TOSHIBA

2003-9

PRODUCT GUIDE

BCE0015A

Horizontal-Deflection Output Transistors

2003 semiconductor

http://www.semicon.toshiba.co.jp/eng

1 Outline

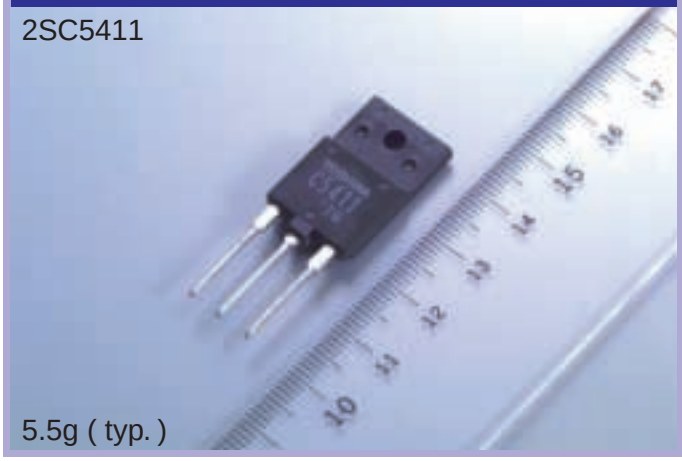
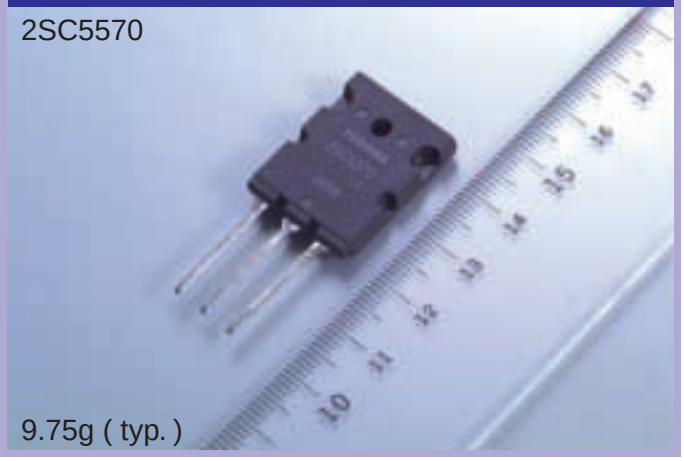
Toshiba has developed a range of fifth-generation horizontal-deflection-output transistors (HV-Trs). Radical redesign of the emitter electrode and the contact pattern has yielded significant improvements, resulting in higher current density and superior electrical characteristics compared to those of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

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 worldwide 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 througu-hole packages used for standard products.

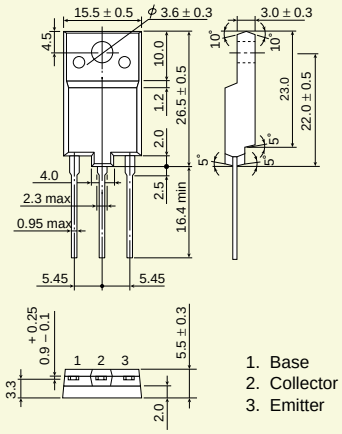
Appearance

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

Package dimensions

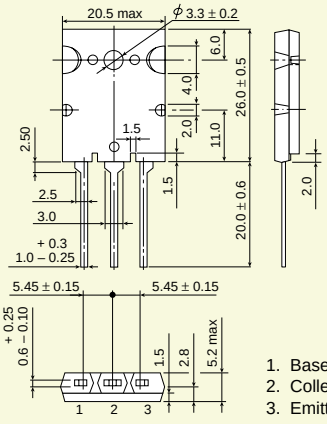
(Unit: mm)

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, Widescreen TVs	HDTVs / Projectors Multimedia TVs Digital TVs	Video display monitors
• Widescreen aspect ratio: (4 : 3) –> (16 : 9) • Large screen size • Flat screen • Low loss • Lower prices	• Improved in screen resolution quality Screen resolution: 525p,1125i,750p 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 (tf parts) due to high-frequency operation tf = 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

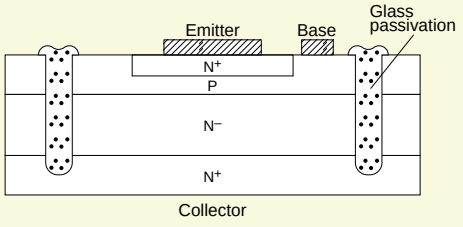
1 High breakdown capability

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

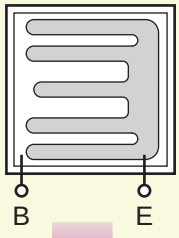
Fluctuation in optimum drive conditions due to variation in device quality has been minimized for ease of design.

4 Revised emitter contact shape and optimized chip size

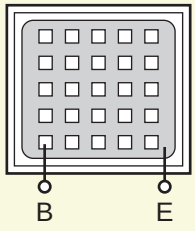
Chip design has been optimized using Toshiba simulation technology. The emitter's contact area has been widened by changing the contact shape below the emitter electrode from comb type to the new mesh type. As a result, the saturation voltage (V_{CE}(sat)) and fall time (tf) have both been reduced, thus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

Contact shape

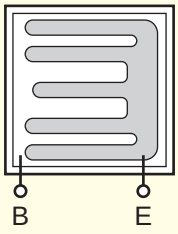
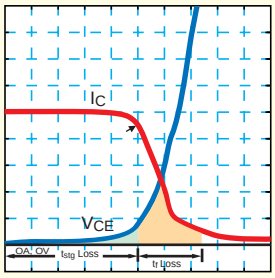
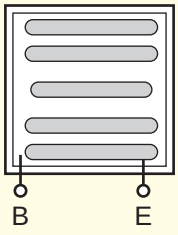
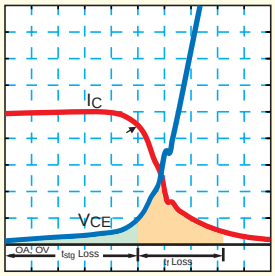
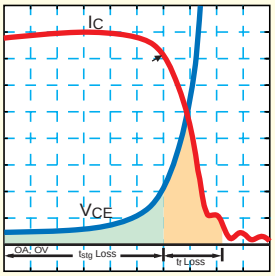
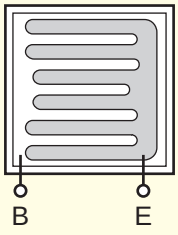
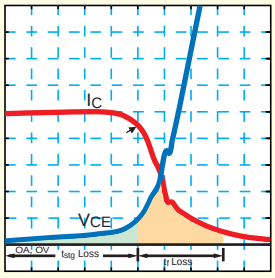
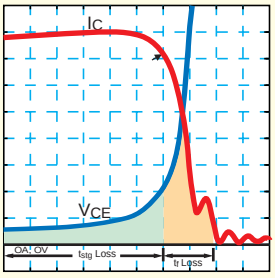
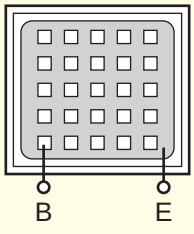
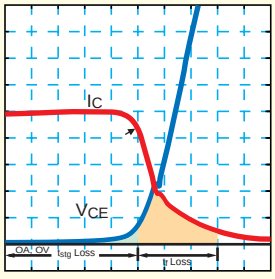
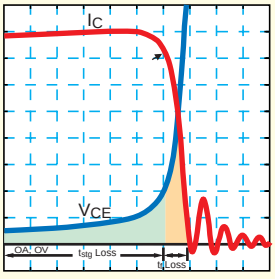
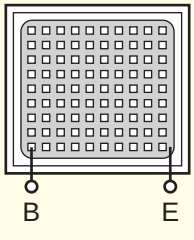
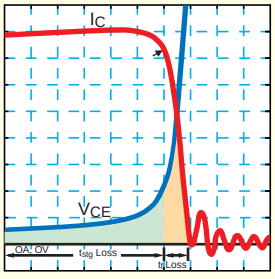
Conventional comb type



Fourth and fifth-generation mesh type



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

Generation	Design	Typical Products and Waveforms	
•Main application • Features	Emitter contact shape	TVs	Video displays
	@f_H, I_{CP}, $I_{B1(end)}$, V_{CP}	@15.75kHz, 5A, 1A, 1200V	@100kHz, 8A, 1A, 1200V
	(t, I_C, V_{CE}) / div	(200ns, 1A, 10v) / div	(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

2SC Series

Part Number	Maximum Ratings			Package**	Di ***	Main Target Use	Remarks
	V_{CBO} (v)	I_C (A)	P_C (W)				
2SC5695	1500	22	200	LH		21 inch, 130 kHz	Equivalent to 2SC5445
2SC5716	1700	8	55	H	✔	28 inch, 32 kHz to~	High-current version of 2SC5143
2SC5717	1500	21	75	H		19 inch, 120 kHz	2SC5717 and 2SC5695 use same chip.
2SC5748	2000	16	210	LH		36 inch, 32 kHz to~	2000 V series
2SC5855	1500	10	50	H		17 inch, 69 kHz	Equivalent to 2SC5387
2SC5856	1500	14	55	H		19 inch, 92 kHz	Equivalent to 2SC5411
2SC5857	1700	21	75	H		36 inch, 45 kHz	High-current version of 2SC5588
2SC5858	1700	22	200	LH		36 inch, 45 kHz	2SC5857 and 2SC5858 use same chip.
2SC5859	1700	23	210	LH		36 inch, 32 kHz to~	High-current version of 2SC5446
**** S3G18***	1700	(16)	75	H	✔	36 inch, 45 kHz to~	High-current version of 2SC5716
**** 2SC5997***	2000	(14)	75	H		36 inch, 45 kHz to~	2000 V series
**** S3G90***	1500	(18)	60	H		19 inch, 110 kHz	High-current version of 2SC5856
**** S3H58***	1500	(10)	50	H	✔	32 inch, 45 kHz	High-current version of 2SC5280
**** S3H60***	2000	(10)	60	H	✔	32 inch, 45 kHz	2000 V series and built-in damper diode

2SD Series

2SD2638	1700	7	50	H	✔	28 inch - 15.75 kHz	Low-current version of 2SD2553

Note *: Under development and tentative specification ***Di: Built-in damper diode
Package**: H···TO-3P(H)IS. LH···TO-3P(LH)

7 Cross Reference

< How to use this table >
Step 1. Check **Ic(sat) of other devices.
Step 2. Check V_{CBO}, package and built-in damper diode or not built-in damper diode.
Step 3. Look for applicable area as step 1 & 2.
Step 4. Recommended devises near to that area.

	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(H)IS		TO-3P(LH)
P_C max	40 to 75 W		180 to 220 W	40 to 75 W		180 to 220 W	40 to 75W		180 to 220 W
** $I_{C(sat)}$	Built-in damper	Not built-in damper	Not built-in damper	Built-in damper	Not built-in damper	Not built-in damper	Built-in damper	Not built-in damper	Not built-in damper
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**	**2SC5386** **2SD2500**		**2SC5716** **2SD2553**					
7 A		**2SC5404**							
8 A	**** S3H58***	**2SC5387** ***2SC5855***					**** S3H60***		
11 A		**2SC5411** ***2SC5856***	**2SC5421**			**2SC5422**		**** 2SC5997***	
12 A				**** S3G18***	**2SC5588**	**2SC5590**			***2SC5748***
14 A		**2SC5587** **** S3G90***	**2SC5589**			**2SC5446**			
15 A			**2SC5445**						
17 A		***2SC5717***	***2SC5695***		***2SC5857***	***2SC5858***			**2SC5612**
18 A						***2SC5859***			
22 A						**2SC5570**			

Note. **2SC** : 3rd Generation (old design)
2SC : 4th Generation (new design)
2SC : 5th Generation (new design)

* : Under development and tentative specification
** : $I_{C(sat)}$ is value of IC condition for $V_{CE(sat)}$.

8 Characteristics List

① 2SC Series

Part Number	Maximum Ratings			** package	*** Di	h_{FE}			$V_{CE(sat)}$ Max(V)			Switching Time (Typ.)				Generation
	V_{CBO} (V)	I_C (A)	P_C (W)			Min (–)	Max (–)	@5 V / I_C (A)		@$I_{C(sat)}$ (A)	@ I_B (A)	t_{stg} (us)	t_f (us)	@ f_H (kHz)	@ I_{CP} (A)	
2SC5280	1500	8	50	H	✔	4	8.5	6	5	6	1.5	4	0.2	31.5	6	4th
2SC5339	1500	7	50	H	✔	4	8	5	5	5	1.25	4	0.2	31.5	5	4th
2SC5386	1500	8	50	H		4.3	7.5	6	3	6	1.5	2.5	0.15	64	5	4th
2SC5387	1500	10	50	H		4.3	7.8	8	3	8	2	2.5	0.15	64	6	4th
2SC5404	1500	9	50	H		4	8	7	3	7	1.75	2.5	0.15	64	5.5	4th
2SC5411	1500	14	60	H		4	8	11	3	11	2.75	2.5	0.15	64	8.5	4th
2SC5421	1500	15	180	LH		4	8	11	3	11	2.75	2.5	0.15	64	8.5	4th
2SC5422	1700	15	200	LH		4.5	8.5	11	3	11	2.75	2.5	0.15	64	8	4th
2SC5445	1500	20	200	LH		4.5	8.5	15	3	15	3.75	2	0.1	100	8	4th
2SC5446	1700	18	200	LH		4	8	14	3	14	3.5	2.1	0.1	100	7	4th
2SC5570	1700	28	220	LH		4.5	7.5	22	3	22	5.5	1.4	0.1	130	8	4th
2SC5587	1500	17	75	H		5	8	14	3	14	3.5	1.8	0.1	100	7.5	4th
2SC5588	1700	15	75	H		4.8	8	12	3	12	3	1.8	0.1	100	6.5	4th
2SC5589	1500	18	200	LH		5	8	14	3	14	3.5	1.8	0.1	100	7.5	4th
2SC5590	1700	16	200	LH		4.8	8	12	3	12	3	1.8	0.1	100	6.5	4th
2SC5612	2000	22	220	LH		4.8	9	17	3	17	4.25	4	0.15	32	8	4th
2SC5695	1500	22	200	LH		4.5	8.5	17	3	17	3.75	1.6	0.1	100	8	*5th*
2SC5716	1700	8	55	H	✔	3.8	9	6	5	6	1.5	3.5	0.2	32	5.5	4th
2SC5717	1500	21	75	H		4.5	8.5	17	3	17	3.75	1.6	0.1	100	8	*5th*
2SC5748	2000	16	210	LH		4.8	7.5	12	3	12	3	4	0.15	32	8	*5th*
2SC5855	1500	10	50	H		4.3	6.7	8	3	8	2	2.3	0.1	80	5.5	*5th*
2SC5856	1500	14	55	H		4.5	7.8	11	3	11	2.75	1.8	0.1	100	6.5	*5th*
2SC5857	1700	21	75	H		5	7.5	17	1.5	17	4.25	3.5	0.1	45	8	*5th*
2SC5858	1700	22	200	LH		5	7.5	17	1.5	17	4.25	3.5	0.1	45	8	*5th*
2SC5859	1700	23	210	LH		4.5	8	18	3	18	4.5	1.8	0.1	100	7.5	*5th*
* *S3G18*	1700	(16)	75	H	✔	(4)	(8)	(12)	(3)	(12)	(3)	(3.5)	(0.1)	(45)	(8)	*5th*
**2SC5997*	2000	(14)	75	H		(5)	(7.2)	(11)	(1.5)	(11)	(2.75)	(5)	(0.12)	(32)	(6)	*5th*
* *S3G90*	1500	(18)	60	H		(5)	(8)	(14)	(3)	(14)	(3.5)	(1.8)	(0.1)	(100)	(7.5)	*5th*
* *S3H58*	1500	(10)	50	H	✔	(4.5)	(7.5)	(8)	(3)	(8)	(2)	(3.5)	(0.2)	(45)	(6)	*5th*
* *S3H60*	2000	(10)	60	H	✔	(4.5)	(7.5)	(8)	(3)	(8)	(2)	(3.5)	(0.2)	(45)	(6)	*5th*

② 2SD Series

Part Number	Maximum Ratings			** package	Built-in damper diode : ✔	h_{FE}			$V_{CE(sat)}$ Max(V)			Switching Time (Typ.)				Generation
	V_{CBO} (V)	I_C (A)	P_C (W)			Min (–)	Max (–)	@5 V / I_C (A)		@$I_{C(sat)}$ (A)	@ I_B (A)	t_{stg} (us)	t_f (us)	@ f_H (kHz)	@ I_{CP} (A)	
2SD2498	1500	6	50	H		5	9	4	5	4	0.8	7	0.4	15.75	4	3rd
2SD2499	1500	6	50	H	✔	5	9	4	5	4	0.8	7.5	0.3	15.75	4	3rd
2SD2500	1500	10	50	H		4	8	6	3	6	1.5	8	0.35	15.75	6	3rd
2SD2539	1500	7	50	H	✔	5	9	5	5	5	1	6	0.3	15.75	5	3rd
2SD2550	1700	4	50	H	✔	8	22	1	8	3	0.8	7.5	0.3	15.75	3	3rd
2SD2551	1700	5	50	H	✔	5	10	4	5	4	0.8	7.5	0.5	15.75	4	3rd
2SD2553	1700	8	50	H	✔	5	9	6	5	6	1.2	9	0.3	15.75	6	3rd
2SD2559	1500	8	50	H	✔	5	9	6	5	6	1.2	6	0.4	15.75	6	4th
2SD2586	1500	5	50	H	✔	4.4	8.5	3.5	5	3.5	0.8	7.5	0.3	15.75	3.5	4th
2SD2599	1500	3.5	40	H	✔	8	25	0.5	8	3	0.8	7.5	0.5	15.75	3	4th
2SD2638	1700	7	50	H	✔	4.5	7.5	5.5	5	5.5	1.2	7	0.4	15.75	5.5	4th

③ S2000 / 2055 Series

Part Number	Maximum Ratings			** package	Built-in damper diode : ✔	h_{FE}			$V_{CE(sat)}$ Max(V)			Switching Time (Typ.)				Generation
	V_{CBO} (V)	I_C (A)	P_C (W)			Min (–)	Max (–)	@5 V / I_C (A)		@$I_{C(sat)}$ (A)	@ I_B (A)	t_{stg} (us)	t_f (us)	@ f_H (kHz)	@ I_{CP} (A)	
S2000N	1500	8	50	H		4.5	9	4.5	5	4.5	1	8	0.4	15.75	4.5	3rd
S2055N	1500	8	50	H	✔	4.5	9	4.5	5	4.5	1	7.5	0.3	15.75	4.5	3rd

*: Under development & tentative spec. **:H ;TO-3P(H)IS LH ; TO-3P(LH)

9 Selection Tables for Video Displays *(Reference only)*

●Video Display Monitor Horizontal-Deflection-Output Transistors (V_{CBO} = 1500 V series)

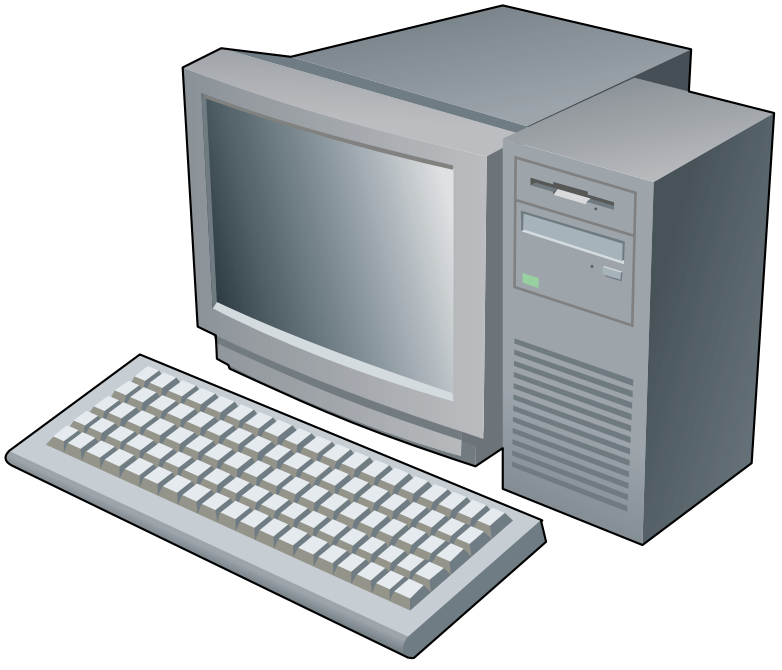
Intended Uses for Horizontal-Deflection-Output Transistors (Note 2)													Package / Recommended Altemative Product (for reference)				Maximum Ratings		Design Gene-ration
Screen size <Icp> & maximum horizontal frequency <f_H(max)>																			
15 inch I_{CP} = 4.5 A: ● ▲ I_{CP} = 5.0 A: ○ △		17 inch I_{CP} = 5.5 A: ● I_{CP} = 6.0 A: ○			19 inch I_{CP} = 6.5 A: ● I_{CP} = 7.0 A: ○				21 inch I_{CP} = 7.5 A: ● I_{CP} = 8.0 A: ○				TO-3P(H)IS		TO-3P(LH)		I_C	P_C	
f_H@(max)													Damper diode		Damper diode		(A)	(W)	
54 kHz	69 kHz	69 kHz	82 kHz	96 kHz	82 kHz	96 kHz	107 kHz	120 kHz	96 kHz	107 kHz	120 kHz	135 kHz	Built-in	Not Built-in	Built-in	Not Built-in		(Note 3)	(Note 1)
▲													2SC5339				7	50	4th
	○													2SC5386			8	50	4th
▲													2SC5280				8	50	4th
	○	●												2SC5404			9	50	4th
	○	○	●											*2SC5855*			10	50	*5th*
	○	○	●											2SC5387			10	50	4th
				○	○	●								2SC5411			14	60	4th
				○	○	●	●							*2SC5856*			14	55	*5th*
				○	○	○	●	●	●							2SC5421	15	180	4th
								○	○	●				2SC5587			17	75	4th
							○	○	●	●				** S3G90*			18	60	*5th*
																2SC5589	18	200	4th
											○	●				2SC5445	20	200	4th
										○	●			*2SC5717*			21	75	*5th*
											○	●				*2SC5695*	22	200	*5th*

●Video Display Monitor Horizontal-Deflection-Output Transistors (V_{CBO} = 1700 V series)

△													2SC5716				8	50	4th
				○	○	●								2SC5588			15	75	4th
				○	○	○	●									2SC5590	16	200	4th
							○	●								2SC5446	18	200	4th
							○	●						*2SC5857*			21	75	*5th*
								○	●							*2SC5858*	22	200	*5th*
									○	●						*2SC5859*	23	210	*5th*
											○	○				2SC5570	28	220	4th

Note 1: 4th and 5th generation devices are new products.
Note 2: The screen size and frequency quoted for intended use and reference only.
Note 3: Tc = 25°C

* : Under development and specifucations are tentative.
△ ▲: Need to additional damper diode



9 Selection Tables for Color TVs *(Reference only)*

●Color TV Horizontal-Deflection-Output Transistors (V_{CBO} = 1500 V Series)

Intended Uses for Horizontal-Deflection-Output Transistors (Note 2)																		Package / Recommended Alternative Product (for reference)				Maximum Ratings		Design Generation (Note 1)
Flat and wide-screen & Projector TVs													HDTV & Digital TVs					TO-3P(H)IS		TO-3P(LH)		I_C (A)	P_C (W)	
525i (480i) fH = 15.75 kHz							525p (480p) fH = 31.5 kHz						1125i (1080i) fH = 33.75 kHz			750p (720p) fH = 45k Hz to			Damper diode		Damper diode				
D1pin							D2 pin						D3 pin			D4 pin								
Screen size (Main inches)							Screen size (Main inches)						Screen size (Main inches)			Screen size (Main inches)								
16	20	24	28	32	36	36 to	20	24	28	32	36	28	32	36	28	32	36	Built-in	Not Built-in	Built-in	Not Built-in		(Note 3)	
●																		2SD2599				3.5	40	4th
●	●																	2SD2586				5	50	4th
	●	●																	2SB2498			6	50	3rd
	●	●																2SD2499				6	50	3rd
		●	●															2SD2539				7	50	3rd
		●	●				●											2SC5339				7	50	4th
			●	●														2SD2559				8	50	4th
	●	●																	S2000N			8	50	3rd
	●	●																S2055N				8	50	3rd
			●	●				●											2SC5386			8	50	4th
			●	●				●										2SC5280				8	50	4th
			●	●					●										2SC5404			9	50	4th
				●	●				●	●		●						*S3H58				10	50	5th
			●	●															2SD2500			10	50	3rd
				●	●				●			●							2SC5855			10	50	5th
						●				●			●		●				2SC5856			14	55	5th
						●					●			●		●			*S3G90			17	60	5th
						●					●			●		●			2SC5587			18	75	4th
						●					●			●		●					2SC5589	18	200	4th
						●					●			●			●				2SC5445	20	200	4th
						●					●			●			●		2SC5717			21	75	5th
						●					●			●			●				2SC5695	22	200	5th

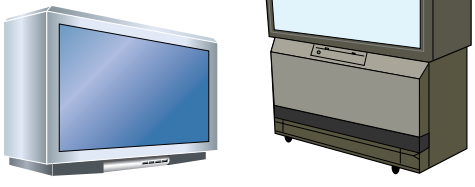
●Color TV Horizontal-Deflection-Output Transistors (V_{CBO} = 1700 V Series)

●	●																	2SD2550				4	50	3th
	●	●																2SD2551				5	50	3th
			●	●														2SD2638				7	50	4th
			●	●														2SD2553				8	50	3th
			●	●			●					●						2SC5716				8	50	4th
					●					●			●		●				2SC5588			15	75	4th
					●					●			●		●			*S3G18				16	75	5th
					●					●			●		●						2SC5590	16	200	4th
					●					●			●		●				*2SC5857			21	75	5th
						●					●			●		●					*2SC5858	22	200	5th
						●					●			●			●				2SC5859	23	210	5th
						●					●			●			●				2SC5570	28	220	4th

●Color TV Horizontal-Deflection-Output Transistors (V_{CBO}=2000V Series)

					●					●		●						*S3H60				10	50	5th
						●					●			●		●			*2SC5997			14	75	5th
						●					●			●			●				2SC5748	18	210	5th
						●					●			●			●				2SC5612	22	220	4th

Note 1: 4th and 5th generation devices are new products. * : Under development and specifications are tentative.
Note 2: The screen size and frequency quoted for intended use and reference only.
Note 3: Tc=25°C
Note 4: Scan type is showed by the number of vertical pixels and scan mode.
e.g.525i means 525 vertical pixels and interlace scan. 720p means 720 vertical pixels and progressive scan.

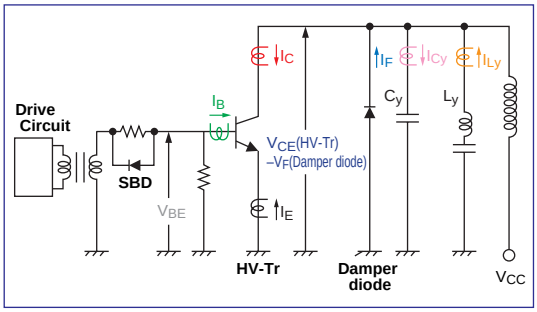


10 Basic Circuit Structure and Operating Waveform of Horizontal-Deflection Output

Measurement conditions

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

Basic circuit structure

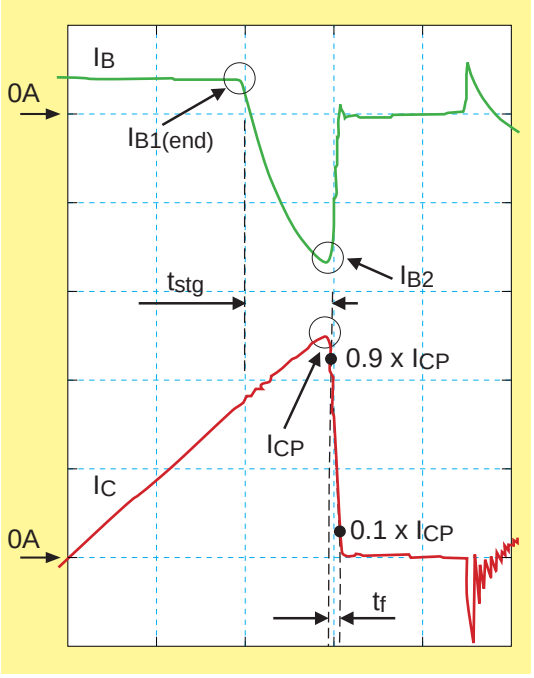


Measurement range

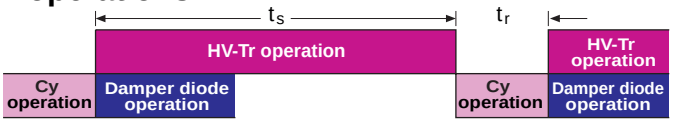
X-axis	
t (time)	2 µs / div

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

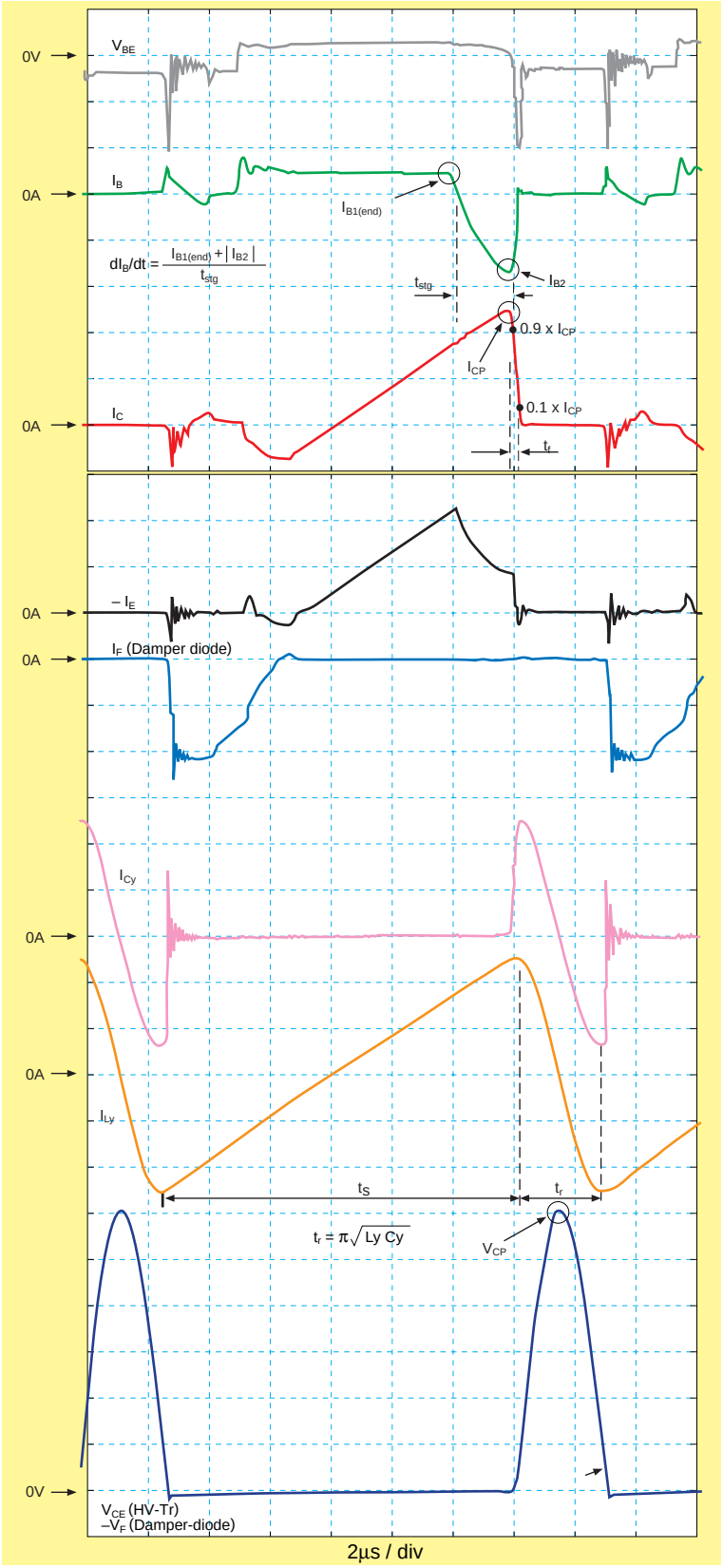
Enlarged wave forms of IB and IC



Main operations



Operating waveform example



11 Switching Data for monitor applications (5tn design) *(Reference only)*

2SC5695

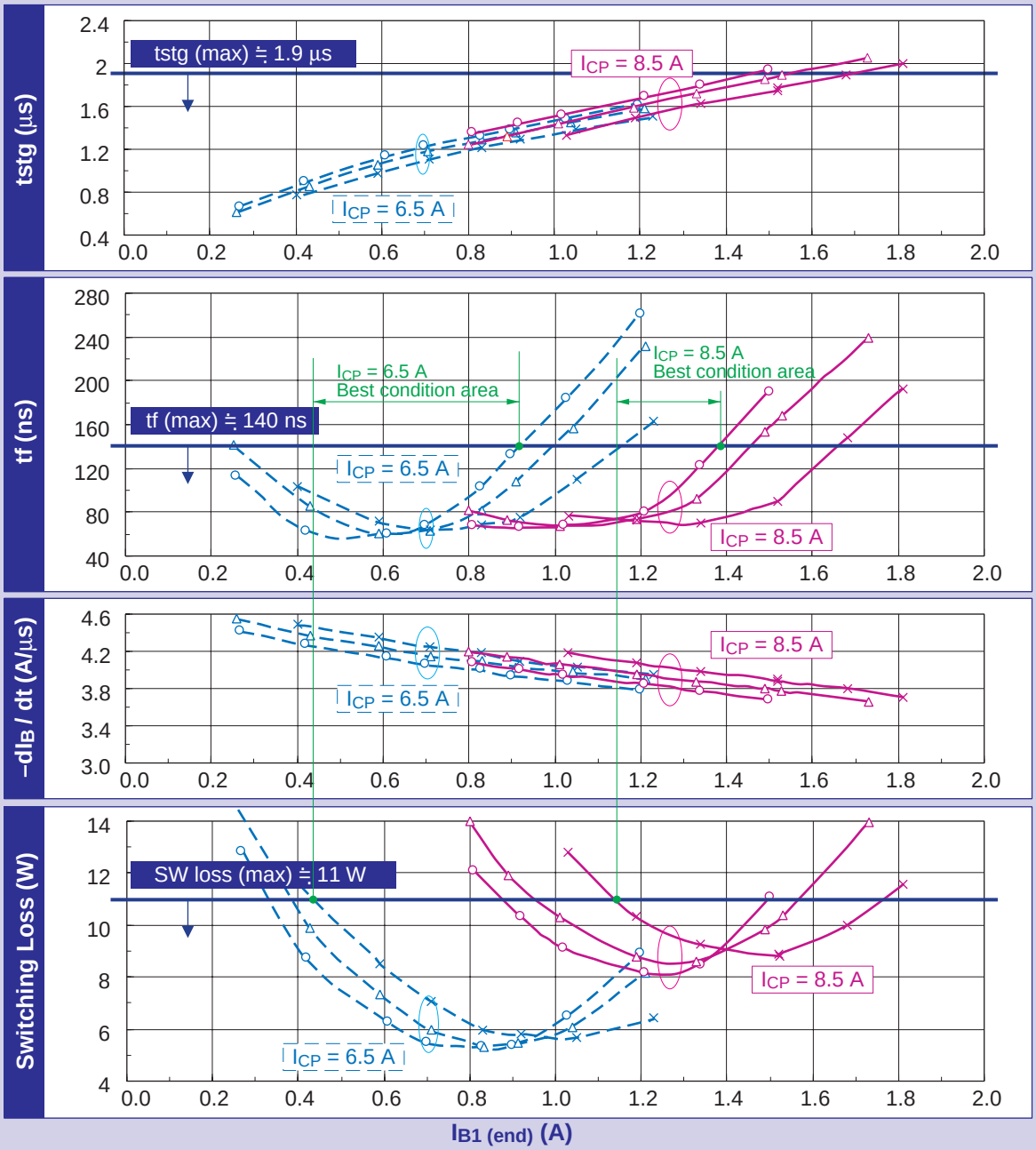
1 Test condition

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

2 Test sample

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

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



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

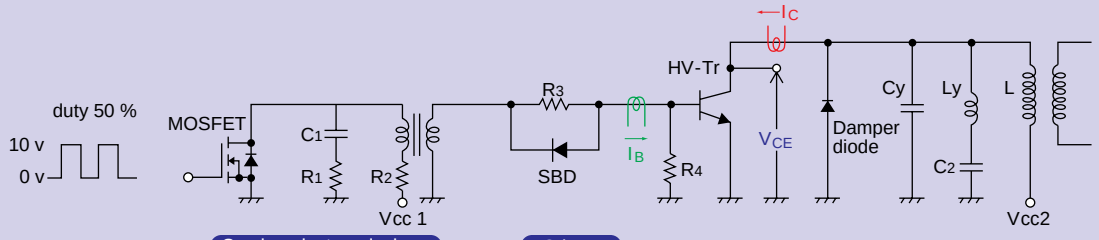
Switching loss capacitance (max)

'@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

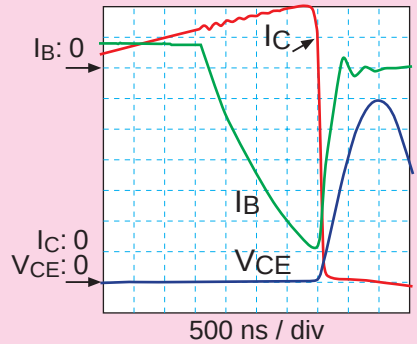
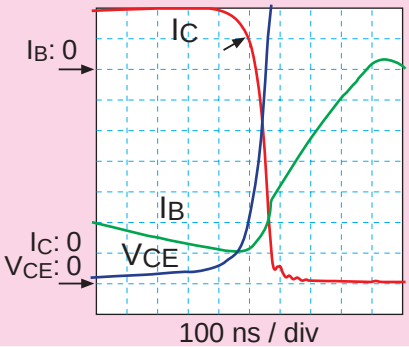
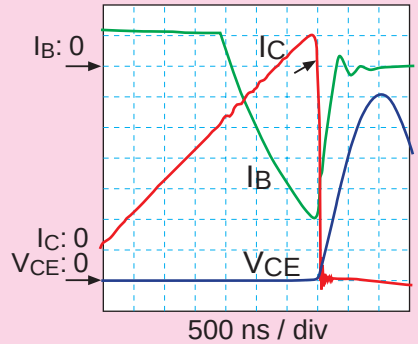
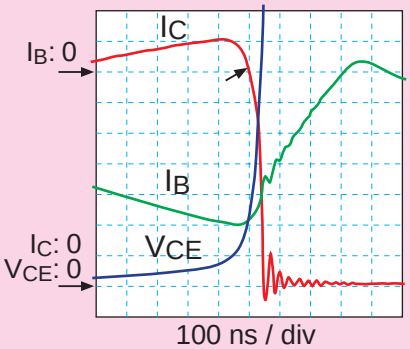


Semiconductors devices
MOSFET : 2SK2146
SBD : 3GWJ42C
HV-Tr : 2SC5695
Damper diode : 5TUZ52

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

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	 500 ns / div	 100 ns / div
@ f_H = 100 kHz I_{cp} = 8 A I_{B1} (end) ≒ 1. 1 A dI_B / dt ≒ 3.8 A / µs	 500 ns / div	 100 ns / div

13 Switching Data for HDTV and PJTV Applications (4th design)

2SC5446 [1700 V / 18 A / 3P(LH)]

Test condition

@ T_C ≒ 100°C
f_H = 35 kHz (duty 50%, 3 cycles opration)
I_{CP} = 9 A → V_{CP} ≒ 1350 V (V_{CC}2 ≒ 157 V)

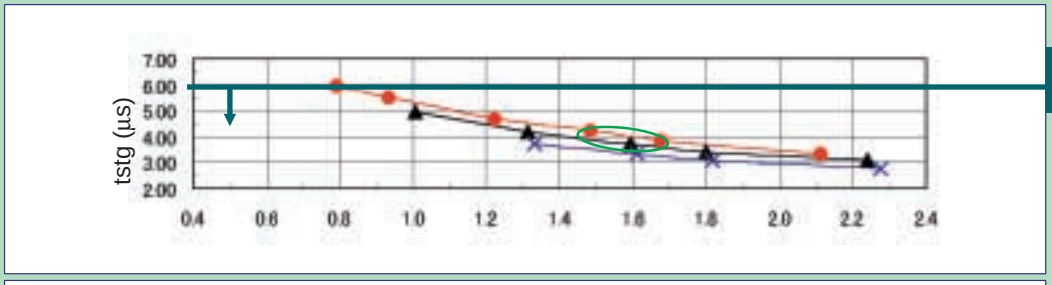
I_{B1}(end) = 1.2 / 1.4 / 1.6 A (VBB = 24.4 / 28.4 / 32.4 V)
Ly = 208 µH,
Cy = 12000 pF

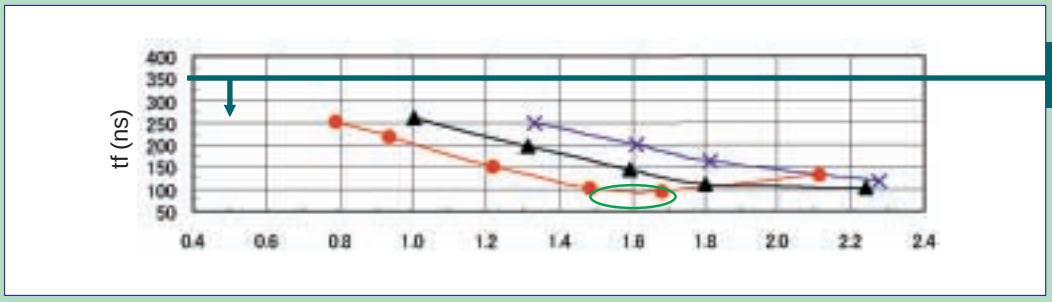
h_{FE} minimum side Sample

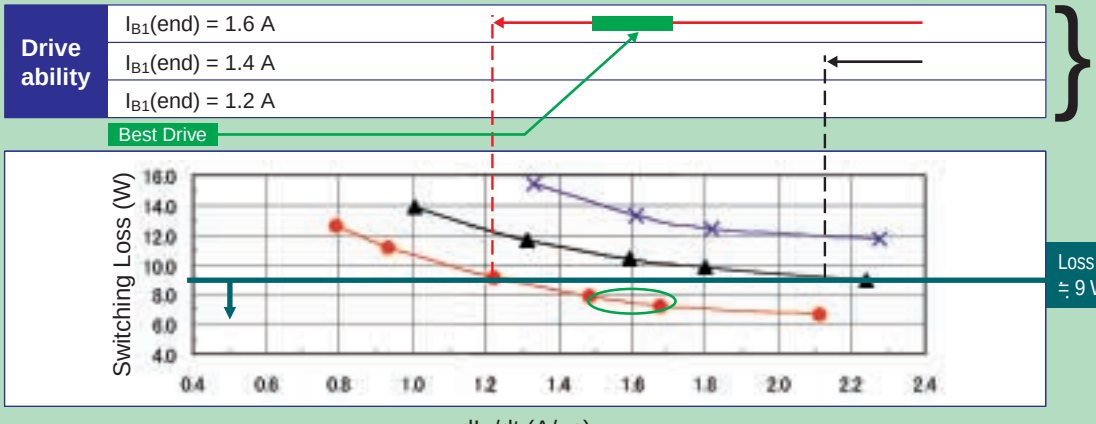
Sample Data

Test Conditions	h_{FE} (1) @5 V / 2 A	h_{FE} (2) @5 V / 9 A	h_{FE} (3) @5 V / 14 A	V_{CE} (sat) @14 A / 3.5 A
2SC5446 specifications	10 (min)	6 (min)	4 (min)	–
	40 (max)	13 (max)	8 (max)	3 V (max)
Sample data	17.5	6.7	4.4	3.3 V

tstg, tf, Switching Loss tstg Loss – $-dI_B/dt$







–dI_B/dt (A/µs)

Switching Loss ≒ 7.5W
by hFE minimum side sample

(Reference only)

Mark

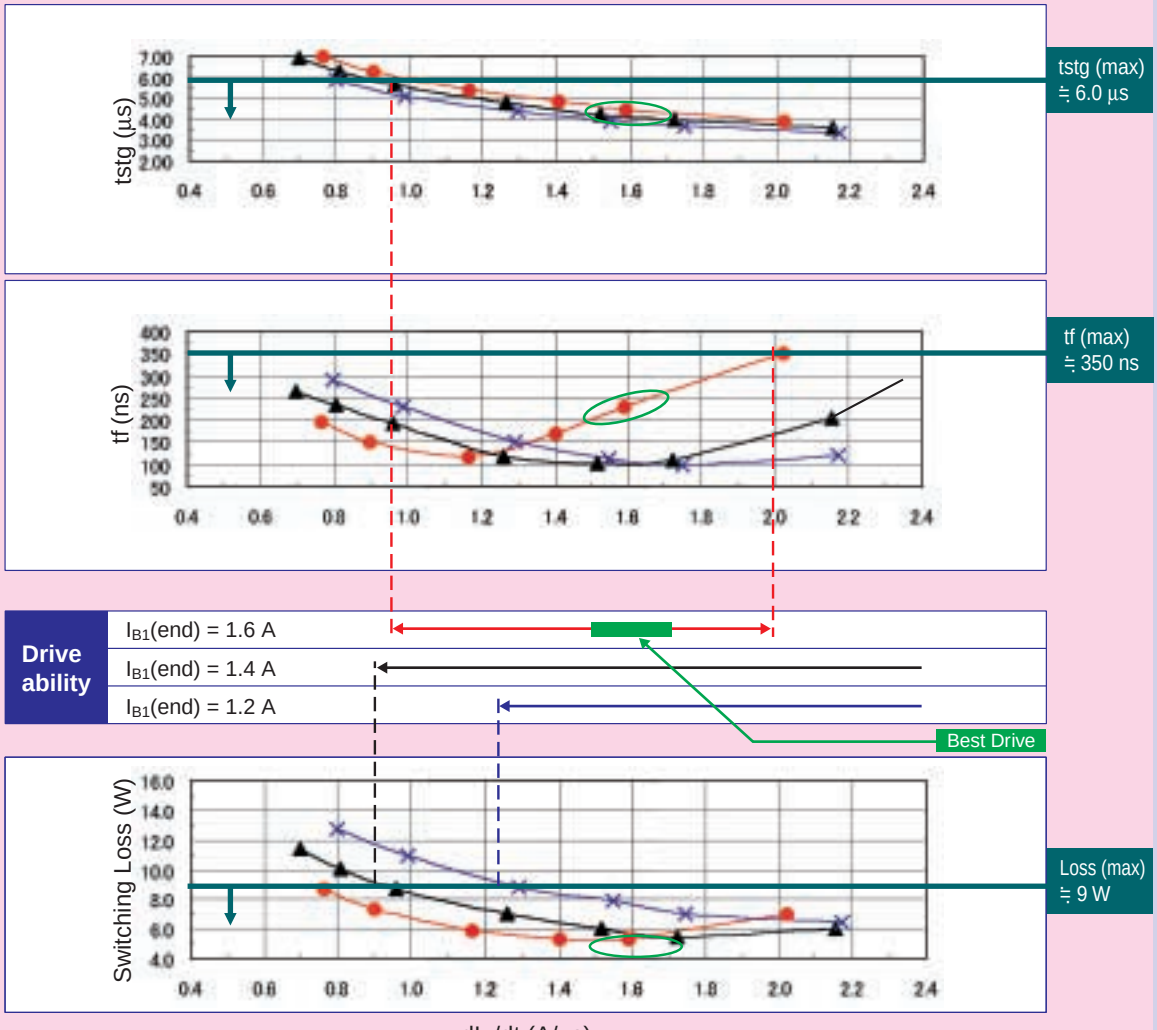
I_{B1}(end)		
1.2 A	1.4A	1.6 A
×——×	▲——▲	●——●

h_{FE} maximum side Sample

Sample Data

Test Conditions	h_{FE} (1) @5 V / 2 A	h_{FE} (2) @5 V / 9 A	h_{FE} (3) @5 V / 14 A	V_{CE} (sat) @14 A / 3.5 A
2SC5446 specifications	10 (min)	6 (min)	4 (min)	–
	40 (max)	13 (max)	8 (max)	3 V (max)
Sample data	28.6	11.7	7.5	0.4 V

tstg, tf, Switching Loss, tstg Loss – $-dI_B/dt$



are =1.6A, 1.6A/µs

Switching Loss ≒ 5W
by hFE maximum side sample

13 Switching Data for HDTV and PJTV Applications (5th design)

2SC5857 [1700 V / 21 A / 3P(H)IS] 2SC5858 [1700 V / 22 A / 3P(LH)]

Test condition

@ T_C ≒ 100°C
f_H = 35 kHz (duty 50%, 3 cycles opration)
I_{CP} = 9 A → V_{CP} ≒ 1350 V ($V_{CC}2$ ≒ 157 V)

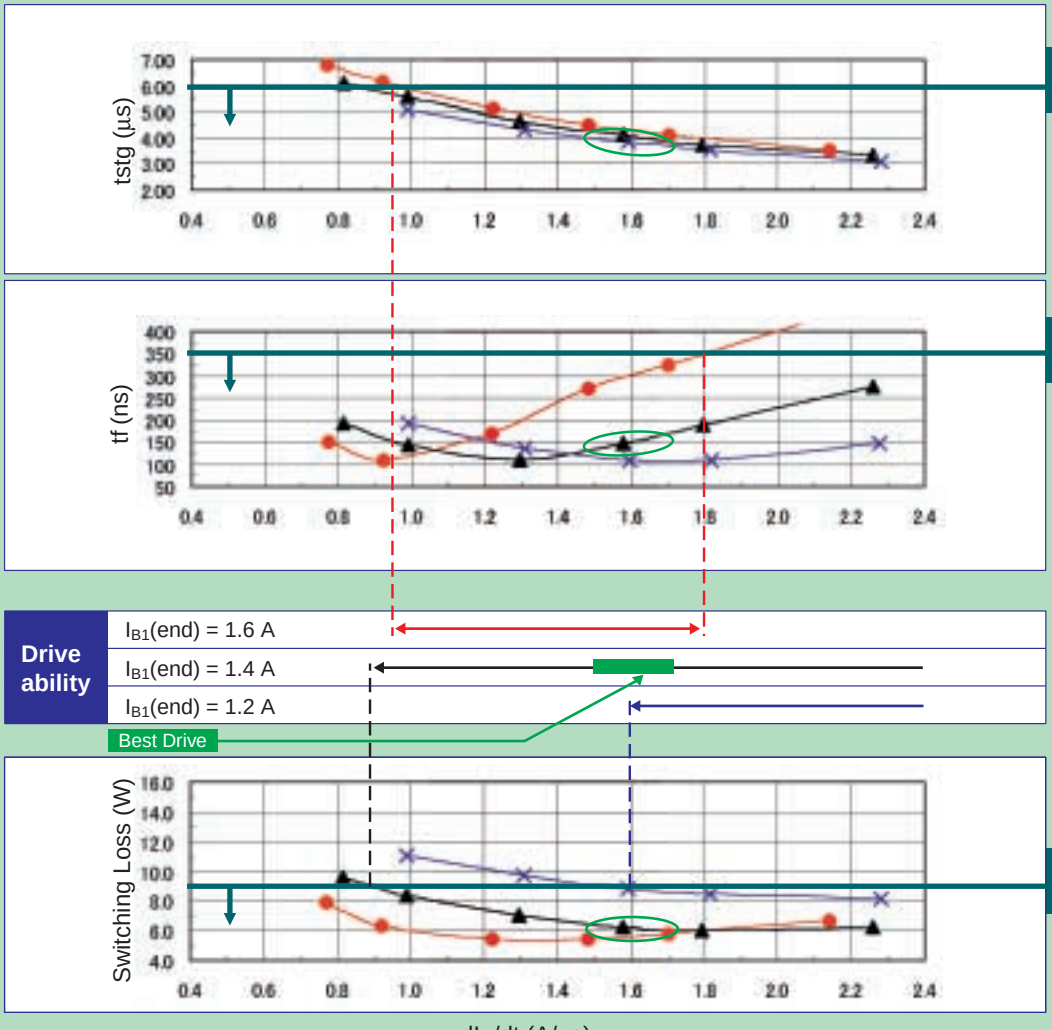
I_{B1}(end) = 1.2 / 1.4 / 1.6 A (VBB = 24.4 / 28.4 / 32.4 V)
Ly = 208 µH,
Cy = 12000 pF

h_{FE} minimum side Sample

Sample Data

Test Conditions	h_{FE} (1) @5 V / 2 A	h_{FE} (2) @5 V / 8 A	h_{FE} (3) @5 V / 17 A	V_{CE} (sat) @17 A / 4.25 A
2SC5857/5858 specifications	30 (min)	11 (min)	5 (min)	–
	60 (max)	19 (max)	7.5 (max)	1.5 V (max)
Sample data	38.2	12.0	5.2	1.3 V

tstg, tf, Switching Loss, tstg Loss – $-dI_B/dt$



Best Drive conditions @I_{B1}(end) -dI_B/dt =

Switching Loss ≒ 6.5W
by hFE minimum side sample

(Reference only)

Mark

I_{B1}(end)		
1.2 A	1.4A	1.6 A

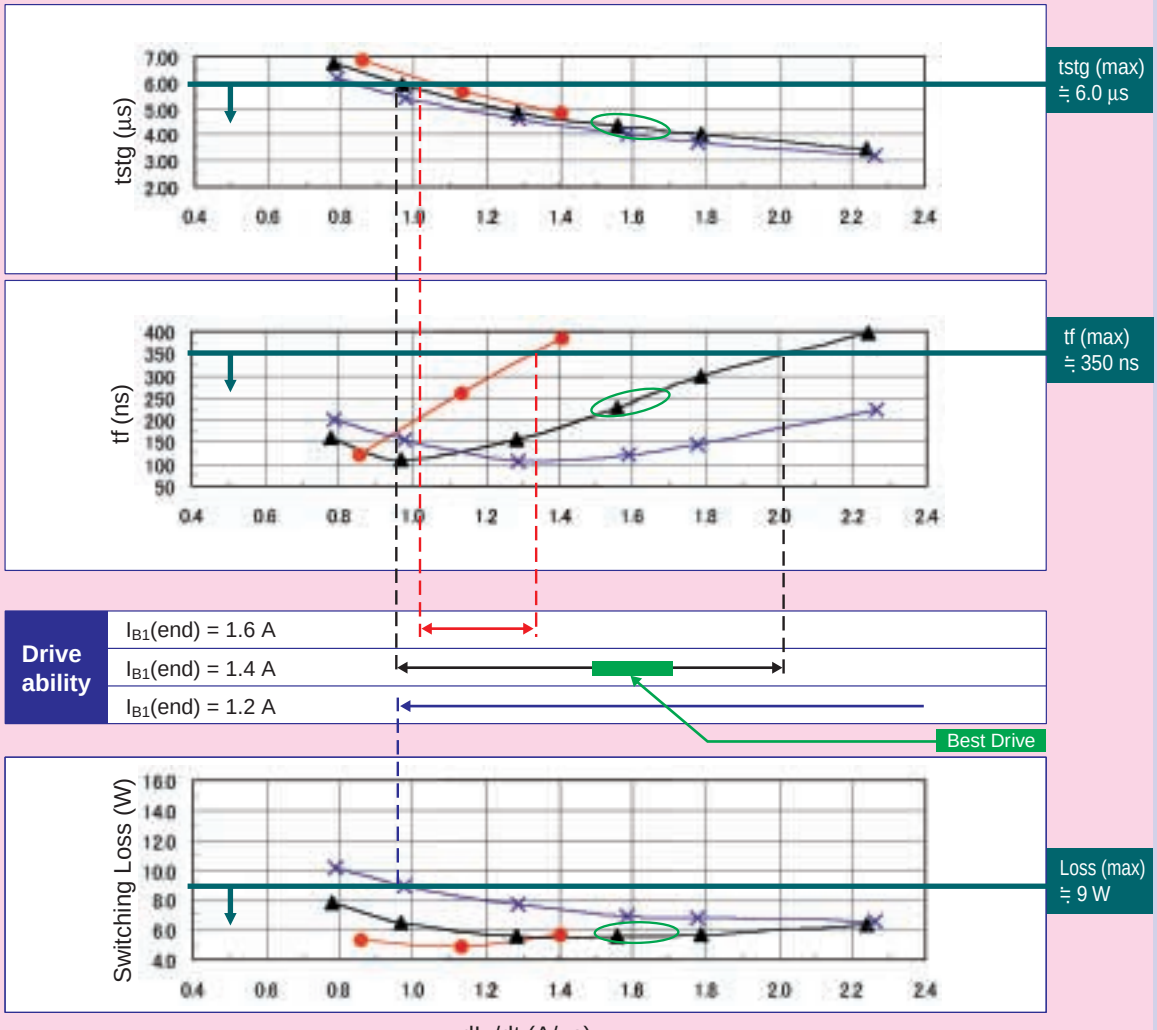
2SC5857 and 2SC5858 (5th design) have better switching loss and I_{B1}(end) characteristics than 2SC5446 does.

h_{FE} maximum side Sample

Sample Data

Test Conditions	h_{FE} (1) @5 V / 2 A	h_{FE} (2) @5 V / 8 A	h_{FE} (3) @5 V / 11 A	V_{CE} (sat) @17 A / 4.25 A
2SC5857/5858 specifications	30 (min)	11 (min)	5 (min)	–
	60 (max)	19 (max)	7.5 (max)	1.5 V (max)
Sample data	53.6	17.1	7.0	0.5 V

tstg, tf, Switching Loss, tstg Loss – $-dI_B/dt$



are =1.4A, 1.6A/µs

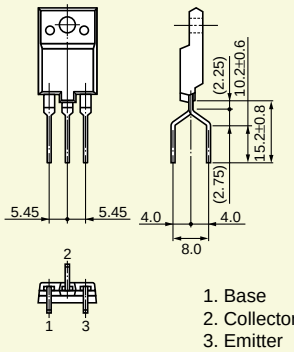
Switching Loss ≒ 5.5W by hFE maximum side sample

14 Lead Formed Through-hole Packages

TO-3P(H)IS

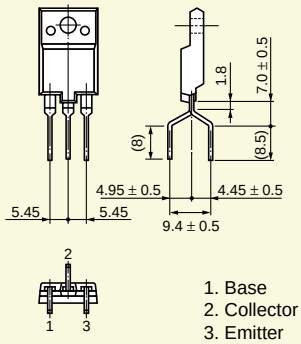
(Unit : mm)

2-16E302A



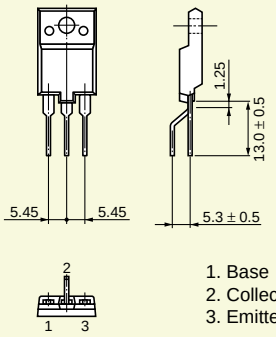
1. Base
2. Collector
3. Emitter

2-16E303A



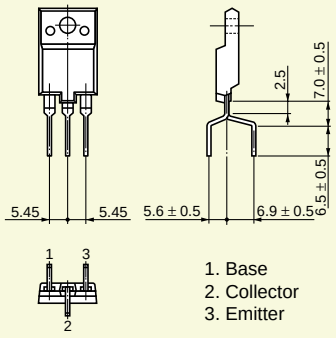
1. Base
2. Collector
3. Emitter

2-16E305A



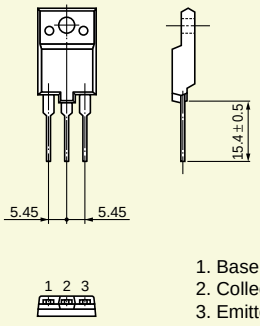
1. Base
2. Collector
3. Emitter

2-16E306A



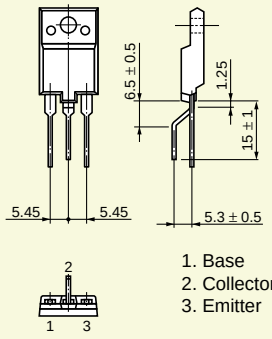
1. Base
2. Collector
3. Emitter

2-16E307A



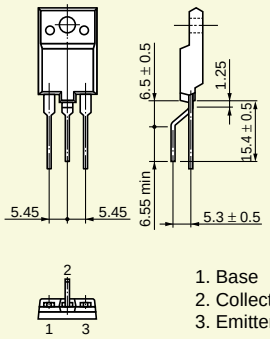
1. Base
2. Collector
3. Emitter

2-16E309A



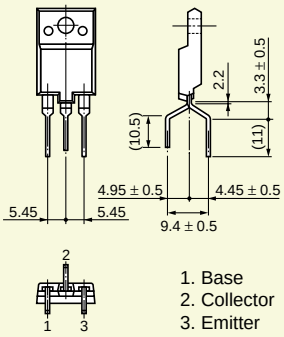
1. Base
2. Collector
3. Emitter

2-16E311A



1. Base
2. Collector
3. Emitter

2-16E313A

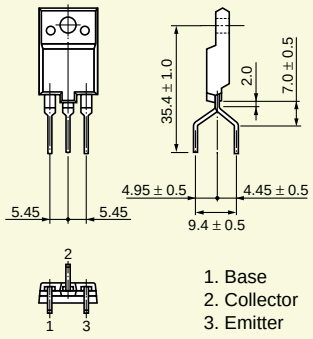


1. Base
2. Collector
3. Emitter

TO-3P(H)IS

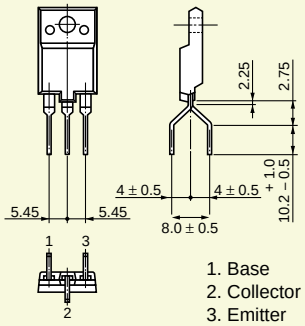
(Unit : mm)

2-16E314A



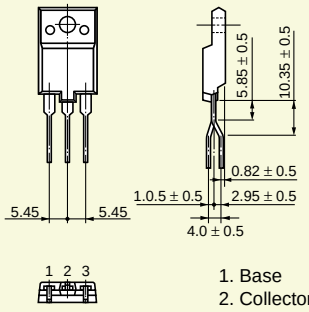
1. Base
2. Collector
3. Emitter

2-16E315A



1. Base
2. Collector
3. Emitter

2-16E316A

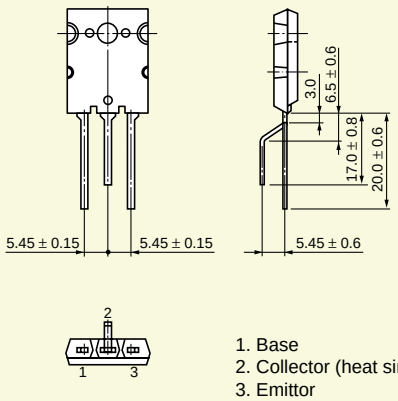


1. Base
2. Collector
3. Emitter

TO-3P(LH)

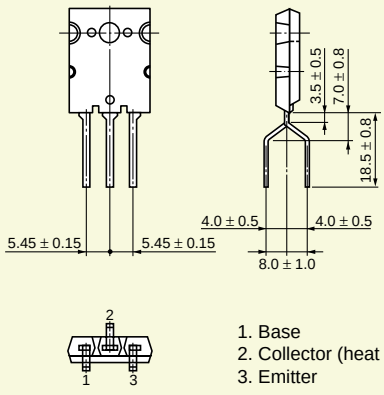
(Unit : mm)

2-21F208A



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

2-21F218A



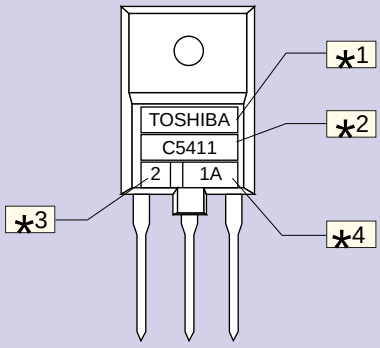
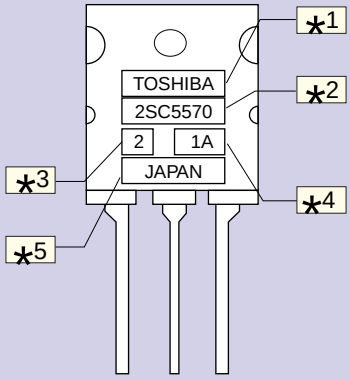
1. Base
2. Collector (heat sink)
3. Emitter

15 Markings

(As of September 2003)

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 Type	Printing by white ink	Carving by laser
Marking Example		
Definition	*1: Manufacturer's marking: "T", " ", "TOSHIBA" *2: Part number or abbreviated Part number *3: Division code: "1", "2", "3", "A", "B", "C" etc. Usually, no marking. *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.	

16 Package Label

(As of September 2003)

Sample label

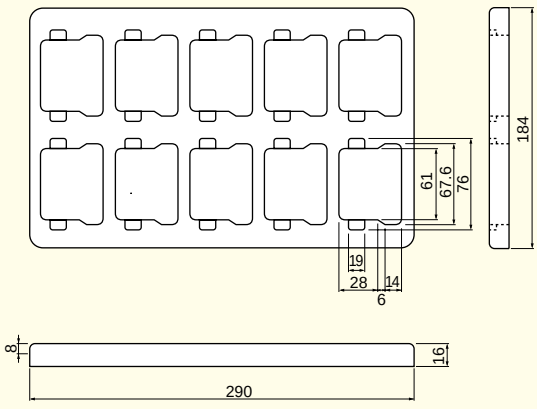
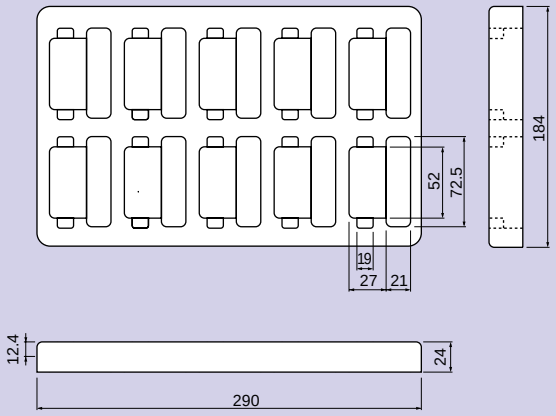
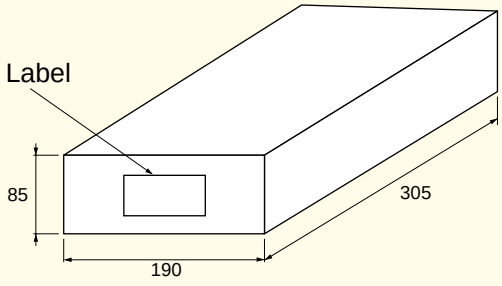
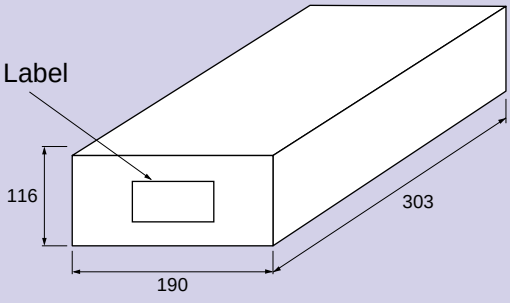
P/N:

TYPE			
ADDC		Q'TY	PCS.
NOTE			

BARCORD

TOSHIBA MADE IN JAPAN

17 Package Specifications *(As of September 2003)*

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)		

18 List of Superseded, Final-Pase and Discontinued Products *(As of September 2003)*

① 2SC Series

Part Number	Super-seded Products	Final Phase Products	Discon-tinued Products	Maximum Ratings			Built-in damper diode	VCE(sat) (V)			Package Type				# Recommended Replacement and Remarks
				V_{CBO} (V)	Ic(A) (A)	Pc (W)		MAX (V)	@Ic(sat) (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	✔				2SC5855:②
2SC3885A			✔	1500	7	50		5	5	1.2	✔				2SC5855:②
2SC3886A			✔	1500	8	50		5	6	1.5	✔				2SC5855:②
2SC3887			✔	1400	6	80		5	4	1		✔			2SC5855:②⑤
2SC3887A			✔	1500	6	80		5	4	1		✔			2SC5855:②⑤
2SC3888			✔	1400	7	80		5	5	1.2		✔			2SC5855:②⑤
2SC3888A			✔	1500	7	80		5	5	1.2		✔			2SC5855:②⑤
2SC3889			✔	1400	8	80		5	6	1.5		✔			2SC5855:⑤
2SC3889A			✔	1500	8	80		5	6	1.5		✔			2SC5855:⑤
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			✔		2SC5589:②
2SC4288A			✔	1500	12	200		5	10	2.5			✔		2SC5589:②
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	✔				2SC5280:②
2SC4532			✔	1700	10	200		5	8	2			✔		2SC5855:②⑤
2SC4542			✔	1500	10	50		5	7	1.7	✔				2SC5855:②
2SC4560			✔	1500	10	80		5	7	1.7		✔			2SC5855:②⑤
2SC4608			✔	1700	8	200		5	6	1.5			✔		2SC5855:②⑤
2SC4757			✔	1500	7	50		5	5	1.2	✔				2SC5855:②
2SC4758			✔	1500	8	50		5	6	1.5	✔				2SC5855:②
2SC4759			✔	1500	10	50		5	7	1.7	✔				2SC5855:②
2SC4760			✔	2000	8	200		5	6	1.5			✔		2SC5748:②
2SC4761			✔	1700	6	50		5	4.5	1.3	✔				2SC5588:③
2SC4762			✔	1500	7	50	✔	5	5	1	✔				2SC5339:②
2SC4763			✔	1500	8	50	✔	5	6	1.2	✔				2SC5280:②
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	✔				2SC5855:②
2SC4916			✔	1500	7	50	✔	5	5	1	✔				2SC5339:①
2SC5048			✔	1500	12	50		3	8	2	✔				2SC5855:①
2SC5129			✔	1500	10	50		3	6	1.5	✔				2SC5855:②
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			✔		2SC5858:①
2SC5148			✔	1500	12	50		5	5	1.3	✔				2SC5855:②
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			✔		2SC5590:②

: Rrecommended replacement and remarks

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

Notes:

2SC : 1st generation
2SC : 2nd generation (final-phase or discontinued products.)
2SC : 3rd generation (old design supersended products.)
2SC : 4th generation (new design)
2SC : 5th generation (the most new design)

① 2SD Series

Part Number	Super-seded Products	Final Phase Products	Discon-tinued Products	Maximum Ratings			Built-in damper diode	VCE(sat) (V)			Package Type				# Recommended Replacement and Remarks
				V_{CBO} (V)	Ic(A) (A)	Pc (W)		MAX (V)	@Ic(sat) (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:**⑤⑥
2SD819			✔	1500	3.5	50		8	3	0.8				✔	**2SD2599:**⑤⑥
2SD820			✔	1500	5	50		5	4	0.8				✔	***2SC5855:***②
2SD821			✔	1500	6	50		5	5	1				✔	***2SC5855:***②
2SD822			✔	1500	7	50		5	6	1.2				✔	***2SC5855:***②
2SD868			✔	1500	2.5	50	✔	8	2	0.6				✔	**2SD2599:**②⑤
2SD869			✔	1500	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				✔	***2SC5855:***①
2SD1425			✔	1500	2.5	80	✔	8	2	0.6		✔			**2SD2599:**②⑤
2SD1426			✔	1500	3.5	80	✔	8	3	0.8		✔			**2SD2599:**⑤
2SD1427			✔	1500	5	80	✔	5	4	0.8		✔			**2SD2499:**①⑤
2SD1428			✔	1500	6	80	✔	5	5	1		✔			**2SD2539:**⑤
2SD1429			✔	1500	2.5	80		8	2	0.6		✔			***2SC5855:***②⑤
2SD1430			✔	1500	3.5	80		8	3	0.8		✔			***2SC5855:***②⑤
2SD1431			✔	1500	5	80		5	4	0.8		✔			***2SC5855:***②⑤
2SD1432			✔	1500	6	80		5	5	1		✔			***2SC5855:***②⑤
2SD1433			✔	1500	7	80		5	6	1.2		✔			***2SC5855:***②⑤
2SD1543			✔	1500	2.5	40		8	2	0.6	✔				***2SC5855:***②
2SD1544			✔	1500	3.5	40		8	3	0.8	✔				***2SC5855:***②
2SD1545			✔	1500	5	50		5	4	0.8	✔				***2SC5855:***②
2SD1546			✔	1500	6	50		5	5	1	✔				***2SC5855:***②
2SD1547			✔	1500	7	50		5	6	1.2	✔				***2SC5855:***①
2SD1548			✔	1500	8	50		5	8	2	✔				***2SC5855:***②
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:**②
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	✔				**2SD2559:**③
2SD2349			✔	1500	10	50	✔	5	7	1.4	✔				**2SD2559:**③
2SD2428			✔	1700	8	200	✔	5	6	1.2			✔		**2SD2553:**⑤
2SD2454			✔	1700	7	50	✔	5	6	1.2	✔				**2SC5716:**①

① S2000 / S2055 Series

Part Number	Super-seded Products	Final Phase Products	Discon-tinued Products	Maximum Ratings			Built-in damper diode	VCE(sat) (V)			Package Type				# Recommended Replacement and Remarks
				V_{CBO} (V)	Ic(A) (A)	Pc (W)		MAX (V)	@Ic(sat) (A)	@I_B (A)	(H)IS	(BS)	(LH)	TO-3	
S2000			✔	1500	5	80		5	4.5	2		✔			**S2000N:**②⑤
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:**②⑤
S2055A			✔	1500	5	80	✔	1	4.5	2		✔			**S2055N:**⑤
S2055AF			✔	1500	5	50	✔	1	4.5	2	✔				**S2055N:**①
S2055F			✔	15000	5	50	✔	5	4.5	2	✔				**S2055N:**②

: Rrecommended replacement and remarks

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

Notes:

2SC : 1st generation
2SC : 2nd generation (final-phase or discontinued products.)
2SC : 3rd generation (old design supersended products.)
2SC : 4th generation (new design)
2SC : 5th generation (the most new design)

19 Replacement Table from Old Device to New Device by Ic(sat) *(As of September 2003)*

	V_{CBO} = ✶900 V, ❖1400 V, 1500 V						
Package	TO-3P(H)IS		TO-3		TO-3P(BS)		TO-3P(LH)
Pc max	40 W to 75 W		50 W		80 W		180 W - 220 W
** Ic(sat)	Built-in damper diode	Not built-in damper diode	Built-in damper diode	Not built-in damper diode	Built-in damper diode	Not built-in damper diode	Not built-in damper diode
2 A	2SC3715 (5 V) 2SD1553 (8 V)	2SD1543 (8 V)	2SD868 (8 V)	2SD818 (8 V)	2SD1425 (8 V)	2SD1429 (8 V)	
2.2 A	2SD2089 (1 V)						
2.5 A	2SC3715 (5 V)			✶2SD811 (10 V)			
3 A	2SC3716 (5 V) 2SD1554 (8 V) 2SD2599 (8 V)	2SD1544 (8 V)	2SD869 (8 V)	2SD819 (8 V)	2SD1426 (8 V)	2SD1430 (8 V)	
3.5 A	2SD2095 (5V) 2SD2586 (5 V)						
4 A	2SC4764 (5 V) 2SD1555 (5 V) 2SD2499 (5 V)	2SC3884A (5 V) 2SC4830 (5 V) 2SD1545 (5 V) 2SD2498 (5 V)	2SD870 (5 V)	2SD820 (5 V)	2SD1427 (5 V)	❖2SC3887 (5 V) 2SC3887A (5 V) 2SD1431 (5 V)	
4.5 A	S2055AF (1 V) S2055F (5 V) S2055N (5V)	S2000AF (1 V) S2000F (5 V) S2000N (5 V)			S2055 (5 V) S2055A (1 V)	S2000 (5 V) S2000A (1 V)	
5 A	2SC4762 (5 V) 2SC4916 (5 V) 2SC5149 (5 V) 2SC5339 (5 V) 2SD1556 (5 V) 2SD2125 (5 V) 2SD2539 (5 V)	2SC3885A (5 V) 2SC4757 (5 V) 2SC5148 (3 V) 2SD1546 (5 V)	2SD871 (5 V)	2SD821 (5 V)	❖2SC3892 (5 V) 2SC3892A (5 V) 2SD1429 (5 V)	❖2SC3888 (5 V) 2SC3888A (5 V) 2SD1432 (5 V)	
5.5 A							
6 A	2SC4763 (5 V) 2SC5280 (5 V) 2SD2348 (5 V) 2SD2559 (5 V)	2SC3886A (5 V) 2SC4758 (5 V) 2SC5129 (3 V) 2SC5386 (3 V) 2SD1547 (5 V) 2SD2500 (3 V)		2SD822 (5 V)	❖2SC3893 (5 V) 2SC3893A (5 V)	❖2SC3889 (5 V) 2SC3889A (5 V) 2SD1433 (5 V)	
7 A	2SC4531 (5 V) 2SD2349 (5 V)	2SC4542 (5 V) 2SC4759 (5 V) 2SC5404 (3 V)				2SC4560 (5 V)	
8 A	** S3H58 (3 V)*	2SD1548 (5 V) 2SC5048 (3 V) 2SC5387 (3 V) *2SC5855 (3 V)*		❖2SD1279 (5 V)			
9 A							2SC5331
10 A							❖2SC4288 (5 V) 2SC4288A (5 V)
11 A		2SC5411 (3 V) 2SC5856 (3 V)					2SC5421 (3 V)
12 A							❖2SC4289 (5 V) 2SC4289A (5 V)
14 A		2SC5587 (3 V) ** S3G90 (3 V)*					❖2SC4290 (5 V) 2SC4290A (5 V) 2SC5142 (3 V) 2SC5589 (3 V)
15 A							2SC5445 (3 V)
17 A		*2SC5717 (3 V)*					*2SC5695 (3 V)*
18 A							
22 A							

Note :

2SC : Superseded, final-phase or discontinued products.

2SC : 3rd generation (old design).
2SC : 4th generation
2SC : 5th generation (the most new design)

* : Under development and tentative specs.
** : Ic(sat) is value of Ic for $V_{CE(sat)}$.
(5 V) means $V_{CE(sat)}$ = 5 V

V_{CBO} = 1700 V			V_{CBO} = 2000 V			
TO-3P(H)IS		TO-3P(LH)	TO-3P(H)IS		TO-3P(LH)	Package
40 W - 75 W		180 W - 220 W	40 W - 75 W		180 W - 220 W	Pc max
Built-in damper diode	Not built-in damper diode	Not built-in damper diode	Built-in damper diode	Not built-in damper diode	Not built-in damper diode	** Ic(sat)
						2 A
						2.2 A
						2.5 A
2SD2550 (5 V)						3 A
2SC4765 (5 V)	**2SC4806 (5 V)**					3.5 A
2SD2551 (5 V)						4 A
2SC4766 (5 V)	**2SC4761 (5 V)**					4.5 A
2SD2253 (5 V)						5 A
2SD2638 (5 V)						5.5 A
2SC5143 (3 V) **2SC5716 (5 V)** **2SD2428 (5 V)** **2SD2454 (5 V)** **2SD2553 (5 V)**	**2SC5150 (3 V)**	**2SC4608 (5 V)**			**2SC4760 (5 V)**	6 A
						7 A
		2SC4532 (5 V) **2SC5332 (3 V)**	***S3H60 (3 V)***			8 A
						9 A
						10 A
		2SC5144 (3 V) **2SC5422 (3 V)**		***2SC5997 (1.5V)***		11 A
S3G18 (3 V)	**2SC5588 (3 V)**	**2SC5590 (3 V)**				12 A
		2SC5446 (3 V)			***2SC5748 (3 V)***	14 A
						15 A
	2SC5857 (1.5 V)	***2SC5858 (1.5 V)***			**2SC5612 (3 V)**	17 A
		2SC5859 (3 V)				18 A
		2SC5570 (3 V)				22 A

PRODUCT GUIDE

Horizontal-Deflection Output Transistors

2003-9

BCE0015A

OVERSEAS SUBSIDIARIES AND AFFILIATES

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 (Denver)
3100 Araphahoe #500,
Boulder, CO 80303, U.S.A.
Tel: (303)442-3801 Fax: (303)442-7216

Wellington
PBM 337, #22, 11924 Forest Hill Blvd.,
Wellington, FL 33414, U.S.A.
Tel: (561)733-4949 Fax: (561)753-1489

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

Duluth, GA (Atlanta)
3700 Crestwood Pkwy, #160,
Duluth, GA 30096, U.S.A.
Tel: (770)931-3363 Fax: (770)931-7602

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

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

Raleigh, NC
3120 Highwoods Blvd., #108, Raleigh,
NC 27604, U.S.A.
Tel: (919)859-2800 Fax: (919)859-2898

Richardson, TX (Dallas)
777 East Campbell Rd., #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)526-8910

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

Toshiba do Brasil, S.A.

Electronics Component Div.
Rua Afonso Celso, 552 3° and CEP 04119-002
Vila Mariana-São Paulo-SP, Brasil
Tel: (011)5576-6619 Fax: (011)5576-6607

Toshiba India Private Ltd.

6F DR. Gopal Das Bhawan 28, Barakhamba Road,
New Delhi, India
Tel: (011)331-8422 Fax: (011)371-4603

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-81379, München, Germany
Tel: (089)748595-0 Fax: (089)748595-42

Toshiba Electronics France S.A.R.L.
Immeuble Robert Schuman 3 Rue de Rome
F-93561, Rosny-Sous-Bois, Cédex, France
Tel: (1)48-12-48-12 Fax: (1)48-94-51-15

Toshiba Electronics Italiana S.R.L.
Centro Direzionale Colleoni,
Palazzo Perseo 3,
I-20041 Agrate Brianza, (Milan), Italy
Tel: (039)68701 Fax: (039)6870205

Toshiba Electronics España, S.A.
Parque Empresarial, San Fernando, Edificio Europa,
1ª Planta, E-28831 Madrid, Spain
Tel: (91)660-6798 Fax:(91)660-6799

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

Toshiba Electronics Scandinavia A.B.
Gustavslundsvägen 18, 5th Floor,
S-167 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: (6278)5252 Fax: (6271)5155

Toshiba Electronics Service (Thailand) Co., Ltd.

135 Moo 5, Bangkadi Industrial Park, Tivanon Road,
Pathumthani, 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: (03)5631-6311 Fax: (03)5631-6307

Penang Office
Suite 13-1, 13th Floor, Menara Penang Garden,
42-A, Jalan Sultan Ahmad Shah,
10050 Penang, Malaysia
Tel: (04)226-8523 Fax: (04)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, Tower 2, Grand Century
Place, No.193, Prince Edward Road West,
Mongkok, Kowloon, Hong Kong
Tel: 2375-6111 Fax: 2375-0969

Beijing Office
Room 714, Beijing Fortune Building,
No.5 Dong San Huan Bei-Lu, Chao Yang District,
Beijing, 100004, China
Tel: (010)6590-8796 Fax: (010)6590-8791

Chengdu Office
Suite 403A, Holiday Inn Crown Plaza 31, Zongfu Street,
Chengdu, 610016, Sichuan, China
Tel: (028)8675-1773 Fax: (028)8675-1065

Shenzhen Office
Room 3010-3013, Office Tower Shun Hing Square,
Di Wang Commercial Centre, 5002 ShenNan
East Road, Shenzhen, 518008, China
Tel: (0755)246-3218 Fax: (0755)246-1581

Qingdao Office
Room B707, Full Hope Plaza,
12 Hong Kong Central Road, Qingdao,
Shandong, 266071, China
Tel: (0532)502-8105 Fax: (0532)502-8109

Toshiba Electronics Korea Corporation

Seoul Head Office
14F, KEC Building, 275-7 Yangjae-dong,
Seocho-ku, Seoul, 137-739, Korea
Tel: (02)589-4334 Fax: (02)589-4302

Gumi Office
6F, Goodmorning Securities Building,
56 Songjung-dong, Gumi-shi,
Kyeongbuk, 730-090, Korea
Tel: (054)456-7613 Fax: (054)456-7617

Toshiba Electronics (Shanghai) Co., Ltd.

23F, HSBC Tower, 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 Building, 109
Min Sheng East Road, Section 3, Taipei,
105, Taiwan
Tel: (02)2514-9988 Fax: (02)2514-7892

Kaohsiung Office
16F-A, Chung-Cheng Building, 2, Chung-Cheng 3Road,
Kaohsiung, 800, Taiwan
Tel: (07)237-0826 Fax: (07)236-0046

(As of April 1, 2003)

TOSHIBA

TOSHIBA CORPORATION
Semiconductor Company
Website: http://www.semicon.toshiba.co.jp/eng

PRINTED WITH SOY INK 100% recycled paper

Previous edition: 3531C-0103
2003-9(0.15k)PC-O
Printed in Japan

Horizontal-Deflection Output Transistors