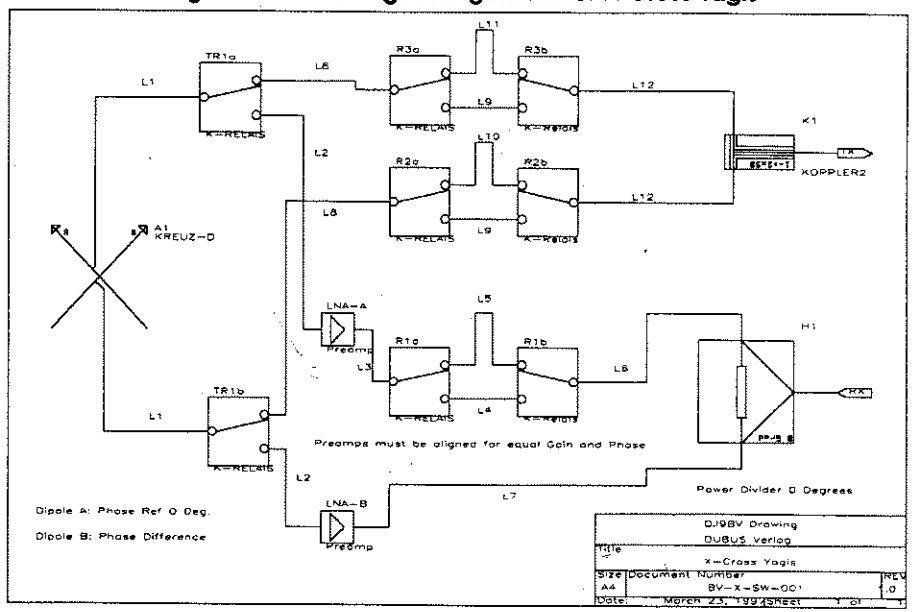
**Fig. 3: Full Switching Arrangement for X-Cross Yagis**




mit, because the maximum difference in polarisation angle could be 45°.

For more versatility you can construct a switching scheme like in figure 1. This enables to switch RX-polarisation in 45° steps and TX-polarisation in 90° steps. Maximum receive loss is then limited to 0.7dB (= $cos(22.5°) = 0.924$) and maximum TX-loss to 3dB.

This scheme uses a high-power DPDT TR-relay (The HF-402 would the ideal choice), a high-power SPDT relay for TX-polarisation,

**Fig. 2: Adjustment Setup for Phase and Gain Adjustment**

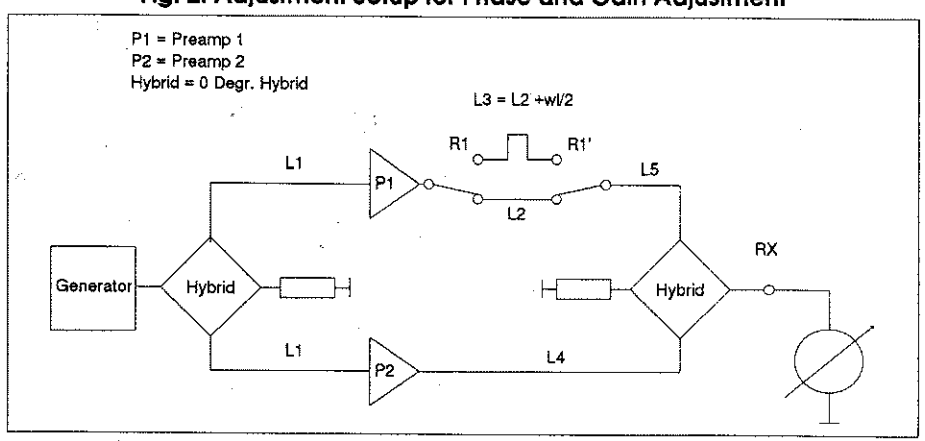







**Table 2: TX-Polarisation for X**

| TX-Polarisation | | | |
|---|---|---|---|
| Pol. | R2 | R3 | $\varphi(A) - \varphi(B)$ (°) |
| Vertical | OFF | OFF | 0 |
| Horizontol | OFF | ON | -180 |
| RHCP | ON | OFF | +90 |
| LHCP | ON | ON | -90 |

| RX-Polarisation | | | | |
|---|---|---|---|---|
| Pol. | LNA-A | LNA-B | R1 | $\varphi(A) - \varphi(B)$ (°) |
| Vertical | ON | ON | OFF | 0 |
| Horizontol | ON | ON | ON | -180 |
| +45° | OFF | ON | OFF | 0 |
| -45° | ON | OFF | OFF | 0 |

**Table 3: RX-Polarisation for X**

two preamplifiers with the same gain and phase, a DPDT low power relay for RX-polarisation and a 0° hybrid for combining. Table 1 gives the switching states according to the polarisation needed.

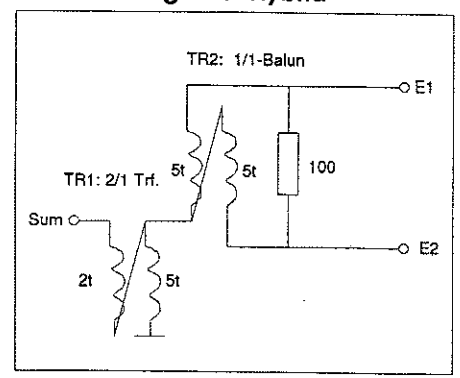
## 2. X-Configuration

The X-configuration uses two sets of elements in ±45° direction. Figure 2 shows a scheme which provides vertical, horizontal, RHCP and LHCP polarisation for transmit and horizontal, vertical and both 45° and 135° polarisation for receive. It uses three high-power DPDT relays and one low power relay.

TX-switching could be simplified to a circular only polarisation by omitting R2 and R3 and providing a $\lambda/4$-delay in one transmit line. To obtain the same signal strength under any condition in comparison to switchable TX-polarisation would require 3dB more transmit power. The advantage is, that the operator must not bother about the correct transmit polarisation. The other stations will hear you always the same. It's just the tradeoff between the cost for two power coxial relays and a bigger power amplifier.

RX-polarisation angle can be changed to 4 directions which limits a possible lost because of misalignment to 0.7dB. This is considerably less than 3dB and should be considered as worthwhile.

**Fig. 4: 0° Hybrid**




## 3. Gain/Phase Equalisation

To adjust the preamps for equal gain and phase could be a serious problem. A possible offline calibration procedure is shown in figure 3. Perform the following steps:

1. Check without preamps. Switching to ½-line should provide a null at output.
2. Insert preamps
3. Switch on R1/R1'.
4. Mutually adjust output of preamps fur Null on RX.

The null indicates the correct 180° phase and the equal amplitude relationship. 0° hybrids can be obtained from any supplier like MCL, ANZAC, MERRIMAC, MA/COM, etc. Broadband devices from 5...500MHz are about US$15.00. Homebrewing is possible also. What you need, is two toroidal cores, a piece of enamelled wire and a 100Ω bridge resistor. Circuit diagram see fig. 4.