



## **USER MANUAL**

For

**AL520**

**CONFIGURABLE MULTIFUNCTION DISPLAY**

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## SECTION 1: INTRODUCTION

### 1.1 OVERVIEW

The AL520 Configurable Multifunction Display provides an adaptable display of test data in aircraft instrument panels by combining a bright, high contrast TFT LCD display with a programmable data processing unit. Up to six gauges which are user defined can be placed on the display. The compact unit utilizes standard Dzus ¼ turn fasteners and mounts in a 5" opening.

There are two phases of operation. First, in the lab the user programs up to 6 Pages of Displays each containing up to 6 gauges. The gauges are driven from input signals supplied from various aircraft data acquisition subsystems. These gauge displays are uniquely programmed, each with selectable display type (arcs, bars, totalizer or Tether Hover) and selectable Units, Label, and Min/Max tracking range color coding. For some gauges, the data can be displayed as either a 'sweep' or a single pointer along with digital data value readout. The resulting pages are stored in the Display's Nonvolatile memory.

The Flight Phase of operation involves simply using the Pushbutton keys located around the perimeter of the unit to select a Display Page, to Reset the Tracking or Totalizer values, or change Display Brightness. Large keys with raised separators facilitate gloved finger use.

After one series of flight tests are completed, the display can be reprogrammed to support the next set, eliminating the need to buy unique, specialized displays per mission.

### FEATURES

- User programmable LCD based display
  - Bright, high contrast display
  - 6 Pages of Displays
  - Up to 6 gages per display
- Stores six display pages in non-volatile memory
- Accepts 12 analog signal inputs (0V to 5V DC corresponds to 0 to Full Scale Indicators)
- Accepts 12 Serial RS232 digital data value inputs on Serial Interface
- Accepts 12 Gigabit Ethernet digital data value input with optional Ethernet Module
- Widely separated keys for operation control (optimized for gloved finger operation)
  - Display Page Select, Dim/Brite, and Tracking/Totalizer reset
- Serial RS-232 programming interface
- Setup GUI software package available
- Operates on 18-36 VDC power, <500mA in basic configuration

## 1.2 SPECIFICATIONS

**Note: Special assembly/disassembly procedures required, No User Serviceable Items**

### MECHANICAL & ENVIRONMENTAL

- DIMENSIONS - Appendix A
- Weighs less than **5 pounds**
- Connectors :
  - Power Input :MIL – 38999 Series III 6-Pin Male Bulkhead  
**Part # - D38999/20WB98PN**
  - Analog Input, Serial Interface, TTL inputs, and Maintenance Mode control:  
MIL – 38999 Series III 37-Pin Female Bulkhead  
**Part # - D38999/20D35SN**
  - Ethernet (Option) MIL – 38999 Series III 8-Pin Female Bulkhead  
**Part # - D-GBE20W11-08SN**
  - Video (Option) - 75 ohm Female TNC, isolated from Chassis  
**Part # - PE9625**
  
- Temperature: -30°C to 70°C operating
- Humidity: 95% non-condensing
- Altitude: 0 to 70,000 feet
- Shock 20 G's half sine, 11ms, 6 shocks minimum any axis PAX to supply more detailed information
- Vibration random 15 G-RMS, 20 Hz to 20,000 Hz, 10 minute duration in any axis.
- Acceleration 20 G's indefinite duration in any axis.

### ELECTRICAL

- Power
  - Input Voltage: +18VDC to 36VDC
  - Power Consumption: 15 watts maximum total
    - Basic unit, no option Modules: TYP <7 Watts
    - Ethernet Option Module adds: TYP < 3 Watts
  - Power Interruption: Resumes operation within 15 seconds of reapplication of power.
  - EMI MIL-STD-461C Design Goal
- Signal Inputs
  - 12 Analog Signals
    - 0 to +5VDC (Arc, Bar & Tether Gauges)
    - 10k input termination
    - 1,000 samples per second, programmable Averaging interval
  - 2 sets of 2 line digital discrete inputs. 5 volt TTL signal levels. (Totalizer Gauge)
    - Min pulse width ->100ns
    - Max frequency-5Hz (Limited due to de-bounce requirements of 125ms)
  - 1 RS232 8N1 format, 9600, 57600, or 115200 baud
    - Also used to implement Pre-Flight Setup

## DISPLAY CHARACTERISTICS

- Any gauge except Totalizer can be driven by any Analog Signal Input
- Display control: Six (6) set-up configurations (pages), selected by pushbuttons
- Update Rate: 50 frames per second
- Sunlight Readable (Luminance up to 800 cd/m<sup>2</sup>)
- Resolution: 480(h) x 640(v) pixels (Viewed in portrait orientation)
- Number of Colors: 8 colors provided for tracking lines display page
- Contrast Ratio: 600:1 typical
- Viewing Angle: >60°
- Rugged LED-based backlight

## GAUGE TYPES

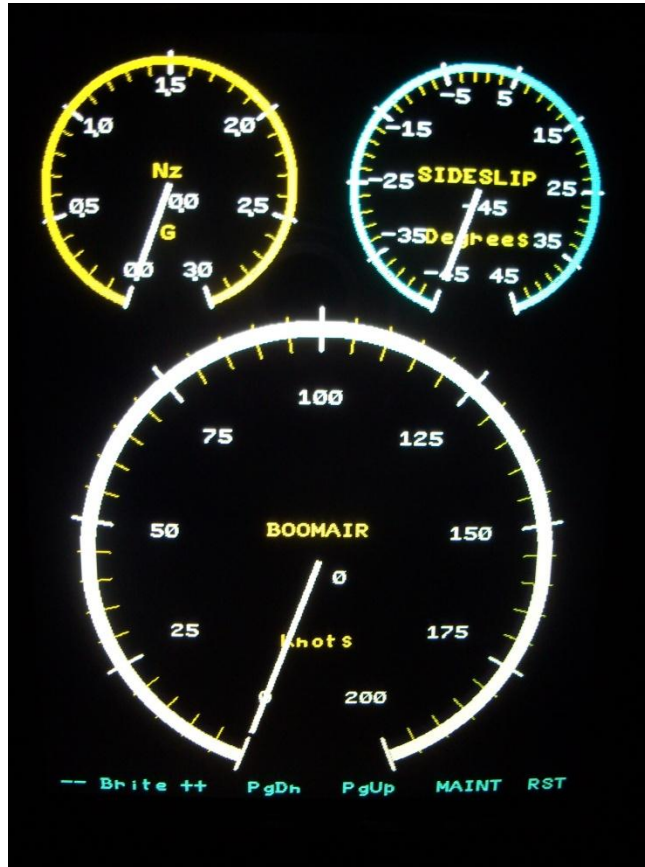
- 320° Arc (1x & 2x sizes)
- Half Arc (160°, left and right side) (1x & 2x sizes)
- Horizontal & Vertical Bars (1x & 2x sizes)
- Accumulator/Counter: Count-Up or Count-Down (1x size only)
- Tether hover (X-Y plot of 2 inputs with 3<sup>rd</sup> input shown as digital value) (1x size only)
- (Additional gauges upon request, consult factory)

## DATA AND DISPLAY FORMAT -General

- User selectable decimal point location for gauge scale and Digital value.
- Separate user selectable +/- sign indicator per gauge's scale values and Digital value per gauge
- Digital Value shows Current Value
- One 8 character Mnemonic per gauge
- One 8 character "Units" field per gauge
- 3 character field value per measurement plus Sign (+/-000)

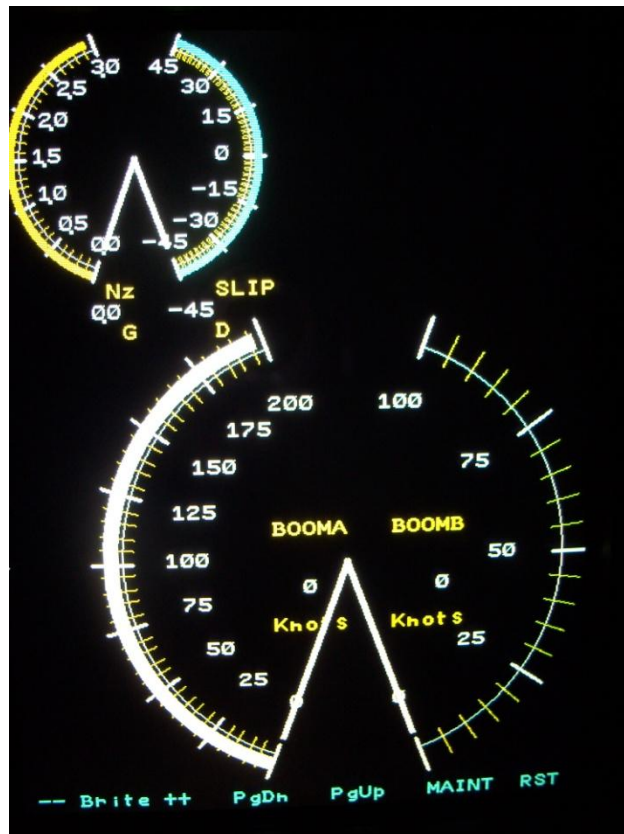
## TRACKING (MIN/MAX HOLD) BANDS

- 6 user-definable color bands per Min/Max hold segment of each gauge
- Color band start stop values percentage of gauge based
- Min/Max hold reset mode user selectable per display
  - Manual reset mode, resets all the Min/Max color bands configured for manual reset when operator presses the reset button. Configured by setting reset interval to a value of 99.
  - Timed reset mode resets the Min/Max color bands at a user configurable interval between 1 and 98 seconds. Configured by setting reset interval between 1 and 98.
  - No Reset: The Min/Max hold color bands reset operation is disabled and the colors serve as Warning Bands. When disabled the color bands are drawn on the display but cannot be reset.



### Type A Gauge

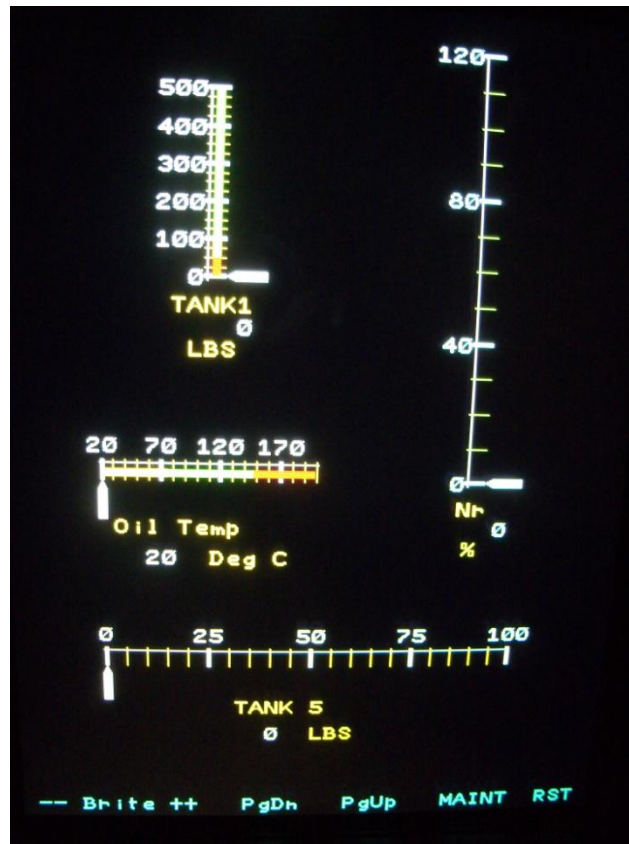
- 320 degree arc
- Center of arc opening programmable to 0,90,180,270 degree positions
- User programmable interval between hash marks (minor tick marks)
- User programmable interval between hash marks with numeric values (major tick marks)
- Minor tick marks will be same color and thickness as arc
- Major tick marks will be 2X thickness and of contrasting color in regards to the arc.
- Min/Max color band function
- Scale values placed inside the min/max ring
- Pointer indicator only\



### Type B Gauge

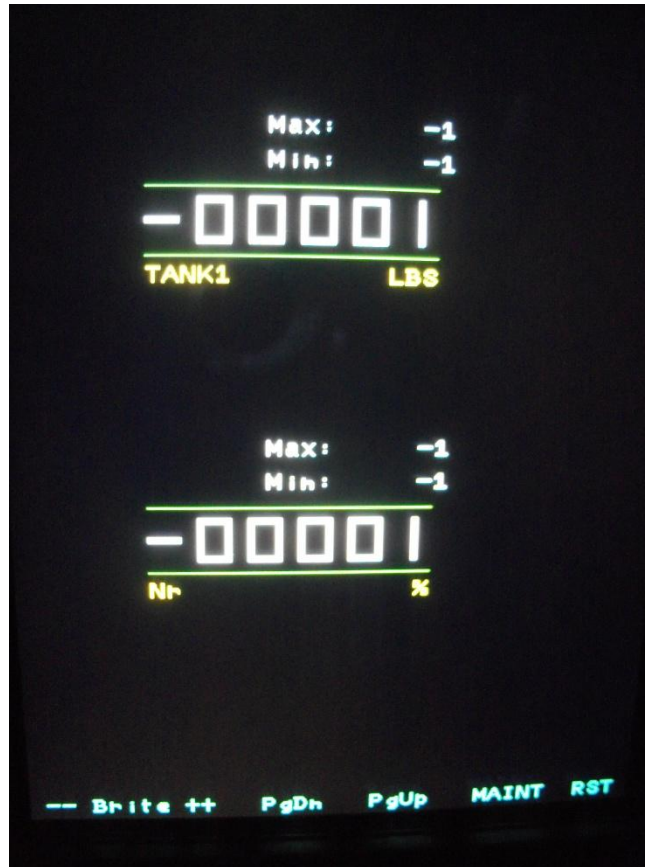
- 160 degree arc gauge
- Left & Right orientation selectable
- Min/Max color band function.
- User programmable interval between hash marks. (minor tick marks)
- User programmable interval between hash marks with numeric values. (major tick marks)
- Minor tick marks will be same color and thickness as arc.
- Major tick marks will be 2X thickness and of contrasting color in regards to the arc.
- Scale values placed inside the min/max ring
- Pointer indicator only





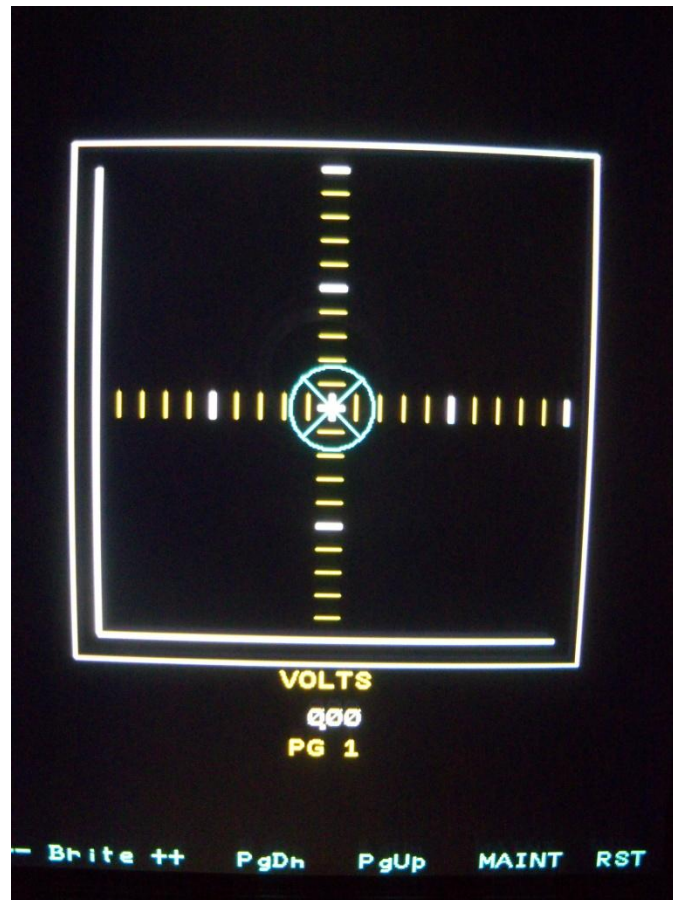
### Bar Gauge

- Horizontal and Vertical orientation selectable
- User selectable Vertical or Horizontal orientation.
- Min/Max color band function.
- User selectable pointer or filled bar.
- User programmable interval between hash marks. (minor tick marks)
- User programmable interval between hash marks with numeric values. (major tick marks)
- Minor tick marks will be same color and thickness as reference line.
- Major tick marks will be 2X thickness and of contrasting color in regards to the reference line.
- Scale values placed inside the min/max tracking line
- Pointer or "SWEEP" / "PISTON" type indicator selectable



### Totalizer

- Two discrete inputs per gauge. (A and B)
- Two independent Totalizers provided
- Totalizer range -32768 to +32767
- Min/Max count values displayed on screen in addition to current total count.
- Count up when A input equals logic 1. Count down when B input equals logic 1.
- User selectable Reset value (-32768 to +32767)
- Totalizer and Min/Max count values can be reset to start value via manual reset button or by driving both A and B inputs to a logic 1 state at the same time.
- Last Total, Min and Max values saved on power down.
- Last power down saved values restored at power up



### Tether Hover

- Three user selectable inputs per gauge.
  - Vertical Axis
  - Horizontal Axis
  - Digital Data Display ( shown at bottom of Gauge)
- Programmable Mnemonic and Units for Digital Display
- Min/Max values not displayed on Vertical and Horizontal axis.
- Vertical and Horizontal minor and major tick mark settings programmable
- Vertical & Horizontal tick marks appear on the center line of display.
- Center of display contains a circle with crosshairs.

## 1.2 Technical Overview

Figure 1 presents the Functional Overview for the AL520 Display unit while Figure 2 provides additional detail of the Display Driver Module functions. Aircraft power is conditioned by an isolated, floating DC-DC converter which provides the voltages required given an input range of 18 to 36 VDC. The display's circuitry is isolated from the metal enclosure to eliminate ground loops.

This application specific design combines a 32-bit Microprocessor Unit (MPU) with a high performance Field Programmable Gate Array (FPGA) to create user defined displays of various data on a 6.5" diagonal LCD color display in formats approximating various gauges found in aircraft control panels. Using the RS-232 serial remote control link, the user pre-defines a set of up to 6 displays. The type, operation, and graphic parameters are stored in the EEROM. On subsequent power up, the MPU will read the data from the EEROM, process this information into display background and foreground shapes, then store the pixel-by-pixel representations into the video memory.

The FPGA's primary task is to constantly read the video memory contents and provide the RGB data along with the raster scan timing to the LCD Display. As a secondary task, the FPGA provides a shared access to the video memory for the MPU for character generation and graphics (lines, circles, arcs, pointers, etc.) In order to provide rapid display updates, the MPU does not need to erase or redraw each of the pixels involved with the individual display items. Characters and lines are drawn by a 'graphic accelerator' circuitry in the FPGA.

The FPGA also provides a "backplane" bus which allows expansion modules to gain access to the display. The expansion modules could include Ethernet, Video, PCM Decommulator, MIL STD 1553, etc.

The MPU also contains a multiplexed analog to digital converter (ADC) which supports the analog input signal acquisition. The 0 to +5 VDC signal inputs are conditioned to match the ADC's input range and provide over voltage protection. Every 1 millisecond, the selected input channel is sampled and converted to a 10 bit binary number. This value is averaged per user setup to provide filtering and prevent 'chatter' of the display. The MPU then scales the derived value per user selected Zero and Full-Scale display range. Thus, the display needle or arc follows the analog input voltage. Note that this entire procedure occurs at the 1 millisecond 'heart beat' rate, even though the LCD display raster scan can only update 50 times a second. This is important so that the MIN/MAX capture function will not miss values.

An asynchronous serial (RS-232) interface on the MPU provides both a data input path and the remote control/setup link. When the Maintenance Mode Pins are shorted together, the serial link operates as the setup link.

For brightness control, the MPU writes a control word to the Display Head which accordingly changes the PWM duty cycle to the LED's backlight power supply thus controlling display brightness.

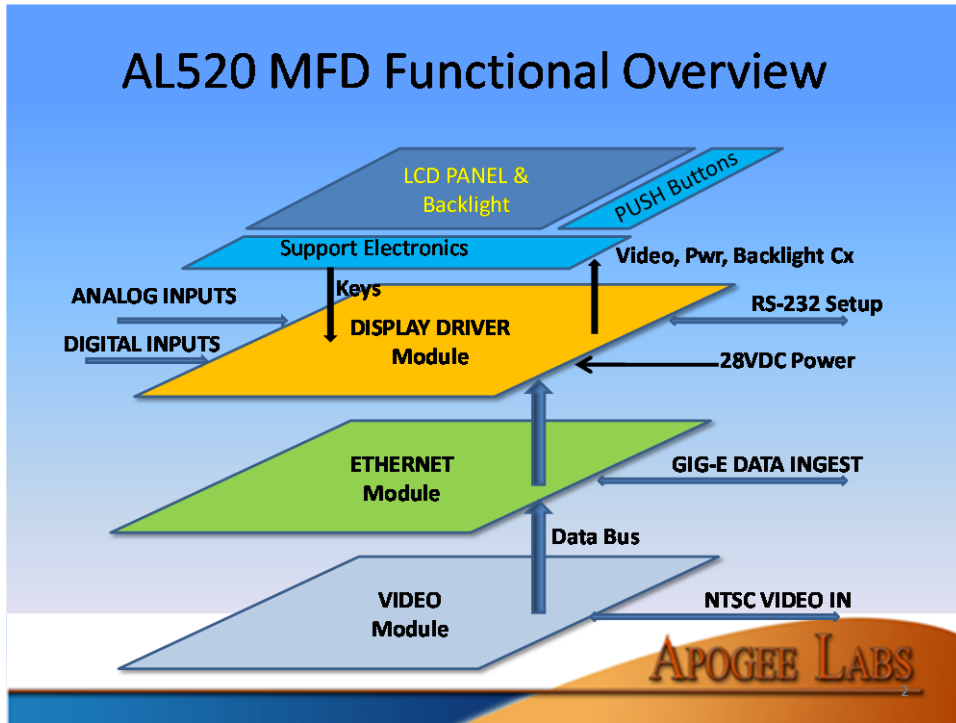


Figure 1: AL520 Functional Overview

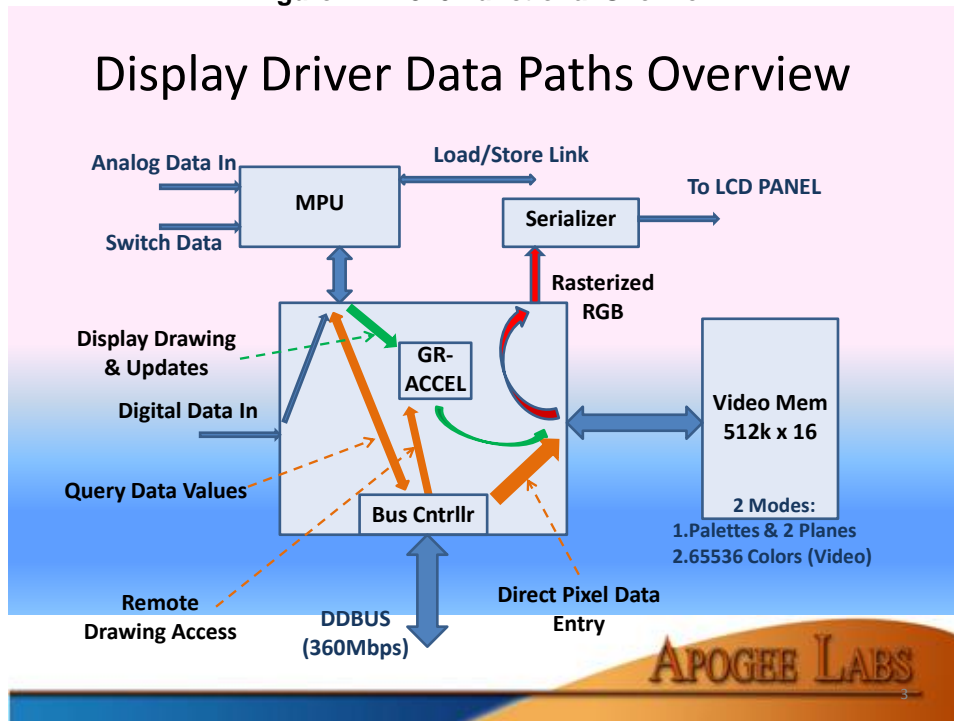


Figure 2: Display Driver Overview

## SECTION 2: UNIT INSTALLATION

### 2.1 Connectors and Pin Functionality

J1 – Input Power

MIL – 38999 Series III 6-Pin Male Bulkhead

Part # - D38999/20WB98PN

Pin #	Functionality
A	+28 VDC PRIMARY POWER INPUT (isolated from chassis and analog/digital grounds)
B	+28 VDC PRIMARY RETURN INPUT (isolated from chassis and analog/digital grounds)
C	CHASSIS GROUND (internally connected to the case only)
D	ANALOG / DIGITAL GROUND (internally connected to analog/digital ground )
E	+28 VDC SECONDARY POWER INPUT (isolated from chassis and analog/digital grounds)
F	+28 VDC SECONDARY RETURN INPUT (isolated from chassis and analog/digital grounds)

J2 – Base Board Input/ Output  
MIL – 38999 Series III 37-Pin Female Bulkhead  
**Part # - D38999/20D35SN**

Pin #	Functionality
1	ANALOG INPUT 1 (+)
2	ANALOG INPUT 1 (-) [internally connected to analog/digital ground]
3	ANALOG INPUT 2 (+)
4	ANALOG INPUT 2 (-) [internally connected to analog/digital ground]
5	ANALOG INPUT 3 (+)
6	ANALOG INPUT 3 (-) [internally connected to analog/digital ground]
7	ANALOG INPUT 4 (+)
8	ANALOG INPUT 4 (-) [internally connected to analog/digital ground]
9	ANALOG INPUT 5 (+)
10	ANALOG INPUT 5 (-) [internally connected to analog/digital ground]
11	ANALOG INPUT 6 (+)
12	ANALOG INPUT 6 (-) [internally connected to analog/digital ground]
13	ANALOG INPUT 7 (+)
14	ANALOG INPUT 7 (-) [internally connected to analog/digital ground]
15	ANALOG INPUT 8 (+)
16	ANALOG INPUT 8 (-) [internally connected to analog/digital ground]
17	ANALOG INPUT 9 (+)
18	ANALOG INPUT 9 (-) [internally connected to analog/digital ground]
19	ANALOG INPUT 10 (+)
20	ANALOG INPUT 10 (-) [internally connected to analog/digital ground]
21	ANALOG INPUT 11 (+)
22	ANALOG INPUT 11 (-) [internally connected to analog/digital ground]
23	ANALOG INPUT 12 (+)
24	ANALOG INPUT 12 (-) [internally connected to analog/digital ground]
25	DIGITAL INPUT / OUTPUT 1
26	DIGITAL RETURN [internally connected to analog/digital ground]
27	DIGITAL INPUT / OUTPUT 2
28	DIGITAL RETURN [internally connected to analog/digital ground]
29	DIGITAL INPUT / OUTPUT 3
30	DIGITAL RETURN [internally connected to analog/digital ground]
31	DIGITAL INPUT / OUTPUT 4
32	DIGITAL RETURN [internally connected to analog/digital ground]
33	RS-232 TxD [serial data output to the external programming terminal]
34	RS-232 RxD [serial data input from the external programming terminal]
35	RS-232 Ground [internally connected to analog/digital ground]
36	MAINTENANCE MODE PIN A ENABLE (shorting maintenance mode pins A & B puts unit in maintenance mode)
37	MAINTENANCE MODE PIN B ENABLE (shorting maintenance mode pins A & B puts unit in maintenance mode)

J3 – IEEE 802.3ab 1000 Base-T Ethernet (Option)  
MIL – 38999 Series III 8-Pin Female Bulkhead  
**Part # - D-GBE20W11-08SN**

Pin #	Functionality
1	BI_DA+ [Bi-directional pair A+ (16transceiver)]
2	BI_DA- [Bi-directional pair A- (16transceiver)]
3	BI_DB+ [Bi-directional pair B+ (receive)]
4	BI_DC+ [Bi-directional pair C+]
5	BI_DC- [Bi-directional pair C-]
6	BI_DB- [Bi-directional pair B- (receive)]
7	BI_DD+ [Bi-directional pair D+]
8	BI_DD- [Bi-directional pair D-]

J4 – NTSC Video Input (Option)  
75 OHM TNC FEMALE TO TNC FEMALE ISOLATED BULKHEAD  
**Part # - PE9625**

Pin #	Functionality
Center	NTSC VIDEO INPUT
Shell	NTSC VIDEO RETURN (isolated from chassis)

## 2.2 Maintenance Mode

Short pins 36 and 37 on J2 together to enable the Maintenance Mode. The Maintenance Mode provides two functions:

- I. The RS232 serial link can now be used for Setup of Display Pages
- II. A “MAINT” soft key appears on the lower right hand corner of the display. Pressing this button suspends normal page display operation and presents a new display of options.

Maintenance options:

- I. Displays the current unit Revision Code
- II. Provides a facility to monitor the data values from all 12 analog inputs
- III. Allows the RS232 link Baud Rate to be viewed & modified
- IV. Provides a facility to return the pages to a basic Factory Default Setting
- V. Provides a Memory Test
- VI. Return to Display Mode



## SECTION 3: DISPLAY PAGE PROGRAMMING

### 3.1 Serial Interface

An RS232 link provides the facility to develop, test, and program Display Pages into the AL520's nonvolatile memory. To activate this feature, the two Maintenance Pins on the 37 pin connector need to be connected together during the application of power to the unit.

Serial communications use a simple COMMAND/RESPONSE technique that allows both flow control and error detection. Users can develop their own program using the information contained in the following section, or purchase the APEX-C program which provides an easy to use GUI.

### 3.2 APEX-C User Interface Program

This program runs in the Microsoft 32 bit environment. It allows a user to create pages of displays, download to the AL520 to verify operation, and save the configurations to files for future reference, updates and download to other AL520 units. A typical display page under development appears as:

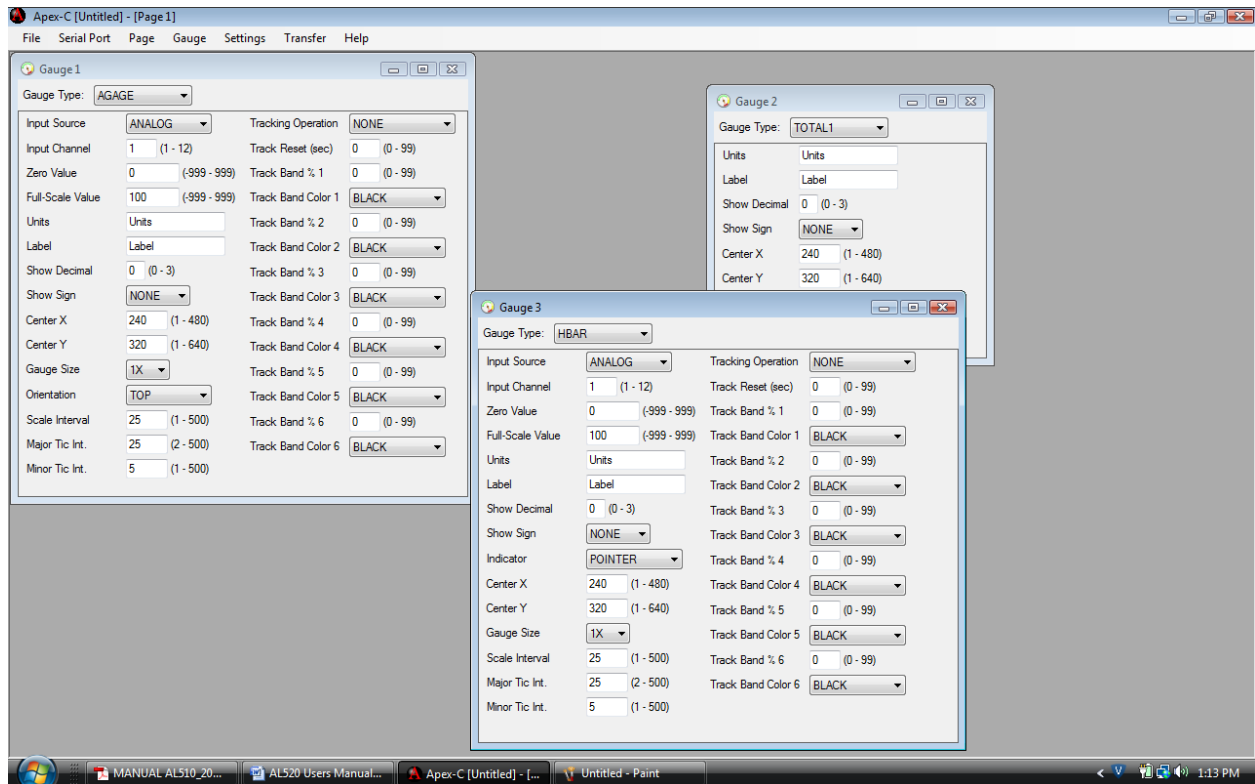


Figure 3: APEX-C User Interface

### 3.3 Gauge Guidelines

#### General

Setting up gauges can be separated into 5 areas:

- Gauge placement & data input selection
- Appearance
- Gauge Scaling
- Tic Marks
- Min/Max Tracking Operation

#### Gauge placement & data input selection

Refer to the following sections for information about placing the gauge using the CenterX & CenterY parameters. It is possible to use numbers that will cause gauges to overlap (sometimes desirable) and also to exceed the right, left, top or bottom boundaries of the display. Typically, using APEX-C, the first step is select a gage type, gage size (1x/2x if available), CenterX & CenterY positions, and then data source & channel number. Transfer this to the AL520 to verify the gauge appears at the proper position and is within boundaries.

#### Appearance

Select the indicator type (Sweep or Pointer) if available and enter the Units and Mnemonic (label) texts.

Although all negative numbers (on the Scale or Digital Values) will automatically be preceded with a MNUS sign, positive numbers can be shown with the PLUS sign either on or off. Select this as desired. Then transfer this to the AL520 to verify the gauge appears as desired.

#### Gauge Scaling

The 0 and +5Volt analog input values (or 0 and 1023 digital values) will correspond to the Zero and Full-Scale positions on the display. These can be “scaled” to represent any integer value between -999 and +999.

For example, if 0V input represents -20° C and +5V input represents +180° C, these could be entered directly as Value\_0 and Value\_FS. This results in a scale of 200 total “steps”. The Scale Interval parameter is then set to the number of steps between each “SCALE” number placed on the gauge. In this example, setting Scale Interval to 50 will result in values of -20, +30, +80,+130,+150 being displayed.

**NOTE: THE TOTAL NUMBER OF “STEPS” MUST BE AN INTEGER-MULTIPLE OF THE SCALE INTERVAL.**

In some cases, it would be appropriate to add a fixed decimal point. For example, a gauge may be driven by a signal that indicates values between -1.0 and +1.0. In this case, set Value\_0 = -100, Value\_FS=100, and set Show Decimal = 2.

### Tic Marks

Tic Marks are placed on the gauge's reference line at intervals selected by the Major and Minor Tic Interval parameters. The value for each is entered as the desired number of "steps" between each mark (see the preceding Gauge Scaling section for "step").

**NOTE: THE TOTAL NUMBER OF "STEPS" MUST BE AN INTEGER-MULTIPLE OF BOTH THE MAJOR AND MINOR TIC INTERVALS.**

For example, if the total steps were 100, Major Tic Int = 5 produces the wider Major Tic every 5 steps, while Minor Tic Int = 1 sets a small Tic mark every step. For small displays and large numbers of tic marks, the gauge can become too busy. Select these and transfer to the AL520 to verify the gauge appears as desired.

### Gauge Min/Max Tracking Operation

Most gauges support a MIN/MAX Tracking function. This is a wide line that follows the data excursions and can be color-coded in up to 6 segments between zero and full scale. Tracking can be operated in 4 modes:

- None (Show all the color bands, typically as warning or target ranges)
- Max Only (track from zero to the Maximum value reached)
- From Mid (track the Minimum and Maximum values reached, from the Mid-scale position)
- From Reset (track the Minimum and Maximum values reached, from the Value at the time the Reset pushbutton was activated)

In the case of the "NONE" mode, the tracking color bands will be displayed as soon as the gauge is drawn on the screen. In the other modes, the bands will be drawn as input values change.

Tracking bands are processed starting with Band number 1 and operate contiguously. That is, band 2 begins after the ending value of Band 1.

Set the Track Band for each segment to the ENDING % of Full Scale desired, NOT the data value or Scaled value.

**NOTE: THE BANDS END AT THE SET VALUE PLUS 1 (IE, 99 CAUSES THE BAND TO FILL OUT TO 100%)**

For each of the 6 "sub-bands", select the Track Band and Track Color. If less than 6 bands are desired, simply end the last desired band with a value of 99. All subsequent bands will be ignored.

It is suggested that the operating mode be set to NONE first and the starts & colors transferred to the AL520 to verify appearance.

Then set the Operating Mode as desired, along with the Track Reset value. The latter determines WHEN the gauge's tracking is reset to zero, mid or current values as described above. The Track Reset Value is set to 0 for None, and 1-99 otherwise. 1-98 represents 1 to 98 second intervals. 99 is the code for MANUAL RESET ONLY. All gauges on the page with 99 coded will be reset simultaneously

when the RESET pushbutton is depressed. When 1-98 seconds are selected, the RESET pushbutton has no effect on that gauge.

**A Gauge**

CenterX and CenterY refer to the center of the gauge.

Only the Pointer type of Indicator is available (sweep would obscure the Scale & Data values)

**B Gauge**

CenterY refers to the center of the gauge vertically.

CenterX refers to the pointer's origin horizontally

Only the Pointer type of Indicator is available.

**Horizontal Bar Gauge**

CenterX and CenterY refer to the Bottom Left Hand corner of the gauge.

**Vertical Bar Gauge**

CenterX and CenterY refer to the Bottom Left Hand corner of the gauge.

**Totalizer 1, Totalizer2**

CenterX refers to the Left Hand side of the gauge, and CenterY refers to the vertical center of the display.

There are only TWO Totalizers available since each has a dedicated set of digital input signals permanently assigned. These two can be placed on multiple pages, with different setup values (position, units, mnemonic, etc) but will all share the same Data Count and Min & Max values.

**Tether Hover Gauge**

CenterX and CenterY refer to the center of the gauge where the "bulls' eye" is located.

Channel 1 refers to the horizontal line input and tic marks.

Channel 2 refers to the vertical line input and tic marks.

Channel 3 refers to the Data Value display at the bottom of the display

### 3.4 Remote Commands

This section details how to implement each instruction command for programming.

Commands are formatted ASCII strings terminated by a <CR><LF> (0x0D 0x0A) character sequence. The remote computer must wait for a response before issuing another command. All commands are not case sensitive.

A remote control computer initiates an action by sending a command string. The AL520 attempts to act on that command and responds with <CR><LF> and either an acknowledge, > [right arrow]), or no acknowledge, ? [question mark] character, or the requested information in the case of a Read request.

Remote control is only active when the Maintenance Mode is enabled (refer to section II).

- All command strings end with a Line Feed (<LF>, \n)
- All commands result in an acknowledge (>) or negative (?) response
- Numbers default to DECIMAL, Hex values must be preceded by '0x'

The Standard Commands are outlined in the following paragraphs:

### 3.5 Standard Commands

**SET [Param]=[Value]<CR><LF>**

Change the selected parameter [Param] to [Value]. Note the space after the SET command.

Example: Set Pagenum=3<CR><LF>

This example selects the third page for subsequent commands.

**READ [Param]<CR><LF>** (sent TO AL520)  
[Field Name] [Value]<CR><LF>'>' (received FROM AL520)

Returns the value of the desired field, [Field Name].

Example: READ Pagenum<CR><LF>

Results in "PAGENUM 3<CR><LF>'>' being returned (notice the "ACK" terminator >).

### 3.6 Housekeeping Commands

#### **HELP<CR><LF>**

Help is a special case of the READ function: The response is a list of valid commands and arguments for the selected module. The first line of the response to the HELP command contains the module name and the version number of the imbedded software contained on the selected module.. The Parameter list, which follows, contains the type of field and acceptable values. The Field Type identifies the field as text (TXT), a decimal number (DEC) and the capability of the field being read / write (RW) or read-only (RO). The Acceptable Value(s), which follow, indicates allowable entries or status responses.

#### **FPUPDATE<CR><LF>**

Front Panel UPDATE causes the AL520 to update the current display shown on the front panel to reflect the current page configuration **IN MEMORY**. This is most often used to show the result of the last command(s) issued to change the appearance of a gauge to judge the result.

Instruction Set Matrix (where/when used)

Param	GENER AL	Used on Gauge Type ?					Comments
		A	B	Bar	Tether	Totalizer	
NUMPAGES	X						Set for this configuration once
NUMGAGES	X						Set for each page
AAVERAGE	X						Set for all analog inputs, all pages
PROGRAM	X						Commit or Recall pages from NVRAM
FACTORY_SET	X						Initialize all pages to Factory Default
DISPLAY	X						Turn off Display during downloads
PAGENUM	X						Select Page to work on
GAGENUM	X						Select Gage to work on
CHAN_NUM		=1	=1	=1	1-3	=1	Select channel within in Gauge
SUB_INDEX		1-6	1-6	1-6			Select Tracking BAND/Color index
GTYPE		X	X	X	X	X	Select type of Gauge
VALUE_0		X	X	X	CH 3		Select 0 Volt input Display Value
VALUE_FS		X	X	X	CH 3		Select +5Volt Full Scale Display Value
UNITS		X	X	X	CH 3	X	8 Character string for units
MNEMONIC		X	X	X	CH 3	X	8 Character string for "Label"
DECIMAL		X	X	X	CH 3	X	Number of zeroes to right of decimal pt
SIGN		X	X	X	CH 3	X	Force + sign for positive numbers
INDICATOR				X			Select Sweep/Piston vs Pointer type
CENTERX		X	X	X	X	X	Reference position, X value
CENTERY		X	X	X	X	X	Reference position, Y value
GSIZE		X	X	X			Gauge size, 1x or 2x
ORIENT		X					A-Gauge opening orientation
SCALE_INT		X	X	X	CH 3		Interval between Scale values displayed
TIC_MINOR		X	X	X	CH1& 2		Interval between minor Tic Marks
TIC_MAJOR		X	X	X	CH17 2		Interval between major Tick Marks
TRAK_OP		X	X	X			Tracking operation per gauge
TRAK_RST		X	X	X			Select Min/Max Tracking type
TRAK_BAND		X	X	X			Set End of tracking Band (in %)
TRAK_BCOLR		X	X	X			Set color of each Band
TOT_RSTVAL						X	Value to force Totalizer to when Reset

PARAMETER DESCRIPTIONS

Param	TYPE	Value Range	Comments
NUMPAGES	DEC	1 to 6	Number of Pages Available / Programmed
NUMGAGES	DEC	1 to 6	Number of Gages on current page
AAVERAGE	DEC	1 to 999	Number of 1milliSecond samples to average
PROGRAM	TXT	RECALL, COMMIT	Commit or Recall current PAGENUM from NVRAM
FACTORY_SET	TXT	OFF,SET	SET Initializes all 6 pages to Factory Default
DISPLAY	TXT	OFF,ON	Use to BLANK off all display
PAGENUM	DEC	1 to 6	Select Page to work on
GAGENUM	DEC	1 to 6	Select Gage to work on
CHAN_NUM	DEC	1 to 3	Select channel within in Gauge
SUB_INDEX	DEC	1 to 6	Select Tracking BAND/Color index
GTYPE	TXT	AGAGE, BGAGEL BGAGER, VBAR, HBAR, TETHER, TOTAL1 TOTAL2	Select type of Gauge
VALUE_0	DEC	-999 TO +999	Select 0 Volt input Display Value
VALUE_FS	DEC	-999 TO +999	Select +5Volt Full Scale Display Value
UNITS	STR	1-8 CHARS, NULL TERM'D	8 Character string for units
MNEMONIC	STR	1-8 CHARS, NULL TERM'D	8 Character string for "Label"
DECIMAL	DEC	0-3	Number of zeroes to right of decimal pt
SIGN	TXT	NONE,ON	Force + sign for positive numbers
INDICATOR	TXT	SWEEP, POINTER	Select Sweep/Piston vs Pointer type
CENTERX	DEC	1 TO 480	Reference position, X value
CENTERY	DEC	1 TO 640	Reference position, Y value
GSIZE	TXT	1X,2X	Gauge size, 1x or 2x
ORIENT	TXT	BOTTOM, TOP, RIGHT, LEFT	A-Gauge opening orientation
SCALE_INT	DEC	1 TO 500	Interval between Scale values displayed
TIC_MINOR	DEC	1 TO 500	Interval between minor Tic Marks
TIC_MAJOR	DEC	2 TO 500	Interval between major Tick Marks
TRAK_OP	TXT	NONE, MAX ONLY, FROM RST, FROM MID	Tracking operation per gauge
TRAK_RST	DEC	0 TO 99	0=None, 99=Manual only, 1-98=time in seconds
TRAK_BAND	DEC	0 TO 99	Set End of tracking Band (in %)
TRAK_BCOLR	TXT	BLACK, CYAN, REA, BLUE, YELLOW, GREEN, MAGENTA, WHITE	Set color of each Band
TOT_RSTVAL	DEC	-32768 TO +32767	Value to force Totalizer to when Reset



Where the TYPEs are defined as:

DEC : Decimal number

TXT : Selection of shown text strings

STR: a null terminated ASCII character string

Programming example (place a single Bar on the page)

```
Set pagenum=1          // set 1 Vertical Bar on the 1st page
Set gagenum=1
Set chan_num=1
Set sub_index=1
Set gtype=VBAR
Set input_src=analog  // use the analog channel #3 as data source
Set input_sel=3
Set average=10        // to prevent 'jitter', average 10 samples together
Set value_0=-10
Set value_fs=150      // setup to show -10 to +150 degrees C temp
Set Units=DegC
Set mnemonic=OAT
Set decimal=0         // no decimal places added
Set sign=none         // will automatically add the MINUS Sign to negative #'s, don't force PLUS signs
Set indicator=pointer
Set centerx=240       // place big gauge in middle of display
Set centery=320
Set gsize=2x
Set scale_int=40      // divide the 160 degree range into even number (4) of shown Scale values
Set tic_minor=4       // show minor tick marks every 5 degrees
Set tic_major=20      // show major tick marks every 20 degrees
Set trak_op=none
Set trak_rst=0
Set trak_band=30      // 1st band is 0-30%: red
Set trak_bcolr=red
Set sub_index=2
Set trak_band=72      // 2nd band is 31-72%: green
Set trak_bcolr=green
Set sub_index=3
Set trak_band=99      // 3rd band is 73-99%: red (last band)
Set trak_bcolr=red
Set program=commit    // store in memory
Fpupdate              // show resulting display
```

## SECTION 4: OPERATION

### 4.1 Keypad Operations

There are 26 pushbuttons around the perimeter of the display. The current AL520 only uses the bottom row as 'soft' keys. That is, they are not permanently labeled on the button itself, but labeled on the display immediate above them. From left to right they are:

<b>BRITE --</b>	<b>BRITE ++</b>	<b>PAGE DOWN</b>	<b>PAGE UP</b>	<b>(UNUSED)*1</b>	<b>RESET</b>
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\*1: When Maintenance Mode is enabled, this key becomes "MAINT"

Press the BRITE buttons to change the LCD display brightness. There are 15 steps of brightness provided. Holding down either key will cause the values to be changed every ½ second. Or, multiple depressions can be used. Either way, the PAGE button labels will be temporarily replaced with a bar graph of the brightness level as well as the digital value(1 to 15). With no activity for 1.5 seconds, the graph and digital value are removed.

Press the Page UP/DOWN buttons to select the next or previous Display page as stored in the unit's nonvolatile memory. The selection operates in a circular fashion and only the number of displays programmed can be selected (up to 6). Typical display update rate is 1-2 seconds depending on the number and complexity of the gauges.

Press the Reset button to reset any Totalizer display counts and the MIN/MAX Tracking rings on any gauges that were setup to use the manual reset. Note that this one pushbutton control all enabled resets simultaneously.

### 4.2 Power Turn On/Off Operations

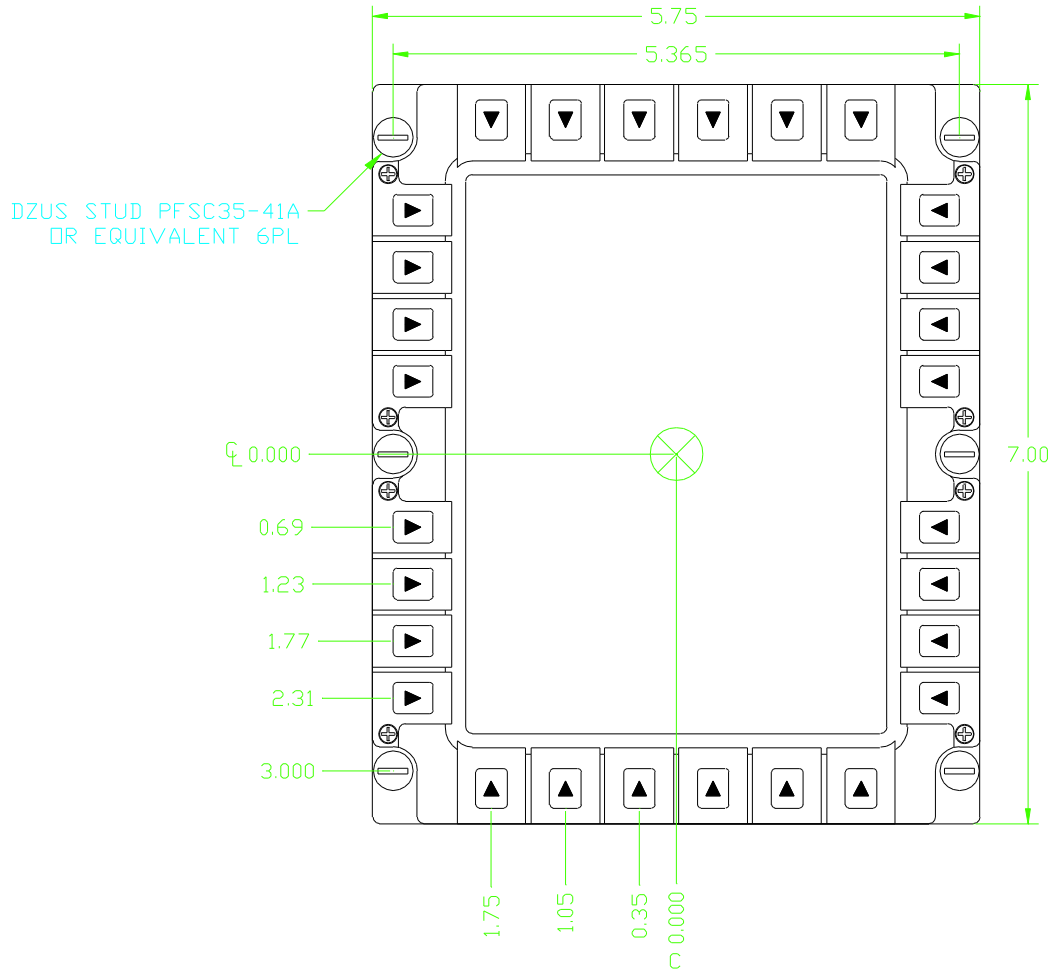
There is no Power On/Off control for the unit. It is designed to operate continuously once power is available. Nominal input voltage is 24VDC, but operation is maintained over the range of 18 to 36VDC. Thus "brownouts" due to poor power source regulation should not have an effect on the AL520.

A monitor circuit detects when the power has dropped below the 18 volt level and is presumably removed. The processor and its nonvolatile memory have a separate supply circuit capable of operation for approximately 75milliseconds, or twice the time needed to write the current TOTAL and MIN/MAX values from the two TOTALIZER type gauges. When power is restored, these values will be automatically loaded into those gauges.

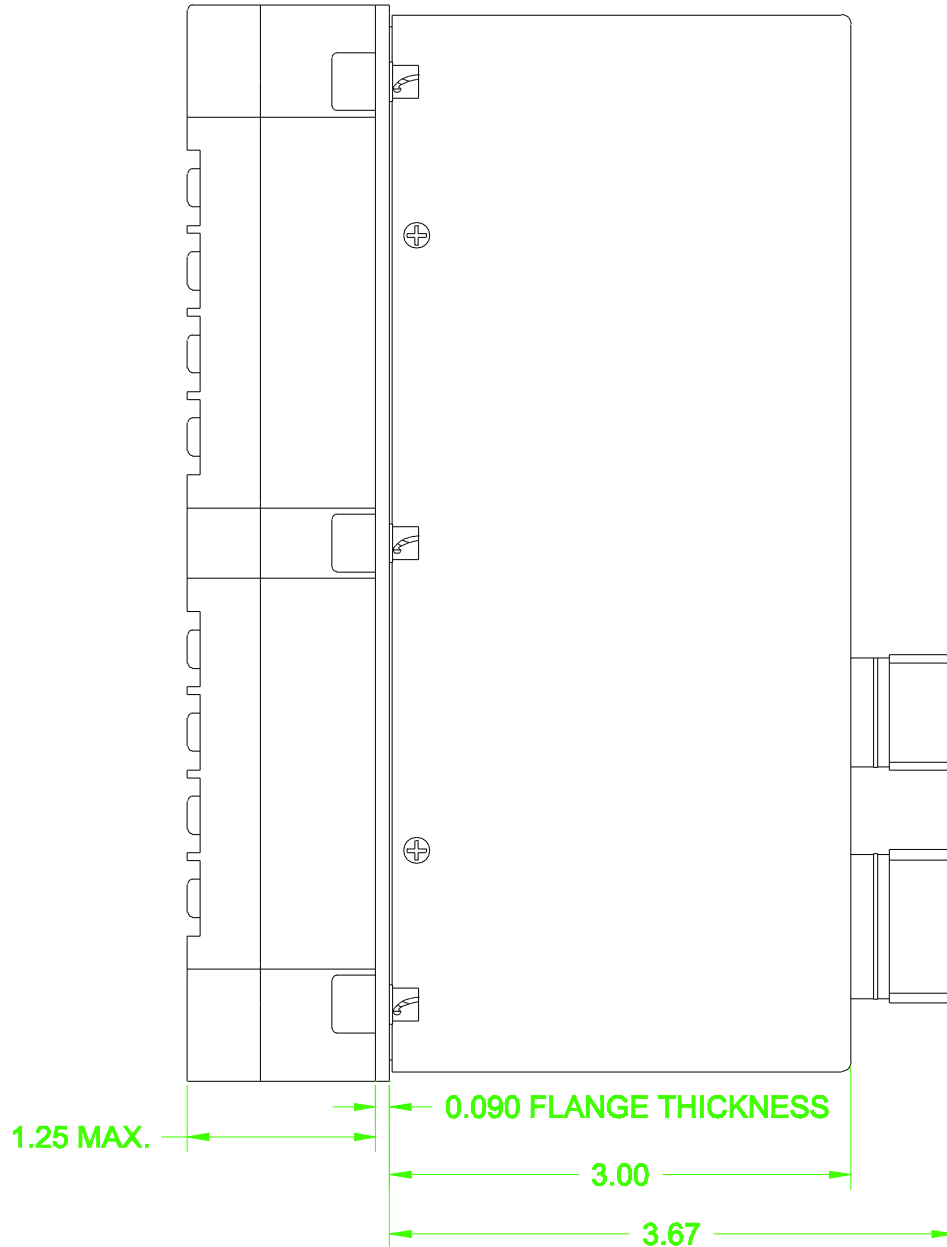
## 1. APPENDIX A

### 3.1 DRAWINGS

#### 1. Front



2. Side



3. REAR

