

# MC34271

## Liquid Crystal Display and Backlight Integrated Controller

The MC34271 is a low power dual switching voltage regulator, specifically designed for handheld and laptop applications, to provide several regulated output voltages using a minimum of external parts. Two uncommitted switching regulators feature a very low standby bias current of 5.0  $\mu\text{A}$ , and an operating current of 7.0 mA capable of supplying output currents in excess of 200 mA.

Both devices have three additional features. The first is an ELD Output that can be used to drive a backlight or a liquid crystal display. The ELD output frequency is the clock divided by 256. The second feature allows four additional output bias voltages, in specific proportions to  $V_B$ , one of the switching regulated output voltages. It allows use of mixed logic circuitry and provides a voltage bias for N-Channel load control MOSFETs™. The third feature is an Enable input that allows a logic level signal to turn-“off” or turn-“on” both switching regulators.

Due to the low bias current specifications, this device is ideally suited for battery powered computer, consumer, and industrial equipment where an extension of useful battery life is desirable.

### MC34271 Features:

- Low Standby Bias Current of 5.0  $\mu\text{A}$
- Uncommitted Switching Regulators Allow Both Positive and Negative Supply Voltages
- Logic Enable Allows Microprocessor Control of All Outputs
- Synchronizable to External Clock
- Mode Commandable for ELD and LCD Interface
- Frequency Synchronizable
- Auxiliary Output Bias Voltages Enable Load Control via N-Channel FETs

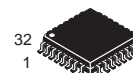
### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Rating	Symbol	Value	Unit
Input Voltage	$V_{DD}$	16	Vdc
Power Dissipation and Thermal Characteristics			
Maximum Power Dissipation – Case 873	$P_D$	1.43	W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	100	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	60	$^\circ\text{C/W}$
Output #1 and #2 Switch Current	$I_{SL}$ & $I_{SB}$	500	mA
Output #1 and #2 “Off”-State Voltage	$V_{SL}$	60	Vdc
Feedback Enable MOSFETs “Off”-State Voltage	$V_{LF}$	20	Vdc
Operating Junction Temperature	$T_J$	125	$^\circ\text{C}$
Operating Ambient Temperature	$T_A$	0 to +70	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-55 to +150	$^\circ\text{C}$



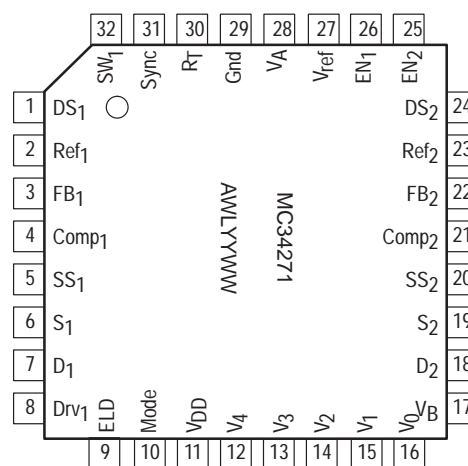
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QFP-32  
FB SUFFIX  
CASE 873

### PIN CONNECTIONS AND MARKING DIAGRAM



(Top View)

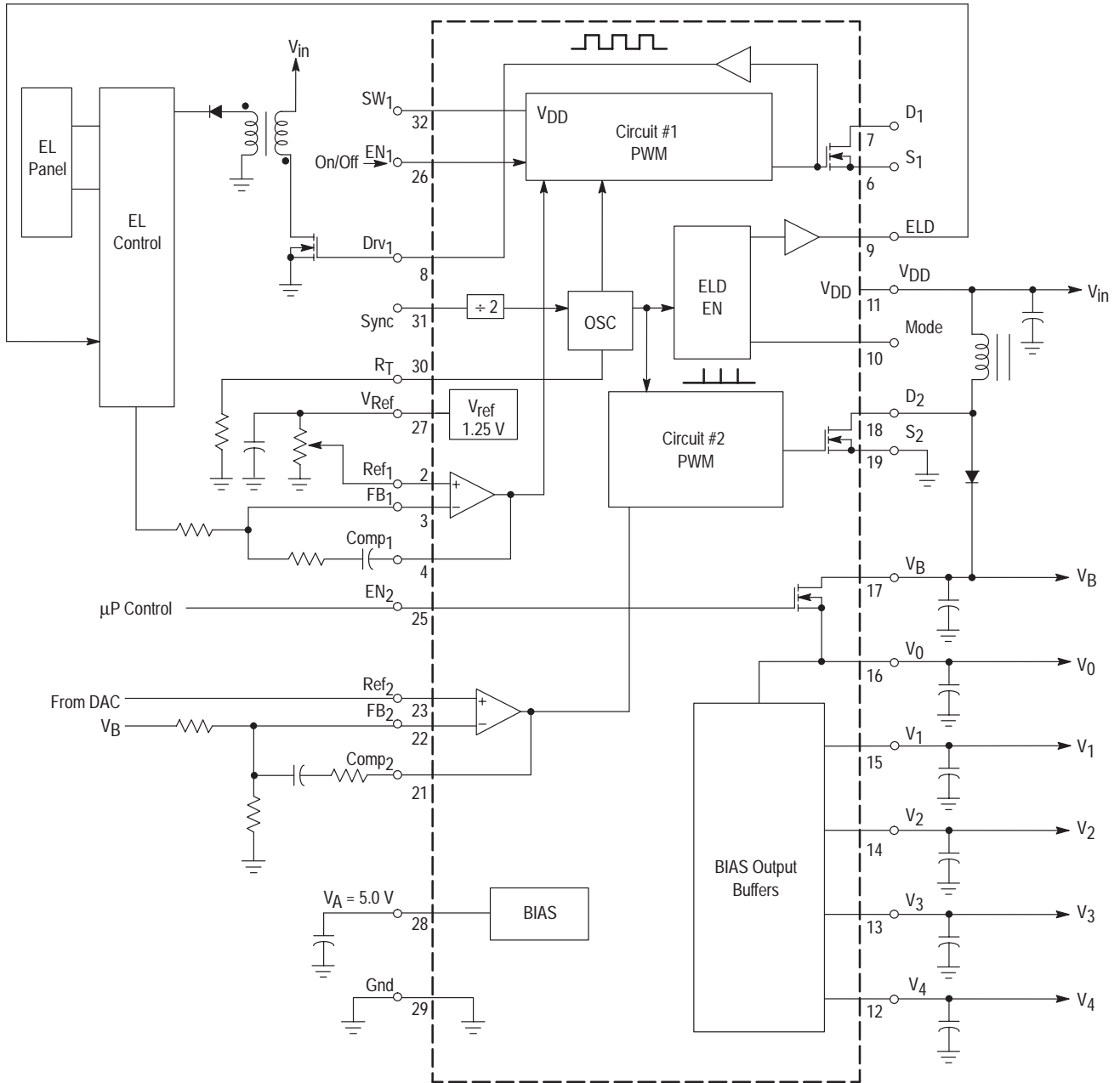
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping
MC34271FB	QFP-32	250 Units / Tray

# MC34271

## Representative Block Diagram



This device contains 350 active transistors.

# MC34271

**ELECTRICAL CHARACTERISTICS** ( $V_{DD} = 6.0\text{ V}$ , for typical values  $T_A = \text{Low to High}$  [Note 1], for min/max values  $T_A$  is the operating ambient temperature range that applies, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
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## REFERENCE SECTION

Reference Voltage ( $T_J = 25^\circ\text{C}$ )	$V_{ref}$	1.225	1.250	1.275	V
Line Regulation ( $V_{DD} = 5.0\text{ V to }12.5\text{ V}$ )	$Reg_{line}$	–	2.0	10	mV
Load Regulation ( $I_O = 0\text{ to }120\text{ }\mu\text{A}$ )	$Reg_{load}$	–	2.0	10	mV
Total Variation (Line, Load and Temperature)	$V_{ref}$	1.215	–	1.285	V

## ERROR AMPLIFIERS

Input Offset Voltage ( $V_{CM} = 1.25\text{ V}$ )	$V_{IO}$	–	1.0	10	mV
Input Bias Current ( $V_{CM} = 1.25\text{ V}$ )	$I_{IB}$	–	120	600	nA
Open Loop Voltage Gain ( $V_{CM} = 1.25\text{ V}$ , $V_{COMP} = 2.0\text{ V}$ )	$A_{VOL}$	80	100	–	dB
Output Voltage Swing High State ( $I_{OH} = -100\text{ }\mu\text{A}$ ) Low State ( $I_{OL} = 100\text{ }\mu\text{A}$ )	$V_{eOH}$ $V_{eOL}$	$V_A - 1.5$ 0	4.0 –	5.5 1.0	V

## BIAS VOLTAGE

Voltage ( $V_{DD} = 5.0\text{ V to }12.5\text{ V}$ , $I_O = 0$ )	$V_A$	4.6	5.0	5.4	V
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## OSCILLATOR AND PWM SECTIONS

Total Frequency Variation Over Line and Temperature $V_{DD} = 5.0\text{ V to }10\text{ V}$ , $T_A = 0^\circ\text{ to }70^\circ\text{C}$ , $R_T = 169\text{ k}$	$f_{OSC}$	90	115	140	kHz
Duty Cycle at Each Output Maximum Minimum	$DC_{max}$ $DC_{min}$	92 –	95 –	– 0	%
Sync Input Input Resistance ( $V_{sync} = 3.5\text{ V}$ ) Minimum Sync Pulse Width	$R_{sync}$ $T_p$	25 –	50 1.0	100 –	k $\Omega$ $\mu\text{s}$

## OUTPUT MOSFETS

Output Voltage – “On”–State ( $I_{sink} = 200\text{ mA}$ )	$V_{OL}$	–	150	250	mV
Output Current – “Off”–State ( $V_{OH} = 40\text{ V}$ )	$I_{OH}$	–	0.1	1.0	$\mu\text{A}$
Rise and Fall Times	$t_r$ , $t_f$	–	50	–	ns

## EL DISCHARGE OUTPUT (ELD) AND DRV<sub>1</sub>

Output Voltage – “On”–State ( $I_{sink} = 100\text{ }\mu\text{A}$ )	$V_{OL}$	–	30	100	mV
Output Voltage – “On”–State ( $I_{sink} = 50\text{ mA}$ )	$V_{OL}$	–	2.0	2.5	V
Output Voltage – “Off”–State ( $I_{source} = -100\text{ }\mu\text{A}$ )	$V_{OH}$	$V_{DD} - 0.5$	5.9	–	V
Output Voltage – “Off”–State ( $I_{source} = -50\text{ mA}$ )	$V_{OH}$	$V_{DD} - 3.5$	3.3	–	V

## FEEDBACK ENABLE SWITCHES (DS<sub>1</sub>, DS<sub>2</sub>)

Output Voltage – “Low”–State ( $I_{sink} = 1.0\text{ mA}$ )	$V_{feOL}$	–	10	100	mV
Output Current – “Off”–State ( $V_{OH} = 12.5\text{ V}$ )	$I_{feOH}$	–	0.6	1.0	$\mu\text{A}$

## SWITCHED $V_{DD}$ OUTPUT (SW<sub>1</sub>)

Output Voltage Switch “On” ( $EN_1 = 1$ , $I_{source} = 100\text{ }\mu\text{A}$ ) Switch “Off” ( $EN_1 = 0$ , $I_{sink} = 100\text{ }\mu\text{A}$ )	$V_{swOH}$ $V_{swOL}$	5.5 0	5.9 0.1	6.0 0.2	V
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## AUXILIARY VOLTAGE OUTPUTS

$V_0$ Enable Switch “On”–Resistance: $V_B$ to $V_0$ “Off”–State Leakage Current ( $V_B = 10\text{ V}$ ) $V_0$ Voltage ( $V_B = 30\text{ V}$ , $I_{source} = 0\text{ mA}$ ) $V_0$ Resistance ( $I_{source} = 4.0\text{ mA}$ )	$R_{ds}$ $I_{lkg}$ $V_0$ $R_0$	0 0 29.5 20	2.0 0.1 29.9 40	10 2.0 30 60	$\Omega$ $\mu\text{A}$ V $\Omega$
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**NOTE:** 1. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

**ELECTRICAL CHARACTERISTICS (continued)** ( $V_{DD} = 6.0\text{ V}$ , for typical values  $T_A = \text{Low to High}$  [Note 1], for min/max values  $T_A$  is the operating ambient temperature range that applies, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>AUXILIARY VOLTAGE OUTPUTS</b>					
$V_1, V_2, V_3, V_4$ Outputs					
1- $V_1/V_0$ Ratio		0.0500	0.0520	0.0535	
1- $V_2/V_0$ Ratio		0.1010	0.1035	0.1065	
$V_3/V_0$ Ratio		0.1010	0.1035	0.1065	
$V_4/V_0$ Ratio		0.0500	0.0520	0.0535	
Output Resistance ( $I_{\text{source}} = 4.0\text{ mA}$ )	$R_O$	20	40	60	$\Omega$
Output Short Circuit Current	$I_{SS}$	5.0	10	20	mA

**LOGIC INPUTS ( $EN_1, EN_2, \text{MODE}$ )**

Input Low State	$V_{IL}$	0	–	0.8	V
Input High State	$V_{IH}$	2.0	–	6.0	V
Input Impedance	$R_{in}$	25	50	100	k $\Omega$

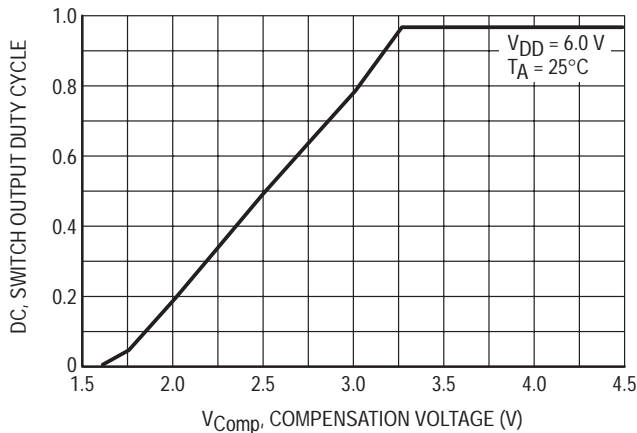
**SOFT START CONTROL ( $SS_1, SS_2$ )**

Charge Current (Capacitor Voltage = 1.0 V to 4.0 V)	$I_{chg}$	0.5	1.0	2.5	$\mu\text{A}$
Discharge Current (Capacitor Voltage = 1.0 V)	$I_{dschg}$	250	650	–	$\mu\text{A}$

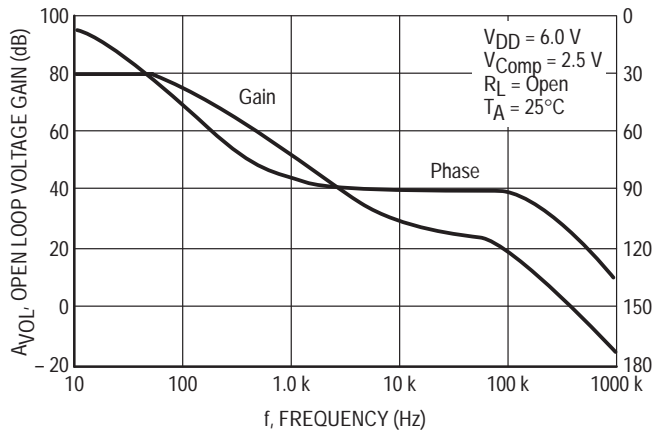
**TOTAL SUPPLY CURRENT**

$V_{DD}$ Current	$V_{DD} = 6.0\text{ V}$	$I_{CC}$	–	2.0	5.0	$\mu\text{A}$
Standby Mode ( $EN_1 = EN_2 = 0$ )	$V_{DD} = 16\text{ V}$		–	3.0	15	
$V_{DD}$ Current		$I_{CC}$	–	0.7	3.0	mA
Backlight "On" ( $EN_1 = 1; EN_2 = 0$ )						
$V_{DD}$ Current		$I_{CC}$	–	0.9	2.0	mA
LCD "On" (No Inductor) ( $EN_1 = 0; EN_2 = 1$ )						
$V_B$ Current ( $V_0 = 35\text{ V}$ )		$I_O$	–	1.2	3.0	mA

**NOTE:** 1. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.



**Figure 1. Switch Output Duty Cycle versus Compensation Voltage**



**Figure 2. Error Amp Open Loop Gain and Phase versus Frequency**

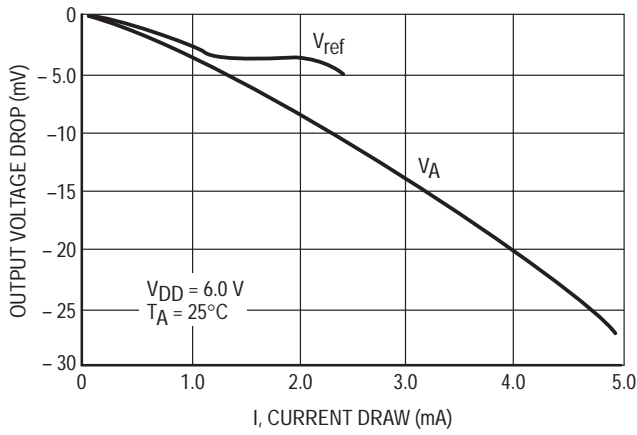


Figure 3. Reference Voltage Change versus Reference Current

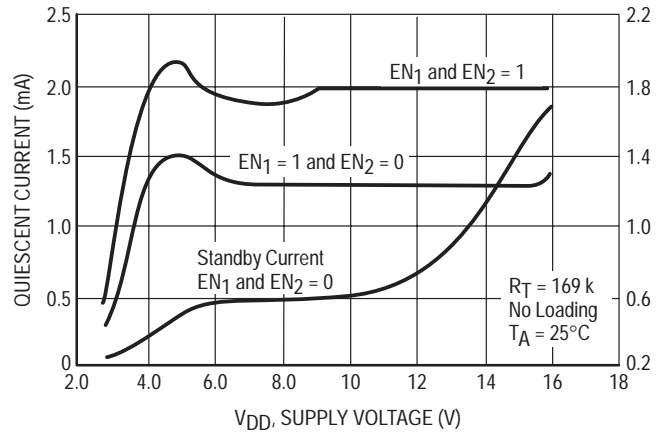


Figure 4. Quiescent Current versus Supply Voltage

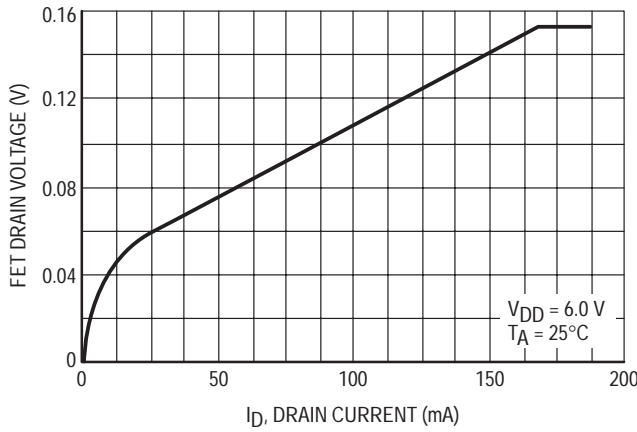


Figure 5. FET Drain Voltage versus Sink Current

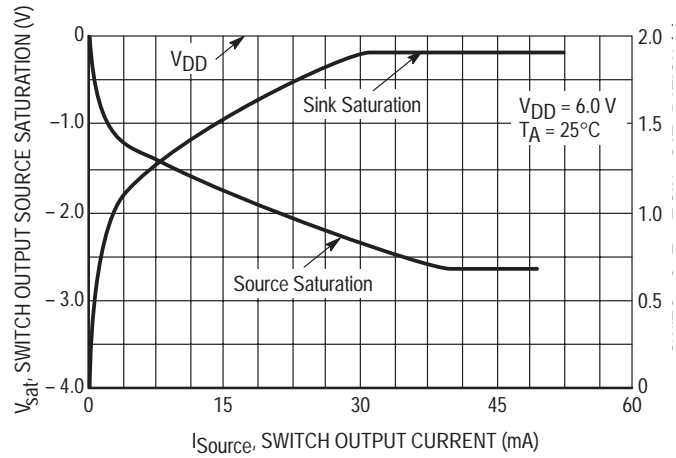


Figure 6. ELD and DRV1 Switch Output Source and Sink Saturation versus Current

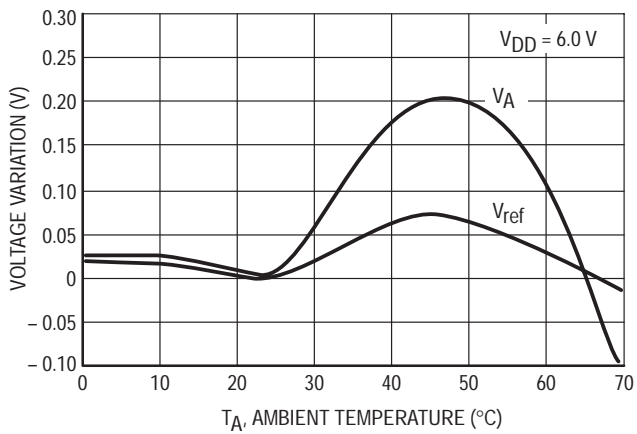


Figure 7.  $V_{ref}$  and  $V_A$  Variation versus Temperature

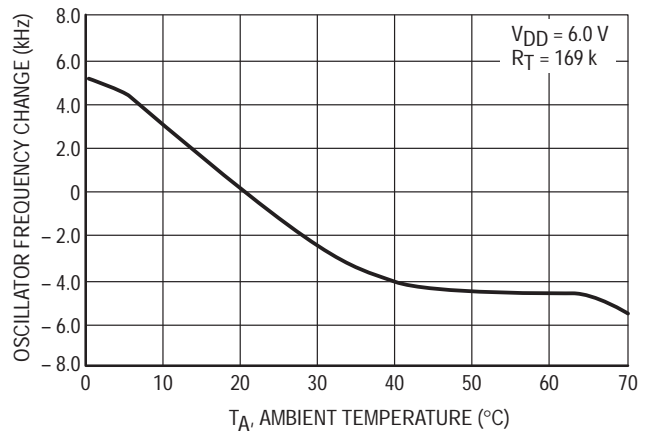


Figure 8. Oscillator Frequency Variation versus Temperature

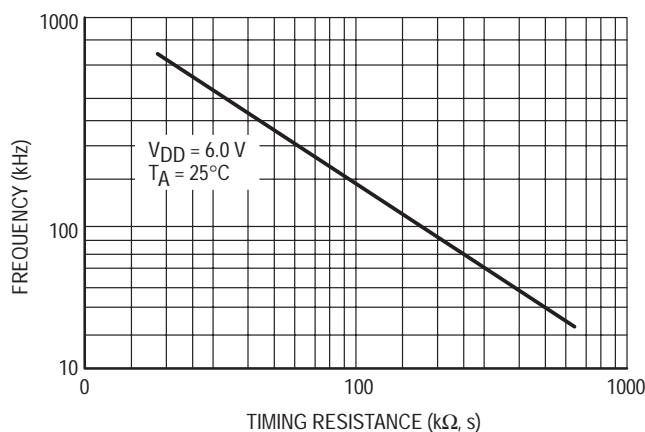
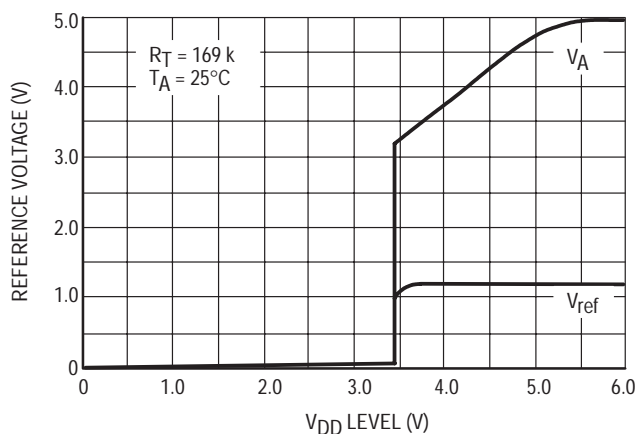


Figure 9. Frequency versus Timing

Figure 10.  $V_A$ ,  $V_{ref}$  versus  $V_{DD}$ 

## OPERATING DESCRIPTION

The MC34271 is a monolithic, fixed frequency power switching regulator specifically designed for dc to dc converter and battery powered applications. This device operates as a fixed frequency, voltage mode regulator containing all the active functions required to directly implement step-up, step-down and voltage inverting converters with a minimum number of external components. Potential markets include battery powered, handheld, automotive, computer, industrial and cost sensitive consumer products. A description of each section is given below with the representative block diagram shown in Figure 11.

### Oscillator

The oscillator frequency is programmed by resistor  $R_T$ . The charge to discharge ratio is controlled to yield a 95% maximum duty cycle at the switch outputs. During the fall time of the internal sawtooth waveform, the oscillator generates an internal blanking pulse that holds the inverting input of the AND gates high, disabling the output switching MOSFETs. The internal sawtooth waveform has a nominal peak voltage of 3.3 V and a valley voltage of 1.7 V.

### Pulse Width Modulators

Both pulse width modulators consist of a comparator with the oscillator ramp voltage applied to the noninverting input, while the error amplifier output is applied to the inverting input. A third input to the comparator has a 0.5 mA typical current source that can be used to implement soft start. Output switch conduction is initiated when the ramp waveform is discharged to the valley voltage. As the ramp voltage increases to a voltage that exceeds the error amplifier output, the latch resets, terminating output MOSFET conduction for the duration of the oscillator ramp. This PWM/latch combination prevents multiple output pulses during a given oscillator cycle.

Each PWM circuit is enabled by a logic input. When disabled, the entire block is turned off, drawing only leakage current from the power source. Shared circuits, like the

reference and oscillator, can be activated by either  $EN_1$  or  $EN_2$ .

Circuit #1 has an ELD output which may be used to drive an LCD or backlight. Its output frequency is the oscillator frequency divided by 1024.

### Error Amplifiers and Reference

Each error amplifier is provided with access to both inverting and noninverting inputs, and the output. The Error Amplifiers' Common Mode Input Range is 0 to 2.5 V. The amplifiers have a minimum dc voltage gain of 60 dB. The 1.25 V reference has an accuracy of  $\pm 4.0\%$  at room temperature.

External loop compensation is required for converter stability. A simple low-pass filter is formed by connecting a resistive divider from the output to the error amplifier inverting input, and a series resistor-capacitor from the error amplifier output also to the inverting input. The step down converter is easiest to compensate for stability. The step-up and voltage inverting configurations, when operated as continuous conduction boost or flyback converters, are more difficult to compensate, and may require a lower loop design bandwidth.

### MOSFET Switch Outputs

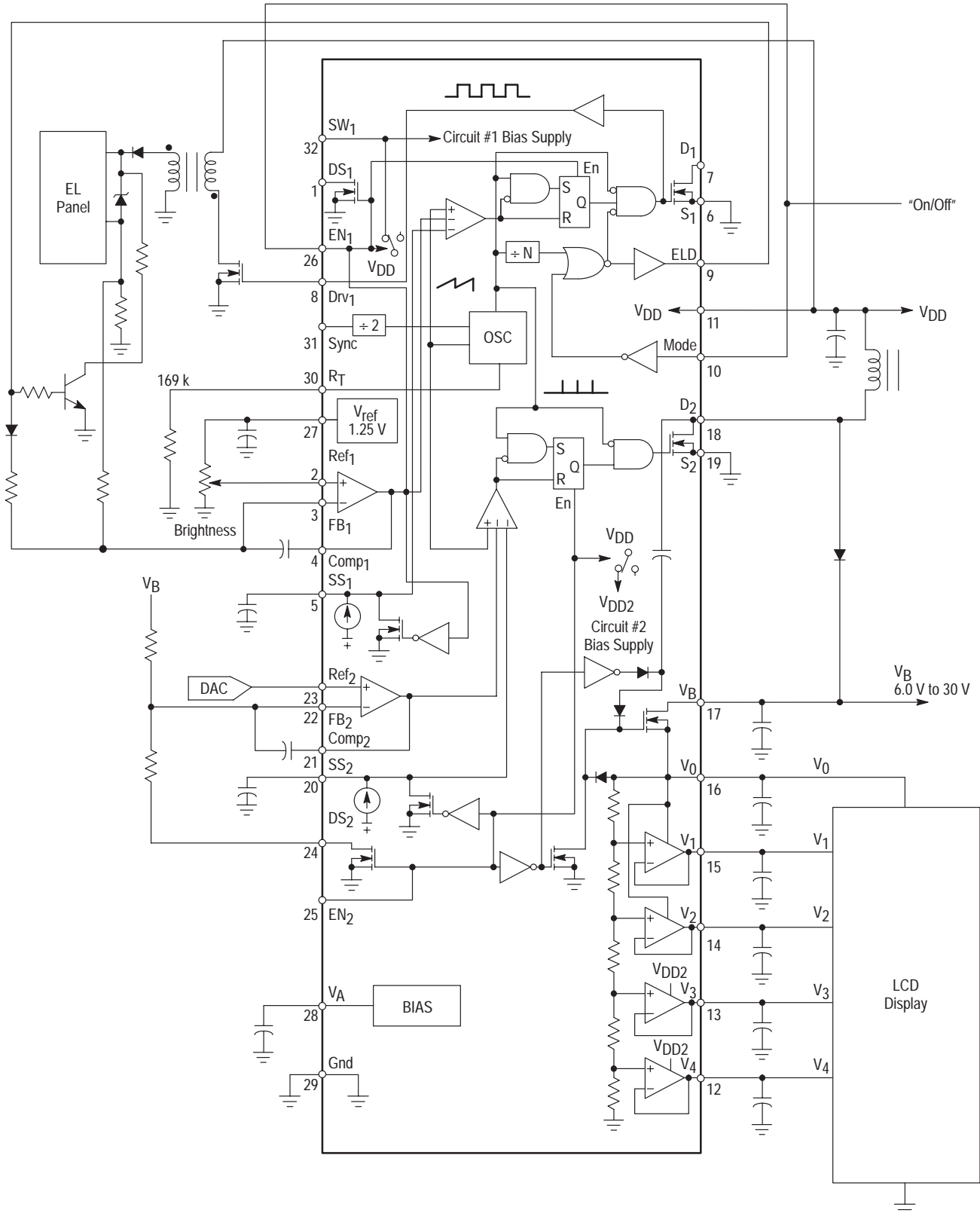
The output MOSFETs are designed to switch a maximum of 60 V, with a peak drain current capability of 500 mA. In circuit #1 an additional  $DRV_1$  output is provided for interfacing with an external MOSFET. The gates of the MOSFETs are held low when the circuit is disabled.

### Auxiliary Output Voltages

Output voltages  $V_0$  through  $V_4$  are provided for use as references or bias voltages.  $V_0$  is the circuit #2 output voltage, when an internal FET switch is activated. The other auxiliary output voltages are proportional to  $V_B$ . The amplifiers for  $V_1$  and  $V_2$  are powered from  $V_0$ , while the amplifiers for  $V_3$  and  $V_4$  are powered from  $V_{DD}$ .

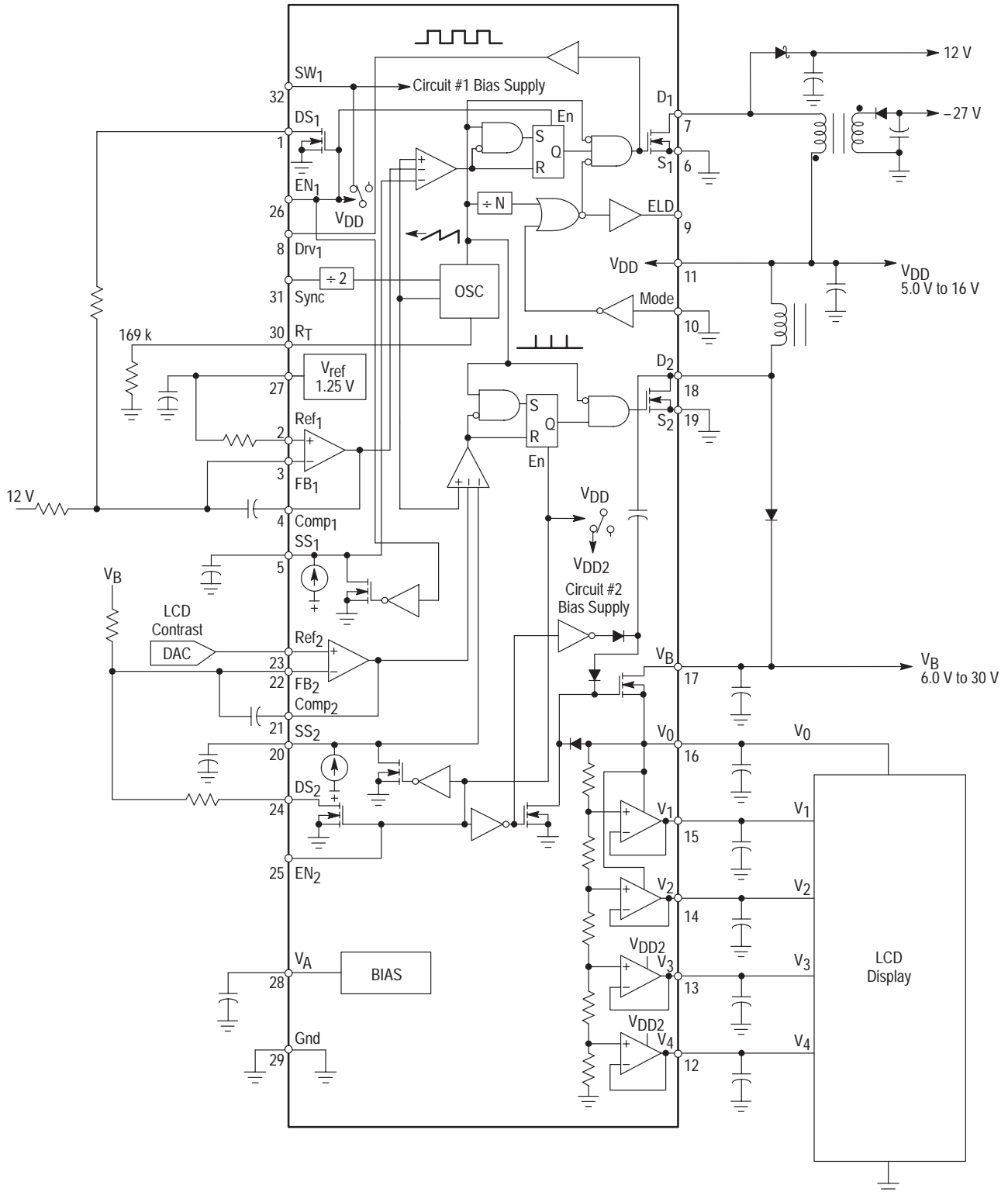
# MC34271

Figure 11. Representative Block Diagram Electroluminescent Backlight Configuration



# MC34271

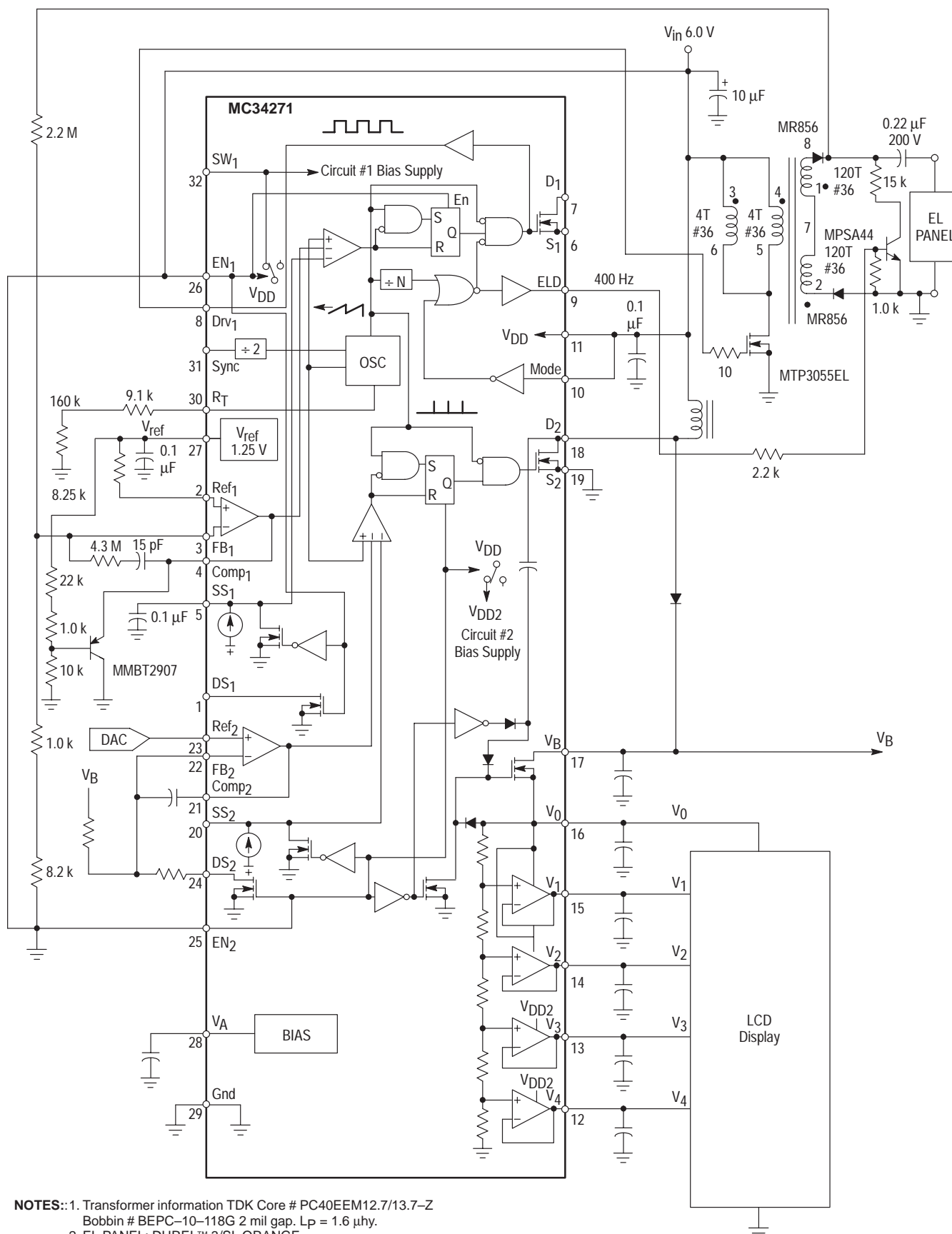
Figure 12. Auxiliary Supply Configuration





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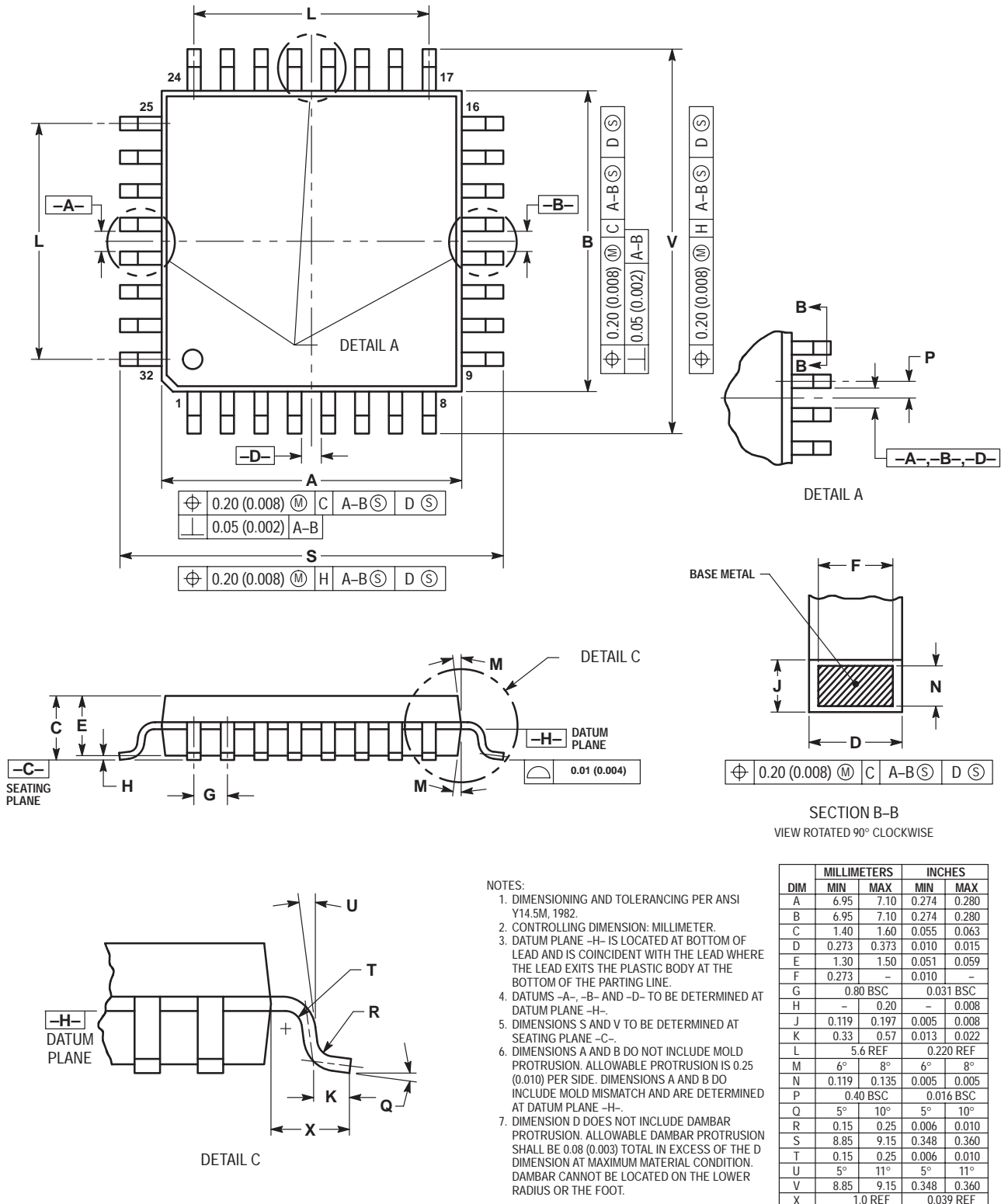
**Figure 13. EL PANEL Drive Circuit**




**NOTES::** 1. Transformer information TDK Core # PC40EEM12.7/13.7-Z  
Bobbin # BEPC-10-118G 2 mil gap. Lp = 1.6 µhy.  
2. EL PANEL: DUREL™ 3/SL ORANGE

## PACKAGE DIMENSIONS

QFP-32  
FB SUFFIX  
CASE 873-01  
ISSUE A



## **Notes**

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