

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.

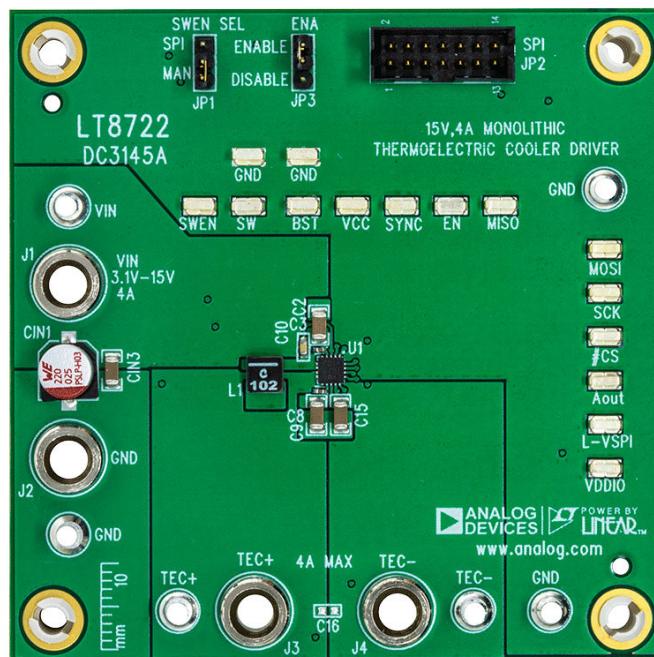
The switching frequency SPI programmable from 500kHz to 3MHz.

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.

1. Set the DC2026C JP3 link to 3.3V as shown in fig. 2.
2. As shown in fig. 6:
 - a. Connect DC2026C to LT8722 demoboard.
 - b. Connect to TEC load as shown in Fig. 3. TEC+ and TEC- correspond to the DC3145A banana jacks with the same labels.
 - c. Connect a voltmeter.
 - d. Connect USB cable from DC2026C to PC.
 - e. Connect bench top power supply to LT8722 demoboard and ensure voltage is set between 3.1V and 15V.
3. 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.
4. Start the Arduino/Linduino software.
 5. Set the Sketchbook location under File->Preferences->Settings.
 6. 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>
 7. Open the LT8722_App0.ino Sketch.
 8. Upload the file to the DC2026C board under Sketch->Upload.
 9. 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.
 10. Open the serial monitor under Tools->Serial Monitor
 11. Set baud rate to 1M at the bottom of the Serial Monitor window as shown in Fig. 5
 12. Commands can now be entered in the command line window of the Serial Monitor. See “Linduino (Sketch) Commands” section for available commands.

DEMO MANUAL DC3145A

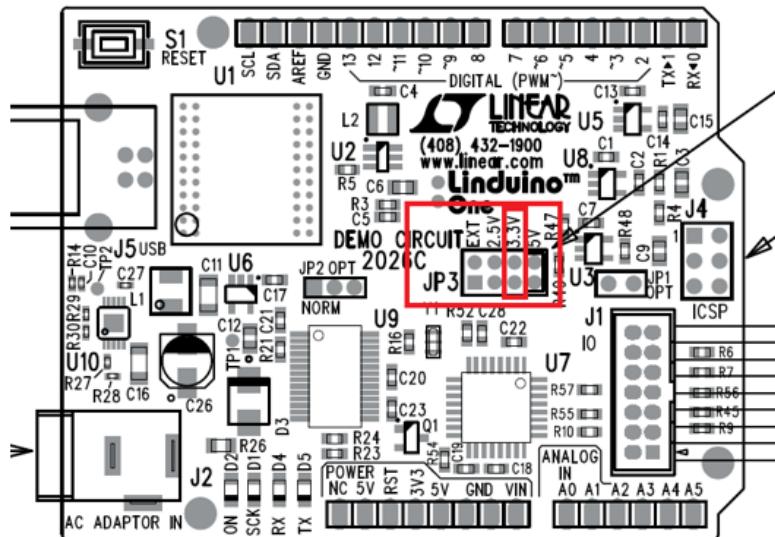


Figure 2: DC2026C Voltage Setting

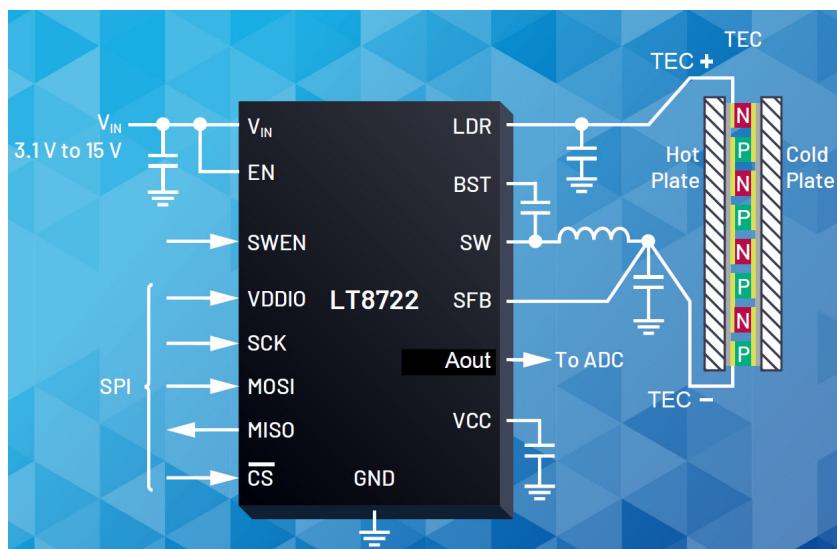


Figure 3: TEC Load Connections

DEMO MANUAL DC3145A

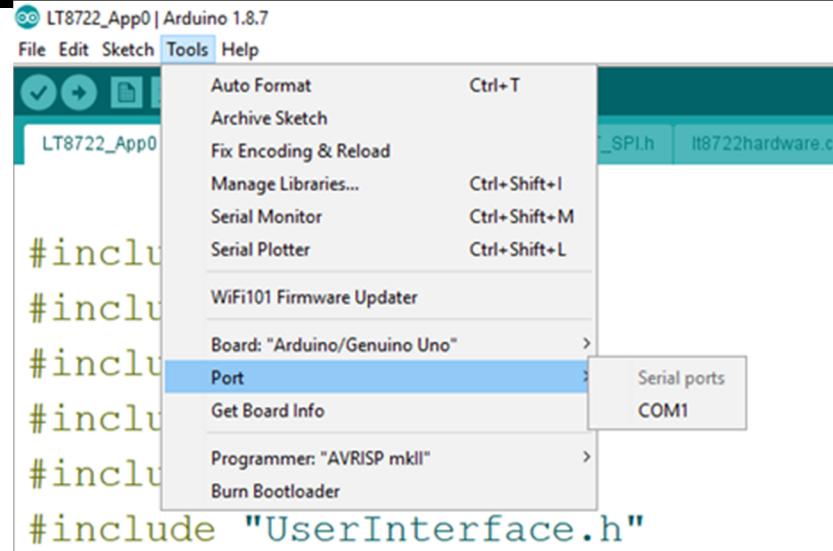


Figure 4: Port Setting

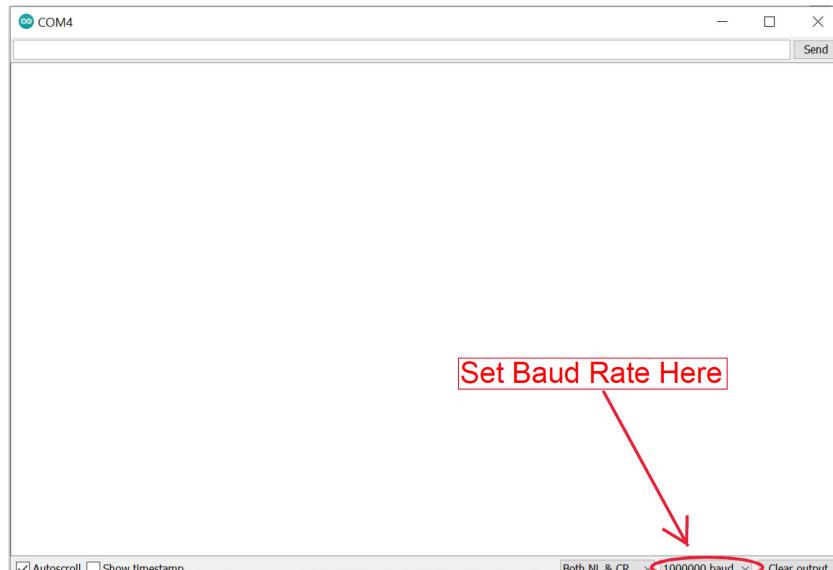


Figure 5: Select Baud Rate

DEMO MANUAL DC3145A

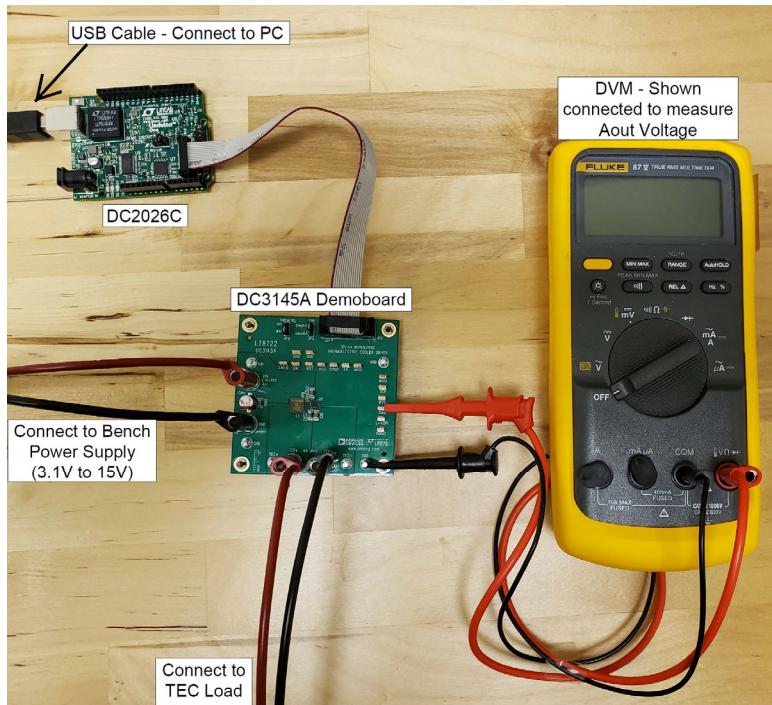


Figure 6: Initial Setup

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:F4004000000000000  
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.

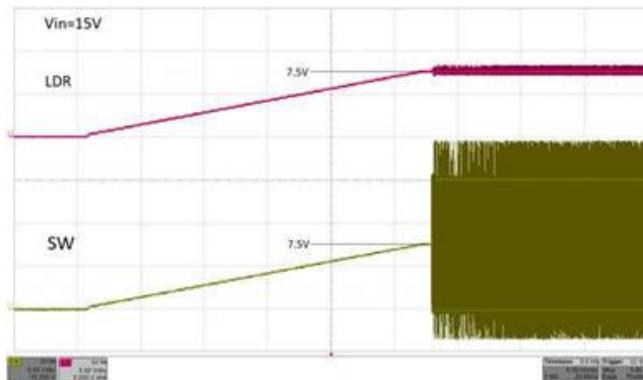


Figure 7: Soft-start Response

THERMAL IMAGE

Conditions:

- Vin = 15V
- Vout = 13.3V, 3.83A
- Ambient temperature = 25°C
- Air Flow – Natural Convection

As shown in Fig. 8, the LT8722 IC reaches 77°C with demoboard efficiency of 95.1%.

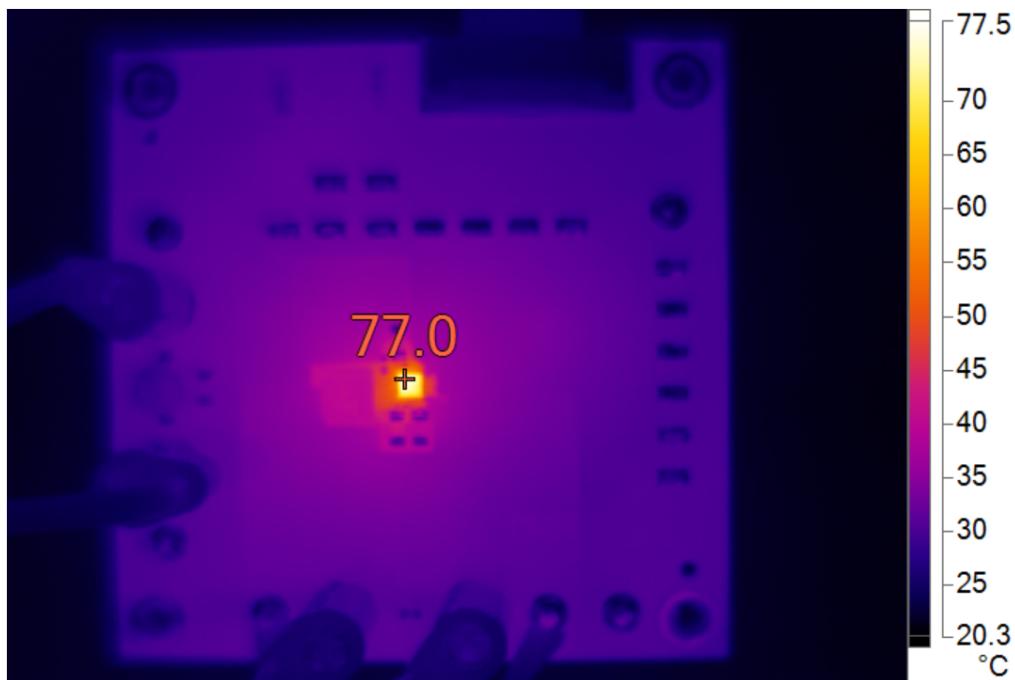


Figure 8: Thermal Image of DC3145A

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,TAJD, NO SUBS. ALLOWED	AVX	TAJD476M020RNJ	Y	47uF		150-0568	
				MURATA	12063C475KA72A	Y				
				NIC	GRM31CR71E475KA88L	L				
2	4	C2,C9,C15,CIN3	CAP.,4.7uF,X7R,25V,10%,1206	TAIYO YUDEN	F	04023D104KAT2A	Y			
				AVX	04023D104KAT2A	Y				
				SAMSUNG	CL05A104KA5NNNC	Y				
3	2	C3,C8	CAP.,0.1uF,X5R,25V,10%,0402	TDK	C1005X5R1E104K050BC	Y	0.1uF		150-0249	
4	3	C4,C5,CN4	CAP.,1uF,X7R,25V,10%,0603,AEC-Q200	MURATA	GCM188R71E105KA64D	Y	1uF		150-0501	
5	0	C7,C16,C17,CINS	CAP., OPTION, 0603				OPT		150-3038	NO STUFF
6	1	C10	CAP.,0.1uF,X7R,25V,10%,0603,AEC-Q200	SAMSUNG	CL10B104KA8WPNC	Y	0.1uF		150-0439	
				AVX	0603C102KAT2A	Y				
				AVX	0603C102KAT4A	Y				
				KEMET	C0603C102K3RACUT	Y				
				NIC	NMC0603X7R102K25TRP	Y				
7	1	C11	CAP.,1000pF,X7R,25V,10%,0603	MURATA	F	GRM188R71E473KA01D	L	1000pF	150-0050	
				NIC	NMC0603X7R473K25TRP	Y				
8	3	C12,C13,C14	CAP.,0.047uF,X7R,25V,10%,0603	AVX	F	0.047uF			150-0063	
9	2	CIN1,CIN2	CAP.,22uF,ALUM,25V,20%,SMD 6.3x5.8mm	WURTH ELEKTRONIK	875105544003	Y	22uF		150-0926	
10	0	D1,D2	DIODE, OPTION, SOD-323				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	2501-2-00-80-00-07-0	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,NON-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	6200311121	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.,1.0uH,POWER,20%,12A,9.0mOHMS,4.3mmx4.3mm,AEC-Q200	COILCRAFT	XGL4020-102MEC	null	1.0uH		TMP-7216	
17	1	L1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY	IHT-96-17-10	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	CRCW06031K00JNEA	Y	1k		100-2534	
21	1	R2	RES.,10 OHM,5%,1/10W,0603,AEC-Q200	PANASONIC	ERI3GEY100V	Y			100-2058	
				VISHAY	CRCW06031R0JNEA	Y				
22	1	R3	RES.,20k OHMS,1%,1/10W,0603	NIC	NRC0602002TR	Y			100-2117	
23	0	R4	RES.,100 OHMS,5%,5W,20x47mm X 10.31mm	OHMITE	RW550FA100RE	Y			100-1740	NO STUFF
24	2	R5,R6	RES.,100k OHMS,5%,1/10W,0603,AEC-Q200	NIC	NRC06104TRF	Y	100k		100-2856	
25	0	R7	RES., OPTION, 0603			OPT			100-2374	NO STUFF
26	1	STNCL1	TOOL, STENCIL, 700-DC3145A	ADI APPROVED SUPPLIER	830-DC3145A	Y	TOOL, STENCIL, 700-DC3145A		830-DC3145A	REV03
27	1	U1	IC,15V, 4A MONOLITHIC THERMOELECTRIC COOLER CONTROLLER	ANALOG DEVICES	LT8722LQFPBF	Y	LT8722LQFN#TRPBF		LT8722LQFN	LT8722LQFN#PBF
28	2	XJP1,XJP2	CONN.,SHUNT,FEMALE,2 POS,2mm	Wurth Elektronik	60800213421	Y	SHUNT		250-0485	

SCHEMATIC DIAGRAM

