

# KA3050

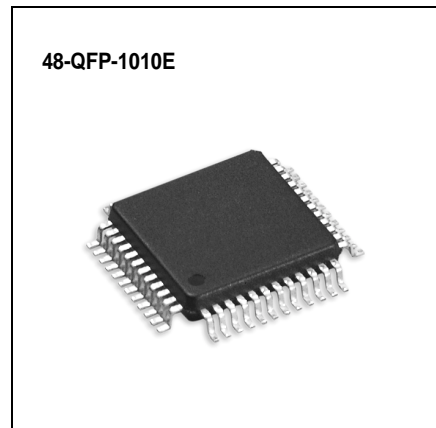
## Camera Motor Drive and Control IC

### Features

- Built-in DC motor driver  
: 1.5-CH DC motor driver : CW, CCW & Brake
- Stepping motor driver
- Built-in strobo control
- Built-in IRED driver for auto-focus
- Built-in  $V_E$  selector
- Built-in  $V_E$  voltage detector
- Built-in 5V regulator
- Built-in step-up DC/DC converter controller

### Description

The KA3050 is a monolithic integrated circuit, and suitable for the motor driver (AE, AF, zoom and reel motor driver) and the controller (strobo trigger, IRED driver, supply voltage detector, step-up converter control, etc.) in camera systems.



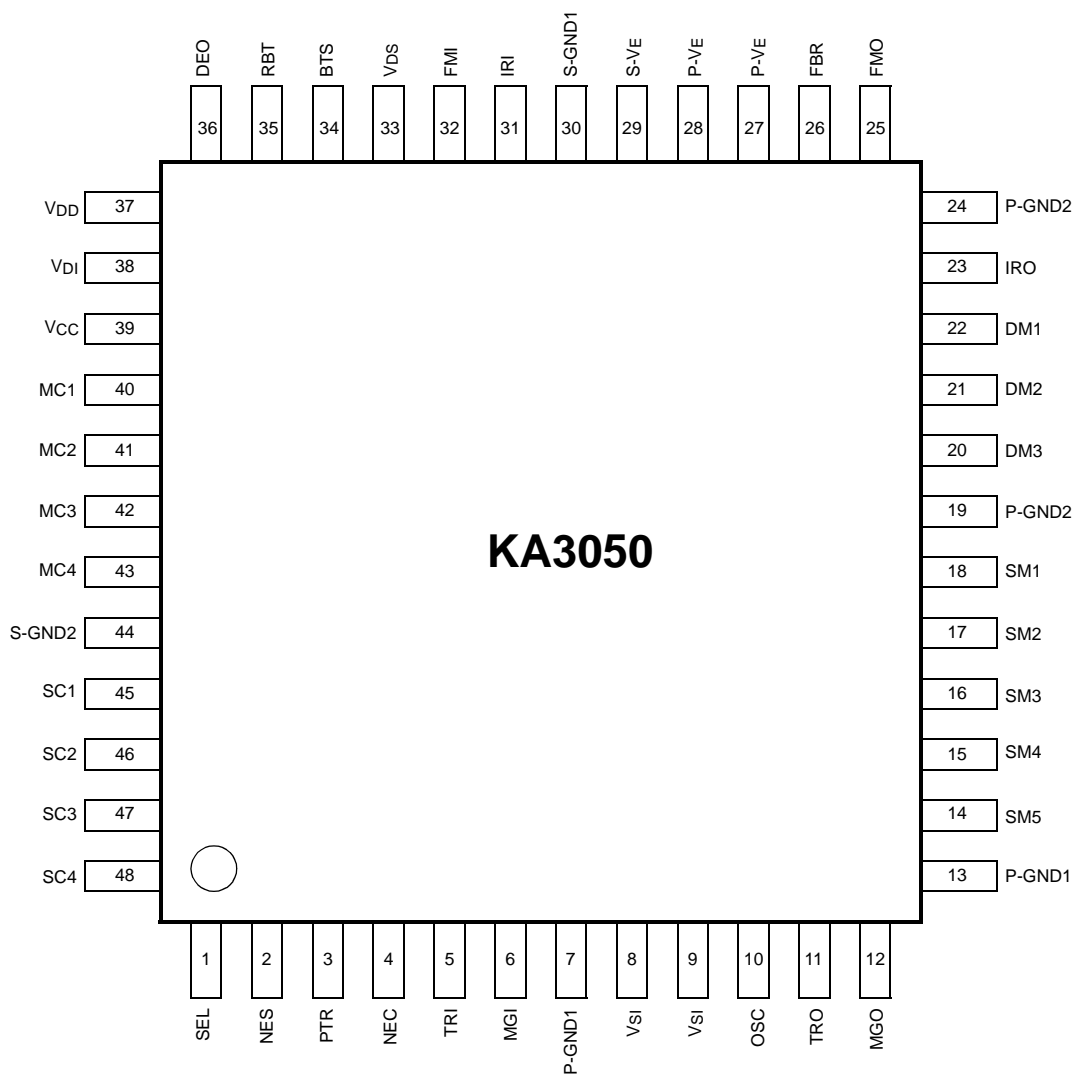
### Typical Applications

- Camera system

### Ordering Information

Device	Package	Operating Temp.
KA3050	48-QFP-1010E	-20°C ~ +50°C

## Pin Assignments



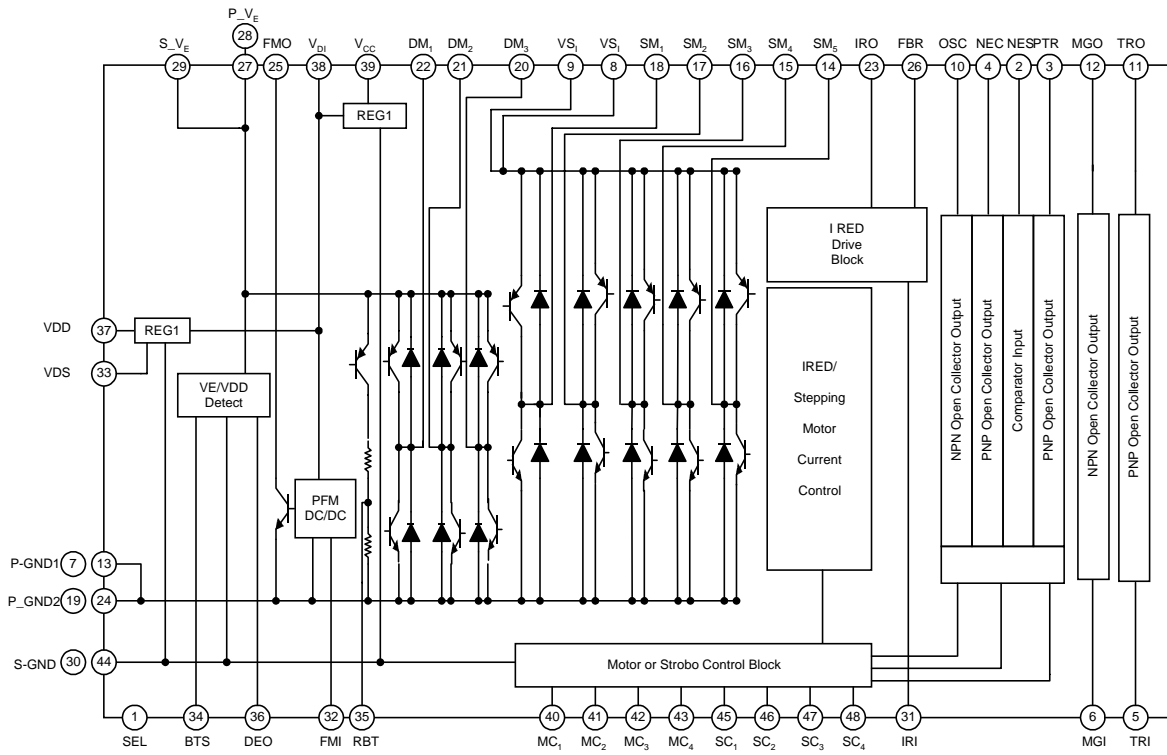
## Pin Definitions

Pin Number	Pin Name	Pin Function Description
1	SEL	IC on/off
2	NES	Comparator input
3	PTR	PNP open collector output
4	NEC	PNP open collector output
5	TRI	Trigger input
6	MGI	Magnet drive input
7	P-GND1	Power ground 1
8	V <sub>S1</sub>	Step motor & AE meter power
9	V <sub>S1</sub>	Step motor & AE meter power
10	OSC	NPN open collector output
11	TRO	PNP open collector output
12	MGO	Magnet drive output (NPN open collector output)
13	P-GND1	Power ground 1
14	SM <sub>5</sub>	Step motor & AE meter output 5
15	SM <sub>4</sub>	Step motor & AE meter output 4
16	SM <sub>3</sub>	Step motor & AE meter output 3
17	SM <sub>2</sub>	Step motor & AE meter output 2
18	SM <sub>1</sub>	Step motor & AE meter output 1
19	P-GND2	Power ground 2
20	DM <sub>3</sub>	DC motor output 3
21	DM <sub>2</sub>	DC motor output 2
22	DM <sub>1</sub>	DC motor output 1
23	IRO	IRED drive output
24	P-GND2	Power ground 2
25	FMO	Step-up converter switching output
26	FBR	IRED feedback input
27	P-VE	Power VE (Battery power)
28	P-VE	Power VE (Battery power)
29	S-VE	Signal VE (Battery power)
30	S-GND1	Signal ground 1
31	IRI	IRED control input
32	FMI	Step-up converter clock input
33	V <sub>DS</sub>	V <sub>DD</sub> selection (4V/5V)
34	BTS	Battery selection (3V/6V)
35	RBT	VE voltage detection output(analog)
36	DEO	VE voltage detection output(digital)
37	V <sub>DD</sub>	Inside power & outside power output
38	V <sub>DI</sub>	Step-up voltage
39	V <sub>CC</sub>	Motor drive IC power & control block power (5V) output
40	MC <sub>1</sub>	MC code input 1

## Pin Definitions (Continued)

Pin Number	Pin Name	Pin Function Description
41	MC <sub>2</sub>	MC code input 2
42	MC <sub>3</sub>	MC code input 3
43	MC <sub>4</sub>	MC code input 4
44	S-GND2	Signal ground 2
45	SC <sub>1</sub>	SC code input 1
46	SC <sub>2</sub>	SC code input 2
47	SC <sub>3</sub>	SC code input 3
48	SC <sub>4</sub>	SC code input 4 / buffer output

## Internal Block Diagram



## Equivalent Circuits

Description	Pin No.	Internal Circuit
<b>1.5-Channel DC Motor Drive Block</b>		
MC1~4	40~43	
SC1~4	45~48	
DM1	22	
DM2	21	
DM3	20	
P_VE	27,28	
P_GND	7, 13, 19, 24	
<b>Stepping Motor Drive Block</b>		
MC1~4	40~43	
SC1~4	45~48	
SM1	18	
SM2	17	
SM3	16	
SM4	15	
SM5	14	
V_Si	8, 9	
P_GND	7, 13, 19, 24	
<b>IRED Drive Block</b>		
MC1~4	40~43	
SC1~4	45~48	
IRO	23	
FBR	26	

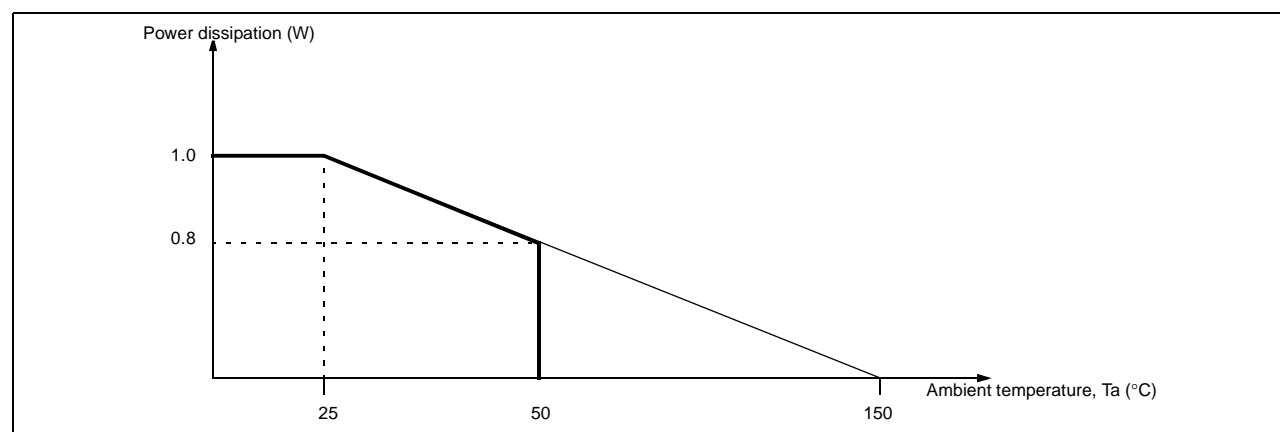
### Equivalent Circuits (Continued)

Description	Pin No.	Internal Circuit
Step-up Control Block		
FMI	32	
V <sub>DI</sub>	38	
FMO	25	
P_GND	7, 13, 19, 24	
General Buffer & Comparator Drive Block		
MC <sub>1</sub> ~4	40~43	
SC <sub>1</sub> ~3	45~47	
MGI	17	
MGO	16	
NES	2	
SC <sub>4</sub>	48	
TRI	5	
TRO	11	
PTR	3	
NEC	4	
OSC	10	
P_GND	7, 13, 19, 24	

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

Parameter	Symbol	Value	Unit	Remark
Supply voltage	VE	-0.3 ~ +7.5	V	
Output current (VDD)	IVDD	80	mA	
Output current (VCC)	IVCC	50	mA	
Output current (Stepping motor)	ISM1, 2, 3, 4	500	mA	Within 70ms
Output current (AE meter)	ISM4, 5	1000	mA	Within 70ms
Current (DC motor)	IDM	3000	mA	Within 10ms
Output current (IRO)	IIRO	2000	mA	Within 500μs
Output current (MGO)	IMGO	500	mA	Within 200ms
Output terminal voltage	VOUT	-0.3 ~ +7.5	V	
Input terminal voltage	VIN	-0.3 ~ +7.5	V	
Power dissipation	PD	1.0	W	
Operating temperature range	TOPR	-20 ~ +50	°C	
Storage temperature	TSTG	-55 ~ +125	°C	

## Power Dissipation Curve



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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating Supply Voltage	VE	2.0	-	7.5	V

## Electrical Characteristics (Ta = 25°C)

Block	Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Notes
Total	Leakage current	ISTB	VE=6.0V	-	-	1.0	μA	1
	Low input voltage range	VINL	-	-0.3	-	0.6	V	2
	High input voltage range	VINH	-	1.6	-	7.0	V	3
	Control input current	I <sub>IH</sub>	V <sub>IH</sub> =4.0V	-	80	120	μA	4
I <sub>IL</sub>		V <sub>IL</sub> =GND	-1	-	0			
Step-up & VDD	Min. operating voltage	V <sub>MIN</sub>	-	-	-	1.0	V	5
	Step-up output voltage 1	V <sub>VDD1</sub>	VE=2.0V, I <sub>LOAD</sub> =100mA	5.35	5.5	5.65	V	6
	Step-up output voltage 2	V <sub>VDD2</sub>	VE=2.0V, I <sub>LOAD</sub> =100mA	8.3	8.6	8.9		
	FMO output voltage 1	V <sub>VOL1</sub>	VE=2.0V, I <sub>LOAD</sub> =700mA	-	-	0.3	V	7
	FMO output voltage 2	V <sub>VOL2</sub>	VE=2.0V, I <sub>LOAD</sub> =1000mA	-	-	0.4		
	FMI step-up clock	f	VE=2.0V	39	156	313	KHz	8
	VDD output voltage 3	V <sub>VDD3</sub>	I <sub>O</sub> =80mA	3.85	4.0	4.15	V	9
	VDD output voltage 4	V <sub>VDD4</sub>	I <sub>O</sub> =80mA	4.85	5.0	5.15		
	Input & output potential difference 1	V <sub>SAT1</sub>	I <sub>O</sub> =80mA	-	-	0.3	V	10
VDET	VE detection voltage (1-1)	V <sub>TH+1</sub>	VE=6V	3.0	3.15	3.3	V	11
	VE detection voltage (1-2)	V <sub>TH-1</sub>	VE=6V	2.7	2.85	3.0		
	VE detection voltage (2-1)	V <sub>TH+2</sub>	VE=6V/3V	1.5	1.65	1.8	V	12
	VE detection voltage (2-2)	V <sub>TH-2</sub>	VE=6V/3V	1.2	1.35	1.5		
	Output saturation voltage	V <sub>DEO</sub>	VE=2.0V, I <sub>OL</sub> =5mA	-	-	0.5	V	13
	Operating voltage range 1	V <sub>OPR1</sub>	VE	1.2	-	7.5	V	14
RBT	Stand-by output voltage	V <sub>SBT</sub>	-	-	-	0.1	V	15
	Output voltage in operating	V <sub>RB1</sub>	I <sub>OL</sub> =10μA	0.47	0.5	0.53	× VE	16
	Operating voltage range 2	V <sub>OPR2</sub>	-	1.5	-	7.5	V	17
	Output voltage temperature coefficient	V <sub>T</sub>	-	-	-	2.0	mV/°C	18
VCC	VCC output voltage	V <sub>VDD5</sub>	I <sub>O</sub> =50mA	4.85	5.0	5.15	V	19
	Input & output potential difference 2	V <sub>DAT2</sub>	I <sub>O</sub> =50mA, V <sub>CC</sub> =3V	-	-	0.3	V	20
	Function compensation voltage range 3	V <sub>OPR3</sub>	VE	1.0	-	7.5	V	21
DC MOTOR	Function compensation voltage range 4	V <sub>OPR4</sub>	-	1.0	-	7.5	V	22
	Output voltage (PNP+NPN) 1	V <sub>VDM1</sub>	VE=2.0V, I <sub>OL</sub> =800mA	-	0.6	0.8	V	23
	Output voltage (PNP+NPN) 2	V <sub>VDM2</sub>	VE=2.0V, I <sub>OL</sub> =1000mA	-	0.8	1.0		



## Electrical Characteristics (Continued)

Block	Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Notes
S.M & AE METER	Function compensation voltage range 5	VOPR5	VSI=VE	1.6	-	7.5	V	24
	Output saturation voltage	VSTP	VSI=3.5V, IO=500mA	-	-	0.8	V	25
	Output voltage relative error	$\Delta V$	IO=300mA, SMI1,2,3,4	-	-	0.1	V	26
	VCOIL voltage	VCOIL	VCC=5V	1.7	1.8	1.9	V	27
	VCOIL voltage STEP	VCOST	-	-	190	-	mV	
STROBO	Function compensation voltage range 6	VOPR6	-	1.0	-	7.5	V	28
	TRO output voltage	VTRO	IO=10mA	-	-	0.5	V	29
	PTR output voltage	VPTR	IO=10mA	-	-	0.5	V	30
	NEC output voltage	VNEC	IO=10mA	-	-	0.5	V	31
	OSC output voltage	VOOSC	IO=10mA	-	-	0.5	V	32
	NES detection voltage	VNES	-	0.27	0.3	0.33	$\times V_{DD}$	33
	SC4 "L" level	VSOL	-	-	-	0.3	V	34
SC4 "H" level	VSOH	-	0.8	-	-	$\times V_{DD}$	35	
IRED	Output saturation voltage 3	VSAT3	IO=1A	-	-	1.0	V	36
	Output current	IO	RFBR=0.25 $\Omega$ VFBR=200mV	0.72	0.8	0.88	A	37
	Operating voltage range	VOP	-	1.5	-	7.5	V	38
MG	MGI detection voltage	VMGI	-	0.22	0.25	0.28	$\times V_{CC}$	39
	MGO output saturation voltage	VMGO	IO=500mA	-	-	0.5	V	40

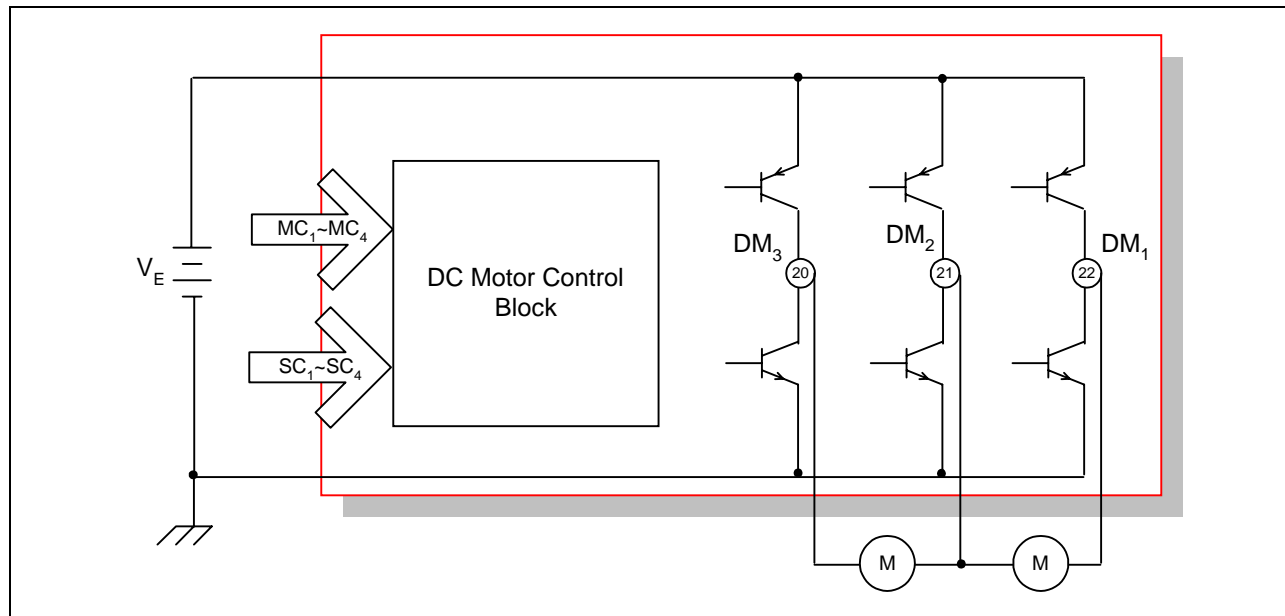
## Electrical Characteristics (Continued)

### Notes:

1. Define Input Current at Stand-By.
2. Define Low Level of Input Terminals.
3. Define High Level of Input Terminals.
4. Define Input Current of Each Control Input Terminals.
5. Define Min. Operating Voltage for Step-up Circuits (SEL, FMO)
6. Define Output Voltage of  $V_{DD}$  at Step-up.
7. Define Saturation Voltage of FMO Output.
8. Define Frequency of Step-up Clock.
9. Define Output Voltage of  $V_{DD}$ .
10. Define Input and Output Potential Difference of  $V_{DD}$  Regulator.
11. Define Detection Voltage of  $V_E$  Detection Circuit. ( with Hysteresis, Using 6V Battery )
12. Define Detection Voltage of  $V_E$  Detection Circuit. ( with Hysteresis, Using 6V or 3V Battery )
13. Define Output Saturation Voltage of DEO.
14. Define Operating Voltage Range of  $V_E$  Detection Circuit.
15. Define Output Voltage at Stand-by.
16. Define RBT Output Voltage at Operating RBT Circuit.
17. Define Operating Voltage Range of RBT Circuit.
18. Define Temperature Coefficient of RBT Output Voltage.
19. Define  $V_{CC}$  Output Voltage at Connecting  $V_{SI}$  and  $V_E$ .
20. Define Input and Output Potential Difference of  $V_{CC}$  Regulator.
21. Define Function Compensation Voltage of  $V_{CC}$  Output Circuit.
22. Define Function Compensation Voltage of DC Motor Driving Circuit.
23. Define Output Saturation Voltage ( PNP + NPN ) of DC Motor Driving Circuit.
24. Define Function Compensation Voltage of Stepping Motor and AE Meter Driving Circuit.
25. Define Output Saturation Voltage ( PNP + NPN ) at Flowing Specified Current.
26. Define Relative Error of Output Voltage at Flowing Specified Current between SM1-2 and SM3-4.
27. Define Voltage between Both Side of  $V_{COIL}$ .
28. Define Function Compensation Voltage of Strobo Control Circuit.
29. Define Output Saturation Voltage of TRO.
30. Define Output Saturation Voltage of PTR.
31. Define Output Saturation Voltage of NEC.
32. Define Output Saturation Voltage of OSC.
33. Define Detection Voltage of NES Voltage Detection Circuit.
34. Define Low Level of SC4.
35. Define High Level of SC4.
36. Define Output Saturation Voltage of IRED Driving Circuit.
37. Define Output Current of IRO.
38. Define Operating Voltage Range of IRED Driving Circuit.
39. Define Detection Voltage of MGI.
40. Define Output Saturation Voltage at Flowing Specified Current of MGO.

## Application Information

### 1. Zoom And Reel Motor Drive Block (1.5-Channel Dc Motor Drive Block)



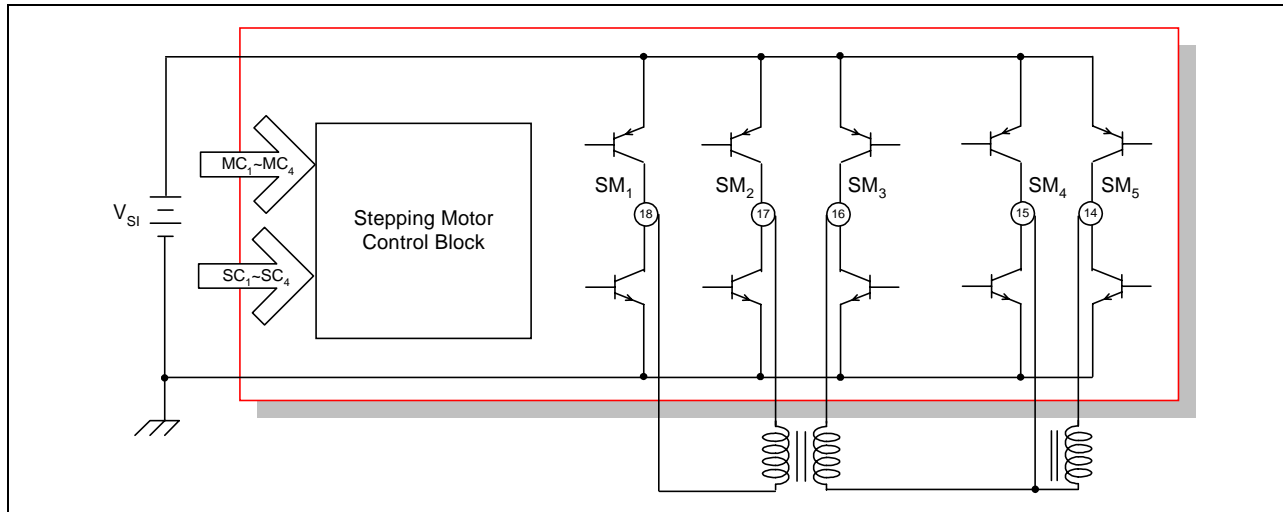
This block diagram describes the driver of zoom and reel motor in camera systems.

The drive block is controlled by  $MC_1 \sim 4$  and  $SC_1 \sim 4$ , which are come from micro controller.

Follow is the control logic table.

INPUT								OUTPUT		
$MC_1$	$MC_2$	$MC_3$	$MC_4$	$SC_1$	$SC_2$	$SC_3$	$SC_4$	$DM_1$	$DM_2$	$DM_3$
L	L	L	H	L	L	L	L	L	H	-
	L	H	L					H	L	-
	L	H	H					L	L	-
	H	L	H					-	H	L
	H	H	L					-	L	H
	H	H	H					-	L	L

## 2. Af Motor And Ae Meter Drive Block (Stepping Motor Drive Block)



The block diagram describes the driver of AF motor and AE meter in camera systems.

The drive output is selected by MC signals (MC1~4).

These MC codes are as follows.

INPUT				OUTPUT				
MC <sub>1</sub>	MC <sub>2</sub>	MC <sub>3</sub>	MC <sub>4</sub>	SM <sub>1</sub>	SM <sub>2</sub>	SM <sub>3</sub>	SM <sub>4</sub>	SM <sub>5</sub>
H	L	L	H	-	-	-	L	H
	L	H	L	-	-	-	H	L
	L	H	H	-	-	-	L	L
	H	L	L	L	H	L	H	-
	H	L	H	L	H	H	L	-
	H	H	L	H	L	L	H	-
	H	H	H	H	H	L	H	L

The output voltage ( $V_{COIL}$ ) is determined by SC1~4.

The  $V_{COIL}$  is potential difference between drive output and ground.

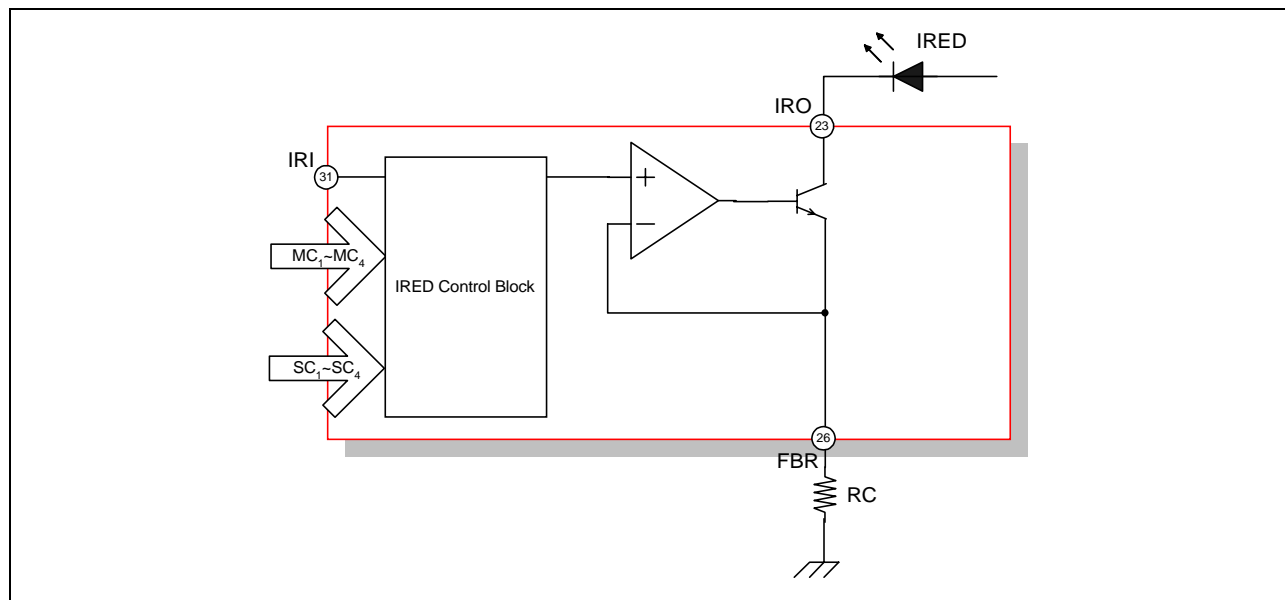
i.e.,

$$V_{COIL} = V_{SM} - GND.$$

The  $V_{COIL}$  is selected by following table.

INPUT				V <sub>COIL</sub> OUTPUT VOLTAGE [V]
SC <sub>1</sub>	SC <sub>2</sub>	SC <sub>3</sub>	SC <sub>4</sub>	
L	L	L	L	1.80
L	L	L	H	1.99
L	L	H	L	2.18
L	L	H	H	2.37
L	H	L	L	2.56
L	H	L	H	2.75
L	H	H	L	2.94
L	H	H	H	3.13
H	L	L	L	3.32
H	L	L	H	3.51
H	L	H	L	3.70
H	L	H	H	3.89
H	H	L	L	4.08
H	H	L	H	4.27
H	H	H	L	4.46
H	H	H	H	4.65

### 3. Ired Drive Block



The block drives infrared emitting diode (IRED).

The FBR voltage (V<sub>FBR</sub>) is controlled by MC codes and SC codes.

The IRED current (I<sub>IRED</sub>) is determined by V<sub>FBR</sub> and resistor R<sub>c</sub>.

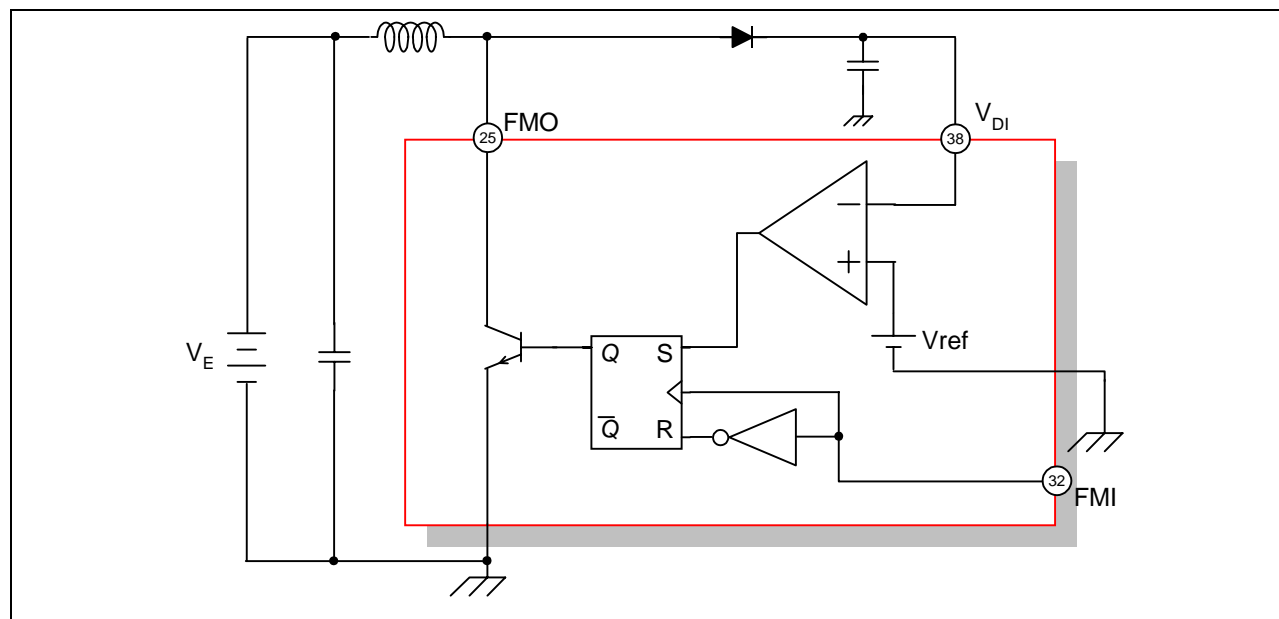
i.e.,

$$I_{IRED} = V_{FBR} / R_C$$

The  $V_{FBR}$  is controlled as following table.

INPUT								$V_{FBR}$ [mV]
MC1	MC2	MC3	MC4	SC1	SC2	SC3	SC4	
L	H	L	L	L	L	L	L	190
L	H	L	L	L	L	L	H	210
L	H	L	L	L	L	H	L	230
L	H	L	L	L	L	H	H	250
L	H	L	L	L	H	L	L	270
L	H	L	L	L	H	L	H	290
L	H	L	L	L	H	H	L	310
L	H	L	L	L	H	H	H	330
L	H	L	L	H	L	L	L	350
L	H	L	L	H	L	L	H	370
L	H	L	L	H	L	H	L	390
L	H	L	L	H	L	H	H	410
L	H	L	L	H	H	L	L	430
L	H	L	L	H	H	L	H	450
L	H	L	L	H	H	H	L	470
L	H	L	L	H	H	H	H	490

#### 4. Step-up Control Block



The FMO frequency from KA3050 steps up the battery voltage  $V_E$ .

The FMO frequency depends on the FMI frequency, which is come from micro controller.

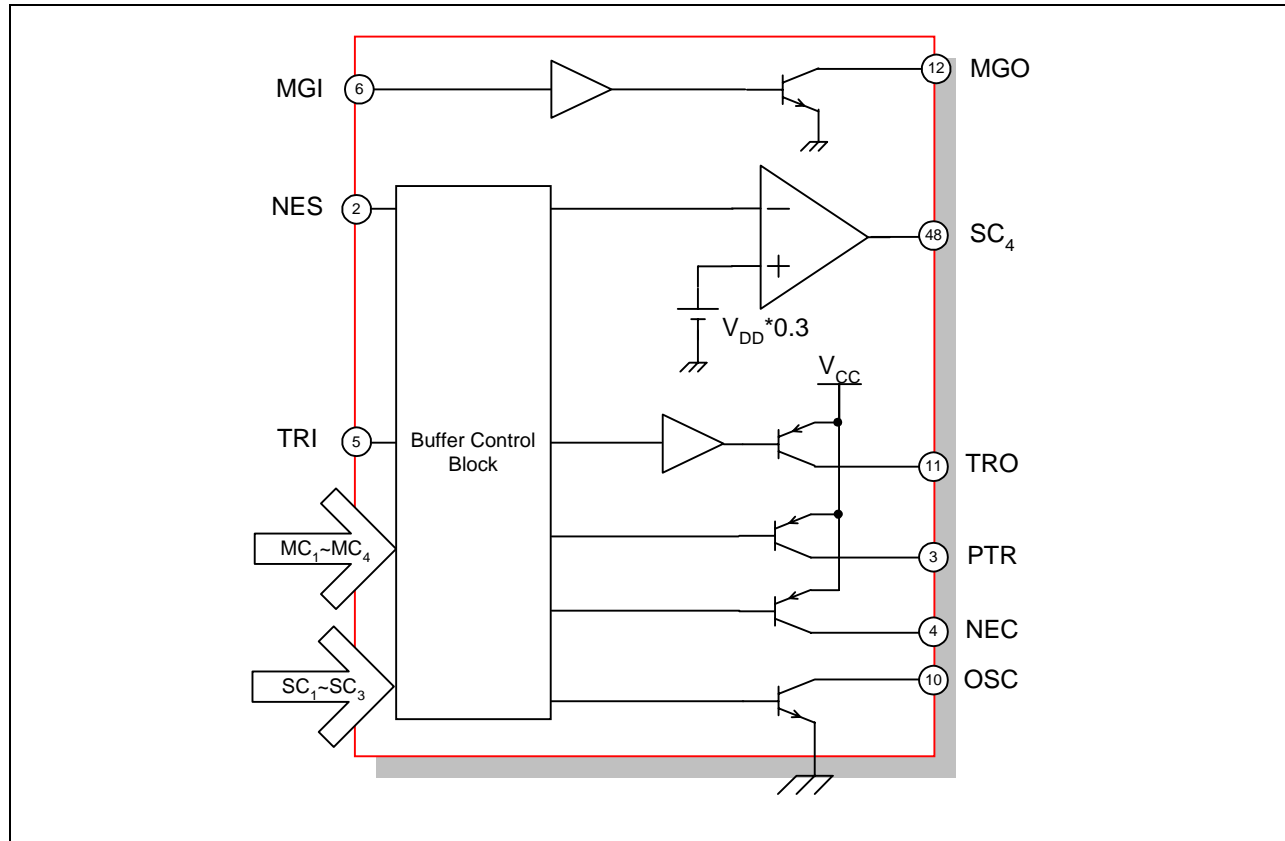
Maximum value of  $V_{DI}$  is 5.5V in normal operation mode, and 8.6V in IRED operation mode.

i.e.,

Normal Operation Mode:  $V_{DI} = 5.5V$

IRED Operation Mode:  $V_{DI} = 8.6V$

## 5. General Buffer And Comparator Drive Block



The KA3050 is composed of 5 general buffers and a comparator.

This block has 10 inputs and 6 outputs.

All output are controlled by MC and SC codes except MGO.

The control codes are as follows.

INPUT									OUTPUT				
MC1	MC2	MC3	MC4	SC1	SC2	SC3	NES	TRI	SC4	OSC	NEC	PTR	TRO
L	L	L	L	L	L	H	H/L	-	L/H	-	H	-	-
				L	H	L	H/L	-	L/H	L	H	-	-
				L	H	H	-	-	-	L	-	-	-
				H	L	L	-	H/L	-	-	-	H	H/ OPEN

The NES and SC4 are conflict with each other, it means.

NES = High  $\rightarrow$  SC4 = Low

NES = Low  $\rightarrow$  SC4 = High

The meaning of H/L in TRI signal and H/OPEN in TRO signal are as follows.

TRI = High → SC4 = High

TRI = Low → SC4 = Open

The OSC signal refer to following table.

VDET1	DEO(VDET2)	BTS	OSC	Step-up Circuit
H	-	Open(6V)	Enable	Enable
L	H		Disable	Enable
	L		Disable	Disable
	H	Ground(3V)	Enable	Enable
	L		Disable	Disable

Where,

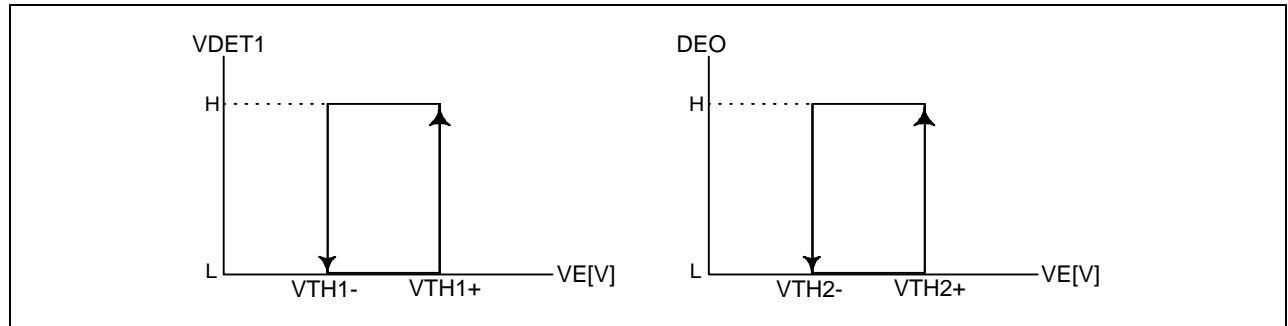
DEO: Battery Voltage Checker, Pin 36

BTS: Battery Selector, Pin 34

Users can't check the VDET1 because VDET1 is selected automatically inside the KA3050 in 6V battery usage.

But step-up circuit (SUC) can be checked by DEO signal.

The VDET1 and DEO have hysteresis loop as following graph.



The VTH1 and VTH2 refer to electrical characteristics.



## 6. Other Control Blocks

The following table is description of other control blocks.

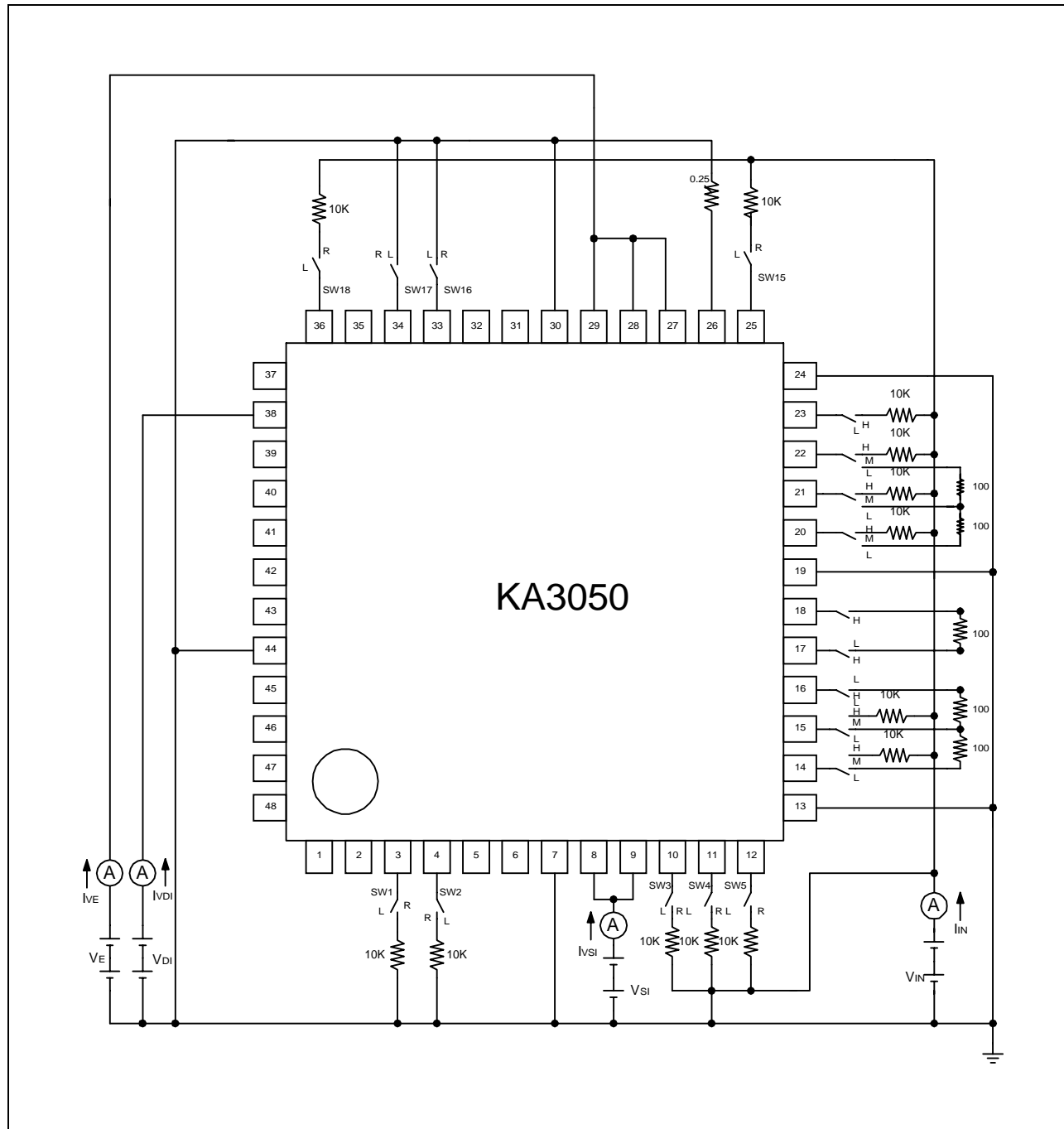
Pin No.	Symbol	Function
1	SEL	High: KA3050 Operation
		Low: KA3050 No Operation
33	VDS	Open: VDD = 5V
		Ground: VDD = 4V
34	BTS	Open: VE = 6V
		Ground: VE = 3V
35	RBT	$VRBT = VE / 2$
36	DEO	High: Sufficient Battery
		Low: Insufficient Battery
37	VDD	4V or 5V Regulator output
39	VCC	5V Regulator output

## Control Code Table

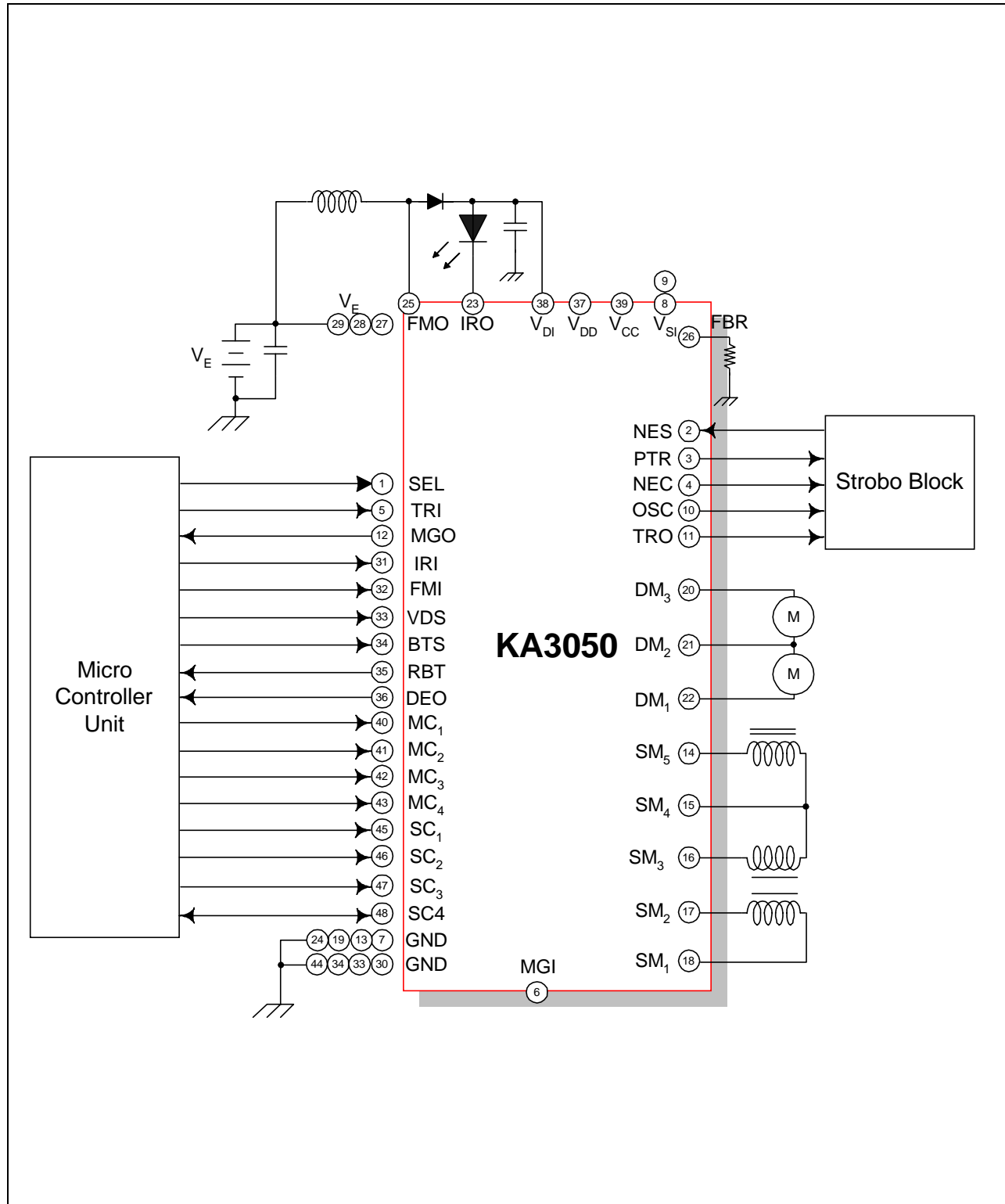
MC1	MC2	MC3	MC4	SC1	SC2	SC3	SC4	DM1	DM2	DM3	SM1	SM2	SM3	SM4	SM5	OSC	NEC	PTR	NES	TR1	TR0	FBR	VCO				
L	L	L	L					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
L	L	L	H	L	L	L	L	L	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
L	L	H	L					H	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
L	L	H	H					L	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
L	H	L	L	CODE				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
L	H	L	H					-	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-				
L	H	H	L	L	L	L	L	-	L	H	-	-	-	-	-	-	-	-	-	-	-	-	-				
L	H	H	H					-	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-				
H	L	L	L	CODE				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
H	L	L	H					-	-	-	-	-	-	-	L	H	-	-	-	-	-	-	-	-	-	-	-
H	L	H	L					-	-	-	-	-	-	-	H	L	-	-	-	-	-	-	-	-	-	-	-
H	L	H	H					-	-	-	-	-	-	-	L	L	-	-	-	-	-	-	-	-	-	-	-
H	H	L	L					-	-	-	L	H	L	H	-	-	-	-	-	-	-	-	-	-	-	-	-
H	H	L	H					-	-	-	L	H	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
H	H	H	L					-	-	-	H	L	L	H	-	-	-	-	-	-	-	-	-	-	-	-	-
H	H	H	H					-	-	-	H	L	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
L	L	L	L	L	L	H	*1	-	-	-	-	-	-	-	-	-	H	-	H/L	-	-	-	-				
L	L	L	L	L	H	L	*1	-	-	-	-	-	-	-	-	L	H	-	H/L	-	-	-	-				
L	L	L	L	L	H	H	*1	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	-				
L	L	L	L	L	L	L	*1	-	-	-	-	-	-	-	-	-	-	H	-	H/L	H/OPEN	-	-				
L / H	H / *	L / *	L / *	L	L	L	L	-	-	-	-	FBR 190mV				-	-	-	VCOIL 1.80V		-	-	-				
				L	L	L	H	-	-	-	-	210mV				-	-	-	1.99V		-	-	-				
				L	L	H	L	-	-	-	-	230mV				-	-	-	2.18V		-	-	-				
				L	L	H	H	-	-	-	-	250mV				-	-	-	2.37V		-	-	-				
				L	H	L	L	-	-	-	-	270mV				-	-	-	2.56V		-	-	-				
				L	H	L	H	-	-	-	-	290mV				-	-	-	2.75V		-	-	-				
				L	H	H	L	-	-	-	-	310mV				-	-	-	2.94V		-	-	-				
				L	H	H	H	-	-	-	-	330mV				-	-	-	3.13V		-	-	-				
				H	L	L	L	-	-	-	-	350mV				-	-	-	3.32V		-	-	-				
				H	L	L	H	-	-	-	-	370mV				-	-	-	3.51V		-	-	-				
				H	L	H	L	-	-	-	-	390mV				-	-	-	3.70V		-	-	-				
				H	L	H	H	-	-	-	-	410mV				-	-	-	3.89V		-	-	-				
				H	H	L	L	-	-	-	-	430mV				-	-	-	4.08V		-	-	-				
				H	H	L	H	-	-	-	-	450mV				-	-	-	4.27V		-	-	-				
H	H	H	L	-	-	-	-	470mV				-	-	-	4.46V		-	-	-								
H	H	H	H	-	-	-	-	490mV				-	-	-	4.65V		-	-	-								

**Note:** \* mark : Detect NES signal and send a inverted signal to SC4.

## Test Circuits



## Typical Application Circuits





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