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CAT93C66, CAT93W66

4 kb Microwire Serial CMOS EEPROM

Description

The CAT93C66 is a 4 kb CMOS Serial EEPROM device which is organized as either 256 registers of 16 bits (ORG pin at V_{CC}) or 512 registers of 8 bits (ORG pin at GND). The CAT93W66 features x16 memory organization only. Each register can be written (or read) serially by using the DI (or DO) pin. The device features sequential read and self−timed internal write with auto−clear. On−chip Power−On Reset circuitry protects the internal logic against powering up in the wrong state.

Features

- High Speed Operation: 2 MHz
- 1.8 V to 5.5 V Supply Voltage Range
- Selectable x8 or x16 Memory Organization: CAT93C66
- Sequential Read
- Software Write Protection
- Power−up Inadvertent Write Protection
- Low Power CMOS Technology
- 1,000,000 Program/Erase Cycles
- 100 Year Data Retention
- Industrial and Extended Temperature Ranges
- 8−lead PDIP, SOIC, TSSOP and 8−pad TDFN Packages
- These Devices are Pb−Free, Halogen Free/BFR Free, and RoHS Compliant

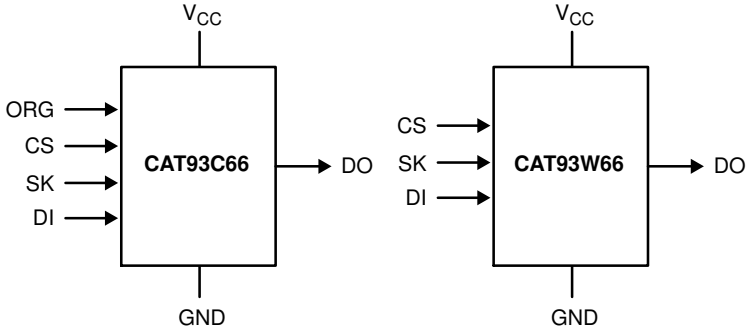

Figure 1. Functional Symbols

CAT93C66 Selectable Organization:

When the ORG pin is connected to V_{CC}, the x16 organization is selected. When it is connected to ground, the x8 organization is selected. If the ORG pin is left unconnected, then an internal pull−up device will select the x16 organization.

CAT93W66*:

The device works in x16 mode only.

*Not recommended for new designs

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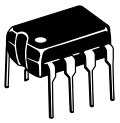
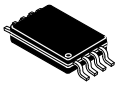
SOIC−8
V SUFFIX
CASE 751BD

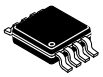
TDFN−8
VP2 SUFFIX
CASE 511AK



PDIP−8
L SUFFIX
CASE 646AA



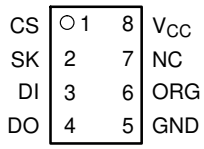
TSSOP−8
Y SUFFIX
CASE 948AL



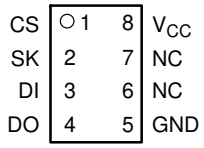
SOIC−8
X SUFFIX
CASE 751BE

PIN CONFIGURATION

(Top View)



PDIP (L), SOIC (V, X),
TSSOP (Y),
TDFN (VP2)



TDFN (VP2)
CAT93W66*

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 13 of this data sheet.

Table 1. PIN FUNCTION

Pin Name	Function	Pin Name	Function
CS	Chip Select	V_{CC}	Power Supply
SK	Clock Input	GND	Ground
DI	Serial Data Input	ORG (Note 1)	Memory Organization
DO	Serial Data Output	NC	No Connection

1. ORG Pin available for the CAT93C66 only.

Table 2. ABSOLUTE MAXIMUM RATINGS

Parameters	Ratings	Units
Storage Temperature	−65 to +150	°C
Voltage on Any Pin with Respect to Ground (Note 2)	−0.5 to +6.5	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

2. The DC input voltage on any pin should not be lower than −0.5 V or higher than V_{CC} + 0.5 V. During transitions, the voltage on any pin may undershoot to no less than −1.5 V or overshoot to no more than V_{CC} + 1.5 V, for periods of less than 20 ns.

Table 3. RELIABILITY CHARACTERISTICS (Note 3)

Symbol	Parameter	Min	Units
N_{END} (Note 4)	Endurance	1,000,000	Program / Erase Cycles
T_{DR}	Data Retention	100	Years

3. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC−Q100 and JEDEC test methods.
4. Block Mode, V_{CC} = 5 V, 25°C.

Table 4. D.C. OPERATING CHARACTERISTICS

(V_{CC} = +1.8 V to +5.5 V, T_A = −40°C to +125°C unless otherwise specified.)

Symbol	Parameter	Test Conditions		Min	Max	Units
I_{CC1}	Power Supply Current (Write)	f_{SK} = 1 MHz, V_{CC} = 5.0 V			1	mA
I_{CC2}	Power Supply Current (Read)	f_{SK} = 1 MHz, V_{CC} = 5.0 V			500	μA
I_{SB1}	Power Supply Current (Standby) (x8 Mode)	V_{IN} = GND or V_{CC}, CS = GND ORG = GND	T_A = −40°C to +85°C		2	μA
			T_A = −40°C to +125°C		4	
I_{SB2}	Power Supply Current (Standby) (x16 Mode)	V_{IN} = GND or V_{CC}, CS = GND ORG = Float or V_{CC}	T_A = −40°C to +85°C		1	μA
			T_A = −40°C to +125°C		2	
I_{LI}	Input Leakage Current	V_{IN} = GND to V_{CC}	T_A = −40°C to +85°C		1	μA
			T_A = −40°C to +125°C		2	
I_{LO}	Output Leakage Current	V_{OUT} = GND to V_{CC}, CS = GND	T_A = −40°C to +85°C		1	μA
			T_A = −40°C to +125°C		2	
V_{IL1}	Input Low Voltage	4.5 V ≤ V_{CC} < 5.5 V		−0.1	0.8	V
V_{IH1}	Input High Voltage	4.5 V ≤ V_{CC} < 5.5 V		2	V_{CC} + 1	V
V_{IL2}	Input Low Voltage	1.8 V ≤ V_{CC} < 4.5 V		0	V_{CC} x 0.2	V
V_{IH2}	Input High Voltage	1.8 V ≤ V_{CC} < 4.5 V		V_{CC} x 0.7	V_{CC} + 1	V
V_{OL1}	Output Low Voltage	4.5 V ≤ V_{CC} < 5.5 V, I_{OL} = 2.1 mA			0.4	V
V_{OH1}	Output High Voltage	4.5 V ≤ V_{CC} < 5.5 V, I_{OH} = −400 μA		2.4		V
V_{OL2}	Output Low Voltage	1.8 V ≤ V_{CC} < 4.5 V, I_{OL} = 1 mA			0.2	V
V_{OH2}	Output High Voltage	1.8 V ≤ V_{CC} < 4.5 V, I_{OH} = −100 μA		V_{CC} − 0.2		V

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Table 5. PIN CAPACITANCE (T_A = 25°C, f = 1.0 MHz, V_{CC} = +5.0 V)

Symbol	Test	Conditions	Min	Typ	Max	Units
C_{OUT} (Note 5)	Output Capacitance (DO)	V_{OUT} = 0 V			5	pF
C_{IN} (Note 5)	Input Capacitance (CS, SK, DI, ORG)	V_{IN} = 0 V			5	pF

5. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC−Q100 and JEDEC test methods.

Table 6. A.C. CHARACTERISTICS
(V_{CC} = +1.8 V to +5.5 V, T_A = −40°C to +125°C, unless otherwise specified.) (Note 6)

Symbol	Parameter	Limits		Units
		Min	Max	
t_{CSS}	CS Setup Time	50		ns
t_{CSH}	CS Hold Time	0		ns
t_{DIS}	DI Setup Time	100		ns
t_{DIH}	DI Hold Time	100		ns
t_{PD1}	Output Delay to 1		0.25	μs
t_{PD0}	Output Delay to 0		0.25	μs
t_{HZ} (Note 7)	Output Delay to High−Z		100	ns
t_{EW}	Program/Erase Pulse Width		5	ms
t_{CSMIN}	Minimum CS Low Time	0.25		μs
t_{SKHI}	Minimum SK High Time	0.25		μs
t_{SKLOW}	Minimum SK Low Time	0.25		μs
t_{SV}	Output Delay to Status Valid		0.25	μs
SK_{MAX}	Maximum Clock Frequency	DC	2000	kHz

6. Test conditions according to “A.C. Test Conditions” table.
7. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC−Q100 and JEDEC test methods.

Table 7. POWER−UP TIMING (Notes 8, 9)

Symbol	Parameter	Max	Units
t_{PUR}	Power−up to Read Operation	1	ms
t_{PUW}	Power−up to Write Operation	1	ms

8. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC−Q100 and JEDEC test methods.
9. t_{PUR} and t_{PUW} are the delays required from the time V_{CC} is stable until the specified operation can be initiated.

Table 8. A.C. TEST CONDITIONS

Input Rise and Fall Times	≤ 50 ns	
Input Pulse Voltages	0.4 V to 2.4 V	4.5 V ≤ V_{CC} ≤ 5.5 V
Timing Reference Voltages	0.8 V, 2.0 V	4.5 V ≤ V_{CC} ≤ 5.5 V
Input Pulse Voltages	0.2 V_{CC} to 0.7 V_{CC}	1.8 V ≤ V_{CC} ≤ 4.5 V
Timing Reference Voltages	0.5 V_{CC}	1.8 V ≤ V_{CC} ≤ 4.5 V
Output Load	Current Source I_{OLmax}/I_{OHmax}; CL = 100 pF	

Device Operation

The CAT93C66 is a 4096−bit nonvolatile memory intended for use with industry standard microprocessors. The CAT93C66 can be organized as either registers of 16 bits or 8 bits. When organized as X16, seven 11−bit instructions control the reading, writing and erase operations of the device. When organized as X8, seven 12−bit instructions control the reading, writing and erase operations of the device. The CAT93W66 works in x16 mode only. The device operates on a single power supply and will generate on chip, the high voltage required during any write operation.

Instructions, addresses, and write data are clocked into the DI pin on the rising edge of the clock (SK). The DO pin is normally in a high impedance state except when reading data from the device, or when checking the ready/busy status after a write operation. The serial communication protocol follows the timing shown in Figure 2.

The ready/busy status can be determined after the start of internal write cycle by selecting the device (CS high) and polling the DO pin; DO low indicates that the write operation is not completed, while DO high indicates that the device is ready for the next instruction. If necessary, the DO pin may be placed back into a high impedance state during chip select by shifting a dummy “1” into the DI pin. The DO pin will enter the high impedance state on the rising edge of the clock (SK). Placing the DO pin into the high impedance state is recommended in applications where the DI pin and the DO pin are to be tied together to form a common DI/O pin.

The format for all instructions sent to the device is a logical “1” start bit, a 2−bit (or 4−bit) opcode, 8−bit address (an additional bit when organized X8) and for write operations a 16−bit data field (8−bit for X8 organizations). The instruction format is shown in Instruction Set table.

Table 9. INSTRUCTION SET

Instruction	Start Bit	Opcode	Address		Data		Comments
			x8 (Note 10)	**x16**	**x8** (Note 10)	**x16**	
READ	1	10	A8–A0	A7–A0			Read Address AN – A0
ERASE	1	11	A8–A0	A7–A0			Clear Address AN – A0
WRITE	1	01	A8–A0	A7–A0	D7–D0	D15–D0	Write Address AN – A0
EWEN	1	00	11XXXXXXX	11XXXXXX			Write Enable
EWDS	1	00	00XXXXXXX	00XXXXXX			Write Disable
ERAL	1	00	10XXXXXXX	10XXXXXX			Clear All Addresses
WRAL	1	00	01XXXXXXX	01XXXXXX	D7–D0	D15–D0	Write All Addresses

10. The x8 memory organization is available for the CAT93C66 only.

Read

Upon receiving a READ command and an address (clocked into the DI pin), the DO pin of the CAT93C66, CAT93W66 will come out of the high impedance state and, after sending an initial dummy zero bit, will begin shifting out the data addressed (MSB first). The output data bits will toggle on the rising edge of the SK clock and are stable after the specified time delay (t_{PD0} or t_{PD1}).

For the CAT93C66, CAT93W66 after the initial data word has been shifted out and CS remains asserted with the SK clock continuing to toggle, the device will automatically increment to the next address and shift out the next data word in a sequential READ mode. As long as CS is continuously asserted and SK continues to toggle, the device will keep incrementing to the next address automatically until it reaches to the end of the address space, then loops back to address 0. In the sequential READ mode, only the initial data word is preceeded by a dummy zero bit. All subsequent data words will follow without a dummy zero bit. The READ instruction timing is illustrated in Figure 3.

Erase/Write Enable and Disable

The device powers up in the write disable state. Any writing after power−up or after an EWDS (erase/write disable) instruction must first be preceded by the EWEN (erase/write enable) instruction. Once the write instruction is enabled, it will remain enabled until power to the device is removed, or the EWDS instruction is sent. The EWDS instruction can be used to disable all CAT93C66, CAT93W66 write and erase instructions, and will prevent any accidental writing or clearing of the device. Data can be read normally from the device regardless of the write enable/disable status. The EWEN and EWDS instructions timing is shown in Figure 4.

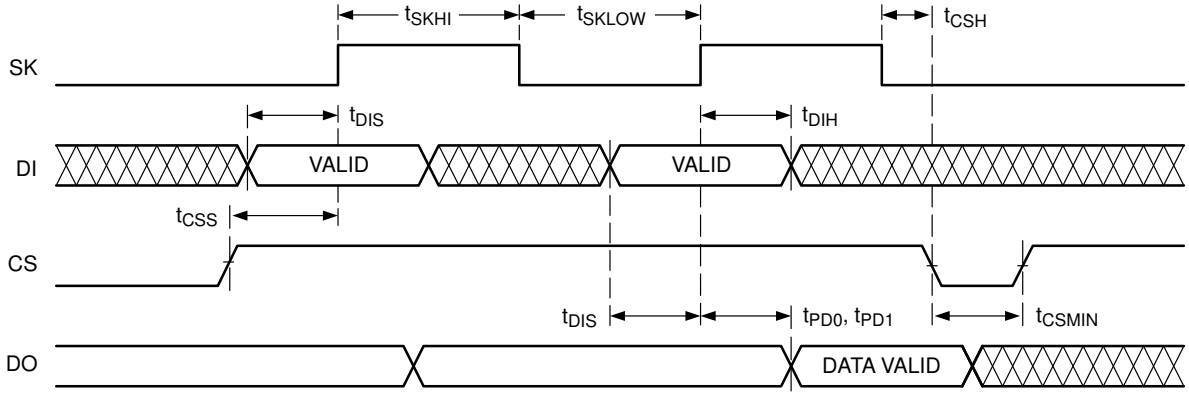


Figure 2. Synchronous Data Timing

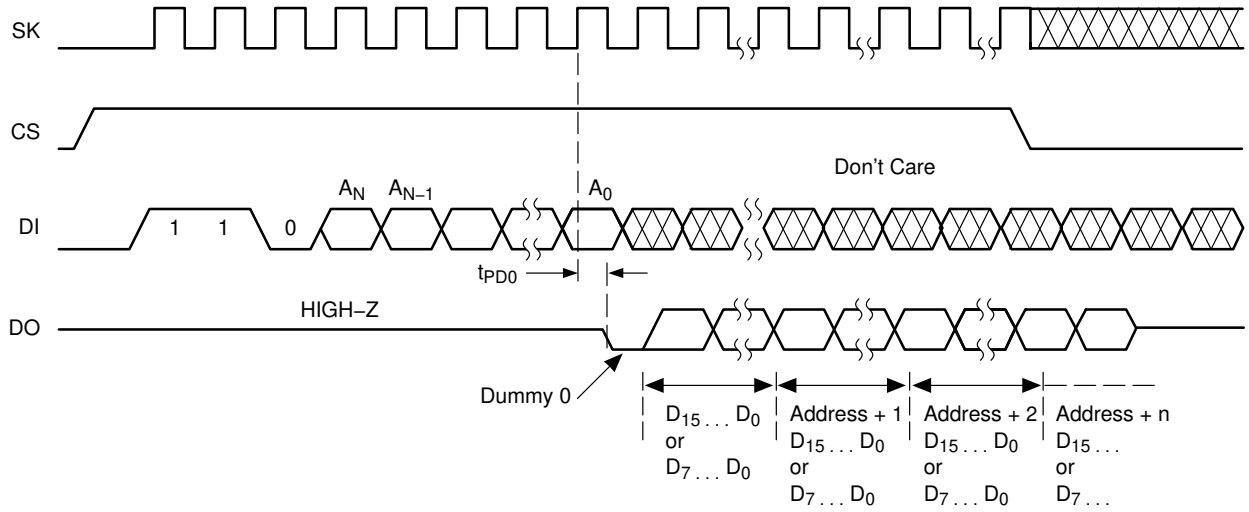


Figure 3. READ Instruction Timing

Write

After receiving a WRITE command (Figure 5), address and the data, the CS (Chip Select) pin must be deselected for a minimum of t_{CSMIN}. The falling edge of CS will start the self clocking clear and data store cycle of the memory location specified in the instruction. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C66, CAT93W66 can be determined by selecting the device and polling the DO pin. Since this device features Auto−Clear before write, it is NOT necessary to erase a memory location before it is written into.

Erase

Upon receiving an ERASE command and address, the CS (Chip Select) pin must be deasserted for a minimum of t_{CSMIN} (Figure 6). The falling edge of CS will start the self clocking clear cycle of the selected memory location. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C66, CAT93W66 can be determined by selecting the device and polling the DO pin. Once cleared, the content of a cleared location returns to a logical “1” state.

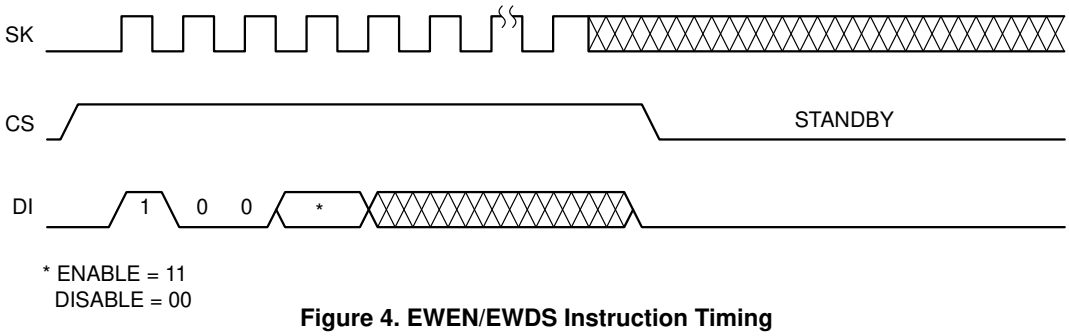


Figure 4. EWEN/EWDS Instruction Timing

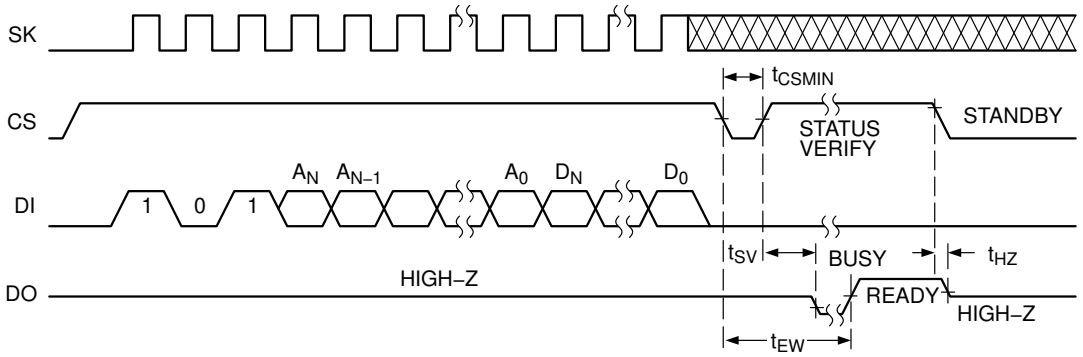


Figure 5. Write Instruction Timing

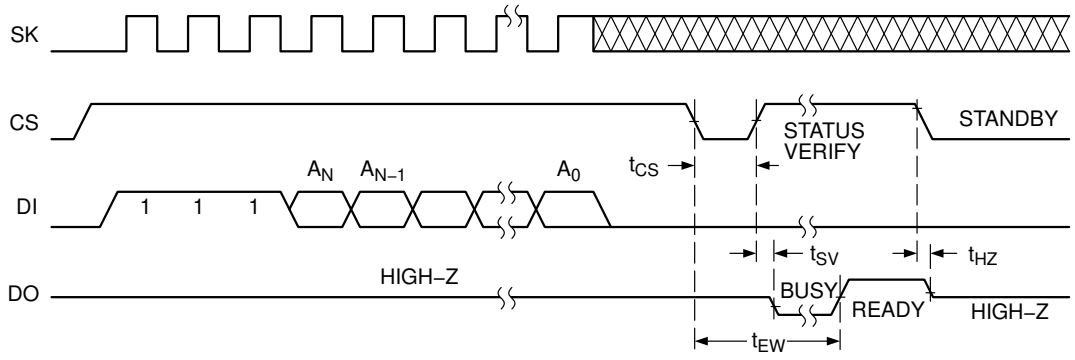


Figure 6. Erase Instruction Timing

Erase All

Upon receiving an ERAL command (Figure 7), the CS (Chip Select) pin must be deselected for a minimum of t_{CSMIN}. The falling edge of CS will start the self clocking clear cycle of all memory locations in the device. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the device can be determined by selecting the device and polling the DO pin. Once cleared, the contents of all memory bits return to a logical “1” state.

Write All

Upon receiving a WRAL command and data, the CS (Chip Select) pin must be deselected for a minimum of t_{CSMIN} (Figure 8). The falling edge of CS will start the self clocking data write to all memory locations in the device. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the device can be determined by selecting the device and polling the DO pin. It is not necessary for all memory locations to be cleared before the WRAL command is executed.

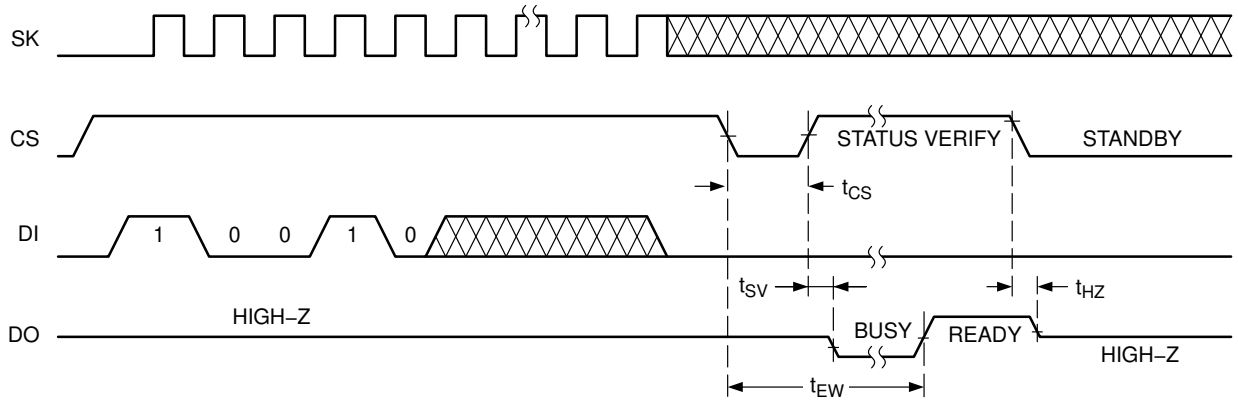


Figure 7. ERAL Instruction Timing

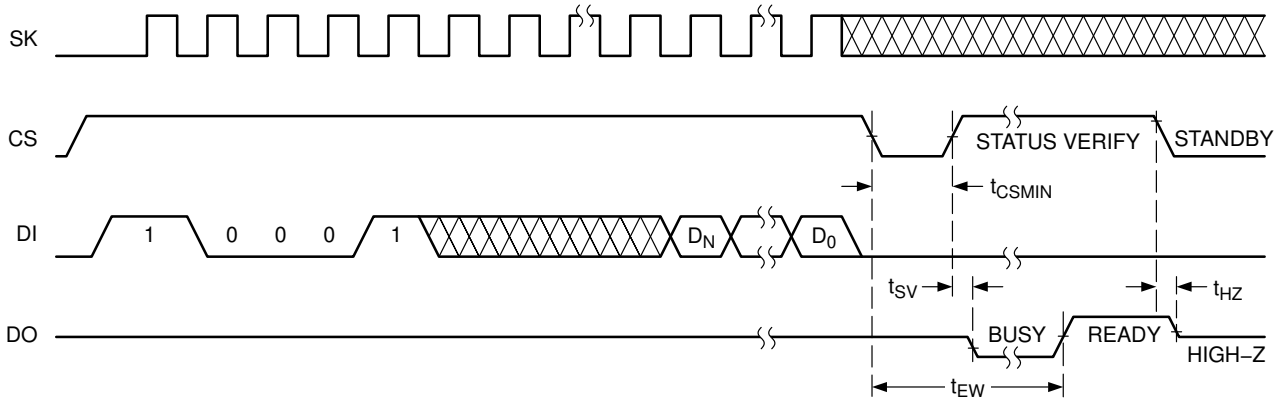
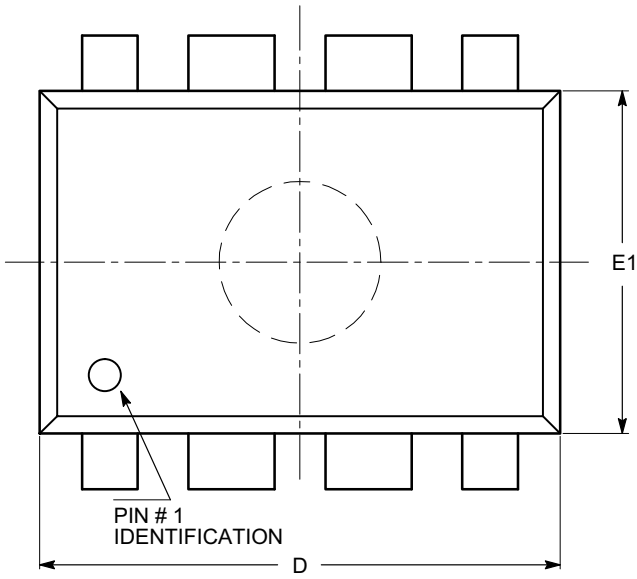


Figure 8. WRAL Instruction Timing

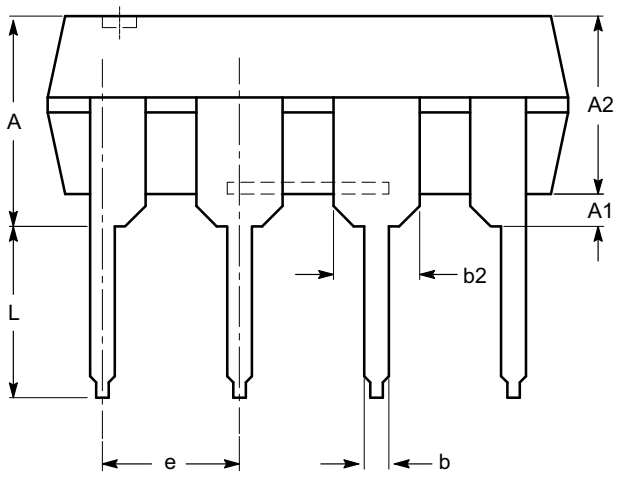
PACKAGE DIMENSIONS

PDIP–8, 300 mils
CASE 646AA–01
ISSUE A

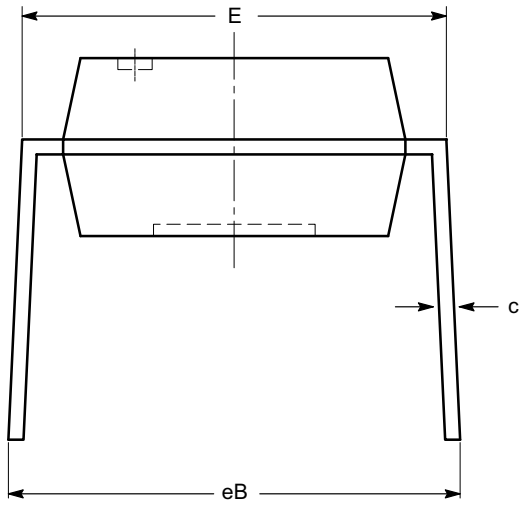


TOP VIEW

SYMBOL	MIN	NOM	MAX
A			5.33
A1	0.38		
A2	2.92	3.30	4.95
b	0.36	0.46	0.56
b2	1.14	1.52	1.78
c	0.20	0.25	0.36
D	9.02	9.27	10.16
E	7.62	7.87	8.25
E1	6.10	6.35	7.11
e		2.54 BSC	
eB	7.87		10.92
L	2.92	3.30	3.80



SIDE VIEW

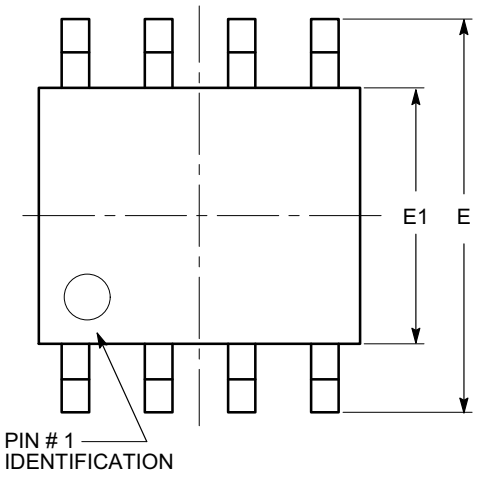


END VIEW

Notes:
(1) All dimensions are in millimeters.
(2) Complies with JEDEC MS-001.

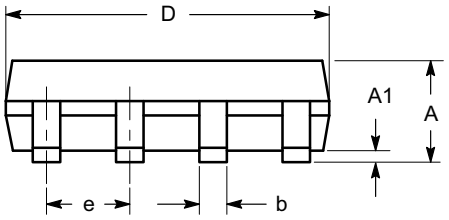
PACKAGE DIMENSIONS

SOIC 8, 150 mils
CASE 751BD–01
ISSUE O

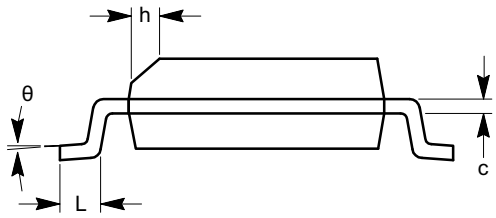


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	4.80		5.00
E	5.80		6.20
E1	3.80		4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
θ	0°		8°



SIDE VIEW

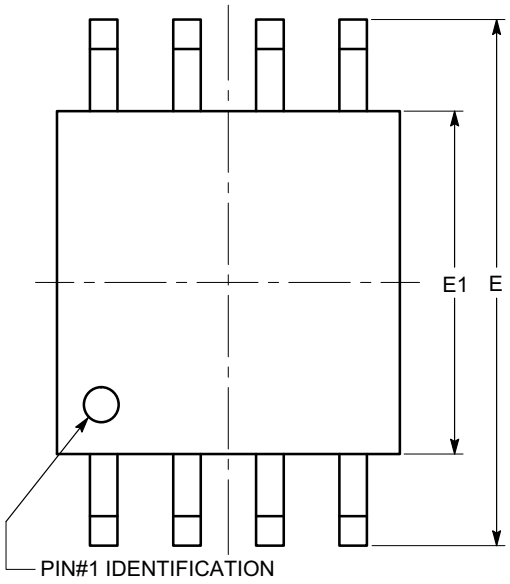


END VIEW

Notes:
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with JEDEC MS-012.

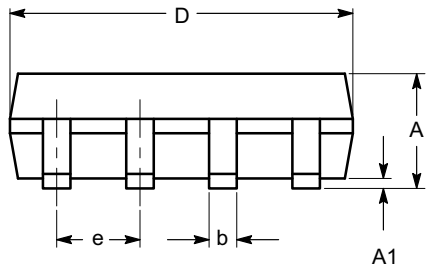
PACKAGE DIMENSIONS

SOIC–8, 208 mils
CASE 751BE–01
ISSUE O

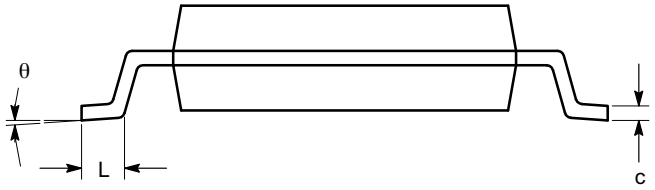


TOP VIEW

SYMBOL	MIN	NOM	MAX
A			2.03
A1	0.05		0.25
b	0.36		0.48
c	0.19		0.25
D	5.13		5.33
E	7.75		8.26
E1	5.13		5.38
e	1.27 BSC		
L	0.51		0.76
θ	0°		8°



SIDE VIEW

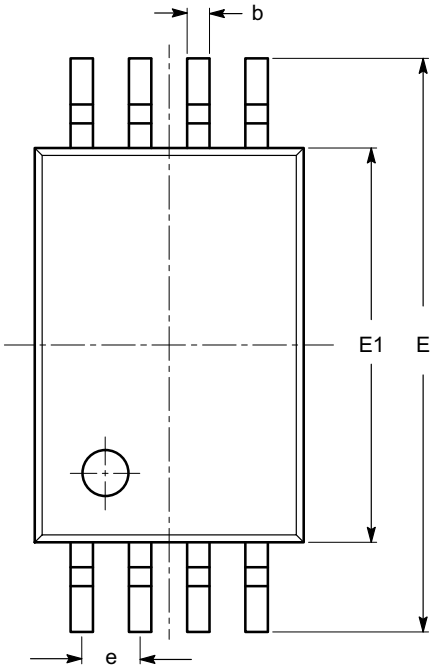


END VIEW

Notes:
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with EIAJ EDR-7320.

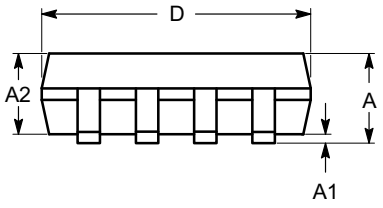
PACKAGE DIMENSIONS

TSSOP8, 4.4x3
CASE 948AL−01
ISSUE O

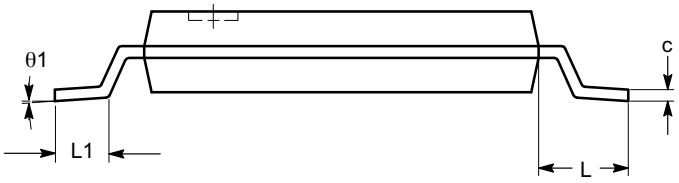


TOP VIEW

SYMBOL	MIN	NOM	MAX
A			1.20
A1	0.05		0.15
A2	0.80	0.90	1.05
b	0.19		0.30
c	0.09		0.20
D	2.90	3.00	3.10
E	6.30	6.40	6.50
E1	4.30	4.40	4.50
e	0.65 BSC		
L	1.00 REF		
L1	0.50	0.60	0.75
θ	0°		8°



SIDE VIEW

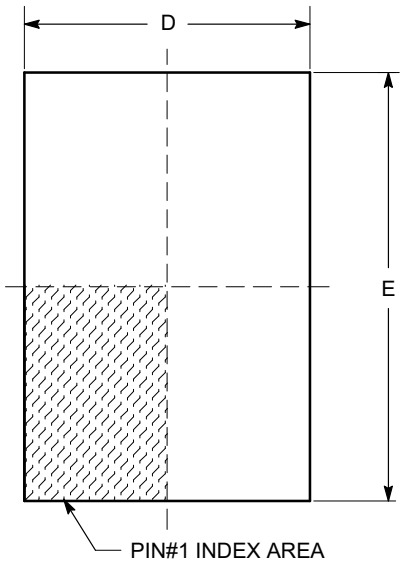


END VIEW

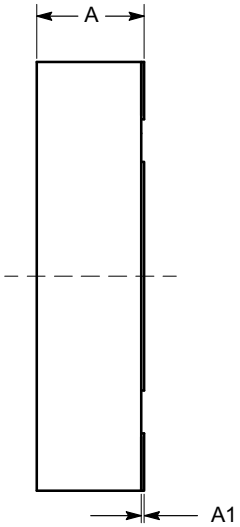
Notes:
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with JEDEC MO-153.

PACKAGE DIMENSIONS

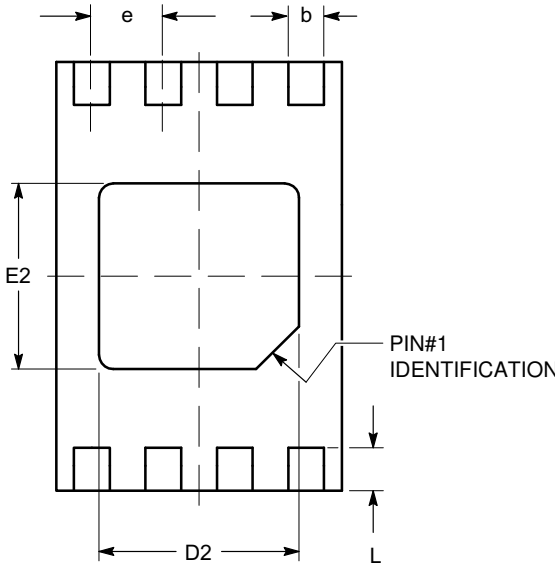
TDFN8, 2x3
CASE 511AK–01
ISSUE A



TOP VIEW

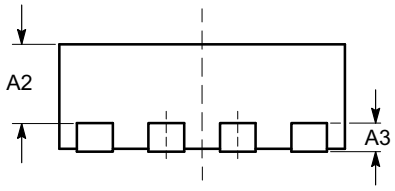


SIDE VIEW



BOTTOM VIEW

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2	0.45	0.55	0.65
A3		0.20 REF	
b	0.20	0.25	0.30
D	1.90	2.00	2.10
D2	1.30	1.40	1.50
E	2.90	3.00	3.10
E2	1.20	1.30	1.40
e		0.50 TYP	
L	0.20	0.30	0.40



FRONT VIEW

Notes:
(1) All dimensions are in millimeters.
(2) Complies with JEDEC MO-229.

Table 10. ORDERING INFORMATION

OPN	Specific Device Marking	Pkg Type	Temperature Range	Lead Finish	Shipping
CAT93C66LI–G	CSI*4G / 93C66LI	PDIP–8	I = Industrial (–40°C to +85°C)	NiPdAu	Tube, 50 Units / Tube
CAT93C66VE–G	CSI*4G / 93C66VE	SOIC–8, JEDEC	E = Extended (–40°C to +125°C)	NiPdAu	Tube, 100 Units / Tube
CAT93C66VE–GT3	CSI*4G / 93C66VE	SOIC–8, JEDEC	E = Extended (–40°C to +125°C)	NiPdAu	Tape & Reel, 3000 Units / Reel
CAT93C66VI–G	CSI*4G / 93C66VI	SOIC–8, JEDEC	I = Industrial (–40°C to +85°C)	NiPdAu	Tube, 100 Units / Tube
CAT93C66VI–GT3	CSI*4G / 93C66VI	SOIC–8, JEDEC	I = Industrial (–40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel
CAT93C66VP2I–GT3	FU	TDFN–8	I = Industrial (–40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel
CAT93C66XI	CSI*3G / 93C66XI	SOIC–8, EIAJ	I = Industrial (–40°C to +85°C)	Matte–Tin	Tube, 94 Units / Tube
CAT93C66XI–T2	CSI*3G / 93C66XI	SOIC–8, EIAJ	I = Industrial (–40°C to +85°C)	Matte–Tin	Tape & Reel, 2000 Units / Reel
CAT93C66YI–G	M66	TSSOP–8	I = Industrial (–40°C to +85°C)	NiPdAu	Tube, 100 Units / Tube
CAT93C66YI–GT3	M66	TSSOP–8	I = Industrial (–40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel
CAT93W66VP2I–GT3	M2C	TDFN–8	I = Industrial (–40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel

11. All packages are RoHS–compliant (Lead–free, Halogen–free).
12. The standard lead finish is NiPdAu.
13. For additional package and temperature options, please contact your nearest ON Semiconductor Sales office.
14. For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
15. For detailed information and a breakdown of device nomenclature and numbering systems, please see the ON Semiconductor Device Nomenclature document, TND310/D, available at www.onsemi.com

PUBLICATION ORDERING INFORMATION

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