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MIC826

Voltage Supervisor with Watchdog Timer, Manual Reset, and Dual Outputs In 1.6mm x 1.6mm TDFN

General Description

The MIC826 is a low-current, ultra-small, voltage supervisor with manual reset input, watchdog timer, and active-high and active-low push-pull outputs. The reset outputs are asserted and held when the supply voltage falls below the factory-programmed threshold voltage, when the /MR pin is pulled low, or if the watchdog times out. Reset is asserted for the reset timeout delay after the supply voltage increases above the rising threshold voltage or when manual reset input is asserted high.

The MIC826 features an integrated pull-up resistor on the /MR. An active-low push-pull reset output (/RESET) and an active-high reset output (RESET) provide flexibility when interfacing with various microcontrollers, PMICs, or load switches. The watchdog input can be left unconnected for applications that do not require watchdog monitoring.

The MIC826 consumes a quiescent current of only 3.8µA and is offered in a tiny, space-saving, 6-pin 1.6mm x 1.6mm Thin DFN package. It is rated for the –40°C to +125°C temperature range.

Datasheets and support documentation are available on Micrel's web site at: www.micrel.com.

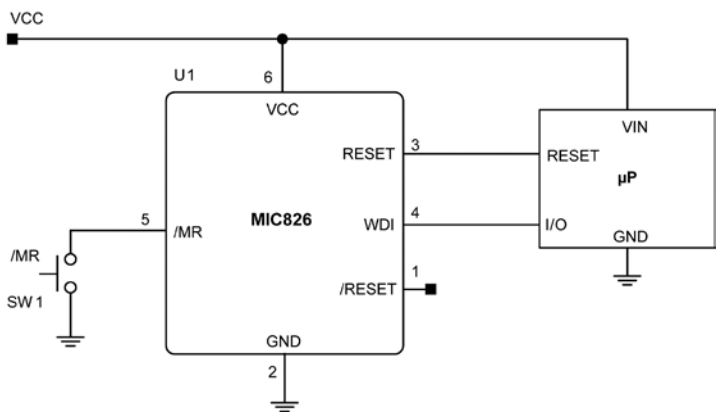
Features

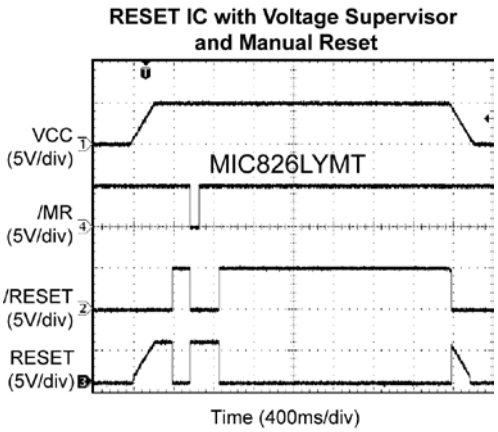
- Precision 1.8V to 5V power supply monitor
- ±0.5% threshold accuracy at T_A = +25°C
- ±1.5% threshold accuracy from T_A = –40°C to +125°C
- 3.8µA supply current (MIC826S/R/T/W/Y/Z)
- 4.8µA supply current (MIC826L/M)
- Manual reset input
- 140ms (min.) reset timeout period
- 1.6s (typ.) watchdog timeout period
- Float watchdog timer input to disable watchdog timer
- Active-high and active-low push-pull outputs
- Guaranteed reset output valid to VCC = 1V
- –40°C to +125°C junction temperature range
- 6-pin 1.6mm x 1.6mm x 0.5mm Thin DFN package
- 50% smaller version of MAX823/MAX824/MAX825/ADM823/ADM824/ADM825
- 8x lower watchdog input current than competition

Applications

- Microprocessor systems
- Computers
- Intelligent instruments

Typical Application



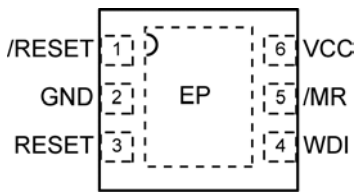


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Ordering Information

Part Number	Top Marking	V_{RST}: Nominal Threshold Voltage (V)	Package	Junction Temperature Range	Lead Finish
MIC826LYMT	82L	4.625	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826MYMT	82M	4.375	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826TYMT	82T	3.075	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826SYMT	82S	2.925	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826RYMT	82R	2.625	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826ZYMT	82Z	2.315	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826YYMT	82Y	2.188	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free
MIC826WYMT	82W	1.665	6-Pin 1.6mm × 1.6mm TDFN	–40°C to +125°C	Pb-Free

Pin Configuration



6-Pin 1.6mm × 1.6mm TDFN
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1	/RESET	Active-Low Reset Output. Pulses low for 200ms when triggered, and remains low whenever VCC is below the reset threshold or when /MR is a logic low. It remains low for 200ms after one of the following occurs: VCC rises above the reset threshold, the watchdog triggers a reset, or /MR goes low to high.
2	GND	Supply Ground.
3	RESET	Active-High Reset Output. Pulses high for 200ms when triggered, and remains high whenever VCC is below the reset threshold or when /MR is a logic low. It remains high for 200ms after one of the following occurs: VCC rises above the reset threshold, the watchdog triggers a reset, or /MR goes low to high. RESET is the inverse of /RESET.
4	WDI	Watchdog Input. If WDI remains either high or low for longer than the watchdog timeout period, the internal watchdog timer runs out and a reset is triggered. The internal watchdog timer clears whenever reset is asserted, or whenever WDI sees a rising or falling edge. If WDI is left unconnected or is connected to a three-stated buffer output, the watchdog feature is disabled.
5	/MR	Manual Reset Input. A logic low on /MR asserts reset. Reset remains asserted as long as /MR is held low and for 200ms after /MR returns high. The active-low input has an internal 52kΩ pull-up resistor. It can be driven from a CMOS logic line or shorted to ground with a switch. Leave open or connect to VCC if unused.
6	VCC	Supply Voltage Pin. VCC is the input to the supply voltage monitor. When the supply voltage falls below the reset threshold voltage, reset outputs (/RESET and RESET) are triggered immediately. When the supply voltage rises above the reset threshold plus hysteresis voltage, the reset outputs remain asserted for the duration of the reset timeout period. A decoupling ceramic capacitor (minimum 0.1µF) must be connected between VCC and GND close to the pins.
EP	ePad	Exposed Pad. Connect to GND.

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Absolute Maximum Ratings[1]

Supply Voltage (VCC) ..... –0.3V to +6.0V
/MR, WDI, RESET, /RESET.....–0.3V to VCC + 0.3V
Input Current, All Pins except (RESET, /RESET) 20mA
Output Current (RESET, /RESET) 20mA
Junction Temperature (T_J) .....–40°C to +150°C
Storage Temperature (Ts).....–65°C to +150°C
ESD Rating (Human Body Model)[3] 1.5kV
ESD Rating (Machine Model)[3].....200V

Operating Ratings[2]

Supply Voltage (VCC)..... +1V to +5.5V
Watchdog Input (WDI) ..... 0V to +VCC
Junction Temperature (T_J) ..... –40°C to +125°C
Junction Thermal Resistance
1.6mm × 1.6mm TDFN (θ_{JA}).....92.4°C/W
1.6mm × 1.6mm TDFN (θ_{JC}).....56.4°C/W

Electrical Characteristics[4]

VCC = 4.7V to 5.5V for MIC826L, VCC = 4.5V to 5.5V for MIC826M, VCC = 3.15V to 3.6V for MIC826T, VCC = 3.0V to 3.6V for MIC826S, VCC = 2.7V to 3.6V for MIC826R, VCC = 2.38V to 2.75V for MIC826Z, VCC = 2.25V to 2.75V for MIC826Y, VCC = 1.75V to 2.0V for MIC826W; T_J = +25°C, **bold** values[5] indicate –40°C ≤ T_J ≤ +125°C, unless otherwise noted.

Parameter	Conditions	Min.	Typ.	Max.	Units
Power Supply Input					
Supply Voltage (VCC)		**1.0**		**5.5**	V
Supply Current (I_{VCC})	MIC826L/M (WDI and /MR unconnected)		4.8	**14**	µA
	MIC826T/S/R/Z/Y/W (WDI and /MR unconnected)		3.8	**8.4**	
Reset Threshold Voltage					
Reset Threshold Voltage (V_{RST})	L (falling) T_A = 25°C	4.602	4.625	4.648	V
	L (falling) –40°C ≤ T_A ≤ +125°C	**4.556**		**4.694**	
	M (falling) T_A = 25°C	4.353	4.375	4.397	
	M (falling) –40°C ≤ T_A ≤ +125°C	**4.309**		**4.441**	
	T (falling) T_A = 25°C	3.060	3.075	3.090	
	T (falling) –40°C ≤ T_A ≤ +125°C	**3.029**		**3.121**	
	S (falling) T_A = 25°C	2.910	2.925	2.940	
	S (falling) –40°C ≤ T_A ≤ +125°C	**2.881**		**2.969**	
	R (falling) T_A = 25°C	2.612	2.625	2.638	
	R (falling) –40°C ≤ T_A ≤ +125°C	**2.586**		**2.664**	
	Z (falling) T_A = 25°C	2.303	2.315	2.327	
	Z (falling) –40°C ≤ T_A ≤ +125°C	**2.280**		**2.350**	
	Y (falling) T_A = 25°C	2.177	2.188	2.199	
	Y (falling) –40°C ≤ T_A ≤ +125°C	**2.155**		**2.221**	
	W (falling) T_A = 25°C	1.657	1.665	1.673	
	W (falling) –40°C ≤ T_A ≤ +125°C	**1.640**		**1.690**	
Reset Threshold Hysteresis	L, M		10		mV
	T, S, R, Z, Y, W		5		mV
Reset Threshold Tempco			40		ppm/°C

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Electrical Characteristics[4] (Continued)

VCC = 4.7V to 5.5V for MIC826L, VCC = 4.5V to 5.5V for MIC826M, VCC = 3.15V to 3.6V for MIC826T, VCC = 3.0V to 3.6V for MIC826S, VCC = 2.7V to 3.6V for MIC826R, VCC = 2.38V to 2.75V for MIC826Z, VCC = 2.25V to 2.75V for MIC826Y, VCC = 1.75V to 2.0V for MIC826W; T_A = +25°C, **bold** values[5] indicate –40°C ≤ T_A ≤ +125°C, unless otherwise noted.

Parameter	Conditions	Min.	Typ.	Max.	Units
Reset Timeout Period (t_{RP})		**140**	200	**280**	ms
Reset Time					
VCC to /RESET Delay (t_{RD})			10		µs
Reset Outputs (/RESET, RESET)					
/RESET Output Voltage High (V_{OH})	L, M: VCC = $V_{RST\ (MAX)}$, I_{SOURCE} = 120µA	**VCC – 1.5**			V
	T, S, R, Z, Y: VCC = $V_{RST\ (MAX)}$, I_{SOURCE} = 30µA	**0.8 × VCC**			
	W: VCC = $V_{RST\ (MAX)}$, I_{SOURCE} = 20µA	**0.8 × VCC**			
/RESET Output Voltage Low (V_{OL})	L, M: VCC = $V_{RST\ (MIN)}$, I_{SINK} = 3.2mA			**0.4**	V
	T, S, R, Z, Y, W: VCC = $V_{RST\ (MIN)}$, I_{SINK} = 1.2mA			**0.3**	
	T_A = 0°C to +70°C, VCC = 1V, I_{SINK} =50µA			**0.3**	
	VCC = 1.2V, I_{SINK} =100µA			**0.3**	
/RESET Output Short-Circuit Current [6]	L, M: /RESET = 0V, VCC = 5.5V			**800**	µA
	T, S, R, Z, Y, W: /RESET = 0V, VCC = 3.6V			**400**	
RESET Output Voltage High (V_{OH})	VCC > 1.6V, I_{SOURCE} = 150µA	**0.8 × VCC**			V
RESET Output Voltage Low (V_{OL})	L, M: VCC = $V_{RST\ (MAX)}$, I_{SINK} = 3.2mA			**0.4**	V
	T, S, R, Z, Y, W: VCC = $V_{RST\ (MAX)}$, I_{SINK} = 1.2mA			**0.3**	
Watchdog Input (WDI)[7]					
Watchdog Timeout Period (t_{WD})		**1.12**	1.60	**2.40**	s
Watchdog Pulse Width		**50**			ns
Watchdog Input Low Voltage (V_{IL})				**0.3 × VCC**	V
Watchdog Input High Voltage (V_{IH})		**0.7 × VCC**			
Watchdog Input Current	WDI = VCC		15	**25**	µA
	WDI = 0V	**–20**	–15		

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Electrical Characteristics[4] (Continued)

VCC = 4.7V to 5.5V for MIC826L, VCC = 4.5V to 5.5V for MIC826M, VCC = 3.15V to 3.6V for MIC826T, VCC = 3.0V to 3.6V for MIC826S, VCC = 2.7V to 3.6V for MIC826R, VCC = 2.38V to 2.75V for MIC826Z, VCC = 2.25V to 2.75V for MIC826Y, VCC = 1.75V to 2.0V for MIC826W; T_A = +25°C, **bold** values[5] indicate –40°C ≤ T_A ≤ +125°C, unless otherwise noted.

Parameter	Conditions	Min.	Typ.	Max.	Units
Manual Reset Input (/MR)					
Input Low Voltage (V_{IL})				**0.3 × VCC**	V
Input High Voltage (V_{IH})		**0.7 × VCC**			V
/MR Pulse Width		**1.0**			µs
/MR Noise Immunity (pulse width with no reset)			100		ns
/MR to RESET Delay			500		ns
/MR Internal Pull-Up Resistor		**35**	52	**75**	kΩ

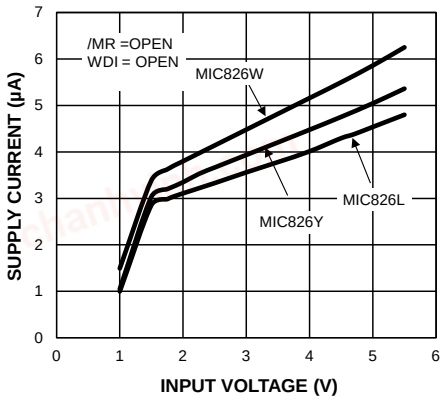
Notes:

1. Exceeding the absolute maximum ratings may damage the device.
2. The device is not guaranteed to function outside its operating ratings.
3. Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5kΩ in series with 100pF.
4. Specifications are for packaged product only.
5. Overtemperature limits are guaranteed by design and not product tested.
6. The /RESET short-circuit current is the maximum pull-up current when /RESET is driven low by µP bidirectional reset pin.
7. The WDI input is designed to drive a three-state output device with a 10µA maximum leakage current and a maximum capacitance of 200pF.

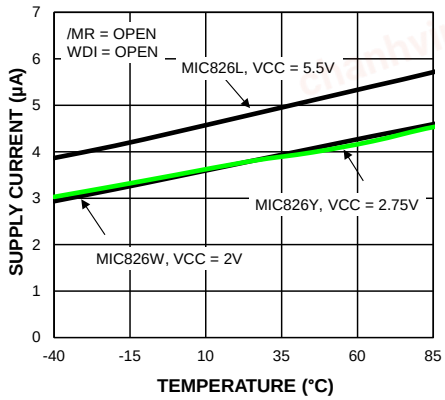
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Typical Characteristics

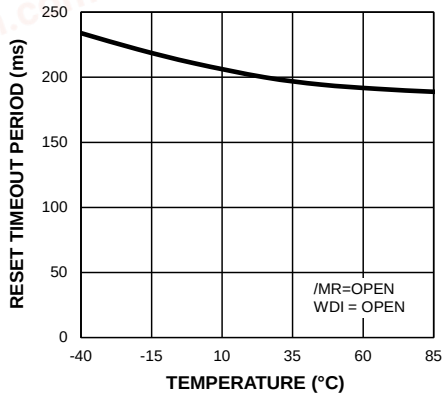
Supply Current vs. Input Voltage



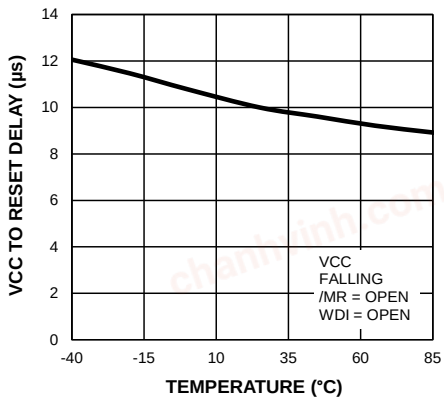
Supply Current vs. Temperature



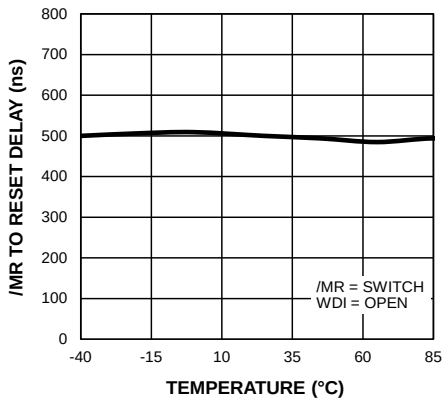
RESET Timeout Period vs. Temperature



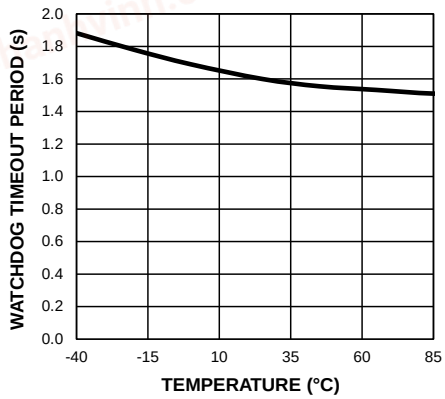
VCC to RESET DELAY vs. Temperature



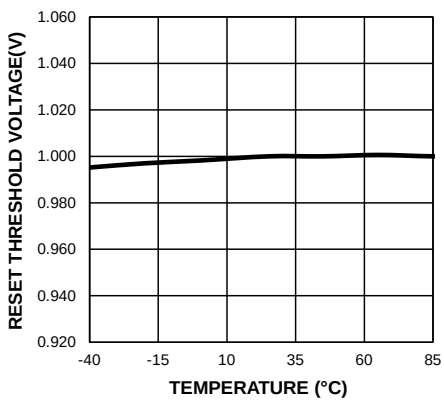
/MR to RESET Delay vs. Temperature



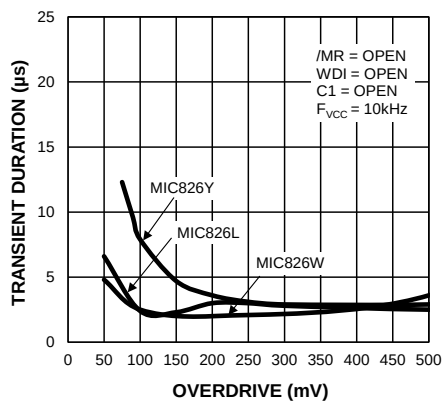
Watchdog Timeout Period vs. Temperature



Normalized Reset Threshold vs. Temperature



Supply Transient Duration vs. Overdrive



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Functional Diagram

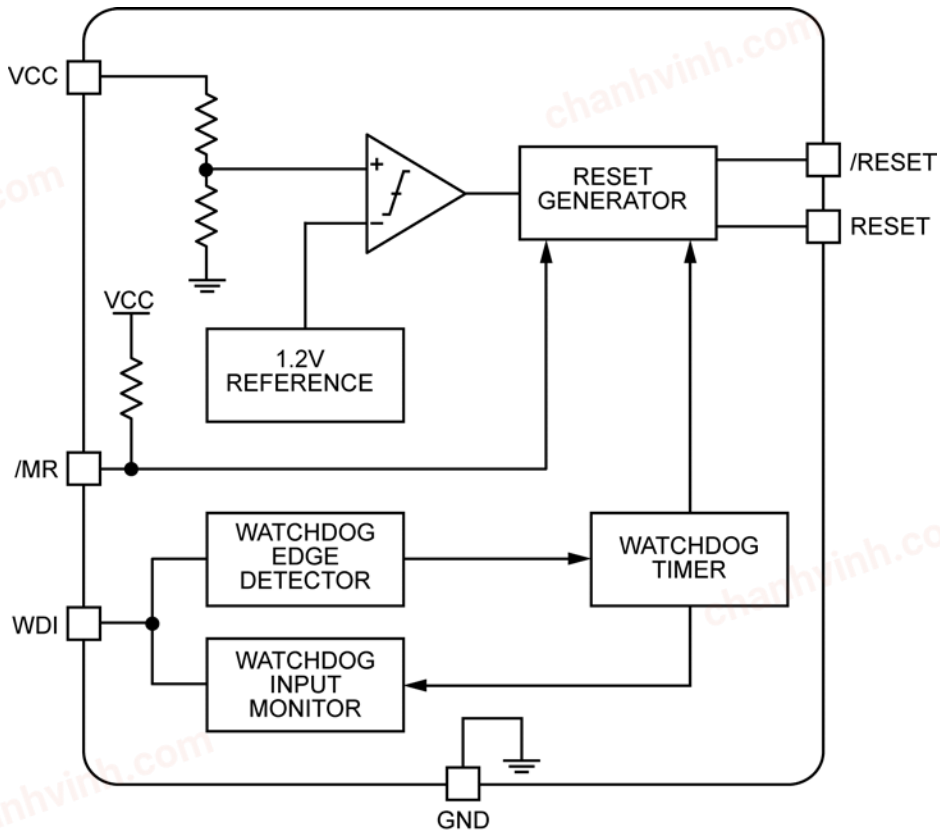


Figure 1. Functional Diagram

Timing Diagram

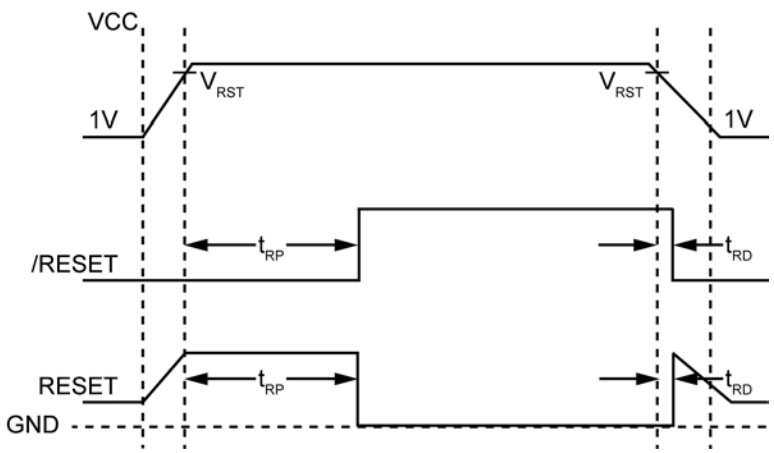


Figure 2. Timing Diagram

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Functional Description

Design and Product Advantages

The MIC826 is a voltage supervisor reset IC with a manual reset input, watchdog input, and dual reset outputs. The MIC826 asserts and holds a reset when the supply voltage falls below the factory-programmed threshold voltage, when /MR is at low logic level, or when watchdog input times out. Reset is asserted for a fixed reset timeout period after the supply voltage increases above the rising threshold voltage or when the manual reset input is asserted high.

The MIC826 features an active-low, push-pull reset output (/RESET) and an active-high, push-pull reset output (RESET). It also contains 52kΩ pull-up resistors on the /MR input to make it easy to connect to pushbutton inputs. The MIC826 also features a watchdog (WDI) input.

Manual Reset Input (/MR)

The /MR input pin has integrated pull-up resistors to keep the current consumption low when the pushbutton switch is pressed.

Reset Outputs (/RESET and RESET)

There are two reset outputs: /RESET and RESET. Both outputs are push-pull, which eliminates the need for pull-up resistors. The RESET output is the inverse of the /RESET output.

Asserting /RESET and RESET Outputs

When Functioning as a Manual Reset

The reset outputs /RESET and RESET are asserted while the /MR pin is driven low. Both reset outputs remain asserted for a factory-programmed reset timeout delay time, t_{RP}. The typical value of a reset timeout period is 200ms. The /RESET pin is driven low while the RESET pin is driven high whenever /MR is pulled low.

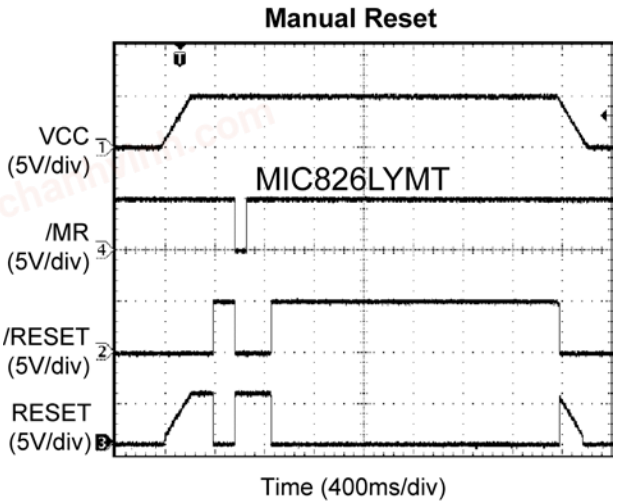


Figure 3. Manual Reset Function

When Functioning as a Voltage Supervisor

The /RESET pin is asserted whenever VCC falls below the reset threshold voltage, V_{RST} (VCC < V_{RST}). The VCC pin circuitry includes hysteresis to prevent /RESET or RESET pin chattering due to noise. The /RESET pin remains asserted for the duration of the reset timeout delay (t_{RP}) after VCC has risen above the reset threshold voltage plus the hysteresis. The reset function ensures that a microprocessor is properly reset and powers up in a known condition after a power failure. The /RESET remains valid with VCC as low as 1V. The RESET output is a complement of the /RESET output.

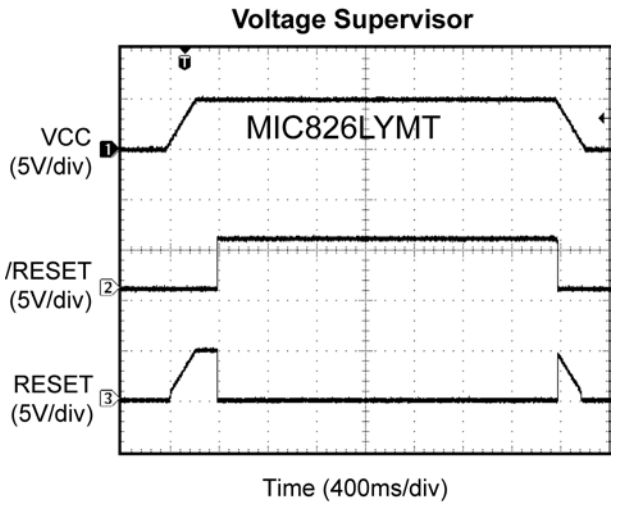


Figure 4. Voltage Supervisor Function

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Watchdog Input

The MIC826 has an on-chip watchdog timer that can reset the microprocessor if it fails to strobe the WDI input within a preset timeout period (t_{WD}). If the WDI pin is left unconnected, this function is disabled. The watchdog timeout period starts when either of the reset outputs becomes inactive and either a high-to-low or low-to-high transition occurs before the watchdog timeout period (t_{WD}). If the watchdog timer times out, then the reset outputs will assert and stay asserted for a reset timeout period (t_{RP}). The watchdog timer is also cleared whenever the reset outputs are asserted by /MR, or if VCC falls below V_{RST}. The watchdog timer starts again whenever the reset outputs are de-asserted.

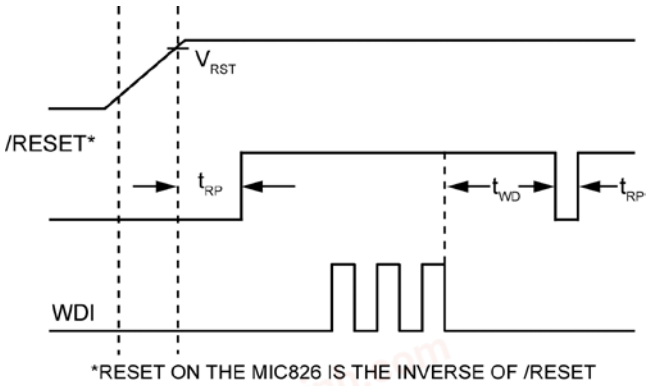


Figure 5. Watchdog Timing

Watchdog Input Current

The WDI input current is the current sourced or sinked by the WDI pin when the WDI input is driven low or high, respectively. The WDI input is designed to drive a tri-state output device with a 10µA maximum leakage current and a maximum capacitance of 200pF.

VCC Transient

The MIC826 is relatively immune to small negative-going VCC glitches below the reset threshold. As shown in Figure 6, the overdrive voltage is the difference between the threshold voltage and the minimum point of the VCC glitch. Typically, an overdrive of 100mV with duration of 2µs or less will not cause a reset.

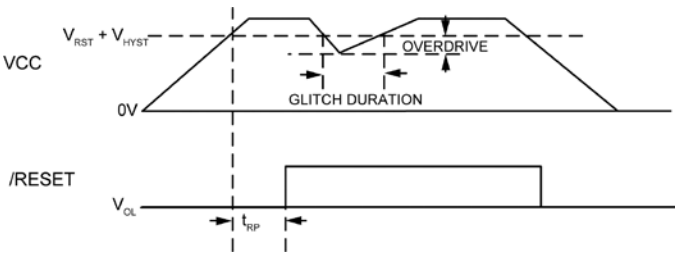


Figure 6. VCC Transient

Reset Valid up-to VCC = 1V

The MIC826 is a supervisory circuit that monitors the power supply voltage level. If the power supply voltage level falls below the factory-programmed threshold level, then the reset signals are asserted. The MIC826 maintains the reset states with VCC as low as 1V.

Supply Bypass Capacitor

An optional 0.1µF input bypass capacitor can be placed from VCC (Pin 6) to GND (Pin 2) to increase glitch rejection.

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Typical Applications

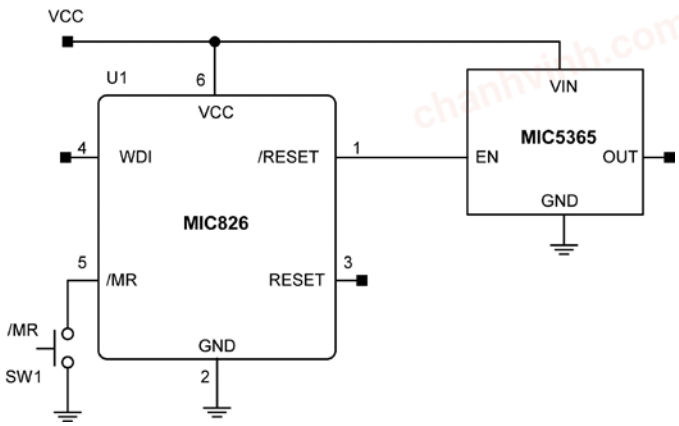


Figure 7. MIC826 for Precision Power Good Function

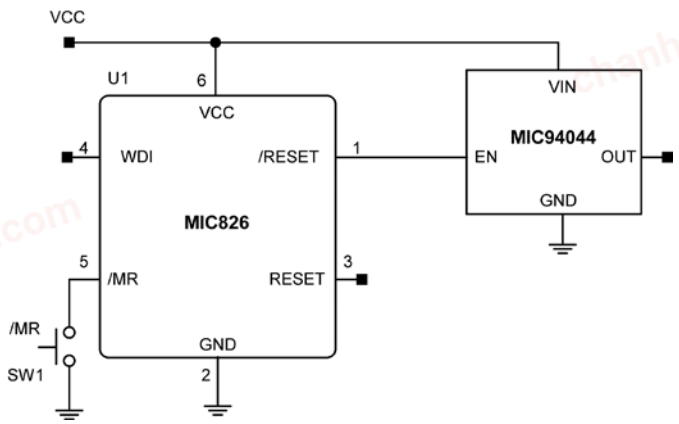


Figure 8. MIC826 Used for Load Switch

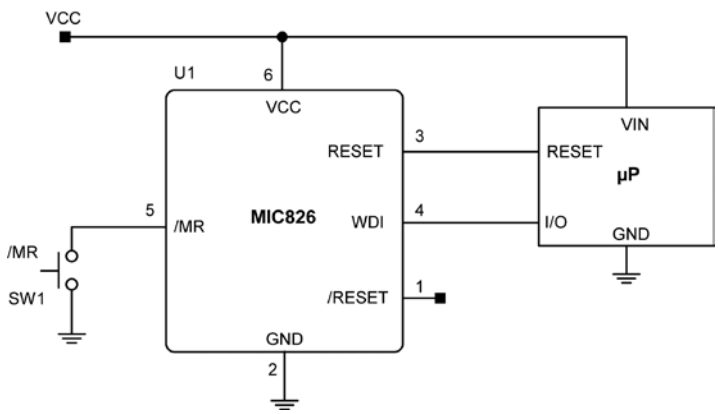
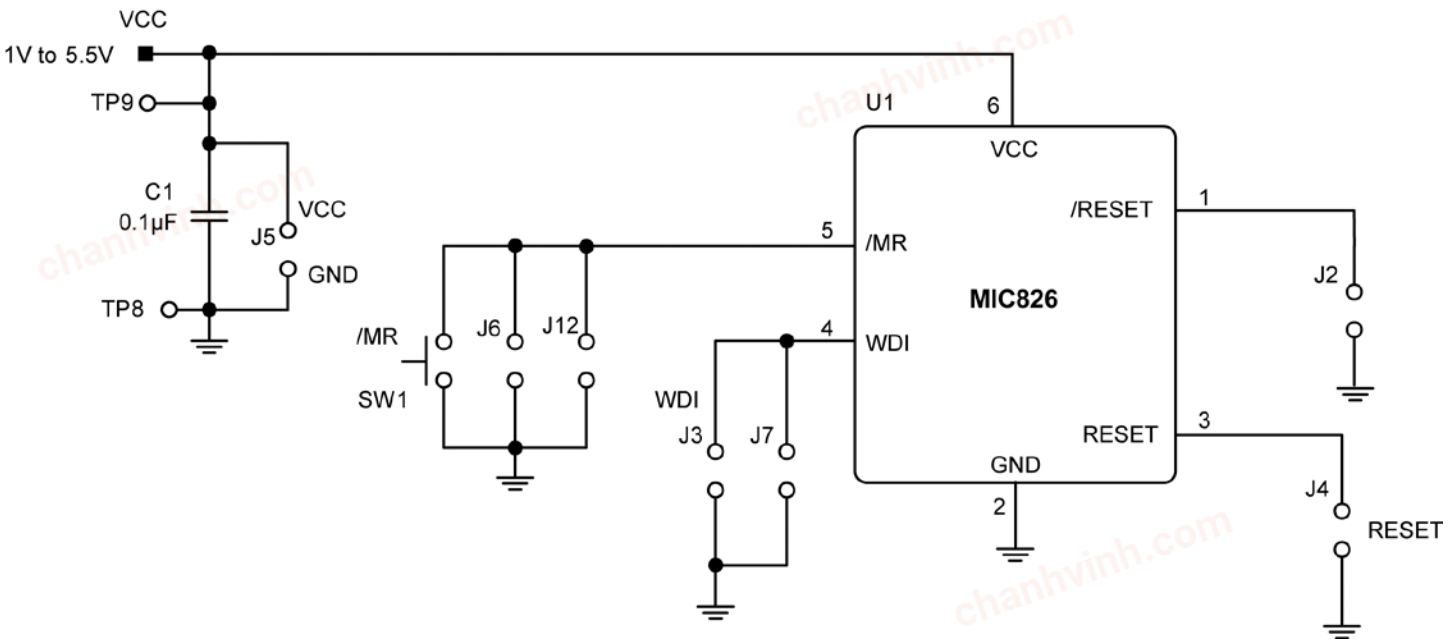


Figure 9. MIC826 Used for Microcontroller Reset with Watchdog Input

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Evaluation Board Schematic



Bill of Materials

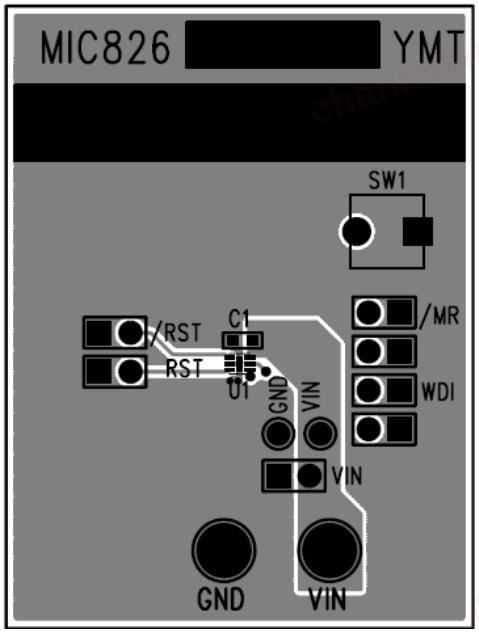
Item	Part Number	Manufacturer	Description	Qty.
C1	GRM188R71C104KA01D	Murata[1]	0.1µF, 16V capacitor, X7R, 0603	1
U1	**MIC826xYMT**	**Micrel, Inc.[2]**	**Voltage Supervisor with Watchdog Timer, Manual Reset, and Dual Outputs in 1.6mm x 1.6mm TDFN**	**1**

Notes:

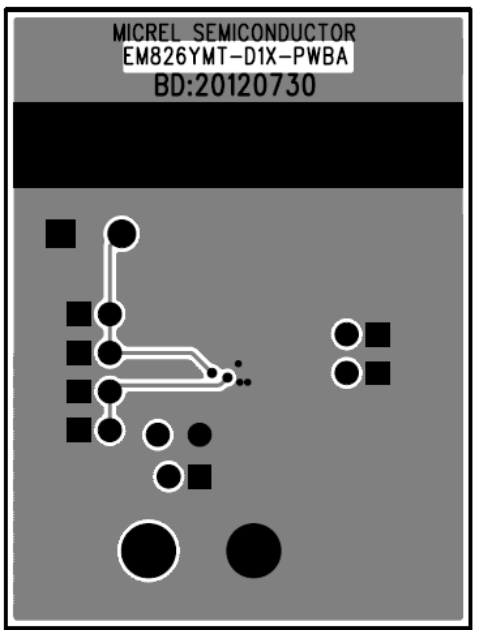
1. Murata: www.murata.com.
2. **Micrel, Inc.: www.micrel.com.**

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PCB Layout Recommendations



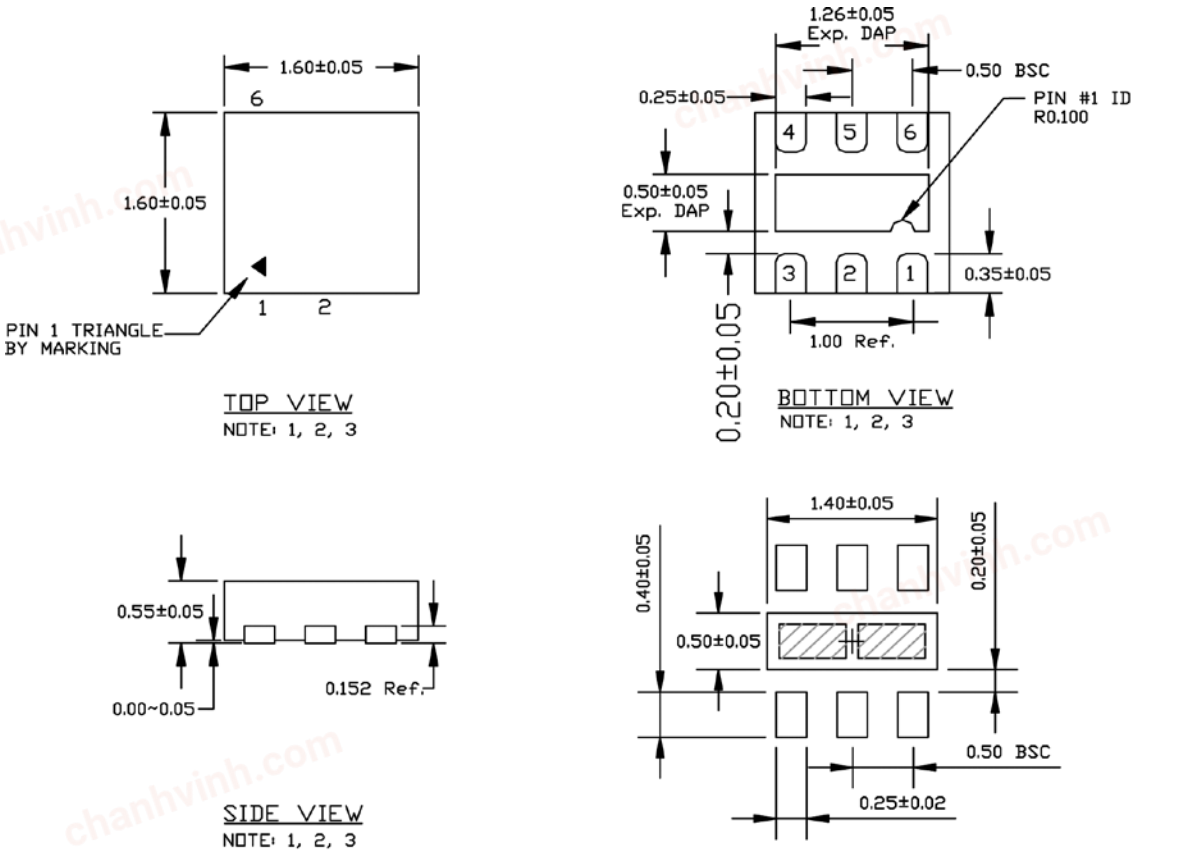
Top Layer



Bottom Layer

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Package Information(1)



NOTE:
1. MAX PACKAGE WARPAGE IS 0.05 MM
2. MAX ALLOWABLE BURR IS 0.076MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. GREEN SHADED AREA REPRESENT SOLDER STENCIL OPENING (OPTIONAL) FOR PROVED THERMAL PERFORMANCE. SIZE: 0.55x0.30MM

6-Pin 1.6mm × 1.6mm TDFN

Notes:

1. Package information is correct as of the publication date. For updates and most current information, go to www.micrel.com.

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