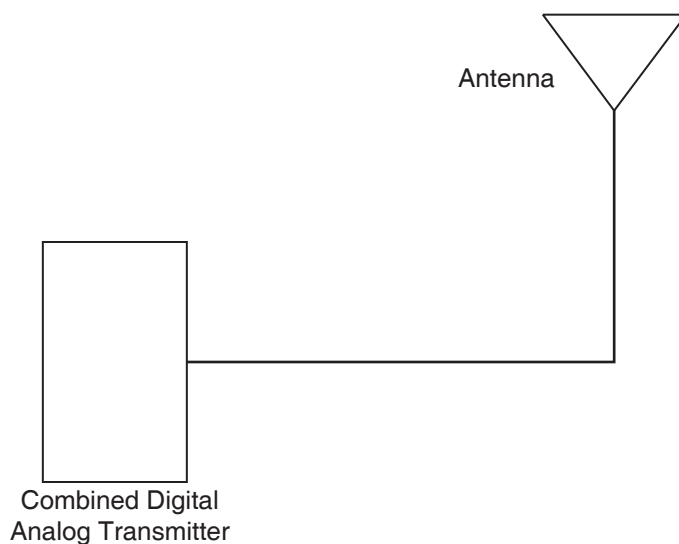


## IBOC Options

### 20 dB Injection

#### Option A: Single Station, Combined Digital/Analog Transmitter, Common Antenna



- In most cases, existing antenna and transmission line can be used with no upgrade.
- Digital and analog signals will have same elevation and azimuth patterns.
- Requires purchase of a combined digital and analog transmitter.

Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA

(207) 647-3327

1-888-SHIVELY

Fax: (207)647-8273

*An Employee-Owned Company*

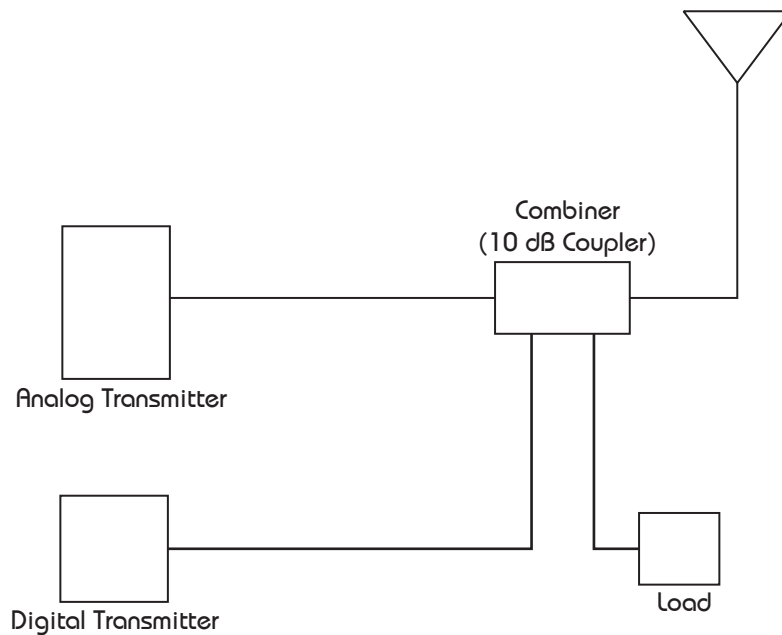
[www.shively.com](http://www.shively.com)

[sales@shively.com](mailto:sales@shively.com)

*Certified to ISO-9001:2000*

## IBOC Options 20 dB Injection

### Option B: Single Station, Separate Analog and Digital Transmitters, Common Antenna, High-Level Combining



- In most cases, existing antenna and transmission line can be used with no upgrade.
- Digital and analog signals will have same elevation and azimuth patterns.
- Combining will cause a 10% loss to the analog signal and a 90% loss to the digital signal.
- Existing analog transmitter may need replacement, depending on existing headroom.
- Digital transmitter will need to be 10 x larger than a transmitter used in a typical "low-level" implementation scheme.
- System requires a load to accommodate the wasted 10% analog and 90% digital signal (for estimating purposes, the load must comfortably handle the equivalent of 20% of the power the analog transmitter runs at in non-HD radio operation).
- May require upgrading the power and air conditioning services to the transmitter room.

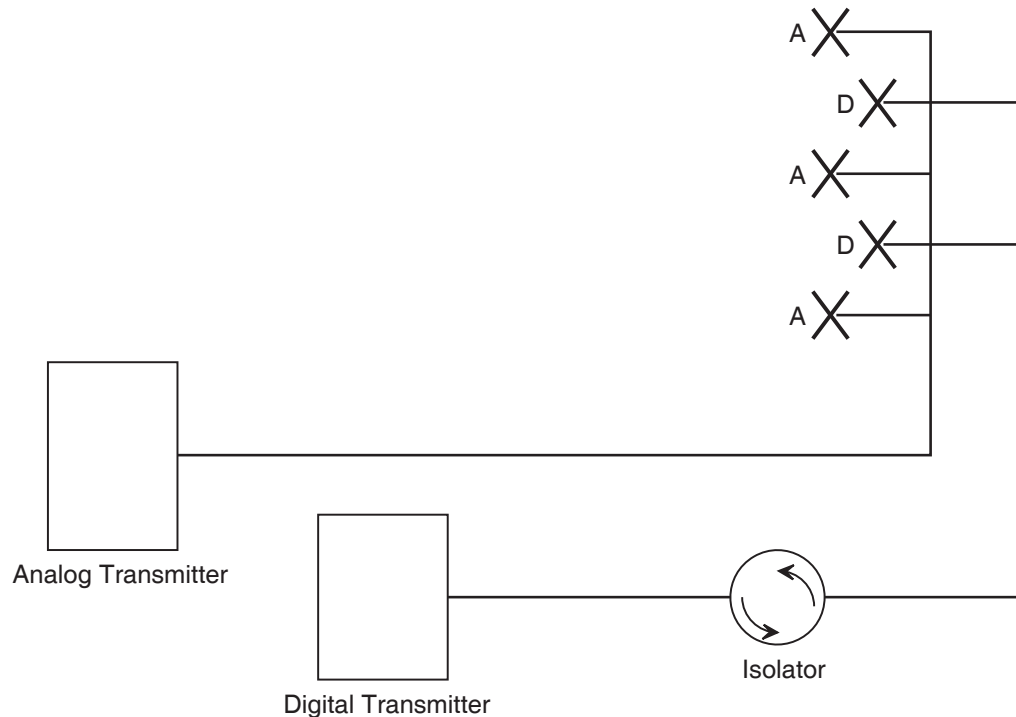
Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA  
 (207) 647-3327 1-888-SHIVELY Fax: (207)647-8273  
 An Employee-Owned Company

[www.shively.com](http://www.shively.com)  
[sales@shively.com](mailto:sales@shively.com)  
 Certified to ISO-9001:2000

## IBOC Options 20 dB Injection

### Option C: Single Station, Separate Analog and Digital Transmitters, Interleaved Antenna



- Existing analog transmitter and transmission line can be used with no upgrade.
- No additional tower aperture is required, though the addition of the digital bays to the antenna will increase windload.
- Can only be done with full-wave-spaced antennas.
- Antennas will have same azimuth pattern – ideal for directional antennas.
- In most cases, analog and digital portions of the antenna will have slightly different gains and elevation patterns.
- Isolation between digital and analog portions of the antenna is approximately 20 dB.
- Isolator must be sized to handle the digital transmitter power plus the return analog power.  
Example: 6 kW ERP analog signal using 3-bay analog antenna and 2-bay digital antenna (no transmission line losses included):

$$\begin{aligned} \text{Analog antenna input} &= 6,000 \text{ W (analog ERP)} / 1.55 \text{ (analog gain)} = 3,871 \text{ W} \\ \text{Analog return power} &= 3,871 \text{ W} \times 20 \text{ dB} = 39 \text{ W} \end{aligned}$$

$$\text{Digital antenna input} = 60 \text{ W (digital ERP)} / 0.99 \text{ (digital gain)} = 61 \text{ W}$$

$$\text{Minimum isolator size required} = 61 \text{ W} + 39 \text{ W} = 100 \text{ W.}$$

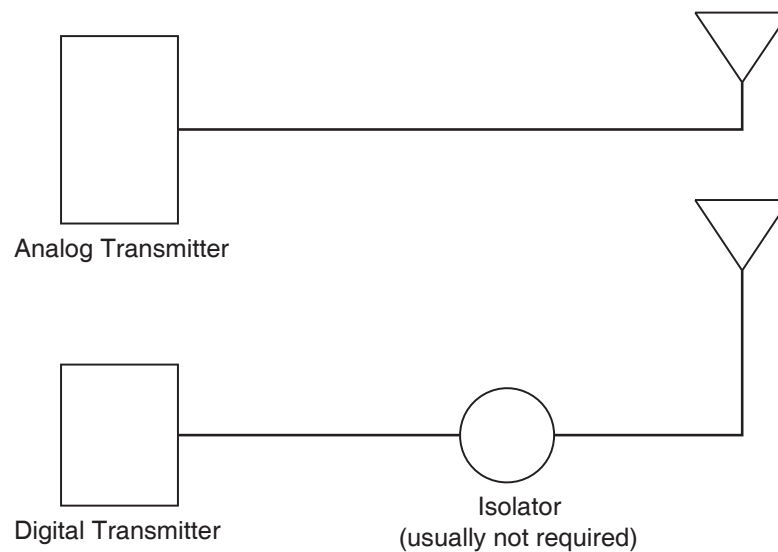
Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA  
(207) 647-3327 1-888-SHIVELY Fax: (207)647-8273  
An Employee-Owned Company

[www.shively.com](http://www.shively.com)  
[sales@shively.com](mailto:sales@shively.com)  
Certified to ISO-9001:2000

## IBOC Options 20 dB Injection

### Option D: Single Station, Separate Analog and Digital Transmitters, Separate Analog and Digital Antennas



- In most cases, the existing analog antenna and transmitter will be reused with no upgrade.
- A separate antenna is added for digital operation – requiring additional aperture to be made available.
- For directional antenna applications, the new antenna will need to go through the same qualification process as the existing antenna.
- Analog and digital antennas may or may not have the same azimuth and elevation patterns.
- For many single station applications, this implementation method will have the lowest equipment costs.

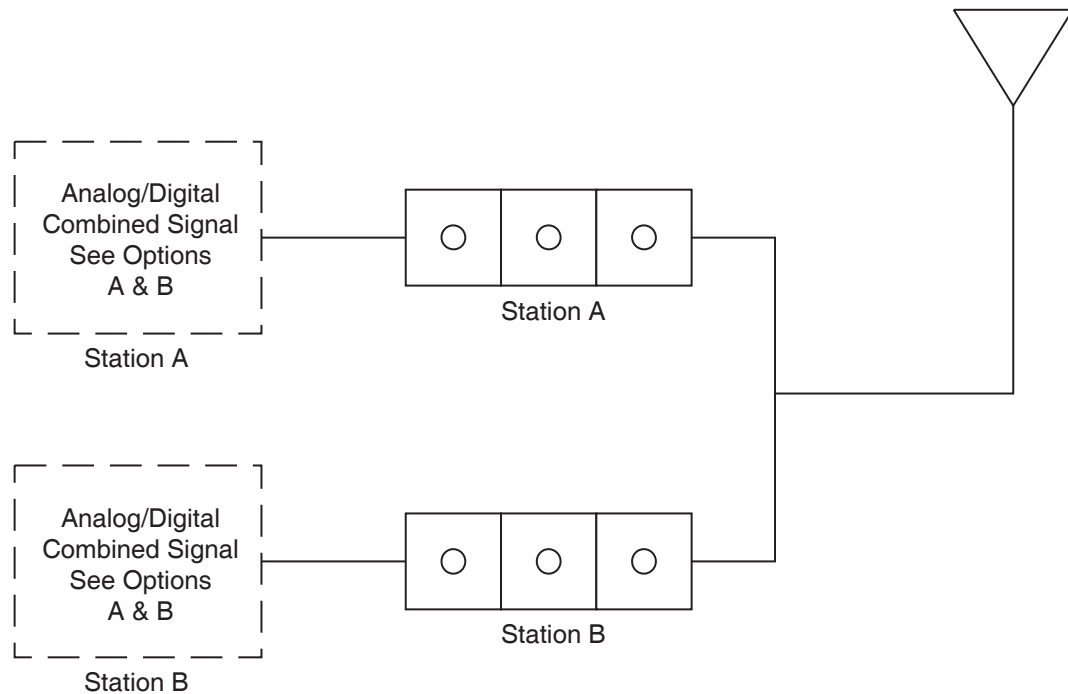
Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA  
(207) 647-3327 1-888-SHIVELY Fax: (207)647-8273  
An Employee-Owned Company

www.shively.com  
sales@shively.com  
Certified to ISO-9001:2000

## IBOC Options 20 dB Injection

### Option E: Multiple Stations; Branched Combiner; Common Antenna



- In most cases, the existing antenna and transmission line can be reused with no upgrade.
- The branched combiner will pass analog, digital, or combined digital and analog signals. Therefore, either of the standard methods for combining the analog and digital signals into a common antenna (Options A and B) can be used to feed each module of the combiner. It is not necessary to use the same method for both stations.
- No isolators are required.

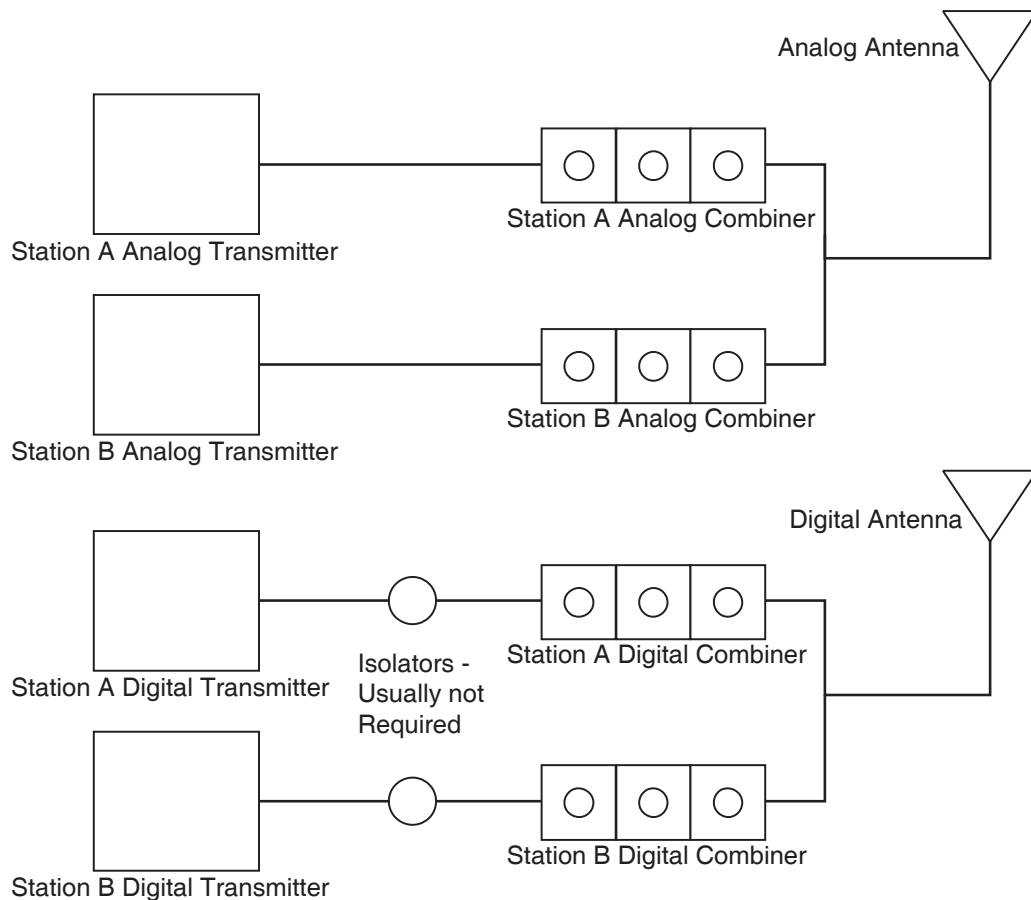
Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA  
(207) 647-3327 1-888-SHIVELY Fax: (207)647-8273  
An Employee-Owned Company

[www.shively.com](http://www.shively.com)  
[sales@shively.com](mailto:sales@shively.com)  
Certified to ISO-9001:2000

## IBOC Options 20 dB Injection

### Option F: Multiple Stations; Branched Combiner; Separate Digital and Analog Antennas



- In most cases, the existing analog antenna and transmitter will be reused with no upgrade.
- A separate antenna is added for digital operation, requiring additional aperture to be made available.
- For directional antenna applications, the new antenna will need to be go through the same qualification process as the existing antenna.
- Analog and digital antennas may or may not have the same azimuth and elevation patterns.
- Requires additional floor space in the transmitter room for the digital combiner.
- Digital combiner is smaller in size than analog.

Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA

(207) 647-3327

1-888-SHIVELY

Fax: (207)647-8273

An Employee-Owned Company

[www.shively.com](http://www.shively.com)

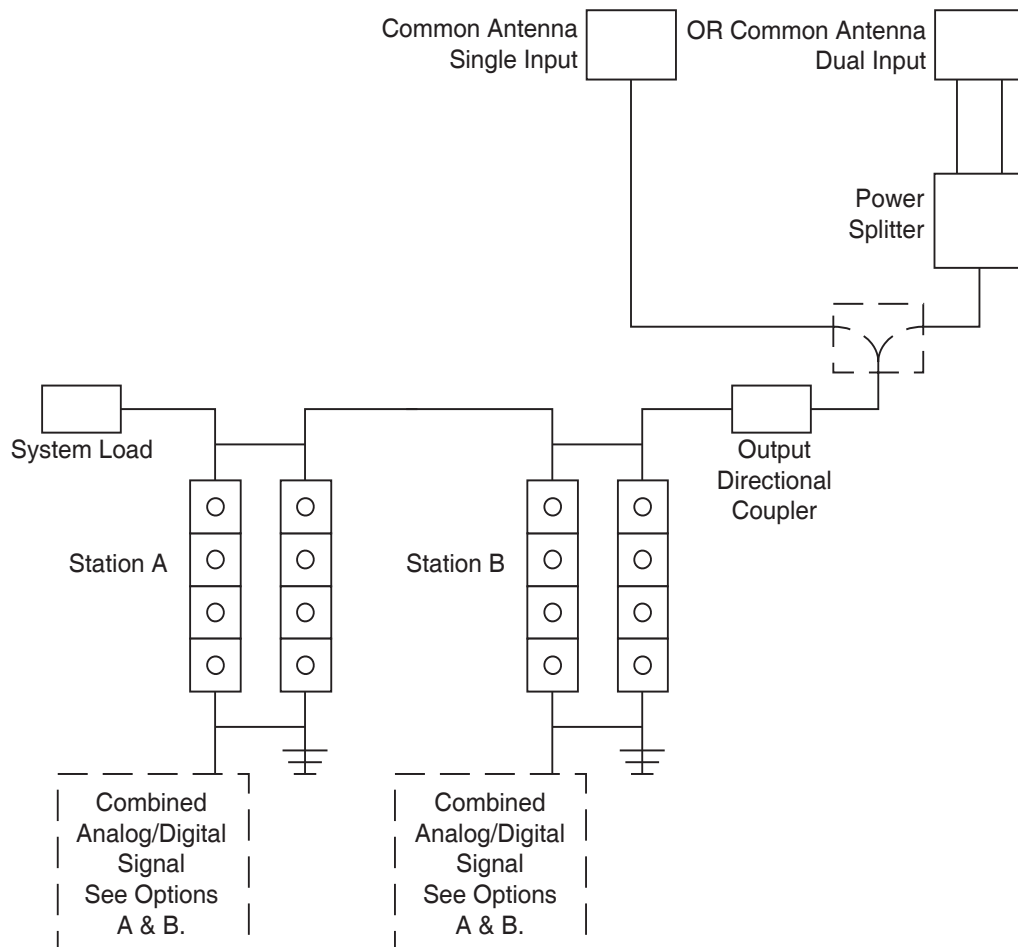
[sales@shively.com](mailto:sales@shively.com)

Certified to ISO-9001:2000

## IBOC Options

### 20 dB Injection

#### Option G: Multiple Stations; Balanced Combiner; Combined Digital and Analog Input for Each Station



- In most cases, the existing antenna and transmission line can be reused with no upgrade.
- The balanced combiner will pass analog, digital, or combined digital and analog signals. Therefore, either of the standard methods for combining the analog and digital signals into a common antenna shown above (Examples A and B) can be used to feed each station module of the combiner. It is not necessary to use the same method for all stations.
- No isolators are required.
- The wideband output from the combiner can be used to feed either a single feed or a split feed to the antenna.

Document No. [tb-iboc\\_options \(100106\)](#)

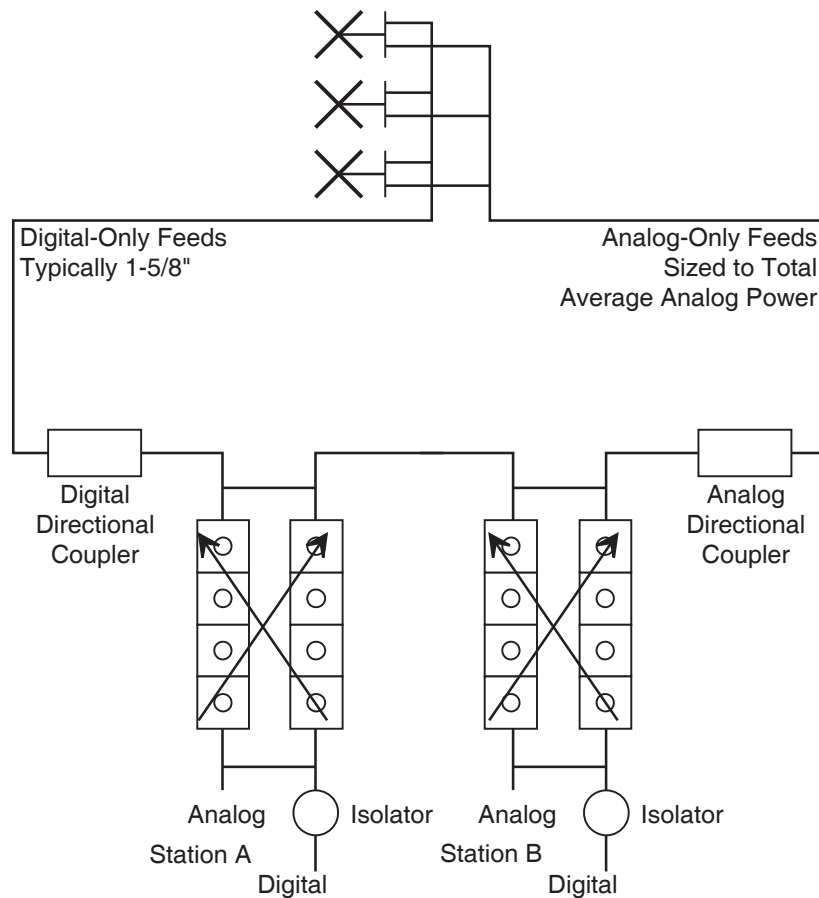
A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA  
 (207) 647-3327 1-888-SHIVELY Fax: (207)647-8273  
 An Employee-Owned Company

www.shively.com  
 sales@shively.com  
 Certified to ISO-9001:2000

## IBOC Options

### 20 dB Injection

Option H: Multiple Stations; Balanced Combiner;  
 Separate Digital and Analog Input per Station;  
 Separate Digital and Analog Feeds to the Antenna; Single Antenna Input



- Also known as "back-feeding".
- Least expensive method for implementing HD Radio on existing balanced combiner.
- Requires separate antenna feed systems for digital and analog signals. Digital and analog signals are combined in the antenna bay and fed into the bay using a 4-port hybrid.
- Isolators must be comfortably sized to handle the digital power for each station to the returned analog power (typically 15-18 dB below transmit level).

Document No. [tb-iboc\\_options \(100106\)](#)

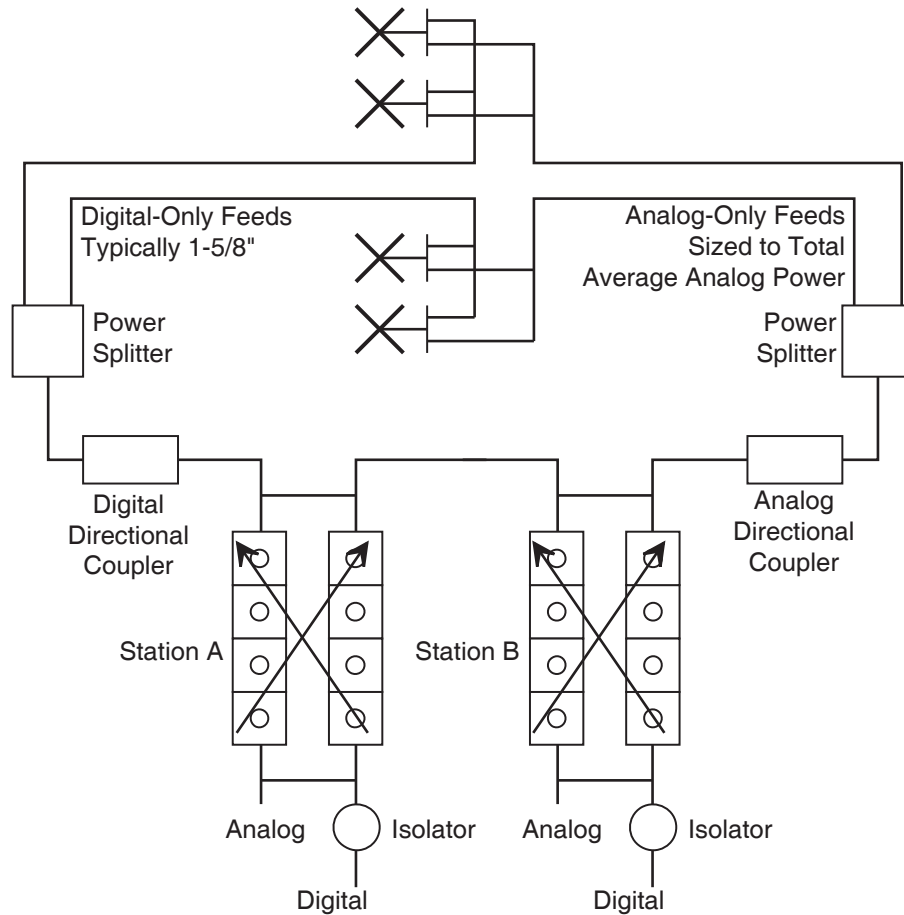
A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA  
 (207) 647-3327 1-888-SHIVELY Fax: (207)647-8273  
 An Employee-Owned Company

www.shively.com  
 sales@shively.com  
 Certified to ISO-9001:2000

## IBOC Options

### 20 dB Injection

Option I: Multiple Stations; Balanced Combiner;  
 Separate Digital and Analog Input per Station;  
 Separate Digital and Analog Feeds to the Antenna; Dual Antenna Inputs



- Also known as "back feeding".
- Least expensive method for implementing HD Radio on existing balanced combiner.
- Requires separate antenna feed systems for digital and analog signals. Digital and analog signals are combined in the antenna bay and fed into the bay using a 4-port hybrid.
- This method is used for antenna systems that can be operated either as a complete array, or on either the top half or bottom half independently.
- Isolators must be sized to comfortably handle the digital power for each station to the returned analog power (typically 15-18 dB below transmit level).

Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA

(207) 647-3327

1-888-SHIVELY

Fax: (207)647-8273

[www.shively.com](http://www.shively.com)

[sales@shively.com](mailto:sales@shively.com)

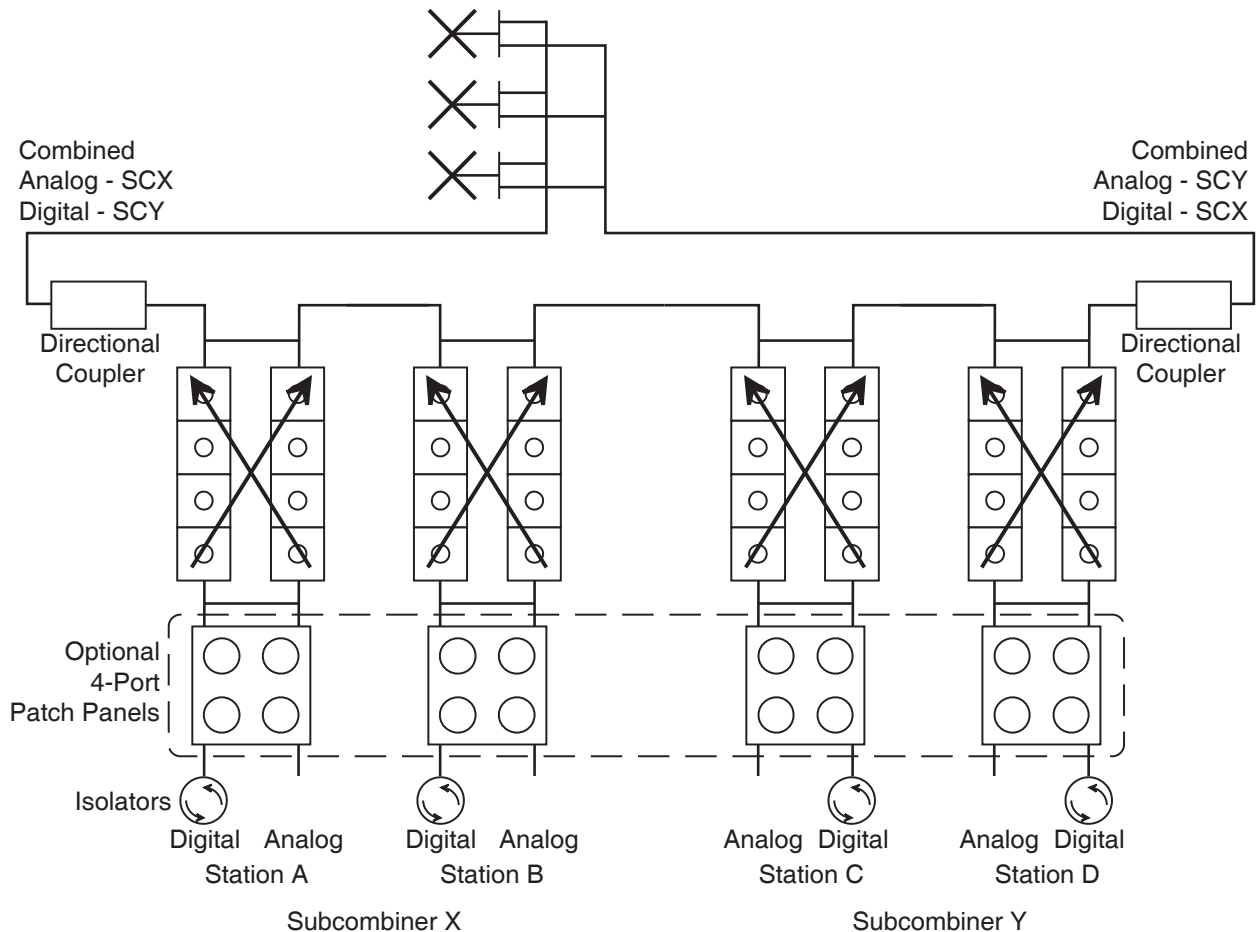
An Employee-Owned Company

Certified to ISO-9001:2000

## IBOC Options

### 20 dB Injection

#### Option J: Multiple Stations; Balanced Combiner; Split Transmission Lines to Feed Combined Digital and Analog Signals over Separate Transmission Lines



- A balanced combiner is used to combine digital and analog signals over common transmission lines. The antenna is fed with dual, parallel feed systems. The separate feeds are combined in the antenna and fed into the bay using a 4-port hybrid.
- This system has the advantage of distributing combined digital and analog signals over two medium-sized transmission lines rather than one large analog and one small digital line (Examples H & I). This power distribution scheme can be used to avoid the use of 9" components.
- The antenna in the example can only be operated in a "full array configuration." Power dividers and additional transmission lines can be added to allow the antenna to be operated as a full array, or on the top or bottom half independently.
- If the stations are configured with patch panels, the option exists to swap the digital and analog feeds in the event of a transmission line failure.
- Isolators may be required on the digital transmitters.

Document No. [tb-iboc\\_options \(100106\)](#)

A Division of Howell Laboratories, Inc., P. O. Box 389, Bridgton, Maine 04009 USA

(207) 647-3327

1-888-SHIVELY

Fax: (207)647-8273

[www.shively.com](http://www.shively.com)

[sales@shively.com](mailto:sales@shively.com)

An Employee-Owned Company

Certified to ISO-9001:2000