1322**), T_A = -40°C to +125°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 µA, $V_{\overline{RST}}$ < 0.3V
Operating Current:	I_{DD}	—	5	10	µA	Watchdog Timer Active
		—	1	2	µA	Watchdog Timer Inactive
		—	1	2	µA	$V_{DD} < V_{TRIP}$
		—	5	10	µA	Reset Delay Timer Active

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

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

4: This specification allows this device to be used in PIC® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) 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°C to +70°C (+25°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 kΩ (only **MCP1320**, **MCP1321** and **MCP1322**), T_A = -40°C to +125°C.

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

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

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

4: This specification allows this device to be used in PIC® 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.

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 kΩ (only **MCP1320**, **MCP1321** and **MCP1322**), T_A = -40°C to +125°C.

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

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

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

4: This specification allows this device to be used in PIC® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) 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°C to +70°C (+25°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 kΩ (only **MCP1320**, **MCP1321** and **MCP1322**), T_A = -40°C to +125°C.

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

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

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

4: This specification allows this device to be used in PIC® 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.

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 kΩ (only **MCP1320**, **MCP1321** and **MCP1322**), T_A = -40°C to +125°C.

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

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

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

4: This specification allows this device to be used in PIC® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) 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°C to +70°C (+25°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 kΩ (only **MCP1320**, **MCP1321** and **MCP1322**), T_A = -40°C to +125°C.

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

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

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

4: This specification allows this device to be used in PIC® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) 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°C to +70°C (+25°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.

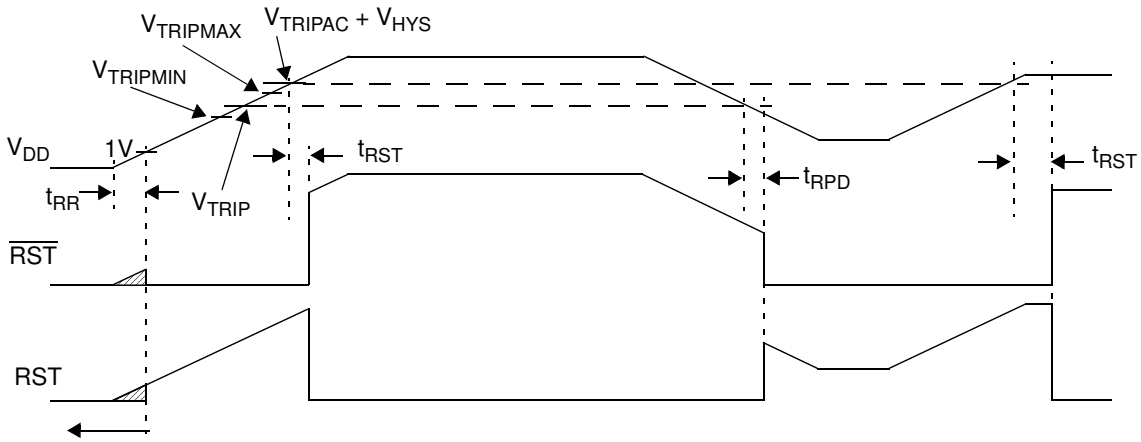


FIGURE 1-1: *Device Voltage and Reset Pin Waveforms.*

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 kΩ (only **MCP1320**, **MCP1321**, and **MCP1322**), T_A = -40°C to +125°C.

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

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

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

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

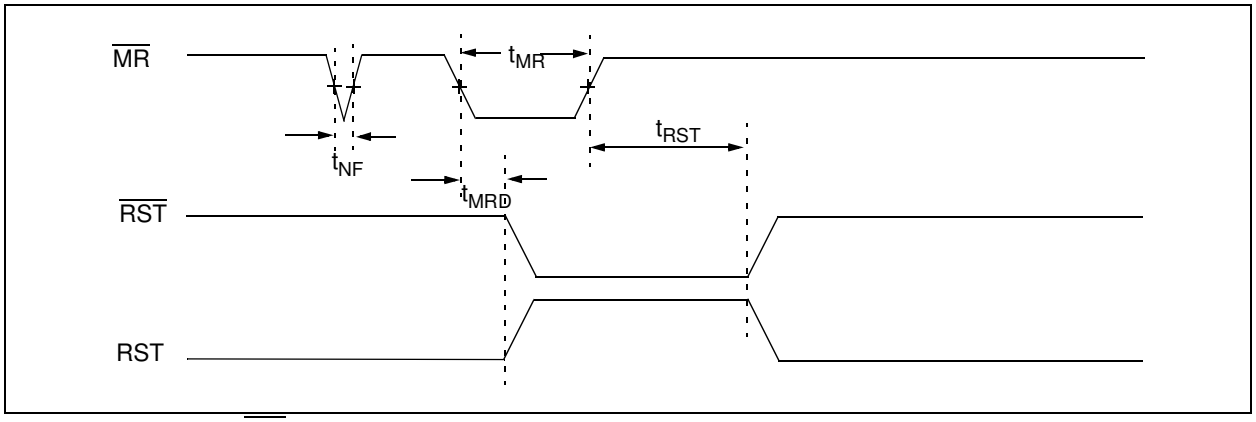
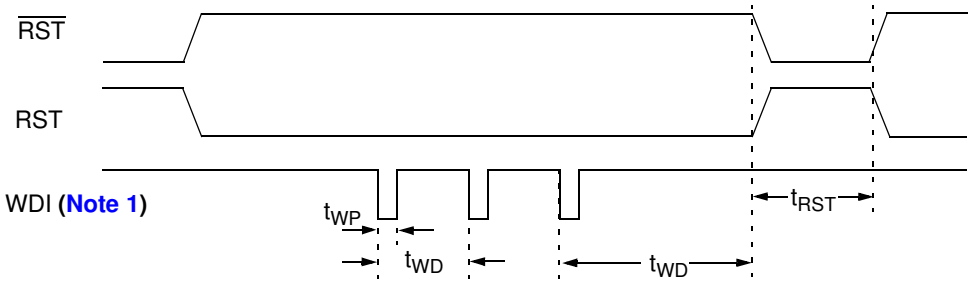


FIGURE 1-2: *$\overline{MR}$ and Reset Pin Waveforms.*

TABLE 1-2: $\overline{MR}$ AND RESET PIN TIMINGS

Electrical Specifications: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP1320**, **MCP1321**, and **MCP1322**), T_A = -40°C to +125°C.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
$\overline{MR}$ Pulse Width	t_{MR}	1	—	—	µs	
$\overline{MR}$ Active to RST/$\overline{RST}$ Active	t_{MRD}	—	235	—	ns	V_{DD} = 5.0V
$\overline{MR}$ Input Noise filter	t_{NF}	—	150	—	ns	V_{DD} = 5.0V

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



Note 1: The WDI pin was a weak pull-up resistor which is disabled after the 1st falling edge on the WDI pin.

FIGURE 1-3: *WDI and Reset Pin Waveforms.*

TABLE 1-3: WDI AND RESET PIN TIMINGS

Electrical Specifications: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP1320**, **MCP1321**, and **MCP1322**), T_A = -40°C to +125°C.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
WDI Pulse Width	t_{WP}	50	—	—	ns	
Watchdog Time-Out Period	t_{WD}	4.3	6.3	9.3	ms	**Note 1**
		71	102	153	ms	**Note 1**
		1.12	1.6	2.4	sec	Standard Time Out
		17.9	25.6	38.4	sec	**Note 1**

Note 1: Custom ordered WatchDog Timer time out; minimum order volume requirement.

TEMPERATURE CHARACTERISTICS

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

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+85	°C	**MCP13XX-25** (or below)
Specified Temperature Range	T_A	-40	—	+125	°C	Except **MCP13XX-25** (or below)
Maximum Junction Temperature	T_J	—	—	+150	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Package Thermal Resistances						
Thermal Resistance, 5L-SOT-23	θ_{JA}	—	220.7	—	°C/W	

NOTES:

2.0 TYPICAL PERFORMANCE CURVES

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

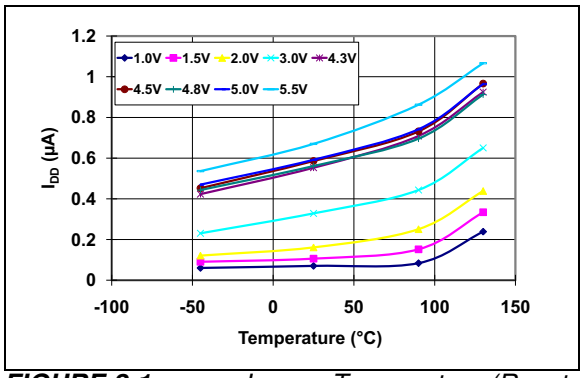


FIGURE 2-1: *I_{DD} vs. Temperature (Reset Power-up Timer Inactive and Watchdog Timer Inactive) (**MCP1318M-4.6**).*

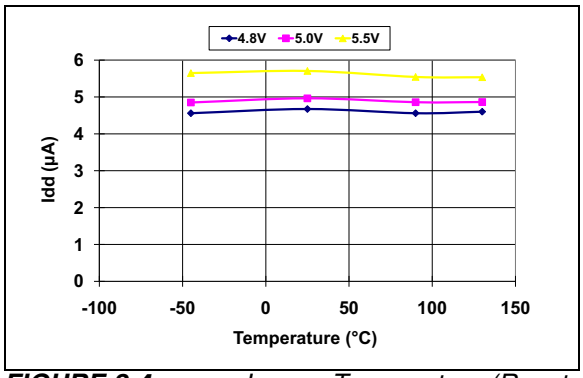


FIGURE 2-4: *I_{DD} vs. Temperature (Reset Power-up Timer Active) (**MCP1318M-4.6**).*

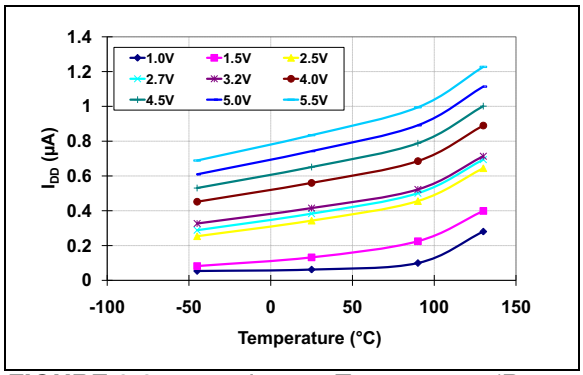


FIGURE 2-2: *I_{DD} vs. Temperature (Reset Power-up Timer Inactive and Watchdog Timer Inactive) (**MCP1319-2.9**).*

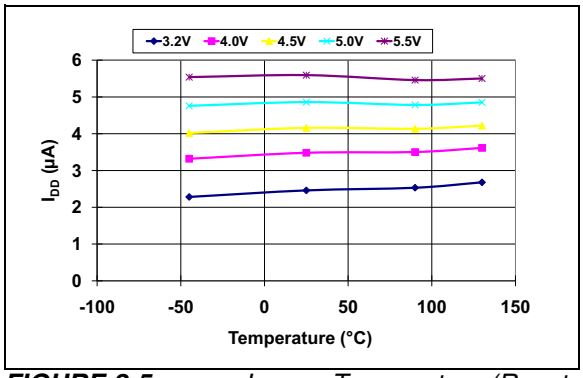


FIGURE 2-5: *I_{DD} vs. Temperature (Reset Power-up Timer Active) (**MCP1319-2.9**).*

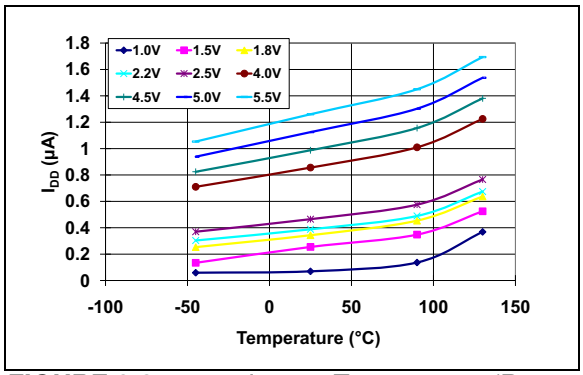


FIGURE 2-3: *I_{DD} vs. Temperature (Reset Power-up Timer Inactive and Watchdog Timer Inactive) (**MCP1316-2.0**).*

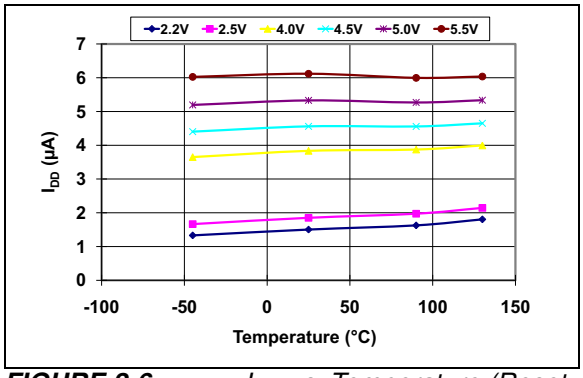


FIGURE 2-6: *I_{DD} vs. Temperature (Reset Power-up Timer Active) (**MCP1316-2.0**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

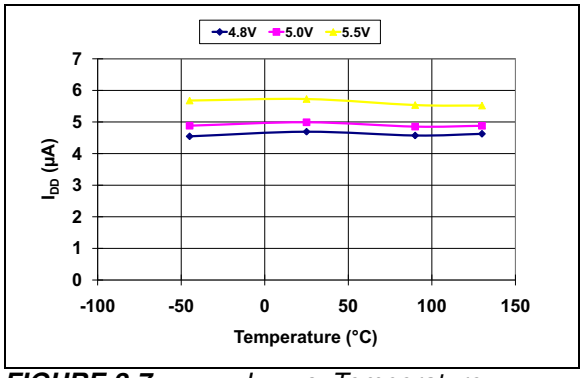


FIGURE 2-7: *I_{DD} vs. Temperature (Watchdog Timer Active) (**MCP1318M-4.6**).*

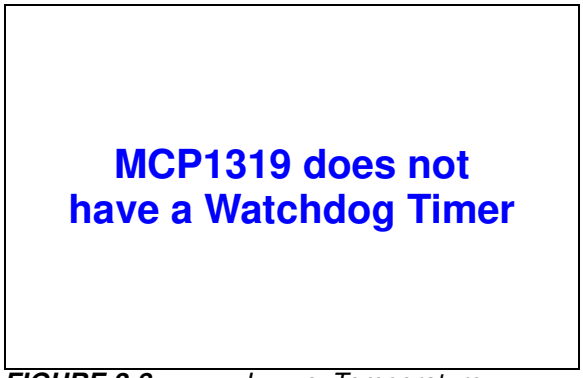


FIGURE 2-8: *I_{DD} vs. Temperature (Watchdog Timer Active) (**MCP1319-2.9**).*

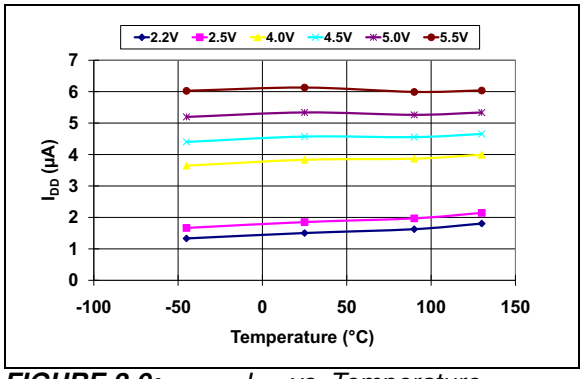


FIGURE 2-9: *I_{DD} vs. Temperature (Watchdog Timer Active) (**MCP1316-2.0**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

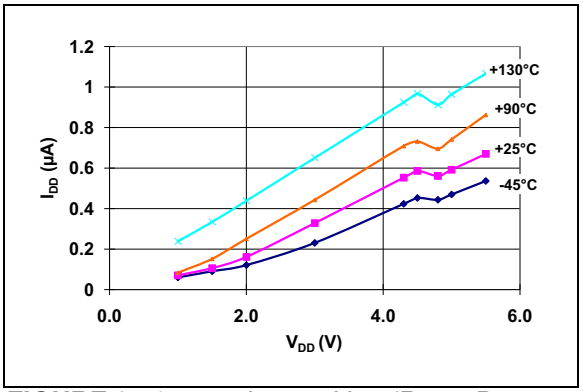


FIGURE 2-10: *I_{DD} vs. V_{DD} (Reset Power-up Timer Inactive and Watchdog Timer Inactive) (**MCP1318M-4.6**).*

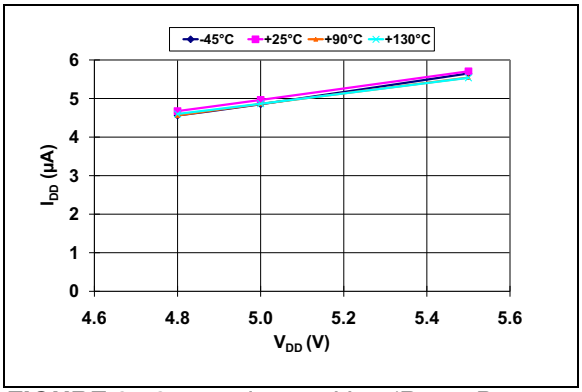


FIGURE 2-13: *I_{DD} vs. V_{DD} (Reset Power-up Timer Active or Watchdog Timer Active) (**MCP1318M-4.6**).*

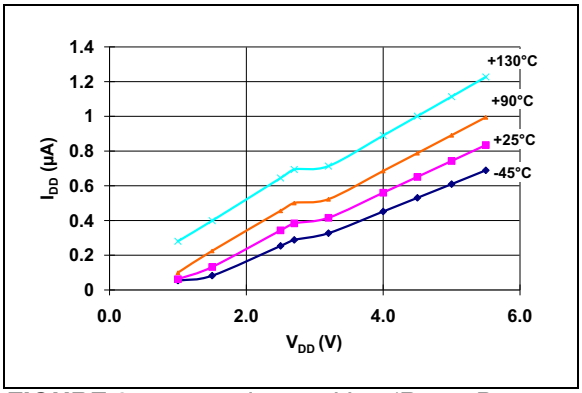


FIGURE 2-11: *I_{DD} vs. V_{DD} (Reset Power-up Timer Inactive and Watchdog Timer Inactive) (**MCP1319-2.9**).*

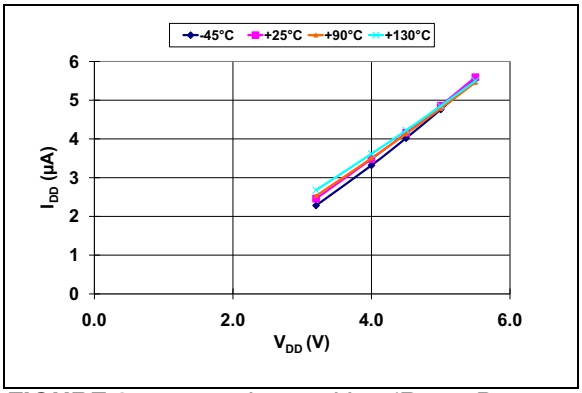


FIGURE 2-14: *I_{DD} vs. V_{DD} (Reset Power-up Timer Active or Watchdog Timer Active) (**MCP1319-2.9**).*

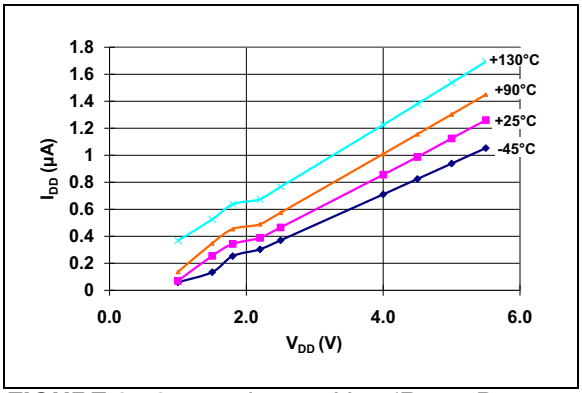


FIGURE 2-12: *I_{DD} vs. V_{DD} (Reset Power-up Timer Inactive and Watchdog Timer Inactive) (**MCP1316-2.0**).*

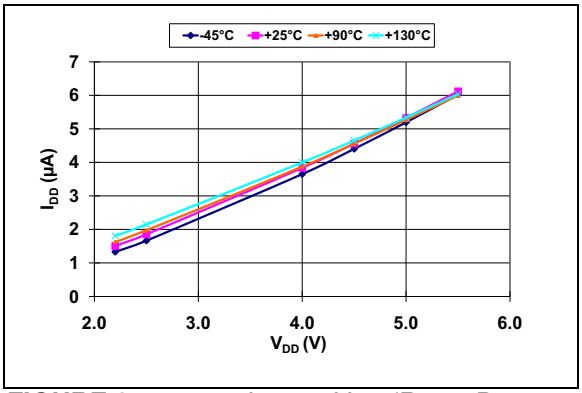


FIGURE 2-15: *I_{DD} vs. V_{DD} (Reset Power-up Timer Active or Watchdog Timer Active) (**MCP1316-2.0**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

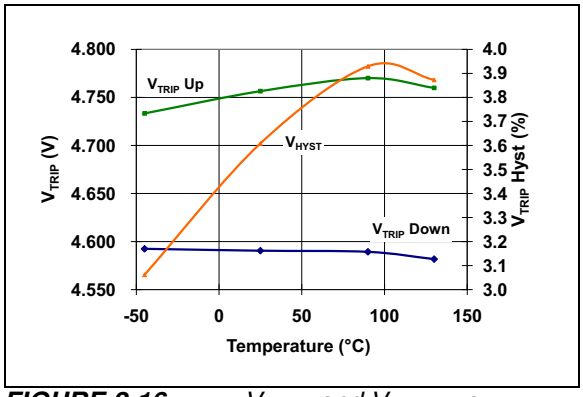


FIGURE 2-16: *V_{TRIP} and V_{HYST} vs. Temperature (**MCP1318M-4.6**).*

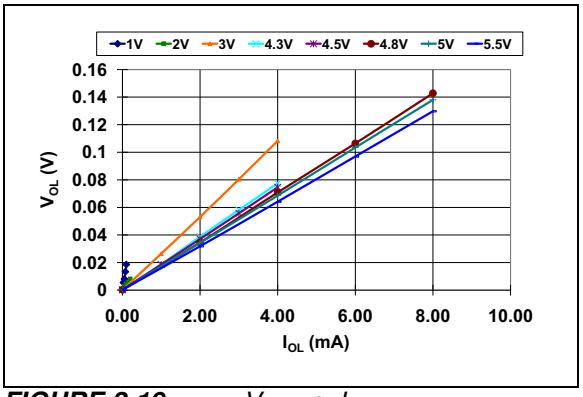


FIGURE 2-19: *V_{OL} vs. I_{OL} (**MCP1318M-4.6**).*

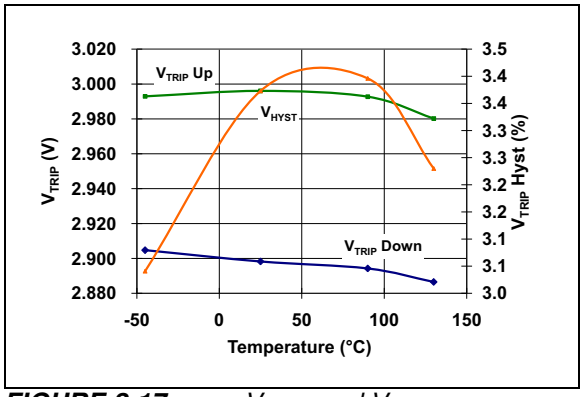


FIGURE 2-17: *V_{TRIP} and V_{HYST} vs. Temperature (**MCP1319-2.9**).*

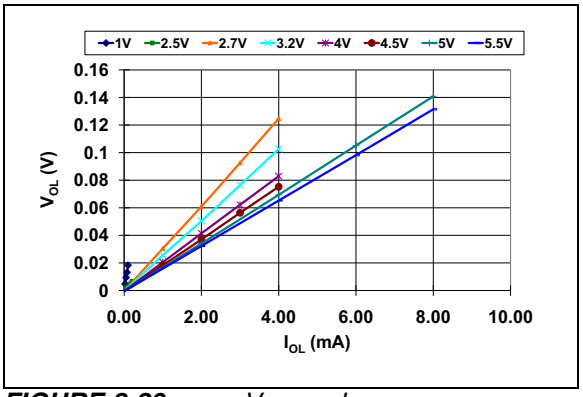


FIGURE 2-20: *V_{OL} vs. I_{OL} (**MCP1319-2.9**).*

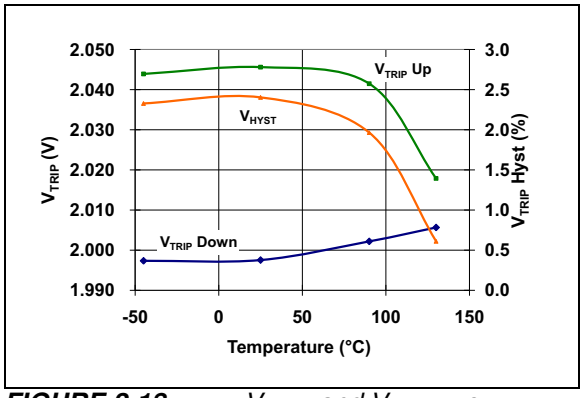


FIGURE 2-18: *V_{TRIP} and V_{HYST} vs. Temperature (**MCP1316-2.0**).*

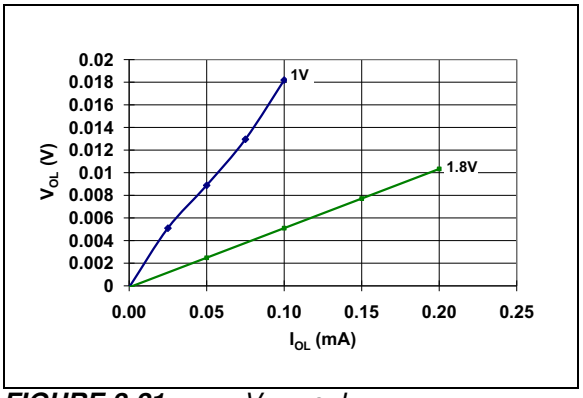


FIGURE 2-21: *V_{OL} vs. I_{OL} (**MCP1316-2.0**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

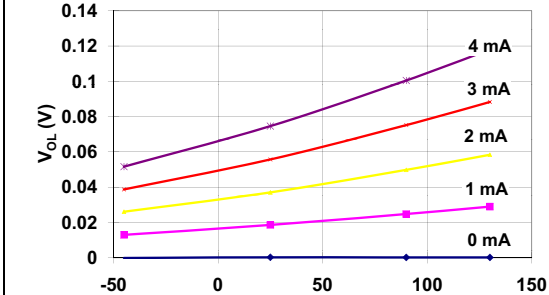


FIGURE 2-22: *V_{OL} vs. Temperature (**MCP1318M-4.6** @ V_{DD} = 4.5V).*

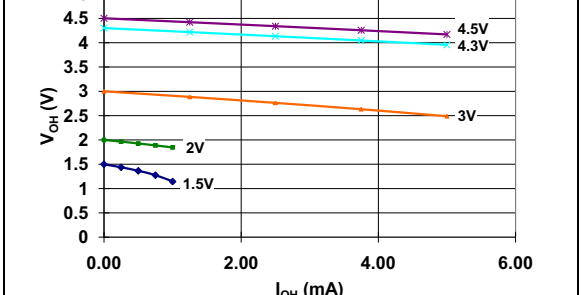


FIGURE 2-25: *V_{OH} vs. I_{OH} (**MCP1318M-4.6** @ +25°C).*

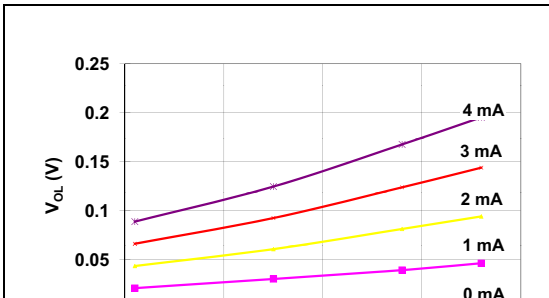


FIGURE 2-23: *V_{OL} vs. Temperature (**MCP1319-2.9** @ V_{DD} = 2.7V).*

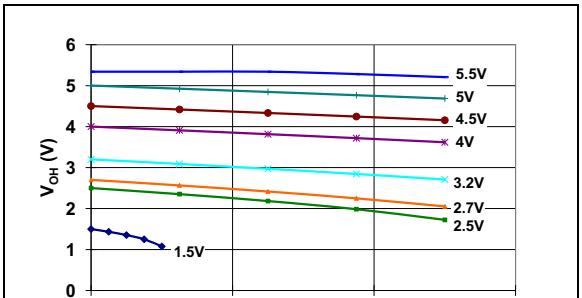


FIGURE 2-26: *V_{OH} vs. I_{OH} (**MCP1319-2.9** @ +25°C).*

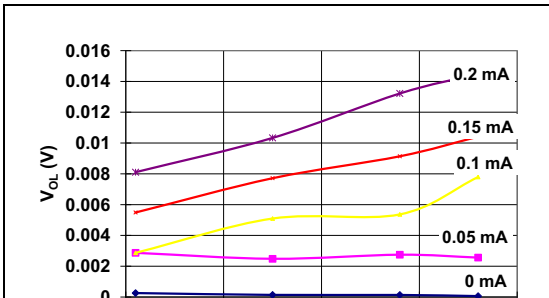


FIGURE 2-24: *V_{OL} vs. Temperature (**MCP1316-2-0** @ V_{DD} = 1.8V).*

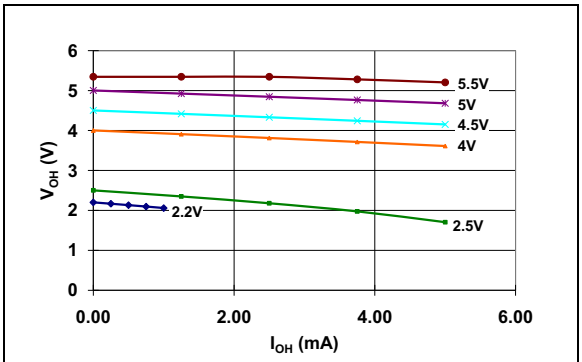


FIGURE 2-27: *V_{OH} vs. I_{OH} (**MCP1316-2.0** @ +25°C).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

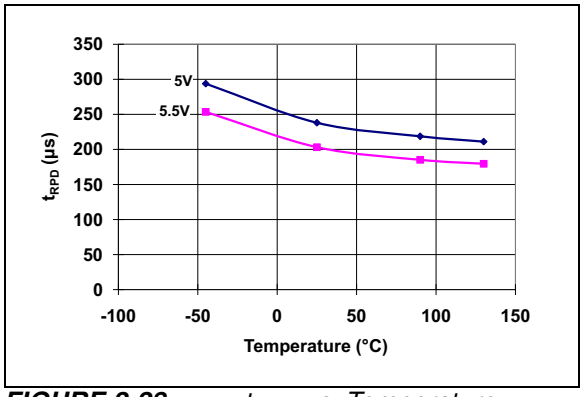


FIGURE 2-28: *t_{RPD} vs. Temperature (**MCP1318M-4.6**).*

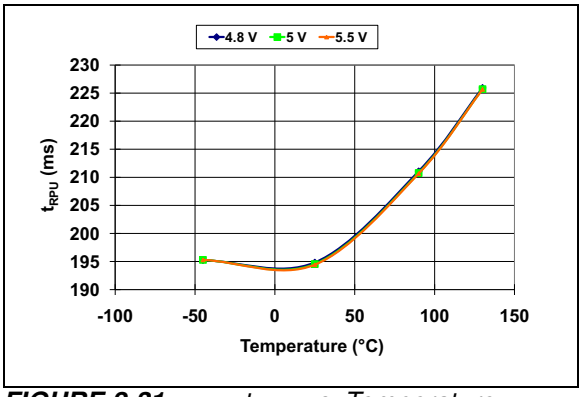


FIGURE 2-31: *t_{RPU} vs. Temperature (**MCP1318M-4.6**).*

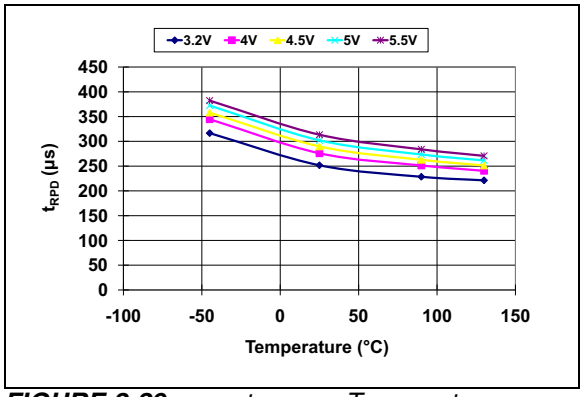


FIGURE 2-29: *t_{RPD} vs. Temperature (**MCP1319-2.9**).*

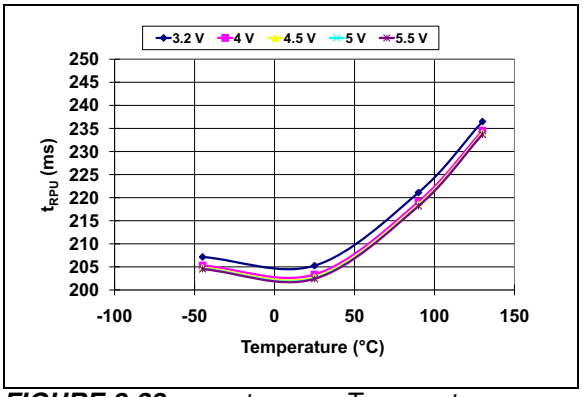


FIGURE 2-32: *t_{RPU} vs. Temperature (**MCP1319-2.9**).*

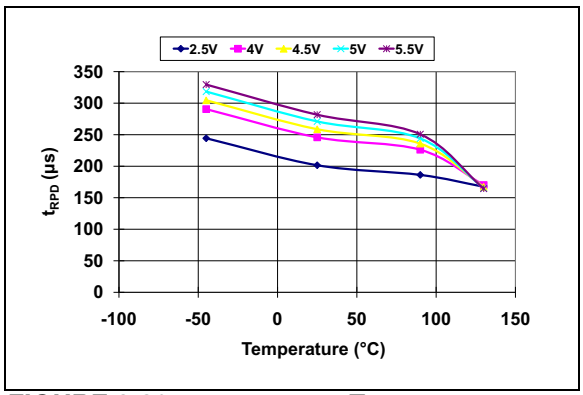


FIGURE 2-30: *t_{RPD} vs. Temperature (**MCP1316-2.0**).*

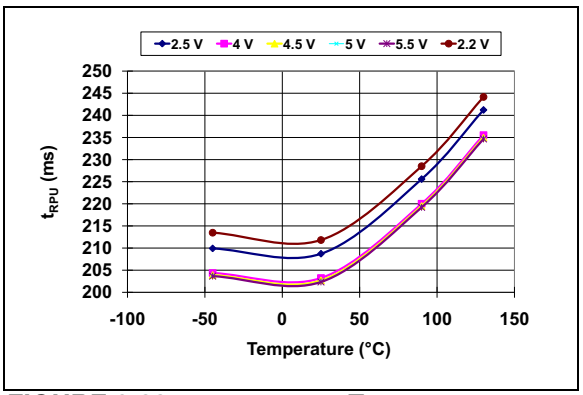


FIGURE 2-33: *t_{RPU} vs. Temperature (**MCP1316-2.0**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

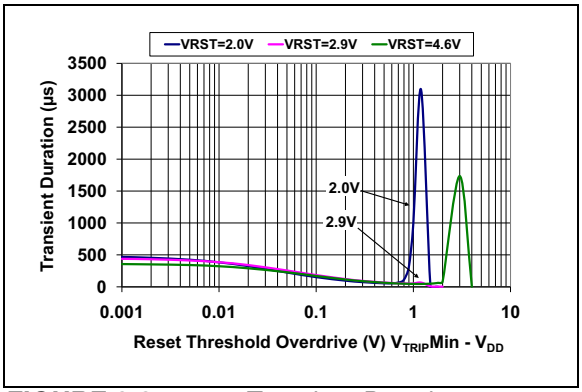


FIGURE 2-34: *Transient Duration vs. V_{TRIP} (min) – V_{DD}.*

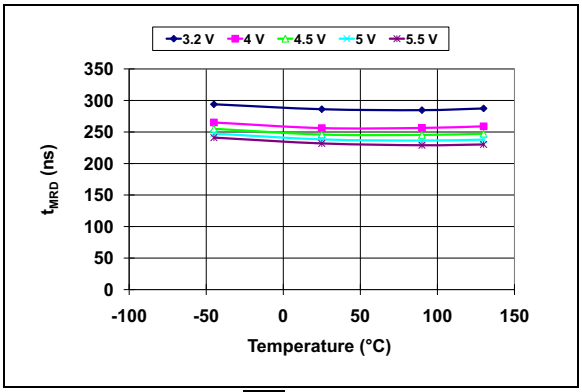


FIGURE 2-37: *$\overline{MR}$ Low to Reset Propagation Delay (**MCP1319-2.9**).*

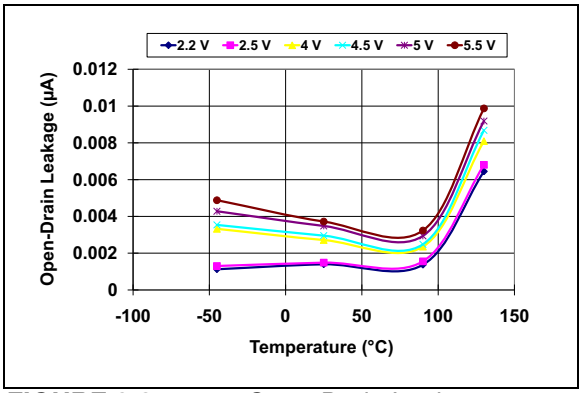


FIGURE 2-35: *Open-Drain Leakage Current vs. Temperature (**MCP1320-2.0**).*

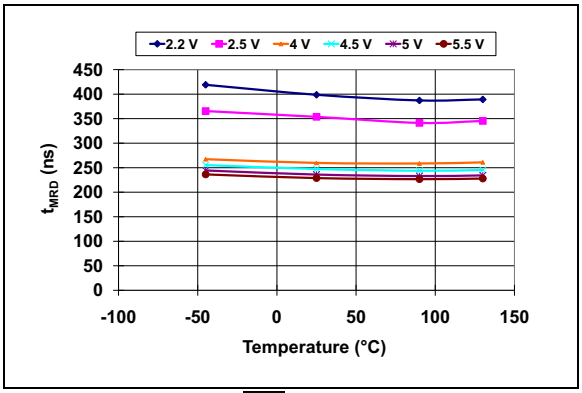


FIGURE 2-38: *$\overline{MR}$ Low to Reset Propagation Delay (**MCP1316-2.0**).*

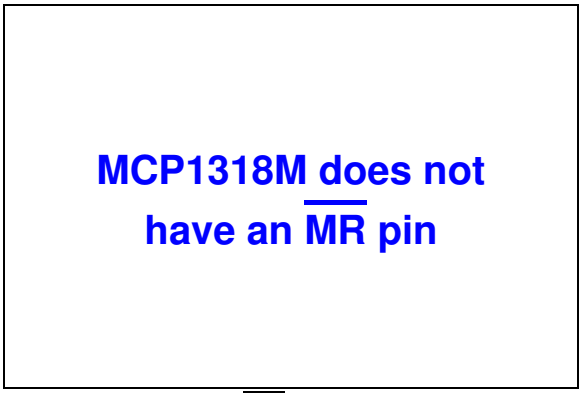


FIGURE 2-36: *$\overline{MR}$ Low to Reset Propagation Delay (**MCP1318M-4.6**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

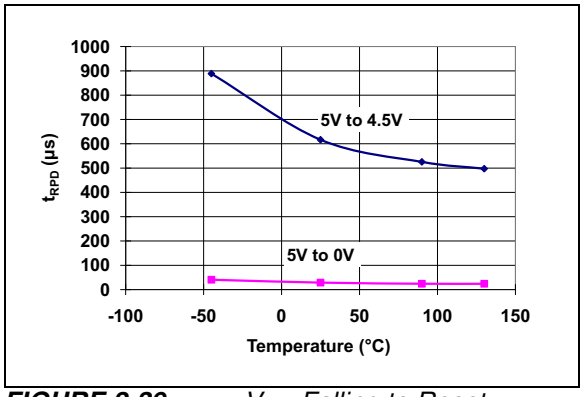


FIGURE 2-39: *V_{DD} Falling to Reset Propagation Delay vs. Temperature (**MCP1318M-4.6**).*

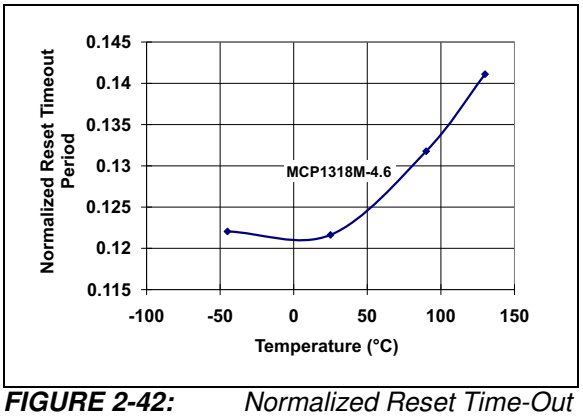


FIGURE 2-42: *Normalized Reset Time-Out Period vs. Temperature (**MCP1318M-4.6**).*

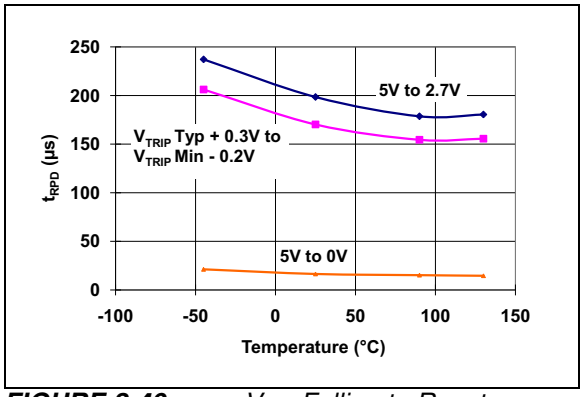


FIGURE 2-40: *V_{DD} Falling to Reset Propagation Delay vs. Temperature (**MCP1319-2.9**).*

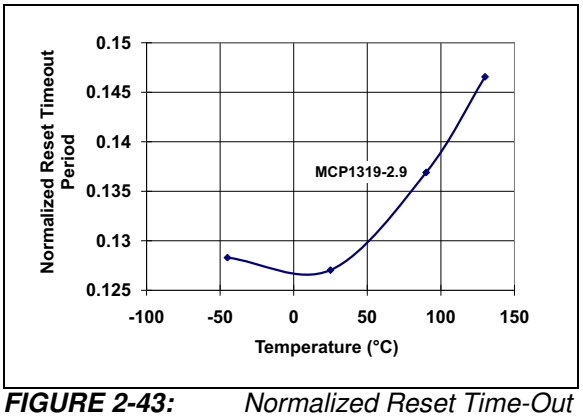


FIGURE 2-43: *Normalized Reset Time-Out Period vs. Temperature (**MCP1319-2.9**).*

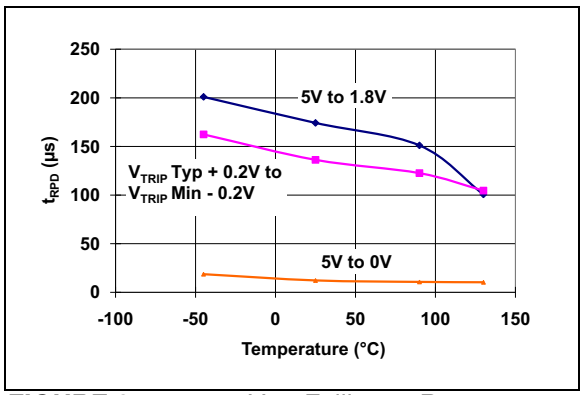


FIGURE 2-41: *V_{DD} Falling to Reset Propagation Delay vs. Temperature (**MCP1316-2.0**).*

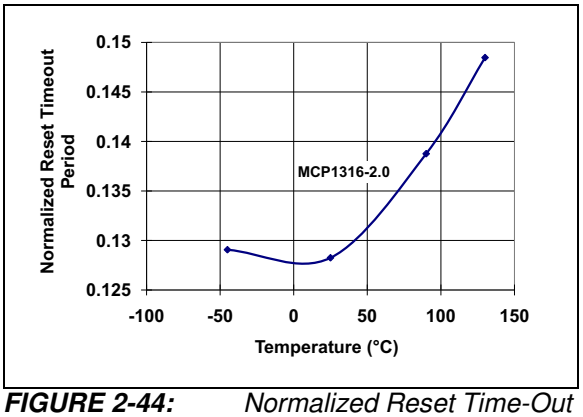


FIGURE 2-44: *Normalized Reset Time-Out Period vs. Temperature (**MCP1316-2.0**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP1316**; see **Figure 4-1**), T_A = -40°C to +125°C.

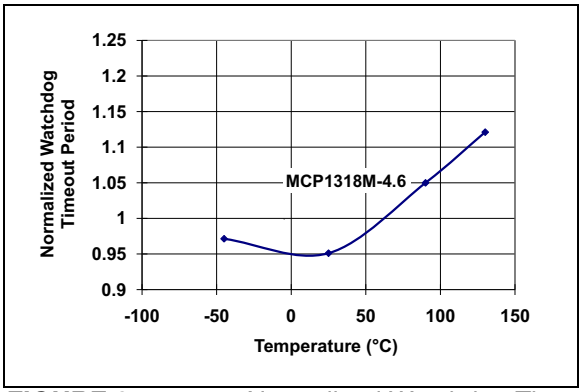


FIGURE 2-45: *Normalized Watchdog Time-Out Period vs. Temperature (**MCP1318M-4.6**).*

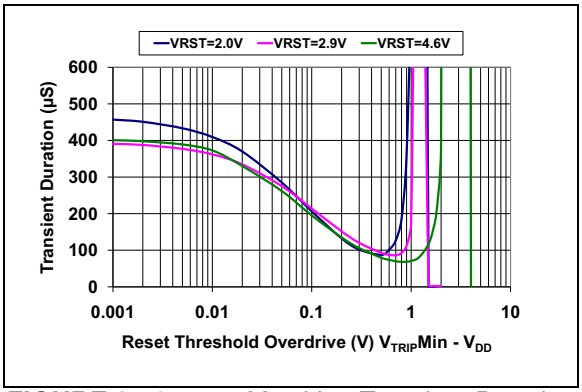


FIGURE 2-48: *Max V_{DD} Transient Duration vs. Reset Threshold Overdrive.*

MCP1319 does not have a Watchdog Timer

FIGURE 2-46: *Normalized Watchdog Time-Out Period vs. Temperature (**MCP1319-2.9**).*

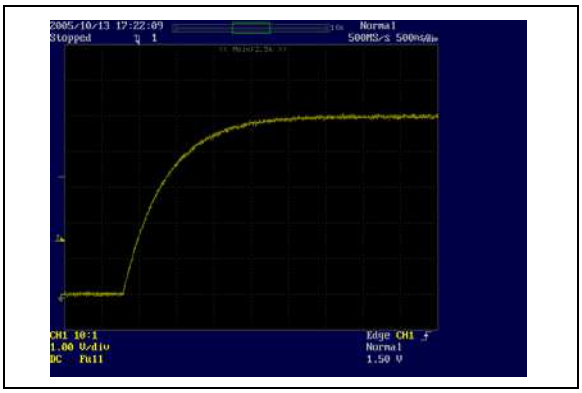


FIGURE 2-49: *"M" Part Number Pull-up Characteristics (**MCP1318M-4.6**).*

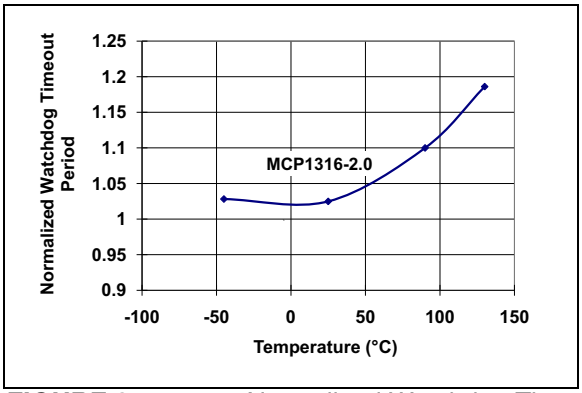


FIGURE 2-47: *Normalized Watchdog Time-Out Period vs. Temperature (**MCP1316-2.0**).*

NOTES:

3.0 PIN DESCRIPTION

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin No. SOT23-5	Device	Symbol	Pin Type	Buffer/ Driver Type	Function
1	MCP1316M (1), MCP1318M (1), MCP1319M (1), MCP1320, MCP1321, MCP1322	$\overline{RST}$	O	Open-Drain	Reset Output (active-low) Goes active (Low) if one of these conditions occurs: 1. If V_{DD} falls below the selected Reset voltage threshold. 2. If the $\overline{MR}$ pin is forced low. 3. If the WDI pin does not detect an edge transition within the minimum selected time-out period. 4. During power-up. **V_{DD} Falling:** Open-Drain = $V_{DD} > V_{TRIP}$ L = $V_{DD} < V_{TRIP}$ **V_{DD} Rising:** Open-Drain = $V_{DD} > V_{TRIP} + V_{HYS}$ L = $V_{DD} < V_{TRIP} + V_{HYS}$
	MCP1316, MCP1318, MCP1319		O	Push-Pull	**V_{DD} Falling:** H = $V_{DD} > V_{TRIP}$ L = $V_{DD} < V_{TRIP}$ **V_{DD} Rising:** H = $V_{DD} > V_{TRIP} + V_{HYS}$ L = $V_{DD} < V_{TRIP} + V_{HYS}$
	MCP1317	RST	O	Push-Pull	Reset Output (active-high) Goes active (High) if one of these conditions occurs: 1. If V_{DD} falls below the selected Reset voltage threshold. 2. If the $\overline{MR}$ pin is forced low. 3. If the WDI pin does not detect an edge transition within the minimum selected time-out period. 4. During power-up. **V_{DD} Falling:** H = $V_{DD} < V_{TRIP}$ L = $V_{DD} > V_{TRIP}$ **V_{DD} Rising:** H = $V_{DD} < V_{TRIP} + V_{HYS}$ L = $V_{DD} > V_{TRIP} + V_{HYS}$
2	All	V_{SS}	—	P	The ground reference for the device.

Note 1: Open-Drain output with internal pull-up resistor.

TABLE 3-1: PIN FUNCTION TABLE (CONTINUED)

Pin No. SOT23-5	Device	Symbol	Pin Type	Buffer/ Driver Type	Function
3	MCP1316, MCP1316M, MCP1317, MCP1320	$\overline{MR}$	I	ST	Manual Reset input for a Reset switch. This input allows a push button switch to be directly connected to the MCP131X/2X $\overline{MR}$ pin, which can then be used to force a system Reset. This input filters (ignores) noise pulses that occur on the $\overline{MR}$ pin. L = Switch is depressed (shorted to ground). This forces the RST/$\overline{RST}$ pins Active. H = Switch is open (internal pull-up resistor pulls signal high). State of the RST/$\overline{RST}$ pins determined by other system conditions.
	MCP1318, MCP1318M, MCP1319, MCP1319M, MCP1321, MCP1322	RST	O	Push-Pull	Reset Output (active-high) Goes active (High) if one of these conditions occurs: 1. If V_{DD} falls below the selected Reset voltage threshold. 2. If the $\overline{MR}$ pin is forced low. 3. If the WDI pin does not detect an edge transition within the minimum selected time-out period. 4. During power-up. **V_{DD} Falling:** H = $V_{DD} < V_{TRIP}$ L = $V_{DD} > V_{TRIP}$ **V_{DD} Rising:** H = $V_{DD} < V_{TRIP} + V_{HYS}$ L = $V_{DD} > V_{TRIP} + V_{HYS}$
4	MCP1316, MCP1316M, MCP1317, MCP1318, MCP1318M, MCP1320, MCP1321	WDI	I	ST	Watchdog Timer Input The WDT period is specified at the time of device order. The Standard WDT period is 1.6s typical. An edge transition on the WDI pin resets the Watchdog Timer counter (no time out). A Falling Edge is required to start the WDT Timer.
	MCP1319, MCP1319M, MCP1322	$\overline{MR}$	I	ST	Manual Reset input for a Reset switch. This input allows a push button switch to be directly connected to the MCP131X/2X $\overline{MR}$ pin, which can then be used to force a system Reset. This input filters (ignores) noise pulses that occur on the $\overline{MR}$ pin. L = Switch is depressed (shorted to ground). This forces the RST/$\overline{RST}$ pins Active. H = Switch is open (internal pull-up resistor pulls signal high). State of the RST/$\overline{RST}$ pins determined by other system conditions.
5	All	V_{DD}	—	P	The positive supply for the device.

Note 1: Open-Drain output with internal pull-up resistor.

3.1 Ground Terminal (V_{SS})

V_{SS} provides the negative reference for the analog input voltage. Typically, the circuit ground is used.

3.2 Supply Voltage (V_{DD})

V_{DD} can be used for power supply monitoring or a voltage level that requires monitoring.

3.3 Reset Output (RST and $\overline{RST}$)

There are four types of Reset output pins. These are:

1. Open-Drain active-low Reset, External pull-up resistor required
2. Open-Drain active-low Reset, Internal pull-up resistor
3. Push-Pull active-low Reset
4. Push-Pull active-high Reset

Some devices have both an active-low and active-high Reset output.

3.3.1 ACTIVE-LOW ($\overline{RST}$) – OPEN-DRAIN, EXTERNAL PULL-UP RESISTOR

The $\overline{RST}$ open-drain output remains low while V_{DD} is below the Reset voltage threshold (V_{TRIP}). Once the device voltage (V_{DD}) returns to a high level ($V_{TRIP} + V_{HYS}$), the device will remain in Reset for the Reset delay timer (T_{RST}). After that time expires, the $\overline{RST}$ pin will float, and an external pull-up resistor is required to bring the output to the high state.

3.3.2 ACTIVE-LOW ($\overline{RST}$) – OPEN-DRAIN, INTERNAL PULL-UP RESISTOR

The $\overline{RST}$ open-drain output remains low while V_{DD} is below the Reset voltage threshold (V_{TRIP}). Once the device voltage (V_{DD}) returns to a high level ($V_{TRIP} + V_{HYS}$), the device will remain in Reset for the Reset delay timer (T_{RST}). After that time expires, the $\overline{RST}$ pin will be pulled high by an internal pull-up resistor (typically 4.7 kΩ).

3.3.3 ACTIVE-LOW ($\overline{RST}$) – PUSH-PULL

The $\overline{RST}$ push-pull output remains low while V_{DD} is below the Reset voltage threshold (V_{TRIP}). Once the device voltage (V_{DD}) returns to a high level ($V_{TRIP} + V_{HYS}$), the device will remain in Reset for the Reset delay timer (T_{RST}). After that time expires, the $\overline{RST}$ pin will be driven to the high state.

3.3.4 ACTIVE-HIGH (RST) – PUSH-PULL

The RST push-pull output remains high while V_{DD} is below the Reset voltage threshold (V_{TRIP}). Once the device voltage (V_{DD}) returns to a high level ($V_{TRIP} + V_{HYS}$), the device will remain in Reset for the Reset delay timer (T_{RST}). After that time expires, the RST pin will be driven to the low state.

3.4 Manual Reset Input ($\overline{MR}$)

The Manual Reset ($\overline{MR}$) input pin allows a push button switch to easily be connected to the system. When the push button is depressed, it forces a system Reset. This pin has circuitry that filters noise that may be present on the $\overline{MR}$ signal.

The $\overline{MR}$ pin is active-low and has an internal pull-up resistor.

3.5 Watchdog Input

In some systems, it is desirable to have an external Watchdog Timer to monitor the operation of the system. This is done by requiring the embedded controller to “pet” the Watchdog Timer within a predetermined time frame (T_{WD}). If the MCP131X/2X is not “petted” within this time frame, the MCP131X/2X will force the Reset pin(s) active.

The embedded controller “pets” the MCP131X/2X by forcing an edge transition on the WDI pin. The WDT Timer is activated by the first falling edge on the WDI pin.

The standard offering devices have a typical Watchdog Timer period (T_{WD}) of 1.6 s. Table 1-3 shows the available Watchdog Timer periods.