MCD-100

NON-TSO

MODE C DECODER

USER'S MANUAL

Adaptive Interfaces, Inc.

2012

The MCD-100 is not certified by the FAA and is intended for use only in Homebuilt, Experimental or Ultralight aircraft. Any questions pertaining to the use of this instrument in a particular aircraft should be addressed to your local aviation authorities. It is the responsibility of the aircraft pilot to be thoroughly familiar with the operation of the MCD-100 and know its limitations. Correct installation of this instrument should be verified by a qualified avionics facility.

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INTRODUCTION

SCOPE

This manual provides specifications, operating instructions and installation instructions for the MCD-100 Mode C Decoder. This manual is for use by persons who are familiar with aircraft, aircraft avionics, and general electronic principles.

DESCRIPTION

The MCD-100 Mode C Decoder is a solid state instrument that displays altitude information provided to a transponder by an encoding altimeter or a "blind" altitude encoder. The MCD-100 samples digital altitude information from 10 digital signal lines used by the transponder and encoder and presents an altitude on a 5-digit LED display. The MCD-100 can display "pressure" altitude, based directly on Mode C encoder values, or a "corrected" altitude (in 100 ft. increments) based on encoder values and local barometric pressure. While displaying "pressure" altitude or "corrected" altitude, the pilot can activate the MCD-100's Altitude Alert function to set a cruise altitude and be notified if that altitude varies by more than +/- 200 ft..

Control of the MCD-100 is by a set of 4 buttons on the front panel of the instrument. The MCD-100 is a standard 2-1/4 inch instrument and is designed to be mounted in a standard 2-1/4 inch aircraft panel cut-out.

SPECIFICATIONS

Supply Voltage:	10 Vdc - 32 Vdc
Maximum Supply Current:	350 mA
Altitude Range:	-1200 ft. to 32000 ft.
Displayed Altitude Resolution:	+/- 100 ft.
Displayed Altitude Accuracy:	+/- 125 ft.
Dimensions:	H 2.40" x W 2.50" x D 1.50"
Weight:	4 Oz. (114 g.)
Mounting Screws:	4 ea. 6-32 x L 0.5" (Max.)
Air Fitting:	1/8 - 27 NPT Female
Upper Connector:	15-Pin DSUB Female 4-40
Lower Connector:	9-Pin DSUB Female 4-40

BUTTON FUNCTIONS

FUNC

This button is used to select and advance instrument functions for each menu level. Holding this button in for 5 seconds will cause the instrument to advance to the next menu level.

▲

▼

When the instrument is in the ALT or MC modes of the MAIN MENU, these buttons are used to adjust the brightness of the digital display when the DISPLAY BRIGHTNESS function is set to FP (Front Panel). Otherwise, these buttons perform no operations. In other functions of the MAIN MENU and MENU LEVEL 1, these buttons are used to increase or decrease values of the selected function.

AA

When the instrument is in the ALT or MC modes of the MAIN MENU, this button is used to activate and deactivate the instrument's ALTITUDE ALERT (AA) mode. When activated, ALTITUDE ALERT mode flashes the display when altitude varies more than +/- 200 ft. from the altitude at which ALTITUDE ALERT is engaged.

In all other cases, the button is used as an "Enter" button to select and retain the value or setting of the displayed function.

INDICATORS

ALT

The ALT indicator is lit when the instrument is displaying "corrected" altitude. This is an altitude based on Mode C data that is corrected to the local barometer. This altitude is displayed in 100 ft. increments.

MC

The MC indicator is lit when the instrument is displaying Mode C Altitude. This altitude is based on a standard barometer of 29.92 inHg, is displayed in 100 ft. increments, and represents the data being supplied to the transponder.

BAR

The BAR indicator is lit when the instrument is displaying the local barometer setting. This setting can be adjusted using the instrument's Up and Down buttons.

FLD

The FLD indicator is lit when the instrument is displaying the Field Altitude setting. This value is set when the aircraft is at a known altitude (usually the run-up pad) using the UP and Down buttons.

AA

The AA indicator is lit when the instrument's ALTITUDE ALERT mode is active.

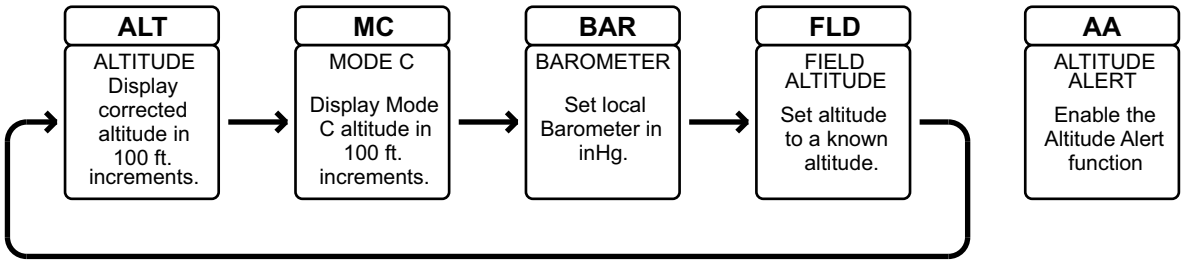
MENUS

The MCD-100 is controlled through a series of menus and functions.

The MAIN MENU (MENU LEVEL 0) allows the pilot to view corrected MSL altitude in 100 ft. increments or the Mode C altitude in 100 ft. increments provided to the aircraft's transponder. Other functions of the MAIN MENU allow the pilot to adjust the corrected altitude by directly entering a barometer setting or by setting a known field altitude altitude before starting a flight. Also available on the MAIN MENU is the instrument's Altitude Alert (AA) function.

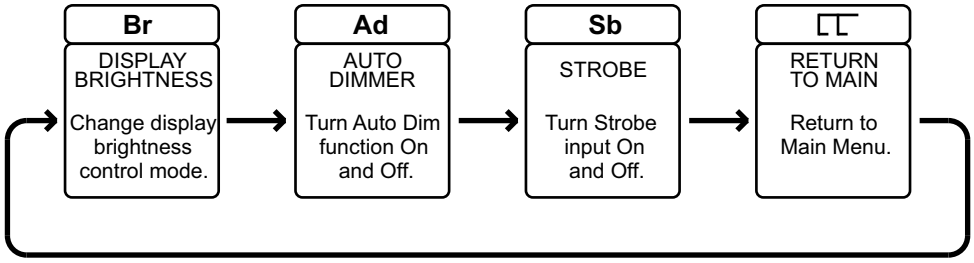
MENU LEVEL 1 is entered by pressing and holding the FUNC button for 5 seconds. When the MCD-100 is in MENU LEVEL 1, the user can change the instrument's optional settings. These settings include the digital display's BRIGHTNESS CONTROL mode, the AUTO DIM function and the use of the instrument's STOBE input signal. A RETURN function brings the instrument back to back to its normal operation mode, MAIN MENU.

MAIN MENU (MENU LEVEL 0)



Press and hold FUNC button 5 seconds to advance to MENU LEVEL 1

MENU LEVEL 1



FUNCTIONS

MAIN MENU (MENU LEVEL 0) FUNCTIONS

ALT (ALTITUDE)

DEFAULT FUNCTION

The ALT function is the normal mode of operation for the MCD-100. In this mode, the MSL (Mean Sea Level) altitude of the aircraft is displayed to the pilot. Altitude is displayed in 100 ft. increments.

In this mode, the displayed altitude is a function of the pressure altitude (29.92 inHg) supplied by the aircraft's altitude encoder corrected by the local barometer setting. This function is similar to calculations made by ATC to judge an aircraft's true MSL altitude based on Mode C transponder information.

MC (MODE C ALTITUDE)

FUNC

Press and release FUNC until the MC function is reached.

The MC (Mode C Altitude) function displays the raw Mode C altitude information that is being supplied to Air Traffic Control via the aircraft's transponder. Mode C altitude information is provided in 100 ft. increments and is based on a barometer setting of 29.92 inHg - standard pressure at sea level. Air Trafic Control calculates an aircraft's altitude from Mode C information provided by the aircraft's transponder and the air pressure reported for the area over which the aircraft is flying.

Unless local weather conditions consist of an air pressure of 29.92 inHg, the MC function will NOT display the aircraft's true altitude and should NOT be used as an altitude reference. The function is provided to inform the pilot of the Pressure Altitude or Flight Level information being supplied to the transponder.

After 30 seconds, the MCD-100 will revert from the MC function to the ALT function.

FUNCTIONS - CONT.

MAIN MENU (MENU LEVEL 0) FUNCTIONS - CONT.

BAR (BAROMETER)

FUNC	▲	AA
Press and release FUNC until MC is reached.	▼ Press UP/DOWN to change value.	Press AA button to set and store.

The BAR function allows the pilot to enter the local barometer setting using the Up and Down buttons. The local barometer pressure is based on the local weather conditions and is entered as inHg (Inches of Mercury). The barometer seting will increase or decrease in 0.01" increments every time the Up or Down button is pressed. If the Up or Down button is held, the barometer setting will increase or decrease in 0.01" increments every .5 second. If the Up or Down button is held for more than 10 increments, the barometer setting will start to change in 0.1" increments to speed up setting.

Once the desired barometer setting is reached, the AA button must be pressed to store (lock in) the new value. When the new value is stored, the instrument will confirm the setting by flashing all the decimal points of the display for 1 second. If the function is changed without pressing the AA button, the old barometer setting will be kept.

FLD (Field Altitude)

FUNC	▲	AA
Press and release FUNC until FLD is reached.	▼ Press UP/DOWN to change value.	Press AA button to set and store.

The FLD function allows the barometer to be set by entering a known altitude. This function can be used when the aircraft is on the ground and the exact altitude of the airfield is known, a function usually performed during run-up. Once the altitude is entered, the MCD-100 will calculate the new barometer setting.

The FLD setting will start at the current altitude reported by the ALT function and can be moved by the Up and Down buttons in 10 ft. increments. After moving 10 increments, the altitude will move by 100 ft. increments to speed the setting. To store the new setting, press the AA button.

It is strongly recommended that this function NOT be used in flight as it will probably result in an incorrect barometer setting.

FUNCTIONS - CONT.

MAIN MENU (MENU LEVEL 0) FUNCTIONS - CONT.

AA (ALTITUDE ALERT)

AA

Press once to engage, once to disengage.

The AA function assists the pilot in maintaining a constant cruising altitude while in flight. The AA function can be engaged while the MCD-100 is in the ALT or MC mode. When the AA function is engaged, the aircraft's current altitude is stored and the pilot is notified by a flashing display when the aircraft flys 200 ft. above or 200 ft. below the set altitude. The ALRM output of the lower electrical connector is also activated to drive an audio or lamp indicator when the display flashes.

To engage the AA function, press the AA button one time while flying at the desired altitude. To turn off the function, press the AA button one time again. To set a new altitude, disengage the function and engage it again at the desired altitude.

MENU LEVEL 1 FUNCTIONS

br (DISPLAY BRIGHTNESS CONTROL)

FUNC	▲ ▼	AA	FUNC	AA
Press and Hold FUNC button for 5 seconds until br function appears on the display, then release.	Use Up and Down buttons to select the brightness control mode.	Press AA button to set and store the mode.	Press and release FUNC button until the Return To Main ⊏⊐ symbol appears on the display.	Press the AA button to return to the MAIN MENU.

The brightness of the digital display and the indicator LEDs can be set to 16 different levels and be controlled in 3 different modes. These modes are as follows:

E (EXTERNAL CONTROL VOLTAGE)

An external control voltage ranging from 0V to the supply voltage is applied to pin 3 of the Lower Electrical Connector. This voltage is sampled by the MCD-100 and its ratio to the Supply Voltage is calculated into 16 levels. This allows a single potentiometer to be connected between ground and the instrument power input and used as a brightness control, its center tap used as the pin 3 input. See the ELECTRICAL CONNECTIONS section of this manual for details of the control circuit.

FP (FRONT PANEL)

When the MCD-100 is operating in the ALT or MC mode, the UP and DOWN buttons are used to set the display brightness. Also see the AUTO DIMMER function.

PH (PHOTOCELL)

The display brightness is controlled automatically by the amount of ambient light seen by the photocell on the front of the instrument.

MENU LEVEL 1 FUNCTIONS - CONT.

Ad (AUTO DIMMER FUNCTION)

FUNC	FUNC	▲ ▼	AA	FUNC	AA
Press and Hold FUNC button for 5 seconds until br function appears on the display, then release.	Press and release FUNC button until the Ad function appears on the display.	Use Up and Down buttons to turn the Ad function ON and OFF.	Press AA button to set and store the selection.	Press and release FUNC button until the Return To Main ⊏⊏ symbol appears on the display.	Press the AA button to return to the MAIN MENU.

When the display brightness mode of the MCD-100 is set to FP (Front Panel) control, the photocell on the front panel can be used to automatically change the brightness of the digital display when lighting conditions change. When flying from low light (ie. clouds, dawn) to bright sunlight, the AUTO DIMMER function will raise the brightness of the digital display to a set level without the need to press the UP/DOWN buttons. When flying from bright light to low light (ie. dusk), the AUTO DIMMER function will lower the brightness of digital display to a set level. After the display brightness is changed with the AUTO DIMMER function, the display brightness can still be adjusted manually with the UP and DOWN buttons.

The 2 AUTO DIMMER modes are as follows:

Ad OFF — The display brightness will stay at the level selected by the UP/DOWN buttons and will not change as lighting conditions change.

Ad On — The display brightness will raise or lower to set levels when lighting conditions change.

MENU LEVEL 1 FUNCTIONS - CONT.

Sb (STROBE FUNCTION)

FUNC	FUNC	▲ ▼	AA	FUNC	AA
Press and Hold FUNC button for 5 seconds until br function appears on the display, then release.	Press and release FUNC button until the Sb function appears on the display.	Use Up and Down buttons to turn the Sb function ON and OFF.	Press AA button to set and store the selection.	Press and release FUNC button until the Return To Main ⊏⊐ symbol appears on the display.	Press the AA button to return to the MAIN MENU.

Most altitude encoders incorporate a STROBE input signal to enable digital outputs that are sent to a transponder. This signal is used by some transponders but many other transponders do not use this signal. When the STROBE signal is used by a transponder and encoder, altitude data is only valid when the the STROBE signal is low. The Sb (STROBE) function of the MCD-100 tells the MCD-100 whether to decode data at all times or only when the STROBE signal is low. When Sb (STROBE) function is enabled, the MCD-100 will display the last valid altitude with the altitude being updated only when STROBE signal is low. The Sb (STROBE) function only needs to be turned ON for use with transponders that use the STROBE signal. See Appendix B for a list of transponders that use the STROBE signal.

The 2 STROBE function modes are as follows:

Sb OFF	The MCD-100 always decodes and displays altitude data.
Sb On	The MCD-100 only decodes altitude and updates the display when the STB (STROBE) signal is enabled (low or ground). The STB (STROBE) signal is on Pin-6 of the Upper Connector.

SPECIAL FUNCTION

Lo E (Low Voltage Warning)

The MCD-100 is designed to operate from a supply voltage of 10V to 30V. Most aircraft operate on a 12V electrical system (voltage is typically around 14V). When the supply voltage to the MCD-100 drops to 11V or lower, the instruments digital display will flash "Lo E" for 1 second every 8 seconds. This function is designed to give a pilot warning that there may be a problem with the aircraft's electrical system. The "Lo E" function is hardwired into the design of the instrument and can not be disabled.

ELECTRICAL CONNECTIONS

POWER INPUT

The MCD-100 is designed to operate from a supply voltage of 10V to 32V with a maximum current draw of 350 mA. Power can be supplied to the instrument using 3 different inputs (Upper Connector Pins 8 and 14 and Lower Connector Pin 9). These 3 inputs are tied together internally through diodes to prevent reverse power being applied to the instrument and to allow all 3 inputs to be connected to different power sources. The MCD-100 will take power from the source with the highest voltage. It is recommended that the MCD-100 be powered from the avionics buss. If the A+ switched output from a transponder is used, be sure the transponder can supply 350 mA with no voltage drop.

The MCD-100 uses an internal switching voltage regulator so no extrenal components are needed when changing from a 12V to a 28V electrical system.

GROUNDS

The case of the MCD-100 is connected to the electrical ground of the instrument. Electrical ground connections are provided to the MCD-100 on pin 15 of the Upper Connector and pins 5, 6 and 7 of the Lower Connector. These pins are all connected internally on the MCD-100.

DIGITAL INPUTS

The digital inputs of the MCD-100 comply with the National Standard for Common System Component Characteristics for the I.F.F. Mark X (SIF) / Air Traffic Control Radar Beacon System (SIF/ATCRBS) and the International Civil Aviation Organization (ICAO) Standard Code for SSR Pressure Altitude Transmission.

The digital inputs of the MCD-100 consist of 11 high impedance sense lines (10 data and 1 strobe). These lines are connected to the existing lines between the transponder and altitude encoder. The lines are designed for minimal electrical loading and are protected from electrical transients by Schottky diodes.

Displayed altitude information is based on the 10 digital data lines using a Gillham Code (also called a Gray Code). This is also the code specified by the ICAO. The digital data lines are designated as: D4, A1, A2, A4, B1, B2, B4, C1, C2 and C4.

GILLHAM CODE EXAMPLE (1's are seen as digital lows on the lines)

ALTITUDE	D4	A1	A2	A4	B1	B2	B4	C1	C2	C4
900	0	0	0	0	1	1	0	0	1	1
1000	0	0	0	0	1	1	0	0	1	0
1100	0	0	0	0	1	1	0	1	1	0
1200	0	0	0	0	1	1	0	1	0	0
1300	0	0	0	0	1	1	1	1	0	0

ELECTRICAL CONNECTIONS - CONT.

DIGITAL INPUTS - CONT.

All digital data inputs are on the 15-pin Upper Connector and are in the same pin locations as most other manufactrurers' altitude encoders. Pin numbers for the digital data inputs are as follows: D4 Pin-1, A1 Pin-2, A2 Pin-3, A4 Pin-4, B1 Pin-5, B2 Pin-9, B4 Pin-10, C1 Pin-11, C2 Pin 13, C4 Pin-12.

All digital data inputs are pulled high internally to +5 Vdc by a 100k ohm resistor and protected by 2 Schottky diodes and a 1000 ohm series resistor. The inputs are also decoupled by 100 pF capacitors placed between each input and ground.

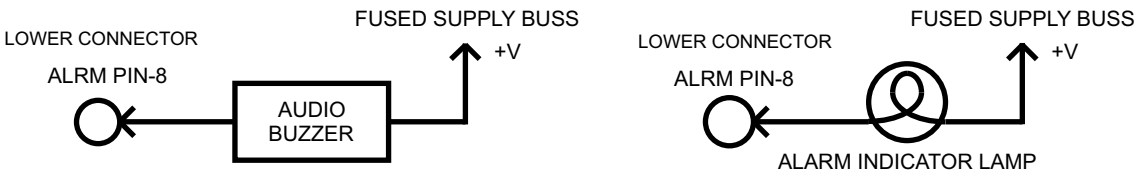
STROBE INPUT

The STROBE input line (Pin-6 of the Upper Connector) is used to sense the state of the STROBE signal. This signal line is used by some transponder/encoder combinations. When used, the transponder drives the signal line to a logical low (<= 1.2 Vdc) to enable the encoder data output lines. Many transponders do not use this signal line and require that the encoder output be enabled at all times. See Appendix B for a list of transponders that use the Strobe line.

As with the digital data inputs, The STROBE input line is pulled high internally to +5 Vdc by a 100k ohm resistor and protected by 2 Schottky diodes and a 1000 ohm series resistor. The input is also decoupled by a 100 pF capacitor placed between the input and ground.

ALARM OUTPUT

The Alarm Output is on Pin-8 of the Lower Connector. This output is used with the AA (Altitude Alert) function to drive a warning lamp or audio alarm. The output uses an open collector transistor that can sink up to 300 mA. The pull-up voltage of the load can be 40 Vdc or less. The output is decoupled by a 100 pF capacitor to ground.



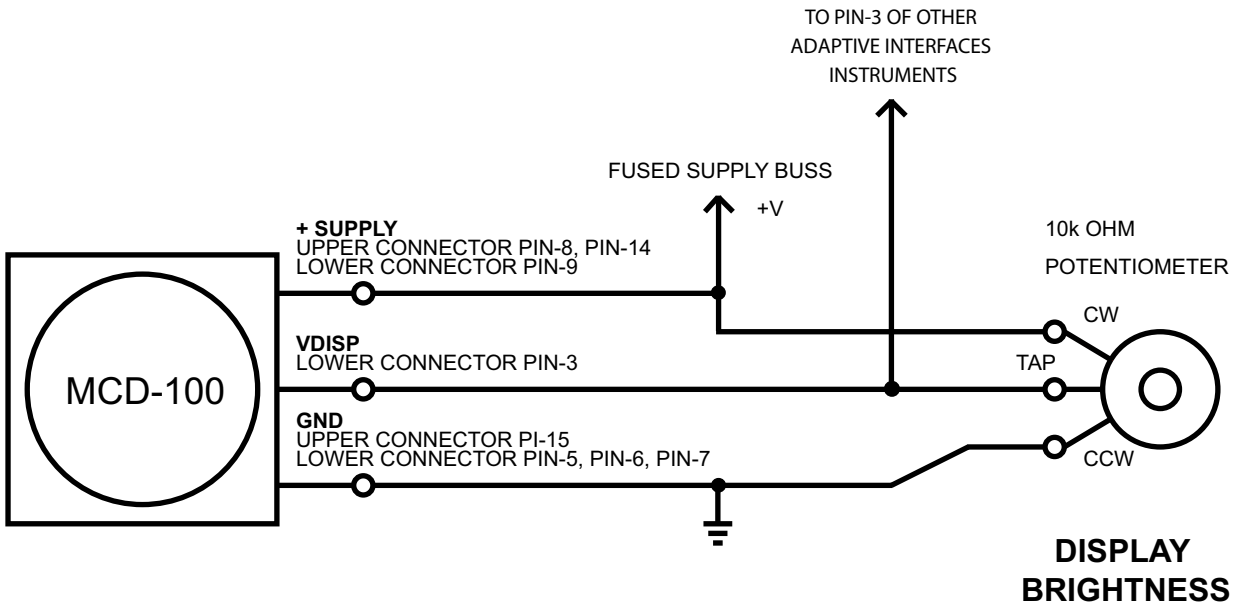
ELECTRICAL CONNECTIONS - CONT.

DISPLAY BRIGHTNESS CONTROL INPUT (VDISP)

The brightness of the digital display and indicator LEDs can be contolled by an external voltage applied to Pin-3 of the Lower Connector when the brightness control mode is set to "E" (See MENU LEVEL 1 FUNCTIONS). In this mode, the display brightness is set by ratio of the voltage at VDISP to the Supply Voltage. This way, a single potentiometer can be placed between ground and the supply voltage with its center tap wired to the VDISP input. Changes or fluctuations of the supply voltage (as can happen when lights and avionics are switched on and off) will not affect the brightness of the display. The display brightness can be set to 16 different levels. The display brightness is limited to 16 levels by the instrument's display driver chip.

To use this function, a linear potentiometer, valued between 10k ohms and 20k ohms, is placed between the instrument supply and ground. The center tap of the potentiometer is wired directly to Pin-3 of the Lower Connector. The input resistance of this input is 200k ohms and the input is protected by Schottky diodes. A single potentiometer can be used to control several Adaptive Interfaces instruments. It is suggested that this input not be connected to existing dimmer controls on the panel as the display brightness is usually the opposite of that desired for nighttime instrument lighting (bright in sunlight - dim at night).

WIRING EXAMPLE



ELECTRICAL CONNECTIONS - CONT.

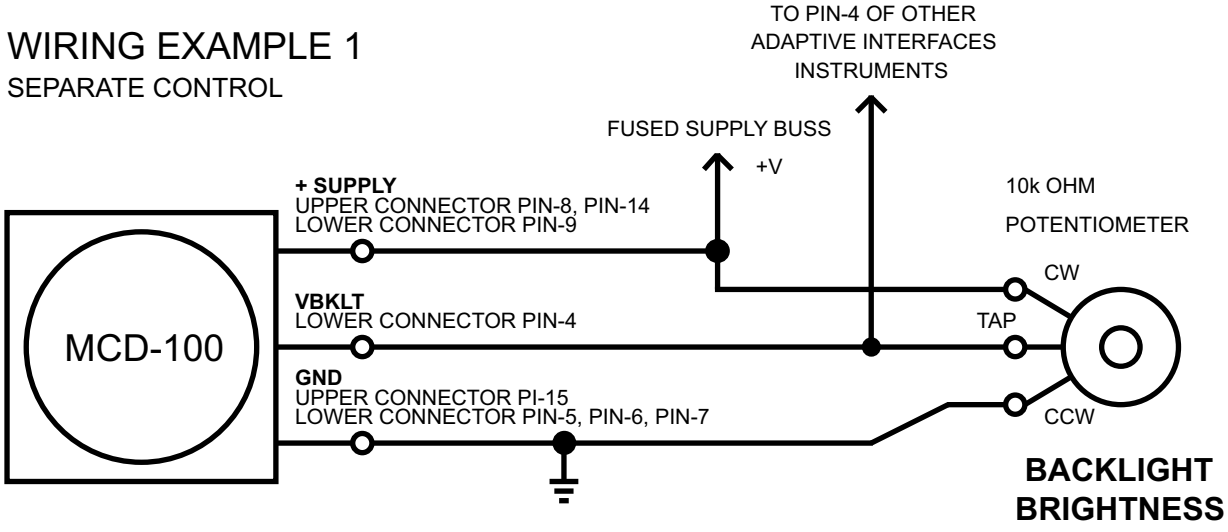
BACKLIGHT BRIGHTNESS CONTROL INPUT (VBKLT)

The MCD-100 has an integrated, white LED, backlight for its front panel graphics. The only way to control the brightness of the backlight is to apply a control voltage to Pin-4 of the Lower Connector (VBKLT). The backlight brightness can be set to 256 levels by the ratio of the voltage at VBKLT to the Supply Voltage. This way, a single potentiometer can be placed between ground and the supply voltage with its center tap wired to the VBKLT input. Changes or fluctuations of the supply voltage (as can happen when lights and avionics are switched on and off) will not affect the brightness of the backlight.

To use this function, a linear potentiometer, valued between 10k ohms and 20k ohms, is placed between the instrument supply and ground. The center tap of the potentiometer is wired directly to Pin-4 of the Lower Connector. The input resistance of this input is 200k ohms and the input is protected by Schottky diodes. A single potentiometer can be used to control several Adaptive Interfaces instruments. The VBKLT input can also be wired into the existing panel lighting circuit.

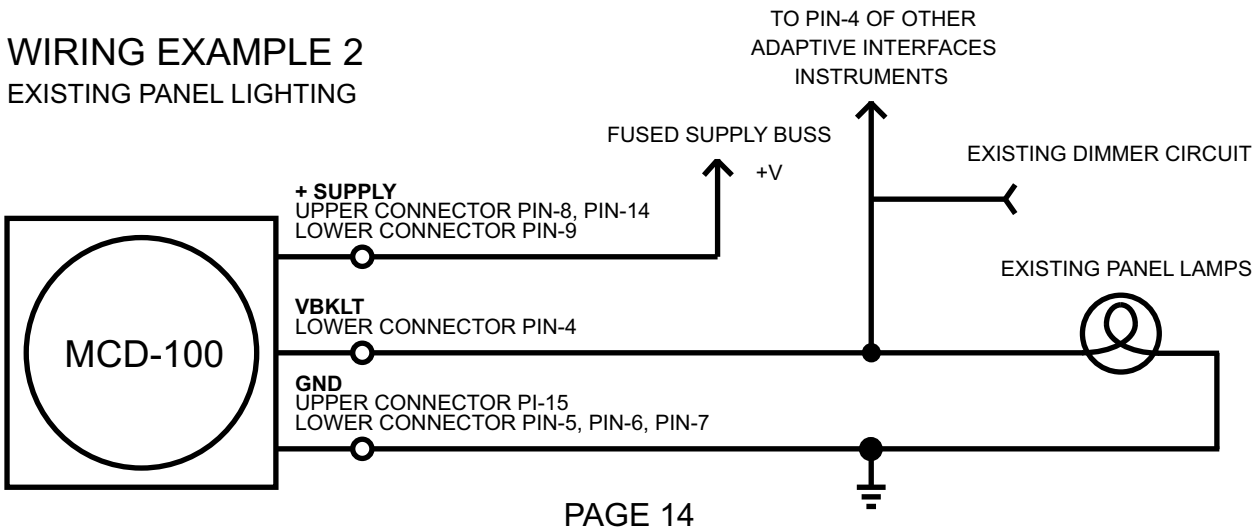
WIRING EXAMPLE 1

SEPARATE CONTROL



WIRING EXAMPLE 2

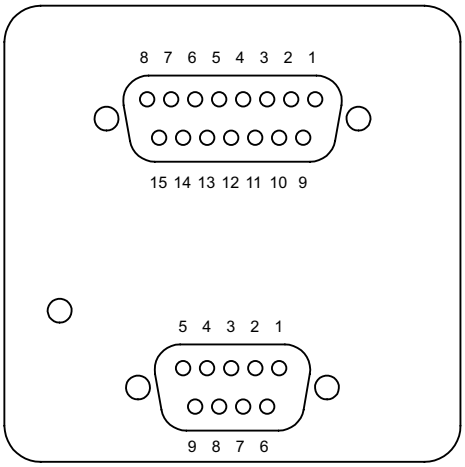
EXISTING PANEL LIGHTING



MCD-100 BACK PANEL

UPPER CONNECTOR

1) D4	4) A4	7) N/C	10) B4	13) C2
2) A1	5) B1	8) +12 Vdc B	11) C1	14) +12 Vdc A
3) A2	6) STB (STROBE)	9) B2	12) C4	15) GND (GROUND)



LOWER CONNECTOR

1) N/C
2) N/C
3) VDISP (DISPLAY BRIGHTNESS CONTROL VOLTAGE INPUT)
4) VBKLT (BACKLIGHT BRIGHTNESS CONTROL VOLTAGE INPUT)
5) GND (GROUND)
6) GND (GROUND)
7) GND (GROUND)
8) ALRM (ALARM OUTPUT - OPEN COLLECTOR)
9) +12 Vdc C

COMMON TRANSPONDER CONNECTIONS

MCD-100

MCD-100 UPPER CONNECTOR

SIGNAL	D4	A1	A2	A4	B1	B2	B4	C1	C2	C4	STROBE
PIN	1	2	3	4	5	9	10	11	13	12	6

MODEL	CONNECTOR										
ARC (CESSNA) RT359A, RT459A, RT859A		10	14	13	15	19	17	16	21	18	20	11
BECKER ATC 2000	J4204	23	16	15	14	17	19	18	22	21	20	(1)
BECKER ATC 3401	P8	23	16	15	14	17	19	18	22	21	20	(1)
BECKER ATC 4401	P1	20	1	2	3	14	15	16	17	18	19	(1)
BENDIX TR541A, TR641A, TR641B		(2)	A	B	C	D	E	F	H	J	K	(1)
BENDIX TPR-660, TPR-2060, TPR-2061		(2)	4	6	8	9	10	11	3	5	7	(1)
CESSNA RT359A, RT459A, RT859A		10	14	13	15	19	17	16	21	18	20	11
COLLINS TDR-950, TDR-950L		(2)	12	10	7	6	5	4	8	11	9	(1)
EDO-AIRE RT-777		15	7	5	3	12	13	14	8	6	4	2
GARMIN GTX 320	P102	18	3	5	6	9	11	12	10	4	7	(1)
GARMIN GTX 320A, GTX 327	P3271	18	3	5	6	9	11	12	10	4	7	(1)
GENAVE BETA 5000		3	4	5	6	7	8	9	10	11	12	3
KING KT 75		(2)	6	7	8	9	10	11	12	13	14	5
KING KT 76, KT 78	P1	(2)	6	7	9	4	1	2	3	8	10	12
KING KT 76A, KT 76C, KT 87A, KT 79	P1	8	M	K	J	E	C	B	D	L	H	(1)
MICROAIR T2000		21	9	10	11	12	13	17	18	19	20	(1)
NARCO AT5, AT6, AT6A		(2)	2	4	8	9	10	11	1	3	5	12
NARCO AT50, AT50A (3)	P101	(2)	7	6	8	12	10	9	14	11	13	5
NARCO AT 150, AT 155	P101	(2)	7	6	8	12	10	9	14	11	13	(1)
NARCO AT 165	P101	(2)	7	6	8	12	10	9	14	11	13	(1)
NARCO AT 165C	P900	(2)	14	13	15	19	17	16	21	18	20	(1)
RADAIR 250		15	7	6	13	9	10	11	14	16	12	19
TERRA TRT250, TRT250D		9	5	17	16	15	2	14	3	4	18	(1)
UPS APOLLO SL70		35	13	31	12	33	14	32	16	34	15	(1)
WILCOX 1014A		(2)	k	c	W	T	L	D	P	f	Z	(1)

(1) This transponder does not have a strobe output and does not use the strobe function. Disable the strobe function of the MCD-100 by tying Pin-6 of the Upper Connector to common ground or by setting the "Sb" function to OFF in MENU LEVEL 1.

(2) This transponder does not use the D4 input. Leave the D4 (Pin-1 of the Upper Connector) input of the MCD-100 unconnected.

(3) Unmodified versions of the Narco AT50A can be unstable with some altitude encoders. Be sure the AT50A is modified in accordance with Narco Service Bulletin AT-50A-5.

This connection list is provided only as an information reference. Adaptive Interfaces does not guaranty the accuracy of this information. Always refer to the transponder manufacturer's technical manual for electrical connections.