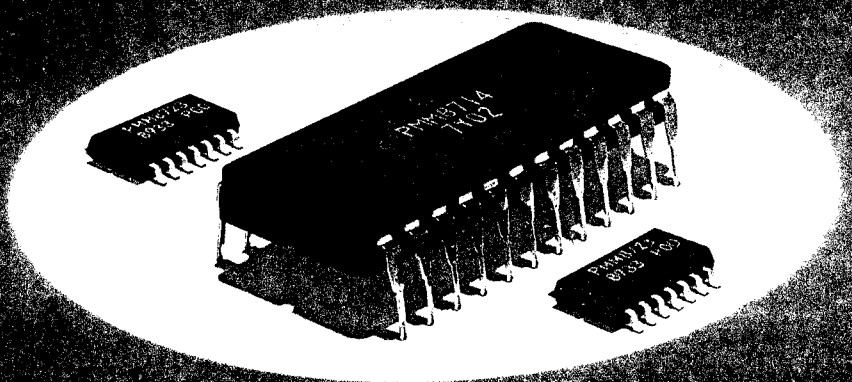
COMPUTER CONTROL COMMUNICATION 3C

UNIVERSAL CONTROLLER
for Driving Stepping Motors

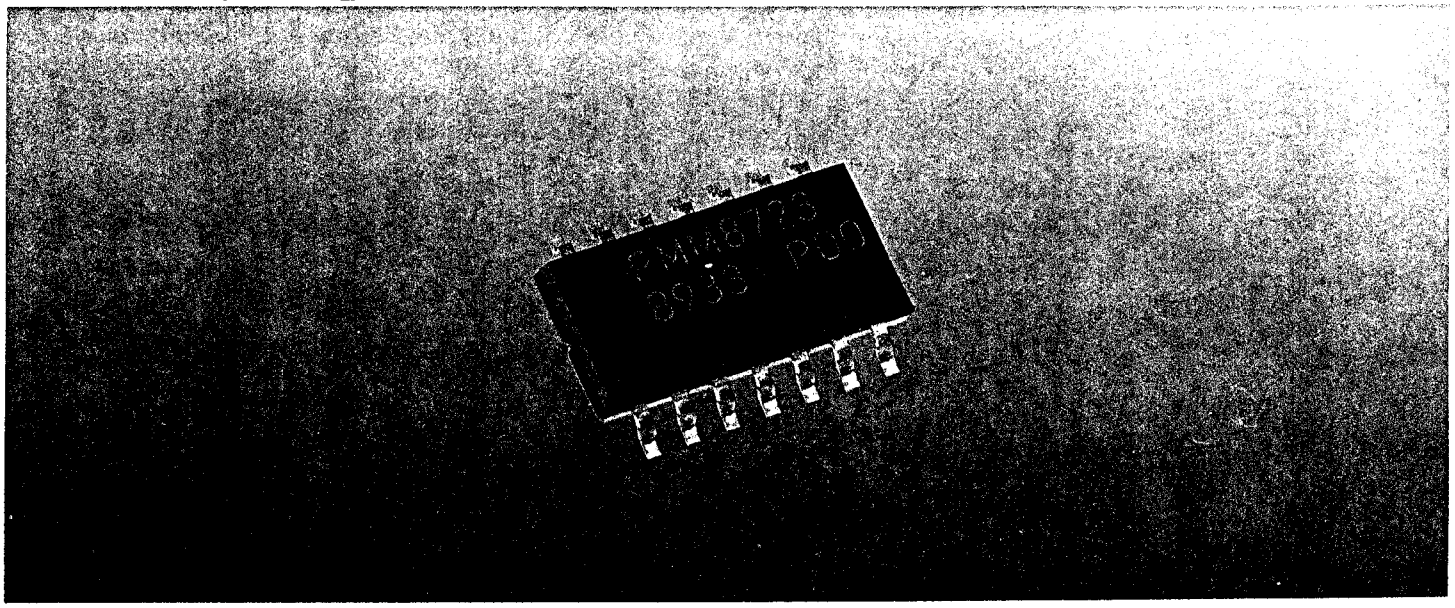
PMM8723
PMM8714



SANYO DENKI CO.,LTD.

NEW PRODUCT

PMM8723 (For driving two-phase stepping motors)



① OUTLINE

The PMM8723 UNIVERSAL CONTROLLER is a C-MOS monolithic type IC designed for controlling two-phase stepping motors.
It is a low cost version of the PMM8713 now in use (The PMM8713 is an IC designed for controlling two and three-phase stepping motors).
The PMM8723 has been developed for the purpose of simplifying stepping motor utilization and it permits a stepping motor drive unit to be easily configured by using a pulse oscillator, power switching transistors and a DC power supply.
In addition, the PMM8723 is a surface-mount type, it permitting compact drive units for stepping motors to be designed.

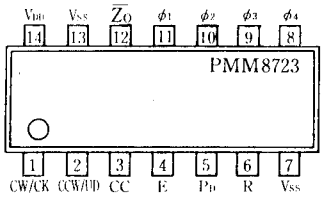
② FEATURES

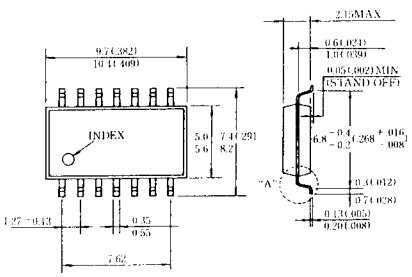
◇ Universal controller : The following 2 modes can be selected using the excitation mode changeover terminals.
○ 1-2 excitation ○ 2 excitation
◇ Power supply voltage : V_{DD} = +5V
◇ High output current : ±20mA minimum for both source and sink
◇ High noise margin : All input terminals have built-in Schmitt circuits
◇ Pulse input : 2 input terminal system (CW and CCW input modes)
1 input, 1 changeover terminal system (CK and U/D input modes)
} selectable
◇ Power down function : Sets all output signals to "L" level.
◇ Reset function : Sets excitation state back to phase origin.
◇ Phase origin monitor : Outputs " L" level signals in phase origin state. (Output is reset mode)

③ PIN CONNECTION

PIN NO.				
	1. CW/CK	Input pulse : UP clock or clock input	8. ϕ_4	Phase output
	2. CCW/U/D	Input pulse : DOWN colck or changeover of rotation direction	9. ϕ_3	Phase output
			10. ϕ_2	Phase output
	3. CC	Changeover of clock input direction	11. ϕ_1	Phase output
	4. E	Excitation mode changeover	12. $\overline{Z_0}$	Phase output monitor
	5. $\overline{P_D}$	Power down	13. V_{SS}	0V
	6. R	Reset	14. V_{DD}	+5V
	7. V_{SS}	0V		

(Fig. 1)





④ FUNCTION TABLE (Table 1)

1) CW and CCW input modes

Excitation mode

Excitation mode	Input			
	R	$\overline{P_D}$	CC	E
2 excitation	0	1	0	0
1-2 excitation	0	1	0	1

Rotation direction

Rotation direction	Input	
	CW/CK	CCW/U/D
CW	⊓	0
CCW	0	⊓

2) CK and U/D input modes

Excitation mode

Excitation mode	Input			
	R	$\overline{P_D}$	CC	E
2 excitation	0	1	1	0
1-2 excitation	0	1	1	1

Rotation direction

Rotation direction	Input	
	CW/CK	CCW/U/D
CW	⊓	1
CCW	⊓	0

Note 1 : When "H" level signals are input to R, output is reset.
Note 2 : When "L" level signals are input to P_D, all outputs become "L" level.

⑤ EXCITATION SEQUENCE (Table 2)

2 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4
ϕ_1	1	1	0	0	1
ϕ_2	0	1	1	0	0
ϕ_3	0	0	1	1	0
ϕ_4	1	0	0	1	1
Up	→				
Down	←				

1-2 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5	6	7	8
ϕ_1	1	1	1	0	0	0	0	0	1
ϕ_2	0	0	1	1	1	0	0	0	0
ϕ_3	0	0	0	0	1	1	1	0	0
ϕ_4	1	0	0	0	0	0	1	1	1
Up	→								
Down	←								

⑥ MAXIMUM RATINGS (Table 3)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	−0.5 ~ +6.0	V
Input voltage	V_{IN}	−0.5 ~ V_{DD} + 0.5	
Output voltage	V_O	−0.5 ~ V_{DD} + 0.5	
Input current	I_I	±20	mA
Output current	I_O	±25	
Allowable dissipation	P_d	500	mW
Operating temperature	T_{OP}	−25 ~ +85	℃
Storage temperature	T_{ST}	−60 ~ +125	

⑦ RECOMMENDED OPERATING CONDITIONS (Table 4)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	+5.0 ± 5 %	V
Input voltage	V_{IN}	0 ~ V_{DD}	
Ambiet temperature	T_A	0 ~ 70	℃
"H" level output current	I_{OH}	−4.0	mA
"L" level output current	I_{OL}	4.0	

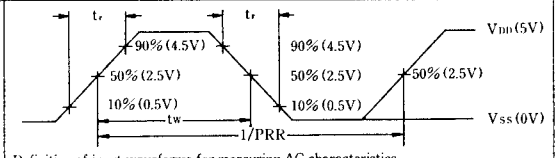
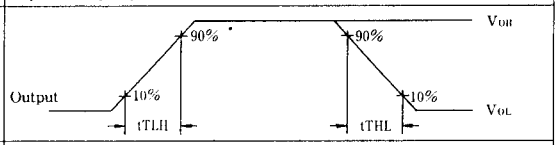
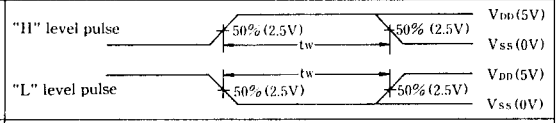
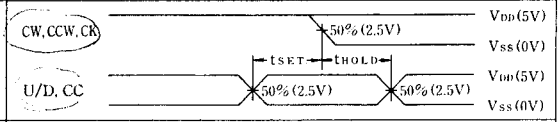
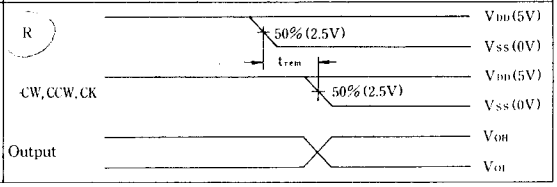
⑧ ELECTRICAL CHARACTERISTICS (Table 5)

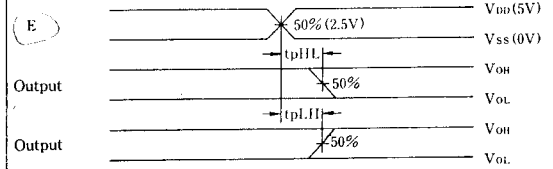
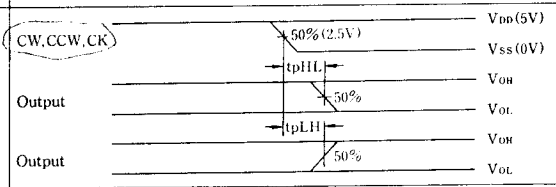
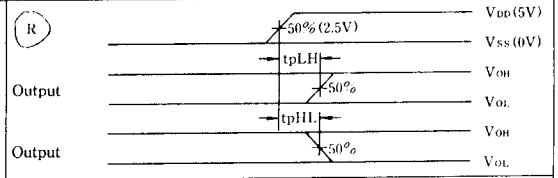
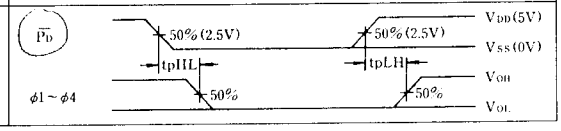
DC characteristics (V_{DD} = +5.0V, T_A = 25℃)

Parameter		Symbol	Test Condition	Limit			Unit
				Min.	Typ.	Max.	
Output current	"H" level	I_{OH}	$V_O = V_{DD} - 2.0$				
	"L" level	I_{OL}	V_O = 0.3V				
Output Voltage	"H" level	V_{OH}	I_O = −4.0mA	4.2		V_{DD}	V
	"L" level	V_{OL}	I_O = 4.0mA	V_{SS}		0.5	V
Input Voltage	"H" level	V_{T+}	Positive direction input threshold current	1.80		3.42	V
	"L" level	V_{T-}	Negative direction input threshold current	1.80		2.70	V
Input current	"H" level	I_{IH}	$V_I = V_{DD} - 0.5$	−1		1	μA
	"L" level	I_{IL}	V_I = 0	−1		1	μA
Static consumption current		I_{CC}	$V_{IN} = V_{DD}$ or V_{SS}			0.1	mA

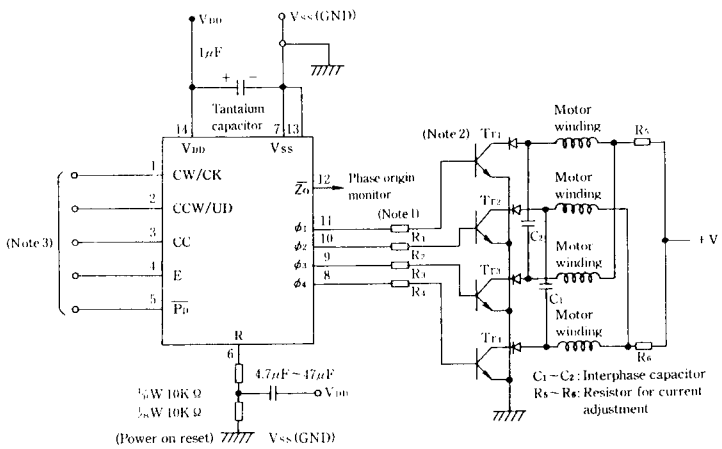
AC characteristics (V_{DD} = +5.0V, T_A = 25℃)

Parameter	Symbol	Limit			Unit
		Min.	Typ.	Max.	
Max. clock frequency	f_{MAX}	20	45		MHz
Min. clock pulse width	t_W	18	8		ns
Min. reset pulse width	t_{WR}	18			ns
Propagation delay time	t_{PLH} t_{PHL}		40	65	ns
Set up time	t_{SET}	18			ns
Hold time	t_{HOLD}			0	ns

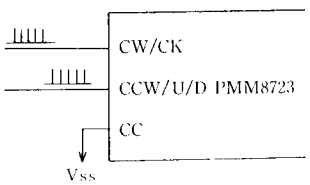
Parameter	Measuring method
Input waveforms	 Definition of input waveforms for measuring AC characteristics Input rise time : t_r=6ns Input fall time : t_f=6ns Repetitive frequency : PRR≦1MHz Duty cycle= $\frac{tw}{1/PRR}\times 100(\%)$
Transition time of output	
Pulse width	
Setup time Hold time	
Removable time	

Parameter	Measuring method
Propagation delay time E ↓ Full output	
Propagation delay time Clock ↓ Full output	
Propagation delay time R ↓ Full output	
Propagation delay time $\overline{P_D}$ ↓ $\phi_1\sim\phi_4$	

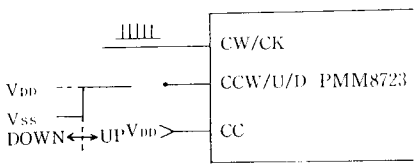
⑨ APPLICATION EXAMPLE (Fig. 2)



2 input terminal system (Fig. 3)



1 input, 1 changeover terminal system (Fig. 4)



Note 1) With regard to output resistors R1-R4,
it is recommended that 1/8W 820Ω be used.
The output current at this time will be about I_{OH}=3.5~4.5mA (with Tr $V_{BE(SAT)}$=1.2V).
If a larger value is required for I_{OH}, please design the unit according to Table 5.

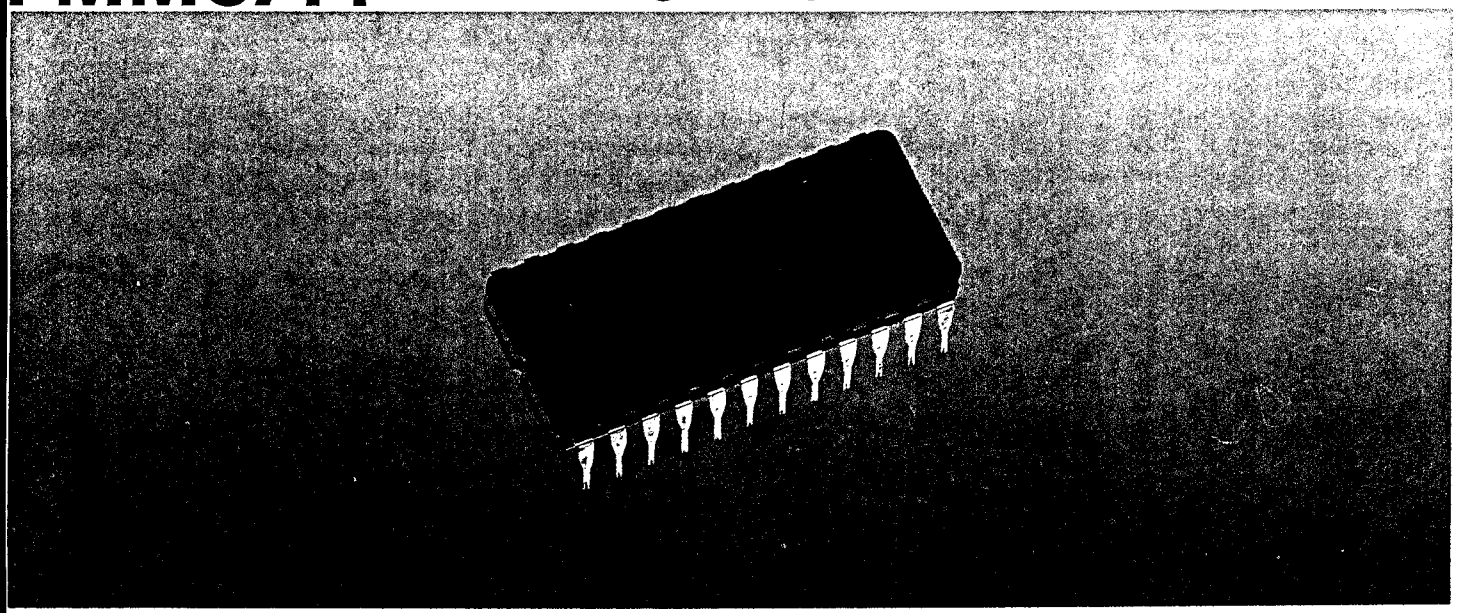
Note 2) With regard to swiching transistors (Tr1-Tr4),
it is recommended that darlington type transistors ($V_{BE(SAT)}$ of less than 2V, h_{FE} of more than 500) de used.

Note 3) Please select the input terminals to suit the type of mode and input system used and connect them as shown in this catalog (Table1, Fig. 3 and Fig. 4).

Note 4) As for the excitation sequence of ϕ_1 to ϕ_4, please refer to Table 2, Excitation Sequence, of this catalog.

The PMM8723 has a built-in protective circuit at its input to prevent it from being damaged by high voltage or static electricity.
However, as its impedance is very high, it should be used with great care to avoid applying a voltage higher than its maximum rating.
Especially during operation, it must be kept within a range of $V_{SS}\leqq(V_{IN}, V_{OUT})\leqq V_{DD}$.
Input terminals not in use should be connected to V_{SS} or V_{DD}.

PMM8714 (For driving five-phase stepping motors)



① OUTLINE

The PMM8714 UNIVERSAL CONTROLLER is an IL monolithic type IC designed for controlling five-phase stepping motors.
It has been developed for the purpose of sumplifying stepping motor utilization and it permits a stepping motor drive unit to be easily configured by using oscillator, power switching transistors and a DC power supply.

② FEATURES

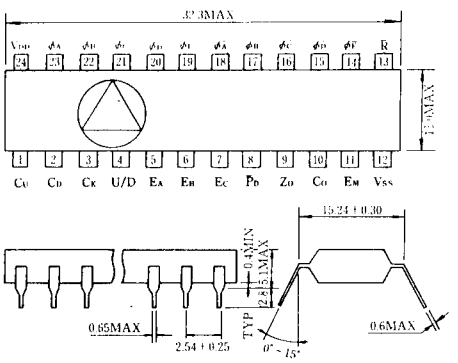
◇ Universal controller : The following 6 modes can be selected using the excitation mode changeover terminals :
○ 4 excitation ○ 4-5 excitation ○ 5 excitation
○ 2 excitation ○ 2-3 excitation ○ 3 excitation

◇ Power supply voltage : V_{DD} = +4V ~ +18V
◇ High output current : 20mA minimum for source
◇ High noise margin : All input terminals have built-in Schmitt circuits.
◇ Pulse input : 2 input terminal system (CW and CCW input modes)
1 input, 1 changeover terminal system(CK and U/D input modes)
◇ Power down function : Sets all output signals to "L" level.
◇ Reset function : Sets excitation state back to phase origin.
◇ Security function of excitation mode : Phase output is not variable according to the excitation mode changeover, as 2Ex↔2-3Ex↔3Ex or 4Ex↔4-5Ex↔5Ex.
◇ Phase origin monitor : Outputs "H" level signals in the phase origin state (output is reset mode).
◇ Excitation detecting monitor : Outputs monitor signal showing operating condition of controller.
◇ Input pulse monitor : Outputs input pulse as monitor signal.

③ PIN CONNECTION (24-LEAD CERAMIC DUAL IN LINE PACKAGE)

PIN NO.
1. C_U Input pulse, Up clock
2. C_D Input pulse, Down clock
3. C_K Input pulse, clock
4. U/D Changeover of rotation direction "0" Down "1" Up
5. E_A
6. E_B } Excitation mode changeover
7. E_C
8. $\overline{P_D}$ Power down
9. Z_O Phase origin monitor
10. C_O Input pulse monitor
11. E_M Excitation monitor
12. V_{SS} 0V
13. $\overline{R}$ Reset
14. ϕ_E Phase output
14. ϕ_D Phase output
16. ϕ_C Phase output
17. ϕ_B Phase output
18. ϕ_A Phase output
19. ϕ_E Phase output
20. ϕ_D Phase output
21. ϕ_C Phase output
22. ϕ_B Phase output
23. ϕ_A Phase output
24. V_{DD} +4 ~ +18V

(Fig. 5)



④ FUNCTION TABLE (Table 6)

1) CW and CCW input modes

Excitation mode

Excitation mode	Input				
	R	$\overline{P_D}$	E_A	E_B	E_C
2 excitation	1	1	0	1	1
2-3 excitation	1	1	0	0	1
3 excitation	1	1	1	0	1
4 excitation	1	1	0	1	0
4-5 excitation	1	1	0	0	0
5 excitation	1	1	1	0	0

Rotation direction

Rotation direction	Input			
	C_U	C_D	C_K	U/D
CW	⌐¬	0	0	0
CCW	0	⌐¬	0	0

2) CK and U/D input modes

Excitation mode

Excitation mode	Input				
	R	$\overline{P_D}$	E_A	E_B	E_C
2 excitation	1	1	0	1	1
2-3 excitation	1	1	0	0	1
3 excitation	1	1	1	0	1
4 excitation	1	1	0	1	0
4-5 excitation	1	1	0	0	0
5 excitation	1	1	1	0	0

Rotation direction

Rotation direction	Input			
	C_U	C_D	C_K	U/D
CW	0	0	⌐¬	1
CCW	0	0	⌐¬	0

Note 1 : When "L" level signals are input to R, output is reset.
Note 2 : When "L" level signals are input to P_D, all outputs become "L" level.

⑤ EXCITATION SEQUENCE (Table 7)

2 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5
ϕ_A	1	0	0	0	1	1
ϕ_B	1	1	0	0	0	1
ϕ_C	0	1	1	0	0	0
ϕ_D	0	0	1	1	0	0
ϕ_E	0	0	0	1	1	0
$\phi\bar{A}$	0	0	0	0	0	0
$\phi\bar{B}$	0	0	0	0	0	0
$\phi\bar{C}$	0	0	0	0	0	0
$\phi\bar{D}$	0	0	0	0	0	0
$\phi\bar{E}$	0	0	0	0	0	0
Z_O	1	0	0	0	0	1
E_M	0	0	0	0	0	0
Up		→				
Down		←				

4 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5	6	7	8	9	10
ϕ_A	1	0	0	0	0	0	0	1	1	1	1
ϕ_B	1	1	0	0	0	0	0	0	1	1	1
ϕ_C	1	1	1	0	0	0	0	0	0	1	1
ϕ_D	1	1	1	1	0	0	0	0	0	0	1
ϕ_E	0	1	1	1	1	0	0	0	0	0	0
$\phi\bar{A}$	0	0	1	1	1	1	0	0	0	0	0
$\phi\bar{B}$	0	0	0	1	1	1	1	0	0	0	0
$\phi\bar{C}$	0	0	0	0	1	1	1	1	0	0	0
$\phi\bar{D}$	0	0	0	0	0	1	1	1	1	0	0
$\phi\bar{E}$	0	0	0	0	0	0	1	1	1	1	0
Z_O	1	0	0	0	0	0	0	0	0	0	1
E_M	0	0	0	0	0	0	0	0	0	0	0
Up		→									
Down		←									

2-3 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5	6	7	8	9	10
ϕ_A	1	1	0	0	0	0	0	1	1	1	1
ϕ_B	1	1	1	1	0	0	0	0	0	1	1
ϕ_C	0	1	1	1	1	1	0	0	0	0	0
ϕ_D	0	0	0	1	1	1	1	1	0	0	0
ϕ_E	0	0	0	0	0	1	1	1	1	1	0
$\phi\bar{A}$	0	0	0	0	0	0	0	0	0	0	0
$\phi\bar{B}$	0	0	0	0	0	0	0	0	0	0	0
$\phi\bar{C}$	0	0	0	0	0	0	0	0	0	0	0
$\phi\bar{D}$	0	0	0	0	0	0	0	0	0	0	0
$\phi\bar{E}$	0	0	0	0	0	0	0	0	0	0	0
Z_O	1	0	0	0	0	0	0	0	0	0	1
E_M	0	1	0	1	0	1	0	1	0	1	0
Up		→									
Down		←									

4-5 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ϕ_A	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
ϕ_B	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
ϕ_C	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
ϕ_D	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1
ϕ_E	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
$\phi\bar{A}$	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
$\phi\bar{B}$	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
$\phi\bar{C}$	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0
$\phi\bar{D}$	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
$\phi\bar{E}$	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
Z_O	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
E_M	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
Up		→																			
Down		←																			

3 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5
ϕ_A	1	1	0	0	1	1
ϕ_B	1	1	1	0	0	1
ϕ_C	0	1	1	1	0	0
ϕ_D	0	0	1	1	1	0
ϕ_E	1	0	0	1	1	1
$\phi\bar{A}$	0	0	0	0	0	0
$\phi\bar{B}$	0	0	0	0	0	0
$\phi\bar{C}$	0	0	0	0	0	0
$\phi\bar{D}$	0	0	0	0	0	0
$\phi\bar{E}$	0	0	0	0	0	0
Z_O	1	0	0	0	0	1
E_M	1	1	1	1	1	1
Up		→				
Down		←				

5 excitation

Phase \ Pulse	0 (Reset)	1	2	3	4	5	6	7	8	9	10
ϕ_A	1	1	0	0	0	0	0	1	1	1	1
ϕ_B	1	1	1	0	0	0	0	0	1	1	1
ϕ_C	1	1	1	1	0	0	0	0	0	1	1
ϕ_D	1	1	1	1	1	0	0	0	0	0	1
ϕ_E	0	1	1	1	1	1	0	0	0	0	0
$\phi\bar{A}$	0	0	1	1	1	1	1	0	0	0	0
$\phi\bar{B}$	0	0	0	1	1	1	1	1	0	0	0
$\phi\bar{C}$	0	0	0	0	1	1	1	1	1	0	0
$\phi\bar{D}$	0	0	0	0	0	1	1	1	1	1	0
$\phi\bar{E}$	1	0	0	0	0	0	1	1	1	1	1
Z_O	1	0	0	0	0	0	0	0	0	0	1
E_M	1	1	1	1	1	1	1	1	1	1	1
Up		→									
Down		←									

⑥ MAXIMUM RATINGS (Table 8)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	−0.5～+18	V
Input voltage	V_{IN}	−0.5～(V_{DD}−1)	
Input current	I_{IN}	±1	mA
Allowable dissipation	P_D	600	mW
Output current	I_O	−30	mA
Operating temperature	T_{OP}	−20～+85	℃
Storage temperature	T_{ST}	−65～+150	

⑦ RECOMMENDED OPERTING CONDITIONS (Table 9)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	+5, +10, +15±5%	V
Input voltage	V_{IN}	0～V_{DD}	
Ambient temperature	T_A	0～70	℃
"H" level output current	I_{OH}	−40	μA
"L" level output current	I_{OL}	1.6	mA

⑧ ELECTRICAL CHARACTERISTICS (Table 10)

DC characteristics

T_A=25℃

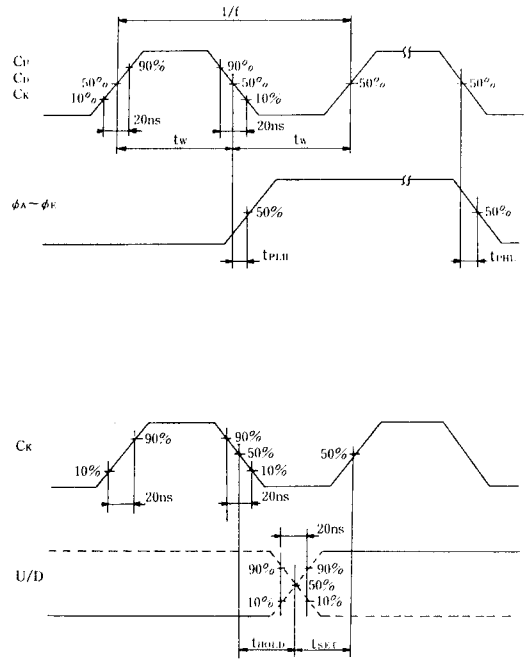
Parameter			Symbol	V_{DD}	Test condition	Limit Min.	Limit Typ.	Limit Max.	Unit
Output current	ϕ_A～ϕ_E	"H" level	I_{OH}	5	V_O=V_{DD}−2.0	−20			mA
				10					
				15		−20			
		"L" level	I_{OL}	5	V_O=0.3V	1.6			mA
				10					
				15		1.6			
Output voltage	C_O E_M Z_O	"H" level	V_{OH}	5	I_O=−40μA	3.6			V
				10					
				15		13.6			
		"L" level	V_{OL}	5	I_O=1.6mA			0.4	V
				10					
				15				0.6	
Input voltage	C_U C_O C_K E_A E_B E_C	"H" level	V_{IH}	5		3.0	2.5		V
				10					
				15		9.0	7.5		
		"L" level	V_{IL}	5			2.0	1.5	V
				10					
				15			6.0	4.5	
Input current	C_U C_O C_K E_A E_B E_C	"H" level	I_{IH}	5	V_I=V_{DD}−0.5			0.4	mA
				10					
				15				0.9	
		"L" level	I_{IL}	5	V_I=0			±10	μA
				10					
				15				±10	
	U/D $\bar{P}_D$ $\bar{R}$	"H" level	I_{IH}	5	V_I=V_{DD}−0.5			−100	μA
				10					
				15				−100	
		"L" level	I_{IL}	5	V_I=0			−0.4	mA
				10					
				15				−0.9	
Static consumption current			I_{CC}	5	All terminals are open.			25	mA
				10					
				15				43	

AC characteristics

T_A=25℃

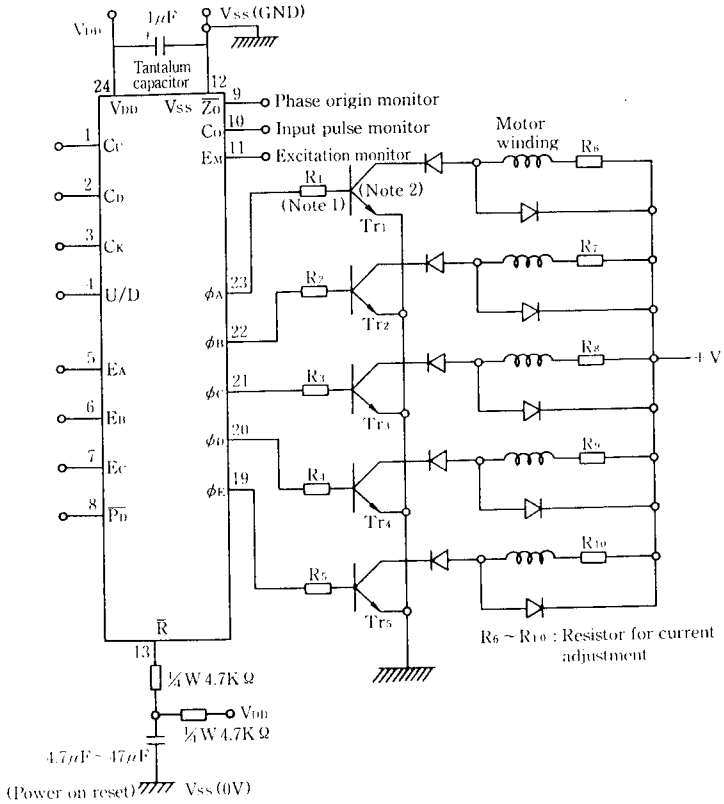
Parameter	Symbol	V_{DD}	Test condition	Limit Min.	Limit Typ.	Limit Max.	Unit
Max. clock frequency	f_{MAX}	5		250	300		KHz
		10					
		15		300	400		
Min. clock frequency	t_W	5			300	500	nS
		10					
		15			300	500	
Min. reset pulse width	t_{WR}	5			200	500	nS
		10					
		15			200	500	
Propagation delay time (From clock input to φ output)	t_{PLH} t_{PHL}	5			2,500	3,500	nS
		10					
		15			2,500	3,500	
Propagation delay time (From clock input to each monitor	t_{PLH} t_{PHL}	5			3,000	4,000	nS
		10					
		15			3,000	4,000	
Setup time	t_{SET}	5		4,000	3,000		nS
		10					
		15		4,000	3,000		
Hold time	t_{HOLD}	5		500	0		nS
		10			0		
		15		500			

Waveforms for measuring switching time

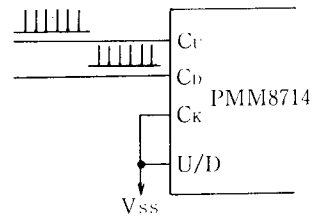


⑨ APPLICATION EXAMPLE

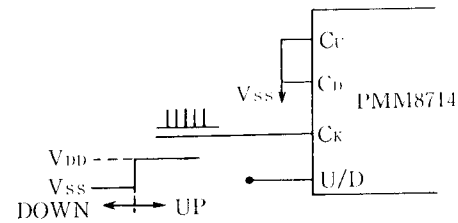
(Fig. 6)



2 input terminal system (Fig. 7)



1 input, 1 change-over terminal system (Fig. 8)



Note 1) With regard to output resistors (R1 to R5) it is recommended that the following be used:
1/2W 220Ω ±5% when V_{DD} = 5 V
1 W 680Ω ±5% when V_{DD} = 10V
1 W 1KΩ ±5% when V_{DD} = 15V
The output current at this time will be about I_{OH} = 8 ~ 15mA (with Tr $V_{BE(SAT)}$ = 1.2V).
If a larger value is required for I_{OH}, please design the unit according to Table 10.

Note 2) With regard to switching transistors (Tr1 to Tr5), it is recommended that darlington type transistors ($V_{BE(SAT)}$ of less than 2V, h_{FE} of more than 500) be used.

Note 3) Please select the input terminals to suit the type of mode and input system used and connect them as shown in this catalog (Table 6, Fig. 7 and Fig. 8).

Note 4) As for the excitation sequence of ϕ_A to ϕ_E, please refer to Table 8, Excitation Sequence, of this catalog.

The PMM8714 has a built-in protective circuit at its input to prevent it from being damaged by high voltage or static electricity.
However, as its impedance is very high, it should be used with great care to avoid applying a voltage higher than its maximum rating.
Especially during operation, it must be kept within a range of $V_{SS} \leqq (V_{IN}, V_{OUT}) \leqq V_{DD}$.
Input terminals not in use should be connected to V_{SS} or V_{DD}.

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