

OTC-043

3-CHANNEL LED DISPLAY DRIVER IC

DATE : March 9, 2001
PRELIMINARY

■ FEATURES

- CMOS technology
- 3-channel NMOS output drivers
- 20mA maximum driving capability per output channel
- Shift registers and latches included
- Built-in gray level adjustment control
- Built-in buffers for cascading serial data, clock and latch signals to other devices
- Gray level auto-scanning

■ GENERAL DESCRIPTIONS

The OTC-043 is a monolithic, 3-channel NMOS output driver device designed for the multi-color LED display system. Especially, 3 sets of independent gray level adjustment control units are also built-in together for each output channel.

In the OTC-043, there are two modes — serial data mode and scan mode to choose for different operations. In serial data mode the output gray level of each channel is decided by the input serial data from external. The scan mode enables the gray level auto-scanning function that make each channel varies 9 different gray levels continuously in order of channel-3, channel-2 and channel-1. When auto-scanning is activated user can choose any desired gray level to output.

(1) Serial data mode

When `MODE_I` is high, serial data mode is selected. In this mode external serial data is loaded into a built-in 24-bit (b23 ~ b0) shift register. Data shifted into the shift register are split to 3 portions — b23 ~ b16, b15 ~ b8 and b7 ~ b0 as gray level adjustment information for channel-1 (OUT1A/B), channel-2 (OUT2A/B) and channel-3 (OUT3A/B), respectively. The serial data are triggered on the falling edge of the system clock, in order of LSB to MSB. After the 24-bit data are shifted in, these data are latched on the rising edge of the latch signal, `LATCH_I`, so



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as to control 3 output channels simultaneously. To attain to the different gray levels of red, green and blue LEDs, each set of 8-bit codes provides 256 levels, 100% of gray level adjustment range. The larger the magnitude of the 8-bit codes, the brighter the visual effect.

(2) Scan mode

When MODE_I is low, scan mode is operating. The signal SCAN can be triggered once to start the 9-bits scan counter until the second trigger comes to stop counting. The scan data are also split to 3 portions — s8~s6, s5~s3 and s2~s0 to set three MSBs gray level of three channels respectively. In the meantime, five LSBs are all set to “1”. 512 composed color from these 3 channels can be easily chosen by user in the scan mode. However, while serial data mode is selected, the scan counter stops counting and keeps the previous scan data. If MODE_I pin is floating, serial data mode is set and scan mode disabled by default.

For being cascaded to other devices OTC-043 provides the related buffered outputs of the serial data and all input signals. In particular, the last stage of the shift register in the OTC-043 advances half one period of the system clock to shift the data out in order to get rid of data transfer error in a long chain of cascaded devices.

■ ORDERING INFORMATION

PART NO.	PACKAGE	NOTE
OTC-043SO	16-PIN SOP	Without mode selection
OTC-043PO	16-PIN SSOP	Without mode selection
OTC-043SW	16-PIN SOP	With mode selection
OTC-043PW	16-PIN SSOP	With mode selection

■ ABSOLUTE MAXIMUM RATINGS

Ta=25°C (UNLESS OTHERWISE SPECIFIED)			
CHARACTERISTICS	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	VDD	2.5 ~ 5.5	V
LOGIC INPUT VOLTAGE	V _{IN}	-0.3 ~ VDD+0.3	V
CLOCK FREQUENCY	FCLK	10	MHz
OUTPUT SUSTAINING VOLTAGE	V _{DS}	9	V
OUTPUT CONTINUOUS CURRENT, EACH CHANNEL	I _{OUT}	25	mA
POWER DISSIPATION, EACH CHANNEL	P _{DISSP}	50	mW
OPERATING TEMPERATURE	T _{OPR}	-40 ~ +85	°C
STORAGE TEMPERATURE	T _{STR}	-60 ~ +150	°C

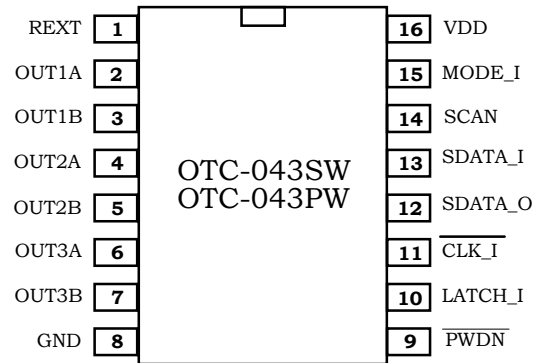
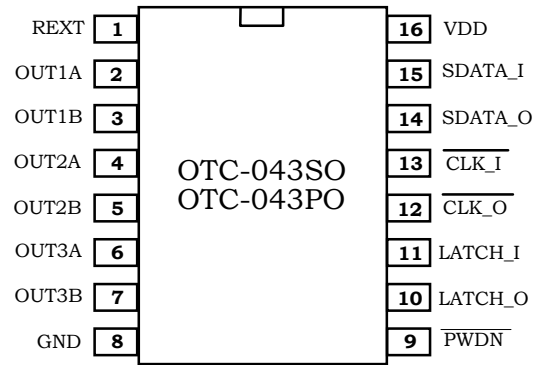


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PIN ASSIGNMENT (TOP VIEW)



PIN DESCRIPTIONS

NO. (SO,PO/SW,PW)	NAME	TYPE	DESCRIPTION
1/1	REXT	INPUT	Connection for external resistor
2/2	OUT1A	OUTPUT	NMOS driver (open drain)
3/3	OUT1B	OUTPUT	NMOS driver (open drain)
4/4	OUT2A	OUTPUT	NMOS driver (open drain)
5/5	OUT2B	OUTPUT	NMOS driver (open drain)
6/6	OUT3A	OUTPUT	NMOS driver (open drain)
7/7	OUT3B	OUTPUT	NMOS driver (open drain)
8/8	GND	GND	Ground
9/9	PWDN	INPUT	Power down enable, low enable
10/-	LATCH_O	OUTPUT	Latch signal output
11/10	LATCH_I	INPUT	Latch signal input
12/-	CLK_O	OUTPUT	System clock output
13/11	CLK_I	INPUT	System clock input
14/12	SDATA_O	OUTPUT	Serial data output
15/13	SDATA_I	OUTPUT	Serial data input
-/14	SCAN	INPUT	Scan signal input
-/15	MODE_I	INPUT	Mode signal input
16/16	VDD	POWER	Supply voltage

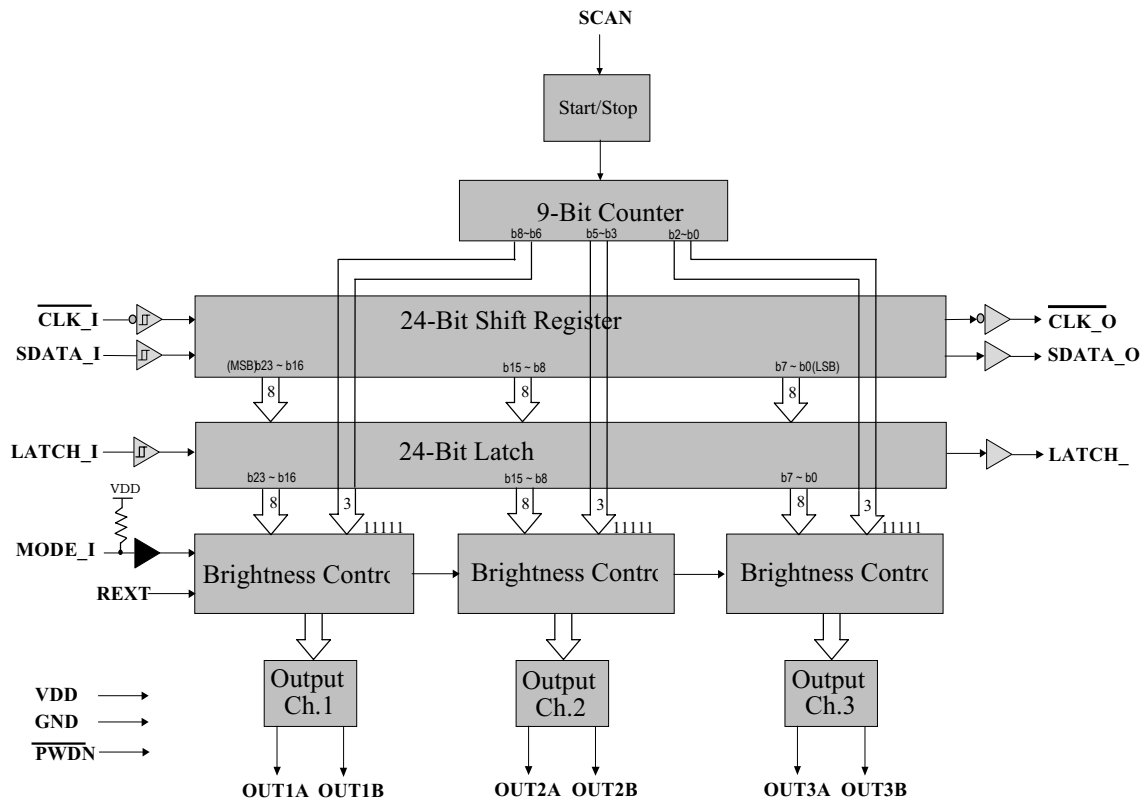


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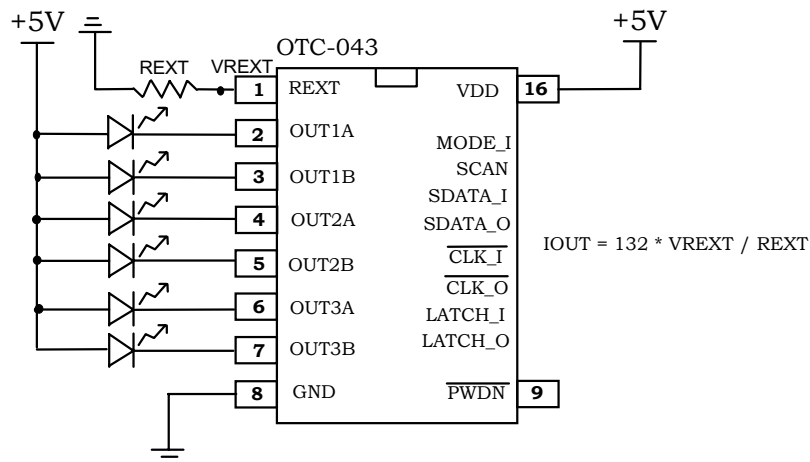
FUNCTION BLOCK DIAGRAM



APPLICATIONS

- Multi color LED back light driver
- Multi color LED lamp bulb driver
- Multi color LED message indicator driver
- Multi color LED cluster driver

TYPICAL APPLICATION CIRCUIT



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RECOMMENDED OPERATING CONDITIONS

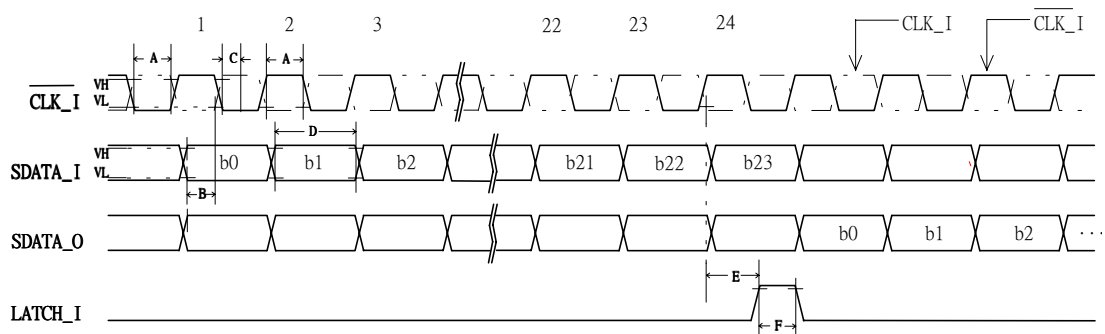
VDD=+5V, Ta=25°C, UNLESS OTHERWISE SPECIFIED					
CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNIT
SUPPLY VOLTAGE	VDD	4.5	5	5.5	V
LOGIC INPUT	V _{IN}	0	-	5	V
SYSTEM CLOCK FREQUENCY	F _{CLK}	-	-	8	MHz
OUTPUT ON CURRENT	I _{DS}	-	-	20	mA
OUTPUT ON VOLTAGE	V _{DS(ON)}	1.5	-	2.5	V
OUTPUT SUSTAINING VOLTAGE	V _{DS(OFF)}	5	-	7	V

DC ELECTRICAL CHARACTERISTICS

VDD=+5V, Ta=25°C, UNLESS OTHERWISE SPECIFIED						
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY	VDD		2.5	5	5.5	V
POWER SUPPLY CURRENT (EXCLUDING OUTPUT CURRENT)	I _{DD}	STATIC	-	-	4	mA
POWER SUPPLY CURRENT	I _{DD}	POWER DOWN ENABLE	-	-	1	μA
OUTPUT SUSTAINING VOLTAGE	V _{DS}	ALL OUTPUT OFF	-	-	9	V
LOGIC INPUT VOLTAGES	V _{IH}		0.8VDD	VDD	VDD+0.1	V
	V _{IL}		VSS-0.1	VSS	0.2VDD	V
LOGIC OUTPUT VOLTAGES	V _{OH}	I _{OH} = -5mA	4.8	-	-	V
	V _{OL}	I _{OL} =+7mA	-	-	0.2	V
SYSTEM CLOCK FREQUENCY	F _{CLK}		-	5	10	MHz
SCAN FREQUENCY	F _{SCAN}		1.6	2	2.4	Hz
REFERENCE VOLTAGE	V _{REXT}		-	1.8	-	V
OUTPUT ON-CURRENT	I _{DS(ON)}	V _{OUT} =2V	2	-	20	mA
OUTPUT OFF-CURRENT	I _{DS(OFF)}	ALL OUTPUT OFF	-	-	<1	μA
CLOCK OUTPUT DELAY TIME	TD,CLK	CL=80pF	-	-	15	nS
DATA OTUPUT DELAY TIME*	TD,DATA	CL=80pF	-	-	15	nS
LATCH OUTPUT DELAY TIME	TD,LATCH	CL=80pF	-	-	15	nS

* DATA OUTPUT DELAY TIME IS THE TOTAL PROPAGATION TIME THROUGH THE INPUT AND OUTPUT BUFFERS OF SERIAL DATA.

TIMING CHART & TIMING CONDITIONS



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VDD=+5V, Ta=25°C, UNLESS OTHERWISE SPECIFIED					
ITEM	DESCRIPTION	MIN	TYP	MAX	UNIT
A	CLOCK PULSE WIDTH	50	-	-	nS
B	SERIAL DATA SETUP TIME	10	-	-	nS
C	SERIAL DATA HOLD TIME	10	-	-	nS
D	SERIAL DATA PULSE WIDTH	50	-	-	nS
E	TIME BETWEEN CLOCK ACTIVATION AND LATCH	50	-	-	nS
F	LATCH PULSE WIDTH	50	-	-	nS

MODE SELECTION

MODE_I	ACTIONS
0	SCAN MODE
1	SERIAL DATA MODE

TRUTH TABLE

SERIAL DATA INPUT	CLOCK INPUT	SHIFT REGISTER CONTENTS	SERIAL DATA OUTPUT	MODE INPUT	SCAN COUNTER CONTENTS	LATCH INPUT	BRIGHTNESS INPUT
		I23 I22 ... I2 I1 I0			q8 q7.....q2 q1 q0		I23 I22 ...I2 I1 I0
H		↓ H R23 R22.....R3 R2 R1	↑ R1				
L		↓ L R23 R22.....R3 R2 R1	↑ R1				
X		R23 R22R2 R1 R0	R0				
		X XX X X	X	1	X XX X X		R23 R22 ...R2 R1 R0
		P23 P22 P2 P1 P0	P0		X XX X X		P23 P22 ...P2 P1 P0
		X XX X X	X	0	X XX X X	X	R23 R22 ...R2 R1 R0
		X XX X X	X		S8 S7.....S2 S1 S0	X	S8 S7 S6 1 1 1 1 1 S5 S4 S3 1 1 1 1 1 S2 S1 S0 1 1 1 1 1

L=LOW LOGIC LEVEL H=HIGH LOGIC LEVEL X=IRRELEVANT R=PREVIOUS STATE P=PRESENT STATE S=SCAN STATE



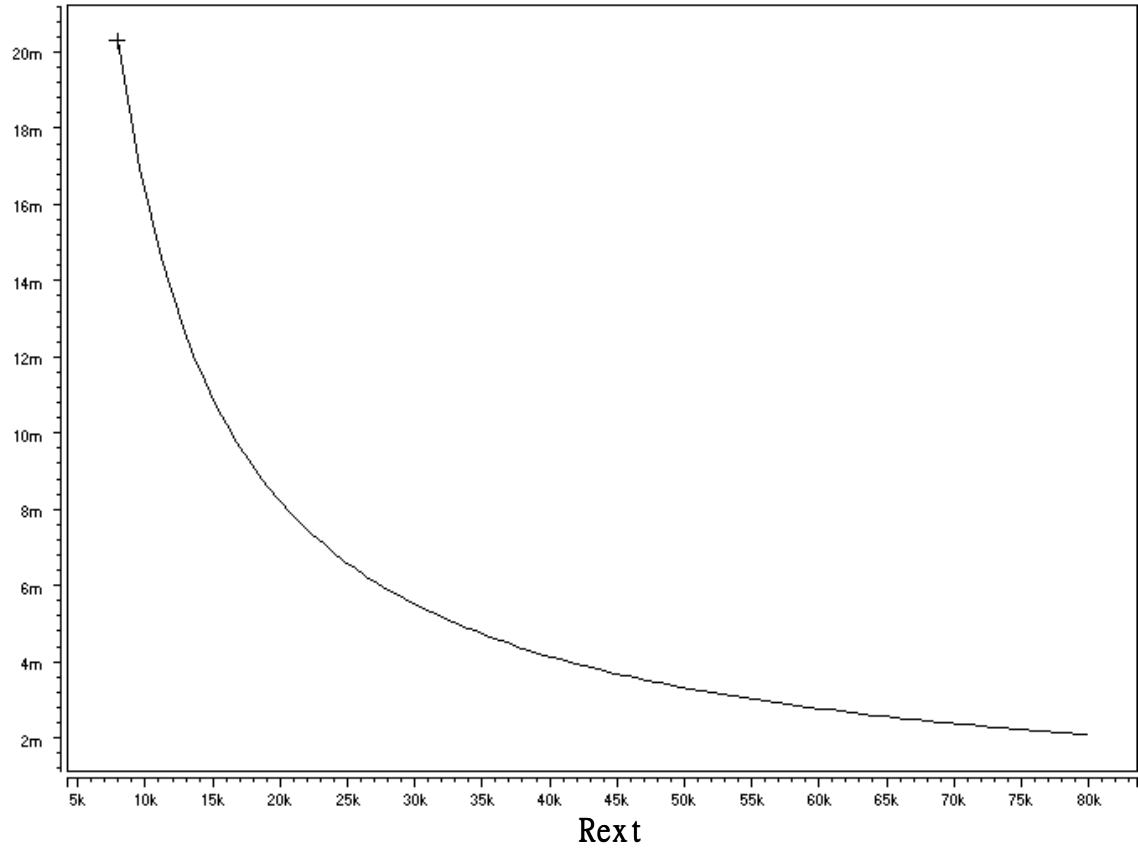
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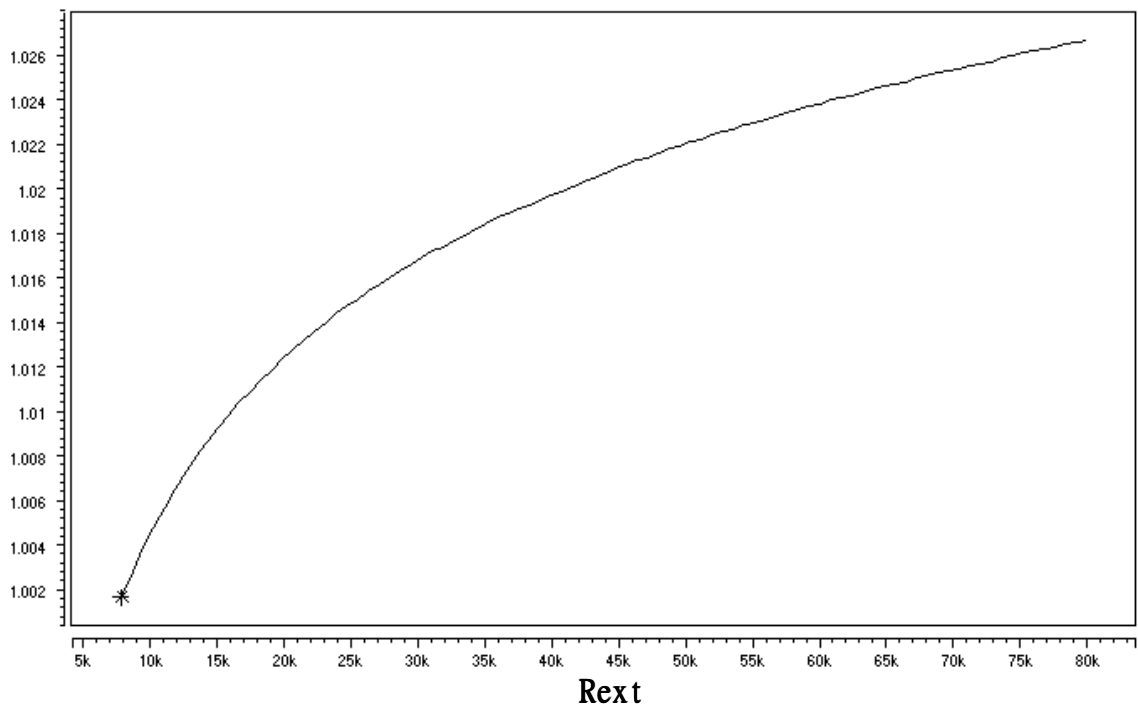
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■ TYPICAL CHARACTERISTIC CURVES

I_{out}



$I_{out}/132$



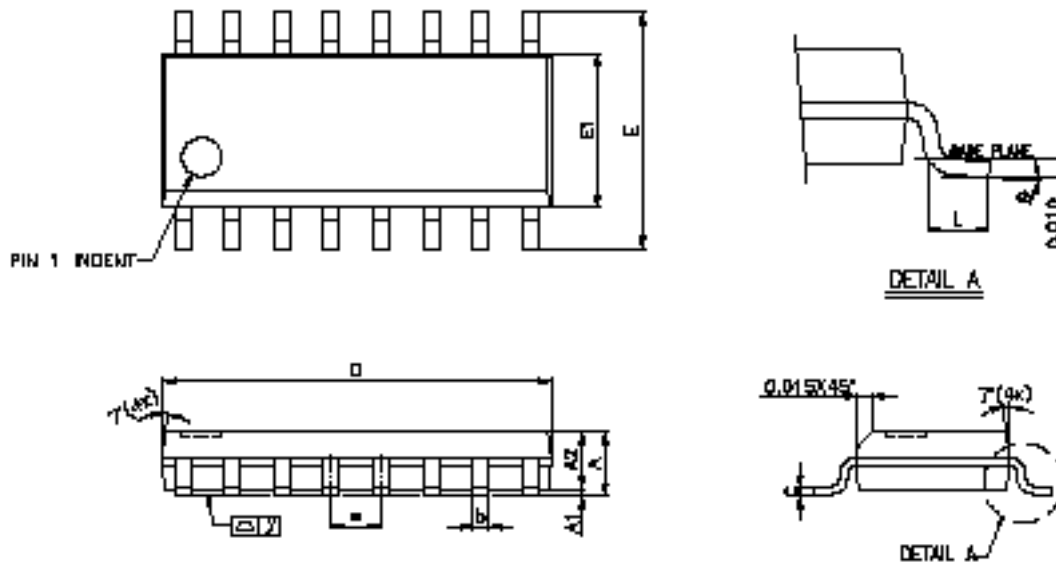
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■ PACKAGE INFORMATION

SOP:



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.47	1.60	1.73	0.058	0.063	0.068
A1	0.10	—	0.25	0.004	—	0.010
A2	—	1.45	—	—	0.057	—
b	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.0098
D	9.80	9.91	10.01	0.386	0.390	0.394
E	5.79	5.99	6.20	0.228	0.236	0.244
E1	3.81	3.91	3.99	0.150	0.154	0.157
e	—	1.27	—	—	0.050	—
L	0.38	0.71	1.27	0.015	0.028	0.050
y	—	—	0.076	—	—	0.003
Ø	Ø	—	Ø	Ø	—	Ø

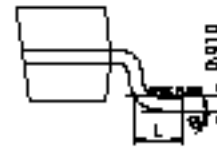
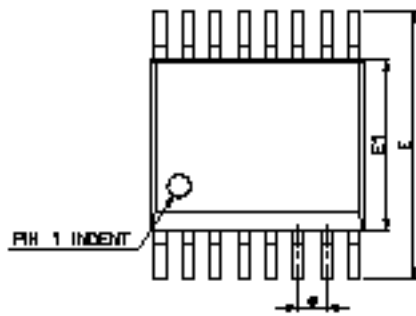


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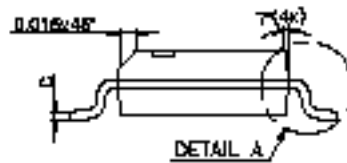
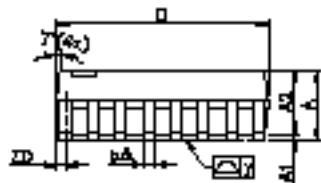
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SSOP:



DETAIL A



DETAIL A

SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.60	1.75	0.053	0.063	0.069
A1	0.10	0.15	0.25	0.004	0.006	0.010
A2	—	—	1.50	—	—	0.059
b	0.20	—	0.30	0.008	—	0.012
c	0.18	—	0.25	0.007	—	0.010
D	4.80	4.85	5.00	0.189	0.191	0.197
ZD	—	0.20	—	—	0.008	—
E	5.79	5.99	6.20	0.228	0.236	0.244
E1	3.81	3.91	3.99	0.150	0.154	0.157
L	0.41	0.71	1.27	0.016	0.028	0.050
e	—	0.64	—	—	0.025	—
f	—	—	0.076	—	—	0.003
φ	0"	—	6"	0"	—	6"



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