AMC7110/1/3/4

WHITE/BLUE LED DRIVER FOR LI-ION BATTERY APPLICATION

DESCRIPTION

The AMC7110 series is member of ADDM North Star White/Blue LED driver family. No external component is required. Especially good for use Li-ion battery powered LCD display's backlight white LEDs. The special circuit design provides over 90% efficiency in low noise.

Target end applications are color LCD display, such as mobile phone with color display, smart phone, PDA, etc.

APPLICATIONS

- Small Size Color LCD Backlights
- Mobile Phone, Smart Phone Keypad Backlights

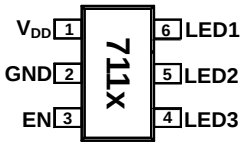
FEATURES

- **LED sink current 20mA and 15mA**
- **Individual current sink circuit for all LEDs outputs to prevent short / open circuit on LEDs.**
- **PTC LED current for luminosity compensation.**
- **3 channels (SOT-26), 4 channels (MSOP-8) available.**
- **90% efficiency**
- **Supply voltage range 2.7V ~ 6V**
- **0.1uA standby current**
- **2KV HBM ESD protection**
- **Advanced Bi-CMOS process.**

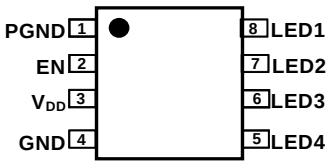
OPTIONS

Device Name	LED Sink Current	Channel Number
AMC7110	20mA	3
AMC7111	20mA	4
AMC7113	15mA	3
AMC7114	15mA	4

PACKAGE PIN OUT

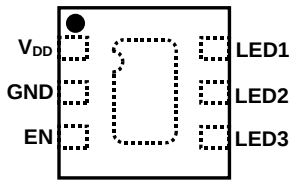


AMC7110 / AMC7113
SOT-26

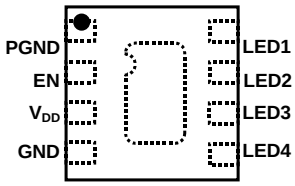


AMC7111 / AMC7114
MSOP-8

AMC7110
TSOT-26

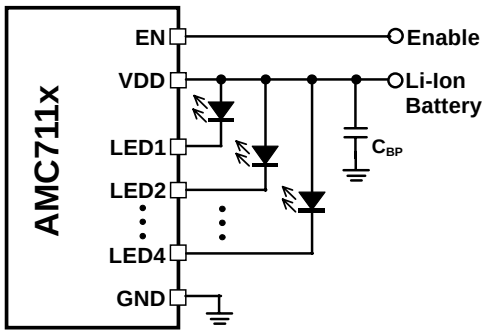


AMC7110
QFN 2mmx2mm



AMC7111
QFN 2mmx2mm

TYPICAL APPLICATION CIRCUIT



ORDER INFORMATION

I_{LED} (mA)	DB SOT-26 6-pin	DN MSOP-8 8-pin	DJ TSOT-26 6-pin	W QFN 2x2 6-pin	W QFN 2x2 8-pin
18 ~ 22	AMC7110DBF	AMC7111DNF	AMC7110DJ	AMC7110WF	AMC7111WF
19 ~ 21	AMC7110ADBF	AMC7111ADNF	-	-	-
13.5 ~ 16.5	AMC7113DBF	AMC7114DNF	-	-	-

Note: Surface-mount packages is available in Tape & Reel. Append "T" to part number (i.e., AMC7111DNFT).
The letter "F" is marked for lead free process.

ABSOLUTE MAXIMUM RATINGS (Note)

Input Voltage, V_{DD}	-0.3V to 7V
Output Voltage, V_{LEDn}	-0.3V to 7V
Voltage at all other pins	-0.3V to 5.5V
Maximum Junction Temperature, T_J	150°C
Storage Temperature Range	-40°C to 150°C
Lead Temperature (soldering, 10 seconds)	260°C

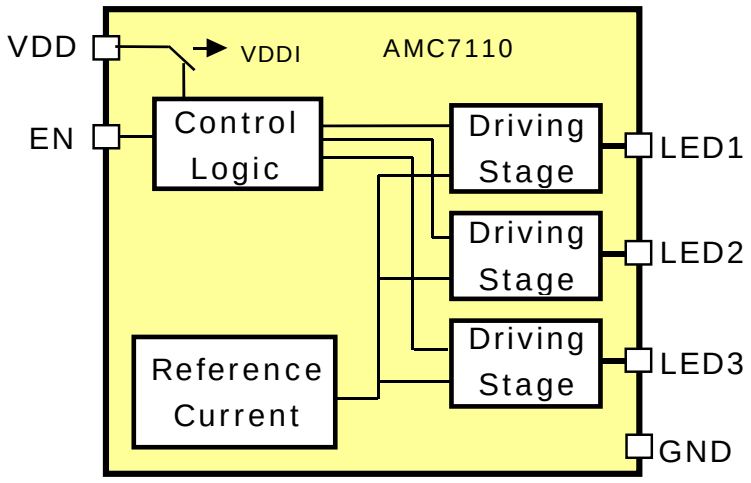
Note:
Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground.
Currents are positive into, negative out of the specified terminal.

POWER DISSIPATION TABLE

Package	θ_{JA} (°C/W)	Derating factor (mW/°C) $T_A \geqq 25$°C	$T_A \leqq 25$°C Power rating (mW)	T_A=70°C Power rating (mW)	T_A= 85°C Power rating (mW)
DB	220	4.5	568	363	295
DJ	220	4.5	568	363	295
DN	180	5.56	695	444	361
W	76.5	13.1	1634	1045	849

Note :
Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
P_D: Power Dissipation, T_A: Ambient temperature, θ_{JA}: Thermal Resistance-Junction to Ambient
The θ_{JA} numbers are guidelines for the thermal performance of the device/PC-board system.
All of the above assume no ambient airflow.

BLOCK DIAGRAM



PIN DESCRIPTION

Pin Name	Pin Function
LED1 ~ LED3/4	Output pins; connect to LED's cathode.
EN	Enable control pin. Pulling this pin high will enable the device. Pulling this pin to GND will disable the device.
V_{DD}	Power supply
GND	Ground
PGND	Power ground

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	2.7		6	V
Output Sink current	I_{LED}			25	mA
Operating free-air temperature range	Ta	-40		+85	℃

ELECTRICAL CHARACTERISTICS

V_{DD}=3.7V, T_A=25°C, No Load, Input: V_{IH}=3.3V, V_{IL}=GND. (Unless otherwise noted)

Parameter	Symbol	Condition		Min	Typ	Max	Unit	Apply Pin
"Low" Input Voltage	V_{IL}					0.4	V	EN
"High" Input Voltage	V_{IH}			1.7			V	
"Low" Input Current	I_{IL}			-5.0		+5.0	µA	
"High" Input Current	I_{IH}			-5.0		+5.0	µA	
LED Dropout Voltage	V_{LEDL}	AMC7110/1	Note		75	90	mV	LEDn
		AMC7113/4	Note		60	75		
LED Sink Current	I_{LED}	AMC7110A AMC7111A	V_{DD}=2.7V~6V V_{LEDn}=0.15~3V	19	20	21	mA	
		AMC7110/1	V_{LEDn}=0.15~3V	18	20	22		
			V_{DD}=2.7V~6V V_{LEDn}=0.15~3V	17	20	23		
		AMC7113/4		13.5	15	16.5		
LED Sink Current Deviation	$\triangle I_{LEDn}$	AMC7110A				±3	%	
						±5		
Supply Current	I_{DD}				400	800	uA	V_{DD}
Standby Supply Current	I_{DDSTBY}				0.1		uA	

Note: LED Dropout Voltage: 90% × I_{LEDn} @ V_{LEDn}=150mV

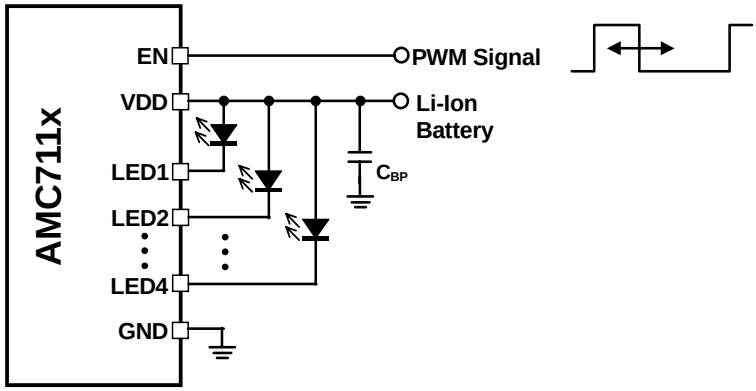
APPLICATION INFORMATION

Enable

The EN pin enables and disables the device. Pulling the EN pin high will enable the device beginning sink current on LED pins. Pulling the EN pin to ground will shutdown the device reducing the I_{DD} current to typical 0.1uA. This pin should not be left floating and need to be terminated.

LED Brightness Control

The LED sink current was fixed at 20mA or 15mA. Apply PWM signal to EN pin and control the duty that could control the LED brightness from 0% to maximum.



Supply Voltage and Li-ion battery low warning

AMC711X works with supply voltage range from 2.7V to 6V. The white/blue LED forward voltage is in the range of 2.9V to 3.5V at 20mA current. The supply voltage range and LED forward voltage (Vf) should be set to fully ultilize Li-ion battery energy. For example, the maximum white LED forward voltage limit at 3.2V (@ 20mA) when Li-ion battery discharg reaches 3.275V(normally around 1% ~ 3% power left in the battery). When Li-ion battery voltage is lower than the presetted low level, the LED current(brightness) will start to decrease.

Efficiency

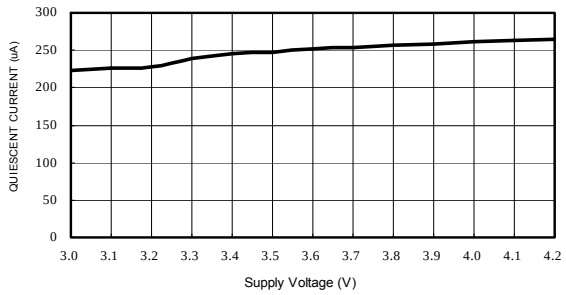
The ACR (Advanced Current Regulator) architecture offers ultra low output dropout that significantly improves the efficiency compared to Inductive Boost type or Capacitor Charge Pump type LED driver. The system efficiency, defined as the ratio between the LEDs power and the input supplied power, is:

$$\text{Efficiency} = (Vf1 \times I_{LED}1 + Vf2 \times I_{LED}2 + Vf3 \times I_{LED}3 + Vf4 \times I_{LED}4) / (V_{DD} \times I_{DD})$$

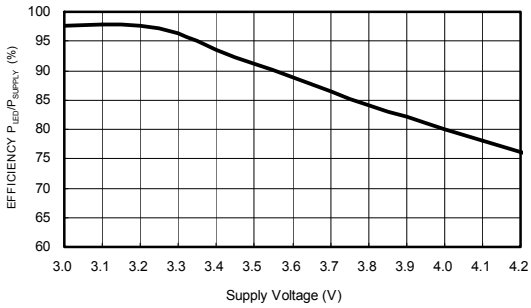
Where, Vf is the forward voltage of LED.

CHARACTERIZATION CURVES

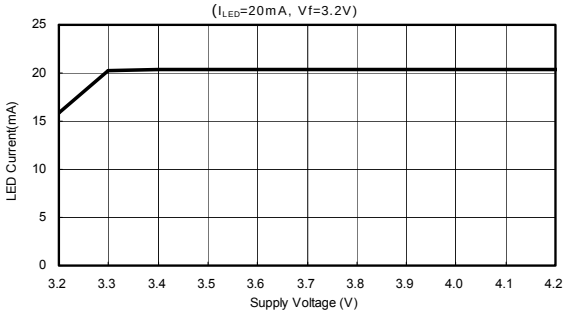
QUIESCENT CURRENT vs. SUPPLY VOLTAGE
(4 LEDs, Vf=3.2V at 20mA/LED)



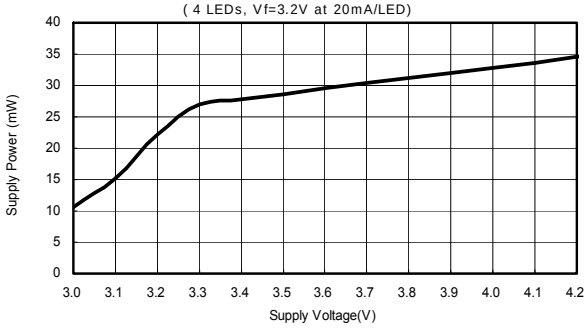
EFFICIENCY vs. SUPPLY VOLTAGE
(4 LEDs, Vf=3.2V at 20mA/LED)



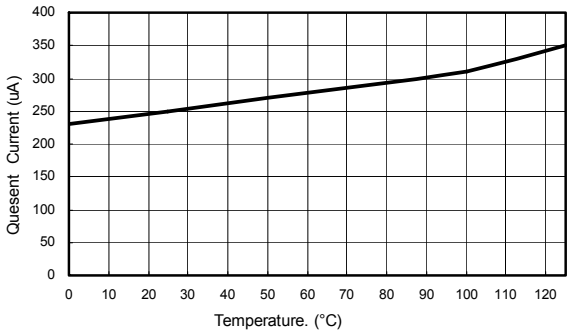
I_{LED} vs. SUPPLY VOLTAGE
(I_{LED}=20mA, Vf=3.2V)

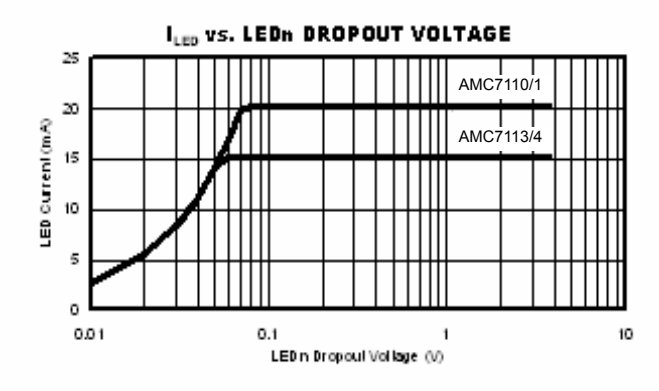


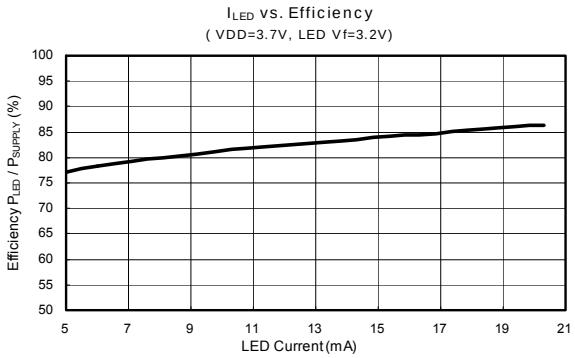
POWER IN vs. SUPPLY VOLTAGE
(4 LEDs, Vf=3.2V at 20mA/LED)

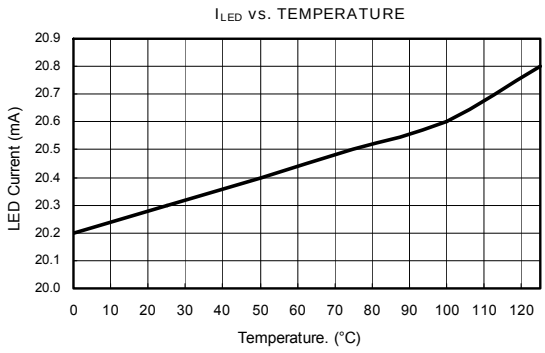


QUIESCENT CURRENT vs TEMPERATURE



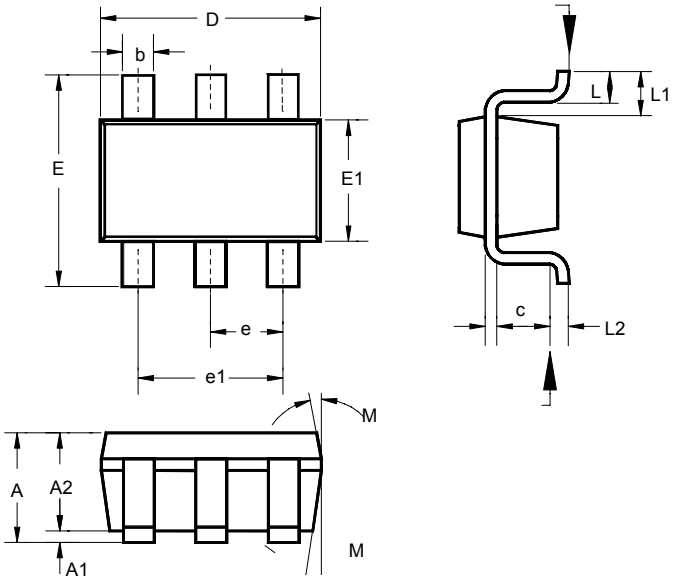



I_{LED} vs. Efficiency
(VDD=3.7V, LED Vf=3.2V)
Efficiency P_{LED} / P_{SUPPLY} (%)
100
95
90
85
80
75
70
65
60
55
50
5
7
9
11
13
15
17
19
21
LED Current (mA)


I_{LED} vs. TEMPERATURE
LED Current (mA)
20.9
20.8
20.7
20.6
20.5
20.4
20.3
20.2
20.1
20.0
0
10
20
30
40
50
60
70
80
90
100
110
120
Temperature. (°C)

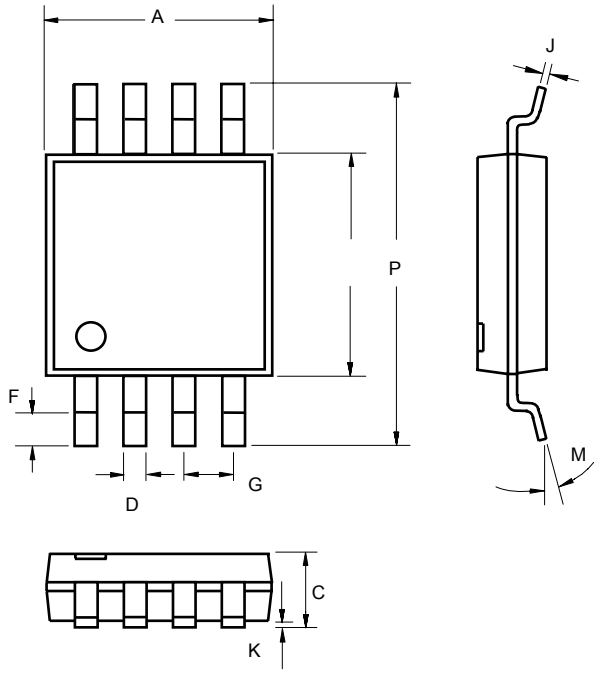
PACKAGE

Surface Mount SOT-26 (DB)



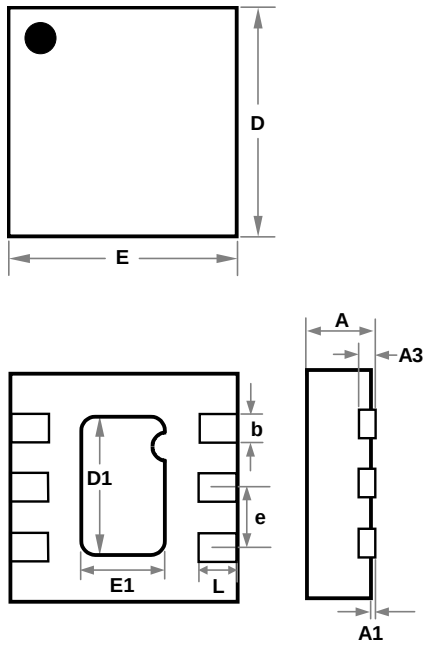
	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	-	-	0.057	-	-	1.45
A1	-	-	0.006	-	-	0.15
A2	0.035	0.045	0.051	0.90	1.15	1.30
b	0.012	-	0.020	0.30	-	0.50
c	0.003	-	0.009	0.08	-	0.22
D	0.114 BSC			2.90 BSC		
E	0.110 BSC			2.80 BSC		
E1	0.063`BSC			1.60 BSC		
e	0.037 BSC			0.95 BSC		
e1	0.075BSC			1.90 BSC		
L	0.012	0.018	0.024	0.30	0.45	0.60
L1	0.024 REF			0.60 REF		
L2	0.010 BSC			0.25 BSC		
°M	5°	10°	15°	5°	10°	15°

8-Pin Plastic MSOP (DN)



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.114	0.118	0.122	2.90	3.00	3.10
B	0.114	0.118	0.122	2.90	3.00	3.10
C		0.040	0.044		1.02	1.12
D		0.012			0.30	
F	0.016	0.021	0.031	0.40	0.53	0.80
G	-	0.026	-	-	0.65	-
J		0.006			0.15	
K	0.000	-	0.006	0.00	-	0.15
M	0º	-	8º	0º	-	8º
P	0.185	0.193	0.201	4.70	4.90	5.10

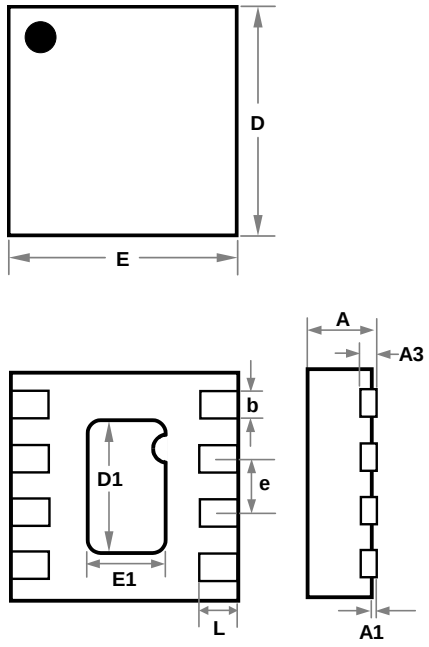
6-Pin QFN 2mm×2mm



SYMBOLS	MIN.	TYP.	MAX.
A	0.800	0.850	0.900
A1	0.000	-	0.050
A3	-	0.203	-
b	0.200	0.250	0.300
D	1.950	2.000	2.050
D1	1.350	1.400	1.450
E	1.950	2.000	2.050
E1	0.750	0.800	0.850
e		0.650	
L	0.300	0.350	0.400

UNIT: MILLIMETERS

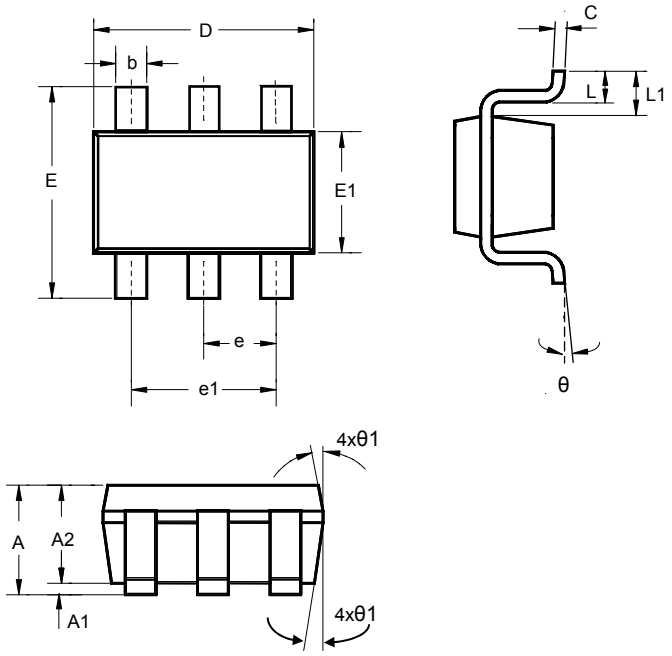
8-Pin QFN 2mm×2mm



SYMBOLS	MIN.	TYP.	MAX.
A	0.800	0.850	0.900
A1	0.000	-	0.050
A3	-	0.203	-
b	0.200	0.250	0.300
D	1.950	2.000	2.050
D1	1.150	1.200	1.250
E	1.950	2.000	2.050
E1	0.550	0.600	0.650
e	-	0.500	-
L	0.300	0.350	0.400

UNIT: MILLIMETERS

Surface Mount TSOT-26



SYMBOLS	MILLIMETERS		
	MIN	TYP	MAX
A	---	---	1.00
A1	0.00	0.05	0.10
A2	0.84	0.87	0.90
b	0.35	0.40	0.50
C	0.10	0.125	0.15
D	2.70	2.90	3.10
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	---	0.95	---
e1	---	1.90	---
L	0.30	0.40	0.60
L1	0.5	0.6	0.7
θ	0°	4°	8°
θ1	4°	10°	12°

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