



FAN7313 LCD Backlight Inverter Drive IC

Features

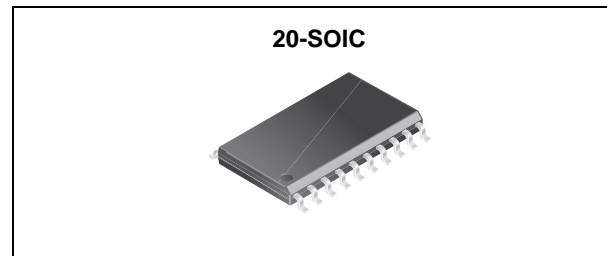
- High-Efficiency Single-Stage Power Conversion
- Wide Input Voltage Range: 4.5V to 25.5V
- Backlight Lamp Ballast and Soft Dimming
- Reduces Required External Components
- Precision Voltage Reference Trimmed to 2%
- Push-Pull Topology
- Soft-Start Capability
- PWM Control at Fixed Frequency
- Analog and Burst Dimming Functions
- Open-Lamp Protection
- Open-Lamp Regulation
- Over-Voltage Protection
- Short-Circuit Protection
- 20-Pin SOIC

Applications

- LCD TV
- LCD Monitor

Description

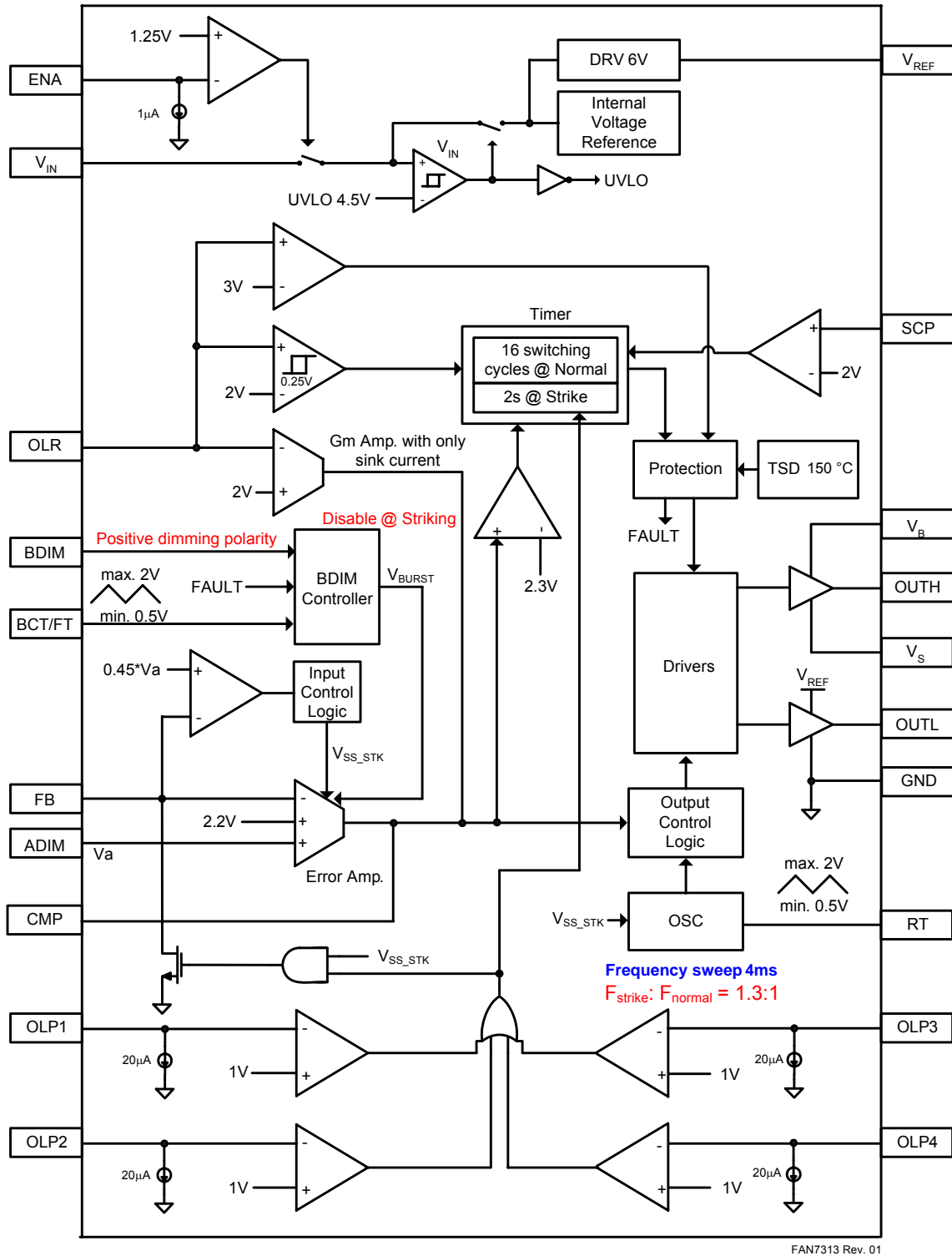
FAN7313 provides all the control functions for a series parallel resonant converter as well as a pulse width modulation (PWM) controller to develop a supply voltage. Typical operating frequency range is between 30kHz and 250kHz, depending on the cold cathode fluorescent lamp (CCFL) and the transformer's characteristics.



Ordering Information

Part Number	Package	Pb-Free	Operating Temperature Range	Packing Method
FAN7313M	20-SOIC	Yes	-25°C ~ 85°C	Rail
FAN7313MX	20-SOIC	Yes		Tape & Reel

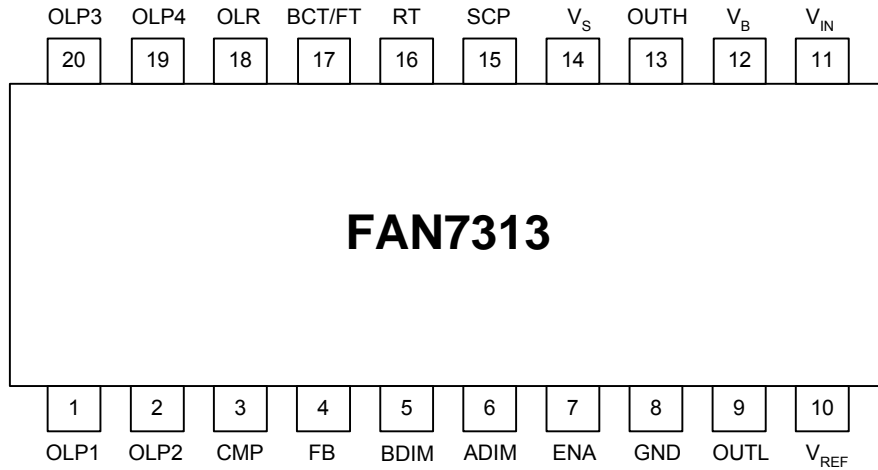
Internal Block Diagram



FAN7313 Rev. 01

Figure 1. Functional Block Diagram of FAN7313

Pin Assignments



FAN7313 Rev. 00

Figure 2. Pin Configuration (Top View)

Pin Definitions

Pin #	Name	Description	Pin #	Name	Description
1	OLP1	Open-Lamp Protection 1	11	V _{IN}	Supply Voltage
2	OLP2	Open-Lamp Protection 2	12	V _B	Connected to V _{REF} Internally
3	CMP	Error Amplifier Output	13	OUTH	High-Side Driver Output
4	FB	Error Amplifier Input	14	V _S	Connected to GND Internally
5	BDIM	Burst Dimming Input	15	SCP	Short-Circuit Protection
6	ADIM	Analog Dimming Input	16	RT	Timing Resistor
7	ENA	Enable Input	17	BCT/FT	Burst Dimming Timing Capacitor/ Fault Signal Output
8	GND	Ground	18	OLR	Open-Lamp Regulation
9	OUTL	Low-Side Driver Output	19	OLP4	Open-Lamp Protection 4
10	V _{REF}	Reference Voltage	20	OLP3	Open-Lamp Protection 3

Absolute Maximum Ratings

The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings.

For typical values, $T_A=25^{\circ}\text{C}$ and $V_{IN}=18\text{V}$. For min./max. values, T_A is the operating ambient temperature range with $-25^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$ and $4.5\text{V} \leq V_{IN} \leq 25.5\text{V}$, unless otherwise specified.

Symbol	Characteristics	Value	Unit
V_{IN}	Supply Voltage	25.5	V
T_A	Operating Temperature Range	-25 ~ 85	$^{\circ}\text{C}$
T_J	Junction Temperature	150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-65 ~ 150	$^{\circ}\text{C}$
θ_{JA}	Thermal Resistance Junction-to-Ambient ⁽¹⁾⁽²⁾	70	$^{\circ}\text{C}/\text{W}$
P_D	Power Dissipation	1.8	W

Notes:

1. Thermal resistance test board size: 76.2 * 114.3 * 1.6mm (1S0P). JEDEC standard: JESD51-2, JESD51-3.
2. Assume no ambient airflow.

Pin Breakdown Voltage

No	Name	Max.	Unit	No	Name	Max.	Unit
1	OLP1	10	V	11	V_{IN}	25.5	V
2	OLP2	10		12	V_B	10	
3	CMP	4		13	OUTH	6	
4	FB	10		14	V_S		
5	BDIM	10		15	SCP	10	
6	ADIM	10		16	RT		
7	ENA	10		17	BCT/FT		
8	GND			18	OLR	10	
9	OUTL	6		19	OLP4	10	
10	V_{REF}	10		20	OLP3	10	

Electrical Characteristics

For typical values, $T_A=25^\circ\text{C}$ and $V_{IN}=18\text{V}$. For min./max. values, T_A is the operating ambient temperature range with $-25^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$ and $4.5\text{V} \leq V_{IN} \leq 18\text{V}$, unless otherwise specified. Specifications to $-25^\circ\text{C} \sim 85^\circ\text{C}$ are guaranteed by design based on final characterization results.

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
REFERENCE SECTION						
V_6	6V Regulation Voltage		5.76	6.00	6.24	V
$V_{6\text{line}}$	6V Line Regulation		0		0.1	V
$V_{6\text{load}}$	6V Load Regulation	$0 < I_L < 10\text{mA}$	0		0.1	V
OSCILLATOR SECTION (MAIN)						
f_{osc}	Oscillation Frequency ⁽⁴⁾	$T_A=25^\circ\text{C}$, $R_T=27\text{k}\Omega$	97.5	100.0	103.7	KHz
		$R_T=27\text{k}\Omega$	96	100	104	KHz
V_{cth}	CT High-Voltage ⁽³⁾			2.0		V
V_{ctl}	CT Low-Voltage ⁽³⁾			0.5		V
f_{str}	Striking Frequency ⁽⁴⁾	$T_A=25^\circ\text{C}$, $R_T=27\text{k}\Omega$	125.7	130	135.6	kHz
		$R_T=27\text{k}\Omega$	124	130	136	KHz
T_{stoff}	Strike-Off Delay Time			4		ms
V_{fbth}	FB Threshold Voltage	ADIM=1	0.35	0.45	0.55	V
OSCILLATOR SECTION (BURST)						
$f_{\text{osc b}}$	Oscillation Frequency	$T_A=25^\circ\text{C}$, BCT/FT=10nF, $R_T=27\text{k}\Omega$	301.6	318	332.5	Hz
		BCT/FT=10nF, $R_T=27\text{k}\Omega$	296	318	340	Hz
V_{bcth}	BCT/FT High-Voltage	BCT/FT=10nF, $R_T=27\text{k}\Omega$	1.9	2.0	2.1	V
V_{bctl}	BCT/FT Low-Voltage	BCT/FT=10nF, $R_T=27\text{k}\Omega$	0.4	0.5	0.6	V
V_{bctff}	BCT/FT Fault-Voltage		3.5	4.0	4.5	V
ERROR AMPLIFIER SECTION						
G_m	Error Amplifier Transconductance ⁽³⁾	ADIM=1~2.2V	100	360	600	μmho
A_v	Error Amplifier Open-Loop Gain ⁽³⁾			59		dB
$V_{2\text{p}2}$	2.2V Regulation Voltage	$T_A=25^\circ\text{C}$, ADIM > 2.2V	2.119	2.150	2.195	V
		ADIM > 2.2V	2.086	2.150	2.215	V
I_{ss}	Soft-Start Current	CMP=2V, FB < 0.45*ADIM	-3.2	-1.7	-1.2	μA
I_{sin}	CMP Sink Current	CMP=1V, ADIM < FB	44	73	100	μA
I_{sur}	CMP Source Current	CMP=1V, $0.45*\text{ADIM} < \text{FB} < \text{ADIM}$	-67	50	-33	μA
G_{molr}	OLR Transconductance ⁽³⁾		300	719	1300	μmho
I_{olr}	Open-Lamp Regulation Current	Striking, OLR=2.5V	60	190	300	μA
		Normal, OLR=2.5V	60	260	400	μA
UNDER-VOLTAGE LOCK OUT SECTION						
V_{th}	Start Threshold Voltage		3.9	4.2	4.5	V
V_{thys}	Start Threshold Voltage Hysteresis		0.20	0.45	0.60	V
I_{st}	Start-up Current	$V_{\text{IN}}=V_{\text{th}}-0.2$	20	55	120	μA
I_{op}	Operating Supply Current	Not switching	0.5	1.5	2.5	mA
I_{sb}	Stand-by Current	ENA=0	60	100	150	μA

Notes:

- These parameters, although guaranteed, are not 100% tested in production.
- These parameters, although guaranteed, are tested in only EDS test.

Electrical Characteristics (Continued)

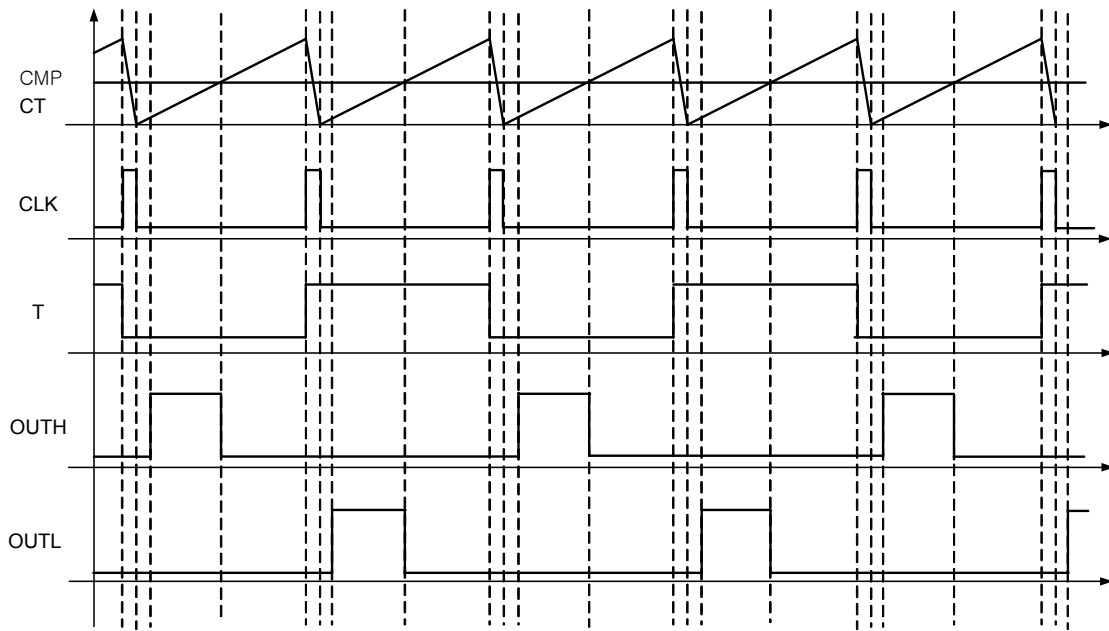
For typical values $T_A=25^\circ\text{C}$ and $V_{IN}=18\text{V}$. For min./max. values, T_A is the operating ambient temperature range with $-25^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$ and $4.5\text{V} \leq V_{IN} \leq 18\text{V}$, unless otherwise specified. Specifications to $-25^\circ\text{C} \sim 85^\circ\text{C}$ are guaranteed by design based on final characterization results.

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
PROTECTION SECTION						
V_{scp}	Short-Circuit Protection Voltage	FB=OLP=2V	1.9	2.0	2.1	V
V_{cmpr}	CMP Protection Voltage		2.1	2.3	2.5	V
V_{olp}	Open-Lamp Protection Voltage		0.95	1.00	1.08	V
V_{ovp}	Over-Voltage Protection		2.85	3.00	3.15	V
V_{olr}	Open-Lamp Regulation Voltage		1.9	2.0	2.1	V
V_{olrhy}	Open-Lamp Regulation Hysteresis ⁽⁵⁾			250		mV
T_{scp}	Short-Circuit Protection Delay	Striking, $F_{osc}=300\text{Hz}$	1.7	2.0	2.3	μsec
		Normal, $F_{osc}=100\text{kHz}$	100	300	500	μsec
T_{cmp}	CMP Protection Delay	Striking, $F_{osc}=300\text{Hz}$	1.7	2.0	2.3	sec
		Normal $F_{osc}=100\text{kHz}$	100	300	500	μsec
T_{olp}	Open-Lamp Protection Delay	$F_{osc}=300\text{Hz}$	1.7	2.0	2.3	sec
T_{olr}	Open-Lamp Regulation Delay	Striking, OLR=2.5V	1.7	2.0	2.3	sec
		Normal, OLR=2.5V	100	300	500	μsec
TSD	Thermal Shutdown			150		$^\circ\text{C}$
ENABLE SECTION						
V_{ena}	Enable State Input Voltage		2		5	V
V_{dis}	Disable State Input Voltage				0.7	V
I_{ena}	Enable Discharge Current		0.2	1.0	4.0	μA
OUTPUT SECTION						
f_{nmo}	Output Normal Frequency ⁽⁶⁾	$V_{FB}=1\text{V}$, $RT=27\text{k}\Omega$	48	50	52	KHz
f_{stro}	Output Striking Frequency ⁽⁶⁾	$V_{FB}=0\text{V}$, $RT=27\text{k}\Omega$	62	65	68	KHz
V_{uvh}	High-Side Output Voltage Before Start-up		-0.5		0.5	V
V_{uvl}	Low-Side Output Voltage Before Start-up		-0.5		0.5	V
V_{enh}	High-Side Output Voltage at $V_{ena}=0\text{V}$		-0.5		0.5	V
V_{enl}	Low-Side Output Voltage at $V_{ena}=0\text{V}$		-0.5		0.5	V
OUTH	High-Side Output Voltage		5.5	6.0	6.5	V
OUTL	Low-Side Output Voltage		5.5	6.0	6.5	V
I_{dsurh}	High-Side Output Drive Source Current ⁽⁵⁾	$V_{IN}=18\text{V}$		530		mA
I_{dsinh}	High-Side Output Drive Sink Current ⁽⁵⁾	$V_{IN}=18\text{V}$		530		mA
I_{dsurl}	Low-Side Output Drive Source Current ⁽⁵⁾	$V_{IN}=18\text{V}$		530		mA
I_{dsinl}	Low-Side Output Drive Sink Current ⁽⁵⁾	$V_{IN}=18\text{V}$		530		mA
t_{rh}	High-Side Output Rising Time ⁽⁵⁾	$V_{IN}=18\text{V}$, $C_{load}=4.7\text{nF}$		100		nsec
t_{fh}	High-Side Output Falling Time ⁽⁵⁾	$V_{IN}=18\text{V}$, $C_{load}=4.7\text{nF}$		100		nsec
t_{rl}	Low-Side Output Rising Time ⁽⁵⁾	$V_{IN}=18\text{V}$, $C_{load}=4.7\text{nF}$		100		nsec
t_{fl}	Low-Side Output Falling Time ⁽⁵⁾	$V_{IN}=18\text{V}$, $C_{load}=4.7\text{nF}$		100		nsec
t_{dead}	Dead Time			430		nsec

Notes:

- These parameters, although guaranteed, are not 100% tested in production.
- Output frequency is half f_{osc} .

Timing Diagram



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Figure 3. Push-Pull PWM Control Waveforms

Typical Application Circuits

Application	Lamps	Input Voltage
19-inch LCD Monitor	4	13V

1. Schematic

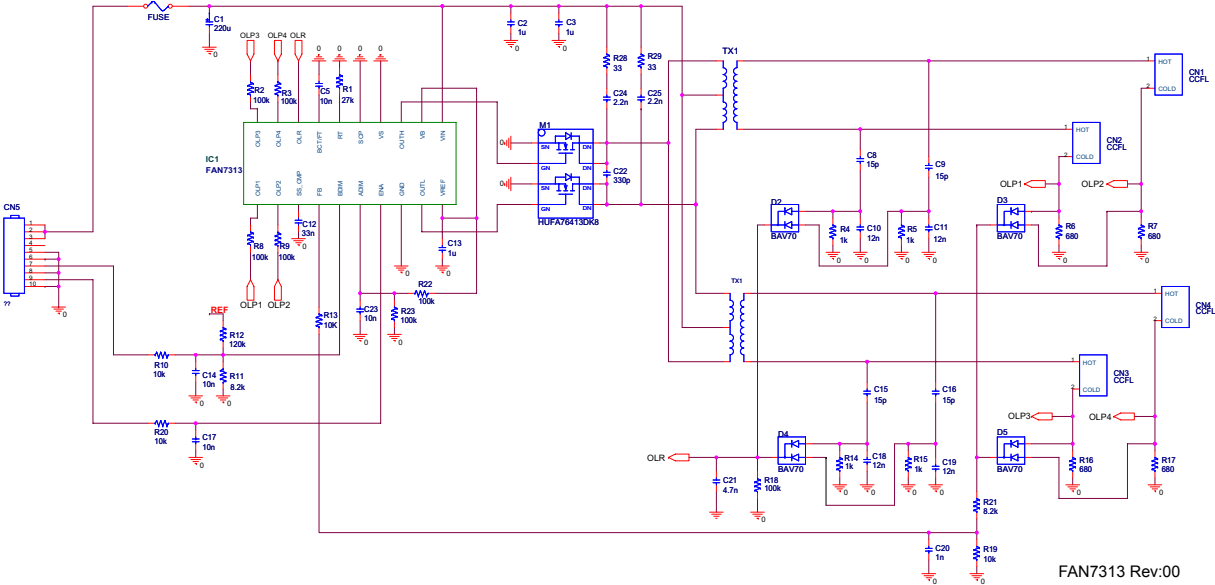


Figure 4. Typical Application Circuit

2. Transformer Schematic Diagram

Supported by Namyang electronics (<http://www.namyangelec.co.kr>).

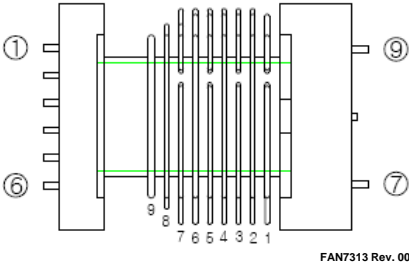


Figure 5. Transformer Schematic

3. Core & Bobbin

- Core: EFD2124
- Material: PL7
- Bobbin: EFE2124

4. Winding Specification

Pin No.	Wire	Turns	Inductance	Leakage Inductance	Remarks
6 --> 4	1 UEW 0.35 φ	19	50μH	1.2μH	1KHz, 1V
3 --> 5	1 UEW 0.35 φ	19	50μH	1.2μH	1KHz, 1V
7 --> 9	1 UEW 0.04 φ	2300	826mH	260mH	1KHz, 1V

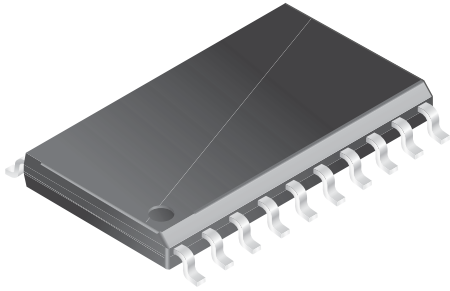
5. BOM of the Application Circuit

Part Ref.	Value	Description / Vendor	Part Ref.	Value	Description / Vendor
Fuse			C10	12nF	50V 1608 K
F1	24V 3A	Fuse	C11	12nF	50V 1608 K
Resistor (SMD)			C12	33nF	50V 1608 K
R1	27k Ω	1608 J	C13	1 μ F	50V 2012 K
R2	100k Ω	1608 F	C14	10nF	50V 1608 K
R3	100k Ω	1608 F	C15	15pF	3KV 3216
R4	1k Ω	1608 F	C16	15pF	3KV 3216
R5	1k Ω	1608 F	C17	10nF	50V 1608 K
R6	680 Ω	1608 F	C18	12nF	50V 1608 K
R7	680 Ω	1608 F	C19	12nF	50V 1608 K
R8	100k Ω	1608 F	C20	1nF	50V 1608 K
R9	100k Ω	1608 F	C21	4.7nF	50V 1608 K
R10	10k Ω	1608 F	C22	330pF	50V 2012 K
R11	8.2k Ω	1608 F	C23	10nF	50V 1608 K
R12	120k Ω	1608 F	C24	2.2nF	50V 2012 K
R13	10k Ω	1608 F	C25	2.2nF	50V 2012 K
R14	1k Ω	1608 F	Diode / TR (SMD)		
R15	1k Ω	1608 F	D2	BAV70	Fairchild
R16	680 Ω	1608 F	D3	BAV70	Fairchild
R17	680 Ω	1608 F	D4	BAV70	Fairchild
R18	100k Ω	1608 J	D5	BAV70	Fairchild
R19	10k Ω	1608 J	Electrolytic Capacitor		
R20	10k Ω	1608 J	C1	220 μ F	25V
R21	8.2k Ω	1608 J	MOSFET (SMD)		
R22	100k Ω	1608 J	M1	HUFA 76413DK8	Fairchild
R23	100k Ω	1608 J	Wafer (SMD)		
R28	33 Ω	3216 J	CN1	35001WR-02A	
R29	33 Ω	3216 J	CN2	35001WR-02A	
Capacitor (SMD)			CN3	35001WR-02A	
C2	1 μ F	50V 2012 K	CN4	35001WR-02A	
C3	1 μ F	50V 2012 K	CN5	12505WR-10	
C5	10nF	50V 1608 K	Transformer (SMD)		
C8	15pF	3KV 3216	TX1	EFD2124	
C9	15pF	3KV 3216	TX2	EFD2124	

Package Dimensions

20-SOIC

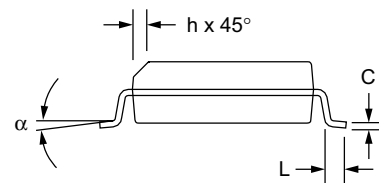
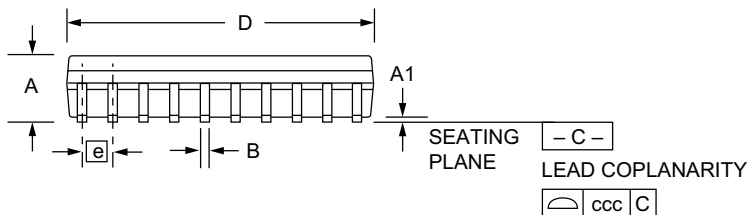
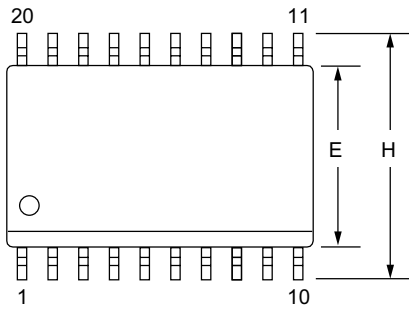
Dimensions are in millimeters unless otherwise noted.



Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.093	.104	2.35	2.65	
A1	.004	.012	0.10	0.30	
B	.013	.020	0.33	0.51	
C	.009	.013	0.23	0.32	5
D	.496	.512	12.60	13.00	2
E	.291	.299	7.40	7.60	2
e	.050 BSC		1.27 BSC		
H	.394	.419	10.00	10.65	
h	.010	.029	0.25	0.75	
L	.016	.050	0.40	1.27	3
N	20		20		6
α	0°	8°	0°	8°	
ccc		.004		0.10	

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. "D" and "E" do not include mold flash. Mold flash or protrusions shall not exceed .010 inch (0.25mm).
3. "L" is the length of terminal for soldering to a substrate.
4. Terminal numbers are shown for reference only.
5. "C" dimension does not include solder finish thickness.
6. Symbol "N" is the maximum number of terminals.



January 2001, Rev. A

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Rev. I20