

# KA3080/KA3080D/KA3080DM

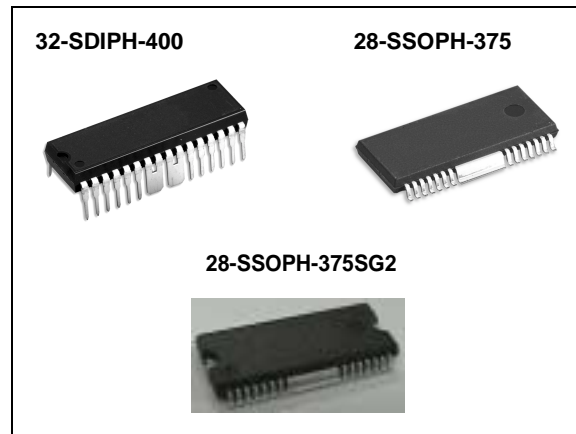
## 3-Phase BLDC Motor Driver

### Features

- 3-Phase, Full-Wave, Linear BLDC Motor Driver With 3 Hall Sensors
- Built-in TSD (Thermal Shutdown) Circuit
- Built-in Torque Ripple Control Circuit
- Built-in Output Current Limiter
- Motor Speed Control
- High Output Current
- Built-in FG Amplifier With Sinusoidal Waveforms
- Built-in Hall Amplifier
- Built-in CW and CCW Circuit

### Description

The KA3080, KA3080D, KA3080DM are a monolithic integrated circuit, and it is suitable for 3-phase capstan motor driver for VCR system.



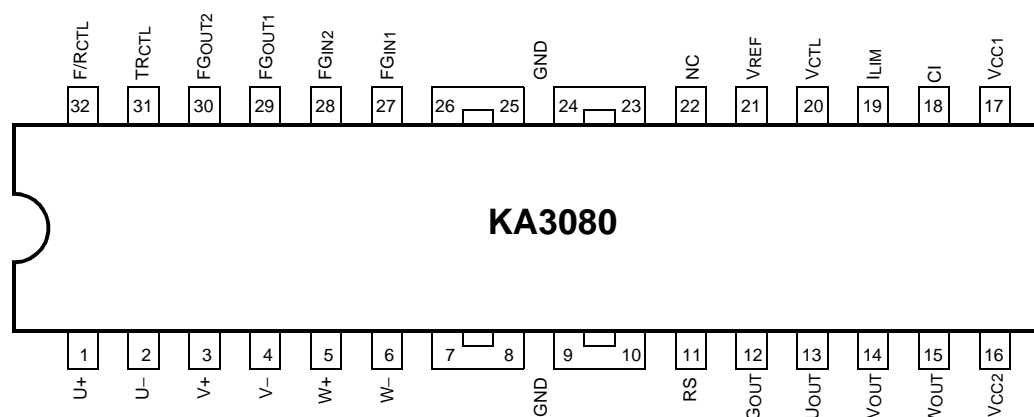
### Target Application

- Video Cassette Recorder (VCR) Capstan Motor
- Other 3-Phase BLDC Motor

### Ordering Information

Device	Package	Operating Temp.
KA3080C	32-SDIPH-400	-25°C ~ +75°C
KA3080BD	28-SSOPH-375	-25°C ~ +75°C
KA3080BDTF	28-SSOPH-375	-25°C ~ +75°C
KA3080BD3	28-SSOPH-375SG2	-25°C ~ +75°C
KA3080BD3TF	28-SSOPH-375SG2	-25°C ~ +75°C

## Pin Assignments (32SDIPH)



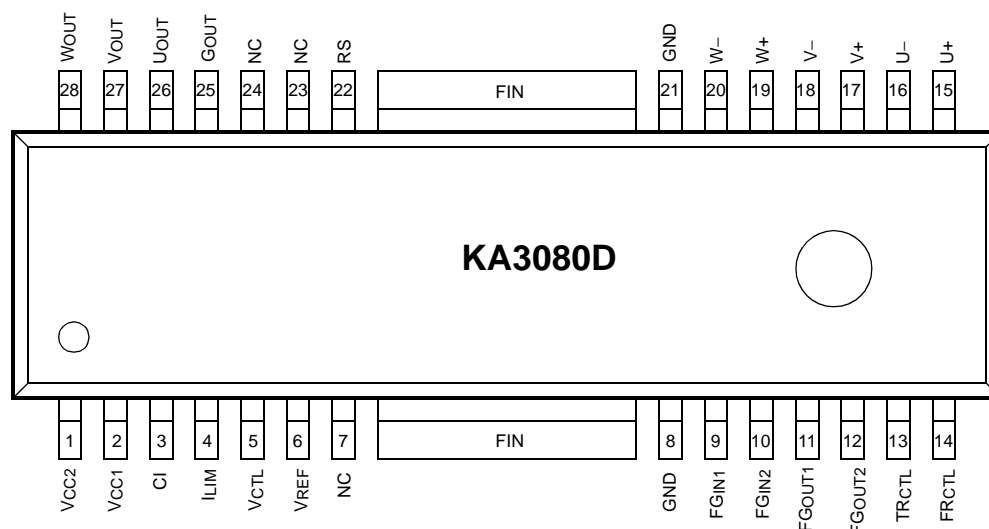
## Pin Definitions (32SDIPH)

Pine Number	Pin Name	I/O	Pin Function Description
1	U+	I	U+ Hall Signal Input
2	U-	I	U- Hall Signal Input
3	V+	I	V+ Hall Signal Input
4	V-	I	V- Hall Signal Input
5	W+	I	W+ Hall Signal Input
6	W-	I	W- Hall Signal Input
7	GND	-	Ground (Signal)
8	GND	-	Ground (Signal)
9	GND	-	Ground (Signal)
10	GND	-	Ground (Signal)
11	RS	O	Output Current Detection
12	GOUT	-	Ground (Power)
13	UOUT	O	U Out
14	VOUT	O	V Out
15	WOUT	O	W Out
16	VCC2	-	Supply Voltage (Power)
17	VCC1	-	Supply Voltage(Signal)
18	CI	-	Phase Stabilization
19	ILIM	I	Current Limitation
20	VCTL	I	Voltage Control
21	VREF	I	Voltage Control Reference
22	NC	-	No Connection
23	GND	-	Ground (Signal)
24	GND	-	Ground (Signal)
25	GND	-	Ground (Signal)
26	GND	-	Ground (Signal)

## Pin Definitions (32-SDIPH) (Continued)

Pine Number	Pin Name	I/O	Pin Function Description
27	FGIN1	I	FG Amp. Input1
28	FGIN2	I	FG Amp. Input2
29	FGOUT1	O	FG Amp. Output
30	FGOUT2	O	FG Comp. Output
31	TRCTL	I	Troque Ripple Control
32	F/RCTL	I	Forward & Reverse Control

## Pin Assignments (28-SSOPH)



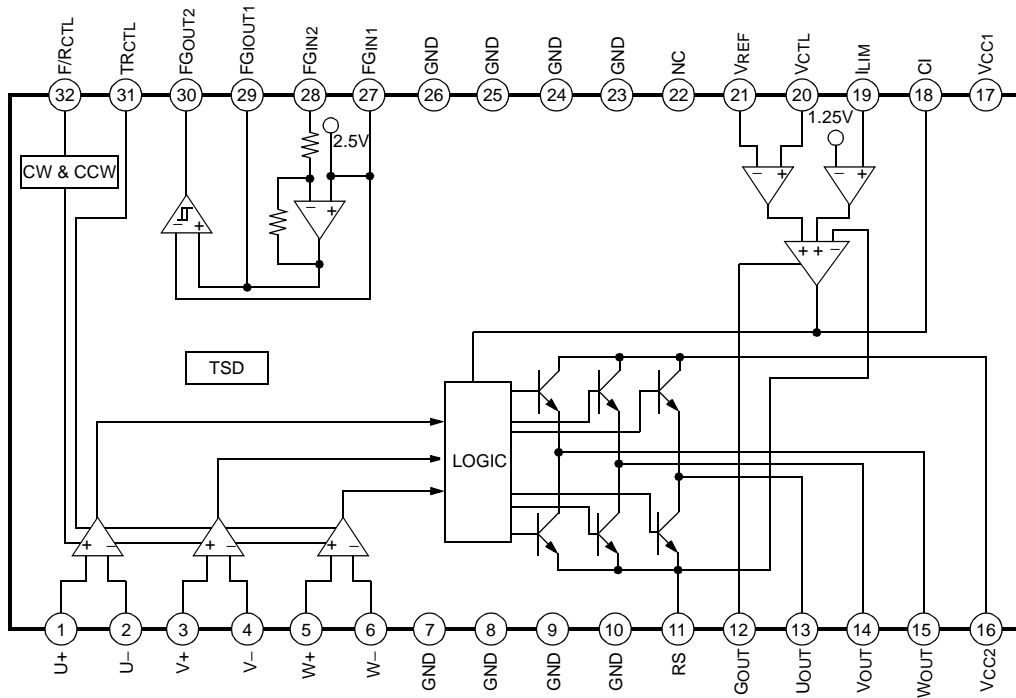
## Pin Definitions (28-SSOPH)

Pine Number	Pin Name	I/O	Pin Function Description
1	VCC2	-	Supply Voltage (Power)
2	VCC1	-	Supply Voltage (Signal)
3	CI	-	Phase Stabilization
4	ILIM	I	Current Limitation
5	VCTL	I	Voltage Control
6	VREF	I	Voltage Control Reference
7	NC	-	No Connection
8	GND	-	Ground (Signal)
9	FGIN1	I	FG Amp. Input 1
10	FGIN2	I	FG Amp. Input 2
11	FGOUT1	O	FG Amp. Output
12	FGOUT2	O	FG Comp. Output
13	TRCTL	I	Torque Ripple Control
14	FRCTL	I	Forward & Reverse Control
15	U+	I	U+ Hall Signal Input

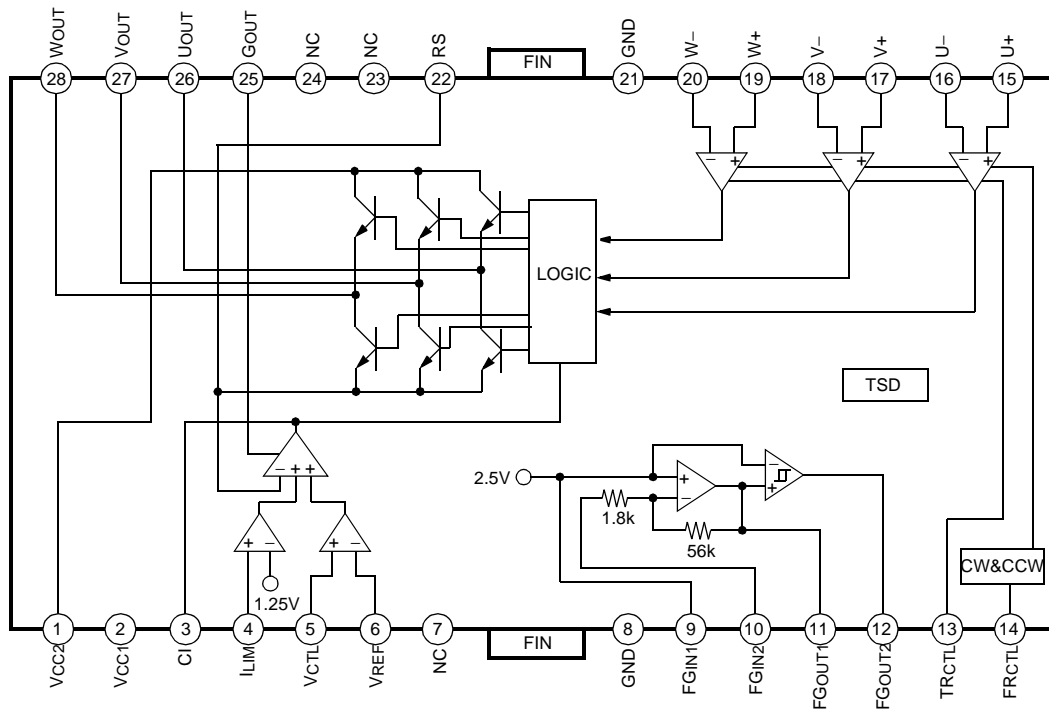
**Pin Definitions (28-SSOPH)** (Continued)

Pin Number	Pin Name	I/O	Pin Function Description
16	U-	I	U- Hall Signal Input
17	V+	I	V+ Hall Signal Input
18	V-	I	V- Hall Signal Input
19	W+	I	W+ Hall Signal Input
20	W-	I	W- Hall Signal Input
21	GND	-	Ground (Signal)
22	RS	O	Output Current Detection
23	NC	-	No Connection
24	NC	-	No Connection
25	GOUT	-	Ground (Power)
26	UOUT	O	U Out
27	VOUT	O	V Out
28	WOUT	O	W Out

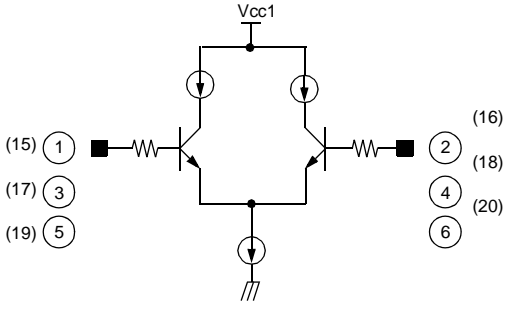
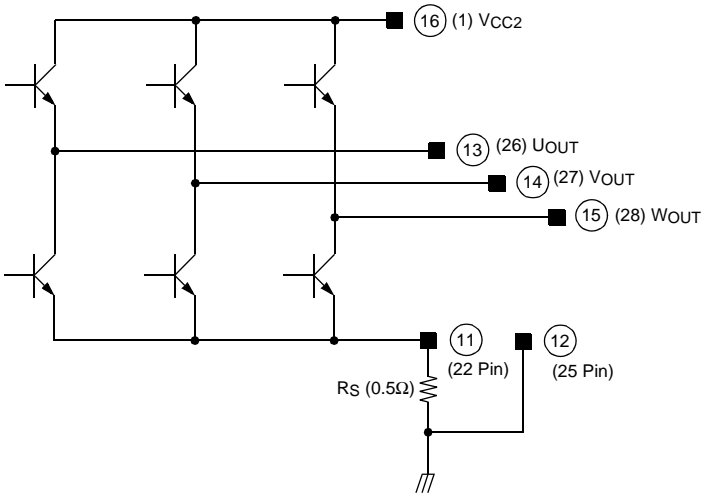
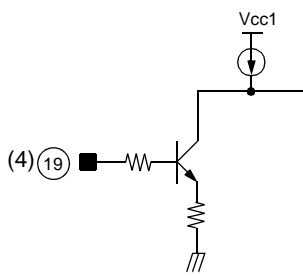
**Internal Block Diagram (32-SDIPH)**



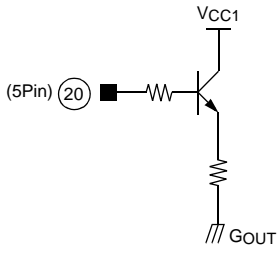
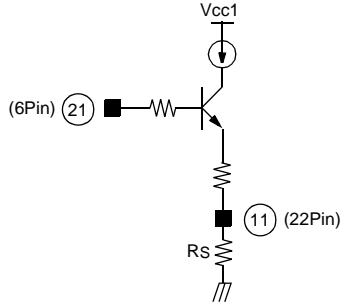
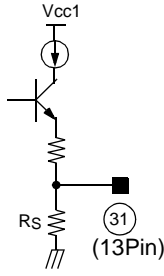
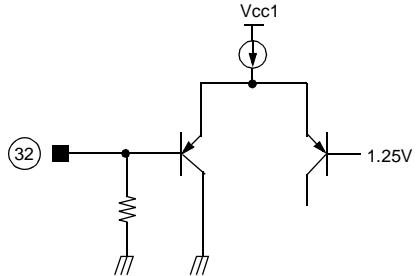
## Internal Block Diagram (28-SSOPH)



**Equivalent Circuits (32-SDIPH: ○, 28-SSOPH: (#))**

Description	Pin No.	Internal Circuit
Hall Input	32-SDIPH 1, 2, 3 4, 5, 6  28-SSOPH 15, 16, 17 18, 19, 20	
Output & Current Detection	32-SDIPH 13, 14, 15, 11  28-SSOPH 26, 27, 28, 22	
Speed Control (Current limitation)	32-SDIPH 19  28-SSOPH 4	

**Equivalent Circuits (32-SDIPH: ○ , 28-SSOPH: #)** (Continued)

Description	Pin No.	Internal Circuit
Speed Control (Voltage Control)	32-SDIPH 20  28-SSOPH 5	
Voltage Control Reference	32-SDIPH 21  28-SSOPH 6	
Torque Ripple Control	32-SDIPH 31  28-SSOPH 13	
Forward & Reverse Control	32-SDIPH 32  28-SSOPH 14	

**Equivalent Circuits (32-SDIPH: O , 28-SSOPH: (#))** (Continued)

Description	Pin No.	Internal Circuit
<p>FG AMP.</p>	<p>32-SDIPH 27, 28, 29, 30</p> <p>28-SSOPH 9, 10, 11, 12</p>	
<p>Phase Stabilization</p>	<p>32-SDIPH 16, 18</p> <p>28-SSOPH 1, 3</p>	



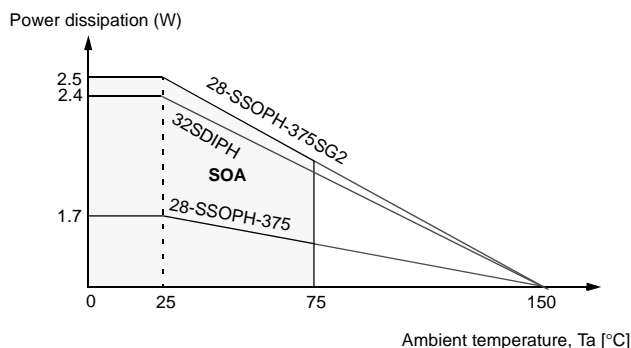
## Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Value	Unit	Remark
Supply Voltage (Signal)	VCC1max	7	V	-
Supply Voltage (Power)	VCC2max	28	V	-
Maxium Output Current	I <sub>Omax</sub>	1.5 <sup>note1</sup>	A / Phase	VCC1=5V, VCC2=16V
Power Dissipation	P <sub>d</sub>	2.4 <sup>note2</sup>	W	32SDIPH-400
		1.7 <sup>note2</sup>	W	28SSOPH-375
		2.5 <sup>note2</sup>	W	28SSOPH-375SG2
Junction Temperature	T <sub>J</sub>	150	°C	VCC1=5V, VCC2=16V
Operating Temperature	T <sub>OPR</sub>	-25 ~ +75	°C	
Storage Temperature	T <sub>STG</sub>	-40 ~ +125	°C	

### Note:

- Duty 1 / 100, pulse width 500μs
- 1) When mounted on glass epoxy PCB (76.2 × 114 × 1.57mm)  
 2) Power dissipation reduces 13.6mW / °C for using above Ta=25°C. (32SDIPH Type)  
 Power dissipation reduces 19.2mW / °C for using above Ta=25°C. (28SSOPH Type)  
 Power dissipation reduces 20.0mW / °C for using above Ta=25°C. (28SSOPH -SG2 Type)
- Do not exceed P<sub>d</sub> and SOA(Safe Operating Area).

## Power Dissipation Curve



## Recommended Operating Conditions (Ta=25°C)

Parameter	Symbol	Value	Unit
Operating Supply Voltage (Signal)	VCC1	4.5 ~ 5.5	V
Operating Supply Voltage (Power)	VCC2	8 ~ 27	V

## Electrical Characteristics

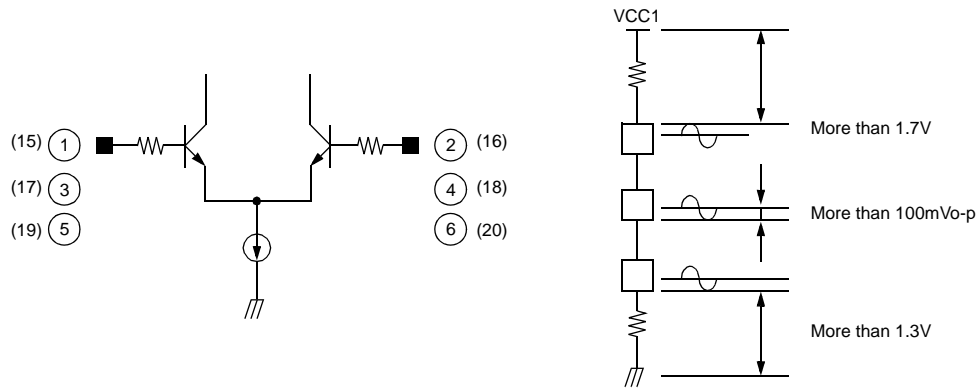
(VCC1=5V, VCC2=16V, RS=0.5Ω, Ta=25°C, unless otherwise specified)

Block	Parameter	Symbol	Conditions	Min.	Typ.	max.	Unit	
Total	Quiescent Input Current 1	ICC1	VCC1=5V, VFR=5V	5.0	8.5	12.0	mA	
	Quiescent Input Current 3	ICC3	VCC1=7V, VFR=5V	6.0	10.0	15.0	mA	
	Quiescent Input Current	IO1	VCC2=16V, VLIM=0V	-	1.5	5.0	mA	
	Quiescent Input Current (Max.)	IO3	VCC2=27V, VLIM=VREF	-	2.7	7.0	mA	
Output	Current Limit Level	GML1	RS=0.5Ω	32-SDIPH	0.61	0.67	0.73	A / V
				28-SSOPH	0.46	0.52	0.58	
	Control Gain	GM1	VIN=0V	32-SDIPH	0.9	1.0	1.1	A / V
				28-SSOPH	0.7	0.8	0.9	
	Output Amp. Saturation Voltage 4 (Outflow Current)	VSU4	IOUT=0.8A / Phase	-	1.8	2.0	V	
	Output Amp. Saturation Voltage 4 (Inflow Current)	VSD4	IOUT=0.8A / Phase	-	1.8	2.0	V	
	Limit Current Gap Of Phases	LD1	LIU2-LIWU2	-20	0	20	mA	
	Current Gap Of Phases	D1	lVU1-lWU1	-20	0	20	mA	
	Phase Output Wave Frequency 1	PF1	15kHz, 5Vp-p	2.45	2.5	2.55	kHz	
Phase Output Wave Frequency 4	PF4	10kHz, 5Vp-p	1.62	1.67	1.72	kHz		
Control	Current Limit Input Current	I19	-	-	350	2000	nA	
	Control Input Current	I20	-	-	350	2000	nA	
	Input Offset Voltage U	VO2U	-	-50	0	50	mV	
Rotation Control	CW Voltage Range	VFRU	-	1.0	1.3	1.6	V	
FG amp & comp	FG Amp. Input DC Voltage	V28(10)	32-SDIPH (28-SSOPH)	2.2	2.5	2.8	V	
	FG Amp. Reference Voltage	V27(9)	32-SDIPH (28-SSOPH)	2.2	2.5	2.8	V	
	FG Amp. Voltage Gain	FGAV1	FGIN3=10kHz, 60mVp-p	28	31	34	Times	
	FG Comp. Output Frequency	FCOMP	FGAMP0=3Vp-p (1kHz)	0.9	1	1.1	kHz	
	FG Comp. Downward Input Threshold Voltage	VTHDW	FGAMP0=3→2 Sweep	2.40	2.45	2.50	V	
	FG Comp. UPward Input Threshold Voltage	VTHUP	FGAMP0=2→3 Sweep	2.50	2.55	2.60	V	
	FG Comp. Hysteresis	VHYS	-	20	100	180	mV	
	FG Output High Voltage	FGHI	FGIN3=3V	4.2	-	-	V	
	FG Output Low Voltage	FGLO	FGIN3=2V	-	-	0.4	V	

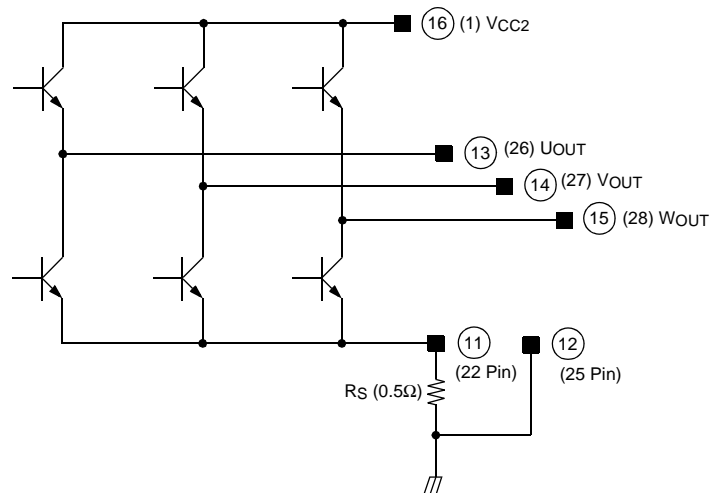
## Application Information (32-SDIPH: O , 28-SSOPH: (#))

### 1. Hall Input

The input signal of the hall sensor requires larger amplitude than 100mVo-p. The operating voltage level of the hall sensor is from 1.2V ~  $V_{CC1}-0.8V$ .



### 2. Output Current Detection



The  $R_S$  (Output current sensing resistor) is connected to  $G_{OUT}$  and Approx.  $0.5\Omega$ . It converts motor current to a voltage which is feedback amplifier.

### 3. Motor Speed Control (Input Current Limitation)

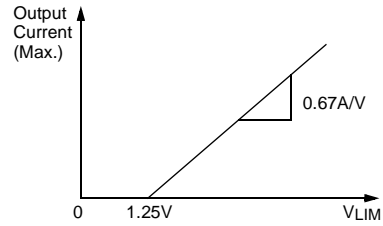
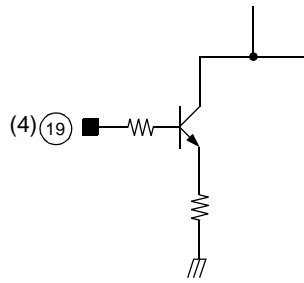
The maximum output current is limited by the  $I_{LIM}$  (Current limiting) voltage.

If current limitation is not in use then connect it to  $V_{CC1}$ .

The control gain is approx.  $0.67A/V$  as follows.

$$GML = \Delta I_O / \Delta V_{LIM} = (I_{O2} - I_{O1}) / (V_{LIM2} - V_{LIM1}), \text{ where } V_{LIM1} = 1.45V \rightarrow \text{Output current} = I_{O1}$$

$$V_{LIM2} = 1.55V \rightarrow \text{Output current} = I_{O2}$$

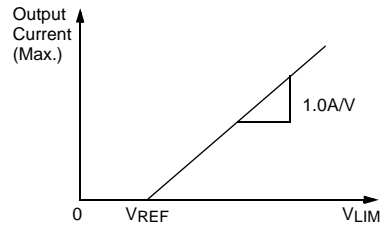
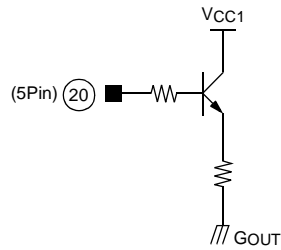


#### 4. Motor Speed Control (Input Voltage Control)

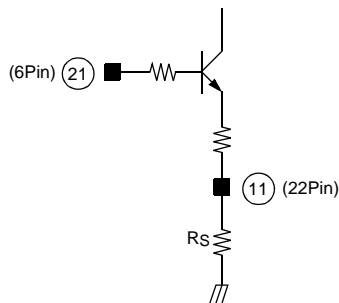
Motor speed control is possible when  $V_{CTL} \geq V_{REF}$ .  
 The control gain is approx. 1.0A/V as follows.

$$GML = \Delta I_O / \Delta V_{CTL} = (I_{O2} - I_{O1}) / (V_{CTL2} - V_{CTL1}), \text{ where } V_{REF} = 2.5V, V_{CTL1} = 2.6V \rightarrow \text{Output current} = I_{O1}$$

$$V_{REF} = 2.5V, V_{CTL2} = 2.7V \rightarrow \text{Output current} = I_{O2}$$

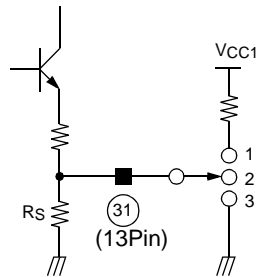


#### 5. Voltage Control Reference



The input voltage range is  $2V \leq V_{REF} \leq (V_{CC1} - 2V)$ .

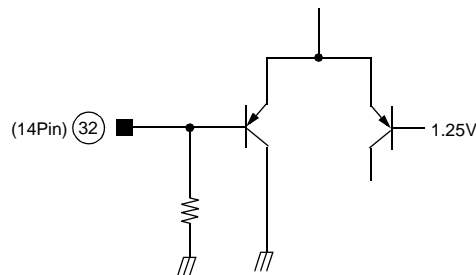
## 6. Torque Ripple Control



The motor torque ripple is controlled by the TRCTL (Torque ripple control) voltage as follows.

1. GND
2. Normal Mode
3. Control Mode

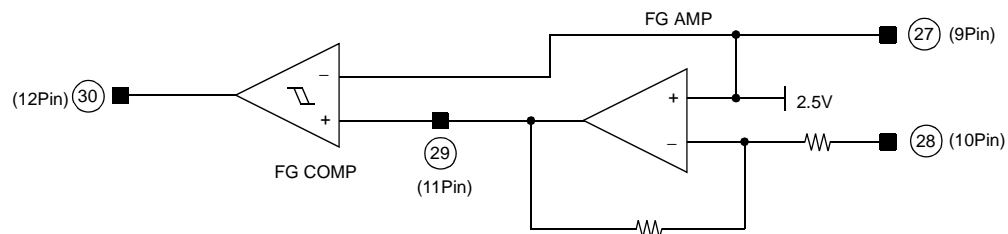
## 7. Forward & Reverse Rotation Control



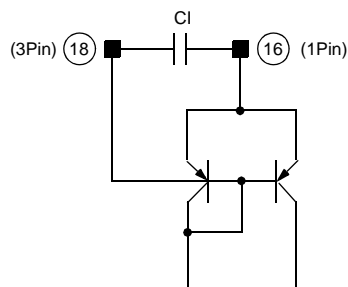
Forward mode:  $V_{FRCTL} \geq 1.8V$

Reverse mode:  $V_{FRCTL} \leq 0.8V$

## 8. FG Amp



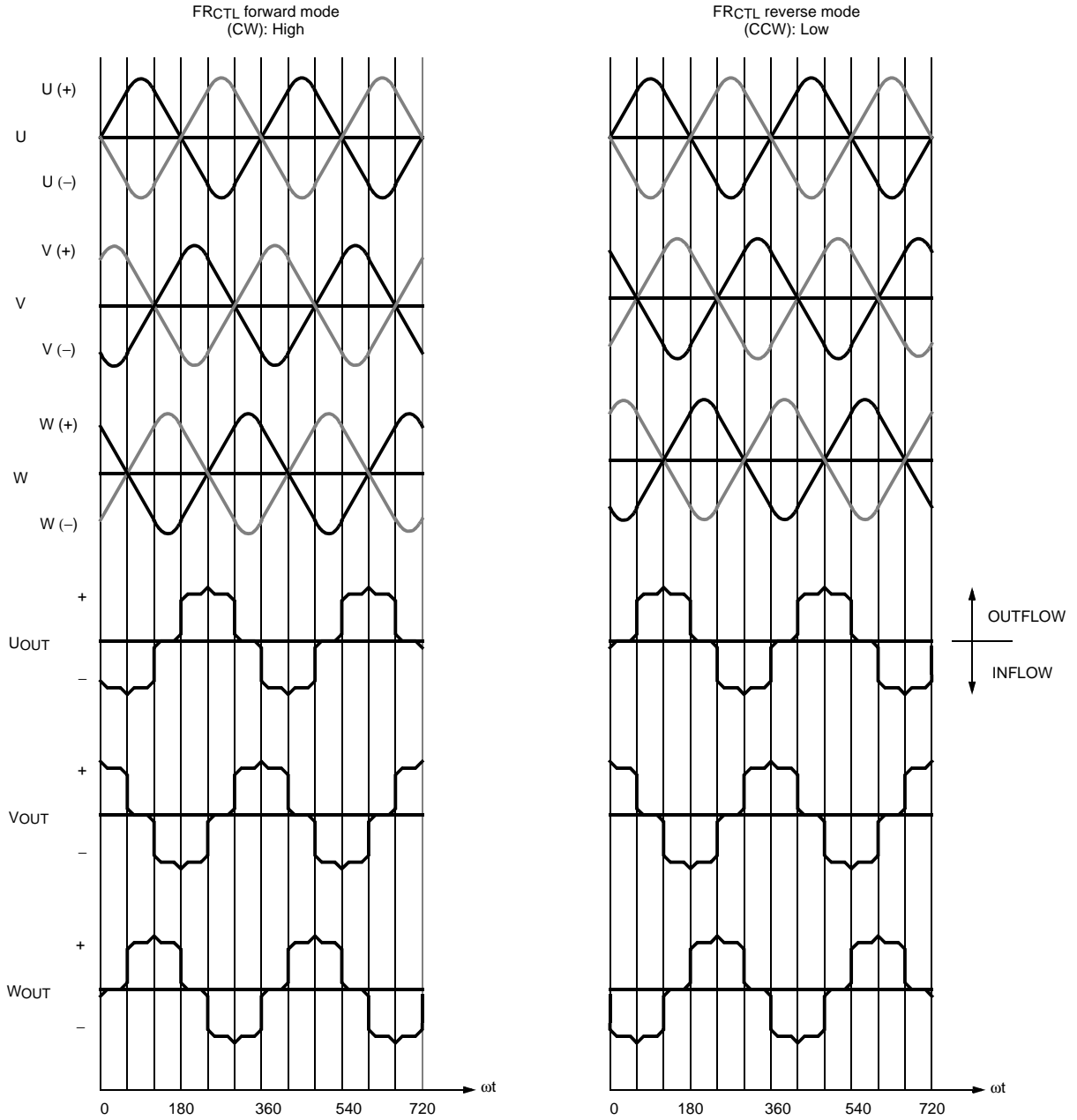
## 9. Phase Stabilization



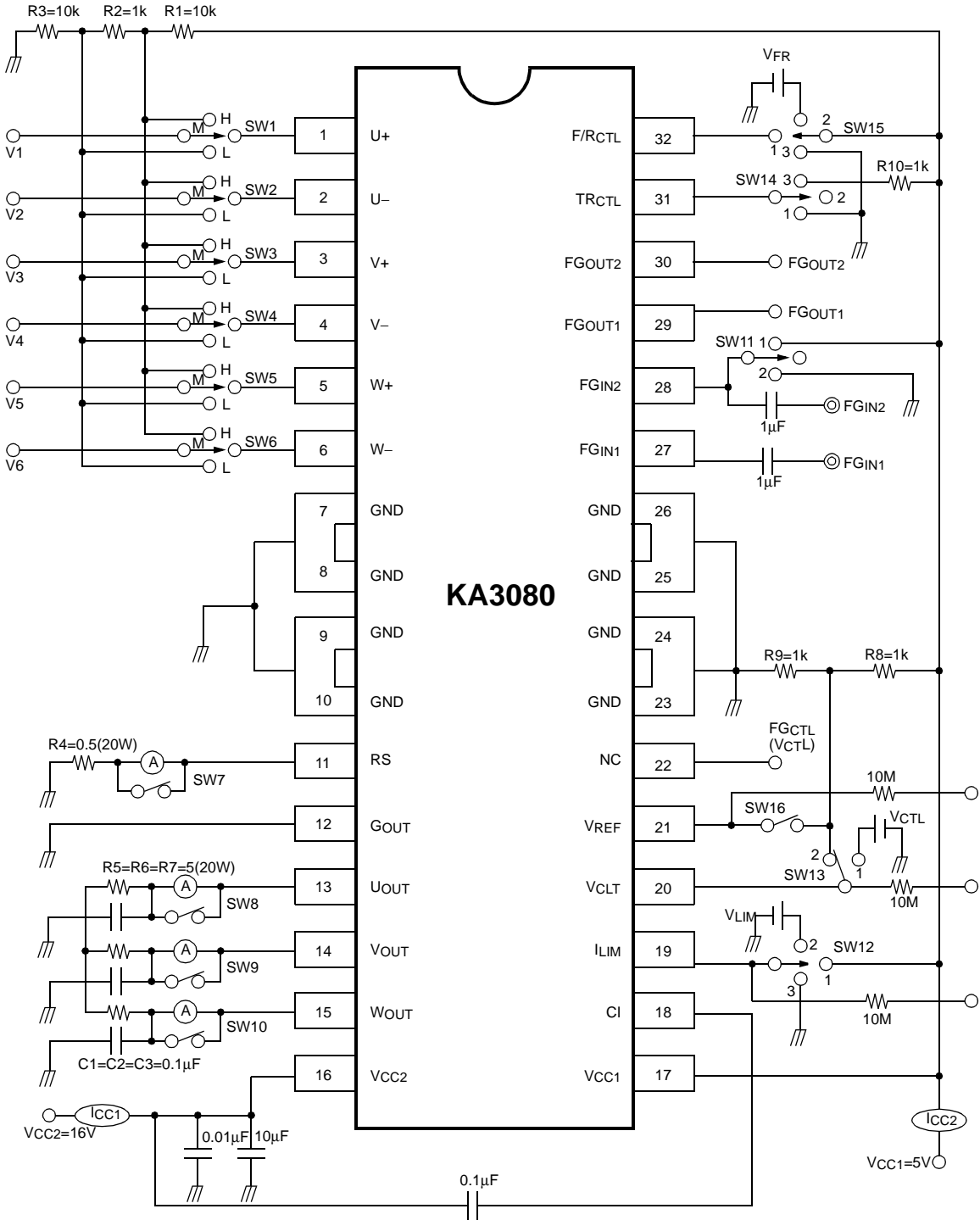
Be inserted a capacitor between VCC2.

This capacitor, approx.  $0.1\mu F$  is for the phase stabilization of the circuit.

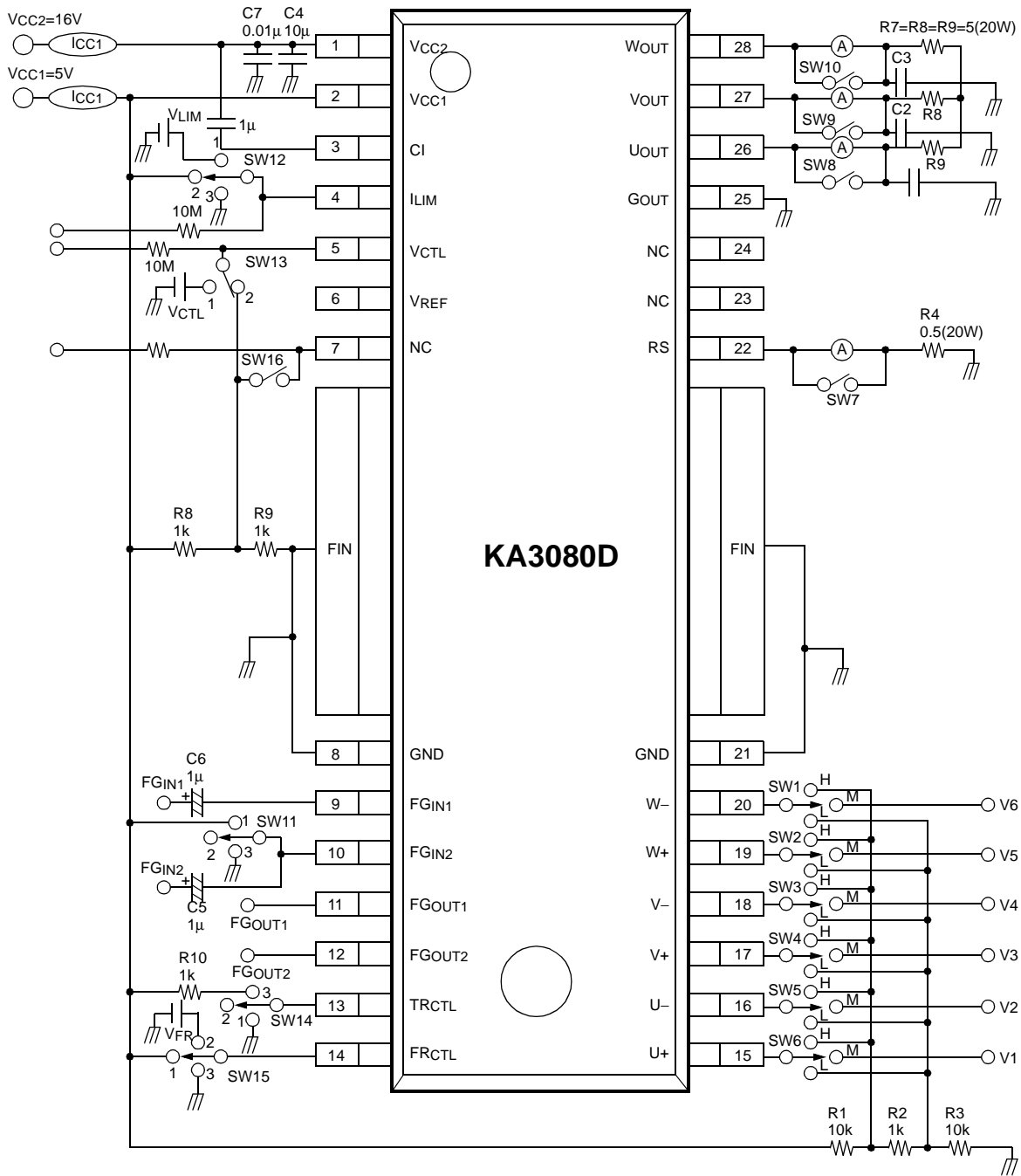
# Timing Chart



# Test Circuits (32-SDIPH)

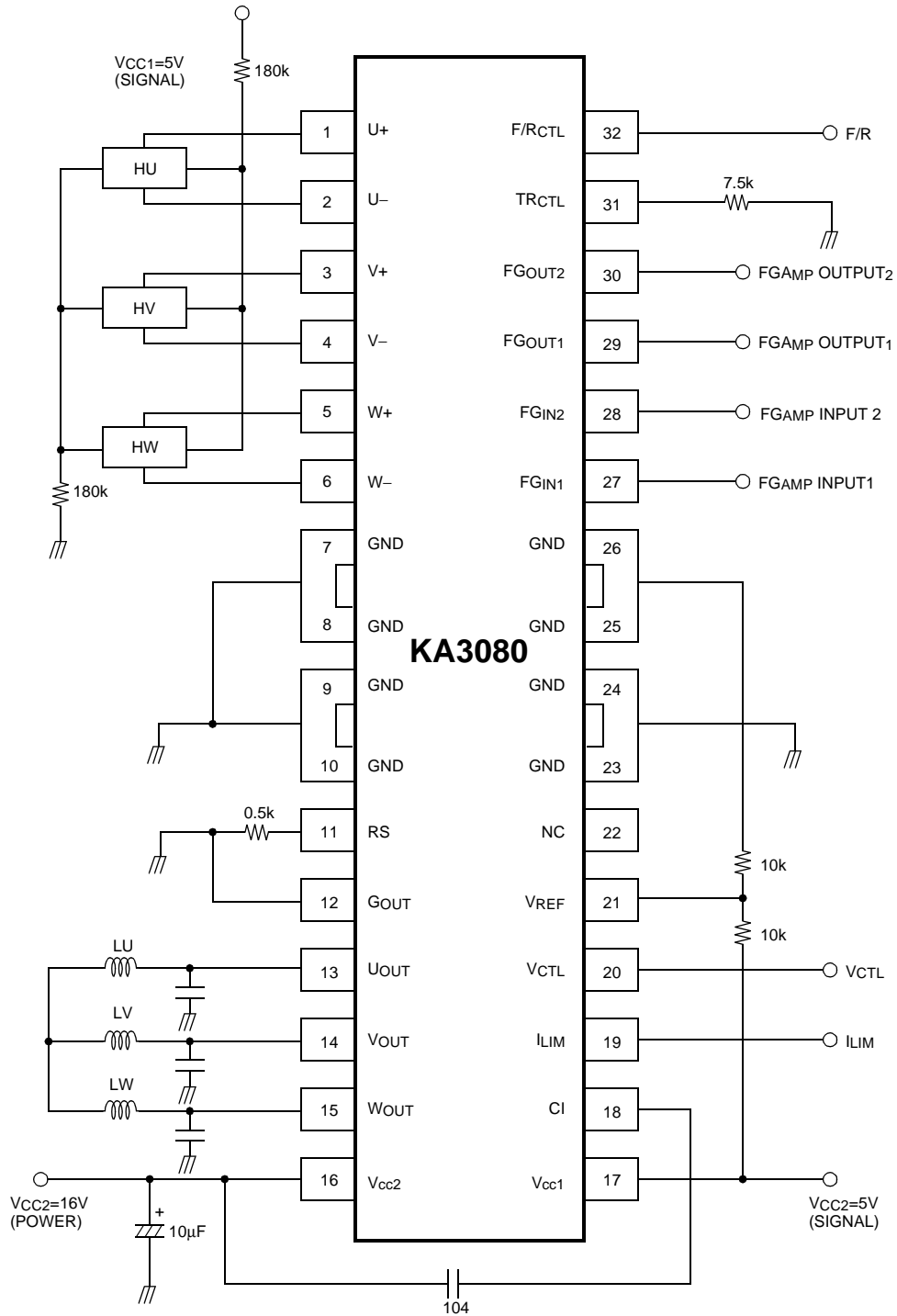


### Test Circuits (28-SSOPH)

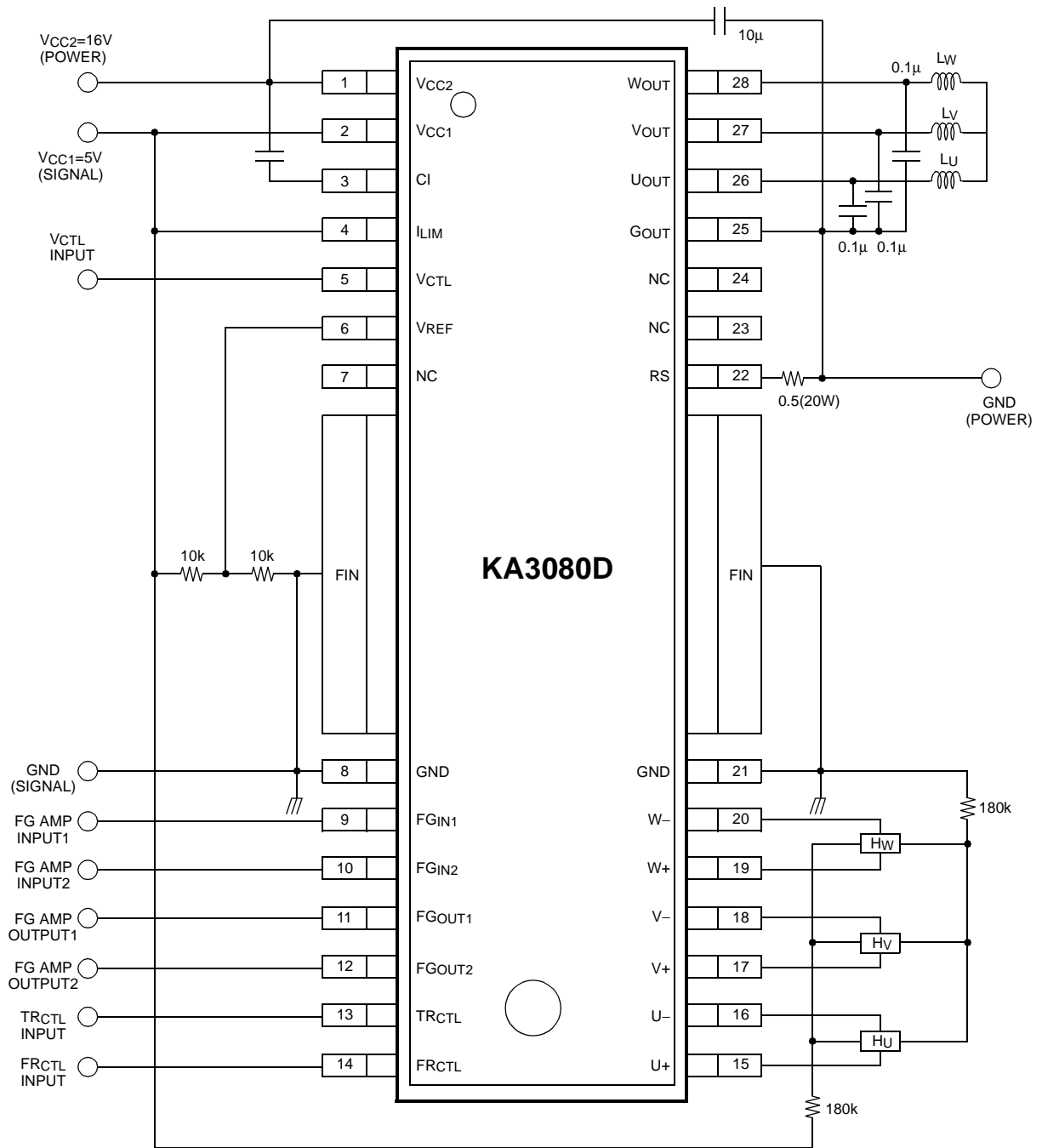




## Typical Application Circuits (32-SDIPH)



## Typical Application Circuits (28-SSOPH)





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