DUPLEXERS
30-88 MHz

T-PASS®
(PATENTED)

SHOWING CENTERED 19" RACK MOUNT BAR
FOR MODELS...
28-28-02A
74-28-02A

19" RACK MOUNTS
FRONT VIEW

MODEL 28-13-01F, MODEL 28-14-01F
REAR VIEW
SHOWING WALL MOUNT BAR

MODEL 28-13-01F, MODEL 28-14-01F
FRONT VIEW

ALTERNATE CABINET MOUNT
FOR MODELS...
28-28-02G
74-28-02G

IN RANGES OF:
30 - 40 MHz
38 - 50 MHz
66 - 88 MHz
### Duplexer Nomenclature

<table>
<thead>
<tr>
<th>First Pair of Numbers</th>
<th>Second Pair of Numbers</th>
<th>Third Pair of Numbers Plus Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Circuit Style</strong></td>
<td><strong>Frequency Range (MHz)</strong></td>
<td><strong>Two Digit Number</strong></td>
</tr>
<tr>
<td>26 : Band Pass Circuit</td>
<td>13 - 30</td>
<td>A : 19&quot; Rack Mount</td>
</tr>
<tr>
<td>27 : Notch Circuit</td>
<td>14 - 38</td>
<td>B : 19&quot; Reverse Flush Rack Mount</td>
</tr>
<tr>
<td>30 : Pseudo-Bandpass/Notch (Non - VARI - NOTCH)</td>
<td>27 - 77</td>
<td>D : Dust Covered Side-of-Cabinet</td>
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<tr>
<td>33 : Series Notch Circuit (Tunable Pass Bands)</td>
<td>28 - 68</td>
<td>E : 24&quot; Rack Mount</td>
</tr>
<tr>
<td>38 : Pseudo Bandpass (Non - VARI-NOTCH)</td>
<td>29 - 88</td>
<td>F : Wall Mount</td>
</tr>
<tr>
<td>74 : Band Pass Circuit (2-Channel T-Pass)</td>
<td>35 - 108</td>
<td>G : Cabinet Mounted</td>
</tr>
<tr>
<td></td>
<td>36 - 132</td>
<td>H : Mobile Plate Mounted</td>
</tr>
</tbody>
</table>

**Example**: A Model 27-26-01C is a Notch circuit, 66 - 77 MHz range, Cross Mount Duplexer.

**VARI-NOTCH**, the trademark for TX RX SYSTEMS' pseudo bandpass circuit design, offers the best cost-to-performance ratio in its class and is unsurpassed for close-spaced duplexing, combining the low loss and close frequency spacing advantages of notch filters with the broad isolation and selective pass characteristics of bandpass filters. The small geometry and efficiency of this circuit design has also resulted in a variety of space efficient mountings.

**Construction**: Our 6.625" diameter Duplexer cavities are constructed of hardened aluminum which does not easily dent, as some copper types do, causing detuning. Cavity surfaces are passivated inside and out with a chromate conversion coating (Airdine). A 1/4" thick end cap hallowed to the top of the cavity at the critical current point eliminates the problem of noise generated by poor metal to metal contact inherent in constructions using pop rivets. Silver plating the movable brass tuning probes and hardened copper contact fingers avoids erratic tuning, high loss, and degraded selectivity which result in extra time and costs. Our 6.625" diameter Duplexer cavities have both coarse and fine tuning controls as well as calibrated, easily adjustable loops to speed tuning time. Our 2" square cavities are high Q helical resonators of extruded aluminum.

**Should Requirements At A Site Change**, the circuit style (Pseudo Bandpass, Bandpass, or Series Notch) of any TX R: SYSTEMS INC. Duplexer built from 6.625" diameter cavities can be easily changed in the field by ordering and installing the appropriate replacement conversion assemblies (loops), thus avoiding obsolescence. Conversion assemblies, along with adaptors, hookup cables, and other hardware are displayed on page 3 of the Duplexer/Filter Price List.

**Other Duplexer Brochures** are available for bands 132-250 MHz (Lit. No. C1024), 405-512 MHz (Lit No. C1034), and 806 MHz to 1.3 GHz (Lit. No. C1044). Also write for Tech-Aid No. 76007 (Lit. No. C3004), "Duplexer Problems and Remedies".

### General Specifications, Electrical:

**Temperature Range**: 40° C to +60° C  
**Impedance**: 50 Ohms  
**VSWR**: 1.3:1

<table>
<thead>
<tr>
<th>Frequency Range MHz</th>
<th>Model No.</th>
<th>Electrical</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min. Freq.</td>
<td>Power Rating</td>
</tr>
<tr>
<td>30-50 (30-40)</td>
<td>28-13-01F</td>
<td>0.3</td>
<td>400</td>
</tr>
<tr>
<td>30-50 (38-50)</td>
<td>28-14-01F</td>
<td>0.3</td>
<td>400</td>
</tr>
<tr>
<td>66-88 (66-77)</td>
<td>27-26-01A</td>
<td>3.0</td>
<td>125</td>
</tr>
<tr>
<td>66-88 (66-77)</td>
<td>27-26-02A</td>
<td>2.5</td>
<td>125</td>
</tr>
<tr>
<td>66-88 (75-88)</td>
<td>27-27-01A</td>
<td>3.0</td>
<td>125</td>
</tr>
<tr>
<td>66-88 (75-88)</td>
<td>27-27-02A</td>
<td>2.5</td>
<td>125</td>
</tr>
<tr>
<td>74-29-02A</td>
<td>28-29-02A</td>
<td>2.0</td>
<td>400</td>
</tr>
<tr>
<td>28-29-02A</td>
<td>28-29-02A</td>
<td>0.350</td>
<td>400</td>
</tr>
</tbody>
</table>

**Cavities**  
**Dimensions**  
**TX and Rx Ports**  
**Antenna Port**  
**Style**  
**Alt. Model No.**  
**H**  
**W**  
**D**  
**STD**  
**OPT**  

**NOTE**: The temperature range for models 27-26-01A, 27-26-02A, 27-27-01A, and 27-27-02A is -40° C to +60° C.
GENERAL DESCRIPTION

Models 27-26-01, 27-26-02, 27-27-01 and 27-27-02 are compact, high-performance base station notch duplexers for the 66-77 MHz and 75-88 MHz frequency ranges. They are rated for continuous-duty operation with transmitters of 125 watts or less output power, in ambient temperatures from -40° to +60° C.

These models fulfill the demand for small-sized midband duplexers for specialized commercial applications in the U.S. and general communications applications in other countries.

SMALL SIZE, LIGHT WEIGHT

These duplexers utilize six notch-type helical resonator filters which measure only 2" x 2" x 7.5" (5.1 x 5.1 x 19.1 cm) and yet provide excellent electrical performance and temperature stability.

The six helical resonators are mounted on a 19" (48.3 cm) wide rack panel, in two compact configurations for installations where either vertical space or depth behind the panel are critical. Both can be mounted on the front or rear mounting rails of 19" rack cabinets, in a maximum of 3.625" (9.2 cm) or 7" (17.8 cm) vertical space.

Their light shipping weight of 12 lbs. (5.45 Kg) makes them extremely economical to ship anywhere in the world.

HIGH PERFORMANCE

Models 27-26-01 and 27-27-01 provide more than 100 dB T-R isolation at frequency separations of 3 MHz or more, at a typical insertion loss of 0.6 to 0.9 dB. Models 27-26-02 and 27-27-02 provide the same performance at spacings of only 2.5 MHz.

EASY FIELD TUNING

Because of their independently tunable pass and notch frequencies, these duplexers are easy to tune in the field over a broad frequency range. They are therefore attractive as "stock" duplexers for manufacturers or installers.

APPLICATION

Models 27-26-01, 27-27-01, 27-26-02 and 27-27-02 are ideal for use with low-to-medium power repeaters which do not require the large broadband isolation provided by larger, more costly pseudo-bandpass duplexers built with quarter-wave, 6 5/8" diameter cavities. In such applications, they result in compact, economical installations, without compromising duplex isolation.
## BASE STATION MODELS

### GENERAL SPECIFICATIONS, ELECTRICAL:
- TEMPERATURE RANGE: -40°C TO +50°C
- IMPEDANCE: 50 Ohms
- VSWR: 1:3:1

<table>
<thead>
<tr>
<th>FREQUENCY RANGE MHz</th>
<th>MODEL NO.</th>
<th>MIN. FREQ.</th>
<th>POWER RATING WATTS</th>
<th>ISO. CHAN.</th>
<th>INSERTION LOSS DB</th>
<th>CAVITIES</th>
<th>MECHANICAL</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MHz</td>
<td></td>
<td>PER CHAN.</td>
<td></td>
<td></td>
<td>DIMENSIONS</td>
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<tr>
<td>(SUB-RANGE)</td>
<td>NO.</td>
<td></td>
<td></td>
<td>BET. CHAN.</td>
<td></td>
<td>NO.</td>
<td>ALT. MODEL NO.</td>
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<tr>
<td>66-88</td>
<td>27-26-01A</td>
<td>3.0</td>
<td>125</td>
<td>100</td>
<td>N/A</td>
<td>1.0</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>27-26-02A</td>
<td>2.5</td>
<td>125</td>
<td>100</td>
<td>N/A</td>
<td>1.0</td>
<td>C 27-26-01C</td>
</tr>
<tr>
<td></td>
<td>27-27-01A</td>
<td>3.0</td>
<td>125</td>
<td>100</td>
<td>N/A</td>
<td>1.0</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>27-27-02A</td>
<td>2.5</td>
<td>125</td>
<td>100</td>
<td>N/A</td>
<td>1.0</td>
<td>C 27-27-01C</td>
</tr>
</tbody>
</table>

### DUPLexer NOMENCLATURE

#### FIRST PAIR OF NUMBERS
- 26 : BAND PASS CIRCUIT
- 27 : NOTCH CIRCUIT
- 28 : VARI-NOTCH CIRCUIT (PSEUDO BAND PASS)
- 30 : PSEUDO-BANDPASS/NOTCH (NON - VARI - NOTCH)
- 33 : SERIES NOTCH CIRCUIT (TUNABLE PASS BANDS)
- 38 : PSEUDO PNP.CIRCUIT (NON - VARI - NOTCH)
- 74 : BAND PASS CIRCUIT (2 - CHANNEL T-PASS)

#### SECOND PAIR OF NUMBERS
- -13 - 30 - 40
- -14 - 38 - 50
- -26 - 66 - 77
- -27 - 77 - 88
- -28 - 66 - 88
- -29 - 88 - 108
- -35 - 108 - 136
- -36 - 132 - 150
- -37 - 144 - 174
- -38 - 132 - 174
- -41 - 148 - 174
- -52 - 215 - 250
- -65 - 406 - 430
- -66 - 442 - 450
- -69 - 470 - 512
- -70 - 450 - 470
- -71 - 470 - 490
- -72 - 490 - 512
- -88 - 890 - 960
- -89 - 806 - 866
- -97 - 1215 - 1300

#### THIRD PAIR OF NUMBERS PLUS LETTER
- A : 19" RACK MOUNT
- B : 19" REVERSE FLUSH MOUNT
- C : 19" CROSS RACK MOUNT
- D : DUST COVERED SIDE-OF-CABINET
- E : 24" RACK MOUNT
- F : WALL MOUNT
- G : CABINET MOUNTED
- H : MOBILE PLATE MOUNTED

**EXAMPLE:** A Model 27-26-01A is a Notch circuit, 66 - 77 MHz range, 19" rack mount Duplexer.

Adaptors, hookup cables, and other hardware are displayed on page 3 of the Duplexer/Filter Price List No. C6457.

**OTHER DUPLexER BROCHURES** are available for bands 30-88 MHz (Lit. No. C1041), 132 - 250 MHz (Lit. No. C1024), 406 - 512 MHz (Lit. NO. C1034), and 806 MHz - 1.3 GHz (Lit. NO. C1044). Also write for Tech-Aid No. 76007 (Lit. NO. C3004), "Duplexer Problems and Remedies", and Tech-Aid No. 80009 (Lit. NO. C3104), "Duplexer Response Curves".
DUPLEXERS
132-250 MHz

IN RANGES OF:
132 - 150 MHz
132 - 174 MHz
144 - 174 MHz
215 - 250 MHz

MODEL 28-38-03A SIDE-OF-CABINET MOUNT
132-174 MHz
80 dB ISOLATION AT 0.5 MHz SEPARATION
150 WATT POWER RATING
MODEL 28-38-03A
19" RACK MOUNT

MODEL 28-38-03D DUST COVERED VERSION

144-174 MHz
85 dB ISOLATION AT 0.5 MHz SEPARATION
400 WATT POWER RATING
MODEL 28-37-02A

MODEL 28-37-02A 19" RACK MOUNT

MODEL 28-37-02G CABINET MOUNT

(PATENTED)

DUPLEXERS • CAVITY FILTERS • MULTICOUPLER SYSTEMS • SIGNAL BOOSTER SYSTEMS • RF SYSTEM PRODUCTS

TX RX SYSTEMS INC. 8825 INDUSTRIAL PARKWAY, ANGOLA, NY 14006
TELEPHONE 716-549-4700  TELEX 755770  FAX 716-549-4772 (24 HRS.)
MODELS FOR VERY CLOSE SPACINGS

100 dB ISOLATION
AT 0.3 MHz SEPARATION
400 WATT POWER RATING

24" RACK MOUNTS
(CABINET MOUNTS AVAILABLE)
MODEL NOS.
28-36-11E
28-37-11E

CLOSE SPACED MODELS FOR LIMITED SPACE OR PORTABLE REPEATER APPLICATIONS

(CROSS MOUNT CAVITIES ARE ALL ON ONE SIDE OF 19" PANEL)

CROSS MOUNTS
MODEL NOS.
28-37-04C
28-37-06C
28-37-07C

SMALL SIZED MODELS FOR WIDER SEPARATIONS

PSEUDO-BANDPASS
19" RACK MOUNTS

MODEL NOS.
38-36-01A
38-37-01A

BANDPASS APPLICATIONS

DUPLEXERS FROM OUR T-PASS EXPANDABLE MULTICOUPLER FAMILY

T-PASS®
(PATENTED)

19" RACK MOUNTS
MODEL NOS.
74-36-02A
74-37-02A

PSEUDO-BANDPASS/NOTCH
19" RACK MOUNTS

MODEL NOS.
30-36-01A
30-37-01A
30-36-02A
30-37-02A
30-36-03A
30-37-03A

(CABINET MOUNTS AVAILABLE)
MODEL NOS.
74-36-02G
74-37-02G

(FRONT)

(REAR)
DUPLEXERS
406-512 MHz

IN RANGES OF:
406 - 430 MHz
442 - 450 MHz
450 - 470 MHz
470 - 512 MHz

450-470 MHz
100 dB ISOLATION AT 5.0 MHz SEPARATION
350 WATT POWER RATING
MODEL 28-70-02A

19" RACK MOUNTS
MODEL NOS.
28-65-02A 28-69-02A
28-65-07A 28-69-05A
28-66-02A 28-70-02A
28-70-09A
(ALTERNATE MOUNT AT LEFT)

ALTERNATE MOUNT "B"
19" REVERSE FLUSH MOUNT
MODEL NOS.
28-65-02B 28-69-02B
28-65-07B 28-69-06B
28-66-02B 28-70-02B
28-70-09B

19" RACK MOUNTS
MODEL NOS
28-65-09A
28-71-01A
28-72-01A

19" RACK MOUNT (ABOVE)
MOBILE MOUNT (LEFT)
80 dB ISOLATION AT 50 MHz SEPARATION
MODEL NOS.
28-70-14A
28-70-15H

DULEXERS • CAVITY FILTERS • MULTICOUPLER SYSTEMS • SIGNAL BOOSTER SYSTEMS • RF SYSTEM PRODUCTS
TX RX SYSTEMS INC. 8625 INDUSTRIAL PARKWAY, ANGOLA, NY 14006-3696
TELEPHONE 716-549-4700 FAX 716-549-4772 (24 HRS.)
A MEMBER OF BIRD TECHNOLOGIES GROUP
MODELS FOR VERY CLOSE SPACING

100 dB ISOLATION
AT 0.7 MHz SEPARATION
350 WATT POWER RATING

BANDPASS APPLICATIONS

DUPLEXERS FROM OUR T-PASS EXPANDABLE MULTICOUPLER FAMILY

T-PASS®
(PATENTED)

19" RACK MOUNTS
MODEL NO.
74-70-04A

19" RACK MOUNTS
MODEL NO.
74-70-04G

CABINET MOUNTS
MODEL NO.
28-65-05A

19" RACK MOUNTS
MODEL NO.
28-69-04A

CABINET MOUNTS
MODEL NO.
28-70-07A

COMBINE DUPLEXER FOR ATV APPLICATIONS

19" RACK MOUNT
MODEL NO.
26-66-01A

(FRONT VIEW)

(BOTTOM VIEW)

MOBILE MOUNTS

MODEL NOS.
28-65-10H
28-66-04H
DUPLEXERS
806 MHz-1.3 GHz

IN RANGES OF:
806 - 866 MHz
890 - 960 MHz
1215 - 1300 MHz

19" RACK MOUNTS
MODEL NOS.
28-89-01A
28-89-01A
28-97-01A

RECEIVER
MULTICOUPLER

BANDPASS TRUNKING COMBINE DUPLEXER
19" RACK MOUNT
MODEL NO. 26-88-01A

TRANSMITTER
MULTICOUPLER

RECEIVER
MULTICOUPLER

BANDPASS TRUNKING COMBINE DUPLEXER
19" RACK MOUNT
MODEL NO. 26-89-03A

TRANSMITTER
MULTICOUPLER

(PATENTED)
DUPLEXER NOMENCLATURE

<table>
<thead>
<tr>
<th>FIRST PAIR OF NUMBERS</th>
<th>SECOND PAIR OF NUMBERS</th>
<th>THIRD PAIR OF NUMBERS PLUS LETTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIRCUIT STYLE</td>
<td>FREQUENCY RANGE (MHz)</td>
<td>TWO DIGIT NUMBER</td>
</tr>
<tr>
<td>26 - : BAND PASS CIRCUIT</td>
<td>-13 - : 30 - 40</td>
<td>A : 19&quot; RACK MOUNT</td>
</tr>
<tr>
<td>27 - : NOTCH CIRCUIT</td>
<td>-14 - : 35 - 50</td>
<td>B : 19&quot; REVERSE FLUSH RACK MOUNT</td>
</tr>
<tr>
<td>28 - : VARI-NOTCH CIRCUIT (PSEUDO BAND PASS)</td>
<td>-26 - : 66 - 77</td>
<td>C : 19&quot; CROSS RACK MOUNT</td>
</tr>
<tr>
<td>30 - : PSEUDO-BANDPASS/NOTCH (NON - VARI - NOTCH)</td>
<td>-27 - : 77 - 88</td>
<td>D : DUST COVERED SIDE-OF-CABINET</td>
</tr>
<tr>
<td>33 - : SERIES NOTCH CIRCUIT (TUNABLE PASS BANDS)</td>
<td>-28 - : 88 - 108</td>
<td>OR WALL MOUNT</td>
</tr>
<tr>
<td>38 - : PSEUDO-BANDPASS (NON - VARI-NOTCH)</td>
<td>-29 - : 108 - 136</td>
<td>E : 24&quot; RACK MOUNT</td>
</tr>
<tr>
<td>74 - : BAND PASS CIRCUIT (2 - CHANNEL T-PASS)</td>
<td>-36 - : 144 - 174</td>
<td>F : WALL MOUNT</td>
</tr>
<tr>
<td></td>
<td>-37 - : 132 - 150</td>
<td>G : CABINET MOUNTED</td>
</tr>
<tr>
<td></td>
<td>-38 - : 144 - 174</td>
<td>H : MOBILE PLATE MOUNTED</td>
</tr>
</tbody>
</table>

EXAMPLE: A Model 26-89-03A is a BANDPASS circuit, 806 - 866 MHz range, 19" rack mount Duplexer.

VARI-NOTCH®, the trademark for TX RX SYSTEMS' pseudo bandpass circuit design, offers the best cost-to-performance ratio in its class and is unsurpassed for close-spaced duplexing, combining the low loss and close frequency spacing advantages of notch filters with the broad isolation and selective pass characteristics of bandpass filters. The small geometry and efficiency of this circuit design has also resulted in a variety of space efficient mountings.

TRUNKING DUPLEXERS combine transmitter and receiver multicoopers to a common antenna. The receive section provides the total system isolation required for carrier suppression. The transmit section usually provides supplemental noise suppression, with the cavities in the transmit multicooper being the major contributor. The model 26-89-03A combines the 806-821 MHz receive and 851-866 MHz transmit bands to a common antenna. Model 26-88-01A combines 896-901 MHz receive and 935-940 MHz transmit similarly.

CONSTRUCTION: Our 4" diameter Duplexer cavities are constructed of hardened aluminum which does not easily dent, as some copper types do, causing detuning. Cavity surfaces are passivated inside and out with a chromate conversion coating (Alodine). A 3/16" thick end cap helarced to the top of the cavity at the critical current point eliminates the problem of noise generated by poor metal to metal contact inherent in constructions using pop rivets. Silver plating the movable brass tuning probes and hardened copper contact fingers avoids erratic tuning, high loss, and degraded selectivity which result in extra time and costs.

Adaptors, hookup cables, and other hardware are displayed on page 3 of the Duplexer/Filter Price List No. C6457.


BASE STATION MODELS

GENERAL SPECIFICATIONS, ELECTRICAL: TEMPERATURE RANGE: -40°C TO +80°C   IMPEDANCE: 50 Ohms   VSWR: 1.3:1

NOTE: Specifications for duplexers of unsymmetrical construction or response are listed as follows: ISOLATION - noise suppression/carryer suppression; INSERTION LOSS - TX insertion loss/ RX insertion loss.

<table>
<thead>
<tr>
<th>FREQUENCY RANGE MHz</th>
<th>MODEL NO.</th>
<th>ELECTRICAL</th>
<th>MECHANICAL</th>
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<td></td>
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<td>MIN. FREQ.</td>
<td>MIN. FREQ.</td>
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<tr>
<td>(SUB-RANGE)</td>
<td>NO.</td>
<td>RAT SP.</td>
<td>SEL. WATTS</td>
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<tr>
<td>(806-866)</td>
<td>26-89-03A</td>
<td>45.0</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>26-88-01A</td>
<td>45.0</td>
<td>125</td>
</tr>
<tr>
<td>(806-960)</td>
<td>28-88-04A</td>
<td>99.0</td>
<td>125</td>
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<td>(810-960)</td>
<td>26-88-01A</td>
<td>60.0</td>
<td>600</td>
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<td>(806-960)</td>
<td>28-88-01A</td>
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<td>26-89-01A</td>
<td>12.0</td>
<td>125</td>
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<tr>
<td></td>
<td>28-87-01A</td>
<td>12.0</td>
<td>125</td>
</tr>
</tbody>
</table>

MEASUREMENTS:

- All measurements use a Vector Network Analyzer (VNA) of the latest generation.
- Measured in a shielded Faraday cage at a distance of 1 meter.
- All tests were run at 10 MHz to minimize errors from the VNA.
- Results are presented in a table format for easy reference.

In summary, the Duplexer Nomencalature section provides a comprehensive overview of the various models available, their specifications, and their applications in different frequency ranges. This information is essential for engineers and technicians involved in design and installation of duplexing equipment.
## INTRODUCTION:
As an aid to those in the field concerned with servicing Duplexers, TX RX SYSTEMS INC. offers this field service guide along with our thanks for their contributions to its contents. Advice from our customers is always most welcome and is a prime source for designs and applications.

Duplexers are passive devices requiring little or no service once installed in a system. The proper design and application of a given Duplexer will give years of trouble free service. When problems do occur in a duplex system it is necessary to identify as many abnormal conditions as possible to zero in on the specific cause of the problem.

Unfortunately, there are only a few measurable or observable performance indicators at the disposal of the field serviceman, and any number of conditions may exist, even simultaneously, which are responsible for the observed phenomena.

Most Duplexer installation problems fall into three categories. Each of these three conditions will be treated separately, using the typical cause and remedy approach:

### A. HIGH INPUT VSWR
### B. EXCESSIVE LOSS
### C. DESENSITIZATION OF THE RECEIVER WHEN TRANSmitter IS KEYED

## POTENTIAL CAUSE

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POTENTIAL CAUSE</th>
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<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>Reverse labeling of Tx and Rx terminals.</td>
</tr>
<tr>
<td>2</td>
<td>Unit tuned to wrong frequencies.</td>
</tr>
<tr>
<td>3</td>
<td>Bad antenna or interconnect cables.</td>
</tr>
<tr>
<td>4</td>
<td>Use of between series adaptors, especially UHF types.</td>
</tr>
<tr>
<td>5</td>
<td>Duplexer detuned in shipment.</td>
</tr>
<tr>
<td>6</td>
<td>Water has entered the Duplexer antenna connector from the antenna feed line.</td>
</tr>
<tr>
<td>7</td>
<td>Spurious Tx output is being reflected by the selective Duplexer input terminal and observed on the wattmeter, the wattmeter being unable to discriminate between on-frequency and off-frequency energy.</td>
</tr>
<tr>
<td>8</td>
<td>Bad joint in a cable or antenna system beyond the antenna terminal of the Duplexer. All lines may show zero reflected power, but noise can still be produced when a corroded or indefinite metal-to-metal contact is exposed to RF energy. When this occurs beyond the Duplexer, it cannot be filtered out, and the noise backs up into the receiver.</td>
</tr>
<tr>
<td>9</td>
<td>Adverse cable length between Duplexer and transmitter using varactor or broadband hybrid combing type transmitter outputs. Even though the Duplexer VSWR is flat on frequency, the reflected impedance of the Duplexer off resonance, transformed by changing cable lengths, can cause parasitics to be generated.</td>
</tr>
<tr>
<td>10</td>
<td>Duplexer transmitter mixing with another outside transmitter, producing intermodulation on or near the receiver frequency.</td>
</tr>
<tr>
<td>11</td>
<td>Transmitter cable leading to Duplexer in close proximity to Duplexer antenna or receiver cable. This is usually only a problem on close separation Duplexers, (1.0 MHz or less) where the 85 to 100 dB isolation is decreased by adverse coupling, created by running these cables too close together for too great a distance.</td>
</tr>
<tr>
<td>12</td>
<td>Inadequate shielding of transmitter and receiver modules in the repeater.</td>
</tr>
<tr>
<td>13</td>
<td>Insufficient duplexer isolation for the application.</td>
</tr>
<tr>
<td>14</td>
<td>A spurious transmitter response outside of the normal Duplexer isolation band or inadequacy of notch filter type Duplexers to suppress a wide enough band of Tx noise to protect the receiver.</td>
</tr>
<tr>
<td>15</td>
<td>Impedance change in antenna due to icing. VSWR increase may be sufficient to reflect back through the Duplexer and upset transmitter tuning, causing parasitics, which are not suppressed sufficiently by the Duplexer.</td>
</tr>
<tr>
<td>16</td>
<td>The addition of a broadband power amplifier to a low power transmitter. The noise floor of the low power radio is raised by an amount equal to the gain of the power amplifier, and in addition, the power amplifier will contribute its own noise. Power amplifiers are just as prone to the generation of parasitics as transmitters, and may be triggered by an adverse cable length between power amplifier and Duplexer, a problem covered above.</td>
</tr>
<tr>
<td>17</td>
<td>Excessive loss with changing temperature and apparent Duplexer detuning.</td>
</tr>
</tbody>
</table>
FIELD SERVICE REMEDIES FOR PAGE ONE PROBLEMS

1. Tune a signal generator to the receive frequency and inject it into the antenna terminal, sampling for the signal at each equipment terminal. Reverse the labels if necessary. It may be that the unit was ordered to the reverse frequencies. If so, the label will indicate this. If the duplexer is symmetrical in design (usually indicated by the same number of Tx and Rx filter sections) just reverse the equipment labels and operate. Generally, no damage will be done to the duplexer when operated in reverse for a short time period. If other adverse symptoms appear, contact the factory.

2. Check the unit label. If needed, the duplexer may be field tuned. Consult the instructions and/or the factory if the duplexer is still under warranty or beyond field tuning capability.

3. Check cable, by substitution, using a termaline wattmeter, or a thruline wattmeter into a good load. Check the antenna line input for reflected power.

4. To eliminate high input VSWR reduce the number of between series adaptors by making up proper interconnect cables. UHF connectors are non-constant impedance, and certain combinations can transform a 1.1:1 VSWR into a 2.0:1, or vice versa.

5. Consult the instruction manual for field tuning procedures, or the factory, if unit is still under warranty or beyond field tuning capability. (We trust that our products will not be prone to this problem).

6. Consult the factory. The affected antenna cables may be field replaceable, or a "baking out" process may be possible.

7. To prove this condition, place a bandpass filter between the Tx and duplexer to clean up the spurious, and put the wattmeter between the bandpass filter and the duplexer to measure reflected power from the duplexer. The bandpass filter selectivity should be equal to or better than that of the duplexer at about the 3.0 dB points.

8. Operate the duplex system into a dummy load. If no desensitization occurs, check out all lines, antennas, and look for potential bad joints close to the radiating antenna where re-radiation of noise may be possible back into the antenna system receiver. Loose metal-to-metal contacts on tower guy systems have also been known to create system noise. Note the effect of vibrating tower guys on system noise.

9. Change the length of cable between the transmitter and duplexer, traversing through a half wave in increments of 1 to 2 inches until desensitization ceases or is minimal. A ferrite isolator will also cure this condition when installed between the transmitter and duplexer. However, this is a much more expensive remedy.

10. If the IM is in the duplex transmitter, a ferrite isolator in the duplex transmitter line (NOT antenna line) will show this by reducing or eliminating it. More isolation can be obtained by cascading isolators if needed. However, IM of this magnitude indicates the system should be studied for possible revision to reduce the production of this IM.

11. Cables such as RG-8a/u and RG-213/u should be at least 3-4" apart over 5-10' runs. Use of double shielded cable will reduce the susceptibility to this problem.

12. Consult the radio manufacturer. This condition can be verified by operating the transmitter into a dummy load while injecting a minimum quieting signal into the receiver. Some radios require special modifications before they are suitable for repeater operation.

13. If this problem is suspected, contact the radio manufacturer for recommended duplex isolation for Tx noise suppression and carrier suppression. Duplexer isolation should be measured first per instruction manual to verify rated specifications are present. If more duplex isolation is required, contact TX RX SYSTEMS for recommended filtering.

14. Consult the factory. Bandpass filter tests can be made to confirm this. In extreme cases, adjustments to the transmitter may be required.

15. Either de-ice the antenna, or use an antenna less sensitive to ice. A ferrite isolator can also be put at the transmitter output to improve the impedance match. Ferrite isolators cannot be put in antenna lines, as they will attenuate Rx signals.

16. A mismatch may possibly be reduced by lengthening the cable between the power amplifier output and the duplexer input until the receiver desensitization disappears, as follows:

- **30 MHz to 512 MHz RANGE:** BNC or N type adaptors may be inserted in the original cable, one at a time and not to exceed a total of 1/2 wavelength, until desensitization disappears.
- **800 MHz to 1.3 GHz RANGE:** Prepare a cable length 3/4" longer than original cable and insert. If desensitization does not disappear, repeat with cables each 3/4" longer than the previous length, not to exceed 1/2 wavelength.

17. We find this cause most commonly relates to shifting impedance of the transmitter or power amplifier with temperature. The duplexer "appears" detuned, since a "conjugate match" (cancelling reactance, and matching resistance component) is approached by shifting the duplexer passband above or below the 50 ohm point, as determined by an increase in output power on the wattmeter. In this case, temperature control of the room is the only answer, other than upgrading the transmitter.