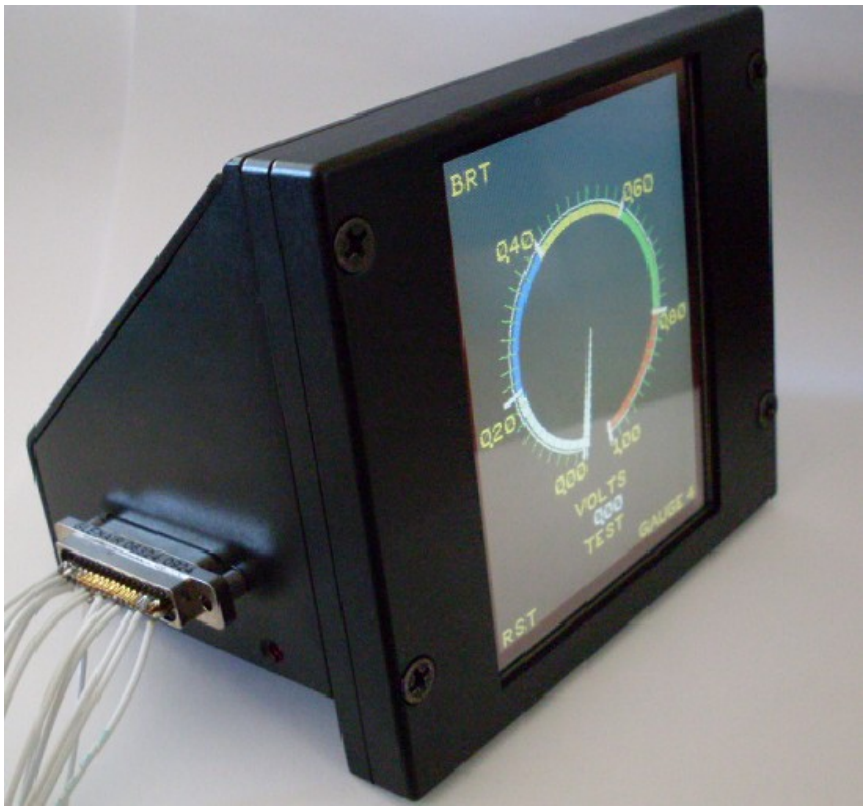
APOGEE LABS

INSTRUCTION MANUAL

For

MODEL AL511

UNIVERSAL INDICATOR DISPLAY



www.apogeelabs.com
210 South Third Street, North Wales, PA 19454
Ph. 215-699-2060

WARRANTY

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SECTION I

1.1 OVERVIEW

The AL511 Universal Indicator provides the user with a multi-instrument display combining a bright, high contrast TFT LCD touch screen display with a programmable data processing unit. The AL511 allows the user to program four display pages (in a laboratory environment before actual flight) for instrument type, measurement ranges, and descriptors . The AL511 is packaged in wedge shaped configuration which includes tapped mounting holes along the bottom edge for attachment purposes. Users select 1 of the 4 configured display pages and at any time can elect to change to any of the other displays in memory. The displays can be independently driven by any of the four analog (0-5V) inputs. The data is displayed as either a 'sweep' or a single pointer along with a digital readout. The AL511 also provides Max and Max/Min hold functions and programmable arch band colors (green, yellow, or red for example). After one series of flight tests are completed, the display can be reprogrammed to support the next set of tests. This eliminates the need to buy unique, specialized displays on a per mission basis.

1.2 SPECIFICATIONS

MECHANICAL

- ◊ Wedge Shaped design Customized
- ◊ Maximum depth of 3" behind panel
- ◊ 4each 6-32 screws, 2 on each side for hard mounting
- ◊ Front bezel maximum of 0.5" depth, 3.5" across
- ◊ Weighs less than 5 pounds

ENVIRONMENTAL

- ◊ Temperature: -30°C to 70°C operating
- ◊ Humidity: 95% non-condensing
- ◊ Altitude: 0 to 70,000 feet
- ◊ Orientation: Unit is capable of operating when mounted in any orientation

ELECTRICAL

- ◊ Input Power: +18VDC to 36VDC, 300mA
- ◊ Power Consumption: 12 watts maximum
- ◊ Power Interruption: Resumes operation within 15 seconds of reapplication of power
- ◊ Connector: GLENAIR M83513/13-F01NP
- ◊

DISPLAY CHARACTERISTICS

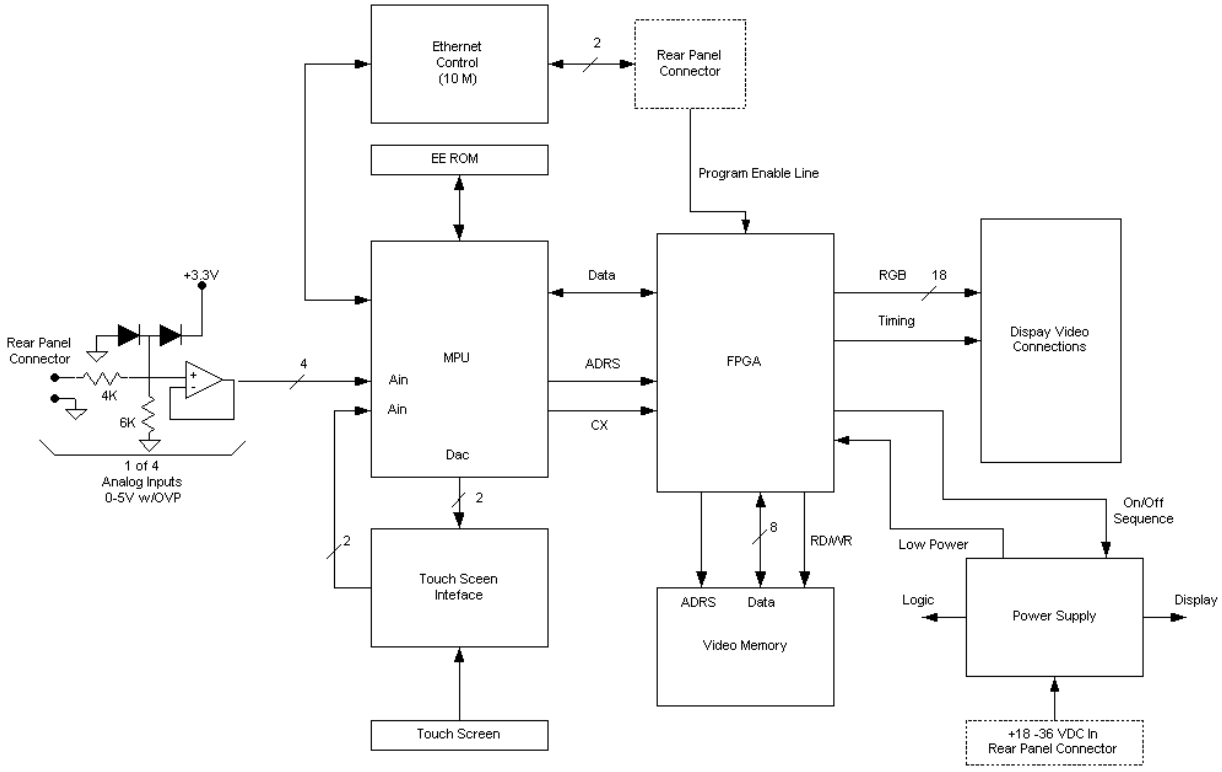
- ◊ Input: Analog DC Voltage 0 to +5VDC
- ◊ Discrete Control: At least four setup configurations (pages) via hand selection on front panel
- ◊ Update Rate: ≥ 30 frames per second
- ◊ Sunlight Readable
- ◊ Resolution: 240 x 160 pixels
- ◊ Number of Colors: 8 colors per display page

1.3 TECHNICAL OVERVIEW

Figure 1 presents the Functional Block Diagram for the AL511 Display unit while Figure 2 provides additional detail of the FPGA 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 an 8-bit Microprocessor Unit (MPU) with a high performance Field Programmable Gate Array (FPGA) to create user defined displays of analog data on a 3" diameter LCD color display in formats approximating circular gauges found in aircraft control panels. Using the RS-232 remote control, the user pre-defines a set of 4 displays. The type, operation, and graphic parameters are stored in the EEROM. In normal operation, the RS-232 interface will not be connected. On 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.



AL510 Functional Block Diagram

Figure 1

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. 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. Instead, each "Graphic Item" (GI) is represented in the video memory as a list of x-y coordinates. In real-time, the MPU need only set or reset one control byte for the entire GI.

The MPU also contains a multiplexed analog to digital converter (ADC) which supports both the analog input signal acquisition and reading of the LCD's touch screen. 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 Min/Max display range) and issues the appropriate GI On/Off command bytes to the FPGA. 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 30 times a second. This is important so that the MIN/MAX capture function will not miss values.

The MPU also provides two digital to analog converters which it uses to 'scan' the Touch Screen (TS) interface. The TS is a resistive, x-y type of interface. The MPU firmware scans the TS to detect when the user is touching the display and divides the screen into 4 quadrants. The firmware debounces the analog input voltages corresponding to the position touched and then processes the selected operation. One hardware-supported operation is DIM/BRITE. The MPU writes a control word to the FPGA which accordingly changes the PWM duty cycle to the LED's backlight power supply thus controlling display brightness.

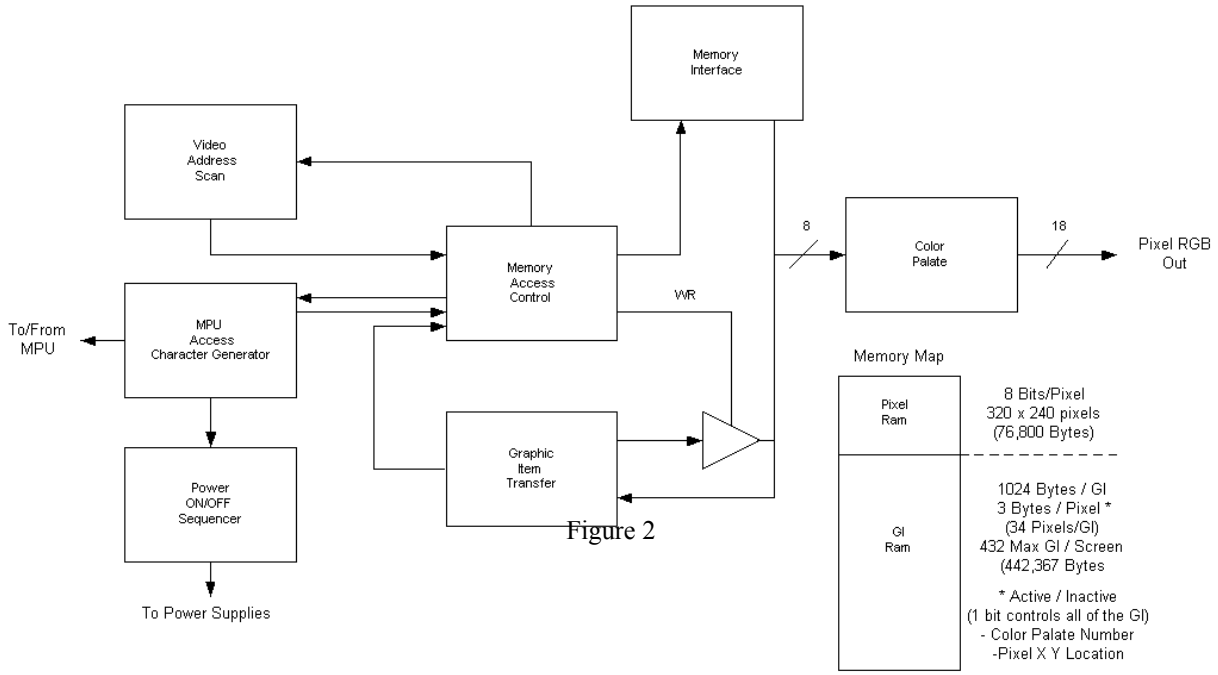


Figure 2

FPGA FUNCTIONAL BLOCK DIAGRAM

SECTION II

2.1 UNIT INSTALLATION

The AL511 is designed to fit a custom application. A customer provided mating bracket is required to adapt the four mounting holes, two on each side, provided on the AL511.

Figure 3

Electrically all I/O is via a 37 pin GLENAIR connector part number M83513/13-F01NP. The connector pin out is listed below: Note: All Signal Return lines are tied together.

I/O connector Pin Number	Function
1	Signal Return
24	Signal Return
26,27,28	Signal Return
4	ANA_CHAN_1
5	GND
22	ANA_CHAN_2
23	GND
3	ANA_CHAN_3
2	GND
21	ANA_CHAN_4
20	GND
13	PROG_EN_1
12	PROG_EN_2
14	GND
7	RS-232 RX
8	RS-232 TX
9	TTL_CLK_INPUT
10	TTL_DATA_INPUT
29,30,31	Signal Return
14,32,33	Signal Return
19	TTL_CLK_INPUT
17,35,36	GROUND EARTH
15,16,34	POWER (-)
18,19,37	POWER (+)

SECTION III

3.1 CONNECTING TO THE AL511

The AL511 is programmable via RS-232 with a fixed setting of 57600, 8 Data Bits, No Parity, 1 Stop Bit and No Flow Control. To put the AL511 in the programming mode, pins 12 and 13 on the rear panel connector must be shorted together.

3.2 AL511 INSTRUCTION SET

Communication with the AL511 can be accomplished by way of a command line interface, user generated program, or with Apogee Labs' APEX-C software package. The commands used by the remote control interface are simple ASCII sequences. Commands are not case sensitive and are terminated by a carriage return character.

INSTRUCTION	TYPE	ACTION	RANGE	DESCRIPTION
DISPLAY TYPE	Text	READ WRITE	A,B,TOT,HOV, BAR,TAB	DEFINES the GAUGE TYPR A—Single Analog B– DUAL ANALOG TOT—Totalizer HOV—Tether Hover BAR—Bar Gauge TaB—Tabular
DISPLAY INDEX	TEXT	READ WRITE	1,2,3,4	DEFINES the current channel under configuration. Used in multichannel gauges
BARON	TEXT	READ WRITE	1,2	Sets the DISPLAY TYPE BAR to either one or two.
ORIENT	Text	Read Write	BOTTOM, TOP, LEFT, RIGHT	Defines the location of the opening in the Display Arch
TRACKING	Text	Read Write	NONE, MAX ONLY, FROM RST, FROM MID	Defines how the Arch bands function: None – Arch bands are static on the display Max only – Arch bands are draw from the current value to the Max value received
PEAK RESET	Decimal	Read Write	00, 99	Defines when the Arch bands are up-dated and redrawn. 0 – Disables reset 1 to 98 – seconds until arch bands are redrawn 99 – Manual front panel rest
DECIMALS	Decimal	Read Write	0, 3	Defines the number of decimal places used to display values
SIGN	Text	Read Write	NONE, ON	When set to "ON" Values are displayed with "+" or "-" indicators

LOW VALUE	Decimal	Read Write	-999, 999	Sets the starting value of the display
HIGH VALUE	Decimal	Read Write	-999, 999	Sets the end value of the display
INTERVAL (Minor Ticks)	Decimal	Read Write	001, 512	Sets the interval between Tick marks with numerical values
TICK MARKS: (Major Ticks)	Decimal	Read Write	000, 999	Set the interval between tick marks without numerical values
INPUT SEL	Decimal	Read Write	1, 4	Selects the input channel to be used.
AVERAGE	Decimal	Read Write	000, 100	Sets the numbers of measurements to be average prior to updating the display
INDICATOR	Text	Read Write	ARC, POINTER	Selects the indicator type. Arch type fills in the area from the start of the arch to the current value.
UNITS	String	Read Write	0,8	User settable eight character string displayed above the current value field
MNEMONIC	String	Read Write	0,8	User settable eight character string displayed below the current value field
STARTn n=1,2,3,4,5,6	Decimal	Read Write	00, 99	Sets the start point of Arch band 1. The value is set in percent of the Display arch to start from. Setting this value to 50 would start the arch at the middle of the display arch.
COLORn n=1,2,3,4,5,6	Text	Read Write	DK_BLU, GREEN, BLUE, YELLOW,GREY, RED, WHITE	Sets the color to be used for the selected arch.
PROGRAM	Text	Read Write	EDIT, RECALL, COMMIT	This sets the programming mode. Default mode is Edit when the programming pins are jumpered together. Commit is used to move the temporary working memory into nonvolatile memory. Recall moves the nonvolatile memory into the temporary working memory.
COPY CHNL	Text	Read Write	1, 2, 3, 4	Copy the settings from another channel into the current channel. Note: the information copied needs to be committed nonvolatile memory
FACTORY SET	Text	Read Write	OFF, SET	Resets the displays to factory default settings. Note: After being reset the touch screen needs to be recalibrated
TS VALUES	Decimal	Read Write	00000, 65535	Displays the current value of the touch screen. This is used to calibrate the touch screen.

SECTION III

3.3 REMOTE CONTROL COMMAND RESPONSE

All commands are terminated with a carriage return. A response will always occur when a command is issued. The response of a properly formatted command will end with a ">" and when an invalid instruction is issued, the response is a question mark "?". A valid response is prefaced with the value "set" or "read". i.e. The command "set color5=Green" results in the flowing response:

COLOR5: GREEN

>

3.4 HELP COMMAND

After issuing the SLOT=n command to address the module, issuing the HELP command results in the listing shown in Table 8. This is a list of all instructions and their character that are associated with the Gauges. Each item in the list reveals an instruction and the characteristics of its associated information. The syntax of the listings is:<instruction>, <value type>, <action>, <value>, <value>, … <value>. From this information, the user is able to determine the type of parameter and the range of values that are assignable to each instruction. The definition of each field in the HELP instruction listing is:

<instruction>: The name of the instruction, such as Color5 delimited by a colon

<value type>, Defines the type of information associated with the instruction, such as DEC for decimal number, TXT for fixed text value, and STR for non fixed text values .

<action>, Identifies the instruction as being capable of read-only (RO) or read / write (RW).

<value>, The "value(s)" are a list or range of entries that are acceptable to the instruction. In the case of the TS VALUES: DEC, RW, ,00000, 65535 equates to a acceptable value range of between 0 and 65535 decimal.

3.5 SET COMMAND

To write a value into a parameter register, the instruction is preceded by the SET command followed by a space. For example, to change the color of Arch1 of the display, the instruction takes the form: SET COLOR1=RED <CR>. Where: "SET" specifies a write operation, "BIT RATE" is the instruction that is to be changed, "=" is the delimiter between the instruction name and the value, "RED" is the text value to be written, <CR> symbolizes the carriage return terminator. Upon successfully executing the command, the unit echoes the result in the form: COLOR1:RED > where ">" is the system command line cursor.

3.6 READ COMMAND

Interrogating a parameter is accomplished using the READ command. The format of a READ is: READ <instruction> <CR>. If the command is successful, the parameter name and its value are returned followed by a carriage return and the ">" symbol.

3.7 SYSTEM LEVEL COMMANDS

Some commands stand-alone. These are listed in the table below and are accessed via the "Commands" instruction.

INSTRUCTION	MEANING
SLOT	Lists the current slot in use.
List Slots	List the slots available in the unit. This is fixed in the AL511 and returns the following values. SLOTS 01 - CHANNEL1, AL511, 1.0 02 - CHANNEL2, AL511, 1.0 03 - CHANNEL3, AL511, 1.0 04 - CHANNEL4, AL511, 1.0
SLOT=n	Selects the slot location to be accessed
READ aaa	Is the read command
SET aaa=xx	Is the write command
FPUpdate	Refreshes the display using currnet values. Note: the Programm=Commit commands must be issued prior to changing the slot in order to save the settings.
Quit Exit	Closes the Socket connection. Note: "Quit" or "Exit" can be used to close the connection.

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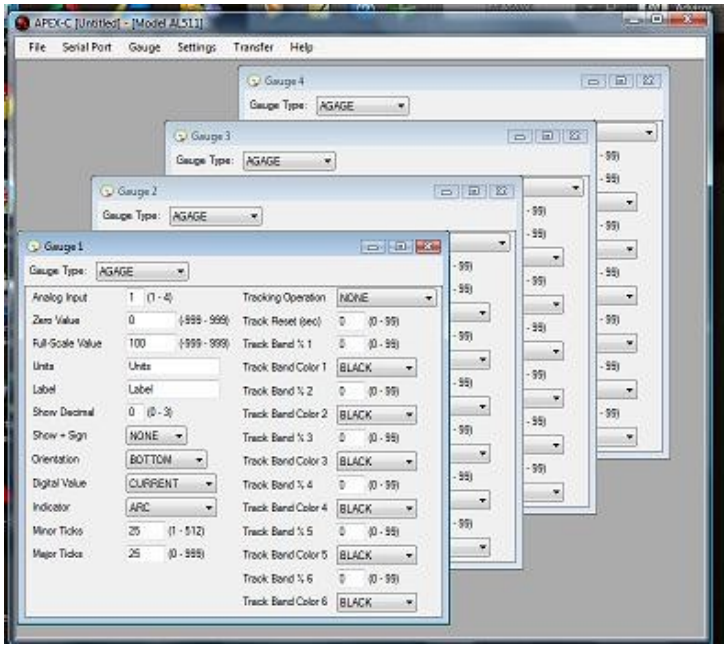
3.8 APEX PROGRAMMING

Programming of the unit is simplified through the use of the Apogee Labs' APEX-C remote control software.

1) After starting the APEX software, select Settings/AL511, the following screen will appear.



2) File menu used to

1. Begin a new configuration
2. Open a saved configuration
3. Import the configuration of the currently connected AL511 to APEX-C
4. Save the current configuration to the same configuration name on the PC
5. Save the current configuration as a new name on the PC
6. Exit the program

These commands to not change the saved configurations in the AL511 memory. See Transfer Command

3) Serial Port menu - Used to select the Comm. Port connected to the AL511

4) Gauge—used to copy gauges amongst each other, menu driven. This menu also provides appearance configuration.
The Gauge command does not change the saved configurations in the AL511 memory. See Transfer Command

5)Transfer menu—Used to write data into the volatile and non-volatile memory of the AL511

1) Transfer Gauge “N” to Display, where N is the current Gauge
   Transfers to volatile memory the currently selected gauge. Settings are not saved if the unit is powered off
2) Recall Gauge “N” on Display, where N is the current Gauge
   Transfers the contents of the current display in volatile memory from the display to APEX-C
3) Transfer and Commit Gauge “N” to Display, where N is the current Gauge
   Transfers to non-volatile memory the currently selected gauge.
4) Transfer and commit ALL Gauges to Display
   Transfers to NON-VOLTILE memory all 4 gauges as displayed on APEX-C

6)HELP

APEX Revision Information

The APEX-C software is a GUI based software package the utilizes the command protocol of the AL511 in easy to use windows.
When started the user is presented with 4 windows that correspond to the 4 gauge screens. The user can modify any or all gauges, load them individually or all at once. The user can save the configurations to a file to load into other AL511 units. Pull downs and direct entry boxes simplify the process.

All value settings are on a per channel basis and fully independent of the other channel(s) configurations. (i.e. Display channels can all be set to use the same or different input channels.)

The front panel can be used to display the 4 gauge selection page and to control brightness.

SECTION IV

4.1 MAIN DISPLAY OPERATION

The AL511 will boot to the Channel displayed when unit was powered off. At this point, the unit is fully functional. The only user configuration allowed when in the operational mode is via the front panel touch screen. The touch screen is divided evenly into four buttons. They are fixed in location and function. See Figure 4 below. The four buttons on the main displays are: BRT, Display Briteness Bar (Hidden Key), RST and GUAGE

Figure 4

BRT causes the display to get progressively brighter. After maximum brightness, the unit will rollover to minimum brightness. Values are 1-15 with 15 being brightest. Touching the top right area of a gauge will display the brightness bar and value.

.RST Peak depends on the tracking and peak rest configuration and will manually reset the maximum values color bands.

GAUGE takes the user to the Display Channel selection page.

The Channel selection page (Figure 5) is divided into four sections and pressing anywhere in the requested channel descriptor for approximately one second will display the indicator configured for that channel.

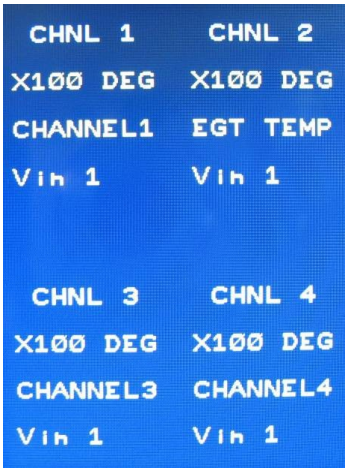


Figure 5