TAIT ELECTRONICS LIMITED
ID: CASTEL0009. 2.983 (d)(8)(9)(10)

CASTEL0008/CASTEL0009

Applicant / Manufacturer:	Tait Electronics Ltd P.O.Box 1645 558 Wairakei Road Burnside Christchurch NEW ZEALAND
Vendor:	Tait Electronics (USA) Inc. 9434 Old Katy Road Suite 110 Houston Texas 77055 UNITED STATES of AMERICA
Model Number:	T856-16-0000 (CASTEL0008) T856-26-0000 (CASTEL0009)

Regular production quantity is planned.

Technical Description:

Type of Emission:	F3E
Frequency Range:	Transmitter: 400-440 Mhz (CASTEL0008) Transmitter: 440-480 Mhz (CASTEL0009)
Power Output:	5-25 Watts
Maximum Power:	25 Watts
DC supply voltage: DC supply current:	13.8V 5.5A Transmit, 150mA Standby
Circuit Description and Theory of Operation	Refer T850 Series II Service Manual.
Description of Circuits Determining Frequency	Standard TCXO.Temperature Compensated Crystal Oscillator rated at ± 1.0ppm, -30° deg C to +70° deg C.
Spurious and Harmonic Emission Suppression	Components: L910, L920, L930, L940, C9090, C910, C920, C930, C940, C950, C960, C970, C980, C990
Active Circuit Devices	Refer T850 Interim Service Manual Parts List.
Tune-up and Alignment Procedure	Refer T850 Interim Service Manual.

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2.7 T856 Drive Amplifier & PA

(Refer to Figure 2.1 and the exciter and PA circuit diagrams (sheets 3 & 4) in Section 6.2.)

The output power of the PA is maintained at a constant level via a power control loop applied to the two-stage, wide band exciter amplifier (Q350, Q355). The forward and reverse RF power levels are sensed via a dual directional coupler and detector diodes (D440, D420 in the PA cavity). The detected DC signals are buffered (IC330) and then summed with the 'power control' level and fed to the control integrator (IC350). The output control voltage is buffered by Q310 and Q315, and applied to the collector of the wide band exciter amplifier.

Note: Forward and reflected power signals are summed so that, under high VSWR, the power control will turn the output RF level down.

To reduce the spurious output level when the synthesiser is out-of-lock, the Tx-Reg and Lock Detect signals are gated to inhibit the PA control circuit and to switch off the RF signal at the input to the drive amplifier. This is achieved by a PIN switch attenuator (D340, D380, D360).

Cyclic keying control is provided by additional circuitry consisting of several time delay, ramp and gate stages:

- Q325, IC350 — Power Ramping.
- Q355, Q325 — Tx-Reg. and Lock Detect gate.
- Q335, Q340, Q345 — Delay and PIN switch drive.

This is to allow the RF power circuits (both exciter and PA) to ramp up and down in a controlled manner so that minimal adjacent channel interference is generated during the transition.

The output of the wide band amplifier is approximately 1W (+30dBm) for an input of 100mW (+20dBm) from the VCO, when the power control is set to maximum.

A temperature sensor (R481) is provided so that the RF output power can be reduced to a preset level when a set temperature is exceeded. This is a protection circuit (IC330, Q305) to prevent overheating, as the unit is ***not*** rated for continuous operation (refer to Section 1.2.3 for duty cycle specifications).

#R517, #R518 and #R519 form an attenuator to provide good VCO/exciter isolation as well as the correct exciter drive level.

The attenuator (#R345, #R396 and #R397) aids in producing the correct exciter drive level to the PA over the three frequency bands.

The RF output from the exciter is fed to the driver stage (Q410) and then to the final (Q420). DC is fed to the final via a low pass filter with special low frequency decoupling. CV475 tunes the output matching across the entire band.

THIS UNIT USES THE T857 EXCITER FOR ITS DRIVE.

2.8 T857 Exciter Drive Amplifier

(Refer to Figure 2.2 and the exciter circuit diagram (sheet 3) in Section 6.3.)

A two-stage, wide band amplifier (Q350, Q355) provides an output level of approximately 1W (+30dBm) for an input of 100mW (+20dBm) from the VCO. IC300, Q302, and Q303 provide a 9V regulated supply for the exciter.

To reduce the spurious output level when the synthesiser is out-of-lock, the Tx-Reg and Lock Detect signals are gated to inhibit the exciter control circuit and to switch off the RF signal at the input to the drive amplifier. This is achieved by a PIN switch attenuator (D201, D202, D203).

Cyclic keying control is provided by additional circuitry consisting of several time delay, ramp and gate stages:

- Q301, Q302, Q303, IC300 Power Ramping.
- Q310, Q311 Tx-Reg. and Lock Detect gate.
- Q320, Q325, Q330, Q335 Delay and PIN switch drive.

This is to allow the RF power circuits (both exciter and PA) to ramp up and down in a controlled manner so that minimal adjacent channel interference is generated during the transition.

R517, R518 and R519 form a 3dB attenuator to provide good VCO/drive amplifier isolation as well as the correct exciter drive level

The attenuator (#R330, #R331 and #R332) assists in producing the correct drive level to the PA over the three frequency bands in the T856. There is no attenuator in the T857.

Note: The exciter provides a DC control signal to the PA via the RF coax. This is injected via L314.

3.4 Short Tuning Procedure

Use this procedure only if you want to reprogram the T856/857 to a frequency outside the 8MHz switching range and do not intend to carry out any other major adjustments or repairs.

3.4.1 Introduction

Reprogram the operating frequency as described in the PGM800Win programming kit (refer to Section 3.2).

Remove the top cover (nearest the handle).

Set up the test equipment as described in Section 3.3.

Set the links in the audio processor section as required (refer to Section 3.5).

3.4.2 Synthesiser Alignment

- Connect a high impedance voltmeter to the junction of L1 & R1 in the VCO (this measures the synthesiser loop voltage).
- Key the transmitter by earthing the Tx key line.
- **Single Channel** Tune VCO trimmer C6 for a synthesiser loop voltage of 9V.

  Multichannel Tune VCO trimmer C6 for a synthesiser loop voltage of 10V on the middle channel.

  If there is no middle channel, tune C6 so that the channels are symmetrically placed around a loop voltage of 10V.

  All channels should lie within the upper and lower limits of 16V and 3V respectively.

  Do not attempt to program channels with a greater frequency separation than the specified switching range of 8MHz.

3.4.3 Output Power Adjustment (T856 Only)

Connect an RF power meter to the output socket and key the transmitter.

Turn RV320 (power adjust) fully clockwise.

Tune CV451 (output power trim) for maximum output power and check that this is >30W.

Adjust RV320 for the required output power (between 5 and 25W).

Readjust CV451 to reduce the supply current by up to 0.5A.

3.4.4 Two Point Modulation Adjustment

Note 1: In this and following sections deviation settings are given first for wide bandwidth sets, followed by settings in brackets for narrow bandwidth sets [ ].

Note 2: Reference modulation and limiter adjustment are controlled by PGM800Win. Electronic potentiometers (256 step) are used to allow channel-by-channel adjustment of deviation and two point modulation.

Note 3: To optimise the modulation response across the switching band, repeat steps 1-4 below for each channel that will be used (usually needed only for data applications). In applications where the modulation response is less critical (e.g. voice use only), carry out steps 1-4 below on the middle channel and cut and paste the value to all other channels.

1. Inject an audio signal of 250Hz 1.5V rms (+5dBm) into the CTCSS input (D-range 1 (PL100) pin 8).

   Key the transmitter by earthing the Tx key line.

2. Adjust the output from the audio generator to obtain ±3kHz [±1.5kHz] deviation at 250Hz.

3. Change the input frequency to 100Hz and adjust IC220 via PGM800Win "reference modulation" to obtain ±3kHz [±1.5kHz] deviation (you can use either the mouse or up and down arrow keys).

4. Change the input frequency back to 250Hz.

   Repeat steps 2 and 3 above until the deviations achieved at the two input frequencies are within 0.2dB of each other. You will need to do this at least four times.

5. Sweep the audio between 50 and 300Hz for peaks.

Note: A peak between 50 and 300Hz will indicate a fault condition, i.e:

- incorrect set-up

or - modulation circuitry fault.

The specification window is ±1dB relative to 150Hz from 67 to 260Hz.

3.4.5 FM Deviation (Limiter) Adjustment

Note: If the T856/857 will be used over the whole 8MHz switching range, you must set the deviation for each channel. However, if the module will be used on frequencies that cover only a 1MHz (or less) switching range, you can set the deviation on the middle channel and use this value for all other channels with the "fill" option in PGM800Win.

Inject 1kHz at -10dBm into the line input (D-range 1 (PL100) pins 1 & 4; pins 2 & 3 shorted).

Adjust RV210 (line sensitivity) fully clockwise and key the transmitter by earthing the Tx key line. Adjust IC220 via PGM800Win "deviation" to set the peak deviation to ±4.7kHz [±2.3kHz] (you can use either the mouse or up and down arrow keys).

Sweep the audio frequency from 100Hz to 4kHz and ensure that the maximum deviation does not exceed 4.7kHz [2.3kHz] (3.8kHz). Readjust IC220 if necessary via PGM800Win "deviation".

3.4.6 Line-in Level Adjustment

Set the injected signal at the line input to the required line level (typically -10 to -20dBm).

Adjust RV210 (line sensitivity) to provide ±3kHz [±1.5kHz] (±2.4kHz) deviation.

3.7 PA Alignment (T856 Only)

Check that the exciter is connected to the PA with the coaxial link.

Connect an RF power meter to the PA output (use appropriate attenution as necessary).

Turn RV310 (power adjust) fully clockwise.

Note: Before the following measurement is taken enusre the heatsink is at ambiant temperature (20-25°C).

Measure and record the voltage (VL) at L481; perform this measurement at room temperature so that the NTC (R481) is close to 25°C.

Key the transmitter by earthing the Tx key line.

Tune #CV475 until maximum power is obtained. Check that the power exceeds 30W.

Adjust RV310 (power control) to 25W.

Re-adjust #CV475 to reduce the supply currant by up to 0.5A.

3.8 Thermal Shutdown (T856 Only)

Key the transmitter by earthing the Tx key line and set the output power to 25W as described in Section 3.7.

Short L481 to ground.

Set RV330 (shutdown power level) for an output power of 5W.

Set RV210 (shutdown temperature) to 0.16VL volts (measured at IC350 pin 3), where VL is the voltage measured at L481 in Section 3.7. This sets the thermal shutdown at 85°C at NTC R481.