QML CLASS V, CURRENT-MODE PWM CONTROLLER

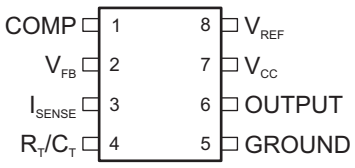
Check for Samples: UC1843-SP

FEATURES

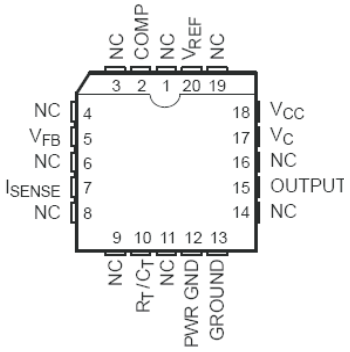
- **QML-V Qualified, SMD 5962-86704**
- **Rad-Tolerant: 50 kRad (Si) TID (ELDRS Free)** (1)
- **Controlled Baseline**
- **Optimized For Off-line and DC-to-DC Converters**
- **Low Start-Up Current (<1 mA)**
- **Automatic Feed Forward Compensation**
- **Pulse-by-Pulse Current Limiting**
- **Enhanced Load Response Characteristics**
- **Under-Voltage Lockout With Hysteresis**
- **Double Pulse Suppression**
- **High Current Totem Pole Output**
- **Internally Trimmed Bandgap Reference**
- **500-kHz Operation**
- **Low R_O Error Amp**

(1) Radiation tolerance is a typical value based upon initial device qualification with dose rate = 10 mrad/sec. Radiation Lot Acceptance Testing is available - contact factory for details.

JG PACKAGE
(TOP VIEW)



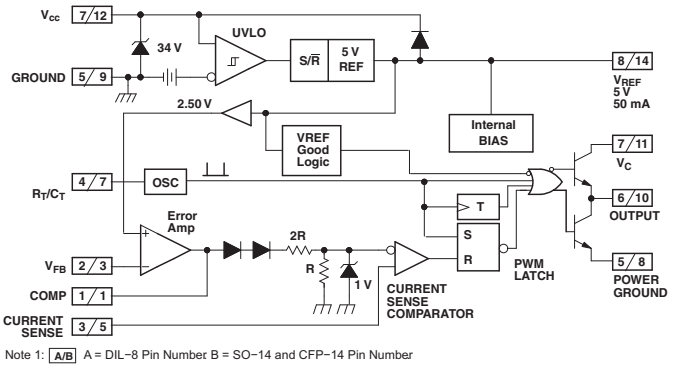
PLCC-20
Q PACKAGE
(TOP VIEW)



DESCRIPTION

The UC1843 family of control devices provides the necessary features to implement off-line or dc-to-dc fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include under-voltage lockout featuring start up current less than 1 mA, a precision reference trimmed for accuracy at the error amp input, logic to insure latched operation, a PWM comparator which also provides current limit control, and a totem pole output stage designed to source or sink high peak current. The output stage, suitable for driving N-Channel MOSFETs, is low in the off state. The under-voltage lockout threshold is 8.4 V and maximum duty cycle range is around 100%.

BLOCK DIAGRAM



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

ORDERING INFORMATION(1)

T_A	PACKAGE(2)	ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	KGD	5962-8670410V9A(3)	NA
	JG	5962-8670410VPA(3)	8670410VPA / UC1843-SP
	JG	5962-8670402VPA	8670402VPA / UC1843
	FK	5962-8670402VXA	5962-8670402VXA / UC1843LQMLV

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging
(3) Radiation tolerant version

BARE DIE INFORMATION

DIE THICKNESS	BACKSIDE FINISH	BACKSIDE POTENTIAL	BOND PAD METALLIZATION COMPOSITION
15 mils.	Silicon with backgrind	Insulated	AlCu (0.5%)

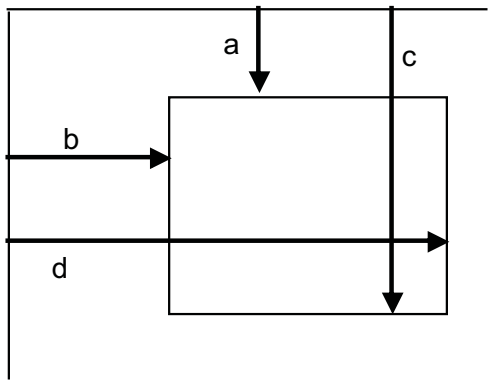
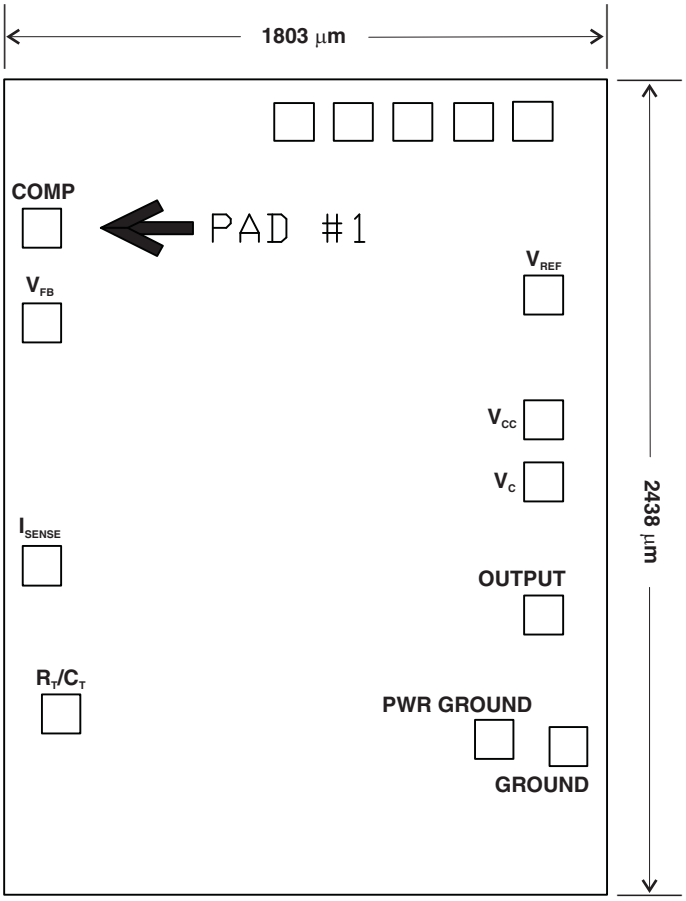


Table 1. BOND PAD COORDINATES (in Mils)

DESCRIPTION	PAD NUMBER	a	b	c	d
COMP	1	78.70	63.40	82.90	67.60
V_{FB}	2	70.60	63.40	74.80	67.60
I_{SENSE}	3	39.40	63.40	43.60	67.60
R_T/C_T	4	18.60	61.20	22.60	65.60
PWR GROUND	5	17.80	11.70	22.00	15.90
GROUND	6	17.40	3.90	21.80	8.10
OUTPUT	7	32.60	6.40	36.80	10.60
V_C	8	47.50	6.40	51.70	10.60
V_{CC}	9	54.60	6.40	58.80	10.60
V_{REF}	10	68.70	6.40	72.90	10.60
NC	TESTPAD	87.10	6.30	90.80	10.30
NC	TESTPAD	87.10	12.60	90.80	16.60
NC	TESTPAD	87.10	18.00	90.80	22.00
NC	TESTPAD	87.10	24.30	90.80	28.30
NC	TESTPAD	87.10	30.60	90.80	34.60



ABSOLUTE MAXIMUM RATINGS

		UNIT
Supply voltage	Low impedance source	30 V
	I_{CC} < 30 mA	Self Limiting
Output current		±1 A
Output energy (capacitive load)		5 μJ
Analog inputs (Pins 2, 3)		–0.3 V to 6.3 V
Error amp output sink current		10 mA
Storage temperature range		–65°C to 150°C
Junction temperature range		–55°C to 150°C

ELECTRICAL CHARACTERISTICS

Unless otherwise stated, these specifications apply for –55°C ≤ T_A ≤ 125°C; V_{CC} = 15 V(1); R_T = 10 kW; C_T = 3.3 nF,T_A = T_J.

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
REFERENCE SECTION						
Output Voltage(2)	T_J = 25°C, I_O = 1 mA	For SMD device option 10	4.94	5.00	5.06	V
		For SMD device option 02	4.95	5.00	5.05	
Line Regulation	12 V ≤ V_{IN} ≤ 25 V			6	20	mV
Load Regulation	1 mA ≤ I_O ≤ 20 mA			6	25	
Temperature Stability	See (3) (4)			0.2	0.4	mV/°C
Total Output Variation	Line, load, tempature (3)		4.9		5.1	V
Output Noise Voltage	10 Hz ≤ f ≤ 10 kHz, T_J = 25°C (3)			50		μV
Long Term Stability	T_A = 125°C, 1000 Hrs (3)			5	25	mV
Output Short Circuit			–30	–100	–180	mA
OSCILLATOR SECTION						
Initial Accuracy	T_J = 25°C(5)		47	52	57	kHz
Voltage Stability	12 V ≤ V_{CC} ≤ 25 V			0.2	1	%
Temperature Stability	T_{MIN} ≤ T_A ≤ T_{MAX} (3)					%
Amplitude	V_{PIN} 4 peak-to-peak (3)			1.7		V
ERROR AMP SECTION						
Input Voltage	$V_{PIN\ 1}$ = 2.5 V		2.45	2.50	2.55	V
Input Bias Current				–0.3	–1	μA
A_{VOL}	2 V ≤ V_O ≤ 4 V		65	90		dB
Unity Gain Bandwidth	T_J = 25°C (3)		0.7	1		MHz
PSRR	12 V ≤ V_{CC} ≤ 25 V		60	70		dB
Output Sink Current	$V_{PIN\ 2}$ = 2.7 V, $V_{PIN\ 1}$ = 1.1 V		2	6		mA
Output Source Current	$V_{PIN\ 2}$ = 2.3 V, $V_{PIN\ 1}$ = 5 V		–0.5	–0.8		
V_{OUT} High	$V_{PIN\ 2}$ = 2.3 V, R_L = 15 kΩ to ground		5	6		V
V_{OUT} Low	$V_{PIN\ 2}$ = 2.7 V, R_L = 15 kΩ to Pin 8			0.7	1.1	
CURRENT SENSE SECTION						
Gain	See (6) (7)		2.85	3	3.15	V/V
Maximum Input Signal	$V_{PIN\ 1}$ = 5 V (6)		0.9	1	1.1	V
PSRR	12 V ≤ V_{CC} ≤ 25 V (3) (6)			70		dB
Input Bias Current				–2	–10	μA
Delay to Output	$V_{PIN\ 3}$ = 0 V to 2 V (3)			150	300	ns
OUTPUT SECTION						
Output Low Level	I_{SINK} = 20 mA			0.1	0.4	V
	I_{SINK} = 200 mA			1.5	2.2	
Output High Level	I_{SOURCE} = 20 mA		13	13.5		
	I_{SOURCE} = 200 mA		12	13.5		

(1) Adjust V_{CC} above the start threshold before setting at 15 V.
(2) V_{REF} parameter is sensitive to very high temperature die attach/die assembly processes. Processing conditions should not exceed 170°C/24 hours or 245°C/40 seconds.
(3) These parameters, although specified, are not 100% tested in production.
(4) Temperature stability, sometimes referred to as average temperature coefficient, is described by the equation:

$$\text{Temp Stability} = \frac{V_{REF}(\max) - \text{VREF (min)}}{\text{TJ}(\max) - \text{TJ (min)}}$$

$V_{REF(max)}$ and $V_{REF(min)}$ are the maximum and minimum reference voltages measured over the appropriate temperature range. Note that the extremes in voltage do not necessarily occur at the extremes in temperature.
(5) Output frequency equals oscillator frequency.
(6) Parameter measured at trip point of latch with $V_{PIN\ 2}$ = 0.
(7) Gain defined as: $A = \frac{\Delta \text{VPIN 1}}{\Delta \text{VPIN 3}}, \ 0 \le \text{VPIN 3} \le 0.8 \text{ V}$

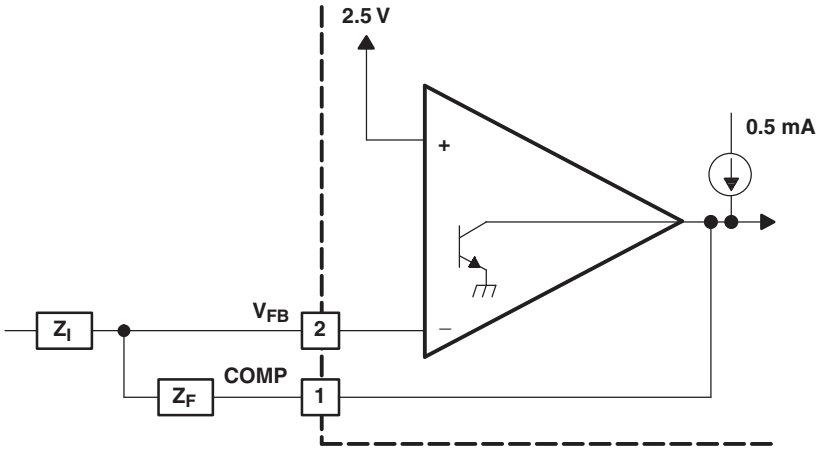
ELECTRICAL CHARACTERISTICS (continued)

Unless otherwise stated, these specifications apply for –55°C ≤ T_A ≤ 125°C; V_{CC} = 15 V (1); R_T = 10 kW; C_T = 3.3 nF,T_A = T_J.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Rise Time	T_J = 25°C, C_L = 1 nF (3)		50	150	ns
Fall Time	T_J = 25°C, C_L = 1 nF(3)		50	150	
UNDER-VOLTAGE LOCKOUT SECTION					
Start Threshold		7.8	8.4	9.0	V
Min. Operating Voltage After Turn On		7.0	7.6	8.2	
PWM SECTION					
Maximum Duty Cycle	For SMD device option 10	94	97	100	%
	For SMD device option 02	93	97	100	%
Minimum Duty Cycle				0	%
TOTAL STANDBY CURRENT					
Start-Up Current			0.5	1	mA
Operating Supply Current	$V_{PIN\ 2}$ = $V_{PIN\ 3}$ = 0 V		11	17	
V_{CC} Zener Voltager	I_{CC} = 25 mA	30	34		V

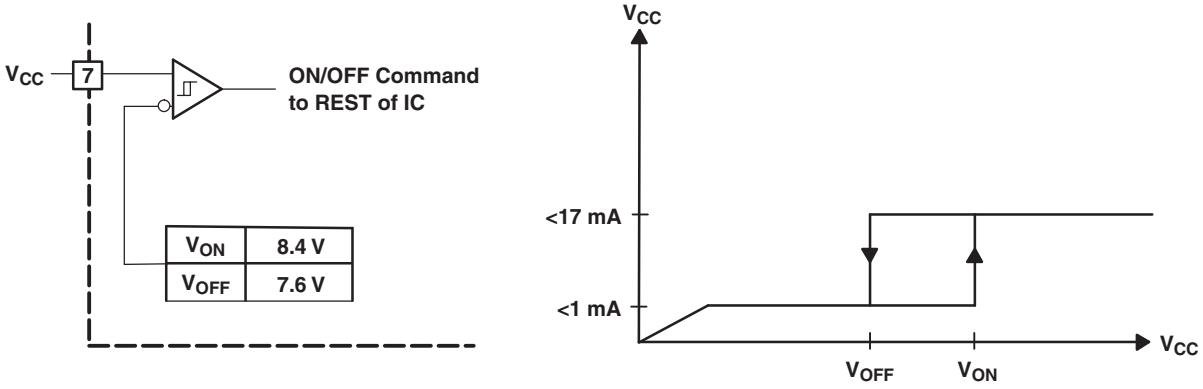
ERROR AMP CONFIGURATION

Error amp can source or sink up to 0.5 mA.



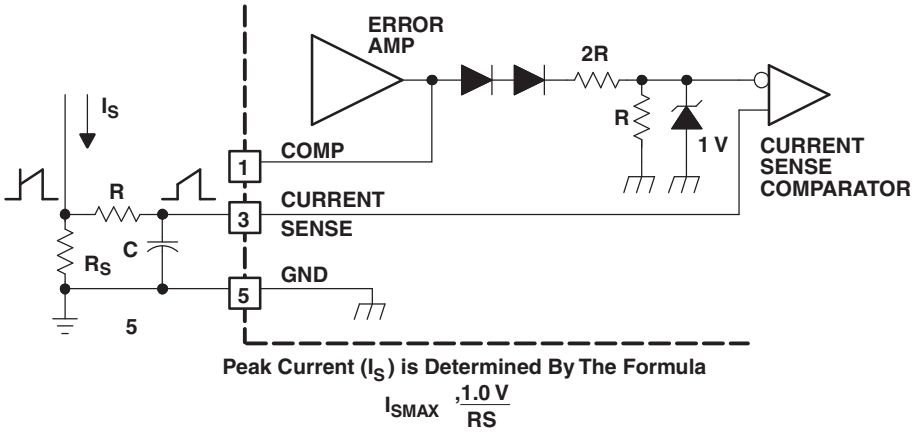
UNDER-VOLTAGE LOCKOUT

During under-voltage lock-out, the output drive is biased to sink minor amounts of current. Pin 6 should be shunted to ground with a bleeder resistor to prevent activating the power switch with extraneous leakage currents.

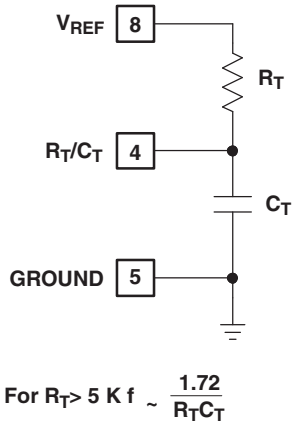


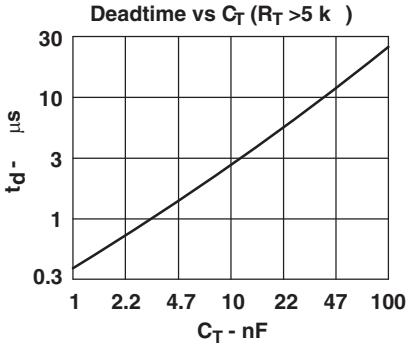
CURRENT SENSE CIRCUIT

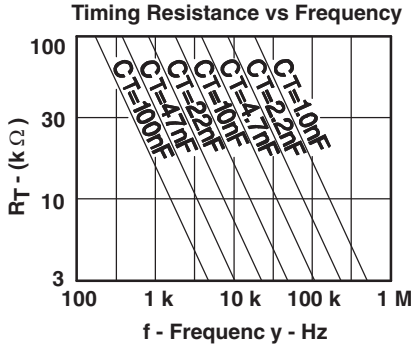
A small RC filter may be required to suppress switch transients.



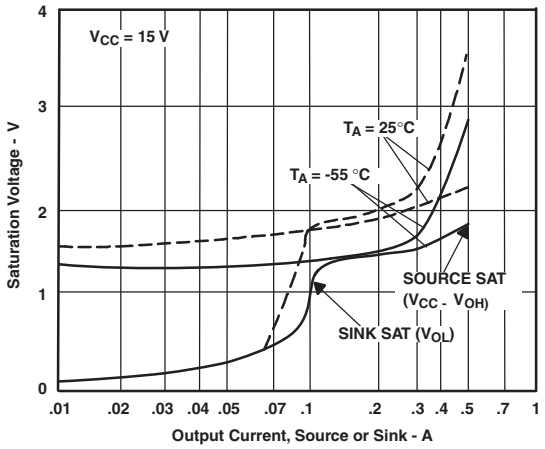
OSCILLATOR SECTION



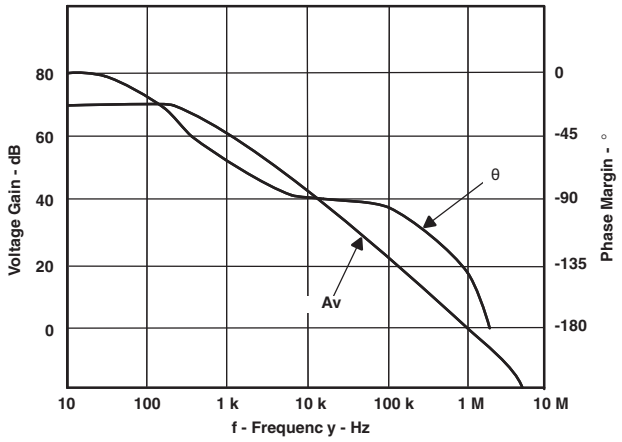




OUTPUT SATURATION CHARACTERISTICS

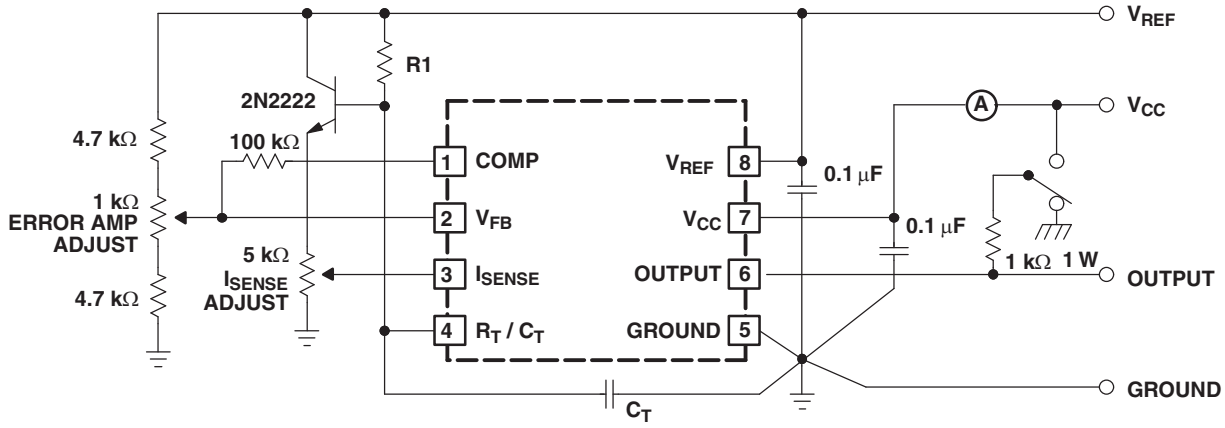


ERROR AMPLIFIER OPEN-LOOP FREQUENCY RESPONSE



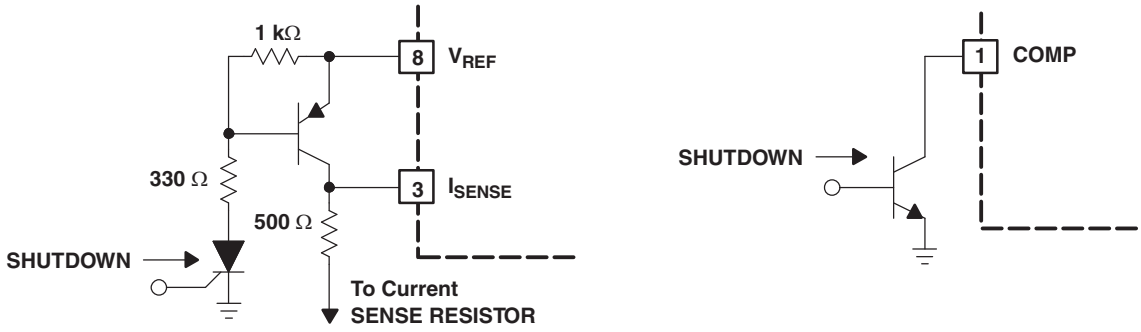
OPEN-LOOP LABORATORY FIXTURE

High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypas capacitors should be conected close to pin 5 in a single point ground. The transistor and 5k potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

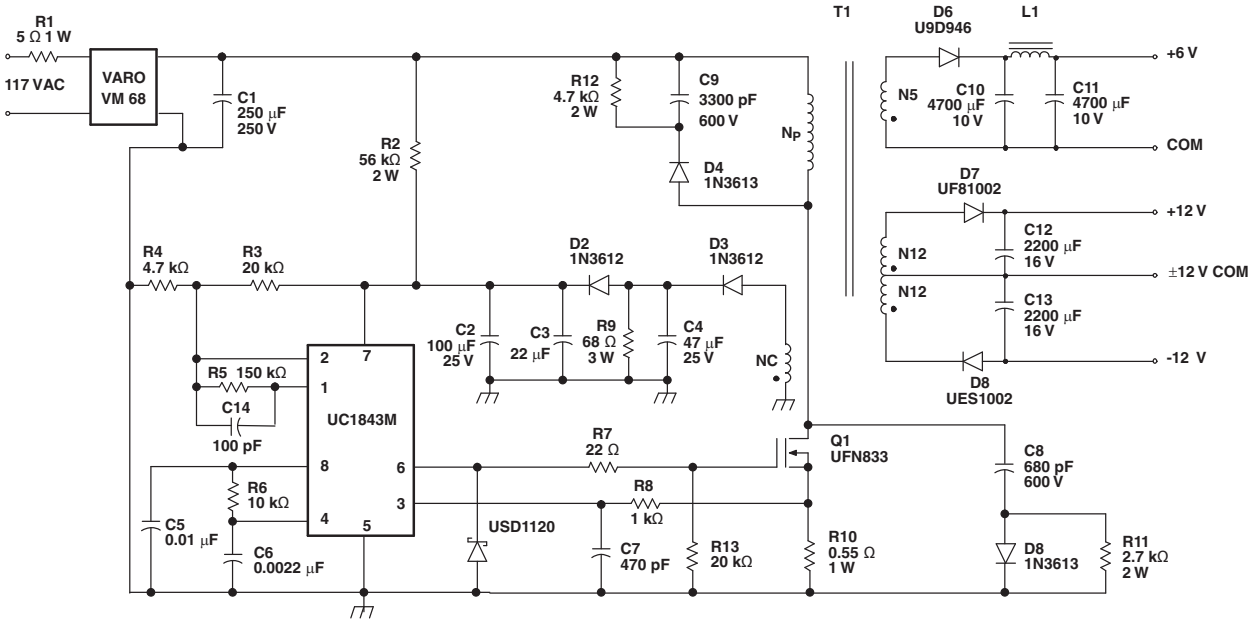


SHUTDOWN TECHNIQUES

Shutdown of the UC1843 can be accomplished by two methods; either raise pin 3 above 1 V or pull pin 1 below a voltage two diode drops above ground. Either method causses the output of the PWM comparator to be high (refer to block diagram). The PWM latch is reset dominant so that the output will remain low until the next clock cycle after the shutdown condition at pin 1 and/or 3 is removed. In one example, an externally latched shutdown may be accomplished by adding an SCR which will be reset by cycling V_{CC} below the lower UVLO threshold. At this pint the reference turns off, allowing the SCR to reset.



OFFLINE FLYBACK REGULATOR

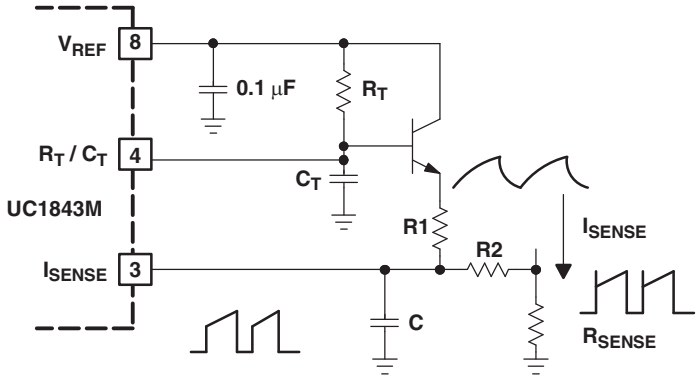


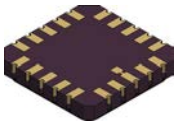
Power Supply Specifications

1. Input Voltages
   (a) 5VAC to 130VA (50 Hz/60 Hz)
2. Line Isolation: 3750 V
3. Switchng Frequency: 40 kHz
4. Efficiency at Full Load 70%
5. Output Voltage:
   (a) +5 V, ±5%; 1A to 4A load
   Ripple voltage: 50 mV P-P Max
   (b) +12 V, ±3%; 0.1A to 0.3A load
   Ripple voltage: 100 mV P-P Max
   (c) –12 V, ±3%; 0.1A to 0.3A load
   Ripple voltage: 100 mV P-P Max

SLOPE COMPENSATION

A fraction of the oscillator ramp can be resistively summed with the current sense signal to provide slope compensation for converters requiring duty cycles over 50%.



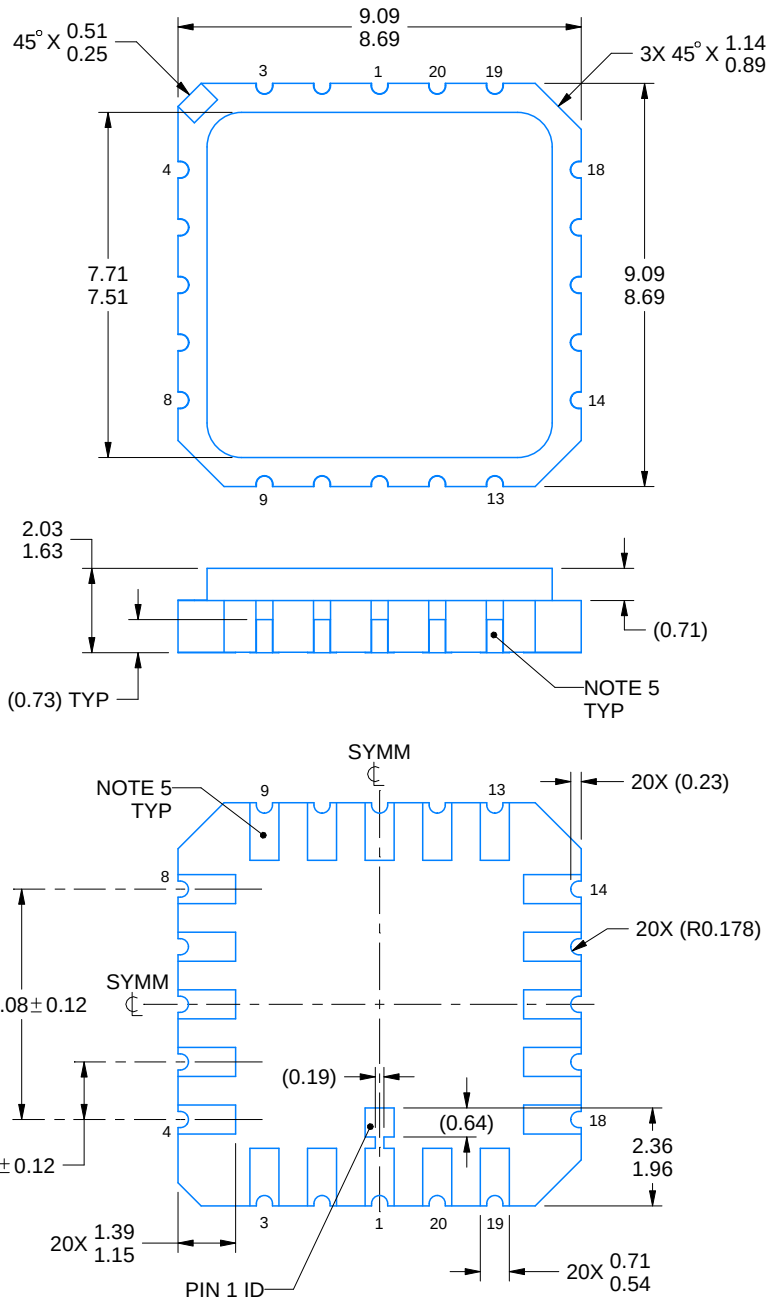


PACKAGE OUTLINE

FK0020A

LCCC - 2.03 mm max height

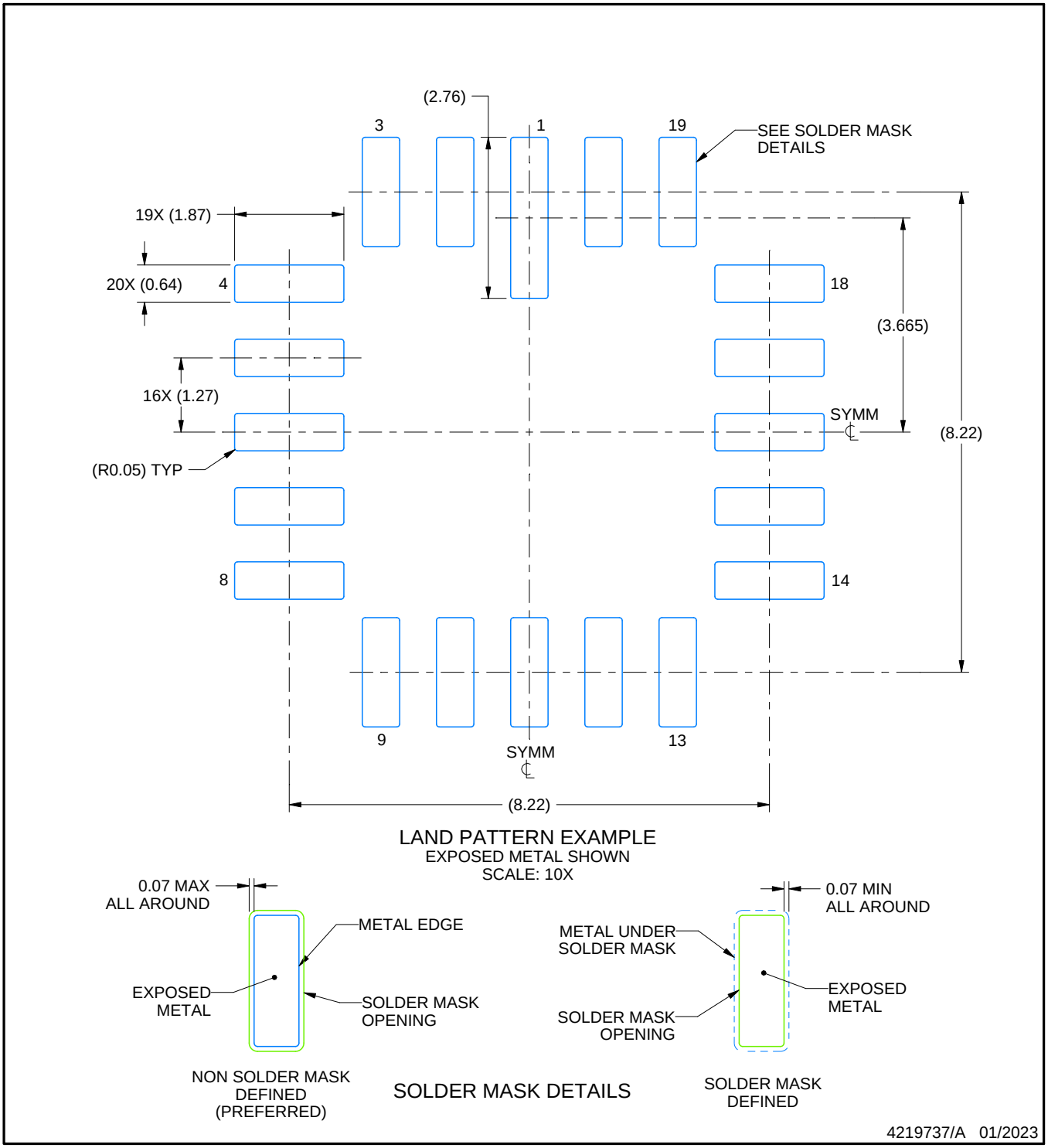
LEADLESS CERAMIC CHIP CARRIER



4219737/A 01/2023

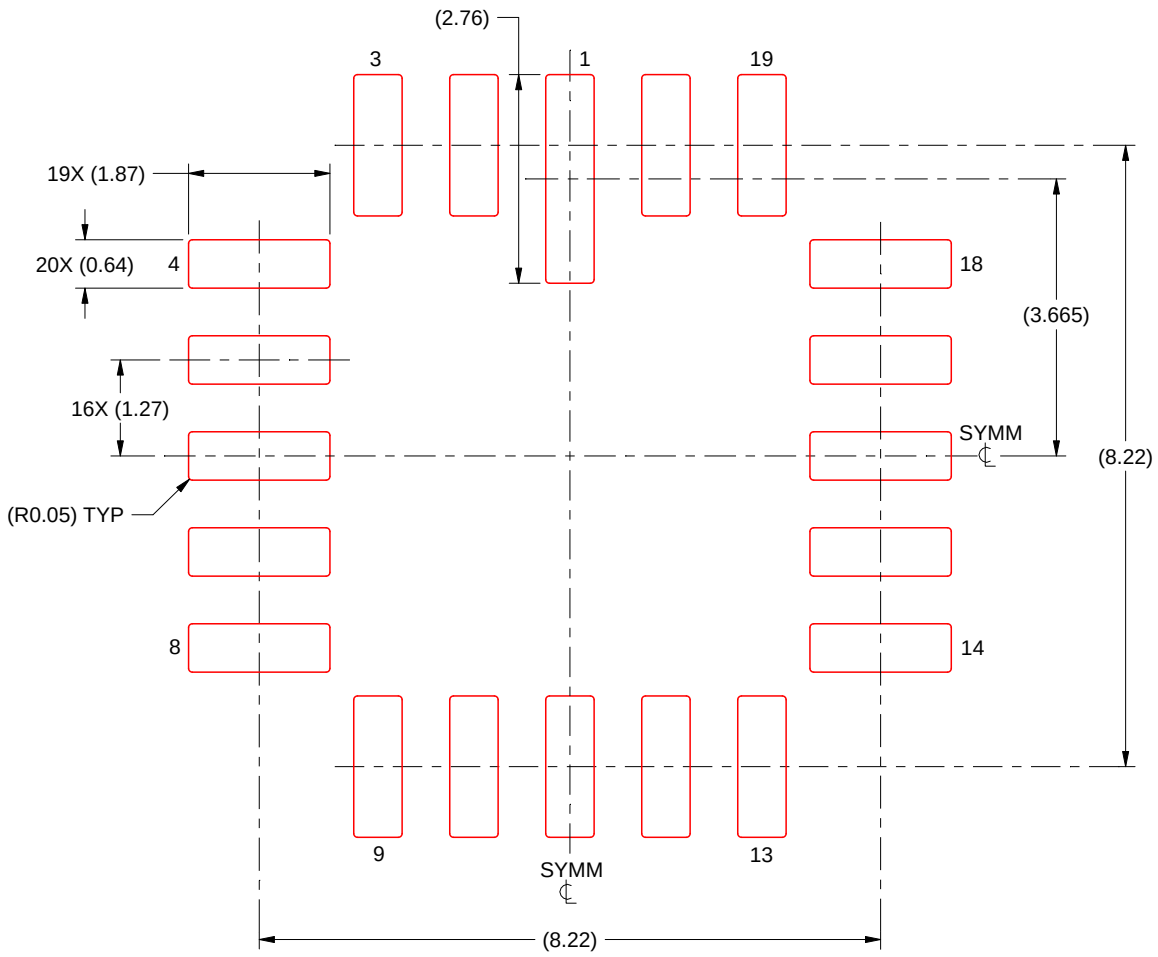
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package can be hermetically sealed with a metal lid.
4. Reference JEDEC Registration MS-004.
5. The terminals are gold-plated.



NOTES: (continued)

6. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm TICK STENCIL
SCALE: 10X

4219737/A 01/2023

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-8670402VPA	ACTIVE	CDIP	JG	8	50	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	8670402VPA UC1843	Samples
5962-8670402VXA	ACTIVE	LCCC	FK	20	55	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8670402VXA UC1843L QMLV	Samples
5962-8670410V9A	ACTIVE	XCEPT	KGD	0	100	RoHS & Green	Call TI	N / A for Pkg Type	0 to 0		Samples
5962-8670410VPA	ACTIVE	CDIP	JG	8	50	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	8670410VPA UC1843-SP	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

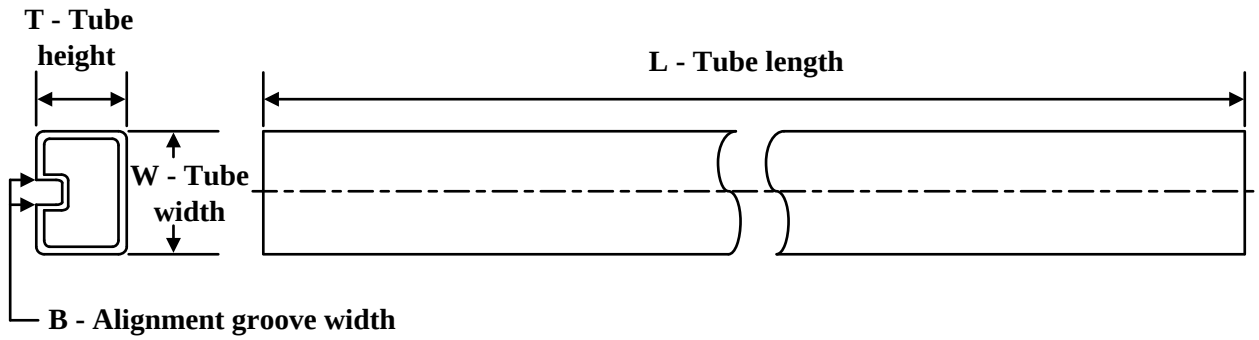
OTHER QUALIFIED VERSIONS OF UC1843-SP :

- Catalog : UC1843

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

TUBE



*All dimensions are nominal

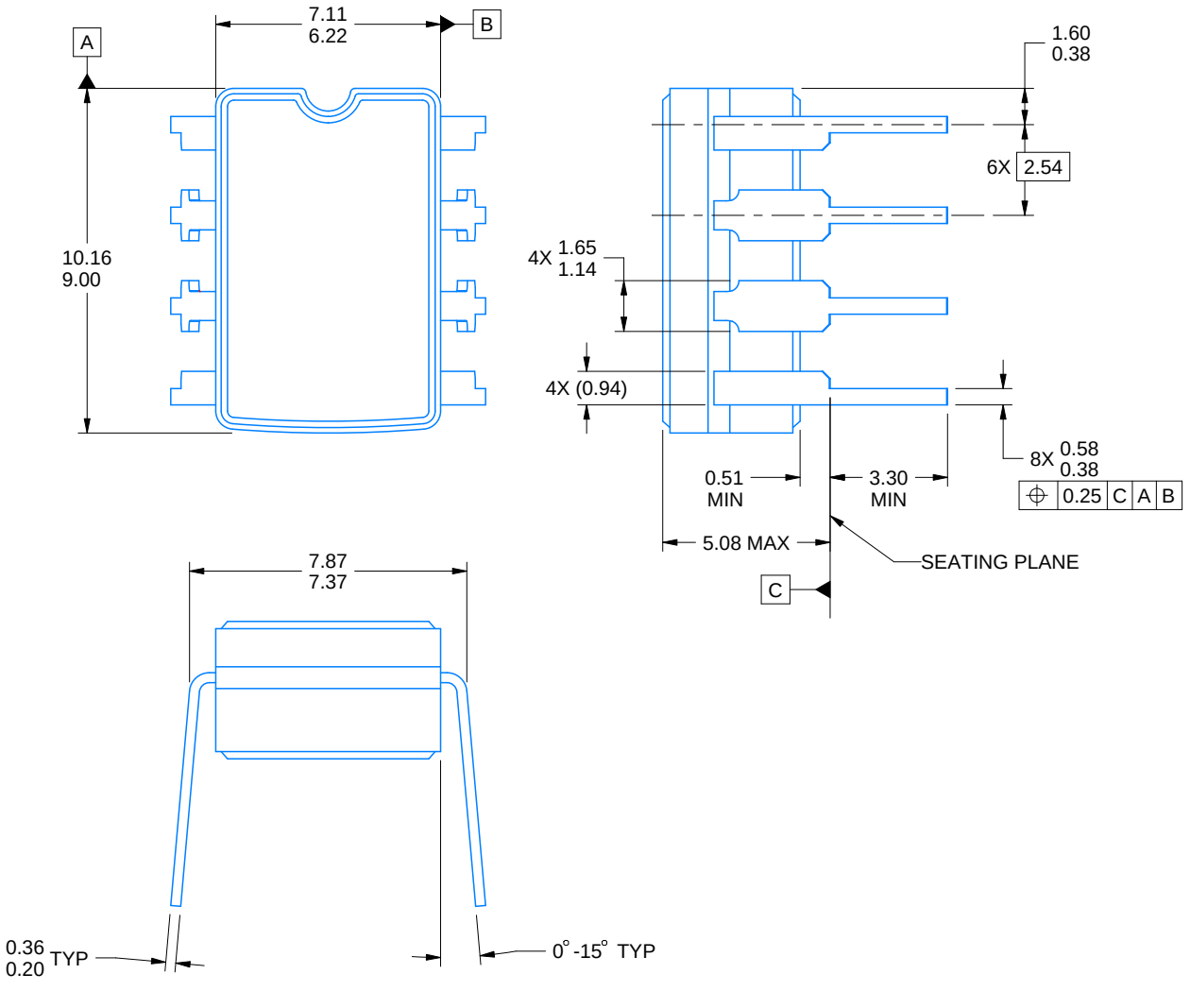
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-8670402VXA	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-8670410VPA	JG	CDIP	8	50	506.98	15.24	13440	NA

PACKAGE OUTLINE

JG0008A

CDIP - 5.08 mm max height

CERAMIC DUAL IN-LINE PACKAGE



4230036/A 09/2023

NOTES:

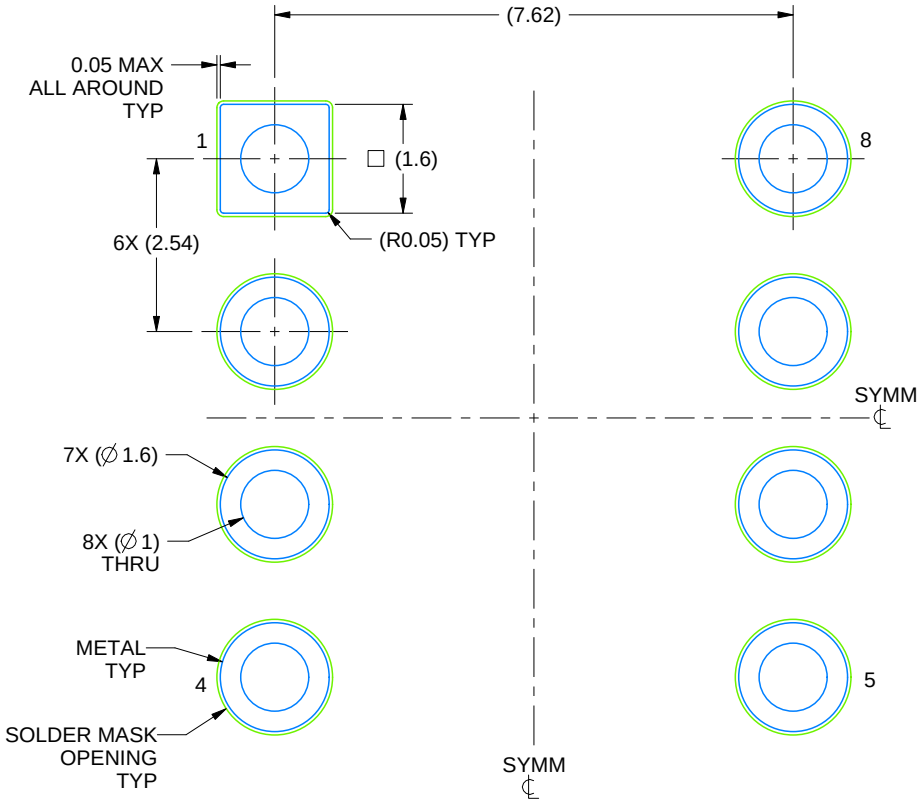
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package can be hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification.
5. Falls within MIL STD 1835 GDIP1-T8

EXAMPLE BOARD LAYOUT

JG0008A

CDIP - 5.08 mm max height

CERAMIC DUAL IN-LINE PACKAGE



LAND PATTERN EXAMPLE
NON SOLDER MASK DEFINED
SCALE: 9X

4230036/A 09/2023

GENERIC PACKAGE VIEW

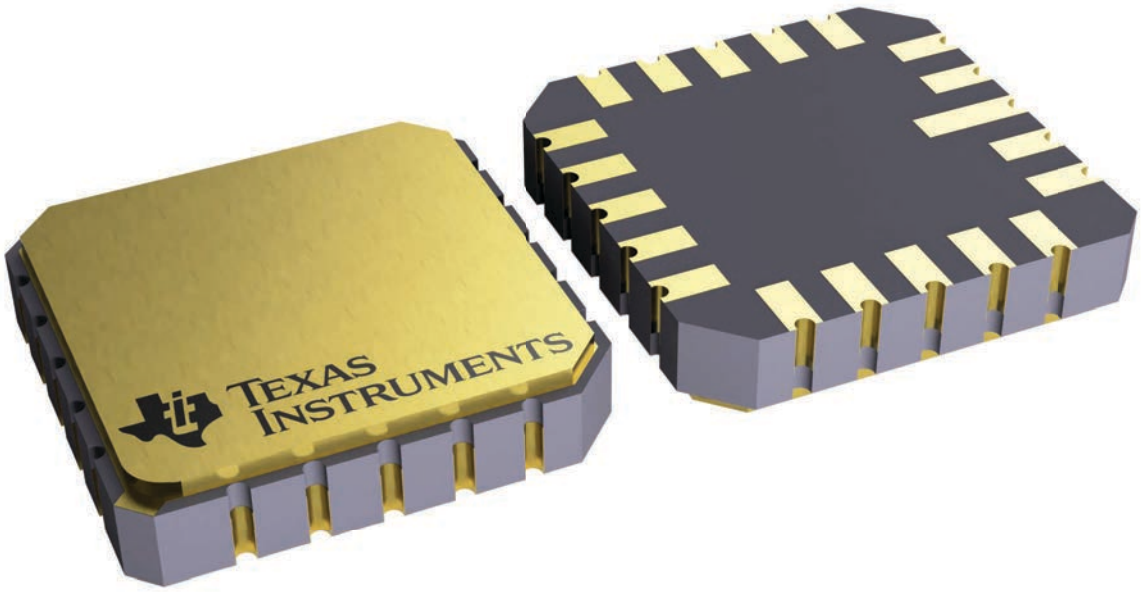
FK 20

LCCC - 2.03 mm max height

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



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