



16-bit Constant Current LED Sink Driver

Features

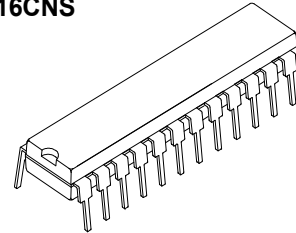
- 16 constant-current output channels
- Output current adjustable through an external resistor
- Serial data in/parallel data out
- Output current: 5-90 mA
- 20MHz clock frequency

Product Description

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

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

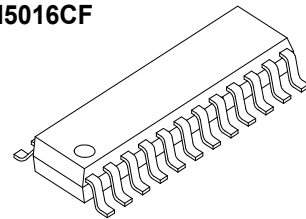
MBI5016CNS



SDIP24-P-300-1.78

Weight: 1.11g(typ)

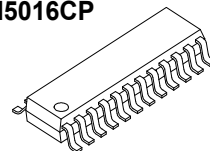
MBI5016CF



SOP24-P-300-1.00

Weight: 0.28g(typ)

MBI5016CP



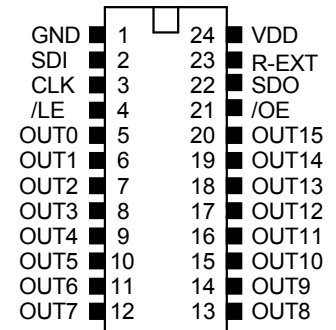
SSOP24-P-150-0.64

Weight: 0.11g(typ)

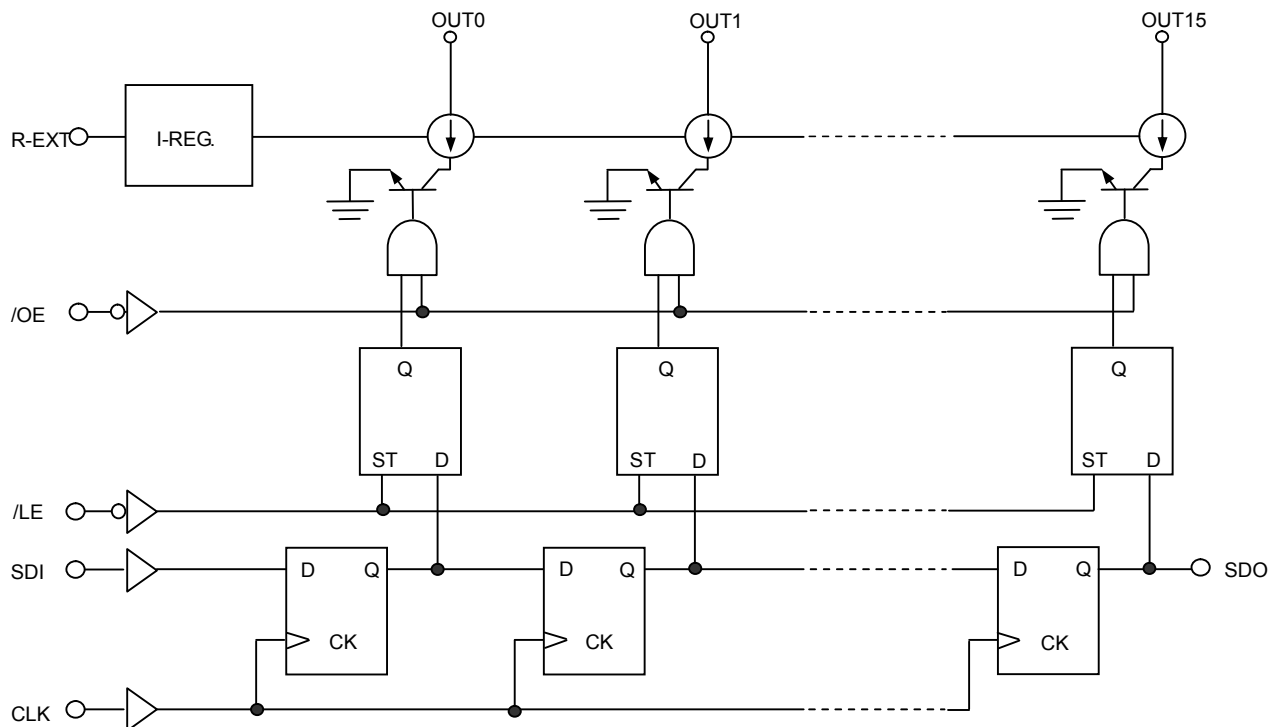
Terminal Description

| PIN NO. | PIN NAME | FUNCTION |
|---------|------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1 | GND | Ground terminal for control logic and current sink |
| 2 | SDI | Serial-data input to the shift register |
| 3 | CLK | Clock input terminal for data shift on rising edge |
| 4 | /LE | Data strobe input terminal Serial data is transferred to the output latch when /LE is high. The data is latched when /LE goes low. |
| 5~20 | OUT0~OUT15 | Constant current output terminals |
| 21 | /OE | Output enable terminal When (active) low, the output drivers are enabled; when high, all output drivers are turned OFF (blanked). |
| 22 | SDO | Serial-data output to the following SDI of next driver IC |
| 23 | R-EXT | Input terminal used to connect an external resistor for setting up output current for all output channels |
| 24 | VDD | 5V supply voltage terminal |

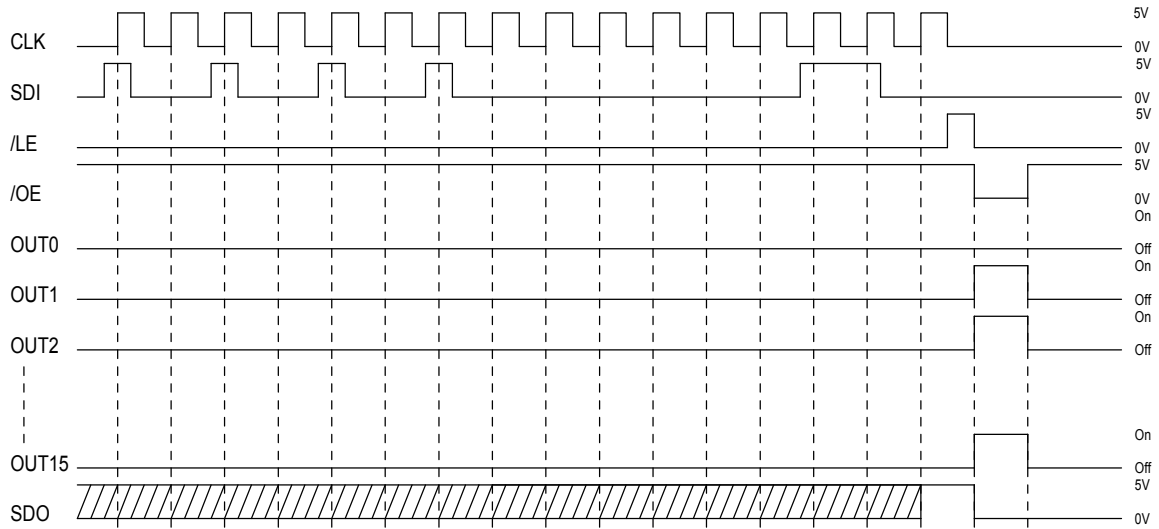
Pin Description



Block Diagram



Timing Diagram

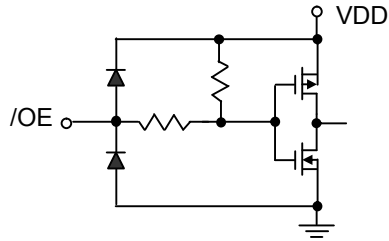


Truth Table

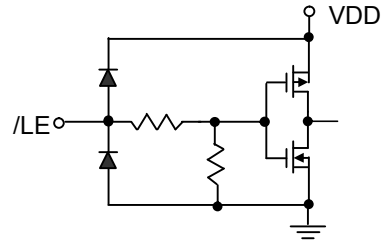
| CLK | /LE | /OE | SDI | OUT0...OUT7...OUT15 | SDO |
|------|-----|-----|-----------|--------------------------------|------------|
| UP | H | L | D_n | D_n D_{n-7} D_{n-15} | D_{n-15} |
| UP | L | L | D_{n+1} | No Change | D_{n-14} |
| UP | H | L | D_{n+2} | D_{n+2} D_{n-5} D_{n-13} | D_{n-13} |
|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

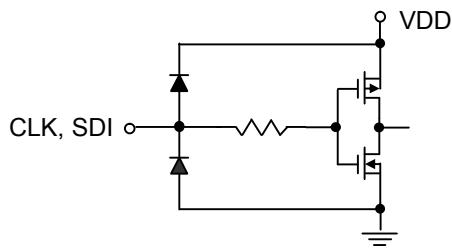
/OE terminal



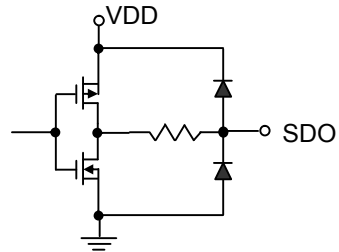
/LE terminal



CLK, SDI terminal



SDO terminal



Maximum Ratings

| CHARACTERISTIC | | SYMBOL | RATING | UNIT |
|----------------------------------------------------|------------|---------------|--------------------|---------------|
| Supply Voltage | | V_{DD} | 0~+7.0 | V |
| Output Voltage | | V_{CE} | -0.5~+17.0 | V |
| Output Current | | I_{OUT} | +90 | mA |
| Input Voltage | | V_{IN} | -0.4~ $V_{DD}+0.4$ | V |
| GND Terminal Current | | I_{GND} | 1440 | mA |
| Clock Frequency | | F_{CLK} | 20 | MHz |
| Power Dissipation (ON PCB, $T_a=25^{\circ}C$) | CNS – type | P_D | 1.52 | W |
| | CF – type | | 1.30 | |
| | CP – type | | 1.11 | |
| Thermal Resistance (ON PCB, $T_a=25^{\circ}C$) | CNS – type | $R_{th(j-a)}$ | 82 | $^{\circ}C/W$ |
| | CF – type | | 96 | |
| | CP – type | | 112 | |
| Operating Temperature | | T_{opr} | -40~+85 | $^{\circ}C$ |
| Storage Temperature | | T_{stg} | -55~+150 | $^{\circ}C$ |

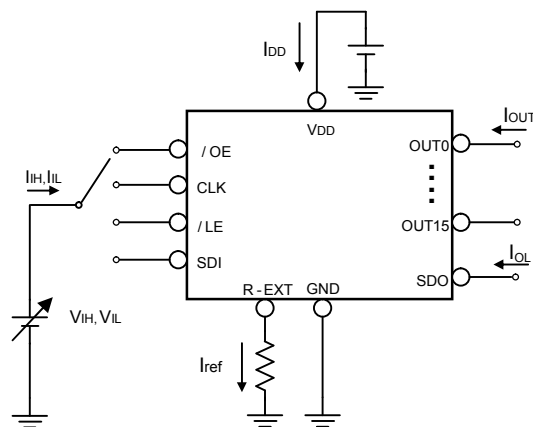
Recommended Operating Condition

| CHARACTERISTIC | | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------------|------------|--------------|-----------------------|-------------------|------|--------------|------|
| Supply Voltage | | V_{DD} | - | 4.5 | 5.0 | 5.5 | V |
| Output Voltage | | V_{CE} | - | - | - | 17.0 | V |
| Output Current | | I_{OUT} | DC Test Circuit | 5 | - | 90 | mA |
| | | I_{OH} | SDO | - | - | -1.0 | mA |
| | | I_{OL} | SDO | - | - | 1.0 | mA |
| Input Voltage | | V_{IH} | - | $0.7V_{DD}$ | - | $V_{DD}+0.3$ | V |
| | | V_{IL} | - | -0.3 | - | $0.3V_{DD}$ | V |
| /LE Pulse Width | | $t_{w(L)}$ | $V_{DD}=4.5\sim 5.5V$ | 25 | - | - | ns |
| CLK Pulse Width | | $t_{w(CLK)}$ | | 25 | - | - | ns |
| /OE Pulse Width | | $t_{w(OE)}$ | | 400 | - | - | ns |
| Setup Time for DATA | | $t_{su(D)}$ | | 20 | - | - | ns |
| Hold Time for DATA | | $t_{h(D)}$ | | 15 | - | - | ns |
| Setup Time for LATCH | | $t_{su(L)}$ | | 60 | - | - | ns |
| Hold Time for LATCH | | $t_{h(L)}$ | | 20 | - | - | ns |
| Clock Frequency | | F_{CLK} | | Cascade Operation | - | - | 20.0 |
| Power Dissipation | CNS – type | P_D | $T_a=85^{\circ}C$ | - | - | 0.79 | W |
| | CF – type | | | | | 0.67 | |
| | CP – type | | | | | 0.57 | |

Electrical Characteristics

| CHARACTERISTIC | | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|------------------------|-----------|-----------------|-----------------------------------------------------------|-------------|-----------|-------------|------------|
| Input Voltage | “H” level | V_{IH} | - | $0.7V_{DD}$ | - | V_{DD} | V |
| | “L” level | V_{IL} | - | 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_{OUT1} | $V_{CE}=0.8V$ $R_{ext} = 865 \Omega$ (Include Skew) | - | 40.0 | - | mA |
| Current Skew | | dI_{OUT1} | $I_{OL}=40mA$ $V_{CE}=0.8V$ $R_{ext} = 865 \Omega$ | - | ± 1.5 | ± 6.0 | % |
| Output Current 2 | | I_{OUT2} | $V_{CE}=1.2V$ $R_{ext} = 330 \Omega$ (Include Skew) | - | 80.0 | - | mA |
| Current Skew | | dI_{OUT2} | $I_{OL}=80mA$ $V_{CE}=1.2V$ $R_{ext} = 330 \Omega$ | - | ± 1.5 | ± 6.0 | % |
| Pull-up Resistor | | RIN(up) | - | 150 | 300 | 600 | K Ω |
| Pull-down Resistor | | RIN(down) | - | 85 | 200 | 400 | K Ω |
| Supply Current | “OFF” | $I_{DD}(off) 1$ | $R_{ext} = OPEN, OUT0\sim 15=Off$ | - | 0.1 | 1.0 | mA |
| | | $I_{DD}(off) 2$ | $R_{ext} = 865 \Omega, OUT0\sim 15=Off$ | 0.1 | 0.2 | 1.0 | |
| | | $I_{DD}(off) 3$ | $R_{ext} = 330 \Omega, OUT0\sim 15=Off$ | 0.1 | 0.2 | 1.0 | |
| | “ON” | $I_{DD}(on) 1$ | $R_{ext} = 865 \Omega, OUT0\sim 15=On$ | 10 | 16 | 22 | |
| | | $I_{DD}(on) 2$ | $R_{ext} = 330 \Omega, OUT0\sim 15=On$ | 18 | 24.3 | 38.5 | |

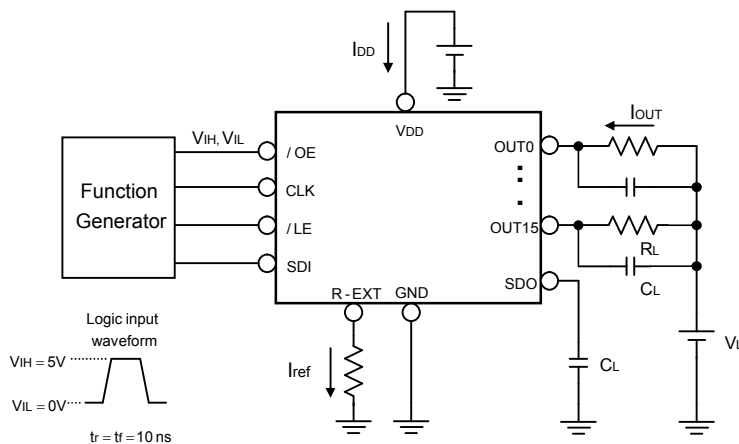
Test Circuit for Electrical Characteristic



Switching Characteristics

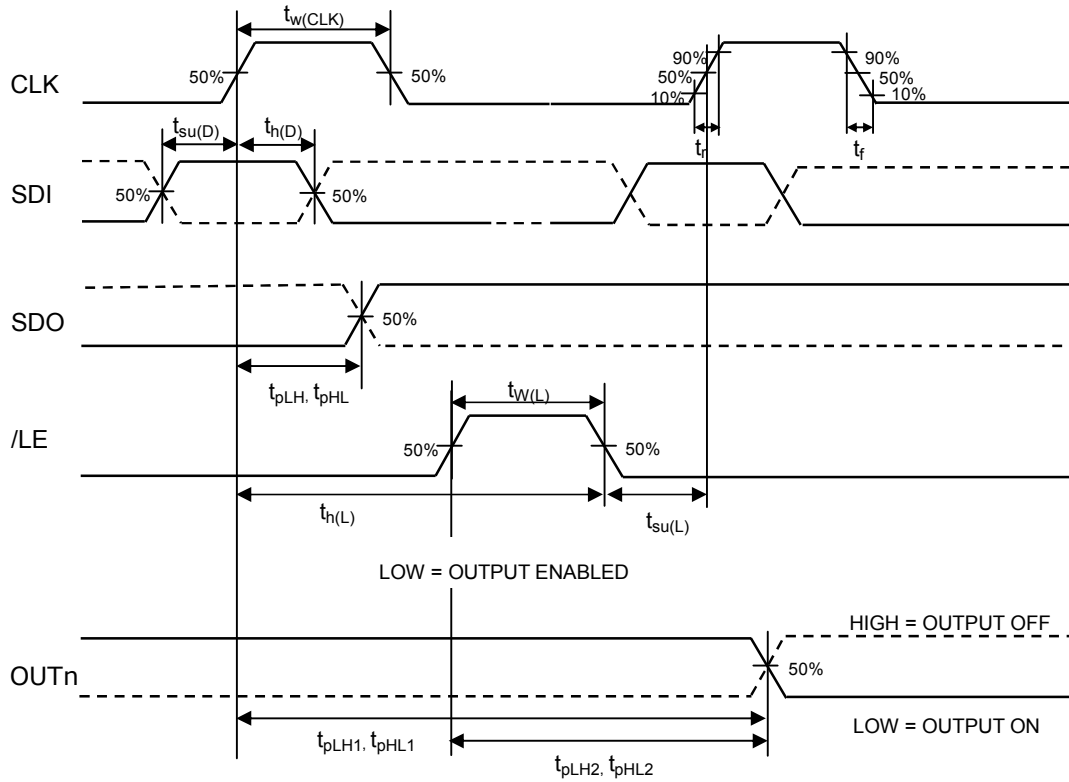
| CHARACTERISTIC | | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Propagation Delay Time ("L" to "H") | CLK - OUTn | t_{pLH1} | $V_{DD}=5.0V$ $V_{CE}=0.8V$ $V_{IH}=V_{DD}$ $V_{IL}=GND$ $R_{ext} = 865 \Omega$ $V_L=3.4V$ $R_L=65 \Omega$ $C_L=10.5pF$ | - | 200 | 300 | ns |
| | /LE - OUTn | t_{pLH2} | | - | 200 | 300 | ns |
| | /OE - OUTn | t_{pLH3} | | - | 200 | 300 | ns |
| | CLK - SDO | t_{pLH} | | 20 | 50 | 70 | ns |
| Propagation Delay Time ("H" to "L") | CLK - OUTn | t_{pHL1} | | - | 200 | 300 | ns |
| | /LE - OUTn | t_{pHL2} | | - | 200 | 300 | ns |
| | /OE - OUTn | t_{pHL3} | | - | 200 | 300 | ns |
| | CLK - SDO | t_{pHL} | | 20 | 50 | 70 | ns |
| Pulse Width | CLK | $t_{w(CLK)}$ | | 15 | - | - | ns |
| | /LE | $t_{w(L)}$ | | 20 | - | - | ns |
| Set-up Time for LATCH | | $t_{su(L)}$ | | 10 | - | - | ns |
| Hold Time for LATCH | | $t_{h(L)}$ | | 10 | - | - | ns |
| Maximum CLK Rise Time | | t_r | | - | - | 500 | us |
| Maximum CLK Fall Time | | t_f | | - | - | 500 | us |
| Output Rise Time | | t_{or} | | - | 150 | 200 | ns |
| Output Fall Time | | t_{of} | | - | 150 | 200 | ns |

Test Circuit for Switching Characteristic

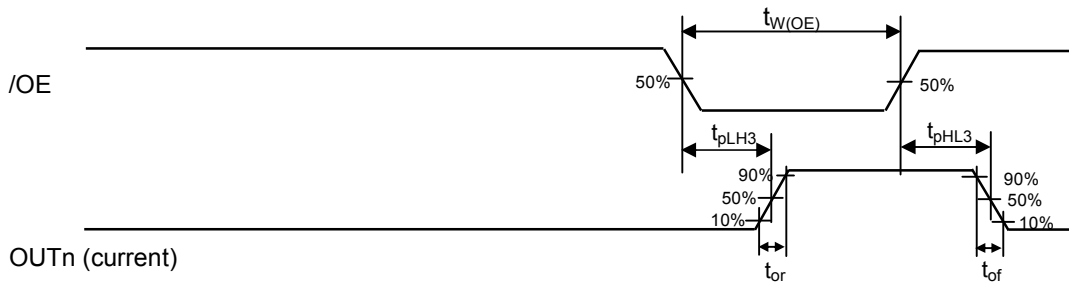


Timing Waveform

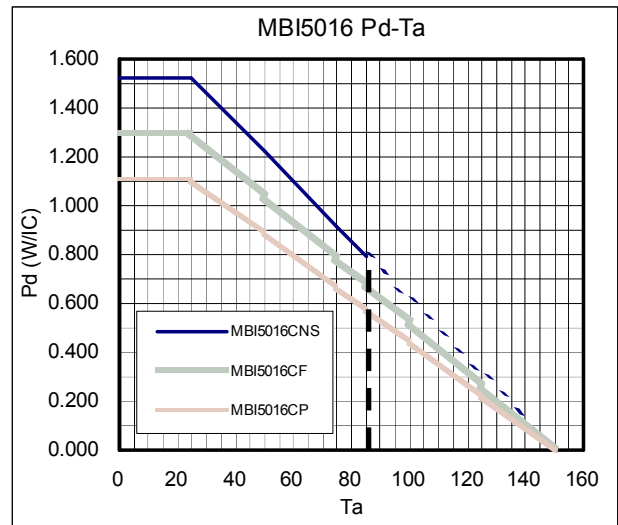
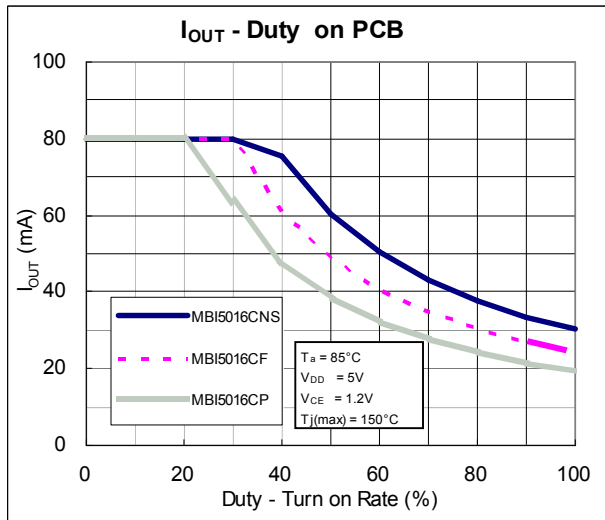
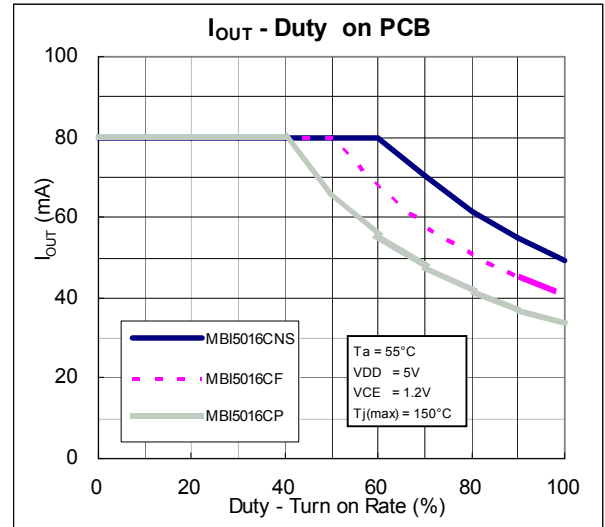
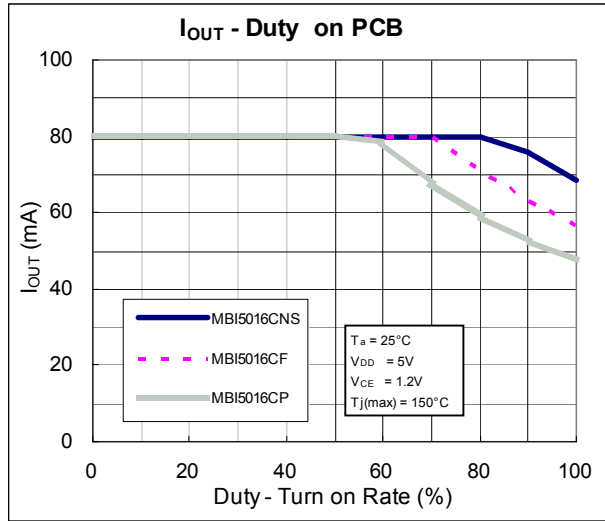
1. CLK, SDO, /LE, OUTn



2. /OE, OUTn

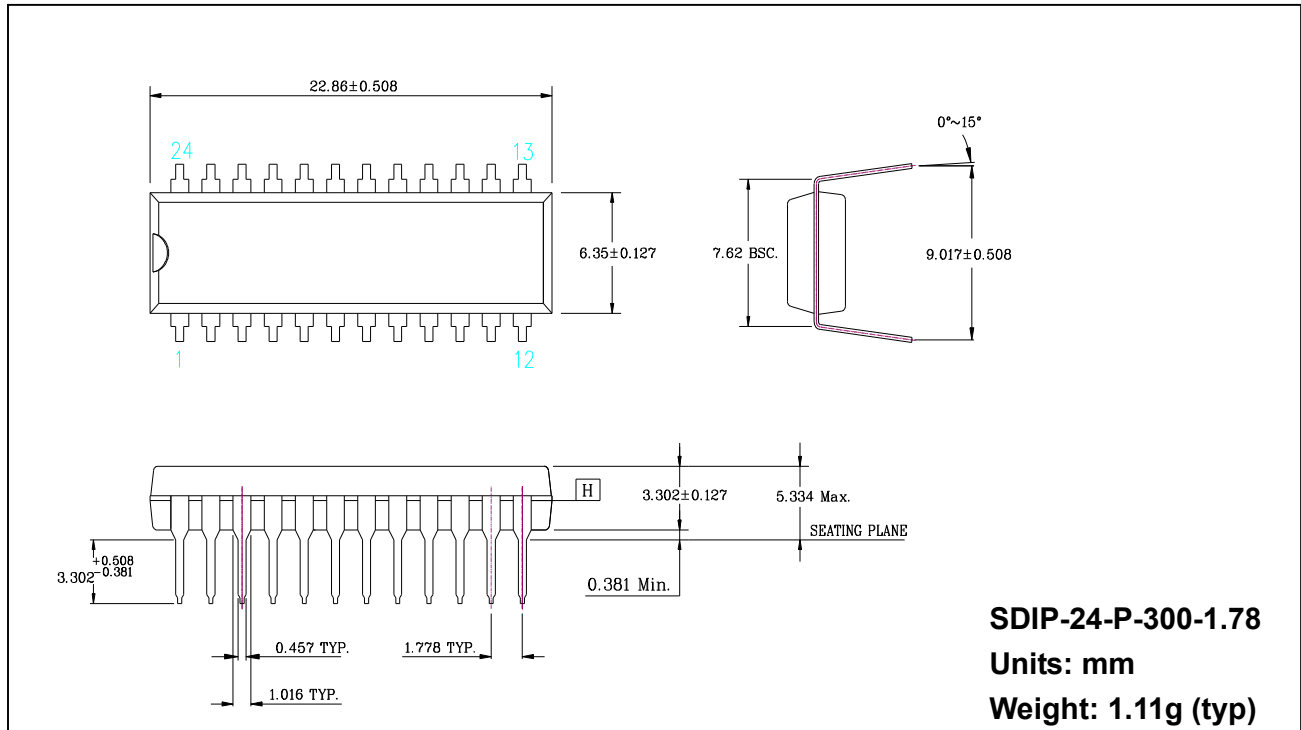


Graphs

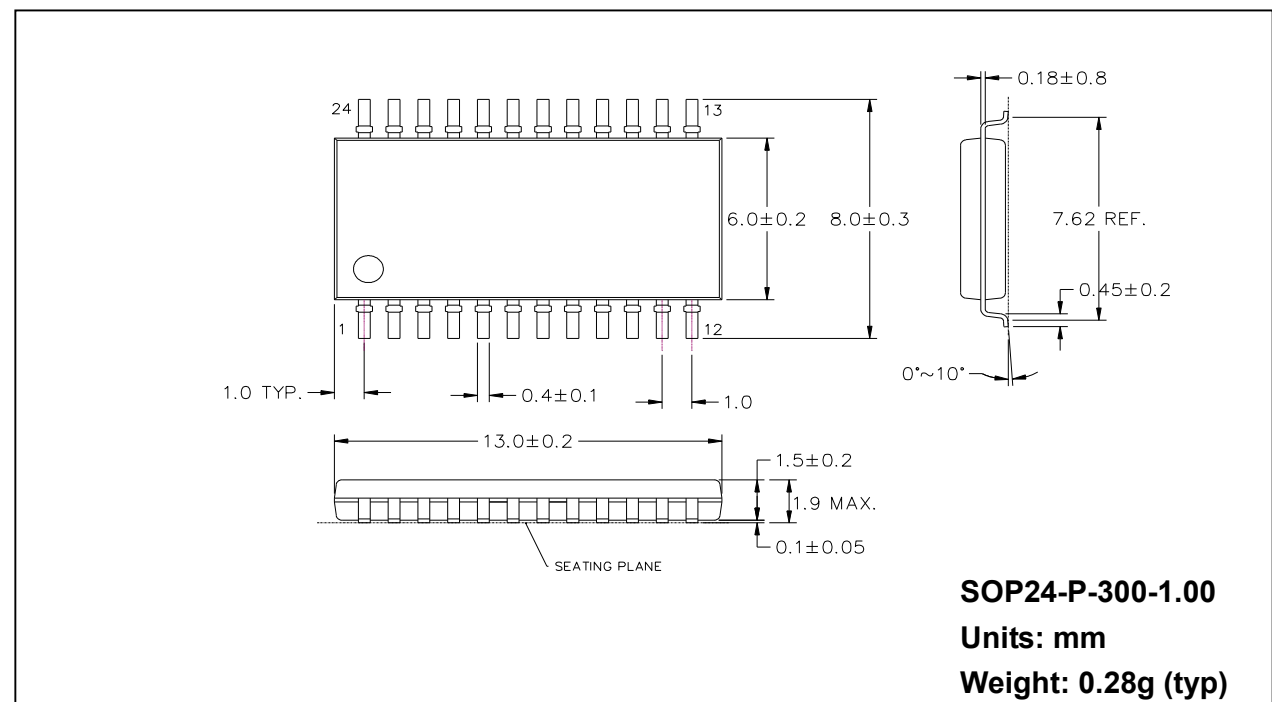


Outline Drawings

MBI5016CNS



MBI5016CF



MBI5016CP

