Introduction to G1000 Search Patterns

Minnesota Wing Advanced Aircrew Training
Introduction and Planning Steps
Introduction

- Some G1000 Integrated Flight Decks (none in Minnesota yet) have the capability to program search patterns in a similar fashion as the GX55
- The G1000 provides
  - 10 inch multi-colored moving map
  - Terrain
  - Obstructions
  - Inset map on PFD
  - Course deviation Indicator (CDI) for search pattern in an HSI format on the PFD
  - Coupling to autopilot
SO, WE GO FROM THIS
TO THIS

AND
But....
Although the G1000 will guide the pilot through the search area safely and accurately, it does require more planning and work before programming.

Why?
Compared to the GX55

- The G1000 (Even with SAR functions) lacks
  - A grid database
    - No grid numbers or grid locations
    - No grid sizes
    - No grid entry waypoint
  - An understanding that the first leg begins $\frac{1}{2}$ track spacing from edge of grid
  - An understanding of which way to turn after the first leg to stay in the grid
  - A calculation of the length of each leg to reach the other end of the grid
  - A calculation of the number of legs to reach the other side of the grid
  - An automatic means to set a true course for grid searching and magnetic courses for everything else
Calculations for Grid Search

- So we must calculate these parameters before programming the G1000

1. Convert grid number and entry corner to a latitude and Longitude
2. Determine track spacing to be used and direction of tracks
3. Offset latitude and Longitude from step 1 by ½ track spacing. Note that:
   a) 1 minute of latitude = 1.0018 NM (close enough to 1 NM)
      - Fly one minute North or South, cover one nautical mile (a 1-nm leg width)
   b) But 1 minute of longitude (moving East or West) = anywhere from 0.65 to 0.92 nm in the continental U.S. (.65 -.72 nm in Minnesota from North to South)

- These parameters determine your initial grid entry waypoint
Grid Worksheet

- The calculations to determine the grid entry location may be made on a worksheet as shown:
  1. Grid number
  2. Entry corner
  3. Grid Corner Lat/Longs
  4. Track Width/direction
  5. Entry point offset ½ track width from grid edge (convert NM to Lat/long)
     a) Layout on gridded sectional or
     b) use sheet shown

### Number of Legs for Minnesota (44 - 49 degrees Latitude only)

<table>
<thead>
<tr>
<th>Track Spacing (NM)</th>
<th>Leg Lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>10, 11</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>10, 11</td>
</tr>
<tr>
<td>5</td>
<td>20, 22</td>
</tr>
<tr>
<td>10, 11</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>20, 22</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: Where more than 1 number is shown, use the larger number for more Southern areas of the State (<46 degrees)

### Number of minutes to offset from Grid corner for starting point

#### Minnesota (44 - 49 deg. Latitude only)

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</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Track Width/direction</th>
<th>N/S legs</th>
<th>E/W legs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.70</td>
<td>1.35</td>
<td>2.75</td>
</tr>
<tr>
<td>0.25</td>
<td>0.50</td>
<td>1.00</td>
</tr>
</tbody>
</table>

G1000 Data Entry table

<table>
<thead>
<tr>
<th>Grid #</th>
<th>GRB 129CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry corner lat/Long</td>
<td>47 00.00' 93 00.00'</td>
</tr>
<tr>
<td>Track course (True)</td>
<td>360</td>
</tr>
<tr>
<td>Variation &amp; mag course</td>
<td>1</td>
</tr>
<tr>
<td>Track Spacing</td>
<td>1.35'</td>
</tr>
<tr>
<td>Entry waypoint Lat/Long</td>
<td>47 00.00' 92 58.65'</td>
</tr>
<tr>
<td>Initial turn direction</td>
<td></td>
</tr>
<tr>
<td>Leg Length</td>
<td></td>
</tr>
<tr>
<td>Number of Legs</td>
<td></td>
</tr>
</tbody>
</table>
Complete Grid planning

1. Direction of first turn
2. Determine length of legs from plotter and gridded sectional
   a) Layout on gridded sectional or
   b) use sheet shown
3. Number of legs
   a) Layout on gridded sectional or
   b) use sheet shown
4. From sectional, obtain mag. variation and convert true course to magnetic course

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<tr>
<td>1/4 grid N/S legs</td>
<td>10, 11</td>
</tr>
<tr>
<td>1/4 grid E/W legs</td>
<td>15</td>
</tr>
<tr>
<td>1/2 grid N/S legs (vert. quads)</td>
<td>10, 11</td>
</tr>
<tr>
<td>1/2 grid N/S legs (Hor. quads)</td>
<td>20, 22</td>
</tr>
<tr>
<td>1/2 grid E/W legs (vert. quads)</td>
<td>30</td>
</tr>
<tr>
<td>1/2 grid E/W legs (Hor. quads)</td>
<td>15</td>
</tr>
<tr>
<td>Full Grid N/S legs</td>
<td>20, 22</td>
</tr>
<tr>
<td>Full Grid E/W legs</td>
<td>30</td>
</tr>
</tbody>
</table>

Note: Where more than 1 number is shown, use the larger number for more Southern areas of the State (<46 degrees)

Number of minutes to offset from Grid corner for starting point

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<td>360</td>
</tr>
<tr>
<td>Variation &amp; mag course</td>
<td>-2, 358</td>
</tr>
<tr>
<td>Track Spacing</td>
<td>1</td>
</tr>
<tr>
<td>Minutes offset for Entry point</td>
<td>1.35'</td>
</tr>
<tr>
<td>Entry waypoint Lat/Long</td>
<td>47 00.00' 92 58.65'</td>
</tr>
<tr>
<td>Initial turn direction</td>
<td>Right</td>
</tr>
<tr>
<td>Leg Length</td>
<td>7.5</td>
</tr>
<tr>
<td>Number of Legs</td>
<td>10</td>
</tr>
</tbody>
</table>
Other Search Patterns

- The G1000 will also perform other searches
  - Creeping line
    - Planning and programming similar to (long skinny) grid search
  - Triangular sector
    - No converting from grids to miles required in planning
    - Simply determine initial waypoint lat/long, and initial leg length, direction and turn direction
  - Expanding Square
    - Similar to GX55 planning
    - No converting from grids to miles required in planning
    - Simply determine initial waypoint lat/long, and initial leg direction, turn direction, spacing, and number of legs
  - Parallel course route search
    - Programmed outside of search and Rescue menu
    - Program normal flight plan and input offset distance
G1000 Controls (for SAR functions)
PFD/MFD Controls

• Dual FMS Knob (3 controls) – Used to select the page to be viewed

  • The large knob selects a page group (MAP, WPT, AUX, NRST), while the small knob selects a specific page within the page group.

  • Pressing the small button turns the selection cursor ON and OFF.

  • The large knob is used to move the cursor on the page, while the small knob is used to select individual characters for the highlighted cursor location.

• FPL Key: Opens Flight Plan page.

• CLR Key (DFLT MAP) Erases information, cancels an entry, or removes page menus.
• **MENU Key** – Displays a context-sensitive list of options (e.g. SAR flight plans). This list allows the user to access additional features, or to make setting changes that relate to certain pages.

• **ENT Key** – Accepts a menu selection or data entry. This key is used to approve an operation or complete data entry. It is also used to confirm selections and information entries.

• **Range/Pan Joystick** – Changes the map range (distance top to bottom of map display) when rotated. Activates the map pointer when pressed.
G1000 Set-up and Hints
Set-up and Hints

- To enable the Search and Rescue functions on the G1000, the software must be recent enough to contain the search pattern features, and

- The features must be enabled with a SD unlock card that is inserted into the top SD card slot on the MFD
Set Latitude and Longitude lines to Appear

- Set Latitude and Longitude lines to show up on the moving maps
  - With the MFD in map mode, Press the MENU button
  - The Map page Menu page pops up
  - If needed, use FMS knob to highlight “Map Setup”
  - Press ENT button to accept
  - The “Map Setup” page appears
Set Latitude and Longitude lines to Appear

- If needed, use FMS knob to highlight “Land”
- Use FMS knob to highlight 1st column of LAT/LON
  - Use small FMS knob to select sml, med, or lrg
  - Accept with ENT or pressing FMS button
  - Use same method to select desired range
- Press FMS button to exit
Latitude and Longitude now appears
Turn off Auto zoom

- Bring up the menu page again, by pressing the MENU button and selecting “Map Setup” with the ENT button to accept.
- If needed, use FMS knob to highlight “MAP”.
- Use FMS knob to highlight 1st column of Auto zoom
  - Use small FMS knob to select “Off”
  - Accept with ENT
  - Press FMS button to exit
Turn on topo and terrain by pressing MAP soft key
Then press TOPO and TERRAIN soft keys
Create User Defined Waypoint
Create Waypoint

- Go to WPT using large FMS knob
- Go to 5th dot using small FMS knob
  - Waypoint page appears
- Push FMS button for cursor
- Use small/large FMS knobs to name waypoint
  - Accept with ENT
- Hit ENT again to say Yes
  - Jumps you down to ref section
Create Waypoint

- Use large FMS knob to highlight Lat/Long section
- Use small FMS knob to highlight N
- Use large FMS knob to move cursor to degrees, minutes, decimal fields
- Use small FMS knob to change values
- When done, press ENT You then get flashing cursor in ref section
- Press FMS button to finish
Program SAR Pattern into G1000
Create Search Pattern

- So far, nothing we’ve done requires a search enabled G1000
- To set up a search flight plan press FPL
- Press MENU to bring up menu page. If SAR is set up on the display, Search and Rescue will be the first on the list
- Press ENT to select – This Brings up the SAR pattern page
Create Search Pattern

- Turn small FMS knob to enter waypoint –
  - Waypoint page comes up
- Use small and large FMS knobs to enter waypoint name to begin search
- Press ENT to enter waypoint name
- This brings up a waypoint page. Press ENT to accept
  - Brings up SAR page again
Create Search Pattern

- Use small and large FMS knobs to enter info earlier calculated:
  - Pattern
  - Initial magnetic course (DTK)
  - Initial turn
  - Leg Length
  - Spacing
  - Number of Legs

- When ACTIVATE SAR?
  Is highlighted, press ENT–flight plan is now activated
Resulting Search Pattern
If full size map is wanted, press CLR
Other search patterns – Creeping Line

- Other search patterns can be entered from the SAR screen:
  - Creeping line (still a parallel search)
- Enter as a parallel pattern and enter appropriate data for other fields
Other Search Patterns - Sector

- Enter waypoint of the center of the sector search
- Select Sector pattern
- Enter initial DTK, turn, and Leg length similar to data required for GX-55
Other Search Patterns – Expanding Square

- Enter waypoint of the center of the search pattern
- Select EXP SQR pattern
- Enter initial DTK, turn, spacing, and number of Legs similar to data required for GX-55
Other Search Patterns
– Parallel course route search

- Programmed outside of search and Rescue menu
- After flight plan is programmed, on FPL Menu page, scroll down and select Parallel Track with ENT button
Other Search Patterns – Parallel Course route search

- Select and accept:
  - Offset direction and
  - Offset distance

- When ACTIVATE PARALLEL TRACK? Is highlighted, press ENT– flight plan is now activated
Useful web locations

- Cessna NAV III G1000 PC Trainer part number. 010-10596-04 ($24.95 from Garmin)

- G1000 Pilot Guides and Cockpit Reference Guides

**G1000: Cessna Nav III:**

- Cockpit Reference Guide (System Software Version 0563.00 or later), Rev. A, Sep, 2006 | Download (7.21 MB)
- Cockpit Reference Guide (System Software Version 0563.03 or later), Rev. A, Mar, 2007 | Download (8.52 MB)
- Cockpit Reference Guide (System Software Version 0563.05), Rev. A, Nov, 2007 | Download (10.00 MB)
- Cockpit Reference Guide Addendum (Cessna Nav III), Rev. A, Jul, 2005 | Download (24 KB)
- Pilot’s Guide (System Software Version 0563.00 or later), Rev. A, Sep, 2006 | Download (28.05 MB)
- Pilot’s Guide (System Software Version 0563.03 or later), Rev. A, Mar, 2007 | Download (37.34 MB)
- Pilot’s Guide (System Software Version 0563.05 or later), Rev. A, Nov, 2007 | Download (38.27 MB)
Useful web locations

- **G1000 Search and Rescue Pilot’s Guide**

- **This Presentation**