Dimming Ballast Controller IC

GENERAL DESCRIPTION

The M8165 is a dimming ballast controller which is available to implement closed loop control of the lamp power. The M8165 features include programmable preheat and run frequencies, programmable preheat time, programmable end-of-life protection, brownout protection and low input offset op amp. Comprehensive protection features such as protection from failure of a lamp to strike, filament failures, end-of-life protection, have been included in the design. The M8165 is available in both 16-pin PDIP and 16-pin SOP packages.

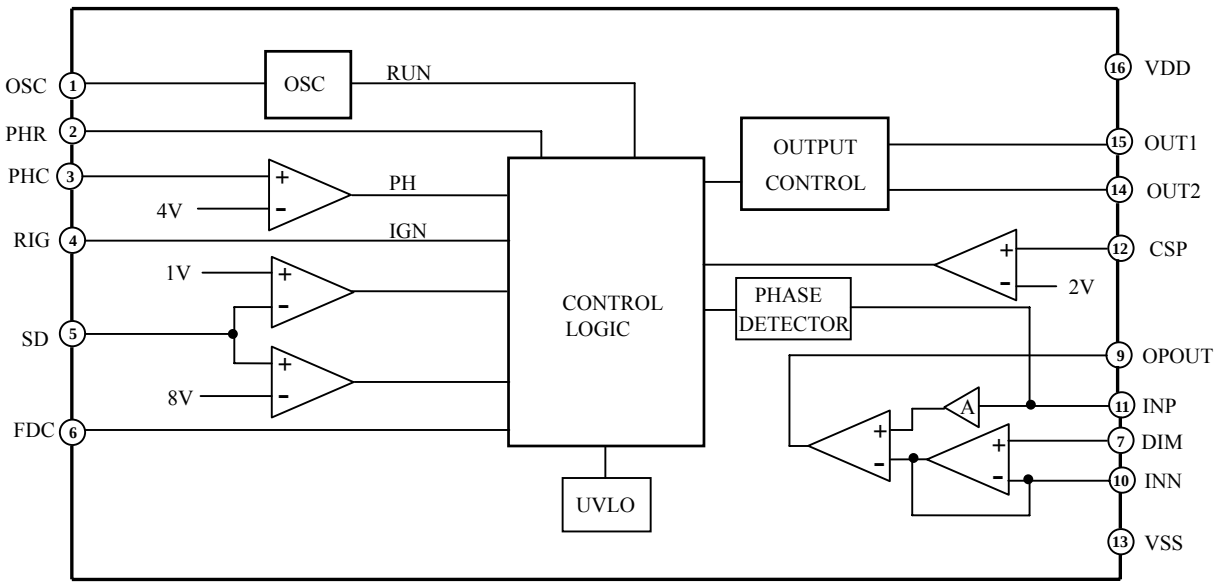
FEATURES

- Dimming range：10%~100%
- Programmable preheat frequency
- Programmable preheat time
- Programmable run frequency
- Programmable dead-time
- Programmable ignition ramp
- Programmable over-voltage protection
- Programmable over-current protection
- Lamp ignition fault protection
- Low offset op amp
- Lamp filament sensing & protection
- Lamp end-of-life detect
- DIP-16 or SOP-16

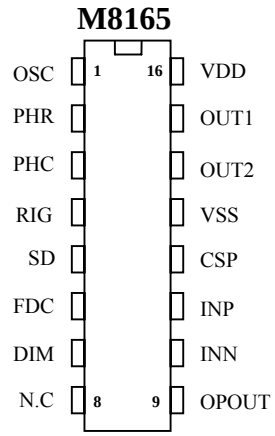
APPLICATIONS

- Electronic ballast control

FUNCTIONAL BLOCK DIAGRAM



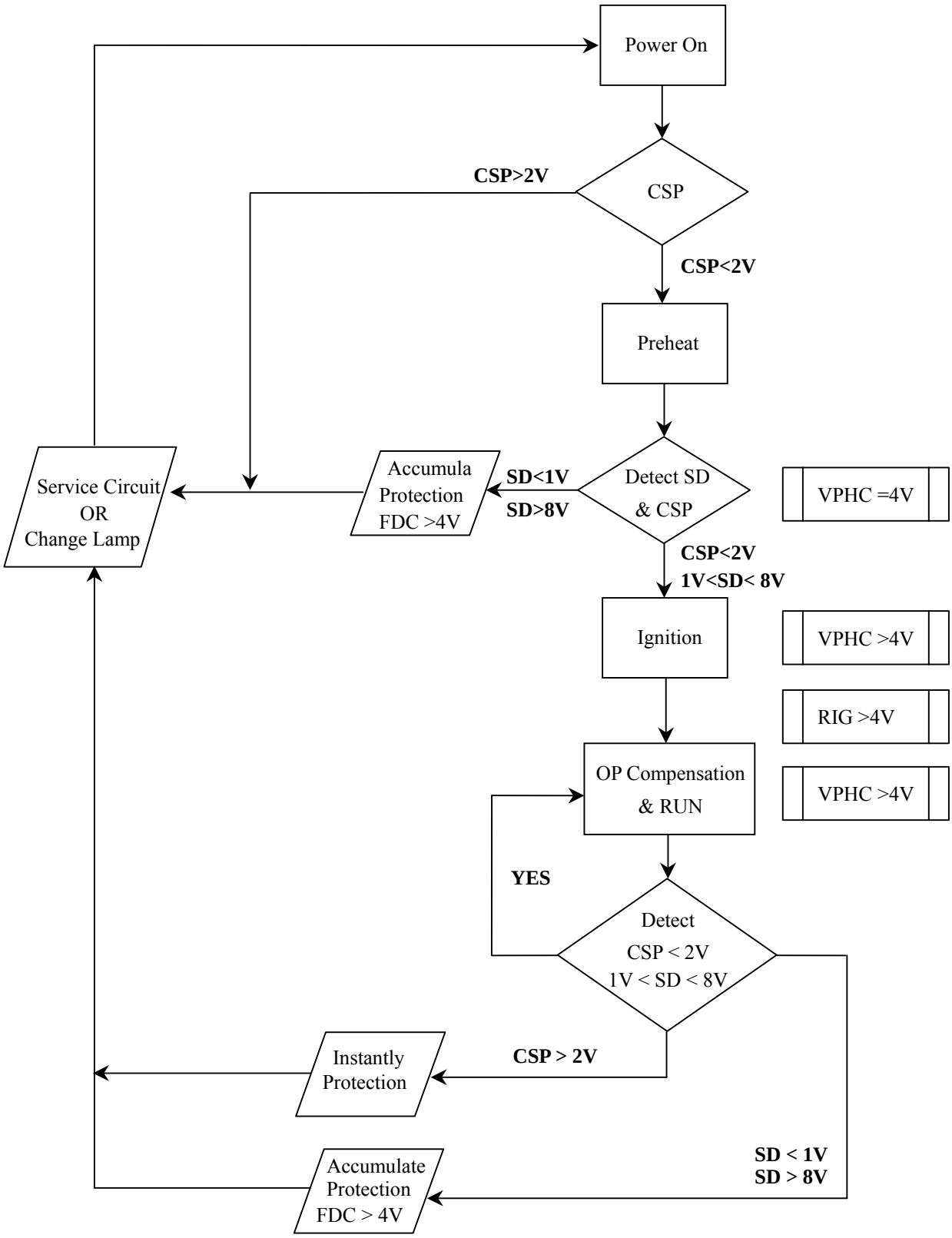
PIN ASSIGNMENT



PIN DESCRIPTION

Pin No.	Pin Name	Description
1	OSC	Oscillator timing capacitor
2	PHR	Preheat current setting. Connecting an external resistor which sets the reheat frequency
3	PHC	Preheat timing capacitor
4	RIG	Ignition Ramp timing resistor
5	SD	Shut-Down Sensing Input
6	FDC	Fault signal accumulate input
7	DIM	Dimming control input which is the setting of brightness. This pin can connect to the specific dimming controller or the potentiometer
8	N.C	No Connect.
9	OPOUT	Dimming OpAmp Output
10	INN	Non-inverting pin of Dimming OpAmp
11	INP	Inverting pin of Dimming OpAmp
12	CSP	The lamp-current sense input of Rectifier. Different resistor value will determine different input current of rectifier.
13	VSS	The ground potential of all the pins.
14	OUT2	The output of a high-current power driver capable of driving the gate of a power MOSFET
15	OUT1	The output of a high-current power driver capable of driving the gate of a power MOSFET.
16	VDD	The logic and control power supply connection.

STAGE DIAGRAM



ELECTRICAL CHARACTERISTICS

VCC = 12V +/- 0.25V , R11 =33K , RRPH = 33K , C11 = 270 pF , VCPH = 0.0V , TA = 25℃ unless otherwise specified.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
Start-up state						
Supply Voltage	VDDmax	10	12	14	V	
Start-up voltage	Vdon	8.5	9	9.5	V	
Start-off voltage	Vdoff	6.5	7	7.5	V	
Start-up current	Istart	40	50	60	μA	VDD=8.5V
Operating current	Iop	1	1.2	1.5	mA	VDD=8.5V
Oscillator Characteristics						
frun	Run frequency	39	42	45	KHz	R11 = 33K , C11 = 270pF
fph	Preheat frequency	75	80	85	KHz	R10 = 33K
PHCcmp	PHC compare voltage	3.88	4	4.12	V	
Over-voltage protection Characteristics						
VSDTH＋	SD pin Rising Reset threshold voltage	7.8	8	8.2	V	
VSDTH—	SD pin Falling Reset threshold hysteresis	0.8	1	1.2	V	
Over-current protection Characteristics						
VCSPTH+	CSP pin Rising Reset threshold voltage		2	—	V	
Output Characteristics						
Tr	Rising time (note)	—	100	—	ns	Load = 2000pF
Tf	Falling time (note)	—	100	—	ns	Load = 2000pF
IOMAX	Maximum allowable output current (OUT1,OUT2)	—	75	—	mA	VDS = 1V
Dimming Characteristics						
FDCcmp	FDC compare voltage	3.88	4	4.12	V	
Unity Gain BW	Operational Amplifier Band Width	—	1	—	MHz	
GDC	DC Open Loop Gain	—	80dB	—		

FUNCTIONAL DESCRIPTION

Under-voltage Lock-Out Mode (UVLO)

The under-voltage lock-out mode (UVLO) is defined as the state the IC is in when VDD is below the turn-on threshold of the IC. The M8165 under voltage lock-out is designed to maintain an ultra low supply voltage exceeds 8.5V, and to guarantee the IC is fully functional before the output drivers are activated.

Preheat Mode (PH)

The preheat mode is defined as the state the IC is in when the lamp filaments are being heated to their correct emission temperature. This is necessary for maximizing lamp life and reducing the required ignition voltage. The M8165 enters preheat mode when VDD exceeds the UVLO positive-going threshold. OUT1 and OUT2 begin to oscillate at the preheat frequency with 50% duty cycle, and with a dead-time which is set by the value of the external timing capacitor, C11, and internal dead-time resistor, preheat frequency which is set by the value of R10.

Ignition Mode (IGN)

The ignition mode is defined as the state the IC is in when a high voltage is being established across the lamp necessary for igniting the lamp. The M8165 enters ignition mode when the voltage on pin#4(RIG) exceeds 4V. The operating frequency to ramp smoothly from the preheat frequency, through the ignition frequency, to the final run frequency. The ignition mode oscillating frequency is determined by the timing resistor R8, R13 and timing capacitor C14 .

Run Mode (RUN)

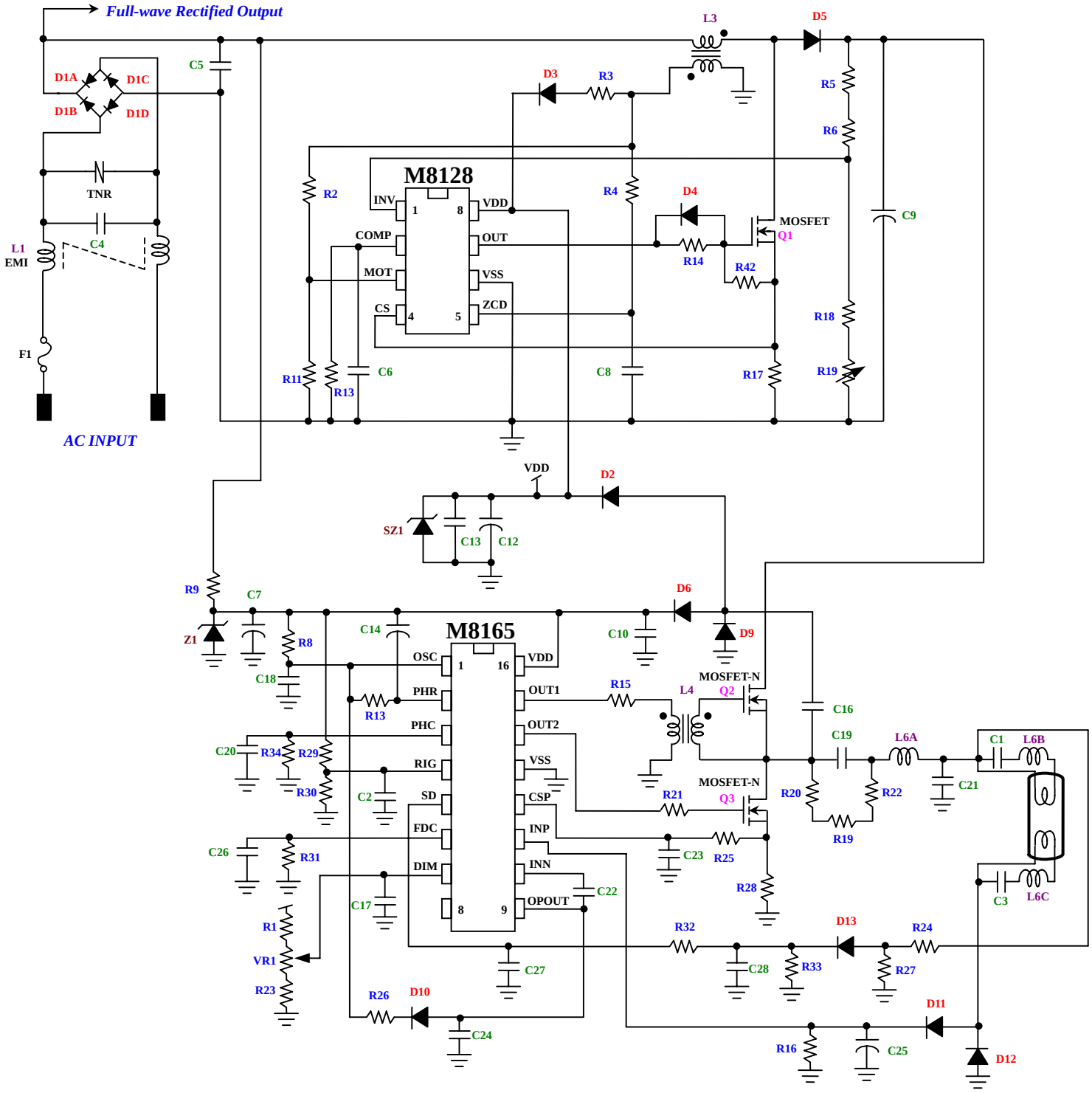
Once the lamp has successfully ignited, the ballast enters run mode. The run mode is defined as the state the IC is in when the lamp are is established and the lamp is being driven to a given power level. The run mode oscillating frequency is determined by the timing resistor R8 .

Protection Mode

The SD pin of the M8165 is used as lamp removal protection. If there is no lamp present the voltage at SD pin will be exceed 8V or decrease below 1V during run mode.

The current sense resistor R13 has been selected so that if the lamp fails to strike as the frequency approaches resonance in ignition mode, M8165 will shut down thus protecting the Q2 and Q3. In order for the system to operate the frequency of the ballast is controlled entirely through the closed loop system.

APPLICATION DIAGRAM



* All specs and applications shown above subject to change without prior notice.

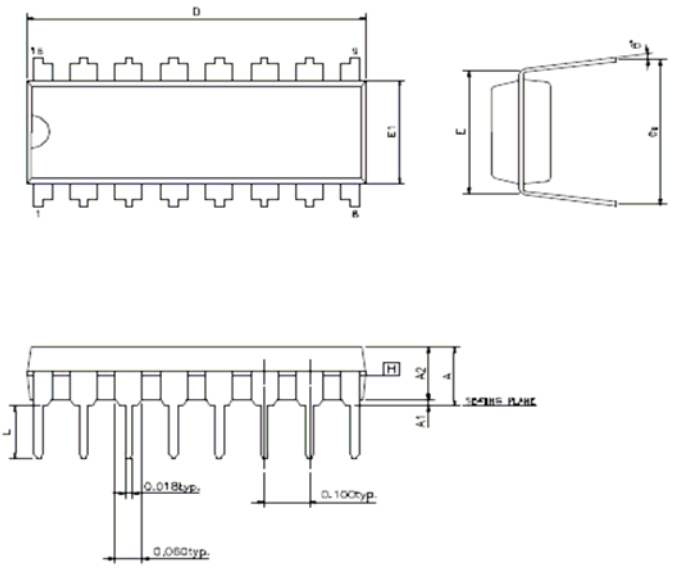
COMPONENT LISTING

Designator	Value	Description	Footprint	Quantity
C1, C3	224/100V	Capacitor	RAD-0.3	2
C2	332	Y Capacitor	RAD-0.3	1
C4	0.1uF	BOX Capacitor	RAD0.6B	1
C5	0.22uF	BOX Capacitor	RAD0.6B	1
C6, C10, C13	104	Capacitor, MLCC Capacitor	RAD0.2B	3
C7	1uF/25V	Electrolytic Capacitor	RB.2/.2	1
C8	12PF	Ceramic Capacitor	C0805A	1
C9	33u/450V	Electrolytic Capacitor	RB.3/.6A	1
C12	2.2uF/25V	Electrolytic Capacitor	RB.2/.2	1
C14,C17,C25	10uF/25V	Electrolytic Capacitor	RB.2/.2	3
C15	224	Capacitor	C0805A	1
C16	821/1KVV	Capacitor	RAD-0.3	1
C18	271pF	Capacitor	C1206A	1
C19	124/400V	Capacitor	RAD0.6B	1
C20	1uF	Electrolytic Capacitor	RAD0.2B	1
C21	562/1KV	Capacitor	RAD0.6C	1
C22	104	Capacitor	C1206A	1
C23	103	Capacitor	C1206A	1
C24	OPEN	Capacitor	C1206A	1
C26	2.2uF/25V	Electrolytic Capacitor	RB.2/.2	1
C27	102	Capacitor	C1206A	1
C28	2.2uF	Electrolytic Capacitor	RB.2/.2	1
CNR1	10D511K	Varistor	RAD-0.2	1
D1	1N4007x4	Diode	DIODE0.4A	1
D3, D4, D10, D11, D12	1N4148	Diode 75V,1A	CD3216-1206A	7
D5	UF208	Diode HIGH EFFICIENCY RECTIFIERS 600V, 2A	DIODE0.7A	1
D7, D8, D14	1N5819	1 Amp General Purpose Rectifier	CD4532-1812A	3
D2, D6, D9	FR107	1 Amp General Purpose Rectifier	DIODE-0.4	3
D13	RS1J	1 Amp General Purpose Rectifier	CD4532-1810	1
F1	3.15A/250V	Fuse	FUSE0.6	1
J1	AC 輸入端	AC SOUCE	IDC6C	1
L1	16mH	EE13H Inductor	EE13H_EMI	1
L3	1.5mH	EE19 Inductor	EE19_PFC	1
L4	18W	PL-18W	4P	1
L5	40T:80T	EE08 Inductor	EE0808	1

Dimming Ballast Controller IC

Designator	Value	Description	Footprint	Quantity
L6	1.5mH	VD3540/E 0914	EE25_V	1
Q1	2SK2996	Transistor, MOSFET 600V, 10A	TO-220D	1
Q2, Q3	2SK2628	Transistor, MOSFET 600V, 7A	TO-220D	2
R1	OPEN	Resistor 1/4W	3216 (1206)A	1
R2, R7	1MEG	Resistor 1/4W	3216 (1206)A	2
R3, R11	10K	Resistor 1/4W	3216 (1206)A	2
R4	47K	Resistor 1/4W	3216 (1206)A	1
R5, R6	510K	Resistor 1/4W	3216 (1206)A	2
R8, R13	33K	Resistor 1/4W	3216 (1206)A	2
R9	100K	Resistor 1/4W	3216 (1206)A	1
R29	100K	Resistor 1/4W	3216 (1206)A	1
R10	20K	Resistor 1/4W	3216 (1206)A	1
R23	0	Resistor 1/4W	3216 (1206)A	1
R14	10	Resistor 1/4W	3216 (1206)A	1
R15, R21	27	Resistor 1/4W	3216 (1206)A	2
R16	6.2	Resistor 1/4W	3216 (1206)A	1
R17	0.75/1W	Resistor 1W	AXIAL-0.6	1
R18	6.34K	Resistor 1/4W	3216 (1206)A	1
R19, R20, R22	30K	Resistor 1/4W	3216 (1206)A	3
R24	1.2MEG	Resistor 1/4W	3216 (1206)A	1
R25	1K	Resistor 1/4W	3216 (1206)A	1
R26	10K	Resistor 1/4W	3216 (1206)A	1
R27	56K	Resistor 1/4W	3216 (1206)A	1
R28	1.5./1W	Resistor 1W	AXIAL-0.6	1
R30	47K	Resistor 1/4W	3216 (1206)A	1
R31, R33	1MEG	Resistor 1/4W	3216 (1206)A	2
R32	300K	Resistor 1/4W	3216 (1206)A	1
R34	910K	Resistor 1/4W	AXIAL-0.3	1
R42	33K	Resistor 1/4W	2012[0805]A	1
SZ1, Z1	12V	Zener Diode, Zener Diode 1/2W	CD3216-1206A	2
U1	M8128	IC, PFC Driver	DIP-8	1
U2	M8165	DIMMER IC	DIP-16	1
VR1	OPEN	Varistor (Voltage-Sensitive Resistor)	VR3A	1

封裝尺寸

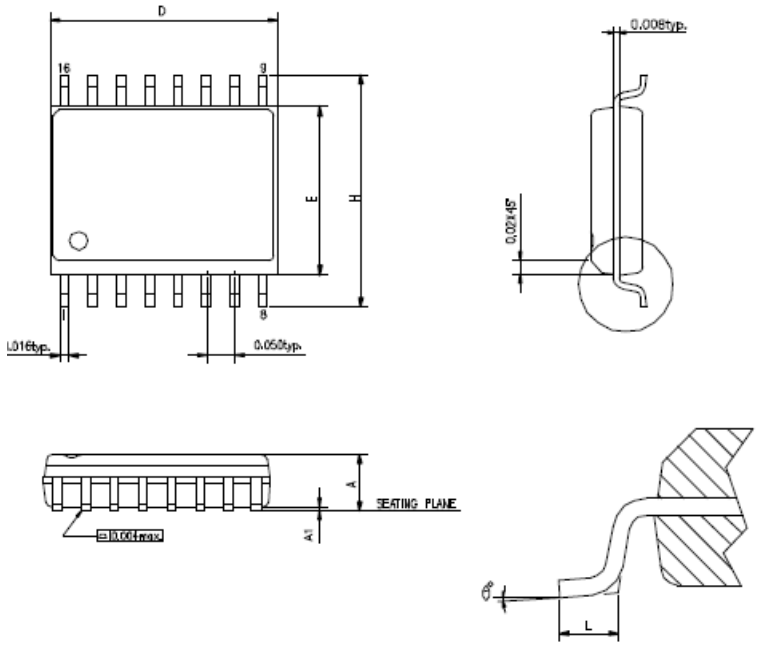


SYMBOLS	MIN.	NOR.	MAX.
A	–	–	0.210
A1	0.015	–	–
A2	0.125	0.130	0.135
D	0.735	0.755	0.775
E		0.300 BSC.	
E1	0.245	0.250	0.255
L	0.115	0.130	0.150
e_B	0.335	0.355	0.375
θ°	0	7	15

UNIT : INCH

NOTES:
1.JEDEC OUTLINE : MS-001 BB
2."D","E1" DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH.
3.eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
4.POINTED OR ROUNDED LEAD TIPS ARE PREFERRED TO EASE INSERTION.
5.DISTANCE BETWEEN LEADS INCLUDING DAM BAR PROTRUSIONS TO BE .005 INCH MININUM.
6.DATUM PLANE [H] COINCIDENT WITH THE BOTTOM OF LEAD, WHERE LEAD EXITS BODY.

16 PIN DIP (300mil)



SYMBOLS	MIN.	MAX.
A	0.093	0.104
A1	0.004	0.012
D	0.398	0.413
E	0.291	0.299
H	0.394	0.419
L	0.016	0.050
θ°	0	8

UNIT : INCH

NOTES:
1.JEDEC OUTLINE : MS-013 AA
2.DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .15mm (.006in) PER SIDE.
3.DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.010in) PER SIDE.

16 PIN SOP (300mil)