MITSUBISHI BIPOLAR DIGITAL ICs

M54914FP

F2F MAGNETIC STRIPE ENCORDING 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 pacage
- Wide operating temperature range T_a=−20∼+75℃

APPLICATION

Magnetic stripe card reader

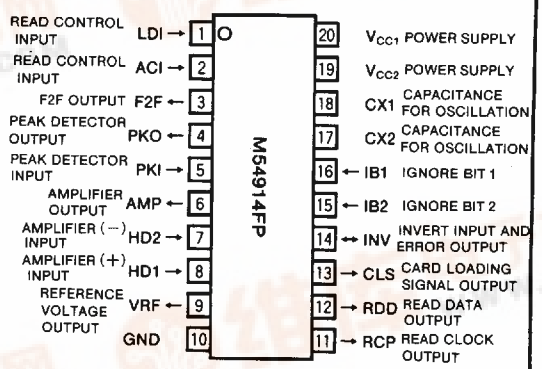
FUNCTION

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)



Outline 20P2

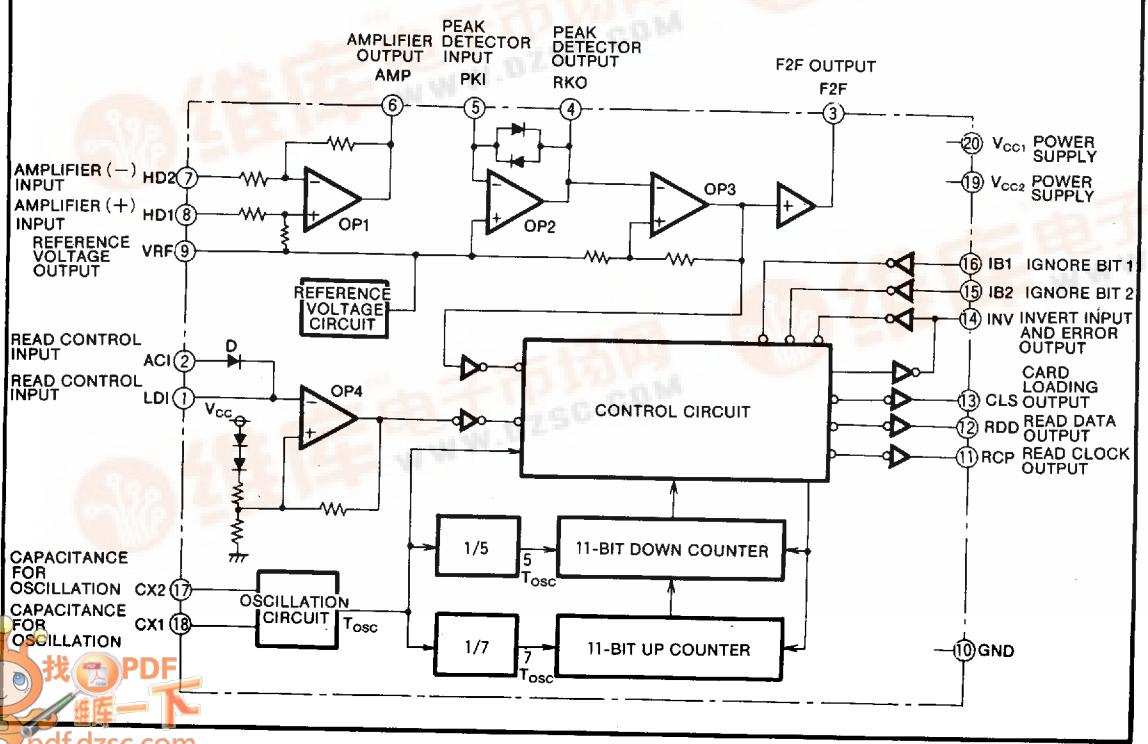
The reference bit is the bit from the Nth flux change to the Nth + 1 flux change when input LDI changes from low to high and time width T_{BO} is bit 0. The bits following this reference bit are treated as data bits.

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 ENCORDING 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.

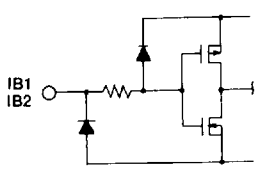
● Time width of the output signal

When the oscillation period of the oscillator is T_{OSC}, the output signals have the following widths ;

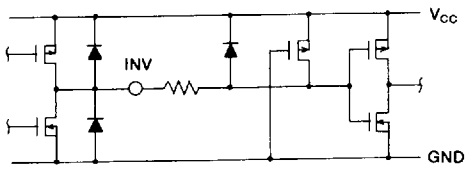
- Output pulse width of RCP, ERR ·····approx. $16T_{OSC}$
- RCP delay time width respect to RDD ···approx. $8T_{OSC}$

I/O CIRCUIT

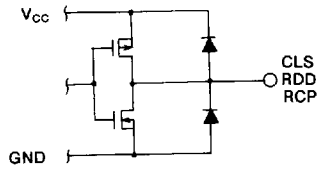
IB 1, IB 2 INPUT CIRCUIT



INV I/O CIRCUIT



CLS, RDD, RCP OUTPUT CIRCUIT



PIN DESCRIPTION

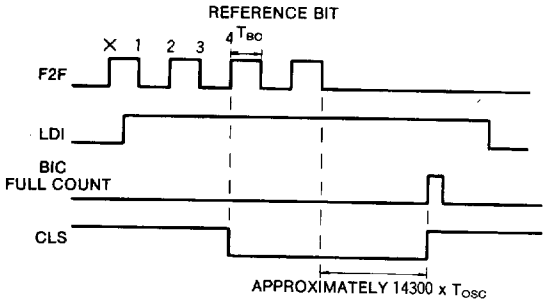
Pinnumber	Symbol	Name	Description
1	LDI	Read control input	Comparator input with hysteresis. When low, it resets the internal digital circuit. When high, F2F demodulation is possible.
2	ACI	Read cotrol input	Read control input connected to LDI using a diode.
3	F2F	F2F output	F2F signal output magnetic 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_{CC} 2).

F2F MAGNETIC STRIPE ENCORDING CARD READER

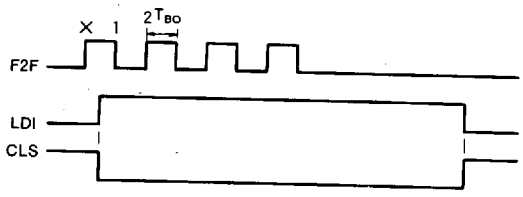
SETTING AND TIMING OF IGNORE BITS USING IB1 AND IB2

IB2 input	IB1 input	Ignore bit number	Description
L	L	4	• When LDI input is, low, the internal digital circuit is reset. • LDI input can always be high. • 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.
L	H	8	
H	L	16	
H	H	2	• When input LDI is low, the internal digital circuit is reset. • Output CLS is determined by the timing of input LDI.

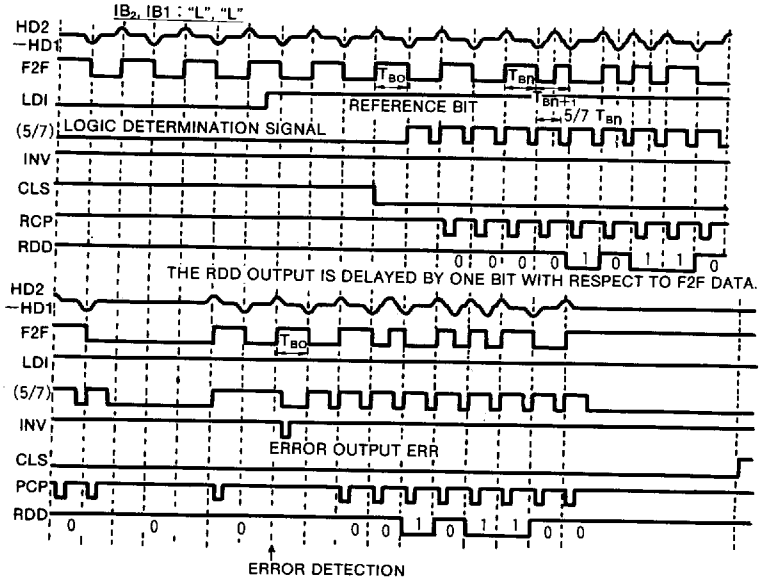
○IB2, IB1 : "L", "L"



○IB2, IB1 : "H", "H"



OPERATIONAL TIMING DIAGRAM



M54914FP

F2F MAGNETIC STRIPE ENCORDING CARD READER

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.3∼+7.0	V
V_I	Input voltage	LDI, IB1, IB2	−0.3∼V_{CC}+0.3	V
V_O	Output voltage	INV, CLS, RDD, RCP	−0.3∼V_{CC}+0.3	V
I_I	Input current	ACI, LDI, IB1, IB2	−10∼+10	mA
I_O	Output current	INV, CLS, RDD, RCP	−10∼+10	mA
V_{ID}	Differential input voltage	Between HD1 and HD2	−0.6∼+0.6	V
Topr	Operating temperature		−20∼+75	℃
Tstg	Storage temperature		−55∼+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=−20∼+75℃, 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	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		Ω
C_{PK} (Note 3)				0.033		μF
C_{NF} (Note 3)				470		pF
R_{PF} (Note 3)				4.7		MΩ
C_{VC} (Note 4)				0.1		μF
C_{VR} (Note 4)				1		μF

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℃.

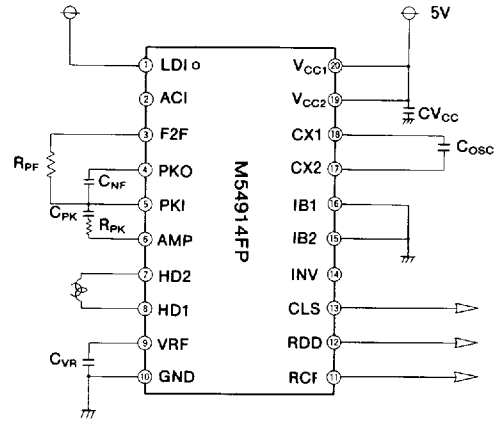
F2F MAGNETIC STRIPE ENCORDING CARD READER

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Test coditions		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	V_{CC}=4V	I_{OL}=10μA	2			0.2	V
		RCP		I_{OL}=5mA	2			0.4	V
V_{OH}	High-level output voltage	INV, CLS, RDD	V_{CC}=4V	I_{OH}=−10μA	2	3.5			V
		RCP		I_{OH}=−100μA	2	2.8			V
I_{IL}	Low-level input current	IB1, IB2	V_{CC}=6V, V_I=1.8V		2	−10		+10	μA
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	μA
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	kΩ
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	μA
V_{CL+2}	Positive clamp current	OP2	V_{CC}=5V, I_{PKI}=0.5mA		4	0.5		0.9	V
V_{CL-2}	Negative clamp current	OP2	V_{CC}=5V, I_{PKI}=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	$V_{TH3}=V_{TH+3}-\lvert V_{TH-3}\rvert$		5	−30		+30	mV
V_{OL3}	Low-level output voltage	F2F	V_{CC}=5V, V_{PKI}=2V, I_{F2F}=0.5mA		5			0.5	V
V_{OH3}	High-level output voltage	F2F	V_{CC}=5V, V_{PKI}=3V, I_{F2F}=−0.5mA		5	4.5			V
V_{F4}	Diode forward voltage	OP4	V_{CC}=5V, V_{LDI}=0V, I_{ACI}=0.5mA		6	0.55		1.1	V
I_{R4}	Diode reverse current	OP4	V_{CC}=5V, V_{LDI}=5V, V_{ACI}=0V		6	−0.5			μA
I_{IN4}	Input current	OP4	V_{CC}=5V, V_{ACI}=0V, V_{LDI}=0V		6	−0.5			μA
V_{TH+4}	Positive threshold voltage	OP4	V_{CC}=5V, V_{ACI}=0V		6	1.6	1.85	2.1	V
V_{TH-4}	Negative threshold voltage	OP4	V_{CC}=5V, V_{ACI}=0V		6	1.2	1.5	1.7	V
V_{TH4}	Threshold difference voltage	OP4	V_{CC}=5V, V_{ACI}=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	μs
T_{OD}	Delay time between outputs	RDD, RCP	V_{CC}=5V, f_{OSC}=1MHz		7	7	8	9	μs
T_{NW}	Input noise width	INV	V_{CC}=5V		7	2			μs

APPLICATION EXAMPLE

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

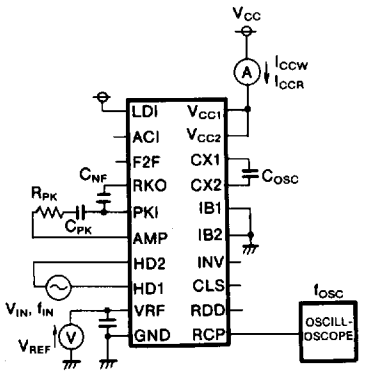


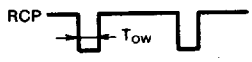
F2F MAGNETIC STRIPE ENCORDING CARD READER

TEST CIRCUIT

In the following figs., C_{OSC}=33pF, R_{PK}=470Ω, C_{PK}=0.033μF, C_{NF}=470pF, C_{VR}=1μF

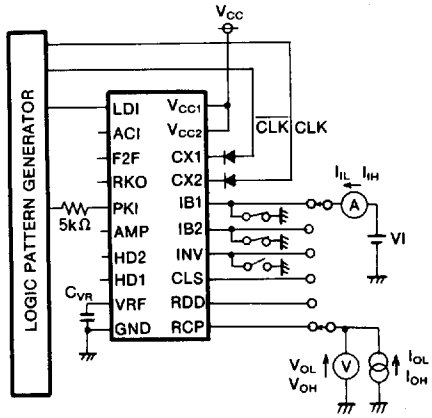
1 · V_{REF}, I_{CCW}, I_{CCR}, f_{OSC} test





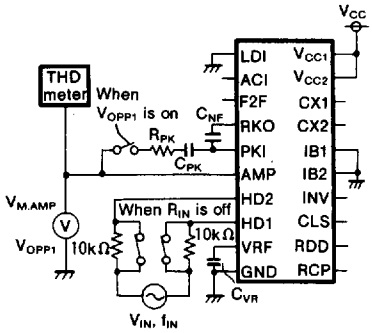
$$f_{OSC}=\frac{16}{T_{OW}}$$

2 · V_{OL}, V_{OH}, I_{IL}, I_{IH} test



Note : IB1 and IB2 must be connected to GND when these pins are not used for testing.

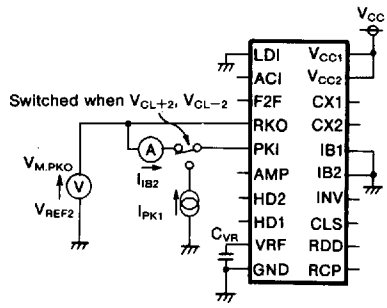
3 · G_{V11}, G_{V21}, R_{IN1}, V_{OPP1} test



$$G_{V11}=\frac{V_{M.AMP}}{V_{IN}}$$

$$R_{IN1}=\frac{2\,V_{M.AMP}}{G_{V11}\cdot V_{IN}-V_{M.AMP}}\times 10\ (k\Omega)$$

4 · I_{IB2}, V_{CL+2}, V_{CL-2} test

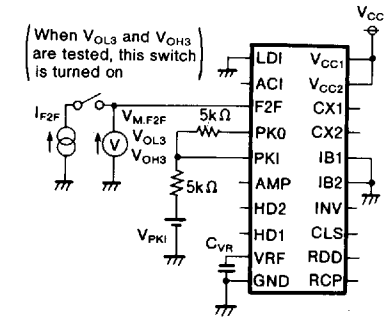


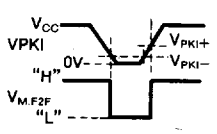
$$V_{CL+2},\ V_{CL-2}=V_{M.PKO}-V_{REF2}$$

Note : V_{REF2} is $V_{M.PKO}$ when V_{CC}=5V.

F2F MAGNETIC STRIPE ENCORDING CARD READER

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





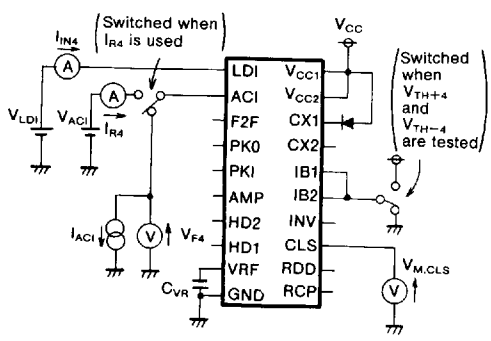
$V_{TH+3}=V_{REF2}-V_{PKI-}$

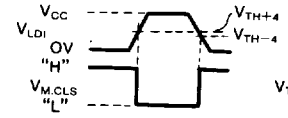
$V_{TH-3}=V_{REF2}-V_{PKI+}$

$V_{TH}=V_{TH+3}-|V_{TH-3}|$

Note : V_{REF2} is measured in test circuit 4.

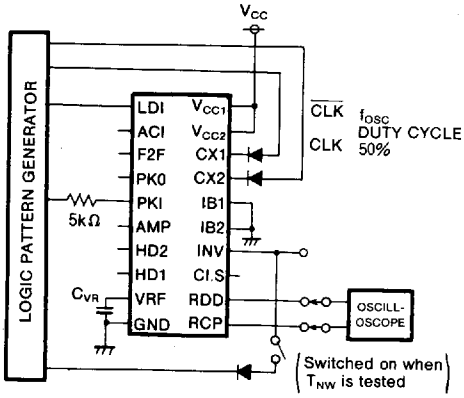
6 • V_{F4}, I_{R4}, I_{IN4}, V_{TH+4}, V_{TH-4}, V_{TH14} test

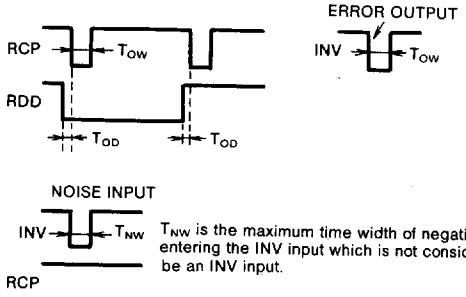




$V_{TH4}=V_{TH+4}-V_{TH-4}$

7 • T_{OW}, T_{OD}, T_{NW} test





T_{NW} is the maximum time width of negative noise entering the INV input which is not considered to be an INV input.