

# 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

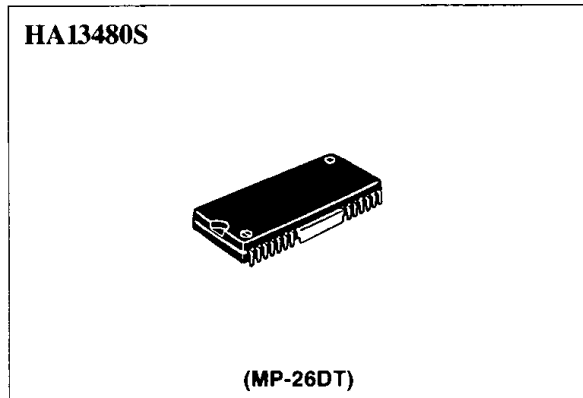
- 1A three phase output circuit (Current drive type)
- Forward/reverse circuit
- Start/stop circuit
- Digital speed control circuit
- Current limiter circuit
- Ready circuit
- OTSD (Over Temperature Shut Down) Circuit

### Features

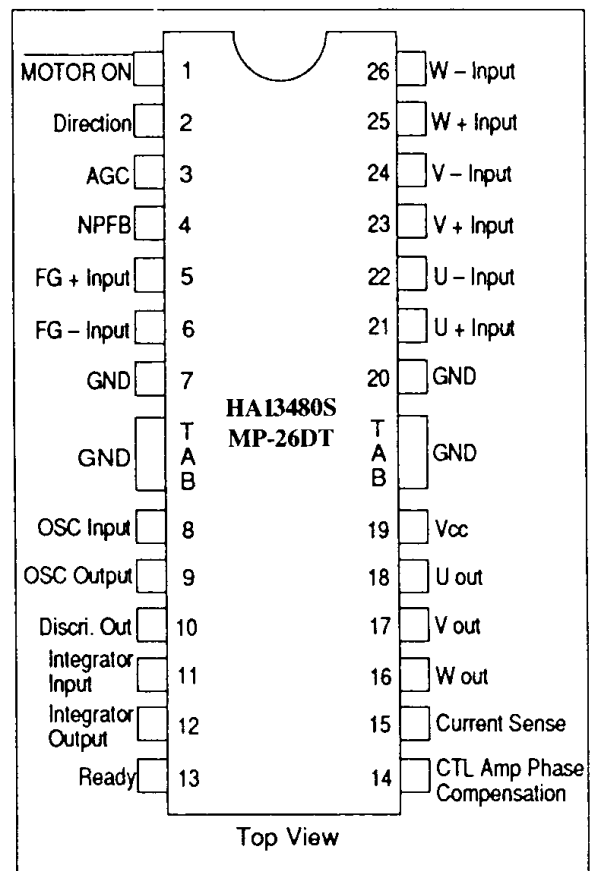
- Soft switching
- Low acoustic noise
- 2kHz FG frequency acceptable
- No chemical capacitor
- No snubber component

### Ordering Information

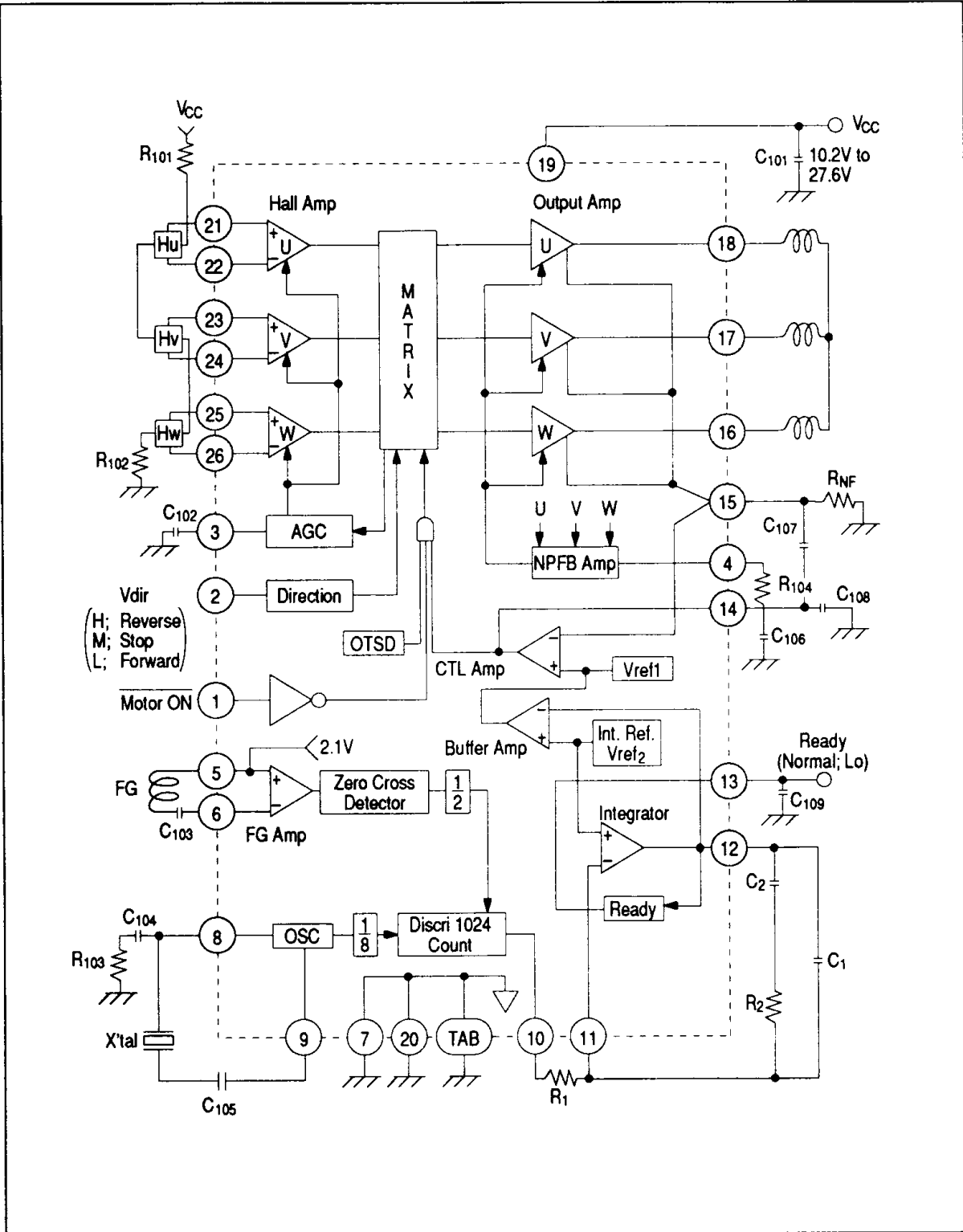
Type No.	Package
HA13480S	MP-26DT



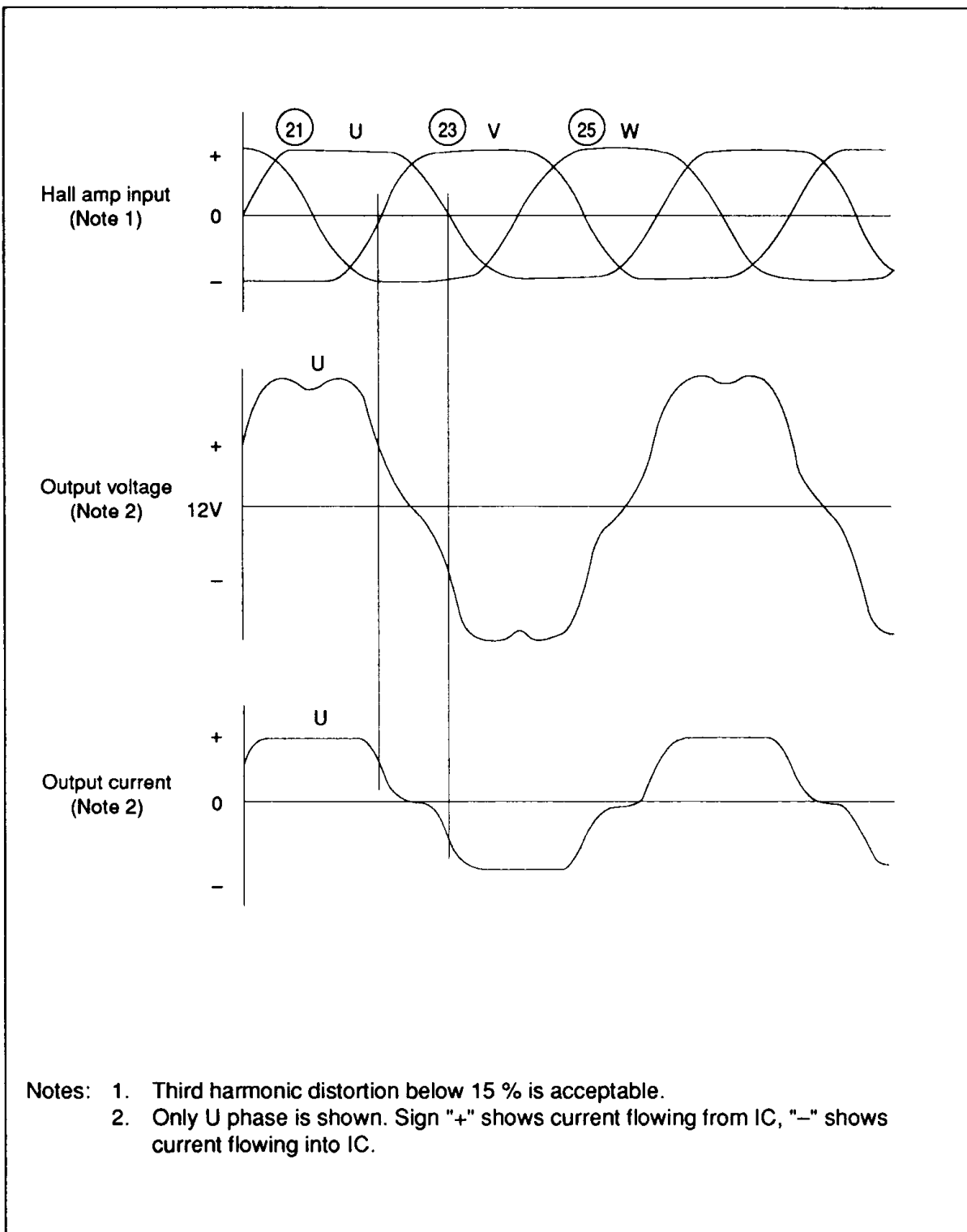
### Pin Arrangement



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 <sub>101</sub> , R <sub>102</sub>	—	Hall element bias	1
R <sub>103</sub>	470 Ω	For oscillation stability	2
R <sub>104</sub>	470 Ω	For stability	
R <sub>1</sub>	—	Integral constant	3
R <sub>2</sub>	—	Integral constant	3
R <sub>NF</sub>	0.68	Current sense	4
C <sub>101</sub>	≥0.1 μF	Bypass	
C <sub>102</sub>	0.047 μF	AGC filter	
C <sub>103</sub>	0.1 μF	FG AC coupling	5
C <sub>104</sub>	4700 pF	For oscillation stability	2
C <sub>105</sub>	10 pF	AC coupling	
C <sub>106</sub>	0.1 μF	Phase compensation for NPFB	
C <sub>107</sub>	0.001 μF	Phase compensation for CTL amp	
C <sub>108</sub>	0.1 μF	Phase compensation for CTL amp	
C <sub>109</sub>	0.1 μF	Filter	
C <sub>1</sub>	—	Integral constant	3
C <sub>2</sub>	—	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.

$$\omega_0 \leq \omega_{fg}/20$$

$$R_2/R_1 = (2/9.55) \times (J\omega_0 N_0 R_{NF}/KT V_{CC})$$

$$C_1 = 1/\sqrt{10} \omega_0 R_2$$

$$C_2 = 10C_1$$

$\omega_{fg}$  : Anguler freq. of FG(rad/s)

$N_0$  : Rotation number(rpm)

$J$  : Inertia moment(kg·cm<sup>2</sup>)

$KT$  : Torque constant(kg·cm/A)

$R_{NF}$  : Sensing resistor(Ω)

$V_{CC}$  : Supply voltage(V)



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4. Current limit value is the following equation.  

$$I_{\text{omax}}(\text{A}) = V_{\text{ref1}}(\text{V}) / R_{\text{NF}}(\Omega)$$
5. See the following equation.  

$$C_{103} \geq 1 / 1400 \omega_{\text{fg}}$$
6. Relationship between FG frequency  $f_{\text{fg}}$  and oscillation frequency  $f_{\text{osc}}$  is as follows;  

$$f_{\text{osc}} = 4094 f_{\text{fg}}$$

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

Item	Symbol	Ratings	Unit	Note
Supply voltage range	Vcc	30	V	1
Instantaneous output current	Iopeak	1.0	A	2
Output current	Io	0.7	A	
Input voltage	Vin	0 to Vcc	V	3
Power dissipation	Pr	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  
 $V_{\text{cc}} = 10.2$  to  $27.6$  V  
 $T_{\text{jopr}} = 0$  to  $125$  °C
  2. Refer to ASO data.
  3. Apply to PIN 21 to 26.
  4. Value at  $T_{\text{tab}} = 94$  °C. Thermal resistance is as follows.  
 $\theta_{\text{j-c}} = 7$  °C/W  
 $\theta_{\text{j-a}} = 15$  °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(T<sub>a</sub>=25 °C, V<sub>CC</sub>=24 V) (cont)

Direction	Input "L" level voltage	V <sub>IL2</sub>	—	—	1.0	V	Forward	2	2
	Input middle voltage	V <sub>im</sub>	1.7	—	2.4	V	Motor off		
	Input "H" level voltage	V <sub>IH2</sub>	3.0	—	—	V	Reverse		
	Input current	I <sub>I2</sub>	—	—	±0.6	mA	V <sub>I</sub> =0 to 7 V		3
Hall amp	Input resistor	R <sub>H1</sub>	7	10	13	kΩ		21 to 26	
	Input common mode voltage	V <sub>H</sub>	2.5	—	V <sub>CC</sub>	V			
	Input difference voltage	V <sub>H</sub>	70	—	210	mVpp			
Output amp	Leak current	I <sub>CEr</sub>	—	—	±100	μA	V <sub>CE</sub> =30 V	16 to 18	
	Saturation voltage	V <sub>sat1</sub>	—	2.6	3.2	V	I <sub>o</sub> =0.7 A		4
		V <sub>sat2</sub>	—	2.0	2.3	V	I <sub>o</sub> =0.35 A		
Integrator amp	Internal ref. voltage	V <sub>ref</sub>	0.9	V <sub>CC</sub> /2	1.1	V		11	
			(V <sub>CC</sub> /2)		(V <sub>CC</sub> /2)				
	Input current	I <sub>B1</sub>	—	—	±0.1	μA			
	Output voltage swing	A+	0.55	0.7	0.85	V	I <sub>i</sub> =-0.1 mA	12	5
A-		-0.55	-0.7	-0.85	V	I <sub>i</sub> =0.1 mA			
	Gain band width	BW	—	500	—	kHz	G <sub>v</sub> =0 dB		
Control amp	Voltage gain	G <sub>ct1</sub>	—	-1.5	—	dB		15	6
	Internal rdf. voltage	V <sub>ref1</sub>	595	660	725	mV			
FG amp	Input resistor	R <sub>fg</sub>	1.2	2	2.8	kΩ		5, 6	
	Input voltage	V <sub>fg</sub>	30	—	300	mVpp	f=1 kHz		
	Noise margin	nd	—	—	10	mVpp	f=1 kHz differential		
nc		—	—	1.0	Vpp	f=1 kHz common			

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

Ready	Threshold voltage	V <sub>THH</sub>	—	V <sub>ref2</sub> +0.35	—	V	12	7
		V <sub>THL</sub>	—	V <sub>ref2</sub> -0.35	—	V		
	Output "H" level voltage	V <sub>OH</sub>	3.6	4.0	4.4	V	13	
	Output "L" level voltage	V <sub>OL</sub>	—	0.4	0.8	V		
OSC	Maximum frequency	f <sub>osc</sub>	—	—	8.0	MHz	Use quartz	9
	Frequency error	Δf <sub>osc</sub>	—	—	±0.1	%	Use quartz	
Speed discri	Count	N	—	1024	—	—		10
	Output "H" voltage	V <sub>dH</sub>	V <sub>CC</sub> -1.0	—	—	V	I <sub>O</sub> =0.1 mA	
	Output "L" voltage	V <sub>dL</sub>	—	—	1.0	V	I <sub>O</sub> =-0.1 mA	
	Leak current	I <sub>doff</sub>	—	—	±0.1	μA		
	Discri. gain	K <sub>v</sub>	—	0.12	—	V/%		
	Operating frequency	f <sub>d</sub>	—	—	8.0	MHz		10
OTSD operating temperature	T <sub>sd</sub>	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 V<sub>ref2</sub>.
  6. See Figure 3.  $G_{ct1} = 20 \log_{10} \frac{\Delta V_{15}}{\Delta V_{12}}$
  7. See Figure 4.



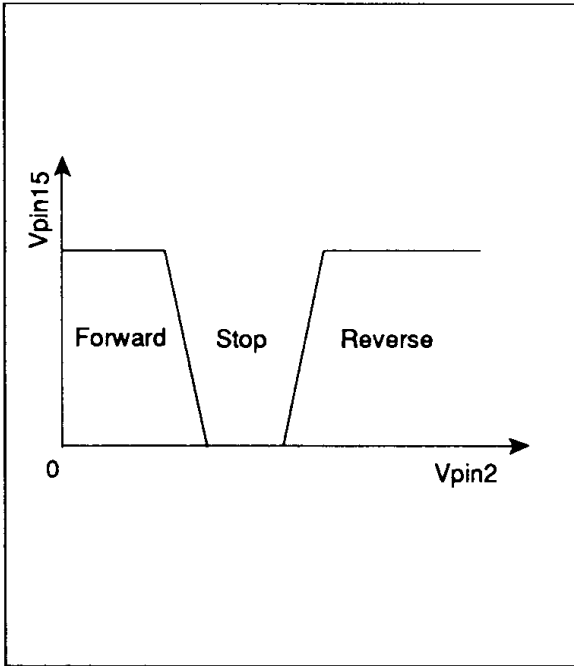


Figure 1

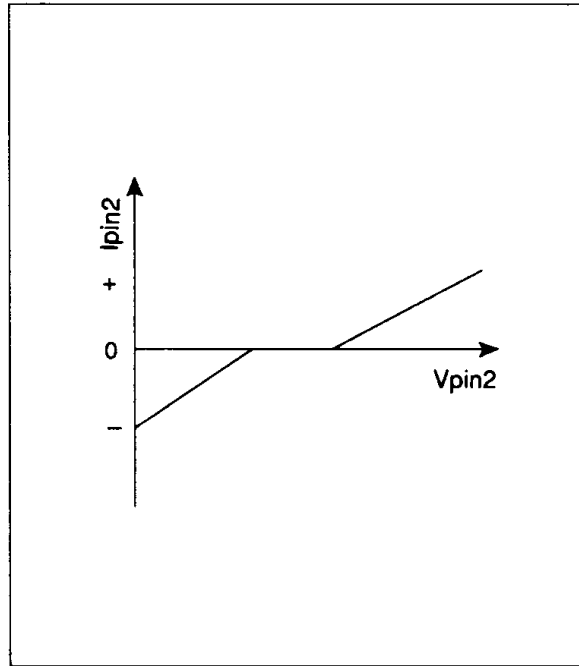


Figure 2

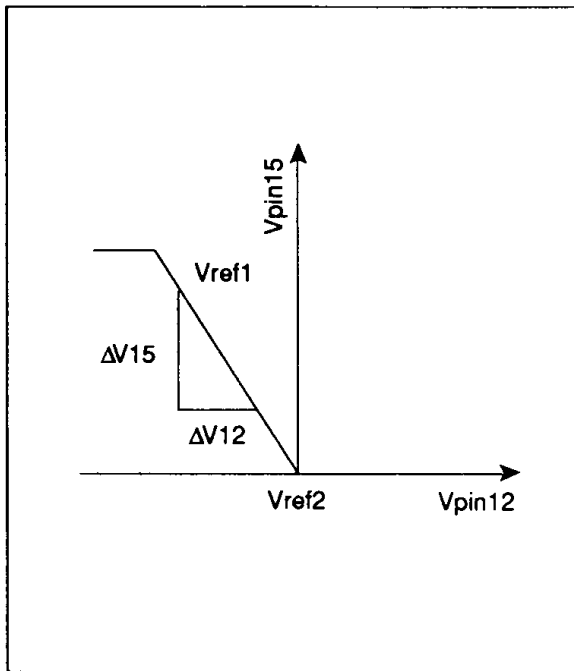


Figure 3

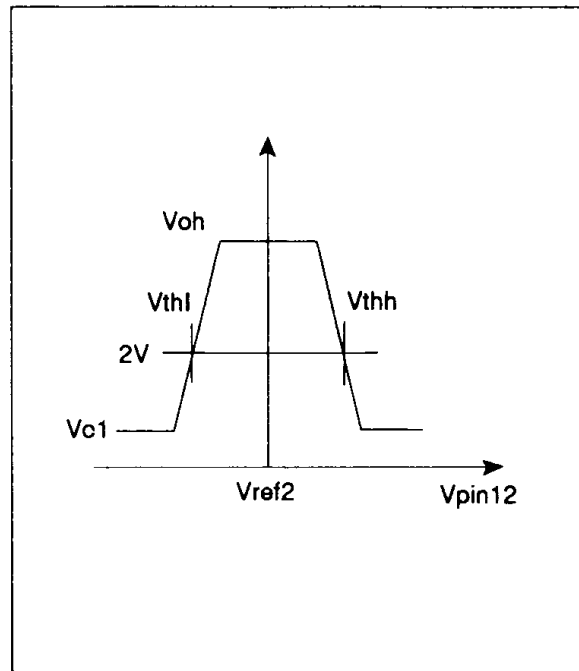
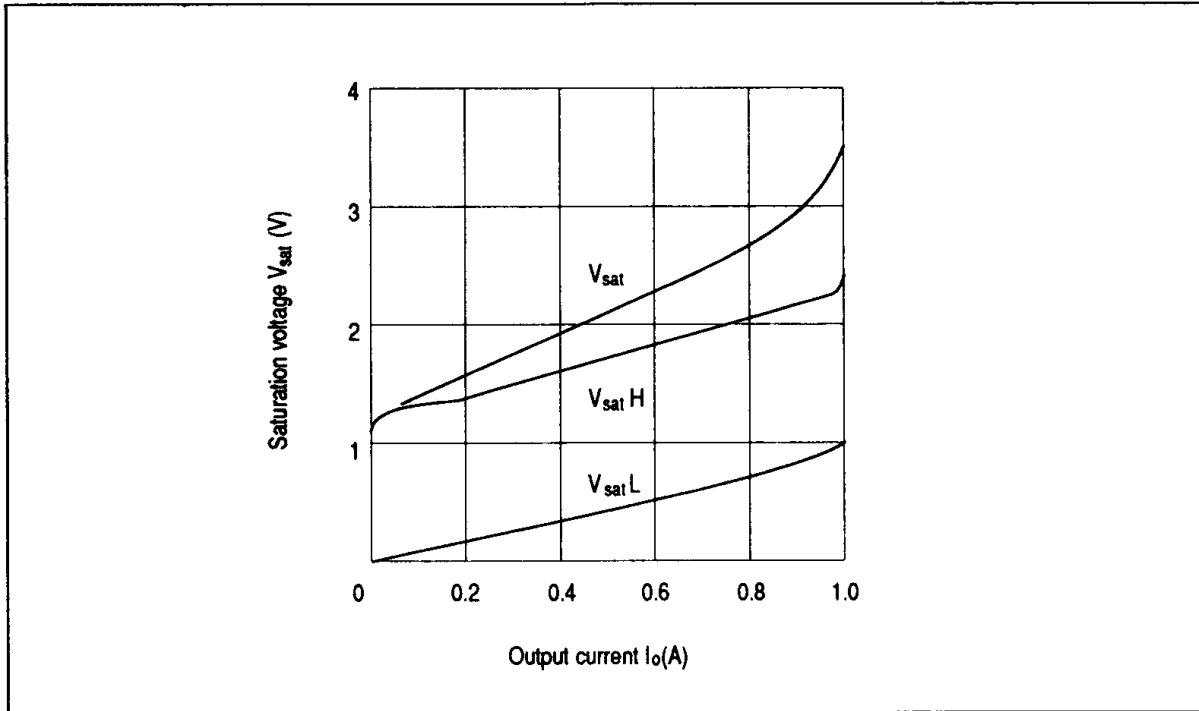
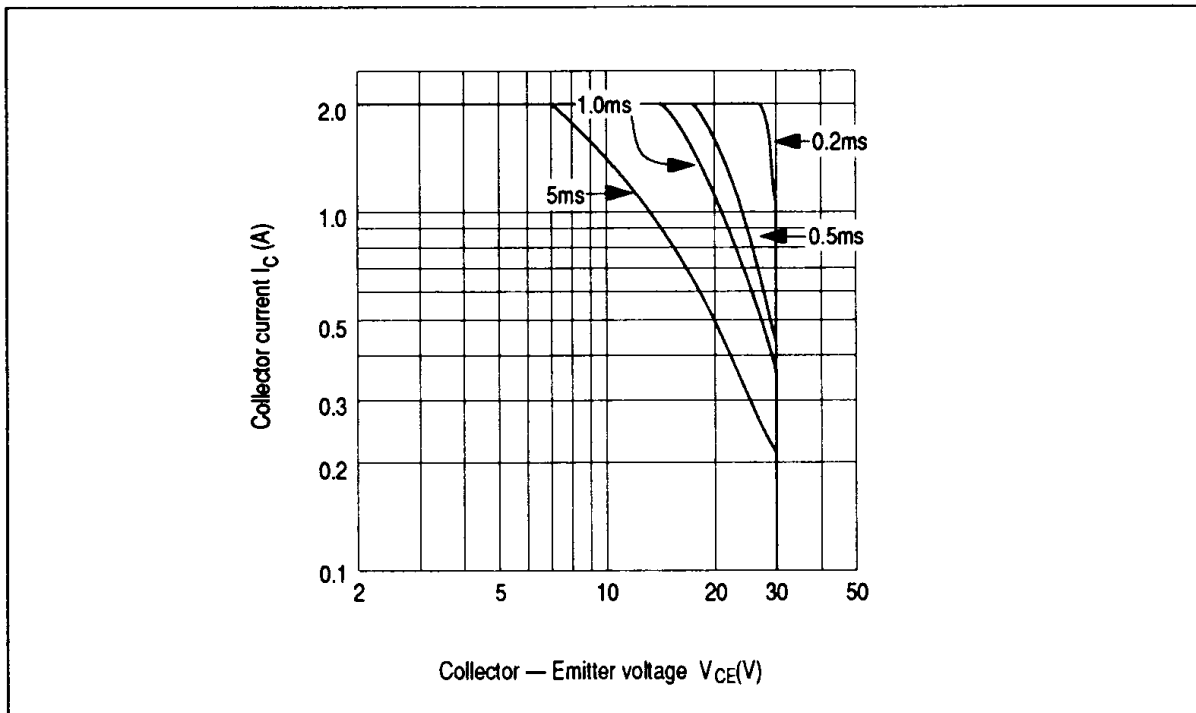


Figure 4





**Figure 5 Reference Data**  
**Saturation Voltage vs. Output Current**



**Figure 6 Reference Data**  
**Output Transistor ASO**