

KA3080 / KA3080D / KA3080DM

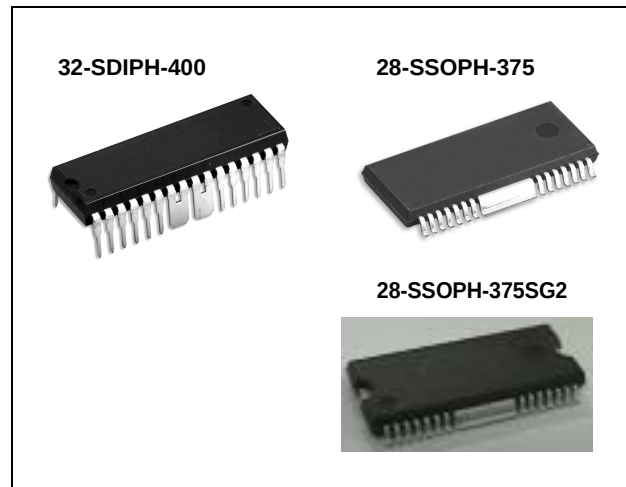
3-Phase BLDC Motor Driver

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.



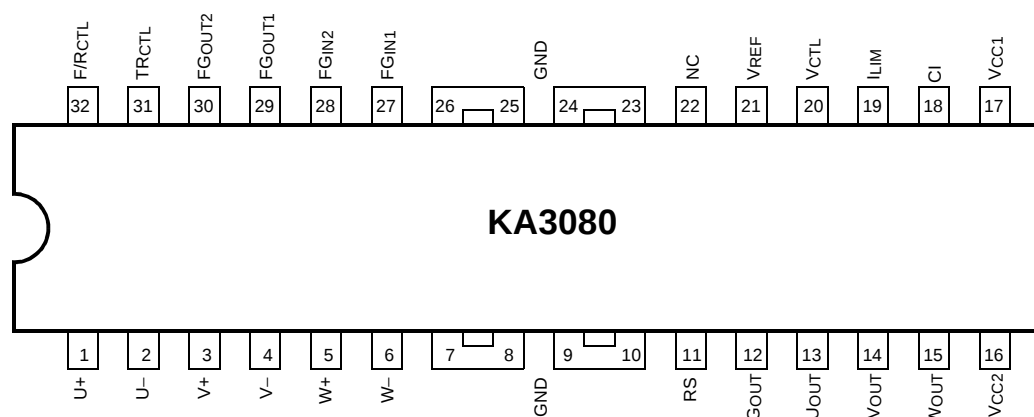
Target Application

- 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)



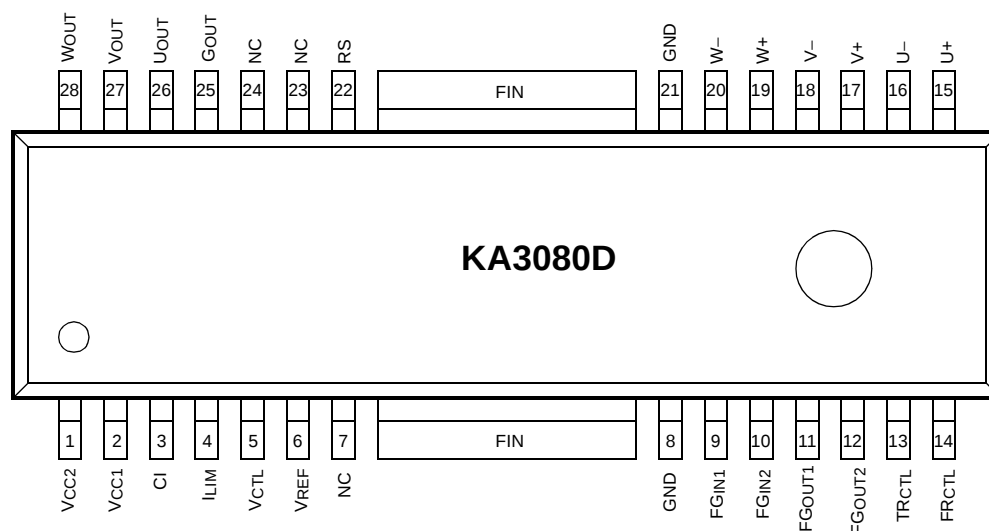
Pin Definitions (32SDIPH)

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 (Continued) (32SDIPH)

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 (28SSOPH)



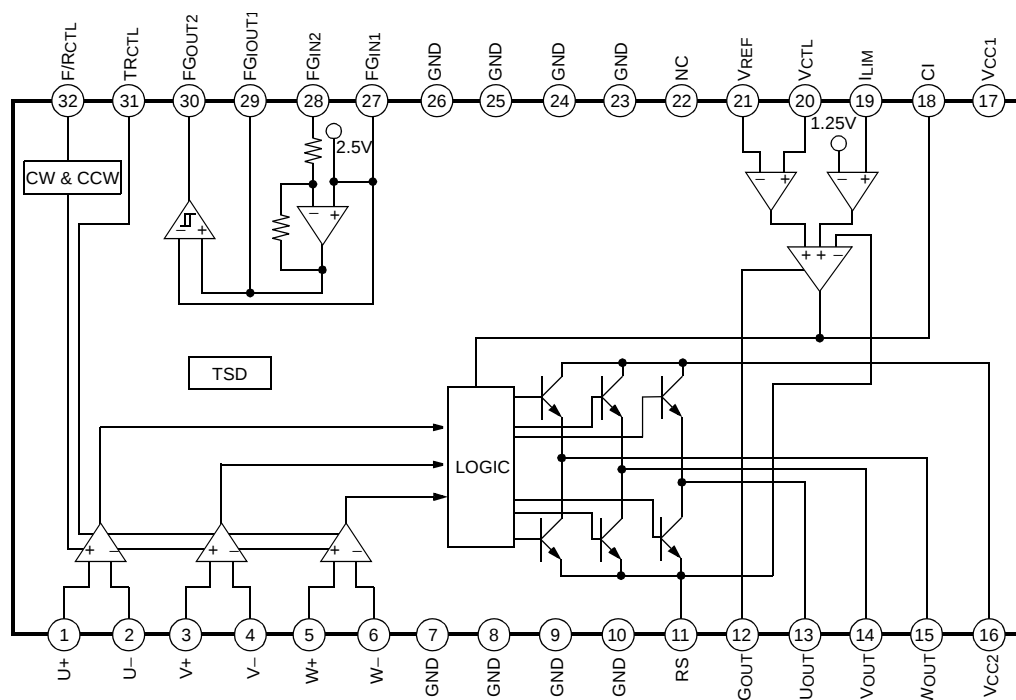
Pin Definitions (28SSOPH)

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

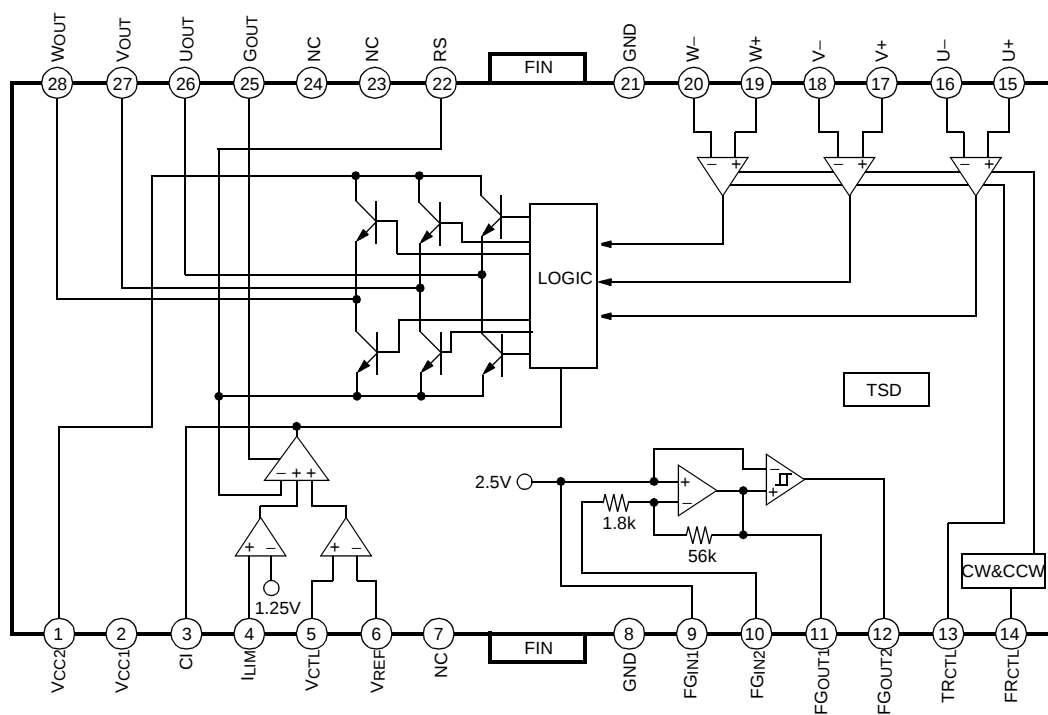
Pin Definitions (Continued) (28SSOPH)

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	GOUT	-	Ground (Power)
26	UOUT	O	U out
27	VOUT	O	V out
28	WOUT	O	W out

Internal Block Diagram (32SDIPH)



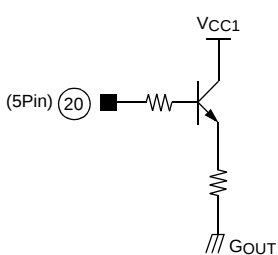
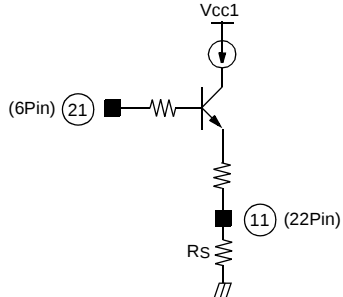
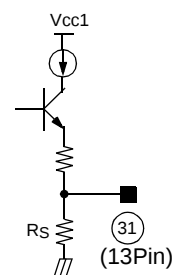
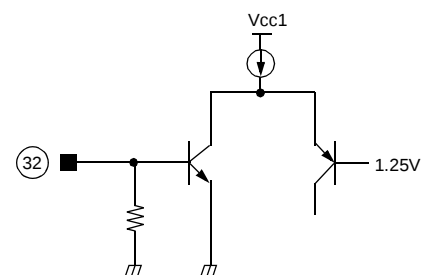
Internal Block Diagram (28SSOPH)



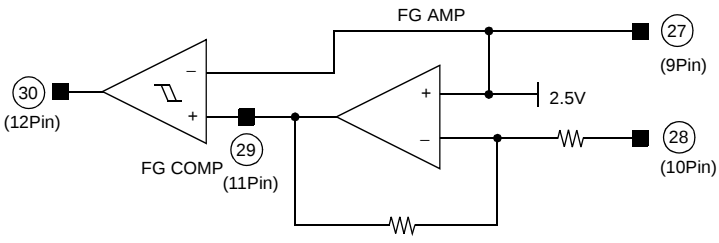
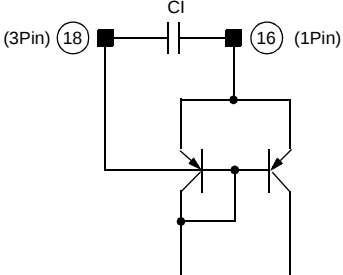
Equivalent Circuits (32SDIPH: ○, 28SSOPH: (#))

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

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

Description	Pin No.	Internal circuit
Speed control (Voltage control)	32SDIPH 20 28SSOPH 5	
Voltage control reference	32SDIPH 21 28SSOPH 6	
Torque ripple control	32SDIPH 31 28SSOPH 13	
Forward & Reverse control	32SDIPH 32 28SSOPH 14	

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

Description	Pin No.	Internal circuit
FG AMP. 28SSOPH 9, 10, 11, 12	32SDIPH 27, 28, 29, 30 28SSOPH 9, 10, 11, 12	
Phase stabilization	32SDIPH 16, 18 28SSOPH 1, 3	

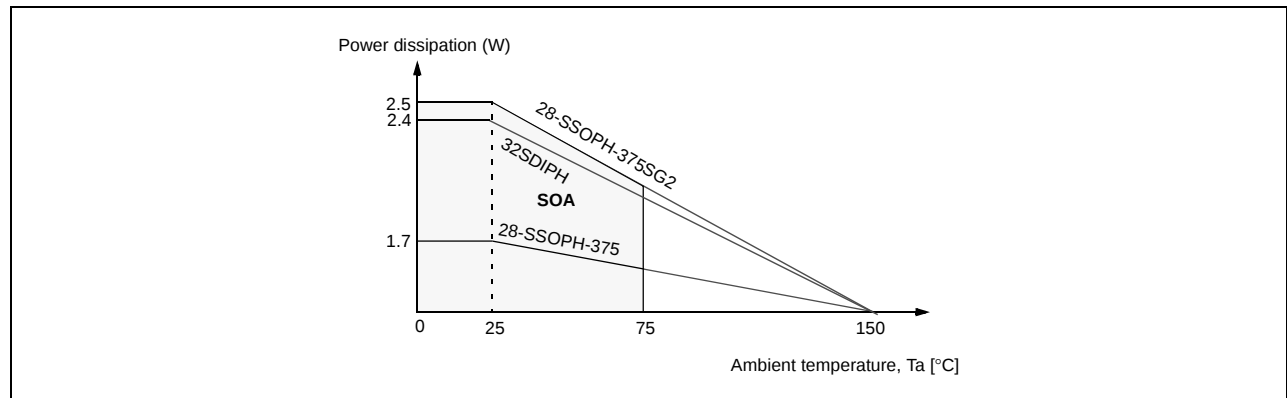
Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Value	Unit	Remark
Supply voltage (Signal)	VCC1max	7	V	-
Supply voltage (Power)	VCC2max	28	V	-
Maxium Output current	I _{Omax}	1.5 ^{note1}	A / Phase	VCC1=5V, VCC2=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	VCC1=5V, VCC2=16V
Operating temperature	T _{OPR}	-25 ~ +75	°C	
Storage temperature	T _{STG}	-40 ~ +125	°C	

Notes:

- 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_d and SOA(Safe Operating Area).

Power Dissipation Curve



Recommened 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

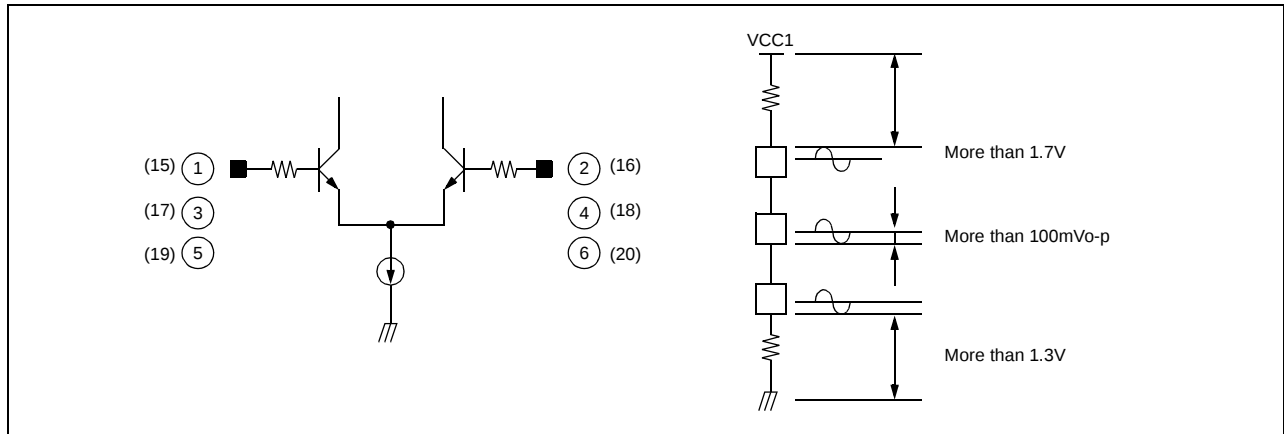
(VCC1=5V, VCC2=16V, RS=0.5Ω, Ta=25°C, unless otherwise specified)

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.)	IO1max	VCC2=27V, VLIM=VREF		-	2.7	7.0	mA
Output	Current limit level	GML1	RS=0.5Ω	32SDIPH	0.61	0.67	0.73	A / V
				28SSOPH	0.46	0.52	0.58	
	Control gain	GM1	VIN=0V	32SDIPH	0.9	1.0	1.1	A / V
				28SSOPH	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	LIvU2-LIwU2		-5	0	5	mA
	Current gap of phases	D1	IvU1-IwU1		-5	0	5	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)	32SDIPH (28SSOPH)		2.2	2.5	2.8	V
	FG amp. reference voltage	V27(9)	32SDIPH (28SSOPH)		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)		0.7	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

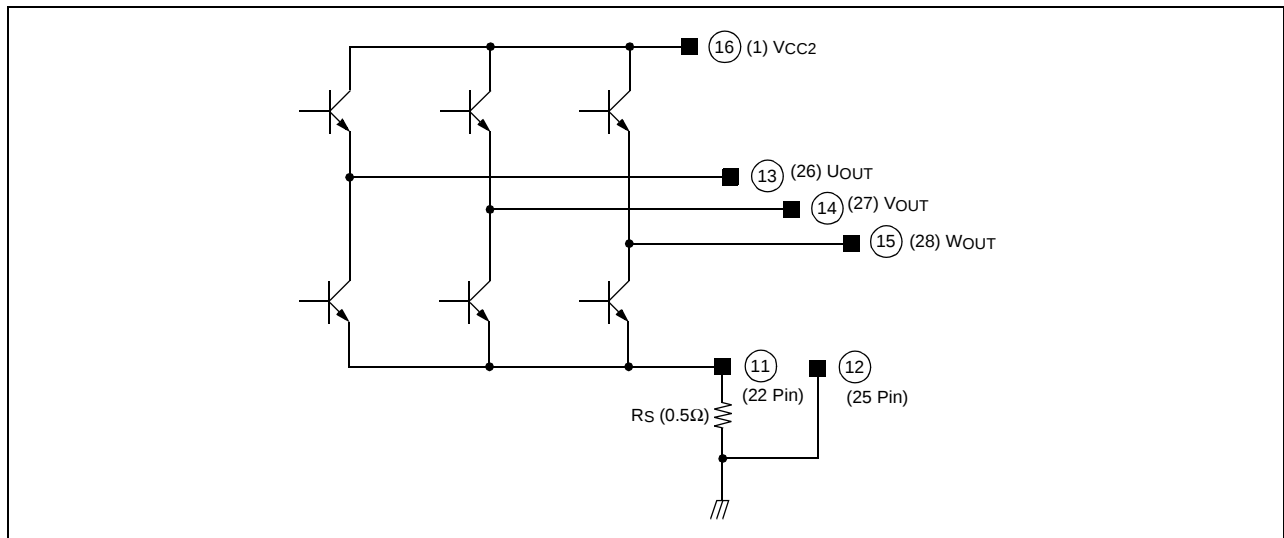
Application Information (32SDIPH: O , 28SSOPH: (#))

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)

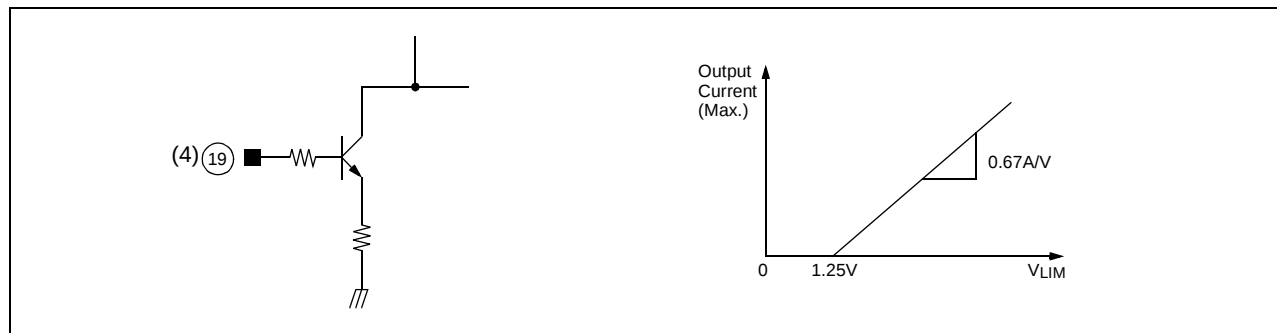
The maximum output current is limited by the I_{LIM} (Current limiting) voltage.

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

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

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

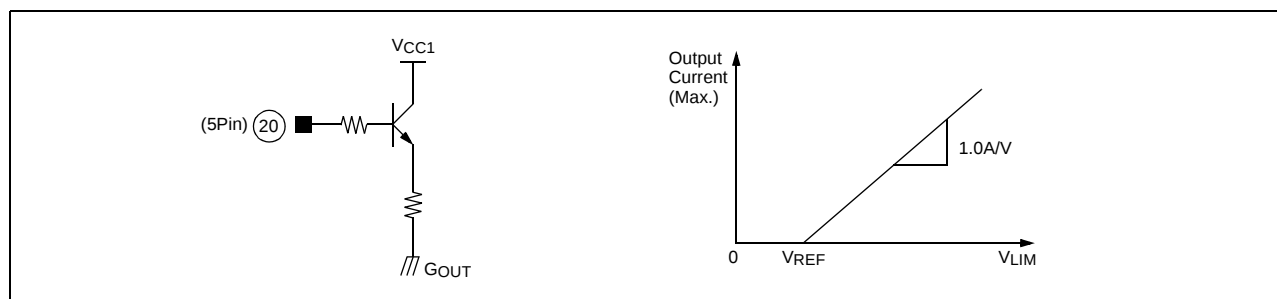
$$V_{LIM2} = 1.55V \rightarrow \text{Output current} = I_{O2}$$



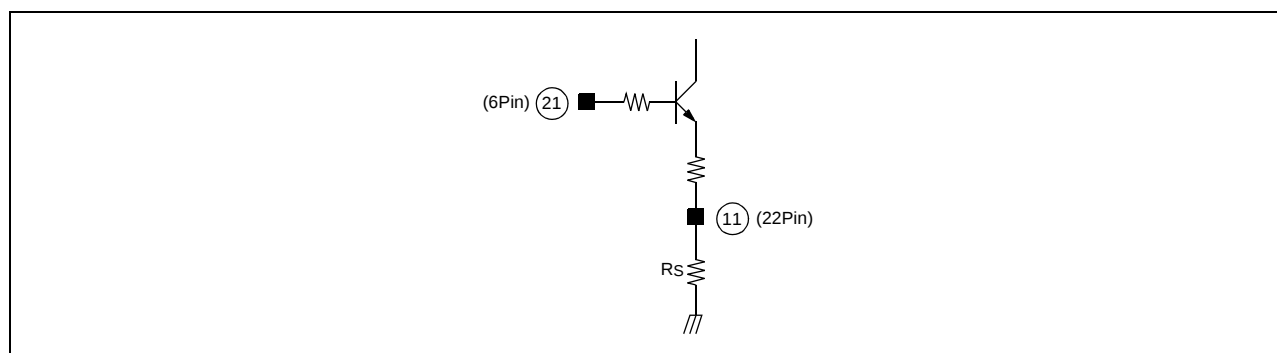
4. Motor Speed Control (Input Voltage Control)

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

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

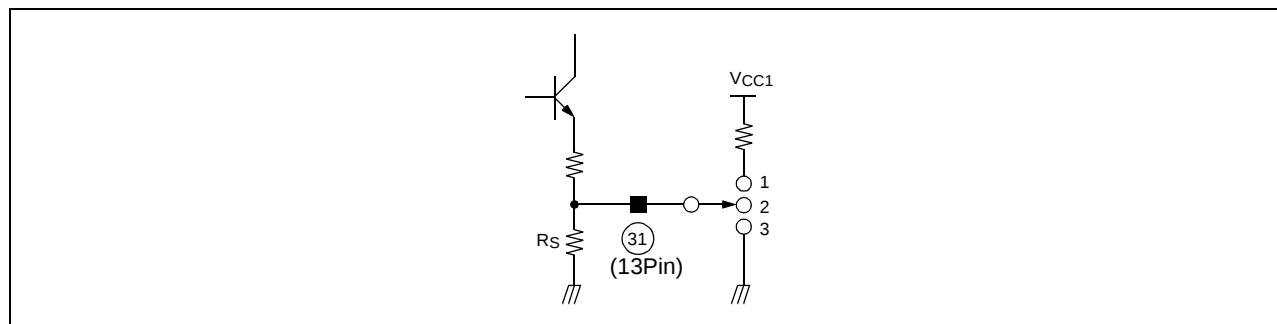


5. Voltage Control Reference



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

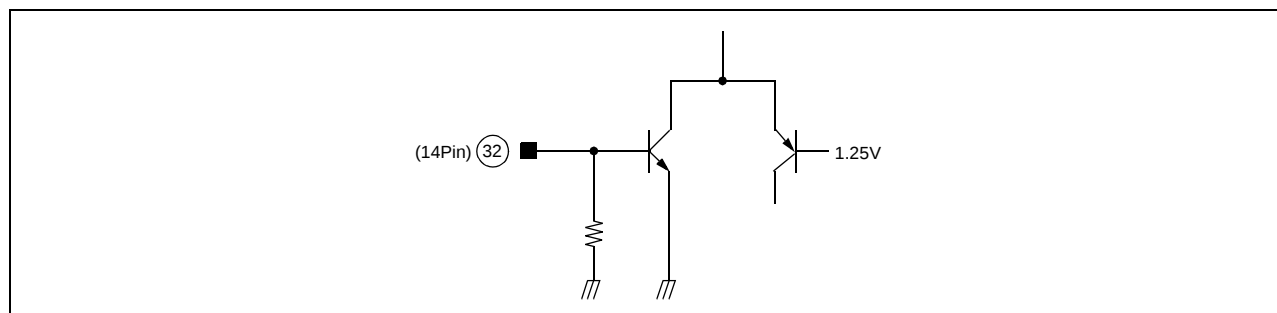
6. Torque Ripple Control



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

1. GND
2. Normal Mode
3. Control Mode

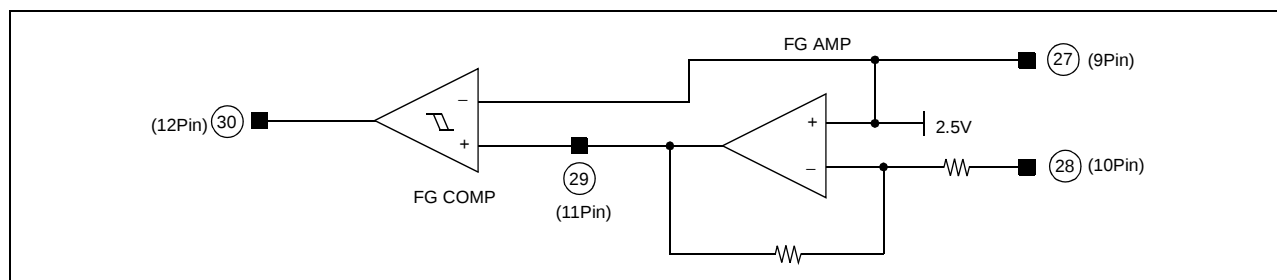
7. Forward & Reverse Rotation Control



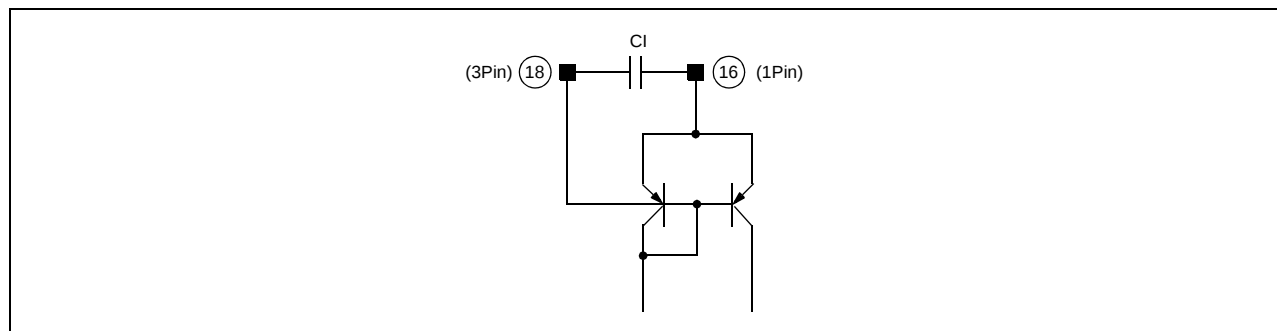
Forward mode: $V_{FRCTL} \geq 1.8V$

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

8. FG Amp



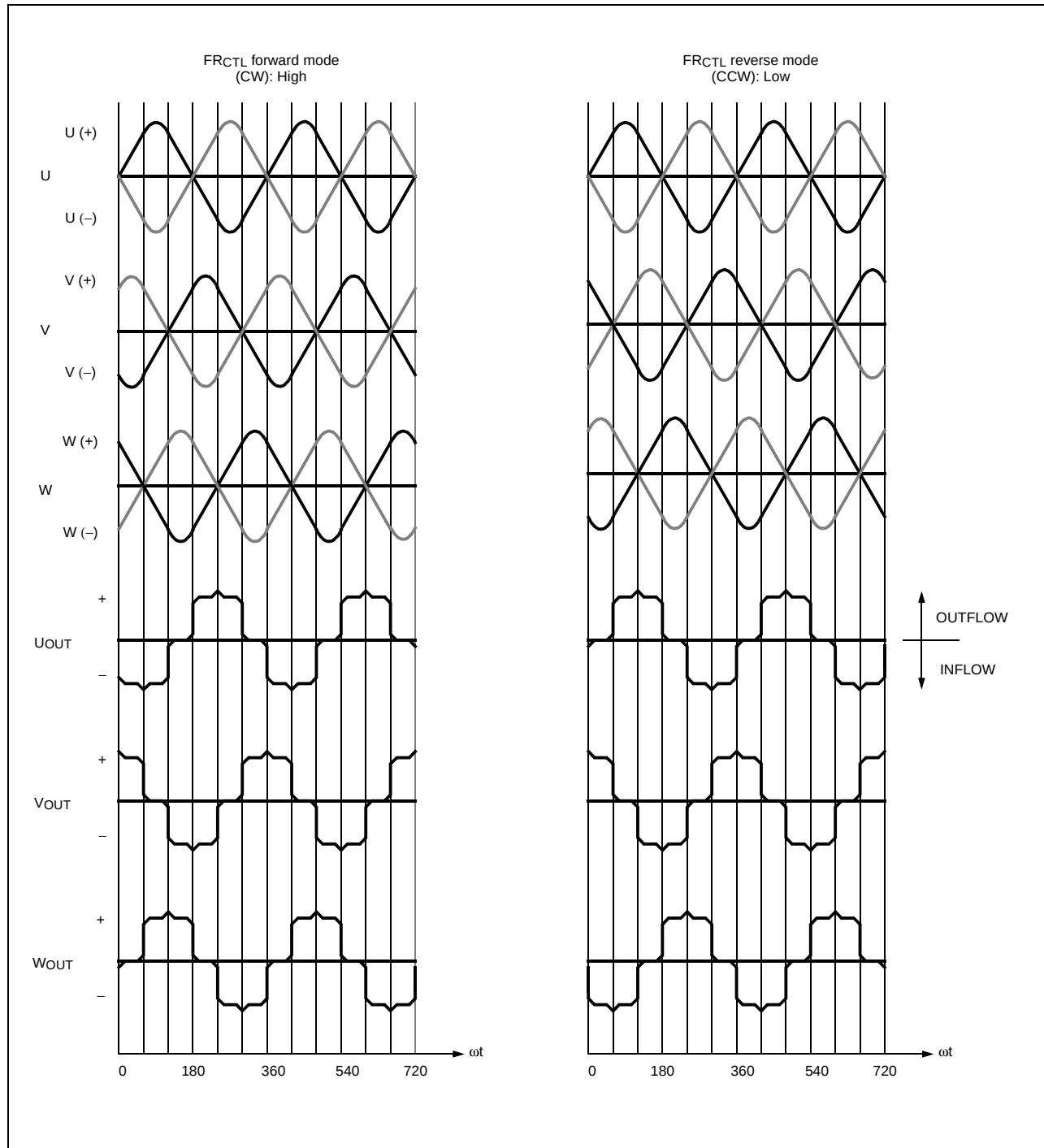
9. Phase Stabilization

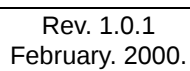


Be inserted a capacitor between V_{CC2} .

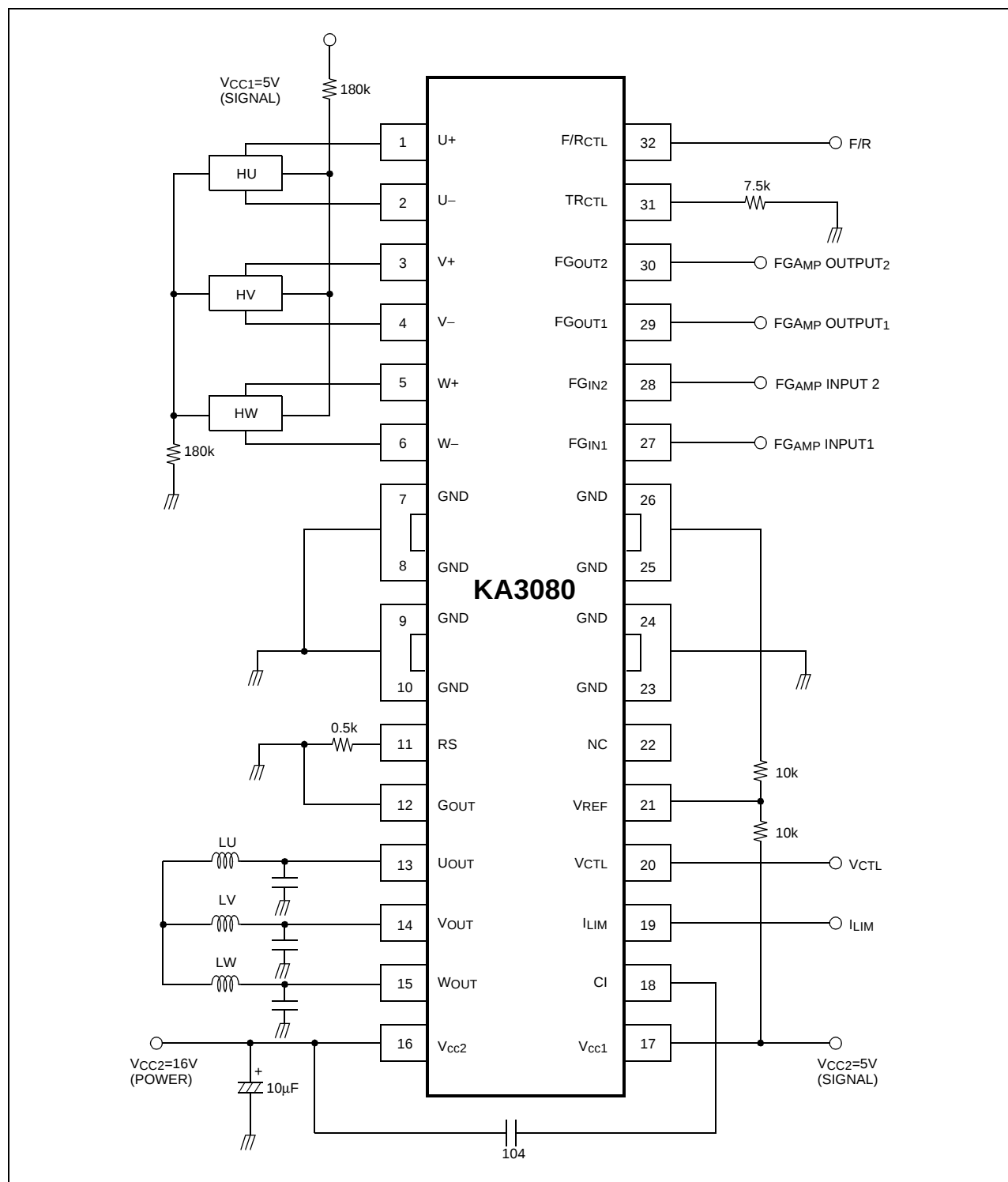
This capacitor, approx. $0.1\mu\text{F}$ is for the phase stabilization of the circuit.

Timing Chart

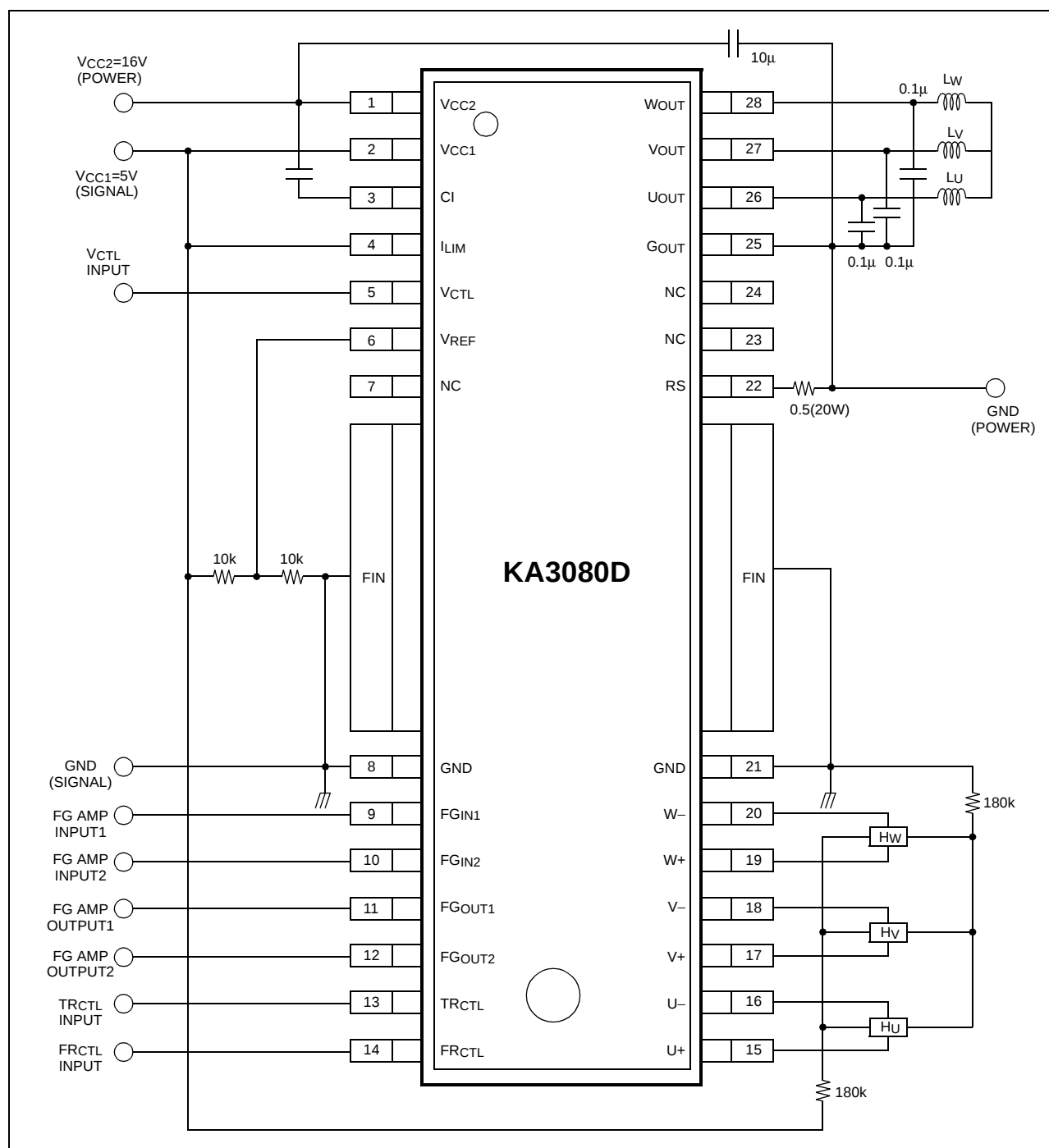




Typical Application Circuits (32SDIPH)



Typical Application Circuits (28SSOPH)



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