MIC2040/41

Single Channel Low Voltage Power Distribution Switch

Features

- 75 mΩ Maximum On-Resistance
- 0.8V to 5.5V Operating Range
- Adjustable Current Limit
- Up to 1.5A Continuous Output Current
- Short Circuit Protection with Thermal Shutdown
- Circuit Breaker Mode (MIC2041)
- Fault Status Flag
- Undervoltage Lockout
- Output MOSFET Reverse Current Flow Block when Disabled
- Very Fast Reaction to Short-Circuits
- Low Quiescent Current

Applications

- Docking Stations
- Notebook PCs
- PDAs
- Board Hot Swap
- RAID Controllers
- USB Peripherals
- ACPI Power Distribution

General Description

The MIC2040 and MIC2041 are high side MOSFET switches optimized for general purpose power distribution applications that require circuit protection. The devices switch up to 5.5V and as low as 0.8V while offering both programmable current limiting and thermal shutdown to protect the device and the load.

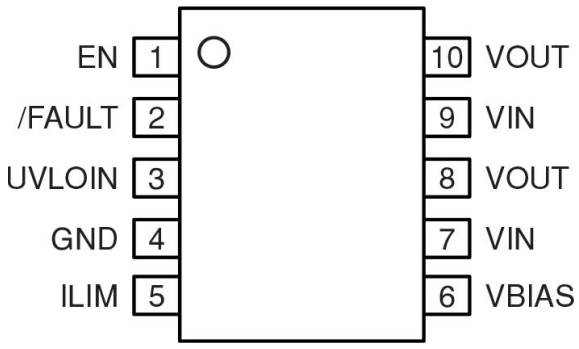
A fault status output is provided in order to detect overcurrent and thermal shutdown fault conditions. Both devices employ soft start circuitry to minimize the inrush current in applications that employ highly capacitive loads. Additionally, the MIC2040 and MIC2041 are both suited for multi-port USB applications to satisfy upstream/downstream power requirements.

The MIC2041 features a auto-reset circuit breaker mode that latches the output off upon detecting an overcurrent condition lasting more than 28 ms. The output is reset by removing or reducing the load.

Package Types

MIC2040/MIC2041

10-Lead MSOP (MM)



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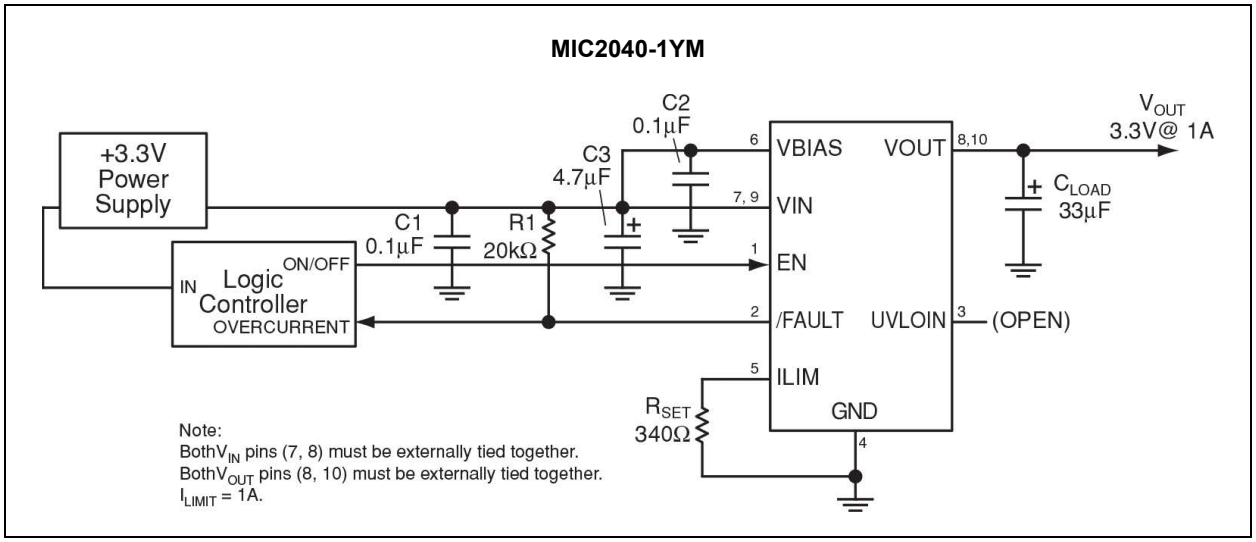
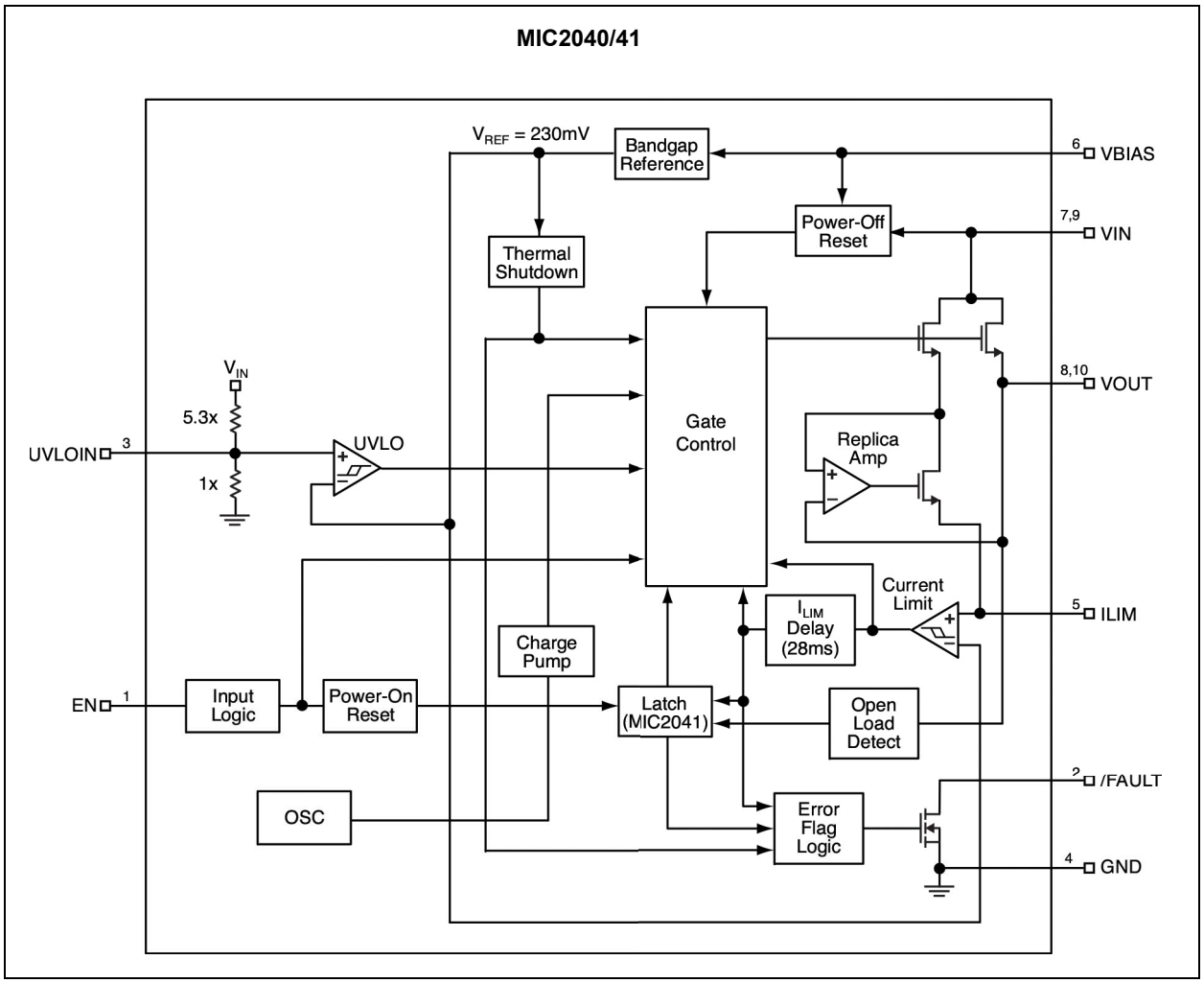
Typical Application



Functional Block Diagram



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1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

V_{IN} and V_{BIAS} 6V
/FAULT, PWRGD Output Voltage 6V
/FAULT, PWRGD Output Current ..... 25 mA
Human Body Model ESD Rating (Note 1) ..... 2 kV
Machine Model ESD Rating (Note 1) 200V

Operating Ratings ‡

V_{IN} Supply Voltage ..... 0.8V to 5.5V
V_{BIAS} Supply Voltage ..... 1.6V to 5.5V
Continuous Output Current ..... 0.25A to 1.5A

† Notice: Stresses above those listed under “Absolute 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 sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ Notice: The device is not guaranteed to function outside its operating ratings.

Note 1: Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100 pF.

ELECTRICAL CHARACTERISTICS

V_{IN} = V_{BIAS} = 5V. T_A = 25°C unless specified otherwise. **Bold** indicates –40°C to +85°C. (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Switch Input Voltage	V_{IN}	0.8	—	5.5	V	$V_{IN} \le V_{BIAS}$
Bias Supply Voltage	V_{BIAS}	1.6	—	5.5	V	—
V_{BIAS} Supply Current - Switch OFF	I_{BIAS}	—	0.1	**5**	µA	No load, Note 2
V_{BIAS} Supply Current - Switch ON		—	250	**400**		
Enable Input Voltage for $V_{IL(MAX)}$	V_{EN}	—	2.4	**1.5**	V	—
Enable Input Voltage for $V_{IH(MIN)}$		**3.5**	2.5			
Enable Threshold Hysteresis	V_{ENHYS}		100		mV	—
Enable Input Current	I_{EN}	**−1**	0.01	**1**	µA	V_{EN} = 0V to 5.5V
Switch Resistance	$R_{DS(ON)}$	—	50	**75**	mΩ	V_{IN} = V_{BIAS} = 3V, 5V I_{OUT} = 500 mA
Output Leakage Current	I_{LEAK}	—	—	**10**	µA	Output off
Current Limit Factor (Note 3)	CLF	**280**	340	**400**	A•Ω	V_{IN} = 3V, 5V; 0.5V ≤ V_{OUT} < 0.5V_{IN} 0.25A ≤ I_{OUT} ≤ 1.5A
Output Reset Threshold	V_{LATCH}	—	V_{IN}−0.2	—	V	V_{IN} = 0.8V to 5.5V V_{OUT} rising (MIC2041)
Latched Output Off Current	I_{LATCH}	1	3	5	mA	Output latched off (MIC2041)
Output Low Voltage (/FAULT)	V_{OL}	—	—	**0.4**	V	I_{OL} (/FAULT) = 15 mA

Note 1: Specification for packaged product only.

2: OFF is V_{EN} < 1.0V for MIC2040/MIC2041–1 and V_{EN} > 4.0V for MIC2040/MIC2041 –2. ON is V_{EN} > 4.0V for MIC2040/MIC2041–1 and V_{EN} < 1.0V for MIC2040/MIC2041 –2.

3: The current limit is determined as follows: I_{LIM} = CLF/R_{SET}.

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ELECTRICAL CHARACTERISTICS (CONTINUED)

V_{IN} = V_{BIAS} = 5V. T_A = 25°C unless specified otherwise. **Bold** indicates –40°C to +85°C. (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
/FAULT Off Current	I_{OFF}	—	—	**1**	µA	V_{FAULT} = 5V
Undervoltage Lockout Threshold	V_{UV}	**1.30**	1.45	**1.58**	V	V_{IN} rising
		1.20	1.35	**1.50**		V_{IN} falling
Undervoltage Lockout Threshold Hesteresis	V_{UVHYS}	—	100	—	mV	—
UVLO Adjust Pin Threshold Voltage	V_{UVINTH}	**200**	220	**240**	mV	V_{IN} rising
		180	200	**220**		V_{IN} falling
UVLO Adjust Pin Threshold Hysteresis	$V_{UVINHYS}$	—	20	—	mV	—
Overtemperature Threshold		—	140	—	°C	T_J increasing
		—	120	—		T_J decreasing
Flag Response Delay	t_{FLAG}	21	28	35	ms	V_{IN} = V_{BIAS} = 3V, 5V
Output Turn-On Delay	t_{ON}	400	600	800	µs	R_{LOAD} = 10Ω, C_{LOAD} = 1 µF
Output Turn-On Rise Time	t_R	0.5	1	1.5	ms	R_{LOAD} = 10Ω, C_{LOAD} = 1 µF
Output Turn-Off Delay	t_{OFF}	—	1	5	µs	R_{LOAD} = 10Ω, C_{LOAD} = 1 µF
Output Turn-Off Fall Time	t_F	—	24		µs	R_{LOAD} = 10Ω, C_{LOAD} = 1 µF

Note 1: Specification for packaged product only.

2: OFF is V_{EN} < 1.0V for MIC2040/MIC2041–1 and V_{EN} > 4.0V for MIC2040/MIC2041 –2. ON is V_{EN} > 4.0V for MIC2040/MIC2041–1 and V_{EN} < 1.0V for MIC2040/MIC2041 –2.

3: The current limit is determined as follows: I_{LIM} = CLF/R_{SET}.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Operating Junction Temperature Range	T_J				°C	Internally limited
Storage Temperature Range	T_S				°C	
Lead Temperature						
Ambient Temperature	T_A	–40		+85	°C	—
Package Thermal Resistance MSOP	θ_{JA}	—	+160	—	°C/W	Note 1

Note 1: The maximum allowable power dissipation at any T_A (ambient temperature) is $P_{D(MAX)}$ = ($T_{J(MAX)}$ – T_A) / θ_{JA}. Exceeding the maximum allowable power dissipation results in excessive die temperature, and causes the regulator to enter thermal shutdown.

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2.0 TIMING DIAGRAMS

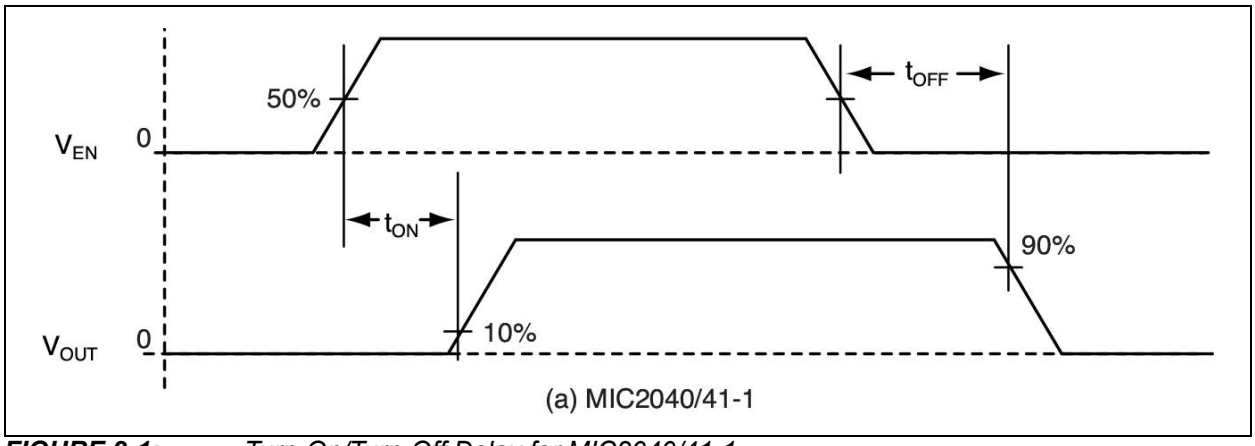


FIGURE 2-1: *Turn-On/Turn-Off Delay for MIC2040/41-1.*

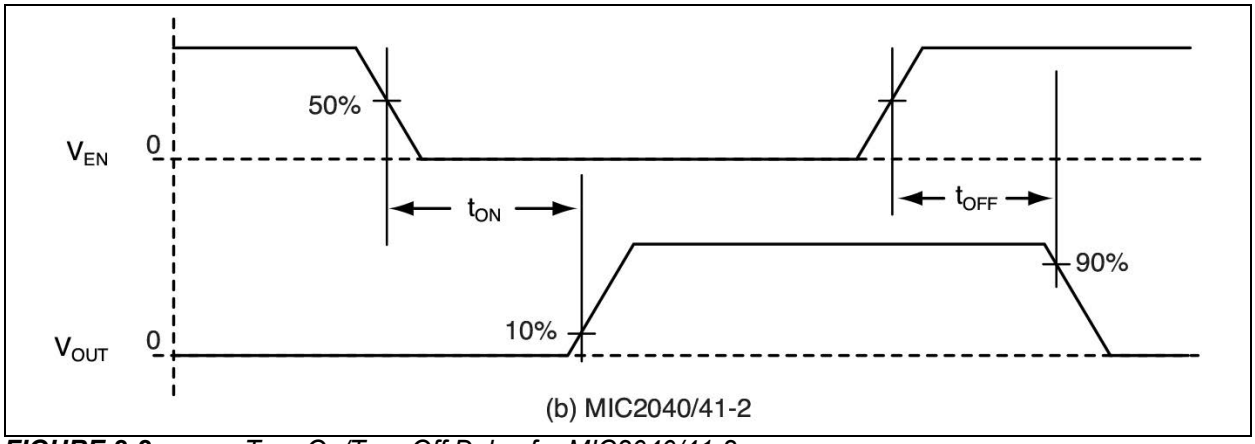


FIGURE 2-2: *Turn-On/Turn-Off Delay for MIC2040/41-2.*

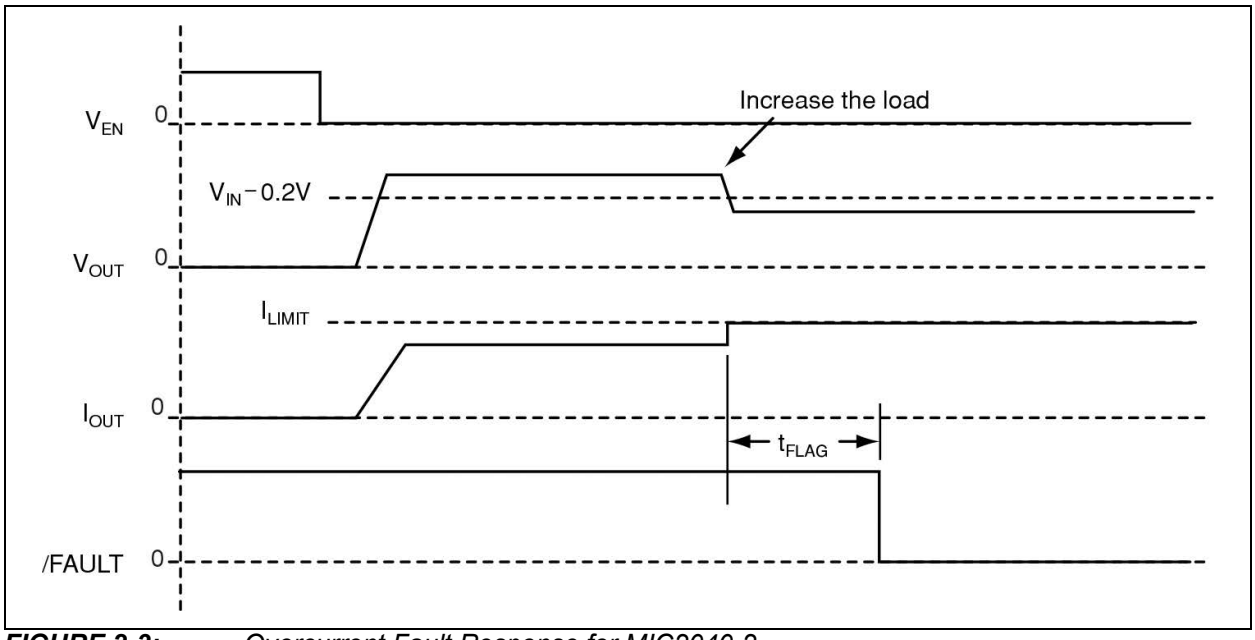
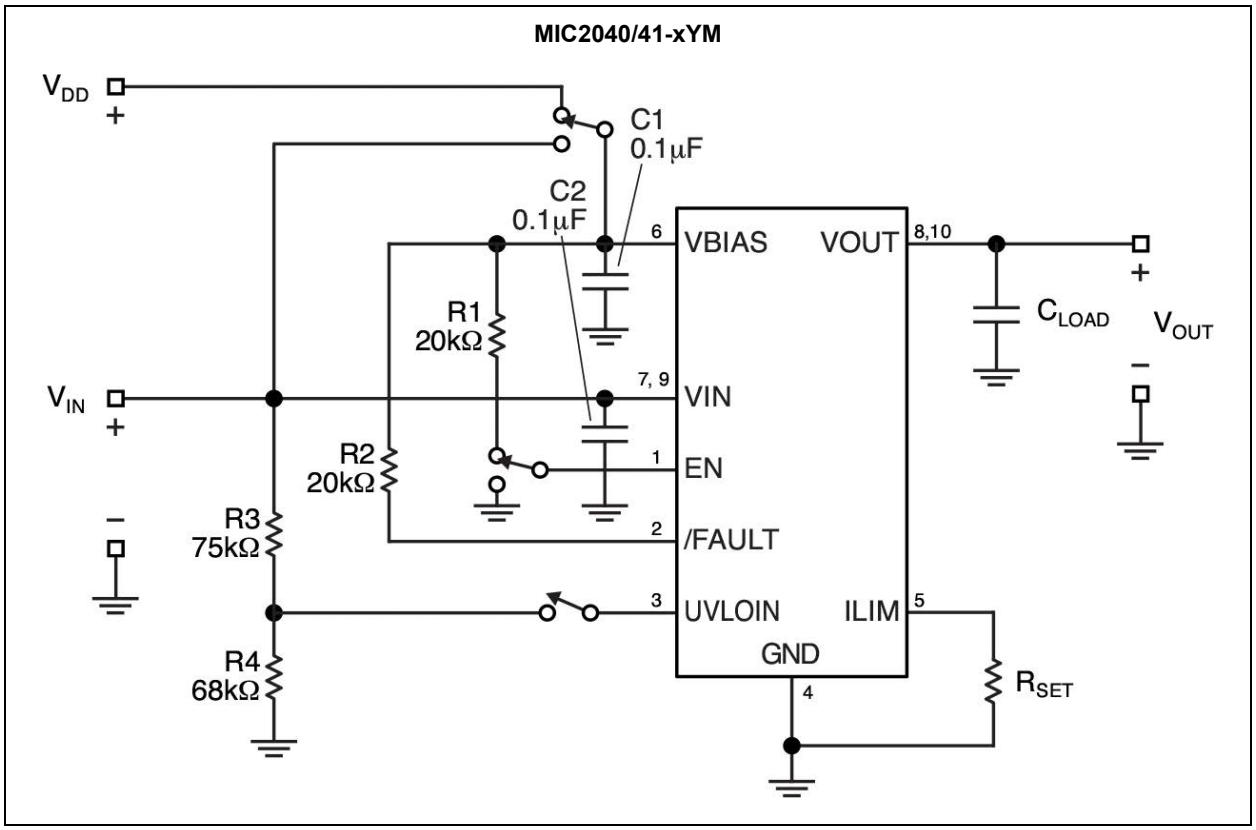


FIGURE 2-3: *Overcurrent Fault Response for MIC2040-2.*

3.0 TEST CIRCUIT



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4.0 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.

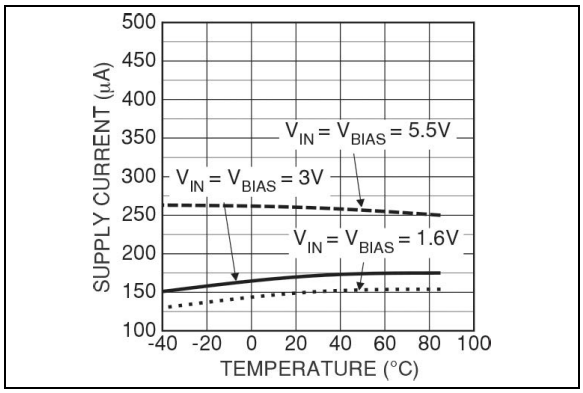

FIGURE 4-1: *Supply Current vs. Temperature.*

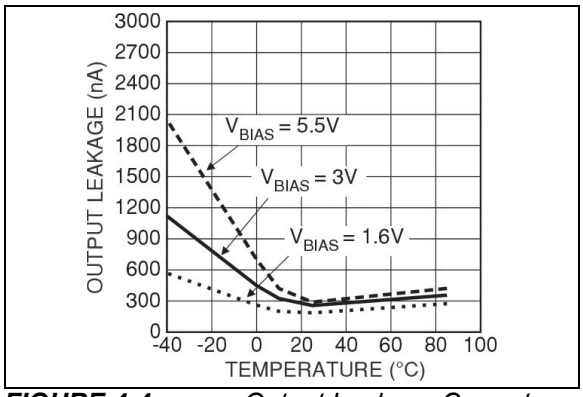

FIGURE 4-4: *Output Leakage Current vs. Temperature.*

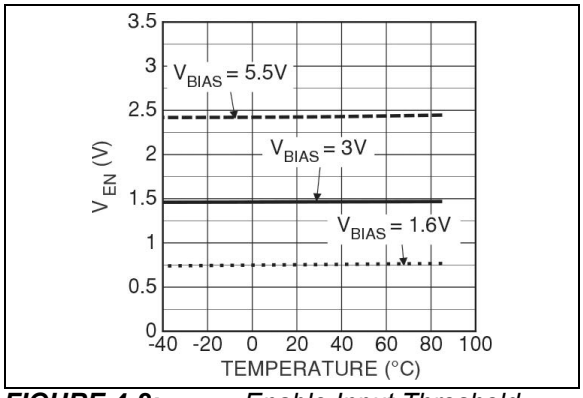

FIGURE 4-2: *Enable Input Threshold (Falling) vs. Temperature.*

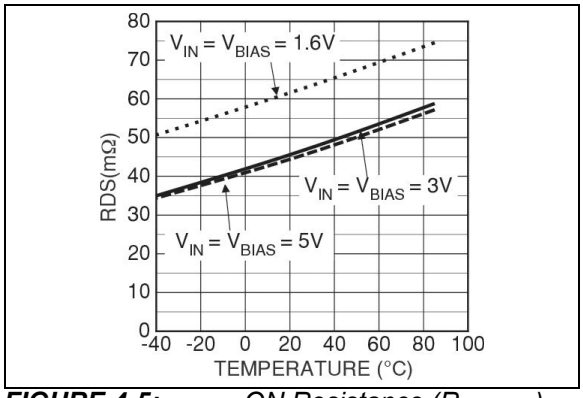

FIGURE 4-5: *ON Resistance ($R_{DS(ON)}$) vs. Temperature.*

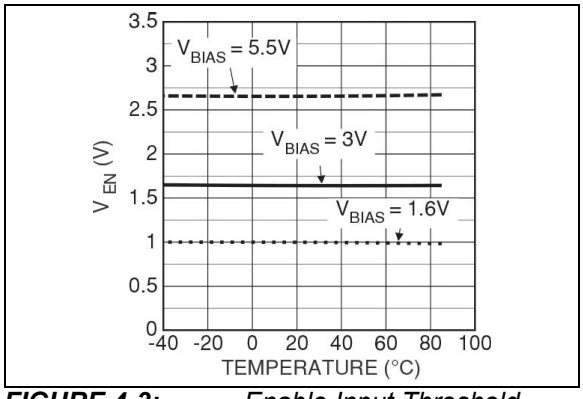

FIGURE 4-3: *Enable Input Threshold (Rising) vs. Temperature.*

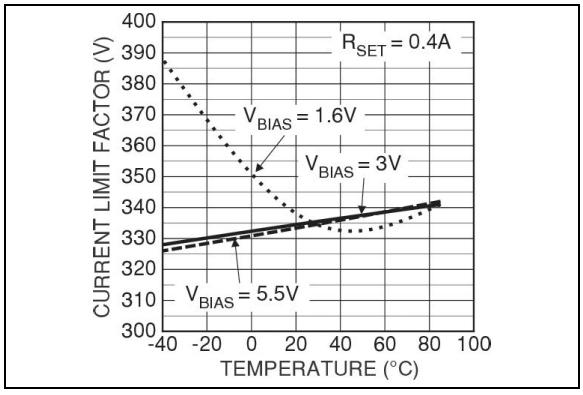

FIGURE 4-6: *Current Limit Factor vs. Temperature.*

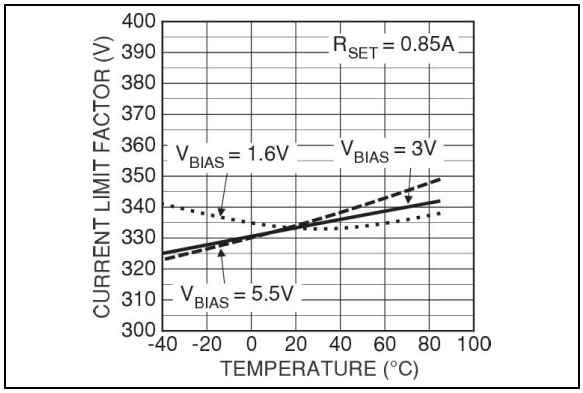

FIGURE 4-7: *Current Limit Factor vs. Temperature.*

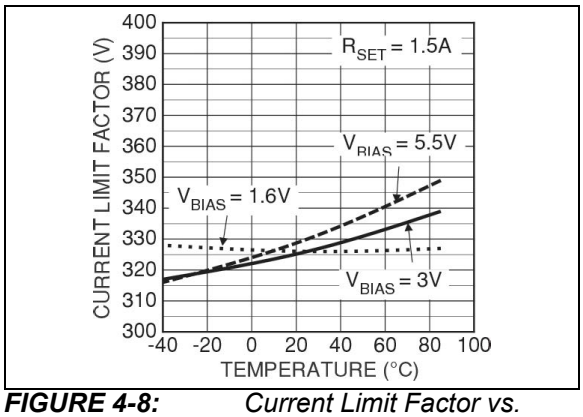

FIGURE 4-8: *Current Limit Factor vs. Temperature.*

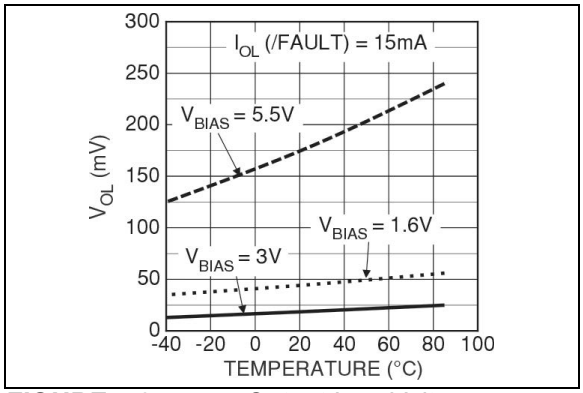

FIGURE 4-9: *Output Low Voltage vs. Temperature.*

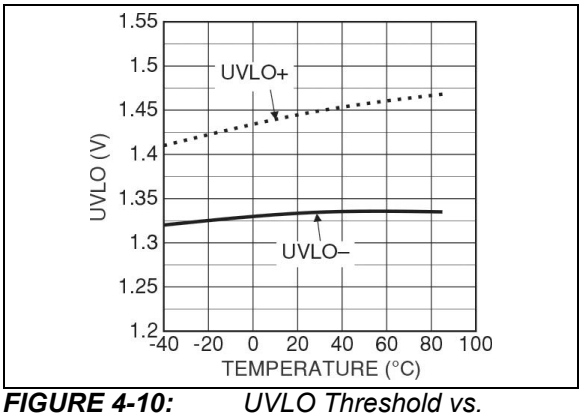

FIGURE 4-10: *UVLO Threshold vs. Temperature.*

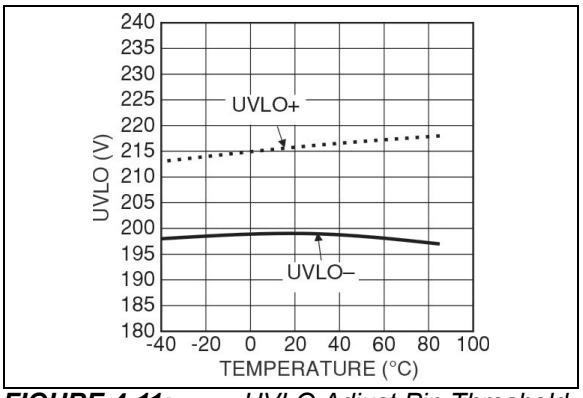

FIGURE 4-11: *UVLO Adjust Pin Threshold vs. Temperature.*

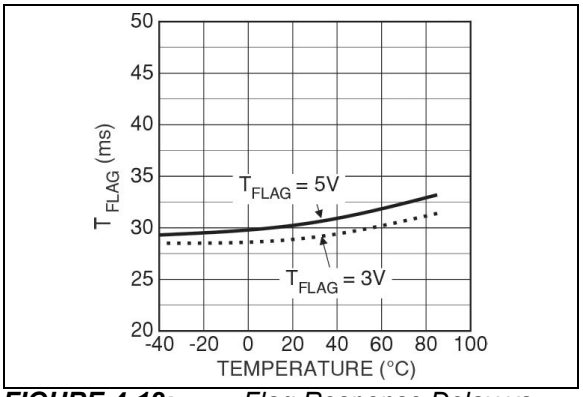

FIGURE 4-12: *Flag Response Delay vs. Temperature.*

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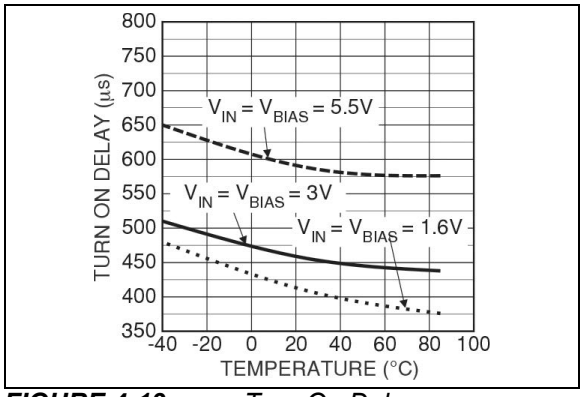

FIGURE 4-13: *Turn-On Delay vs. Temperature.*

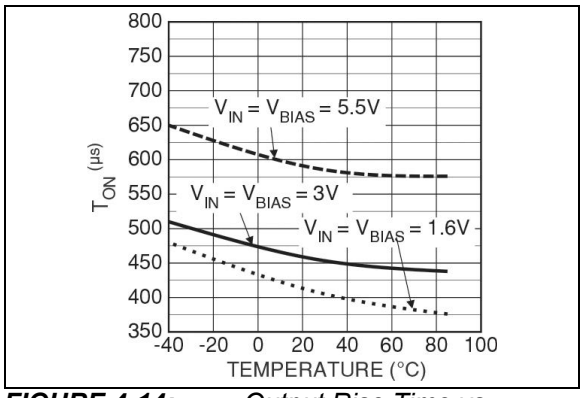

FIGURE 4-14: *Output Rise Time vs. Temperature.*

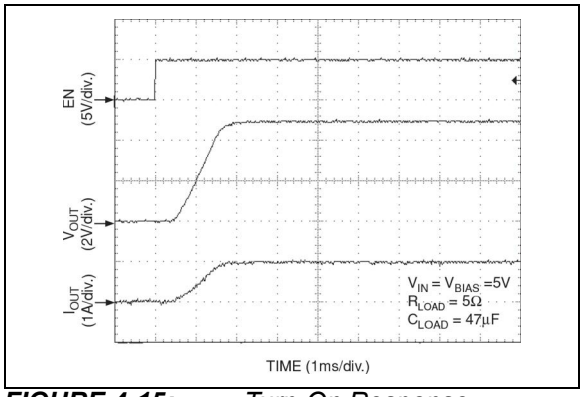

FIGURE 4-15: *Turn-On Response.*

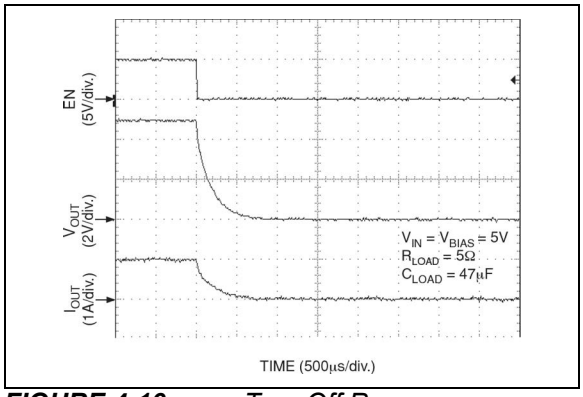

FIGURE 4-16: *Turn-Off Response.*

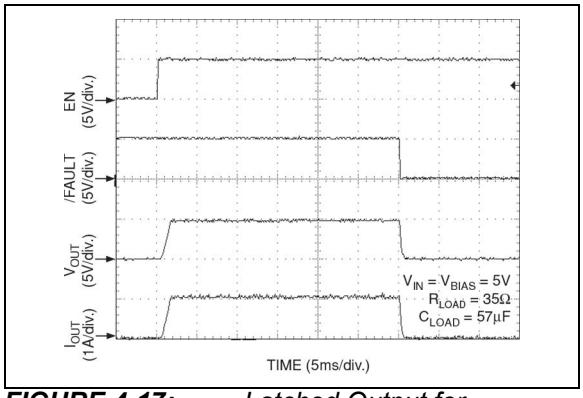

FIGURE 4-17: *Latched Output for MIC2041.*

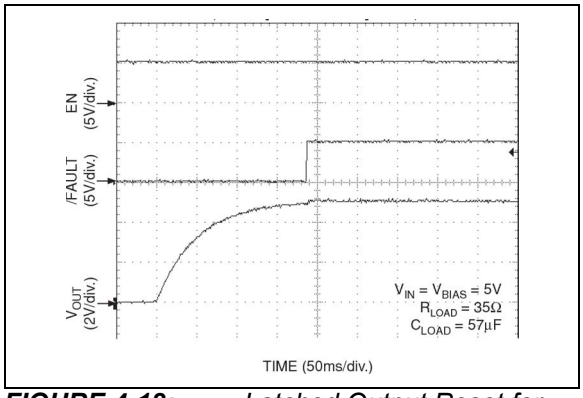

FIGURE 4-18: *Latched Output Reset for MIC2041.*

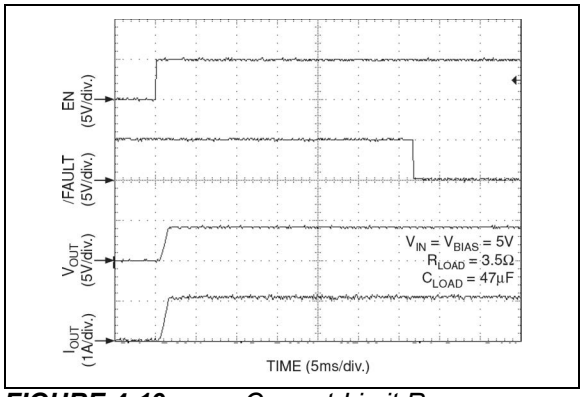

FIGURE 4-19: *Current-Limit Response.*

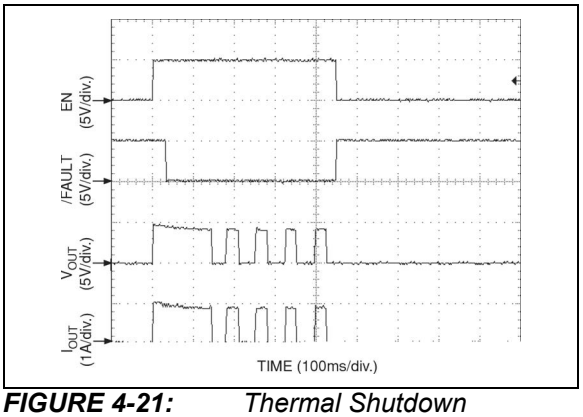

FIGURE 4-21: *Thermal Shutdown Response.*

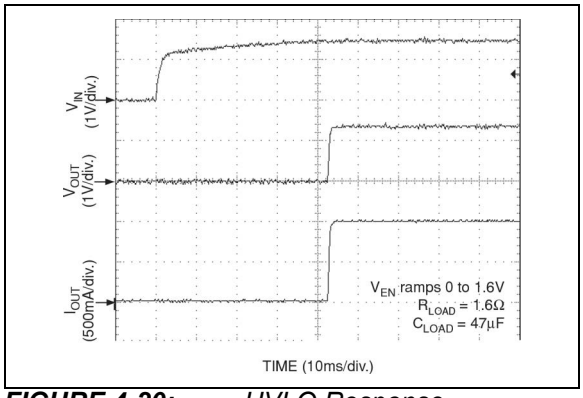

FIGURE 4-20: *UVLO Response.*

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5.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 5-1.

TABLE 5-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	EN	Switch Enable Input: Gate control pin of the output MOSFET available as an active high (–1) or active low (–2) input signal.
2	/FAULT	Fault Status Output: Open drain N-Channel device, active low. This pin indicates an overcurrent, or thermal shutdown condition. For an overcurrent event, /FAULT is asserted if the duration of the overcurrent condition lasts longer than 28 ms.
4	GND	Ground Connection: Tie to analog ground.
5	ILIM	Current Limit Set: A resistor, R_{SET}, connected to this pin sets the current limit threshold as CLF/R_{SET}, where CLF is the current limit factor specified in the electrical characteristics table. For the MIC2040/41, the continuous output current range is 0.25A to 1.5A.
7, 9	VIN	Switch Input Supply: The drain of the output MOSFET. The range of input for the switch is 0.8V to 5.5V. These pins must be externally connected together.
8, 10	VOUT	Switch Output: The source of the output MOSFET. These pins must be externally connected together.
6	VBIAS	Bias Supply Input: This input pin supplies bias to operate the switch with range from 1.6V to 5.5V. When switching voltage (V_{IN}) is between 1.6V to 5.5V and the use of a single supply is desired, connect VBIAS to VIN externally.
3	UVLOIN	Undervoltage Lockout Adjust Input: With this pin left open, the UVLO threshold is internally set to 1.45V. When the switching voltage (V_{IN}) is at or below 1.6V, connecting an external resistive divider to this input will lower the UVLO threshold. The total resistance must be less than 200 kΩ. See Section 7.0, Application Information for further detail.

6.0 FUNCTIONAL DESCRIPTION

The MIC2040 and MIC2041 are high-side N-Channel switches equipped with programmable current limit up to 1.5A for use in general purpose power distribution applications. The switches, available with active-high or active-low enable inputs, operate down to 0.8V and provide circuit protection via thermal shutdown and an optional output latch during overcurrent conditions.

6.1 Input and Output

VBIAS supplies power to the internal circuitry of the switch and must be present for the switch to operate. VIN is connected to the drain of the output MOSFET and sources power to the switched load. VIN must be less than or equal to VBIAS. VOUT is the source terminal of the output MOSFET and attaches to the load. In a typical circuit, current flows from VIN to VOUT toward the load. If VOUT is greater than VIN, current will flow from VOUT to VIN since the switch is bi-directional when the device is enabled. When disabled (OFF), the switch will block current flow from either direction.

6.2 Enable Input

Enable, the ON/OFF control for the output switch, is a digital input available as an active-high (–1) or active-low (–2) signal. The EN pin, referenced to approximately 0.5 × VBIAS, must be driven to a clearly defined logic high or logic low. Failure to observe this requirement, or allowing EN to float, will cause the MIC2040/41 to exhibit unpredictable behavior. EN should not be allowed to go negative with respect to ground, nor allowed to exceed VBIAS. Failure to adhere to these conditions may result in damage to the device.

6.3 Undervoltage Lockout

When the switch is enabled, undervoltage lockout (UVLO) monitors the input voltage, VIN, and prevents the output MOSFET from turning on until VIN exceeds a predetermined level, nominally set at 1.45V.

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The UVLO threshold is adjustable and can be varied by applying an external resistor divider to the UVLOIN pin from VIN to GND. The resistive divider network is required when the input voltage is below 1.5V. The UVLO threshold is internally preset to 1.45V if the UVLOIN pin is left open. See Section 7.0, Application Information.

6.4 Programmable Current Limit

The MIC2040/41 is designed to prevent damage to the external load by limiting the maximum amount of current it can draw. The current limit is programmed by an external resistor (R_{SET}) connected from ILIM to ground and becomes active when the output voltage is at least 200 mV below the voltage at the input to the device. The limiting current value is defined by the current limit factor (CLF) divided by R_{SET}, and the MIC2040/41 will limit from 0.25A to 1.5A with a set point accuracy of ±18%. In programming the nominal current limit, the value of R_{SET} is determined using the following equation:

EQUATION 6-1:

$$R_{SET} = \frac{CLF}{I_{LIM}} = \frac{(340A \times \Omega)}{I_{LIM}}$$

And given the ±18% tolerance of the current limit factor (CLF), the external resistor is bound by:

EQUATION 6-2:

$$187\Omega \leq R_{SET} \leq 1.6k\Omega$$

The graph in Figure 6-1 displays the current limit factor characteristic over the full temperature and voltage range indicated on the graph. This curve can be used as a point of reference in determining the maximum variation in the device's current limit over the full temperature range. For example:

With VIN = VBIAS = 3.0V and a nominal 1A current limit (R_{SET} = 340Ω), the low and high current limit settings for the MIC2040/41 would be approximately 0.82A and 1.18A, respectively, as shown on the graph using the 340Ω reference.

The MIC2041 is equipped with an internal circuit breaker for overcurrent protection. During an overcurrent event which exceeds the flag delay, the /FAULT output is asserted and the MIC2041 latches the output off. Once the overcurrent load is removed, the output automatically resets.

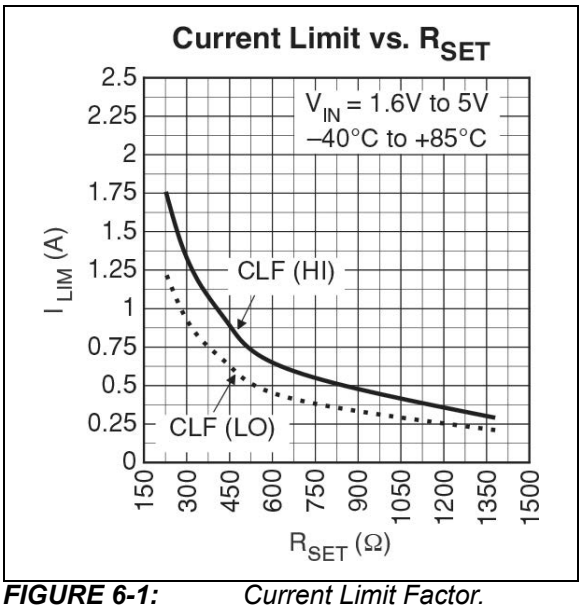

FIGURE 6-1: *Current Limit Factor.*

6.5 /FAULT

The /FAULT signal is an N-Channel, open-drain MOSFET output. An external pull-up resistor tied to a maximum 6V rail is required for the /FAULT pin. The /FAULT pin is asserted (active-low) when either an overcurrent or thermal shutdown condition occurs. During a hot insert of a PCB or when turning on into a highly capacitive load, the resulting high transient inrush current may exceed the current limit threshold of the MIC2040/41. In the case where an overcurrent condition occurs, /FAULT will assert only after the flag delay time has elapsed, typically 28 ms. This ensures that /FAULT is asserted only upon valid overcurrent conditions and that nuisance error reporting is prevented.

6.6 Thermal Shutdown

For the MIC2040, thermal shutdown is employed to protect the device from damage should the die temperature exceed safe margins due to a short circuit or an excessive load. Thermal shutdown shuts off the output MOSFET and asserts the /FAULT output if the die temperature exceeds 140°C. The MIC2040 automatically resets its output and resumes supplying current to the load when the die temperature drops to 120°C. If the fault is still present, the MIC2040 will quickly reheat and shut down again.

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This process of turning ON-OFF-ON is called thermal cycling and will continue as long as the power switch is enabled while the fault or excessive load is present. Depending on PCB layout (including thermal considerations such as heat sinking), package, and ambient temperature, it may take several hundred milliseconds from the incidence of the fault to the output MOSFET being shut off.

6.7 Circuit Breaker Function (MIC2041)

The MIC2041 is designed to shut off all power to the load when a fault condition occurs, just as a circuit breaker would do. A fault condition is deemed to be anytime the output current exceeds the current limit for more than the flag delay period, nominally 28 ms.

Once the output shuts off, it remains off until either the fault load is removed from VOUT or the EN input is cycled ON-OFF-ON. If the fault is still present after EN has been cycled, the MIC2041 will again shut off all power to the load after 28 ms. Once the fault has been removed, then normal operation will resume.

6.7.1 OPEN LOAD DETECTION

The MIC2041 will automatically reset its output when the fault load is cleared. This is accomplished by applying a small current to VOUT and watching for the voltage at VOUT to rise to within 200 mV of VIN. This current is supplied by an internal resistor connected to VIN and is connected to VOUT when MIC2041 latches off.

7.0 APPLICATION INFORMATION

7.1 Input and Output

7.1.1 SUPPLY BYPASS FILTERING

The need for input supply bypass is brought about due to several factors, most notably the input/output inductance along the power path, operating current and current limit, and output capacitance. A 0.1 µF to 0.47 µF bypass capacitor positioned very close to the VIN pin to GND of the device is strongly recommended to filter high frequency oscillations due to inductance.

Also, a sufficient bypass capacitor positioned close to the input source to the switch is strongly advised in order to suppress supply transient spikes and to limit input voltage droop. Inrush current increases with larger output capacitance, thus the minimum value of this capacitor will require experimental determination for the intended application and design. A good starting point is a capacitor between 4.7 µF to 15 µF.

Without these bypass capacitors, an extreme overload condition such as a short circuit, or a large capacitive load, may cause either the input supply to exceed the maximum rating of 6V and possibly cause damage to the internal control circuitry or allow the input supply to droop and fall out of regulation and/or below the minimum operating voltage of the device.

7.1.2 OUTPUT CAPACITANCE

When the MIC2040 die exceeds the overtemperature threshold of approximately 140°C, the device can enter into a thermal shutdown mode if the die temperature falls below 120°C and then rises above 140°C in a continuous cycle.

With the VOUT and /FAULT outputs cycling on and off, the MIC2040 will reset the /FAULT while in an overtemperature fault condition if the output voltage is allowed to swing below ground. The inductance present at the output must be neutralized by capacitance in order to ensure that the output does not fall below ground.

In order to counter the board parasitic inductance and the inductance of relatively short-length (<1 ft., 16-20 gauge wire), a minimum output capacitance of 22µF is strongly recommended and should be placed close to the VOUT pin of the MIC2040. For applications that use more than a foot of cable, an additional 10 µF/ft. is recommended.

7.1.3 REVERSE CURRENT BLOCK

The MIC2040/41 provides reverse current flow block through the output MOSFET if the voltage at VOUT is greater than VIN when the device is disabled.

The VBIAS supply has a limited reverse current flow if the voltage at VOUT is pulled above VBIAS when the device is disabled.

The reverse current for VBIAS can be completely blocked by inserting a Schottky diode from the VBIAS pin (cathode) to the supply (anode). However, the minimum voltage of 1.6V must be supplied to VBIAS after accounting for the voltage drop across the diode.

7.2 UVLO Threshold Setting With Low Input Voltages

When the switching voltage is below 1.6V, the device's standard UVLO threshold (1.45V nominal) will hinder the output MOSFET in switching VIN to VOUT. In this case, the use of the UVLOIN pin is required to override the standard UVLO threshold and set a new, lower threshold for the lower input operating voltages.

An external resistive divider network connected at the UVLOIN pin is used to set the new threshold. Due to the ratio of the internal components, the total series resistance of the external resistive divider should not exceed 200 kΩ. The circuit shown in Figure 7-1 illustrates an application that switches 0.8V while the device is powered from a separate 2.5V power supply. The UVLO threshold is set by the following equation.

EQUATION 7-1:

$$V_{UVTH} = 0.23V \times \left(1 + \frac{R2}{R3}\right)$$

In substituting the resistor values from Figure 7-1, the resulting UVLO threshold (VUVTH) is calculated as 0.6V for this 0.8V switching application. When using the UVLOIN pin to set a new UVLO threshold, an optional 0.1 µF to 1.0 µF capacitor from UVLOIN to GND may be used as a glitch filter in order to avoid nuisance tripping of the UVLO threshold.

If the UVLOIN pin is not in use, this pin should be left open (floating). The use of a pull-down resistor to ground will offset the ratio of the internal resistive divider to this pin resulting in a shift in the UVLO threshold. To bypass (disable) UVLO, connect the UVLOIN pin directly to the VIN pin of the MIC2040/41.

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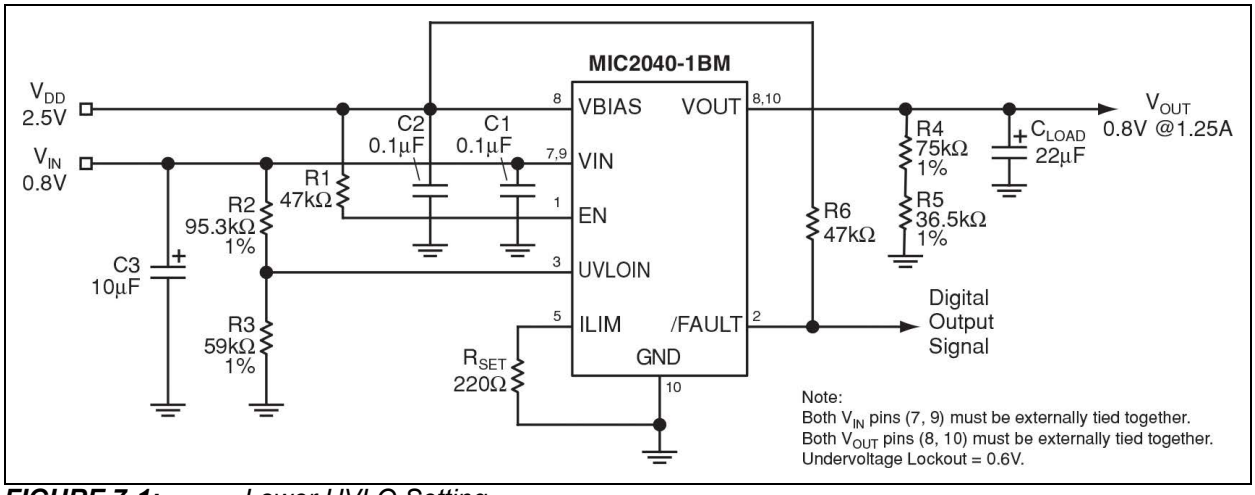

FIGURE 7-1: *Lower UVLO Setting.*

7.3 Power Dissipation

Power dissipation depends on several factors such as the load, PCB layout, ambient temperature, and package type. The following equations can be used to calculate power dissipation and die temperature. Calculation of power dissipation can be accomplished by the following equation:

EQUATION 7-2:

$$P_D = R_{DS(ON)} \times (I_{OUT})^2$$

To relate this to junction temperature, the following equation can be used:

EQUATION 7-3:

$$T_J = P_D \times \theta_{JA} + T_A$$

Where T_J = junction temperature, T_A = ambient temperature and θ_{JA} is the thermal resistance of the package.

7.4 Printed Circuit Board Hot-Plug

The MIC2040/41 are ideal inrush current limiting power switches suitable for hot plug applications. Due to the integrated charge pump, the MIC2040/41 present a high impedance when in the off state and the device slowly becomes a low impedance as it turns on. This effectively isolates power supplies from highly capacitive loads by reducing inrush current during hot plug events. This same feature also can be used for soft-start requirements.

7.5 Bus-Powered Hub (USB)

Figure 7-2 illustrates a bus-powered hub application where the MIC2040 provides ganged power switching to multiple downstream ports. A low-cost MIC5203 (SOT-143) or MIC5207 (TO-92) 3.3V low-dropout (LDO) regulator provides power from the bus to the USB controller.

7.6 PCB Layout Recommendations

The MIC2040 and MIC2041 have very low on-resistance, typically 50 mΩ, and the switches can provide up to 1.5A of continuous output current. Under maximum load, the power consumed by the devices may cause the devices to heat up considerably.

The following list contains some useful suggestions for PCB layout design of the MIC2040/41 in order to prevent the die from overheating under normal operating conditions.

1. Supply additional copper area under the device to remove heat away from the IC. (Refer to the “Micrel Application Hint 17” document for a general guideline in calculating the suggested area.)
2. Provide additional pad area on the corner pins of the MIC2040/41 IC for heat distribution.
3. Tie the common power pins (VIN = pins 7 and 9 and VOUT = pins 8 and 10) together in a manner such that the traces entering and leaving the device have a uniform width sufficient for the application’s current requirements plus added margin (25% minimum recommended).
   Ex: For 1A maximum current, design traces for 1.25A capability
4. For PCB trace width calculations, there are numerous calculator programs available on the internet and elsewhere. As a general rule of thumb, 15-20 mils for every 1A of current when using 1 oz. copper. However, the trace width calculators often take into account maximum temperature increase constraints, as well as layer arrangement, in determining the PCB trace widths.

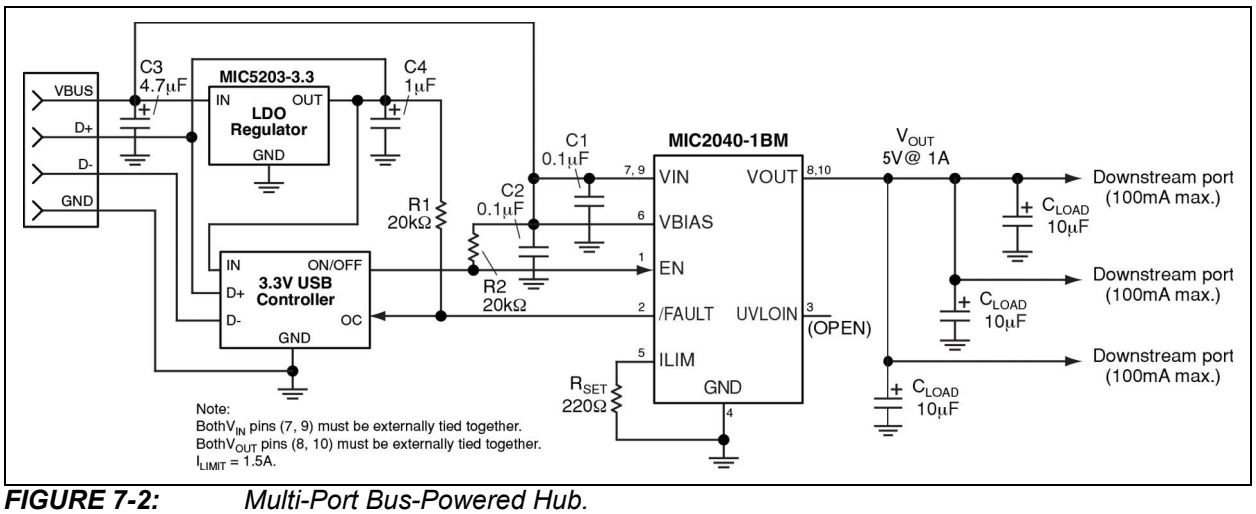

FIGURE 7-2: *Multi-Port Bus-Powered Hub.*

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8.0 PACKAGING INFORMATION

8.1 Package Marking Information

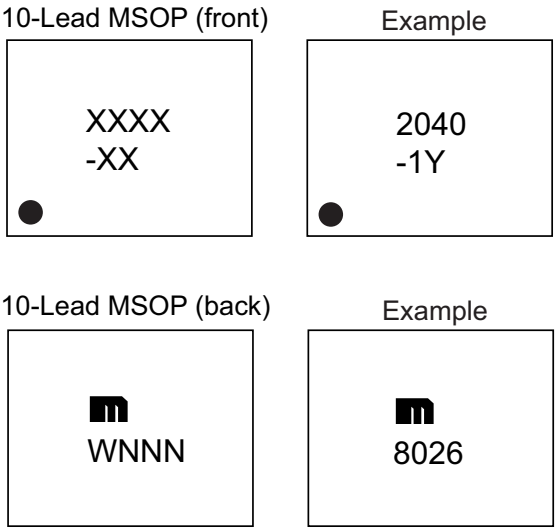


TABLE 8-1: ORDERING INFORMATION

Part Number	Enable	Circuit Breaker	Package
MIC2040-1YMM	Active-High	No	10-Lead MSOP
MIC2040-2YMM	Active-Low	No	10-Lead MSOP
MIC2041-1YMM	Active-High	Yes	10-Lead MSOP
MIC2041-2YMM	Active-Low	Yes	10-Lead MSOP

Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).
Note:	In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.	
	Underbar (_) and/or Overbar (¯) symbol may not be to scale.	

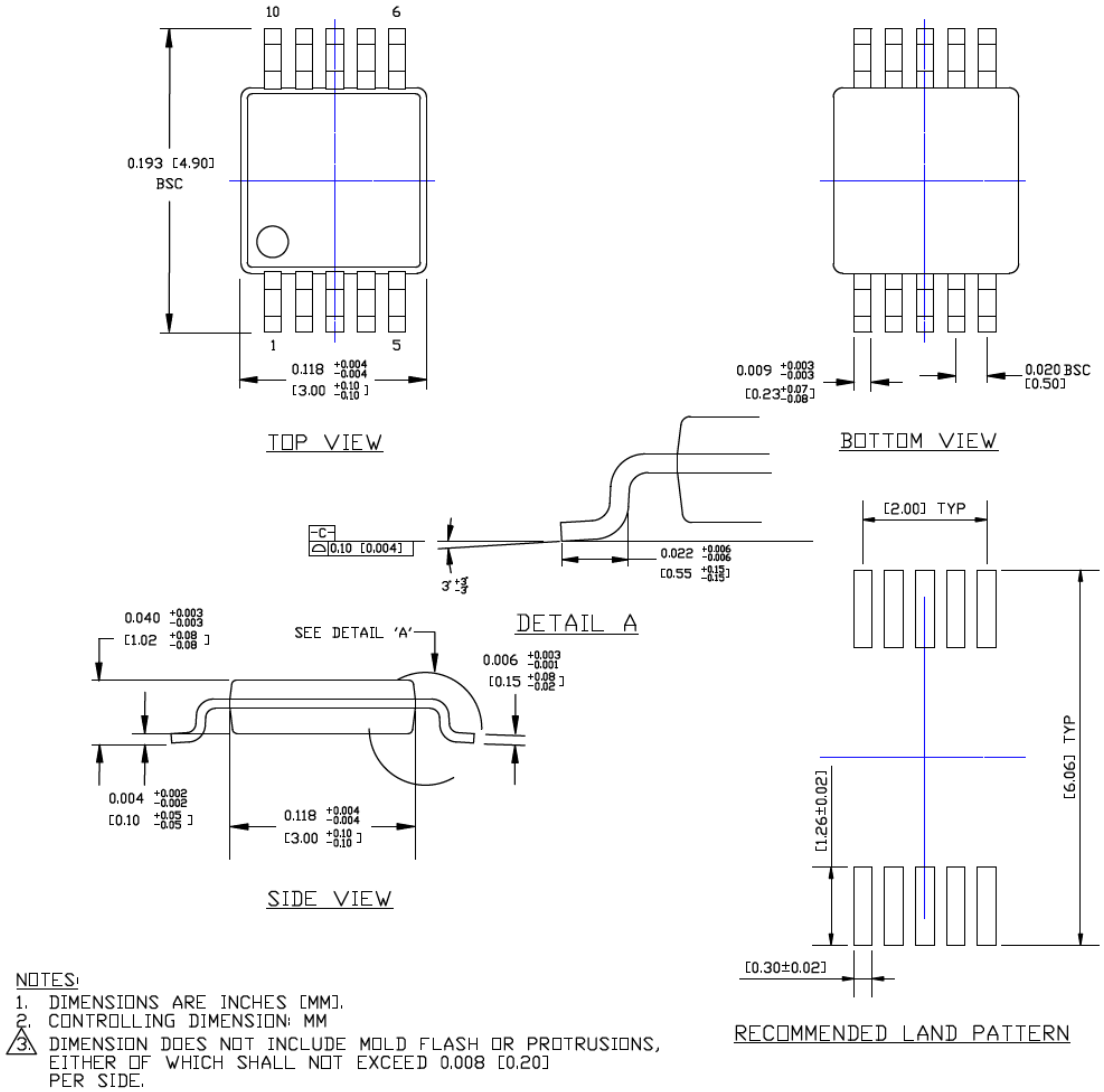
Note: If the full seven-character YYWWNNN code cannot fit on the package, the following truncated codes are used based on the available marking space:
6 Characters = YWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN;
2 Characters = NN; 1 Character = N.

10-Lead MSOP (MM) Package Outline and Recommended Land Pattern

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

TITLE
10 LEAD MSOP PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	MSOP-10LD-PL-1	**UNIT**	INCH [MM]



NOTES:
1. DIMENSIONS ARE INCHES [MM].
2. CONTROLLING DIMENSION: MM
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.008 [0.20] PER SIDE.

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APPENDIX A: REVISION HISTORY

Revision A (February 2023)

- Converted Micrel document MIC2040/41 to Microchip data sheet DS20006765A.
- Minor text changes throughout.

NOTES:

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PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART No.	-X	X	XX	-XX
Device	Enable	Junction Temp. Range	Package	Media Type

Device:	MIC2040: Single Channel Low Voltage Power Distribution Switch without Circuit Breaker MIC2041: Single Channel Low Voltage Power Distribution Switch with Circuit Breaker
Enable:	-1 = Active-High Enable -2 = Active-Low Enable
Junction Temperature Range:	Y = –40°C to +85°C
Package:	MM = 10-Lead 3 mm × 3 mm MSOP
Media Type:	<blank>= 100/Tube -TR = 2500/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

Examples:

a) MIC2040-1YMM: MIC2040 (without Circuit Breaker), Active-High Enable, –40°C to +85°C Temp. Range, 10-Lead MSOP, 100/Tube

b) MIC2040-2YMM-TR: MIC2040 (without Circuit Breaker), Active-Low Enable, –40°C to +85°C Temp. Range, 10-Lead MSOP, 2500/Reel

c) MIC2041-2YMM: MIC2041 (with Circuit Breaker), Active-Low Enable, –40°C to +85°C Temp. Range, 10-Lead MSOP, 100/Tube

d) MIC2041-1YMM-TR: MIC2040 (with Circuit Breaker), Active-High Enable, –40°C to +85°C Temp. Range, 10-Lead MSOP, 2500/Reel

NOTES:

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