TOSHIBA

Horizontal-Deflection Output Transistors

PRODUCT GUIDE

1 Outline

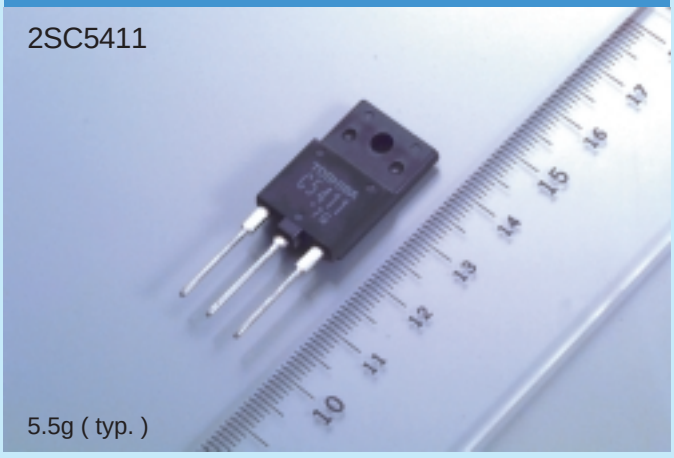
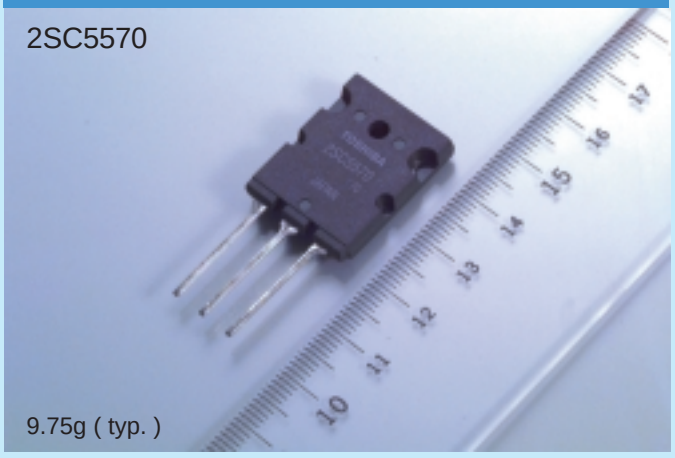
Toshiba has developed a range of fifth-generation horizontal-deflection-output transistors (HV-Trs). Radical redesign of the emitter electrode and the contact pattern has yielded significant improvements, resulting in higher current density and superior electrical characteristics compared to those of fourth-generation products. Toshiba's propriety glass-mesa structure results in a high breakdown voltage.

Thanks to Toshiba's wealth of experience and the wide variety of products which the company can offer, Toshiba horizontal-deflection-output transistors are used World-wide in color TVs and video display monitors.

2 Appearance, Package and Weight

The photographs below show the products and their markings. The packages shown are is the straight-lead packages used for standard products.

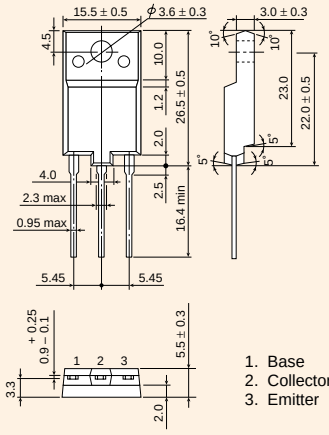
Appearance

TO-3P(H)IS	TO-3P(LH)
2SC5411  5.5g (typ.)	2SC5570  9.75g (typ.)

Package dimensions

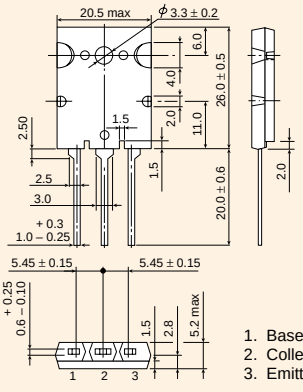
(Unit : mm)

TO-3P(H)IS



1. Base
2. Collector
3. Emitter

TO-3P(LH)



1. Base
2. Collector (heat sink)
3. Emitter

3 Device Trends

Market trends and the development of horizontal-deflection output transistors

Device Trends

Market requirements

TV Wide-screen TVs	HDTVs / Projectors Multimedia-compatible TVs Digital TVs	Video display monitors
• Wide-screen aspect ratio: (4 : 3) –> (16 : 9) • Large screen size • Flat screen • Low loss • Lower prices	• Improved in screen resolution quality Screen resolution: 525p,1125i,780p Progressive system is improved Starting grand wave digital broadcasting Various appllications such as DVDs and Cable TVs • Various screen size • Flat screen • Low loss	• High horizontal frequency 21 inches f_H = 120 kHz –> 135 kHz • Large screen size Standard size: 15 inches –> 17 inches • Low price Reduced part count (driving circuit and resonating capacitor are fixed) • Low loss • Flat screen

Development of Horizontal-Deflection Output Transistors

Emitter contact shape and chip size optimization

• Enhancement of 1700 V product line • Low price due to reduction in chip size	• Development of 2000-V products • Development of products incorporating diodes for use in digital TVs • Shorter t_{rr} • Reduced saturation voltage V_{CE}(sat) = 3 V (max) • High-current devices housed in TO-3P(H)IS packages 21-A products available • Reduced variation in product characteristics	• Reduced switching loss (t_f parts) due to high-frequency operation t_f = 150 ns (max) • Reduced saturation voltage at high currents V_{CE}(sat) = 3 V (max) • High-current devices housed in TO-3P(H)IS packages 21-A products available • Increased allowable power dissipation TO-3P(H) IS 65 W –> 75 W TO-3P(LH) 200 W –> 220 W • Reduced variation in product characteristics
Fourth generation of horizontal-deflection output transistors	**Fifth generation of horizontal-deflection output transistors**	

4 Features of Fourth and Fifth Generation

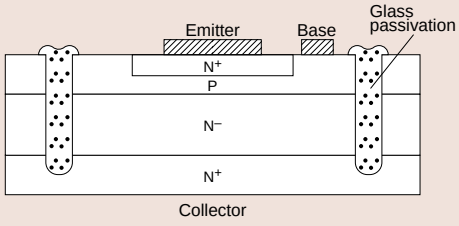
1 High breakdown capability

The product features a glass mesa structure, the use of which yields a wide forward- and reverse-biased safe operating area.

2 Low saturation voltage

V_{CE}(sat) = 3 V (max)
Note: Used for 2SC-Series devices without damper diodes.

Toshiba's proprietary "glass mesa" structure



3 Wider range of optimum drive conditions

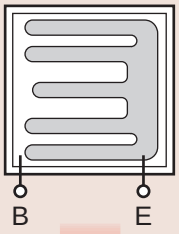
Fluctuation in optimum drive conditions due to variation in device quality has been minimized for ease of design.

3 Revised emitter contact shape and optimized chip size

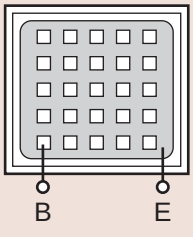
Chip design has been optimized using Toshiba simulation technology. The emitter's contact area has been widened by changing the contact shape below the emitter electrode from comb type to the new mesh type. As a result, the saturation voltage (V_{CE}(sat)) and fall time (tf) have both been reduced, thus reducing switching loss.

Contact shape

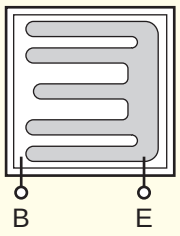
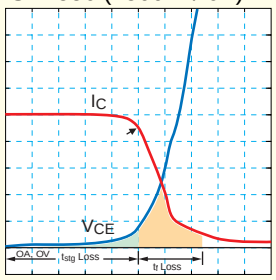
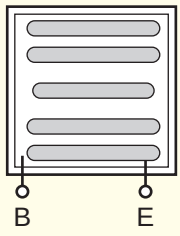
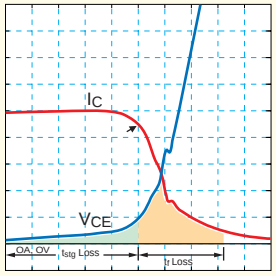
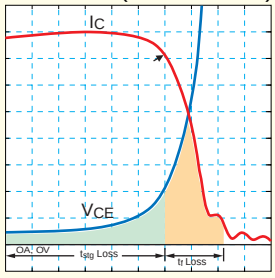
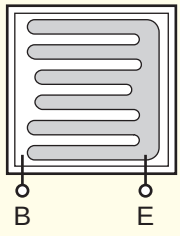
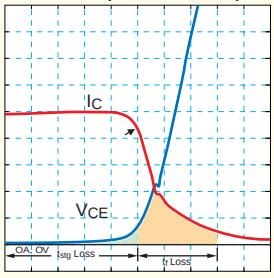
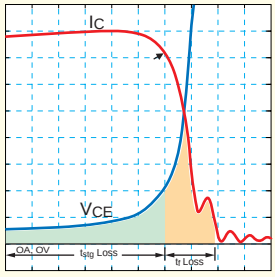
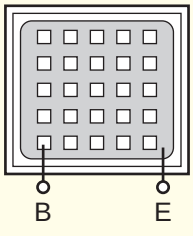
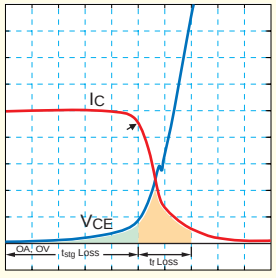
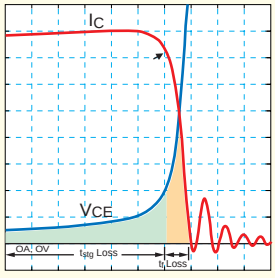
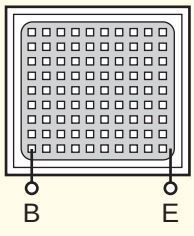
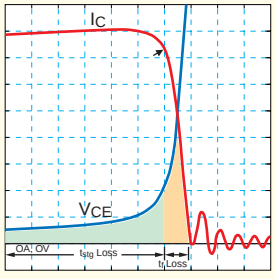
Conventional comb type



Fourth and fifth-generation mesh type



5 Comparison of Product Characteristic Curve, Features and Emitter-Contact Design

Generation •Main application • Features	Design Emitter contact shape @f_H, I_{CP}, $I_{B1(end)}$, V_{CP} (t, I_C, V_{CE}) / div	Typical Products and Waveforms TVs @15.75kHz, 5A, 1A, 1200V (200ns, 1A, 10v) / div	Video displays @100kHz, 8A, 1A, 1200V (50ns, 1A, 10v) / div
First Generation •TVs • High-voltage →1500 V • Improved R-SOA • Improved switching speeds fH(max) = 32 kHz • Development of TO-3P(H)IS Package	Comb type I 	2SD1556 (1500 V / 6A) 	
Second Generation •TVs • High-current devices products •Video displays • Improved switching speeds fH(max) = 64 kHz • Development of TO-3P(LH) Package	STRIPE type 	2SD2253 (1700 V / 6A) 	2SC4290A (1500 V / 20A) 
Third Generation •TVs • Improvements over first-generation products •Video displays • Improvements over second-generation products • Improved switching speeds fH(max) = 80 kHz	Comb type II 	2SD2553 (1700 V / 8A) 	2SC5142 (1500 V / 20A) 
Fourth Generation •TVs • Improvements over first- and third-generation products •Digital TVs • Development of new 2000-V products •Video displays • Improvements over third-generation products • Improved switching speeds fH(max) = 130 kHz	Mesh type I or Crystal-mesh type 	2SD2638 (1700 V / 7A) 	2SC5445 (1500 V / 20A) 
Fifth Generation •Digital TVs • Enhanced 2000-V product line • Improved speeds for products incorporating damper diodes •Video displays • Improvements over fourth-generation products • Reduced loss • Improvement in drivability	Mesh type II 		2SC5695 (1500 V / 22A) 

6 New Products

1 For video displays

Product No.	Maximum Ratings V_{CBO} (V)	I_C (A)	P_C (W)	Target Use	Remarks	Note
2SC5570	1700	28	220	21-inch, 130 kHz	Device with highest I_C (max) ratings	
2SC5587	1500	17	75	19-inch, 110 kHz	High-current version of 2SC5411	
2SC5588	1700	15	75	19-inch, 90 kHz	1700-V version of 2SC5411	
2SC5589	1500	18	200	19-inch, 120 kHz	2SC5587 and 2SC5589 use same chip.	
2SC5590	1700	16	200	19-inch, 100 kHz	2SC5588 and 2SC5590 use same chip.	
2SC5695	1500	22	200	21-inch, 130 kHz	Equivalent to 2SC5445	
2SC5717	1500	21	75	19-inch, 120 kHz	2SC5717 and 2SC5695 use same chip.	
***(S3D20)**	1500	14	55	19-inch, 92 kHz	Equivalent to 2SC5411	★
***(S3D21)**	1700	28	210	21-inch, 130 kHz	Equivalent to 2SC5570	★

★: Production schedules are provisional.

2 For color TVs

Product No.	Maximum Ratings V_{CBO} (V)	I_C (A)	P_C (W)	Target Use	Remarks	Note
2SD2638	1700	7	50	28-inch, 15.75 kHz	Equivalent to 2SD2553	

3 For digital TVs

Product No.	Maximum Ratings V_{CBO} (V)	I_C (A)	P_C (W)	Target Use	Remarks	Note
2SC5570	1700	28	220	32-inch, 32 kHz~	Device with highest I_C (max) ratings	
2SC5588	1700	15	50	24-inch, 32 kHz	1700-V version of 2SC5411	
2SC5590	1700	16	50	28-inch, 32 kHz~	2SC5588 and 2SC5590 use same chip.	
2SC5612	2000	22	220	32-inch, 32 kHz	V_{CBO} = 2000 V series	
2SC5716	1700	8	55	32-inch, 32 kHz	Built-in damper diode (High-current version of 2SC5143)	
***(2SC5748)**	2000	16	210	32-inch, 32 kHz	V_{CBO} = 2000 V series	★
***(2SC5749)**	2000	16	210	32-inch, 32 kHz	V_{CBO} = 2000 V series (built-in damper diode)	★
***(S3D21)**	1700	28	210	32-inch, 32 kHz~	Equivalent to 2SC5570	★

★: Production schedules are provisional.

7 Product Line Matrix

	V_{CBO} = 1500 V			V_{CBO} = 1700 V			V_{CBO} = 2000 V	
Package	TO-3P(H)IS		TO-3P(LH)	TO-3P(H)IS		TO-3P(LH)	TO-3P(LH)	
P_C	40 W to 75 W		180 W to 220 W	40 W to 75 W		180 W to 220 W	180 W to 220 W	
**I_C (sat)	Built-in damper diode	No built-in damper diode	No built-in damper diode	Built-in damper diode	No built-in damper diode	No built-in damper diode	Built-in damper diode	No built-in damper diode
3 A	**2SD2599**			2SD2550				
3.5 A	**2SD2586**							
4 A	2SD2499	2SD2498		2SD2551				
4.5 A	S2055N	S2000N						
5 A	2SD2539 **2SC5339**							
5.5 A				**2SD2638**				
6 A	**2SC5280** **2SD2559**	2SD2500 **2SC5386**		2SD2553 **2SC5716**				
7 A		**2SC5404**						
8 A		**2SC5387**						
11 A		**2SC5411** ***(S3D20)**	**2SC5421**			**2SC5422**		
12 A					**2SC5588**	**2SC5590**	***(2SC5749)**	***(2SC5748)**
14 A		**2SC5587**	**2SC5589**			**2SC5446**		
15 A			**2SC5445**					
17 A		***2SC5717***	***2SC5695***					**2SC5612**
22 A						**2SC5570** ***(S3D21)**		

Notes: **: I_C(sat) is value of I_C for V_{CE} (sat).
: 3rd generation (old design)
: 4th generation (new design)
: 5th generation (new design)
*( ) : 5th generation (new design under development)

8 Characteristics List

1 2SC Series

Product No.	Maximum Ratings			Built-in damper diode	h_{FE}			$V_{CE(sat)}$ Max			Switching Time (Max)				Gene-ration
	V_{CBO} (V)	I_C (A)	P_C (W)		Min (–)	Max (–)	@5V/I_C (A)	(V)	@ I_C (A)	@ I_B (A)	t_{stg} (µs)	t_f (µs)	@ f_H (kHz)	@ I_{cp} (A)	
2SC5280	1500	8	50	✓	4.0	8.5	6	5	6	1.5	6.0	0.50	32	6.0	**4th**
2SC5339	1500	7	50	✓	4.0	8.0	5	5	5	1.25	6.0	0.50	32	5.0	**4th**
2SC5386	1500	8	50		4.3	7.5	6	3	6	1.5	3.5	0.30	64	5.0	**4th**
2SC5387	1500	10	50		4.3	7.8	8	3	8	2	3.5	0.30	64	6.0	**4th**
2SC5404	1500	9	50		4.0	8.0	7	3	7	1.75	3.5	0.30	64	5.5	**4th**
2SC5411	1500	14	60		4.0	8.0	11	3	11	2.75	3.5	0.30	64	8.5	**4th**
2SC5421	1500	15	180		4.0	8.0	11	3	11	2.75	3.5	0.30	64	8.5	**4th**
2SC5422	1700	15	200		4.5	8.5	11	3	11	2.75	3.5	0.30	64	8.0	**4th**
2SC5445	1500	20	200		4.5	8.5	15	3	15	3.75	2.2	0.15	100	8.0	**4th**
2SC5446	1700	18	200		4.0	8.0	14	3	14	3.5	2.3	0.15	100	7.0	**4th**
2SC5570	1700	28	200		4.5	7.5	22	3	22	5.5	1.6	0.15	130	8.0	**4th**
2SC5587	1500	17	75		5.0	8.0	14	3	14	3.5	2.0	0.15	100	7.5	**4th**
2SC5588	1700	15	75		4.8	8.0	12	3	12	3	2.0	0.15	100	6.5	**4th**
2SC5589	1500	18	200		5.0	8.0	14	3	14	3.5	2.0	0.15	100	7.5	**4th**
2SC5590	1700	16	200		4.8	8.0	12	3	12	3	2.0	0.15	100	6.5	**4th**
2SC5612	2000	22	220		4.8	9.0	17	3	17	4.25	5.0	0.35	32	8.0	**4th**
2SC5695	1500	22	200		4.5	8.5	17	3	17	3.75	2.1	0.15	100	8.0	***5th***
2SC5716	1700	8	55	✓	3.8	9.0	6	5	6	1.5	5.0	0.35	32	5.5	**4th**
2SC5717	1500	21	75		4.5	8.5	17	3	17	3.75	2.1	0.15	100	8.0	***5th***
***(2SC5748)**	2000	16	210		4.8	7.5	12	3	12	3	5.0	0.35	32	8.0	***5th***
***(2SC5749)**	2000	16	210	✓	4.8	9.0	12	3	12	3	5.0	0.35	32	8.0	***5th***
***(S3D20)**	1500	14	55		4.0	8.0	11	3	11	2.75	3.5	0.30	90	6.5	***5th***
***(S3D21)**	1700	28	210		4.5	7.5	22	3	22	5.5	1.6	0.15	130	8.0	***5th***

2 2SD Series

Product No.	Maximum Ratings			Built-in damper diode	h_{FE}			$V_{CE(sat)}$ Max			Switching Time (Max)				Gene-ration
	V_{CBO} (V)	I_C (A)	P_C (W)		Min (–)	Max (–)	@5V/I_C (A)	(V)	@ I_C (A)	@ I_B (A)	t_{stg} (µs)	t_f (µs)	@ f_H (kHz)	@ I_{cp} (A)	
2SD2498	1500	6	50		5	9	4	5	4	0.8	10	0.7	15.75	4	3rd
2SD2499	1500	6	50	✓	5	9	4	5	4	0.8	11	0.6	15.75	4	3rd
2SD2500	1500	10	50		4	8	6	3	6	1.5	11	0.7	15.75	6	3rd
2SD2539	1500	7	50	✓	5	9	5	5	5	1	9	0.6	15.75	5	3rd
2SD2550	1700	4	50	✓	8	22	1	8	3	0.8	10	0.6	15.75	3	3rd
2SD2551	1700	5	50	✓	5	10	4	5	4	0.8	10	1.0	15.75	4	3rd
2SD2553	1700	8	50	✓	5	9	6	5	6	1.2	12	0.7	15.75	6	3rd
2SD2559	1500	8	50	✓	5	9	6	5	6	1.2	12	1.0	15.75	6	**4th**
2SD2586	1500	5	50	✓	4.4	8.5	3.5	5	3.5	0.8	10	0.6	15.75	3.5	**4th**
2SD2599	1500	3.5	40	✓	8	25	0.5	8	3	0.8	10	1.0	15.75	3	**4th**
2SD2638	1700	7	50	✓	4.5	7.5	5.5	5	5.5	1.2	9	0.8	15.75	5.5	**4th**

3 S2000 / S2055 Series

Product No.	Maximum Ratings			Built-in damper diode	h_{FE}			$V_{CE(sat)}$ Max			Switching Time (Max)				Gene-ration
	V_{CBO} (V)	I_C (A)	P_C (W)		Min (–)	Max (–)	@5V/I_C (A)	(V)	@ I_C (A)	@ I_B (A)	t_{stg} (µs)	t_f (µs)	@ f_H (kHz)	@ I_{cp} (A)	
S2000N	1500	8	50		4.5	9	4.5	5	4.5	1	12	0.7	15.75	4.5	3rd
S2055N	1500	8	50	✓	4.5	9	4.5	5	4.5	1	11	0.6	15.75	4.5	3rd

: 3rd generation (old design)
: 4th generation (new design)
: 5th generation (new design)
*( ) : 5th generation (new design under development)

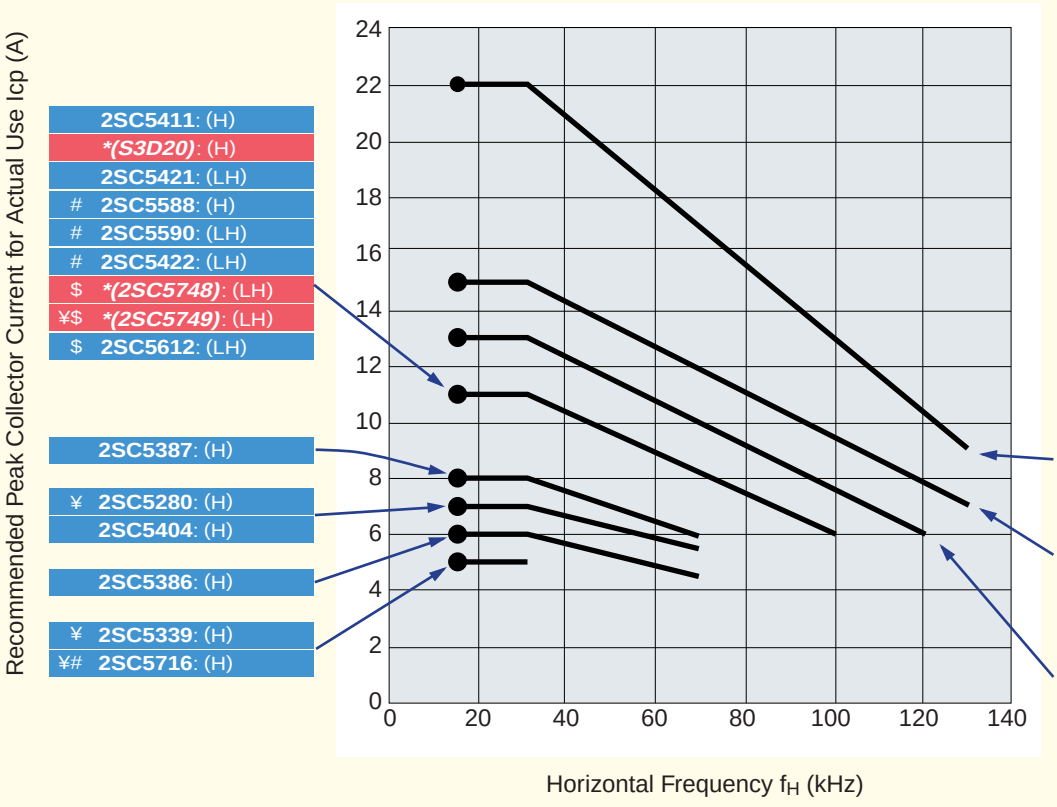
9 Application Map

(Reference only)

Generations

Example
- 2SDXXXX : 3rd Gen. (old design)
- 2SCXXXX : 4th Gen. (new design)
- *2SCXXXX* : 5th Gen. (new design)
- **(2SCXXXX)* : under development

1 2SC Series



Note

DAMPER

¥ : Built-in damper
f_H (max) = 32kHz
@without additional
Damper diode

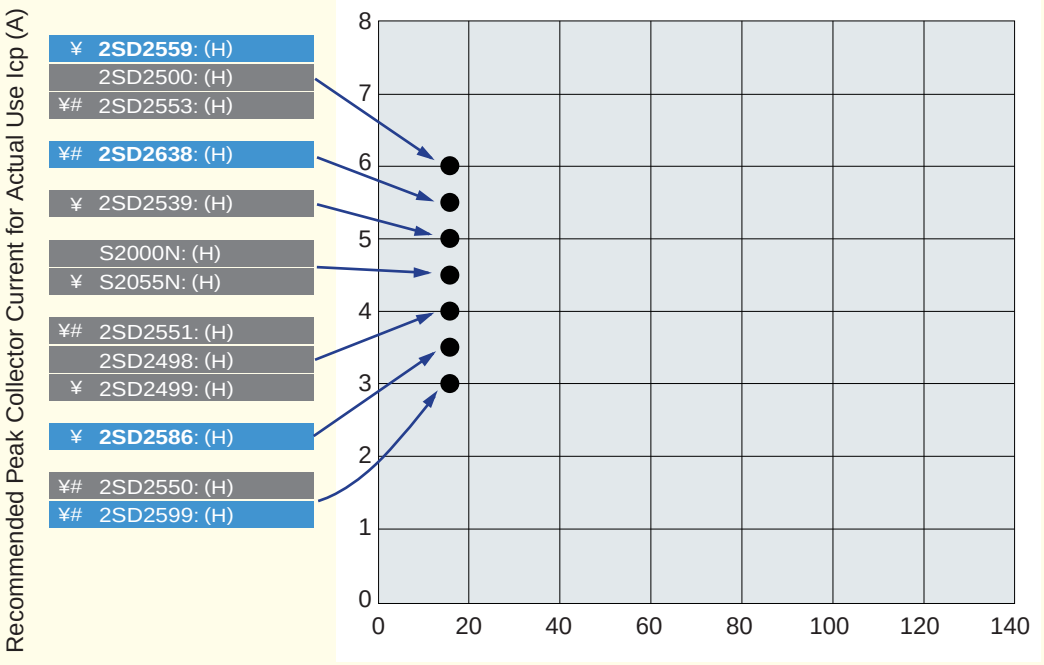
V_{CBO}

: V_{CBO} = 1700V
$: V_{CBO} = 2000V
(Another 1500V)

PACKAGE

(H) : TO-3P(H)IS
(Full mold type)
(LH) : TO-3P(LH)

2 2SD / S2000 / S2055 Series



Note

DAMPER

¥ : Built-in damper
f_H (max) = 32kHz
@without additional
Damper diode

V_{CBO}

: V_{CBO} = 1700V
$: V_{CBO} = 2000V
(Another 1500V)

PACKAGE

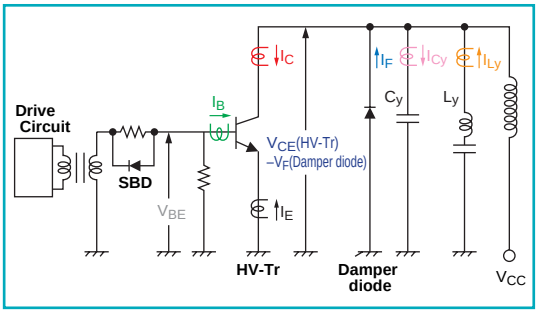
(H) : TO-3P(H)IS
(Full mold type)
(LH) : TO-3P(LH)

10 Basic Circuit Structure and Operating Waveform of Horizontal-Deflection Output

Measurement conditions

f_H = 69 kHz (duty 50%)
I_{CP} = 5 A
V_{CP} = 1200 V

Basic circuit structure

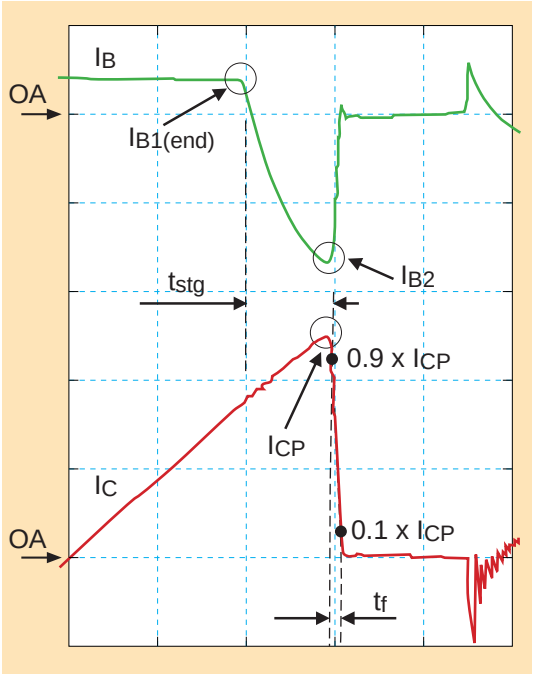


Measurement range

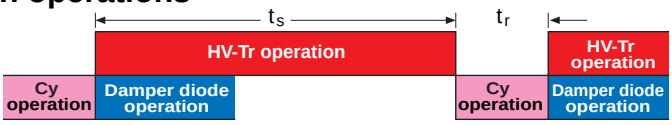
X-axis	
t (time)	2µs / div

Y-axis	
V_{BE} (Base-emitter voltage)	5V / div
I_B (Base current)	2A / div
I_C (Collector current)	2A / div
$-I_E$ (Reverse emitter current)	2A / div
I_F (Forward current)	2A / div
V_{CE} (Collector-emitter voltage)	200V / div
I_{LY} (Deflection coil current)	2A / div
I_{CY} (Resonance capacitor current)	2A / div

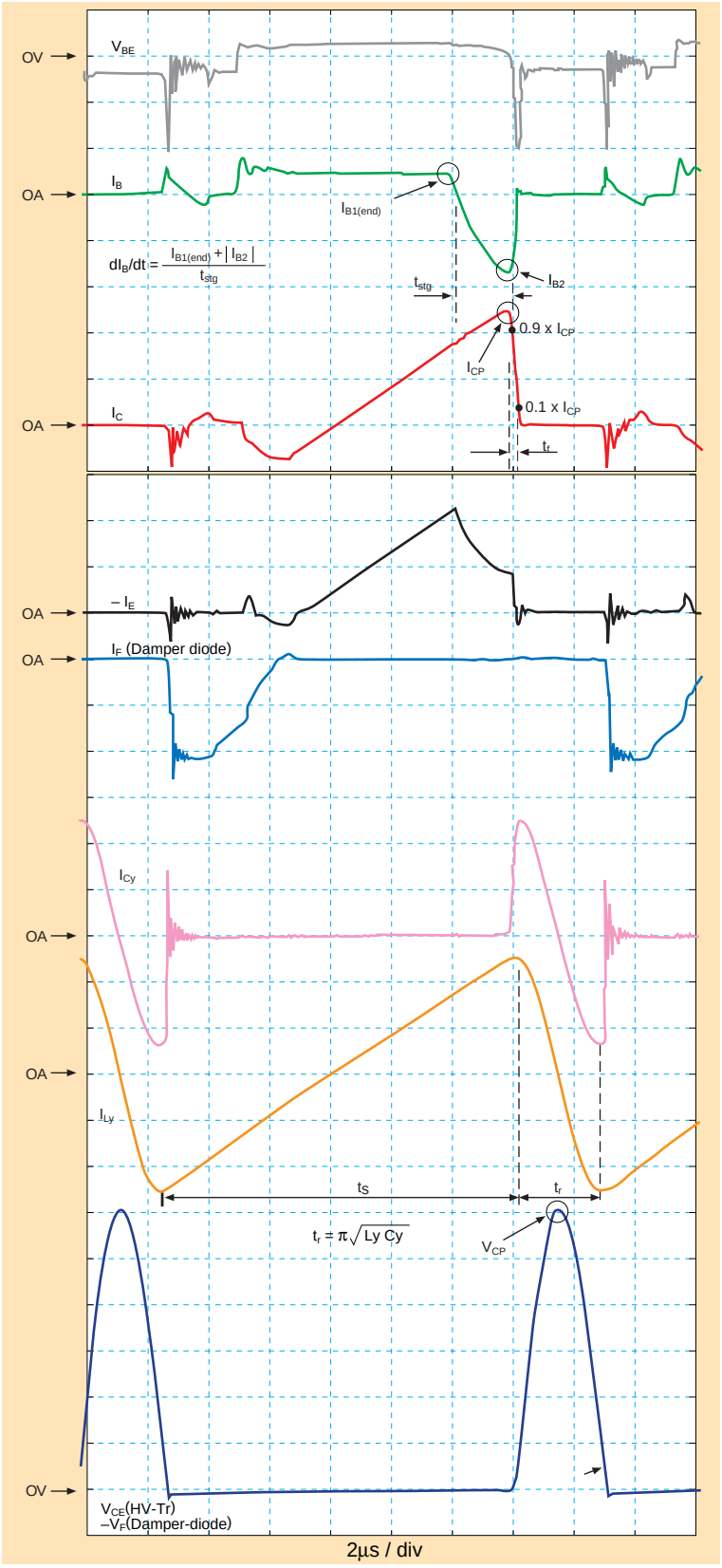
Enlarged wave forms of IB and IC



Main operations



Operating waveform example



11 Switching Data of 2SC5695 (Reference only)

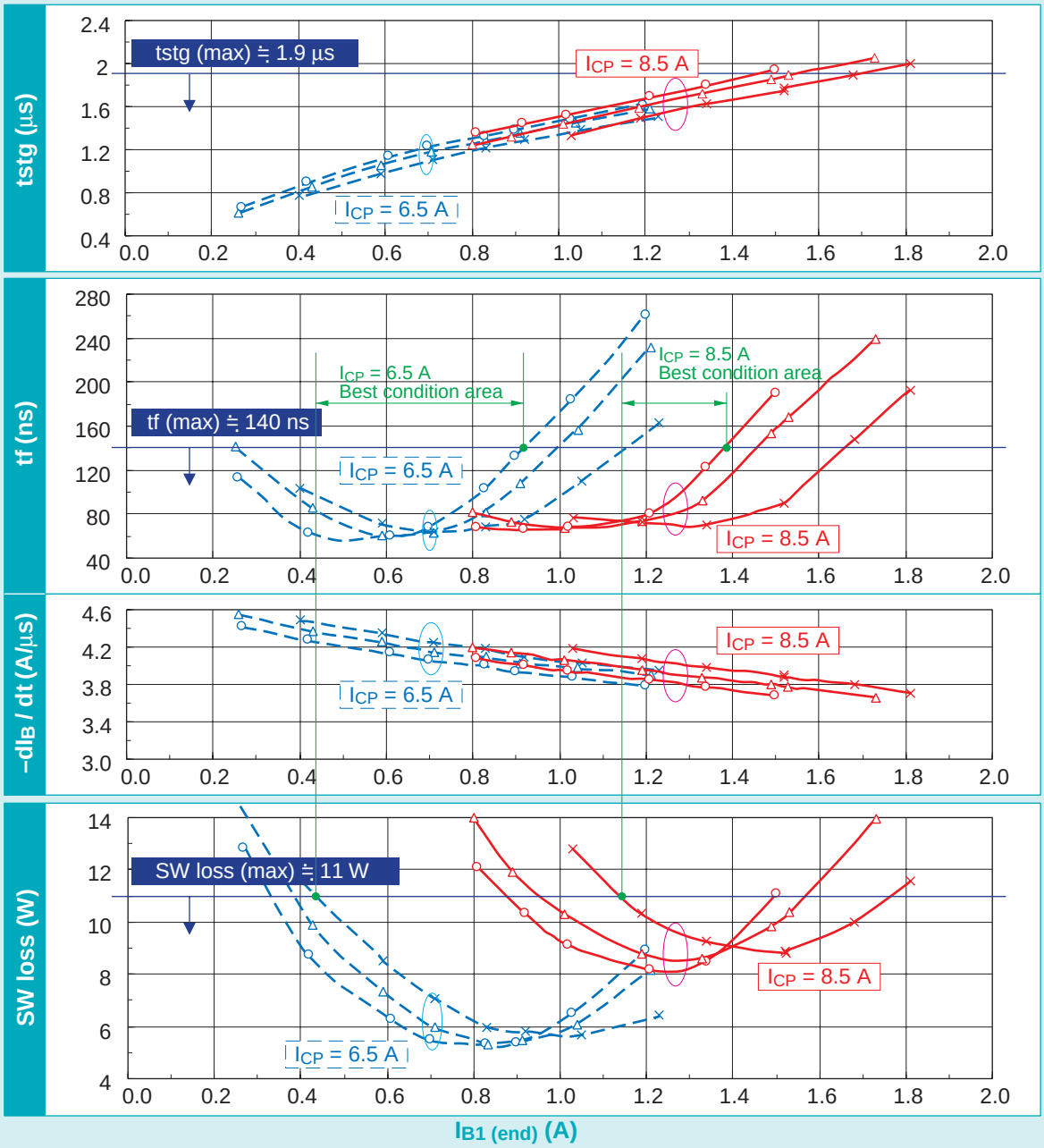
1 Test condition

@ T_C ≒ 25˚C
f_H = 105 kHz (duty 50%, continuous opration)
I_{CP} = 6.5 A → V_{CP} ≒ 953V ($V_{CC}2$ ≒ 107 V)
I_{CP} = 8.5 A → V_{CP} ≒ 1220V ($V_{CC}2$ ≒ 140 V)
$-dI_B / dt$ ≒ 4.0A/μs ($V_{CC}1$ = 24V)
Ly = 63 μH, Cy = 4000 pF

2 Test sample

Mark		Test Sample	h_{FE} (1) @5V / 2A	h_{FE} (2) @5V / 10A	h_{FE} (3) @5V / 17A	V_{CE} (sat) @17A / 4.25A
I_{CP} = 6.5 A	I_{CP} = 8.5 A	Standerd spec.	20 (min) 50 (max)	8 (min) 17 (max)	4.8 (min) 8.3 (max)	3V (max)
○	○	tail side	50.5	15.6	8.2	0.4V
△	△	Typ	33.8	12.1	6.6	0.6V
×	×	storage side	24.1	8.2	4.6	2.9V

3 tstg, tf, $-dI_B / dt$, SW loss –– $I_{B1\ (end)}$



11 Switching Data of 2SC5695

4 Recomended values (rough calculation)

tstg (max) tstg (max) = (1/fH) x 0.2 → tstg (max) ≒ 1.9µs

tf (max) tf (max) = (1/fH) x 0.01 + 50ns → tf (max) ≒ 140 ns

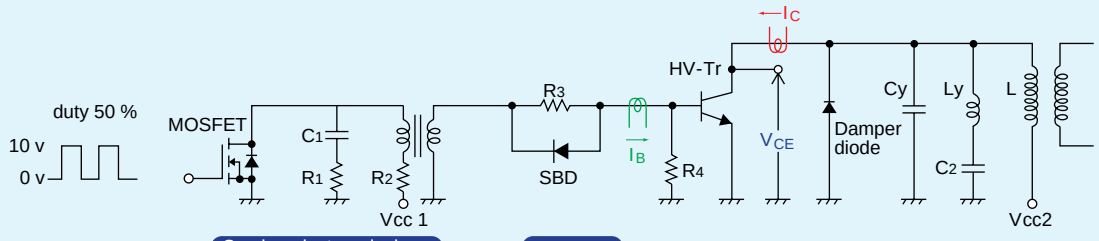
Switching loss capacitance (max)

'@Ta (max) = 40˚C, Tj (max) = 110˚C Recommended
ΔTj (max) = 110˚C – 40˚C
→ ΔTj (max) = 70˚C Recommended

thermal resistance
junction to case: Rth (j-c) = 0.625˚C/W (2SC5695)
case to fin (heat-sink): Rth (c-f) = 1˚C/W (supposition)
+) fin (heat-sink) to air: Rth (f-a) = 3.5˚C/W (supposition)
TOTAL (junction on ari): Rth (f-a) = 5.125˚C/W
SW Loss Capasitance (max) = ΔTj (max)/Rth (j-a) x 80% derating
= 70/5.125 x 0.8
= 10.9

SW loss Capasitance (max) ≒ 11 W

12 Application Circuit Example of 2SC5695

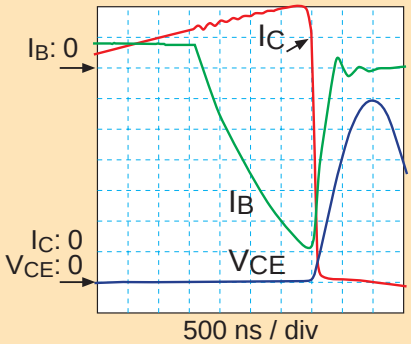
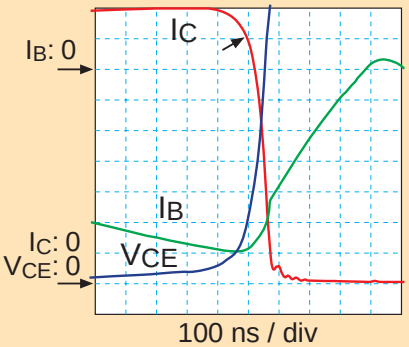
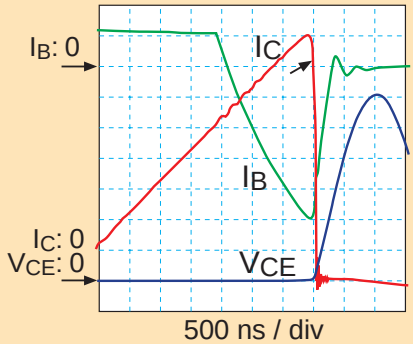
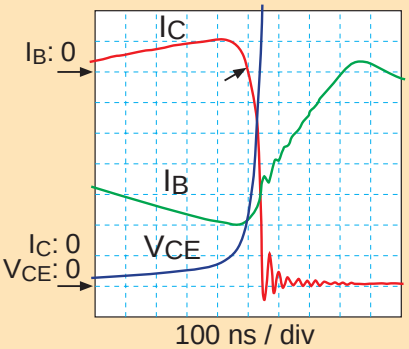


Semiconductors devices
MOSFET : 2SK2146
SBD : 3GWJ42C
HV-Tr : 2SC5695
Damper diode : 5TUZ52

Others
Vcc1 ≒ 15 V
Vcc2 ≒ (47 V (@ 32 kHz) / 156 V (@ 100 kHz))
Cy = 4500 pF
Ly = 80µH

R1 = 200 Ω
R2 = 3 Ω
R3 = 1.85 Ω
R4 = 15 Ω
C1 = 200 pF
C2 = 3.3 µF
L = 10 mH

Operating waveform example (21-inch ultra-high-resolution monitor) f_H = 32 kHz to 100 kHz monitor

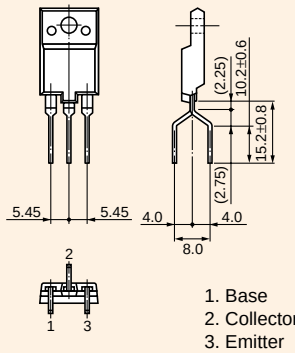
X-axis	500 ns / div	100 ns / div
Y-axis	I_B : 1 A / div V_{CE} : 200 V / div I_C : 1 A / div	I_B : 1 A / div V_{CE} : 10 V / div I_C : 1 A / div
@ f_H = 32 kHz I_{cp} = 9 A I_{B1} (end) ≒ 0.75 A dI_B / dt ≒ 3.5 A / µs		
@ f_H = 100 kHz I_{cp} = 8 A I_{B1} (end) ≒ 1. 1 A dI_B / dt ≒ 3.8 A / µs		

13 Lead-Forming

TO-3P(H)IS

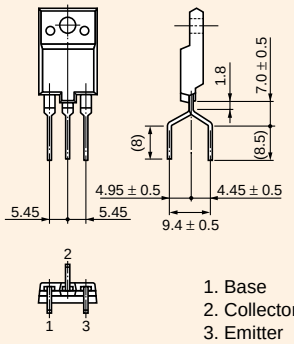
(Unit : mm)

2-16E302A



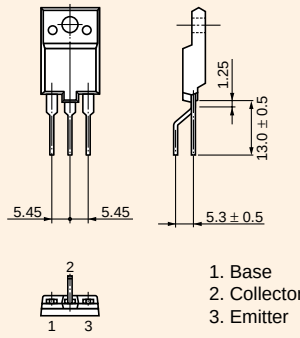
1. Base
2. Collector
3. Emitter

2-16E303A



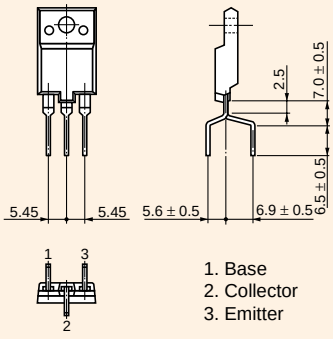
1. Base
2. Collector
3. Emitter

2-16E305A



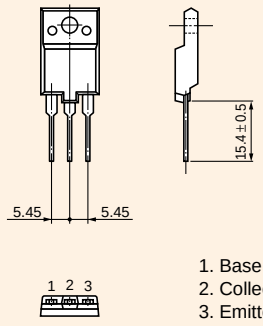
1. Base
2. Collector
3. Emitter

2-16E306A



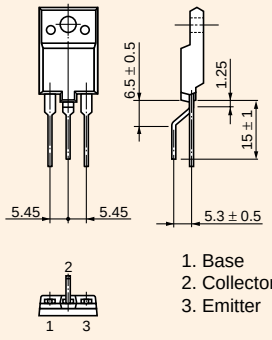
1. Base
2. Collector
3. Emitter

2-16E307A



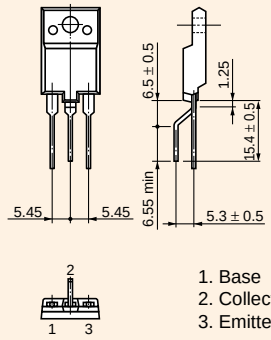
1. Base
2. Collector
3. Emitter

2-16E309A



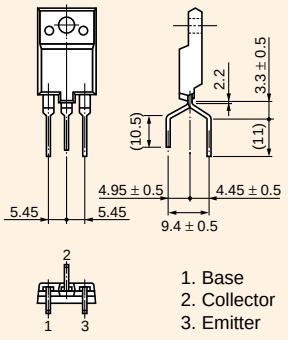
1. Base
2. Collector
3. Emitter

2-16E311A



1. Base
2. Collector
3. Emitter

2-16E313A

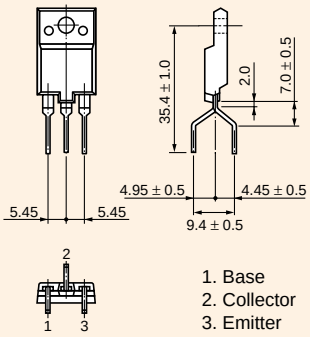


1. Base
2. Collector
3. Emitter

TO-3P(H)IS

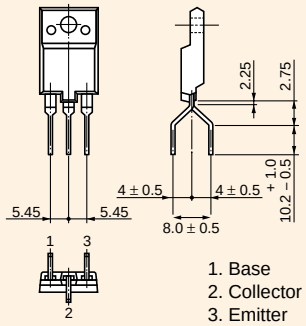
(Unit : mm)

2-16E314A



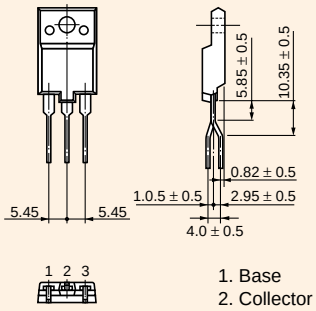
1. Base
2. Collector
3. Emitter

2-16E315A



1. Base
2. Collector
3. Emitter

2-16E316A

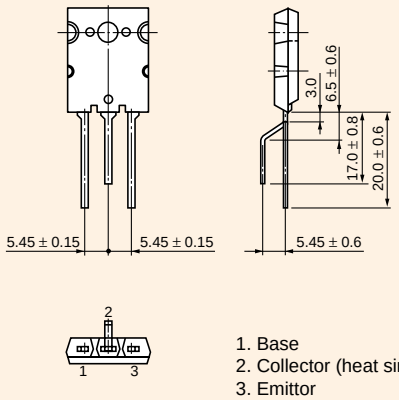


1. Base
2. Collector
3. Emitter

TO-3P(LH)

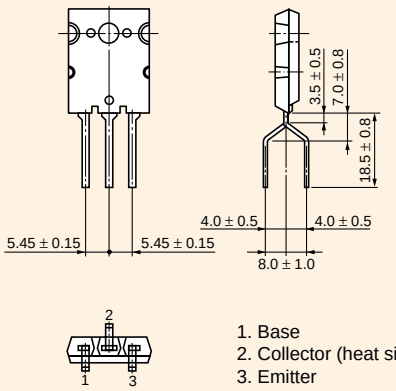
(Unit : mm)

2-21F208A



1. Base
2. Collector (heat sink)
3. Emittor

2-21F218A



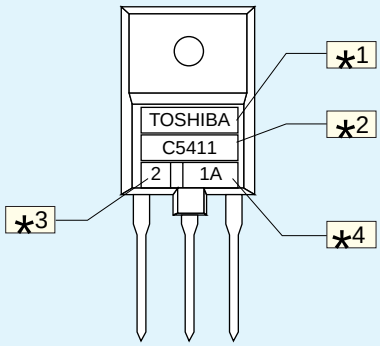
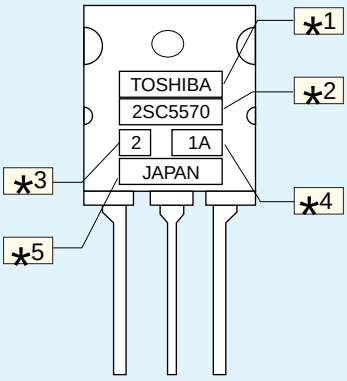
1. Base
2. Collector (heat sink)
3. Emitter

14 Markings

(As of April 2001)

Explanation of markings

Toshiba horizontal-deflection output transistors are manufactured in Japan (at the Himeji Semiconductor Works) and in Malaysia (at Toshiba Electronics Malaysia Sdn. Bhd.). Toshiba Electronics Malaysia Sdn. Bhd. only manufactures TO-3P(H)IS products.

Place of Manufacture	TOSHIBA ELECTRONICS MALAYSIA SDN. BHD (made in Malaysia)	Himeji Semiconductor Works (made in Japan)
Package type	**TO-3P(H)IS**	**TO-3P(LH)**
Marking Example		
Definition	*1: Manufacturer's marking: "T", " ", "TOSHIBA" *2: Product number or abbreviated product number *3: Code: "1", "2", "3", "A", "B", "C" *4: Lot number: month and year of manufacture Month of manufacture: January to December are denoted by the letters A to L respectively. Year of manufacture: last decimal digit of year of manufacture "1A", as shown on the above package, indicates manufacture in January 2001. *5: Country of origin Since TO-3P(LH) packages are only made in Japan, "JAPAN" is displayed.	

15 Package Label

(As of April 2001)

Sample label

P/N:

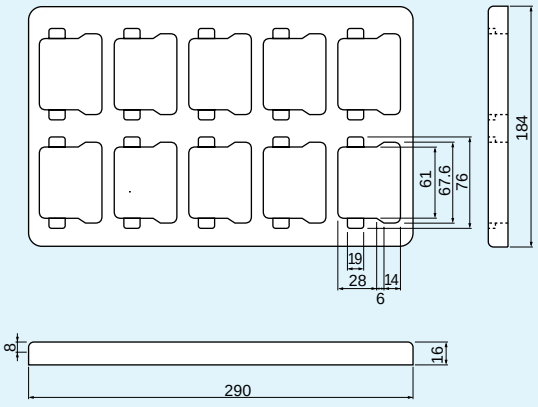
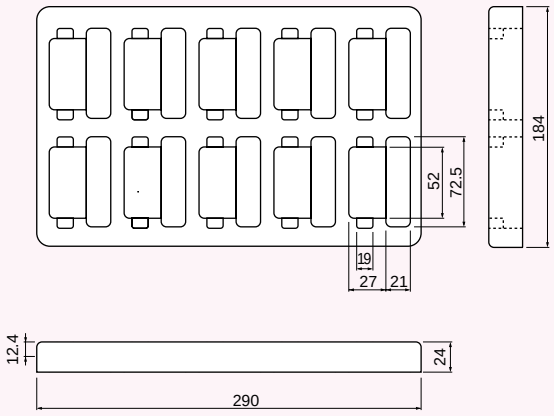
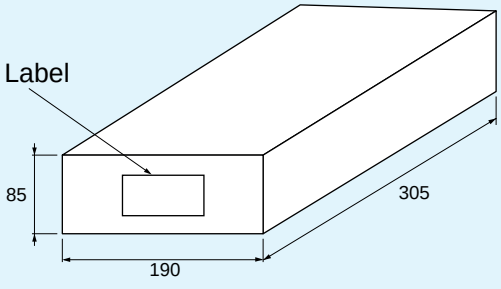
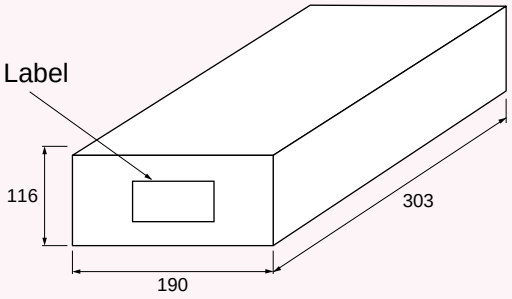
TYPE		
ADDC	Q'TY	PCS.
NOTE		

BARCORD

TOSHIBA MADE IN JAPAN

16 Package Specifications

(As of April 2001)

Package type	TO-3P(H)IS	TO-3P(LH)
Packing Type	100 per tray, 5 trays per carton	
Tray Dimensions (unit: mm)	Tolerance: ±0.7 Material: rigid vinyl chloride 	Tolerance: ±0.7 Material: rigid vinyl chloride 
Carton Dimensions (unit: mm)		

17 List of Superseded, Final-Phase and Discontinued Products

(As of April 2001)

1 2SC Series

Product No.	Super-seded Products	Final Phase Products	Discon-tinued Products	Maximum Ratings			Built-in damper diode	$V_{CE(sat)}$ (V)			Package Type				*Recommended Replacement and Remarks
				V_{CBO} (V)	I_C (A)	P_C (W)		Max	@ I_C (A)	@ I_B (A)	(H)IS	(BS)	(LH)	TO-3	
2SC3715			✓	1500	4	50		5	2.5	0.6	✓				2SD2599; ②
2SC3716			✓	1500	5	50		5	3	0.8	✓				2SD2599; ①
2SC3884A			✓	1500	6	50		5	4	1	✓				2SC5386; ②
2SC3885A			✓	1500	7	50		5	5	1.2	✓				2SC5386; ②
2SC3886A			✓	1500	8	50		5	6	1.5	✓				2SC5386; ②
2SC3887			✓	1400	6	80		5	4	1		✓			2SC5386; ② ⑤
2SC3887A			✓	1500	6	80		5	4	1		✓			2SC5386; ② ⑤
2SC3888			✓	1400	7	80		5	5	1.2		✓			2SC5386; ② ⑤
2SC3888A			✓	1500	7	80		5	5	1.2		✓			2SC5386; ② ⑤
2SC3889			✓	1400	8	80		5	6	1.5		✓			2SC5386; ⑤
2SC3889A			✓	1500	8	80		5	6	1.5		✓			2SC5386; ⑤
2SC3892			✓	1400	7	50	✓	5	5	1.2	✓				2SC5339; ①
2SC3892A			✓	1500	7	50	✓	5	5	1.2	✓				2SC5339; ①
2SC3893			✓	1400	8	50	✓	5	6	1.5	✓				2SC5280; ①
2SC3893A			✓	1500	8	50	✓	5	6	1.5	✓				2SC5280; ①
2SC4288			✓	1400	12	200		5	10	2.5			✓		2SC5421; ⑤
2SC4288A			✓	1500	12	200		5	10	2.5			✓		2SC5421; ⑤
2SC4289			✓	1400	16	200		5	12	3			✓		2SC5589; ②
2SC4289A			✓	1500	16	200		5	12	3			✓		2SC5589; ②
2SC4290			✓	1400	20	200		5	14	3.5			✓		2SC5589; ②
2SC4290A			✓	1500	20	200		5	14	3.5			✓		2SC5589; ②
2SC4531			✓	1500	10	50	✓	5	7	1.7	✓				2SC5280; ③
2SC4532			✓	1700	10	200		5	8	2			✓		2SC5422; ②
2SC4542			✓	1500	10	50		5	7	1.7	✓				2SC5404; ①
2SC4560			✓	1500	10	80		5	7	1.7		✓			2SC5404; ⑤
2SC4608			✓	1700	8	200		5	6	1.5			✓		2SC5422; ②
2SC4757			✓	1500	7	50		5	5	1.2	✓				2SC5386; ②
2SC4758			✓	1500	8	50		5	6	1.5	✓				2SC5386; ①
2SC4759			✓	1500	10	50		5	7	1.7	✓				2SC5404; ①
2SC4760		✓		2000	8	200		5	6	1.5			✓		2SC5612; ②
2SC4761			✓	1700	6	50		5	4.5	1.3	✓				2SC5588; ②
2SC4762			✓	1500	7	50	✓	5	5	1	✓				2SC5280; ①
2SC4763			✓	1500	8	50	✓	5	6	1.2	✓				2SC5280; ③
2SC4764			✓	1500	6	50	✓	5	4	0.8	✓				2SC5339; ②
2SC4765			✓	1700	5	50	✓	5	3.5	1	✓				2SC5716; ②
2SC4766			✓	1700	6	50	✓	5	4.5	1.3	✓				2SC5716; ②
2SC4806			✓	1700	5	50		5	3.5	1	✓				2SC5588; ②
2SC4830			✓	1500	6	50		5	4	1	✓				2SC5386; ②
2SC4916			✓	1500	7	50	✓	5	5	1	✓				2SC5280; ①
2SC5048	✓			1500	12	50		3	8	2	✓				2SC5387; ①
2SC5129	✓			1500	10	50		3	6	1.5	✓				2SC5386; ①
2SC5142		✓		1500	20	200		3	14	3.5			✓		2SC5589; ①
2SC5143	✓			1700	10	50	✓	3	6	1.5	✓				2SC5716; ③
2SC5144	✓			1700	20	200		3	11	2.75			✓		2SC5590; ①
2SC5148	✓			1500	12	50		3	8	2	✓				2SC5386; ②
2SC5149		✓		1500	8	50	✓	5	5	1.3	✓				2SC5339; ①
2SC5150	✓			1700	10	50		3	6	1.5	✓				2SC5588; ②
2SC5331	✓			1500	15	180		3	9	2.25			✓		2SC5421; ②
2SC5332		✓		1700	14	200		3	8	2			✓		2SC5422; ②

(*) ① Electrical characteristics and packages are same.
② Electrical characteristics have are high grade.
③ Electrical characteristics are low grade.
④ Package (allowable power disspation) are high grade.
⑤ Package (allowable power disspation) are low grade.
⑥ Damper diode is built-in or not.

Notes: : 1st generation
: 2nd generation (final-phase or discontinued products)
: 3rd generation (old design superseded products)
: 4th generation (new design)

2 2SD Series

Product No.	Super-seded Products	Final Phase Products	Discon-tinued Products	Maximum Ratings			Built-in damper diode	$V_{CE(sat)}$ (V)			Package Type				*Recommended Replacement and Remarks
				V_{CBO} (V)	I_C (A)	P_C (W)		Max	@ I_C (A)	@ I_B (A)	(H)IS	(BS)	(LH)	TO-3	
2SD811			✓	900	6	50		10	2.5	0.25				✓	2SC3657; ⑤
2SD818			✓	1500	2.5	50		8	2	0.6				✓	**2SD2599; ⑥**
2SD819			✓	1500	3.5	50		8	3	0.8				✓	**2SD2599; ⑥**
2SD820			✓	1500	5	50		5	4	0.8				✓	**2SC5386; ②**
2SD821			✓	1500	6	50		5	5	1				✓	**2SC5386; ②**
2SD822			✓	1500	7	50		5	6	1.2				✓	**2SC5386; ②**
2SD868			✓	1500	2.5	50	✓	8	2	0.6				✓	**2SD2599; ② ⑤**
2SD869			✓	1400	3.5	50	✓	8	3	0.8				✓	**2SD2599; ⑤**
2SD870			✓	1500	5	50	✓	5	4	0.8				✓	2SD2499; ①
2SD871			✓	1500	6	50	✓	5	5	1				✓	2SD2539; ①
2SD1279			✓	1400	10	50		5	8	2				✓	**2SC5404; ①**
2SD1425			✓	1500	2.5	80	✓	8	2	0.6		✓			**2SD2599; ② ⑤**
2SD1426			✓	1500	3.5	80	✓	8	3	0.8		✓			**2SD2599; ⑤**
2SD1427			✓	1500	5	80	✓	5	4	0.8		✓			2SD2499; ①
2SD1428			✓	1500	6	80	✓	5	5	1		✓			2SD2539; ⑤
2SD1429			✓	1500	2.5	80		8	2	0.6		✓			2SD2498; ⑤
2SD1430			✓	1500	3.5	80		8	3	0.8		✓			2SD2498; ⑤
2SD1431			✓	1500	5	80		5	4	0.8		✓			2SD2498; ⑤
2SD1432			✓	1500	6	80		5	5	1		✓			**2SC5386; ⑤**
2SD1433			✓	1500	7	80		5	6	1.2		✓			**2SC5404; ⑤**
2SD1543			✓	1500	2.5	40		8	2	0.6	✓				2SD2498; ②
2SD1544			✓	1500	3.5	40		8	3	0.8	✓				2SD2498; ②
2SD1545			✓	1500	5	50		5	4	0.8	✓				2SD2498; ①
2SD1546			✓	1500	6	50		5	5	1	✓				**2SC5386; ①**
2SD1547			✓	1500	7	50		5	6	1.2	✓				**2SC5404; ①**
2SD1548			✓	1500	8	50		5	8	2	✓				**2SC5404; ①**
2SD1553			✓	1500	2.5	40	✓	8	2	0.6	✓				**2SD2599; ②**
2SD1554			✓	1500	3.5	40	✓	8	3	0.8	✓				**2SD2599; ①**
2SD1555			✓	1500	5	50	✓	5	4	0.8	✓				2SD2499; ①
2SD1556			✓	1500	6	50	✓	5	5	1	✓				2SD2539; ①
2SD2089			✓	1500	3.5	40	✓	1	2.2	0.7	✓				**2SD2599; ①**
2SD2095			✓	1500	5	50	✓	5	3.5	0.8	✓				**2SD2586; ①**
2SD2125			✓	1500	6	50	✓	5	5	1	✓				2SD2539; ①
2SD2253			✓	1700	6	50	✓	5	5	1	✓				**2SD2638; ①**
2SD2348			✓	1500	8	50	✓	5	6	1.2	✓				**2SC5280; ③**
2SD2349			✓	1500	10	50	✓	5	7	1.4			✓		**2SC5280; ③**
2SD2428			✓	1700	8	200	✓	5	6	1.2	✓				2SD2553; ⑤
2SD2454			✓	1700	7	50	✓	5	6	1.2					**2SD2638; ①**

3 S2000 / S2055 Series

Product No.	Super-seded Products	Final Phase Products	Discon-tinued Products	Maximum Ratings			Built-in damper diode	$V_{CE(sat)}$ (V)			Package Type				*Recommended Replacement and Remarks
				V_{CBO} (V)	I_C (A)	P_C (W)		Max	@ I_C (A)	@ I_B (A)	(H)IS	(BS)	(LH)	TO-3	
S2000			✓	1500	5	80		5	4.5	2		✓			S2000N; ② ⑤
S2000A			✓	1500	5	80		1	4.5	2		✓			S2000N; ⑤
S2000AF			✓	1500	5	50		1	4.5	2	✓				S2000N; ①
S2000F			✓	1500	5	50		5	4.5	2	✓				S2000N; ②
S2055			✓	1500	5	80	✓	5	4.5	2		✓			S2055N; ② ⑤
S2055A			✓	1400	5	80	✓	1	4.5	2		✓			S2055N; ⑤
S2055AF			✓	1500	5	50	✓	1	4.5	2	✓				S2055N; ①
S2055F			✓	1500	5	50	✓	5	4.5	2	✓				S2055N; ②

(*) ① Electrical characteristics and packages are same.
② Electrical characteristics have are high grade.
③ Electrical characteristics are low grade.
④ Package (allowable power disspation) are high grade.
⑤ Package (allowable power disspation) are low grade.
⑥ Damper diode is built-in or not.

Notes: : 1st generation
: 2nd generation (final-phase or discontinued products)
: 3rd generation (old design)
: 4th generation (new design)

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	V_{CBO} = $900V, *1400V,1500 V							V_{CBO} = 1700 V			V_{CBO} = 2000 V		
Package	TO-3P(H)IS		TO-3		TO-3P(BS)		TO-3P(LH)	TO-3P(H)IS		TO-3P(LH)	TO-3P(LH)		Package
P_C max	40 W to 75 W		50 W		80 W		180 W to 220 W	40 W to 75 W		180 W to 220 W	180 W to 220 W		P_C max
**I_C(sat)	Built-in damper diode	No built-in damper diode	Built-in damper diode	No built-in damper diode	Built-in damper diode	No built-in damper diode	No built-in damper diode	Built-in dampe dioder	No built-in damper diode	No built-in damper diode	Built-in damper diode	No built-in damper diode	**I_C(sat)
2 A	2SD1553 (8V)	2SD1543 (8V)	2SD868 (8V)	2SD818 (8V)	2SD1425 (8V)	2SD1429 (8V)							2 A
2.2 A	2SD2089 (1V)												2.2 A
2.5 A	2SC3715 (5V)			$2SD811 (10V)									2.5 A
3 A	2SC3716 (5V) 2SD1554 (8V) **2SD2599** (8V)	2SD1544 (8V)	2SD869 (8V)	2SD819 (8V)	2SD1426 (8V)	2SD1430 (8V)		2SD2550 (5V)					3 A
3.5 A	2SD2095 (5V) **2SD2586** (5V)							2SC4765 (5V)	2SC4806 (5V)				3.5 A
4 A	2SC4764 (5V) 2SD1555 (5V) 2SD2499 (5V)	2SC3844A (5V) 2SC4830 (5V) 2SD1545 (5V) 2SD2498 (5V)	2SD870 (5V)	2SD820 (5V)	2SD1427 (5V)	*2SC3887 (5V) 2SC3887A (5V) 2SD1431 (5V)		2SD2551 (5V)					4 A
4.5 A	S2055AF (1V) S2055F (5V) S2055N (5V)	S2000AF (1V) S2000F (5V) S2000N (5V)			S2055 (5V) S2055A (1V)	S2000 (5V) S2000A (1V)		2SC4766 (5V)	2SC4761 (5V)				4.5 A
5 A	2SC4762 (5V) 2SC4916 (5V) 2SC5149 (5V) **2SC5339** (5V) 2SD1556 (5V) 2SD2125 (5V) 2SD2539 (5V)	2SC3885A (5V) 2SC4757 (5V) 2SC5148 (3V) 2SD1546 (5V)	2SD871 (5V)	2SD821 (5V)	*2SC3892 (5V) 2SC3892A (5V) 2SD1429 (5V)	*2SC3888 (5V) 2SC3888A (5V) 2SD1432 (5V)		2SD2253 (5V)					5 A
5.5 A								**2SD2638** (5V)					5.5 A
6 A	2SC4763 (5V) **2SC5280** (5V) 2SD2348 (5V) **2SD2559** (5V)	2SC3886A (5V) 2SC4758 (5V) 2SC5129 (3V) **2SC5386** (3V) 2SD1547 (5V) 2SD2500 (3V)		2SD822 (5V)	*2SC3893 (5V) 2SC3893A (5V)	*2SC3889 (5V) 2SC3889A (5V) 2SD1433 (5V)		2SC5143 (3V) **2SC5716** (5V) 2SD2428 (5V) 2SD2454 (5V) 2SD2553 (5V)	2SC5150 (3V)	2SC4608 (5V)		2SC4760 (5V)	6 A
7 A	2SC4531 (5V) 2SC2349 (5V)	2SC4542 (5V) 2SC4759 (5V) **2SC5404** (3V)				2SC4560 (5V)							7 A
8 A		2SD1548 (5V) 2SC5048 (3V) **2SC5387** (3V)		*2SD1279 (5V)					2SC4532 (5V)	2SC5332 (3V)			8 A
9 A													9 A
10 A							2SC5331 *2SC4288 (5V)						10 A
11 A		**2SC5411** (3V) ***(S3D20)***					2SC4288A (5V) **2SC5421** (3V)			**2SC5422** (3V)			11 A
12 A							*2SC4289 (5V)		**2SC5588** (3V)	**2SC5590** (3V)	***(2SC5749)***	***(2SC5748)***	12 A
14 A		**2SC5587** (3V)					2SC4289A (5V) *2SC4290 (5V) 2SC4290A (5V) 2SC5142 (3V) **2SC5589** (3V)			**2SC5446** (3V)			14 A
15 A							**2SC5445** (3V)						15 A
17 A		***2SC5717*** (3V)					***2SC5695*** (3V)					**2SC5612** (3V)	17 A
22 A										**2SC5570** (3V) ***(S3D21)***			22 A

Notes: **: I_C (sat) is value of I_C for V_{CE} (sat).
: Superseded, final-phase or discontinued products
: 3rd generation (old design)
: 4th generation (new design)

(5V) means V_{CE} (sat) = 5 V
: 5th generation (new design)
*( ) : 5th generation (new design under development)

OVERSEAS SUBSIDIARIES AND AFFILIATES

010124 (D)

Toshiba America Electronic Components, Inc.

Headquarters-Irvine, CA
9775 Toledo Way, Irvine, CA 92618, U.S.A.
Tel: (949)455-2000 Fax: (949)859-3963

Boulder, CO
3100 Arapahoe Avenue, Ste. 500,
Boulder, CO 80303, U.S.A.
Tel: (303)442-3801 Fax: (303)442-7216

Boynton Beach, FL(Orlando)
11924 W. Forest Hill Blvd., Ste. 22-337,
Boynton Beach, FL 33414, U.S.A.
Tel: (561)374-6193 Fax: (561)374-6194

Deerfield, IL(Chicago)
One Pkwy., North, Suite 500, Deerfield,
IL 60015-2547, U.S.A.
Tel: (847)945-1500 Fax: (847)945-1044

Duluth, GA(Atlanta)
3700 Crestwood Parkway, Ste. 460,
Duluth, GA 30096, U.S.A.
Tel: (770)931-3363 Fax: (770)931-7602

Edison, NJ
2035 Lincoln Hwy. Ste. #3000, Edison
NJ 08817, U.S.A.
Tel: (732)248-8070 Fax: (732)248-8030

Orange County, CA
2 Venture Plaza, #500 Irvine, CA 92618, U.S.A.
Tel: (949)453-0224 Fax: (949)453-0125

Portland, OR
1700 NW 167th Place, #240,
Beaverton, OR 97006, U.S.A.
Tel: (503)629-0818 Fax: (503)629-0827

Raleigh, NC
5511 Capitol Center Dr., #114,
Raleigh, NC 27606, U.S.A.
Tel: (919)859-2800 Fax: (919)859-2898

Richardson, TX(Dallas)
777 East Campbell Rd., Suite 650, Richardson,
TX 75081, U.S.A.
Tel: (972)480-0470 Fax: (972)235-4114

San Jose Engineering Center, CA
1060 Rincon Circle, San Jose, CA 95131, U.S.A.
Tel: (408)526-2400 Fax:(408)526-2410

Wakefield, MA(Boston)
401 Edgewater Place, Suite #360, Wakefield,
MA 01880-6229, U.S.A.
Tel: (781)224-0074 Fax: (781)224-1095

Toshiba Do Brasil S.A.

Electronic Components Div.
Estrada Dos Alvarengas, 5. 500-Bairro Alvarenga
09850-550-Sao Bernardo do campo - SP
Tel: (011)7689-7171 Fax: (011)7689-7189

Toshiba Electronics Europe GmbH

Düsseldorf Head Office
Hansaallee 181, D-40549 Düsseldorf
Germany
Tel: (0211)5296-0 Fax: (0211)5296-400

München Office
Büro München Hofmannstrasse 52,
D-81378, München, Germany
Tel: (089)748595-0 Fax: (089)748595-42

Toshiba Electronics France SARL
Immeuble Robert Schumann 3 Rue de Rome,
F-93561, Rosny-Sous-Bois, Cedex, France
Tel: (1)48-12-48-12 Fax: (1)48-94-51-15

Toshiba Electronics Italiana S.R.L.
Centro Direzionale Colleoni
Palazzo Perseo Ingr. 2-Piano 6,
Via Paracelso n.12,
1-20041 Agrate Brianza Milan, Italy
Tel: (039)68701 Fax:(039)6870205

Toshiba Electronics España, S.A.
Parque Empresarial San Fernando Edificio Europa,
1^{a} Planta, ES-28831 Madrid, Spain
Tel: (91)660-6700 Fax:(91)660-6799

Toshiba Electronics(UK) Limited
Riverside Way, Camberley Surrey,
GU15 3YA, U.K.
Tel: (01276)69-4600 Fax: (01276)69-4800

Toshiba Electronics Scandinavia AB
Gustavslundsvägen 12, 2nd Floor
S-161 15 Bromma, Sweden
Tel: (08)704-0900 Fax: (08)80-8459

Toshiba Electronics Asia (Singapore) Pte. Ltd.

Singapore Head Office
438B Alexandra Road, #06-08/12 Alexandra
Technopark, Singapore 119968
Tel: (278)5252 Fax: (271)5155

Bangkok Office
135 Moo 5 Bangkadi Industrial Park, Tivanon Rd.,
Bangkadi Amphur Muang Pathumthani, Bangkok, 12000,
Thailand
Tel: (02)501-1635 Fax: (02)501-1638

Toshiba Electronics Trading (Malaysia)Sdn. Bhd.

Kuala Lumpur Head Office
Suite W1203, Wisma Consplant, No.2,
Jalan SS 16/4, Subang Jaya, 47500 Petaling Jaya,
Selangor Darul Ehsan, Malaysia
Tel: (3)731-6311 Fax: (3)731-6307

Penang Office
Suite 13-1, 13th Floor, Menard Penang Garden,
42-A, Jalan Sultan Ahmad Shah,
100 50 Penang, Malaysia
Tel: 4-226-8523 Fax: 4-226-8515

Toshiba Electronics Philippines, Inc.

26th Floor, Citibank Tower, Valero Street, Makati,
Manila, Philippines
Tel: (02)750-5510 Fax: (02)750-5511

Toshiba Electronics Asia, Ltd.

Hong Kong Head Office
Level 11, Top Glory Insurance Building, Grand Century
Place, No.193, Prince Edward Road West,
Mong Kok, Kowloon, Hong Kong
Tel: 2375-6111 Fax: 2375-0969

Beijing Office
Rm 714, Beijing Fortune Building,
No.5 Dong San Huan Bei-Lu, Chao Yang District,
Beijing, 100004, China
Tel: (010)6590-8795 Fax: (010)6590-8791

Chengdu Office
Unit F, 18th Floor, New Times Plaza, 42 Wenwu Road,
Xinhua Avenue, Chengdu, 610017, China
Tel: (028)675-1773 Fax: (028)675-1065

Shenzhen Office
Rm 3010-3012, Office Tower Shun Hing Square,
Di Wang Commercial Centre, 333 ShenNan
East Road, Shenzhen, 518008, China
Tel: (0755)246-1582 Fax: (0755)246-1581

Toshiba Electronics Korea Corporation

Seoul Head Office
14/F, KEC B/D, 257-7 Yangjae-Dong,
Seocho-ku, Seoul, Korea
Tel: (02)589-4334 Fax: (02)589-4302

Gumi Office
6/F, Ssangyong Investment Securities B/D,
56 Songjung-Dong, Gumi City
Kyeongbuk, Korea
Tel: (82)54-456-7613 Fax: (82)54-456-7617

Toshiba Technology Development (Shanghai) Co., Ltd.

23F, Shanghai Senmao International Building, 101
Yin Cheng East Road, Pudong New Area, Shanghai,
200120, China
Tel: (021)6841-0666 Fax: (021)6841-5002

Tsurong Xiamen Xiangyu Trading Co., Ltd.

8N, Xiamen SEZ Bonded Goods Market Building,
Xiamen, Fujian, 361006, China
Tel: (0592)562-3798 Fax: (0592)562-3799

Toshiba Electronics Taiwan Corporation

Taipei Head Office
17F, Union Enterprise Plaza Bldg. 109
Min Sheng East Rd., Section 3, 0446 Taipei,
Taiwan
Tel: (02)514-9988 Fax: (02)514-7892

Kaohsiung Office
16F-A, Chung-Cheng Bldg., Chung-Cheng 3Rd.,
80027, Kaohsiung, Taiwan
Tel: (07)222-0826 Fax: (07)223-0046

In Touch with Tomorrow

TOSHIBA

TOSHIBA CORPORATION

Electronic Devices Sales & Marketing Division
1-1, Shibaura 1-chome, Minato-ku, Tokyo, 105-8001, Japan
Tel: +81-3-3457-3405 Fax: +81-3-5444-9431

Website: http://doc.semicon.toshiba.co.jp/indexus.htm