Preliminary WS2803

18-Channel Constant Current LED Driver With Programmable PWM Outputs

Features

- ●Supports both constant voltage and constant current drive mode
  - Constant output current range
  - -5-30mA@5V supply voltage
  - -5-20mA@3.3V supply voltage
- ●18 constant current driving channels
- ● 30V high voltage output channels
- ● 8bit PWM gray level control
- ● Precision output driving current
  - Between channels in a chip: ±2 %
  - Between chips: ±4%
- ● Maximum clock frequency up to 25MHz.
- ● Free run ability
- ● Over temperature protection

Applications

- ● LED decorative lighting
- ● Indoor/Outdoor LED video or massage display

General Description

The WS2803 is a constant current LED driver. It is designed for indoor/ outdoor LED displays and decorative LED lighting system. It is suitable for LED cascading applications. The WS2803 ownes 18 output channels, each channel can drive a constant current up to 30mA. WS2081 contains serial shift registers, data latches, output registers, band gap reference voltage generator, internal oscillator, and programmable constant output current drivers. The serial data is read into the shift registers at the rise edge of the external clock. The data and clock output buffers are designed for cascading another chip. The output current can be set by connect a resistor at IREF pin to set the output current of each channel. The over temperature protection is built in to protect the chip from thermal damage, if the core temperature level rise over 120℃, the output current will be decreased to stable the core temperature within a safe level. The 2-wire control scheme can reduce the system cost; it is very suitable for low cost LED decorative LED lighting systems.

WS2803 is available in both SOP-28 and DIP-28 package, the operating temperature is -40~85℃

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Power Supply Voltage	VCC	-0.3 to 6V	V
Input Voltage	V_{IN}	-0.3 to VCC+0.3V	V
Output Voltage	V_{OUT}	-0.4 to 45V	V
Output Pin Voltage	V_{XOUT}	-0.3 to 30V，I_{OUT} off	V
	V_{XOUT}	-0.3 to 10V，	V
Output Current Constant Current Drive Mode	I_{OUTCC}	5 to 30	mA
Output Current Deviation Between output channels Between chips	 D_{IOI} D_{IOE}	 ±2 ±4	%
Input Clock Frequency	F_{CLK}	25	MHz
Maximum Power Dissipation	P_D	2600	mW
Operating Junction Temperature	Topr	-40 to + 150	℃
Storage Temperature Range	Tstg	-55 to + 150	
Lead Temperature (Soldering, 10 seconds)	Tsolder	300	
ESD susceptibility		2000	V

Note: If the voltage on the pins exceeds the maximum ratings may cause permanent damage to the device.

Electrical Characteristics (VCC=5V, TA= 25℃, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Power Supply Voltage Range	V_{CC}		3.3	--	5.5	V
Output Voltage	VOUT	IOUT=1uA	-0.3	--	40	V
Output Current	I_{outH}	Constant Current Output	5	--	30	mA
	I_{outL}	Output Cut Off, VOUT=30V	--	0.1	1	uA
	I_{SOURCE}	Other Output	--	1	--	mA
	I_{SINK}	Other Output	--	-1	--	mA
Standby Supply Current	I_{STB}	IREF floating	--	1	1.5	mA
Minimum Constant Current Output Time	I_{OH}	V_{IN}=V_{IH} or V_{IL}, I_{OUT}=20mA	--	14	--	uS
Input Current	I_{IN}	PIN：CKI，SDI V_{IN}=VDD or GND	--	--	±1	uA
		PIN：LIN V_{IN}=VDD or GND	--	±10	±20	uA
Input Voltage Level	V_{IH}	TA=-40～125℃	0.8*VDD	--	VDD	V
	V_{IL}		GND	--	0.2*VDD	V
Output Current vs. Output Voltage Regulation	$\%dV_{OUT}$	IREF=700Ω, @20mA	--	±0.1	--	%/V
Output Current Line Regulation	$\%dV_{CC}$	V_{CC} = 4 ～ 5.5V,V_{OUT} between 1.0V and 3.0V	--	±0.1	--	%/V
Pull LOW Resistance	R_{INLOW}	R_{LIN},	--	30	--	KΩ

Switching Characteristics (VCC=5V, TA=25℃)

Parameter		Symbol	Conditions	Min	Typ	Max	Units
Propagation Delay (‘L’ to ‘H’)	CKI-to-CKO	T_{pLH}	V_{IH}=VCC V_{IL}=GND R_{XFBs}=30 RL=180Ω CL=30pF	--	12	--	ns
Propagation Delay (‘L’ to ‘H’)	CKI-to-CKO	T_{pHL}		--	13.2	--	ns
Output Current Rise Time		T_{or}		--	50	--	ns
Maximum Turn ON and OFF time of Drive Current		T_{of}		--	50	--	ns
Output Current Propagation		①T_{OP}		--	--	3.3	mS

Switching Characteristics (VCC=3.3V, TA=25℃)

Parameter		Symbol	Conditions	Min	Typ	Max	Units
Propagation Delay (‘L’ to ‘H’)	CKI-to-CKO	T_{pLH}	V_{IH}=VCC V_{IL}=GND R_{XFBs}=30Ω RL=180Ω CL=30pF	--	24	--	ns
Propagation Delay (‘L’ to ‘H’)	CKI-to-CKO	T_{pHL}		--	28	--	ns
Output Current Rise Time		T_{or}		--	50	--	
Output Current Fall Time		T_{of}		--	50	--	ns
Output Current Propagation		①T_{OP}		--	--	3.3	mS

Typical Block Diagram

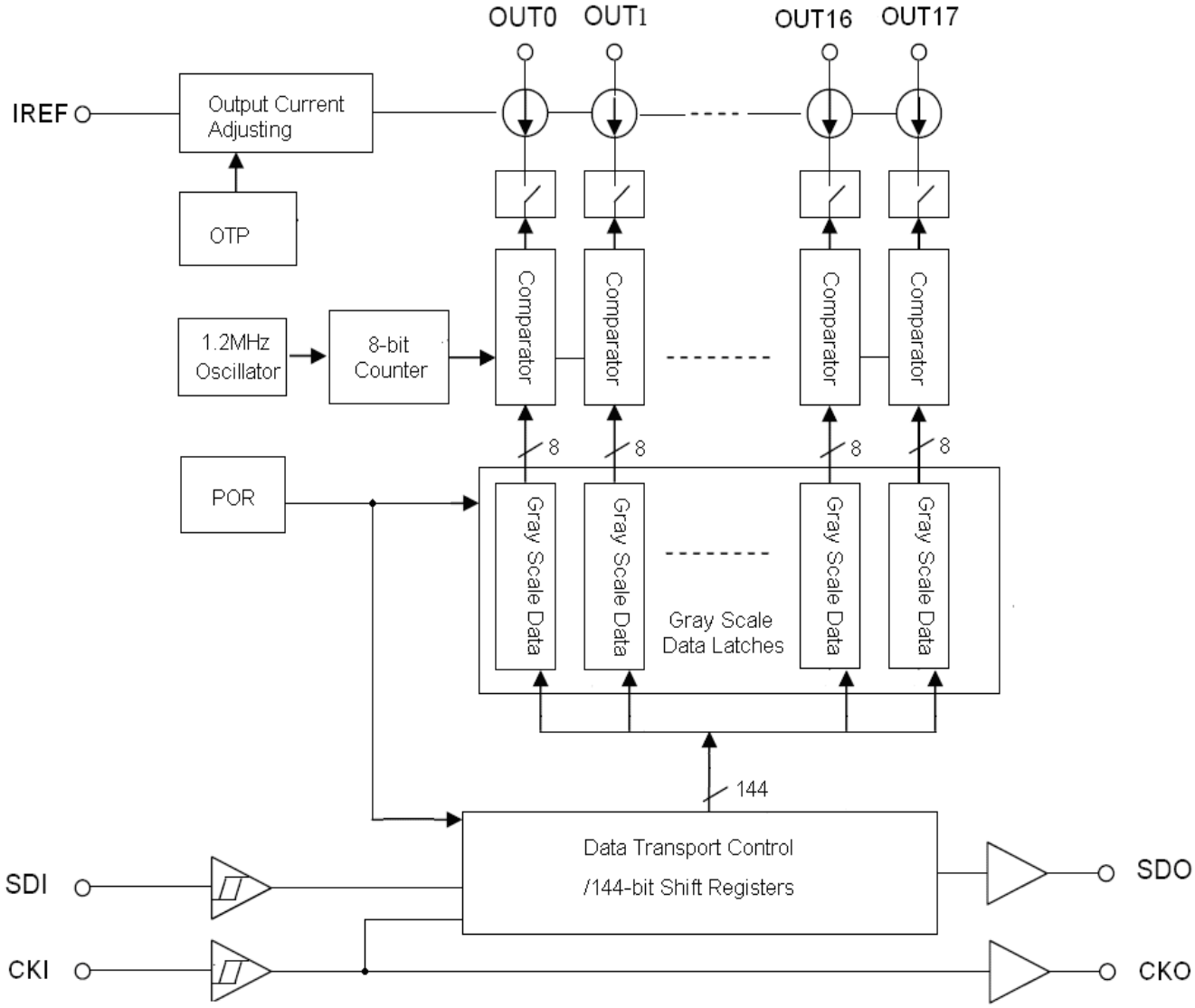

Fig1, Block Diagram of WS2803

Pin Configurations

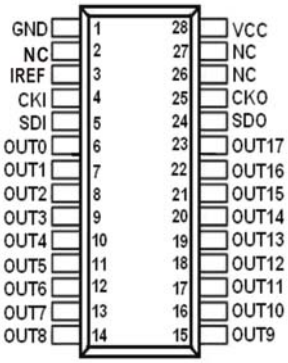

Fig2.a SOP-28package

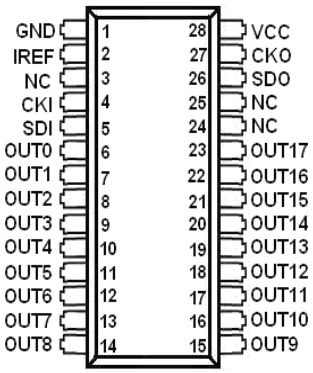

Fig2.b DIP-28 package

Pin Description

SOP-28

Pin No.	Pin Name	Pin Description
1	GND	Ground
2	IREF	A resistor connected to this pin can set the output constant current.
3	NC	None connection
4	CKI	Data clock input
5	SDI	Serial gray scale data input
6~23	OUT0~17	Constant current output terminals
24	SDO	Buffered serial data output
25	CKO	Buffered clock output
26	NC	None connection
27	NC	None connection
28	VCC	VCC input

DIP-28

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26	SDO	Buffered serial data output
27	CKO	Buffered clock output
28	VCC	VCC input

Application note:

Output Constant Current

In LED display and decorative applications, WS2803 provides nearly no variations in current from channel to channel and from IC to IC. This can be achieved by:

1) The maximum current variation between channels is less than 2%, and between chips is less than 4%.
2) In addition, the current characteristic of the output stages is flat and users can refer to the figures as shown below. The output current can be kept constant regardless of the variations of led forward voltages (VF). This performs as a perfection of load regulation.

Adjusting the output current

The output current of each channel can be set by an external resistor, REXT, the output current can be set by the following formula:

$$I_{OUT} = \frac{V_{REXT}}{R_{EXT}} \times 22$$

Where, REXT is the resistance of the external resistor connected to REXT terminal, and VREXT is the voltage of REXT pin

VREXT=1.25V. To set the output current at 20mA, a resistor with 1.25Kohm resistance should be connected from REXT to GND. The relationship between IOUT and REXT is shown in the following figure.

Package Power Dissipation (PD)

The maximum allowable package power dissipation is determined as PD(max)=(Tj-Ta)/Rth(j-a), when all 18 output channels are turned on simultaneously, the actual package power dissipation is:

$$P_D(act) = (I_{DD} \times V_{DD}) + (I_{OUT} \times Duty \times V_{DS} \times 18)$$

Therefore, to keep PD(act)≤PD(MAX), the maximum output current as a function of duty cycle is:

$$I_{OUT} = (\frac{T_j \quad T_a}{R_{th(j\ a)}} \quad I_{CC} \times V_{CC}) / V_{DS} / Duty \ / 18$$

The maximum power dissipation PD(MAX)=(Tj-Ta)/Rth(j-a), decreases as the ambient temperature increases.

Load Supply Voltage (VLED)

WS2803 is designed to operate VDS ranging from 0.4 to 1.0V, considering the package power dissipating limits. VDS maybe high enough to ensure PD(ACT)>PD(MAX), when VLED=24V and VDS=VLED-VF, in which VLED is the load supply voltage. In case it is recommended to use the lowest possible supply voltage or to set an external voltage reducer, VDROP, to dissipate the excessive power.

A voltage reducer lets $V_{DS}=(V_{LED}-V_F)-V_{DROP}$.

Resistors or zener diode can be used in the applications as shown in the following figures.

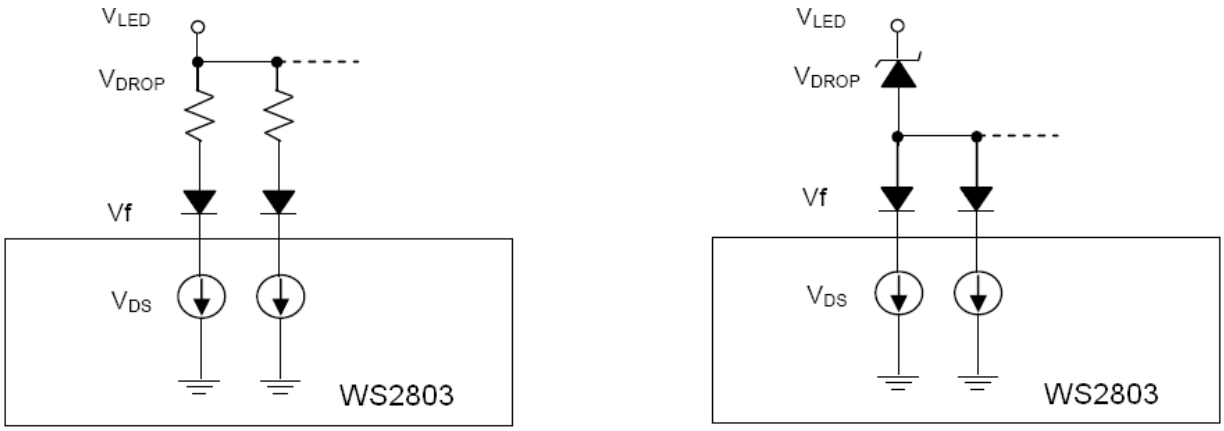


Fig 3 power reducer of WS2803

2-wire Control Mode

When MS pin is connected to VCC, WS2803 operates in 2-wire control mode, at this mode, only 2 wires are needed to transmit the grayscale data. It is a low cost solution. Only 2 ports of MCU are needed to control over thousand WS2803 chips.At this mode, CKI pin keeps LOW more than 600us, the internal logic control circuitry will be reset. Once reset, the internal circuitry wait for the positive pulse on the CKI pin, at this state, the signal on SDI pin is shifted in to the internal data registers, once total 144 pulses are detected, WS2803 will latch the signal from the shift registers, and the WS2803 operates as a signal relay, at this state, the CKO and SDO are enabled. If the CKI keeps LOW for more than 600us, all the internal data control circuit will back to the original states, wait for next data transmi

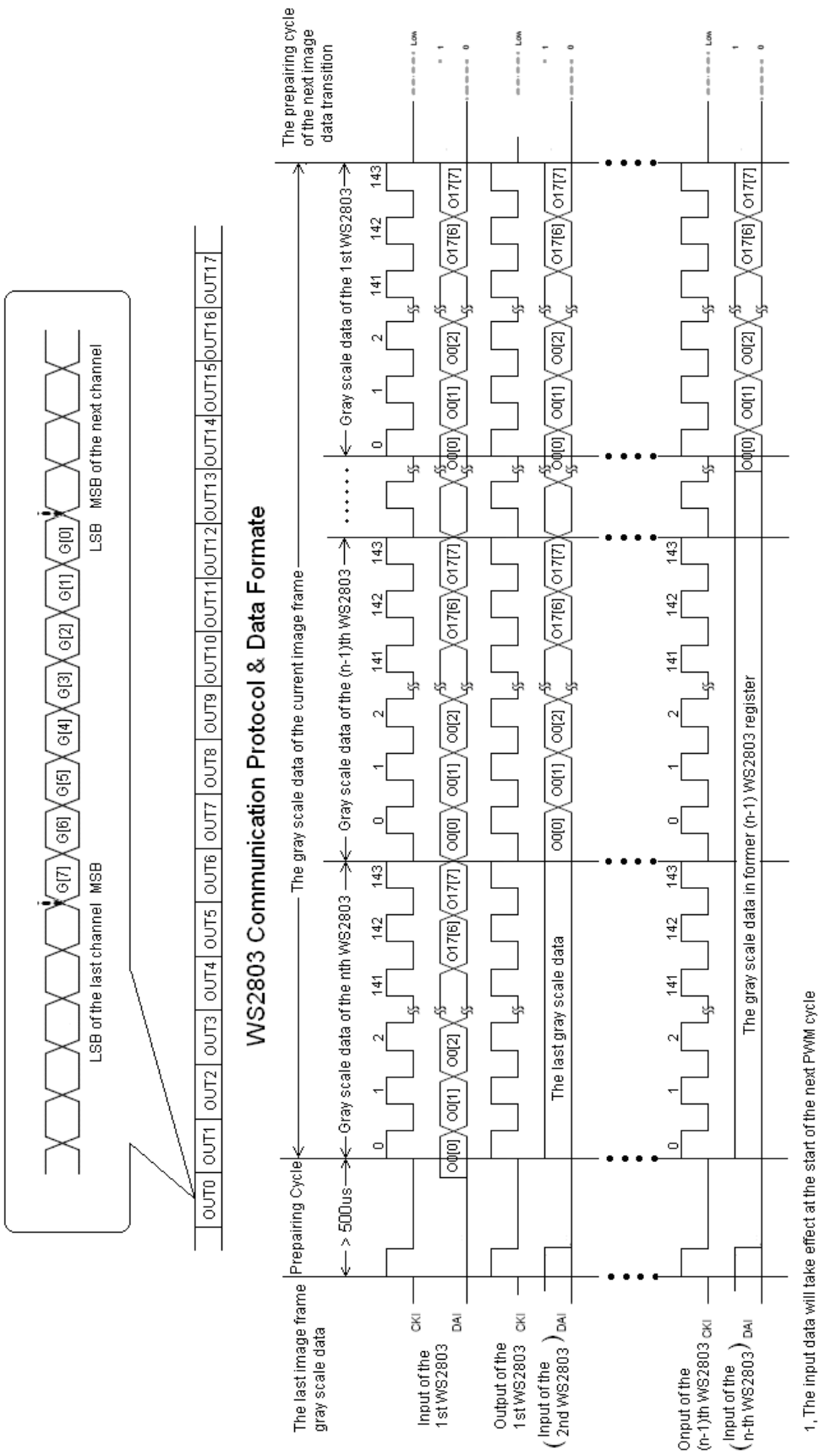


Fig 4, WS2803 timing chart with 2-wire control in cascading application

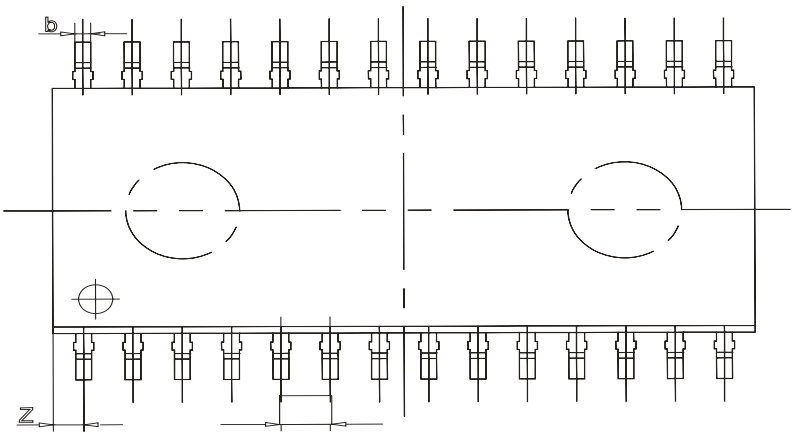
The Connection and Driving of Cascading Operation

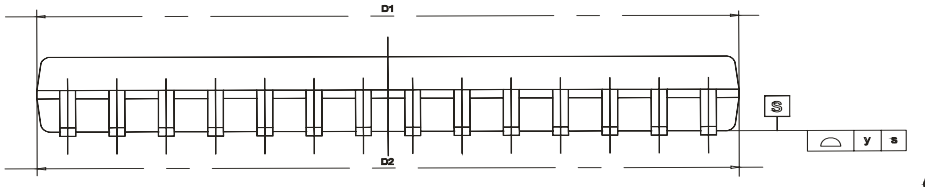
The transmit the data over long distance by cascading, the WS2803 integrates push-pull output stage with strong driving capability which enables the data and clock can be transmitted up to 6 meters at 2MHz clock frequency.

To prevent the reflection, it is necessary to connect a 50Ω resistor at the data input or output port for impedance match.

Package Information

SOP-28 package (Unit:mm)

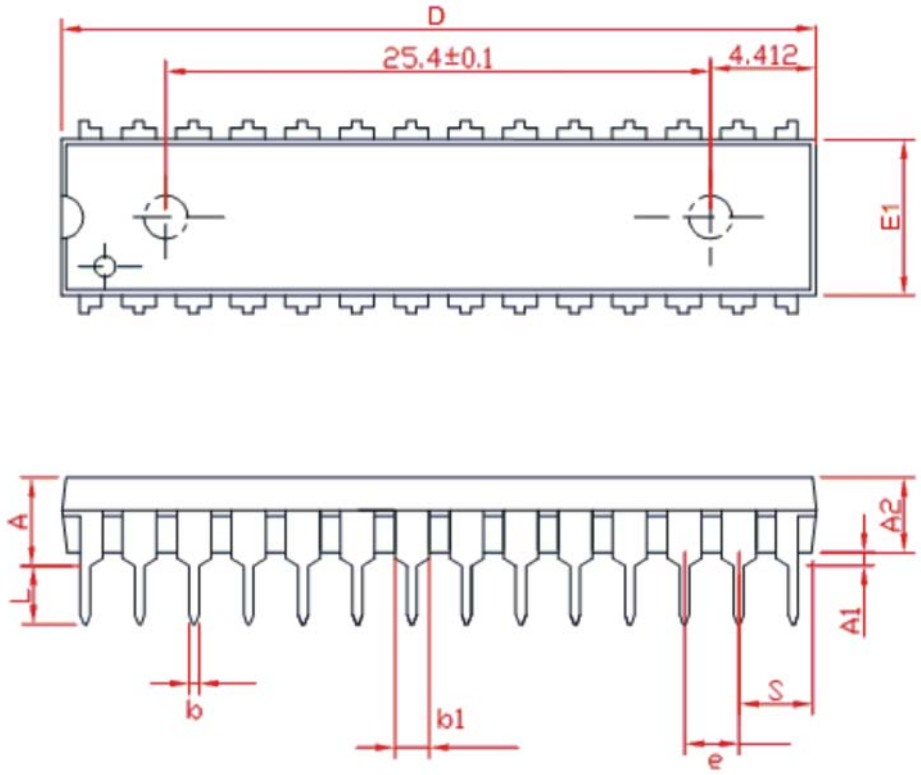




Symbol	Min	Nom	Max
A	2.465	2.515	2.565
A1	0.100	0.150	0.200
A2	2.100	2.300	2.500
A3	--------	0.274	--------
b	0.356	0.406	0.456
b1	0.366	0.426	0.486
c	-------	0.254	-------
D1	17.750	17.950	18.150
D2	17.800	18.000	18.200
E	10.100	10.300	10.500
E1	7.374	7.450	7.574
E2	7.424	7.500	7.624
e	-------	1.270	-------
L	0.764	0.864	0.964
L1	1.303	1.403	1.503
R	-------	0.200	-------
R1	-------	0.300	-------
θ	0	-------	-------
θ 1	0	-------	10 °
y	-------	-------	0.1
Z	-------	0.745	------

Fig 6.a SOP-28

DIP-28 package (Unit:mm)



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	3.67	3.69	3.70	0.144	0.145	0.146
A1	0.33	0.39	0.46	0.013	0.015	0.018
A2	3.27	3.30	3.31	0.129	0.130	0.131
b	-	0.46	-	-	0.018	-
b1	1.52	1.55	1.61	0.060	0.061	0.063
C	0.24	-	0.26	0.009	-	0.01
D	34.96	35.18	35.30	1.376	1.385	1.389
S	3.34	3.38	3.40	0.131	0.133	0.134
E	8.12	8.13	8.15	0.319	0.320	0.321
E1	7.32	7.38	7.40	0.288	0.290	0.291
e	-	2.54	-	-	0.1	-
L	-	3.23	3.25	-	0.127	0.128
eB	8.4	8.9	9.4	0.330	0.350	0.370

Fig 6.b DIP-28

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