General Description

The KIC3522F is a single stage primary side regulation (PSR) power factor correction (PFC) controller, specially designed for LED driver.

The Device adopts constant on time operation to achieve high power factor.

The KIC3522F provides accurate constant current control and operates in boundary conduction mode (BCM) with high efficiency.

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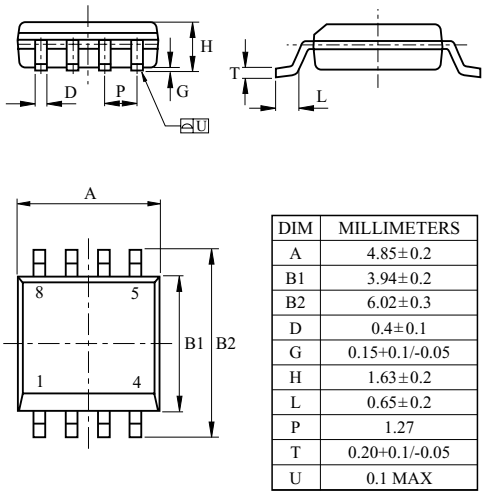
The KIC3522F provides completed protections such as short LED protection, open LED protection and over temperature protection, etc.



DIM	MILLIMETERS
A	4.85±0.2
B1	3.94±0.2
B2	6.02±0.3
D	0.4±0.1
G	0.15+0.1/-0.05
H	1.63±0.2
L	0.65±0.2
P	1.27
T	0.20+0.1/-0.05
U	0.1 MAX

FLP-8

Features

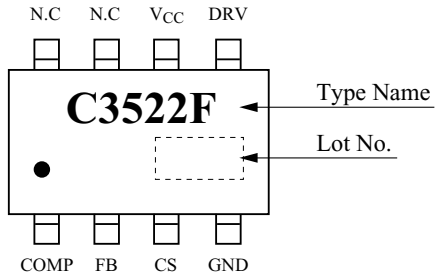
- PSR Flyback topology
- Boundary Conduction Mode
- Low start Current
- Leading edge blanking
- Constant on-time control
- VCC over voltage protection.
- VCC under voltage lockout
- Over temperature protection.
- Cycle by cycle current limiting
- Peak current compensation
- Short LED protection and Open LED protection

Applications

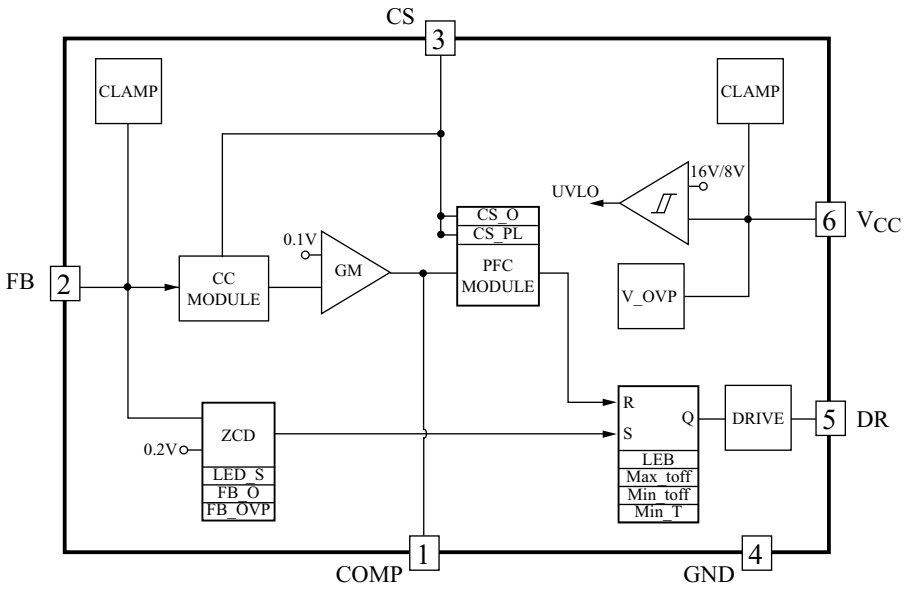
- LED LAMP
- LED illuminance With AC Input

Pin Configurations

(Top View)



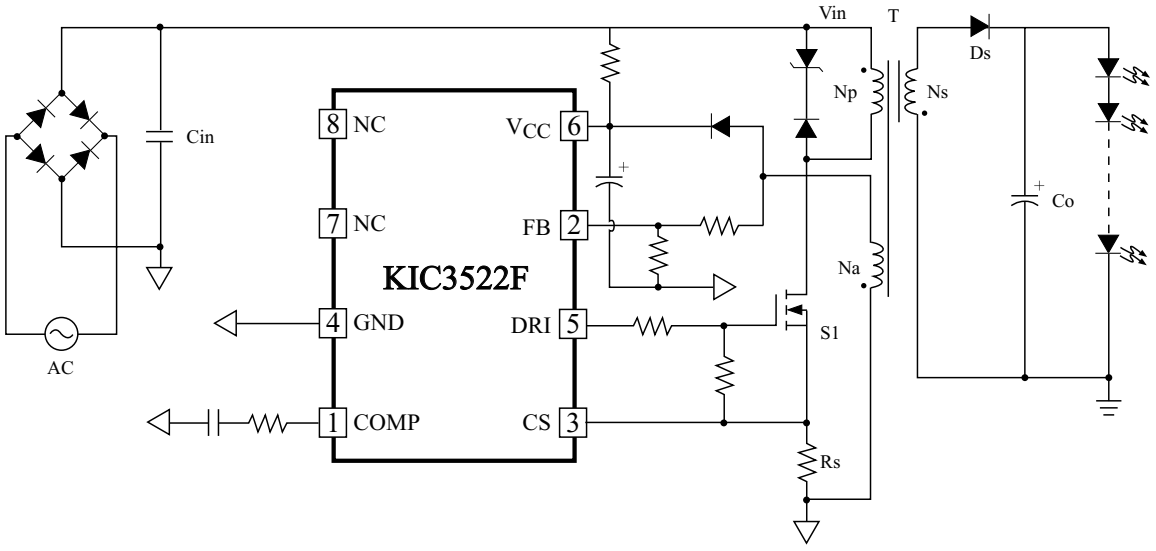
Functional Block Diagram



Pin Description

Pin No.	Function	I/O	Description
1	COMP	I/O	RC loop compensation pin, output of transconductance amplofier
2	FB	I	Feedback voltage input pin
3	CS	I	Current sense pin
4	GND	I/O	Ground
5	DR	O	Drive pin
6	V_{CC}	I/O	Power supply
7	N.C	-	N.C
8	N.C	-	N.C

Typical Application Circuit



Absolute Maximum Ratings

Characteristics	Symbol	Rating	Units
Supply Voltage	V_{CC}	-0.3 ~ 23	V
Analog Pin Voltage	-	-0.3 ~ 5.5	V
Power Dissipation *Note)	P_D	600	mW
Junction Temperature Range	T_j	-40 ~ 150	℃
Storage Temperature Range	T_{stg}	-55 ~ 150	℃

*Note) Dimensions 40mm×40mm (Glass Epoxy (FR-4), Thickness 1.6mm)

Electrical Characteristics (Unless otherwise specified, V_{CC}=18V, T_{amb}=25℃)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage Section						
Operating Voltage	V_{CC}	After IC starts	9	-	18	V
Turn-on threshold	V_{CCON}	-	14.4	16	17.6	V
Turn-off Voltage	V_{CCOFF}	-	6.9	8.0	9.1	V
Clamp Voltage	V_Z	I_{CC} = 20mA	-	27	-	V
V_{CC} Over Voltage Threshold	V_{CC_OVP}	-	21.4	23	24.6	V
Start-up Current	I_{START}	V_{CC} = 15V	0	3	10	μA
Operating current	I_{OP}	-	300	500	800	μA
FB Feedback Section						
OVP Threshold Value	V_{FBOVP}	-	1.38	1.46	1.54	V
Short-circuit Detect Voltage	V_{SHT}	-	0.24	0.29	0.34	V
Short-circuit Detect timing	T_{SHT}	After 768 switching periods	-	768	-	-
Zero-crossing detection	V_{ZCS}	-	0.17	0.2	0.23	V
FB open loop switching times	N	-	-	768	-	-
Dynamitic Characteristic Section						
Leading-edge Blanking Time	T_{LEB}	-	0.6	0.75	0.9	μS
Max. On Time	T_{ONmax}	COMP connected to 4V via 20k Ω	24	33	42	μS
Max. Off Time	T_{OFFmax}	-	25	34	43	μS
Min. Off Time	T_{OFFmin}	-	3.2	4.2	5.2	μS
Min. Period	T_{min}	-	6.3	8.3	10.3	μS
Current Limit Section						
CS Peak Limit	V_{CSPL}	-	0.49	0.60	0.71	V
Gm amplifier Section						
CS CC Compare Point	V_{CSCC}	-	0.097	0.100	0.103	V

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Drive Section						
DR Rising Time	T_R	C=1nF	100	200	400	ns
DR Falling Time	T_F	C=1nF	40	60	80	ns
DR High Clamp Voltage	V_{DRC}	-	16	17.5	19	V
Peak Drive Source Current	I_{SRCPK}	C=1nF	0.2	-	-	A
Peak Drive Sink Current	I_{SNKPK}	C=1nF	0.7	-	-	A
DR High Level	V_{DRH}	I_{SOURCE}=25mA	14	15.6	-	V
DR Low Level	V_{DRL}	I_{SINK}=20mA	-	0.3	0.5	V
OTP (Over Temperature Protection) Section						
OTP Temperature Detection	T_{SD}	-	-	150	-	℃
OTP Temperature Hysteresis	T_{sdhys}	-	-	20	-	℃

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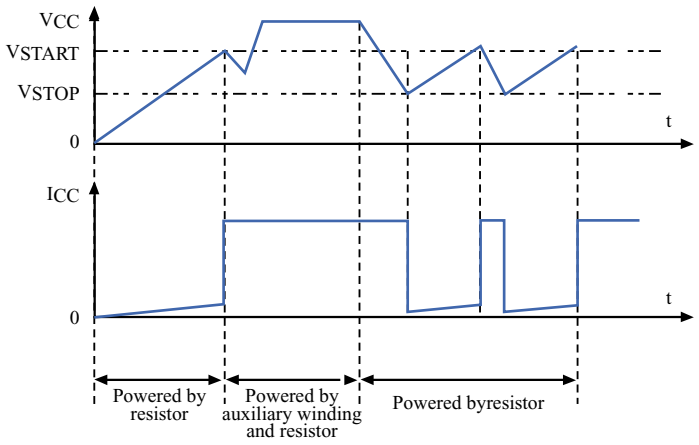
The KIC3522F provides completed protections such as short LED protection, open LED protection and over temperature protection, etc.

1. Start-up and under voltage lockout

After AC supply is powered on, the capacitor connected to pin VCC is charged by AC supply through a start resistor. Once VCC voltage rises up to 16V, the circuit starts to work. VCC voltage will be pulled down by internal consumption of IC until the auxiliary winding of Flyback transformer could supply enough energy to maintain VCC voltage above 8V. If the protection occurs, the output of circuit is off, VCC voltage starts to decrease. If VCC voltage is decreased to 8V, the capacitor connected to pin VCC is recharged through start resistor.



2. Drive Circuit

Drive circuit is power by V_{CC}. When DR＝1, MOSFET is on; When DR＝0, MOSFET is off. T_{LEB}＝0.75 μs is set to avoid the burr which will cause error at the turn-on transient of MOSFET.

3. Peak current detection and sense

When MOSFET is on, the primary current, which is detected by sense resistor, increases linearly. If this current exceeds the threshold value 0.6V, the current limit comparator acts to turn off MOSFET and DR＝0.

When it is normal, primary peak current is I_{pk}, and the secondary diode on time detected at FB is T_{off1}, hence, the output current is given by:

$$I_{OUT} = 0.5 \cdot n \cdot I_{PK} \cdot T_{OFF1}/T$$

Where, n is the primary/secondary turns ratio. $I_{PK} \cdot T_{OFF1}/T$ is calculated in integral mode, and $I_{PK} \cdot T_{OFF1}/T=V_{CSCC}/R_{SEN}$ is realized through loop control. Where, Rsen is the sense resistor. That is,

$$I_{OUT} = 0.5 \cdot n \cdot V_{CSCC}/R_{SEN}$$

The output of error amplifier COMP is used for switch on control. When the on time is up, DR＝0, MOSFET is off.

4. Boundary Conduction Mode

The pin FB detects the voltage across the auxiliary winding by a resistor divider. When the secondary current turns to zero, FB voltage starts to decrease. If FB voltage is decreased to 0.2V, the MOSFET would be turned on.

5. VCC over voltage protection and Open LED protection

The output voltage is reflected by the auxiliary winding voltage of the Flyback transformer, and both pin FB and pin VCC provide over voltage protection function. When VCC voltage exceeds 23V, or FB voltage exceeds 1.46V, the over voltage protection is triggered and the IC will discharge, VCC voltage start to decrease. If VCC voltage is decreased to 8V, the capacitor connected to pin VCC is recharged through start resistor. If the over voltage condition still exists, the system will operate in hiccup mode.

6. Over Temperature Protection

If the circuit is over temperature, the output is shut down to prevent the circuit from damage. The over temperature protection has the hysteresis characteristic. The temperature should be decreased lower than the threshold temperature by 20 ℃ for normal operation. This is adopted to avoid frequently change between normal and protection modes.

7. LEB Short-circuit protection

When LED is short-circuit and held for 768 periods, the protection acts and the circuit restarts after the protection.