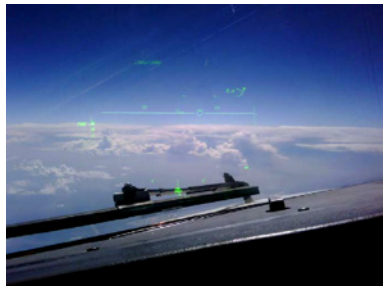
In-flight scenarios – Note: the following scenarios are examples of how MultiScan™ in AUTO differs from MultiScan in MAN (manual mode) or from a standard manual radar.

Quiet, Dark Cockpit (only threat weather is displayed) – during auto operation, MultiScan detects and stores in memory *all* the weather from the surface to well above the aircraft altitude. MultiScan then compares cell height to the aircraft altitude. If the weather is below the aircraft altitude (i.e., nonthreat weather), then it is not displayed. The quiet, dark cockpit philosophy prevents unnecessary clutter while alerting crews to weather threats that are at the aircraft altitude. Note that the radar is able to more accurately determine cell height as the aircraft gets closer to the cell. Therefore, when weather is close to but below the aircraft altitude, it may fall off the display as the aircraft approaches the cell.

The view is through the HUD combiner. The Flight Path Vector (FPV) is indicating acceptable overflight clearance, so the weather below the aircraft is NOT displayed.



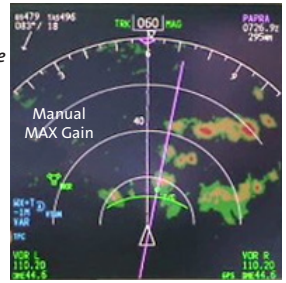
From a distance this cell appears dangerous. However, upon further examination, it can be seen that it is post-convective and has very little substance. It is also slightly below the aircraft flight path. Therefore, it is not displayed.

Automatic Temperature-based Gain – above an altitude where the outside air temperature is less than minus 40 degrees C, thunderstorm cells are composed almost entirely of ice crystals, are nonreflective and are very difficult for radar to detect. When in AUTO, MultiScan compensates for this lack of reflectivity by increasing the gain as temperature decreases. As a result, by the time the aircraft is at cruise altitude, the gain is roughly equivalent to the manual MAX gain position. MultiScan is designed to be operated in AUTO mode with gain set to CAL. Using MAX gain while in AUTO will result in an over warning condition and pilots may be inclined to make larger deviations than the actual weather conditions require. Note: significantly more gain is available during AUTO operation than during MAN operation.

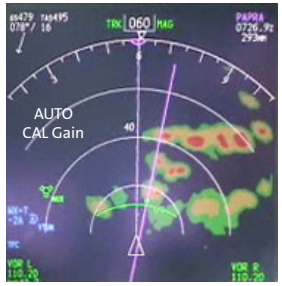
The view from the cockpit shows a major line of cells whose tops tend to be nonreflective due to the fact that they are composed almost entirely of ice crystals.

Manual CAL gain shows only the thunderstorm cores and displays them as green.

Manual MAX gain better represents the actual storm threat and displays the edges of the cells.



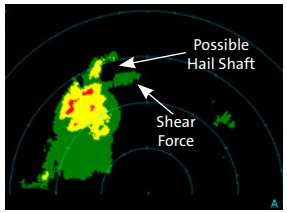
AUTO CAL gain and Manual MAX gain are essentially equivalent.



What green means – older radars with insufficient gain often portrayed thunderstorm cores at cruise altitude as green (see the MAN CAL gain picture above). Because MultiScan incorporates weather analysis and temperature-based gain, *significant areas of green may be displayed that are not a threat to the aircraft*. Four examples of green and their relative threat are shown below.
1. A pressure ridge is displayed that may result in light to moderate chop. Note: in manual, this would not be displayed on the ND due to the absence of Automatic Temperature-based Gain.
2. "Fingers" extending from a significant cell represent shear forces and the black area in between is a possible hail shaft. This area should not be transited. 3. At lower altitudes, a green screen represents stratiform rain with little to no turbulence. At cruise altitude, an extensive area of green may represent High-altitude Ice Crystal Icing and should be exited as soon as practicable.
4. Red Out (or, in this case, Yellow Out) often occurs near the freezing level or in heavy rains such as monsoons. Reducing the gain by one color level (four clicks counterclockwise) enables pilots to look for strong, embedded cells.

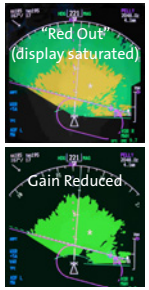
1. MultiScan's analysis has determined that the threat from the cells does not extend to the aircraft's altitude and has painted the returns green. Upon transit, light to moderate chop may be experienced.

2. A significant cell is producing shear forces that result in two "fingers" protruding from the cell. The black area in between is a possible hail shaft. This region of green should not be transited.



3. Solid green at lower altitudes represents non-turbulent stratiform rain. However, at cruise altitude, it may represent High-altitude Ice Crystal Icing and the region should be exited as soon as practicable.

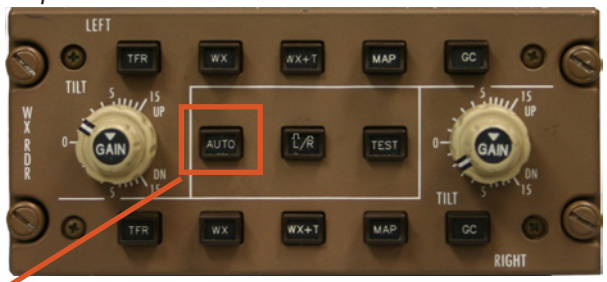
4. If "Red Out" occurs, decrease gain one color level (four clicks counterclockwise). If a strong, embedded cell is present, it will display as a yellow or red core. Return to CAL gain as soon as practicable.



NOTE: The display in AUTO *will* be different than in Manual due to the Quiet, Dark Cockpit and Automatic Temperature-based Gain concepts. **AUTO, CAL gain and WX+T are recommended during all phases of flight.**

WXR-2100 MultiScan ThreatTrack™ weather radar
Controls (Boeing 737NG, 757, 767, 777, 747-400 and 747-8)

Captain's controls



First officer's controls

AUTO – recommended during all phases of flight. In the AUTO position (button in), the radar controls tilt and gain and analyzes thunderstorm threats to present the best representation of the actual threat. In the MAN position (button out), the radar functions as a traditional radar. AUTO features including hazard analysis are disabled.

L/R (dual systems) – L (button out) selects the left R/T. R (button in) selects the right R/T.

TEST – initiates the radar test sequence for whichever R/T (L or R) is selected. Two Predictive Overflight™ icons to the left and right of the windshear icon indicate that the MultiScan ThreatTrack software is installed.

TFR (Transfer) – transfers the opposite side to the user's side (e.g., if the captain presses transfer, the first officer's radar settings are shown on the captain's side). Note: if both pilots select transfer, a test pattern will be displayed.

WX (Weather) – displays weather targets as green, yellow and red threats.

WX+T (Weather plus Threat) – displays weather targets PLUS MultiScan ThreatTrack's Core Threat Analysis, Two-level Enhanced Turbulence, Predictive Overflight and Associated Threat information (see back page for details).

MAP – allows ground mapping of terrain. However, weather targets are not removed from the display.

GC (Ground Clutter) – deactivates the ground clutter removal algorithms and displays ground clutter. This function is deactivated during MAN radar operation.

TILT – **this knob is disabled during AUTO operation.** The tilt knob is enabled during MAN (manual) operation.

GAIN – during AUTO operation, CAL gain provides the best representation of the actual threat and is recommended. MAX gain significantly increases the receiver sensitivity, whereas MIN gain decreases receiver sensitivity. Full above and below gain control is available during both manual and automatic operation. Increasing gain above CAL during AUTO operation will result in artificially intense returns that overemphasize the actual threat. (See Automatic Temperature-based Gain on page 2.)

When the triangle on the gain knob is in the 12 o'clock position (see picture above), CAL gain is set. Turning the knob fully clockwise selects MAX gain. Fully counterclockwise selects MIN gain.

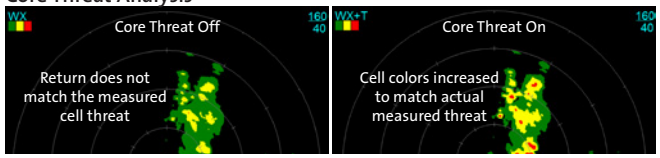
Caution: selecting below CAL gain decreases receiver sensitivity and causes thunderstorms to appear less hazardous than is actually the case. Below CAL gain should be used only for short time periods. The control should then be returned to the CAL gain position.

WXR-2100 MultiScan ThreatTrack weather radar
Features/icons (Boeing)

MultiScan ThreatTrack provides six new features to aid pilots in evaluating thunderstorm severity. Three of these features are based on *direct measurement* of the cell. The other three features are "associated" with the relative severity and maturity of the cell and are *inferred*.

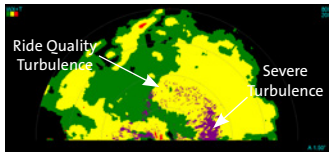
ThreatTrack (directly measured) features:

Core Threat Analysis



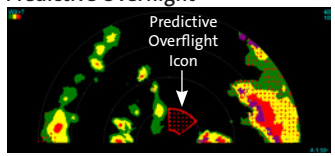
Core Threat Analysis increases cell color level to more accurately represent theactual threat of underrepresented thunderstorms.

Two-level Enhanced Turbulence



Two-level Enhanced Turbulence measures severe and ride- quality turbulence out to 40 NM. When the new FAA standards for severe turbulence are met, solid magenta is displayed. When the radar detects less severe ride-quality turbulence consisting of light to moderate chop, then speckled magenta is displayed.

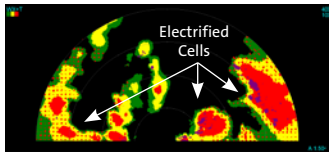
Predictive Overflight



Predictive Overflight detects and measures cell growth rate and predicts the resulting bow wave turbulence. Rapidly growing cells can produce severe turbulence even though the aircraft is well above the visible top. The Predictive Overflight icon warns crews of this potential turbulence threat and of a cell that is growing toward the aircraft's flight level.

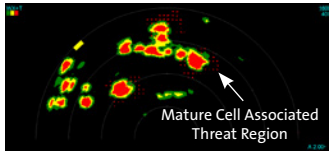
ThreatTrack Associated Threat (inferred) features:

Mid-altitude Associated Threat



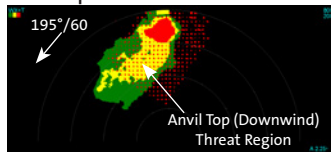
Mid-altitude Associated Threat places red speckles within the cell boundaries to denote lightning threats. These mid-altitude cells are electrified but do not have high-altitude convective activity. Transit through the area near the freezing level as quickly as possible. Note: icon is active until aircraft climbs higher than 10,000 feet above the freezing level.

Mature Cell Associated Threat



The Mature Cell Associated Threat places red speckles outside the cell boundary to denote hail, lightning and turbulence potential. Strong updrafts exiting the top or sides of the cell create a potential danger in these areas. The associated threat icon for mature cells is displayed at all altitudes.
Note: the speckled region is not a threat boundary.

Anvil Top Associated Threat



The Anvil Top Associated Threat warns of a hail danger region downwind of the cell. Above 25,000 feet, upper-level wind information is used to define a potential region of ejected hail. The region will be larger or smaller depending on the wind speed. This is another reminder that, whenever possible, it is best to transit thunderstorms to the upwind side.

Important: observed (directly measured) weather returns always take priority over inferred Associated Threat information

Rockwell Collins