

FEATURES**NEW**

- ▶ Industrial Standard Quarter Brick Package
- ▶ Ultra-wide Input Range 36-160VDC
- ▶ I/O Isolation 2000VAC with Reinforced Insulation
- ▶ Excellent Efficiency up to 90%
- ▶ Operating Baseplate Temp. Range -40°C to +105°C
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload/Voltage/Temp. and Short Circuit Protection
- ▶ Remote On/Off Control, Output Voltage Trim, Output Sense
- ▶ Vibration and Shock/Bump Test EN 61373 Approved
- ▶ Cooling, Dry & Damp Heat Test IEC/EN 60068-2-1, 2, 30 Approved
- ▶ Railway EMC Standard EN 50121-3-2 Approved
- ▶ Railway Certified EN 50155 (IEC60571) Approved
- ▶ Fire Protection Test EN 45545-2 Approved
- ▶ UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking

**PRODUCT OVERVIEW**

The MINMAX MRZ1150 series is a new generation of high performance 150W DC-DC converters in quarter brick package designed specifically for railway applications with popular 36-160 VDC input ranges. MRZ1150 is approved by railway industry standard EN 50155 and complies with EMC standard EN 50121-3-2.

Advanced circuit topology provides a very high efficiency up to 90% which allows baseplate temperature up to 105°C and very high I/O isolation up to 2000VAC with reinforced insulation which are designed to meet stringent requirements and harsh environment.

Further product features include under-voltage, overload/voltage/temp., short circuit protection, remote On/Off Control(positive/negative logic), output voltage trim, output sense and complies specifically fire protection test meets EN45545-2 to ensure safety during railway/railroad vehicle operation.

Model Selection Guide

| Model Number | Input Voltage (Range) ⁽¹⁰⁾ | Output Voltage | Output Power | Output Current | Input Current | | Over Voltage Protection | Max. capacitive Load | Efficiency (typ.) |
|----------------|---------------------------------------|----------------|--------------|----------------|---------------|----------|-------------------------|----------------------|-------------------|
| | | | | | Max. | @No Load | | | @Max. Load |
| | VDC | VDC | W | A | mA(typ.) | mA(typ.) | VDC | µF | % |
| MRZ1150-110S05 | 110 (36 ~ 160) | 5 | 135 | 27 | 1364 | 10 | 6.2 | 51000 | 90 |
| MRZ1150-110S12 | | 12 | 150 | 12.5 | 1515 | 10 | 15 | 8850 | 90 |
| MRZ1150-110S15 | | 15 | 150 | 10 | 1532 | 10 | 18 | 5700 | 89 |
| MRZ1150-110S24 | | 24 | 150 | 6.25 | 1550 | 10 | 30 | 2200 | 88 |
| MRZ1150-110S54 | | 54 | 150.12 | 2.78 | 1542 | 10 | 66 | 550 | 88.5 |

Input Specifications

| Parameter | Min. | Typ. | Max. | Unit |
|-------------------------------------|--------------------|------|------|------|
| Input Voltage Range ⁽¹⁰⁾ | 36 | 110 | 160 | VDC |
| Input Surge Voltage (100ms. max) | -0.7 | --- | 170 | |
| Start-up Threshold Voltage | --- | --- | 36 | |
| Under Voltage Shutdown | --- | 35 | --- | |
| Input Filter | Internal Capacitor | | | |

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 | --- | --- | ±0.3 | % | |
| Min.Load | | No minimum Load Requirement | | | | | |
| Ripple & Noise | 0-20 MHz Bandwidth | 5V Output | Measured with a 22uF/25V POLYMER | --- | 100 | --- | mV _{p-p} |
| | | 12V, 15V Output | | --- | 150 | --- | mV _{p-p} |
| | | 24V Output | Measured with a 33uF/35V POLYMER | --- | 200 | --- | mV _{p-p} |
| | | 54V Output | Measured with a 1uF/100V MLCC | --- | 300 | --- | mV _{p-p} |
| Start-up Time (Power On) | | | --- | 50 | --- | mS | |
| Transient Recovery Time | | 25% Load Step Change (4) | --- | 250 | --- | µsec | |
| Transient Response Deviation | | | --- | ±3 | ±5 | % | |
| Temperature Coefficient | | | --- | --- | ±0.02 | %/°C | |
| Trim Up / Down Range (9) | | % of Nominal Output Voltage | Other Models | | --- | ±10 | % |
| | | | 54V Output | | --- | +5 / -15 | % |
| Over Load Protection (8) | | Current Limitation at 150% typ. of Iout max., Hiccup | | | | | |
| Short Circuit Protection | | Hiccup Mode 0.3 Hz typ., Automatic Recovery | | | | | |

General Specifications

| Parameter | | Conditions | Min. | Typ. | Max. | Unit |
|---------------------------|----------------|--|---------|------|------|-------|
| I/O Isolation Voltage | | Reinforced Insulation, Rated For 60 Seconds | 2000 | --- | --- | VAC |
| Isolation Voltage | Input to case | | 1500 | --- | --- | VAC |
| | Output to case | | 500 | --- | --- | VAC |
| I/O Isolation Resistance | | 500 VDC | 10 | --- | --- | GΩ |
| I/O Isolation Capacitance | | 100kHz, 1V | --- | 2000 | --- | pF |
| Switching Frequency | | Other Models | --- | 200 | --- | kHz |
| | | 54V Output | --- | 180 | --- | kHz |
| MTBF(calculated) | | MIL-HDBK-217F@25°C Full Load, Ground Benign | 412,541 | --- | --- | Hours |
| Safety Standards | | EN 50155, IEC 60571 | | | | |
| | | UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1 | | | | |

Remote On/Off Control

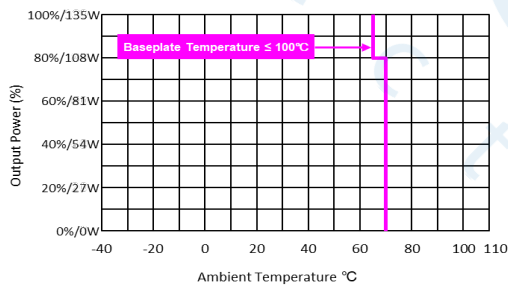
| Parameter | | Conditions | Min. | Typ. | Max. | Unit | |
|---------------------------|-----------------------|------------------------------|--------------|------|------|------|----|
| Positive logic (Standard) | Converter On | 3.5V ~ 12V or Open Circuit | | | | | |
| | Converter Off | 0V ~ 1.2V or Short Circuit | | | | | |
| Negative logic (Option) | Converter On | 0V ~ 1.2V or Short Circuit | | | | | |
| | Converter Off | 3.5V ~ 12V or Open Circuit | | | | | |
| Positive logic | Control Input Current | Converter On | Vctrl = 5.0V | --- | --- | 0.5 | mA |
| | | Converter Off | Vctrl = 0V | --- | --- | -0.5 | mA |
| Negative logic | Control Input Current | Converter On | Vctrl = 0V | --- | --- | -0.5 | mA |
| | | Converter Off | Vctrl = 5.0V | --- | --- | 0.5 | mA |
| Control Common | | Referenced to Negative Input | | | | | |
| Standby Input Current | | Nominal Vin | --- | 3 | --- | mA | |

EMC Specifications

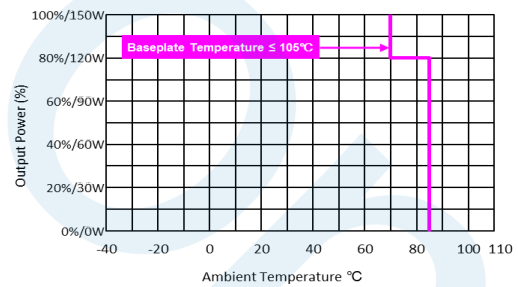
| Parameter | Standards & Level | | | Performance | |
|-----------|---|---------------------------------------|------------------------------|---------------|---|
| General | Compliance with EN 50121-3-2 Railway Applications | | | | |
| EMI | Conduction | EN 55032/11 | With external components | Class A (5) | |
| | Radiation | | | | |
| EMS | EN 55024, EN 55035 | | | | |
| | ESD | Direct discharge | Indirect discharge HCP & VCP | | |
| | | EN 61000-4-2 air ± 8kV, Contact ± 6kV | | Contact ± 6kV | |
| | Radiated immunity | EN 61000-4-3 10V/m | | | A |
| | Fast transient (6) | EN 61000-4-4 ±2kV | | | A |
| | Surge (6) | EN 61000-4-5 ±1kV | | | A |
| | Conducted immunity | EN 61000-4-6 10Vrms | | | A |
| PFMF | EN 61000-4-8 3A/M | | | A | |

Environmental Specifications

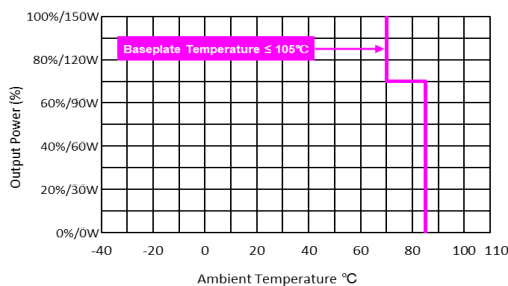
| Parameter | Model | Min. | Typ. | Max. | Unit |
|---|--|------|------|------|----------|
| Baseplate Temperature Range | MRZ1150-110S05 | -40 | --- | +100 | °C |
| | MRZ1150-110S12, MRZ1150-110S24, MRZ1150-110S54, MRZ1150-110S15 | | | +105 | |
| Over Temperature Protection (Baseplate) | | --- | +110 | --- | °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 | | | | |
| Vibration and Shock/Bump | Compliance to IEC/EN 61373 | | | | |
| Operating Humidity (non condensing) | | 5 | | 95 | % rel. H |
| Lead Temperature (1.5mm from case for 10Sec.) | | --- | | 260 | °C |

Power Derating Curve


MRZ1150-110S05



MRZ1150-110S12, MRZ1150-110S24, MRZ1150-110S54

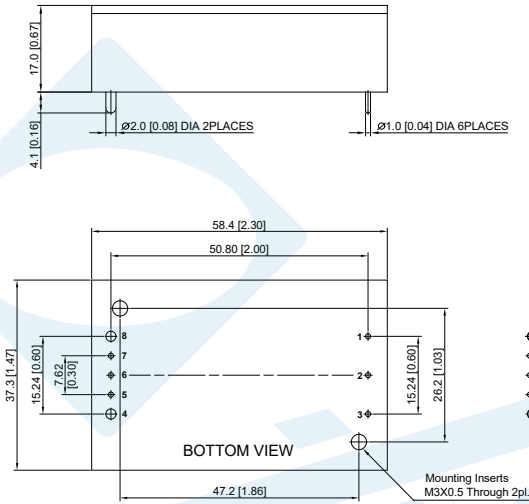


MRZ1150-110S15

* The power module can deliver full rated power as long as users keep operating baseplate temperature below 105°C within defined ambient temperature range.

Notes

- 1 Specifications typical at $T_a=+25^{\circ}\text{C}$, 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 Other input and output voltage may be available, please contact MINMAX.
- 4 **It is necessary to parallel a capacitor across the input pins under normal operation. Minimum Capacitance: 150 μF /250V KXJ.**
- 5 To meet EN 55032 Class A with an external filter, please contact MINMAX.
- 6 To meet EN 61000-4-4 & EN 61000-4-5 with an external filter requested, please contact MINMAX.
- 7 **The hot-swap operation is extremely prohibited.**
- 8 Over Current Protection (OCP) is built in and works over 130% of the rated current or higher. However, use in an over current situation over 4 seconds must be avoided whenever possible.
- 9 Do not exceed maximum power specification when adjusting output voltage. Please see the External Output Trimming table at page 6.
- 10 ***Input Voltage $V_{in}=36\text{VDC}/1\text{s}$ for Start-up Operation and $V_{in}=40\text{VDC}$ for Continuous Operation.**
- 11 Specifications are subject to change without notice.

Package Specifications
Mechanical Dimensions

Pin Connections

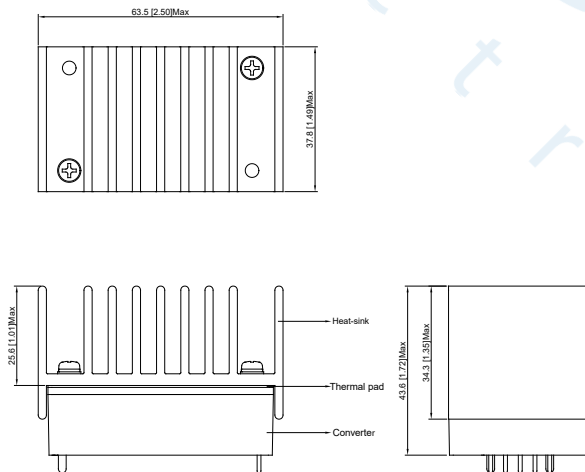
| Pin | Function |
|-----|---------------|
| 1 | +Vin |
| 2 | Remote On/Off |
| 3 | -Vin |
| 4 | -Vout |
| 5 | * -Sense |
| 6 | Trim |
| 7 | * +Sense |
| 8 | +Vout |

* If remote sense not used the +sense should be connected to +output and -sense should be connected to -output
Maximum output deviation is 10% inclusive of 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 $\varnothing 1.0 \pm 0.05$ (0.04 ± 0.002)
- ▶ Pin diameter $\varnothing 2.0 \pm 0.05$ (0.06 ± 0.002)

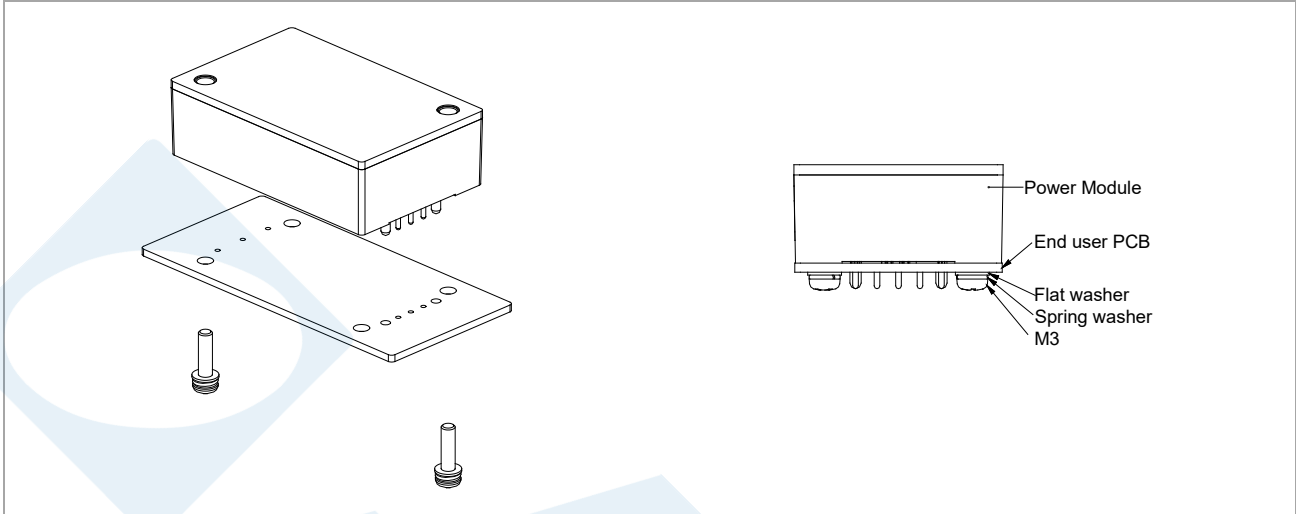
Physical Characteristics

| | |
|------------------------|--|
| Case Size | : 58.4x37.3x17.0 mm (2.30x1.47x0.67 inches) |
| Case Material | : Plastic resin (flammability to UL 94V-0 rated) |
| Top Side Base Material | : Aluminum Plate |
| Pin Material | : Copper |
| Potting Material | : Silicone (UL94-V0) |
| Weight | : 110g |

Heatsink (Option -HS7)

Physical Characteristics

| | |
|-------------------|--------------------------|
| Heatsink Material | : Aluminum |
| Finish | : Black Anodized Coating |
| Weight | : 63g |

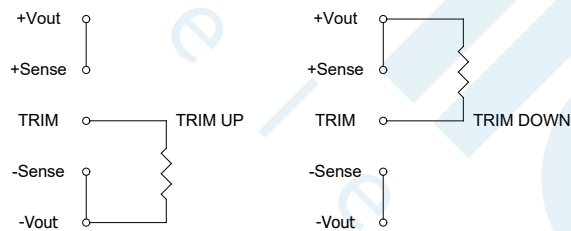
*For more power derating information, please refer to E.C Note.

PCB Installation of End Users


1. Please evaluate mechanical stress (vibration, shock, bump) during field applications.
2. It has to equip with installation kit if it exceeds the guaranteed specifications, please contact MINMAX for detail information.
3. Applied torque per screw 9 kgf.cm min.

External Output Trimming

Output can be externally trimmed by using the method shown below

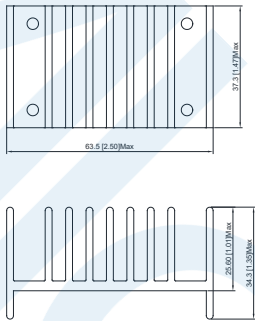


| Trim Range (%) | MRZI150-110S05 | | MRZI150-110S12 | | MRZI150-110S15 | | MRZI150-110S24 | | MRZI150-110S54 | |
|----------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|
| | Trim down (kΩ) | Trim up (kΩ) | Trim down (kΩ) | Trim up (kΩ) | Trim down (kΩ) | Trim up (kΩ) | Trim down (kΩ) | Trim up (kΩ) | Trim down (kΩ) | Trim up (kΩ) |
| 1 | 138.88 | 106.87 | 413.55 | 351.00 | 530.73 | 422.77 | 598.66 | 487.14 | 1,882.57 | 560.73 |
| 2 | 62.41 | 47.76 | 184.55 | 157.50 | 238.61 | 189.89 | 267.78 | 218.02 | 877.94 | 230.36 |
| 3 | 36.92 | 28.06 | 108.22 | 93.00 | 141.24 | 112.26 | 157.49 | 128.31 | 543.06 | 120.24 |
| 4 | 24.18 | 18.21 | 70.05 | 60.75 | 92.56 | 73.44 | 102.34 | 83.46 | 375.62 | 65.18 |
| 5 | 16.53 | 12.30 | 47.15 | 41.40 | 63.35 | 50.15 | 69.25 | 56.55 | 275.15 | 32.15 |
| 6 | 11.44 | 8.36 | 31.88 | 28.50 | 43.87 | 34.63 | 47.19 | 38.61 | 208.18 | --- |
| 7 | 7.79 | 5.55 | 20.98 | 19.29 | 29.96 | 23.54 | 31.44 | 25.79 | 160.34 | --- |
| 8 | 5.06 | 3.44 | 12.80 | 12.37 | 19.53 | 15.22 | 19.62 | 16.18 | 124.46 | --- |
| 9 | 2.94 | 1.79 | 6.44 | 7.00 | 11.41 | 8.75 | 10.43 | 8.70 | 96.55 | --- |
| 10 | 1.24 | 0.48 | 1.35 | 2.70 | 4.92 | 3.58 | 3.08 | 2.72 | 74.23 | --- |
| 11 | --- | --- | --- | --- | --- | --- | --- | --- | 55.96 | --- |
| 12 | --- | --- | --- | --- | --- | --- | --- | --- | 40.74 | --- |
| 13 | --- | --- | --- | --- | --- | --- | --- | --- | 27.86 | --- |
| 14 | --- | --- | --- | --- | --- | --- | --- | --- | 16.82 | --- |
| 15 | --- | --- | --- | --- | --- | --- | --- | --- | 7.25 | --- |

| Order Code Table | |
|---------------------------|--------------------------------|
| Standard (Positive logic) | With heatsink (Positive logic) |
| MRZI150-110S05 | MRZI150-110S05-HS7 |
| MRZI150-110S12 | MRZI150-110S12-HS7 |
| MRZI150-110S15 | MRZI150-110S15-HS7 |
| MRZI150-110S24 | MRZI150-110S24-HS7 |
| MRZI150-110S54 | MRZI150-110S54-HS7 |
| Negative logic | With heatsink (Negative logic) |
| MRZI150-110S05N | MRZI150-110S05N-HS7 |
| MRZI150-110S12N | MRZI150-110S12N-HS7 |
| MRZI150-110S15N | MRZI150-110S15N-HS7 |
| MRZI150-110S24N | MRZI150-110S24N-HS7 |
| MRZI150-110S54N | MRZI150-110S54N-HS7 |

Order Code For Heatsink kit (including: Heatsink x1, Screw (M3/14mm) x 2, Thermal Pad x1)

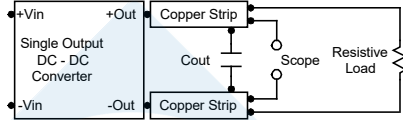
HS-QB004



Test Setup

Peak-to-Peak Output Noise Measurement Test

Use a 22 μ F polymer capacitor for 5V, 12V, 15V output models and a 33 μ F polymer capacitor for 24V output model and a 1 μ F ceramic capacitor for 54V output model. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.



Technical Notes

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 2) during a logic low is -500 μ A.

Negative logic remote on/off turns the module on during a logic low voltage on the remote on/off pin, and off during a logic high. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum source current at the on/off terminal (Pin 2) during a logic high is 500 μ A.

Overload Protection

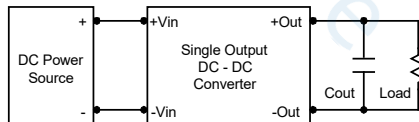
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage. The OVP level can be found in the output data.

Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7 μ F capacitors at the output.



Maximum Capacitive Load

The MRZ1150 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the baseplate temperature must be kept below 105°C. The derating curves are determined from measurements obtained in a test setup.

