

Standalone $\pm 30A$ Power/ Energy Monitor with LCD

DESCRIPTION

The DC2574A-KIT is a standalone power/energy monitor that allows users to evaluate the [LTC[®]2947](#) power/energy monitor without a PC. This document describes how to quickly set up and operate the DC2574A-KIT; users should also refer to the DC2334 demo manual and LTC2947 data sheet for more details. The DC2574A-KIT includes all components required for stand-alone operation except for a power supply and load. The DC2574A-KIT operates with any USB compatible power supply and any load compatible with the LTC2947.

The DC2574A-KIT includes the following items:

- DC2334A: LTC2947 Demo Circuit
- DC2026: Linduino[®] One with Pre-Programmed "LTC2947 - DC2574A_KIT Linduino.INO File"

- LCD Keypad Shield
- USB Cable: Power Supply And Optional Communication Interface for Operating with the GUI
- 14-pin Ribbon Cable. Only necessary for usage of the Linduino with some other LTC demo boards, see Linduino DC590 Mode section on how to reprogram the supplied Linduino for full compatibility with QuikEval[®].

The KIT is provided fully assembled and all boards plugged together (LCD on top of DC2334A on top of DC2026) for easy usage without soldering anything.

Design files for this circuit board are available at <http://www.linear.com/demo/DC2574A-KIT>

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CONNECTIONS

Make sure the DC2334A demo board is configured for I²C mode (JP5, JP6) with AD0, AD1 both being set to the L position (JP8, JP7) which sets the slave address to 0x5C. This is the factory default setting of the jumpers on the DC2334 demo board.

Connect an external supply (0V to 15V) and load ($\pm 30A$) to be monitored by the LTC2947 and plug in a USB power supply to the USB port of the Linduino. See the DC2334 demo manual for more information on possible measurement configurations.

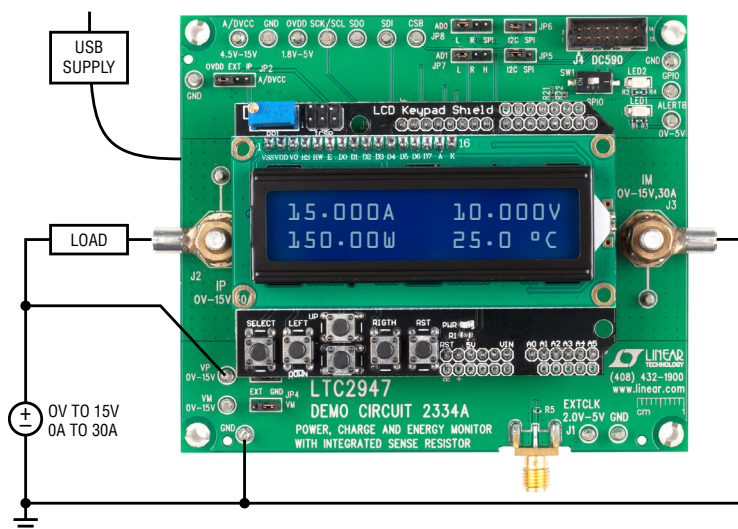


Figure 1. DC2574A-KIT Connection Diagram

DEMO MANUAL

DC2574A-KIT

CONNECTIONS

Note: If you use the USB port of a PC as a power supply, the board will make periodic resets. This is caused by Windows and the USB COM port driver accessing the COM port assigned to the Linduino. This can be prevented by making a connection via a serial terminal (see Serial

Terminal Operation) or via the LTC2947 GUI (see QuikEval/ GUI Operation) to the COM port of the Linduino. If a plain external USB power supply is used, this problem does not appear.

OPERATION

Upon power up, the LCD shows four numerical values. They correspond to the current, voltage, die temperature and power measurements, in clockwise order.

Description		Example	
Current	Voltage	0.003A	0.000V
Power	Die Temperature	0.000W	25.0 °C

The keys of the LCD keypad shield are used to select what values are displayed.

Key	Description
LEFT, RIGHT	Press and hold to navigate through and select measurement group to be displayed
UP, DOWN	Press and hold to navigate through and select status/alerts registers to be displayed.
SELECT	Clear accumulators and tracking registers. Press and hold this key until the display shows the message CLEAR. After releasing the key again the clearing will be acknowledged by the message ****CLEARED****
RST	Reset the controller (the Linduino) and start over. This will not reset the LTC2947

MEASUREMENT GROUPS (LEFT, RIGHT KEYS)

Press and hold the LEFT or RIGHT key to cycle through and select the measurement group to be displayed. As the RIGHT key is held down, the display will cycle through the following measurement groups (the same applies to the LEFT key but it will cycle through measurement groups in the opposite order):

I	V	Current (I), Voltage (V),
P	TEMP	Power (P) and Temperature (TEMP) Measurement
↓		
C1	VDVCC	Charge1 (C1), LTC2947 Supply Voltage (VDVCC),
E1	TB1	Energy1 (E1), Time Base 1 (TB1)
↓		
C2	VDVCC	Charge2 (C2), LTC2947 Supply Voltage (VDVCC),
E2	TB2	Energy2 (E2), Time Base 2 (TB2)
↓		
IMIN	IMAX	Minimum/Maximum Current (IMIN, IMAX),
PMIN	PMAX	Minimum/Maximum Power (PMIN, PMAX)
↓		
VMIN	VMAX	Minimum/Maximum Voltage (VMIN, VMAX),
TMIN	TMAX	Minimum/Maximum Temperature (TMIN, TMAX)
↓		
TMIN	TMAX	Minimum/Maximum Temperature (TMIN, TMAX),
VDMIN	VDMAX	Minimum/Maximum LTC2947 Supply Voltage (VDMIN, VDMAX)
↓		
CYCLE ALL measurements		If "CYCLE ALL measurements" is selected, the display will cycle through all available measurement groups.

OPERATION

Once the key is released the measurements of the selected group will be displayed.

Measurement Report

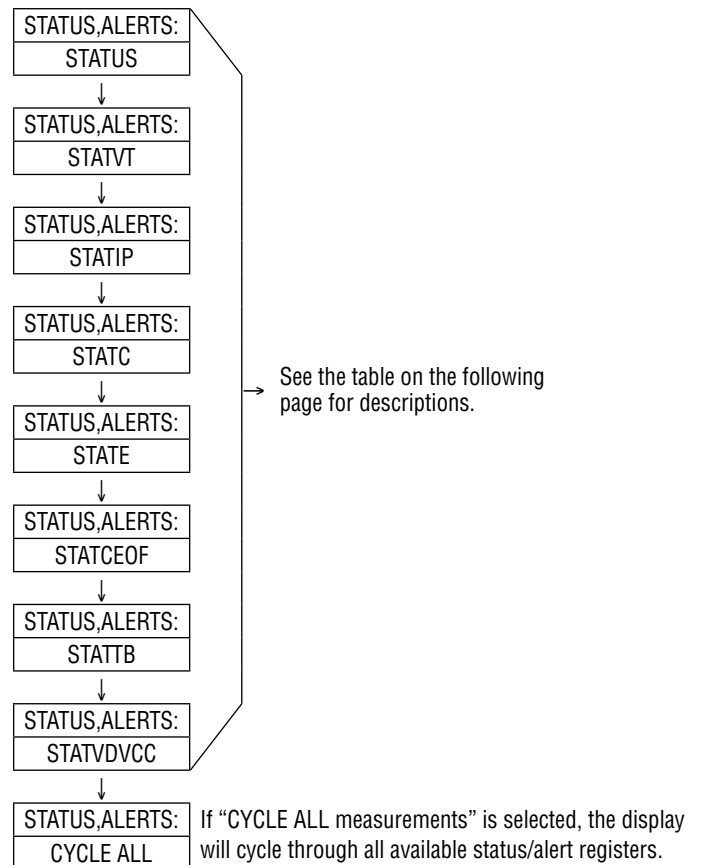
The measurement results will be reported in the following units:

Measurement	Unit	Description	Example
Current	A	Amperes	1.003A
Voltage	V	Volts	5.200V
Power	W	Watts	-99.050W
Charge	mAh, kAh, Ah	(milli, kilo) ampere hours	999mAh
Energy	mWh, kWh, Wh	(milli, kilo) watt hours	120Wh
Time	s, m, h, d	Seconds, minutes, hours, days	1d3h

The tracking-registers that store the minimum and maximum values of measurements are reported in the following way: VALMIN...VALMAX, e.g. -10.03A...12.00A.

STATUS/ALERT REGISTERS (UP, DOWN KEYS)

Press and hold the UP or DOWN key to cycle through and select a status/alert registers to be displayed. As the DOWN key is held down, the display will cycle through the following status/alert registers (the same applies to the UP key but it will cycle through status/alert registers in the opposite order):



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OPERATION

Status/Alerts Report

The contents of the status/alert registers are reported by mnemonics. Due to restricted number of characters, the LCD shows acronyms for some of the registers and bit names.

Only the bits that are set (1) are reported. Bits that are cleared (0) won't be reported.

ACRONYM	DATA SHEET NAME	DESCRIPTION
STAT	STATUS	The Status Register reports the status of Register Updates, Undervoltage Lockout, and Reference Clock Errors
UVA	UVLOA	Undervoltage in the Analog Domain Including ADCs During a Conversion
POR	PORA	Power-On Reset Has Occurred Due to Undervoltage in the Analog Domain
UVS	UVLOSTBY	Undervoltage in the Standby Domain
UVD	UVLOD	Undervoltage in the Digital Domain
UPD	UPDATE	Result Registers Have Been Updated (Measurement Was Performed)
AER	ADCERR	The ADC Conversion Is Not Valid Due to Undervoltage During a Conversion
TER	TBERR	Overflow of the Internal Timebase Register. The Values of Accumulated Result Registers Are Invalid
STATVT	STATVT	Voltage, Temperature Threshold Alerts
VH	VH	Voltage VD High Threshold Exceeded
VL	VL	Voltage VD Low Threshold Exceeded
TEH	TEMPH	Temperature High Threshold Exceeded
TEL	TEMPL	Temperature Low Threshold Exceeded
FH	FANH	Fan High Temperature Threshold Exceeded
FL	FANL	Fan Low Temperature Threshold Exceeded

ACRONYM	DATA SHEET NAME	DESCRIPTION
STATIP	STATIP	Current, Power Threshold Alerts
IH	IH	Current High Threshold Exceeded
IL	IL	Current Low Threshold Exceeded
PH	PH	Power High Threshold Exceeded
PL	PL	Power Low Threshold Exceeded
STATC	STATC	Charge Thresholds Alerts
C1H	C1H	Charge 1 High Threshold Exceeded
C1L	C1L	Charge 1 Low Threshold Exceeded
C2H	C2H	Charge 2 High Threshold Exceeded
C2L	C2L	Charge 2 Low Threshold Exceeded
STATE	STATE	Energy Threshold Alerts
E1H	E1H	Energy 1 High Threshold Exceeded
E1L	E1L	Energy 1 Low Threshold Exceeded
E2H	E2H	Energy 2 High Threshold Exceeded
E2L	E2L	Energy 2 Low Threshold Exceeded
STATCEOF	STATCEOF	Charge, Energy Overflow Alerts
C1OF	C1OF	Charge 1 Overflow Alert
C2OF	C2OF	Charge 2 Overflow Alert
E1OF	E1OF	Energy 1 Overflow Alert
E2OF	E2OF	Energy 2 Overflow Alert
STATTB	STATTB	Time Base Alerts
1TH	TB1TH	Time 1 Threshold Exceeded
2TH	TB2TH	Time 2 Threshold Exceeded
1OF	TB1OF	Time 1 Overflow
2OF	TB2OF	Time 2 Overflow
STATVDVCC	STATVDVCC	VDVCC Threshold Alerts
VDVCCCH	VDVCCCH	Voltage at DVCC High Threshold Exceeded
VDVCCCL	VDVCCCL	Voltage at DVCC Low Threshold Exceeded

SERIAL TERMINAL OPERATION

The DC2574A-KIT can also be operated via a serial terminal by connecting the Linduino to the USB port of a PC. For this you can use the Serial Monitor of the Arduino IDE which can be accessed from the Tools menu as shown in Figure 2.

Make sure to select the right COM port of your Linduino. In the screenshot in Figure 2, COM30 is selected. Depending on your system and the used USB port, you may see a different COM port number. One way to identify the right

COM port is to plug and unplug your Linduino and check in the list of available COM ports which one disappears.

In the serial monitor, set the baud rate to 115200 and select the “No line ending” option, see Figure 3.

Initial output on the serial monitor is:

```
Hello LTC2947
30A PowerMonitor
LCD found! Enter 1 or m for options.
```

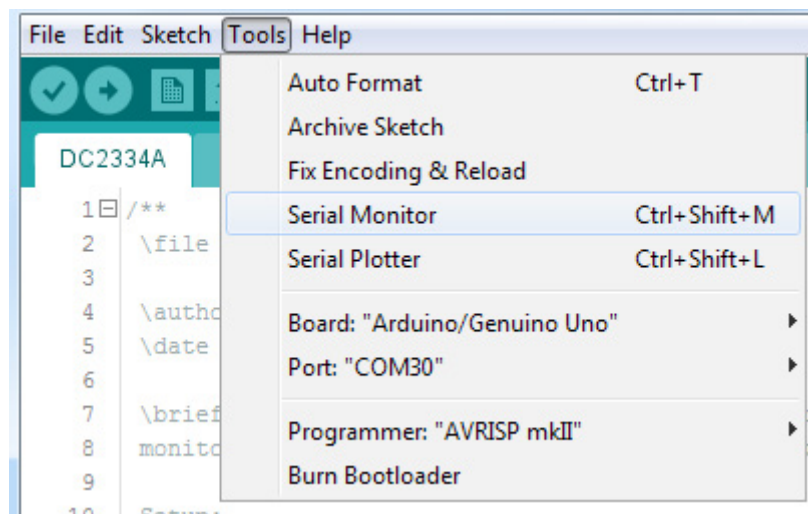


Figure 2. Tools Menu

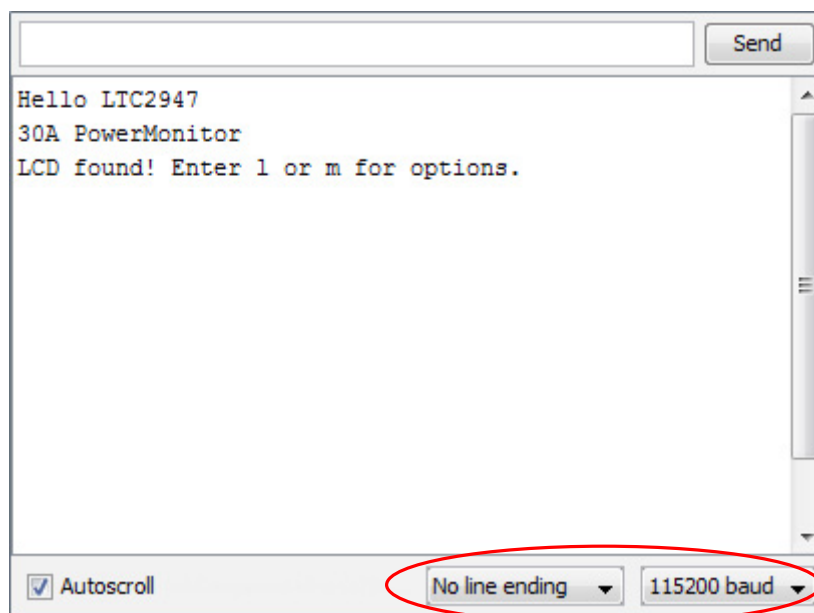


Figure 3.

SERIAL TERMINAL OPERATION

The following table lists the menu items that are shown after entering m or l.

KEY	OPTIONS	DESCRIPTION
l	0:STATUS 1:STATVT 2:STATIP 3:STATC 4:STATE 5:STATCEOF 6:STATTB 7:STATVDVCC 8:CYCLE ALL enter 0-8, any other to cancel	Status and Alert Registers Menu. E.g. enter 0 to periodically output the status register via the serial monitor and on the LCD. Example output: STAT:UPD, UVA, POR, UVS, UVD See Status/Alert Registers (UP, DOWN Keys) for details.
m	0:I V P TEMP 1:C1 VDVCC E1 TB1 2:C2 VDVCC E2 TB2 3:IMIN IMAX PMIN PMAX 4:VMIN VMAX TMIN TMAX 5:TMIN TMAX VDMIN VDMAX 6:CYCLE ALL measurements enter 0-6, any other to cancel	Measurements Menu. E.g. enter 0 to periodically output Current (I), Voltage (V), Power (P) and Temperature (TEMP) measurements via the serial monitor and on the LCD. Example output: 0:I V P TEMP 0.012A -0.402V 0.000W 29.2°C See Measurement Groups (LEFT, RIGHT Keys) for details.

Once one of the options is selected the related results will be periodically reported via the serial monitor and also via the LCD.

To change the serial output, send again the “m” or “l” character and select another option to be displayed or any number >8 to disable the serial output.

QuikEval/GUI OPERATION

The DC2574A-KIT can also be operated via the LTC2947 GUI which is integrated in the QuikEval evaluation system. If not yet installed, QuikEval may be downloaded from the linear web page:

<http://www.linear.com/quikeval>

QuikEval will automatically detect the connected DC2574A-KIT and download and launch the LTC2947 GUI.

The GUI will automatically connect to the DC2574A-KIT on start-up. Please refer to the DC2334 demo manual for details on GUI operation.

There are two limitations when operating DC2574A-KIT with the GUI:

1. The LTC2947 will always operate in continuous mode. If the continuous mode is disabled via the operation control

of the GUI it will be enabled again by the DC2574A-KIT firmware.

2. Shutdown is not possible as the DC2574A-KIT firmware will wake-up the device again immediately.
3. If the DC2574A-KIT's LCD displays any of the status/alert registers, asserted bits reported by the LCD might not be reported by the GUI and vice versa. This is an result of the clear-on-read behavior of those bits when read by two agents (the GUI and the DC2574A-KIT firmware). This can be avoided by setting the LCD output to any of the measurement results, use the LEFT/RIGHT keys for this purpose.
4. Connection to the device is only possible in the GUI's Auto mode or with fixed setting to I²C and slave address 0x5C.

DC2574A-KIT FIRMWARE SOURCE CODE

The DC2574A-KIT uses "LTC2947 - DC2574A_KIT Lin-duino.INO File" available on:

<http://www.linear.com/product/LTC2947#code>

or in the LTSketchbook (Linduino library) which can be downloaded from the Linduino home page:

<http://www.linear.com/solutions/Linduino>

Once installed, the source code may be accessed within the Arduino IDE from File → Sketchbook → Part Number → 2000 → 2900 → 2947 → DC2574A_KIT

LINDUINO DC590 MODE

It is possible to reprogram the Linduino that is part of this kit so it can be used for operation with any other LTC demo board and QuikEval. This is done by programming the DC590 Sketch from the LTSketchbook which is accessible within the Arduino IDE from File → Sketchbook → Utilities → DC590B.

After this change, the Linduino can also be used together with the DC2334A demo board by connecting the supplied 14-pin ribbon cable to the DC590 connector J4. See DC2334A demo manual for more details.

DEMO MANUAL

DC2574A-KIT

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