



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

1K Microwire Compatible Serial EEPROM

Device Selection Table

Part Number	VCC Range	ORG Pin	Word Size	Temp Ranges	Packages
93AA46A	1.8-5.5	No	8-bit	I	P, SN, ST, MS, OT
93AA46B	1.8-5.5	No	16-bit	I	P, SN, ST, MS, OT
93LC46A	2.5-5.5	No	8-bit	I, E	P, SN, ST, MS, OT
93LC46B	2.5-5.5	No	16-bit	I, E	P, SN, ST, MS, OT
93C46A	4.5-5.5	No	8-bit	I, E	P, SN, ST, MS, OT
93C46B	4.5-5.5	No	16-bit	I, E	P, SN, ST, MS, OT
93AA46C	1.8-5.5	Yes	8 or 16-bit	I	P, SN, ST, MS
93LC46C	2.5-5.5	Yes	8 or 16-bit	I, E	P, SN, ST, MS
93C46C	4.5-5.5	Yes	8 or 16-bit	I, E	P, SN, ST, MS

Features

- Low-power CMOS technology
- ORG pin to select word size for '46C version
- 128 x 8-bit organization 'A' ver. devices (no ORG)
- 64 x 16-bit organization 'B' ver. devices (no ORG)
- Self-timed ERASE/WRITE cycles (including auto-erase)
- Automatic ERAL before WRAL
- Power-on/off data protection circuitry
- Industry standard 3-wire serial I/O
- Device Status signal (READY/BUSY)
- Sequential READ function
- 1,000,000 E/W cycles
- Data retention > 200 years
- Temperature ranges supported
 - Industrial (I) -40°C to +85°C
 - Automotive (E) -40°C to +125°C

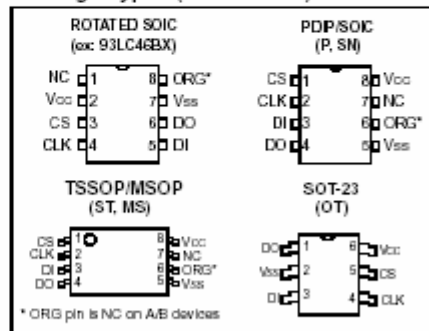
Pin Function Table

Name	Function
CS	Chip Select
CLK	Serial Data Clock
DI	Serial Data Input
DO	Serial Data Output
VSS	Ground
NC	No internal connection
ORG	Memory Configuration
VCC	Power Supply

Description

The Microchip Technology Inc. 93XX46A/B/C devices are 1K bit low voltage serial Electrically Erasable PROMs (EEPROM). Word-selectable devices such as the 93AA46C, 93LC46C or 93C46C are dependent upon external logic levels driving the ORG pin to set word size. For dedicated 8-bit communication, the 93AA46A, 93LC46A or 93C46A devices are available, while the 93AA46B, 93LC46B and 93C46B devices provide dedicated 16-bit communication. Advanced CMOS technology makes these devices ideal for low power, nonvolatile memory applications. The entire 93XX Series is available in standard packages including 8-lead PDIP and SOIC, and advanced packaging including 8-lead MSOP, 6-lead SOT-23, and 8-lead TSSOP. Pb-free (Pure Matte Sn) finish is also available.

Package Types (not to scale)



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings^(†)

VCC	7.0V
All inputs and outputs w.r.t. VSS	-0.6V to VCC +1.0V
Storage temperature	-65°C to +150°C
Ambient temperature with power applied	-40°C to +125°C
ESD protection on all pins	≥ 4 kV

† NOTICE: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

TABLE 1-1: DC CHARACTERISTICS

All parameters apply over the specified ranges unless otherwise noted.			VCC = range by device (see Table on Page 1)				
			Industrial (I): TA = -40°C to +85°C				
			Automotive (E): TA = -40°C to +125°C				
Param. No.	Symbol	Parameter	Min	Typ	Max	Units	Conditions
D1	VH1	High-level input voltage	2.0	—	VCC +1	V	VCC ≥ 2.7V
	VH2		0.7 VCC	—	VCC +1	V	VCC < 2.7V
D2	VL1	Low-level input voltage	-0.3	—	0.8	V	VCC ≥ 2.7V
	VL2		-0.3	—	0.2 VCC	V	VCC < 2.7V
D3	VOL1	Low-level output voltage	—	—	0.4	V	IOL = 2.1 mA, VCC = 4.5V
	VOL2		—	—	0.2	V	IOL = 100 µA, VCC = 2.5V
D4	VOH1	High-level output voltage	2.4	—	—	V	IOH = -400 µA, VCC = 4.5V
	VOH2		VCC - 0.2	—	—	V	IOH = -100 µA, VCC = 2.5V
D5	I _I	Input leakage current	—	—	±1	µA	V _{IN} = VSS to VCC
D6	I _O	Output leakage current	—	—	±1	µA	V _{OUT} = VSS to VCC
D7	C _{IN} , C _{OUT}	Pin capacitance (all inputs/outputs)	—	—	7	pF	V _{IN} /V _{OUT} = 0V (Note 1) TA = 25°C, F _{CLK} = 1 MHz
D8	I _{CC} write	Write current	—	—	2	mA	F _{CLK} = 3 MHz, VCC = 5.5V
			—	500	—	µA	F _{CLK} = 2 MHz, VCC = 2.5V
D9	I _{CC} read	Read current	—	—	1	mA	F _{CLK} = 3 MHz, VCC = 5.5V
			—	—	500	µA	F _{CLK} = 2 MHz, VCC = 3.0V
			—	100	—	µA	F _{CLK} = 2 MHz, VCC = 2.5V
D10	I _{CCS}	Standby current	—	—	1	µA	I-Temp
			—	—	5	µA	E-Temp
CLK = CS = 0V ORG = DI = VSS or VCC (Note 2) (Note 3)							
D11	VPOR	VCC voltage detect 93AA46A/B/C, 93LC46A/B/C 93C46A/B/C	—	1.5V	—	V	(Note 1)
			—	3.8V	—	V	
			—	—	—	V	

Note 1: This parameter is periodically sampled and not 100% tested.

2: ORG pin not available on 'A' or 'B' versions.

3: READY/BUSY status must be cleared from DO, see Section 3.4 "Data Out (DO)".

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

TABLE 1-2: AC CHARACTERISTICS

All parameters apply over the specified ranges unless otherwise noted.			VCC = range by device (see Table on Page 1)			
			Industrial (I): TA = -40°C to +85°C			
			Automotive (E): TA = -40°C to +125°C			
Param. No.	Symbol	Parameter	Min	Max	Units	Conditions
A1	FCLK	Clock frequency	—	3	MHz	4.5V ≤ VCC < 5.5V, 93XX46C only
				2	MHz	2.5V ≤ VCC < 5.5V
				1	MHz	1.8V ≤ VCC < 2.5V
A2	TCKH	Clock high time	200 250 450	—	ns	4.5V ≤ VCC < 5.5V, 93XX46C only
				—	ns	2.5V ≤ VCC < 5.5V
				—	ns	1.8V ≤ VCC < 2.5V
A3	TCKL	Clock low time	100 200 450	—	ns	4.5V ≤ VCC < 5.5V, 93XX46C only
				—	ns	2.5V ≤ VCC < 5.5V
				—	ns	1.8V ≤ VCC < 2.5V
A4	TCSS	Chip Select setup time	50 100 250	—	ns	4.5V ≤ VCC < 5.5V
				—	ns	2.5V ≤ VCC < 4.5V
				—	ns	1.8V ≤ VCC < 2.5V
A5	TCSH	Chip Select hold time	0	—	ns	1.8V ≤ VCC < 5.5V
A6	TCSL	Chip Select low time	250	—	ns	1.8V ≤ VCC < 5.5V
A7	TDIS	Data input setup time	50 100 250	—	ns	4.5V ≤ VCC < 5.5V, 93XX46C only
				—	ns	2.5V ≤ VCC < 5.5V
				—	ns	1.8V ≤ VCC < 2.5V
A8	TDIH	Data input hold time	50 100 250	—	ns	4.5V ≤ VCC < 5.5V, 93XX46C only
				—	ns	2.5V ≤ VCC < 5.5V
				—	ns	1.8V ≤ VCC < 2.5V
A9	TPD	Data output delay time	— — —	200	ns	4.5V ≤ VCC < 5.5V, CL = 100 pF
				250	ns	2.5V ≤ VCC < 4.5V, CL = 100 pF
				400	ns	1.8V ≤ VCC < 2.5V, CL = 100 pF
A10	Tcz	Data output disable time	— —	100	ns	4.5V ≤ VCC < 5.5V, (Note 1)
				200	ns	1.8V ≤ VCC < 4.5V, (Note 1)
A11	Tsv	Status valid time	—	200	ns	4.5V ≤ VCC < 5.5V, CL = 100 pF
				300	ns	2.5V ≤ VCC < 4.5V, CL = 100 pF
				500	ns	1.8V ≤ VCC < 2.5V, CL = 100 pF
A12	TWC	Program cycle time	—	6	ms	Erase/Write mode (AA and LC versions)
A13	TWC			2	ms	Erase/Write mode (93C versions)
A14	TEC			6	ms	ERAL mode, 4.5V ≤ VCC ≤ 5.5V
A15	TWL			15	ms	WRAL mode, 4.5V ≤ VCC ≤ 5.5V
A16	—			Endurance	1M	—

Note 1: This parameter is periodically sampled and not 100% tested.

2: This application is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance™ Model which may be obtained from www.microchip.com.

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

FIGURE 1-1: SYNCHRONOUS DATA TIMING

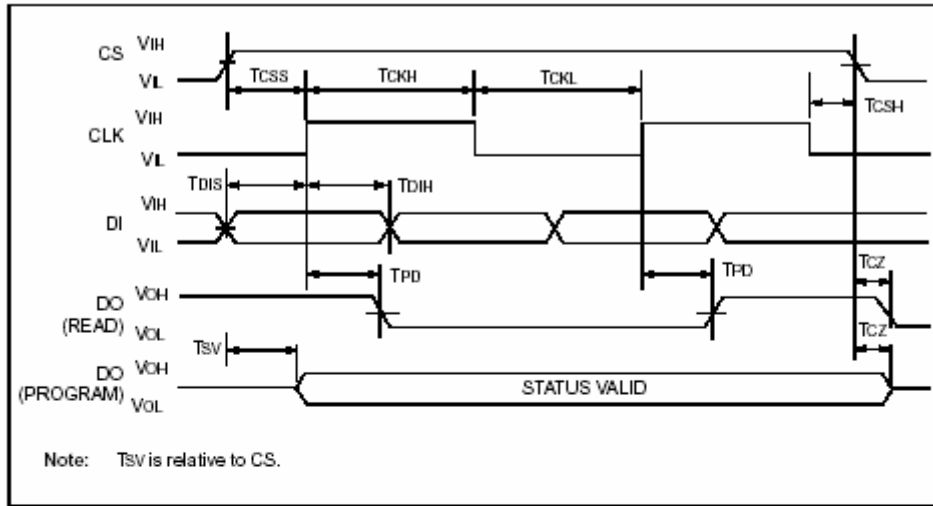


TABLE 1-3: INSTRUCTION SET FOR X 16 ORGANIZATION (93XX46B OR 93XX46C WITH ORG = 1)

Instruction	SB	Opcode	Address	Data In	Data Out	Req. CLK Cycles
ERASE	1	11	A5 A4 A3 A2 A1 A0	—	(RDY,BSY)	9
ERAL	1	00	1 0 X X X X X	—	(RDY,BSY)	9
EWDE	1	00	0 0 X X X X X	—	HIGH-Z	9
EWEN	1	00	1 1 X X X X X	—	HIGH-Z	9
READ	1	10	A5 A4 A3 A2 A1 A0	—	D15 - D0	25
WRITE	1	01	A5 A4 A3 A2 A1 A0	D15 - D0	(RDY,BSY)	25
WRAL	1	00	0 1 X X X X X	D15 - D0	(RDY,BSY)	25

TABLE 1-4: INSTRUCTION SET FOR X 8 ORGANIZATION (93XX46A OR 93XX46C WITH ORG = 0)

Instruction	SB	Opcode	Address	Data In	Data Out	Req. CLK Cycles
ERASE	1	11	A6 A5 A4 A3 A2 A1 A0	—	(RDY,BSY)	10
ERAL	1	00	1 0 X X X X X	—	(RDY,BSY)	10
EWDE	1	00	0 0 X X X X X	—	HIGH-Z	10
EWEN	1	00	1 1 X X X X X	—	HIGH-Z	10
READ	1	10	A6 A5 A4 A3 A2 A1 A0	—	D7 - D0	18
WRITE	1	01	A6 A5 A4 A3 A2 A1 A0	D7 - D0	(RDY,BSY)	18
WRAL	1	00	0 1 X X X X X	D7 - D0	(RDY,BSY)	18

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

2.0 FUNCTIONAL DESCRIPTION

When the ORG^* pin is connected to VCC , the (x16) organization is selected. When it is connected to ground, the (x8) organization is selected. Instructions, addresses and write data are clocked into the DI pin on the rising edge of the clock (CLK). The DO pin is normally held in a HIGH-Z state except when reading data from the device, or when checking the READY/BUSY status during a programming operation. The READY/BUSY status can be verified during an Erase/Write operation by polling the DO pin; DO low indicates that programming is still in progress, while DO high indicates the device is ready. DO will enter the HIGH-Z state on the falling edge of CS.

2.1 Start Condition

The Start bit is detected by the device if CS and DI are both high with respect to the positive edge of CLK for the first time.

Before a Start condition is detected, CS, CLK, and DI may change in any combination (except to that of a Start condition), without resulting in any device operation (READ, WRITE, ERASE, EWEN, EWDS, ERAL, or WRAL). As soon as CS is high, the device is no longer in Standby mode.

An instruction following a Start condition will only be executed if the required opcode, address and data bits for any particular instruction are clocked in.

2.2 Data In/Data Out (DI/DO)

It is possible to connect the Data In and Data Out pins together. However, with this configuration it is possible for a "bus conflict" to occur during the "dummy zero" that precedes the READ operation, if A0 is a logic high level. Under such a condition the voltage level seen at Data Out is undefined and will depend upon the relative impedances of Data Out and the signal source driving A0. The higher the current sourcing capability of A0, the higher the voltage at the Data Out pin. In order to limit this current, a resistor should be connected between DI and DO.

2.3 Data Protection

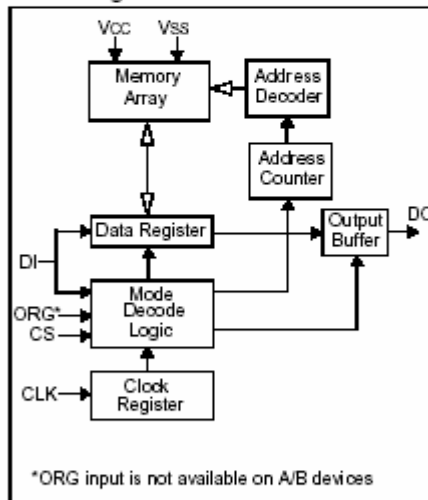
All modes of operation are inhibited when VCC is below a typical voltage of 1.5V for '93AA' and '93LC' devices or 3.8V for '93C' devices.

The EWEN and EWDS commands give additional protection against accidentally programming during normal operation.

Note: For added protection, an EWDS command should be performed after every write operation.

After power-up, the device is automatically in the EWDS mode. Therefore, an EWEN instruction must be performed before the initial ERASE or WRITE instruction can be executed.

Block Diagram



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

2.4 ERASE

The ERASE instruction forces all data bits of the specified address to the logical '1' state. CS is brought low following the loading of the last address bit. This falling edge of the CS pin initiates the self-timed programming cycle, except on '93C' devices where the rising edge of CLK before the last address bit initiates the write cycle.

The DO pin indicates the READY/ $\overline{\text{BUSY}}$ status of the device if CS is brought high after a minimum of 250 ns low (T_{CSL}). DO at logical '0' indicates that programming is still in progress. DO at logical '1' indicates that the register at the specified address has been erased and the device is ready for another instruction.

Note: Issuing a Start bit and then taking CS low will clear the READY/ $\overline{\text{BUSY}}$ status from DO.

FIGURE 2-1: ERASE TIMING FOR 93AA AND 93LC DEVICES

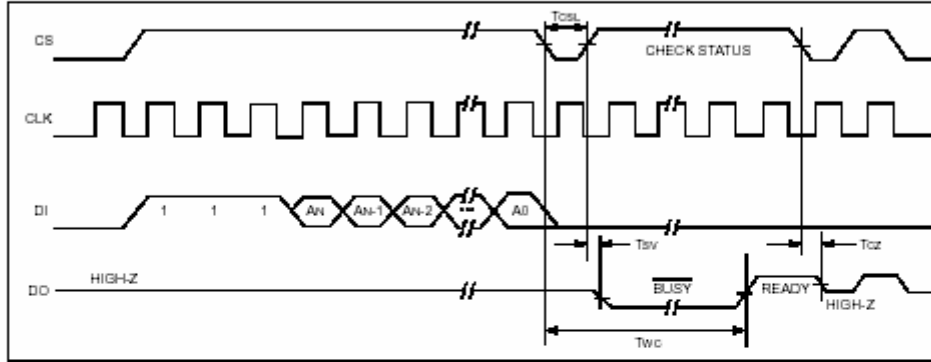
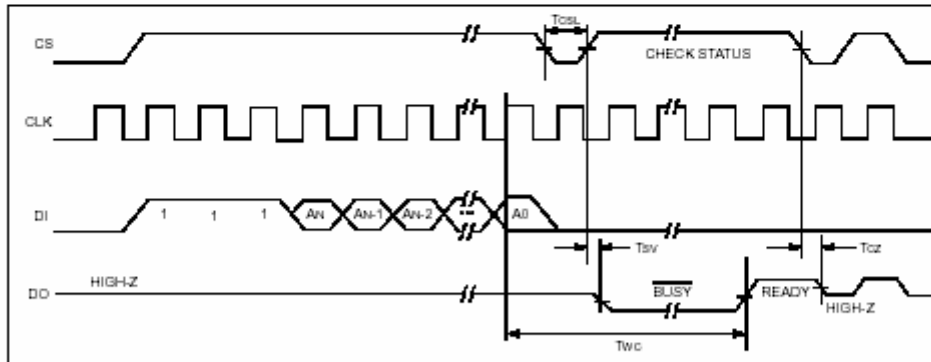


FIGURE 2-2: ERASE TIMING FOR 93C DEVICES



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

2.5 ERASE ALL (ERAL)

The Erase All (ERAL) instruction will erase the entire memory array to the logical '1' state. The ERAL cycle is identical to the ERASE cycle, except for the different opcode. The ERAL cycle is completely self-timed and commences at the falling edge of the CS, except on '93C' devices where the rising edge of CLK before the last data bit initiates the write cycle. Clocking of the CLK pin is not necessary after the device has entered the ERAL cycle.

The DO pin indicates the READY/ $\overline{\text{BUSY}}$ status of the device, if CS is brought high after a minimum of 250 ns low (T_{CSL}).

Note: Issuing a Start bit and then taking CS low will clear the READY/ $\overline{\text{BUSY}}$ status from DO.

V_{CC} must be $\geq 4.5V$ for proper operation of ERAL.

FIGURE 2-3: ERAL TIMING FOR 93AA AND 93LC DEVICES

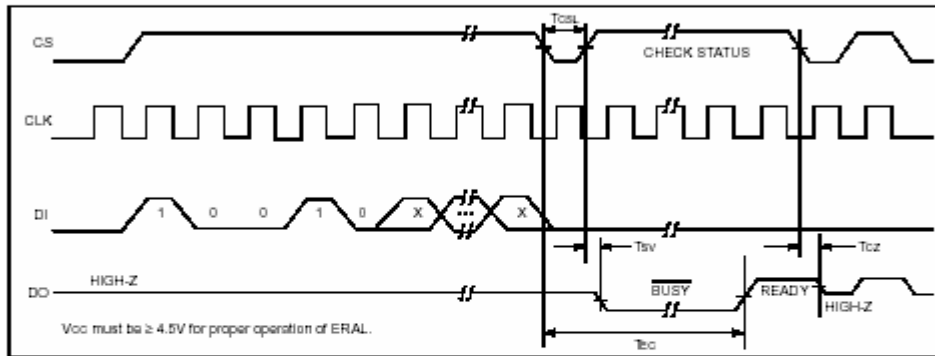
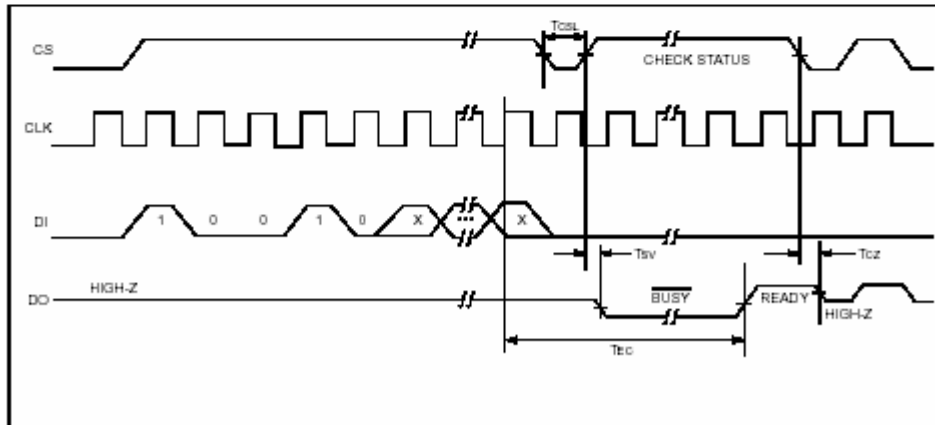


FIGURE 2-4: ERAL TIMING FOR 93C DEVICES



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

2.6 ERASE/WRITE DISABLE And ENABLE (EWDS/EWEN)

The 93XX46A/B/C powers up in the ERASE/WRITE Disable (EWDS) state. All Programming modes must be preceded by an ERASE/WRITE Enable (EWEN) instruction. Once the EWEN instruction is executed, programming remains enabled until an EWDS instruction is executed or Vcc is removed from the device.

To protect against accidental data disturbance, the EWDS instruction can be used to disable all ERASE/WRITE functions and should follow all programming operations. Execution of a READ instruction is independent of both the EWEN and EWDS instructions.

FIGURE 2-5: EWDS TIMING

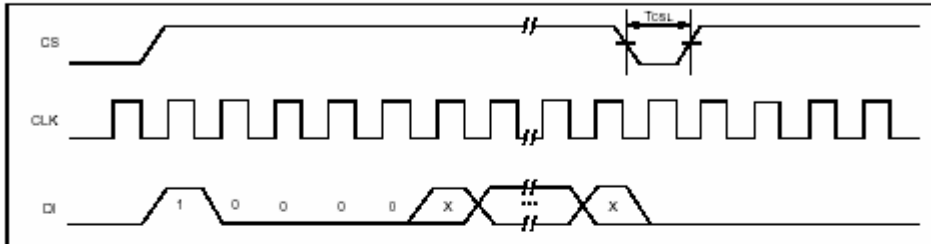
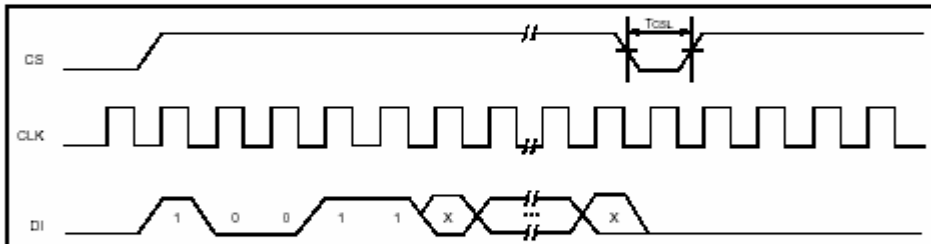


FIGURE 2-6: EWEN TIMING

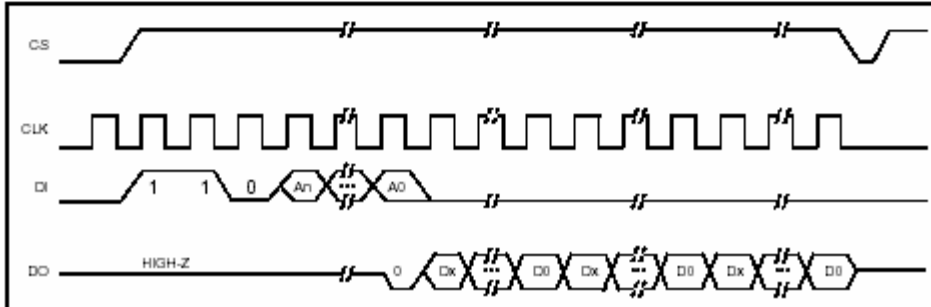


2.7 READ

The READ instruction outputs the serial data of the addressed memory location on the DO pin. A dummy zero bit precedes the 8-bit (If ORG pin is low or A-Version devices) or 16-bit (If ORG pin is high or B-version devices) output string. The output data bits will toggle on

the rising edge of the CLK and are stable after the specified time delay (T_{PD}). Sequential read is possible when CS is held high. The memory data will automatically cycle to the next register and output sequentially.

FIGURE 2-7: READ TIMING



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

2.8 WRITE

The WRITE instruction is followed by 8 bits (If ORG is low or A-version devices) or 16 bits (If ORG pin is high or B-version devices) of data which are written into the specified address. For 93AA46A/B/C and 93LC46A/B/C devices, after the last data bit is clocked into DI, the falling edge of CS initiates the self-timed auto-erase and programming cycle. For 93C46A/B/C devices, the self-timed auto-erase and programming cycle is initiated by the rising edge of CLK on the last data bit.

The DO pin indicates the READY/ $\overline{\text{BUSY}}$ status of the device, if CS is brought high after a minimum of 250 ns low (T_{CSL}). DO at logical '0' indicates that programming is still in progress. DO at logical '1' indicates that the register at the specified address has been written with the data specified and the device is ready for another instruction.

Note: Issuing a Start bit and then taking CS low will clear the READY/ $\overline{\text{BUSY}}$ status from DO.

FIGURE 2-8: WRITE TIMING FOR 93AA AND 93LC DEVICES

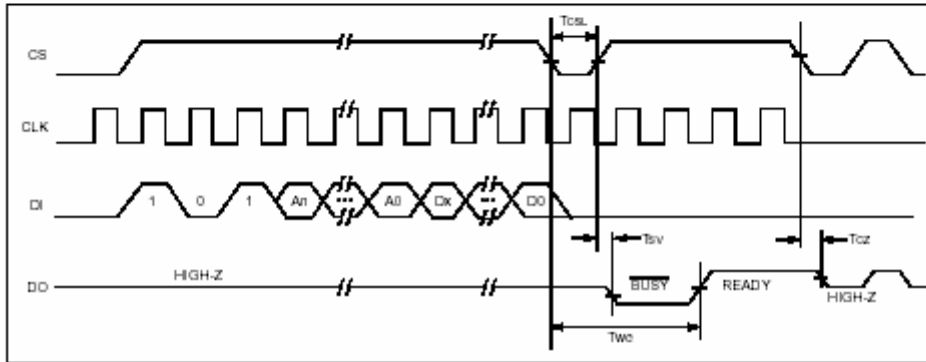
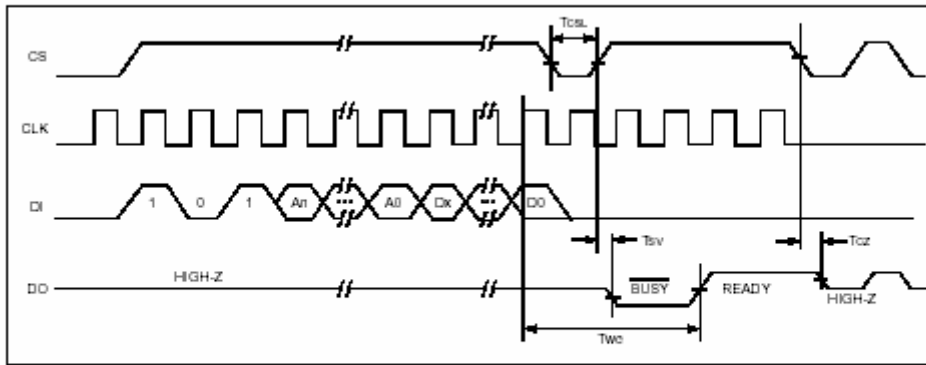


FIGURE 2-9: WRITE TIMING FOR 93C DEVICES



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

2.9 WRITE ALL (WRAL)

The Write All (WRAL) instruction will write the entire memory array with the data specified in the command. For 93AA46A/B/C and 93LC46A/B/C devices, after the last data bit is clocked into DI, the falling edge of CS initiates the self-timed auto-erase and programming cycle. For 93C46A/B/C devices, the self-timed auto-erase and programming cycle is initiated by the rising edge of CLK on the last data bit. Clocking of the CLK pin is not necessary after the device has entered the WRAL cycle. The WRAL command does include an automatic ERAL cycle for the device. Therefore, the WRAL instruction does not require an ERAL instruction but the chip must be in the EWEN status.

The DO pin indicates the READY/ $\overline{\text{BUSY}}$ status of the device if CS is brought high after a minimum of 250 ns low (TCSL).

Note: Issuing a Start bit and then taking CS low will clear the READY/ $\overline{\text{BUSY}}$ status from DO.

VCC must be $\geq 4.5\text{V}$ for proper operation of WRAL.

FIGURE 2-10: WRAL TIMING FOR 93AA AND 93LC DEVICES

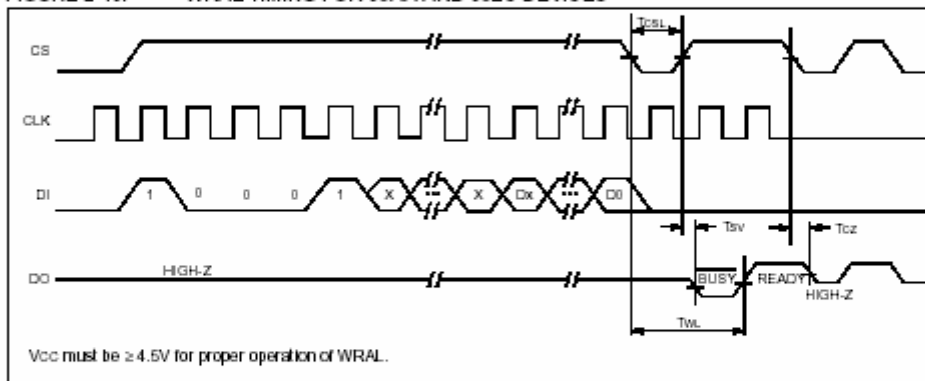
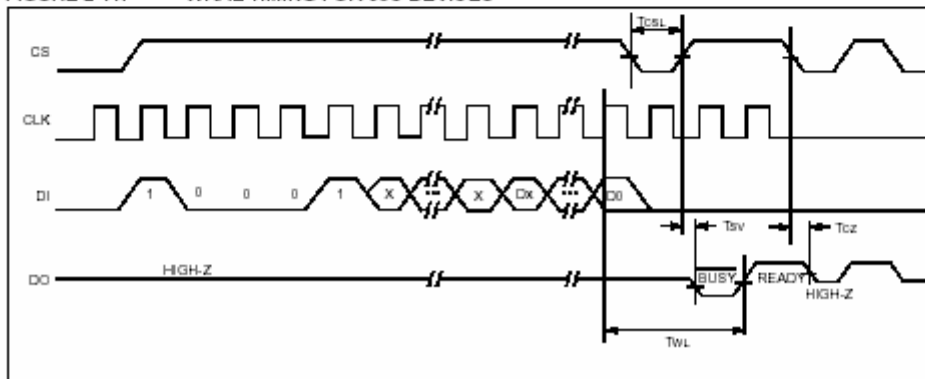


FIGURE 2-11: WRAL TIMING FOR 93C DEVICES



93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

3.0 PIN DESCRIPTIONS

TABLE 3-1: PIN DESCRIPTIONS

Name	SOIC/PDIP/ MSOP/ TSSOP	SOT-23	Rotated SOIC	Function
CS	1	5	3	Chip Select
CLK	2	4	4	Serial Clock
DI	3	3	5	Data In
DO	4	1	6	Data Out
V _{ss}	5	2	7	Ground
ORG/NC	6	N/A	8	Organization / 93XX46C No internal connection / 93XX46A/B
NC	7	N/A	1	No Internal Connection
V _{CC}	8	6	2	Power Supply

3.1 Chip Select (CS)

A high level selects the device; a low level deselects the device and forces it into Standby mode. However, a programming cycle which is already in progress will be completed, regardless of the Chip Select (CS) input signal. If CS is brought low during a program cycle, the device will go into Standby mode as soon as the programming cycle is completed.

CS must be low for 250 ns minimum (T_{CSL}) between consecutive instructions. If CS is low, the internal control logic is held in a Reset status.

3.2 Serial Clock (CLK)

The Serial Clock is used to synchronize the communication between a master device and the 93XX series device. Opcodes, address and data bits are clocked in on the positive edge of CLK. Data bits are also clocked out on the positive edge of CLK.

CLK can be stopped anywhere in the transmission sequence (at high or low level) and can be continued anytime with respect to clock high time (T_{CKH}) and clock low time (T_{CKL}). This gives the controlling master freedom in preparing opcode, address and data.

CLK is a "Don't Care" if CS is low (device deselected). If CS is high, but the Start condition has not been detected (DI = 0), any number of clock cycles can be received by the device without changing its status (i.e., waiting for a Start condition).

CLK cycles are not required during the self-timed WRITE (i.e., auto ERASE/WRITE) cycle.

After detection of a Start condition the specified number of clock cycles (respectively low-to-high transitions of CLK) must be provided. These clock cycles are required to clock in all required opcode, address and

data bits before an instruction is executed. CLK and DI then become don't care inputs waiting for a new Start condition to be detected.

3.3 Data In (DI)

Data In (DI) is used to clock in a Start bit, opcode, address and data synchronously with the CLK input.

3.4 Data Out (DO)

Data Out (DO) is used in the READ mode to output data synchronously with the CLK input (T_{PD} after the positive edge of CLK).

This pin also provides READY/BUSY status information during ERASE and WRITE cycles. READY/BUSY status information is available on the DO pin if CS is brought high after being low for minimum Chip Select low time (T_{CSL}) and an ERASE or WRITE operation has been initiated.

The Status signal is not available on DO, if CS is held low during the entire ERASE or WRITE cycle. In this case, DO is in the HIGH-Z mode. If status is checked after the ERASE/WRITE cycle, the data line will be high to indicate the device is ready.

Note: Issuing a Start bit and then taking CS low will clear the READY/BUSY status from DO.

3.5 Organization (ORG)

When the ORG pin is connected to V_{CC} or Logic HI, the (x16) memory organization is selected. When the ORG pin is tied to V_{SS} or Logic LO, the (x8) memory organization is selected. For proper operation, ORG must be tied to a valid logic level.

93XX46A devices are always x8 organization and 93XX46B devices are always x16 organization.

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

4.0 PACKAGING INFORMATION

4.1 Package Marking Information

8-Lead MSOP (150 mil)



Example:



Device	std mark	Pb-free mark
93AA46A	3A46AT	GA46AT
93AA46B	3A46BT	GA46BT
93AA46C	3A46CT	GA46CT
93LC46A	3L46AT	GL46AT
93LC46B	3L46BT	GL46BT
93LC46C	3L46CT	GL46CT
93C46A	3C46AT	GC46AT
93C46B	3C46BT	GC46BT
93C46C	3C46CT	GC46CT

T = blank for commercial, "I" for Industrial, "E" for Extended.

6-Lead SOT-23



Example:



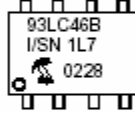
Device	I-temp	E-temp
93AA46A	1BNN	-
93AA46B	1LNN	-
93LC46A	1ENN	1FNN
93LC46B	1PNN	1RNN
93C46A	1HNN	1JNN
93C46B	1TNN	1UNN

Pb-free topside mark is same; Pb-free noted only on carton label.

8-Lead PDIP



Example:



8-Lead SOIC



Example:



Device	std mark	Pb-free mark
93AA46A	A46A	GAAA
93AA46B	A46B	GAAB
93AA46C	A46C	GAAC
93LC46A	L46A	GLAA
93LC46B	L46B	GLAB
93LC46C	L46C	GLAC
93C46A	C46A	GCAA
93C46B	C46B	GCAB
93C46C	C46C	GCAC

Temperature grade is marked on line 2.

8-Lead TSSOP



Example:

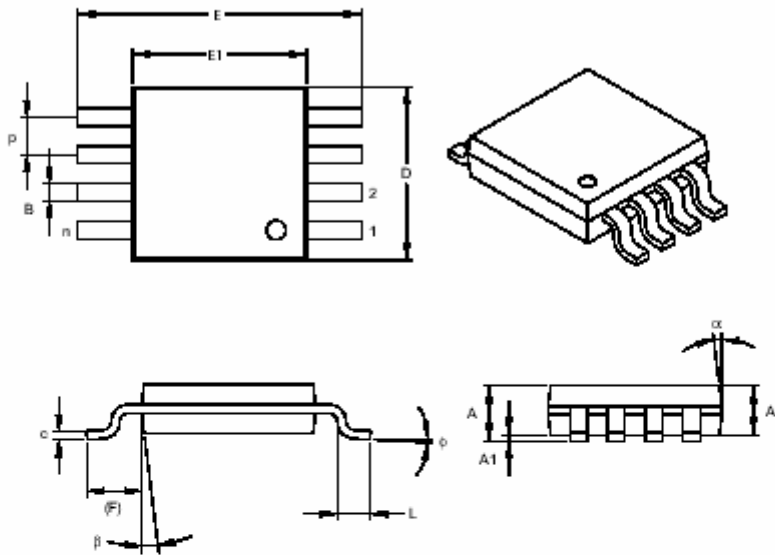


XX..X	Part number
T	Temperature
Blank	Commercial
I	Industrial
E	Extended
YY	Year code (last 2 digits of calendar year) except TSSOP and MSOP which use only the last 1 digit
WW	Week code (week of January 1 is week '01')
NNN	Alphanumeric traceability code

Note: Custom marking available.

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

8-Lead Plastic Micro Small Outline Package (MS) (MSOP)



Dimension Limits	Units	INCHES			MILLIMETERS*		
		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	P		.026 BSC			0.65 BSC	
Overall Height	A	-	-	.043	-	-	1.10
Molded Package Thickness	A2	.030	.033	.037	0.75	0.85	0.95
Standoff	A1	.000	-	.006	0.00	-	0.15
Overall Width	E		.193 TYP.			4.90 BSC	
Molded Package Width	E1		.118 BSC			3.00 BSC	
Overall Length	D		.118 BSC			3.00 BSC	
Foot Length	L	.016	.024	.031	0.40	0.60	0.80
Footprint (Reference)	F		.037 REF			0.95 REF	
Foot Angle	phi	0°	-	8°	0°	-	8°
Lead Thickness	c	.003	.006	.009	0.08	-	0.23
Lead Width	B	.009	.012	.016	0.22	-	0.40
Mold Draft Angle Top	alpha	5°	-	15°	5°	-	15°
Mold Draft Angle Bottom	beta	5°	-	15°	5°	-	15°

*Controlling Parameter

Notes:

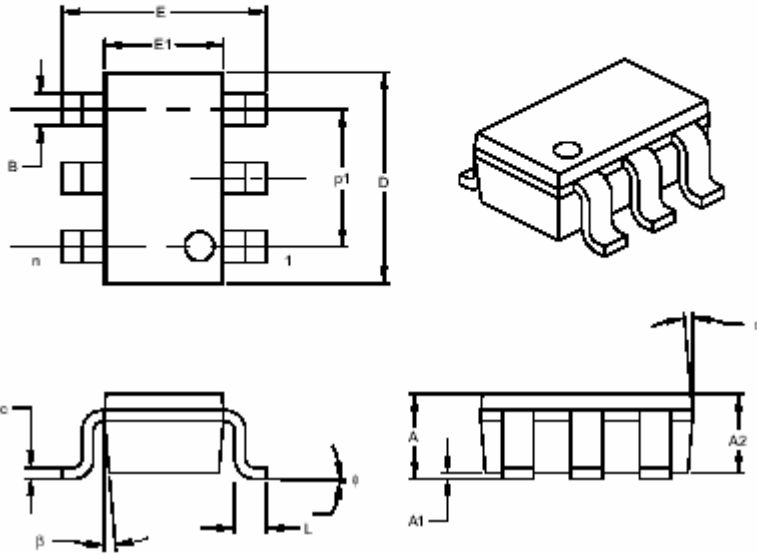
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254 mm) per side.

JEDEC Equivalent: MO-187

Drawing No. C04-111

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

6-Lead Plastic Small Outline Transistor (OT) (SOT-23)



Dimension Limits	Units	INCHES*			MILLIMETERS		
		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		6			6	
Pitch	p		.038			0.95	
Outside lead pitch (basic)	p1		.075			1.90	
Overall Height	A	.035	.045	.057	0.90	1.18	1.45
Molded Package Thickness	A2	.035	.043	.051	0.90	1.10	1.30
Standoff	A1	.000	.003	.006	0.00	0.08	0.15
Overall Width	E	.102	.110	.118	2.60	2.80	3.00
Molded Package Width	E1	.059	.064	.069	1.50	1.63	1.75
Overall Length	D	.110	.116	.122	2.80	2.95	3.10
Foot Length	L	.014	.018	.022	0.35	0.45	0.55
Foot Angle	alpha	0	5	10	0	5	10
Lead Thickness	c	.004	.006	.008	0.09	0.15	0.20
Lead Width	B	.014	.017	.020	0.35	0.43	0.50
Mold Draft Angle Top	beta	0	5	10	0	5	10
Mold Draft Angle Bottom	beta	0	5	10	0	5	10

*Controlling Parameter

Notes:

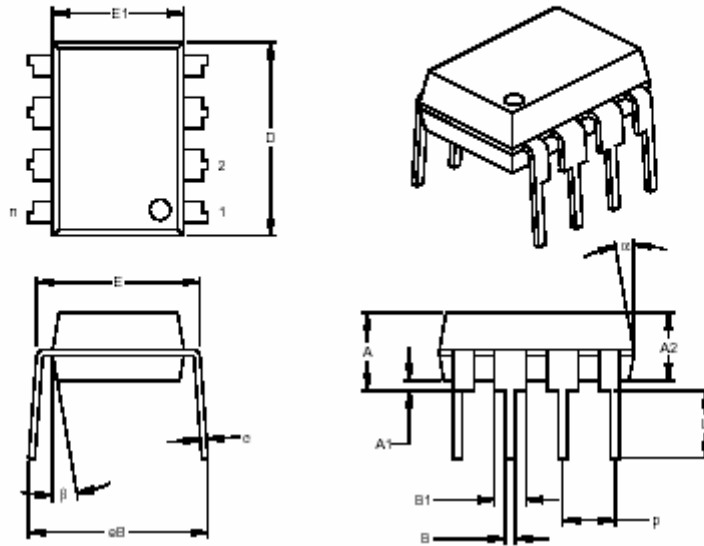
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.

JEITA (formerly EIAJ) equivalent: SC-74A

Drawing No. C04-120

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

8-Lead Plastic Dual In-line (P) – 300 mil (PDIP)



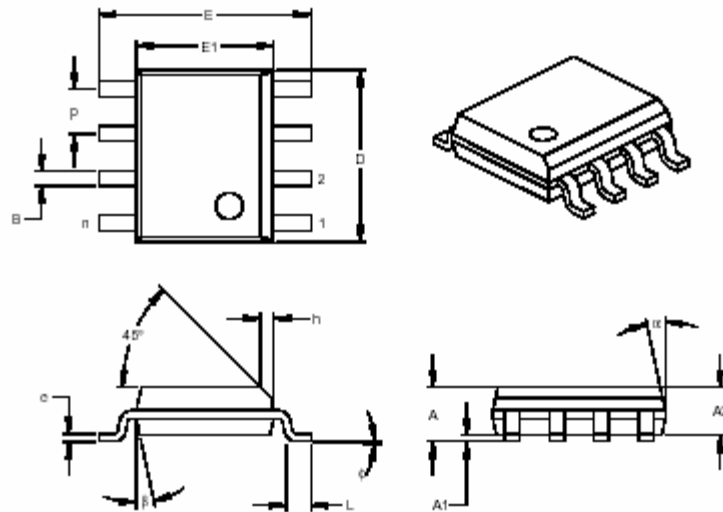
Units		INCHES*			MILLIMETERS		
Dimension	Limits	MIN	NCM	MAX	MIN	NCM	MAX
Number of Pins	n		8			8	
Pitch	p		.100			2.54	
Top to Seating Plane	A	.140	.155	.170	3.56	3.94	4.32
Molded Package Thickness	A2	.115	.130	.145	2.92	3.30	3.68
Base to Seating Plane	A1	.015			0.38		
Shoulder to Shoulder Width	E	.300	.313	.325	7.62	7.94	8.28
Molded Package Width	E1	.240	.250	.260	6.10	6.35	6.60
Overall Length	D	.360	.373	.385	9.14	9.46	9.78
Tip to Seating Plane	L	.125	.130	.135	3.18	3.30	3.43
Lead Thickness	e	.008	.012	.015	0.20	0.29	0.38
Upper Lead Width	B1	.045	.058	.070	1.14	1.46	1.78
Lower Lead Width	B	.014	.018	.022	0.36	0.46	0.56
Overall Row Spacing	§ eB	.310	.370	.430	7.87	9.40	10.92
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

* Controlling Parameter
 § Significant Characteristic

Notes:
 Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.
 JEDEC Equivalent: MS-001
 Drawing No. C04-018

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

8-Lead Plastic Small Outline (SN) – Narrow, 150 mil (SOIC)



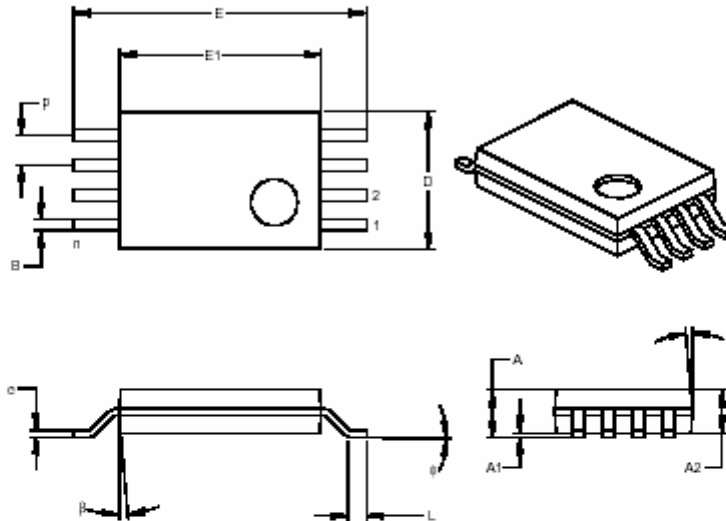
Dimension Limits	Units	INCHES*			MILLIMETERS		
		MIN	NCM	MAX	MIN	NCM	MAX
Number of Pins	n		8			8	
Pitch	P		.050			1.27	
Overall Height	A	.053	.061	.069	1.35	1.55	1.75
Molded Package Thickness	A2	.052	.056	.061	1.32	1.42	1.55
Standoff §	A1	.004	.007	.010	0.10	0.18	0.25
Overall Width	E	.228	.237	.244	5.79	6.02	6.20
Molded Package Width	E1	.146	.154	.157	3.71	3.91	3.99
Overall Length	D	.189	.193	.197	4.80	4.90	5.00
Chamfer Distance	h	.010	.015	.020	0.25	0.38	0.51
Foot Length	L	.019	.025	.030	0.48	0.62	0.76
Foot Angle	θ	0	4	8	0	4	8
Lead Thickness	c	.008	.009	.010	0.20	0.23	0.25
Lead Width	B	.013	.017	.020	0.33	0.42	0.51
Mold Draft Angle Top	α	0	12	15	0	12	15
Mold Draft Angle Bottom	β	0	12	15	0	12	15

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.
JEDEC Equivalent: MS-012
Drawing No. C04-057

93AA46A/B/C, 93LC46A/B/C, 93C46A/B/C

8-Lead Plastic Thin Shrink Small Outline (ST) – 4.4 mm (TSSOP)



Dimension Limits	Units	INCHES			MILLIMETERS*		
	n	MIN	NCM	MAX	MIN	NCM	MAX
Number of Pins	n		8			8	
Pitch	P		.026			0.65	
Overall Height	A			.043			1.10
Molded Package Thickness	A2	.033	.035	.037	0.85	0.90	0.95
Standoff §	A1	.002	.004	.006	0.05	0.10	0.15
Overall Width	E	.246	.251	.256	6.25	6.38	6.50
Molded Package Width	E1	.169	.173	.177	4.30	4.40	4.50
Molded Package Length	D	.114	.118	.122	2.90	3.00	3.10
Foot Length	L	.020	.024	.028	0.50	0.60	0.70
Foot Angle	φ	0	4	8	0	4	8
Lead Thickness	c	.004	.006	.008	0.09	0.15	0.20
Lead Width	B	.007	.010	.012	0.19	0.25	0.30
Mold Draft Angle Top	α	0	5	10	0	5	10
Mold Draft Angle Bottom	β	0	5	10	0	5	10

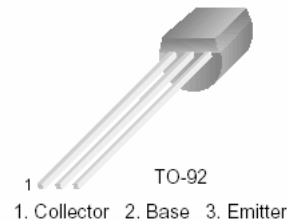
* Controlling Parameter
§ Significant Characteristic

Notes
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.
JEDEC Equivalent: MO-153
Drawing No. 004-086

BC546/547/548/549/550

Switching and Applications

- High Voltage: BC546, $V_{CE0}=65V$
- Low Noise: BC549, BC550
- Complement to BC556 ... BC560



NPN Epitaxial Silicon Transistor

Absolute Maximum Ratings $T_a=25^\circ C$ unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage : BC546	80	V
	: BC547/550	50	V
	: BC548/549	30	V
V_{CEO}	Collector-Emitter Voltage : BC546	65	V
	: BC547/550	45	V
	: BC548/549	30	V
V_{EBO}	Emitter-Base Voltage : BC546/547	6	V
	: BC548/549/550	5	V
I_C	Collector Current (DC)	100	mA
P_C	Collector Power Dissipation	500	mW
T_J	Junction Temperature	150	$^\circ C$
T_{STG}	Storage Temperature	-65 ~ 150	$^\circ C$

Electrical Characteristics $T_a=25^\circ C$ unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
I_{CBO}	Collector Cut-off Current	$V_{CB}=30V, I_E=0$			15	nA
h_{FE}	DC Current Gain	$V_{CE}=5V, I_C=2mA$	110		800	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=10mA, I_B=0.5mA$		90	250	mV
		$I_C=100mA, I_B=5mA$		200	600	mV
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C=10mA, I_B=0.5mA$		700		mV
		$I_C=100mA, I_B=5mA$		900		mV
$V_{BE(on)}$	Base-Emitter On Voltage	$V_{CE}=5V, I_C=2mA$	580	660	700	mV
		$V_{CE}=5V, I_C=10mA$			720	mV
f_T	Current Gain Bandwidth Product	$V_{CE}=5V, I_C=10mA, f=100MHz$		300		MHz
C_{ob}	Output Capacitance	$V_{CB}=10V, I_E=0, f=1MHz$		3.5	6	pF
C_{ib}	Input Capacitance	$V_{EB}=0.5V, I_C=0, f=1MHz$		9		pF
NF	Noise Figure	: BC546/547/548	$V_{CE}=5V, I_C=200\mu A$	2	10	dB
		: BC549/550	$f=1KHz, R_G=2K\Omega$	1.2	4	dB
		: BC549	$V_{CE}=5V, I_C=200\mu A$	1.4	4	dB
		: BC550	$R_G=2K\Omega, f=30\sim 15000MHz$	1.4	3	dB

h_{FE} Classification

Classification	A	B	C
h_{FE}	110 ~ 220	200 ~ 450	420 ~ 800

Typical Characteristics

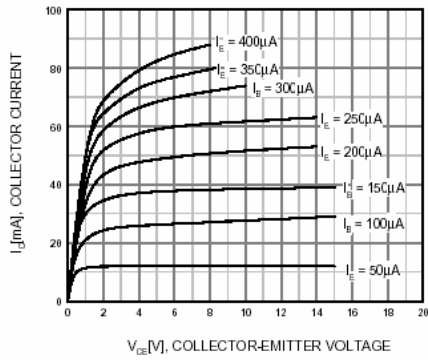


Figure 1. Static Characteristic

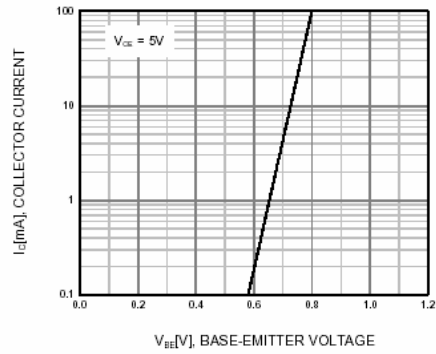


Figure 2. Transfer Characteristic

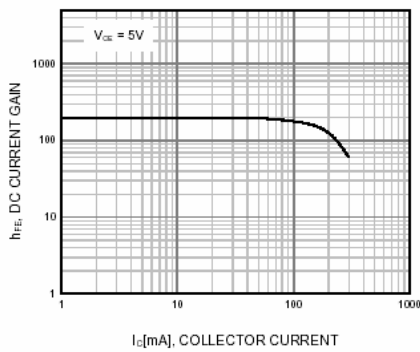


Figure 3. DC current Gain

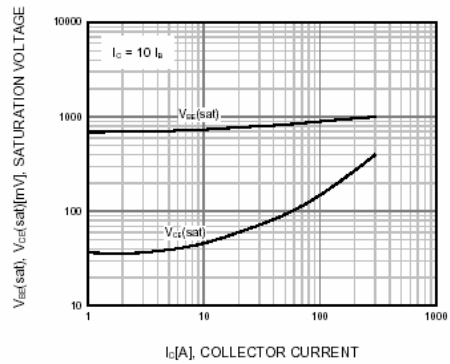


Figure 4. Base-Emitter Saturation Voltage
Collector-Emitter Saturation Voltage

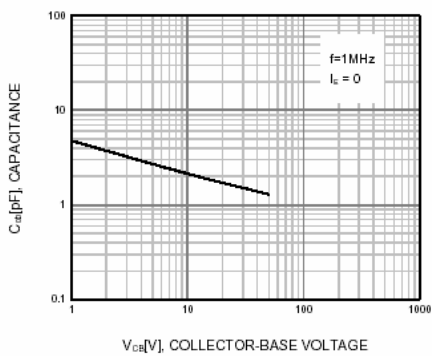


Figure 5. Output Capacitance

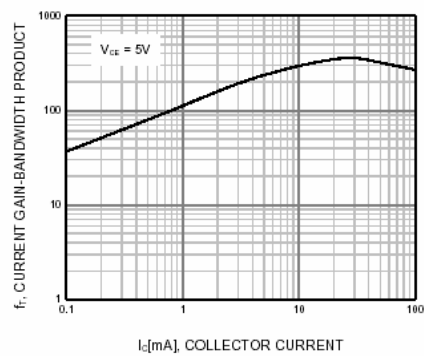
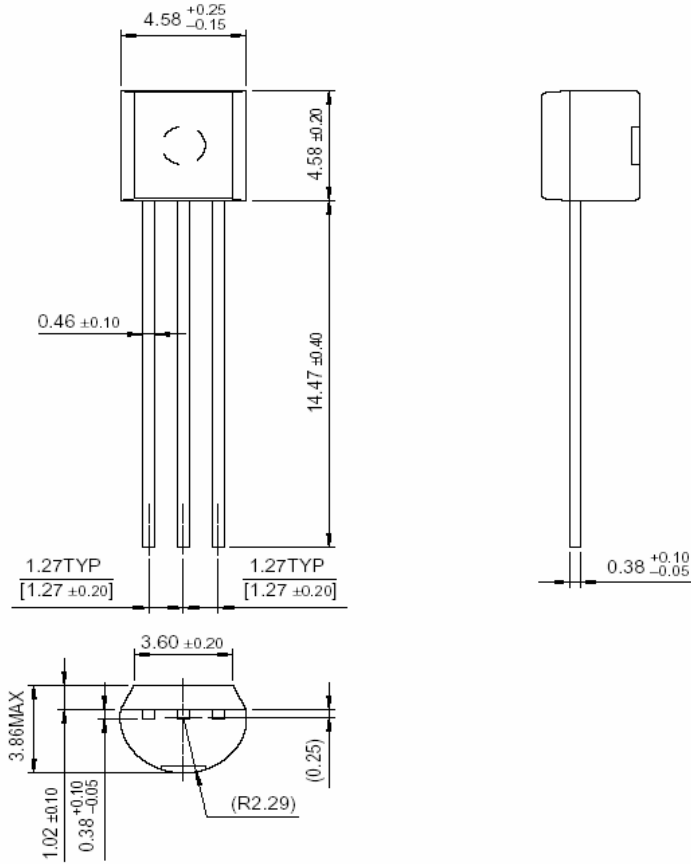


Figure 6. Current Gain Bandwidth Product

Package Dimensions

TO-92



Dimensions in Millimeters

BC546/547/548/549/550

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Bottomless™	FAST®	LittleFET™	Power247™	SuperSOT™-3
CoolFET™	FASTr™	MicroFET™	PowerTrench®	SuperSOT™-6
CROSSVOLT™	FRFET™	MicroPak™	QFET™	SuperSOT™-8
DOME™	GlobalOptoisolator™	MICROWIRE™	QS™	SyncFET™
EcoSPARK™	GTO™	MSX™	QT Optoelectronics™	TinyLogic™
E ² C MOS™	HiSeC™	MSXPro™	Quiet Series™	TruTranslation™
EnSigna™	I ² C™	OCX™	RapidConfigure™	UHC™
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Programmable Active Droop™		OPTOPLANAR™	SMART START™	

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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