Dummy Load Use is Good Operating Practice

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Figure-1: Model 8860, 1.5 KW, DC to 2.0 GHz
Bird Electronics Corporation Termaline® Series RF Coaxial Termination

1. A **'Dummy Load'** also called a **'Dummy Antenna', 'RF Coaxial Termination'** **or** **'RF Terminating Liquid-Air Load'**.

    a. **Figure-1 shows one of the Bird Electronics Corporation Termaline® Series RF Coaxial Terminations.**

2. Use of a **'Dummy Load'** at any Radio Frequency Communication Electronics Station (**RFCES**) with all Transmitting Radio Frequency Communication Electronics Equipment (**RFCEE**) is considered **'Good Operating Practice'**.

    a. A Dummy Load is a piece of **Test Measurement Diagnostic Equipment (TMDE)** designed with an **Impedance**, (electronic symbol **'Z'**) of a pure **Resistance**, (electronic symbol **'R'**), equaling 50 Ohms (electronic symbol **'Ω'**) and a minimal to

no **Inductive Reactance** (electronic symbol **'X_L'**) and a minimal to no **Capacitive Reactance** (electronic symbol **'Xc'**).

*i. Note: A **Inductor, Inductive and Inductance (electronic symbol 'L'),** a **Capacitor, Capacitive and Capacitance (electronic symbol 'C')** and **Reactance (electronic symbol 'X').***

b. To obtain the benefit of this useful piece of **TMDE**, a two or more position 'Coaxial Cable RF Switch', should be connected as the last piece of inline **RFCEE** in the **RFCES** to select the appropriate Load(s). Connect the 'Dummy Load' and 'Active Load(s)' (also called an 'Active Antenna') to this Coaxial Cable RF Switch for appropriate selection.

i. *Alpha Delta Communications, Inc. Company Models 'Delta 2B' and 'Delta 4B' are examples of outstanding quality constructed Coaxial Cable RF Switches.*

c. All modern RFCEE is designed with an 'Input' and 'Output' 'Z 'of 50Ω. The appropriate RF Feed Line that must be used to connect this RFCEE, is a Coaxial Cable designed with a Characteristic Impedance, (electronic symbol 'Zo') of 50Ω.

d. When 50Ω 'Zo' Coaxial Cable RF Feed Line is used, it ensures an 'Z' match between <u>all</u> RFCEE 'Sources' and 'Loads' and allows the maximum transfer of Electromagnetic (EM) Energy.

e. Examples of 'Sources' and 'Loads' in a Transmit and Receive Mode:

i. <u>Transmit Mode</u>:

- 1st Source = Transmitter Stage of the Transceiver
- 1st Load = Transmitter Coaxial Cable RF Feed Line Jumper - 1
- 2nd Source = Transmitter Coaxial Cable RF Feed Line Jumper - 1
- 2nd Load = RF Power Amplifier (RFPA)
- 3rd Source = RF Power Amplifier (RFPA)
- 3rd Load = RFPA Coaxial Cable RF Feed Line Jumper - 2
- 4th Source = RFPA Coaxial Cable RF Feed Line Jumper - 2
- 4TH Load = Impedance Matching Network (IMN)
- 5th Source = Impedance Matching Network (IMN)
- 5th Load = IMN Coaxial Cable RF Feed Line Jumper - 3
- 6th Source = IMN Coaxial Cable RF Feed Line Jumper - 3
- 6th Load = Coaxial Cable RF Feed Line Switch
- 7th Source = Coaxial Cable RF Feed Line Switch
- 7th Load = Coaxial Cable RF Feed Line Switch RF Feed Line Jumper - 4
- 8th Source = Coaxial Cable RF Feed Line Switch RF Feed Line Jumper - 4
- 8th Load = Active Antenna or Dummy Load

ii. <u>Receive Mode</u>:

- 1st Source = Active Antenna
- 1st Load = Active Antenna Coaxial Cable RF Feed Line Jumper - 4
- 2nd Source = Active Antenna Coaxial Cable RF Feed Line Jumper - 4
- 2nd Load = Coaxial Cable RF Feed Line Switch
- 3rd Source = Coaxial Cable RF Feed Line Switch
- 3rd Load = Coaxial Cable RF Feed Line Switch RF Feed Line Jumper - 3
- 4th Source = Coaxial Cable RF Feed Line Switch RF Feed Line Jumper - 3
- 4TH Load = Impedance Matching Network (IMN)
- 5th Source = Impedance Matching Network (IMN)
- 5th Load = IMN Coaxial Cable RF Feed Line Jumper - 2
- 6th Source = IMN Coaxial Cable RF Feed Line Jumper - 2
- 6th Load = RF Power Amplifier (RFPA)
- 7th Source = RF Power Amplifier (RFPA)
- 7th Load = RFPA Coaxial Cable RF Feed Line - 1
- 8th Source = RFPA Coaxial Cable RF Feed Line - 1
- 8th Load = Receiver Stage of the Transceiver

3. The **'First Benefit'** of using a Dummy Load is **as a troubleshooting aid to measure the Voltage Standing Wave Ratio (VSWR) of reflected RF Power, on the station's RFCEE Coaxial Cable RF Feed Line connected to the 'Dummy Load'**.

    a. With the inline Coaxial Cable RF Feed Line Switch in the appropriate position to choose the Dummy Load, transmit a CW signal with the Transmitter or Transceiver, using as low a power as necessary to get a reading on a VSWR Meter. Measure the VSWR on the station's connecting Coaxial Cable RF Feed Lines while connected to the Dummy Load.

        i. If an 'Infinite' VSWR (full scale meter reading) is measured on the station's connecting Coaxial Cable RF Feed Lines, it is because this condition is mostly likely caused by a 'Short' or an 'Open' in one or more of the Coaxial Cable RF Feed Line 'Jumpers'. This problem must be corrected prior to switching the Coaxial Cable RF Switch to any Active Antenna and checking it's Coaxial Cable RF Feed Line VSWR.

        ii. To correct an 'Infinite' VSWR problem, disconnect one Jumper at a time from each piece of RFCEE and connect the Dummy Load directly to the Jumper and recheck the VSWR on that Jumper. Repeat this procedure until you find the offending Jumper cable. Once the offending Jumper is found it must be fixed or replaced.

        iii. If a VSWR of '1.0:1 ~ 1.2:1' or less is measured on the RFCES connecting Coaxial Cable RF Feed Lines while connected to the Dummy Load, then all the interconnecting Jumper cables are fine and you can move to the second benefit of using a Dummy Load.

4. The **'Second Benefit'** of using a Dummy Load is **as a troubleshooting aid to measure the Voltage Standing Wave Ratio (VSWR) of reflected RF Power, on the station's Coaxial Cable RF Feed Line connected to the 'Active Antenna'.**

    a. With the inline Coaxial Cable RF Feed Line Switch in the appropriate position to choose the Active Antenna, transmit a CW signal with the Transmitter or Transceiver, using as low a power as necessary to get a reading on a VSWR Meter. Measure the VSWR on the station's Coaxial Cable RF Feed Line connected to the Active Antenna.

        i. If an 'Infinite' VSWR (full scale meter reading) is measured on the RFCES Coaxial Cable RF Feed Line connected to the Active Antenna, the problem must be found and fixed.

        ii. Disconnect the Coaxial Cable RF Feed Line from the Active Antenna and connect the Dummy Load to the end of the Coaxial Cable RF Feed Line removed from the Active Antenna.

        iii. Transmit a CW signal with the Transmitter or Transceiver, using as low a power as necessary to get a reading on a VSWR Meter and re-measure the VSWR on the Coaxial Cable RF Feed Line while connected to the Dummy Load.

            1. If the Coaxial Cable RF Feed Line VSWR measures an 'Infinite' full scale reading, the Coaxial Cable RF Feed Line most likely has a 'Short' or 'Open' and the problem must be corrected before transmitting further.

            2. If the Coaxial Cable RF Feed Line VSWR measures a '1.0:1 ~ 1.25:1' or less the connected Coaxial Cable RF Feed Line is fine.

        iv. Disconnect the Dummy Load and reconnect the Active Antenna to the Coaxial Cable RF Feed Line and re-measure the VSWR on the Coaxial Cable RF Feed Line.

            1. If the Coaxial Cable RF Feed Line VSWR measures an 'Infinite' full scale reading, the problem is in the Active Antenna Feedpoint or one of its' element(s) and the problem must be corrected before transmitting further.

        v. If any problems were found with the connected Coaxial Cable RF Feed Line *or* the Active Antenna and subsequently corrected, re-measure the VSWR on the Coaxial Cable RF Feed Line connected to the Active Antenna. Transmit a CW signal with the Transmitter or Transceiver, using as low a power as necessary to get a reading on a VSWR Meter. If the VSWR measurement is a '1.0:1 ~ 1.5:1' or less you are fine and ready to use the RFCES.

5. The **'Third Benefit'** of using a Dummy Load is **that it can be used to eliminate unnecessary interference transmitted 'Over-The-Air', caused by tuning any**

transmitting equipment into an Active Antenna, which does not have an impedance of 50Ω.

a. The appropriate way to ‘Tune’ & ‘Load’ any Transceiver, with an Electron Tube RF Power Amplifier (RFPA) Final Section and ‘Tune’ & ‘Load’ any Inline External Electron Tube RF Power Amplifier (RFPA), for optimum impedance matching and accurate transmit ‘RF Power’ output measurements, is by first transmitting and 'Tuning' and 'Loading' them into a Dummy Load which has an Impedance of 50Ω. All RFCEE is designed with an Impedance of 50Ω.

   i. Before tuning a Transceiver with an Electron Tube RF Power Amplifier (RFPA) Final Section, place any Inline Inline External Electron Tube ***'RFPA'*** into the ***‘Standby’*** mode.

   ii. Before tuning a Transceiver with an Electron Tube RF Power Amplifier (RFPA) Final Section, place any Inline External 'Manual Tune' or 'Automatic Tune' Impedance Matching Network (***'IMN'***) into the ***'By-Pass'*** mode.

      1. A IMN is commonly referred to as a, 'Antenna Coupler', Antenna System Coupler', ‘Antenna Tuner’, 'Antenna System Tuner', ‘Transmatch’ or 'Tuner'.

   iii. Place the ***'RF Coaxial Switch'*** into the position to choose the ***'Dummy Load'***.

   iv. **'Tune' and 'Load'** the Electron Tube RF Power Amplifier (RFPA) Final Section '**Transceiver'** for maximum RF output power into the **'Dummy Load'**.

   v. Place the Inline External Electron Tube ***'RFPA'*** into the ***‘Operate’*** mode.

   vi. Transmit with the Transceiver into the Inline External Electron Tube RF Power Amplifier (RFPA) and **'Tune' and 'Load'** the Inline External Electron Tube RF Power Amplifier (RFPA) for maximum RF output power into the **'Dummy Load'**.

   vii. After 'Tuning' and 'Loading' the Inline External Electron Tube RF Power Amplifier (RFPA) into the Dummy Load, place the Inline External Electron Tube RF Power Amplifier (RFPA) into a ***‘Standby’*** mode.

   viii. Place the ***'RF Coaxial Switch'*** into the position to choose the ***'Active Antenna'***.

   ix. Transmit a CW signal with the Transmitter or Transceiver, using as low a power as necessary to get a reading on a VSWR Meter and **‘Tune & Load’** any Automatic Tune or Manual Tune '**IMN'** for a 1.0:1 VSWR into the **'Active Antenna'.** The IMN corrects any mismatch of impedance between the Coaxial Cable RF Feed Lines Characteristic Impedance (Zo) and the Active Antenna Feedpoint impedance (Z).

1. If the Coaxial Cable RF Feed Line VSWR measures a 'High' VSWR of approximately '2.0:1 or Higher' impedance match to the Active Antenna, adjust the Inline External Manual Tune or Automatic Tune Tuner to obtain a VSWR of '1.0:1'.

x. Once a suitable '1.0:1' impedance match to the Active Antenna with the use of the Inline External Automatic Tune or Manual Tune Tuner, then the Inline External Electron Tube RF Power Amplifier (RFPA) may be placed into an '*Operate*' mode and used.