APPENDIX 1

REFERENCES USED TO DEVELOP THE TRAMAN

NOTE: Although the following references were current when this TRAMAN was written, their continued currency cannot be assured. Therefore, you need to be sure that you are studying the latest revision.

Chapter 1

Communication, TACAN, ADF Electronic Altimeter and IFF Systems, Navy Model F/TF-18A 160775 thru 161251, A1-F18AA-600-100, Naval Air Systems Command, Washington, D.C., 1 March 1980; Change 2, 15 October 1980.

Electronic Systems, Navy Model EA-6A Aircraft, NAVAIR 01-85ADB-2-3, Naval Air Systems Command, Washington, D.C., 15 April 1980; Change 3, 1 March 1991.

Integrated Navigation/Communication Station, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-10, Naval Air Systems Command, Washington, D.C., 15 September 1991; Rapid Action Change 4, 15 June 1992.

Navy Electricity and Electronics Training Series (NEETS), Module 17, *Radio Frequency Communication Principles,* NAVEDTRA 172-17-00-84, Naval Education and Training Program Development Center, Pensacola, Fla., 1984.

Chapter 2

Air Navigation, NAVAIR 00-80V-49, Chapters 1,2,4,7, 18, and 19, Office of the Chief of Naval Operations, Washington D.C., 15 March 1983.

Principles of Operation - Avionic Systems - Nonacoustic Sensors, Electronic Countermeasures, Navigation, Automatic Flight Control and Communications, Navy Model S-3A, NAVAIR 01-S3AAA-2-2.14, Naval Air Systems Command, Washington, D.C., 15 April 1979; Change 7, 15 April 1989.

Electronic Systems, Navy Model EA-6A Aircraft, NAVAIR 01-85ADB-2-3, Naval Air Systems Command, Washington, D.C., 15 April 1980; Change 3, 1 March 1991.

Electronics Installation and Maintenance Book (EIMB), General, NAVSEA SE000-00-EIM-100, Naval Sea Systems Command, Washington D.C., 1983.

Integrated Navigation/Communication Station, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-10, Naval Air Systems Command, Washington, D.C., 15 September 1991; Rapid Action Change 4, 15 June 1992.

Principles of Operation, Navigation Systems, Navy Models F-14A and F-14A (PLUS) Aircraft, NAVAIR 01-F14AAA-2-2-10, Naval Air Systems Command, Washington, D.C., 16 January 1989.

Chapter 3

Principles of Operation - Avionic System - Nonacoustic Sensors, Electronic Countermeasures, Navigation, Automatic Flight Control and Communications, Navy Model S-3A, NAVAIR 01-S3AAA-2-2.14, Naval Air Systems Command, Washington, D.C., 15 April 1979; Change 7, 15 April 1989.

Communication, TACAN, ADE Electronic Altimeter and IFF Systems, Navy Model F/TF-18A 160775 thru 161251, A1-F18AA-600-100, Naval Air Systems Command, Washington, D.C., 1 March 1980; Change 2, 15 October 1980.

Integrated Sensor Station 3, Navy Models P-3C Aircraft, NAVAIR 01-75PAC-2-8, Naval Air Systems Command, Washington, D.C., 1 October 1984; Change 3, 1 March 1991.

Chapter 4

NATOPS Flight Manual S-3A Aircraft, NAVAIR 01-S3AAA-1, Naval Air System Command, Washington D.C., September 1982; Change 1, January 1983.

General Information and Principles of Operation, Volume II, Avionics, Navy Model SH-3H, NAVAIR 01-230HLH-2-1.2, Naval Air Systems Command, Washington, D.C., 1 November 1989; Change 7, 15 February 1992.

Integrated Sensor Stations 1 and 2 - Update III, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-15, Naval Air Systems Command, Washington, D.C., 1 April 1985; Change 5, 15 January 1989.

Chapter 5

Attitude Heading Reference System, AN/ASN-50, NAVAIR 05-35LAA-1, Naval Air Systems Command, Washington D.C., January 1984.

Principles of Operation - Avionics Systems - Data Processing Display and Control Acoustic Processing, Armament and Stores Control, NAVAIR 01-S3AAA-2-2.13, Naval Air System Command, Washington D.C., February 1976, Change 5, December 1987.

NATOPS Flight Manual S-3A Aircraft, NAVAIR 01-S3AAA-1, Naval Air System Command, Washington D.C., September 1982; Change 1, January 1983.

Integrated Flight Station Systems, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-9, Naval Air Systems Command, Washington, D.C., 31 October 1984; Change 9, 1 February 1991.

Chapter 6

Forward Linking Infrared System, Navy Model F/TF-18A 160782 and 160785 thru 161251, A1-F18AA-744-100, Naval Air Systems Command, Washington, D.C., 1 February 1981.

Integrated Sensor Station 3, Navy Models P-3C Aircraft, NAVAIR 01-75PAC-2-8, Naval Air Systems Command, Washington, D.C., 1 October 1984; Rapid Action Change 9, 9 June 1988.

Chapter 7

Airborne Weapons/Stores Loading Manual, Navy Model F-14A/A+ Aircraft, NAVAIR 01-F14AAA-75, Naval Air Systems Command, Washington, D.C., 1 July 1990; Rapid Action Change 23, 1 November 1990.

Principles of Operation, Instruments and Displays, Navy Models F-14A and F-14A (PLUS) Aircraft, NAVAIR 01-F14AAA-2-2-8, Naval Air Systems Command, Washington, D.C., 16 January 1989.

LAMPS MK III Weapon System Manual, A1-H60BB-NFM-010, Naval Air Systems Command, Washington, D.C., 1 March 1992.

Chapter 8

Navy Electricity and Electronics Training Series (NEETS), Module 22, *Introduction to Digital Computers,* NAVEDTRA B72-22-00-88, Naval Education and Training Program Management Support Activity, Pensacola, Fla., 1988

Chapter 9

Automatic Flight Control Systems AN/ASW-16 and AN/ASW-42, Navy Models A-6E and KA-6D Aircraft, NAVAIR 01-85 ADA-2-5.1, Naval Air Systems Command, Washington, D.C., 15 July 1974; Rapid Action Change 2, 15 May 1991.

Chapter 10

Electronics Installation and Maintenance Book (EIMB), General, NAVSEA SE000-00-EIM-100, Naval Sea Systems Command, Washington D.C., 1983.

Electronics Installation and Maintenance Book (EIMB), General Maintenance, NAVSEA SE000-00-EIM-160, Naval Sea Systems Command, Washington D.C., 1981.

Installation Practices Aircraft Electric and Electronic Wiring, NAVAIR 01-1A-505, Naval Air Systems Command, Washington D.C., 1 December 1987.

APPENDIX II

ANSWERS TO REVIEW QUESTIONS

CHAPTER 1

A1. *Radio.*

A2. *3 GHz to 30 GHz*

A3. *Three.*

A4. *Manchester word encoding/decoding.*

A5. *116.000 to 155.975 MHz*

A6. *20.*

A7. *An interface fault.*

A8. *7.9000 to 9.1000 MHz and 18.9000 to 20.1000 MHz*

A9. *To protect the radio if lightning strikes the long-wire antenna.*

A10. *HF-1, HF-2, and UHF-2.*

A11. *The NAV/COMM.*

A12. *The TTY signal data converter.*

A13. *Communications Interface No. 1.*

CHAPTER 2

A1. *The position of one point in space relative to another without reference to the distance between them.*

A2. *12 miles.*

A3. *Parallels of latitudes and meridians of longitudes.*

A4. *The actual height that an aircraft is above the surface of the earth.*

A5. *One.*

A6. *20 to 5,000 feet.*

A7. *It automatically resets.*

A8. *ADF mode, loop mode, and antenna mode.*

A9. *RECEIVE mode.*

A10. *10.2 kHz, 11.3 kHz and 13.6 kHz.*

A11. *Drift; angle and ground speed.*

CHAPTER 3

A1. Airborne X-band.

A2. 20 degrees down to 10 degrees up.

A3. Scan switch.

A4. Four.

A5. 6 RPM.

A6. Three (search, fire control, and bomb director).

A7. 3,500 yards.

A8. Jizzle.

A9. Greater than 700 knots.

A10. A large X is displayed.

A11. 1, 2, 3/A, C, and 4.

A12. The UHF L-band blade antennas.

A13. 1030 MHz carrier.

A14. The fail light on the control box.

CHAPTER 4

A1. From the initial letters of SOund, NAvigation and Ranging.

A2. The transducer

A3. The salinity, the pressure, and the temperature.

A4. It controls the brightness of the cursor.

A5. 500±5 feet.

A6. Oil.

A7. A detectable distortion.

A8. The magnetic field will change.

A9. One.

A10. 50.

CHAPTER 5

A1. HSI.

A2. No.

A3. A fixed reference mark used to read the heading on the compass card.

A4. Head-Up Display.

A5. Tactical Display System.

A6. A transparent mirror positioned directly in front of the pilot at eye level.

A7. Seven.

A8. Five.

A9. The ADP

A10. A pickup device.

A11. The breaking up of the scene into minute elements and using these elements in an orderly manner.

A12. Four.

CHAPTER 6

A1. Between wavelengths 0.72 and 1,000 micrometers.

A2. They differ only in wavelength and frequency of oscillation.

A3. About 0.98 on a scale of 0 to 1.

A4. Photographic film.

A5. Each detector element requires a supporting electronic circuit.

A6. One element width.

A7. Passive.

A8. 180.

A9. Three are connected in a wye configuration, and three are connected in a delta configuration.

A10. The position mode, the FWD mode, the computer track mode, and the manual track mode.

A11. False. The status light and the picture are the only indications of a properly functioning indicator.

CHAPTER 7

A1. False.

A2. Notify the appropriate person(s).

A3. It symbolizes that the weapon station is loaded, ready, and selected.

A4. The armament safety override switch.

A5. AIM-7 missiles.

A6. Eight.

A7. 52.

A8. 25.

CHAPTER 8

A1. Cathode-ray tubes, transistors, microchips, and printed circuit cards.

A2. False.

A3. Binary, octal, decimal equivalents.

A4. Control unit, arithmetic-logic unit, and internal data storage unit.

A5. Coincident-current technique.

A6. 12.7 to 50.8 centimeters (5 to 20 inches).

A7. Linking two or more computers together.

A8. Speed versus power dissipation.

A9. The use of subroutines.

A10. Statement, analysis, flow diagram, encoding, debugging, and documentation.

CHAPTER 9

A1. False.

A2. Automatic, semiautomatic, and manual.

A3. As the aircraft passes through the acquisition window.

A4. No, the pilot can continue in any other mode.

CHAPTER 10

A1. Circuit deficiencies.

A2. Grass.

A3. A conductor semiconductor or solid-state device whose resistance or impedance varies with the voltage applied across it.

A4. 0.41 MHz

A5. 3 inches.

A6. High repair costs, excessive equipment downtime, and reduced equipment effectiveness.

A7. 35,000 volts.

A8. Conductive and antistatic.

APPENDIX III

FORMULAS

FORMULAS

Ohm's Law for dc Circuits

$$I = \frac{E}{R} = \frac{P}{E} = \sqrt{\frac{P}{R}}$$

$$R = \frac{E}{I} = \frac{P}{I^2} = \frac{E^2}{P}$$

$$E = IR = \frac{P}{I} = \sqrt{PR}$$

$$P = EI = \frac{E^2}{R} = I^2R$$

Resistors in Series

$$R_T = R_1 + R_2 + \ldots$$

Resistors in Parallel

Two resistors

$$R_T = \frac{R_1R_2}{R_1 + R_2}$$

More than two

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

RL Circuit Time Constant

$$\frac{\text{L (in henrys)}}{\text{R (in ohms)}} = \text{t (in seconds), or}$$

$$\frac{\text{L (in microhenrys)}}{\text{R (in ohms)}} = \text{t (in microseconds)}$$

RC Circuit Time Constant

R (ohms) $\times$ C (farads) = t (seconds)

R (megohms) $\times$ C (microfarads) = t (seconds)

R (ohms) $\times$ C (microfarads) = t (microseconds)

R (megohms) $\times$ C (micromicrofarads) = t (microseconds)

Capacitors in Series

Two capacitors

$$C_T = \frac{C_1C_2}{C_1 + C_2}$$

More than two

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$$

Capacitors in Parallel

$$C_T = C_1 + C_2 + \ldots$$

Capacitive Reactance

$$X_C = \frac{1}{2\pi fC}$$

Impedance in an RC Circuit (Series)

$$Z = \sqrt{R^2 + (X_C)^2}$$

Inductors in Series

$L_T = L_1 + L_2 + \ldots$ (No coupling between coils)

Inductors in Parallel

Two inductors

$L_T = \frac{L_1L_2}{L_1 + L_2}$ (No coupling between coils)

More than two

$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \ldots$ (No coupling between coils)

Inductive Reactance

$$X_L = 2\pi fL$$

Q of a Coil

$$Q = \frac{X_L}{R}$$

Impedance of an RL Circuit (Series)

$$Z = \sqrt{R^2 + (X_L)^2}$$

Impedance with R, C, and L in Series

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

Parallel Circuit Impedance

$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

Sine-Wave Voltage Relationships

Average value

$$E_{ave} = \frac{2}{\pi} \times E_{max} = 0.637E_{max}$$

Effective or rms value

$$E_{eff} = \frac{E_{max}}{\sqrt{2}} = \frac{E_{max}}{1.414} = 0.707E_{max} = 1.11E_{ave}$$

Maximum value

$$E_{max} = \sqrt{2}\,(E_{eff}) = 1.414E_{eff} = 1.57E_{ave}$$

Voltage in an ac circuit

$$E = IZ = \frac{P}{I \times PF}$$

Current in an ac circuit

$$I = \frac{E}{Z} = \frac{P}{E \times PF}$$

Power in AC Circuit

Apparent power: $P = EI$

True power: $P = EI \cos\theta = EI \times PF$

Power Factor

$$PF = \frac{P}{EI} = \cos\theta$$

$$\cos\theta = \frac{\text{true power}}{\text{apparent power}}$$

Transformers

Voltage relationship

$$\frac{E_p}{E_s} = \frac{N_p}{N_s} \text{ or } E_s = E_p \times \frac{N_s}{N_p}$$

Current relationship

$$\frac{I_p}{I_s} = \frac{N_s}{N_p}$$

Induced voltage

$$E_{eff} = 4.44 \times BAfN \times 10^{-8}$$

Turns ratio

$$\frac{N_p}{N_s} = \sqrt{\frac{Z_p}{Z_s}}$$

Secondary current

$$I_s = I_p \times \frac{N_p}{N_s}$$

Secondary voltage

$$E_s = E_p \times \frac{N_s}{N_p}$$

Three-Phase Voltage and Current Relationships

With wye connected windings

$$E_{line} = \sqrt{3}\,(E_{coil}) = 1.732E_{coil}$$

$$I_{line} = I_{coil}$$

With delta connected windings

$$E_{line} = E_{coil}$$

$$I_{line} = 1.732I_{coil}$$

With wye or delta connected winding

$$P_{coil} = E_{coil}I_{coil}$$

$$P_t = 3P_{coil}$$

$$P_t = 1.732E_{line}I_{line}$$

(To convert to true power multiply by $\cos\theta$)

Resonance

At resonance

$$X_L = X_C$$

Resonant frequency

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$

Series resonance

$$Z \text{ (at any frequency)} = R + j\,(X_L - X_C)$$

$$Z \text{ (at resonance)} = R$$

Parallel resonance

$$Z_{max} \text{ (at resonance)} = \frac{X_L X_C}{R} = \frac{X_L{}^2}{R} = QX_L = \frac{L}{CR}$$

Bandwidth

$$\Delta = \frac{F_o}{Q} = \frac{R}{2\pi L}$$

Tube Characteristics

Amplification factor

$$\mu = \frac{\Delta e_p}{\Delta e_g} \text{ (}i_p\text{ constant)}$$

$$\mu = g_m r_p$$

AC plate resistance

$$r_p = \frac{\Delta e_p}{\Delta i_p} \text{ (}e_g\text{ constant)}$$

Grid-plate transconductance

$$g_m = \frac{\Delta i_p}{\Delta e_g} \text{ (}e_p\text{ constant)}$$

Decibels

NOTE: Wherever the expression "log" appears without a subscript specifying the base, the logarithmic base is understood to be 10.

Power ratio

$$dB = 10 \log \frac{P_2}{P_1}$$

Current and voltage ratio

$$dB = 20 \log \frac{I_2\sqrt{R_2}}{I_1\sqrt{R_1}}$$

$$dB = 20 \log \frac{E_2\sqrt{R_1}}{E_1\sqrt{R_2}}$$

NOTE: When R_1 and R_2 are equal they may be omitted from the formula. When reference level is one milliwatt

$$dBm = 10 \log \frac{P}{0.001} \text{ (when P is in watts)}$$

Synchronous Speed of Motor

$$\text{rpm} = \frac{120 \times \text{frequency}}{\text{number of poles}}$$

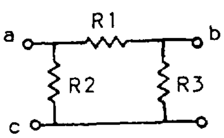
Wavelength

$$\text{wavelength (in meters)} = \frac{300}{\text{frequency (in megahertz)}}$$

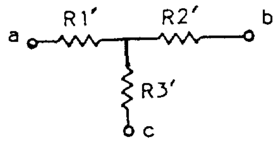
$$\lambda = \frac{300}{f\text{ (MHz)}}$$

BRIDGE CIRCUIT CONVERSION FORMULAS

PI to Tee



PI



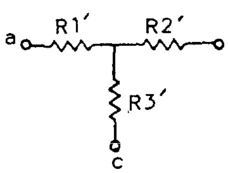
TEE

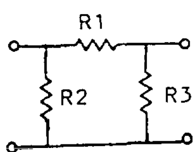
$$R_{1'} = \frac{R_1R_2}{R_1 + R_2 + R_3}$$

$$R_{2'} = \frac{R_1R_3}{R_1 + R_2 + R_3}$$

$$R_{3'} = \frac{R_2R_3}{R_1 + R_2 + R_3}$$

Tee to PI



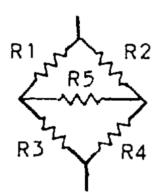


$$R_1 = \frac{R_{1'}R_{2'} + R_{2'}R_{3'} + R_{1'}R_{3'}}{R_{3'}}$$

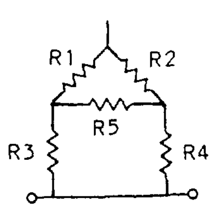
$$R_2 = \frac{R_{1'}R_{2'} + R_{2'}R_{3'} + R_{1'}R_{3'}}{R_{2'}}$$

$$R_3 = \frac{R_{1'}R_{2'} + R_{2'}R_{3'} + R_{1'}R_{3'}}{R_{1'}}$$

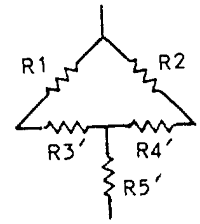
Calculating R_T for Bridge



1. **Redraw**



2. **Convert PI network made up of resistors $R_3R_4R_5$ to Tee network made up of $R_{3'}R_{4'}R_{5'}$**

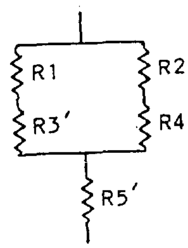


$$R_{3'} = \frac{R_3R_5}{R_3 + R_4 + R_5}$$

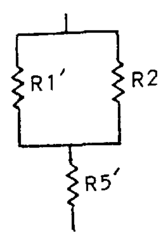
$$R_{4'} = \frac{R_4R_5}{R_3 + R_4 + R_5}$$

$$R_{5'} = \frac{R_3R_4}{R_3 + R_4 + R_5}$$

3. **Redraw circuit**

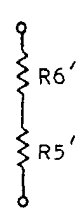


4. **Simplify circuit by combining**



$R_{1'} = R_1 + R_{3'}$ $R_{2'} = R_2 + R_{4'}$

5. **Simplify again**



$$R_{6'} = \frac{R_{1'}R_{2'}}{R_{1'} + R_{2'}}$$

6. **Solve for R_T**

$$R_T = R_{6'} + R_{5'}$$

Comparison of Units in Electric and Magnetic Circuits

	Electric circuit	Magnetic circuit
Force, ...	Volt, E, or emf	Gilberts, F, or mmf
Flow	Ampere, I	Flux, ϕ, in maxwells
Opposition	Ohms, R	Reluctance, $\mathcal{R}$
Law	Ohm's law, $I = \frac{E}{R}$	Rowland's law, $\phi = \frac{F}{\mathcal{R}}$
Intensity of force	Volts per cm of length.	$H = \frac{1.257IN}{L}$, gilberts per centimeter of length.
Density	Current density—for example, amperes per cm^2.	Flux density—for example, lines per cm^2 or gausses.

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