Macroblock

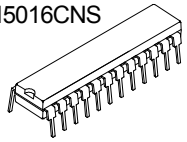
16-bit Constant Current LED Sink Driver MBI5016

January 2003,V1.2

Features

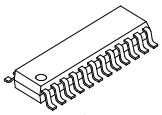
- 16 constant current output channels
- Adjustable output current through an external resistor
- Serial data in/parallel data out
- Output current: 5-90 mA
- 20MHz clock frequency

MBI5016CNS



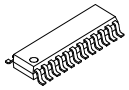
SDIP24-P-300-1.78
Weight: 1.11g(typ)

MBI5016CF



SOP24-P-300-1.00
Weight: 0.28g(typ)

MBI5016CP



SSOP24-P-150-0.64
Weight: 0.11g(typ)

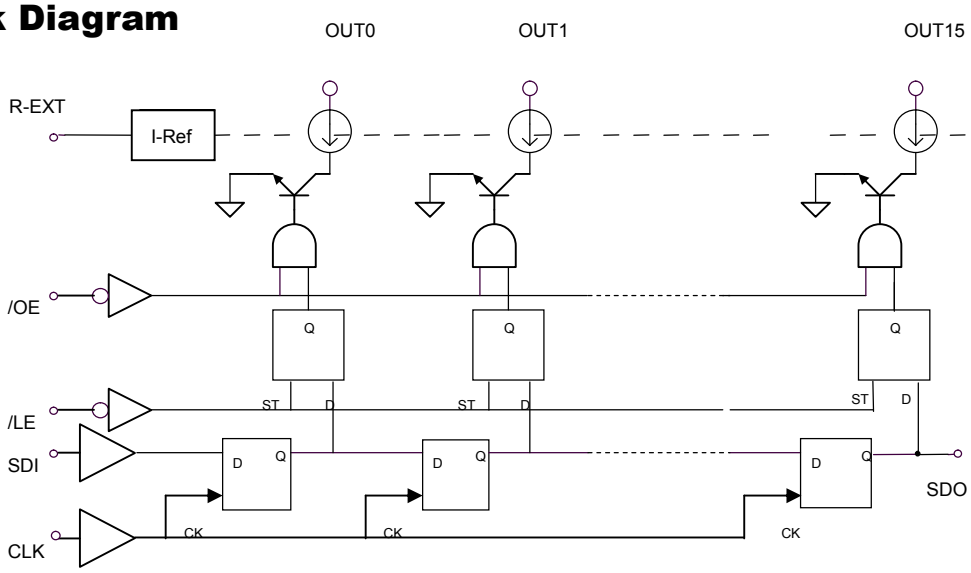
Product Description

The MBI5016, utilizing the most advanced silicon technology, is targeted for LED panel display. The MBI5016 contains CMOS shift registers and latch functions, converting serial input data into parallel output format. At output stage, sixteen regulated current sources, implemented in Bipolar Junction Transistor, were designed to provide 5-90 mA constant current for driving the LEDs.

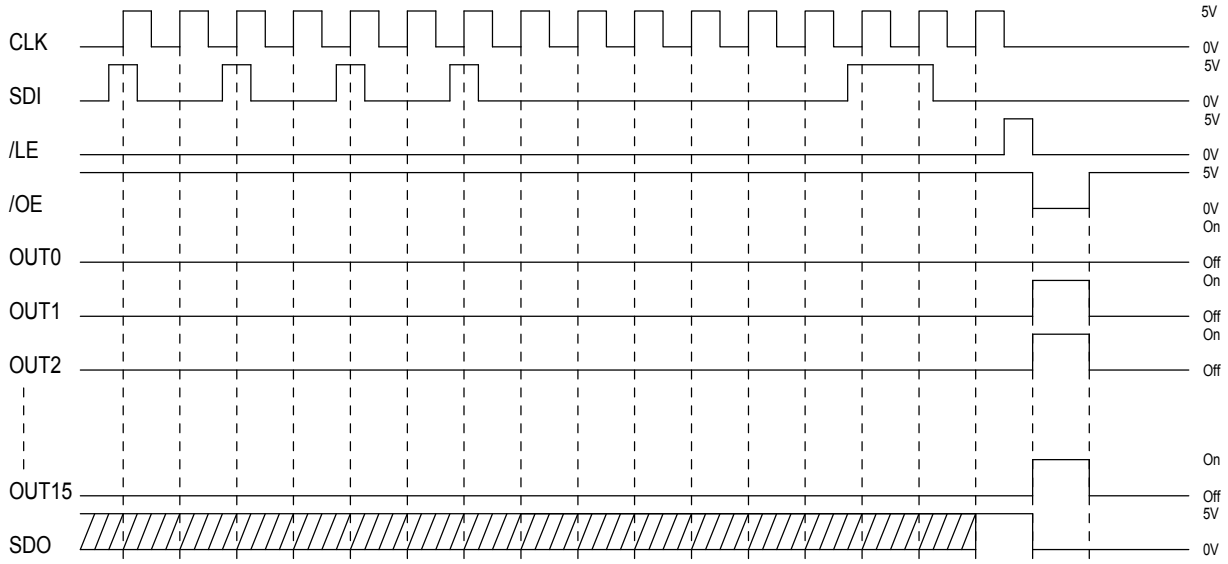
The MBI5016 provides users great flexibility and device performance while using the MBI5016 in their LED panel system design. Users may adjust the output current of the MBI5016 through an external resistor R-EXT, which gives users flexibility in controlling the light intensity of LEDs. The MBI5016 guarantees 17V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 20 MHz, also satisfies the system requirement of high volume data transmission.

Floor 6-4, No. 18, Pu-Ting Rd., Hsinchu, Taiwan 30077, ROC.
TEL: +886-3-579-0068, FAX: +886-3-579-7534 E-mail: info@mblock.com.tw

Block Diagram

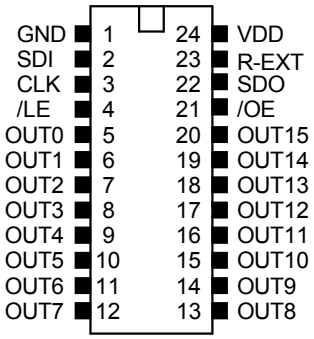


Timing Diagram



Terminal Description and Pin Out

Pin No.	Pin Name	Function
1	GND	GND terminal for control logic.
2	SDI	Input terminal of a serial-data for shift register
3	CLK	Input terminal of a clock for data shift to up-edge.
4	/LE	Input terminal of a data strobe. Latches passes data with "H" level input of /LE-terminal, and hold data with "L" level input.
5~20	OUT0~15	Output terminals
21	/OE	Input terminal of output enable. All outputs (OUT~15) do off with "H" level input of /OE-terminal, and do on with "L" level input.
22	SDO	Output terminal of a serial-data for next SDI terminal.
23	R-EXT	Input terminal of connects with a resister for setting up all output current.
24	VDD	5V Supply voltage terminal

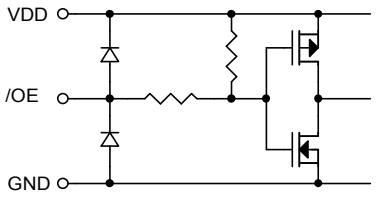


Truth Table

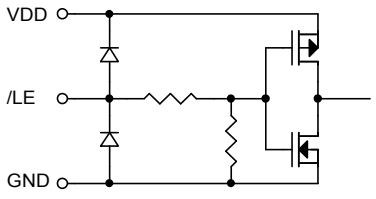
CLK	/LE	/OE	SDI	OUT0...OUT7...OUT15	SDO
UP	H	L	D_n	D_n D_{n-7} D_{n-15}	D_{n-15}
UP	L	L	D_{n+1}	No Change	D_{n-14}
UP	H	L	D_{n+2}	D_{n+2} D_{n-5} D_{n-13}	D_{n-13}
DOWN	X	L	D_{n+3}	D_{n+2} D_{n-5} D_{n-13}	D_{n-13}
DOWN	X	H	D_{n+3}	Off	D_{n-13}

Equivalent Circuits of Inputs and Outputs

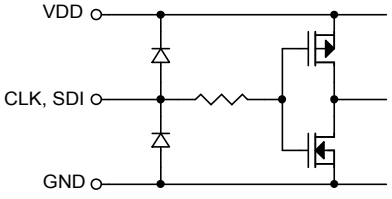
1. /OE terminal



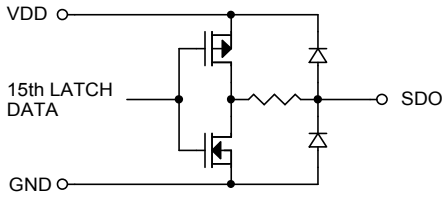
2. /LE terminal



3. CLK, SDI terminal



4. SDO terminal



Maximum Ratings

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0~7.0	V
Input Voltage	V_{IN}	-0.4~V_{DD} + 0.4	V
Output Current	I_{OUT}	+90	mA
Output Voltage	V_{OUT}	-0.5~+17.0	V
Clock Frequency	F_{CLK}	20	MHz
GND Terminal Current	I_{GND}	1440	mA
Power Dissipation	P_D	1.78 (CNS type: On PCB, Ta=25°C)	W
		1.00 (CF/CP type: On PCB, Ta=25°C)	
Thermal Resistance	Rth(j-a)	82 (CNS type: On PCB)	°C/W
		96, 112 (CF/CP type: On PCB)	
Operating Temperature	Topr	-40~+85	°C
Storage Temperature	Tstg	-55~+150	°C

Recommended Operating Condition

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	-	4.5	5.0	5.5	V
Output Voltage	V_{OUT}	-	-	-	17.0	V
Output Current	I_{OUT}	DC Test Circuit	5	-	90	mA
	I_{OH}	SERIAL-OUT	-	-	-1.0	mA
	I_{OL}	SERIAL-OUT	-	-	1.0	mA
Input Voltage	V_{IH}	-	$0.7V_{DD}$	-	V_{DD}+0.3	V
	V_{IL}	-	-0.3	-	$0.3V_{DD}$	
/LE Pulse Width	tw LAT	V_{DD}=4.5~5.5V	25	-	-	ns
CLK Pulse Width	tw CLK		25	-	-	ns
/OE Pulse Width	tw EN		400	-	-	ns
Setup Time for DATA	tsetup(D)		20	-	-	ns
Hold Time for DATA	thold(D)		15	-	-	ns
Setup Time for LATCH	tsetup(L)		20	-	-	ns
Hold Time for ENABLE	thold(L)		60	-	-	ns
Clock Frequency	F_{CLK}	Cascade Operation	-	-	20.0	MHz
Power Dissipation	P_D	Ta=85°C (CNS type)	-	-	0.92	W
		Ta=85°C (CF/CP type)	-	-	0.50	

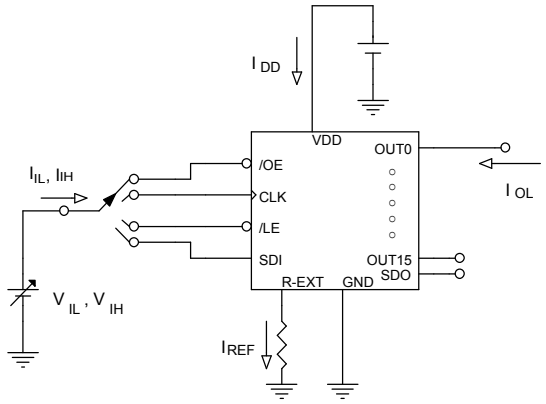
Electrical Characteristics

Characteristic		Symbol	Condition		Min.	Typ.	Max.	Unit
Input Voltage	"H" level	V_{IH}	Ta = -40~85ºC		$0.7V_{DD}$	-	V_{DD}	V
	"L" level	V_{IL}	Ta = -40~85ºC		GND	-	$0.3V_{DD}$	
Output Leakage Current		I_{OH}	V_{OH}=17.0V		-	-	10	μA
Output Voltage	SDO	V_{OL}	I_{OL}=+1.0mA		-	-	0.4	V
		V_{OH}	I_{OH}=-1.0mA		4.6	-	-	V
Output Current 1		I_{OL1}	V_{CE}=0.8V	R-EXT=865 Ω (Include Skew)	-	40.0	-	mA
Current Skew		dI_{OL1}	I_{OL}=40mA V_{CE}=0.8V	R-EXT=865 Ω	-	±1.5	±6.0	%
Output Current 2		I_{OL2}	V_{CE}=1.2V	R-EXT=330 Ω (Include Skew)	-	80.0	-	mA
Current Skew		dI_{OL2}	I_{OL}=80mA V_{CE}=1.2V	R-EXT=330 Ω	-	±1.5	±6.0	%
Pull-up Resistor		RIN(up)	/OE		150	300	600	KΩ
Pull-down Resistor		RIN(down)	/LE		85	200	400	KΩ
Supply Current	"OFF"	I_{DD}(off) 1	R-EXT=OPEN OUT0~15=Off		-	8.5	12	mA
		I_{DD}(off) 2	R-EXT=865 Ω OUT0~15=Off		-	10	12	
		I_{DD}(off) 3	R-EXT=330 Ω OUT0~15=Off		-	11.5	15	
	"ON"	I_{DD}(on) 1	R-EXT=865 Ω OUT0~15=On		10	16	22	
		I_{DD}(on) 2	R-EXT=330 Ω OUT0~15=On		18	24.3	38.5	

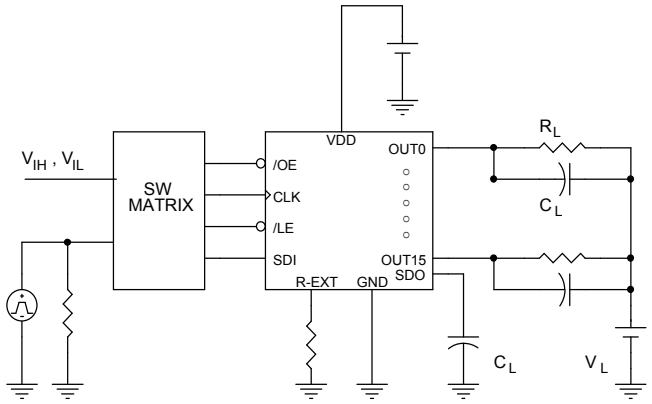
Switching Characteristics

Characteristic		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time ("L" to "H")	CLK - OUTn	tpLH	V_{DD}=5.0V V_{CE}=0.8V V_{IH}=V_{DD} V_{IL}=GND R-EXT=865 Ω V_L=3.4V R_L=65 Ω C_L=10.5pF	-	200	300	ns
	/LE - OUTn			-	200	300	ns
	/OE - OUTn			-	200	300	ns
	CLK - SDO			20	50	70	ns
Propagation Delay Time ("H" to "L")	Inn - OUTn	tpHL		-	200	300	ns
	/LE - OUTn			-	200	300	ns
	/OE - OUTn			-	200	300	ns
	CLK - SDO			20	50	70	ns
Pulse Width	CLK	tw CLK-CLK		15	-	20	ns
	/LE	tw LAT-LAT		20	-	30	ns
Set-up Time for LATCH		tsetup LAT		10	-	20	ns
Hold Time for LATCH		thold LAT		10	-	25	ns
Maximum CLK Rise Time		tr		-	-	5	us
Maximum CLK Fall Time		tf		-	-	5	us
Output Rise Time		tor		-	150	200	ns
Output Fall Time		tof		-	150	200	ns

Test Circuit for DC Characteristic

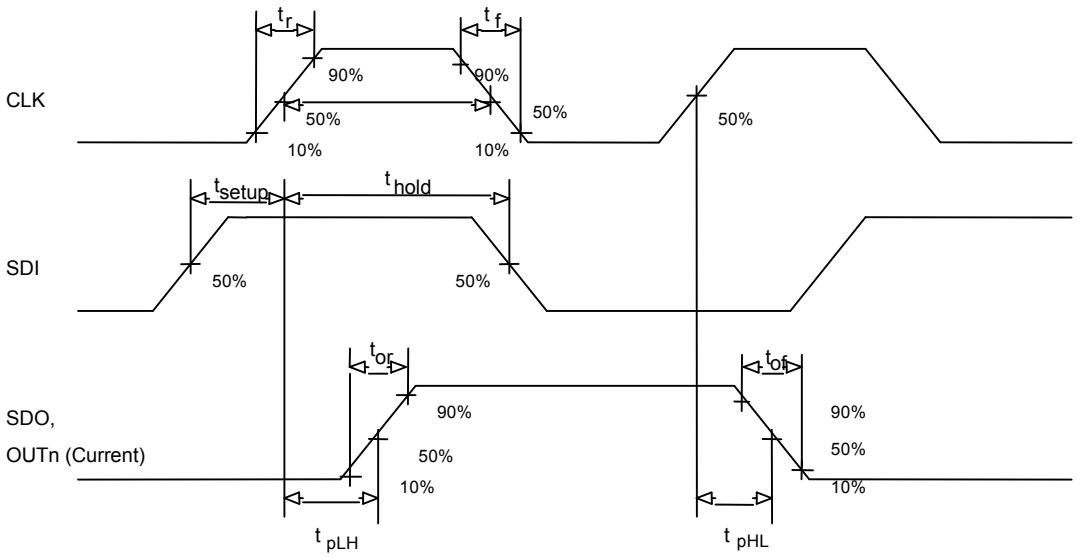


Test Circuit for AC Characteristic

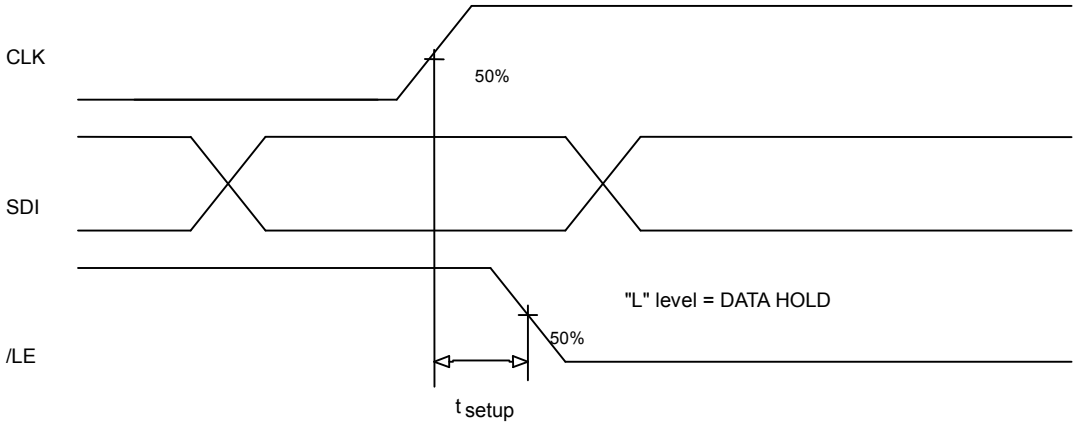


Timing Waveform

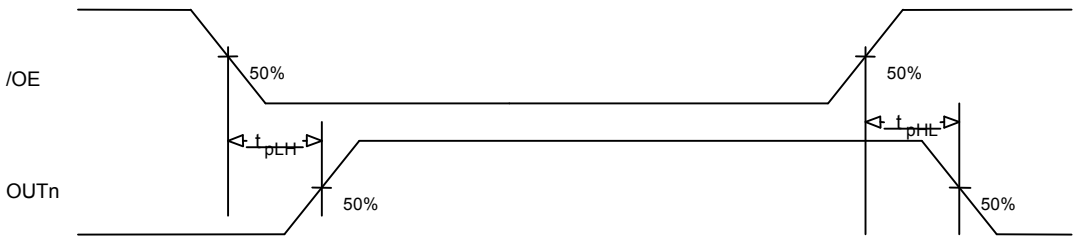
1. CLK, SDI, SDO, OUTn



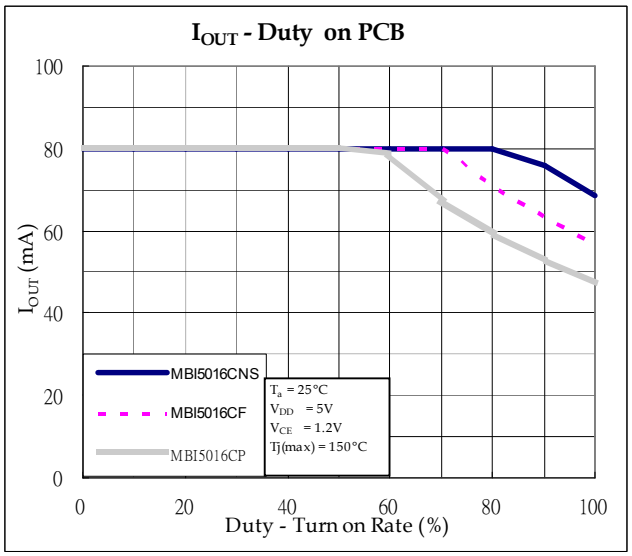
2. CLK - /LE

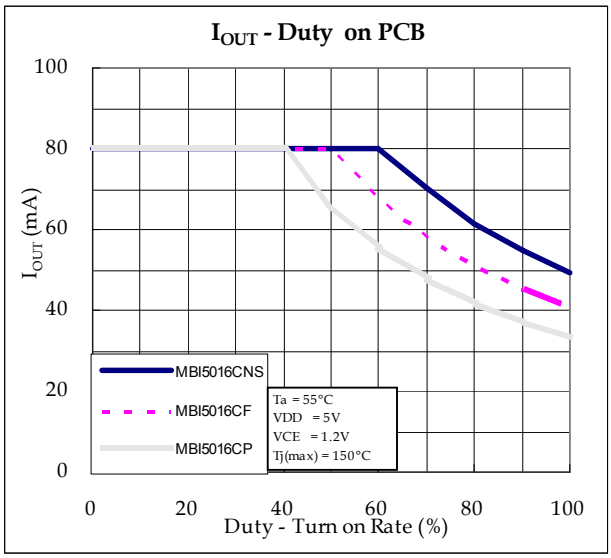


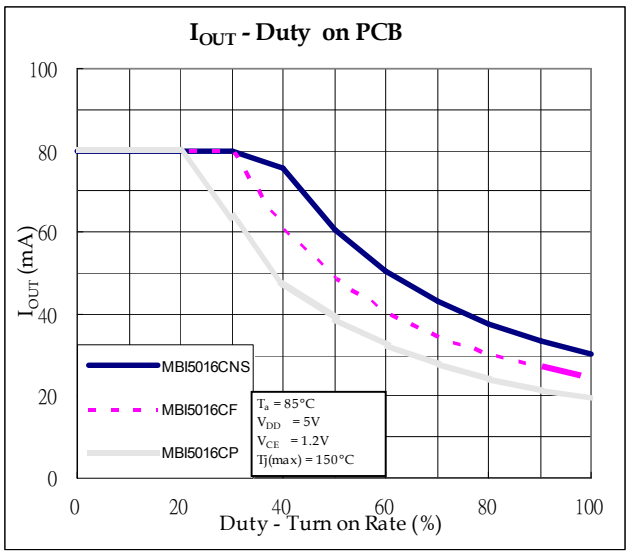
3. /OE - OUTn

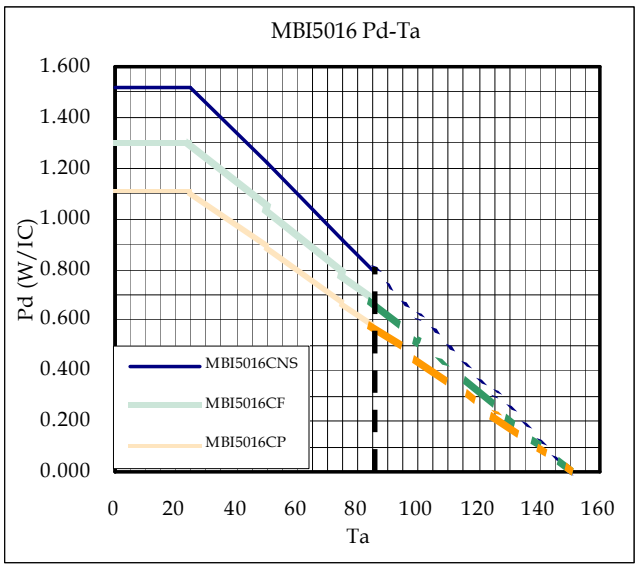


Graphs


IOUT - Duty on PCB
IOUT (mA)
Duty - Turn on Rate (%)
MBI5016CNS
MBI5016CF
MBI5016CP
Ta = 25°C
VDD = 5V
VCE = 1.2V
Tj(max) = 150°C

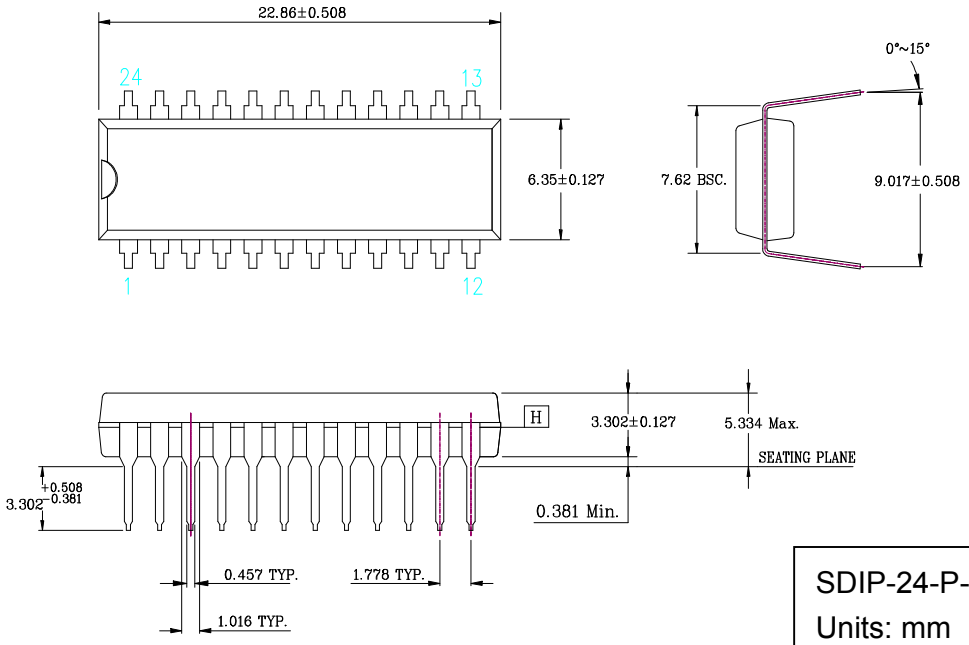

IOUT - Duty on PCB
IOUT (mA)
Duty - Turn on Rate (%)
MBI5016CNS
MBI5016CF
MBI5016CP
Ta = 55°C
VDD = 5V
VCE = 1.2V
Tj(max) = 150°C


IOUT - Duty on PCB
IOUT (mA)
Duty - Turn on Rate (%)
MBI5016CNS
MBI5016CF
MBI5016CP
Ta = 85°C
VDD = 5V
VCE = 1.2V
Tj(max) = 150°C


MBI5016 Pd-Ta
Pd (W/IC)
Ta
MBI5016CNS
MBI5016CF
MBI5016CP

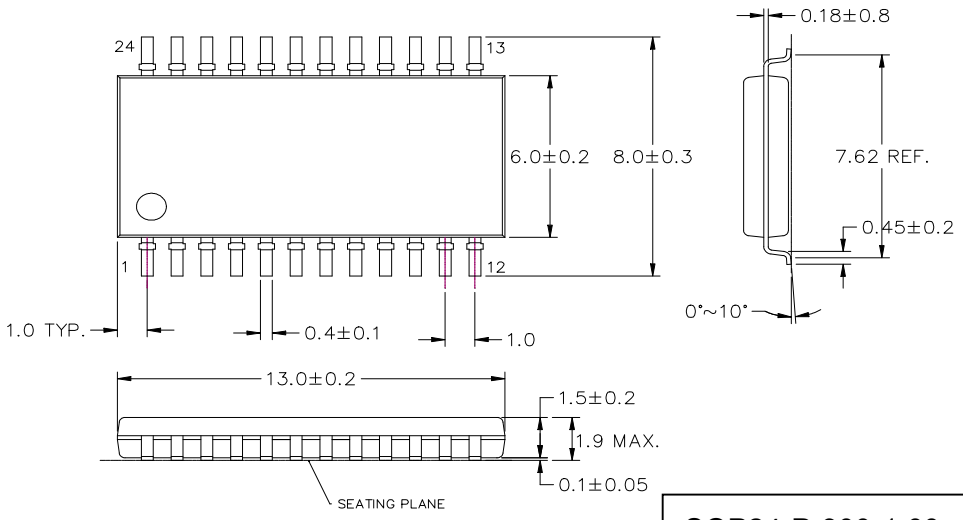
Outline Drawings

MBI5016CNS Outline Drawing



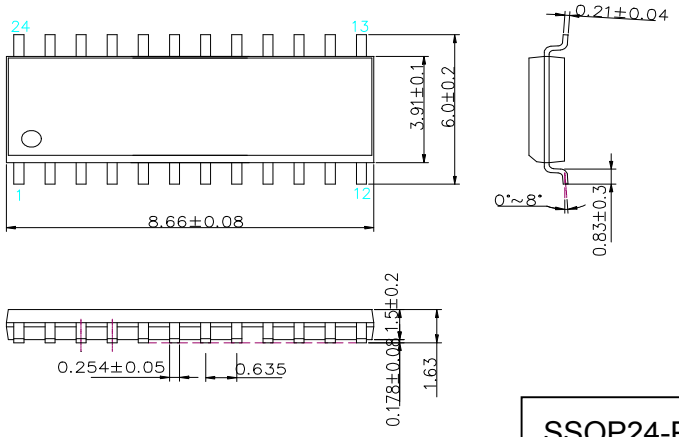
SDIP-24-P-300-1.78
Units: mm
Weight:1.11g(typ)

MBI5016CF Outline Drawing



SOP24-P-300-1.00
Units: mm
Weight:0.28g(typ)

MBI5016CP Outline Drawing



SSOP24-P-150-0.64
Units: mm
Weight:0.11g(typ)