

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 (50 µA 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(A)
- 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 MIC38C4x are fixed-frequency, high performance, current-mode PWM controllers. Microchip's BiCMOS devices are pin compatible with 384x bipolar devices, but feature several improvements.

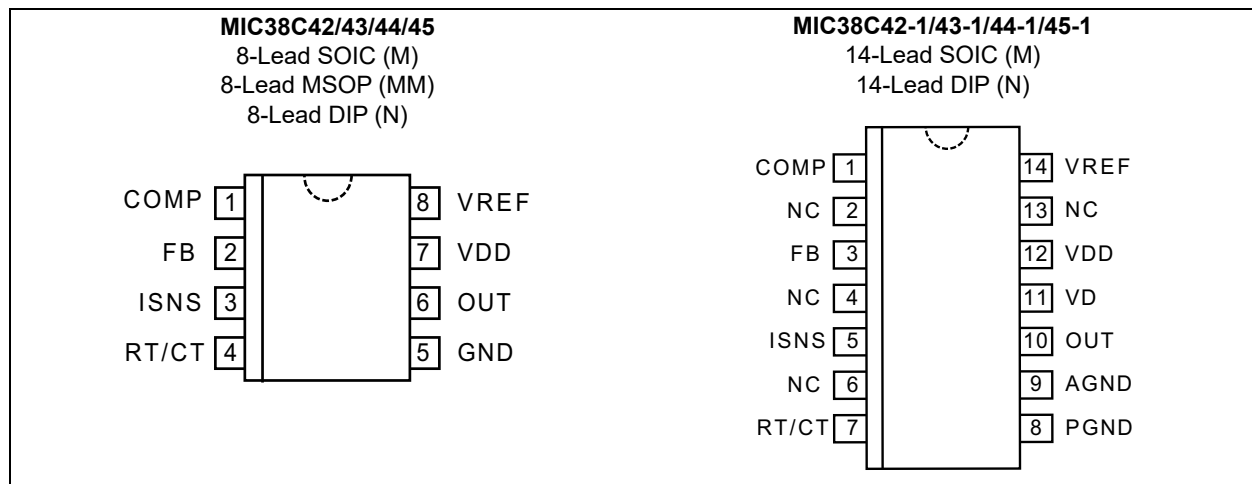
Undervoltage lockout circuitry allows the '42 and '44 versions to start up at 14.5V and operate down to 9V, and the '43 and '45 versions start at 8.4V with operation down to 7.6V. All versions operate up to 20V.

When compared to bipolar 384x devices operating from a 15V supply, start-up current has been reduced to 50 µA 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 MIC38C4x also features a trimmed oscillator discharge current and bandgap reference.

The MIC38C4x denotes 8-pin plastic DIP, SOIC, and MSOP packages. MIC38C4x-1 denotes 14-pin plastic DIP and SOIC packages. 8-pin devices feature small size, while 14-pin devices separate the analog and power connections for improved performance and power dissipation.

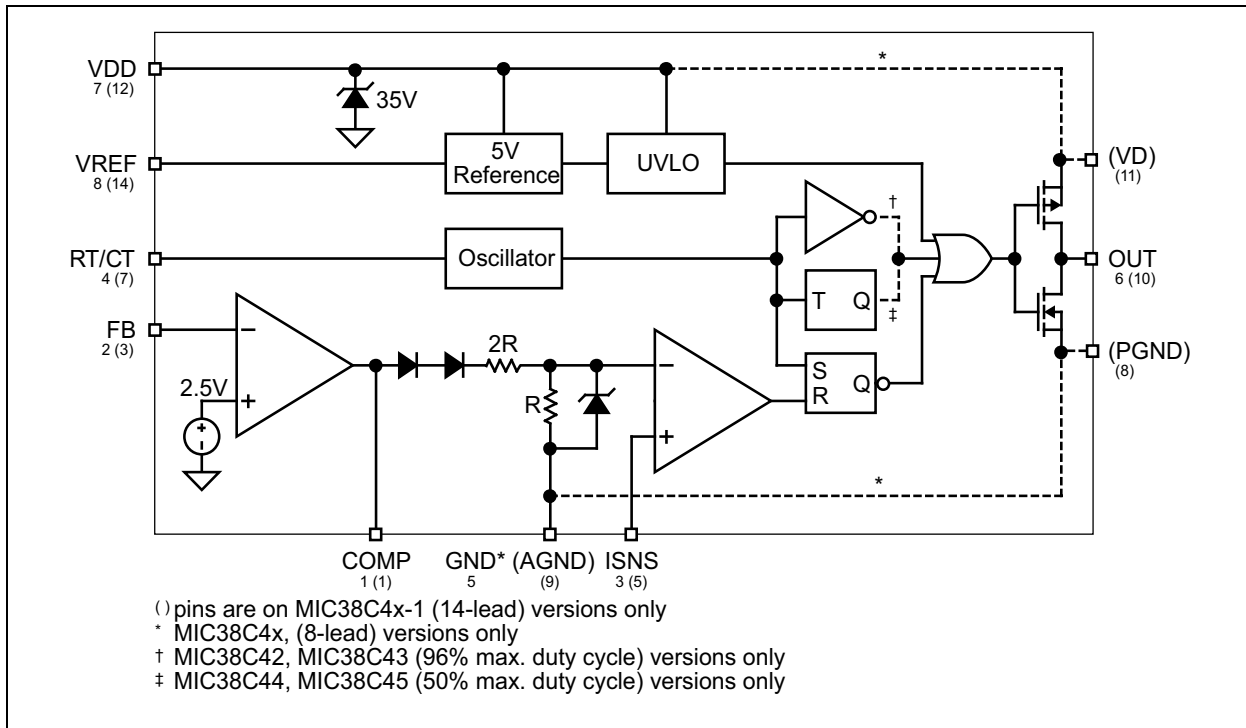
For fast rise and fall times and higher output drive, refer to the MIC38HC4x.

Package Types



MIC38C42/43/44/45

Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Zener Current (I_Z at VDD Pin).....	30 mA
Operation at $\geq 18V$ may require special precautions. See Note 1 .	
Supply Voltage (V_{DD} , Note 1).....	+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.

Note 1: On the 8-pin version, 20V is the maximum input on Pin 7 because this is also the supply pin for the output stage. On the 14-pin version, 40V is the maximum for Pin 12 and 20V is the maximum for Pin 11.

MIC38C42/43/44/45

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
Reference						
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	$12V \leq V_{DD} \leq 18V$, $I_{VREF} = 5\text{ }\mu\text{A}$, Note 6
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/ $^\circ\text{C}$	Note 2
Total Output Variation	$\Delta V_{REF(TOT)}$	4.82	—	5.18	V	Line, Load, Temperature, Note 2
Output Noise Voltage	V_{NOISE}	—	50	—	μV	$10\text{ Hz} \leq f \leq 10\text{ kHz}$, $T_A = +25^\circ\text{C}$, Note 2
Long-Term Stability	$\Delta V_{REF(LT)}$	—	5	25	mV	$T_A = +125^\circ\text{C}$, 1000 hours, Note 2
Output Short-Circuit	$I_{VREF(SC)}$	-30	-80	-180	mA	—
Oscillator						
Initial Accuracy	$\Delta f_{OSC(INIT)}$	49	52	55	kHz	$T_A = +25^\circ\text{C}$, Note 3
Voltage Stability	$\Delta f_{OSC(VS)}$	—	0.2	1.0	%	$12V \leq V_{DD} \leq 18V$, Note 6
Temperature Stability	TC_{FOSC}	—	0.04	—	%/ $^\circ\text{C}$	$T_{MIN} \leq T_A \leq T_{MAX}$, Note 2
Clock Ramp Reset Current	I_{DISCHG}	6.0	8.4	9.0	mA	$T_A = +25^\circ\text{C}$, $V_{RT/CT} = 2V$
		6.0	8.4	9.5	mA	$T_A = T_{MIN}$ to T_{MAX}
Amplitude	V_{AMP}	—	1.9	—	V_{PP}	$V_{RT/CT}$ peak-to-peak
Error Amp						
Input Voltage	$V_{IN(EA)}$	2.42	2.50	2.58	V	$V_{COMP} = 2.5V$
Input Bias Current	$I_{BIAS(EA)}$	—	-0.1	-2	μA	$V_{FB} = 5.0V$
Open Loop Voltage Gain	A_{VOL}	65	90	—	dB	$2V \leq V_{COMP} \leq 4V$
Unity Gain Bandwidth	GBW	0.7	1.0	—	MHz	Note 2
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	$I_{COMP(SRC)}$	-0.5	-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}
Current Sense						
Divider Gain Input-to-Output	A_{DIV}	2.85	3.0	3.15	V/V	Note 4 , Note 5
Maximum Threshold	$V_{TH(MAX)}$	0.9	1	1.1	V	$V_{COMP} = 5V$, Note 4
Power Supply Rejection Ratio	$PSRR_{CS}$	—	70	—	dB	$12V \leq V_{DD} \leq 18V$, Note 4
Input Bias Current	$I_{BIAS(CS)}$	—	-0.1	-2	μA	—
Delay to Output	t_D	—	120	250	ns	—
Output						
$R_{DS(ON)}$ Pull High	R_{DSON_H}	—	20	—	Ω	$I_{SOURCE} = 200\text{ mA}$
$R_{DS(ON)}$ Pull Low	R_{DSON_L}	—	11	—	Ω	$I_{SINK} = 200\text{ mA}$
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	$T_A = +25^\circ\text{C}$, $C_{LOAD} = 1\text{ nF}$

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
Undervoltage Lockout						
Start Threshold	$V_{TH(ST)}$	13.5	14.5	15.5	V	MIC38C42/44
		7.8	8.4	9.0	V	MIC38C43/45
Minimum Operating Voltage	$V_{DD(MIN)}$	8	9	10	V	MIC38C42/44
		7.0	7.6	8.2	V	MIC38C43/45
Pulse Width Modulator						
Maximum Duty Cycle	D_{MAX}	94	96	—	%	MIC38C42/43
		46	50	—	%	MIC38C44/45
Minimum Duty Cycle	D_{MIN}	—	—	0	%	—
Total Standby Current						
Start-Up Current	$I_{DD(START)}$	—	50	200	μA	$V_{DD} = 13V$ for MIC38C42/44
		—	—	—	—	$V_{DD} = 7.5V$ for MIC38C43/45
Operating Supply Current	$I_{DD(Q)}$	—	4.0	6.0	mA	$V_{FB} = V_{ISNS} = 0V$
Zener Voltage at VDD Pin	V_Z	30	37	—	V	$I_{DD} = 25\text{ mA}$, Note 6

Note 1: Specification for packaged product only.

2: These parameters, although guaranteed, are not 100% tested in production.

3: Output frequency equals oscillator frequency for the MIC38C42 and MIC38C43. Output frequency for the MIC38C44 and MIC38C45 equals one-half the oscillator frequency.

4: Parameter measured at trip point of latch with $V_{FB} = 0V$.

5: Gain defined as [Equation 1-1](#); $0V \leq V_{TH(ISNS)} \leq 0.8V$.

6: On the 8-pin version, 20V is the maximum input on Pin 7 because this is also the supply pin for the output stage. On the 14-pin version, 40V is the maximum for Pin 12 and 20V is the maximum for Pin 11.

EQUATION 1-1:

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

MIC38C42/43/44/45

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
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	—
Package Thermal Resistance						
Thermal Resistance 8-Ld Plastic DIP	θ_{JA}	—	125	—	°C/W	—
Thermal Resistance 8-Ld MSOP	θ_{JA}	—	250	—	°C/W	—
Thermal Resistance 8-Ld SOIC	θ_{JA}	—	170	—	°C/W	—
Thermal Resistance 14-Ld Plastic DIP	θ_{JA}	—	90	—	°C/W	—
Thermal Resistance 14-Ld SOIC	θ_{JA}	—	145	—	°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 , θ_{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.

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.

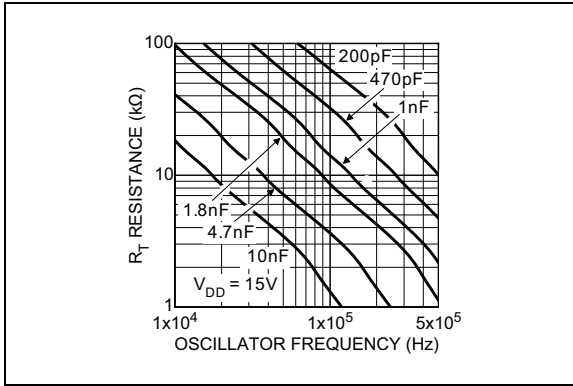


FIGURE 2-1: Oscillator Frequency Configuration.

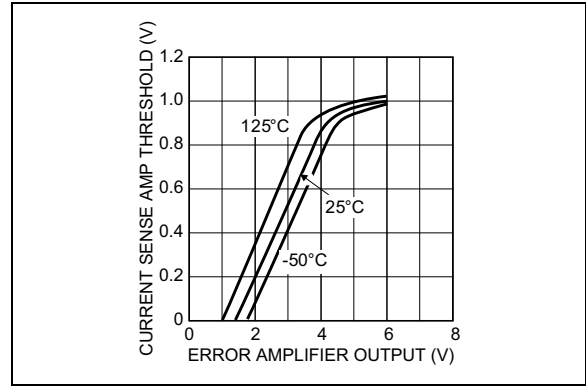


FIGURE 2-4: Current Sense Amplifier Threshold vs. Error Amplifier Output.

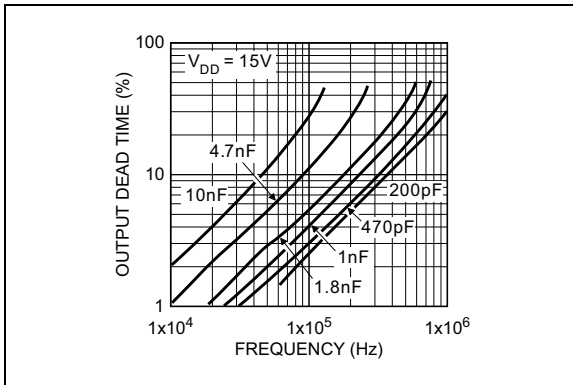


FIGURE 2-2: MIC38C42/43 Output Dead Time vs. Oscillator Frequency.

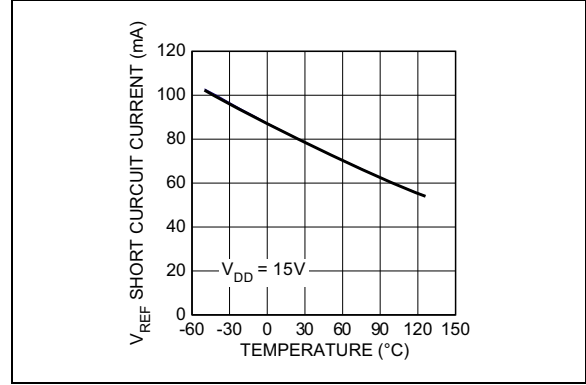


FIGURE 2-5: Short-Circuit Reference Current vs. Temperature.

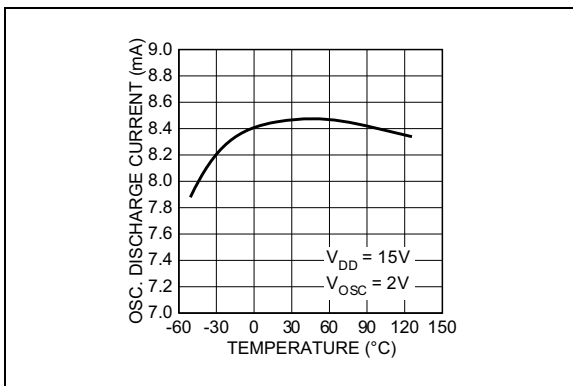


FIGURE 2-3: Oscillator Discharge Current vs. Temperature.

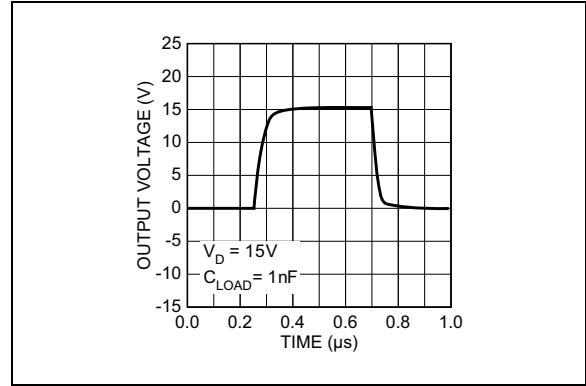


FIGURE 2-6: MIC38C4x Output Waveform.

MIC38C42/43/44/45

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

Pin Number 8-Pin DIP, SOIC, MSOP	Pin Number 14-Pin DIP and SOIC	Pin Name	Description
1	1	COMP	Compensation: Connect external compensation network to modify the error amplifier output.
—	2	NC	Not internally connected.
2	3	FB	Feedback (Input): Error amplifier input. Feedback is 2.5V at desired output voltage.
—	4	NC	Not internally connected.
3	5	ISNS	Current Sense (Input): Current sense comparator input. Connect to current sensing resistor or current transformer.
—	6	NC	Not internally connected.
4	7	RT/CT	Timing Resistor/Timing Capacitor: Connect external RC network to select switching frequency.
5	—	GND	Ground: Combined analog and power ground.
—	8	PGND	Power Ground: N-channel driver transistor ground.
—	9	AGND	Analog Ground: Controller circuitry ground.
6	10	OUT	Gate Driver Output: Totem-pole output.
—	11	VD	Power Supply (Input): P-channel driver transistor supply input. Return to power ground (PGND).
7	12	VDD	Analog Supply (Input): Controller circuitry supply input. Return to analog ground (AGND).
—	13	NC	Not internally connected.
8	14	VREF	5V Reference (Output): Connect external RC network.

4.0 FUNCTIONAL DESCRIPTION

Familiarity with 384x converter designs is assumed.

4.1 MIC38C4x Advantages

4.1.1 START-UP CURRENT

Start-up current has been reduced to an ultra-low 50 μA (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 μF low-ESR capacitor to next to the controller's supply V_{DD} (or V_{D} for '-1' versions) 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 MIC38C42). 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	$V_{\text{IN}} = 26\text{V to } 80\text{V}$, $V_{\text{OUT}} = 12\text{V}$, $I_{\text{O}} = 2\text{A}$	0.5%
Load Regulation	$V_{\text{IN}} = 48\text{V}$, $V_{\text{OUT}} = 12\text{V}$, $I_{\text{O}} = 0.2\text{A to } 2\text{A}$	0.6%
Efficiency	$V_{\text{IN}} = 48\text{V}$, $V_{\text{OUT}} = 12\text{V}$, $I_{\text{O}} = 2\text{A}$	90%
Output Ripple	$V_{\text{IN}} = 48\text{V}$, $V_{\text{OUT}} = 12\text{V}$, $I_{\text{O}} = 2\text{A}$ (20 MHz BW)	100 mV

MIC38C42/43/44/45

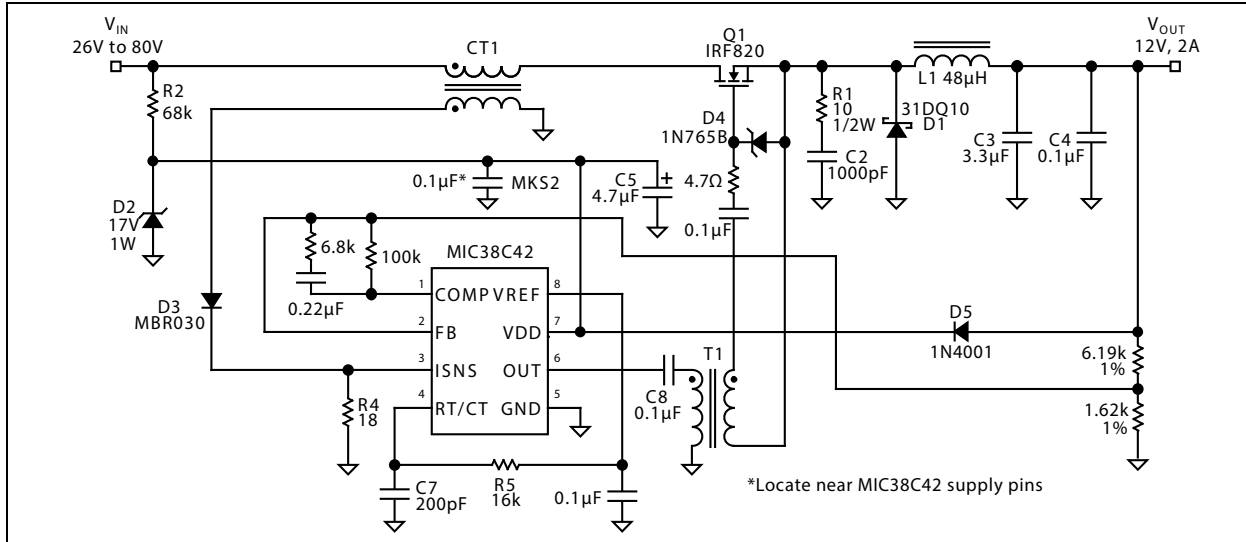


FIGURE 4-1: 500 kHz, 25W, Buck Converter.

4.4 Synchronous Buck Converter

Refer to [Figure 4-2](#). This MIC38C43 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.

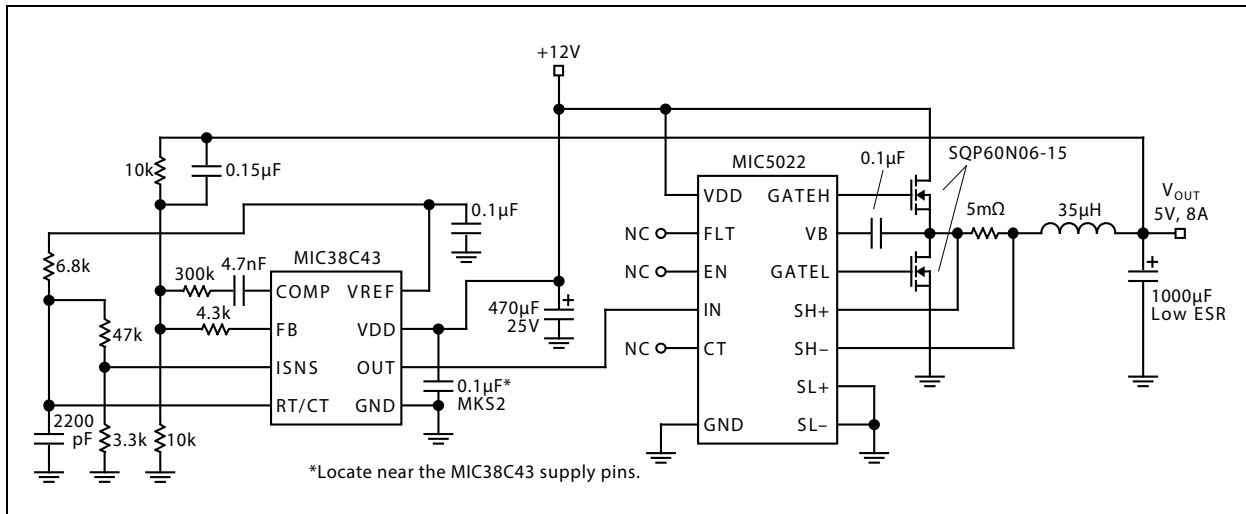


FIGURE 4-2: 100 kHz Synchronous Buck Converter.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

8-Lead SOIC*	Example	14-Lead SOIC*	Example
8-Lead DIP*	Example	14-Lead DIP*	Example
8-Lead MSOP* (Front)	Example	8-Lead MSOP* (Back)	Example

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

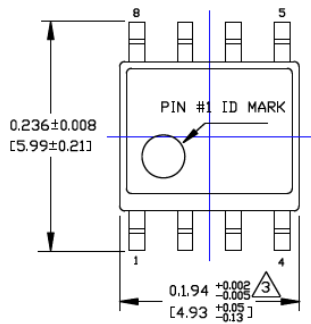
MIC38C42/43/44/45

8-Lead SOIC Package Outline and Recommended Land Pattern

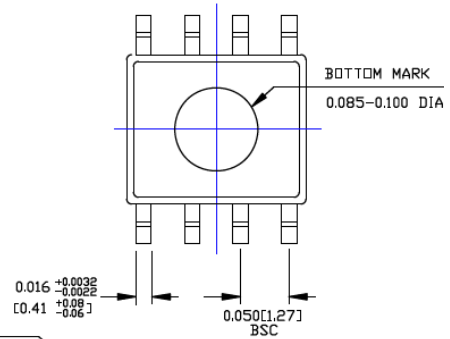
TITLE

8 LEAD SOICN PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

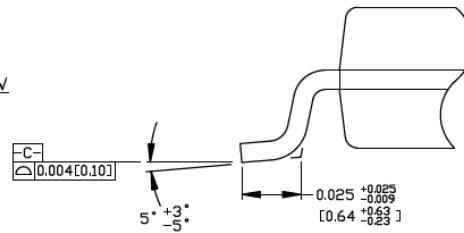
DRAWING #	SOICN-8LD-PL-1	UNIT	INCH [MM]
-----------	----------------	------	-----------



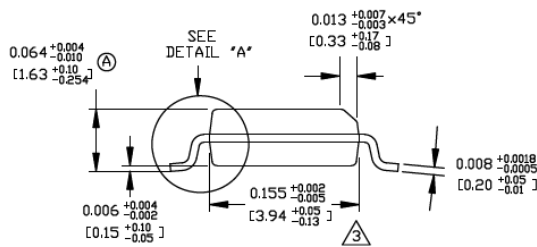
TOP VIEW



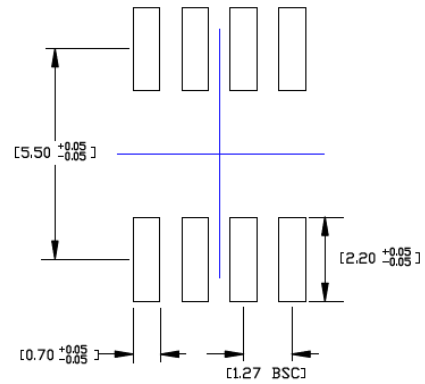
BOTTOM VIEW



DETAIL "A"



END VIEW



RECOMMENDED LAND PATTERN

NOTES:

1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.010[0.25] PER SIDE.

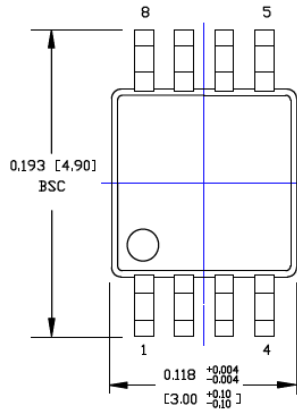
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

8-Lead MSOP Package Outline and Recommended Land Pattern

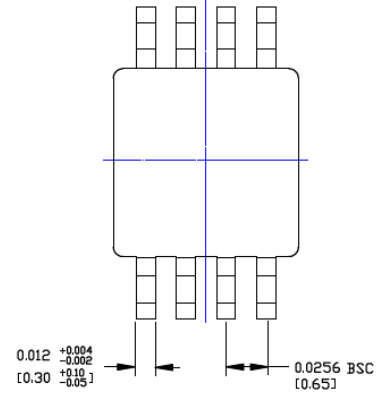
TITLE

8 LEAD MSOP PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

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



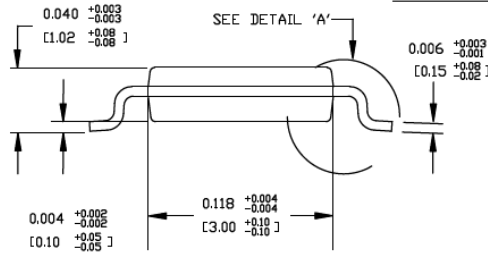
TOP VIEW



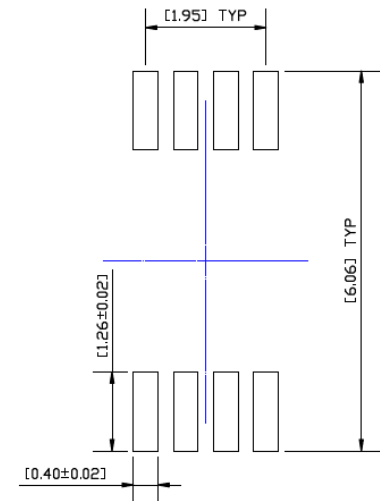
BOTTOM VIEW



DETAIL A



SIDE VIEW



RECOMMENDED LAND PATTERN

NOTES:

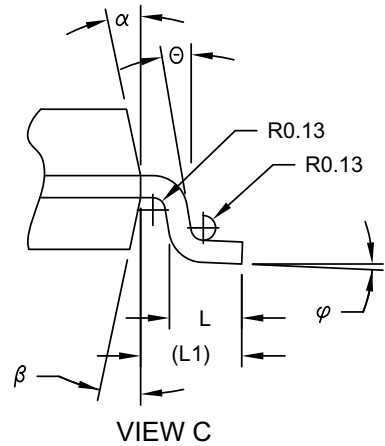
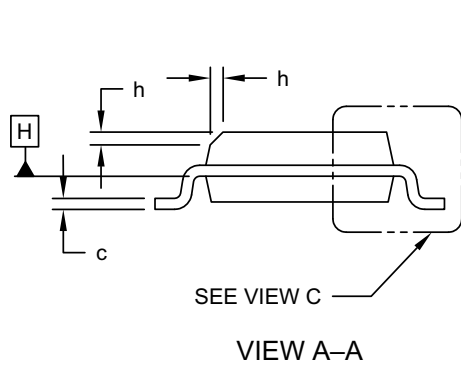
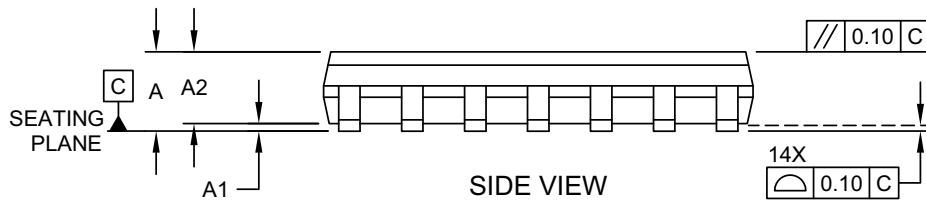
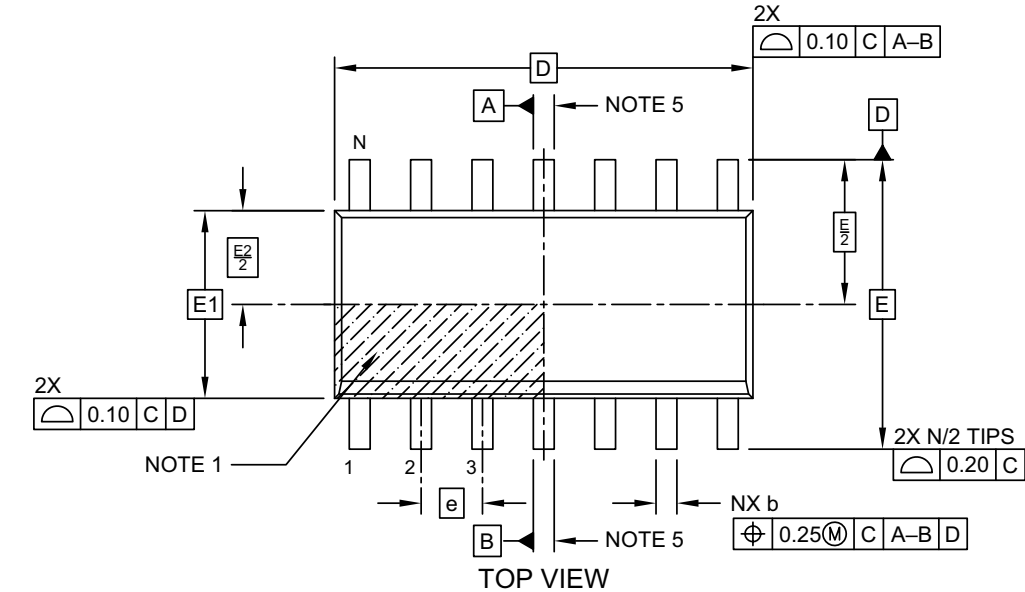
1. DIMENSIONS ARE IN INCHES [MM].
2. CONTROLLING DIMENSION: MM
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.008 [0.20] PER SIDE.

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

14-Lead SOIC Package Outline and Recommended Land Pattern

14-Lead Plastic Small Outline (D3X, UEB, M5B, UEB) - Narrow, 3.90 mm Body [SOIC] Atmel Legacy Global Package Code SVQ

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

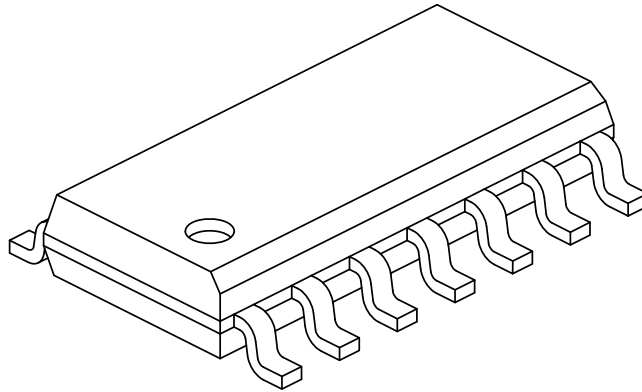


Microchip Technology Drawing No. C04-065-D3X Rev D

MIC38C42/43/44/45

14-Lead Plastic Small Outline (D3X, UEB, M5B, UEB) - Narrow, 3.90 mm Body [SOIC] Atmel Legacy Global Package Code SVQ

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



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	14		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	8.65 BSC		
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1	1.04 REF		
Lead Angle	θ	0°	-	-
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.10	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

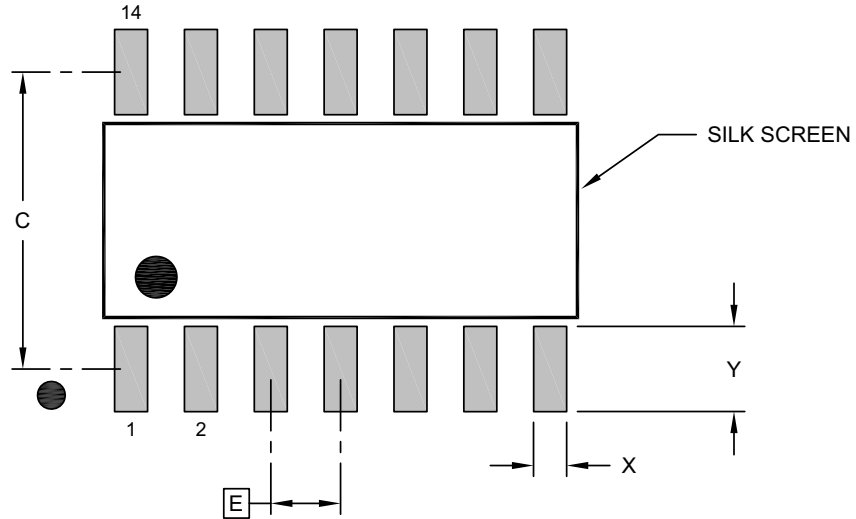
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-065-D3X Rev D Sheet 2 of 2

14-Lead Plastic Small Outline (D3X, UEB, M5B, UEB) - Narrow, 3.90 mm Body [SOIC] Atmel Legacy Global Package Code SVQ

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



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		5.40	
Contact Pad Width (X14)	X			0.60
Contact Pad Length (X14)	Y			1.55

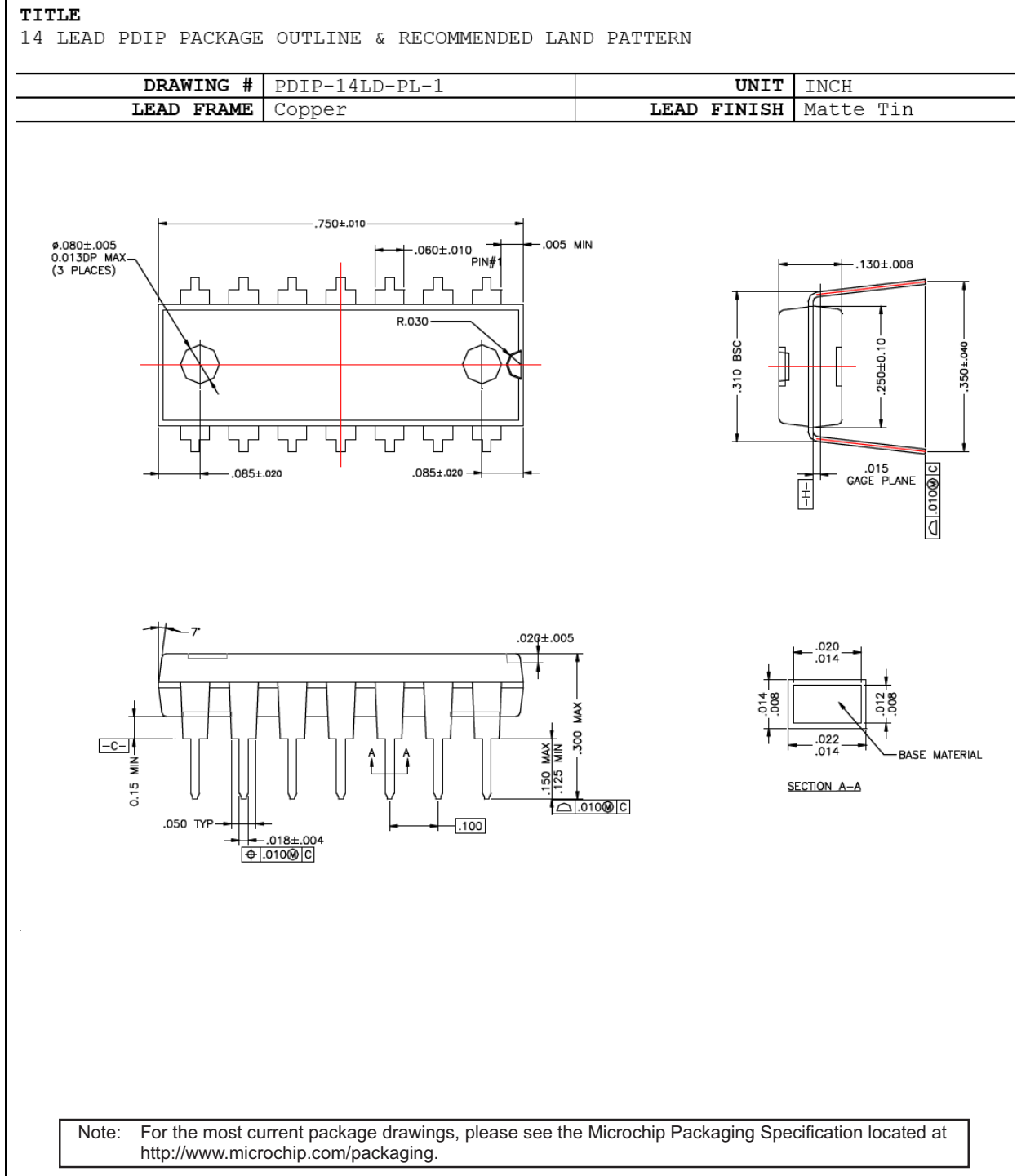
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2065-D3X Rev D

MIC38C42/43/44/45

14-Lead DIP Package Outline and Recommended Land Pattern



APPENDIX A: REVISION HISTORY

Revision A (October 2020)

- Converted Micrel document MIC38C42/43/44/45 to Microchip data sheet DS20006436A.
- Minor text changes throughout.

Revision B (February 2022)

- Updated the [Package Marking Information](#) drawing with the most current marking information.
- Updated the [14-Lead SOIC Package Outline and Recommended Land Pattern](#) drawing with the most current file.

MIC38C42/43/44/45

NOTES:

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>X</u>	<u>XX</u>	<u>[-XX]</u>	Examples:		
Part No.	Product Feature	Temp. Range	Package	Media Type			
Device:	MIC38C4x:	BiCMOS Current-Mode PWM Controller (See Selection Guide Below for Part-Specific Detail)				a) MIC38C42:	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
	MIC38C42:	96% Max. Duty Cycle, UVLO Threshold Startup 14.5V, Min. Operating 9V				MIC38C42YM:	8-Lead SOIC, 95/Tube
	MIC38C43:	96% Max. Duty Cycle, UVLO Threshold Startup 8.4V, Min. Operating 7.6V				MIC38C42-1YM	14-Lead SOIC, 54/Tube
	MIC38C44:	50% Max. Duty Cycle, UVLO Threshold Startup 14.5V, Min. Operating 9V				MIC38C42YM-TR:	8-Lead SOIC, 2,500/Reel
	MIC38C45:	50% Max. Duty Cycle, UVLO Threshold Startup 8.4V, Min. Operating 7.6V				MIC38C42-1YM-TR	14-Lead SOIC, 2,500/Reel
						MIC38C42YMM:	8-Lead MSOP, 100/Tube
						MIC38C42YMM-TR:	8-Lead MSOP, 2,500/Reel
						MIC38C42-1YN	14-Lead DIP, 25/Tube
						MIC38C42YN	8-Lead DIP, 50/Tube
Product Feature:	<blank> = 8-Lead					b) MIC38C43:	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
	1 = 14-Lead					MIC38C43YM:	8-Lead SOIC, 95/Tube
Junction Temperature Range:	Y =	-40°C to +125°C, RoHS-Compliant				MIC38C43-1YM	14-Lead SOIC, 54/Tube
						MIC38C43YM-TR:	8-Lead SOIC, 2,500/Reel
Package:	M =	SOIC Package				MIC38C43-1YM-TR	14-Lead SOIC, 2,500/Reel
	MM =	MSOP Package				MIC38C43YMM:	8-Lead MSOP, 100/Tube
	N =	DIP Package				MIC38C43YMM-TR:	8-Lead MSOP, 2,500/Reel
Media Type:	TR =	2,500/Reel				MIC38C43-1YN	14-Lead DIP, 25/Tube
	<blank>=	95/Tube for 8-Lead M Package				MIC38C43YN	8-Lead DIP, 50/Tube
	<blank>=	100/Tube for MM Package				c) MIC38C44:	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
	<blank>=	50/Tube for 8-Lead N Package				MIC38C44YM:	8-Lead SOIC, 95/Tube
	<blank>=	25/Tube for 14-Lead N Package				MIC38C44-1YM	14-Lead SOIC, 54/Tube
	<blank>=	54/Tube for 14-Lead M Package				MIC38C44YM-TR:	8-Lead SOIC, 2,500/Reel
						MIC38C44-1YM-TR	14-Lead SOIC, 2,500/Reel
						MIC38C44YMM:	8-Lead MSOP, 100/Tube
						MIC38C44YMM-TR:	8-Lead MSOP, 2,500/Reel
						MIC38C44-1YN	14-Lead DIP, 25/Tube
						MIC38C44YN	8-Lead DIP, 50/Tube
						d) MIC38C45:	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
						MIC38C45YM:	8-Lead SOIC, 95/Tube
						MIC38C45-1YM	14-Lead SOIC, 54/Tube
						MIC38C45YM-TR:	8-Lead SOIC, 2,500/Reel
						MIC38C45-1YM-TR	14-Lead SOIC, 2,500/Reel
						MIC38C45YMM:	8-Lead MSOP, 100/Tube
						MIC38C45YMM-TR:	8-Lead MSOP, 2,500/Reel
						MIC38C45-1YN	14-Lead DIP, 25/Tube
						MIC38C45YN	8-Lead DIP, 50/Tube
						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.

Selection Guide

Duty Cycle	UVLO Thresholds	
	Start-Up 8.4V Min. Operating 7.6V	Start-Up 14.5V Min. Operating 9V
—		
0% to 96%	MIC38C43	MIC38C42
0% to 50%	MIC38C45	MIC38C44

MIC38C42/43/44/45

NOTES:

Note the following details of the code protection feature on Microchip products:

- 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, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, QuietWire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2020 - 2022, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-5224-9769-1



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta

Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX

Tel: 512-257-3370

Boston

Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago

Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas

Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit

Novi, MI
Tel: 248-848-4000

Houston, TX

Tel: 281-894-5983

Indianapolis

Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles

Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC

Tel: 919-844-7510

New York, NY

Tel: 631-435-6000

San Jose, CA

Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto

Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Microchip:

[MIC38C42AYM](#) [MIC38C42AYM TR](#) [MIC38C42AYMM](#) [MIC38C42AYMM TR](#) [MIC38C43AYM](#) [MIC38C43AYM TR](#)
[MIC38C43AYMM](#) [MIC38C43AYMM TR](#) [MIC38C44AYM](#) [MIC38C44AYM TR](#) [MIC38C44AYMM](#) [MIC38C44AYMM TR](#)
[MIC38C45AYM](#) [MIC38C45AYM TR](#) [MIC38C45AYMM](#) [MIC38C45AYMM TR](#) [MIC38C42-1YM](#) [MIC38C42-1YM TR](#)
[MIC38C42YM](#) [MIC38C42YM TR](#) [MIC38C42YMM](#) [MIC38C42YMM TR](#) [MIC38C42YN](#) [MIC38C43-1YM](#) [MIC38C43-1YM TR](#)
[MIC38C43YM](#) [MIC38C43YM TR](#) [MIC38C43YMM](#) [MIC38C43YMM TR](#) [MIC38C43YN](#) [MIC38C44-1YM](#)
[MIC38C44-1YM TR](#) [MIC38C44-1YN](#) [MIC38C44YM](#) [MIC38C44YM TR](#) [MIC38C44YMM](#) [MIC38C44YMM TR](#)
[MIC38C44YN](#) [MIC38C45-1YM](#) [MIC38C45-1YM TR](#) [MIC38C45YM](#) [MIC38C45YM TR](#) [MIC38C45YMM](#)
[MIC38C45YMM TR](#) [MIC38C45YN](#) [MIC38C42AYMM-TR](#) [MIC38C45AYM-TR](#) [MIC38C43AYM-TR](#) [MIC38C43AYMM-TR](#)
[MIC38C45AYMM-TR](#) [MIC38C42AYM-TR](#) [MIC38C44AYMM-TR](#) [MIC38C44AYM-TR](#) [MIC38C42-1YM-TR](#)
[MIC38C44YM-TR](#) [MIC38C45YMM-TR](#) [MIC38C43YMM-TR](#) [MIC38C45-1YM-TR](#) [MIC38C44-1YM-TR](#) [MIC38C42YM-TR](#)
[MIC38C42YMM-TR](#) [MIC38C43-1YM-TR](#) [MIC38C43YM-TR](#) [MIC38C44YMM-TR](#) [MIC38C45YM-TR](#)
[MIC38C43XYM](#) [MIC38C43XYM-TR](#)