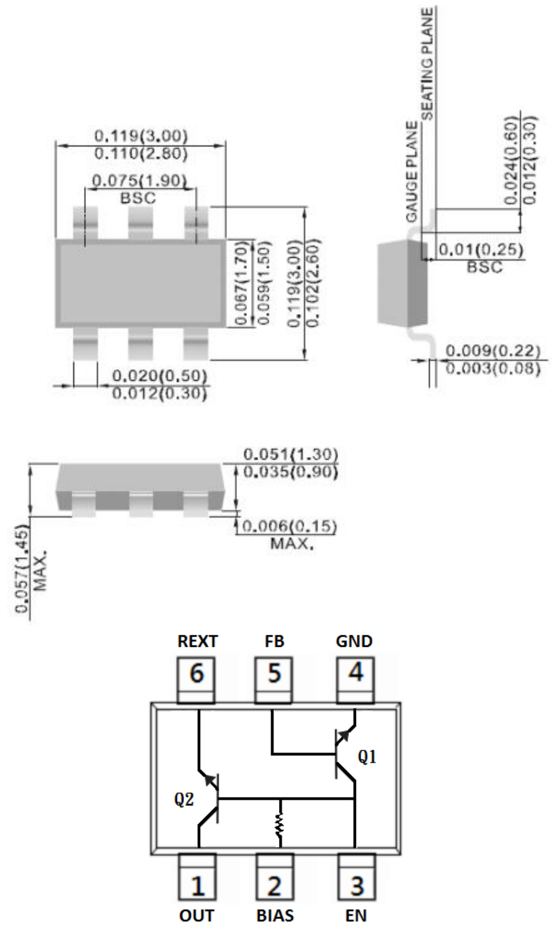
2SC164S

Application Specific Multichip Circuit

Voltage	40V	Current	150mA

SOT-23 6L　　　Unit: inch(mm)



Features

- Silicon NPN epitaxial type
- Includes one NPN Transistor(Q1) and one NPN Base Accessible Pre-biased Transistor(Q2)
- Through reductions in component count and footprint
- Lead free in comply with EU RoHS 2011/65/EU directives.
- Green molding compound as per IEC61249 Std. (Halogen Free)

Mechanical Data

- Case: SOT-23 6L Package
- Terminals : Solderable per MIL-STD-750, Method 2026
- Approx. Weight: 0.0005 ounces, 0.014 grams
- Marking: C4S

Maximum Ratings (Q1) (T_A=25 ^{o}C unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNITS
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6.0	V
Collector Current (DC)	I_C	200	mA

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Maximum Ratings (Q2) (T_A=25°C unless otherwise noted)

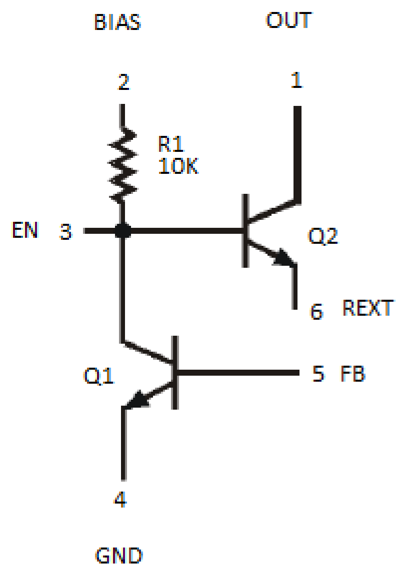
PARAMETER	SYMBOL	LIMIT	UNITS
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	5.0	V
Collector Current (DC)	I_C	150	mA

Thermal Characteristics (T_A=25°C unless otherwise noted)

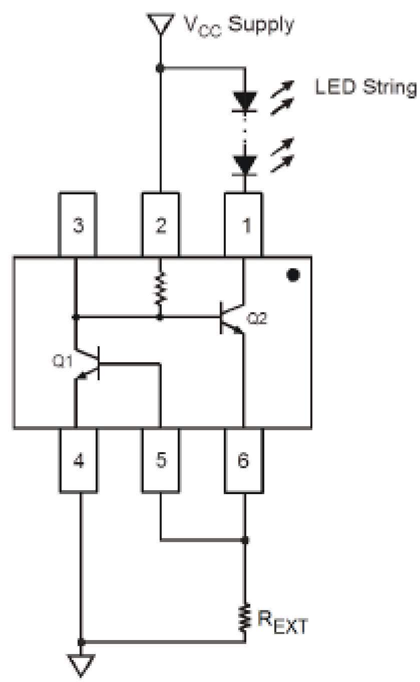
PARAMETER	SYMBOL	LIMIT	UNITS
Collector Power Dissipation (Note)	P_D	1	W
Operating Junction and Storage Temperature Range	T_J,T_{STG}	-55~150	°C
Thermal Resistance from Junction to Ambient (Note)	$R_{\theta JA}$	125	°C/W

Note : Mounted on a 1 inch FR-4 with 2oz. square pad of copper.

Device Schematic



Applications Circuit



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Electrical Characteristics (Q1) (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNITS
OFF Characteristics						
Collector-Emitter Breakdown Voltage	BV_{CEO}	I_C= 1mA, I_B= 0A	40	-	-	V
Collector-Base Breakdown Voltage	BV_{CBO}	I_C= 10uA, I_E= 0A	60	-	-	V
Emitter-Base Breakdown Voltage	BV_{EBO}	I_E= 10u A, I_C= 0A	6	-	-	V
Collector Cutoff Current	I_{CEX}	V_{CE}= 30V, V_{EB} = 3V	-	-	50	nA
Base Cutoff Current	I_{BL}	V_{CE}= 30V, V_{EB} = 3V	-	-	50	nA
ON characteristics						
DC Current Gain	h_{FE}	V_{CE}= 1V, I_C= 0.1mA	40	-	-	-
		V_{CE}= 1V, I_C= 1mA	70	-	-	
		V_{CE}= 1V, I_C= 10mA	100		300	
		V_{CE}= 1V, I_C= 50mA	60			
		V_{CE}= 1V, I_C= 100mA	30			
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	I_C= 10mA, I_B= 1mA	-	-	200	mV
		I_C= 50mA, I_B= 5mA			300	
Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	I_C= 10mA, I_B= 1mA	650	-	850	mV
		I_C= 50mA, I_B= 5mA	-	-	950	
Transition Frequency	f_T	V_{CE}= 20V, I_C= 10mA	300	-	-	MHz
Collector-Base Capacitance	C_{CBO}	V_{CB}= 5V, f= 1MHz	-	-	4	pF
Emitter-Base Capacitance	C_{EBO}	V_{EB}= 0.5V, f= 1MHz	-	-	8	pF

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Electrical Characteristics (Q2) (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNITS
OFF Characteristics						
Collector-Emitter Breakdown Voltage	BV_{CEO}	I_C= 1mA, I_B= 0A	40	-	-	V
Collector-Base Breakdown Voltage	BV_{CBO}	I_C= 50uA, I_E= 0A	40	-	-	V
Emitter-Base Breakdown Voltage	BV_{EBO}	I_E= 50u A, I_C= 0A	5	-	-	V
Collector Cutoff Current	I_{CBO}	V_{CB}= 30V, I_E= 0A	-	-	0.5	uA
Emitter Cutoff Current	I_{EBO}	V_{EB}= 4V, V_{EB} = 3V	-	-	0.5	uA
ON characteristics						
DC Current Gain	h_{FE}	V_{CE}= 5V, I_C= 150mA	100	-	-	-
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	I_C= 10mA, I_B= 1mA	-	-	300	mV
Transition Frequency	f_T	V_{CE}= 10V, I_E= -5mA	-	250	-	MHz
Input Resistance	R1	-	7	10	13	Kohm

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TYPICAL CHARACTERISTIC CURVES

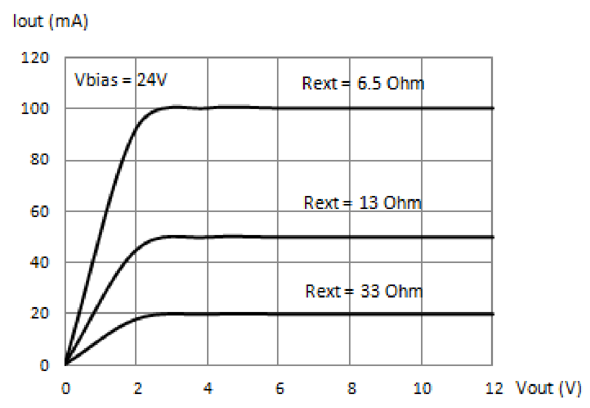

Fig.1 Out Current VS. Vout

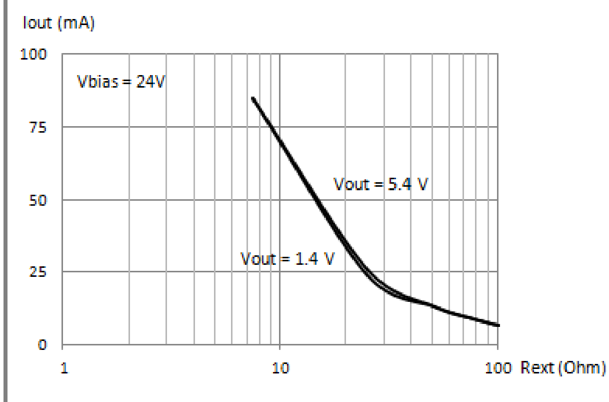

Fig.2 Out Current VS. Rext

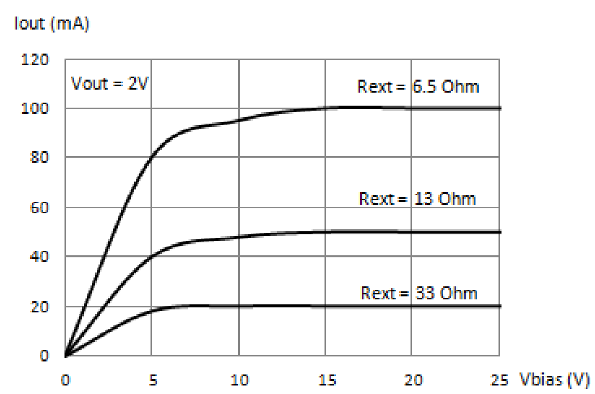

Fig.3 Out Current VS. Vbias

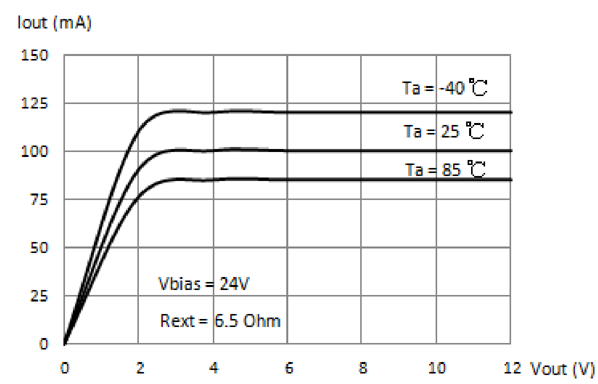

Fig.4 Out Current VS. Vout

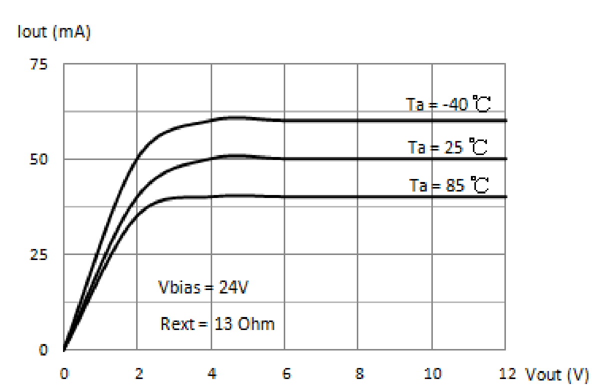

Fig.5 Out Current VS. Vout

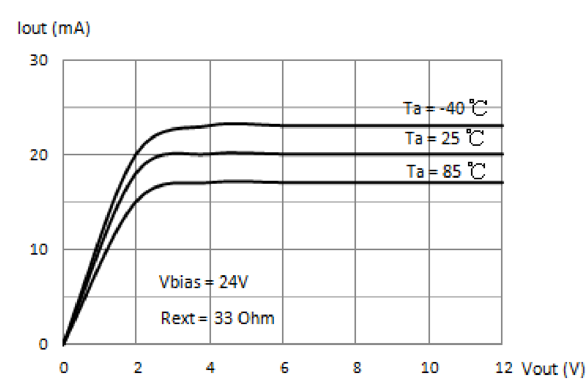

Fig.6 Out Current VS. Vout

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Application Information

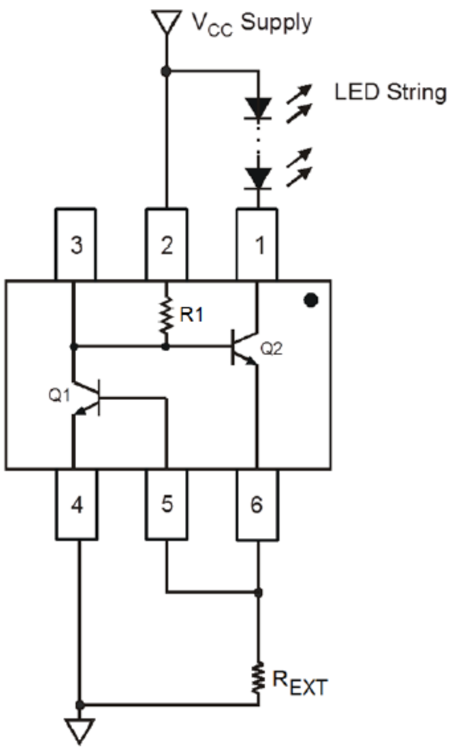


Fig. 7 Typical Application Circuit for Linear Mode Current Sink LED Driver

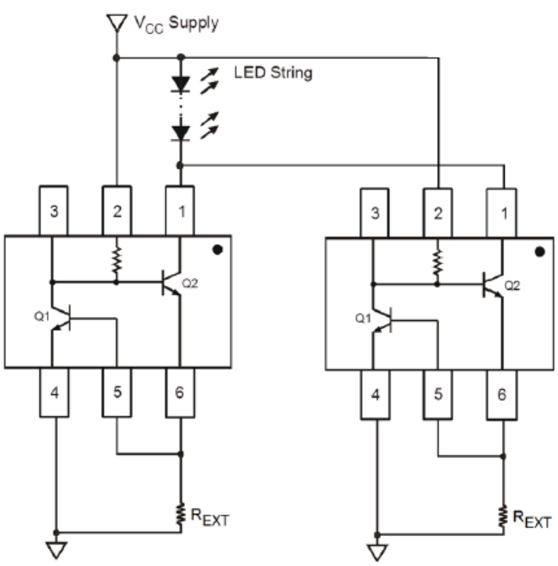


Fig. 8 Application Circuit for Increasing LED Current

The 2SC164S has been designed for driving low current LEDs with typical LED current of 20mA to 100mA. It provides a cost effective way for driving low current LEDs compared with more complex switching regulator solutions. Furthermore, it reduces the PCB board area of the solution as there is no need for external components like inductors, capacitors and switching diodes.

Figure 7 shows a typical application circuit diagram for driving an LED or string of LEDs. The NPN transistor Q1 measures the LED current by sensing the voltage across an external resistor R_{EXT}. Q1 uses its V_{BE} as reference to set the voltage across R_{EXT} and controls the base current into Q2. Q2 operates in linear mode to regulate the LED current. The LED current is

$$I_{LED} = V_{BE(Q1)} / R_{EXT}$$

From this, for any required LED current the necessary external resistor R_{EXT} can be calculated from

$$R_{EXT} = V_{BE(Q1)} / I_{LED}$$

Two or more 2SC164S can be connected in parallel to construct higher current LED strings as shown in Figure 8

Consideration of the expected linear mode power dissipation must be factored into the design, with respect to the 2SC164S's thermal resistance. The maximum voltage across the device can be calculated by taking the maximum supply voltage less the voltage across the LED string.

$$V_{CE(Q2)} = V_{CC} - V_{LED} - V_{BE(Q1)}$$
$$P_D = V_{CE(Q2)} * I_{LED} + (V_{CC} - V_{BE(Q2)} - V_{BE(Q1)})^2 / R_1$$

As the output current of 2SC164S increases, it is necessary to provide appropriate thermal relief to the device. The power dissipation supported by the device is dependent upon the PCB board material, the copper area and the ambient temperature. The maximum dissipation the device can handle is given by:

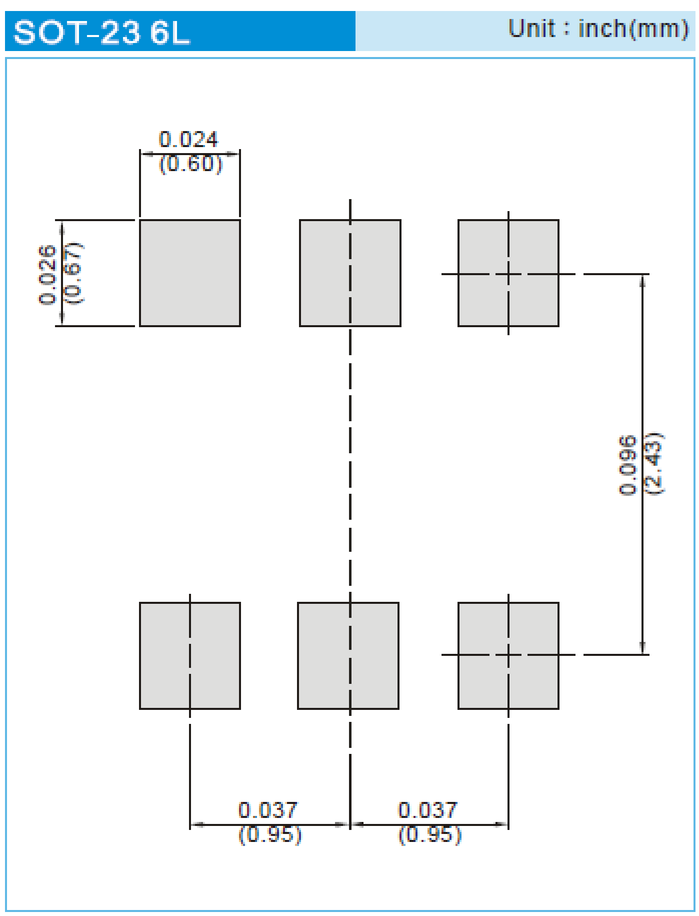
$$P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$$

2SC164S

PART NO PACKING CODE VERSION

Part No Packing Code	Package Type	Packing type	Marking	Version
2SC164S_S1_00001	SOT-23 6L	3K pcs / 7" reel	C4S	Halogen free
2SC164S _S2_00001	SOT-23 6L	10K pcs / 13" reel	C4S	Halogen free

MOUNTING PAD LAYOUT



2SC164S

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