KA3080/KA3080D/KA3080DM

3-Phase BLDC Motor Driver

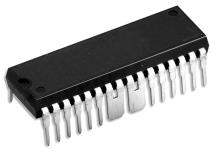
Features

- 3-Phase, Full-Wave, Linear BLDC Motor Driver With 3 Hall Sensors
- Built-in TSD (Therml 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

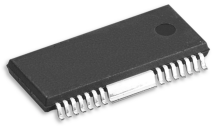
Description

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

32-SDIPH-400



28-SSOPH-375



28-SSOPH-375SG2

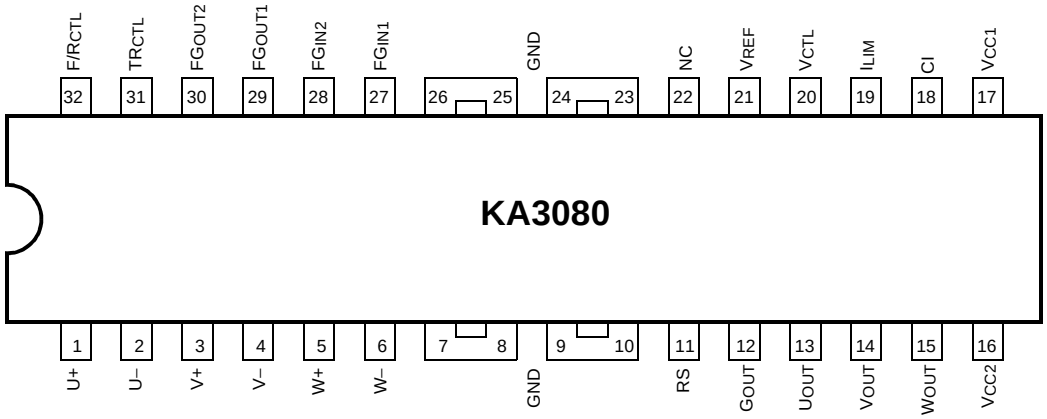
Target Application

- 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)



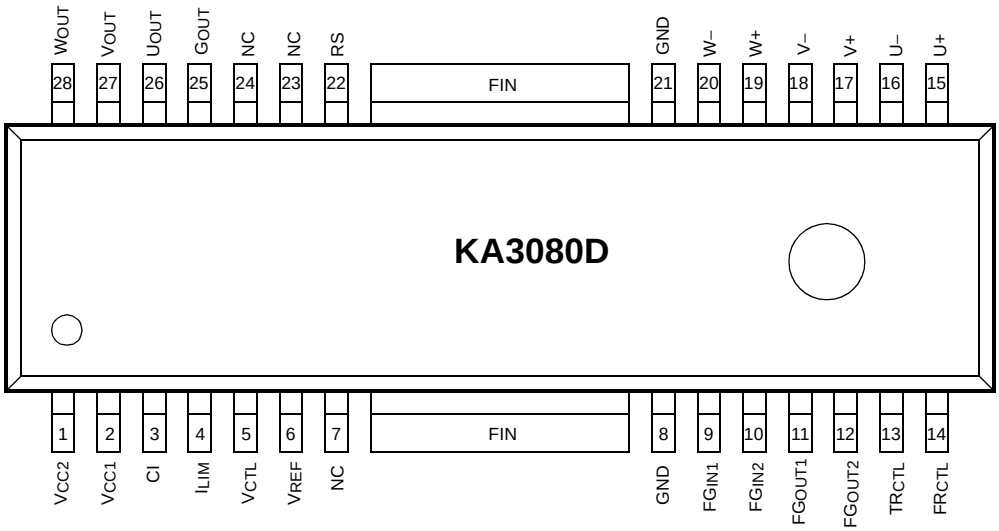
Pin Definitions (32SDIPH)

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	G_{OUT}	-	Ground (Power)
13	U_{OUT}	O	U Out
14	V_{OUT}	O	V Out
15	W_{OUT}	O	W Out
16	V_{CC2}	-	Supply Voltage (Power)
17	V_{CC1}	-	Supply Voltage(Signal)
18	CI	-	Phase Stabilization
19	I_{LIM}	I	Current Limitation
20	V_{CTL}	I	Voltage Control
21	V_{REF}	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	FG_{IN1}	I	FG Amp. Input1
28	FG_{IN2}	I	FG Amp. Input2
29	FG_{OUT1}	O	FG Amp. Output
30	FG_{OUT2}	O	FG Comp. Output
31	TR_{CTL}	I	Troque Ripple Control
32	F/R_{CTL}	I	Forward & Reverse Control

Pin Assignments (28-SSOPH)



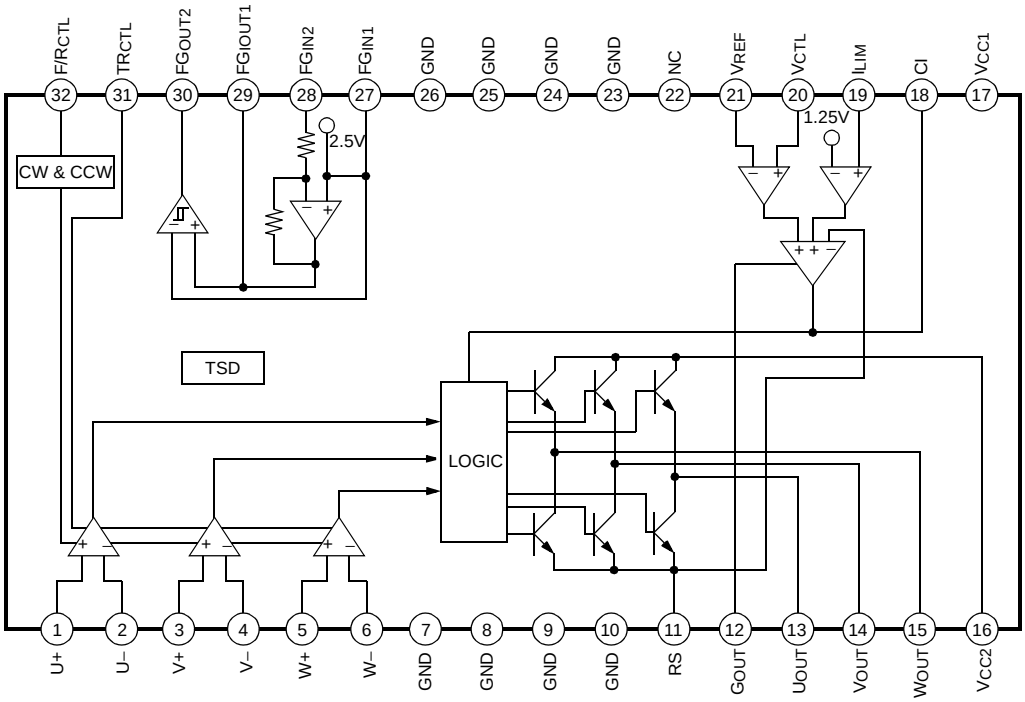
Pin Definitions (28-SSOPH)

Pine Number	Pin Name	I/O	Pin Function Description
1	V_{CC2}	-	Supply Voltage (Power)
2	V_{CC1}	-	Supply Voltage (Signal)
3	CI	-	Phase Stabilization
4	I_{LIM}	I	Current Limitation
5	V_{CTL}	I	Voltage Control
6	V_{REF}	I	Voltage Control Reference
7	NC	-	No Connection
8	GND	-	Ground (Signal)
9	FG_{IN1}	I	FG Amp. Input 1
10	FG_{IN2}	I	FG Amp. Input 2
11	FG_{OUT1}	O	FG Amp. Output
12	FG_{OUT2}	O	FG Comp. Output
13	TR_{CTL}	I	Torque Ripple Control
14	FR_{CTL}	I	Forward & Reverse Control
15	U+	I	U+ Hall Signal Input

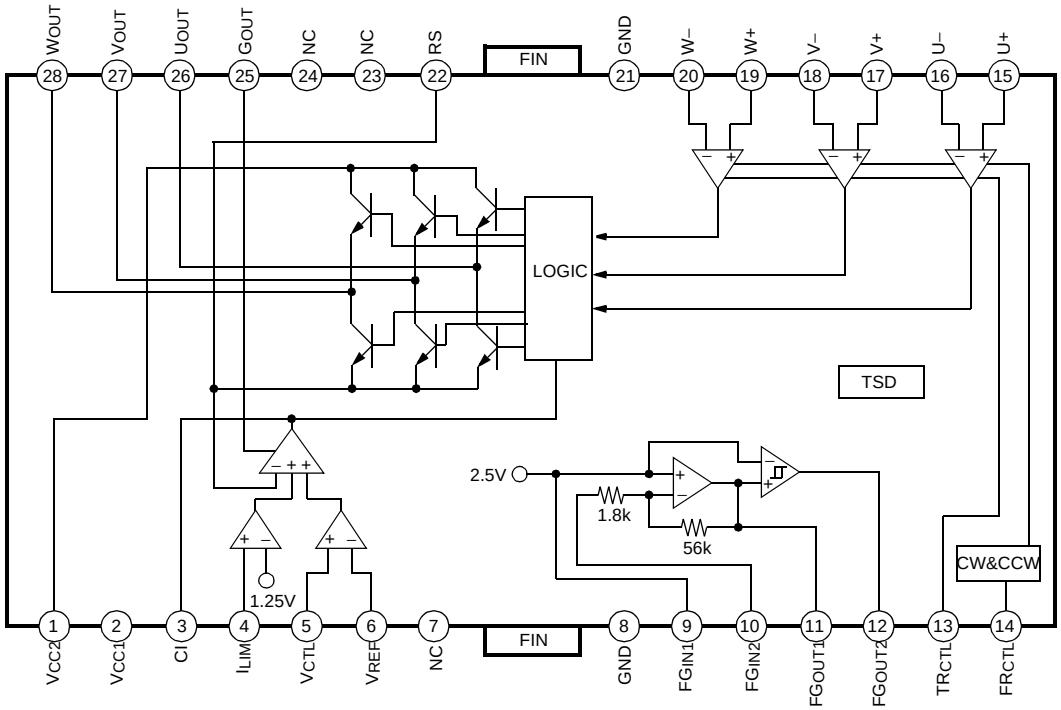
Pin Definitions (28-SSOPH) (Continued)

Pine 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	G_{OUT}	-	Ground (Power)
26	U_{OUT}	O	U Out
27	V_{OUT}	O	V Out
28	W_{OUT}	O	W Out

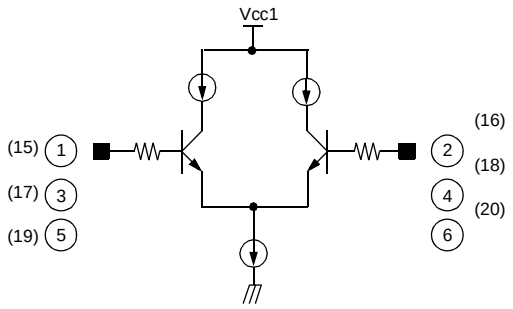
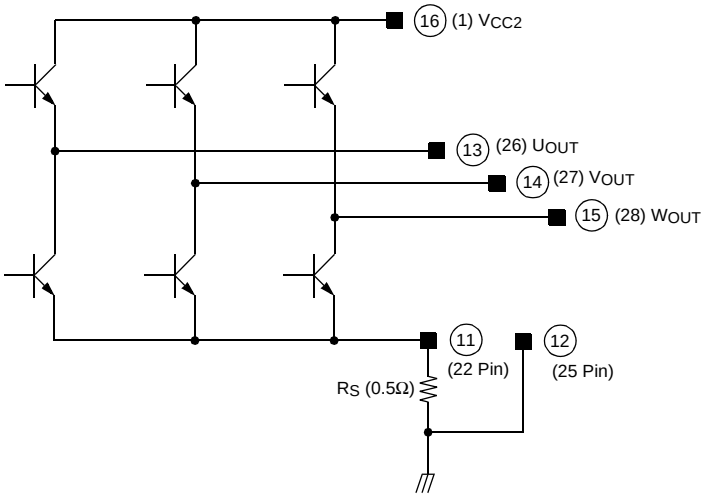
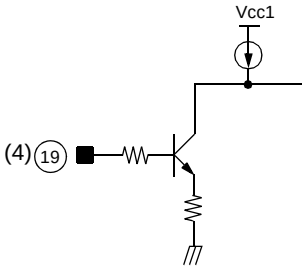
Internal Block Diagram (32-SDIPH)



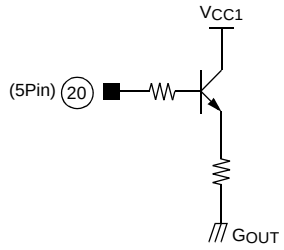
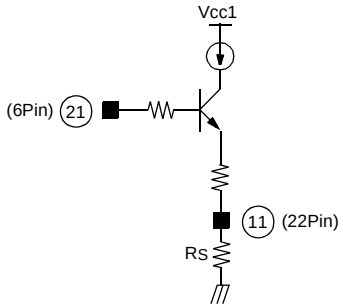
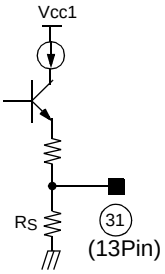
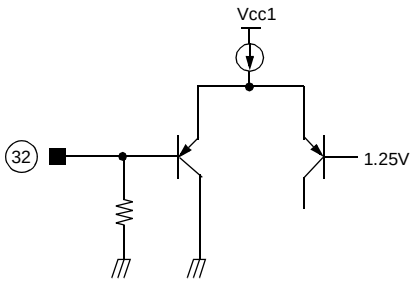
Internal Block Diagram (28-SSOPH)



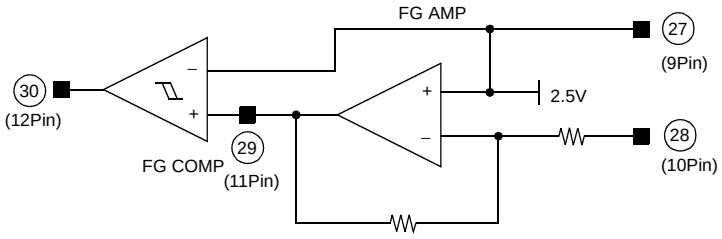
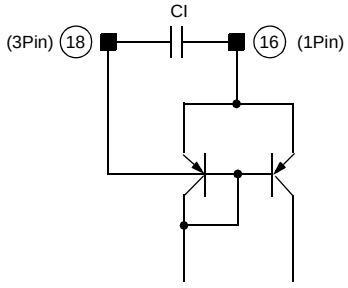
Equivalent Circuits (32-SDIPH: O, 28-SSOPH: (#))

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: O , 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
FG AMP.	32-SDIPH 27, 28, 29, 30 28-SSOPH 9, 10, 11, 12	
Phase Stabilization	32-SDIPH 16, 18 28-SSOPH 1, 3	

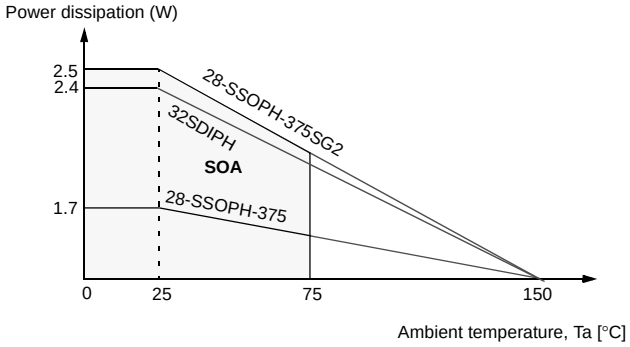
Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Value	Unit	Remark
Supply Voltage (Signal)	V_{CC1max}	7	V	-
Supply Voltage (Power)	V_{CC2max}	28	V	-
Maxium Output Current	I_{Omax}	1.5[note1]	A / Phase	V_{CC1}=5V, V_{CC2}=16V
Power Dissipation	P_d	2.4[note2]	W	32SDIPH-400
		1.7[note2]	W	28SSOPH-375
		2.5[note2]	W	28SSOPH-375SG2
Junction Temperature	T_J	150	°C	V_{CC1}=5V, V_{CC2}=16V
Operating Temperature	T_{OPR}	-25 ~ +75	°C	
Storage Temperature	T_{STG}	-40 ~ +125	°C	

Note:

1. Duty 1 / 100, pulse width 500μs
2. 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)
   3) Do not exceed Pd and SOA(Safe Operating Area).

Power Dissipation Curve



Recommened Operating Conditions (Ta=25°C)

Parameter	Symbol	Value	Unit
Operating Supply Voltage (Signal)	V_{CC1}	4.5 ~ 5.5	V
Operating Supply Voltage (Power)	V_{CC2}	8 ~ 27	V

Electrical Characteristics

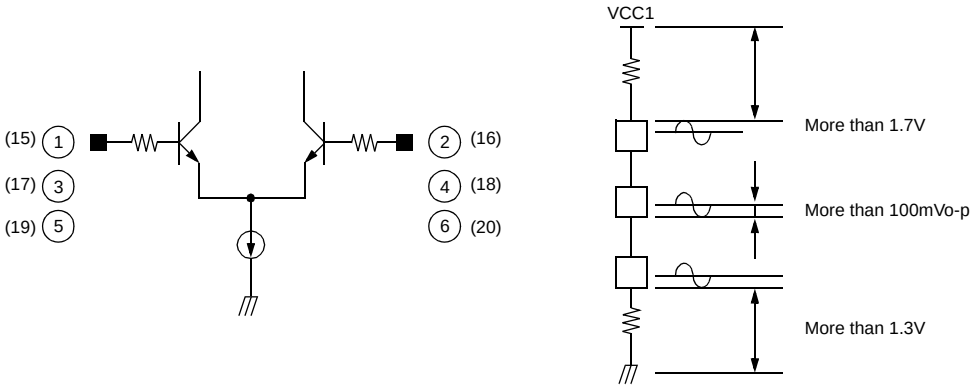
(V_{CC1}=5V, V_{CC2}=16V, R_S=0.5Ω, Ta=25°C, unless otherwise specified)

Block	Parameter	Symbol	Conditions		Min.	Typ.	max.	Unit
Total	Quiescent Input Current 1	I_{CC1}	V_{CC1}=5V, V_{FR}=5V		5.0	8.5	12.0	mA
	Quiescent Input Current 3	I_{CC3}	V_{CC1}=7V, V_{FR}=5V		6.0	10.0	15.0	mA
	Quiescent Input Current	I_{O1}	V_{CC2}=16V, V_{LIM}=0V		-	1.5	5.0	mA
	Quiescent Input Current (Max.)	I_{O3}	V_{CC2}=27V, V_{LIM}=V_{REF}		-	2.7	7.0	mA
Output	Current Limit Level	GM_{L1}	RS=0.5Ω	32-SDIPH	0.61	0.67	0.73	A / V
				28-SSOPH	0.46	0.52	0.58	
	Control Gain	GM_1	V_{IN}=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)	V_{SU4}	I_{OUT}=0.8A / Phase		-	1.8	2.0	V
	Output Amp. Saturation Voltage 4 (Inflow Current)	V_{SD4}	I_{OUT}=0.8A / Phase		-	1.8	2.0	V
	Limit Current Gap Of Phases	LD1	LI_{VU2}-LI_{WU2}		-20	0	20	mA
	Current Gap Of Phases	D1	I_{VU1}-I_{WU1}		-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	V_{O2U}	-		-50	0	50	mV
Rotation Control	CW Voltage Range	V_{FRU}	-		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	FG_{AV1}	FG_{IN3}=10kHz, 60mVp-p		28	31	34	Times
	FG Comp. Output Frequency	F_{COMP}	FG_{AMP0}=3Vp-p (1kHz)		0.9	1	1.1	kHz
	FG Comp Downward Input Threshold Voltage	V_{THDW}	FG_{AMP0}=3→2 Sweep		2.40	2.45	2.50	V
	FG Comp. UPward Input Threshold Voltage	V_{THUP}	FG_{AMP0}=2→3 Sweep		2.50	2.55	2.60	V
	FG Comp. Hysteresis	V_{HYS}	-		20	100	180	mV
	FG Output High Voltage	FG_{HI}	FG_{IN3}=3V		4.2	-	-	V
	FG Output Low Voltage	FG_{LO}	FG_{IN3}=2V		-	-	0.4	V

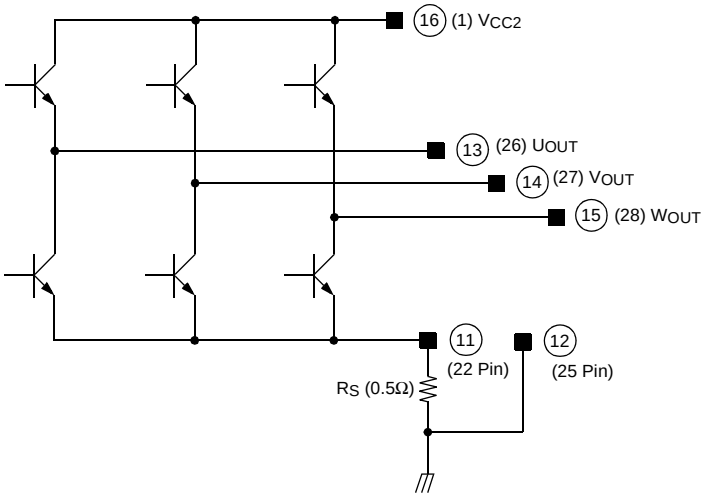
Application Information (32-SDIPH: O , 28-SSOPH: (#))

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. 0.5Ω, It converts motor current to a voltage which is feedback amplifier.

3. Motor Speed Control (Input Current Limitation)

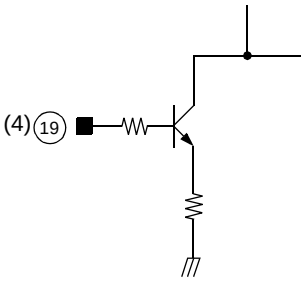
The maxmum output current is limitted by the I_{LIM} (Current limiting) voltage.

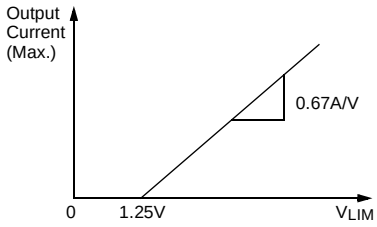
If current limitation is not in use then connect it to V_{CC1}.

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

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

V_{LIM2} = 1.55V → Output current=I_{O2}

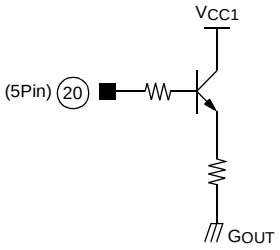


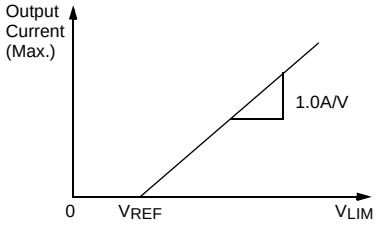


4. Motor Speed Control (Input Voltage Control)

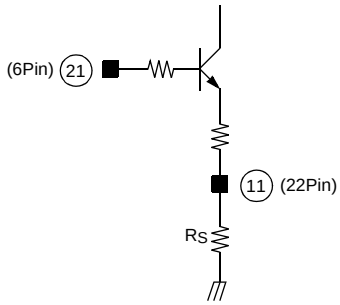
Motor speed control is possible when $V_{CTL} \geq V_{REF}$.
The control gain is approx. 1.0A/V as follows.

GML = $\Delta I_O / \Delta V_{CTL} = (I_{O2} - I_{O1}) / (V_{CTL2} - V_{CTL1})$, where V_{REF} = 2.5V, V_{CTL1} = 2.6V → Output current=I_{O1}
V_{REF} = 2.5V, V_{CTL2} = 2.7V → Output current=I_{O2}



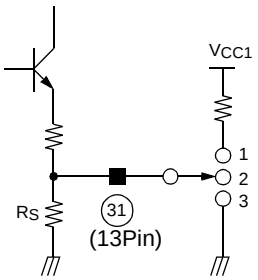


5. Voltage Control Reference



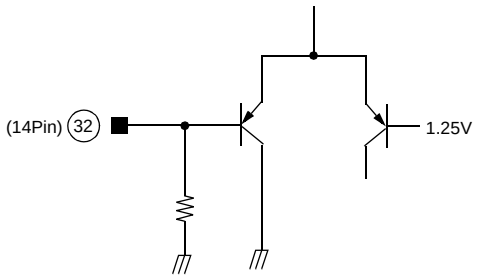
The input voltage range is $2V \leq V_{REF} \leq (V_{CC1} - 2V)$.

6. Torque Ripple Control



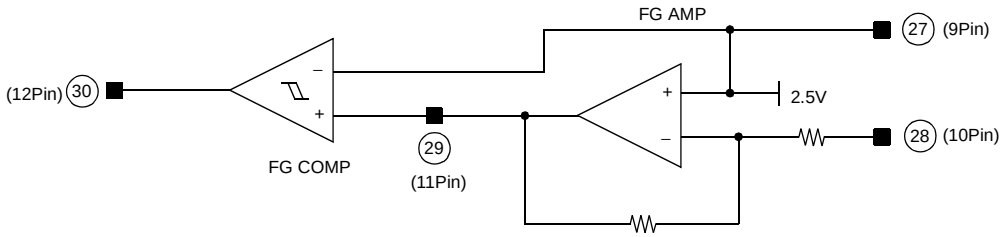
The motor torque ripple is controlled by the TR_{CTL} (Torque ripple control) voltege as follows.
1. GND
2. Normal Mode
3. Control Mode

7. Forward & Reverse Rotation Control

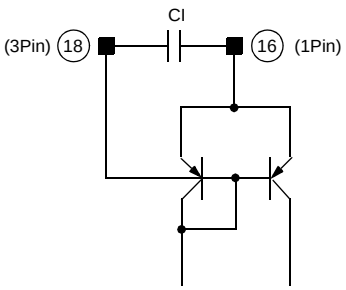


Forward mode: $V_{FRCTL} \geq 1.8V$
Reverse mode: $V_{FRCTL} \leq 0.8V$

8. FG Amp

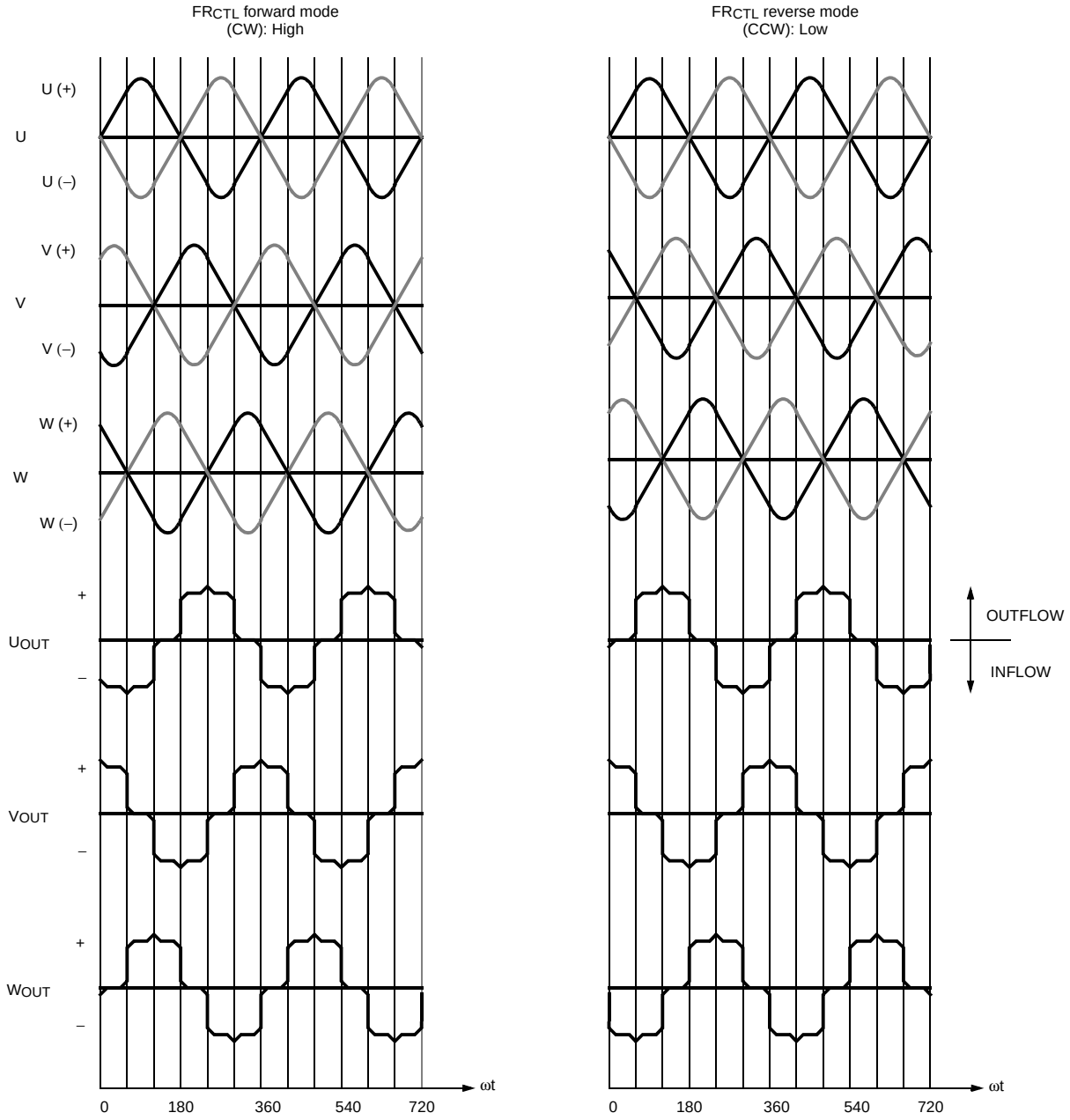


9. Phase Stabilization

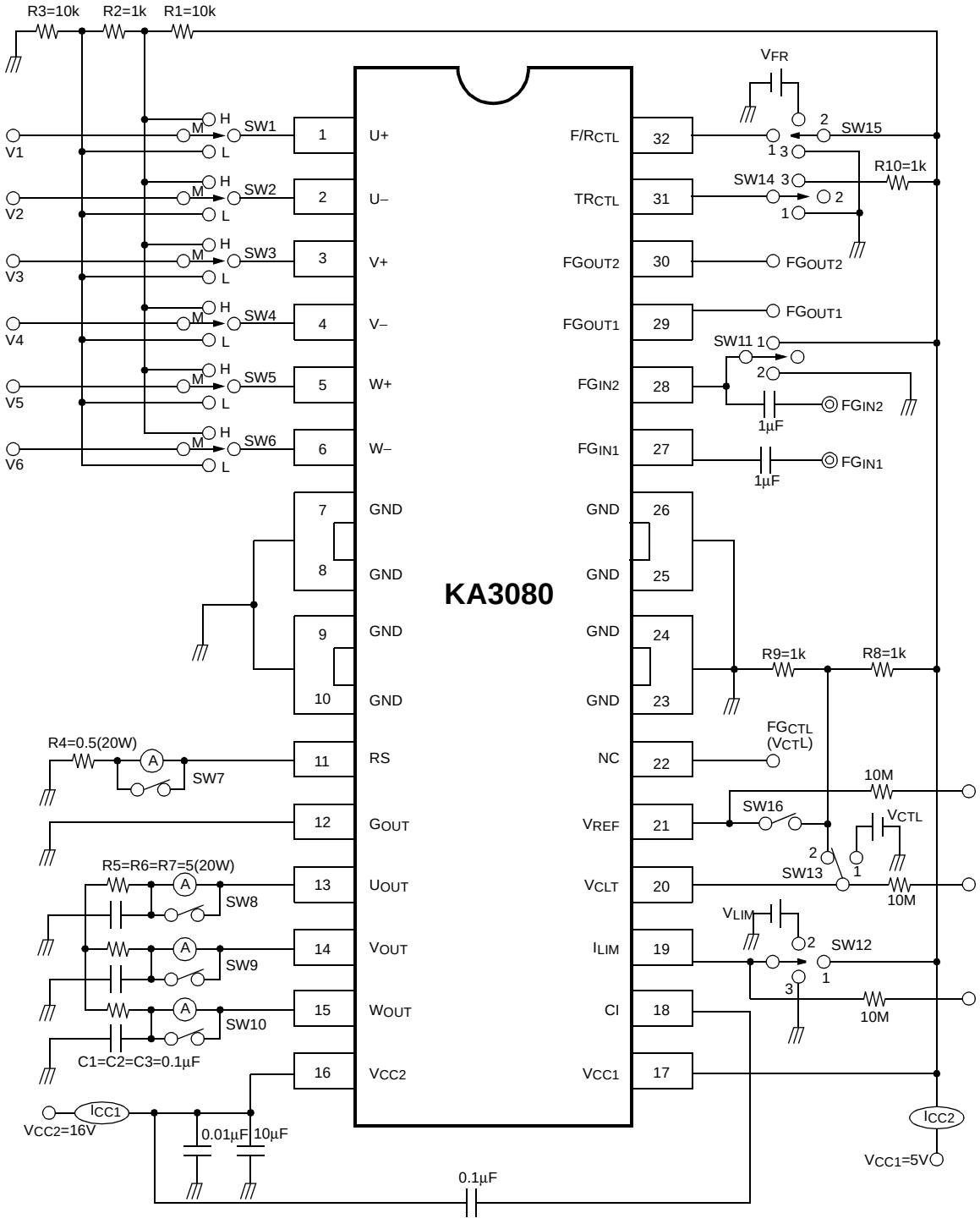


Be inserted a capacitor between V_{CC2}.
This capacitor, approx. 0.1μF is for the phase stabilization of the circuit.

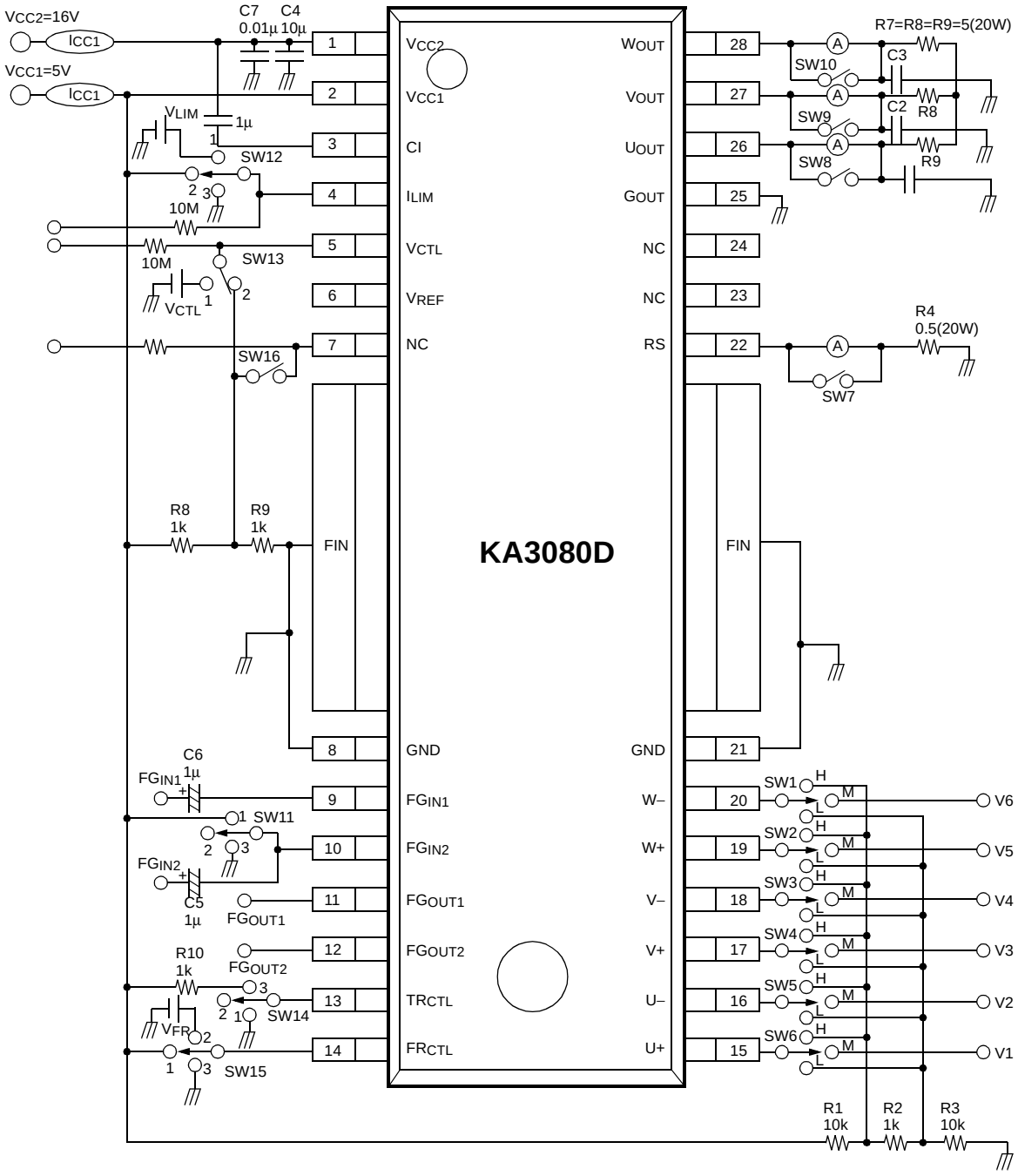
Timming Chart



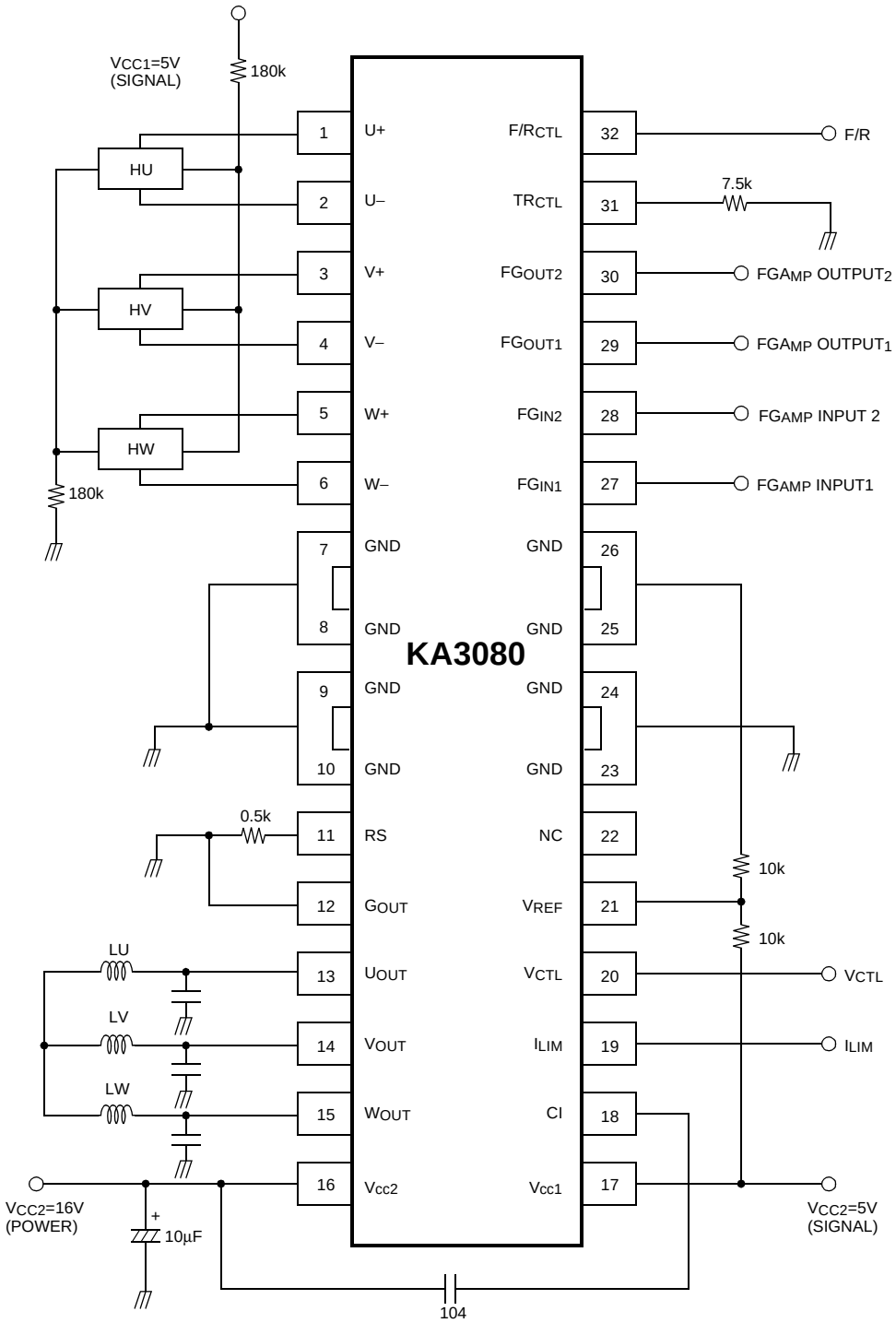
Test Circuits (32-SDIPH)



Test Circuits (28-SSOPH)



Typical Application Circuits (32-SDIPH)



Typical Application Circuits (28-SSOPH)