

# MDC4500-4B

## Amplifier/Combiner

### Data Sheet & User Manual

February 2016 - Rev 0.95



## MDC4500-4B Amplifier

### **IMPORTANT SAFETY and USEAGE INFORMATION**

Please review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only **The Moving Pixel Company** should perform service procedures. Do not attempt service yourself. Return the unit to **The Moving Pixel Company** for service.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

#### **To Avoid Fire or Personal Injury or Damage to Equipment**

##### **Qualified Personnel to Operate this Product**

This manual and the product marking assumes that the user has more than basic electrical/electronic circuit knowledge and is a person comfortable by experience and education to safely connect probes to electrical circuits and systems. Do not operate this equipment nor connect it to any circuit or system if you are not qualified to do so by either education or experience.

##### **Use Proper Power Cord.**

Use only the power cord specified for this product and certified for the country of use. Use only the external power supply that is included with the product.

##### **Connect and Disconnect Properly.**

Do not connect or disconnect probes or test leads while they are connected to a voltage source.

##### **Ground the Product.**

***This product is not inherently grounded through the grounding conductor of the power cord;*** it has a “floating” power supply. The negative lead of the power supply is directly connected to the metal shell of the unit and all SMA connections are also electrically connected to the metal shell of the unit. It is possible that improper connection to an external system could electrify the shell to potentially high voltages above “ground”. To avoid electric shock, the product must be tied to ground externally.

Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Any markings, symbols, or textual references to “ground”, GND, and similar refer to the metal shell of the unit and assume that the metal shell is tied to a safety ground externally.

**Observe All Terminal Ratings.**

To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits. Connect the probe reference lead to earth ground only, no floating grounds allowed.

**Power Disconnect.**

The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

**Do Not Operate Without Covers.**

Do not operate this product with covers or panels removed.

**Do Not Operate With Suspected Failures.**

If you suspect that there is damage to this product, have it inspected by **The Moving Pixel Company**.

**Avoid Exposed Circuitry.**

Do not touch exposed connections and components when power is present.

**Do Not Operate in Wet/Damp Conditions.****Do Not Operate in an Explosive Atmosphere.****Keep Product Surfaces Clean and Dry.****Provide Proper Ventilation.**

Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

**Symbols and Terms**

These terms may appear in this manual:



**WARNING.** *Warning statements identify conditions or practices that could result in injury or loss of life.*



**CAUTION.** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



# Before Operating the Instrument

- Verify the ambient temperature: +5 °C to +45 °C.
- Verify the operating humidity:
  - 8% to 80% relative humidity at up to +32 °C
  - 5% to 45% relative humidity above +32 °C up to +45 °C noncondensing, and is limited by a maximum wet-bulb temperature of +29 °C (derates relative humidity to 32% at +45 °C)
- Verify the operating altitude: 3,000 m, de-rate maximum operating temperature by 1 °C per 300 meters above 1500 meters altitude.

## **CAUTION.**

*Operate in upright position only, keeping cooling holes on the sides of the unit clear of obstructions.*

### **Power Supply Requirements for the external power supply (provided):**

<b>Source Voltage</b>	100–240 VAC
<b>Frequency</b>	50–60 Hz
<b>Power Consumption</b>	20 W maximum

It may be helpful to check our website for any updates to this documentation before you operate the instrument: <http://www.movingpixel.com/MIPI.html>

If you have any questions at all about the warnings or operating conditions listed above:

## **STOP!**

Do not operate the instrument.

Contact **The Moving Pixel Company** and resolve your question before continuing.

## Contacting **The Moving Pixel Company**

**Phone** +1.503.626.9663 US Pacific Time Zone (UTC-8)

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**Email** [information@movingpixel.com](mailto:information@movingpixel.com)  
**Web site** <http://www.movingpixel.com>



# Declaration of Conformity

The *Moving Pixel Company* declares that the **MDC4500-4B** product conforms to the following Standards:

- **EN/IEC 61326-1:2013, Class A** Radiated Emissions
- **AS/NZS CISPR 11:2011 Class A** Radiated Emissions
- **FCC 15.109(g):2014 Class A** Radiated Emissions
- **FCC 15.109:2014 Class A** Radiated Emissions
- **ICES-003:2012 Class A** Radiated Emissions
- **VCCI:2014-04 Class A** Radiated Emissions
- **EN/IEC 61326-1:2013, Class A** Conducted Emissions
- **AS/NZS CISPR 11:2011 Class A** Conducted Emissions
- **FCC 15.107:2014 Class A** Conducted Emissions
- **ICES-003:2012 Class A** Conducted Emissions
- **VCCI:2014-04 Class A** Conducted Emissions
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- **EN61326-1:2013 Industrial** in the following areas:
  1. **IEC 61000-4-2:2008** ESD immunity
  2. **IEC 61000-4-3:2010** RF electromagnetic field immunity
  3. **IEC 61000-4-4:2012** Electrical fast transient/burst immunity
  4. **IEC 61000-4-5:2005** Power line surge immunity
  5. **IEC 61000-4-6:2013** Conducted RF immunity
  6. **IEC 61000-4-8:2009** Magnetic Field immunity
  7. **IEC 61000-4-11:2004** Voltage dips and interruptions immunity
- Equipment type: Test and measurement equipment, indoor use only.
- Pollution Degree 2 as defined in IEC61010-1. Rated for indoor use only.
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This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.

Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.

For compliance with the EMC standards listed here, high quality shielded interface cables that incorporate low impedance connection between the cable shield and the connector shell should be used.

## Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

**Equipment recycling.** Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site ([www.tektronix.com](http://www.tektronix.com)).

### Restriction of hazardous substances

This product is classified as an industrial monitoring and control instrument accessory, and is not required to comply with the substance restrictions of the recast RoHS Directive 2011/65/EU until July 22, 2017.

## **MDC4500-4B Amplifier**

### **1.0 General:**

The MDC4500-4B (“MDC”) is a product designed to work with one or two Tektronix AWG7000x Arbitrary Waveform Generators (“AWG”), typically in a MIPI CPhy/DPhy signal generation environment.

The MDC adds capabilities to the AWG including DC offset (also known as common-mode voltage, “CM”), coarse amplitude gain/loss, and a combiner function for two external signals (used to generate the LP-part of the MIPI waveform). Inherently the gain/loss in the MDC is in one dB steps. Fine gain control is managed by the AWG by adjusting the MDC gain and the AWG output level. In this way the user can get the exact amplitude desired.

The MDC provides 4 channels of capability, usually supporting two 2-channel AWGs. Each channel is independent; there is no need to do anything with any unused channels.

It is powered by an external (provided) power supply and receives control information over 2x USB2.0/3.0 link (usually provided by the AWGs).

The user may note that each analog input from the AWG connects to an external 6dB attenuator that comes assembled onto the unit.

The unit is rack-mountable.

**The software for controlling the MDC is provided by Tektronix as part of the AWG software package.**

### **2.0 Requirements:**

- Microsoft Windows XP, Windows7, Windows 8.1, or Windows 10 computer. Typically the AWG is used as the control platform with USB2/3 capability.

### **3.1 Inputs/Outputs and Indicators**

For each of the 4 sets of I/O:

Inputs, Front Panel:

- Differential analog signal (from AWG Analog Out)
- M1+ (from AWG Marker 1 out)
- M2+ (from AWG Marker 2 out)
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Inputs, Rear Panel:

- Flag from AWG

Outputs, Front panel:

- Differential MIPI output

Indicator:

- Front panel green LED indicating that the amplifier board is powered for a given channel. Channels cannot be independently powered down.

For each unit:

Power: a single connection to +24Vdc provided by external power supply (provided) on the rear panel of the instrument. Power switch provided on rear panel.

Indicators:

- Rear panel green LED indicating 24 Vdc power is applied.

2x USB2.0/3.0 – one for controlling outputs associated with AWG\_A and one controlling outputs associated with AWG\_B.

## **3.2 Inputs/Outputs Functional Details**

The front panel of the MDC is marked in such a way as to group the 6 signals per channel into 4 groups. Two groups of signals are normally associated with a single AWG. So two groups of signals have a name “AWG\_A” and two groups have a name “AWG\_B” to indicate connection to either the first AWG “AWG\_A” or the second AWG “AWG\_B”.

### **3.2.1 Differential Analog Inputs:**

The Differential Analog Inputs labeled “Ch +” and “Ch –” are designed to be connected to the AWG Analog Outputs. The AWG has a full-scale single-ended analog swing from +250mV to -250mV (500mVsep-p). Both inputs must be connected to the AWG. Leaving one input disconnected or connected to a DC source will not work and the unit will not function as expected. The input stage is fully-differential and expects a true differential signal.

These inputs are inherently differentially terminated in 100 ohms.

The user may note that each analog input from the AWG connects to an external 6dB attenuator that comes assembled onto the unit. Each attenuator is marked with its channel association as the unit is one-time calibrated with these attenuators in place. In normal operation a user should not remove these attenuators. They are provided in order to best use the gain range of the MDC for MIPI applications. A further benefit is that they provide some isolation between the AWG and the MDC for some signal impedance mismatch that occurs in the MDC.

### **3.2.2 M1+, M2+ Digital Inputs (“Markers”):**

The Marker inputs labeled “M1 +” and “M2 +” are designed to be connected to the AWG Marker 1+ and Marker2+ outputs. On the AWG, these signals are binary in nature. Note that the AWG provides these marker signals as differential output signals. The MDC does not use the “M1-“ and M2-“ signal. The AWG does not require connection of the M1- and M2- signals for proper operation of the M1+ and M2+ signals.

Each Marker input is terminated with 50 ohms to ground inside the MDC. When selected by the associated Flag input, it is passed through to the output via an electronic switch (controlled by the Flag input) and ~200 ohms series resistance. The amplitude of the Marker is set on the AWG and gets passed directly through the MDC. The Marker voltage is typically set to the MIPI C/DPhy LP voltage of 1.2 Vdc with a low level of 0.0Vdc.

The Markers can be left disconnected and unterminated. In this case, the user should leave the associated Flag disconnected or driven to zero volts so that the MDC will not connect the Markers through to the Outputs.

### **3.2.3 Flag Input (“Flag”):**

The Flag input is connected to the AWG flag output.

The state of the Flag determines what signal is output from the MDC.

When the Flag is low or not connected, the AWG Analog Inputs are connected through an internal amplifier and switch to the Outputs.

When the Flag is driven high, the AWG Markers are connected through an internal switch and a resistance of approximately 200 ohms to the Outputs.

### **3.2.4 D+, D- MIPI Outputs (“Outputs”):**

The outputs are intended for use in MIPI CPhy and DPhy system. The output signal consists of the combination of the Marker inputs and the Analog inputs from the AWG.

The Flag input to the MDC determines what signal is output from the MDC.

Without the Flag and Markers connected, the MDC passes the AWG Analog Inputs through an internal amplifier and DC offset to the output.

## 5.0 Electrical specification for the MDC4500-4B

Characteristic	Specification	Notes
Data Rate, maximum	4.5Gsps/4.5Gbps	
Output impedance	50 $\Omega$ 100 $\Omega$	Single-ended differential
Input impedance, analog inputs	100 $\Omega$	differential
Input impedance, Flag inputs	~50 ohms	
Input impedance, Marker inputs	50 ohms	Outputs not connected
Gain range	~-18dB to +14dB	With external 6dB attenuators installed. Does not include ~6dB AWG analog range.
Output DC offset range (CM)	+800mV/-400mVdc	Differential terminated in 100 ohms
Maximum peak amplitude	+1.0Vdc	Terminated in 50 ohms, each output, AC + DC,
Gain error	+/- 5mV	Final correction applied by AWG
Offset error	+/- 5mV	Each output, parallel 100 ohm terminated, 0 Vdc offset
Power Requirement	Less than 10 watts	24 Vdc via external supply (provided)
Weight	~3600grams	approximate, without USB cable, power supply
Overall Dimensions	545mm x 430mm x 45mm	Approximate

For more information contact:

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