7 Inductor Specification

7.1 Electrical Diagram

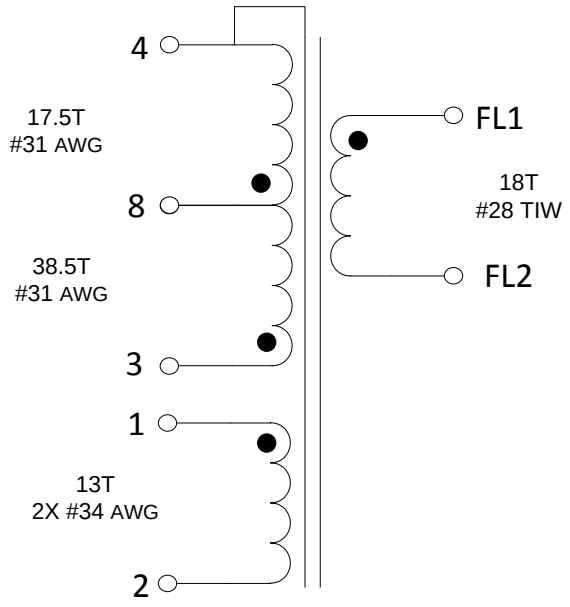

Figure 7 – Inductor Electrical Diagram.

7.2 Electrical Specifications

Parameter	Condition	Spec.
Nominal Primary Inductance	Measured at 1 V_{PK-PK}, 100 kHz switching frequency, between pin 1 and pin 2, with all other windings open.	420 µH
Tolerance	Tolerance of primary inductance.	±5%

7.3 Material List

Item	Description
[1]	Core: EE1621.
[2]	Bobbin, EE1621, Horizontal, 10 pins, Part no. 25-01044-00.
[3]	Magnet Wire: #31 AWG.
[4]	Magnet Wire: #34 AWG.
[5]	Triple Insulated Wire: #28 AWG.
[6]	Polyester Tape: 5.5 mm.
[7]	Transformer Tape: 6 mm.
[8]	Non-insulated Wire: #30 AWG.

7.4 Inductor Build Diagram

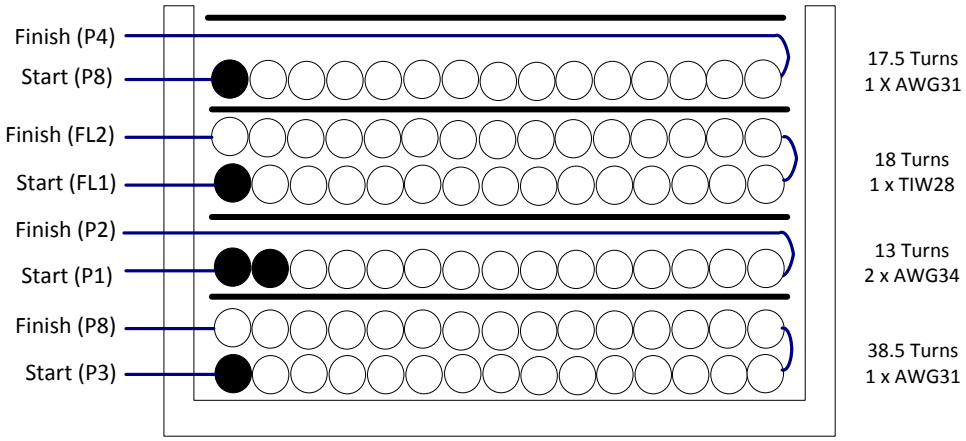

Figure 8 – Transformer Build Diagram.

7.5 Inductor Construction

Bobbin Modification	Cut the bobbin extension as shown on figure below.
Winding Directions	Bobbin placed on winder jig such that terminal pin 1-4 is in the left side. The winding direction is clockwise.
Winding 1	Use wire item [3], start at pin 3 and wind 38.5 turns in 2 layers, then finish the winding on pin 8.
Insulation	Add 1 layer of tape, item [6], for insulation.
Winding 2	Use wire item [4] in bifilar, start at pin 1 and wind 13 turns evenly from left to right, then finish the winding on pin 2.
Insulation	Add 1 layer of tape, item [6], for insulation.
Winding 3	Use wire item [5], allot 25 mm length for fly lead wire no.1 (mark as FL1) then wind 18 turns from left to right, finished the winding with 25 mm length fly lead wire no. 2 (mark as FL2).
Insulation	Add 1 layer of tape, item [7], for insulation.
Winding 4	Use wire item [3], start at pin 8 and wind 17.5 turns in 1 layer, then finish the winding on pin 4.
Insulation	Add 1 layer of tape, item [6], for insulation.
Core Grinding	Grind the center leg of one core until it meets the nominal inductance of 420 µH with ±5% inductance tolerance.
Assemble Core	Assemble the 2 cores on the bobbin with the gapped core place on top side of the bobbin and the un-gapped core at the bottom side. Wrap the cores with tin wire and terminate it to pin 4. Wrap the 2 cores with 2 layer of tape, item (6).
Pins	Pull out terminal pin no. 7
Finish	Dip the transformer assembly in varnish.

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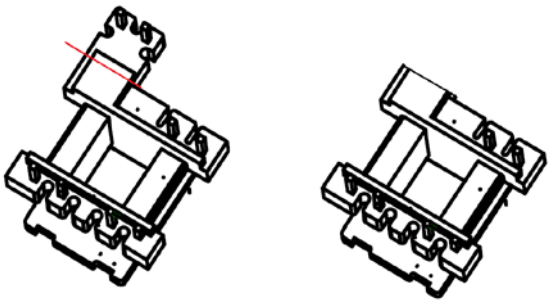
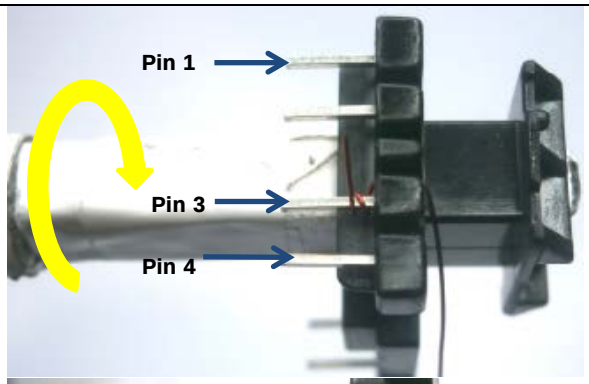
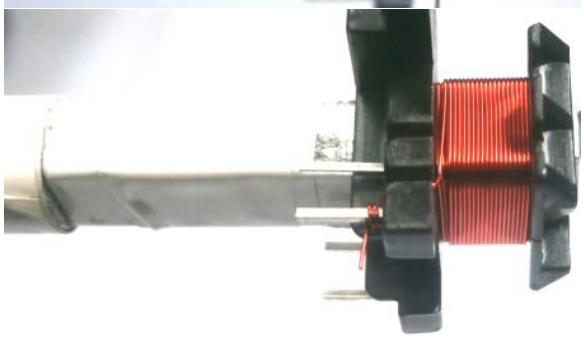
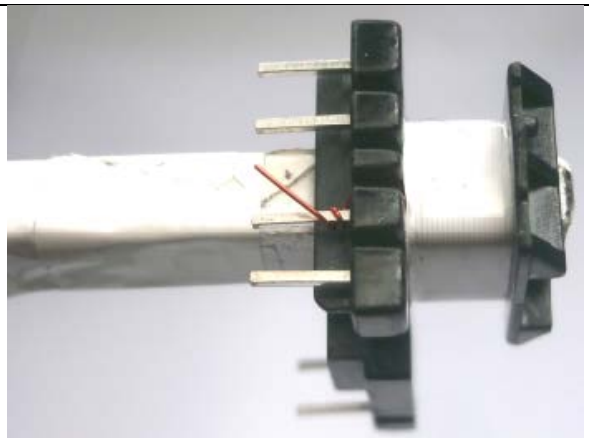
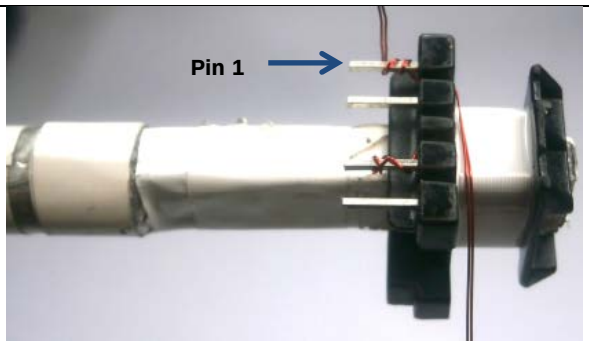
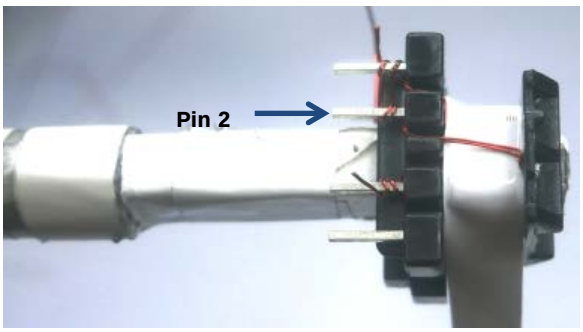
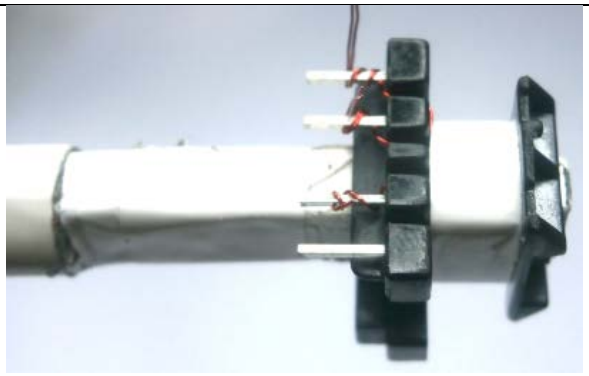
7.6 Winding Illustrations

Bobbin Modification Cut the bobbin extension as shown in the figure.	
Winding Directions Bobbin placed on winder jig such that terminal pin 1-4 is in the left side. The winding direction is clockwise. **Winding 1** Use wire item [3], start at pin 3 and wind 38.5 turns in 2 layers, then finish the winding on pin 8.	 
Insulation Add 1 layer of tape, item [6], for insulation.	

Winding 2 Use wire item [4] in bifilar, start at pin 1 and wind 13 turns evenly from left to right, then finish the winding on pin 2.	 
Insulation Add 1 layer of tape, item [6], for insulation.	

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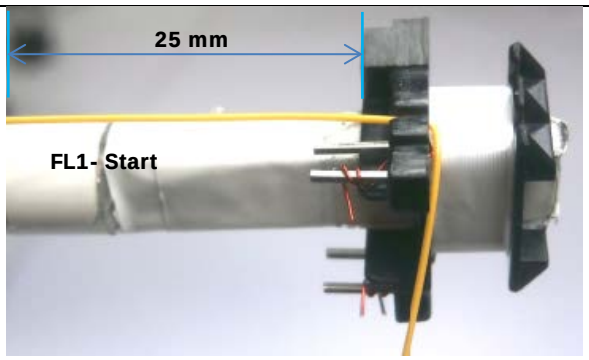
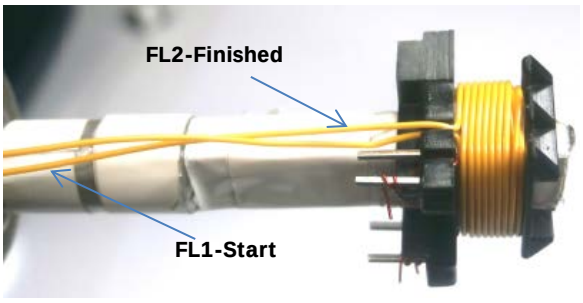
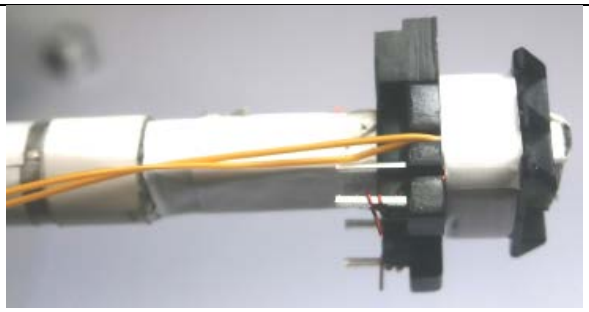
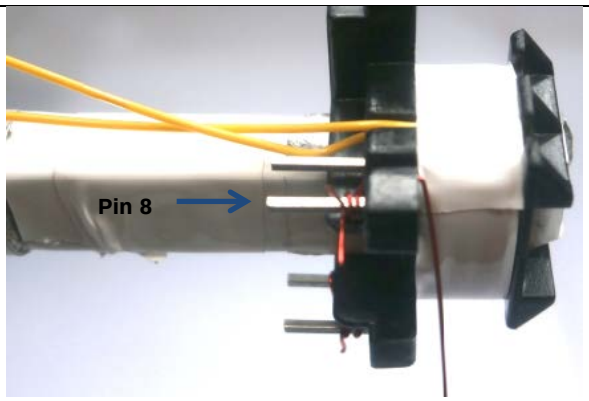
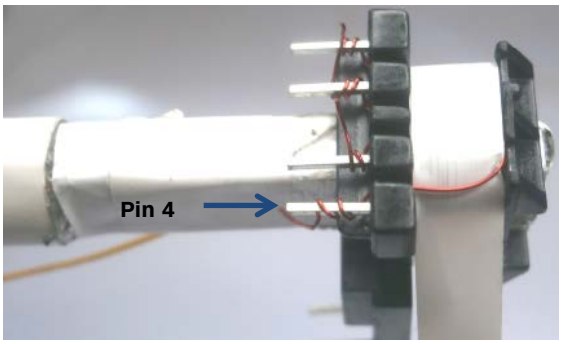
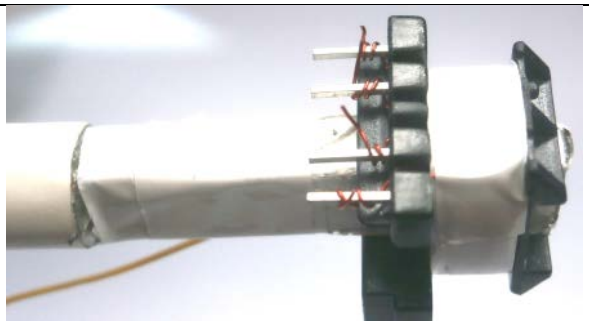
Winding 3 Use wire item [5], allot 25 mm length for fly lead wire no.1 (mark as FL1) then wind 18 turns from left to right, finish the winding with 25 mm Length fly lead wire no. 2 (mark as FL2).	 
Insulation Add 1 layer of tape, item [7], for insulation.	

Winding 4 Use wire item [3], start at pin 8 and wind 17.5 turns in 1 layer, then finish the winding on pin 4.	 
Insulation Add 1 layer of tape, item [6], for insulation.	

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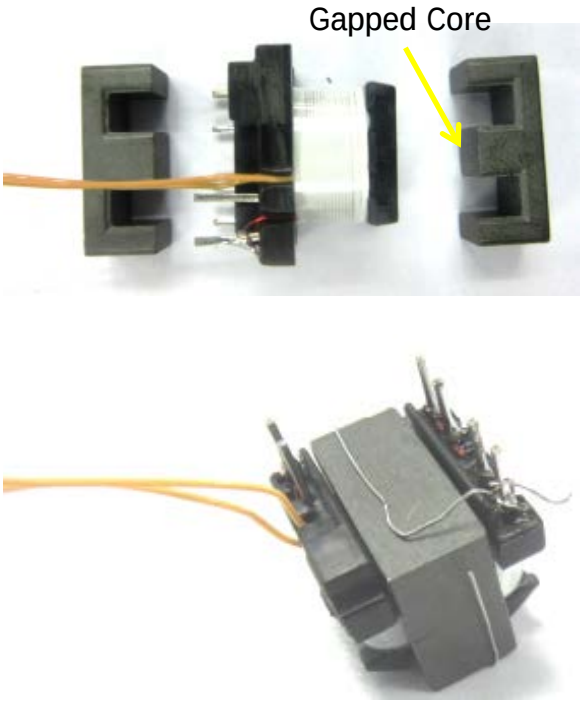
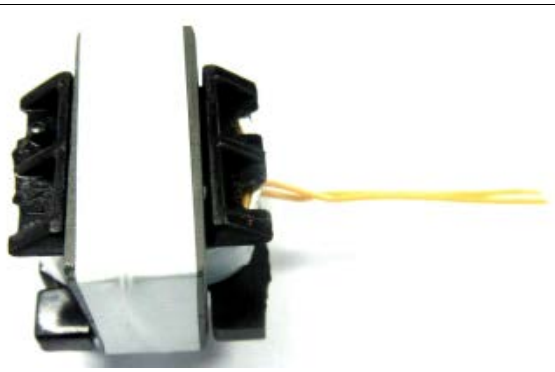
Assemble Core Assemble the 2 cores on the bobbin with the gapped core placed on top side of the bobbin and the un-gapped core at the bottom side. Wrap the cores with tin wire (item 8) and terminate it to pin 4. Wrap the 2 cores with 2 layers of tape, item (7).	
Finish Dip the transformer assembly in 2:1 thinner and varnish solution.	

8 Inductor Design Spreadsheet

ACDC LYTSwitch5 IsolatedFlyback 011916; Rev.1.0; Copyright Power Integrations 2016	INPUT	INFO	OUTPUT	UNITS	LYTSwitch-5 Isolated Flyback Design Spreadsheet
ENTER APPLICATION VARIABLES					
VACMIN	90.0		90.0	Volts RMS	Minimum AC line voltage.
VACNOM			177.5	Volts RMS	Nominal AC line voltage.
VACMAX	265.0		265.0	Volts RMS	Maximum AC line voltage.
FL			50	Hertz	AC line frequency.
VO_MIN			36.0	Volts DC	Guaranteed minimum VO that maintains output regulation.
VO	40.0		40.0	Volts DC	Worst case normal operating output voltage.
VO_OVP_MIN			52.7	Volts DC	Minimum Voltage at which output voltage protection may be activated.
IO	350.0		350.0	m-Amperes	Average output current specification.
EFFICIENCY	0.87		0.87	Dimensionless	Total power supply efficiency.
Z			0.50	Dimensionless	Loss allocation factor.
PO			14.00	Watts	Output power.
LYTSwitch-5 DESIGN VARIABLES					
BREAKDOWN VOLTAGE	725		725	Volts DC	Choose between 650V and 725V.
GENERIC DEVICE	LYT52X6D		LYT52X6D		Chosen LYTSwitch-5 generic device.
ACTUAL DEVICE			LYT5226D		Chosen LYTSwitch-5 device code.
ILIMITMIN			1.767	Amperes	Minimum device current limit.
ILIMITTYP			1.900	Amperes	Typical Current Limit.
ILIMITMAX			2.033	Amperes	Maximum Current Limit.
IP_MOSFET			1.319	Amperes	Worst case peak drain current of the MOSFET.
TON_MIN			1.327	u-seconds	Worst case minimum on-time of the MOSFET.
TON_MAX			3.887	u-seconds	Worst case maximum on-time of the MOSFET.
IAVG_MOSFET			0.167	Amperes	Worst case average drain current of the MOSFET.
IRMS_MOSFET			0.320	Amperes	Worst case maximum RMS current of the MOSFET.
KDP			1.123	Dimensionless	Ratio between off-time of the MOSFET and on-time of the secondary diode.
VDRAIN			529.8	Volts DC	Estimated worst case drain voltage of the MOSFET.
DEVICE PROGRAMMING PARAMETERS					
RDO			6	k-ohms	DO pin resistor.
RDS			6	k-ohms	Current sense programming resistor connected to the DS pin for the isolated flyback converter.
ENTER TRANSFORMER CONSTRUCTION VARIABLES					
CORE TYPE	EE1621		EE1621		Core type.
AE	33.77		33.77	mm^2	Core effective cross sectional area.
LE	29.00		29.00	mm	Core effective path length.
AL	2600		2600	nH/T^2	Ungapped core effective inductance.
VE	980		980	mm^3	Core volume.
AW	15.00		15.00	mm^2	Window area of the bobbin.
BW	5.00		5.00	mm	Bobbin physical winding width.
MARGIN			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
TRANSFORMER DESIGN PARAMETERS					
Primary winding parameters					
LP	420		420	u-Henrys	Typical value of the primary inductance.
LP_TOL	5		5	%	Tolerance of the primary inductance.
LP_MIN			399	u-Henrys	Minimum value of the primary inductance.
LP_MAX			441	u-Henrys	Maximum value of the primary inductance.
NP			56	Turns	Number of primary turns.
ALG			133.93	nH/T^2	Gapped core effective inductance.
BM			3075	Gauss	Maximum flux density.
BP		Warning	4741	Gauss	The peak flux density is higher than 4200 Gauss.

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					Increase the number of primary winding turns to avoid core saturation.
BAC			1538	Gauss	Worst case AC Flux Density for Core Loss Curves (0.5 X Peak to Peak).
LG			0.3	mm	Core gap length.
LAYERS_PRIMARY_DESIRED			4	Dimensionless	Desired number of primary layers.
AWG_PRIMARY	31		31	AWG	Primary wire gauge.
OD_PRIMARY_INSULATED			0.272	mm	Outer diameter of the primary winding wire with insulation.
OD_PRIMARY_BARE			0.227	mm	Outer diameter of the primary winding wire without insulation.
IRMS_PRIMARY			0.320	Amperes	Maximum RMS current flowing through the primary winding.
CMA_PRIMARY			249	mils^2/Amperes	Primary winding CMA.
J_PRIMARY			7.92	Amperes/mm^2	Primary winding current density.
Secondary winding parameters					
VOR	125		125	Volts DC	Output voltage reflected to the primary winding when the MOSFET is off.
NS	18		18	Dimensionless	Number of secondary turns.
AWG_SECONDARY			27	Dimensionless	Secondary wire gauge.
OD_SECONDARY_INSULATED			0.418	mm	Outer diameter of the secondary winding wire with insulation.
OD_SECONDARY_BARE			0.361	mm	Outer diameter of the secondary winding wire without insulation.
IRMS_SECONDARY			0.979	Amperes	Maximum RMS current flowing through the secondary winding.
CMA_SECONDARY			206	mils^2/Amperes	Secondary winding CMA.
J_SECONDARY			9.59	Amperes/mm^2	Secondary winding current density.
Bias winding parameters					
VD_BIAS			0.70	Volts DC	Bias winding diode forward drop voltage.
BIAS TURNS			13	Turns	Number of bias winding turns.
VBIAS	28.0		28.0	Volts DC	Bias Voltage. Check performance at minimum VO and VACMAX.
PIVBS			132.4	Volts DC	Output Rectifier Maximum Peak Inverse Voltage (calculated at VACMAX)
CBIAS			22.0	u-Farads	Bias winding rectification capacitor.
RBP			25.00	k-Ohms	Bias supply resistor assuming 1mA current necessary to supply the BP pin.
CBP			2.2	u-Farads	Minimum BP pin capacitance.
SECONDARY DIODE PARAMETERS					
VF_DIODE			0.7	Volts DC	Output diode forward voltage drop.
IRMS_DIODE			0.979	Amperes	Diode RMS current at LP_MIN, VACMIN and PO_MAX.
IP_DIODE			4.103	Amperes	Diode peak current at LP_MIN ,VACMAX and PO_MAX.
PIV_DIODE			190.4	Volts DC	Peak Inverse Voltage at VO_MAX on output diode.
FEEDBACK AND PROTECTION PARAMETERS WITH FINE TUNING					
RL	4.00		4.00	M-Ohms	Standard (E96 / 1%) L pin resistor.
OVP_LINE			339.4	Volts RMS	Line overvoltage based on the actual L pin resistor used.
RDC_THEORETICAL			2.40	Ohms	Theoretical DS pin sense resistor.
RDC			2.43	Ohms	Standard (E96 / 1%) DS pin sense resistor.
CDC			10.0	u-Farads	Standard capacitor connected in parallel with the DS pin sense resistor.
VBIAS_MEASURED	30.0		30.0	Volts DC	Actual bias voltage (across the bias capacitor) measured on the bench.
VO_MEASURED			40.0	Volts DC	Actual load voltage measured on the bench.
ROC			280.0	k-Ohms	Standard (E96 / 1%) OC pin resistor.
IO_ACTUAL			350.0	m-Amperes	Actual output current seen on the bench.
RFB_THEORETICAL			39.5	k-Ohms	Calculated value of RFB, using standard values for RDS, ROVP, and RL

RFB			39.2	k-Ohms	Standard (E96 / 1%) F pin resistor.
CFB			150.0	n-Farads	Standard capacitor connected to the F pin.

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