MAXM20343/MAXM20344

0.5V to 5.5V, 2.5W Himalaya uSLIC Step-Up/Down Power Modules

FEATURES

- Easy to Use
  - Wide 0.5V to 5.5V Input
  - Adjustable 2.5V to 5.5V Output
  - Up to 2.5W Output Power
  - Internally Compensated
  - All Ceramic Capacitors, Compact Layout
  - Low Profile, Compact 20-Pin,
  - 3.5mm x 3.5mm x 1.35mm, uSLIC Package
- High Efficiency
  - Peak Efficiency of 95%
  - Adaptive Frequency to Increase Efficiency at Light Loads
  - 3.5µA Quiescent Current
- Flexible Design
  - Internal Soft-Start
  - Prebias Startup in MAXM20344
  - Open-Drain Input Power Good (INGOOD Pin)
  - Open-Drain Output Power Good (PGOOD Pin)
- Robust Operation
  - Overcurrent, Overtemperature Protection
  - Wide -40°C to +125°C Ambient Operating Temperature/ -40°C to +150°C Junction Temperature
  - Complies with CISPR32 Class B Conducted and Radiated Emissions
  - Passes Drop, Shock, and Vibration Standards: JESD22-B103, B104, B111

APPLICATIONS

- Industrial Sensors
- Low-Power WAN
- Wearables, IoT

GENERAL DESCRIPTION

The MAXM20343 and MAXM20344 are ultra-low quiescent current, non-inverting buck-boost, Himalaya modules with an integrated inductor. The MAXM20343 and MAXM20344 operate over a wide input range of 0.5V to 5.5V, support up to 2.5W output power and allow the use of small, low-cost input and output capacitors. The output voltage can be adjusted from 2.5V to 5.5V. The modules significantly reduce design complexity, manufacturing risks and offer a true plug-and-play power supply solution, reducing time-to-market.

The MAXM20343 and MAXM20344 employ a unique control algorithm that transitions between buck, buck boost, and boost modes of operation, minimizing discontinuities and sub-harmonics in the outputvoltage ripple. Both modules use an adaptive frequency mechanism to increase the efficiency at light loads. The low 1.9V startup input voltage allows users to power the modules from a variety of sources and the 0.5V minimum operating voltage offers the ability to extract as much energy as possible from the source. The MAXM20343 offers active discharge upon shutdown for fast decay of output voltage. The MAXM20344 does not offer active discharge upon shutdown but supports applications that have prebiased output voltage.

***Ordering Information* appears at end of data sheet.**

SIMPLIFIED APPLICATION DIAGRAM

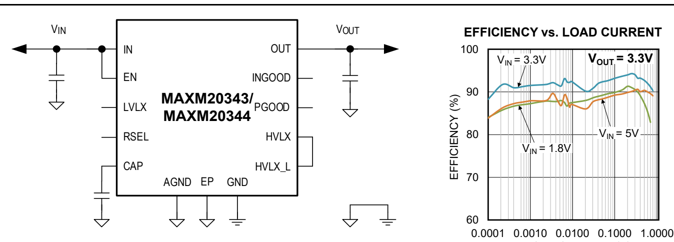

Figure 1. Simplified Application Diagram and Efficiency vs. Load Current

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SPECIFICATIONS

Table 1. Electrical Characteristics

(V_{IN} = V_{EN} = 1.9V to 5.5V, C_{CAP} = 2.2µF, V_{AGND} = V_{GND} = V_{EP} = 0V, V_{OUT} = 3.67V, RSEL = LVLX = HVLX = HVLX_L = INGOOD = PGOOD = OPEN, T_A = -40°C to 125°C, unless otherwise noted. Typical values are at T_A = +25°C. All voltages are referenced to AGND, unless otherwise noted.) ([1])

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}	For steady-state operation ([2])	0.5		5.5	V
	V_{IN_START}	For startup	1.9		5.5	
Quiescent Supply Current	I_Q	No load, V_{OUT} = 3.3V, V_{IN} = 5V		3.5		µA
Shutdown Supply Current	I_{SHDN}			0.1		µA
Maximum Output-Operative Power ([2])	P_{MAX}	V_{IN} ≥ 2.7V, C_{OUT} = 8µF	2.5			W
Output Voltage Set Range	V_{OUT}	V_{IN} ≥ 2.1V	2.5		5.5	V
		V_{IN} < 2.1V	3.3		5.5	
Output Voltage Regulation Accuracy	V_{OUT_REG}		-3		+3	%
Startup Time	$t_{STARTUP}$			32		ms
Output Voltage Threshold for PGOOD Rising	V_{PGOOD_R}			85.8		%V_{OUT}
Output Voltage Threshold for PGOOD Falling	V_{PGOOD_F}			83.6		%V_{OUT}
Input Voltage Threshold for INGOOD Rising	V_{INGOOD_R}	Soft-start active or V_{OUT} set below 3.3V		1.836		V
		V_{OUT} set higher than 3.3V and soft-start period complete		2.185		
Input Voltage Threshold for INGOOD Falling	V_{INGOOD_F}	Soft-start active or V_{OUT} set below 3.3V		1.782		V
		V_{OUT} set higher than 3.3V and soft-start period complete		2.101		

(V_{IN} = V_{EN} = 1.9V to 5.5V, C_{CAP} = 2.2µF, V_{AGND} = V_{GND} = V_{EP} = 0V, V_{OUT} = 3.67V, RSEL = LVLX = HVLX = HVLX_L = INGOOD = PGOOD = OPEN, T_A = -40°C to 125°C, unless otherwise noted. Typical values are at T_A = +25°C. All voltages are referenced to AGND, unless otherwise noted.) ([1])

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
Output UVLO Falling Threshold	$V_{OUT\_UVLO\_F}$	V_{OUT} falling		1.873		V
Output UVLO Rising Threshold	$V_{OUT\_UVLO\_R}$	V_{OUT} rising		1.963		V
EN, INGOOD, PGOOD, RSEL Leakage Current	I_{LK}	T_J = +25°C	-1		+1	µA
EN Input Logic High	V_{IO_IH}		1.4			V
EN Input Logic Low	V_{IO_IL}				0.4	V
PGOOD, INGOOD Output Logic Low	V_{IO_OL}	I_{OL} = 4mA			0.4	V
Active Shutdown Current Sink	I_{ACT_SHDN}	MAXM20343, V_{EN} = 0		20		mA
Active Shutdown Duration	t_{ACT_SHDN}	MAXM20343, V_{EN} = 0		50		ms

1 All devices are 100% production tested at TA = +25°C. Limits over the operating temperature range are guaranteed by design.

2 The parameter is not production tested and values are generated through characterization only.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise specified.

Table 2. Absolute Maximum Ratings

PARAMETER	RATING
IN, OUT, EN, INGOOD to AGND	-0.3V to +6.0V
RSEL, PGOOD, CAP to AGND	-0.3V to +6.0V
LVLX, HVLX_L to AGND	-0.3 to V_{IN} + 0.3V
HVLX to AGND	-0.3 to min(V_{OUT} + 0.3V, +6.0V)
AGND to GND	-0.3V to 0.3V
Output Short-Circuit Duration	Continuous
Operating Temperature Range ([1])	-40°C to 125°C
Junction Temperature	-40°C to +150°C
Storage Temperature Range	-40°C to +150°C
Lead Temperature (soldering, 10s)	+260°C
Soldering Temperature (reflow)	+260°C

[1] Junction Temperature greater than +125°C degrades operating lifetimes.

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

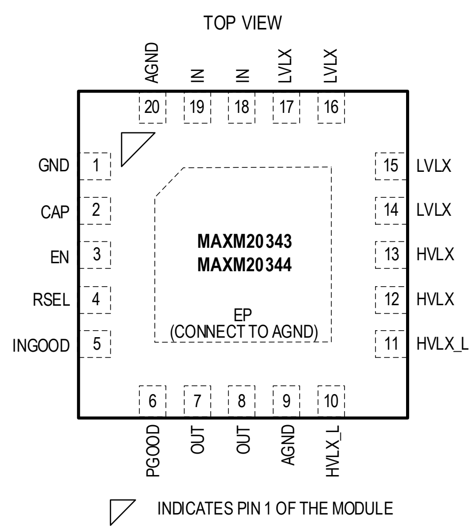


Table 3. Pin Descriptions

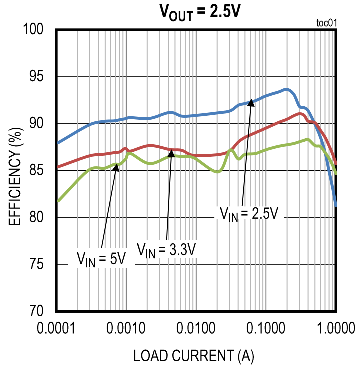
PIN	NAME	DESCRIPTION
1	GND	Ground for Internal Supply. Connect to the AGND pin.
2	CAP	Bypass Capacitor Connection for Internal Supply. Connect a 2.2μF ceramic capacitor between CAP and AGND.
3	EN	Active High Enable Input Pin. Connect to IN for always-on operation. Connect to AGND to disable the module output.
4	RSEL	Output Voltage Selection Pin. Connect a resistor from RSEL to AGND based on the desired output voltage. See *Table 5* for selection options.
5	INGOOD	Open-Drain Input Good Status Pin. Pull up INGOOD to an external logic supply using a pullup resistor. INGOOD is high if the input voltage is above V_{INGOOD_R}. INGOOD is driven low if the input voltage falls below V_{INGOOD_F}.
6	PGOOD	Open-Drain Output Power Good Status Pin. Pull up PGOOD to an external logic supply using a pullup resistor. PGOOD is high if the output voltage is above V_{PGOOD_R}. PGOOD is driven low if the output voltage falls below V_{PGOOD_F}.
7, 8	OUT	Module Output Pins. Connect the output capacitor C_{OUT} from OUT to AGND, placing the capacitor close to OUT and AGND pins. See the *PCB Layout Guidelines* section for more details.
9, 20	AGND	Ground Pins. Connect externally to the power ground plane. Refer to the MAXM20343/MAXM20344 evaluation board user guide for a layout example.

10, 11	HVLX_L	Inductor Terminal Pins. Connect to pins 12 and 13 externally. Do not connect external components.
12, 13	HVLX	Module Switching Node. Connect to pins 10 and 11 externally. Do not connect external components.
14, 15, 16, 17	LVLX	Module Switching Node Internally Connected to the Inductor. Do not connect external components.
18, 19	IN	Power-Supply Input Pins. Decouple the IN pin to AGND using a ceramic capacitor, placing the capacitor close to the IN and AGND pins. See the *PCB Layout Guidelines* section for more details.
—	EP	Exposed Pad. Connect EP to AGND pin of the module. Also, connect EP to a large AGND plane with several thermal vias for the best thermal performance. Refer to the MAXM20343/MAXM20344 evaluation board user guide for an example of the correct method for EP connection and thermal vias.

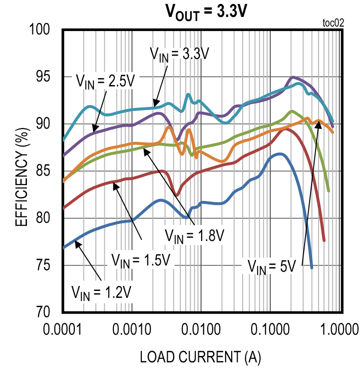
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25°C, unless otherwise noted.

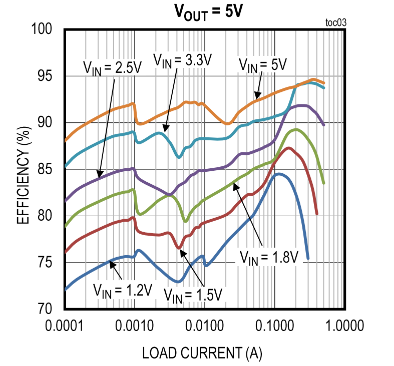
MAXM20343/MAXM20344
EFFICIENCY vs. LOAD CURRENT
V_{OUT} = 2.5V



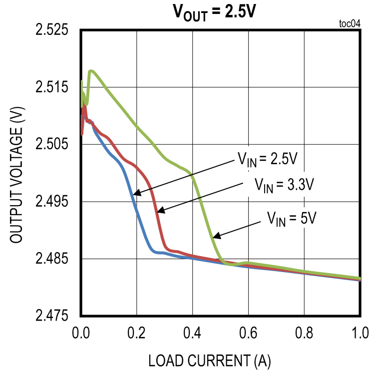
MAXM20343/MAXM20344
EFFICIENCY vs. LOAD CURRENT
V_{OUT} = 3.3V



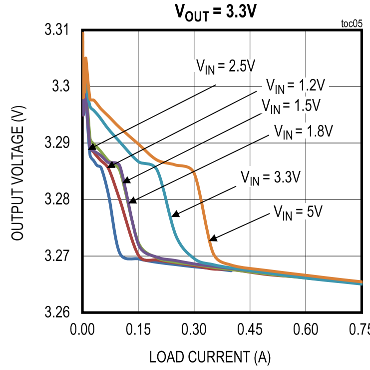
MAXM20343/MAXM20344
EFFICIENCY vs. LOAD CURRENT
V_{OUT} = 5V



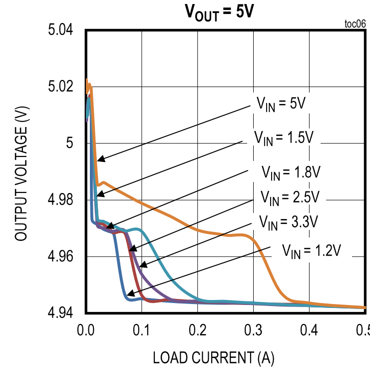
MAXM20343/MAXM20344
OUTPUT VOLTAGE vs. LOAD CURRENT
V_{OUT} = 2.5V



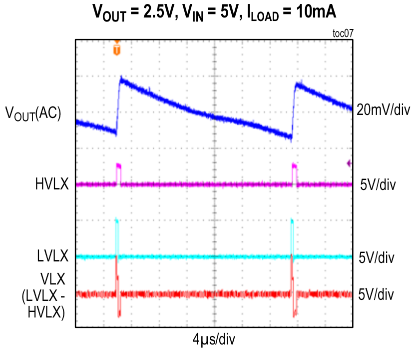
MAXM20343/MAXM20344
OUTPUT VOLTAGE vs. LOAD CURRENT
V_{OUT} = 3.3V



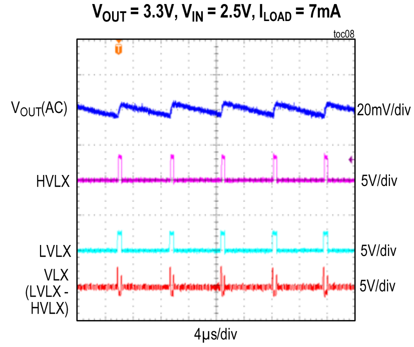
MAXM20343/MAXM20344
OUTPUT VOLTAGE vs. LOAD CURRENT
V_{OUT} = 5V



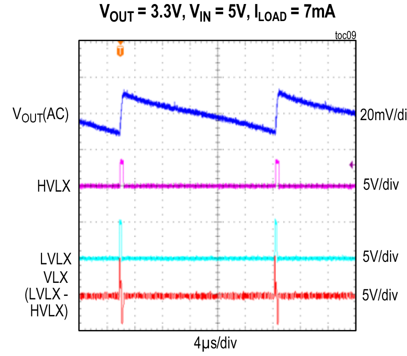
MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 2.5V, V_{IN} = 5V, I_{LOAD} = 10mA



MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 3.3V, V_{IN} = 2.5V, I_{LOAD} = 7mA

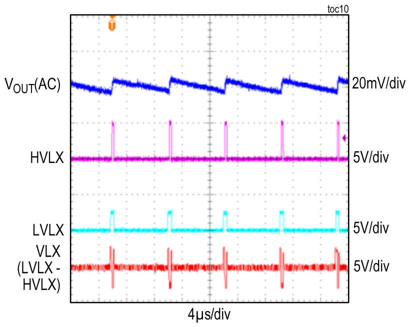


MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 3.3V, V_{IN} = 5V, I_{LOAD} = 7mA

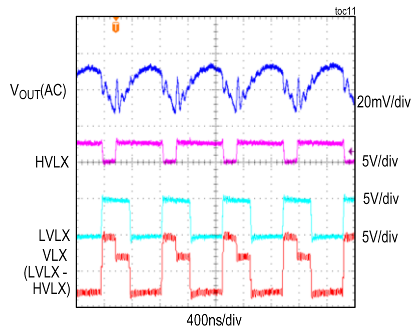


T_A = 25°C, unless otherwise noted.

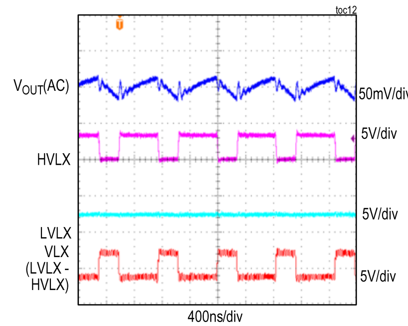
MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 5V, V_{IN} = 2.5V, I_{LOAD} = 7mA



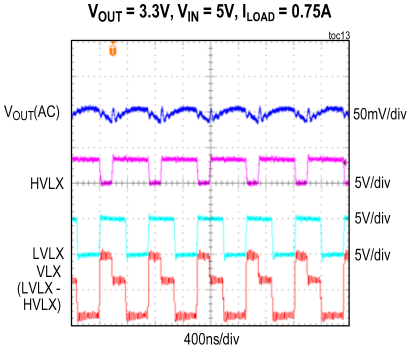
MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 2.5V, V_{IN} = 5V, I_{LOAD} = 1A



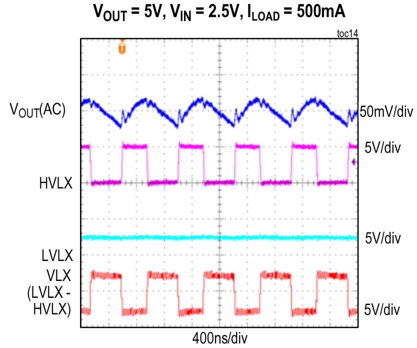
MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 3.3V, V_{IN} = 2.5V, I_{LOAD} = 0.75A



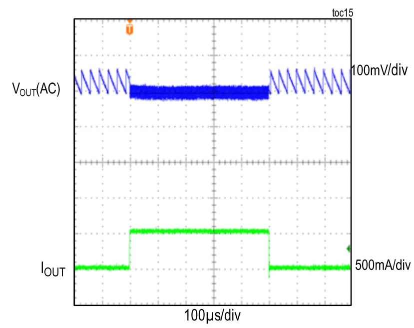
MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 3.3V, V_{IN} = 5V, I_{LOAD} = 0.75A



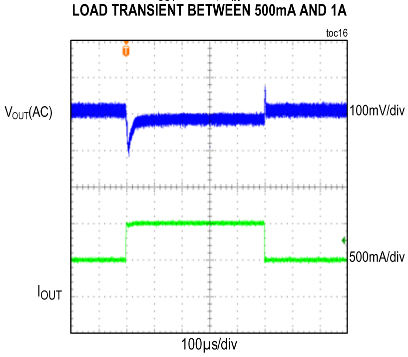
MAXM20343/MAXM20344
STEADY STATE OUTPUT VOLTAGE RIPPLE
V_{OUT} = 5V, V_{IN} = 2.5V, I_{LOAD} = 500mA



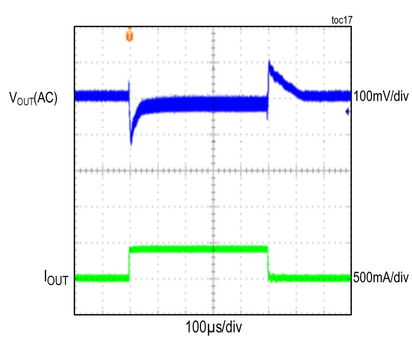
MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 2.5V, V_{IN} = 5V
LOAD TRANSIENT BETWEEN 5mA AND 500mA



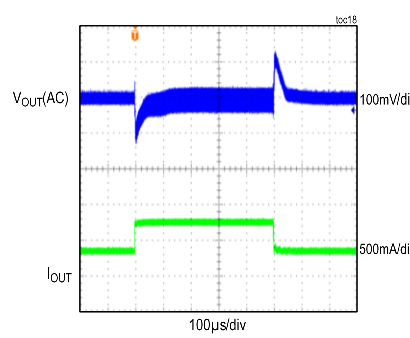
MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 2.5V, V_{IN} = 5V
LOAD TRANSIENT BETWEEN 500mA AND 1A



MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 3.3V, V_{IN} = 2.5V
LOAD TRANSIENT BETWEEN 10mA AND 375mA

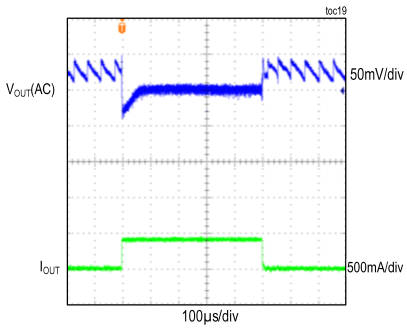


MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 3.3V, V_{IN} = 2.5V
LOAD TRANSIENT BETWEEN 375mA AND 0.75A

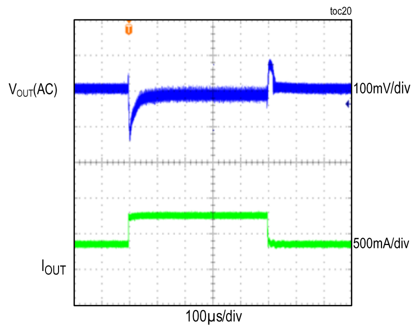


T_A = 25°C, unless otherwise noted.

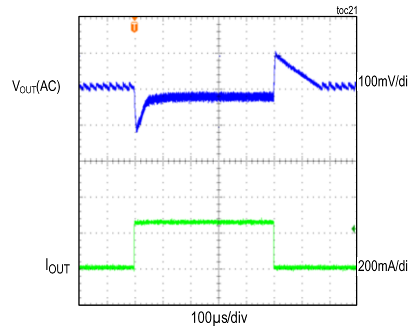
MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 3.3V, V_{IN} = 5V
LOAD TRANSIENT BETWEEN 10mA AND 375mA



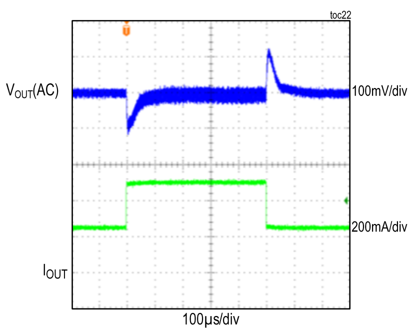
MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 3.3V, V_{IN} = 5V
LOAD TRANEINT BETWEEN 375mA AND 0.75A



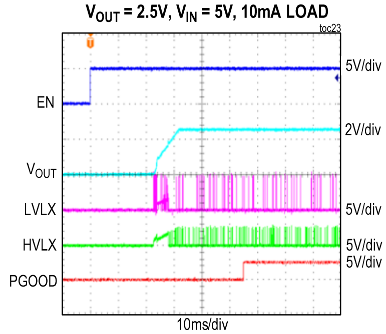
MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 5V, V_{IN} = 2.5V
LOAD TRANSIENT BETWEEN 5mA AND 250mA



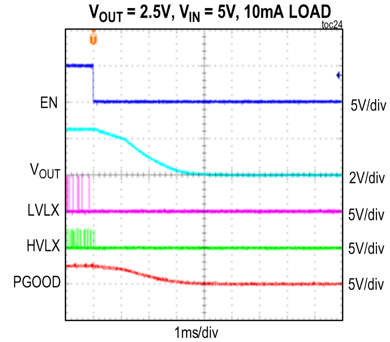
MAXM20343/MAXM20344 LOAD TRANSIENT RESPONSE
V_{OUT} = 5V, V_{IN} = 2.5V
LOAD TRANSIENT BETWEEN 250mA AND 500mA



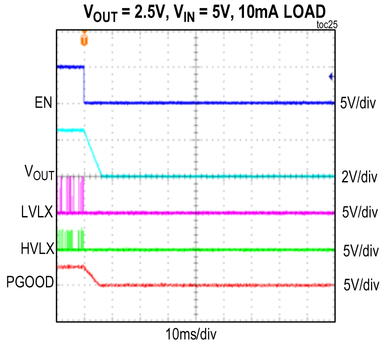
MAXM20343/MAXM20344
STARTUP THROUGH ENABLE
V_{OUT} = 2.5V, V_{IN} = 5V, 10mA LOAD



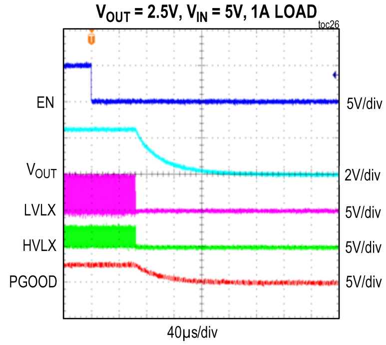
MAXM20343
SHUTDOWN THROUGH ENABLE
V_{OUT} = 2.5V, V_{IN} = 5V, 10mA LOAD



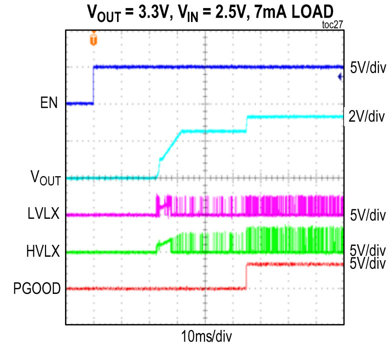
MAXM20344
SHUTDOWN THROUGH ENABLE
V_{OUT} = 2.5V, V_{IN} = 5V, 10mA LOAD



MAXM20343/MAXM20344
SHUTDOWN THROUGH ENABLE
V_{OUT} = 2.5V, V_{IN} = 5V, 1A LOAD

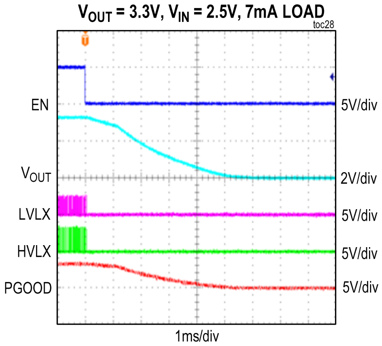


MAXM20343/MAXM20344
STARTUP THROUGH ENABLE
V_{OUT} = 3.3V, V_{IN} = 2.5V, 7mA LOAD

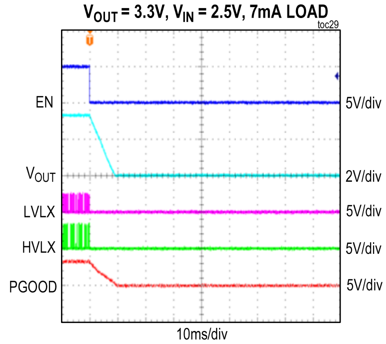


T_A = 25°C, unless otherwise noted.

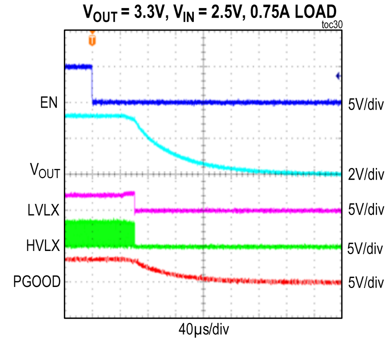
MAXM20343 SHUTDOWN THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 2.5V, 7mA LOAD



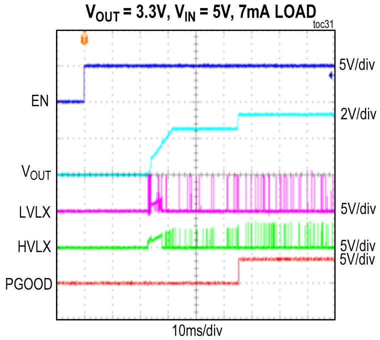
MAXM20344 SHUTDOWN THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 2.5V, 7mA LOAD



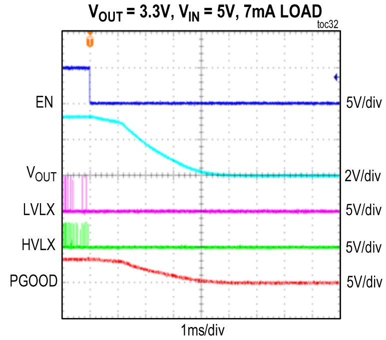
MAXM20343/MAXM20344 SHUTDWON THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 2.5V, 0.75A LOAD



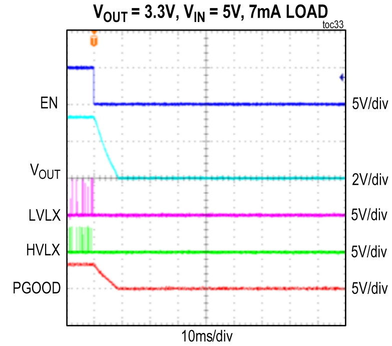
MAXM20343/MAXM20344 STARTUP THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 5V, 7mA LOAD



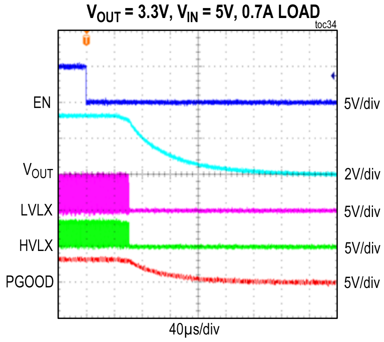
MAXM20343 SHUTDOWN THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 5V, 7mA LOAD



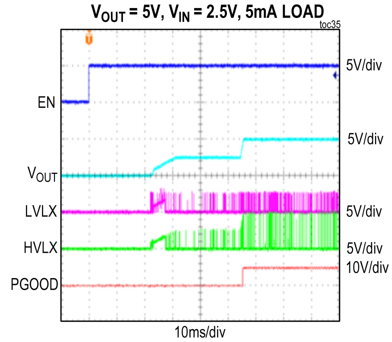
MAXM20344 SHUTDOWN THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 5V, 7mA LOAD



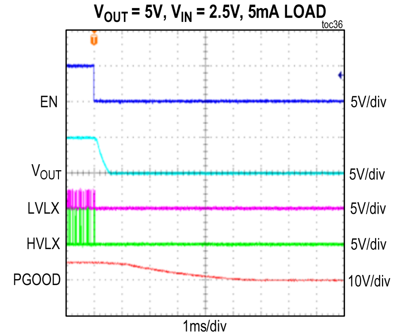
MAXM20343/MAXM20344 SHUTDWON THROUGH ENABLE V_{OUT} = 3.3V, V_{IN} = 5V, 0.7A LOAD



MAXM20343/MAXM20344 STARTUP THROUGH ENABLE V_{OUT} = 5V, V_{IN} = 2.5V, 5mA LOAD

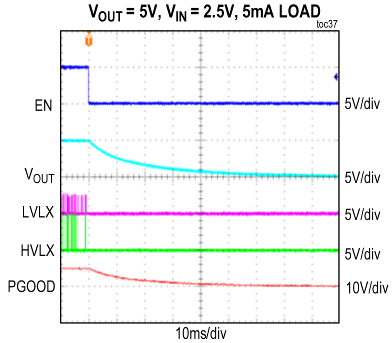


MAXM20343 SHUTDOWN THROUGH ENABLE V_{OUT} = 5V, V_{IN} = 2.5V, 5mA LOAD

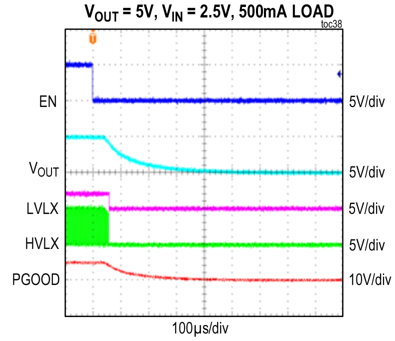


T_A = 25°C, unless otherwise noted.

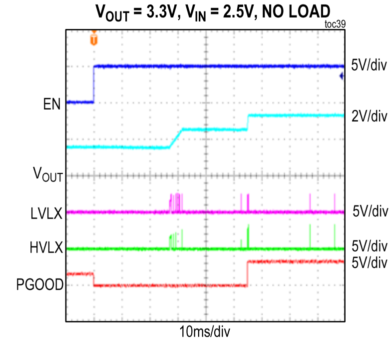
MAXM20344
SHUTDOWN THROUGH ENABLE
V_{OUT} = 5V, V_{IN} = 2.5V, 5mA LOAD



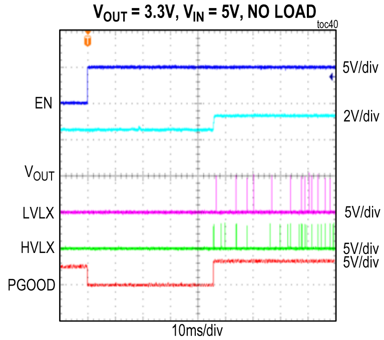
MAXM20343/MAXM20344
SHUTDWON THROUGH ENABLE
V_{OUT} = 5V, V_{IN} = 2.5V, 500mA LOAD



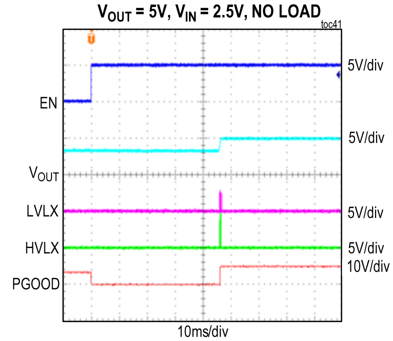
MAXM20344
STARTUP THROUGH ENABLE (1.5V PREBIAS)
V_{OUT} = 3.3V, V_{IN} = 2.5V, NO LOAD



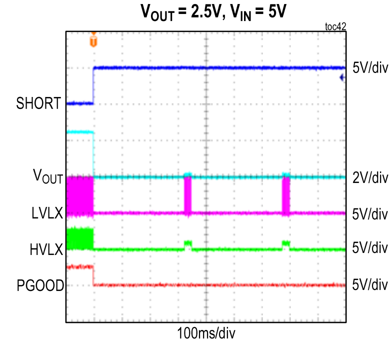
MAXM20344
STARTUP THROUGH ENABLE (2.5V PREBIAS)
V_{OUT} = 3.3V, V_{IN} = 5V, NO LOAD



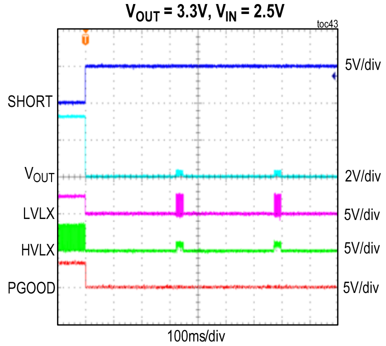
MAXM20344
STARTUP THROUGH ENABLE (3.3V PREBIAS)
V_{OUT} = 5V, V_{IN} = 2.5V, NO LOAD



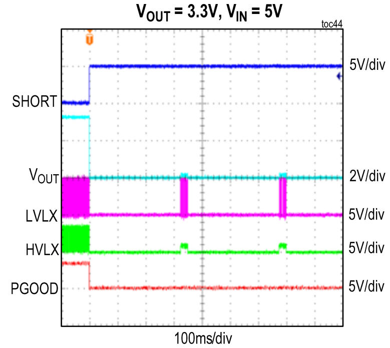
MAXM20343/MAXM20344
OUTPUT SHORT IN STEADY STATE
V_{OUT} = 2.5V, V_{IN} = 5V



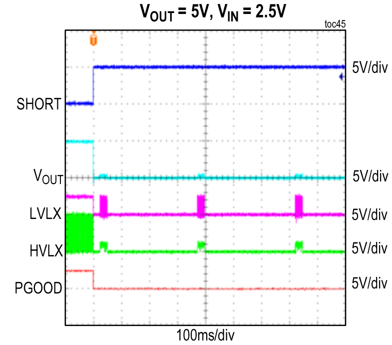
MAXM20343/MAXM20344
OUTPUT SHORT IN STEADY STATE
V_{OUT} = 3.3V, V_{IN} = 2.5V



MAXM20343/MAXM20344
OUTPUT SHORT IN STEADY STATE
V_{OUT} = 3.3V, V_{IN} = 5V

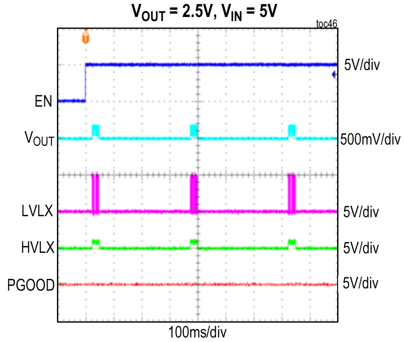


MAXM20343/MAXM20344
OUTPUT SHORT IN STEADY STATE
V_{OUT} = 5V, V_{IN} = 2.5V

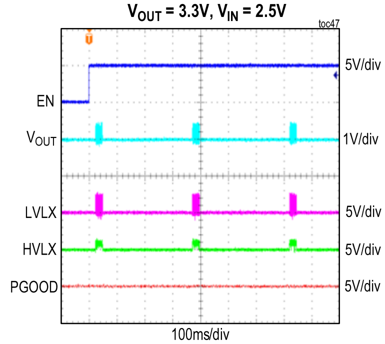


T_A = 25°C, unless otherwise noted.

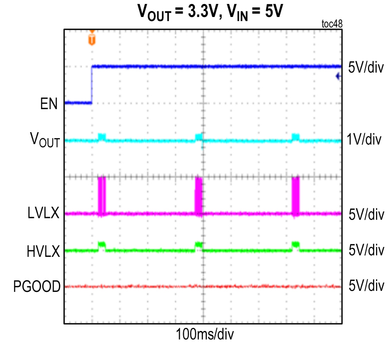
MAXM20343/MAXM20344
OUTPUT SHORT DURING STARTUP
V_{OUT} = 2.5V, V_{IN} = 5V



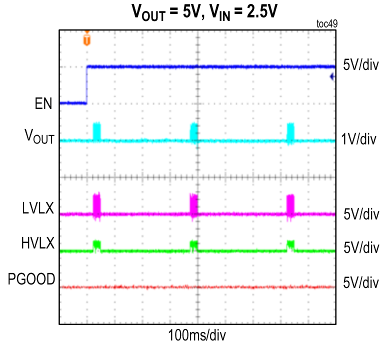
MAXM20343/MAXM20344
OUTPUT SHORT DURING STARTUP
V_{OUT} = 3.3V, V_{IN} = 2.5V



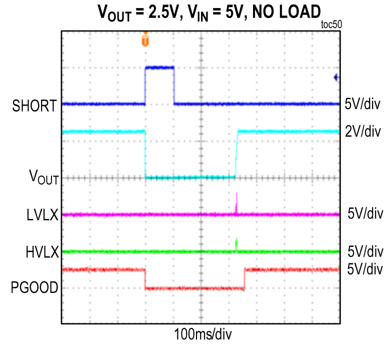
MAXM20343/MAXM20344
OUTPUT SHORT DURING STARTUP
V_{OUT} = 3.3V, V_{IN} = 5V



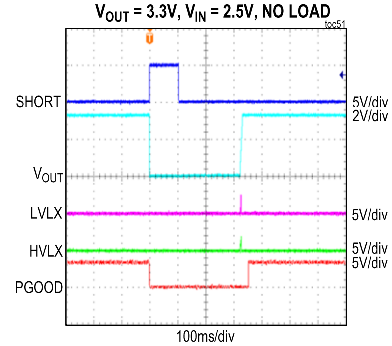
MAXM20343/MAXM20344
OUTPUT SHORT DURING STARTUP
V_{OUT} = 5V, V_{IN} = 2.5V



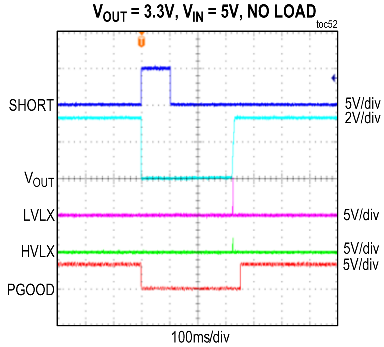
MAXM20343/MAXM20344
RECOVERY FROM OUTPUT SHORT
V_{OUT} = 2.5V, V_{IN} = 5V, NO LOAD



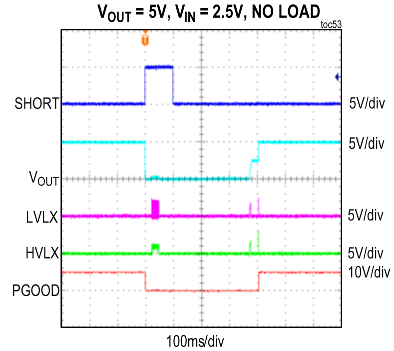
MAXM20343/MAXM20344
RECOVERY FROM OUTPUT SHORT
V_{OUT} = 3.3V, V_{IN} = 2.5V, NO LOAD



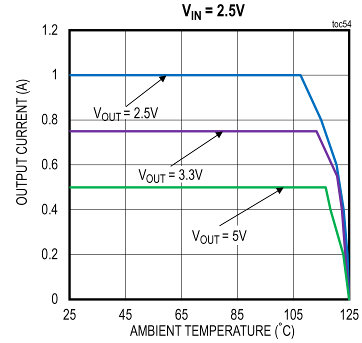
MAXM20343/MAXM20344
RECOVERY FROM OUTPUT SHORT
V_{OUT} = 3.3V, V_{IN} = 5V, NO LOAD



MAXM20343/MAXM20344
RECOVERY FROM OUTPUT SHORT
V_{OUT} = 5V, V_{IN} = 2.5V, NO LOAD



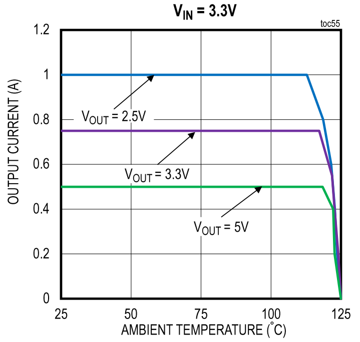
MAXM20343/MAXM20344
OUTPUT CURRENT vs. AMBIENT TEMPERATURE
V_{IN} = 2.5V



MEASURED ON MAXM20343EVKIT#/MAXM20344EVKIT#

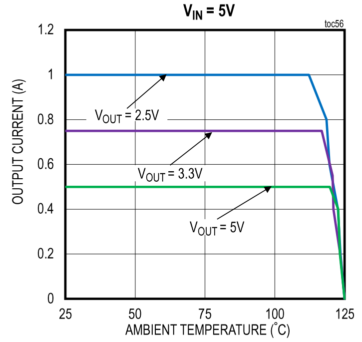
T_A = 25°C, unless otherwise noted.

MAXM20343/MAXM20344
OUTPUT CURRENT vs. AMBIENT TEMPERATURE
V_{IN} = 3.3V



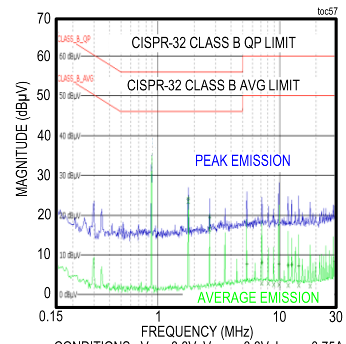
MEASURED ON MAXM20343EVKIT#/MAXM20344EVKIT#

MAXM20343/MAXM20344
OUTPUT CURRENT vs. AMBIENT TEMPERATURE
V_{IN} = 5V



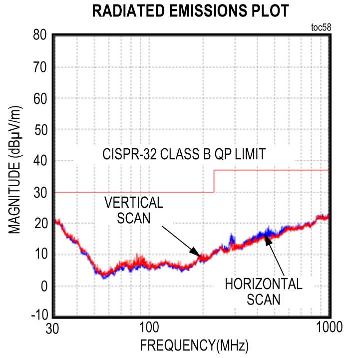
MEASURED ON MAXM20343EVKIT#/MAXM20344EVKIT#

MAXM20343/MAXM20344
CONDUCTED EMISSIONS PLOT



CONDITIONS : V_{IN} = 3.3V, V_{OUT} = 3.3V, I_{OUT} = 0.75A
MEASURED ON THE MAXM20343EVKIT#

MAXM20343/MAXM20344
RADIATED EMISSIONS PLOT



CONDITIONS : V_{IN} = 3.3V, V_{OUT} = 3.3V, I_{OUT} = 0.75A
MEASURED ON MAXM20343EVKIT#

FUNCTIONAL BLOCK DIAGRAM

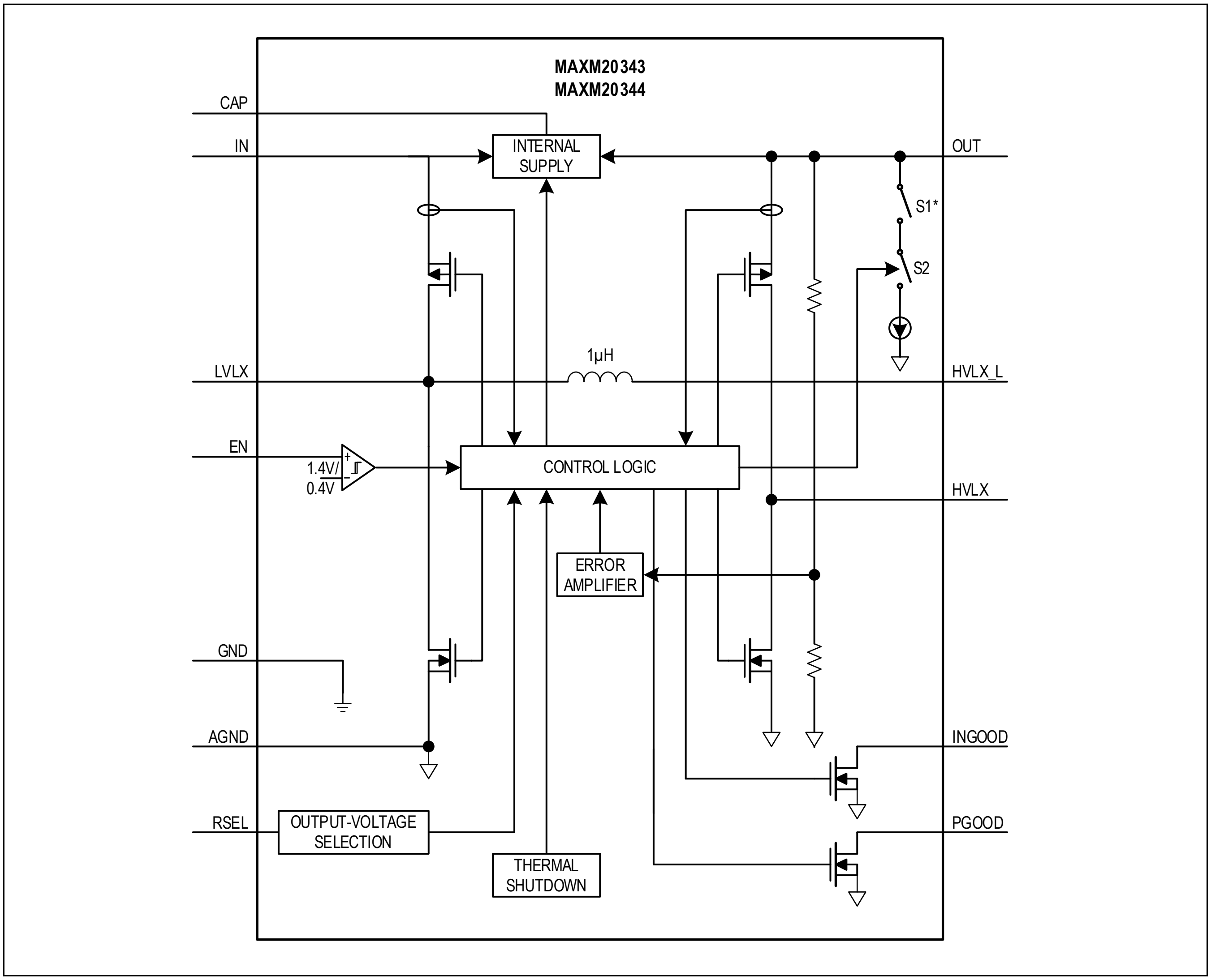


Table 4. Active Discharge Switch

PART NUMBER	*S1 SWITCH
MAXM20343	CLOSE
MAXM20344	OPEN

DETAILED DESCRIPTION

The MAXM20343 and MAXM20344 are ultra-low quiescent current, non-inverting buck-boost modules with an integrated controller, MOSFETs, compensation components, and inductors that operate over a 0.5V to 5.5V input voltage range. The MAXM20343 and MAXM20344 support up to 2.5W output power and allow the use of small, low-cost input and output capacitors. The output voltage can be adjusted from 2.5V to 5.5V. Built-in compensation across the output voltage range eliminates the need for external compensation components. The output voltage regulation accuracy over -40°C to +125°C is ±3%.

The MAXM20343 and MAXM20344 employ a unique control algorithm that transitions seamlessly between buck, buck-boost, and boost modes of operation, minimizing discontinuities and sub-harmonics in the output voltage ripple. To reduce input inrush current, the modules offer a soft-start mechanism. Both modules use an adaptive frequency scheme to increase efficiency at light loads. The low 1.9V startup input voltage allows users to power the device from a variety of sources, and the 0.5V minimum operating voltage offers the ability to extract as much energy as possible from the source. The MAXM20343 offers active discharge upon shutdown for fast decay of the output voltage. The MAXM20344 supports pre-biased output voltage and hence disables active discharge upon shutdown. The modules offer low quiescent operation mode by turning off selective internal blocks to enhance efficiency down to very light loads.

Enable Input (EN), Soft-Start

When the EN voltage goes above 1.4V (min), the internal error-amplifier reference voltage starts to ramp up to 2.5V in 8ms. When the output voltage reaches 2.5V, the device reads the RSEL resistor. The controller sets the reference output voltage as programmed by RSEL. The output voltage is then increased at a rate of 2mV/µs until it reaches the programmed target value. *Figure 2* illustrates this startup sequence.

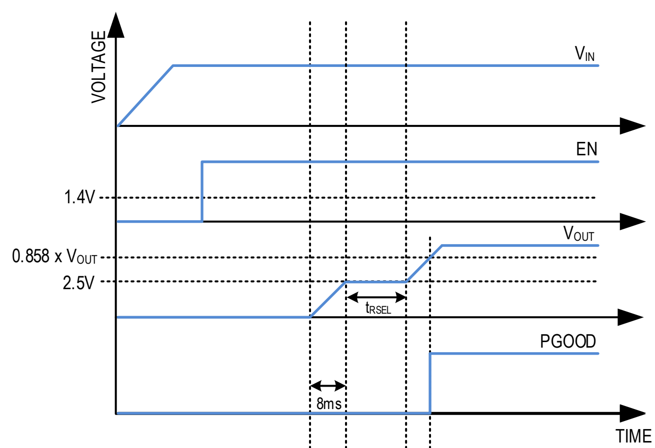


Figure 2. Startup Sequence (Typ)

Internal Supply (CAP)

The modules include a CAP pin to connect a capacitor that provides supply to internal blocks. Before soft start is complete, CAP is internally connected to IN, so the internal blocks are powered by the input supply. When the soft start is complete, CAP switches over to OUT. In this case, the internal blocks are powered by the output voltage generated by the modules.

Input Power Good (INGOOD)

The modules include an open-drain input power good pin that indicates the input voltage status. INGOOD goes high when the input voltage goes above V_{INGOOD_R} and goes low when the input voltage goes below V_{INGOOD_F}. Connect the INGOOD pin to an external logic supply using a pullup resistor.

Power Good Output (PGOOD)

The modules include an open-drain power good output that indicates the output voltage status. PGOOD goes high when the output voltage is above V_{PGOOD_R} and goes low when the output voltage is below V_{PGOOD_F} of the target value. Connect the PGOOD pin to an external logic supply using a pullup resistor.

Active Discharge

The MAXM20343 offers an active discharge of the output upon shutdown. When the EN voltage goes below 0.4V, a current source of 20mA is activated for a duration of 50ms. This current source ensures fast decay of the output voltage.

Overcurrent Protection/Hiccup Mode

The modules are provided with a robust overcurrent protection (OCP) scheme that protects the modules under overload and output short-circuit conditions. Due to any fault, if the output voltage drops below 1.873V any time after soft-start is completed, the hiccup mode is activated. In hiccup mode, the modules are protected by suspending switching for a hiccup timeout period of 300ms. Once the hiccup timeout period expires, soft-start is attempted again. When soft-start is attempted under overload conditions, if the output voltage does not exceed 1.963V, the modules shut down and continue to operate in Hiccup mode. Hiccup mode of operation ensures low power dissipation under output short-circuit and overload conditions.

Output Power

At low input voltages, the output power that the modules can deliver reduces.

Under steady-state operation, the modules can deliver 2.5W down to an input voltage of 2V (typ), below which the current that can be drawn from the output reduces.

During startup, the modules can deliver 2.5W above the input voltage of 2.5V (typ). The modules do not reach steady-state operation if the load exceeds the guaranteed output power that can be drawn during startup (*Figure 3*). In this phase, the modules exit the startup sequence after a 30ms timeout period and turn off. A new soft-start is attempted after a 300ms hiccup timeout period, and the cycle continues until the startup power requirement is met. *Figure 3* shows the values of output power for a given input voltage.

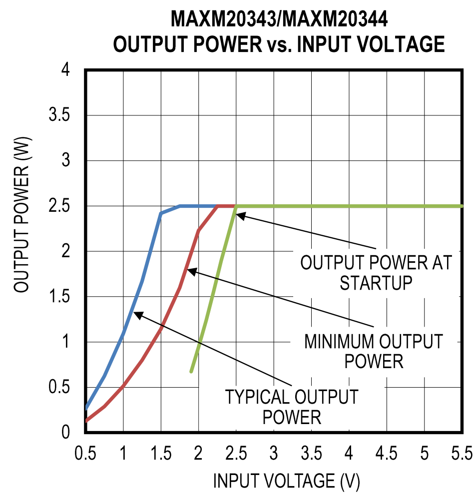


Figure 3. Output Power vs. Input Voltage

Thermal Overload Protection

Thermal overload protection limits the total power dissipation in the device. When the junction temperature exceeds +165°C, an on-chip thermal sensor shuts down the device and turns off the internal power MOSFETs, allowing the device to cool down. The thermal sensor turns the device on after the junction temperature cools by 10°C.

APPLICATIONS INFORMATION

Input Operating Voltage

Operating across wide input voltages enables a system to extract as much energy as possible from its energy source before shutting down. Though the MAXM20343/MAXM20344 modules need a minimum of 1.9V input voltage for startup, the modules can operate with input voltages as low as 0.5V after starting up for output voltages programmed at and above 3.3V. This allows a system to run the modules well below the minimum startup voltage, although with a reduced power capability.

Setting Output Voltage (RSEL)

Select the value of the RSEL resistor for the required output voltage using *Table 5*. Leaving RSEL open sets the output to 3.3V.

Table 5. RSEL Selection

OUTPUT VOLTAGE (V)	RSEL VALUE (kΩ)
3.3	OPEN
2.5	590
2.7	422
3.0	301
3.2	210
3.3	150
3.4	105
3.5	75
3.6	53.6
3.7	37.4
3.8	26.7
4.0	18.7
4.2	13.3
4.5	9.31
5.0	6.65
5.5	SHORT

Selection of Input Capacitor

The input filter capacitor reduces peak currents drawn from the power source and reduces noise and voltage ripple on the input caused by switching the module. Low-ESR ceramic X7R-grade capacitors with high-ripple-current capability at the input are recommended in industrial applications for their temperature stability. See *Table 6* for recommended input capacitors.

Selection of Output Capacitor

Small ceramic X7R-grade capacitors are sufficient and recommended for the modules. The output capacitor has two functions: it filters the square wave generated by the modules along with the internal inductor, and it stores sufficient energy to support the output voltage under load transient conditions and stabilizes the internal control loop of the modules. See *Table 6* for recommended output capacitors.

Table 6. Selection of Components

V_{INMIN} (V)	V_{INMAX} (V)	V_{OUT} (V)	C_{IN}	C_{OUT}	R1 (kΩ)
2.1	5.5	2.5	1 x 10µF 0805 6.3V GRM21BR70J106KA73#	1 x 22µF 0805 6.3V GRM21BZ70J226ME44#	590
0.5	5.5	3.3	1 x 10µF 0805 6.3V GRM21BR70J106KA73#	1 x 22µF 0805 6.3V GRM21BZ70J226ME44#	OPEN
0.5	5.5	5	1 x 10µF 0805 6.3V GRM21BR70J106KA73#	1 x 22µF 0805 6.3V GRM21BZ70J226ME44#	6.65

Power Dissipation

The power dissipation inside the MAXM20343/MAXM20344 leads to an increase in the junction temperature of the modules. The power loss inside the modules at full load is estimated as follows:

$$P_{LOSS} = P_{OUT} \times \left[\frac{1}{\eta} - 1\right]$$

Where η is the efficiency of the power module at the desired operating conditions. The junction temperature T_J of the module can be estimated at any given maximum ambient temperature T_A from the following equation:

$$T_J = T_A + [\theta_{JA} \times P_{LOSS}]$$

For the MAXM20343/MAXM20344 evaluation board, the thermal resistance from junction-to-ambient (θ_{JA}) is 26°C/W. Operating the module at junction temperatures greater than +125°C degrades operating lifetimes. An EE-Sim model is available for the MAXM20343/MAXM20344 to simulate efficiency and power loss for the desired operating conditions.

PCB Layout Guidelines

Careful PCB layout is critical to achieve low switching losses and clean, stable operation.

Use the following guidelines for good PCB layout:

- Keep the input capacitors as close as possible to the IN and AGND pins.
- Keep the output capacitors as close as possible to the OUT and AGND pins.
- Connect all the AGND connections to a copper plane area that is as large as possible on the top and bottom layers.
- Use multiple vias to connect internal AGND planes to the top layer AGND plane.

Refer to the MAXM20343/MAXM20344 evaluation board layout for first pass success.

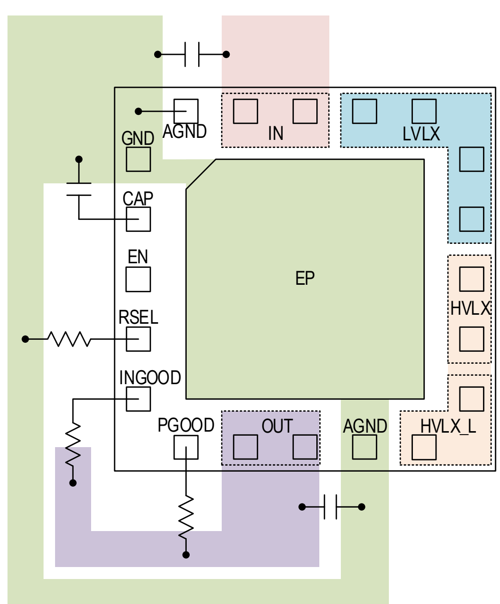


Figure 4. Layout Guidelines

TYPICAL APPLICATION CIRCUITS

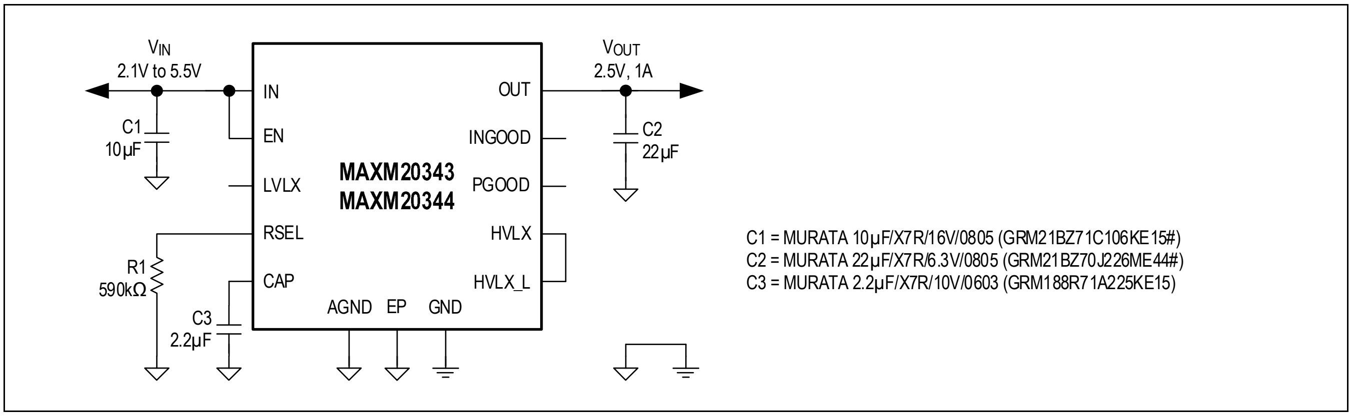


Figure 5. Typical Application Circuit—2.5V Output

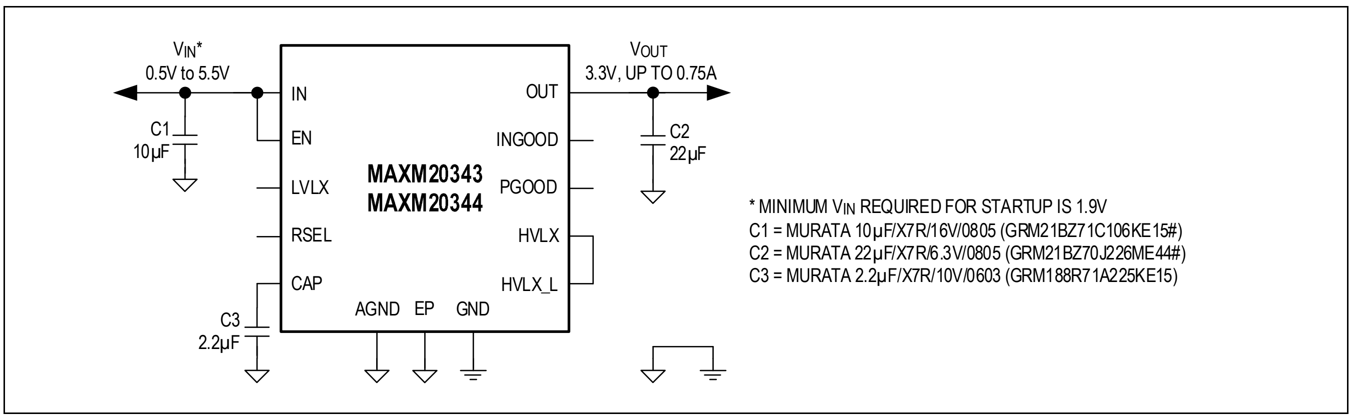


Figure 6. Typical Application Circuit—3.3V Output

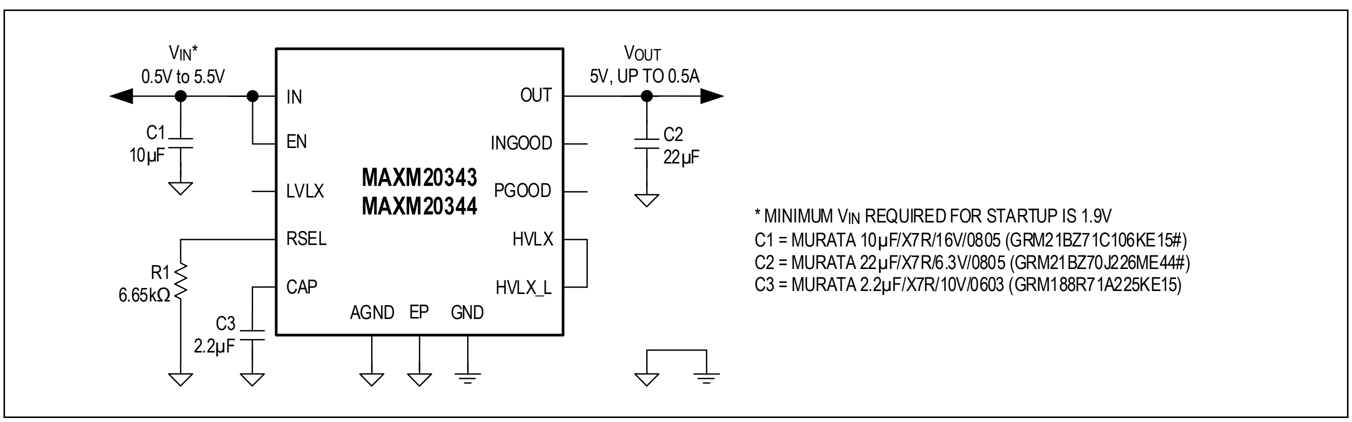


Figure 7. Typical Application Circuit—5V Output

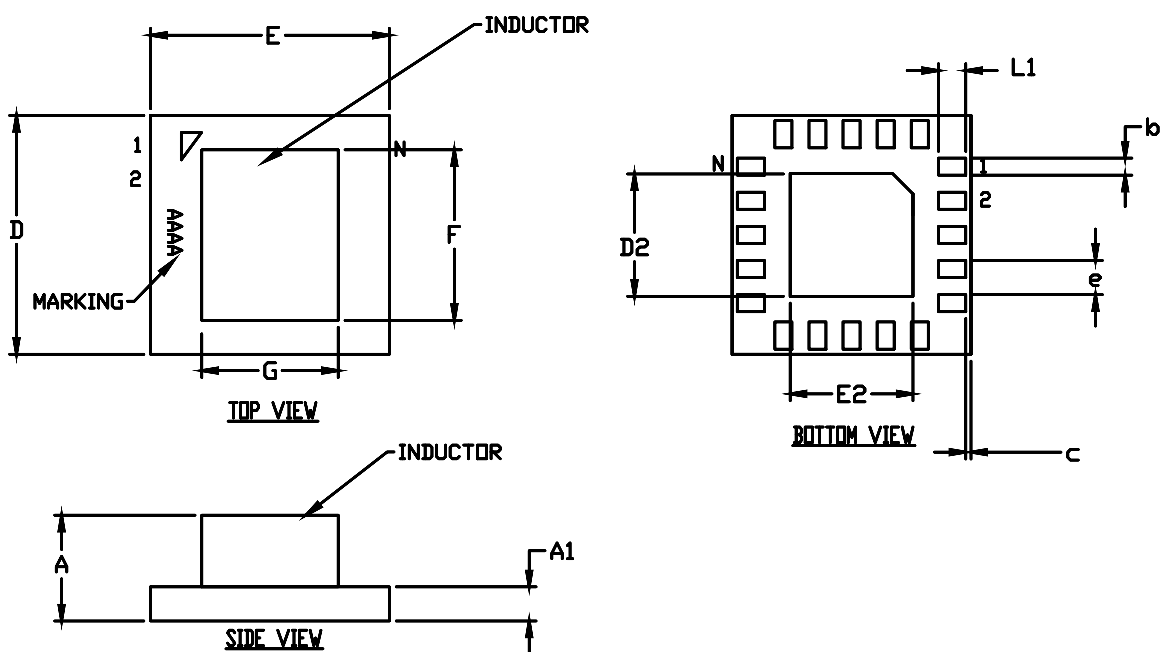
OUTLINE DIMENSIONS

Table 7. Thermal Resistance of 20-Pin uSLIC

Thermal Resistance, Four Layer Board ([1])	
Junction-to-Ambient (Θ_{JA})	26°C/W

[1] Package thermal resistances were obtained using the MAXM20343/4 evaluation board with no airflow.

PACKAGE OUTLINE
20-Pin uSLIC



SYMBOL	20L 3.5x3.5 MIN.	NOM.	MAX.	NOTE
A	1.10	1.35	1.60	
A1	0.25	0.30	0.35	
b	0.20	0.25	0.30	
c	0.025	0.075	0.125	
D	3.40	3.50	3.60	
D2	1.75	1.80	1.85	
E	3.40	3.50	3.60	
E2	1.75	1.80	1.85	
e	0.50 BSC			
F	2.50 REF			
G	2.00 REF			
L1	0.35	0.40	0.45	
N	20			2

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. 'N' IS THE TOTAL NUMBER OF TERMINALS.
3. ALL DIMENSIONS AND TOLERANCES CONFORM TO ANSI Y14.5M-1994.
4. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC #10-0131.
5. ALL DIMENSIONS APPLY TO PbFREE (+) PKG. CODE ONLY.
6. PACKAGE CODE: M203A3+1
7. REFER TO 73-100015 FOR PACKAGE DRAWING FOR INTERNAL HARDWARE TOOLING

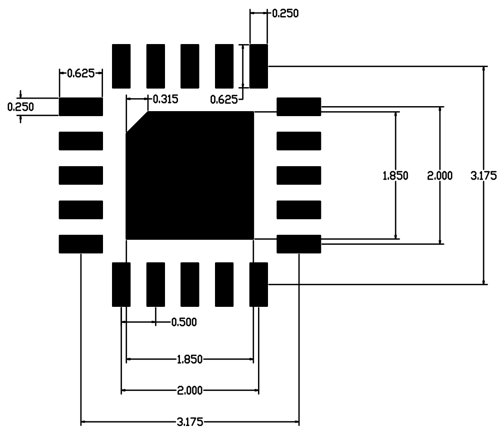
DOCUMENT CONTROL No.: 21-100447F

-DRAWING NOT TO SCALE-

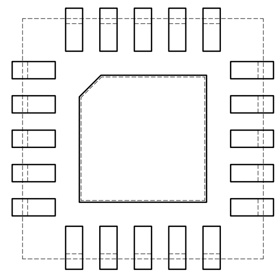
LAND PATTERN

PACKAGE LAND PATTERN
20-Pin uSLIC

RECOMMENDED LAND PATTERN



PACKAGE OVERLAY



NOTES:
1. REFERENCE PKG. OUTLINE: 21-100447F
2. LAND PATTERN COMPLIES TO: IPC7351A.
3. TOLERANCE: +/- 0.02 MM.
4. ALL DIMENSIONS APPLY TO LEADED, PbFREE PACKAGES.
5. ALL DIMENSIONS IN MM.

-DRAWING NOT TO SCALE-

DOCUMENT CONTROL No.: 90-100158A

This document (including dimensions, notes & specs) is a recommendaton based on typical circuit board manufacturing parameters. Since land pattern design depend on many factors unknown to Maxim (eg. user's board manufacturing specs), user must determine suitability for use.
This document is subject to change without notice.

ORDERING INFORMATION

PART NUMBER	TEMP RANGE	PIN-PACKAGE	ACTIVE SHUTDOWN
MAXM20343AMP+	-40°C to +125°C	20-pin 3.5mm x 3.5mm x 1.35mm uSLIC package	Enabled
MAXM20343AMP+T	-40°C to +125°C	20-pin 3.5mm x 3.5mm x 1.35mm uSLIC package	Enabled
MAXM20344AMP+	-40°C to +125°C	20-pin 3.5mm x 3.5mm x 1.35mm uSLIC package	Disabled
MAXM20344AMP+T	-40°C to +125°C	20-pin 3.5mm x 3.5mm x 1.35mm uSLIC package	Disabled

+Denotes a lead (Pb)-free/RoHS-compliant package.

T = Tape and reel.

REVISION HISTORY

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/24	Initial release	—
1	8/25	Updated package height from 1.45mm to 1.35mm	1, 23