

MITSUBISHI (DGTL LOGIC)

**M54914FP**

**F2F MAGNETIC STRIPE ENCODING CARD READER**

**DESCRIPTION**

The M54914FP is a Bi-CMOS semiconductor integrated circuit consisting of an F2F demodulator for magnetic stripe card readers.

**FEATURES**

- Low power dissipation (standby current 1mA typ)
- Ignore bit selector input (bits 4, 8, 16)
- Output polarity (low-active, high-active) selector input
- Compact mini-molded package
- Wide operating temperature range  $T_a = -20 \sim +75^\circ\text{C}$

**APPLICATION**

Magnetic stripe card reader

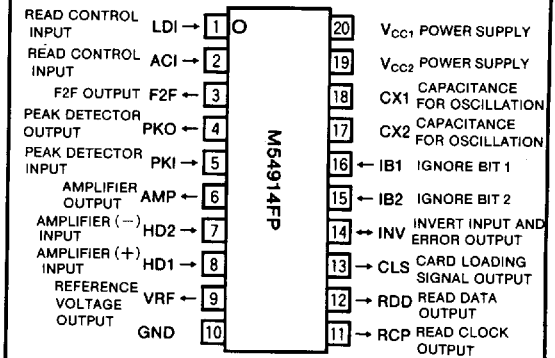
**FUNCTION**

The data signal read from a magnetic stripe card by a magnetic head is applied to HD-1 and HD-2. It is converted to an F2F pattern signal by analog processing in an amplifier OP1, peak detector OP2, and waveform regulator OP3. The bit numbers set by inputs IB1 and IB2 are ignored and the data receives digital processing to generate the card lording signal CLS, read clock signal RCP, read data signal RDD and error signal ERR (shared by INV pin). Outputs CLS, RCP and RDD are changed from low-active to high-active when INV is set low.

● Reference bit

N is the number of bits ignored by inputs IB1 and IB2.

**PIN CONFIGURATION (TOP VIEW)**



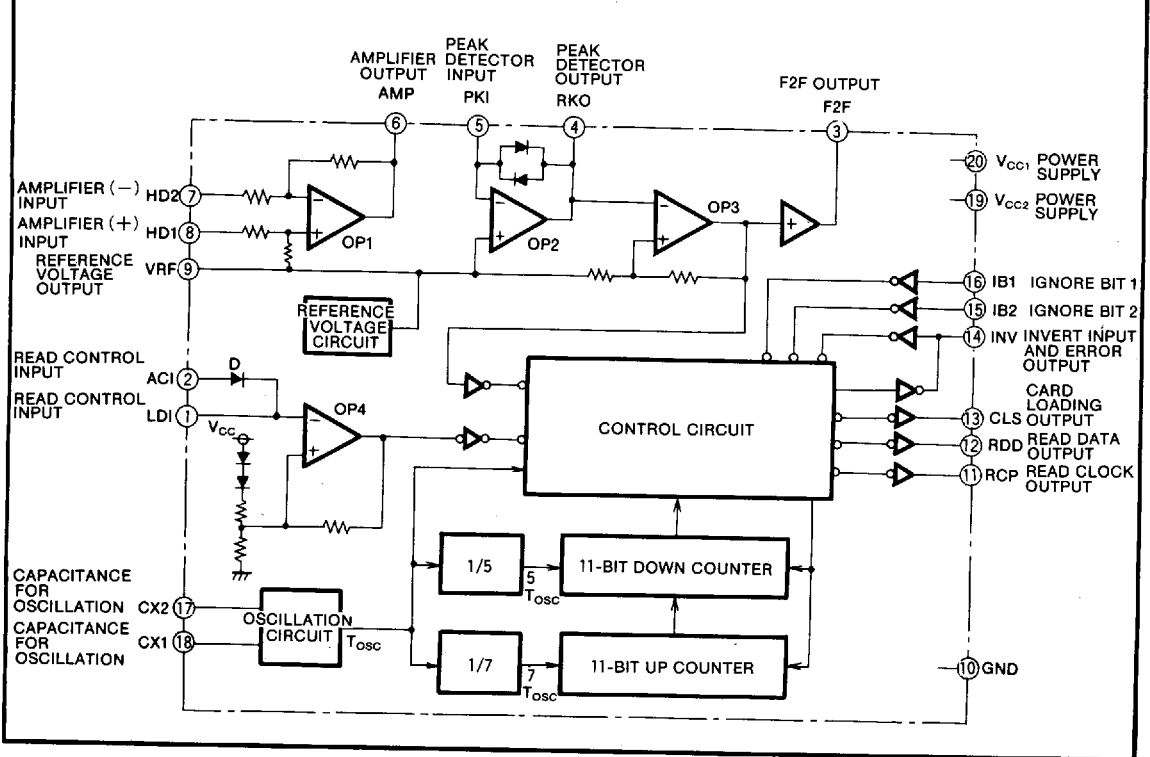
The reference bit is the bit from the Nth flux change to the Nth + 1 flux change when input LDI changes from low to high and time width  $T_{BO}$  is bit 0. The bits following this reference bit are treated as data bits.

When an error signal ERR is output, that bit becomes the reference bit.

● Logic determination

$T_{BN}$  is the time width of a data bit. If a "1" flux change is found between the flux change at the end of one bit (the beginning of the next bit) and  $5/7 T_{BN}$ , the next bit ( $B_{N+1}$ )

**BLOCK DIAGRAM**



**F2F MAGNETIC STRIPE ENCODING CARD READER**

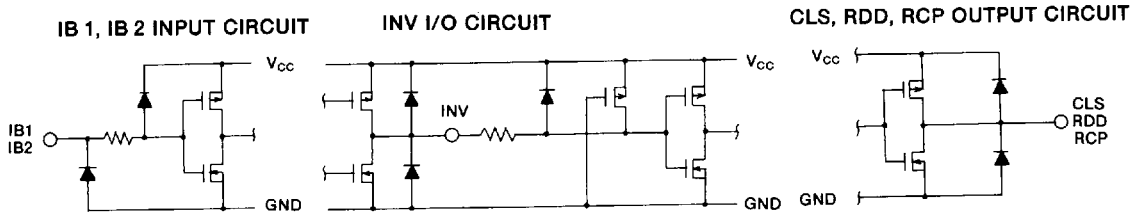
is determined to be 1; if no flux change is found, the bit is determined to be 0. If two flux changes are found, error signal ERR is output.

● Time width of the output signal

When the oscillation period of the oscillator is  $T_{osc}$ , the output signals have the following widths:

- Output pulse width of RCP, ERR ..... approx.  $16T_{osc}$
- RCP delay time width respect to RDD ... approx.  $8T_{osc}$

**I/O CIRCUIT**



**PIN DESCRIPTION**

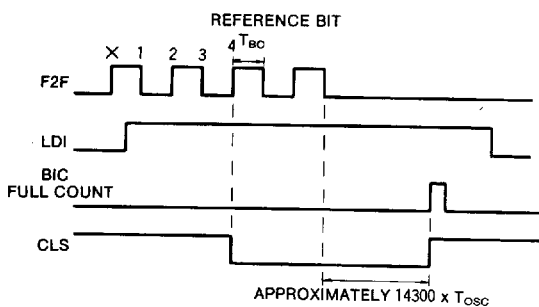
Pinnumber	Symbol	Name	Description
1	LDI	Read control input	Comparator input with hysteresis. When low, it resets the internal digital circuit. When high, F2F demodulation is possible.
2	ACI	Read control input	Read control input connected to LDI using a diode.
3	F2F	F2F output	F2F signal output magnetic head signal after amplification, peak detection and waveform regulation.
4	PKO	Peak detector output	Noise filter $C_{NF}$ is connected between PKI and PKO.
5	PKI	Peak detector input	Refer to PKI, PKO and F2F.
6	AMP	Amplifier output	Resistance RPK and capacitance CPK are connected between AMP and PKI.
7	HD2	Amplifier (-) input	The magnetic head is connected between HD1 and HD2.
8	HD1	Amplifier (+) input	The magnetic head is connected between HD1 and HD2.
9	VRF	Reference voltage output	$1/2 V_{CC}$ reference voltage output
10	GND	GND	
11	RCP	Read clock output	Clock pulse output after F2F demodulation
12	RDD	Read data output	Data output after F2F demodulation
13	CLS	Card loading signal output	signal output to indicate a running card
14	INV	Invert input and error	When high or open, CLS, RDD and RCP outputs become low-active; when low, CLS, RDD and RCD become high-active. Shared with error output pin ERR.
15	IB2	Ignore bit 2	Pin to set ignore bits
16	IB1	Ignore bit 1	Pin to set ignore bits
17	CX2	Capacitance for oscillation	Capacitance $C_{osc}$ is connected between CX1 and CX2 to set the oscillation frequency.
18	CX1	Capacitance for oscillation	Capacitance $C_{osc}$ is connected between CX1 and CX2 to set the oscillation frequency.
19	$V_{CC2}$	Power supply	Power supply pin for digital circuit. Supply voltage is $V_{CC}$ .
20	$V_{CC1}$	Power supply	Power supply pin for analog circuit. Supply voltage is $V_{CC}$ (same as $V_{CC2}$ ).

## F2F MAGNETIC STRIPE ENCODING CARD READER

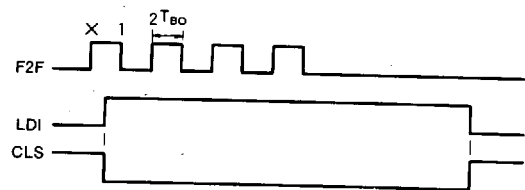
## SETTING AND TIMING OF IGNORE BITS USING IB1 AND IB2

IB2 Input	IB1 Input	Ignore bit number	Description
L	L	4	<ul style="list-style-type: none"> <li>When LDI input is, low, the internal digital circuit is reset.</li> <li>LDI input can always be high.</li> </ul>
L	H	8	<ul style="list-style-type: none"> <li>With the low-active setting, output CLS becomes low after flux changes (state changes of F2F) corresponding to the number of ignored bits have been counted; CLS becomes high when the BIC (bit interval count) is fully counted.</li> </ul>
H	L	16	
H	H	2	<ul style="list-style-type: none"> <li>When input LDI is low, the internal digital circuit is reset.</li> <li>Output CLS is determined by the timing of input LDI.</li> </ul>

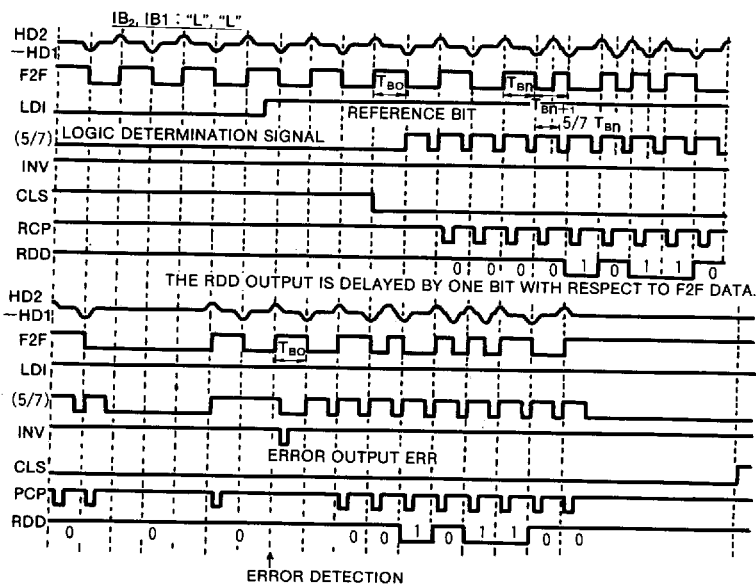
○IB2, IB1 : "L", "L"



○IB2, IB1 : "H", "H"



## OPERATIONAL TIMING DIAGRAM



## F2F MAGNETIC STRIPE ENCODING CARD READER

ABSOLUTE MAXIMUM RATINGS ( $T_a = -20 \sim +75^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC}$	Supply voltage		$-0.3 \sim +7.0$	V
$V_I$	Input voltage	LDI, IB1, IB2	$-0.3 \sim V_{CC} + 0.3$	V
$V_O$	Output voltage	INV, CLS, RDD, RCP	$-0.3 \sim V_{CC} + 0.3$	V
$I_I$	Input current	ACI, LDI, IB1, IB2	$-10 \sim +10$	mA
$I_O$	Output current	INV, CLS, RDD, RCP	$-10 \sim +10$	mA
$V_{ID}$	Differential input voltage	Between HD1 and HD2	$-0.6 \sim +0.6$	V
$T_{opr}$	Operating temperature		$-20 \sim +75$	$^\circ\text{C}$
$T_{stg}$	Storage temperature		$-55 \sim +125$	$^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS ( $T_a = -20 \sim +75^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
$V_{CC}$ (Note 1)	Supply voltage	$V_{CC1}, V_{CC2}$	4.0	5	6.0	V
$V_I$	Input voltage	LDI	0		$V_{CC}$	V
$V_{IH}$ (Note 2)	High-level input voltage	IB1, IB2	$0.7V_{CC}$		$V_{CC}$	V
$V_{IL}$	Low-level input voltage	IB1, IB2, INV	0		$0.3V_{CC}$	V
$V_{OH}$	High-level output voltage	INV, CLS, RDD, RCP			$V_{CC}$	V
$I_{OL}$	Low-level output current	INV, CLS, RDD, RCP			5	mA
$V_{IN}$	Differential input voltage	HD2-HD1	3		80	$\text{mV}_{PP}$
$f_{IN}$	Input frequency	HD2-HD1	0.3		15	kHz
$f_{OSC}$	Oscillation frequency		0.2		2	MHz
$C_{OSC}$ (Note 3)				33		pF
$R_{PK}$ (Note 3)				470		$\Omega$
$C_{PK}$ (Note 3)				0.033		$\mu\text{F}$
$C_{NF}$ (Note 3)				470		pF
$R_{PF}$ (Note 3)				4.7		$\text{M}\Omega$
$C_{VC}$ (Note 4)				0.1		$\mu\text{F}$
$C_{VR}$ (Note 4)				1		$\mu\text{F}$

Note 1.  $V_{CC1}$  and  $V_{CC2}$  are equal.

2. A high input voltage cannot be applied externally as the INV pin is used for both input and output.

3. Reference value at 210BPI

4. Reference value

5. Typical values are at  $T_a = 25^\circ\text{C}$ .

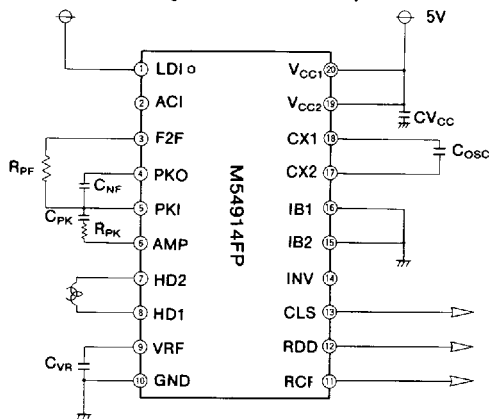
## F2F MAGNETIC STRIPE ENCODING CARD READER

ELECTRICAL CHARACTERISTICS ( $T_a = -20 \sim +75^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter		Test conditions	Test circuit	Limits			Unit
					Min	Typ	Max	
$V_{TH}$	Threshold voltage	IB1, IB2, INV	$V_{CC}=5V$	—	$0.3V_{CC}$		$0.7V_{CC}$	V
$V_{OL}$	Low-level output voltage	INV, CLS, RDD RCP	$V_{CC}=4V$		$I_{OL}=10\mu A$		0.2	V
					$I_{OL}=5mA$		0.4	V
$V_{OH}$	High-level output voltage	INV, CLS, RDD RCP	$V_{CC}=4V$		$I_{OH}=-10\mu A$	2	3.5	V
					$I_{OH}=-100\mu A$	2	2.8	V
$I_{IL}$	Low-level input current	IB1, IB2	$V_{CC}=6V, V_I=1.8V$	2	-10		+10	$\mu A$
$I_{IL}$	Low-level input current	INV	$V_{CC}=6V, V_I=1.8V$	2	-40			mA
$I_{IH}$	High-level input current	IB1, IB2	$V_{CC}=6V, V_I=4.2V$	2	-10		+10	$\mu A$
$V_{REF}$	Reference voltage	VRF	$V_{CC}=5V, V_{IN}=0mV_{PP}$	1	2.3	2.5	2.7	V
$G_{V11}$	Voltage gain 1	OP1	$V_{CC}=5V, f_{IN}=1kHz, V_{IN}=80mV_{PP}$	3	18	20	24	V/V
$G_{V21}$	Voltage gain 2	OP1	$V_{CC}=5V, f_{IN}=15kHz, V_{IN}=80mV_{PP}$	3	18	20	24	V/V
$R_{IN1}$	Input resistance	OP1	$V_{CC}=5V, f_{IN}=1kHz, V_{IN}=80mV_{PP}$	3	6	10	15	k $\Omega$
$V_{OPP1}$	Maximum output voltage	OP1	$V_{CC}=5V, f_{IN}=1kHz, THD_{AMP}=5\%$	3	2			$V_{PP}$
$I_{IB2}$	Input bias current	OP2	$V_{CC}=5V$	4			0.1	$\mu A$
$V_{CL+2}$	Positive clamp current	OP2	$V_{CC}=5V, I_{PK1}=0.5mA$	4	0.5		0.9	V
$V_{CL-2}$	Negative clamp current	OP2	$V_{CC}=5V, I_{PK1}=0.5mA$	4	-0.9		-0.5	V
$V_{TH+3}$	Positive threshold voltage	OP3	$V_{CC}=5V$	5	80		150	mV
$V_{TH-3}$	Negative threshold voltage	OP3	$V_{CC}=5V$	5	-150		-80	mV
$V_{TH3}$	Threshold difference voltage	OP3	$V_{TH3}=V_{TH+3} -  V_{TH-3} $	5	-30		+30	mV
$V_{OL3}$	Low-level output voltage	F2F	$V_{CC}=5V, V_{PK1}=2V, I_{F2F}=0.5mA$	5			0.5	V
$V_{OH3}$	High-level output voltage	F2F	$V_{CC}=5V, V_{PK1}=3V, I_{F2F}=-0.5mA$	5	4.5			V
$V_{F4}$	Diode forward voltage	OP4	$V_{CC}=5V, V_{LD1}=0V, I_{AC1}=0.5mA$	6	0.55		1.1	V
$I_{R4}$	Diode reverse current	OP4	$V_{CC}=5V, V_{LD1}=5V, V_{AC1}=0V$	6	-0.5			$\mu A$
$I_{IN4}$	Input current	OP4	$V_{CC}=5V, V_{AC1}=0V, V_{LD1}=0V$	6	-0.5			$\mu A$
$V_{TH+4}$	Positive threshold voltage	OP4	$V_{CC}=5V, V_{AC1}=0V$	6	1.6	1.85	2.1	V
$V_{TH-4}$	Negative threshold voltage	OP4	$V_{CC}=5V, V_{AC1}=0V$	6	1.2	1.5	1.7	V
$V_{TH4}$	Threshold difference voltage	OP4	$V_{CC}=5V, V_{AC1}=0V$	6	0.25	0.35	0.5	V
$I_{CCW}$	Standby circuit current		$V_{CC}=5V, V_{IN}=0mV_{PP}$	1		1.0	1.4	mA
$I_{CCR}$	Operating circuit current		$V_{CC}=5V, V_{IN}=80mV_{PP}, f_{IN}=5kHz$ $f_{OSC}=1MHz$	1		2.0	3.0	mA
$f_{OSC}$	Oscillation frequency		$V_{CC}=5V, C_{OSC}=33pF$	1	0.6		1.5	MHz
$T_{OW}$	Output pulse width	INV, RCP	$V_{CC}=5V, f_{OSC}=1MHz$	7	15	16	17	$\mu s$
$T_{OD}$	Delay time between outputs	RDD, RCP	$V_{CC}=5V, f_{OSC}=1MHz$	7	7	8	9	$\mu s$
$T_{NW}$	Input noise width	INV	$V_{CC}=5V$	7	2			$\mu s$

## APPLICATION EXAMPLE

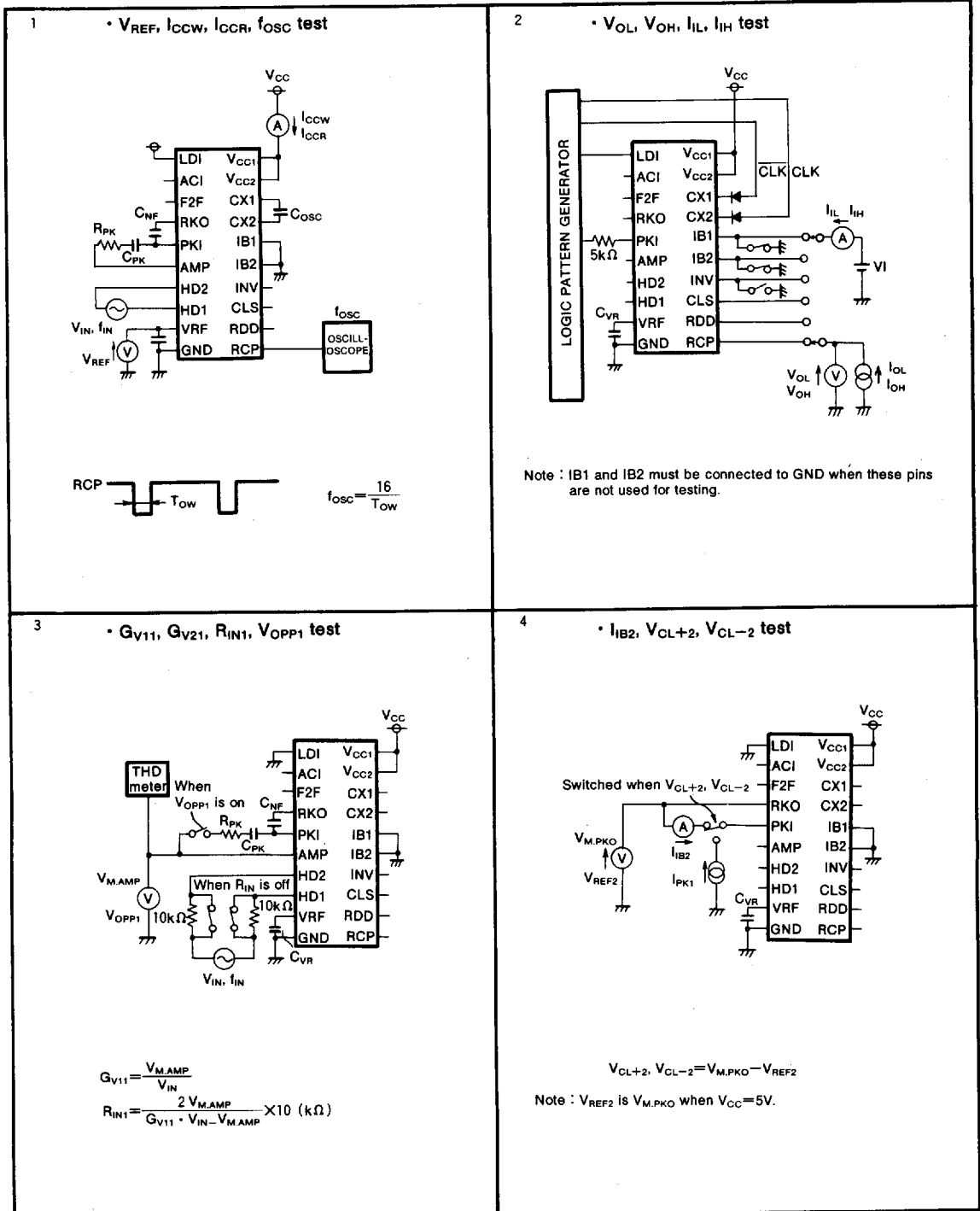
When the 4th bit is ignored and the output is low-active



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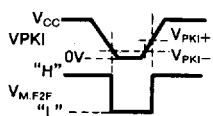
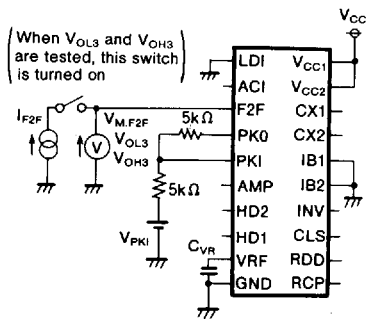
**TEST CIRCUIT**

In the following figs.,  $C_{osc}=33pF$ ,  $R_{PK}=470\Omega$ ,  $C_{PK}=0.033\mu F$ ,  $C_{NF}=470pF$ ,  $C_{VR}=1\mu F$



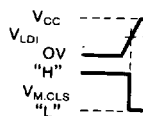
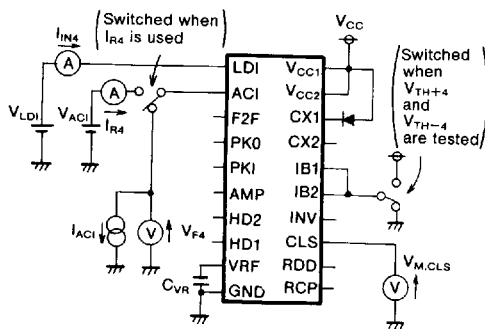
**F2F MAGNETIC STRIPE ENCODING CARD READER**

5 •  $V_{TH+3}$ ,  $V_{TH-3}$ ,  $V_{TH3}$ ,  $V_{OL3}$ ,  $V_{OH}$  test



$V_{TH+3} = V_{REF2} - V_{PKI-}$   
 $V_{TH-3} = V_{REF2} - V_{PKI+}$   
 $V_{TH} = V_{TH+3} - V_{TH-3}$   
 Note:  $V_{REF2}$  is measured in test circuit 4.

6 •  $V_{F4}$ ,  $I_{R4}$ ,  $I_{IN4}$ ,  $V_{TH+4}$ ,  $V_{TH-4}$ ,  $V_{TH14}$  test



$V_{TH4} = V_{TH+4} - V_{TH-4}$

7 •  $T_{ow}$ ,  $T_{OD}$ ,  $T_{NW}$  test

