NORMARC 7013

INSTRUMENT LANDING SYSTEM

TRANSMITTER DESCRIPTION

NAVIA AVIATION

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DESCRIPTION OF NORMARC 2-FREQUENCY TRANSMITTER

1 Functional Description

The transmitter section generates the ILS signal with the required RF power levels and modulations levels. The section comprises two identical transmitters, TX 1 and TX 2, where one is connected to the antenna, while the other is connected to dummy loads, acting as a back-up.

The reference signals in the transmitter section are RF signals from the oscillator OS1221A and LF modulation signals (90Hz and 150Hz) from the low frequency generator LF1223A. The LF 1223A also generates the keyed 1020Hz signal for the Ident. System DC voltages comes from the Power Supply board PS1227A.

In each transmitter, the RF oscillator has separate outputs for Course and Clearance. These two channels are offset by 10 kHz. The LF Generator also has independent outputs for Course and Clearance.

The LPA 1230 Localizer Power Amplifier Assembly contains modules to modulate, amplify and combine signals into the required CSB and SBO signals. Amplitude- and RF phase feedback ensures correct RF power level and modulation.

The COA 1207B Change Over section has relays to connect the CSB and SBO outputs from one transmitter to the antenna while the other is connected to dummy loads. The relays are controlled by a Coax-control signal. SBO phase shifters and attenuators are incorporated for obtaining the correct CSB/SBO relationship.

The block diagram is shown on the next page.

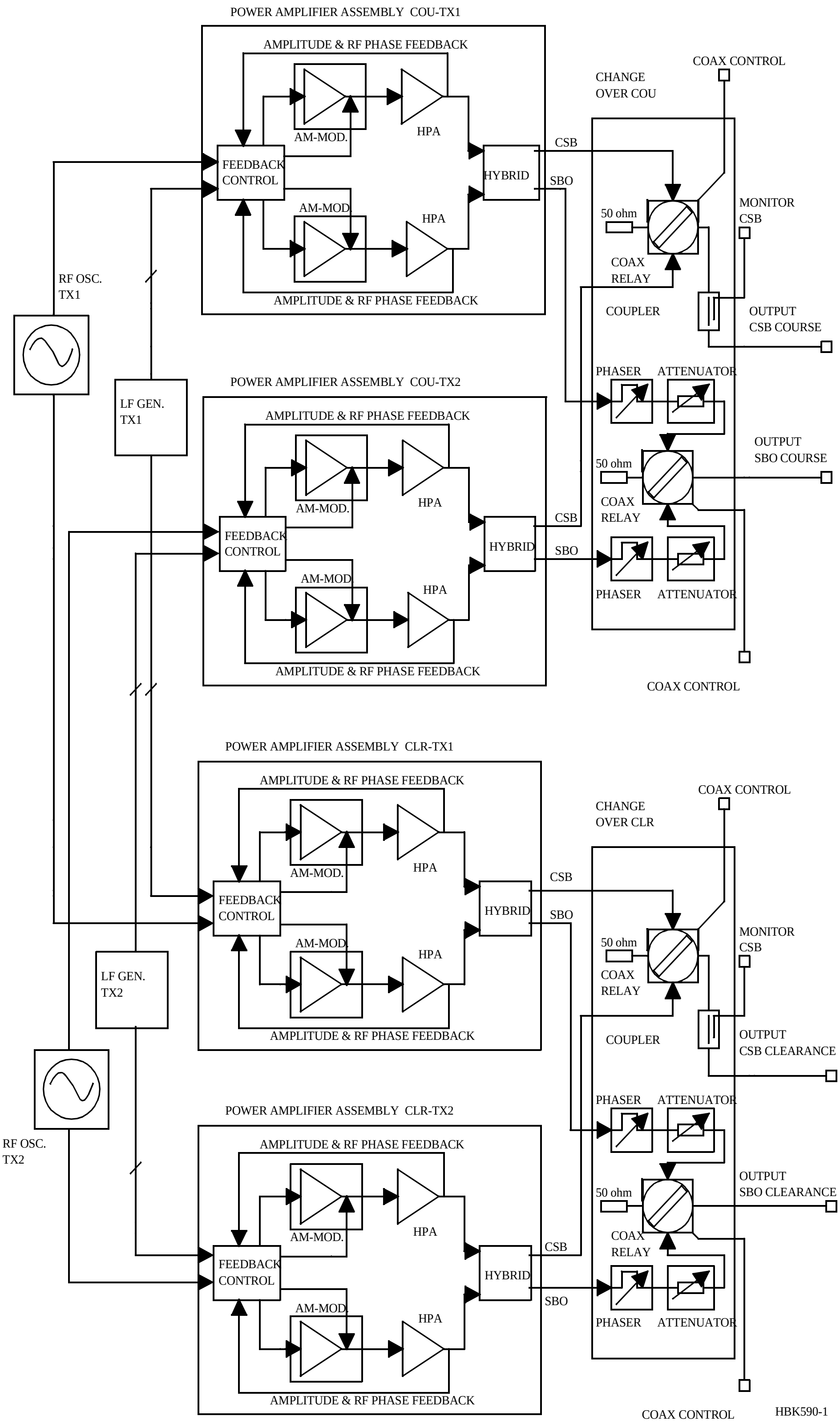

Figure 1-1 System Block Diagram of a 2-Frequency LLZ Transmitter

2 Detailed Description

2.1 Transmitter block diagrams

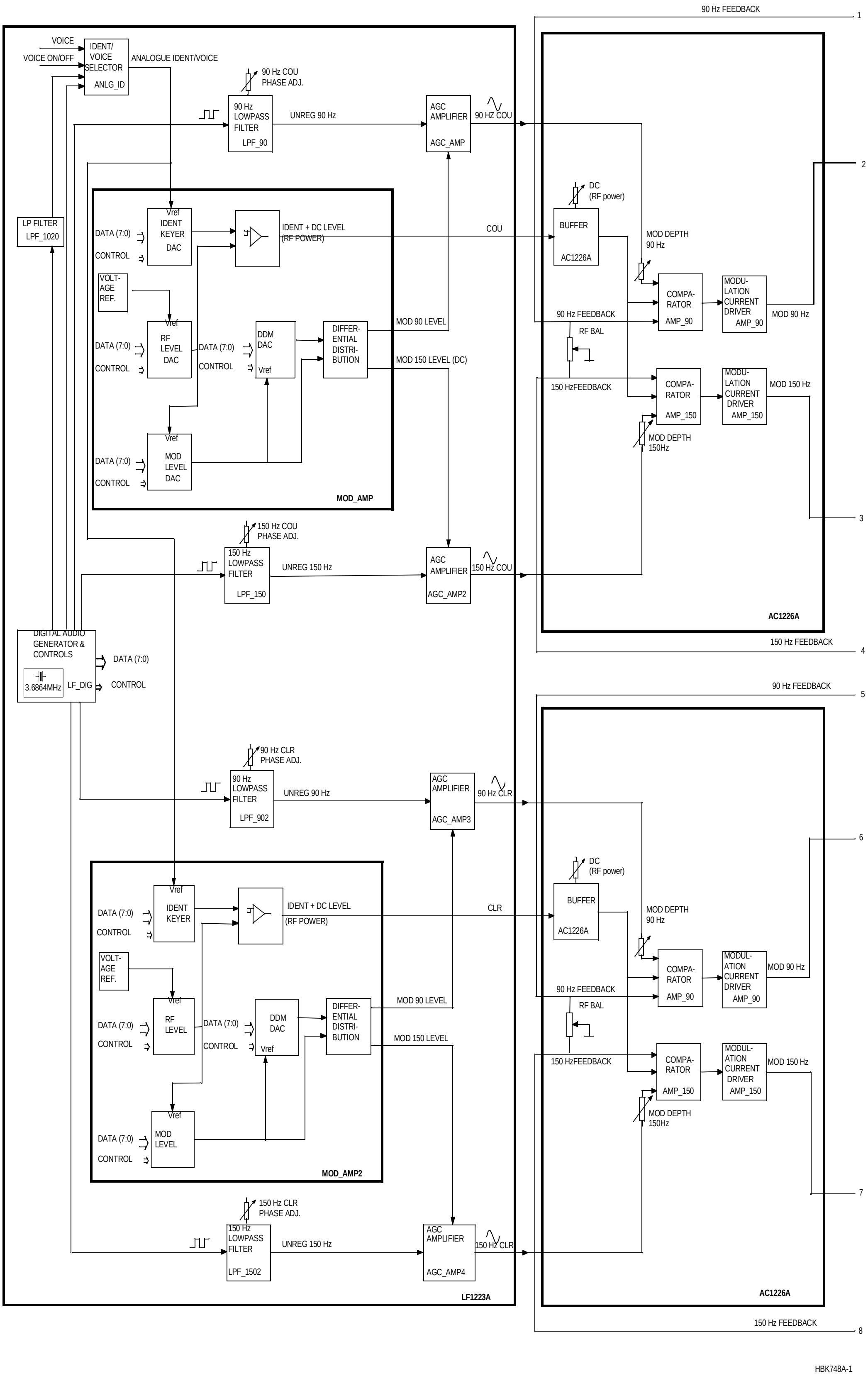

Figure 2-1 NM 7013 Transmitter Block Diagram part 1

Figure 2-2 NM 7013 Transmitter Block Diagram part 2

2.2 LF1223A Low Frequency Generator

General Description:

LF1223A provides the audio signals to be modulated onto the carrier signal in the transmitter (AC 1226A). The levels of the 90Hz, 150Hz, RF level and ident signals and the morse code of the ident signal are programmable from the RMS.

Block Diagram:

See Figure 2-1.

Block Description:

<u>DIGITAL SECTION</u>
The LF_DIG block provides the interface to the RMS, the parameter storage (EEPROM) and the analog section. All sequencing and local parameter update is performed by this block. Most of the functionality of the DIGITAL SECTION is handled by the NMP110A FPGA described in chapter 2.2.1.

<u>ANALOG SECTION.</u>
All levels are controlled digitally through multiplying DACs (MDACs), and the AC levels are stabilized through AGC amplifiers. The fine tuning of the phase between the 90 and 150Hz signals is done manually with potentiometers. The morse code is keyed in an analog multi-plexer, and can be synchronized with a DME.

RF level and ident (DC_IDENT), SDM and DDM (90/150Hz) are generated in the MDAC chain. Multiplication (m) in the MDACs are $0 \le m < 1$.

- The reference voltage is multiplied in the first MDAC to form the DC portion of DC_IDENT. The keyed 1020Hz sine wave is multiplied in an other MDAC to control the ident amplitude, this signal forms the IDENT portion of DC_IDENT signal.
- The DC portion of DC_IDENT is multiplied in the third MDAC to form the modulation sum reference .
- This modulation sum reference is split in two signals where one is modified by a fourth MDAC before they are combined again to form the modulation difference.

2.2.1 NMP110A Low Frequency Generator Control

General description:

NMP110A is a FPGA within the LF_DIG block. It provides the interface between the RMS and the local parameter storage and sequencing of the LF signals are performed here. NMP110A is based on the Actel ACT1020 FPGA. For electrical specifications see the ACT1020 datasheet.

Block diagram:

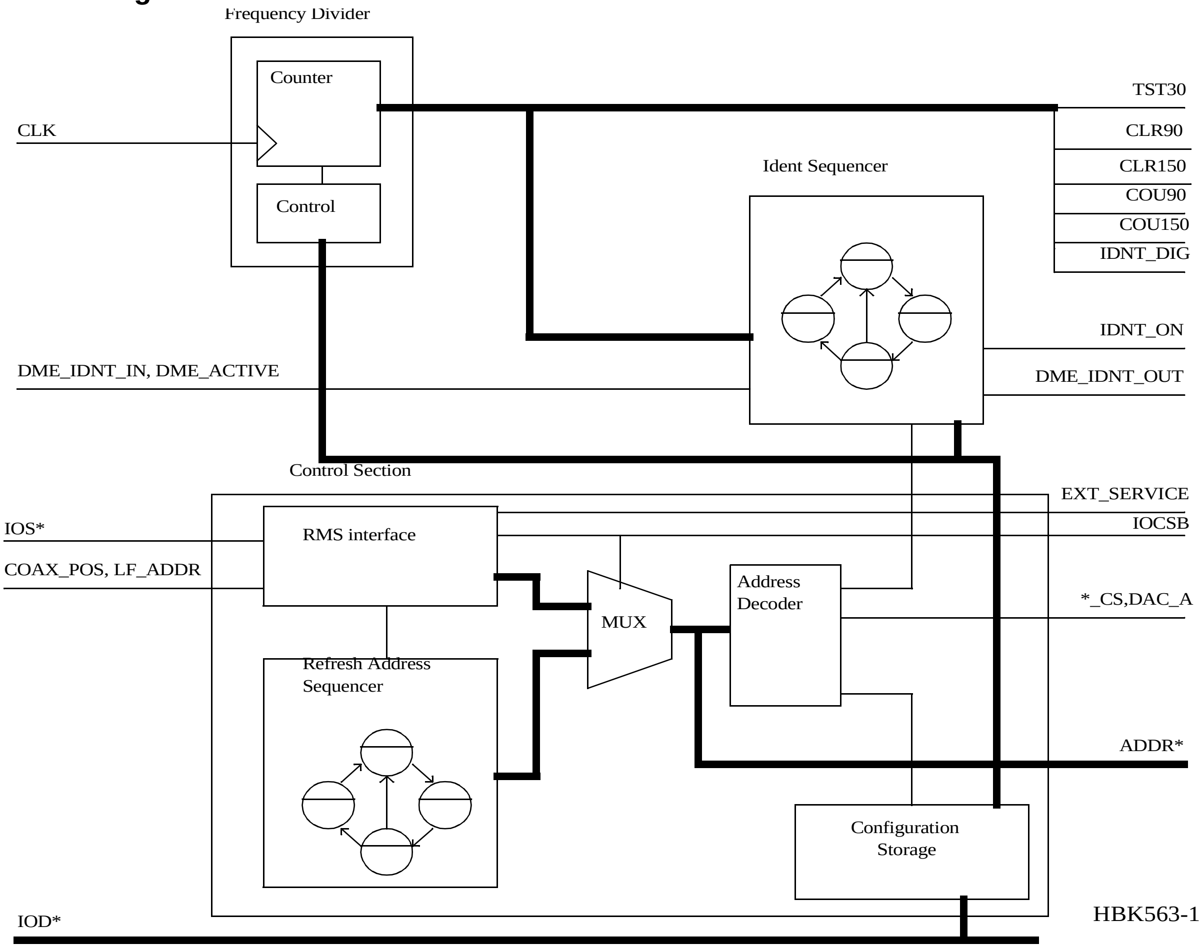

Figure 2-3 NMP110A block diagram.

Block description:

<u>FREQUENCY DIVIDER</u>
divides the system clock (3.6864MHz) into 30Hz, 90Hz, 150Hz, 1020Hz, morse code tick length and morse code word length clock signals.

<u>IDENT SEQUENCER</u>
generates the programmed ident envelope for the ILS signal and external DME equipment.

<u>CONTROL SECTION</u>
includes the RMS interface, address decoding, configuration control and automatic refresh of the DACs and the other registers. The refresh cycle is performed after a completed RMS access cycle.

2.3 OS1221A RF Oscillator

General Description:

The OS1221A module generates the RF signals used for the generation of the carrier signals in the transmitters (ch. 2.5).

Block Diagram:

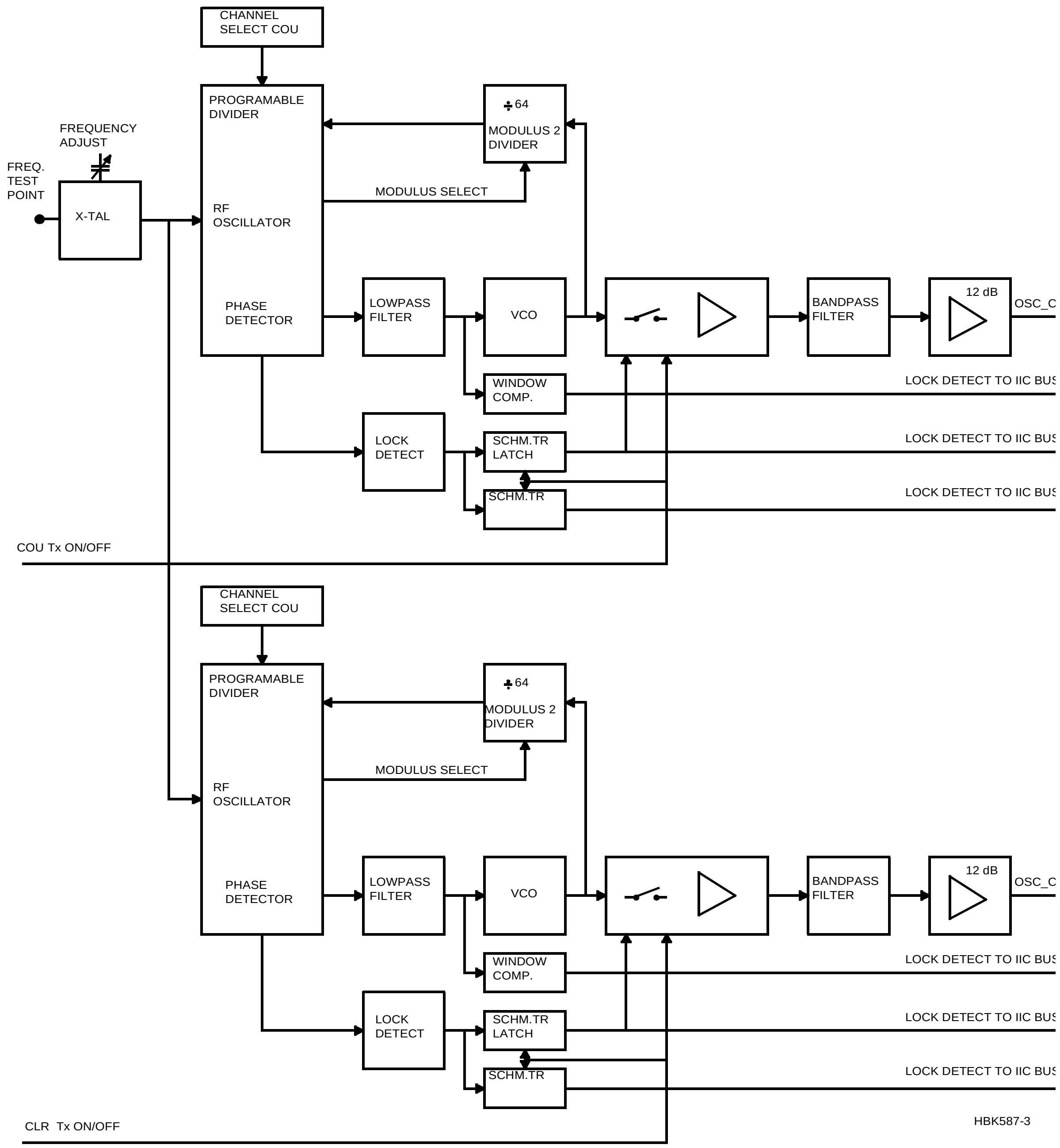

Figure 2-4 OS1221A block diagram.

Block Description:

The RF signal is generated by a voltage controlled oscillator (VCO) built around a Dual Gate Mosfet Transistor, chosen because of its good noise properties, and the possibility to have an isolated output at the drain.

A part of the signal is fed back, via a buffer for isolation, to a divide by 64, modulus 2 prescaler. This is connected to a MC145152-2, a phase locked loop circuit that performs the counting and control of the prescaler. The total count, and thereby the frequency, is set by inserting shunts onto an array of pins.

The correct count for a desired frequency (FRQ) is found as follows:

COUNT = FRQ / 5KHZ

In order to set the frequency on the OS1221, the count must be rounded off to the nearest integer value and converted to a binary number.

Insert shunts for binary zeros on the pin arrays P2 or P102 (COU/CLR) starting with the most significant bit on P2/102,A0 and the least significant bit on P2/102,N9. Be aware that most calculators discards leading zeros. Please find tables of jumper settings in chapter 3.4.

The internal oscillator of the Course PLL is also used to control the Clearance PLL.

The differential output of the phase comparator is made single ended by a balanced amplifier. A combined low-pass filter and integrator is built around an operational amplifier, that generates the control voltage for the RF oscillator. This control voltage is also fed to a window comparator that alarms the system via the I^2C-bus if it falls outside its limits (another control of the PLL is via the Lock Detect output of the PLL). The Lock Detect output of the PLL circuit is fed to a low pass filter and a transistor. This output consists of narrow negative going pulses when the loop is locked, and wide pulses of variable width when out of lock. Therefore the transistor will be turned off when in lock, and on when out of lock.

The output from the transistor goes to two Schmidt triggers, one latching and one unlatching. The latching Schmidt triggers turns the signal off if the loop goes out of lock and alarms the I^2C-bus. It is reset by power on and/or a low transition of the COU_OFF signal (CLR_OFF for the clearance channel). The other Schmidt trigger is used to inform the system of the situation that the loop have been out of lock, but is in lock at the present time even if the signal is turned off (this might be the situation if a short drop in the 12V supply occurs, or a change in frequency setting has taken place).

The signal switching is done in two steps. The first is a diode switch and the next is a Dual Gate Mosfet transistor that can be turned off by taking its control gate to a low potential. This transistor acts as a buffer for the signal when in the on state. At the output of this transistor, a second order bandpass filter follows, that serves as an output match of the transistor and to filter out harmonics of the output voltage. The last stage is a 12dB gain block that delivers 10mW of power to the PC1225 card.

The Clearance channel is identical to the Course channel except for the crystal oscillator for the PLL.

2.4 LPA1230A Localizer Power Amplifier Assembly

Physical Organization

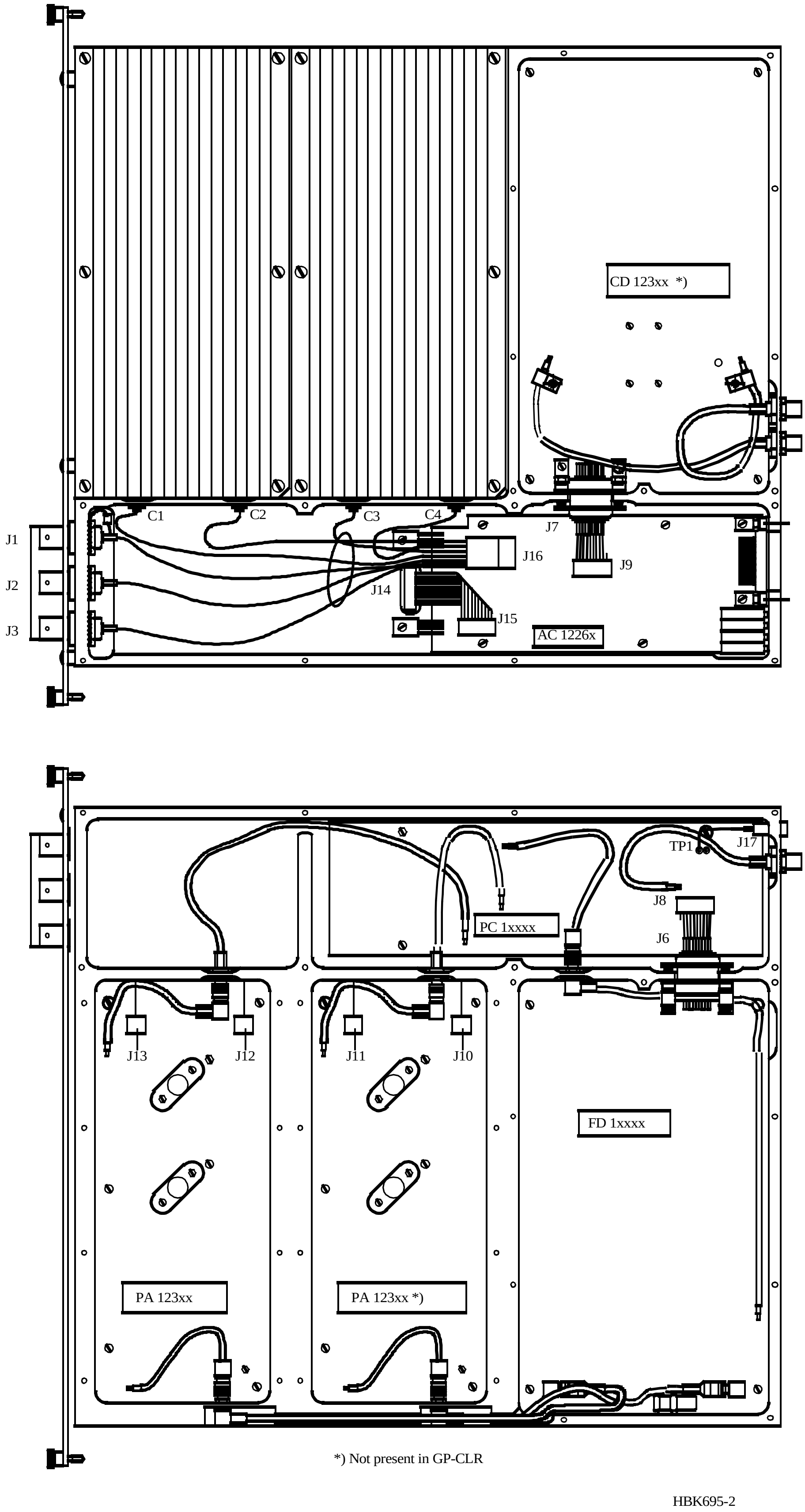

Figure 2-5 Physical organization of power amplifier assembly.

General Description:

The Localizer Power Amplifier Assembly LPA1230A consists of the following modules mounted together as shown on Fig. 2-5.

2	Power Amplifiers	PA1233A
1	Amplitude Control	AC1226A
1	Phase Control	PC1225A
1	Feedback Detector	FD1235A
1	Combiner Detector	CD1237A

The LPA1230A receives RF signals and LF signals from the OS1221A Oscillator (Ch. 2.3) and LF1223A low frequency generator (Ch. 2.2) respectively. The outputs from the LPA1230A are carrier sideband (CSB) signal and sideband only (SBO) signal. Detected samples of the CSB and SBO signals and the phase feedback signal are available on the BNC connectors on the front panel. Information about signals and status are interfaced with the RMS.

Block Diagram:

See Figure 2-1 and Figure 2-2.

Block Description:

The PC1225A Phase Control receives the RF signal from the oscillator OS1221A and splits this signal into two paths (90Hz and 150Hz branch). The RF phase regulator blocks ensure correct phase relationship between the 90Hz and 150Hz modulated RF signals prior to combining them into CBS and SBO signals.

The AC1226A Amplitude Control provides and controls the required LF modulation signals (90Hz and 150Hz) for the PA 1233A power amplifiers that keeps the output RF level and amplitude modulation constant.

The PA1233A Power Amplifier modulates the incoming RF signal from PC1225A with a 90Hz or a 150Hz LF signal to obtain an AM-signal and amplifies the modulated signals.

The FD1235A Feedback Detector provides feedback signals for amplitude and phase correction of the 90 and 150 Hz modulated RF signals.

The CD1237A Combiner Detector combines the 90 Hz modulated RF signal and the 150 Hz modulated RF signal in such a way that true CSB and SBO RF signals are generated. In addition, detected and filtered CSB and SBO signals for measurement purposes are provided to the test connectors on the front panel.

Detailed description about the individual modules are found below.

2.4.1 PA1233A Power Amplifier

General Description :

Power amplifier PA1233A is a three stage single-ended amplifier.

The first stage works as an AM-modulator. The modulation tone (90Hz or 150Hz) is fed to the collector of a bipolar transistor. This modulation stage is operating in class C and has impedance matching network at both input and output. Nominal RF input level is approximate 20dBm.

Second stage consists of a 5W MOSFET-transistor operating in class B. The input impedance network is matched to 50Ω, while the output impedance network is matched to the complex conjugated impedance of the third stage transistor. This stage has a collector-to-gate feedback and a input shunt loading resistor at the transistor gate, to prevent unwanted oscillations and keep the transistor unconditionally stable.

Third stage is a 45W MOSFET-transistor operating in class AB. Its output impedance network consists of microstrip transmission lines and a variable capacitor to achieve maximum power and efficiency. This stage has also feedback and shunt resistors to prevent unwanted oscillations. As gain control, both the second and third stage have potentiometers to set the operating point. A positive voltage regulator is used to keep a fixed input voltage to these gain control circuits.

The lowpass filter at the output is a 9th order-filter, giving better than 65dB attenuation of all harmonics and forward loss is less than 0.5dB. Filter input and output impedance are 50Ω.

2.4.2 AC1226A Amplitude control

General Description :

The main purpose of the AC1226A is to maintain a constant modulation and RF level for the output signals from the PA 1233A power amplifiers. The RF level and modulation depths are derived from three reference input signals coming from LF 1233A. A DC reference level sets the RF level for both power amplifiers and one 90Hz and one 150Hz AC reference signal determines the modulation depths of the 90Hz and 150Hz power amplifiers respectively. The AC1226A also contains measurement circuits for the RMS.

ADJUSTMENTS:

The levels of the reference DC signal and the two reference AC signals are separately adjustable. In addition, the power balance between the two power amplifiers can be adjusted. The goal of these adjustments is to compensate various tolerances inside the LPA1230A. Adjusted correctly, any LPA1230A can be replaced by any other LPA1230A without any adjustments, and still be within specified limits.

Any site or RF frequency dependent adjustments shall be made on the LF1223A module via the RMS system.

FEEDBACK FUNCTION:

The 90 and 150 Hz LF signals from LF1233A are combined with the DC (ident) signal also coming from LF1233A to form the desired RF envelope for each of the PA1233A. This envelope is compared with the envelope detected by FD1235A and the resulting signal is fed to the PA1233A modulator. This process eliminates any ground offset between the LPA1230A and the LF1223A generating the reference signals.

MAINTENANCE MEASUREMENTS:

Following measurements are reported to the RMS:

The 22-28V DC power supply for each PA1233A.

Detected CSB and SBO RF level.

Peak of the phase correction curve.

2.4.3 PC1225A Phase Control

General Description:

The RF carrier signal from OS1221A (Ch. 2.3) is split in two paths, one to be modulated with 150 Hz, and one to be modulated with 90 Hz. The first stage of each path is a phase regulator, with a range of ±100 degrees. In the 90Hz path, the phase is set with a potentiometer for reference, in the 150Hz path the phase is controlled by a phase comparator. The phase comparator is a part of a negative feedback loop which ensures the correct phase relationship between the 90Hz and 150Hz modulated RF signals from the PA1233A power amplifiers prior to combining them into CBS and SBO. Each of the phase regulators is followed by a buffer amplifier, a 15dB gain block and a output stage.

The RF level at the output is fed back in an automatic gain control feedback loop ensuring constant output level of 20dBm.

2.4.4 FD1235A Feedback Detector

General Description:

The function of FD1235A is to provide feedback signals for amplitude and phase correction of the 90 and 150 Hz modulated RF signals. Two dual directional couplers sample the main RF signal from the 90 Hz and the 150 Hz modulated power amplifiers, respectively. One half of each dual coupler is used for amplitude control, while the other half is used for phase control.

For AMPLITUDE control, the sampled RF signal is detected by a diode that is slightly forward biased for linearity, bias being provided by another diode. The detector time constant is short; the detected signal consist of a positive voltage proportional to the RF carrier level and an LF voltage proportional to the modulation. When this output is fed back to the power amplifiers via the Amplitude Control board, RF power and modulation depth will be held constant, and distortion will be practically eliminated. A low-pass filter is inserted between the detector diode and the coupled lines to prohibit RF harmonics generated by the detector to couple back onto the main RF line. Coupler directivity is much improved by very small capacitances connected across the lines.

For PHASE control, a 90 degree 3 dB hybrid is used as a phase discriminator. Such a device has the property that the resulting amplitude at its outputs depend upon the phase difference at its inputs. Here, the two sampled RF signals, which have equal amplitudes, are applied to the hybrid inputs. The two output signals from the hybrid are rectified, giving positive output voltages with some LF components. Normally, these two voltages will be equal. Any shift in RF input phase will make these voltages unequal. When these output voltages are fed back to the Phase Control board, the phase relations at the input will be held constant. For equal magnitude at the outputs of the 90 degree 3 dB hybrid, the phase difference at the hybrid inputs must be zero. Proper phasing initially is here obtained by the insertion of a delay line in the 150 Hz modulated path. The main RF input signals applied to the couplers are already 90 degrees out of phase here, with the 90 Hz modulated signal lagging. Therefore, the additional delay line between the 150 Hz coupler and the hybrid will provide the missing 90 degree delay for zero phase difference at the hybrid inputs. A small trimming capacitor is included to facilitate an offset to compensate for eventual minor phase errors in the remaining RF circuitry outside the phase feedback loop. Adjustment can therefore only be done properly with the whole transmitter module working. This trimmer is the only adjustable component on this board. All diodes used on this board are matched pairs for temperature stability reasons.

The RF power output from this board is fed through a pair of 50 Ohm coaxial connections inside the housing directly to the Combiner board CD1237A, the connections being disconnectable to facilitate removal for repair. Inserted in a properly adjusted transmitter module, the 90 and 150 Hz modulated output (and input) power signals of the Feedback Detector board will have equal amplitudes with the 90 Hz path lagging the 150 Hz path by 90 degrees (except for eventual offset), and this condition will be held constant by the feedback loops.

2.4.5 CD1237A Combiner Detector

General Description:

The function of CD1237A is to combine the 90 Hz modulated RF signal and the 150 Hz modulated RF signal from FD1235A to form the CSB and SBO RF signals to be transmitted. In addition, detected and filtered CSB and SBO signals for measurement purposes are provided to BNC test connectors on the front panel.

The 90 Hz and 150 Hz modulated RF input signals are of equal amplitude in phase quadrature, with the 90 Hz signal lagging. A 90 degree 3 dB hybrid is used as a combiner. When two RF signals of equal frequency and amplitude but with 90 degrees phase difference are applied to the two input ports of such a hybrid, the signals will add in phase at one output port but will be in reverse phase and cancel each other at the other port. This is the situation for the carrier frequency, resulting in twice the input power at the CSB port and no power at the SBO port. However, the sideband frequencies at the two inputs are not identical. The power of each sideband frequency will therefore be split equally between the two outputs. The resulting depth of modulation at the CSB output will be one half relative to the input value. At the SBO output, the two sidebands will be in reverse phase at the instant when the LF components are in phase. Thus true CSB and SBO signals are generated at the outputs.

A pair of directional couplers sample the CSB and SBO RF output signals for measurement purposes. The RF samples are detected by matched diodes that are slightly forward biased. Detector filters have short time constant to preserve the LF envelopes. A low-pass filter is inserted between each detector diode and the coupled lines to prohibit RF harmonics generated by the detector to couple back onto the main RF line. Coupler directivity is much improved by very small capacitors connected across the lines.

2.5 COA1207B Change-Over Assembly

General Description:

The COA1207B consists of two Change-Over Relay Assemblies CRA1228A, one for the Course signals and one for the Clearance signals.

The Change-Over Assembly utilizes double-throw coaxial relays to connect the CSB and SBO output signals from either the main or standby transmitter (LPA1230A) to the antenna system or to a dummy load.

The assembly includes attenuators and phase shifters required to obtain the correct CSB/SBO relationship.

One CRA1228A is shown below.

Block Diagram:

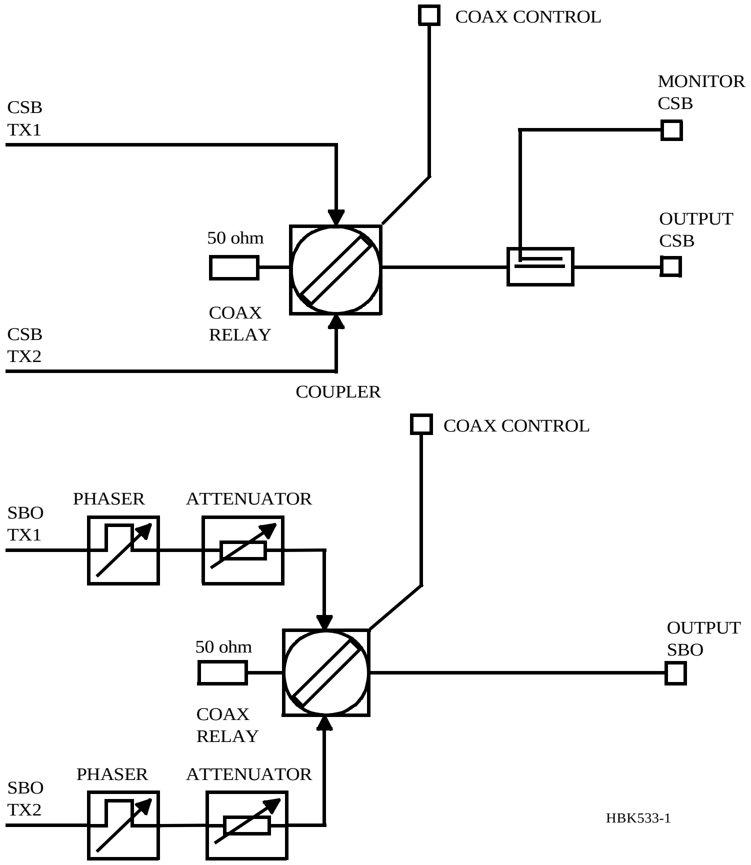

Figure 2-6 Changeover system block diagram.

3 Tests and Adjustments

3.1 Transmitter Alignments and Calibration

Test Equipment required:
- Oscilloscope general purpose
- NM 3710 Field Test Set (with 20 dB attenuator)
- BNC Test Cable
- Frequency Counter RF

Carry out the alignment steps in the order outlined below:

3.1.1	RF Phase feedback adjustment
3.1.2	RF power
3.1.3	LF phase adjustment
3.1.4	RF power balance adjustment
3.1.5	RF phase combiner at I/P
3.1.6	SDM calibration
3.1.7	DDM calibration
3.1.7.1	Test DDM setting
3.1.8	Ident tone modulation depth
3.1.9	RF frequency adjustment

NOTE:

If some of the functions/parameters depart considerably from normal, then repeat the steps in sequence once more, except steps 3.1.7.1 - 3.1.9.

3.1.1 RF Phase Feedback Adjustment

Connect the oscilloscope to the BNC test connector labelled PHASE CORR. located on the transmitter modules.

NOTE

Set the scope's input mode to DC.

The waveform observed should take a continuous form without limiting segments or deep notches or other discontinuities.

(Each modulator develops it's own waveform shape due to spreads in insertion phases).

The dynamic maximum point should be adjusted to approximately -4 volt.

The average operating point of the PHASE CORR signal can be shifted by means of adjusting potentiometer PH.OFFS. at the back of the LPA/GPA (See Figure 3-6).

3.1.2 RF Power

The CSB and corresponding SBO output power can be adjusted by means of the RMM Program or the Local Display/Keyboard.

LLZ Course	15W CSB
LLZ Clearance	15W CSB
GP Course	5W CSB
GP Clearance	0,5W CSB

Table 3-1 Normal operating power level

The output power can be read by means of the RMM Program or the Local Display/Keyboard.

3.1.3 LF Phase Adjustment

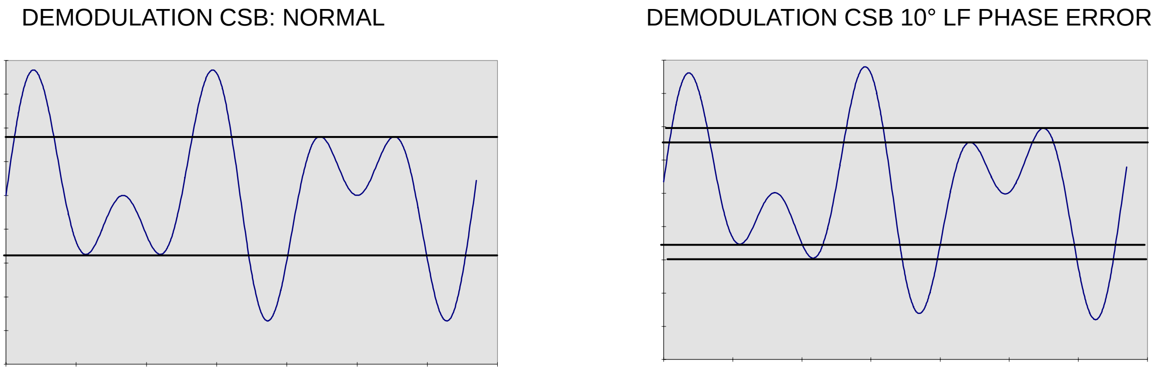

Figure 3-1 LF phase CSB illustration.

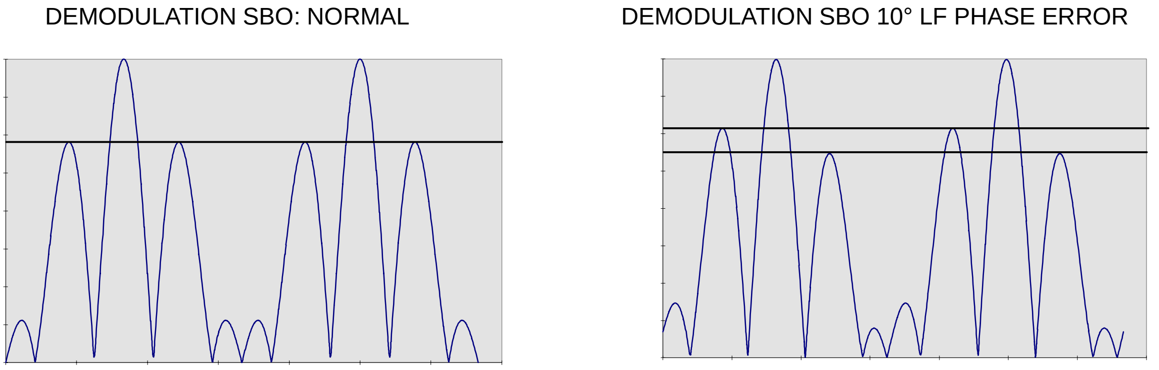

Figure 3-2 LF phase SBO illustration.

3.1.3.1 One-frequency system

Connect oscilloscope channel A to the BNC test connector labelled CSB located on LPA/GPA Course 1 (2).

Set oscilloscope input mode to DC.

Adjust **150 Hz COU phase adj** R3 on Low Frequency generator LF1223A (Figure 3-5) observing oscilloscope channel A until the waveform equals left hand graph in Figure 7-2.

A significant indication of correct LF phase is that the pair of the intermediate peaks are equal in amplitude.

3.1.3.2 Two-frequency system

Connect oscilloscope channel A to the BNC test connector labelled CSB located on LPA/GPA Course 1 (2).

Connect oscilloscope channel B to the BNC test connector labelled CSB located on LPA/GPA Clearance 1 (2).

Set oscilloscope input mode to DC. Select CHOP mode.

Adjust channel A and B gain so that both waveforms show the same amplitude.

By means of the RMM turn off 90 Hz modulation for Course Tx and Clearance Tx.

On Low Frequency generator LF1223A Tx1 (Tx2) adjust **150 Hz COU phase adj.** R3 to physical centre position.

Adjust **150 Hz CLR phase adj.** R180 to track 150 Hz Course waveform in the same phase (waveform overlap).

By means of the RMM turn on 90 Hz modulation for both Course Tx and Clearance Tx.

Adjust **90 Hz COU phase adj.** R1 (LF1223A) observing oscilloscope channel A until the waveform equals left hand graph in Figure 7-2.

Adjust **90 Hz CLR phase adj.** R179 (LF1223A) observing oscilloscope channel B until the waveform equals left hand graph in Figure 7-2.

A significant indication of correct LF phase is that the pair of the intermediate peaks are equal in amplitude.

3.1.4 RF Power Balance Adjustment

Connect the oscilloscope to the BNC test connector labelled SBO located on the transmitter modules.

NOTE:

Set the scope's input mode to <u>DC</u>.

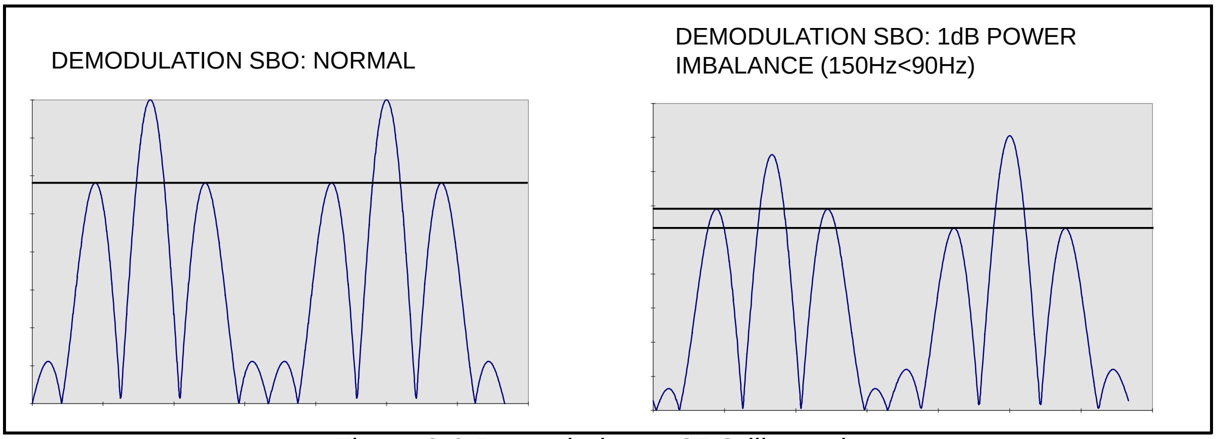

Figure 3-3 Power balance SBO illustration.

Perfect power balance between the 90 Hz modulated carrier and the 150 Hz modulated carrier is indicated when the two largest sets of peak waveforms fall on lines parallel to the baseline. A more accurate way of observing a power balance error is to double the sweep rate in non-trigger mode such that the second 60 Hz half of the cycle is folded back on the first half and tracks the envelope waveform.

RF Power Balance can be adjusted by potentiometer RF-BAL on the back of the LPA/GPA (See Figure 3-6). Adjust until both halves fall on the same envelope waveform or the two largest sets of peak waveforms fall on lines parallel to the baseline (See Figure 3-3).

3.1.5 RF Phase at Combiner I/P

Connect the oscilloscope to the BNC test connector labelled SBO located on the transmitter modules.

NOTE:

Set the scope's input mode to DC. Set the oscilloscope in normal trigger mode such that the waveform below can be observed.

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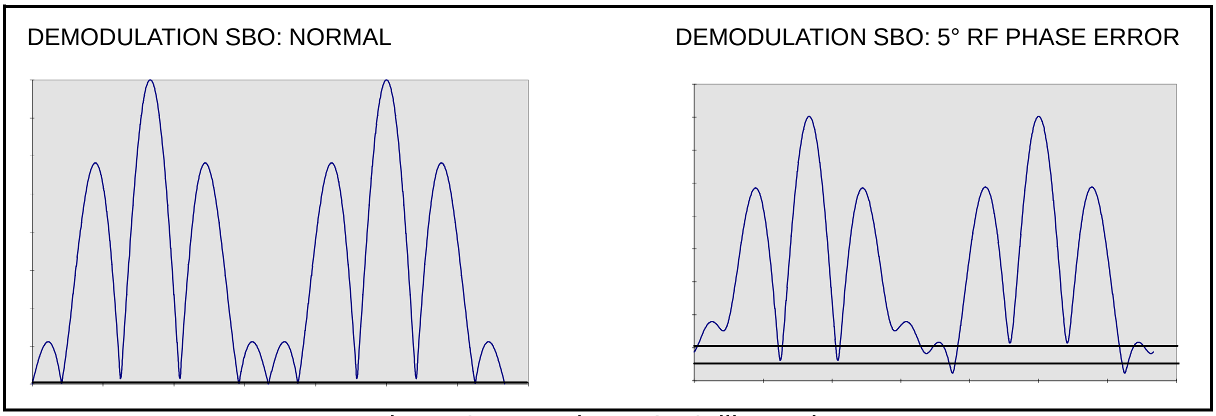

Figure 3-4 RF phase SBO illustration

The RF phase (90° start phase) can be adjusted by trimmer RF PHASE on the back of the LPA/GPA. Adjust until the minima points between the smallest peak waveform reach the baseline or a minimum.

3.1.6 SDM Calibration

Connect the NM 3710 Field Test Set to the CSB BNC test connector in the Cabinet's Change-over section.

(Insert a 20 dB attenuator at the input of the Field Test Set in order to avoid overloading).

SDM should be calibrated to 40,0% +/- 0,1% SDM by adjusting SDM from the RMM Program or the Local Display/Keyboard.

3.1.7 DDM Calibration

NOTE:

Check that all TEST DDM settings are in NORMAL.

Connect the NM 3710 Field Test Set to the CSB BNC test connector in the Cabinet's Change-over section.

(Insert a 20 dB attenuator at the input of the Field Test Set in order to avoid overloading).

DDM should be calibrated to 0.0% +/-0.05% DDM by adjusting DDM from the RMM Program or the Local Display/Keyboard.

3.1.7.1 Test DDM Setting

TEST DDM with 90Hz or 150Hz dominance can be switched on and off from the RMM Program or the Local Display/Keyboard. The DDM values inserted by TEST DDM are preset values which is set as described below.

90Hz Dominance Preset

Utilize the Field Test Set as in the previous test.Set the TEST DDM in position 90 Hz dominance from the RMM Program or the Local Display/Keyboard. Adjust the (90 Hz) test DDM setting until a wanted DDM value indicating (-) sign is obtained. (Typical value: -0.8%...-1.0% DDM).

150Hz Dominance Preset

Utilize the Field Test Set as in the previous test.Set the TEST DDM in position 150 Hz dominance from the RMM Program or the Local Display/Keyboard. Adjust the (150 Hz) test DDM setting until a wanted DDM value indicating (+) sign is obtained. (Typical value: 0.8%...1.0% DDM).

Set the TEST DDM back to normal.

3.1.8 Ident Tone Modulation Depth

3.1.8.1 Method 1

Connect the Field Test Set to the CSB BNC test connector in the Cabinet's Change-over section.

(Insert a 20 dB attenuator at the input of the Field Test Set in order to avoid overloading).

Set the Ident Control to CONTINUOUS from the RMM Program or the Local Display/Keyboard.

On the Field Test Set, press IDENT.

1020 Hz modulation depth can be adjusted from the RMM Program or the Local Display/Keyboard.

Adjust modulation depth to 10.0% +/-0.3%.

If VOICE modulation is implemented, the ident modulation depth should be set to 5.5% +/-0.3% to avoid over modulation. Before this adjustment is done, follow the instructions in the appendix VOICE GENERATOR. Make sure VOICE is turned off from the RMM program or the Local Keyboard/Display when adjusting the modulation depth.

3.1.8.2 Method 2

An alternative method of checking 1020 Hz modulation depth to 10% is described below:

Connect the oscilloscope to the BNC test Connector labelled CSB.

Switch off the 90 Hz modulation and the 1020 Hz modulation.

Note the peak-to-peak deflection of the remaining 150 Hz waveform.

Then switch off the 150 Hz modulation and switch the 1020 Hz modulation to CONTINUOUS.

The observed 1020 Hz peak-to-peak waveform amplitude should be 50% of the 150 Hz amplitude providing the 1020 Hz modulation depth is 10% (or 1/2 of 150 Hz depth).

3.1.9 RF Frequency Adjustment

Fine-adjustment of the operating frequency can be carried out by adjusting C1 in the OS1221A/B RF Oscillator module.

Mount the Oscillator OS1221A/B on an extension board.

In order to monitor the frequency, connect the Frequency Counter to the BNC test connector labelled CSB. (Make sure the transmitter under test is routed to Antenna). If necessary for stable counting switch off modulation tones.

Adjust until frequency is less than 1 kHz from operating frequency. Trimmer C1 adjusts course and clearance frequencies simultaneously.

3.2 Antenna System Adjustments

After the transmitters has been aligned correctly the antenna system must be aligned. This includes mechanical adjustments of the Antenna System, electrical adjustments (phasing) and adjustments of the ADU and MCU.

For details, refer to the adjustment procedure for each antenna system.

3.3 Adjustment points

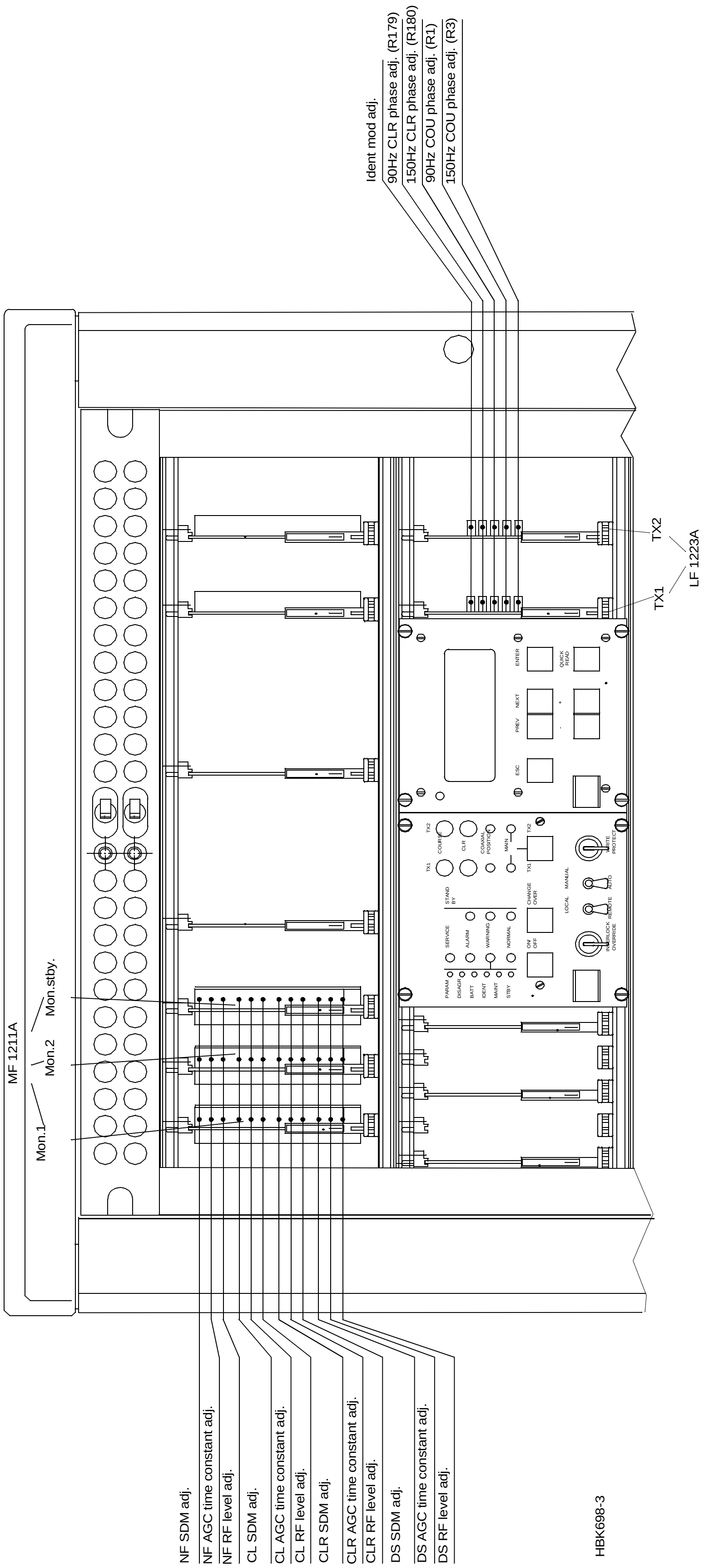

Figure 3-5 Front side adjustment points.

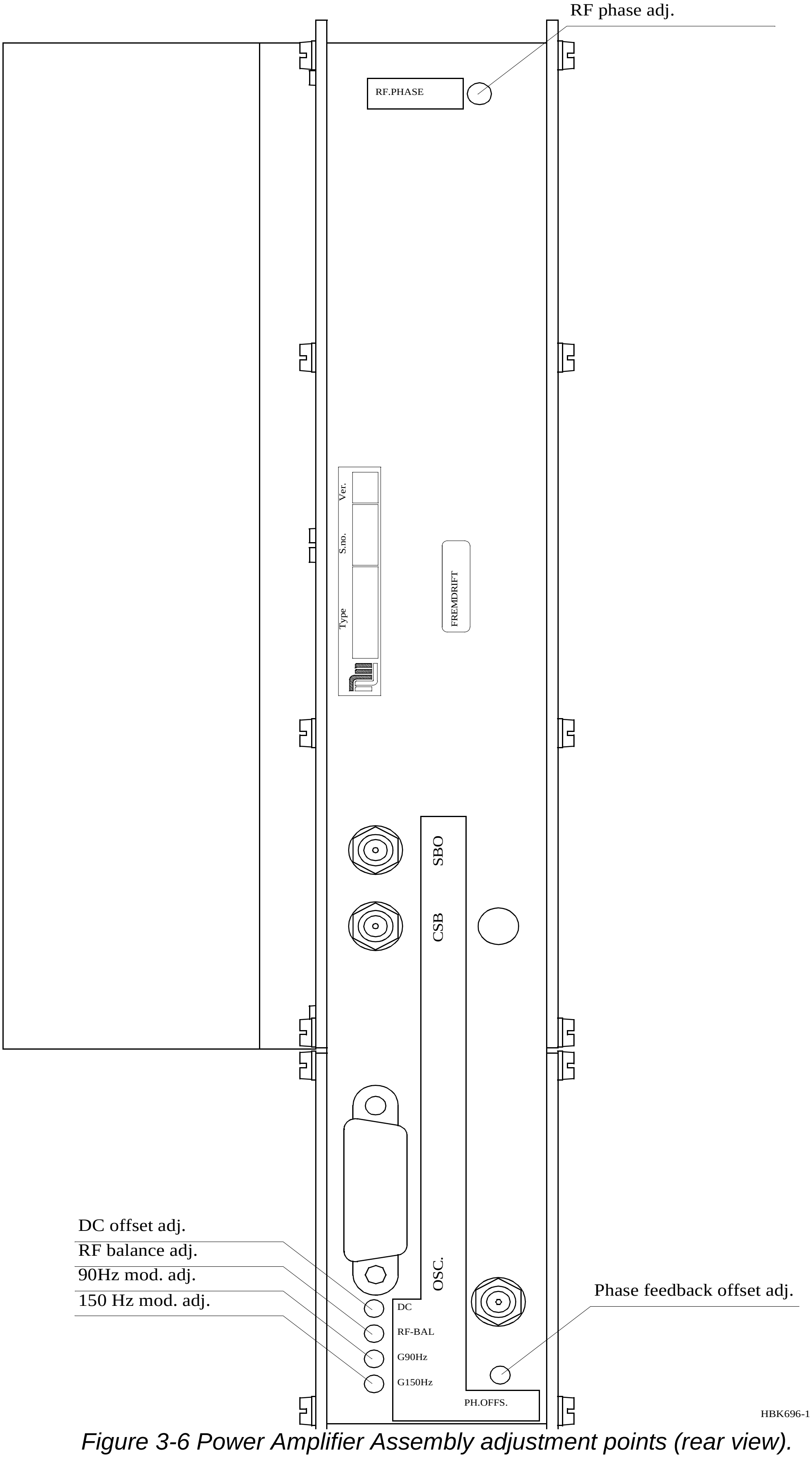

Figure 3-6 Power Amplifier Assembly adjustment points (rear view).

3.4 Frequency configuration strap settings

This section defines the strap settings on the for the standard ICAO Annex 10 ILS frequencies.

The strap settings for each frequency and equipment type are shown in Table 0-1 and Table 0-2. The straps are numbered from A0 to A5 and N0 to N9. A0 is the bottom strap in two groups of straps. (when the board is held as inserted in the cabinet).

An “X” character in the table means the strap must be inserted. A blank means the strap must be removed.

0.0.1 OS1221A strap settings for 2-frequency LLZ

The course transmitter frequency is set with straps in the J2 strap block. The configured course frequency is the channel frequency + 5 kHz.

Ch. freq. (MHz)	A0	A1	A2	A3	A4	A5	N0	N1	N2	N3	N4	N5	N6	N7	N8	N9
108.1		X		X				X	X	X		X		X		X
108.15									X	X		X		X		X
108.3		X				X	X		X	X		X		X		X
108.35				X	X		X		X	X		X		X		X
108.5		X		X	X	X			X	X		X		X		X
108.55					X	X			X	X		X		X		X
108.7		X			X				X	X		X		X		X
108.75				X					X	X		X		X		X
108.9		X		X		X	X	X		X		X		X		X
108.95						X	X	X		X		X		X		X
109.1		X					X	X		X		X		X		X
109.15				X	X	X		X		X		X		X		X
109.3		X		X	X			X		X		X		X		X
109.35					X			X		X		X		X		X
109.5		X			X	X	X			X		X		X		X
109.55				X		X	X			X		X		X		X
109.7		X		X			X			X		X		X		X
109.75							X			X		X		X		X
109.9		X				X				X		X		X		X
109.95				X	X					X		X		X		X
110.1		X		X	X	X	X	X	X			X		X		X
110.15					X	X	X	X	X			X		X		X
110.3		X			X		X	X	X			X		X		X
110.35				X			X	X	X			X		X		X
110.5		X		X		X		X	X			X		X		X
110.55						X		X	X			X		X		X
110.7		X						X	X			X		X		X
110.75				X	X	X	X		X			X		X		X
110.9		X		X	X		X		X			X		X		X
110.95					X		X		X			X		X		X

111.1		X			X	X			X			X		X		X
111.15				X		X			X			X		X		X
111.3		X		X					X			X		X		X
111.35												X		X		X
111.5		X				X	X	X				X		X		X
111.55				X	X		X	X				X		X		X
111.7		X		X	X	X		X				X		X		X
111.75					X	X		X				X		X		X
111.9		X			X			X				X		X		X
111.95				X				X				X		X		X

Table 0-1 OS1221A Course frequency settings for 2-freq. LLZ

The clearance transmitter frequency is set with straps in the J102 strap block. The configured clearance frequency is the channel frequency - 5 kHz.

Ch. freq. (MHz)	**A0**	**A1**	**A2**	**A3**	**A4**	**A5**	**N0**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	**N9**
108.1			X	X				X	X	X		X		X		X
108.15		X						X	X	X		X		X		X
108.3			X			X	X		X	X		X		X		X
108.35		X		X	X		X		X	X		X		X		X
108.5			X	X	X	X			X	X		X		X		X
108.55		X			X	X			X	X		X		X		X
108.7			X		X				X	X		X		X		X
108.75		X		X					X	X		X		X		X
108.9			X	X		X	X	X		X		X		X		X
108.95		X				X	X	X		X		X		X		X
109.1			X				X	X		X		X		X		X
109.15		X		X	X	X		X		X		X		X		X
109.3			X	X	X			X		X		X		X		X
109.35		X			X			X		X		X		X		X
109.5			X		X	X	X			X		X		X		X
109.55		X		X		X	X			X		X		X		X
109.7			X	X			X			X		X		X		X
109.75		X					X			X		X		X		X
109.9			X			X				X		X		X		X
109.95		X		X	X					X		X		X		X
110.1			X	X	X	X	X	X	X			X		X		X
110.15		X			X	X	X	X	X			X		X		X
110.3			X		X		X	X	X			X		X		X
110.35		X		X			X	X	X			X		X		X
110.5			X	X		X		X	X			X		X		X
110.55		X				X		X	X			X		X		X
110.7			X					X	X			X		X		X
110.75		X		X	X	X	X		X			X		X		X
110.9			X	X	X		X		X			X		X		X
110.95		X			X		X		X			X		X		X
111.1			X		X	X			X			X		X		X

111.15		X		X		X			X			X		X		X
111.3			X	X					X			X		X		X
111.35		X							X			X		X		X
111.5			X			X	X	X				X		X		X
111.55		X		X	X		X	X				X		X		X
111.7			X	X	X	X		X				X		X		X
111.75		X			X	X		X				X		X		X
111.9			X		X			X				X		X		X
111.95		X		X				X				X		X		X

Table 0-2 OS1221A Clearance frequency settings for 2-freq. LLZ