

High Speed PWM Controller

FEATURES

- Compatible with Voltage or Current Mode Topologies
- Practical Operation Switching Frequencies to 1MHz
- 50ns Propagation Delay to Output
- High Current Dual Totem Pole Outputs (1.5A Peak)
- Wide Bandwidth Error Amplifier
- Fully Latched Logic with Double Pulse Suppression
- Pulse-by-Pulse Current Limiting
- Soft Start / Max. Duty Cycle Control
- Under-Voltage Lockout with Hysteresis
- Low Start Up Current (1.1mA)

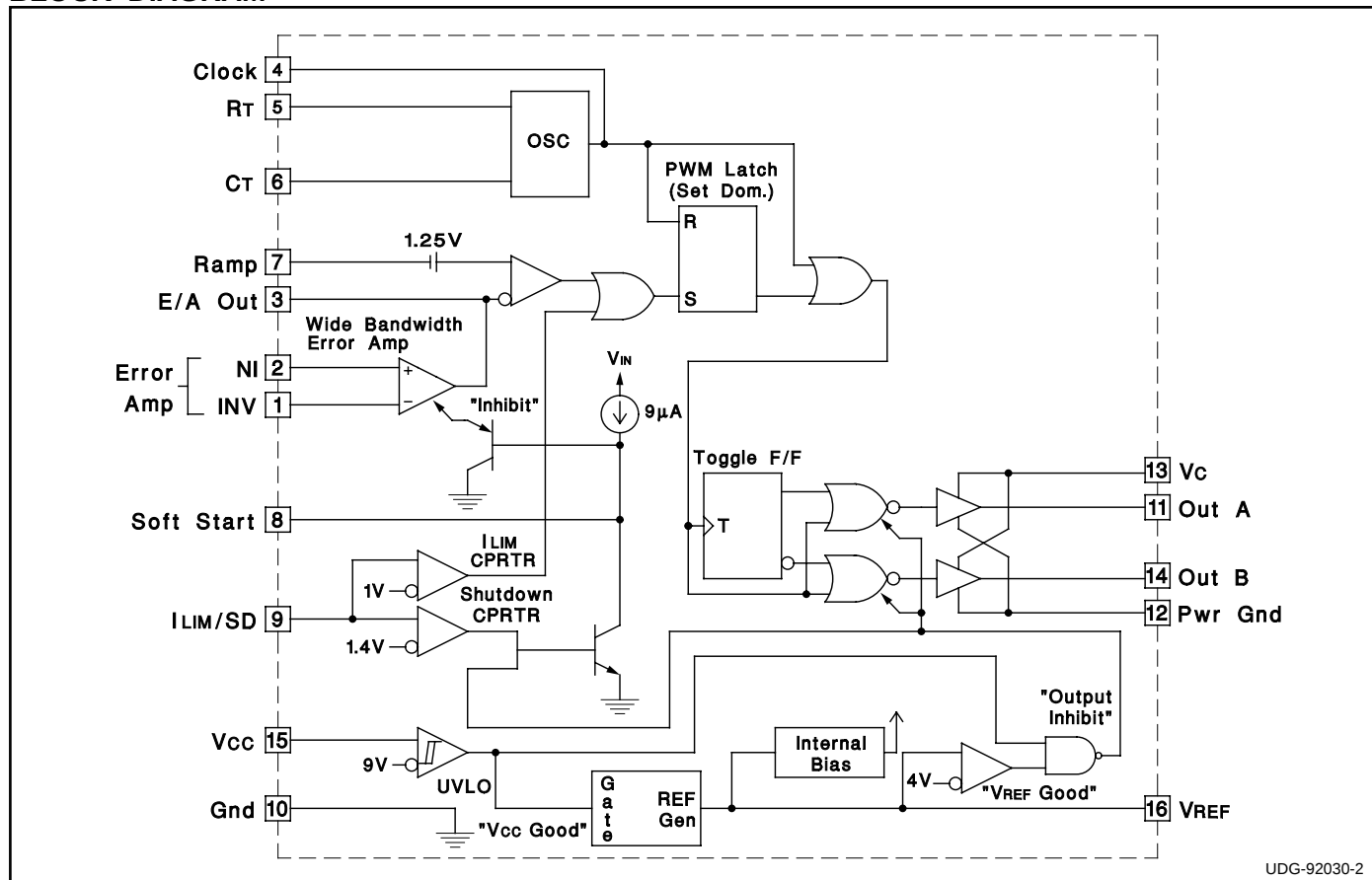
DESCRIPTION

The UC1825 family of PWM control ICs is optimized for high frequency switched mode power supply applications. Particular care was given to minimizing propagation delays through the comparators and logic circuitry while maximizing bandwidth and slew rate of the error amplifier. This controller is designed for use in either current-mode or voltage mode systems with the capability for input voltage feed-forward.

Protection circuitry includes a current limit comparator with a 1V threshold, a TTL compatible shutdown port, and a soft start pin which will double as a maximum duty cycle clamp. The logic is fully latched to provide jitter free operation and prohibit multiple pulses at an output. An under-voltage lockout section with 800mV of hysteresis assures low start up current. During under-voltage lockout, the outputs are high impedance.

These devices feature totem pole outputs designed to source and sink high peak currents from capacitive loads, such as the gate of a power MOSFET. The on state is designed as a high level.

BLOCK DIAGRAM



UDG-92030-2

ABSOLUTE MAXIMUM RATINGS (Note 1)

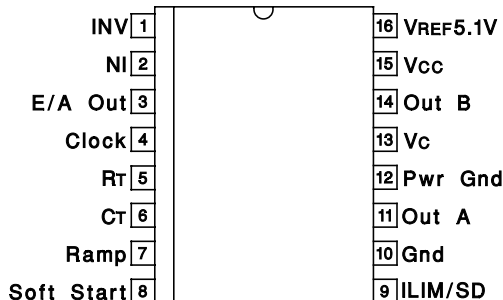
Supply Voltage (Pins 13, 15)	30V
Output Current, Source or Sink (Pins 11, 14)	
DC	0.5A
Pulse (0.5 s)	2.0A
Analog Inputs	
(Pins 1, 2, 7)	-0.3V to 7V
(Pin 8, 9)	-0.3V to 6V
Clock Output Current (Pin 4)	-5mA
Error Amplifier Output Current (Pin 3)	5mA
Soft Start Sink Current (Pin 8)	20mA
Oscillator Charging Current (Pin 5)	-5mA
Power Dissipation	1W
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Note 1: All voltages are with respect to GND (Pin 10); all currents are positive into, negative out of part; pin numbers refer to DIL-16 package.

Note 3: Consult Unitrode Integrated Circuit Databook for thermal limitations and considerations of package.

SOIC-16 (Top View)

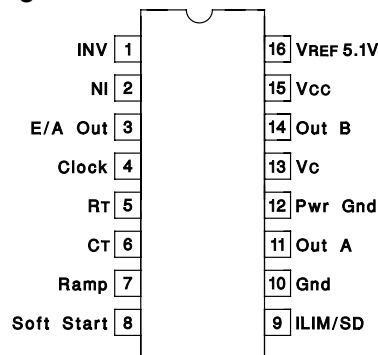
DW Package



CONNECTION DIAGRAMS

DIL-16 (Top View)

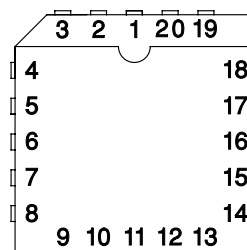
J or N Package



PLCC-20 & LCC-20

(Top View)

Q & L Packages



PACKAGE PIN FUNCTION

FUNCTION	PIN
N/C	1
INV	2
NI	3
E/A Out	4
Clock	5
N/C	6
RT	7
CT	8
Ramp	9
Soft Start	10
N/C	11
ILIM/SD	12
Gnd	13
Out A	14
Pwr Gnd	15
N/C	16
Vc	17
Out B	18
Vcc	19
VREF 5.1V	20

THERMAL RATINGS TABLE

Package	Θ_{JA}	Θ_{JC}
DIL-16J	80-120	28 ⁽²⁾
DIL-16N	90 ⁽¹⁾	45
PLCC-20	43-75(1)	34
LCC-20	70-80	20 ⁽²⁾
SOIC-16	50-120 ⁽¹⁾	35

(1) Specified Θ_{JA} (junction to ambient) is for devices mounted to 5in² FR4 PC board with one ounce copper where noted. When resistance range is given, lower values are for 5in² aluminum PC board. Test PWB was 0.062in thick and typically used 0.635mm trace widths for power packages and 1.3mm trace widths for non-power packages with 100 x 100 mil probe land area at the end of each trace.

(2) Θ_{JC} data values stated were derived from MIL-STD-1835B. MIL-STD-1835B states that the baseline values shown are worst case (mean +2s) for a 60 x 60mil microcircuit device silicon die and applicable for devices with die sizes up to 14400 square mils. For device die sizes greater than 14400 square mils use the following values; dual-in-line, 11°C/W; flat pack 10°C/W; pin grid array, 10°C/W.

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for , $R_T = 3.65k$, $C_T = 1nF$, $V_{CC} = 15V$, $-55^{\circ}C < T_A < 125^{\circ}C$ for the UC1825, $-40^{\circ}C < T_A < 85^{\circ}C$ for the UC2825, and $0^{\circ}C < T_A < 70^{\circ}C$ for the UC3825, $T_A = T_O$.

PARAMETERS	TEST CONDITIONS	UC1825 UC2825			UC3825			UNITS
		MIN	TOP	MAX	MIN	TOP	MAX	
Reference Section								
Output Voltage	To = 25°C, Io = 1mA	5.05	5.10	5.15	5.00	5.10	5.20	V
Line Regulation	10V < Vcc < 30V		2	20		2	20	mV
Load Regulation	1mA < Io < 10mA		5	20		5	20	mV
Temperature Stability*	TMIN < TA < TMAX		0.2	0.4		0.2	0.4	mV/°C
Total Output Variation*	Line, Load, Temperature	5.00		5.20	4.95		5.25	V
Output Noise Voltage*	10Hz < f < 10kHz		50			50		µV
Long Term Stability*	TJ = 125°C, 1000hrs.		5	25		5	25	mV
Short Circuit Current	VREF = 0V	-15	-50	-100	-15	-50	-100	mA
Oscillator Section								
Initial Accuracy*	TJ = 2°C	360	400	440	360	400	440	kHz
Voltage Stability*	10V < Vcc < 30V		0.2	2		0.2	2	%
Temperature Stability*	TMIN < TA < TMAX		5			5		%
Total Variation*	Line, Temperature	340		460	340		460	kHz
Oscillator Section (cont.)								
Clock Out High		3.9	4.5		3.9	4.5		V
Clock Out Low			2.3	2.9		2.3	2.9	V
Ramp Peak*		2.6	2.8	3.0	2.6	2.8	3.0	V
Ramp Valley*		0.7	1.0	1.25	0.7	1.0	1.25	V
Ramp Valley to Peak*		1.6	1.8	2.0	1.6	1.8	2.0	V
Error Amplifier Section								
Input Offset Voltage				10			15	mV
Input Bias Current			0.6	3		0.6	3	µA
Input Offset Current			0.1	1		0.1	1	µA
Open Loop Gain	1V < Vo < 4V	60	95		60	95		dB
CMRR	1.5V < VCM < 5.5V	75	95		75	95		dB
PSRR	10V < Vcc < 30V	85	110		85	110		dB
Output Sink Current	VPIN 3 = 1V	1	2.5		1	2.5		mA
Output Source Current	VPIN 3 = 4V	-0.5	-1.3		-0.5	-1.3		mA
Output High Voltage	IPIN 3 = -0.5mA	4.0	4.7	5.0	4.0	4.7	5.0	V
Output Low Voltage	IPIN 3 = 1mA	0	0.5	1.0	0	0.5	1.0	V
Unity Gain Bandwidth*		3	5.5		3	5.5		MHz
Slew Rate*		6	12		6	12		V/µs

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for , $R_T = 3.65k$, $C_T = 1nF$, $V_{CC} = 15V$, $-55^{\circ}C < T_A < 125^{\circ}C$ for the UC1825, $-40^{\circ}C < T_A < 85^{\circ}C$ for the UC2825, and $0^{\circ}C < T_A < 70^{\circ}C$ for the UC3825, $T_A = T_J$.

PARAMETERS	TEST CONDITIONS	UC1825 UC2825			UC3825			UNITS
		MIN	TOP	MAX	MIN	TOP	MAX	
PWM Comparator Section								
Pin 7 Bias Current	V _{PIN 7} = 0V		-1	-5		-1	-5	μA
Duty Cycle Range		0		80	0		85	%
Pin 3 Zero DC Threshold	V _{PIN 7} = 0V	1.1	1.25		1.1	1.25		V
Delay to Output*			50	80		50	80	ns
Soft-Start Section								
Charge Current	V _{PIN 8} = 0.5V	3	9	20	3	9	20	μA
Discharge Current	V _{PIN 8} = 1V	1			1			mA
Current Limit / Shutdown Section								
Pin 9 Bias Current	0 < V _{PIN 9} < 4V			15			10	μA
Current Limit Threshold		0.9	1.0	1.1	0.9	1.0	1.1	V
Shutdown Threshold		1.25	1.40	1.55	1.25	1.40	1.55	V
Delay to Output			50	80		50	80	ns
Output Section								
Output Low Level	I _{OUT} = 20mA		0.25	0.40		0.25	0.40	V
	I _{OUT} = 200mA		1.2	2.2		1.2	2.2	V
Output High Level	I _{OUT} = -20mA	13.0	13.5		13.0	13.5		V
	I _{OUT} = -200mA	12.0	13.0		12.0	13.0		V
Collector Leakage	V _C = 30V		100	500		10	500	μA
Rise/Fall Time*	CL = 1nF		30	60		30	60	ns
Under-Voltage Lockout Section								
Start Threshold		8.8	9.2	9.6	8.8	9.2	9.6	V
UVLO Hysteresis		0.4	0.8	1.2	0.4	0.8	1.2	V
Supply Current Section								
Start Up Current	V _{CC} = 8V		1.1	2.5		1.1	2.5	mA
ICC	V _{PIN 1} , V _{PIN 7} , V _{PIN 9} = 0V: V _{PIN 2} = 1V		22	33		22	33	mA

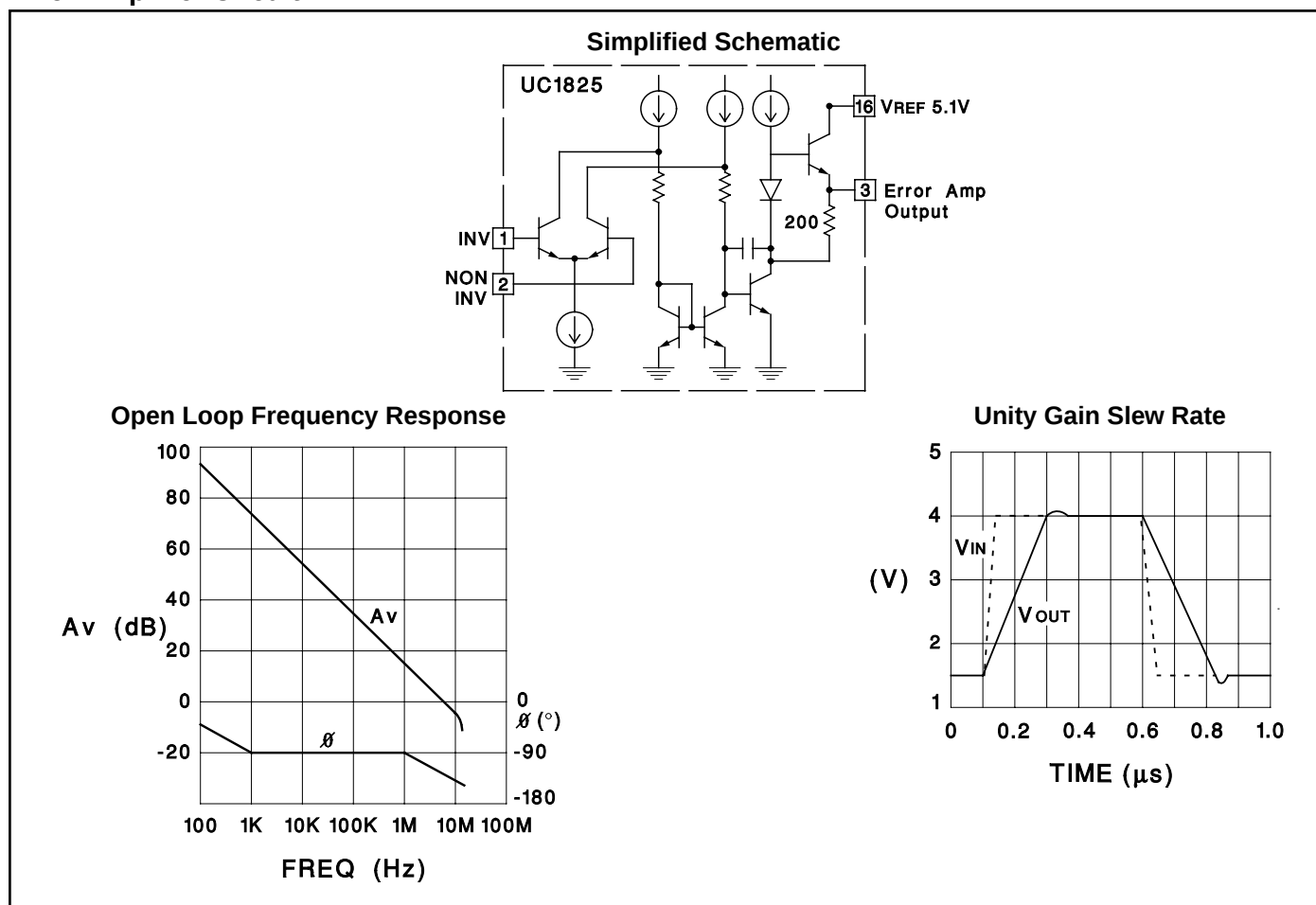
* This parameter not 100% tested in production but guaranteed by design.

Printed Circuit Board Layout Considerations

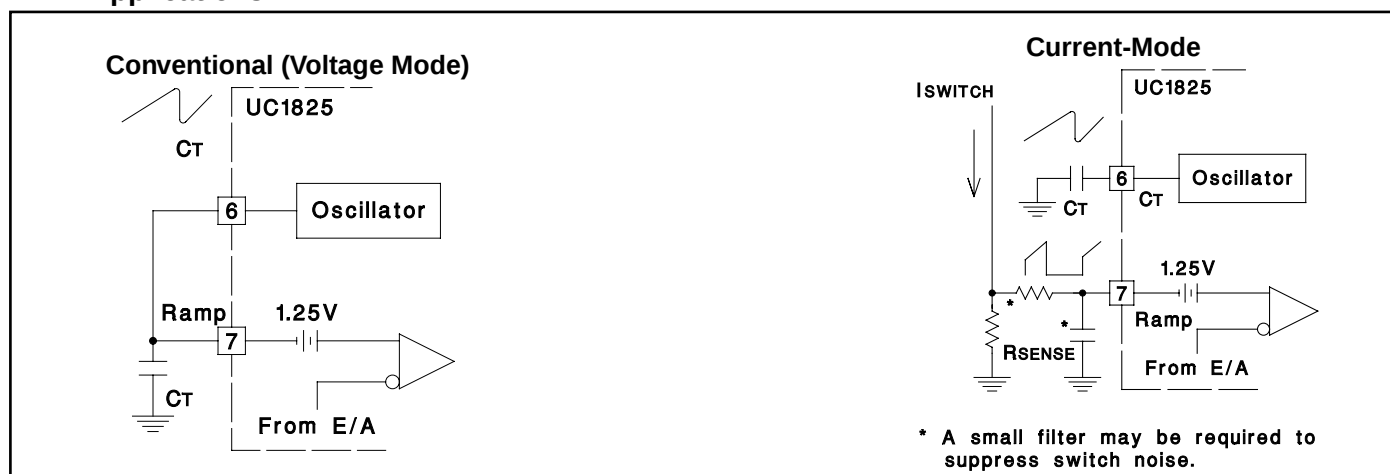
High speed circuits demand careful attention to layout and component placement. To assure proper performance of the UC1825 follow these rules: 1) Use a ground plane. 2) Damp or clamp parasitic inductive kick energy from the gate of driven MOSFETs. Do not allow the output pins to ring below ground. A series gate resistor or a shunt 1 Amp Schottky diode at the output pin will serve

this purpose. 3) Bypass VCC, V_C, and V_{REF}. Use 0.1μF monolithic ceramic capacitors with low equivalent series inductance. Allow less than 1 cm of total lead length for each capacitor between the bypassed pin and the ground plane. 4) Treat the timing capacitor, C_T, like a bypass capacitor.

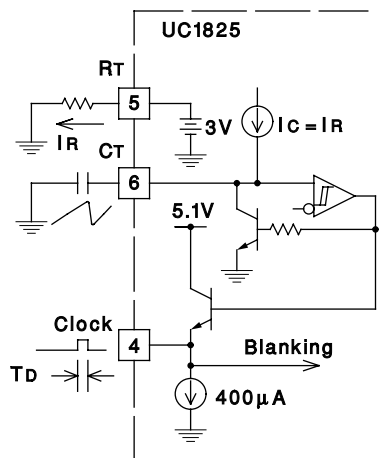
Error Amplifier Circuit



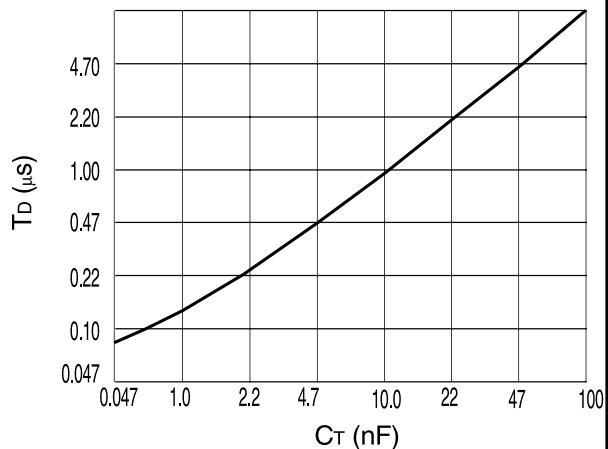
PWM Applications



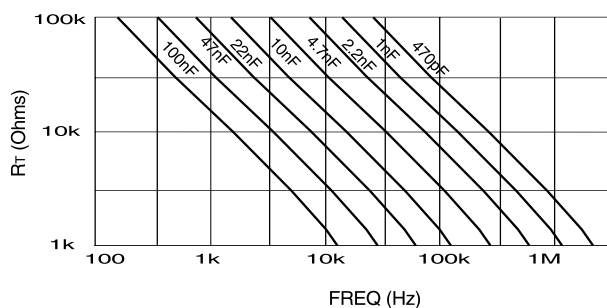
Oscillator Circuit



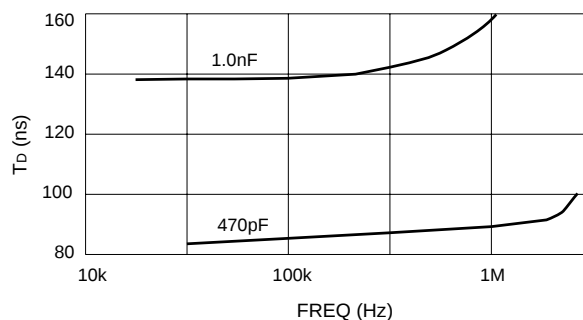
Deadtime vs C_T (3k R_T 100k)



Timing Resistance vs Frequency

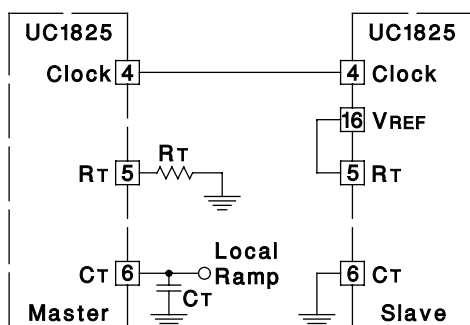


Deadtime vs Frequency

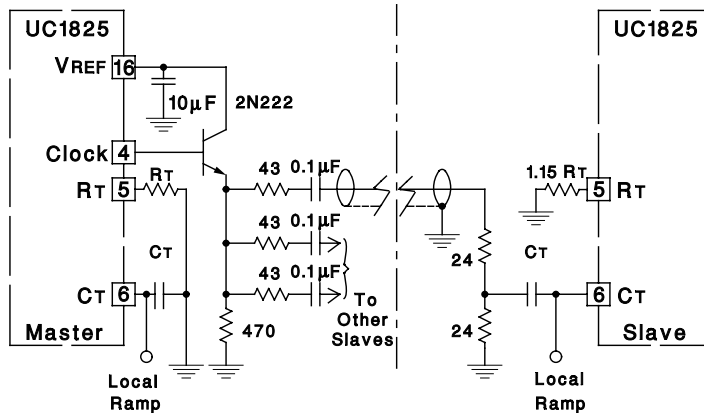


Synchronized Operation

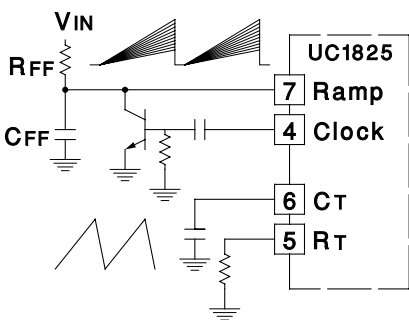
Two Units in Close Proximity



Generalized Synchronization

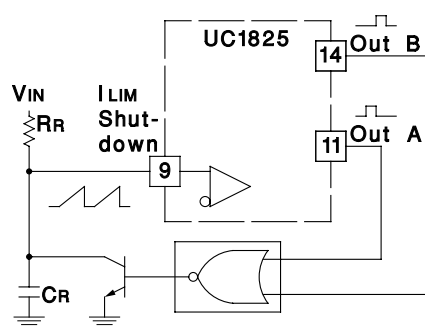


Forward Technique for Off-Line Voltage Mode Application



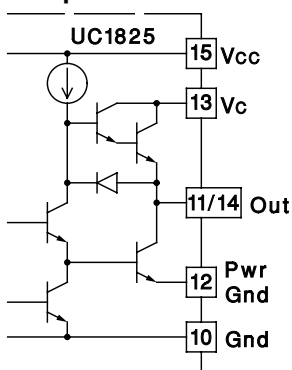
Constant Volt-Second Clamp Circuit

The circuit shown here will achieve a constant volt-second product clamp over varying input voltages. The ramp generator components, R_T and C_T are chosen so that the ramp at Pin 9 crosses the 1V threshold at the same time the desired maximum volt-second product is reached. The delay through the functional nor block must be such that the ramp capacitor can be completely discharged during the minimum deadtime.

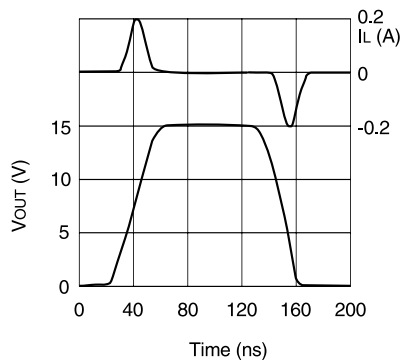


Output Section

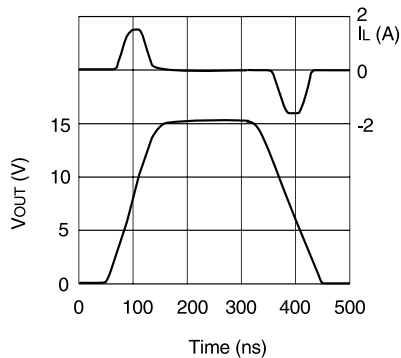
Simplified Schematic



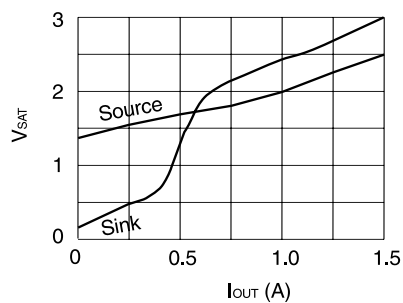
Rise/Fall Time ($C_L=1nF$)



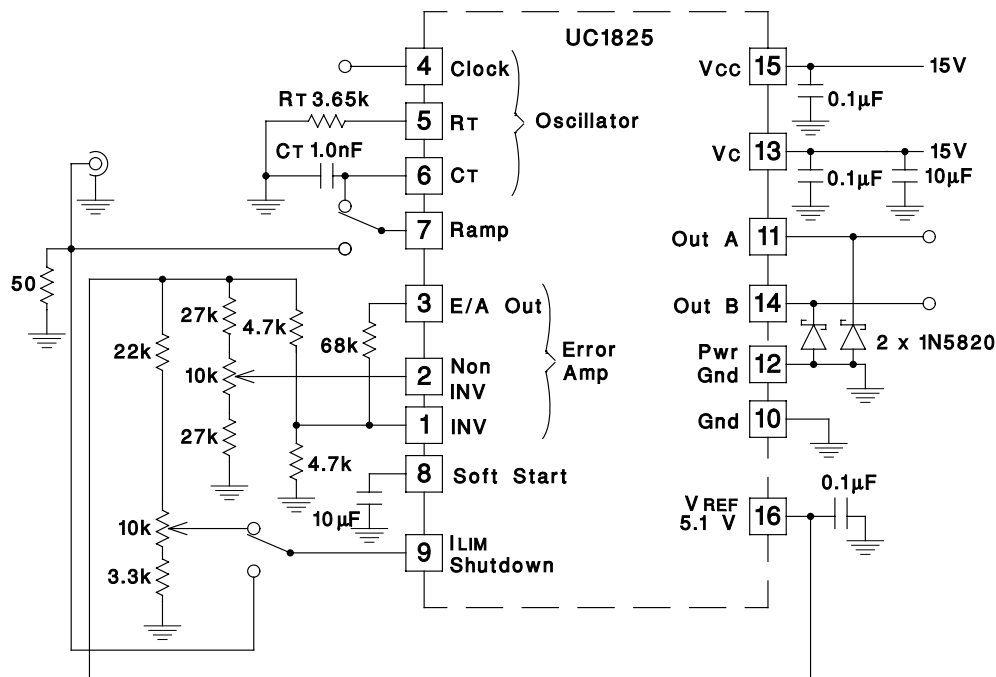
Rise/Fall Time ($C_L=10nF$)



Saturation Curves



Open Loop Laboratory Test Fixture

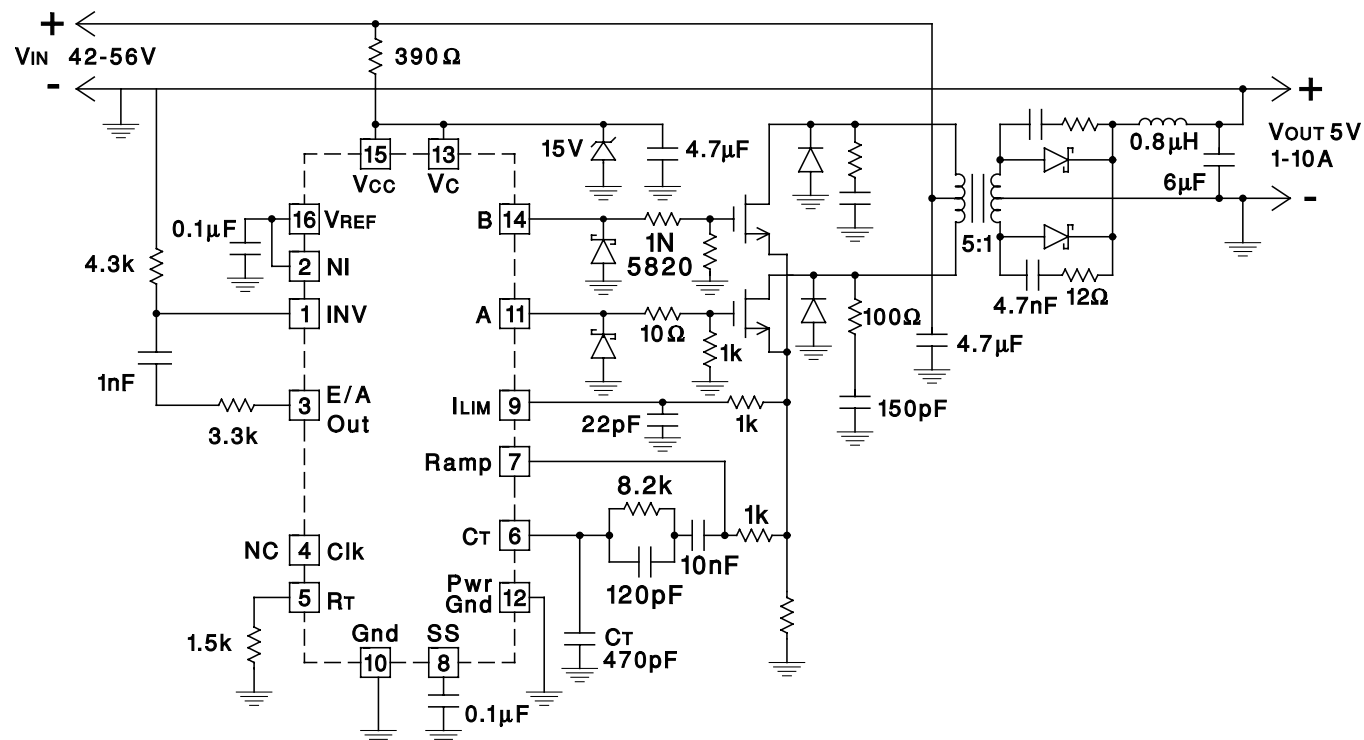


UDG-92032-2

This test fixture is useful for exercising many of the UC1825's functions and measuring their specifications.

As with any wideband circuit, careful grounding and bypass procedures should be followed. The use of a ground plane is highly recommended.

Design Example: 50W, 48V to 5V DC to DC Converter - 1.5MHz Clock Frequency



UDG-92033-3

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-87681012A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 87681012A UC1825L/ 883B	Samples
5962-8768101EA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8768101EA UC1825J/883B	Samples
5962-8768101QFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8768101QF A UC1825W/883B	Samples
UC1825J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	UC1825J	Samples
UC1825J883B	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8768101EA UC1825J/883B	Samples
UC1825L	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	UC1825L	Samples
UC1825L883B	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 87681012A UC1825L/ 883B	Samples
UC1825W883B	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8768101QF A UC1825W/883B	Samples
UC2825DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2825DW	Samples
UC2825DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2825DW	Samples
UC2825DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2825DW	Samples
UC2825DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	UC2825DW	Samples
UC2825J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-40 to 85	UC2825J	Samples
UC2825N	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	-40 to 85	UC2825N	Samples
UC2825NG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	-40 to 85	UC2825N	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
UC2825Q	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 85	UC2825Q	Samples
UC2825QG3	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 85	UC2825Q	Samples
UC2825QTR	OBSOLETE	PLCC	FN	20		TBD	Call TI	Call TI	-40 to 85	UC2825Q	
UC2825QTRG3	ACTIVE	PLCC	FN	20		TBD	Call TI	Call TI	-40 to 85		Samples
UC3825DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3825DW	Samples
UC3825DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3825DW	Samples
UC3825DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3825DW	Samples
UC3825DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	UC3825DW	Samples
UC3825J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	0 to 70	UC3825J	Samples
UC3825N	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	0 to 70	UC3825N	Samples
UC3825NG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	0 to 70	UC3825N	Samples
UC3825Q	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 70	UC3825Q	Samples
UC3825QG3	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 70	UC3825Q	Samples
UC3825QTR	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 70	UC3825Q	Samples
UC3825QTRG3	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 70	UC3825Q	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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF UC1825, UC2825, UC2825M, UC3825, UC3825M :

• Catalog: [UC3825](#), [UC2825](#), [UC3825M](#), [UC3825](#)

• Military: [UC2825M](#), [UC1825](#)

• Space: [UC1825-SP](#)

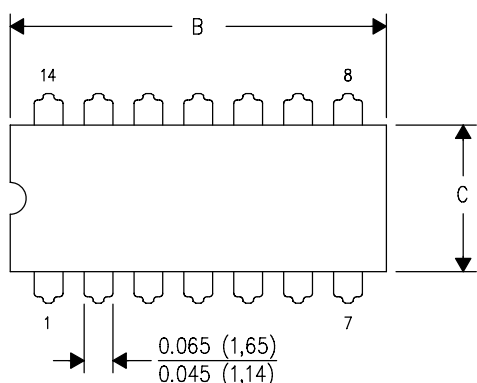
NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

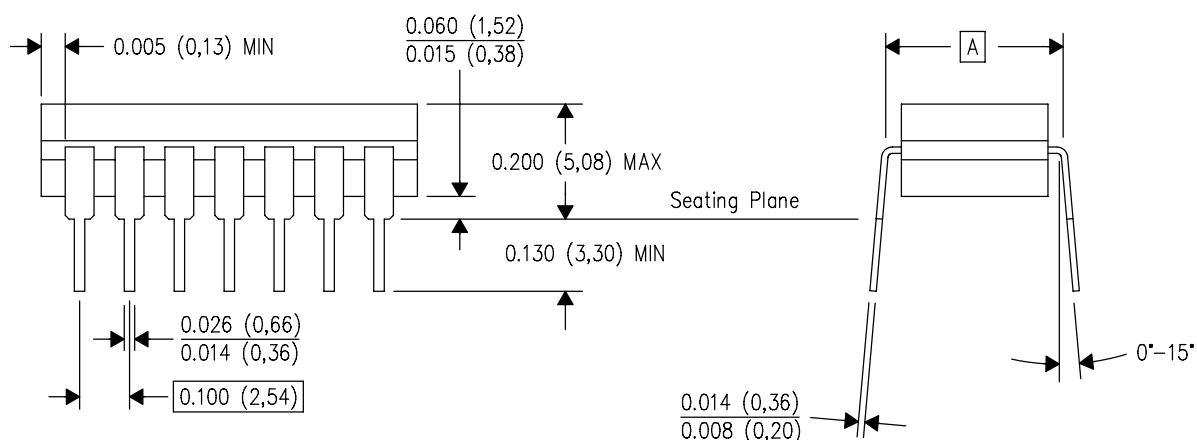
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

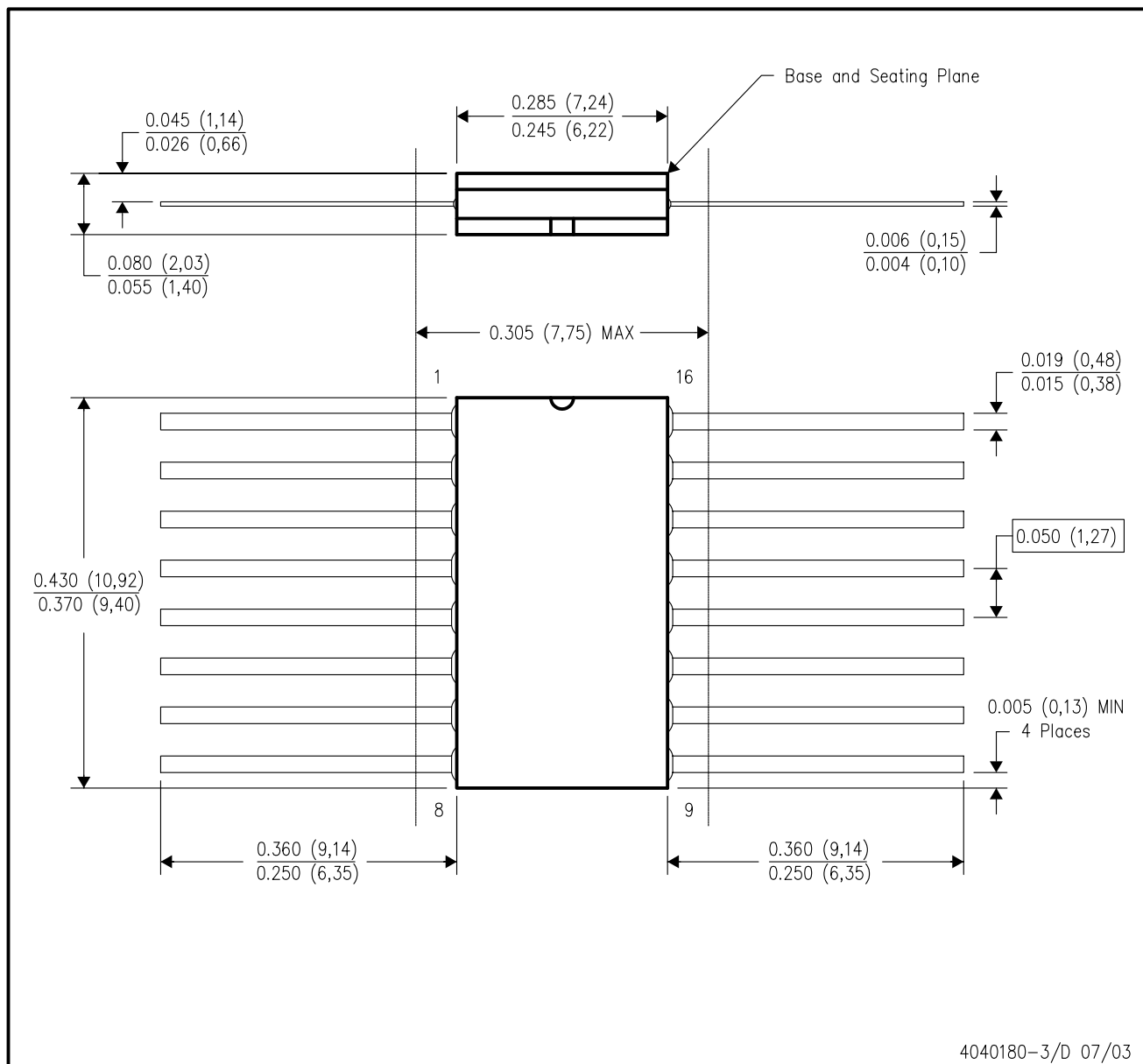


4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK

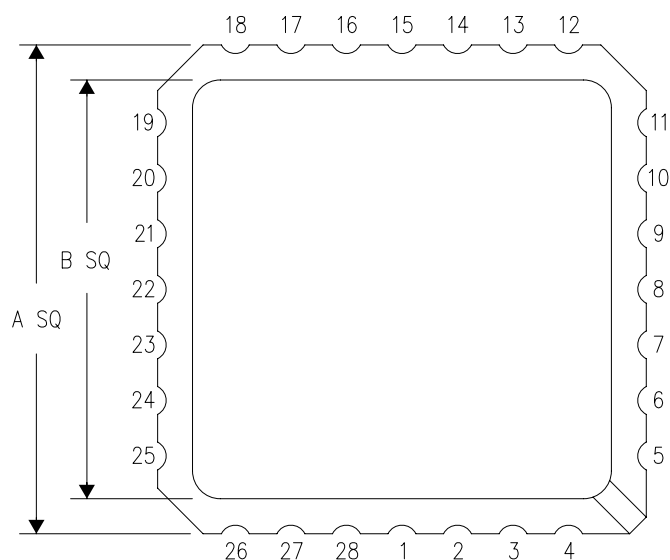


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only.
 - Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

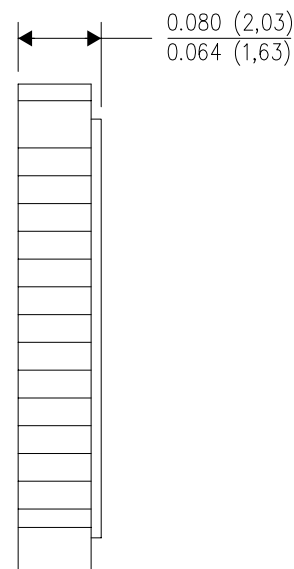
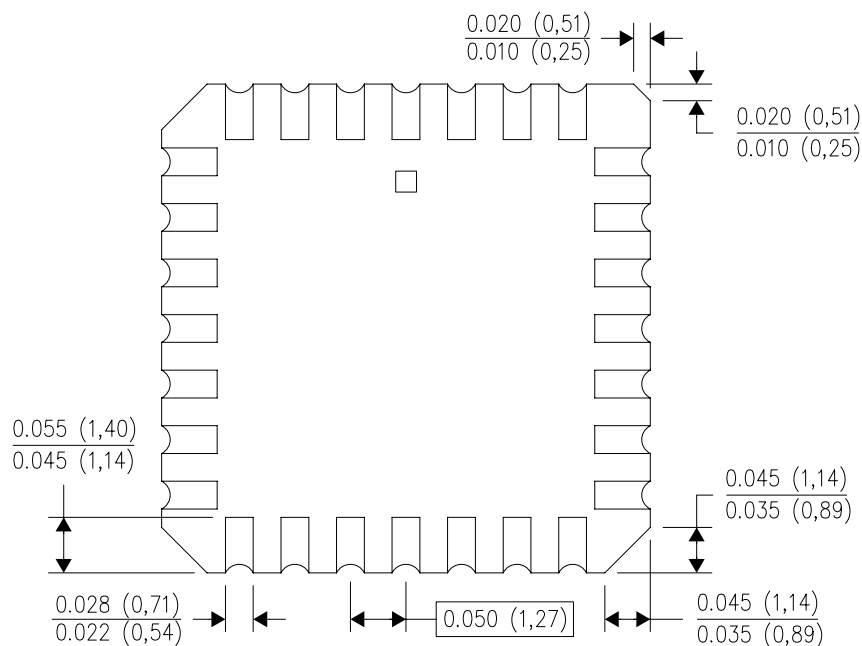
FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



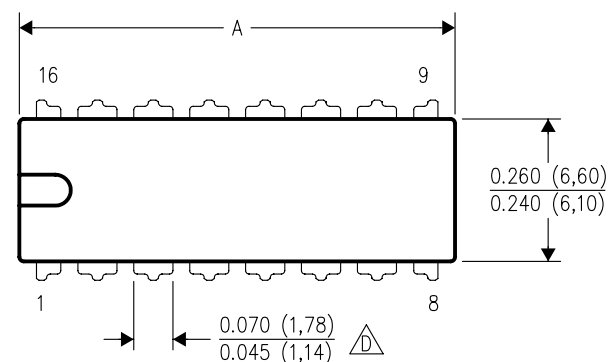
4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

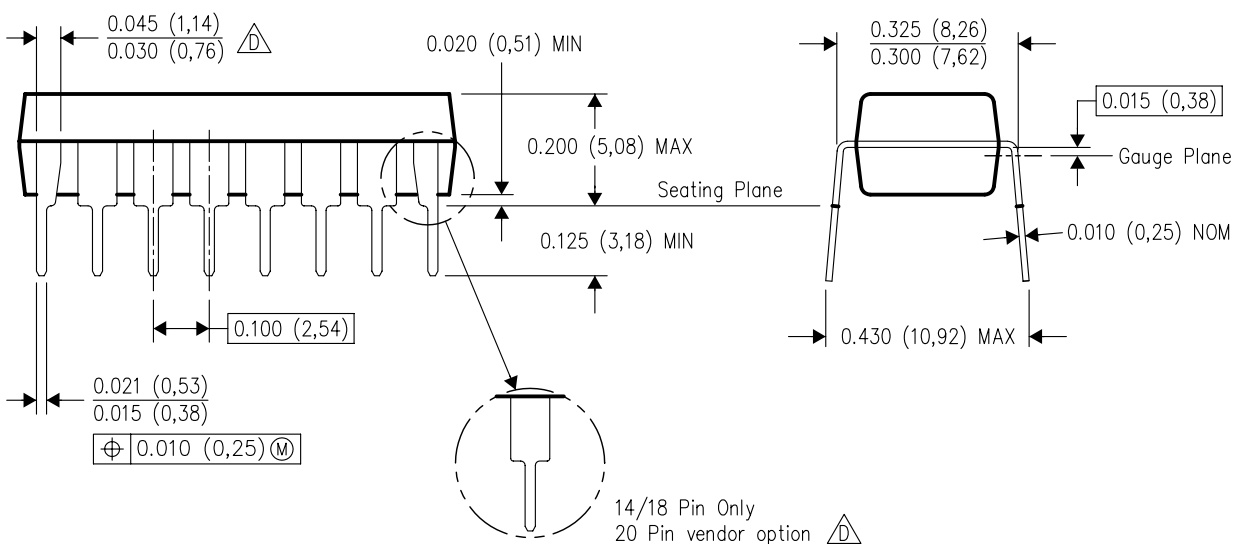
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS **	14	16	18	20
DIM				
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



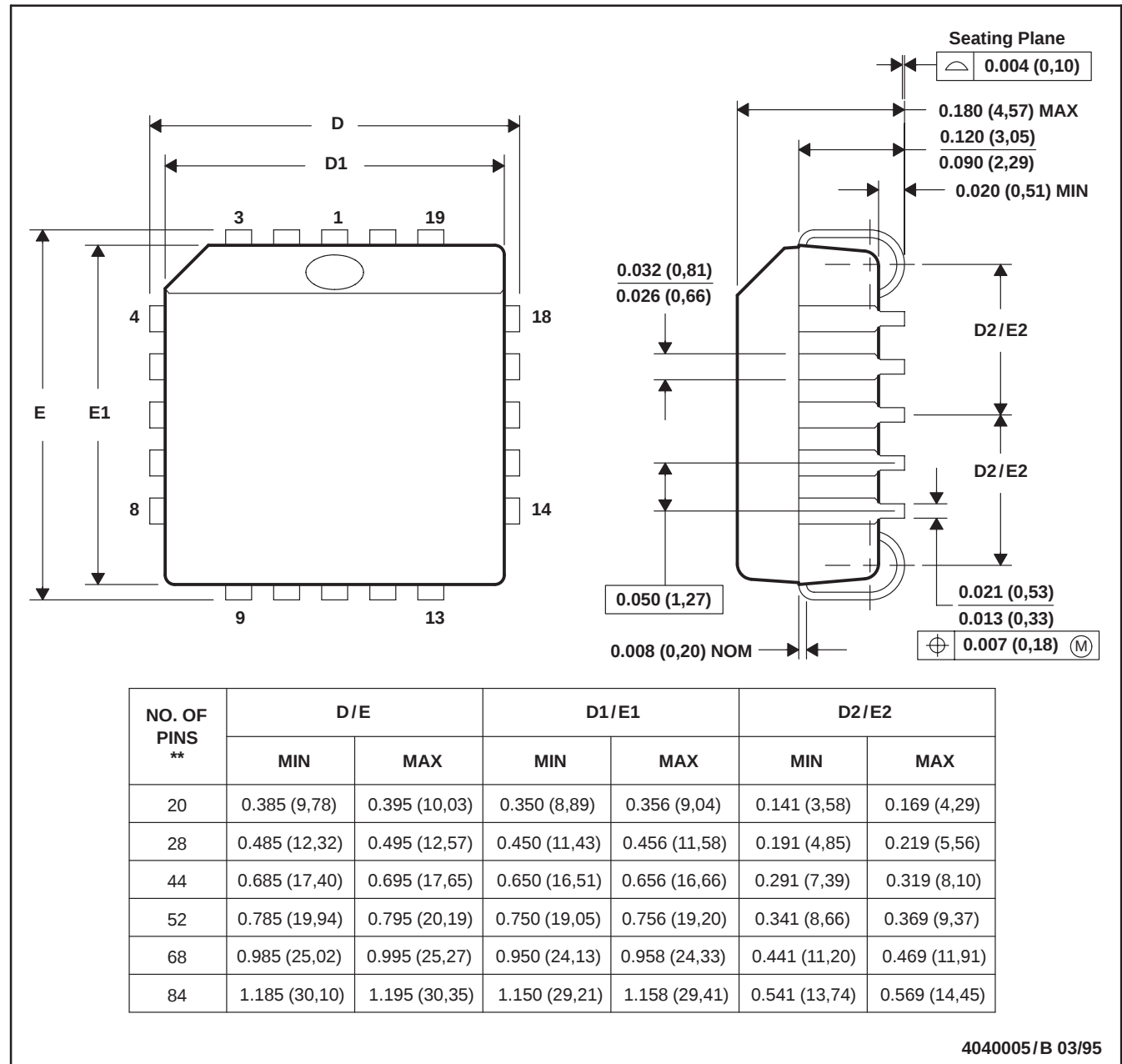
4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

FN (S-PQCC-J**)

PLASTIC J-LEADED CHIP CARRIER

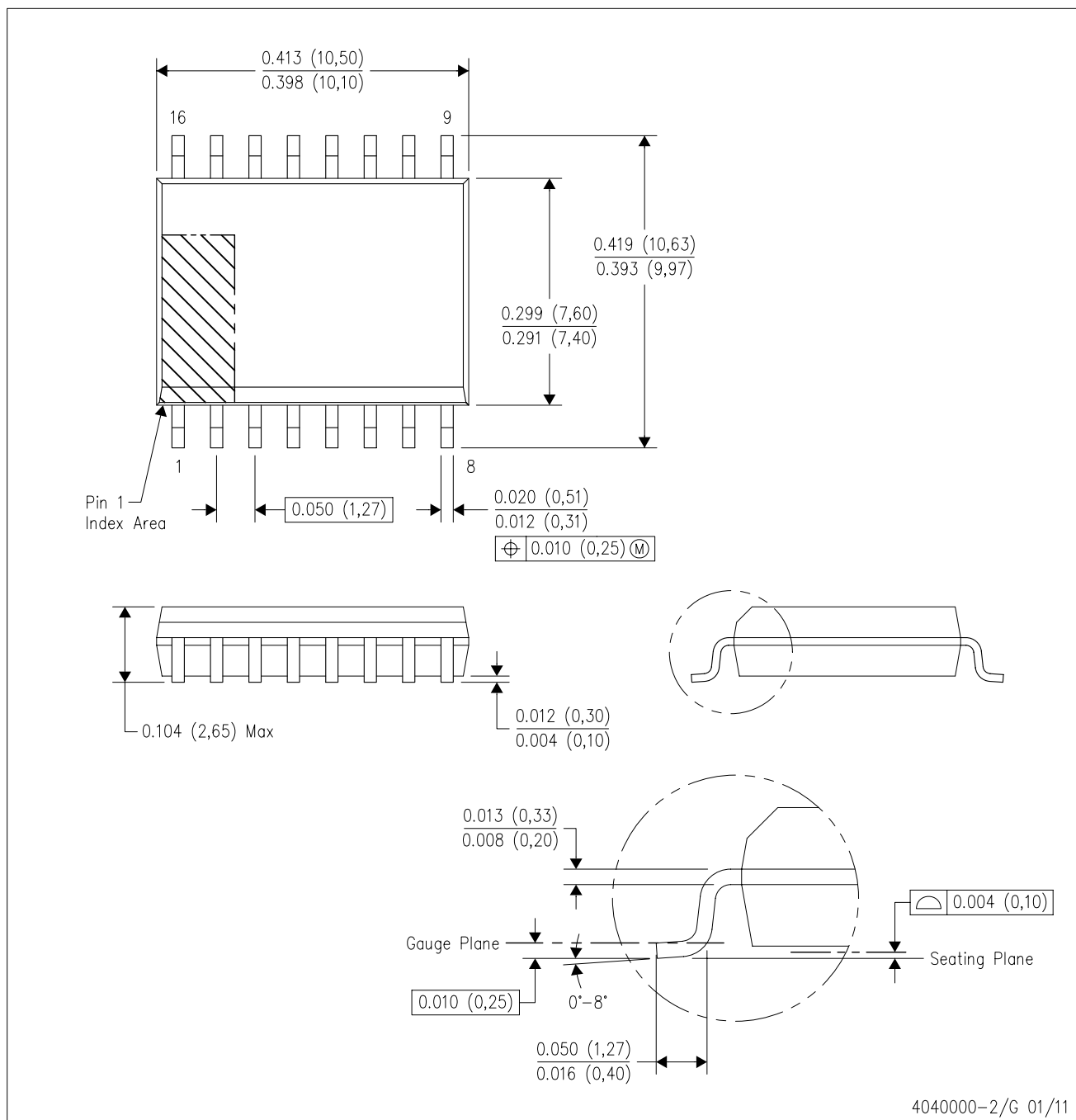
20 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-018

DW (R-PDSO-G16)

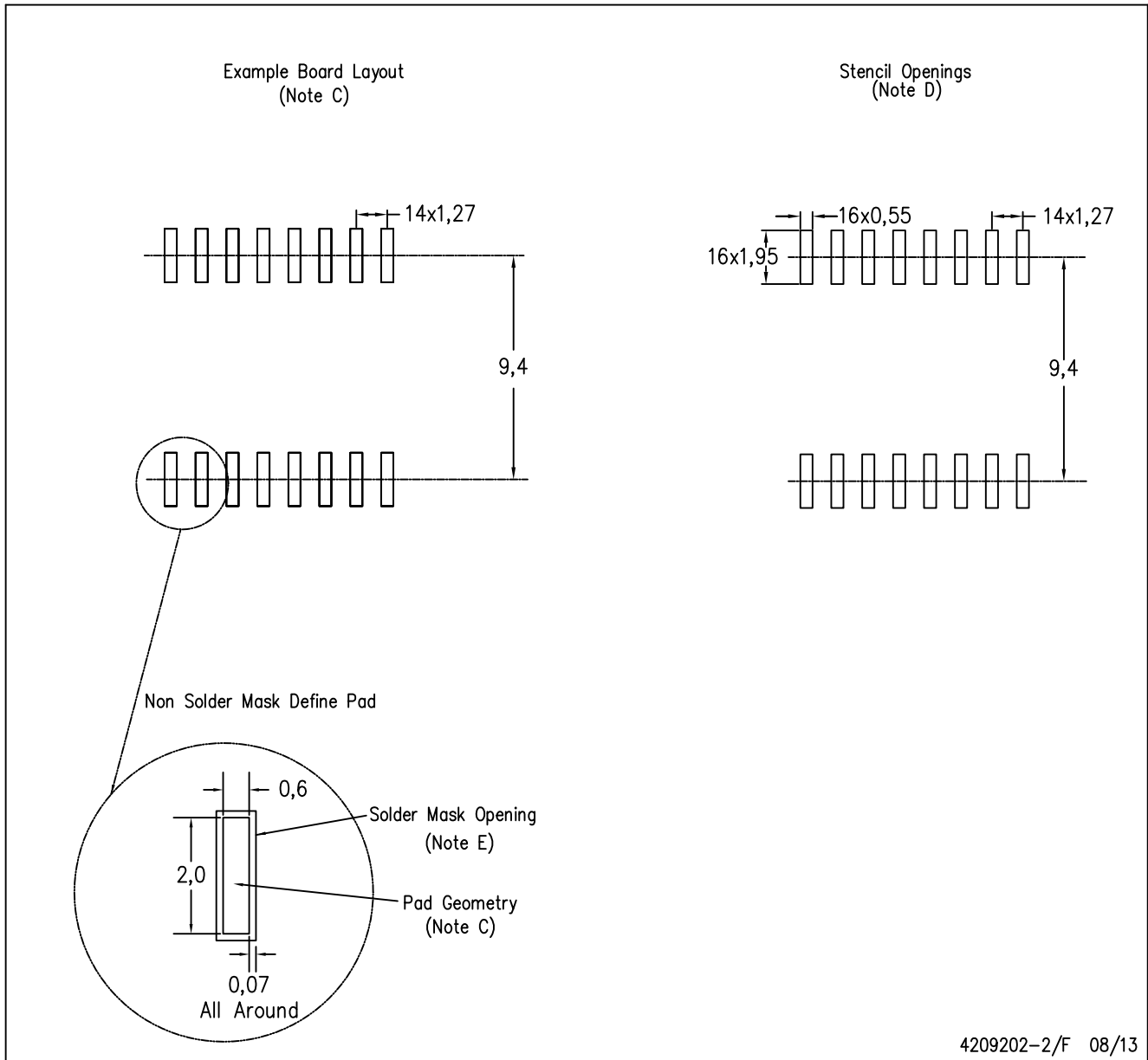
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AA.

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Refer to IPC7351 for alternate board design.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com