

FRONTGRADE

DATASHEET

UT54ACS191E

Synchronous 4-Bit Up-Down Binary Counters

3/1/2015

Version #: 1.0

Features

- Single down/up count control line
- Look-ahead circuitry enhances speed of cascaded counters
- Fully synchronous in count modes
- Asynchronously pre-settable with load control
- 0.6µm CRH CMOS process
 - > Latchup immune
- High speed
- Low power consumption
- Wide power supply operating range of 3.0V to 5.5V
- Available QML Q or V processes
- 16-lead flatpack
- UT54ACS191E - SMD 5962-96564

Description

The UT54ACS191E is a performance and voltage enhanced version of the UT54ACS191 synchronous 4-bit, reversible up down binary counter. Synchronous counting operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed. Synchronous operation eliminates the output counting spikes associated with asynchronous counters.

The outputs of the four flip-flops are triggered on a low-to-high level transition of the clock input if the enable input (\overline{CTEN}) is low. A logic one applied to \overline{CTEN} inhibits counting. The direction of the count is determined by the level of the down/up (D/\overline{U}) input. When D/\overline{U} is low, the counter counts up and when D/\overline{U} is high, it counts down.

The counter features a fully independent clock circuit. Changes at control inputs (\overline{CTEN} and D/\overline{U}) that will modify the operating mode have no effect on the contents of the counter until clocking occurs.

The counter is fully programmable. The outputs may be preset to either logic level by placing a low on the load input and entering the desired data at the data inputs. The output will change to agree with the data inputs independently of the level of the clock input. The asynchronous load allows counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

Two outputs have been made available to perform the cascading function: ripple clock and maximum/minimum (MAX/MIN) count. The MAX/MIN output produces a high-level output pulse with a duration approximately equal to one complete cycle of the clock while the count is zero (all outputs low) counting down or maximum (15) counting up.

The ripple clock output (\overline{RCO}) produces a low-level output pulse under those same conditions but only while the clock input is low. The counters easily cascade by feeding the \overline{RCO} to the enable input of the succeeding counter if parallel clocking is used, or to the clock input if parallel enabling is used. Use the MAX/MIN count output to accomplish look-ahead for highspeed operation.

The device is characterized over full military temperature range of -55°C to +125°C.

Pinout

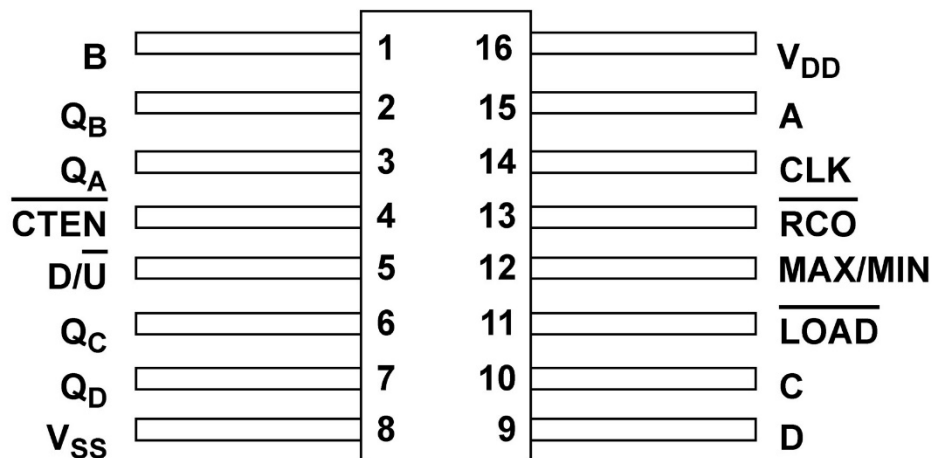
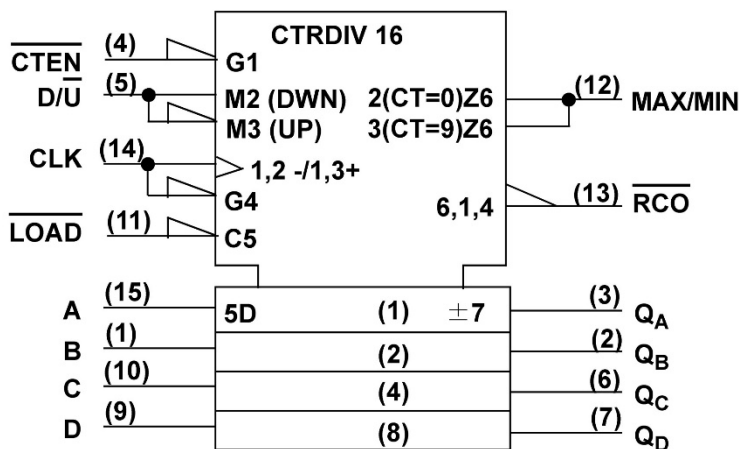


Figure 1: 16-Lead Flatpack, Top View

Function Table

Function	$\overline{\text{LOAD}}$	$\overline{\text{CTEN}}$	$\text{D}/\overline{\text{U}}$	CLK
Count Up	H	L	L	-
Count Down	H	L	H	-
Asynchronous Reset	L	X	X	X
No Change	H	H	X	X

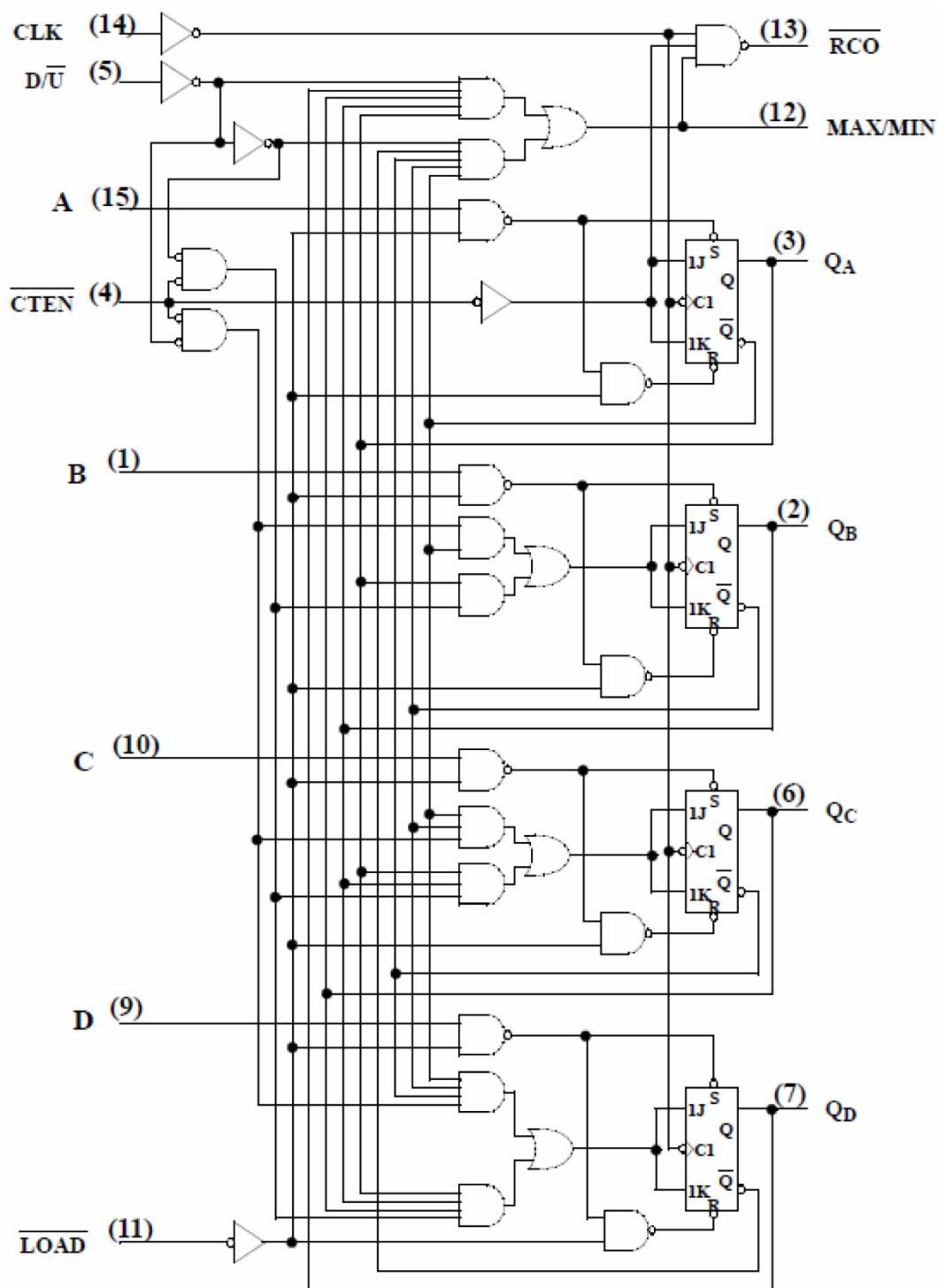
Logic Symbol



Note:

- Logic symbol in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Logic Diagram



Operational Environment¹

Parameter	Limit	Units
Total Dose	1.0E6	rads(Si)
SEU Threshold ²	108	MeV-cm ² /mg
SEL Threshold	120	MeV-cm ² /mg
Neutron Fluence	1.0E14	n/cm ²

Notes:

- Logic will not latchup during radiation exposure within the limits defined in the table.
- Device storage elements are immune to SEU affects.

Absolute Maximum Ratings¹

Symbol	Parameter	Limit	Units
V _{DD}	Supply voltage	-0.3 to 7.0	V
V _{I/O}	Voltage any pin	-0.3 to V _{DD} +0.3	V
T _{STG}	Storage Temperature range	-65 to +150	°C
T _J	Maximum junction temperature	+175	°C
T _{LS}	Lead temperature (soldering 5 seconds)	+300	°C
Θ _{JC}	Thermal resistance junction to case	15	°C/W
I _I	DC input current	±10	mA
P _D ²	Maximum package power dissipation permitted @ T _C = +125°C	3.2	W

Notes:

- Stresses outside the listed absolute maximum ratings may cause permanent damage to the device. This is a stress rating only, functional operation of the device at these or any other conditions beyond limits indicated in the operational sections is not recommended. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
- Per MIL-STD-883, method 1012.1, Section 3.4.1, $P_D = (T_{j(max)} - T_{C(max)}) / \Theta_{JC}$

Recommended Operating Conditions

Symbol	Parameter	Limit	Units
V _{DD}	Supply voltage	3.0 to 5.5	V
V _{IN}	Input voltage any pin	0 to V _{DD}	V
T _C	Temperature range	-55 to +125	°C

Electrical Characteristics for the UT54ACS191E⁷

($V_{DD} = 3.0V$ to $5.5V$; $V_{SS} = 0V^6$; $-55^{\circ}C < T_C < +125^{\circ}C$)

Symbol	Parameter	Condition	MIN	MAX	Unit
V_{IL}	Low-level input voltage ¹	V_{DD} from 3.0V to 5.5V		$0.3V_{DD}$	V
V_{IH}	High-level input voltage ¹	V_{DD} from 3.0V to 5.5V	$0.7V_{DD}$		V
I_{IN}	Input leakage current	$V_{IN} = V_{DD}$ or V_{SS}	-1	1	μA
V_{OL}	Low-level output voltage ³	$I_{OL} = 100\mu A$; V_{DD} from 3.0V to 5.5V		0.25	V
V_{OH}	High-level output voltage ³	$I_{OH} = -100\mu A$; V_{DD} from 3.0V to 5.5V	$V_{DD} - 0.25$		V
I_{OS1}	Short-circuit output current ^{2,4}	$V_O = V_{DD}$ and V_{SS} V_{DD} from 4.5V to 5.5V	-200	+200	mA
I_{OS2}	Short-circuit output current ^{2,4}	$V_O = V_{DD}$ and V_{SS} V_{DD} from 3.0V to 3.6V	-100	+100	mA
I_{OL1}	Low level output current ¹⁰ (Sink)	$V_{IN} = V_{DD}$ or V_{SS} ; $V_{OL} = 0.4V$ V_{DD} from 4.5V to 5.5V	+8		mA
I_{OL2}	Low level output current ¹⁰ (Sink)	$V_{IN} = V_{DD}$ or V_{SS} ; $V_{OL} = 0.4V$ V_{DD} from 3.0V to 3.6V	+6		mA
I_{OH1}	High level output current ¹⁰ (Source)	$V_{IN} = V_{DD}$ or V_{SS} ; $V_{OH} = 0.4V$ V_{DD} from 4.5V to 5.5V	-8		mA
I_{OH2}	High level output current ¹⁰ (Source)	$V_{IN} = V_{DD}$ or V_{SS} ; $V_{OH} = 0.4V$ V_{DD} from 3.0V to 3.6V	-6		mA
P_{total1}	Power dissipation ^{2,8,9}	$C_L = 50pF$; V_{DD} from 4.5V to 5.5V		1.4	mW/ MHz
P_{total2}	Power dissipation ^{2,8,9}	$C_L = 50pF$; V_{DD} from 3.0V to 3.6V		1.0	mW/ MHz
I_{DDQ}	Quiescent Supply Current	$V_{IN} = V_{DD}$ or V_{SS} V_{DD} from 3.0V to 5.5V		25	μA
C_{IN}	Input capacitance ⁵	$f = 1MHz$ $V_{DD} = 0V$		15	pF
C_{OUT}	Output capacitance ⁵	$f = 1MHz$ $V_{DD} = 0V$		15	pF

Notes:

- Functional tests are conducted in accordance with MIL-STD-883 with the following input test conditions: $V_{IH} = V_{IH(min)} + 20\%$, -0% ; $V_{IL} = V_{IL(max)} + 0\%$, -50% , as specified herein, for TTL, CMOS, or Schmitt compatible inputs. Devices may be tested using any input voltage within the above specified range, but are guaranteed to $V_{IH(min)}$ and $V_{IL(max)}$.
- Supplied as a design limit but not guaranteed or tested.
- Per MIL-PRF-38535, for current density $\leq 5.0E5$ amps/cm², the maximum product of load capacitance (per output buffer) times frequency should not exceed 3,765pF/MHz.
- Not more than one output may be shorted at a time for maximum duration of one second.
- Capacitance measured for initial qualification and when design changes may affect the value. Capacitance is measured between the designated terminal and VSS at frequency of 1MHz and a signal amplitude of 50mV rms maximum.
- Maximum allowable relative shift equals 50mV.
- For devices procured with a total ionizing dose tolerance guarantee, the post-irradiation performance is guaranteed at 25°C per MIL-STD-883 method 1019 condition A up to the maximum TID level procured.
- Power dissipation specified per switching output.
- Power does not include power contribution of any TTL output sink current.
- Guaranteed by characterization, but not tested.

AC Electrical Characteristics for UT54ACS191E2

 $(V_{DD} = 3.0V \text{ to } 5.5V; V_{SS} = 0V^1, -55^\circ C < T_C < +125^\circ C)$

Symbol	Parameter	Condition	V_{DD}	Minimum	Maximum	Unit
t_{PLH1}	\overline{LOAD} to Q_n	$C_L = 50pF$	4.5V to 5.5V	2	14	ns
			3.0V to 3.6V	2	18	
t_{PHL1}	\overline{LOAD} to Q_n	$C_L = 50pF$	4.5V to 5.5V	2	15	ns
			3.0V to 3.6V	2	20	
t_{PLH2}	Data in to Q_n	$C_L = 50pF$	4.5V to 5.5V	2	13	ns
			3.0V to 3.6V	2	18	
t_{PHL2}	Data in to Q_n	$C_L = 50pF$	4.5V to 5.5V	2	15	ns
			3.0V to 3.6V	2	20	
t_{PLH3}	CLK to Q_n	$C_L = 50pF$	4.5V to 5.5V	2	12	ns
			3.0V to 3.6V	2	16	
t_{PHL3}	CLK to Q_n	$C_L = 50pF$	4.5V to 5.5V	2	13	ns
			3.0V to 3.6V	2	18	
t_{PLH4}	CLK to \overline{RCO}	$C_L = 50pF$	4.5V to 5.5V	2	8	ns
			3.0V to 3.6V	2	10	
t_{PHL4}	CLK to \overline{RCO}	$C_L = 50pF$	4.5V to 5.5V	2	10	ns
			3.0V to 3.6V	2	12	
t_{PLH5}	CLK to MAX/MIN	$C_L = 50pF$	4.5V to 5.5V	2	14	ns
			3.0V to 3.6V	2	19	
t_{PHL5}	CLK to MAX/MIN	$C_L = 50pF$	4.5V to 5.5V	2	15	ns
			3.0V to 3.6V	2	20	
t_{PLH6}	D/\overline{U} to \overline{RCO}	$C_L = 50pF$	4.5V to 5.5V	2	11	ns
			3.0V to 3.6V	2	15	
t_{PHL6}	D/\overline{U} to \overline{RCO}	$C_L = 50pF$	4.5V to 5.5V	2	12	ns
			3.0V to 3.6V	2	16	
t_{PLH7}	D/\overline{U} to MAX/MIN	$C_L = 50pF$	4.5V to 5.5V	2	10	ns
			3.0V to 3.6V	2	13	
t_{PHL7}	D/\overline{U} to MAX/MIN	$C_L = 50pF$	4.5V to 5.5V	2	11	ns
			3.0V to 3.6V	2	14	
t_{PLH8}	\overline{CTEN} to \overline{RCO}	$C_L = 50pF$	4.5V to 5.5V	2	8	ns
			3.0V to 3.6V	2	11	
t_{PHL8}	\overline{CTEN} to \overline{RCO}	$C_L = 50pF$	4.5V to 5.5V	2	10	ns
			3.0V to 3.6V	2	12	
f_{MAX}^3	Maximum clock frequency	$C_L = 50pF$	3.0V to 5.5V		70	MHz
t_{SU1}	D/\overline{U} Setup time before CLK \uparrow	$C_L = 50pF$	4.5V to 5.5V	8		ns
			3.0V to 3.6V	10		
t_{SU2}	\overline{CTEN} low Setup time before CLK \uparrow	$C_L = 50pF$	4.5V to 5.5V	10		ns
			3.0V to 3.6V	12		

Symbol	Parameter	Condition	VDD	Minimum	Maximum	Unit
t_{SU3}	A, B, C, D setup time before \overline{LOAD} \uparrow	$C_L = 50pF$	4.5V to 5.5V	4		ns
			3.0V to 3.6V	5		
t_{SU4}	\overline{LOAD} high Setup time before CLK \uparrow	$C_L = 50pF$	4.5V to 5.5V	3		ns
			3.0V to 3.6V	4		
t_{H1}	D/ \overline{U} hold time after CLK \uparrow	$C_L = 50pF$	3.0V to 5.5V	0		ns
t_{H2}	\overline{CTEN} low hold time after CLK \uparrow	$C_L = 50pF$	4.5v to 5.5V	1		ns
			3.0V to 3.6V	2		
t_{H3}	A, B, C, D hold time after \overline{LOAD} \uparrow	$C_L = 50pF$	3.0V to 5.5V	2		ns
t_W	Minimum pulse width CLK high or low \overline{LOAD} low	$C_L = 50pF$	3.0V to 5.5V	7		ns

Notes:

- Maximum allowable relative shift equals 50mV.
- For devices procured with a total ionizing dose tolerance guarantee, the post-irradiation performance is guaranteed at 25°C per MIL-STD-883 method 1019 condition A up to the maximum TID level procured.
- Maximum clock frequency f_{MAX} is the max rate at which the device will count up or down at the given voltage. However, the user must wait the appropriate UP-to-Qn or Down-to-Qn propagation delay time in order to observe the current counter value.

Packaging

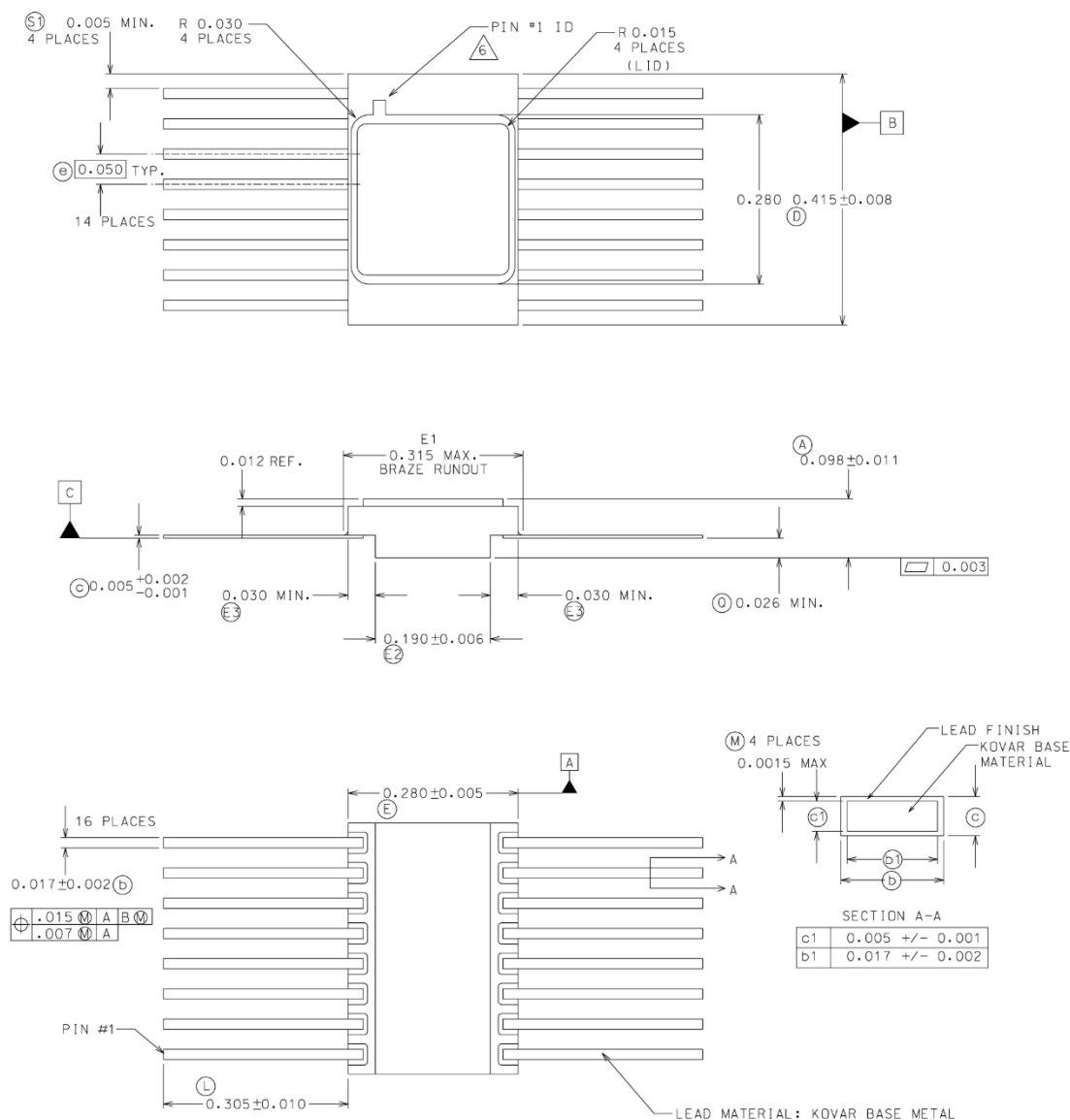


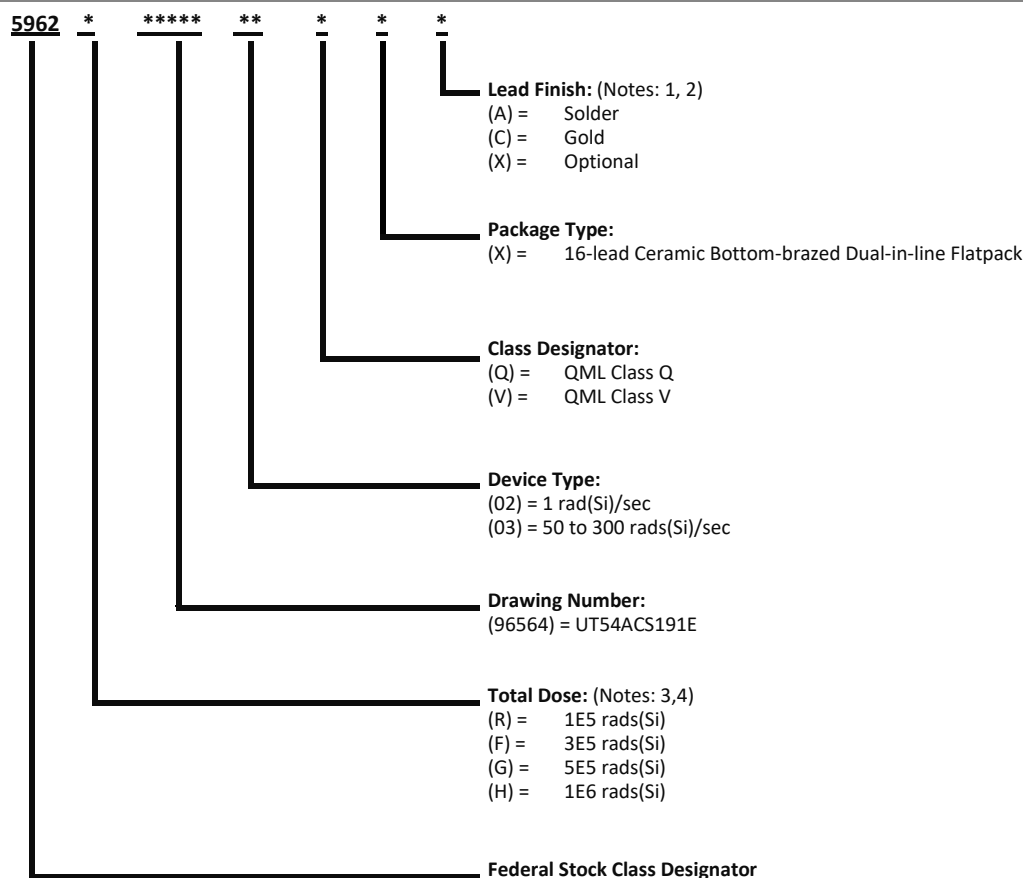
Figure 2: Lead Flatpack

Notes:

1. All exposed metalized areas must be gold plated over electrically plated nickel per MIL-PRF-38535.
2. The lid is electrically connected to V_{SS} .
3. Lead finishes are in accordance with MIL-PRF-38535.
4. Dimension symbology is in accordance with MIL-PRF-38535.
5. Lead position and coplanarity are not measured.
6. ID mark symbol is vendor option no alpha-numerics.

Ordering Information

UT54ACS191E SMD Part Number Ordering Information



Notes:

- Lead finish (A, C or X) must be specified.
- If an "X" is specified when ordering, part marking will match the lead finish and will be either "A" (solder) or "C" (gold).
- Total dose radiation must be specified when ordering. QML Q and QML V not available without radiation hardening. For prototype inquiries, contact factory.
- Device type 02 is only offered with a TID tolerance guarantee of 3E5 rads(Si) or 1E6 rads(Si) and is tested in accordance with MIL-STD-883 Test Method 1019 Condition A and section 3.11.2. Device type 03 is only offered with a TID tolerance guarantee of 1E5 rads(Si), 3E5 rads(Si), and 5E5 rads(Si), and is tested in accordance with MIL-STD-883 Test Method 1019 Condition A.

Revision History

Date	Revision #	Author	Change Description	Page #
2/15			Initial Release of Datasheet	

Datasheet Definitions

	Definition
Advanced Datasheet	Frontgrade reserves the right to make changes to any products and services described herein at any time without notice. The product is still in the development stage and the datasheet is subject to change . Specifications can be TBD and the part package and pinout are not final .
Preliminary Datasheet	Frontgrade reserves the right to make changes to any products and services described herein at any time without notice. The product is in the characterization stage and prototypes are available.
Datasheet	Product is in production and any changes to the product and services described herein will follow a formal customer notification process for form, fit or function changes.

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