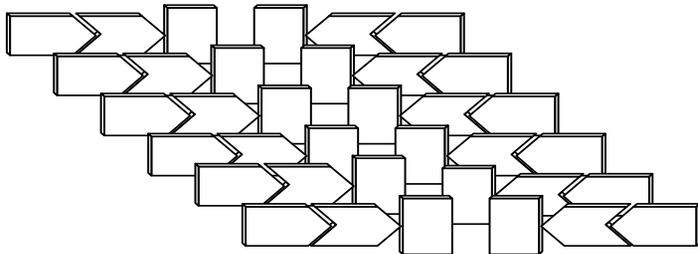


***ISAIX16***  
***ISA Bus Isolation Extender***

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***User's Manual***  
***Rev E***

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## PREFACE

ISAIX16 is a 16 bit Industrial Standard Architecture (ISA) bus isolation extender. It allows ISA adapter boards to be added or removed from the ISA system bus without having to power down the system. It offers time and labor cost savings in product development and production board testing. It also serves to protect the motherboard from being damaged during testing.

Operation of the ISAIX16 extender can be controlled by on-board toggle switch or by external TTL input signal. User is required to provide initialization routines to restore the state of the board under test during successive testing.

### **Product Options:**

-T for additional connector at right angle.

### **Related Products:**

ISASX2           ISA wearout Extender.  
ISABK1           ISA Tie down bracket.

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Rev E 1/1999

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**Product Specifications:**

Bus: ISA (Industrial Standard Architecture) 16 bit bus.

Power: +5V with 4 amp slow blow plug fuse.  
-5V with 1.6 amp slow blow plug fuse.  
+12V with 1.6 amp slow blow plug fuse.  
-12V with 1.6 amp slow blow plug fuse.  
Plus short circuit sensing logic on +5 and +12V.

Control: Single toggle switch or external TTL controls.

Signal Delay: Less than 500 picosecond (250 picosecond max. through the buffer).

Environment: 0-60 degree C (operating and storage).

Dimension: Length 7.2 inches; Height 5.2 inches; Width 0.6 inches (Not including bracket).

**Product Features:**

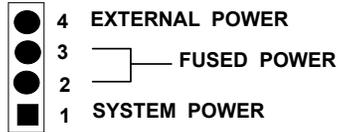
- Total power and signal isolation.
- No disturbance to the system bus during bus isolation and reconnection.
- Less than 500ps signal delay (isolation buffer + trace delay).
- Minimum voltage drop.
- Single switch operation or external TTL control signals.
- Voltage margin and current measurement.
- Over voltage and over current protection on power lines.
- Pluggable fuse allows easy replacement and change to other types and values of fuses.
- Fused power status green LED indicators.
- Short ckt sensing on +5 and +12V with auto power shut off.
- Reset pulse generation during power on.
- Flashing operating red status LED.
- Two-tone adjustable volume speaker for board status.
- Header pins for logic analyzer hook up.
- Supports low cost wearout extender.
- Optional right angle extender connector.
- Durable extender connector.
- Quality multilayer construction.

**ISAIX16 OPERATING INSTRUCTIONS**

1. Insert the extender into an ISA expansion slot on an ISA motherboard. Secure the extender to the system enclosure with mounting bracket.
2. Power up the system, SW1 switch can be in either position, all green LEDs should light to show the state of the fused power.
3. Test the extender by switching the SW1 switch up and down. The red LED should be flashing with SW1 in up position, indicating bus connection. The speaker should also buzz about once per second. Adjust the volume of the speaker via the trim pot by the speaker.
4. **Add or remove add-on boards to the extender only when the SW1 switch is in down position, the red LED is not flashing and the speaker is not buzzing (bus isolated).**
5. Run test to the add-on boards with SW1 switch in the up position..
6. To make current measurements without the fuse, remove the corresponding plug fuse and place an ampere meter across pin 1 and pin 3 of the fuse socket pins. To make measurement with the fuse, insert fuse at pin 2 and pin 4 of the socket pins, and connect the ampere meter across pin 1 and pin 4 of the fuse socket pins.
7. To make voltage margin tests without the fuse, remove the corresponding plug fuse and connect external voltages to pin 3 of the socket pin and connect external ground to system ground. To make voltage margin with the fuse; move fuse to pin 2 and pin 4 of the socket pins and connect external voltage to pin 4 of the socket. **Warning! Pin 1 of the fuse sockets should not be connected, because they are tied directly to the system power.**
8. The green LEDs at the upper right hand corner indicate the status of the fused power. If not lit, check the corresponding fuses and replace them accordingly.
9. To remove the adapter boards from the extender, one should be careful not to lift the extender out of its system expansion slot. Keep the extender down while removing the adapter board and make sure the extender is **turned off**.

**FUSE and PIN HEADER DEFINITION**

**Fuse Socket**



- W1 +5V
- W2 -5V
- W3 +12V
- W4 -12V

**W6, Speaker Jumper**

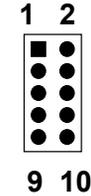


Jumper in - Speaker will buzz at approximately once per second during normal operation while bus signal and power is fully connected. It will also generate a continuous tone if logic detects a short circuit condition.

Jumper out - Speaker will not buzz during normal operation, but will still generate a continuous tone if logic detects a short circuit condition.

To adjust the volume of the speaker, turn the trim pot by the speaker. Turn counter clockwise to increase the sound and turn clockwise to decrease the sound.

**W7 Pin Headers**



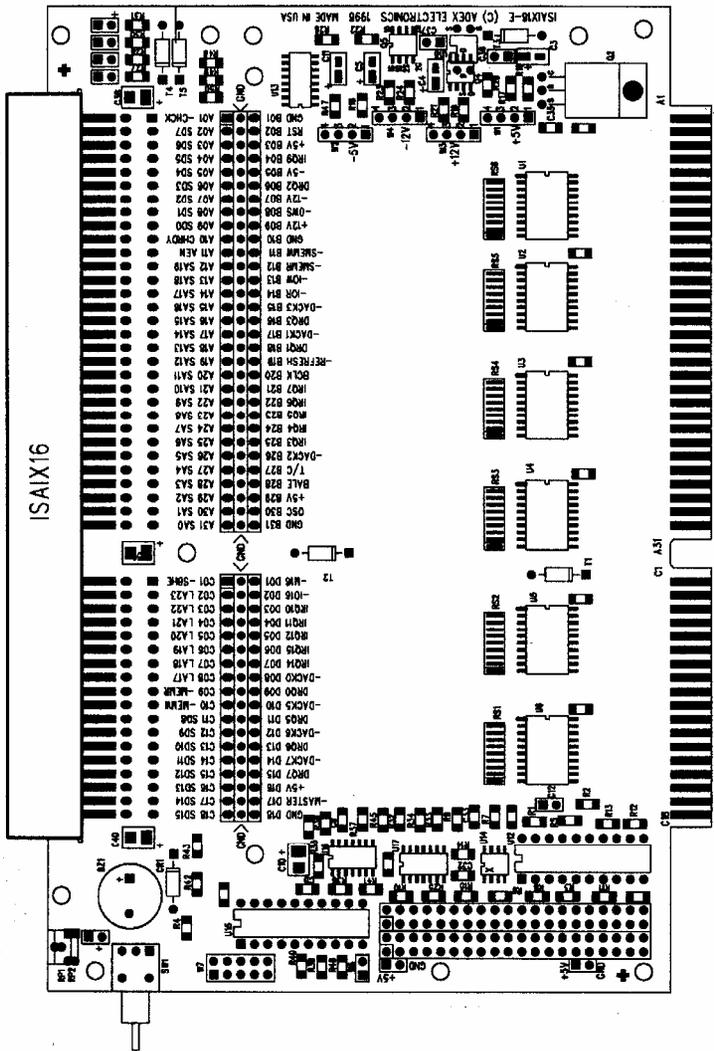
- 1 #Power\_Control (Internal)
- 2 +5V
- 3 #Signal\_Control (External Input, Low enable)
- 4 Key
- 5 #Power\_Control (External Input, Low enable)
- 6 Gnd
- 7 Gnd
- 8 Power\_Control (External Input, High enable)
- 9 LED-
- 10 LED+

**# indicates low active input.**

Pin 1 and pin 3 are jumped together in default to allow single toggle switch operation, which both power and bus signals are turned on together. User may connect an external toggle switch to pin 5 or an external TTL high signal to pin 8 to control the board.

To control the bus signals separately from the bus power, remove the jumper at pin 1 and pin 3 and connect external TTL control at pin 3. Power should be connected first, then the bus signals.

The on-board toggle switch should be at down (off) position, if external TTL control is used.



## **THEORY OF OPERATION**

The Bus Isolation Extender provides bus signals and power isolation between the system motherboard and the add-on board on the extender. The signals are isolated using state of art analog switches that allows bi-directional signal flow. When the analog switches are turned off, the bus signals at the extender side are isolated from the system bus. When the analog switches are turned on, the bus signals are connected. The analog switch provides no signal "buffering". That means, the bus signals are not reconditioned at TTL levels, nor are they redriven by any active amplifier. Any AC/DC signal loading on the add-on board will have a direct effect on the signal lines on the system motherboard. The analog switch introduces only less than 250 picoseconds delay to the signals. Such minimal delay makes the analog switch suitable for very fast bus operation.

The power isolation is implemented using MOSFETs. The MOSFETs are biased to allow slow ramping up of current through the Bus Isolation Extender to the add-on boards without causing a power surge or glitch to the system power. When the voltage on the +5V line on the add-on board reaches above 4.5 volts, the logic on the extender will turn on the analog switches to connect the bus signals. When the Bus Isolation Extender is switched off, the logic on the extender board will disconnect the bus signals immediately, and shut down the power slowly.

In addition, a 16ms reset pulse is generated to the add-on board on top of the extender, whenever the extender is switched on. If the system issues a reset pulse while the bus is connected, the extender will pass that reset pulse to the add-on board without disconnection or reconnection.

An on-board red status LED will blink about twice a second, when the power and the signals are completely connected between the add-on board and the system bus. The red LED will stay off, if the Bus Isolation Extender is turned off or if the +5 and +12 volts do not reach operating voltages within 16ms after power up.

During operation, if a short circuit condition is developed between +5 and +12V to ground, the logic will shut off the power and the red LED. The speaker will buzz in a continuous tone to alert the operator. User needs to switch the extender off, to reset the short circuit logic.

The add-on boards should be inserted or removed from the extender only when the extender is switched off and the red LED is not blinking and the speaker is not buzzing. ***Serious damages to the system, extender and the add-on board could happen if the add-on board is inserted or removed when the bus is still connected.***

## **LOCAL and EXTERNAL CONTROL**

The Bus Isolation Extender has an unique external control feature. This feature is very useful in production environment and it can be easily implemented in many ways. It allows external toggle switch or TTL logic inputs to control the operation of the extender. When used with proper software, this feature helps to automate the test process without requiring manual switching by the operator. This external control feature is accessible through the W7 header located by the on-board toggle switch. The header is keyed for ribbon type of connector interface. The 2X5 header has the pins defined as on page 7 under W7 Pin headers.

## **ON-BOARD TOGGLE SWITCH OPERATION**

This is the default operation mode as configured by the factory. This configuration allows single toggle switch operation without any external connection. A jumper is installed between pin 1 and pin 3 of the W7 header. It requires an operator to manually toggle the switch up for bus connection and toggle it down for bus isolation. When the switch is toggled up, both the power and the signals are connected by the on-board logic.

### **EXTERNAL TOGGLE SWITCH OPERATION**

An external toggle switch can be connected between pin 5 and pin 6 of the W7 header to simulate the on-board toggle switch. In this configuration, the on-board toggle switch should be turned off (down position), and the jumper remains in pin 1 and pin 3 of W7 header. The external switch can be mounted anywhere outside the chassis for easier access. An external LED can also be connected through pin 9 and pin 10 of the W7 header, so it can provide a status outside the chassis. A blinking LED is recommended instead of regular LED. The on-board LED and the toggle switch do not need to be removed in this mode of operation.

### **EXTERNAL LOGIC CONTROL OPERATION**

The Bus Isolation Extender can also be controlled by external TTL compatible signals. If the jumper remains on pin 1 and pin 3 of W7 header, a single TTL low control line connecting to pin 5 or a TTL high signal to pin 8 of W7 header can control both the power and signal isolation and connection as the toggle switch. If the jumper on pin 1 and pin 3 of W7 header is removed, then two TTL control lines can be used to control the bus signals and the power separately. The TTL control line connects to pin 5 or pin 8 will control the power and the TTL control line that connects to pin 3 will control the signal. The TTL control lines can come from any digital output source, such as the output pins of the parallel printer port in the CPU system. If the external TTL control lines are from sources outside the same CPU system, the ground pins on pin 6 or pin 7 of the W7 header should be connected to the signal ground of the external sources. The power should be connected first, then followed by the bus signals.

Notice that pin 5 allows a TTL low signal to power up the extender, while pin 8 allows a TTL high signal to power up the extender. For system that requires the extender to be powered up from cold start, user can choose from available sources of either initial high or initial low signal to bring the extender up.

### **VOLTAGE MARGIN, CURRENT MEASUREMENT AND EXTERNAL POWER SOURCE**

The ISAIX16 Bus Isolation Extender is provided with pluggable slow blow fuses. One 4 amp fuses is used for the +5V and three 1.6 amp fuses are used for the -5V, +12V, and -12V. User can perform voltage margin and current measurement with or without the fuses. Without using the fuse, external power can be connected to pin 2 or pin 3 of the fuse sockets to provide voltage margin test to the add-on boards on the extender. By moving the fuse to pin 2 and pin 4 location, user can provide power to pin 4 and still protected by the fuse. **The pin 1 of these jumpers are tie directly to the system power and they should not be connected to external sources.** When external power are applied through the fuse sockets, the current are still controlled by the MOSFETs, which regulates the ramping of the voltages.

A minimum of +4.5V on the +5V power line is required to maintain the operation. Otherwise the logic on the extender will shut down the analog switches and isolate the bus signals. A short circuit sensing logic is also built in to protect the system. The short circuit logic will sense shorts on +5V and +12V and automatically shut off all power. The shorts can be either introduced accidentally during test or may already exist on the board under test. In short circuit condition, the speaker will generate a continuous tone to alert the user. In normal condition, the speaker will buzz once a second to alert the user that the Bus Isolation Extender is powered up.

An ampere meter can be connected between the fuse socket pins with or without the fuse to measure the current consumed by the add-on board on top of the extender. The leads of the ampere meter should be as short as possible, to avoid excessive voltage drop below 4.5V.

User may change the fuses to other type, as long as the 5V will not drop below 4.5V when the add-on board draws maximum current.

### **TROUBLESHOOTING AND SELF SERVICE**

It is possible the Bus Isolation Extender could be damaged during operation. Our experience has shown, two of the most common problems associated with the Bus Isolation Extenders are blown fuses and blown buffer ICs. Such failures are usually caused by:

1. Users accidentally pull the add-on board while the bus is still connected. This happens especially when the user is not yet used to the procedure, and occasionally forget to switch the extender off while removing the add-on board. One must observe the red LED to make sure it is not blinking or listen to the speaker before adding or removing the add-on board. This action will cause the fuses and the buffer ICs to blow; especially, the one have signals next to the power pins. Because the add-on board could be removed at an angle, which shorted the power pins to the signal pins nearby.
2. The extender is lifted or wiggled side to side while add-on board is being removed or added. This happens if the extender is not tied down firmly. It is very important for user to find an appropriate way to hold down the extenders using brackets or fixtures in open or closed chassis environment, to prevent this to happen. Since the Bus Isolation Extender is still connected to the system bus, this will cause sparking in both power and signal pins that will most likely damage the buffer ICs.
3. Shorted power to signal pins or signal to signal pins on the add-on board. This condition will usually cause an overload to the buffer IC and damage it. **Do not test the failed add-on board on the Bus Isolation Extender again until the cause is corrected.**
4. Extender connector pins are damaged due to wearout or rough handling. We strongly recommend the use of Bus Wearout Extenders, especially in production environment.

We would recommend the following steps for user self troubleshooting and field testing before returning the extender for factory service.

1. Check the extender connector pins for any physical damage, and correct them if possible.
2. Check the fuses for continuity and replaced them if not.
3. Check for all power to ground short. There are over-voltage protection components on-board that will short to ground when fired in severe sparking conditions. Locate and replace the components.
4. Visually inspect the buffer ICs for physical cracks, burn marks, etc. When the buffer IC is damaged, it will usually smoke while the bus is being connected. The damage could be caused by sparking or ESD from previous operation. Replace the damaged buffer ICs and try again.
5. Check buffer ICs by looking at the buffer pins with or without the add-on board and turn on the extender. The IC has pin 1 and 10 grounded, pin 20 connected to VCC and pin 19 as control (low for connect). Pin 2-9 and pin 18-11 are the corresponding buffer pins. Test the pins using a logic probe. The probe should indicate the same condition; H, L or blinking on both pins of the buffer pair. Replace the buffer IC, if the condition is not the same.

Our experience shows the buffers ICs at four corners are most likely to be damaged in the operation. Adex Electronics will assist customers over the phone to locate the damaged components and recommend further actions. Adex Electronics can also provide the components as spare parts to the customers. Each bus isolation extender is provided with a bag of spare parts, with 2 fuses of each type and 2 buffer ICs.

### **BOARD INITIALIZATION**

Bus Isolation Extender isolates power and bus signals between the add-on board and the motherboard. Each time the toggle switch is turned off, the power to the add-on board is lost. Therefore, the information in the registers and memory on the add-on board will also be lost. For the next add-on boards to be tested again, the add-on board will need to be reinitialized, after the powers are reconnected. User will need to develop an initialization routine to restore the information back to the add-on board, before running the test. It can be done in a batch file where the initialization routine is placed before the test routine. The initialization routine can search for a previous saved configuration file and use it to reinitialize the add-on board. The test software should display the test results and messages to tell the operator when to remove and add another board for test, and how to restart the test.

Every time the Bus Isolation Extender is power up or down, the on-board logic will resynchronize itself to disconnect or reconnect properly. A reset signal will also be generated to the add-on board under test during reconnection. In automated system, the initialization software should allow approximately **20 ms delay** after the extender is turned on, before attempt to reinitialized the board. In manual toggle switch operation, the user should wait until the red LED is blinking before reinitialization. In software control operation, the LED- signal could be sensed externally at logic low state at least twice contiguously by the software to confirm the bus is reconnected, before reinitialization. During disconnect, the user should wait for the red LED to stop blinking before removing the add-on board under test. In software control operation, the LED- should be sensed high at least twice contiguously before putting out messages to remove the board.

### **MOUNTING OF BUS ISOLATION EXTENDER**

The Bus Isolation Extender incorporates very fast CMOS buffers for isolation of bus signals between the add-on board and the motherboard. These CMOS buffers are extremely sensitive to voltage spikes and can be easily damaged by Electrostatic Discharge (ESD) or any sparking due to intermittent contacts. It is necessary for users in production environment to mount the Bus Isolation Extender firmly against a common platform where the motherboard is mounted. For in chassis testing, a fixture or a bracket should be developed to hold the Bus Isolation Extender to the chassis. For out of chassis environment, user should tie the motherboard and the Bus Isolation Extender down against a common platform. Whatever the fixture or bracket design is used, one should not allow the Bus Isolation Extender to be lifted with the add-on board nor to wiggle side to side.

An inexpensive and simple bracket has been designed by Adex Electronics for in chassis use and they can be ordered with part number ISABK1. The bracket design, however is free to user as reference.

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## **Appendix**

**USING PARALLEL PORT as EXTERNAL TTL CONTROL**

The following information on the PC/AT parallel ports is provided for users, who wish to use the parallel port pins as the TTL control lines to the Bus Isolation Extenders.

**1st Parallel Port:** Data Register = 378; Status Register = 379; Control Register = 37A; IRQ = 7

**2nd Parallel Port:** Data Register = 278; Status Register = 279; Control Register = 27A; IRQ = 5

**Data Register:** Bit 0 - 7 = Data Bit 0 - 7

**Status Register:**

- Bit 7 = /BUSY
- Bit 6 = /ACK
- Bit 5 = PE
- Bit 4 = SLCT
- Bit 3 = /ERROR
- Bit 2 = N/A
- Bit 1 = N/A
- Bit 0 = N/A

**Control Register:**

- Bit 7 = N/A
- Bit 6 = N/A
- Bit 5 = N/A
- Bit 4 = IRQ\_ENABLE
- Bit 3 = SLCT\_IN
- Bit 2 = /INIT
- Bit 1 = AUTO\_FEED
- Bit 0 = STROBE

**The female 25 pin parallel port pin outs are:**

1	/STROBE	(output)	14	/AUTO_FEED	(output)
2	Data 0	(I/O)	15	/ERROR	(Input)
3	Data 1	(I/O)	16	/INIT	(output)
4	Data 2	(I/O)	17	/SLCT_IN	(output)
5	Data 3	(I/O)	18	Gnd	
6	Data 4	(I/O)	19	Gnd	
7	Data 5	(I/O)	20	Gnd	
8	Data 6	(I/O)	21	Gnd	
9	Data 7	(I/O)	22	Gnd	
10	/ACK	(Input)	23	Gnd	
11	BUSY	(Input)	24	Gnd	
12	PE	(Input)	25	Gnd	
13	SLCT	(Input)			

**Note:**

1. /STROBE, BUSY, /AUTO\_FEED, /SLCT\_IN are inverted by Hardware (1 in software will appear as low at pin).
2. During power up, parallel port pins /STROBE, /AUTO\_FEED, /SLCT\_IN are reset to logic high; and /INIT is reset to logic low. After BIOS initialization, /INIT is toggled to high and /SLCT\_IN is toggled to low.
3. Depending on the sequence of the BIOS initialization in each CPU system, one can use any of the signal pins, low or high to bring the extender up during cold boot. In some systems, an extra soft reboot by Ctrl Alt Del, after the first power up, may be necessary to get the plug and play boards to be recognized by BIOS.
4. The LED- pin on the W7 header on the Bus Isolation Extender could be connected to the SLCT pin on the parallel port (pin 13) as status input. The LED- at low will indicate successful bus connection and at high indicates no signal connection. The #Power\_Control at pin 1 of the W7 header can also be used as a positive indication of cable connection and power connection. It could be connected to BUSY pin of the printer port for that purpose.
5. Some CPU system may relocate the parallel port I/O addresses or may use 3BC-3BF as the 1st parallel port I/O addresses. One may verify the I/O addresses by looking at memory location 0:408, ROM BIOS data areas using the DOS debug command.

**ISA BUS PINOUT**

SOLDER SIDE B	PIN NO.	COMPONENT SIDE A
GND	01	-CHCK
RESET	02	SD7
+5V	03	SD6
IRQ9	04	SD5
-5V	05	SD4
DRQ2	06	SD3
-12V	07	SD2
-0WS	08	SD1
+12V	09	SD0
GND	10	CHRDY
-SMEMW	11	AEN
-SMEMR	12	SA19
-IOW	13	SA18
-IOR	14	SA17
-DACK3	15	SA16
DRQ3	16	SA15
-DACK1	17	SA14
DRQ1	18	SA13
-REFRESH	19	SA12
BCLK	20	SA11
IRQ7	21	SA10
IRQ6	22	SA09
IRQ5	23	SA08
IRQ4	24	SA07
IRQ3	25	SA06
-DACK2	26	SA05
T/C	27	SA04
BALE	28	SA03
+5V	29	SA02
OSC	30	SA01
GND	31	SA00

**ISA BUS PINOUT**

SOLDER SIDE D	PIN NO.	COMPONENT SIDE C
-M16	01	-SBHE
-IO16	02	L23
IRQ10	03	LA22
IRQ11	04	LA21
IRQ12	05	LA20
IRQ15	06	LA19
IRQ14	07	LA18
-DACK0	08	LA17
DRQ0	09	-MEMR
-DACK5	10	-MEMW
DRQ5	11	SD8
-DACK6	12	SD9
DRQ6	13	SD10
-DACK7	14	SD11
DRQ7	15	SD12
+5V	16	SD13
-MASTER	17	SD14
GND	18	SD15

## **WARRANTY**

Adex Electronics warrants this product against defects in material and workmanship for a period of one year from the date of purchase. During the warranty period, Adex Electronics will repair or replace this product at no charge. This warranty does not apply if the product has been damaged by accident, abuse, misuse or misapplication, nor as a result of service or modification made by others.

Adex Electronics is not responsible for incidental or consequential damages resulting from use of this product. This includes damages to property and personal injury. The information in this manual has been carefully checked and is believed to be accurate. However, if there are any inaccuracies in this manual, Adex Electronics assumes no responsibility for any damages resulting from any omission or defects in this manual.

**Caution! Handle and store this product in an electrostatic safe environment. ESD could damage this product.**

Adex Electronics reserves the right to make changes in future product design without reservation and without notification to its users.

### ***For technical assistance contact:***

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