

Piezo Ceramics DC-AC Inverter Specification

[RoHS Compliant]



Note: Actual product image may be different.

Model	FC01-12-03
Part No.	D00-8888-048
Description	1 lamps with wide range dimming control Independent open lamp protection
Customer	-
Application	-
Hardware Rev	1.0
Document Rev	1.5

Approved by	Verified by	Prepared by
Eddie	Bart	Yiman



Zippy Piezo Inverter
The ultimate solution for LCD backlight

**** Important Notes ****

Automatic Output Impedance Matching

Why Zippy 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.

Zippy 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, Zippy 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 $\pm 5\%$ 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 $117K \times 6ma \cong 700V$. 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 $83K \text{ ohm} \times 6ma = 498V$.

Automatic Output Impedance Matching is a unique feature of Zippy 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

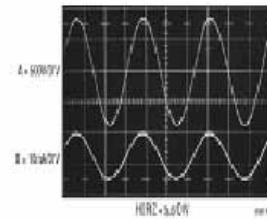
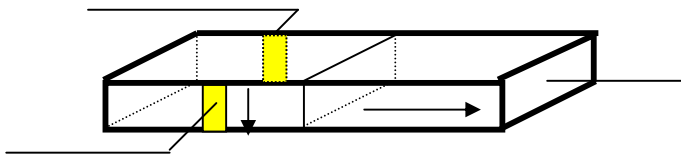
Request Document No.	Date	Page	Item	Description	Revision
FC09172006	9/17/2006	1		Change Document Rev to 1.1 Consolidate pin 1 definition on page 6 & 8	1.1
FC12272006	12/27/2006	5 6 7 7 7	2.2 5.1 5.2 6.1 7.1	Change Document Rev to 1.2 Correct Environmental Characteristic Correct Production tests Delete Typical duty cycle Correct Applicable safety standards Correct Label Set	1.2
FC04092007	04/09/2007	7	7.1	Change Document Rev to 1.3 Correct Label Set	1.3
FC07112007	07/11/2007	6	4.1	Change Document Rev to 1.4 Correct Input connector in assignment.	1.4
FC12262007	12/26/2007	1 2 4 5 6	1.2 2.1 4.1	Change Document Rev to 1.5 Increases a item - Application Increases the page 2 Correct Advantages & special features Correct Electrical Characteristics Correct In put connector pin assignment	1.5

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 E304655
 - RoHS compliant with Piezo ceramic exemption
- *Spec subject to models

2. Detailed specification:

2.1 Electrical characteristics (Ta=25±5)

ITEM		TEST	Min.	Typ.	Max.	Unit	Notes	
1	Input voltage	Vin	-	10.8	12	13.2	v	8-18V DC input voltage acceptable
2	Input current	Min	D _{PWM} =0% & V _{IPWM} =5V	-	0.1	-	A	
		Max	D _{PWM} =100% & V _{IPWM} =0V	-	0.35	-		
3	Input Inrush Current	-	D _{PWM} =100% & V _{IPWM} =0V	-	-	2	A _{peak}	Initial power on only.
4	Output Inrush Current	-	D _{PWM} =50%	-	-	11	mA _{peak}	
5	Total Output Current	I _{out}	D _{PWM} =100% & V _{IPWM} =0V	5.5	6.0	6.5	mA	
6	Individual Output Current	Min	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	F _w	-	70	74	80	KHz	
8	Minimum Duty Ratio	D _{min}	D _{PWM} =D _{min}	-	-	-	%	
9	On/Off Control Voltage	On	-	1.8	-	5	v	
		Off	-	0	-	1.7	v	
10	On/Off Control Current	I _{B_{LON}}	-	5	-	10	mA	
11	Internal DC Control Voltage	Min	-	-	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	V _s	Ta=0	1200	-	-	V _{rms}	Under B/L condition
			Ta=25	1400	-	-		
14	Lamp Voltage	V _w	-	550	600	650	V _{rms}	*90KΩ load
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	: -40 ~+85	Operating Temperature:	-40 ~+85
Storage Humidity	: 90% Max	Operating Humidity	: 90% Max
	(RH Non-condensation)		

2.3 Protection Mechanism:

Condition	Test Method	Protection	NOTE
Over Voltage	Open Lamp	Shutdown	0.1S<T _{fault} <2S
Over Current	Input Shutter	Shutdown	
Output Short	Output Shutter: 2K	Shutdown	
Arcing	Transformer Open	Shutdown	

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 [MOLEX 53261-0671]

Pin	Signal name	Function
1, 2	VIN	+12V
3	VADJ	0 to +5V voltage level or 100-1000Hz 0 to +5V PWM
4	ON/OFF	+5V / 0V
5, 6	GND	Ground

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

4.2 Output connector pin assignment:

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

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

*Wrong connections will cause electric shock and also break down of the product.

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.	Measurement must be performed 4 hr. after taking out from the chamber. Must meet initial performance except CCFL deterioration.
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: E304655.

7. Additional notes:

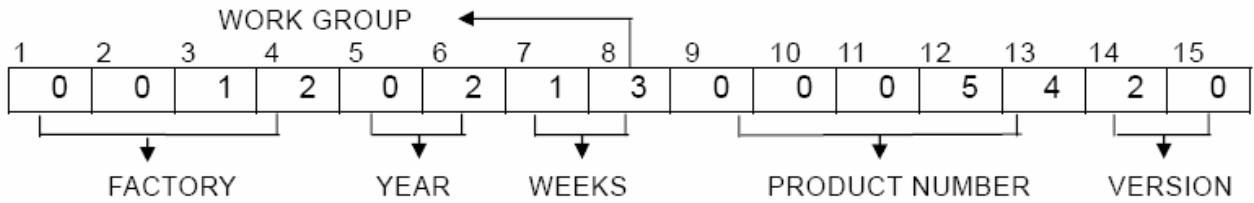
7.1 Label position (Reverse side of PCB)



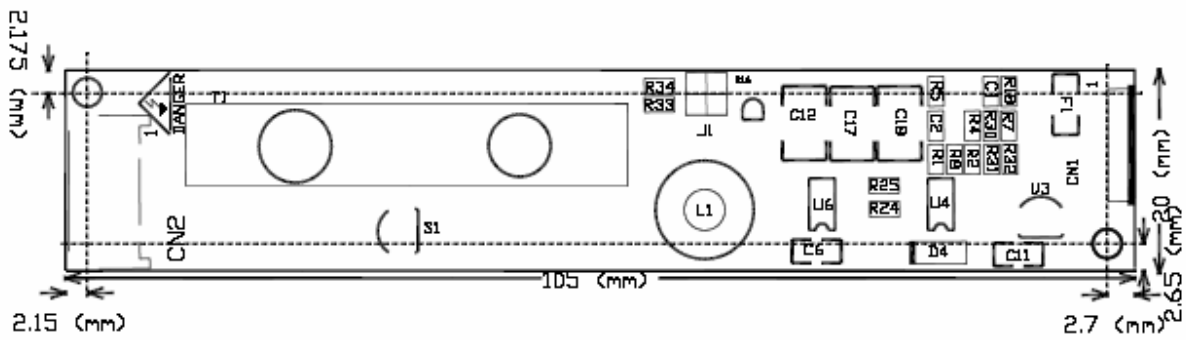
Label: Includes model, part number and data code.

Model
Part No
Data code

7.2 Data code (example):



8. PCB layout:



NOTES:

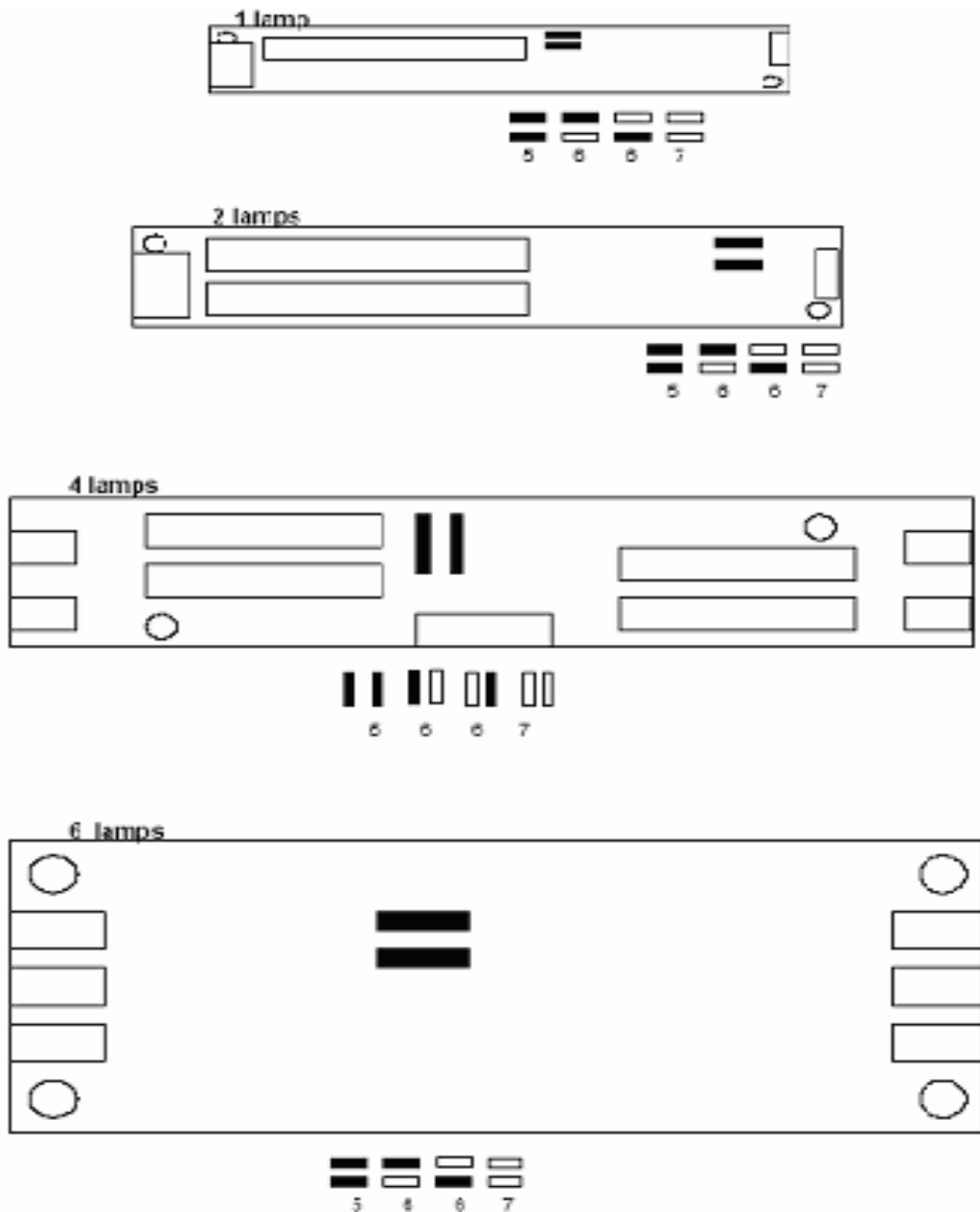
1. PCB Board general tolerance: $\pm 0.1\text{mm}$
2. Hole tolerance: $\pm 0.1\text{mm}$
3. Base board thickness: 1.0mm
4. Material: FR-4
5. Thru hole: 3.0mm



ZIPPY TECHNOLOGY CORP.

Appendix

Zippy Piezo Inverter lamp current jumper



ZIPPY USA INC.
ZIPPY TECHNOLOGY CORP.

TEL: 1-973-463-9499
TEL: 886-2-2918-8512

e-mail: edward@zippy.com
e-mail: ceramicsales@zippy.com.tw