LD1018

16 Channel Constant Current LED Driver

Ver. 2.0 / Mar. 2009

LDT Inc. Mplaza 3F, 538, Dujeong-dong, Seobuk-gu, Cheonan, Chungnam, 331-958, Korea
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LD1018 Revision History

Version	Contents	Transfer Date
1.0	Preliminary Spec.	2008.08.12
2.0	1. Change : Supply Voltage Regulation : max ± 3% to Max 6% 2. Add : Rext vs Iout (3.3V) Diagram. 3. Add : DC Characteristics (3.3V) 4. Add : AC Characteristics (3.3V) 5. Change :Propagation Delays	2009.03.25

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DESCRIPTION

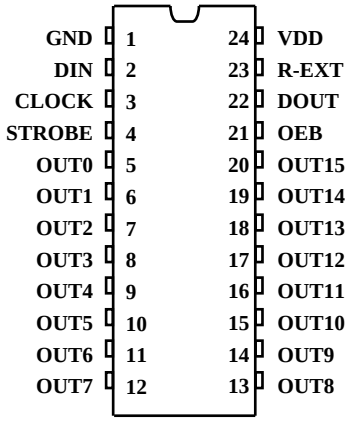
The LD1018 is specifically designed for LED display applications. The constant current output can be preset through an external resistor (I_{OUT} = 3mA to 45mA). The device consists of 16bit shift register, latch and constant current output driver. The LD1018 provides a constant output current for driving the LEDs against for the variation of LED forward voltage(Vf).

The LD1018's excellent current matching characteristics among the output ports and fast output response time will give you the best display quality for LED display system.

FEATURES

- **16 constant-current output channels**
- **Output current : set -up at 3mA to 45mA with an external resistor**
- **Pin to pin deviation : max ± 1.5%**
- **Chip to chip deviation : max ± 3%**
- **3.3V/5V CMOS compatible input**
- **Delayed output to prevent inrush current**
- **Maximum data transfer rate : max 30MHz**
- **Fast response of OEB - OUTn (min) : 60ns @V_{DD}=5V, 100ns @V_{DD}=3.3V**
- **3.3V/5V supply voltage**
- **Package : LD1018-SP (SOP-24), LD1018-SS (SSOP-24)**
- **"Pb_free & Green" Package**

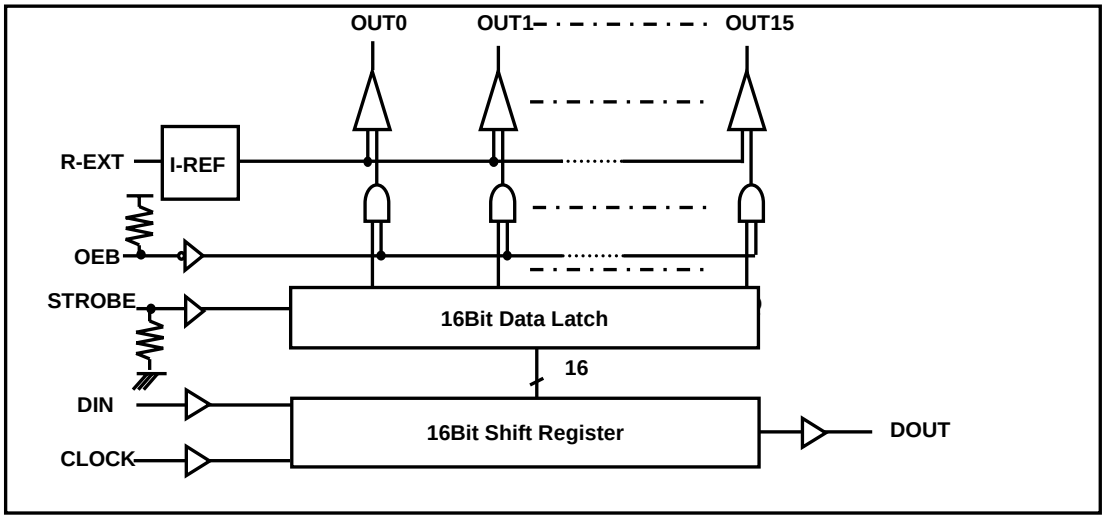
PIN CONNECTION



ORDERING INFORMATION

PART NUMBER	PACKAGE	TA
LD1018-SS	24 SSOP	-40°C to 85 °C
LD1018-SP	24 SOP	-40°C to 85 °C

BLOCK DIAGRAM



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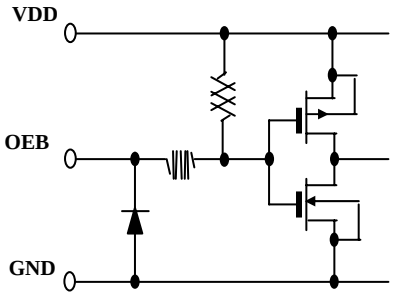
TERMINAL DESCRIPTION

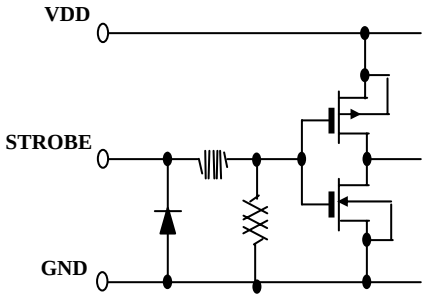
PIN NO	PIN NAME	FUNCTION
1	GND	Ground terminal
2	DIN	Serial input data
3	CLOCK	Shift input clock for serial input data DIN(Rising Edge Clocking)
4	STROBE	Data is transferred to the output latch at STROBE rising edge
5 -20	OUTn	Constant current outputs for LEDs, n = 0 ~ 15
21	OEB	Output Enable. Active Low
22	DOUT	Serial data output terminal for shifting the data to next chip
23	REXT	Connect the resistor between this pin and GND to set up the constant output current for all the OUTn.
24	VDD	Supply voltage

EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

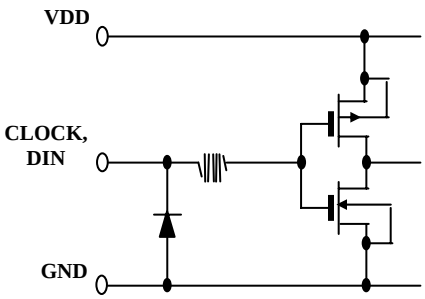
1. OEB terminal



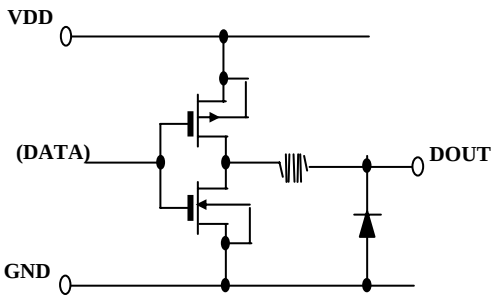
2. STROBE terminal



3. CLOCK, DIN terminal



4. DOUT terminal



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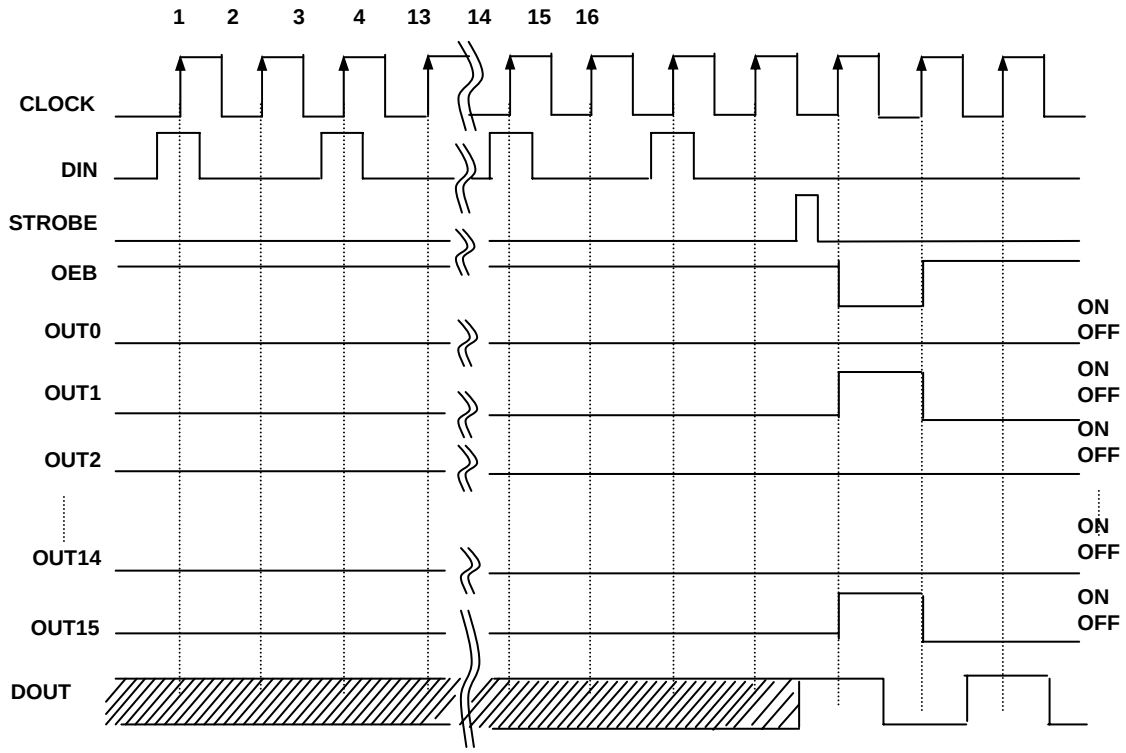
TIMING DIAGRAM



TRUTH TABLE

Input				Output	
CLOCK	STROBE	OEB	DIN	OUT0 …… OUT7 ……OUT15	DOUT
↑	H	L	Dn	D_n ---- D_{n-7} ---- D_{n-15}	No Change
↑	L	L	Dn	No change	No Change
↑	*	H	Dn	OFF ---- OFF ---- OFF	No Change
↓	H	L	Dn	D_n ---- D_{n-7} ---- D_{n-15}	D_{n-15}
↓	L	L	Dn	No change	D_{n-15}
↓	*	H	Dn	OFF ---- OFF ---- OFF	D_{n-15}

[Note] 1) When the state of D_n ~ D_{n-15} is "H", the OUTn is turned ON("L" : OUTn is turned OFF).
2) * : Don't Care

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MAXIMUM RATINGS

(Ta = 25 ℃ unless otherwise noted)

Characteristic		Symbol	Rating	Unit
Supply Voltage		V_{DD}	0 ~ 7.0	V
Output Voltage		V_{OUT}	-0.5 ~ 7.0	V
Output Current		I_{OUT}	60	mA
Input Voltage		V_{IN}	-0.4 ~ V_{DD} + 0.4	V
GND Terminal Current		I_{GND}	725	mA
CLOCK Frequency		F_{CLK}	30	MHz
Power Dissipation (On PCB, TA = 25 ℃)	SOP	P_D	1.67	W
	SSOP		1.48	
Thermal Resistance (On PCB, TA = 25 ℃)	SOP	$R_{th(j-a)}$	75	℃/W
	SSOP		85	
Operation Temperature		T_{opr}	-40 ~ 85	℃
Storage Temperature		T_{stg}	-55 ~ 150	℃

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DC CHARACTERISTICS (5.0V)

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Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage		V_{DD}		3.0	5.0	5.5	V
Output Voltage		V_{OUT}				5.5	-
Output Current	OUTn	I_{OUT}		3		45	mA
	DOUT	I_{OH}		-1.0			
		I_{OL}				1.0	
Input Voltage	‘H” Level	V_{IH}		$0.8V_{DD}$	-	$1.0V_{DD}$	V
	‘L” Level	V_{IL}		GND	-	$0.2V_{DD}$	
Output Voltage	DOUT ‘L” Level	V_{OL}		GND	-	$0.2V_{DD}$	V
		V_{OH}		$0.8V_{DD}$	-	V_{DD}	
Output Current1 Pint to Pin		I_{OL1}	R_{EXT} = 1.0 kΩ		20		mA
		ΔI_{OL1}	R_{EXT} = 1.0 kΩ I_{OUT} = 20mA			±1.5	%
Output Current2 Pin to Pin		I_{OL2}	R_{EXT} = 0.5 kΩ		40		mA
		ΔI_{OL2}	R_{EXT} = 0.5 kΩ I_{OUT} = 40mA			±1.5	%
Output Current vs. Output Voltage Regulation		$\%/dV_{DS}$	VDS Within 1.0V and 3.0V			±0.2	%
Output Current vs. Supply Voltage Regulation		$\%/dV_{DD}$	VDD Within 4.5V and 5.5V			6.0	%
Pull Up Resistor		R_{UP}		100	200	400	kΩ
Pull Down Resistor		R_{DOWN}		100	200	400	kΩ
Supply Current		I_{DD}(off)1	R_{EXT} = OPEN		1	2	mA
		I_{DD}(off)2	R_{EXT} = 1.0 kΩ I_{OUTn} = 20mA		3	5.4	mA
		I_{DD}(off)3	R_{EXT} = 0.5 kΩ I_{OUT} = 40mA		6	8	mA
		I_{DD}(on)1	R_{EXT} = 1.0 kΩ I_{OUTn} = 20mA		3	5.4	mA
		I_{DD}(on)2	R_{EXT} = 0.5 kΩ I_{OUT} = 40mA		6	8	mA

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DC CHARACTERISTICS(3.3V)

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Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage		V_{DD}		3.0	5.0	5.5	V
Output Voltage		V_{OUT}				5.5	-
Output Current	OUTn	I_{OUT}		3		45	mA
	DOUT	I_{OH}		-1.0			
		I_{OL}				1.0	
Input Voltage	‘H” Level	V_{IH}		$0.8V_{DD}$	-	$1.0V_{DD}$	V
	‘L” Level	V_{IL}		GND	-	$0.2V_{DD}$	
Output Voltage	DOUT ‘L” Level	V_{OL}		GND	-	$0.2V_{DD}$	V
		V_{OH}		$0.8V_{DD}$	-	V_{DD}	
Output Current1 Pint to Pin		I_{OL1}	R_{EXT} = 1.0 kΩ		20		mA
		ΔI_{OL1}	R_{EXT} = 1.0 kΩ I_{OUT} = 20mA			±1.5	%
Output Current2 Pin to Pin		I_{OL2}	R_{EXT} = 0.5 kΩ		40		mA
		ΔI_{OL2}	R_{EXT} = 0.5 kΩ I_{OUT} = 40mA			±1.5	%
Output Current vs. Output Voltage Regulation		$\%/dV_{DS}$	VDS Within 1.0V and 3.0V			±0.2	%
Output Current vs. Supply Voltage Regulation		$\%/dV_{DD}$	VDD Within 4.5V and 5.5V			6.0	%
Pull Up Resistor		R_{UP}		100	200	400	kΩ
Pull Down Resistor		R_{DOWN}		100	200	400	kΩ
Supply Current		I_{DD}(off)1	R_{EXT} = OPEN		1	2	mA
		I_{DD}(off)2	R_{EXT} = 1.0 kΩ I_{OUTn} = 20mA		3	5.4	mA
		I_{DD}(off)3	R_{EXT} = 0.5 kΩ I_{OUT} = 40mA		6	8	mA
		I_{DD}(on)1	R_{EXT} = 1.0 kΩ I_{OUTn} = 20mA		3	5.4	mA
		I_{DD}(on)2	R_{EXT} = 0.5 kΩ I_{OUT} = 40mA		6	8	mA

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AC CHARACTERISTICS (V_{DD}=5.0V)

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Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time (Low to High)	CLOCK-OUTn	T_{pLH1}	V_{DD} = 5.0V V_{OUT} = 1.0V V_{IH} = V_{DD} V_{IL} = GND f_{CLK} = 10MHz R_{EXT} = **0.5**kΩ I_{OUTn} = 40mA V_L = 3.0V C_L = 10.0pF R_L = 50Ω	50		110	ns
	CLOCK-DOUT	t_{pLH}		20	-	25	ns
	STROBE-OUTn	t_{pLH2}		50		110	ns
	OEB-OUTn	t_{pLH3}		30	-	120	ns
Propagation Delay Time (High to Low)	CLOCK-OUTn	t_{pHL1}		50		110	ns
	CLOCK-DOUT	t_{pHL}		20	-	25	ns
	STROBE-OUTn	t_{pHL2}		-	-	-	ns
	OEB-OUTn	t_{pHL3}		40		90	ns
Pulse Width	CLOCK	t_{W_CLK}		10	20		ns
	STROBE	t_{W_STB}		40			ns
	OEB	t_{W_OEB}		60	-		ns
Maximum CLOCK Frequency		f_{CLKMAX}				30	MHz
Data Setup Time		t_{sD}		10	-	-	ns
Data Hold Time		t_{hD}		10	-	-	ns
STROBE Setup Time		t_{sS}		10	-	-	ns
STROBE Hold Time		t_{hS}		10	-	-	ns
Maximum Clock Rise Time		t_r				50	ns
Maximum Clock Fall Time		t_f				50	ns
Maximum Output Rise Time		t_{or}				25	ns
Maximum Output Fall Time		t_{of}				25	ns

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AC CHARACTERISTICS (V_{DD}=3.3V)

(Ta = 25 ℃ unless otherwise noted)

Characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time (Low to High)	CLOCK-OUTn	T_{pLH1}	V_{DD} = 5.0V V_{OUT} = 1.0V V_{IH} = V_{DD} V_{IL} = GND f_{CLK} = 10MHz R_{EXT} = **0.5**kΩ I_{OUTn} = 40mA V_L = 3.0V C_L = 10.0pF R_L = 50Ω	60		160	ns
	CLOCK-DOUT	t_{pLH}		-	-	25	ns
	STROBE-OUTn	t_{pLH2}		50		160	ns
	OEB-OUTn	t_{pLH3}		30	-	120	ns
Propagation Delay Time (High to Low)	CLOCK-OUTn	t_{pHL1}		60		160	ns
	CLOCK-DOUT	t_{pHL}		-	-	25	ns
	STROBE-OUTn	t_{pHL2}		-	-	-	ns
	OEB-OUTn	t_{pHL3}		50		180	ns
Pulse Width	CLOCK	t_{W_CLK}		10	20		ns
	STROBE	t_{W_STB}		40			ns
	OEB	t_{W_OEB}		80	-		ns
Maximum CLOCK Frequency		f_{CLKMAX}				30	MHz
Data Setup Time		t_{sD}		10	-	-	ns
Data Hold Time		t_{hD}		10	-	-	ns
STROBE Setup Time		t_{sS}		40	-	-	ns
STROBE Hold Time		t_{hS}		10	-	-	ns
Maximum Clock Rise Time		t_r				50	ns
Maximum Clock Fall Time		t_f				50	ns
Maximum Output Rise Time		t_{or}				25	ns
Maximum Output Fall Time		t_{of}				25	ns

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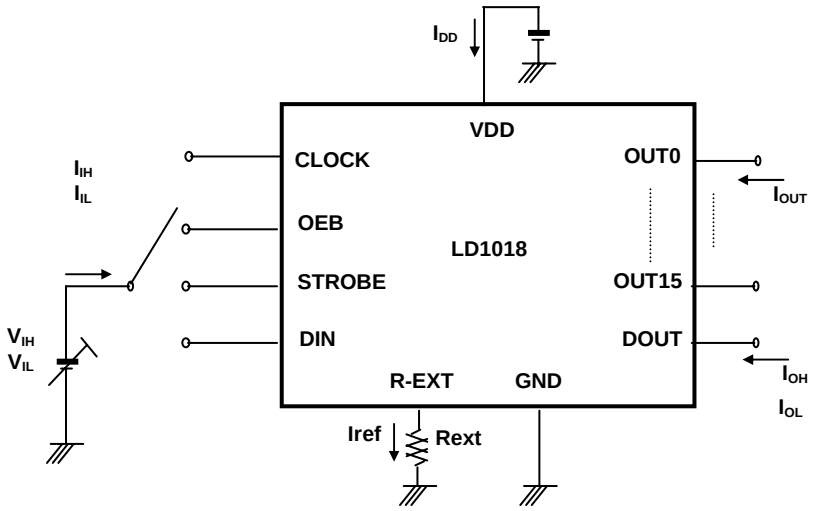
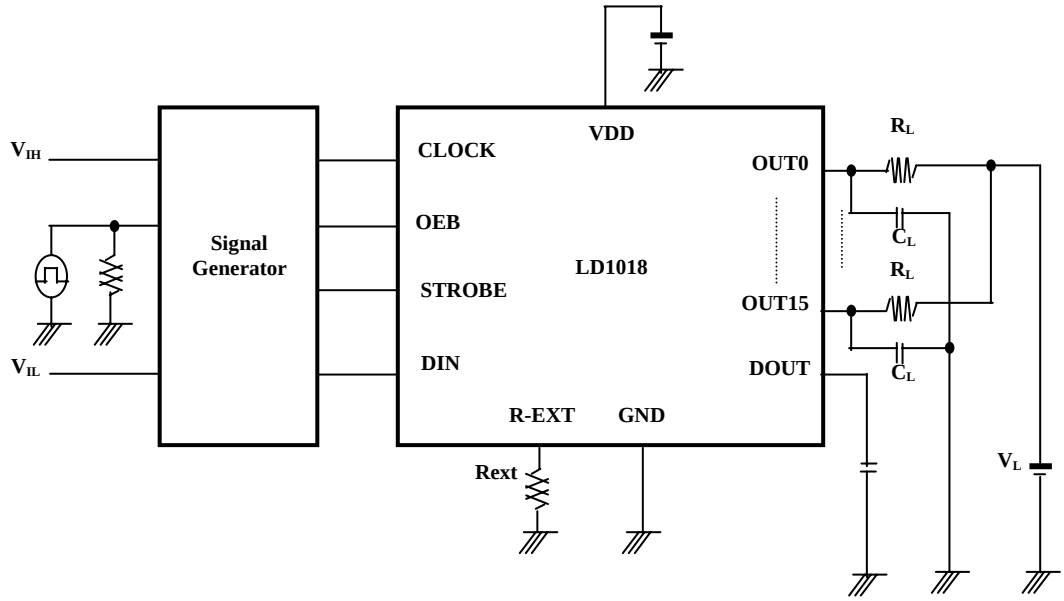
DC CHARACTERISTIC TEST CIRCUIT



AC CHARACTERISTIC TEST CIRCUIT



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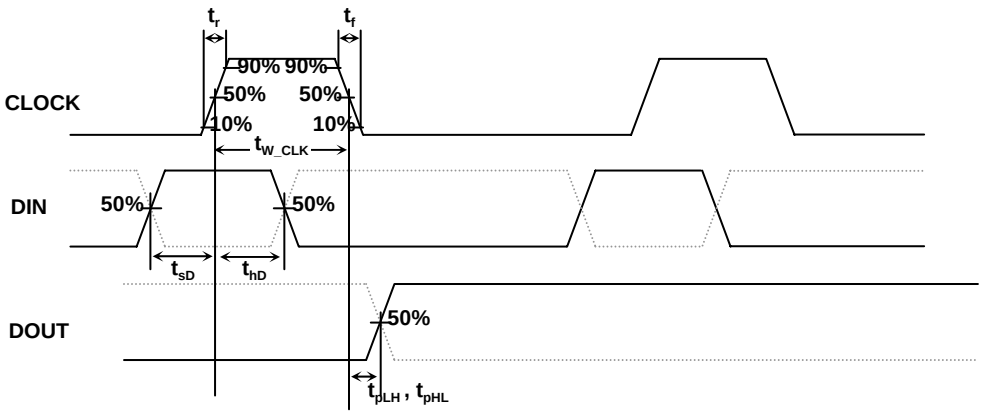
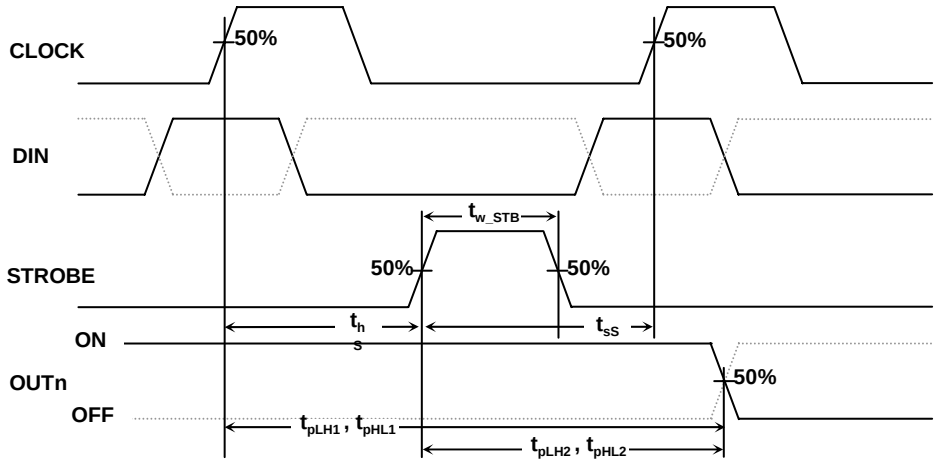
TIMING WAVEFORM

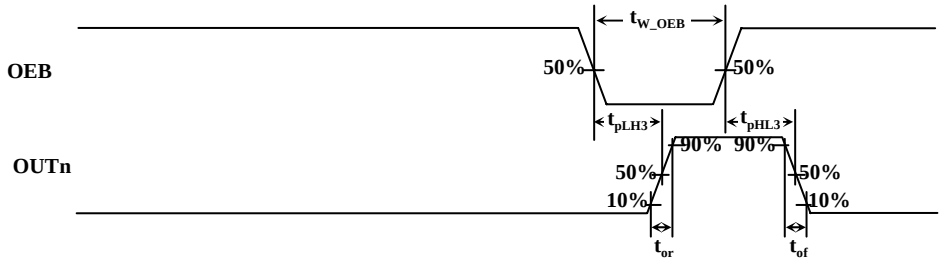
CLOCK-DOUT, OUTn



CLOCK-STROBE



OEB-OUTn



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ADJUSTING OUTPUT CURRENT

The output current is determined by an external resistor. The relationship between I_{OUT} and R_{EXT} is as follows;

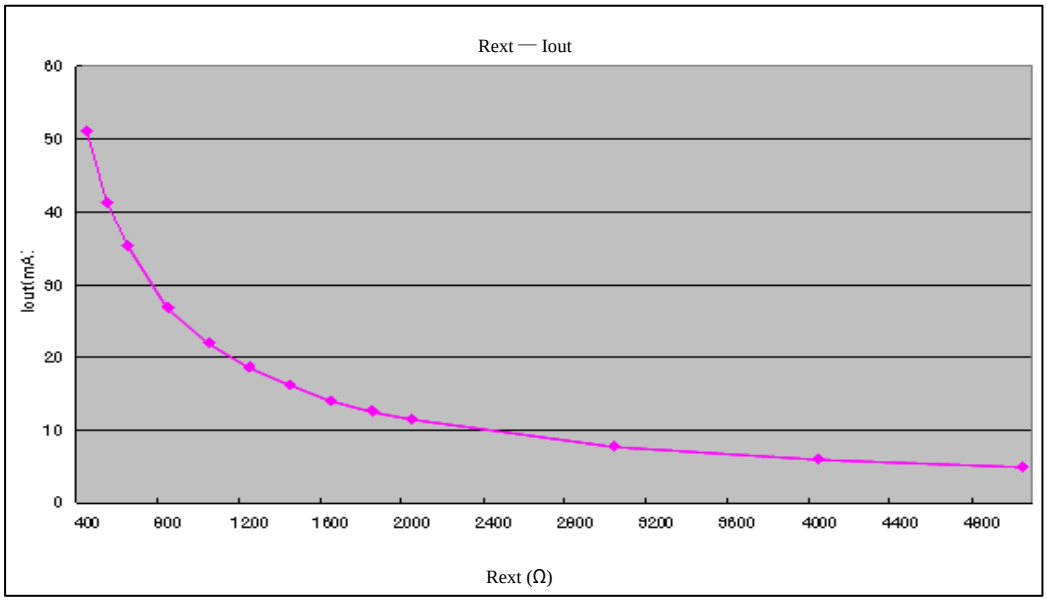
When VDD = 5V

$$I_{OUT}[A] = \{1.16/(90+R_{EXT})\} * 22$$

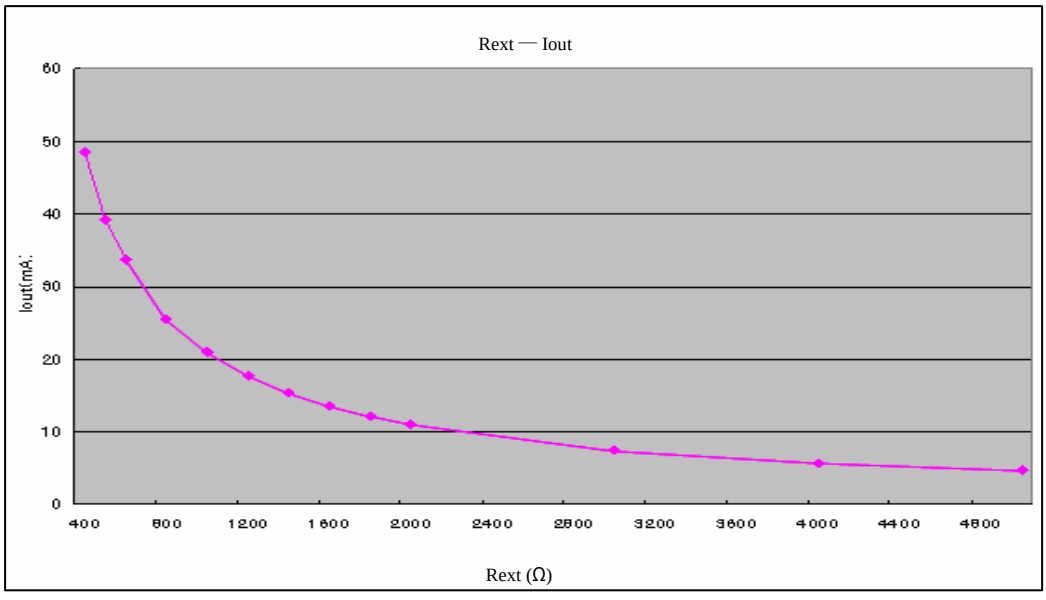
When VDD = 3.3V

$$I_{OUT}[A] = \{1.16/(90+R_{EXT})\} * 21$$

VDD = 5.0V



VDD = 3.3V



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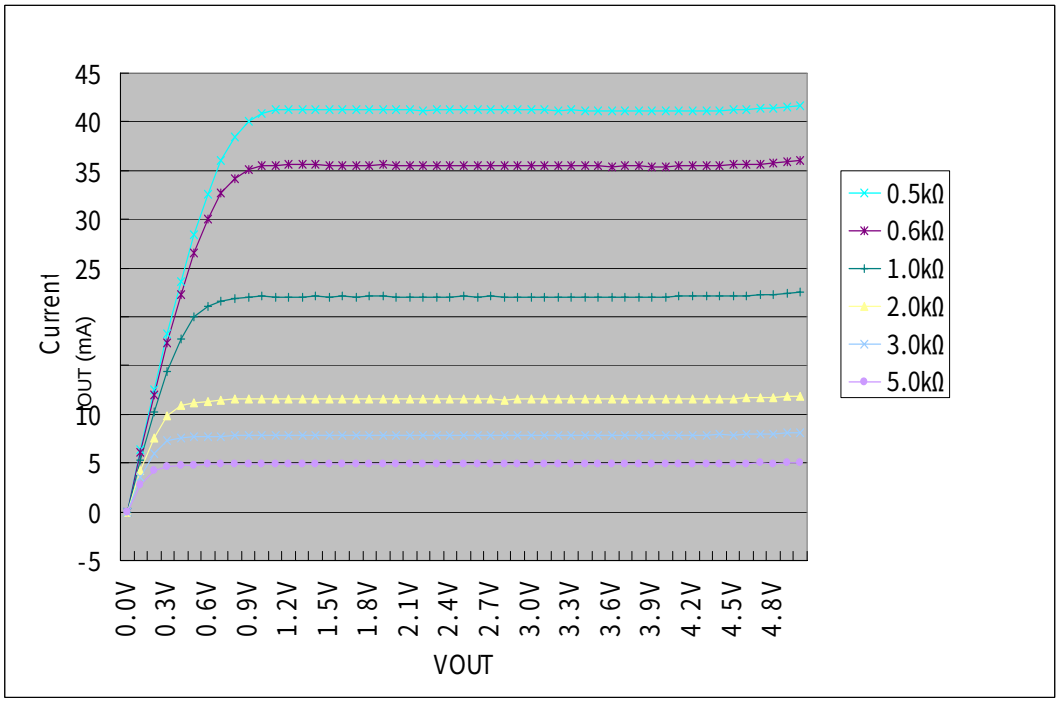
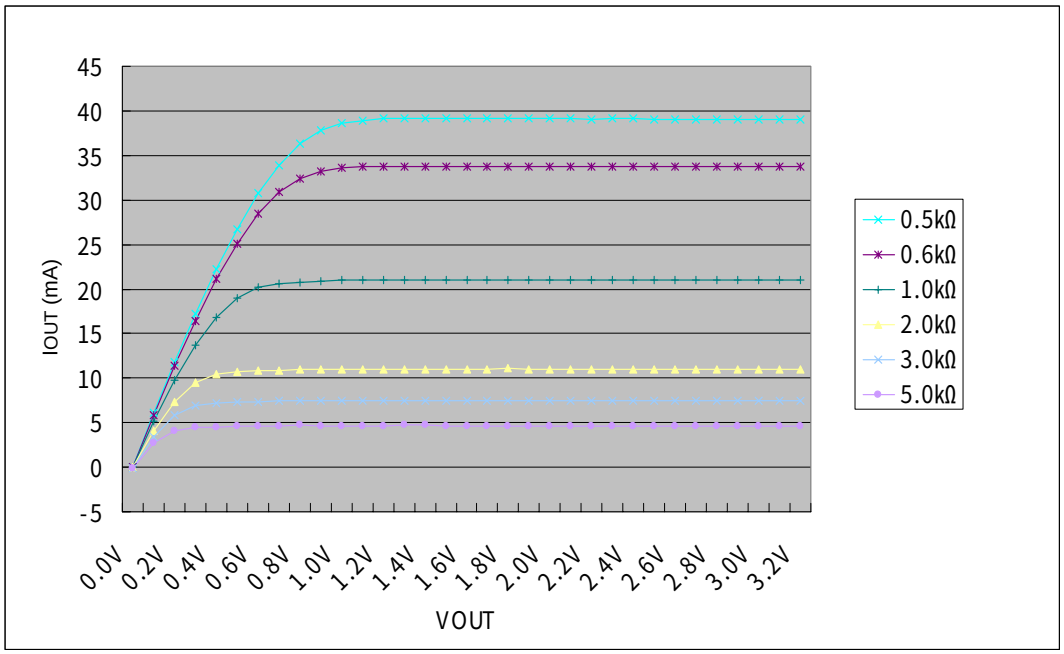
CONSTANT OUTPUT CURRENT

The LD1018 provides a constant current output characteristics for LED display application. The pin to pin deviation is max +/- 1.5% and chip to chip deviation is max +/- 3%.

When VDD = 5.0V



When VDD = 3.3V



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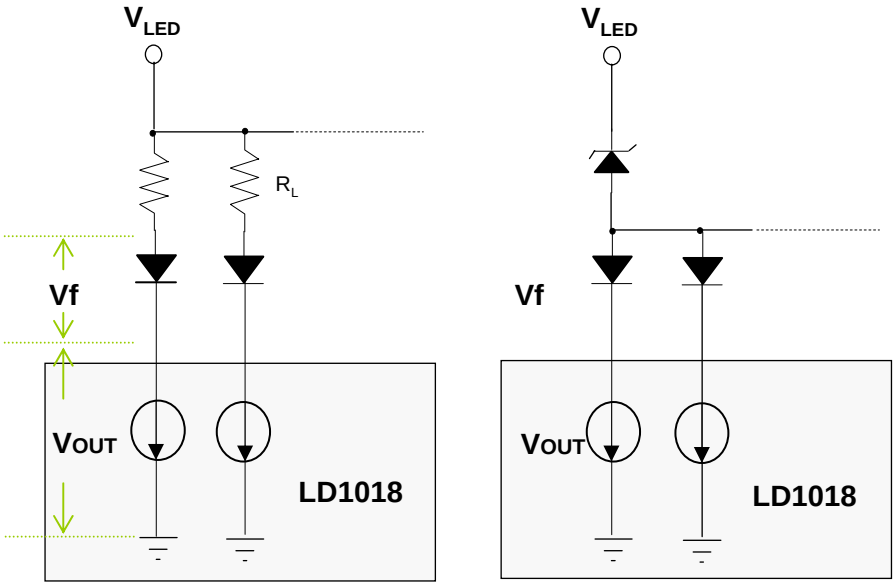
LED SUPPLY VOLTAGE(VLED)



It is very important to select the proper value of Load Resistor(RL). Because the optimal VOUT value guarantees the constant output current and long life time of LED driver IC without over power consumption.

For example, let's calculate the Load Resistor value at VLED=5V, Iout=20mA, LED Forward Voltage(Vf)=3V.

1. The full current of LD1018 = 20mA x 16 (channels) = 320mA

2. The power consumption is 320mA x VOUT voltage.
- when VOUT = 1V, the power consumption is 320mW.
- when VOUT= 2V, the power consumption is 640mW.

Therefore, the Load Resistor (RL) = (VLED – VOUT– Vf) / Iout

RL = (5V – VOUT – 3V) / 20mA = 50Ω (When VOUT = 1V)

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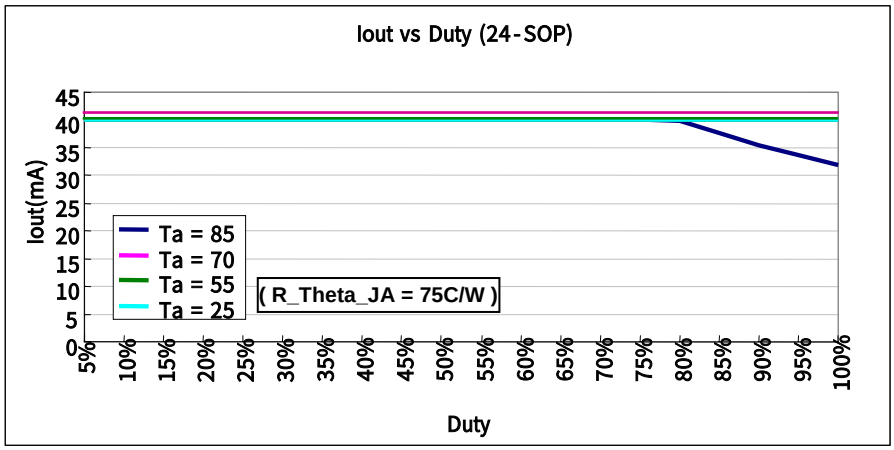
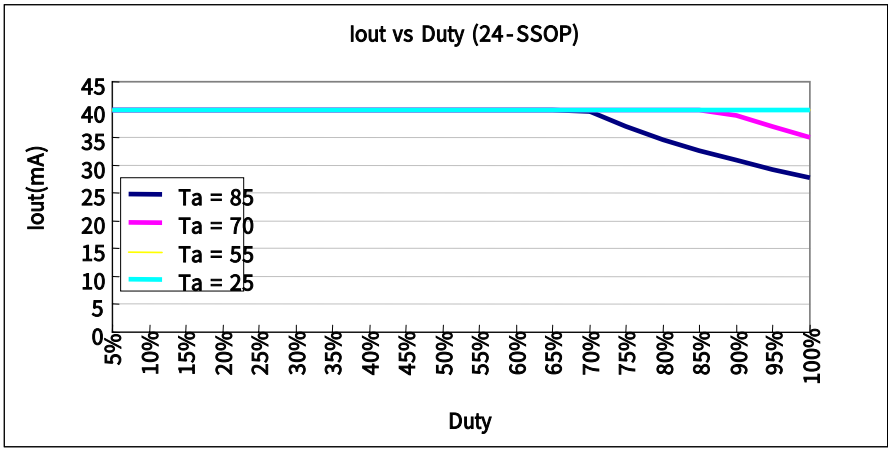
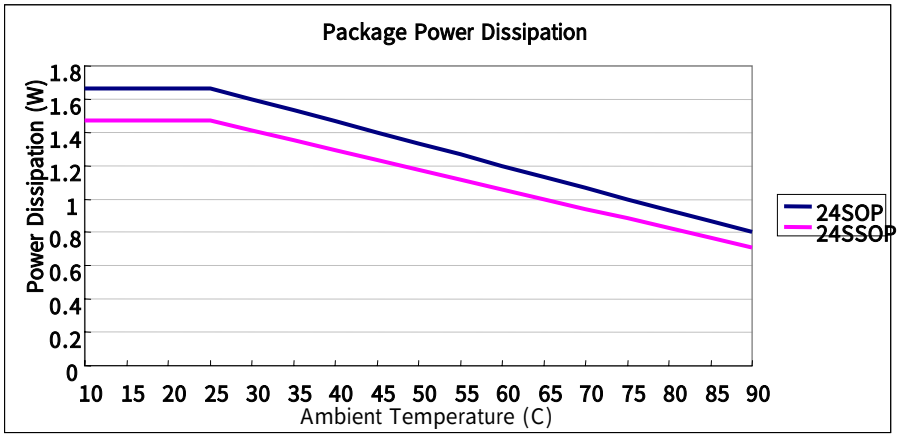
PACKAGE POWER DISSIPATION(PD)

The LD1018 provides many package types such as 24-SOP package and 24-SSOP package. The maximum allowable package power dissipation is determined as PD(max) = (Tj – Ta) / R_Theta_JA. When 16 output channels are turned on simultaneously, the actual power dissipation of package is PD(act) = (IDD x VDD) + (IOUT x Duty x VOUT x 16). Therefore, to keep that PD(act) is less than PD(max).
The maximum allowable output current as a function of duty cycle is:

IOUT = {[(Tj – Ta) / R_Theta_JA] – (IDD x VDD)} / VOUT / Duty / 16
where Tj = 150C







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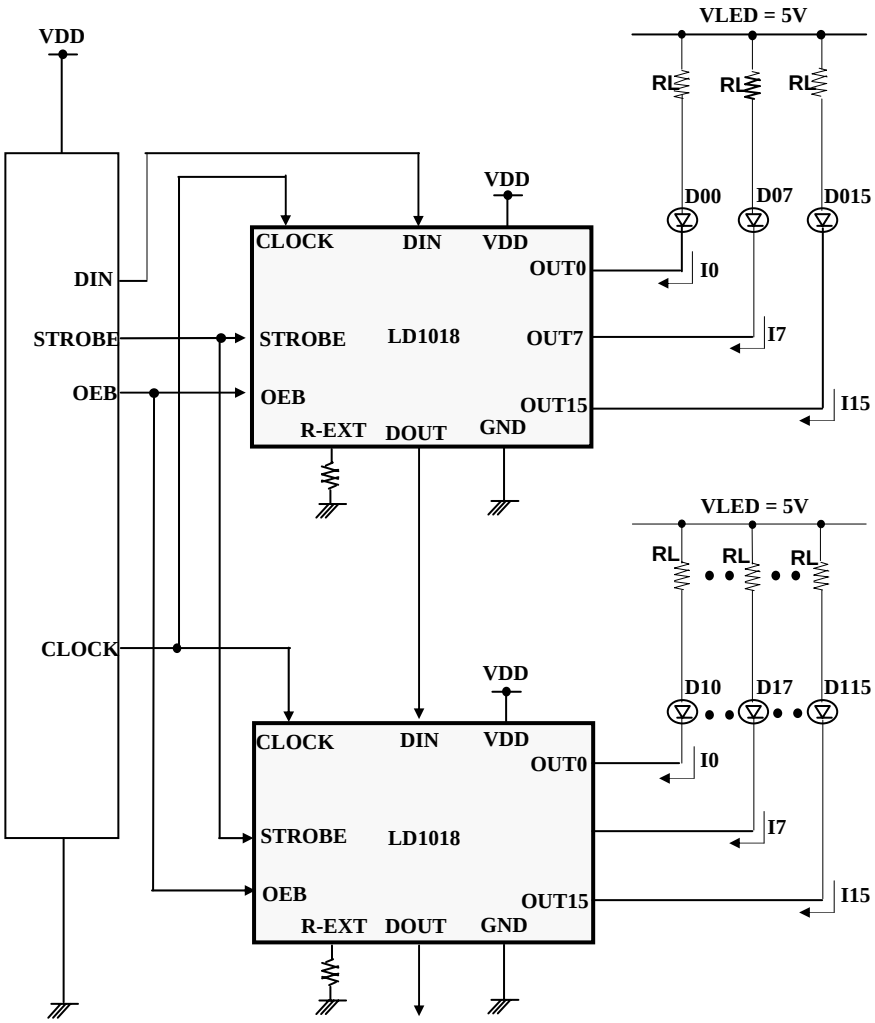
APPLICATION CIRCUIT - CASE1



Data & Control Signal Connection for 16x2 Static Type Application

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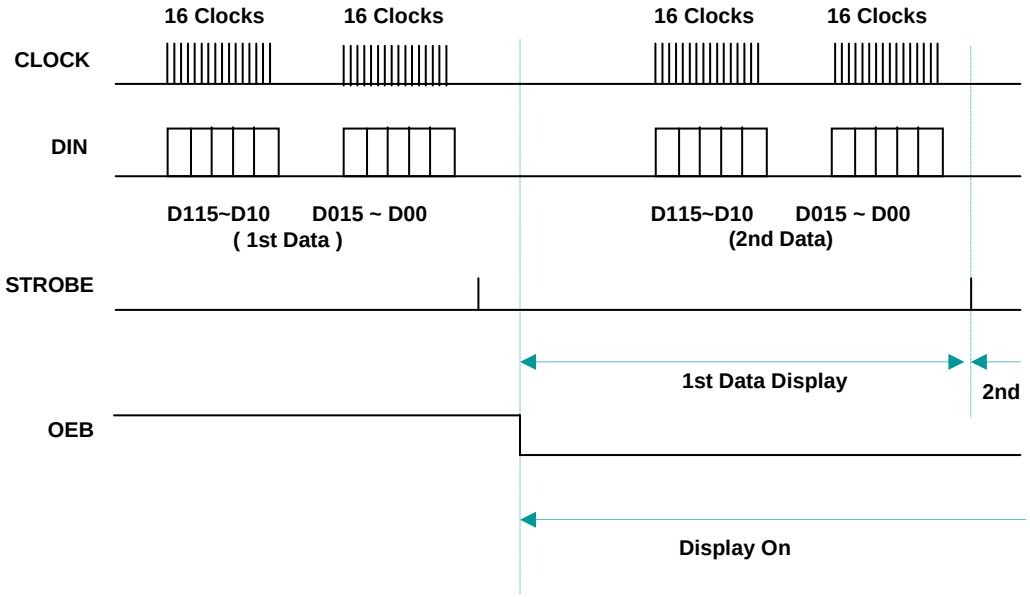
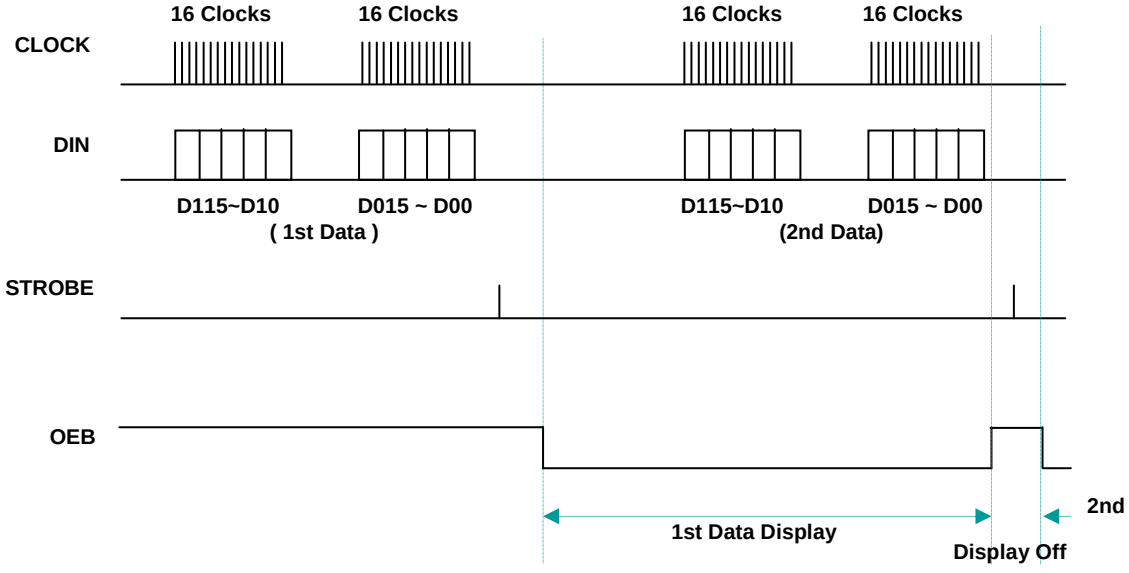
TIMING DIAGRAM – CASE1



Timing Diagram for 16x2 Static Type Application

TIMING DIAGRAM – CASE1-1



Timing Diagram for 16x2 Static Type Application

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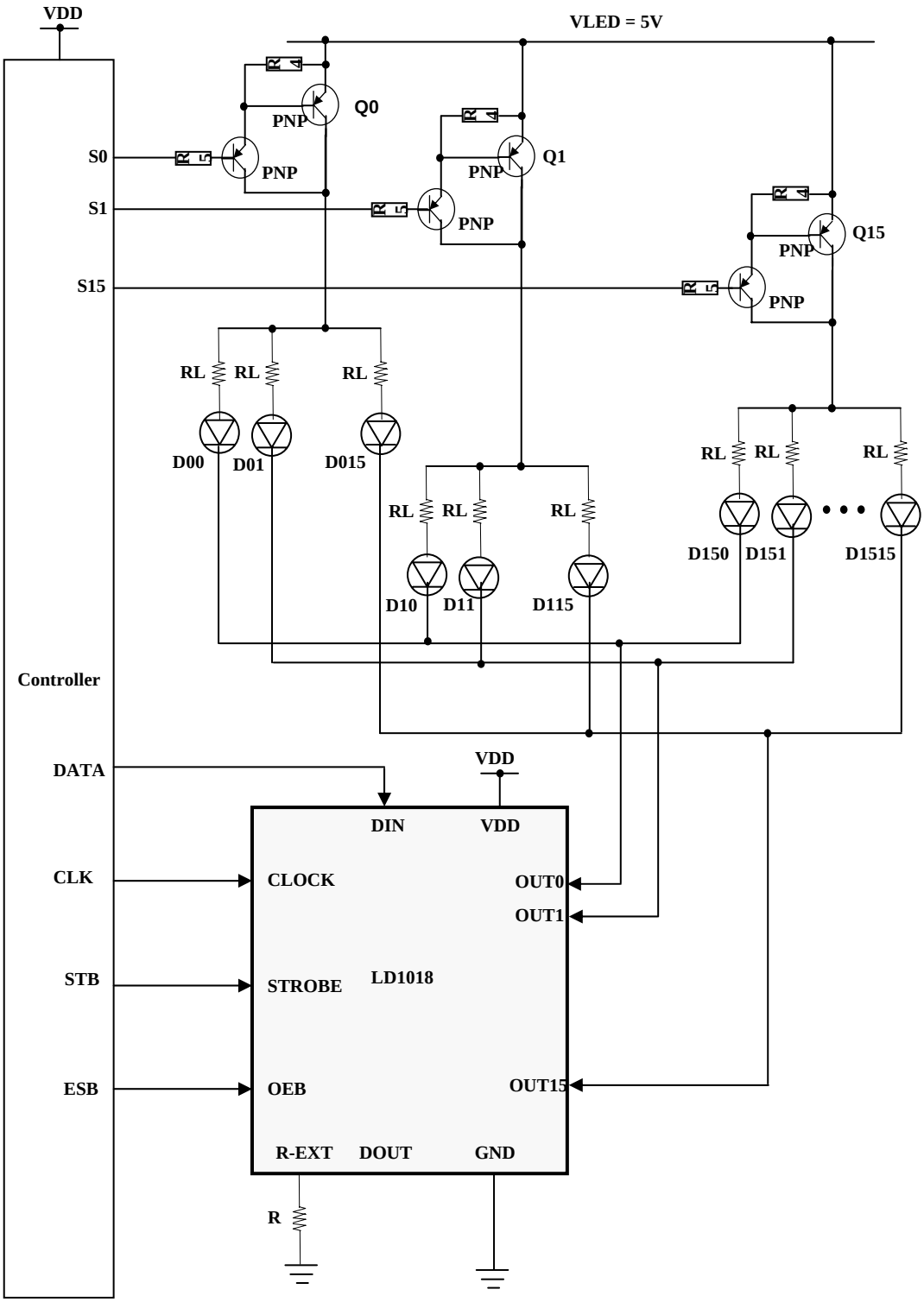
APPLICATION CIRCUIT – CASE2



Data & Control Signal Connection for 16x16 Dynamic Type Application

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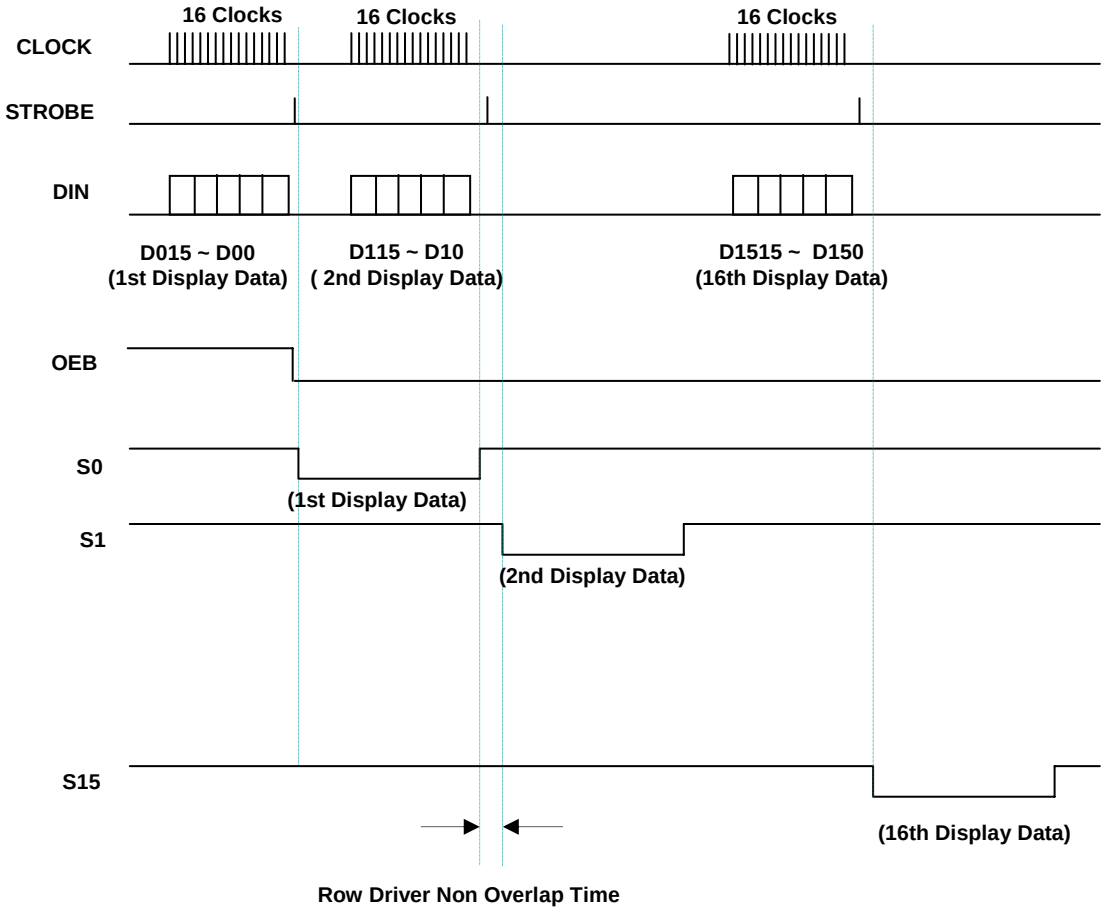
TIMING DIAGRAM CASE2



Timing Diagram for 16x16 Dynamic Type Application

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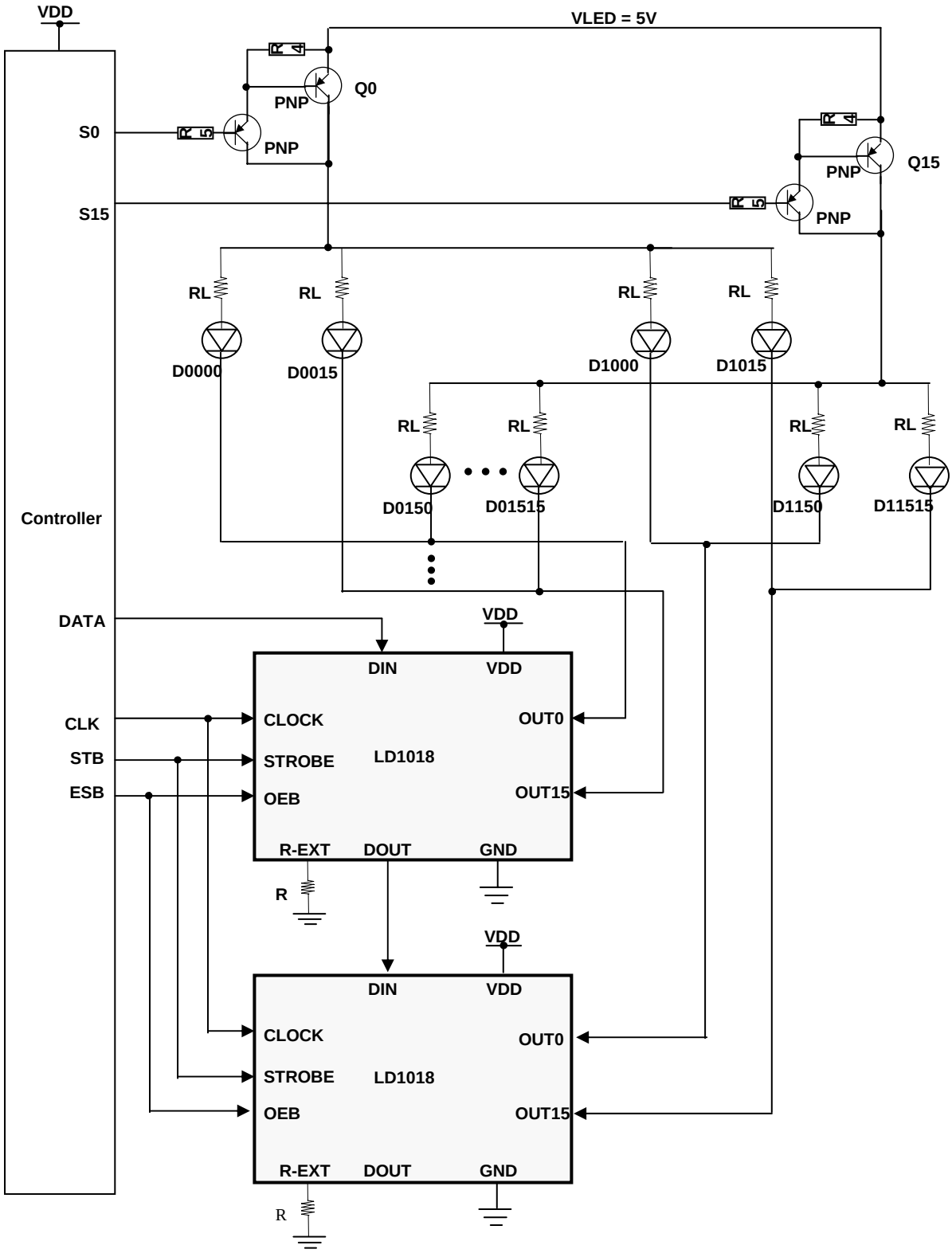
APPLICATION CIRCUIT – CASE3



Data & Control Signal Connection for 32x16 Dynamic Type Application

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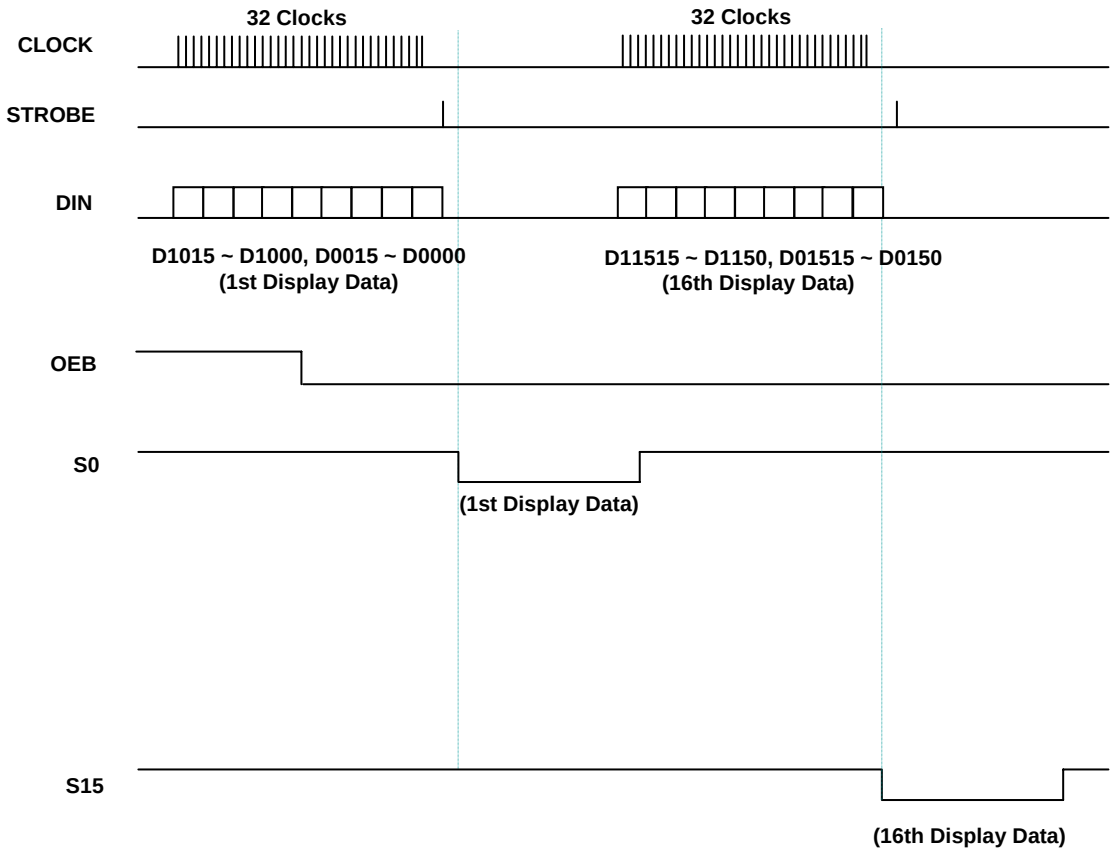
TIMING DIAGRAM - CASE3



Timing Diagram for 32x16 Dynamic Type Application

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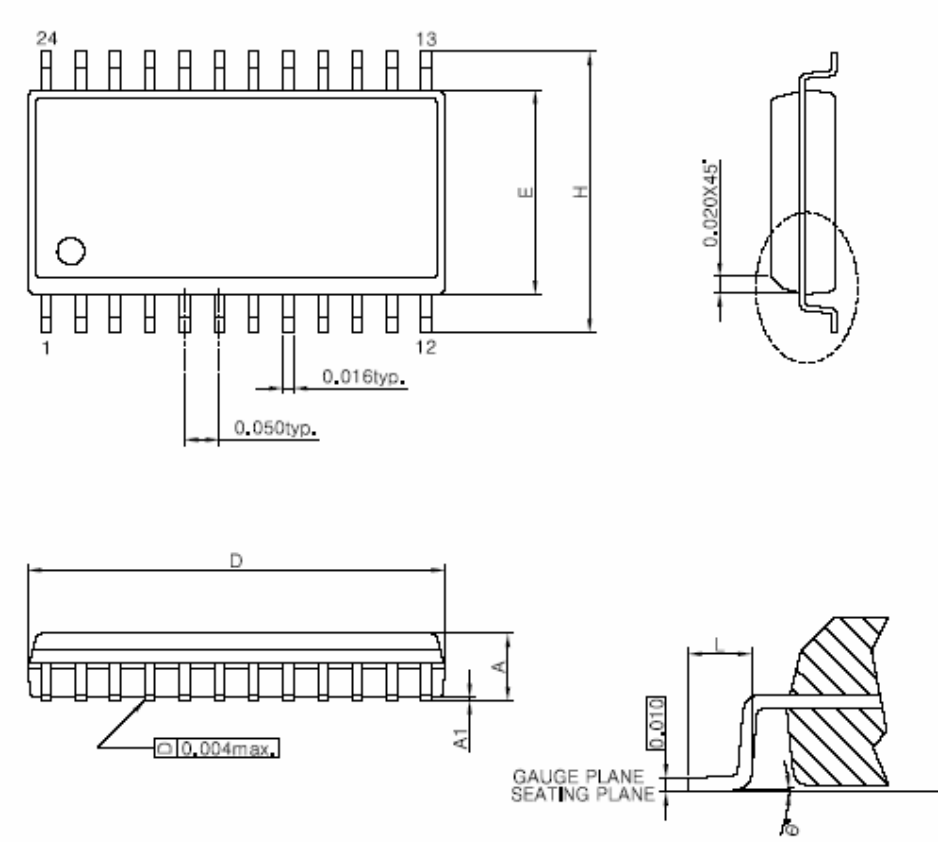
PACKAGE INFORMATION

LD1018-SP (SOP 24)



SYMBOLS	MIN.	NOM	MAX.
A	-	-	0.104
A1	0.004	-	-
D	0.612	0.618	0.624
E	0.292	0.296	0.299
H	0.405	0.412	0.419
L	0.021	0.031	0.041
θ°	0	4	8

UNIT : INCH

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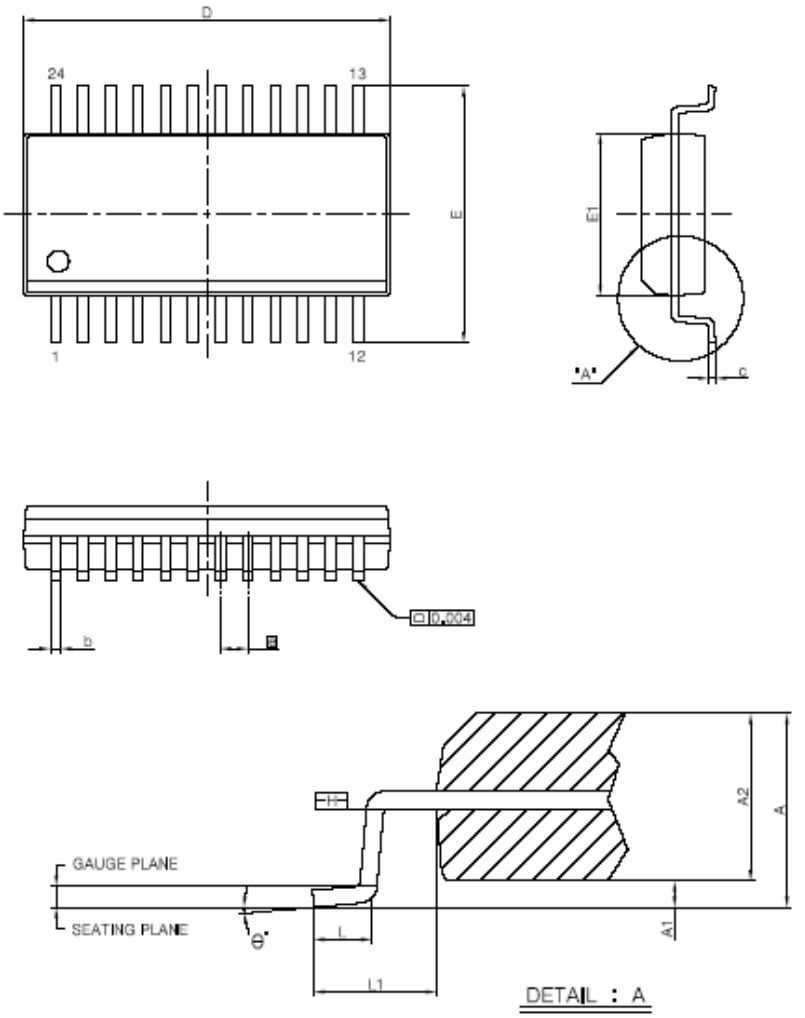
LD1018-SS (SSOP 24)



SYMBOLS	MIN.	NOM	MAX.
A	0.053	0.064	0.069
A1	0.004	0.006	0.010
A2	–	–	0.059
D	0.337	0.341	0.344
E	0.228	0.236	0.244
E1	0.150	0.154	0.157
b	0.008	–	0.012
C	0.007	–	0.010
e		0.025 BASIC	
L	0.016	0.025	0.050
L1		0.041 BASIC	
θ°	0°	–	8°

UNIT : INCH

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