

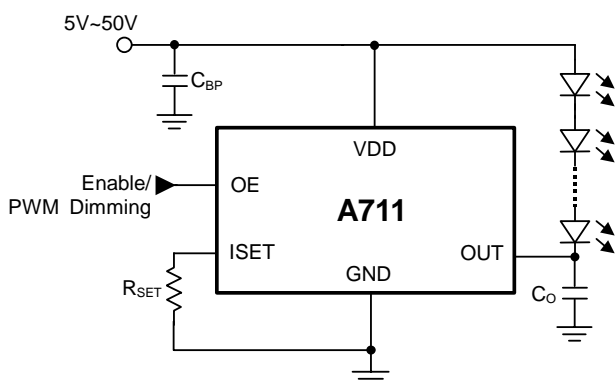
1.1A HIGH VOLTAGE ADJUSTABLE CURRENT REGULATOR WITH ENABLE CONTROL

DESCRIPTION

The A711 is a high voltage, low dropout current regulator for high power LED, that the maximum output current can be up to 1.1Amp. The output current was decided by an external resistor. The output sink current could be disabled via OE pin. PWM dimming function could also be controlled by OE pin.

TO-263 package is available for good power dissipation ability. Build-in thermal protection to prevent the chip from over heat damage, and adequate thermal pad PCB area is required to control the junction temperature below 125°C.

TYPICAL APPLICATION CIRCUIT



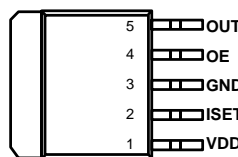
FEATURES

- 0.8V Output Drop-out Voltage at 1.1Amp.
- 1.1Amp. Maximum Output Current.
- Output Current Controlled by External Resistor.
- 3us Fast Response Output Stage Enable Control.
- Output Pin Sustain Voltage Up To 75V.
- Supply Voltage Range 5V~50V.
- TO-263-5L package.

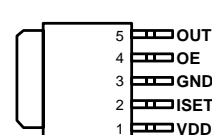
APPLICATIONS

- High Power LED Driver
- RGB Full Color Power LED driver
- LCD Monitor/TV LED Backlight Driver
- LED Lighting
- LED Street Lamp / Table Lamp

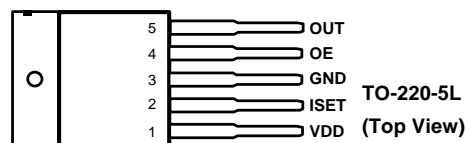
PACKAGE PIN OUT



TO-263-5L
(Top View)



TO-252-5L
(Top View)



TO-220-5L
(Top View)

ORDER INFORMATION

V	TO-263-5L	P	TO-220-5L	S	TO-252-5L
	5 pin		5 pin		5 pin
	A711VFT		A711PFT		A711SGT

Note:

Part Number: A 7 1 1 ☐ ☐ ☐

Package Type: V: TO-263-5L ☐ Packing. T: Tape & Reel

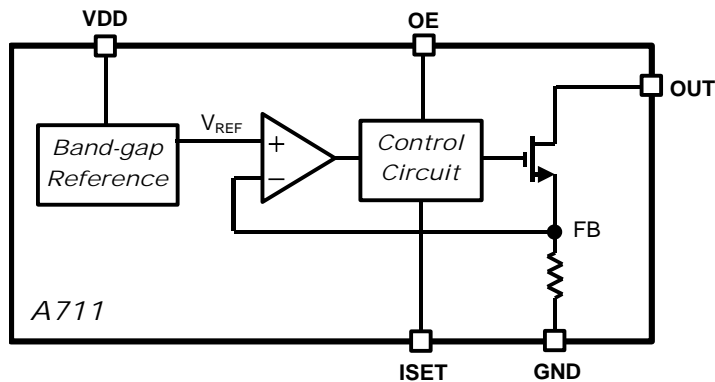
P: TO-220-5L ☐ Package Process. F: Lead Free; G: Green

S: TO-252-5L ☐

ABSOLUTE MAXIMUM RATINGS (Note)

Input Voltage, V_{DD}	50V
Output Pin Sustain Voltage, V_{OUT}	75V
Enable Voltage, V_{OE}	13.2V
Maximum Operating Junction Temperature, T_J	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (soldering, 10 seconds)	260°C

Note: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground.
Currents are positive into, negative out of the specified terminal.

BLOCK DIAGRAM

PIN DESCRIPTION

Pin Name	Pin Function
OUT	Output pin. Sink current is decided by the current on R_{SET} connected to I_{SET} . $I_{OUT} = I_{SET} \times 500 = \frac{1.2V}{R_{SET}} \times 500$
OE	Output stage enable control pin. High enable the OUT pin. It can be left floating for normally on.
I_{SET}	Output current set input. Connect a resistor from I_{SET} to GND to set the LED bias current.
VDD	Power supply.
GND	Ground.
Thermal Pad	Ground.

THERMAL DATA
TO-263, TO-220 Package:

Thermal Resistance-Junction to Tab, θ_{JT}	3 °C /W
Thermal Resistance-Junction to Ambient, θ_{JA}	45 °C /W

TO-252 Package:

Thermal Resistance-Junction to Tab, θ_{JT}	7 °C /W
Thermal Resistance-Junction to Ambient, θ_{JA}	80 °C /W

Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.

The θ_{JA} numbers are guidelines for the thermal performance of the device/pc-board system. Connect the thermal pad to ground using a large pad or ground plane for better heat dissipation. All of the above assume no ambient airflow.

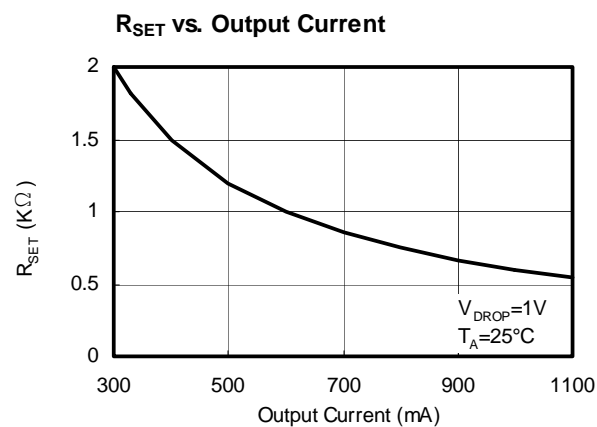
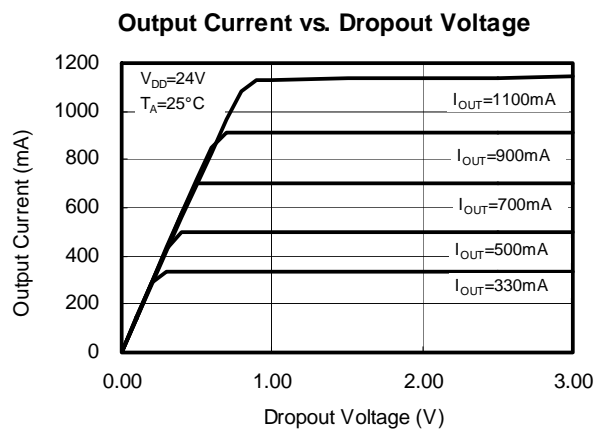
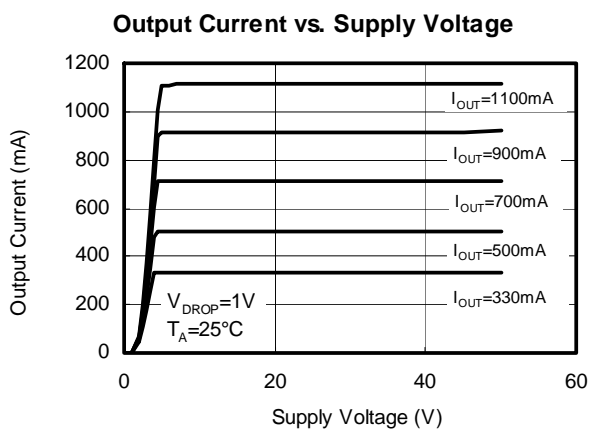
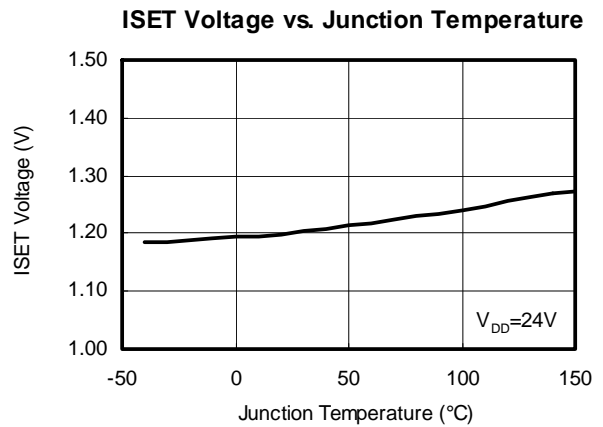
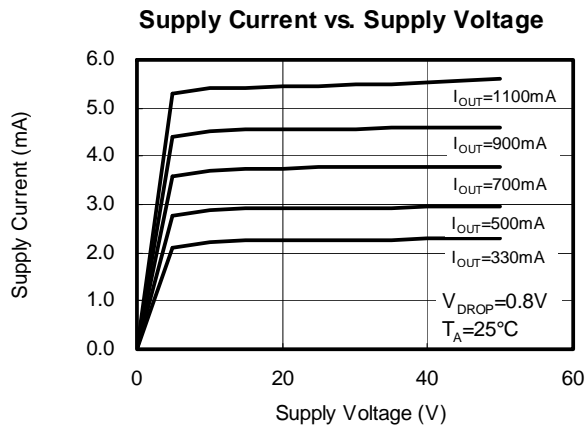
RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	5		50	V
Output Sink Current	I_{OUT}	0.3		1.1	A
Operating Free-Air Temperature Range	T_A	-40		+85	°C
Operating Junction Temperature	T_J			+125	°C

DC ELECTRICAL CHARACTERISTICS
 $V_{DD}=24V$, $T_A=25^{\circ}C$ (Unless otherwise noted)

Parameter	Condition	Min	Typ	Max	Unit
Output Current	$V_{OUT}=0.5V$, $R_{SET}=800\Omega$		750		mA
	$V_{OUT}=0.7V$, $R_{SET}=600\Omega$		1000		
Output Current Deviation	$V_{OUT}=0.5V$, $R_{SET}=800\Omega$			± 5	%
	$V_{OUT}=0.7V$, $R_{SET}=600\Omega$			± 5	
ISet Pin Current Range		0.6		2.2	mA
Maximum Output Current	$V_{OUT}=0.8V$, $R_{SET}=545\Omega$		1100		mA
Output Drop-out Voltage ^{Note 1}	$R_{SET}=800\Omega$, $I_{OUT}=750mA$		0.5		V
	$R_{SET}=600\Omega$, $I_{OUT}=1A$		0.7		
Load Regulation	$I_{OUT}=750mA$, $V_{OUT}=0.5V$ to $3V$			8	mA
Line Regulation	$I_{OUT}=750mA$, $V_{OUT}=0.5V$, $V_{DD}=5V$ to $50V$,			6	mA
Thermal Shut-down Junction Temperature	Hysteresis $20^{\circ}C$		160		$^{\circ}C$
“Low” Input Voltage		0		0.8	V
“High” Input Voltage		2		$\text{Min}\{V_{DD}, 12\}$	V
“Low” Input Current		-20		+20	μA
“High” Input Current		-5.0		+5.0	μA
Output Enable Delay Time	OE from Low to High, $V_{OUT}=0.5V$, $I_{OUT}=750mA$, 50%		5		μS
Output Disable Delay Time	OE from High to Low, $V_{OUT}=0.5V$, $I_{OUT}=750mA$, 50%		5		μS
Supply Current Consumption				7	mA

Note1: Output dropout voltage: $90\% \times I_{OUT}$ @ $V_{OUT}=0.8V$

CHARACTERIZATION CURVES


APPLICATION INFORMATION

A711 is a high voltage, high current, and low dropout current regulator for maximum output current up to 1.1A. The OE pin is used for enabling/disabling the output stage of the chip. The current could be linearly adjusted through external resistor, R_{SET} , connected to I_{SET} pin, or by PWM control via OE pin. Although the absolute maximum rating of OUT pin 75V, the dropout voltage between OUT pin and GND pin should not be too large when current is sinking because of the heat dissipation capability of the package and PCB layout.

Setting LED Current

An external resistor R_{SET} connected to I_{SET} pin sets the sink current of OUT pin. The value of R_{SET} is calculated by the following formula:

$$I_{OUT} = I_{SET} \cdot 500 = \frac{1.2V}{R_{SET}(K\Omega)} \cdot 500 \text{ (mA)}$$

PWM Dimming Control

A711 provides PWM dimming control function through OE pin. Basically, by changing the duty cycle of the PWM control signal, the ratio of LED ON-time to OFF-time can be changed. Consequently, larger duty cycle results in larger average current for driving LED and thus higher luminance.

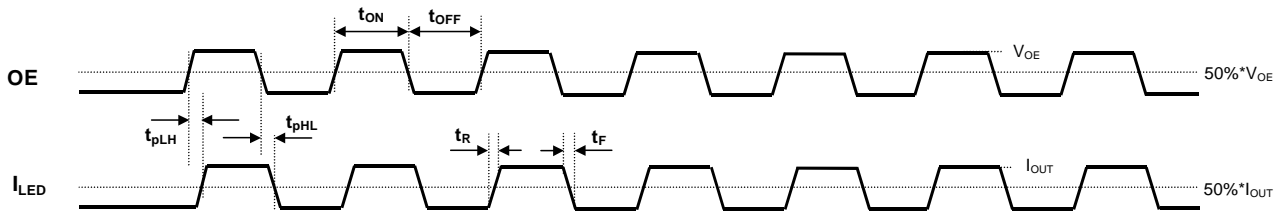
Ideally, the average LED driving current is in linear proportion to the duty cycle of the PWM control signal in spite of the frequency. However, due to the inherent propagation delay of the chip and the rising/falling time of the driving current, the deviation of the actual current from theoretical value will become larger when the PWM frequency gets higher. That is, if the PWM frequency exceeds certain recommended value, the effect of the fixed propagation delay and the rising/falling time of LED current on the linear relationship between the duty cycle and the average current will become more apparent. On the other hand, if the PWM frequency is too low, the flicker will become observable. Therefore, it is important to choose a suitable frequency for the PWM signal.

Please refer to the following timing chart & table for the limitation of maximum dimming frequency. It is determined by the minimum duty ratio, D_{MIN} , and the minimum LED “ON” time, $t_{ON,MIN}$. The maximum dimming frequency, f_{PWM} , can be calculated by the following formula:

$$\frac{1}{f_{PWM,MAX}} = \frac{t_{ON,MIN}}{D_{MIN}}$$

Where, duty ratio is defined as:

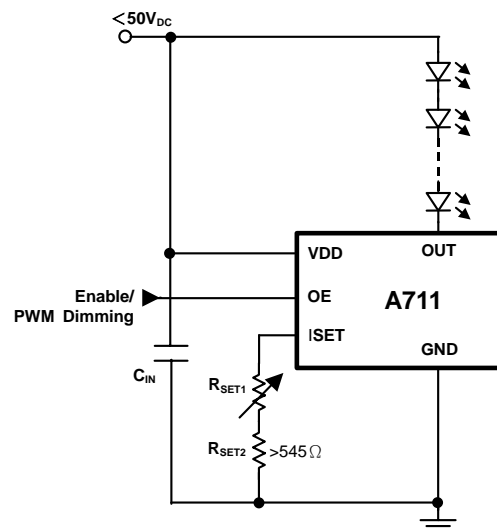
$$D = \frac{t_{ON}}{t_{ON} + t_{OFF}}$$



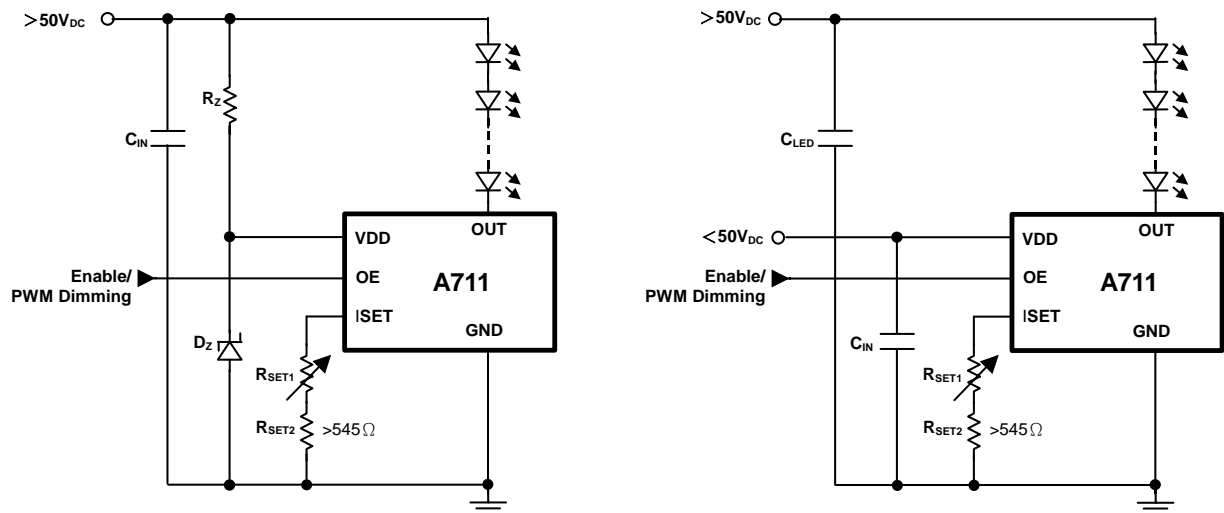
Characteristic	Symbol	Min	Typ	Max	Unit
LED "ON" Period (OE Pin Control Signal)	t_{ON}	5			us
LED "OFF" Period (OE Pin Control Signal)	t_{OFF}	5			us
Propagation Delay Time (Output Current from "L" to "H")	t_{pLH}		1.5	3	us
Propagation Delay Time (Output Current from "H" to "L")	t_{pHL}		1.5	3	us
Output Current Rising Time (Rising from 10% to 90%)	t_R		1.5	3	us
Output Current falling Time (Falling from 90% to 10%)	t_F		1.5	3	us

DC Voltage Input

Any DC voltage level between 5V to 50V could be adopted as power source VDD for typical application of A711 as long as VDD is larger than the total forward voltage drop of the LED string by the minimum dropout voltage (between OUT pin and GND pin) needed for the expecting current.

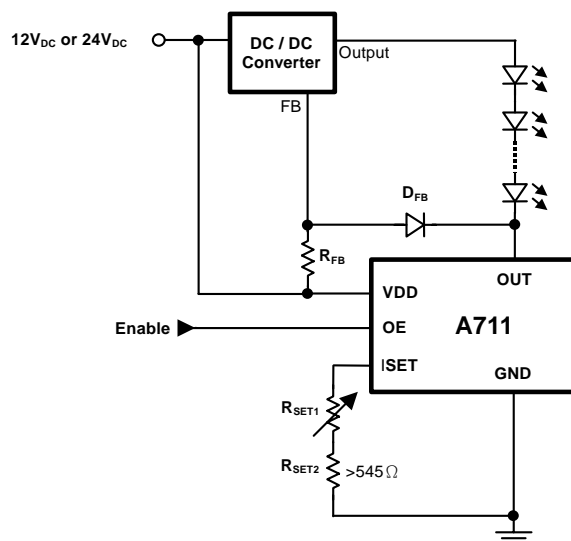


If 50V ~ 100V voltage level is adopted as power source to positive end of the LED string, one Zener shunt regulator could be used to provide appropriate voltage (lower than 50V) to VDD pin. The supply voltage to VDD pin and LED+ end could also be separated. Note that, heat-sink area on PCB is required if the dropout voltage between OUT pin and GND pin is too large. Please refer to the “Thermal Consideration” section.



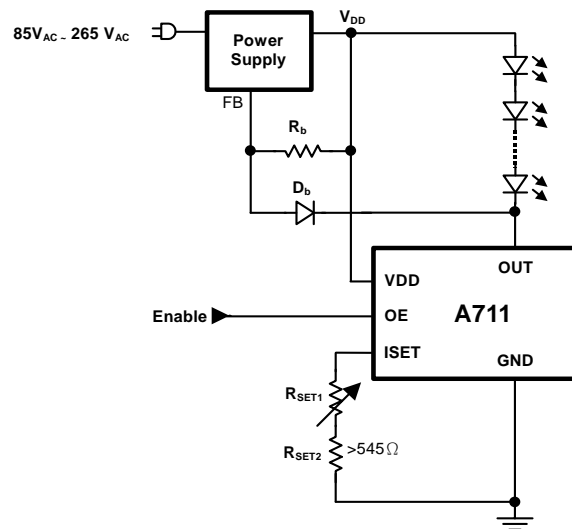
Application for LED Lighting

A711 could coordinate with any type of DC-to-DC converter through feedback path to realize LED lighting module. The number of LEDs in the string is variable even with certain fixed power source since the output voltage of the DC-to-DC converter could be modulated according to feedback signal. In the following figure, D_{FB} is used to feed the dropout voltage of OUT pin of the A711 back to DC/DC converter; and R_{FB} is the pull-high resistor for D_{FB} .



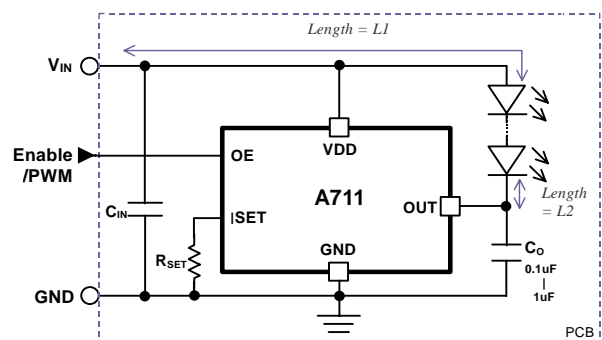
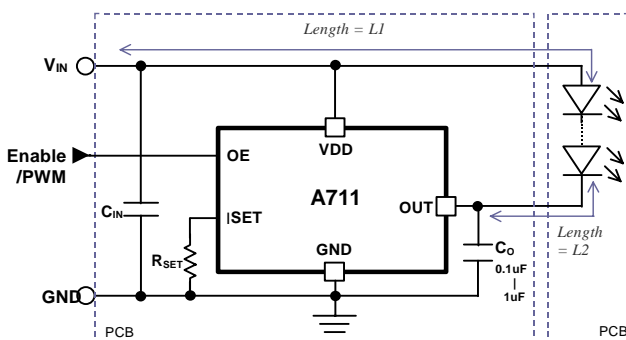
AC Voltage Input

A711 could work with any kind of well-developed switch-mode power supply system. Simply cut off the internal feedback path of the power supply system and then feed the signal from A711 back to the power supply system instead.

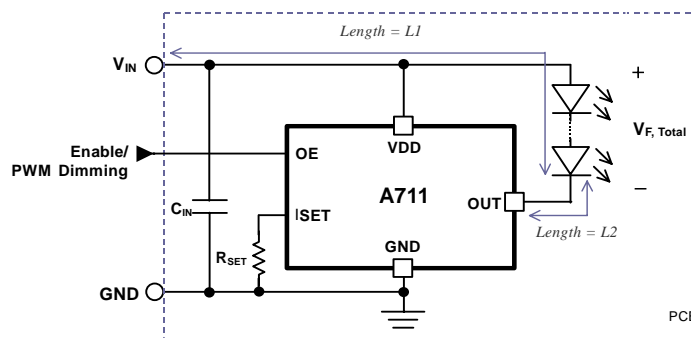


Output Capacitor C_O

If the LED string and A711 is located in separate PCBs, or the length of the routing path $L1 > 10\text{cm}$ or $L2 > 3\text{cm}$, the output capacitor C_O should be added. Typically, capacitance of $0.1\mu\text{F} \sim 1\mu\text{F}$ is recommended and $1\mu\text{F}$ is needed when $L2$ is much longer than 3cm .



The output capacitor C_O may be neglected under certain condition. If the LED string and A711 are located in the same PCB, and the length of the routing path $L1 < 10\text{cm}$ & $L2 < 3\text{cm}$, the output capacitor C_O can be neglected.



THERMAL CONSIDERATION

The Maximum Power Dissipation on Current Regulator

$$P_{D(MAX)} = V_{OUT(MAX)} \times I_{OUT(NOM)} + V_{IN(MAX)} \times I_{DD}$$

$V_{OUT(MAX)}$ = the maximum voltage on output pin;

$I_{OUT(NOM)}$ = the nominal output current;

I_{DD} = the quiescent current the regulator consumes at $I_{OUT(NOM)}$;

$V_{IN(MAX)}$ = the maximum input voltage.

Thermal Consideration

The A711 has internal power and thermal limiting circuitry designed to protect the device under overload conditions. However, maximum junction temperature ratings should not be exceeded under continuous normal load conditions. The thermal protection circuit of A711 prevents the device from damage due to excessive power dissipation. When the device junction temperature rises to approximately 160°C, the regulator will be turned off. When power consumption is over about 1.22W (TO-263 and TO-220 package, at $T_A=70^\circ\text{C}$), additional heat sink is required to control the junction temperature below 125°C.

The junction temperature is:

$$T_J = P_D (\theta_{JT} + \theta_{TS} + \theta_{SA}) + T_A$$

P_D : Dissipated power.

θ_{JT} : Thermal resistance from the junction to the mounting tab of the package.

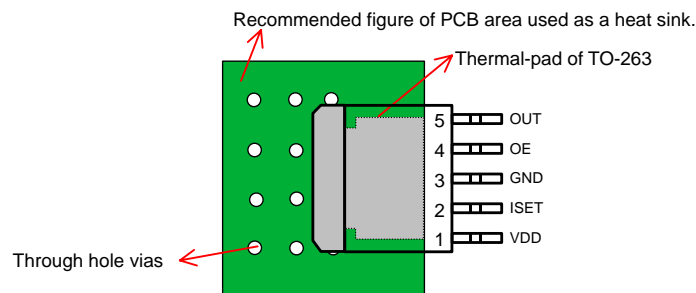
For TO-263 package, $\theta_{JT} = 3.0^\circ\text{C/W}$.

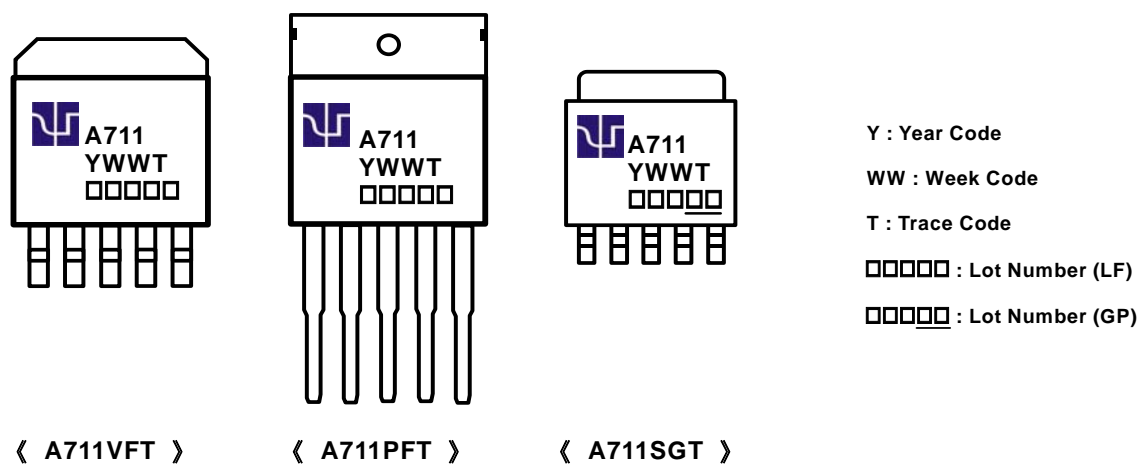
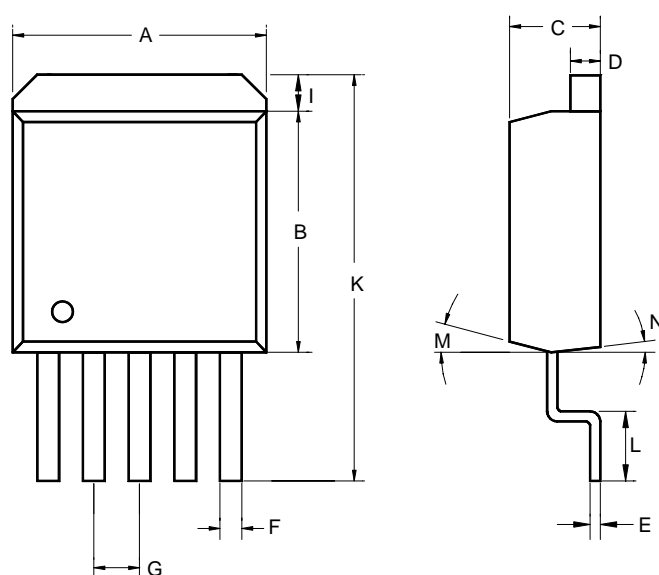
θ_{TS} : Thermal resistance through the interface between the IC and the surface on which it is mounted.
(typically, $\theta_{TS} < 1.0^\circ\text{C/W}$)

θ_{SA} : Thermal resistance from the mounting surface to ambient (thermal resistance of the heat sink).

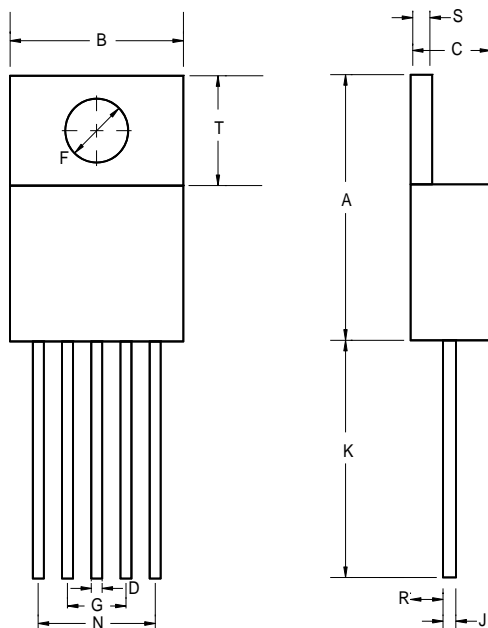
If PC Board copper is going to be used as a heat sink, below table can be used to determine the appropriate size of copper foil required. For multi-layered PCB, these layers can also be used as a heat sink. They can be connected with several through-hole vias.

PCB θ_{SA} ($^\circ\text{C/W}$)	59	45	38	33	27	24	21
PCB heat sink size (mm^2)	500	1000	1500	2000	3000	4000	5000

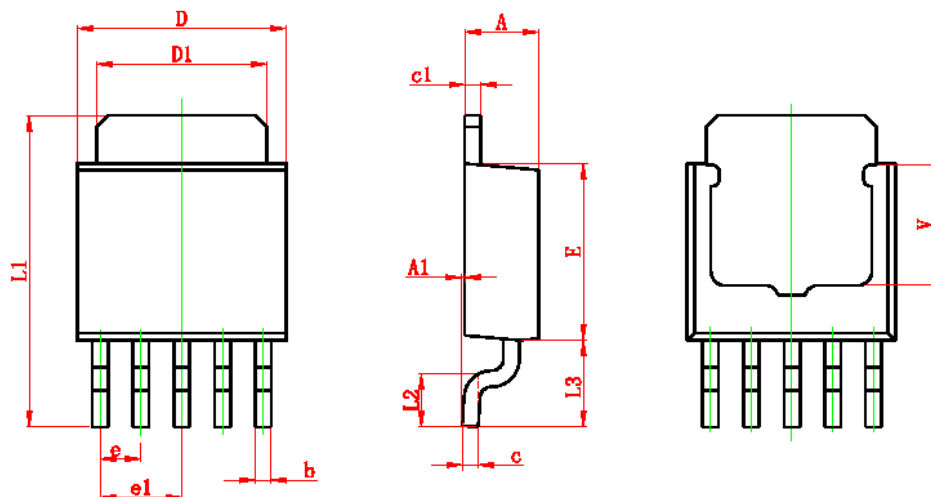


PACKAGE
Top Marking

5-Pin Surface Mount TO-263


	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.395	-	0.420	10.03	-	10.67
B	0.325	-	0.361	8.25	-	9.17
C	0.171	-	0.181	4.34	-	4.59
D	0.045	-	0.055	1.14	-	1.40
E	0.013	-	0.017	0.330	-	0.432
F	0.029	-	0.035	0.737	-	0.889
G	0.062	-	0.072	1.57	-	1.83
I	-	-	0.065	-	-	1.65
K	0.575		0.635	14.60		16.13
L	0.090		0.110	2.29		2.79
M	7°			7°		
N	3°			3°		

5-Pin Plastic TO-220


	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.560	-	0.650	14.23	-	16.51
B	0.380	-	0.420	9.66	-	10.66
C	0.140	-	0.190	3.56	-	4.82
D	0.018	-	0.035	0.46	-	0.89
F	0.140	-	0.160	3.56	-	4.06
G	0.134	-	-	3.40	-	-
J	0.012	-	0.045	0.31	-	1.14
K	0.500	-	0.580	12.70	-	14.73
N	0.268 TYP			6.80 TYP		
R	0.080	-	0.115	2.04	-	2.92
S	0.045	-	0.055	1.14	-	1.39
T	0.230	-	0.270	5.85	-	6.85

TO-252-5L


Symbol	Dimensions in Millimeters		Dimensions in Inches	
	MIN	MAX	MIN	MAX
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
B	0.400	0.600	0.016	0.024
C	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
E	1.270 TYP		0.050 TYP	
e1	2.540 TYP		1.000 TYP	
L1	9.500	9.900	0.374	0.390
L2	1.400	1.780	0.055	0.070
L3	2.550	2.900	0.100	0.114
V	3.800 REF		0.150 REF	

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