

LT8722

Monolithic Thermoelectric Cooler Driver

DESCRIPTION

Demonstration circuit 3145A demonstrates a high efficiency thermoelectric cooler driver and features the LT8722 monolithic driver.

The input voltage range of the DC3145A is from 3.1V to 15V and the output is a SPI programmable differential voltage output. The maximum output current is 4A.

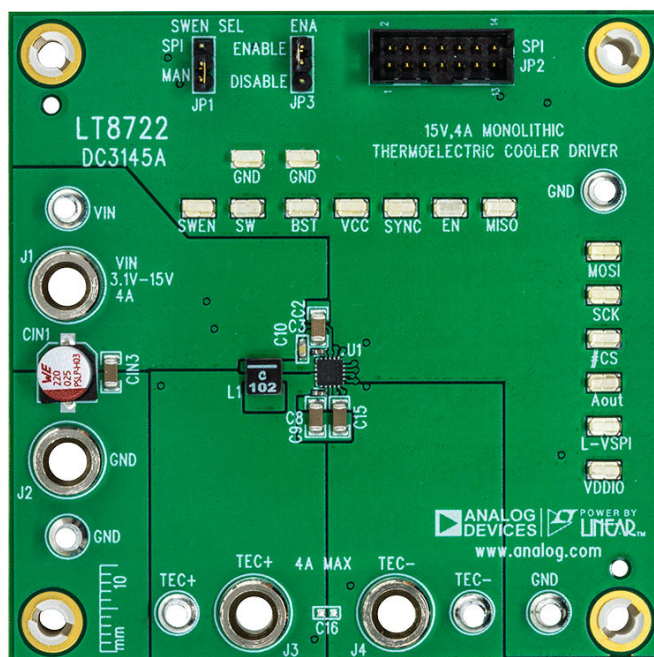
The switching frequency SPI programmable from 500kHz to 3MHz.

The LT8722 is controlled through an SPI interface and therefore the demonstration circuit is also setup to interface through SPI. For demonstration purposes this manual provides instruction on how to connect the DC2026C Linduino board to monitor and control the DC3145A with a PC using a command line Arduino IDE interface.

Demoboard Features

- The (JP2) connector is intended to connect to the DC2026C through a ribbon cable.
- The (JP1) jumper has two positions; ENABLE and LIN. Ensure the jumper is connected to ENABLE to enable the LT8722.
- The (JP3) jumper has two positions; MANUAL and LIN. Ensure the jumper is connected to MANUAL.
- The SYNC input can be used to sync LT8722 with an external signal. There are also terminals that make it easy to monitor the various points in the circuit.
- Aout is an analog output of the LT8722 and can be used to output various signals as described in the LT8722 datasheet. A DVM can be used to monitor the Aout signal.

BOARD PICTURE



PERFORMANCE SUMMARY

PARAMETER	CONDITIONS	MIN	TYP	MAX
Minimum Input Voltage, V_{IN}				3.1V
Maximum Input Voltage, V_{IN}		15V		
Output Voltage, V_{out}				
Output current, I_{in}				4A
Efficiency	$V_{IN} = 15V, I_{OUT} = 4A, 3MHz$		92.6%	
Switching Frequency			2MHz	

QUICK START PROCEDURE

To evaluate the performance of DC3145A follow procedure below.

- Set the DC2026C JP3 link to 3.3V as shown in fig. 2.
- As shown in fig. 6:
 - Connect DC2026C to LT8722 demoboard.
 - Connect to TEC load as shown in Fig. 3. TEC+ and TEC- correspond to the DC3145A banana jacks with the same labels.
 - Connect a voltmeter.
 - Connect USB cable from DC2026C to PC.
 - Connect bench top power supply to LT8722 demoboard and ensure voltage is set between 3.1V and 15V.
- Refer to "dc2026cfe.pdf" for Linduino software initial setup. Instructions and files for Linduino can be found by searching "DC2026C" on the Analog website or by clicking on the following link <https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/dc2026c.html#eb-overview> Once installed proceed to the next step.
- Start the Arduino/Linduino software.
- Set the Sketchbook location under File->Preferences->Settings.
- Download the LT8722_App0.ino Sketch file which can be found under "Resources" for the DC3145A Evaluation Kit or by clicking on the following link <https://www.analog.com/en/products/lt8708.html#product-evaluationkit>
- Open the LT8722_App0.ino Sketch.
- Upload the file to the DC2026C board under Sketch->Upload.
- Next, ensure the Arduino/Linduino software is properly connected to the port for the DC2026C. See fig. 4. The correct port is typically the one with the smallest number however you may need to experiment until you find it.
- Open the serial monitor under Tools->Serial Monitor
- Set baud rate to 1M at the bottom of the Serial Monitor window as shown in Fig. 5
- Commands can now be entered in the command line window of the Serial Monitor. See "Linduino (Sketch) Commands" section for available commands.

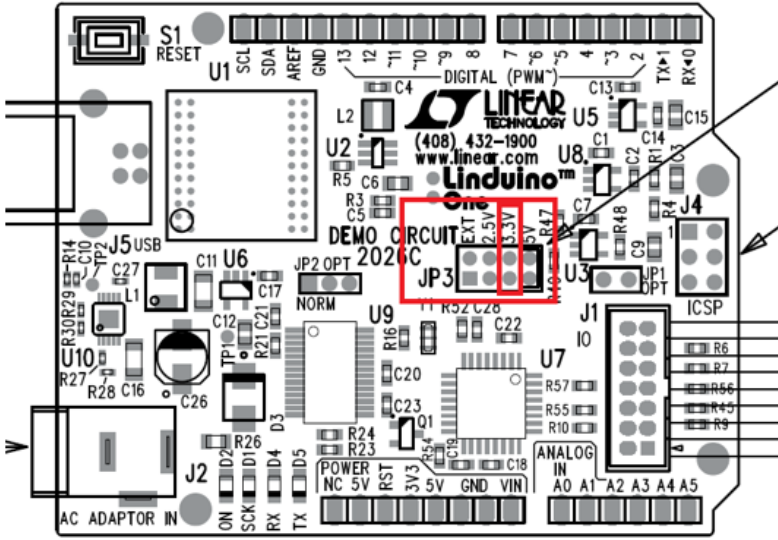


Figure 2: DC2026C Voltage Setting

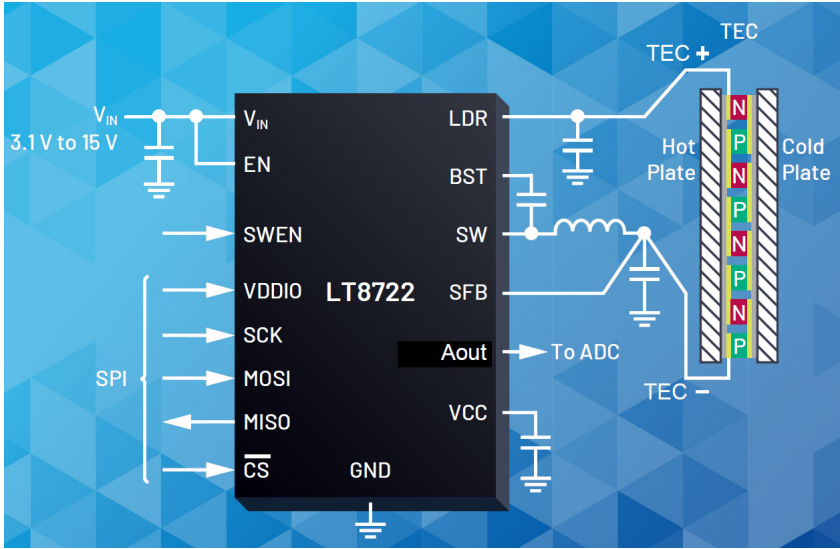


Figure 3: TEC Load Connections

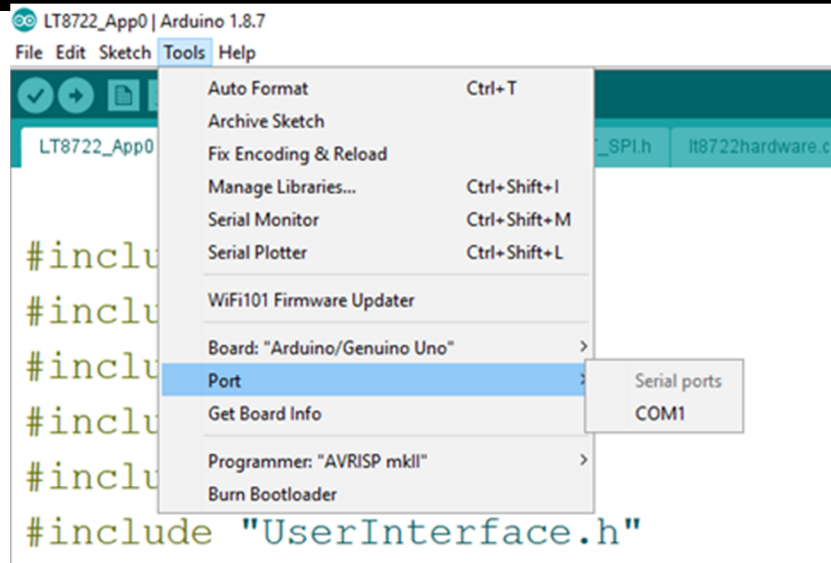


Figure 4: Port Setting



Figure 5: Select Baud Rate

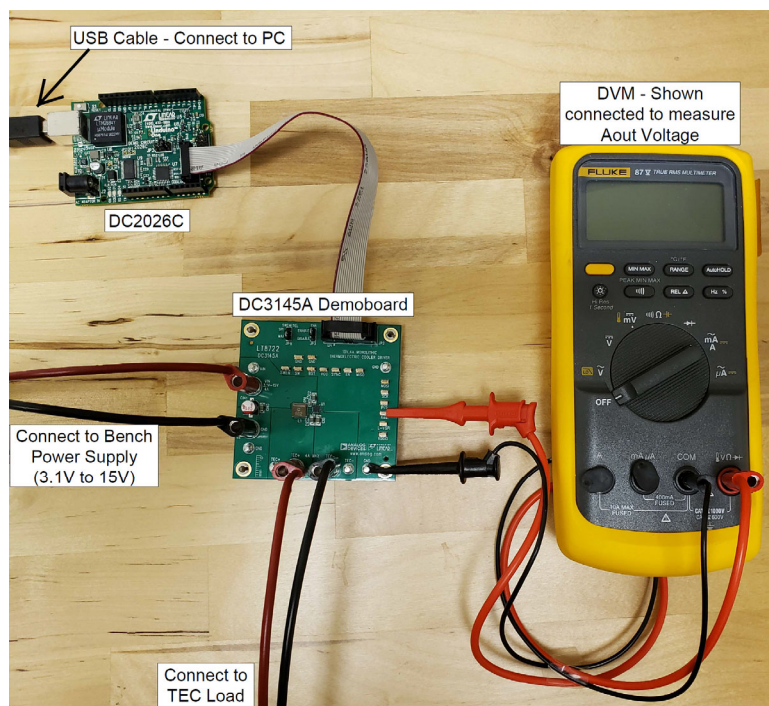


Figure 6: Initial Setup

QUICK START PROCEDURE

Linduino (Sketch) Commands:

- Please refer to the datasheet for register addresses. These registers are 32 bit.
- 'e' command - Read register command
 - Any register as defined in the LT8722 datasheet can be read with this command.
 - Example: e00 entered in the command line displays the result for the SPIS_COMMAND register (address 00). Entering this command will output a result similar to the following:

```
MOSI:F400400000000000
MISO:00010000120F32A5
```

We need to explain to the customer how to interpret this result. Dave to provide explanation.

- 'E' command - Write register command
 - 'E' followed by the register address followed by the data to be written. Examples:

- A command line entry of E000000A214 writes the hex value "0000A214" to the SPIS_COMMAND register (address 00).
- A Command line entry of E02000001FF writes the hex value "000001FF" to the SPIS_DAC_ILIMP register (address 02).
- 'U' command - Soft-start command
 - Entering the 'U' command does a soft-start startup of the LT8722
 - The LDR (TEC+) output and SW pin voltage response should be similar to what is shown in Fig. 7.
- 'u' command - Stop command
 - Entering the 'u' command disables the switcher output (SW) and resets the LT8722
- 'D' command - Zero the output voltage command
 - Entering the 'D' command sets the differential output voltage to zero volts
- 'V' command - Set output voltage command

DEMO MANUAL DC3145A

- Entering 'V' followed by the voltage desired, sets the desired output voltage. Examples:
 - V1.0 sets the output voltage to 1.0 volts
 - V-1.0 sets the output voltage to minus 1.0 volts
- V1.000001 sets the output voltage to 1.000001 volts
- "t" command – Configures the Aout pin to output a voltage corresponding to the IC temperature.
 - See LT8722 datasheet for equation to convert this voltage to temperature.

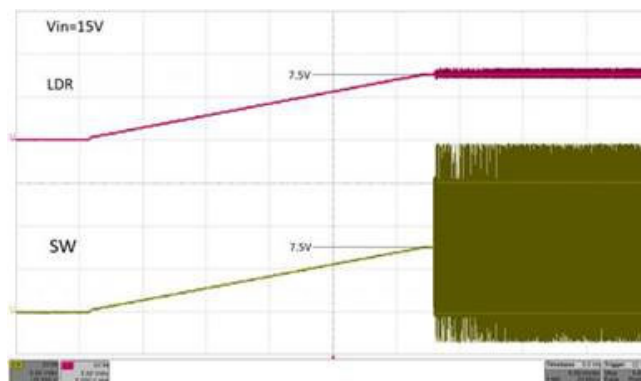


Figure 7: Soft-start Response

THERMAL IMAGE

Conditions:

- $V_{in} = 15V$
- $V_{out} = 13.3V, 3.83A$
- Ambient temperature = $25^{\circ}C$
- Air Flow – Natural Convection

As shown in Fig. 8, the LT8722 IC reaches $77^{\circ}C$ with demoboard efficiency of 95.1%.



Figure 8: Thermal Image of DC3145A

DEMO MANUAL DC3145A

PARTS LIST

Item Number	Quantity	Part Reference	Description	Manufacturer	Manufacturer PN	MFR PN Status	Value	PART_NUMBER	BOM Notes
1	1	C1	CAP,.47uF,TANT,.20V,20%,7343,TAID, NO SUBS. ALLOWED	AVX	TAJD476M020RNJ	Y	47uF	150-0568	
2	4	C2,C9,C15,CIN3	CAP,.47uF,X7R,25V,10%,1206	AVX	12063C475KAT2A	Y	4.7uF	150-0422	
3	2	C3,C8	CAP,.01uF,X5R,25V,10%,0402	SAMSUNG	04023D104KAT2A	Y	0.1uF	150-0249	
4	3	C4,C5,CIN4	CAP,.1uF,X7R,25V,10%,0603,AEC-Q200	TDK	CL05A104KA5NNNC	Y	1uF	150-0501	
5	0	C7,C16,C17,CIN5	CAP,.OPTION, 0603	MURATA	C1005X5R1E104K050BC	Y	OPT	150-3038	NO STUFF
6	1	C10	CAP,.01uF,X7R,25V,10%,0603,AEC-Q200	AVX	06033C104K4T4A	Y	0.1uF	150-0439	
7	1	C11	CAP,.1000pF,X7R,25V,10%,0603	SAMSUNG	CL10B104KA8WPNPNC	Y	1000pF	150-0050	
8	3	C12,C13,C14	CAP,.0047uF,X7R,25V,10%,0603	AVX	06033C102KAT2A	Y	0.047uF	150-0063	
9	2	CIN1,CIN2	CAP,.22uF,ALUM,25V,20%,SMD 6.3x5.8mm	AVX	06033C102KAT4A	Y	22uF	150-0926	
10	0	D1,D2	DIODE, OPTION, SOD-323	WURTH ELEKTRONIK	875105544003	Y	OPT	210-0118	NO STUFF
11	6	E1,E2,E3,E4,E5,E6	TEST POINT,TURRET,0.094" MTG. HOLE,PCB 0.062" THK	MILL-MAX	2501-2-00-80-00-00-07-0	Y	TEST POINT	260-0003	
12	15	E7,E8,E9,E10,E11,E12,E13	TEST POINT,SILVER PLATE,PHOSPHOR BRONZE,3.81mmX2.03mm,2.29mm H	KEYSTONE	5019	Y	TEST POINT	260-0018	
13	4	J1,J2,J3,J4	CONN,BANANA JACK,FEMALE,THT,NO INSULATED,SWAGE,0.218"	KEYSTONE	575-4	Y	BANANA JACK	250-0428	
14	2	JP1,JP3	CONN,HDR,MALE,1x3,2mm,VERT,ST,THT,NO SUBS. ALLOWED	Wurth Elektronik	62000311121	Y	HDR	250-0639	
15	1	JP2	CONN,HDR,SHROUDED,PLUG,MALE,2x7,2mm,VERT,ST,THT,KEYED	MOLEX	87831-1420	Y	HDR,SHROUDED	250-0403	
16	1	L1	IND,.10uH,POWER,20%,12A,9.0mOHMS,4.3mmX4.3mm,AEC-Q200	COILCRAFT	XGL4020-102MEC	Y	1.0uH	TMP-7216	
17	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY	THT-96-717-10	Y	LABEL	895-0154	
18	4	MP1,MP2,MP3,MP4	STANDOFF,NYLON,SNAP-ON,0.50"	KEYSTONE	8833	Y	STANDOFF	763-0007	
19	1	PCB1	PCB, DC3145A	ADI APPROVED SUPPLIER	600-DC3145A	Y	PCB, DC3145A	600-DC3145A	REV03
20	1	R1	RES,.1k OHM,5%,1/10W,0603,AEC-Q200	VISHAY	CRCW06031K00INEA	Y	1k	100-2534	
21	1	R2	RES,.10 OHMS,5%,1/10W,0603,AEC-Q200	PANASONIC	ERJ3GEY100V	Y		100-2058	
22	1	R3	RES,.20k OHMS,1%,1/10W,0603	VISHAY	CRCW060310R0INEA	Y		100-2117	
23	0	R4	RES,.100 OHMS,5%,SW,20.47mm X 10.31mm	PANASONIC	NRC06F2002TRF	Y		100-1740	NO STUFF
24	2	R5,R6	RES,.100k OHMS,5%,1/10W,0603,AEC-Q200	YAGEO	CRCW060320K0FKEA	Y	100k	100-2856	
25	0	R7	RES,.OPTION, 0603	OHMITE	ERJ3KEF2002V	Y	OPT	100-2374	NO STUFF
26	1	STNCL1	TOOL, STENCIL, 700-DC3145A	NI	RW550FA100RIE	Y	TOOL, STENCIL, 700-DC3145A	700-DC3145A	REV03
27	1	U1	IC,15V, 4A MONOLITHIC THERMOELECTRIC COOLER CONTROLLER	ADI APPROVED SUPPLIER	830-DC3145A	Y			
28	2	XIP1,XIP2	CONN,SHUNT,FEMALE,2 POS,2mm	ANALOG DEVICES	LT8722LQFN#PBF	Y	SHUNT	250-0485	
				Wurth Elektronik	60800213421	Y			

SCHEMATIC DIAGRAM

