HA13480S

Three-Phase Motor Driver with Speed Discriminator

Description

HA13480S is three phase brushless DC motor driver for scanner of 24V LBP (Laser Beam Printer) application. Features and functions are as follows.

Functions

- 1A three phase output circuit (Current drive type)
- Forward/reverse circuit
- Start/stop circuit
- Digital speed control circuit
- Current limiter circuit
- Ready circuit
- OTSD (Over Temperature Shut Down) Circuit

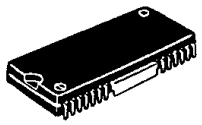
Features

- Soft switching
- Low acoustic noise
- 2kHz FG frequency acceptable
- No chemical capacitor
- No snubber component

Ordering Information

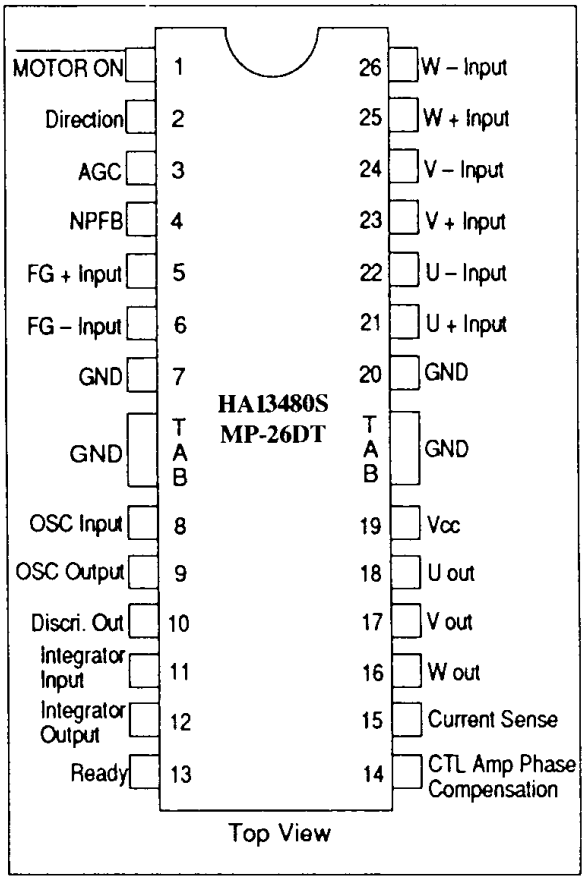
Type No.	Package
HA13480S	MP-26DT

HA13480S

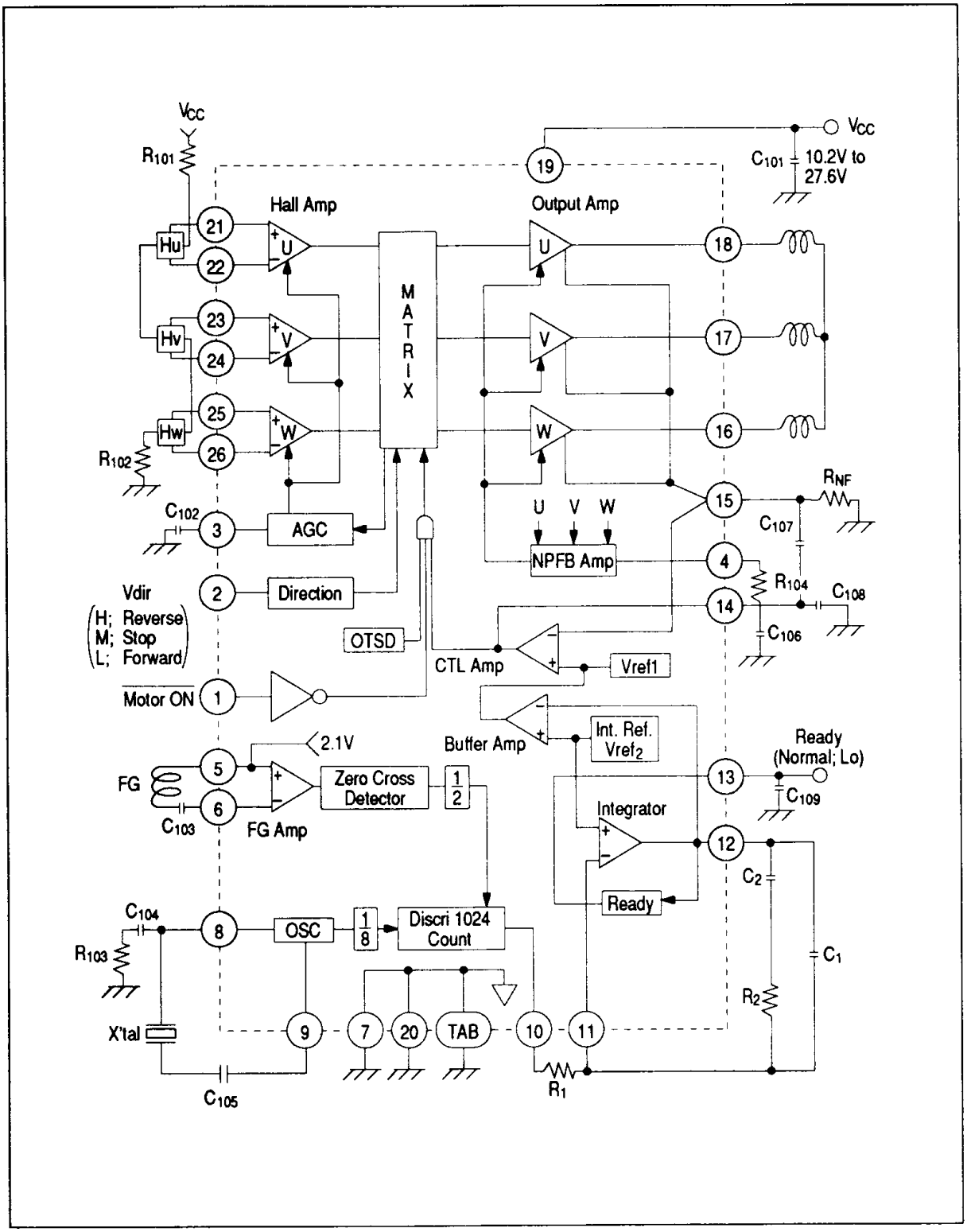


(MP-26DT)

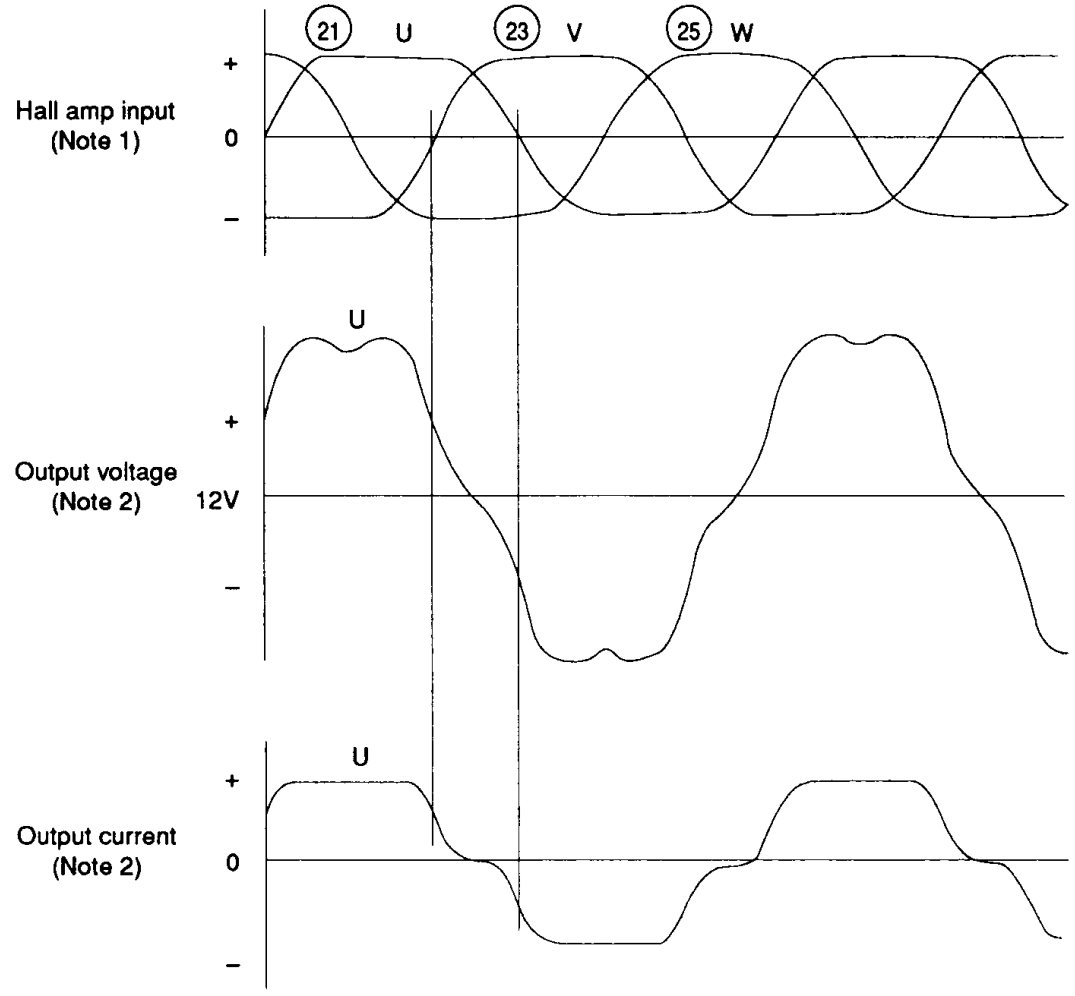
Pin Arrangement



Block Diagram



Timing Chart (Forward Mode)



Notes: 1. Third harmonic distortion below 15 % is acceptable.
2. Only U phase is shown. Sign "+" shows current flowing from IC, "–" shows current flowing into IC.

Table 1 External Component

Parts No.	Recommended Value	Purpose	Note
R_{101}, R_{102}	—	Hall element bias	1
R_{103}	470 Ω	For oscillation stability	2
R_{104}	470 Ω	For stability	
R_1	—	Integral constant	3
R_2	—	Integral constant	3
R_{NF}	0.68	Current sense	4
C_{101}	≥0.1 μF	Bypass	
C_{102}	0.047 μF	AGC filter	
C_{103}	0.1 μF	FG AC coupling	5
C_{104}	4700 pF	For oscillation stability	2
C_{105}	10 pF	AC coupling	
C_{106}	0.1 μF	Phase compensation for NPFB	
C_{107}	0.001 μF	Phase compensation for CTL amp	
C_{108}	0.1 μF	Phase compensation for CTL amp	
C_{109}	0.1 μF	Filter	
C_1	—	Integral constant	3
C_2	—	Integral constant	3
X'tal	—	Internal clock	6

Notes:
1. Determine the value so that hall amp common mode voltage and differential voltage range within the spec.
2. Those components are not necessary when oscillation frequency is below 4MHz.
3. Following equations are guideline for determining the constant of components.

$\omega_o \leq \omega_{fg}/20$

$R_2/R_1=(2/9.55) \times (J\omega_o N_o R_{NF}/K_T V_{CC})$

$C_1=1/\sqrt{10}\ \omega_o R_2$

$C_2=10C_1$

ω_{fg} : Anguler freq. of FG(rad/s)
N_o : Rotation number(rpm)
J : Inertia moment(kg·cm^2)
K_T : Torque constant(kg·cm/A)
R_{NF} : Sensing resistor(Ω)
V_{CC} : Supply voltage(V)

4. Current limit value is the following equation.
   $I_{omax}(A)=V_{ref1}(V)/R_{NF}(\Omega)$
5. See the following equation.
   $C_{103} \geq 1/1400\omega fg$
6. Relationship between FG frequency ffg and oscillation frequency fosc is as follows;
   fosc=4094ffg

Table 2 Absolute Maximum Ratings (Ta=25 °C)

Item	Symbol	Ratings	Unit	Note
Supply voltage range	Vcc	30	V	1
Instanteneous output current	Iopeak	1.0	A	2
Output current	Io	0.7	A	
Input voltage	Vin	0 to Vcc	V	3
Power dissipation	PT	8	W	4
Junction temperature	Tj	150	°C	1
Storage temperature	Tstg	–55 to +125	°C	

The absolute maximum ratings are limiting values, to be applied individually, beyond which the device may be permanently damaged. Functional operation under any of these conditions is not guaranteed. Exposing a circuit to its absolute maximum rating for extended periods of time may affect the device's reliability.

Notes: 1. Recommended operation voltage range is
   Vcc=10.2 to 27.6 V
   Tjopr=0 to 125 °C
2. Refer to ASO data.
3. Apply to PIN 21 to 26.
4. Value at Ttab=94 °C. Thermal resistance is as follows.
   θj-c=7 °C/W
   θj-a=15 °C/W (mounted on Fe metal PCB)

Table 3 Electrical Characteristics (Ta=25 °C, Vcc=24 V)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions	Test Terminal	Note
Quiescent current		Icco	—	32	45	mA	Vcc=27.6 V, Pin1=H	19	1
		Icc	—	32	45	mA	Vcc=27.6 V, Pin1=L		
Motor on	Input "L" level voltage	VIL1	—	—	1.5	V	Motor on	1	
	Input "L" level voltage	VIH1	2.5	—	—	V	Motor off		
	Input current	II1	—	—	±10	μA	VI=0 to 7 V		

Electrical Characteristics(Ta=25 °C, V_{CC}=24 V) (cont)

Direction	Input "L" level voltage	V_{IL2}	—	—	1.0	V	Forward	2	2
	Input middle voltage	Vim	1.7	—	2.4	V	Motor off		
	Input "H" level voltage	V_{IH2}	3.0	—	—	V	Reverse		
	Input current	I_{I2}	—	—	±0.6	mA	V_I=0 to 7 V		3
Hall amp	Input resistor	R_{HI}	7	10	13	kΩ		21 to 26	
	Input common mode voltage	V_H	2.5	—	Vcc −2.0	V			
	Input difference voltage	V_H	70	—	210	mVpp			
Output amp	Leak current	I_{CER}	—	—	±100	μA	V_{CE}=30 V	16 to 18	
	Saturation voltage	Vsat1	—	2.6	3.2	V	I_O=0.7 A		4
		Vsat2	—	2.0	2.3	V	I_O=0.35 A		
Integrator amp	Internal ref. voltage	Vref	0.9 (Vcc/2)	Vcc/2	1.1 (Vcc/2)	V		11	
	Input current	I_{B1}	—	—	±0.1	μA			
	Output voltage swing	A+	0.55	0.7	0.85	V	I_R=−0.1 mA	12	5
		A−	−0.55	−0.7	−0.85	V	I_R=0.1 mA		
	Gain band width	BW	—	500	—	kHz	Gv=0 dB		
Control amp	Voltage gain	Gct1	—	−1.5	—	dB		15	6
	Internal rdf. voltage	Vref1	595	660	725	mV			
FG amp	Input resistor	Rfg	1.2	2	2.8	kΩ		5, 6	
	Input voltage	Vfg	30	—	300	mVpp	f=1 kHz		
	Noise margin	nd	—	—	10	mVpp	f=1 kHz differential		
		nc	—	—	1.0	Vpp	f=1 kHz common		

Electrical Characteristics(Ta=25 °C, Vcc=24 V) (cont)

Ready	Threshold voltage	V_{THH}	—	Vref2 +0.35	—	V		12	7
		V_{THL}	—	Vref2 −0.35	—	V			
	Output "H" level voltage	V_{OH}	3.6	4.0	4.4	V		13	
	Output "L" level voltage	V_{OL}	—	0.4	0.8	V			
OSC	Maximum frequency	fosc	—	—	8.0	MHz	Use quartz	9	
	Frequency error	Δfosc	—	—	±0.1	%	Use quartz		
Speed discri	Count	N	—	1024	—	—		10	
	Output "H" voltage	V_{dH}	Vcc −1.0	—	—	V	Io=0.1 mA		
	Output "L" voltage	V_{dL}	—	—	1.0	V	Io=−0.1 mA		
	Leak current	Idoff	—	—	±0.1	μA			
	Discri. gain	Kv	—	0.12	—	V/%			
	Operating frequency	fd	—	—	8.0	MHz		10	3
OTSD operating temperature		Tsd	125	150	—	°C			4

Notes:
1. Measured at Synchronous state
2. See Figure 1.
3. See Figure 2.
4. Specified by the sum of the upper and lower saturation voltage.
5. Voltage from Vref2.
6. See Figure 3. $Gctl=20\log 10 \frac{\Delta V15}{\Delta V12}$
7. See Figure 4.

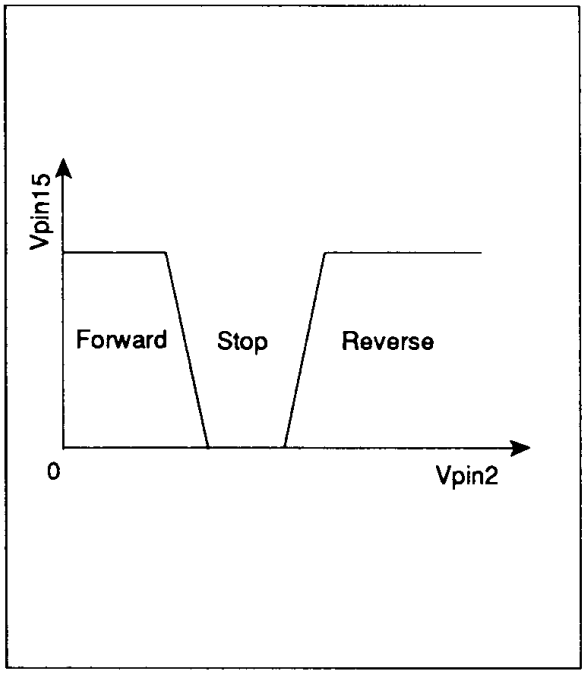


Figure 1

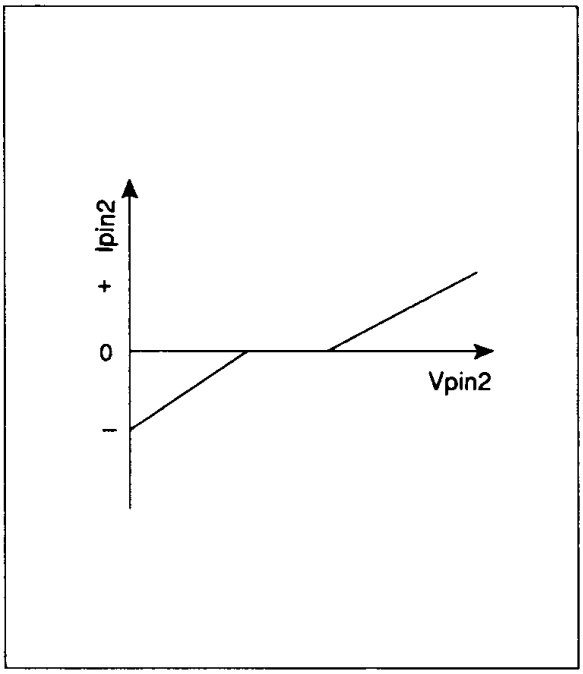


Figure 2

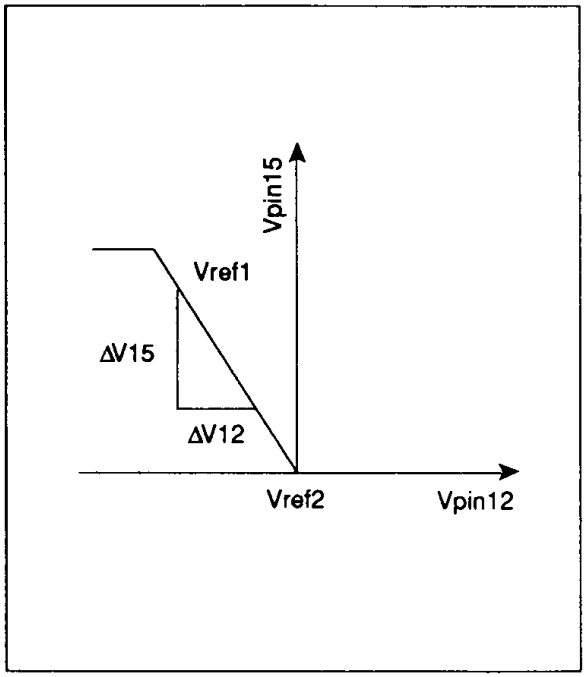


Figure 3

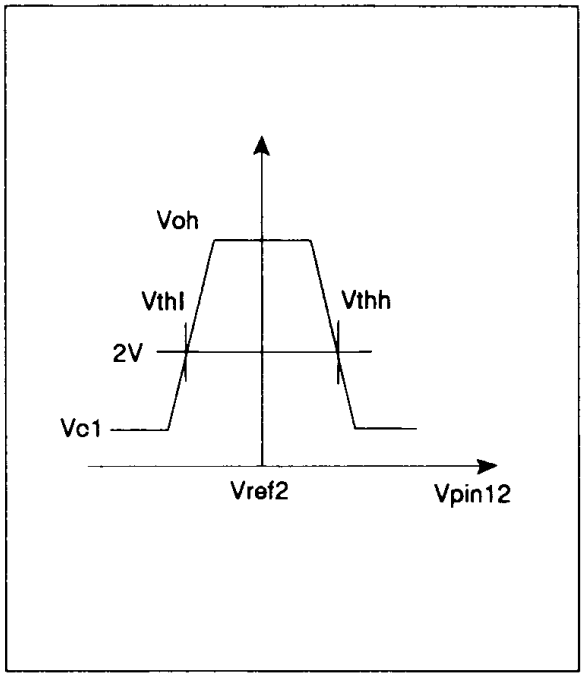


Figure 4

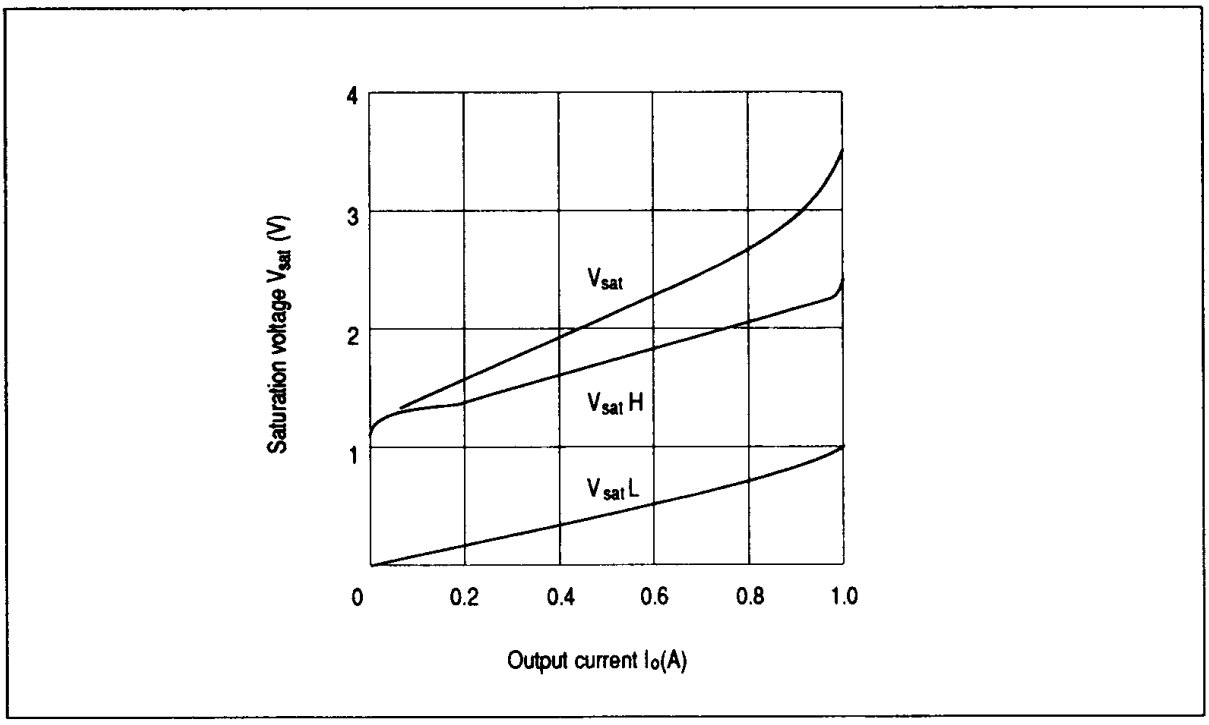


Figure 5 Reference Data
Saturation Voltage vs. Output Current

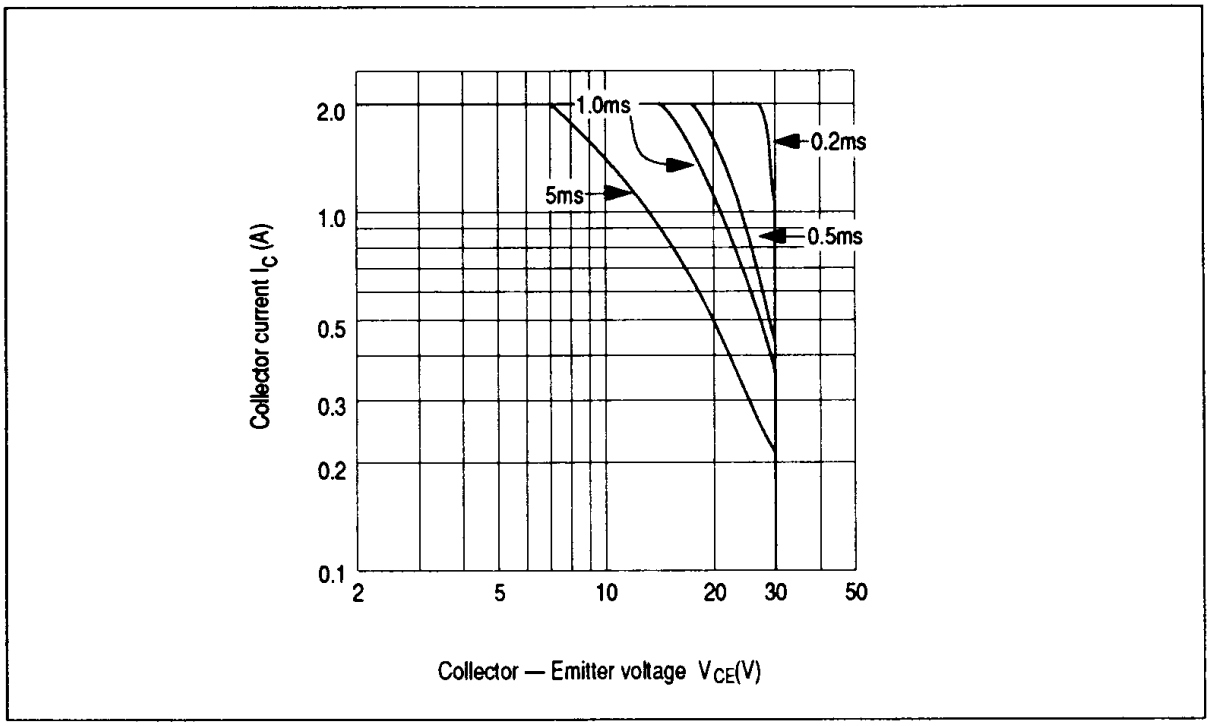


Figure 6 Reference Data
Output Transistor ASO