TDK·Lambda

I6AxxA-001-EVK-S1CC

Evaluation Kit Manual for i6x Non-Isolated DC-DC for Constant Current Application

Contents

1. Introduction

This evaluation kit has been designed to provide an easy way to characterize the product performance and its features. It is intended to aid customers and determine the product suitability for the target application. The evaluation board incorporates the required external components to demonstrate the complete product functionality. It also includes other components (e.g. test points, etc…) to facilitate a successful end user experience. Not all these external components are required if the product features are not needed. Details of the external components, schematics, and PCB layout are provided in this documentation for reference only. Final design and qualification needs to be verified at customer's end system level.

2. Ordering Information

TDK-Lambda offers a wide variety of non-isolated dc-dc power modules in the i6A series. Not every product is currently available in an evaluation kit. The table below includes description and ratings which should help in selecting the most applicable evaluation kit.

Evaluation Kit Part Number	Non-Isolated DC-DC Module *(Included and Mounted on the Evaluation Board)*					
	DC-DC Module Part Number	Type	I/P Range	O/P Range	O/P Current (max)	O/P Power (Max)
i6A10A-001-EVK-S1CC	i6A4W010A033V-001-R	Buck	9 – 53 V	5 - 15 V **	10 A	250 W

** This evaluation kit run as constant current operation mode, so output voltage is limited than module spec number.

3. Design Consideration

- The purpose of this reference design is to assist the engineer to design the printed circuit board and select the additional components from commonly available material.
- <mark>The design is NOT full characterized. This remains in the responsibility of the end user.</mark>
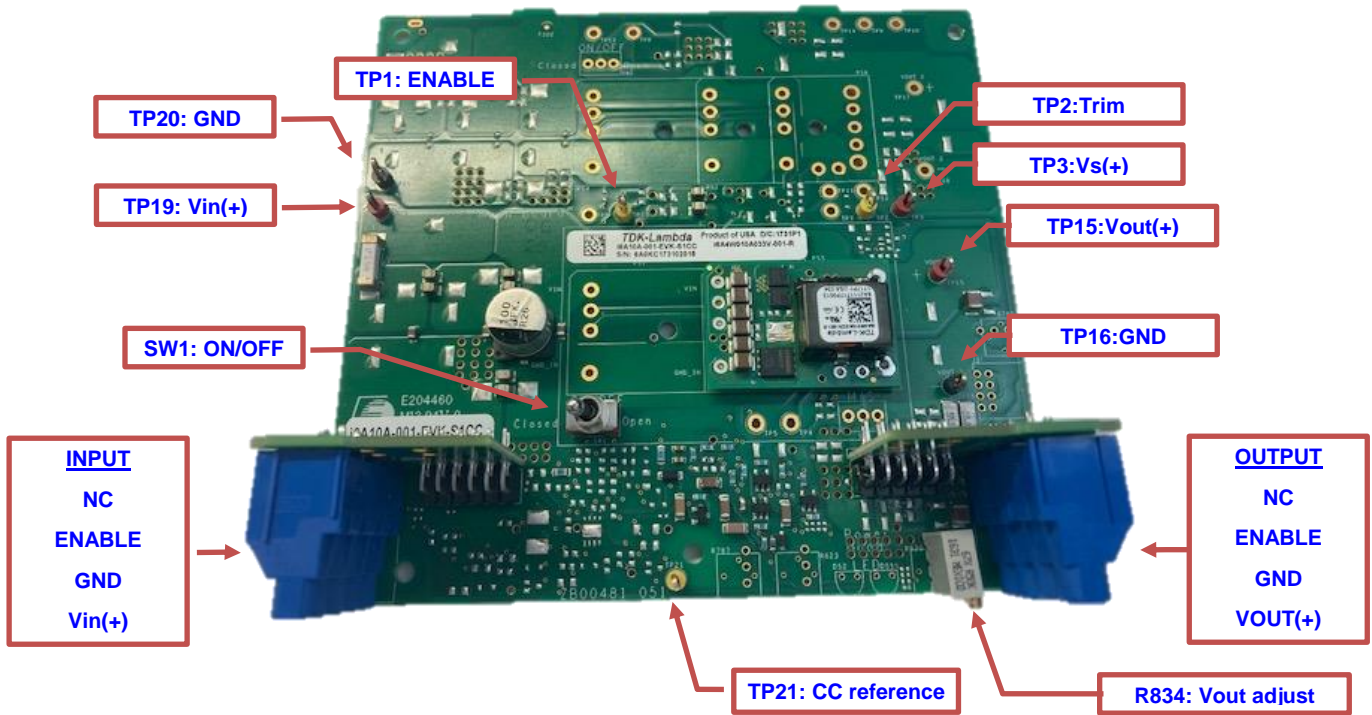- TDK-Lambda Technical Support will be glad to assist you further.

⚠ IMPORTANT INFORMATION

- Observe proper safety and laboratory procedures when testing electronic products. This list serves as general guide only and not a substitute for common sense and best practices.
- Before applying power, double check and ensure all connections to the evaluation board interface are correct (e.g. Input source polarity connections, etc…).
- Although highly efficient, these high power density modules can dissipate significant amounts of power, especially at heavy load. Care should be taken to ensure adequate cooling is provided and the modules are operated within the thermal specifications outlined in the product data sheets.
- This evaluation kit is designed for general laboratory use. It is not intended for installation in end customer product or equipment.
- Please check the pertinent product (DC-DC Module) datasheets and specifications for complete information.
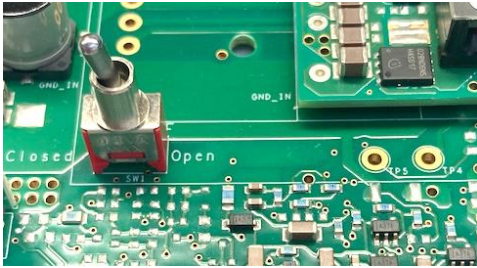
4. General Features

- Screw Terminals for secured input and output connections
- Toggle switch for Remote ON/OFF
- Test points / Scope probe hook-ups for ease of measurement
- Trim Potentiometer for adjusting the output voltage setting

Test Point	Description	Test Point	Description
TP1	ENABLE / ONOFF	TP19	Vin(+) / INPUT(+)
TP2	TRIM	TP20	Vin(-) / GND
TP3	Vs(+) / Remote sense(+)	TP21	CC Reference
TP15	Vout(+) / OUTPUT(+)	SW1	ON/OFF Switch
TP16	Vout(-) / GND	R834	Trim Resistor for Vout Adjust

Please use "Resistive Load" (or "CR mode" for Electric Load). Otherwise, the module may shutdown or get damaged.
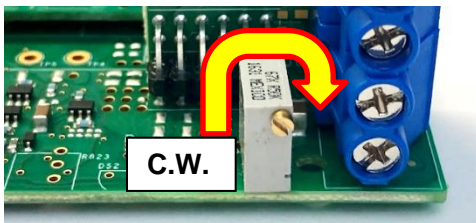
5. Turn-on / Turn-off module by switch

Change position of toggle switch"S1" to "CLOSE" turns-on the power supply unit.

6. Set up Constant Current Value

TP21:CC REF

Inject signal from Output Source into TP21. This is reference signal for constant current.
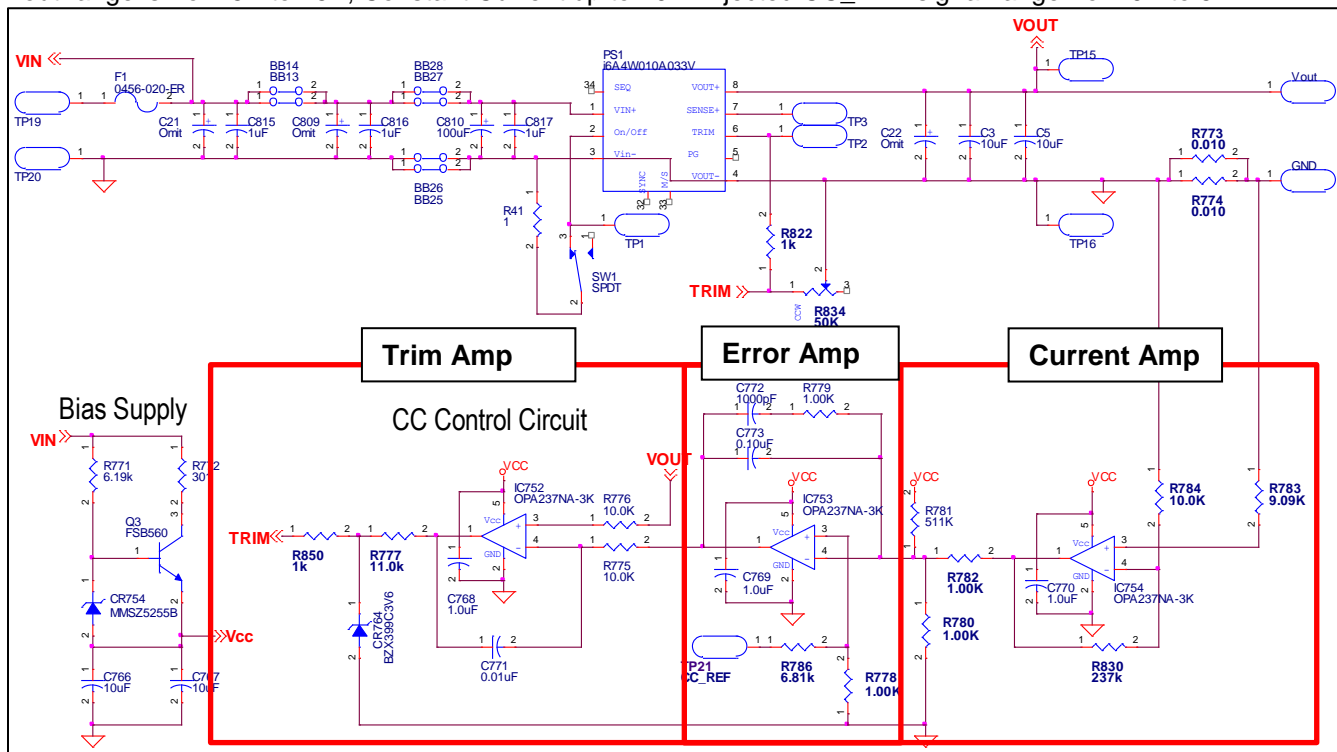
7. Change Output Voltage

C.W.

Turn screw on trimmer pot "VR1" to change the output voltage.
Turn clockwise to increase output voltage.
Turn counter clockwise to decrease output voltage.

Inject CC_REF first then adjust voltage with NO load.
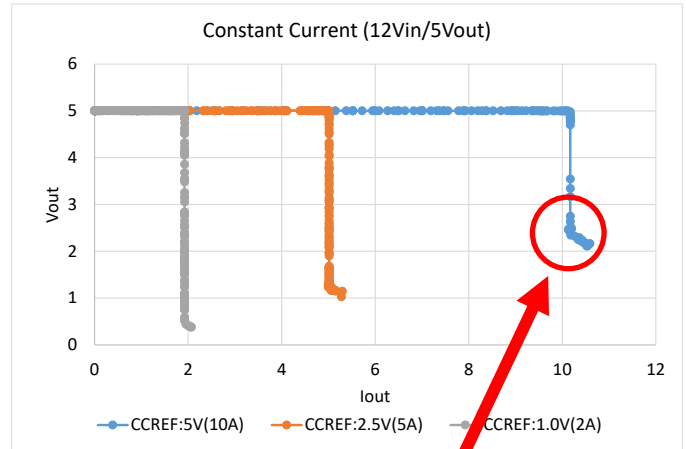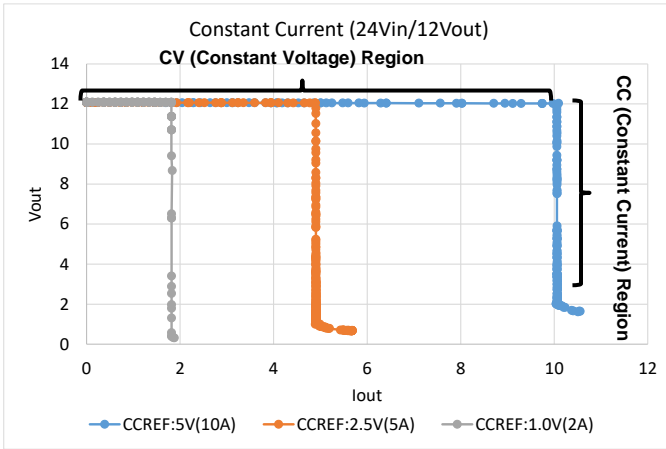
8. Design example (I6A10A-001-EVK-S1CC)

This example is using i6A4W10A033V,
Vout range is from 5V to 15V, Constant Current up to 10A. Injected CC_REF signal range from 0V to 5V.
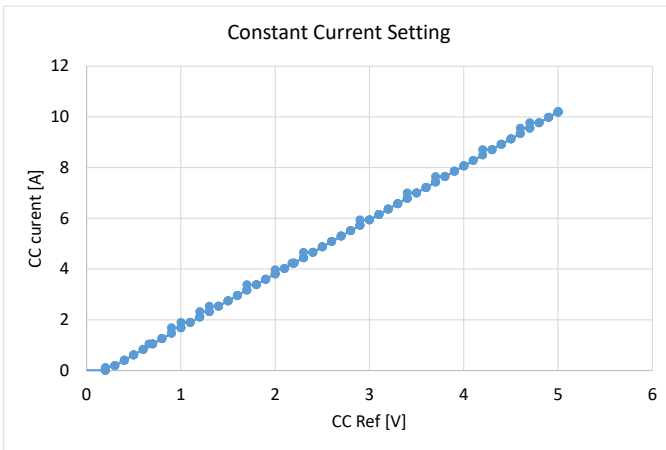

- Current Amp:
  Current Amp circuit block get output current information by using shunt resistor. EVKIT uses 10mohm resistor as parallel, **total 5mohm**. It shown as R773 and R774. To reduce power loss at RSHUNT a smaller value can be used, keeping in mind that smaller resistor will make signal smaller and reduce their accuracy. Voltage range from 5mohm RSHUNT is **0V to 50mV** for current from **0 to 10A**.
  Then gain signal by IC754. DC Gain is calculated as "R830/R784+1". So approximately **"25"**, followed by **"0.5times"** resistor divider R782 and R780. So **total DC gain is 12.5.**
  Therefore, **"0V to 50mV"** from RSHUNT signal convert to "**0V to 625mV"**

- Error Amp:
  Error Amp compare between **"CC_REF"** and signal from current amp. Maximum current amp is 625mV.
  CC_REF range is **between 0V and 5V**. Therefore, CC_REF maximum signal 5V must be down to 625mV by resistor divider. R786 and R778 are chosen by equation below.
  5V * R778 / (R786+R778) = 625mV
  Pick R778:1.0k and R786:6.81k is good value for this example.

- Trim Amp:
  Output of trim amp IC752 connected to trim terminal in order to get constant current.
  To change output voltage provide constant current against changing load resistance.
  R775 and C771 decide how quick response for transient situation. Small value creates quick response but it may have overshoot or undershoot. Large value create slow response but more stable.

9. Characteristic(I6A10A-001-EVK-S1CC)

Constant Current (24Vin/12Vout)

Constant Current (12Vin/5Vout)

Constant Current Setting

Maximum trim down voltage for the i6A is limited to how much current the inverter amp can pull out of the trim pin. The used TI OPA237 Op-amp typically pulls around -150µA.
If a wider trim range is required a better quality Op-amp can be selected.

Start-up waveform with 24Vin, Constant Voltage 12Vo, Constant Current 10A, CC_REF:5V
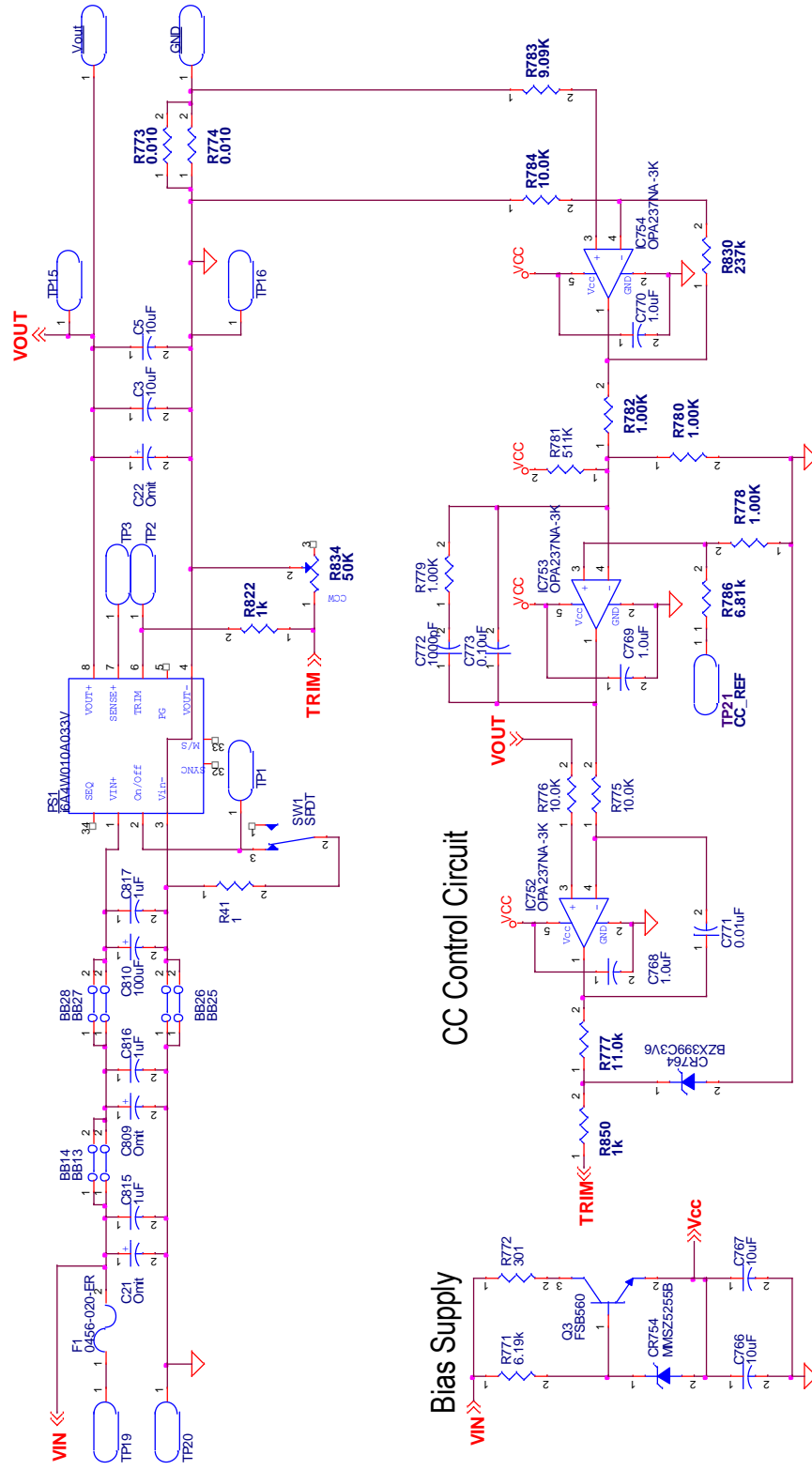
1.2ohm CR-mode (Start-up with CV region)

0.8ohm CR-mode(Start-up with CC region)

During On/Off or Vin start-up, the CC_REF should be set to zero before start-up. Otherwise, there will be overshoot of output voltage and output current before settling to the final value. Depending on circuit values, it is also possible the overshoot would cause the module to enter an over current protection hiccup mode. Generally, the recommend sequence is apply input voltage, set reference as zero, then apply on/off signal to enable module, then finally increase CC_REF to drive the output current to desired value.

10. Schematic

General Schematic: Check the accompanying parts list that pertains to the actual Evaluation Kit part number to see which circuit codes/components are used.
It may need higher sink/source current capability for IC752 if user want wide output voltage range.
VCC of IC752 must be above Vout.

11. Component Layout

12. Parts List

Evaluation Kit Part Number		i6A10A-001-EVK-S1CC		i6A20A-001-EVK-S1CC	
Parts Location	Part Type	Mfr Part No.	Manufacturer (Mfr)	Mfr Part No.	Manufacturer (Mfr)
PS1	DC-DC Module	I6A4W010A033V-001-R	TDK LAMBDA	I6A4W020A033V-001-R	TDK LAMBDA
BBxx	Copper Pin	ZP00185	TDK LAMBDA	ZP00185	TDK LAMBDA
C3	Capacitor	GRM32ER71J106KA12L	MURATA	GRM32ER71J106KA12L	MURATA
C5	Capacitor	GRM32ER71J106KA12L	MURATA	GRM32ER71J106KA12L	MURATA
C766 - C767	Capacitor	C3216X7R1V106KT	TDK	C3216X7R1V106KT	TDK
C768 - C770	Capacitor	C3216X7R1H105KT	TDK	C3216X7R1H105KT	TDK
C771	Capacitor	C1608X7R1H103KT	TDK	C1608X7R1H103KT	TDK
C772	Capacitor	C1608X7R1H102KT	TDK	C1608X7R1H102KT	TDK
C773	Capacitor	C1608X7R1H104KT	TDK	C1608X7R1H104K080AA	TDK
C810	Capacitor	EEEFK1J101P	PANASONIC	EEEFK1J101P	PANASONIC
C815 - C817	Capacitor	C2012X7S2A105KT	TDK	C2012X7S2A105KT	TDK
CR754	Diode	MMSZ5255BT1G	ON SEMI (FAIRCHILD)	MMSZ5255BT1G	ON SEMI (FAIRCHILD)
CR764	Diode	PDZ3.6B	NXP	PDZ3.6B	NXP
F1	Fuse	0456025.ER	LITTLEFUSE	0456025.ER	LITTLEFUSE
IC752 - IC754	IC	OPA237NA-3K	TEXAS INSTRUMENTS	OPA237NA-3K	TEXAS INSTRUMENTS
Q3	Transistor	FSB560_NL	ON SEMI (FAIRCHILD)	FSB560_NL	ON SEMI (FAIRCHILD)
R41	Resistor	RK73H2ATTE1R00F	KOA SPEER	RK73H2ATTE1R00F	KOA SPEER
R771	Resistor	RK73H2ATTE6191F	KOA SPEER	RK73H2ATTE6191F	KOA SPEER
R772	Resistor	RK73H1JTTD3010F	KOA SPEER	RK73H1JTTD3010F	KOA SPEER
R773 - R774	Resistor	TLR2HDTE10L0F	KOA SPEER	TLR2HDTE10L0F	KOA SPEER
R775	Resistor	RK73H1JTTD1002F	KOA SPEER	RK73H1JTTD1002F	KOA SPEER
R776	Resistor	RK73H1JTTD1002F	KOA SPEER	RK73H1JTTD1002F	KOA SPEER
R777	Resistor	RK73H1JTTD1102F	KOA SPEER	RK73H1JTTD6041F	KOA SPEER
R778	Resistor	RK73H1JTTD1001F	KOA SPEER	RK73H1JTTD1001F	KOA SPEER
R779	Resistor	RK73H1JTTD1001F	KOA SPEER	RK73H1JTTD1001F	KOA SPEER
R780	Resistor	RK73H1JTTD1001F	KOA SPEER	RK73H1JTTD1001F	KOA SPEER
R781	Resistor	RK73H1JTTD5113F	KOA SPEER	RK73H1JTTD3323F	KOA SPEER
R782	Resistor	RK73H1JTTD1001F	KOA SPEER	RK73H1JTTD1001F	KOA SPEER
R783	Resistor	RK73H1JTTD9091F	KOA SPEER	RK73H1JTTD9091F	KOA SPEER
R784	Resistor	RK73H1JTTD1002F	KOA SPEER	RK73H1JTTD1002F	KOA SPEER
R786	Resistor	RK73H1JTTD6811F	KOA SPEER	RK73H1JTTD4221F	KOA SPEER
R821	Resistor	RK73H1ETTP1001F	KOA SPEER	RK73H1ETTP1001F	KOA SPEER
R830	Resistor	RK73H1JTTD2373F	KOA SPEER	RK73H1JTTD1693F	KOA SPEER
R834	Resistor	3296X-1-503LF	BOURNS	3296X-1-503LF	BOURNS
R850	Resistor	RK73H1JTTD1001F	KOA SPEER	RK73H1JTTD6041F	KOA SPEER
SCR1-SCR4	Screw	SPC13372	MULTICOMP	SPC13372	MULTICOMP
SO1 - SO4	Spacer	1902C	KEYSTONE ELECTRONICS	1902C	KEYSTONE ELECTRONICS
SW1	Switch	2MS1T2B2M2RE	MULTICOMP	2MS1T2B2M2RE	MULTICOMP
TPxx	Test Point	5010,5011 or 5014	KEYSTONE ELECTRONICS	5010,5011 or 5014	KEYSTONE ELECTRONICS

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