Table of Contents

NOTE TO THE OPERATOR

The µMONITOR manuals are open to revision based on your needs. If you have suggestions for improvement or clarification, please write or call.

Rocky Mountain Instrument · PO Box 683 · 202 Fremont Street · Thermopolis, WY 82443
Phone (307) 864-9300 · Fax (307) 864-9264 · techsupport@rkymtn.com

Description

The µMONITOR is a microprocessor controlled engine monitor for four and six cylinder aircraft engines. The Greek symbol µ (mu) represents the word micro in electronics. µMONITOR is pronounced micro-MONITOR.

The µMONITOR, in one compact instrument, continuously monitors and displays all of the usual engine functions in a digital format. All critical engine functions have user selected alarm points. Any of the critical functions that are out of limits will blink on the display and an audio alarm will sound. Besides the 90db+ external alarm, the unit provides a 600-ohm audio output for audio input direct to the headphones.

There are additional features that complement the µMONITOR such as a multifunction clock and user defined alarm inputs for such items as gear or canopy warning.

The µMONITOR uses a nonvolatile memory to store information during shutdowns. All user programmed settings for the unit, and totals of certain other functions are stored in nonvolatile memory. These settings and totals include LMT/GMT difference, timer, flight time, tachtime, fuel remaining, backlighting intensity, sensor calibration factors, alarm set points and extra features data in addition to other necessary information. The type of nonvolatile memory used does not require a battery and will retain data for a minimum of 10 years.

The µMONITOR has a float-charging circuit and connections for an optional external gel-cell battery. This will operate the instrument for eight to 10 hours in case of electrical failure. The unit will operate on 12 or 24 volts electrical systems.

All alarm settings, calibration, backlighting intensity and other programming are performed using front panel controls and can be done without removing the unit from the instrument panel.

Functions Provided

The following table lists the µMONITOR's functions along with the upper and lower range limits and alarms provided for:

function	range	alarm
OIL PRESSURE	0 to 99 psi	LOW
FUEL PRESSURE	0 to 31 psi ***note4**	LOW
MANIFOLD PRESSURE	10.0 to 51.0 inhg	HI
OIL TEMPERATURE	-9 to +150 °C	HI
CYLINDER TEMPERATURE	0 to 500 °C	HI
EXHAUST GAS TEMPERATURE	0 to 999 °C	NONE
CARBURETOR TEMPERATURE	-19 to +19 °C	LO
OUTSIDE AIR TEMPERATURE	-50 to +150 °C ***note2**	NONE
AMMETER	-9 to +75 amp	LO
VOLTMETER	0 to 39.9 V ***note1**	NONE
TACHOMETER	0 to 4500 RPM 4 cyl ***note3** 0 to 3000 RPM 6 cyl	HI
FUEL FLOW	.6 to 60 GPH	NONE
FUEL QUANTITY REMAINING	0 to 99.9 gal (0 to 999 liters optional)	LO
GMT	0 to 2359.9	NONE
LMT	0 to 2359.9	NONE
TIMER	0 to 59.9 min	AT '0'
FLIGHT TIME	0 to 25.5 hr	NONE
TACH TIME	0 to 6553.5 hr	NONE
ENDURANCE	0 to 99.9 hr ***note1**	NONE

USER FUNCTION #1	SWITCH CLOSE
USER FUNCTION #2	SWITCH CLOSE
USER FUNCTION #3	SWITCH CLOSE

***note1:** Voltage and endurance are only displayed when the **[SIL/VOLT]** button is pressed and held in. The voltage then appears in the **GAL** position of the display and the endurance appears in the clock position of the display.

***note2:** Outside air temperature is displayed when the **[SIL/VOLT]** button is pressed and held in. If manifold pressure is not installed, the outside air temperature can be displayed continuously by setting the OAT flag on (see PROGRAMMING EXTRA FEATURES in the operations manual). When displayed, the outside air temperature appears in the **MAP** (manifold pressure) position of the display.

***note3:** Tachometer will operate to 7500 RPM. The limits shown are the maximum that resolution of every 10 RPMs will always display. Over these limits, RPM resolution will become larger. For example: 5110 - 5120 - 5130 - 5150 or 7100 - 7120 - 7150.

***note4:** Optional 0 to 99 psi for high pressure fuel systems.

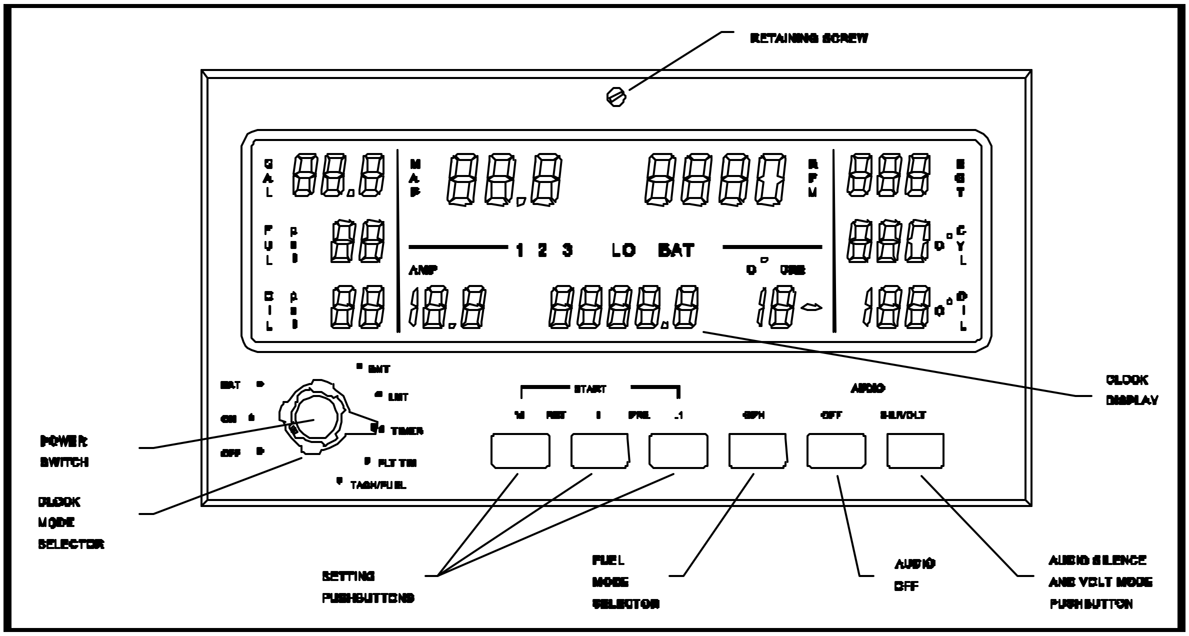
Technical Characteristics

specification	characteristic
Electrical:	a. All solid state using CMOS integrated circuits b. Electronically controlled by an 8 bit microprocessor c. Large digit liquid crystal display
Panel height:	3.25 inches
Panel width:	6.31 inches
Overall dimensions: (including mounting tray and connectors)	
Depth from back of faceplate:	4.5 inches (add apx 1 inch for wiring)
Width:	6.31 inches face 6.25 inches mounting tray
Height:	3.25 inches
Weight:	1.5 pounds (no senders or wiring)
Power requirements:	12-31VDC at 1.8AMP max, 150ma typical
Clock power requirements:	8-31VDC at 140/280 µAMP @ 12/24 VDC
Cooling:	Forced air cooling not required
Audio output:	200mw into 600 ohm load @ max volume
Operating temperature:	-15 to 50 C (-45 to 65 C storage)
Operating altitude:	0-30,000 feet
External backup battery (optional)	12 VDC 1.2 amphour gel-cell Powersonics PS1212, YUASA NP1.2-12 or equal

Operating Controls

The operating controls are of two types, rotary switches and pushbutton switches.

The power switch and the clock mode selector are rotary switches. The indicator lines on the knobs align with the desired mode that is printed on the panel.



The gray pushbuttons are momentary switches that have to be held in to accomplish their function. The two yellow pushbuttons are push-push switches that alternately lock in when pushed and then release when pushed again. When either yellow pushbutton is 'in' it activates the function that is printed directly above it.

Power Switch

When the power switch is positioned at **ON** the unit is powered by the master bus. Also, the optional external gel-cell battery (<u>if installed</u>) is being charged whenever the bus voltage is above 13.7 volts. On 28 volt aircraft systems, the external battery is charging whenever the unit is in the **ON** position. On 14 volt aircraft systems, the external battery charges only when the engine is running. An internal circuit in the µMONITOR maintains the external battery in a float charge condition, so high bus voltage will not harm the battery.

When the power switch is positioned at **BAT** the unit is powered by the external battery (<u>if installed</u>). The unit will operate for 8 to 10 hours when powered by the external battery if it is in a full charge state. The **BAT** legend on the display blinks as a reminder that the external battery is being used. When the external battery voltage drops to approximately 1 hour of use remaining, the alarm sounds and the **LO** legend on the display will blink along with the **BAT** legend.

Because of the low power consumption of the µMONITOR, most users will elect to not install the optional battery. Even in the case of a failed alternator, the unit does not discharge the aircraft battery significantly enough to warrant turning it off.

NOTE: If the external battery is a size other than specified (1.2 amp hours), divide the amp hour rating of the battery by the .120/.240 amps (14v/28v) required by the µMONITOR to obtain the approximate number of hours the unit will operate when the power switch is in the **BAT** position.

The most handy feature of the optional external battery is using the **BAT** position for turning the unit on without the master switch to read tachtime, flight time etc.

Alarms

The µMONITOR has both an audio and visual alarm indication for any function that is out of limits. There are some functions that do not provide for an alarm; i.e. VOLT. Refer to the list in the FUNCTIONS PROVIDED section on page 1. The function that is out of limits will blink on the display, and an audio alarm will pulse. The audio alarm is a 90db+ unit mounted in the cockpit. The µMONITOR also has a 600 ohm audio output with volume control for input to a headset. Whenever the term 'audio' is used in this manual, it applies to both headset and cockpit audio alarms.

The visual blinking will continue as long as the function is out of limits. The audio may be silenced by momentarily pressing the **[AUDIO SIL/VOLT]** button. Any further alarm conditions will again sound the audio. The **[AUDIO OFF]** pushbutton also disables the audio but has the feature of locking in. This pushbutton is locked in before turning on the µMONITOR and starting the engine because of the certainty of alarms before and during engine start.

To reduce the possibility of an intermittent alarm, the unit will not activate the alarm for most functions unless the function has been continuously out of limits for 5 seconds.

AUDIO OFF PUSHBUTTON - The **[AUDIO OFF]** pushbutton is a push-push type switch. When the pushbutton is in the 'in' position the audio portion of the alarm is shut off. Any alarm condition that occurs will still blink the display, but there will be no sound. This pushbutton should be 'in' before turning on the µMONITOR to prevent annoying alarms before engine start and should be 'out' before takeoff (refer to CHECKLIST section on page 19).

AUDIO SILENCE PUSHBUTTON - The **[AUDIO SIL/VOLT]** switch, when momentarily pushed will stop the audio after an alarm condition has been activated. The function that is out of limits can then be identified by the blinking display. The display will stop blinking when the function that is out of limits returns to normal. If a function returns to normal before the **[AUDIO SIL/VOLT]** (or **[AUDIO OFF]**) pushbutton is pushed, the audio will still have to be manually cancelled.

This switch also displays the three additional functions (VOLTS, OUTSIDE AIR TEMPERATURE and ENDURANCE) in the place of normal display readouts when pushed. Refer to those additional function's sections.

Fuel Mode Pushbutton

The **[GPH]** pushbutton controls whether the fuel portion of the display shows GPH or fuel remaining. In the 'in' position the display will show gallons per hour, in the 'out' position the display will show fuel quantity remaining.

Setting Pushbuttons

The three setting pushbuttons change the current value of whatever mode is selected by the rotary CLOCK MODE switch. The pushbuttons are used singly or in various combinations to perform certain changes. The three pushbuttons are the ten **[10]**, one **[1]**, and tenth **[.1]** buttons. The action performed by each depends on the mode selected and will be described in the instructions for each of the modes.

The reset command **[RST]** can be activated by pushing both the **[10]** and **[1]** pushbuttons at the same time. The buttons are close enough together so that both buttons can be pushed with one finger by aiming at the **[RST]** between the buttons.

The preload command **[PRE]** can be activated in the same manner by pushing the **[1]** and **[.1]** buttons at the same time.

The start command **[START]** is activated by pressing the **[10]** and **[.1]** buttons at the same time. The bar extending on either side of **[START]** is a pointer to the proper two buttons.

Clock Mode Switch

The clock mode switch selects which time related function is displayed in the clock portion of the display. The function selected can also be changed using the setting pushbuttons as explained in the following sections.

GMT - When the clock mode switch is positioned to **GMT**, the clock portion of the display shows Greenwich Mean Time. The display is in a 24 hour mode and will roll over from 23 hours 59.9 minutes back to 0000.0. The smallest time division is one tenth of a minute, or six seconds.

When the clock mode switch is in this position the **[10]** pushbutton will advance the hours and the **[1]** pushbutton will advance the minutes. If the **[10]** pushbutton is held down, the hours will continue to advance at a rate of one count per 1/2 second to the limit of 23 hours and then roll over to zero.

If the **[1]** pushbutton is held down, the minutes will continue to advance at a rate of one count per 1/2 second to the limit of 59 minutes and then roll over to zero (does not increment hours). The tenths of minutes is reset to zero every time a one is added to the minutes. To accurately set the tenths, adjust the minutes using the **[1]** pushbutton until the minutes equal the reference clock minutes, then when the reference clock rolls over to the next minute, add a minute to the µMONITOR. Adding the last minute will also reset the tenths to zero, which now matches the reference clock.

No other pushbutton or pushbutton combination is effective in this mode.

If the installation has provided for a direct connection to the aircraft battery for the internal clock, proper time will always be available.

LMT - When the clock mode switch is positioned to **LMT**, the clock portion of the display indicates Local Mean Time. The display is in a 24 hour mode and will roll over from 23 hours 59.9 minutes back to 0000.0. The smallest time division is one tenth of a minute, or six seconds.

The computer only maintains one time... GMT. To display LMT the computer subtracts an hourly difference from GMT. When the clock mode switch is in this position, the **[10]** pushbutton changes this hourly difference. If the **[10]** pushbutton is held down, the hours will decrease at the rate of one count per 1/2 second until zero is reached and then roll under to 23 hours.

No other pushbutton or pushbutton combination is effective in this mode.

The hourly difference is stored in the nonvolatile memory of the unit.

TIMER - When the clock mode switch is positioned to **TIMER,** the clock portion of the display shows the value of the countdown timer. The display shows only minutes in the range of zero to 59.9. The smallest time division is one tenth of a minute, or six seconds.

Pressing **[RST]** stops the timer if it was running and resets it to 0.0.
Pressing **[PRE]** stops the timer if it was running and sets it to the preload value.
Refer to the PROGRAMMING EXTRA FEATURES section to change the preload value.
Pressing **[10]** will add ten minutes to the value shown.
Pressing **[1]** will add one minute to the value shown.
Pressing **[.1]** will add 1/10 minute (6 seconds) to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/2 second. If the maximum of 59.9 minutes is reached or exceeded, the computer will subtract 60.0 from the result before displaying it.

Generally, it is usually best to reset the timer to zero by pressing **[RST]** and then setting the desired count down time with the **[10]**, **[1]**, and **[.1]** pushbuttons.

CAUTION: Pressing the **[10]**, **[1]**, or **[.1]** pushbuttons will add to the value of the timer even when it is already running when the CLOCK MODE switch is in the TIMER position.

Pressing the **[START]** combination (**[10]** & **[.1]**) starts the timer counting down. The timer won't change value for six seconds, so the audio emits a short beep to acknowledge that the computer received the start signal.

When the timer reaches 0.0 the alarm will sound and the clock portion of the display will blink to indicate time-out. Then the timer will count up. Pressing the **[SIL/VOLT]** pushbutton will silence the alarm and stop the display from blinking but the timer will continue to run. Thereafter, every time the timer passes through zero (every hour) the alarm will sound, until the timer is stopped. When the timer reaches 0.0 the alarm will sound and the clock portion of the display will blink regardless where the clock mode switch is positioned. If the preload value of the timer is 30.0 minutes, the preload value can be loaded and the timer started at takeoff. Then the clock mode switch can be set to **GMT** or **LMT**. The alarm will sound in 30 minutes and every hour thereafter as a reminder for fuel tank changes.

CAUTION: Whenever the **[SIL/VOLT]** pushbutton is pushed to silence an alarm occurring at the same time as the timer alarm, it will stop the clock portion of the display from blinking.

The timer is intended primarily as an approach timer and a fuel tank change reminder. It can be used as an elapsed time clock (keeping in mind the 59.9 minute maximum and the alarm when the timer goes through 0.0). Set the start time to 0.0 using the **[RST]** pushbuttons and then start the timer. There is no provision for stopping the timer other than resetting back to 0.0, however.

The timer value is stored in the nonvolatile memory on shutdown. However, the computer flags that indicate that the timer is running and whether up or down are not stored. When the unit is turned back on, the timer value at turnoff is restored but the timer will be stopped. So, if your using the timer for fuel tank changes and want to maintain the timing cycle after stopping for lunch, you merely switch the clock mode switch to **TIMER** and **[START]** the timer at takeoff.

FLG TIM SETTING - When the clock mode switch is positioned to **FLG TIM**, the clock portion of the display shows flight time. The display is in hours and 1/10's of hours and ranges from 0.0 to 25.5 hours. The flight time readout is a convenient way to keep log book time.

Pressing **[RST]** will reset the flight time readout to zero.

The flight time clock only runs when there is oil pressure, which means the engine is running. Multiple leg flight time can be accurately kept for the log book. Reset flight time to zero after recording the time.

Flight time is stored in the nonvolatile memory.

TACH/FUEL SETTING - When the clock mode switch is positioned at **TACH/FUEL**, the clock portion of the display shows tachometer hours. The display is in hours and 1/10's of hours and ranges from 0.0 to 6553.5 hours. The tachtime recorded is the same time based on RPM as shown on standard tachometers. If the tachtime counter of the unit is set at 2400 rpm, the tachometer hours shown by the µMONITOR will increase by one hour for every actual clock hour if the engine is running at 2400 rpm. If the engine is running at 1200 rpm, the tachometer hours shown by the µMONITOR will increase 1/2 hour for each actual clock hour that the engine is running. The tachtime counter can be adjusted to record at different cruise RPM's (refer to PROGRAMMING EXTRA FEATURES section).

No other pushbutton or pushbutton combination is effective in this mode.

When the clock mode switch is positioned at **TACH/FUEL**, the setting buttons are used to change the fuel quantity remaining, since the tachometer hours are not changeable during normal operation (refer to PROGRAMMING EXTRA FEATURES section on how to set the µMONITOR's beginning engine TACHTIME). The fuel remaining is displayed in the **GAL** section of the display when the **[GPH]** pushbutton is in the out position.

Pressing **[RST]** resets the fuel quantity to zero.
Pressing **[PRE]** sets the fuel quantity to the preload value.
Refer to the PROGRAMMING EXTRA FEATURES section to change the preload value.
Pressing **[10]** will add ten gallons to the value shown.
Pressing **[1]** will add one gallon to the value shown.

Pressing **[.1]** will add 1/10 gallon to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/2 second. If the maximum of 99.9 gallons (or 999 liters) is reached or exceeded, the computer will subtract 100.0 (or 1000 liters) from the result before displaying it. The liters option is only available by installing a special order software EPROM.

CAUTION: Pressing the **[10]**, **[1]**, or **[.1]** buttons while the clock mode switch is in the "TACH/FUEL" position will add to the value of the fuel quantity remaining even though the FUEL MODE switch is "in" and the fuel readout on the display is showing GPH. To prevent errors, always double check the position of the clock mode switch before pressing any setting pushbuttons.

When the fuel quantity reaches the alarm value, the alarm will sound and the fuel portion of the display will blink to indicate low fuel (even if **GPH** is selected). The fuel portion of the display will blink even if the FUEL MODE switch is set to display **GPH** instead of fuel remaining. Pressing the **[AUDIO SIL/VOLT]** pushbutton will silence the audio. The display will continue to blink and will continue to indicate the correct fuel remaining.

WARNING: The fuel totalizer MUST NOT be used as the only indication of fuel remaining. Like all totalizers, the unit relies on the PILOT to insure that the amount of fuel stored in the unit is CORRECT before flight. Also, the fuel remaining and endurance provided by the unit is based on measuring the amount of fuel going to the engine—so the totalizer CANNOT detect loss of fuel due to a leaking gas cap or other fuel malfunction as can an in-flight sight gage or internal tank sensor type fuel gage.

Before engine start, the fuel quantity actually aboard the aircraft must be entered into the µMONITOR. There are three different ways to enter the fuel amount. 1) If the actual amount of fuel in the aircraft is known by measurement or calculation, the fuel quantity remaining can be **[RST]** to zero and then changed to actual with the SETTING PUSHBUTTONS. 2) If the aircraft is partially refueled and the current quantity of fuel remaining is accurate, the amount delivered to the aircraft can be added to the current fuel quantity remaining. 3) If the tanks are topped off and the preload value is equal to the aircraft capacity, **[PRE]** can be pressed to change the fuel quantity remaining to indicate full tanks.

The alarm value for low fuel and the preload value for full tanks can be adjusted. Refer to SETTING ALARM POINTS and PROGRAMMING EXTRA FEATURES sections.

Displaying Additional Functions

Pressing the **[AUDIO SIL/VOLT]** pushbutton displays the additional functions of VOLTAGE, OUTSIDE AIR TEMPERATURE and ENDURANCE in place of other normal functions while the pushbutton is held in. When the pushbutton is released, the display will return to normal. The usual purpose of this pushbutton is to silence the audio alarm, but it also doubles for the following three features:

Voltmeter

When the **[SIL/VOLT]** pushbutton is held in, the **GAL** portion of the display changes to a readout of the system voltage with a resolution of 1/10 of a volt.

If the power switch is positioned to **ON** the µMONITOR shows the aircraft master bus voltage, which will also be the voltage as set by the aircraft voltage regulator if the alternator is functioning. Since the unit is measuring the voltage being supplied, a diode between the actual aircraft bus (or battery) voltage and the µMONITOR will cause the µMONITOR to read a bus voltage ABOUT one volt less than actual. This error can be corrected by programming the unit to add to the measured voltage the amount lost across the diode (see “Programming Extra Features”, feature #6).

NOTE: The descriptor legend ‘GAL’ does not change even though displaying VOLTS.

Outside Air Temperature

When the **[SIL/VOLT]** pushbutton is held in, the **MAP** portion of the display changes to read the outside air temperature in degrees Celsius with a resolution of 1 degree. If manifold pressure is not needed for the aircraft, the **MAP** position of the display may be permanently changed to indicate outside air temperature. Refer to the PROGRAMMING EXTRA FEATURES section. If RMI’s µEncoder is installed (it has, and needs OAT) you may want to use the µMONITOR OAT function to read engine compartment or cabin temperature.

NOTE: The descriptor legend **MAP** does not change even though displaying OUTSIDE AIR TEMPERATURE.

Endurance

When the **[SIL/VOLT]** pushbutton is held in, the clock portion of the display indicates the time to fuel exhaustion in hours and 1/10’s. The endurance is calculated using the amount of fuel remaining and the fuel flow in gallons per hour - both of which can be displayed in the **GAL** portion of the display.

NOTE: If the fuel flow is zero, the GPH is assumed to be .1, so the endurance shown will be the gallons remaining divided by .1 GPH.

Programming the µMONITOR

There are four different programming routines that can be entered by pressing ALL THREE of the setting pushbuttons at the same time. Selecting which of the four routines is entered is done by first setting the two push-push yellow pushbuttons in a certain order before the THREE setting pushbuttons are pressed.

In the following sections, the pushbuttons will be referred to by different names than their normal use. The programming names are as follows:

UP		DOWN	LEFT	RIGHT	ADVANCE
[THREE SETTING PUSHBUTTONS]			[YELLOW]		

The four possible combinations of yellow pushbuttons and the programming routine that is entered when the 3 setting pushbuttons are pressed at once are as follows:

[LEFT]	**[RIGHT]**	ROUTINE ENTERED
out	out	SETTING THE BACKLIGHTING
in	out	SENSOR CALIBRATION
out	in	SETTING ALARM POINTS
in	in	PROGRAMMING EXTRA FEATURES

If you wish to memorize the combination table, here is the reasoning for the table organization: BACKLIGHTING will be the most used routine so it was selected to be entered with both yellow pushbuttons out... which is where they will usually be in flight. EXTRA FEATURES will seldom, if ever, be used after initial installation so it was selected to be entered with both yellow pushbuttons in. Of the two remaining one-in one-out combinations, the ALARM SET was selected to be the pushbutton pushed in next to the ALARM AUDIO SILENCE pushbutton.

The **[UP]**, **[DOWN]** and **[ADVANCE]** pushbuttons will be explained in the following sections.

To Set the Backlight Intensity

To enter the backlight programming routine, first set both **[LEFT]** and **[RIGHT]** to the out position and press all 3 setting pushbuttons at once.

The display will blank except for an 'L' in the **EGT** position. The current brightness is shown as a percent in the clock portion of the display. Press and hold in either the **[UP]** or **[DOWN]** pushbutton until the desired backlighting intensity is reached, from 0% to 100%. Then press **[ADVANCE]** to return to normal operation.

The setting of the backlighting is stored in the nonvolatile memory.

Sensor Calibration

The calibration programming routine is to enter data into the nonvolatile memory that the computer can use to adjust for sensor errors. The sensor to be calibrated MUST be connected for the calibration routine to work properly.

To enter the calibration programming routine, first set the **[LEFT]** pushbutton to the in position, the **[RIGHT]** pushbutton to the out position and press all 3 setting pushbuttons at once.

> **NOTE:** EGT, CHT and voltage do not have provisions for calibration. The µMONITOR circuit components and the sensors used determine the accuracy. Voltage accuracy is within 1/10 of a volt and EGT/CHT accuracy is ±3°C. Fuel flow and fuel quantity calibration are described in the PROGRAMMING EXTRA FEATURES section.

The display will be blank except for three positions. 1) A 'CA' will appear in the **EGT** position as a reminder that the calibration routine has been entered. 2) The calibration factor that is currently stored in nonvolatile memory is displayed in the **CLOCK** position. The calibration factor ranges from -31 to +31. 3) The function that is ready for calibration is shown in its proper position on the display. The reading displayed is the result of the sensor input adjusted by the calibration factor showing in the **CLOCK** position.

To calibrate any sensor, it first must be determined what the actual temperature or pressure of that particular sensor is at the time. Pressure sensors are easily calibrated at zero pressure without the engine running. Temperature sensors can be calibrated by immersion in water (equal parts ice and water equals 0 degrees Centigrade - boiling water equals 100 degrees Centigrade) or by measurement using an accurate thermometer. Note that the OAT and oil temperature sensor must not be tested "bare", with their leads coming into contact with the water. It doesn't hurt the sensor, but the reading will be in error.

When the actual pressure or temperature is known, adjust the result to equal actual by pressing and holding the **[UP]** or **[DOWN]** pushbutton. The calibration factor is shown for information. The longer the **[UP]** or **[DOWN]** pushbutton is held in, the faster the reading changes. When close to the desired result, the **[UP]** or **[DOWN]** pushbuttons can be pressed and released to move one digit at a time. There is software filtering built into the computer that will cause a few seconds delay between changing the calibration factor and seeing the result change.

> **NOTE:** The µMONITOR displays illegal negative values for fuel and oil pressure down to a -9 to aid in calibration of those sensors.

When the function is calibrated, press the **[ADVANCE]** pushbutton to move to the next function to be calibrated. Each press of the **[ADVANCE]** pushbutton will store the displayed calibration factor in nonvolatile memory and the computer will use that factor for all future calculations of the function displayed. When the last function is calibrated, pressing **[ADVANCE]** will return to normal operation. Not all functions have to be calibrated - if only one calibration is desired, step to that function with the **[ADVANCE]** pushbutton, calibrate and then **[ADVANCE]** until normal operation is reached. Do not turn the unit off (that's when the actual memory storage occurs) **UNTIL** returning to normal operation.

> **NOTE:** Two different functions appear in the 'MAP' position of the display during calibration. The first is MANIFOLD PRESSURE and is distinguished by a decimal point, and the second is OUTSIDE AIR TEMPERATURE and is distinguished by no decimal point.

All calibration factors are stored in nonvolatile memory.

MANIFOLD PRESSURE CALIBRATION - To adjust the zero point of the manifold pressure circuit, the local barometric pressure is needed. If your elevation is 1000 feet or less and an adjustable altimeter is handy, just crank the adjusting knob until the altimeter indicates sea level (zero feet) and the setting in the window will equal the manifold pressure.

If that won't work, use the following table and instructions.

STANDARD DAY TABLE

ALTITUDE (FEET)	PRESSURE (inHG)	PRESSURE CHANGE PER FOOT
-1000	31.0185	9
-900	30.9073	.001112
0	29.9213	.001096
500	29.3846	.001073
1000	28.8557	.001058
1500	28.3345	.001042
2000	27.8210	.001027
3000	26.8167	.001004
4000	25.8418	.000975
6000	23.9782	.000932
8000	22.2250	.000877
10000	20.5770	.000824

Call the closest airport or service for their current altimeter setting and their elevation. Ask if they can convert the altimeter setting to actual pressure in inHG (actual barometric pressure not corrected for elevation). If they can, it will save doing the following calculation.

1. Station elevation... (example)(3570) _____________

2. Station altimeter setting...(30.15) _____________

3. Next higher altitude from table ....(4000) _____________

4. Standard pressure from table for step 3 ....(25.8418) _____________

5. Subtract step 1 from step 3...(4000 - 3570 = 430) _____________

6. Pressure change per foot for step 3...(.000975) _____________

7. Step 5 times step 6...(430 x .000975 = .4193) _____________

8. Add step 4 and step 7..(25.8418 + .4193 = 26.2611) _____________

9. Subtract step 8 from 29.9213 ....(29.9213 - 26.2611 = 3.660) _____________

Step 9 represents the difference in pressure (in inHG) between the station and sea level.

10. Subtract step 9 from step 2 ....(30.15 - 3.66 = 26.49) _____________

If your elevation is different than the elevation of the station where you got the altimeter setting, adjust the result of step 10 by an amount equal to step 6 times the difference between your elevation and the station's elevation. If you are higher than the station, subtract the correction, otherwise add it.

11. Final local pressure in inHG.. ____________

UNINSTALLED FUNCTIONS - Setting the calibration factor to -31 for any of the functions that can be calibrated will leave that portion of the display blank during normal operation. This is to keep from cluttering up the display with zero readings for functions like carburetor temperature that are not used for injected engines. EXCEPTION! Since the MAP and OAT share the same display location, do not set either one of the calibration factors to -31 unless **both** are not connected.

Setting Alarm Points

The alarm set programming routine is to enter data into the nonvolatile memory that the computer can use to compare with calculated results to determine if the function is out of limits.

NOTE: See PROGRAMMING EXTRA FEATURES to set tachometer (RPM) redline.

To enter the ALARM SET programming routine, first set the **[LEFT]** pushbutton to the out position, the **[RIGHT]** pushbutton to the in position and press all 3 SETTING PUSHBUTTONS at once.

The display will be blank except for three positions. 1) An **AL** will appear in the **EGT** position as a reminder that the alarm routine has been entered. 2) The function that is ready for its alarm set point to be adjusted is shown in its proper position on the display. The reading displayed is the current alarm set point for that function that is stored in the nonvolatile memory. 3) A **HI** or **LO** will be displayed in the **CLOCK** position to indicate whether the alarm set point being adjusted will cause an alarm when the result is higher than the set point (HI) or lower than the set point (LO).

Adjust the alarm set point by pressing and holding the **[UP]** or **[DOWN]** pushbutton. The longer the **[UP]** or **[DOWN]** pushbutton is held in, the faster the set point changes. When close to the desired result, the **[UP]** or **[DOWN]** pushbuttons can be pressed and released to move one digit at a time.

When the function alarm set point is as desired, press the **[ADVANCE]** pushbutton to move to the next alarm set point. Each press of the **[ADVANCE]** pushbutton will store the displayed alarm set point in nonvolatile memory and the computer will use that value for all future alarm comparisons for the function displayed. When the last alarm set point has been adjusted, pressing **[ADVANCE]** will return to normal operation. Not all alarm set points have to be adjusted - if only one adjustment is desired, step to that function with the **[ADVANCE]** pushbutton, set the alarm set point and then **[ADVANCE]** until normal operation is reached.

All alarm set points are stored in nonvolatile memory.

DISABLING AN ALARM - If NO audio or visual alarms are desired for a particular function, set the alarm set point at maximum if it is a HI alarm or minimum if it is a LO alarm. To set maximum, hold the **[UP]** pushbutton in until the alarm set point stops. To set minimum, hold the **[DOWN]** pushbutton in until the alarm set point stops.

Programming Extra Features & Tach Alarm Setting

The extra feature programming routine is to enter various necessary data into the nonvolatile memory. There are seven extra feature sections to this routine (described later). This routine is usually only necessary during initial installation.

To enter the extra features programming routine, first set both the **[LEFT]** and **[RIGHT]** pushbuttons to the in position and press all 3 setting pushbuttons at once.

The display will be blank except for two positions. 1) A number between 0 and 7 will appear in the **EGT** position to indicate which extra feature subroutine is being performed. 2) The value of the extra feature that is stored in the nonvolatile memory and currently being adjusted is displayed in the **CLOCK** position of the display.

The following table relates the 0 to 7 number with the extra feature being adjusted:

NUMBER DISPLAYED	FEATURE
0	Set timer PRELOAD value
1	Set full fuel tanks PRELOAD value
2	Set LOW FUEL QUANTITY alarm value
3	Set beginning engine TACHTIME
4	Set TACHOMETER (RPM) HI ALARM limit (redline)
5	Set FUEL FLOW sensor calibration
6	Set 4 or 6 cyl engine & Set OAT to permanently replace MAP & Set Tach measurement for 1 or 2 pulses per revolution & Set Volts to correct for diode on input bus
7	Set cruise RPM for TACH TIME recording

When the extra feature setting is as desired, press the **[ADVANCE]** pushbutton to advance to the next feature. Each press of the **[ADVANCE]** pushbutton will store the displayed reading in nonvolatile memory for the computer. When the last extra feature has been adjusted, pressing **[ADVANCE]** will return to normal operation. Not all extra features have to be adjusted - if only one adjustment is desired, step to that function with the **[ADVANCE]** pushbutton, set to the desired reading and then **[ADVANCE until]** normal operation is reached.

The following sections detail each of the extra feature programming:

0 - TIMER PRELOAD - When the **EGT** indicator reads 0, the clock portion of the display shows the current value of TIMER PRELOAD. The display shows only minutes in the range of zero to 59.9. The smallest time division is one tenth of a minute, or six seconds.

Pressing **[10]** will add ten minutes to the value shown.
Pressing **[1]** will add one minute to the value shown.
Pressing **[.1]** will add 1/10 minute (6 seconds) to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/4 second. If the maximum of 59.9 minutes is exceeded, the computer will subtract 60.0 from the result before displaying it.

Pressing **[ADVANCE]** will store the current reading and step to the next extra function.

1 - FUEL PRELOAD - When the **EGT** indicator reads 1, the clock portion of the display shows the current value of FUEL PRELOAD. The display shows gallons in the range of zero to 99.9. The smallest fuel division is one tenth of a gallon.

Pressing **[10]** will add ten gallons to the value shown.
Pressing **[1]** will add one gallon to the value shown.
Pressing **[.1]** will add 1/10 gallon to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/4 second. If the maximum of 99.9 gallons is exceeded, the computer will subtract 100.0 from the result before displaying it.

Press **[ADVANCE]** to store the current reading and step to the next extra function.

2 - LOW FUEL ALARM - When the **EGT** indicator reads 2, the clock portion of the display shows the current value of LOW FUEL ALARM. The display shows gallons in the range of zero to 50.0. The smallest fuel division is one tenth of a gallon.

Pressing **[10]** will add ten gallons to the value shown.
Pressing **[1]** will add one gallon to the value shown.
Pressing **[.1]** will add 1/10 gallon to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/4 second. If the maximum of 50.0 gallons is exceeded, the computer will subtract 50.1 from the result before displaying it.

Press **[ADVANCE]** to store the current reading and step to the next extra function.

3 - BEGINNING TACHTIME - When the **EGT** indicator reads 3, the clock portion of the display shows the current value of accumulative TACHTIME. The display shows hours in the range of zero to 6553.5. The smallest time division is one tenth of an hour.

Pressing **[10]** will add ten hours to the value shown.
Pressing **[1]** will add one hour to the value shown.
Pressing **[.1]** will add 1/10 hour to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/4 second. If the maximum of 6553.5 hours is exceeded, the computer will subtract 6553.6 from the result before displaying it.

Press **[ADVANCE]** to store the current reading and step to the next extra function.

4 - TACHOMETER HI ALARM - When the **EGT** indicator reads 4, the clock portion of the display shows the current value of TACHOMETER (RPM) HI ALARM. The display shows engine (or prop if a Hall Effect device is used to measure prop RPM) revolutions divided by ten in the range of zero to 999. When setting, keep in mind that you must multiply the reading shown by ten to obtain the actual setting. The smallest division is ten RPM.

Pressing **[10]** will add one thousand RPM to the value shown.
Pressing **[1]** will add one hundred RPM to the value shown.
Pressing **[.1]** will add ten RPM to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/4 second. If the maximum of 999 (times 10) RPM is exceeded, the computer will subtract 999 from the result before displaying it.

Press **[ADVANCE]** to store the current reading and step to the next extra function.

5 - FUEL FLOW CALIBRATION - When the **EGT** indicator reads 5, the clock portion of the display shows the current value of the number of pulses the fuel sensor sends per 1/10 gallon of fuel passing through it. The display shows pulses in the range of zero to 13000.

Pressing **[10]** will add 100 pulses to the value shown.
Pressing **[1]** will add 10 pulses to the value shown.
Pressing **[.1]** will add 1 pulse to the value shown.

Holding down the **[10]**, **[1]**, or **[.1]** buttons will add its respective value once every 1/4 second. If the maximum of 13000 pulses is exceeded, the computer will subtract 13001 from the result before displaying it.

Press **[ADVANCE]** to store the current reading and step to the next extra function.

The accuracy of the FUEL REMAINING and FUEL FLOW is dependent on the number of pulses that the fuel sensor sends for each 1/10 gallon of fuel going through it. When new, the factory calibration shown on the tag attached to the FloScan sensor will show the number of pulses counted per 1/10 gallon. For example, a reading on the tag of:

16 2942

means that this sensor was calibrated at 16.0GPH and it generated 2942 pulses per 1/10 gallon passing through.

The pulses per 1/10 gallon for the 201-B sensor will be approximately 2,800. If by chance, you have an older 201 sensor with the original 18 spoke paddle wheel vs. the current 6 spoke paddle wheel, the pulses per 1/10 gallon will be three times larger.

NOTE: To convert the µMONITOR to Imperial gallons multiply the pulses per 1/10 gallon from the sensor by 1.20. To convert to liters multiply by .264 (also requires liter EPROM).

With some careful record keeping, the µMONITOR can be fine tuned for fuel quantity remaining. Even though the unit shows fuel remaining, it really is measuring the FUEL USED and subtracting it from the initial amount aboard. If it is found that the FUEL REMAINING is consistently off, the FUEL Sensor CALIBRATION can be changed to correct.

The following example explains how to determine the amount and direction of the correction:

µMONITOR current fuel calibration number = 2942

1st flight:
- before takeoff, tanks topped to known 50.0 gallons aboard
- after landing, before fueling, µMONITOR fuel remaining reads 22.5 gallons
  therefore: µMONITOR says (50.0 - 22.5) = 27.5 gallons used

- tanks are then topped off and actual fueling amount is 27.0 gallons

2nd flight:
- at intermediate stop 15.0 gallons added to aircraft (tanks not topped)
- 15.0 gallons added to µMONITOR before takeoff at intermediate stop
- at destination, before fueling, µMONITOR fuel remaining reads 21.4 gal
  therefore: µMONITOR says (50.0 - 21.4) + 15.0 = 43.6 gallons used
- tanks are then topped off and actual fueling amount is 27.6 gallons
  therefore: actual fuel used is 15.0 + 27.6 = 42.6 gallons

RECAP:

- 1st flight	µMONITOR = 27.5	actual = 27.0
- 2nd flight	µMONITOR = 43.6	actual = 42.6
total	71.1	69.6

The new calibration number is:

(µMONITOR fuel used/actual fuel used) X current calibration number

(71.1/69.6) X 2942 = 3005

If the formula is used, the direction of the correction in addition to the amount of the correction is automatically determined.

6 - SET 4/6 CYL, PERMANENT OAT, TACH PULSES PER REV and VOLTS - When the **EGT** indicator reads 6, the clock portion of the display shows the current code for the 4/6 CYLINDER FLAG, the PERMANENT OAT FLAG, the TACH PULSES PER REV FLAG and the VOLT ADD FLAG. The display shows the code in the range of 0 to 7.

Pressing **[1]** will add 1 to the code shown.
Holding down the **[1]** pushbutton will add 1 to the code shown once every 1/4 second. If the maximum of 7 is reached the result will roll over to 0.
Press **[ADVANCE]** to store the current reading and step to the next extra function.

The 4/6 CYLINDER FLAG is used by the computer to calculate the proper RPM based on ignition pulses from a 4 cylinder or 6 cylinder engine when the µMONITOR is connected to the magnetos for input. For tach inputs from Hall effect sensors, this flag should be set to 4 cylinders even when using a 6 cylinder engine.

The PERMANENT OAT flag is used by the computer to display the outside air temperature in the **MAP** position of the display only when the **[SIL/VOLT]** button is pushed or to permanently show it in that position. If a MAP sensor is not installed, the permanent setting will keep volts on the display whether the **[SIL/VOLT]** button is pressed or not.

The TACH PULSES PER REV flag is used by the computer to properly calculate the RPM depending on whether the RPM source is providing one or two pulses per revolution. When the ignition source is magnetos, this flag should be set to two pulses per revolution for both four and six cylinder engines. Also, most electronic ignition systems output two pulses per revolution on their tach output. If the RMI magnetic pickup (Hall effect) sensor is used, the flag would be set for one pulse per revolution. This is also the case if you can obtain one pulse per revolution from an electronic ignition.

The VOLT adder flag is used by the computer to properly calculate the main bus voltage for display. The unit actually measures the voltage being supplied to it. If that voltage is coming off an essential bus that has a isolating diode on its input, the µMONITOR would display a low voltage because of the voltage drop across the diode. The volt flag will tell the computer to add one volt to the measured voltage before displaying it.

This routine does not show the flags themselves, but uses a code with sixteen possible meanings to help set them. The meaning of the codes is shown in the following table:

CODE	4/6 CYL	OUTSIDE AIR TEMPERATURE	TACH PULSES/REV	ADD VOLT
0	4	press SIL/VOLT	1	No
1	6	press SIL/VOLT	1	No
2	4	permanent	1	No
3	6	permanent	1	No
4	4	press SIL/VOLT	2	No
5	6	press SIL/VOLT	2	No
6	4	permanent	2	No
7	6	permanent	2	No
8	4	press SIL/VOLT	1	Yes
9	6	press SIL/VOLT	1	Yes
10	4	permanent	1	Yes
11	6	permanent	1	Yes
12	4	press SIL/VOLT	2	Yes
13	6	press SIL/VOLT	2	Yes
14	4	permanent	2	Yes
15	6	permanent	2	Yes

The most common setting would be 4 which would be a 4 cylinder engine, press SIL/VOLT to see outside air temperature, connection to magnetos for the tachometer source and don't add one volt.

Enter the proper code for your installation.

7 - SET TACHTIME CRUISE RPM - When the **EGT** indicator reads 7, the clock portion of the display shows the current value for the cruise RPM that the computer uses to record TACHTIME. The display shows the value in the range of 0 to 6708 RPM if the 4/6 CYL FLAG is set to 4 cylinder and a range of 0 to 6720 RPM if the 4/6 CYL FLAG is set to 6 cylinder.

If the 4/6 CYL FLAG is set to 4:
  Pressing **[10]** will add 430 to the value shown.
  Pressing **[1]** will add 43 to the value shown.

If the 4/6 CYL FLAG is set to 6:
  Pressing **[10]** will add 280 to the value shown.
  Pressing **[1]** will add 28 to the value shown.

Holding down the **[10]** or the **[1]** pushbutton will add the value above to the value shown once every 1/4 second. If the maximum is exceeded the computer will subtract the maximum range and display the result.

Pressing **[ADVANCE]** will store the current reading and return to normal operation.

Determine the value of the cruise RPM to enter. The easiest way to enter the RPM (due to the unusual amounts shown in above tables) is to mentally add the **[10]** pushbutton value to the value shown. If the result would still be less than the target desired, push the **[10]** pushbutton. When the next push would go past the target desired, repeat the process with the **[1]** pushbutton amount. When the next push of the **[1]** pushbutton would go past the target, decide whether the value shown or the next result would be better.

Charging the Optional External Battery

The external battery (if installed) is maintained in a float charge by the µMONITOR's internal charging circuit when the aircraft is operating. However, if the gel-cell needs to be charged on the ground, connect a battery charger to the µMONITOR or the aircraft and not directly to the gel-cell. The µMONITOR must then be turned on to recharge the external battery. Direct connection to a standard automobile type battery charger will destroy the gel-cell.

If the µMONITOR is being operated solely on the external battery on an aircraft without an alternator or generator system, a convenient plug may be installed for easy connection of the µMONITOR to the battery charger.

Centigrade to Fahrenheit Conversion

°C to °F — (°C x 9/5)+32 = °F

°F to °C — (°F-32)/(9/5) = °C

°C = °F
-40 = -40
-30 = -22
-20 = - 4
-10 = 14

0=32	100=212	200=392	300=572	400=752	600=1112	800=1472
10=50	110=230	210=410	310=590	420=788	620=1148	820=1508
20=68	120=248	220=428	320=608	440=824	640=1184	840=1544
30=86	130=266	230=446	330=626	460=860	660=1220	860=1580
40=104	140=284	240=464	340=644	480=896	680=1256	880=1616
50=122	150=302	250=482	350=662	500=932	700=1292	900=1652
60=140	160=320	260=500	360=680	520=968	720=1328	920=1688
70=158	170=338	270=518	370=698	540=1004	740=1364	940=1724
80=176	180=356	280=536	380=716	560=1040	760=1400	960=1760
90=194	190=374	290=554	390=734	580=1076	780=1436	980=1832

Checklist

BEFORE STARTING ENGINE:

AUDIO SILENCE IN
µMONITOR ON

	FUEL QUANTITY ADJUSTED TO ACTUAL
TAXI:	AUDIO SILENCE OUT
TAKEOFF:	TIMER PRELOAD TO 30.0 MINUTES TIMER START
AFTER LANDING:	AUDIO SILENCE IN
AFTER SHUTDOWN:	RECORD FLIGHT TIME AND RESET TO ZERO FUEL QUANITY ADJUSTED TO ACTUAL IF FUELED µMONITOR OFF

NOTE: Regardless of the checklist above, make it a habit to adjust the fuel quantity to actual immediately after adding any fuel to the aircraft rather than waiting until next flight.