Bipolar Analog Integrated Circuit

μPC2138

4 Channel Read/Write Amplifier For MIG Heads Of Hard Disk Drive

Remark MIG: Metal In Gap

The μPC2138 is a low noise, high speed monolithic bipolar integrated circuit for hard disk drives, performing both read and write functions. The μPC2138 is applicable to four center tapped MIG heads and features low noise and high bandwidth, so the μPC2138 is suitable for high density small size (2.5/3.5 inch) hard disk drives.

FEATURES

- Low Noise and Low Input Capacitance: 0.7 nV/√Hz (typ.),10pF (typ.)
- Wide Bandwidth: 70 MHz (typ.)
- Wide Operating Supply Voltage: 2.7 to 5.5 V
- Power Save Mode
- Write Current Range: 5 to 30 mA
- Write Unsafe Detection
- Package: 20 Pin Shrink SOP (300 mil)

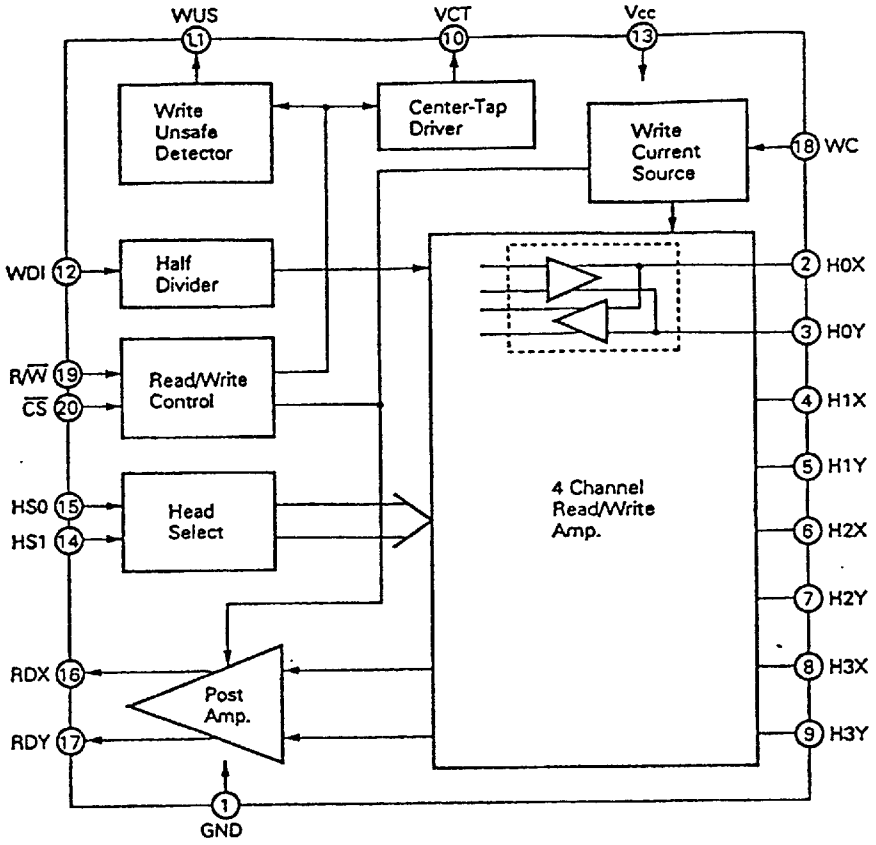
ORDERING INFORMATION

Ordering Code	Package	Quality Grade
μPC2138GS	20-pin Shrink SOP (300 mil)	Standard

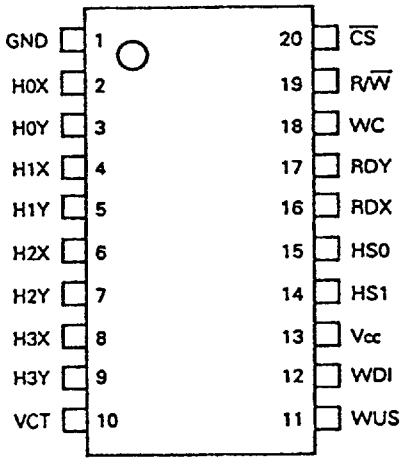
Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

Document No. IP-3139
(O.D.No. IP-8690)
Date Published October 1992 P
Printed in Japan

BLOCK DIAGRAM



PIN CONFIGURATION



PIN FUNCTIONS

PIN No.	PIN SYMBOL	I/O	FUNCTION DESCRIPTION
1	GND		Ground
2	H0X	I/O	X, Y head connection No. 0
3	H0Y		
4	H1X	I/O	X, Y head connection No. 1
5	H1Y		
6	H2X	I/O	X, Y head connection No. 2
7	H2Y		
8	H3X	I/O	X, Y head connection No. 3
9	H3Y		
10	VCT	O	Write current set at WC flows into the center-tap of the head.
11	WUS	O	WRITE UNSAFE OPERATION Write unsafe (WUS) detection outputs a high level from the WUS pin in the following error conditions. The output pin structure is open collector. (Normal write mode operation level is low.) ① The head pin is short-circuited to the GND. ② The head pin is unconnected. (Open) ③ The head pins are short-circuited. ④ The head pin is short-circuited to the center-tap. ⑤ The center-tap is unconnected. (Open) ⑥ Write data transition rate is too low. ⑦ No write current. ⑧ Combination of above situation. ⑨ Read mode operation. ⑩ Power save mode operation.
12	WDI	I	Write data input The input data is written after frequency division by 2. A negative transition toggles the write current direction. Initial write current after read mode flows X-side of head pins.
13	Vcc		Power supply
14	HS1	I	Head select See function table
15	HS0		
16	RDX	O	Read data differential output
17	RDY		
18	WC		Set the value of write current by following formula. $I_W = K / R_{WC}$ (A) K: See the write mode table of Electrical characteristics.
19	R/$\overline{W}$	I	Read/Write mode select See function table.
20	$\overline{CS}$	I	Chip select See function table.

FUNCTION TABLE

Head Select

HS1	HS0	Selected Head
L	L	0
L	H	1
H	L	2
H	H	3

Mode Select

$\overline{CS}$	R/$\overline{W}$	Operation Mode
L	L	Write
L	H	Read
H	L	Power Save
H	H	Power Save

ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Conditions	Rating	Unit
Supply voltage	V_{CC}		7	V
Write current	I_W		35	mA
Digital input voltage	V_{DI}	$\overline{CS}$, R/$\overline{W}$, WDI, HS0, HS1	−0.3 to Vcc + 0.3	V
Write unsafe output	V_{WUS}	WUS	−0.3 to Vcc + 0.3	V
	I_{WUS}	WUS	12	mA
Center-tap current	I_{VCT}		−35	mA
Read data output current	I_{ORD}	RDX, RDY	−10	mA
Head input voltage	V_{HIN}	H0X to H3X, H0Y to H3Y	0 to Vcc	V
Differential head input voltage	V_{FB}	HnX − HnY	5	V
Storage temperature	T_{STG}		−50 to +150	°C
Operating temperature	T_{OPT}		0 to +70	°C
Operating junction temperature	T_J		0 to +125	°C

RECOMMENDED OPERATING CONDITIONS

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Power supply						
Supply voltage	V_{CC}		2.7		5.5	V
Digital interface						
Low level input voltage	V_{IL}		0		0.8	V
High level input voltage	V_{IH}		2.0		Vcc	V
Read/write						
Head inductance	L_H		2.5	3.0		μH
Dumping resistor	R_T					Ω
Differential head input voltage	V_{FB}		2.0		4.0	V
Write current	I_W		5		30	mA

ELECTRICAL CHARACTERISTICS

Supply Current and Power Consumption

(Ta = 0 to +70 °C, Vcc = +2.7 to +5.5 V) ( ) at 5V

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply current	I_{CCR}	Read mode		22 (24)	32 (35)	mA
	I_{CCW}	Write mode		30+Iw(35)	40+Iw(50)	mA
	I_{CCPS}	Power save mode			1.0(2.5)	mA
Power Consumption	P_{C-R}	Read mode Vcc = 3.6 V		66	115.2	mW
	P_{C-W}	Write mode Vcc = 3.6 V, Iw = 15 mA		135	198	mW
	P_{C-PS}	Power save mode (Vcc = 3.6 V)			3.6	mW

Digital Interface

(Ta = 0 to +70 °C, Vcc = +2.7 to +5.5 V)

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Low level input current	$\|I_{IL}\|$	V_{IL} = 0.8 V			100	μA
High level input current	$\|I_{IH}\|$	V_{IH} = 2.0 V			100	μA
Low level output voltage	V_{OL}	I_{OL} = 8 mA, WUS pin			0.5	V
High level output current	I_{OH}	V_{OH} = 3.0 V, WUS pin			100	μA
Read to write transition time	t_{dRW}	Delay to 90 % of write current		250	600	ns
Write to read transition time	t_{dWR}	Delay from 10 % of write current to 90 % of 10 MHz read signal		400	600	ns
Head select switching delay	t_{dHS}	Read or write mode		130	600	ns
Chip Disable transition time	t_{dCS}	Power save to read or write R_L = 3 kΩ, C_L = 1800 pF		1.5	5	μs
Unsafe to safe delay	t_{dUS}	f(data) = 1 MHz, Iw = 15 mA, L_H = 2.5 μH			1.0	μs
Safe to unsafe delay	t_{dSU}	f(data) = 1 MHz, Iw = 15 mA, L_H = 2.5 μH	1.6		8.0	μs

Read Mode

(Ta = 0 to +70 °C, Vcc = +2.7 to +5.5 V)

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Differential voltage gain	A_V	V_{IN} = 1 m V_{P-P}, f = 300 kHz R_L = 3 kΩ Ta = 25 °C	240	300	360	V/V
Voltage band width (–3 dB)	fc	Z_S < 5 Ω, V_{IN} = 1 m V_{P-P} Reference frequency: 300 kHz	40	70		MHz
Input noise voltage	V_N	Band width: 15 MHz, Z_S = 0, Ta = 25 °C		0.7	1.0	$nV/\sqrt{Hz}$
Differential input capacitance	C_{IN}	f = 5 MHz		10	15	pF
Differential input resistance	R_{IN}	f = 5 MHz	1.6	3		kΩ
Input bias current	I_{IN}	Read mode		15	45	μA
Dynamic range	V_{DR}	THD (Distortion rate) ≤ 1 %	2.5			mV_{P-P}
Common mode rejection ratio	CMRR	V_{IN} 100 m V_{P-P}, f = 5 MHz	50	70		dB
Power supply rejection ratio	PSRR	100 m V_{P-P} on Vcc f = 5 MHz	48	60		dB
Channel separation	XT	Unselected channels driven with V_{IN} = 100 mV_{P-P}, f = 5 MHz	50	90		dB
Common mode output voltage	V_{OUT}			1.5		V
Single ended output impedance	R_{OUT}	f = 5 MHz			50	Ω
Output offset voltage	V_{OFR}	Read mode			500	mV
Output voltage change	V_{OFWR}	Write to read mode output DC level change			100	mV
VCT voltage	VCT(R)			1.6		V

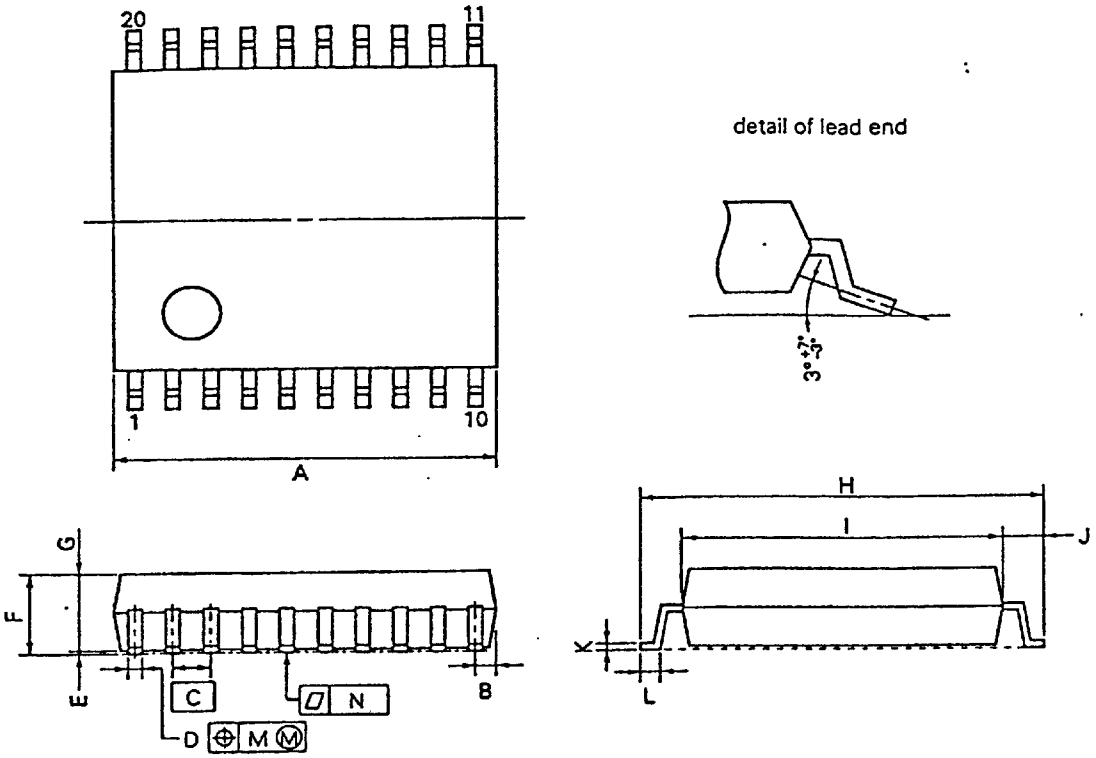
Write mode

(Ta = 0 to +70 °C, Vcc = +2.7 to +5.5 V)

Item		Symbol	Condition	MIN.	TYP.	MAX.	Unit
Write current constant		K	K = Iw × Rwc, Ta = 25 °C	18.4	20	21.6	
Head current rise time		t_r	Iw = 15 mA, L_H = 0 μH			20	ns
Head current delay	Time	t_d	Iw = 15 mA, L_H = 0 μH			30	ns
	Asymmetry	Δ t_d				1.5	ns
Unselected differential head current		Δ Iw	Iw = 15 mA, L_H = 2.5 μH			1	mA
VCT voltage		VCT(W)	Vcc–VCT Iw = 30 mA		0.3	0.5	V

Package Outline

20 PIN PLASTIC SHRINK SOP (300 mil)



P20GM-65-300B-1

ITEM	MILLIMETERS	INCHES
A	7.00 MAX.	0.276 MAX.
B	0.575 MAX.	0.023 MAX.
C	0.65 (T.P.)	0.026 (T.P.)
D	0.30±0.10	$0.012^{+0.004}_{-0.005}$
E	0.1±0.1	0.004±0.004
F	2.0 MAX.	0.079 MAX.
G	1.7	0.067
H	8.1±0.3	0.319±0.012
I	6.1±0.2	0.240±0.008
J	1.0±0.2	$0.039^{+0.009}_{-0.008}$
K	$0.15^{+0.10}_{-0.05}$	$0.006^{+0.004}_{-0.002}$
L	0.5±0.2	$0.020^{+0.008}_{-0.009}$
M	0.12	0.005
N	0.10	0.004

NOTE
Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.