A.G.P. Pro Specification

Revision 1.0

Intel Corporation

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A.G.P. Pro Specification

Contents

1. Introduction

This document defines an extension to the A.G.P. interface specification to meet the needs of advanced workstation graphics. The new specification, A.G.P. Pro, is primarily designed to deliver additional electrical power to the graphics add-in cards. The A.G.P. Pro definition includes an extended connector, thermal envelope, mechanical specifications for cards, I/O brackets, and motherboard layout requirements.

A.G.P. Pro extends the existing A.G.P. connectors on both ends to deliver additional power on the 12 V and 3.3 V rails. The extension is illustrated in Figure 1-1. A.G.P. Pro is intended to supplement, not replace, the existing A.G.P. connector set.
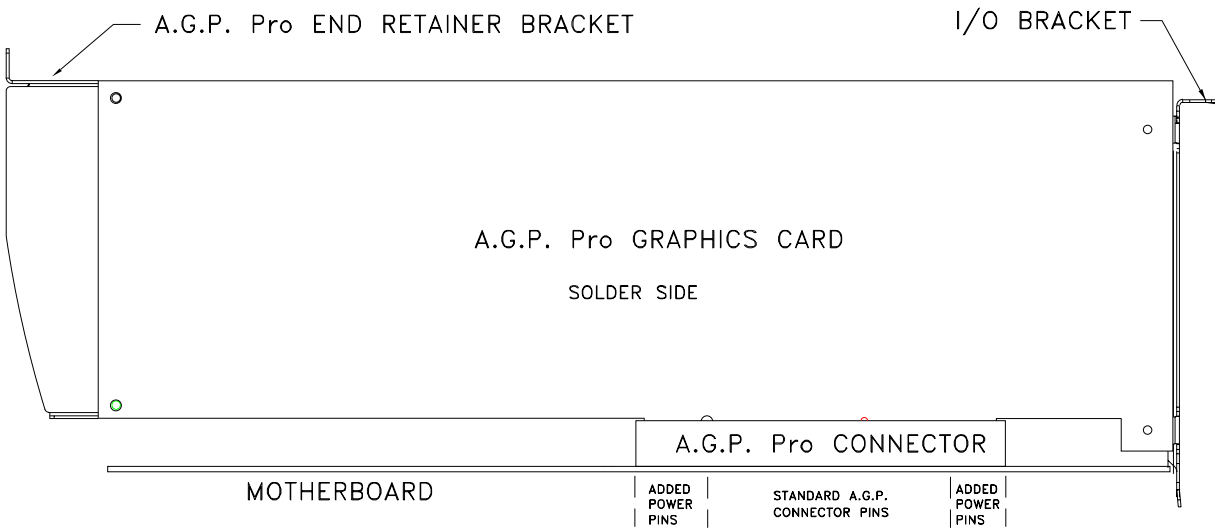
Figure 1-1: A.G.P. Pro Connector Orientation

2. System Design Implementation

A.G.P. cards come in two form factors, ATX and NLX. ATX form factor cards have the same component area, I/O bulkhead panel, and brackets as PCI cards. NLX form factor are smaller and target Basic PC systems. The A.G.P. Pro specification targets the ATX form factor implementation of the A.G.P. specification. NLX implementations for A.G.P. cards are not defined.

2.1 System Design Requirements

An A.G.P. Pro compliant system must have two PCI slots adjacent to the A.G.P. Pro connector as illustrated in Figure 2-1. The PCI slots will at least guarantee 33 MHz / 32 bit operation. 66 MHz or 64 bit operation is not guaranteed to be provided on the two adjacent PCI slots. Section 2.5 describes how the PCI slots can be optionally used by an A.G.P. Pro card for electrical, mechanical, or PCI functional purposes.
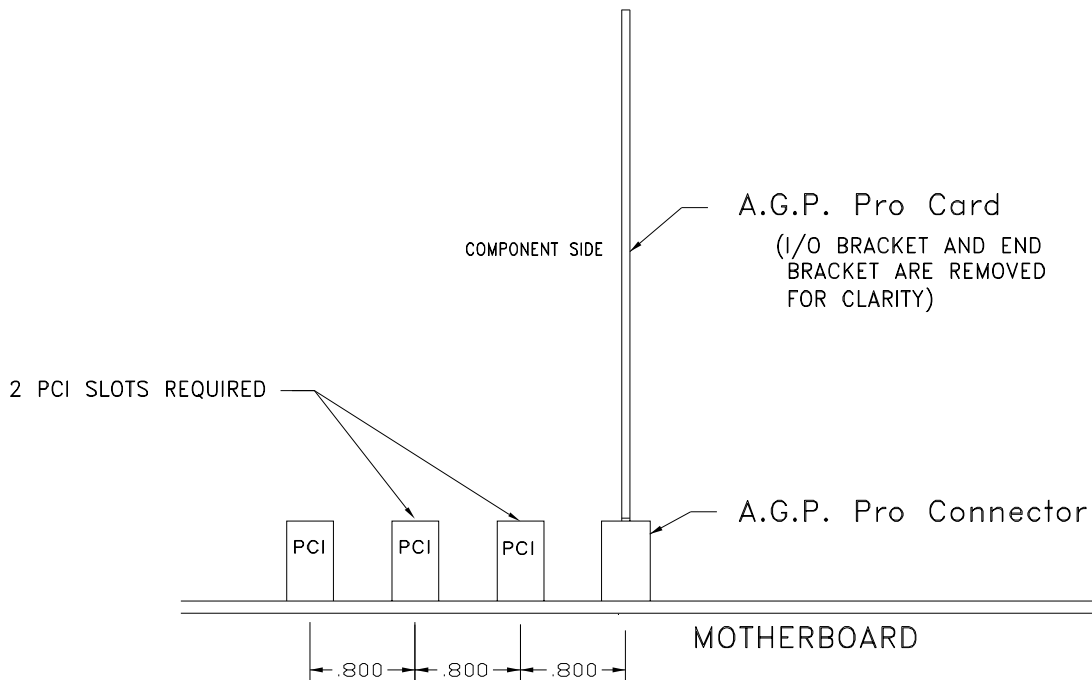
Figure 2-1: A.G.P. Pro System Design Requirement

2.1.1 High Power A.G.P. Pro Card

A High Power A.G.P. Pro card consumes 50 to 110 Watts of power. This card requires sufficient space on the component side to facilitate cooling as shown in Figure 2-2. Two adjacent PCI slots must be left unoccupied to provide this space. The unused PCI connections provide 2.17 inches of clearance space for the card. A special three slot wide I/O bracket installed on the A.G.P. Pro High Power card will reserve the use of this space. This bracket is defined in the Mechanical Specification section of this document.

NOTE: All retail channel High Power A.G.P. Pro cards must use the three slot wide I/O bracket. A.G.P. Pro card vendors may have OEM specific solutions that do not require this bracket. Also, a chassis that supports an A.G.P. Pro connector on motherboard must be able to accept a High Power A.G.P. Pro card equipped with up to a three wide I/O bracket.

Figure 2-2: Orientation for High Power A.G.P. Pro Cards

2.1.2 Low Power A.G.P. Pro Card

A Low Power A.G.P. Pro card consumes 25 to 50 Watts of power. This card requires space on the component side to facilitate cooling. One adjacent PCI slot must be left unoccupied to provide this space. This allows for 1.37" of clearance space for the card as illustrated in Figure 2-3. A special two slot wide I/O bracket installed on the A.G.P. Pro Low Power card will reserve the use of this space. This bracket is defined in the Mechanical Specification section of this document.

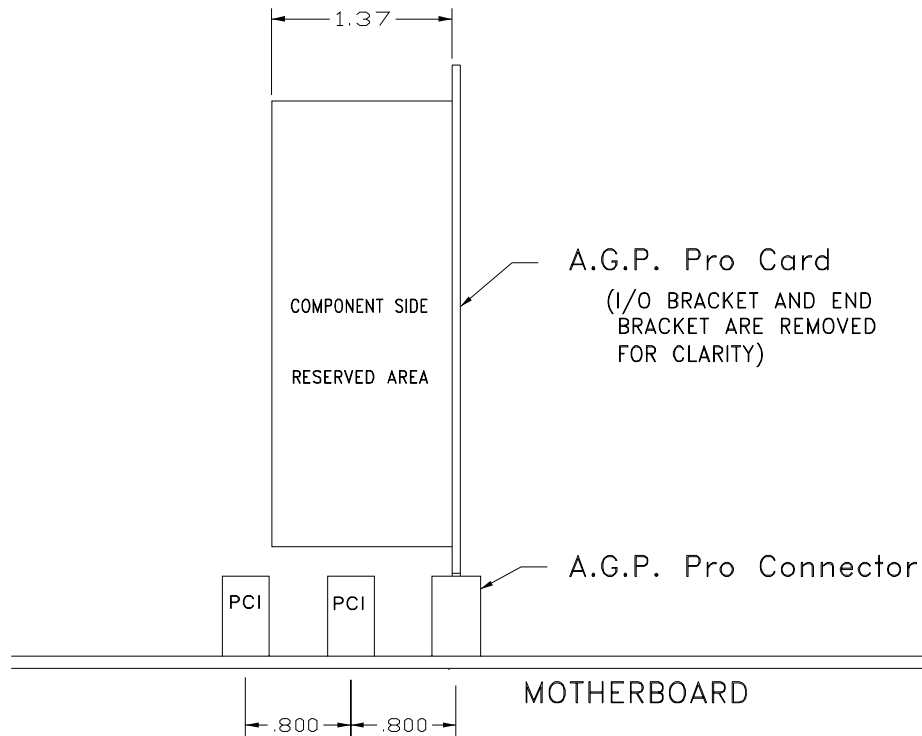NOTE: All retail channel Low Power A.G.P. Pro cards must use a two slot wide I/O bracket. A.G.P. Pro card vendors may have OEM specific solutions that do not require this bracket. Also, the chassis that implement an A.G.P. Pro connector on motherboard must be able to accept a Low Power A.G.P. Pro card equipped with up to a two wide I/O bracket.

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                    |←——— 1.37 ———→|


                    ┌──────────────┐  ┌─┐
                    │              │  │ │
                    │              │  │ │ ——  A.G.P. Pro Card
                    │              │  │ │
        COMPONENT SIDE             │  │ │      (I/O BRACKET AND END
                    │              │  │ │       BRACKET ARE REMOVED
        RESERVED AREA              │  │ │       FOR CLARITY)
                    │              │  │ │
                    │              │  │ │
                    │              │  │ │
                    └──────────────┘  │ │
                                      │ │
               ┌──┐      ┌──┐      ┌──┴─┴──┐ ——  A.G.P. Pro Connector
               │PCI│      │PCI│      │       │
               │  │      │  │      │       │
    ───────────┴──┴──────┴──┴──────┴───────┴──────────────
               |←.800→|←.800→|          MOTHERBOARD
```

NOTE: ALL DIMENSIONS ARE IN INCHES.

Figure 2-3: Orientation for Low Power A.G.P. Pro Cards

2.2 A.G.P. Pro Motherboard Implementation

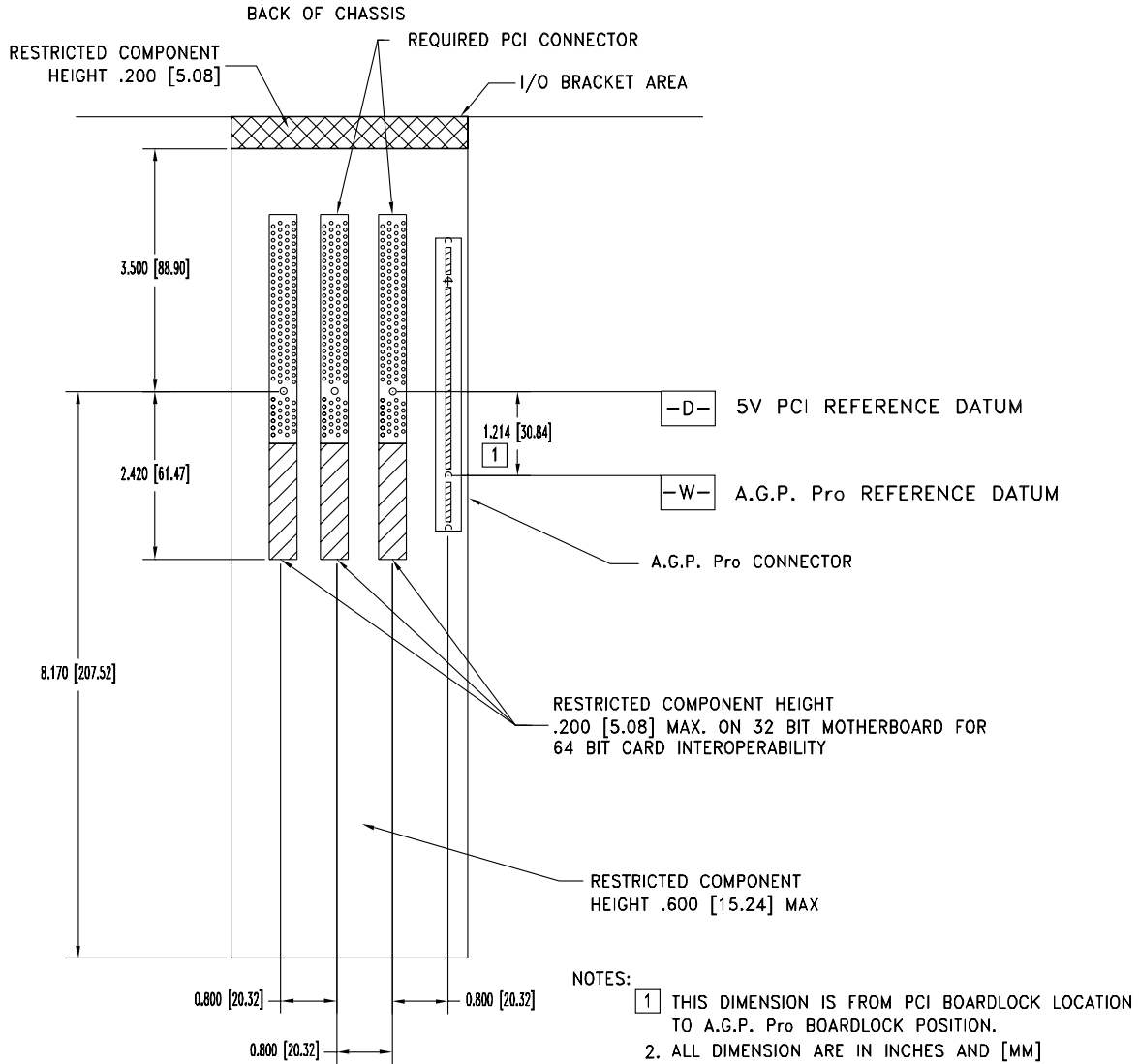An A.G.P. Pro connector on a motherboard is illustrated in Figure 2-4.

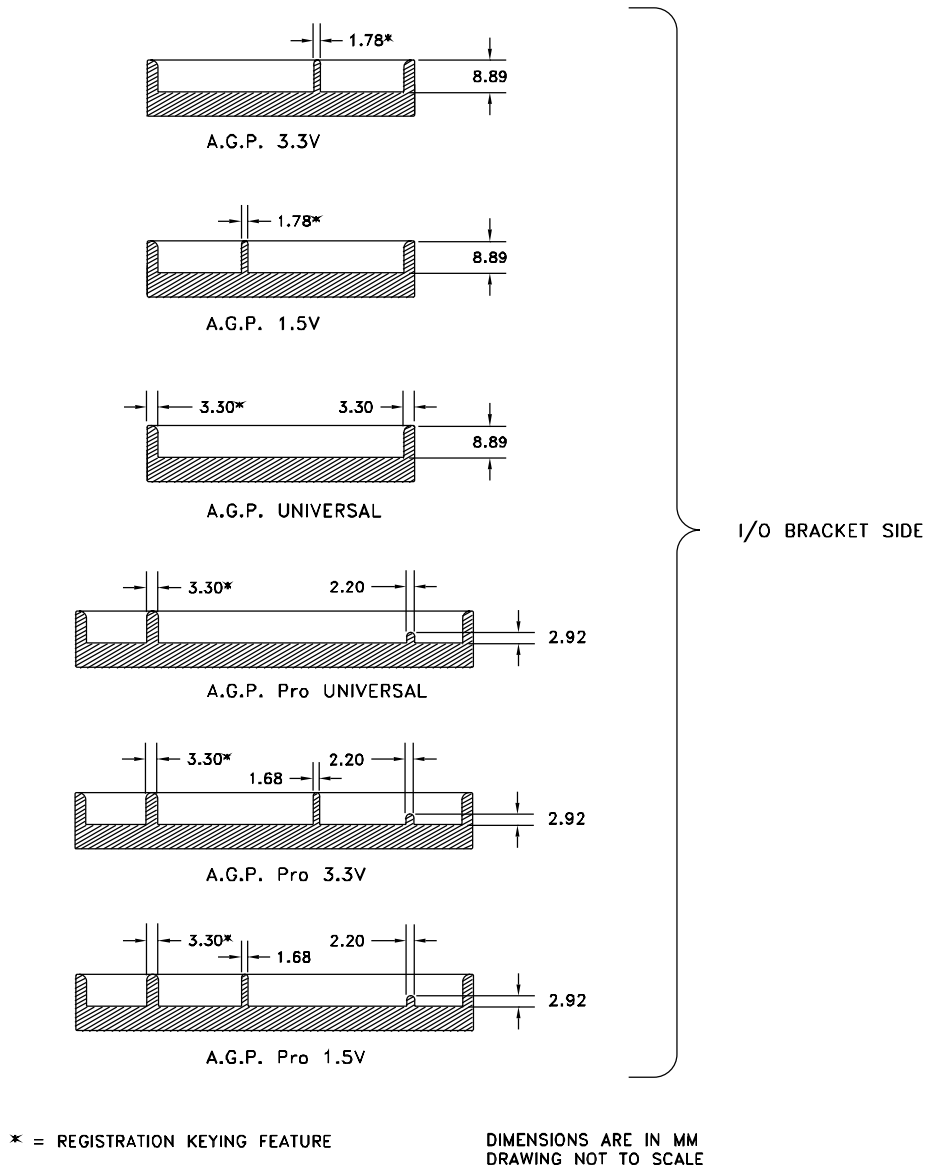**Figure 2-4: A.G.P. Pro Motherboard Implementation**

2.3 A.G.P. Card in an A.G.P. Pro Connector

A.G.P. 3.3 V and 1.5 V connectors use the 1.78 mm wide voltage key to register the AGP add-in card. The A.G.P. Universal connector makes use of the 3.30 mm end housing in conjunction with the registration tab on the A.G.P. add-in card to register.

The A.G.P. Pro connector is an extension of the existing A.G.P. connector and will accept existing A.G.P. cards. All versions of the A.G.P. Pro connector make use of the 3.30 mm wide key to register existing A.G.P. cards. Therefore, the A.G.P. cards must have a registration tab as defined in the A.G.P. specification to work in the A.G.P. Pro connector. Note that the width of the 3.3 V and 1.5 V voltage key on the A.G.P. Pro connector has been reduced to 1.68 mm from 1.78 mm as these keys are not used to register the AGP card. Also, to ensure correct operation with the A.G.P. Pro connector, no vias or components should be placed on the registration tab.

2.4 A.G.P. Pro Card in an A.G.P. Connector

A.G.P. Pro add-in cards will not fit into systems designed with existing A.G.P. connectors. This is ensured by selecting a shorter height key for A.G.P. Pro connectors as compared to the height of the end housing on A.G.P. connectors as illustrated in Figure 2-5. The height of the key on the side closer to the I/O bracket is 2.92 mm for A.G.P. Pro connectors. The corresponding height of the end housing for existing A.G.P. connectors is 8.89 mm. This ensures that A.G.P. Pro add-in cards designed to the 2.92 mm height of the key will not fit into the existing A.G.P. connectors.

Figure 2-5: A.G.P. Pro Key Dimensions

Figure 2-5 shows an A.G.P. Pro connector based on extending the Universal A.G.P. connector. If an A.G.P. Pro connector is built by extending the 3.3 V or 1.5 V A.G.P. connectors, the width of the keys must remain the same as on the A.G.P. Pro connector. The width of the keys is fixed at 2.20 mm on one end and 3.30 mm on the other end.

2.5 Usage Rules of PCI Slots for Multi-Slot A.G.P. Pro Cards

An A.G.P. Pro compliant system must provide two PCI slots adjacent to the A.G.P. Pro slot. The A.G.P. Pro card may use these PCI slots for mechanical support, electrical power, or PCI bus functional purposes. Multi-slot A.G.P. Pro cards must follow the rules below in order to use the PCI slots.

If the PCI slots are used for additional power, then:

- Design a Universal PCI card edge so that it can plug into a 3 V or 5 V PCI connector.

- Do not use V I/O pins on the PCI connector for power.

- Use the 3.3 V or 5 V rail for power. Note that 3.3 V pins are provided on a 5 V connector also.

- Do not tie **M66EN** (pin 49-side B) to GND on the card because this will slow a 66 MHz bus to 33 MHz operation.

If the multi-slot A.G.P. Pro card is using the PCI slots for PCI Bus functionality, then:

- Design the card to work with 33 MHz/32bit PCI bus as only this is guaranteed to be available. 66 MHz or 64 bit PCI operation is not guaranteed to be provided on the adjacent PCI slots.

- Design the I/O buffers on the PCI component to operate at 3.3 V with 5 V tolerance.

3. Electrical Specification

3.1 A.G.P. Pro Connector Pinout

The A.G.P. Pro connector is designed as an extension to the existing A.G.P. connectors. The A.G.P. connectors are extended on both ends to build the A.G.P. Pro connector. It is a monolithic connector. Any of the specified A.G.P. connectors can be extended to build the A.G.P. Pro connector. This section illustrates the use of Universal A.G.P. connector to build the A.G.P. Pro connector. The Universal connector can be replaced with 3.3 V or 1.5 V A.G.P. connectors to build the A.G.P. Pro connector.

Figure 3-1 shows the A.G.P. Pro connector layout based on extending the Universal A.G.P. connector.

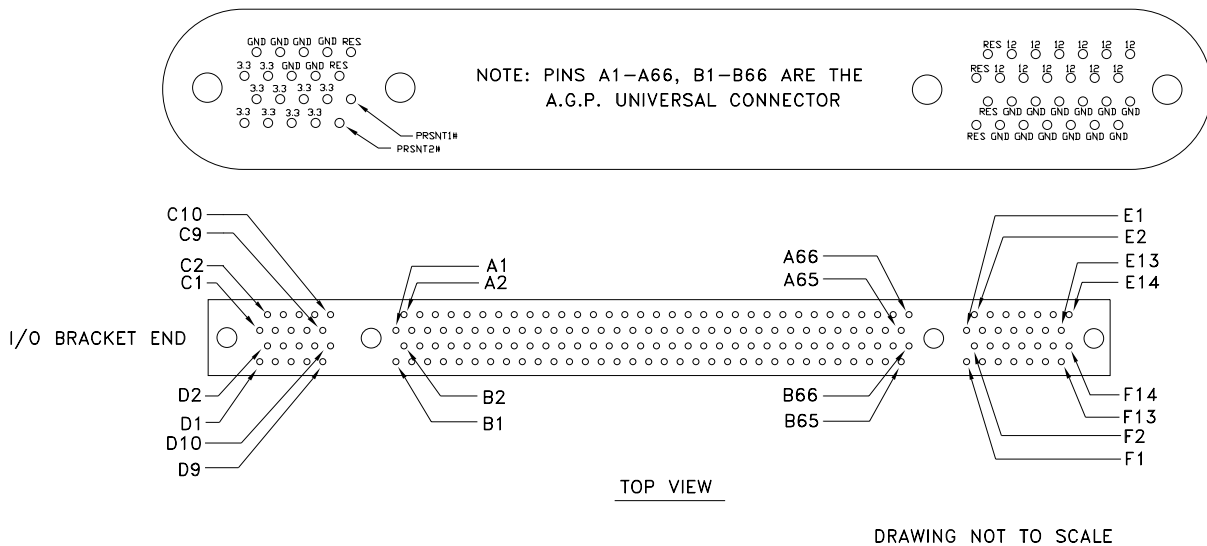Table 3-1 lists the pinout for the extended part of the A.G.P. Pro connector.

Figure 3-1: A.G.P. Pro Connector Pinout Assignments

Table 3-1: A.G.P. Pro Connector Pinout

	A.G.P. Pro Extended Connector	
Pin#	**D**	**C**
1	VCC3.3	VCC3.3
2	VCC3.3	Ground
3	VCC3.3	VCC3.3
4	VCC3.3	Ground
5	VCC3.3	Ground
6	VCC3.3	Ground
7	VCC3.3	Ground
8	VCC3.3	Ground
9	PRSNT2#	Reserved
10	PRSNT1#	Reserved
	F	**E**
1	Reserved	Reserved
2	Reserved	Reserved
3	Ground	VCC12
4	Ground	VCC12
5	Ground	VCC12
6	Ground	VCC12
7	Ground	VCC12
8	Ground	VCC12
9	Ground	VCC12
10	Ground	VCC12
11	Ground	VCC12
12	Ground	VCC12
13	Ground	VCC12
14	Ground	VCC12

NOTE: Pins A1–A66 and B1–B66 are same as for the A.G.P. connector.

3.2 A.G.P. Pro Power

3.2.1 A.G.P. Pro Power Delivery

Table 3-2 lists the voltage ranges for the 3.3 V and 12 V power supplies and the maximum current that can be supplied via the connector.

Table 3-2: A.G.P. Pro Add-in Card Power Supply Limits

Symbol	Parameter	Condition	Min	Max	Units
VCC3.3	3.3 V power supply	Imax = 7.6 A	3.15	3.45	Volts
VCC12	12 V power supply	Imax = 9.2 A	11.4	12.6	Volts

The motherboard must connect all power supply pins on the connector to guarantee proper current delivery and to provide proper AC signal return paths. The A.G.P. Pro add-in card must attach all connector power pins to appropriate power planes on the card for good power delivery and signal returns. A.G.P. Pro cards must use all ground pins. Appropriate capacitive decoupling (high frequency and bulk) must be provided on all voltage rails used on the add-in card and on the motherboard.

To prevent interactions with other items powered by the VCC rails, the DC-DC converters on the A.G.P. Pro card cannot induce transients on either the VCC3.3 or VCC12 input lines greater that 0.1A/µs under any loading conditions including going from low power mode (i.e., sleep mode) to full power mode.

3.2.2 Power For Single Slot A.G.P. Pro Add-in Cards

An A.G.P. Pro card may draw power either from the existing part of the A.G.P. Pro connector, the extended part, or a combination of the two. In all cases, the maximum power that may be drawn by an A.G.P. Pro card is limited to 110 W. Power on the existing part of the connector is delivered on 5.0 V and 3.3 V rails. Power on the extensions is delivered on the 12 V and 3.3 V rails.

Table 3-3 lists some of the possible combinations allowed for an A.G.P. Pro add-in card designed for the A.G.P. Pro connector. This add-in card draws no power from the two adjacent PCI slots. Other combinations are possible within the guidelines.

Table 3-3: Single Slot A.G.P. Pro Add-in Card Power

A.G.P. Pro		Total Power	Comments
Supported Combinations			
A.G.P. connector (Max Power)	Additional power from extensions (Max Power)		
0 W	110 W–12 V	110 W	
25 W	85 W–12V	110 W	
25 W	25 W–3.3 V 60 W–12 V	110 W	
Unsupported Combinations			
25 W	110 W–12 V	135 W	Exceeds total power limit of 110 W
25 W	25 W–3.3 V 110 W–12 V	160 W	Exceeds total power limit of 110 W

3.2.3 Power For Multiple Slot A.G.P. Pro Add-in Cards

Multi Slot A.G.P. Pro cards draw power from the adjacent PCI slots in addition to the A.G.P. Pro slot. The maximum power budget for A.G.P. Pro plus two adjacent PCI slots is limited to 110 W. Table 3-4 lists some possible combinations allowed for an A.G.P. Pro add-in card designed for the multiple slots. Other combinations are possible but must be kept below the 110 W maximum.

Table 3-4: Multiple Slot A.G.P. Pro Add-in Card Power

A.G.P. PRO CONNECTOR		PCI Slot 1 (Max power)	PCI Slot 2 (Max Power)	Total Power	Comments
Supported Combinations					
A.G.P. connector (Max Power)	Additional power from extensions (Max Power)				
0 W	110 W–12 V	0 W	0 W	110 W	
25 W	85 W–12 V	0 W	0 W	110 W	
25 W	25 W–3.3V 10 W–12 V	25 W	25 W	110 W	
25 W	25 W–3.3 V 35 W–12 V	25 W	0 W	110 W	
Unsupported Combinations					
25 W	25 W–3.3 V 20 W–12 V	25 W	25 W	120 W	Exceeds total power limit of 110 W
25 W	25 W–3.3 V 110 W–12V	25 W	25 W	210 W	Exceeds total power limit of 110 W

3.3 Power ID Pins A.G.P. Pro Card

Two pins are defined specifically on the A.G.P. Pro connector: **PRSNT1#** and **PRSNT2#**. They are used for two purposes: indicating that an A.G.P. Pro card board is physically present in the slot and providing information on the maximum power requirements of the card plugged into the A.G.P. Pro connector. Table 3-5 defines the required settings for the **PRSNT#** pins for the A.G.P. Pro add-in card.

Table 3-5: Add-in Card Present Settings

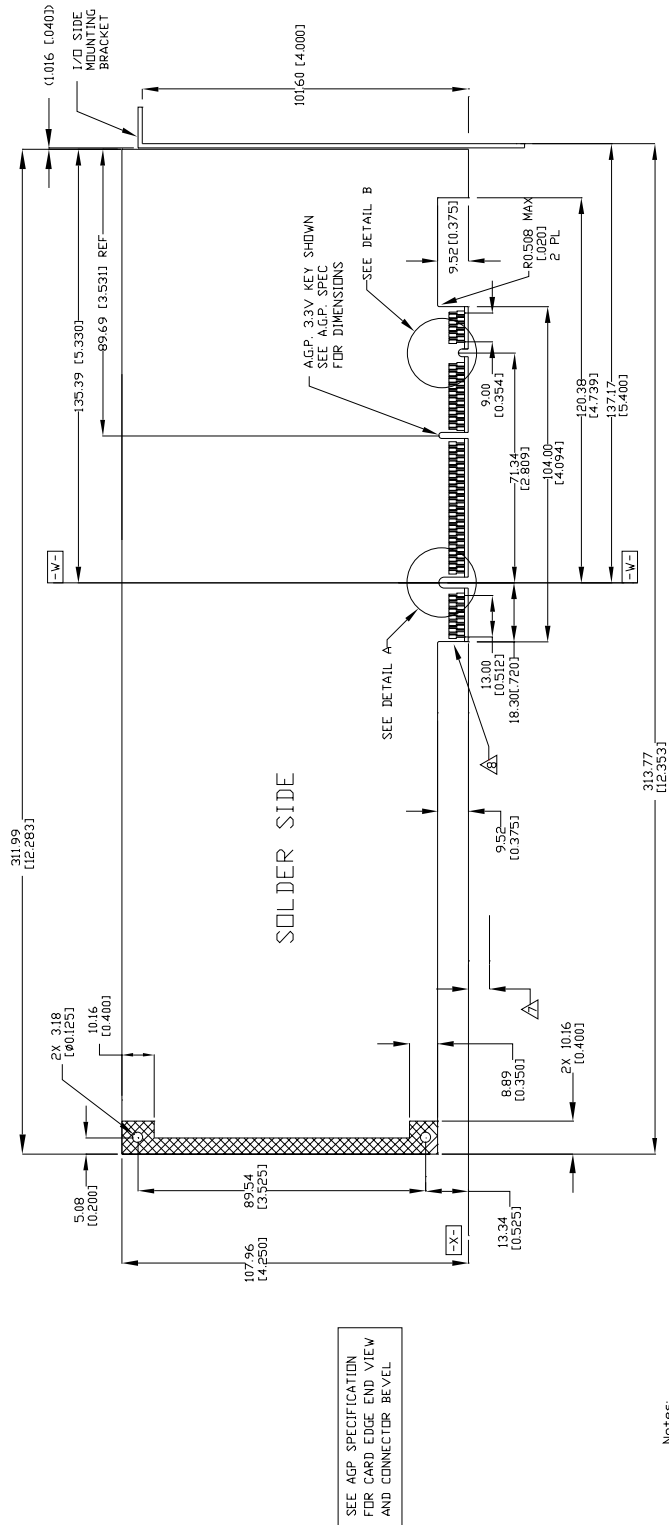| PRSNT1#	PRSNT2#	A.G.P. Pro Slot Configuration
Open	Open	No expansion board present
Ground	Open	Expansion board present, 50 W max. power
Ground	Ground	Expansion board present, 110 W max. power
Open	Ground	Reserved

In providing the power level indication, the pin strapping must indicate the total maximum power consumption of a fully configured A.G.P. Pro card. The maximum power consumption may be more than that consumed in the card's shipping configuration. (e.g., sockets for memory expansion, etc.)

The system designer may use these signals for system configuration, diagnostics, or power allocation. If the signals are used by the motherboard, the system designer must provide pull-up resistors for both these signals. The value of the resistor and the pull up voltage is to be decided by the system designer based on the associated circuitry. Note that on the A.G.P. Pro add-in cards, these signals are either tied to ground or left unconnected based on the information in Table 3-5.

4. Mechanical Specification

4.1 Expansion Card Dimensions and Tolerances

Figure 4-1 shows an A.G.P. Pro ATX form factor add-in card based on 3.3V card edge. A.G.P. Pro add-in cards designed for 1.5 V card edge must change the location of the 3.3 V key to the 1.5 V key location. Refer to the A.G.P. specification for the location and dimension of the 1.5 V key.
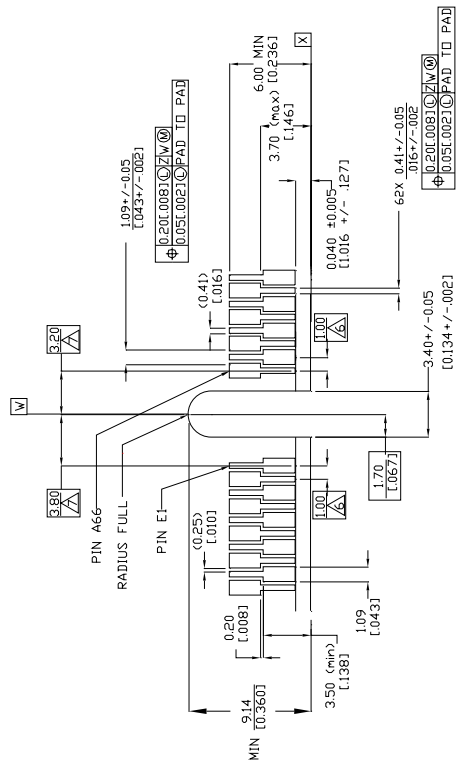
Figure 4-1A: A.G.P. Pro ATX Form Factor Add-in Card (3.3 V)
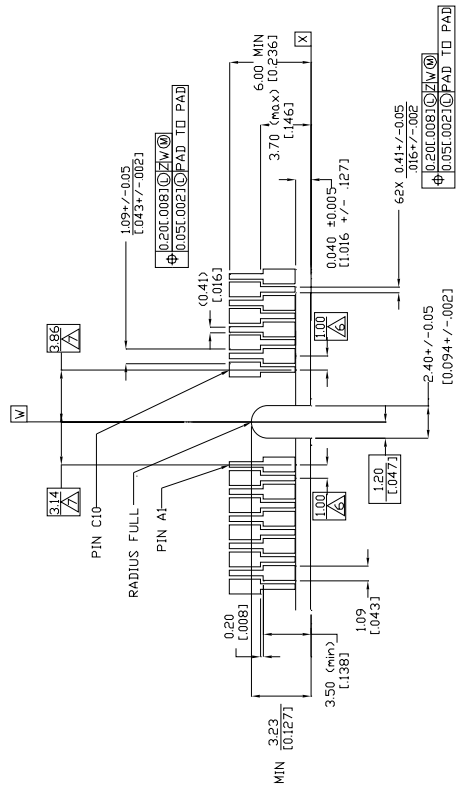
Figure 4-1B: Detail A and B: A.G.P. Pro Card Edge Finger Layout

23

4.2 A.G.P. Pro Add-in Card Connector Physical Description

Any of the specified A.G.P. connectors can be extended to build the A.G.P. Pro connector. This section illustrates the use of the Universal A.G.P. connector to build the Universal version of the A.G.P. Pro connector. This section also illustrates the use of 1.5 V A.G.P. connector to build the 1.5 V version of the A.G.P. Pro connector. The 3.3 V version of the A.G.P Pro connector is not illustrated. The 3.3 V A.G.P. Pro connector can easily be designed based on the data provided.

Contact specifications for the A.G.P. connector family are listed in the A.G.P. specification. Only the specifications of the A.G.P. Pro connector are listed in this section.

4.2.1 A.G.P. Pro Add-in Card Connectors

4.2.1.1 Universal A.G.P. Pro Connector

See Figure 4-2 for the Universal A.G.P. Pro connector dimensions. See Figure 4-3 for the Universal A.G.P. Pro connector layout dimensions.
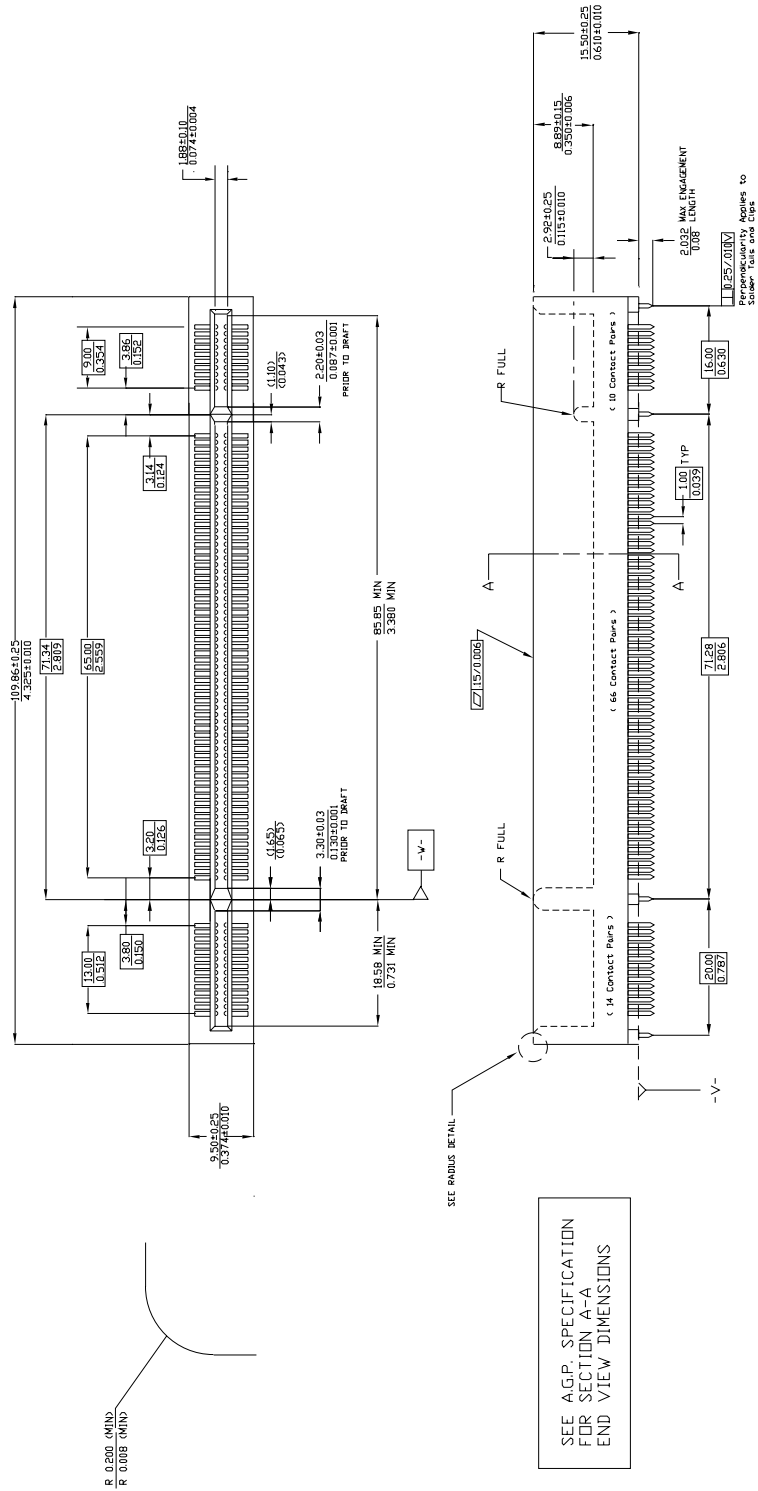
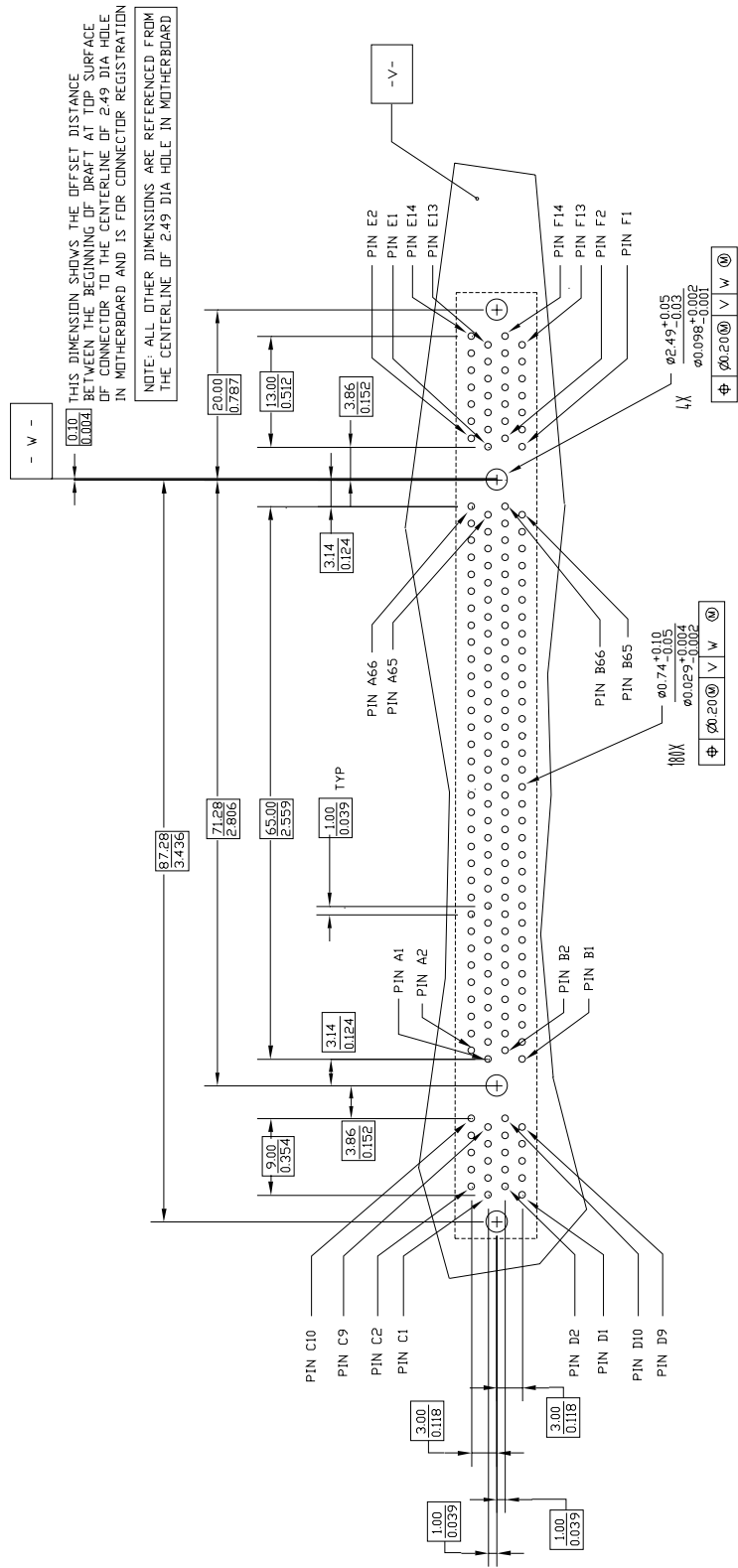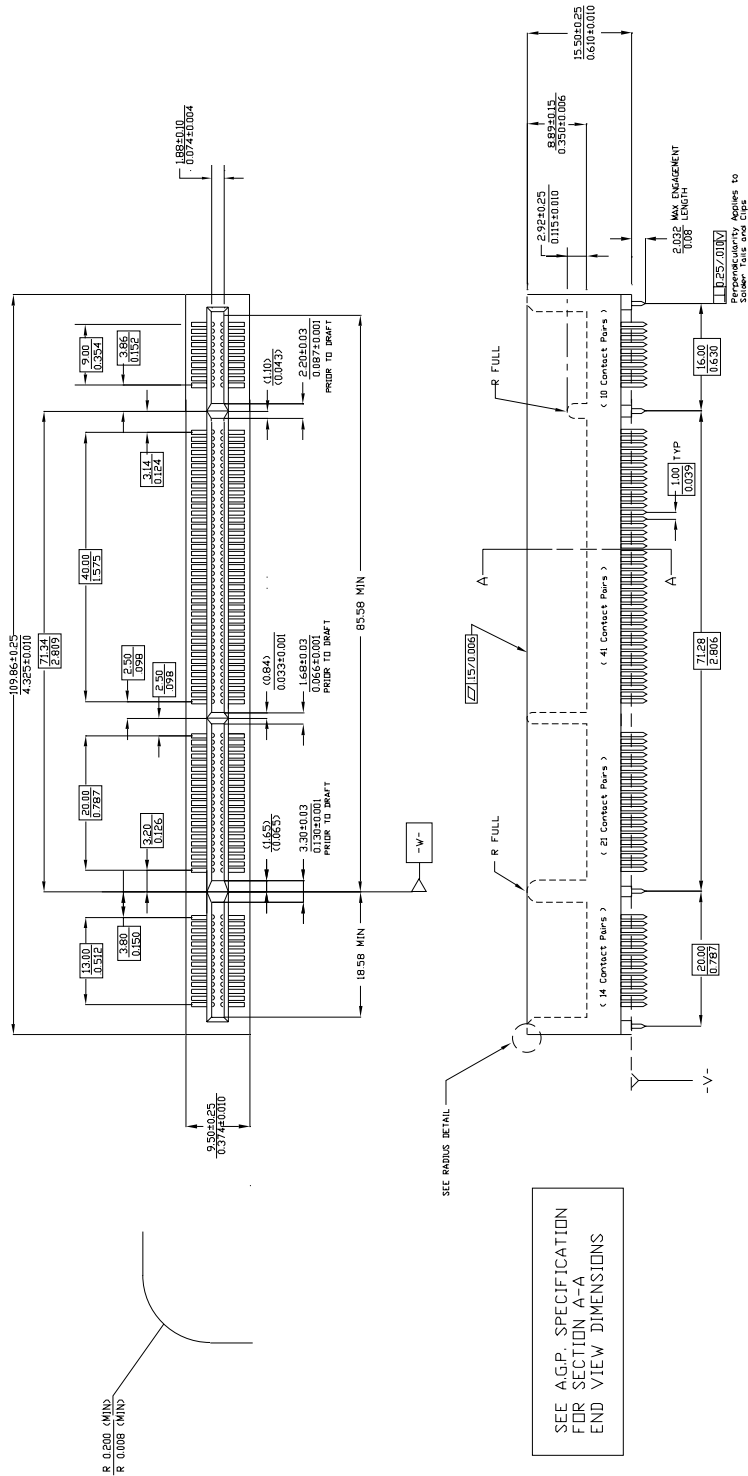**Figure 4-2: A.G.P. Pro Connector Footprint (Based on the A.G.P. Universal Connector)**

THIS DIMENSION SHOWS THE OFFSET DISTANCE
BETWEEN THE BEGINNING OF DRAFT AT TOP SURFACE
OF CONNECTOR TO THE CENTERLINE OF 2.49 DIA HOLE
IN MOTHERBOARD AND IS FOR CONNECTOR REGISTRATION

NOTE: ALL OTHER DIMENSIONS ARE REFERENCED FROM
THE CENTERLINE OF 2.49 DIA HOLE IN MOTHERBOARD

Figure 4-3: A.G.P. Pro Connector Layout Dimensions (Based on the A.G.P. Universal Connector)

4.2.1.2 1.5 V A.G.P. Pro Connector

See Figure 4-4 for the 1.5 V A.G.P. Pro connector dimensions. See Figure 4-5 for the 1.5V A.G.P. Pro connector layout dimensions.

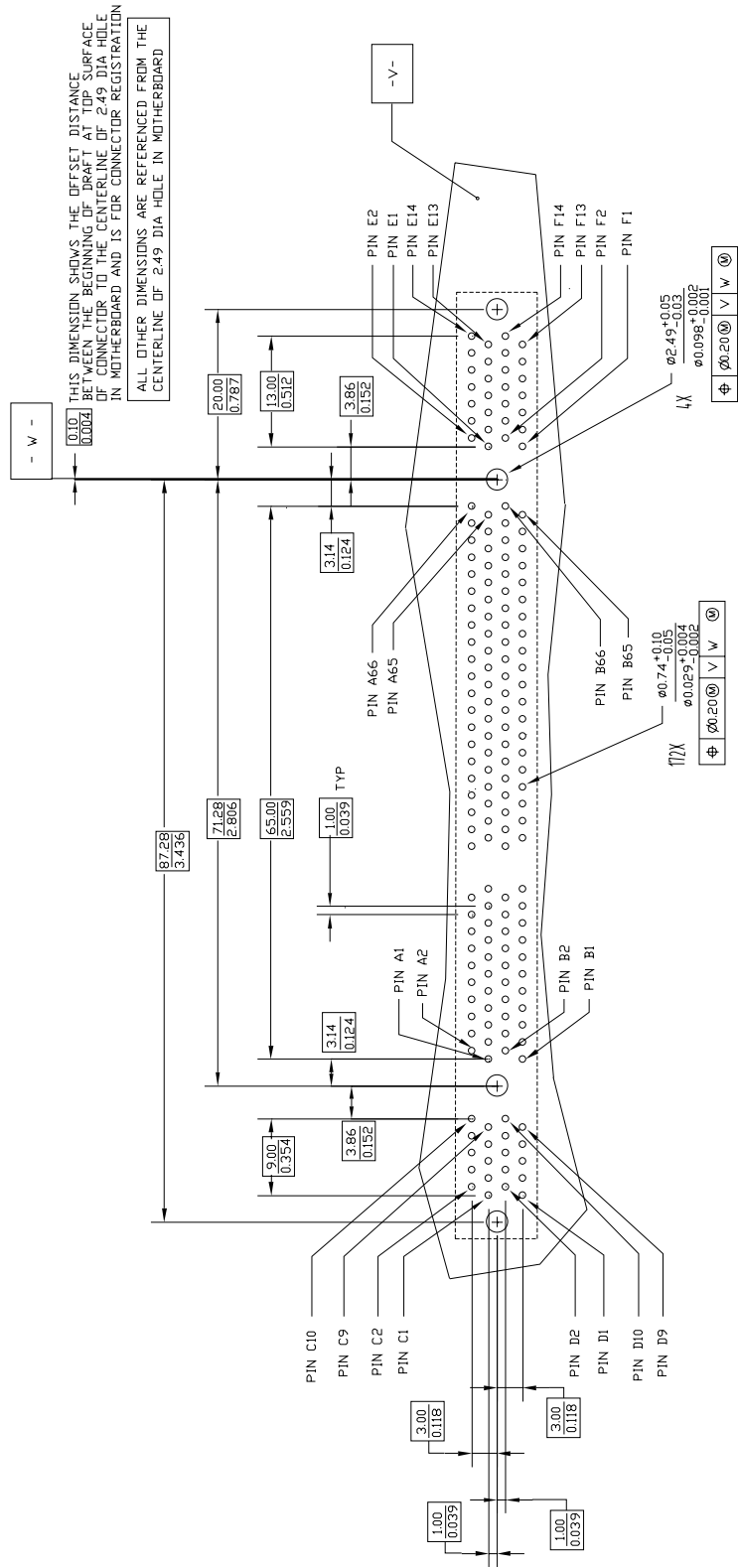**Figure 4-4: A.G.P. Pro Connector Footprint (Based on the A.G.P. 1.5V Connector)**

27

Figure 4-5: A.G.P. Pro Connector Layout Dimensions (Based on the A.G.P. 1.5V Connector)

4.2.2 Insertion/Extraction Force

Insertion force of PCB into A.G.P Pro connector: 18.6 lbf (max)

Extraction force of PCB from A.G.P connector: 11.2 lbf (max)

A.G.P. Pro connector shall withstand a minimum of 50 insertion/extraction cycles with an A.G.P. Pro add-in card.

4.3 A.G.P. Pro Connector Electrical Requirements

All A.G.P. Pro connector electrical requirements are the same as the A.G.P. connector specification except for the changes listed in Sections 4.3.1, 4.3.2, and 4.3.3.

4.3.1 Determination of Average Contact Resistance

- Measure Total Contact Resistance R_{AB} for each of the 180 A.G.P. Pro contacts.

- Measure Bulk Contact Resistance R_{AC} for each of the 90 A.G.P. Pro lower contacts.

- Determine Contact Resistance for each of the 180 A.G.P. Pro contacts using either
  $R_{CB} = R_{AB}$ for upper contacts or
  $R_{CB} = R_{AB} - R_{AC}$ for lower contacts.

4.3.2 Mating Force

The total mating force for the A.G.P. Pro Connector is <18.7 lb. Refer to the A.G.P. specification for specific testing requirements.

4.3.3 Unmating Force

The total extraction force for the A.G.P. Pro connector is <11.3 lb. See the A.G.P. specification for specific testing requirements.

4.4 A.G.P. Pro Brackets

Specially designed I/O brackets are necessary for proper implementation of the A.G.P. Pro. Figure 4-6 shows a High Power A.G.P. Pro add-in card with three slot wide I/O bracket and an end retainer bracket.
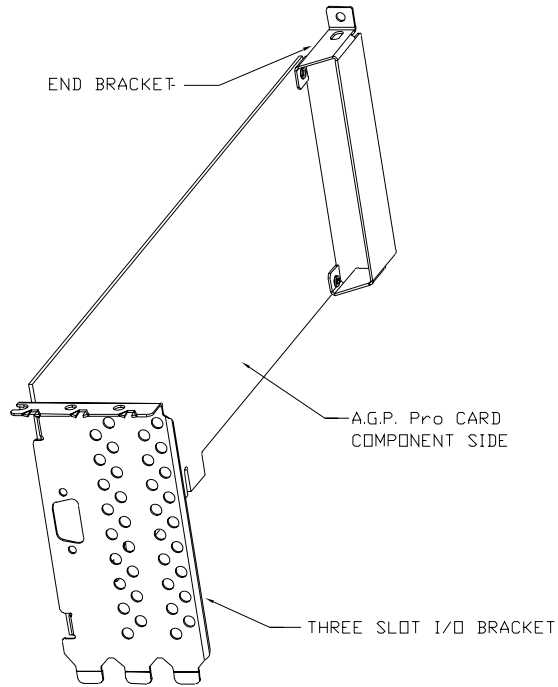
Figure 4-6: Isometric View of A.G.P. Pro Brackets

4.4.1 Three Slot I/O Bracket Design

Figure 4-7 shows a detailed drawing of a three Slot I/O Bracket design. Figure 4-8 shows an isometric view of the three slot I/O bracket with holes in the I/O connector venting window. The size and number of holes must follow proper EMI and thermal design guidelines.
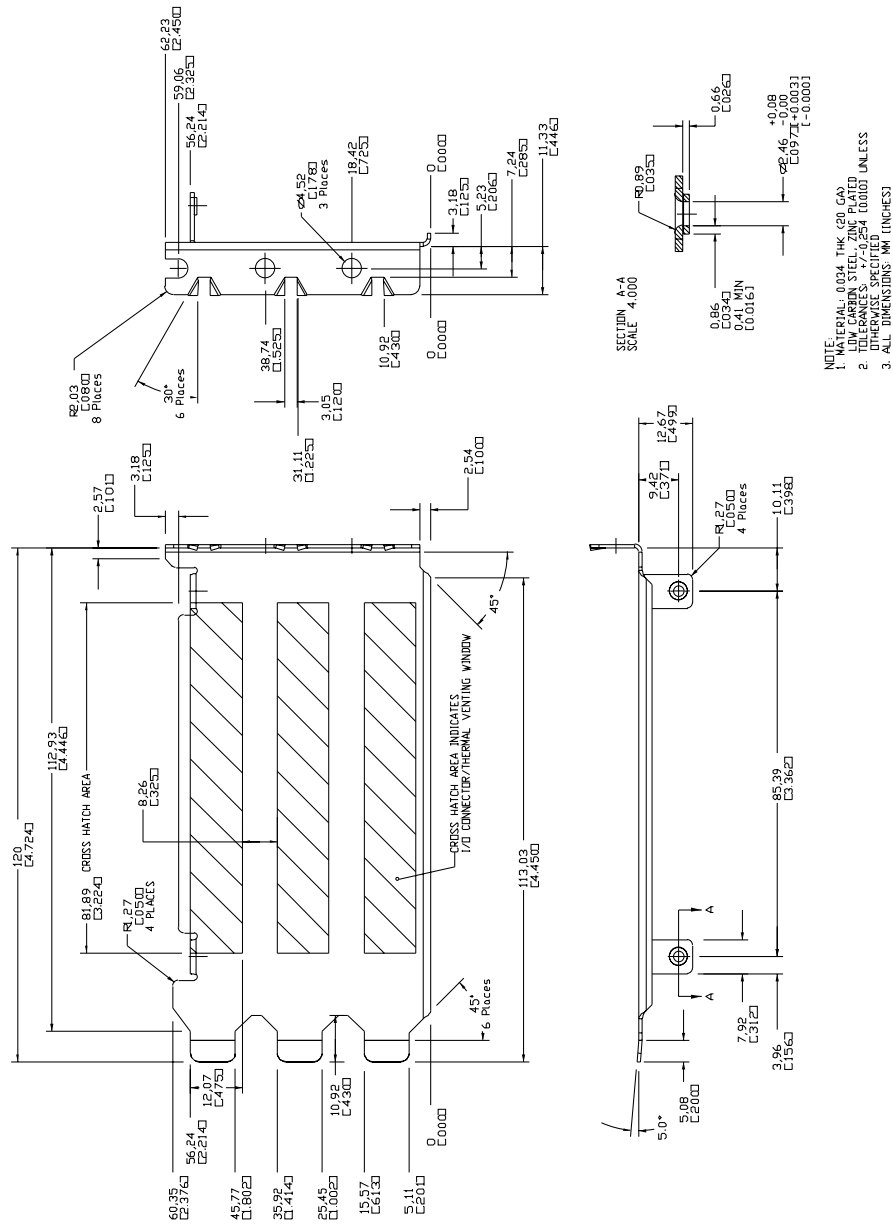

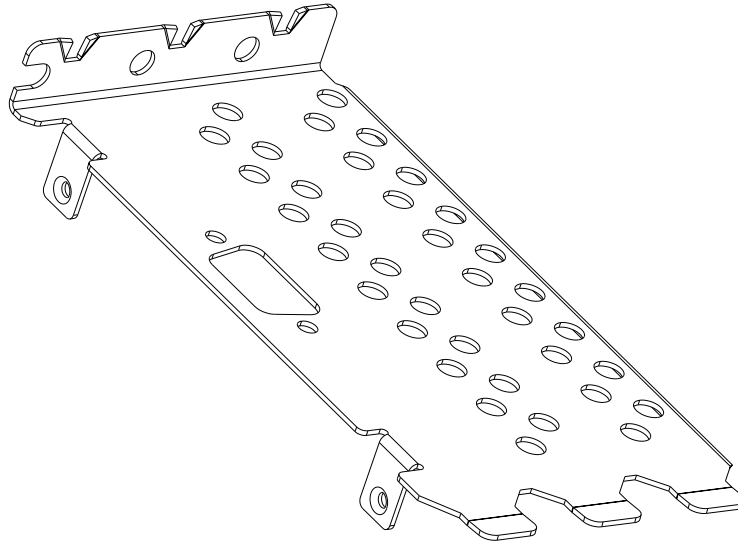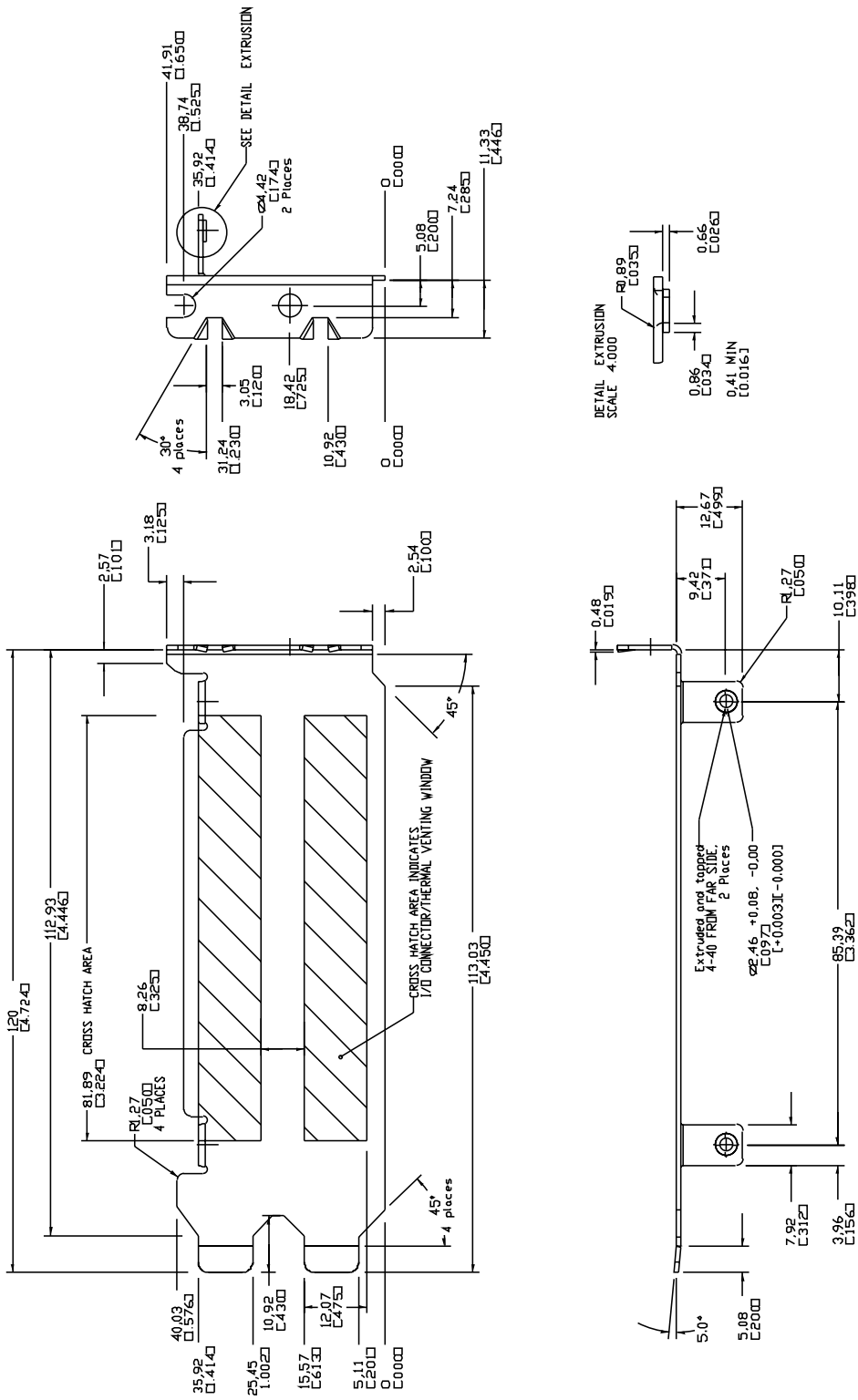**Figure 4-7: Detailed Three Slot I/O Bracket Design**

Figure 4-8: Three Slot I/O Bracket Example (Isometric View)

4.4.2 Two Slot I/O Bracket Design

Figure 4-9 shows a detailed drawing of a two Slot I/O Bracket design. Figure 4-10 shows an isometric view of the two slot I/O bracket with holes in the I/O connector venting window. The size and number of holes must follow proper EMI and thermal design guidelines.

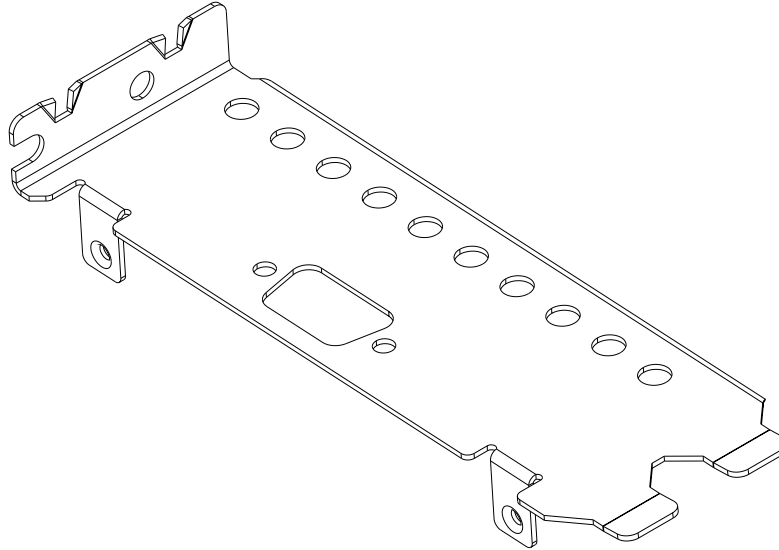**Figure 4-9: Detailed Two Slot I/O Bracket Design**

33

Figure 4-10: Two Slot I/O Bracket Example (Isometric View)

4.4.3 A.G.P. Pro End Retaining Bracket

A full length A.G.P. Pro card must be equipped with an end retaining bracket as shown in Figure 4-11. Figure 4-11 also shows an isometric view of the A.G.P. Pro End Retaining Bracket design. This end bracket provides holes for two additional hold down locations. OEM's may use this feature on the end brackets to hold down A.G.P. Pro add-in cards.
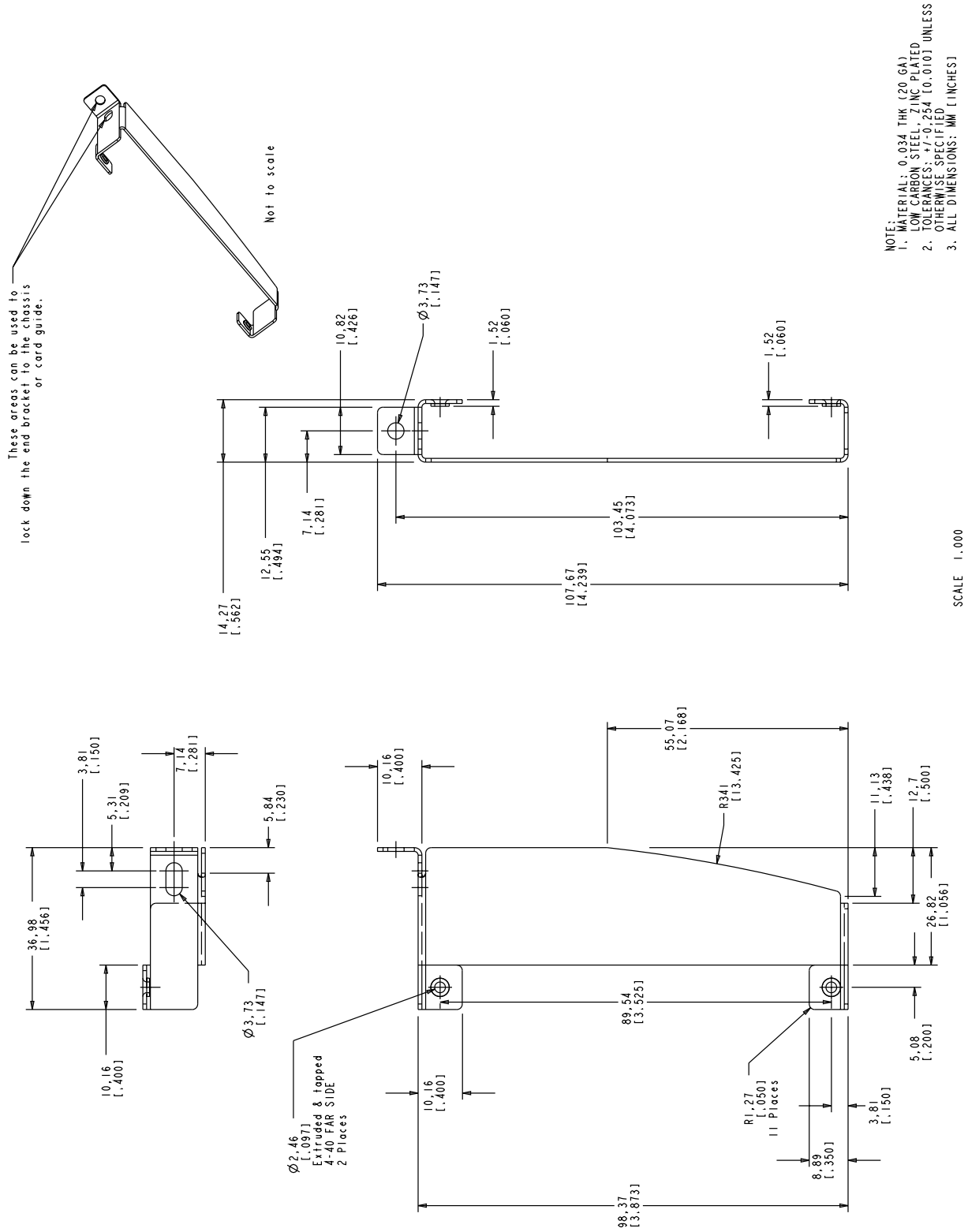
Figure 4-11: Detail Drawing of an A.G.P. Pro End Bracket

For A.G.P. Pro cards that are not full length, it is strongly recommended that the card be extended to utilize the A.G.P. Pro end retaining bracket. This will provide a retention mechanism for the card. The card can be extended using the concept shown in Figure 4-12. Other mechanical means can be used to extend the card.
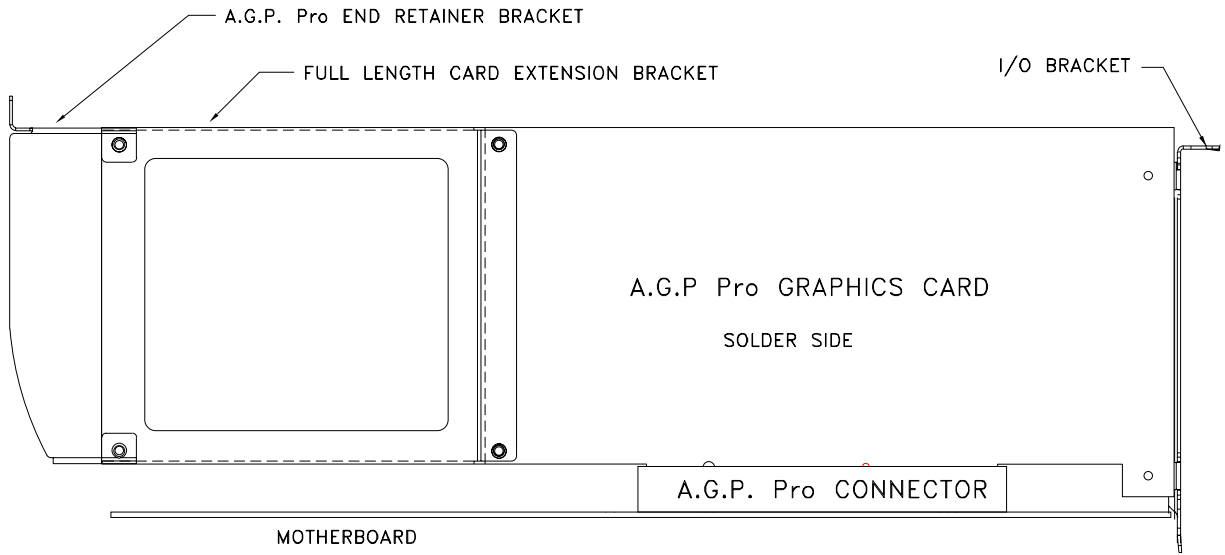

Figure 4-12: Full Length Card Extension Concept

5. Thermal Specification

Figure 5-1 represents a thermal envelope for A.G.P. Pro implementations. System vendor will need to provide a minimum of 200 LFM of non-obstructed airflow at the inlet of this envelope. The maximum inlet temperature is 45 °C.
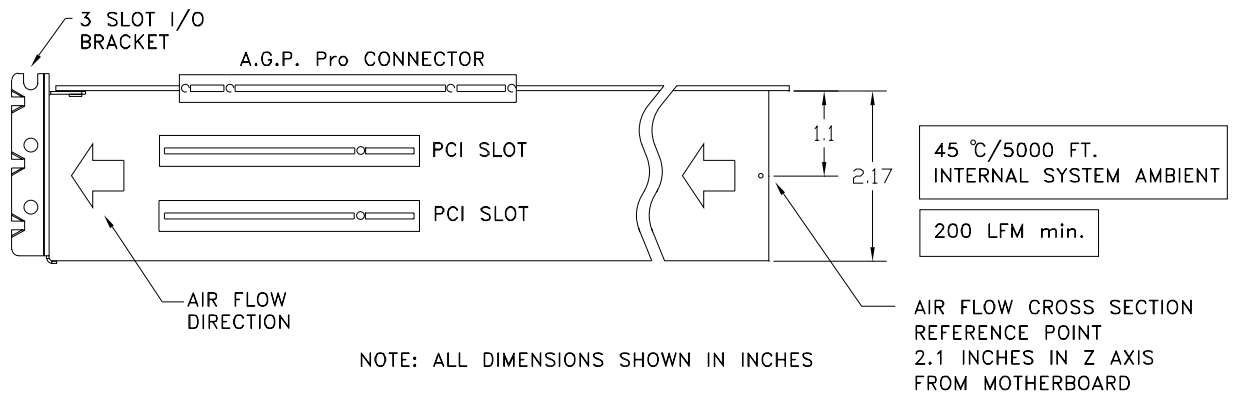

Figure 5-1: Thermal Envelope for A.G.P. Pro Implementation

The A.G.P. Pro add-in card vendor should do thermal modeling based on the requirements listed in Table 5-1. If the A.G.P. Pro card has additional cooling requirements, it must provide its own cooling solutions within the A.G.P. Pro envelope. I/O brackets with holes may be used by graphics vendors to provide venting. These brackets are specified in Section 4.

Table 5-1: Thermal Specification for A.G.P. Pro System

Symbol	Parameter	Min	Max	Units	Notes
Ta	Ambient Temperature		45	°C	1
Af	Air flow	200		LFM	1, 2

Notes:

1. Measured at the reference point in the cross section of inlet.

2. LFM is linear feet per minute.