Phase Locked Frequency Controller

FEATURES

- Precision Phase Locked Frequency Control System
- Crystal Oscillator
- Programmable Reference Frequency Dividers
- Phase Detector with Absolute Frequency Steering
- Separate Divider Outputs and Phase Detector Input Pins
- Double Edge Option on the Frequency Feedback Sensing Amplifier
- Two High Current Op Amps
- 5V Reference Output

DESCRIPTION

The UC1635 family of integrated circuits was designed for use in precision speed control of DC motors. An extension to the UC1633 line of phase locked controllers, these devices provide access to both of the digital phase detector's inputs, and include a reference frequency divider output pin. With this added flexibility, this family of controllers can be used to obtain phase synchronization of multiple motors.

A reference frequency can be generated using the device's crystal oscillator and programmable dividers. The oscillator operates using a broad range of crystals, or, can function as a buffer stage to an external frequency source.

The phase detector responds proportionally to the phase error between the detector's minus input pin and the sense amplifier output. This phase detector includes absolute frequency steering to provide maximum drive signals when any frequency error exists. This feature allows optimum start-up and lock times to be realized.

Two op-amps are included that can be configured to provide necessary loop filtering. The outputs of these op-amps will source or sink in excess of 16mA, so they can provide a low impedance control signal to driving circuits.

Additional features include a double edge option on the sense amplifier that can be used to double the loop reference frequency for increased loop bandwidths. A 5V reference output can be used to accurately set DC operating levels.
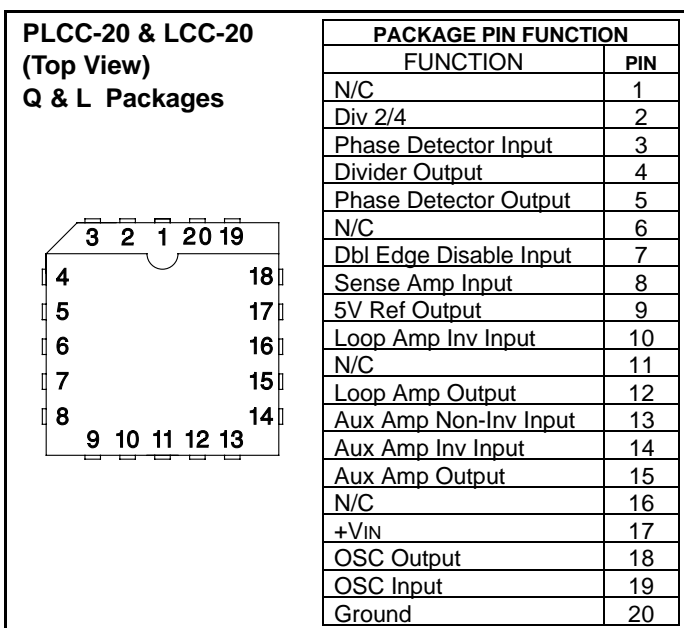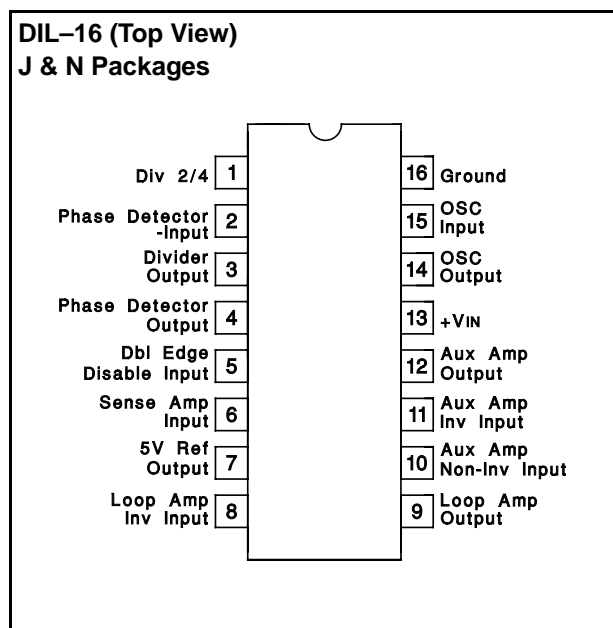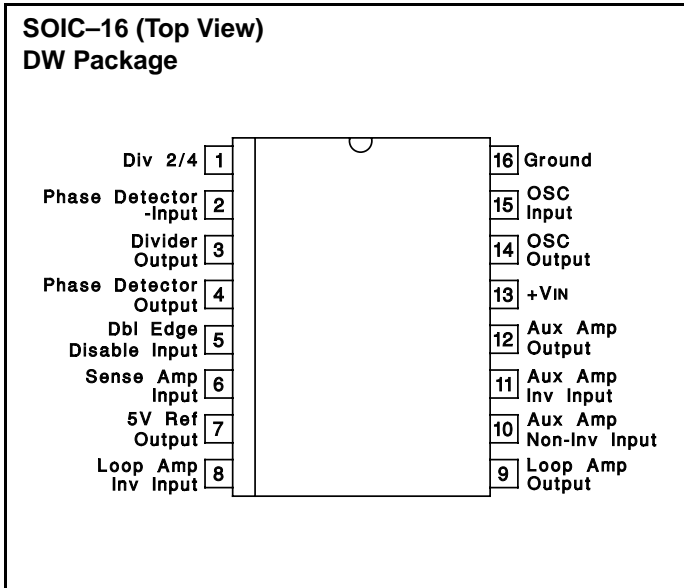
BLOCK DIAGRAM
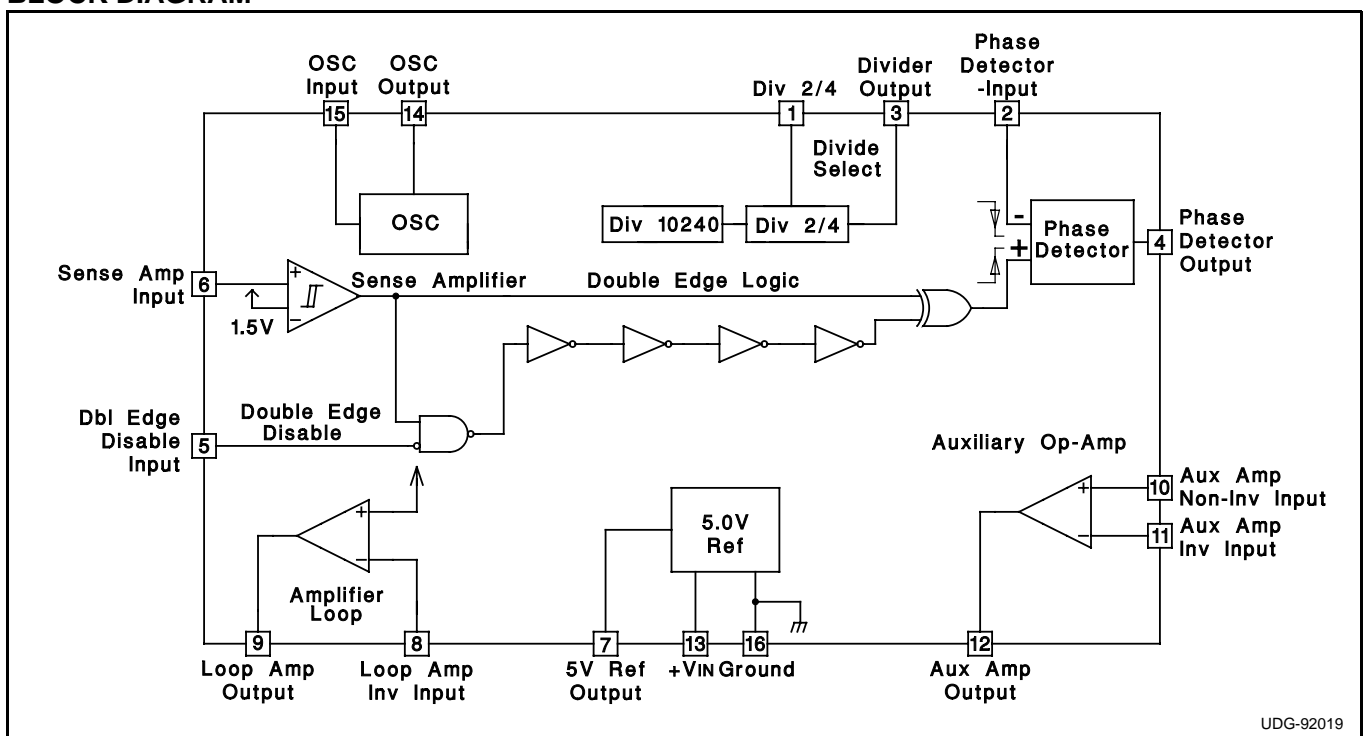
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ABSOLUTE MAXIMUM RATINGS

Input Supply Voltage (+V_{IN}) . . . . +20V
Reference Output Current . . . . -30mA
Op-Amp Output Currents . . . . ±30mA
Op-Amp Input Voltages . . . . -0.3 to +20V
Phase Detector Input Voltage . . . . -0.3V to +5V
Phase Detector Output Current . . . . ±10mA
Lock Indicator Output Current . . . . +15mA
Lock Indicator Output Voltage . . . . +20V
Divide Select Input Voltages . . . . -0.3V to +10V
Double Edge Disable Input Voltage . . . . -0.3V to +10V
Oscillator Input Voltage . . . . -0.3V to +5V
Sense Amplifier Input Voltage . . . . -0.3V to +20V
Power Dissipation at T_A = 25°C, (Note 2) 1000mW
Power Dissipation at T_C = 25°C, (Note 2) 2000mW
Operating Junction Temperature . . . . -55° to 150°C
Storage Temperature . . . . -65° to +150°C
Lead Temperature (Soldering, 10 Seconds) . . . . 300°C

Note 1: Voltages are referenced to ground, (Pin 16). Currents are positive into, negative out of, the specified terminals.
Note 2: Consult Unitrode Integrated Circuits databook for information regarding thermal specifications and limitations of packages.

CONNECTION DIAGRAMS

SOIC–16 (Top View) DW Package

DIL–16 (Top View) J & N Packages

PLCC-20 & LCC-20 (Top View) Q & L Packages

PACKAGE PIN FUNCTION	
FUNCTION	PIN
N/C	1
Div 2/4	2
Phase Detector Input	3
Divider Output	4
Phase Detector Output	5
N/C	6
Dbl Edge Disable Input	7
Sense Amp Input	8
5V Ref Output	9
Loop Amp Inv Input	10
N/C	11
Loop Amp Output	12
Aux Amp Non-Inv Input	13
Aux Amp Inv Input	14
Aux Amp Output	15
N/C	16
+V_{IN}	17
OSC Output	18
OSC Input	19
Ground	20

ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, specifications hold for T_A = 0°C to +70°C for the UC3635, -25°C to +85°C for the UC2635 and -55°C to +125°C for the UC1635, +V_{IN} = 12V. T_A = T_J.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current	+V_{IN} = 15V		20	28	mA
Reference					
Output Voltage (V_{REF})		4.75	5.0	5.25	V
Load Regulation	I_{OUT} = 0 to 7mA		5.0	20	mV
Line Regulation	+V_{IN} = 8 to 15V		2.0	20	mV
Short Circuit Current	V_{OUT} = 0V	15	35		mA

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, specifications hold for T_A = 0°C to +70°C for the UC3635, -25°C to +85°C for the UC2635 and -55°C to +125°C for the UC1635, +Vin = 12V. T_A = T_J.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Oscillator					
DC Voltage Gain	Oscillator Input to Oscillator Output	12	16	20	dB
Input DC Level (VIB)	Oscillator Input Pin Open, T_J = 25°C	1.15	1.3	1.45	V
Input Impedance (Note 2)	V_{IN} = V_{IB} ±0.5V, T_J = 25°C	1.3	1.6	1.9	kΩ
Output DC Level	Oscillator Input Pin Open, T_J = 25°C	1.2	1.4	1.6	V
Maximum Operating Frequency		10			MHz
Dividers					
Maximum Input Frequency	Input = 1Vpp at Oscillator Input	10			MHz
Div 2/4 Input Current	Input = 5V (Div. by 2)		150	500	μA
	Input = 0V (Div. by 4)	-5.0	0.0	5.0	μA
Div 2/4 Threshold		0.5	1.6	2.2	V
Divider Output	High Level (w/6.8k Load to GND)	4.0	4.5		V
	Low Level (Open Collector Leakage)			10	μA
Sense Amplifier					
Threshold Voltage	Percent of V_{REF}	27	30	33	%
Threshold Hysteresis			10		mV
Input Bias Current	Input = 1.5V	-1.0	-0.2		μA
Double Edge Disable Input					
Input Current	Input = 5V (Disabled)		150	500	μA
	Input = 0V (Enabled)	-5.0	0.0	5.0	μA
Threshold Voltage		0.5	1.6	2.2	V
Phase Detector					
-Input Threshold	Detector Responds to Falling Edge	0.5	1.6	2.2	V
-Input Current	Input = 2.2V		100	250	μA
High Output Level	Positive Phase/Freq. Error, Volts Below V_{REF}		0.2	0.5	V
Low Output Level	Negative Phase/Freq. Error		0.2	0.5	V
Mid Output Level	Zero Phase/Freq. Error, Percent of V_{REF}	47	50	53	%
High Level Maximum Source Current	V_{OUT} = 4.3V	2.0	8.0		mA
Low Level Maximum Sink Current	V_{OUT} 0.7V	2.0	5.0		mA
Mid Level Output Impedance (Note 3)	I_{OUT} = -200 to +200μA, T_J = 25°C	4.5	6.0	7.5	kΩ
Loop Amplifier					
Non-Inv Reference Voltage	Percent of V_{REF}	47	50	53	%
Input Bias Current	Input = 2.5V	-0.8	-0.2		μA
AVOL		60	75		dB
PSRR	+V_{IN} = 8 to 15V	70	100		dB
Short Circuit Current	Source, V_{OUT} = 0V	16	35		mA
	Sink, V_{OUT} = 5V	16	30		mA

*Note 3: These impedance levels will vary with T_J at about 1700ppm/°C.*

ELECTRICAL CHARACTERISTICS (cont.): Unless otherwise stated, specifications hold for T_A = 0°C to +70°C for the UC3635, -25°C to +85°C for the UC2635 and -55°C to +125°C for the UC1635, +Vin = 12V. T_A = T_J.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Auxiliary Op-Amp					
Input Offset Voltage	V_{CM} = 2.5V			8	mV
Input Bias Current	V_{CM} = 2.5V	-0.8	-0.2		µA
Input Offset Current	V_{CM} = 2.5V		.01	0.1	µA
AVOL		70	120		dB
PSRR	+V_{IN} = 8 to 15V	70	100		dB
CMRR	V_{CM} = 0 to 10V	70	100		dB
Short Circuit Current	Source, V_{OUT} = 0V	16	35		mA
	Sink, V_{OUT} = 5V	16	30		mA

Application and Operation Information
(For Additional Application Information see the UC1633 Data Sheet)
(Pin numbers refer to DIL and SOIC packages)

Phase Detector Input Detail

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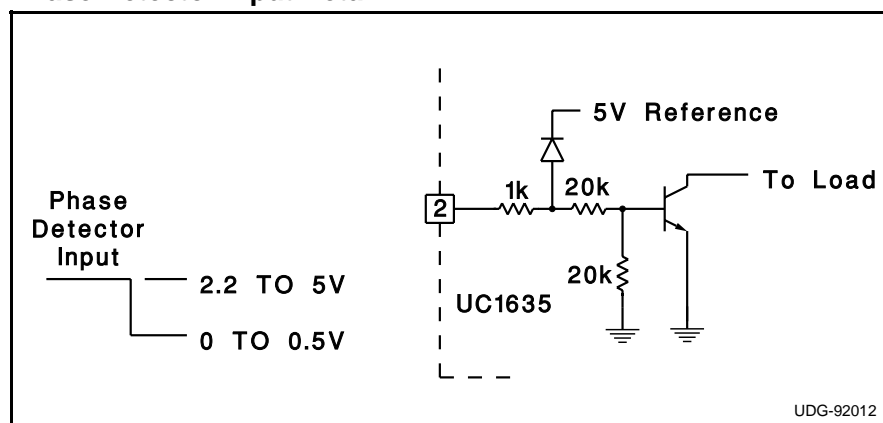
Reference Divider Output Detail

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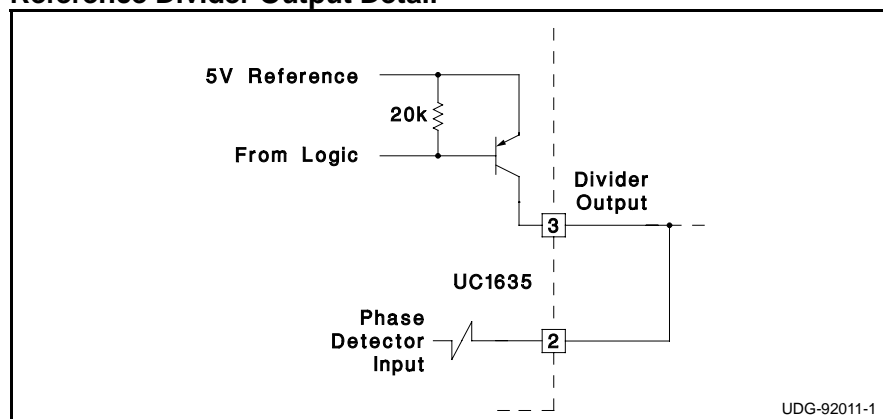
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