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FUJITSU

DATA SHEET

MB86520
STEPPING MOTOR CONTROLLER

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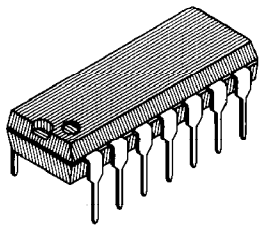
The Fujitsu MB86520, utilizing CMOS technology, is a universal controller for 4-phase stepping motor.

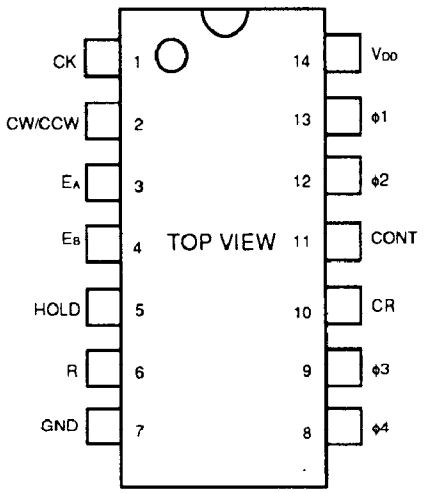
It is intended to be used in conjunction with switching transistor (e.g. Fujitsu FT 6000 series), pulse generator, and DC power supply source to produce a motor drive equipment.

- Drive mode
  4-phase 1 excitation drive mode
  4-phase 2 excitation drive mode
  4-phase 1-2 excitation drive mode
- Single power supply voltage : +5 V
- High-level output current : –0.4 mA max.
- Low-level output current : 10 mA max.
- 4-phase wave output delay function can be achieved in connection with external capacitor and external resistor
- Clock input ineffective function
- All input pins involve the schmitt trigger circuit
- 14-pin plastic DIP Package (Suffix: -P)



PLASTIC PACKAGE
DIP-14P-M02

PIN ASSIGNMENT



ABSOLUTE MAXIMUM RATINGS (see NOTE)

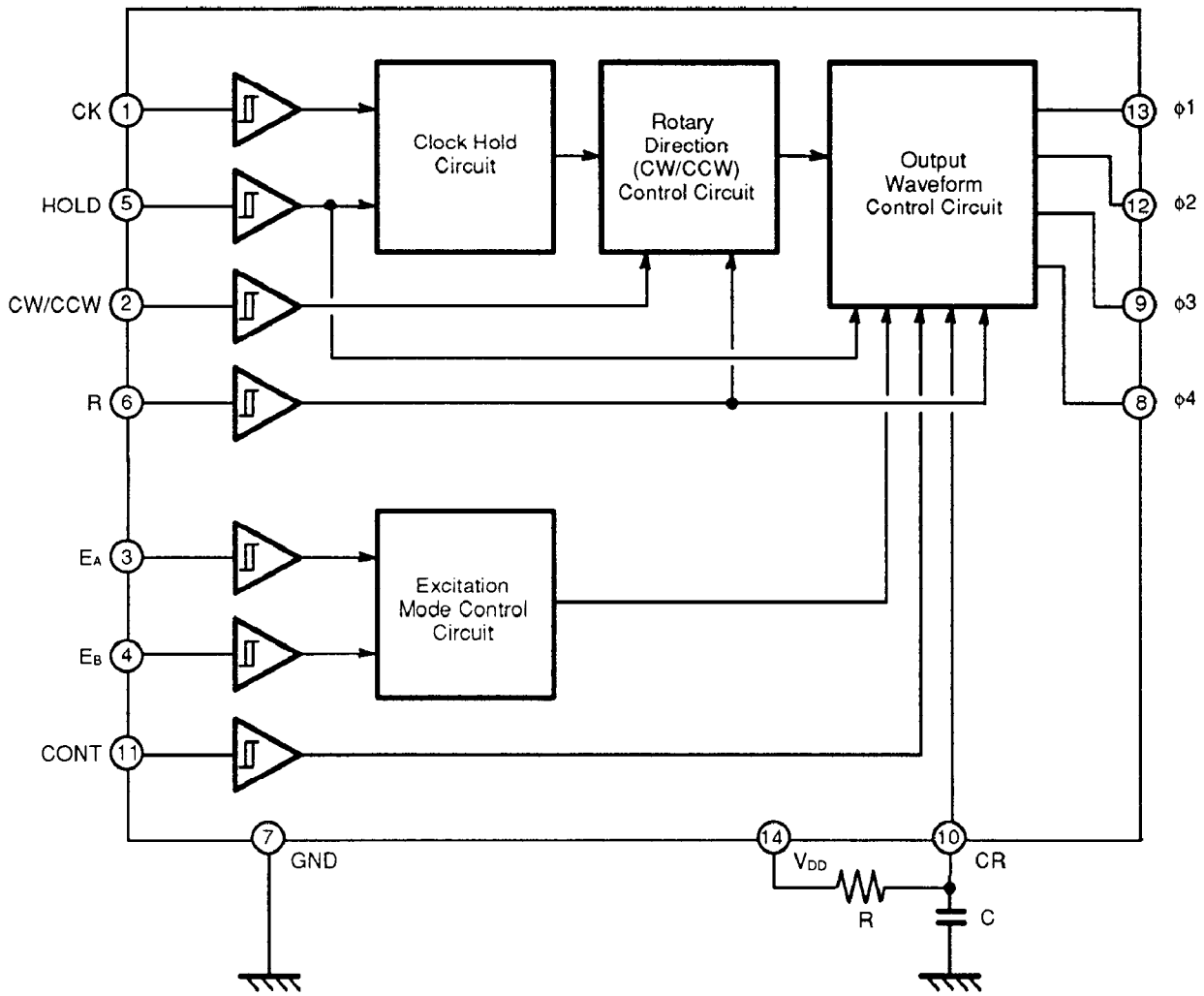
Rating	Symbol	Condition		Value	Unit
Power Supply Voltage	V_{DD}			GND–0.5 to+6.0	V
Input Voltage	V_I			GND–0.5 to V_{DD}+0.5	V
Output Voltage	V_O			GND–0.5 to V_{DD}+0.5	V
Operating Temperature	T_A			–25 to +85	°C
Storage Temperature	T_{STG}			–40 to +125	°C
Output Current*	I_O	V_{DD} = max.	V_O = V_{DD}	+140	mA
			V_O = 0V	–80	

*One pin within one second.

NOTE: Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

MB86520 BLOCK DIAGRAM



BLOCK DESCRIPTIONS

Block Name	Descriptions
Clock Hold Circuit	Clock control function Clock hold function
Rotary Direction Control Circuit	Clockwise rotation control function Counterclockwise rotation control function
Excitation Mode Control Circuit	4-phase 1 excitation drive mode control function 4-phase 2 excitation drive mode control function 4-phase 1-2 excitation drive mode control function
Output Waveform Control Circuit	4-phase output waveform control function 4-phase output waveform delay function

PIN DESCRIPTIONS

Pin No.	Symbol	I/O	Descriptions
1	CK	I	Clock input
2	CW/CCW	I	Rotary direction control input (High-level: Clockwise, Low-level: Counterclockwise
3	E_A	I	Excitation mode control input
4	E_B	I	Excitation mode control input
5	HOLD	I	Clock input ineffective input
6	R	I	Reset signal input
7	GND	–	Ground (0V)
8	$\phi 4$	O	Excitation output (No. 4)
9	$\phi 3$	O	Excitation output (No. 3)
10	CR	I/O	This pin is provided to connect an external capacitor and an external resistor
11	CONT	I	Output signal delay control input
12	$\phi 2$	O	Excitation output (No. 2)
13	$\phi 1$	O	Excitation output (No. 1)
14	V_{DD}	–	Power supply voltage input (+5V)

RECOMMENDED OPERATING CONDITIONS

GND = 0V

Parameter	Symbol	Value	Unit
Power Supply Voltage	V_{DD}	+5.0 ±5%	V
Operating Temperature	T_A	0 to +70	°C
High-level Output Current	I_{OH}	–0.4 Max.	mA
Low-level Output Current	I_{OL}	10 Max.	mA
Rise Time	t_r	6	ns
Fall Time	t_f	6	ns

ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

GND = 0V, T_A = 25°C

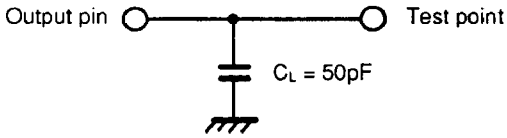
Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
High-level Input Voltage	V_{IH}		V_{DD} x 0.8	–	–	V
Low-level Input Voltage	V_{IL}		–	–	0.6	V
High-level Output Voltage	V_{OH}	I_{OH} = –0.4 mA	4.2	–	–	V
Low-level Output Voltage	V_{OL}	I_{OL} = 10 mA	–	–	0.5	V
Input Current	I_I	$V_I = V_{DD}$ or V_I = GND	–10	–	10	µA
Static Power Supply Current	I_{DD}		–	–	0.1	mA

AC CHARACTERISTICS

GND = 0V

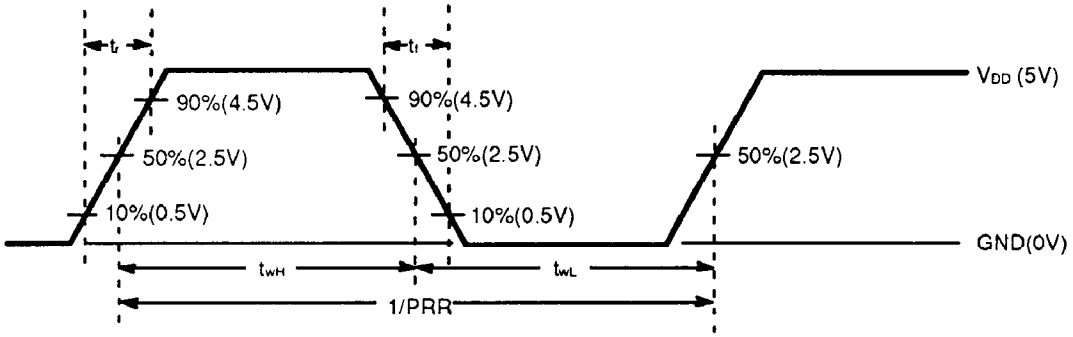
Parameter	Symbol	Condition	Value					Unit
			T_A = 25°C			T_A = −40 to +85°C		
		V_{DD}	Min	Typ	Max	Min	Max	
Maximum Clock Frequency (CK)	f_{max}	2.0V	3	5	–	2	–	MHz
		5.0V	10	20	–	8	–	
		6.0V	12	25	–	9	–	
Clock Pulse Width (CK)	t_{wH} t_{wL}	2.0V	100	50	–	120	–	ns
		5.0V	70	30	–	84	–	
		6.0V	50	20	–	60	–	
Reset Pulse Width (R)	t_{wH}	2.0V	40	20	–	48	–	ns
		5.0V	20	10	–	24	–	
		6.0V	18	8	–	22	–	
Setup Time (CW/CCW, HOLD)	t_{su}	2.0V	20	10	–	24	–	ns
		5.0V	10	5	–	12	–	
		6.0V	8	4	–	10	–	
Hold Time (CW/CCW, HOLD)	t_h	2.0V	0	–	–	0	–	ns
		5.0V	0	–	–	0	–	
		6.0V	0	–	–	0	–	
Removal Time (R)	t_{rem}	2.0V	40	–	–	48	–	ns
		5.0V	20	–	–	24	–	
		6.0V	18	–	–	22	–	
Output Transit Time	t_{TLH} t_{THL}	2.0V	–	25	40	–	48	ns
		5.0V	–	12	20	–	20	
		6.0V	–	10	16	–	19	
Propagation Delay Time (CK → φ1 to φ4)	t_{PLH} t_{PHL}	2.0V	–	135	220	–	270	ns
		5.0V	–	40	64	–	77	
		6.0V	–	35	60	–	72	
Propagation Delay Time (R, HOLD → φ1 to φ4)	t_{PLH} t_{PHL}	2.0V	–	135	220	–	270	ns
		5.0V	–	40	64	–	77	
		6.0V	–	35	60	–	72	

LOAD CIRCUIT



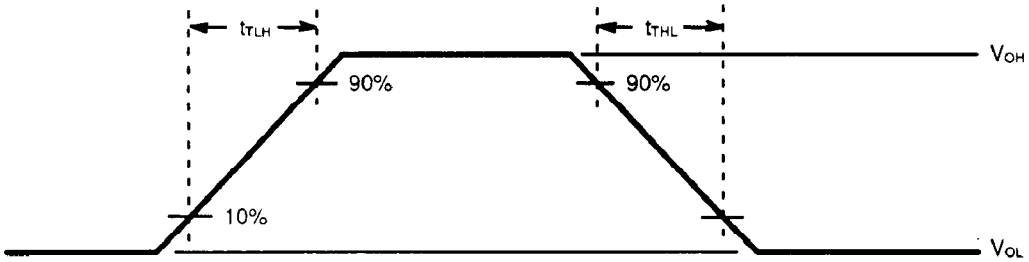
TIMING CHART-I

Input Waveform (Rise Time, Fall Time, Pulse Width)

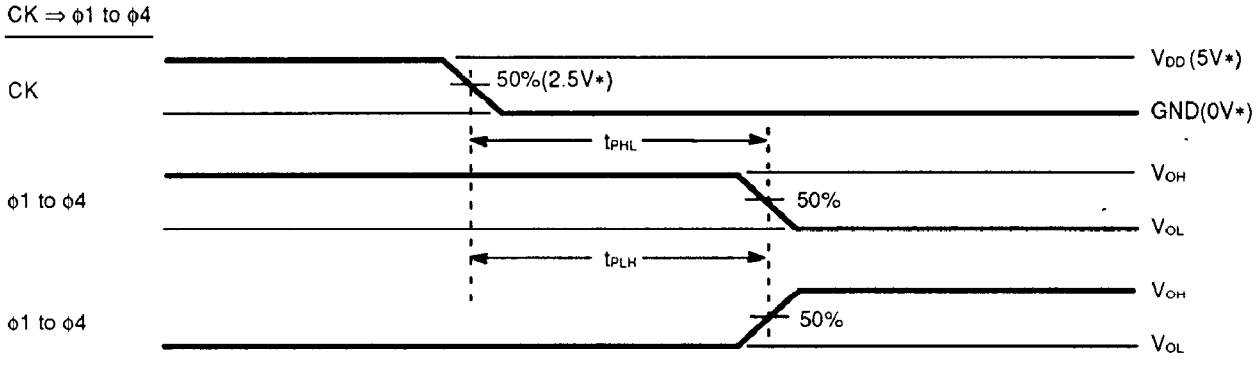


Note) • t_r = 6ns, t_f = 6ns, Repetition frequency: PRR = 1MHz, Duty CYCLE = 50%
• Change PRR to measure the maximum clock frequency (fmax.).

Output Waveform (Propagation Time)

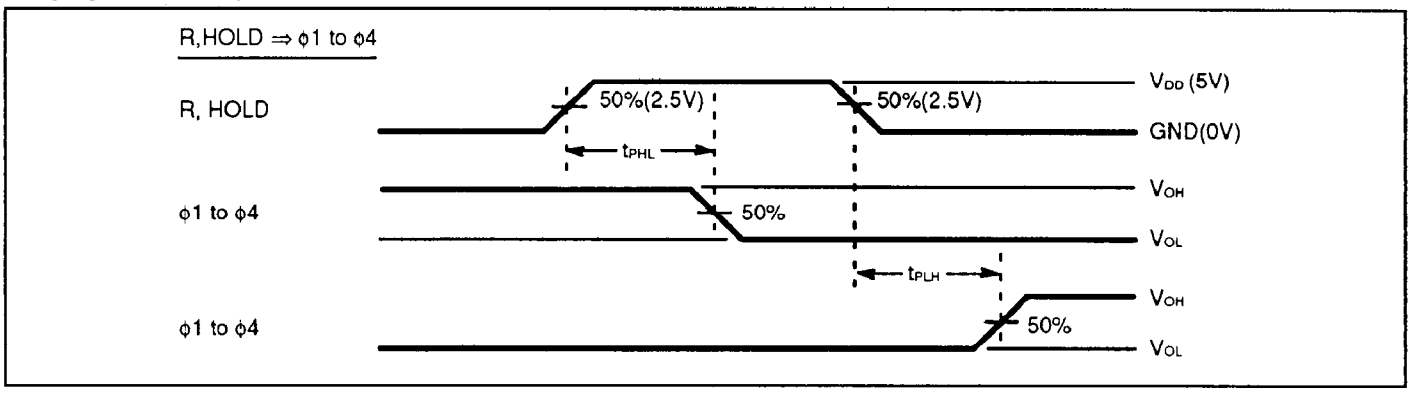


Propagation Delay Time

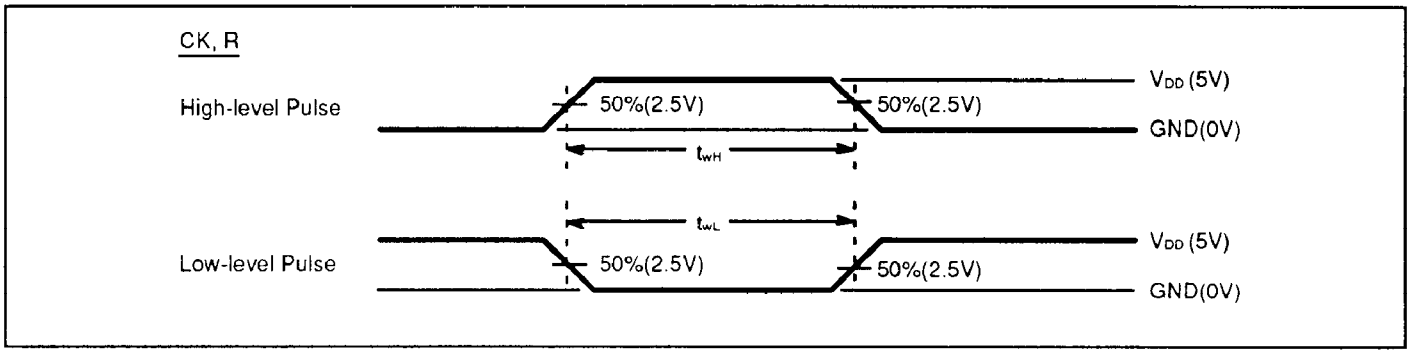


Note: *Recommended operating condition

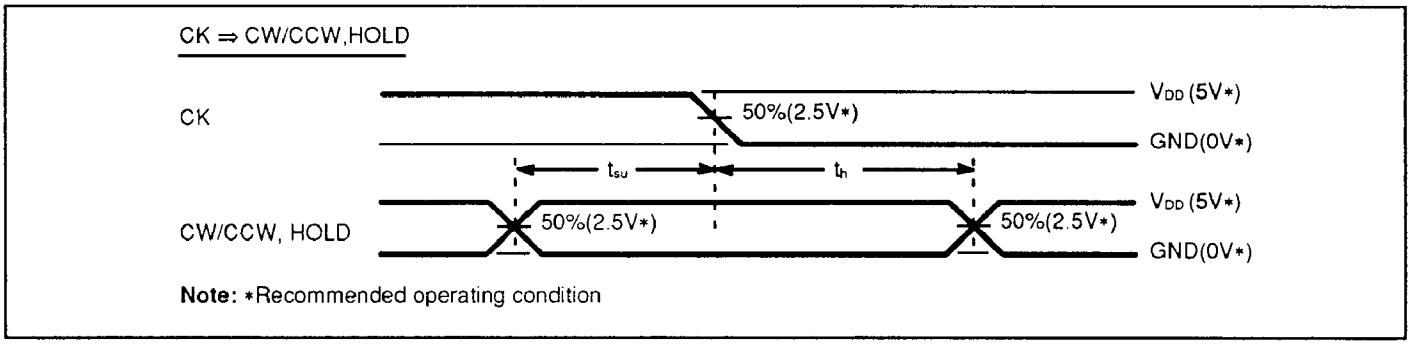
Propagation Delay Time



Pulse Time

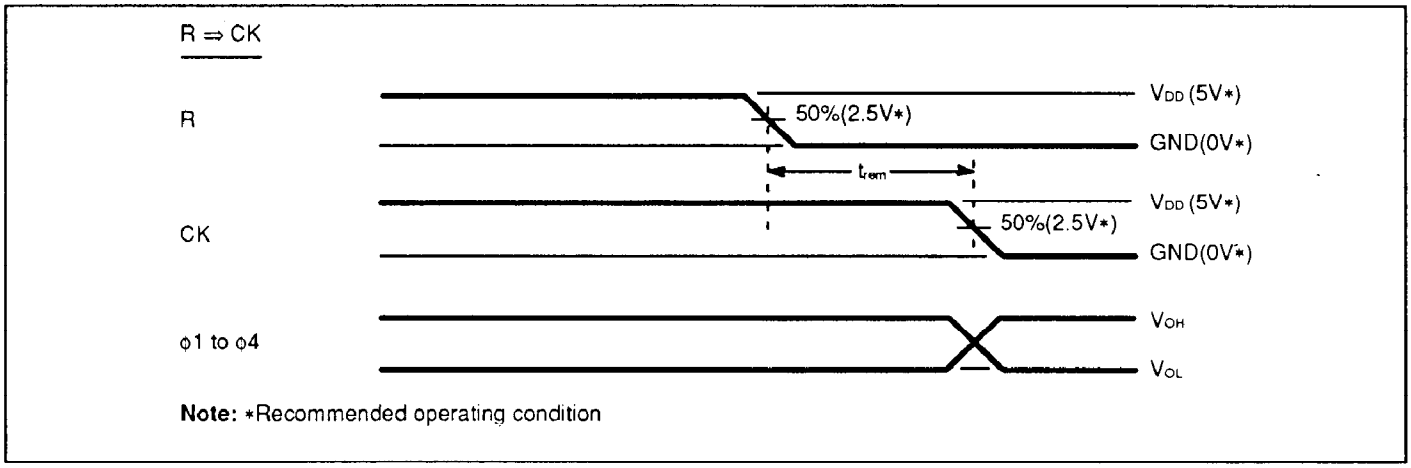


Setup Time, Hold Time



Note: *Recommended operating condition

Removal Time



Note: *Recommended operating condition

FUNCTIONAL TABLE

Normal Operation

Excitation Mode	Motor Rotary Direction	Input						Output
		R	HOLD	E_A	E_B	CK	CW/CCW	φ1, φ2, φ3, φ4
2 Excitation	Clockwise	L	L	L	L		H	See Fig.1
	Counterclockwise						L	
1 Excitation	Clockwise				H		H	See Fig.2
	Counterclockwise						L	
	Clockwise			H	L		H	See Fig.3
	Counterclockwise						L	
1-2 Excitation	Clockwise				H		H	See Fig.4
	Counterclockwise						L	

Note) See 4-phase output delay function description on page 10 about usage of CONT, CR pins.

Reset Operation

Excitation Mode	Input								Output			
	R	HOLD	E_A	E_B	CK	CW/CCW	CONT	CR	φ1	φ2	φ3	φ4
All Excitation	H	X	X	X	X	X	X	X	L	L	L	L

Note) X : Don't care

Reset Operation to Normal Operation

Excitation Mode	Input								Output			
	R	HOLD	E_A	E_B	CK	CW/CCW	CONT	CR	φ1	φ2	φ3	φ4
2 Excitation	H→L	L	L	L	X	X	X	X	L→H	L	L	L→H
1 Excitation				H								L
			H	L								
1-2 Excitation				H								L→H

Note) X : Don't care

Clock Input Ineffective Operation

Excitation Mode	Input								Output			
	R	HOLD	E_A	E_B	CK	CW/CCW	CONT	CR	φ1	φ2	φ3	φ4
All Excitation	L	H	X	X	X	X	X	X	L	L	L	L

Note) X : Don't care

Clock Input Ineffective Operation to Normal Operation

Excitation Mode	Input								Output			
	R	HOLD	E_A	E_B	CK	CW/CCW	CONT	CR	φ1	φ2	φ3	φ4
All Excitation	L	H→L	X	X	X	X	X	X	Excitation condition before clock input ineffectiveness			

Note) X : Don't care

TIMING CHART-II

Fig.1 – 4 Phase 2 Excitation Drive Mode

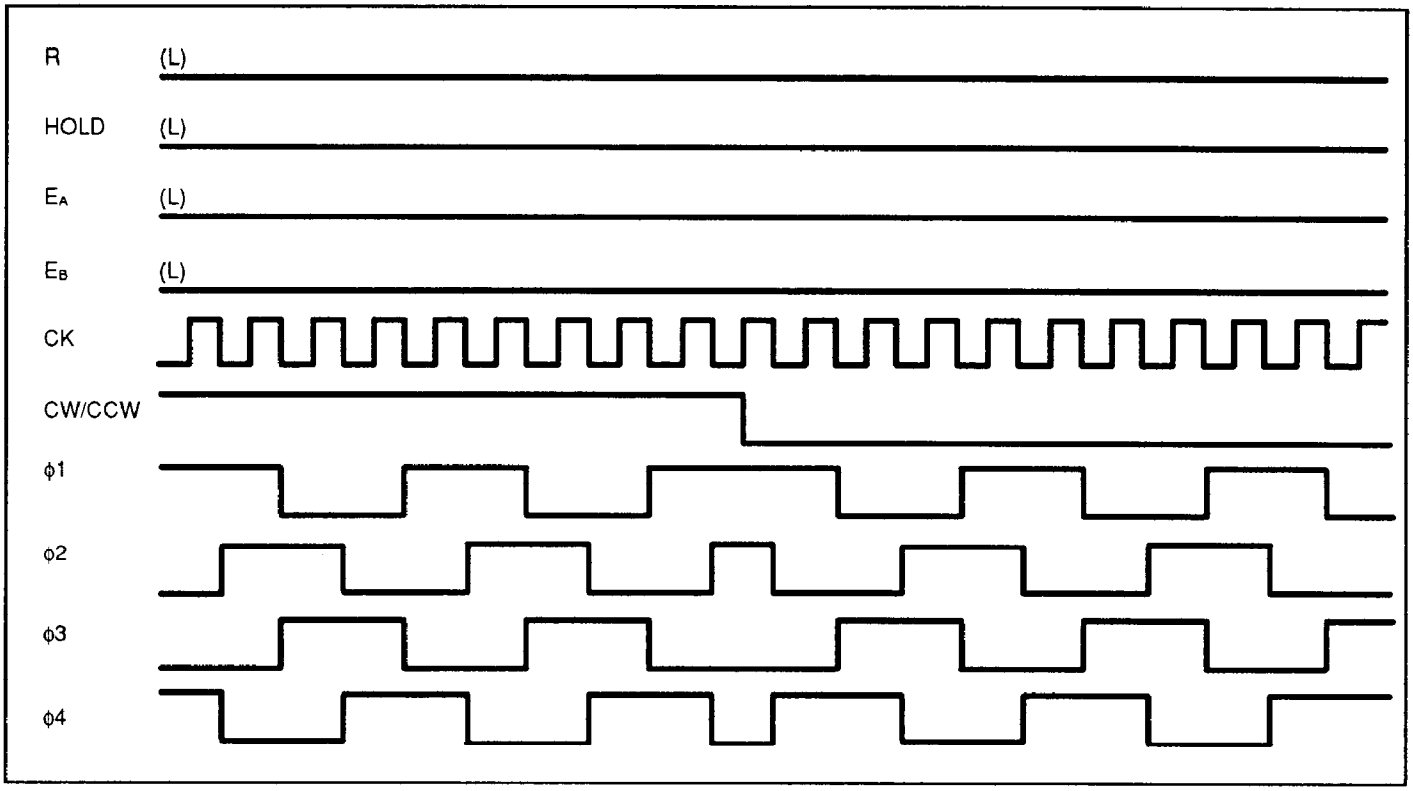


Fig.2 – 4 Phase 1 Excitation Drive Mode

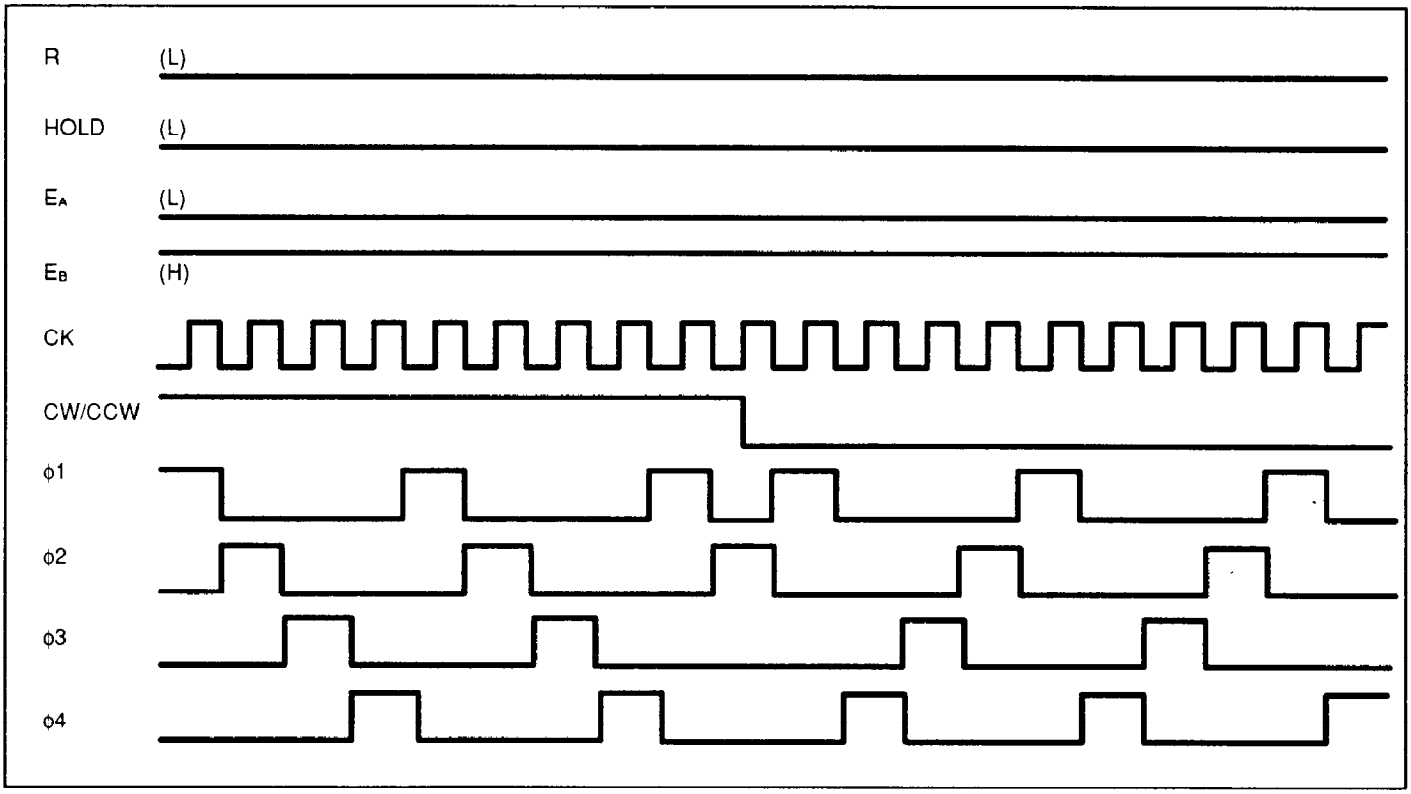


Fig.3 – 4 Phase 1 Excitation Drive Mode

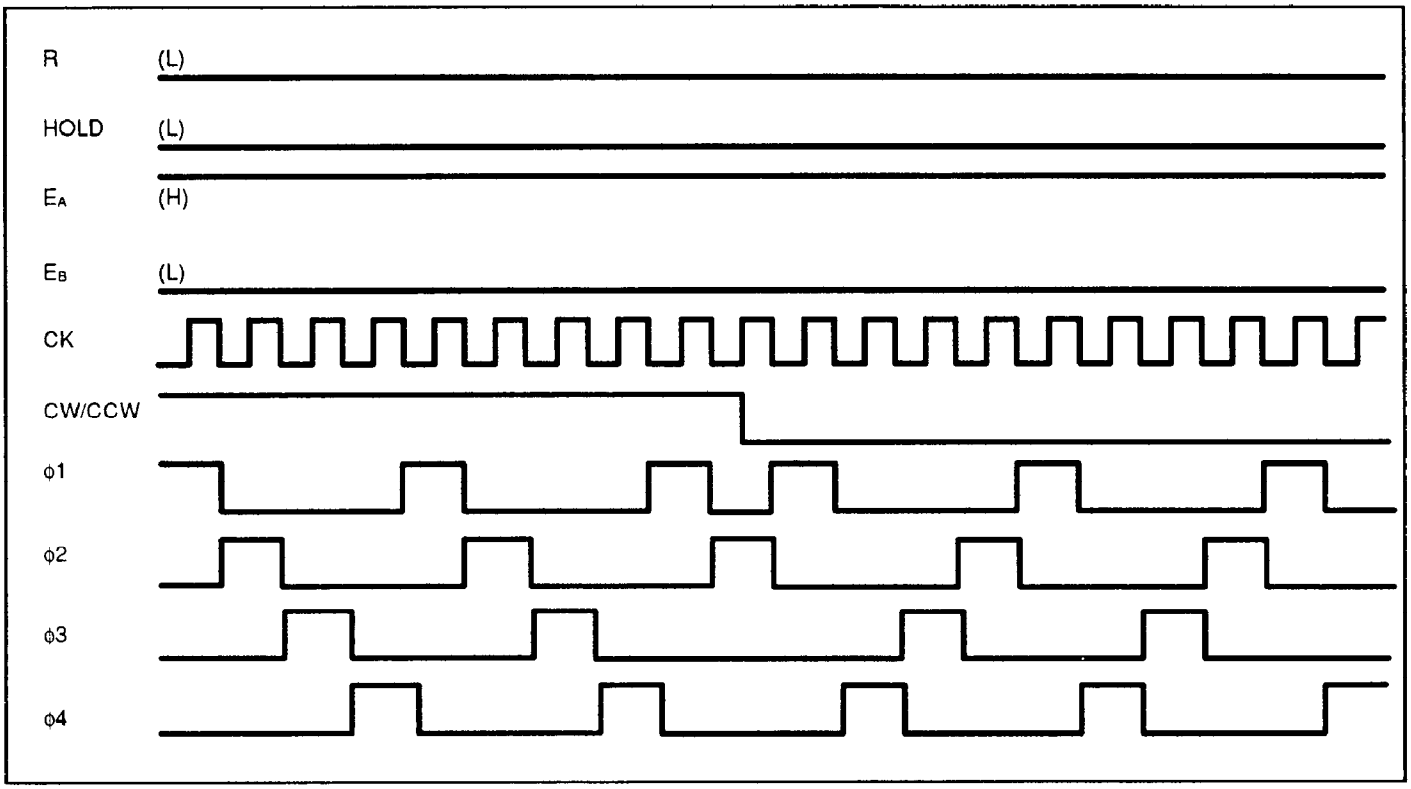
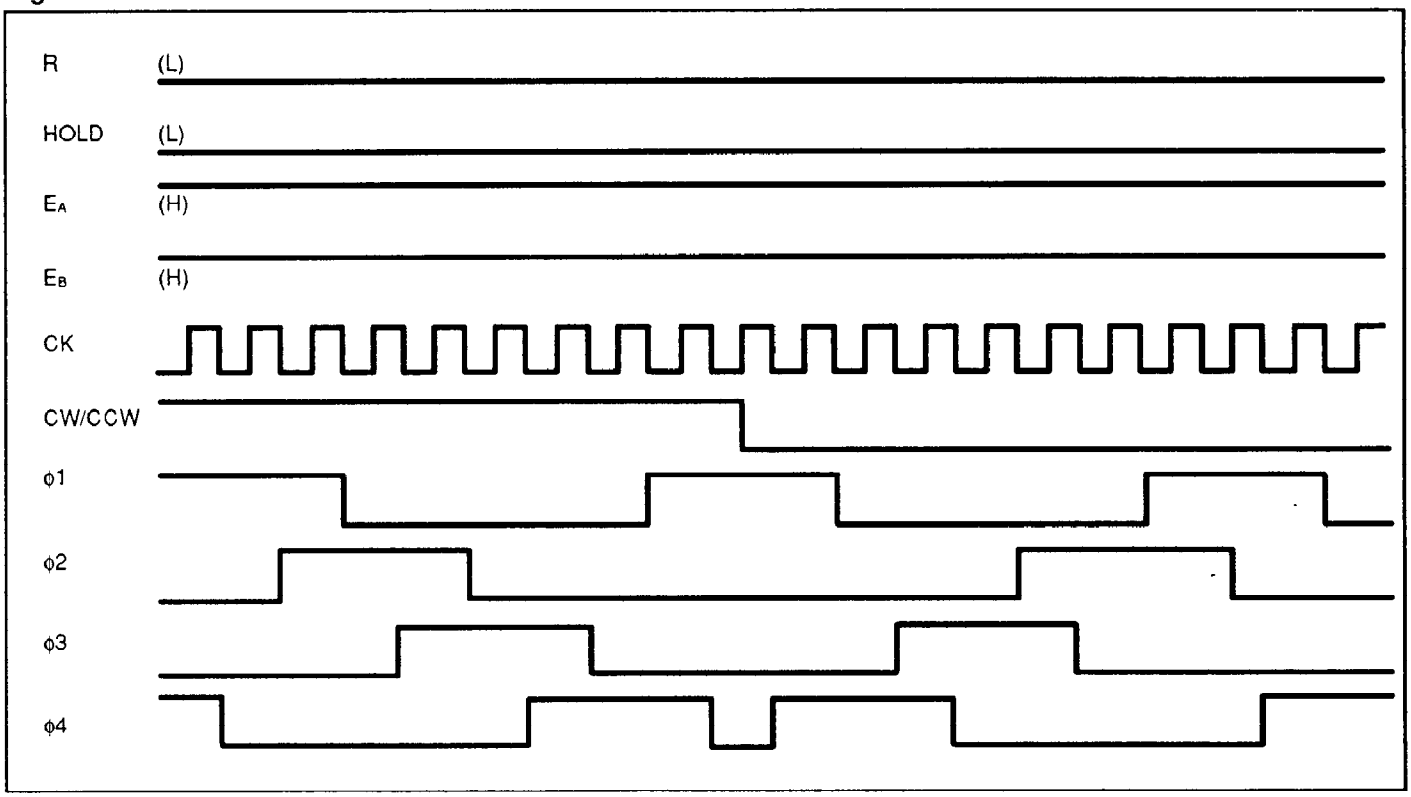


Fig.4 – 4 Phase 1-2 Excitation Drive Mode



4 PHASE OUTPUT DELAY FUNCTIONAL DESCRIPTIONS

Function

The 4-phase output delay function protects an inflow of abnormal current to a stepping motor in 4-phase 2 excitation drive mode.
During all excitation drive mode, the rising of 4-phase output (φ1 to φ4) waveform delays TD (sec) from normal output waveform.

Use

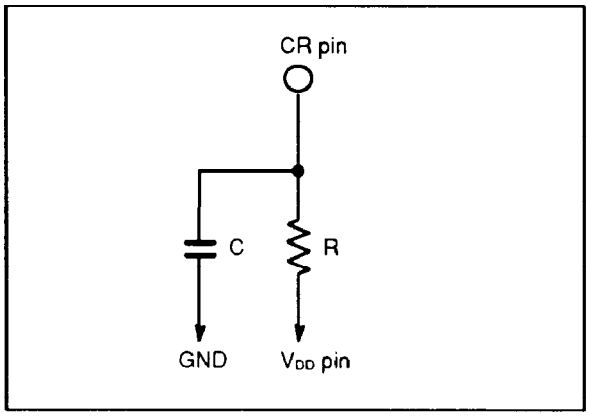
- Please connect an external capacitor and an external resistor to CR pin. When delay function is not used, CR pin is grounded.
- CONT pin is set to high level.

Delay Time Equation

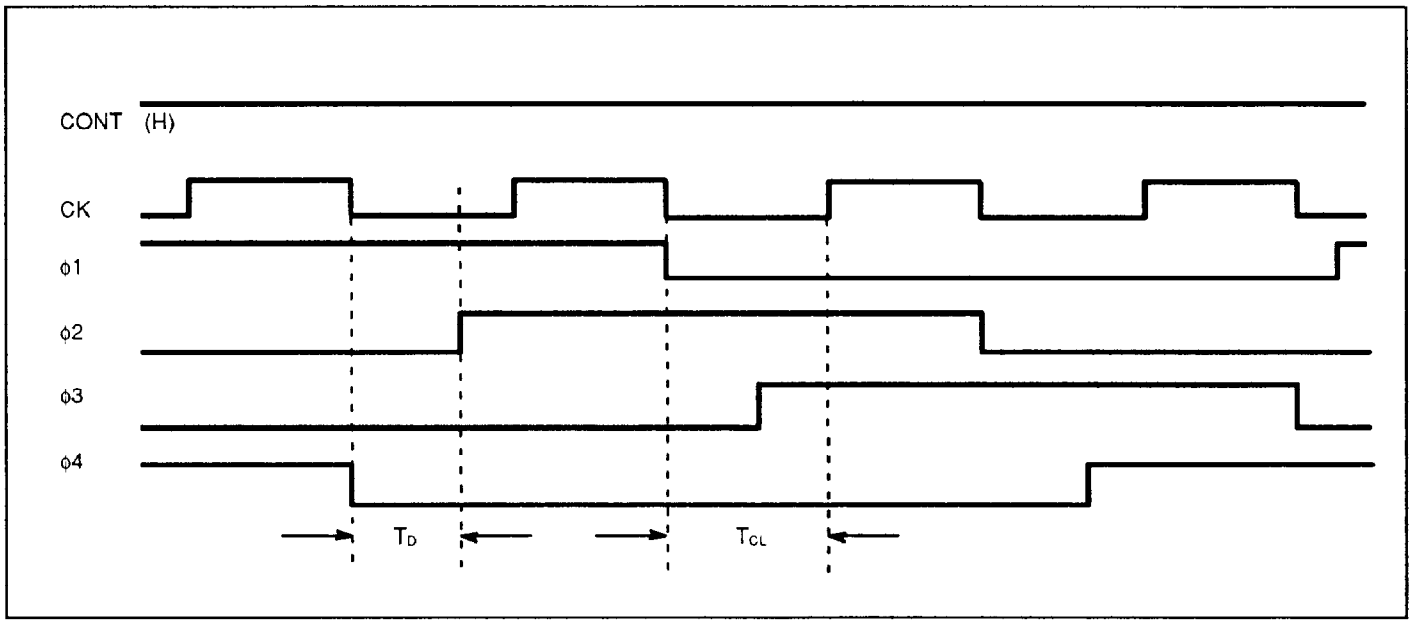
$T_D \fallingdotseq K \times C \times R \; (\fallingdotseq 0.45 \times C \times R)$

($T_D \leqq T_{CL}$, T_{CL} = L cycle of CK, Cmax. = infinite, Rmax. = 1MΩ)

Connection Circuit



Output Timing Chart (e.g. 4 Phase 2 Excitation Drive Mode: Clockwise)

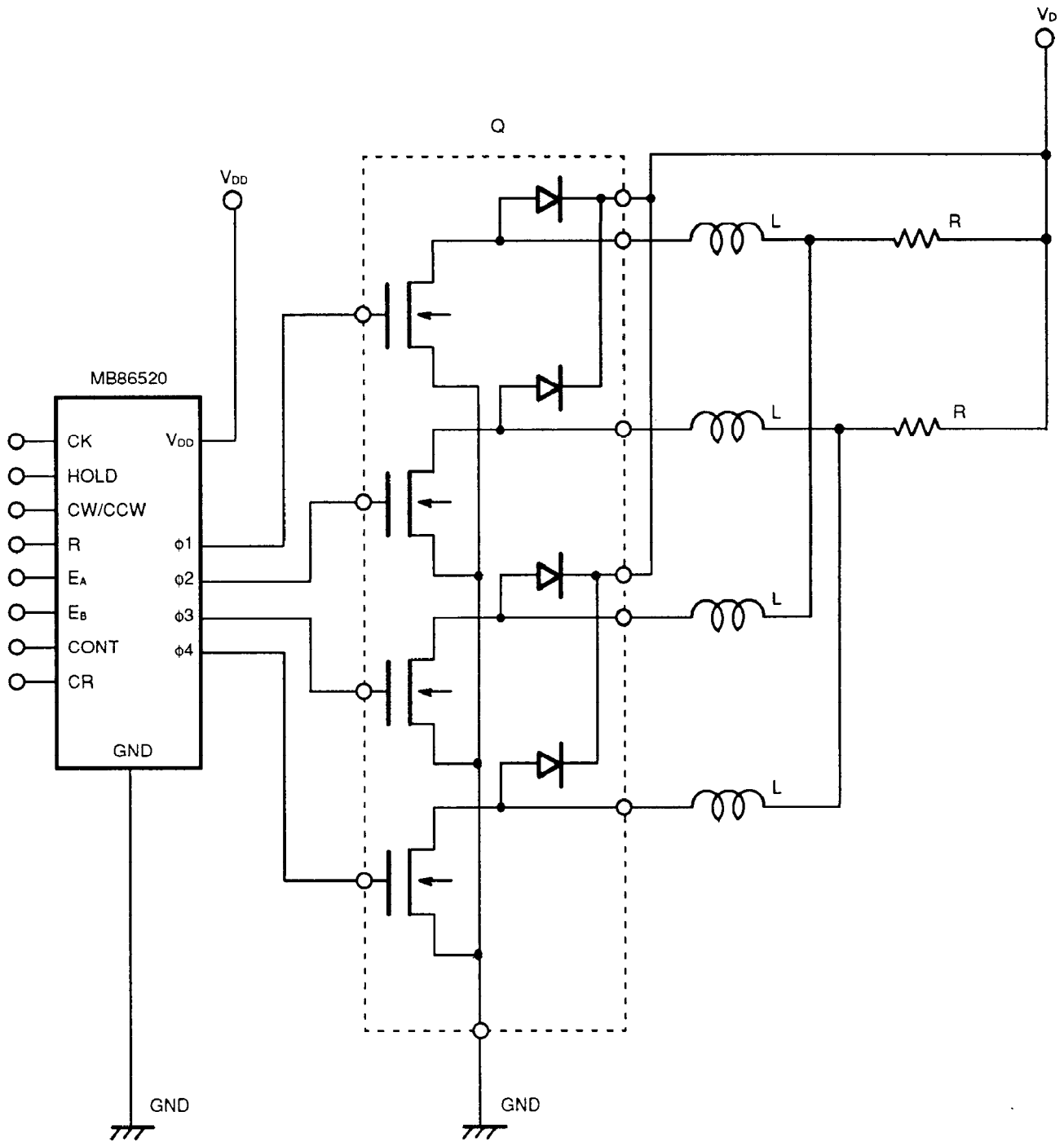


Summary

CONT pin Input Level	CR pin Connection *	4 Phase Output Condition (Delay Time)
High-level	External capacitor, resistor	Delay output (T_D sec)
	GND**	Delay output (T_{QL} sec)
Low-level	External capacitor, resistor	Normal output (no delay)
	GND**	

Note) * : Do not connect CR pin to V_{DD}, and not left open.
** : When delay function is not used, CR pin is grounded.

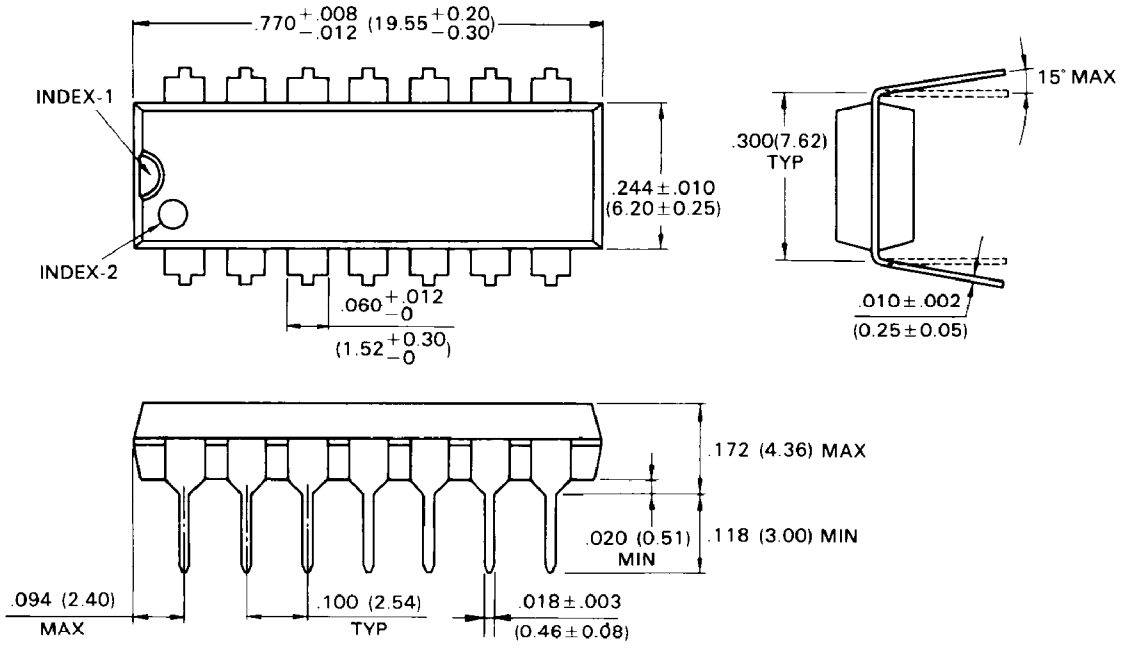
MB86520 APPLICATION CIRCUIT EXAMPLE



Note) L : Motor winding
R : Current control resistor
Q : Fujitsu N-channel Mos FET Array (FT6000 series)

PACKAGE DIMENSIONS

14-LEAD PLASTIC DUAL IN-LINE PACKAGE
(CASE No.: DIP-14P-M02)



Dimensions in
inches (millimeters)

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