

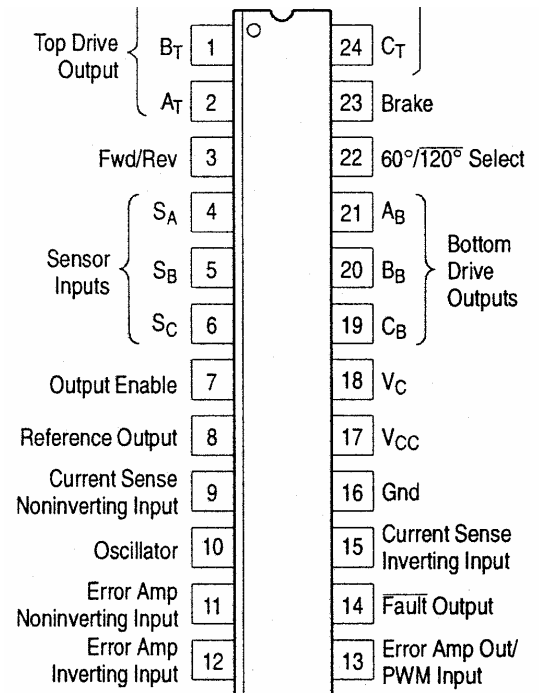
# IL33035

## BRUSHLESS DC MOTOR CONTROLLER

The IL33035 is a high performance second generation monolithic brushless DC motor controller containing all of the active functions required to implement a full featured open loop, three or four phase motor control system. This device consists of a rotor position decoder for proper commutation sequencing, temperature compensated reference capable of supplying sensor power, frequency programmable sawtooth oscillator, three open collector top drivers, and three high current totem pole bottom drivers ideally suited for driving power MOSFETs.

Also included are protective features consisting of undervoltage lockout, cycle-by-cycle current limiting with a selectable time delayed latched shutdown mode, internal thermal shutdown, and a unique fault output that can be interfaced into microprocessor controlled systems.

Typical motor control functions include open loop speed, forward or reverse direction, run enable, and dynamic braking. The MC33035 is designed to operate with electrical sensor phasings of 60°/300° or 120°/240°, and can also efficiently control brush DC motors



### FEATURES

- 10 to 30 V Operation
- Undervoltage Lockout
- 6.25V Reference Capable of Supplying Sensor Power
- Fully Accessible Error Amplifier for Closed Loop Servo Applications
- High Current Drivers Can Control External 3-Phase MOSFET Bridge
- Cycle-By-Cycle Current Limiting
- Pinned-Out Current Sense Reference
- Internal Thermal Shutdown
- Selectable 60°/300° or 120°/240° Sensor Phasings
  - Can Efficiently Control Brush DC Motors with External MOSFET H-Bridge

# IL33035

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Power Supply Voltage	V <sub>CC</sub>	40	V
Digital Inputs (Pins 3, 4, 5, 6, 22, 23)	-	V <sub>ref</sub>	V
Oscillator Input Current (Source or Sink)	I <sub>osc</sub>	30	mA
Error Amp Input Voltage Range (Pins 11, 12, Note 1)	V <sub>IR</sub>	-0.3 to V <sub>ref</sub>	V
Error Amp Output Current (Source or Sink, Note 2)	I <sub>Out</sub>	10	mA
Current Sense Input Voltage Range (Pins 9, 15)	V <sub>Sense</sub>	-0.3 to 5.0	V
Fault Output Voltage	V <sub>CE(Fault)</sub>	20	V
Fault Output Sink Current	I <sub>Sink(Fault)</sub>	20	mA
Top Drive Voltage (Pins 1, 2, 24)	V <sub>CE(top)</sub>	40	V
Top Drive Sink Current (Pins 1, 2, 24)	I <sub>Sink(top)</sub>	50	mA
Bottom Drive Supply Voltage (Pin 18)	V <sub>C</sub>	30	V
Bottom Drive Output Current (Source or Sink, Pins 19, 20, 21)	I <sub>DRV</sub>	100	mA
Power Dissipation and Thermal Characteristics			
DIP package Maximum Power Dissipation T <sub>A</sub> = 85°C Thermal Resistance, Junction-to-Air	P <sub>D</sub> R <sub>θJA</sub>	860 75	mW °C/W
SO Package Maximum Power Dissipation T <sub>A</sub> = 85°C Thermal Resistance, Junction-to-Air	P <sub>D</sub> R <sub>θJA</sub>	650 100	mW °C/W
Operating Junction Temperature	T <sub>J</sub>	150	°C
Operating Ambient Temperature Range	T <sub>A</sub>	-40 to +65	°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +150	°C

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = V<sub>C</sub> = 20 V, R<sub>τ</sub> = 4.7 k, C<sub>τ</sub> = 10 nF, T<sub>A</sub> = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Reference Output Voltage (I <sub>ref</sub> = 1.0 mA) T <sub>A</sub> = 25°C T <sub>A</sub> = -40°C to +85°C	V <sub>ref</sub>	5.9 5.82	6.24 -	6.5 6.57	V
Line Regulation (V <sub>CC</sub> = 10 to 30 V, I <sub>ref</sub> = 1.0 mA)	Reg <sub>line</sub>	-	1.5	30	mV
Load Regulation (I <sub>ref</sub> = 1.0 to 20 mA)	Reg <sub>load</sub>	-	16	30	mV
Output Short Circuit Current (Note 3)	I <sub>sc</sub>	40	75	-	mA
Reference Under Voltage Lockout Threshold	V <sub>th</sub>	4.0	4.5	5.0	V
Input Offset Voltage (T <sub>A</sub> = -40°C to +85°C)	V <sub>IO</sub>	-	0.4	10	mV
Input Offset Current (T <sub>A</sub> = -40°C to +85°C)	I <sub>IO</sub>	-	8.9	500	nA
Input Bias Current (T <sub>A</sub> = -40°C to +85°C)	I <sub>IB</sub>	-	-46	-1000	nA
Input Common Mode Voltage Range	V <sub>ICR</sub>	(OV to V <sup>+</sup> )			V
Open Loop Voltage Gain (V <sub>O</sub> = 3.0 V, R <sub>L</sub> = 15 k)	A <sub>VOL</sub>	70	80	-	dB
Input Common Mode Rejection Ratio	CMRR	55	86	-	dB
Power Supply Rejection Ratio (V <sub>CC</sub> = V <sub>C</sub> = 10 to 30 V)	PSRR	65	105	-	dB

# IL33035

## ELECTRICAL CHARACTERISTICS

(V<sub>cc</sub> = V<sub>c</sub> = 20 V, R<sub>τ</sub> = 4.7 k, C<sub>τ</sub> = 10 nF, T<sub>A</sub> = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage Swing					
High State (R <sub>L</sub> = 15k to Gnd)	V <sub>OH</sub>	4.6	5.3	-	V
Low State (R <sub>L</sub> = 15k to V <sub>ref</sub> )	V <sub>OL</sub>	-	0.5	1.0	
Oscillator Frequency	f <sub>osc</sub>	22	25	28	kHz
Frequency Change with Voltage (V <sub>cc</sub> = 10 to 30 V)	Δfosc/ΔV	-	0.01	5.0	%
Sawtooth Peak Voltage	V <sub>OSC(P)</sub>	-	4.1	4.5	V
Sawtooth Valley Voltage	V <sub>OSC(V)</sub>	1.2	1.5	-	V
Input Threshold Voltage (Pins 3, 4, 5, 6, 7, 22, 23) High State	V <sub>IH</sub>	3.0	2.2	-	V
Low State	V <sub>IL</sub>	-	1.7	0.8	
Sensor Inputs (Pins 4, 5, 6)					
High State Input Current (V <sub>IH</sub> = 5.0 V)	I <sub>IL</sub>	-150	-70	-20	nA
Low State Input Current (V <sub>IL</sub> = 0 V)	I <sub>IL</sub>	-600	-337	-150	
Forward/Reverse, 60°/120° Select (Pins 3, 22, 23) High State Input Current (V <sub>IH</sub> = 5.0 V)	I <sub>IL</sub>	-75	-36	-10	nA
Low State Input Current (V <sub>IL</sub> = 0 V)	I <sub>IL</sub>	-300	-175	-75	
Output Enable High State Input Current (V <sub>IH</sub> = 5.0 V)	I <sub>IH</sub>	-60	-29	-10	μA
Low State Input Current (V <sub>IL</sub> = 0 V)	I <sub>IL</sub>	-60	-29	-10	
Threshold Voltage	V <sub>th</sub>	85	101	115	mV
Input Common Mode Voltage Range	V <sub>ICR</sub>	-	3.0	-	V
Input Bias Current	I <sub>IB</sub>	-	-0.9	-5.0	nA
Top Drive Output Sink Saturation (I <sub>Sink</sub> = 25 mA)	V <sub>CE(SAT)</sub>	-	0.5	1.5	V
Top Drive Output Off-State Leakage (V <sub>CE</sub> = 30 V)	I <sub>DRV(leak)</sub>	-	0.06	100	nA
Top Drive Output Switching Time (C <sub>L</sub> = 47 pF, R <sub>L</sub> = 1.0 k)					
Rise Time	t <sub>r</sub>		107	300	ns
Fall Time	t <sub>f</sub>		26	300	
Bottom Drive Output Voltage					
High State (V <sub>cc</sub> =20V, V <sub>c</sub> = 30 V, I <sub>source</sub> = 50 mA) Low State (V <sub>cc</sub> = 20 V, V <sub>c</sub> = 30 V, I <sub>sink</sub> = 50 mA)	V <sub>OH</sub> V <sub>OL</sub>	(V <sub>cc</sub> -2.0) -	(V <sub>cc</sub> -1.1) 1.5	- 2.0	V
Bottom Drive Output Switching Time (C <sub>L</sub> = 1000 pF)					
Rise Time	t <sub>r</sub>		38	200	ns
Fall Time	t <sub>f</sub>		30	200	
Fault Output Sink Saturation (I <sub>Sink</sub> = 16 mA)	V <sub>CE(sat)</sub>	-	225	500	mV
Fault Output Off-State Leakage (V <sub>CE</sub> = 20 V)	I <sub>FLT(leak)</sub>	-	1.0	100	nA
Under Voltage Lockout				10 0.3	V
Drive Output Enabled (V <sub>cc</sub> or V <sub>c</sub> Increasing) Hysteresis	V <sub>th(on)</sub> V <sub>H</sub>	8.2 0.1	8.9 0.2		
Power Supply Current					
Pin 17 (V <sub>cc</sub> = V <sub>c</sub> = 20 V)	I <sub>CC</sub>	"	12	16	mA
Pin 17 (V <sub>cc</sub> = 20V, V <sub>c</sub> = 30V)			14	20	
Pin 18 (V <sub>cc</sub> = V <sub>c</sub> = 20V)	I <sub>C</sub>		3.5	6.0	
Pin 18 (V <sub>cc</sub> = 20 V, V <sub>c</sub> = 30V)			5.0	10	