TOSHIBA CMOS Integrated Circuits Silicon Monolithic

TCA62724FMG

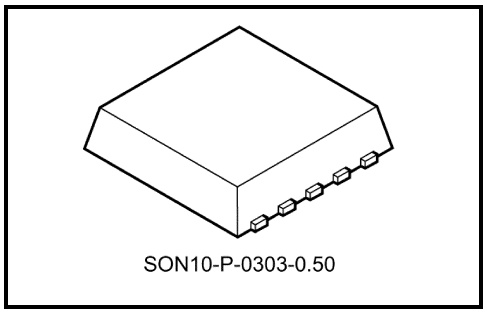
Three-Channel Constant-Current LED Driver

The TCA62724FM is an optimal constant-current LED driver for RGB pixel LEDs.

The device supports 16 dimming states for each color in the RGB pixel LED setup, resulting in 4096 colors for carrying out illumination by internal PWM.

Moreover, it is not necessary to connect external resistance to an output in almost all cases.

The forward current of the LED is set up using the external resistor.



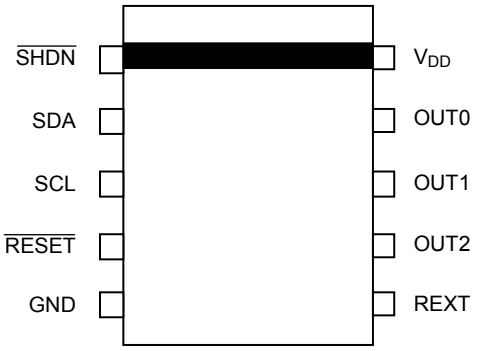
SON10-P-0303-0.50

Weight: 0.016 g (typ.)

Features

- Output current capability and the number of outputs : 155 mA x 3 outputs
- Constant current range : 5 to 150 mA
- Low consumption current
  - Supply current at operation (Iout = 20 mA) : 600 μA
  - Supply current at standby : 1 μA
- For anode common LED
- Power supply voltage range : V_{DD} = 2.8 to 5.5 V
- I^2C interface (I^2C is a trademark of Philips Electronics N.V.)
- Package : SON10-P-0303-0.50 (height : 0.8 mm)

Package and Pin Layout (top view)



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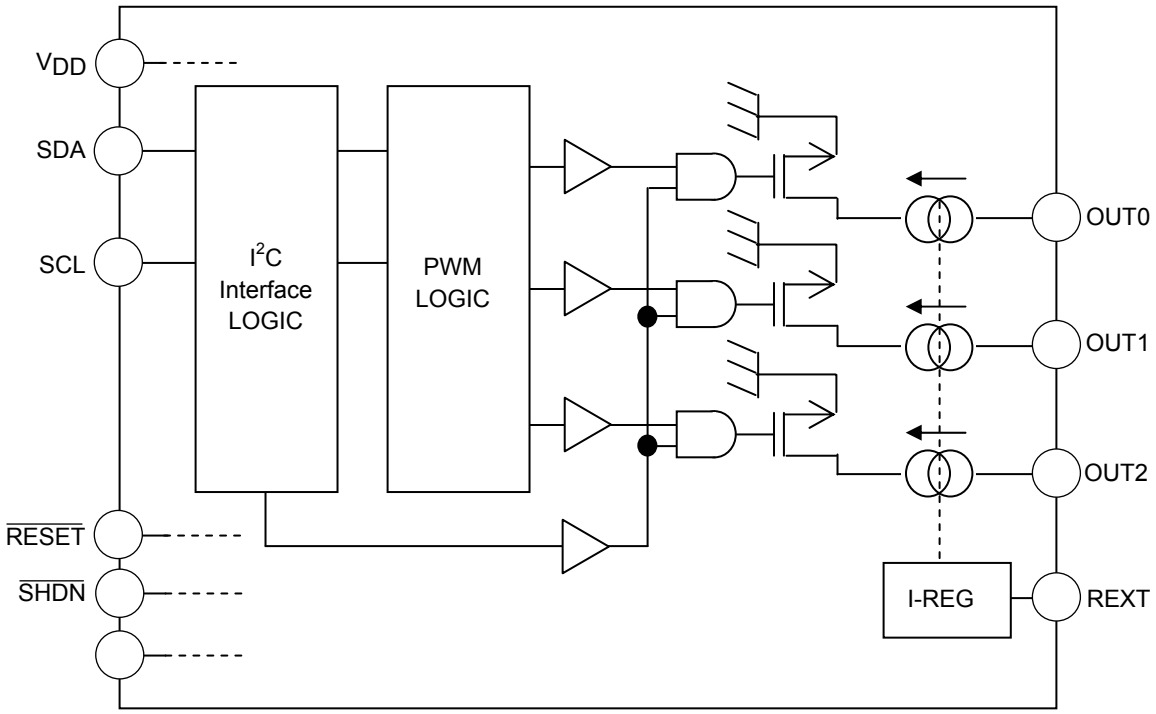
Block Diagram



Terminal Description

Pin No.	Pin Name	Function
1	$\overline{\text{SHDN}}$	IC input terminal enable When the data is “L”, power-saving mode applies; when the data is “H”, the IC operates.
2	SDA	Serial data input / output terminal
3	SCL	Serial clock input terminal
4	$\overline{\text{RESET}}$	Low active reset input terminal
5	GND	GND terminal
6	REXT	This is an output current setting resistor connect terminal. The output current does not flow when this terminal is opened. Excessive output current will destroy the IC if this terminal is connected to GND.
7	OUT2	Output terminal
8	OUT1	
9	OUT0	
10	V_{DD}	2.8 V to 5.5 V supply voltage terminal

Maximum Ratings (T_{opr} = 25°C)

Characteristic	Symbol	Ratings	Unit
Supply voltage	V_{DD}	−0.3 ~ +6.0	V
Output voltage	V_{OUT}	−0.3 ~ +6.0	V
Output current	I_{OUT}	155	mA/ch
Input voltage	V_{IN}	−0.3 ~ V_{DD}+0.3	mA
SDA terminal current	I_{SDA}	10	mA
GND current	I_{GND}	470	mA
Power dissipation	P_D	0.41 (free air)	W
		0.47 (on PCB)*	
Thermal resistance	$R_{th\ (j-a)}$	300 (free air)	°C/W
		260 (on PCB)	
Operating temperature	T_{opr}	−40 ~ +85	°C
Storage temperature	T_{stg}	−55 ~ +150	°C
Maximum junction temperature	T_j	150	°C

Note: Subtract 3.8 mW / degree from the maximum rating value about a degree if the operation temperature exceeds 25°C when the device is mounted on a PCB.

Recommended Operating Condition (unless otherwise specified, T_{opr} = - 40 to 85°C)

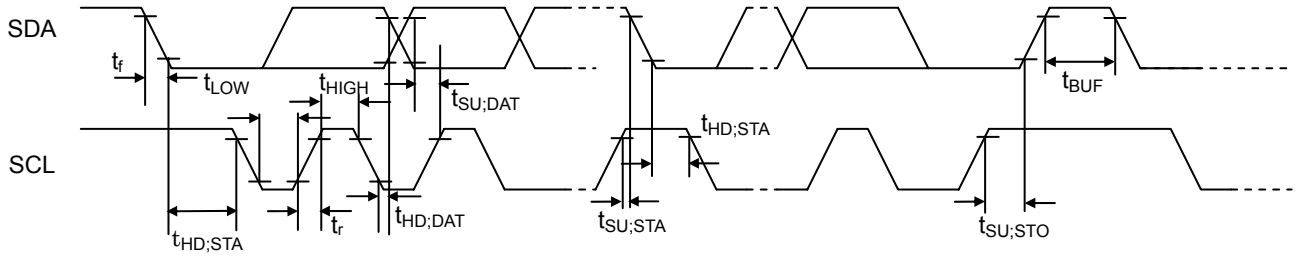
Characteristic		Symbol	Condition	Min	Typ.	Max	Unit
Supply voltage		V_{DD}	-	2.8	3.6	5.5	V
Input voltage	High level	V_{IH}	SDA, SCL, $\overline{SHDN}$, $\overline{RESET}$	0.7V_{DD}	-	V_{DD}+0.15V	V
	Low level	V_{IL}	SDA, SCL, $\overline{SHDN}$, $\overline{RESET}$	−0.15	-	0.3V_{DD}	
Constant current output		I_{OUT}	OUT0 to OUT2	5	-	150	mA/ch
REXT		REXT	-	3.7	-	109	kΩ
SDA terminal current		I_{SDA}	Acknowledge	-	3	-	mA

Electrical Characteristics (unless otherwise specified, V_{DD} = 2.8 to 5.5 V, T_{opr} = 25°C)

Characteristic		Symbol	Condition	Min	Typ	Max	Unit
Supply voltage		V_{DD}	-	2.8	3.6	5.5	V
Supply current (IC operation)		I_{DD} (On)	REXT = 27.6 kΩ, V_{DD} = 3.6 V	-	-	700	μA
Supply current (IC standby)		I_{DD} (Off)	$\overline{SHDN}$ = L	-	-	1.0	μA
Input voltage	High level	V_{IH}	SDA, SCL, $\overline{SHDN}$, $\overline{RESET}$	0.7V_{DD}	-	V_{DD}+0.15V	V
	Low level	V_{IL}	SDA, SCL, $\overline{SHDN}$, $\overline{RESET}$	−0.15	-	0.3V_{DD}	
Input current		I_{IN}	SCL, $\overline{SHDN}$, RESET	−1.0	-	1.0	μA
Gain		GAIN	I_{OUT}/I_{REXT}, REXT = 11 kΩ	359	460	560	A/A
REXT terminal voltage		V_{REXT}	V_{DD}=3.6 V, REXT = 11 kΩ	1.09	1.17	1.25	V
Output leakage current		I_{OZ}	$\overline{SHDN}$ = "L", V_{OUT} = 5.5 V	-	-	0.1	μA
Constant current accuracy between bits		dI_{OUT}	V_{DD} = 3.6 V, REXT = 11 kΩ	-	±1	±7.5	%
PWM frequency		f_{PWM}	-	-	3.0	-	kHz
Time from SHDN release to start of operation		t_{RE}	-	-	2	5	ms

Characteristics of the SDA and SCL Bus Lines for I^2C-bus Devices

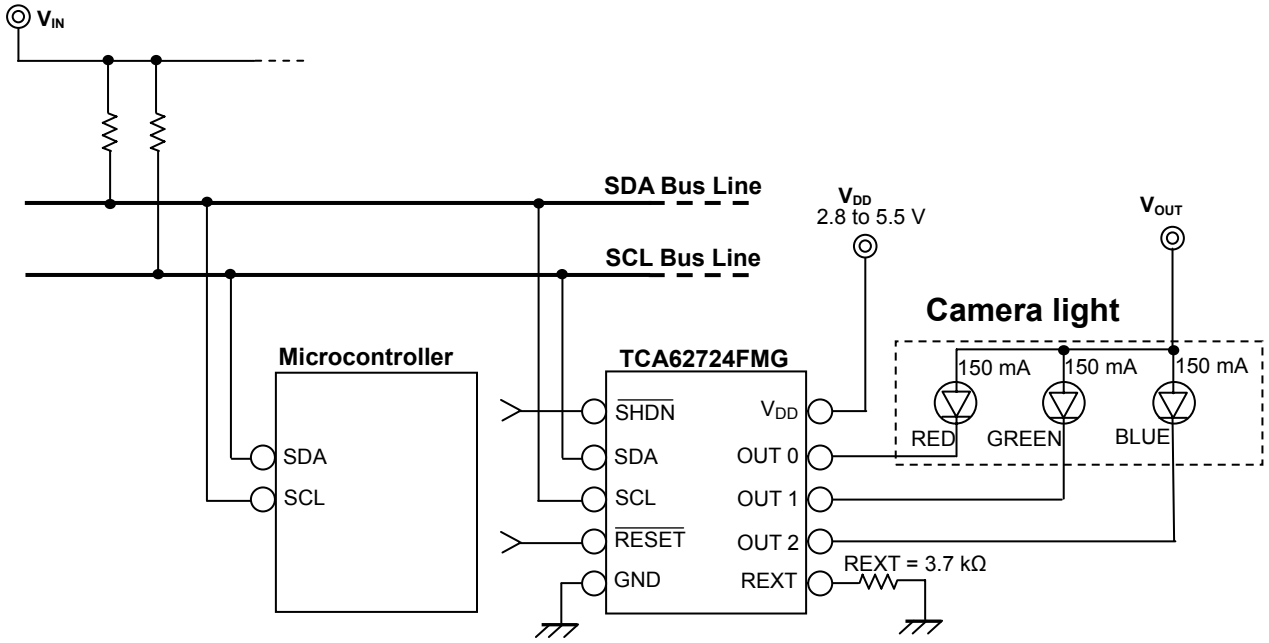
Characteristic	Symbol	Standard Mode		Unit
		Min	Max	
SCL clock frequency	f_{SCL}	0	100	kHz
Bus free time between STOP and START condition	t_{BUF}	4.7	-	μs
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	μs
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	μs
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	μs
Data hold time	$t_{HD;DAT}$	0	-	ns
Data setup time	$t_{SU;DAT}$	250	-	ns
LOW period of the SCL clock	t_{LOW}	4.7	-	μs
HIGH period of the SCL clock	t_{HIGH}	4.0	-	μs
Rise time of both SDA and SCL signals	t_f	-	1000	ns
Fall time of both SDA and SCL signals	t_r	-	300	ns



Example Applications : Cellular Phone

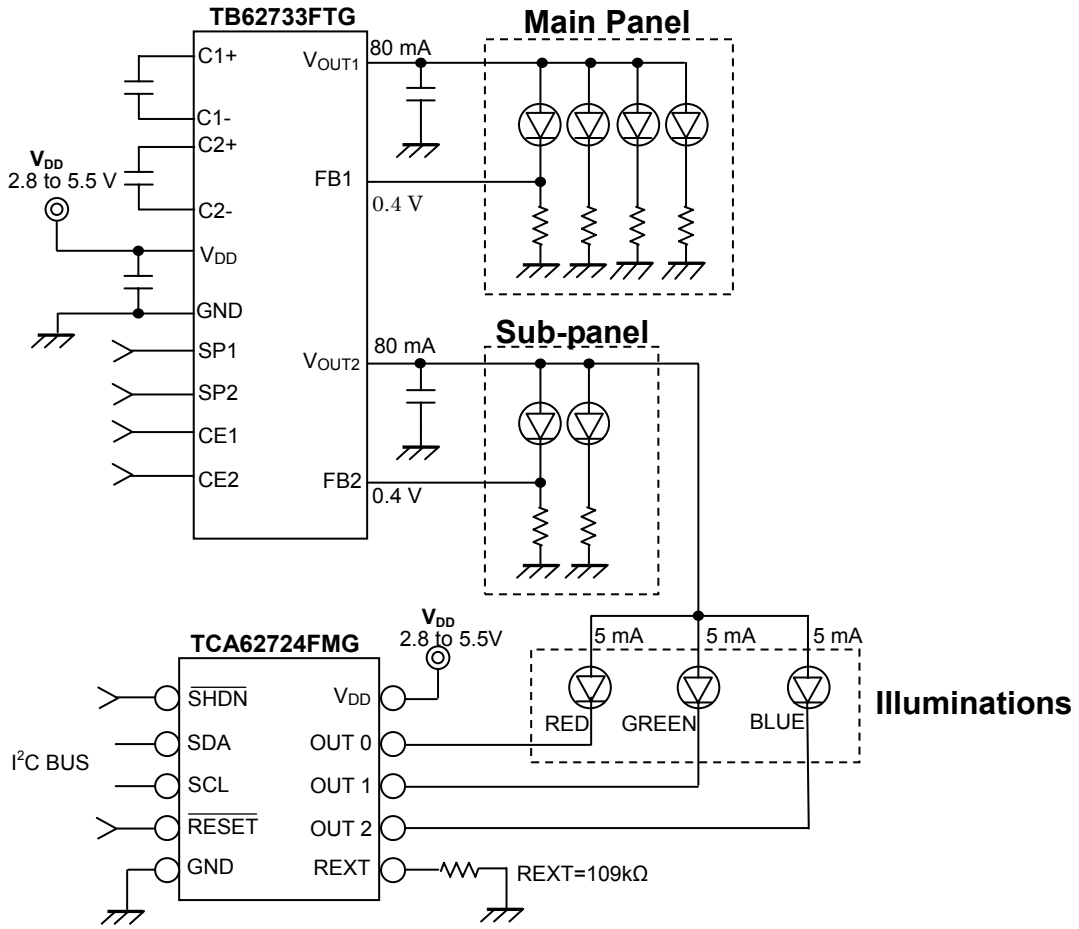
Application as Camera Light

(Primary-color red, green and blue LEDs combine to emit good-quality white light for color reproducibility.)



Application as Cellular Phone Illumination

(Combination with the TB62733FTG and the drive of two or more cellular phone LEDs is possible.)



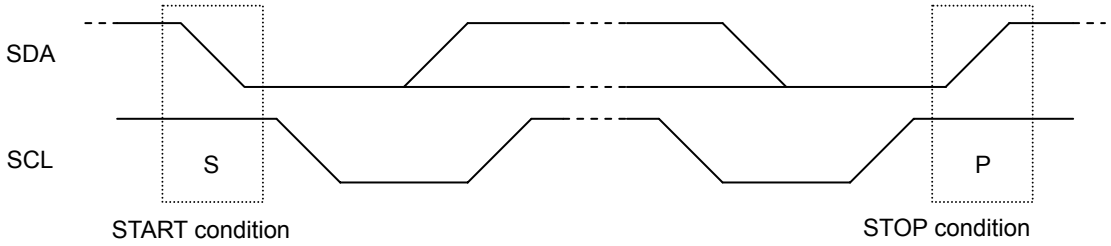
I²C Interface

*DATA transfer format

S	Slave address 7 bits	R/W	A	Sub-address 8 bits	A	DATA byte 8 bits	A	P

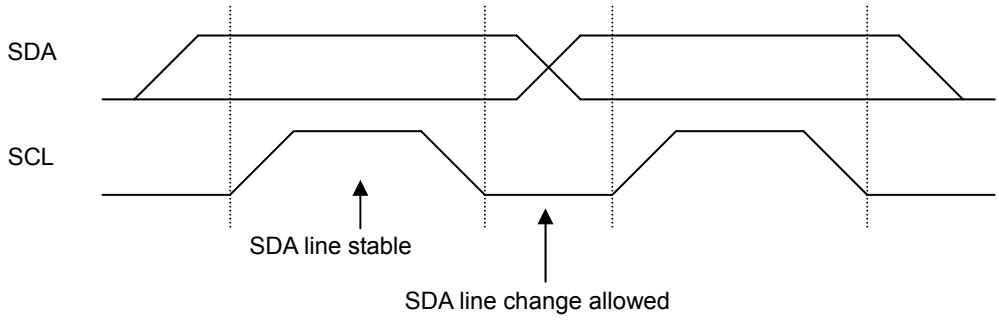
*START condition (S), STOP condition (P)

START condition : A HIGH to LOW transition on the SDA line while SCL is HIGH.
STOP condition : A LOW to HIGH transition on the SDA line while SCL is HIGH.



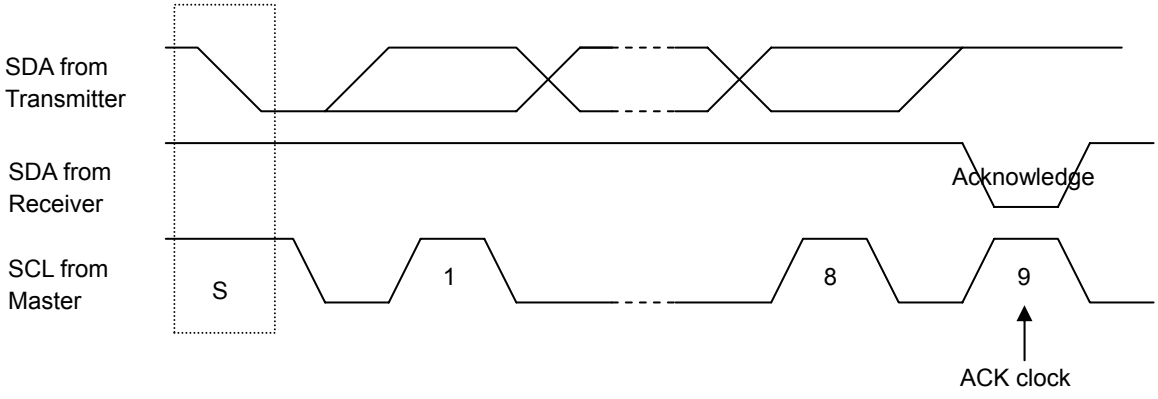
*DATA validity

The data on the SDA line must be stable during the HIGH period of the clock.
The HIGH or LOW state of the data line can only change when the clock signal on the SCL line is LOW.



*Acknowledge (A)

The receiver is obliged to generate an Acknowledge after each byte has been received.



*Slave address

TCA62724FMG

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	1	0	1	0	1	R/W

R/W: When this bit is set to “H”, READ mode applies; when it is set to “L”, WRITE mode applies.

*Sub-address

PWM0 (PWM Duty Data Setup of OUT0)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
AI	0	0	0	0	0	0	1

PWM1 (PWM Duty Data Setup of OUT1)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
AI	0	0	0	0	0	1	0

PWM2 (PWM Duty Data Setup of OUT2)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
AI	0	0	0	0	0	1	1

ENABLE / SHDN (Data Setup of ENABLE / SHDN)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
AI	0	0	0	0	1	0	0

AI: When this bit is set to “H”, auto-increment is OFF; when it is set to “L”, auto-increment is ON.

*DATA byte

PWM0, PWM1, and PWM2 DATA
PWM ON Duty DATA (0/15 to 15/15)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Don't use				PWM ON Duty DATA			

(default ="0000")

Bit 3	Bit 2	Bit 1	Bit 0	PWM ON Duty
DATA				
1	1	1	1	15/15
1	1	1	0	14/15
1	1	0	1	13/15
1	1	0	0	12/15
1	0	1	1	11/15
1	0	1	0	10/15
1	0	0	1	9/15
1	0	0	0	8/15
0	1	1	1	7/15
0	1	1	0	6/15
0	1	0	1	5/15
0	1	0	0	4/15
0	0	1	1	3/15
0	0	1	0	2/15
0	0	0	1	1/15
0	0	0	0	0/15

ENABLE / SHDN DATA

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Don't use				X	X	ENABLE	SHDN

(default = "00000000")

ENABLE DATA

H : Output blinks at PWM0, PWM1, and PWM2 rate
L : Output is OFF

SHDN data

H : Output blinks at PWM0, PWM1, and PWM2 rate
L : Power-saving mode

*WRITE mode

Auto-increment OFF

S	Slave Address	R/W (0)	A	Sub-address	A	DATA	A	Sub-address	A	DATA	- - -	P

Auto-increment ON

S	Slave Address	R/W (0)	A	Sub-address	A	DATA	A	DATA	A	- - -	P

The data of the immediately following Sub-address can be written in.

*READ mode

S	Slave Address	R/W (1)	A	First Byte	A	Second Byte	P

First byte (ENABLE / SHDN DATA and PWM2 DATA)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x	x	ENABLE	SHDN	PWM2 DATA			

Second byte (PWM1 DATA and PWM0 DATA)

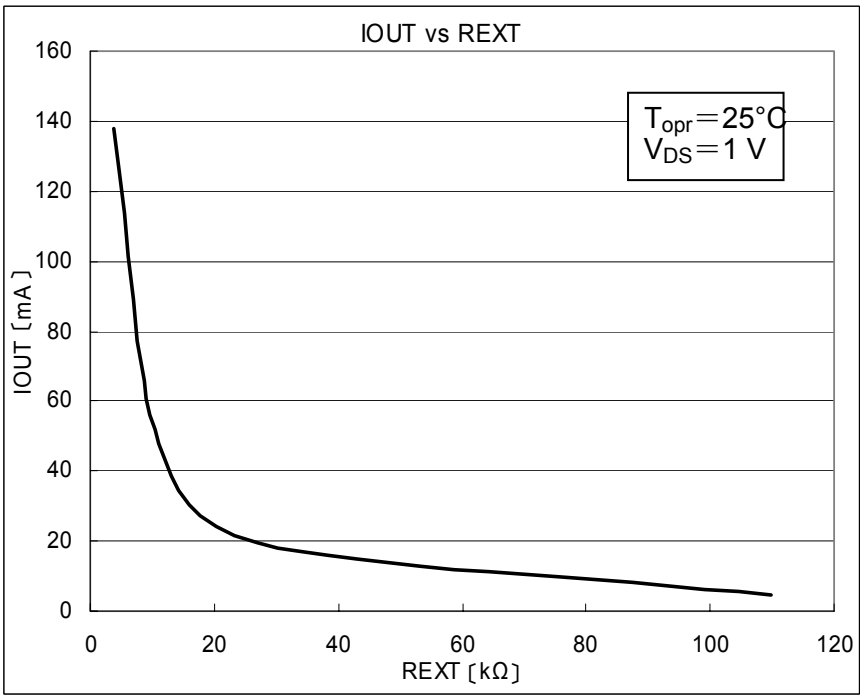
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
PWM1 DATA				PWM0 DATA			

Purchase of TOSHIBA I^2C components conveys a license under the Philips I^2C Patent Rights to use these components in an I^2C system, provided that the system conforms to the I^2C Standard Specification as defined by Philips.

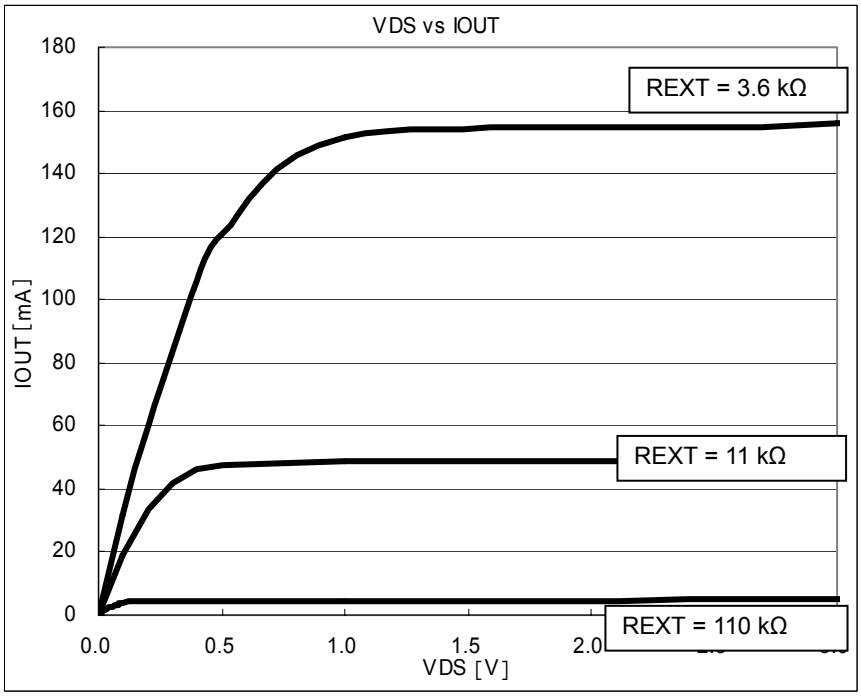
Setting of Output Current (Reference Data)

The output current is set by the resistance connected between terminal REXT and GND.
The output current can be set according to the following expression.

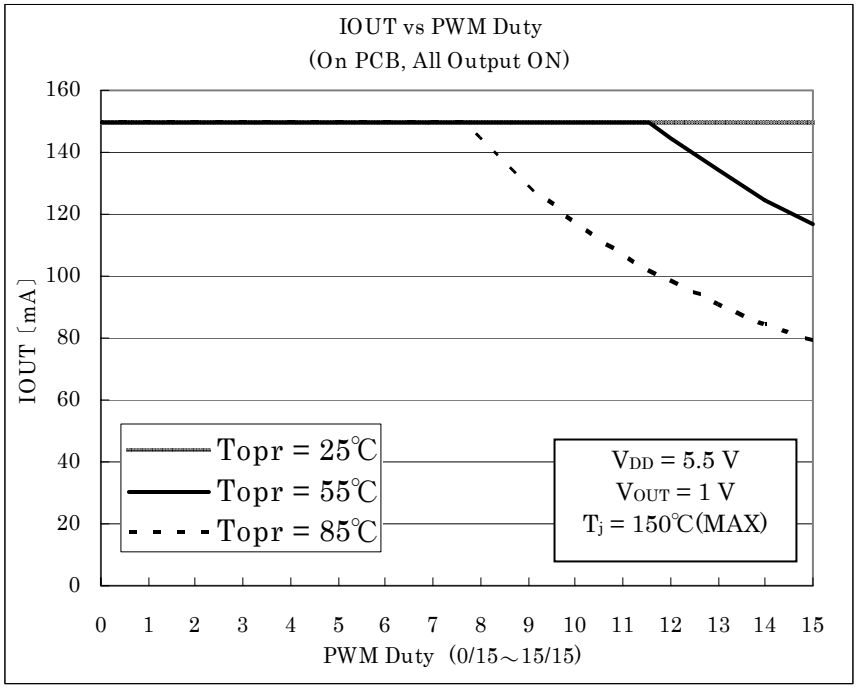
$$I_{OUT}\ (mA) = \frac{1.17\ (V)}{REXT\ (k\Omega)} \times 460$$



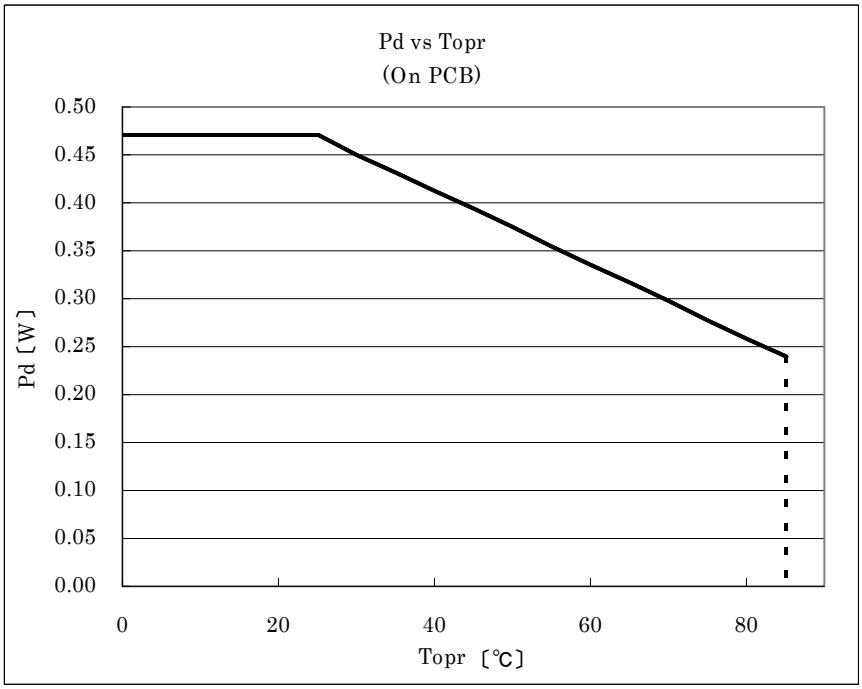
Output Voltage – Output Current (Reference Data)



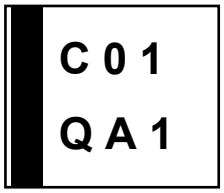
Output Current - PWM Duty (Reference Data)



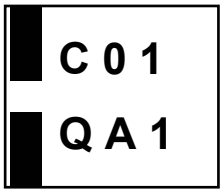
Power Dissipation - Operating Temperature (Reference Data)



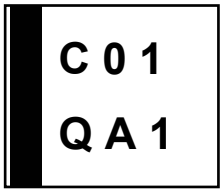
Marking



Week 1-26



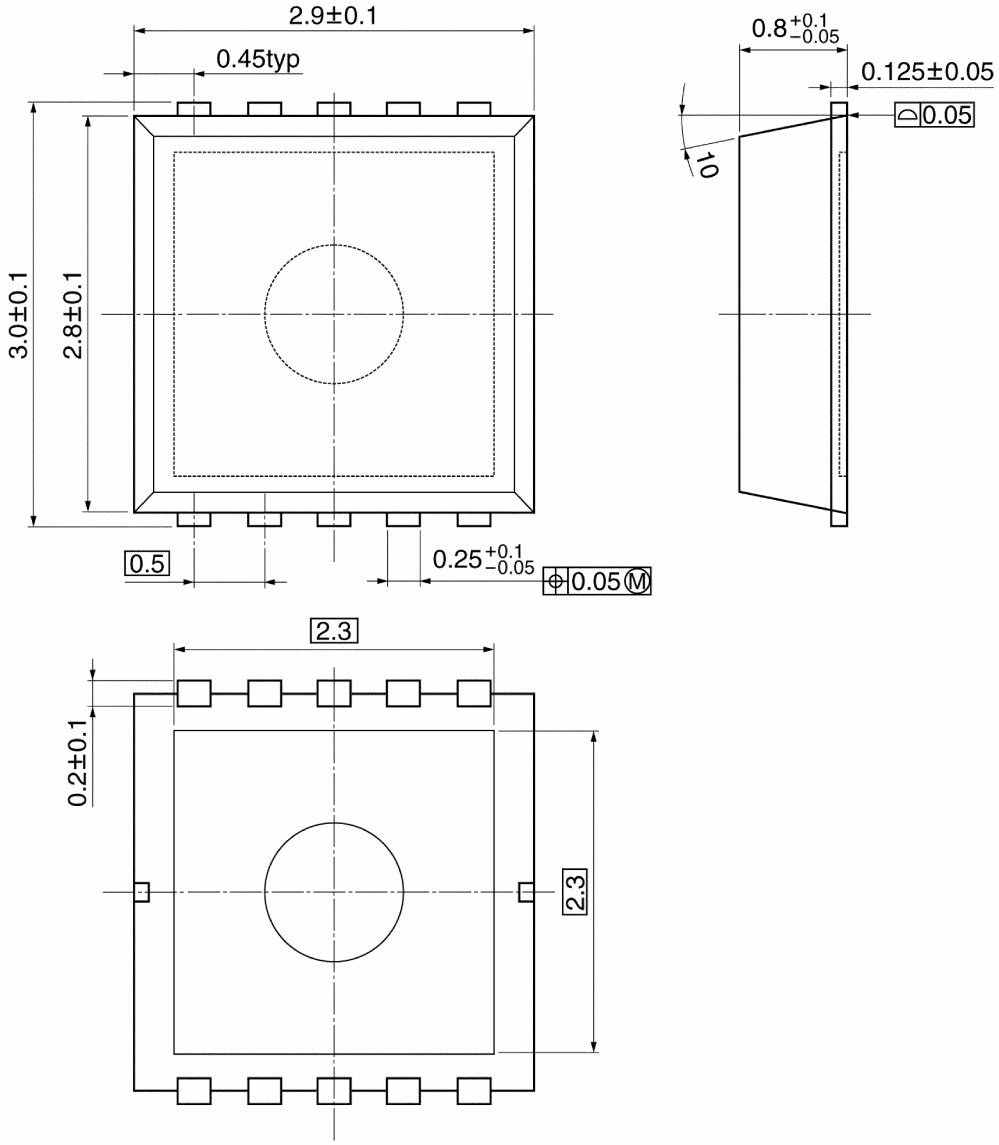
Week 27-53



C01	: Product number
Q	: Monthly and weekly code
A1	: Lot code

Package Dimensions

SON10-P-0303-0.50 Unit: mm



Weight: 0.016 g (typ.)

SOLDERABILITY

The following conditions apply to solderability.

- Solderability
  (1) Use of Sn-63Pb solder bath
    • solder bath temperature = 230°C, dipping time = 5 seconds, number of times = once, use of R-type flux
  (2) Use of Sn-3.0Ag-0.5Cu solder bath
    • solder bath temperature = 245°C, dipping time = 5 seconds, number of times = once, use of R-type flux

CAUTION

- Particular care is necessary in the design of the output, VCC, COMMON and GND lines since the IC may be destroyed by short circuits between outputs, air contamination faults, or faults arising from improper grounding.
- Do not insert devices in the wrong orientation. Make sure that the positive and negative terminals of power supplies are connected correctly. Otherwise the rated maximum current or power dissipation may be exceeded and the device may break down or undergo performance degradation, causing it to catch fire or explode and resulting in injury.
- Note that the IC may be destroyed as a result of damage to or misconnection of external components.

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