



# MIC38C42A/43A/44A/45A

## BiCMOS Current-Mode PWM Controllers

### Features

- Fast 40 ns Output Rise and 30 ns Output Fall Times
- -40°C to +85°C Ambient Temperature Range Meets UC284x Specifications
- High-Performance, Low-Power BiCMOS Process
- Ultra-Low Start-Up Current (100  $\mu$ A Typical)
- Low Quiescent Operating Current (4 mA Typical)
- CMOS Outputs with Rail-to-Rail Swing
- Up to 500 kHz Current-Mode Operation
- Trimmed 5V Bandgap Reference
- Pin-for-Pin Compatible with UC3842/3843/3844/3845
- Trimmed Oscillator Discharge Current
- UVLO with Hysteresis
- Low Cross-Conduction Currents

### Applications

- Current-Mode, Offline, Switched-Mode Power Supplies
- Current-Mode, DC-to-DC Converters
- Step-Down Buck Regulators
- Step-Up Boost Regulators
- Flyback, Isolated Regulators
- Forward Converters
- Synchronous FET Converters

### General Description

The MIC38C4xA are fixed-frequency, high performance, current-mode PWM controllers. Microchip's BiCMOS devices are pin compatible with 384x bipolar devices, but feature several improvements.

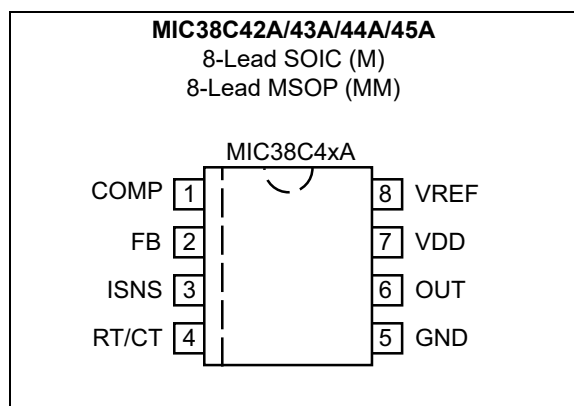
Undervoltage lockout circuitry allows the '42A and '44A versions to start up at 14.5V and operate down to 9V, and the '43A and '45A versions start at 8.4V with operation down to 7.6V. All versions operate up to 20V.

When compared to bipolar 384x devices operating from a 15V supply, start-up current has been reduced to 100  $\mu$ A typical and operating current has been reduced to 4.0 mA typical. Decreased output rise and fall times drive larger MOSFETs, and rail-to-rail output capability increases efficiency, especially at lower supply voltages. The MIC38C4xA also features a trimmed oscillator discharge current and bandgap reference.

The MIC38C4xA family is available in 8-pin SOIC and MSOP-8 package options.

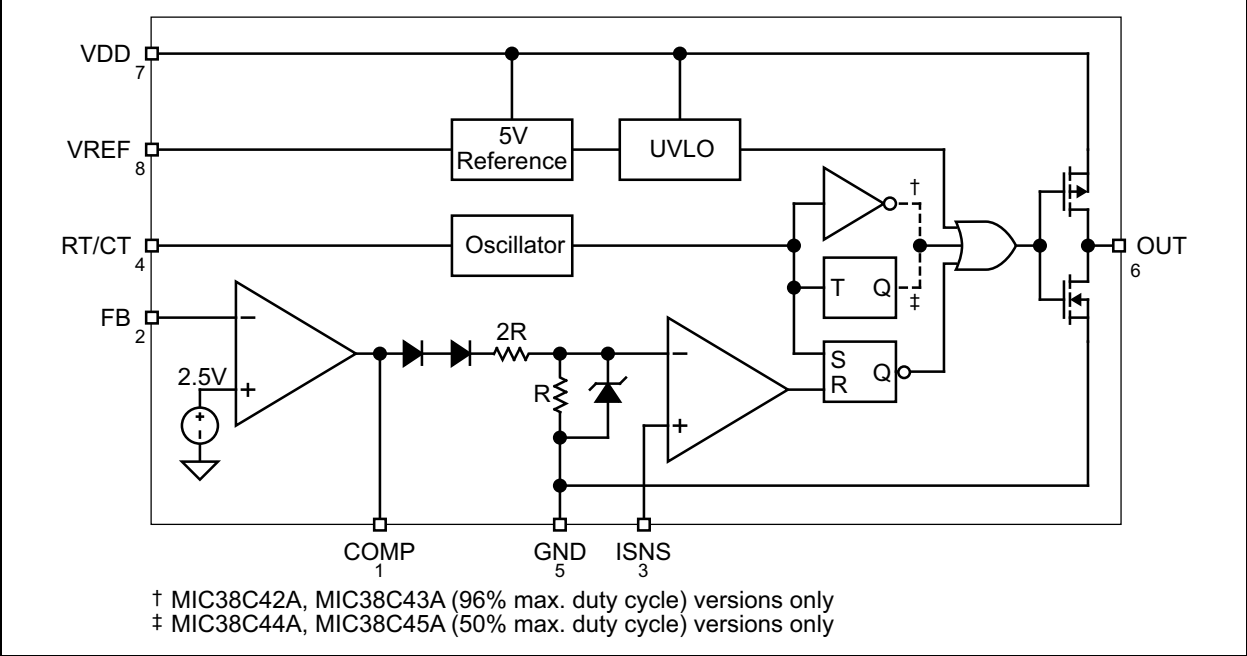
For fast rise and fall times and higher output drive, refer to the MIC38HC4x.

### Package Type



# MIC38C42A/43A/44A/45A

## Functional Diagram



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage ( $V_{DD}$ ) .....	+20V
Switch Supply Voltage ( $V_D$ ).....	+20V
Current Sense Voltage ( $V_{ISNS}$ ) .....	-0.3V to +5.5V
Feedback Voltage ( $V_{FB}$ ).....	-0.3V to +5.5V
Output Current ( $I_{OUT}$ ).....	0.5A

† **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.

# MIC38C42A/43A/44A/45A

## ELECTRICAL CHARACTERISTICS

**Electrical Characteristics:**  $V_{DD} = 15V$ , Adjust  $V_{DD}$  above the start threshold before setting at 15V;  $R_T = 11.0\text{ k}\Omega$ ;  $C_T = 3.3\text{ nF}$ ;  $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ ; unless noted. [Note 1](#)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>Reference</b>						
Output Voltage	$V_{REF}$	4.90	5.00	5.10	V	$T_A = +25^\circ\text{C}$ , $I_{VREF} = 1\text{ mA}$
Line Regulation	$\Delta V_{REF(LINE)}$	—	2	20	mV	$12V \leq V_{DD} \leq 18V$ , $I_{VREF} = 5\text{ }\mu\text{A}$
Load Regulation	$\Delta V_{REF(LOAD)}$	—	1	25	mV	$1\text{ mA} \leq I_{VREF} \leq 20\text{ mA}$
Temperature Stability	$TC_{VREF}$	—	0.2	—	mV/ $^\circ\text{C}$	<a href="#">Note 2</a>
Total Output Variation	$\Delta V_{REF(TOT)}$	4.82	—	5.18	V	Line, Load, Temperature, <a href="#">Note 2</a>
Output Noise Voltage	$V_{NOISE}$	—	50	—	$\mu\text{V}$	$10\text{ Hz} \leq f \leq 10\text{ kHz}$ , $T_A = +25^\circ\text{C}$ , <a href="#">Note 2</a>
Long-Term Stability	$\Delta V_{REF(LT)}$	—	5	25	mV	$T_A = +125^\circ\text{C}$ , 1000 hours, <a href="#">Note 2</a>
Output Short-Circuit	$I_{VREF(SC)}$	-30	-80	-180	mA	—
<b>Oscillator</b>						
Initial Accuracy	$\Delta f_{OSC(INIT)}$	47	53	59	kHz	$T_A = +25^\circ\text{C}$ , <a href="#">Note 3</a>
Voltage Stability	$\Delta f_{OSC(VS)}$	—	0.2	1.0	%	$12V \leq V_{DD} \leq 18V$
Temperature Stability	$TC_{FOSC}$	—	0.04	—	%/ $^\circ\text{C}$	$T_{MIN} \leq T_A \leq T_{MAX}$ , <a href="#">Note 2</a>
Clock Ramp Reset Current	$I_{DISCHG}$	6.0	8.4	9.0	mA	$T_A = +25^\circ\text{C}$ , $V_{RT/CT} = 2V$ , <a href="#">Note 2</a>
Amplitude	$V_{AMP}$	—	1.9	—	$V_{PP}$	$V_{RT/CT}$ peak-to-peak
<b>Error Amp</b>						
Input Voltage	$V_{IN(EA)}$	2.4	2.50	2.58	V	$V_{COMP} = 2.5V$
Input Bias Current	$I_{BIAS(EA)}$	—	-0.1	-2	$\mu\text{A}$	$V_{FB} = 5.0V$
Open Loop Voltage Gain	$A_{VOL}$	65	90	—	dB	$2V \leq V_{COMP} \leq 4V$
Unity Gain Bandwidth	GBW	0.7	1.0	—	MHz	<a href="#">Note 2</a>
Power Supply Rejection Ratio	$PSRR_{EA}$	60	—	—	dB	$12V \leq V_{DD} \leq 18V$
Output Sink Current	$I_{COMP(SINK)}$	2	14	—	mA	$V_{FB} = 2.7V$ , $V_{COMP} = 1.1V$
Output Source Current	$I_{COMP(SRC)}$	-0.3	-1	—	mA	$V_{FB} = 2.3V$ , $V_{COMP} = 5V$
COMP High Voltage	$V_{COMP\_H}$	5	6.8	—	V	$V_{FB} = 2.3V$ , $R_{LOAD} = 15\text{ k}\Omega$ to ground
COMP Low Voltage	$V_{COMP\_L}$	—	0.1	1.1	V	$V_{FB} = 2.7V$ , $R_{LOAD} = 15\text{ k}\Omega$ to $V_{REF}$
<b>Current Sense</b>						
Divider Gain Input-to-Output	$A_{DIV}$	2.85	3.0	3.15	V/V	<a href="#">Note 4</a> , <a href="#">Note 5</a>
Maximum Threshold	$V_{TH(MAX)}$	0.9	1	1.1	V	$V_{COMP} = 5V$ , <a href="#">Note 4</a>
Power Supply Rejection Ratio	$PSRR_{CS}$	—	70	—	dB	$12V \leq V_{DD} \leq 18V$ , <a href="#">Note 4</a>
Input Bias Current	$I_{BIAS(CS)}$	—	-0.1	-2	$\mu\text{A}$	—
Delay to Output	$t_D$	—	120	250	ns	—
<b>Output</b>						
$R_{DS(ON)}$ Pull High	$R_{DS(ON\_H)}$	—	20	—	$\Omega$	$I_{SOURCE} = 200\text{ mA}$
$R_{DS(ON)}$ Pull Low	$R_{DS(ON\_L)}$	—	11	—	$\Omega$	$I_{SINK} = 200\text{ mA}$
Rise Time	$t_R$	—	40	80	ns	$T_A = +25^\circ\text{C}$ , $C_{LOAD} = 1\text{ nF}$
Fall Time	$t_F$	—	30	60	ns	$T_A = +25^\circ\text{C}$ , $C_{LOAD} = 1\text{ nF}$

# MIC38C42A/43A/44A/45A

## ELECTRICAL CHARACTERISTICS (CONTINUED)

**Electrical Characteristics:**  $V_{DD} = 15V$ , Adjust  $V_{DD}$  above the start threshold before setting at 15V;  $R_T = 11.0\text{ k}\Omega$ ;  $C_T = 3.3\text{ nF}$ ;  $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ ; unless noted. [Note 1](#)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>Undervoltage Lockout</b>						
Start Threshold	$V_{TH(ST)}$	13.5	14.5	15.5	V	MIC38C42A/4A
		7.8	8.4	9.0	V	MIC38C43A/5A
Minimum Operating Voltage	$V_{DD(MIN)}$	8	9	10	V	MIC38C42A/4A
		7.0	7.6	8.2	V	MIC38C43A/5A
<b>Pulse Width Modulator</b>						
Maximum Duty Cycle	$D_{MAX}$	94	96	—	%	MIC38C42A/3A
		46	50	—	%	MIC38C44A/5A
Minimum Duty Cycle	$D_{MIN}$	—	—	0	%	—
<b>Total Standby Current</b>						
Start-Up Current	$I_{DD(START)}$	—	100	230	$\mu\text{A}$	$V_{DD} = 13V$ for MIC38C42A/44A
		—	—	—	—	$V_{DD} = 7.5V$ for MIC38C43A/45A
Operating Supply Current	$I_{DD(Q)}$	—	4.0	6.0	mA	$V_{FB} = V_{ISNS} = 0V$

- Note 1:** Specification for packaged product only.
- These parameters, although guaranteed, are not 100% tested in production.
  - Output frequency equals oscillator frequency for the MIC38C42A and MIC38C43A. Output frequency for the MIC38C44A and MIC38C45A equals one-half the oscillator frequency.
  - Parameter measured at trip point of latch with  $V_{FB} = 0V$ .
  - Gain defined as [Equation 1-1](#);  $0V \leq V_{TH(ISNS)} \leq 0.8V$ .

### EQUATION 1-1:

$$A_{DIV} = \frac{\Delta V_{COMP}}{\Delta V_{TH(ISNS)}}$$

# MIC38C42A/43A/44A/45A

## TEMPERATURE SPECIFICATIONS (Note 1)

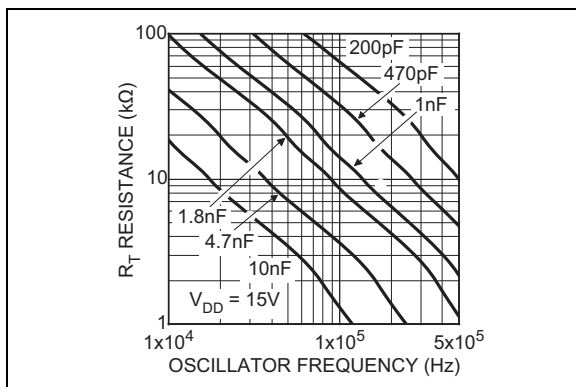
Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
<b>Temperature Ranges</b>						
Storage Temperature Range	$T_S$	-65	—	+150	°C	—
Operating Ambient Temperature Range	$T_A$	-40	—	+85	°C	—
Operating Junction Temperature Range	$T_J$	-40	—	+125	°C	—
Maximum Junction Temperature	$T_{J(MAX)}$	—	—	+150	°C	—
<b>Package Thermal Resistance</b>						
Thermal Resistance MSOP-8	$\theta_{JA}$	—	250	—	°C/W	—
Thermal Resistance SOIC-8	$\theta_{JA}$	—	170	—	°C/W	—

**Note 1:** The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e.,  $T_A$ ,  $T_J$ ,  $\theta_{JA}$ ). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

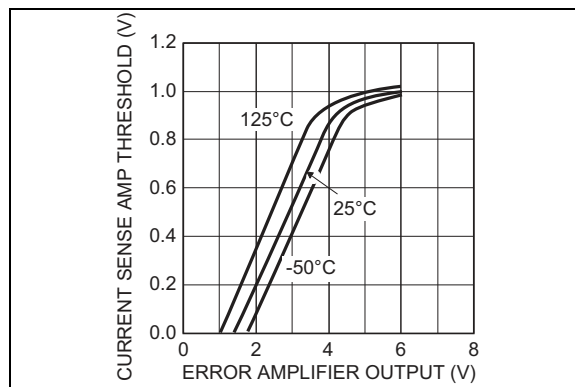
# MIC38C42A/43A/44A/45A

## 2.0 TYPICAL PERFORMANCE CURVES

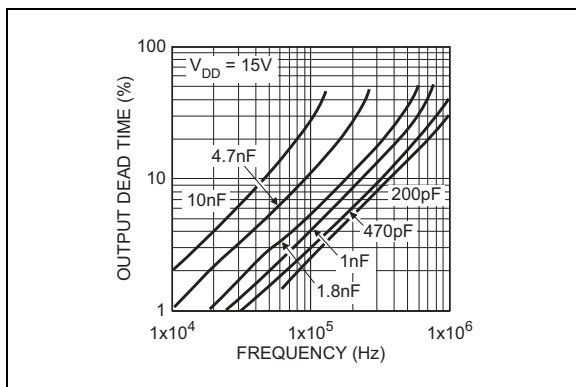
**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be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



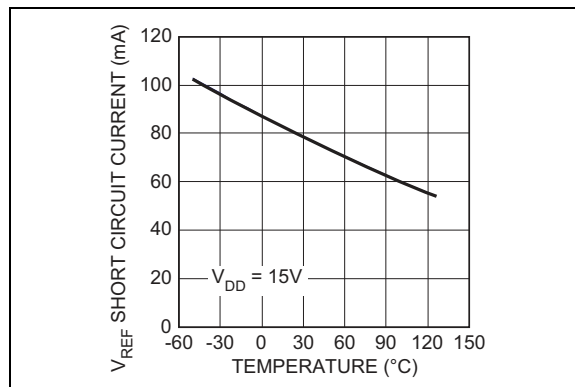
**FIGURE 2-1:** Oscillator Frequency Configuration.



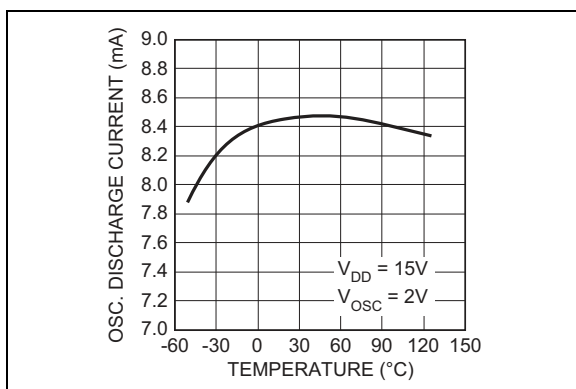
**FIGURE 2-4:** Current Sense Amplifier Threshold vs. Error Amplifier Output.



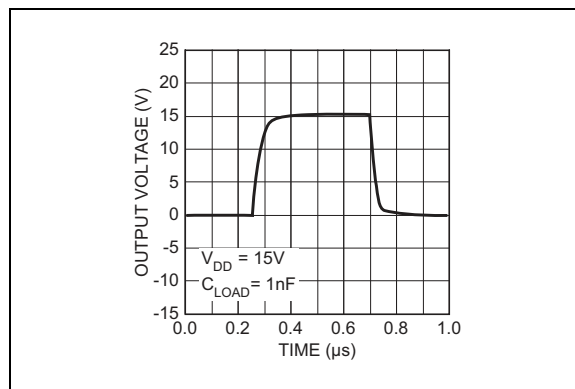
**FIGURE 2-2:** MIC38C42A/43A Output Dead Time vs. Oscillator Frequency.



**FIGURE 2-5:** Short-Circuit Reference Current vs. Temperature.



**FIGURE 2-3:** Oscillator Discharge Current vs. Temperature.



**FIGURE 2-6:** MIC38C4xA Output Waveform.

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## 3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

**TABLE 3-1: PIN FUNCTION TABLE**

Pin Number	Pin Name	Description
1	COMP	Compensation: Connect external compensation network to modify the error amplifier output.
2	FB	Feedback (Input): Error amplifier input. Feedback is 2.5V at desired output voltage.
3	ISNS	Current Sense (Input): Current sense comparator input. Connect to current sensing resistor or current transformer.
4	RT/CT	Timing Resistor/Timing Capacitor: Connect external RC network to select switching frequency.
5	GND	Ground: Combined analog and power ground.
6	OUT	Gate Driver Output: Totem-pole output.
7	VDD	Analog Supply (Input): Controller circuitry supply input. Return to analog ground (GND).
8	VREF	5V Reference (Output): Connect external RC network.



# MIC38C42A/43A/44A/45A

## 4.0 FUNCTIONAL DESCRIPTION

Familiarity with 384x converter designs is assumed.

### 4.1 MIC38C4xA Advantages

#### 4.1.1 START-UP CURRENT

Start-up current has been reduced to an ultra-low 100  $\mu$ A (typical) permitting higher-resistance, lower-wattage, start-up resistors (powers controller during power supply start-up). The reduced resistor wattage reduces cost and printed circuit space.

#### 4.1.2 OPERATING CURRENT

Quiescent operating current has been reduced to 4 mA compared to 11 mA for a typical bipolar controller. The controller runs cooler and the  $V_{DD}$  hold-up capacitance required during start-up may be reduced.

#### 4.1.3 OUTPUT DRIVER

Complementary internal P-channel and N-channel MOSFETs produce rail-to-rail output voltages for better performance driving external power MOSFETs. The driver transistor's low on resistance and high peak current capability can drive gate capacitances of greater than 1000 pF. The value of output capacitance which can be driven is determined only by the rise/fall time requirements. Within the restrictions of output capacity and controller power dissipation, maximum switching frequency can approach 500 kHz.

## 4.2 Design Precautions

When operating near 20V, circuit transients can easily exceed the 20V absolute maximum rating, permanently damaging the controller's CMOS construction. To reduce transients, connect a 0.1  $\mu$ F low-ESR capacitor to next to the controller's supply  $V_{DD}$  and ground connections. Film type capacitors, such as Wima MKS2, are recommended.

When designing high-frequency converters, avoid capacitive and inductive coupling of the switching waveform into high impedance circuitry such as the error amplifier, oscillator, and current sense amplifier. Avoid long printed-circuit traces and component leads. Locate oscillator and compensation circuitry near the IC. Use high frequency decoupling capacitors on  $V_{REF}$ , and if necessary, on  $V_{DD}$ . Return high di/dt currents directly to their source and use large area ground planes.

## 4.3 Buck Converter

Refer to [Figure 4-1](#). When at least 26V is applied to the input, C5 is charged through R2 until the voltage  $V_{DD}$  is greater than 14.5V (the undervoltage lockout value of the MIC38C42A). Output switching begins when Q1 is

turned on by the gate drive transformer T1, charging the output filter capacitor C3 through L1. D5 supplies a regulated +12V to  $V_{DD}$  once the circuit is running.

Current sense transformer CT1 provides current feedback to ISNS for current-mode operation and cycle-by-cycle current limiting. This is more efficient than a high-power sense resistor and provides the required ground-referenced level shift.

When Q1 turns off, current flow continues from ground through D1 and L1 until Q1 is turned on again.

The 100V Schottky diode D1 reduces the forward voltage drop in the main current path, resulting in higher efficiency than could be accomplished using an ultra-fast-recovery diode. R1 and C2 suppress parasitic oscillations from D1.

Using a high-value inductance for L1 and a low-ESR capacitor for C3 permits small capacitance with minimum output ripple. This inductance value also improves circuit efficiency by reducing the flux swing in L1.

Magnetic components are carefully chosen for minimal loss at 500 kHz. CT1 and T1 are wound on Magnetics, Inc. P-type material toroids. L1 is wound on a Siemens N49 EFD core.

TABLE 4-1: MAGNETIC COMPONENTS

Symbol	Custom Coils (Note 1)	ETS (Note 2)
CT1	4923	ETS 92420
T1	4924	ETS 92419
L1	4925	ETS 92421

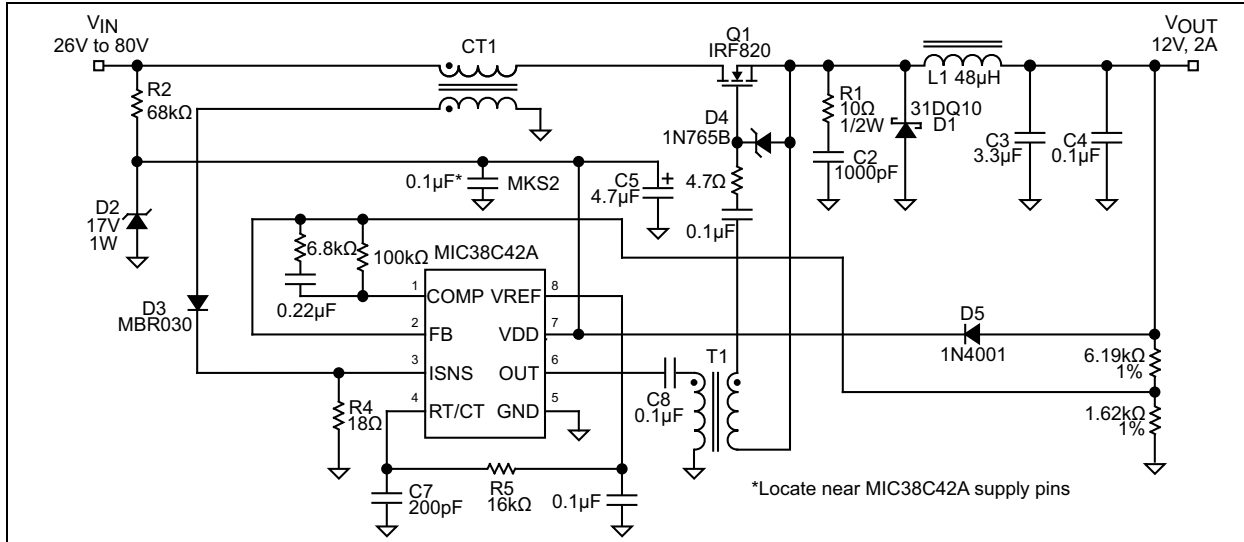
Note 1: Custom Coils, Alcester, SD. Tel: (605) 934-2460.

2: Energy Transformation Systems, Inc. Tel: (510) 656-2012.

TABLE 4-2: COMPONENT TEST RESULTS

Test	Conditions	Results
Line Regulation	$V_{IN} = 26V$ to $80V$ , $V_{OUT} = 12V$ , $I_O = 2A$	0.5%
Load Regulation	$V_{IN} = 48V$ , $V_{OUT} = 12V$ , $I_O = 0.2A$ to $2A$	0.6%
Efficiency	$V_{IN} = 48V$ , $V_{OUT} = 12V$ , $I_O = 2A$	90%
Output Ripple	$V_{IN} = 48V$ , $V_{OUT} = 12V$ , $I_O = 2A$ (20 MHz BW)	100 mV

# MIC38C42A/43A/44A/45A



**FIGURE 4-1:** 500 kHz, 25W, Buck Converter.

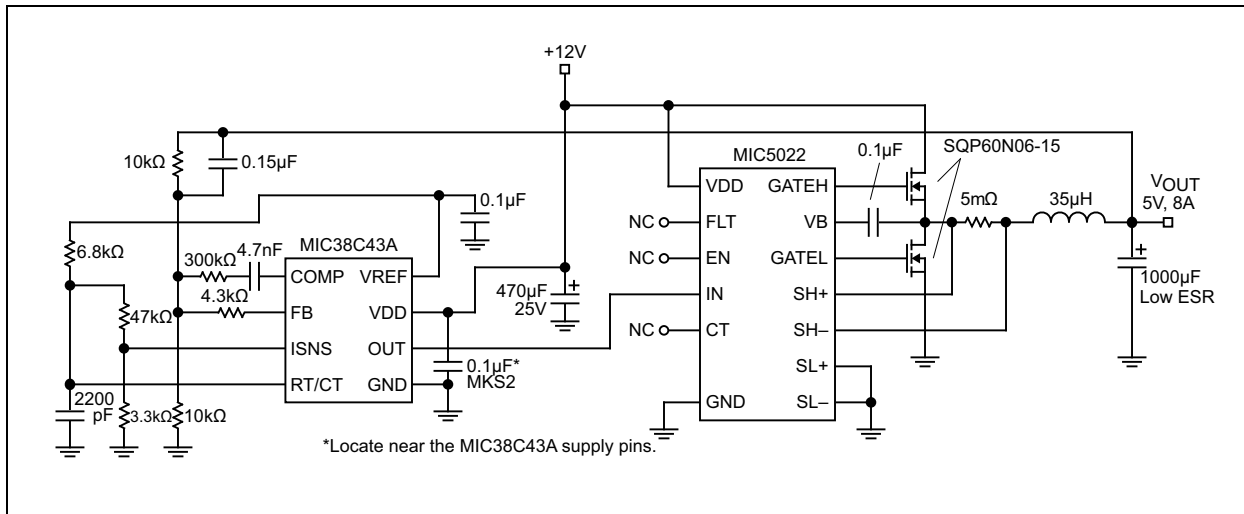
## 4.4 Synchronous Buck Converter

Refer to [Figure 4-2](#). This MIC38C43A synchronous buck converter uses an MIC5022 half-bridge driver to alternately drive the PWM switch MOSFET (driven by GATEH, or high-side output) and a MOSFET which functions as a synchronous rectifier (driven by the GATEL, or low-side output).

The low-side MOSFET turns on when the high-side MOSFET is off, allowing current to return from ground. Current flows through the low-side MOSFET in the source to drain direction.

The on-state voltage drop of the low-side MOSFET is lower than the forward voltage drop of an equivalent Schottky rectifier. This lower voltage drop results in higher efficiency.

A sense resistor (5 mΩ) is connected to the driver's high-side current sense inputs to provide overcurrent protection. Refer to the MIC5020, MIC5021, and MIC5022 data sheets for more information.



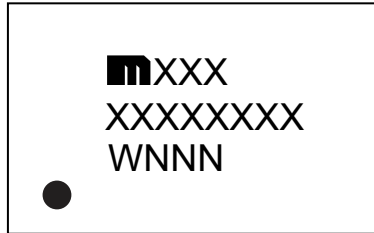
**FIGURE 4-2:** 100 kHz Synchronous Buck Converter.

# MIC38C42A/43A/44A/45A

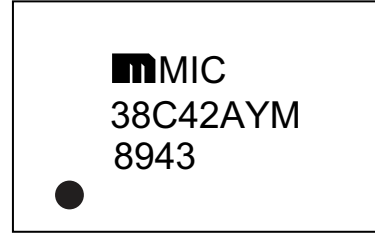
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

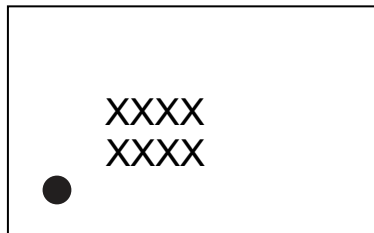
8-Pin SOIC\*



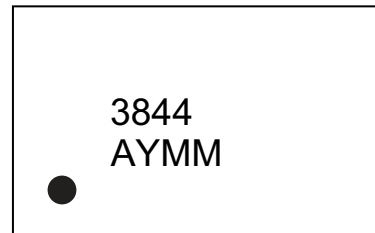
Example



8-Pin MSOP\*



Example



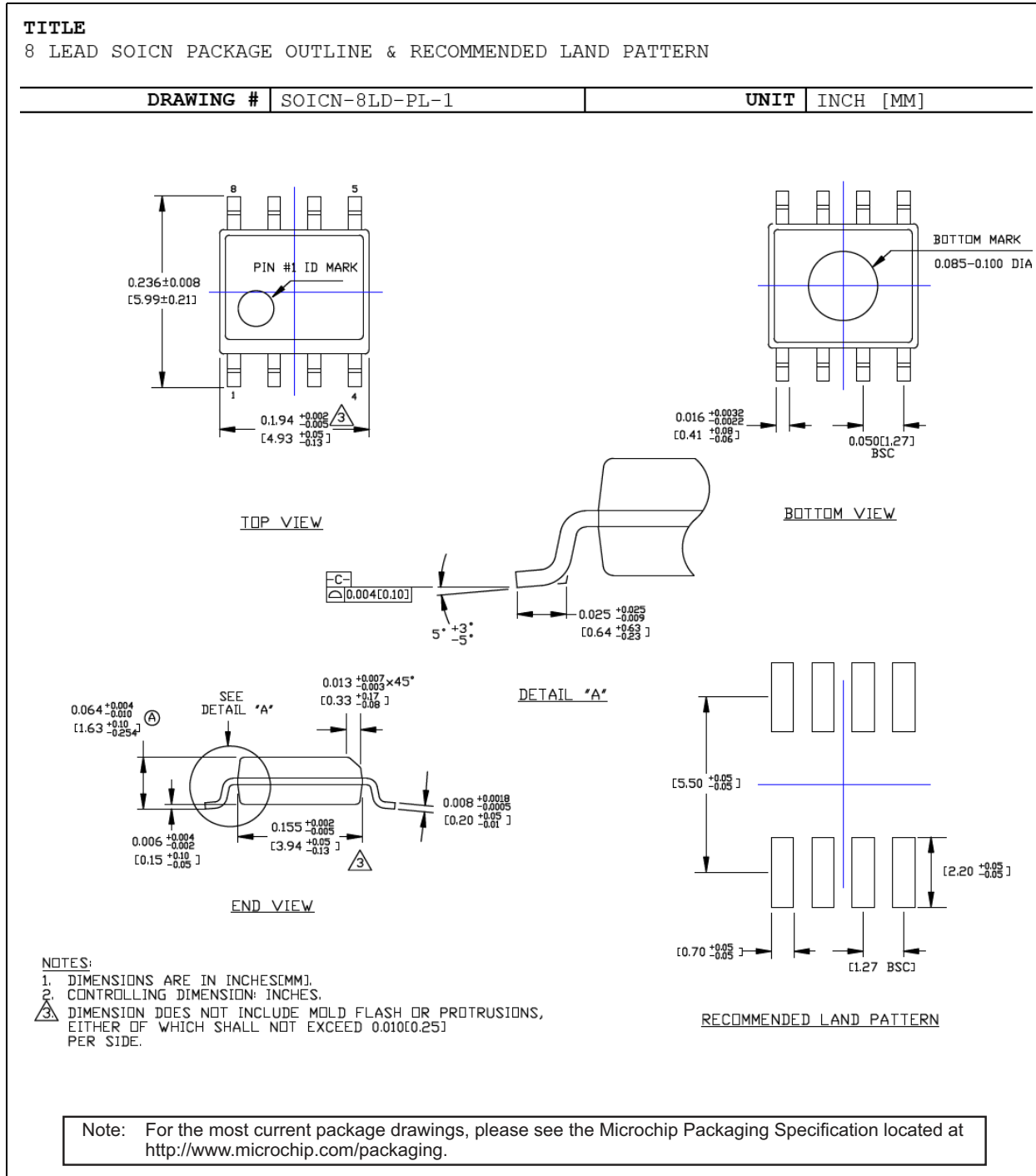
<b>Legend:</b>	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package 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.

# MIC38C42A/43A/44A/45A

## 8-Lead SOIC Package Outline and Recommended Land Pattern



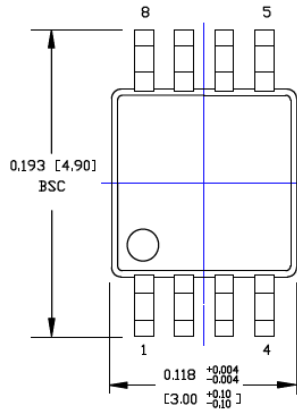
# MIC38C42A/43A/44A/45A

## 8-Lead MSOP Package Outline and Recommended Land Pattern

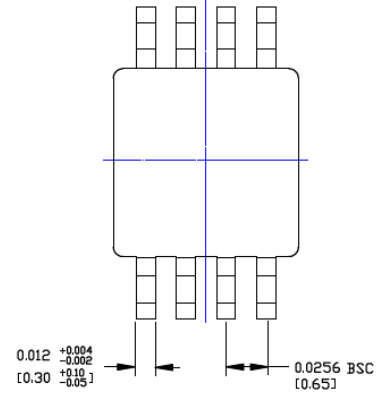
**TITLE**

8 LEAD MSOP PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	MSOP-8LD-PL-1	UNIT	INCH [MM]
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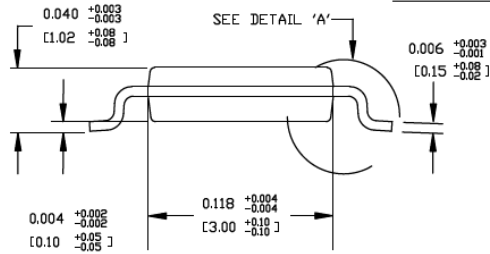
TOP VIEW



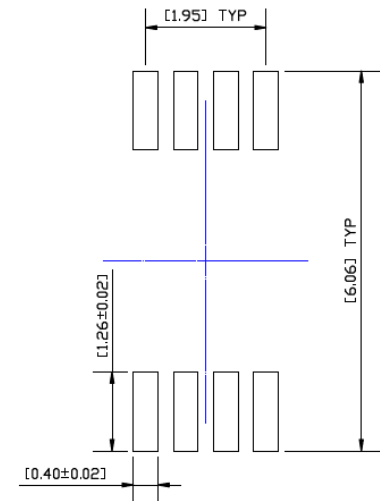
BOTTOM VIEW



DETAIL A



SIDE VIEW



RECOMMENDED LAND PATTERN

**NOTES:**

1. DIMENSIONS ARE IN 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.

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

# MIC38C42A/43A/44A/45A

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NOTES:

## APPENDIX A: REVISION HISTORY

### Revision A (October 2020)

- Converted Micrel document MIC38C42A/43A/44A/45A to Microchip data sheet DS20006437A.
- Minor text changes throughout.

# MIC38C42A/43A/44A/45A

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NOTES:



# MIC38C42A/43A/44A/45A

## PRODUCT IDENTIFICATION SYSTEM

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

<u>Device</u>	<u>X</u>	<u>XX</u>	<u>[-XX]</u>	<b>Examples:</b>
Part No.	Temp. Range	Package	Media Type	
<b>Device:</b>	MIC38C4xA:	BiCMOS Current-Mode PWM Controller (See Selection Guide Below for Part-Specific Detail)		a) MIC38C42A:
	MIC38C42A:	96% Max. Duty Cycle, UVLO Threshold Startup 14.5V, Min. Operating 9V		BiCMOS Current-Mode PWM Controller, 96% Max. Duty Cycle, UVLO Threshold Startup 14.5V, Min. Operating 9V, -40°C to +125°C Junction Temperature Range
	MIC38C43A:	96% Max. Duty Cycle, UVLO Threshold Startup 8.4V, Min. Operating 7.6V		MIC38C42AYM:
	MIC38C44A:	50% Max. Duty Cycle, UVLO Threshold Startup 14.5V, Min. Operating 9V		MIC38C42AYM-TR:
	MIC38C45A:	50% Max. Duty Cycle, UVLO Threshold Startup 8.4V, Min. Operating 7.6V		MIC38C42AYMM:
				MIC38C42AYMM-TR:
<b>Junction Temperature Range:</b>	Y =	-40°C to +125°C, RoHS-Compliant		b) MIC38C43A:
<b>Package:</b>	M =	8-Lead SOIC		BiCMOS Current-Mode PWM Controller, 96% Max. Duty Cycle, UVLO Threshold Startup 8.4V, Min. Operating 7.6V, -40°C to +125°C Junction Temperature Range
	MM =	8-Lead MSOP		MIC38C43AYM:
<b>Media Type:</b>	TR =	2,500/Reel		MIC38C43AYM-TR:
	(blank)=	95/Tube for M Package		MIC38C43AYMM:
	(blank)=	100/Tube for MM Package		MIC38C43AYMM-TR:
				c) MIC38C44A:
				BiCMOS Current-Mode PWM Controller, 50% Max. Duty Cycle, UVLO Threshold Startup 14.5V, Min. Operating 9V, -40°C to +125°C Junction Temperature Range
				MIC38C44AYM:
				MIC38C44AYM-TR:
				MIC38C44AYMM:
				MIC38C44AYMM-TR:
				d) MIC38C45A:
				BiCMOS Current-Mode PWM Controller, 50% Max. Duty Cycle, UVLO Threshold Startup 8.4V, Min. Operating 7.6V, -40°C to +125°C Junction Temperature Range
				MIC38C45AYM:
				MIC38C45AYM-TR:
				MIC38C45AYMM:
				MIC38C45AYMM-TR:
				<b>Note 1:</b> 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.

### Selection Guide

Duty Cycle	UVLO Thresholds	
	Start-Up 8.4V Min. Operating 7.6V	Start-Up 14.5V Min. Operating 9V
—	MIC38C43A	MIC38C42A
0% to 96%	MIC38C45A	MIC38C44A

# MIC38C42A/43A/44A/45A

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NOTES:

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**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
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