7.1.1 THE NOAA TOGA ANTENNA ARRAY

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NOAA's Aeronomy Laboratory has recently installed a 100 by 100 meter array antenna with limited beam steering on Christmas Island as part of the TOGA (Tropical Ocean and Global Atmosphere) program. In this report, we describe the array and the associated beam steering and indicating hardware. The array consists of center-fed 48-dipole coaxial-collinear antenna strings. Thirty-two of these strings are installed parallel to each other at one-half wavelength spacing to make a 100 by 100 meter array. A second set of 32 antenna strings are physically superimposed perpendicular to the first set to form the other polarization. The TOGA antenna strings are aligned north-south and east-west geographic.

Figure 1 shows the feed network for the TOGA array. Each string of 48 dipoles is indicated at the top of the figure by numbered open circles. The antenna strings are fed in a repeating pattern of 8 (a spacing of 4 wavelengths) by equal lengths of transmission line. Antenna strings 1, 9, 17 and 25 are fed through phase shift module 1 in the field box. Strings 2, 10, 18, and 26 are fed by module 2, etc. In this way, only 7 phase shift modules provide 5 usable beam positions (vertical, and 15 or 30 degrees east and west of the zenith). In the initial TOGA installation, one polarization is switched between vertical and 15 degrees east of zenith. The other polarization is hard-wired to 15 degrees north of zenith, but a second field box can be installed later to provide steering in the north-south direction as well. A coaxial SPDT vacuum relay selects either the east-west or north-south array.

Each basic phase shift module consists of 2 SPDT vacuum relays mounted in a block with clamp fixtures to attach 2 fixed lengths of RG-213 coaxial cable. Seven of these basic modules allow any 2 of 5 beam positions to be selected. Addition of a second module set in series (in the same field box) provides 4 positions. One set of cables in the seven modules and the fixed cable shown in Figure 1 are cut for identical phase shifts to form the vertical beam. The 15-degree east beam is formed by switching in a second set of cables in modules 1 through 7 that are longer than the vertical set by progressive one-eighth wavelength increments.

The phase shift modules and the polarization switch are driven via a multiconductor cable by the beam selector-indicator box located in the equipment shelter at the edge of the array. Beam positions can be selected by computer control or by manual control from either the shelter or the field box located in the center of the array. Beam positions and possible vacuum relay faults are indicated by logic circuitry located in the field box. The position of each SPDT vacuum relay is monitored by checking continuity of the transmission line center conductor through the 2 or 4 SPDT relays in each module and the polarization switch to the shorted quarter-wavelength stub shown in Figure 1. This position information is decoded, indicated in the field box and equipment shelter, and compared with the selected position. Any discrepancies (indicating a relay problem) are indicated by fault lights. The beam position and fault lights are read and logged by the system computer.

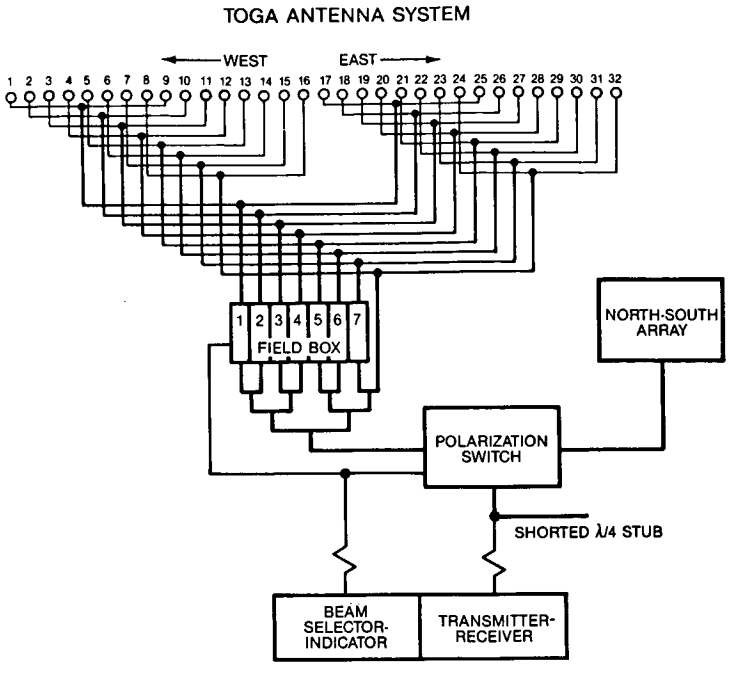
TOGA ANTENNA SYSTEM
WEST
EAST
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
1 2 3 4 5 6 7
FIELD BOX
NORTH-SOUTH ARRAY
POLARIZATION SWITCH
SHORTED λ/4 STUB
BEAM SELECTOR-INDICATOR
TRANSMITTER-RECEIVER

Figure 1.