High voltage, high current Darlington transistor array

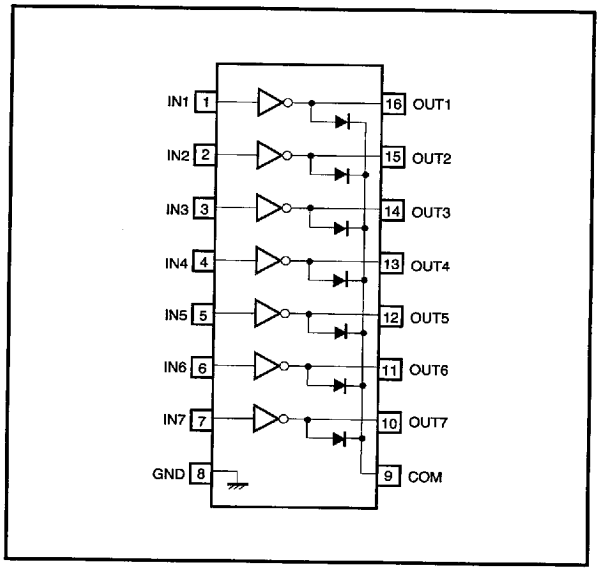
BA12001B/BA12002/BA12003B/BA12003BF/ BA12004B

The BA12001B, BA12002, BA12003B, BA12003BF, and BA12004B are high current transistor arrays featuring high voltage withstand resistance and consisting of seven circuits of Darlington transistors.
Because it incorporates built-in surge-absorbing diodes and base current-control resistors needed when using inductive loads such as relay coils, attachments can be kept to a minimum.
With an output withstanding voltage as high as 60V (BA12001B, BA12003B, BA12003BF, and BA12004B) and an output current (sink current) of 500mA, this product is ideal for use with various drivers and as an interface with other elements.

●Applications
Drivers for LEDs, lamps, relays and solenoids
Interface with other elements

●Features
1) High output current. (I_{OUT} = 500mA max.)
2) High output voltage withstand resistance. (V_{OUT} = 50V max.)
3) Seven Darlington transistors built in.
4) Equipped with output surge-absorbing clamp diode.

●Block diagram



●Internal circuit configuration diagram

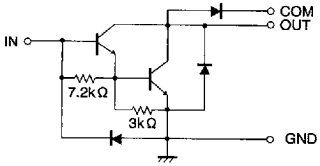


Fig.1 BA12001B

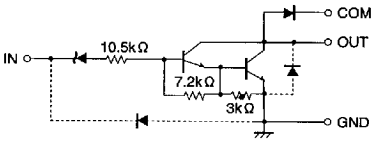


Fig.2 BA12002

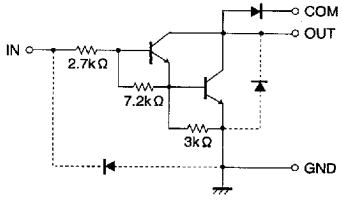


Fig.3 BA12003B / BF

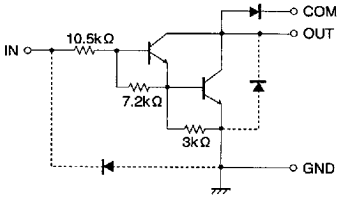


Fig.4 BA12004B

●Absolute maximum ratings (Ta=25℃)

Parameter		Symbol	Limits	Unit
Power supply voltage	other than BA12002	V_{CE}	60	V
	BA12002		50	
Input voltage	other than BA12001B	V_{IN}	−0.5~30	V
Input current	BA12001B	I_{IN}	25	mA / unit
Output current		I_{OUT}	500	mA / unit
Ground pin current		I_{GND}	2.3 *1	A
Power dissipation	DIP package	Pd	1250 *2	mW
	SOP package		625 *3	
Diode reverse voltage		V_R	60	V
Diode forward current		I_F	500	mA
Operating temperature		Topr	−25~75	℃
Storage temperature		Tstg	−55~150	℃

*1 Pulse width ≤ 20 ms, duty cycle ≤ 10%, same current for all 7 circuits

*2 Reduced by 10 mW for each increase in Ta of 1°C over 25°C .

*3 Reduced by 50 mW for each increase in Ta of 1°C over 25°C .

●Recommended operating conditions (Ta=25℃)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions
Output current		I_{OUT}	—	—	350	mA	Fig.8, 9
Power supply voltage	Other than BA12002	V_{CE}	—	—	55	V	—
	BA12002		—	—	50		—
Input voltage (excluding BA12001B)		V_{IN}	—	—	30	V	—
Input current (BA12001B only)		I_{IN}	—	—	25	mA / unit	—

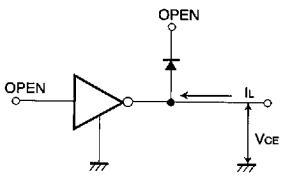
●Electrical characteristics (unless otherwise noted, Ta=25℃)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Output leakage current		I_L	—	0	10	μA	V_{CE}=50V	Fig.4
DC current gain		h_{FE}	1000	2400	—	V	V_{CE}=2V, I_{OUT}=350mA	Fig.4
Output saturation voltage		$V_{CE(sat)}$	—	0.94	1.1	V	I_{OUT}=100mA, I_{IN}=250μA	Fig.4
				1.14	1.3		I_{OUT}=200mA, I_{IN}=350μA	Fig.4
				1.46	1.6		I_{OUT}=350mA, I_{IN}=500μA	Fig.4
Input voltage	BA12002	V_{IN}	—	10.2	11	V	V_{CE}=2V, I_{OUT}=100mA	Fig.4
	BA12003B/BF			1.75	2			
	BA12004B			2.53	5			
	BA12002	V_{IN}	—	10.4	12	V	V_{CE}=2V, I_{OUT}=200mA	Fig.4
	BA12003B/BF			1.91	2.4			
	BA12004B			2.75	6			
	BA12002	V_{IN}	—	10.7	13.5	V	V_{CE}=2V, I_{OUT}=350mA	Fig.4
	BA12003B/BF			2.17	3.4			
	BA12004B			3.27	8			
Input current	BA12002	I_{IN}	—	0.88	1.3	mA	V_{IN}=17V	Fig.4
	BA12003B/BF			0.90	1.35		V_{IN}=3.85V	
	BA12004B			0.39	0.5		V_{IN}=5V	
Diode reverse current		I_R	—	0	50	μA	V_R=50V	Fig.4
Diode forward voltage		V_F	—	1.73	2	V	I_F=350mA	Fig.4
Input capacitance		C_{IN}	—	30	—	pF	V_{IN}=0V, f=1MHz	Fig.4

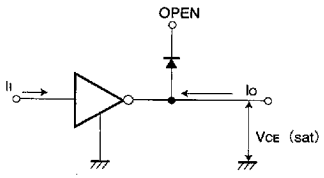
Note: Input voltage and input current for BA12001 vary based on external resistor.

●Measurement circuits

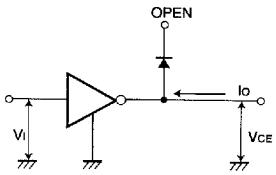
(1) Output leakage current I_L



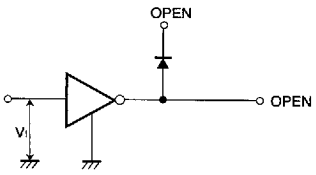
(2) DC current gain $h_{FE} = \frac{I_O}{I_I}$
Output saturation voltage $V_{CE}(sat)$



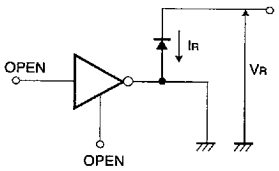
(3) Input voltage V_{IN}



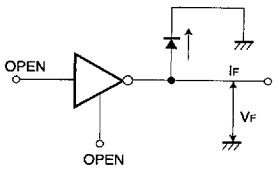
(4) Input current I_{IN}



(5) Diode reverse current I_R



(6) Diode forward voltage I_F



(7) Input capacitance C_{IN}

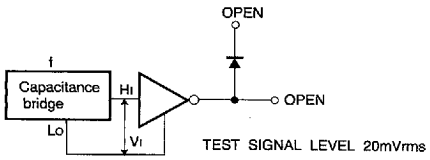
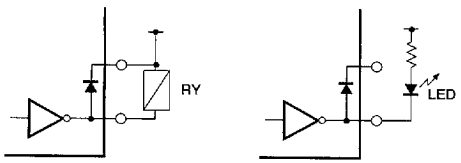


Fig. 4

●Application example



(1) Relay driver (2) LED driver

Fig. 5

●Reference items when using in application

The BA12001B is a transistor array which can be directly coupled to a general logic circuit such as PMOS, CMOS, or TTL.

Because the base current is limited to 25mA, a current limiting resistor needs to be connected in series with the input.

The BA12002 is designed for direct coupling with a 14 to 25V system PMOS. In order to limit the input current, a level shift diode (7V) and resistor are connected in series to each of the inputs.

The BA12003B / BF can be coupled directly to TTL or CMOS output (when operating at 5V). In order to limit the input current to a stable value, resistors are connected in series to each of the inputs.

The BA12004B is designed for direct coupling to CMOS or PMOS output using a 6 to 15V power supply voltage. In order to limit the input current to a stable value, resistors are connected in series to each of the inputs.

The load for each of these products should be connected between the driver output and the power supply. To protect the IC from excessive swing voltage, the COM pin (Pin 9) should be connected to the power supply.

●Electrical characteristic curves

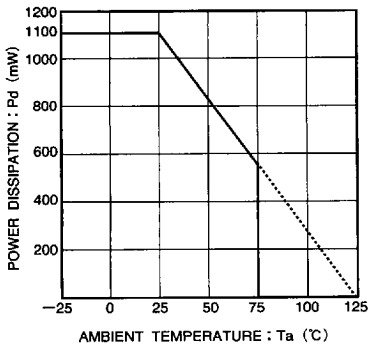


Fig. 6 Power dissipation - ambient temperature characteristic

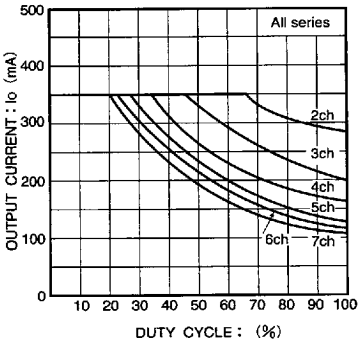


Fig. 7 Output conditions (1)

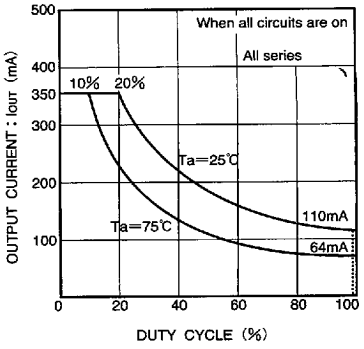


Fig. 8 Output conditions (2)

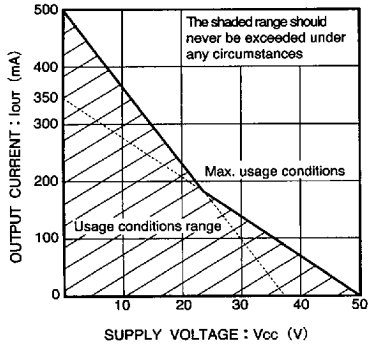


Fig. 9 Usage conditions range per circuit

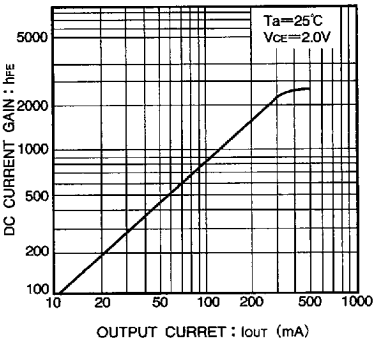


Fig. 10 DC current gain-output current characteristic

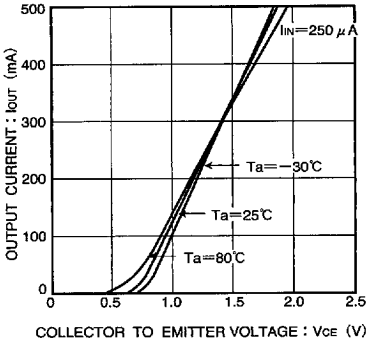


Fig. 11 Output current - voltage characteristic between collector and emitter

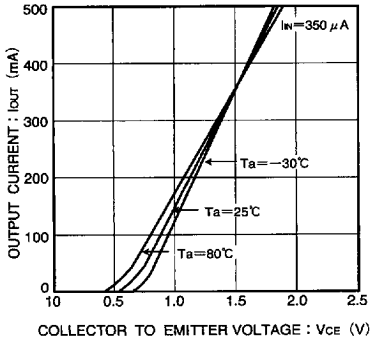


Fig. 12 Output current - voltage characteristic between collector and emitter

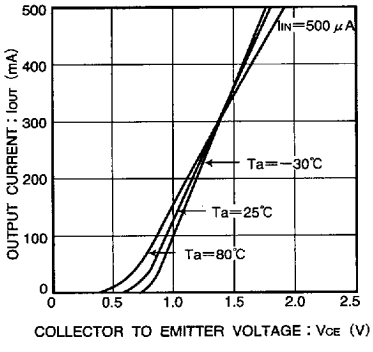


Fig. 13 Output current - voltage characteristic between collector and emitter

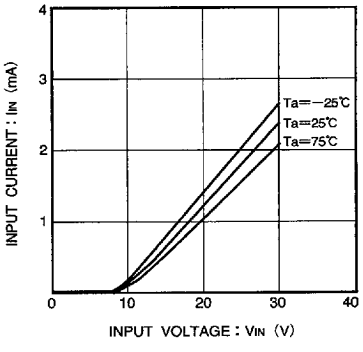


Figure 14 Input current - input voltage characteristic (BA12002)

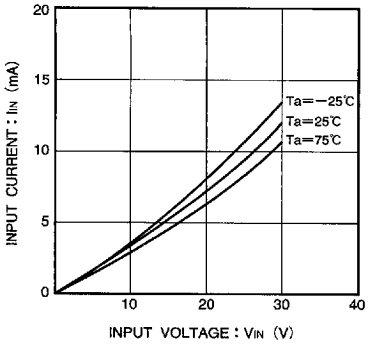


Fig. 15 Input current - input voltage characteristic (BA12003B/BF)

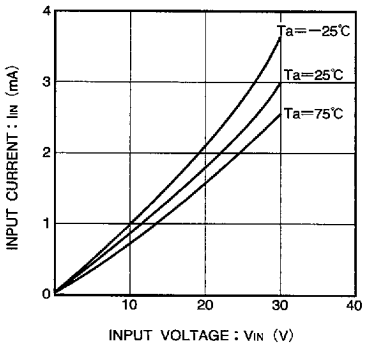


Fig. 16 Input current - input voltage characteristic (BA12004B)

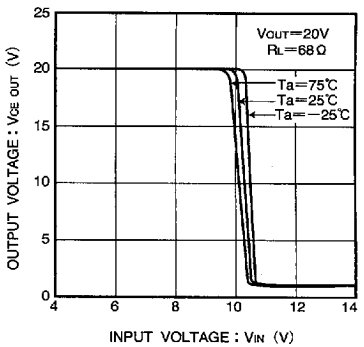


Fig.17 Output current - input voltage characteristics (BA12002)

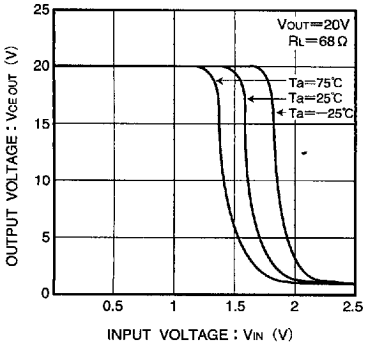


Fig. 18 Output voltage - input voltage characteristic (BA12003B/BF)

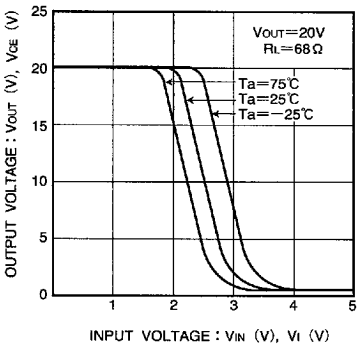
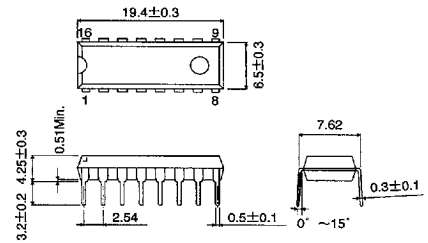


Fig. 19 Output voltage - input voltage characteristic (BA12004B)

●External dimensions (Units: mm)

BA12001B/BA12002/BA12003B/BA12004B



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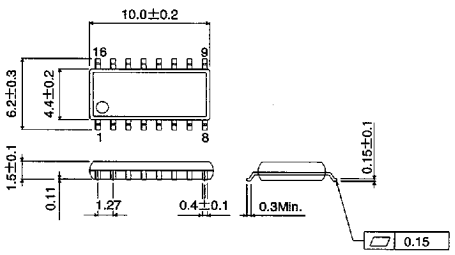
BA12003BF



SOP16