Low Saturation, Linear Brushless DC Motor Driver

FEATURES

- Total Saturation Voltage of Less Than 1 Volt
- Sink Current Capability of up to 3 Amps
- Quiescent Current Less Than 10mA
- Single Supply 5 Volt Operation
- Motor Voltage of 5 to 40 Volts
- Full Decode for 3 Phase TTL Hall Sensors
- 120 Electrical Degree Logic
- Linear Closed-Loop Motor Current Control

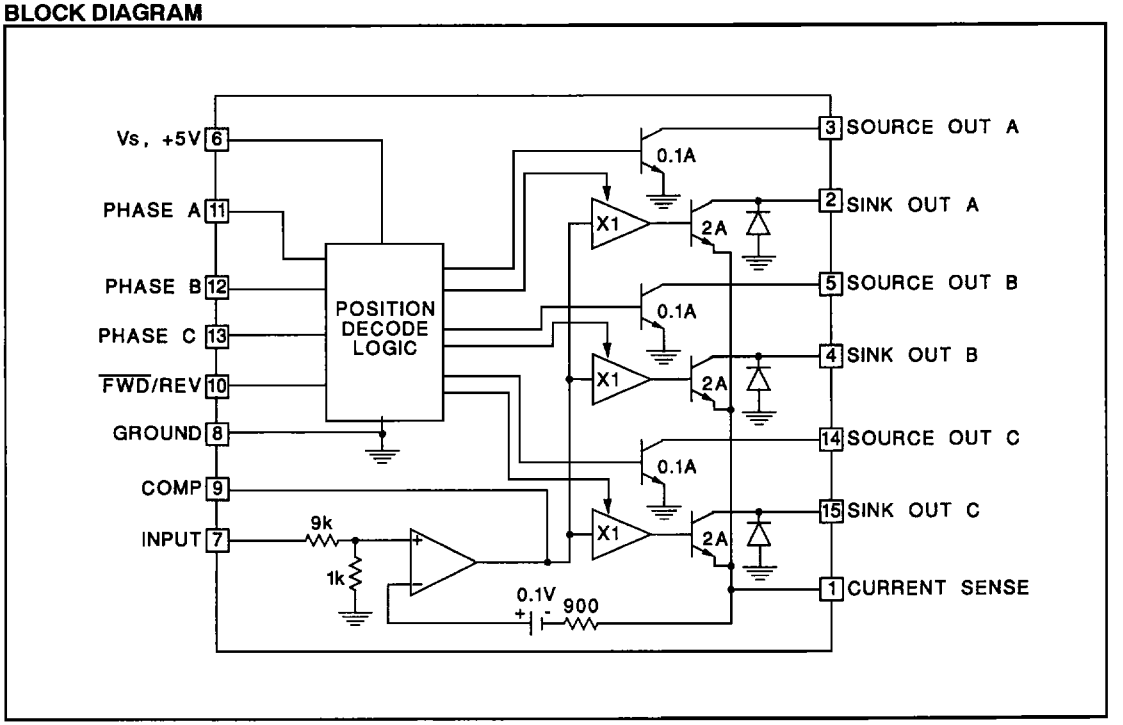
DESCRIPTION

The UC3655 DC motor driver achieves extremely efficient operation by using external PNP transistors selected for low saturation voltage as high side drivers. These are complemented with low side NPN drivers internal to the UC3655 which also have very low saturation losses. The PNP's can be low power devices as they are always switched into saturation by the action of internal 100mA base drivers, while the on-chip NPN's are driven linearly to control motor current. The result is a total source/sink saturation voltage drop of less than 1V at 1A load current.

This controller offers further efficiency by using only a 5V supply with a current requirement proportional to motor current. The quiescent supply current with the outputs off is less than 10mA.

In addition to the power output stages, the UC3655 contains 120 electrical degree hall logic decoding with forward, reverse, and inhibit functions selectable by a single pin. Also included in control amplifier to drive the sink output current linearly response to an input command voltage. Finally, full protection is offered with under-voltage lockout, current limiting, and thermal shutdown. The UC3655 is packaged in both a high-power 15-pin Multiwatt® plastic package and, for low power requirements, a 28-pin PLCC surface mount configuration.

BLOCK DIAGRAM



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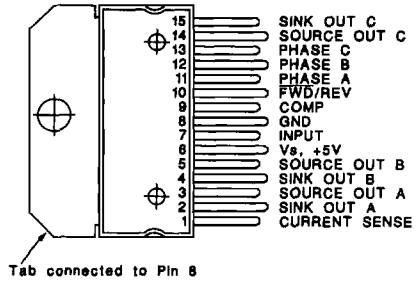
ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage, Vs 7V
Output Voltage, Vc (Source and Sink) 40V
Sink Output Current 3A
Source Drive Current ..... Internally Limited
Logic and Analog Inputs ..... -0.3 to 7V
Total Power Dissipation (At T_{TAB} = 75°C)
V Package 25W
QP Package 4.0W
Storage and Junction Temperature ..... -40°C to 150°C

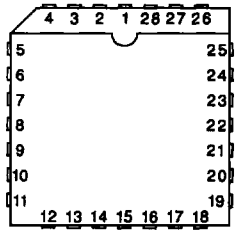
Note 1: All voltages are with respect to ground. Currents are positive into, negative out of the specified terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages.

UC3655V(H)
(TOP VIEW)



CONNECTION DIAGRAMS

PLCC-28
(TOP VIEW)
QP Package



PACKAGE PIN FUNCTIONS	
FUNCTION	PIN
GND	1-2
COMP	3
FWD/REV	4
PHASE A	5
PHASE B	6
PHASE C	7
SOURCE OUT C	8
N/C	9
SINK OUT C	10
N/C	11
GND (HEAT FLOW)	12-18
CURRENT SENSE (SENSE)	19
CURRENT SENSE (FORCE)	20
SINK OUT A	21
SOURCE OUT A	22
N/C	23
SINK OUT B	24
SOURCE OUT B	25
Vs, +5V	26
N/C	27
INPUT	28

ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, these specifications apply for T_A = 0°C to 70°C, Vs = 5.0 Volts and R_{SENSE} = 0.2W, T_A = T_J.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Sink Driver Section					
Collector Leakage	V_C = 40V			500	mA
Saturation Voltage	I_C = 2A, R_S = 0		0.8	1.0	V
	I_C = 1A, R_S = 0		0.4	0.5	V
Coll. Diode V_f	I_f = -1A			2.0	V
Source Driver Section					
Collector Leakage	V_C = 40V			100	mA
Saturation Voltage	I_C = 0.1A		1.9	2.3	V
Current Limit	V_C = 5V, T_A = 25°C	100	175	300	mA
Amplifier Section					
Input Low Voltage	Sink Current = 0A	0.8	1.0	1.2	V
Input High Voltage	Sink Current = 2A	4.5	5.0	5.5	V
Closed Loop Transconductance	Sink Current = 0-2A	0.45	0.5	0.55	S
Control Amp Transconductance	I_{COMP} = æ 50mA		0.2		mS
Voltage Gain to Current Sense	V_{IN} = 2-3V		-20		dB
Input Bias Current	V_{IN} = 5V		0.5	1.0	mA
Comp. Source Current	V_{IN} = 5V, V_{COMP} = .9V	-50	-100	-150	mA
Comp. Sink Current	V_{IN} = 0V, V_{COMP} = .9V	50	100	150	mA
Decoder Section					
High-level Input Voltage	Phase Input	2.2			V
Low-level Input Voltage	Phase Input			0.8	V
High-level Input Current	Phase Input			10	mA
Low-level Input Current	Phase Input	-10			mA

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for T_A = 0°C to 70°C, Vs = 5.0 Volts and R_{SENSE} = 0.2W, T_A = T_J.

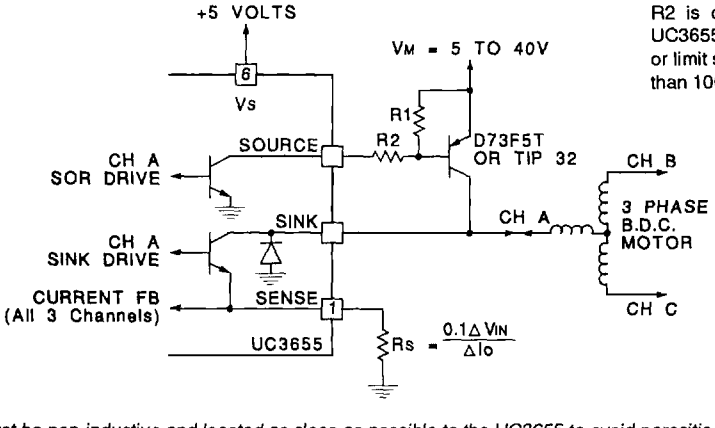
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Decoder Section (cont.)					
Input Voltage to Inhibit	$\overline{FWD}$/REV	1.8		3.2	V
Forward Command Input V	$\overline{FWD}$/REV			0.6	V
Reverse Command Input V	$\overline{FWD}$/REV	4.4			V
Supply Section					
Turn-on Threshold	Vs Low to High	3.5	4.0	4.7	V
Threshold Hysteresis			0.5		V
Supply Current	Outputs Inhibited		6.0	10	mA
Supply Current	Sink Current = 2A		25	100	mA
Thermal Shutdown	Junction Temperature		150		°C
Shutdown Hysteresis	Junction Temperature		15		°C

DECODE LOGIC TRUTH TABLE:

Inhibit	Phase Input			Source Drive			Sink Output			Motor Term		
$\overline{FWD}$/REV	A	B	C	A	B	C	A	B	C	A	B	C
X	0	0	0	Off	Off	Off	Off	Off	Off	0	0	0
X	1	1	1	Off	Off	Off	Off	Off	Off	0	0	0
Inhibit	X	X	X	Off	Off	Off	Off	Off	Off	0	0	0
L	1	0	1	On	Off	Off	Off	On	Off	H	L	0
L	1	0	0	On	Off	Off	Off	Off	On	H	0	L
L	1	1	0	Off	On	Off	Off	Off	On	0	H	L
L	0	1	0	Off	On	Off	On	Off	Off	L	H	0
L	0	1	1	Off	Off	On	On	Off	Off	L	0	H
L	0	0	1	Off	Off	On	Off	On	Off	0	L	H
H	1	0	1	Off	On	Off	On	Off	Off	L	H	0
H	1	0	0	Off	Off	On	On	Off	Off	L	0	H
H	1	1	0	Off	Off	On	Off	On	Off	0	L	H
H	0	1	0	On	Off	Off	Off	On	Off	H	L	0
H	0	1	1	On	Off	Off	Off	Off	On	H	0	L
H	0	0	1	Off	On	Off	Off	Off	On	0	H	L

(Note: X = Don't Care; Inh = 2.5 ±1V; H and L levels defined by applications; Motor Term O = High Impedance).

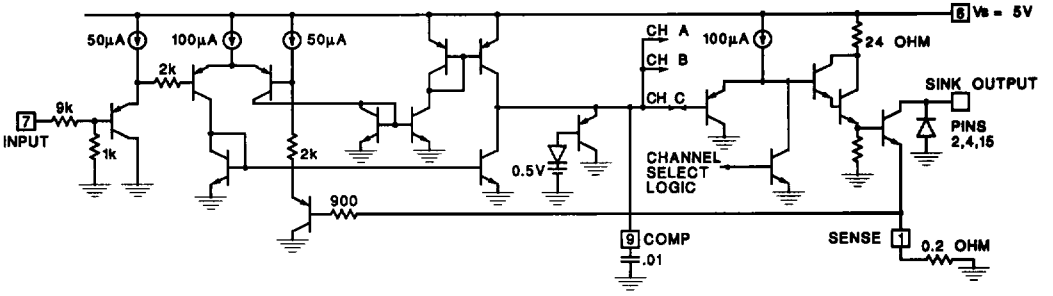
TYPICAL MOTOR DRIVE APPLICATION



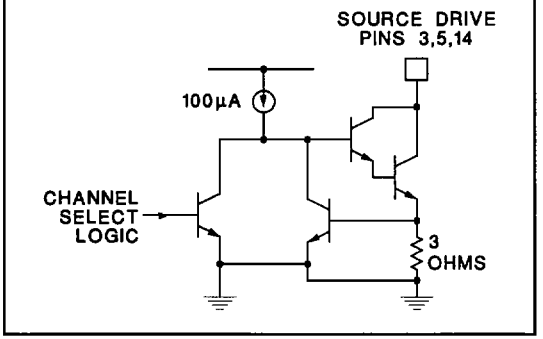
R2 is only used to reduce UC3655 power dissipation or limit source current to less than 100mA

Note: Rs must be non-inductive and located as close as possible to the UC3655 to avoid parasitic oscillations.

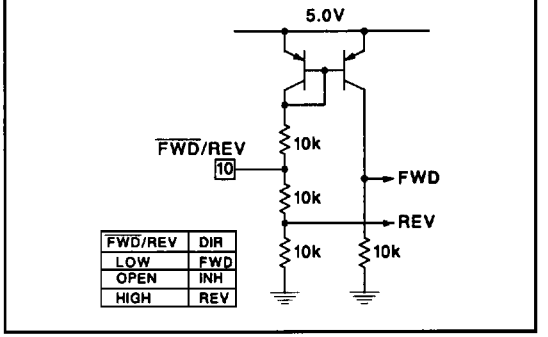
Linear Transconductance Amplifier



Source Drivers

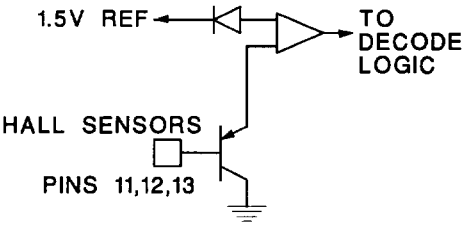


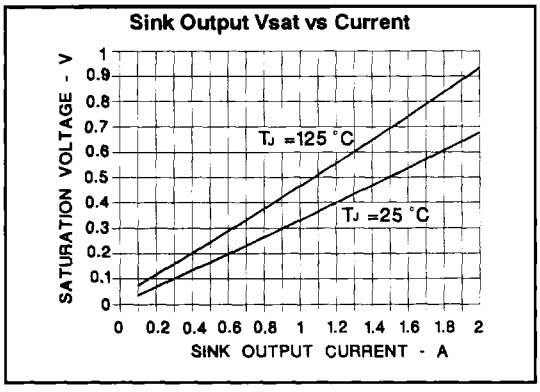
Forward/Reverse Input

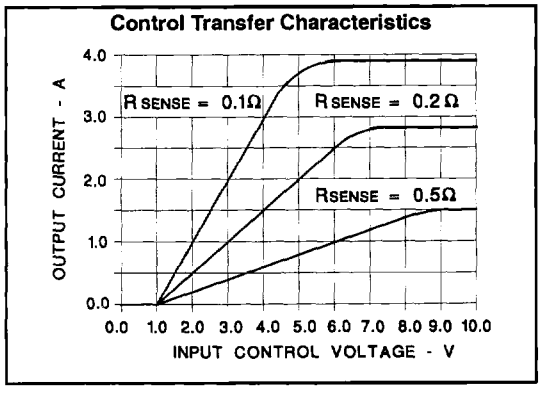


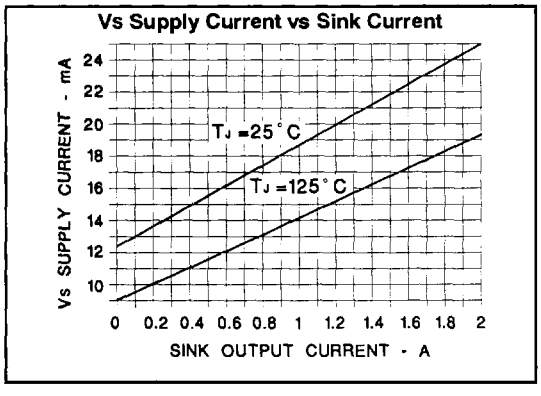
FWD/REV	DIR
LOW	FWD
OPEN	INH
HIGH	REV

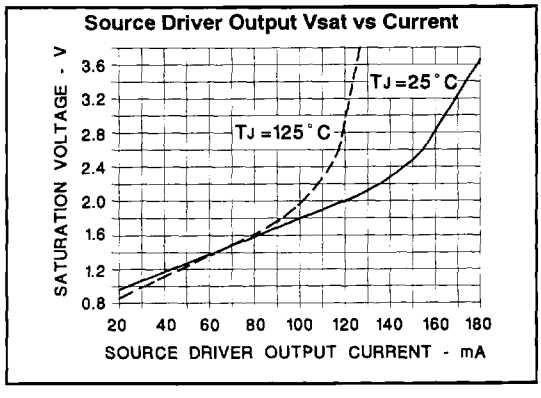
Phase Inputs











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