As Built Note 1 and 2

ICOM and Linear Amplifier Interface Unit

This unit is described in The Design Report – Regional HF Station 20161121 on pages 13-15.

The amended version has several minor circuit changes included in the following:

Band Selector and Linear Amp Interface

The design for the Band Interface Unit has been adapted from one developed by Bob Wolbert K6XX (1997). It is presented in Drawing 6.

The interface Unit has two parts:

1. The A to D converter that uses a LED bar graph meter driver (LM3914) and a line-up of robust PNP transistors that switch the Linear amplifier filters.
2. A Push to talk (PTT) control that uses the ICOM PTT output to turn on the Linear Amplifier. This part of the circuit also has the switches to enable or inhibit the TX On command reaching the TW1000 A/B Linear Amplifier, set manually to allow operation on those bands that have available antennas.

A to D Converter

The voltages shown in Drawing 5 are the band voltages measured on an ICOM 7410. It has been found in practice that these voltages can vary from these values quite a bit between different models of ICOM rigs although the relative voltage steps are much as expected.This variation can cause the selection of the 30M band in particular to be affected where near zero Volts are required. Some adjustment to the 16k resistor and IN4148 diode feeding pin 1 on the LM 3914 may be required.

In addition, a loading resistor might be added between pin 5 on the DIN 6-Pin socket and earth so that all voltages across the range are be pulled down to the value that gives reliable operation. Alternatively, the 4.7K resistor on the board (connected to pin 5 on DIN 6pin) may be changed to a lower (or higher) value.

It is recommended that the Band Selector interface is adjusted and paired with a particular ICOM transceiver and clearly labeled accordingly once customized adjustments have been made and reliable switching has been confirmed.

As shown in the table below there is a bit of variation that can be expected between different models of ICOM transceiver. The ones tested here were the IC7000, IC7140, and IC7100.

Band Label	Linear Band	ICOM Frequency	Linear Frequency	ICOM 7410 Measured V	ICOM 7000 Measured V	ICOM 7100 Measured V	ICOM 7300 Measured V
160	A	1800 - 1950	2 - 3 MHz	7.55	7.05	6.84	6.8
80	B	3500 - 3800	3 – 5 MHz	6.18	5.75	5.61	5.57
40	C	7000 - 7300	5 – 8 Mhz	5.16	4.81	4.69	4.65
30	D	10100 - 10150	8 - 13 MHz	0.1	0.01	0.45	0.027
20	E	14000 - 14300	13 – 20 MHz	4.14	3.85	3.78	3.75
20		18000 - 21450	13 – 20 MHz	3.24	3.0	2.9	2.91
10	F	24890-29700	20 – 30 MHz	2.67	2.0	2.1	2.04

Measured V at ACC Socket between pin 5 and pin 2 (Earth) with a load across the pins of 4.7K Ohms. Meter DVM.

PTT Control

The PTT control from the ICOM takes pin 3 of DIN 6-pin socket to ground thereby activating the TX ON LED and grounding the PTT control to the linear via the Band Enable relay. PTT from the ICOM also supplies a ground via an isolating diode to the RCA connector so that this command can be used to inhibit the operation of the Antenna Switch and 4 Square Array switching during transmission.

The Band Enable toggle switches are used to manually preset the bands allowed (determined by the antennas available) which energise the Band Enable relay that in turn allows the TX On ground to be applied to pin5 of the DB25 Output Connector. This is pin H on PL3 of the TW1000 A/B Linear.

The PTT line of the TW1000A/B is a low current drain (typically less than 1mA) circuit, enabling it to be switched by any normal transceiver PTT that provides a ground for transmitting. It is internally diode isolated to prevent undesirable interaction between the linear and transceiver. The switch times are very fast in accordance with modern ARQ teletype systems and are typically 10 milliseconds or less.

TX ON Inhibit Operation

As described above the TX ON command originates from the ICOM via the ICOM and Linear Interface Unit. This appears on the RCA connector that gets patched into the Site SCADA Unit. The Site SCADA Unit in turn sends the TX ON command to:

Antenna Selector Control Unit: Pin 8 of the DB 15 connector on that unit.

Four Square Control Unit: Pin 6 of the DB 25 connector on that unit.

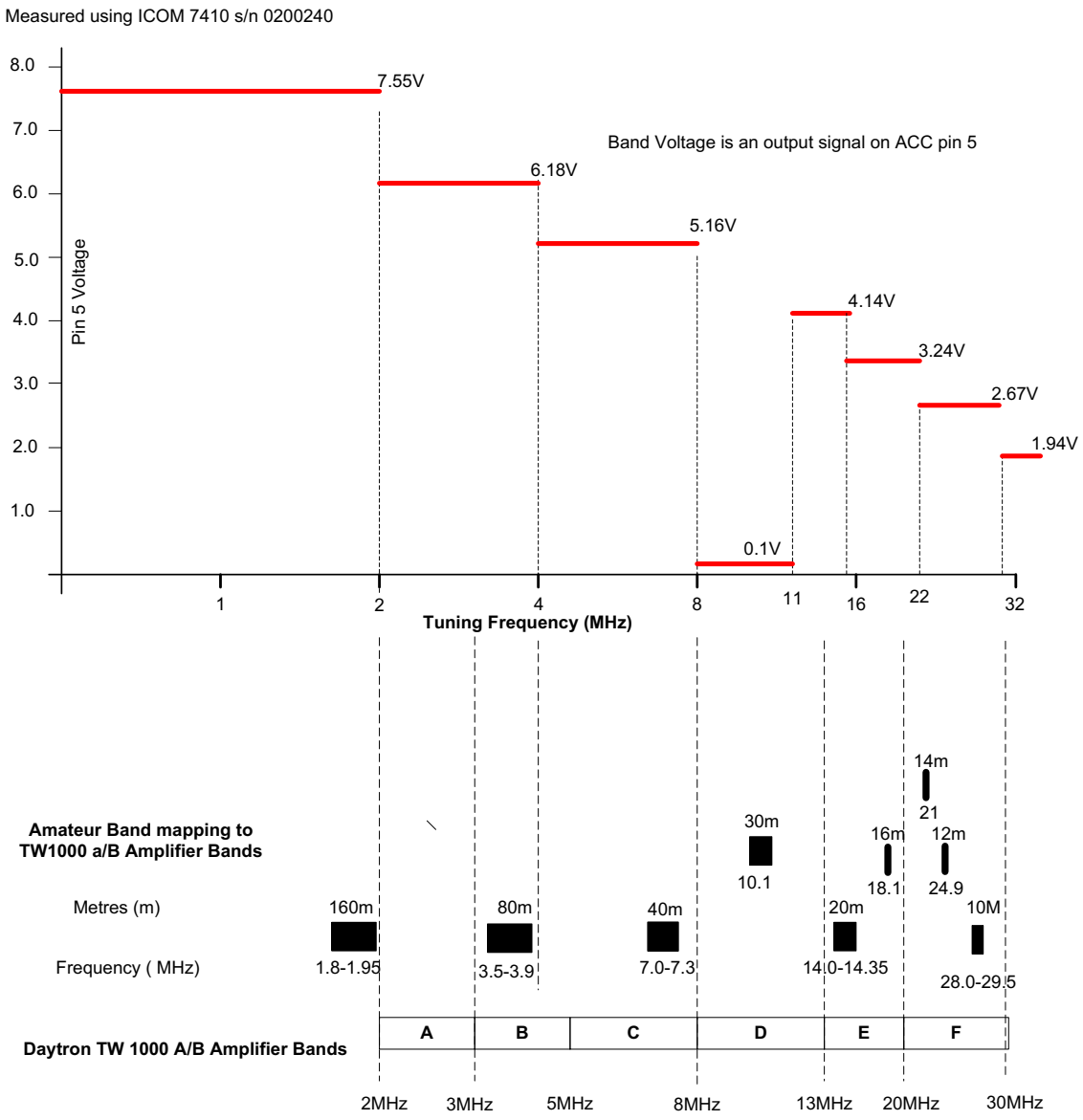
TX ON commands are also available on RCA connectors on the Site SCADA Unit to assist testing.

RCA connectors are also supplied on the Antenna Selector Control Unit and the Four Square Control Units to assist testing.

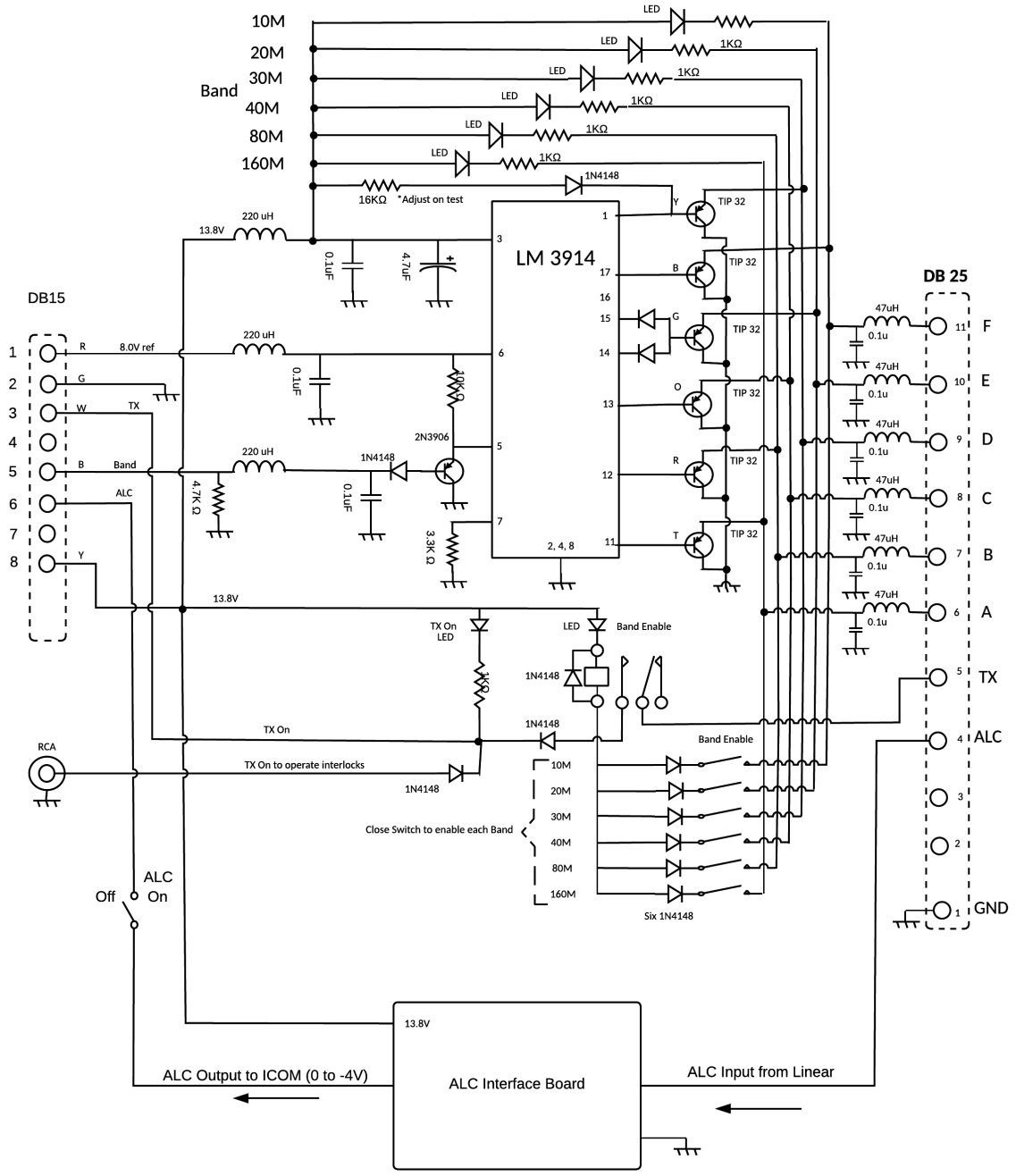
Drawing 5 ICOM IC 7410 Band Voltages:

This picture shows how the IC 7410 band voltages map to the bands available in the Datron TW 100A/B Linear amplifier. In Table form the data is:

Drawing 5 ICOM Band Voltages



ICOM and Linear Interface Unit



The tray that contains the Band Switch Interface also houses the ACL Interface Board.

The connector that connects to the ICOM is a DB 15 female with pin assignments that mirrors those of the 13 pin ACC connector on the back of the ICOM Transceiver.

Description of Automatic Level Control (ALC)

ALC has two major functions:

One is to put out an ALC signal that will reduce the drive from the exciter (transceiver) driving the Linear to protect the output transistors in the linear being over driven. It is set up so that the power out of the transceiver-linear combo does not exceed a preset level.

The other is internal to the TW1000 A/B unit and is used to shut down the amplifier to self-protect the PA power modules in event of abnormal operation.

There are two different ALC systems in the TW 1000 A/B. The one labeled **Peak ALC** is the one the RemoteDX station uses. The other (Average ALC) is disabled by turning the control on the back panel to its maximum power condition (completely clockwise)

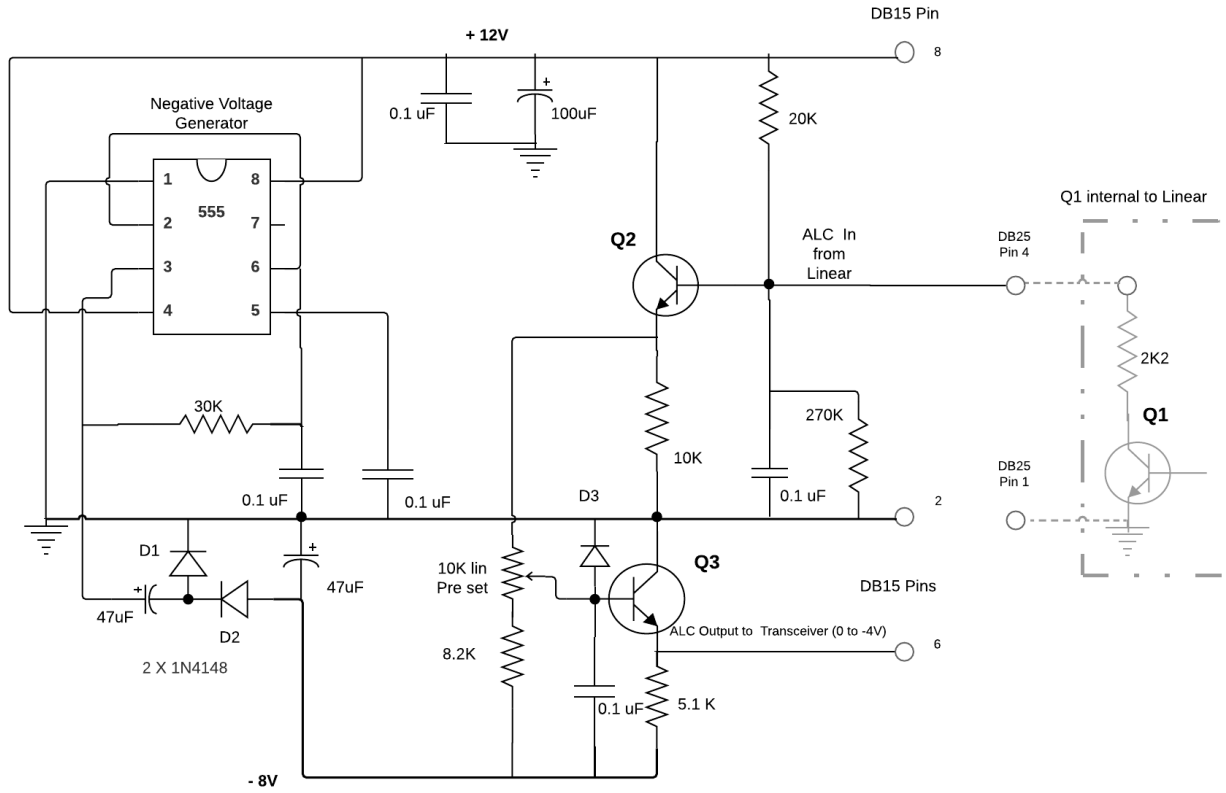
The ALC output of the TW 1000 A/B is a relatively high impedance line that is taken lower (towards ground) to reduce the power of a transceiver driving it. (Meg Ohms to a low of 2.2K Ohm).

This cannot be connected directly to an ICOM transceiver. Instead this signal has to be proportionally translated to a DC voltage of 0 Volts to -4 Volts. This is achieved with the ALC Interface Board.

The following ALC Interface Board is powered from the ICOM supply and facilitates the correct operation of the ALC for the combo of the ICOM and TW1000 A/B

Bernard Robbins | February 26, 2017

CIRCUIT DIAGRAM ICOM ALC INTERFACE 20170217

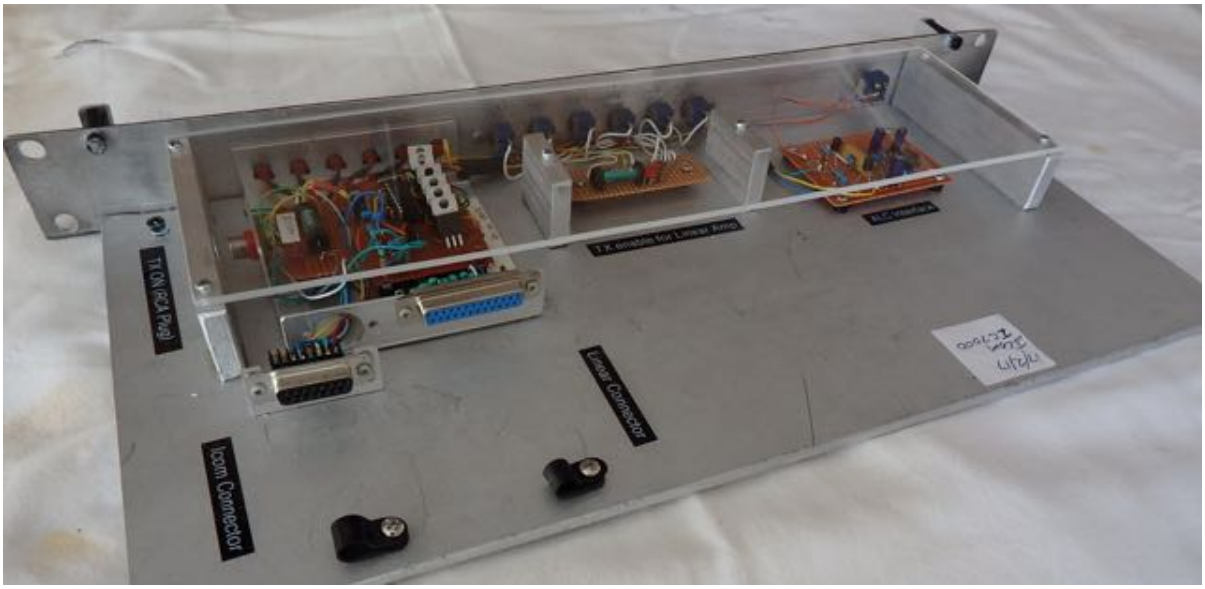


The function of the 555 is to generate a negative supply voltage in reference to ground from the 12 Volt supply from the ICOM. This is used along with Q2 and Q3 to create a 0v to -4V ALC output range from the ALC input from the TW 1000A/B. The 10K Lin preset pot is set to give a voltage range on the output of 0 to -4Volts

The instructions for setting the ALC are as follows:

1. Connect up the ICOM exciter to the TW1000A/B and connect its output to a 1kW test load.
2. Select a test frequency band by tuning the ICOM and ensuring that the correct band is tracked by the LED illuminated on the interface unit.
3. With the ALC switched “OFF” on Interface Unit ,apply a low level of RF drive starting at 5watts or so from the ICOM.
4. Check that the Linear is working correctly with the expected power gain.
5. There are two controls on the TW1000A/B labeled “Peak ALC” and the other “Average ALC”. Disable the Average ALC by turning this control fully clockwise and set the Peak ALC control fully clockwise also.
6. Turn the ALC Interface Unit “On”
7. Starting with the low level of drive (5Watts) gradually increase the drive until the Linear output is say 500Watts. Turn the Peak ALC anti-clockwise until it starts to decrease the output power of the linear.
8. Gradually increase the drive from the ICOM until it is set to maximum drive (100%). The ALC should hold the output power of the linear at 500Watts as set in 7 above.
9. Finally adjust the Peak ALC so that the Linear Output power is 1000Watts.
10. Turn the linear off (so that the bypass relay operates) causing the ICOM to be connected to the output. Measure the output power of the ICOM in this mode and it should be providing its Maximum Power into the load.(100 Watts).

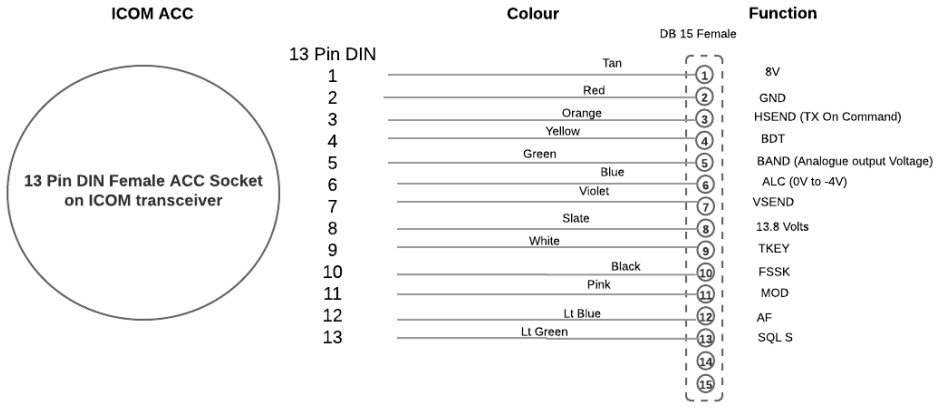
Integration of As-Built Notes 1 and 2 in this document provides the basis of the Service Manual for the new **ICOM and Linear Interface Unit**


Tx ON (RCA Plug)
Icom Connector
Linear Connector

Appendices

ICOM ACC Socket Pin-outs

Pin out details of the ICOM ACC connector to DB 15 Female adaptor is below. This is the recommended use for the 13pin Din that is usually supplied with an ICOM rig. The DB15 is a much easier (and cheaper) connector to use if any other ACC functions need to be used.



TW1000 A/B Manual Extract on ALC

The description in the TW1000 A/B Linear manual is very brief and assumes the exciter being used is a Datron make.

5.8 *ALC Operation*

The three outputs from the directional coupler are applied to the base of the Darlington transistor, Q1. In the DWC transceivers, the gain is controlled by reducing the voltage on the high-impedance control line. The collector of Q1 is connected to the control line, as the forward bias increases on Q1. The collector voltage is reduced until the system gain reaches the preset level.

The peak and average reading outputs from the bridge are adjusted to give the correct output in the SSB and FSK or CW modes. There is no output from the reverse arm of the bridge when the amplifier is operating into a correctly matched load. This output increases as the VSWR rises and progressively reduces the power output. This protects the RF transistors in the TW1000A/B against mismatches.

The two separate ALC are labeled average and peak. In general, it is intended that only the peak control be used with full 1kW average systems using the 80A supply; and the average control should only be used with the smaller system using the 40A supply. In either case, the control not in use should be rotated clockwise to its maximum power position.

5.11.1 *Transceiver ALC System*

The transceiver ALC system keeps the transceiver from supplying normal drive to the amplifier and is not subject to adjustment by either of the amplifier's ALCs. (High SWR provides an open collector ground via the 2.2k ohm resistor, R4, at pin I of the control socket.)

Note: If a transceiver not made by DWC is used, it may be necessary to use a different ALC interface.

The ICOM description in the manual for its IC 2K Linear is quite detailed and provided the information necessary to design a suitable interface to the TW1000 A/B as shown above.

ICOM7100 ALC requirements for control

The ICOM 7100 requires a control voltage that is fed into pin 6 of the 13 pin ACC Socket on the back of the transceiver.
The control voltage has to be in the range of 0V to -4 Volts. The power from the ICOM to drive the linear is decreased as the ALC goes more negative.

◇ ACC socket information

• ACC socket

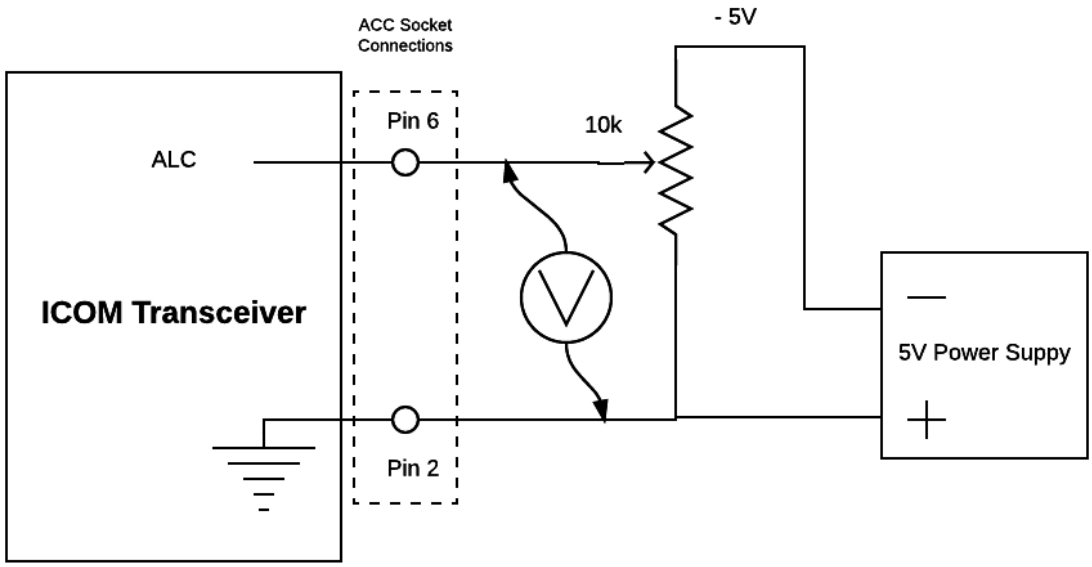
ACC	PIN No.	NAME	DESCRIPTION		SPECIFICATIONS	
 Rear panel view ① brown ⑧ gray ② red ⑨ white ③ orange ⑩ black ④ yellow ⑪ pink ⑤ green ⑫ light blue ⑥ blue ⑦ purple ⑬ light green Color refers to the cable strands of the supplied cable.	1	8 V	Regulated 8 V output.		Output voltage: Output current:	8 V ± 0.3 V Less than 10 mA
	2	GND	Connects to ground.			———
	3	HSEND *1, 2	Input/output pin.	An external equipment controls the transceiver. When this pin goes low, the transceiver transmits.	Input voltage (High): Input voltage (Low): Current flow:	2.0 V to 20.0 V −0.5 V to +0.8 V Maximum 20 mA
				The transceiver outputs a low signal to control external equipment.	Output voltage (Low): Current flow:	Less than 0.1 V Maximum 200 mA
	4	BDT	Data line for the optional AT-180.			———
	5	NC (BAND*3)	*3 If the modification is performed, band voltage output. (FM sec. 19)			———
					Output voltage:	0 to 8 V
	6	ALC	ALC voltage input.		Control voltage: Input impedance:	−4 V to 0 V More than 3.3 kΩ
	7	VSEND *1, 2	Input/output pin.	An external equipment controls the transceiver. When this pin goes low, the transceiver transmits.	Input voltage (High): Input voltage (Low): Current flow:	2.0 V to 20.0 V −0.5 V to +0.8 V Maximum 20 mA
				The transceiver outputs a low signal to control external equipment.	Output voltage (Low): Current flow:	Less than 0.1 V Maximum 200 mA
	8	13.8 V	13.8 V output when power is ON.		Output current:	Less than 1 A
	9	TKEY	Key line for the optional AT-180.			———
	10	FSKK	Controls RTTY keying		"High" level: "Low" level: Output current:	More than 2.4 V Less than 0.6 V Less than 2 mA
	11	MOD	Modulator input.		Input impedance: Input level:	10 kΩ Approx. 100 mV rms
	12	AF*3	AF detector output. Fixed level, regardless of the [AF] control position.		Output impedance: Output level:	4.7 kΩ 100 to 300 mV rms
	13	SQL S	Squelch output. Grounded when squelch opens.		SQL open: SQL closed:	Less than 0.3 V/5 mA More than 6.0 V/100 µA

ALC Testing of the ICOM

The following test is recommended to help understand how the ALC works and as a means of noting any minor differences between different models of ICOM.

Assemble a simple test jig using an independent 5Volt power supply and a potentiometer (pot). Connect up as follows:

ALC Test setup for ICOM transceiver



Measurement Method:

1. Set up the ICOM for transmitting into a 50 Ohm test load.
2. Adjust the Pot and measure the negative ALC voltage on pin 6 and
3. record the RF output power of the ICOM while the transceiver is transmitting for different settings of the pot.

A typical result for this test is:

ALC Voltage	Power Output
- 0.5 V	100 W
- 1.0 V	100 W
- 1.5 V	100 W
- 1.9 V	45 W
- 2.0 V	30 W
- 2.1 V	12 W
- 2.2 V	8 W
- 2.3 V	4 W

ALC Power output Characteristic Graph