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CoPilot

User's Manual



*Flight Planning Software for
Palm OS® Handhelds*

Laurie J. Davis

Version 5.3

CoPilot User's Manual

Flight Planning Software for Palm OS® Handhelds

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General Description

CoPilot is an application program for Palm OS® handhelds that performs flight-planning calculations – the calculations that are normally performed with a ruler, a protractor and an E6B calculator. CoPilot does time, distance, heading, fuel, and weight & balance calculations. It prepares flight plans (Canadian, American, and ICAO formats) with all the information required when calling the FSS. It also has utilities to aid in plotting routes on a map. CoPilot stores the data for all flights in the flight database.

Install CoPilot by double clicking on the CoPilot.prc file and then perform a HotSync. CoPilot requires that MathLib be installed on the Palm OS® handheld to support trigonometric functions. Install MathLib by double clicking on the MathLib.prc file and then perform a HotSync. Some devices (such as the Handspring Visor) have MathLib built in; therefore it does not need to be installed. CoPilot requires Palm OS® 3.5 or higher in order to operate, and occupies approximately 325K of memory (excluding MathLib). CoPilot also requires HotSync version 2.1 or higher.

Component Overview

Before planning a flight, basic information must be entered into three databases: an aircraft database which stores information about the aircraft, a pilot database which stores information about the pilot, and a waypoint database which stores information about points along the route. Details on database entry and editing are available in the “Database Entry” section on page 4.

CoPilot is based on the concept of a flight. A flight consists of four components – a flight description, a route, a weight and balance calculation, and a flight plan. Each of these components has an associated form. The information entered on these forms is automatically stored in the flight database.


Flight Description   

Description:
 Rockcliffe to Toronto Island




Aircraft: ▼ C-GXBU
 Pilot: ▼ Davis, Laurie

Date: Sat Jan 12, 2002
 10:30 am 15:30 Z

Note:


 The *Flight Description* form is used to enter basic information about the flight. Aircraft and pilot information must have been previously entered into their respective databases in order to have them available for selection on this form (see page 4 – “Database Entry”). This form also contains buttons to create a new flight, display an existing flight in the database, or delete the currently displayed flight from the database.

Detail on the use of this form is provided in the “Trip Planning” section on page 8.




Route   

	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➔	10.6	278	279	0:07
• YOW				
➔ +	185.0	249	252	1:47
• CYTZ				
<input type="checkbox"/>				
<input type="checkbox"/>				

21.4 gal 195.6 1:54

 The *Route* form is used to specify the legs of the flight. A leg is a section of the route between two waypoints. For each leg, the distance, the magnetic track, the magnetic heading, and the estimated time enroute are displayed. The waypoints must have been previously entered into the waypoint database in order to make them available for selection on this form (see page 4 – “Database Entry”).


Detail on the use of this form is provided in the “Trip Planning” section on page 8.

Weight & Balance   

Basic empty	1357	lb
Fuel (max 50 gal)	50	gal
Pilot	170	lb
Front passenger	115	lb
Rear passenger	25	lb
Rear passenger		lb
Bag (max: 200 lbs)	20	lb


Reserve

	Wgt	Arm
2:51 ♦ Ramp	1987	88.6
<input type="button" value="Init"/> ♦ Takeoff	1977	88.6
♦ Landing	1858	88.2
<input type="button" value="Graph"/> ♦ No Fuel	1687	87.5


 The *Weight & Balance* form is used to calculate and plot the aircraft weight and balance. The aircraft specific data must have been previously entered into the aircraft database (see page 4 – “Database Entry”).

The weight and balance is calculated for various phases of the route (e.g. takeoff, landing). The route is defined on the *Route* form.

Detail on the use of this form is provided in the “Trip Planning” section on page 8.

Flight Plan 23:54 Z   

Aircraft Ident: C-GXBU
 Flight Rules: V(VFR)
 Type of Flight: G (General)
 # of Aircraft: 1
 Aircraft Type: P28A
 Wake Turb: L (Light)
 Equipment: LOVG/C
 Dep. Ident: CYRO
 Dep. Time: 15:30 Z
 Cruise Speed: 115 knots
 Altitude: 1500

 The *Flight Plan* form is used to collect the data required when calling the FSS to file a flight plan. It supports the standard ICAO flight plan format as well as the Canadian and American formats. Most of the form is automatically generated using information from the aircraft database, the pilot database, the *Flight Description* form, the *Route* form, and the *Weight & Balance* form.

Detail on the use of this form is provided in the “Trip Planning” section on page 8.

Menus



There are several menus used by CoPilot. The key one is the *Record* menu. The *Record* menu has items to add/edit aircraft, pilots, and waypoints. These menu items open the associated database entry forms. The database entry forms are described in detail in the "Database Entry" section on page 4.

The edit items open forms with a list of the items in the database. For example, the *Edit Aircraft...* item opens a form with a list of all the aircraft in the aircraft database. When an aircraft is selected, the data entry form for the specified aircraft opens.

The *Record* menu also has items to send an aircraft, pilot, or waypoint to another Palm handheld. The method of sending depends on the configuration of the Palm handheld, but beaming via the infrared port is usually available.

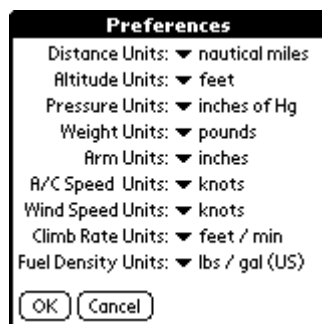
The *Edit* menu provides the basic Palm edit commands (*Cut*, *Copy*, *Paste*, *Undo*, and *Select All*). It also provides items to display the keyboard and the Graffiti help screen.

A simple calculator is also provided on the *Edit* menu. If a number is highlighted when the calculator is opened, the calculator is initialized with that number. If the cursor is in a data field when the calculator is opened, the result of the calculation can be entered into the field with the *Paste* button.

The *Flight Description* form has a special *Flight* menu with an item to duplicate the entire flight, an item to estimate the cost of the flight (see "Cost Estimates" on page 20), and an item to print the flight information (see "Printing" on page 21). The *Route* form has a special *Route* menu with an item to reverse the route. The *Edit Aircraft* form has a special *Aircraft* menu with an item to duplicate the entire aircraft entry. The *Weight & Balance* form has a special *W&B* menu with an item to show the fuel summary for the route.

The *Options* menu contains an *About CoPilot* item that shows the CoPilot version number, a *Database Info* item that shows the size of all the CoPilot databases, and a *System Waypoint Info* item that displays information about the system waypoint database.

Measurement Units



The *Options* menu has a *Preferences...* item that opens a form on which the measurement units are specified. This form also opens when the CoPilot application is first launched (it keeps opening on each launch until the *OK* button is tapped).

The chosen units are used to input data and display results. The data is actually stored in the databases using a "neutral" set of units; therefore, when the preferences are changed, existing data is displayed correctly (converted to the new units).

The units can be temporarily changed in order to enter or view data in a set of units that are not normally used. For example, if aircraft speed is normally measured in knots, the *A/C Speed Units* would be set to knots in the *Preferences* form. In order to enter data for an aircraft that has speed measured in miles per hour, simply set the preferences form to miles per hour (*A/C Speed Units*), enter the data into the aircraft database, and then set the preferences form back to knots.

The fuel measurement unit is set in the aircraft database rather than the *Preference* form. Since some aircraft measure fuel by volume (e.g. gallons or litres) and some aircraft measure fuel by weight (e.g. pounds or kilograms), the fuel measurement unit is specified for each aircraft.

Database Entry

Note: required entries are indicated on the database entry forms in **bold**.

Edit Aircraft Form

There are seven *Edit Aircraft* sub forms. The specific sub form to be edited is chosen using the buttons at the top of the form. Although there is much information that may be entered, most of it is optional. **The only mandatory data is the aircraft ident (*Gen* form), and at least one cruise speed (*Cruise* form).**

The units to be used are specified on the *Preferences* form (*Options* menu).

The *Edit Aircraft* forms have an *Aircraft* menu with an item to duplicate the entire aircraft entry.

The screenshot shows the 'Edit Aircraft' form with the 'Gen' tab selected. The fields are: Ident: C-GXBU, Type: P28A, Wake Turb: Light, ELT: AF, Homebase: CYRO, Fuel Density: 6.01 lb/gal (US), Start/Taxi Fuel: 1.6 gal (US), and Description: white with green trim. There are OK, Cancel, and Delete buttons at the bottom.

The first *Edit Aircraft* form (*Gen*) specifies basic information about the aircraft. **The only required field is the aircraft ident.**

Type, Wake Turbulence, ELT, Homebase, and Description are used to complete the *Flight Plan* form.

Valid wake turbulence entries are Light, Medium, or Heavy.

Valid ELT (Emergency Locator Transmitter) entries are A (Automatic ejectable), AD (Automatic Deployable), F (Fixed), AF (Automatic Fixed), AP (Automatic Portable), P (Personnel), W (Water activated), or S (Survival).

The Start/Taxi Fuel is added for each takeoff when performing fuel consumption calculations.

The units that are chosen for the Start/Taxi fuel are used for all subsequent fuel displays for this aircraft.

Fuel density is used to convert between fuel measured by weight and fuel measured by volume. It is possible to switch between fuel units. For example, it may be desirable to enter all of the database items in pounds, but display fuel consumption in gallons. Simply set fuel units to pounds, fill in the aircraft database forms, and then switch the units back to gallons. The data that was entered in pounds is now displayed in gallons.

The screenshot shows the 'Edit Aircraft' form with the 'Cruise' tab selected. It displays a table for 'Cruise Performance' with columns for Altitude, TAS, and Fuel Flow. The example data is: Altitude 0, TAS 110, Fuel Flow 10.0; Altitude 8000, TAS 120, Fuel Flow 10.0. There are OK, Cancel, and Delete buttons at the bottom.

The second aircraft form (*Cruise*) collects the data used to calculate cruise performance. **At least one altitude and cruise speed must be entered.**

Note: The cruise airspeed entered on this form should be the **true** airspeed (TAS) at the specified altitude.

The program fits a quadratic curve to the points given, and calculates cruise speed and fuel flow at a given altitude using this mathematical model of the cruise performance. Populate this table based on the method used for flying the aircraft (for example, some pilots fly at a constant RPM regardless of altitude, while other pilots fly at a constant brake horsepower by changing

RPM as they change altitude). As long as the data matches the flying method, CoPilot correctly calculates the cruise performance. The example uses a constant brake horsepower (75%).

The performance model derived from this data is most accurate if the data is provided for a wide range of altitudes. If possible, include the sea level data.

If the fuel flow information is not provided, fuel consumption is not calculated.

Edit Aircraft				
Gen	Cruise	Climb	Equip	WB 1 WB 2 \$
Climb Performance				
Altitude	Rate	IAS	Fuel Flow	
0	750	74	16.0	
16400	100	74	12.0	
.....	
.....	
.....	
OK Cancel Delete				

The third aircraft form (*Climb*) collects the data used to calculate climb performance and climb fuel consumption. Climb performance (time to climb, distance to climb, etc.) is used to estimate flight times. In most cases, the two easiest altitudes to enter are zero (sea level) and the service ceiling. Note: the service ceiling is defined as the altitude at which the climb speed drops to 100 ft/min. If two altitudes are entered, it is assumed that the values change linearly between sea level and the service ceiling. If more than two altitudes are entered, the program fits a quadratic curve to the points given, and performs the calculations by integrating the appropriate curves.

Note: The climb airspeed entered on this form should be the **indicated** airspeed (IAS) at the specified altitude.

It is very important to include a wide range of altitudes. The time to climb and the fuel to climb are calculated by integrating the equations that are derived from the data. It is important that the data is provided for a full range of altitudes from sea level to the service ceiling. A wide range of altitudes results in the most accurate mathematical model of the aircraft performance.

Edit Aircraft				
Gen	Cruise	Climb	Equip	WB 1 WB 2 \$
Climb Performance				
Altitude	Rate	IAS	Fuel Used	
0	645	78	
2000	560	76	0.7	
4000	480	74	1.5	
6000	395	72	2.3	
8000	315	70	3.3	
10000	230	68	4.5	
12000	145	66	6.1	
.....	
OK Cancel Delete				

There is an option for entering fuel as *Fuel Flow*, which is the flow rate (e.g. in gallons per hour) when climbing **through** the specified altitude, or *Fuel Used* which is the amount of fuel (e.g. in gallons) required to climb **to** the specified altitude. Most light aircraft manuals specify the amount of fuel required to climb **to** various altitudes. The C172 manual provides climb fuel as a measure of fuel required to climb to a specified altitude. In the example shown, the column header has been changed to *Fuel Used* and the number of gallons required to climb **to** the specified altitude is entered.

If this climb data is not provided, the leg times assume that the aircraft is already at the cruising altitude (i.e. no extra time is added for the climb). In practice, this is not a big problem since it is easy to add an estimate of climb time.

The additional fuel used for climbing is calculated. If the information is not supplied, the cruise fuel flow is used for the climb.

CoPilot does not perform descent calculations -- it assumes that descent is at cruise speed.

Edit Aircraft				
Gen	Cruise	Climb	Equip	WB 1 WB 2 \$
Climb Performance				
Altitude	Rate	IAS	Fuel Flow	
0	730	76	18.0	
10000	400	76	16.0	
10000	400	76	16.0	
13000	250	69	14.8	
16400	100	65	14.0	
.....	
OK Cancel Delete				

There are cases when there is a different climb profile for different parts of the climb. For example, high power for the first part of the climb, and then a lower power for the remainder of the climb. CoPilot can accommodate two climb profiles. If an altitude is repeated, two equations are calculated. The first equation is used when climbing below the repeated altitude, and the second equation is used when climbing above the repeated altitude.

In the example shown, a linear equation is calculated for climbs below 10,000 feet (linear since two data points are given), and a quadratic equation is calculated for climbs above 10,000 feet (quadratic since more than two data points are given).

Edit Aircraft ⓘ

Gen | Cruise | Climb | Equip | WB 1 | WB 2 | \$

Communication Navigation

VHF VOR

Mode A ADF

Mode C ILS

Mode A DME

Mode C RNAV

Mode A Loran C

Mode C VFR GPS

IFR GPS

OK Cancel Delete

The fourth aircraft form (*Equip*) collects the data used to prepare the flight plan. This form specifies the equipment installed (and certified if required) in the aircraft.

CoPilot uses this data to determine the COM/NAV/SSR suffixes for the ICAO or Canadian flight plan, and the type and equipment field for the American flight plan

Edit Aircraft ⓘ

Gen | Cruise | Climb | Equip | WB 1 | WB 2 | \$

Arm	Wgt	Tank	Description
86.5	1357.0		Basic empty
95.0	300.5	1	Fuel (max 50 gal)
85.5			Pilot
85.5			Front passenger
118.1			Rear passenger
118.1			Rear passenger
142.8			Bag (max 200 lbs)

OK Cancel Delete

The fifth aircraft form (*WB 1*) collects data required to calculate the weight and balance. If the weights are known, they should be entered here. If the weights are not yet known, they are entered when the data specific to a particular flight (the *Weight & Balance* form) is entered. For example, the basic empty weight of the aircraft is known ahead of time, but until a specific flight is planned, the weight for pilot, passengers, baggage, etc. is not known. The weight on these lines should therefore be left blank.

The weights that are entered on this form are the default values for the *Weight & Balance* form, therefore it may be desirable to enter values that are “usually” correct, but may change. For example, if the aircraft is normally flown with full fuel, the fuel weight could be entered on this form, and then changed on the *Weight & Balance* form on those occasions when the aircraft is flown without full fuel.

The tank column is used to indicate that the item is a fuel tank. The number indicates the order in which the tanks are used. If a set of tanks are used simultaneously, they should all have the same number.

The descriptions are used to prompt for input when the weight and balance is entered for a specific flight. The arm must be specified for each item.

There is no limit to the number of weight and balance stations. A scrollbar appears when the eighth arm is entered.

Edit Aircraft ⓘ

Gen | Cruise | Climb | Equip | WB 1 | WB 2 | \$

Normal		Utility	
Weight	Arm	Weight	Arm
1300.0	84.0	1300.0	84.0
1650.0	84.0	1650.0	84.0
1990.0	86.0	1950.0	85.8
2400.0	92.0	1950.0	86.5
2400.0	94.0	1300.0	86.5
2200.0	96.0		
1300.0	96.0		

OK Cancel Delete

The sixth aircraft form (*WB 2*) collects the data used to plot the weight and balance graph. Enter the points on the weight and balance envelope. Start at the lowest arm and enter the points as they appear along the curve.

If the aircraft manual only has a graph that shows weight versus moment, the arm must be calculated by dividing the moment by the weight to get the arm. This calculation is performed for each of the “corners” along the curve. More detail on populating this form from the graphs in the aircraft manual can be found in “Appendix B: Weight & Balance Database Entry” on page 26.

Edit Aircraft ⓘ

Gen Cruise Climb Equip WB 1 WB 2 \$

This data is used to estimate the cost of a flight in this aircraft.

Time: per hour

Distance: per nm

Legs: per takeoff

On the flight cost form you will select whether to use the time, distance or leg based cost (or the sum of the selected costs).

OK Cancel Delete

The seventh aircraft form (\$) collects the data used to estimate the cost of a flight in this aircraft. The cost is specified as an amount per hour, an amount per unit distance (distance unit as specified on the *Preferences* form), and/or an amount per takeoff. On the *Flight Cost* form (see “Cost Estimates” on page 20), it is possible to select which of these amounts is included in the cost of a particular flight.

Edit Pilot Form

Edit Pilot ⓘ

Last Name: Davis.....

First Name: Laurie.....

Licence: PA733996.....

Phone: (819) 827-3317.....

Address: 116 Ojai Road.....
Chelsea Quebec.....
J9B 1Y7.....

OK Cancel Delete

The *Edit Pilot* form collects the data used to complete the flight plan. All of this information is optional, but if a pilot is added to the database, the minimum information required is the last name.

Edit Waypoint Form

Edit Waypoint ⓘ

System Waypoint User Waypoint

Ident: CYRO.....

Name: Rockcliffe.....

Latitude: 45..... deg
27..... min ▼ N
37.0..... sec

Longitude: 75..... deg
38..... min ▼ W
46.0..... sec

Mag Var: 14.0..... deg ▼ W

Elevation: 188..... ft

OK Cancel Delete Note

The *Edit Waypoint* form collects the data for waypoints that are used in flight planning.

Latitude and longitude can be entered either as degree/minute/second, or as decimal values. For example, the latitude at Rockcliffe in this example could also have been entered as 45.4603 degrees, or as 45 degrees and 27.62 minutes. Regardless of how they are entered, the latitude and longitude are always displayed in degree/minute/second format.

There is a *Base on Radial/Distance...* menu item on the *Waypoint* menu that allows the latitude/longitude to be specified as a radial and distance from any waypoint already in the database.

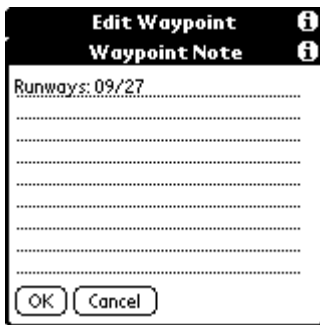
The magnetic variance is used to calculate the magnetic course for the flight.

The elevation is used to calculate the time to climb. If it is not entered, the elevation is assumed to be zero (sea level). The units to be used are specified on the *Preferences* form (see *Options* menu).

There are two categories of waypoints – system waypoints and user waypoints. System waypoints are typically waypoints that are downloaded into CoPilot. User waypoints are waypoints that are manually entered. When a new downloaded database is installed, all of the system waypoints are replaced with the new data, but the user waypoints are preserved. Any waypoint may be specified as either system or user, but it is highly recommended that system waypoints be reserved for downloaded databases.

When searching for waypoints, CoPilot looks for user waypoints before it looks for system waypoints.

The *Note* button opens the *Waypoint Note* form.



The screenshot shows a dialog box titled "Edit Waypoint" with a sub-section "Waypoint Note". The "Waypoint Note" section contains a text area with the text "Runways: 09/27" and several horizontal dotted lines for additional input. At the bottom of the dialog box are two buttons: "OK" and "Cancel".

The *Waypoint Note* form is used to store data about the waypoint. The data on this form is displayed in the *Waypoint Info* window that is opened when the waypoint ident on the *Route* form is tapped (see page 10 - *Route* Form).

Waypoints can be entered manually into CoPilot, or downloaded from the internet. Unfortunately if I want the various download sites to list this application, I am not allowed to give you the url of the website (they do not allow any references to other websites). If you do a search for "CoPilot waypoint database", you should easily find it.

Trip Planning

CoPilot is structured around the concept of a flight. A flight consists of four components – a flight description, a route, a weight and balance calculation, and a flight plan. The information is stored in the flight database.

The navigation buttons at the top of the screen are used to navigate among the four components of the flight.

Flight Description Form

Flight Description [Navigation Icons]

Description:
Rockcliffe to Toronto Island

Aircraft: ▼ C-GXBU
Pilot: ▼ Davis, Laurie

Date: Sat Jan 12, 2002
10:30 am 15:30 Z

Note:
.....
.....

[New] [Select...] [Delete]

CoPilot opens to the *Flight Description* form. This form is used to specify some of the basic elements of a flight.

Description: Enter text to identify this particular flight. When the *Select...* button is tapped in order to retrieve an existing flight from the flight database, the list of descriptions is displayed. Since this field is used to identify flights in the database, it is a required field (all required fields are shown in **bold**).

Aircraft: Use this popup menu to select an aircraft for the flight. CoPilot maintains a database of information specific to particular aircraft in order to calculate performance, weight and balance, etc. Aircraft data must be entered into the database before flight planning can begin (see "Database Entry" section on page 4). This is also a required field. The default value is the last aircraft that was selected.

Pilot: Use this popup menu to select a pilot. This field is optional. The information is used to prepare the flight plan. The default value is the last pilot that was selected.

Date: Specify the date and time using the selector buttons. The date is used to calculate the beginning and end of the aviation day. The default is today's date. The time is used to set the departure time in the flight plan. It is assumed that this is local time. The time is converted to Zulu time for the flight plan.

For OS versions prior to 4.0, the zulu offset is set via the *Zulu Time* menu item in the *Options* menu. For OS version 4.0 and later, the time zone must be set in the system preferences.

Note: Enter any other information about the flight.

New To create a new flight, use the *New* button to clear the form in preparation for entering the information for a new flight. The flight that was previously displayed is saved in the flight database (assuming that the required fields are filled in).

Select... To view or change an existing flight, use the *Select...* button to retrieve the information from the database. This button opens a form with a list of all the flights that are stored in the database (a list of the flight descriptions). The selected flight is displayed. The flight that was previously displayed is saved in the flight database (assuming that the required fields are filled in).

Delete To delete the flight that is currently displayed, use the *Delete* button. This button clears the form and removes the displayed flight from the database.

The *Flight Description* form has a *Flight* menu with an item to duplicate the entire flight.

Route Form

	Dist	Mag Trk	Mag Hdg	ETE
○				
○				
○				
○				

The next step is to plan the route. A route is a set of legs. A leg is a section of the flight from one waypoint to another.

Each blank button on the left side of the form corresponds to a leg of the flight. To add a new leg to a flight, tap on one of the blank buttons to open the *Edit Leg* form.

The *Edit Leg* form is used to enter the start and end waypoints for the leg.

The waypoints are the only required entries on this form. The cruising altitude, wind, atmospheric pressure, and temperature (the expected temperature at the cruising altitude) can also be specified. These items are used to calculate climb and cruise performance.

If the ident of the waypoint is not known, the *Find...* button opens a dialog box that facilitates a search of the waypoint database for any text within the waypoint description or waypoint ident. For example, “Rockcliffe” could have been found by searching for “rock”, or “cliffe”, or “ck” or “yro”. The *New...* button opens the *Edit Waypoint* form in order to add a new waypoint to the database. The small triangle button opens a dialog box with a list of the most recently used waypoints.

- ⬆️ This button is used to interchange the From and To waypoints (if one of the waypoints is shared with the previous or next leg, the waypoint cannot be changed, therefore this button is not visible).
- ➡️ This button is used to copy data from the last leg that was edited (the last leg for which the *OK* button was tapped). The Airway data is only copied if it is blank on the current leg.

The units to be used are specified on the *Preferences* form (see *Options* menu).

If the altitude is not entered, it is assumed to be zero (sea level cruise performance is used, and there is no time and fuel calculations performed for the climb phase). If the wind is not entered, it is assumed to be zero. If the pressure is not entered, it is assumed to be 29.92126 (the pressure altitude is the same as the specified altitude). If the temperature is not entered, it is assumed to be the ICAO standard temperature for the specified altitude (the density altitude is the same as the pressure altitude).

If this leg of the route is on a published airway, the airway can be entered (e.g. “V123”). This information is used to prepare the route description in the flight plan. See “IFR Operations” on page 16 for more information.

The page up/down buttons can be used to display the previous/next leg of a route. The page up/down buttons are the built in buttons below the screen of the Palm handheld. When a page up/down button is pressed, the data for the currently visible leg is saved (if both waypoints were specified) before the new leg is displayed.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➤	10.6	278	279	0:07
• YOW				
➤ +	185.0	249	252	1:47
• CYTZ				
○				
○				
21.4 gal		195.6		1:54

Enter up to 40 legs, as required, to complete the flight. The distance for each leg is displayed along with the magnetic track, the magnetic heading, and the estimated time enroute. The total distance, fuel consumption, and total ETE are also displayed. The fuel (in the bottom left corner) includes the start/taxi fuel, the fuel used for the climb, and the cruise fuel.

The route can be edited by tapping on any of the leg buttons to add a new leg or edit an existing one. A leg can be moved by pressing its button and dragging it to another position. CoPilot only allows a leg to be dragged to a valid position. For example a leg can only be placed directly after another leg if the *To* waypoint of the earlier leg is the same as the *From* waypoint of the later leg. When buttons are dragged around to rearrange a flight, the screen scrolls as the stylus is moved to the top or bottom of the screen.

If a leg is so short that the aircraft is incapable of climbing to the specified altitude, the climb is continued on the next leg.

The scroll bar or the page up/down buttons may be used to scroll the form. The page up/down buttons are the built in buttons below the screen of the Palm handheld.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➤	10.6	278	279	0:07
• YOW				
➤ +	185.0	249	252	1:47
• CYTZ				
○ Land and Takeoff				
• CYTZ				
➤	194.4	064	061	1:37
• CYRO				
40.2 gal		390.1		3:31

If the *From* and *To* waypoints are the same, CoPilot considers this leg a ground leg. It is assumed that the aircraft lands and takes off. The start/taxi fuel and the time to climb to altitude are added to the next leg.

Edit Leg 3 ⓘ

From: CYTZ
Toronto Island

To: CYTZ
Toronto Island

Ground Leg Alternate Leg

Specify a time for this leg that will be added to the total ETE.

Hours: 1..... Minutes: 30.....

OK Cancel Delete

If the ground leg button is tapped, the duration of the ground leg can be specified. The duration of the ground leg is added to the total ETE for the flight. If this ground leg is in the middle of a route, the route description in the flight plan indicates a stopover.

If the *From* and *To* waypoints are the same, the leg can also be specified to be the start of the route to the alternate destination. See “IFR Operations” on page 16 for more information.

Edit Route ⓘ

Change Delete Insert New Seg.

Insert waypoint:

YOW

➤ Waypoint: VIE.....

• VIE Coehill VOR

➤

CYTZ

New... Find...

50% Mid...

OK Cancel

- The tiny button in front of each waypoint can be used to modify the route. The button opens a form that allows a choice among changing the selected waypoint, deleting the selected waypoint, inserting a new waypoint before the selected waypoint, or starting a new segment after the selected waypoint (see “Flight Segments” on page 17 for more information).



This icon indicates the waypoint that was selected.



This icon indicates the waypoint that is being edited.

When inserting a new waypoint, the *Mid...* button displays the twenty waypoints that are nearest a midpoint of the leg. The midpoint is the specified percentage of the way from the previous waypoint to the selected waypoint. In order to split a leg into two, simply specify a 50% midpoint and then select a new waypoint to be inserted into the route. In order to split a leg into three, first select a 33% midpoint to find the first intermediate waypoint, and then select a 50% midpoint of the remaining portion to find the second intermediate waypoint.

If the ident of the new waypoint is not known, the *Find...* button opens a dialog box that facilitates a search of the waypoint database for any text within the waypoint description or waypoint ident. The *New...* button opens the *Edit Waypoint* form in order to add a new waypoint to the database. The small triangle button opens a dialog box with a list of the most recently used waypoints.

CYRO	Jan 12, 2002
Rockcliffe	
Lat: 45° 27.6 N	Lon: 75° 38.8 W
Elevation: 188 ft	Day Start: 12:07 Z
--- -- -- --	Day End: 22:15 Z
Runways: 09/27	

If one of the idents on the *Route* form is tapped, a window opens that displays some useful information about the waypoint. The beginning and end of the aviation day are specified as UTC time, and are valid for the date specified for the flight. CoPilot uses the aviation definition of day and night (night is defined as when the sun is six degrees or more below the horizon). This differs (by about 30 minutes) from the official definition of sunrise/sunset. The Morse code for the ident is also displayed.

After the Morse code, any information that was entered into the *Waypoint Note* field of the waypoint database is displayed (see page 7 - *Edit Waypoint* Form).

Tap anywhere to return to the *Route* form.

From: Ottawa VOR
To: Toronto Island
True Track: 235°
Cruise TRS: 115 knots
Cruise GS: 107 knots
Altitude: 6500 ft
Pressure Alt: 6631 ft
Density Alt: 3903 ft
Fuel: 18.5 gal
Airway:
Climb Dist: 8.1 nm
Time to Climb: 7:15
Cum. ETE: 1:54
ETA: 17:24

If one of the lines of leg information on the *Route* form is tapped, a window opens that displays the details of the leg calculations.

Tap anywhere to return to the *Route* form.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➔	194.4	251	254	1:50
• CYTZ				
○ Land and Takeoff				
• CYTZ				
➔	194.4	064	061	1:37
• CYRO				
○				
39.6 gal	388.8			3:27

This example explains some of the calculations. The first leg is from CYRO to CYTZ, and the second leg is from CYTZ back to CYRO. A blank leg separates the two legs; therefore, the legs are treated as two independent flights. It is assumed that the aircraft lands in CYTZ and takes off again; therefore, the second leg includes a calculation of the time to climb out of CYTZ. The start/taxi fuel is included twice in the total fuel consumption.

The distances are the same, but there are different times for the two legs. The ETE for the first leg is 1:50, and the ETE for the second leg is 1:37. The most obvious reason for the difference is the wind. The first leg has a headwind and the return leg has a tailwind. There are three other possible contributors to the difference. First, the pressure and temperature may be different for the two legs. Differences in pressure or temperature affect the density altitude; therefore, the cruise speed and the time/distance to climb. Second, the altitude may be different for the two legs. This affects both the time/distance to climb and the cruise speed. Third, the starting altitude (elevation of the departure point) is different for the two legs; therefore, the time/distance to climb is different.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➤	194.4	251	254	1:50
• CYTZ				
➤	194.4	064	061	1:34
• CYRO				
○				
○				
36.7 gal		388.8		3:24

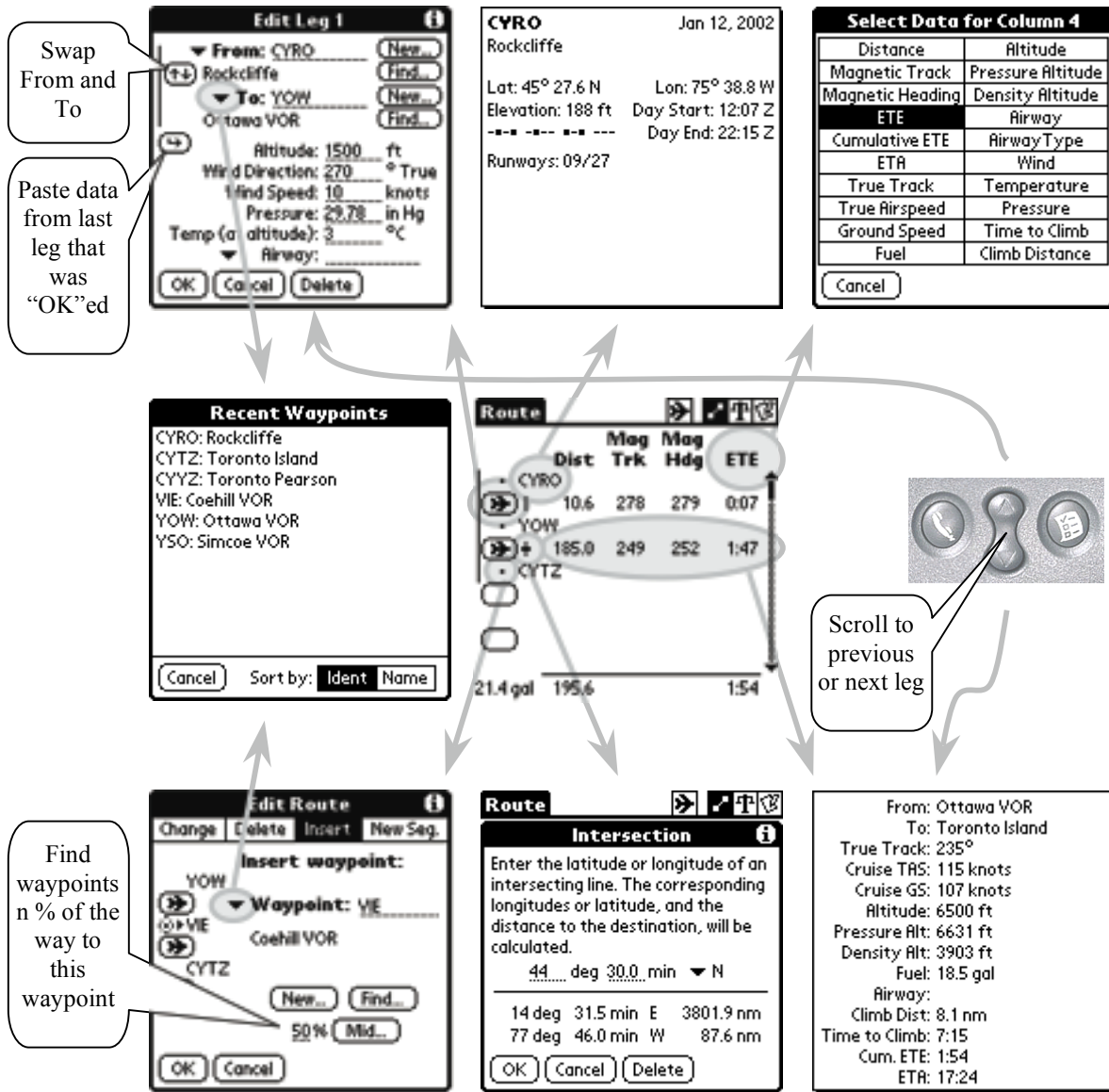
This example looks similar to the previous one, but there is one key difference. In this example there is not a blank leg between the two legs, therefore it is assumed that this is one flight. It is assumed that the aircraft flies over CYTZ and returns to CYRO. If the altitude of the second leg is higher than the first leg, the time to climb to the second altitude is calculated. The time to descend to a lower altitude (or to land) is not calculated, since it is assumed that descent is at cruise speed.

Route				
	Climb Time	Climb Dist	Cum ETE	Cum Fuel
• CYRO				
➤	1:45	1.8	0:07	1.3
• YOW				
➤ +	7:15	8.1	1:54	18.5
• CYTZ				
○				
○				
21.4 gal				

The *Route* form can be customized to display many different pieces of data. Tap on the column header to select the data that is displayed.

The fuel total in the bottom left corner is the total fuel for the flight. The Start/Taxi fuel that was specified in the aircraft database is added each time the aircraft takes off.

The *Route* form has a *Route* menu with an item to reverse the entire route.



Weight & Balance Form

Weight & Balance		
Basic empty	1357	lb
Fuel (max 50 gal)	50	gal
Pilot	170	lb
Front passenger	115	lb
Rear passenger	25	lb
Rear passenger		lb
Bag (max 200 lbs)	20	lb
Reserve	Wgt	Arm
2:51	◆ Ramp	1987 88.6
<input type="button" value="Init"/>	◆ Takeoff	1977 88.6
<input type="button" value="Graph"/>	◆ Landing	1858 88.2
	◆ No Fuel	1687 87.5

Once the flight route has been planned, the weight and balance can be checked. Enter the weight of the various items, and the total weight and arm are displayed at the bottom of the form.

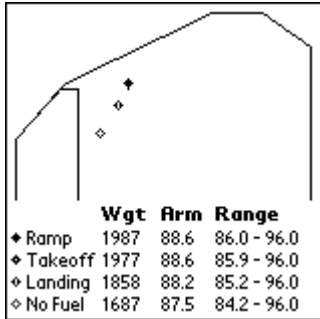
The units are specified on the *Preferences* form (see *Options* menu). If the station was specified in the aircraft database as a fuel tank, the units for the station are fuel units as specified in the aircraft database (*Gen* form).

If a weight was entered in the aircraft database, it is displayed here as a default value. These default weights can be changed for a particular flight.

The takeoff w&b is adjusted by subtracting the start/taxi fuel as defined in the aircraft database (*Gen* form). The landing weight is adjusted by subtracting the enroute fuel. The zero fuel weight is adjusted by subtracting

the total fuel load. Fuel is subtracted from the tanks in the order specified in the aircraft database (*WB I* form).

The fuel reserve is based on the amount of fuel remaining at the destination. It is based on the average cruise altitude of the flight. A warning message is displayed if there is not enough fuel available to reach the destination.



The graph button opens a window that displays the weight and balance graph.

The range is the valid arm range for the specified weight.

Tap anywhere to return to the *Weight & Balance* form.

The *Weight & Balance* form has a *W&B* menu with an item to display the fuel summary.

Flight Plan Form

Flight Plan 23:54 Z

Aircraft Ident: C-GXBU
 Flight Rules: V (VFR)
 Type of Flight: G (General)
 # of Aircraft: 1
 Aircraft Type: P28A
 Wake Turb: L (Light)
 Equipment: LOVG/C
 Dep. Ident: CYRO
 Dep. Time: 15:30 Z
 Cruise Speed: 115 knots
 Altitude: 1500

Canadian American ICAO

The next step in planning a flight is to fill in the *Flight Plan* form. It is possible to specify whether the flight plan is to be completed in Canadian, American, or ICAO standard formats. CoPilot partially completes the flight plan with information specified on other forms.

The items that need to be added are underlined (e.g. # persons). Some of these items can be changed, but default values are entered (e.g. Flight Rules = VFR). These default values are “sticky” – they are saved in the pilot database, therefore the default is the last value that was entered for the pilot.

If fuel tanks are specified in the aircraft database, the Fuel on Board is calculated automatically. The available fuel is taken from the *Weight & Balance* form and the endurance is calculated by adjusting for the start/taxi fuel and the time to climb. The cruise speed used for the calculation is the weighted average cruise speed for the various legs.

The Zulu time is displayed at the top of the form. If the device is running Palm OS 4.0 or later, the Zulu time is calculated using the system preferences. For OS versions earlier than 4.0, tap on the time to open a form that allows the offset to be set.

IFR Operations

CoPilot has a number of features to facilitate IFR flight planning.

Route				
	Alt	Air way	ETE	Cum ETE
• CYRO				
➤	6500		0:09	0:09
• YOW				
➤	6500	V300	0:55	1:04
• VIE				
➤	6500	V300	0:34	1:38
• YSO				
➤	6500		0:20	1:59
• CYTZ				
22.3 gal			1:59	

Multiple legs of a route may actually be a part of a single airway. The airway designations are entered on the *Edit Leg* forms.

Flight Plan	
23:53 Z	
Equipment: LOWG/C	
Dep. Ident: CYRO	
Dep. Time: 21:00 Z	
Cruise Speed: 115 knots	
Altitude: 6500	
Route: to YOW, V300 to YSO	
Dest. Ident: CYTZ	
ETE: 1:59	
SRR Time: 1:00	
Alt. Ident: CYYZ	
Canadian American ICRO	

The flight plan route is summarized to eliminate waypoints that are intermediate waypoints along an airway.

In addition to specifying a leg to be a part of an airway, legs can also be specified to be part of a SID (Standard Instrument Departure), a STAR (Standard Terminal Arrival), or an Approach. All of these legs are included in the route calculations (e.g. flight time and fuel consumption). Legs specified to be part of an Airway, SID, or STAR are summarized on the flight plan route. Legs specified to be part of an Approach are not included on the flight plan route.

Edit Leg 2	
From: CYTZ	Toronto Island
To: CYTZ	Toronto Island
<input type="checkbox"/> Ground Leg <input checked="" type="checkbox"/> Alternate Leg	
The rest of the segment is for the route to the alternate destination.	
<input type="button" value="OK"/> <input type="button" value="Cancel"/> <input type="button" value="Delete"/>	

A section of a route may be specified as a route to an alternate destination. The alternate destination is entered into the flight plan.

The start of the route to the alternate destination is specified by entering a leg with the *From* and *To* waypoints set to the primary destination. Any legs after this leg are considered part of the route to the alternate destination.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• VIE				
➤	60.6	258	260	0:34
• YSO				
➤	37.9	205	210	0:20
• CYTZ				
➤	Route to Alternate			
• CYTZ				
➤	10.6	296	295	0:09
• CYYZ				
22.6 gal			205.6	1:59

In this example, the primary destination is CYTZ and the alternate destination is CYYZ. Totals on the *Route* form are calculated to the primary destination. Totals to the alternate destination can be seen by tapping on the segment bar on the left side of the form.

The ETE on the *Flight Plan* form is the time to the primary destination. The flight cost (see "Cost Estimates" on page 20) is calculated to the primary destination. The fuel reserve on the *Weight & Balance* form is for the alternate destination.

Flight Segments

A route can be split into multiple segments. A segment is defined as a set of legs that specify a subset of the total route for which separate calculations are desired. For each segment, a new weight and balance calculation is performed and a new flight plan is created.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➤ I	10.6	278	279	0:07
• YOW				
➤ +	185.0	249	252	1:47
• CYTZ				
○ Land and Takeoff				
• CYTZ				
➤ I	194.4	064	061	1:37
• CYRO				
40.2 gal 390.1				3:31

The example shows a return trip from Toronto Island. The route is considered one segment, as indicated by the segment bar on the left side of the form. Since the weight & balance is different for the return trip, and a new flight plan must be filed, the route is split into two segments.

Edit Route ⓘ

Change Delete Insert New Seg.

New segment at:

YOW

➤ Waypoint: CYTZ.....

○ Toronto Island

○

▶CYTZ

○

New... Find...

OK Cancel

There are two ways to split an existing segment. The tiny dot before the waypoint identifiers opens an *Edit Route* dialog box. This form allows the insertion of a new segment and the specification of the waypoint that will start the new segment. This waypoint defaults to the primary destination of the previous segment.

Edit Leg 3 ⓘ

End: CYTZ
Toronto Island

Start: CYTZ
Toronto Island

Start new segment

Ground time:

Hours: 1..... Minutes: 30.....

DepartureTime: 18:54 Z

OK Cancel Delete

The *Edit Leg* form also has an option to start a new segment. There is a segment bar on the left side of the waypoints. Tapping on this bar changes the leg into a “new segment” leg.

Route				
	Dist	Mag Trk	Mag Hdg	ETE
• CYRO				
➤ I	10.6	278	279	0:07
• YOW				
➤ +	185.0	249	252	1:47
• CYTZ				
○ New Segment				1:30
• CYTZ				
➤ I	194.4	064	061	1:37
• CYRO				
40.2 gal 390.1				3:31

When the route is split into multiple segments, the segment bar on the left side of the form indicates how the route has been split.

From: Rockcliffe
To: Toronto Island
Distance: 195.6 nm
Time: 1:54
Fuel: 21.4 gal
Alt:
Distance:
Time:
Fuel:
Total
Distance: 195.6 nm
Time: 1:54
Fuel: 21.4 gal

Tapping on a segment bar opens a window that displays a summary of the data for that segment. If an alternate destination is defined, a summary of the route to the alternate is also displayed (see “IFR Operations” on page “16”).

Weight & Balance		
CYRO - CYTZ		
Basic empty	1357	lb
Fuel (max 50 gal)	50	gal
Pilot	170	lb
Front passenger	115	lb
Rear passenger	25	lb
Rear passenger		lb
Reserve	Wgt	Arm
2:51	◆ Ramp	1988 88.6
	◆ Takeoff	1978 88.6
	◆ Landing	1859 88.2
	◆ No Fuel	1687 87.5
<input type="button" value="Init"/>		
<input type="button" value="Graph"/>		

The *Weight & Balance* and *Flight Plan* forms display separate subforms for each segment.

- ▶ Display the next segment.
- ◀ Display the previous segment.
- ↵ Copy data from the previous segment.
- ↶ Copy data from the next segment.



Weight & Balance		
CYRO - CYTZ		
Fuel Summary		
	gal (US)	lb
Start/Taxi:	1.6	9.6
Top of Climb:	2.1	12.4
Destination:	21.4	128.8
Alternate:		
Reserve:	28.6	171.7
On Board:	50.0	300.5
<input type="button" value="Cancel"/>		

The *Fuel Summary* form displays the fuel summary for the currently displayed segment.

Weight & Balance		
CYTZ - CYRO		
Basic empty	1357	lb
Fuel (max 50 gal)	29	gal
Pilot	170	lb
Front passenger	115	lb
Rear passenger	25	lb
Rear passenger		lb
Reserve	Wgt	Arm
0:59	◆ Ramp	1859 88.2
	◆ Takeoff	1849 88.1
	◆ Landing	1746 87.7
	◆ No Fuel	1687 87.5
<input type="button" value="Init"/>		
<input type="button" value="Graph"/>		

There is a button on the top left of the *Weight & Balance* form that specifies if the aircraft is refueled for this segment. If the button is set to “no refuel” (as shown here), the fuel stations are set to the fuel remaining from the previous segment(s). Tapping the button sets it to “refuel”, and the fuel for the segment is entered. Setting the button to “refuel” will set the fuel to the default value from the aircraft database.

E6B Functions

Cross Wind i	
True to Magnetic Wind	
West: add magnetic variance East: subtract magnetic variance	
Wind: 230.....	degrees (magnetic)
12.....	knots
Runway: 27.....	
Crosswind: 8	knots 
Headwind: 9	knots 
<input type="button" value="OK"/>	

The *Options* menu contains a *Cross Wind...* item. Enter the wind direction/speed and runway, and the crosswind and headwind components are calculated.

DA & TAS i	
Altitude: 6500.....	ft
Pressure: 29.78.....	in Hg
Indicated Airspeed: 112.....	knots
▼ True Temp: -20.....	°C
<hr/>	
Pressure Altitude: 6631	ft
Density Altitude: 3903	ft
True Airspeed: 118.6	knots
Mach #: 0.191	
<input type="button" value="OK"/> True Temp: -20 °C	

The *Options* menu also contains a *Density Alt & True Airspeed...* item. Enter the altitude and pressure, and the pressure altitude is calculated. Enter the indicated airspeed and the true airspeed and Mach number are calculated (if the temperature has not yet been entered, a standard lapse rate is assumed). Enter the true temperature and the airspeed is corrected for temperature effects.

Temperature can be entered either as true or indicated. If indicated temperature is entered, CoPilot first calculates the true temperature by compensating for air compressibility.

Winds Aloft i	
Mag. Track: 249.....	degrees
Mag. Heading: 252.....	degrees
True Airspeed: 115.....	knots
Ground Speed: 107.....	knots
<hr/>	
Wind Direction: 287	degrees
Wind Speed: 10	knots
<input type="button" value="OK"/>	

The *Options* menu also contains a *Winds Aloft...* item. The wind speed and direction are calculated from the true airspeed, ground speed, heading, and course.

Cost Estimates

CoPilot has a facility for estimating the cost of a flight. For each aircraft, the cost per hour, the cost per unit distance (as specified on the *Preferences* form), and/or the cost per takeoff can be specified in the aircraft database.

In the example, the possible ways of costing a flight in this aircraft are \$40 per hour, and/or \$5.75 per nautical mile, and/or \$8 per takeoff.

The time used to calculate the “per hour” cost of the flight is the time in the air. In order to include other “engine on” time in the costs, use the *per takeoff* field. In the example, it is assumed that the engine is on for an additional 0.2 hours per flight, so this amount is added “per takeoff”. On the *Gen* form, the amount of fuel required for Start/Taxi is specified. This covers the additional fuel used “per takeoff”.

Once the aircraft has been specified, the cost for the flight can be calculated using the *Flight Cost* form (see *Flight* menu on the *Flight Description* form). At the top of the form, there are check boxes to select which items from the aircraft database are included. In the example, both the cost per hour and the cost per takeoff are included in the total cost.

If the cost of fuel (fuel units as specified in the aircraft database) is entered, the cost of the fuel is added to the total cost. A checkbox is provided so that the fuel cost can be included/excluded without having to enter/remove the cost value.

In the example, the cost is estimated at \$40 per hour times 1:54 (\$75.90), plus \$8 per takeoff times one takeoff (\$8), plus \$4 per gallon of fuel times 21.4 gallons (\$85.60) for a total cost of \$169.63. Note that the numbers on the individual items on the *Route* form are rounded for display, but the total is calculated using the more exact numbers.

The other lines are used to enter other costs and specify how they are measured. The *% of Subtotal* item may be used to add taxes or other overheads. In the example, the total cost is increased by 5%. A blank selection in the popup causes the entry to be ignored (without having to erase the description and cost value).

Printing

CoPilot has a facility for printing flight information on IR (Infra Red) equipped printers. There is a *Print...* item on the *Flight* menu. A third party print application must be installed on the Palm handheld to support this capability. Currently supported applications are:

PalmPrint: <http://www.stevenscreek.com>

TealPrint: <http://www.tealpoint.com>

It is also possible to send the print output to the clipboard or directly to a Memo. In order for the output to be formatted properly, the data must be printed with a fixed-pitch font (e.g. Courier).

```

Rockcliffe to Toronto Island

Aircraft: C-GXBU
Pilot: Davis, Laurie
Date: Sat Jan 12, 2002
Time: 15:30 Z (10:30 am)


```

	Dist	MagTrk	TAS	ETE	ETA	Wind
	Alt	MagHdg	GS	Cum	Fuel	Airway
CYRO	10.6	278	111	0:07	15:37	270 10
	1500	279	101	0:07	1.3	
YOW	185.0	249	115	1:47	17:24	270 10
	6500	252	107	1:54	18.5	
CYTZ						

There are a few restrictions regarding how the printing software should be configured:

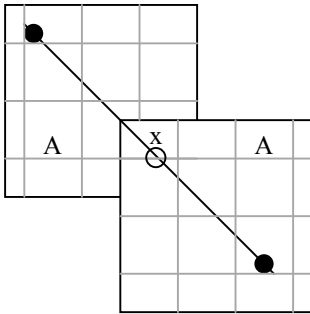
- The font must be a fixed-pitch font such as Courier.
- There must be at least 56 characters available to print on each line

There are a few restrictions for TealPrint:

- Select "Print as Text"
- Select "eject paper after printing" in the "Text Options" or only the first page prints.

Map Intersections

When plotting a trip route on a map, a leg may cross from one map to another. CoPilot provides an intersection function that makes plotting across maps very simple.



The first step is to find a longitude or latitude common to both maps. In the example shown, latitude A is common to both maps. When this latitude is entered into the intersection function for this leg, the corresponding longitude for point x is calculated. It is then a simple matter to plot point x on both maps and draw the two lines independently.

- | This button on the *Route* form opens the *Intersection* dialog box. It appears between the two idents on a leg.
- + If an intersection is defined, the button looks like this. Tapping this button opens the *Intersection* dialog box.



The intersection function calculates all of the intersections along the entire great circle path defined by the leg.

In the case when latitude is specified, there are actually two intersections calculated. In the example shown, the great circle defined by the path between Rockcliffe and Toronto intersects latitude 44 degrees 30 minutes once between Rockcliffe and Toronto (77 degrees, 46.0 minutes), and once again at 14 degrees, 31.5 minutes (which is somewhere over the Adriatic Sea). In this case, it is obvious which is the correct one. Unfortunately, there are some cases (legs that are almost exactly east or west) where the two points are relatively close together, and it is not obvious which one is correct.

External Memory

CoPilot has the ability to move the system waypoint database to an external memory card. There is a new *Move to External Memory* button on the *System Waypoint Database* form (open with the *System Waypoint Database* menu item on the *Options* menu). If there is a database on the external memory card, the button changes to *Move to Internal Memory*.

Most operations should work properly with the database in external memory. The two exceptions are the *Find* buttons (e.g. on the *Edit Leg* form), and the *Mid* button on the *Delete, Change or Insert* form. Both of these operations are exceedingly slow when the waypoint database is in external memory. In both cases, the *Cancel* button can be used to stop the search.

Rather than transfer an internal database to the card, it is possible to HotSync a database directly to the external card. Any file with a file type of .way (e.g. xyz.way) is placed in the correct directory on the memory card. The Palm Install Tool must be used to select the file. In order for this facility to work, at least one HotSync must have been performed with a version of CoPilot that supports this feature. This is so that CoPilot can tell HotSync where to place the file.

The third way to get a waypoint database onto the card is to write it directly to the card via a card reader attached to a pc. The file should be a .way file (e.g. xyz.way), and it should be placed in the /Palm/Programs/CoPilot directory. CoPilot renames the file to CoPilot_Waypoint.pdb the next time that it runs.

Rather than use this facility, it may be more beneficial to use an external utility to place CoPilot and/or the waypoint database into external memory. Most of these utilities work by copying the application and/or database to main memory when the application is launched. This has the disadvantage that it takes a long time to launch the application, but the advantage that the application runs at full speed once it has been launched.

Appendix A: Tips & Tricks

General

1. Online help is available by tapping the *Tips* button that is displayed in the upper right corner of dialog boxes.
2. Whenever scroll bars or scroll buttons are shown, use the page up/down buttons to scroll by one page. The page up/down buttons are the built in buttons below the screen of the Palm handheld.
3. If the Palm has a 5-way navigator, it may be used within CoPilot. If there is a cursor showing, the 5-way navigator is used for field navigation. If there is no cursor showing, the 5-way navigator is used for page navigation. Press the select button to put the cursor in the first field. If the cursor is in the top/left field, the left button removes the cursor from the form.
4. It is possible to put a number into any field using the calculator (*Edit* menu). The Paste button puts the result of the calculation into the field that was active when the calculator was opened.
5. If a number is highlighted when the calculator (*Edit* menu) is opened, the calculator is initialized with that number.
6. A number of menu items (e.g. *Calculator*, *Flight Cost...*, *Duplicate Flight*, *Reverse Route*) have command toolbar items that can be invoked.
7. Most units are specified on the *Preferences* form (see *Options* menu).
8. Fuel units are defined for each aircraft, and are specified in the aircraft database (*Gen* form).
9. For convenience, it is possible to switch between units. CoPilot only uses the units to collect and display data; therefore, changing the units does not affect the database content or the calculations. There may be minor rounding errors introduced when switching back and forth between units. A common application for this feature is to enter the weight and balance information into the aircraft database with the units set to pounds and inches since this matches the data in many aircraft manuals. Switch the preferences to back to kilograms if weights on the *Weight & Balance* form are entered in kilograms
10. Aircraft, pilots, and waypoints can be sent to another Palm handheld. See the send menu items in the *Record* menu.
11. Whenever a waypoint ident is required, the tiny triangle button opens a dialog box with a list of the most recently used waypoints. Tap on one of the waypoint descriptions to select the waypoint.

Flight Description Form

12. In the *Flight Description* form, the page up/down buttons can be used to switch to other flights.
13. An entire flight can be duplicated using the *Duplicate Flight* menu item on the *Flight* menu.
14. The cost of a flight is calculated using the *Flight Cost* menu item on the *Flight* menu.
15. Flight data can be printed to a printer that is IR (Infra Red) equipped, or connected via a serial link. The *Print...* menu item is on the *Flight* menu. Print software must be installed on the Palm handheld.

Route Form

16. If a blank leg separates two legs on the *Route* form, the calculations assume that there are two flights. The time and fuel to climb, and the start/taxi fuel, is added for the second leg.
17. Any leg can be dragged to a new location on the *Route* form by dragging the button with the stylus. The new leg position must be consistent with any adjacent legs.
18. A waypoint can be deleted by tapping on the tiny button before the waypoint.
19. A waypoint may be changed by tapping on the tiny button before the waypoint.
20. A new waypoint may be inserted before an existing waypoint by tapping on the tiny button before the existing waypoint.
21. Tap on an ident on the *Route* form to see more information about the waypoint. If the waypoint information has scrollbars, the page up/down buttons can be used to scroll by one page.
22. Tap on a line of leg information on the *Route* form to see more information about the leg. The page up/down buttons scroll to the previous/next leg.
23. The columns on the *Route* form can be configured by tapping on the column header and choosing what to display
24. The direction of an entire route can be reversed using the *Reverse Route* menu item on the *Route* menu.

Edit Leg Form

25. When entering an ident on the *Edit Leg* form, it is possible to stop when enough letters have been entered to uniquely identify the waypoint. The waypoint has been uniquely identified when the correct waypoint description appears.
26. The page up/down buttons can be used to switch to the next or previous leg.
27. When the OK button in the *Edit Leg* form is tapped (or the leg is scrolled to the another leg with the scroll buttons), the information about the leg (altitude, wind, pressure, temperature) is saved. This data can be applied to a new leg using the *Previous* button. This button is only visible if information has been saved.
28. A combination of the last two tips can be used to quickly change the leg information (altitude, wind, pressure, and temperature) for an entire trip. Open the first leg and enter the data. Use the page down button to go to the next leg. Tap the *Previous* button to update the second leg with the data from the first leg. Keep doing this until all of the legs have been updated.
29. The leg-scrolling feature can be used to quickly enter an initial route. After entering the first leg, instead of tapping the *OK* button, use the page down button to scroll to the next leg and enter the next waypoint (and leg data with the *Previous* button). Continue in this manner until the entire route is entered.
30. Swap the *To* and *From* waypoints in the *Edit Leg* form using the *Swap* button. This button is only visible if the waypoints can be swapped without affecting the adjacent legs.
31. If the *From* and *To* waypoints are the same, the leg is considered a ground leg and the duration of the stop can be entered.

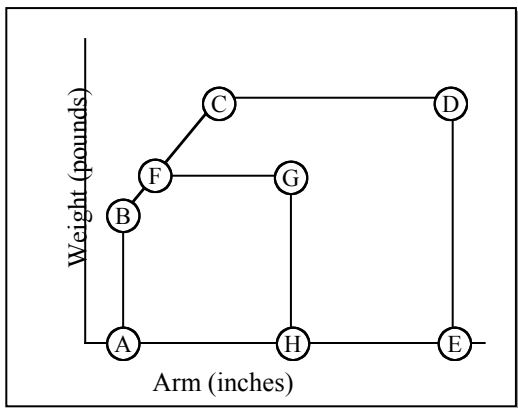
Edit Waypoint Form

32. Latitude and longitude on the *Waypoint Edit* form can be entered in several ways. For example 45 degrees, 27 minutes, 35 seconds could also have been entered as 45 degrees, 27.62 minutes, or as 45.4603 degrees.
33. There is a *Base on Radial/Distance...* menu item on the *Waypoint* menu of the *Edit Waypoint* form that allows the waypoint to be specified as a radial and distance from any waypoint already in the database.

Edit Aircraft Form

34. An aircraft can be duplicated using the *Duplicate Aircraft* menu item on the *Aircraft* menu of the *Edit Aircraft* form.
35. Climb fuel consumption data can be entered as either the fuel flow **at** the specified altitude, or the fuel used **to** the specified altitude. Tap on the column header to select the appropriate method.

Appendix B: Weight & Balance Database Entry

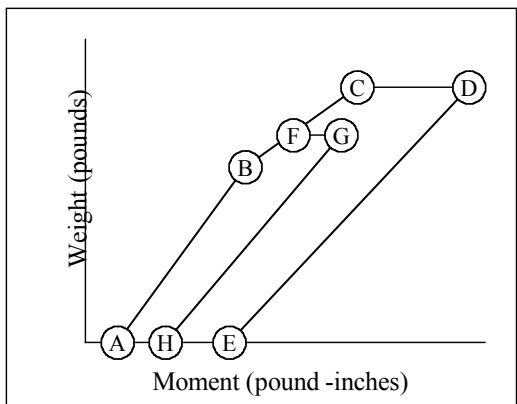


CoPilot plots the weight and balance curves with arm on the horizontal axis and weight on the vertical axis. If the aircraft manual presents the data in this format, simply transfer the data directly into the *WB 2* form. The appropriate graph in Cessna manuals is usually called “Center of Gravity Limits”, and the arm is referred to as “Center of Gravity Location”. The Cirrus manuals refer to the graph as “Weight & Center-of-Gravity Envelope”, and they refer to arm as “Fuselage Station” or FS).

a different number of points.

In the example shown, the normal curve consists of points A, B, C, D and E; while the utility curve consists of points A, B, F, G and H. This is an example; the curves for another aircraft may be a completely different shape, with

Edit Aircraft						
Gen	Cruise	Climb	Equip	WB 1	WB 2	\$
Normal			Utility			
A	Weight	Arm		Weight	Arm	A
B	1500.0	35.0		1500.0	35.0	B
C	1950.0	35.0		1950.0	35.0	F
D	2300.0	38.5		2000.0	35.5	G
E	2300.0	47.3		2000.0	40.5	H
	1500.0	47.3		1500.0	40.5	
<input type="button" value="OK"/> <input type="button" value="Cancel"/> <input type="button" value="Delete"/>						



If the aircraft manual plots the weight and balance curves with weight on the vertical axis and **moment** on the horizontal axis, convert the data to the other format. In order to convert the moment to arm, simply divide by the corresponding weight.

For example, point C is 2300 pounds and 88,500 pound-inches. Divide 88,500 by 2300, to get 38.5, which is the arm in line C of the *WB 2* form. Point G is 2000 pounds and 81,000 pound-inches. Divide 81,000 by 2000, to get 40.5, which is the arm in line G of the *WB 2* form.

Appendix C: Sample Aircraft Data

Piper Cherokee 180 (P28A)

Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Ident: C-GXBU Type: P28A Wake Turb: ▼ Light ELT: ▼ AF Homebase: CYRO Fuel Density: 6.01 lb/gal (US) Start/Taxi Fuel: 1.6 gal (US) Description: white with green trim OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Cruise Performance Altitude TAS Fuel Flow 0 110 10.0 8000 120 10.0 OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Climb Performance Altitude Rate IAS Fuel Flow 0 750 74 16.0 16400 100 74 12.0 OK Cancel Delete		
Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Communication Navigation <input checked="" type="checkbox"/> VHF <input checked="" type="checkbox"/> VOR <input type="checkbox"/> ADF Transponder <input checked="" type="checkbox"/> ILS <input type="checkbox"/> Mode A <input type="checkbox"/> DME <input checked="" type="checkbox"/> Mode C <input type="checkbox"/> RNAV <input type="checkbox"/> Loran C <input type="checkbox"/> VFR GPS <input checked="" type="checkbox"/> IFR GPS OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Arm Wgt Tank Description 86.5 1357.0 Basic empty 95.0 300.5 1 Fuel (max 50 gal) 85.5 Pilot 85.5 Front passenger 118.1 Rear passenger 118.1 Rear passenger 142.8 Bag (max 200 lbs) OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Normal Utility Weight Arm Weight Arm 1300.0 84.0 1300.0 84.0 1650.0 84.0 1650.0 84.0 1990.0 86.0 1950.0 85.8 2400.0 92.0 1950.0 86.5 2400.0 94.0 1300.0 86.5 2200.0 96.0 1300.0 96.0 OK Cancel Delete		

Cessna 172 (C172)

Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Ident: C-GPHV Type: C172 Wake Turb: ▼ Light ELT: ▼ AF Homebase: CYRO Fuel Density: 6.01 lb/gal (US) Start/Taxi Fuel: 1.1 gal (US) Description: white with blue trim OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Cruise Performance Altitude TAS Fuel Flow 2000 101 6.7 4000 100 6.5 6000 98 6.3 8000 97 6.2 10000 96 6.0 12000 95 5.9 OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Climb Performance Altitude Rate IAS Fuel Used 0 645 78 2000 560 76 0.7 4000 480 74 1.5 6000 395 72 2.3 8000 315 70 3.3 10000 230 68 4.5 12000 145 66 6.1 OK Cancel Delete		
Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Communication Navigation <input checked="" type="checkbox"/> VHF <input checked="" type="checkbox"/> VOR <input type="checkbox"/> ADF Transponder <input checked="" type="checkbox"/> ILS <input type="checkbox"/> Mode A <input type="checkbox"/> DME <input checked="" type="checkbox"/> Mode C <input type="checkbox"/> RNAV <input type="checkbox"/> Loran C <input type="checkbox"/> VFR GPS <input type="checkbox"/> IFR GPS OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Arm Wgt Tank Description 40.1 1504.5 Basic empty 46.0 Fuel (max 228) 37.0 Pilot 37.0 Co-pilot 73.0 Passenger 73.0 Passenger 95.0 Baggage 1 123.0 Baggage 2 OK Cancel Delete			Edit Aircraft ⓘ Gen Cruise Climb Equip WB 1 WB 2 \$ Normal Utility Weight Arm Weight Arm 1500.0 35.0 1500.0 35.0 1950.0 35.0 1950.0 35.0 2300.0 38.5 2000.0 35.5 2300.0 47.3 2000.0 40.5 1500.0 47.3 1500.0 40.5 OK Cancel Delete		

Aircraft databases are available for download from the CoPilot website. Unfortunately if I want the various download sites to list this application, I am not allowed to give you the url of the website (they do not allow any references to other websites). If you do a search for “CoPilot flight planning”, you should easily find it.