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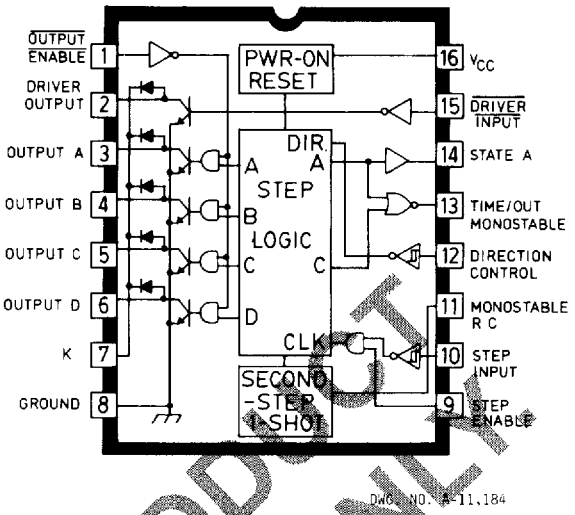
INTEGRATED CIRCUIT
ENGINEERING BULLETIN

UCN-4202A
UCN-4203A

UCN-4202A AND UCN-4203A STEPPER-MOTOR TRANSLATORS AND DRIVERS

FEATURES

- 600 mA Output Current
- Full-Step or Double-Step Operation
- Single-Input Direction Control
- Power-On Reset
- Internal Transient Suppression
- Schmitt Trigger Inputs



DWG. NO. A-11,184

DESIGNED TO DRIVE permanent-magnet stepper motors with current ratings of up to 500 mA, these integrated circuits employ a full-step, double-pulse drive scheme that allows use of up to 90 percent of available motor torque. The two devices differ only in output-voltage ratings: Type UCN-4202A has a 20 V breakdown-voltage rating and a 15 V sustaining voltage rating; Type UCN-4203A has a 50 V breakdown-voltage rating and a 35 V sustaining voltage rating.

Both drivers are bipolar I^2L designs containing approximately 100 logic gates, TTL-compatible input/output circuitry, and 600 mA outputs with internal transient suppressors. The devices operate with a minimum of external components.

The four-phase stepper-motor load is controlled by step-logic functions. To step the load from one position to the next, STEP INPUT is pulled down to a logic low for at least 1 μs, then allowed to return to a logic high. The step logic is activated on the positive-going edge, which in turn activates one of the four current-sink outputs. DIRECTION CONTROL determines the sequence of states (A-B-C-D or A-D-C-B).

In the full-step mode, the MONOSTABLE RC timing pin is tied to V_{CC}, making states B and D stationary. A separate input pulse is required to move through each of the four output states.

In the double-step mode, states B and D are transition states with duration determined by MONOSTABLE RC timing. Improved motor torque is obtained at double the nominal motor step angle, and motor stability is improved for high step rates.

Higher current ratings, or bipolar operation, can be obtained by using Type UCN-4202A or UCN-4203A as a logic translator to drive integrated motor drivers (Sprague Type UDN-2949Z or UDN-2952B/W) or discrete high-power transistors.

ABSOLUTE MAXIMUM RATINGS at $T_A = +25°C$

Supply Voltage, V_{CC}	7.0 V
V_K (UCN-4202A)	20 V
(UCN-4203A)	50 V
Output Voltage, V_{OUT} (UCN-4202A)	20 V
(UCN-4203A)	50 V
Input Voltage, V_{IN}	7.0 V
Output Sink Current, I_{OUT}	600 mA
Power Dissipation, P_D (One Driver)	0.8 W
(Total Package)	2.0 W*
Operating Temperature Range, T_A	−20°C to +85°C
Storage Temperature Range, T_S	−55°C to +150°C

*Derate at the rate of 16.6 mW/°C above +25°C.

DISCONTINUED PRODUCT
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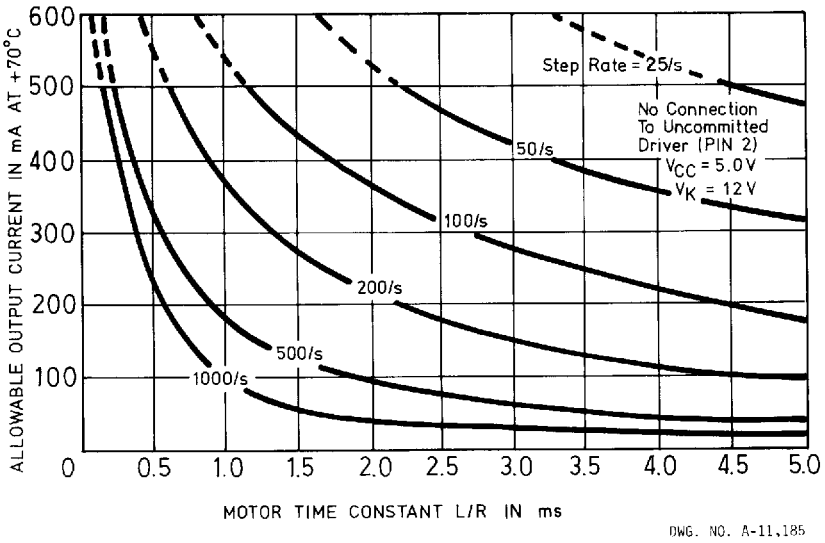
UCN-4202A AND UCN-4203A
STEPPER-MOTOR TRANSLATORS AND DRIVERS

ENGINEERING BULLETIN 26184

RECOMMENDED OPERATING CONDITIONS

Characteristic	UCN-4202A			UCN-4203A			Units
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply Voltage, V_{CC}	4.5	5.0	5.5	4.5	5.0	5.5	V
V_K	—	12	13.5	—	30	35	V
Output Voltage, V_{CE}	—	—	13.5	—	—	35	V
Output Sink Current, I_{OUT}	—	—	500	—	—	500	mA
Operating Temperature, T_A	0	25	70	0	25	70	°C

MAXIMUM COLLECTOR CURRENT AS A FUNCTION OF MOTOR TIME CONSTANT



Notes: 1. Values shown take into account static d-c losses ($V_{SAT}I_{OUT}$ and $V_{CC}I_{CC}$) as well as switching losses induced by inductive flyback through the clamp diodes at V_K = 12 V. Maximum package power dissipation is assumed to be 1.33 W at +70°C. Higher package power dissipation may be obtained at lower operating temperatures.

2. Use of external discrete flyback diodes will eliminate power dissipation resulting from switching losses and will allow the full 500 mA output capability (Output A, B, C, or D and the Driver Output) under all conditions.

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ELECTRICAL CHARACTERISTICS at $T_A = +25°C$, $V_{CC} = +5.0$ V (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions	Limits Min.	Limits Max.	Units
Supply Current	I_{CC}	All	2 Drivers ON	—	85	mA
TTL Inputs (Pins 1, 9, and 15), TTL Outputs (Pins 13 and 14)						
Input Voltage	$V_{IN(1)}$	All	$V_{CC} = 4.5$ V	2.0	—	V
	$V_{IN(0)}$	All	$V_{CC} = 5.5$ V	—	0.8	V
Input Current	$I_{IN(1)}$	All	$V_{CC} = 5.5$ V, $V_{IN} = 2.4$ V	—	40	μA
	$I_{IN(0)}$	All	$V_{CC} = 5.5$ V, $V_{IN} = 0.4$ V	—	−1.6	mA
Input Clamp Voltage	V_{IK}	All	$I_{IN} = -12$ mA	—	−1.5	V
Output Voltage	$V_{OUT(1)}$	All	$V_{CC} = 4.5$ V, $I_{OUT} = 80$ μA	2.4	—	V
	$V_{OUT(0)}$	UCN-4202A	$V_{CC} = 4.5$ V, $I_{OUT} = 3.2$ mA	—	0.4	V
		UCN-4203A	$V_{CC} = 4.5$ V, $I_{OUT} = 1.5$ mA	—	0.4	V
Output Current	$I_{OUT(SC)}$	All	$V_{CC} = 5.5$ V, $V_{OUT} = 0$	—	38	mA
Second-Step Monostable RC Input (Pin 11)						
Time Constant	t_{RC}	All		0.95	1.3	s/RC
Reset Voltage	V_{MR}	All	$R = 200$ kΩ, $I_{IN} = 25$ μA	—	50	mV
Reset Current	I_{MR}	All	$V_{IN} = 2.0$ V	40	—	μA
Schmitt Trigger Inputs (Pins 10 and 12)						
Threshold Voltage	V_{T+}	All		1.3	2.1	V
	V_{T-}	All		0.6	1.1	V
Hysteresis	ΔV_T	All		0.2	—	V
Input Current	$I_{IN(1)}$	All	$V_{CC} = 4.5$ V, $V_{IN} = 2.4$ V, $T_A = 25°C$	—	5.0	μA
		All	$V_{CC} = 4.5$ V, $V_{IN} = 2.4$ V, $T_A = 70°C$	—	40	μA
	$I_{IN(0)}$	All	$V_{CC} = 5.5$ V, $V_{IN} = 0.4$ V	—	−1.6	mA
Input Clamp Voltage	V_{IK}	All	$I_{IN} = -12$ mA	—	−1.5	V
Open Collector Outputs (Pins 2, 3, 4, 5, and 6)						
Output Leakage Current	I_{CEX}	UCN-4202A	$V_{CC} = 5.5$ V, K = Open, $V_{OUT} = 20$ V	—	500	μA
		UCN-4203A	$V_{CC} = 5.5$ V, K = Open, $V_{OUT} = 50$ V	—	500	μA
Output Saturation Voltage	$V_{CE(SAT)}$	UCN-4202A	$V_{CC} = 4.5$ V, $I_{OUT} = 300$ mA	—	500	mV
			$V_{CC} = 4.5$ V, $I_{OUT} = 400$ mA	—	750	mV
			$V_{CC} = 4.5$ V, $I_{OUT} = 500$ mA	—	900	mV
		UCN-4203A	$V_{CC} = 4.5$ V, $I_{OUT} = 300$ mA	—	850	mV
			$V_{CC} = 4.5$ V, $I_{OUT} = 400$ mA	—	1100	mV
			$V_{CC} = 4.5$ V, $I_{OUT} = 500$ mA	—	1350	mV
Output Sustaining Voltage	$V_{CE(SUS)}$	UCN-4202A	$I_{OUT} = 30$ mA, $t_p \leq 300$ μs, Duty Cycle ≤ 2%	15	—	V
		UCN-4203A	$I_{OUT} = 30$ mA, $t_p \leq 300$ μs, Duty Cycle ≤ 2%	35	—	V
Turn-On Delay	t_{pd0}	All	0.5 E_{in} (Pin 10) to 0.5 E_{out}	—	10	μs
Turn-Off Delay	t_{pd1}	All	0.5 E_{in} (Pin 10) to 0.5 E_{out}	—	10	μs
Clamp Diode Leakage Current	I_R	UCN-4202A	$V_R = 20$ V	—	50	μA
		UCN-4203A	$V_R = 50$ V	—	50	μA
Clamp Diode Forward Voltage	V_F	All	$I_F = 500$ mA	—	3.0	V

FUNCTIONAL DESCRIPTION

Power-On Reset

An internal RS flip-flop sets the Output A "ON" with the initial application of power. This state occurs approximately 30 μs after the logic supply voltage reaches 4 V with supply rise times of up to 10 ms/V. Once reset, the circuit functions according to the logic input conditions.

Step Enable

Pin 9 (STEP ENABLE) must be held high to enable the step pulses for advancing the motor to reach the translator logic clock circuits. Pulling this pin low inhibits the translator logic.

Step Input

Pin 10 (STEP INPUT) is normally high. The logic will advance one position on the positive transition after the input has been pulled low for at least 1 μs. The STEP INPUT current specification is compatible with NMOS and CMOS.

Direction Control

The direction of output rotation is determined by the logic level at pin 12. If the input is held high the rotation is A-D-C-B; if pulled low the rotation is A-B-C-D. This input is also NMOS and CMOS compatible.

Output Enable

Outputs A through D are inhibited (all outputs OFF) when pin 1 (OUTPUT ENABLE) is at high level. This condition creates a potential for wired-OR device outputs, or other potential control functions such as chopping or bi-level drive.

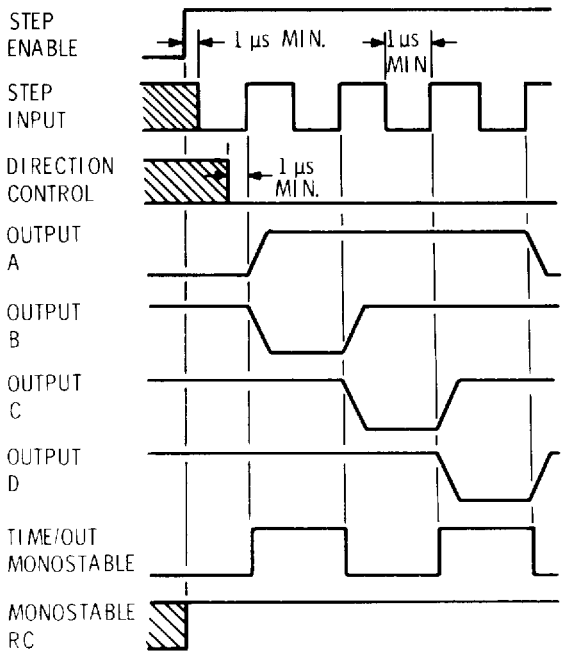
Transient Suppression

All five power outputs are diode protected against inductive transients. Zener diode or resistor "flyback" transient suppression is often used, provided the peak output voltage does not exceed the sustaining voltage rating of the device (15 V for Type UCN-4202A or 35 V for Type UCN-4203A).

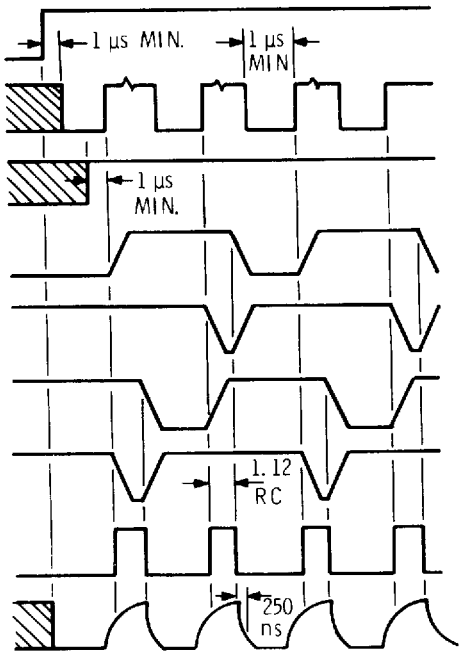
Full-Step/Double-Step

Full-step operation is the most commonly used drive technique. The devices are capable of unipolar drive without external active devices, either in a full-step mode (pin 11, Monostable RC, tied high), or in a double-step mode (pin 11 connected to RC timing). The double-step mode provides improved torque characteristics, while the specified angular increment is doubled.

FULL-STEP MODE



DOUBLE-STEP MODE



Dwg. No. A-11,844

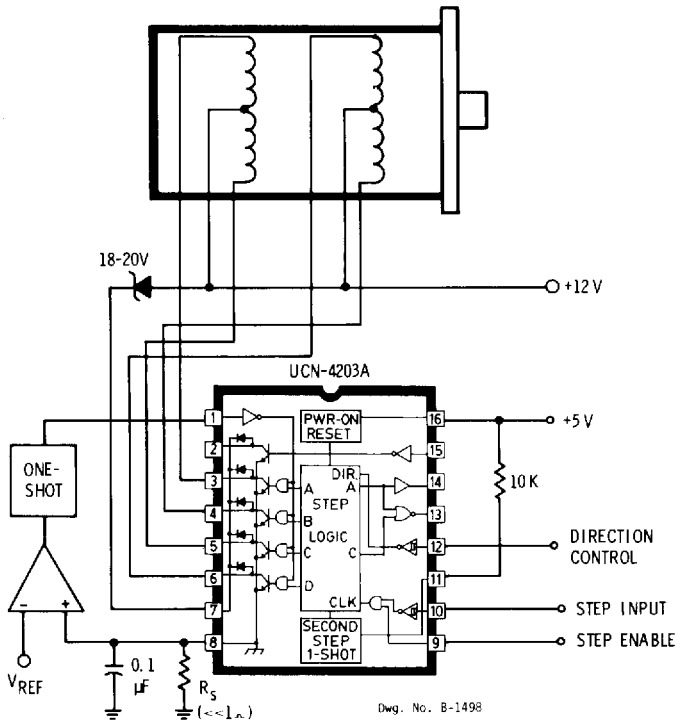
STEPPER MOTORS

(Representative List)

Manufacturer	Model	L/R	Typ. Ratings	Step
Eastern Air Devices	LA23ACK-2	1.4 ms	440 mA, 12 V	1.8°
	LA23ACK-3	1.25 ms	220 mA, 24 V	1.8°
	LA23ACY-1	1.2 ms	440 mA, 12 V	7.5°
	LA34ADK-6	2.6 ms	530 mA, 14 V	1.8°
IMC Hanson	S-114	1.6 ms	340 mA, 12 V	7.5°
	S-115	1.9 ms	130 mA, 12 V	7.5°
	S-382	1.6 ms	171 mA, 24 V	7.5°
	S-406	4.3 ms	280 mA, 24 V	15°
	S-451	3.9 ms	280 mA, 24 V	7.5°
North American Phillips	K82701-P2	1.5 ms	330 mA, 12 V	7.5°
	K83701-P2	1.5 ms	330 mA, 12 V	15°
Septor	S-0912A	1.5 ms	340 mA, 12 V	9°
Superior Electric	M061-FD-301	0.8 ms	440 mA, 12 V	1.8°
	M061-FD-311	1.5 ms	220 mA, 20 V	1.8°

TYPICAL APPLICATIONS

CHOPPER DRIVE CIRCUIT
Used to Drive a 12 V, 500 mA Unipolar Stepper Motor



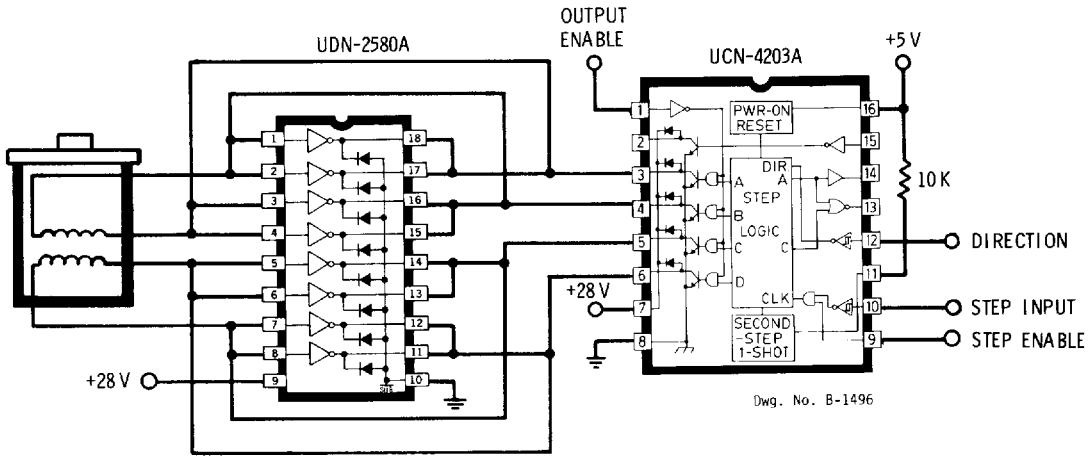
DISC DRIVE APPLICATIONS

These stepper-motor translator/drivers provide additional special-purpose logic for use in disc drive applications. Pin 14 (STATE A) is high with OUTPUT A activated and is used with other drive logic in determining Track 0 Position on the disc. Pin 13 (TIME/OUT MONOSTABLE) in disc drive applications is called ON TRACK and is low with either OUTPUT A or OUTPUT C activated. It is used as a WRITE ENABLE condition with other drive logic.

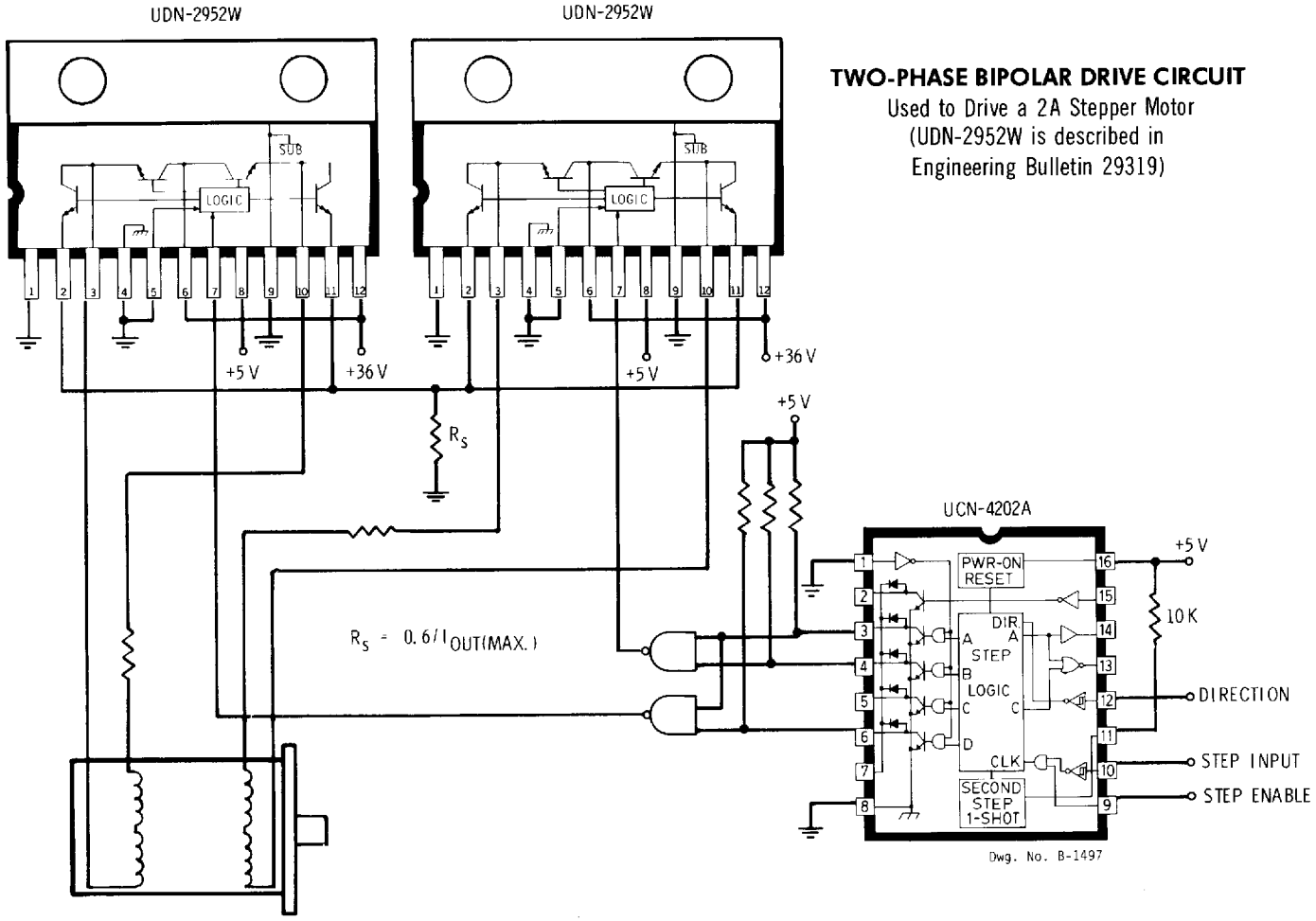
An independent driver (pins 2 and 15) is used to control the head load solenoid.

TYPICAL APPLICATIONS (Continued)

TWO-PHASE BIPOLAR DRIVE CIRCUIT
Used to Drive a 500 mA Stepper Motor
(UDN-2580A is described in Engineering Bulletin 29316)



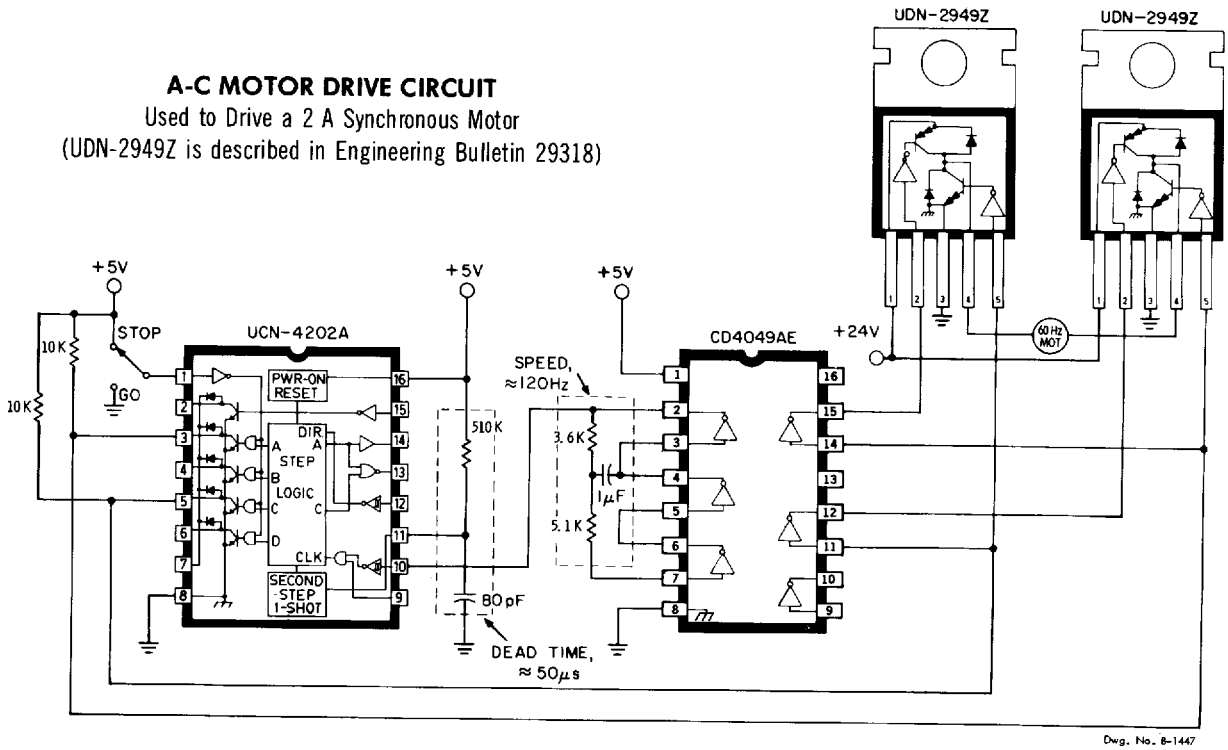
TWO-PHASE BIPOLAR DRIVE CIRCUIT
Used to Drive a 2A Stepper Motor
(UDN-2952W is described in
Engineering Bulletin 29319)



TYPICAL APPLICATIONS (Continued)

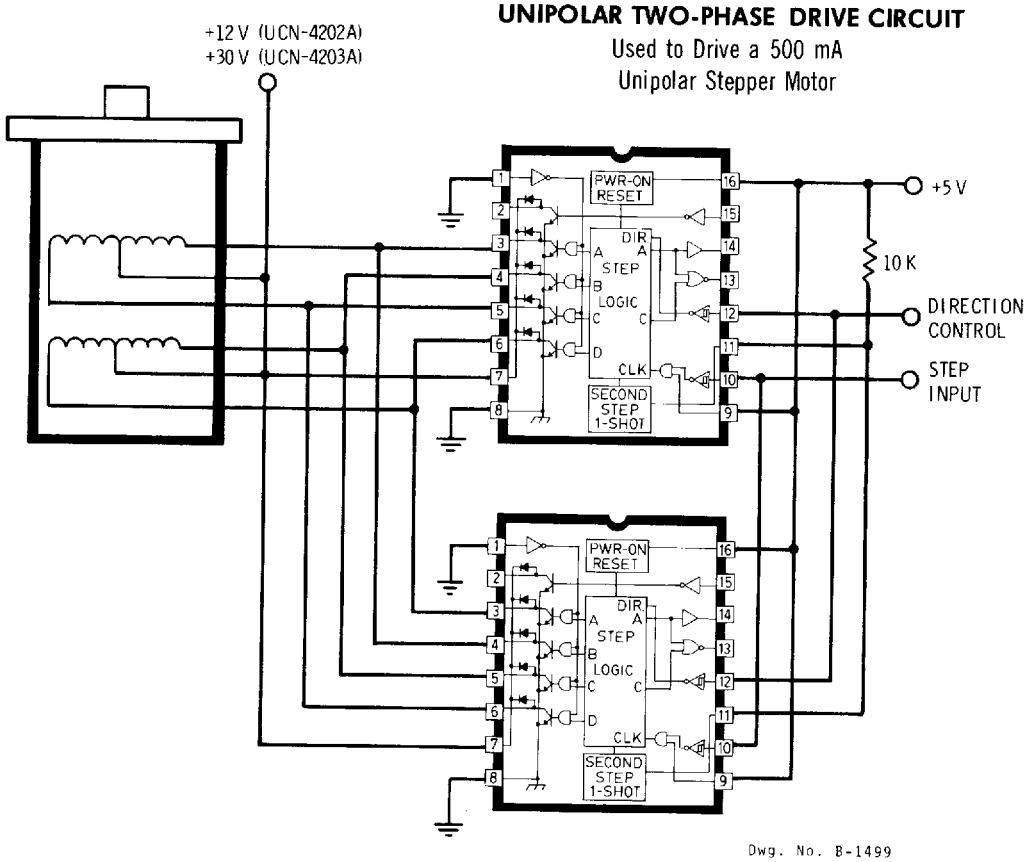
A-C MOTOR DRIVE CIRCUIT

Used to Drive a 2 A Synchronous Motor
(UDN-2949Z is described in Engineering Bulletin 29318)



UNIPOLAR TWO-PHASE DRIVE CIRCUIT

Used to Drive a 500 mA
Unipolar Stepper Motor



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