High Accuracy 2.5A Low-Voltage AOT Synchronous Buck Regulator

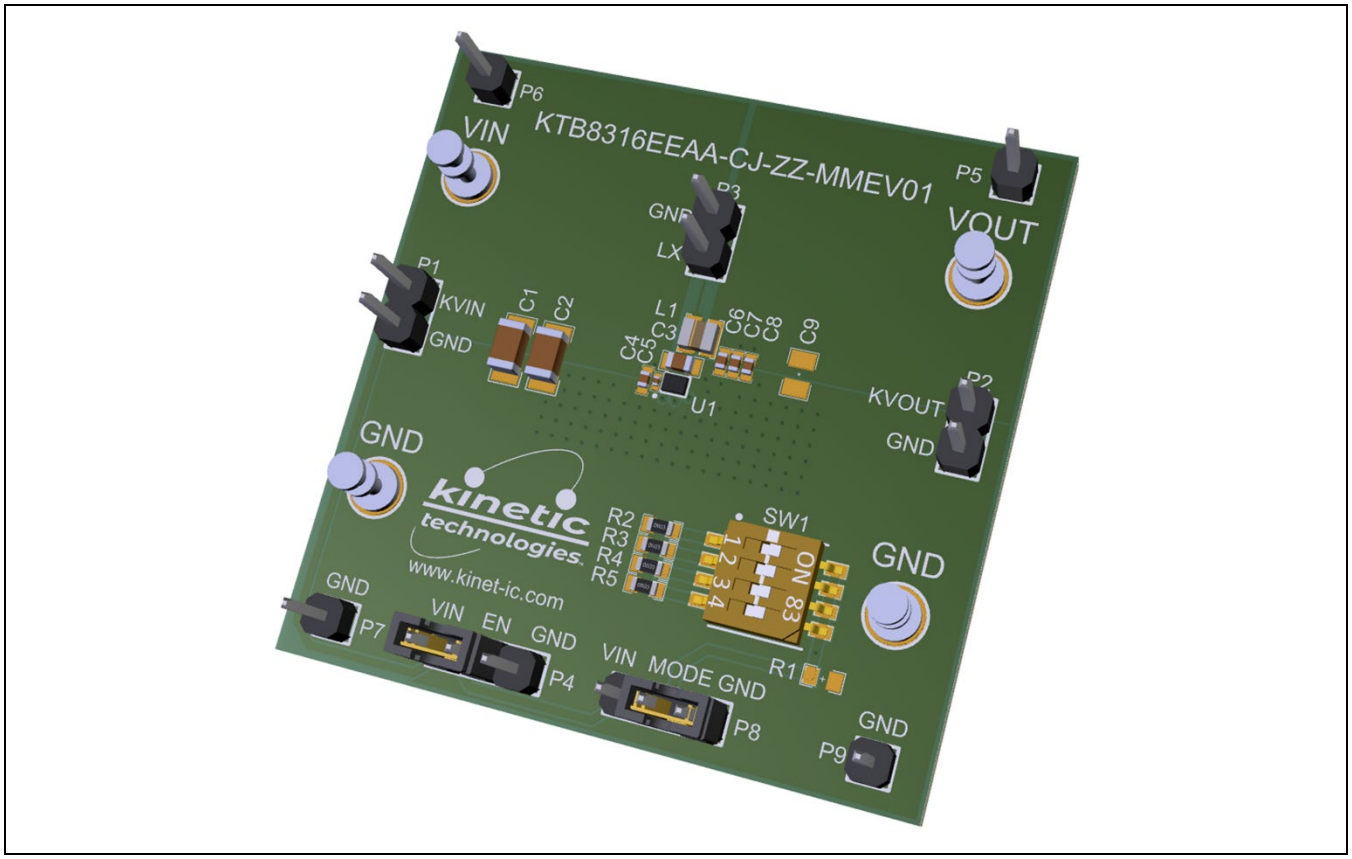
Brief Description

This Manual describes the detailed operation of the KTB8316 (4MHz) evaluation board. KTB8316 is a precision adaptive-on-time step-down switching regulator with high accuracy, fast transient response, high efficiency, and small solution size optimized for mobile and non-mobile applications. The KTB8316 (4MHz) Evaluation (EVAL) board demonstrates the KTB8316 step-down regulator detailed functionality, performance, and the PCB layout. The kit includes a fully assembled and tested KTB8316 (4MHz) EVAL board, and a printed copy of the Quick Start Guide.

Ordering Information

Part Number	Description	IC Package
KTB8316EEAA-CJ-ZZ-MMEV01	KTB8316 (4MHz) EVAL Kit – Output voltage range = 0.9V to 3.3V	PwrCSP™ HP-WLCSP-6

3D CAD Image



EVAL Kit Physical Contents

Item #	Description	Included	Download
1	KTB8316 (4MHz) EVAL fully assembled PCB in Anti-static bag	1	
2	Hard copy for the Quick Start Guide, 1 page (A4 or US Letter)	1	
3	EVAL Kit box	1	
4	EVAL Kit Manual, available at clickable URL		1

QR Links for Documents

IC Datasheet	KTB8316EEAA-CJ-ZY-MMEV01 Kit Landing Page
https://www.kinet-ic.com/ktb8316/	https://www.kinet-ic.com/ktb8316eeaa-cj-zz-mmev01/

User-Supplied Equipment

Required Equipment

1. Bench Power Supply for VIN: 0 to 5V, 3A minimum output range as needed for the intended application.
2. Digital Multimeter – used to measure input/output voltages and current. Two to four meters are required depending upon specific measurements.
3. Load – An Electronic Load (E-Load) is recommended for functional testing and power conversion efficiency measurements. Power resistors or an actual system load may also be used.

Optional Equipment

1. Oscilloscope and Voltage Probes – for dynamic testing and measurements of input/output and inductor (LX) switching voltage waveforms.
2. Additional Digital Multimeters

Recommended Operating Conditions

Symbol	Description	Value	Units
V_{IN}	Input Operating Voltage	2.5 to 5.5	V
I_{OUT}	Output Load Current	0 to 2.5	A

Jumper and Test Point Descriptions

Designator	Name	Description	Default
P1	KVIN	VIN supply kelvin voltage test points for VIN and GND	-
P2	KVOUT	VOUT kelvin voltage test points for VOUT and GND	-
P3	LX	Buck regulator inductor switch node. Connect 10:1 oscilloscope probe to LX to observe switching waveforms	-
P4	EN	Jumper for Active-High Enable Input: GND: Shutdown Mode – device disabled VIN: Enable device on	VIN
P5	VOUT	Connecting Header for VOUT	-
P6	VIN	Connecting Header for VIN	-
P7	GND	Connecting Header for GND	-
P8	MODE	Jumper to MODE input pin to VIN or GND Open: VOUT Select via SW1 switch selection VIN: MODE to VIN - Default VOUT in FPWM mode, All SW1 switches OFF GND: MODE to GND - Default VOUT in Skip mode, All SW1 Switches OFF	GND
P9	GND	Connecting Header for GND	

Switch Mode and Output Voltage Settings

All SW1 switches should be set to the OFF position for EVB Assembly test and shipping.

MODE (P8) JUMPER[1]	SW1 Switch Setting[2]	R_{SET} Resistor	4MHz Operation		Switching Mode	Default
			R_{SET} Value[3] (Ω)	VOUT (V)		
MODE to GND	All OFF	N/A	N/A	1.2	Skip	Default Setting
OFF	SW1-1 ON	R2	0	1.2	Skip	
OFF	SW1-2 ON	R3	12.1k	0.9	Skip	
OFF	SW1-3 ON	R4	22.1k	1.8	Skip	
OFF	SW1-4 ON	R5	30.1k	3.3	Skip	
MODE to VIN	All OFF	N/A	N/A	1.2	FPWM	

1. The MODE Jumper must be open (not placed) when setting the output voltage by the SW1 switch. Placing the MODE jumper to VIN or GND with any SW1 switch closed will result in non-specified output mode and voltage conditions.
2. Only one SW1 switch position should be ON at a time. Closing more than one switch will result in non-specified output voltage conditions. All SW1 switches should be OFF when the MODE pin jumper (P8) is connected to VIN or GND.
3. Consult the KTB8316 datasheet applications information to adjust the value of the R2, R3, R4 or R5 RSET resistor values to set an output voltage condition not shown in this table.

Regulator Switching Frequency and Output Voltage

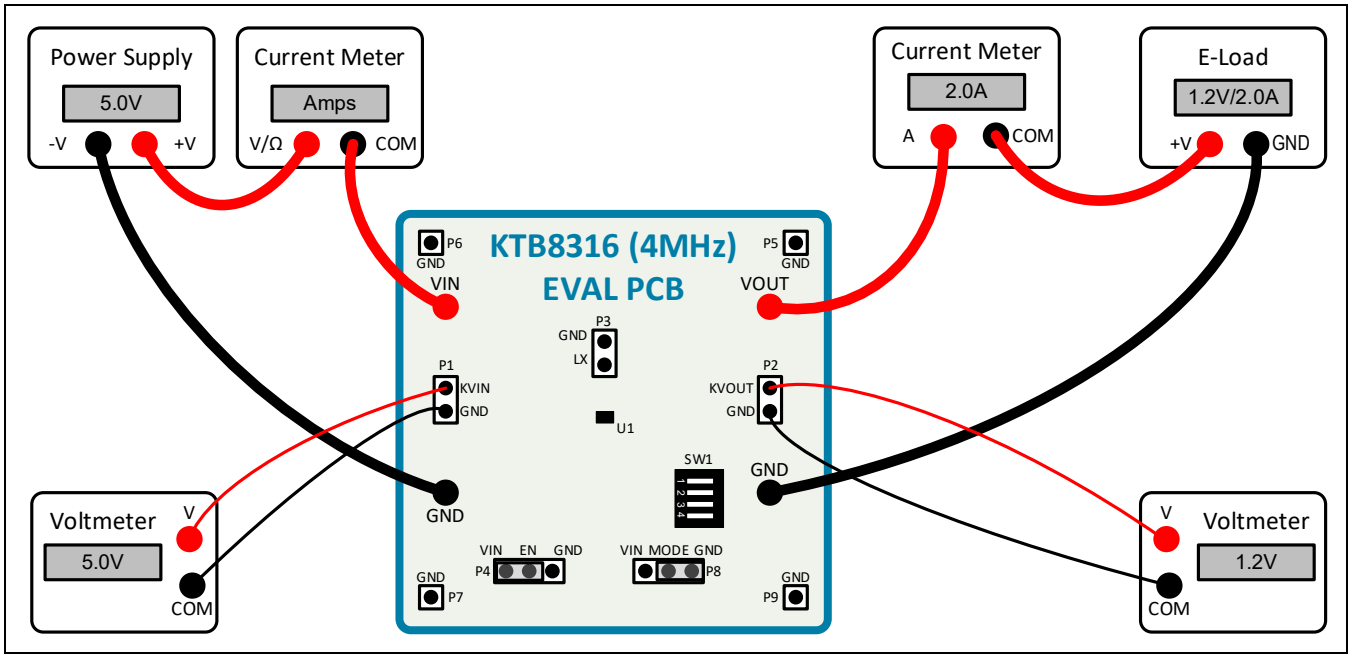
IC Part Number	Switching Frequency (MHz)	L1 Inductor Value (nH)	Minimum Output Voltage (V)	Maximum Output Voltage (V)
KTB8316EEAA-CJ	4	330	0.9	3.3

Quick Start Procedures

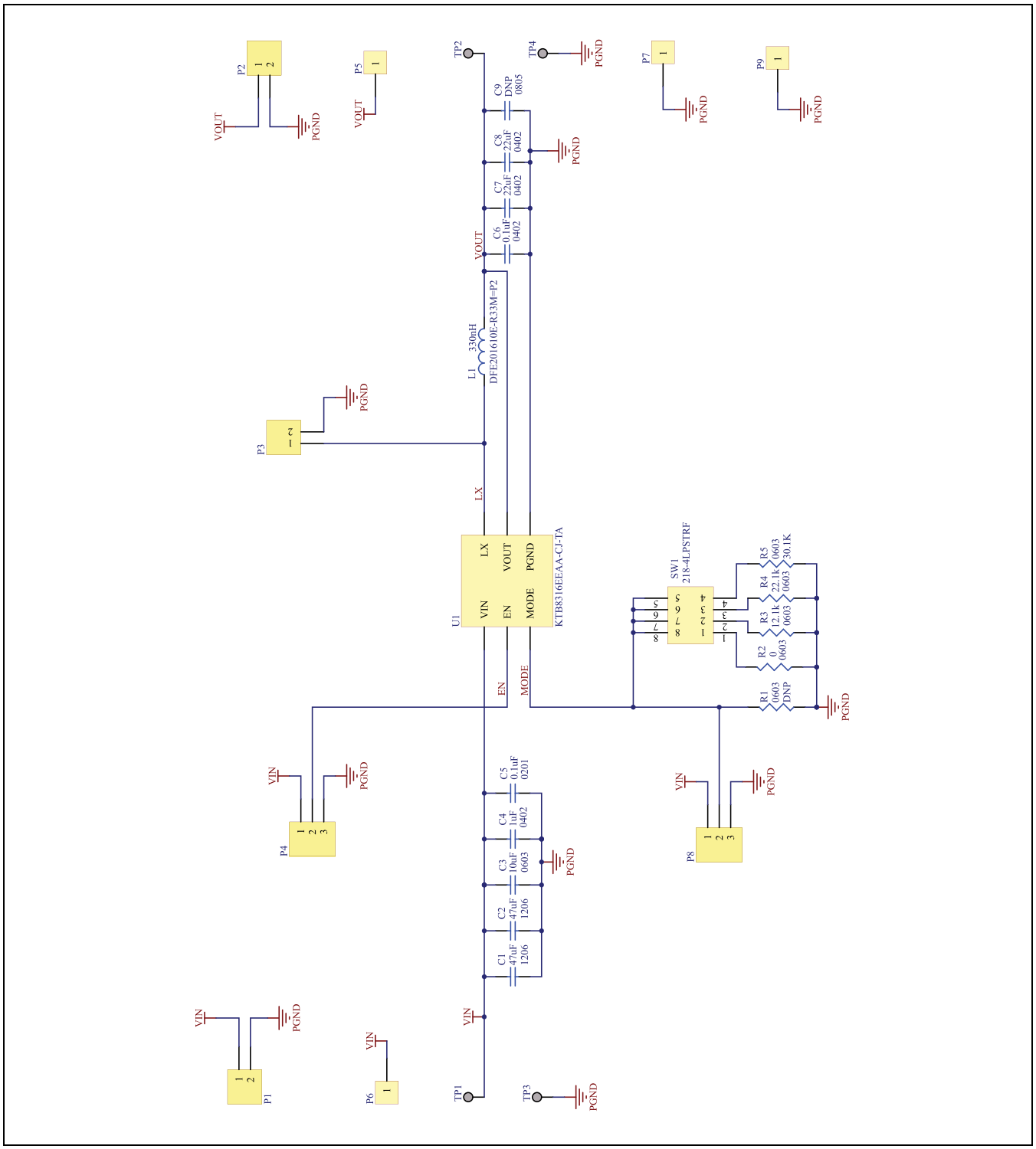
1. Check Jumpers P4, P8 and SW1 switch settings for default conditions.
    a. Default Settings:
        i. P4 = Jumper EN to VIN to enable the device
        ii. P8 = MODE to GND for skip mode
        iii. All SW1 switches set to the OFF position for skip mode and nominal output voltage
2. Before connecting the EVAL Kit input supply test leads to the VIN bench power supply, turn the supply on and adjust the voltage as close to 0V as possible. Disable the power supply output or turn the supply off. While disabled or off, connect the VIN test leads to the bench power supply.
3. Connect the power supply positive test lead to VIN and negative test lead to GND on the evaluation board.
4. Connect the step-down (buck) regulator output to an electronic load, load resistor or system load. Connect VOUT to the positive load terminal and GND to the negative or ground terminal.
5. Enable or turn on the VIN bench power supply and very slowly ramp its voltage to the desired input voltage. While ramping VIN slowly, use the bench supply's output current indication (or a digital multimeter) to monitor the VIN current. If the current becomes high, reduce the VIN voltage quickly to prevent damage. Then inspect the setup for any wiring errors.
6. Regulator operation may be validated by observing the VOUT voltage level, this may be performed with or without an applied load. The output voltage is monitored by connecting multimeter across the KVOUT/GND P2 terminals.
7. To hardware shutdown the step-down (buck) regulator, move the P4 jumper to connect EN to GND.

Typical Test Setup Diagram

As an example, use the following test setup to measure input/output in the Quick Start Procedures.



Electrical Schematic

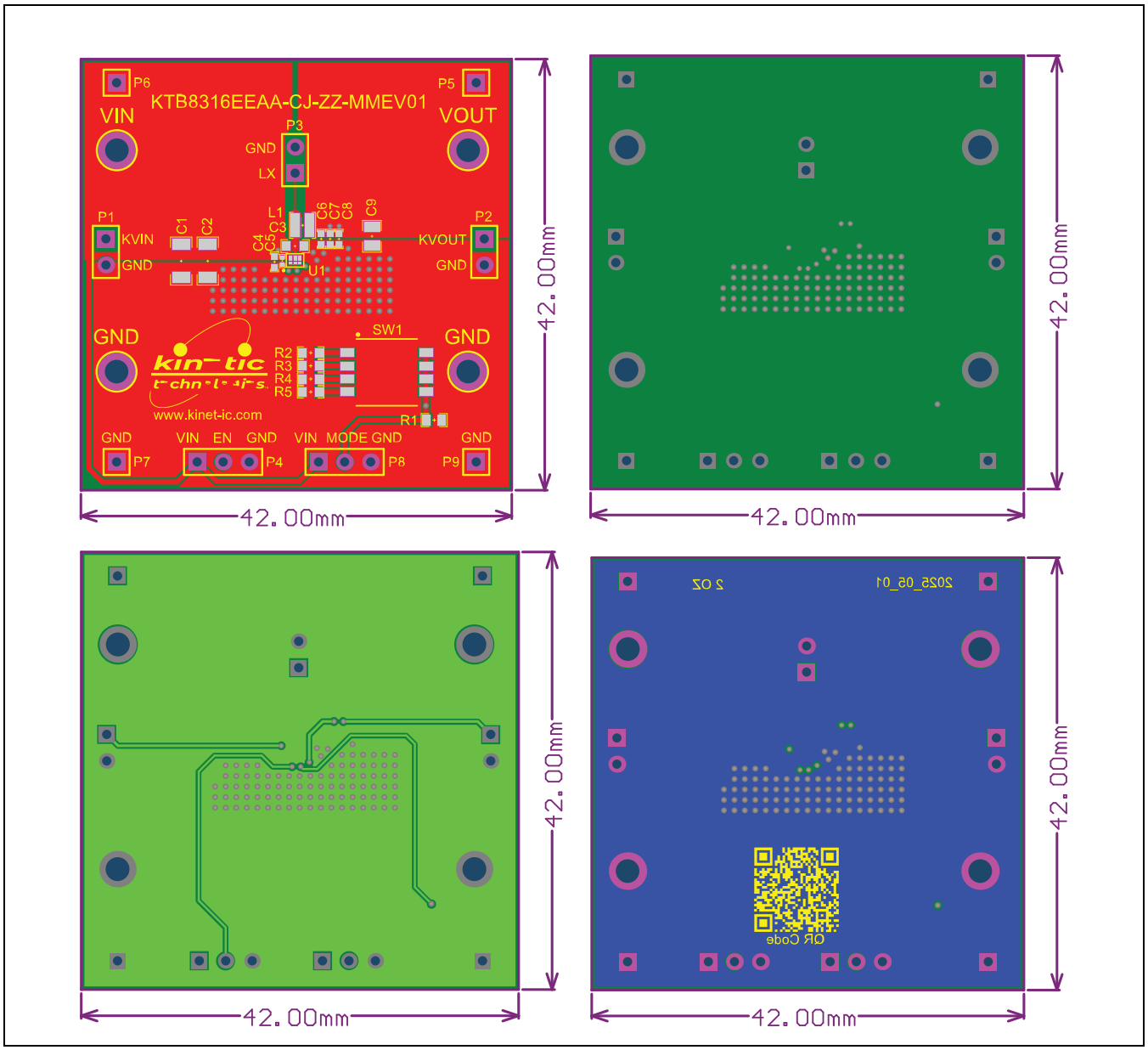


Bill of Materials (BOM)

KTB8316EEAA-CJ-ZZ-MMEV01 – 4MHz Operation, VOUT range = 0.9V to 3.3V.

Designator	Description	Quantity	Value	Manufacturer	Manufacturer Part Number
C1, C2	CAP CER 47µF 10V X5R 1206	2	47µF	Samsung	CL31A476MPHNNNE
C3	CAP CER 10µF 10V X5R 0603	1	10µF	Samsung	CL10A106MP8NNNC
C4	CAP CER 1µF 10V X5R 0402	1	1µF	Samsung	CL05A105KP5NNNC
C5	CAP CER 0.1µF 10V X5R 0201	1	0.1µF	Samsung	CL03A104KP3NNNC
C6	CAP CER 0.1µF 6.3V X5R 0402	1	0.1µF	Murata Electronics	GRM152R60J104KE19D
C7, C8	CAP CER 22µF 6.3V X5R 0402	2	22µF	Murata Electronics	GRM158R60J226ME01D
C9	Cap 0805 DNP	1	DNP		
L1	FIXED IND 330NH 4A 26MOHM SMD	1	330nH	Murata Electronics	DFE201610E-R33M=P2
P1, P2, P3	CONN HEADER VERT 2POS 2.54MM	3		Sullins Connector Solutions	PREC002SAAN-RC
P4, P8	CONN HEADER VERT 3POS 2.54MM	2		Sullins	PREC003SAAN-RC
P5, P6, P7, P9	Connector Header Through Hole 1 position	4		Sullins Connector Solutions	PREC001SAAN-RC
R1	Res 0603 DNP	1	DNP		
R2	RES 0 OHM JUMPER 1/10W 0603	1	0	Yageo	RC0603JR-070RL
R3	RES 12.1K OHM 1% 1/10W 0603	1	12.1k	Yageo	RC0603FR-0712K1L
R4	RES 22.1K OHM 1% 1/10W 0603	1	22.1k	Yageo	RC0603FR-0722K1L
R5	RES 30.1K OHM 1% 1/10W 0603	1	30.1K	Yageo	RC0603FR-0730K1L
SW1	SWITCH SLIDE DIP SPST 0.025A 24V	1		CTS Electrocomponents	218-4LPSTRF
TP1, TP2, TP3, TP4	TERM TURRET SINGLE L=5.56MM TIN	4		Keystone	1502-2
U1	High Accuracy 2.5A Low-Voltage AOT Synchronous Buck Regulator	1		Kinetic Technologies	KTB8316EEAA-CJ-TA

Printed Circuit Board (PCB)



Additional Test Procedures

1. The DC-to-DC step-down switching waveform may be observed on the P3 LX/GND terminals. Connect a 10:1 high impedance oscilloscope probe to LX with as short as possible ground lead to GND. Adjust the oscilloscope as needed to observe the LX switching waveform.
2. To test or observe step-down output voltage or switch mode to a different setting from the default condition, turn off or disconnect the input power source. Change the SW1 switch settings as outlined in the switch mode and output voltage setting table. Re-apply power to the device and observe operation.
3. Step-down regulation efficiency measurement:
    a. Place a current meter in series with the positive input supply to VIN. Place a second current meter between VOUT and the applied load which may be a variable load resistor or electronic load.
    b. Connect a voltmeter to measure input voltage on the input supply P1 test pins KVIN and GND. Connect a second voltmeter to the P2 VOUT test pins KVOUT and GND to measure output voltage.
    c. Simultaneously record the Input voltage, Input current, output voltage and output current for a given input voltage level and applied load current. The efficiency is then calculated using equation:

$$\text{Efficiency (\%)} = (P_{OUT}/P_{IN}) \times 100\% = [(V_{OUT} \times I_{OUT}) / (V_{IN} \times I_{IN})] \times 100\%$$

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