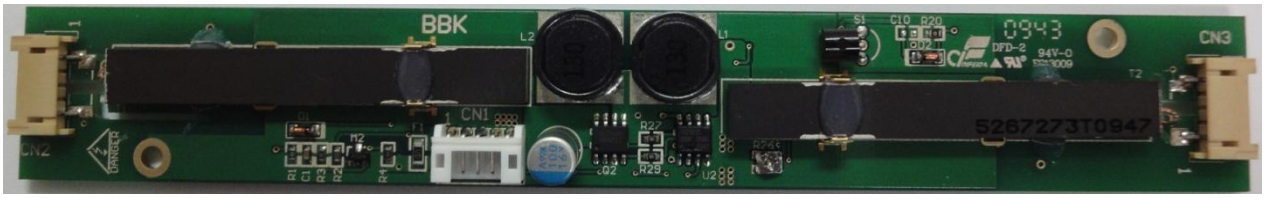
BBK Technology Corp.

Piezo Ceramics DC-AC Inverter Specification

[RoHS Compliant]



Note: Actual product image may be different.

Model	BBK02-12-06
Part No.	T0-260B0
Description	2 lamps with wide range dimming control
Customer	
Application	-
Hardware Rev	1.0
Document Rev	1.0

Approved by	Verified by	Prepared by
Bart	Bart	Catherine

Piezo Inverter
The ultimate solution for LCD backlight

** Important Notes **

Automatic Output Impedance Matching

Why BBK Piezo inverter lamp voltage is differing from panel spec?

One key advantage of Piezo inverter is the ability to AUTOMATICALLY adjust the output voltage based on lamp working condition. Unlike traditional transformer type inverter with fixed output voltage, Piezo inverter will automatically adjust output voltage for different lamp length, ambient temperature, lamp diameters, aging of lamp and etc.

BBK Piezo inverter is working in constant current source mode. Whenever lamp impedance changes, in order to maintain same lamp current, Piezo inverter will automatically raise or lower output voltage.

For example, same 6 watt Piezo inverter can turn on lamps with length ranging from <70mm to >620mm within -40 to +85 °C extreme working temperature range without any adjustment.

Most traditional inverter voltage spec is prepared for specific panel, BBK Piezo inverter voltage spec is for general reference. As lamp impedance varies a lot (manufacturing tolerance is high), we are using 90K or 120K ohm precision dummy resistor in production line to simulate lamp impedance. Our lamp voltage spec is based on this ± 5% tolerance.

For example, at 25 degree C, the impedance of a typical 17" panel with 330mm lamp is 117K ohm. The typical working lamp voltage will be 117K x 6ma ≅ 700V. Our voltage spec will show 720V with 120K Ohm dummy load and 6ma typical lamp current. This voltage spec will automatically adjust to meet panel spec. So, if you move same Piezo inverter to a smaller panel with 220mm lamp (with 83K ohm impedance), the lamp voltage will automatically adjust to 83K ohm x 6ma = 498V.

Automatic Output Impedance Matching is a unique feature of BBK Piezo inverter. It will provide cooler lamp working temperature (when lamp temperature rise, impedance go lower and lamp voltage will go lower) , extend lamp lifespan (when lamp aged, impedance go higher, lamp voltage will go higher to maintain same brightness).

Revision Record

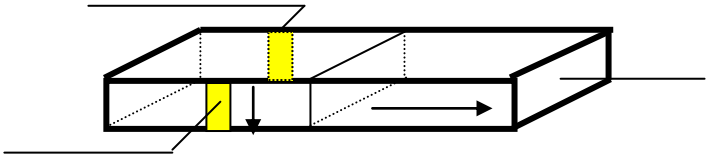
Request Document No.	Date	Page	Item	Description	Revision
0209122201	2009/12/22				1.0

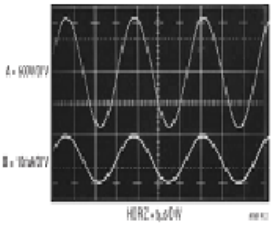
1. General:

Piezoelectric ceramics are used to convert electric energy to mechanical energy and vice versa. Piezoelectric transformer can generate a high voltage output by a low voltage input through the utilization of mechanical resonance and magnification phenomenon of the piezoelectric transducer.

1.1 Principle:

The piezoelectric transformer has primary and secondary electrodes on the piezoelectric ceramics. The primary side is polarized in the thickness direction and secondary side is polarized in the length direction. When a voltage with the resonance frequency is applied on the primary side, a strong mechanical vibration is generated by "inverse piezoelectric effect" of the ceramics, and a high voltage is output from the secondary side, matching its vibration frequency by "direct piezoelectric effect".





1.2 Advantages & special features:

- No EMI (Piezo ceramics)
- > 85% High efficiency
- Inflammability (no liability)
- Wide range no flicker dimming
- One size fits all
- Constant current mode
- Wide operating temperature –40℃ to +85℃
- Independent open lamp protection
- Independent short circuit protection
- Balanced sine wave output, ultra low harmonic current noise
- Short start up time, extended CCFL lifespan
- Open lamp and short circuit protection
- Built-in Arc Protection
- 100% full load test
- Compact Size, high reliability
- Low heat generation
- UL approval :
- RoHS compliant with Piezo ceramic exemption

*Spec subject to models

2. Detailed specification:

2.1 Electrical characteristics (Ta=25±5℃, Vin=12V, Load=120KΩ)

	ITEM			TEST	Min.	Typ.	Max.	Unit	Notes
1	Input voltage		Vin	-	-	12	-	V	Tolerance±10%
2	Input current	Min	Iin	D_{PWM}=0% & V_{IPWM}=5V	-	0.1	-	A	
		Max		D_{PWM}=100% & V_{IPWM}=0V	-	1.2	-		
3	Input Inrush Current		-	D_{PWM}=100% & V_{IPWM}=0V	-	-	2	Apeak	Initial power on only.
4	Output Inrush Current		-	D_{PWM}=50%	-	-	10	mApeak	
5	Total Output Current		Iout	D_{PWM}=100% & V_{IPWM}=0V	11	12	13	mA	
6	Individual Output Current	Min	I_L	D_{PWM}=0% & V_{IPWM}=5V	≧0	≦0.5	≦1	mA	Low volt side of LOAD
		Max		D_{PWM}=100% & V_{IPWM}=0V	5.5	6.0	6.5		
7	Oscillating Frequency		Fw	-	50	53	56	KHz	
8	Minimum Duty Ratio		Dmin	$D_{PWM}=D_{min}$	-	-	-	%	
9	On/Off Control Voltage	On	V_{BLON}	-	1.5	-.	5	V	
		Off		-	0	-	0.5	V	
10	On/Off Control Current		I_{BLON}	-	5	-	10	mA	
11	Internal DC Control Voltage	Min	V_{IPWM}	-	-	5	-	V	Duty Ratio ≤ 1%
		Max		-	-	0	-	V	Duty Ratio=100%
12	Internal DC Control Current		I_{IPWM}	-	5	-	-	mA	Dimming input current
13	Lamp Turn On Voltage		Vs	Ta=0℃	1400	-	-	Vrms	Under B/L condition
				Ta=25℃	1600	-	-		
14	Lamp Voltage		Vw	-	700	750	800	Vrms	
15	DC Bias Level		I_{DC}	-	-	-	10	%	$\|I_{peak} - I_{-peak}\|/I_L$

Note: Lamp voltages are measured with a simulated resistive load. Piezo inverter will automatically adjust output voltage to compensate for load changes caused by lamp manufacturing tolerance, ambient temperature, lamp aging and etc.

2.2 Environmental Characteristic:

Storage Temperature : -20℃～+85℃ Operating Temperature: -10℃～+85℃
Storage Humidity : 90% Max. Operating Humidity : 90% Max
(Non-condensation)

2.3 Protection Mechanism:

Condition	Test Method	Protection	NOTE
Over Voltage	Open Lamp	Shutdown	$0.1mS<T_{fault}<2S$
Over Current	Input Shutter	Shutdown	
Output Short	Output Shutter: 2K	Safety Voltage	0V<V<50V
Arcing	Transformer Open	Shutdown	$0.1mS<T_{fault}<2S$

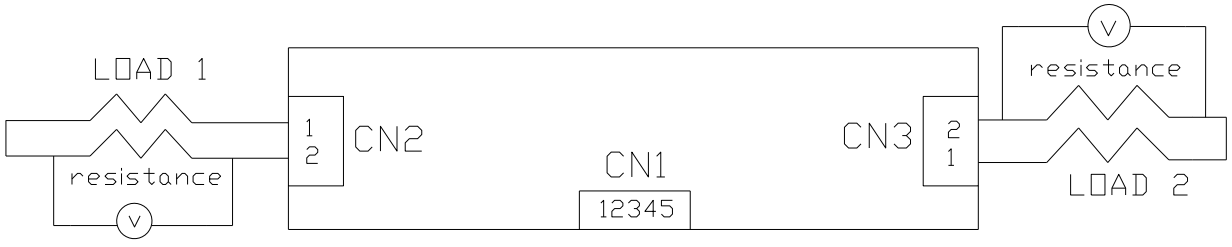
3. Application Notes:

3.1 Always connect output loading before turning on the unit to avoid damages.
3.2 Avoid over stressing the high voltage output connector by using short wire.
3.3 Avoid bending, twisting or applying any pressure to the PCB and Piezo transformer.

4. Typical Application:

LCD-TV, LCD-Monitor CCFL backlight

4.1 Input connector pin assignment:



Input: CN1 [JST S5B-PH-KL]

Pin	Signal name	Function
1	VIN	+12V
2	VADJ	100-1000HZ 0 to +5V PWM
3	ON/OFF	+5V / 0V
4,5	GND	Ground

Voltage level dimming: 0V Brightness, +5V Dark

4.2 Output connector pin assignment:

Output: CN2,CN3 [JST SM02(8.0)B-BHS-1-TB]

Pin	Signal name	Function
1	CFL HOT	CFL High voltage
2	CFL COLD	CFL Low Voltage

5. Reliability

5.1 Production tests

	Test item	Test condition	Criteria
1	Low temp. Operation	Ta=-40℃ 500 hr.	Measurement must be performed 1 hr. after taken out from the chamber. Must meet initial performance except CCFL deterioration.
2	High temp. Operation	Ta=+85℃ 500 hr.	
3	High temp & Humidity	Ta=50℃, 80%RH, 1000 hr.	
4	Low temp. Storage	Ta=-40℃, 240hr. Non operation	Measurement must be performed 4 hr. after taking out from the chamber. Must meet initial performance except CCFL deterioration.
5	High temp. Storage	Ta=+85℃, 240hr. Non operation	
6	Thermal shock	Ta=-20℃, 30min.<->+60℃, 30min. 200 cycles, non operation, Transition duration less than 3 min.	
7	On-Off Cycle	Ta=25 ± 3℃ 500 hr., 10[s] ON, 10[s] OFF 100,000 cycles	Must meet Initial performance except CCFL deterioration.
8	Shock	100G 11mSec. Half-sine pulse 1time each axis X, Y, Z,	No noticeable changes allowed
9	Vibration	10-57Hz, Amplitude 0.75mm, 57~500Hz 2G Sweep: 11 min., 60 min. each axis X, Y, Z,	No noticeable changes allowed

6. Safety requirements

6.1 Applicable safety standards

- UL 60950-1:2003
- CSA C22.2 NO.60950-1-03
- IEC60950-1:2001
- EN 60950-1:2001

6.2 Abnormal tests

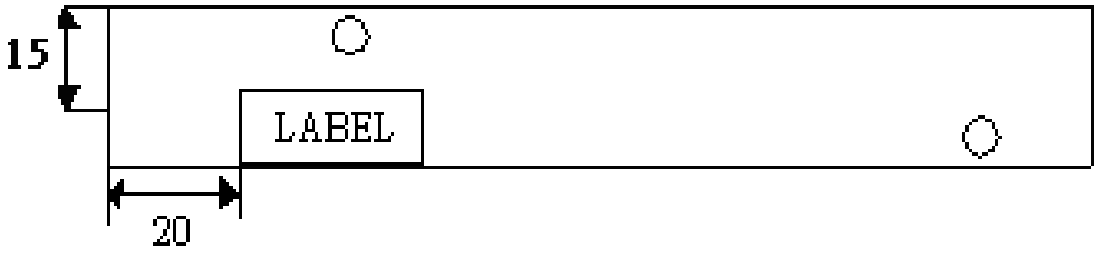
There must be no smell, smoke and fire cause by any failure on the inverter circuit. All components open/short test must be performed and reported. Especially, should not rely on a fuse or an over load protection function of the power supply.

6.3 Limited current circuit

The inverter conforms to IEC60950 limited current circuit spec and is UL approved with file number: xxxxxxx

7. Additional notes:

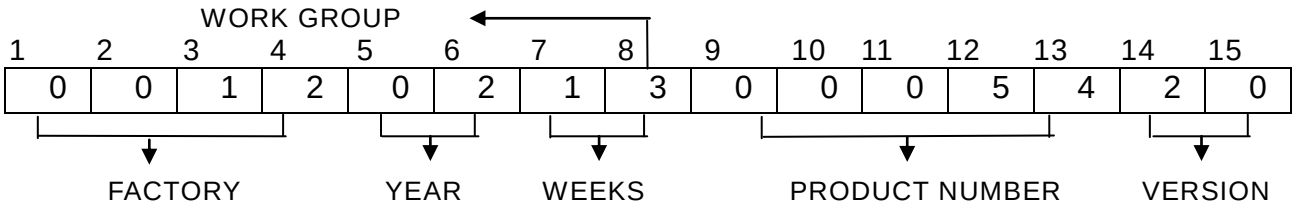
7.1 Label position (Reverse side of PCB)



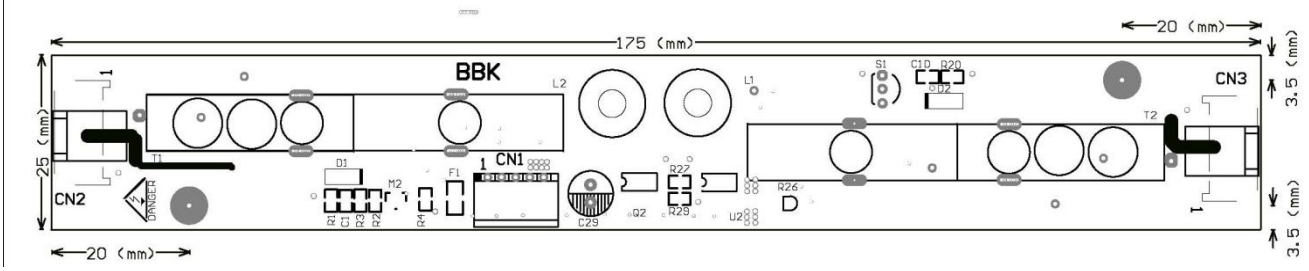
Label: Includes model, part number and data code.

Model Part No Data code

7.2 Data code (example):



8. PCB layout:



NOTES:

1. PCB Board general tolerance: ± 0.1mm
2. Hole tolerance: ± 0.1mm
3. Base board thickness: 1.6mm
4. Material: FR-4
5. Thru hole: 3.0mm
6. **products composition has to keep 3 mm safety distance away**

9. BOM List:

項次	料號	零件位置	品名規格
1	4213200911	T1	PZT 53.6K707120L
2	4213200911	T3	PZT 53.6K707120L
3	D200000001	U4	IC TL494BDR2G SO16
4	D200000001	U6	IC TL494BDR2G SO16
5	D200000005	U2	IC IR2302SPBF SOCI-8
6	D200010005	M2	N_MOSFET 2N7002LT1G SOT-23
7	D200010005	M3	N_MOSFET 2N7002LT1G SOT-23
8	D200010006	Q2	MOS AP4228G SO-8
9	D200020001	D1	Diode LL4148 SMD
10	D200020001	D11	Diode LL4148 SMD
11	D200020001	D17	Diode LL4148 SMD
12	D200020001	D2	Diode LL4148 SMD
13	D200020001	D3	Diode LL4148 SMD
14	D200020001	D4	Diode LL4148 SMD
15	D200020001	D6	Diode LL4148 SMD
16	D200020001	D7	Diode LL4148 SMD
17	D200070001	S1	SCR LT S08M02-600A
18	D200111012	R14	C/R SMD 1206 1M 1%
19	D200111012	R15	C/R SMD 1206 1M 1%
20	D200111013	R11	C/R SMD 1206 5.6M 5%

21	D200111013	R12	C/R SMD 1206 5.6M 5%
22	D200113001	R3	C/R SMD 0603 0Ω 5%
23	D200113001	R42	C/R SMD 0603 0Ω 5%
24	D200113001	R7	C/R SMD 0603 0Ω 5%
25	D200113003	R32	C/R SMD 0603 16.2Ω 1%
26	D200113004	R27	C/R SMD 0603 18Ω 1%
27	D200113004	R29	C/R SMD 0603 18Ω 1%
28	D200113018	R1	C/R SMD 0603 180Ω 5%
29	D200113018	R20	C/R SMD 0603180Ω 5%
30	D200113030	R17	C/R SMD 0603 2.2K 5%
31	D200113030	R18	C/R SMD 0603 2.2K5%
32	D200113030	R41	C/R SMD 0603 2.2K 5%
33	D200113034	R38	C/R SMD 0603 4.7K 5%
34	D200113034	R4	C/R SMD 0603 4.7K 5%
35	D200113034	R40	C/R SMD 0603 4.7K 5%
36	D200113034	R45	C/R SMD 0603 4.7K 5%
37	D200113034	R46	C/R SMD 0603 4.7K 5%
38	D200113034	R6	C/R SMD 0603 4.7K 5%
39	D200113049	R37	C/R SMD 0603 51K 1%
40	D200113049	R44	C/R SMD 0603 51K 1%
41	D200113065	R28	C/R SMD 0603 470K 5%
42	D200113065	R43	C/R SMD 0603 470K 5%
43	D200113072	R25	C/R SMD 0603 1M 5%
44	D200113072	R60	C/R SMD 0603 1M 5%
45	D200113082	R31	C/R SMD 0603 15K 1%
46	D200113100	R2	C/R SMD 0603 1K 5%
47	D200113103	R34	C/R SMD 0603 10K 5%
48	D200113103	R5	C/R SMD 0603 10K 5%
49	D200113103	R8	C/R SMD 0603 10K 5%
	D200113034	**R8**	**C/R SMD 0603 4.7K 5%**
50	D200113270	R33	C/R SMD 0603 2.7K5%
51	D200113523	R35	C/R SMD 0603 52.3K 1%
52	D200113624	R23	C/R SMD 0603 620K 5%
53	D200140001	R26	VR SMD 3mm 2K BOURNS
54	D200200001	C29	DIP PAS 100uF/16V
55	D200202001	C20	S/C SMD 0805 Y5V 106/10V
56	D200203001	C1	S/C SMD 0603 Y5V 104/50V

57	D200203001	C10	S/C SMD 0603 Y5V 104/50V(no mont)
58	D200203001	C12	S/C SMD 0603 Y5V 104/50V
59	D200203001	C13	S/C SMD 0603 Y5V 104/50V
60	D200203001	C15	S/C SMD 0603 Y5V 104/50V
77	D200203001	C6	S/C SMD 0603 Y5V 104/50V
78	D200203001	C7	S/C SMD 0603 Y5V 104/50V
61	D200203003	C14	S/C SMD 0603 NPO 561/50V 2%
62	D200340501	CN1	CON.DIP 2.0mm-5P 90°
63	D200341401	CN2	CON.SMD 8.0mm-2P
64	D200341401	CN3	CON.SMD 8.0mm-2P
65	D200400002	L1	13uH,125
66	D200400002	L2	13uH,125
67	D210090001		PCB INVERTER 1 TO 2
68	D210100001	F1	CHIP FUSE 1206 SMD 3.15A/32V
69	D300000001		103-MB 鍍金>3um A 模
70	D700020002		序號貼紙
71	D700060102		外箱(高)
72	D700060207		蜂巢隔板(中) 14 刀
73	D700060208		蜂巢隔板(中) 9 刀
74	D700060301		雙面背膠 圓 5mm×厚度 0.75mm
75	D700060302		雙面背膠 圓 8mm×0.75mm
76	D700060501		天地板 356×336mm 3 層板

10. CIRCUIT SCHEMATIC: