FEATURES

- Industrial Standard 2"×1" Package
- Input Ranges 9-36VDC, 18-75VDC, 40-160VDC
- I/O Isolation 2250VDC with Reinforced Insulation
- Operating Temp. Range -40°C to +95°C
- No Min. Load Requirement
- Over Load/Voltage and Short Circuit Protection
- Remote On/Off, Output Voltage Trim
- Conducted EMI meets EN55022 Class A & FCC Level A
- Vibration and Thermal Shock meets EN61373
- Cooling, Dry & Damp Heat Test meet IEC/EN60068
- Railway EMC Standard meets EN50121-3-2
- Railway Standard meets EN50155 (IEC60571)
- UL/cUL/IEC/EN 60950-1 Safety Approval & CE Marking (Pending)

PRODUCT OVERVIEW

The MINMAX MKZI10 series is a new range of high performance 10W isolated dc-dc converter within encapsulated 2"x1" package which specifically design for railway applications. There are 12 models available for railway input voltage of either 24(9~36)VDC or 48(18~75)VDC or 72/110(40~160)VDC and tight output voltage regulation. Further features include over current, over voltage, short circuit protection, remote ON/OFF, output trim and EMI filter meets EN55022 & FCC Part15 Class A as well. MKZI10 series conform to vibration and thermal shock test meets EN61373, cooling, dry and damp heat test meets IEC/EN 60068-2 and railway EMC standard EN50121-3-2 and complies also with railway standard EN50155 (IEC60571). MKZI10 series offer an highly reliable solution for critical applications in railway systems, battery-powered equipment, measure instrumentation and many critical applications.

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Over Voltage Protection	Max. capacitive Load	Efficiency (typ.)
			Max.	@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	VDC	μF	%
MKZI10-24S05	24 (9 ~ 36)	5	2000	496	25	6.2	2200	84
MKZI10-24S12		12	830	483		15	330	86
MKZI10-24S15		15	670	481		18	220	87
MKZI10-24S24		24	417	474		27	100	88
MKZI10-48S05	48 (18 ~ 75)	5	2000	245	15	6.2	2200	85
MKZI10-48S12		12	830	239		15	330	87
MKZI10-48S15		15	670	241		18	220	87
MKZI10-48S24		24	417	242		27	100	86
MKZI10-110S05	110 (40 ~ 160)	5	2000	111	10	6.2	2200	82
MKZI10-110S12		12	830	107		15	330	85
MKZI10-110S15		15	670	107		18	220	85
MKZI10-110S24		24	417	107		27	100	85

Input Specifications

Parameter	Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (100ms. max)	24V Input Models	-0.7	---	50	VDC
	48V Input Models	-0.7	---	100	
	110V Input Models	-0.7	---	170	
Start-Up Threshold Voltage	24V Input Models	---	---	9	
	48V Input Models	---	---	18	
	110V Input Models	---	---	40	
Under Voltage Shutdown	24V Input Models	---	7.5	---	
	48V Input Models	---	16	---	
	110V Input Models	---	37	---	
Start Up Time	All Models	---	50	---	mS
Input Filter		Internal Pi Type			

Output Specifications

Parameter	Conditions			Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy				---	---	±1.0	%
Line Regulation	Vin=Min. to Max. @ Full Load			---	---	±0.2	%
Load Regulation	Min. Load to Full Load			---	---	±0.5	%
Minimum Load	No minimum Load Requirement						
Ripple & Noise	0-20 MHz Bandwidth	5Vo	Measured with a 10μF/25V MLCC	---	50	---	mV P-P
		12Vo,15Vo		---	100	---	mV P-P
		24Vo	Measured with a 4.7μF/50V MLCC	---	150	---	mV P-P
Transient Recovery Time	25% Load Step Change (2)			---	---	300	μsec
Transient Response Deviation				---	±3	±5	%
Temperature Coefficient				---	---	±0.02	%/℃
Over Current Protection	Current Limitation at 150% typ. of Iout max., Hiccup						
Short Circuit Protection	Hiccup Mode 0.7Hz typ.						

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage (60 sec.)		2250	---	---	VDC
Isolation Voltage Input/Output to case		1500	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100KHz, 1V	---	1500	---	pF
Switching Frequency		---	320	---	KHz
MTBF(calculated)	MIL-HDBK-217F@25℃ Full Load, Ground Benign		TBD		Hours
Safety Approval (pending)	cUL/UL 60950-1, IEC/EN 60950-1, EN50155,IEC60571				

Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	3.5V ~ 12V or Open Circuit				
Converter Off	0V ~ 1.2V or Short Circuit				
Control Input Current (on)	Vctrl = 5.0V	---	0.5	---	mA
Control Input Current (off)	Vctrl = 0V	---	-0.5	---	mA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	---	2.5	---	mA

Output Voltage Trim

Parameter	Conditions	Min.	Typ.	Max.	Unit
Trim Up / Down Range (See Page 7)	% of Nominal Output Voltage	±10	---	---	%

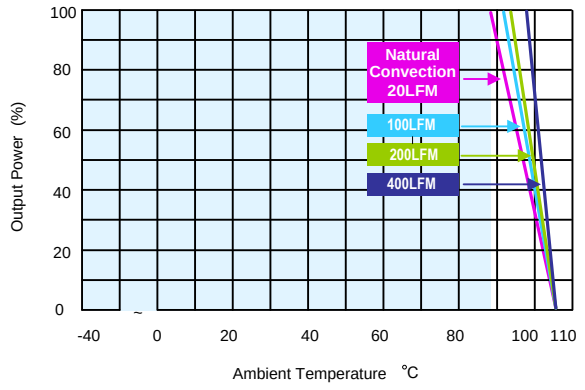
Environmental Specifications

Parameter	Model	Min.	Max.		Unit
			without Heatsink	with Heatsink	
Operating Temperature Range Natural Convection (8) Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MKZI10-24S24	-40	88	92	°C
	MKZI10-24S15, MKZI10-48S12 MKZI10-48S15		87	90	
	MKZI10-24S12, MKZI10-48S24		85	89	
	MKZI10-48S05, MKZI10-110S12 MKZI10-110S15, MKZI10-110S24		84	88	
	MKZI10-24S05		82	86	
	MKZI10-110S05		78	83	
Thermal Impedance	Natural Convection without Heatsink	12.1	---		°C/W
	Natural Convection with Heatsink	9.8	---		°C/W
	100LFM Convection without Heatsink	9.2	---		°C/W
	100LFM Convection with Heatsink	5.4	---		°C/W
	200LFM Convection without Heatsink	7.8	---		°C/W
	200LFM Convection with Heatsink	4.5	---		°C/W
	400LFM Convection without Heatsink	5.2	---		°C/W
	400LFM Convection with Heatsink	3.0	---		°C/W
Case Temperature		---	+105		°C
Storage Temperature Range		-50	+125		°C
Cooling Test	Compliance to IEC/EN60068-2-1				
Dry Heat	Compliance to IEC/EN60068-2-2				
Damp Heat	Compliance to IEC/EN60068-2-30				
Shock & Vibration Test	Compliance to IEC/EN 61373				
Operating Humidity (non condensing)		---	95		% rel. H
RFI	Six-Sided Shielded, Metal Case				
Lead Temperature (1.5mm from case for 10Sec.)		---	260		°C

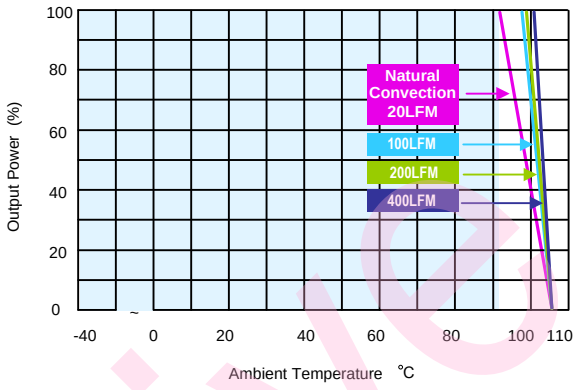
EMC Specifications

Parameter	Standards & Level		Performance
General	Compliance with EN 50121-3-2 Railway Applications		
EMI	Conduction	EN55022, EN55011, FCC part 15	Class A
EMS	EN55024		
	ESD	EN61000-4-2 air ± 8kV, Contact ± 6kV	A
	Radiated immunity	EN61000-4-3 10V/m	A
	Fast transient(7)	EN61000-4-4 ±2kV	A
	Surge(7)	EN61000-4-5 ±2kV	A
	Conducted immunity	EN61000-4-6 10Vrms	A

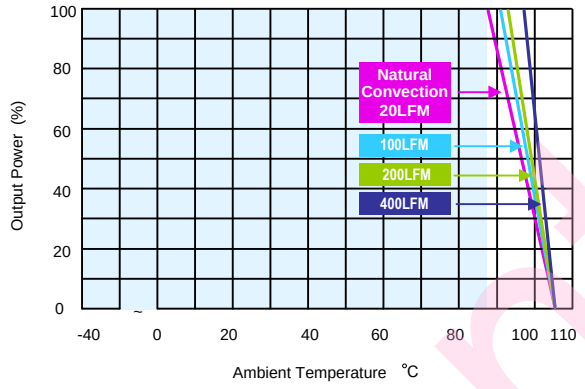
Power Derating Curve



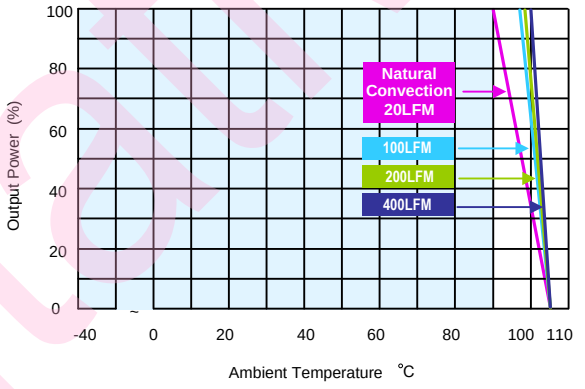
MKZI10-24S24 Derating Curve without Heatsink



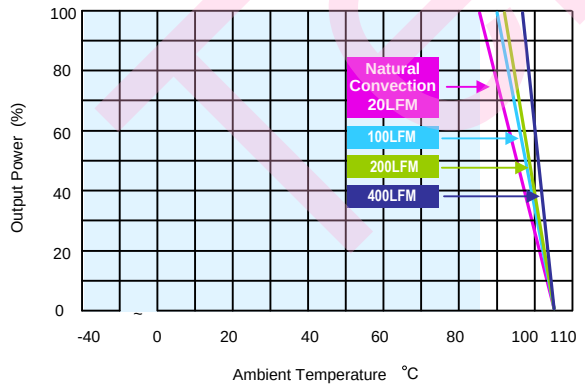
MKZI10-24S24 Derating Curve with Heatsink



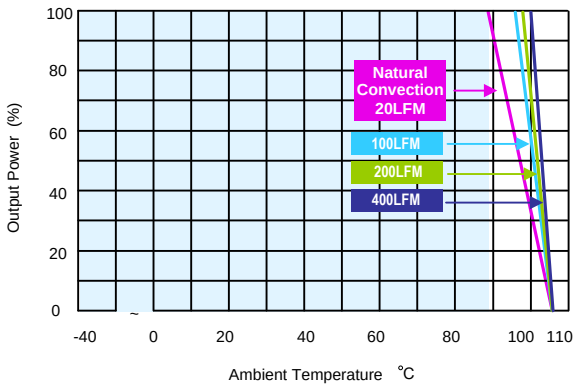
MKZI10-24S15,MKZI10-48S12, MKZI10-48S15 Derating Curve without Heatsink



MKZI10-24S15,MKZI10-48S12, MKZI10-48S15 Derating Curve with Heatsink

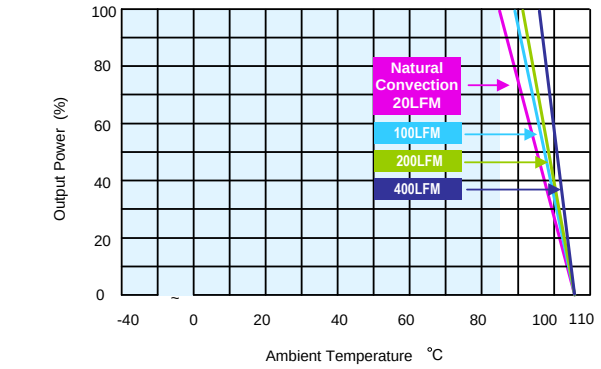


MKZI10-24S12,MKZI10-48S24 Derating Curve without Heatsink

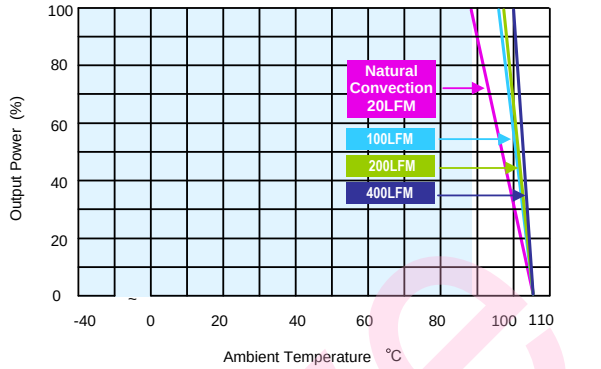


MKZI10-24S12,MKZI10-48S24 Derating Curve with Heatsink

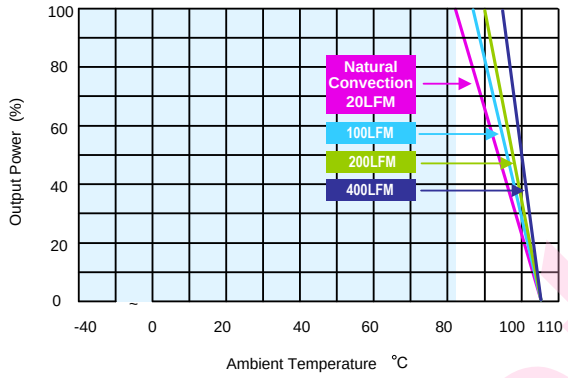
Power Derating Curve



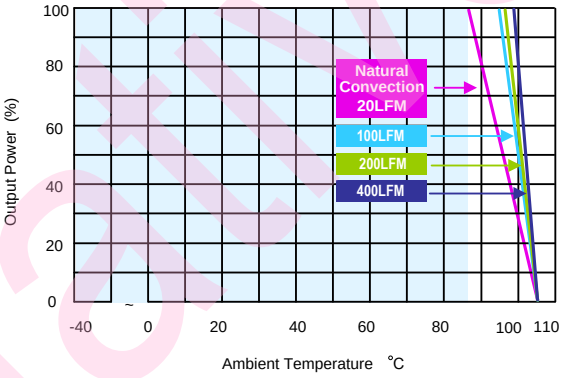
MKZI10-48S05, MKZI10-110S12, MKZI10-110S15, MKZI10-110S24
Derating Curve without Heatsink



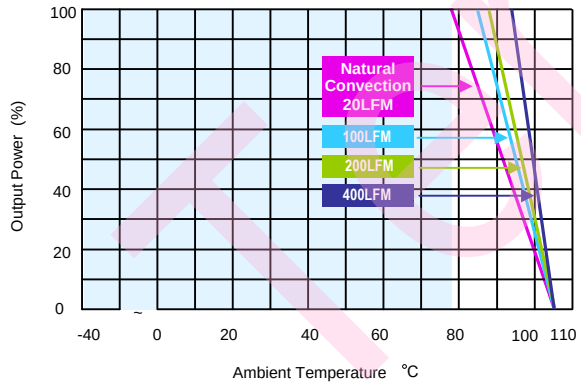
MKZI10-48S05, MKZI10-110S12, MKZI10-110S15, MKZI10-110S24
Derating Curve with Heatsink



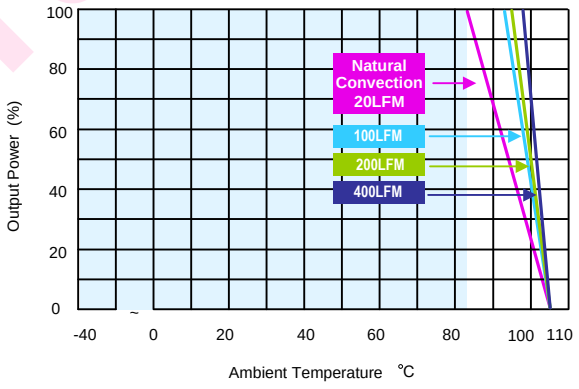
MKZI10-24S05 Derating Curve without Heatsink



MKZI10-24S05 Derating Curve with Heatsink



MKZI10-110S05 Derating Curve without Heatsink



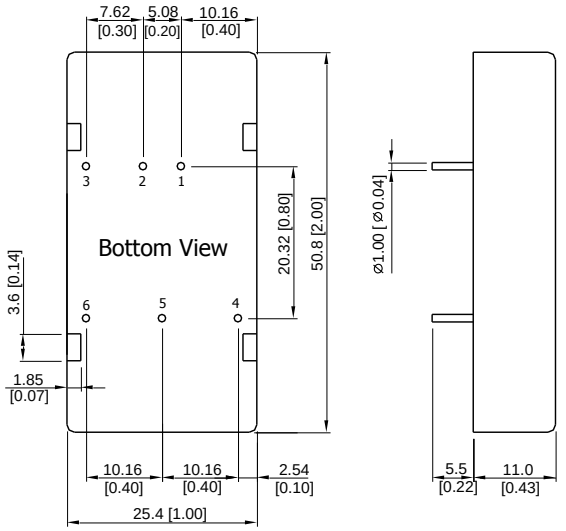
MKZI10-110S05 Derating Curve with Heatsink

Notes

1 Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3 We recommend to protect the converter by a slow blow fuse in the input supply line.
4 Other input and output voltage may be available, please contact factory.
5 To order the converter with "A" Pinning, please add a **suffix A** (e.g. MKZI10-24S05A) to order code.
6 To order the converter with heatsink, please add a **suffix –HS** (e.g. MKZI10-24S05-HS, MKZI10-24S05A-HS) to order code.
7 To meet EN61000-4-4 & EN61000-4-5 an external capacitor across the input pins is required.Suggested capacitor:TBD
8 That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
9 Specifications are subject to change without notice.

Package Specifications

Mechanical Dimensions

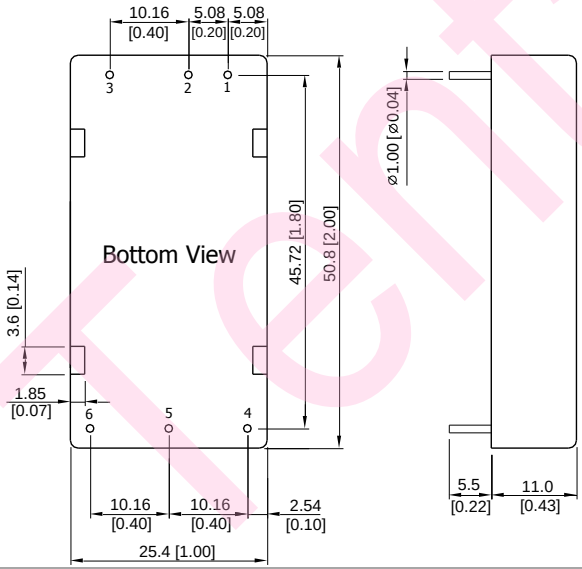


Pin Connections	
Pin	Function
1	+Vin
2	-Vin
3	Remote On/Off
4	+Vout
5	Trim
6	-Vout

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)
- Pin diameter ∅ 1.0 ±0.05 (0.04±0.002)

Package Specifications with "A" Pinning (order code suffix $A_{(5)}$)

Mechanical Dimensions



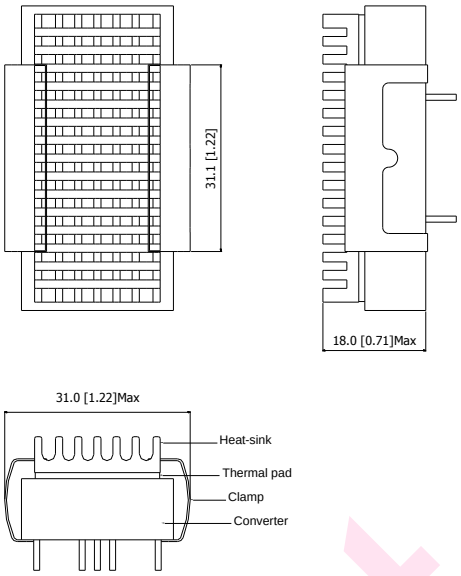
Pin Connections	
Pin	Function
1	+Vin
2	-Vin
3	Remote On/Off
4	+Vout
5	-Vout
6	Trim

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)
- Pin diameter ∅ 1.0 ±0.05 (0.04±0.002)

Physical Characteristics

Case Size	:	50.8x25.4x11.0 mm (2.0x1.0x0.43 inches)
Case Material	:	Aluminium Alloy, Black Anodized Coating
Base Material	:	FR4 PCB (flammability to UL 94V-0 rated)
Pin Material	:	Tinned Copper
Potting Material	:	Epoxy (UL94-V0)
Weight	:	TBD

Heatsink (Option, –HS(6))



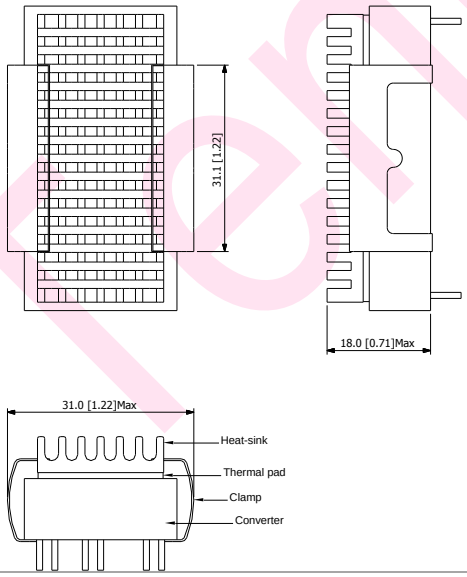
Physical Characteristics

Heatsink Material	:	Aluminum
Finish	:	Black Anodized Coating
Weight	:	9g

▶ The advantages of adding a heatsink are:

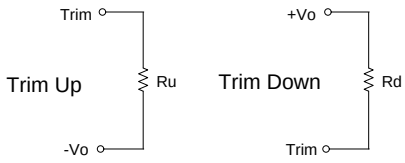
1. To improve heat dissipation and increase the stability and reliability of the DC/DC converters at high operating temperatures.
2. To increase operating temperature of the DC/DC converter, please refer to Derating Curve.

"A" Pinning Heatsink (Option, –HS(6))



External Output Trimming

Output can be externally trimmed by using the method shown below



MKZI10-XXS05 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	137.88	61.93	36.61	23.95	16.35	11.29	7.67	4.96	2.85	1.16	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	108.09	48.39	28.49	18.54	12.56	8.58	5.74	3.61	1.95	0.62	KOhms

MKZI10-XXS12 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	419.81	187.68	110.30	71.61	48.40	32.93	21.87	13.58	7.13	1.98	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	344.74	154.37	90.92	59.19	40.15	27.46	18.39	11.59	6.31	2.07	KOhms

MKZI10-XXS15 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	602.92	269.91	158.91	103.41	70.10	47.90	32.05	20.15	10.90	3.50	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	482.88	215.89	126.89	82.40	55.70	37.90	25.18	15.65	8.23	2.30	KOhms

MKZI10-XXS24 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	598.97	267.93	157.59	102.42	69.31	47.25	31.48	19.66	10.46	3.11	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	486.83	217.87	128.21	83.38	56.49	38.56	25.75	16.14	8.67	2.69	KOhms