µMONITOR Operations & Programming Manual

About This Manual

This manual is divided into two sections, Operations and Programming. We suggest that the entire operations section be read first before attempting to change any options or warning limits.

Those tasks that would normally be performed in flight are in the operations section and those performed on the ground are in the programming section.

This manual describes µMONITOR software version: 6.0x

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NOTE TO THE USER

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

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Description

The µMONITOR is a microprocessor controlled engine monitor for aircraft engines of all types. 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 adjusted upper and lower 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.

Temperatures can be displayed in degrees Fahrenheit or Celsius, and fuel in gallons or liters.

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.

A logging feature allows saving all engine function readings to the nonvolatile memory on a periodic basis for later download through the serial port. The log data will hold over 16 hours of engine data when the logging period is every minute.

As modifications and features are added to the software, users may download newer versions to their computer from the RMI website and then upload them to the µMONITOR using the serial port.

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 lower and upper range limits:

function	range	notes
OIL PRESSURE	0 to 99 psi	
FUEL PRESSURE	0 to 99 psi ***note2**	
MANIFOLD PRESSURE	10.0 to 59.0 InHg	
OIL TEMPERATURE	-40 to +390 °F (-40 to +199 °C)	
CYLINDER TEMPERATURE	32 to 700 °F (0 to 370 °C)	
EXHAUST GAS TEMPERATURE	32 to 1652 °F (0 to 900 °C)	No alarms
CARBURETOR TEMPERATURE	-10 to +200 °F (-23 to +93 °C) ***note1**	
OUTSIDE AIR TEMPERATURE	-40to +390 °F (-40 to 198 °C) ***note1**	No alarms
AMMETER	-80 to +80 amp	
VOLTMETER	0 to 39.9 V ***note1**	No alarms
TACHOMETER	60 to 8000 RPM	
FUEL FLOW	.6 to 60 GPH (1 to 240 LPH)	No alarms
FUEL QUANTITY REMAINING	0 to 99.9 gal (0 to 999 liters)	
GMT	0 to 2359.9	

LMT	0 to 2359.9	
TIMER	0 to 59.9 min	Alarm at zero
FLIGHT TIME	0 to 6553.5 hr	
TACH TIME	0 to 6553.5 hr	
ENDURANCE	0 to 99.9 hr	
USER FUNCTION #1		Alarm on switch close
USER FUNCTION #2		Alarm on switch close
USER FUNCTION #3		Alarm on switch close

***note1:** Carburetor temperature, outside air temperature, and voltage all share the **Utility** position on the display. Pressing the **[SIL/VOLT]** button displays alternate functions. The function that normally displays, and the function(s) that display on button press, is dependent on which functions are installed or not installed. See details in the Utility portion of this manual.

***note4:** Fuel pressure is programmable for 0 to 31 psi range for low pressure fuel systems and 0 to 99 psi range for high pressure fuel systems. Each range requires a different sensor.

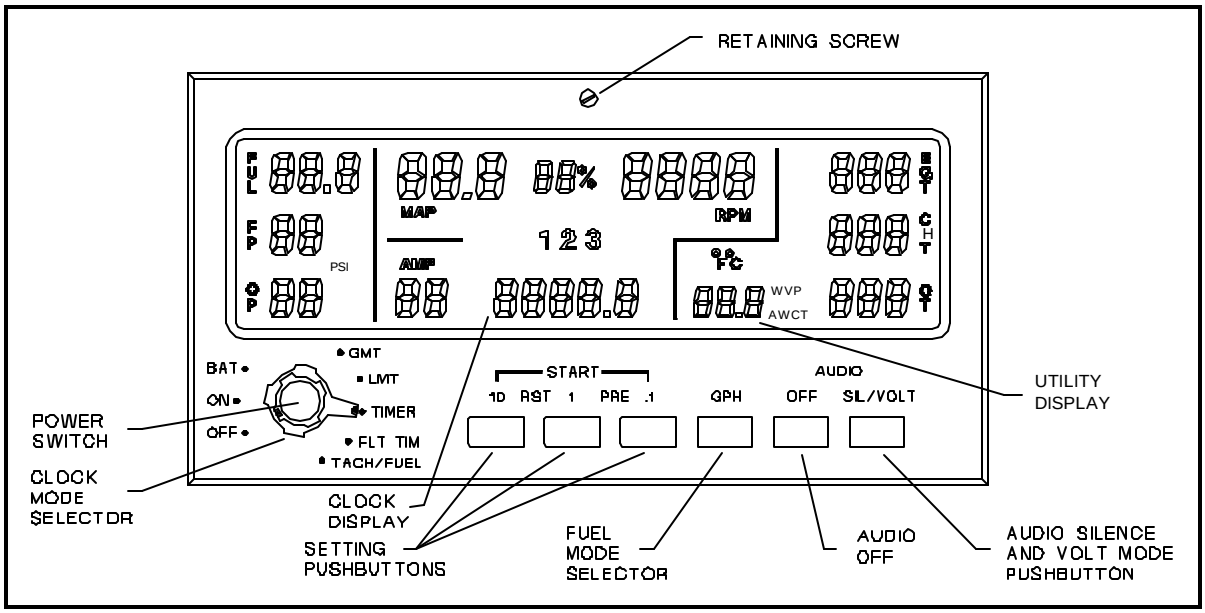
Technical Characteristics

specification	characteristic
Electrical:	a. 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 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 amp-hour 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. The utility portion of the display shows optional functions such as carburetor temperature, outside air temperature and voltage.

The temperature units symbols for degrees Fahrenheit and Celsius that appear just above the utility display apply to all the temperature functions grouped together to the right of the heavy line.

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 (if installed) 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 (if installed). The unit will operate for 8 to 10 hours when powered by the external battery if it is in a full charge state.

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 handiest 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 10).

AUDIO SILENCE PUSHBUTTON - The audio **[SIL/VOLT]** pushbutton, 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 **[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) when pushed. Refer to those additional function's sections.

Fuel Mode Pushbutton

The **[GPH]** pushbutton controls whether the fuel portion of the display shows fuel flow or fuel remaining. In the "in" position the display will show gallons per hour (LPH if selected), 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 MANUAL 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. However, the computer signals 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 you're 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 6553.5 hours. The flight time readout is a convenient way to keep log book time. A separate Hobbs timer that can be accessed only through the programming mode is better used to keep track of aircraft total hours, even though flight time can maintain a large number of total hours.

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

The flight time clock only runs when there is over 200 RPM, 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 (**MSC/ttrPM** menu item in the programming manual) 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

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 manual on how to set the µMONITOR's beginning engine TACHTIME). The fuel remaining is displayed in the **FUL** 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 **MSC/FLPrE** menu item in the programming manual 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.

If the **[GPH]** pushbutton is in the in position, so the **FUL** portion of the display is showing fuel flow, the three setting buttons are disabled so that you are not changing something you can't see.

When the fuel quantity reaches the alarm value, the alarm will sound and the fuel portion of the display will blink to indicate low. The fuel portion of the display will blink even if the **[GPH]** pushbutton is in the in position to display fuel flow 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 the **ALr/LOFUL** and **ALr/FLPrE** menu items in the programming manual.

Tachometer Display

Because of the smoothing action of the software, the RPM will not indicate other than zero on the display for about five seconds when the engine is started, or when the µMONITOR is turned on with the engine already running. This is intended to prevent erroneous readings until enough tachometer pulses have been received to establish a filtered average.

Displaying Utility Functions & Endurance

Pressing the **[SIL/VOLT]** pushbutton displays the additional functions of VOLTAGE, OUTSIDE AIR TEMPERATURE and ENDURANCE 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 to show additional functions.

The utility portion of the display shows (in priority order) carburetor temperature, bus voltage and air temperature. If installed, carburetor temperature will normally appear in the utility spot with the designator letters **CT**. If carburetor temperature is disabled (see Calibrate Menu section of the programming manual), then volts becomes the primary function to display in the utility portion of the display, and outside air temperature will display when the **[SIL/VOLT]** button is pressed (if not also disabled).

Voltmeter

If carburetor temperature is installed, then when the **[SIL/VOLT]** pushbutton is held in, the utility portion of the display changes to system voltage with a resolution of 1/10 of a volt with the designator letter **V**. Of course, if the unit is programmed to disable carburetor temperature, volts becomes the priority and the pushbutton is not required.

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 less than actual. This error can be corrected by calibrating the voltage function as explained in the programming manual.

If carburetor temperature is installed and the pushbutton is held in, the voltage is shown for three seconds and then the air temperature is shown for three seconds. They will continue to alternate until the button is released.

Air Temperature

When the **[SIL/VOLT]** pushbutton is held in, the utility portion of the display will read the outside air temperature when the designator shows **AT**. If carburetor temperature is installed, the air temperature will alternate with voltage at three second intervals. If the carburetor temperature is not installed, holding down the pushbutton will continuously show air temperature. If RMI's µEncoder is installed (it has, and needs OAT) you may want to use the µMONITOR air temperature function to read engine compartment or cabin 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. While the endurance is being displayed, the first digits of the clock portion of the display will read **E=**, as a reminder. If the fuel flow is zero, the display will read **E=OFF**. 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 **FUL** portion of the display.

Backlight Control

Two of the six pushbuttons are renamed for controlling the intensity of the backlight. The **10** button becomes **UP** to increase the intensity, and the **1** button becomes **DOWN** to decrease the intensity. To enter the backlight control, press ALL THREE of the setting pushbuttons at the same time. The display will show **L=xxx** in the clock portion of the display, with the **xxx** indicating the current percentage of backlight intensity from **5%** to **100%**.

[THREE SETTING PUSHBUTTONS] [YELLOW]

If you enter the backlight control, and don't change the intensity, that is a signal to turn the backlight on if it was off, or turn the backlight off it was on.

NOTE: It is recommended that the function switch always be set on LMT before trying to enter backlight mode. That way, an inadvertent, sloppy press of other than all three buttons won't result in an accidental change of a function that is hard to correct

There is a three second limit (or timeout) when in the backlight control is being used. Three seconds after the last button has been pressed, the timeout will return the operation to normal. As an example, to turn the backlight off, press the three setting pushbuttons. The display will show **L=xxx**. After three seconds, the unit will turn the backlight off and return to normal operation.

The backlight intensity and on/off state are saved in nonvolatile memory, so when the µMONITOR is turned on, the backlight will revert to the same state as when the µMONITOR was turned off.

Experiment with backlighting intensity. Many users find that in daylight, the contrast of the display is better with the backlight completely off, and that only dusk and nighttime need backlight.

Checklist

BEFORE ENGINE START:	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 QTY 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.