SC1271K
InnoSwitch Family

Off-Line CV/CC Flyback Switcher IC with Integrated MOSFET, Synchronous Rectification and Feedback

Product Highlights

Highly Integrated, Compact Footprint
- Incorporates flyback controller, 725 V MOSFET, secondary-side sensing and synchronous rectification driver
- Integrated FluxLink™, HIPOT-isolated, feedback link
- Exceptional CV/CC accuracy, independent of transformer design or external components
- Instantaneous transient response ±5% CV with 0%-100%-0% load step

EcoSmart™– Energy Efficient
- <10 mW no-load at 230 VAC when supplied by transformer bias winding
- Easily meets all global energy efficiency regulations
- Low heat dissipation

Advanced Protection / Safety Features
- Primary sensed output OVP
- Secondary sensed output overshoot clamp
- Secondary sensed output OCP to zero output voltage
- Hysteretic thermal shutdown

Full Safety and Regulatory Compliance
- 100% production HIPOT compliance testing at 6 kV DC/1 sec
- Reinforced insulation
- Isolation voltage >3,500 VAC
- UL1577 and TUV (EN60950) safety approved
- EN61000-4-8 (100 A/m) and EN61000-4-9 (1000 A/m) compliant

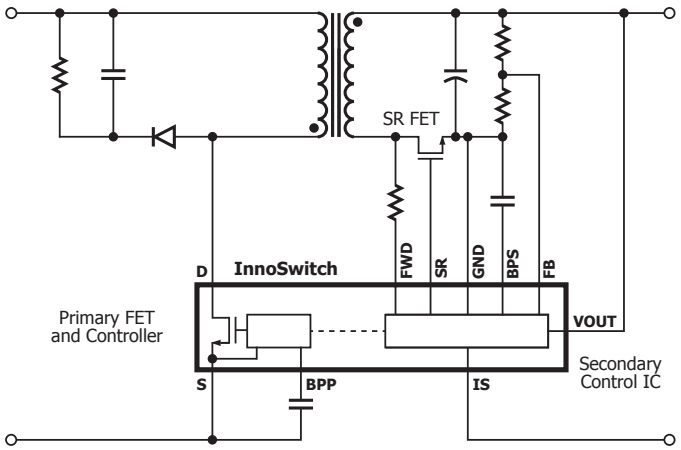
Green Package
- Halogen free and RoHS compliant

Applications
- Chargers and adapters for smart mobile devices
- High efficiency, low voltage, high current power supplies

Description

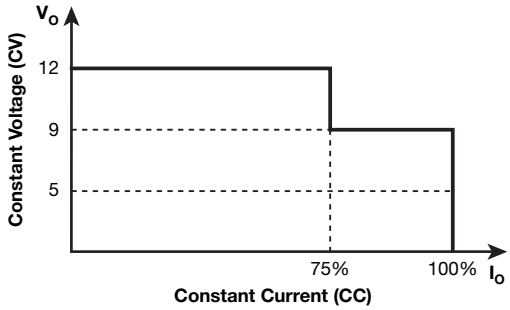
The InnoSwitch™ family of ICs dramatically simplifies the development and manufacturing of low-voltage, high current power supplies, particularly those in compact enclosures or with high efficiency requirements. The InnoSwitch architecture is revolutionary in that the devices incorporate both primary and secondary controllers, with sense elements and a safety-rated feedback mechanism into a single IC.

Close component proximity and innovative use of the integrated communication link permit accurate control of a secondary-side synchronous rectification MOSFET and optimization of primary-side switching to maintain high efficiency across the entire load range. Additionally, the minimal DC bias requirements of the link enables the system to achieve less than 10 mW no-load in challenging applications such as smart-mobile device chargers.



(a) Typical Application Schematic

PI-7519-020615



(b) Output Characteristic

PI-7146-121213

Figure 1. Typical Application/Performance.

Figure 2. High Creepage, Safety-Compliant eSOP Package.

Output Power Table

Product[3]	85-265 VAC	
	Adapter[1]	Peak or Open Frame[2]
SC1271K	20 W	25 W

Table 1. Output Power Table.

Notes:
1. Minimum continuous power in a typical non-ventilated enclosed typical size adapter measured at 40 °C ambient. Max output power is dependent on the design. With condition that package temperature must be < = 125 °C.
2. Minimum peak power capability.
3. Package: eSOP-R16B.

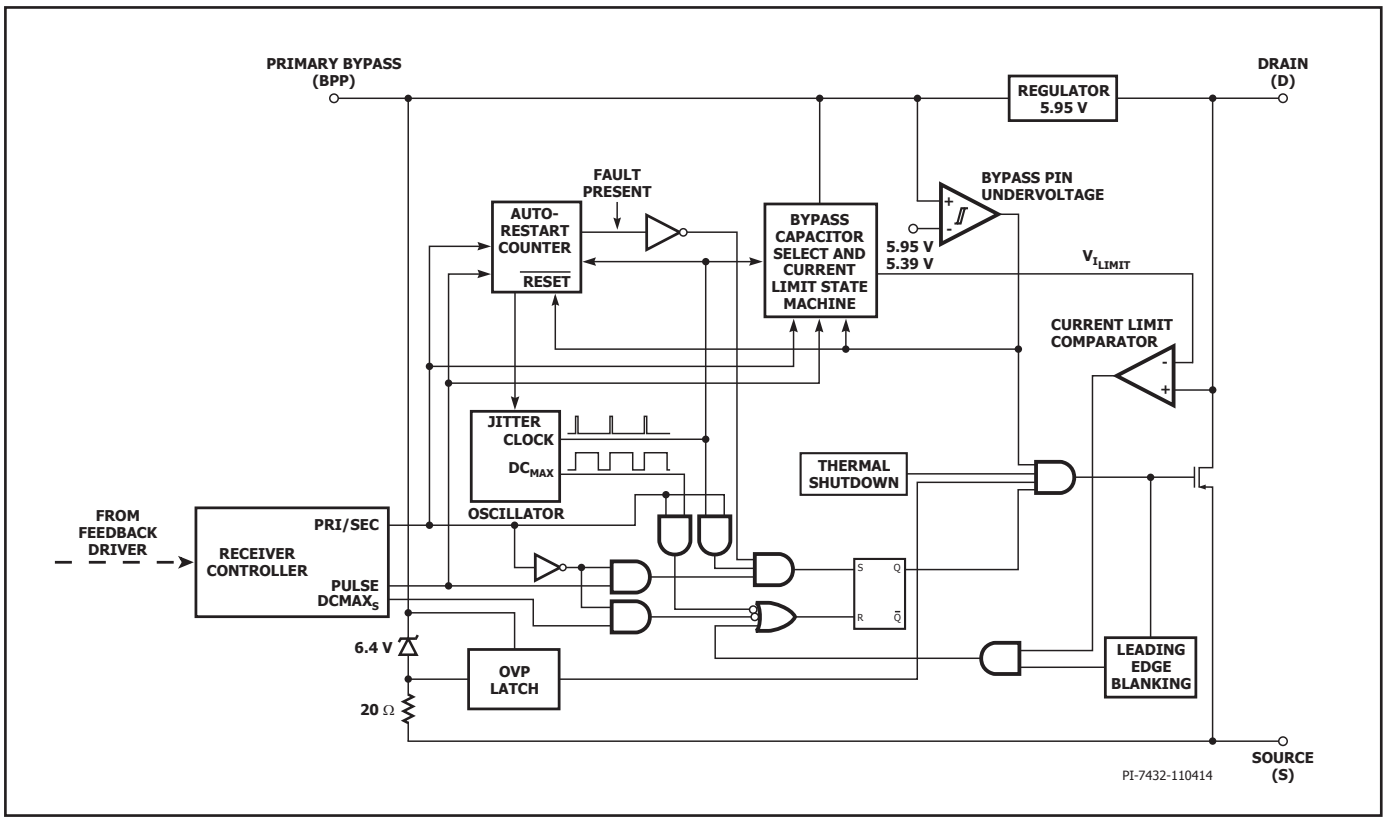


Figure 3. Primary-Side Controller Block Diagram.

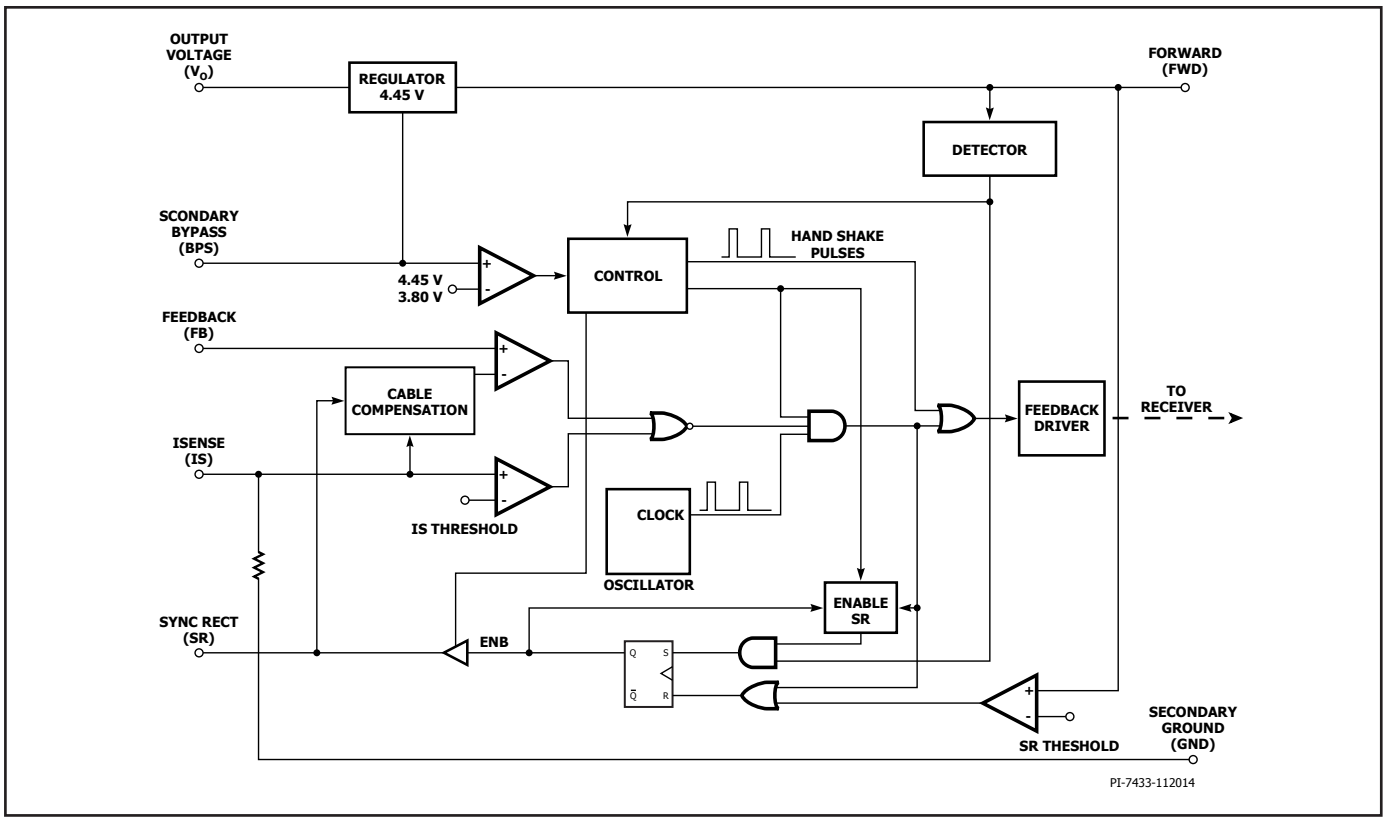


Figure 4. Secondary-Side Controller Block Diagram.

Pin Functional Description

DRAIN (D) Pin (Pin 1)
This pin is the power MOSFET drain connection.

SOURCE (S) Pin (Pin 3-6)
This pin is the power MOSFET source connection. It is also the ground reference for the BYPASS and FEEDBACK pins.

PRIMARY BYPASS (BPP) Pin (Pin 7)
It is the connection point for an external bypass capacitor for the primary IC supply.

FORWARD (FWD) Pin (Pin 10)
The connection point to the switching node of the transformer output winding for sensing and other functions.

OUTPUT VOLTAGE (VOUT) Pin (Pin 11)
This pin is connected directly to the output voltage of the power supply to provide bias to the secondary IC.

SYNCHRONOUS RECTIFIER DRIVE (SR) Pin (Pin 12)
Connection to external SR FET gate terminal.

SECONDARY BYPASS (BPS) Pin (Pin 13)
It is the connection point for an external bypass capacitor for the secondary IC supply.

FEEDBACK (FB) Pin (Pin 14)
This pin connects to an external resistor divider to set the power supply CV voltage regulation threshold.

SECONDARY GROUND (GND) (Pin 15)
Ground connection for the secondary IC.

ISENSE (IS) Pin (Pin 16)
Connection to the power supply output terminals. Internal current sense is connected between this pin and the SECONDARY GROUND pin.

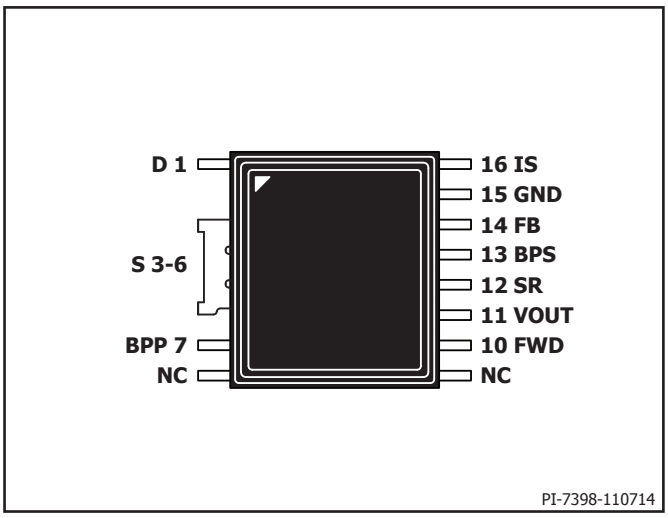


Figure 5. Pin Configuration.

Absolute Maximum Ratings[1,2]

DRAIN Pin Voltage ..... -0.3 V to 725 V
DRAIN Pin Peak Current[3] ..... 1680 (3150) mA
PRIMARY BYPASS/SECONDARY BYPASS Pin Voltage ..... -0.3 V to 9 V
PRIMARY BYPASS/SECONDARY BYPASS Pin Current ..... 100 mA
FORWARD Pin Voltage ..... -1.5 V to 150 V
FEEDBACK Pin Voltage ..... -0.3 to 9 V[6]
SR/P Pin Voltage ..... -0.3 to 9 V
OUTPUT VOLTAGE Pin Voltage ..... -0.3 to 15 V
Storage Temperature ..... -65 to 125 °C
Operating Junction Temperature[4,6] ..... -40 to 125 °C
Ambient Temperature ..... -40 to 85 °C
Lead Temperature[5] ..... 260 °C

Notes:
1. All voltages referenced to Source and Secondary Ground, T_A = 25 °C.
2. Maximum ratings specified may be applied one at a time without causing permanent damage to the product. Exposure to Absolute Maximum Ratings conditions for extended periods of time may affect product reliability.
3. Higher peak Drain current is allowed while the Drain voltage is simultaneously less than 400 V.
4. Normally limited by internal circuitry.
5. 1/16" from case for 5 seconds.
6. -1.8 V for a duration of ≤500 nsec.
7. Maximum silicon operating junction temperature is 150 °C, however safety agency maximum operating junction is 125 °C.
8. The maximum current out of the FORWARD pin when the FORWARD pin is below Ground is -40 mA.
9. Maximum current into VOUT pin at 15 V should not exceed 10 mA.

Thermal Resistance

Thermal Resistance: eSOP-R16B Package:
(θ_{JA}) ..... 65 °C/W[2], 69 °C/W[1]
(θ_{JC}) ..... 12 °C/W[3]

Notes:
1. Solder to 0.36 sq. in (232 mm²), 2 oz. (610 g/m²) copper clad.
2. Solder to 1 sq. in (645 mm²), 2 oz. (610 g/m²) copper clad.
3. The case temperature is measured at the plastic surface at the top of the package.

Parameter	Conditions	Rating	Units
Ratings for UL1577 (Adapter power rating is derated power capability)			
Primary-Side Current Rating	Current from pin (3-6) to pin 1	1.5	A
Primary-Side Power Rating	T_{AMB} = 25 °C (Device mounted in socket resulting in T_{CASE} = 120 °C)	1.35	W
Secondary-Side Current Rating	Current from pin 16 to pin 15	2.0	A
Secondary-Side Power Rating	T_{AMB} = 25 °C (Device mounted in socket)	0.125	W

Parameter	Symbol	Conditions SOURCE = 0 V, T_{JI} = -40 °C to +125 °C (Note C) (Unless Otherwise Specified)		Min	Typ	Max	Units
Control Functions							
Output Frequency Applies to Both Primary and Secondary Controllers	f_{OSC}	T_J = 25 °C	Average	93	100	107	kHz
			Peak-to-Peak Jitter		6		
Maximum Duty Cycle	DC_{MAX}	T_J = 0 °C to 125 °C		60			%

Parameter	Symbol	Conditions SOURCE = 0 V T_{JI} = -40 °C to +125 °C (Unless Otherwise Specified)	Min	Typ	Max	Units
Control Functions (cont.)						
PRIMARY BYPASS Pin Supply Current	I_{S1}	T_J = 25 °C, V_{BPP} + 0.1 V (MOSFET not Switching) See Note B		250		µA
	I_{S2}	T_J = 25 °C, V_{BPP} + 0.1 V (MOSFET Switching at f_{OSC}) See Note A, C		970	1100	
PRIMARY BYPASS Pin Charge Current	I_{CH1}	T_J = 25 °C, V_{BP} = 0 V See Notes D, E	-5.4	-4.5	-3.6	mA
	I_{CH2}	T_J = 25 °C, V_{BP} = 4 V See Notes D, E	-3.8	-2.9	-2.0	
PRIMARY BYPASS Pin Voltage	V_{BPP}	See Note D	5.73	5.95	6.15	V
PRIMARY BYPASS Pin Voltage Hysteresis	$V_{BPP(H)}$		0.48	0.56	0.65	V
PRIMARY BYPASS Shunt Voltage	V_{SHUNT}	I_{BPP} = 2 mA	6.15	6.45	6.75	V
Circuit Protection						
Standard Current Limit (BPP) Capacitor = 0.1 µF	I_{LIMIT} See Note E	di/dt = 213 mA/µs T_J = 25 °C	893	950	1007	mA
Increased Current Limit (BPP) Capacitor = 1 µF	$I_{LIMIT+1}$ See Note E	di/dt = 213 mA/µs T_J = 25 °C	955	1050	1145	mA
Reduced Current Limit (BPP) Capacitor = 10 µF	$I_{LIMIT-1}$ See Note E	di/dt = 213 mA/µs T_J = 25 °C	773	850	927	mA
Power Coefficient	I^2f	Standard Current Limit, $I^2f = I_{LIMIT(TYP)}^2 \times f_{OSC(TYP)}$ See Note A	0.87 × I^2f	I^2f	1.15 × I^2f	A^2Hz
		Reduced Current Limit, $I^2f = I_{LIMITred(TYP)}^2 \times f_{OSC(TYP)}$ See Note A	0.84 × I^2f	I^2f	1.18 × I^2f	A^2Hz
		Increased Current Limit, $I^2f = I_{LIMITinc(TYP)}^2 \times f_{OSC(TYP)}$ See Note A	0.84 × I^2f	I^2f	1.18 × I^2f	
Initial Current Limit	I_{INIT}	T_J = 25 °C See Note A	0.75 × $I_{LIMIT(TYP)}$			mA
Leading Edge Blanking Time	t_{LEB}	T_J = 25 °C See Note A	170	250		ns
Current Limit Delay	t_{ILD}	T_J = 25 °C See Note A, F		170		ns
Thermal Shutdown	T_{SD}	See Note A	135	142	150	°C

Parameter	Symbol	Conditions SOURCE = 0 V T_{JI} = -40 °C to +125 °C (Unless Otherwise Specified)		Min	Typ	Max	Units
Circuit Protection (cont.)							
Thermal Shutdown Hysteresis	$T_{SD(H)}$	See Note A			75		°C
PRIMARY BYPASS Pin Shutdown Threshold Current	I_{SD}			5.6	7.6	9.6	mA
Primary Bypass Power-Up Reset Threshold Voltage	$V_{BPP(RESET)}$	T_J = 25 °C		2.8	3.0	3.3	V
Auto-Restart On-Time at f_{osc}	t_{AR}	T_J = 25 °C See Note G		64	77	90	ms
Auto-Restart Trigger Skip Time	$t_{AR(SK)}$	T_J = 25 °C See Note G			1		s
Auto-Restart Off-Time at f_{osc}	$t_{AR(OFF)}$	T_J = 25 °C See Note G				2	s
Short Auto-Restart Off-Time at f_{osc}	$t_{AR(OFF)SH}$	T_J = 25 °C See Note G			0.5		s
Output							
ON-State Resistance	$R_{DS(ON)}$	I_D = 1050 mA	T_J = 25 °C		1.70	2.00	Ω
			T_J = 100 °C		2.70	3.10	
OFF-State Drain Leakage Current	I_{DSS1}	V_{BPP} = 6.2 V, V_{DS} = 580 V, T_J = 125 °C See Note H				200	µA
OFF-State Drain Leakage Current	I_{DSS2}	V_{BPP} = 6.2 V, V_{DS} = 325 V, T_J = 25 °C See Notes A, H			15		µA
Breakdown Voltage	BV_{DSS}	V_{BPP} = 6.2 V T_J = 25 °C See Note I		725			V
Drain Supply Voltage				50			V

Parameter	Symbol	Conditions SOURCE = 0 V T_{JI} = -40 °C to +125 °C (Unless Otherwise Specified)	Min	Typ	Max	Units
Secondary						
FEEDBACK Pin Voltage	V_{FB}	T_J = 25 °C	1.250	1.265	1.280	V
OUTPUT VOLTAGE Pin Auto-Restart Threshold	$V_{OUT(AR)}$	See Note K	3.00	3.45	3.65	V
Cable Drop Compensation Factor	ϕ_{CD}	T_J = 25 °C	1.05	1.06	1.07	
SECONDARY BYPASS Pin Current at No-Load	I_{SNL}	T_J = 25 °C	225	265	305	µA
SECONDARY BYPASS Pin Voltage	V_{BPS}		4.25	4.45	4.65	V
SECONDARY BYPASS Pin Undervoltage Threshold	$V_{BPS(UVLO)}$		3.45	3.8	4.15	V
SECONDARY BYPASS Pin Undervoltage Hysteresis	$V_{BPS(HYS)}$		0.10	0.65	1.2	V
Output (IS Pin) Current Limit Voltage Threshold	$IS_{V(TH)}$	T_J = 25 °C		33		mV
Constant Current Regulation Threshold	I_{CC}	T_J = 0 °C to 100 °C	2.00	2.20	2.40	A
Normalized Output Current	I_O	T_J = 25 °C	1.00	1.04	1.08	
FEEDBACK Pin AR Timer	$t_{FB(AR)}$		8			ms
FEEDBACK Pin Short-Circuit	$V_{FB(OFF)}$			0.1		V
Synchronous Rectifier						
SYNCHRONOUS RECTIFIER Pin Threshold	$V_{SR(TH)}$	T_J = 25 °C	-19	-24	-29	mV
SYNCHRONOUS RECTIFIER Pin Pull-Up Current	$I_{SR(PU)}$	T_J = 25 °C C_{LOAD} = 2 nF, f_S = 100 kHz	125	162	200	mA

Parameter	Symbol	Conditions SOURCE = 0 V T_{JI} = -40 °C to +125 °C (Unless Otherwise Specified)		Min	Typ	Max	Units
Synchronous Rectifier[1] (cont.)							
SYNCHRONOUS RECTIFIER Pin Pull-Down Current	$I_{SR(PD)}$	T_J = 25 °C C_{LOAD} = 2 nF, f_S = 100 kHz		230	280	315	mA
SYNCHRONOUS RECTIFIER Pin Drive Voltage	V_{SR}	See Note A		4.2	4.4	4.6	V
Rise Time	t_R	T_J = 25 °C C_{LOAD} = 2 nF See Note A	0-100%		71		ns
			10-90%		40		
Fall Time	t_F	T_J = 25 °C C_{LOAD} = 2 nF See Note A	0-100%		32		ns
			10-90%		15		
Output Pull-Up Resistance	R_{PU}	T_J = 25 °C V_{SPS} = 4.4 V I_{SR} = 10 mA See Note A			11.5		Ω
Output Pull-Down Resistance	R_{PD}	T_J = 25 °C V_{SPS} = 4.4 V I_{SR} = 10 mA See Note A			3.5		Ω

NOTES:

A. This parameter is derived from characterization.

B. I_{S1} is an estimate of device current consumption at no-load, since the operating frequency is so low under these conditions. Total device consumption at no-load is sum of I_{S1} and I_{DSS2} (this does not include secondary losses)

C. Since the output MOSFET is switching, it is difficult to isolate the switching current from the supply current at the Drain. An alternative is to measure the PRIMARY BYPASS pin current at 6.2 V.

D. The PRIMARY BYPASS pin is not intended for sourcing supply current to external circuitry.

E. To ensure correct current limit it is recommended that nominal 0.1 µF/1 µF/10 µF capacitors are used. In addition, the BPP capacitor value tolerance should be equal or better than indicated below across the ambient temperature range of the target application. The minimum and maximum capacitor values are guaranteed by characterization.

Nominal PRIMARY BYPASS Pin Capacitor Value	Tolerance Relative to Nominal Capacitor Value	
	Minimum	Maximum
0.1 µF	-60%	+100%
1 µF	-50%	+100%
10 µF	-50%	N/A

F. This parameter is derived from the change in current limit measured at 1X and 4X of the di/dt shown in the I_{LIMIT} specification.

G. Auto-restart on-time has same temperature characteristics as the oscillator (inversely proportional to frequency).

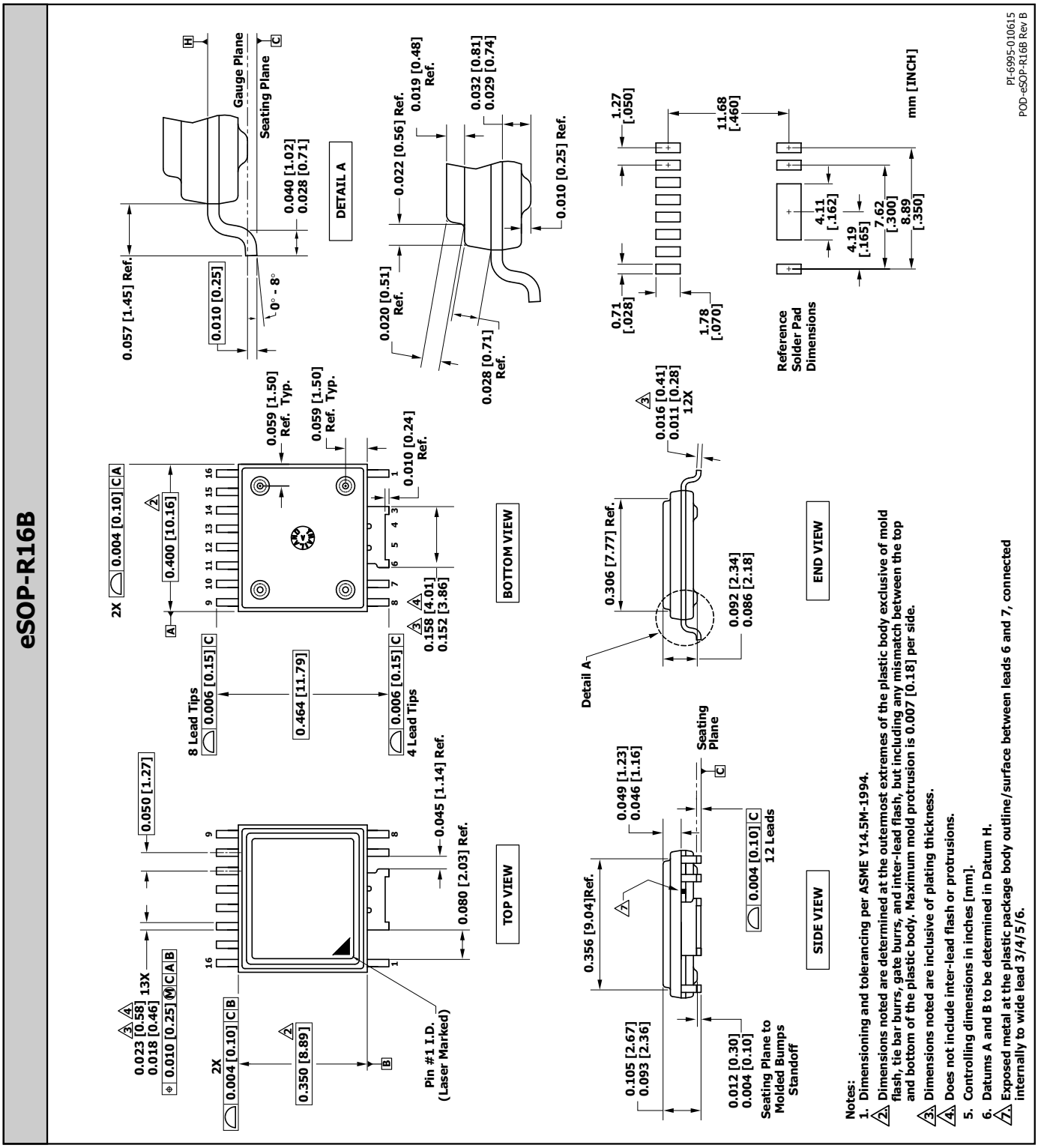
H. I_{DSS1} is the worst-case OFF-state leakage specification at 80% of BV_{DSS} and the maximum operating junction temperature. I_{DSS2} is a typical specification under worst-case application conditions (rectified 230 VAC) for no-load consumption calculations.

I. Breakdown voltage may be checked against minimum BV_{DSS} specification by ramping Drain voltage up to but not exceeding minimum BV_{DSS}.

J. For reference only. This is the total range of current limit threshold which corrects for variations in the current sense bond wire. Both of which are trimmed to set the normalized output constant current.

K. Measured at the VOUT pin of the device. At the end of the cable under-load, the apparent auto-restart threshold will be lower.

eSOP-R16B



Part Ordering Table

Product	Cable Compensation
SC1271K	6%

Revision	Notes	Date
A	Initial Release.	04/15
B	Changed Bypass Capacitor selection and limit on non-critical parameters.	06/15

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