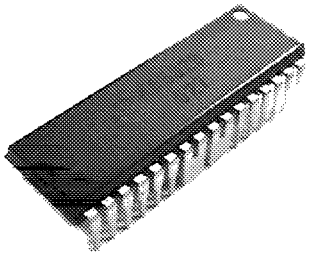
## 3-PHASE CAPSTAN MOTOR DRIVER

The KA8329B is a monolithic integrated circuit, and it is suitable for 3-phase capstan motor driver of VCR system.

32-SDIPH-400



## 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

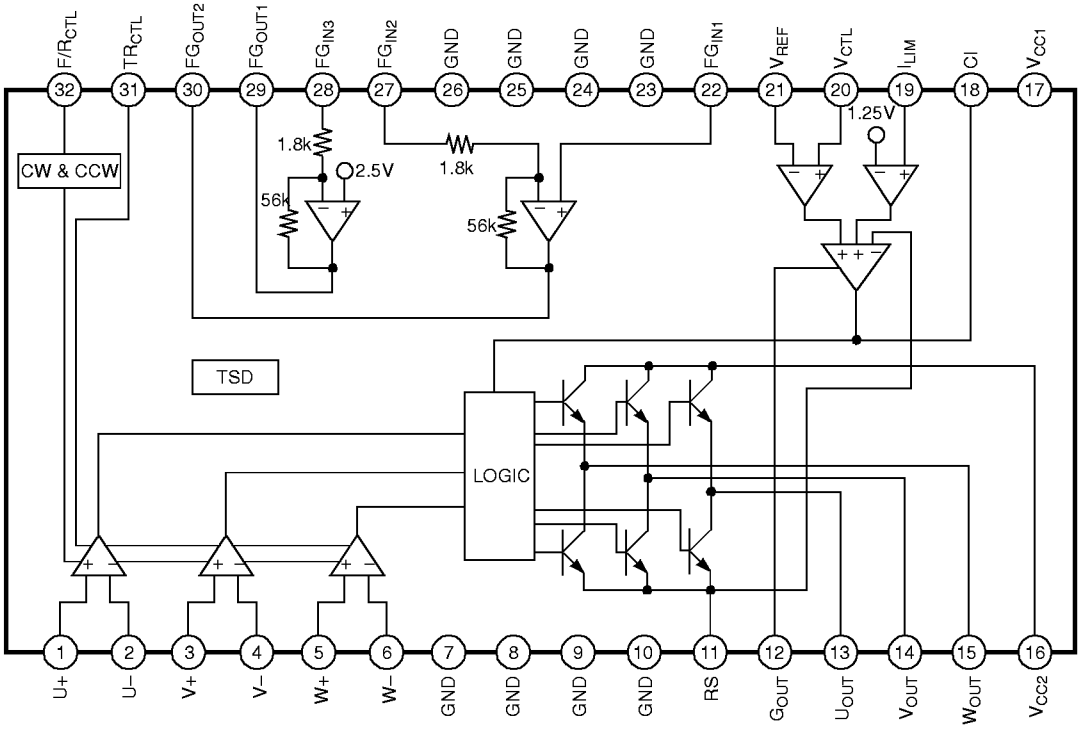
## ORDERING INFORMATION

| Device | Package | Operating Temperature |
|---|---|---|
| KA8329B | 32-SDIPH-400 | –25°C ~ +75°C |

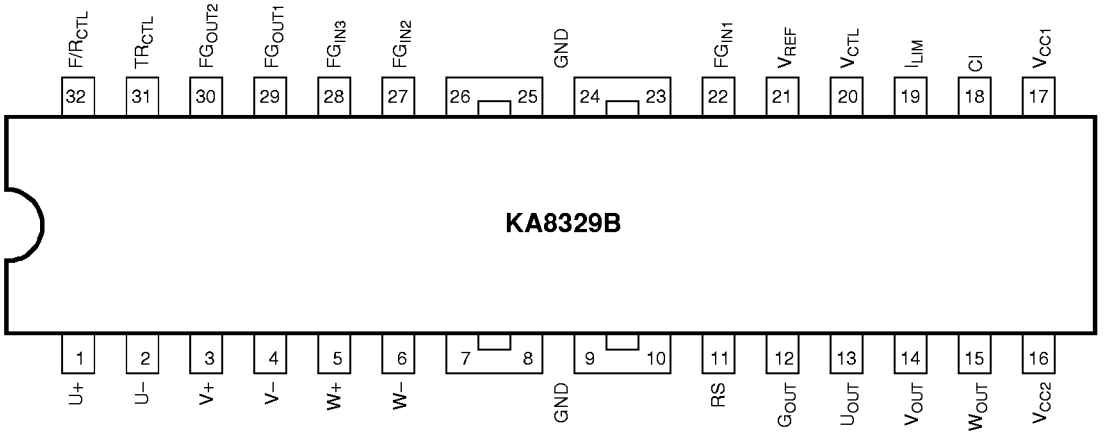
## TARGET APPLICATION

- VCR capstan motors

## BLOCK DIAGRAM



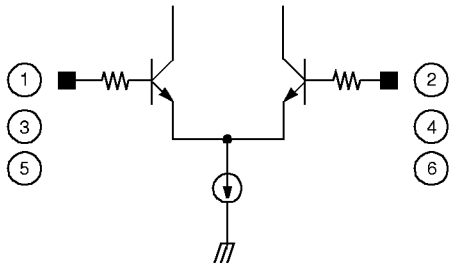
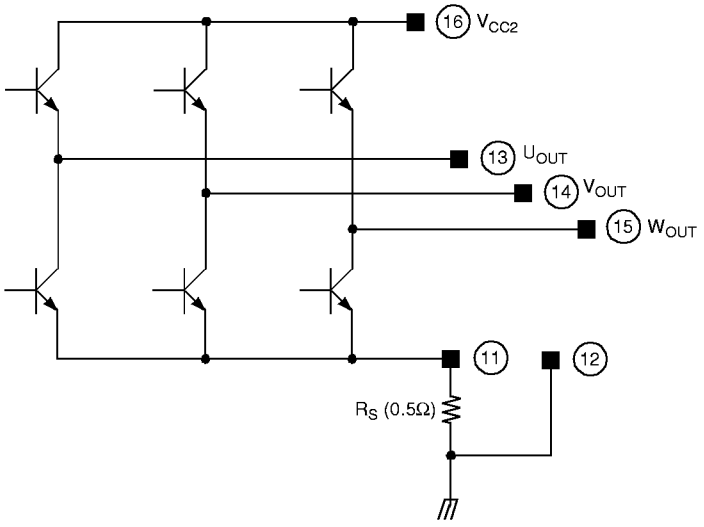
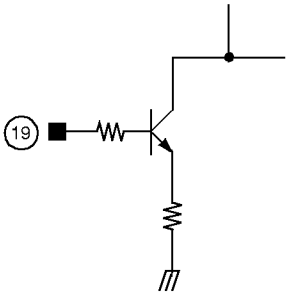
## PIN CONFIGURATIONS



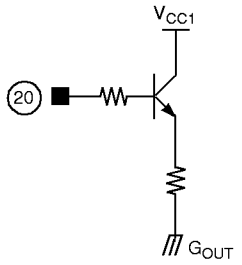
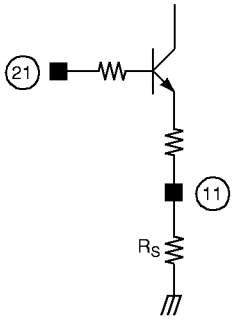
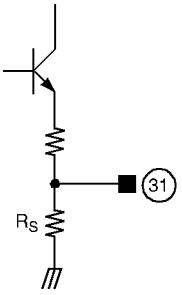
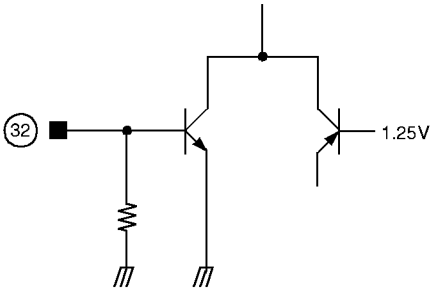

## PIN DESCRIPTION

| Pin No. | Symbol | I/O | Description | Pin No. | Symbol | I/O | Description |
|---|---|---|---|---|---|---|---|
| 1 | U+ | I | U+ hall signal input | 17 | $V_{CC1}$ | – | Supply voltage |
| 2 | U– | I | U– hall signal input | 18 | CI | – | Phase stabilization |
| 3 | V+ | I | V+ hall signal input | 19 | $I_{LIM}$ | I | Current limitation |
| 4 | V– | I | V– hall signal input | 20 | $V_{CTL}$ | I | Voltage control |
| 5 | W+ | I | W+ hall signal input | 21 | $V_{REF}$ | I | Voltage control reference |
| 6 | W– | I | W– hall signal input | 22 | $FG_{IN1}$ | I | FG amp1 input1 |
| 7 | GND | – | Ground (Signal) | 23 | GND | – | Ground (Signal) |
| 8 | GND | – | Ground (Signal) | 24 | GND | – | Ground (Signal) |
| 9 | GND | – | Ground (Signal) | 25 | GND | – | Ground (Signal) |
| 10 | GND | – | Ground (Signal) | 26 | GND | – | Ground (Signal) |
| 11 | RS | O | Output current detection | 27 | $FG_{IN2}$ | I | FG amp1 input2 |
| 12 | $G_{OUT}$ | – | Ground (Power) | 28 | $FG_{IN3}$ | I | FG amp2 input1 |
| 13 | $U_{OUT}$ | O | U-phase output | 29 | $FG_{OUT1}$ | O | FG amp2 output |
| 14 | $V_{OUT}$ | O | V-phase output | 30 | $FG_{OUT2}$ | O | FG amp1 output |
| 15 | $W_{OUT}$ | O | W-phase output | 31 | $TR_{CTL}$ | I | Troque ripple control |
| 16 | $V_{CC2}$ | – | Supply voltage (Power) | 32 | $F/R_{CTL}$ | I | Forward & reverse control |

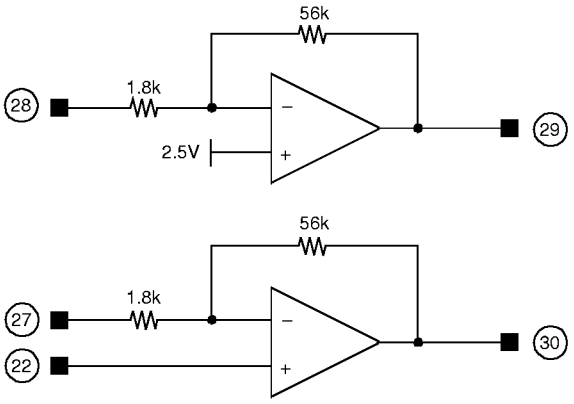
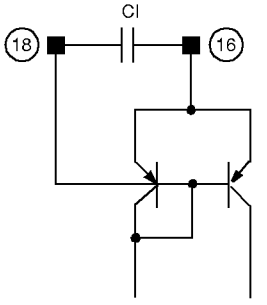
## INTERNAL CIRCUIT

| Description | Pin No. | Internal circuit |
|---|---|---|
| Hall input | 1, 2, 3<br>4, 5, 6 |  |
| Output &<br>Current detection | 13, 14, 15,<br>12 |  |
| Speed control<br>(Current limitation) | 19 |  |

## INTERNAL CIRCUIT (Continued)

| Description | Pin No. | Internal circuit |
|---|---|---|
| Speed control (Voltage control) | 20 |   |
| Voltage control reference | 21 |   |
| Torque ripple control | 31 |   |
| Forward & Reverse control | 32 |   |

## INTERNAL CIRCUIT (Continued)

| Description | Pin No. | Internal circuit |
|---|---|---|
| FG AMP. | 28, 29<br>22, 27, 30 |  |
| Phase stabilization | 16, 18 |  |

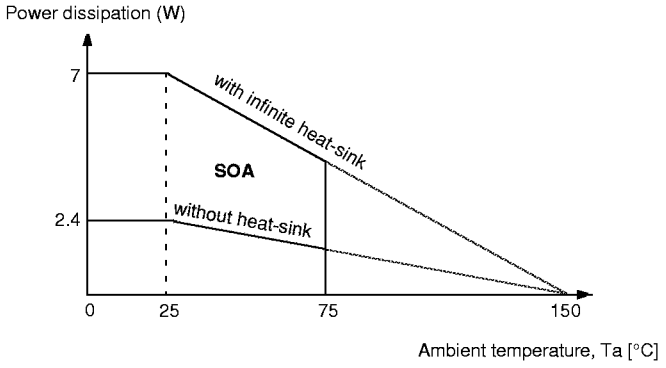
## ABSOLUTE MAXIMUM RATING (Ta=25°C)

| Characteristics | Symbol | Value | Unit | Remark |
|---|---|---|---|---|
| Supply voltage (Signal) | $V_{CC1max}$ | 7 | V | – |
| Supply voltage (Power) | $V_{CC2max}$ | 28 | V | – |
| Output current | $I_{Omax}$ | 1.5[note1] | A / Phase | – |
| Power dissipation | $P_d$ | 2.4[note2] | W | No heat sink |
| Thermal resistance | $R_T$ | 60.2 | mW / °C | No heat sink |
| Junction temperature | $T_J$ | 150 | °C | – |
| Operating temperature | $T_{OPR}$ | –25 ~ +75 | °C | – |
| Storage temperature | $T_{STG}$ | –40 ~ +125 | °C | – |

**NOTES:**

1. Duty 1/100, pulse width 500μs
2. 1) When mounted on glass epoxy PCB (76.2 × 114 × 1.57mm)
   2) Power dissipation reduces 19.2mW / °C for using above Ta=25°C. (Without heat-sink)
   3) Do not exceed Pd and SOA.

## PD GRAPH




## RECOMMENED OPERATING CONDITIONS (Ta=25°C)

| Characteristics | 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

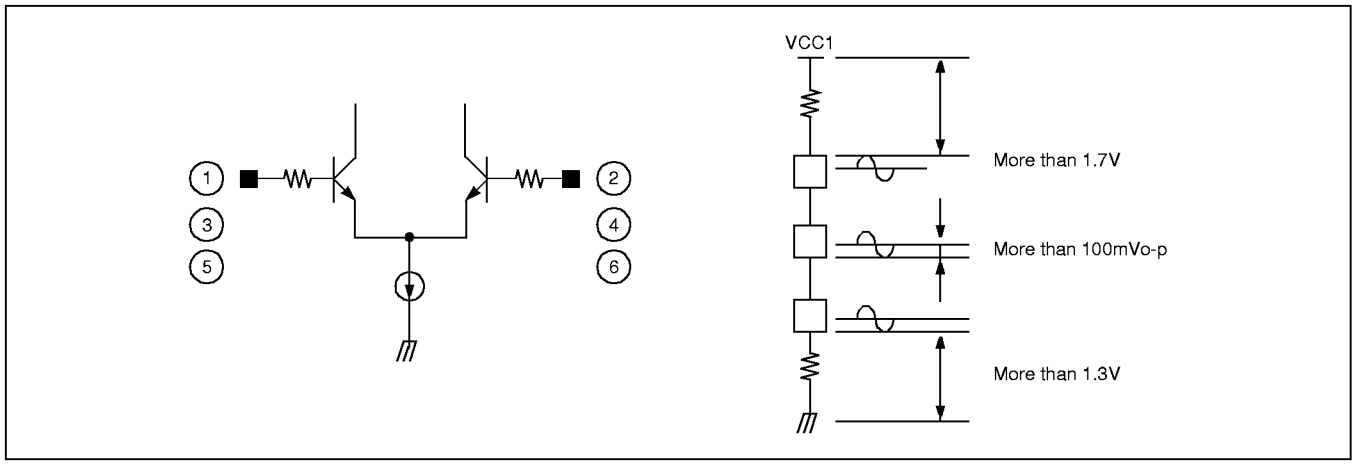
(Ta=25°C, $V_{CC1}$=5V, $V_{CC2}$=16V, $R_S$=0.5Ω, unless otherwise specified)

| Characteristic | Symbol | Pin No. | Test conditions | Min. | Typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| Quiescent input current | $I_{CC1}$ | 17 | VF/R=0V or 5V | 5 | 8.5 | 12 | mA |
| Hall amp. input voltage range | $V_{INS}$ | 1 ~ 6 | mVo-p | 100 | – | – | mV |
| Power TR stauration voltage (Outflow current) | $V_{SAT1}$ | 16–13, 14, 15 | $V_{CC2}$=13V, $I_{OUT}$=0.8A/Phase | – | 1.8 | 2.0 | V |
| Power TR saturation voltage (Inflow current) | $V_{SAT2}$ | 11–13, 14, 15 | $V_{CC2}$=13V, $I_{OUT}$=0.8A/Phase | – | 1.8 | 2.0 | V |
| $I_{LIM}$ input voltage range | $V_{LIM}$ | 19 | – | 0 | – | $V_{CC1}$ | V |
| $I_{LIM}$ input current | $I_{19}$ | 19 | $V_{CTL}$=3.5V, $V_{LIM}$=3V | – | 350 | 2000 | nA |
| $I_{LIM}$ current limit level | GML | 19–13, 14, 15 | $V_{CTL}$=3.5V, $V_{LIM}$=Adjustable | 0.61 | 0.67 | 0.73 | A/V |
| $I_{LIM}$ quiescent output current | $I_{O1}$ | 19 | $V_{LIM}$=0V | – | 1.5 | 5.0 | mA |
| $I_{LIM}$ limit offset voltage | $V_{O1}$ | 19 | $V_{REF}$=2.5V | 1.17 | 1.25 | 1.33 | V |
| $V_{CTL}$ input voltage range | $V_{CTL}$ | 20 | – | 0 | – | $V_{CC1}$ | V |
| $V_{CTL}$ input current | $I_{20}$ | 20 | $V_{CTL}$=3V, $V_{LIM}$=5V | – | 350 | 2000 | nA |
| $V_{CTL}$ control gain | GM | 20–13, 14, 15 | $V_{CTL}$=3.5V, $V_{LIM}$=Adjustable | 0.9 | 1.0 | 1.1 | A/V |
| $V_{CTL}$ quiescent output current | $I_{O2}$ | 20 | $V_{CTL}$=0V | – | 1.5 | 5.0 | mA |
| $V_{CTL}$ input offset voltage | $V_{O2}$ | 20 | $V_{CTL}$=Adjustable | –50 | 0 | 50 | mV |
| Forward rotation mode | $V_F$ | 32 | – | 1.0 | 1.3 | 1.6 | V |
| Reverse rotation mode | $V_R$ | 32 | – | 0 | – | 0.8 | – |
| $V_{REF}$ input voltage range | $V_{REF}$ | 21 | – | 2.0 | – | $V_{CC1}$–2.0 | V |
| $FG_{AMP}$ internal reference voltage | $V_{28}$ | 28 | – | 2.2 | 2.5<br>– | 2.8 | V<br>V |
| $FG_{AMP}$ input voltage range | $FG_{IN}$ | 27, 28 | Pin28=10kHz, 60mVp-p | 1 | – | 4 | – |
| $FG_{AMP1}$ gain | $FG_{AV1}$ | 28, 29 | Sinusoidal waveforms Pin27=10kHz, 60mVp-p | 28 | 31 | 34 | Times |
| $FG_{AMP2}$ gain | $FG_{AV2}$ | 27 ~ 30 | Sinusoidal waveforms Pin22=2.5V | 28 | 31 | 34 | Times |

## APPLICATION INFORMATION

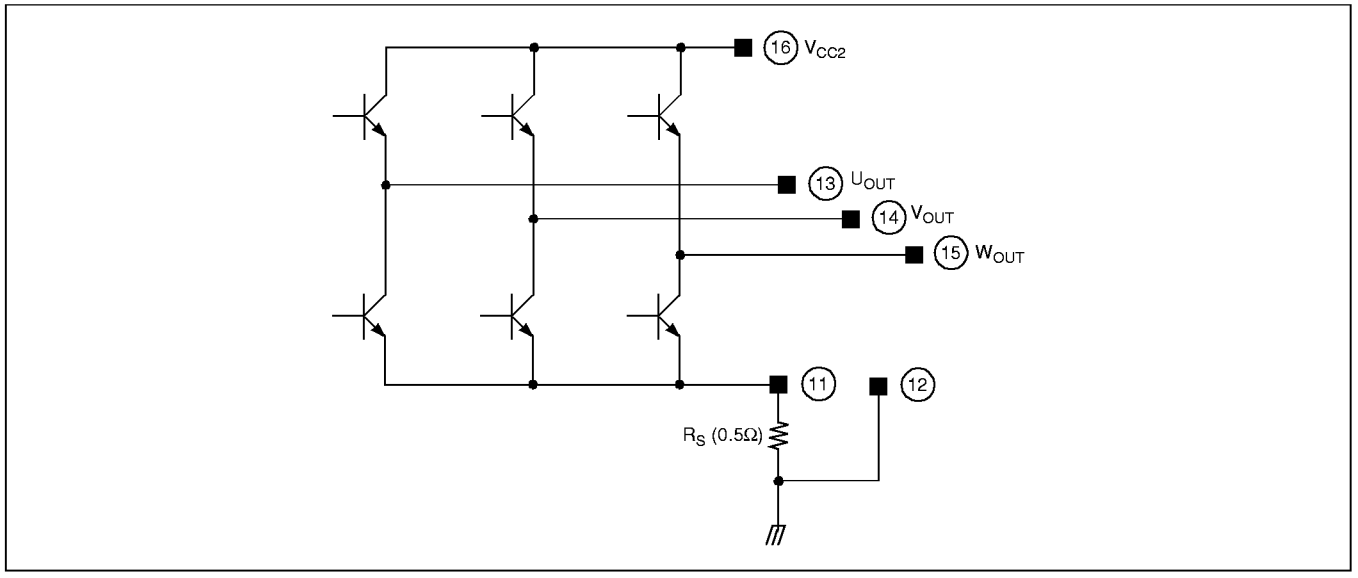
### 1. HALL INPUT

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




### 2. OUTPUT CURRENT DETECTION

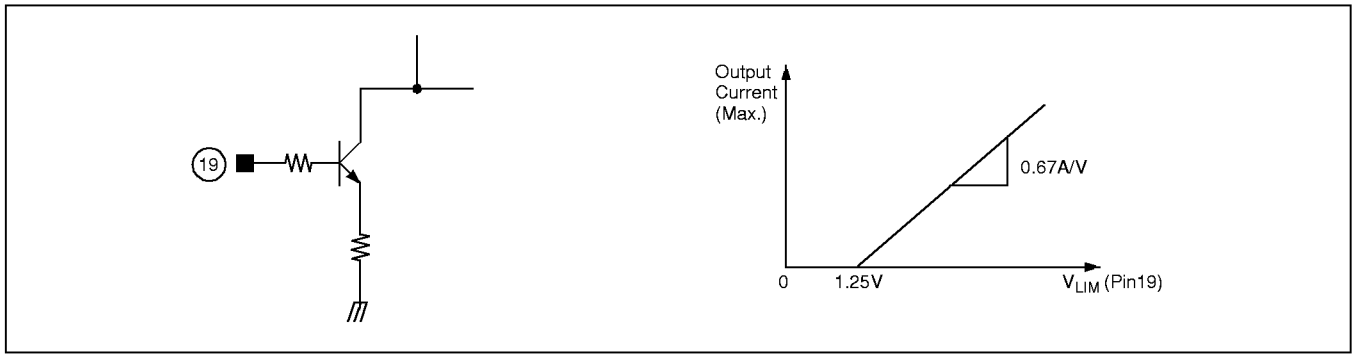
Pin 11 is usually connected with $R_S$ (Approx. 0.5Ω), and the motor current is converted to a voltage by the $R_S$ and provided to a feedback amplifier. Pin 12 is connected to the circuit with the ground side or $R_S$.



### 3. MOTOR SPEED CONTROL (INPUT CURRENT LIMITATION)

The maximum output current is limitted by pin 19 voltage as follows. So a motor speed is controlled by the output current. In case of no-use, it is to be short-circuit with $V_{CC1}$.

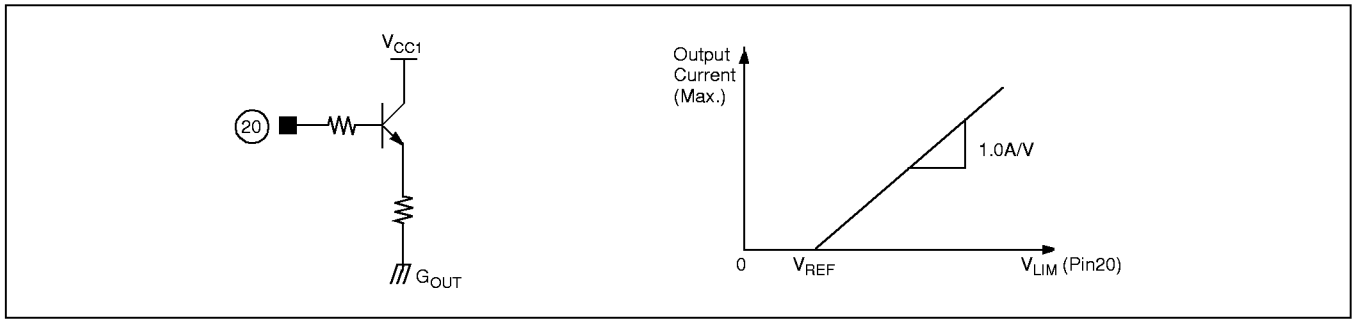
$GML = \Delta I_O / \Delta V_{LIM} = (I_{O2} - I_{O1}) / (V_{LIM2} - V_{LIM1})$, where $V_{LIM1} = 1.45V \rightarrow$ Output current=$I_{O1}$
$V_{LIM2} = 1.55V \rightarrow$ Output current=$I_{O2}$



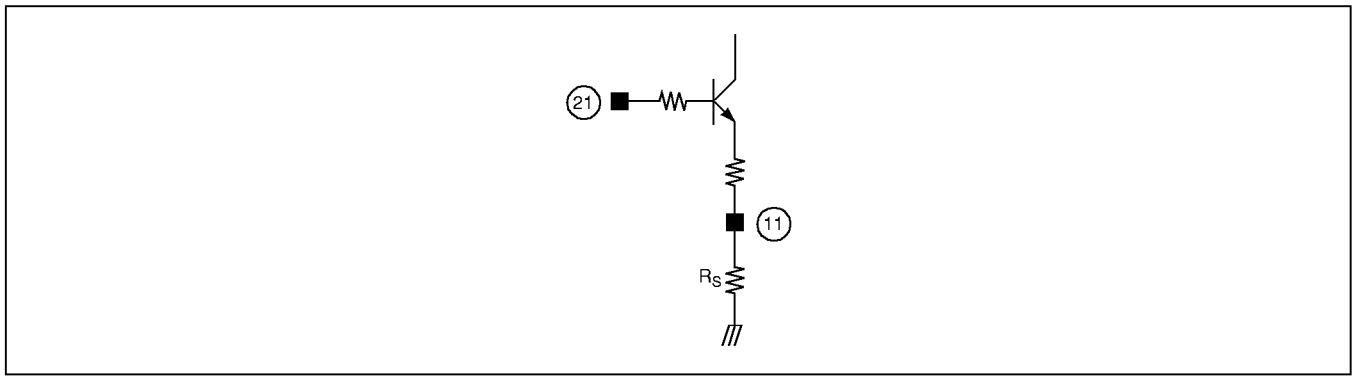

### 4. MOTOR SPEED CONTROL (INPUT VOLTAGE CONTROL)

The control of motor speed is possible on the conditions of $V_{CTL}$ (Pin20) $\geq V_{REF}$.
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=$I_{O2}$

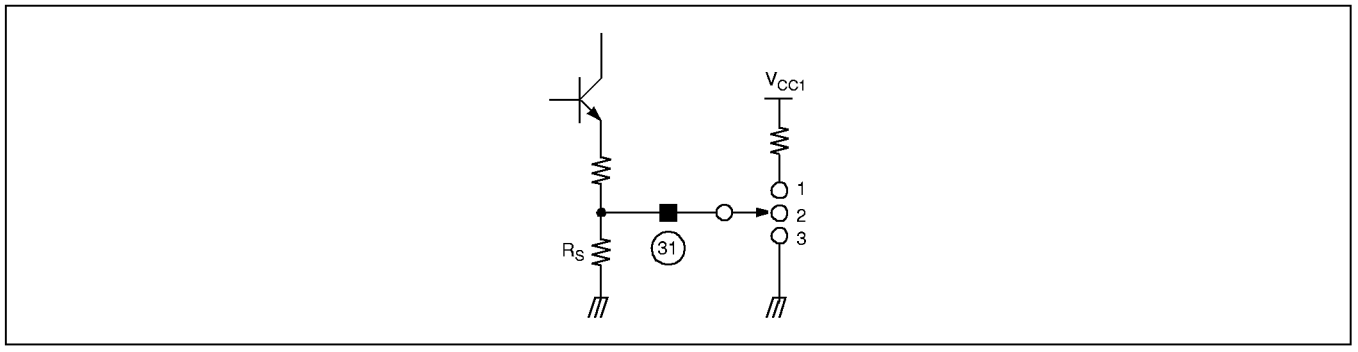


## 5. VOLTAGE CONTROL REFERENCE




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

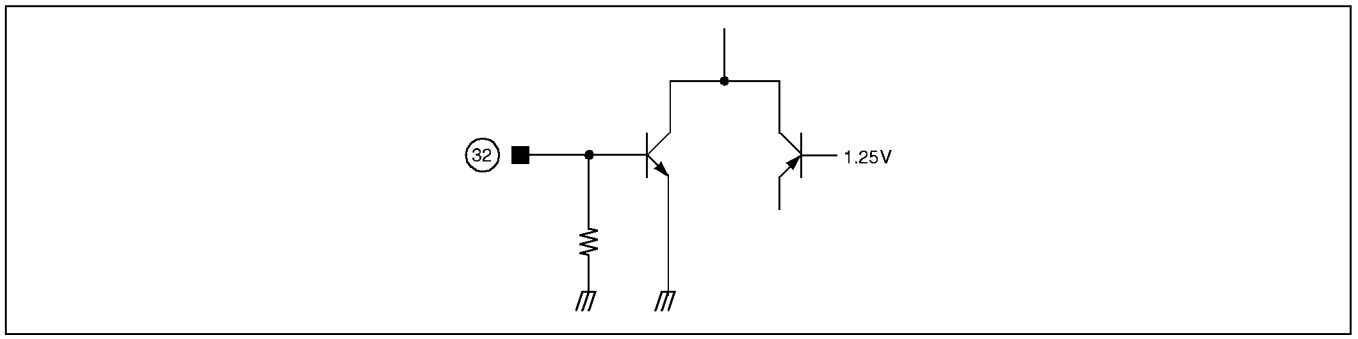
## 6. TORQUE RIPPLE CONTROL




The motor torque ripple is controlled by Pin 31 voltege as follows.

1. GND
2. Normal Mode
3. Control Mode

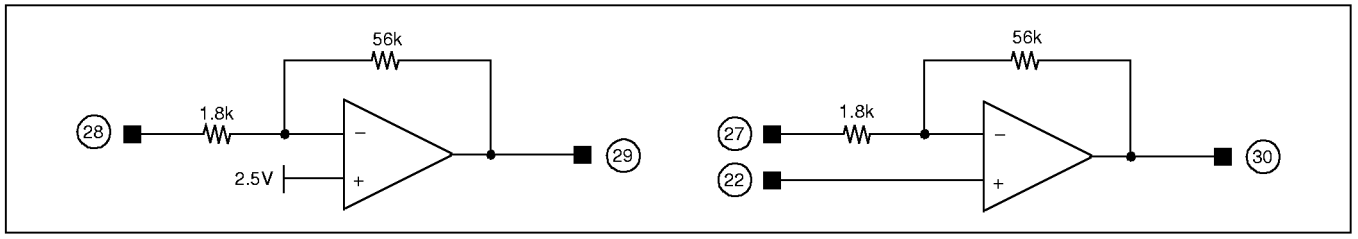
### 7. FORWARD & REVERSE ROTATION CONTROL



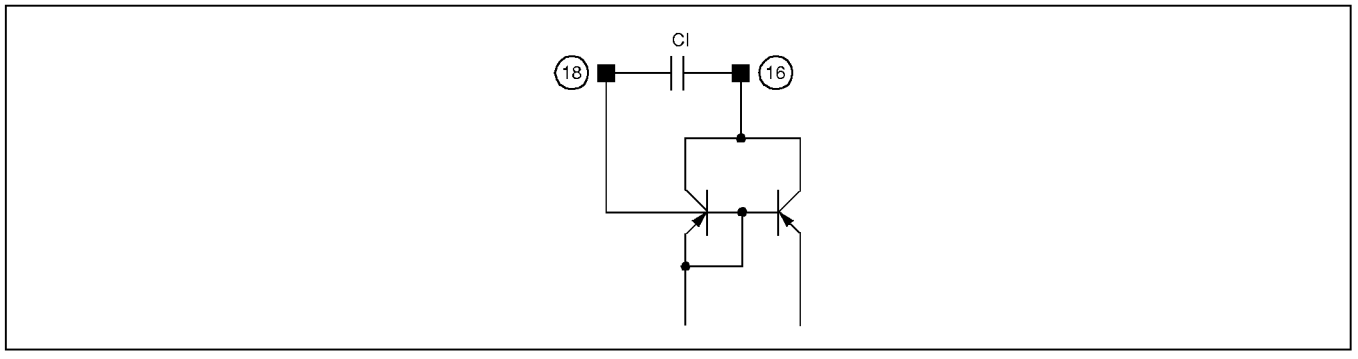

Forward mode: Pin 32 ≥ 1.8V
Reverse mode: Pin 32 ≤ 0.8V

### 8. FG AMP

These amplifiers are the inversion type. One amplifier is built in both the reference voltage (Approx. 2.5V) and the gain setting resistors. The voltage gain is approx. 31 times.

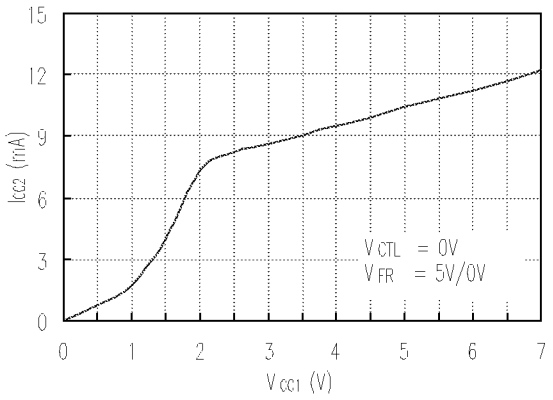



### 9. PHASE STABILIZATION

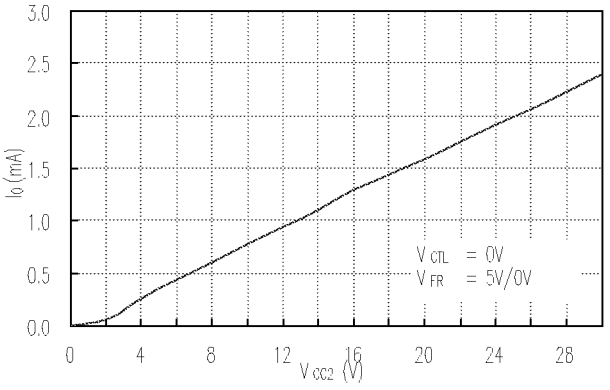



Be inserted a capacitor between pin 16 and pin 18. This capacitor, approx. 0.1μF is for the phase stabilization of the circuit.

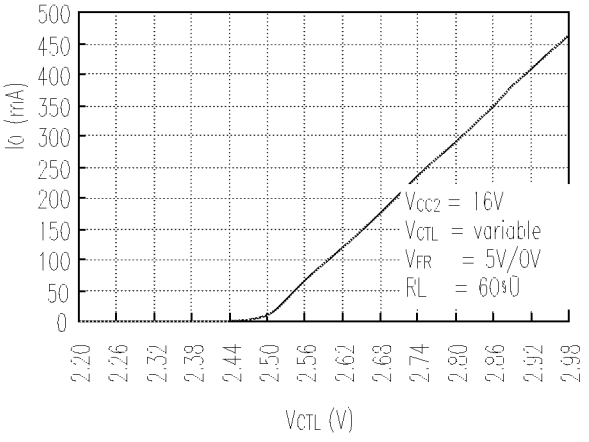
## CHARACTERISTIC GRAPHS



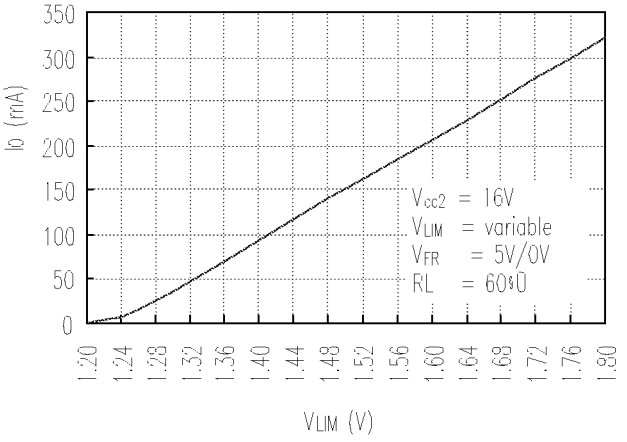

**1. $V_{CC1}$ vs $I_{CC2}$**




**2. $V_{CC2}$ vs $I_O$**

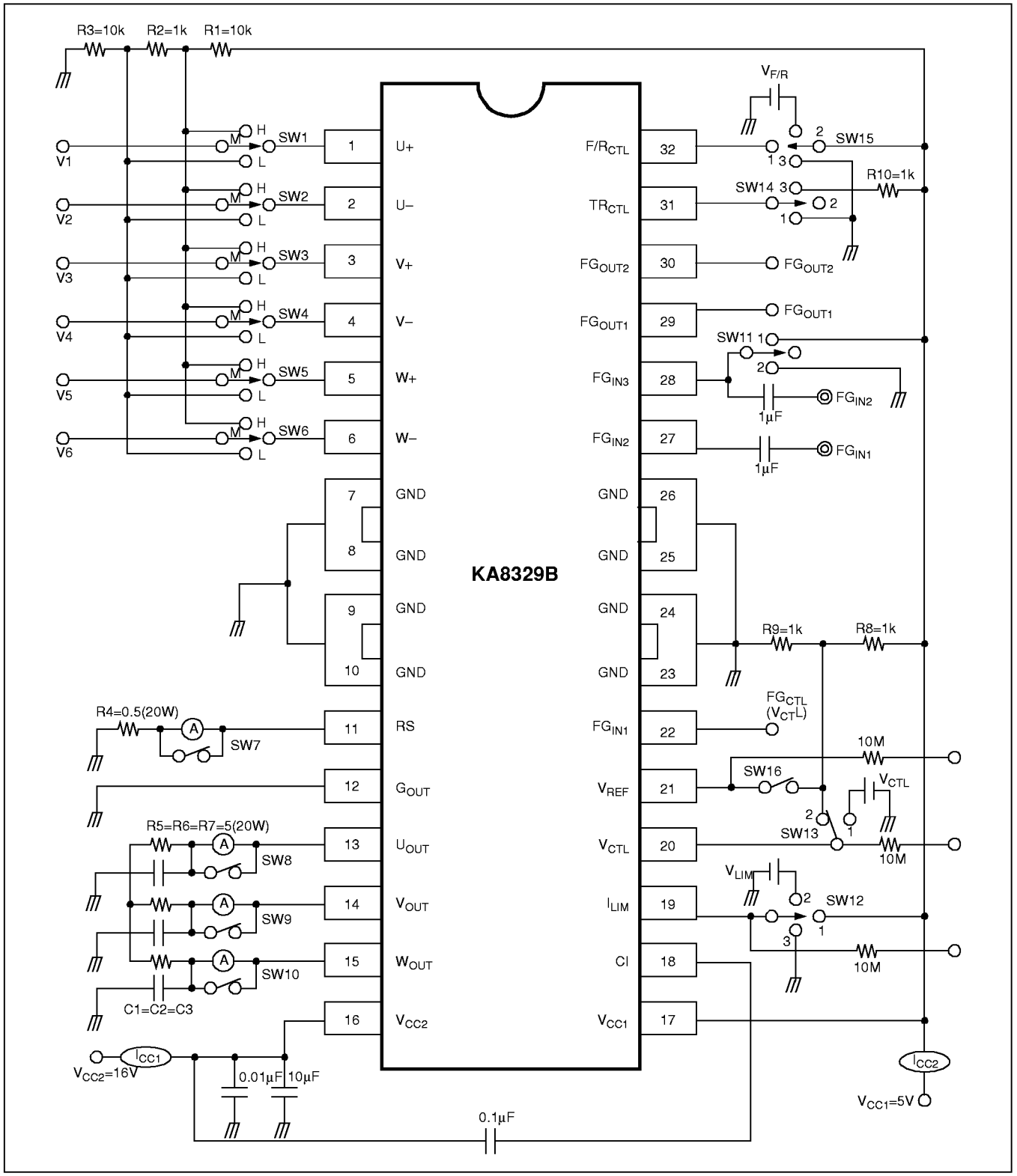



**3. $V_{CTL}$ vs $I_O$**

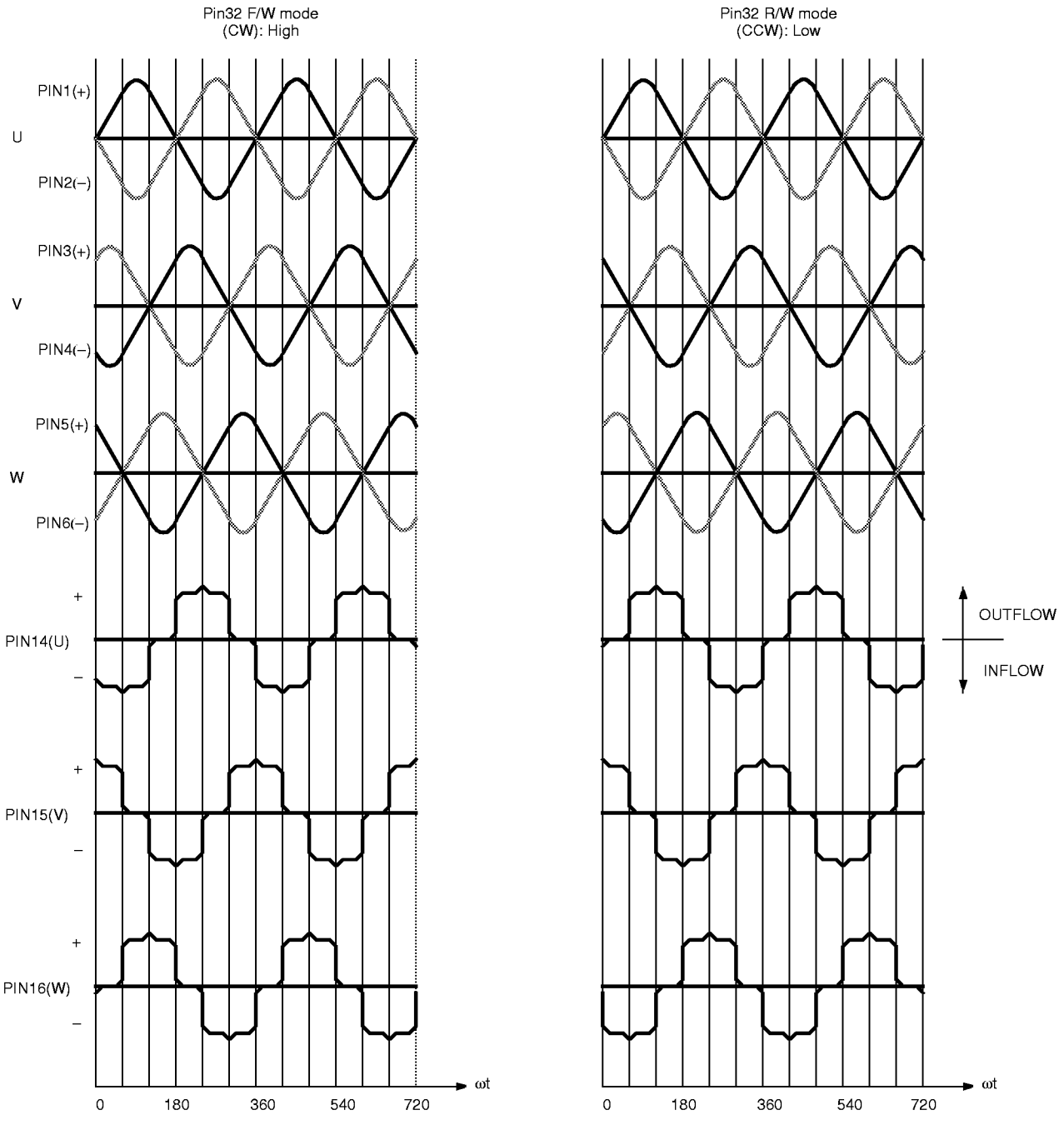



**4. $V_{LIM}$ vs $I_O$**

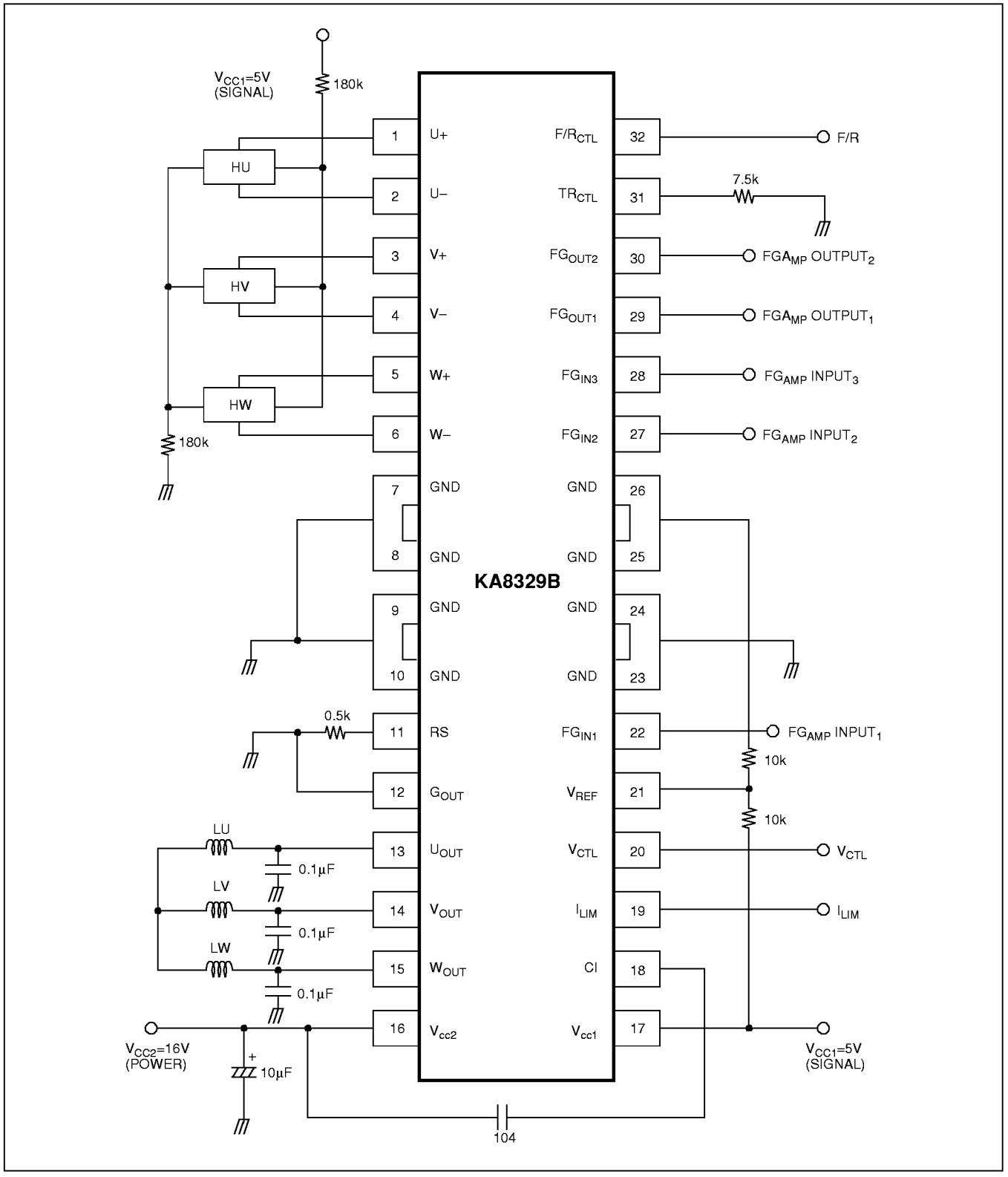
## TEST CIRCUIT



## TIMMING CHART



## APPLICATION CIRCUIT



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