

## 3.3V Zero Delay Buffer

### Features

- Zero input-output propagation delay, adjustable by capacitive load on FBK input
- Multiple configurations, see *Table 2*
- Multiple low-skew outputs
  - Output-output skew less than 200 ps
  - Device-device skew less than 700 ps
  - Two banks of four outputs, three-stateable by two select inputs
- 10-MHz to 133-MHz operating range
- Low jitter, less than 200 ps cycle-cycle (–1, –1H, –4)
- Advanced 0.65 $\mu$ m CMOS technology
- Space-saving 16-pin 150-mil SOIC package
- 3.3V operation
- Spread Aware™

### Functional Description

The CY23S08 is a 3.3V zero delay buffer designed to distribute high-speed clocks in PC, workstation, datacom, telecom, and other high-performance applications.

The part has an on-chip PLL which locks to an input clock presented on the REF pin. The PLL feedback is required to be driven into the FBK pin, and can be obtained from one of the outputs. The input-to-output propagation delay is guaranteed to be less than 350 ps, and output-to-output skew is guaranteed to be less than 250 ps.

The CY23S08 has two banks of four outputs each, which can be controlled by the Select inputs as shown in *Table 1*. If all output clocks are not required, Bank B can be three-stated. The select inputs also allow the input clock to be directly applied to the output for chip and system testing purposes.

The CY23S08 PLL enters a power-down state when there are no rising edges on the REF input. In this mode, all outputs are three-stated and the PLL is turned off, resulting in less than 50  $\mu$ A of current draw. The PLL shuts down in two additional cases as shown in *Table 1*.

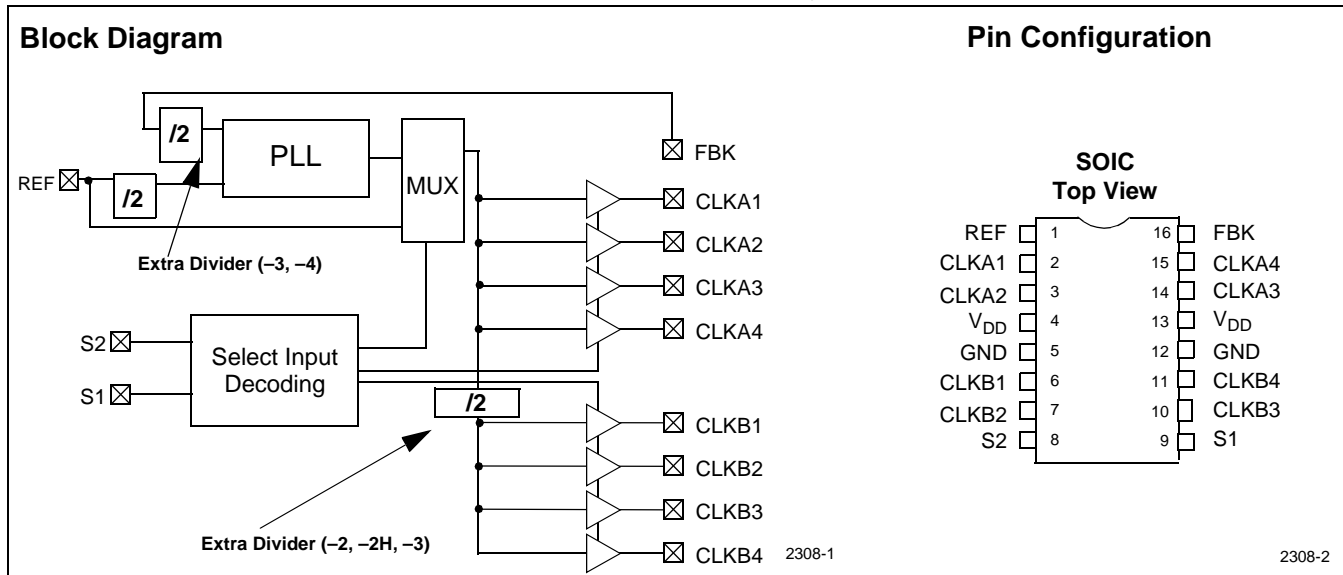
Multiple CY23S08 devices can accept the same input clock and distribute it in a system. In this case, the skew between the outputs of two devices is guaranteed to be less than 700 ps.

The CY23S08 is available in five different configurations, as shown in the *Table 2*. The CY23S08–1 is the base part, where the output frequencies equal the reference if there is no counter in the feedback path. The CY23S08–1H is the high-drive version of the –1, and rise and fall times on this device are much faster.

The CY23S08–2 allows the user to obtain 2X and 1X frequencies on each output bank. The exact configuration and output frequencies depends on which output drives the feedback pin. The CY23S08–2H is the high-drive version of the –2, and rise and fall times on this device are much faster.

The CY23S08–3 allows the user to obtain 4X and 2X frequencies on the outputs.

The CY23S08–4 enables the user to obtain 2X clocks on all outputs. Thus, the part is extremely versatile, and can be used in a variety of applications.



**Table 1. Select Input Decoding.**

S2	S1	CLOCK A1–A4	CLOCK B1–B4	Output Source	PLL Shutdown
0	0	Three-State	Three-State	PLL	Y
0	1	Driven	Three-State	PLL	N
1	0	Driven	Driven	Reference	Y
1	1	Driven	Driven	PLL	N

**Table 2. Available CY23S08 Configurations.**

Device	Feedback From	Bank A Frequency	Bank B Frequency
CY2308–1	Bank A or Bank B	Reference	Reference
CY2308–1H	Bank A or Bank B	Reference	Reference
CY2308–2	Bank A	Reference	Reference/2
CY2308–2H	Bank A	Reference	Reference/2
CY2308–2	Bank B	2 X Reference	Reference
CY2308–2H	Bank B	2 X Reference	Reference
CY2308–3	Bank A	2 X Reference	Reference or Reference <sup>[1]</sup>
CY2308–3	Bank B	4 X Reference	2 X Reference
CY2308–4	Bank A or Bank B	2 X Reference	2 X Reference

**Spread Aware™**

Many systems being designed now utilize a technology called Spread Spectrum Frequency Timing Generation. Cypress has been one of the pioneers of SSFTG development, and we designed this product so as not to filter off the Spread Spectrum feature of the Reference input, assuming it exists. When a zero delay buffer is not designed to pass the SS feature through, the result is a significant amount of tracking skew which may cause problems in systems requiring synchronization.

For more details on Spread Spectrum timing technology, please see Cypress's Application Note "EMI Suppression Techniques with Spread Spectrum Frequency Timing Generator (SSFTG) ICs."

**Note:**

1. Output phase is indeterminant (0° or 180° from input clock). If phase integrity is required, use the CY23S08–2.

**Pin Description**

Pin	Signal	Description
1	REF <sup>[2]</sup>	Input reference frequency, 5V tolerant input
2	CLKA1 <sup>[3]</sup>	Clock output, Bank A
3	CLKA2 <sup>[3]</sup>	Clock output, Bank A
4	V <sub>DD</sub>	3.3V supply
5	GND	Ground
6	CLKB1 <sup>[3]</sup>	Clock output, Bank B
7	CLKB2 <sup>[3]</sup>	Clock output, Bank B
8	S2 <sup>[4]</sup>	Select input, bit 2
9	S1 <sup>[4]</sup>	Select input, bit 1
10	CLKB3 <sup>[3]</sup>	Clock output, Bank B
11	CLKB4 <sup>[3]</sup>	Clock output, Bank B
12	GND	Ground
13	V <sub>DD</sub>	3.3V supply
14	CLKA3 <sup>[3]</sup>	Clock output, Bank A
15	CLKA4 <sup>[3]</sup>	Clock output, Bank A
16	FBK	PLL feedback input

**Maximum Ratings**

Supply Voltage to Ground Potential ..... -0.5V to +7.0V  
 DC Input Voltage (Except Ref) ..... -0.5V to V<sub>DD</sub> + 0.5V  
 DC Input Voltage REF ..... -0.5 to 7V

**Notes:**

2. Weak pull-down.
3. Weak pull-down on all outputs.
4. Weak pull-ups on these inputs.

Storage Temperature ..... -65°C to +150°C  
 Max. Soldering Temperature (10 sec.) ..... 260°C  
 Junction Temperature ..... 150°C  
 Static Discharge Voltage  
 (per MIL-STD-883, Method 3015) ..... >2000V

**Operating Conditions for CY23S08SC-XX Commercial Temperature Devices**

Parameter	Description	Min.	Max.	Unit
$V_{DD}$	Supply Voltage	3.0	3.6	V
$T_A$	Operating Temperature (Ambient Temperature)	0	70	°C
$C_L$	Load Capacitance, below 100 MHz		30	pF
	Load Capacitance, from 100 MHz to 133 MHz		15	pF
$C_{IN}$	Input Capacitance <sup>[5]</sup>		7	pF

**Electrical Characteristics for CY23S08SC-XX Commercial Temperature Devices**

Parameter	Description	Test Conditions	Min.	Max	Unit
$V_{IL}$	Input LOW Voltage			0.8	V
$V_{IH}$	Input HIGH Voltage		2.0		V
$I_{IL}$	Input LOW Current	$V_{IN} = 0V$		50.0	μA
$I_{IH}$	Input HIGH Current	$V_{IN} = V_{DD}$		100.0	μA
$V_{OL}$	Output LOW Voltage <sup>[6]</sup>	$I_{OL} = 8\text{ mA } (-1, -2, -3, -4)$ $I_{OL} = 12\text{ mA } (-1H, -2H)$		0.4	V
$V_{OH}$	Output HIGH Voltage <sup>[6]</sup>	$I_{OH} = -8\text{ mA } (-1, -2, -3, -4)$ $I_{OH} = -12\text{ mA } (-1H, -2H)$	2.4		V
$I_{DD}$ (PD mode)	Power Down Supply Current	REF = 0 MHz		12.0	μA
$I_{DD}$	Supply Current	Unloaded outputs, 100-MHz REF, Select inputs at $V_{DD}$ or GND		45.0	mA
				70.0 (-1H, -2H)	mA
		Unloaded outputs, 66-MHz REF (-1,-2,-3,-4)		32.0	mA
		Unloaded outputs, 33-MHz REF (-1,-2,-3,-4)		18.0	mA

**Notes:**

5. Applies to both Ref Clock and FBK.
6. Parameter is guaranteed by design and characterization. Not 100% tested in production.

**Switching Characteristics for CY23S08SC-XX Commercial Temperature Devices <sup>[7]</sup>**

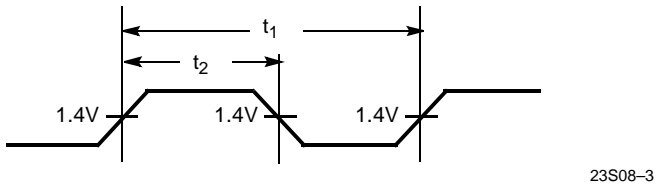
Parameter	Name	Test Conditions	Min.	Typ.	Max.	Unit
t <sub>1</sub>	Output Frequency	30-pF load, All devices	10		100	MHz
t <sub>1</sub>	Output Frequency	20-pF load, -1H device	10		133.3	MHz
t <sub>1</sub>	Output Frequency	15-pF load, -1, -2, -3, -4 devices	10		133.3	MHz
	Duty Cycle <sup>[6]</sup> = $t_2 \div t_1$ (-1, -2, -3, -4, -1H, -2H)	Measured at 1.4V, F <sub>OUT</sub> = 66.66 MHz 30-pF load	40.0	50.0	60.0	%
	Duty Cycle <sup>[6]</sup> = $t_2 \div t_1$ (-1, -2, -3, -4, -1H, -2H)	Measured at 1.4V, F <sub>OUT</sub> < 50.0 MHz 15-pF load	45.0	50.0	55.0	%
t <sub>3</sub>	Rise Time <sup>[6]</sup> (-1, -2, -3, -4)	Measured between 0.8V and 2.0V, 30-pF load			2.20	ns
t <sub>3</sub>	Rise Time <sup>[6]</sup> (-1, -2, -3, -4)	Measured between 0.8V and 2.0V, 15-pF load			1.50	ns
t <sub>3</sub>	Rise Time <sup>[6]</sup> (-1H, -2H)	Measured between 0.8V and 2.0V, 30-pF load			1.50	ns
t <sub>4</sub>	Fall Time <sup>[6]</sup> (-1, -2, -3, -4)	Measured between 0.8V and 2.0V, 30-pF load			2.20	ns
t <sub>4</sub>	Fall Time <sup>[6]</sup> (-1, -2, -3, -4)	Measured between 0.8V and 2.0V, 15-pF load			1.50	ns
t <sub>4</sub>	Fall Time <sup>[6]</sup> (-1H, 2H)	Measured between 0.8V and 2.0V, 30-pF load			1.25	ns
t <sub>5</sub>	Output to Output Skew on same Bank (-1, -2, -3, -4) <sup>[6]</sup>	All outputs equally loaded			200	ps
	Output to Output Skew (-1H, -2H)	All outputs equally loaded			200	ps
	Output Bank A to Output Bank B Skew (-1, -4)	All outputs equally loaded			200	ps
	Output Bank A to Output Bank B Skew (-2, -3)	All outputs equally loaded			400	ps
t <sub>6</sub>	Delay, REF Rising Edge to FBK Rising Edge <sup>[6]</sup>	Measured at V <sub>DD</sub> /2		0	±250	ps
t <sub>7</sub>	Device to Device Skew <sup>[6]</sup>	Measured at V <sub>DD</sub> /2 on the FBK pins of devices		0	700	ps
t <sub>8</sub>	Output Slew Rate <sup>[6]</sup>	Measured between 0.8V and 2.0V on -1H, -2H device using Test Circuit #2	1			V/ns
t <sub>J</sub>	Cycle to Cycle Jitter <sup>[6]</sup> (-1, -1H, -4)	Measured at 66.67 MHz, loaded outputs, 15-pF load			200	ps
		Measured at 66.67 MHz, loaded outputs, 30-pF load			200	ps
		Measured at 133.3 MHz, loaded outputs, 15-pF load			100	ps
t <sub>J</sub>	Cycle to Cycle Jitter <sup>[6]</sup> (-2, -2H, -3)	Measured at 66.67 MHz, loaded outputs 30-pF load			400	ps
		Measured at 66.67 MHz, loaded outputs 15-pF load			400	ps
t <sub>LOCK</sub>	PLL Lock Time <sup>[6]</sup>	Stable power supply, valid clocks presented on REF and FBK pins			1.0	ms

**Notes:**

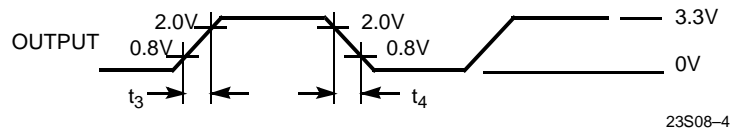
7. All parameters are specified with loaded outputs.

## Switching Waveforms

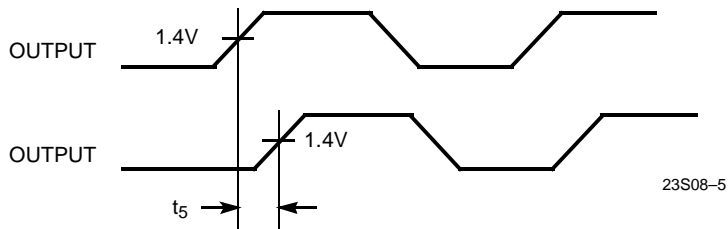
### Duty Cycle Timing



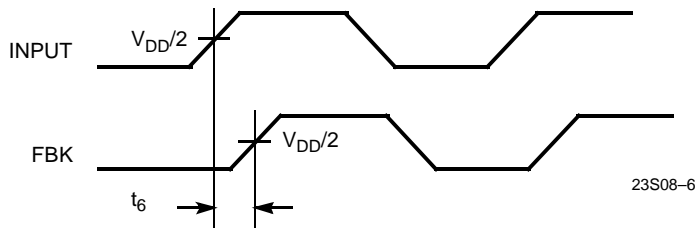
### All Outputs Rise/Fall Time



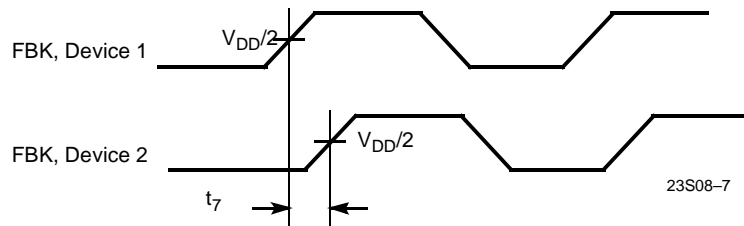
### Output-Output Skew



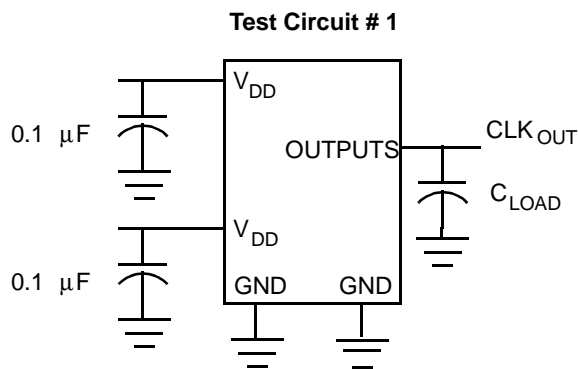
### Input-Output Propagation Delay



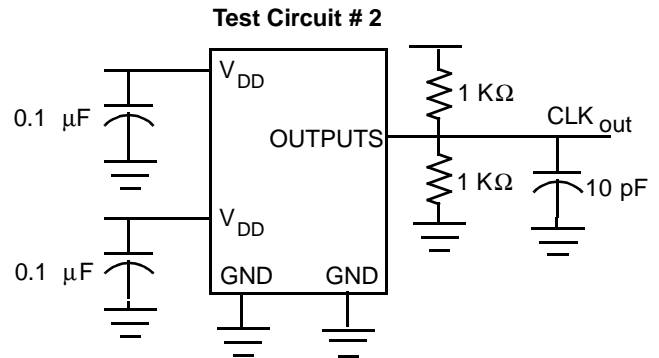
### Device-Device Skew



## Test Circuits



Test Circuit for all parameters except  $t_g$



Test Circuit for  $t_g$ , Output slew rate on –1H device

## Ordering Information

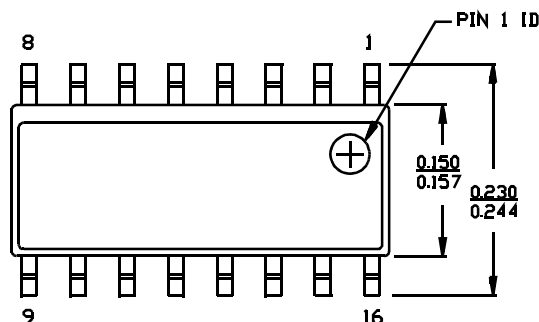
Ordering Code	Package Name	Package Type	Operating Range
CY23S08SC-1	S16	16-pin 150-mil SOIC	Commercial
CY23S08SC-1H	S16	16-pin 150-mil SOIC	Commercial
CY23S08ZC-1H	Z16	16-pin 150-mil TSSOP	Commercial
CY23S08SC-2	S16	16-pin 150-mil SOIC	Commercial
CY23S08SC-2H	S16	16-pin 150-mil SOIC	Commercial
CY23S08SC-3	S16	16-pin 150-mil SOIC	Commercial
CY23S08SC-4	S16	16-pin 150-mil SOIC	Commercial

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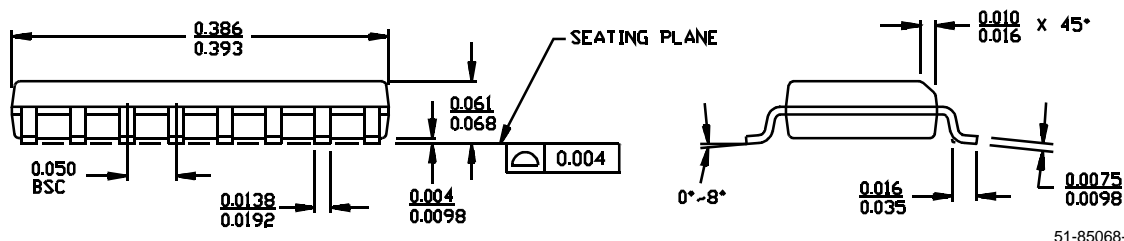
Spread Aware is a trademark of Cypress Semiconductor



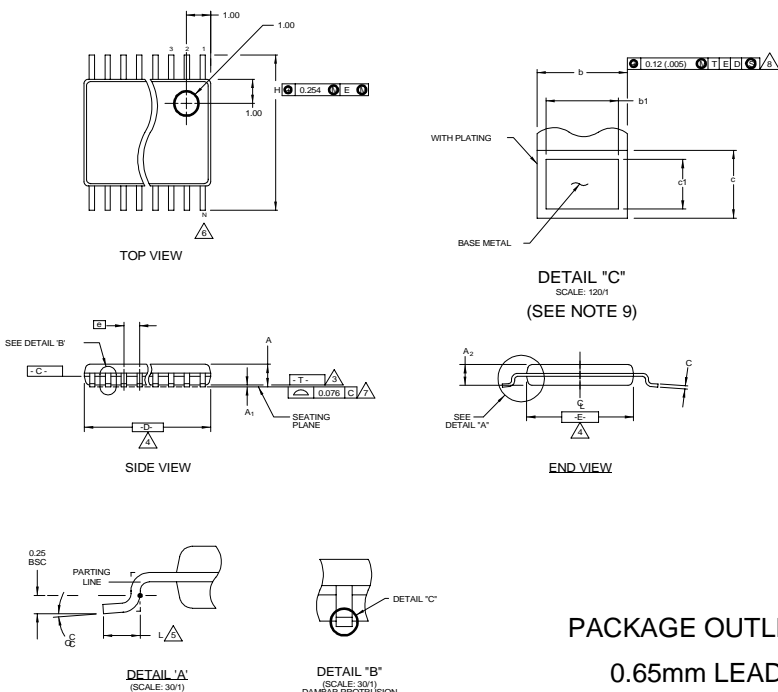
### 16-Lead (150-Mil) Molded SOIC S16



DIMENSIONS IN INCHES		MIN.	MAX.
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### 16-Lead Thin Shrunk Small Outline Package (4.40 MM Body) Z16



NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.2790.0127 (0.1010 DIE THICKNESS ALLOWABLE IS 0.279.0005 INCHES)
2. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982.
3. "T" IS A REFERENCE DATUM.
4. "D" & "E" ARE REFERENCE DATUMS AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS, AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.5mm PER SIDE. DIMENSION IS THE LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
5. TERMINAL POSITIONS ARE SHOWN FOR REFERENCE ONLY.
6. FORMED LEADS SHALL BE FLAT WITH RESPECT TO ONE ANOTHER WITHIN 0.001mm OF SEATING PLANE. THE LEAD WIDTH DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND AN ADJACENT LEAD TO BE 0.14mm SEE DETAILS "B" & "C".
7. DETAIL "C" TO BE DETERMINED AT 0.10 TO 0.25mm IN DEPENDENT ON LEAD WIDTH.
8. CONTROLLING DIMENSION MILLIMETERS.
9. THIS PART IS COMPLIANT WITH JEDEC SPECIFICATION MO-153. VARIATIONS A8, A9, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20, A21, A22, A23, A24, A25, A26, A27, A28, A29, A30, A31, A32, A33, A34, A35, A36, A37, A38, A39, A40, A41, A42, A43, A44, A45, A46, A47, A48, A49, A50, A51, A52, A53, A54, A55, A56, A57, A58, A59, A60, A61, A62, A63, A64, A65, A66, A67, A68, A69, A70, A71, A72, A73, A74, A75, A76, A77, A78, A79, A80, A81, A82, A83, A84, A85, A86, A87, A88, A89, A90, A91, A92, A93, A94, A95, A96, A97, A98, A99, A100, A101, A102, A103, A104, A105, A106, A107, A108, A109, A110, A111, A112, A113, A114, A115, A116, A117, A118, A119, A120, A121, A122, A123, A124, A125, A126, A127, A128, A129, A130, A131, A132, A133, A134, A135, A136, A137, A138, A139, A140, A141, A142, A143, A144, A145, A146, A147, A148, A149, A150, A151, A152, A153, A154, A155, A156, A157, A158, A159, A160, A161, A162, A163, A164, A165, A166, A167, A168, A169, A170, A171, A172, A173, A174, A175, A176, A177, A178, A179, A180, A181, A182, A183, A184, A185, A186, A187, A188, A189, A190, A191, A192, A193, A194, A195, A196, A197, A198, A199, A200, A201, A202, A203, A204, A205, A206, A207, A208, A209, A210, A211, A212, A213, A214, A215, A216, A217, A218, A219, A220, A221, A222, A223, A224, A225, A226, A227, A228, A229, A230, A231, A232, A233, A234, A235, A236, A237, A238, A239, A240, A241, A242, A243, A244, A245, A246, A247, A248, A249, A250, A251, A252, A253, A254, A255, A256, A257, A258, A259, A260, A261, A262, A263, A264, A265, A266, A267, A268, A269, A270, A271, A272, A273, A274, A275, A276, A277, A278, A279, A280, A281, A282, A283, A284, A285, A286, A287, A288, A289, A290, A291, A292, A293, A294, A295, A296, A297, A298, A299, A300, A301, A302, A303, A304, A305, A306, A307, A308, A309, A310, A311, A312, A313, A314, A315, A316, A317, A318, A319, A320, A321, A322, A323, A324, A325, A326, A327, A328, A329, A330, A331, A332, A333, A334, A335, A336, A337, A338, A339, A340, A341, A342, A343, A344, A345, A346, A347, A348, A349, A350, A351, A352, A353, A354, A355, A356, A357, A358, A359, A360, A361, A362, A363, A364, A365, A366, A367, A368, A369, A370, A371, A372, A373, A374, A375, A376, A377, A378, A379, A380, A381, A382, A383, A384, A385, A386, A387, A388, A389, A390, A391, A392, A393, A394, A395, A396, A397, A398, A399, A400, A401, A402, A403, A404, A405, A406, A407, A408, A409, A410, A411, A412, A413, A414, A415, A416, A417, A418, A419, A420, A421, A422, A423, A424, A425, A426, A427, A428, A429, A430, A431, A432, A433, A434, A435, A436, A437, A438, A439, A440, A441, A442, A443, A444, A445, A446, A447, A448, A449, A450, A451, A452, A453, A454, A455, A456, A457, A458, A459, A460, A461, A462, A463, A464, A465, A466, A467, A468, A469, A470, A471, A472, A473, A474, A475, A476, A477, A478, A479, A480, A481, A482, A483, A484, A485, A486, A487, A488, A489, A490, A491, A492, A493, A494, A495, A496, A497, A498, A499, A500, A501, A502, A503, A504, A505, A506, A507, A508, A509, A510, A511, A512, A513, A514, A515, A516, A517, A518, A519, A520, A521, A522, A523, A524, A525, A526, A527, A528, A529, A530, A531, A532, A533, A534, A535, A536, A537, A538, A539, A540, A541, A542, A543, A544, A545, A546, A547, A548, A549, A550, A551, A552, A553, A554, A555, A556, A557, A558, A559, A560, A561, A562, A563, A564, A565, A566, A567, A568, A569, A570, A571, A572, A573, A574, A575, A576, A577, A578, A579, A580, A581, A582, A583, A584, A585, A586, A587, A588, A589, A590, A591, A592, A593, A594, A595, A596, A597, A598, A599, A600, A601, A602, A603, A604, A605, A606, A607, A608, A609, A610, A611, A612, A613, A614, A615, A616, A617, A618, A619, A620, A621, A622, A623, A624, A625, A626, A627, A628, A629, A630, A631, A632, A633, A634, A635, A636, A637, A638, A639, A640, A641, A642, A643, A644, A645, A646, A647, A648, A649, A650, A651, A652, A653, A654, A655, A656, A657, A658, A659, A660, A661, A662, A663, A664, A665, A666, A667, A668, A669, A670, A671, A672, A673, A674, A675, A676, A677, A678, A679, A680, A681, A682, A683, A684, A685, A686, A687, A688, A689, A690, A691, A692, A693, A694, A695, A696, A697, A698, A699, A700, A701, A702, A703, A704, A705, A706, A707, A708, A709, A710, A711, A712, A713, A714, A715, A716, A717, A718, A719, A720, A721, A722, A723, A724, A725, A726, A727, A728, A729, A730, A731, A732, A733, A734, A735, A736, A737, A738, A739, A740, A741, A742, A743, A744, A745, A746, A747, A748, A749, A750, A751, A752, A753, A754, A755, A756, A757, A758, A759, A7

PACKAGE OUTLINE, 4.40mm (.173") BODY,  
0.65mm LEAD PITCH, TSSOP