MCP111/112

Micropower Voltage Detector

Features

- Ultra-low supply current: 1.75 µA (max.)
- Precision monitoring options of:
  - 1.90V, 2.32V, 2.63V, 2.90V, 2.93V, 3.08V, 4.38V and 4.63V
- Resets microcontroller in a power-loss event
- Active-low V_{OUT} pin:
  - **MCP111** active-low, open-drain
  - **MCP112** active-low, push-pull
- Available in SOT23-3, TO-92, SC-70 and SOT-89-3 packages
- Temperature Range:
  - Extended: -40°C to +125°C (**except MCP1XX-195**)
  - Industrial: -40°C to +85°C (**MCP1XX-195 only**)
- Pb-free devices

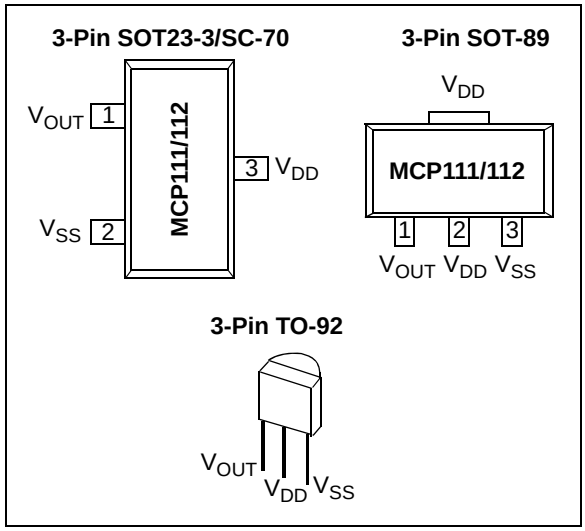
Applications

- Critical Microcontroller and Microprocessor Power-Monitoring Applications
- Computers
- Intelligent Instruments
- Portable Battery-Powered Equipment

Description

The MCP111/112 are voltage-detecting devices designed to keep a microcontroller in reset until the system voltage has stabilized at the appropriate level for reliable system operation. These devices also operate as protection from brown-out conditions when the system supply voltage drops below the specified threshold voltage level. Eight different trip voltages are available.

Package Types



Block Diagram

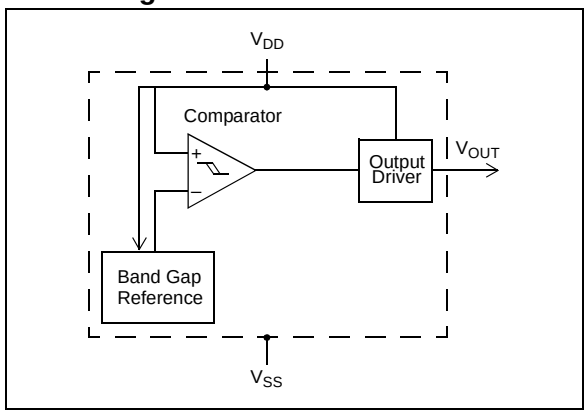


TABLE 1: DEVICE FEATURES

Device	Output		Reset Delay (typ)	Package Pin Out (Pin # 1, 2, 3)	Comment
	Type	Pull-up Resistor			
MCP111	Open-drain	External	No	V_{OUT}, V_{SS}, V_{DD}	
MCP112	Push-pull	No	No	V_{OUT}, V_{SS}, V_{DD}	
MCP102	Push-pull	No	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	See **MCP102/103/121/131** Data Sheet (DS21906)
MCP103	Push-pull	No	120 ms	Vss, $\overline{RST}$, V_{DD}	See **MCP102/103/121/131** Data Sheet (DS21906)
MCP121	Open-drain	External	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	See **MCP102/103/121/131** Data Sheet (DS21906)
MCP131	Open-Drain	Internal (~95 kΩ)	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	See **MCP102/103/121/131** Data Sheet (DS21906)

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

V_{DD} 7.0V
Input current (V_{DD}) . . . . . .10 mA
Output current ($\overline{RST}$) . . . . . .10 mA
Rated Rise Time of V_{DD} 100V/µs
All inputs and outputs (except $\overline{RST}$) w.r.t. V_{SS} . . . . . .-0.6V to (V_{DD} + 1.0V)
$\overline{RST}$ output 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
ESD protection on all pins . . . . . ≥ 2 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 **MCP111**), 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, $V_{\overline{RST}}$ < 0.2V
Operating Current		I_{DD}	—	< 1	1.75	µA	
V_{DD} Trip Point	**MCP1XX-195**	V_{TRIP}	1.872	1.900	1.929	V	T_A = +25°C **(Note 1)**
			1.853	1.900	1.948	V	T_A = -40°C to +85°C **(Note 2)**
	MCP1XX-240		2.285	2.320	2.355	V	T_A = +25°C **(Note 1)**
			2.262	2.320	2.378	V	**Note 2**
	MCP1XX-270		2.591	2.630	2.670	V	T_A = +25°C **(Note 1)**
			2.564	2.630	2.696	V	**Note 2**
	MCP1XX-290		2.857	2.900	2.944	V	T_A = +25°C **(Note 1)**
			2.828	2.900	2.973	V	**Note 2**
	MCP1XX-300		2.886	2.930	2.974	V	T_A = +25°C **(Note 1)**
			2.857	2.930	3.003	V	**Note 2**
	MCP1XX-315		3.034	3.080	3.126	V	T_A = +25°C **(Note 1)**
			3.003	3.080	3.157	V	**Note 2**
	MCP1XX-450		4.314	4.380	4.446	V	T_A = +25°C **(Note 1)**
			4.271	4.380	4.490	V	**Note 2**
	MCP1XX-475		4.561	4.630	4.700	V	T_A = +25°C **(Note 1)**
			4.514	4.630	4.746	V	**Note 2**
V_{DD} Trip Point Tempco		T_{TPCO}	—	±100	—	ppm/°C	

Note 1: Trip point is ±1.5% from typical value.
2: Trip point is ±2.5% from typical value.
3: This specification allows this device to be used in PICmicro® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) feature (see device-specific programming specifications for voltage requirements). This specification DOES NOT allow a continuous high voltage to be present on the open-drain output pin (V_{OUT}). The total time that the V_{OUT} pin can be above the maximum device operational voltage (5.5V) is 100 sec. Current into the V_{OUT} 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, please refer to Figure 2-28.
4: This parameter is established by characterization and is not 100% tested.

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP111**), T_A = -40°C to +125°C.

Parameters		Sym	Min	Typ	Max	Units	Conditions
Threshold Hysteresis (min. = 1%, max = 6%)	**MCP1XX-195**	V_{HYS}	0.019	—	0.114	V	T_A = +25°C
	MCP1XX-240		0.023	—	0.139	V	
	MCP1XX-270		0.026	—	0.158	V	
	MCP1XX-290		0.029	—	0.174	V	
	MCP1XX-300		0.029	—	0.176	V	
	MCP1XX-315		0.031	—	0.185	V	
	MCP1XX-450		0.044	—	0.263	V	
	MCP1XX-475		0.046	—	0.278	V	
V_{OUT} Low-level Output Voltage		V_{OL}	—	—	0.4	V	I_{OL} = 500 µA, V_{DD} = $V_{TRIP(MIN)}$
V_{OUT} High-level Output Voltage		V_{OH}	V_{DD} – 0.6	—	—	V	I_{OH} = 1 mA, For only **MCP112** (push-pull output)
Open-drain High Voltage on Output		V_{ODH}	—	—	13.5 **(3)**	V	**MCP111** only, V_{DD} = 3.0V, Time voltage > 5.5V applied ≤ 100s, current into pin limited to 2 mA, +25°C operation recommended **Note 3, Note 4**
Open-drain Output Leakage Current (**MCP111** only)		I_{OD}	—	0.1	—	µA	

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

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

3: This specification allows this device to be used in PICmicro® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) feature (see device-specific programming specifications for voltage requirements). This specification DOES NOT allow a continuous high voltage to be present on the open-drain output pin (V_{OUT}). The total time that the V_{OUT} pin can be above the maximum device operational voltage (5.5V) is 100 sec. Current into the V_{OUT} 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, please refer to Figure 2-28.

4: This parameter is established by characterization and is not 100% tested.

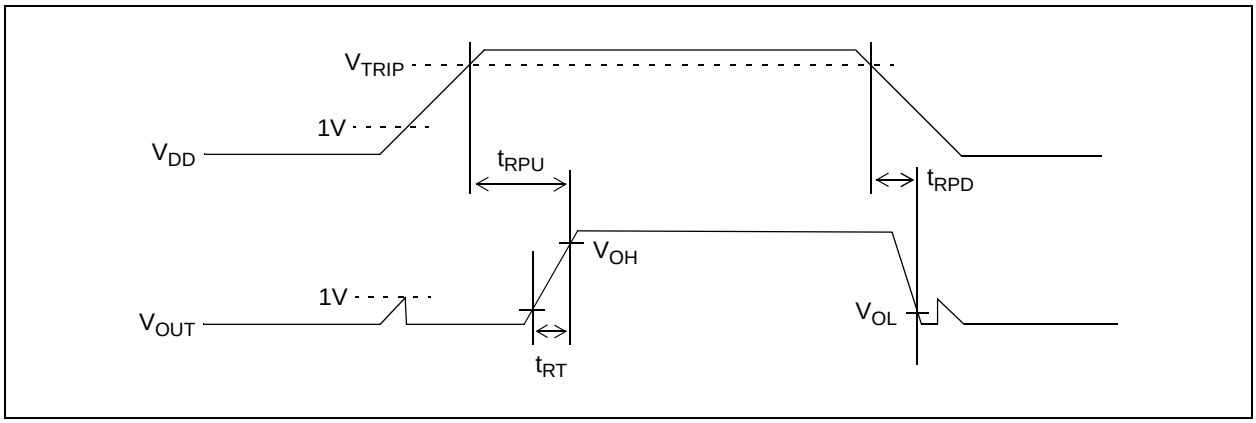


FIGURE 1-1: *Timing Diagram.*

AC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP111**), T_A = -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
V_{DD} Detect to V_{OUT} Inactive	t_{RPU}	—	90	—	µs	**Figure 1-1** and C_L = 50 pF **(Note 1)**
V_{DD} Detect to V_{OUT} Active	t_{RPD}	—	130	—	µs	V_{DD} ramped from $V_{TRIP(MAX)}$ + 250 mV down to $V_{TRIP(MIN)}$ − 250 mV, per **Figure 1-1**, C_L = 50 pF **(Note 1)**
V_{OUT} Rise Time After V_{OUT} Active	t_{RT}	—	5	—	µs	For V_{OUT} 10% to 90% of final value per **Figure 1-1**, C_L = 50 pF **(Note 1)**

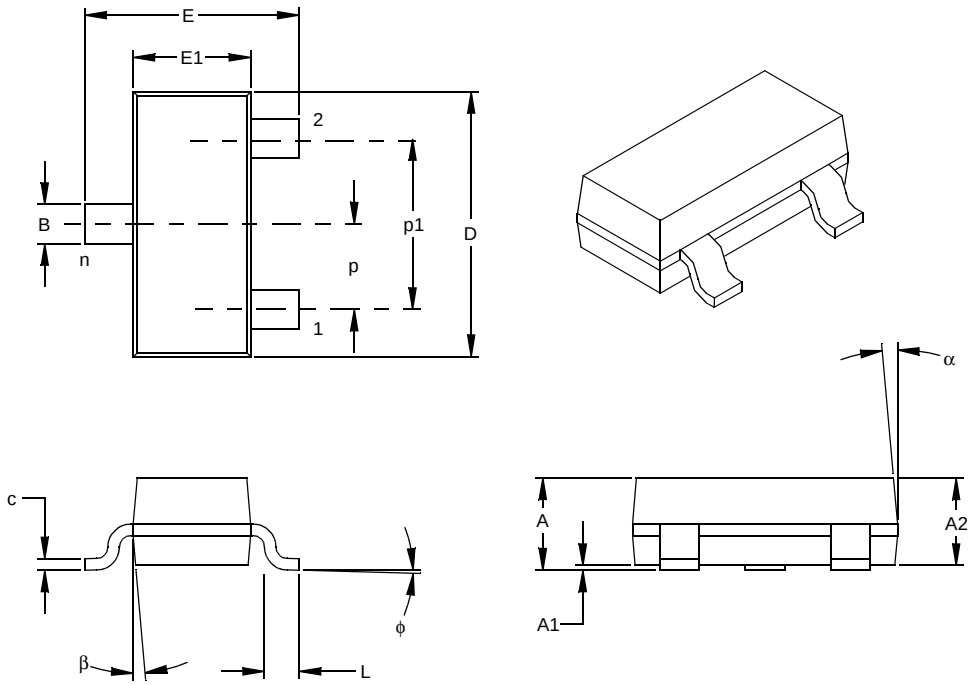
Note 1: These parameters are for design guidance only and are not 100% tested.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP111**), T_A = -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+85	°C	**MCP1XX-195**
Specified Temperature Range	T_A	-40	—	+125	°C	Except **MCP1XX-195**
Maximum Junction Temperature	T_J	—	—	+150	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Package Thermal Resistances						
Thermal Resistance, 3L-SOT23	θ_{JA}	—	336	—	°C/W	
Thermal Resistance, 3L-SC-70	θ_{JA}	—	340	—	°C/W	
Thermal Resistance, 3L-TO-92	θ_{JA}	—	131.9	—	°C/W	
Thermal Resistance, 3L-SOT-89	θ_{JA}	—	110	—	°C/W	

3-Lead Plastic Small Outline Transistor (TT) (SOT-23)



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		3			3	
Pitch	p		.038			0.96	
Outside lead pitch (basic)	p1		.076			1.92	
Overall Height	A	.035	.040	.044	0.89	1.01	1.12
Molded Package Thickness	A2	.035	.037	.040	0.88	0.95	1.02
Standoff §	A1	.000	.002	.004	0.01	0.06	0.10
Overall Width	E	.083	.093	.104	2.10	2.37	2.64
Molded Package Width	E1	.047	.051	.055	1.20	1.30	1.40
Overall Length	D	.110	.115	.120	2.80	2.92	3.04
Foot Length	L	.014	.018	.022	0.35	0.45	0.55
Foot Angle	ϕ	0	5	10	0	5	10
Lead Thickness	c	.004	.006	.007	0.09	0.14	0.18
Lead Width	B	.015	.017	.020	0.37	0.44	0.51
Mold Draft Angle Top	α	0	5	10	0	5	10
Mold Draft Angle Bottom	β	0	5	10	0	5	10

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: TO-236
Drawing No. C04-104

5.2 Product Tape and Reel Specifications

FIGURE 5-1: EMBOSSED CARRIER DIMENSIONS (8, 12, 16 AND 24 MM TAPE ONLY)

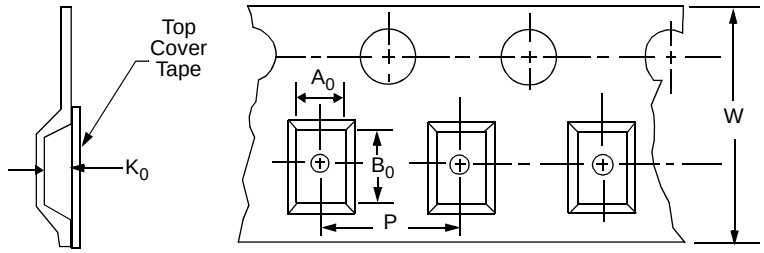
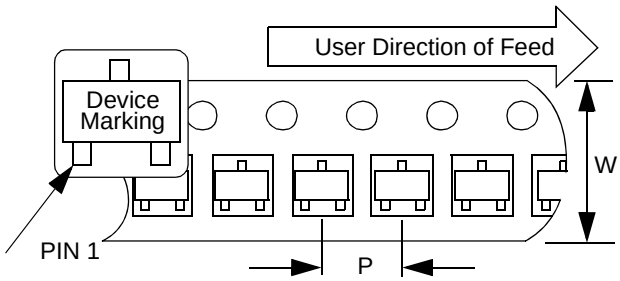


TABLE 1: CARRIER TAPE/CAVITY DIMENSIONS

Case Outline	Package Type		Carrier Dimensions		Cavity Dimensions			Output Quantity Units	Reel Diameter in mm
			W mm	P mm	A0 mm	B0 mm	K0 mm		
TT	SOT-23B	3L	8	4	3.15	2.77	1.22	3000	180
LB	SC-70	3L	8	4	2.4	2.4	1.19	3000	180

FIGURE 5-2: 3-LEAD SOT-23/SC70 DEVICE TAPE AND REEL SPECIFICATIONS



Standard Reel Component Orientation

PRODUCT IDENTIFICATION SYSTEM

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

PART NO.	X	XXX	X	XX
Device	Tape/Reel Option	Monitoring Options	Temperature Range	Package

Device:	MCP111: MicroPower Voltage Detector, open-drain MCP111T: MicroPower Voltage Detector, open-drain (Tape and Reel) MCP112: MicroPower Voltage Detector, push-pull MCP112T: MicroPower Voltage Detector, push-pull (Tape and Reel)
Monitoring Options:	195 = 1.90V 240 = 2.32V 270 = 2.63V 290 = 2.90V 300 = 2.93V 315 = 3.08V 450 = 4.38V 475 = 4.63V
Temperature Range:	I = -40°C to +85°C (MCP11X-195 only) E = -40°C to +125°C (Except MCP11X-195 only)
Package:	LB = SC-70, 3-lead MB = SOT-89, 3-lead TO = TO-92, 3-lead TT = SOT-23B, 3-lead

Examples:

a) MCP111T-195I/TT: Tape and Reel, 1.95V option, open-drain, -40°C to +85°C, SOT-23B package.

b) MCP111T-315E/LB: Tape and Reel, 3.15V option, open-drain, -40°C to +125°C, SC-70-3 package.

c) MCP111-300E/TO: 3.00V option, open-drain, -40°C to +125°C, TO-92-3 package.

d) MCP111-315E/MB: 3.15V option, open-drain, -40°C to +125°C, SOT-89-3 package.

a) MCP112T-290E/TT: Tape and Reel, 2.90V option, push-pull, -40°C to +125°C, SOT-23B-3 package.

b) MCP112T-475E/LB: Tape and Reel, 4.75V option, push-pull, -40°C to +125°C, SC-70-3 package.

c) MCP112-450E/TO: 4.5V option, push-pull, -40°C to +125°C, TO-92-3 package.

d) MCP112-315E/MB: 3.15V option, push-pull, -40°C to +125°C, SOT-89-3 package.